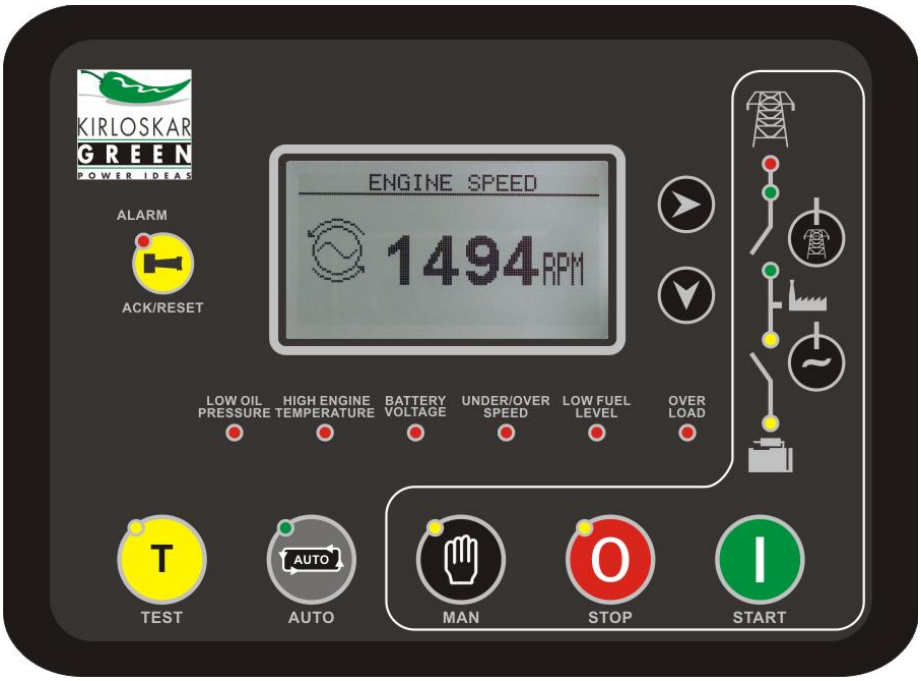
KG-545 AUTOMATIC MAINS FAILURE UNIT



FEATURES

Automatic mains failure
Engine control
Generator protection
Built in alarms and warning
Manual control enabled
Magnetic pickup input
Dual genset mutual standby operation
Load shedding, dummy load
Gas engine support
Engine idle speed control
3 phase mains voltage inputs
3 phase genset voltage inputs
3 phase genset CT inputs
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Engine coolant temperature measurement
Fuel level measurement
Oil temperature measurement
Canopy temperature measurement
Genset active power measurement
Genset power factor measurement
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Engine hours counter
Event logging with date-time stamp and complete measurement values
Stores last 100 events
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Battery backed-up real time clock
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Programmable parameters
RS-232/ RS-485 selectable serial port
Firmware downloadable from serial port
MS-Windows Remote monitoring SW:
-local and GSM connection
-monitoring,
GSM and PSTN modem support
GSM-SMS sending on fault
Modem calls on fault
MODBUS communication
128x64 graphic LCD display
KOEL logo display
Analogue inputs: 5
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Digital outputs: 7
Input / output expansion capability
Remote Start operation available
Survives cranking dropouts
Sealed front panel
Plug-in connection system for easy replacement

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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:

Engine Parameters:

Engine speed (rpm)
Battery voltage,
Coolant temperature
Oil pressure
Fuel level
Oil temperature
Canopy temperature
Engine run hours

Genset Parameters:

Gen voltage phase L1 to neutral
Gen voltage phase L2 to neutral
Gen voltage phase L3 to neutral
Gen voltage phase L1-L2
Gen voltage phase L2-L3
Gen voltage phase L3-L1
Gen current phase L1
Gen current phase L2
Gen current phase L3
Gen frequency
Gen KW phase L1
Gen KW phase L2
Gen KW phase L3
Gen total KW
Gen KVA phase L1
Gen KVA phase L2
Gen KVA phase L3
Gen KVAr phase L1
Gen KVAr phase L2
Gen KVAr phase L3
Earth Fault Current
Gen pf phase L1
Gen pf phase L2
Gen pf phase L3
Gen total pf

Mains Parameters:

Mains voltage phase L1 to neutral
Mains voltage phase L2 to neutral
Mains voltage phase L3 to neutral
Mains voltage phase L1-L2
Mains voltage phase L2-L3
Mains voltage phase L3-L1
Mains 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.

Do not tighten brackets excessively. This may brake the unit.

Engine body must be grounded for correct operation of the unit, otherwise incorrect 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,Y,B, Generator phase: R,Y,B, 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) **An appropriate and readily accessible set of disconnection devices (e.g. automatic fuses) MUST be provided as part of the installation.**
3) **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).**
4) **Use cables of adequate current carrying capacity (at least 0.75mm2) and temperature range.**

2. CONNECTOR DETAILS

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 input / output extension modules. Each optional extension module provides 8 programmable inputs or outputs. The unit allows the use of up to 2 input and 2 output extension modules.

Term	Function	Technical data	Description
01	**BATTERY NEGATIVE**	0VDC	Power supply negative connection.
02	**BATTERY POSITIVE**	+12 or 24VDC	The positive DC Supply terminal for both 12V and 24V battery systems.

Term	Function	Technical data	Description
03	**RL-01: CRANK OUTPUT**	Output 1A/28VDC	This output controls the engine cranking.
04	**RL-02: FUEL OUTPUT**	Output 1A/28VDC	Fuel solenoid output.
05	**CHARGER WL**	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.
06	**RL-03: IDLE OUTPUT**	Output 1A/28VDC	This output controls the idle speed operation.
07	**RL-04: STOP OUTPUT**	Output 1A/28VDC	This output controls the engine stop solenoid.
08	**RL-05: ALARM OUTPUT**	Output 1A/28VDC	This output controls the audible alarm (hooter)

Term	Function	Technical data	Description
09	**RL-06: MAINS CONTACTOR**	Output 1A/28VDC	This output controls the mains contactor. If the mains phase voltages and frequency are not within limits, the mains contactor will be de-energized.
10	**RL-07: GENSET CONTACTOR**	Output 1A/28VDC	This output controls the mains contactor. If the mains phase voltages and frequency are not within limits, the mains contactor will be de-energized.
11	**COOLANT TEMP. SENDER**	Input, 0-5000 ohms	Analogue temperature sender connection. Do not connect the sender to other devices. The input has programmable characteristics.
12	**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.
13	**FUEL LEVEL SENDER**	Input, 0-5000 ohms	Analogue fuel level sender connection. Do not connect the sender to other devices. The input has programmable ohm value.
14	**CANOPY TEMPERATURE SENDER**	Input, 0-5000 ohms	Analogue canopy temperature sender connection. Do not connect the sender to other devices.
15	**OIL TEMPERATURE SENDER**	Input, 0-5000 ohms	Analogue oil temperature sender connection. Do not connect the sender to other devices. The input has programmable characteristics.
16	**SPARE ANALOG INPUT -1**	Input, 0-5000 ohms	This input is reserved for future use.
17	**SPARE ANALOG INPUT -2**	Input, 0-5000 ohms	This input is reserved for future use.

Term	Function	Technical data	Description
18	**COOLANT LEVEL**	Digital input	This terminal drives the coolant level sensor with AC signal and senses the coolant liquid level.
19	**IN-0: HIGH TEMP**	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 to battery+ or battery-. The effect of the switch is also selectable from a list. See PROGRAMMING section for more details.
20	**IN-1: LOW OIL PRESSURE**		
21	**IN-2: EMERGENCY STOP**		
22	**IN-3: AUTO START**		
23	**IN-4: FUEL LEVEL**		
24	**IN-5: SPARE-1**		
25	**IN-6: SPARE-2**		
26	**IN-7: SPARE-3**		
27	**MAGNETIC PICKUP +**		
28	**MAGNETIC PICKUP -**		

Term	Function	Technical data	Description
29	**MR-MAINS-R PHASE**	Mains phase inputs, 0-300V-AC	Connect the mains phases to these inputs. The mains voltages upper and lower limits are programmable.
30	**MY-MAINS-Y PHASE**		
31	**MB-MAINS-B PHASE**		
32	**MN-MAINS NEUTRAL**	Input, 0-300V-AC	Neutral terminal for the mains phases.

Term	Function	Technical data	Description
33	**I Earth +**	Current transformer inputs, 5A-AC	Connect the earth current transformer terminals to these inputs.
34	**I Earth -**		
35	**BS 2**	Current transformer inputs, 5A-AC	Connect the load 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).
36	**BS 1**		
37	**YS 2**		
38	**YS 1**		
39	**RS 2**		
40	**RS 1**		

Term	Function	Technical data	Description
41	**GN-GENERATOR NEUTRAL**	Input, 0-300V-AC	Neutral terminal for the generator phases.
42	**GR-GEN-R PHASE**	Generator phase inputs, 0-300V-AC	Connect the generator phases to these inputs. The generator phase voltages upper and lower limits are programmable.
43	**GY-GEN-Y PHASE**		
44	**GB-GEN-B PHASE**		

Term	Function	Technical data	Description
45	**RS-485-H**	Input / output	This is + terminal of the RS-485 port.
45	**RS-485-L**	Input / output	This is - terminal of the RS-485 port.
45	**RS-485-GND**	Output	This terminal is internally connected to battery negative. Connect the shield of the RS-485 cable to this terminal, from one end only.

3. DISPLAYS

3.1 LED Displays

The unit has**16** LEDs, divided in 3 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.

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.
LOAD MAINS	Green	It turns on when the mains contactor is activated.
LOAD GENERATOR	Yellow	It turns on when the generator contactor is activated.
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.
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.
STOP	Yellow	
AUTO	Green	
MANUAL	Yellow	
ALARM	Red	If a fault condition resulting to the engine shutdown has occurred, the alarm led turns on steadily. If a warning condition occurs, this led will flash. Alarms work on a first occurring basis. The occurrence of a fault will disable other faults of lower or equal priority.
LOW OIL PRESSURE	Red	Turns on when a low oil pressure condition is detected either from the sender or switch input.
HIGH ENGINE TEMP	Red	Turns on when a high coolant temperature condition is detected either from the sender or switch input.
BATTERY VOLTAGE	Red	Turns on when a low or high battery voltage condition is detected.
UNDER/OVER SPEED	Red	Turns on when a low or high speed condition is detected.
LOW FUEL LEVEL	Red	Turns on when a low fuel level condition is detected either from the sender or switch input.
OVERLOAD	Red	Turns on when overcurrent or excess load condition is detected.

3.2 Digital Display

The unit has a graphical 128x64 pixel LCD display. It shows:

-Measured parameters,
-The company logo,
-The alarm list,
-Software version and date-time information,
-Statistical counters,
-Event records,
-Program parameters.

Navigation between different screen groups is done with the ► button. Each depression of the ► button switches the display to the next screen group.

Navigation within a group is done with with the ▼ button. Each depression of the ▼ button switches the display to the next screen in the same group.

During operation, the unit will scroll automatically between different screens, displaying always the most important parameters for the current operating status.

AUTO SCROLL may be stopped by long-pressing the ► button

If an alarm or warning occurs during operation, in other then programming mode, the display will automatically switch to **ALARM LIST** position. The ▼ or ► buttons will not function. To enable display navigation and mute the internal buzzer, press **ACK/RESET** button first. If there is more than one alarm, the next alarm is displayed by pressing the ▼ button. Thus all existing alarms can be scanned. '**END OF ALARM LIST**' will be displayed when there is no more alarm to display.

Group	Screen	Contents	Description
GENSET PARAMETERS	**1**	Genset Phase voltages, phase-to-neutral and phase-to-phase	Presented as a table.
	2	Genset Phase Currents and Genset frequency	Presented as a table.
	3	Genset Phase kW and power factor	Presented as a table.
	4	Genset Phase kVA and kVAr values	Presented as a table.
	5	Genset average current and voltage, genset frequency, total kW and PF	Presented as a table.
	6	Genset R Current	Genset Phase R Current, large characters
	7	Genset Y Current	Genset Phase Y Current, large characters
	8	Genset B Current	Genset Phase B Current, large characters
	9	Genset Frequency	with large size characters
	10	Genset Active Power	with large size characters
	11	Genset Average Voltage	with large size characters
	12	Genset kW-hours	8 digit counter
	13	Earth Leakage Current	in Amps and % of CT ratio, large characters

Group	Screen	Contents	Description
ENGINE PARAMETERS	**1**	Oil Pressure	Displayed in bars and kPa, large characters If PSİ display is enabled by program parameter, then displayed in bars and psi.
	2	Engine Temperature	Displayed in degrees C and degrees F, large characters
	3	Fuel Status	Displayed in % of full tank capacity. If **Fuel Consumption/ Hour** parameter is not zero,then also displayed in engine hrs. If **Fuel Tank Capacity** parameter is not zero, then also displaed in liters.
	4	Engine Speed	Displayed in RPMs
	5	Battery Voltage, Minimum battery voltage	Displayed in Volts DC. The Minimum Battery Voltage is reset before each engine crank cycle. Thus the displayed value reflects the most recent status.
	6	Oil Temperature	Displayed in degrees C and degrees F. This screen is displayed only if the Oil Temp analog input is enabled.
	7	Canopy Temperature	Displayed in degrees C and degrees F. This screen is displayed only if the Canopy Temp analog input is enabled.
	8	Engine Hours, Total Starts	The engine hours is displayed up to 999'999.9 hours. Total start count is displayed up to 9999.

Group	Screen	Contents	Description
MAINS PARAMETERS	**1**	Mains Phase voltages, phase-to-neutral and phase-to-phase	Presented as a table.
	2	Mains Phase Currents	Presented as a table.
	3	Mains Frequency and Average Voltage	Frequency in Hertz. The voltage is the average of both phase voltages.

Group	Screen	Description
ALARM LIST	**1**	If no alarm exists, then **END OF ALARM LIST** is displayed. Otherwise the first alarm is displayed. Each depression of the ▼ button will cause the screen to switch to the next alarm.

Group	Screen	Description
COMMUNICATION STATUS	**1**	This screen shows the modem parameters. It is displayed only if the modem is enabled.

Group	Screen	Contents	Description
GENSET STATUS	**1**	Genset Status	Ascii explanation of the current status.
	2	Logo	Company logo, Kirloskar Green Power Ideas.
	3	Date & time	Current date and time, displayed in large characters.
	4	Site Id	The generator site id string, displayed in large characters.
	5	Serial Number	The generator serial number string, displayed in large characters.
	6	Software Version	The unit firmware version number displayed in large characters.
	7	Maintenance Counters	Time to maintenance (days) and engine hours to maintenance.

4. ALARMS AND WARNINGS

Alarms indicate an abnormal situation in the generating set are divided into 3 priority levels:

1- **SHUTDOWN ALARMS:** These are the most important fault conditions and cause:
- The **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** digital outputs to operate, (if selected via programming menu)

2- **LOAD_DUMPS:** These fault conditions cause:
- The 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** digital outputs to operate, (if selected via programming menu)

3- **WARNINGS:** These conditions cause:
- The ALARM led to flash,
- The **Horn** and **Alarm+Load_dump+Warning** digital outputs to operate, (if selected via programming menu)

If the ACK/RESET button is pressed, the Horn output will be deactivated; however the existing alarms will persist and disable the operation of the genset.

A second press on ACK/RESET button will clear existing alarms.

Alarms operate in a first occurring basis:
-If a shutdown alarm is present, following alarms, load_dumps and warnings will not be accepted,
-If a load_dump is present, following 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 cancelled** by pressing one of the operating mode buttons (**TEST / OFF / AUTO/MANUAL**).

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 and alarm limits are separately programmable for the oil pressure sender input. This fault will be monitored with **Holdoff Timer** 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 "**Oil Pressure Exists!**" information is displayed. 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 and alarm limits are separately programmable for the temperature sender input.
LOW TEMPERATURE (warning) : Set if the coolant temperature value measured from the sender is below the **Engine Heating Temperature** limit.
LOW FUEL: Set if a signal is detected at the low fuel level input or the the fuel level measured from the sender is below the programmed limit. Warning and alarm limits are separately programmable for the fuel level sender input.
HIGH OIL TEMPERATURE: Set if the oil temperature value measured from the sender is above the programmed limit. Warning and alarm limits are separately programmable for the temperature sender input.
HIGH CANOPY TEMPERATURE: Set if the canopy temperature value measured from the sender is above the programmed limit. Warning and alarm limits are separately programmable for the temperature sender input.
LOW COOLANT LEVEL: Set if a signal is detected at the low coolant level input.
EMERGENCY STOP: Set if a signal is detected at the emergency stop input.
SPARE-1 / SPARE-2 / SPARE-3: Set if a signal is detected from the related spare fault input.
LOW SPEED / HIGH SPEED: Set if the generator frequency is outside programmed limits. These faults will be monitored with **Holdoff Timer** delay after the engine is running. Low and high limits for warning and alarm are separately programmable. Another high frequency shutdown limit which is 12% above the high limit is always monitored and stops the engine immediately.
If engine rpm limits are programmed, these faults will be equally set using engine rpm limits.
START FAIL (alarm): Set if the engine is not running after programmed number of start attempts.
STOP FAIL (warning): Set if the engine has not stopped before the expiration of the **Stop Timer**.
OVERLOAD (load_dump): Set if one of the genset phase currents goes over the **Overcurrent Limit** for **Overload Timer**. If currents goes below the limit before expiration of the timer then no alarm will be set.
EXCESS POWER (load_dump): Set if the genset power (KW) supplied to the load goes over the **Excess Power** limit for **Overload Timer**. If the power goes below the limit before expiration of the timer then no alarm will be set.
REVERSE POWER (load_dump): Set if the genset power (KW) supplied to the load is negative and goes over the **Reverse Power** limit for **Overload Timer**. If the power goes below the limit before expiration of the timer then no alarm will be set.
HIGH EARTH CURRENT: Set if the earth current goes over the **Earth Current Warning or Loaddump Limit** for **Overload Timer**. If the current goes below the limit before expiration of the timer then no alarm will be set. Separate loaddump and warning limits are available through program menu.
GENSET LOW VOLTAGE: Set if any of the generator phase voltages goes outside programmed limits for **Overload Timer**. This fault will be monitored with **holdoff timer** delay after the engine is running.
GENSET HIGH VOLTAGE: Set if any of the generator phase voltages goes outside programmed limits for **Overload Timer**. This fault will be monitored with **holdoff timer** delay after the engine is running.
GENSET PHASE ORDER FAIL (load dump): Set if the genset phase order checking is enabled, genset phases are present and genset phase order is reversed.
LOW BATTERY VOLTAGE (warning): Set if the battery voltage goes below the programmed limit. During engine cranking this fault is not monitored.
HIGH BATTERY VOLTAGE: Set if the battery voltage goes above programmed limits. Both warning and alarm 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.
MAINS PHASE ORDER FAIL (warning): Set if the mains phase order checking is enabled, mains phases are present and mains phase order is reversed. This fault prevents the Mains Contactor to close.
SERVICE REQUEST (warning): Set if either time to service or engine hours to service timer is expired.

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 into a behavior suitable for the new operating mode. For example, if the AUTO mode is selected when genset is running at TEST mode, and mains phases are present then the genset will stop after cooldown.

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, the mains contactor will be deactivated.
The diesel will be started for programmed times after the preheat timer. When the engine runs, the crank relay will be immediately deactivated. The engine will run without load during engine heating period. After this, if alternator phase voltages and frequency are within limits, then the unit will wait for the generator contactor period 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. At the end of this period the generator contactor is deactivated and the mains contactor will be energized. If a cooldown period is given, the generator will continue to run during cooldown 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.

TEST: It is used to test the generator when the mains are on, or keep the generator running in the emergency backup mode. 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.

MANUAL: It is used to run and stop then engine and operate contactors manually. Separate pushbuttons for each operation are provided.

6. OTHER FEATURES

6.1 Remote Start Operation

The unit offers the possibility of **REMOTE START** mode of operation. Any digital input may be assigned as **Remote Start Input** using **Input Function Select** program parameters.

AMF/REMOTE Dev parameter should be set to **'1'** in **Controller Configuration**.

The REMOTE START signal should be set to NO contact, switching to battery negative. These selections are made using programming menu.

It is also necessary to set the **ACTION** program parameter of the related input to **3** in order to prevent any alarm 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.

Note: For AMF Application AMF/REMOTE Dev parameter should be set to '0' and Input Function IN-04 should be other than Remote Start Input.

6.2 Engine Heating Operation

Especially on engines 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 **Engine Heating Method** parameter is set to **0**. In this mode, the engine will run during parameter **Engine Heating Timer**, and then the genset will take the load.

2. Timer and temperature controlled heating:
This operation mode is selected when the **Engine Heating Method** parameter is set to **1**. In this mode, at first the engine will run during parameter **Engine Heating Timer**, then it will continue to run until the measured coolant temperature reaches the limit defined in parameter **Engine Heating Temperature**. 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.

6.3 Engine Idle Speed Operation

It may be required that the engine runs at the idle speed for a programmed duration for engine heating. The idle operation duration is adjusted with the parameter **Idle Speed Timer**. 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 **Relay Definition** program parameters. Also relays on an extension module may be assigned to this function.

The Idle speed operation is performed both in engine start-up and cool-down sequences. Speed and voltage protections are disabled during idle speed operation.

6.4 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 **Relay Definition** program parameters. Also relays on an extension module may be assigned to this function.

The engine body temperature limit is adjusted using the parameter **Engine Heating Temperature**. 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 **Engine Heating Temperature**. It turns off when the body temperature exceeds **Engine Heating Temperature**.

6.5 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 below **Fuel Pump Low Limit** parameter, the fuel pump relay output will operate. When the fuel level reaches **Fuel Pump High Limit** parameter, the relay will turn off. Thus the chassis fuel tank level will be always kept between **Fuel Pump Low Limit** and **Fuel Pump High Limit** parameters.

Note: Settable only through PC software.

6.6 Mains Simulation (Disable Start)

The unit offers an optional **SIMULATE MAINS** signal input. Any digital input may be assigned as **Simulate Mains** using **Input Function Select** program parameters**.**

It is also necessary to set the **ACTION** program parameter of the related input to **3** in order to prevent any alarms 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 **Simulate Mains** input is defined 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 and FORCE TO START operations.

6.7 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. Any digital input may be assigned as **Simulate Mains** using **Input Function Select** program parameters**.**

It is also necessary to set the **ACTION** program parameter of the related input to **3** in order to prevent any alarms 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 **Delayed Simulate Mains** program parameter 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 voltages 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 **Flashing Relay Timer** program parameter. 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 "Remote Start Operation" and "Delayed Simulate Mains" are set then REMOTE START operation mode is performed.

6.8 Dual Genset Mutual Standby 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 purposes in case of a genset failure or to a continuous operation requesting service stops.

The running period for each genset is adjustable using **Flashing Relay Timer** program parameter. If the time is adjusted as 0 hours, it will be actually set to 2 minutes for faster testing purposes.

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

The flashing relay function may be assigned to spare relays using **Relay Definition** program parameters. 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.

Priority In Dual Genset Mutual Standby Operation:

It may be required that the dual genset system starts the same genset at every mains failure. This is achieved using the PRIORITY input.

Any digital input may be assigned as **Priority** using **Input Function Select** program parameters**.**

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

The **Priority** 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 a **Priority** input is defined, then the system will work in priority mode. If the priority signal is applied, the unit will become master after each mains failure. If the priority signal is not applied, then the unit will become the slave one and the other genset will start.

Please contact KOEL for a complete application manual.

6.9 Service Request Warning

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 warning 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, the time limit is programmable with 1 month steps. 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** warning will occur. In such case contct KOEL engineer to service the engine.

6.10 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 and classic cable network (**PSTN**) modems are acceptable.

If the modem is connected to the unit, the **Modem Enable** program parameter should be set to 1, otherwise faulty operation may occur.

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.

When the modem call is in progress, a telephone icon ( ) will appear at the upper right corner of the screen.

If **Modem Enable** or **SMS Enable** or **MODBUS Address** or **RS-485 Enable** parameters are different from zero, the local PC connection will not work.

Advised modems are KOEL 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 KOEL.

Modem calls are always terminated by the central PC 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 PC 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.

6.11 SMS Message Sending

The GSM SMS sending is activated by setting the **SMS Enable** program parameter to **1**.

If **Modem Enable** or **SMS Enable** or **MODBUS Address** or **RS-485 Enable** parameters are different from zero, the local PC connection will not work.

When a fault condition occurs, the unit will compose an SMS message and will send it to up to 6 phone numbers. If modem is enabled, only 4 telephone numbers are available for SMS sending.

The unit is also able to send SMS messages in below conditions, without creating a visible alarm or warning:
Mains Fail, Mains Restored (enabled via **SMS on Mains Change** program parameter)
Fuel Theft, Fuelling (enabled by setting the **Fuel Consumption / Hour** parameter to other than 0)

If both modem and SMS are enabled, the unit will send SMS messages first and attempt modem connection afterwards.

When SMS sending is in progress, an (**SMS**) icon will appear at the upper right corner of the screen.

The maximum number of alarms transmitted in a SMS message is 4. This limitation is due to the maximum length of an SMS message which is 160 characters.

A sample GSM SMS message is given below:

KOEL <SITE-ID>
STOP :LOW OIL PRESSURE SW.
END OF ALARM LIST

The first line of the message carries information about the unit type and the site identity string. This line is intended for the identification of the genset sending the SMS message.

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 consecutive 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 KOEL. This is the same cable as PSTN (land) modems.

6.12 Remote Monitoring

Thanks to its standard serial RS-232 port, the unit offers the remote monitoring.
The modem, SMS and Modbus modes are not compatible with the local PC connection. **Modem Enable**, **SMS Enable** and **MODBUS Address** program parameters should be set to 0 before connection.

The PC software allows the visualization and recording of all measured parameters. The recorded parameters may then be analyzed graphically and printed.

6.13 RS-485 Port

The unit offers an RS-485 port as a standard feature. Together with the MODBUS communication protocol, this offers a convenient way to connect the unit to external automation and management systems.
The RS-485 port is not isolated, it references to the battery negative connection of the unit.

The external MODBUS device communicating with the unit should use the same potential as ground reference.

6.14 External Control of the Unit

The unit offers total external control through programmable digital inputs. Each digital input may be programmed for below functions:

- Force OFF mode
- Force AUTO mode
- Force TEST mode
- Disable Auto Start
- Force to Start
- Fault Reset
- Alarm Mute
- Panel Lock

External mode select signals have priority on mode buttons of the unit. If the mode is selected by external signal, it is impossible to change this mode with front panel keys. However if the external mode select signal is removed, the unit will revert to the last selected mode via pushbuttons.

It is also possible to lock the front panel completely for remote command.

6.15 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.

Program parameters related to the exerciser are:
Exercise start day and hour
Exercise duration
Exerciser Period (Daily / Weekly / Monthly)

Exerciser can only be enabled through PC. It cannot be programmed from front panel.

When the start day and hour of exercise has come, the unit will automatically switch **TEST** mode and the engine will run.

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

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.

6.16. 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 **Gas Solenoid Delay** program parameter.
The gas engine fuel solenoid relay function may be assigned to spare relays using **Relay Definition** program parameters. Also relays on an extension module may be assigned to this function.

6.17. Load Shedding / Dummy Load

The load shedding feature consists on the disconnection of the least crucial loads when the genset power approaches to its limits. These loads will be supplied again when the genset power falls below the programmed limit. The internal Load Shedding function is always active. Any of the auxiliary relays may be used as the load shedding output.
The dummy load function consists on the connection of a dummy load if the total genset load is below a limit and to disconnection of the dummy load when the total power exceeds another limit. The dummy load function is the inverse of the load shedding function, thus the same output may be used for both purposes.
The parameters used in Load Shedding feature are in the Electrical Parameters Group:
Load Shedding Low Limit: If the genset active power output goes below this limit, then the Load Shedding relay will be deactivated.
Load Shedding High Limit: If the genset active power output goes above this limit, then the Load Shedding relay will be activated.
Note: Settable only through PC software.

6.18. Fuel Theft / Fuelling Messages

The unit is able to send SMS messages in fuel theft or fuelling conditions.

These SMS messages are sent without creating visible fault condition.

These features are enabled by setting the program parameter **Engine Parameters > Fuel Consumption / Hour** to a value other than 0%.

The **Fuel Consumption / Hour** parameter should be set to a value clearly greater than the maximum fuel consumption of the engine.

If the fuel level measured from the sender input is decreased more than **twice this parameter** in 1 hour period, then a FUEL THEFT sms message is sent to programmed telephone numbers.

If the fuel level measured from the sender input is increased more than this parameter in 1 hour period, then a FUELLING sms message is sent to programmed telephone numbers.

6.19. Firmware Update

The unit offers possibility of updating the firmware in the field. The firmware is updated through the RS-232 serial port using PC software or a special DOS program.

7. 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.

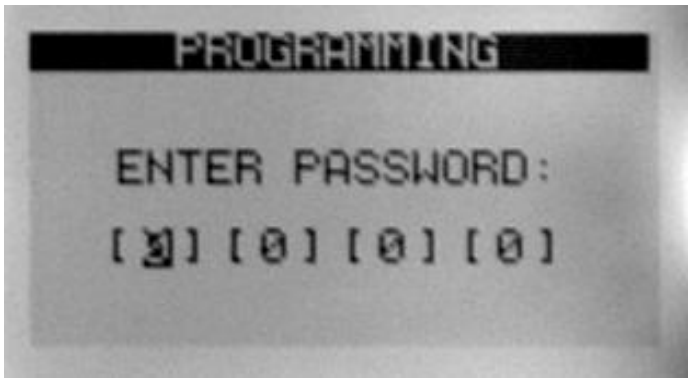
The MODBUS mode is activated by assigning a controller address to the unit using **MODBUS Address** program parameter. The possible address range is 1 to 144. Setting the address to 0 will **disable** the MODBUS mode and allow communication under PC software protocol.

8. PROGRAMMING

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

To **enter the program mode**, press together ►and ▼buttons together for 5 seconds.

When the program mode is entered, below password entry screen will be displayed.



A 4 digit password must be entered using **ACK/RESET,** ▼ and ►buttons.

The unit stores 2 different passwords. Each password allows access to a different level of program parameters.

The password level-1 allows access to field adjusted parameters. The level-2 allows access to factory setup.

The password level-1 is factory set to '**1234**' .

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

The program mode is driven with a two level menu system. The top menu consists on program groups and each group consists of various program parameters.

When program mode is entered, a list of available groups will be displayed. Navigation between different groups are made with **ACK/RESET** and ▼ buttons. A "**>**" character will appear at the first column of the selected group.

In order to enter inside a group, please press ► button. In order to exit from the group to the main list please press **0 (STOP)** button.

Navigation inside a group is made also with ▼and **ACK/RESET** buttons. A list of available parameters will be displayed. Selected parameter is shown with a "**>**" character at the first column. In order to display/change the value of this parameter, please press ►button. Parameter value may be increased and decreased with ▼and **ACK/RESET** buttons. If these keys are hold pressed, the program value will be increased/decreased by steps of 10. When a program parameter is modified, it is automatically saved in memory. If ►button is pressed, next parameter will be displayed. If **0 (STOP)** button is pressed, then the list of parameters in this group will be displayed.

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

If no button is pressed during 1 minute the program mode will be cancelled automatically.

Program Group: EVENT LOGGING

The unit keeps record of the last **100** events in order to supply information for the service personal.

The date-time, genset status information and a comprehensive set of measured values are stored within the event memory. The events are recorded with a time stamp which comes from the internal real time clock circuit of the unit.

The events are stored in a circular memory. This means that a new coming event will erase the oldest recorded event. The events are always displayed starting from the most recent one.

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

The event record is reached through programming menu.

Switching to the previous event is made with ▶ button.

To exit event record pages press 0 (STOP) button.

Each event is displayed in **4** pages. Event and page numbers are shown at the top right corner of the display. Events are numbered starting from 1, number 1 being the latest one. Pages are listed from **A to D**. Navigation between different pages of the same event is done with ▼ button.

Event sources are:

-Shutdown alarms, Load dump alarms, Warnings
-Operating mode change (OFF, AUTO, etc…)
-Periodic records.

Event record contents are:

Event type (alarms, mode change, periodic, etc…)
Date and time
Genset operating mode (AUTO, MANUAL,OFF,TEST)
Genset operation status (mains ok, running, cooldown etc…)
Genset phase voltages L1-L2-L3
Genset phase currents L1-L2-L3
Genset frequency
Genset active power (KW)
Genset power factor
Engine rpm
Oil pressure
Coolant temperature
Fuel level
Battery voltage
Mains phase voltages L1-L2-L3
Mains frequency
Digital input voltages
Charge input voltage

Program Group: Controller Configuration

Parameter Definition	Unit	Factory Set	Description
LCD Contrast	-	35	This parameter is used to set LCD contrast. Adjust for the best viewing angle.
Alarm Relay Timer	sec	60	This is the period during which the **ALARM** relay is active. If the period is set to 0, this will mean that the period is unlimited.
Exercise Day and Time	-	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 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, then the day information is don't care and the exercise will be performed every day regardless of the day selection. If the monthly exerciser is selected, then the exercise will be performed during the first 7 days of each month at the programmed day and hour.
Exercise Duration	min	10	This parameter defines the exercise duration and programmed in 10 minute steps up to 24 hours.
Exercise Off/On Load	-	0	**0:** Exercise at **TEST** mode **1:** Exercise at **LOAD TEST** mode
Exercise Period	-	1	**0:** exercise every day (the exercise will be performed every day regardless of the day selection of Exercise Dat and Time parameter). **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).
AMF / Remote Start Device	-	0	**0: AMF unit** (Note:For this function set IN-04 to any input other than remote start input) **1: Remote Start Unit**. (Note: Set IN-04 to Remote start input and set it's Action-03)
Modem Enable	-	0	**0:** The serial port is connected to PC **1:** Modem connected.
SMS Enable	-	0	**0:** SMS not enabled **1:** SMS enabled
GPRS Call Enable	-	0	**0:** standard modem calls **1:** GPRS modem calls
RS-485 Enable	-	0	**0:** RS-232 comm port enabled **1:** RS-485 comm port enabled
MODBUS Address	-	0	**0:** PC software communication protocol. **1-144:** MODBUS communication. This parameter is also the MODBUS controller address of the unit.
Real Time Clock Adjust	-	117	This parameter trims precisely the real time clock circuit. 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.

Program Group: Controller Configuration (continued)

Parameter Definition	Unit	Factory Set	Description
SMS on Mains Change	-	0	This parameter controls SMS sending when mains voltages status is changed. No warnings generated. **0:** no SMS when mains failed or restored **1:** SMS sent when mains failed or restored
Fuel Level Sender Enable	-	1	0: Fuel level sender not connected 1: Low fuel level warning and alarm enabled.
Canopy Temp Sender Enable	-	0	0: Canopy temp sender not connected 1: High canopy temp warning and alarm enabled.

Program Group: Electrical Parameters

Parameter Definition	Unit	Factory Set	Description
Current Transformer Ratio	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.
Earth Fault Current Transformer Ratio	A	500	This is the rated value of earth current transformer. The secondary of the transformer will be 5 Amps.
Overcurrent Limit	A	700	If the current goes above this limit, during the period defined in **Overload Timeout** then a **Overcurrent Load Dump** alarm will be generated. If this parameter is 0 then Overcurrent check is disabled.
Excess Power Limit	KW	440	If the active power goes above this limit, during the period defined in Overload Timeout then an **Excess Power Load Dump** alarm will be generated. If this parameter is 0 then Excess Power check is disabled.
Mains Voltage Low Limit	V	180	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** mode.
Mains Voltage High Limit	V	260	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** mode.
Mains Frequency Low Limit	Hz	45	If the mains frequency goes under this limit, it means that the mains are off and it starts the transfer to the genset in **AUTO** mode.
Mains Frequency High Limit	Hz	55	If the mains frequency goes above this limit, it means that the mains are off and it starts the transfer to the genset in **AUTO** mode.
Genset Low Voltage Shutdown Limit	V	190	If one of the generator phase voltages goes under this limit when feeding the load, this will generate a **GENSET LOW VOLTAGE** shutdown alarm and the engine will stop.
Genset Low Voltage Warning Limit	V	200	If one of the generator phase voltages goes under this limit when feeding the load, this will generate a **GENSET LOW VOLTAGE** warning.
Genset High Voltage Warning Limit	V	250	If one of the generator phase voltages goes above this limit when feeding the load, this will generate a **GENSET HIGH VOLTAGE** warning.
Genset High Voltage Shutdown Limit	V	260	If one of the generator phase voltages goes over this limit when feeding the load, this will generate a **GENSET HIGH VOLTAGE** alarm and the engine will stop.

Program Group: Electrical Parameters (continued)

Parameter Definition	Unit	Factory Set	Description
Low Battery Voltage Warning	V	19.0	If the battery voltage falls below this limit, this will generate a **LOW BATTERY** warning.
High Battery Voltage Warning	V	29.0	If the battery voltage goes over this limit, this will generate a **HIGH BATTERY** warning.
Mains Waiting Timer	min	0.5	This is the time between the mains voltages entered within the limits and the generator contactor is deactivated.
Mains Phase Order Enable	-	0	**0:** mains phase order checking disabled **1:** if mains phase order is faulty, then a warning is given and mains contactor deenergized.
Reverse power warning limit	KW	0	If the genset power is negative and goes above this limit then a **REVERSE POWER** warning will be generated.
Reverse power loaddumpg limit	KW	0	If the genset power is negative and goes above this limit then a **REVERSE POWER** loaddump will be generated.
Genset Phase Order Loaddump	-	0	**0:** genset phase order checking disabled **1:** if genset phase order is faulty, then a loaddump is generated and the genset stops after cooldown.
Earth Fault Current Warning Limit	%	0	If the earth current goes above this limit for overload timeout, then a warning will be generated. The value is defined as a percentage of genset CT rating.
Earth Fault Current Loaddump Limit	%	0	If the earth current goes above this limit for overload timeout, then a loaddump alarm will be generated. The value is defined as a percentage of genset CT rating.

Program Group: Engine Parameters

Parameter Definition	Unit	Factory Set	Description
Low Frequency Shutdown	Hz	47	If the genset frequency goes under this limit, a **GENSET LOW SPEED** alarm is generated and the engine stops.
Low Frequency Warning	Hz	48	If the genset frequency goes under this limit, a **GENSET LOW SPEED** warning is generated.
High Frequency Warning	Hz	54	If the genset frequency goes over this limit, a **GENSET HIGH SPEED** warning is generated.
High Frequency Shutdown	Hz	55	If the genset frequency goes over this limit, a **GENSET HIGH SPEED** alarm is generated and the engine stops.
Engine Heating Temperature	°C	0	If it is requested that the engine runs without load until reaching a certain temperature, this parameter defines the temperature. If the coolant temperature falls below this parameter, an **Engine Low Temperature** warning will occur.
Engine Start Delay	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.
Preheat Timer	sec	0	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 assigned by **Relay Definitions**)

Program Group: Engine Parameters (continued)

Parameter Definition	Unit	Factory Set	Description
Crank Timer	sec	10	This is the maximum start period. Starting will be automatically cancelled if the genset fires before the timer.
Wait Between Starts	sec	10	This is the waiting period between two start attempts.
Cooldown Timer	min	1.0	This is the period that the generator runs for cooling purpose after the load is transferred to mains.
Idle Speed Timer	sec	10	When the engine runs, the Idle output relay function will be active during this timer.
Low Fuel Warning	%	20	If the fuel level measured from the analog input falls below this limit, a LOW FUEL LEVEL SENDER warning is generated.
Low Fuel Shutdown	%	10	the fuel level measured from the analog input falls below this limit, a LOW FUEL LEVEL SENDER shutdown alarm is generated and the engine stops.
Fuel Consumption per Hour	%	0	This parameter is used to calculate the fuel quantity in the fuel tank in engine-hours. This is also the threshold for sending FUEL THEFT and FUELLING sms messages. If this parameter is set to 0, then no Fuel Theft and Fuelling sms messages will be sent. Check chapter 6.19 for details of fuel theft SMS messages.
Fuel Tank Capacity	Lts	0	This parameter is used to calculate the fuel quantity in the fuel tank. If this parameter is set to zero then the fuel quantity in liters will not be displayed.
High Canopy Temperature Warning	°C	80	If the canopy temperature measured from the analog input goes over this limit, this will generate a HIGH CANOPYTEMPERATURE SENDER warning.
High Canopy Temperature Shutdown	°C	90	f the oil temperature measured from the analog input goes over this limit, this will generate a HIGH OIL TEMPERATURE SENDER alarm and the engine will stop.

Program Group: Adjust Date and Time (password level-2)

Parameter Definition	Unit	Factory Set	Description
Date	-	01-31	Current day of the month.
Month	-	01-12	Current month.
Year	-	00-99	Last two digits of the current year.
Hours	-	00-23	Current hour of the day.
Minutes	-	00-59	Current minute of the hour.
Seconds	-	00-59	Current second of the minute.

Program Group: Input Configuration-01 (High Temperature Switch)

Parameter Definition	Unit	Fac.Set	Description
Action		0	**0:** Shutdown (the engine stops immediately)
Sampling		1	**1:** After holdoff timer
Latching		1	**1:** Latching
Contact type		0	**0:** Normally open
Switching		0	**0:** Battery negative (Note: Alaways Set to Zero)
Response delay		0	**0:** No delay

Program Group: Input Configuration-02 (Low Oil Pressure Switch)

Parameter Definition	Unit	Fac.Set	Description
Action		1	**0:** Shutdown (the engine stops immediately) **1:** Load Dump (the engine stops after cooldown)
Sampling		1	**1:** After holdoff timer
Latching		1	**1:** Latching
Contact type		0	**0:** Normally open
Switching		0	**0:** Battery negative(Note: Alaways Set to Zero)
Response delay		1	**1:** Delayed (4sec)

Program Group: Input Configuration-03 (Emergency Stop)

Parameter Definition	Unit	Fac.Set	Description
Action		0	**0:** Shutdown (the engine stops immediately)
Sampling		0	**0:** Always
Latching		0	**0:** Non latching
Contact type		0	**0:** Normally open
Switching		0	**0:** Battery negative(Note: Alaways Set to Zero)
Response delay		0	**0:** No delay

Program Group: Input Configuration-04 (Remote Start Input)

Parameter Definition	Unit	Fac.Set	Description
Action		3	**3:** No alarm/warning
Sampling		0	**0:** Always
Latching		0	**0:** Non latching
Contact type		0	**0:** Normally open **1:** Normally closed
Switching		0	**0:** Battery negative(Note: Alaways Set to Zero)
Response delay		1	**1:** Delayed (4sec)

Program Group: Input Configuration-05 (Low Fuel Switch Input)

Parameter Definition	Unit	Fac.Set	Description
Action		0	**0:** Shutdown (the engine stops immediately)
Sampling		0	**0:** Always
Latching		1	**1:** Latching
Contact type		0	**0:** Normally open **1:** Normally closed
Switching		0	**0:** Battery negative(Note: Alaways Set to Zero)
Response delay		1	**0:** No delay **1:** Delayed (4sec)

Program Group: Input Configuration-06 (Spare–1 Input)

Parameter Definition	Unit	Fac.Set	Description
Action		0	**0:** Shutdown (the engine stops immediately)
Sampling		0	**0:** Always
Latching		1	**1:** Latching
Contact type		0	**0:** Normally open **1:** Normally closed
Switching		0	**0:** Battery negative(Note: Alaways Set to Zero)
Response delay		0	**0:** No delay **1:** Delayed (4sec)

Program Group: Input Configuration-07 (Spare-2 Input)

Parameter Definition	Unit	Fac.Set	Description
Action		0	**0:** Shutdown (the engine stops immediately)
Sampling		0	**0:** Always
Latching		1	**1:** Latching
Contact type		0	**0:** Normally open **1:** Normally closed
Switching		0	**0:** Battery negative(Note: Alaways Set to Zero)
Response delay		0	**0:** No delay **1:** Delayed (4sec)

Program Group: Input Configuration-08 (Low Coolant Level Switch)

Parameter Definition	Unit	Fac.Set	Description
Action		0	**0:** Shutdown (the engine stops immediately)
Sampling		0	**0:** Always
Latching		1	**1:** Latching
Contact type		1	**1:** Normally closed
Switching		0	**0:** Battery negative(Note: Alaways Set to Zero)
Response delay		0	**0:** No delay

The below parameters defines the functions of digital outputs. The unit has 7 digital outputs. All outputs have programmable functions, selected from a list.

The relays may be extended up to 23 using **Relay Extension Modules**.

Program Group: Relay Definitions

Parameter Def.	Factory Set	Description
Relay 01	02: CRANK	RELAY-1 function selected from list
Relay 02	00: FUEL	RELAY-2 function selected from list
Relay 03	26: IDLE	RELAY-3 function selected from list
Relay 04	03: STOP	RELAY-4 function selected from list
Relay 05	01: ALARM	RELAY-5 function selected from list
Relay 06	05: MAINS C.	RELAY-6 function selected from list
Relay 07	04: GEN C.	RELAY-7 function selected from list

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

00	Fuel
01	Alarm
02	Start
03	Stop
04	Gen. Contactor
05	Mains Contactor

32	Temp switch alarm
33	Oil switch alarm
34	Emerg.Stop alarm
35	-
36	Fuel Level switch alarm
37	Spare-1 Alarm

80	Temp switch warning
81	Oil switch warn.
82	Emerg Stop warning
83	-
84	Low Fuel Level switch warning

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	Mains Fail
17	Block Heater
18	Service Request
19	-
20	Load Shedding Relay
21	Flashing Relay
22	Gas Solenoid
23	Fuel Pump
24	Mains Phase Order Fail
25	Genset Phase Order Fail
26	Idle Speed
27	Cooler Fan
28	-
29	-
30	-
31	-

38	Spare-2 Alarm
39	Spare-3 Alarm
40	Oil sender alarm
41	Temp sender alarm
42	Low speed alarm
43	High speed alarm
44	Low voltage alarm
45	High voltagealarm
46	Fail to start alarm
47	Low fuel sender alarm
48	Oil Temp sender alarm
49	Canopy Temp sender alarm
50	-
51	High battery voltage alarm
52	Charge fail alarm
53	-
54	Coolant Level AC switch alarm
55	-
56	Temp sw. load_dump
57	Oil switch load_dump
58	Emerg.Stop load_dump
59	-
60	Low Fuel Level switch load_dump
61	Spare-1 load_dump
62	Spare-2 load_dump
63	Spare-3 load_dump
64	Oil sender fail ldd
65	Temp sender fail ldd
66	Fuel Lev sender fail ldd
67	Oil Temp snd fail ldd
68	Canopy Temp snd fail ldd
69	Spare-1 sender fail ldd
70	Spare-2 sender fail ldd
71	-
72	Overcurrent load_dump
73	Excess power ldd
74	Reverse power ldd
75	High Earth current ldd
76	-
77	-
78	-
79	Genset Phase Order Fail Loaddump

85	Spare-1 warning
86	Spare-2 warning
87	Spare-3 warning
88	Oil sender warning
89	Temp sender warn.
90	Low speed warning
91	High speed warning
92	-
93	Low Temp snd warn.
94	Fail to stop warning
95	Low fuel sender warn.
96	Service request warn.
97	Mains Phase Order Fail warning
98	Low battery warning
99	High battery warning
100	Charge fail warning
101	-
102	-
103	High Earth Current warning
104	Gen Low voltge warn.
105	Gen High voltge warn.
106	Reverse Power warn.
107	High oil temp warn.
108	High canopy temp warning
109	-
110	Low coolant level AC switch warning
111	-
112	Oil sender fail warn
113	Temp sender fail warn
114	Fuel sender fail warn
115	Oil temp snd fail warn
116	Canopy temp snd fail warning
117	Spare-1 sender fail warning
118	Spare-2 sender fail warning
119	-

The parameters below define the functions of digital inputs, selected from a list.

Functions from 12 to 23 activate also the related operating sequence.

The related input configuration parameters apply for each input, thus any signal can be programmed for NO or NC contact, closing to BAT+ or BAT-.

Program Group: Input Function Select

Parameter Definition	Fact. Set	Description
Input 01 Function Select	1	High Temp. Switch
Input 02 Function Select	0	Oil Pressure Switch
Input 03 Function Select	4	Emergency Stop
Input 04 Function Select	18	Remote Start Input
Input 05 Function Select	7	Low Fuel Level Switch
Input 06 Function Select	11	Spare-1 Input
Input 07 Function Select	10	Spare-2 Input
Input 08 Function Select	2	Low Coolant Level switch

Input Function Select List

Number	Description
0	Oil Pressure Switch
1	High Temp. Switch
2	Low Coolant Level switch
3	Rectifier Fail
4	Emergency Stop
5	Alternator High Temp.
6	Door Open
7	Low Fuel Level Switch
8	Earthquake Detector
9	Spare-3 Input
10	Spare-2 Input
11	Spare-1 Input
12	Force AUTO Mode
13	Force OFF Mode
14	Force TEST Mode
15	Overload Input
16	By-pass I/P input
17	Priority Input
18	Remote Start Input
19	Disable Auto Start
20	Force to Start
21	Fault Reset
22	Alarm Mute
23	Panel Lock

Program Group: Site Id

Parameter Definition	Factory Set	Description
Site Id String	----------	This is the site Id string sent at the beginning of an SMS message for the identification of the genset sending the SMS message. Any 20 character long string may be entered.

Program Group: Modem-1/SMS-1 Telephone Number

Parameter Definition	Factory Set	Description
Modem-1 / SMS-1 telephone number	----------	This telephone number buffer accepts up to 16 digits, including the wait charater (“,”) in order to enable dialing through a pabx. **If Modem Enabled:** This is the first telephone number used for modem calls. **If Modem Disabled:** This is the first SMS telephone number.

Program Group: Modem-2 / SMS-2 Telephone Number

Parameter Definition	Factory Set	Description
Modem-2 / SMS-2 telephone number	----------	This telephone number buffer accepts up to 16 digits, including the wait charater (“,”) in order to enable dialing through a pabx. **If Modem Enabled:** This is the second telephone number used for modem calls. **If Modem Disabled:** This is the second SMS telephone number.

Program Group: SMS-3 Telephone Number

Parameter Definition	Factory Set	Description
SMS-3 telephone number	----------	This SMS telephone number accepts up to 16 digits.

Program Group: SMS-4 Telephone Number

Parameter Definition	Factory Set	Description
SMS-3 telephone number	----------	This SMS telephone number accepts up to 16 digits.

Program Group: SMS-5 Telephone Number

Parameter Definition	Factory Set	Description
SMS-3 telephone number	----------	This SMS telephone number accepts up to 16 digits.

Program Group: SMS-6 Telephone Number

Parameter Definition	Factory Set	Description
SMS-3 telephone number	----------	This SMS telephone number accepts up to 16 digits.

9. 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 on the screen.
-Upper and lower limits of the mains voltages may be too tight. Check the parameters **Mains Voltage Low Limit** and **Mains Voltage High Limit**. Standard values are 170/270 volts.
-Check AC mains frequency.
-The hysteresis voltage may be given to excessive. 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 again.

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 EXISTS ! message is displayed:

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 EXISTS ! message is displayed:

-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 **GEN L1-L2-L3** 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 19 and 22 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.

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 program parameters.

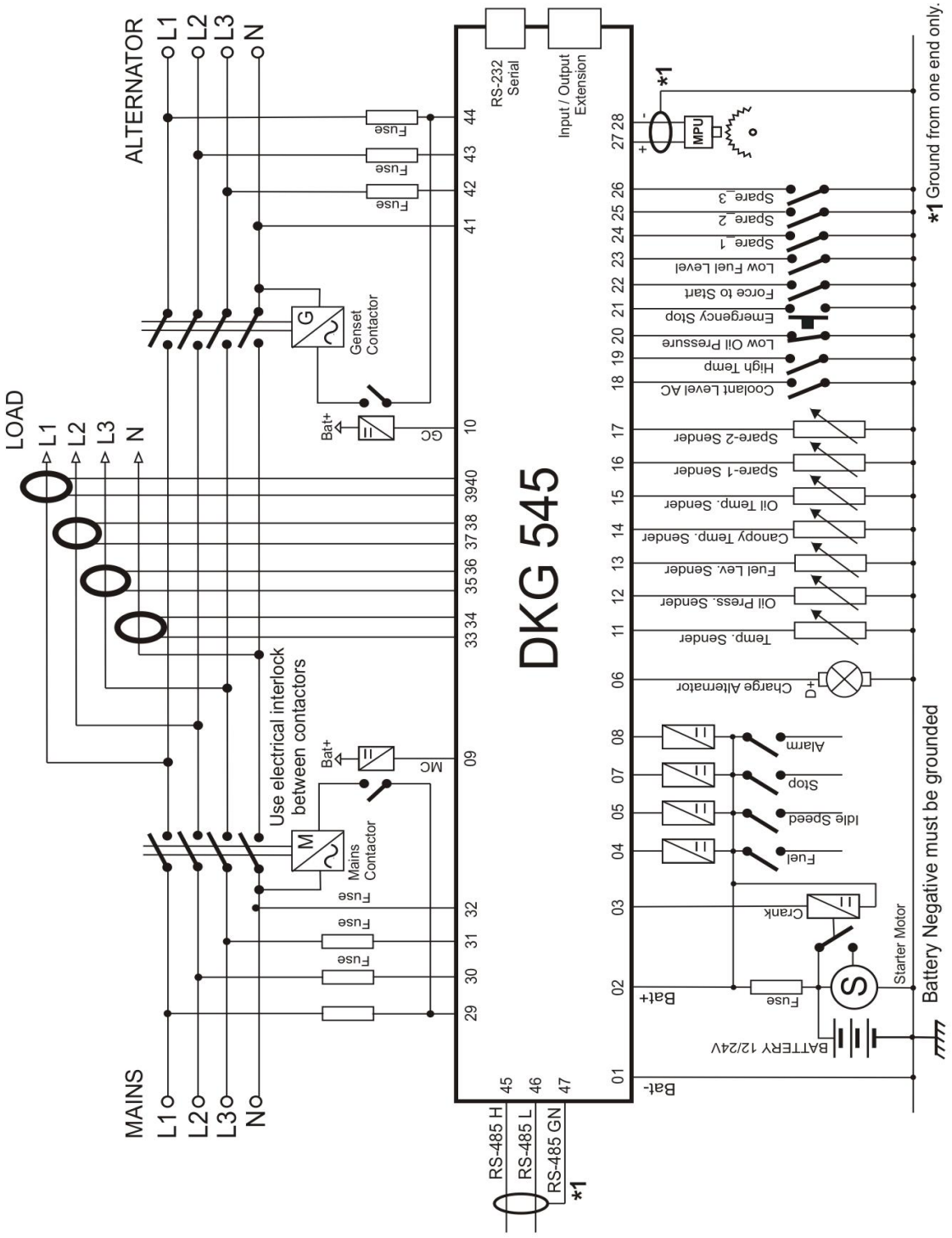
10. DECLARATION OF CONFORMITY

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.

11. TECHNICAL SPECIFICATIONS

Alternator voltage: 0 to 300 V-AC Phase to Neutral (0 to 520 V-AC Phase to Phase)
Alternator frequency: 0-100 Hz.
Mains voltage: 0 to 300 V-AC Phase to Neutral (0 to 520 V-AC Phase to Phase)
Mains frequency: 0-100 Hz.
DC Supply range: 8.0 VDC to 36.0 VDC
Communication port: RS-232/RS-485. 9600 bauds, no parity, 1 stop bit.
Operating temperature range: -20°C to +70°C (-4 ºF to +158 ºF)
Maximum humidity: 95%, non-condensing
Dimensions: 202x148x48mm (WxHxD)
Panel Cut-out dimensions: 183 x 134mm minimum.
Weight: 400 g (approx.)
Case material: High temperature, self extinguishing ABS/PC (UL94-V0)
IP protection: IP65 from front panel, IP30 from the rear

12. CONNECTION DIAGRAM



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