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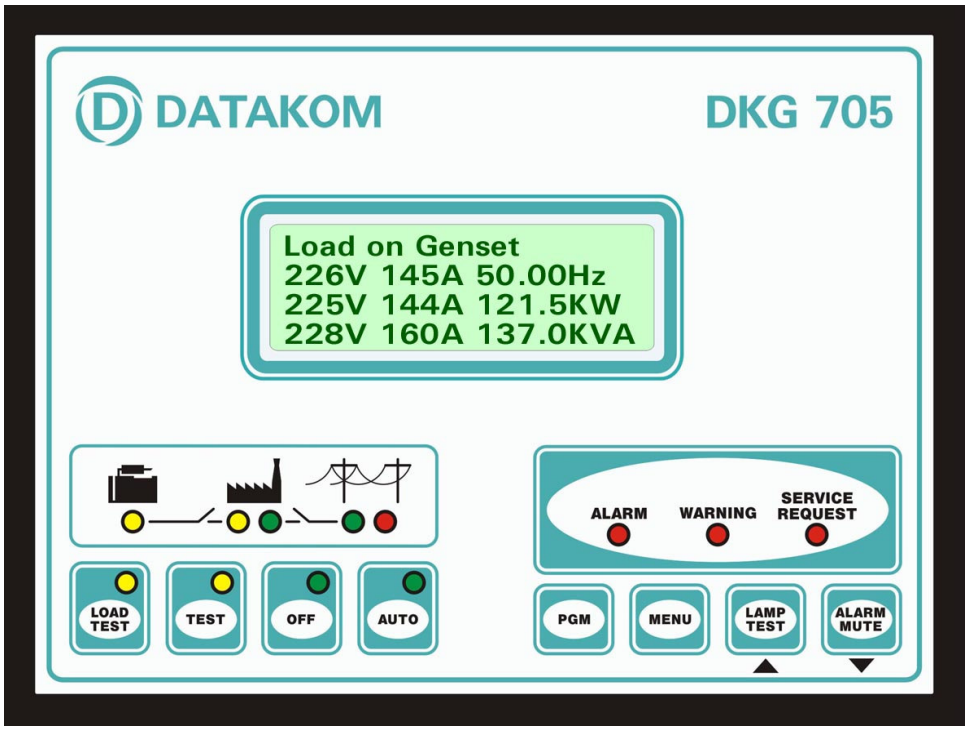
DKG-705 AUTOMATIC MAINS FAILURE AND REMOTE START UNIT WITH PARALLEL TO MAINS AND DUAL GENSET PARALLEL FEATURES



FEATURES

Automatic mains failure,
Remote start operation,
Engine control,
Generator protection,
Built in alarms and warnings,
Programmable analogue inputs: 4
Programmable digital inputs: 8
Programmable relay outputs: 7
I/O expansion capability,
LCD display 4 lines by 20 characters,
Periodic maintenance request indicator,
True RMS AC measurements,
Built-in exerciser,
Remote Start capability,
Statistical counters,
Event logging,
Field adjustable parameters,
Governor and AVR control outputs,
No break transfer,
Soft transfer,
Paralleling with the mains,
Peak lopping (peak shaving),
Load shedding,
Dual genset parallel with load sharing,
G-59 protections,
Remote monitoring (MS-Windows based),
RS-232 serial port,
Software downloadable from serial port,
Survives cranking dropouts,
Sealed front panel.

VERSION: 01.16 DATE: 20-02-2006

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1. INSTALLATION

1.1 Introduction to the Control Panel

The DKG-705 is a control and protection unit used in gensets. The 4 lines by 20 characters LCD display allows the visualization of many measured parameters. 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 measurable 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
Mains current phase R (optional)
Mains current phase S (optional)
Mains current phase T (optional)
Mains frequency
Mains KW phase R (optional)
Mains KW phase S (optional)
Mains KW phase T (optional)
Mains KVA phase R (optional)
Mains KVA phase S (optional)
Mains KVA phase T (optional)
Mains KVAr phase R (optional)
Mains KVAr phase S (optional)
Mains KVAr phase T (optional)
Mains cosΦ phase R (optional)
Mains cosΦ phase S (optional)
Mains cosΦ phase T (optional)
Mains total KW (optional)
Mains total KVA (optional)
Mains total KVAr (optional)
Mains total cosΦ (optional)

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
Gen KW phase U
Gen KW phase V
Gen KW phase W
Gen KVA phase U
Gen KVA phase V
Gen KVA phase W
Gen KVAr phase U
Gen KVAr phase V
Gen KVAr phase W
Gen cosΦ phase U
Gen cosΦ phase V
Gen cosΦ phase W
Gen total KW
Gen total KVA
Gen total KVAr
Gen total cosΦ

Synchronoscope phase angle
Voltage match U-R
Battery voltage,
Engine RPM
Coolant temperature
Oil pressure
Oil temperature
Fuel level

1.2 Mounting the Unit

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

Mount the unit on a flat, vertical surface. The unit fits into a standard panel meter opening of 188x140 millimeters. Before mounting, remove retaining steel springs from the unit, then pass the unit through the mounting opening. The unit will be maintained in its position by the steel springs.

The DKG-705 is factory set for 24V-DC operation. If the unit is used in a 12V-DC system, the 12V jumper terminals must be short-circuited.

Do not operate a 12V-DC unit with a 24V-DC system. This may cause the destruction of the unit. Always disconnect the voltage selector jumper of a stocked unit.

The engine body must be grounded for correct operation of the unit. Otherwise incorrect voltage and frequency measurements may occur, resulting in faulty operation of the genset.

The output of the current transformers shall be 5 Amperes. The input current rating of the current transformers may be selected as needed (between 50/5 and 5000/5 amps). Current transformer outputs shall be connected by separate cable pairs from each transformer, to related DKG-705 inputs. Never use common terminals or grounding. The power rating of the transformer should be at least 5 Watts. It is recommended to use 1% precision transformers.

If analogue sensors (e.g. temperature, oil pressure, oil temperature or fuel level) are connected to DKG-705, it is not possible to use auxiliary displays. If temperature or oil pressure displays are already present on the generator control panel, do not connect the sensors to the DKG-705. The unit is factory programmed for VDO type sensors. However if a different type of sensor is to be used, it is possible to recalibrate the unit. The calibration process will be explained later in this document.

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

12V JUMPER: When this jumper is placed, 12V-DC operation is selected. Do not operate a 12V-DC unit with a 24V-DC system. This may cause the destruction of the unit. Always disconnect the voltage selector jumper of a stocked unit.

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

EXTENSION CONNECTOR (OPTIONAL): This connector is intended for the connection of input and output extension modules. The optional relay extension module provides 8 programmable 16A relay outputs. The DKG-705 allows the use of up to 2 I/O extension modules.

Term	Function	Technical data	Description
1	**GENERATOR CONTACTOR**	Relay output, 10A-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 standard genset applications, in order to provide extra security, the normally closed contact of the mains contactor should be serially connected to this output. In '**no break transfer**' or '**parallel with mains**' applications, this output will drive directly the generator contactor.
2	**U**	Generator phase inputs, 0-300V-AC	Connect the generator phases to these inputs. The generator phase voltages upper and lower limits are programmable.
3	**V**		
4	**W**		
5	**GENERATOR NEUTRAL**	Input, 0-300V-AC	Neutral terminal for the generator phases.
6	**MAINS NEUTRAL**	Input, 0-300V-AC	Neutral terminal for the mains phases.
7	**T**	Mains phase inputs, 0-300V-AC	Connect the mains phases to these inputs. The mains voltages upper and lower limits are programmable.
8	**S**		
9	**R**		
10	**MAINS CONTACTOR**	Relay output, 10A-AC	This output provides energy to the mains contactor. If the mains phases do not have acceptable voltage or frequency values, the mains contactor will be de-energized. In standard genset applications, in order to provide extra security, the normally closed contact of the generator contactor should be serially connected to this output. In '**no break transfer**' or '**parallel with mains**' applications, this output will drive directly the mains contactor.

Term	Function	Technical data	Description
11	**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 units than DKG-705 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).
12	**CURR_W-**		
13	**CURR_V+**		
14	**CURR_V-**		
15	**CURR_U+**		
16	**CURR_U-**		
17	**COOLANT TEMP. SENSOR**	Input, 0-5000 ohms	Analogue temperature sensor connection. Do not connect the sensor to other devices.
18	**OIL PRESSURE SENSOR**	Input, 0-5000 ohms	Analogue oil pressure sensor connection. Do not connect the sensor to other devices.
19	**FUEL LEVEL SENSOR**	Input, 0-5000 ohms	Analogue fuel level sensor connection. Do not connect the sensor to other devices.
20	**OIL TEMP. SENSOR**	Input, 0-5000 ohms	Analogue oil temperature sensor connection. Do not connect the sensor to other devices.

Term	Function	Technical data	Description
21	**PROGRAM LOCK**	Digital input	This input is used to prevent unwanted modification to programmed values. If this input is left open, program values can be modified via the front panel buttons, but if this input is connected to battery- it will not be possible to change the program values.
22	**DIGITAL INPUT-7**	Digital inputs	These inputs have programmable functions, selectable from a list 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.
23	**DIGITAL INPUT-6**		
24	**DIGITAL INPUT-5**		
25	**DIGITAL INPUT-4**		
26	**DIGITAL INPUT-3**		
27	**DIGITAL INPUT-2**		
28	**DIGITAL INPUT-1**		
29	**DIGITAL INPUT-0**		

Term	Function	Technical data	Description
30	**GROUND**	O VDC	Power supply negative connection.
31	**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.
32	**RELAY-6 (FUEL RELAY)**	Output 10A/28VDC	This relay is normally used for fuel solenoid control. It is internally connected to terminal **31** for supplying the charge alternator's excitation current.
33	**RELAY-2 (CRANK RELAY)**	Output 10A/28VDC	This relay has programmable function, selectable from a list. However it is generally used as engine crank output.
34	**BATTERY POSITIVE**	+12 or 24VDC	The positive terminal of the DC Supply shall be connected to this terminal. The unit operates on both 12V and 24V battery systems, depending on the voltage selection jumper. Do not operate a 12V-DC unit with a 24V-DC system. This may cause the destruction of the unit. Always disconnect the voltage selector jumper of a stocked unit.
35	**RELAY-7 (STOP RELAY)**	Output 10A/28VDC	These relays have programmable functions, selectable from a list.
36	**RELAY-1 (PREHEAT)**	Output 10A/28VDC	
37	**RELAY-3 (ALARM RELAY)**	Output 10A/28VDC	

Term	Function	Technical data	Description
38	**CURR_R+**	Current transformer inputs, 5A-AC	Connect the mains current transformer terminals to these inputs. Do not connect the same current transformer to other units than DKG-705 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).
39	**CURR_R-**		
40	**CURR_S+**		
41	**CURR_S-**		
42	**CURR_T+**		
43	**CURR_T-**		

Term	Function	Technical data	Description
44	**MAGNETIC PICKUP**	Inputs, 0.5-70V 0-20KHz	Connect the magnetic pickup signal to these inputs.
45	**MAGNETIC PICKUP**		
46	**AVR CONTROL**	Output, isolated resistor, 300-100,000 ohms.	AVR voltage control outputs. Connect to the external adjust potentiometer terminals of the AVR. The polarity is not important.
47	**AVR CONTROL**		
48	**GOVERNOR CONTROL**	Output, 0-10VDC	Connect this output to the terminal '**J**' or '**EXT**' of the speed governor.

3. DISPLAY

3.1 Led Displays

The DKG-705 has 12 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 existency of abnormal conditions encountered during operation.

Function	Color	Description
MAINS ON	Green	The LED will turn on when all 3 mains phase voltages and the mains frequency are within the limits.
MAINS OFF	Red	The LED will turn on when at least one of the mains phase voltages or the mains frequency are outside limits.
GENERATOR	Yellow	The LED will turn on when all 3 generator phase voltages are within the programmed limits.
LOAD GENERATOR	Yellow	It turns on when the generator contactor is activated.
LOAD MAINS	Green	It turns on when the mains contactor is activated.
LOAD TEST	Yellow	It turns on when the related operation mode is selected. One of these LEDs is always on and indicates which operation mode is selected. If the operation of the genset is disabled by the **weekly operation schedule**, then the **AUTO** led will flash.
TEST	Yellow	
OFF	Green	
AUTO	Green	
ALARM	Red	It turns on when an engine shutdown or load_dump condition is occurred.
WARNING	Red	It turns on when an engine shutdown or load_dump or warning condition is occurred.
SERVICE REQUEST	Red	Engine periodic maintenance request indicator. It turns on when the preset engine hours or time duration after previous service has elapsed.

3.2 Digital Display

The digital display is of LCD type, with 4 lines by 20 characters.
It shows:

-The software version and release date,
-The genset status,
-Measured parameters,
-Alarm information,
-Date and time,
-Service counters,
-Statistical counters,
-Logged events,
-Program parameters.

During power on, the display shows the software version and the release date for 1 seconds.

The display has basically two modes:

-Normal operation,
-Programming mode.

The programming mode will be explained later in this document.

The display is driven by a menu system. The display has many different screens, divided into 3 main groups.

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.

During operation, the DKG-705 will switch automatically between different screens, displaying each time the most important screen for the given situation.

If an alarm or warning occurs during operation other then programming mode, the display will automatically switch to **ALARM LIST** position. The MENU button will not allow to switch to other modes. To enable display navigation, press **ALARM MUTE** button.

The display has a **backlight** illumination feature. The **backlight** turns on with the depression of any button. It turns off after 1 minute to allow power economy. Also note that the backlight will turn off during engine cranking.

Group	Screen	Description	Contents
1	**1**	Mains parameters	Genset status Voltage R (or RS), current R, Mains Frequency Voltage S (or ST), current S Voltage T (or TR), current T
1	**2**	Mains parameters	Genset status Voltage RS (or R), current R, Mains Frequency Voltage ST (or S), current S Voltage TR (or T), current T
1	**3**	Basic genset parameters	Genset status Voltage U (or UV), current U, Genset Frequency Voltage V (or VW), current V, Genset Active Power (KW) Voltage W (or WU), current W, Genset Power Factor (cosΦ)
1	**4**	Basic genset parameters	Genset status Voltage UV (or U), current U, Genset Frequency Voltage VW (or V), current V, Genset Active Power (KW) Voltage WU (or W), current W, Genset Power Factor (cosΦ)

Group	Screen	Description	Contents
1	**5**	**Engine parameters**	**Engine rpm, Battery Voltage** **Coolant Temperature, Fuel Level** **Oil Temperature, Oil Pressure**
1	**6**	**Genset power**	**Genset Active Power (KW) , Genset Frequency** **Genset Apparent Power (KVA), Genset Power Factor (cosΦ)** **Genset Reactive Power (KWr)**
1	**6**	**Alarm list**	**If no alarm exists this screen will display 'END OF ALARM LIST'. Existing alarms, load_dumps and warnings will be displayed as one screen for each entry. Switching to the next entry will be made with the MENU button.**

Group	Screen	Description	Contents
2	**1**	Genset phase U parameters	Phase to Neutral Voltage, Phase Active Power (KW) Phase Current , Phase Apparent Power (KVA) Phase Power Factor, Phase Reactive Power (KWr)
2	**2**	Genset phase V parameters	Phase to Neutral Voltage, Phase Active Power (KW) Phase Current , Phase Apparent Power (KVA) Phase Power Factor, Phase Reactive Power (KWr)
2	**3**	Genset phase W parameters	Phase to Neutral Voltage, Phase Active Power (KW) Phase Current , Phase Apparent Power (KVA) Phase Power Factor, Phase Reactive Power (KWr)
2	**4**	Synchronoscope	Governor Output (%)I AVR Output(%) Voltage RU, Phase Angle (degrees) Phase U Voltage, Genset Frequency Phase R Voltage, Mains Frequency
2	**5**	Soft transfer parameters	Remaining Duration Governor Output (%), AVR Output(%) Genset Active Power (KW), Gen. Reactive Power (KWr) Target Active Power (KW), Target React. Power (KWr)
2	**6**	Date, time, engine hours	Date, Time Engine Hours Run
2	**7**	Service display	Time to Service Engine Hours to Service
2	**8**	Total power counters	Total Genset Active Power (KW-h) Total Genset Apparent Power (KVA-h) Total Genset Reactive Power (KWr-h)
2	**9**	Statistical counters	Total Engine Cranks Total Genset Runs Total Genset on Load
2	**10**	Mains phase R parameters	Phase to Neutral Voltage, Phase Active Power (KW) Phase Current , Phase Apparent Power (KVA) Phase Power Factor, Phase Reactive Power (KWr)
2	**11**	Mains phase S parameters	Phase to Neutral Voltage, Phase Active Power (KW) Phase Current , Phase Apparent Power (KVA) Phase Power Factor, Phase Reactive Power (KWr)
2	**12**	Mains phase T parameters	Phase to Neutral Voltage, Phase Active Power (KW) Phase Current , Phase Apparent Power (KVA) Phase Power Factor, Phase Reactive Power (KWr)

Group	Screen	Description	Contents
3	**1…32**	Event logging	This group comprises 32 screens, each screen displaying one recorded event, starting from the most recent one.

3.3 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 365 days).

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

The DKG-705 has both programmable engine hours and maintenance time limit. The engine hours is programmable between 0 and 2500 hours with 10-hour steps (**P_624**), the time limit is programmable between 0 and 2500 days with 10 day steps (**P_625**). If any of the programmed values is zero, this means that the parameter will not be used. For example a maintenance period of 0 days indicates that the DKG-705 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.

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 engine hours and time to service may be checked on the LCD display. (group_2, screen_7)

When the engine hours **OR** the time limit is over, the **SERVICE REQUEST** led (red) will start to flash. To turn off the led, select programming mode, enter factory password and set the parameter_600 to 1, then check the remaining time and engine hours to service using group_2, screen_7.

4. ALARMS

Alarms indicate an abnormal situation in the generating set.

The alarms are divided into 3 priority level:

1- **SHUTDOWN ALARMS:** These are the most important alarm conditions and cause:
   - The genset contactor to be released immediately,
   - The engine to be stopped immediately,
   - The alarm relay output to operate,
   - The **ALARM** led to turn on,
   - The LCD display to switch to alarm display mode (except when programming).

2- **LOAD DUMP ALARMS:** These conditions cause:
   - The genset contactor to be released immediately,
   - The engine to be stopped after the cooldown cycle,
   - The alarm relay output to operate,
   - The **ALARM** led to turn on,
   - The LCD display to switch to alarm display mode (except when programming)

3- **WARNINGS:** These conditions cause:
   - The alarm relay output to operate,
   - The **WARNING** led to turn on.

Most of the alarms are of LATCHING type. 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**) or by pressing the **ALARM MUTE** button twice.

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

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

The digital inputs are programmable and may be set to provide a large variety of alarms and warnings. See the programming chapter for digital input programming.

The alarms may be cancelled either by pressing any of the front panel mode selection buttons or by a change in external mode force inputs.

4.1 Shutdown Alarms

Definition	Source	Description
Low Oil Pressure Switch	Digital Input	These shutdown alarms are set depending on the digital input settings. The related program parameters are **P_700** to **P_776**.
High Eng.Temp.Switch	Digital Input	
Emergency Stop	Digital Input	
Low Coolant Level	Digital Input	
Alternator High Temp.	Digital Input	
High Oil Temp.	Digital Input	
Overload	Digital Input	
Low Fuel Level	Digital Input	
Battery Charger Fail	Digital Input	
Spare Alarm 7	Digital Input	
Spare Alarm 6	Digital Input	
Spare Alarm 5	Digital Input	
Spare Alarm 4	Digital Input	
Spare Alarm 3	Digital Input	
Spare Alarm 2	Digital Input	
Spare Alarm 1	Digital Input	
Gen Under-Frequency	Phase U	Set if the genset frequency goes under the **Low Frequency Shutdown (P_516)** limit for **Frequency Timer (P_520)** period.
Gen Over Frequency	Phase U	Set if the genset frequency goes over the **High Frequency Shutdown (P_518)** limit for **Frequency Timer (P_520)** period.
High Battery Voltage	Battery	Set if the battery voltage goes over the **High Battery Voltage Shutdown (P_610)** limit.
Low Fuel Level	Analog In.	Set if the fuel level measured from analog input goes under the **Low Fuel Level Shutdown (P_608)** limit.
High Oil Temperature	Analog In.	Set if the oil temperature measured from analog input goes over the **High Oil Temperature Shutdown (P_606)** limit.
High Coolant Temperature	Analog In.	Set if the coolant temperature measured from analog input goes over the **High Coolant Temperature Shutdown (P_604)** limit.
Low Oil Pressure Measured	Analog In.	Set if the oil pressure measured from analog input goes under the **Low Oil Pressure Shutdown (P_602)** limit.
Fail To Stop	Internal	Set if the engine is not stopped before the expiration of the **Stop Timer (P_505)**.
Fail To Start	Internal	Set if the engine has not started after **Start Attempts (P_504)** number of attempts.
Genset Low Voltage	U-V-W	Set if any of the genset phase voltages goes under the **Generator Low Limit (P_514)** voltage.
Genset High Voltage	U-V-W	Set if any of the genset phase voltages goes over the **Generator High Limit (P_515)** voltage.
Slave Unavailable (dual genset mode)	Serial Comm.	Set if a **shutdown or load dump alarm** has occurred in the slave genset and **Single Genset Load Enable** parameter (**P_A32**) is set to **0**.
Gen Phase Sequence Fail	U-V-W	Set if the generator phase sequence is not correct. This alarm may be cancelled also by programming the **Ignore Phase Order** parameter (**P_A06**) to **1**.
Low Engine Speed	Magnetic Pickup	Set if the engine rpm goes under the **Low rpm Shutdown (P_613)** limit. If the **Crank Teeth Count (P_619)** is set to '0', this alarm will be disabled.
High Engine Speed	Magnetic Pickup	Set if the engine rpm goes over the **High rpm Shutdown (P_615)** limit. If the **Crank Teeth Count (P_619)** is set to '0', this alarm will be disabled.
Communication Lost (dual genset mode)	Serial Comm.	Set if the serial communication between Master and Slave gensets is interrupted and **Single Genset Load Enable** parameter (**P_A32**) is set to **0**.

4.2 Load Dump Alarms

Definition	Source	Description
Low Oil Press.Switch	Digital Input	These load dump alarms are set depending on the digital input settings. The related program parameters are **P_700** to **P_776**.
High Eng.Temp.Switch	Digital Input	
Emergency Stop	Digital Input	
Low Coolant Level	Digital Input	
Alternator High Temp.	Digital Input	
High Oil Temp.	Digital Input	
Overload	Digital Input	
Low Fuel Level	Digital Input	
Battery Charger Fail	Digital Input	
Spare Alarm 7	Digital Input	
Spare Alarm 6	Digital Input	
Spare Alarm 5	Digital Input	
Spare Alarm 4	Digital Input	
Spare Alarm 3	Digital Input	
Spare Alarm 2	Digital Input	
Spare Alarm 1	Digital Input	
Gen Reverse Power	Internal	Set if the genset consumes active power (KW) from the mains and this power goes over the **Reverse Power Load Dump (P_618)** limit.
Gen Excess Power	Internal	Set if the genset power (KW) supplied to the load goes over the **Excess Power Load Dump (P_617)** limit for **Overcurrent** / **Excess Power Timer (P_511)**.
Alternator Overcurrent	Internal	Set if at least one of the genset phase currents goes over the **Overcurrent Limit (P_510)** for **Overcurrent** / **Excess Power Timer (P_511)**.

4.3 Warnings

Definition	Source	Description
Low Oil Press.Switch	Digital Input	These warnings are set depending on the digital input settings. The related program parameters are **P_700** to **P_776**.
High Eng.Temp.Switch	Digital Input	
Emergency Stop	Digital Input	
Low Coolant Level	Digital Input	
Alternator High Temp.	Digital Input	
High Oil Temp.	Digital Input	
Overload	Digital Input	
Low Fuel Level	Digital Input	
Battery Charger Fail	Digital Input	
Spare Alarm 7	Digital Input	
Spare Alarm 6	Digital Input	
Spare Alarm 5	Digital Input	
Spare Alarm 4	Digital Input	
Spare Alarm 3	Digital Input	
Spare Alarm 2	Digital Input	
Spare Alarm 1	Digital Input	
Synchronization Fail	Internal	Set if the phase and voltage synchronization is not successful before the expiration of **Synchronization Fail Timeout (P_A07)**.
Gen Under-Frequency	Phase-U	Set if the genset frequency goes under the **Low Frequency Warning (P_517)** limit for **Frequency Timer (P_520)** period.
Gen Over-Frequency	Phase-U	Set if the genset frequency goes over the **High Frequency Warning (P_519)** limit for **Frequency Timer (P_520)** period.
High Battery Voltage	Internal	Set if the battery voltage goes over the **High Battery Voltage Warning (P_611)** limit.
Low Fuel Level	Analog Input	Set if the fuel level measured from analog input goes under the **Low Fuel Level Warning (P_609)** limit.
High Oil Temperature	Analog Input	Set if the oil temperature measured from analog input goes over the **High Oil Temperature Warning (P_607)** limit.
High Coolant Temperature	Analog Input	Set if the coolant temperature measured from analog input goes over the **High Coolant Temperature Warning (P_605)** limit.
Low Oil Pressure Measured	Analog Input	Set if the oil pressure measured from analog input goes under the **Low Oil Pressure Warning (P_603)** limit.
Mains Phase Sequence Fail	R-S-T	Set if the mains phase sequence is not correct and **Ignore Phase Order (P_A06)** parameter is '**0**'.
Charge Failure	Charge input	Set if the **Charge input (terminal_31)** is pulled to battery negative when the engine is running.
Low Battery Voltage	Internal	Set if the battery voltage goes under the **Low Battery Voltage Warning (P_612)** limit.
AVR Control Fail	Internal	Set if the **AVR control output** has gone to the low or high limit value for 1 second.
GOV Control Fail	Internal	Set if the **GOV control output** has gone to the low or high limit value for 1 second.
Low Engine Speed	Magnetic Pickup	Set if the engine rpm goes under the **Low rpm Warning (P_614)** limit. If the **Crank Teeth Count (P_619)** is set to '0', this warning will be disabled.
High Engine Speed	Magnetic Pickup	Set if the engine rpm goes over the **High rpm Warning (P_616)** limit. If the **Crank Teeth Count (P_619)** is set to '0', this warning will be disabled.

Definition	Source	Description
Parallel Mains Fail	Internal	This general warning is set if any of the protection functions have detected a mains failure during **parallel with mains** operation.
Mains Reverse Power	Internal	In **parallel with mains** operation and after the parallel check timeout delay (**P_A23**) has elapsed, this warning will be set if the mains power is negative and over the reverse power limit defined in **P_A24**.
Mains Frequency Fail	R	In parallel with mains operation and after the parallel check timeout delay (**P_A23**) has elapsed, this warning will be set if the mains frequency is out of the limits defined in **P_522** and **P_523** for 4 consecutive cycles.
No Mains Frequency	R	In parallel with mains operation and after the parallel check timeout delay (**P_A23**) has elapsed, this warning will be set if the mains frequency disappears for more than 2,5 periods.
ROCOF (df/dt) Fail	R	In parallel with mains operation and after the parallel check timeout delay (**P_A23**) has elapsed, this warning will be set if the mains frequency change exceeds the limit defined in **P_A25** for 4 consecutive cycles.
Vector Shift (df/dt) Fail	R	In parallel with mains operation and after the parallel check timeout delay (**P_A23**) has elapsed, this warning will be set if the phase of the mains measured on last 2 cycles jumps over the limit defined in **P_A26** on the phase measured on last 4^{th} and 5^{th} period.
Communication Lost (dual genset mode)	Serial Comm.	Set if the serial communication between Master and Slave gensets is interrupted and **Single Genset Load Enable** parameter (**P_A32**) is set to **1**.

5. MODES OF OPERATION

The modes of operation are selected either by pushing the front panel keys or using the external mode select inputs. External inputs override the front panel selection. If none of the external inputs is active, the unit resumes to the mode selected by the front panel. Following selected mode, the DKG-705 will have different behavior.

OFF: In this mode, the mains contactor will be energized if mains phase voltages and frequency 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 or the mains frequency is outside limits, the mains contactor will be deactivated.
The diesel will be started for programmed times after the wait period. 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, the unit will wait for the generator contactor period and the generator contactor will be energized.
When all the mains phase voltages and the mains frequency 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 cooling period is given, 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.

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.

TEST: It is used to test the generator when the mains are on, or keep the generator waiting 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. The emergency backup operation may be prohibited using the program parameter **P_629**.

5.1 External Switching of the Operation Mode

The Mode of operation of the unit may also be selected by external inputs instead of front panel keys. For this, at least one of the digital inputs should be programmed as an input to force one of the 4 operating modes. The corresponding input's **P_7x0** parameter should be set to **18**, **19**, **20** or **21**. The mode selection signal may be a NO or NC contact, switching to either battery positive or battery negative. These selections are made using parameters **P_7x5** and **P_7x6**.

The external selection input has a higher level of priority than the front panel keys. Thus if the operating mode is forced by the external input, this will override the selection made by the front panel keys. However, when the external selection signal goes off, the unit will resume to the mode selected by the front panel keys.

If a front panel mode selection key is pressed while the external mode select input is active, then the key selection will be stored and when the external selection signal goes off, the unit will resume to this mode.

5.2. Remote Start Operation

The unit offers the possibility of **REMOTE START** mode of operation. 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 panel mimic diagram's mains LEDs will reflect the status of the REMOTE START input.

Any of the digital inputs may be programmed as a REMOTE START input. For this the corresponding input's **P_7x0** parameter should be set to **23**. The REMOTE START signal may be a NO or NC contact, switching to either battery positive or battery negative. These selections are made using parameters **P_7x5** and **P_7x6**.

6. SYNCHRONIZING WITH MAINS

The DKG-705 offers the possibility of synchronizing the genset with the mains.

The synchronization comprises frequency, phase and voltage matching features.

The synchronization properties of the unit are adjusted with program parameters.

These parameters are reserved for factory and qualified installation personal use and must not be modified by end users or non-qualified service personal. Otherwise severe damage may occur!

6.1 Governor Control

The frequency and phase matching is made by controlling the engine's governor module. The DKG-705 compares the mains phase R with the genset phase U. If the engine does not have a speed governor it is not possible to make frequency or phase control.

The GOV output (terminal 45) is an analog voltage output of 0-10 VDC. The output impedance is 180 ohms.

The functions of the GOV output are controlled by programmed parameters:

P_A02 GOV Control Enable: This parameter enables/disables the activation of the governor control output. If governor control is disabled, the output will always stay at the rest level defined by **P_A13**.

P_A03 GOV Reverse Polarity: In normal polarity, the governor control voltage increases in order to increase the engine speed. If reverse polarity is selected the governor control voltage decreases in order to increase the engine speed.

P_A13 Governor Start: This is the rest value of the governor control output. Always set this value to 128, which is the mid-course, and then adjust the engine speed from the speed governor. However, if needed, engine speed adjustment may be made through this parameter. Do not forget that, if this parameter is modified, the adjustment range will be reduced.

P_A15 Frequency Lock Gain: This parameter defines the reaction speed of the governor output to phase differences between genset and mains phases during synchronization. The standard value for this parameter is 32. But it must be readjusted for the engine during manufacturing. If this parameter is too high, a phase oscillation may occur. If it is too low, the phase locking will have a lazy behavior.

6.2 AVR Control

The voltage matching is controlled by the alternator's AVR module. The DKG-705 compares the mains phase R voltage with the genset phase U voltage.

The AVR control output (terminals 43-44) is similar to an isolated variable resistor. Usually all brands and types of AVR accept an external adjustment potentiometer. The AVR control will use these inputs, thus the DKG-705 is able to control most of the AVRs found on the market.

The impedance range of the AVR output is 300 ohms to 200 K-ohms. The range is adjustable with an internal potentiometer accessible from the back panel of the unit.

The functions of the AVR output are controlled by programmed parameters:

P_A04 AVR Control Enable: This parameter enables/disables the activation of the AVR control output. If AVR control is disabled, the output will always stay at the rest level defined by **P_A14**.

P_A05 AVR Reverse Polarity: In normal polarity, the AVR control impedance decreases in order to increase the alternator voltage. If reverse polarity is selected the AVR impedance increases in order to increase the alternator voltage.

P_A14 AVR Start: This is the rest value of the AVR control impedance. Always set this value to 160 and then adjust the alternator voltage with the AVR's control pot. However, if needed, alternator voltage adjustment may be made through this parameter. Do not forget that, if this parameter is modified, the adjustment range will be reduced.

P_A16 AVR Gain: This parameter defines the reaction speed of the AVR output to voltage differences between genset and mains phases during synchronization. The standard value for this parameter is 64. But it must be readjusted for the genset during manufacturing. If this parameter is too high, a voltage oscillation may occur. If it is too low, the voltage matching will be slower.

7. LOAD TRANSFER MODES

The DKG-705 has more than one ways of transferring the load from genset to mains and vice versa.

These modes are:

-transfer with interruption,
-no break transfer, (with or without synchronization)
-soft transfer.

7.1 Transfer with Interruption

This is the most conventional way of transferring the load between the genset and mains. There will be a power interruption period duration during the transfer. Note that the program parameters **P_508** and **P_509** define the power interruption period.

If this transfer method is used, it is advised to make an electrical interlock between the two contactors to prevent a phase to phase short circuit.

Transfer from genset to mains:

-The generator contactor releases,
-The unit waits for Mains Contactor Timer (**P_508**)
-The mains contactor is energized.

Transfer from mains to genset:

-The mains contactor releases,
-The unit waits for Generator Contactor Timer (**P_509**)
-The generator contactor is energized.

7.2 No Break Transfer

In this mode, the transfer will be made **without power interruption**. This implies that both of the mains and generator contactors will be active during transfer.

The maximum duration that both contactors will be active is programmable. However this process may be quicker with the use of one auxiliary contact at each contactor. Thus the changeover will be quite instantaneous, preventing any excess or reverse power condition. Normally the digital input_6 (terminal **23**) is used for mains contactor auxiliary contact and the digital input_7 (terminal **22**) is used for generator contactor auxiliary contact.

To prevent a phase to phase short circuit below criteria must be met:
-The mains and generator voltages must be equal,
-The mains and generator voltages must have the same phase,
-The mains and generator voltages must have the same phase sequence order.

The DKG-705 will allow a **No Break Transfer** only if **all** of the below conditions are fulfilled:
-Mains phase voltages within the programmed limits,
-Mains frequency within the programmed limits,
-Genset phase voltages within the programmed limits,
-Genset frequency within the programmed limits,
-Mains phase order correct (or phase order check must be disabled),
-Genset phase order correct (or phase order check must be disabled),
-The difference between mains and genset frequencies not more than programmed limit,
-The voltage difference between phase R and phase U not more than programmed limit,
-The phase angle between phase R and phase U not more than programmed limit,

When a **No Break Transfer cycle** is initiated, the DKG-705 checks all the above criteria to be satisfied. If any of the checks fail, then the unit reverts to a **Transfer with Interruption**.

If all conditions are met, the unit proceeds to the synchronization. The GOV output, if enabled, acts to equalize the phase between the genset and the mains voltages. The AVR output, if enabled, tends to equalize the genset and mains voltages.

It is also possible to make a **No Break Transfer** without **GOV** or **AVR** control. In this case the unit will wait until the expiration of the **Synchronization Fail Timeout** (**P_A07**), to find a matching phase and voltage. Normally with frequencies matching at +/- 2Hz and voltages matching at +/-10 volts an **uncontrolled No Break Transfer** will be successful if auxiliary contacts of the contactors are used. Also note that most of the standard AVRs will accept external voltage matching, thus only a rough frequency matching will be enough to succeed a **No Break Transfer**.

If matching is found before the expiration of the **Synchronization Fail Timeout** (**P_A07**), then both contactors will be activated. If contactor auxiliary contacts are used, the other contactor will release immediately. If contactor auxiliary contacts are not used, the other contactor will release after **contactor timeout (P_A09)**.

The DKG-705 has a set of programmable parameters to define the No Break Transfer operation. These parameters are:

P 512 Mains Low Limit: Each of the mains phase voltages must be over this limit.

P 513 Mains High Limit: Each of the mains phase voltages must be below this limit.

P 514 Gen Low Limit: Each of the genset phase voltages must be over this limit.

P 515 Gen High Limit: Each of the genset phase voltages must be below this limit.

P 516 Low Frequency Shutdown: The genset frequency must be over this limit.

P 517 Low Frequency Warning: The genset frequency must be over this limit.

P 518 High Frequency Shutdown: The genset frequency must be below this limit.

P 519 High Frequency Warning: The genset frequency must be below this limit.

P 522 Mains Frequency Low Limit: The mains frequency must be over this limit.

P 523 Mains Frequency High Limit: The mains frequency must be below this limit.

P A00 No Break Transfer: This parameter enables/disables the No Break Transfer feature.

P A06 Ignore Phase Order: If set, this parameter will disable the phase order check. The phase order check should be disabled only in single phase gensets.

P A07 Synchronization Fail Timeout: If the phase and voltage synchronization is not successful before the expiration of this timer, then the DKG-705 renounces the **No Break Transfer** and makes a Transfer with Interruption.

P A09 Contactor Timeout: This is the maximum time duration in which both contactors are active in case of **No Break Transfer**.

P A10 Max Frequency Difference: This is the maximum difference between mains and genset frequencies to enable a **NO Break Transfer**.

P A11 Max Voltage Difference: This is the maximum difference between the mains phase-R and the genset phase-U voltages to enable a **NO Break Transfer**.

P A12 Max Phase Difference: This is the maximum phase difference between the mains phase-R and the genset phase-U to enable a **No Break Transfer**.

P 760 to P 766: These parameters define the function of digital input_6.

P 770 to P 776: These parameters define the function of digital input_7.

7.3 Soft Transfer

In this mode, the transfer will be made without interruption like the **No Break Transfer** mode. But the load will not be transferred suddenly, instead of this it will be gradually transferred under **GOV** and **AVR** control.

The **AVR** and **GOV** control are absolutely necessary to succeed a **Soft Transfer**.

With the basic DKG-705 unit, only a soft transfer from the genset to the mains is possible. The transfer from mains to the genset will simply be a **No Break Transfer**.

With a full version of DKG-705 with mains current inputs, soft transfer in both directions are allowed.

The Soft Transfer sequence starts like a No Break transfer. But when both contactors are activated, the unit starts transferring the KW and KVAr load to the mains with predefined ramps. This ramping is achieved with **GOV** and **AVR** control. The duration of the load transfer sequence is controlled by the **Soft Transfer Timer (P_A08)**.

The unit includes a comprehensive set of protection functions to detect quickly a mains failure during parallel with mains operation. The protections are enabled after the timeout defined by the parameter **P_A23**. These protections will be explained with more detail in the following chapter.

If a **mains failure** occurs during parallel with mains operation, the mains contactor will immediately deenergize, a general **Parallel Mains Fail** warning and a specific protection function warning will be generated.

At the end of the **Soft Transfer Timer (P_A08)** the generator contactor will be released. If any alarm is encountered during **the Soft Transfer** sequence, the DKG-705 will revert to Interrupted transfer.

The DKG-705 has a set of programmable parameters to define the Soft Transfer operation. All parameters used in No Break Transfer are also used in Soft Transfer. Additional parameters are:

P_A01 Soft Transfer Enable: This parameter enables/disables the Soft Transfer feature.

P_A08 Soft Transfer Timer: This is the time duration of the Soft Transfer. At the end of this timer one of the contactors will release to terminate the parallel operation.

P_633 Mains Current Transformers: This parameter enables/disables the Soft Transfer from Mains to Genset.

P_A18 KW Ramp: The load's active power (KW) will be transferred to the mains with this rate.

P_A19 KVAr Ramp: The load's reactive power (KVAr) will be transferred to the mains with this rate.

P_A20 KW Gain: This parameter defines the reaction speed of the KW control during soft transfer.

P_A21 KVAr Gain: This parameter defines the reaction speed of the KVAr control during soft transfer.

P_A23 Parallel Check Timeout: This is the delay after the mains contactor is energized (for parallel to mains) and before the protections for mains failure are enabled.

8. PARALLELING WITH MAINS: PEAK LOPPING

The Peak Lopping feature consists on the use of the genset as a backup to the mains in cases where the mains power rating is insufficient to supply the load.

The peak lopping application is only possible with slowly varying loads.

When peak lopping is enabled and the unit is in **AUTO** mode, the genset will start and enter in parallel with the mains if mains power exceeds the parameter **P_A29** (genset start limit). As the mains power limit is not exceeded it will not supply power to the load.

When the total load power exceeds the parameter **P_A28** (mains power limit) the unit will allow the mains to deliver only **P_A28** (mains power limit) to the load. The exceeding quantity will be supplied by the genset.

When the total load power falls below the parameter **P_A30** the generator contactor will release and the genset will stop following a cooldown cycle.

The parameter **P_A30** should be less than the parameter **P_A29** in order to prevent immediate stopping of the genset after start.

The unit includes a comprehensive set of protection functions to detect quickly a mains failure during parallel with mains operation. The protections are enabled after the timeout defined by the parameter **P_A23**. These protections will be explained with more detail in the following chapter.

If a **mains failure** occurs during parallel with mains operation, the mains contactor will immediately deenergize, a general **Parallel Mains Fail** warning and a specific protection function warning will be generated. The load will be supplied by the genset without interruption. When mains is restored again, the genset will synchronize with the mains and resume to parallel operation.

The DKG-705 has a set of programmable parameters to define the Peak Lopping operation. All parameters used in No Break Transfer and Soft transfer are also used in Peak Lopping. Additional parameters are:

P_A27 Peak Lopping Enable: This parameter enables/disables the Peak Lopping operation.

P_A28 Mains Power Limit: This is maximum active power that the mains may deliver.

P_A29 Genset Start Limit: This is the mains active power limit for the start of the genset.

P_A30 Genset Stop Limit: This is the total load active power for the stop of the genset.

9. DUAL GENSET PARALLEL OPERATION

The DKG-705 is able to work in Dual Genset Parallel mode without any hardware or software modifications. The only additional accessory needed is a simple RS-232 serial data cable.

The units used in paralleling are standard DKG-705s with standard software, which permits very low cost synchronization applications.

The basic features are:

-simple and cost effective application,

-adaptation to all kinds of AVR and GOV controllers without extra hardware,

-different power ratings acceptable for both gensets,

-single genset load enabling,

-slave genset run/stop depending on user defined power levels and time delays,

-equal aging: automatic master/slave switching depending on '**Engine Hours to Service**',

-automatic master/slave switching in case of failure of the Master unit,

-manual master/slave switching allowed,

-predefined Master unit without the need for AVR and GOV controls on master,

-synchronization with mains: uninterrupted transfer to/from mains,

-load share with mains: soft transfer to/from mains.

Please refer to the **DKG-705 Dual Genset Parallel Application Manual** for a detailed application guide.

10. PROTECTION FUNCTIONS FOR PARALLEL WITH MAINS

The dkg-705 includes a comprehensive set of protection functions to detect quickly a **mains failure** during **parallel with mains** operation.

The protections are enabled after the timeout defined by the parameter **P_A23 (**Parallel Check Timeout) in order not to detect a mains failure during transients caused by the closing of the contactors.

WARNING: Do not forget that the protections are disabled during Parallel Check Timeout. Set this timeout as short as possible.

If any of the protection functions detects a mains failure during parallel with mains:
-the mains contactor is immediately deenergized,
-a Parallel Mains Fail warning is generated,
-a specific warning to the related protection function is generated.

Separating the generator from the mains in case of a mains failure is requested as condition in most countries for connection of synchronous generators to the mains.

10.1 ROCOF FUNCTION (rate of change of frequency)

The ROCOF measures the frequency of the mains for each period. If the frequency change exceeds the predefined limit for 4 successive periods, the ROCOF detects a mains failure. Thus the response time of the ROCOF is approximately 4 cycles.

However the ROCOF will not detect relatively slow changes in mains frequency.

Related parameter: **P_A25 ROCOF df/dt Limit:**

10.2 VECTOR SHIFT FUNCTION

The Vector Shift measures and stores the periods of last 5 cycles. At the end of each cycle it compares the average period of last 2 cycles with the average period of 4th and 5th cycles. If the difference exceeds the predefined limit the vector shift detects a mains failure. Thus the response time of the vector shift is 5 cycles.

However the vector shift will not detect relatively slow changes in mains frequency.

Related parameter: **P_A26 Vector Shift Limit**

10.3 OVER/UNDER FREQUENCY FUNCTION

The mains frequency measures the frequency of the mains for each period. If the frequency is outside limits for 4 successive periods, it detects a mains failure. The response time of the mains frequency is approximately 4 cycles.

Related parameters:
P_522 Mains Frequency Low Limit
P_523 Mains Frequency High Limit

10.4 OVER/UNDER VOLTAGE FUNCTION

The mains phase voltages are measured twice a second and compared with predefined high and low limits. If at least one of the phase voltages is outside limits, this will mean a mains failure. The response time is approximately 500ms.

Related parameters:
P_512 Mains Voltage Low Limit
P_513 Mains Voltage High Limit

10.5 MAINS REVERSE POWER FUNCTION

The mains active power is measured for each period. If the genset supplies power to mains and this power exceeds the predefined limit this will mean a mains failure.

The mains reverse power detector has a variable response time. For a power not exceeding 2 times the predefined limit the response time is 8 cycles. The response time is reduced with larger reverse powers. It is approximately 1 cycle with a reverse power of 8 times the predefined limit.

If mains current transformers are not fitted, the mains reverse power protection will not operate. Thus a full version of DKG-705 is required for this protection.

Related parameters:
P_633 Mains Current Transformers
P_A24 Reverse Power Limit

10.6 NO FREQUENCY FUNCTION

The unit counts the time after the last detection of the mains frequency pulses. If no mains pulses is detected for a period corresponding to 2,5 times the Mains Frequency Low Limit (**P_522**), a mains failure alarm is generated.

Related parameter:
P_522 Mains Frequency Low Limit

11. 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:

P 631 Load Shedding Low Limit: If the genset active power output goes below this limit, then the Load Shedding relay will be deactivated.

P 632 Load Shedding High Limit: If the genset active power output goes above this limit, then the Load Shedding relay will be activated.

12. WEEKLY OPERATION SCHEDULE

In AUTO mode, the unit offers the capability of defining a weekly schedule of operation.

The unit has 8 programmable turn-on/turn-off time pairs. These programmable parameters allow the genset to operate automatically only in allowed time limits.

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

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 15 minute steps. These parameters are defined in the program group_4, parameters 400 to 415. An example setup may be as follows:

P_400: Turn on: MO 07:00
P_401: Turn off: MO 18:00
P_402: Turn on: TU 07:00
P_403: Turn off: TU 18:00
P_404: Turn on: WE 07:00
P_405: Turn off: WE 18:00
P_406: Turn on: TH 07:00
P_407: Turn off: TH 18:00
P_408: Turn on: FR 07:00
P_409: Turn off: FR 18:00
P_410: Turn on: SA 07:00
P_411: Turn off: SA 13:00
P_412: Turn on: SA 13:00
P_413: Turn off: SA 13:00
P_414: Turn on: SA 13:00
P_415: Turn off: SA 13:00

If the same time is used in more than one parameter, only the first encountered one is considered. In the above example, SATURDAY 13:00 will be a **turn-off** time.

13. BUILT-IN 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_635: Exercise start day and hour
P_636: Exercise duration
P_637: Exercise off-load / on load
P_638: 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_629** 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.

14. EVENT LOGGING

The DKG-705 keeps records of the last 32 events in order to supply information for the service personal.

The events are recorded with a time stamp. The date and time information comes from the internal real time clock of the unit.

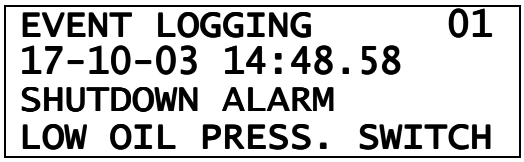
The events are stored in a circular memory. This means that a new coming event will erase the oldest recorded event. The events are always displayed starting from the most recent one.

The **Event Logging screens** are included in **menu group 3**. Switching from one menu group to another is made by holding the **MENU** button pressed for 1 second. When the **Event Logging screen** is displayed, each depression on the **MENU** button makes the screen switch to the next event record. Please see **chapter 3.2** for more detailed information on navigation between different screens.

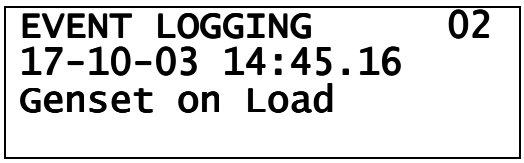
The event sources are:

-Genset on load,
-Genset off load,
-Shutdown alarms,
-Load dump alarms,
-Warnings.

An example journal record may be like one below:



Another one example:



15. STATISTICAL COUNTERS

The DKG-705 provides a set of non resettable incremental counters for statistical purposes.

The counters consist on:

-total engine hours run,
-total genset active power (KW),
-total genset apparent power (KVA),
-total genset reactive power (KVAr),
-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.

16. 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

17. SOFTWARE DOWNLOAD

The DKG-705 application software is held in a flash memory and is field downloadable.

The software download is made using the serial port at the back panel of the unit.

Use a standard serial cable to download a new software version from the laptop computer. The cable configuration is:

PC		**DKG-705**
D_SUB 9 pin female……..		D_SUB 9 pins male
Pin_2……	connected to……	pin_2
Pin_3……	connected to……	pin_3
Pin_5……	connected to……	pin_5 (using the shield)

The software is downloaded using the MS-WINDOWS monitoring and configuration software. This software may be downloaded from internet address: www.datakom.com.tr\downloads\dkg705

18. PROGRAMMING

The programming mode is used to program the timers, operational limits and the configuration of the unit. The programming mode is protected by a 3 level password system.

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

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

Upon pressing the PGM button the unit will ask the password to be entered. Enter the password using ↑ (UP) and ↓ (DOWN) buttons. Holding the button pressed will cause a fast scroll of the value enabling quick operation.

When the desired password is entered, press MENU button. This will cause the first program parameter to appear.

The program menu is organized as program groups, each group including a set of parameters.

Each depression of the MENU button will cause the current program parameter to be stored to the non-volatile memory if modified; and the display to switch to the next program parameter in the current group if the current parameter is not modified. This means that after modification, the MENU key should be pressed twice to switch to the next parameter. After the last parameter, the display switches back to the first parameter.

The displayed program parameter may be modified using ↑ (UP) and ↓ (DOWN) buttons.

The program value modification is only allowed if the **PROGRAM LOCK** input (terminal_21) 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**.

If the MENU button is held pressed for 1 second, the display will switch to the next program group.

Each password is a number between 0 and 65535. They will allow different levels of program modification.

Level	Definition	Factory set	Description
1	Service password	1	Allows the modification of service parameters.
2	Factory password	2	Allows the modification of factory set parameters and service parameters.
3	Production password	3	Allows the modification of all parameters, including the operation mode and calibration.

Programmed values are stored in a Non Volatile Memory, which is not affected by energy failures. **To EXIT programming,** press the PGM button.

Group	Definition	Level	Description
1	Set date and time	**1**	Unit's internal date and time used for event logging.
2	Change Password	**1**	Changes password. Only the password of the current level may be changed.
3	Site ID	**1**	20 character ASCII string defining the genset location. This string is used in modem calls and SMS operation.
4	Weekly Schedule Programs and Telephone numbers	**1**	8 sets of turn-on and turn-off times for AUTO mode. 2 telephone numbers of 16 digits maximum used for modem calls and SMS operation.
5	Generator Control	**1**	Basic timers and operation limits.
6	Configuration	**2**	The factory configuration parameters of the genset.
7	Input Definitions	**2**	The parameters which define the function of 8 programmable digital inputs.
8	Relay Definitions	**2**	The parameters which define the function of 24 possible relays.
9	Sensor calibration	**2**	Calibration points information for each of the 4 analog sensor inputs.
A	Operation Mode	**3**	No Break transfer, parallel with mains, AVR and GOV control parameters.
B	Input Calibration	**3**	Voltage and current input calibration parameters.

Program Group 1

Group	Parameter	Definition	Min	Max	Description
1	**100**	Set Date	00	99	Sets date of month (1-31)
1	**101**	Set Month	00	99	Sets month (1-12)
1	**102**	Set Year	00	99	Sets year. Only the last 2 digits are used.
1	**103**	Set Hour	00	99	Sets hour (00-23)
1	**104**	Set Minute	00	99	Sets minute (00-59)
1	**105**	Set Second	00	99	Sets second (00-59)

Program Group 2

Group	Parameter	Definition	Min	Max	Description
2	**200**	Change Password	0	65535	Changes the current level's password.

Program Group 3

Group	Parameter	Definition	Min	Max	Description
3	**300-319**	**Site ID**	**-**	**-**	Each program parameter changes one character of the SITE ID string. The parameter 300 points to the first character of the string, the parameter 301 points to the second character etc…

Program Group 4

Group	Parameter	Definition	Min	Max	Description
4	**400, 402, 404,406, 408, 410, 412, 414**	Turn_on	-	-	Weekly schedule turn_on times. The day and time information is defined in 15 minute steps.
4	**401, 403, 405,407, 409, 411, 413, 415**	Turn-off	-	-	Weekly schedule turn-off times. The day and time information is defined in 15 minute steps.
4	**416-431**	Telephone number #1	-	-	Each program parameter changes one digit of the first telephone number. The parameter 416 points to the first digit of the number, the parameter 417 points to the second digit etc… Non-numeric characters will be skipped.
4	**432-447**	Telephone number #2	-	-	Each program parameter changes one digit of the second telephone number. The parameter 432 points to the first digit of the number, the parameter 433 points to the second digit etc… Non-numeric characters will be skipped.

Program Group 5

Group	Parameter	Definition	Unit	Min	Max	Description
5	**500**	Wait before Fuel	Min.	0	240	This is the time between the mains fails and the fuel solenoid turns on for starting the genset.
5	**501**	Wait before Start	Sec	0	30	This is the time after the fuel solenoid is energized and before the genset is started. This will be the **preheat** period if glow plugs are used.
5	**502**	Wait between Starts	Sec	1	30	This is the waiting period between two start attempts.
5	**503**	Start Timer	Sec	1	15	This is the maximum start period. Starting will be automatically cancelled if the genset fires before the timer.
5	**504**	Start Attempts	-	1	6	This is the maximum number of start attempts.
5	**505**	Stop Timer	Sec	0	90	This is the maximum time duration for the engine to stop. For **Activate to Stop** type engines this will be the period during which the stop solenoid is energized. If the genset has not stopped after this period, a **FAIL TO STOP** alarm will occur.
5	**506**	Mains Waiting Timer	Min.	0.0	60.0	This is the time between the mains voltages and frequency entered within the limits and the generator contactor is deactivated.
5	**507**	Cooling Timer	Min.	0.0	30.0	This is the period that the generator runs for cooling purpose after the load is transferred to mains.
5	**508**	Mains Contactor Timer	Sec	0.5	15.0	This is the period after the generator contactor has been deactivated and before the mains contactor has been activated.

Group	Parameter	Definition	Unit	Min	Max	Description
5	**509**	Gen. Contactor Timer	Sec	0.5	120	This is the period after the mains contactor has been deactivated and before the generator contactor has been activated.
5	**510**	Overcurrent Limit	Amp	20	5000	If the current is over this limit, an **Alternator Overcurrent alarm** will be generated after the **Overcurrent Timer (P511)** period.
5	**511**	Overcurrent Timer / Excess Power Timer	Sec	1	20	This is the period between the current goes over the **Overcurrent Limit (P510)** and the **Alternator Overcurrent alarm** occurs. This is also the period between the genset power goes over the **Excess Power Load Dump Limit (P617)** and the **Gen Excess Power Load Dump** occurs.
5	**512**	Mains Low Limit	Volt	0	240	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	**513**	Mains High Limit	Volt	100	300	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.
5	**514**	Gen Low Limit	Volt	60	240	If one of the generator phase voltages goes under this limit when feeding the load, this will generate a **Genset Low Voltage Alarm** and the engine will stop.
5	**515**	Gen High Limit	Volt	100	300	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.
5	**516**	Low Freq. Shutdown	Hz	10	60	If the genset frequency goes under this limit for **Frequency Timer (P520)** period, this will generate a Genset **Under-Frequency Alarm** and the engine will stop.
5	**517**	Low Freq. Warning	Hz	10	60	If the genset frequency goes under this limit for **Frequency Timer (P520)** period, this will generate a **Genset Under-Frequency Warning**.
5	**518**	High Freq. Shutdown	Hz	40	150	If the genset frequency goes over this limit for **Frequency Timer (P520)** period, this will generate a **Genset Over-Frequency Alarm** and the engine will stop.
5	**519**	High Freq. Warning	Hz	40	150	If the genset frequency goes over this limit for **Frequency Timer (P520)** period, this will generate a **Genset Over-Frequency Warning**.
5	**520**	Frequency Timer / Engine rpm Timer	Sec	1	20	This is the period between the genset frequency or engine rpm goes out of the limits and an alarm occurs.
5	**521**	Horn Timer	Sec	0	240	This is the maximum period during which the alarm relay output may stay active. If the period is set to 0, this will mean that the delay is unlimited.

5	**522**	Mains Freq Low Limit	Hz	0	60	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** and **TEST** modes. In parallel with mains operation it will cause the mains contactor to deenergize and a warning given.
5	**523**	Mains Freq High Lim	Hz	44	70	If the mains frequency goes over this limit, it means that the mains are off and it starts the transfer to the genset in **AUTO** and **TEST** modes. In parallel with mains operation it will cause the mains contactor to deenergize and a warning given.
5	**524**	Genset Voltage Fail Timer	Sec	0	30	This is the period between the genset voltages go outside limits (defined by P_514, P_515, P_620) and the Genset Low/High Voltage alarm occurs.

Program Group 6

Group	Parameter	Definition	Unit	Min	Max	Description
6	**600**	Reset Maintenance Counters	-	0	1	Setting this parameter to 1 will 1) Reset the **Time to Service** variable to **Maintenance Period (days) (P625)** value, 2) Reset the **Engine Hours to Service** variable to **Maintenance Period (Engine Hours) (P624)** value. This means that a new service period has started with default values. The program parameter **P600** itself is not modified and reads always 0.
6	**601**	Current Transformer Primary	A	50	5000	This is the rated value of current transformers. All transformers must have the same rating. The secondary of the transformer will be 5 Amps.
6	**602**	Low Oil Pr. Shutdown	Bar	0	4.0	If the oil pressure measured from the analog input falls below this limit while the engine is running, this will generate a **Low Oil Pressure Measured** alarm and shut down the engine immediately.
6	**603**	Low Oil Pr. Warning	Bar	0	4.0	If the oil pressure measured from the analog input falls below this limit while the engine is running, this will generate a **Low Oil Pressure Measured Warning**.
6	**604**	High Temperature Shutdown	°C	80	120	If the water temperature measured from the analog input goes over this limit, this will generate a **High Coolant Temperature Alarm** and shut down the engine immediately.
6	**605**	High Temp. Warning	°C	80	120	If the water temperature measured from the analog input goes over this limit, this will generate a **High Coolant Temperature Warning**.
6	**606**	High Oil T. Shutdown	°C	80	250	If the oil temperature measured from the analog input goes over this limit, this will generate a **High Oil Temperature Alarm** and shut down the engine immediately.
6	**607**	High Oil T. Warning	°C	80	250	If the oil temperature measured from the analog input goes over this limit, this will generate a **High Oil Temperature Warning**.
6	**608**	Low Fuel Level Shutdown	%	0	50	If the fuel level measured from the analog input falls below this limit, this will generate a **Low Fuel Level Alarm** and shut down the engine immediately.
6	**609**	Low Fuel Level Warning	%0	0	50	If the fuel level measured from the analog input falls below this limit, this will generate a **Low Fuel Level Warning**.

Group	Parameter	Definition	Unit	Min	Max	Description
6	**610**	High Bat Voltage Shutdown	V	12.0	33.0	If the battery voltage goes over this limit, this will generate a **High Battery Voltage Alarm** and shut down the engine immediately.
6	**611**	High Bat Voltage Warning	V	12.0	33.0	If the battery voltage goes over this limit, this will generate a **High Battery Voltage Warning**.
6	**612**	Low Bat Voltage Warning	V	0	28.0	If the battery voltage falls below this limit, this will generate a **Low Battery Voltage Warning**.
6	**613**	Low rpm Shutdown	Rpm	0	6000	If engine speed measured from the magnetic pickup input falls below this limit, this will generate a **Low rpm Alarm** and shut down the engine immediately.
6	**614**	Low rpm Warning	Rpm	0	6000	If engine speed measured from the magnetic pickup input falls below this limit, this will generate a **Low rpm Warning**.
6	**615**	High rpm Shutdown	Rpm	0	6000	If engine speed measured from the magnetic pickup input goes over this limit, this will generate a **High rpm Alarm** and shut down the engine immediately.
6	**616**	High rpm Warning	Rpm	0	6000	If engine speed measured from the magnetic pickup input goes over this limit, this will generate a **High rpm Warning**.
6	**617**	Excess Power Load dump	KW	0	2500	If the genset load goes over this limit, this will generate a **Excess Power Load Dump Alarm** and shut down the engine after cooling period.
6	**618**	Reverse Power Load dump	KW	0	2500	If the genset is consuming more power from the mains than this limit, this will generate a **Reverse Power Load Dump Alarm** and shut down the engine after cooling period.
6	**619**	Crank Teeth Count / Multiplier Coefficient	-	0	250	**P_626=0 :** This is the number of pulses received from the magnetic pickup input for one turn of engine crank. This parameter is used for the calculation of the engine rpm. If this parameter is set to '0' then the magnetic pickup input is not used. **P_626=1 :** This is the **multiplier coefficient** of the alternator when the engine RPM is computed from the genset frequency.
6	**620**	Hysteresis Voltage	V	0	30	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_512**. When the mains fails, the low limit will be used as **P_512+P_620**. It is advised to set this value to 10 volts.

Group	Parameter	Definition	Unit	Min	Max	Description
6	**621**	Engine Heating Type	-	0	2	This parameter defines the engine heating method. The genset will not be put under load before engine heating is completed. **0:** engine is heated during the period defined by the **Engine Heating Timer (P_622)**. **1:** engine is heated until the coolant temperature reaches the temperature defined by **Engine Heating Temperature (P_623)**. **2:** engine is heated until the coolant temperature reaches the temperature defined by **Engine Heating Temperature (P_623)** and at least during the period defined by the **Engine Heating Timer (P_622)**.
6	**622**	Engine Heating Timer	Sec	0	240	This is the period used for engine heating following the program parameter **P_621**.
6	**623**	Engine Heating Temperature	°C	0	80	This is the temperature which is used for engine heating following the program parameter **P_621**.
6	**624**	Maintenance Period (Engine Hours)	h.	0	2500	The **SERVICE REQUEST** led indicator will turn on after this quantity of engine hours from the last service. This is useful to prevent the periodic maintenance from being omitted. If the period is set to '0' no **SERVICE REQUEST** will be indicated depending on engine hours, however service may still be requested on a time limit basis (see also parameter **P_625**).
6	**625**	Maintenance Period (Days)	day	0	2500	The **SERVICE REQUEST** led indicator will turn on after this amount of time from the last service. This is useful to prevent the periodic maintenance from being omitted. If the period is set to '0' no **SERVICE REQUEST** will be indicated depending time, however service may still be requested on an engine hours basis (see also parameter **P_624**).
6	**626**	RPM from Genset Frequency	-	0	1	Following the value of this parameter, the RPM display will use either the magnetic pickup input or the genset frequency for engine RPM calculation. **0:** The magnetic pickup inputs are used for RPM calculation. The magnetic pickup frequency will be divided by **P_619 (Crank Teeth Count)**. **1:** The genset frequency is used for engine RPM calculation. The genset frequency will be multiplied by **P_619 (Crank Teeth Count / Multiplier Coefficient)**. Thus for 1500 rpm gensets, P_619=30, For 3000 rpm gensets, P_619=60.
6	**627**	Genset L-L Voltages	-	0	1	0: Display genset L-N voltages, 1: Display genset L-L voltages.
6	**628**	Mains L-L Voltages	-	0	1	0: Display mains L-N voltages, 1: Display mains L-L voltages.

Group	Parameter	Definition	Unit	Min	Max	Description
6	**629**	Emergency Backup	-	0	1	If this parameter is set to 1, in the TEST mode, the load will be transferred to the genset if the mains fail.
6	**630**	Frequency Voltage Offset	V	5	50	This parameter adjusts the sensitivity for genset frequency reading. If the genset frequency appears to be a non-zero value while the engine is at rest, increase this parameter. The standard value is 20V.
6	**631**	Load Shedding Low Limit	KW	0	5000	If the genset active power output goes below this limit, then the Load Shedding relay will be deactivated.
6	**632**	Load Shedding High Limit	KW	0	5000	If the genset active power output goes above this limit, then the Load Shedding relay will be activated.
6	**633**	Mains Current Transformers	-	0	1	**0:** Mains current transformers are not connected. All mains current, power and cosΦ values are zeros, **peak lopping** and **soft transfer to genset** are not allowed **1:** Mains current transformers are connected and used. All mains current, power and cosΦ measurements are valid, **peak lopping** and **soft transfer to genset** are allowed.
6	**634**	Modem Connection	-	0	1	**0:** No modem connection, the serial port is connected to PC **1:** Modem connected.

Group	Parameter	Definition	Unit	Min	Max	Description
6	**635**	Exercise start day and hour	-	0	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_638=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_638=2 then the exercise will be performed during the first 7 days of each month at the programmed day and hour.
6	**636**	Exercise duration	min.	10	1430	This parameter defines the exercise duration and programmed in 10 minute steps up to 24 hours.
6	**637**	Daily / Weekly / Monthly Exercise	-	0	2	**0:** exercise every day (the exercise will be performed every day regardless of the day selection with parameter P_635). **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).
6	**638**	Exercise off_load/on_load	-	0	1	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.

Program Group: 7

This group defines the properties of the digital inputs and comprises 56 parameters. The DKG-705 unit has 8 programmable digital inputs, each input having 7 parameters.

Thus this program group will consist on 8 blocks, each block having the same structure of 7 parameters. Check below tables for more details.

Group	Parameter	Definition
7	**70x**	Digital input 0 parameters
7	**71x**	Digital input 1 parameters
7	**72x**	Digital input 2 parameters
7	**73x**	Digital input 3 parameters
7	**74x**	Digital input 4 parameters
7	**75x**	Digital input 5 parameters
7	**76x**	Digital input 6 parameters
7	**77x**	Digital input 7 parameters

Group	Parameter	Definition	Min	Max	Description
7	**7x0**	Digital input x function	0	31	Please check the function list below.
7	**7x1**	Digital input x alarm level	0	3	0: Shutdown alarm. 1: Load dump alarm. 2: Warning. 3: No alarm given from this input
7	**7x2**	Digital input x delay	0	1	0: Delay= 1 second. 1: Delay= 4 seconds. This is the alarm detection speed of the input. If the parameter is set to 1, the input becomes compatible with slow signals provided by coolant level sensors.
7	**7x3**	Digital input x sampling type	0	1	0: Always active. The signal is continuously checked. 1: Active on engine running. The signal may generate an alarm only when the engine is running and after the protection delay (8 seconds).
7	**7x4**	Digital input x latching	0	1	0: Non latching. The alarm turns off when the alarm signal is removed. 1: Latching. The alarm will persist even if the alarm signal is removed. The alarm must be reset manually.
7	**7x5**	Digital input x contact type	0	1	0: Normally open. Open in normal operation, closed on fault. 1: Normally closed. Closed in normal operation, open on fault.
7	**7x6**	Digital input x switch polarity	0	1	0: Battery (-) switching. The signal source pulls to battery negative (ground). 1: Battery (+) switching. The signal source pulls to battery positive.

Group	Parameter	Value	Definition
7	**7x0**	**0**	Low Oil Pressure Switch
		1	High Engine Temperature Switch
		2	Emergency Stop
		3	Low Coolant Level
		4	Alternator High Temperature
		5	High Oil Temperature
		6	Overload
		7	Low Fuel Level
		8	Battery Charger Fail
		9	Spare Alarm 7
		10	Spare Alarm 6
		11	Spare Alarm 5
		12	Spare Alarm 4
		13	Spare Alarm 3
		14	Spare Alarm 2
		15	Spare Alarm 1
		16	Mains Contactor Switch: This signal is used for No Break transfer operation.
		17	Genset Contactor Switch: This signal is used for No Break transfer operation.
		18	Force AUTO mode
		19	Force OFF mode
		20	Force TEST mode
		21	Force LOAD TEST mode
		22	Force MASTER mode
		23	REMOTE START
		24	Function-24
		25	Function-25
		26	Function-26
		27	Function-27
		28	Function-28
		29	Function-29
		30	Function-30
		31	Function-31

Program Group: 8

This group defines the functions of relay outputs. The DKG-705 base unit has 7 relay outputs. The relays may be extended up to 23 using **Relay Extension Modules**.

The function of a given relay output may be selected from a list of 112 entries. Here are the usual functions of the internal relays.

Group	Parameter	Definition	Terminal	Description / Usual Function
8	**800**	Relay 0 function	**-**	⚠ **This relay output is not provided**
8	**801**	Relay 1 function	**36**	Auxiliary relay output, mostly used as **Preheat** output.
8	**802**	Relay 2 function	**33**	Start relay output.
8	**803**	Relay 3 function	**37**	Auxiliary relay output, mostly used as **Alarm** output.
8	**804**	Relay 4 function	**1**	Generator contactor relay output. ⚠ **The common terminal of the internal relay is connected to the generator phase U.**
8	**805**	Relay 5 function	**10**	Mains contactor relay output. ⚠ **The common terminal of the internal relay is connected to the mains phase R.**
8	**806**	Relay 6 function	**32**	Fuel relay output. ⚠ **This relay output feeds also the charge alternator excitation circuit.**
8	**807**	Relay 7 function	**35**	Auxiliary relay output, mostly used as **Activate to Stop** output.
8	**808**	Relay 8 function	**-**	These relays are found on the first **Relay Extension Module**.
8	**809**	Relay 9 function		
8	**810**	Relay 10 function		
8	**811**	Relay 11 function		
8	**812**	Relay 12 function		
8	**813**	Relay 13 function		
8	**814**	Relay 14 function		
8	**815**	Relay 15 function		
8	**816**	Relay 16 function	**-**	These relays are found on the second **Relay Extension Module**.
8	**817**	Relay 17 function		
8	**818**	Relay 18 function		
8	**819**	Relay 19 function		
8	**820**	Relay 20 function		
8	**821**	Relay 21 function		
8	**822**	Relay 22 function		
8	**823**	Relay 23 function		

No:	FUNCTION
000	Choke Relay
001	Preheat Relay
002	Start Relay
003	Alarm Relay (timed)
004	Generator Contactor Relay
005	Mains Contactor Relay
006	Fuel Relay
007	Stop Relay
008	Load Shedding Relay
009	Alarm Relay (without timeout)
010	Load Contactor relay for dual
011	Auto ready
012	Master request relay for dual
013	Exerciser on
014	not used
015	not used
016	Shutdown: Digital Input_0
017	Shutdown: Digital Input_1
018	Shutdown: Digital Input_2
019	Shutdown: Digital Input_3
020	Shutdown: Digital Input_4
021	Shutdown: Digital Input_5
022	Shutdown: Digital Input_6
023	Shutdown: Digital Input_7
024	not used
025	Shutdown: Gen Under-Frequency
026	Shutdown: Gen Over Frequency
027	Shutdown: High Battery Voltage
028	Shutdown: Low Fuel Level
029	Shutdown: High Oil Temp. Mea.
030	Shutdown: High Temp. Measured
031	Shutdown: Low Oil Pressure Mea.
032	Shutdown: Fail To Stop
033	Shutdown: Fail To Start
034	Shutdown: Genset Low Voltage
035	Shutdown: Genset High Voltage
036	Shutdown: Slave not available
037	Shutdown: Gen phase seq. fail
038	Shutdown: Low Engine Speed
039	Shutdown: High Engine Speed
040	Shutdown: not used
041	Shutdown: not used
042	Shutdown: not used
043	Shutdown: not used
044	Shutdown: not used
045	Shutdown: not used
046	Shutdown: Communication lost
047	Shutdown: not used
048	Load Dump: Digital Input_0
049	Load Dump: Digital Input_1
050	Load Dump: Digital Input_2
051	Load Dump: Digital Input_3
052	Load Dump: Digital Input_4
053	Load Dump: Digital Input_5
054	Load Dump: Digital Input_6
055	Load Dump: Digital Input_7

No:	FUNCTION
056	Load Dump: not used
057	Load Dump: not used
058	Load Dump: not used
059	Load Dump: not used
060	Load Dump: not used
061	Load Dump: Gen Reverse Power
062	Load Dump: Gen Excess Power
063	Load Dump: Alternator Overcurr.
064	Load Dump: not used
065	Load Dump: not used
066	Load Dump: not used
067	Load Dump: not used
068	Load Dump: not used
069	Load Dump: not used
070	Load Dump: not used
071	Load Dump: not used
072	Load Dump: not used
073	Load Dump: not used
074	Load Dump: not used
075	Load Dump: not used
076	Load Dump: not used
077	Load Dump: not used
078	Load Dump: not used
079	Load Dump: not used
080	Warning: Digital Input_0
081	Warning: Digital Input_1
082	Warning: Digital Input_2
083	Warning: Digital Input_3
084	Warning: Digital Input_4
085	Warning: Digital Input_5
086	Warning: Digital Input_6
087	Warning: Digital Input_7
088	Warning: Synchronization Fail
089	Warning: Gen Under-Frequency
090	Warning: Gen Over-Frequency
091	Warning: High Battery Voltage
092	Warning: Low Fuel Level
093	Warning: High Oil Temp. Mea.
094	Warning: High Temp. Measured
095	Warning: Low Oil Pressure Mea.
096	Warning: Mains Phase Seq. Fail
097	Warning: not used
098	Warning: Charge Failure
099	Warning: Low Battery Voltage
100	Warning: AVR Control Fail
101	Warning: GOV Control Fail
102	Warning: Low Engine Speed
103	Warning: High Engine Speed
104	Warning: Mains Fail at Parallel
105	Warning: Mains Reverse Power
106	Warning: Mains Freq. Failure
107	Warning: No Mains Frequency
108	Warning: ROCOF (df/dt) Failure
109	Warning: Vector Shift (df/dt) Fail
110	Warning: Communication lost
111	Warning: not used

Program Group: 9

This program group defines the characteristics of the Analog sensors.

The DKG-705 unit has 4 analog sensor inputs. These are:
- -Coolant temperature sensor input,
- -Oil temperature sensor input
- -Oil pressure sensor input,
- -Fuel level sensor input.

The analog inputs are capable of measuring resistor values between 0 and 5000 ohms. Thanks to the programmable characteristics, the DKG-705 may be adapted to any brand and type of sensor.

Each sensor's characteristics are defined using a maximum of 8 known points. Each point consists of a pair of value, the first being the resistor value and the second being the corresponding analog measurement. For each sensor, 16 program parameters are reserved. Using defined points, the DKG-705 applies a linear approximation algorithm to find the analog value corresponding to an unknown resistor value.

For a given sensor, the points must be entered in the increasing order of resistor values, or faulty measurements may occur.
If less than 8 points are used, unused point resistor values must be entered as '0'.

Group	Parameter	Definition
9	**900-915**	Coolant Temperature
9	**920-935**	Oil Temperature
9	**940-955**	Oil Pressure
9	**960-975**	Fuel Level

Program Group: 10

This group of programs defines the **No Break Transfer** and **Parallel with Mains** feature characteristics.

This group is reserved for factory and qualified installation personal and must not be modified by end users or non-qualified service personal. Otherwise severe damage may occur.

Group	Param.	Definition	Unit	Min	Max	Description
10	**A00**	No Break Transfer	-	0	1	0: No break transfer disabled. 1: No break transfer enabled.
10	**A01**	Soft Transfer Enable	-	0	1	0: Soft transfer disabled. 1: Soft transfer enabled.
10	**A02**	GOV Control Enable	-	0	1	0: Governor control disabled. 1: Governor control enabled.
10	**A03**	GOV Reverse Polarity	-	0	1	0: Governor control normal polarity (speed increases with voltage increase). 1: Governor control reverse polarity (speed decreases with voltage increase).
10	**A04**	AVR Control Enable	-	0	1	0: AVR control disabled. 1. AVR control enabled.
10	**A05**	AVR Reverse Polarity	-	0	1	0: AVR control normal polarity (voltage increases with resistor decrease). 1: AVR control reverse polarity (voltage decreases with resistor decrease).
10	**A06**	Ignore Phase Order	-	0	1	0: Phase order check enabled. This option is used in 3 phase gensets. 1: Phase order check disabled. This option is used in single phase gensets.
10	**A07**	Synchronization Fail Timeout	Sec.	0	60	If the phase and voltage synchronization is not successful before the expiration of this timer, then a **Synchronization Fail Warning** is given and the DKG-705 renounces the **No Break Transfer** and makes a conventional changeover.
10	**A08**	Soft Transfer Timer	Sec.	0	60	This is the time duration of the Soft Transfer. At the end of this timer one of the contactors will release to terminate the parallel operation.
10	**A09**	Contactor Timeout	Sec.	0	5	This is the maximum time duration in which both contactors are active in case of **No Break Transfer**. It is advised to set this timer to 0.5sec.
10	**A10**	Max Frequency Difference	Hz	0.1	2.0	This is the maximum difference between mains and genset frequencies to enable a **NO Break Transfer**. Note that the DKG-705 adjusts the **GOV** output to bring the genset to the same frequency with the mains.
10	**A11**	Max Voltage Difference	V	0	20	This is the maximum difference between the mains phase-R and the genset phase-U voltages to enable a **NO Break Transfer**. Note that the DKG-705 adjusts the **AVR** output to bring the genset to the same voltage with the mains.

Group	Param.	Definition	Unit	Min	Max	Description
10	**A12**	Max Phase Difference	Deg.	0	20	This is the maximum phase difference between the mains phase-R and the genset phase-U to enable a **NO Break Transfer**. Note that the DKG-705 adjusts the **GOV** output to bring the genset to the same phase with the mains.
10	**A13**	Governor Start	-	0	255	This is the rest value of the governor control output. Always set this value to 128, which is the mid-course. However, if needed, engine frequency adjustment may be made through this parameter.
10	**A14**	AVR Start	-	0	255	This is the rest value of the AVR control output. Always set this value to 160. However, if needed, genset voltage adjustment may be made through this parameter.
10	**A15**	Frequency Lock Gain	-	0	255	This parameter defines the reaction speed of the governor output to phase differences between genset and mains phases during synchronization. The standard value for this parameter is 32. But it must be readjusted for the engine during manufacturing. If this parameter is too high, a phase oscillation may occur. If it is too low, the phase locking will be slower.
10	**A16**	AVR Gain	-	0	255	This parameter defines the reaction speed of the AVR output to voltage differences between genset and mains phases during synchronization. The standard value for this parameter is 64. But it must be readjusted for the genset during manufacturing. If this parameter is too high, a voltage oscillation may occur. If it is too low, the voltage matching will be slower.
10	**A17**	Genset Power Rating	KW	10	2400	This value will be used in future load sharing option.
10	**A18**	KW Ramp	KW/s	0	240	In case of a soft transfer, the load's active power (KW) will be transferred to the mains with this rate.
10	**A19**	KVAr Ramp	KVAr/s	0	240	In case of a soft transfer, the load's reactive power (KVAr) will be transferred to the mains with this rate.
10	**A20**	KW Gain	-	0	255	This parameter defines the reaction speed of the KW control during soft transfer. The standard value for this parameter is 64. But it must be readjusted for the genset during manufacturing. If this parameter is too high, a KW oscillation may occur. If it is too low, the KW transfer will be slower.
10	**A21**	KVAr Gain	-	0	255	This parameter defines the reaction speed of the KVAr control during soft transfer. The standard value for this parameter is 64. But it must be readjusted for the genset during manufacturing. If this parameter is too high, a KVAr oscillation may occur. If it is too low, the KVAr transfer will be slower.
10	**A22**	Controller ID	-	0	15	This is the address of the unit in an interconnected group for use in parallel operation.
10	**A23**	Parallel Check	Sec.	0.0	25.0	This is the delay after the mains contactor is

		Timeout				energized (for parallel to mains) and before the protections for mains failure are enabled. These protections will deenergize the mains contactor in case of a mains failure in order to prevent the genset from feeding the network.
10	**A24**	Reverse Power Limit	KW	0	1000	This parameter defines the sensitivity of the reverse power protection while operating in parallel with the mains. When the parallel protections are enabled, if the genset supplies a power over this limit to the mains, the mains contactor will be deenergized and a warning will be generated. It is advised to set this parameter to 15% of the genset power rating.
10	**A25**	ROCOF df/dt Limit	Hz/Sec	1.0	25.0	This parameter defines the sensitivity of the ROCOF (rate of change of frequency) protection while operating in parallel with mains. When the parallel protections are enabled, if the mains frequency change exceeds this limit for 4 consecutive periods, the mains contactor will be deenergized and a warning will be generated. It is advised to set this parameter to 4 Hz/Sec.
10	**A26**	Vector Shift Limit	Degr.	1	30	This parameter defines the sensitivity of the vector shift protection while operating in parallel with mains. When the parallel protections are enabled, if the phase of the mains measured on last 2 cycles jumps over this limit on the phase measured on last 4th and 5th period, the mains contactor will be deenergized and a warning will be generated. It is advised to set this parameter to 10 degrees.
10	**A27**	Peak Lopping Enable	-	0	1	**0: Peak lopping disabled.** In AUTO mode the genset will start only if a mains failure occurs. **1: Peak lopping enabled.** In AUTO mode, the genset will start and share the load if the mains power exceeds **P_A29** (genset start power).
10	**A28**	Peak Lopping: Mains Power Limit	KW	0	5000	In **peak lopping** mode, the unit will not allow the mains to deliver to the load a power higher than this limit in order to protect the mains.
10	**A29**	Peak Lopping: Genset Start Limit	KW	0	5000	In **peak lopping** mode the genset will start and enter in parallel with the mains only if the mains power exceeds this limit. However it will supply power to the load only if the load power exceeds **P_A28** (mains power limit). This parameter should be set lower than **P_A28**.
10	**A30**	Peak Lopping: Genset Stop Limit	KW	0	5000	In **peak lopping** mode the genset will stop only when the total load power falls below this limit. This parameter should be set lower than **P_A29** (genset start limit).
10	**A31**	Dual Genset Operation Enable	-	0	1	**0:** Single genset operation. **1:** Dual genset operation.

10	**A32**	Single Genset Load Enable (dual genset mode)	-	0	1	**0:** Single genset loading disabled. On mains failure both gensets will run and synchronize between them, after this the load will be transferred to gensets. **1:** Single genset loading enabled. On mains failure, at first the master genset will take the load and then the slave genset will synchronize and share the load. Also when one of the gensets fails, the other will be authorized to feed the load.
10	**A33**	Dual Genset No Break Transfer to Mains Enable	-	0	1	**0:** No break transfer disabled. **1:** No break transfer enabled.
10	**A34**	Dual Genset Soft Transfer to Mains Enable	-	0	1	**0:** Soft transfer disabled. **1:** Soft transfer enabled.
10	**A35**	Dual Genset Delayed Start Power	%	0	100	If the **total active load** is above this level for the period defined in **P_A38**, the slave genset will start, synchronize and share the load. This parameter is defined as a percentage of the **Genset Power Rating** defined in parameter **P_A17**.
10	**A36**	Dual Genset Quick Start Power	%	0	100	If the **total active load** is above this level, the slave genset will start, synchronize and share the load without delay. This parameter is defined as a percentage of the **Genset Power Rating** defined in parameter **P_A17**.
10	**A37**	Dual Genset Delayed Stop Power	%	0	100	If the total active load is below this level for the period defined in **P_A38**, the slave genset will stop. This parameter is defined as a percentage of the **Genset Power Rating** defined in parameter **P_A17**.
10	**A38**	Dual Genset Start/Stop Delay	Sec	0	120	This is the time delay used for starting and stopping of the slave genset. Related starting and stopping power levels are defined in parameters **P_A35** and **P_A37**.
10	**A39**	Master Genset Frequency Lock Gain in Dual Genset Mode	-	0	255	This parameter defines the reaction speed of the governor output to phase differences between the dual genset system and mains phases during synchronization. The standard value for this parameter is 4. But it must be readjusted for the dual genset system during manufacturing. If this parameter is too high, a phase oscillation may occur. If it is too low, the phase locking will be slower.
10	**A40**	Master Genset AVR Gain in Dual Genset Mode	-	0	255	This parameter defines the reaction speed of the AVR output to voltage differences between the dual genset system and mains phases during synchronization. The standard value for this parameter is 8. But it must be readjusted for the dual genset system during manufacturing. If this parameter is too high, a voltage oscillation may occur. If it is too low, the voltage matching will be slower.

Program Group: 11

This group of programs defines the calibration coefficients for the voltage and current measurements.

This group is strictly reserved for manufacturing process and must not be modified. Otherwise faulty measurements and unpredicted operation may occur.

Group	Param.	Definition	Min	Max	Description
11	**B00**	Phase R Calibration	0	60000	Each parameter defines the sensitivity of one measurement input. If the parameter increases, the input becomes more sensitive and reads a higher value. The calibration must be verified with a certified calibrated test equipment.
11	**B01**	Phase S Calibration			
11	**B02**	Phase T Calibration			
11	**B03**	Phase U Calibration			
11	**B04**	Phase V Calibration			
11	**B05**	Phase W Calibration			
11	**B06**	Current R Calibration			
11	**B07**	Current S Calibration			
11	**B08**	Current T Calibration			
11	**B09**	Current U Calibration			
11	**B10**	Current V Calibration			
11	**B11**	Current W Calibration			
11	**B12**	Battery Voltage Calibration			

19. TROUBLESHOOTING

The genset starts to operate while AC mains are OK or faulty voltage or frequency measurements:

Check engine body grounding.
AC mains voltages may be outside programmed limits.
Mains frequency may be outside limits.
Check the AC voltage readings by pressing the MENU button.
Check the mains frequency reading by pressing the MENU button.
Upper and lower limits of the mains voltages may be too tight.
Upper and lower limits of the mains frequency may be too tight.
Get in the PROGRAM mode and check for the mains voltage and frequency upper and lower limits. If necessary, widen the limits.

The genset continues to operate after AC mains are reestablished:

Check engine body grounding.
Widen the AC voltage limits.
The **hysteresis** value for the AC voltages is programmable **(P_620)**.
When the AC mains fail, the lower limit is raised and the upper limit is reduced by the **hysteresis value** to prevent a new load transfer after the load is transferred to the mains.

AC voltages displayed on the unit are not correct:

Check engine body grounding.
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.

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. Check the connections of each individual CT in order to obtain correct KW and cosΦ for the related phase, 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, then gives fail to start alarm:

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 falls, 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:

-The oil pressure switch closes very lately. As the unit senses an oil pressure, it does not start. When oil pressure falls 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 FAIL TO START alarm and then the engine stops:

-The generator phase voltage is not connected to the unit. Measure the AC voltage between terminals (U) and (Generator Neutral) at the rear of the unit while engine is running. The fuse protecting the generator phase 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 alternator voltage rises lately. Also the generator remanant 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 (+) and (-) terminals 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 try the unit again.

Programs are modified but not stored:

-The modified program value is saved after the next depression on MENU button. Press MENU before exiting the program mode.

Programs can not be modified:

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

The unit makes an Interrupted Transfer although No Break Transfer or Soft Transfer is selected:

There may be a phase sequence failure on the mains or generator side.
The synchronization process may be failed. Voltage or phase not matched.
Check chapter 7 for synchronization conditions.

Parallel with mains : The unit gives PARALLEL MAINS FAIL warning although mains are OK:

One of the protection functions is too sensitive.
Check protection specific warning on the ALARM LIST menu of the unit and reduce the sensitivity of the corresponding protection using the programming menu.

Synchronization failure:

Check the parameters **P_A02**, **P_A04**, **P_A15** and **P_A16**. If Dual Genset mode is used then check also **P_A39** and **P_A40**. If one of them is defined too low, this may delay or disable the synchronization process.

Check the synchronization fail timeout parameter (**P_A07**), if necessary increase. A typical delay may be 20 seconds.

Check the synchronization limits (**P_A10**, **P_A11**, **P_A12**), If necessary widen the limits. A typical application may be **P_A10=0.5Hz**, **P_A11=5V**, **P_A12=5º**

20. DECLARATION OF CONFORMITY

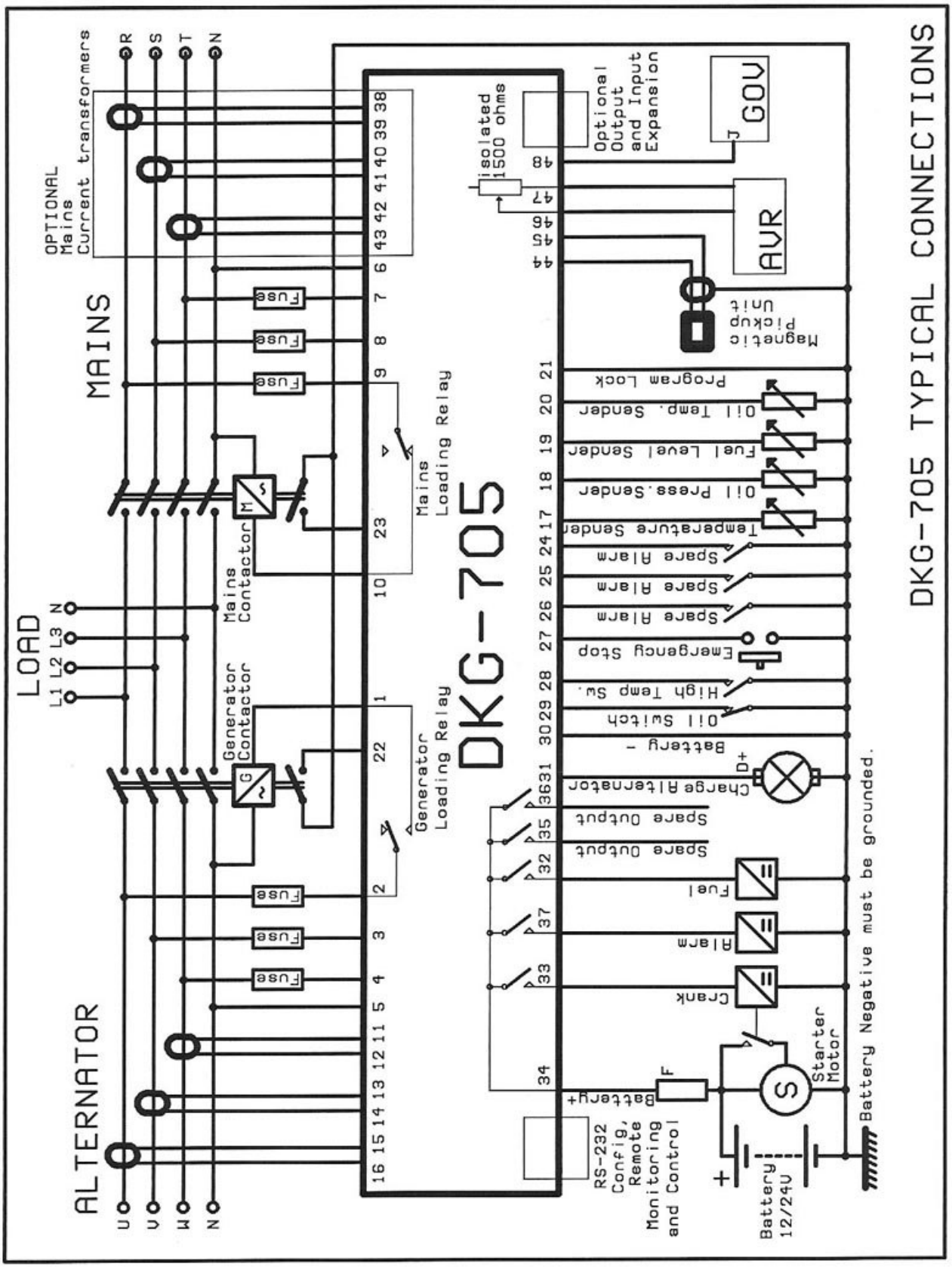
The unit conforms to the EU directives
-73/23/EEC and 93/68/EEC (low voltage)
-89/336/EEC, 92/31/EEC and 93/68/EEC (electro-magnetic compatibility)
Norms of reference:
EN 61010 (safety requirements)
EN 50081-2 (EMC requirements)
EN 50082-2 (EMC requirements)

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

21. TECHNICAL SPECIFICATIONS

Alternator voltage: 0 to 300 V-AC (Ph-N)
Alternator frequency: 0-200 Hz.
Mains voltage: 0 to 300 V-AC (Ph-N)
Mains frequency: 0-200 Hz.
Current Measurement: from current transformers. ../5A. Max load 0.7 VA per phase.
Digital inputs: input voltage 0 to 35 V-DC. Internally connected to battery positive via 10 K-ohm resistors.
Analog Inputs: Resistor input 0 to 5000 ohms connected to battery negative. 10mA source current when closed to battery negative.
Measurement Category: CAT II
Air Category: Pollution degree II
DC Supply Range:
12 V selection: 9.0 V-DC to 17.0 V-DC.
24 V selection: 18.0 V-DC to 30.0 V-DC.
Cranking dropouts: survives 0V for 100ms.
Current consumption: 500 mA-DC max. (Relay outputs open)
Total DC Current Output Rating: 10A-DC.
Max. Current for each Terminal: 10A-RMS.
Magnetic pickup voltage: 0.5 to 70Vpk.
Magnetic pickup frequency: 0 to 20000 Hz.
GOV Control Output: 0 – 10VDC
AVR Control Output: 300 ohms to 200 K-ohms adjustable, isolated.
Charge Alternator Excitation Current: Through resistor connected to FUEL output.
12 V selection: 36 mA-DC.
24 V selection: 72 mA-DC.
Communication Port: RS-232. 9600 bauds, no parity, 1 stop bit.
Operating temperature range: -20°C to 70°C (-4 to +158 °F).
Storage temperature range: -40°C to 80°C (-40 to +176°F).
Maximum humidity: 95% non-condensing.
IP Protection: IP65 from front panel, IP30 from the rear.
Dimensions: 192 x 144 x 49mm (WxHxD)
Mounting Opening Dimensions: 188 x 140mm minimum.
Weight: 800 g (approx.)
Case Material: High Temperature Self Extinguishing ABS (UL94-V0, 110°C)

22. CONNECTION DIAGRAM



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