

OPERATING INSTRUCTIONS



MANUFACTURED FOR
**Stowers Engines and
Power Products**

RENTAL CONTAINER PROJECT

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46630

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GENERAL INFORMATION



IMPORTANT

Before installing or operating the switchgear, read this instruction book thoroughly.



IMPORTANT

If the generator phase sequence is 3-2-1 (CBA), connect the generator phase 1 to the switchgear phase 3, generator phase 2 to the switchgear phase 2, and the generator phase 3 to the switchgear phase 1.

TRANSPORTATION DAMAGE

Immediately upon receipt of the switchgear, an examination should be made for any damage or loss sustained during transportation. If damage or rough handling is evident, a damage claim should be filed at once with the transportation company and the Enercon

Engineering Inc., sales office should be promptly notified.

UNPACKING

The switchgear should be unpacked as soon as possible after being received. Failure to do so may cause difficulty in making claims for damage not evident upon receipt. Care should be used in unpacking in order to avoid damaging any of the switchgear components. Be sure that no loose parts are missing or left in the packing material. Blow out any dirt or foreign material that may have accumulated on and in the switchgear or its components.

If the switchgear contains drawout circuit breakers, shipping straps are often bolted to the frames to prevent movement during shipping. These **MUST BE REMOVED**.

STORAGE

If the switchgear is not to be installed in its permanent location at once, it should be stored in an upright position in a clean and dry environment.

INTERCONNECTION

Control wire interconnections between the switchgear and all external equipment are illustrated in the interconnection diagram. All wiring shown with solid lines are connections made by Enercon. All connections shown with dashed lines are connections the user must make, to complete the installation. Unless otherwise noted on the interconnect drawing, all control wiring is to be #14 AWG or larger.

Be sure to observe minimum wire sizes when they are called out. If the engine/generator is located over one hundred (100) feet from the switchgear, special consideration must be given to the control wire size.

If revisions or changes are made to the current transformers (CT), be sure the white dot is as shown on the drawings, that the black leads are grounded, and the phase rotation is as indicated on the drawings.

PHASE ROTATION

The switchgear is designed for a phase rotation sequence of 1-2-3. The generator must be connected to the switchgear so the phase sequence is 1-2-3 (ABC). If the generator sequence is 1-2-3, connect the generator phase 1 to the switchgear phase 1, generator phase 2 to the switchgear phase 2, and the generator phase 3 to the switchgear phase 3.

GENERAL INFORMATION

WHEN TO INSPECT

Since maintenance requirements are low, it is recommended that a routine inspection be performed at the end of the first six months of operation. Inspect at least once a year thereafter or if the initial inspection indicates, then more often.

PREPARATION FOR INSPECTION

Record the positions of all control switches and place the Engine Control Switch in OFF/RESET. Disconnect the A.C. power to the battery chargers, and remove the battery starting cables. Disconnect all other AC power to heaters etc. Failure to comply with the above can result in electronic governor or component failure.

INSPECTION

Clean all dust and debris which could lead to future dielectric problems from the interior and exterior of each cubicle with a vacuum cleaner or non metallic brush. Inspect all internal components and wiring for signs of excessive heating and /or deteriorated insulation, especially at high stress points such as door cables. Physically check for tightness of electrical connections, and retorquing as required, especially at generator mounted breakers and all bus and cable connections. Check 'plug-in' relays for proper seating in sockets. Manually operate all circuit breakers two or three times, checking operation for any abnormality. Correct defects found during inspection.

AFTER INSPECTION

Before re-energizing the switchgear, connect battery cables first, then apply the A.C. power to the battery charger to prevent damage to electronic components and engine electronic governor systems.

Reconnect any AC power which was previously disconnected in preparation for maintenance.

Functional test the entire generating system in accordance with this manual. Place all control switches and the Engine Control Switch in the recorded positions.



CAUTION
NEVER WORK
ON ENERGIZED
ELECTRICAL EQUIPMENT
Disable switchboard by
shutting down all generators.



WARNING

Prior to high-pot testing switchgear bus and/or connected cabling, you must disconnect potential transformer primaries, surge arrestors and surge capacitors. Failure to do so will result in damage to these and possibly additional components.

A. To disconnect transformers, open trunnions or drawers when applicable. On transformers without disconnect means you must remove the primary (high voltage) fuses.

B. To disconnect arrestors and/or capacitors, remove all phase cabling. Insure cables are held clear of other phases and ground during testing.

If any questions arise, contact factory prior to testing.

GENERAL DESCRIPTION

This project involves controls for monitoring and protection of the utility supply plus controls for monitoring and protection for a Caterpillar generator set, rated 1500 kW continues at 480 volts, 3 phase, 60 hertz service. The generator set shall be capable of operating in parallel with the utility source serving as a “base load” unit and a standby power source.

The controls are comprised of (1) generator control cubicle which contains an Automatic Genset Controller (AGC-3), Additional Operators Panel (AOP-1), an Emergency Stop Pushbutton, and generator circuit breaker.

The switchgear shall be designed for automatic starting, paralleling and loading/unloading of the station engine generator set plus control of circuit breaker as required. For automatic operation, the generator set may be started and stopped by customer’s signal from a remote location.

During all modes of operation the control system shall provide automatic standby operation in the event of a utility failure as sensed by the utility monitoring circuits or upon receipt of a customer’s remote contact signal.

The unit will start when in semi-automatic mode by operator utilizing the “start” selection on the OIM panel.

Should the engine generator set fail to start, fail to automatically parallel, or develop a critical running monitored fault, the control system shall cause the engine to automatically shutdown with its circuit breaker automatically tripped open.

The design of the control system shall also permits manual starting, stopping of the station engine generator set plus manual control of circuit breaker as required.

Emergency Stop Pushbutton (ESPB):

The emergency stop switch has a red mushroom operator to easily locate the switch. The switch is maintained and must be turned to the right to reset.

POSITIONS:

OUT (normal): The engine will start normally.

IN: Will stop the engine and will keep it from starting.

CONTROL SWITCHES

Annunciation display:

Individual Electrical Faults
Low Battery Voltage
Fail To Parallel
Common Engine Fault
Common Engine Warning
Emergency Stop

Control Functions:

Engine Start/Stop & Protection
Synchronizing, Auto and Manual
kW and kVAR Sharing
Breaker Close & Trip
Speed Raise/Lower
Voltage Raise/Lower

Metering Functions:

3 Phase Voltage
3 Phase amperage
Frequency
Power Factor
3 Phase kilowatts
3 Phase kilovars
3 Phase kVA
kW Hours
kVAR Hours
Bus Voltage
Bus Frequency
Synchroscope
Battery Voltage

Protective Functions:

27/59 Under/Over Voltage
32 Reverse Power
32RV Reverse Vars (Loss of Excitation)
46Q Negative Phase Sequence Current
47Q Negative Phase Sequence Voltage
81O/U Over/Under Frequency

AUTOMATIC GENSET CONTROLLER OVERVIEW

AUTOMATIC GENSET CONTROLLER LEDS

LED functions

The display unit holds 10 LED functions. The color is green or red or a combination in different situations.

Alarm:

LED flashing indicates that unacknowledged alarms are present. LED fixed light indicates that ALL alarms are acknowledged, but some are still present.

Power:

LED indicates that the auxiliary supply is switched on.

Self check OK:

LED indicates that the unit is OK.

Run:

LED indicates that the generator is running.

Hz/V OK:

LED green light indicates that the voltage/frequency is present and OK.

GB ON:

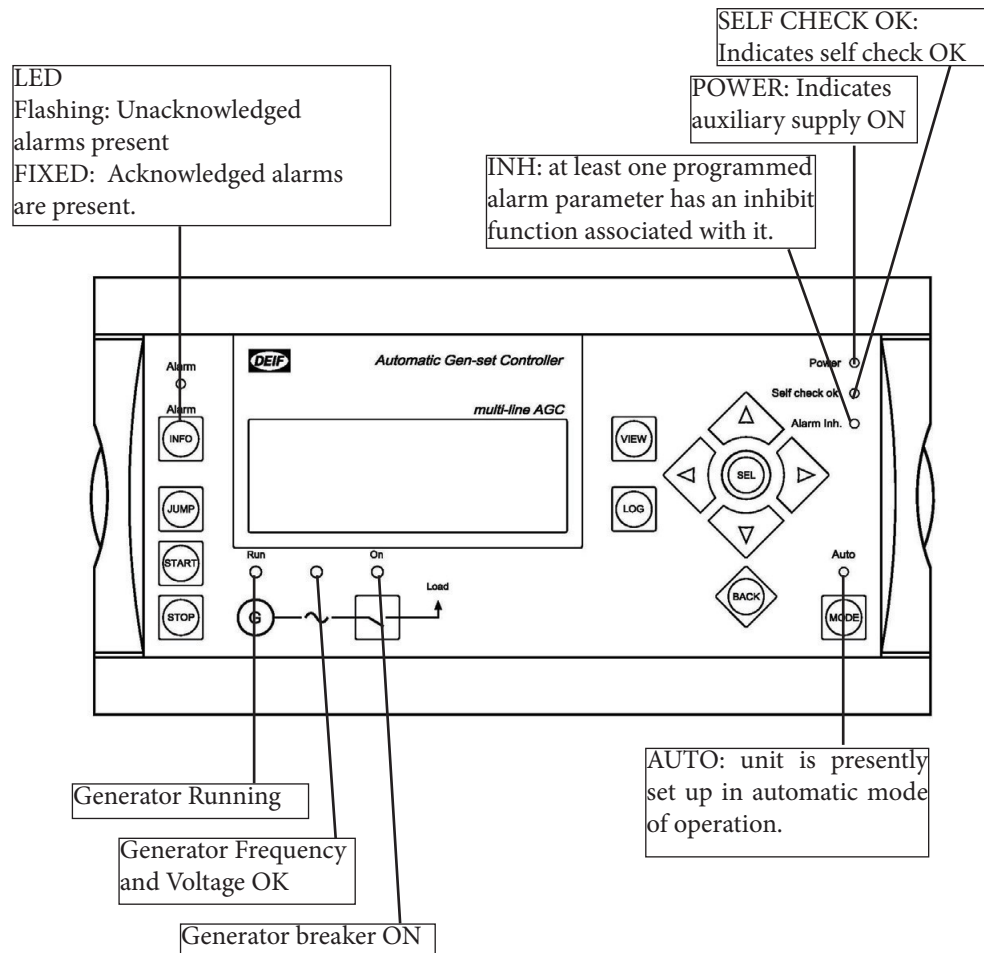
LED indicates that the generator breaker is closed.

Alarm INH

LED indicates at least one programmed alarm parameter has an inhibit function associated with it.

Auto

LED indicates unit is presently set up in the automatic mode of operation.



The display unit holds a number of push-button functions which are described below.

AUTOMATIC GENSET CONTROLLER PUSHBUTTONS

INFO:

Shifts the display 3 lower lines to show the alarm list.

JUMP:

Enters a specific menu number selection. All settings have a specific number attached to them. The JUMP button enables the user to select and display any setting without having to navigate through the menus (see later).

VIEW:

Shifts the first line displaying in the setup menus. Push 2 sec. to switch to master display in case more than 1 display is connected.

LOG:

Shifts the display 3 lower lines to show the event and alarm list. The list holds 150 events. These events are deleted when the AGC is switched off.



Moves the cursor left for maneuvering in the menus.



Increases the value of the selected setpoint (in the setup menu). In the daily use display, this button function is used for scrolling the second line displaying of generator values.

SEL:

Selects the underscored entry in the fourth line of the display.



Decreases the value of the selected setpoint (in the setup menu). In the daily use display, this button function is used for scrolling the second line displaying of generator values.



Moves the cursor right for maneuvering in the menus.

BACK:

Jumps one step backwards in the menu (to previous display or to the entry window).

START:

Start of the gen-set if 'Manual' or 'Semi-Auto Mode' is selected.

STOP:

Stop of the gen-set if 'Manual' or 'Semi-Auto Mode' is selected.

GB ON:

Manual activation of close and open breaker sequence if 'Manual' or 'Semi-Auto Mode' is selected.

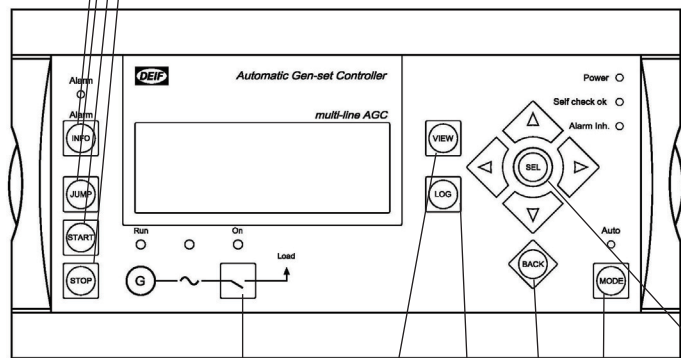
AUTOMATIC GENSET CONTROLLER PUSHBUTTONS

INFO:
Shifts the display three lower lines to show the alarm list.

JUMP:
Enters a specific menu number selection.

START:
Start of the gen-set if 'SEMI-AUTO' or 'MANUAL' is selected.

STOP:
Stop of the gen-set of "SEMI-AUTO" or "MANUAL" is selected.



GB:
Opens the GB if it is closed. Closes (sync) the GB if it is opened.

VIEW:
Shifts the first line displaying in the setup menus. Push 2 sec. to switch to master display in case more than 1 display is connected.

LOC:
Shifts the display three lower lines to show the event and alarm list.

SEL:
Selects the underscored entry in the fourth display line.

MODE:
Changes the display menu line (line four) to mode selection.

BACK:
Jumps one step backwards in the menu.

Battery Charger Malfunction	Common Engine Alarm	High Fuel Level	
Gen Running	Voltage Reg Alarm	Low Fuel Level	
Rem Eng Controls Not in Auto	Voltage Reg Failure	Critical Low Fuel Level	
Remote Engine Failure	Overcurrent	Fuel Tank Leak	
Lamp Test	Manual Speed Raise	Manual Voltage Raise	
Voltage Regulator Reset	Manual Speed Lower	Voltage Manual Lower	

ADDITIONAL OPERATOR PANEL (AOP-1)

The Additional Operators Panel (AOP-1) is a 16 LED and 8 pushbutton programmable panel that is connected to the display of each generator. The panel was programmed with the following functions.

AOP-1 LED indications

Battery Charger Malfunction

A signal has been received indicating a battery charger malfunction.

Gen Running

The generator is running.

Rem Eng Controls Not in Auto

A signal has been received indicating remote engine controls are not in auto.

Remote Engine Failure

A signal has been received indicating a remote engine failure.

Common Engine Alarm

A signal has been received indicating a common engine alarm. Yellow indicates a warning condition.

Voltage Reg Alarm

A signal has been received indicating a voltage regulator alarm. This condition is reset through the voltage regulator reset pushbutton.

Voltage Reg Shutdown

A signal has been received indicating a voltage regulator shutdown. This condition is reset through the voltage regulator reset pushbutton.

Overcurrent

A signal has been received indicating an overcurrent condition. Yellow indicates a warning condition; red indicates a shutdown condition.

High Fuel Level

A signal has been received indicating a high fuel level.

Low Fuel Level

A signal has been received indicating a low fuel level. Yellow indicates a warning condition.

ADDITIONAL OPERATOR PANEL (AOP-1)

Battery Charger Malfunction	Common Engine Alarm	High Fuel Level	
Gen Running	Voltage Reg Alarm	Low Fuel Level	
Rem Eng Controls Not in Auto	Voltage Reg Failure	Critical Low Fuel Level	
Remote Engine Failure	Overcurrent	Fuel Tank Leak	
Lamp Test	Manual Speed Raise	Manual Voltage Raise	
Voltage Regulator Reset	Manual Speed Lower	Voltage Manual Lower	

AOP-1 LED INDICATORS, cont.

Critical Low Fuel Level

A signal has been received indicating a critical low fuel level.

Fuel Tank Leak

A signal has been received indicating a fuel tank leak.

PUSHBUTTONS

Lamp Test

Depressing the lamp test pushbutton will illuminate all the indicating lights to insure they are working properly.

Voltage Regulator Reset

Clears voltage regulator alarms and shutdowns.

Manual Speed Raise

Manual regulation of speed dependent of the generator breaker (52G) position. Active only in local control or service mode.

Manual Speed Lower

Manual regulation of speed dependent of the generator breaker (52G) position. Active only in local control or service mode.

Manual Voltage Raise

Manual regulation of voltage dependent of the generator breaker (52G) position. Active only in local control or service mode.



Manual Voltage Lower

Manual regulation of voltage dependent of the generator breaker (52G) position. Active only in local control or service mode.

Mode	Description
SEMI-AUTO	<ul style="list-style-type: none"> - The display push-buttons (START, STOP, GB ON, GB OFF) are active and can be used by the operator. - The regulators are also active, i.e. the speed control will bring the generator to nominal speed upon start. - When pushing a breaker button for closing, the AGC will synchronize and close the breaker. When the breaker closes, the controls stop.
AUTO	<ul style="list-style-type: none"> - The unit will automatically carry out the control type selected (AMF, fixed power etc.). Initiated by user-provided contact. - The display control push-buttons (START, STOP, GB ON, GB OFF) are disabled. <p>If the selected running mode is fixed power, mains power export, load take over or island, timer start/stop (week watch) or binary input, then start/stop can be used.</p> <p>NOTE: Only active when group master is added/programmed.</p>
(MAN)	<p>Manual Mode is only available if programmed on the AOP-1</p> <ul style="list-style-type: none"> - The display push-buttons (START, STOP) are active and can be used by the operator. - The regulators are not active, i.e. speed (and voltage) control has to take place using binary inputs for UP and DOWN control. - The breakers will be able to open or close at any time. A synchronisation check will always be performed to ensure safe closing of the breakers or will enable closing to a dead bus.
(BLOCK)	<ul style="list-style-type: none"> - Block Mode is only available if programmed on the AOP-1 - The unit will not be able to start. BLOCK mode can be selected during standstill and the password is needed to go away from BLOCK mode. If the BLOCK mode is selected while the gen-set is running, the mode will have no effect until the gen-set is stopped. To select another mode after the BLOCK mode, the password must be entered.

MODE MENU

If the MODE push-button is pushed, a selection of possible running modes appears in the fourth display line.

Using the  and  push-buttons moves the cursor, and the appropriate mode may be selected by using the SEL button

MODE MENU

When an alarm occurs, the unit will automatically go to the alarm list for display of the alarm. If reading of the alarms is not desired, use the BACK push-button to exit the alarm list.

If you decide to enter the alarm list later, use the INFO push-button to jump directly to the alarm list reading.

The alarm list contains both acknowledged and unacknowledged alarms provided that they are still active (i.e. the alarm condition is still present). Once an alarm is acknowledged and the condition has disappeared, the alarm will no longer be displayed in the alarm list.

This means that if there are no alarms, the alarm list will be empty.

G	0	0	0	V
1230	Gen	low-volt	1	
UN-ACK		2 Alarm(s)		
ACK		FIRST	LAST	

This display example indicates an unacknowledged alarm. The display can show only one alarm at a time. Therefore, all other alarms are hidden.

To see the other alarms, use the  and  push-buttons to scroll in the display.

To acknowledge an alarm, place the cursor (underscore) under 'ACK' and then press SEL.

To jump to the first (oldest) or the last (latest) alarm, place the cursor under the selection (FIRST or LAST) and press SEL.

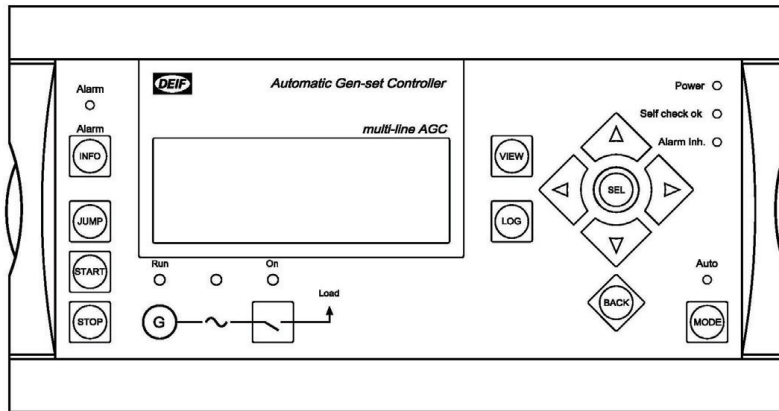
LOG LISTS

The log is divided into 3 different lists:

1. EVENTS
2. ALARMS
3. BATTERY TEST

The log list contains up to 150 events, the alarm list contains up to 30 historical alarms and the battery test list contains up to 52 historical battery tests.

An event is e.g. closing of breaker and starting of engine. An alarm is e.g. overcurrent or high cooling water temperature. A battery test is e.g. test OK or test failed.



ISLAND MODE OPERATION

AUTOMATIC OPERATION

The unit will automatically carry out the control type selected (AMF, fixed power etc.).

The display control push-buttons (START STOP GB ON GB OFF) are disabled.

Enable AUTO mode by pressing MODE softkey navigating with the and arrow keys to AUTO and pressing SEL to select.

Upon sensing a loss of utility, the genset will automatically start.

Once operational speed and voltage are achieved the generator will synchronize and close its breaker to the bus.

Upon return of utility the generator circuit breaker will trip open and the engine will run for a cooldown period prior to shutdown.

NOTE: All modes in automatic are totally dependent on the site adding A0 group main sAGC which is programmed for the application.

SEMI- AUTOMATIC OPERATION

The unit will automatically carry out the control type selected (AMF, fixed power etc.).

Enable SEMI mode by pressing MODE softkey, navigating with the and arrow keys to SEMI and pressing SEL to select.

With SEMI selected on the AGC, depress the START pushbutton, and the engine is signaled to start.

Once operational speed and voltage are achieved the generator will synchronize and its breaker will automatically close to the bus.

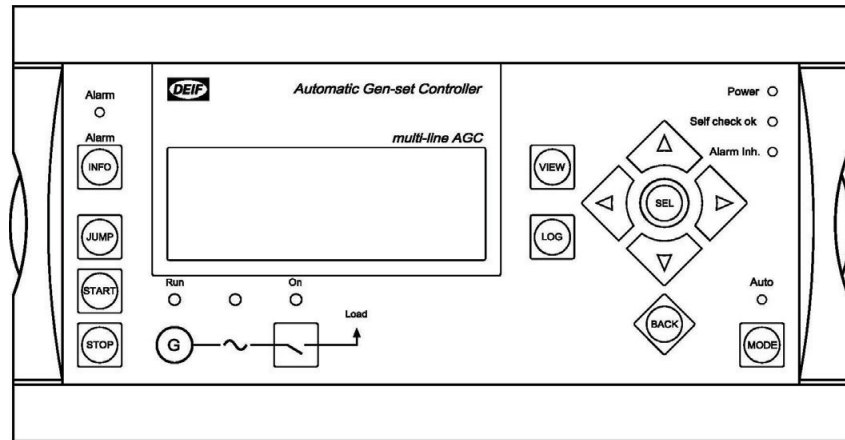
To discontinue SEMI-AUTO operation, depress the STOP pushbutton. The generator circuit breaker will trip open and the engine will run for a cooldown period prior to shutdown.

NOTE: Any mode above and beyond strictly an island mode of operation is totally dependent on the site adding a group mains AGC which is programmed for the application. The unit selected for base load operation will automatically be set in SEMI-AUTO.

In all semi-automatic modes of operation, the control will be required to have this set via operator selection using the “mode” selector on the main DU-2 operator panel.

NOTE: While in semi-automatic mode, all sequence descriptions are identical to those described in the automatic mode except that the operator will be required to start/stop the unit and initiate circuit breaker close/open operations from the main DU-2 operator panel.

ISLAND MODE OPERATION



MANUAL OPERATION

The station operator may initiate the island mode of operation by following the procedure below:

1. At the AGC, press MODE pushbutton
2. Press arrow key ◀ and ▶ to navigate to MAN.
3. Press SEL to select MAN mode.
3. The generator will start and achieve rated speed and voltage.
4. Press GB pushbutton to close the generator circuit breaker.

In all manual modes of operation, the control will be required to have this set via operator selection using the “mode” selector on the main DU-2 operator panel.

NOTE: While in manual mode, all sequence descriptions are identical to those described in the automatic mode except that the operator will be required to start/stop the unit, initiate circuit breaker close/open operations from the main DU-2 operator panel, and shall be in control of speed and voltage to adjust for nominal settings.

SEQUENCE OF OPERATION

The unit is programmed to operate in three modes of operation. These modes are:

1. **Auto Mains Failure (AMF)**
2. **Fixed Power (Baseload)**
3. **Multiple Unit Island**

The unit can be set to operate in three different types of operation. These types of operation are :

1. **Automatic**
2. **Semi-Automatic**
3. **Manual**

In order to operate in any of the three modes of operation, the AGC will require discrete inputs to sequence through operations. These are:

1. **Auto start enable.** This is required for all modes of operation with control in automatic.
2. **Utility circuit breaker auxiliary contact.** This is required for auto mains failure and fixed power with control in auto, semi-auto, or manual.
3. **Power management enable.** Required only for multiple unit island with control in Auto, Semi-Auto, or Manual

Automatic Mode

In all automatic modes of operation, control will be set via operator selection using the “mode” selector on the main DU-2 operator panel.

Automatic/Auto Mains Failure

1. When a utility failure event occurs, the utility circuit breaker auxiliary contact (52U/”a”) at discrete input 25 (terminal 158) shall open.
2. At the same time that the utility circuit breaker auxiliary contact opens, the auto start enable contact at discrete input 23 (terminal 157) shall close.
3. The unit will start and will ramp up to rated voltage and frequency.
4. Once the control reaches nominal parameters, it shall use the busbar voltage inputs to sequence through the circuit breaker close permissive operation (multiple unit). If this is the only unit on the system CANBUS, the control system shall issue a circuit breaker close signal to put it online. For multiple units on system CANBUS, the control shall place the first unit on line with other units initiating an automatic synchronizing scheme before a close permissive is issued.
5. The unit shall remain online in Auto Mains Failure until the return of the main.
6. Once the normal source has returned the unit can be shut down by removing the Auto Start Enable input.
7. The generator circuit breaker will be opened and the normal source circuit breaker can be closed. The return is open transition.
8. The unit will run unloaded in a cool down cycle before shutting down.

SEQUENCE OF OPERATION

Automatic/Fixed Power

1. With the utility circuit breaker auxiliary contact (52U^{”a”}) at discrete input 25 (terminal 158) closed, the unit can be selected to run in the fixed power mode (baseload) of operation.
2. To run in fixed power, close the auto start enable contact at discrete input 23 (terminal 157).
3. The unit will start and will ramp to rated voltage and frequency.
4. Once the control reaches nominal parameters, it shall initiate the automatic synchronizer. The synchronizer shall send the corresponding bias signals to the unit to bring it in parallel with the normal source.
5. When properly synchronized, the control shall issue a circuit breaker close command. After circuit breaker closure the unit runs in parallel to the normal source.
6. The control initiates a soft ramp, loading to the base load setting.
7. When the Fixed Power mode ends, the Auto Start Enable contact shall open.
8. The unit will now soft unload the generator to the unload trip level. The control issues a circuit breaker open command at the unload trip level
9. Once the circuit breaker opens, the unit shall run unloaded in a cooldown cycle before shutting down.

Automatic/Multiple Unit Island

1. The utility circuit breaker auxiliary contact is not required for this mode.
2. A jumper or a contact will be required at discrete input 55 (terminal 150) to place the control in this mode. All units set to run in this mode must have this discrete input enabled and must have their CANBUS lines interconnected to operate properly. Each unit must also have a unique CANBUS ID number entered into parameter 7531.
3. When properly configured for this mode and no alarms exist, units can be signaled to run with the Auto Start enable contact input at discrete input 23 (terminal 157).
4. At this time the unit will start and will ramp to rated voltage and frequency.
5. Once the control reaches nominal parameters, it shall use the Busbar voltage inputs to sequence through the circuit breaker close permissive operation. If this is the only unit on the system CANBUS, the control shall issue a circuit breaker close signal to put it online. For multiple units on system CANBUS, the control shall place the first unit online with the other units initiating an automatic synchronizing scheme before a close permissive is issued.
6. The unit shall remain online in island mode until the Auto Start Enable contact is opened.
7. After opening the Auto Start Enable contact, the unit will soft unload to the unload trip level (multiple Units) or will immediately open the generator circuit breaker (single unit).
8. The unit shall run unloaded in a cooldown cycle before shutting down.

JOB NO. 46630
DRAWING INDEX

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