WOODWARD

**Operation Manual**


# EGCP-3
# Engine Generator Control Package

## LS (Load Sharing) Model
## 8406-113

**Manual 26194 (Revision E)**

## WARNING—DANGER OF DEATH OR PERSONAL INJURY

**WARNING—FOLLOW INSTRUCTIONS**

**Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.**

**WARNING—OUT-OF-DATE PUBLICATION**

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**WARNING—OVERSPEED PROTECTION**

**The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.**

**The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.**

**WARNING—PROPER USE**

**Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.**

## CAUTION—POSSIBLE DAMAGE TO EQUIPMENT OR PROPERTY

**CAUTION—BATTERY CHARGING**

**To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.**

**CAUTION—ELECTROSTATIC DISCHARGE**

**Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.**

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

## IMPORTANT DEFINITIONS

- **A WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**
- **A CAUTION indicates a potentially hazardous situation which, if not avoided, could result in damage to equipment or property.**
- **A NOTE provides other helpful information that does not fall under the warning or caution categories.**

**Revisions—Text changes are indicated by a black line alongside the text.**

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# Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

2. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.

3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cup holders, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, and plastic ash trays) away from the control, the modules, and the work area as much as possible.

4. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:

    - Do not touch any part of the PCB except the edges.

    - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.

    - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

**CAUTION—ELECTROSTATIC DISCHARGE**

**To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.**

# Chapter 1.
# General Information

## Introduction

This manual describes the Woodward EGCP-3 Engine Generator Control Package, Load Sharing (LS) model, **part number 8406-113**. It provides description, operation, tuning, and troubleshooting information for EGCP-3 digital controls. The details on installation, wiring, communication, Regulatory Notes and Warnings are in the **EGCP-3 Installation Manual 26122**. The EGCP-3 LS is intended for power generator applications where multiple control/generators will supply an isolated bus, or operate in parallel with a Mains (Utility) bus. The EGCP-3 can perform engine start/stop sequencing. For isolated load operation, the control will operate in isochronous speed control. For a multiple engine bus, up to 16 generators can share load, operate in BaseLoad, or process control modes.

**WARNING—OVERSPEED**

**The generator should be equipped with a sync check relay, circuit breaker, and other fast-acting protective relays as required by local codes and practices to protect against damage to the generator with possible personal injury, loss of life, or property damage.**

**The overspeed shutdown device, sync check relay, circuit breaker, and other fast-acting protective relays must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.**

**WARNING—PROTECTIVE EARTH**

**Protective Earth (PE) must be connected to the termination point on the backside of the unit next to the label with the ⏚ symbol (or 1 of 3 other like termination points without label) to reduce the risk of electric shock. This connection will be made using a thread-forming screw. The conductor providing the connection must have a properly sized ring lug and wire larger than or equal to 4 mm² (12 AWG).**

**WARNING—HIGH VOLTAGE**

**The calibration and checkout procedure should only be performed by authorized personnel knowledgeable of the risks posed by live electrical equipment.**

**WARNING—POWER CONNECTION**

**The installation must include the following:**

- **The power supply mains should be properly fused according to the installation instructions and the appropriate wiring requirements.**
- **A switch or circuit breaker must be included in the building installation in close proximity to the equipment and within easy reach of the operator, and must be clearly marked as the disconnecting device for the equipment. The switch or circuit breaker will only remove power to the unit—hazardous voltages may still be connected to other terminals on the unit.**

# Application and Functions

The EGCP-3 control is a microprocessor-based generator load control designed for use with a separate speed control and an automatic voltage regulator to provide synchronizing, paralleling, loading and unloading. All transitions between EGCP-3 functions are coordinated to provide smooth operation.

## EGCP-3 LS Functions:

- Display/Keypad Interface for local setup/monitoring
- Engine Start/Stop Sequence Control
- Monitor of Generator and Bus power
- Unit sequencing and individual unit protection
- Engine Protection and Monitoring
- Synchronizer with speed, phase, voltage matching, token passing for dead bus closure, and multiple unit synchronizing
- KW Control with automatic generator loading and unloading for bumpless load transfer
- Droop, BaseLoad, Isochronous, and Isochronous load sharing control capability
- Frequency and voltage trimming in Isochronous mode
- Communication bus between Master Control and other LS units
- Master/Slave Process control for cogeneration, import/export, pressure control, or other processes
- KVAR/PF Control and bus /PF sharing
- Individual generator stable timing
- Built in diagnostics
- Generator and Bus Protective Relaying
- Generator Power & Energy Metering
- Modbus® * and ServLink communications for remote HMI/PLC connections

*—Modbus is a trademark of Schneider Automation Inc.

## HMI/Front Panel Display

The EGCP-3 has a keypad and two 4-line display panels on the front cabinet mounted chassis. The display can be used to configure and set up the control for site specific requirements. The display is also used in normal operating service to monitor operation and view alarm data. All functions performed and parameters monitored by the front panel are also available through the three serial ports. These ports can be configured to use Woodward Watch Window software, an external HMI and Modbus communication, or ServLink DDE software.

## Engine Control

The EGCP-3 control performs stop and start logic for both gas and diesel reciprocating engines. The starting logic includes: pre-glow capability, separate enabling for ignition, fuel pump/FSOV logic, and a configurable pause at idle. The engine stop function includes: controlled cooldown, soft shutdown logic and emergency stop logic. The start and stop logic includes closing and opening of generator breaker. Typical protections such as over speed, coolant temperature, oil pressure, and battery voltage are also provided. Configurable digital and analog fault inputs are provided for use with temperature, pressure, or level switches. All the faults may be disabled when not needed. In addition to automatic modes, Manual start and stop for the engine is possible. The circuit breaker can be closed manually to load the generator in the selected load control mode (Process, Droop, BaseLoad, Isochronous) when manual control is desired.

## Synchronizer

The EGCP-3 control uses digital signal processing techniques to derive both true RMS voltages and relative phase of the fundamental frequencies of the bus and generator voltage wave forms. Digital signal processing techniques offer significantly improved measurement accuracy in the presence of waveform distortions, particularly since the phase measurement does not depend on zero crossings of the waveforms.

Either phase matching or slip frequency synchronizing may be selected. Phase matching method controls the engine speed to give zero speed error and minimal phase error between the generator and bus; this provides rapid synchronizing for critical standby power applications. Slip frequency synchronizing guarantees a fixed speed difference between generator and bus. This insures the generator to be faster than the bus and initial power flow is out of the machine for larger generators. For both synchronizing methods, the EGCP-3 control uses actual slip frequency and breaker delay values to anticipate a minimum phase difference between bus and generator at actual breaker closure.

The synchronizer can sense a dead local bus and close the generator circuit breaker automatically when safe to do so. The network communication between EGCP-3 control assures that multiple generators cannot close simultaneously onto a dead bus.

There are four synchronizer modes of operation: Run, Check, Permissive, Off. The mode can be selected through Watch Window, the front panel display, or Modbus. The last mode selected by any of these interface methods will be the mode of operation.

Additional synchronizer features include: voltage matching, time delayed automatic multi-shot reclosing, and a synchronizer timeout alarm. Raise and lower inputs can be used to manually adjust speed for manual synchronizing. Voltage raise and lower inputs can be used to manually adjust voltage for manual voltage matching. Each of these features may be enabled or disabled during setup.

## Load Control

When the generator circuit breaker is closed, the LS model is in Isochronous and will Load Share with other units also connected to the bus. The speed bias output will control the load of each engine by slight changes to the speed control's speed reference. When the breaker is open, the EGCP-3 will be in droop operation. Another mode of Load control is BaseLoad; it begins at breaker closure when the load control function takes control of the EGCP-3 speed bias output directly from the synchronizer. The matching of synchronizer slip frequency to initial load (unload trip level) can result in a bumpless transfer to load control. On command, the adjustable ramp allows smooth, time-controlled loading into Load Sharing, BaseLoad, or process control. A ramp pause switch input allows holding of the load ramp for warm-up or other purposes. Process Control is a derivative of BaseLoad operation. In this control mode, one genset may be assigned as a master, to control the loading of other gensets on the bus.

The EGCP-3 control provides switch inputs to allow raising or lowering the internal BaseLoad reference. The control also provides a 4–20 mA (or 1–5 Vdc) analog input for remote load setpoint, if desired. The load reference can also be set through a Modbus or ServLink DDE communication interface.

When unloading, an adjustable unload ramp provides time controlled unloading to the unload trip level. When load reaches the unload trip level, the control will hold the load at the unload value, the breaker can then be opened manually to remove the genset from service. The ramp pause switch can be used to stop the load ramp at its present value for cool-down or other purposes.

The load and unload ramps also provide smooth transition between BaseLoad and process control any time the operating mode is changed.

The EGCP-3 control includes several additional load control features:

- Simple load droop operation provides safe operation in parallel bus applications in the event of a circuit breaker aux contact failure.
- Isochronous operation when the bus is isolated.
- Adjustable load switch output with independent pick-up and drop-out points provides a signal when the specified load is exceeded.

## Process Control

A cascade process controller is provided for cogeneration, import/export control, pond level maintenance, pressure maintenance, or other application. An adjustable bandwidth input filter, flexible controller adjustments, an adjustable deadband, and direct or indirect control action, allow the process control to be used in a wide variety of applications.

A 4–20 mA (or 1–5 Vdc) process transmitter provides the process signal to the EGCP-3 control. The control includes an internal digital process reference which may be controlled by raise and lower switch contact inputs or by an external 4–20 mA (or 1–5 Vdc) process reference, or by a Modbus or ServLink communication interface. The output of the process control provides the cascade load reference to the BaseLoad control.

Adjustable ramps allow smooth entry to or exit from the process control mode. When the process control mode is selected, an adjustable ramp moves the load reference in a direction to reduce the process control error. When the error is minimized, or the reference first reaches either the specified high or low load pick-up limits, the process controller is activated. When unloading from the process control, an adjustable unload ramp provides time controlled unloading to the unload trip level. When load reaches the unload trip level, the EGCP-3 control automatically issues a breaker open command to remove the generator set from the system. The ramp pause switch input allows holding of the load ramp for cool-down or warm-up purposes.

Additional functions include selectable and adjustable process high and low limit switches and alarm activation.

When multiple gensets and EGCP-3 LS controls are connected to a bus in process control mode one unit is automatically assigned as the “Process Master”. It’s process control loop then dictates through the LON network the load levels of other gensets on the bus.

## VAR/PF Control

The VAR/PF functions control the reactive power component of the generator in parallel systems. The reactive load mode can be configured for VAR or Power Factor control. The controller compares the reactive load on the generator with an adjustable internal reference and makes corrections to the setpoint of the Automatic Voltage Regulator (AVR) until the desired reactive power is obtained. The reactive power level can be maintained while also controlling real load through the generator breaker. The analog voltage bias output can be directly connected to compatible voltage regulators. The control also has raise and lower contact outputs to activate a voltage regulator MOP when an analog input is not provided on the AVR. The EGCP-3 control has a selectable voltage range alarm that is activated if the analog output to the voltage regulator reaches high or low saturation. The EGCP-3 control also has selectable and adjustable high and low voltage limit switches and alarm outputs.

The EGCP-3 control provides switch inputs to allow raising or lowering the generator voltage reference. The control also provides a 4–20 mA (or 1–5 Vdc) analog input for kVAR/PF setpoint control, if desired. The kVAR/PF reference can also be set through a Modbus or ServLink DDE communication interface.

While the EGCP-3 is controlling unit load to accomplish real load (kW) sharing, the voltage of the generators in parallel will be controlled to accomplish equal Power Factor levels of each generator.

## ATS Control

ATS functions are not included in the LS model of EGCP-3. A Master Control (MC) is used to control the mains circuit breakers and local bus circuit breakers to perform ATS functions.

## Peaking and Demand Operation

The LS model does not have Peaking and Demand functions. This function is provided from an MC control that provides the interface with the mains(utility) and LS units.

## Genset Sequencing

While the details of how to start and stop a genset is determined by the Engine Control sequence, when to initiate a start or stop is the function of the sequence configuration. The starting and stopping of Gensets is closely associated with the configuration of the system bus structure and genset characteristics. All EGCP-3 LS and EGCP-3 MC controls on a common network communicate their operation status and the mains and bus status over a Echelon Network (LON). Systems with up to 16 gensets, and/or four local bus segments, and/or two mains connections for a split bus arrangement can be configured. When automatic connection(s) to the mains is configured an EGCP-3 MC connected to the LON network is required. The user can configure the criteria used to start and stop genset(s) and the priority of which genset is the next to start or stop.

A typical start/stop sequence would be:

- When the units on a bus segment are above a configured Maximum Load Level or above their 100% Load Level, a start command will be given to the next scheduled unit.
- When the units on this bus segment are below a configured Minimum Load Level, a stop command will be given to the next scheduled unit.

## Power and Energy Metering

The digital signal processing techniques are used to provide significantly improved accuracy and speed of response over conventional analog measurement techniques. Accuracy is improved using rapid sampling of the voltage and current signal waveforms and developing a true RMS measurement. Measuring true RMS power allows optimal accuracy, even in the presence of power line distortions.

The PowerSense board receives the PT and CT inputs for both the generator and bus for calculation of parameters for the EGCP-3 to use in system control. The algorithms used are based on IEEE 1459-2000. For the generator and bus the following parameters are provided: Hz, Vac, Amps, W, VA, VAR, PF, Phase, Voltage harmonics, Current harmonics, Negative Phase Sequence Voltage, Negative Phase Sequence Current.

Available for selection at the 4–20 mA analog outputs: Synchroscope, Generator metering, Mains metering

## Protective Relaying

The PT and CT inputs were designed for accurate voltage and current monitoring in applications of display and control. They are not designed for high speed, sub-cycle, or cycle-to-cycle protective relaying though time delay protective relaying can be used.

**WARNING—OVERSPEED/OVERCURRENT**

**The EGCP-3 should not be used as the only means for detecting voltage or current disturbances, dead bus conditions, or overcurrent conditions. The generator should be equipped with a sync check relay, circuit breaker, and other fast-acting protective relays as required by local codes and practices to protect against damage to the generator with possible personal injury, loss of life, or property damage. The sync check relay, circuit breaker, and other fast acting protective relays must be totally independent of the EGCP-3.**

Alarms can be configured for generator and bus protective relay (i.e. Reverse power, Under Voltage) functions. Time delay, and separate warning and trip thresholds can be set. A complete list of protective relay functions available is given in Chapter 3. Current based protections are implemented using the ANSI/IEEE C37.112 Very Inverse curve.

## Communications

The EGCP-3 includes three serial ports for simultaneous connection to remote HMI, PLC, remote control and monitoring equipment. The remote monitoring and interface can be by Modbus tools or Woodward ServLink tools. Configuration of the EGCP-3 may be done from the front panel or through a serial port using Woodward Watch Window software. The Watch Window software allows easy configuration in a Windows environment.

# Chapter 2.
# Front Panel Operator Interface

## Introduction

The EGCP-3 Operator Interface is designed for simplicity and redundancy of function in all operating modes. Two backlit LCD (Liquid Crystal Display) screens are used to display various operating and status information to the operator, as well as for configuration of setpoints. This chapter is intended to show the operation of and features available though the EGCP-3 display. The function of the configurable items shown here are described in more detail in following chapter(s).

**NOTE**

**The EGCP-3 Operator Interface can only be used for unit configuration and monitoring. Unit start/stop, sync, or mode selection commands cannot be given through the EGCP-3's front panel.**

**CAUTION—SOFTWARE TOOLS**

**An unsafe condition could occur with improper use of these software tools. Only trained personnel should have access to these tools.**

The unit's front panel screens provide eight lines of status information, with the option of displaying four lines of configuration or Alarm Log information. These screens allow the user to monitor and tune related parameters at the same time.


Figure 2-1a. EGCP-3 Front Panel and Operator Interface

# Keypad

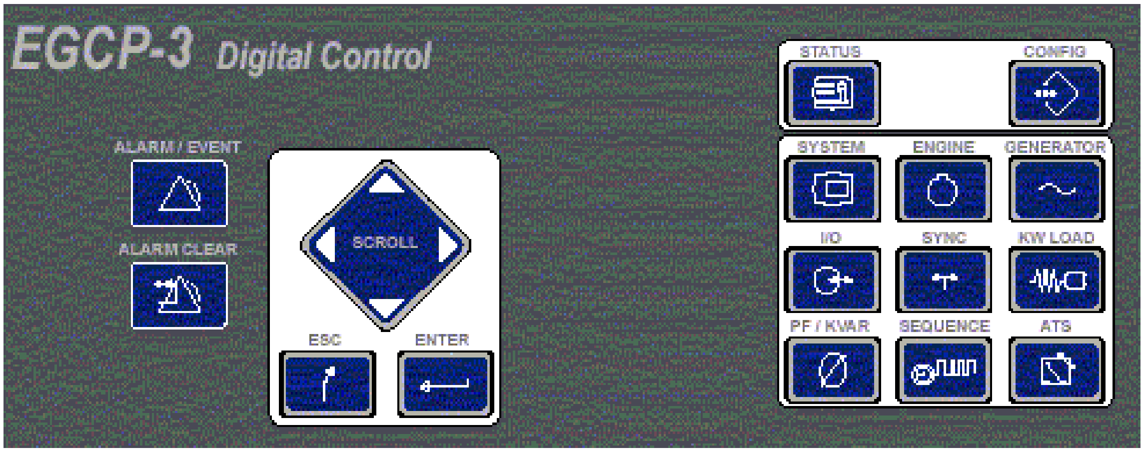


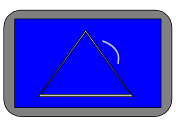

Figure 2-1b. Keypad

There are three modes of keypad/display operation: Alarm, Configure, and Status. To go into one of these modes, simply press the key named with that mode. The Alarm and Configure menus only appear on the right hand screen, the left hand screen will continue showing the Status menu for that screen. When the Status key is pressed both screens will display status menus.

## Alarm/Event, Status, and Configuration Keys:

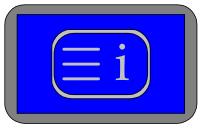
These three keys determine the type of menus being displayed by the EGCP-3.

ALARM / EVENT



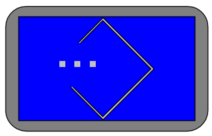
The ALARM/EVENT KEY is used to access the alarm and event menu in the right hand display screen. When pressed once, this key will cause the right hand LCD display to show the current active alarm(s) and the time of the alarm occurrence. Press the scroll down to view more alarms, End of List will be displayed after the last alarm. If pressed twice, this key will cause the right hand LCD display to show the latest alarm in the complete ALARM HISTORY log of the generator set. As confirmation, the top line of the display will indicate when the alarm history is being displayed. Press the scroll down to view previous alarms and their occurrence time and date. Press CONFIG or STATUS to exit the ALARM/EVENT mode. The ALARM CLEAR function is active while viewing the active alarm screen and the proper security code entered. The acknowledge function is available from all modes.

STATUS



The STATUS KEY, when pressed, will put both left and right LCD into the monitor display mode. The status displays provide information about different items of engine, generator set and bus operation. See the STATUS MENU buttons, below for details on the various status keys. There are no adjustment values in the status display mode. The left screen portion of the active status screen will remain for monitoring when the Alarm or Configure mode is selected. The Scroll Up, and Scroll Down are the only navigation keys active in the Status mode.

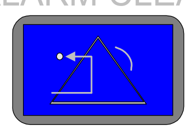
CONFIG



The CONFIG KEY, when pressed, will put the right hand LCD into the configuration mode, and if not already entered, ask for a security code to be entered. After a proper code is entered, the Configuration menu items will be displayed in the right hand screen. Status information will continue to be displayed in the left hand screen. Since there are various menu items and adjustments in the configuration menu, a blinking cursor is provided in the right hand display to indicate the value may be adjusted.

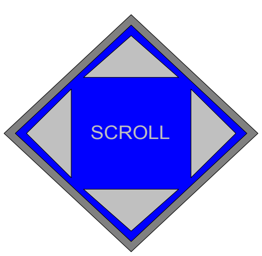
### Alarm/Event Keys

ALARM CLEAR

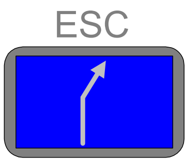


The ALARM CLEAR KEY is used to acknowledge and clear alarm events from the current event status log. Events are never cleared from the history log. When pressed, this key will silence the AUDIBLE ALARM (if present). When pressed a second time this key will clear all alarms that are no longer active (if at the proper security level). When an active alarm is cleared (Reset), the action(s) associated with the alarm event will also be cleared from the control logic.

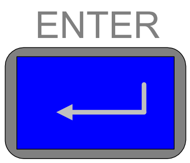
### Navigation and Adjustment Keys




The SCROLL KEY is used to move the screen's cursor up, down, left and right by pressing the respective corner of the scroll diamond. In the Status mode and Alarm mode the Up and Down Scroll will change the screen to the next set of parameters or Alarms. This key is also used to increment and decrement values while in a Component Value Menu of the Configuration menu.



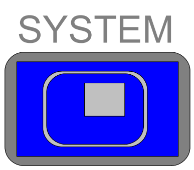

The ESCAPE KEY is used to move upwards (out of) the configuration menu levels. It also is used when tuning a value to restore the previous value, if the new value is not entered into memory (see the enter key, below). The ESCAPE KEY has no function in the Alarm mode or Status mode



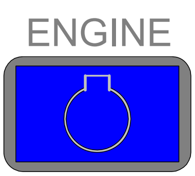

The ENTER KEY is used to move downwards (into) the configuration menu levels. It is also used when tuning a value to enter the new value to memory. The ENTER KEY has no function in the Alarm mode or Status mode.

## Status Menu Keys

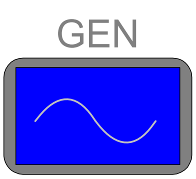
Once the STATUS key has been pressed, the following keys can be pressed to display the respective unit information. Many of the Status menus have more than one screen. Pressing the Scroll Down key will show more parameters in the same group.




The SYSTEM STATUS key, when pressed displays general system status information. The system status display is also the default status display screen (it is always the first display shown after a power up of the control). This display shows general information about the operation of the engine generator set. There is only one System status screen.

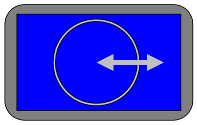



Press the ENGINE STATUS key to display status information about the engine functions and operation. There are two Engine status screens.



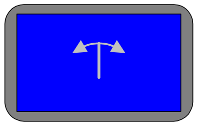

Press the GEN STATUS key to display the three phase based generator and bus parameters. There are eight status screens to monitor the generator and bus electrical parameters.

I/O



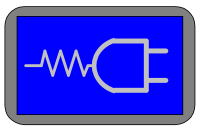
Press the I/O STATUS key to display the status of all the discrete inputs and outputs, as well as information on analog inputs and outputs. There are three I/O status screens.

SYNC



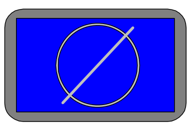
Press the SYNC STATUS key to display status information regarding the generator breaker and mains breaker synchronizer. The Synchronizer status is on two screens.

KW LOAD



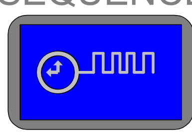
Press the KW LOAD STATUS key to display the unit's kW load control status information. There is one Load status screen.

PF / KVAR



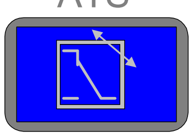
Press the PF/KVAR STATUS key to display VAR/PF Mode information, as well as related three phase generator and bus parameters. The reactive power values are contained on only one status screen.

SEQUENCE



Press the SEQUENCE STATUS key to display SEQUENCE information. This screen displays information and status on LON sequencing. The sequence values are contained on three screens.

ATS



The ATS STATUS key selects a status screen that is not available on the EGCP3 LS software version.

## Navigation Procedure

The following drawings detail a step-by-step procedure for navigating through the EGCP-3 software. Additionally, the typical display entries seen at each step are shown. The cursor position is shown with an Underline of the first letter in the active line. Stepping through this example will give the user a quick feel for the display and keypad operation.

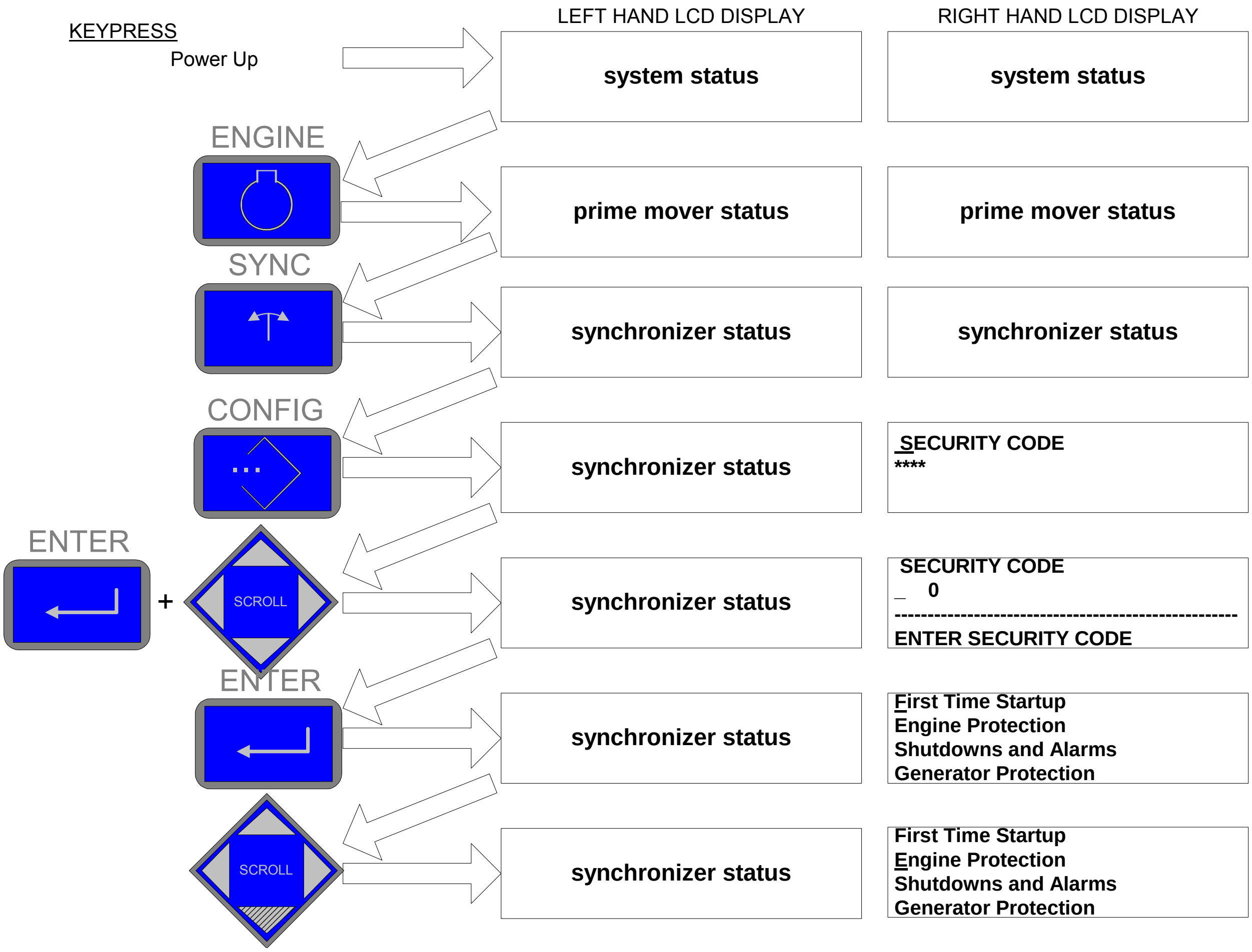



Figure 2-2a. EGCP-3 Navigation (1)

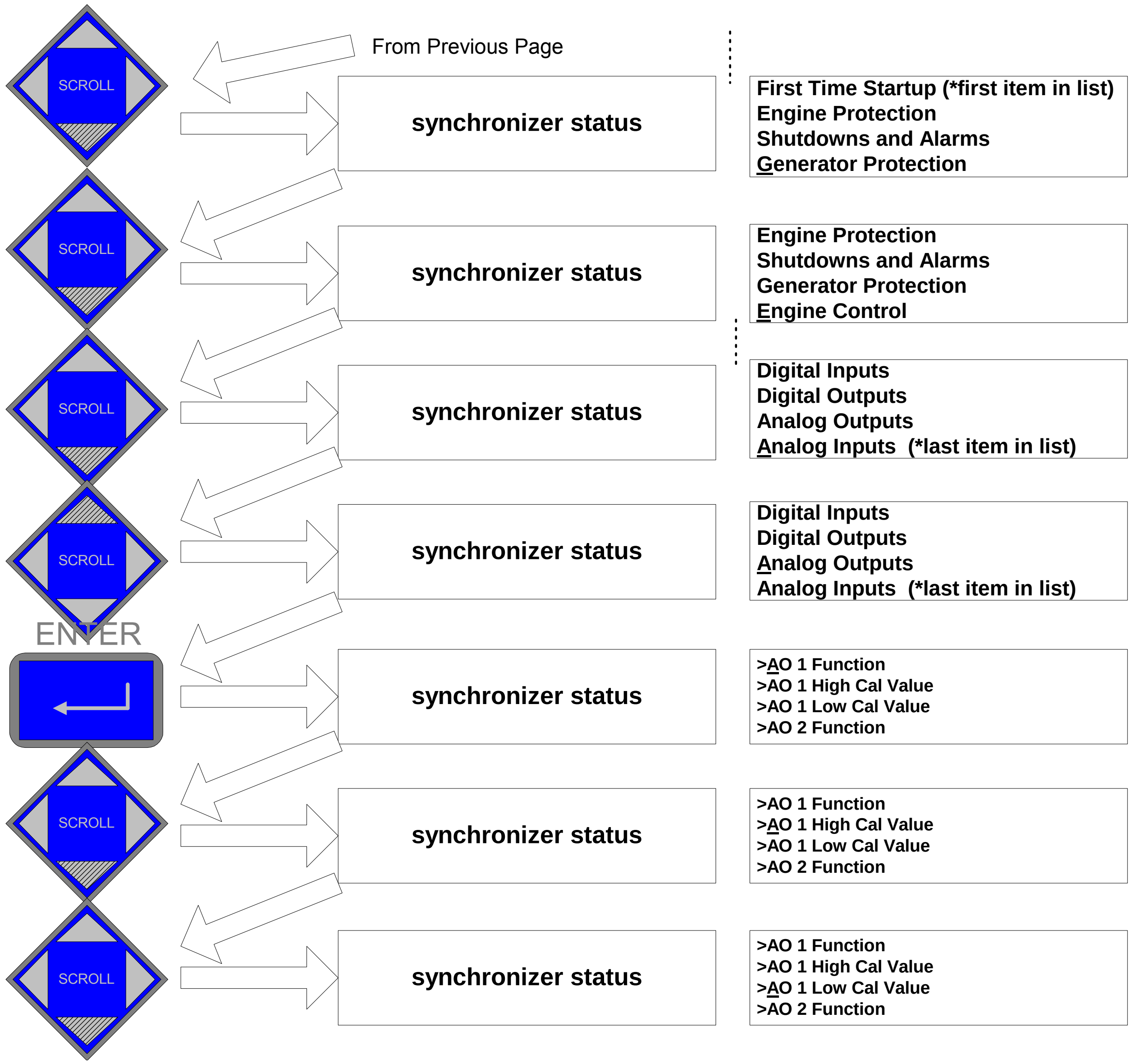



Figure 2-2b. EGCP-3 Navigation (2)

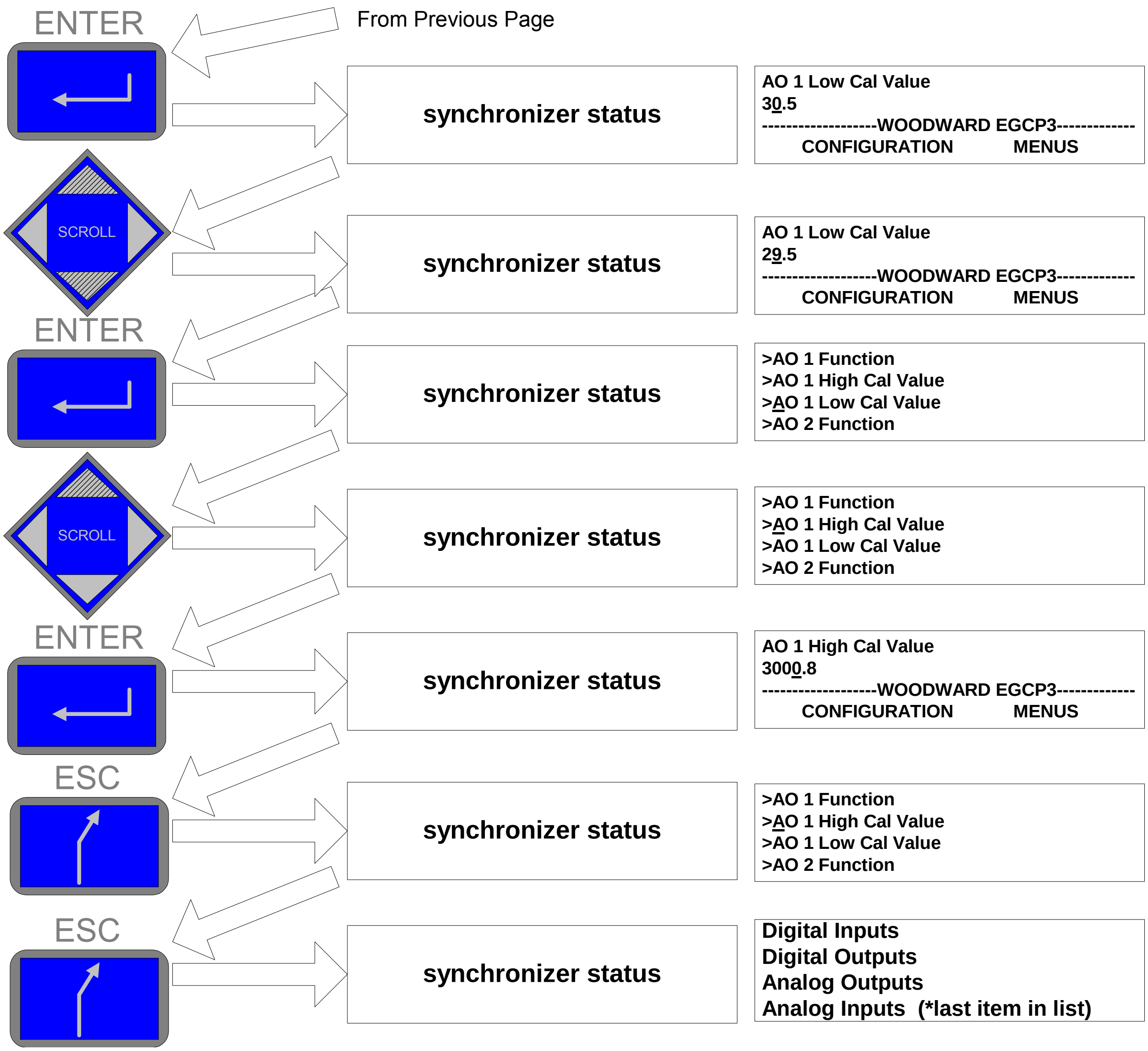



Figure 2-2c. EGCP-3 Navigation (3)

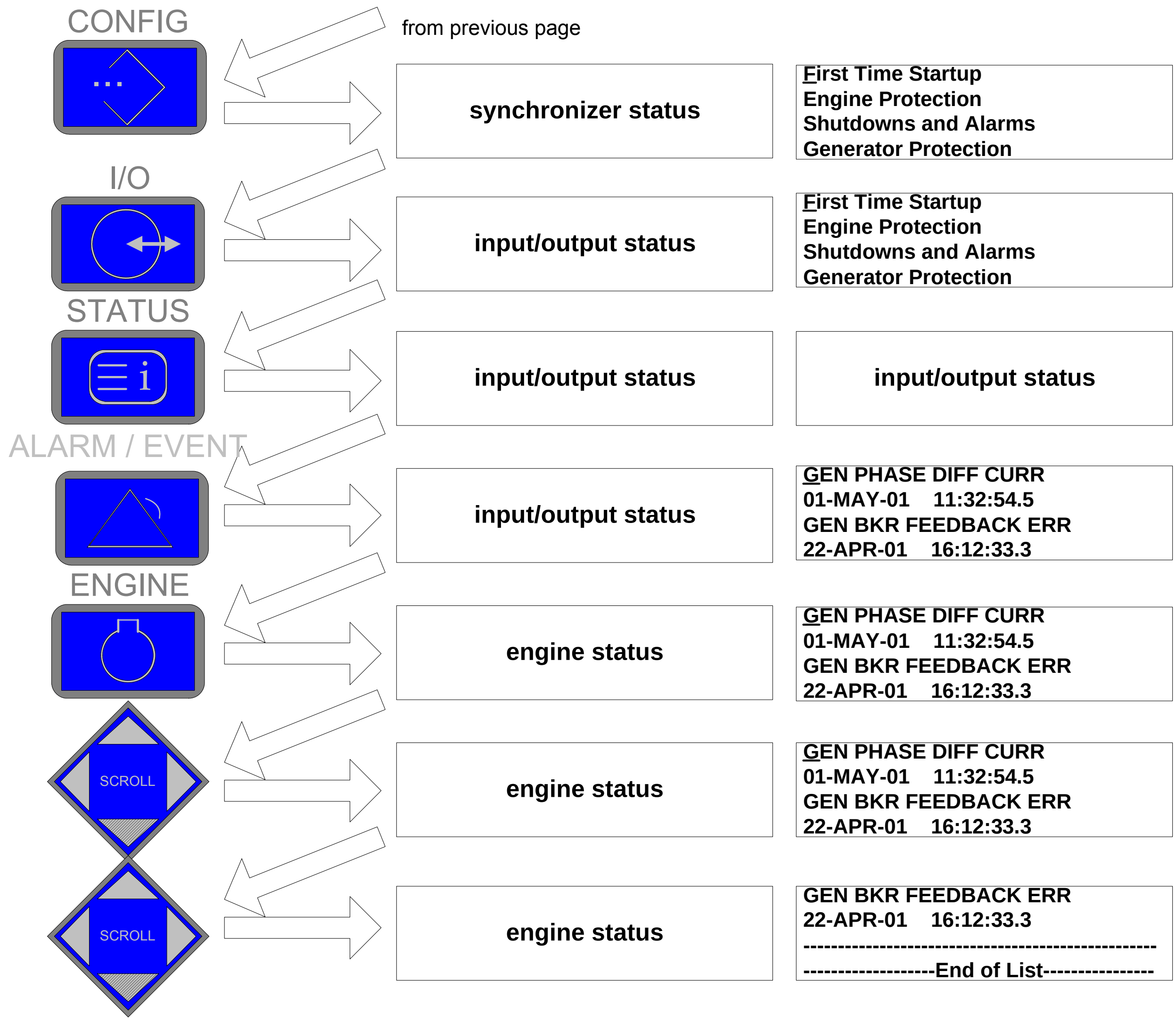



Figure 2-2d. EGCP-3 Navigation (4)

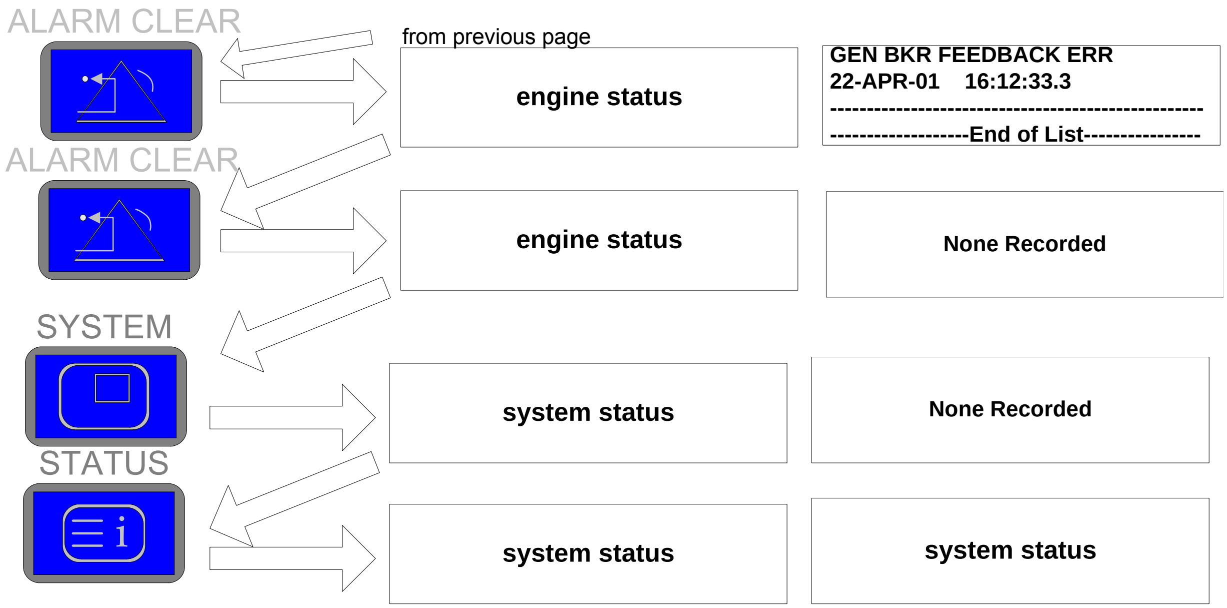



Figure 2-2e. EGCP-3 Navigation (5)

# Alarms and Events

The EGCP-3 contains two separate events lists. Both lists contain a combination of diagnostics, warnings, and alarms. One list contains only the current events. The other list is referred to as a history log. It contains all events that have occurred at any time in the past or present. Any event that was listed in the current event list will be listed in the history log. When the history log fills up, the oldest event will be lost. The history log is kept in non-volatile memory. The current event list is saved only in volatile memory and will be cleared on loss of the 24 Vdc power input.

## Current Alarms and Events

The ALARM/EVENT KEY provides access to the EGCP-3's Alarm and Event Log. This log contains up to 100 individual diagnostics, warning alarm, or shutdown items. When the ALARM/EVENT KEY is pressed once on the EGCP-3 keypad, the right hand LCD screen will switch to display the current events and the time an event occurred. Up to two events will be displayed at a time. Pressing the Down Scroll key will page down to the next pair of events, until the last (oldest) active alarms is displayed. End of List will be display after the last alarm. If the total number of current events exceeds 100, the oldest events will be dropped off the list to make room for the newer events. Pressing the Up Scroll key will page up to the previous pair of events but not go further than the top of the list. There is no wrap-around feature. The Side Scroll keys will have no effect. The left screen will continue to show whatever status screen it was showing prior to entering the Alarm/Event display mode.

In case the ALARM/EVENT KEY is pressed and there are no active or logged alarms, the display will look like this:

| | |
|---|---|
| S T A T U S<br>D I S P L A Y | N o n e   R e c o r d e d |

Current Alarm/Events

The standard format to display the current Alarms and Events is shown below if at least two exist.

| | |
|---|---|
| S T A T U S<br>D I S P L A Y | A L A R M   N A M E<br>Y Y / M M / D D   H H : M M : S S<br>A L A R M   N A M E<br>Y Y / M M / D D   H H : M M : S S |

Current Alarm/Events

**ALARM NAME**: The name, as defined by the particular warning, alarm, or shutdown event.

**HH:MM:SS** The hour, minute, seconds, of the alarm occurrence in 24 hr format.

**YY/MM/DD** The Year, Month and Day of the alarm occurrence. Only a 2-digit year is shown due to space limitations. The month is shown as the conventional numerical 01-12

The ALARM CLEAR KEY is used to acknowledge and reset alarm events from the current event status list. When pressed, this key will acknowledge all alarms in the Current Alarm/Event List by silencing (turning off) the AUDIBLE ALARM output (if present). When pressed a second time, this key will reset the alarm relay outputs (visual audible, soft shutdown etc.). However, if an event is still active, it will not be cleared. If an event was latching an associated control action(s), the latch will also be cleared from the control logic thus allowing that action to continue (if appropriate). The Alarm/Event list will be cleared only if the reset button is pressed, and the alarm condition has cleared, and the control security level is at operator or greater level

**WARNING—ALARM CLEAR**

**The unit may start unintentionally if a fault, which caused the unit to shut down, is cleared and the operating mode is enabled for Automatic Starting. Before clearing the fault, check the cause of the fault, in order to protect operating personnel located in the vicinity against injuries, and to protect the engine against unintentional damage.**

**⇒ If the cause of the fault is not known or is unclear, NEVER press the ALARM CLEAR KEY.**

To enter a clear command, it is necessary to press the CLEAR ALARM key, wait two seconds, and then press CLEAR ALARM again. If another alarm has occurred during this two second wait period, the new alarm will be acknowledged, but no alarms(s) will be cleared. Another press of the CLEAR ALARM key is now required to clear the alarm list, and reset the alarm(s). There is no maximum wait time for the alarm clear function. Once the CLEAR ALARM key is pressed, the second ALARM CLEAR can occur any time (provided there are no new alarms), the list will be cleared, and the alarm(s) will be reset.

## History Log

The ALARM/EVENT KEY is used to access the alarm and event menu in the right hand display screen. When pressed once, this key will cause the right hand LCD display to show the current event status of the generator set as described above. If pressed a second time, this key will cause the right hand LCD display to show the complete historical event log of the generator set. As confirmation, the top line of the right display will indicate ALARM HISTORY when the history log is being displayed. If the ALARM/EVENT KEY is pressed a third time, the display will return to showing the current events.

Pressing the Down Scroll key will page down to the other events and their occurrence time and date. The Down Scroll key will stop at the end of the list, which may be less than the 100 events. Pressing the Up Scroll key will page up to the previous event but not go further than the top of the list. There is no wrap-around feature. The Side Scroll keys will have no effect. The left screen will continue to show whatever status screen it was showing prior to entering the Alarm/Event display mode.

The events displayed are arranged in a first in, last out (FILO) order. The most recent events will appear at the top of the list, followed by older events. If the total number of events exceeds 100, the oldest events will be dropped off the list to make room for the newer events. Events are never cleared from the history log until the log becomes full. The history log is saved in non-volatile memory so the equipment owner can always see past events. A sample of a History Screen is shown below:

| | |
|---|---|
| | ALARM HISTORY |
| STATUS | |
| DISPLAY | ALARM NAME |
| | YY/MM/DD HH:MM:SS |

History Log

The ALARM CLEAR KEY has no effect when viewing the History Log. No password is needed to view the History Log.

# Status Menus

There are nine status menus in the EGCP-3. Use the status keys on the face of the EGCP-3 to access these status menus. The information in the status menus is dynamic, and updates about every 200 milliseconds (ms). The status menus are used to display all of the inputs and outputs of the control and the associated modes of operation for the control. The status screens are to be used for monitoring and troubleshooting.

All status screens include a wrap-around feature when more than one page of data is available. Upon reaching the last page of data, pressing the scroll down arrow key again will cause the EGCP-3 to wrap-around and display the first page again. Likewise, if the first page is being displayed and the Scroll up key is pressed, the last page will then be displayed.

## System Status

When the EGCP-3 is initially powered up, it will default to the System Status Screen 1. Below is an example of what the Screen may look like. The System Status Screen can be accessed while in any other status screen by pressing the SYSTEM key. The System Status #1 screen is the only screen shown in the System Status section. Pressing the Scroll Down or Up button will continue to display System Status Screen #1.

```
Alarms:1      UNIT:1        kW:       0        0.0Hz
BUS--         GEN--         PF:1.00LG
Engine:OFF                  MW-hrs           Run-Time
State:AUTO                     11223,30      12345.0
```

System Status #1

The screen displays the following information:

**Alarms**: Displays the number of active alarms on the unit.
**UNIT:** The LON Address of the EGCP-3 Unit.
**BUS:** A graphic display of the local bus condition. Two minus symbols (– –) indicates the bus is out of spec, (+ +) indicates that the bus has voltage on it.
**GEN**: A graphic display of the status of the generator. Two minus symbols (– –) indicates the generator is out of spec, one plus symbol indicates the generator is in spec, but not declared stable; (+ –) two plus symbols (+ +) indicates the generator is in spec and stable.
**Engine**: Shows the operating state of the engine.

| Displayed State | Meaning |
|---|---|
| | |
| **OFF** | The engine is off. |
| **PREGLOW** | During a start sequence, the preglow is active. |
| **CRANK** | The starter is engaged. |
| **RUN** | The starter is disengaged and the engine is running at rated speed. |
| **COOLDOWN** | The cooldown timer is running. |
| **SPINDOWN** | The fuel solenoid is "off" and the engine is coasting to a stop. |
| **RETRY** | The engine controller is waiting for the crank retry timer to expire before attempting another start. The last start failed. |
| **IDLE** | The engine is waiting at idle for the idle timer to expire before going to rated speed. This state only occurs during start. If the engine is told to idle during cooldown, the state will show cooldown. |

**State**: Shows the state of the genset as a whole. Display shows how/why the unit started.

| Displayed State | Meaning |
|---|---|
| | |
| **OFF** | The Test/Run/Auto switches are all off. |
| **TEST ENGINE** | The Test switch (only) was asserted and the engine is running in Droop. |
| | |
| **RUN WITH LOAD** | The Run switch was asserted and the engine is running. With the Auto switch the unit will automatically synchronize and close the gen breaker. Without the auto switch the engine can be manually synchronized. Once the breaker is closed, the unit will go into the appropriate Load Control Mode. |
| **AUTO** | The Auto switch (only) is asserted and the EGCP-3 is waiting for network start command. The unit is in standby and ready to start. |
| **NETWORK START** | Start initiated over the LON network from a MC or LS unit. |

**KW**: The total kW load on the generator. Note: The display will put a blank, k, or M as the first letter so that the units appear as W, kW, or MW for the displayed value.

**Hz**: The frequency of the generator set, in Hertz.

**PF**: The average three phase power factor of the generator set.

**MW-Hrs**: The total accumulated MW hours produced by the generator set since it was installed. This value is periodically saved in non-volatile memory to preserve the value if power is interrupted to the control. This value may be cleared, reset to zero, from the Configure Engine Control menu.

**Run-Time**: The total accumulated run time of the generator set in hours. This value is also periodically saved in non-volatile memory to preserve the value if power is interrupted to the control. This value may be cleared, reset to zero, from the Configure Engine Control menu.

This is what the System Status screen would look like when the unit was started manually, the engine running, carrying 100 kW load, and the generator voltage is within specified limits.

```
Alarms:0        UNIT:1            kW:    100.0     60.0Hz
BUS+-           GEN++             PF:1.00LAG
    +
Engine:RUN                        MW-hrs         Run-Time
State:RUN WITH LOAD                2000.00          200.0
```

System Status #1

This is what the System Status screen looks like for a generator set that was started on a Network start from another EGCP-3 and is load sharing with other units on the bus at 500 kW, 0.80 lagging PF, with one alarm.

```
Alarms:1          UNIT:3          kW:    500.0     60.0Hz
BUS++             GEN++           PF:0.80LAG
Engine:RUN                        MW-hrs         Run-Time
State:NETWORK START                2000.00         4000.0
```

System Status #1

## Engine Status

Engine Status screen #1 contains summary information for engine functions. It is the top screen shown in the Engine Status section. Pressing the Scroll Down button will page down to Engine Status Screen #2.

```
HH:MM   DD-MMM    YYYY            H2O Temp:100.0 deg C
Engine:OFF                        Oil Press:10.0KPA
RPM:     0                        Gen Breaker:OPEN
Battery Volts:24.0V               GEN --
```

Engine Status #1

**HH:MM**: Time of Day (24 hour clock format)
**DD-MMM**: Date with two digits for the day and three letters for the month.
**YYYY**: Four digit year.
**Engine**: The state of the engine control function. This is a repeated element from System Status Screen #1. See system status above for a description of the states.
**RPM**: Engine speed in rpm.
**Battery Volts**: Battery Voltage in Volts dc.
**H2O Temp**: Coolant Temperature in °C, or °F, depending upon the units selected in configuration.
**Oil Press**: Oil Pressure in kPa or psi, depending upon the units selected in configuration.
**Gen Breaker**: The Status of the generator breaker as provided by the generator CB aux discrete input.
**Gen**: The status of the generator. Two minus symbols (– –) indicates the generator is out of spec, one plus symbol indicates the generator is in spec, but not declared stable (+ –); two plus symbols (+ +) indicate the generator is in spec and stable.

Engine Status Screen #2 contains the parameters associated with engine start and stop. Pressing the Scroll Up key pages back to Engine Status Screen #1. Pressing the Down Scroll key also goes back to Engine Status Screen #1 because there are only two screens in this status area.

| | |
|---|---|
| Engine: OFF | Fuel: OFF |
| Speed: 0 RPM | Ignition: OFF |
| Preglow: OFF | Air: CLOSED |
| Crank: OFF | Control: IDLE |

Engine Status #2

**Engine**: See Engine in Status Screen #1.
**Speed**: Engine speed in rpm.
**Preglow**: Shows OFF or PREGLOW depending on the state of the discrete output. If an output is not assigned for Preglow, this field will always show '– – –'.
**Crank**: Shows OFF or CRANKING depending on the state of the starter motor discrete output.
**Fuel**: Shows OFF or ON depending on status of Fuel Solenoid output.
**Ignition**: Shows OFF or ON depending on state of Ignition relay output. If an output not assigned for Ignition control, this field will always show '– – –'.
**Air**: Shows TRIPPED or OPEN depending on status of Air Shutdown damper output. The output is a 5 second pulse; the display will remain TRIPPED until a fault reset is received. If an output is not assigned for Air Shutoff, this field will always show '– – –'.
**Control**: Shows IDLE or RATED depending on the state of the Idle/Rated output. If an output is not assigned for Idle/Rated, this field will always show '– – –'.

## Generator Status Screens

Generator Status Screen #1 contains summary information for both the generator and bus sources. It displays totals and averages as appropriate. It is the first screen shown in the generator status section. Pressing the Scroll Down button will page down to Generator Status Screen #2. Pressing the Scroll Up button will page up to Generator Status Screen #8. This wrap around feature is intended to allow the user to quickly get to L-L phase values by pressing Down or L-N phase values by pressing Up. When the generator PT configuration is set to a Zig Zag configuration, the L-L and L-N voltage readings will be the same.

| | | | |
|---|---|---|---|
| GEN | | | 99999 kVA |
| 99999 | VLL | | 99999 kW |
| 99999 | VLN | | 99999 kVR |
| 99999 | A | | PF: 0.99LG |

| | | | |
|---|---|---|---|
| BUS | | | 99999 kVA |
| 99999 | VLL | | 99999 kW |
| 999.9 | VLN | | 999.9 kVR |
| 99999 | A | | PF: 0.99LG |

Generator Status #1

**GEN**: Denotes this screen is for the generator bus.
**BUS** Denotes this screen is for the local bus.
**KVA**: Total KVA reading. The display will put a blank, k, or M as the first letter so that the units appear as VA, kVA or MVA for the displayed value.
**KW**: Total kW readings. The display will put a blank, k, or M as the first letter so that the units appear as W, kW, or MW for the displayed value.
**KVR**: Total kVAR reading. The display will put a blank, k, or M as the first letter so that the units appear as VR, kVR, or MVR for the displayed value.
**VLL**: Average Volts L-L. The display will put a blank, k, or M as the first letter so that the units appear as V, kV, or MV for the displayed value.
**VLN**: Average Volts L-N. The display will put a blank, k, or M as the first letter so that the units appear as V, kV, or MV for the displayed value.
**A**: Average Amps. The display will put a blank, k, or M as the first letter so that the units appear as A, kA, or MA for the displayed value.
**PF**: Average Power Factor; with LG (Lag)or LD (Lead).

Generator Status Screen #2 contains the three phase power calculations from the generator sensors. Pressing the Scroll Up key pages up to Generator Status Screen #1. Pressing the Scroll Down key pages down to Generator Status Screen #3.

| | | | |
|---|---|---|---|
| GEN | A ∅ | B ∅ | C ∅ |
| kVA | 32000 | 32000 | 32000 |
| kW | 32000 | 32000 | 32000 |
| kVR | 32000 | 32000 | 32000 |

| | | | |
|---|---|---|---|
| A ∅ | B ∅ | C ∅ | GEN |
| 9999 | 9999 | 9999 | VLL |
| 9999 | 9999 | 9999 | A |
| 1.0LG | 1.0LG | 1.0LG | PF |

Generator Status #2

**GEN**: Denotes this screen is for the generator bus.
**A∅ B∅ C∅**: Three phase readings for the generator.
**KVA**: Phase KVA reading. The display will put a blank, k, or M as the first letter so that the units appear as VA, kVA or MVA for the displayed value.
**KW**: Phase kW readings. The display will put a blank, k, or M as the first letter so that the units appear as W, kW, or MW for the displayed value.
**KVR**: Phase kVAR reading. The display will put a blank, k, or M as the first letter so that the units appear as VR, kVR, or MVR for the displayed value.
**VLL**: Phase Volts L-L. The display will put a blank, k, or M as the first letter so that the units appear as VLL, kVLL, or MVLL for the displayed value.
**A**: Phase Amps. The display will put a blank, k, or M as the first letter so that the units appear as A, kA, or MA for the displayed value.
**PF**: Phase Power Factor, with (Lag)or LD (Lead)..

Generator Screen #3 is the electric power overview for the Local Bus three-phase power sensor. Pressing the Scroll Up key pages up to Generator Status Screen #2. Pressing the Down Scroll key pages down to Generator Status Screen #4.

| BUS | A ∅ | B ∅ | C ∅ |
|---|---|---|---|
| kVA | 32000 | 32000 | 32000 |
| kW | 32000 | 32000 | 32000 |
| kVR | 32000 | 32000 | 32000 |

| A ∅ | B ∅ | C ∅ | BUS |
|---|---|---|---|
| 9999 | 9999 | 9999 | VLL |
| 9999 | 9999 | 9999 | A |
| 1.0LG | 1.0LG | 1.0LG | PF |

Generator Status #3

**BUS** Denotes this screen is for the Local bus.
All other fields on this screen are identical in format to those on Screen #2 above.

Generator Screen #4 is the first Harmonics screen for both power sources: generator and bus. Pressing the Scroll Up button pages up to Generator Status Screen #3. Pressing the Scroll Down key pages down to Generator Status Screen #5 which is the second Harmonics screen. **NOTE:** The local display only shows the current harmonics, all voltage harmonics are shown in the Watch Window software, and are available through Modbus or ServLink.

| | I-THD | V-THD |
|---|---|---|
| GEN | 100.0 | 19.99 |
| BUS | 99.99 | 99.99 |

| | 3RD | 4TH | 5TH |
|---|---|---|---|
| GEN | 9.99 | 0.99 | 9.99 |
| BUS | 9.99 | 0.99 | 9.99 |
| CURRENT HARMONICS | | | |

Generator Status #4

**GEN**: Denotes this row is for the generator bus.
**BUS**: Denotes this row is used for the local bus.
**I-THD**: Total Harmonic Distortion of the Current in percent.
**V-THD**: Total Harmonic Distortion of the Voltage in percent.
**3RD**: Third Harmonic in percent.
**4TH**: Fourth Harmonic in percent.
**5TH**: Fifth Harmonic in percent.
**CURRENT HARMONICS**:
Denotes this screen shows current rather than voltage harmonics.

Generator Screen #5 is the second Harmonics screen for both power sources: generator and bus. Pressing the Scroll Up button pages up to Generator Status Screen #4. Pressing the Scroll Down key pages down to Generator Status Screen #6.

```
      6TH   7TH   9TH  |       11TH  13TH
GEN   9.99  0.99  99.9 | GEN   9.99  0.99
BUS   9.99  0.99  99.9 | BUS   9.99  0.99
CURRENT HARMONICS      | CURRENT HARMONICS
```

Generator Status #5

**6TH**: Sixth Harmonic in percent
**7TH**: Seventh Harmonic in percent
**9TH**: Ninth Harmonic in percent
**11TH**: Eleventh Harmonic in percent
**13TH**: Thirteenth Harmonic in percent

Generator Status Screen #6 contains negative sequence voltage and currents. It covers both power sources: generator and bus. Pressing the Scroll Up button pages up to Generator Status Screen #5. Pressing the Scroll Down key pages down to Generator Status Screen #7.

```
GEN                          | BUS
Neg∅ Seq:99999 V             | Neg∅ Seq:99999 V
Neg∅ Seq:99999 A             | Neg∅ Seq:99999 A
I-THD 999   V-THD 999        | I-THD 999   V-THD 999
```

Generator Status #6

**NEG∅ SEQ**: Negative Phase Sequence. The descriptor after the value will indicate if this is Negative Phase Sequence Voltage or Current. The display will put a blank, k, or M as the first letter so that the units appear as V, kV, MV, A, kA, or MA for the displayed value.

**I-THD**: Total harmonic distortion of the current in percent. Repeated from Generator Status Screen #4

**V-THD**: Total harmonic distortion of the voltage in percent. Repeated from Generator Status Screen #4.

Generator Status Screen #7 contains the three phase power calculations from the bus sensors. This is a repeat for Generator Status Screen #3 except that L-N values are used. Pressing the Up Scroll key pages up to Generator Status Screen #6. Pressing the Down Scroll key pages down to Generator Status Screen #8.

```
BUS   A∅     B∅     C∅     |  A∅     B∅     C∅    BUS
kVA32000  32000  32000     | 9999   9999   9999   VLN
kW 32000  32000  32000     | 9999   9999   9999     A
kVR32000  32000  32000     | 1.0LG  1.0LG  1.0LG   PF
```

Generator Status #7

Generator Screen #8 is the electric power overview for the generator three-phase power sensor. This is a repeat for Generator Status Screen #2 except that L-N values are used. Pressing the Scroll Up key pages up to Generator Status Screen #7. Pressing the Scroll Down key wraps around to Generator Status Screen #1.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| GEN | A ∅ | B ∅ | C ∅ | | A ∅ | B ∅ | C ∅ | GEN |
| kVA | 32000 | 32000 | 32000 | | 9999 | 9999 | 9999 | VLN |
| kW | 32000 | 32000 | 32000 | | 9999 | 9999 | 9999 | A |
| kVR | 32000 | 32000 | 32000 | | 1.0LG | 1.0LG | 1.0LG | PF |

Generator Status #8

## I/O Status Screens

I/O Status Screen #1 contains summary information for discrete and analog I/O. It is primarily useful for troubleshooting. It is the top screen shown in the I/O status section. Pressing the Scroll Down button will page down to I/O Status Screen #2. Pressing the Scroll Up button will page to I/O Status Screen #3.

| | | | |
|---|---|---|---|
| DISCRETE I/O | | Volt Bias: | 99.9% |
| 1234567890123456 | | Speed Bias: | 99.9% |
| XXXXXXXXXXXXXXXX | IN | Load Ref: | 99999 |
| XXXXXXXXXXXX---- | OUT | LD Mode: | ISOCH |

I/O Status #1

**IN**: Discrete Inputs 1 through 16. X=Active, Blank=Off.

**OUT**: Discrete Outputs 1 through 12. X=Active, Blank=Off.

**1234….56:** These are the channel number 1-16 of the Discrete Inputs and 1-12 of the Discrete Outputs. **NOTE:** 0 = Input # 10, the 1-6 to the right of 0 are 1 = Input #11, 2 = input #12, etc.

**Volt Bias**: % voltage bias output (±100% range).

**Speed Bias**: % speed bias output (±100% range).

**Load Ref**: This is the load reference used in the Real Load Controller. If Process control is used, this load reference will be the load reference driven by the process controller. This readout is only active when in a BASELOAD or PROCESS control mode. It will show (– – –) if not in control.

**LD Mode**: This is the Load Control Mode from the Real Load Status Screen. See the Real Load Status Screens section for details.

I/O Status Screen #2 contains troubleshooting data on the left screen by indicating the actual mA value of the Analog Output 1-4 at the I/O terminal, and IN1 – IN4 is the mA or voltage (as configured for each input) at the terminal strip. The right screen gives the scaled value for only the inputs. Pressing the Scroll Up key pages up to I/O Status Screen #1. Pressing the Scroll Down goes to I/O status screen #3.

| | | | | | |
|---|---|---|---|---|---|
| OUT1: | 19.99 | IN1: | 19.99 | Coolant: | 999.9deg C |
| OUT2: | 19.99 | IN2: | 19.99 | Oil Press: | 999.9 kPa |
| OUT3: | 19.99 | IN3: | 19.99 | Dynamic Label | A999.9 |
| OUT4: | 19.99 | IN4: | 19.99 | Dynamic Label | A99.99 |

I/O Status #2

**OUT#**: The current in mA being output at the indicated analog output point.

**IN#**: The current in mA or voltage in Vdc detected at the indicated analog input point.

**Coolant**: Coolant temperature displayed using the configured units, either °C or °F. This value comes from analog input #1.

**Oil Press**: Oil Pressure displayed using the configured units, either kPa or psi. This value comes from analog input #2.

**Analogin3**: The scaled value for input 3 as setup in the Analog Input menu.

**Analogin4**: The scaled value for input 4 as setup in the Analog Input menu.

**NOTE:** The descriptive label for analog inputs 3 and 4 in the right side screen can be changed from Watch Window.

I/O Status Screen #3 contains network troubleshooting data. Pressing the Up Scroll key pages up to I/O Status Screen #2. Pressing the Down Scroll goes back to I/O status screen #1.

| | |
|---|---|
| Com Port 1: NORMAL | TIE BUS MAINS |
| Com Port 2: NORMAL | WXYZ ABCD OPEN |
| Com Port 3: NORMAL | X X |
| LON Status: ALARM | Gen Breker: OPEN |

I/O Status #3

**Com Port 1** The status of serial communication port 1. ALARM indicates a port fault exists, NORMAL indicates the port does not have a fault.

**Com Port 2** The status of serial communication port 2. ALARM indicates a port fault exists, NORMAL indicates the port does not have a fault.

**Com Port 3** The status of serial communication port 3. ALARM indicates a port fault exists, NORMAL indicates the port does not have a fault.

**LON Status** The status of LON communication between EGCP-3 or compatible controls. ALARM indicates a LON port error, NORMAL indicates the port does not have an error.

**TIE:** The status of each tie breaker (W, X, Y, and Z) is indicated. 'X' means it is closed, and ' ' (blank) means it is open.

**BUS:** The status of each bus segment is indicated where 'X' means it is part of the active bus and ' ' (blank) means it is not included.

**MAINS:** Indicates the position of the Mains breaker. If none of the discrete inputs are configured as a Mains Breaker, it will show (---)

**Gen Breaker:** Indicates the position of the GEN breaker, OPEN or CLOSED.

## Synchronizer Status Screens

Synchronizer Status Screen #1 contains general interest synchronizing data. It is the top screen shown in the Synchronizer Status section. Pressing the Scroll Down or Up button will page to Synchronizer Status Screen #2.

| | |
|---|---|
| Slip Phase Volts | Synchro: OFF |
| 9.99Hz 180.0 100.0% | VB: 99.9% SB: 99.9% |
| OK OK OK | Gen Avg: 99999 VLN |
| Bus Dead? TRUE | Bus Avg: 99999 VLN |

Synchronizer Status #1

**Slip**: The slip frequency in Hz of the generator with relationship to the bus.

**Phase**: The phase angle difference in degrees between the generator and the bus.

**Volts**: The voltage differential in percent between the generator and the bus.

**OK**: Shows two minus symbols (– –) if not within programmed window. Shows one plus symbol and one minus symbol (+ –) if working to correct. Shows two plus symbols (+ +) if within window.

**Bus Dead?**: Indicates if the bus PT input being measured is dead.

**Synchro**: Displays the synchronizer's configured mode. These are as follows:
OFF
PERMISSIVE
CHECK
RUN/AUTO

**VB**: Voltage Bias Output in percent of the output range.

**SB**: Speed Bias Output in percent of the output range.

**GEN AVG**: Average L-L Voltage of the generator. The display will put a blank, k, or M as the first letter so that the units appear as VL-L, kVL-L, or MVL-L for the displayed value.

**BUS AVG**: Average L-L Voltage of the bus. The display will put a blank, k, or M as the first letter so that the units appear as VL-L, kVL-L, or MVL-L for the displayed value.

**NOTE**

**The synchronizer displays **** in the place of values for Slip, Phase, and Volts when the synchronizer is inactive or off.**

Synchronizer Status Screen #2 contains timing status data on the right screen and status data on the left screen. The left screen is repeated from Synchronizer Status #1. Pressing the Scroll Up key pages up to Synchronizer Status Screen #1. Pressing the Scroll Down also pages to the Synchronizer Status Screen #1 since there are only two screens.

```
 Slip     Phase    Volts     | Synchro  OFF
99.9HZ   999.9    999.9%     | State:  OFF
  OK       OK       OK       | Attempt#  99
                             | Timeout:  999 sec
```

Synchronizer Status #2

**State**: Displays the state of the synchronizer:

| Displayed State | Meaning |
|---|---|
| | |
| **OFF** | The generator is off or the breaker is closed so synchronization is not needed. |
| **IN SYNC** | Gen Breaker has Closed Successfully, and held for synch timer. |
| **SYNCING GEN** | The gen is being actively synchronized to the bus/mains to close the Gen CB |
| **GEN STABLE TMR** | The synchronizer is waiting for the Generator voltage to be stable |

**Attempt#**: Number of synchronization attempts (will always be less than or equal to Close Attempts set point).

**Timeout**: The amount of time left on the Synchronizer Timeout timer in seconds.

## KW Load Status Screens

KW Load Status Screen #1 contains kW Load, Process Load, and Demand data. It is the only screen in the kW Load Status section.

| | |
|---|---|
| Gen Load: 9999 KW | Proc Actual:0.000% |
| Load Ref: 9999 KW | Process Ref:0.000% |
| % Rating 9999 % | LD Mode:OFF |
| System Load 0.0% | State: --- |

KW Load Status #1

**Gen Load**: The sum of the three-phase generator real power output. The display will put a blank, k, or M as the first letter so that the units appear as W, kW, or MW for the displayed value.
**Load Reference**: The load reference for the generator. The display will put a blank, k, or M as the first letter so that the units appear as W, kW, or MW for the displayed value.
**% Rating** Percent of Rated Load on this Genset.
**System Load**: Percent of total rated capacity of all generators on the LON network.
**Proc Actual**: The actual process level as seen by the EGCP-3. Units are percent of rated process.
**Process Ref**: The process reference for the process control. Its source is from; an internal setpoint, or an external devise, determined by the control configuration. Units are in percent of rated process.
**Load Mode**: The current load control mode in operation.

| Displayed Mode | Meaning |
|---|---|
| | |
| **OFF** | The load controller is off . |
| **DROOP** | Droop Load Control |
| **ISOCH** | Normal or Soft Transfer Load Control Setpoint Selected, and Gen on load, but not in parallel with mains. |
| **BASELOAD** | Gen on load at the internal configured kW level. |
| | |
| **PROCESS** | Controlling using Temperature or Pressure Process input. |
| **RMT PROCESS** | Controlling based on Temperature/Pressure Process input and a process reference from elsewhere. |
| | |
| **RMT BASELD** | Controlling load to a BaseLoad reference provided on an analog input. |
| | |
| **LOAD SHARE** | Two or more EGCP-3s are tied to the same bus and are sharing load via LON information |
| **PROC SLAVE** | There is an EGCP-3 acting as a process master on this active bus. This unit is a slave to that master. |

**State**: The state of the load controller:

| Displayed State | Meaning |
|---|---|
| | |
| **---** | The circuit breaker is open. |
| **RAMPING UP** | The load is being increased. |
| **PAUSE** | A user has manually (or through Modbus) stopped a load ramp. |
| **RAMPING DOWN** | The load is being decreased |
| **AT REFERENCE** | The load has reached the configured level and is tracking. |
| **MANUAL** | The load controller was placed in a manual mode and load is being controlled by external inputs. |

## PF/KVAR Status Screens

PF/KVAR Status Screen #1 contains PF/KVAR data. It is the only screen in the PF/KVAR Status section.

```
Mode: PF  CONTROL              GEN          BUS
State:  RAMPING UP          0.99  LG     1.00  LD
PF  Ref:   0.99  LG         99999kVAR    99999kVAR
VAR  Ref:  99999kVAR        VBias:  100.0%
```

KVAR/PF Status #1

**Mode**: The actual VAR/PF control mode.

| Displayed Mode | Meaning |
|---|---|
| | |
| **OFF** | VAR/PF control is off |
| **VOLT TRIM** | The EGCP-3 is adjusting the gen voltage to rated value. The unit is isolated, and is VAR/PF enabled. |
| **PF CONTROL** | EGCP-3 is biasing to control PF. |
| **PF SHARING** | The voltage bias is controlling to a specific PF that is broadcast over the LON. |
| **VAR CONTROL** | EGCP-3 is biasing to control kVAR. |
| **REMOTE CONTROL** | EGCP-3 is responsible for biasing the regulator but another device is doing the control via an analog input to the EGCP-3. |
| **MANUAL** | Manual-voltage bias controlled using panel raise/lower switches. |
| | |
| | |

**State**: The state of the VAR/PF controller:

| Displayed State | Meaning |
|---|---|
| | |
| **---** | The Breaker is open. |
| **RAMPING UP** | The voltage is being increased. |
| **PAUSE** | A user has manually (or through Modbus) stopped the voltage ramp. |
| **RAMPING DOWN** | The voltage is being decreased, automatically or manually, at the configured ramp rate. |
| **AT REFERENCE** | The voltage has reached the configured level and is tracking. |
| **Manual** | The VAR/PF control is in manual, and may be controlled by the raise and lower contacts. |

**PF REF**: The PF control reference value for the control. This field will show '– – –' if the control is using, kVAR, or Manual voltage control modes. The display shows LAG or LEAD as appropriate.

**VAR REF**: The VAR control reference value for the control. This field will show '– – –' if the control is using PF, or Manual voltage control modes. The display will put a blank, k, or M as the first letter so that the units appear as VAR, kVAR, or MVAR for the displayed value.

**PF**: The average three phase PF of the generator or mains. The display shows LAG or LEAD depending on the power factor detected.

**KVAR**: The total VAR reading for the generator or mains. The display will put a blank, k, or M as the first letter so that the units appear as VAR, kVAR, or MVAR for the displayed value.

**VBias**: Voltage Bias Output in percent of the output range.

## Sequence Status Screens

On the EGCP-3 Load Sharing (LS) units, this screen will always report as shown below. No other sequencing screens are available or applicable.

| | |
|---|---|
| Unit: 1 State:OFF | Next On: 1 |
| Gen Breaker:CLOSED | Next Off: 0 |
| Seq.Mode:Equal Time | Seq Delay: – – – |
| Service Hours: 0 | #Units On Load: 0 |

Sequence Status #1

**Unit:** Network Address of this unit.

**State**: Indicates the availability of the genset:
**Ready** - unit is Ready to Start.
**Alarm** - an alarm exists from the LON . Starting may or may not be affected. LS unit may not be setup correctly. Verify network addresses and start stop arbitration.
**Off -** the Mode switch is not in Auto.

**Gen Breaker:** The status of the generator breaker as determined by the generator CB aux discrete input.

**Seq.Mode:** The Sequencing Mode for starts and stops is selected from the configure menu. All modes require the next unit to also be in the Start Ready State.
**Unit Number:** Unit with the lowest Unit Number will start next, Highest number will stop first.
**Small 1st:** The unit configured for the smallest rated power will start next, Largest power will stop first
**Large 1st:** The unit configured for the largest rated power will start first, smallest power will stop first.
**Equal Time:** Based on the Service Hours, the next unit to start will have the highest Service Hours. Next stop will be the unit with the lowest Service Hour time.
**Staggered:** Based on the Service hours, this method attempts to keep the Service hours spread apart as much as possible, so that all of the units do not come up for maintenance service at the same time. Lowest Service hours is first to start. Highest Service hours is the first to stop.
**Disabled:** This unit will not be included in the auto stop/start sequence

**Service Hours:** Number of hours left on the service meter. This value may be negative if the engine is not serviced when it should be.

**Next On:** Unit Number of next unit to be sequenced onto the network. Will show ALL if all are being started. Places an asterisk (*) after the unit number when this unit is currently being sequenced (while Seq. Delay timer decrements). This is done for troubleshooting.

**Next Off:** Unit Number of next unit to be sequenced off the network. Will show ALL if all are being stopped. Places an asterisk (*) after the unit number when this unit is currently being sequenced (while Seq. Delay timer decrements). This is done for troubleshooting.

**Seq Delay:** Amount of time before the genset will start or stop. It will show "---" when the timer is not active. The time starts from either the *Rated Load Delay* or the *Reduced Load D*elay depending on if it is starting or stopping.

**#Units On Load:** Total number of units operating in isochronous load sharing.

| | |
|---|---|
| Seg Units: 1<br>Rdy To Strt Units: 0<br>Rdy To Stop Units: 0<br>LS Units: 0 | TIE BUS MAINS<br>WXYZ ABCD OPEN<br>X X<br>Net Units: 1 |

Sequence Status #2

| | |
|---|---|
| **Seg Units:** | Number of units on the active bus segment. |
| **Rdy to Strt Units:** | Number of units on the active bus ready to start. |
| **Rdy to Stop Units:** | Number of units on the active bus ready to stop. |
| **LS Units:** | Number of load share units on the active bus. |
| **Ties:** | Status Tie breakers W,X,Y,Z, 'X' below the breaker identification means the breaker is closed, and '_' (blank) means it is open. |
| **Bus:** | Each bus segment A,B,C,D is indicated where 'X' means it is part of the active bus and '_' (blank) means it is not included. |
| **Net Units:** | Number of units communicating on the LON network. |

### ATS Status Screens

There are no Transfer Switch functions in the LS units, When the local system bus is tied to the mains, an MC unit is required to do the ATS function.

| | |
|---|---|
| LOAD SHARE UNIT<br><br>NO ATS | |

ATS Status #1

## Security Access

The EGCP-3 has built-in security to protect against configuration changes and alarm log purges by unauthorized personnel. There are five levels of access to the configuration menus. They are listed in the table below. Each successive level has access to all of the levels above. A four-digit security code is required for access to the configuration menus. If a proper code is not entered within 60 seconds, the display will default to the System Status display.

For security purposes, all passwords may be changed. In order to change any password, you must log in at the Technician or Factory level. See Calibration Menu for ability to change passwords.

Security access is cleared once the escape (ESC) key is pressed while at the configuration menu screen. A password must be re-entered if accessed is again desired. While in the configuration modes, the Status menus may be selected for monitoring, then press CONFIG to return to configuration menus.

| Level | Type of Access | Default Password |
|---|---|---|
| **Monitor** | View Status Screens,<br>View current events and event history log<br>Silence-Acknowledge alarms<br>View and Reset (clear) current Alarm/Event action | None Required |
| **Operator** | View Status Screens,<br>View Configuration menus,<br>Configure LON Network sequencing arbitration start /stop setting<br>View and Reset (clear) current Alarms(Event) from Alarm Screen | 9002 |
| **Supervisor** | View Status Screens,<br><br>View Configuration menus<br>Configure LON Network address, and arbitration start/stop setting<br>View and Reset (clear) current Alarms (Event) from Alarm Screen | 9003 |
| **Technician** | View Status Screens,<br>Change Operator and Supervisor passwords,<br>Set all Configuration points<br>Not able to reset run time and Mw-Hour accumulators | 9004 |
| **Factory** | Full access | **** |

Table 2-1 Security Access Codes

## Entering and Changing Values

To change an **analog value**: Use the Left or Right Scroll key to move the cursor to the position or digit in the number that is to be changed. Then use the Up or Down scroll key to change that number. To change another digit in the number, use the Left/Right key to move to the next digit/position to change. If a value cannot be changed, it may be a its highest or lowest limit. Pressing the Up key when the digit is at 9 will roll the value to 0, and the digit to the left will increment. Pressing the Down key when a 0 is displayed will roll that digit to 9, and the digit to the left will decrement. After all digits have been changed to the desired value, press the ENTER key to save the value. To return to the last saved value, and return to the previous menu list, press the ESC key.

To change a **function string**: Press the Scroll Up/Down key until the desired action/function is displayed. These selection menus wrap-around, so all options can be seen when pressing the up or down key. When the desired action is shown, press the ENTER key to save the displayed action or function. To revert to the last saved function and to return to the previous menu list, press the ECS key.

## Configuration Menus

The following sections list the configuration options for items available through the front panel display. Descriptions of functions, settings, options and ranges of menu items are described in more detail in Chapter 3

## Configure Menu Listing

To enter the configure mode, Press Configure key, and then press Enter. The cursor will move to the second line. After setting the proper Security Code number, press Enter. When a valid security code has been entered, the configuration menu list will be displayed on the right side screen. If a low-level security code is entered, the configuration menu, and all values can be observed, but only the values authorized for the entered code can be changed. The configuration list allows the user to configure, calibrate, and adjust all common items for EGCP-3 operation. Only four lines may be viewed at a time but the complete list is shown below for simplicity. The Up and Down Scroll keys allow one to navigate to different menu items in the list. There is no wrap-around feature in this menu. The blinking cursor will indicate which menu item is currently selected. Pressing the Enter key will display the contents of the selected menu, press Enter again to see and adjust the specific component value or function. See the Navigation figure ( 3-7) in this chapter for more information on navigating through the configuration menus. See Chapter 3 for detailed instruction to configure the control.

| **Configure Menu Listing** |
| --- |
| First Time Startup |
| Engine Protection |
| Shutdowns and Alarms |
| Generator Protection |
| Bus Protection |
| Engine Control |
| Synchronizer |
| Real Load Control |
| Reactive Load Cntrl |
| Process Control |
| Transfer Switch |
| Sequencing |
| Communications |
| Calibration |
| Remote Alarm |
| Digital Inputs |
| Digital Outputs |
| Analog Outputs |
| Analog Inputs |

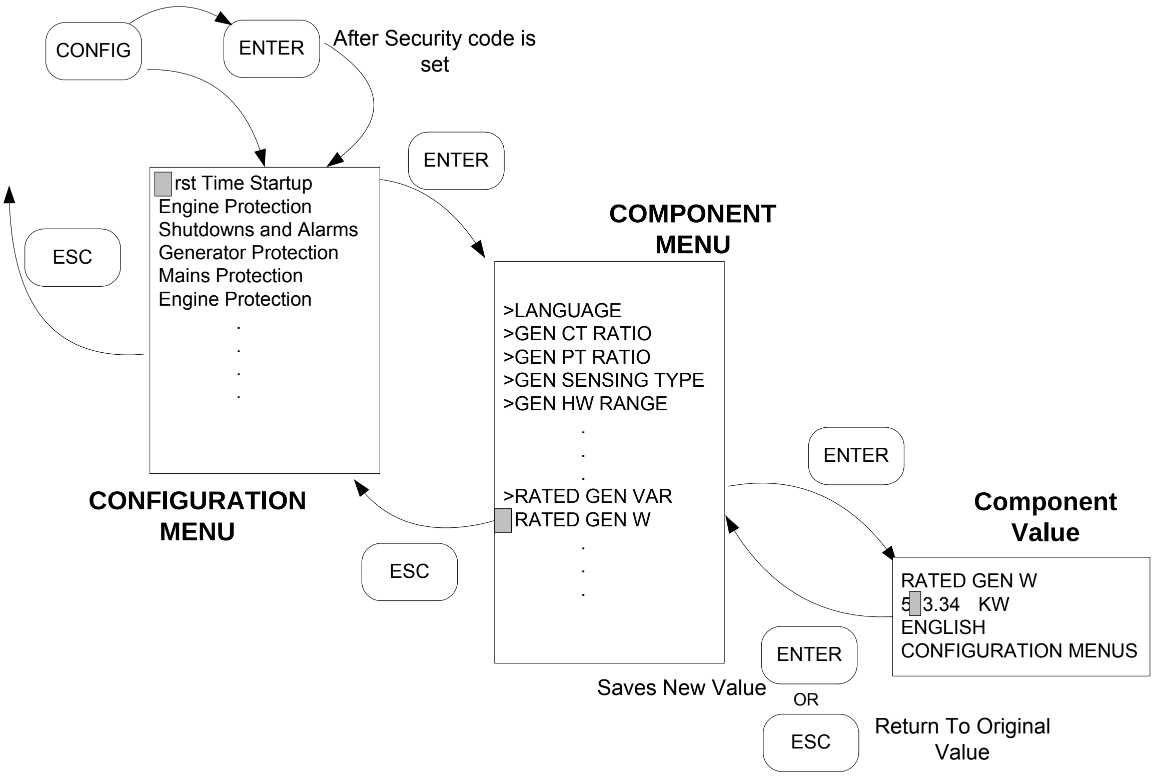



Figure 2-3. Navigation in Configure Mode

# Chapter 3.
# Control Configuration

## Introduction

The EGCP-3 must be configured before it can be used. All configuration points that are necessary for standard operation are available from the front panel display. These configuration points plus additional points are available when using Watch Window software through the ServLink communications serial link. The additional configuration points enable additional features but are not required for basic operation. This chapter discusses EGCP-3 setup using Watch Window user interface, and the front panel display.

The Service and Configure sheets in Watch Window are designed to mimic the front panel display menu structure. This structure allows a user to utilize the Quick Configure feature of Watch Window to create logical and manageable sheets (tabs) of parameters. To create these sheets (menus), 'click' on the large **Q** near the left end of the Windows Menu-bar. The table below indicates the sheets that will be created by a Quick Configure agent. The agent will sort the Service sheets first followed by the Configure sheets in order from left to right as shown top to bottom in the table below. The window containing the Quick Configure sheets is referred to as an Inspector Window. Multiple inspectors can be used at once. Customized inspectors can be made by adding or deleting sheets, or parameter within a sheet.

The organization of tunable parameters is important because of the sheer number of them and due to the existence of a front panel display. The first character of most sheet names is a letter to allow control of the sheet order. Within the sheet, the parameters are numbered to control their order. This also gives a logical reference to refer to parameters, i.e. generator overvoltage trip level is set on sheet C, line 03. The numbering of the STATUSXX sheets also controls their order of placement.

Parameters are separated in Configure and Service blocks in Watch Window. All parameters that should not be changed while the engine is running are placed in Configure blocks. The parameters that can not be changed are in the following menus; First Time Startup, Digital Inputs, Relay Outputs. Configure blocks require IO Lock to be set in order to allow changes in a parameter. Many of the parameters in Watch Window Configure blocks are also parameters in the First Time Startup menu on the front panel display.

Many of the Service sheets are intended to allow the user to monitor operation of the engine, generator and bus/mains. The sheets named STATUS01 – STATUS10 will present data that closely resembles the STATUS screens of the front panel.

There are additional configuration settings within many of the Quick Configure tabs. They are inserted in a logical order together with the front panel content. Service and Configure sheets and corresponding menu item(s) from the front panel display are listed below. Those that do not have a matching menu are marked with 'XX' in the table below. Front panel items that are in a Configure Menu are marked with an *.

**NOTE**
**The * is only shown here for reference, it is not shown on the display.**

**CAUTION—MENUS WITH AN ***

**Menus that are shown with an * and are in the display Configure menus require that the engine be shut down before they can be changed, but if they are in Watch Window Service menus, they can be changed while the engine is running. Likewise, an item in a Watch Window Configure menu requires that the control be in I/O lock, but to change that item from the front panel requires only that the engine be shut down.**

| Corresponding Front Panel Menu | Watch Window Configure Sheet Names | Comments / Function |
|---|---|---|
| * First Time Startup | A# FIRST TIME CONFIG ## | System Configuration values at installation |
| * Digital Inputs | B# DIGITAL INPUTS ## | Define Function of Configurable Discrete Inputs |
| * Digital Outputs | C# RELAY OUTPUTS ## | Define Function of Configurable Relay Driver Outputs |

| Corresponding Front Panel Menu | Watch Window Service Sheet Names | Comments / Function |
|---|---|---|
| * Engine Protection | A ENGINE PROTECTION | Engine Protection Setup |
| * Shutdowns and Alarms | B SHUTDOWN AND ALARMS | Define Alarm Thresholds |
| * Generator Protection | C GENERATOR PROTECTION | Define Generator Trip Levels |
| * Bus Protection | D BUS PROTECTION | Define Bus Trip Levels |
| * Engine Control | E ENGINE CONTROL | Setup Engine Start Sequence |
| * Synchronizer | F SYNCHRONIZER | Define Synchronizer operating Parameters |
| * Real Load Control | G REAL LOAD CONTROL | Set Load Control Parameters |
| * Reactive Load Cntrl | H REACTIVE LOAD CNTRL | Set Reactive Load Control Parameters |
| * Process Control | I PROCESS CONTROL | Define Process Control Function, Parameters |
| * Transfer Switch | J TRANSFER SWITCH | Define Gen stable Timing |
| * Sequencing | K SEQUENCING | Setup Auto Start/Stop Conditions |
| * Communications | L COMMUNICATIONS | Serial Port Setup Values |
| * Calibration | M CALIBRATION | Set Clock and Hardware Input/Output Calibration |
| * Remote Alarm | N REMOTE ALARM INPUTS | Set Remote Discrete Alarm Functions |
| XX | O FORCE RELAYS | Enables test and manual operation of Discrete Outputs |
| * Analog Outputs | P ANALOG OUTPUTS | Define Function and Scaling of Analog Outputs |
| * Analog Inputs | Q ANALOG INPUTS | Define Function and Scaling of Analog Inputs |
| | | |
| | | |
| XX | T REMOTE CONTROL | Monitor ServLink Parameters |
| XX | U SEQUENCE STATES | Use to Observe the State of the EGCP-3 engine Sequence |
| XX | V UNITS | Displays the Units (KW, MW) of the System |
| XX | W LON MESSAGING | Displays all LON Messages (for Load |
| System Status | STATUS01- SYSTEM | Displays the System Operating Status and Values |
| Engine Status | STATUS02- ENGINE | Display the Engine Operating Status |
| Gen Status | STATUS03- GENERATOR | Displays the Generator Operation Values |
| Gen Status | STATUS04- BUS | Observe the Bus Operation Values |
| I/O Status | STATUS05- I/O | Displays EGCP-3 Inputs and Outputs |
| Sync Status | STATUS06- SYNCHRONIZER | Displays Synchronizer States |
| KW Load Status | STATUS07- KW LOAD | Displays Load Control Values and Status |
| PF/KVAR Status | STATUS08- PF / KVAR | Displays VAR/PF control Values and Status |
| Sequence Status | STATUS09- SEQUENCE | Displays Sequencing operation States |
| ATS Status | XX | No ATS function in LS model |
| Alarms/Event | STATUS10- ALARMS | Displays Order of Alarm Occurrence and Times |

* Configure menu items
XX No corresponding item

Table 3-1. Front Panel Menu ↔ Watch Window Sheet

# Parameter Descriptions

Within a given menu in the following sections, each parameter will be described in detail. Separating each parameter will be a quick reference block like the one shown below. Details for the parameter will follow the quick reference block.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Over Voltage Alarm Level | GEN VOLT HI LVL | Both | 50 | 30000 | 600 | Volts |

The display name is the description used on the front panel display or in Watch Window. The names may differ because the field is limited to 20 characters on the display and 27 in Watch Window. Both interface use upper case for the parameter name, the parameter value (when in text form) uses upper and lower case. Numeric values may be shown as integer or real with appropriate decimals.

The Panel / WW column indicates where the item can be found. If “Panel”, it is only found on the front panel display. If “WW”, it is only found using Watch Window. If “Both”, it can be found on the front panel display and in Watch Window.

The Default value is the value that this parameter will be when shipped from the factory.

The Units column indicates the configuration units for a numerical parameter. For items in electrical units, an asterisk (*) will precede the unit in the table. This indicates that the units are variable (_, K, or M). The variable units depend on the configured CT Ratio, PT Ratio, Sensing Type, and Hardware Range for the generator or mains input. The appropriate units calculated by the EGCP-3 are shown on the V UNITS sheet of Watch Window, or throughout the Status screens on the display.

## Alarm Action Definition

Below is the list of alarm actions. It is used in many places within the Configuration Menus.

| Value | Alarm Actions Definition | Display | Notes |
|---|---|---|---|
| 8 | Trip Tie Breaker With Alarm | Trip Breaker w/Alarm | Opens the Bus Breaker, Initiates a start,, adds an event to the alarm list. |
| 7 | Trip Tie Breaker | Trip Breaker | Opens the Bus Breaker, Initiates a start |
| 6 | Hard Shutdown | Hard Shutdown | Engine is shutdown immediately, same as an Emergency Shutdown |
| 5 | Soft Shutdown | Soft Shutdown | Non-critical shutdown, smooth unload, cooldown, then shutdown |
| 4 | Audible Alarm | Audible Alarm | A discrete output will be given, connected to an external audible device, An acknowledge from ALARM CLEAR will turn this output off. |
| 3 | Visual Alarm | Visual Alarm | A discrete output will be given, connected to an external visual indication device. This is not effected by an Acknowledge |
| 2 | Warning | Warning | An event will be shown on the alarm list only |
| 1 | Disabled | Disabled | No Action will be taken |

Table 3-2. Alarm Action Definitions

## Program Configuration Checks

In order to prevent improper configuration of the control, “sanity checks” are made automatically in software.

Safety related Parameters (values that could cause equipment damage) must be within a specified range, calculated from the following:

- Rated VA
- Number of Poles
- Rated Speed
- Rated Frequency
- Function selection of discrete inputs 6 through16
- Function selection of analog inputs 3 and 4

If an entered value does not pass the configuration check when compared to other entered values, an alarm will be logged in the Alarm/Event list and the control will not be available for operation (Hard Shutdown) until this value is corrected, and a reset/clear given. The STATUS01 SYSTEM sheet in Watch Window will indicate which configured item is entered incorrectly.

# First Time Configure Menu

The First Time Startup Menu is included in both the front panel display and Watch Window. Items in it can be viewed but not edited while the engine is running. This menu is shown as a Configure sheet in Watch Window, Configure sheets are near the end (right side) of the Quick Configure agent tabs. When using Watch Window for Configuration, IO Lock must also be set. IO Lock will set all EGCP-3 outputs to the same level/value as when input supply power is removed from the unit.

Every item in the First Time Startup menu must ALWAYS be checked and configured upon first usage of the control. The first 12 items in the Front Panel menu and the first 17 items in the Watch Window menu must be correctly configured prior to any other configuration.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Language | LANGUAGE | Both | 1 | 2 | 1=English | NA |

1 = English, 2 = 2$^{nd}$ Language. Second Language is not available at his time.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Gen CT Ratio | GEN CT RATIO | Both | 5.0 | 30000.0 | 150 | Ratio |

This value represents a scalar for the generator ac current inputs. If a CT has a turns ratio of 1500:5, then the value to enter here is 1500. The value actually represents the Primary Turns on the transformer. The EGCP-3 will multiply the sensed current at the input by this value to determine the actual current on the generator for the given phase.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Gen PT Ratio | GEN PT RATIO | Both | 1.0 | 1000.0 | 3.8 | Ratio |

This value represents a scalar for the generator ac voltage inputs. If a PT has a turns ratio of 13,800:120, then the value to enter here is 115. (13800 ÷ 120 = 115) The EGCP-3 will multiply the sensed voltage at the input by this value to determine the actual voltage on the generator for the given phase. The EGCP-3 will also need to know the next two parameters to fully define the voltage.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Gen Sensing Type | GEN SENSING TYPE | Both | False | True | True=3∅ | |

This value can be either 1∅ or 3∅ with a default of 3∅. If set to 1∅, the EGCP-3 will ignore any inputs on the B and C phase generator ac voltage inputs and current inputs, and set these phase values to zero. When 1Ø is selected the power measurements will be a per-phase value, and not the total.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Gen Hardware Range | GEN HW RANGE | Both | 1 | 3 | 2=120V | Volts |

This value can be either 70, 120, or 240 Vac with a default of 240 Vac. This setting is important to the EGCP-3 for both calibration accuracy as well as ability to measure the voltage. The range limits for each selection are indicated in the table below.

| Value | Configured Range | | Maximum Voltage |
|---|---|---|---|
| 1 | 70 | | 100 Vac |
| 2 | 120 | | 150 Vac |
| 3 | 240 | | 300 Vac |

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus CT Ratio | BUS CT RATIO | Both | 5.0 | 30000.0 | 500 | |

This value represents a scalar for the bus ac current inputs. If a CT has a turns ratio of 1500:5, then the value to enter here is 1500. The value actually represents the Primary Turns on the transformer. The EGCP-3 will multiply the sensed current at the input by this value to determine the actual current on the bus for the given phase.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus PT Ratio | BUS PT RATIO | Both | 1.0 | 1000.0 | 3.8 | |

This value represents a scalar for the bus ac voltage inputs. If a PT has a turns ratio of 13,800:120, then the value to enter here is 115 (13800 ÷ 120 = 115). The EGCP-3 will multiply the sensed voltage at the input by this value to determine the actual voltage on the bus for the given phase. The EGCP-3 will also need to know the next two parameters to fully define the voltage.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Sensing Type | BUS SENSING TYPE | Both | False | True | True=3∅ | |

This value can be either 1∅ or 3∅ with a default of 3∅. If set to 1∅, the EGCP-3 will ignore any inputs on the B and C phase bus ac voltage inputs and current inputs, and set these phase values to zero. When 1Ø is selected the power measurements will only be a per-phase value, and not the total.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Hardware Range | BUS HW RANGE | Both | 1 | 3 | 2=120V | Volts |

This value can be either 70, 120, or 240 Vac with a default of 240 Vac. This setting is important to the EGCP-3 for both calibration accuracy as well as ability to measure the voltage. The range limits for each selection are listed in the table below. When the voltage drops below the Dead Bus value, the bus is considered dead. If the control is configured to perform Dead Bus breaker closing the breaker close command will be armed.

| Value | Configured Range | Dead Bus Voltage Detected | Maximum Voltage |
|---|---|---|---|
| 1 | 70 | <27 Vac | 100 Vac |
| 2 | 120 | <40 Vac | 150 Vac |
| 3 | 240 | <80 Vac | 300 Vac |

**CAUTION—CONFIGURE THESE ITEMS FIRST**

**It is very important that PT Ratio, CT Ratio, Sensing Type, and Hardware Range be configured for each bus prior to anything else. These values are used to determine the units for all other configurable parameters.**

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Number of Poles | NUMBER POLES | Both | 2 | 18 | 4 | NA |

This value is the number of poles on the generator. It is used to calculate the generators frequency. Then the measured speed from the MPU is compared with this frequency. The EGCP-3 constantly watches to be sure the calculation for frequency and the sensed generator frequency match. This diagnostic is used to determine MPU failure, or generator excitation failure. It will also trigger a configuration error if values are not entered properly.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Number of Teeth | NUMBER TEETH | Both | 6 | 500 | 60 | NA |

This value is the number of teeth on the flywheel where the MPU sensor is located. Even if no MPU is provided, this must be properly configured in order to pass the configuration check. The EGCP-3 assumes the MPU is located on a flywheel that spins at the same rate as the crankshaft and the generator. If this is not the case (for example, if there is a gear box between the engine and generator), then either the number of poles or the number of teeth must be adjusted so that the rpm reads correctly and the EGCP-3 configuration check is also satisfied.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Rated Gen VA | RATED GEN VA | Both | 0.001 | 30000.0 | 156.00 | *VA |

This value is the nameplate Volt-Ampere (VA) rating for the generator set. Be careful to observe the indicated units when configuring this parameter. When using Watch Window, the units are in a separate Quick Configure Sheet labeled UNITS.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Rated Gen VAR | RATED GEN VAR | Both | 0.001 | 30000.0 | 35.0 | *VAR |

This value is the nameplate Volt-Ampere-Reactive (VAR) rating for the generator set. Be careful to observe the indicated units when configuring this parameter. When using Watch Window, the units are in a separate Quick Configure Sheet labeled UNITS.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Rated Gen Watts | RATED GEN W | Both | 0.001 | 30000.0 | 125.00 | *Watts |

This value is the nameplate Watt (W) rating for the generator set. Be careful to observe the indicated units when configuring this parameter. When using Watch Window, the units are in a separate Quick Configure Sheet labeled UNITS.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Rated Speed | RATED SPEED | Both | 100 | 5000 | 1800 | RPM |

This is the rpm value when the engine is at synchronous speed. This value is used in the configuration check together with the number of teeth and rated frequency.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Rated Gen Voltage | RATED GEN VOLTAGE | Both | 0.001 | 30000.0 | 480.0 | *Volts |

This value is the nameplate Voltage of the generator set. This value is used to set up rated current of the machine for use in protection of the generator. Be careful to observe the indicated units when configuring this parameter. When using Watch Window, the units are in a separate Quick Configure Sheet labeled UNITS.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Gen Configuration | GEN PT CONFIGURATION | Both | 1 | 3 | 1=Delta(L-L) | NA |

This value can be either 1= Delta (Line-to-Line) 2= Wye (Star, Line-to-Neutral), or 3=Zig Zag (single phase). If set to Wye, it indicates that the wiring between the generator and the EGCP-3 is done in a L-N manner. It does NOT necessarily relate to how the generator is connected to the load. For example, the generator could be wired to the load as Wye but wired to EGCP-3 as Delta using Open Delta transformers. When the configuration is set for Zig Zag, the setting Gen Sensing type must also be set to False for single phase.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Rated VA | RATED BUS VA | Both | 0.001 | 30000.0 | 1000.0 | *VA |

This value is the Volt-Ampere (VA) rating of the bus tie. It should be based on the bus side values seen by the PTs and CTs. Be careful to observe the indicated units when configuring this parameter. When using Watch Window, the units are in a separate Quick Configure Sheet labeled UNITS.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Rated VAR | RATED BUS VAR | Both | 0.001 | 30000.0 | 1000.0 | *VAR |

This value is the Volt-Ampere-Reactive (VAR) rating of the bus tie. It should be based on the bus side values seen by the PTs and CTs. Be careful to observe the indicated units when configuring this parameter. When using Watch Window, the units are in a separate Quick Configure Sheet labeled UNITS.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Rated Watts | RATED BUS WATTS | Both | 0.001 | 30000.0 | 1000.0 | *Watts |

This value is the Watt (W) rating of the bus tie. It should be based on the bus side values seen by the PTs and CTs. Be careful to observe the indicated units when configuring this parameter. When using Watch Window, the units are in a separate Quick Configure Sheet labeled UNITS.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Rated Voltage | RATED BUS VOLTAGE | Both | 0.001 | 30000.0 | 480.0 | *Volts |

This value is the voltage of the bus where the PTs are connected. Be careful to observe the indicated units when configuring this parameter. When using Watch Window, the units are in a separate Quick Configure Sheet labeled UNITS.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Configuration | BUS PT CONFIGURATION | Both | 1 | 3 | 1=Delta (L-L) | |

This value can be either 1= Delta (Line-to-Line), 2= Wye (Star, Line-to-Neutral), or 3=Zig Zag. If set to Wye, it indicates that the wiring between the bus and the EGCP-3 is done in a L-N manner. It does NOT necessarily relate to the bus configuration.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| System Frequency | SYSTEM FREQUENCY | Both | 1 | 2 | 2=60 | Hertz |

This value can be either 50Hz or 60Hz with a default of 60Hz. It applies to both the generator and bus inputs.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Speed Bias Output Type | SPEED BIAS TYPE | Both | 1 | 5 | 3= ±3 | |

| Value | Output | Typical Speed Control Type |
|---|---|---|
| 5 | Raise/Lower | Motor Operated Potentiometer |
| 4 | 500 Hz, PWM | CAT ADEM controls |
| 3 | ±3 volt | Woodward Governor Controls |
| 2 | 0-5 volt | DDEC controls |
| 1 | 4–20 mA | |

This value in the list above selects the type of speed bias output compatible with the speed control being used. This software selection will configure the Speed Bias output hardware to provide the electrical characteristic selected.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Bias Output Type | VOLTAGE BIAS TYPE | Both | 1 | 5 | 4= ±1 | |

| Value | Output |
|---|---|
| 5 | Raise/Lower |
| 4 | ±1 volt |
| 3 | ±3 volt |
| 2 | ±9 volt |
| 1 | 4–20 mA |

This value in the list above selects the type of voltage bias output compatible with the voltage regulator being used. This software selection will configure the Voltage Bias output hardware to provide the electrical characteristic selected.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Display Units | DISPLAY UNITS | Both | 1 | 2 | 2=Metric | |

This value can be either Metric or American. When set for Metric, pressures will be displayed in kilopascals (kPa) and temperatures will be displayed in Celsius (°C). When set for American, pressures will be displayed in pounds per square inch (psi) and temperatures will be displayed in Fahrenheit (°F).

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| System Phase Rotation | SYS PHASE ROTATION | Both | False | True | True=CW, ABC | NA |

This value is a True/False selection that can be either CW (ABC-Clockwise) or CCW (ACB-Counterclockwise). It is best to wire the PT inputs to the EGCP-3 with the same phase relationship as the actual generator and bus. This configuration is used when determining negative phase sequence metering values.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Breaker Type | GEN BREAKER TYPE | Both | 1 | 2 | 1=Breaker | NA |

This value can be either Breaker or Contactor. If set to breaker, the EGCP-3 operates two relay outputs. The shunt trip output will open the breaker, and the breaker close output will close the breaker. If set to contactor, the EGCP-3 operates one relay output, the output is the breaker close it will toggle the output for open and close When the contactor option, the Generator Shunt Trip output is not used.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Unit Number | UNIT NUMBER | Both | 1 | 16 | 1 | NA |

This is the LON network address for the EGCP-3. Each Unit must have a unique unit number.. The Unit numbers in the system do not need to be consecutive. If an EGCP-3 MC is used, it must also be assigned a unit number within the allowed range (1-16). The LS sets priorities for process master from the lower LS unit number. The MC sets priorities for Master in Control from the higher MC unit number.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| DSLC/MSLC Compatible Mode | D/MSLC COMPATIBLE MODE | Both | 1 | 2 | 1=EGCP-3 | |

If the system consists ONLY of EGCP-3 connected to the LON bus, this is set to “EGCP-3”. If the system is required to interface with Woodward MSLC or DSLC controls, this is set for D/MSLC to allow communication between these controls and the EGCP-3.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Segment Assignment | BUS SEGMENT | Both | 1 | 4 | 1=A Segment | |

Enter the bus segment this EGCP-3 is connected to via PT/CT and breaker wiring. The table below shows the different bus segment options. Application of Digital Input Selectable requires a digital input or multiple digital inputs to select the bus segment. This also limits the functionality of the W, X, Y, and Z tiebreaker feedback. Example: If an LS unit has digital inputs for Bus A and Bus B, and they are closed, the unit will be on bus AB even if tiebreaker W is open.

| Value | Bus segment |
|---|---|
| 1 | A Segment |
| 2 | B Segment |
| 3 | C Segment |
| 4 | D Segment |
| 5 | Digital Input Selectable |

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| ServLink Address | SERVLINK ADDRESS | Both | 0 | 15 | 0 | |

When the ServLink communication is configured for Multi-drop (multiple ServLink devices sharing the same information) enter the address of this control.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| LON Start Sequencing | LON START SEQUENCING | Both | False | True | True=Enabled | |

This will enable the EGCP-3 to initiate engine starts when a start is requested from the LON network.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Engine Start Sequencing | START SEQUENCING | Both | False | True | True=Enabled | |

This value is a True/False selection that can be either Enabled or Disabled. If set to Enabled, the EGCP-3 will control engine cranking, fuel shutoff, and ignition shutoff, etc. If Disabled, the EGCP-3 will only provide a contact output for external equipment that provides the starting logic. A MPU is required when Start Sequencing is Enabled.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Action | PROCESS ACTION | Both | False | True | True=Direct | |

This value is a True/False selection that can be either Direct or Indirect. If set TRUE, the action is set to Direct, and an increase in process is proportional to an increase in kW. If set FALSE, the control action is set to Indirect, an increase in process is directly proportional to a decrease in kW.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Analog 3 Function | AI 3 FUNCTION | Both | 1 | 7 | 4=Proc Ref | |

This value is detailed in the table below.

| Value | Command | Display | Notes |
|---|---|---|---|
| 7 | Remote Analog Level Alarm | Analog Alarm | Transducer connection for alarm and value display |
| 6 | Remote KVAR Reference | VAR Reference | Overrides the internal VAR control configuration |
| 5 | Remote PF Reference | PF Reference | Overrides the internal PF control configuration |
| 4 | Remote Process Reference | Process Reference | Overrides the internal Process or Import/Export level configuration |
| 3 | Process Control Input | Proc Control Input | Transducer connection |
| 2 | Remote BaseLoad Reference | BaseLoad Reference | Overrides the internal BaseLoad configuration |
| 1 | Not Used | Not Used | |

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Analog 4 Function | AI 4 FUNCTION | Both | 1 | 7 | 5=PF Ref | |

The function of Analog Input 4 can be selected from the list detailed in the table above with Analog 3.

## Digital Input Menu

The Digital Input Menu is included in both the front panel display and Watch Window. All items appear in both. In Watch Window, the Digital Input Menu is a Configure menu located near the end (right) of the Quick Configure tabs following the First Time Startup Menu. When using Watch Window, IO Lock must be set.

**FIXED INPUTS**

| Inputs | Function |
|---|---|
| Digital Input 1 | Emergency Stop |
| Digital Input 2 | Auto |
| Digital Input 3 | Test |
| Digital Input 4 | Run with Load |
| Digital Input 5 | Generator Breaker (Auxiliary 52) |

| Units | Display Name | Panel / WW | Min | Max | Default | |
|---|---|---|---|---|---|---|
| Digital Input 6 | DIGITAL INPUT 6 | Both | 1 | 25 | 2=Mains breaker aux contact | |
| Digital Input 7 | DIGITAL INPUT 7 | Both | 1 | 25 | 18= Enable VAR/PF Control | |
| Digital Input 8 | DIGITAL INPUT 8 | Both | 1 | 25 | 19= Unload Command | |
| Digital Input 9 | DIGITAL INPUT 9 | Both | 1 | 25 | 3=Voltage/PF/VAR Raise | |
| Digital Input 10 | DIGITAL INPUT 10 | Both | 1 | 25 | 4=Voltage/PF/VAR Lower | |
| Digital Input 11 | DIGITAL INPUT 11 | Both | 1 | 25 | 5=Load/Speed Raise | |
| Digital Input 12 | DIGITAL INPUT 12 | Both | 1 | 25 | 6=Load/Speed Lower | |
| Digital Input 13 | DIGITAL INPUT 13 | Both | 1 | 25 | 11= Remote Alarm Input #1 | |
| Digital Input 14 | DIGITAL INPUT 14 | Both | 1 | 25 | 12= Remote Alarm Input #2 | |
| Digital Input 15 | DIGITAL INPUT 15 | Both | 1 | 25 | 17= Reset Alarm/Fault | |
| Digital Input 16 | DIGITAL INPUT 16 | Both | 1 | 25 | 8= Enable Process Control | |

The configurable functions are shown in the list below. The list is identical for all the configurable digital inputs. No two inputs should be configured to the same function. An error will result if two inputs are configured for the same function and the engine will not be allowed to start until it is corrected.

| Value | Command | Display | Notes |
|---|---|---|---|
| 32 | KW Derate Select | KW Derate Select | Changes the kW rating of the genset for loadsharing and sequencing |
| 31 | Droop Track Select | Droop Track Select | Switches the Load control mode to droop, without any speed change (bumpless) |
| 30 | Enable Bus Segment D | Bus Segment D | Puts control unit on bus D |
| 29 | Enable Bus Segment C | Bus Segment C | Puts control unit on bus C |
| 28 | Enable Bus Segment B | Bus Segment B | Puts control unit on bus B |
| 27 | Enable Bus Segment A | Bus Segment A | Puts control unit on bus A |
| 26 | Enable Skip Idle Timer | Skip Idle Timer | Input used to skip idle timer during start |
| 25 | Reset to Internal Load Setting | Reset to Internal Load Setting | Should be a momentary switch Resets load or process to internal default |
| 24 | Enable BaseLoad | BaseLoad Select | Load Control in BaseLoad mode |
| 23 | z Segment Breaker Aux | Z Breaker Aux Contact | Breaker Connects Bus Seg D to A |
| 22 | y Segment Breaker Aux | Y Breaker Aux Contact | Breaker Connects Bus Seg C to D |
| 21 | x Segment Breaker Aux | X Breaker Aux Contact | Breaker Connects Bus Seg B to C |
| 20 | w Segment Breaker Aux | W Breaker Aux Contact | Breaker Connects Bus Seg A to B |
| 19 | Unload Command | Unload Command | Ramp Load to minimum |
| 18 | Enable VAR/PF Control | Enable VAR/PF Control | Reactive Load Control Enabled |
| 17 | Reset Alarm/Fault | Reset Alarm/Fault | Should be a momentary switch. First contact silences the horn, second contact resets the fault. |
| 16 | Remote Alarm Input #6 | Remote Alarm #6 | See also Remote Alarm Menu |
| 15 | Remote Alarm Input #5 | Remote Alarm #5 | See also Remote Alarm Menu |
| 14 | Remote Alarm Input#4 | Remote Alarm #4 | See also Remote Alarm Menu |
| 13 | Remote Alarm Input #3 | Remote Alarm #3 | See also Remote Alarm Menu |
| 12 | Remote Alarm Input #2 | Remote Alarm #2 | See also Remote Alarm Menu |
| 11 | Remote Alarm Input #1 | Remote Alarm #1 | See also Remote Alarm Menu |
| 10 | Meter Phase Select B | Meter Phase Select B | Must be used together with Meter Phase Select A (see table below) |

| Value | Command | Display | Notes |
|---|---|---|---|
| 9 | Meter Phase Select A | Meter Phase Select A | Must be used together with Meter Phase Select B see table below |
| 8 | Enable Process Control | Enable Process Control | Close to enable control for Process Master or Back-up Master |
| 7 | Load Ramp Pause | Load Ramp Pause | Should be a momentary switch |
| 6 | Load / Speed Lower Command | Load / Speed Lower Command | Should always be used together with Load/Speed Raise Command as a pair |
| 5 | Load / Speed Raise Command | Load / Speed Raise Command | Should always be used together with Load/Speed Lower Command as a pair |
| 4 | Voltage/PF/VAR Lower Command | Voltage/PF/VAR Lower Command | Should always be used together with Voltage/PF/VAR Raise Command as a pair |
| 3 | Voltage/PF/VAR Raise Command | Voltage/PF/VAR Raise Command | Should always be used together with Voltage/PF/VAR Lower Command as a pair |
| 2 | Mains Breaker Aux Contact | Mains Breaker Aux Contact | Only required when bus connected to the mains. Used for BaseLoad control or Process Master. |
| 1 | Not Used | Not Used | |

The Meter Phase Select pair is a input pair. It is intended to be used together with analog outputs configured to indicate Power Metering values. The output of the Power Metering analog outputs will follow the Meter Select input as indicated in the below table. There are four possible positions of the Meter Select input. A ‘0’ indicates no connection and a ‘1’ indicates the input is active.

| Meter Phase Select A | Meter Phase Select B | Meter Output |
|---|---|---|
| 1 | 0 | Phase A |
| 0 | 1 | Phase B |
| 1 | 1 | Phase C |
| 0 | 0 | Average/Total |

When a Discrete Input is selected to have a function of Remote Alarm 1-6, the alarm characteristics need to be configured in the REMOTE ALARM INPUT menu.

## Digital Output Menu

Selection of Digital Output functions is included in both the front panel display and Watch Window menus. Some configurable items appear only in Watch Window. Configure: “C# RELAY OUTPUTS ## “ Watch Window menu is located at the end (right) of the Quick Configure tabs. Items in the menu can be viewed but not edited until the EGCP-3 is in I/O Lock. Some items from this menu are also present on the front panel display in the CONFIG, Digital Outputs menu. Output channels 1,2,5,7, and 9 are pre-configured outputs and cannot be changed.

The function list is identical for all the configurable digital outputs . It is possible to configure more than one digital output for the same function, and no error will result. The first table below are the outputs that can not be configured.

**FIXED OUTPUTS**

| Output | Function |
|---|---|
| Digital Output 1 | Generator Breaker Close |
| Digital Output 2 | Generator Breaker Open |
| Digital Output 5 | Fuel Solenoid |
| Digital Output 7 | Starter |
| Digital Output 9 | Alarm Horn (Audible Alarm) |

**CONFIGURABLE OUTPUTS**

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Digital Output 3 | DIGITAL OUTPUT 3 | Both | 1 | 21 | 1=Not Used | |
| Digital Output 4 | DIGITAL OUTPUT 4 | Both | 1 | 21 | 2=Bus Breaker Shunt Trip Command | |
| Digital Output 6 | DIGITAL OUTPUT 6 | Both | 1 | 21 | 3=Pre-Glow | |
| Digital Output 8 | DIGITAL OUTPUT 8 | Both | 1 | 21 | 4=Idle/Rated Command | |
| Digital Output 10 | DIGITAL OUTPUT 10 | Both | 1 | 21 | 19=Warning | |
| Digital Output 11 | DIGITAL OUTPUT 11 | Both | 1 | 21 | 20=Soft Shutdown Issued | |
| Digital Output 12 | DIGITAL OUTPUT 12 | Both | 1 | 21 | 21=Hard Shutdown Issued | |

Each configurable digital output can be one of the 21 functions described in the enumeration table below.

| Value | Command | Display | Notes |
|---|---|---|---|
| 23 | Self Test | Loss of Power | This relay will be energized whenever the control is in operation. |
| 22 | Node Num Mismatch | LON Node Num Mismatch | Node numbers on LON do not match the expected node number in the sequencing menu |
| 21 | Hard Shutdown Initiated | Hard Shutdown | Active for any Hard Shutdown. Latches closed until alarm is cleared from the alarm log. |
| 20 | Soft Shutdown Initiated | Soft Shutdown | Active for any Soft or Hard Shutdown. Latches closed until alarm is cleared from the alarm log. |
| 19 | Warning Alarm | Warning Alarm | Active for any Warning or higher alarm. Latches closed until alarm is cleared from the alarm log. |
| 18 | Analog Pre-Alarm 4 Occurred | AI-4 Pre-Alarm | Provides discrete indication of a configurable analog Pre-Alarm occurrence |
| 17 | Analog Pre-Alarm 3 Occurred | AI-3 Pre-Alarm | Provides discrete indication of a configurable analog Pre-Alarm occurrence |
| 16 | KVA Switch | KVA Switch | Indicates when generator power output exceeds a configurable level |
| 15 | EPS Supplying Load | EPS Supplying Load | Indicates when the generator (only) is providing power to the load |
| 14 | Analog Alarm 4 Occurred | AI-4 Alarm Occurred | Provides discrete indication of an analog alarm occurrence |
| 13 | Analog Alarm 3 Occurred | AI-3 Alarm Occurred | Provides discrete indication of an analog alarm occurrence |
| 12 | KW-hr pulse | KW - hr pulse | Pulses every 100 kW-hrs for 100msec duration |
| 11 | Engine Running | Engine Running | A “Run Relay” function |
| 10 | Voltage Bias Lower | Voltage Bias Lower | Used in place of Voltage Bias Analog Output. Always use with Voltage Bias Raise as a pair. |
| 9 | Voltage Bias Raise | Voltage Bias Raise | Used in place of Voltage Bias Analog Output. Always use with Voltage Bias Lower as a pair. |
| 8 | Speed Bias Lower | Speed Bias Lower | Used in place of Speed Bias Analog Output. Always use with Speed Bias Raise as a pair. |
| 7 | Speed Bias Raise | Speed Bias Raise | Used in place of Speed Bias Analog Output. Always use with Speed Bias Lower as a pair. |

| Value | Command | Display | Notes |
|---|---|---|---|
| 6 | Spark Ignition Command | Ignition Enable | Used to enable an external ignition controller |
| 5 | Air Shutoff Solenoid | Air Shutoff Solenoid | Used to starve air from engine inputs. This output activated by an emergency stop or overspeed will engage for 5 seconds and is non-latching. |
| 4 | Idle/Rated Command | Idle Rated Command | Used to switch external governor modes |
| 3 | Pre-Glow Command | Preglow Command | Used with glow plugs |
| 2 | Bus Breaker Trip Command | Bus Bkr Shunt Trip | Sources to open the breaker or contactor |
| 1 | Not Used | Not Used | |

The second half of the Digital Outputs menu is located in Watch Window only. It configures the action state of the relay driver.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Digital Output 3 Normal State | DIGITAL OUTPUT 3 ACTION | WW | FALSE | TRUE | TRUE=Normally Open | |
| Digital Output 4 Normal State | DIGITAL OUTPUT 4 ACTION | WW | FALSE | TRUE | TRUE=Normally Open | |
| Digital Output 6 Normal State e | DIGITAL OUTPUT 6 ACTION | WW | FALSE | TRUE | TRUE=Normally Open | |
| Digital Output 8 Normal State | DIGITAL OUTPUT 8 ACTION | WW | FALSE | TRUE | TRUE=Normally Open | |
| Digital Output 10 Normal State | DIGITAL OUTPUT 10 ACTION | WW | FALSE | TRUE | TRUE=Normally Open | |
| Digital Output 11 Normal State | DIGITAL OUTPUT 11 ACTION | WW | FALSE | TRUE | TRUE=Normally Open | |
| Digital Output 12 Normal State | DIGITAL OUTPUT 12 ACTION | WW | FALSE | TRUE | TRUE=Normally Open | |

The output state for discrete outputs can be Normally Open or Normally Closed. Each can be configured to close (energize) when active or open (de-energize) when active. These modes can mimic a Normally Open or Normally Closed relay. For safety, use caution when assigning the actions of the outputs.

## Engine Protection Menu

The Engine Protection Menu is included in both the front panel display and Watch Window (WW). However, some items only appear in Watch Window. Items in this menu can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for the list of alarm actions. It is used in many places within the Engine Protection Menu

The values are entered in the units selected (American or Metric) in the First Time Configure menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Coolant Temp. High Alarm | HIGH H20 TEMP AL | Both | 1 | 6 | 5=Soft Shutdown | |
| Coolant Temp. High Alarm Level | HIGH H20 TEMP LVL | Both | 75.0 | 300.0 | 145.0 | °C/°F |

Coolant Temp. High Alarm Level should be set to a value higher than the Coolant Temperature High Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Coolant Temp. High Pre-Alarm | HIGH H20 TEMP PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Coolant Temp. High Pre-Alarm Level | HIGH H20 TEMP PRE-ALM LVL | WW | 75.0 | 300.0 | 125.0 | °C/ºF |

Coolant Temp. High Pre-Alarm Level should be set to a value lower than the Coolant Temp High Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Coolant Temp. Low Pre-Alarm | LO H20 TEMP PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Coolant Temp. Low Pre-Alarm Level | LO H20 TEMP PRE-ALM LVL | WW | -40.0 | 100.0 | 30.0 | °C/ºF |

Coolant Temp Low Pre-Alarm should be set to a value higher than the Coolant Temp Low Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Coolant Temp. Low Alarm | LO H20 TEMP AL | Both | 1 | 6 | 4=Audible | |
| Coolant Temp. Low Alarm Level | LO H20 TEMP LVL | Both | 0.0 | 100.0 | 20.0 | °C/ºF |

Coolant Temp Low Alarm should be set to a value lower than the Coolant Temp Low Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Idle Oil Pressure High Alarm | HI IDLE OIL PRES AL | Both | 1 | 6 | 2=Warning | |
| Idle Oil Pressure High Alarm Level | HI IDLE OIL PRES LVL | Both | 1.0 | 1000.0 | 60.0 | psi/kPa |

This alarm will operate if the oil pressure exceeds the set limit while speed is between 90% of idle speed and 90% of rated speed.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Idle Oil Pressure Low Alarm | LO IDLE OIL PRES AL | Both | 1 | 6 | 6=Hard Shutdown | |
| Idle Oil Pressure Low Alarm Level | LO IDLE OIL PRES LVL | Both | 1.0 | 1000.0 | 10.0 | psi/kPa |

This alarm will operate if the oil pressure is below the set limit while speed is between 90% of idle speed and 90% of rated speed.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Rated Oil Pressure High Alarm | HI RTD OIL PRES AL | Both | 1 | 6 | 2=Warning | |
| Rated Oil Pressure High Alarm Level | HI RTD OIL PRES LVL | Both | 1.0 | 1000.0 | 80.0 | psi/kPa |

This alarm will operate if the oil pressure exceeds the set limit and speed goes above 90% of rated speed and the Idle/Rated output is set to rated.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Rated Oil Pressure Low Pre-Alarm | LO RTD OIL PRES PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Rated Oil Pressure Low Pre-Alarm Level | LO RTD OIL PRES PALM LVL | WW | 1.0 | 1000.0 | 40.0 | psi/kPa |

This pre-alarm will operate if the oil pressure is below the set limit and engine speed goes above 90% of rated speed and the Idle/Rated output is set to rated.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Rated Oil Pressure Low Alarm | LO RTD OIL PRES AL | Both | 1 | 6 | 6=Hard Shutdown | |
| Rated Oil Pressure Low Alarm Level | LO RTD OIL PRES LVL | Both | 1.0 | 1000.0 | 30.0 | psi/kPa |

This alarm will operate if the oil pressure is below the set limit and engine speed goes above 90% of rated speed and the Idle/Rated output is set to rated.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Over Speed Alarm | OVER SPEED ALM | Both | 1 | 6 | 6=Hard Shutdown | |
| Over Speed Alarm Level | OVER SPEED ALM LVL | Both | 100 | 5000 | 1950 | RPM |

This alarm will operate if the engine speed is greater than the limit value set here and a MPU is provided.

## Shutdowns and Alarms Menu

The Shutdowns & Alarms Menu is included in both the front panel display and Watch Window. All items appear in both locations. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for the list of alarm actions. It is used in many places within the Shutdowns & Alarms Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Battery Voltage High Alarm | BATT VOLT HIGH AL | Both | 1 | 6 | 4=Audible | |
| Battery Voltage High Alarm Level | BATT VOLT HIGH LVL | Both | 5.0 | 50.0 | 28.0 | Vdc |

This alarm will operate if the input supply voltage exceeds this level for 1.0 second. It is continuously enabled, except when the Starter relay is energized. It should be set to a value higher than the normal battery charging voltage.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Battery Voltage Low Alarm | BATT VOLT LOW AL | Both | 1 | 6 | 4=Audible | |
| Battery Voltage Low Alarm Level | BATT VOLT LOW LVL | Both | 5.0 | 50.0 | 18.0 | Vdc |

This alarm will operate if the input supply voltage is below this level for 1.0 seconds. It is continuously enabled, except when the Starter relay is energized. It should be set to a value lower than the nominal battery voltage.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Speed/Freq Mismatch | SPD FREQ MISMATCH | Both | 1 | 6 | 6=Hard Shutdown | |

This alarm is active when the engine has been at rated speed for 5 seconds. The alarm will operate when the measured generator frequency and the frequency calculated from the engine speed has an error of more than 1 Hz. It is used to detect a failed MPU, or failed generator excitation problem.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Speed Adjust Limits Reached | SPD LMT REACHED AL | Both | 1 | 6 | 2=Warning | |

This alarm is continuously enabled. It operates when the speed bias output is at its minimum or maximum value for 10.0 seconds.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Adjust Limits Reached | VLT LMT REACHED AL | Both | 1 | 6 | 2=Warning | |

This alarm is continuously enabled. It operates when the voltage bias output is limited because the maximum or minimum generator voltage. This alarm will also activate when the voltage bias has been limited because the VAR limit of the generator has been reached. The alarm is delayed for 10 seconds after the bias has been limited.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Powersense Board Fail Alarm | POWERSENSE FAIL ALM | ww | 1 | 6 | 4=Audible | |

This alarm is continuously enabled. It operates when the main CPU board detects a problem with the Powersense board of the EGCP-3.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Phase Rotation Mismatch | PHASE ROTATION MISMATCH | ww | 1 | 6 | 6=Hard Shutdown | |

This alarm is detected when the synchronizer is enabled. This alarm occurs when the control detects a  the generator and bus voltages are not rotating correctly. This is detected by a large occurrence of negative sequence voltage.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Phase Rotation Mismatch Level | PHASE ROT MM LEVEL | ww | 1 | 100 | 50 % | % |

This is the level of negative phase sequence voltage that will trigger the phase rotation mismatch alarm.l

## Generator Protection Menu

The Generator Protection Menu is included in both the front panel display and Watch Window. However, some items only appear in Watch Window. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for the list of alarm actions. It is used in many places within the Generator Protection Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Over Voltage Alarm | GEN VOLT HI ALM | Both | 1 | 6 | 6=Hard Shutdown | |
| Generator Over Voltage Alarm Level | GEN VOLT HI LVL | Both | 0 | 30000 | 600 | *Volts |

This alarm will operate when the highest phase voltage is continuously greater than the limit setting for the time delay setting. It is always enabled. It should be set to a value higher than the Generator Over Voltage Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Over Voltage Pre-Alarm | GEN VOLT HI PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Over Voltage Pre-Alarm Level | GEN VOLT HI PRE-ALM LVL | WW | 0 | 30000 | 550 | *Volts |

This alarm input is also the highest phase voltage, and is always enabled. It should be set to a value lower than the Generator Over Voltage Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Under Voltage Pre-Alarm | GEN VOLT LO PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Under Voltage Pre-Alarm Level | GEN VOLT LO PRE-ALM LVL | WW | 0 | 30000 | 400 | *Volts |

This alarm is only enabled when the generator breaker is closed. It should be set to a value lower than Rated Generator Voltage and higher than Generator Under Voltage Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Under Voltage Alarm | GEN VOLT LO ALM | Both | 1 | 6 | 5=Soft Shutdown | |
| Generator Under Voltage Alarm Level | GEN VOLT LO LVL | Both | 0 | 30000 | 300 | *Volts |

This alarm will operate when the lowest phase voltage (or AØ when 1Ø is selected) is less than the under voltage level for the time delay configured. It is only enabled when the generator breaker is closed. It should be set to a value lower than the Generator Under Voltage Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Voltage Pre-Alarm Delay | GEN VOLT PRE-ALM DELAY | WW | 0.1 | 120.0 | 5.0 | Seconds |

This value determines the amount of time that the generator voltage must be above the Generator Over Voltage Pre-Alarm Level or below the Generator Under Voltage Pre-Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Voltage Alarm Delay | GEN VOLT ALM DELAY | Both | 0.1 | 120.0 | 10.0 | Seconds |

This value determines the amount of time that the generator voltage must be above the Generator Over Voltage Alarm Level, or below the Generator Under Voltage Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Phase Over Current Alarm | GEN CURRENT HI ALM | Both | 1 | 6 | 6=Hard Shutdown | |
| Generator Phase Over Current Alarm Level | GEN CURRENT HI LVL | Both | 0 | 30000 | 1500 | *Amps |

This alarm is continuously enabled. It first selects the generator phase with the highest current. It will operate when that phase current exceeds the set limit. It should be set to a value higher than the Generator Phase Over Current Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Phase Over Current Pre-Alarm | GEN CURRENT HI PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Phase Over Current Pre-Alarm Level | GEN CURRENT HI PRE-ALM LVL | WW | 0 | 30000 | 1000 | *Amps |

This alarm is continuously enabled. It will operate when a generator phase current exceeds the set limit. It should be set to a value lower than the Generator Phase Over Current Alarm but higher than Rated Generator Current.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Phase Over Current Curve Shift | GEN CURR CURVE SHIFT | Both | 0.01 | 10.0 | 1.0 | |

This value acts to level shift the inverse time curve, defined by IEEE and IEC. The purpose of a level shift is to match a desired time delay to the specific trip set point. The higher the current is above rated value, the shorter the delay automatically becomes. Increasing the shift value above 1.0 will increase the time delay, below 1.0 will decrease the delay, without changing the shape of the curve. This shift value is NOT the amount of time that the generator current must be above the Generator Over Current Alarm Level before declaring an alarm. But, it is used to determine that delay time. See Chapter 7 for a detailed description of the Inverse Time Curve.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Over Frequency Alarm | GEN FREQ HI ALM | Both | 1 | 6 | 6=Hard Shutdown | |
| Generator Over Frequency Alarm Level | GEN FREQ HI LVL | Both | 40.0 | 70.0 | 70.0 | Hertz |

This alarm is continuously enabled. It should be set to a value higher than the Generator Over Frequency Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Over Frequency Pre-Alarm | GEN FREQ HI PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Over Frequency Pre-Alarm Level | GEN FREQ HI PRE-ALM LVL | WW | 40.0 | 70.0 | 65.0 | Hertz |

This alarm is continuously enabled. It should be set to a value lower than the Generator Over Frequency Alarm but higher than the System Rated Frequency.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Under Frequency Pre-Alarm | GEN FREQ LO PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Under Frequency Pre-Alarm Level | GEN FREQ LO PRE-ALM LVL | WW | 40.0 | 70.0 | 45.0 | Hertz |

This alarm is only enabled only when the generator breaker is closed. It should be set to a value lower than System Rated Frequency and higher than Generator Under Frequency Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Under Frequency Alarm | GEN FREQ LO ALM | Both | 1 | 6 | 5=Soft Shutdown | |
| Generator Under Frequency Alarm Level | GEN FREQ LO LVL | Both | 40.0 | 70.0 | 40.0 | Hertz |

This alarm is only enabled when the generator breaker is closed. It should be set to a value lower than the Generator Under Frequency Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Frequency Pre-Alarm Delay | GEN FREQ PRE-ALM DELAY | WW | 0.1 | 120.0 | 5.0 | Seconds |

This value determines the amount of time that the generator frequency must be above the Generator Over Frequency Pre-Alarm Level. This value also determines the amount of time that the generator frequency must be below the Generator Under Frequency Pre-Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Frequency Alarm Delay | GEN FREQ ALM DELAY | Both | 0.1 | 120.0 | 10.0 | Seconds |

This value determines the amount of time that the generator frequency must be above the Generator Over Frequency Alarm Level before declaring an alarm. This value also determines the amount of time that the generator frequency must be below the Generator Under Frequency Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Over Power Alarm | GEN PWR HI ALM | Both | 1 | 6 | 6=Hard Shutdown | |
| Generator Over Power Alarm Level | GEN PWR HI LVL | Both | -30000 | 30000 | 1500 | *Watts |

This alarm is continuously enabled. It should be set to a value higher than the Generator Over Power Pre-Alarm. The Generator Over Power Level should also be set higher than the Rated Power in the First Time Configuration menu. The EGCP-3 uses the lower of these two settings when calculating the System Load percentage for isolated load sharing.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Over Power Pre-Alarm | GEN PWR HI PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Over Power Pre-Alarm Level | GEN PWR HI PRE-ALM LVL | WW | -30000 | 30000 | 1000 | *Watts |

This alarm is continuously enabled. It should be set to a value lower than the Generator Over Power Alarm but higher than Rated Generator Real Power.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Reverse Power Pre-Alarm | GEN REV-PWR PRE-ALM | WW | | | Disabled | |
| Generator Reverse Power Pre-Alarm Level | GEN REV-PWR PRE-ALM LVL | WW | -30000 | 30000 | -10 | *Watts |

This alarm is continuously enabled. It should be set to a value higher than the Generator Reverse Power Alarm but lower than Rated Generator Real Power.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Reverse Power Alarm | GEN REV-PWR ALM | Both | 1 | 6 | 6=Hard Shutdown | |
| Generator Reverse Power Alarm Level | GEN REV-PWR LVL | Both | -30000 | 30000 | -50 | *Watts |

This alarm is continuously enabled. It should be set to a value lower than the Generator Reverse Power Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Directional Power Curve Shift | GEN PWR CURVE SHIFT | Both | 0.01 | 10.0 | 1.0 | |

This value acts to level shift the inverse time curve, defined by IEEE and IEC. The purpose of a level shift is to match a desired time delay to the specific trip set point. The higher the power is above rated value, the shorter the delay automatically becomes. Increasing the shift value above 1.0 will increase the time delay, below 1.0 will decrease the delay, without changing the shape of the curve. This shift value is NOT the amount of time that the generator power must be above the Generator Directional Power Alarm Level before declaring an alarm. But, it is used to determine that delay time. See Chapter 7 for a detailed description of the Inverse Time Curve.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Over VAR Alarm | GEN VAR HI ALM | Both | 1 | 6 | 6=Hard Shutdown | |
| Generator Over VAR Alarm Level | GEN VAR HI LVL | Both | -30000 | 30000 | 1500 | *VAR |

This alarm is continuously enabled. It should be set to a value higher than the Generator Over VAR Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Over VAR Pre-Alarm | GEN VAR HI PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Over VAR Pre-Alarm Level | GEN VAR HI PRE-ALM LVL | WW | -30000 | 30000 | 1000 | *VAR |

This alarm is continuously enabled. It should be set to a value lower than the Generator Over VAR Alarm but higher than Generator Rated VAR. The action is defined by Generator Over VAR Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Reverse VAR Pre-Alarm | GEN REV-VAR PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Reverse VAR Pre-Alarm Level | GEN REV-VAR PRE-ALM LVL | WW | -30000 | 30000 | -10 | *VAR |

This alarm is continuously enabled. It should be set to a value higher than the Generator Reverse VAR Alarm but lower than Generator Rated VAR.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Reverse VAR Alarm | GEN REV-VAR ALM | Both | 1 | 6 | 6=Hard Shutdown | |
| Generator Reverse VAR Alarm Level | GEN REV-VAR LVL | Both | -30000 | 30000 | -50 | *VAR |

This alarm is continuously enabled. It should be set to a value lower than the Generator Reverse VAR Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Directional VAR Pre-Alarm Delay | GEN VAR PRE-ALM DELAY | WW | 0.1 | 120.0 | 5.0 | Seconds |

This value determines the amount of time that the generator VAR must be above the Generator Over VAR Pre-Alarm Level before declaring an alarm. This value also determines the amount of time that the generator VAR must be below the Generator Reverse VAR Pre-Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Directional VAR Alarm Delay | GEN VAR ALM DELAY | Both | 0.1 | 120.0 | 10.0 | Seconds |

This value determines the amount of time that the generator VAR must be above the Generator Over VAR Alarm Level before declaring an alarm. This value also determines the amount of time that the generator VAR must be below the Generator Reverse VAR Alarm Level before declaring an alarm.

| Item | Display Name | Panel/WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Negative Phase Sequence Over Voltage Alarm | GEN NEG SQ V HI AL | Both | 1 | 6 | 1=Disabled | |
| Generator Negative Phase Sequence Over Voltage Alarm Level | GEN NEG SQ V HI LV | Both | 0 | 30000 | 150 | *Volts |

This alarm is continuously enabled. It should be set to a value higher than the Generator Negative Phase Sequence Over Voltage Pre-Alarm but lower than Generator Rated Voltage.

| Item | Display Name | Panel/WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Negative Phase Sequence Over Voltage Pre-Alarm | GEN NEG SEQ-V HI PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Negative Phase Sequence Over Voltage Pre-Alarm Level | GEN NEG SEQ V HI PALM LV | WW | 0 | 30000 | 100 | *Volts |

This alarm is continuously enabled. It should be set to a value lower than the Generator Negative Phase Sequence Over Voltage Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Negative Phase Sequence Over Voltage Pre-Alarm Delay | GEN NSEQ-V HI PALM DLY | WW | 0.1 | 120.0 | 5.0 | Seconds |

This value determines the amount of time that the generator Negative Phase Sequence voltage must be above the Generator Negative Phase Sequence Over Voltage Pre-Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Negative Phase Sequence Over Voltage Alarm Delay | GEN NEG SEQ V HI ALM DL | Both | 0.1 | 120.0 | 10.0 | Seconds |

This value determines the amount of time that the generator Negative Phase Sequence voltage must be above the Generator Negative Phase Sequence Over Voltage Alarm Level before declaring an alarm.

| Item | Display Name | Panel/WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Negative Phase Sequence Over Current Alarm | GEN NEG SQ I HI AL | Both | 1 | 6 | 1=Disabled | |
| Generator Negative Phase Sequence Over Current Alarm Level | GEN NEG SQ I HI LV | Both | 0 | 30000 | 150 | *Amps |

This alarm is continuously enabled. It should be set to a value higher than the Generator Negative Phase Sequence Over Current Pre-Alarm but lower than Generator Rated Current.

| Item | Display Name | Panel/WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Negative Phase Sequence Over Current Pre-Alarm | GEN NEG SEQ-I HI PALM | WW | 1 | 6 | 1=Disabled | |
| Generator Negative Phase Sequence Over Current Pre-Alarm Level | GEN NEG SEQ-I HI PALM LVL | WW | 0 | 30000 | 100 | *Amps |

This alarm is continuously enabled. It should be set to a value lower than the Generator Negative Phase Sequence Over Current Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Negative Phase Sequence Over Current Pre-Alarm Delay | GEN NEG SEQ-I HI PALM DL | WW | 0.1 | 120.0 | 5.0 | Seconds |

This value determines the amount of time that the generator Negative Phase Sequence Current must be above the Generator Negative Phase Sequence Over Current Pre-Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Negative Phase Sequence Over Current Alarm Delay | GEN NEG SEQ-I HI DL | Both | 0.1 | 120.0 | 10.0 | Seconds |

This value determines the amount of time that the generator Negative Phase Sequence Current must be above the Generator Negative Phase Sequence Over Current Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Phase Current Differential Alarm | GEN DIFF CURRENT ALM | Both | 1 | 6 | 5=Soft Shutdown | |
| Generator Phase Current Differential Alarm Level | GEN DIFF CURRENT LVL | Both | 0 | 30000 | 150 | *Amps |

This alarm is continuously enabled in 3Ø installations. It should be set to a value higher than the Generator Phase Current Differential Pre-Alarm but lower than Rated Generator Current.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Phase Current Differential Pre-Alarm | GEN DIFF CURRENT PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Generator Phase Current Differential High Pre-Alarm Level | GEN DIFF CURRENT PREALM LVL | WW | 0 | 30000 | 100 | *Amps |

This alarm is continuously enabled in 3Ø installations. It should be set to a value lower than the Generator Phase Current Differential Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Phase Current Differential Curve Shift | GEN DIFF CURR SHIFT | Both | 0.01 | 10.0 | 1.0 | |

This value acts to level shift the inverse time curve, defined by IEEE and IEC. The purpose of a level shift is to match a desired time delay to the specific trip set point. The higher the current is above rated value, the shorter the delay automatically becomes. Increasing the shift value above 1.0 will increase the time delay, below 1.0 will decrease the delay, without changing the shape of the curve. This shift value is NOT the amount of time that the generator current must be above the Generator Over Current Alarm Level before declaring an alarm. But, it is used to determine that delay time. See also Chapter 7 for a detailed description of the Inverse Time Curve.

| Item | Display Name | Panel /WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Breaker Feedback Error Alarm | GEN BRK FDBK ERROR ALM | WW | 1 | 8 | 1=Disabled | |

This alarm is continuously enabled. The alarm activates when a current is sensed, and the generator breaker does not show closed.

| Item | Display Name | Panel /WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Breaker Shunt Trip Error Alarm | GEN BRK SHUNT TRP ER ALM | WW | 1 | 8 | 2=Warning | |

This alarm is continuously enabled. The alarm activates when a breaker open command is given, and the breaker feedback does not show open within 5 seconds.

## Bus Protection Menu

The Bus Protection Menu is included in both the front panel display and Watch Window. However, there are items that only appear in Watch Window. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for the list of alarm actions. It is used in many places within the Bus Protection Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Over Voltage Alarm | BUS VOLT HI ALM | Both | 1 | 8 | 6=Hard Shutdown | |
| Bus Over Voltage Alarm Level | BUS VOLT HI ALM LVL | Both | 0 | 30000 | 600 | *Volts |

This alarm will trip when the highest phase voltage is continuously greater than the limit setting for the time delay setting. It is continuously enabled. It should be set to a value higher than the Bus Over Voltage Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Over Voltage Pre-Alarm | BUS VOLT HI PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Over Voltage Pre-Alarm Level | BUS VOLT HI PRE-ALM LVL | WW | 0 | 30000 | 550 | *Volts |

This alarm input is also the highest phase voltage, and is continuously enabled. It should be set to a value lower than the Bus Over Voltage Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Under Voltage Pre-Alarm | BUS VOLT LO PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Under Voltage Pre-Alarm Level | BUS VOLT LO PRE-ALM LVL | WW | 0 | 30000 | 400 | *Volts |

This alarm is continuously enabled. It should be set to a value lower than Rated Bus Voltage and higher than Bus Under Voltage Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Under Voltage Alarm | BUS VOLT LO ALM | Both | 1 | 8 | 2=Warning | |
| Bus Under Voltage Alarm Level | BUS VOLT LO ALM LVL | Both | 0 | 30000 | 300 | *Volts |

This alarm will activate when the lowest phase voltage (or AØ when 1Ø is selected) is continuously less than the limit setting for the time delay setting. It is continuously enabled. It should be set to a value lower than the Bus Under Voltage Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Voltage Pre-Alarm Delay | BUS VOLT PRE-ALM DLY | WW | 0.1 | 120.0 | 5.0 | Seconds |

This value determines the amount of time that the Bus voltage must be above the Bus Over Voltage Pre-Alarm Level or below the Bus Under Voltage Pre-Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Voltage Alarm Delay | BUS VOLT ALM DLY | Both | 0.1 | 120.0 | 10.0 | Seconds |

This value determines the amount of time that the bus voltage must be above the Bus Over Voltage Alarm Level or below the Bus Under Voltage Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Phase Over Current Alarm | BUS CURRENT HI ALM | Both | 1 | 8 | 2=Warning | |

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Phase Over Current Alarm Level | BUS CURRENT HI ALM LVL | Both | 0 | 30000 | 1500 | *Amps |

This alarm is continuously enabled. It first selects the Bus phase with the highest current. It will activate when that phase current exceeds the set limit. It should be set to a value higher than the Bus Phase Over Current Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Phase Over Current Pre-Alarm | BUS CURRENT HI PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Phase Over Current Pre-Alarm Level | BUS CURR HI PRE-ALM LVL | WW | 0 | 30000 | 1000 | *Amps |

This alarm is continuously enabled. It will activate when a bus phase current exceeds the set limit. It should be set to a value lower than the Bus Phase Over Current Alarm but higher than Rated Bus Current.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Phase Over Current Curve Shift | BUS CURRENT SHIFT | Both | 0.01 | 10.0 | 1.0 | |

This value acts to level shift the inverse time curve, defined by IEEE and IEC. The purpose of a level shift is to match a desired time delay to the specific trip set point. The higher the current is above rated value, the shorter the delay automatically becomes. Increasing the shift value above 1.0 will increase the time delay, below 1.0 will decrease the delay, without changing the shape of the curve. This shift value is NOT the amount of time that the Bus current must be above the Bus Over Current Alarm Level before declaring an alarm. But, it is used to determine that delay time. See also Chapter 7 for a detailed description of the Inverse Time Curve.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Over Frequency Alarm | BUS FREQ HI ALM | Both | 1 | 8 | 6=Hard Shutdown | |
| Bus Over Frequency Alarm Level | BUS FREQ HI ALM LVL | Both | 40.0 | 70.0 | 70.0 | Hertz |

This alarm is continuously enabled. It should be set to a value higher than the Bus Over Frequency Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Over Frequency Pre-Alarm | BUS FREQ HI PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Over Frequency Pre-Alarm Level | BUS FREQ HI PRE-LVL | WW | 40.0 | 70.0 | 65.0 | Hertz |

This alarm is continuously enabled. It should be set to a value lower than the Bus Over Frequency Alarm but higher than the System Rated Frequency.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Under Frequency Pre-Alarm | BUS FREQ LO PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Under Frequency Pre-Alarm Level | BUS FREQ LO PRE-LVL | WW | 40.0 | 70.0 | 45.0 | Hertz |

This alarm is continuously enabled. It should be set to a value lower than System Rated Frequency and higher than Bus Under Frequency Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Under Frequency Alarm | BUS FREQ LO ALM | Both | 1 | 8 | 2=Warning | |
| Bus Under Frequency Alarm Level | BUS FREQ LO ALM LVL | Both | 40.0 | 70.0 | 40.0 | Hertz |

This alarm is continuously enabled. It should be set to a value lower than the Bus Under Frequency Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Frequency Pre-Alarm Delay | BUS FREQ PRE-ALM DELAY | WW | 0.1 | 120.0 | 5.0 | Seconds |

This value determines the amount of time that the Bus frequency must be above the Bus Over Frequency Pre-Alarm Level. This value also determines the amount of time that the Bus frequency must be below the Bus Under Frequency Pre-Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Frequency Alarm Delay | BUS FREQ ALM DELAY | Both | 0.1 | 120.0 | 10.0 | Seconds |

This value determines the amount of time that the Bus frequency must be above the Bus Over Frequency Alarm Level before declaring an alarm. This value also determines the amount of time that the Bus frequency must be below the Bus Under Frequency Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Export Power Alarm | BUS EXP-PWR ALM | Both | 1 | 8 | 6=Hard Shutdown | |
| Bus Export Power Alarm Level | BUS EXP-PWR LVL | Both | -30000 | 30000 | 1500 | *Watts |

This alarm is continuously enabled. It should be set to a value indicating the Bus export level is above an alarm condition. Negative numbers indicate Importing power and Positive numbers indicate exporting power.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Export Power Pre-Alarm | BUS EXP-PWR HI PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Export Power Pre-Alarm Level | BS EX-PW PRE-ALM LVL | WW | -30000 | 30000 | 1000 | *Watts |

This alarm is continuously enabled. It should be set to a value indicating the Bus export level is above a warning (pre-alarm) condition. Negative numbers indicate Importing power and Positive numbers indicate exporting power.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Import Power Pre-Alarm | BUS IMP-PWR PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Import Power Pre-Alarm Level | BUS IMP-PWR PRE ALM LVL | WW | -30000 | 30000 | -10 | *Watts |

This alarm is continuously enabled. It should be set to a value indicating the Bus import level is greater (more negative) than an alarm condition. Negative numbers indicate Importing power and Positive numbers indicate exporting power.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Import Power Alarm | BUS IMP-PWR ALM | Both | 1 | 8 | 2=Warning | |
| Bus Import Power Alarm Level | BUS IMP-PWR LVL | Both | -30000 | 30000 | -100 | *Watts |

This alarm is continuously enabled. It should be set to a value indicating the Bus import level is greater than a warning (pre-alarm) condition. Negative numbers indicate Importing power and Positive numbers indicate exporting power.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Directional Power Curve Shift | BUS PWR CURVE SHFT | Both | 0.01 | 10.0 | 1.0 | |

This value acts to level shift the inverse time curve, defined by IEEE and IEC. The purpose of a level shift is to match a desired time delay to the specific trip set point. The higher the Bus power is above rated value, the shorter the delay automatically becomes. Increasing the shift value above 1.0 will increase the time delay, below 1.0 will decrease the delay, without changing the shape of the curve. This shift value is NOT the amount of time that the Bus power must be above the Bus Import or Export Alarm Level before declaring an alarm. But, it is used to determine that delay time. See also Chapter 7 for a detailed description of the Inverse Time Curve.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Export VAR Alarm | BUS EXP-VAR ALM | Both | 1 | 8 | 6=Hard Shutdown | |
| Bus Export VAR Alarm Level | BUS EXP-VAR LVL | Both | -30000 | 30000 | 1500 | *VAR |

This alarm is continuously enabled. It should be set to a value indicating the Bus export VAR level is greater than an alarm condition. Negative numbers indicate a leading or capacitive power factor and Positive numbers indicate a lagging or inductive power factor.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Export VAR Pre-Alarm | BUS EXP-VAR HI PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Export VAR Pre-Alarm Level | BUS EXP-VAR HI PRE-ALM LVL | WW | -30000 | 30000 | 1000 | *VAR |

This alarm is continuously enabled. It should be set to a value indicating the Bus export VAR level is greater than a warning (pre-alarm) condition. Negative numbers indicate a leading or capacitive power factor and Positive numbers indicate a lagging or inductive power factor.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Import VAR Pre-Alarm | BUS IMP-VAR PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Import VAR Pre-Alarm Level | BUS IMP-VAR PRE-ALM LVL | WW | -30000 | 30000 | -10 | *VAR |

This alarm is continuously enabled. It should be set to a value indicating the Bus import VAR level is greater than a warning (pre-alarm) condition. Negative numbers indicate a leading or capacitive power factor and Positive numbers indicate a lagging or inductive power factor.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Import VAR Alarm | BUS IMP-VAR ALM | Both | 1 | 8 | 6=Hard Shutdown | |
| Bus Import VAR Alarm Level | BUS IMP-VAR LVL | Both | -30000 | 30000 | -50 | *VAR |

This alarm is continuously enabled. It should be set to a value indicating the Bus import VAR level is greater (more negative) than an alarm condition. Negative numbers indicate a leading or capacitive power factor and Positive numbers indicate a lagging or inductive power factor.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Directional VAR Pre-Alarm Delay | BUS VAR PRE-ALM DELAY | WW | 0.1 | 120.0 | 5.0 | Seconds |

This value determines the amount of time that the Bus VAR must be above the Bus Export VAR Pre-Alarm Level before declaring an alarm. This value also determines the amount of time that the Bus VAR must be below the Bus Import VAR Pre-Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Directional VAR Alarm Delay | BUS VAR ALM DELAY | Both | 0.1 | 120.0 | 10.0 | Seconds |

This value determines the amount of time that the Bus VAR must be above the Bus Export VAR Alarm Level before declaring an alarm. This value also determines the amount of time that the Bus VAR must be below the Bus Import VAR Alarm Level before declaring an alarm.

| Item | Display Name | Panel/WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Negative Phase Sequence Over Voltage Alarm | BUS NEG SEQ-V HI AL | Both | 1 | 8 | 1=Disabled | |
| Bus Negative Phase Sequence Over Voltage Alarm Level | BUS NEG SEQ-V HI LV | Both | 0 | 30000 | 150 | *Volts |

This alarm is continuously enabled. It should be set to a value higher than the Bus Negative Phase Sequence Over Voltage Pre-Alarm but lower than Bus Rated Voltage.

| Item | Display Name | Panel/WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Negative Phase Sequence Over Voltage Pre-Alarm | BUS NEG SEQ-V HI PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Negative Phase Sequence Over Voltage Pre-Alarm Level | BUS NEG SEQ-V HI PALM LV | WW | 0 | 30000 | 100 | *Volts |

This alarm is continuously enabled. It should be set to a value lower than the Bus Negative Phase Sequence Over Voltage Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Negative Phase Sequence Over Voltage Pre-Alarm Delay | BUS NEG SEQ-V HI PALM DL | WW | 0.1 | 120.0 | 5.0 | Seconds |

This value determines the amount of time that the Bus Negative Phase Sequence voltage must be above the Bus Negative Phase Sequence Over Voltage Pre-Alarm Level but below the Bus Negative Phase Sequence Over Voltage Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Negative Phase Sequence Over Voltage Alarm Delay | BUS NEG SEQ V HI DL | Both | 0.1 | 120.0 | 10.0 | Seconds |

This value determines the amount of time that the Bus Negative Phase Sequence voltage must be above the Bus Negative Phase Sequence Over Voltage Alarm Level before declaring an alarm.

| Item | Display Name | Panel/WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Negative Phase Sequence Over Current Alarm | BUS NEG SEQ I HI AL | Both | 1 | 8 | 1=Disabled | |
| Bus Negative Phase Sequence Over Current Alarm Level | BUS NEG SEQ-I HI LV | Both | 0 | 30000 | 150 | Amps |

This alarm is continuously enabled. It should be set to a value higher than the Bus Negative Phase Sequence Over Current Pre-Alarm but lower than Bus Rated Current.

| Item | Display Name | Panel/WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Negative Phase Sequence Over Current Pre-Alarm | BUS NEG SEQ-I HI PRE-ALM | WW | 1 | 8 | 1=Disabled | |
| Bus Negative Phase Sequence Over Current Pre-Alarm Level | BUS NEG SEQ-I HI PALM LV | WW | 0 | 30000 | 100 | Amps |

This alarm is continuously enabled. It should be set to a value lower than the Bus Negative Phase Sequence Over Current Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Negative Phase Sequence Over Current Pre-Alarm Delay | BUS NEG SEQ-I HI PALM DL | WW | 0.1 | 120 | 5 | Seconds |

This value determines the amount of time that the Bus Negative Phase Sequence Current must be above the Bus Negative Phase Sequence Over Current Pre-Alarm Level but below the Bus Negative Phase Sequence Over Current Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Negative Phase Sequence Over Current Alarm Delay | BUS NEG SEQ I HI DL | Both | 0.1 | 120 | 10 | Seconds |

This value determines the amount of time that the Bus Negative Phase Sequence Current must be above the Bus Negative Phase Sequence Over Current Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Phase Current Differential Alarm | BUS DIFF CURNT ALM | Both | 1 | 6 | 6=Hard Shutdown | |
| Bus Phase Current Differential High Alarm Level | BUS DIFF CURRENT LVL | Both | 0 | 30000 | 150 | *Amps |

This alarm is continuously enabled. It should be set to a value higher than the Bus Phase Current Differential Pre-Alarm but lower than Rated Bus Current.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Phase Current Differential Pre-Alarm | BUS DIFF CURRENT PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Bus Phase Current Differential High Pre-Alarm Level | BUS DIFF CURR PRE-ALM LVL | WW | 0 | 30000 | 100 | *Amps |

This alarm is continuously enabled. It should be set to a value lower than the Bus Phase Current Differential Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Phase Current Differential Curve Shift | BUS DIFF CURR SHIFT | Both | 0.01 | 10.0 | 1.0 | |

This value acts to level shift the inverse time curve. The purpose of a level shift is to fine tune the tripping characteristics at a specific trip level that can be located on the inverse time trip curve. This value is NOT the amount of time that the Bus current differential must be above the Bus Current Differential Pre-Alarm Level before declaring an alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Voltage Restrained Phase Over Current Alarm | BUS RES CURR HI ALM | Both | 1 | 6 | 5=Soft Shutdown | |
| Bus Voltage Restrained Phase Over Current Alarm Level | BUS RES CURR HI LVL | Both | 0 | 30000 | 1500 | *Amps |

This alarm is continuously enabled. It should be set to a value higher than the Bus Voltage Restrained Phase Over Current Pre-Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Voltage Restrained Phase Over Current Pre-Alarm | BUS RES CURR HI PRE-ALM | WW | 1 | 6 | 1=Disabled | |
| Bus Voltage Restrained Phase Over Current Pre-Alarm Level | BUS RES CURR HI PALM LVL | WW | 0 | 30000 | 1000 | *Amps |

This alarm is continuously enabled. It should be set to a value lower than the Bus Voltage Restrained Phase Over Current Alarm but higher than Rated Bus Current.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Voltage Restrained Phase Over Current Curve Shift | BUS RES CURR SHIFT | Both | 0.01 | 10 | 1.0 | |

This value acts to level shift the inverse time curve. The purpose of a level shift is to fine tune the tripping characteristics at a specific trip level that can be located on the inverse time trip curve. This value is NOT the amount of time that the Bus current must be above the Bus Voltage Restrained Phase Over Current Pre-Alarm Level before declaring an alarm.

# Engine Control Menu

The Engine Control Menu is included in both the front panel display and Watch Window. However, there are some items that only appear in Watch Window. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for the list of alarm actions. It is used in a few places within the Engine Control Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preglow Time | PREGLOW TIME | Both | 0 | 1200 | 0 | Seconds |

This value sets the length of time to engage glow plugs in a diesel engine prior to starter motor engagement. The output will stay on until the starter motor has been disengaged. This feature is active regardless of the engine coolant temperature as long as Start Sequencing is Enabled. If Start Sequencing is Disabled, it will never be activated.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Fuel on Delay Time | FUEL ACTIVATION DELAY | Both | 0.0 | 240.0 | 0.2 | Seconds |

Typically for use on Gas Engines. This is the time delay between energizing the crank relay and energizing the fuel solenoid relay. This feature is only active when Start Sequencing is Enabled.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Crank Active Time | CRANK TIME | Both | 1 | 240 | 10 | Seconds |

This value sets the length of time the starter will be engaged. If the engine has not started prior to expiration of this time, the starter motor will be disengaged and one start attempt will be considered used. If Start Sequencing is Disabled, this time is ignored and the Start Motor Crank output will never be engaged.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Crank Cutout Speed | CRANK CUTOUT | Both | 5 | 5000 | 550 | RPM |

This value sets the speed at which to disengage the starter motor. This feature is only active when Start Sequencing is Enabled.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Retry Crank Delay | CRANK DELAY | Both | 1 | 240 | 30 | Seconds |

This value sets the amount of time to wait between start attempts. This feature is only active when Start Sequencing is Enabled.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Crank Repeats | CRANK REPEATS | Both | 0 | 20 | 3 | |

This value defines the number of start attempts that will be made after the first attempt (2 repeats = 3 attempts). This feature is only active when Start Sequencing is Enabled.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Crank Fail Alarm Action | CRANK FAIL | Both | 1 | 6 | 5=Soft Shutdown | |

This value defines the action taken when all start attempts are exhausted without the engine starting. This feature is only active when Start Sequencing is Enabled.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| No Speed Crank Delay | NO SPEED CRANK DELAY | WW | 0.1 | 30.0 | 3.0 | Seconds |

This value sets the amount of time to wait before a speed signal is expected. If there is no speed signal detected the crank attempt will be stopped after this delay, and the crank relay will be opened.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Idle Speed | IDLE SPEED | Both | 5 | 5000 | 1200 | RPM |

This value indicates to the EGCP-3 what speed the external speed control will control at when Idle is selected. The EGCP-3 needs to know this speed so that it can determine when the engine has reached 90% of idle. This feature is only active when Start Sequencing is Enabled.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Idle Time | IDLE TIME | Both | 0 | 1200 | 20 | Seconds |

This value sets the amount of time the EGCP-3 will hold the engine at Idle before energizing the Rated Speed Relay output. This timer does not start until 90% of idle speed has been detected unless Start Sequencing is Disabled. If Start Sequencing is Disabled, the Idle/Rated relay is energized immediately when the start command is given so the Glow Plug Time, Cranking Time, and Idle Time is skipped.

**APPLICATION NOTE**

**Set the assigned relay action to Normally Closed and the relay will energize at Idle (an Idle Relay vs. a Rated Relay), and de-energize to ramp to rated.**

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Cooldown Time | COOLDOWN TIME | Both | 0 | 2400 | 15 | Seconds |

This value sets the amount of time the EGCP-3 will run the engine prior to shutdown if it was loaded above the Cooldown Power Limit. This feature is active regardless of Start Sequencing Enable/Disable.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Cooldown Enable Power Limit | COOLDOWN ENABLE LIMIT | Both | 0 | 30000 | 20 | *VA |

This value sets the load level that must be exceeded during the active running sequence before Cooldown will be used when a shutdown command is received. If the genset is started, but shutdown before being loaded to this level, the Cooldown time will be skipped. This feature is active regardless of Start Sequencing Enable/Disable.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Cooldown Speed Selection | COOLDOWN SPEED | Both | FALSE | TRU E | TRUE=Rated | |

This value can be set for either Idle or Rated. If Cooldown is initiated, the engine will be told to run at either Idle or Rated speed during the Cooldown period, based upon this parameter. This feature is active regardless of Start Sequencing Enable/Disable.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Reset Engine Run Time | RESET ENG RUN TIME | Both | FALSE | TRUE | FALSE | |

This parameter will initialize the Engine Run Hour clock to the values that are programmed in the next 2 settings. There is one setting for thousands of hours and one for hundreds of hours. It is useful if the EGCP-3 is retrofitted to a new engine or newly rebuilt engine.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the engine run hours Hundres place | ENG RUN HOURS (HUN) | Both | 0.0 | 999 | 0.0 | Hrs |

This parameter is used to program in a preset engine run hour time. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the running hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the engine run hours Thousands place | ENG RUN HOURS (THSND) | Both | 0.0 | 999 | 0.0 | Hrs |

This parameter is used to program in a preset engine run hour time. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the running hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Reset Generator KW Hours | RESET GEN KW HOURS | Both | FALSE | TRUE | FALSE | |

This parameter will set the Megawatt-Hours to meter to a value determined by the next 5 settings. There is one setting for Single hours, one for Hundreds of hours, one for Thousands of hours, one for Millions of hours, and one for Billions of hours. It is useful if the EGCP-3 is retrofitted to a new engine or newly rebuilt genset.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the gen kW hours | GEN KW HOURS (ONES) | Both | 0.0 | 99.0 | 0.0 | KW Hrs |

This parameter is used to program in a preset the gen kW hours. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the kW hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the gen kW hours hundreds place | GEN KW HOURS (HUN) | Both | 0.0 | 999.0 | 0.0 | KW Hrs |

This parameter is used to program in a preset number of gen kW hours. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the kW hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the gen kW hours Thousands place | GEN KW HOURS (THSND) | Both | 0.0 | 999.0 | 0.0 | KW Hrs |

This parameter is used to program in a preset number of gen kW hours. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the running hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the gen kW hours Millions place | GEN KW HOURS (MEGA) | Both | 0.0 | 999.0 | 0.0 | MW Hrs |

This parameter is used to program in a preset number of megawatt hours. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the MW hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the gen kW hours Billions place | GEN KW HOURS (GIGA) | Both | 0.0 | 999.0 | 0.0 | GW Hrs |

This parameter is used to program in a preset number of gigawatt hours. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the GW hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Reset Bus KW Hours | RESET GEN KW HOURS | Both | FALSE | TRUE | FALSE | |

This parameter will set the Bus Kilowatt-Hours meter to a value determined by the next 4 settings. There is one setting for Hundreds of hours, one for Thousands of hours, one for Millions of hours, and one for Billions of hours. It is useful if the EGCP-3 is retrofitted to a new engine or newly rebuilt genset.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the Bus kW hours hundreds place | BUS KW HOURS (HUN) | Both | 0.0 | 999.0 | 0.0 | KW Hrs |

This parameter is used to program in a preset number of Bus kW hours. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the kW hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the Bus kW hours Thousands place | BUS KW HOURS (THSND) | Both | 0.0 | 999.0 | 0.0 | KW Hrs |

This parameter is used to program in a preset Bus kW hours. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the Bus kW hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the Bus kW hours Millions place | BUS KW HOURS (MEGA) | Both | 0.0 | 999.0 | 0.0 | MW Hrs |

This parameter is used to program in a preset number of Bus MW hours. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the MW hours to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Preset the Bus kW hours Billions place | BUS KW HOURS (GIGA) | Both | 0.0 | 999.0 | 0.0 | GW Hrs |

This parameter is used to program in a preset number of Bus gigawatt hours. For example, if the EGCP-3 were installed on an existing generator, it may be necessary to preset the GW to a certain value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Fail to Reach Idle Alarm | FAIL TO REACH IDLE ALM | WW | 1 | 6 | 2=Warning | |

This value defines the action taken when the engine has exceeded the crank-cutout speed but does not reach or sustain idle speed within the Fail to Reach Idle Delay Tme afterdisengaging the starter motor. This feature is active only when Start Sequencing is Enabled.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Fail to Reach Idle Delay Time | FAIL TO REACH IDLE DLY | WW | 1.0 | 600.0 | 10.0 | |

This value determines the amount of time the control waits before issuing a Fail to Reach Idle Alarm.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Fail to Reach Rated Alarm | FAIL TO REACH RATED ALM | WW | 1 | 6 | 2=Warning | |

This value defines the action taken when the engine has reached idle speed but does not reach or sustain running at rated speed within the Fail to Reach Rated Delay Time after engaging the rated speed output. This feature is active only when Start Sequencing is Enabled. The Idle to Rated ramp time is a function of the external speed control, to stop nuisance alarms from this function the speed ramp should be set to less than the alarm delay time.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Fail to Reach Rated Delay Time | FAIL TO REACH IDLE DLY | WW | 1.0 | 600.0 | 10.0 | |

This value determines the amount of time the control waits before issuing a Fail to Reach Idle Alarm.

## Synchronizer Menu

The Synchronizer Menu is included in both the front panel display and Watch Window. All items appear in both. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block. A detailed description of the synchronizer operation and configuration options is in a dedicated chapter later in this manual.

Refer to Table 3-2 for the list of alarm actions. It is used in a few places within the Synchronizer Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Synchronizer Mode | SYNC MODE | Both | 1 | 4 | 4=Run/Auto | |

This value is used to select the synchronizer control mode. It may be Off, Check, Permissive, or Run/Auto. The mode may be selected by the front panel display, Watch Window menu, or Modbus HMI. The last mode selected by any of these interface methods will be the mode of operation used.
**Off mode**, the EGCP-3 performs no synchronization functions, The running sequence would stop with the engine at rated speed, and an external function would be required to close the breaker and continue the sequence.
**Check** mode is used to confirm that the synchronizer works properly by allowing synchronizing to be performed but not closing the breaker. The Synchronizer status screen can be used to observe the Slip, Phase, and voltage indication, (Displays ++ when matched). In the Check mode these indication must match external metering and wiring before allowing the breaker to close.
**Permissive** mode is used to replace a sync check relay function, the bias outputs are passive, but the breaker command will be given when speed, phase, and voltage parameters are within the window.
**Run/Auto** mode is the normal mode with active synchronizing and breaker control.

**NOTE**

**Due to delays in communication to the display or Watch Window the phase information and breaker closing indication may be inaccurate or delayed from actual values. This would be most obvious in systems configured with large slip windows.**

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Synchronizer Gain | SYNC GAIN | Both | 0.01 | 100.00 | 0.15 | |

This value is the proportional gain of a P-I controller. It determines how fast the synchronizer responds to an error in speed or phase. Adjust this gain to provide stable control during synchronizing. Lower the value to slow the response.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Synchronizer Integral Gain | SYNC INTEGRAL | Both | 0.00 | 20.00 | 0.55 | Repeats/sec |

This value is the integral gain of a P-I controller. It determines how quickly the synchronizer responds to a large error in synchronism and prevents low frequency hunting and damping (overshoot or undershoot) when the synchronizer is first enabled or when a speed transient occurs during synchronizing. Lower the value to slow the response.

A monitor value of the phase angle, or Synchroscope is provided in Watch Window to observe the response and assist with dynamic adjustment.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Matching | VOLTAGE MATCHING | Both | False | True | True=Enabled | |

This value will Enabled or Disabled the voltage matching function of the synchronizer. When enabled, the synchronizer output will match the bus and generator voltages.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Match Window | VOLTAGE WINDOW | Both | 0.1 | 10.0 | 1.0 | Percent (%) |

When voltage matching is enabled, this value is the allowable percent the generator voltage may be above or below the bus voltage for the synchronizer to initiate breaker closure.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Type of Synchronizer Action | SYNC TYPE | Both | 1 | 3 | 1=Phase Matching | |

This value is an enumerated list that indicates Phase Matching (=1), Slip Frequency (=2), or Off/None (=3). When Phase Matching is selected, the synchronizer will match the generator phase to the bus phase and hold the phase error to minimum. When the phase error is within the configured error window, for a time based on the slip window, the synchronizer will issue a breaker close command. When Slip Frequency is selected, the synchronizer will create a frequency error between the bus and generator where the generator is moving faster than the bus by a configured amount, the breaker close command will be given when phase error is within the phase window.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Phase Match Window | PHASE WINDOW | Both | 2.0 | 20.0 | 10.0 | Degrees |

This value is the maximum allowable electrical phase angle between the bus and generator when the synchronizer initiates breaker closure. This parameter is used when either type of synchronizing is selected.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Slip Window | SLIP WINDOW | Both | 0.0 | 0.3 | 0.1 | Hertz |

This value is the maximum allowed deviation in slip (frequency difference) from the slip frequency reference when initiating breaker closure. For phase control, it determines the maximum rate through the phase window. For slip control, it determines the error in slip frequency from the reference.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Slip Frequency Reference | SLIP FREQUENCY | Both | 0.0 | 0.3 | 0.1 | Hertz |

This value specifies the positive (fast) slip frequency reference (generator frequency higher than bus frequency). This parameter is used when slip frequency synchronizing is selected. For Phase Matching type, this value is internally set to 0.0.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Close Attempts | CLOSE ATTEMPTS | Both | 1 | 20 | 3 | |

This value is the number of attempts the synchronizer will make to close the circuit breaker. The synch fail alarm (if enabled) will be activated and the synchronizer will enter the auto-off mode if the breaker fails to close in the specified number of tries. Woodward suggests setting Close Attempts to 2 or greater for any application.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Reclose Delay | RECLOSE DELAY | Both | 1 | 1200 | 5 | Seconds |

This value is the number of seconds between attempts to close the circuit breaker. If the CB Aux contact remains closed for one reclose delay interval, synchronization is assumed to have occurred. If the CB Aux contact opens during the reclose delay interval, it is considered a failed closed attempt. The EGCP-3 will remain in the selected operating mode (run, check, or permissive) during the Reclose Delay interval.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Reclose Alarm | GEN RECLOSE ALARM | Both | 1 | 6 | 2=Warning | |

This value defines the action taken when the synchronizer has exhausted its reclose attempts without successfully closing the breaker. It applies to the generator breaker closure only.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Synchronizer Timeout | SYNC TIMEOUT | Both | 0 | 1200 | 0 | Seconds |

This value is the interval over which the synchronizer will attempt to get synchronization. A value of 0 seconds disables the Sync Timeout function. The interval begins when generator voltage is detected above the Dead Bus value and synchronization is activated. Failure to get a CB Aux contact closure within the specified time will result in a synch timeout alarm. This time includes the reclose delay and should always be longer than the reclose delay.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Synchronizer Timeout Alarm | SYNC TIMEOUT ALM | Both | 1 | 5 | 2=Warning | |

This value defines the action taken when the synchronizer has exhausted the timeout without successfully closing the generator breaker.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Dead Bus Closure | DEADBUS CLOSURE | Both | False | True | True=Enabled | |

This value enables or disables the synchronizer's automatic dead-bus detection and breaker closure functions. When enabled, the synchronizer will insure a breaker closure signal when a dead-bus is detected and the genset is ready to assume load. When disabled, the synchronizer will not be allowed to close onto a dead bus. A dead bus is when the input voltage is less than the value given in the hardware voltage range description.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Breaker Hold Time | BREAKER HOLD TIME | Both | 0.0 | 5.0 | 1.0 | Seconds |

This value specifies the maximum elapsed time the synchronizer will maintain the breaker closure relay driver output. Failure to receive the CB Aux contact signal during this interval results in a failed close attempt. The breaker closure relay driver is de-energized when: the CB Aux contact signal is received, the specified time expires, the generator is out of the phase window, the generator exceeds the slip window, or the generator voltage exceeds the voltage window (if voltage matching is enabled).

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Breaker Close Delay Time | GEN C B CLOSE DLY | Both | 0.01 | 2.0 | 0.10 | Seconds |

This value specifies the time required for the circuit breaker contacts to engage after receiving a closure command. It is normally found in the circuit breaker manufacturer's specifications. The EGCP-3 will automatically subtract this time from the calculated time to initiate breaker closure in order to maintain proper phase alignment when performing slip frequency synchronizing.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus Synchronizing Rate | BUS SYNC RATE | WW | 0 | 50 | 2.0 | Seconds |

This value is used to change the rate of the sync bias signal. The rate is changed also by the SYNC GAIN FACTOR. This value is multiplied by the SYNC GAIN FACTOR then taken to the "X" power. The "X" is equal to the number of LS units on the active bus.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Synchronizer Gain Factor | SYNC GAIN FACTOR | Both | 0.8 | 1.0 | 0.8 | |

This value specifies change in proportional gain when synchronizing a multi-genset bus to another bus, based on the single genset gain.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Synchronizer Voltage Gain | SYNC VOLTAGE GAIN | WW | 0.1 | 10.0 | 1.0 | |

This value is used to increase or decrease the rate of the voltage change during the synchronization process.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Enable Synchronizer Test | ENABLE SYNC TEST | Both | Disabled | Enabled | Disabled | |

This selects the synchronizer into test. When this value is true the synchronizer is turned on for verifying voltages and phases. When enabled the synchronizer is in the check operating mode, and the breaker close command is disabled.

## Real Load Control Menu

The Real Load Control Menu is included in both the front panel display and Watch Window. Most items appear in both. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for the list of alarm actions. It is used in a few places within the Real Load Control Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Load Control Mode | LOAD CTRL MODE | Both | False | True | True=Isoch | |

This selects the control mode. It may be Droop or Isochronous. Droop mode is used only if load sharing, BaseLoad, or process functions are not desired. The normal method is Isochronous which provides closed loop regulation of frequency and/or load control.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Load Control Proportional Gain | LOAD CTRL GAIN | Both | 0.001 | 20.00 | 0.20 | |

This value is the proportional gain of the P-I-D load controller in Droop, BaseLoad, or Process Control. It determines how fast the load control responds to a load error. Lower the value to slow the response.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Load Sharing Proportional Gain | LOAD SHARE GAIN | Both | 0.01 | 2.00 | 0.20 | |

This value is the proportional gain of a P only controller when in Isochronous load share mode. It determines how fast the load control responds to a load error. Lower the value to slow the response.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Load Integral Gain | LOAD INTEGRAL | Both | 0.00 | 20.00 | 0.15 | Repeats/sec |

This value is the integral gain of the P-I-D load controller. It determines how fast the load control responds to a load error. It prevents slow hunting and controls damping (overshoot or undershoot) after a load change. Lower the value to slow the response. In Isochronous load share mode, this value is not used, the controller is then proportional only. See section on PID tuning.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Load Derivative Gain | LOAD DERIVATIVE | Both | 0.01 | 100.00 | 100.00 | |

This value is the derivative gain of the P-I-D load controller. It determines the response of the load control for a rate of load error. In Isochronous load share mode, this value is not used. See section on PID tuning.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Load Control Filter | LOAD CTRL FILTER | Both | 0.01 | 10.00 | 1.00 | Hertz |

This value adjusts the bandwidth of the low pass filter at the load input for the load controller. Higher frequency settings than default result in faster control response, but also more response to system noise. Lower frequency settings result in slower control response and less response to noise.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| BaseLoad Reference | BASELOAD REFERENCE | Both | 0 | 30000 | 50 | *Watts |

This value is the default BaseLoad set point. This setting must be greater than the Unload Trip set point. It is the generator load level when in BaseLoad mode. This value is part of the calculation for initial loading rate.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Unload Trip Level | UNLOAD TRIP LEVEL | Both | -10 | 30000 | 10 | *Watts |

This value is the real load level where the breaker open command is given when the generator is being automatically unloaded. It is also the load reference level used when the Unload Switch is engaged. This value is part of the calculation for automatic unloading rate.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Load Droop | LOAD DROOP | Both | 0 | 50 | 5 | % |

This value is the percent speed reference bias, for full load operation when is the droop mode of load control. Droop is the default mode when load is applied to the generator but the CB Aux contact input indicates open. [The Load Droop setting is only approximate due to dependence on the gain (RPM speed change per unit of bias input) of the speed control's bias input.]

| Item | Display Name | Panel /WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Load Time | LOAD TIME | Both | 1 | 7200 | 10 | Seconds |

This value is the time required to automatically ramp the load from the zero load to the internal BaseLoad set point. The same rate is used after first closing the breaker when the units are load sharing. This rate is used to soft load the units until the load is within 2% of the load sharing signal. The Load Rate is used for manually changing load.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Unload Time | UNLOAD TIME | Both | 1 | 7200 | 10 | Seconds |

This value is the time required to automatically ramp the load from the internal BaseLoad set point to the unload trip level. This rate is used when the unit is being unloaded by sequencing or soft shutdown. The Load Rate is used for manually changing load.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Load Rate | LOAD RATE | Both | 0.01 | 100.00 | 2.00 | %KW / Sec |

This value is the rate at which the load is increased when the load is manually raised.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Unload Rate | UNLOAD RATE | Both | 0.01 | 100.00 | 2.00 | %kW / Sec |

This value is the rate at which the load is decreased when the load is manually lowered.

**NOTE**

**The following Load Level switches are not intended to be Generator Protection Functions.**

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| High Load Level Alarm | HIGH LOAD ALM | Both | 1 | 6 | 2=Warning | |

This value defines the alarm action taken when the genset load exceeds the configured High Load Level.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| High Load Alarm Level | HIGH LOAD LEVEL | Both | 0 | 30000 | 300 | *VA |

This value is the highest load that should be carried by the genset. It may be lower than the genset Rated VA but should not be higher.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Low Load Level Alarm | LOW LOAD ALM | Both | 1 | 6 | 1=Disabled | |

This value defines the alarm action taken when the genset load drops below the configured Low Load Level.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Low Load Alarm Level | LOW LOAD LEVEL | Both | 0 | 30000 | 5 | *VA |

This value is the lowest load that should be carried by the genset. It may be lower than the configured Unload Trip, if set higher will cause nuisance alarms on every unload.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| KVA Switch High Level | VA SWITCH HIGH LVL | Both | 0 | 30000 | 30 | *VA |

This value is the load level at which the KVA Switch Discrete Output (if configured) and/or KVA Switch Alarm (if configured) will be activated. Any load at or above this level will latch the output active. The output will remain active even below this level until it reaches the KVA Switch Low Level.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| KVA Switch Low Level | VA SWITCH LOW LVL | Both | 0 | 30000 | 5 | *VA |

This value is the load level at which the KVA Switch Discrete Output (if configured) and/or KVA Switch Alarm (if configured) will be de-activated. Once inactive, the switch will remain inactive until again reaching the VA Switch High Level.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| VA Switch Alarm Action | VA SWITCH ALM | WW | 1 | 6 | 1=Disabled | |

This value defines the action taken when the genset load has activated the KVA switch.

**NOTE**

**This configures an alarm function, and can be used to trigger a stored event. A Discrete Output configured for the KVA Switch will not be stored to the alarm list or alarm history.**

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Frequency Trim Enable | ENABLE FREQUENCY TRIM | WW | False | True | True=Enabled | |

Frequency trim is used primarily when the governor is operating in the droop mode. On isolated systems the frequency trim will maintain rated frequency. Typically not used with isochronous governor controls

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Frequency Trim Deadband (Hz) | FRQ TRIM DEADBND(HZ) | WW | 0.001 | 5.0 | 0.1 | Hz |

This value determines how closely the Frequency trim function will keep the bus frequency to the rated frequency.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Speed Raise Lower Pulse Frequency | SPEED R/L FREQUENCY | WW | 0.15 | 10 | 0.5 | Sec |

This value sets the pulse frequency of the Raise and Lower discrete outputs for speed/load control. A setting of 1 means that every 1 second the EGCP-3 will decide whether to make a raise or lower pulse. This setting is only applicable when the Speed Bias Type, in the First Time Config menu, is set for Raise/Lower.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Speed Raise Lower Pulse Duty Cycle | SPEED R/L DUTY CYCLE | WW | 1.0 | 99 | 50 | % |

This value sets the pulse length of the Raise and Lower discrete outputs for speed/load control. A setting of 50 means that pulse length will be 50% of the Freequency time above. If the Frequency is 1 second, then the pulse length will be 0.5 seconds, followed by a pause of 0.5 seconds. This setting is only applicable when the Speed Bias Type, in the First Time Config menu, is set for Raise/Lower.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Speed Raise Lower Pulse Deadband | SPEED R/L DEADBND(%) | WW | 0.01 | 100 | 1.0 | % |

The deadband setting is used to stop the raise lower pulses once the EGCP-3 speed or load control has reached its correct value. This setting is a window around the speed bias variable of the EGCP-3 which can be viewed on the I/O Display Screen. A setting of 1 means that the EGCP-3 will not give any pulses if the speed bias is between –1% and 1%. This setting is only applicable when the Speed Bias Type, in the First Time Config menu, is set for Raise/Lower.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Rated kW Load Derate Value | RATED LOAD DE-RATE (%) | WW | 25.0 | 125.0 | 100.0 | % |

This setting is used in conjunction with the KW De-rate Select Discrete input and the Rated W setting in the First Time Config menu. When the KW De-rate input is closed, the Rated W setting is multiplied by this %. A value of 80% for a 1000 KW generator, means that the new Rated W setting will be 800 KW. This new rating is used for the load sharing calculations and for the start stop sequencing algorithms. It is not used for any alarms. All alarms, such as Overload, will remain at their same value.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Slave Gain Scale | PROC SLAVE GAIN SCALE | WW | 0.01 | 100.0 | 1.0 | |

This setting is used to increase or decrease the reaction time of the control when in the Process slave mode. This setting was added in EGCP-3 LS revision K. Previously, the Load Share Gain setting was used for isolated loadsharing between units, and also for control with an EGCP-3 MC master control. In some applications, this one number could not satisfy both modes, so now the Load Share Gain can be scaled with this setting. The load share gain is multiplied by this number so a value of 1 is no change, a value less than 1 will reduce the response, and a value greater than 1 will increase the response.

# Reactive Load Control Menu

The Reactive Load Control Menu is included in both the front panel display and Watch Window. All items appear in both. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for configuration of alarm action. It is used in a few places within the Real Load Control Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| VAR/PF Mode | VAR/PF MODE | Both | 1 | 4 | 3=PF control | |

This value is used to select the control mode. It may be Manual, VAR control, PF control, or Remote control. Manual is only used if no automatic control is desired. Remote control is used if external equipment will control the VAR or PF through the EGCP-3. This may be useful in order to still have the ability for Raise/Lower switches and voltage matching during synchronizing. Power Factor or VAR control is used when in parallel with the mains.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| VAR/PF Control Auto/Manual Enable | VAR/PF AUTO ENABLE | WW | False | True | False= Contact Enable | |

This value can be selected to enable reactive load control from an assigned discrete input, or enable reactive load control automatically whenever the generator breaker is closed.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| VAR/PF Gain | VAR/PF GAIN | Both | 0.01 | 20.00 | 0.20 | |

This value is the proportional gain of the reactive load P-I-D controller for all modes of operation other than VAR/PF Sharing. This value determines how fast the VAR/PF control responds to an error between kVAR/PF and VAR or PF reference. The gain is set to provide stable control of kVAR or power factor. Lower the value to slow the response.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Reference Ramp Time | VOLTAGE REF RAMP TIME | Both | 0.0 | 1000.0 | 80.0 | Second |

This value specifies the time required to ramp the reactive load setpoint over its full range, PF control, VAR control, Remote control, and Manual control.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| VAR/PF Sharing Proportional Gain | VAR/PF SHARING GAIN | Both | 0.001 | 20.00 | 0.20 | |

This value is the proportional gain of the reactive load P-I-D controller when VAR/PF sharing is the active control mode. This value determines how fast the VAR/PF control responds to an error between kVAR/PF and VAR or PF reference. The gain is set to provide stable control of kVAR or power factor. Lower the value to slow the response.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| VAR/PF Integral Gain | VAR/PF INTEGRAL GN | Both | 0.00 | 20.00 | 0.10 | Repeats/Sec |

This value is the integral gain of the reactive load P-I-D controller. It determines how fast the reactive load control responds to an error between kVAR/PF and VAR or PF reference. It prevents slow hunting and controls damping (overshoot or undershoot) after a load disturbance. Lower the value to slow the response.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| KVAR Reference | KVAR REFERENCE | Both | -30000 | 30000 | 10 | *VAR |

This value specifies the desired VAR load at which to control in the VAR control mode. It is active when Reactive Load Control is active, and the mode is selected as VAR control. For monitor purposes, Watch Window displays the VAR load on the generator.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| PF Reference | PF REFERENCE | Both | -0.5 | 0.5 | 0.0 | PF |

This value specifies a value representing the PF at which to control in the PF control mode. This value is continuous over the tunable range (lag = negative) of –0.50 <-> 0.0 <-> +0.50. Where values on a Power Factor meter are discontinuous at unity (0.5 LAG <-> 1.0 .<-> 0.5 LEAD). For monitor purposes, Watch Window displays the PF Reference converted to values as seen on a PF meter, and displays the measured generator average PF.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| PF Deadband | PF DEADBAND | Both | 0.000 | 1.000 | 0.0 | PF |

This value specifies an error window about the measured PF input, inside of which the power factor control will not adjust the voltage regulator. Deadband is especially useful in systems using a MOP to adjust voltage.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Adjust On Time | VOLTS ADJUST ON TIME | Both | 0.1 | 2.0 | 0.2 | Seconds |

This value is the minimum amount of time to keep the MOP discrete output on (when configured). This is useful for controllers that require a minimum contact time to react.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Operation Voltage | OPERATION VOLTAGE | WW | 0.001 | 30000 | 480.0 | (_,k,M) Volts |

This is the voltage that the generator will excite to during start or voltage trim to during isolated operation. Example: Used on systems where the rated voltage of the generator is different from the utility or system voltage (A 13.8 kV generator operating with a 13.2 kV utility). To activate this value after a change a reset trigger must be given.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| RESET OPERATING VOLTAGE | RESET OPERATING VOLTAGE | WW | False | True | False | |

This value is used as a trigger to command the EGCP-3 to use the Operating Voltage setting above. Normally this value would be False. The user would change the value to True to set the trigger and then back to False again.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Trim Enable | VOLT TRIM ENABLE | WW | False | True | True=Enabled | |

Voltage trim is used to compensate for the droop of the voltage regulator. On isolated systems the voltage trim will maintain the operating voltage.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Trim Rate | VOLT TRIM RATE | WW | 0.0 | 10. | 1.0 | N/A |

When the Voltage Trim is active, this rate can be used to make the trim function faster or slower. Adjusting this value will depend on how quickly the voltage regulators in the system can smoothly adjust the voltage. Settings that are too high will tend to cause instability in the Power Factor sharing. Settings that are too low will cause a very slow return to the operating voltage after a load change to the system.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Trim Deadband | VOLT TRIM DEADBAND | WW | 0.01 | 100 | 1.0 | % |

This value determines how closely the Voltage trim function will keep the bus voltage to the operating voltage setpoint.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Raise Lower Pulse Frequency | VOLT R/L FREQUENCY | WW | 0.15 | 10 | 0.5 | Sec |

This value sets the pulse frequency of the Raise and Lower discrete outputs for volt/VAR control. A setting of 1 means that every 1 second the EGCP-3 will decide whether to make a raise or lower pulse. This setting is only applicable when the Voltage Bias Type, in the First Time Config menu, is set for Raise/Lower.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Raise Lower Pulse Duty Cycle | VOLT R/L DUTY CYCLE | WW | 1.0 | 99 | 50 | % |

This value sets the pulse length of the Raise and Lower discrete outputs for volt/VAR control. A setting of 50 means that pulse length will be 50% of the Frequency time above. If the Frequency is 1 second, then the pulse length will be 0.5 seconds, followed by a pause of 0.5 seconds. This setting is only applicable when the Voltage Bias Type, in the First Time Config menu, is set for Raise/Lower.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage Raise Lower Pulse Deadband | VOLT R/L DEADBND(%) | WW | 0.01 | 100 | 1.0 | % |

The deadband setting is used to stop the raise lower pulses once the EGCP-3 voltage or VAR control has reached its correct value. This setting is a window around the voltage bias variable of the EGCP-3 which can be viewed on the I/O Display Screen. A setting of 1 means that the EGCP-3 will not give any pulses if the voltage bias is between –1% and 1%. This setting is only applicable when the Voltage Bias Type, in the First Time Config menu, is set for Raise/Lower.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Isolated Power Factor Control Threshold | PF CONTROL THRESHOLD | WW | 0.1 | 10.0 | 2.0 | % |

For isolated multi-unit systems, controlling the power factor at very low loads is not practical, because the power factor ratio can change so dramatically because Reactive Load (KVAR) is higher than the Real Load (KW). This threshold turns off the EGCP-3 Power Factor control when the KVA reading is below this level. For example, a setting of 2 % means that the EGCP-3 must measure at least 2% of its rated KVA setting before the Power Factor control is enabled on an isolated bus.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| VAR/Power Factor Derivative Ratio | VAR\PF DERIV RATIO | WW | 0.001 | 100.0 | 100 | |

This value is the derivative gain of the P-I-D reactive load controller. It determines the response of the control for an error in the power factor or reactive load. A value of 100 is minimum derivative effect. A value of 1 is maximum derivative effect because this value is a ratio. Then a value of .001 is again minimum derivative effect. The closer this number is to 1, the larger the derivative effect.

## Process Control Menu

The Process Control Menu is included in both the front panel display and Watch Window. All items appear in both. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for the configuration of alarm action. It is used in a few places within the Process Control Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Proportional Gain | PROCESS GAIN | Both | 0.001 | 20.00 | 0.50 | |

This value is the proportional gain of the Process P-I-D controller. It determines how fast the process control responds to an error between process variable and process reference. Lower the value to slow the response.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Integral | PROCESS INTEGRAL | Both | 0.00 | 20.00 | 0.10 | Repeats/sec |

This value is the integral gain of the process PID controller. It determines how fast the process control responds to an error between process variable and process reference. It prevents slow hunting and controls damping (overshoot or undershoot) after a disturbance. Lower the value to slow the response.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Derivative | PROCESS DERIVATIVE | Both | 0.01 | 100.0 | 0.20 | |

This value is the derivative gain of the P-I-D load controller. It determines the response of the process control for a rate of change in the process error. See section on PID tuning.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Deadband | PROCESS DEADBAND | Both | -30000 | 30000 | 0 | User units |

This value specifies an error window about the measured process input, inside of which the process controller will not adjust its output. This is used for control of processes with a large noise component on the input. Set to 0 for normal, non-deadband control. It is configured in the same units as the process input.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Droop | PROCESS DROOP | Both | 0 | 50 | 5 | % |

This value is the process droop desired based on process level. It is typically only used on slow moving process.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Filter | PROCESS FILTER | Both | 0.01 | 10.00 | 1.00 | Hz |

This value adjusts the bandwidth of the low pass filter for the process controller. Higher frequency settings than default result in faster control response, but also more response to system noise. Lower frequency settings result in slower control response and less response to noise.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Control Setpoint | PROCESS REFERENCE | Both | -30000 | 30000 | 0 | User |

This value is the reference used by process control. It is configured in the same engineering units as the analog input sensor was calibrated.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| High Process Limit Alarm | PROC HI LVL ALM | Both | 1 | 6 | 1=Disabled | |

This value defines the action taken when the process exceeds the configured High Process Level.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process High Limit | PROCESS HIGH LVL | Both | -30000 | 30000 | 10 | User units |

This value is the highest process that should be carried by the genset. If the monitored process exceeds this level, a High Process Limit Alarm will be issued (if configured).

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Low Process Limit Alarm | PROC LOW LVL ALM | Both | 1 | 6 | 1=Disabled | |

This value is an enumerated list that defines the action taken when the process drops below the configured Low Process Level.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Process Low Limit | PROCESS LOW LVL | Both | -30000 | 30000 | -10 | User units |

This value is the lowest process that should be carried by the genset. If the monitored process drops below this level, a Low Process Limit Alarm will be issued (if configured).

## Transfer Switch Menu

The Transfer Switch Menu is included in both the front panel display and Watch Window. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for the of alarm action. It is used in the Transfer Switch Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator Stable Delay | GEN STABLE DELAY | Both | 1 | 30000 | 30 | Seconds |

This value is the amount of time the generator must be running stable at rated speed and rated voltage before the control will allow closing of the generator breaker (Dead Bus) or activating the synchronizer to close the generator breaker.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| EPS Supplying Load Alarm | EPS SUP LOAD ALM | Panel | 1 | 4 | 1=Disabled | |

This value selects the action taken when the genset is supplying the load (Gen Breaker is closed) without the mains present (a configurable discrete input is selected as the Mains breaker aux input, and it is open).

## Sequencing Menu

The Sequencing Menu is included in both the front panel display and Watch Window. One additional item appears in Watch Window. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for configuration of alarm action. It is used in a few places within the Sequencing Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Start/Stop Sequencing logic | RUN TIME MANAGER | Both | 0 | 5 | 5=Unit Number | |

The sequence function is performed between LS units on the same active bus segment. It may also be initiated by a Master Controller (MC) but the negotiation between units is performed by the slaves themselves with the start and stop order determined by the run-time mode. All modes require the next unit to also be in the Start Ready State. This value is used to select the run-time mode
**0=Disabled:** This unit will not be included in the auto stop/start sequence with other LS connected to the bus. In First Time Setup, the parameter ENABLE START SEQUENCE will have to be set to False to disable this control from responding to start/stop commands from a Master Control.
**1=Staggered Run-Time:** The next genset to start/stop will be based on the service hour time of each unit on the bus. When staggered is selected the control selects units so no more than one service hour meter reaches 0.0 at the same time. The next unit to start will therefore be the unit with the lowest Service hour meter. Next stop will be the unit with the highest service hour time meter
**2=Equal Run-Time:** Next unit to start will have the highest Service hours meter. Next stop will be the unit with the lowest service hours meter
**3=Largest 1st**: Will start the largest rated power unit next. Smallest power will stop first.
**4=Smallest 1st:** Will start the smallest rated power unit next. Largest power will stop first.

**5=Unit Number:** the unit with the lowest unit number will started next, and stop first.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Start Delay above Max Load Level | MAX LOAD DELAY | Both | 1 | 1200 | 30 | Sec |

When this genset is at or above the Maximum Load Level for this delay time, a start command will be given to the next scheduled unit.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Start Delay above Rated Load Level | RATED LOAD DELAY | Both | 1 | 1200 | 2 | Sec |

When this genset is at or above 100% Load Level for this delay time, a start command will be given to the next scheduled unit.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Stop Delay below minimum Load Level | REDUCED LOAD DELAY | Both | 1 | 1200 | 30 | Sec |

When this genset is at or below the Minimum Load Level for this delay time, a stop command will be given to the next scheduled unit.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Maximum % Load to Trigger a Start | MAX LOAD LVL | Both | 1 | 100 | 80 | % |

The desired upper load level for this genset, when demand is above this level a start command will be given to the next scheduled unit

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Minimum % Load to Trigger a Stop | MIN LOAD LVL | Both | 1 | 100 | 30 | % |

The desired lower load level for this genset, when demand is below this level a stop command will be given to the next scheduled unit

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Time to Stop a Genset | STOP GENSET TIME | Both | 1 | 30000 | 3 | Sec |

After a stop command is issued, this is the amount of time the control waits to send out another stop command. If the commanded genset does not stop after the third attempt the failed to stop sequence alarm is triggered.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Time to Start a Genset | START GENSET TIME | Both | 1 | 30000 | 60 | Sec |

After a start command is issued, this is the amount of time the control waits to send another start command. If the commanded genset does not start after the third attempt the failed to start sequence alarm is triggered.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Interval for Next Scheduled Service | SERVICE INTERVAL | Both | 0 | 32000 | 0 | Hrs |

This value is the number of hours until the next scheduled service. When the Service Hour Meter counts down to 0.0 or below, a Service Hour Alarm will be activated.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Service Hour Clock Reset | RESET SERVICE HOURS | Both | False | True | False | |

Setting this value TRUE then False will initialize the Service Hour Meter to the Service Interval time. The service hour reset must be used every time the service hour meter is set.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Failed Auto Start Sequence Alarm Action | AUTO START SEQ ALM | Both | 1 | 4 | 2=Warning | |

This value is the action taken when the genset fails to start when triggered from LON.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Failed Auto Stop Sequence Alarm Action | AUTO STOP SEQ ALM | Both | 1 | 4 | 2=Warning | |

This value is the action taken when the genset fails to stop when triggered from LON.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Service Hour Alarm Action | SERVICE HOURS ALARM | Both | 1 | 5 | 1=Disabled | |

This value is the action taken when the engine service hour meter has reached 0.0 and the genset is due for service.

The Watch Window K SEQUENCING sheet has Displays monitoring and troubleshooting information:
**LON NODE NUMBER-** This is a number that represents all nodes that are responding on the LON network.
**LON FAULT STATUS-** False when all there are no faults
**TIE BREAKER STATUS-** for W, X, Y, and Z segment breakers, true indicates a closed breaker
**NODES ON ACTIVE BUS-** Number of units communicating by LON that are on this units same bus segment
**NODES ON NETWORK-** Number units (LS and MC) communicating on the LON

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Clear Failed deadbus close attempt | CLEAR DEADBUS ATTEMPTS | WW | False | True | False | |

If a node wins the arbitration to close onto a dead bus, and fails to close, this input field is used to determine the failed nodes arbitration status. If the "Clear Attempt" input field is FALSE, all other nodes will be allowed to close before the failing node is allowed back into the arbitration. If all nodes were to fail, all nodes would again be equal in the arbitration algorithm. If the "Clear Attempt" input field is TRUE, the failing node is allowed back into the arbitration at the same priority as all other nodes.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Enable Bus to Bus Synchronization | ENABLE EXT LS TIE SYNCH | WW | False | True | False | |

Needs to be enabled for the EGCP-3 to react to contact inputs from an external synchronizer to perform bus to bus synchronizing. The LS unit then broadcasts a sync bias level to all LS units on the same bus segment.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus to Bus Synch Reset Time | LS TIE SYNC BIAS RESET | WW | 0.0 | 300.0 | 10.0 | Sec |

This timer resets the control after an attempt to synchronize bus to bus. Any speed or voltage change that was added from the sync attempt will be removed.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus to Bus Synch Frequency Gain | LS TIE SYNC FREQ GAIN | WW | 0.01 | 10.0 | 1.0 | |

This value is used to increase or decrease the affect of the bus to bus synchronization on the frequency adjustment. Larger values will give the Bus to Bus synchronizing more frequency change. Smaller values reduce the frequency change.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Bus to Bus Synch Voltage Gain | LS TIE SYNC VOLT GAIN | WW | 0.01 | 10.0 | 1.0 | |

This value is used to increase or decrease the affect of the bus to bus synchronization on the voltage adjustment. Larger values will give the Bus to Bus synchronizing more voltage change. Smaller values reduce the voltage change.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Auto Start With Trip Alarm | AUTO STRT W/TRIP TIE | WW | False | True | False | |

When enabled the LS will start automatically when any alarm is configured for **Trip Tie** or **Trip Tie with alarm**, and that alarm condition occurs. Only when the LS is in Auto. This feature is used primarily for isolated prime power systems where start stop sequencing is Enabled. If the Bus Undervoltage alarm for example were set to Trip Tie, then any EGCP-3 units in Auto would start when this alarm occurred.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Expected Number of Nodes in the System | EXPECTED NODE NUMBER | WW | 1 | 16 | 1 | |

If the Net Nodes from the LON do not match this number, and a digital output is configured for LON Node Num Mismatch, the digital output will be set. Used to validate LON health.

## Communications Menu

The Communications Menu is included in both the front panel display and Watch Window. Some items will only appear through Watch Window. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 1 Type | SERIAL 1 TYPE | Both | 1 | 3 | 1=RS232 | |

This value is an enumerated list used to select the serial hardware interface for Serial Port 1. It may be RS232 =1, RS422 =2, or RS485 =3. See the EGCP-3 Installation Manual for details on each.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 1 Mode | SERIAL 1 MODE | Both | 1 | 2 | 2=ServLink | |

This value is an enumerated list used to select the software protocol interface for Serial Port 1. It may be Modbus =1 or ServLink =2. Selecting Modbus will enable the Modbus RTU slave serial protocol. Selecting ServLink will enable the Woodward ServLink server protocol.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 1 Baud Rate | SERIAL 1 BAUD | Both | 7 | 12 | 11=57,600 | |

This value selects the serial baud rate for Serial Port1. The following table lists the possible baud rates:

| Value | Baud Rate |
|---|---|
| 12 | 115,200 |
| 11 | 57,600 |
| 10 | 38,400 |
| 9 | 19,200 |
| 8 | 9600 |
| 7 | 4800 |

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 1 Bits | SERIAL 1 BITS | WW | 1 | 2 | 2=8 bits | |

This value is an enumerated list used to select the number of bits for Serial Port 1. It may be 1 = 7 Bits or 2 = 8 Bits.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 1 Stop Bits | SERIAL 1 STOP BITS | WW | 1 | 3 | 1=1 Stop Bit | |

This value is an enumerated list used to select the number of stop bits for Serial Port 1. It may be 1 = 1 stop bit or 2 = 2 stop bits or 3 = 1.5 stop bits.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 1 Parity | SERIAL 1 PARITY | WW | 1 | 3 | 1=1 No Parity | |

This value is an enumerated list used to select the parity for Serial Port 1. It may be 1 = No Parity or 2 = Odd or 3 = Even.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Modbus Network Address | MODBUS ID | Both | 1 | 257 | 1 | |

This value is used when communicating to several Modbus items on the same serial cable. This number assigns an address to the Modbus for this unit.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Modbus Reset | MODBUS RESET | Both | False | True | False | |

This value when set true will reset the faults on the Modbus port.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 2 Type | SERIAL 2 TYPE | Both | 1 | 3 | 1=RS232 | |

This value is an enumerated list used to select the serial hardware interface for Serial Port 2. It may be RS232, RS422, or RS485. See the EGCP-3 Installation Manual for details on each.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 2 Baud Rate | SERIAL 2 BAUD | Both | 7 | 12 | 11=57600 | |

This value selects the serial baud rate for Serial Port2. See Serial 1 Baud Rate for a list of possible choices.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 2 Bits | SERIAL 2 BITS | WW | 1 | 2 | 2=8 bits | |

This value is an enumerated list used to select the number of bits for Serial Port 2. It may be 1 = 7 Bits or 2 = 8 Bits.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 2 Stop Bits | SERIAL 2 STOP BITS | WW | 1 | 3 | 1=1 Stop Bit | |

This value is an enumerated list used to select the number of stop bits for Serial Port 2. It may be 1 = 1 stop bit or 2 = 2 stop bits or 3 = 1.5 stop bits.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 2 Parity | SERIAL 2 PARITY | WW | 1 | 3 | 1=1 No Parity | |

This value is an enumerated list used to select the parity for Serial Port 2. It may be 1 = No Parity or 2 = Odd or 3 = Even.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 3 Baud Rate | SERIAL 3 BAUD | Both | 7 | 12 | 12=115200 | |

This value selects the serial baud rate for Serial Port3. See Serial 1 Baud Rate for a list of possible choices.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 3 Bits | SERIAL 3 BITS | WW | 1 | 2 | 2=8 bits | |

This value is an enumerated list used to select the number of bits for Serial Port 3. It may be 1 = 7 Bits or 2 = 8 Bits.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 3 Stop Bits | SERIAL 3 STOP BITS | WW | 1 | 3 | 1=1 Stop Bit | |

This value is an enumerated list used to select the number of stop bits for Serial Port 3. It may be 1 = 1 stop bit or 2 = 2 stop bits or 3 = 1.5 stop bits.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Serial 3 Parity | SERIAL 3 PARITY | WW | 1 | 3 | 1=1 No Parity | |

This value is an enumerated list used to select the parity for Serial Port 3. It may be 1 = No Parity or 2 = Odd or 3 = Even.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Modbus Network Address | MODBUS ID | Both | 1 | 257 | 1 | |

This value is used when communicating to several Modbus items on the same serial cable. This number assigns an address to the Modbus for this unit.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Modbus Reset | MODBUS RESET | Both | False | True | False | |

This value when set true will reset the faults on the Modbus port.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Modbus Timeout | MODBUS TIMEOUT | WW | 0.1 | 100.0 | 3.0 | Seconds |

This value defines the amount of time that must pass without communication from the Master before announcing a Link Failure. The same timeout is used for Serial Port 2 and Serial Port 1 if Serial Port 1 is configured as a Modbus port. However, the alarms generated by this timeout are specific for each serial port.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Port 1 Timeout Alarm Action | PORT 1 TIMEOUT ALARM | WW | 1 | 6 | 1=Disabled | |

This value defines the action taken when the Serial Port 1 fails to communicate within the time-out period.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Port 2 Timeout Alarm Action | PORT 2 TIMEOUT ALARM | WW | 1 | 6 | 1=Disabled | |

This value defines the action taken when the Serial Port 2 fails to communicate within the time-out period.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Modbus Multiplier for Gen Voltage | MBUS MULT – GEN VOLT | WW | 1 | 4 | 1=1X Multiplier | |
| Modbus Multiplier for Gen Current | MBUS MULT – GEN CURRENT | WW | 1 | 4 | 1=1X Multiplier | |
| Modbus Multiplier for Gen Power | MBUS MULT – GEN POWER | WW | 1 | 4 | 1=1X Multiplier | |
| Modbus Multiplier for Bus Voltage | MBUS MULT – BUS VOLT | WW | 1 | 4 | 1=1X Multiplier | |
| Modbus Multiplier for Bus Current | MBUS MULT – BUS CURRENT | WW | 1 | 4 | 1=1X Multiplier | |
| Modbus Multiplier for Bus Power | MBUS MULT – BUS POWER | WW | 1 | 4 | 1=1X Multiplier | |
| Modbus Multiplier for Baseload Reference | MBUS MULT - BASELOAD REF | WW | 1 | 4 | 1=1X Multiplier | |
| Modbus Multiplier for VAR Reference | MBUS MULT - VAR REF | WW | 1 | 4 | 1=1X Multiplier | |

This value defines the multiplier used hen sending a value over Modbus. The multiplier moves the decimal of the value so Modbus can have more resolution. For example if the value was 2.0 kV, and you used a multiplier of 1000 the Modbus value would be 2000. See the table below for the multiplier list.

| | |
|---|---|
| 1 | X 1 |
| 2 | X10 |
| 3 | X100 |
| 4 | X1000 |

## Calibration Menu

The Calibration Menu is included in both the front panel display and Watch Window. Some items appear only on the front panel but others are included on both the front panel and in Watch Window. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Day of Week | DAY OF WEEK | Panel | Sunday | Saturday | Sunday | |

This value selects the current day of the week. It is part of the date and time configuration. The EGCP-3 has a battery backed real time clock that, once properly configured, will keep the date, time, and day of week even if control power is removed. This configurable appears in the Calibration Menu when viewing the menu through the front panel. When set on the panel, the day-of-week will not update until Enter is pressed while in the SET DATE menu. Below is a description of setting the day by Watch Window.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Set Date | SET DATE | Panel | | | 01-JAN-2001 | |

This value is the exact day in a calendar year. The Day, Month, and Year are independently configurable as separate fields. Use the navigation keys to select and change each field separately. The EGCP-3 has a battery backed real time clock that, once properly configured, will keep the date, time, and day of week even if control power is removed. This configurable appears in the Calibration Menu when viewing the menu through the front panel. Below is a description of setting the date by Watch Window.

| Item | Display Name | Panel /WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Set Time | SET TIME | Panel | | | 00:00 | |

This value is the exact time of day. The Hours, and Minutes, are independently configurable as separate fields. Use the navigation keys to select and change each one separately. The clock is a 24-hour clock, enter 6 pm as 18. When the Enter key is pressed the clock will be initialized to the Hour and minute and 0.0 seconds. The EGCP-3 has a battery backed real time clock that, once properly configured, will keep the date, time, and day of week even if control power is removed. This configurable appears in the Calibration Menu when viewing the menu through the front panel. Below is a description of setting the time by Watch Window.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Current year | UPDATE YEAR TO: | WW | 2000 | 2070 | 2001 | |

Numerical value of the present year.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Current month | UPDATE MONTH TO: | WW | 1 | 12 | 1=JAN | |

The convention of the value is January = 1, February = 2, etc.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Current date | UPDATE DATE TO: | WW | 1 | 31 | 1 | |

Numerical entry of calendar date 1-31.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Current day of Week | UPDATE CURRENT DAY TO: | WW | 1 | 7 | 1=Sunday | |

The convention of the value is Sunday = 1, Monday = 2, etc.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Set Calendar | UPDATE CALENDAR TRIGGER | WW | FALSE | TRUE | FALSE | |

Adjust the above calendar parameters to indicate the current date. The EGCP-3 calendar will not change until the Up Date Calendar trigger is set TRUE, then FALSE.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Current time(hour) | UPDATE HOURS TO: | WW | 0 | 24 | 0 | |

Clock hours, 24 hour clock.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Current time (minutes) | UPDATE MINUTES TO: | WW | 0 | 59 | 0 | |

Clock minutes.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Set Clock | UPDATE CLOCK TRIGGER | WW | FALSE | TRUE | FALSE | |

Adjust the clock parameters above to the current time. The EGCP-3 clock will be set to these values when the trigger is set TRUE, the seconds will be set to 0.0. The trigger must then be returned to FALSE.

The next lines on the sheet will display the current time, date and day-of-week from the EGCP-3 to verify its setting.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Speed Bias Offset | SPEED BIAS OFFSET | Both | -100 | 100 | 0 | |
| Voltage Bias Offset | VOLTAGE BIAS OFFSET | Both | -100 | 100 | 0 | |

The Offset of the Bias outputs can be used to adjust the “off” setting to give rated voltage or rated speed when the EGCP-3 is not in control. See the Calibration Chapter of this manual.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Generator A∅ Voltage Scale Factor | GEN A∅ VOLTAGE SCALE | Both | 0.5 | 1.5 | 1 | |
| Generator B∅ Voltage Scale Factor | GEN B∅ VOLTAGE SCALE | Both | 0.5 | 1.5 | 1 | |
| Generator C∅ Voltage Scale Factor | GEN C∅ VOLTAGE SCALE | Both | 0.5 | 1.5 | 1 | |
| Generator A∅ Current Scale Factor | GEN A∅ CURRENT SCALE | Both | 0.5 | 1.5 | 1 | |
| Generator B∅ Current Scale Factor | GEN B∅ CURRENT SCALE | Both | 0.5 | 1.5 | 1 | |
| Generator C∅ Current Scale Factor | GEN C∅ CURRENT SCALE | Both | 0.5 | 1.5 | 1 | |
| Bus A∅ Voltage Scale Factor | BUS A∅ VOLT SCALE | Both | 0.5 | 1.5 | 1 | |
| Bus B∅ Voltage Scale Factor | BUS B∅ VOLT SCALE | Both | 0.5 | 1.5 | 1 | |
| Bus C∅ Voltage Scale Factor | BUS C∅ VOLT SCALE | Both | 0.5 | 1.5 | 1 | |
| Bus A∅ Current Scale Factor | BUS A∅ CURR SCALE | Both | 0.5 | 1.5 | 1 | |
| Bus B∅ Current Scale Factor | BUS B∅ CURR SCALE | Both | 0.5 | 1.5 | 1 | |
| Bus C∅ Current Scale Factor | BUS C∅ CURR SCALE | Both | 0.5 | 1.5 | 1 | |

The Scale setting is used to match the input value and the EGCP-3 displayed value. From Watch Window the EGCP-3 measured value is also monitored here to assist with calibration. These items are discussed in the Calibration Chapter of this manual.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Operator Password | OPERATOR PASSWORD | Both | 0 | 9999 | 9002 | |

This value is the password to use when logging in at the Operator Level. It can only be changed if logged in as a Technician.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Supervisor Password | SUPERVISOR PASSWORD | Both | 0 | 9999 | 9003 | |

This value is the password to use when logging in at the Supervisor Level. It can only be changed if logged in as a Technician or Factory.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Technician Password | TECHNICIAN PASSWORD | Both | 0 | 9999 | 9004 | |

This value is the password to use when logging in at the Technician Level. It can only be changed if logged in as a Technician or Factory.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Factory Password | FACTORY PASSWORD | Both | 0 | 9999 | 9005 | |

This value is the password to use when logging in at the Factory Level. It can only be changed if logged in at the Factory Level.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Disable Passwords | DISABLE PASSWORDS | Both | True | False | FALSE | |

This value can be True of False. If set to False, passwords are enabled to prevent unauthorized alteration of critical parameters. If set to True, anyone can change any value in the control. Technician level access is required to change this parameter. This value will automatically revert to False when the control power is cycled off and on.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Clear Alarms With No Password Entered | CLEAR ALARM NO PASSWORD | WW | True | False | FALSE | |

This value can be True of False. If set to False, the user must enter a password level of operator or higher to clear alarms. If set to True no password level is required to clear alarms. Alarms will still remain in the Alarm History Log for either case.

**WARNING—ALARM CLEAR**

**The unit may start unintentionally if a fault, which caused the unit to shut down, is cleared and the operating mode is enabled for Automatic Starting. Before clearing the fault, check the cause of the fault, in order to protect operating personnel located in the vicinity against injuries, and to protect the engine against unintentional damage.**

⇒ **If the cause of the fault is not known or is unclear, NEVER press the ALARM CLEAR KEY.**

## Remote Alarm Menu

The Remote Alarm Menu is included in both the front panel display and Watch Window. Some items appear only through Watch Window. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

Refer to Table 3-2 for the enumerated list for configuration of alarm action. It is used in a few places within the Remote Alarm Menu.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Remote Alarm 1 | REMOTE ALARM 1 | Both | 1 | 8 | 1=Disabled | |
| Remote Alarm 1 Delay | REMOTE ALARM 1 DLY | Both | 0.0 | 30.0 | 0.0 | Seconds |
| Remote Alarm 1 Level | REMOTE ALARM 1 LVL | Both | False | True | True=Active High | |
| Remote Alarm 1 Label | REMOTE ALARM 1 LABEL | WW | | ~~~~ | REMOTE FAULT 1 | ASCII |
| Remote Alarm 1 Engine Enable | RM1 COND W/ENGINE RUN | WW | False | True | True=Wait for Engine Run | |

This group of 4 configurable items is used to configure Remote Alarm #1. This group can be configured and used even if no Digital Input is configured for Remote Alarm #1. In the case where no Digital Input is configured for Remote Alarm #1, the Alarm can be activated and de-activated via Modbus by changing the “input state” of Remote Alarm Input #1 with Boolean Write commands.

The Remote Alarm 1 value is the action taken when the input is activated.

The Remote Alarm 1 Delay value is the time to wait after activation of the input prior to announcing the alarm condition.

The Remote Alarm 1 Level is used to configure how the EGCP-3 interprets the input state. If set to Active Low, the absence of an input at the Digital Input terminals will be considered an active alarm. This mode is useful for normally closed contacts. If configured to Active High, Application of voltage at the Digital Input terminals will be considered an active alarm. If using Modbus to set the alarm states, only High should be used.

The Remote Alarm 1 Label is used to provide a customized name for the actual device connected to the input. It is limited to 20 characters all of which must be ASCII characters {within the range of ASCII(20) ‘space’, to ASCII(7E) ‘~’}.

The Remote Alarm 1 Engine Enable is used to disable the remote alarm until the engine is running. If this value is false, the remote alarm will always be active.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Remote Alarm 2 | REMOTE ALARM 2 | Both | 1 | 8 | 1=Disabled | |
| Remote Alarm 2 Delay | REMOTE ALARM 2 DLY | Both | 0.0 | 30.0 | 0.0 | Seconds |
| Remote Alarm 2 Level | REMOTE ALARM 2 LVL | Both | False | True | True=Active High | |
| Remote Alarm 2 Label | REMOTE ALARM 2 LABEL | WW | | ~~~~ | REMOTE FAULT 2 | ASCII |
| Remote Alarm 2 Engine Enable | RM2 COND W/ENGINE RUN | WW | False | True | True=Wait for Engine Run | |

See Remote Alarm 1 above for configuration description.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Remote Alarm 3 | REMOTE ALARM 3 | Both | 1 | 8 | 1=Disabled | |
| Remote Alarm 3 Delay | REMOTE ALARM 3 DLY | Both | 0.0 | 30.0 | 0.0 | Seconds |
| Remote Alarm 3 Level | REMOTE ALARM 3 LVL | Both | False | True | True=Active High | |
| Remote Alarm 3 Label | REMOTE ALARM 3 LABEL | WW | | ~~~~ | REMOTE FAULT 3 | ASCII |
| Remote Alarm 3 Engine Enable | RM3 COND W/ENGINE RUN | WW | False | True | Tru=Wait for Engine Run | |

See Remote Alarm 1 above for configuration description.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Remote Alarm 4 | REMOTE ALARM 4 | Both | 1 | 8 | 1=Disabled | |
| Remote Alarm 4 Delay | REMOTE ALARM 4 DLY | Both | 0.0 | 30.0 | 0.0 | Seconds |
| Remote Alarm 4 Level | REMOTE ALARM 4 LVL | Both | False | True | True=Active High | |
| Remote Alarm 4 Label | REMOTE ALARM 4 LABEL | WW | | ~~~~ | REMOTE FAULT 4 | ASCII |
| Remote Alarm 4 Engine Enable | RM4 COND W/ENGINE RUN | WW | False | True | True=Wait for Engine Run | |

See Remote Alarm 1 above for configuration description.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Remote Alarm 5 | REMOTE ALARM 5 | Both | 1 | 8 | 1=Disabled | |
| Remote Alarm 5 Delay | REMOTE ALARM 5 DLY | Both | 0.0 | 30.0 | 0.0 | Seconds |
| Remote Alarm 5 Level | REMOTE ALARM 5 LVL | Both | False | True | True=Active High | |
| Remote Alarm 5 Label | REMOTE ALARM 5 LABEL | WW | | ~~~~ | REMOTE FAULT 5 | ASCII |
| Remote Alarm 5 Engine Enable | RM5 COND W/ENGINE RUN | WW | False | True | True=Wait for Engine Run | |

See Remote Alarm 1 above for configuration description.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Remote Alarm 6 | REMOTE ALARM 6 | Both | 1 | 8 | 1=Disabled | |
| Remote Alarm 6 Delay | REMOTE ALARM 6 DLY | Both | 0.0 | 30.0 | 0.0 | Seconds |
| Remote Alarm 6 Level | REMOTE ALARM 6 LVL | Both | False | True | True=Active High | |
| Remote Alarm 6 Label | REMOTE ALARM 6 LABEL | WW | | ~~~~ | REMOTE FAULT 6 | ASCII |
| Remote Alarm 6 Engine Enable | RM6 COND W/ENGINE RUN | WW | False | True | True=Wait for Engine Run | |

See Remote Alarm 1 above for configuration description.

## Force Relay Menu

The items in the first Watch Window Digital Outputs menu are shown below. Items shown below only appear in Watch Window and will follow the Remote Alarms Menu. Items in this menu are part of a Service Block. These configuration points are to be used for troubleshooting only. If any are set true, the corresponding digital output will be turned “on” so that wiring can be tested.

The fist parameter, ENABLE RELAY FORCING, must be set to TRUE before the relays can be manually energized. To enable the test the genset must have these conditions True: Technician or higher Password, Engine stopped, Fuel shutoff output off, and generator output off. If any of these condition become false, the relay test will return all relays to their normal conditions. The FORCING ENABLE should be returned to False when the test is completed. After 60 minutes, the force mode will be disabled.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Enable Relay Forcing Test | ENABLE RELAY FORCING | WW | False | True | False | |
| Force DO 1 | ENERGIZE RELAY 1 | WW | False | True | FALSE=off | |
| Force DO 2 | ENERGIZE RELAY 2 | WW | False | True | FALSE=off | |
| Force DO 3 | ENERGIZE RELAY 3 | WW | False | True | FALSE=off | |
| Force DO 4 | ENERGIZE RELAY 4 | WW | False | True | FALSE=off | |
| Force DO 5 | ENERGIZE RELAY 5 | WW | False | True | FALSE=off | |
| Force DO 6 | ENERGIZE RELAY 6 | WW | False | True | FALSE=off | |
| Force DO 7 | ENERGIZE RELAY 7 | WW | False | True | FALSE=off | |
| Force DO 8 | ENERGIZE RELAY 8 | WW | False | True | FALSE=off | |
| Force DO 9 | ENERGIZE RELAY 9 | WW | False | True | FALSE=off | |
| Force DO 10 | ENERGIZE RELAY 10 | WW | False | True | FALSE=off | |
| Force DO 11 | ENERGIZE RELAY 11 | WW | False | True | FALSE=off | |
| Force DO 12 | ENERGIZE RELAY 12 | WW | False | True | FALSE=off | |

## Analog Outputs Menu

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Analog output 1 Function | ANOUT1 FUNCTION | Both | 1 | 18 | 2=Synchroscope | |
| Input Value at Max output | ANOUT1 HI CAL VALUE | Both | -30000 | 30000 | 200 | |
| Input Value at Minimum | ANOUT1 LO CAL VALUE | Both | -30000 | 30000 | -200 | |

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Analog output 2 Function | ANOUT2 FUNCTION | Both | 1 | 18 | 1=Not Used | |
| Input Value at Max output | ANOUT2 HI CAL VALUE | Both | -30000 | 30000 | 100 | |
| Input Value at Minimum | ANOUT2 LO CAL VALUE | Both | -30000 | 30000 | 0 | |

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Analog output 3 Function | ANOUT3 FUNCTION | Both | 1 | 18 | 1=Not Used | |
| Input Value at Max output | ANOUT3 HI CAL VALUE | Both | -30000 | 30000 | 100 | |
| Input Value at Minimum | ANOUT3 LO CAL VALUE | Both | -30000 | 30000 | 0 | |

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Analog output 4 Function | ANOUT4 FUNCTION | Both | 1 | 18 | 1=Not Used | |
| Input Value at Max output | ANOUT4 HI CAL VALUE | Both | -30000 | 30000 | 100 | |
| Input Value at Minimum | ANOUT4 LO CAL VALUE | Both | -30000 | 30000 | 0 | |

| Value | Command | Display | Notes |
|---|---|---|---|
| 18 | System Load | System Load | |
| 17 | Unit Load | Unit Load | |
| 16 | Bus Power Factor | BUS Power Factor | |
| 15 | Bus Frequency Meter | BUS Freq Meter | |
| 14 | Bus KVAR Meter | BUS KVAR Meter | |
| 13 | Bus KVA Meter | BUS KVA Meter | |
| 12 | Bus KW Meter | BUS KW Meter | |
| 11 | Bus Current Meter | BUS Current Meter | |
| 10 | Bus Voltage Meter | Bus Voltage Meter | |
| 9 | Generator Power Factor | Gen Power Factor | |
| 8 | Generator Frequency Meter | Gen Freq Meter | |
| 7 | Generator KVAR Meter | Gen KVAR Meter | |
| 6 | Generator KVA Meter | Gen KVA Meter | |
| 5 | Generator KW Meter | Gen KW Meter | |
| 4 | Generator Current Meter | Gen Current Meter | |
| 3 | Generator Voltage Meter | Gen Voltage Meter | |
| 2 | Synchroscope | Synchroscope | |
| 1 | Not Used | Not Used | |

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Speed Bias Max Limit | SPEED BIAS MAX LIMIT | WW | -100 | 100 | 100 | % |
| Speed Bias Min Limit | SPEED BIAS MIN LIMIT | WW | -100 | 100 | -100 | % |

The Min and Max limits for the speed bias signal can be used to clamp the output range. For example, if the Speed Bias Output is programmed for a ±3 Vdc signal, this could be clamped to a ±2 Vdc output by setting the Max to 66 and the Min to –66.

## Analog Inputs Menu

The Analog Input Menu is included in both the front panel display and Watch Window. Some items appear only in Watch Window, but others are included on both the front panel and in Watch Window. Items in it can be viewed and edited with caution while the engine is running. Items in this menu are part of a Service block.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage or Current input Selection | ANALOG INPUT 1 TYPE | Both | 1 | 3 | 1=4–20 mA | |
| User Defined Label | ANALOG IN 1 LABEL | WW | | ~~~~ | H2O TEMP | ASCII |
| Sensor Value at Minimum Input | ANIN1 LOW CAL VALUE (C) | Both | -3000 | 3000 | 0.0 | Deg C |
| Sensor Value at Maximum Input | ANIN1 HIGH CAL VALUE (C) | Both | -3000 | 3000 | 100.0 | Deg C |

The function of Analog Input 1 is the Engine Coolant temperature input. In this menu the user defines the input type and calibration values. For the input type 1=4–20 mA, 2=1–5 V, and 3=not used. The Sensor temperature for minimum (1.0 V or 4.0 mA) output, and the temperature for maximum output (5.0 V or 20.0 mA). The calibration values must be entered in degrees centigrade. The label may be changed to a user defined ASCII string.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage or Current input Selection | ANALOG INPUT 2 TYPE | Both | 1 | 3 | 1=4–20 mA | |
| User Defined Label | ANALOG IN 2 LABEL | WW | | ~~~~ | OIL PRESS | ASCII |
| Sensor Value at Minimum Input | ANIN2 LOW CAL VALUE (C) | Both | -3000 | 3000 | 0.0 | KPA |
| Sensor Value at Maximum Input | ANIN2 HIGH CAL VALUE (C) | Both | -3000 | 3000 | 100.0 | KPA |

The function of Analog input 2 is the Engine Lube Oil pressure input. In this menu the user defines the input type and calibration values. For the input type 1=4–20 mA, 2=1–5 V, and 3=not used. The Sensor pressure for minimum (1.0 V or 4.0 mA) output, and the pressure for maximum output (5.0 V or 20.0 mA). The calibration values must be entered in Kilopascal-Absolute units. The label may be changed to a user defined ASCII string.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage or Current input Selection | ANALOG INPUT 3 TYPE | Both | 1 | 3 | 1=4–20 mA | |
| User Defined Label | ANALOG IN 3 LABEL | WW | | ~~~~ | ANALOG IN 3 | ASCII |
| Sensor Value at Minimum Input | ANIN3 LOW CAL VALUE | Both | -3000 | 3000 | 0.0 | User |
| Sensor Value at Maximum Input | ANIN3 HIGH CAL VALUE | Both | -3000 | 3000 | 100.0 | User |
| High Alarm Action | ANIN3 HIGH ALARM | Both | 1 | 8 | 1=Disabled | |
| High Alarm Level | ANIN3 HIGH ALARM LEVEL | Both | -3000 | 3000 | 100.0 | User |
| High Pre-alarm Action | ANIN3 HIGH PRE-ALARM | WW | 1 | 8 | 1=Disabled | |
| High Pre-alarm Action | ANIN3 HIGH PRE-ALARM LVL | WW | -9999 | 9999 | 100.0 | User |
| Low Pre-alarm Action | ANIN3 LOW PRE-ALARM | WW | 1 | 8 | 1=Disabled | |
| Low Pre-alarm Level | ANIN3 LOW PRE-ALARM LVL | WW | -9999 | 9999 | 0.0 | User |
| Low Alarm Action | ANIN3 LOW ALARM | Both | 1 | 8 | 1=Disabled | |
| Low Alarm Level | ANIN3 LOW ALARM LEVEL | Both | -3000 | 3000 | 0.0 | User |
| Pre Alarm Delay Time | ANIN3 PRE-ALARM DELAY | WW | 0.10 | 1200 | 5.0 | Sec |
| Alarm Delay Time | ANIN3 ALARM DELAY | Both | 0.10 | 1200 | 10.0 | Sec |

The configurable function of inputs 3 and 4 is selected in the First Time Configuration Menu. In this menu the user defines the input type and calibration values for all inputs. Inputs 3 and 4 the can be configured for an alarm function and the alarm action and alarm levels are set here. For the input type 1=4–20 mA, 2=1–5 V, and 3=not used. When analog input 3 or 4 is configured as process input or an external reference, the alarm action and level setpoints are configured for input out-of-range sensing.

| Item | Display Name | Panel / WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Voltage or Current input Selection | ANALOG INPUT 4 TYPE | Both | 1 | 3 | 1=4–20 mA | |
| User Defined Label | ANALOG IN 4 LABEL | WW | | ~~~~ | ANALOG IN 4 | ASCII |
| Sensor Value at Minimum Input | ANIN4 LOW CAL VALUE | Both | -3000 | 3000 | 0.0 | User |
| Sensor Value at Maximum Input | ANIN4 HIGH CAL VALUE | Both | -3000 | 3000 | 100.0 | User |
| High Alarm Action | ANIN4 HIGH ALARM | Both | 1 | 8 | 1=Disabled | |
| High Alarm Level | ANIN4 HIGH ALARM LEVEL | Both | -3000 | 3000 | 100.0 | User |
| High Pre-alarm Action | ANIN4 HIGH PRE-ALARM | WW | 1 | 8 | 1=Disabled | |
| High Pre-alarm Action | ANIN4 HIGH PRE-ALARM LVL | WW | -9999 | 9999 | 100.0 | User |
| Low Pre-alarm Action | ANIN4 LOW PRE-ALARM | WW | 1 | 8 | 1=Disabled | |
| Low Pre-alarm Level | ANIN4 LOW PRE-ALARM LVL | WW | -9999 | 9999 | 0.0 | User |
| Low Alarm Action | ANIN4 LOW ALARM | Both | 1 | 8 | 1=Disabled | |
| Low Alarm Level | ANIN4 LOW ALARM LEVEL | Both | -3000 | 3000 | 0.0 | User |
| Pre Alarm Delay Time | ANIN4 PRE-ALARM DELAY | WW | 0.10 | 1200 | 5.0 | Sec |
| Alarm Delay Time | ANIN4 ALARM DELAY | Both | 0.10 | 1200 | 10.0 | Sec |

# Remote Control Menu

The Remote Control Menu contains items that can be tuned or configured from Watch Window, but would normally be set from an external device. They are included here as items that can be used during installation tests.

| Item | Display Name | Panel WW | Min | Max | Default | Units |
|---|---|---|---|---|---|---|
| Acknowledge Cmd Input | ACKNOWLEDGE ALARMS | WW | False | True | False | |
| Reset Command Input | RESET ALARMS | WW | False | True | False | |
| Test Mode Switch Input | TEST COMMAND | WW | False | True | False | |
| Run Mode Switch Input | RUN COMMAND | WW | False | True | False | |
| Auto Mode Switch Input | AUTO COMMAND | WW | False | True | False | |
| Process Mode Enable | PROCESS ENABLE COMMAND | WW | False | True | False | |
| Reactive Load Enable | VAR\PF ENABLE COMMAND | WW | False | True | False | |
| Unload Command Input | UNLOAD COMMAND | WW | False | True | False | |
| Ramp Pause Input | LOAD RAMP PAUSE CMD | WW | False | True | False | |
| Speed/Load Raise Input | SPEED RAISE COMMAND | WW | False | True | False | |
| Speed/Load Lower Input | SPEED LOWER COMMAND | WW | False | True | False | |
| Monitor Value | SPEED BIAS ANALOG OUTPUT | Monitor Value | | | | |
| Voltage/PF/VAR Raise In | VOLTAGE RAISE COMMAND | WW | False | True | False | |
| Voltage/PF/VAR Lower In | VOLTAGE LOWER COMMAND | WW | False | True | False | |
| Monitor Value | VOLTAGE BIAS ANLG OUTPUT | Monitor Value | | | | |
| Monitor Value | RMT BASELOAD REF | Monitor Value | | | | |
| Read Phase A at Anout | METER PHASE A SELECT | WW | False | True | False | |
| Read Phase B at Anout | METER PHASE B SELECT | WW | False | True | False | |
| Reset Load Reference | RESET LOAD CMD | WW | False | True | False | |
| Enable BaseLoad | BASE LOAD COMMAND | WW | False | True | False | |
| Droop Track Command | DROOP TRACK COMMAND | WW | False | True | False | |
| KW De-rate Command | KW DE-RATE COMMAND | WW | False | True | False | |

# Chapter 4. Monitoring by Watch Window

## Introduction

The following page describe the Watch Window sheets that contain information used in monitoring the status of the Genset or to assist in troubleshooting procedures.

## Sequence States Menu

The EGCP-3 uses a state machine for determining its operating mode at any given time. The unit will step through these state from start to stop. Some states the control will skip or step through too quickly to see indication change.

| Display Name | Item | Units |
|---|---|---|
| 01 INITIALIZE POWER UP | Power has just came on, initializing parameters | T/F |
| 02 S100 OUT OF OPERATION | Engine is off, waiting for a start command | T/F |
| 03 S210 INITIALIZE START | Start command has been received, initializing timers | T/F |
| 04 S220 GLOW PLUGS | The Glow plugs are on, waiting for timeout | T/F |
| 05 S230 TURN ON STARTER | Engage starter motor, cranking engine | T/F |
| 06 S240 STARTER COOL DOWN | Engine did not start, waiting for timeout | T/F |
| 07 S250 AT IDLE SPEED | Engine is rung at idle speed | T/F |
| 08 S260 IDLE OK START RAMP | Idle time complete, start ramp to rated | T/F |
| 09 S270 RAMP TO RATED | Engine speed is between idle and rated | T/F |
| 10 S280 AT RATED SPEED | Genset is at rated speed, no load | T/F |
| 11 S290 GEN SYNCHRONIZE | Synchronizer is active | T/F |
| 12 S300 SOFT LOAD CONTROL | Gen Breaker is closed, ramping into load control | T/F |
| 13 S320 LOAD CONTROL | Normal running state. Controlling load in configured mode and level | T/F |
| 14 S340 SOFT UNLOAD CONTROL | A normal stop has been received, ramping load to minimum | T/F |
| 15 S350 GEN BREAKER OPENING | Opening generator breaker | T/F |
| 16 S360 COOLDOWN | Running at no load and at cooldown speed, a normal shutdown will return to S100, out of operation. | T/F |
| 17 S400 SOFT SHUTDOWN | A soft shutdown alarm is active, reset is required | T/F |
| 18 S500 HARD SHUTDOWN | A hard Shutdown alarm is active, reset is required | T/F |

## Units Menu

The Units Menu is included only in Watch Window. The purpose of this data is to serve as units of measurement for all ac parameters in other Service and Configuration menus.

| Display Name | Item | Units |
|---|---|---|
| GEN. POWER | Gen. Power Units | W, VA, VAR; KW, KVA, KVAR; MW, MVA, MVAR; GW, GVA, GVAR |
| GEN. VOLTAGE | Gen. Voltage Units | Volts, Kilovolt |
| GEN. CURRENT | Gen. Current Units | Amps, Kilamps |
| BUS POWER | Bus Power Units | W, VA, VAR; KW, KVA, KVAR; MW, MVA, MVAR; GW, GVA, GVAR |
| BUS VOLTAGE | Bus Voltage Units | Volts, Kilovolts |
| BUS CURRENT | Bus Current Units | Amps, Kilamps |

If a value of Kilovolt is observed, the related ac quantity is scaled by 1000. For example, if Bus Voltage Units is Kilovolt than a value of 4.160 in Bus Rated Voltage will be interpreted as 4160 volts. On the front panel display this can be observed as the units changing to kV.

If a value of MW, MVA, MVAR is observed, the related ac quantity is scaled by 100,000. For example, if Bus Power Units is MW, MVA, MVAR than a value of 30.456 in Bus Rated Watts will be interpreted as 30,456,000 watts or 30.456 megawatts. On the front panel display this can be observed as the units changing to MW.

## LON Status Messaging Menu

A troubleshooting aid of the LON information

IN = Input from this application and sent to other LON Units
OUT= Output from other units and input into this application

| Display Name | IN/OUT | | Units |
|---|---|---|---|
| NODE NUM | IN | This units assigned unit/node number | # |
| UNIT PF | IN | Power Factor of this unit | # |
| UNIT LOAD | IN | Real Load on this unit | # |
| LOAD SHARE | OUT | Indicates that this unit is Load Sharing | T/F |
| PF SHARE | OUT | Indicates that this unit is PF sharing | T/F |
| PROC MSTR | OUT | Indicates this node is acting as the process master | T/F |
| BRK CLOSED | IN | Gen Breaker Closed | T/F |
| DEADBUS | IN | This unit sees the bus a being dead | T/F |
| DB REQUEST | IN | This unit would like to close onto the deadbus | T/F |
| CLR ATTEMPT | IN | Clear the Deadbus close failure for this unit | T/F |
| BUS SEG A | IN | Bus Segment A is Active | T/F |
| BUS SEG B | IN | Bus Segment B is Active | T/F |
| BUS SEG C | IN | Bus Segment C is Active | T/F |
| BUS SEG D | IN | Bus Segment D is Active | T/F |
| START RDY | IN | This genset is ready to start | T/F |
| START RQST | IN | Request to start next available genset | T/F |
| STOP RQST | IN | Request to stop next available genset | T/F |
| STOP RDY | IN | Genset Ready to be stopped | # |
| CAPACITY | IN | Rated Power of this genset | # |
| PWR UNITS | IN | Indicates the units (K, M, etc) of the active units power | # |
| SVC HOURS | IN | Hours remaining before service | # |
| MON TBKR | IN | Enables transmission of segment tie breakers to other units | T/F |
| TIE W | IN | W Tie Breaker Aux contact input | T/F |
| TIE X | IN | X Tie Breaker Aux contact input | T/F |
| TIE Y | IN | Y Tie Breaker Aux contact input | T/F |
| TIE Z | IN | Z Tie Breaker Aux contact input | T/F |
| SS ARB ALG | IN | Tell LON logic which algorithm to use for starting/stopping | # |
| IN S BIAS | IN | Value of unit synchronizer bias signal | # |
| SEND SYNC | IN | Enable send of the sync bias message | T/F |
| RAISE VOLT | IN | Message for all other units to raise their voltage | T/F |
| LOWER VOLT | IN | Message for all other units to lower their voltage | T/F |
| TIE BRKR W | OUT | W Tie Breaker is closed, two bus segments are connected | T/F |
| TIE BRKR X | OUT | X Tie Breaker is closed, two bus segments are connected | T/F |
| TIE BRKR Y | OUT | Y Tie Breaker is closed, two bus segments are connected | T/F |
| TIE BRKR Z | OUT | Z Tie Breaker is closed, two bus segments are connected | T/F |
| DEAD BUS GRANT | OUT | This unit has received ok to close onto the deadbus | T/F |
| PROC SLAVE | OUT | A process master controller is in control of the network | T/F |
| VOLT RAISE | OUT | A voltage raise command has been given by the master | T/F |
| VOLT LOWER | OUT | A voltage lower command has been given by the master | T/F |
| NET NODE | OUT | Number of LON devices on the network | # |
| SEG NODES | OUT | Number of nodes active on this bus segment | # |

| Display Name | IN/OUT |  | Units |
|---|---|---|---|
| LS NODES | OUT | Indicates the number of units sharing load on this bus segment | # |
| STRT NODES | OUT | Number of Gensets ready to start on this bus | T/F |
| STOP NODES | OUT | Number of Gensets ready to stop on this bus | T/F |
| SYS PF | OUT | indicates the system power factor | # |
| SYS LOAD | OUT | System Load % | # |
| SYNC BIAS | OUT | Indicates the master sync bias command value. | # |
| ONLINE DMD | OUT | Total power being generated by all the generator sets on the same active bus segment who have their breakers closed | # |
| OL D UNITS | OUT | Indicates the units (K, M, etc) of the active units ONLINE DMD | # |
| ONLINE CAP | OUT | Maximum total power output capable of being generated by all the generator sets on the same active bus segment who have their breakers closed | # |
| OL C UNITS | OUT | Indicates the units (K, M, etc) of the active units ONLINE_CAP | # |
| START CMD | OUT | Start this genset | T/F |
| STOP CMD | OUT | Stop this genset | T/F |
| START DONE | OUT | The requested genset has finished starting | T/F |
| STOP DONE | OUT | The requested genset has finished stopping | T/F |
| NEXT START | OUT | Displays which unit/node number will get the next start cmd | # |
| NEXT STOP | OUT | Displays which unit/node number will get the next stop cmd | # |
| SYS NUM ID | OUT | This number, when decoded, give the node numbers that are active | # |
| ERR FLAG | OUT | Indicates an error has occurred with the LON communication | T/F |
| MSTART CMD | OUT | Tells all units to initiate a start | T/F |
| MSTOP CMD | OUT | Tells all units to initiate a stop | T/F |
| ERROR NUMBER | OUT | This value is a coded number for troubleshooting the LON network | # |
| SYNC MSTR IN CONTROL | OUT | Indicates that this unit is the unit that is the master synching unit | |

# 01 Status System Menu

An overview of the system operation.

| Display Name | Item | Units |
|---|---|---|
| 01 ALARMS: | Displays the number of active alarms on the unit | # |
| 02 UNIT | Displays the number of this unit | # |
| 03 GEN | Stable (++), Stable timing (+-), Out of Spec(--) | |
| 04 BUS | Stable (++),Out of Spec(--) | |
| 05 ENGINE: | Shows the operating state of the engine | |
| 06 GENERATOR SET STATE: | Shows the state of the genset as a whole, how/why the unit started | |
| 07 HZ | The frequency of the generator set | Hz |
| 08 KW | The total kW load on the generator | W |
| 09 PF: | The average three phase power factor of the generator set | NA |
| 10 PF DIRECTION | Lead / Lag | |
| 11 Watt-HOURS | The total accumulated Watt hours produced by the generator set | MW-HR |
| 12 RUN-TIME HUN | The total accumulated run time of the generator set in hours. (NOT Service Hours) | Hours |
| 13 RUN-TIME THSND | The total accumulated run time of the generator set in hours. (NOT Service Hours) | Hours |
| 14 CONFIGURATION STATUS | Source of error causing a Configuration Alarm | |
| 15 CONTACT IN CONFIGURE ERR | Displays which input channels are configured wrong. | |
| 16 DEAD BUS | Displays if the bus segment is dead | T/F |

## 02 Status Engine Menu

An overview of the Engine state and operating parameters.

| Display Name | Item | Units |
|---|---|---|
| 01 DATE / TIME | Current Date and Time of the EGCP-3 Clock | Y/M/D H:M:S |
| 02 ENGINE: | The state of the engine control function | |
| 03 RPM: | Engine speed | RPM |
| 04 BATTERY VOLT: | Battery Voltage | Volts dc |
| 05 ENGINE TEMP: | Coolant Temperature | °F / °C |
| 06 OIL PRESSURE: | Oil Pressure | kPa / psi |
| 07 GEN BREAKER: | The Status of the generator breaker | Opn/Clsd |
| 08 GEN | Stable (++), Stable timing (+-), Out of Spec(--) | |
| 09 PREGLOW: | Shows OFF or PREGLOW | |
| 10 CRANK: | Shows OFF or CRANKING | |
| 12 IGNITION: | Shows OFF or ON | |
| 13 AIR: | Shows TRIPPED or OPEN | |
| 14 CONTROL: | Shows IDLE or RATED | |

## 03 Status Generator Menu

An overview of the generator outputs.

| Display Name | Item | Units |
|---|---|---|
| 01 GEN VOLT LINE-LINE | Average Volts L-L. | V* |
| 02 GEN VOLT LINE-NEUTRAL | Average Volts L-N | V* |
| 03 GEN AMPS | Average Amps | A* |
| 04 GEN VOLT-AMP | Total KVA reading. | VA* |
| 05 GEN WATT | Total kW readings | W* |
| 06 GEN VAR | Total kVAR reading. | VAR* |
| 07 GEN PWR-FACTOR | Average Power Factor; with +/- Lag or Lead | - |
| 08 GEN VA, PHS A | Phase A KVA reading | VA* |
| 09 GEN VA, PHS B | Phase B KVA reading | VA* |
| 10 GEN VA, PHS C | Phase C KVA reading | VA* |
| 11 GEN WATT, PHS A | Phase A kW readings | W* |
| 12 GEN WATT, PHS B | Phase B kW readings | W* |
| 13 GEN WATT, PHS C | Phase C kW readings | W* |
| 14 GEN VAR, PHS A | Phase A kVAR reading | VAR* |
| 15 GEN VAR, PHS B | Phase B kVAR reading | VAR* |
| 16 GEN VAR, PHS C | Phase C kVAR reading | VAR* |
| 17 GEN VOLT, PHS A | Phase A Volts reading | Volt* |
| 18 GEN VOLT, PHS B | Phase B Volts reading | Volt* |
| 19 GEN VOLT, PHS C | Phase C Volts reading | Volt* |
| 20 GEN AMP, PHS A | Phase A Amps reading | Amp* |
| 21 GEN AMP, PHS B | Phase B Amps reading | Amp* |
| 22 GEN AMP, PHS C | Phase C Amps reading | Amp* |
| 23 GEN PF PHS A | Phase A Power Factor reading | - |
| 24 PF A DIRECTION | Direction of phase A Power Factor Lead/Lag | |
| 25 GEN PF PHS B | Phase B Power Factor reading | - |
| 26 PF B DIRECTION | Direction of phase B Power Factor Lead/Lag | |
| 27 GEN PF PHS C | Phase C Power Factor reading | - |
| 28 PF C DIRECTION | Direction of phase C Power Factor Lead/Lag | |
| 29 GEN CURR, THD | Total Harmonic Distortion of the Current | % |
| 30 GEN CURR, 3RD HARM | Third Current Harmonic | % |
| 31 GEN CURR, 4TH HARM | Fourth Current Harmonic | % |
| 32 GEN CURR, 5TH HARM | Fifth Current Harmonic | % |
| 33 GEN CURR, 6TH HARM | Sixth Current Harmonic | % |
| 34 GEN CURR, 7TH HARM | Seventh Current Harmonic | % |
| 35 GEN CURR, 9TH HARM | Ninth Current Harmonic | % |

| Display Name | Item | Units |
|---|---|---|
| 36 GEN CURR, 11TH HARM | Eleventh Current Harmonic | % |
| 37 GEN CURR, 13TH HARM | Thirteenth Current Harmonic | % |
| 38 GEN VOLT, THD | Total Harmonic Distortion of the Voltage | % |
| 39 GEN VOLT, 3RD HARM | Third Voltage Harmonic | % |
| 40 GEN VOLT, 4TH HARM | Fourth Voltage Harmonic | % |
| 41 GEN VOLT, 5TH HARM | Fifth Voltage Harmonic | % |
| 42 GEN VOLT, 6TH HARM | Sixth Voltage Harmonic | % |
| 43 GEN VOLT, 7TH HARM | Seventh Voltage Harmonic | % |
| 44 GEN VOLT, 9TH HARM | Ninth Voltage Harmonic | % |
| 45 GEN VOLT, 11TH HARM | Eleventh Voltage Harmonic | % |
| 46 GEN VOLT, 13TH HARM | Thirteenth Voltage Harmonic | % |
| 47 GEN NEG-PHS-SEQ VOLT | Negative Phase Sequence Voltage | Amp* |
| 48 GEN NEG-PHS-SEQ AMP | Negative Phase Sequence Current | Amp* |

## 04 Status Bus Menu

An overview of inputs from or outputs to the bus.

| Display Name | Item | Units |
|---|---|---|
| 01 BUS VOLT LINE-LINE | Average Volts L-L. | V* |
| 02 BUS VOLT LINE-NEUTRAL | Average Volts L-N | V* |
| 03 BUS AMPS | Average Amps | A* |
| 04 BUS VOLT-AMP | Total KVA reading. | VA* |
| 05 BUS WATT | Total kW readings | W* |
| 06 BUS VAR | Total kVAR reading. | VAR* |
| 07 BUS PWR-FACTOR | Average Power Factor; with +/- Lag or Lead | - |
| 08 BUS PF DIRECTION | Direction of Power Factor Lead/Lag | |
| 09 BUS VA, PHS A | Phase A KVA reading | VA* |
| 10 BUS VA, PHS B | Phase B KVA reading | VA* |
| 11 BUS VA, PHS C | Phase C KVA reading | VA* |
| 12 BUS WATT, PHS A | Phase A kW readings | W* |
| 13 BUS WATT, PHS B | Phase B kW readings | W* |
| 14 BUS WATT, PHS C | Phase C kW readings | W* |
| 15 BUS VAR, PHS A | Phase A kVAR reading | VAR* |
| 16 BUS VAR, PHS B | Phase B kVAR reading | VAR* |
| 17 BUS VAR, PHS C | Phase C kVAR reading | VAR* |
| 18 BUS VOLT, PHS A | Phase A Volts reading | Volt* |
| 19 BUS VOLT, PHS B | Phase B Volts reading | Volt* |
| 20 BUS VOLT, PHS C | Phase C Volts reading | Volt* |
| 21 BUS AMP, PHS A | Phase A Amps reading | Amp* |
| 22 BUS AMP, PHS B | Phase B Amps reading | Amp* |
| 23 BUS AMP, PHS C | Phase C Amps reading | Amp* |
| 24 BUS PF PHS A | Phase A Power Factor reading | - |
| 25 PF A DIRECTION | Direction of phase A Power Factor Lead/Lag | |
| 26 BUS PF PHS B | Phase B Power Factor reading | - |
| 27 PF B DIRECTION | Direction of phase B Power Factor Lead/Lag | |
| 28 BUS PF PHS C | Phase C Power Factor reading | - |
| 29 PF C DIRECTION | Direction of phase C Power Factor Lead/Lag | |
| 30 BUS CURR, THD | Total Harmonic Distortion of the Current | % |
| 31 BUS CURR, 3RD HARM | Third Current Harmonic | % |
| 32 BUS CURR, 4TH HARM | Fourth Current Harmonic | % |
| 33 BUS CURR, 5TH HARM | Fifth Current Harmonic | % |
| 34 BUS CURR, 6TH HARM | Sixth Current Harmonic | % |
| 35 BUS CURR, 7TH HARM | Seventh Current Harmonic | % |
| 36 BUS CURR, 9TH HARM | Ninth Current Harmonic | % |
| 37 BUS CURR, 11TH HARM | Eleventh Current Harmonic | % |
| 38 BUS CURR, 13TH HARM | Thirteenth Current Harmonic | % |
| 39 BUS VOLT, THD | Total Harmonic Distortion of the Voltage | % |
| 40 BUS VOLT, 3RD HARM | Third Voltage Harmonic | % |
| 41 BUS VOLT, 4TH HARM | Fourth Voltage Harmonic | % |

| Display Name | Item | Units |
|---|---|---|
| 42 BUS VOLT, 5TH HARM | Fifth Voltage Harmonic | % |
| 43 BUS VOLT, 6TH HARM | Sixth Voltage Harmonic | % |
| 44 BUS VOLT, 7TH HARM | Seventh Voltage Harmonic | % |
| 45 BUS VOLT, 9TH HARM | Ninth Voltage Harmonic | % |
| 46 BUS VOLT, 11TH HARM | Eleventh Voltage Harmonic | % |
| 47 BUS VOLT, 13TH HARM | Thirteenth Voltage Harmonic | % |
| 48 BUS NEG-PHS-SEQ VOLT | Negative Phase Sequence Voltage | Amp* |
| 49 BUS NEG-PHS-SEQ AMP | Negative Phase Sequence Current | Amp* |

## 05 Status I/O Menu

The monitor menu for all inputs to the EGCP-3 and its outputs to the system.

| Display Name | Item | Units |
|---|---|---|
| 01 DI - IN 1 STATE | Input 1 Open or Closed | |
| 02 DI - IN 2 STATE | Input 2 Open or Closed | |
| 03 DI - IN 3 STATE | Input 3 Open or Closed | |
| 04 DI - IN 4 STATE | Input 4 Open or Closed | |
| 05 DI - IN 5 STATE | Input 5 Open or Closed | |
| 06 DI - IN 6 STATE | Input 6 Open or Closed | |
| 07 DI - IN 7 STATE | Input 7 Open or Closed | |
| 08 DI - IN 8 STATE | Input 8 Open or Closed | |
| 09 DI - IN 9 STATE | Input 9 Open or Closed | |
| 10 DI - IN 10 STATE | Input 10 Open or Closed | |
| 11 DI - IN 11 STATE | Input 11 Open or Closed | |
| 12 DI - IN 12 STATE | Input 12 Open or Closed | |
| 13 DI - IN 13 STATE | Input 13 Open or Closed | |
| 14 DI - IN 14 STATE | Input 14 Open or Closed | |
| 15 DI - IN 15 STATE | Input 15 Open or Closed | |
| 16 DI - IN 16 STATE | Input 16 Open or Closed | |
| 17 RELAY OUT 1 STATE | Output 1 is On or Off | |
| 18 RELAY OUT 2 STATE | Output 2 is On or Off | |
| 19 RELAY OUT 3 STATE | Output 3 is On or Off | |
| 20 RELAY OUT 4 STATE | Output 4 is On or Off | |
| 21 RELAY OUT 5 STATE | Output 5 is On or Off | |
| 22 RELAY OUT 6 STATE | Output 6 is On or Off | |
| 23 RELAY OUT 7 STATE | Output 7 is On or Off | |
| 24 RELAY OUT 8 STATE | Output 8 is On or Off | |
| 25 RELAY OUT 9 STATE | Output 9 is On or Off | |
| 26 RELAY OUT 10 STATE | Output 10 is On or Off | |
| 27 RELAY OUT 11 STATE | Output 11 is On or Off | |
| 28 RELAY OUT 12 STATE | Output 12 is On or Off | |
| 29 VOLT BIAS OUT %: | Voltage bias output (±100% range) | % |
| 30 SPEED BIAS OUT %: | Speed bias output (±100% range). | % |
| 31 LOAD REF: | load reference used in the Real Load Controller | W |
| 32 LOAD MODE: | Load Control Mode of the Real Load controller | na |
| 33 ANALOG OUT 1 MA: | Current being output at analog output 1 | mA |
| 34 ANALOG OUT 2 MA: | Current being output at analog output 2 | mA |
| 35 ANALOG OUT 3 MA: | Current being output at analog output 3 | mA |
| 36 ANALOG OUT 4 MA: | Current being output at analog output 4 | mA |
| 37 ANALOG IN 1 (V/MA) | Electrical units Input of Analog Input 1 | V/mA |
| 38 ANALOG IN 1 (EU): | Scaled units of Analog Input 1 | EU |
| 39 ANALOG IN 2(V/MA): | Electrical units Input of Analog Input 2 | V/mA |
| 40 ANALOG IN 2 (EU): | Scaled units of Analog Input 2 | EU |
| 41 ANALOG IN 3 (V/MA): | Electrical units Input of Analog Input 3 | V/mA |
| 42 ANALOG IN 3 (EU): | Scaled units of Analog Input 3 | EU |
| 43 ANALOG IN 4 (V/MA): | Electrical units Input of Analog Input 4 | V/mA |
| 44 ANALOG IN 4 (EU): | Scaled units of Analog Input 4 | EU |
| 45 COM PORT 1 | Status of com port 1 normal/alarm | |

| Display Name | Item | Units |
|---|---|---|
| 46 COM PORT 2 | Status of com port 2 normal/alarm | |
| 47 COM PORT 3 | Status of com port 3 normal/alarm | |
| 48 LON STATUS | Normal or Alarm | |
| 49 TIE BREAKER “W” | Status of tie breaker “W” open or closed | |
| 50 TIE BREAKER “X” | Status of tie breaker “X” open or closed | |
| 51 TIE BREAKER “Y” | Status of tie breaker “Y” open or closed | |
| 52 TIE BREAKER “Z” | Status of tie breaker “Z” open or closed | |
| 53 A BUS | Active or Not Active (bus compared to this unit) | |
| 54 A BUS | Active or Not Active (bus compared to this unit) | |
| 55 A BUS | Active or Not Active (bus compared to this unit) | |
| 56 A BUS | Active or Not Active (bus compared to this unit) | |
| 57 MAINS BREAKER STATUS | Open/Closed | |
| 58 GEN BREAKER STATUS | Open/Closed | |

## 06 Status Synchronizer Menu

Monitoring menu of the synchronizing function and states.

| Display Name | Item | Units |
|---|---|---|
| 01 SLIP FREQ: | The slip frequency of the generator in relation to the bus. | HZ |
| 02 SLIP WINDOW: | Matched (++), Controlling (+-), Out of window (--) | na |
| 03 PHASE ERROR: | The phase angle difference between the generator and the bus | deg |
| 04 PHASE WINDOW: | Matched (++), Controlling (+-), Out of window (--) | na |
| 05 VOLTAGE ERROR: | The voltage differential between the generator and the bus | % |
| 06 VOLTAGE WINDOW: | Matched (++), Controlling (+-), Out of window (--) | |
| 07 BUS DEAD ? | Indicates if the bus PT input is less than minimum | T/F |
| 08 SYNCHRONIZER MODE | Displays the synchronizer's configured mode | |
| 09 VOLT BIAS %: | Voltage Bias Output | % |
| 10 SPEED BIAS % | Speed Bias Output | % |
| 11 GEN AVG VOLTS | Average Voltage of the generator | V* |
| 12 BUS AVG VOLTS | Average Voltage of the mains. | V* |
| 13 SYNC STATE | The operating state of the synchronizer | na |
| 14 NUMBER OF ATTEMPTS | Number of synchronization attempts (will always be ≤ Close Attempts set point) | na |
| 15 SEC BEFORE TIMEOUT | Time left on the Timeout timer. If disabled, the field will display ‘– – –‘. | sec |

## 07 StatusKW Load Menu

An overview of the Real Load control.

| Display Name | Item | Units |
|---|---|---|
| 01 GEN LOAD: | Generator real power output (1Ø or 3Ø sum) | W* |
| 02 % RATING | Percent of unit rating | % |
| 03 SYSTEM LOAD | Percent of system loading | % |
| 04 LOAD REFERENCE: | The load reference for the generator | W* |
| 05 PROCESS ACTUAL IN %: | The actual process level as seen by the EGCP-3 | % |
| 06 PROCESS REF %: | The process reference for the process control | % |
| 07 LOAD MODE: | The current load control mode in operation | na |
| 08 LOAD STATE: | The state of the load controller | na |
| 09 KVA SWITCH: | Status of the KVA level switch | T/F |

# 08 Status PF/KVAR Menu

An overview of the reactive Power control.

| Display Name | Item | Units |
|---|---|---|
| 01 MODE: | The actual control mode | na |
| 02 VOLT CNTRL STATE: | The state of the VAR/PF controller | na |
| 03 PWR FACTR REF: | The PF control reference value. Shows --- if PF control is not used | na |
| 04 VAR REF: | The VAR control reference value. Shows --- if VAR control is not used | VAR* |
| 05 GENERATOR PF: | The average three phase PF of the generator | - |
| 06 PF DIRECTION | The direction of PF lead/lag | |
| 07 BUS PF: | The average three phase PF of the bus | - |
| 08 GENERATOR VAR: | The total VAR reading for the generator. | VAR* |
| 09 BUS VAR: | The total VAR reading for the bus | VAR* |
| 10 VOLT BIAS OUTPUT %: | Voltage Bias Output | % |

# 09 Status Sequencing Menu

A monitoring menu of the functions an operation of the sequencer.

| Display Name | Item | Units |
|---|---|---|
| 01 UNIT NUMBER | Network Address of this unit | na |
| 02 STATE | Indicates the availability of the genset: Ready, Alarm, Off | na |
| 03 GEN BREAKER CLOSED | The status of the generator breaker as determined by the generator CB aux discrete input. | na |
| 04 SEQUENCE MODE | The Sequencing Mode for starts and stops is selected from the configure menu. All modes require the next unit to also be in the Start Ready State | na |
| 05 SERVICE HOURS | Number of hours left on the service mete | - |
| 06 NEXT UNIT ON | Unit Number of next unit to be sequenced onto the network | - |
| 07 START TIMER ACTIVE | True when conditions indicate a start should be given, but waiting for delay to expire. | T/F |
| 08 START TIMER | Amount of time before the genset will start. | - |
| 09 NEXT UNIT OFF | Unit Number of next unit to be sequenced off the network | - |
| 10 STOP TIMER ACTIVE | True when conditions indicate a stop should be given, but waiting for delay to expire. | T/F |
| 11 STOP TIMER | Amount of time before the genset will stop. | - |
| 12 UNITS ON LOAD | Total number of units operating in isochronous load sharing. | - |
| 13 SEGMENT UNITS | Number of units on the active bus segment | - |
| 14 SERVICE HOURS REMAINING | Number of service hours left before service is required | |
| 15 READY TO START UNITS | Number of units on the active bus ready to start | - |
| 16 READY TO STOP UNITS | Number of units on the active bus ready to stop | - |
| 17 LS UNITS | Number of load share units on the active bus. | - |
| 18 TIE "W" CLOSED | Status Tie of breaker W | T/F |
| 19 TIE "X" CLOSED | Status Tie of breaker X | T/F |
| 20 TIE "Y" CLOSED | Status Tie of breaker Y | T/F |
| 21 TIE "Z" CLOSED | Status Tie of breaker Z | T/F |
| 22 BUS "A" ACTIVE | Bus A is part of the active bus | T/F |
| 23 BUS "B" ACTIVE | Bus B is part of the active bus | T/F |
| 24 BUS "C" ACTIVE | Bus C is part of the active bus | T/F |
| 25 BUS "D" ACTIVE | Bus D is part of the active bus | T/F |
| 26 MAINS BREAKER CONFIGURED | Indicates a Mains Breaker is being used | T/F |
| 27 NETWORK UNITS | Number of units communicating on the LON network | - |

# 10 Status Alarms Menu

A monitor of the alarm condition of the genset.

| Display Name | Item | Units |
|---|---|---|
| 01 CURRENT DATE / TIME | Current Date & Time of internal clock | Y/M/D H:M:S |
| 02 NUMBER OF ALARMS ACTIVE | Number of Active or un-cleared alarms | - |
| 03 AUDIBLE ALARM ACTIVE | True/False | - |
| 04 SOFT SHUTDOWN ACTIVE | True/False | - |
| 05 HARD SHUTDOWN ACTIVE | True/False | - |
| 06 ALARM EVENT _#1 | Description of the alarm that occurred first | - |
| 07 TIME OF EVENT #1 | Date and Time of the first alarm | Y/M/D H:M:S |
| 08 ALARM EVENT _#2 | Description of the alarm that occurred second | - |
| 09 TIME OF EVENT #2 | Date and Time of the second alarm | Y/M/D H:M:S |
| 10 ALARM EVENT #3 | Description of the alarm that occurred third | - |
| 11 TIME OF EVENT #3 | Date and Time of the third alarm | Y/M/D H:M:S |
| 12 ALARM EVENT #4 | Description of the alarm that occurred fourth | - |
| 13 TIME OF EVENT #4 | Date and Time of the fourth alarm | Y/M/D H:M:S |
| 14 ALARM EVENT #5 | Description of the alarm that occurred fifth | - |
| 15 TIME OF EVENT #5 | Date and Time of the fifth alarm | Y/M/D H:M:S |

# 11 Status Metering Menu

| Display Name | Item |
|---|---|
| 01 GENERATOR | Total Watt-Hours Meter of Generator |
| 02 GENERATOR W_UNITS | Units (KW, MW, GW) of the Generator l W-Hr number above |
| 03 GENERATOR W_H | 000 000 000 **000.00** Hundred portion of the W-Hr |
| 04 GENERATOR W_K | 000 000 **000** 000.00 Thousands portion of the W-Hr |
| 05 GENERATOR W_M | 000 **000**,000,000.00 Mega portion of the W-Hr |
| 06 GENERATOR W_G | **000,**000,000,000.00 Giga portion of the W-hr |
| 07 BUS W_HRS | Total Watt-Hours Meter of Bus |
| 08 BUS W_UNITS | Units (KW, MW, GW) of the BUS W-Hr number above |
| 09 BUS W_H | 000 000 000 **000.00** Hundred portion of the W-Hr |
| 10 BUS W_K | 000 000 **000** 000.00 Thousands portion of the W-Hr |
| 11 BUS W_M | 000 **000**,000,000.00 Mega portion of the W-Hr |
| 12 BUS W_G | **000,**000,000,000.00 Giga portion of the W-hr |

# Chapter 5.
# Startup Checkout Procedures

## Before Starting the Generator Set

Before starting the generator set, configure the EGCP-3 for values which best match the generator set operating and performance characteristics. Double check these values prior to starting the unit. Verify mechanical connections to the EGCP-3. The checklist below may be useful:

Refer to the Installation Manual 26122 for wire terminal location and terminal numbers.

1. Check for correct wiring. Take note of polarity, signal type, terminal connection, grounding, and shielding as shown in the Installation Manual.
   - Power Supply Input
   - Generator PT Inputs
   - Generator CT Inputs
   - Bus PT Inputs
   - Bus CT Inputs
   - Magnetic Pickup Input
   - Voltage Bias Output
   - Speed Bias Output
   - Emergency Stop Input, Fuel Shutoff Value output operation
   - Air Shutoff Shutter output
   - Control Switch Inputs (Run, Test, Auto)
2. Check for broken terminals and loose terminal screws.
3. Check for shield faults by measuring the resistance from control terminals to chassis. If a resistance less than infinite is obtained, remove the connections from each terminal one at a time until the resistance is infinite. Check the line that was last removed to locate the fault.

Once these items have been checked, check the power supply voltage for proper amplitude. When this is confirmed, apply the power supply to the EGCP-3.

When the EGCP-3 is given power, it will go through RAM test and self test. After a self check period it will display the System Status Menu. If the EGCP-3 fails to power up properly, remove the power supply input and double check the polarity and amplitude of the voltage feeding the EGCP-3.

Refer to "I/O Status Screens" section of Chapter 2. With the EGCP-3 powered, go to the I/O Status screen #1 in the Status menus. This display shows the state of the discrete inputs and outputs of the control. Monitor this screen and close each discrete input to the EGCP-3 that is being used in this particular application. Verify that the EGCP-3 recognizes these inputs in the I/O Status screen.

**WARNING—LOCK OUT ENGINE/BREAKERS**
**When operating the discrete inputs, certain outputs may be activated. Make sure that the engine and various breakers are locked out to prevent an inadvertent start or breaker close.**

**Leave the Control Switch in the "Off" position until all I/O checks are complete and the engine is ready to start.**

Verify that the transducer and other analog input signal levels are at the proper levels with respect to a measured or known input. The I/O Status screen #2 displays the analog inputs in volt or mA and in the configured parameter units.

Read Chapter 3 section “Force Relay Menu” and confirm that each relay picks up and drops out when tested.

Verify that the Speed Bias, and Voltage Bias outputs are at zero percent, or the proper levels if there is a bias offset used.

Verify that the analog outputs are at 4mA or the appropriate level for the configured parameter. This is observed at the I/O status screen #2.

**WARNING—EMERGENCY STOP**
**Make sure that a means exist of performing an emergency stop on the unit prior to starting it. Check the emergency stop devices to make sure they are functioning properly prior to starting the unit.**

**WARNING—SITE SAFETY PROCEDURES**
**The start procedures and tests listed here are only a general guide. ALL site safety procedures take precedent over the steps given here.**

## Sequence Of Startup And Checking Parameters

1. Enter program set points in all menus.
2. Check I/O status menu.
3. Set crank repeats to 0, in the Engine Control menu.
4. Set synchronizer mode to Off, in the Synchronizer menu.
5. Set load control mode to Isochronous, in the Real Load menu.
6. Manually start the engine using only the TEST switch of EGCP-3.
7. Check engine overview status screen for engine rpm readout. Confirm rpm is correct for unit.
8. If unit is programmed for an Idle Speed discrete output , verify the engine runs at the correct Idle speed for the Idle Time period.
9. With the engine running at rated speed, check voltage of generator in Generator Status menu.
10. Adjust AVR voltage at AVR if needed to achieve rated generator voltage.
11. For fine tune adjustment use the Voltage Bias Output % in the Calibration menu to set the correct voltage level. See the Calibration section of this manual for more information.
12. Check that voltage raise/lower switches operate properly. Set voltage ramp time if needed.
13. Adjust AVR trim pot (if equipped) for ±10% of rated voltage for ±100% voltage bias output from EGCP-3. If this range cannot be achieved, shut down the generator set, and select the next highest voltage bias output level for the Voltage Bias Type in the First Time Setup menu. Repeat steps 9 through 11 until satisfactory results are achieved.
14. Check that load raise/lower switches operate properly. Set load raise/lower rates if needed. Verify speed change with raise/lower load inputs.
15. Check voltage of mains in Generator Status menu— Fine tune this reading using the Bus Voltage Scale Factors. See the Calibration section of this manual for more information.
16. Set the synchronizer mode to Check. Verify proper phase matching of the generator and bus. Verify proper synchronizer action in Permissive and Run modes. Do not let the breaker close at this time.
17. Remove Test Input at Control Switch. Verify engine shuts down properly.

# Loading The Generator Set

**WARNING—CT/PT PHASING**
**Operation of the engine/generator set with incorrect CT and PT phasing could cause serious injury or damage to equipment. If the load on the unit rises rapidly when the generator or mains breaker is closed, immediately open the breaker and shut the unit down. Check the phasing of the PT and CTs. DO NOT permit the unit to continue to pick up load or operate the system without correcting this condition.**

## Isolated Load Setup

Perform this test and setup **ONLY** if the genset can carry the existing load on the bus or a load bank is available. Skip to the Bus Parallel Setup if this load requirement cannot be met.
Use the following instructions for setup of Single Genset Applications.

1. For applications that have no mains breaker control, manually open the mains breaker. For this test insure that all other gensets are disconnected from the Bus. Verify the control sees the dead bus and that all breakers are open.
2. Set unit for Dead Bus Closing Enabled.
3. Perform a test by closing the Run Control Switch input.
4. Unit will start and come to rated speed.
5. Close the Auto Control Switch (leave the Run Switch closed) the generator breaker should close to bus.
   - Verify dead bus closing.
   - Apply load to unit using load bank or plant load as applies
   - Adjust Generator Current Scale Factors if needed. See the Calibration section of this manual for more information.
   - Verify correct voltage level on bus. Using the GEN Status screens verify the control measures the correct generator power values.
6. Load Control. Verify isochronous operation. Unit speed should not droop as load is applied.
7. If the Bus PT and CT power inputs are in a location that the bus now sees load:
   - Adjust Bus Current Scale Factors if needed. See the Calibration section of this manual for more information.
   - Using the GEN Status screens verify the control measures the correct bus power values.
8. On the Sync screen Verify the Bus Input shows a ++ reading indicating the voltage and frequency are within specification.
9. Open the Test and Auto inputs to shutdown the unit.
   - Verify generator breaker open.
   - Verify cooldown if unit has exceeded cooldown limit.

This concludes the Isolated setup.

## Bus Parallel Setup

Follow these steps if you are configuring a Bus Parallel Unit.

1. Set Synchronizer Mode to Check.
2. On the Sync screen verify the Bus Input shows a ++ reading indicating the voltage and frequency are within specification.
3. Start unit using both Auto and Run with Load inputs.
   - Unit will start and attempt to synchronize, but will not close the breaker in the Check mode.
   - By opening the Auto switch the synchronizer can be turned on and off for testing purposes.
4. Adjust Synchronizer proportional Gain and Integral Gain for best control (monitor sync status menu and synchroscope to see phase and slip errors).
5. Use voltmeter to check voltage across generator breaker to assure proper voltage matching.
6. Use phase rotation meter on generator and bus inputs to verify correct wiring.
7. Shut down the unit by removing the Auto and Run with Load Inputs.
8. Set Load/Unload Ramp Times to at least 60 seconds.
9. Close BasLoad Enable Switch, Set BaseLoad Reference to 30% of rated load.
10. Set Synchronizer Mode to Run.
11. If kVAR or Power Factor control are to be used:
    - Verify one of these choices is selected for the VAR/PF Mode in the Reactive Load menu.
    - Close the Enable VAR/PF Control Contact.
12. Start unit using both Auto and Run with Load inputs
13. Monitor synchroscope status menu. Verify action of synchronizer.

**NOTE**
**If using a Process input, Set Process Reference to Proper Level.**

14. After generator breaker closes to the bus, monitor System Status menu:
    - Monitor kW load on unit.
    - Monitor kVAR/PF on unit.
15. Adjust Load Control Gain, Integral, and Derivative for stable load control
16. Adjust the load on the generator using the Load Raise and Load Lower inputs. Set Load Raise/Lower rates if needed.
17. Once satisfied with load control operation, switch to process control (if applicable) by closing the Process Enable input. **Note:** Mains Parallel Operation is required for Process Control. EGCP-3 must be configured for Mains Breaker inputs.
18. Confirm ramp to process reference level. Adjust Process Gain, Integral, Derivative, and Deadband for best response.
19. Return to BaseLoad control, by opening the Process input, and adjust VAR/PF Gain and Integral for stable reactive load control.
20. If other EGCP-3 LS or MC units are in this bus, observe I/O status and Sequence status to confirm that controls are communicating on LON Network.
21. If other EGCP-3 LS units are closed to the bus, enable Load Sharing, Open BaseLoad Enable. Verify Load Sharing operation.

22. Remove Run with Load input to unit.
    - Verify unload ramping.
    - Verify unload trip point.
    - Verify generator breaker opens.
    - Verify cooldown timer (if reached).
23. Set Crank Repeats, BaseLoad Reference, Process Reference, Load Ramp Times, and Load Control Mode as required for proper operation.

This concludes the Bus Parallel Setup.

# Chapter 6. Application Overview

In this chapter, block diagrams of the control functions are shown to give the basic signal flow and control methods.

## Control Block Diagram

The basic overall control flow can be represented by the below flowchart. Each mode is further described in the next section.

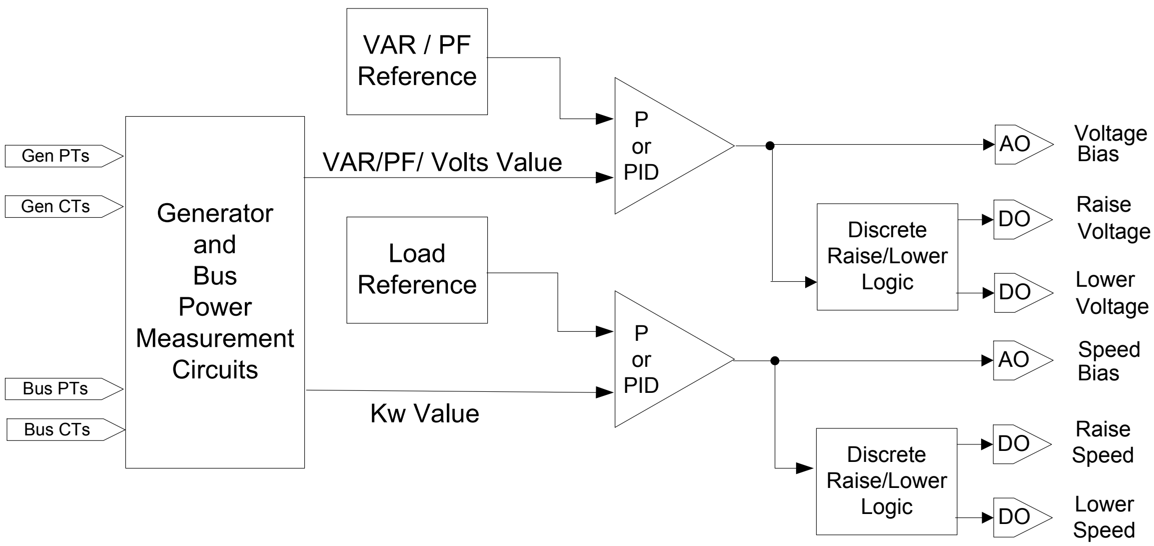



Figure 6-1. Basic Control Block Diagram

The alarm and event logic within the EGCP-3 can be simplified to the below flowchart. The flowchart also indicates how events can be reset and cleared.

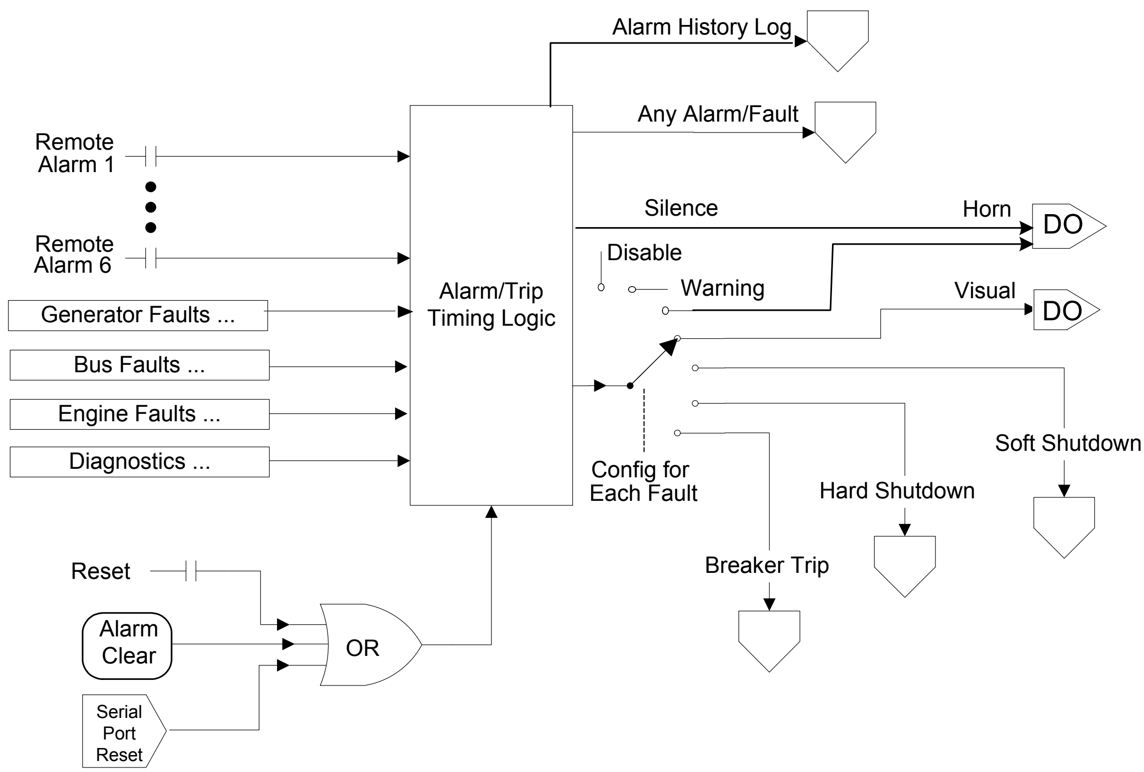



Figure 6-2. Alarm Logic Block Diagram

# Load Controller

The load controller controls the speed bias output and therefore, it controls real load only. The synchronizer works through the load controller in order to get to the speed bias output so that they do not fight over control of the output. Process is considered a type of load control and will also work through the load controller.

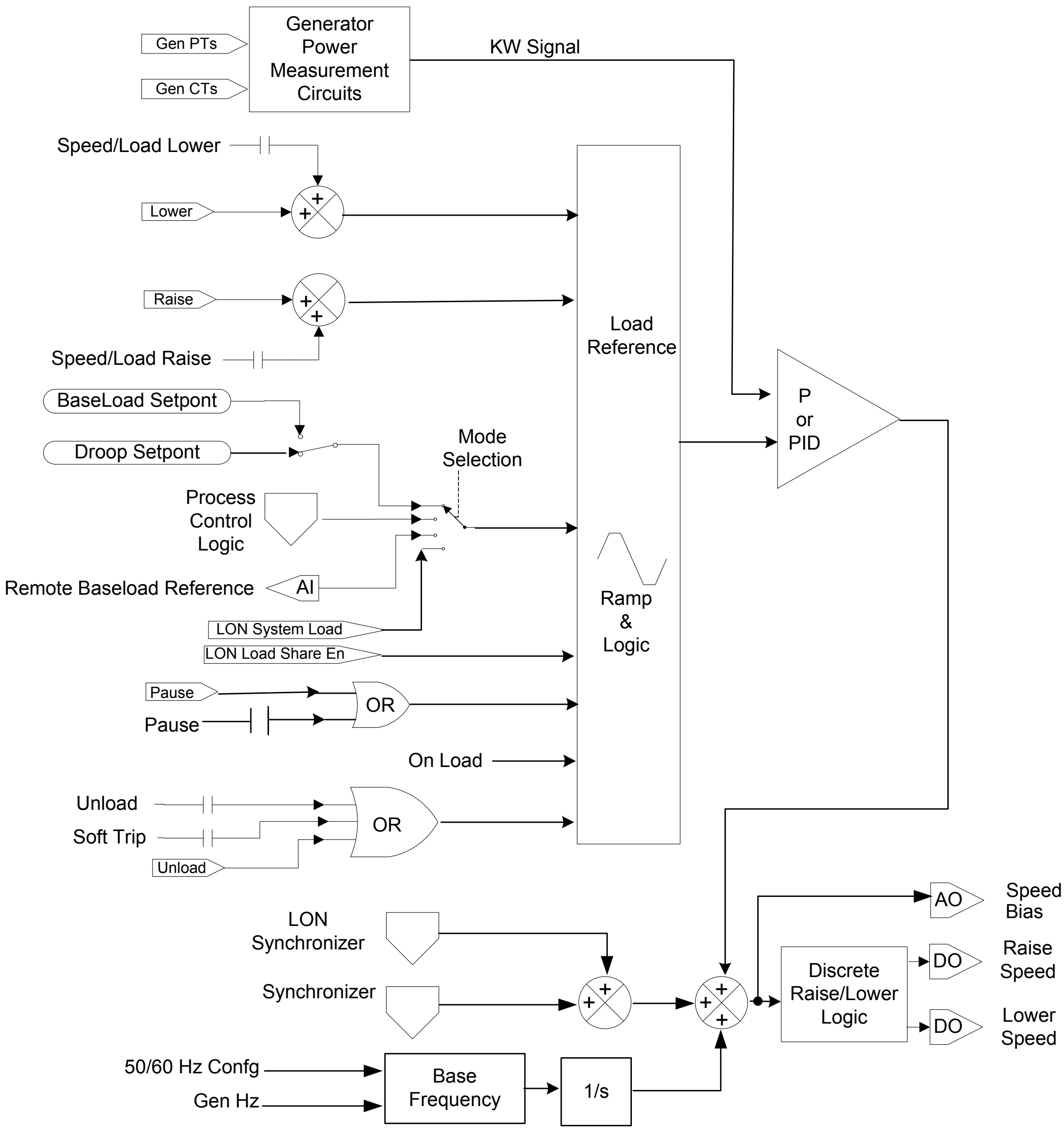



Figure 6-3. Load Control Block Diagram

# Process Controller

The process controller controls the real and reactive loads using the Real and Reactive Load Controllers. The output of the process controller is an input to the load controllers.

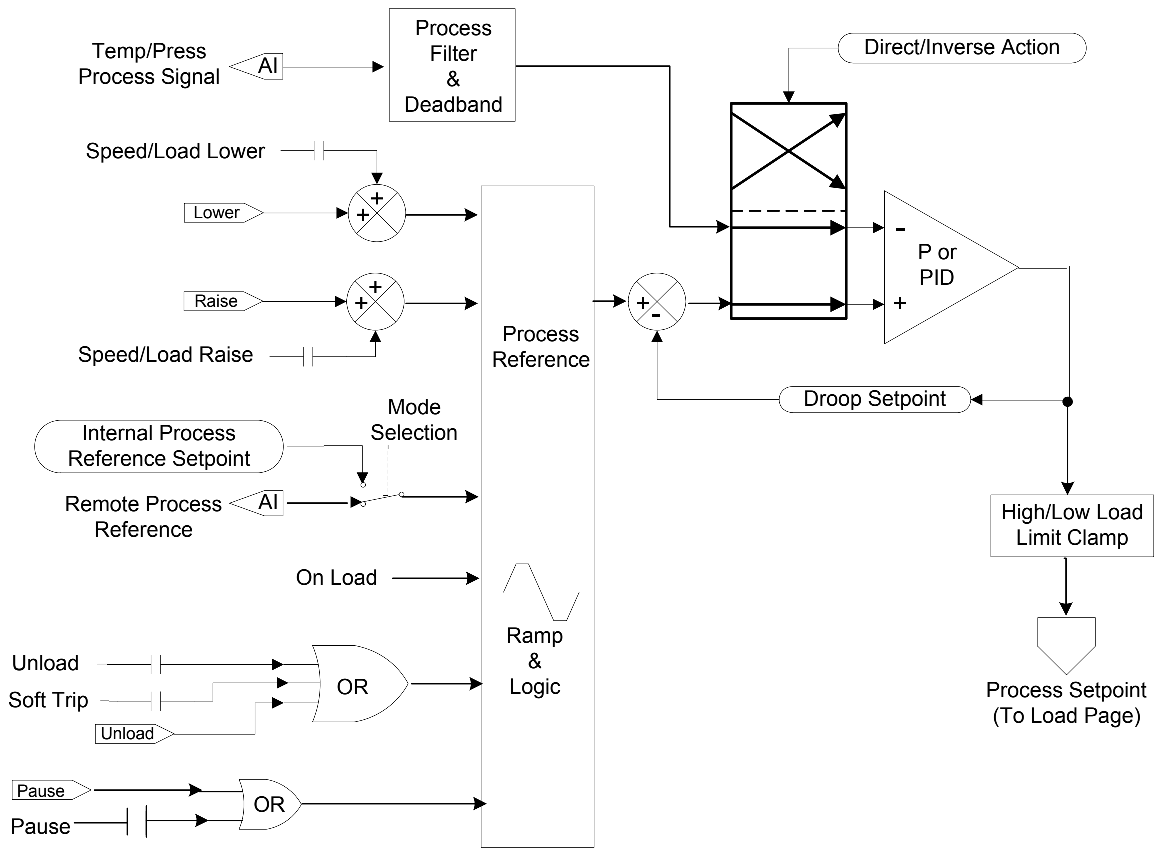



Figure 6-4. Process Control Block Diagram

## Reactive Load Controller

The reactive load controller controls the voltage bias output and therefore, it controls reactive load only. The synchronizer works through the reactive load controller in order to get to the voltage bias output so that they do not fight over control of the output.

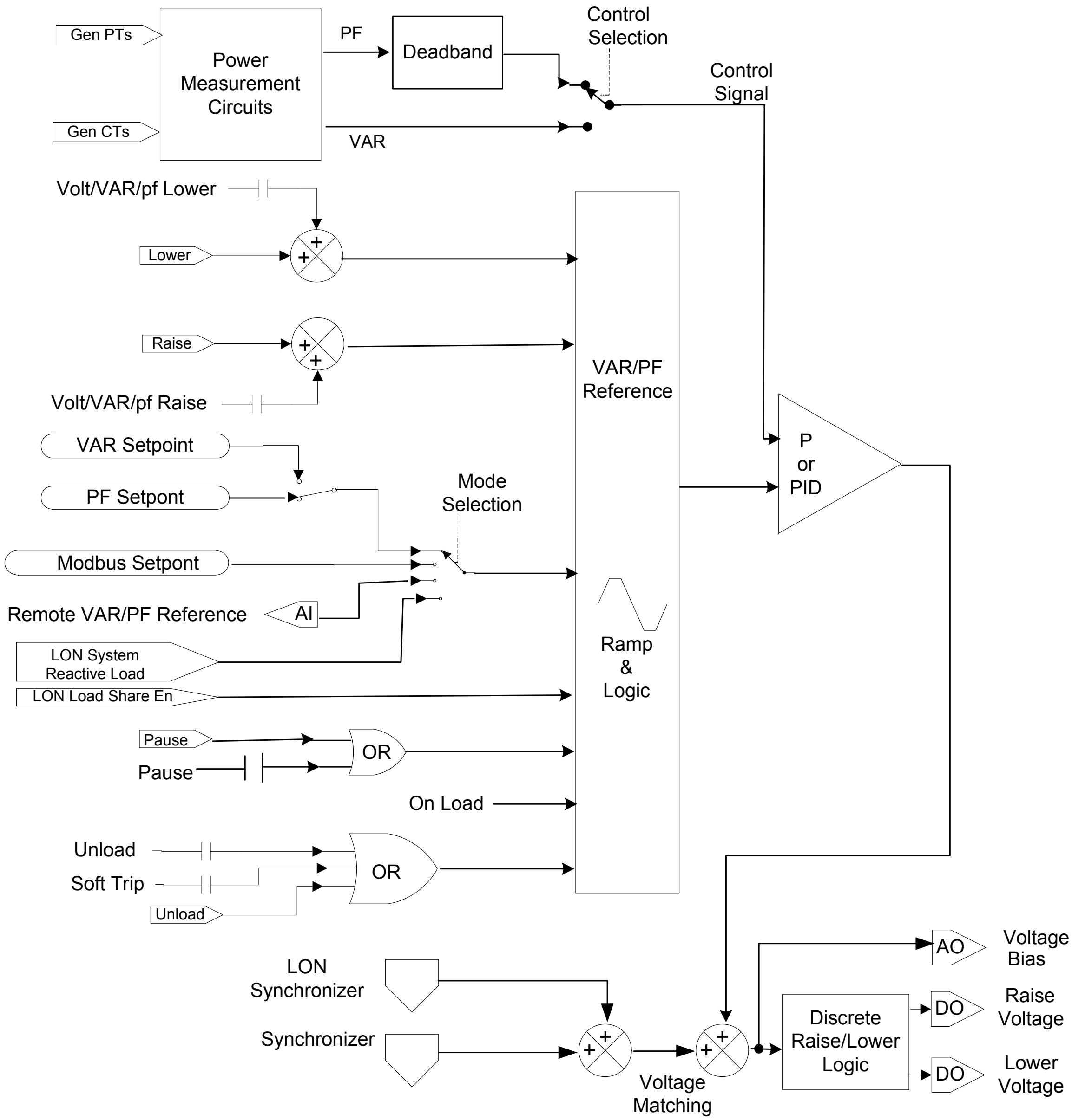



Figure 6-5. VAR / Power Factor Control Block Diagram

## Synchronizer

The synchronizer controls the voltage bias output and the speed bias output through the load controllers. It is only active when necessary. When it transitions from active to inactive, the load controllers will ramp out the synchronizer effect in a slow controlled ramp.

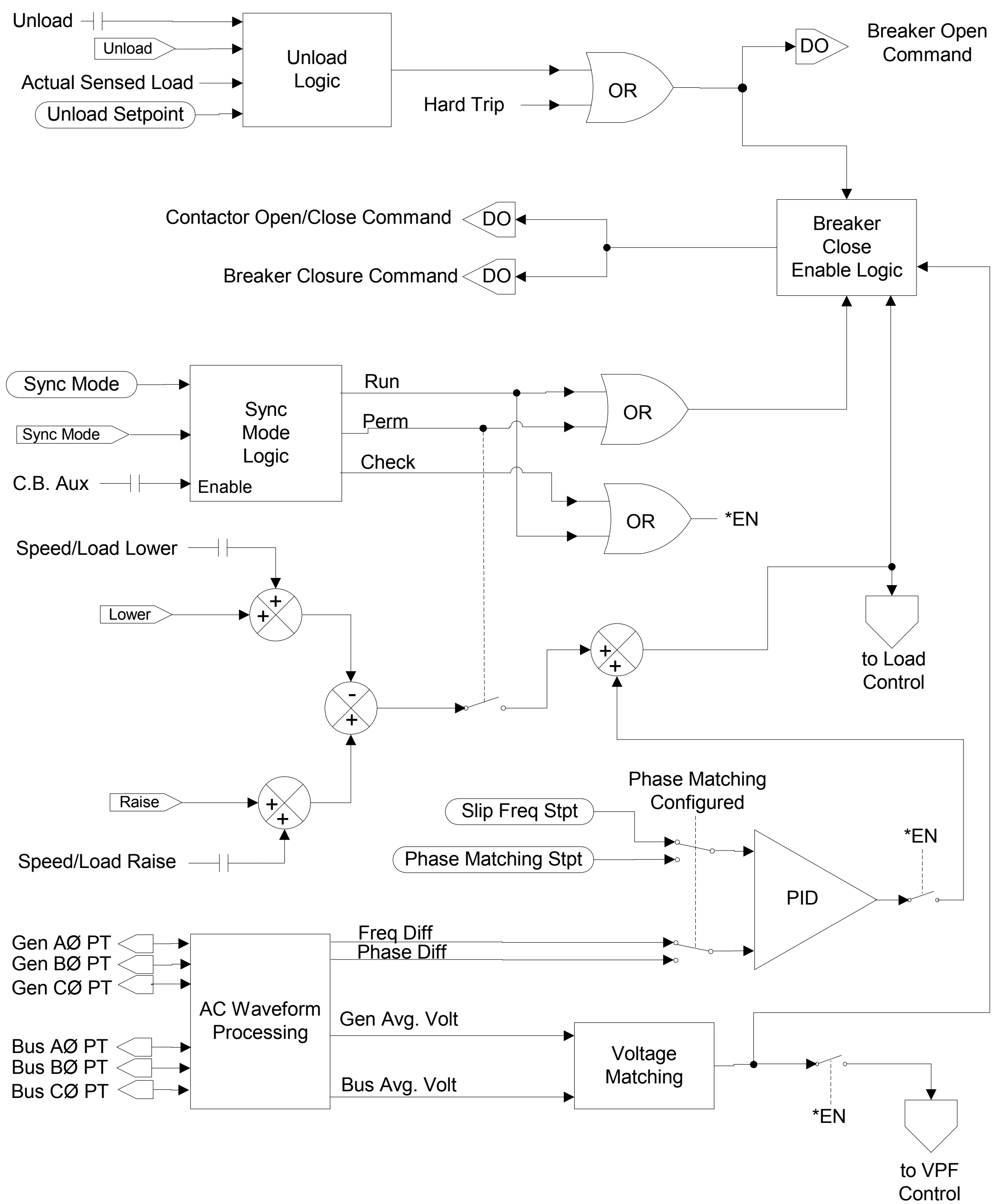



Figure 6-6. Synchronizer Block Diagram

# Chapter 7.
# Calibration Procedures

## Factory Calibrations

This calibration is provided to adjust the readings of the EGCP-3 control. This will compensate for errors that occur in the sensing equipment such as PTs, CTs, or engine senders. Overall, the EGCP-3 is a highly accurate device that is factory calibrated before shipping. **The calibration settings are not intended to calibrate the EGCP-3 control. In almost all cases, the EGCP-3 accuracy will be rated higher than the sensing devices it is reading**.

## AC Voltage Inputs

AC Voltage inputs are calibrated based on the selected hardware PT input level (70, 120, 240). Therefore, for accurate readings, it is important to select the correct hardware input level.

When a potential transformer is used between the EGCP-3 and the generator or mains bus, the transformer will certainly be less accurate than the EGCP-3.

The EGCP-3 allows the user to correct for this error on each phase independently. The correction factors may be found in the calibration menu. Increase the correction to compensate for a low voltage reading. It is important that the equipment used to compare readings with the EGCP-3 be at least as accurate as the EGCP-3 itself. A Fluke 87 type meter is generally NOT as accurate and hence does not make for a very good comparison.

## AC Current Inputs

AC Current inputs are calibrated at 5 A. Therefore, for accurate readings, CTs should be sized to provide nearly 5 A at full load. 1A CTs are not recommended for use with the EGCP-3.

The current transformers will certainly be less accurate than the EGCP-3 across the full range. The EGCP-3 allows the user to correct for error on each phase independently. The correction factors may be found in the calibration menu. Increase the correction to compensate for a low current reading. It is important that the equipment used to compare readings with the EGCP-3 be at least as accurate as the EGCP-3 itself. A Fluke 87 type meter with a clamp on current probe is generally NOT as accurate and hence does not make for a very good comparison.

## Analog Inputs

The four analog inputs are factory calibrated in both the 4–20 mA current mode and the 1–5 Vdc voltage mode. For this reason, it is very important to select the appropriate mode when configuring the inputs.

Although the inputs are accurate, they must be scaled to the device being connected to the input. This scaling is referred to as calibration in this manual. The configuration settings are found in the Analog Input Menu and are called a Low Calibration Value and a High Calibration Value.

The Low Calibration value should be configured for the engineering units represented by 4 mA or 1Vdc depending on the type of input used. As an example, for the temperature sensor input, if the output of the transducer is 4 mA when the temperature measured is 40°C, then the Low Calibration value should be configured for 40.

The High Calibration value should be configured for the engineering units represented by 20 mA or 5 Vdc depending on the type of input used. As an example, for the temperature sensor input, if the output of the transducer is 20 mA when the temperature measured is 200 °C, then the High Calibration value should be configured for 200.

The EGCP-3 will interpolate the temperature using a linear interpolation between and beyond the two calibration points.

## Analog Outputs

The four analog outputs are factory calibrated at 4 mA and 20 mA. Although the outputs are accurate, they must be scaled to the device being connected to the output. This scaling is referred to as calibration in this manual. The configuration settings are found in the Analog Output Menu and are called a Low Calibration Value and a High Calibration Value.

The Low Calibration value should be configured for the engineering units represented by 4 mA. As an example, consider the case of a kW panel meter connected to Analog Output #1. If the meter expects 4 mA when the kW should indicate 0 kW, then the Low Calibration value should be configured for 0.

The High Calibration value should be configured for the engineering units represented by 20 mA. Continuing with the example above, If the meter expects 20 mA when the kW should indicate 1500 kW, then the High Calibration value should be configured for 1500.

The EGCP-3 will interpolate the mA level to provide using a linear interpolation between and beyond the two calibration points.

## MPU Input

The MPU input itself needs no calibration. However, for the frequency detected at the input to be meaningful, the EGCP-3 must know the number of teeth on the gear being measured. With this single data point, the EGCP-3 can determine the speed of the gear. It is assumed that the gear in use is the flywheel so that the gear speed is indicative of the shaft speed to the generator.

If the gear in use is not the flywheel or there is a gearbox between the sensed gear and the generator, it will be necessary to modify the value entered for the number of teeth. The EGCP-3 correlates the rpm to the generator frequency and will indicate an error if they do not correlate. The error will inhibit starting the generator set.

The number of flywheel teeth is configured in the First Time Startup Menu.

## Voltage Bias Output

The voltage bias output is factory calibrated in two modes. The 4–20 mA current mode is one calibration. The other calibration is at the ±9Vdc level. There is a validation at the ±1 and ±3Vdc levels.

Although the output is accurate, it must be correlated to the voltage regulator. A zero bias offset adjustment is provided in the Calibration Menu and is called Voltage Bias Offset. This offset functions for both the current and voltage output types. The configuration setting should be set to the voltage or current level necessary to cause the voltage regulator to leave the voltage at rated. This dc voltage offset is applied to the voltage bias input of the automatic voltage regulator, and is maintained as a starting point for all voltage bias operations used by the EGCP-3.

Most regulators that have a voltage trim bias input require a 0.0 Vdc voltage bias offset. These types of regulators operate with a ±dc voltage applied to the trim input. The voltage is then centered around zero volts offset, or zero Voltage Bias.

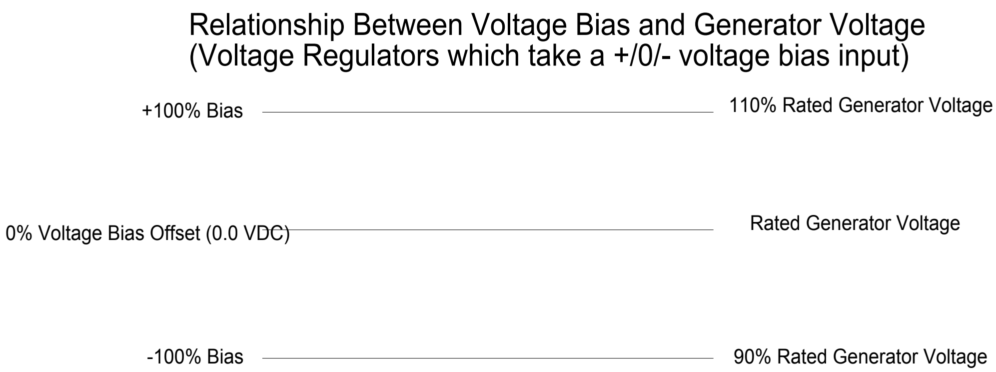



Figure 7-1. Relationship Between Voltage Bias and Generator Voltage

Some regulators cannot accept a bi-polar (±) voltage trim input, and require a voltage bias signal that is only positive (or negative) in value. In this case the Voltage Bias offset can be used to raise (or lower) the offset of the voltage bias output.

The Voltage Bias Offset will affect the rated voltage of the generator at synchronous speed prior to the generator breaker closing. The effect the voltage bias offset has on the generator voltage can be observed by running the unit in a test mode, and measuring the generator voltage. It is recommended that the voltage adjustment of the automatic voltage regulator be set for the desired rated voltage of the generator with the EGCP-3 Voltage Bias Offset applied to the regulator.

## Speed Bias Output

The speed bias output is calibrated in three modes. The 4–20 mA current mode is one calibration. Another calibration is at ±3Vdc. The final calibration is for 1–5 Vdc. The PWM control does not need calibration.

Although the output is accurate, it must be correlated to the speed controller. A zero bias adjustment is provided in the Calibration Menu and is called Speed Bias Offset. This offset functions for both the current and voltage output types but not the PWM. The configuration setting should be set to the voltage or current level necessary to cause the speed control to leave the speed at rated. This output is fed into the speed control to bias the governing speed for synchronization and load control functions. This offset is the starting point from which the EGCP-3 begins all of its speed biasing operations.

Usually the speed bias output should remain at the factory default. The speed control is used to set the synchronous speed of the generator, and no additional bias is required. However, if interfacing the EGCP-3 with speed controls other than those manufactured by Woodward Governor Company, an offset may be required for proper operation.

When initially powered up, the EGCP-3 will always apply the value for the speed bias offset to the speed bias output. When calibrating, it is best to start from a known state where the speed control is already properly configured for rated speed when the EGCP-3 is not connected to it. From this starting point, the speed bias offset can be adjusted once the EGCP-3 is connected to the speed control.

The speed bias offset will affect the bus frequency of a single unit machine operating on an isolated bus. The speed bias offset will also affect the load sharing between machines operating on an isolated bus. The effect the speed bias offset has on the engine speed can be observed by running the unit in a test mode, and observing the rpm. It is recommended that the speed bias output be calibrated for 0% ( 0.0 Vdc) when using Woodward Governor speed controls. Otherwise, adjust the speed bias offset until rated speed is achieved.

# Chapter 8. Alarm and Diagnostic Summary

## Introduction

All Alarms can be configured to perform a specific action when detected. The complete list of actions that can be taken are described below. Some alarms cannot be configured for all Alarm Actions on the list. An action is available only when the listed actions are appropriate.

**Disabled**
The EGCP-3 will not look for the alarm condition. No alarm will be logged, sent over a communication link, or shown on the display.

**Warning**
When the EGCP-3 detects the event/alarm condition, the alarm will be added to the current event list and the alarm history log. If a discrete output is configured to indicate a warning alarm condition, the output will be asserted. The communication links will indicate a warning alarm condition exists. The generator set will remain active without changing its operation. The alarm item will remain in the active alarm list until the condition is removed and an alarm reset is received while in the operator or greater security level.

**Visual Alarm**
When the EGCP-3 detects the event/alarm condition, the alarm will be added to the current event list and the alarm history log. The communication links will indicate a visual alarm condition exists. If a discrete output is configured to indicate a visual alarm condition, the output will be asserted. This type of alarm configuration can be used as an additional warning alarm condition. The visual alarm output will remain active until all visual alarms have been reset The generator set will remain active without changing its operation. The alarm item will remain in the active alarm list until the condition is removed and an alarm reset is received while in the operator or greater security level.

**Audible Alarm**
When the EGCP-3 detects the event/alarm condition, the alarm will be added to the current event list and the alarm history log. If a discrete output is configured as an alarm horn, the output will be asserted. The communication links will indicate an audible alarm condition exists. Pressing the Alarm Clear Key once will turn off the Alarm Horn output. Alternatively, momentarily asserting the Reset Alarm/Fault discrete input (if configured) will also turn off the Alarm Horn output. The horn alarm output will remain off until any other audible alarm condition becomes active. The horn output will turn off without resetting the alarm. The alarm item(s) will remain in the active alarm list until the condition is removed and an alarm reset is received while in the operator or greater security level. The generator set will remain active without changing its operation.

**Soft Shutdown**
When the EGCP-3 detects the event/alarm condition, the alarm will be added to the current event list and the alarm history log. If a discrete output is configured to indicate a soft shutdown alarm condition, the output will be asserted. The communication links will indicate a soft shutdown alarm condition exists. The generator set will unload in the configured manner, open the generator breaker, cool down (if conditions met) and stop. It will remain stopped and not restart unless all configured shutdown alarms are cleared.

**Hard Shutdown**
When the EGCP-3 detects the event/alarm condition, the alarm will be added to the current event list and the alarm history log. If a discrete output is configured to indicate a Herd Shutdown alarm condition, the output will be asserted. The communication links will indicate a hard shutdown alarm condition exists. The generator set will immediately open the generator breaker and stop according to the Emergency Stop procedure. It will remain stopped and not restart unless all configured shutdown alarms are cleared.

**Trip Tie Breaker**
When the EGCP-3 detects the event/alarm condition, the alarm will not be added to the current event list and the alarm history log. If a discrete output is configured to indicate a trip tie alarm condition, the output will be asserted. The Modbus and LON communication links will indicate a Trip Tie Breaker condition exists. The EGCP-3 will immediately open the tie breaker.

**Trip Tie Breaker w/ Alarm**
When the EGCP-3 detects the event/alarm condition, the alarm will be added to the current event list and the alarm history log. If a discrete output is configured to indicate a visual alarm condition, the output will be asserted. The Modbus and LON communication links will indicate a trip tie alarm condition exists. The EGCP-3 will immediately open the tie breaker.

**NOTE**
**If the control is set to Auto Start on TRIP TIE or TRIP TIE w/alarm, the control will automatically start. This could be used for a black bus start. Configure the Bus under voltage (or something similar) for Trip tie of Trip tie w/ alarm action. When the alarm occurs the unit will start if in Auto. To stop the unit the input alarm must be cleared, and you must open the Auto input.**

**Alarm Action list**

| Value | Alarm Actions Definition | Display |
|---|---|---|
| 8 | Trip Tie Breaker With Alarm | Trip Breaker w/Alarm |
| 7 | Trip Tie Breaker | Trip Breaker |
| 6 | Hard Shutdown | Hard Shutdown |
| 5 | Soft Shutdown | Soft Shutdown |
| 4 | Audible Alarm | Audible Alarm |
| 3 | Visual Alarm | Visual Alarm |
| 2 | Warning | Warning |
| 1 | Disabled | Disabled |

# Alarm List

The following table is a list of all alarms generated by the EGCP-3. The Modbus ID is the Boolean Read address where the status of the named alarm can be determined via Modbus.

| Alm # | Event Name | Display Name | Modbus ID |
|---|---|---|---|
| 1 | Battery Volt High Alarm | BATTERY VOLTAGE HIGH | 10048 |
| 2 | Battery Volt Low Alarm | BATTERY VOLTAGE LOW | 10047 |
| 3 | Coolant Temp. High Alarm | COOLANT TEMP HIGH | 10043 |
| 4 | Coolant Temp. High Pre-Alarm | PRE COOLANT TMP HI | 10073 |
| 5 | Coolant Temp. Low Alarm | COOLANT TEMP LOW | 10044 |
| 6 | Coolant Temp. Low Pre-Alarm | PRE COOLANT TMP LOW | 10074 |
| 7 | Crank Fail Alarm | CRANK FAIL | 10036 |
| 8 | Emergency Stop | EMERGENCY STOP | 10137 |
| 9 | EPS Supplying Load | EPS SUPPLYING LOAD | 10079 |
| 10 | Not Used | | X |
| 11 | Not Used | | X |
| 12 | Not Used | | X |
| 13 | Gen Breaker Feedback Error | GEN BKR FEEDBACK ERR | 10157 |
| 14 | Gen Breaker Shunt Trip Error | GEN BKR SHUNT TRIP ERR | 10155 |
| 15 | Gen Neg. Phase Sequence Over Current Alarm | GEN NEG PHS OVR CURR | 10095 |
| 16 | Gen Neg. Phase Sequence Over Current Pre-Alarm | PRE GEN NPHS OVR CUR | 10096 |
| 17 | Gen Neg. Phase Sequence Over Voltage Alarm | GEN NEG PHS OVR VOLT | 10097 |
| 18 | Gen Neg. Phase Sequence Over Voltage Pre-Alarm | PRE GEN NPHS OVR VLT | 10098 |
| 19 | Gen Over Freq Alarm | GEN OVER FREQUENCY | 10051 |
| 20 | Gen Over Freq Pre-Alarm | PRE GEN OVER FREQ | 10084 |
| 21 | Gen Under Freq Alarm | GEN UNDER FREQUENCY | 10052 |
| 22 | Gen Under Freq Pre-Alarm | PRE GEN UNDER FREQ | 10085 |
| 23 | Gen Over Volt Alarm | GEN OVER VOLTAGE | 10050 |
| 24 | Gen Over Volt Pre-Alarm | PRE GEN OVER VOLTAGE | 10083 |
| 25 | Gen Under Volt Alarm | GEN UNDER VOLTAGE | 10049 |
| 26 | Gen Under Volt Pre-Alarm | PRE GEN UNDER VOLT | 10082 |
| 27 | Gen Over Power Alarm | GEN OVER POWER | 10087 |
| 28 | Gen Over Power Pre-Alarm | PRE GEN OVER POWER | 10088 |
| 29 | Gen Reverse Power Alarm | GEN REVERSE POWER | 10040 |
| 30 | Gen Reverse Power Pre-Alarm | PRE GEN REVERSE POWR | 10086 |
| 31 | Gen Over VAR Alarm | GEN OVER VARs | 10090 |
| 32 | Gen Over VAR Pre-Alarm | PRE GEN OVER VARs | 10091 |
| 33 | Gen Reverse VAR Alarm | GEN REVERSE VARs | 10041 |
| 34 | Gen Reverse VAR Pre-Alarm | PRE GEN REVERSE VARs | 10089 |
| 35 | Gen Phase Current Differential Alarm | GEN PHASE DIFF CURR | 10093 |
| 36 | Gen Phase Current Differential Pre-Alarm | PRE GEN PHS DIFF CUR | 10094 |
| 37 | Gen Phase Over Current Alarm | GEN PHASE OVER CURR | 10039 |
| 38 | Gen Phase Over Current Pre-Alarm | PRE GEN PHS DIF CURR | 10092 |
| 39 | Not Used | GROUND OVER VOLTAGE | X |
| 40 | KVA Switch | KVA SWITCH | 10163 |
| 41 | Load High Limit | LOAD HIGH LIMIT | 10053 |
| 42 | Load Low Limit | LOAD LOW LIMIT | 10054 |
| 43 | Not Used | LOAD SURGE | 10063 |
| 44 | Loss of Bus Alarm | LOSS OF BUS | 10005 |
| 45 | Not Used | | X |
| 46 | Not Used | | X |
| 47 | Not Used | | X |
| 48 | Not Used | | X |
| 49 | Bus Export Power Alarm | BUS EXPORT POWER | 10105 |
| 50 | Bus Export Power Pre-Alarm | PRE BUS EXPORT PWR | 10106 |
| 51 | Bus Import Power Alarm | BUS IMPORT POWER | 10103 |
| 52 | Bus Import Power Pre-Alarm | PRE BUS IMPORT PWR | 10104 |

| Alm # | Event Name | Display Name | Modbus ID |
|---|---|---|---|
| 53 | Bus Export VAR Alarm | BUS EXPORT VARs | 10109 |
| 54 | Bus Export VAR Pre-Alarm | PRE BUS EXPORT VAR | 10110 |
| 55 | Bus Import VAR Alarm | BUS IMPORT VARs | 10107 |
| 56 | Bus Import VAR Pre-Alarm | PRE BUS IMPORT VAR | 10108 |
| 57 | Bus Neg. Phase Sequence Over Current Alarm | BUS N-PHS-OVER CURR | 10115 |
| 58 | Bus Neg. Phase Sequence Over Current Pre-Alarm | PRE BUS N-PHS OVR CUR | 10116 |
| 59 | Bus Neg. Phase Sequence Over Voltage Alarm | BUS N-PHS-OVER VOLT | 10117 |
| 60 | Bus Neg. Phase Sequence Over Voltage Pre-Alarm | PRE BUS N-PHS OVR VLT | 10118 |
| 61 | Bus Over Freq Alarm | BUS OVER FREQ | 10066 |
| 62 | Bus Over Freq Pre-Alarm | PRE BUS OVER FREQ | 10101 |
| 63 | Bus Under Freq Alarm | BUS UNDER FREQ | 10067 |
| 64 | Bus Under Freq Pre-Alarm | PRE BUS UNDER FREQ | 10102 |
| 65 | Bus Over Volt Alarm | BUS OVER VOLTAGE | 10065 |
| 66 | Bus Over Volt Pre-Alarm | PRE BUS OVER VOLT | 10100 |
| 67 | Bus Under Volt Alarm | BUS UNDER VOLTAGE | 10064 |
| 68 | Bus Under Volt Pre-Alarm | PRE BUS UNDER VOLT | 10099 |
| 69 | Bus Phase Current Differential Alarm | BUS PHASE DIFF CUR | 10113 |
| 70 | Bus Phase Current Differential Pre-Alarm | PRE BUS PHS DIF CUR | 10114 |
| 71 | Bus Phase Over Current Alarm | BUS PHASE OVER CUR | 10111 |
| 72 | Bus Phase Over Current Pre-Alarm | PRE BUS PHS OVER CUR | 10112 |
| 73 | Bus Volt Restrained Phase Over Current Alarm | BUS VLT R-PH OVR CUR | 10119 |
| 74 | Bus Volt Restrained Phase Over Current Pre-Alarm | P-BUS V R-PH OVR CUR | 10120 |
| 75 | Over Speed | OVER SPEED | 10038 |
| 76 | Phase Rotation Mismatch | PHASE ROTATN MISMTCH | 10161 |
| 77 | Process High Limit | PROCESS HIGH LIMIT | 10055 |
| 78 | Process Low Limit | PROCESS LOW LIMIT | 10056 |
| 79 | Idle Oil Press High Alarm | OIL PRESS HI (IDLE) | 10080 |
| 80 | Idle Oil Press Low Alarm | OIL PRESS LO (IDLE) | 10081 |
| 81 | Rated Oil Press High Alarm | OIL PRESS HI (RATED) | 10045 |
| 82 | Rated Oil Press Low Alarm | OIL PRESS LO (RATED) | 10046 |
| 83 | Rated Oil Press Low Pre-Alarm | PRE OIL PRES LO -RTD | 10075 |
| 84 | Remote Fault1 | REMOTE FAULT 1 | 10057 |
| 85 | Remote Fault2 | REMOTE FAULT 2 | 10058 |
| 86 | Remote Fault3 | REMOTE FAULT 3 | 10059 |
| 87 | Remote Fault4 | REMOTE FAULT 4 | 10060 |
| 88 | Remote Fault5 | REMOTE FAULT 5 | 10061 |
| 89 | Remote Fault6 | REMOTE FAULT 6 | 10062 |
| 90 | Program Configuration Check Error | PROG CONFIG ERROR | 10162 |
| 91 | Not Used | X | X |
| 92 | Not Used | X | X |
| 93 | Not Used | X | X |
| 94 | Not Used | X | X |
| 95 | Not Used | X | X |
| 96 | Not Used | X | X |
| 97 | Not Used | X | X |
| 98 | Not Used | X | X |
| 99 | Analog 3 High Alarm | ANALOG IN 3 HIGH | 10130 |
| 100 | Analog 3 High Pre-Alarm | PRE ANALOG IN 3 HIGH | 10129 |
| 101 | Analog 3 Low Alarm | ANALOG IN 3 LOW | 10132 |
| 102 | Analog 3 Low Pre-Alarm | PRE ANALOG IN 3 LOW | 10131 |
| 103 | Analog 4 High Alarm | ANALOG IN 4 HIGH | 10134 |
| 104 | Analog 4 High Pre-Alarm | PRE ANALOG IN 4 HIGH | 10133 |
| 105 | Analog 4 Low Alarm | ANALOG IN 4 LOW | 10136 |
| 106 | Analog 4 Low Pre-Alarm | PRE ANALOG IN 4 LOW | 10135 |
| 107 | Gen breaker Sync Timeout | GEN BKR SYNC TIMEOUT | 10034 |
| 108 | Not Used | | X |
| 109 | Gen breaker Sync Reclose Alarm | GEN SYNC RECLOSE | 10035 |

| Alm # | Event Name | Display Name | Modbus ID |
|---|---|---|---|
| 110 | Not Used | | X |
| 111 | Speed/Freq Mismatch | SPEED / FREQ MISMTCH | 10042 |
| 112 | Speed Range Alarm | SPEED RANGE | 10072 |
| 113 | Voltage Range Alarm | VOLTAGE RANGE | 10037 |
| 114 | Crank Denied Alarm | CRANK DENIED | 10164 |
| 115 | Fail to Reach Idle Alarm | FAIL TO REACH IDLE | 10165 |
| 116 | Fail to Reach Rated Alarm | FAIL TO REACH RATED | 10166 |
| 117 | Modbus Port 1 Failed | MODBUS PORT 1 FAILED | 10167 |
| 118 | Modbus Port 2 Failed | MODBUS PORT 2 FAILED | 10168 |
| 119 | Analog In 1 Failed | Analog Input 1 Failed | 10171 |
| 120 | Analog In 2 Failed | Analog Input 2 Failed | 10172 |
| 121 | Analog In 3 Failed | Analog Input 3 Failed | 10173 |
| 122 | Analog In 4 Failed | Analog Input 4 Failed | 10174 |
| 123 | Atlas Power Module Fault | EGCP3 Power Board Fault | 10175 |
| 124 | Genset failed to start after LON start command | LON Auto Start Fault | 10195 |
| 125 | Genset failed to stop after LON stop command | LON Auto Stop Fault | 10196 |
| 126 | Service hours has counter down to zero | Service Hours Expired | 10197 |

## Protective Relay Descriptions

The PT and CT inputs were designed for accurate voltage and current monitoring in applications of display and control. They are not designed for high speed, sub-cycle, or cycle-to-cycle protective relaying though time delay protective relaying can be used.

**WARNING—OVERSPEED/OVERCURRENT**

**The EGCP-3 should not be used as the only means for detecting voltage or current disturbances, dead bus conditions, or overcurrent conditions. The generator should be equipped with a sync check relay, circuit breaker, and other fast acting protective relays as required by local codes and practices to protect against damage to the generator with possible personal injury, loss of life, or property damage. The sync check relay, circuit breaker, and other fast-acting protective relays must be totally independent of the EGCP-3.**

The table below gives some summary information about each type of protective relay function provided. Details for each follow the table. Note that the Alarm and Pre-Alarm Time Delays are used for both high and low conditions.

| Name | Functionality | Type |
|---|---|---|
| Generator Under/Over Voltage (27,59) | Alarm and Pre-Alarm capability | Definite Time |
| Bus Under/Over Voltage (27,59) | Alarm and Pre-Alarm capability | Definite Time |
| Generator Over/Under Frequency (81O, 81U) | Alarm and Pre-Alarm capability | Definite Time |
| Bus Over/Under Frequency (81O, 81U) | Alarm and Pre-Alarm capability | Definite Time |
| Generator Directional Power Relay (32) | Alarm and Pre-Alarm capability | Inverse Time |
| Bus Directional Power Relay (32) | Alarm and Pre-Alarm capability | Inverse Time |
| Generator Negative Phase Sequence Over Current (46) | Alarm and Pre-Alarm capability | Definite Time |
| Generator Negative Phase Sequence Over Voltage (47) | Alarm and Pre-Alarm capability | Definite Time |
| Mains Negative Phase Sequence Over Current (46) | Alarm and Pre-Alarm capability | Definite Time |

| Name | Functionality | Type |
|---|---|---|
| Mains Negative Phase Sequence Over Voltage (47) | Alarm and Pre-Alarm capability | Definite Time |
| Generator Phase Over Current (51) | Alarm and Pre-Alarm capability | Inverse Time |
| Mains Phase Over Current (51) | Alarm and Pre-Alarm capability | Inverse Time |
| Mains Voltage Restrained Phase Over Current (51V) | Alarm and Pre-Alarm capability | Inverse Time |
| Generator Directional VAR Relay | Alarm and Pre-Alarm capability | Definite Time |
| Bus Directional VAR relay | Alarm and Pre-Alarm capability | Definite Time |
| Generator Phase Current Differential Imbalance relay (87) | Alarm and Pre-Alarm capability | Inverse Time |
| Bus Phase Current Differential Imbalance relay (87) | Alarm and Pre-Alarm capability | Inverse Time |
| Sync Check (25) | True / False (no alarm) | Definite Time |
| Voltage (VAR/PF) Adjust Limits Reached | High and Low Alarms | Definite Time |
| Speed (Load) Adjust Limits Reached | High and Low Alarms | Definite Time |
| Over Speed Alarm (12) | Alarm only | Definite Time |
| Battery Voltage | Alarm only | Definite Time |
| Coolant Temperature | Alarm and Pre-Alarm capability | Definite Time |
| Rated Oil Pressure | Alarm and Pre-Alarm capability | Definite Time |
| Idle Oil Pressure | Alarm only | Definite Time |
| Remote Fault1 | Alarm only | Definite Time |
| Remote Fault2 | Alarm only | Definite Time |
| Remote Fault3 | Alarm only | Definite Time |
| Remote Fault4 | Alarm only | Definite Time |
| Remote Fault5 | Alarm only | Definite Time |
| Remote Fault6 | Alarm only | Definite Time |
| Spare Analog Alarm 3 | Alarm and Pre-Alarm | Definite Time |
| Spare Analog Alarm 4 | Alarm and Pre-Alarm | Definite Time |
| Speed / Frequency Mismatch | Alarm only | Definite Time |

## Over and Under Voltage

The Over and Under Voltage protective relay is definite time. It operates by comparing the actual voltage to the level set points for this relay. The highest voltage of the 3 phase inputs is always used for the Over Voltage protective relay. Likewise, the lowest voltage of the 3 phase inputs is always used for the Under Voltage protective relay. Once an alarm is issued, it is latched until the EGCP-3 is reset. The generator Under Voltage relay is automatically disabled anytime the generator breaker is open. The Bus Under Voltage relay, Generator and Bus Over Voltage relays are not inhibited by breaker position.

The action to be taken for an Over Voltage Pre-Alarm, Over Voltage Alarm, Under Voltage Pre-Alarm, and Under Voltage Alarm are all independently configurable. There are separate Delay times for Pre-Alarm and Alarm. The delay times for Over Voltage and Under Voltage are identical but Generator and Bus are independently configured.

The Alarm and Pre-Alarm trigger levels for an Over Voltage Pre-Alarm, Over Voltage Alarm, Under Voltage Pre-Alarm, and Under Voltage Alarm are all independently configurable. The worst case phase voltage must exceed the configured level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram below shows how the Pre-Alarm and final Alarm events are envisioned to operate. Note that the delay times are identical between Over and Under Voltage event examples but the trigger levels are all separately configurable.

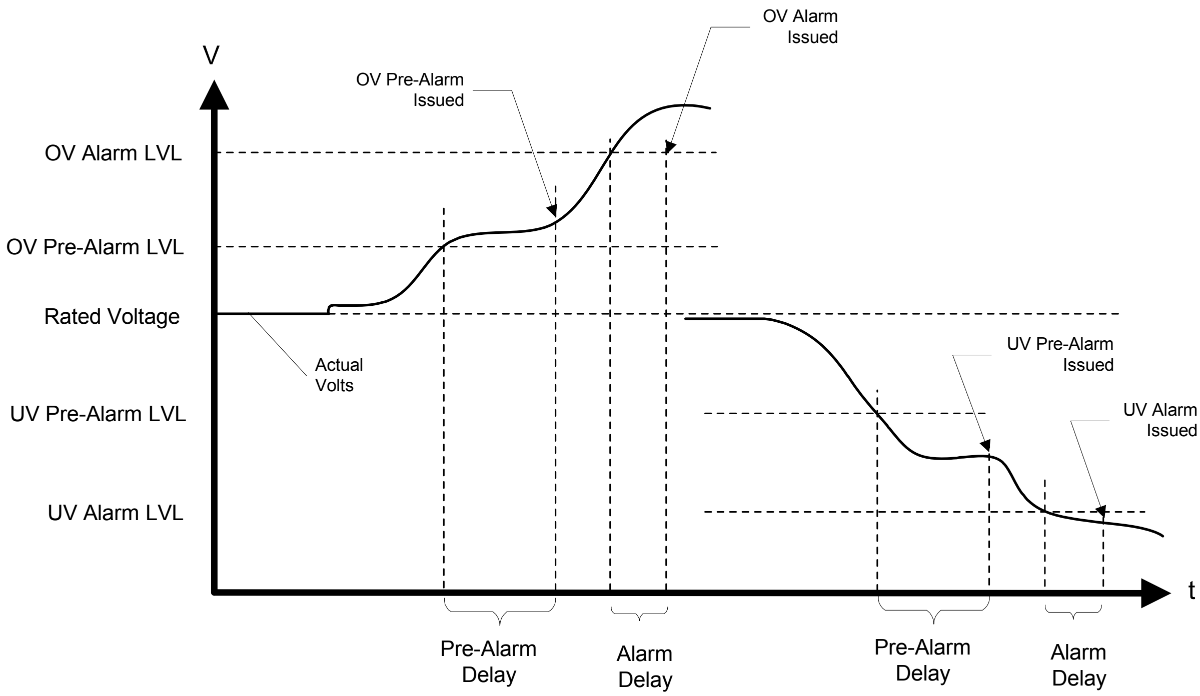



Figure 8-1. Over Voltage/Under Voltage Alarm

## Over and Under Frequency

The Over and Under Frequency protective relay is definite time. It operates by comparing the actual frequency to the level set points for this relay. Once an alarm is issued, it is latched until the EGCP-3 is reset. The generator Under Frequency relay is automatically disabled anytime the generator breaker is open. The Bus Under Frequency relay, Generator and Bus Over Frequency relays are not inhibited by breaker position.

The action to be taken for an Over Frequency Pre-Alarm, Over Frequency Alarm, Under Frequency Pre-Alarm, and Under Frequency Alarm are all independently configurable. There are separate Delay times for Pre-Alarm and final Alarm. The delay times for Over Frequency and Under Frequency are identical but Generator and Bus are independently configured.

The Alarm and Pre-Alarm trigger levels for an Over Frequency Pre-Alarm, Over Frequency Alarm, Under Frequency Pre-Alarm, and Under Frequency Alarm are all independently configurable. The frequency must exceed the level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram in Over and Under Voltage above shows how the Pre-Alarm and final Alarm events are envisioned to operate. The Over and Under Frequency protective relay function operates in the same manner as the Over and Under Voltage protective relay function.

## Directional Power

The Over and Reverse Power protective relays are inverse time. They operate by comparing the actual real power to the level set point for this relay. Only real power is of interest for this protection. Over power for the generator is power flowing out of the generator (produced by the generator). Over power for the Bus is defined as power flowing into the Bus (same relationship as generator). Over power for the Bus is denoted as Export Power and Reverse Power for the Bus is denoted as Import Power.

A configurable time delay setting is provided to shift the inverse time curve along the time axis. This movement allows adjustment of the minimum trip time at the configured level. The same shifted curve is used for Pre-Alarms and Alarms so a time shift done for one will affect the other as well. The same shift is also applied to both the Over Power and the Reverse Power protective relays.

The power level must exceed the level continuously for the calculated delay time before the Alarm or Pre-Alarm action is taken. The delay time is recalculated each time the power level changes. Once an alarm is issued, it is latched until the EGCP-3 is reset. The Directional Power relays are continuously enabled.

The below graph shows how the Pre-Alarm and final Alarm settings relate to actual and rated power levels. Notice the delay time for the over power pre alarm is longer than the delay time for the over power alarm. This time difference results from the difference in the actual power compared to the pre-alarm and alarm set points. A long time delay is seen when the actual power is only slightly higher than the pre-alarm level. When the actual power goes above the alarm level it goes noticeably higher so the time delay is shorter. In order to determine the calculated delay and to see how the curve shift is used, refer to the second graph below.

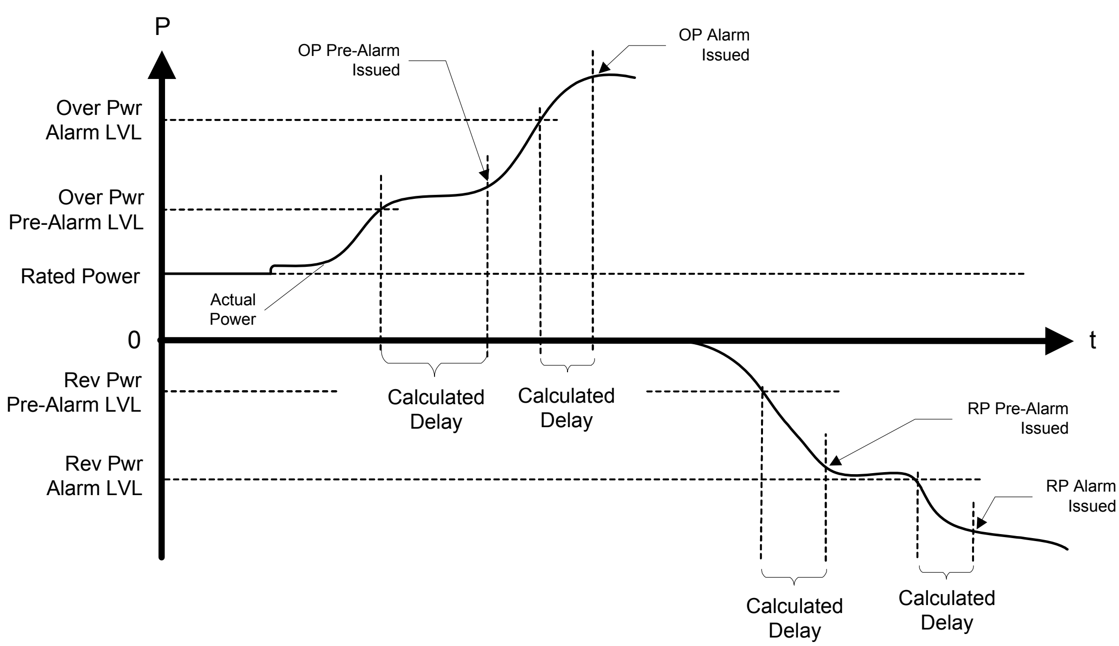



Figure 8-2. Over Power/Reverse Power

The graph below shows how the inverse time curve is applied to the directional power protective relay. Note the same curve shift applies to both Over and Reverse Power. Likewise, for the Bus, the same curve shift would apply to both Import and Export Power but is different than the curve shift used for the generator directional power protective relay.

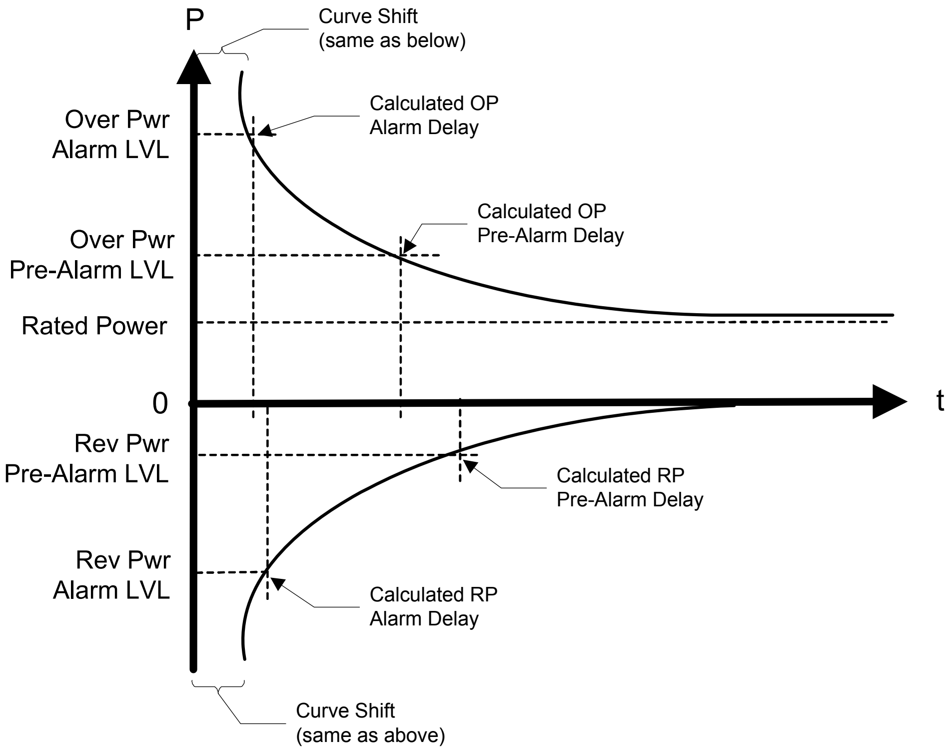



Figure 8-3. Over Power/Reverse Power Time Delay

## Negative Phase Sequence Over Voltage

Negative Phase Sequence Voltage (NPS) is a measure of the imbalance in a three phase system. Any imbalance due to unequal voltage amplitude of the three phases or a phase angle error between phases creates NPS voltage. A completely balanced system with positive phase sequence generates 0% NPS voltage. Complete loss of one phase results in 50% NPS voltage, a 100% NPS voltage would result from a balanced system with reversed phase sequence. The NPS protection function must know the correct (expected) phase rotation in order to function properly.

Typical causes of voltage unbalance are large unbalanced loads (single phase loads in the system) and unbalances in the supply due to transformer designs or other customer loads in the power system. The most common effect of voltage unbalance (detected by NPS voltage) is rotor overheating on 3-phase motors.

For installations where significant regenerated EMF may occur (lifts, cranes, or similar), a sensitivity of 5%-7% is recommended above what is necessary for the system unbalance. To avoid tripping on system transient disturbances, this relay should be configured with a timeout from 2 to 4 seconds.

This Negative Phase Sequence Over Voltage protective relay is a definite time relay. As the name implies, it tracks levels ABOVE a configured setting. It operates by comparing the actual Negative Phase Sequence Voltage with the level set point for this relay. Once an alarm is issued, it is latched until the EGCP-3 is reset. The Negative Phase Sequence Over Voltage relays are continuously enabled.

The actions to be taken for a Negative Phase Sequence Over Voltage Pre-Alarm or a Negative Phase Sequence Over Voltage Alarm are both independently configurable. The Negative Phase Sequence Over Voltage trigger levels are also independently configurable for the Pre-Alarm and Alarm. There are separate Delay times for Pre-Alarm and Alarm. The Negative Phase Sequence Voltage must exceed the trigger level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram in Over and Under Voltage above shows how the Pre-Alarm and final Alarm events are envisioned to operate. Only the Over Voltage portion of the diagram is used. The Negative Phase Sequence Over Voltage protective relay function operates in the same manner as the Over Voltage protective relay function.

## Negative Phase Sequence Over Current

This Negative Phase Sequence Over Current protective relay is a definite time relay. The negative phase sequence over current is derived the same as the voltage above. Once an alarm is issued, it is latched until the EGCP-3 is reset. The Negative Phase Sequence Over Current relays are continuously enabled.

The actions to be taken for a Negative Phase Sequence Over Current Pre-Alarm or a Negative Phase Sequence Over Current Alarm are both independently configurable. The Negative Phase Sequence Over Current trigger levels are also independently configurable for the Pre-Alarm and Alarm. There are separate Delay times for Pre-Alarm and Alarm. The Negative Phase Sequence Current must exceed the trigger level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram in Over and Under Voltage above shows how the Pre-Alarm and Alarm events are envisioned to operate. Only the Over Voltage portion of the diagram is used. The Negative Phase Sequence Over Current protective relay function operates in the same manner as the Over Voltage protective relay function.

## Phase Over Current

The Phase Over Current protective relay is an inverse time relay. It operates by comparing the actual phase current to the level set point for this relay. The highest current of the 3 phase inputs is always used for the Phase Over Current protective relay. Total current is not evaluated. This protective relay is NOT meant to replace a breaker.

A configurable time delay setting is provided to shift the inverse time curve along the time axis. This movement allows adjustment of the minimum trip time at the configured level. The same shifted curve is used for Pre-Alarms and Alarms so a time shift done for one will affect the other as well.

The worst case current level must exceed the configured level continuously for the calculated delay time before the Alarm or Pre-Alarm action is taken. The delay time is always being recalculated for the present current level input. Once an alarm is issued, it is latched until the EGCP-3 is reset. The Phase Over Current protective relay is continuously enabled.

The diagram in Directional Power above shows how the Pre-Alarm and final Alarm events are envisioned to operate as well as the interaction with the inverse time curve. Only the Over Power portion of the diagram is used. The Phase Over Current protective relay function operates in the same manner as the Over Power protective relay function.

## Voltage Restrained Phase Over Current

The Voltage Restrained Phase Over Current protective relay is an inverse time relay and is only available for the bus inputs. It operates by comparing the highest current of the 3 phase inputs to the level set point for this relay. The bus average voltage is used to determine the amount of restraint. Total current is not evaluated.

A configurable time delay setting is provided to shift the inverse time curve along the time axis. This movement allows adjustment of the minimum trip time at the configured level. The same shifted curve is used for Pre-Alarms and Alarms so a time shift done for one will affect the other as well.

The protective relay uses the average of the bus phase voltages to modify the Pre-Alarm and Alarm trigger levels. The phase current event trigger level is adjusted proportional to the voltage. The relationship is a 1:1 scaling. For example, if the bus voltage is at 100% of rated, the trigger level is unmodified. However, if the voltage is at 25% of rated, the phase current trigger level will also be scaled to 25% of the configured trigger level. A simple proportional multiplier is used for this purpose multiplying both the Pre-Alarm level and the Alarm level by the voltage derived scalar. The figure below shows the relationship between the current alarm level multiplier and the voltage level.

The scaled worst case current level must exceed the level continuously for the calculated delay time before the Alarm or Pre-Alarm action is taken. The delay time is always being recalculated for the present current level input. Once an alarm is issued, it is latched until the EGCP-3 is reset. The Voltage Restrained Phase Over Current protective relay is continuously enabled.

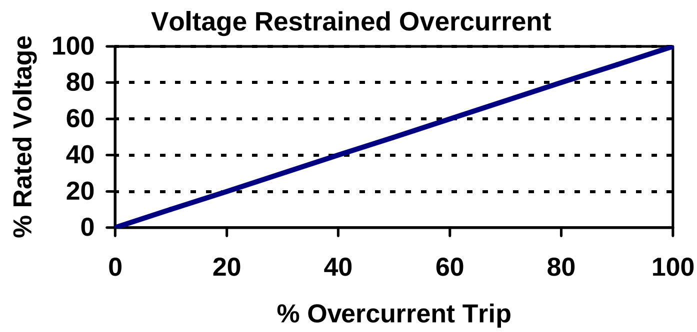



Figure 8-4. Voltage Restrained Over Current

The diagram in Directional Power above shows how the Pre-Alarm and Alarm events are envisioned to operate as well as the interaction with the inverse time curve. Only the Over Power portion of the diagram is used. The Voltage Restrained Phase Over Current protective relay function operates in the same manner as the Phase Over Current protective relay function except that the trigger level is automatically scaled proportional to the bus voltage.

## Directional VAR

The Over and Reverse VAR (Import and Export VAR) protective relay is definite time. It operates by comparing the actual reactive power to the level set points for this relay. Only reactive power is of interest for this protection. Over VAR for the generator is reactive power flowing out of the generator (produced by the generator) and is representative of lagging power factor. Over VAR for the Bus is defined as reactive power flowing into the Bus. We will refer to this as Export VAR for the Bus. Reverse VAR for the Bus will be referred to as Import VAR. Once an alarm is issued, it is latched until the EGCP-3 is reset.

The action to be taken for an Over (Export) VAR Pre-Alarm, Over (Export) VAR Alarm, Reverse (Import) VAR Pre-Alarm, and Reverse (Import) VAR Alarm are all independently configurable. There are separate Delay times for Pre-Alarm and Alarm. The delay times for Forward and Reverse VAR are identical but Generator and Bus are independently configured.

The Alarm and Pre-Alarm trigger levels for an Over (Export) VAR Pre-Alarm, Over (Export) VAR Alarm, Reverse (Import) VAR Pre-Alarm, and Reverse (Import) VAR Alarm are all independently configurable. The reactive power level must exceed the trigger level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram in Over and Under Voltage above shows how the Pre-Alarm and Alarm events are envisioned to operate. The Directional VAR protective relay function operates in the same manner as the Over and Under Voltage protective relay function.

## Phase Current Imbalance

The Phase-balance Current protective relay is an inverse time relay. It operates by comparing the actual current between each phase to the level set point for this relay. The highest differential current of the 3 comparisons is always used for the Phase Current Imbalance protective relay.

A configurable time delay setting is provided to shift the inverse time curve along the time axis. This movement allows adjustment of the minimum trip time at the configured level. The same shifted curve is used for Pre-Alarms and Alarms so a time shift done for one will affect the other as well.

The worst case current differential must exceed the trigger level continuously for the calculated delay time before the Alarm or Pre-Alarm action is taken. The delay time is always being recalculated for the present current imbalance level input. Once an alarm is issued, it is latched until the EGCP-3 is reset. The Phase Current Differential protective relay is continuously enabled.

The below graph shows how the Pre-Alarm and Alarm settings relate to actual current imbalance levels. The current imbalance levels are internally normalized against the rated current. This provides the inverse time function with a valid comparison because the IEEE definition is only valid above 1 per unit. Nevertheless, the configuration values for the Alarm and Pre-Alarm Level are to be entered as the actual allowed difference. The EGCP-3 will automatically add Rated Current to the configured value.

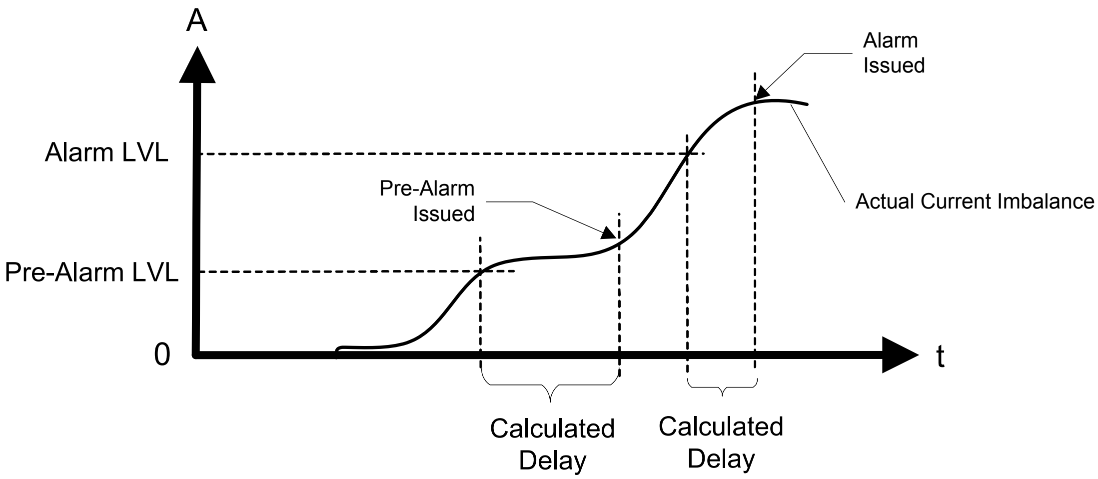



Figure 8-5. Phase Current Imbalance

In order to determine the calculated delay and to see how the curve shift is used, refer to the graph below. The Phase Current Imbalance protective relay function operates in nearly the same manner as the Over Power protective relay function except that rated current is automatically added into the percentage calculation for the IEEE inverse time curve input. The information is provided in case an exact trip time must be calculated.

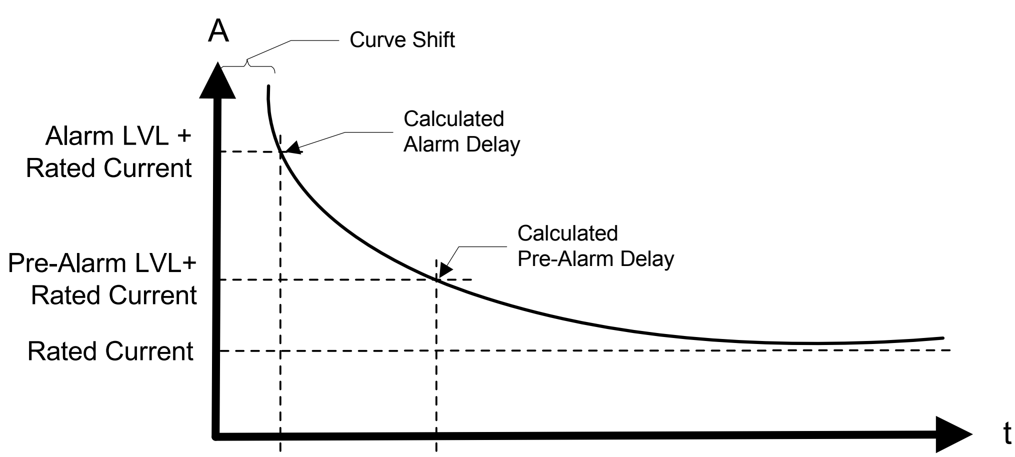



Figure 8-6. Phase-Balance Current, Inverse Time Delay

## Sync Check

The EGCP-3 synchronizer provides the Sync Check protective relay function. It is listed here due to its nature as a protective relay. It is enabled during synchronizing only. The synchronizer always performs a Sync Check function regardless of the configured mode since it will never assert the breaker close output unless the two A-phase inputs are in sync with each other. The synchronizer may also be placed in the Permissive Mode which mimics a typical ANSI 25 device by closing the output when the two sources are in sync.

## Voltage (VAR/PF) and Speed (Load) Adjust Limits Reached

The Limits Reached alarm function applies to the two closed loop analog outputs – one for voltage adjust and the other for speed adjust. Each output has separate alarm due to exceeding the limits in the high direction or low direction. There is a fixed timeout of 10 seconds to ensure that a short bump into the limit does not cause an alarm. The alarm action is configurable.

This protection determines if the analog output or digital outputs (depending on configuration) have reached their limits. Since a digital output has no definite limit, the protection also reacts to the situation where the control is requesting more adjustment but the system is not responding. This condition would be indicative of reaching a limit.

## Over Speed

The Over Speed protection watches the magnetic speed pickup input. It compares the scaled value of the MPU (the rpm value) to a single configurable set point for over speed. In order to provide a swift response, no delay is used. As soon as an over speed condition is detected, the alarm is issued. How the alarm reacts is configurable. If one of the digital outputs is programmed for Air Shutoff Solenoid, this relay will be energized by an overspeed alarm.

## Battery Voltage

The Battery Voltage protection watches an internal measurement of 24vdc input supply voltage. One configurable high and one configurable low level trigger are provided. The low level alarm is disabled while the engine is cranking since the EGCP-3 may be powered from the same set of batteries and would see a "normal" low voltage during this time. Otherwise, this protection is always enabled. It is a definite time protection with a fixed timeout period of 10 seconds. This timeout is used to ensure that voltage transients due to equipment power up do not cause erroneous alarms. How the alarms react is independently configurable.

## Coolant Temperature

Analog Input #1 is reserved for a coolant temperature sensor. In addition to providing coolant temperature metering, the data can be used for protection and alarm. The Coolant Temperature Pre-Alarm and Alarms are definite time with a fixed timeout period of 10 seconds. This timeout period is used to ensure that noise or other disturbances do not cause erroneous alarms. If no coolant temperature sensor is provided, this protection is disabled. Once an alarm is issued, it is latched until the EGCP-3 is reset.

The action to be taken for a High Coolant Temperature Pre-Alarm, High Coolant Temperature Alarm, Low Coolant Temperature Pre-Alarm, and Low Coolant Temperature Alarm are all independently configurable. The Alarm and Pre-Alarm trigger levels are also all independently configurable. The temperature must exceed the trigger level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram below shows how the Pre-Alarm and Alarm events are envisioned to operate. The Coolant Temperature protection operates as a simple comparison between actual and the configured set points.

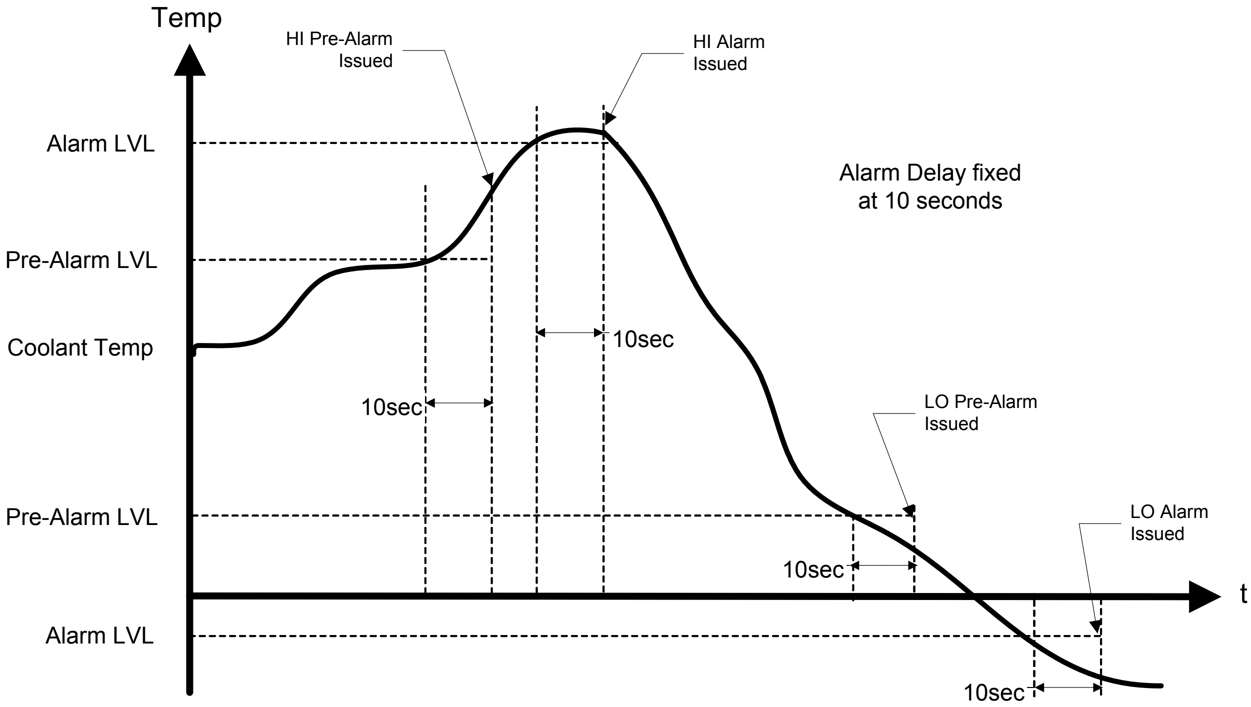



Figure 8-7. Coolant Level Alarm

## Oil Pressure

Analog Input #2 is reserved for an oil pressure sensor. In addition to providing oil pressure metering, the data can be used for protection and alarm. There are three stages for oil pressure due to its natural tie to engine speed. The first stage is during Idle, the next is while ramping to rated, and the last while at Rated speed. If no oil pressure sensor is provided, this protection is disabled. Once an alarm is issued, it is latched until the EGCP-3 is reset. Speeds are determined from the MPU. If no MPU is provided, the Idle Oil Pressure protection will not be able to operate.

### Idle Oil Pressure Alarm

The Idle Oil Pressure Alarms are definite time delay with a fixed timeout period of 2 seconds. This timeout period is used to allow oil pressure to build-up after an engine start and to ensure that noise or other disturbances do not cause erroneous alarms.

The action to be taken and the Alarm trigger levels for a High Idle Oil Pressure Alarm and Low Idle Oil Pressure Alarm are each independently configurable. The pressure must exceed the trigger level (High Pressure), or be below the trigger level (Low Pressure) continuously for the delay time before the Alarm action is taken.

The diagram in below shows when the Idle Oil Pressure Alarms are enabled. During the ramp from Idle to Rated speed, the Low Idle Oil Pressure Alarm remains enabled.

**Rated Oil Pressure Alarm**

The Rated Oil Pressure Pre-Alarm and Alarms are definite time delay with a fixed timeout period of 2 seconds.

The action to be taken for a High Rated Oil Pressure Alarm, Low Rated Oil Pressure Pre-Alarm, and Low Rated Oil Pressure Alarm are all independently configurable. No High Rated Oil Pressure Pre-Alarm is provided.

The Alarm and Pre-Alarm trigger levels for a High Rated Oil Pressure Alarm, Low Rated Oil Pressure Pre-Alarm, and Low Rated Oil Pressure Alarm are all independently configurable. The pressure must exceed the trigger level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram in Coolant Temperature above shows how the Pre-Alarm and Alarm events are envisioned to operate. The Rated Oil Pressure protection operates in the same manner as the Coolant Temperature protection function, with the exception that the time delay is only two seconds compared to ten. The graph below shows when the Rated Oil Pressure Alarms and Pre-Alarms are enabled as well as when the Idle Oil Pressure Alarms are enabled. During the ramp from Idle to Rated speed, the High Rated Oil Pressure Alarm is enabled but the Low Rated Oil Pressure Alarm and Pre-Alarm are not enabled.

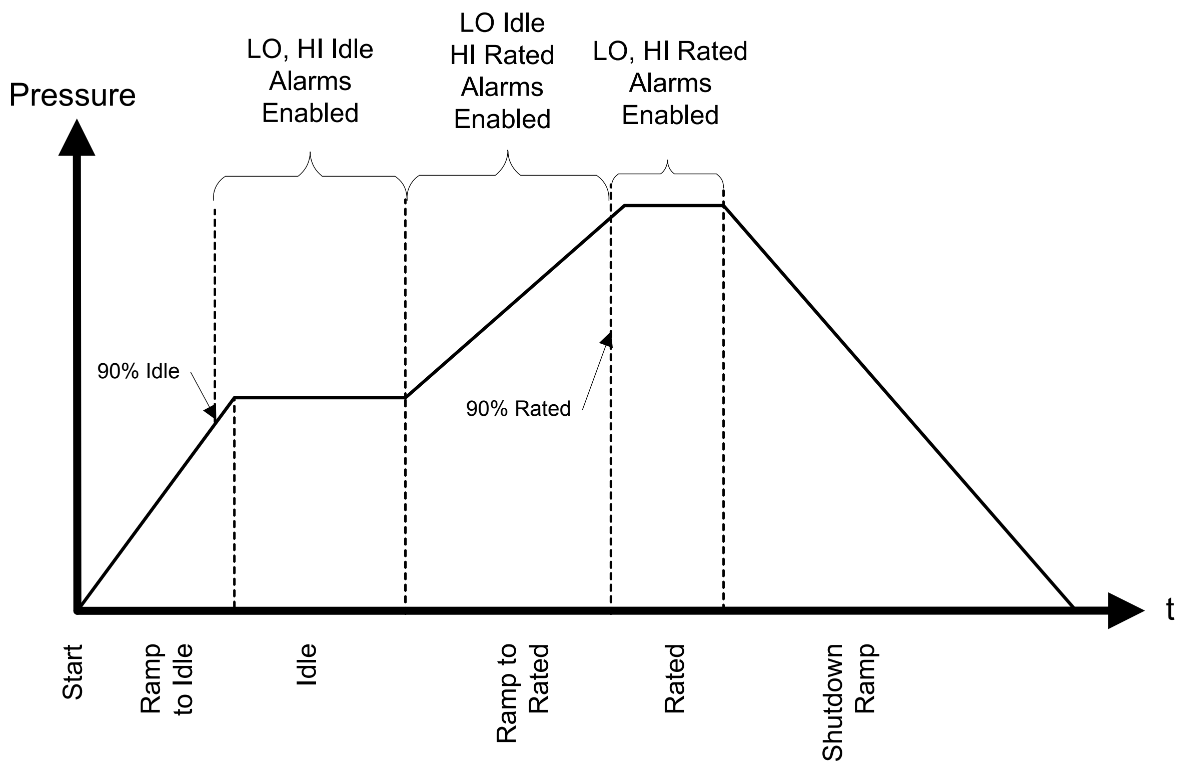



Figure 8-8. Oil Pressure Engine Protection

### Remote Alarms

There are six (6) configurable alarms based on digital inputs. Each alarm is a definite time function with a configurable delay time. The action taken by each alarm is configurable for Disabled, Warning, Audible, Visual, Soft Shutdown, Hard Shutdown, Trip tie breaker, and Trip tie breaker with alarm. Each input may be configured to consider the active condition as one with +24 Vdc applied to the input (active high) or with the input floating (active low). The input must meet the active condition continuously for the delay time before the Alarm action is taken.

### Remote Analog Alarm

There are two (2) configurable alarms based on the spare analog inputs. Each has High Alarm and High Pre-Alarm level set points and Low Alarm and Low Pre-Alarm level set points. The action taken by the Alarms and Pre-Alarms are all configurable for Disabled, Warning, Audible, Visual, Soft Shutdown, Hard Shutdown, Trip tie breaker, and trip tie breaker with alarm.

The Spare Analog Alarms are all definite time alarms with configurable timeouts. Each is configured in the same manner as the Coolant Temperature Alarms described above except that the delay time is configurable.

### Speed / Frequency Mismatch

The Speed/Frequency Mismatch protection watches the magnetic pickup speed input and the measured frequency on the generator input. It compares the scaled value of the MPU (the rpm value) to the frequency using a simple formula. The formula also depends on the configured number of generator poles.

$$Frequency = \frac{\#GenPoles \bullet RPM}{120}$$

The purpose of this protection is partly to identify an incorrect configuration for the number of teeth but primarily to diagnose a failed MPU signal or a generator failure. If the one of the signals fail, a mismatch will occur between the measured MPU speed and the measured generator frequency. Since over speed is determined from the MPU input, this protection is an important adder to the over speed protection.

A fixed delay of 5 seconds is incorporated. A one hertz margin is allowed. How the alarm reacts is configurable.

## Inverse Time Curve

All protective relays that utilize inverse time trips will use the same curve shape as defined below. Each relay will be allowed to independently adjust the curve along the time axis. This adjustment does not alter the curve shape. The reason for the adjustment is to allow fine tuning of the alarm levels and timing.

The EGCP-3 takes the ratio of the input being used (phase current, power, etc.) to the rated value of that unit. The inverse time curve always uses a ratio of rated for its data element.

The inverse time curve plotted below is defined in IEEE C37.112 as the Very Inverse formula

$$Time = \left( \frac{A}{x^p - 1} + B \right) * D$$

where:

| | |
|---|---|
| **Time** | The amount of time to wait before an alarm is issued for the given value of x. As x increases, the time will decrease. |
| **X** | A ratio of the measured parameter in protection to rated value. |
| **A** | IEEE defined constant that affects the curve shape. It is fixed at **19.61.** |
| **B** | IEEE defined constant that affects the curve position. It is fixed at **0.491** |
| **P** | IEEE defined constant that defines the curve type. It is fixed at **2.** |
| **D** | Adjustable time delay. This allows the curve to be shifted along the time axis by a variable amount.**, 0.01 to 10.0, default =1.0** |

For high alarms: If the input is less than the Alarm level and Pre-Alarm level, no action will be taken. When the input is above the Pre-Alarm level, the configured action will be taken for the pre-alarm after the timeout defined by the formula. When the input is above the Alarm level, the appropriate (and typically more severe) action will be taken after the (shorter) timeout defined by the formula.

For low alarms: If the input is greater than the Alarm level and Pre-Alarm level, no action will be taken. When the input is less than the Pre-Alarm level, the configured action will be taken for the pre-alarm after the timeout defined by the formula. When the input is less than the Alarm level, the appropriate (and typically more severe) action will be taken after the (shorter) timeout defined by the formula.

The IEEE curve implemented is the Very Inverse curve defined in IEEE C37.112 and also matches the IEC curve defined in IEC 255-03 except for the additional time shift (B) that is not defined in IEC. The formula will not function at rated or below rated for the parameter in protection. Therefore, if a trip value is set at or below rated, the timeout for these conditions will be fixed at 10 seconds. This causes a discontinuity in the curve at 100% rated. The values for A and B in the IEEE formula change at the discontinuity point. The constant A becomes 0 and the constant B becomes 10. Due to the location of the B constant and the D variable, the 10 second timeout will also adjust with the curve shift.

The figure below is a set of curves showing the IEEE Very Inverse formula plotted three times. The center plot is the default curve with no level shift, Shift value = 1.0. The upper plot is the same curve with a level shift of five. The lower plot is the same curve with a level shift of 0.1. Note the curve shape does not change. Also note the fixed timing at or below rated as shown by the straight horizontal line; and note how the fixed timing is varied with the curve shift. The EGCP-3 curve does extend to the right beyond the time shown.
Also shown below is a figure with the Inverse Time Curve converted to linear axis scale. The values used in the EGCP-3 extend above 25 second delay between 1.0 and 1.35, and also extend to the right beyond the ratio of 5.0.

**Example:** If the alarm set point is 150% of the rated (1.5 ratio) and the input is at this setpoint value and the shift = 1.0, the delay will be 16 seconds. When shift = 5, delay will be 80 seconds. When shift = 0.1, delay will be 1.6 seconds. As the input value exceeds the setpoint, the delay will become shorter.
**Example:** For an Over Current Trip Relay function: If Rated Phase Current is 500 Amps, and a trip delay of 5.0 second is desired at 700 Amp.
Ratio = 1.4, from formula (or reading from curve below) the Normalized Delay = 20.9 sec.
5.0 / 21.0 = 0.24

The curve shift value of 0.24 is required to meet the desired level and delay requirement.

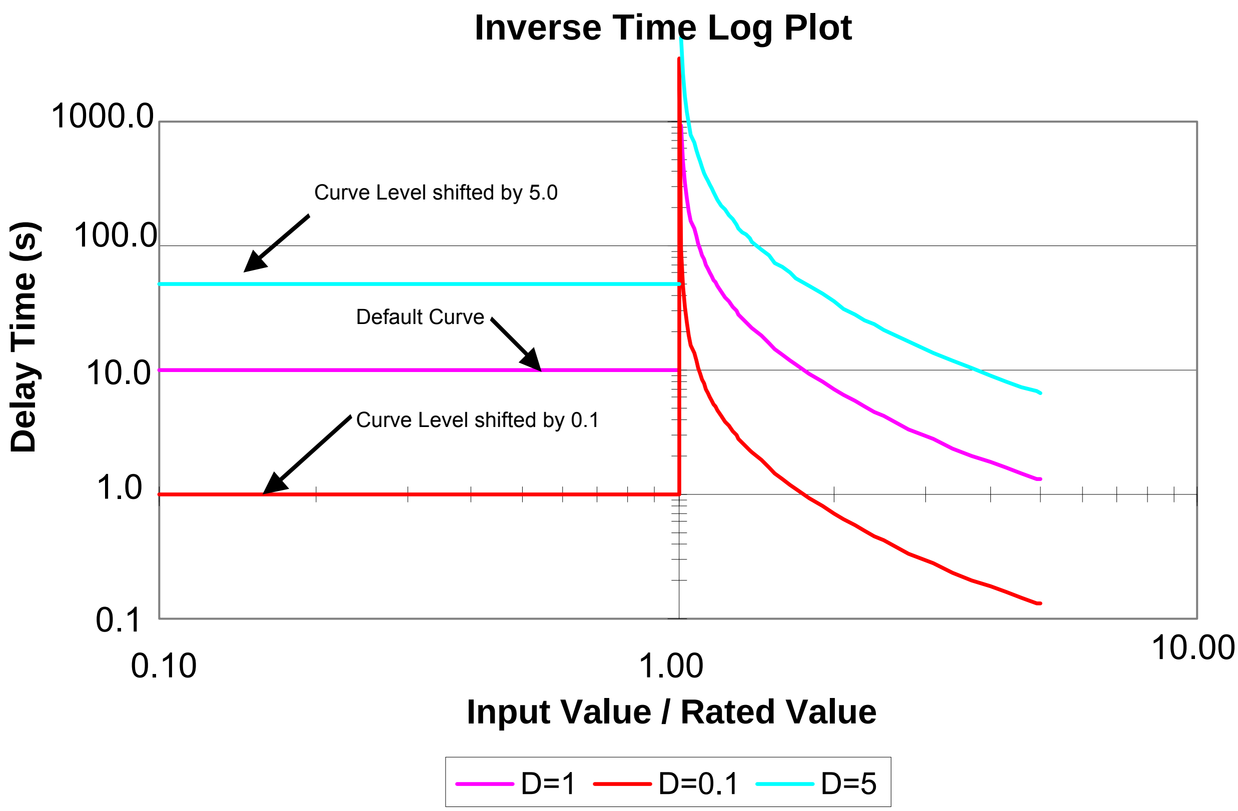



Figure 8-9. Inverse Curve Time Delay, Level Shift

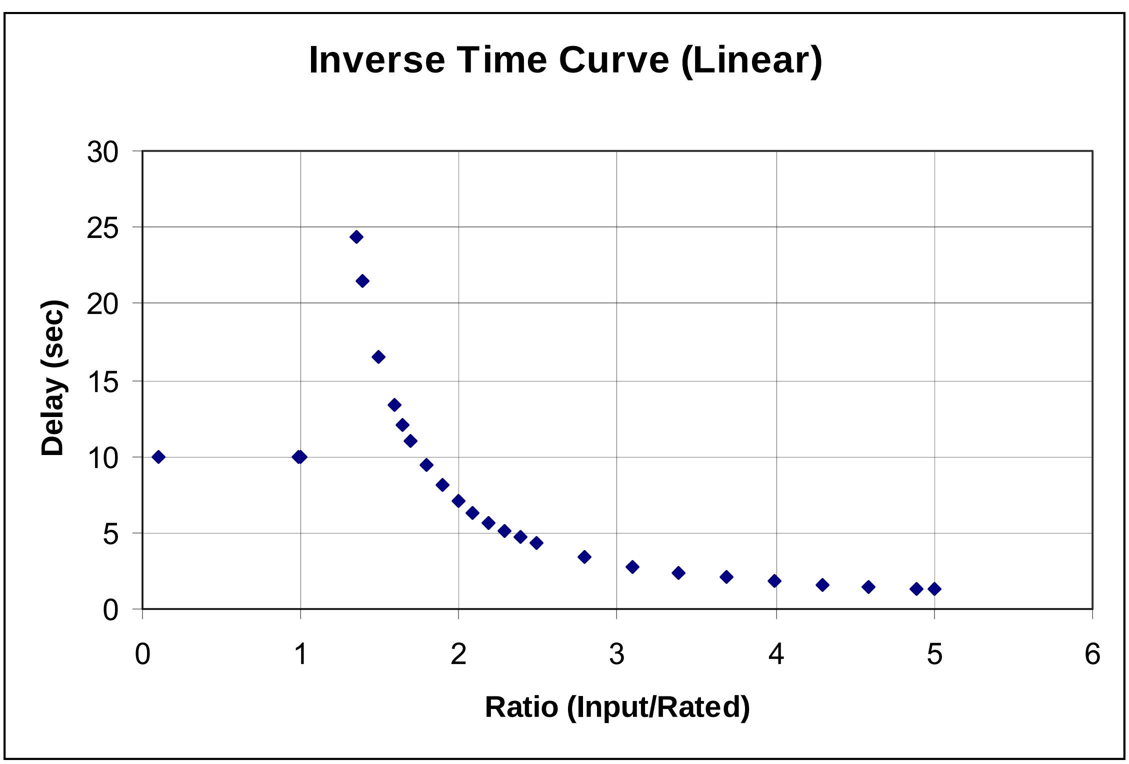



Figure 8-10. Inverse Curve Time Delay, Linear Graph

# Diagnostics

The following table is a concise list of all diagnostics generated by the EGCP-3. The Modbus ID is the Boolean Read address where the status of the named diagnostic can be determined via Modbus. Diagnostic actions are not configurable. All diagnostics generate a warning condition and some force a specific action to be taken.

| Event | Display Name | MODBUS ID |
|---|---|---|
| Analog IN 1 Out of Range | AI 1 OUT OF RANGE | 10171 |
| Analog IN 2 Out of Range | AI 2 OUT OF RANGE | 10172 |
| Analog IN 3 Out of Range | AI 3 OUT OF RANGE | 10173 |
| Analog IN 4 Out of Range | AI 4 OUT OF RANGE | 10174 |
| Crank Denied Alarm | CRANK DENIED | 10164 |
| Crank Failed Alarm | CRANK FAIL | 10036 |
| Fail to Reach Idle | FAIL TO REACH IDLE | 10165 |
| Fail to Reach Rated | FAIL TO REACH RATED | 10166 |
| Fail to Synchronize | FAIL TO SYNC | 10160 |
| Gen Breaker Close Error | GEN BRKR CLOSE ERROR | 10153 |
| Gen Breaker Feedback Error | GEN BKR FEEDBACK ERR | 10157 |
| Gen Breaker Shunt Trip Error | GEN BKR SHNT TRP ERR | 10155 |
| Modbus Link 1 Error | MODBUS LINK 1 ERR | 10167 |
| Modbus Link 2 Error | MODBUS LINK 2 ERR | 10168 |
| Phase Rotation Mismatch | PHASE ROTATN MISMTCH | 10161 |
| Power Module Board Fault | POWER BOARD FAULT | 10175 |

## Analog Input Out of Range

The Out of Range Diagnostic function applies to all four analog inputs where the first two analog inputs have the fixed functions of Coolant Temperature input and Oil Pressure input respectively. A separate alarm is issued for each input. The default alarm action for Out of Range alarms is Disabled, The Alarm Action can be configured from the Watch Window Service Analog Input menu for: Disabled, Warning, Visual Alarm, Audible Alarm, Soft Shutdown, and Hard Shutdown.

If an analog input measures a value less than 2 mA or greater than 22 mA, this diagnostic becomes true. When the input is configured as a voltage input, the equivalent range is 0.5 V at the low end and 5.5 volts at the high end. This diagnostic is always enabled.

## Crank Denied

The Crank Denied Diagnostic will occur if a start request is made while engine speed is detected. The start request is queued while the diagnostic is active. Once engine speed falls to zero, the start will automatically take place unless the request has been removed. When this diagnostic occurs, it is logged in the event list as a Warning and the Warning output is engaged.

## Crank Failed

The Crank Failed Diagnostic will occur if a start request is made and attempted but the engine does not successfully start. All crank attempts must be exhausted before the Crank Fail diagnostic is generated. Once this diagnostic occurs, it is latched and no further start attempts can be made until the event is cleared. The Alarm Action can be Configured from the Engine Control menu. The Alarm Action is defaulted for Soft Shutdown, it can be configured for: Disabled, Warning, Visual Alarm, Audible Alarm, Soft Shutdown, and Hard Shutdown.

## Fail to Reach Idle

The Fail to Reach Idle Diagnostic will occur if a successful start is made (crank cutout speed is reached) but the speed input does not register 90% or more of the configured idle speed within 10 seconds of reaching crank cutout speed. The Alarm Action can be Configured from the Engine Control menu. The Alarm Action is defaulted for Warning, it can be configured for: Disabled, Warning, Visual Alarm, Audible Alarm, Soft Shutdown, and Hard Shutdown. When this diagnostic occurs, the configured action is taken. If shutdown action is not selected, start control is not inhibited. Then the state is set to IDLE and the idle timer is started even though the engine does not appear to be at idle. This control action is performed in case the engine is very slow to accelerate and/or the idle speed setting is incorrect.

## Fail to Reach Rated

The Fail to Reach Rated Diagnostic will occur if a successful start is made (crank cutout speed is reached) but the speed input does not register 90% or more of the configured rated speed within 14 seconds of energizing the rated speed output. The rated speed output is set after the idle timer expires.

The Alarm Action can be Configured from the Engine Control menu. The Alarm Action is defaulted for Warning, it can be configured for: Disabled, Warning, Visual Alarm, Audible Alarm, Soft Shutdown, and Hard Shutdown. When this diagnostic occurs, the configured action is taken. If shutdown action is not selected, start control is not inhibited. Then the state is set to RATED and the start is considered complete even though the engine does not appear to be at rated. Until conditions are met, Generator Stable will not allow automatic breaker closure. This control action is performed in case the engine is very slow to accelerate.

## Fail to Synchronize

This Fail to Synchronize Diagnostic will occur if the EGCP-3 was not able to bring the generator and bus into synchronization long enough to close the breaker prior to the Synchronizer Timeout expiring. If the EGCP-3 attempts to close the breaker but cannot due to other reasons, this diagnostic would not apply. Breaker Close Error covers that condition instead.
The Alarm Action can be Configured from the Synchronizer menu in Watch Window. The Alarm Action is defaulted for Warning, it can be configured for: Disabled, Warning, Visual Alarm, Audible Alarm, Soft Shutdown. When this diagnostic occurs, the configured action is taken.

## Breaker Close Error

This diagnostic results when a breaker close output is operated more than 3 times without the breaker auxiliary contact reporting that the breaker has closed. This typically indicates that the charge circuit is not working or the close spring/motor is damaged. The diagnostic indicates which breaker output is in error: When this diagnostic occurs, by the default action, it is logged in the event list as a warning and the warning output is engaged. From the Front panel or Watch Window it can be configured for: Disabled, Warning, Visual Alarm, Audible Alarm, Soft Shutdown or Hard Shutdown.

## Breaker Feedback Error

The Generator Breaker Feedback Error Diagnostic results when the breaker auxiliary contact reports that the breaker is open but current is observed flowing through the breaker. This indicates that the breaker auxiliary contact circuit is open or failed. When this condition occurs, the EGCP-3 automatically begins performing the actions associated with the relevant breaker closure as if the auxiliary contact indicated the breaker was closed.

The default action is Warning, so when this diagnostic occurs, by, it is logged in the event list as a warning and the warning output is engaged. From the Front panel or Watch Window it can be configured for: Disabled, Warning, Visual Alarm, Audible Alarm, Soft Shutdown or Hard Shutdown.

## Breaker Shunt Trip Error

The Breaker Shunt Trip Error Diagnostic results when a breaker shunt trip output is operated without the breaker auxiliary contact reporting that the breaker has opened. It may be that the auxiliary contact is failed closed but typically will indicate that the shunt trip wiring is open or the shunt trip coil in the breaker is failed. From Watch Window Engine Protection menu, it can be configured for: Disabled, Warning, Visual Alarm, Audible Alarm, Soft Shutdown or Hard Shutdown. The default action is to initiate a soft shutdown.

## Modbus Link Error

There is a Link Error for each of the 2 possible Modbus connections. The Link Error is flagged when a Modbus Timeout is detected. The timeout period is configurable in the Communications Menu. The default action is Warning, so when this diagnostic occurs, by, it is logged in the event list as a warning and the warning output is engaged.

## Phase Rotation Mismatch

The Phase Rotation Mismatch Diagnostic indicates that the configuration for phase rotation on the generator or bus does not match the observed phase rotation. This diagnostic relies on Negative Phase Sequence Voltage to determine the mismatch. If either bus is configured to use single phase sensing, the phase rotation mismatch check will not operate. When this diagnostic occurs, it is logged in the event list as and an audible alarm output is engaged. It will also prevent generator breaker closure.

## Power Module Board Fault

The Power Module Board Fault Diagnostic occurs when an error is detected with the PowerSense board in EGCP-3. The PowerSense board is the board that monitors ac inputs and calculates the control values based on the inputs. This board is located in the middle of the stack. If this diagnostic occurs, the EGCP-3 will automatically perform an I/O Lock, which will shutdown the genset, and open the generator breaker.

There is a LED on the top of the board closest to the display, labeled CPU. Check the LED to see if it is blinking, solid on, or off. If it is blinking, make a note of how many times it blinks before it starts the sequence over. There will be a long pause when the sequence is starting over. The LED may blink up to 24 times in a sequence. Making a note of the LED status will help Woodward applications staff determine the nature of the problem.

Before calling Woodward, cycle power to the EGCP-3. The board fault may clear by itself and allow normal operation again. If, after cycling power to the EGCP-3, the board fault remains, call Woodward for assistance in troubleshooting.

## Configuration Check

The EGCP-3 performs some configuration checks to determine if the control is configured in a manner that is inconsistent, dangerous, or non-functional. An error message is issued in the Watch Window- System Status for configuration error.
This check covers:

- The same feature should not be assigned to more than one discrete input.
- The same feature should not be assigned to more than one analog input.
- Value entered for Rated kW must be between 70% to 100% of entered Rated KVA.
- Entered Rated kVAR should be between 0.0 and 70% of Rated KVA.
- The entered Rated Speed and Entered Number of Generator Poles do not match with the entered System Frequency.

# Status Indicators

Both the SmartCore board and the PowerSense board have red status LEDs. The LEDs indicate internal CPU detected errors. These indicators are useful for troubleshooting problems. The status LEDs on the PowerSense board are located on the bottom edge (when panel mounted) of the board between terminals 36 and 45 (terminals 37-45 are not used). The status LED on the SmartCore board is next to terminal 82.

Check the LED to see if it is blinking, solid on, or off. It is normal for both board's status LEDs to be on for approximately 60 sec during power-up tests, and then turn off. If an LED is blinking, make a note of how many times it blinks before it starts the sequence over. There will be a long pause when the sequence is starting over. The PowerSense board LED may blink up to 24 times in a sequence. The SmartCore board LED may blink up to 14 times in a sequence. Interpretation of the LED flash codes is not provided here since it will not help the user to correct the problem. However, the flash codes will help Woodward personnel in troubleshooting the problem.

The PowerSense board also has LEDs for the LON status; these are located next to the CPU status LED. The center LON Status LED will flash green to indicate the LON communication is operational. The rate of flashing indicates the amount of “traffic” on the LON network. The LON Service LED will be off during normal operation. The Service LED may turn on during power-up tests, but will turn off when the application is running. If this LED is flashing, the rate of flashes will indicate the possible LON network problem.

# Chapter 9. Engine Start Sequencing

## Introduction

The EGCP-3 contains routines that execute standard start and stop sequencing logic applicable for both Gas and Diesel reciprocating engines. The logic provides control and protection of the engine. There are separate states for the various phases of start and stop sequencing. Shutdown, Cooldown, and Hard Stop states are all shutdown methods with subtle differences between how they shutdown the engine.

It is also possible to enable/disable the Start Sequencing from either the front panel or Watch Window with configuration parameter, “First Time Start-up, Engine Start Sequencing.” When disabled, the Fuel Control Relay becomes a start/stop request. When the start routine is entered, the first check is for a Disable setting of Start Sequencing. When a stop request occurs, the first check is also to see if Start Sequencing is disabled. An external device is expected to handle all elements of start and stop excluding cooldown that the EGCP-3 can still provide (but doesn’t have to).

## Starting Procedure

When a START signal is received, this routine will perform the necessary sequence to start the engine. Although repeated checks are not shown in the flowchart for E-stop, the EGCP-3 does continuously look for an E-stop request during the start sequence and will respond accordingly.

The magnetic pickup is required for the EGCP-3 to perform the Start Sequencing routine. If a discrete output is configured for Engine Running, it will be energized when the starter is energized and will be de-energized when the engine comes to rest. If the control does not see a minimum engine speed three seconds after energizing the Starter relay, the crank attempt will be stopped. The crank delay and crank repeats will continue on the next attempt. An application note: If the idle/rated speed control discrete output is not used, the user should set the idle timer to zero. This will allow the low oil pressure protection to work properly and will remove unnecessary delays. If it is not set to zero, the engine will go to rated but will still be using the idle oil pressure alarm and pre-alarm settings until the timer expires. Furthermore, the generator stable timer cannot start until the idle timer is expired which can delay the loading procedure.

There are two diagnostic conditions checked during start. Neither inhibits continued operation but both are logged in the event history log and current event list. A Fail to Reach Idle alarm is issued if the speed does not reach 90% of the configured idle speed within 10 seconds after the starters have been disengaged. The Idle Timer will begin only after the idle has reached 90% of the configured idle speed or after the Fail to Reach Idle alarm is issued. This is also when the Engine State will change from Cranking to Idle. The Fail to Reach Rated alarm is issued if the speed does not reach 90% of the configured rated speed within 10 seconds after the idle/rated output is energized for rated speed. This is also when the Engine State will change from Idle to Rated.

The start routine is shown below. This flowchart assumes Start Sequencing is enabled. If disabled, see the External Starting Procedure section later in this manual.

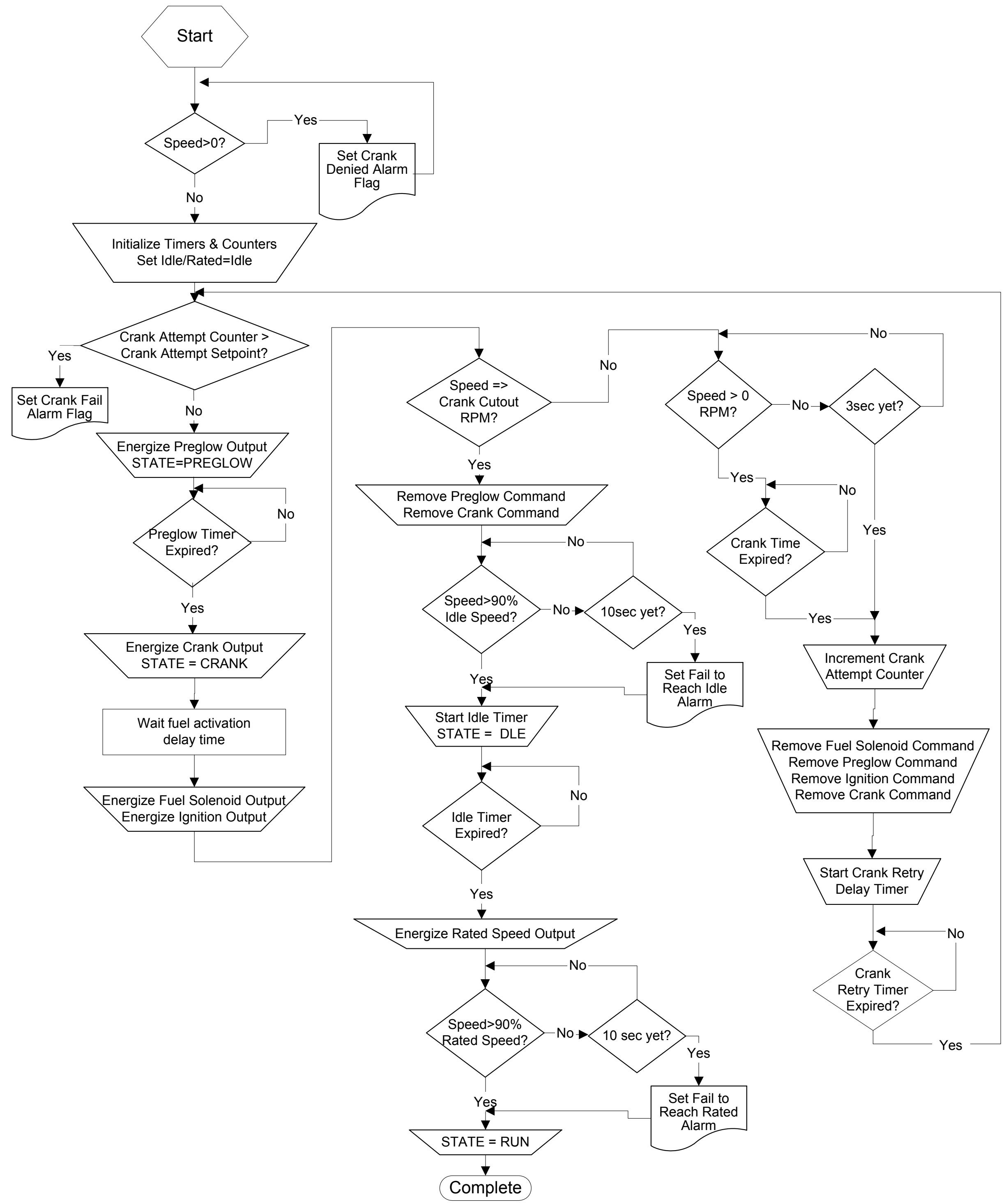



Figure 9-1. Engine Starting Flow Chart

# Stopping Procedure

When a STOP signal is received, this routine will perform the necessary sequence to stop the engine. The initial step in all shutdown routines is to remove load and open the generator breaker. If Cooldown at Idle is selected during configuration, the EGCP-3 will switch the idle/rated output to idle during cooldown. If a discrete output is configured for Engine Running, it will be de-energized when the engine comes to rest.

A Hard Shutdown and an Emergency Stop are treated identically with the exception of the Air Shutoff Solenoid. A hard shutdown does not activate the Air Shutoff. The three conditions that will close the Air Shutoff relay are an Emergency Stop, overspeed, or a failure to stop defined as the engine not dropping at least 20 rpm per sec after five seconds. Note: the Air Shutoff Solenoid is a one shot type of relay that will close for 5 seconds and then release to protect the closing solenoid. Most Air Shutoff devices need to be reset mechanically at the device after a trip. The flowchart indicates a check for E-stop but also applies to a Hard Shutdown request except that a Hard Shutdown will not engage the Air Shutoff Solenoid. An E-stop or Hard Shutdown is a latching shutdown and requires acknowledgement and rest of the alarm before the engine can be restarted.

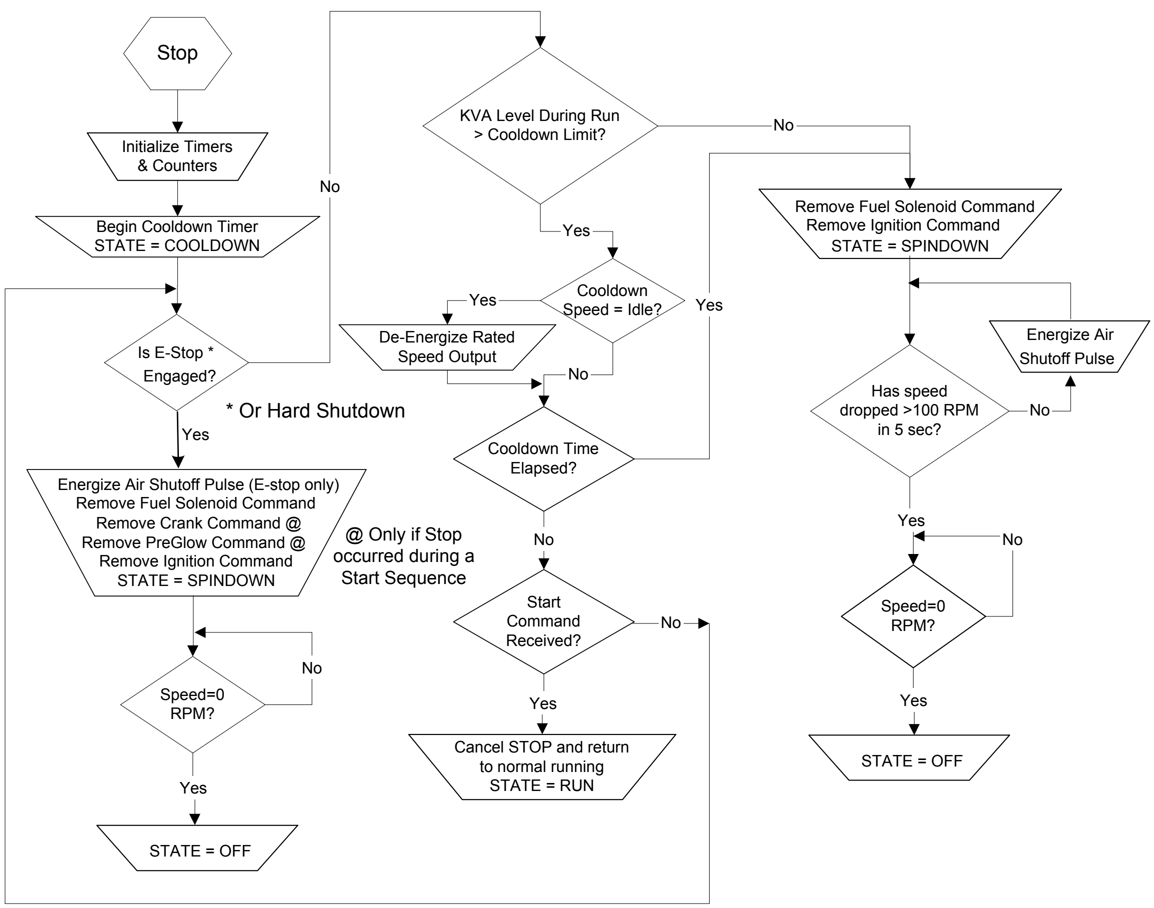



Figure 9-2. Engine Stopping Flow Chart

# External Starting Procedure

When a START signal is received, this routine assumes and external device will perform the necessary sequence to start the engine. Although repeated checks are not shown in the flowchart for E-stop, the EGCP-3 does continuously look for an E-stop request during the start sequence and will respond accordingly.

With Engine Sequencing Disabled, a magnetic pickup is no longer required. Removing the magnetic pickup will prevent certain alarms from functioning such as overspeed and speed/frequency mismatch. However, if the magnetic pickup is present, those existing alarms will continue to function. If no MPU is provided, speed will be detected using generator frequency. Generator frequency can only be detected when voltage is above the minimum voltage level. Therefore, some functions may not work as intended if voltage is not present. If a discrete output is configured for Engine Running, it will be energized and de-energized at the same times as the Fuel Solenoid (Run Relay) output. The Idle/Rated function will not operate in this mode. If the Idle/Rated Relay is configured, it will turn on simultaneous with the Fuel Solenoid output. The EGCP-3 will wait for the Generator Stable conditions before continuing with any breaker closure or synchronizing actions.

The start routine is shown below. This flowchart assumes Start Sequencing is disabled. The Fuel Solenoid Output is treated like a Run Relay or a request for start.

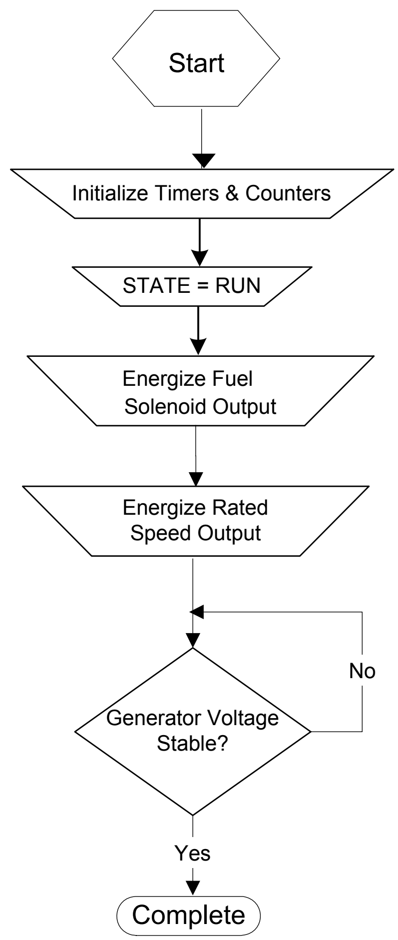



Figure 9-3. Engine Starting-External Sequencing Flow Chart

## External Stopping Procedure

When the EGCP-3 is configured for Engine Start Sequence disabled, a STOP signal will perform the same sequence to stop the engine as when internal logic is enabled. The engine will unload, open breaker(s) and cooldown. The discrete output for Engine Running will be de-energized simultaneous with the Fuel Solenoid (Run Relay) Output.

# Chapter 10.
# Mode Control Switch

## Introduction

The mode control switch is defined as the three (3) switch inputs labeled, Test, Run w/ Load, and Auto. The Process Enable and BaseLoad Enable switch inputs affects the final mode but does not affect starting conditions. As long as the physical Auto switch is closed (asserted), the mode switch “inputs” can also be received via a communication link such as Modbus. In the case of communication link usage, all three switch “Enable” and switch “Disable” positions should be sent together as a precaution.

In the tables below, the following key applies:
X—denotes open or closed (don’t care)
1—denotes connection made, On (+V applied to input)
0—denotes input point floating, Off

| Test | Run | Auto | Engine Control | Load Control Mode (Brkr open/Brkr closed) | Gen Breaker | Gen Shunt Trip |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | Off - stop | Droop / NA | Locked out | De-energized |
| 1 | 0 | 0 | Run to rated | Droop / NA | Locked out | De-energized |
| 1 | 0 | 1 | Not Valid | Off / NA | Off | De-energized |
| 0 | 1 | 0 | Run to Rated | Droop / As configured | Manual | Energized |
| 0 | 1 | 1 | Run to Rated | Droop / As configured | Sync Control | Energized |
| 0 | 0 | 1 | Auto(waiting for network start or stop) | Droop / As Configured | Sync Control | Energized |
| 1 | 1 | 0 | Run to rated | Droop / NA | Locked out | De-energized |
| 1 | 1 | 1 | Not Valid | Off / NA | Off | De-energized |

## Test Mode

If the Test input is asserted but the Run and Auto inputs are not asserted, the control will assume the test mode. In the test mode the genset is started but automatic functions such as synchronization are disabled. The generator breaker will be locked out and cannot be closed manually. Load droop will automatically be enabled in the event that load is added. Process and BaseLoad modes will not be available. KVAR/PF control and PF Sharing will also not be available.

## Run Mode

If the Run w/ Load input is asserted but the Auto input is not asserted, the control will assume a manual run mode. In the manual run mode, the genset is started but synchronization is disabled along with most other automatic functions. The generator breaker will be unlocked upon expiration of the generator stable timer. If the genset is to be connected to a load or bus in this mode, it must be done manually. If the genset is connected to a load/bus manually, the configured load mode will automatically be selected and begin operation. The control will continue to operate until the Run with Load input is opened. Protective relay functions will operate normally. Process and KVAR/PF control will not be available unless the mains breaker feedback is detected in the control.

# Auto Mode

If the Auto Input is asserted, then a different mode will be selected depending on the state of the Test Input, Run Input, Process Enable Input, BaseLoad Enable, or bus/mains condition. In all cases, the Auto Input must be asserted for automatic breaker operation to be engaged. If neither the Test or Run inputs are asserted, the control will assume any mode command provided from Modbus, ServLink (WW), or LON communications links.

## Configuration Settings That Affect Auto Mode

For all the below conditions, it is assumed that the Auto Input is asserted.

### Synchronizer Mode

- **Off**—Genset will start if commanded but no mode will be engaged unless the breaker(s) is closed manually.
- **Check**—Active synchronization will take place but the breaker will not be closed by the EGCP-3.
- **Permissive**—If the system is in sync and the slip frequency is within the window, the breaker will close and the appropriate loading mode will take effect. Otherwise, the system must have manual intervention to bring it into sync so the breaker may be closed. Once the breaker is closed, the appropriate load control mode will assume control. The Gen Circuit Breaker Close relay can be wired in series with a manual close circuit to allow the Permissive check mode to function as a sync-check relay.
- **Run**—Normal condition where active synchronization takes place with breaker closure.

### Load Control Mode

- **Droop**–Does not allow the control to use Isochronous or Load Sharing functions. Will not inhibit synchronization but when in parallel the control mode will still be Droop. KW Control functions will still function after the mains breaker auxiliary contact indicates the breaker is closed. However, the droop function may cause the regulated load to be other than expected.

- **Isochronous**—This is the normal setting that will allow isochronous speed control during kW Control. The Load Control mode is always droop until the generator breaker is closed.

### Process Control Mode

When the Process Enable input is closed, the Process mode is active if the unit is operating in parallel with the mains. When in parallel with other EGCP-3 LS units, the Process Mode of the Process Master will control the load of the other LS units as Process Slaves. If the LS unit has the process input closed, and is not the process master unit it will be considered the back up process master. If just LS units are on the Network then the lowest Unit (node) number will be the master. If there is a MC in the network, and the MC is in control it will always be the master. See the detailed description of Process in a later Chapter.

# Chapter 11.
# Unit Sequencing Configuration

## Introduction

Sequencing operation of EGCP-3 LS units is designed to function as a supervisory control that allows operators to configure the control to their system specifications. The controls are set up to start and stop gensets on a percentage of rated load basis and can be configured for six different sequencing types:

- Disabled
- Staggered Run Time
- Equal Run Time
- Smallest Unit First
- Largest Unit First
- Node Number

The mechanism of how the sequencing works is similar for all control types, but setting up the sequencing can create problems if configured incorrectly. This application note describes setup for every type of sequencing mechanism as well as problems that could occur with improper configuration.

## Sequencing Types

### Disabled

When the Run-Time Manager is set for Disabled operation, no individual sequencing is performed, but all starts initiated by an EGCP-3 MC will still occur. This feature allows an operator to keep single units or all units online all of the time. An example of this would be a plant with a large constant load and a smaller variable load. Knowing the plant's load profile, the operator might want to keep a large generator on all of the time supplying the large constant load. Other generators could be configured with another sequencing type and supply the varying load by sequencing units on and off the bus during the variations. Figure 11-1 illustrates the use of this type of sequencing.

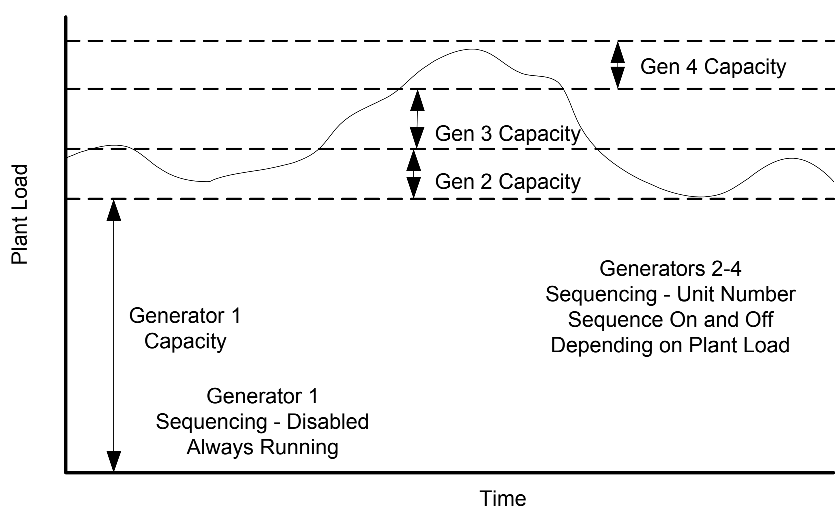



Figure 11-1. Disabled Sequencing

**NOTE**

**Disabled is the only sequencing algorithm that can be configured with another algorithm. For example, all units must be on Staggered Run Time or Disabled. The controls cannot have Staggered and Unit number. If the controls are configured incorrectly, a LON ERROR 261 will be present in:**

- **W LON MESSAGING—62 ERROR NUMBER for the LS**
- **U LON MESSAGING—58 LON OUT – ERR NUM for the MC**

## Staggered Run Time

Staggered Run Time sequencing applies the Service Interval in its sequencing mechanism. The Service Interval is configured in the Sequencing menu and is set up so that alarms can be configured when this time expires. When a genset is running, its service hours decrement. This sequencing algorithm attempts to stagger the service hours so that single units can be taken out of service for repairs and maintenance at different times. When a start is requested on the network, the algorithm looks for the LS unit with the least amount of service hours remaining and starts that unit. On a stop request, the unit with the largest amount of service hours remaining is stopped. If there is an equal amount of service hours on two LS gensets, the LS unit with the lowest unit number is started or stopped. Figure 11-2 illustrates how this algorithm functions.

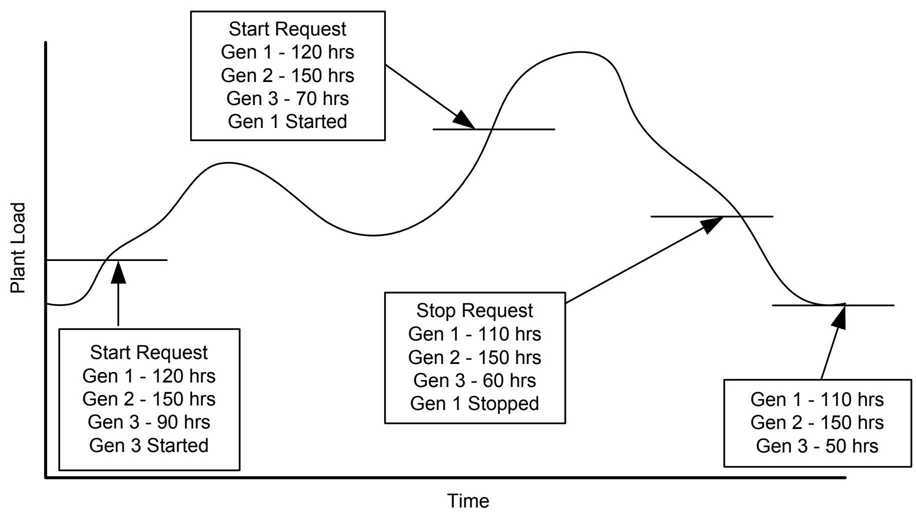



Figure 11-2. Staggered Run Time Sequencing

## Equal Run Time

Equal Run Time sequencing applies the Service Interval in its sequencing mechanism. The Service Interval is configured in the Sequencing menu and is set up so that alarms can be configured when this time expires. When a genset is running, the service hours decrement. This sequencing algorithm attempts to equal all of the gensets the service hours so that all units can be taken out of service for repairs and maintenance at the same time. When a start is requested on the network, the algorithm looks for the LS unit with the largest amount of service hours remaining and starts that unit. On a stop request, the unit with the least amount of service hours remaining is stopped. If there is an equal amount of service hours on two LS gensets, the LS unit with the lowest unit number is started or stopped. Figure 11-3 illustrates how this algorithm functions.

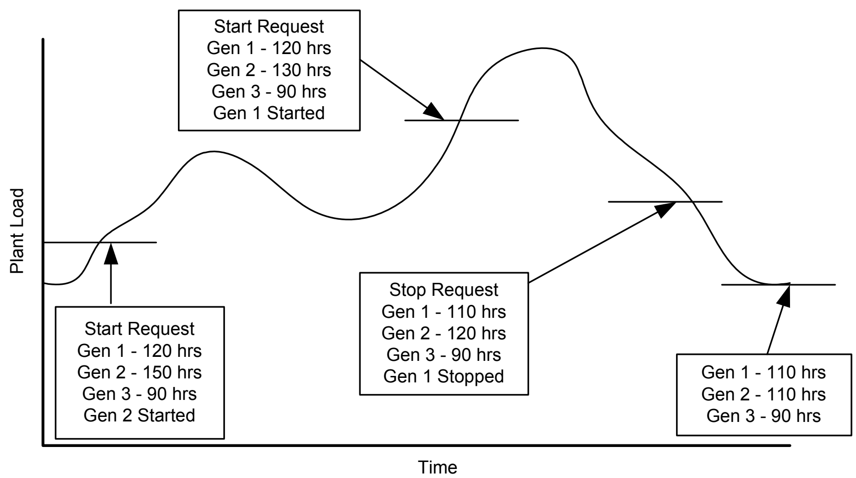



Figure 11-3. Equal Run Time Sequencing

## Largest Unit First

The Largest Unit First sequencing algorithm starts the largest real load capacity unit upon a start request and stops the smallest real load capacity unit upon a stop request. The stopping order will always be exactly the opposite of the starting order. This sequencing algorithm is best used for plants with large load changes and large differences in the size of the gensets available. Figure 11-4 illustrates how the algorithm functions.

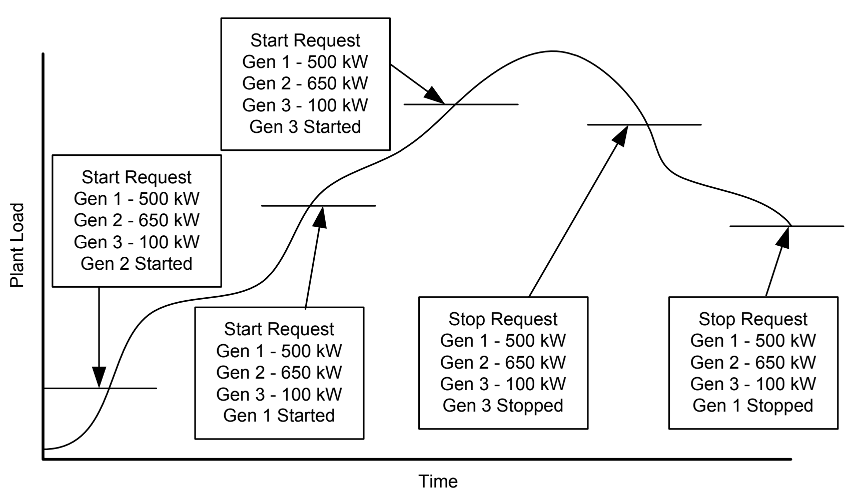



Figure 11-4. Largest Unit First Sequencing

## Smallest Unit First

The Smallest Unit First sequencing algorithm starts the smallest real load capacity unit upon a start request and stops the largest real load capacity unit upon a stop request. The stopping order will always be exactly the opposite of the starting order. This sequencing algorithm is best used for plants where large units only need to be operated during small periods of large plant load, and during all other periods, the load is fairly constant. Figure 11-5 illustrates how the algorithm functions.

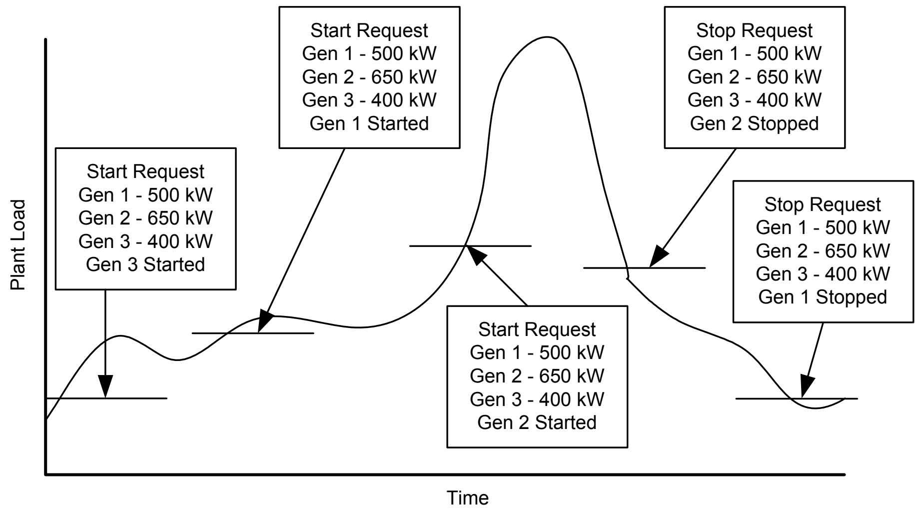



Figure 11-5. Smallest Unit First Sequencing

## Unit Number

The Unit Number sequencing algorithm starts the LS genset with the lowest node number upon a start request and stops the unit with the lowest node number upon a stop request. The stopping order will always be exactly the same as the starting order. Figure 11-6 illustrates how the algorithm functions.

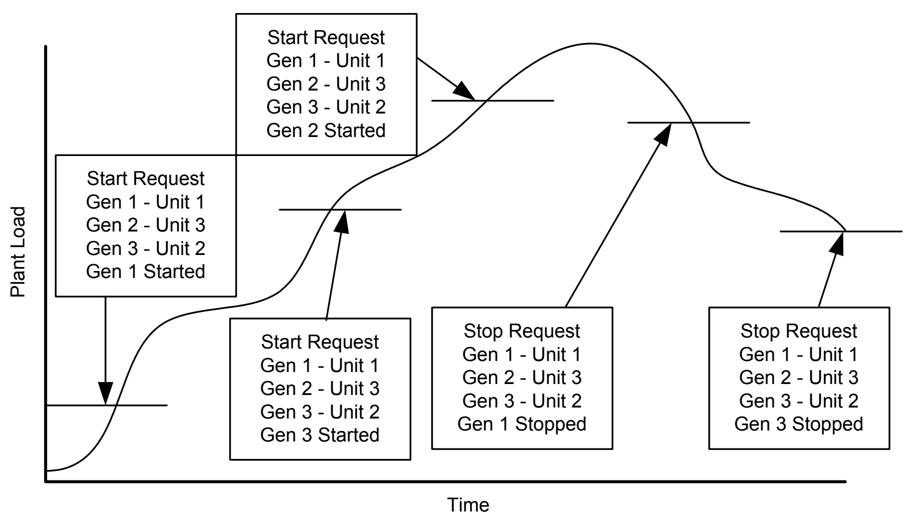



Figure 11-6. Unit Number Sequencing

## Sequencing Mechanism

The operator has several configurations to work with in the sequencing menu.

- Run-Time Manager
  Type of sequencing performed by LS units
- Max Load Delay
  Time above the Max Gen Load Level before the next unit is started
- Rated Load Delay
  Time above rated load before the next unit is started
- Reduced Load Delay
  Time below the Min Gen Load Level before the next unit is stopped
- Max Gen Load Level
  Percent of system load at which one unit should be sequenced on
- Min Gen Load Level
  Percent of system load at which one unit should be sequenced off
- Stop Gen Time
  Time between a LON stop attempt before the next stop attempt it tried
- Start Gen Time
  Time between a LON start attempt before the next start attempt it tried
- Service Interval
  Hours between service periods
- Reset Service Hours
  Resets the Service hours to the service interval
- Auto Start Sequence Alarm
  Alarm if the LON has requested three starts separated by the Start Gen Time and a Start Done has not been received
- Auto Stop Sequence Alarm
  Alarm if the LON has requested three stops separated by the Stop Gen Time and a Stop Done has not been received
- Service Hours Alarm
  Alarm occurs if service hours reaches zero

The sequencing algorithm is based on System Load. System load is the percentage of rated load on the gensets. For example, if there are two units online, one rated at 500 kW and the other at 200 kW, and the system load is 50%, the units will be generating 250 kW and 100 kW respectively. The sequencing algorithm uses two setpoints and three delays for all action taken. The following diagrams the action.

- System Load > **Max Gen Load Level** for **Max Load Delay**
  Start Request is sent over LON
- System Load = **100% for Rated Load Delay**
  Start Request is sent over LON
- System Load < **Min Gen Load Level** for **Min Load Delay**
  Stop Request is sent over LON

Start and stop requests will depend on which sequencing type is configured as discussed in the previous section. Take care when configuring the max and min gen load levels in order to avoid overloading a genset, especially when units are being sequenced offline. The following section describes how to configure these levels to eliminate the possibility of overloading a unit.

# Sequencing Configuration

In order to avoid overloading, and also to increase efficiency of operation, the sequencing configurables Max Gen Load Level and Min Gen Load Level need to be analyzed for different sized units and also for different sequencing types. The most important transition that needs to be analyzed is the sequencing of gensets offline in isolated operation, especially if the transition is from two units online to one unit online. The following setup will be analyzed for different types of sequencing operation:

- Generator 1—200 kW Rated Capacity
- Generator 2—400 kW Rated Capacity
- Generator 3—600 kW Rated Capacity

For all sequencing operations, the first decision that needs to be made is the value of the Max Gen Load Level. This value can be arbitrarily selected and depends on operator preference. Usually the efficiency of operation is a top priority and having the gensets close to their rated capacity when online is a key factor in improving the efficiency of the system. For the following examples, a value of 90% was chosen for the Max Gen Load Level.

Additionally, every sequencing case needs to take into consideration three configuration errors:

- Overloading of a single unit online
- Start/Stop cycling
- Double starting

Overloading can be eliminated if the Min Gen Load Level is selected such that the system load on one generator will never exceed 100%.

Start/Stop cycling occurs when the Min Gen Load Level and Max Gen Load Level are too close together when a unit is taken offline or placed online. This occurs when the addition of another unit online creates a system load that is below the Min Gen Load Level, but its removal (taken offline) creates a system load that is above the Max Gen Load Level. This setup creates a perpetual start/stop action around that load level.

Double starting can occur if the Load Time (Real Load Control Menu) is very large and the Max Load Delay is very short. The problem occurs after a genset has been sequenced online and has closed its breaker to the bus. When the breaker closes, the Max Load Delay begins to decrement again because the load is above the Max Gen Load Level. If the delay expires because the genset took too long to ramp load, the system load could still be above the Max Gen Load Level, and the system could request another start. To eliminate this problem, the Load Time should be less than the Max Load Delay.

The next sub-sections details how to avoid the first two problems for different sequencing types.

### Largest to Smallest

The largest to smallest stop sequence will be Gen1 – Gen 2 – Gen 3. This can occur for any sequencing type except Smallest Unit First.

| | |
|---|---|
| Number of Units Online: | 3 (System Capacity = 1200 kW) |
| Initial Plant Load: | 1000 kW |
| Initial System Load: | 83.3% |

Plant load decreases to 900 kW (System Load = 75%). By setting the Min Gen Load Level below 75%, start/stop cycling will be eliminated when Gen 1 is taken offline but may not eliminate the overloading of Gen 3 when Gen 2 is taken offline.

| | |
|---|---|
| Number of Units Online: | 2 (System Capacity = 1000 kW) |
| Plant Load: | 890 kW |
| System Load: | 74.2% |

Plant load decreases to 600 kW (System Load = 60%). By setting the Min Gen Load Level below 60%, overloading of Gen 3 will be eliminated but start/stop cycling will occur between Gen 2 and Gen 3 as seen below:

| | |
|---|---|
| Number of Units Online: | 2 (System Capacity = 1000 kW) |
| Min Gen Load Level: | 60% |
| Plant Load: | 590 kW |
| System Load: | 59% (Stop Request to Gen 2) |

| | |
|---|---|
| Number of Units Online: | 1 (System Capacity = 600 kW) |
| Plant Load: | 590 kW |
| System Load: | 98.3% (Start Request to Gen 2) |

This start/stop cycling will continue to occur at this load level. To eliminate this problem, the Min Gen Load Level needs to be less than 90% of rated load on Gen 3 (540 kW).

| | |
|---|---|
| Number of Units Online: | 2 (System Capacity = 1000 kW) |
| Plant Load: | 540 kW |
| System Load: | 54% |

Setting the Min Gen Load Level below 54% will eliminate overloading and start/stop cycling. Setting the level at 52% will create sequencing at the following load levels:

Gen 1—624 kW
Gen 2—520 kW

The units will be sequenced on at load levels:

Gen 1—900 kW
Gen 2—540 kW

### Smallest to Largest

The smallest to largest stop sequence will be Gen 3 – Gen 2 – Gen 1. This can occur for any sequencing type except Smallest Unit First.

| | |
|---|---|
| Number of Units Online: | 3 (System Capacity = 1200 kW) |
| Initial Plant Load: | 1000 kW |
| Initial System Load: | 83.3% |

Plant load decreases to 540 kW (System Load = 45%). By setting the Min Gen Load Level below 45%, start/stop cycling will be eliminated when Gen 1 is taken offline but may not eliminate the overloading of Gen 1 when Gen 2 is taken offline.

| | |
|---|---|
| Number of Units Online: | 2 (System Capacity = 600 kW) |
| Plant Load: | 530 kW |
| System Load: | 88.3% |

Plant load decreases to 200 kW (System Load = 33.3%). By setting the Min Gen Load Level below 33.3%, overloading of Gen 1 will be eliminated but start/stop cycling will occur between Gen 2 and Gen 1 as seen below:

| | |
|---|---|
| Number of Units Online: | 2 (System Capacity = 600 kW) |
| Min Gen Load Level: | 33.3% |
| Plant Load: | 190 kW |
| System Load: | 31.7% (Stop Request to Gen 2) |

| | |
|---|---|
| Number of Units Online: | 1 (System Capacity = 200 kW) |
| Plant Load: | 190 kW |
| System Load: | 95% (Start Request to Gen 2) |

This start/stop cycling will continue to occur at this load level. To eliminate this problem, the Min Gen Load Level needs to be less than 90% of rated load on Gen 1 (180 kW).

| | |
|---|---|
| Number of Units Online: | 2 (System Capacity = 600 kW) |
| Plant Load: | 180 kW |
| System Load: | 30% |

Setting the Min Gen Load Level below 30% will eliminate overloading and start/stop cycling. Setting the level at 28% will create sequencing at the following load levels:

Gen 3—336 kW
Gen 2—168 kW

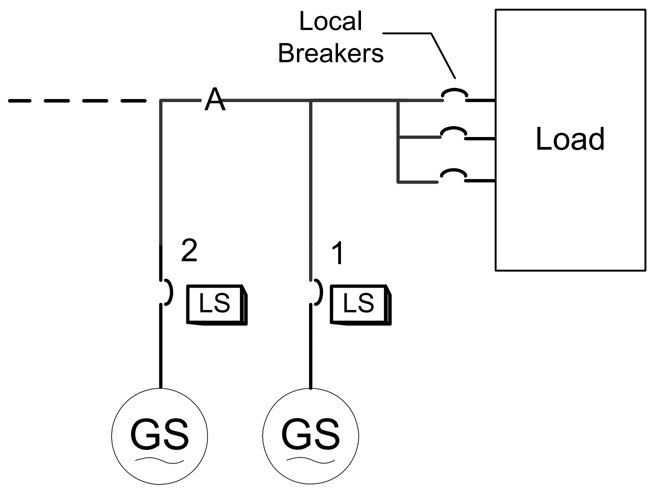
The units will be sequenced on at load levels:

Gen 3—540 kW
Gen 2—180 kW

## Summary

By applying sequencing functionality to a system, efficiency can be improved and maintenance can be reduced. Avoiding sequencing configuration errors is critical to obtaining optimum performance from the EGCP-3. With an understanding of the process of sequencing, operators should be able to custom fit the EGCP-3 network to their system. By running through the above calculations with your system, problems can be eliminated and performance improved.

# Chapter 12.
# LS Isolated Application




In a Multiple Unit Prime Power Application, the EGCP-3 controls will operate an isolated load bus (A) that never operates in parallel with the mains bus. Breakers 1,2, --- (up to 16), are Generator breakers controlled by the EGCP-3. The Local Breakers are not controlled by the EGCP-3s.

The EGCP-3 controls will:

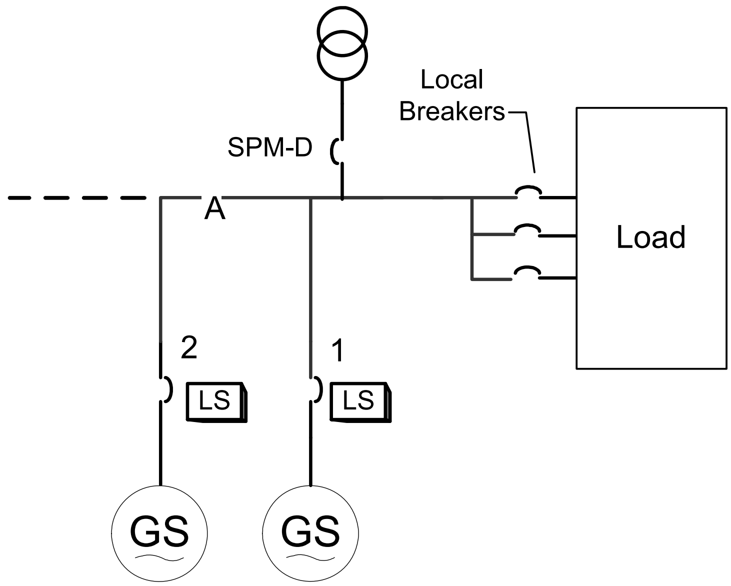
- Start the genset, and place the generator on load (dead bus closing or active synchronization) upon receipt of the appropriate input commands.
- Operate in Isochronous Loadsharing Control
- Operate in PF sharing control (load sharing mode only)
- Voltage Trim (isoch operation only)
- Frequency Trim (isoch operation only)
- Provide Auto Sequencing based upon system load levels and service hour times.
- Remove the generator from load (open generator breaker) upon shutdown signal i.e., either from discrete input (mode switch, LON, or internally generated shutdown condition.
- Engine cooldown and stop.
- The local display and HMI will:

  Provide V, A, W, KVA, KVAR, PF information for single or three phase configuration.
  Provide Engine Speed, Oil Pressure, Coolant Temp, Battery (supply) voltage, kW-hours, accumulated engine run time (hours), and Service hours information.
  Provide Engine and Generator Status Information, i.e. Running, Stopped, Isoch, BaseLoad, etc.
  Provide dynamic adjustment of relative control loops (load, synch, PF/VAR).
  Provide calibration of analog I/O
  Provide LON network information
  Number of units on the network
  Number of units on load
  Next unit start sequence
  Next unit stop sequence

## Start/Stop

To initiate the first start, manually give the control a run input. If Auto and Run inputs are given the control will start the engine ramp to rated, and close the breaker onto a dead bus. Once the unit (LS1) is running the run input can be taken away. When the units are isolated and not in baseload taking the run input away will NOT stop the unit. The control will wait for a stop command to come over the LON network. At this point the unit will be stand alone in isoch. With the Auto input still active if the load gets above the max load setpoint a start command will be given to the other unit in Auto. The other unit (LS2) will then start, once this unit synchronizes to the bus it will soft load, then begin Loadsharing with the first unit (LS1). Either unit can be manually stopped by taking away the auto and run inputs. The LS can also be started by configuring an alarm for trip tie breaker. To initiate this type of start the Auto start trip tie must be enabled in the sequencing menu. An example would be to set up Bus frequency or voltage low for trip tie action, then when the bus went low and the LS is in Auto it will issue a start.

# Chapter 13.
# LS Mains Parallel Application




In a Multiple Unit Prime Power Application, the EGCP-3 controls will operate into an isolated load bus (A) that can also operates in parallel with the mains bus. Breakers 1,2, --- (up to 16), are Generator breakers controlled by the EGCP-3. The Local Breakers are not controlled by the EGCP-3s. The Mains Tie breaker (16) is controlled by a synchronizer device such as a SPM-D.

The EGCP-3 controls will:

- Start the genset, and place the generator on load (dead bus closing or active synchronization) upon receipt of the appropriate input commands.
- Operate in Isochronous Loadsharing Control
- Operate in PF sharing control (load sharing mode only)
- Operate in BaseLoad Control
- Operate in Process Control (Mains Parallel only)
- Voltage Trim (isoch operation only)
- Operate in PF Control (BaseLoad or Process mode only)
- Operate in KVAR Control (BaseLoad or Process mode only)
- Frequency Trim (isoch operation only)
- Provide Auto Sequencing based upon system load levels and accumulated unit run times.
- Remove the generator from load (open gen breaker) upon shutdown signal i.e., either from discrete input (mode switch, LON, or internally generated shutdown condition.
- Engine cooldown and stop.

- The local display and HMI will:
  - Provide V, A, W, KVA, KVAR, PF information for single or three phase configuration.
  - Provide Engine Speed, Oil Pressure, Coolant Temp, Battery (supply) voltage, kW-hours, accumulated engine run time (hours), and Service hours information.
  - Provide Engine and Generator Status Information, i.e. Running, Stopped, Isoch, BaseLoad, etc.
  - Provide dynamic adjustment of relative control loops (load, synch, PF/VAR).
  - Provide calibration of analog I/O
  - Provide LON network information
  - Number of units on the network
  - Number of units on load
  - Next unit start sequence
  - Next unit stop sequence

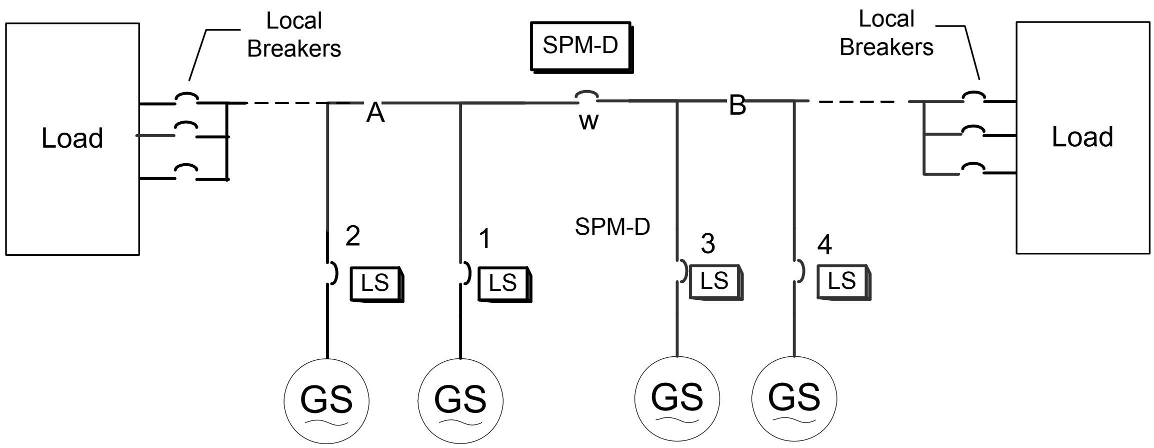
The SPM-D can perform the following functions:

- Synchronize Bus to Mains

## Start/Stop

To initiate the first start, manually give the control a run input. If Auto and Run inputs are given the control will start the engine ramp to rated, and synchronize the breaker. As long as the run input is active the LS unit will continue to run. If the LS control does not have the mains breaker feedback, the baseload contact must be given. As long as the LS has the Mains breaker feedback or the baseload contact, the LS will be in baseload control. If the mains breaker opens or the baseload input goes away, the LS assumes it is isolated and goes into isoch. With the Auto input still active if the load gets above the max load setpoint a start command will be given to the other unit in Auto. The other unit (LS2) will then start, once this unit synchronizes to the bus it will soft load, then begin Loadsharing with the first unit (LS1). Either unit can be manually stopped by taking away the auto and run inputs. The LS can also be started by configuring an alarm for trip tie breaker. To initiate this type of start the Auto start trip tie must be enabled in the sequencing menu. An example would be to set up Bus frequency or voltage low for trip tie action, then when the bus went low and the LS is in Auto it will issue a start. If the breaker feedback is closed or the control has the baseload input enabled taking away the run input will cause the unit to unload and shutdown.

# Chapter 14.
# LS Isolated, Split Bus Application




In a Multiple Unit, Prime Power, Split bus Application, the EGCP-3s control the load allocation and receive synchronizing signals for closing of the tie breaker(w) from an SPM-D.

The EGCP-3 controls and SPM-D will perform the following functions:

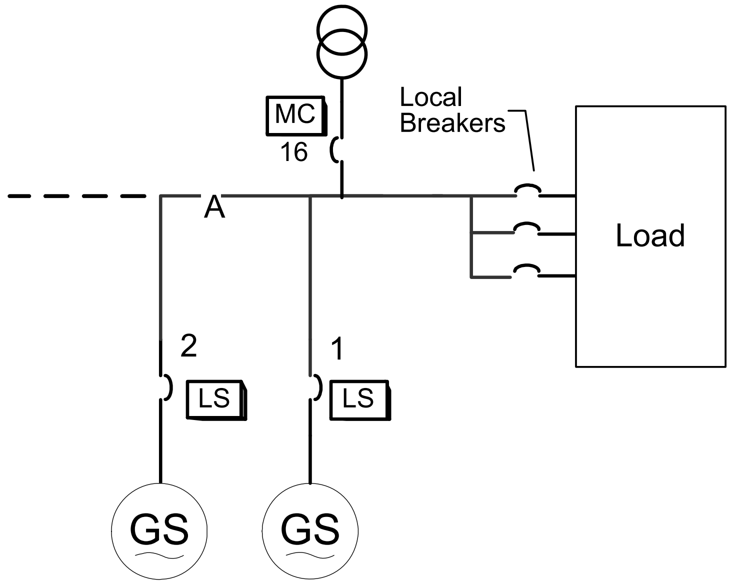
- Start the genset, and place the generator on load (dead bus closing or active synchronization) upon receipt of the appropriate input commands.
- Operate in Isochronous Loadsharing Control (A, B, C, D Bus, or Combined, depending upon configuration and status of the tie breaker).
- Genset Cooldown when a set KVA load level is exceeded.
- Smooth load transition upon closure of the tie breaker.
- Operate in PF sharing control (load sharing mode only)
- Voltage Trim (isoch operation only)
- Frequency Trim (isoch operation only)
- Provide Auto Sequencing based upon system load levels and accumulated unit run times.
- Remove the generator from load (open gen breaker) upon shutdown signal i.e., either from discrete input or internally generated shutdown condition.
- Engine stop
- Synchronize Bus “A” to Bus “B”, or vice Versa as determined by SPM-D.
- Dead bus closing to Bus “A” or Bus “B” as determined by SPM-D.

- The local display and HMI will:
  - Provide V, A, W, KVA, KVAR, PF information for single or three phase configuration.
  - Provide Engine Speed, Oil Pressure, Coolant Temp, Battery (supply) voltage, kW-hours, accumulated engine run time (hours), and Service hours information.
  - Provide Engine and Generator Status Information, i.e. Running, Stopped, Isoch, BaseLoad, etc.
  - Provide dynamic adjustment of relative control loops (load, synch, PF/VAR)
  - Provide calibration of analog I/O
  - Provide LON network information
  - Number of units on the network
  - Number of units on load
  - Next unit start sequence
  - Next unit stop sequence

## Start/Stop

To initiate the first start, manually give the control a run input. If Auto and Run inputs are given the control will start the engine ramp to rated, and close the breaker onto a dead bus. Once the unit (LS1) is running the run input can be taken away. When the units are isolated and not in baseload taking the run input away will **NOT** stop the unit. The control will wait for a stop command to come over the LON network. At this point the unit will be stand alone in isoch. With the Auto input still active if the load gets above the max load setpoint a start command will be given to the other unit in Auto. The other unit (LS2) will then start, once this unit synchronizes to the bus it will soft load, then begin Loadsharing with the first unit (LS1). Either unit can be manually stopped by taking away the auto and run inputs. The LS can also be started by configuring an alarm for trip tie breaker. To initiate this type of start the Auto start trip tie must be enabled in the sequencing menu. An example would be to set up Bus frequency or voltage low for trip tie action, then when the bus went low and the LS is in Auto it will issue a start. If the “w” breaker is closed, and the feedback goes into one of the LS units, then all of the LS units are on the same active bus.

# Chapter 15.
# LS-MC Mains Parallel Application




In a Multiple Unit Mains Parallel Application, a EGCP-3 MC is will sequence gensets, synchronize the Mains (breaker 16) to the local bus (A) and control import/export of power with the mains by controlling genset/bus power through the LS units.

The MASTER EGCP-3 control shall be capable of:

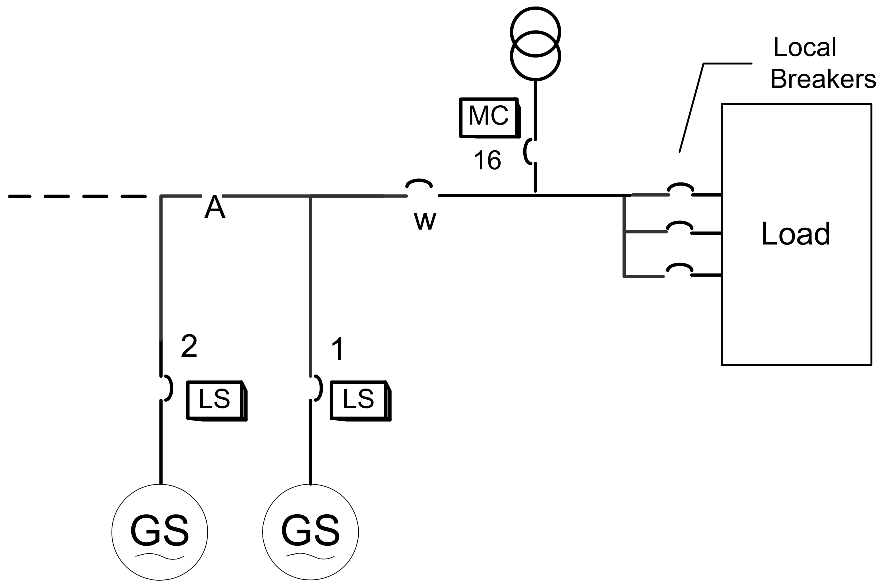
- Control Auto Start Sequencing of LS units based upon system load levels and accumulated unit run times.
- Synchronize Bus generators to the Utility, and close the utility breaker.
- Soft Load Bus generators to and from the utility
- Open the utility breaker in the event of a loss of utility, or during an open transition return to utility power.
- Control the Bus Generators in BaseLoad Control Mode
- Control the Bus Generators in Process Control Mode
- Control the Bus Generators in Import Export Control Mode
- Control the bus Generators in PF or KVAR control mode (relative to the utility feed)
- Control the bus generators in a Fixed PF control mode (PF BaseLoad)

- The local display and HMI will:
  - Provide V, A, W, KVA, KVAR, PF information for single or three Mains phase configuration.
  - Provide Mains Total VA, VAR, and W information
  - Provide Bus and Breaker Status Information, i.e. Stopped, Isoch, BaseLoad, etc.
  - Provide dynamic adjustment of relative control loops (load, synch, PF/VAR)
  - Provide calibration of analog I/O
  - Provide LON network information
  - Number of units on the network
  - Number of units on load
  - Next unit start sequence
  - Next unit stop sequence

The EGCP-3 LS slave control shall perform the following functions:

- Start the genset(s), and placing the generator on load (dead bus closing or active synchronization) upon receipt of the appropriate input commands.
- Operate in Isochronous Loadsharing Control (A, B, C, D Bus, or Combined, depending upon configuration and status of the Mains tie breaker).
- Genset Cooldown when a set KVA load level is exceeded.
- Ramp to master controlled load upon closure of the tie breaker.
- Operate in BaseLoad Control
- Operate in Process Load Control
- Operate in PF sharing control (load sharing mode only)
- Operate in PF Control (BaseLoad or process mode only)
- Operate in KVAR Control (BaseLoad or process mode only)
- Voltage Trim (isoch operation only)
- Frequency Trim (isoch operation only)
- Remove the generator from load (open gen breaker) upon shutdown signal i.e., either from discrete input or internally generated shutdown condition.
- Engine stop
- The local display and HMI will:
  - Provide V, A, W, KVA, KVAR, PF information for single or three phase configuration.
  - Provide Engine Speed, Oil Pressure, Coolant Temp, Battery (supply) voltage, kW-hours, accumulated engine run time (hours), and Service hours information.
  - Provide Engine and Generator Status Information, i.e. Running, Stopped, Isoch, BaseLoad, etc.
  - Provide dynamic adjustment of relative control loops (load, synch, PF/VAR)
  - Provide calibration of analog I/O
  - Provide LON network information
  - Number of units on the network
  - Number of units on load
  - Next unit start sequence
  - Next unit stop sequence

# Chapter 16.
# LS-MC Mains Parallel ATS Application




In a Multiple Unit Mains Parallel Application, a EGCP-3 MC is required to sequence, synchronize and control import/export of power with the mains (breaker 16). With the addition of the bus tie breaker (w) the MC control is capable of ATS operation.

The MASTER EGCP-3 control shall be capable of:

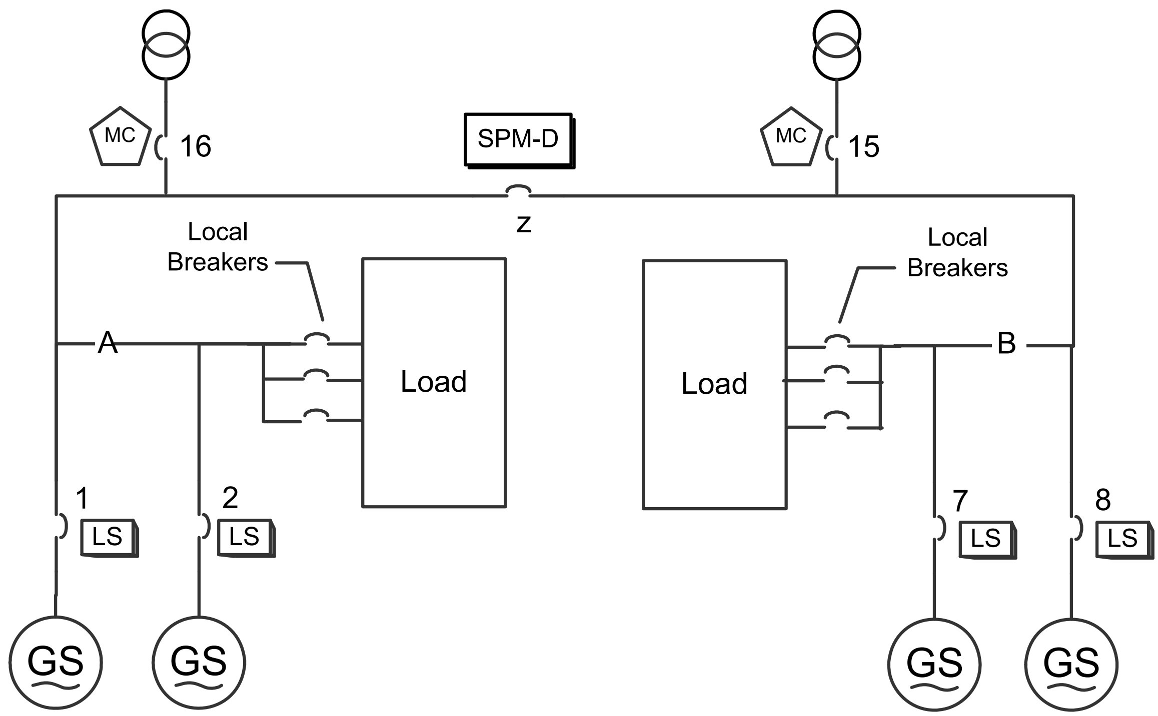
- Perform Open and Closed Transition ATS functions with 100msec overlap capability
- Synchronize Bus generators to the Utility, and close the utility breaker.
- Soft Load Bus generators to and from the utility
- Open the utility breaker in the event of a loss of utility, or during an open transition return to utility power.
- Monitor the capacity of engines on load to close group breaker (w) for isolated load.
- Control the Bus Generators in BaseLoad Control Mode
- Control the Bus Generators in Process Control Mode
- Control the Bus Generators in Import Export Control Mode
- Control the bus Generators in PF or KVAR control mode (relative to the utility feed)
- Control the bus generators in a Fixed PF control mode (PF BaseLoad)

- The local display and HMI will:
  - Provide V, A, W, KVA, KVAR, PF information for single or three phase configuration.
  - Provide Total VA, VAR, and W information
  - Provide system load and system PF averages
  - Provide Engine Speed, Oil Pressure, Coolant Temp, Battery (supply) voltage, kW-hours, accumulated engine run time (hours), and Service hours information.
  - Provide Bus and Breaker Status Information, i.e. Stopped, Isoch, BaseLoad, etc.
  - Provide dynamic adjustment of relative control loops (load, synch, PF/VAR)
  - Provide calibration of analog I/O
  - Provide LON network information
  - Number of units on the network
  - Number of units on load
  - Next unit start sequence
  - Next unit stop sequence

The EGCP-3 slave control shall be capable of:

- Start the genset(s), and placing the generator on load (dead bus closing or active synchronization) upon receipt of the appropriate input commands.
- Operate in Isochronous Loadsharing Control (A, B, C, D Bus, or Combined, depending upon configuration and status of the group and Mains Tie breaker).
- Genset Cooldown when a set KVA load level is exceeded.
- Ramp to master controlled load upon closure of the tie breaker.
- Operate in BaseLoad Control
- Operate in Process Load Control
- Operate in PF sharing control (load sharing mode only)
- Operate in PF Control (BaseLoad or process mode only)
- Operate in KVAR Control (BaseLoad or process mode only)
- Voltage Trim (isoch operation only)
- Frequency Trim (isoch operation only)
- Provide Auto Sequencing based upon system load levels and accumulated unit run times.
- Remove the generator from load (open gen breaker) upon shutdown signal i.e., either from discrete input or internally generated shutdown condition.
- Engine stop
- The local display and HMI will:
  - Provide V, A, W, KVA, KVAR, PF information for single or three phase configuration.
  - Provide Engine Speed, Oil Pressure, Coolant Temp, Battery (supply) voltage, kW-hours, accumulated engine run time (hours), and Service hours information.
  - Provide Engine and Generator Status Information, i.e. Running, Stopped, Isoch, BaseLoad, etc.
  - Provide dynamic adjustment of relative control loops (load, synch, PF/VAR)
  - Provide calibration of analog I/O
  - Provide LON network information
  - Number of units on the network
  - Number of units on load
  - Next unit start sequence
  - Next unit stop sequence

# Chapter 17.
# LS-MC Mains Parallel, Split Bus Application




A Multiple Unit, Mains Parallel, Split bus Application would use EGCP-3 LS, and MC control with a SPM-D synchronizer. Each bus is capable of isolated or mains parallel operation. Both local buses can also be tied together. In this and all applications with split buses, and multiple feeds, location of the mains and bus PT/CT sensors is important for the proper measurements.

The MASTER EGCP-3 control shall be capable of:

- Perform Open and Closed Transition ATS functions with 100msec overlap capability
- Synchronize Bus generators to the Utility, and close the utility breaker.
- Soft Load Bus generators to and from the utility
- Open the utility breaker in the event of a loss of utility, or during an open transition return to utility power.
- Control the Bus Generators in BaseLoad Control Mode
- Control the Bus Generators in Process Control Mode
- Control the Bus Generators in Import Export Control Mode
- Control the bus Generators in PF or KVAR control mode (relative to the utility feed)
- Control the bus generators in a Fixed PF control mode (PF BaseLoad)
- Provide Auto Sequencing based upon system load levels and accumulated unit run times.

- The local display and HMI will:
  - Provide V, A, W, KVA, KVAR, PF information for single or three phase configuration.
  - Provide Total VA, VAR, and W information
  - Provide bus and breaker Status Information, i.e. Running, Stopped, Isoch, BaseLoad, etc.
  - Provide Unit Sequencing Status Information
  - Provide system load and system PF averages
  - Provide dynamic adjustment of relative control loops (load, synch, PF/VAR)
  - Provide calibration of analog I/O
  - Provide LON network information
  - Number of units on the network
  - Number of units on load
  - Next unit start sequence
  - Next unit stop sequence

The EGCP-3 slave control shall be capable of:

- Start the genset(s), and placing the generator on load (dead bus closing or active synchronization) upon receipt of the appropriate input commands.
- Operate in Isochronous Loadsharing Control (A, B, C, D Bus, or Combined, depending upon configuration and status of the tie breaker).
- Genset Cooldown when a set KVA load level is exceeded.
- Ramp to master controlled load upon closure of the tie breaker.
- Operate in BaseLoad Control
- Operate in Process Load Control
- Operate in PF sharing control (load sharing mode only)
- Operate in PF Control (BaseLoad or process mode only)
- Operate in KVAR Control (BaseLoad or process mode only)
- Voltage Trim (isoch operation only)
- Frequency Trim (isoch operation only)
- Remove the generator from load (open gen breaker) upon shutdown signal i.e., either from discrete input or internally generated shutdown condition.
- Engine stop
- The local display and HMI will:
  - Provide V, A, W, KVA, KVAR, PF information for single or three phase configuration.
  - Provide Engine Speed, Oil Pressure, Coolant Temp, Battery (supply) voltage, kW-hours, accumulated engine run time (hours), and Service hours information.
  - Provide Engine and Generator Status Information, i.e. Running, Stopped, Isoch, BaseLoad, etc.
  - Provide dynamic adjustment of relative control loops (load, synch, PF/VAR)
  - Provide calibration of analog I/O
  - Provide LON network information
  - Number of units on the network
  - Number of units on load
  - Next unit start sequence
  - Next unit stop sequence

The SPM-D shall can perform the following functions:

- Synchronize Bus “A” to Bus “B”, or vice Versa
- Dead bus closing to Bus “A” or Bus “B”

# Chapter 18.
# Synchronizer Description

## Introduction

Synchronization, as normally applied to the generation of electricity, is the matching of the output voltage wave form of one synchronous alternating current electrical generator with the voltage wave form of another alternating current electrical system. For the two systems to be synchronized and connected in parallel, five conditions must be considered:

- the number of phases in each system
- the direction of rotation of the phases
- the voltage amplitudes of the two systems
- the frequencies of the two systems
- the phase angle of the voltage of the two systems

The first two conditions are determined when the equipment is specified, installed, and wired. The synchronizer matches the remaining conditions (voltage, frequency, and phase) before the paralleling breakers are closed.

## Functional Description

The Synchronizer is the functional section in software and hardware of the EGCP-3 that synchronizes the generator(s) to the bus and closes the breaker. To accomplish this the synchronizer has three outputs, a speed bias output, a voltage bias output, and a breaker/contactor command. Working with the outputs are the four "modes" of operation. These modes may be configured from the front panel or any of the communications links (ServLink Watch Window, Modbus). The last command given from any of these sources dictates the synchronizer mode.

The synchronizer may be configured for either Phase Matching or Slip Frequency Synchronizing. If the system does not require synchronizing functions, the sync type may be configured to Off. Phase Matching provides rapid synchronizing for critical standby power applications. Slip Frequency Synchronizing is used for larger generators and guarantees minimum transients at breaker closing and that initial power flow is out of the machine. In the slip mode a synchroscope will continuously rotate slowly clockwise, in the phase mode a synchroscope will hold at the 12:00 position.

Additional synchronizer features include voltage matching, time delayed automatic multi-shot re-closing, breaker / contactor control configuration, synchronizer time-out alarm, phase rotation mismatch alarm, fail to synchronize alarm, and fail to close breaker alarm. Each of these features may be enabled or disabled according to the needs of the application.

## Operating Modes

| Mode | Speed Bias Output | Voltage Bias Output | Breaker control |
|---|---|---|---|
| Off | Disabled | Disabled | Disabled |
| Check | Active | Active ◊ | Disabled |
| Permissive | Disabled | Disabled | Active |
| Run | Active | Active ◊ | Active |

◊ If the synchronizer is configured without voltage matching, this output is always disabled.

The operation of the synchronizer is determined by the mode configuration. When in the **Off Mode**, the synchronizer is out of operation. This mode is entered when the Mode Switch is not in the Auto position, the Synchronizer mode is configured as “Off”, or the breaker closes successfully. In the Off mode the user has the ability to manually bias the speed control via the speed bias output with the Raise/Lower Speed panel switches. The user also has the ability to manually bias the voltage regulator via the voltage bias output with the Raise/Lower Voltage panel switches.

**Run mode** allows normal automatic synchronizer operation and breaker closure signals. It will only occur if the Mode Switch input is in Auto. The Raise/Lower Speed and Voltage panel switches are ignored. The speed bias signal (explained below) is maintained throughout the breaker closure signal. The voltage bias signal is also maintained throughout the breaker closure signal if voltage matching is enabled. When the specified closure signal time has elapsed or the CB (circuit breaker) aux contact closure signal is received at terminal 5, the synchronizer is automatically turned off.

The **Check mode** allows normal synchronizing and voltage matching, but does not issue a breaker closure signal. It will only occur if the Auto Mode Switch input is asserted. The Raise/Lower Speed and Voltage panel switches are ignored. It is used during commissioning or if the user wishes only to close a breaker manually. The mode applies to closure of both the generator and mains breakers.

**Permissive mode** enables the synch-check function for proper synchronization, but synchronizer operation does not affect the engine's speed or generator voltage. If phase, frequency, and voltage are within proper limits, the synchronizer issues the breaker closure command. It will only occur if the Auto switch input is asserted. The user also has the ability to manually bias the voltage regulator via the voltage bias output with the Raise/Lower Voltage panel switches and the speed controller via the speed bias output with the Raise/Lower Speed panel switches. This mode is typically used with breaker closure wiring in series with a manual closure command such that the EGCP-3 is not actually closing the breaker but allowing it to close.

## Dead Bus

The dead bus closing function may be enabled or disabled during configuration. The dead bus detection level depends on the three hardware range selections for the PT inputs. A dead bus will be indicated when the voltage is less than 27,40, or 80 Vac L-N respectively. The synchronizer will allow generator breaker closure only if the bus breaker aux contact indicates the breaker is open AND the configuration for dead bus is enabled AND the bus voltage is below the threshold.

## Dynamic Adjustments

The Synchronizer has a PI controller to determine the dynamic response during synchronizing. The proportional gain determines how fast the synchronizer responds to an error in speed or phase. Adjust this gain to provide stable control during synchronizing. Lower the value to slow the response.

Integral gain determines how quickly the synchronizer responds to a large error in phase or frequency. It prevents low frequency hunting and damping (overshoot or undershoot) when the synchronizer is first enabled or when a speed transient occurs during synchronizing. Lower the value to slow the response.

A monitor value of the phase angle, or Synchroscope, is provided in Watch Window to observe the response and assist with dynamic adjustment.

## Slip Frequency

In larger systems, it is often desirable for the oncoming generator speed to be slightly higher than the bus when the generator breaker is closed. This assures that power immediately flows out of the generator and into the system. The slip frequency synchronizing function is enabled when the Sync Type configuration setting indicates Slip Frequency. A Slip Window and a Slip Frequency may be configured. The Slip Frequency is the exact frequency difference desired between the generator and bus. The Slip Window is the amount of error around the slip frequency that is allowed. The phase error must be within the Phase Match Window before a breaker close command output will be issued.

The synchronizer automatically controls the generator at the specified slip frequency. The EGCP-3 outputs an error signal to the auxiliary or summing point of an electronic speed control to provide the correction. Gain and Stability adjustments to the slip frequency PI controller are provided to allow stable operation of the automatic synchronizer function over a wide range of system dynamics.

During Phase Matching synchronizing, the Slip Frequency represents the maximum speed difference allowed before the breaker close command is active. This is proportional to the time the phase match must be within the phase window.

## Phase Match

The phase matching synchronizing mode corrects the frequency and phase of the generator to lock it to the bus frequency and phase. Phase matching synchronizing is exclusive of the slip frequency method. The EGCP-3 uses signal processing techniques to derive the difference in phase of the generator A and bus A phase voltage signals. When there is a difference, the synchronizer sends a correction signal to the speed control. The correction signal from the speed bias output increases or decreases engine speed depending on whether the slip is faster or slower than the bus. Corrections will occur when the phase is not within the configured phase match window. Slip Window is not used in Phase Match mode.

A PI (proportional, integral) controller provides the correction signal. Proportional Gain and Integral Gain adjustments to the PI controller are provided to allow stable operation of the automatic synchronizer function over a wide range of system dynamics.

## Voltage Match

The voltage of a generator in a parallel system must be matched to the bus within a small percentage to minimize the reactive power flow upon breaker closure and to maximize breaker contact life. If a synchronous generator is paralleled to a larger system such as a utility, a difference in voltages before paralleling will not change the voltage of the bus. If the generator voltage is lower than the bus voltage, reactive power will be drawn from the bus and used to excite the generator to the higher bus voltage. In the case where the generator voltage is low enough, the reactive power flow could motorize the generator with potential damage to the generator windings.

The voltage matching function of the EGCP-3 uses generator A phase and mains A phase signals. True RMS measurements are compared and matched. The processor issues appropriate raise or lower commands to the voltage regulator MOP, or adjustment of the voltage bias signal if used, to the voltage regulator to bring the generator voltage within the specified window of the bus voltage. Once the difference between generator and bus is within the configured voltage match window, the voltage bias output will hold steady. If the voltage match falls out of the window, the voltage bias will again affect a change to bring the generator voltage back into compliance.

The automatic voltage matching function may be enabled or disabled in the Synchronizer menu. When enabled, voltage matching will occur in both the Check and Run modes and is verified only by the sync-check function in Permissive mode.

If the limits of the voltage bias output are reached without matching the voltage, a Voltage Adjust Limits Reached alarm will be issued. The configured action will take place.

## Synch-check

The synch-check function is enabled when the Permissive mode is selected as described earlier. The synch-check function determines when all conditions for proper synchronization are satisfied and energizes the breaker closure relay. The generator and bus voltage comparison is made if the voltage matching function is enabled. The generator voltage must be within the specified voltage window before the breaker closure command may be given.

To minimize transients, the breaker must be closed when the phase difference between the generator and bus is near zero. Due to delays in any interposing relays and to the delay in closing the circuit breaker, the synchronizer may initiate the breaker closing ahead of the zero phase point. The control uses slip frequency and the specified breaker delay to predict breaker closure. The phase window and slip frequency (and slip window) provide maximum and minimum conditions on the prediction. When all conditions of voltage and phase are met, then the breaker closure command is given.

## Multiple Shot Reclosing

The multiple shot reclosing function allows multiple closing attempts. The EGCP-3 provides a configuration for the number of close attempts and the reclose delay timing. Failure to get closure after the specified number of attempts locks out the synchronizer by setting it to the auto-off mode and; if the reclose alarm is enabled, issuing an alarm. The synchronizer must then be reset by cycling the auto mode switch to off and back to auto and/or by clearing the reclose alarm. Setting the number of close attempts to one disables the multiple shot closing function.

When the Permissive or Check modes are selected, the number of close attempts is considered infinite.

## Synchronizer Time Out

When in the Run mode, the synchronizer will attempt to synchronize and close the breaker in the minimum time, as soon as all conditions are met. If the synchronization process has not successfully closed the breaker within a time equal to the Synchronizer Timeout value, the synchronizer will be latched into the Auto-Off mode.

If the Synchronizer Timeout value is configured as zero, this timeout is disabled and the synchronizer will continue to attempt synchronization indefinitely until turned off. When the Permissive or Check modes are selected, the synchronizer timeout is considered infinite. If a Synchronizer Time Out occurs, the EGCP-3 will initiate a Synchronizer Time Out Alarm based on the Synchronizer Time Out Alarm Action.

## Phase Rotation Check

The EGCP-3 will automatically check for proper phase rotation between the generator and bus inputs. If the phase rotation does not match, synchronization will be halted and set to Auto-Off. A manual double-check of phase rotation may be performed by observing the Negative Phase Sequence Voltage reported by the EGCP-3. If the Negative Phase Sequence Voltage for the Generator and Bus are both below 50% or rated voltage, the phase rotation check is considered passing.

Note that if either sensed bus is set to use single phase sensing, the phase rotation check is not useful.

## Synchronizer Time Line

The time line diagrams below illustrate a couple of timing sequences the synchronizer function uses when operating. First is a successful closure on the first attempt. Second is an unsuccessful closure where timeouts where configured such that the second attempt would not complete before total synchronizer timeout happens.

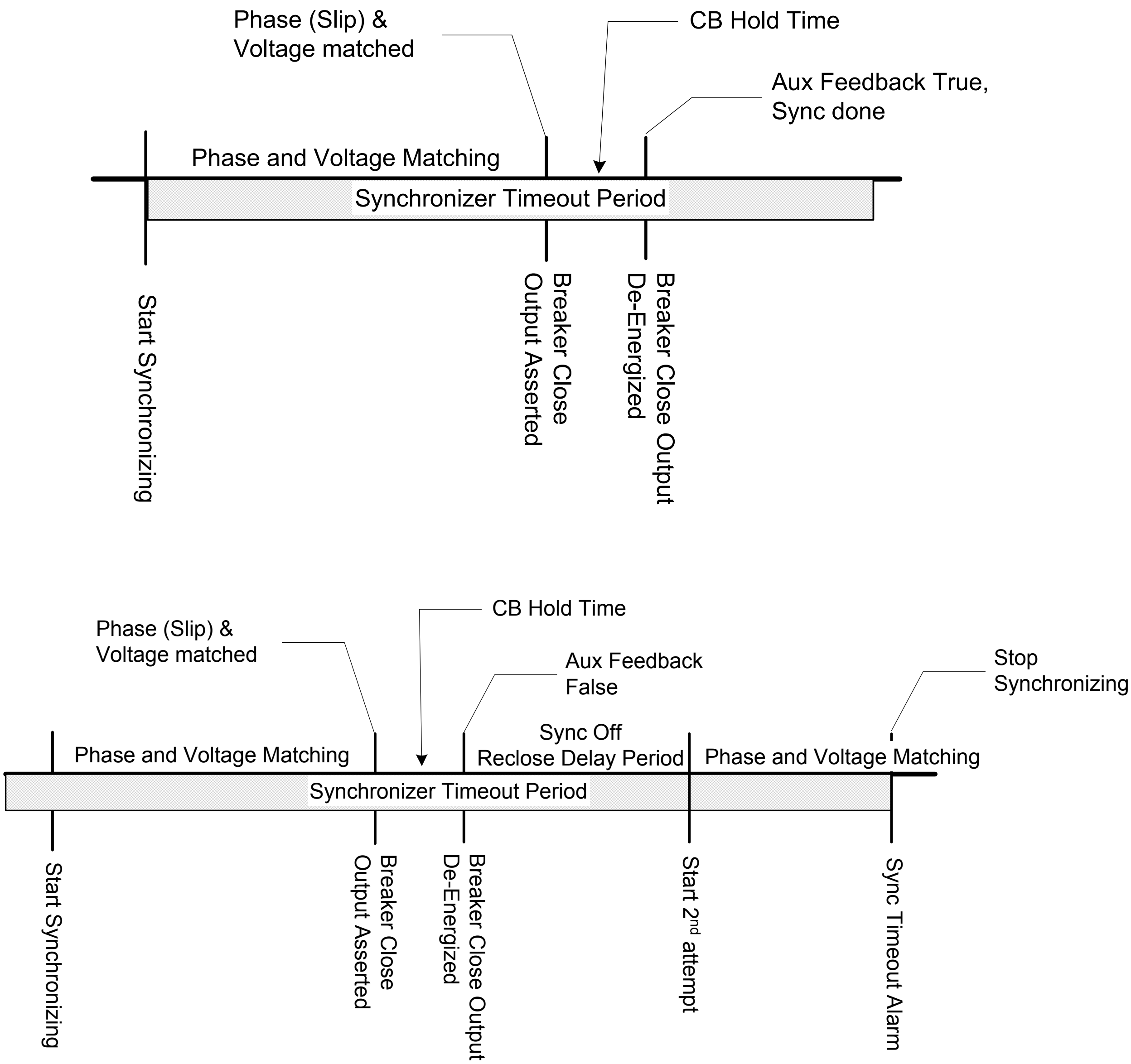



Figure 18-1. Synchronizer Action Time-Line

## Breaker/Contactor Control

The generator and bus breaker outputs are configured independently of each other. Either one or both may be configured as breakers or contactors. Open and Close logic for each type is indicated below.

In Breaker operation the EGCP-3 control has a pulsed output to the breaker closing circuit, and a separate pulsed output to give an open command the breaker shunt trip circuit. For Contactor type operation, a constant level close command holds the contactor closed, this command is removed to open the contactor.

## Shunt Trip

When Breaker type logic is selected, the generator breaker open command output is wired to protect the generator from wire break and power failure by using indirect logic. When the EGCP-3 wishes to open the generator breaker (shunt trip), it will REMOVE 24V from the generator breaker shunt trip discrete output. When the mode switch inputs and system configuration is such that synchronizing the generator will normally occur, the discrete output will be turned on (providing 24 Vdc), in order to allow the breaker to close. The bus breaker operation will be done with direct logic so that providing 24 Vdc will open the breaker. This combination will ensure that the bus breaker powers the plant bus if the EGCP-3 control power is lost.

When the EGCP-3 is put into a manual start using the Run input, the generator breaker shunt trip output will be energized (providing 24 Vdc) once generator stable is declared so that manual breaker operation may occur. However, when the EGCP-3 is put into a test start (only the test input is asserted), the generator breaker shunt trip output will NOT be energized. This will prevent manual breaker closure. If the auto input is asserted, the generator breaker open output will be energized (to allow closure) after the generator stable time delay has expired. If auto and manual inputs are asserted on the mode switch, the breaker operation will follow the auto operation. If the generator breaker is configured for contactor operation, the above does not apply, as there is no “open” output – only a combination open/close output.

When contactor logic is enabled for the generator output, it will operate in exactly the opposite logic from contactor operation for the mains breaker. The generator contactor open/close output will be sourcing 24 Vdc to close the contactor and off to open the contactor. The mains contactor open/close output will be off to close the contactor and sourcing 24 Vdc to open the contactor. This combination will ensure that the mains contactor powers the plant bus if the EGCP-3 control power is lost.

All optional discrete outputs have a configurable operation. Since the bus breaker/contactor control is an optional discrete output (pair), its operation is configurable for normally closed or normally open. Therefore, the bus breaker logic described above may be configured exactly opposite so that it behaves like the generator breaker. If configured as normally open, it will behave as described above and as recommended. This is the default setting.

## Breaker/Contactor Closure

If the breaker closure conditions are met, the synchronizer will give a breaker closure command for a time equal to the Breaker Hold Time configuration setting. If breaker closure feedback (breaker auxiliary contact) is not received within the Breaker Hold Time configuration setting, a failed close attempt condition exists. The synchronizer will not attempt to close the breaker again for a time equal to the Reclose Delay configuration. If the breaker closure feedback signal is received, and then lost before the Reclose Delay time, this is also a failed close attempt. If the number of failed close attempts is equal to the Close Attempts configuration, the synchronizer is latched into the Auto-Off mode. A Reclose Attempts Alarm will be issued according to the Reclose Attempts Alarm Configuration. Also, if the total time to synchronize, including reclose attempts and delays, exceeds the Synchronizer Time-Out Alarm configuration prior to the reclose attempts expiring, the synchronizer will be latched into the Auto-Off mode.

The user also has the ability to configure breaker or contactor logic for breaker closure. This configuration may be set for each breaker (generator and bus) independently. When configured as a breaker the output is held on until an auxiliary contact feedback is received or for the Breaker Hold Time configuration – whichever is shorter. When configured as a contactor, the output will be held on, as long as the auxiliary contact feedback is first sensed within the Breaker Hold Time configuration. The output will also follow the auxiliary contact input if the input indicates the contactor has opened.

When the breaker does close, either manually or automatically, synchronization is complete and control is relinquished to the load controller.

# Chapter 19.
# Real Load Control Description

## Introduction

The Real Load Controller is the software functional section of the EGCP-3 that controls the generator load. Load control begins at breaker closure when the load control function takes control of the EGCP-3 speed bias output directly from the synchronizer. If load is sensed on the generator but the control has not sensed the generator breaker closure, the load control will operate in droop. The passing of the speed bias required to synchronize the generator to the Real Load Controller as the beginning speed bias provides bumpless transfer of load between sources. A bumpless transfer is optimized by matching the synchronizer slip frequency to initial load (unload trip level). On command, the adjustable ramp allows smooth, time-controlled loading into isochronous, BaseLoad, isochronous load sharing, or process control.

## Functional Description

The Load controller compares the measured Load signal with the configured Load setting. The Load controller adjusts the Speed Bias output until the load signal and the Load setting match. The configured Load setting is adjustable with raise or lower commands issued from external raise/lower contacts, the communications links: Front panel HMI, ServLink/Watch Window, or Modbus. The configuration setting can be directly entered from the communications links or the front panel. In addition, a remote Load reference analog input can be programmed to remotely position the load level. When in Process control the load level is controlled by the Process PID output.

The EGCP-3 provides several modes of generator load operation. These are:
- isochronous
- mains parallel or isolated unit droop based on real power
- mains parallel generator BaseLoad
- process controlled generator load

Automatic ramping functions provide bumpless transfer of load when adding or removing generator capacity to a system or changing the mode of load control operation.

The real load controller has both high and low limits. The controller will not allow the limits to be exceeded nor will it allow the generator rated kW limit to be exceeded. If a configuration setting in the real load controller tries to drive the load beyond the generator rated kW configuration setting, the load will be held at the rated kW instead.

# Power Sensor Operation

The digital signal processing (DSP) power measurement technique used by the EGCP-3 control involves sampling of the voltage and current over a number of waveform periods. The microprocessor computes the product of the voltage and current samples, then sums and averages the products to give a computation of power. All formulas for calculation of voltage, current, power, and harmonics are performed in accordance with IEEE 1459-2000 (Definitions for the Measurement of Electric Power Quantities).

# Mode Description

This section provides a review of the operation of droop, isochronous, and BaseLoad. These concepts provide an understanding for power management.

Load control operation is determined by the status of the generator, bus, and mains CB Aux contact inputs and the load control mode. When the mains CB Aux contact input is open, droop and isochronous are the only available operating modes. When the mains CB Aux contact input is closed, the BaseLoad mode is used or alternately, Process Control may be used if the Process Enable contact input is closed. For a description of operation of the process control, see Chapter 21.

## Droop

Droop is a change in speed or frequency, proportional to load. That is, as the load increases, the speed or frequency decreases as illustrated in Figure 16-1. This reduction in speed is accomplished with negative feedback. The feedback increases as the system is loaded, causing a decrease in speed reference.

Droop is expressed as the percentage reduction in speed that occurs when the generator is fully loaded. With a given droop setting, a generator set will always produce the same power output at a particular speed or frequency. Droop sometimes is called the percent speed regulation.

If all generator sets in a droop system have the same droop setting, they will each share load proportionally. The amount of load will depend on their speed settings. If the system load changes, the system frequency will also change. A change in speed reference will then be required to offset the change in feedback and return the system to its original speed or frequency. In order for each generator set in the system to maintain the same proportion of the shared load, each generator will require the same change in speed reference.

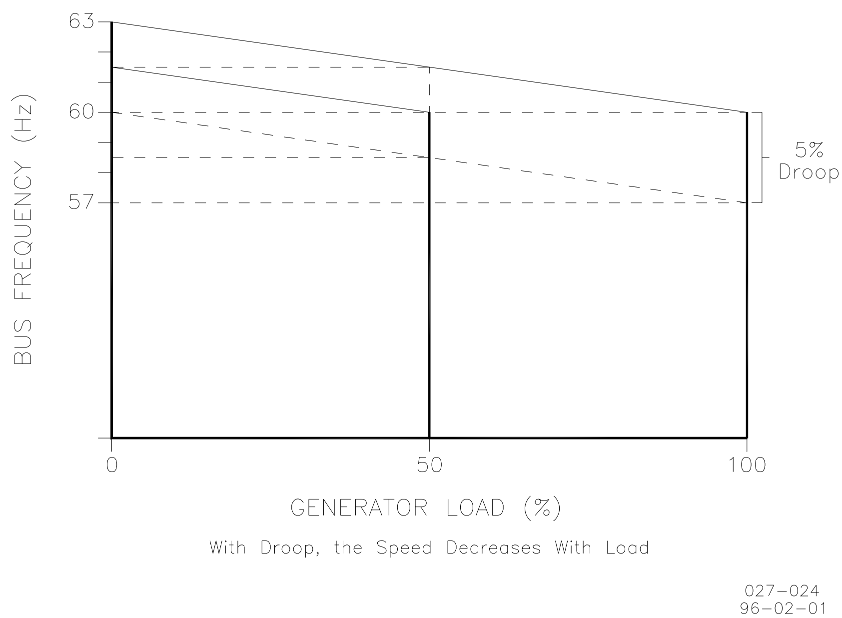



Figure 19-1. Droop Mode

The Droop load control operation is internal to the EGCP-3. The primary speed control receiving the speed bias signal must be configured to operate in Isochronous.

In the Droop mode the load control droops the speed by an amount equal to the Droop setting. When paralleling a generator in droop, at the time of breaker closure, the load control will not take on any load. In other words, the load reference is equal to zero immediately after the breaker has closed. The load is increased by closing the Load Raise input. Anytime droop is enabled, the user has the ability to raise or lower the load reference with the Raise/Lower Load panel switches. These switches ramp the load reference at the Load Raise/Lower Rate configurations.

Droop Tracking will be implemented such that when the control is switched to droop from another mode the load on that generator will not change.

Droop will take effect if current is sensed but the breaker position indicates open. This is regardless of the configuration setting that could otherwise be configured for isochronous.

## Isochronous

Isochronous means repeating at a single rate or having a fixed frequency or period. A generating set operating in the isochronous mode will operate at the same set frequency regardless of the load it is supplying up to the full load capability of the generator set, as illustrated in Figure 20-2. Isochronous control has no feedback of load level, therefore this mode can be only be used on one generator set running by itself in an isolated system. When two or more generators are paralleled, a method of load feedback must be used to managed load level of generators.

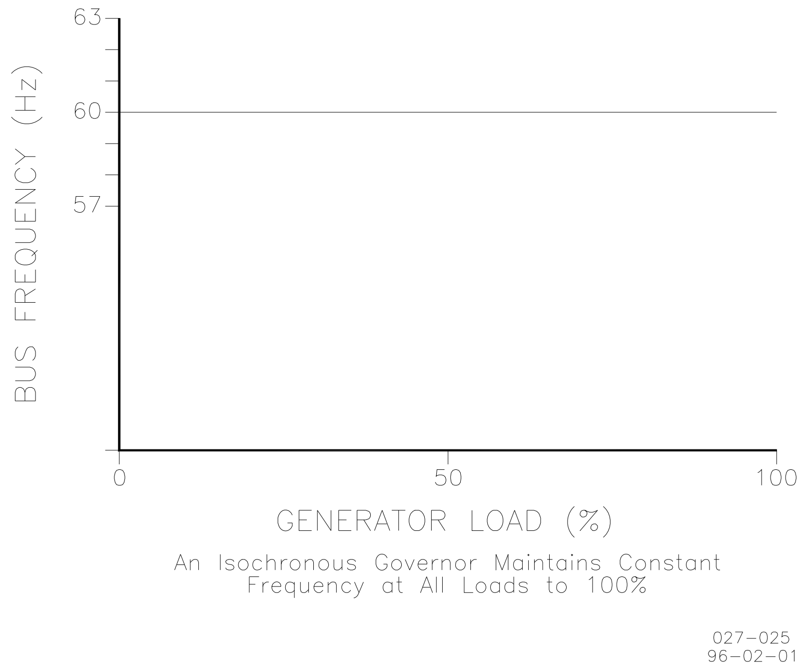



Figure 19-2. Isochronous Mode

## Isochronous Load Sharing

The LS Model of EGCP-3 is capable of controlling the load distribution between multiple gensets in Isochronous mode. The feedback signal is provided from load information supplied by the LON Network. Because of feedback, the speed can remain constant over the load range of the genset.
The LON information is normalized to rated load capability. Therefore gensets of unequal ratings can be paralleled onto the bus, they will load share to equal percentage load.

## Frequency Trim

When operating in the Isochronous Load Sharing mode the EGCP-3 will make corrections to the load reference to maintain the bus frequency at the configured system frequency.

## BaseLoad

BaseLoad operation is performed when operating in parallel with an infinite bus or utility. The advantage of BaseLoad over droop is that when separating from a utility, there is no frequency change. Simply returning the bias signal to zero when breaking from the utility returns the system to isochronous.

BaseLoad is a method of automatically setting a base or fixed load on a generator. There are two methods of setting the BaseLoad Reference, internally and from a remote analog device, such as a PLC or transducer.

### Internal BaseLoad

When Internal BaseLoad is active at the time of breaker closure to the utility, the load control will ramp the load reference to the BaseLoad configuration setting using the Load or Unload Time, whichever applies. In addition the user also has the ability to stop the ramp with the activation of the Load Raise/Lower switches or the Pause switch. If the Load Raise/Lower switches are activated during a ramp the load reference assumes the current load.

Once the load has reached the BaseLoad configuration setting the user has the ability to change the load reference using the Load Raise/Lower switches. When these switches are activated, the load is ramped at the Load or Unload Rate, whichever applies. When switching from any other mode to BaseLoad, the BaseLoad configuration setting becomes the current load reference in order to provide for a bumpless mode transfer.

### Remote BaseLoad

A Remote BaseLoad mode is one where the BaseLoad reference is determined by an analog input. If an analog input is configured for Remote BaseLoad Reference, the analog input reference will automatically be used in place of the internal BaseLoad setting. When switching from any other mode to Remote BaseLoad Control mode, the load reference is ramped to match the Remote BaseLoad Reference (the analog input) using the Load or Unload Time, whichever applies. Once the load has reached the Remote BaseLoad Reference, the load reference tracks changes to the Remote BaseLoad Reference using the Load and Unload Rates, whichever applies. In the Remote BaseLoad mode, the Speed/Load Raise/Lower panel switches will be deactivated.

The Process Control Mode controller (PI) will vary the internal BaseLoad reference to control the load.

## Optional Load Functions

The functions described below are available when the auto input is asserted and apply mainly to the mains parallel operation where load can be controlled. They are optional because a discrete input must be configured for the function or a Modbus command must be given to effect the function. These functions are operated in common with the reactive load functions by the same name. The discrete inputs operate both simultaneously.

### Reset Load

The Reset Load panel switch is used to reset the BaseLoad control mode. When the Reset Load switch is closed and then opened and the load control is in Internal BaseLoad control mode, the load control will ramp the load reference to the original internal reference (configuration setting) at the Load or Unload Rate. In addition the user also has the ability to stop the ramp with the activation of the Load Raise/Lower switches. If the Load Raise/Lower switches are activated during a ramp the current load becomes the load reference.

## Ramp Pause

When the Ramp Pause panel switch is closed the load reference ramp will pause and hold the current load until the switch is opened again. The ramp pause allows for temperature, oil pressure, etc., to reach the desired operating point while hold the load at a safe level. When the switch is opened again, the load ramp will continue where it left off. The Ramp Pause panel switch will not stop the load reference from ramping if a shutdown is present.

## Unload

If the Unload panel switch is activated before or after breaker closure, the load reference will ramp to the Unload configuration setting and remain there until the Unload panel switch is deactivated. This is true whether starting from below the Unload configuration setting or above. If the Unit Load never reaches the Unload Setpoint, a breaker open command is given after a fixed amount of time.
The Unload configuration setting can be automatically overridden. The Unload configuration setting is considered the larger of the Low Load Limit and the Unload Trip configuration settings.

# Chapter 20.
# Reactive Load Control Description

## Introduction

The VAR/PF (Volt Amp Reactive or Power Factor) controller adjusts the reactive power component of the generator in parallel systems. In an infinite bus system, the controller compares either the reactive power on the generator with an reactive power setpoint, and makes corrections to the voltage regulator until the desired reactive power is obtained. An analog output can be directly connected to compatible voltage regulators with an analog voltage setting input. The VAR/PF mode is activated by closing a digital input configured for Enable VAR/PF Control.

## Functional Description

The VAR/PF controller is determined by the VAR/PF Mode selection in the Reactive Load menu. When set to Off the operation is manual. Automatic control is enabled when set to either VAR control or PF control. If the Enable VAR/PF Control input is open the control will always be Off regardless of the mode selection. The auto VAR/PF mode reference can be adjusted using Raise/Lower commands or with a remote 4–20 mA analog input reference. The manual mode reference can only be adjusted using Raise/Lower commands. When in the Automatic Mode, a PI controller modulates the output directly based on the VAR/PF input and reference. The Manual Mode provides no controller action, just a manually adjustable signal output.

The VAR/PF controller output can be either an analog output (4–20 mA, ±1Vdc, ±3Vdc, or ±9Vdc) or discrete outputs (raise and lower voltage commands). The discrete outputs can be used to activate a voltage regulator MOP (motor operated potentiometer) when an analog input is not provided on the Automatic Voltage Regulator (AVR).

The VAR/PF control mode will provide closed loop control of either VARs or Power Factor when operating in parallel with another power system when that system can accept the reactive load. In isolated operation closing the Enable VAR/PF Control contact will activate a voltage trim function. .

**NOTE**

**If cross-current compensation is installed on the voltage regulator, it must be removed prior to using the VAR/PF mode of control, or instabilities may result. The droop CTs must remain connected to their voltage regulator.**

# Mode Description

## Off / Droop Control

The manual control mode keeps the EGCP-3 from regulating PF or VAR levels. The Voltage Raise/Lower switches will allow a user to change the voltage of the generator. An analog input cannot be used to control PF or VAR levels in this mode. If the voltage regulator has a droop function, that droop function will be the active control method.

If a VAR/PF Enable Discrete Input is configured and the input is open/Disabled, the droop control mode will be assumed.

## PF Control

The power factor control adjusts generator voltage to maintain a constant power angle throughout the kW operating range. A configuration setting is provided to set the desired power factor reference. The power factor control function may be enabled with the VAR/PF Control mode configuration setting.

The VAR/PF control is in PF Control when the load control mode is in BaseLoad or Process, and the PF control mode is selected and enabled. When switching to this mode, the PF control will ramp the PF reference to the Power Factor configuration setting at a rate determined by the Voltage Ramp Time and the power factor set point range. In addition the user has the ability to stop the ramp with the activation of the Voltage Raise/Lower switches. Once the Power Factor has reached the Power Factor configuration setting, the user has the ability to change the Power Factor reference using the Voltage Raise/Lower switches. When these switches are activated, the PF load reference is ramped at a rate determined by the Voltage Ramp Rate.

## VAR Control

The VAR control adjusts generator voltage to maintain a constant reactive power (VAR) load on the generator throughout the kW operating range. This assures sufficient excitation of the generator field under all load conditions. A configuration setting is provided to set the desired VARs. The VAR control function may be enabled with VAR/PF Control mode configuration setting.

The VAR/PF control is in VAR Control when the load control mode is in BaseLoad or Process, and the VAR control mode is selected and enabled. When switching to this mode, the VAR control will ramp the VAR reference to match the VAR configuration setting at a rate determined by the Voltage Ramp Rate. In addition the user has the ability to stop the ramp with the activation of the Voltage Raise/Lower switches. Once the VAR load has reached the VAR configuration setting, the user has the ability to change the VAR load reference using the Voltage Raise/Lower switches. When these switches are activated, the VAR load reference is ramped at a rate determined by the Voltage Ramp Rate.

### Analog Input of VAR/PF Reference

When this mode is selected, the PF or VAR reference level is determined by an analog input. The EGCP-3 is still controlling PF or VAR but the reference is set by an analog input or from Modbus. The range / calibration of how to use the signal is achieved using the calibration for the input. The input should be calibrated appropriately during setup for this to work properly. The Voltage Ramp Rate will be used for all raise and lower adjustments. The Voltage Raise and Lower input switches will be ignored when in this mode. To use a Remote VAR/PF reference Analog Input 3 or 4 must be set to either VAR reference or PF reference.

### VAR/PF Sharing

When an isolated bus system is configured for Isochronous Load Sharing the system can also control the generator voltage bias so that all generators on the bus will match proportional VAR level, or match PF readings. This requires the EGCP-3s in the system to have LON communication functional.

### Voltage Trim

When the EGCP-3 is operating in isochronous mode on an isolated bus, the voltage will be trimmed to the configured rated value. The Voltage Bias Output will be adjusted to maintain the generator voltage is within a deadband window of the rated voltage. The purpose is to offset any voltage regulator induced droop. If a VAR/PF enabled switch is configured, the switch must be asserted for this function to be active.

## Optional Load Functions

The functions described below are available when the auto input is asserted and apply mainly to the mains parallel operation where reactive load can be controlled. They are optional because a discrete input must be configured for the function or a MODBUS command must be given to effect the function. These functions are operated in common with the real load functions by the same name. The discrete inputs operate both simultaneously.

### Reset Load

The Reset Load panel switch is used to reset the VAR/PF control mode. When the Reset Load switch is closed and then opened and the load control is in Internal VAR or PF control modes, the load control will ramp the load reference to the original configured reference (configuration setting) at the Voltage Ramp Rate. In addition the user also has the ability to stop the ramp with the activation of the Voltage Raise/Lower switches. If the Voltage Raise/Lower switches are activated during a ramp the current reactive load becomes the reactive load reference.

## Ramp Pause

When the Ramp Pause panel switch is closed the reactive load reference ramp will pause and hold the current reactive load until the switch is opened again. When the switch is opened again, the load ramp will continue where it left off. The Ramp Pause panel switch will not stop the reactive load reference from ramping if a shutdown is present.

## Unload

If the Unload panel switch is activated before or after breaker closure, the reactive load controller will switch to the PF controller (if not there already) and control based on PF at the configured PF level until the Unload panel switch is deactivated. If remote PF or VAR control is active, no specific action will take place and the reactive load will continue to be controlled remotely.

## Limits

The reactive load controller will not allow the VAR level to exceed the configured generator rated VAR level. If a configured level in the reactive load controller tries to drive the VAR level above the configured generator rated VAR level, it will be held at the rated VAR level instead.

# Chapter 21.
# Process Control Description

## Introduction

A function that is relative to genset or bus load can be controlled through the Process Control of the EGCP-3 LS. The process control mode is selected when the process enable input, generator CB Aux, Bus CB Aux and mains CB Aux switch inputs are closed. To control a process the EGCP-3 LS has to vary the genset and bus power output level. Increasing or decreasing power will increase or decrease a measured parameter (temperature, pressure, KW, etc). The genset load will therefore control the parameter to a set value. The EGCP-3 will control, based upon an input sensor connected to one of the configurable analog inputs. This process input signal is the feedback to tell the control a load level to maintain the process reference. To do this the bus must be connected to a mains bus that will keep the frequency constant.

## Functional Description

When the process control is enabled, the error signal between the process reference and process signal is input to a PID (Proportional, Integral, Derivative) controller operating in cascade with the load control. The output of the process controller is a load reference to the Real Load Controller. The load signal is output from the load control to the bias input of the speed control, causing the genset to run at the required load to maintain the desired process level.

The Temperature/Pressure process control function is flexible enough to control any process where the controlled parameter can be monitored as an analog input signal. This analog input can be a measure of the mains Import or Export power level. A load sensing transducer can then make the process control becomes an Import/Export control.

The Process Control can be configured as direct or indirect acting, depending on the process input increasing value with a power increase (direct), or increasing value with a power decrease (indirect).

The process reference may be either an internal reference or the analog remote process reference input. The internal reference value could also come for the Modbus communication port.

When the process control is enabled, the load controller will ramp the load reference till the Process Input matches Process Reference at the Load or Unload Rate, whichever applies. When the process reference is the internal configured value, the user has the ability to change the set point using the Load Raise/Lower switches. When these switches are activated the process reference is ramped at the Load or Unload Rate, whichever applies. If a remote reference or Modbus reference is used, the Raise/Lower load switches will be ignored. When switching from any other load control mode to Process Control, the current load becomes the new process reference, and the reference begins ramping from that point. This provides for a bumpless mode transfer.

In order to appropriately display the sensor value on the front panel, any sensor connected to an analog input of the EGCP-3 may be scaled to appropriate engineering units in the calibration menu. The Process Reference will be configured in the same scale for simplicity, whether internally set or from a remote analog input.

At no time will the Process control be allowed to drive the load above the Rated kW of the genset.

# Mode Description

## Master Process Control

When an EGCP-3 LS is connected to a bus system and the Process Enable input, Generator CB Aux, Bus CB Aux and Mains CB Aux switch inputs are closed, the first (or only) genset on the bus becomes the Master Process Control. When the next genset's generator breaker closes, the LON communication must evaluate each EGCP-3 control to make mode decisions. If the Process Input of the 2nd unit is open, the 2nd unit becomes a Process Slave unit. If the 2nd unit also has its Enable input closed, the LON network looks at the Unit Node Number. The Genset with the Lowest Node Number becomes the Master (or stays the Master), Each time another units is added on the bus, the same decision is made. Units that meet all the input requirements to be a master, but have a higher node number are Back-up Master Process controllers. They will assume master process control when the present master is removed from service. There can only be one Master Process Control on a connected bus system. The Master Process Control will then monitor it's Process Input and it's Process Reference to determine it's Load Reference. This Master Reference will be communicated over the LON network to all Slave units. The Slave units will then also use this received value as their Load Reference. The Master therefore sets the proportional load of each genset in the system.

## Slave Process

When a genset is determined to be a Slave Process unit, it's Process Control PID becomes disabled. The received input over the LON is the Load Reference and the unit adjusts it's Speed Bias Output to control at that load value. The Load Control dynamics of the Slave units are still used to determine the reaction time to transients. The dynamics and operation of the Slave unit is similar in all respect to BaseLoad operation. If you want a designated unit to always be a slave, do not configure the Mains Breaker Input to that unit.

# Optional Process Functions

The process control input is only used to control real load. The Reactive Load Controller will control independently and simultaneously. The appropriate mode (VAR, PF, VAR Sharing, or PF Sharing) is determined by the Reactive Load Control Mode configuration setting.

The functions described below are available when the process mode is active. They are optional because a discrete input must be configured for the function or a MODBUS command must be given to effect the function. These functions are operated in common with the reactive load functions by the same name. The discrete inputs operate both simultaneously.

## Reset Load

When the Reset Load switch is closed and then opened, the process control will ramp the process reference to the original internal reference (configuration setting) at the Load or Unload Rate. This function will not work with a Remote Reference. In addition the user also has the ability to stop the ramp with the activation of the Load Raise/Lower switches. If the Load Raise/Lower switches are activated during a ramp the current level becomes the process reference.

## Ramp Pause

The Ramp Pause Load panel switch is used to pause an internal process control ramp. When the Ramp Pause panel switch is closed the process reference ramp will pause and hold the current process level until the switch is opened again. When the switch is opened again, the process ramp will continue where it left off. The Ramp Pause panel switch will not stop the process reference from ramping if a shutdown is present.

In addition the user also has the ability to stop the ramp with the activation of the Load Raise/Lower switches (when they are enabled). If the Load Raise/Lower switches are activated during a ramp the current load becomes the load reference, and the reference will ramp in up or down respectively. This is used to manually assume a new reference, where the pause would be used to hold a load to allow system stabilization, then move to the configured reference.

## Unload

If the Unload panel switch is activated before or after breaker closure, the process reference will ramp to the Unload configuration setting and remain there until the Unload panel switch is deactivated. This is true whether starting from below the Unload configuration setting or above. If the load level never reaches the Unload configuration setting, a breaker open command is given after a fixed amount of time.

The Unload configuration setting can be automatically overridden. The Unload configuration setting is considered the larger of the Process Low Limit and the Unload Trip configuration settings when evaluated from the perspective of the load controller.

## Droop Control

Process Droop can be added to any process mode. The droop amount is configurable in percent of the process range up to 50%. The process reference will be decreased proportional to the generator load. This is typically only used in temperature/pressure control but there are no restrictions on its use. It is added to the otherwise isochronous control already in place. The Droop will add an element of stability to the process control loop by limiting large load variations for small process variations.

## Filter

The process being controlled will react to load changes quickly or slowly. The process controller includes an adjustable filter to adjust the process control rate of response. The filter is a low pass filter where the frequency is adjustable. Higher frequency settings result in faster control response, but also more response to process noise. In systems experiencing rapid fluctuations in the process input signal (such as digester gas fuel pressure maintenance), reducing the Process Control Filter setpoint and increasing the Process Deadband will reduce control sensitivity to the fluctuations. This allows for slower, but more stable, performance. When the input reacts very slowly to load change a lower frequency setpoint is needed so as not to over-compensate.

## Deadband

The process controller includes an adjustable deadband above and below the input signal. The deadband is useful in both noisy applications as well as for very slow processes. When the process input is within a deadband amount of the previous measurement (one rate group ago), no active adjustment will be made. For example, if Temperature process is enabled with a deadband of 10°C, the process sensor input is 200°C, and the temperature sensed moves to 207°C, no adjustment will be made because the level sensed is within the deadband, the controller will continue to base its output on 200° input. If the next sample measures 212° the process will react and use 212° as a comparison to the reference.

## Process Action

The process control function is configurable for direct and inverse action. Direct process control is where the sensed input signal increases as the load increases (such as where the sensed input is exhaust pressure or export power). An inverse action control is where the sensed input signal decreases as the load increases (such as when controlling import power where the import power will decrease as the generating system picks up more of the local load).

## Limits

The process controller has both high and low limits. The controller will not allow the limits to be exceeded nor will it allow the generator rated kW limit to be exceeded. If a configuration setting in the process controller tries to drive the load beyond the generator rated kW configuration setting, the load will be held at the rated kW instead. Likewise, the process controller will not allow the generator to operate below minimum power.

# Chapter 22.
# PID Tuning Description

## Overview

The Real load, reactive load, and process control all utilize PID controllers. The response of each control loop can be adjusted for optimum response, however it is important to understand what a PID controller is and the effect of each controller adjustment has on the controller response. Proportional gain, integral gain (stability), and DR (speed derivative ratio) are the adjustable and interacting parameters used to match the response of the control loop with the response of the system. They correspond to the P (proportional), I (integral), and D (derivative) terms, and are displayed the EGCP3 as follows:

- P= Proportional gain (%)
- I= Integral gain (%)
- D= Derivative gain (determined by DR and I)

### Proportional Control

Proportional response is directly proportional to a process change. [Analogy: Setting hand throttle to keep constant speed on straight and level.]

Proportional control (using the same analogy) results in a certain speed as long as the car is not subjected to any load change such as a hill. If a throttle is set to any particular setting, the speed of the car will remain constant as long as the car remains straight and level. If the car goes up a hill it will slow down. Of course, going down a hill the car would gain speed.

### Integral Control

Integral compensates for process and setpoint load changes. [Analogy: Cruise control maintains constant speed regardless of hills.]

Integral, sometimes called reset, provides additional action to the original proportional response as long as the process variable remains away from the setpoint. Integral is a function of the magnitude and duration of the deviation. In this analogy the reset response would keep the car speed constant regardless of the terrain.

### Derivative

Derivative provides a temporary over-correction to compensate for long transfer lags and reduce stabilization time on process upsets (momentary disturbances). [Analogy: Accelerating into high speed lane with merging traffic.]

Derivative, sometimes called “preact” of “rate”, is very difficult to draw an accurate analogy to, because the action takes place only when the process changes and is directly related to the speed at which the process changes. Merging into high speed traffic of a freeway from an “on” ramp is no easy task and requires accelerated correction (temporary overcorrection) in both increasing and decreasing directions. The application of brakes to fall behind the car in the first continuous lane or passing gear to get ahead of the car in the first continuous lane is a derivative action.

## Proportional Response

The amount of proportional response is directly related to the process change and the Proportional gain stetting on the controller; Controller output change is proportional to the process change. If there is no process change, there is no change in output from the controller ( or valve change) regardless of the deviation. This results in an undesired offset between the original desired setpoint and the resulting drop in the control point.

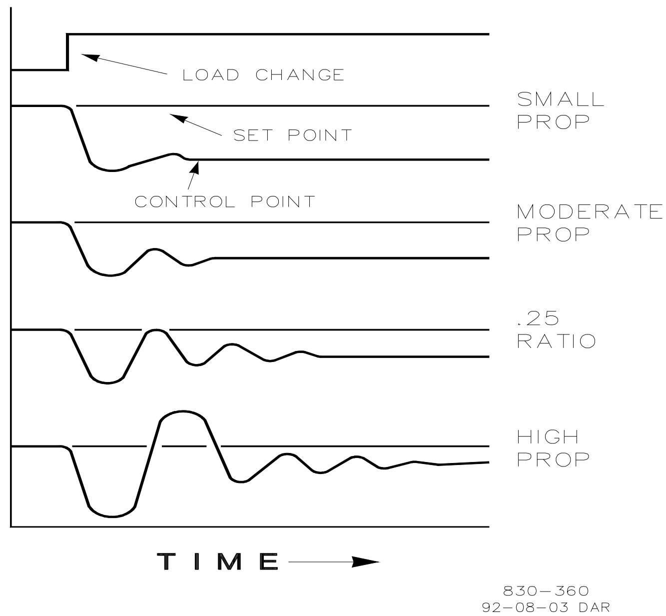



Figure 22-1. Proportional Gain Setting Effects

The figure above shows the effect of proportional gain settings on control. Starting at the top of the graph a load change is introduced. With a small proportional gain (meaning a large process change is required to produce a full valve travel), stability is good but offset is very high. With a moderate gain setting (higher number setting) stability is still good – offset is still fairly high. With a high setting, offset is considerably smaller but stability is poor. The .25% ratio effects a minimum area whereby the offset is reduced to a minimum while the stability is decaying manner at a 0.25% ratio. The decay ratio used (0.25%) means that if the second cycle is ¼ of the first cycle, then each succeeding cycle will be ¼ of the preceding cycle until the cycle is not visible. Since the proportional gain is adjusted to produce (only) the proper stability of a process, do not continue increasing its effect to correct offset conditions. The amount of stability and offset is directly related to the setting of the proportional setting. Stability is of course also affected by the stability of the process. In essence, the amount of output from the controller due to the proportional setting is from the error. If there is no error, then there is no proportional effect.

The EGCP3 when load sharing with other LS units uses only proportional gain for the load control. So there will always be an error from the system load demand.

## Integral Response

Integral gain as stated in the Woodward controls is repeats per minute (or Reset Rate). Therefore, a high amount of Integral gain (high number) would result in a large amount of reset action. Conversely, a low integral gain (low number) would result in a slower reset action.

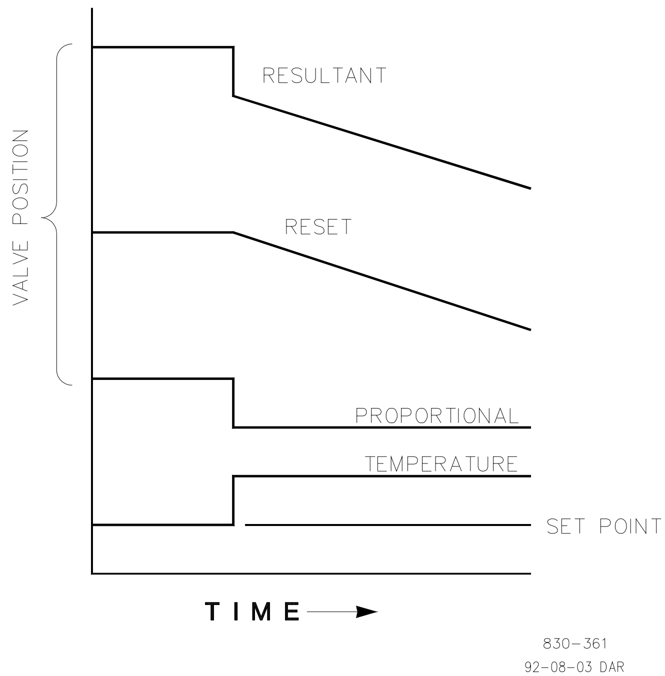



Figure 22-2. Open Loop Proportional and Integral Response

Integral response is provided to eliminate the offset that resulted from straight proportional control. The figure above shows how the controller action is proportional to the measurement change, but as we saw earlier, this results in offset. The integral (or reset) action is a function of both time and magnitude of the deviation. As long as an offset condition (due to load changes) exists, integral action is taking place.

The amount of integral action is a function of four things:

- The magnitude of the deviation.
- The duration of the deviation.
- The proportional gain setting.
- The Integral setting.

In this open loop figure above, the integral response is shown increasing due to the offset condition existing between temperature and setpoint. The resultant action is the top curve showing the step proportional response that ends as soon as the measurement stops changing. Then the integral (or reset) action is added to the proportional action in an amount equal to the integral of the deviation. In other words, reset action continues (in either or both directions) as long as there is a difference (deviation) between the setpoint and the process measurement. In this case, the deviation will never be eliminated (or even reduced) because the system is in open loop.

## Proportional and Integral Response (closed loop)

The figure below shows the closed loop effects of integral action. The bottom curve displays the load change. The next curve up shows the setpoint and the measured variable, temperature. With the load change the temperature droops or deviates from the setpoint.

The next highest curve is the proportional curve resulting in a different valve position, thereby returning the process to the setpoint.

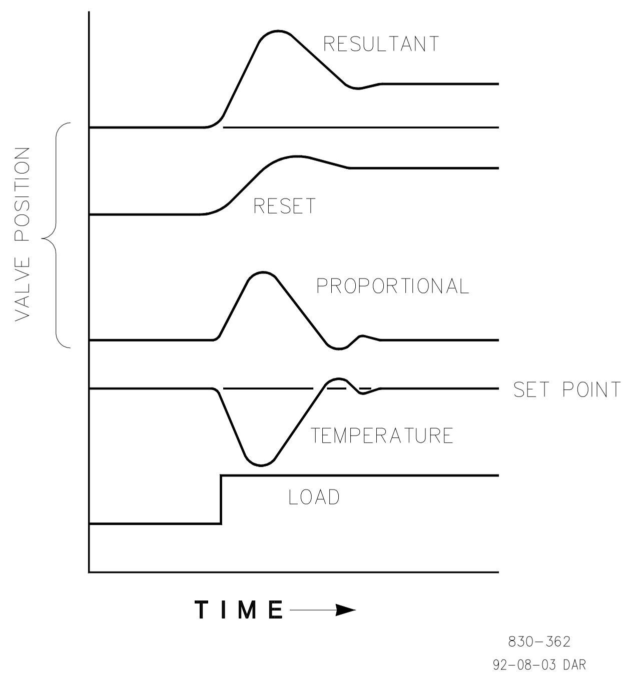



Figure 22-3. Closed Loop Proportional and Integral Response

In closed loop, as opposed to open loop, as the measurement decays toward the setpoint, the proportional action is taking place proportionally to the measurement change, and the integral action is decaying proportionally to the magnitude and duration of the deviation until the measurement reaches the setpoint at which time the integral action is zero.

## Integral (Effects Of Settings)

The figure below shows the effect of fast or slow integral action. For a given load change an offset results with proportional response only. Since recovery time (for a given load change) is important, the integral setting should remove the offset in minimum time without adding additional cycling. If two cycles are added, then too much integral gain has been added. Of course, proportional only must first establish the 1/4 decay ratio. If increased cycling occurs, the integral must be turned off or the controller switched to “manual” if allowed to go too far. Ideally, the process should not continue to cycle after the setpoint has been reached as in the second curve from the bottom.

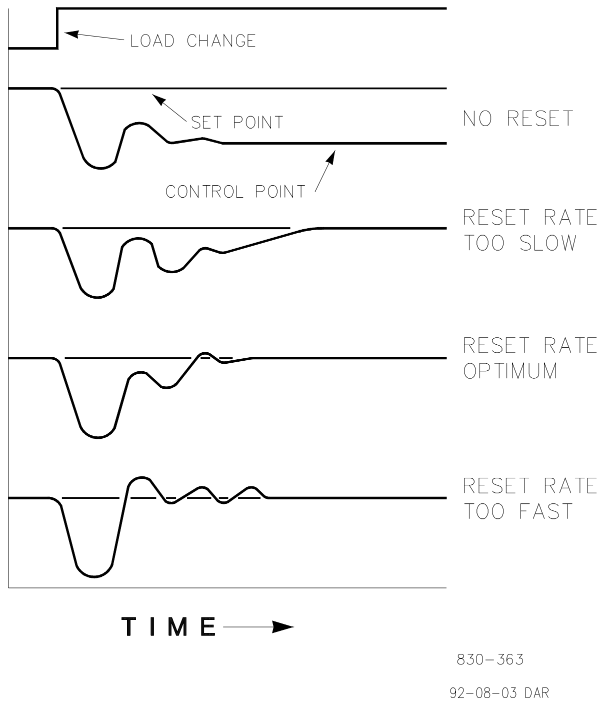



Figure 22-4. Derivative Response

## Derivative Response

In a process control loop the Derivative action is directly related to how fast the process changes (rate of change). If the process change is slow then the Derivative action is proportional to that rate of change. Derivative acts by advancing the Proportional action. Derivative acts at the start of the process change, when the process changes its rate and when the process stops its change.

Derivative action takes place at only three times:

- When the process starts to change
- When the rate of change takes place in the process
- When the process stops changing.

The net result of Derivative action is to oppose any process change and combined with Proportional action to reduce stabilization time in returning the process to the setpoint after an upset. Derivative will not remove offset.

Woodward Derivative is split into two working domains, Input dominant and Feedback dominant. The allowed values for DR range from 0.01 to 100. The most common derivative is Feedback dominant, it is automatically selected with an Derivative Ratio (DR) from 1 to 100. The Input dominant domain is selected with DR values between 0.01 to 1.

Feedback dominant applies the derivative action to the integrator feedback term of the PID equation and is more stable than input dominant derivative. This will not take corrective action as early and it will be less noise sensitive. When tuning the derivative, the DR will be established in the 1 to 100 range because it is easier to tune and more forgiving of excessive values. Most PIDs will employ feedback dominant derivative.

Input dominant derivative applies the DR term before the integrator term of the PID equation. When the DR is less than 1, the derivative is input dominant and reacts very quickly to process upsets. This function is very adapted for PIDs that control the load parameter, such as load shaft turbine speed. Since the input dominant derivative is so sensitive, it should be reserved only for applications without high frequency noise.

Except for input dominant and feedback dominant features, the reciprocal of one domain will appear identical in the other domain. As an example, consider an DR of 5.0, the reciprocal being 1/5. That means that an DR of 5.0 will appear the same as DR of 0.200. The difference in response between these values of 5.0 and 0.2 is in the dominance feature.

If in doubt about the type of derivative to use, then set up for feedback dominant, 1 < DR < 100.

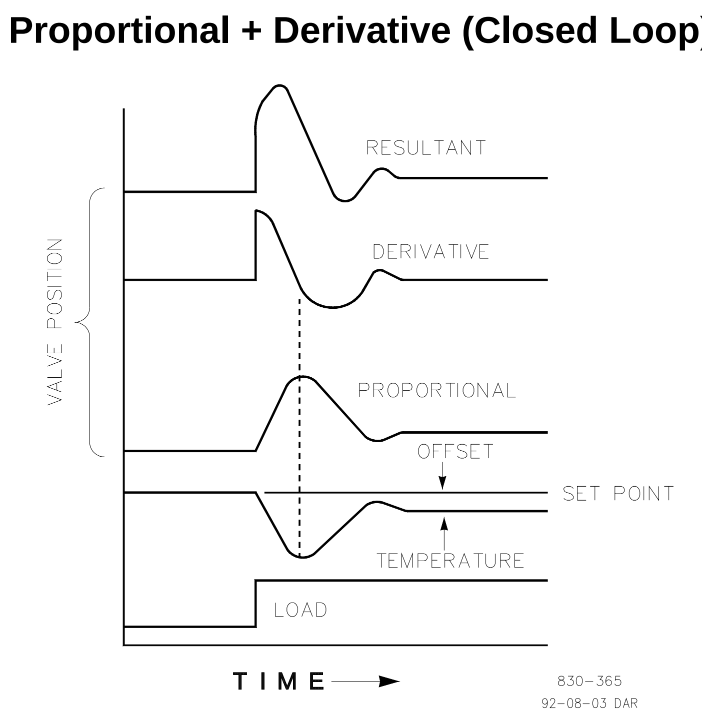



Figure 22-5. Closed Loop Proportional and Derivative Action

The figure above shows how derivative acts to oppose a change in process in either direction. The dashed line shows the Derivative action going through zero to oppose the process deviation traveling toward zero. Notice offset still exists between the desired setpoint and the drooped control point that resulted from the load change. The top curve is the resultant controller output, Proportional plus Derivative.

If an upset (momentary) had occurred rather than a load change, there would be no offset.

## Derivative (Effects Of Settings)

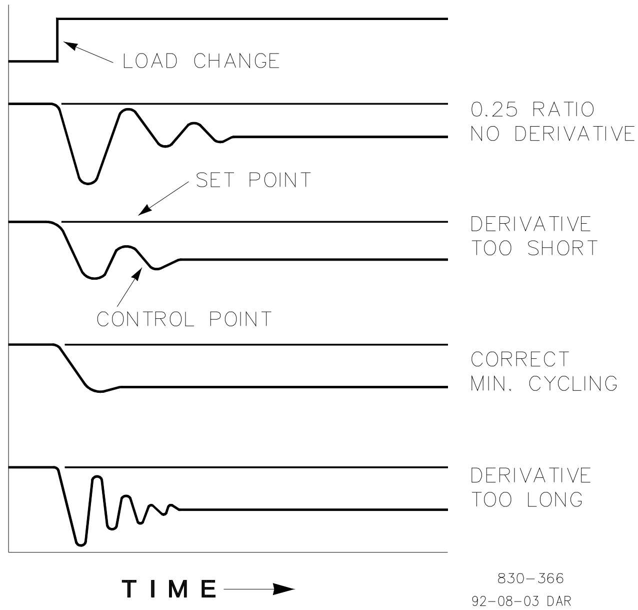



Figure 22-6. Derivative Setting Effects

The figure above shows the effect of different derivative settings. The curves are relative since it depends on what type of control is desired in order to properly adjust derivative time. For example, if minimum cycling is desired (as is shown here) then derivative is added to the 1/4 decay cycle provided by proportional until more than one cycle is removed and of course the 1/4 decay is destroyed. However, in most cases it is desirable to retain the 1/4 decay cycle, in which case derivative is added to the point of removing only one cycle from the 1/4 decay ratio then the gain is increased until the 1/4 decay ratio is restored.
In all the above curves, you will note offset exists since offset can only be eliminated by the addition of Integral (or Reset).

## Proportional + Integral + Derivative (Closed Loop)

The figure below shows the relationship of valve position to the interaction of the PID modes of control whenever a load change takes place in closed loop. As the temperature drops due to the load change, the proportional action moves the control valve proportionately to the measurement (temperature) change. The integral gain/reset adds to the proportional action as a result of the magnitude and time (duration) of the deviation. And the derivative temporarily over-corrects based on the speed at which the measurement moves in any direction. The resultant curve (at the top) shows a similar over-correction (in this case), but in addition the valve will stay at the new position required to keep the measurement at the setpoint.

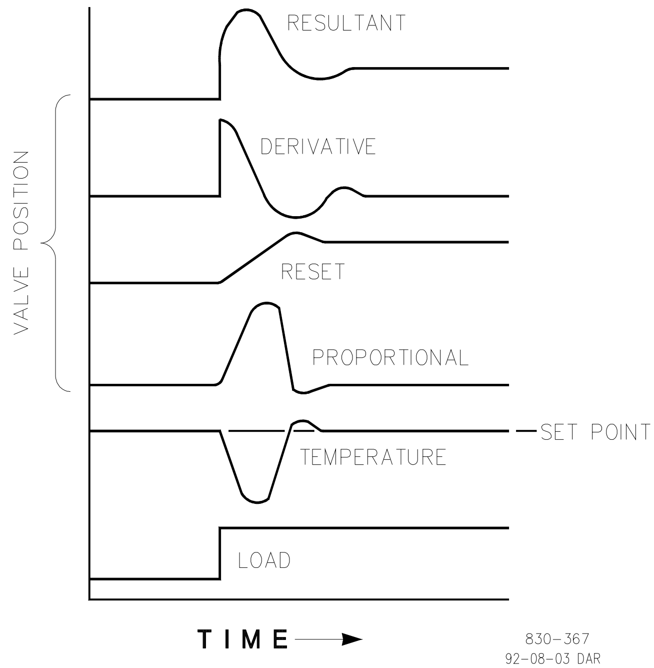



Figure 22-7. Closed Loop Proportional, Integral and Derivative Action

In summary, Derivative provides a temporary over-correction to compensate for long transfer lags and reduce stabilization time on process upsets (momentary disturbances).

Do not use if high frequency noise is normally in the measured variable or the main lag is dead time. After Proportional is set to 1/4 decay ratio and Derivative is adjusted to remove one cycle as well as decreasing the 1/4 decay ratio, then the Proportional gain can be increased to restore the 1/4 decay ratio.

## Adding Derivative

The value of the Derivative Ratio (DR) term can range from 0.01 to 100. In order to simplify adjustment of the dynamics of the EGCP3, adjusting the integral gain value sets both the I and D terms of the PID controller. The DR term establishes the degree of effect the integral gain value has on the "D" term, and changes the configuration of a controller from input rate sensitive (input dominant) to feedback rate sensitive (feedback dominant) and vice versa.

Another possible use of the DR adjustment is to reconfigure the controller from a PID to a PI controller. This is done by adjusting the DR term to its upper or lower limits, depending on whether an input or feedback dominant controller is desired.

- A DR setting of 1 to 100 selects feedback dominant mode.
- A DR setting of .01 to 1 selects input dominant mode.
- A DR setting of .01 or 100 selects a PI only controller, input and feedback dominant respectively.

The change from one of these configurations to the other may have no effect during normal operation, however, it can cause great differences in response when the governor is coming into control. (i.e. at startup, during a full load change, or during transfer of control from another channel).

An input dominant controller is more sensitive to the change-of-rate of its input (i.e. Speed, Cascade in or Auxiliary in), and can therefore prevent overshoot of the setpoint better than a feedback dominant controller. Although this response is desirable during a startup or full load rejections, it can cause excessive control motions in some systems where a smooth transition response is desired.
A controller configured as feedback dominant is more sensitive to the change-of- rate of its feedback (LSS). A feedback dominant controller has the ability to limit the rate of change of the LSS bus when a controller is near its setpoint but is not yet in control. This limiting of the LSS bus allows a feedback dominant controller to make smoother control transitions than an input dominant controller.

## General Guidelines Field Tuning

The quality of regulation obtained from an automatic control system depends upon the adjustments that are made to the various controller modes. Best results are obtained when the adjustment (tuning) is done systematically. Prior training and experience in controller tuning are desirable for effective application of this procedure.

This procedure will lead to controller settings which will provide:

- Process control without sustained cycling.
- Process recovery in a minimum time.

Controller settings derived for given operating conditions are valid over a narrow range of load change. The settings made for one operating set of conditions may result in excessive cycling or highly damped response at some other operating condition. This procedure should be applied under the most difficult operating conditions to assure conservative settings over the normal operating range.

It is good practice to keep the average of the setpoint changes near the normal setpoint of the process to avoid excessive departure from normal operating level.

After each setpoint change, allow sufficient time to observe the effect of the last adjustment. It is wise to wait until approximately 90% of the change has been completed.

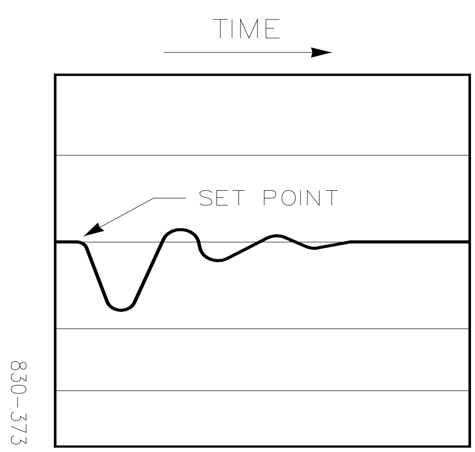



Figure 22-8. Typical Response to Load Change

## Tuning Example

If the system is unstable, make sure the governor is the cause. This can be checked by closing the valve limiter until it has control of the actuator output. If the governor is causing the oscillation, time the oscillation cycle time. A rule-of-thumb is, if the system's oscillation cycle time is less than 1 second reduce the Proportional gain term. A rule-of-thumb is, if the system's oscillation cycle time is greater the 1 second reduce the Integral gain term (proportional gain may need to be increased also).

On an initial startup with the EGCP3, all PID dynamic gain terms will require adjustment to match the respective PID's response to that of its control loop. There are multiple dynamic tuning methods available that can be used with the EGCP3's PIDs to assist in determining the gain terms that provide optimum control loop response times.

The following method can be used to achieve PID gain values that are close to optimum:

1. Increase Derivative Ratio (DR) to 100 (Service Mode adjustment)
2. Reduce integral gain to 0.01 (Run Mode adjustment)
3. Increase proportional gain until system just starts to oscillate (Run Mode).
4. The optimum gain for this step is when the system just starts to oscillate and maintains a self-sustaining oscillation that does not increase or decrease in magnitude.
5. Record the control gain (Kc) and oscillation period (T) in seconds.
6. Set the dynamics as follows:

   For PI control : G=P(I/s + 1)
   Set: Proportional gain = 0.45*Kc
   Integral gain = 1.2/T
   Derivative ratio = 100
   For PID control : G=P(I/s + 1 + Ds)
   Set: Proportional gain = 0.60*Kc
   Integral gain = 2/T
   Deriv ratio = 8/(T*Integral Gain) for fdbk dominant
   = (T*Integral Gain)/8 for input dominant
7. This method of tuning will get the gain settings close, they can be fine-tuned from this point.

# Chapter 23.
# LON (Local Network) Description

## Introduction

This section describes the messaging between LS and MC units over the Echelon Network (LON). The LON will allow multiple units to synchronize, share load, control processes and sequence the starting and stopping of units. The LON is a software and hardware configuration. See also the chapter on Unit Sequencing.

## Functional Description

The EGCP-3 LON is capable of working with multiple bus segments all connected on the same LON link. In the EGCP-3 implementation, the LON segments are always joined and the messaging indicates which genset is in which segment and which tie breakers are closed. Up to four separate buses are supported. The four buses may be isolated buses, mains feeds, or a combination of the two. Although many networks can be created, the below diagram is a single representation used to facilitate explanation. A network may contain up to 16 nodes (masters and slaves together) and up to 4 bus segments. In the below diagram, the bus segments are identified with a capital letter A-D. The gensets (LS units) are identified with a number 1-8 which would also represent the node number on LON for this example. The bus segment tie breakers are identified with a letter w-z simply to set them apart from the gensets.

The LON block has inputs from the application that inform it as to which segment it resides on and which other segments are currently tied to the same segment by closed tie-breakers. The application determines the active bus segment by observing which tie-breakers are closed.

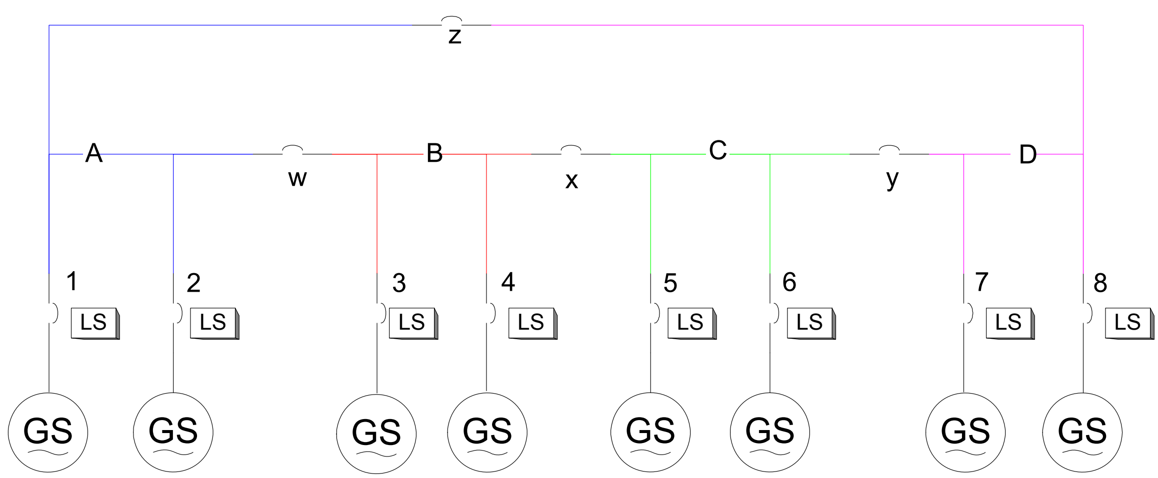



Figure 23-1. LON bus configuration

If the system also has mains connections, it may be modified as below. The masters (MC units) on the LON still have a node number within the range of 1–16.

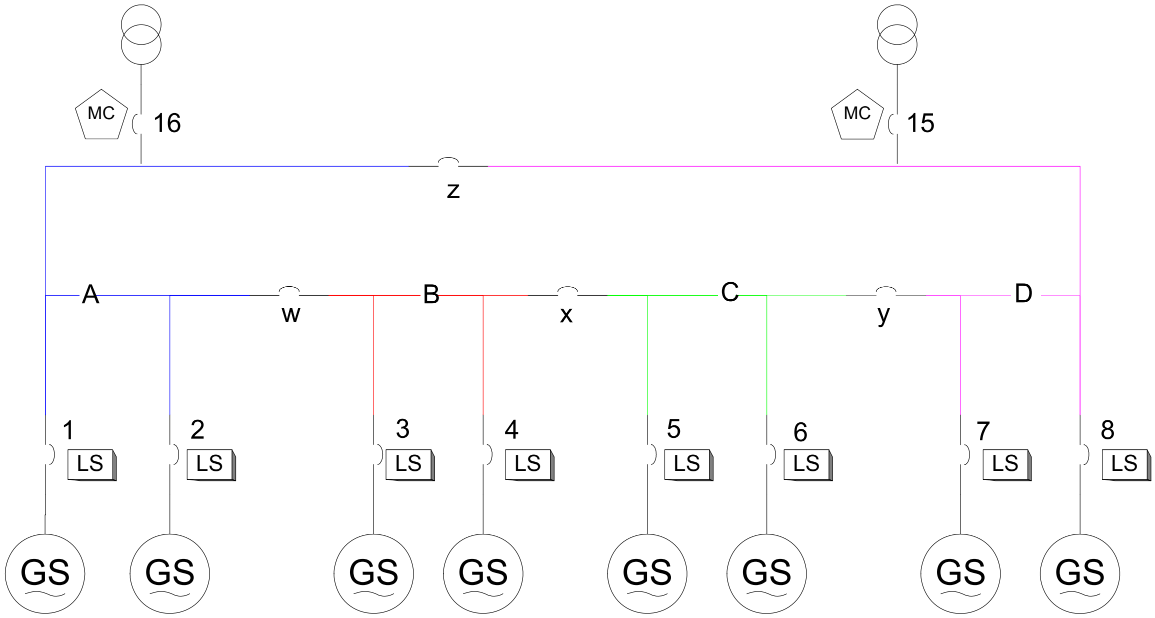



Figure 23-2. LON bus configuration, with Mains Tie(s)

## Dead Bus Closing

Using the bus segment information and tie-breaker status to define the active bus segment, the LON block will perform dead bus arbitration with all other nodes that identify themselves on LON as participating in that active bus segment.

The algorithm uses a special LON message where each node that sees a dead bus and wishes to close to that bus requests permission to close. The information detailing the genset status is provided by the application, engine running, generator stable, voltage ok, etc. Once a single node has been granted permission to close it will attempt to close by signaling the application that it is OK to close. If the application is not able to close, the node will release the token to allow another node to close. Once released, the node falls to the end of the priority line because priority is determined first by the number of attempts to close and then by the node number with smaller node numbers having a higher priority.

This function is performed between slaves (LS controls) on the active bus segment only. Any master (MC Control) that also participates in the active bus segment must also grant permission to close. The active bus segment depends on what tie breakers are closed. The active bus is at least the single segment on which the controls reside but may be more than one segment if tie breakers are closed to other segments. All controls designated as on a common segment must declare the segment to be a Dead Bus before any control will be allowed to close it’s breaker.

## Real Load Sharing

This function is performed between LS controls on the same active bus segment only. The LON block will determine which nodes are part of the active bus segment and perform all calculations necessary to provide the application with the average load value. The application is responsible for using the average load information and its actual load to bias the speed output thus changing the power output.

The LON block will be informed, via the application, if it is to participate in the load sharing. There are times when the application will wish the LON block not to participate in load sharing so that it may BaseLoad. There are also times when a master may indicate that it is in control of the slave node. In this case, the LON block is to inform the application that it is now under the control of a master. The LON will pass the master's requested load to the application for use in biasing the speed output.

A Speed Trim feature is activated with the Load Sharing mode. The error between generator frequency and system configured frequency will be added to the speed bias. The application is responsible for performing the speed trim and does not need the assistance of the LON block.

## Power Factor sharing

This function is performed between slaves on the same active bus segment only. The LON block will determine which nodes are part of the active bus segment and perform all calculations necessary to provide the application with the average PF value. The application is responsible for using the average PF information and its actual PF to bias the voltage output thus changing the power factor.

A Voltage Trim feature is also included with Power Factor sharing. The feature may be disabled through configuration. The application is responsible for performing the voltage trim and does not need the assistance of the LON block.

The LON block will be informed, via the application, if it is to participate in the PF sharing. There are times when the application will wish the LON block not to participate in PF sharing so that it may use another method (like BaseLoad mode or when the mains are connected). There are also times when a master may indicate that it is in control of the slave node. In this case, the LON block is to inform the application that it is now under the control of a master. It will pass the master's requested PF to the application for use in biasing the voltage output.

The Power Factor sharing function cannot be configured as the VAR/PF selection in the Reactive Load Control function, VAR is not a configurable parameter for this function.

## Bus to Bus Synchronizing

When the application indicates it is necessary, a Sync Master will send (via the LON) the synchronizing message to the Sync Slaves. The sync slaves will pass the data to the application upon receipt if it applies to that slave as determined using the Bus Segment indication. The application is responsible for using the sync bias information to bias the speed of the unit. This feature will work between bus segments and between the active segment and the mains.

In all cases, the application will use the block output of how many gensets are active on the segment as a gain scalar. This allows the synchronizing gain to be scaled by the number of units participating. The base gain should be configured for a single unit.

In the LS, the unit itself does not perform bus-to-bus synchronization but rather it relies on raise/lower commands from an external control – typically a SPM-D.

## Master Load / Process / PF Control

This function is performed between a master and its slaves on the same active bus segment only. The master tells the LON block what load level and PF level it is requesting and asserts the Master and Breaker closed flags to the block to indicate that it wishes to control the slaves. The slave LON block will simply report the percent load and PF values requested to the application for use as speed and voltage bias. It also asserts the slave flag to indicate a master is controlling it. The application is responsible for using the requested information to bias the speed and voltage outputs thus changing the power output.

The GAP application will respond to the block "slave" output as an overriding command to become a slave regardless of the other GAP inputs. This will allow someone to apply switch inputs consistent with providing 2 masters but only one will be in control (highest node # for a MC, and lowest # for an LS master). The result of the feature is a backup master.

## Networked Start/Stop

The EGCP-3 LS can determine when there is a need to start and stop gensets on a bus. It communicates this over the LON network, The decision to start/stop units will be due to generator load, buss failure (trip tie function), mains failure, MC time scheduled start, MC demand start, or manual request from MC.

## MC All Start / Stop

This function is performed between a MC and the LS units on the same active bus segment. The MC tells all LS units to start or stop. The slaves respond directly without performing arbitration. In the EGCP-3, the ATS and test start modes are the only usage for this requirement and will start/stop ALL units on the active bus. They don't necessarily parallel but they will start. As an ATS start, the gensets are all told to start, parallel, and be ready to assume load.

## MC Single Start / Stop

The difference between this method and the slaves deciding on their own to start/stop is that the master control decides WHEN to start/stop a genset based on mains demand. The MC does not decide WHICH unit to start/stop. The "which" is still controlled by the LS units using the run time manager. The MC simply requests the sequencing algorithm to initiate the start or stop of an LS unit without the need for the MC to implement the same sequencing functionality.

## LS Single Start / Stop

See Chapter 9, Engine Start Sequencing.

## Compatibility

There is a software configurable parameter to allow the EGCP-3 to use LON messaging and application consistent with the DSLC and MSLC products. This mode will be used when a DSLC and/or MSLC are present on the same LON network with one or more EGCP-3 controls. Using this mode will render some features of the EGCP-3 disabled. The Dead bus, load sharing, Pf sharing, and synchronizing function are limited in the DSLC/MSLC operation because the DSLC LON does not support multiple bus segment layouts.

# Chapter 24. Acronyms

| Abbreviation | Definition |
|---|---|
| A/D | Analog to Digital Converter |
| AI | Analog Input |
| AO | Analog Output |
| Atlas | Woodward turbine control platform |
| AVR | Automatic Voltage Regulator |
| CAN | Controller Area Network |
| Coder | The Code generator, used to convert GAP output files into executable code. |
| Control | EGCP-3 Control System |
| CPU | Central Processing Unit. |
| DG | Distributed Generation (Connected to mains and operated by utility) |
| DI | Discrete Input (Contact Input) |
| DO | Discrete Output (Relay Driver Output) |
| DR | Distributed Resource EGCP-3 (May be connected to mains) |
| DSLC | Digital Synchronizer and Load Controller |
| DSP | Digital Signal Processing |
| EGCP | Engine Generator Control Panel |
| EPS | Emergency Power System |
| EU | Engineering Unit (psi, KW, ºC, etc.) |
| FFT | Fast Fourier Transform |
| FW | Firmware (embedded software) |
| GAP | Graphical Applications Programmer used to create application programs. |
| HW | Hardware |
| I/O | Input/Output, typically the interface to field devices such as switches, transducers, meters, controls, or actuators. |
| Interrupt Latency | The time delay from when an interrupt is generated in hardware until the processor has started the user interrupt service code. |
| ISLU | Isochronous Load Sharing Unit |
| LON | Echelon Network (Load Sharing, Sequence Communication |
| LS | Load Sharing EGCP-3 (Multiple Unit parallel) |
| MC | Master Control EGCP-3 (Sequence and monitoring) |
| MOP | Motor Operated Potentiometer |
| MSLC | Master Synchronizer and Load Controller |
| PI | Proportional, Integral controller |
| PID | Proportional, Integral, Derivative controller |
| Rate Group | Recursion rate assigned to each GAP Block. |
| RTD | Resistive Temperature Device. |
| SPM-D | Woodward Digital Synchronizer |
| SUMP | Single Unit Mains Parallel |
| SW | Software |
| TC | Thermocouple |
| THD | Total Harmonic Distortion |

# Chapter 25.
# Application Download

The following will guide the user through the boot up and application-loading procedure used for the EGCP-3.

1. Apply power to the EGCP-3. At this point the control will begin to boot and perform diagnostic tests on the hardware. NOTE: This will take slightly less than 1 minute to complete. The status of the diagnostics can be monitored on the front panel displays.
2. After the one minute of diagnostics the EGCP-3 will wait for a ServLink connection on any serial port configured for ServLink. By default, port 3 will always be a ServLink port. Port 1 is configurable for ServLink also. For 10 seconds the serial ports will be scanned at baud rates of 57,600 and 115,200. If after the 10 seconds a ServLink connection has not been established, the currently loaded application will run. If the 10 seconds has expired and a ServLink connection has not been established, but there isn't an application currently loaded, the EGCP-3 will continue to scan the ports waiting for a ServLink connection.
3. When the ServLink connection has been made, use Watch Window Professional to load the desired .SCP file, created by the Woodward Coder program, into the control. After the application file is loaded, the application will begin to run automatically.

It is also possible to load a new application via an existing ServLink connection without re-booting the EGCP-3.

1. Run current application.
2. Connect ServLink to an existing ServLink port.
3. Open Watch Window Professional and load the .SCP file for your new application. The engine must be stopped and IO Lock set in order to load the application.
4. When the load is complete the new application will run automatically.

# Chapter 26.
# Service Options

## Product Service Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

**OEM and Packager Support:** Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

**Woodward Business Partner Support:** Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/support**.

# Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

**Replacement/Exchange:** Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

**Flat Rate Repair:** Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

**Flat Rate Remanufacture:** Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in "like-new" condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

# Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

## Packing a Control

Use the following materials when returning a complete control:
- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

**CAUTION—ELECTROSTATIC DISCHARGE**

**To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.**

# Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

## Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

**Technical Support** is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

**Product Training** is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

**Field Service** engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website and reference **www.woodward.com/support**, and then ***Customer Support***.

## How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

| Electrical Power Systems | | Engine Systems | | Turbine Systems | |
|---|---|---|---|---|---|
| **Facility** | **Phone Number** | **Facility** | **Phone Number** | **Facility** | **Phone Number** |
| Australia | +61 (2) 9758 2322 | Australia | +61 (2) 9758 2322 | Australia | +61 (2) 9758 2322 |
| Brazil | +55 (19) 3708 4800 | Brazil | +55 (19) 3708 4800 | Brazil | +55 (19) 3708 4800 |
| China | +86 (512) 6762 6727 | China | +86 (512) 6762 6727 | China | +86 (512) 6762 6727 |
| Germany: | | Germany: | | | |
| Kempen | +49 (0) 21 52 14 51 | | | | |
| Stuttgart | +49 (711) 78954-0 | Stuttgart | +49 (711) 78954-0 | | |
| India | +91 (129) 4097100 | India | +91 (129) 4097100 | India | +91 (129) 4097100 |
| Japan | +81 (43) 213-2191 | Japan | +81 (43) 213-2191 | Japan | +81 (43) 213-2191 |
| Korea | +82 (51) 636-7080 | Korea | +82 (51) 636-7080 | Korea | +82 (51) 636-7080 |
| | | The Netherlands | +31 (23) 5661111 | The Netherlands | +31 (23) 5661111 |
| Poland | +48 12 618 92 00 | | | | |
| United States | +1 (970) 482-5811 | United States | +1 (970) 482-5811 | United States | +1 (970) 482-5811 |

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (**www.woodward.com/support**) for the name of your nearest Woodward distributor or service facility.

For the most current product support and contact information, please refer to the latest version of publication **51337** at **www.woodward.com/publications**.

# Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

## General

Your Name________________________________________
Site Location________________________________________
Phone Number________________________________________
Fax Number________________________________________

## Prime Mover Information

Engine/Turbine Model Number______________________________
Manufacturer________________________________________
Number of Cylinders (if applicable)______________________________
Type of Fuel (gas, gaseous, steam, etc)______________________________
Rating________________________________________
Application________________________________________

## Control/Governor Information

Please list all Woodward governors, actuators, and electronic controls in your system:

Woodward Part Number and Revision Letter
________________________________________
Control Description or Governor Type
________________________________________
Serial Number ________________________________________

Woodward Part Number and Revision Letter
________________________________________
Control Description or Governor Type
________________________________________
Serial Number ________________________________________

Woodward Part Number and Revision Letter
________________________________________
Control Description or Governor Type
________________________________________
Serial Number ________________________________________

*If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.*

# EGCP-3 LS Control Specifications

Please refer to the EGCP-3 Installation Manual 26122 for all control specifications.

**We appreciate your comments about the content of our publications.**

**Send comments to: icinfo@woodward.com**

**Please include the manual number from the front cover of this publication.**

WOODWARD

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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**Complete address / phone / fax / email information for all locations is available on our website.**

2008/9/Fort Collins