WOODWARD

Product Manual 26086
(Revision E)
Original Instructions

EGCP-2
Engine Generator Control Package

8406-115, 150–300 Vac PT Input, 9–32 Vdc
8406-116, 50–150 Vac PT Input, 9–32 Vdc

Operation (End User) Manual

General Precautions

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.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

www.woodward.com/publications

The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

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.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

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Illustrations

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Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

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

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

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.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

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.**

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*.

Follow these precautions when working with or near the control.

1. 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.
2. 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.

Regulatory Compliance

European Compliance for CE Mark:

EMC Directive	Declared to 89/336/EEC COUNCIL DIRECTIVE of 03 May 1989 on the approximation of the laws of the member states relating to electromagnetic compatibility.
Low Voltage Directive	Declared to the 73/23/EEC COUNCIL DIRECTIVE of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.

North American Compliance:

UL	UL Listed for Ordinary Locations at 70°C maximum Ambient. For use in the United States and Canada. UL File E97763
CSA	CSA Certified for Ordinary Locations at 70°C maximum Ambient. For use in the United States and Canada. Certificate 1159277
NOTE	Wiring must be in accordance with applicable electric codes with the authority having jurisdiction.

- The EGCP-2 is suitable for use in non-hazardous locations only.
- Wiring must be in accordance with applicable electrical codes and in accordance with the authority having jurisdiction.
- Field wiring must be suitable for at least 90 °C (194 °F).
- Connect ground terminal to PE (Protective Earth).
- More than one live circuit (see wiring diagram)

Chapter 1.
General Information

Introduction

This manual describes the Woodward EGCP-2 Engine Generator Control Package models 8406-115 and 8406-116 (9–32 Vdc maximum input voltage range).

Control Electrical Ratings

nominal supply voltage range	10–29 Vdc (12 or 14 volt systems)
max. power consumption at rated voltage	20 W
max. PT input voltage range	150–300 Vac rms (8406-115) 50–150 Vac rms (8406-116)
max. CT current input range	0–6 A rms
max. generator frequency range	40–70 Hz

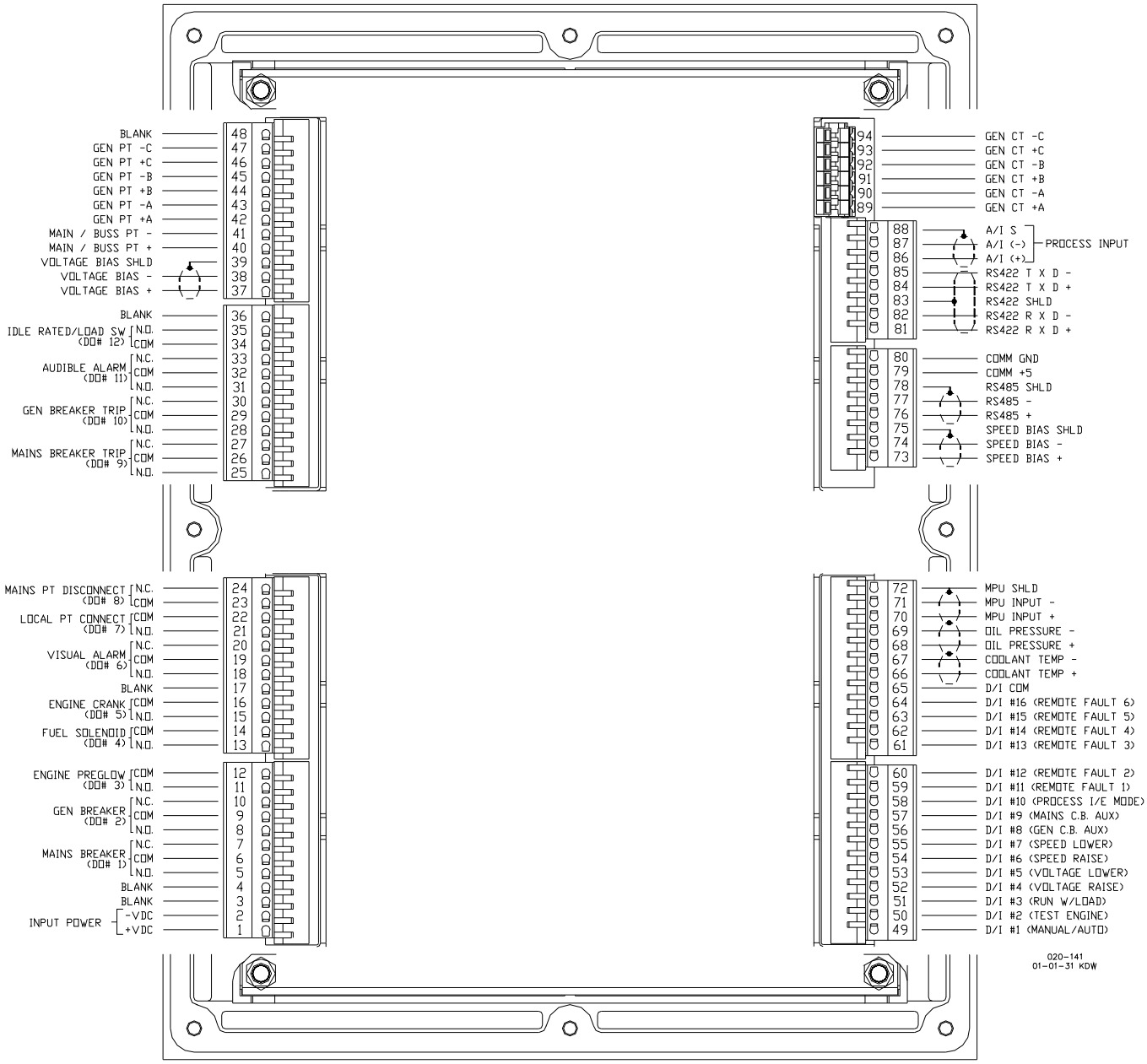


Figure 1-1. EGCP-2 Wiring Diagram

Chapter 2.
Control Overview

Introduction

The EGCP-2 is a microprocessor based complete generator load control and engine management package designed for use with an Electronic engine speed control and a separate voltage regulator. The control's functions include:

Engine Control
- Engine Pre-glow
- Fuel Solenoid Control
- Engine Starter Control
- KVA Controlled Cool-down Timer
- Oil Pressure Monitoring
- Water Temperature Monitoring
- Battery Voltage Monitoring
- Speed Monitoring with Overspeed Protection
- Idle/Rated Relay Output

Synchronizing
- Digital signal processing to eliminate problems induced in systems with high harmonic content causing multiple zero crossing of voltage wave forms
- Adjustable maximum phase window, voltage window, and dwell times—windows as small as 2° phase error and 1% voltage matching respectively
- Safe dead bus closing logic internal to the control
- Multiple shot re-closing with adjustable time delays, auto-resynchronizing, and synchronizer time-outs all available
- Manual voltage and speed adjusts for manual synchronizing (Sync-Check still active during manual parallels)
- Synchronization across generator and mains breakers

Real (kW) Load Control
- True RMS power calculations for rapid, accurate load control even in the presence of harmonics
- Smooth user chosen ramp rates into and out of each mode of operation
- Isochronous load-sharing of up to 8 units based on percentage loading (allows different rated machines to proportionally balance kW loads)
- Constant base loading for optimum fuel efficiency with discrete inputs to change load levels remotely
- Import/Export control with an external watt transducer
- Soft Utility Transfer Function
- Externally adjustable Base Load or Process Reference Levels with independent ramp rates
- kW droop provided for manual load control

Reactive (KVAR) Control

- VAR sharing on isolated busses based on percentage reactive load (allows different rated machines to proportionally balance KVAR loads)
- Constant Power factor or VAR base loading on units which are in kW base load control mode, or process control mode
- Externally adjustable VAR or PF control reference levels
- KVAR droop for manual VAR control

Automatic Generator Sequencing

- Automatically starts additional EGCP-2 equipped generators when load exceeds a user specified percentage of the rated load of the operating machines
- Provides controlled unloads for engines when the load is low enough that the remaining engines will not exceed a user specified percentage of the rated load
- Engine priority sequence can be changed from any unit or from a PC to equalize run-time

Generator Protective Features

- Over/Under Voltage
- Over/Under Frequency
- Reverse Power (Inverse time delay)
- Loss of Excitation
- Overcurrent (Inverse time delay)
- Loss of mains detection
- Over/Under Voltage
- Over/Under Frequency
- Generator Load Surge
- Speed/Frequency Mismatch
- Load Surge
- KVA Load Switch

Engine Protective Features

- High/Low Coolant Temperature
- High/Low Oil Pressure
- Overspeed
- Over Crank
- Start Failure
- Six User Configurable Discrete Fault Inputs

Communication - PC Interface

- Easy upload and download of configuration setpoints
- A PC can control or monitor any unit at a site by a single connection to the local operating network via RS-422 serial port using Modbus® * or ServLink protocol

*—Modbus is a registered trademark of Schneider Automation Inc.

Operator Interface

The EGCP-2 Operator Interface is designed for simplicity and redundancy of function in all operating modes. The backlit LCD screens are used to display various operating and status information to the operator, as well as for reading configuration setpoints and alarm information. The backlight on the LCD screen will stay on whenever the engine's speed is over 50 RPM. When the engine shuts down, the backlight will turn off after five minutes. Pressing any key on the front panel will first turn on the backlight and pressing the key a second time will perform that function. The backlight will turn off after five minutes of non-use and the engine is shut down.

IMPORTANT

The EGCP-2 Operator Interface can only be used for unit configuration and monitoring. Unit start/stop, sync, or mode selection commands can not be given through the EGCP-2's front panel.

WARNING

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

The screens provide eight lines of Status Information, with the option of displaying four lines of Setpoint tuning or Alarm Log information. These screens allow the user to monitor and tune related parameters at the same time.

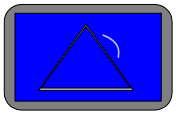
Figure 2-1. Operator Interface

A red Light Emitting Diode (LED) on the face of the control is used to indicate an alarm condition by flashing repeatedly, and to indicate a shutdown condition by staying on continuously.

There are a total of 19 keys on the keypad. Each of the keys has the following function(s):

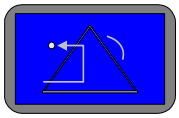
ALARM/EVENT LOG KEYS:

ALARM / EVENT



The ALARM/EVENT key is used to access the Event log. When pressed, the current alarm events will be displayed on the right hand LCD screen. When multiple alarms are logged, the up and down scroll keys will allow you to navigate within the Event log. The Event log will store up to 16 events, as more events happen the oldest alarms will be dropped off to make room for the newer events. If power is cycled to the control, the Event log will be cleared.

ALARM CLEAR



The ALARM CLEAR key is used to acknowledge and clear alarm events from the Event log. To acknowledge and clear alarm and shutdown events a Security Code of Operator Level or higher is needed. After selecting the ALARM/EVENT key:

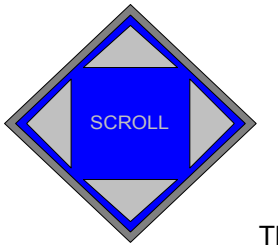
If the Alarm mode is Visual or Warning –

1. Pressing the ALARM CLEAR key will acknowledge the selected alarm, this means the cursor will move from the Alarm Name line down to the Time and Date line.
2. Pressing the Alarm Clear key a second time will remove the event from the log.

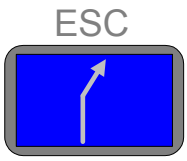
If the Alarm/Shutdown mode is Audible, Soft Shutdown, or Hard Shutdown –

1. Pressing the ALARM CLEAR key once will de-energize Discrete Output #11, Audible Alarm. This will happen without selecting the ALARM/EVENT key and without a Security Code entered.
2. With the ALARM/EVENT key pressed, so the Event log is being displayed: Pressing the ALARM CLEAR key a second time will acknowledge the selected alarm. This means the cursor will move from the Alarm Name line down to the Time and Date line.
3. Pressing the Alarm Clear key a third time will remove the event from the log.

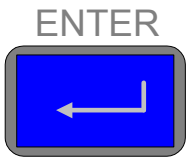
NAVIGATION and ADJUSTMENT KEYS:



The SCROLL KEY is used to move the cursor up, down , left and right. It also is used to increment and decrement values while in the configuration menus.

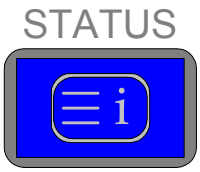


The ESCAPE KEY is used to move upwards (out of)the configuration menu levels. It also is used when tuning a value to restore the previous value, if the new value is not entered into memory (see the enter key, below).



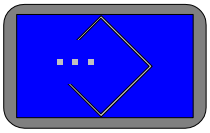
The ENTER KEY is used to move downwards (into) the configuration menu levels. It is also used to when tuning a value to enter the new value to memory. It also serves as a means to commit alarm event items to the alarm event list without removing them. This is known as logging the alarm event item. Pressing the enter key while on the selected alarm/event item will “save” that item to the event list. If the selected alarm event was an active alarm event, the action(s) associated with the alarm event will also be cleared from the control logic.

STATUS and CONFIGURATION KEYS:



The STATUS KEY, when pressed, will put both left and right LCDs into the status display mode. The status displays provide information about different items of engine and generator set operation. See the STATUS MENU buttons, below for details on the various status keys. There are no adjustment values in the status menus.

CONFIG

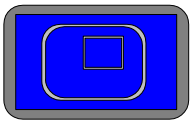


The CONFIG KEY, when pressed, will put the right hand LCD into the configuration mode. Configuration menu items will be displayed in the right hand screen. Status information will continue to be displayed in the left hand screen. Since there are various menu items and adjustments in the configuration menu, a blinking cursor is provided in the right hand display when the configure mode is active.

STATUS MENU KEYS:

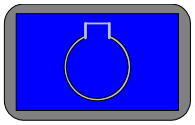
The contents of the various status menus are described in the Status Screens section in Chapter 3 of this manual.

SYSTEM



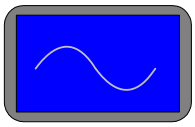
The SYSTEM STATUS key, when pressed displays the system status information. The system status display is also the default status display screen (it is always the first display shown after a power up of the control). This display shows general information about the operation of the engine generator set.

ENGINE



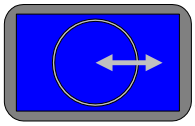
The ENGINE STATUS key , when pressed displays status information about the engine functions and operation.

GEN



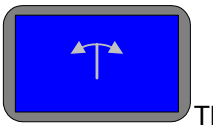
The GEN STATUS key shows three phase generator parameters when pressed.

I/O



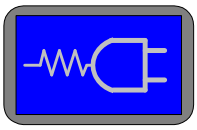
The I/O STATUS key provides the status of all the discrete inputs and outputs, as well as information on analog inputs and outputs.

SYNC



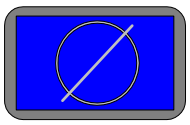
The SYNC STATUS key shows status information regarding the generator breaker and utility breaker synchronizer.

KW LOAD



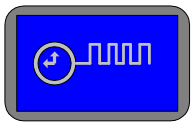
The KW LOAD STATUS key, when pressed, shows the status information for the KW load control of the EGCP-2.

PF / KVAR



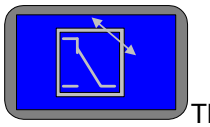
Press the PF/KVAR STATUS key to display VAR/PF Mode information, as well as three phase generator voltage and current.

SEQUENCE



The SEQUENCE STATUS key provides sequencing information for multiple unit systems. Single unit systems, and units not in the AUTO mode will not provide status information in this screen.

ATS

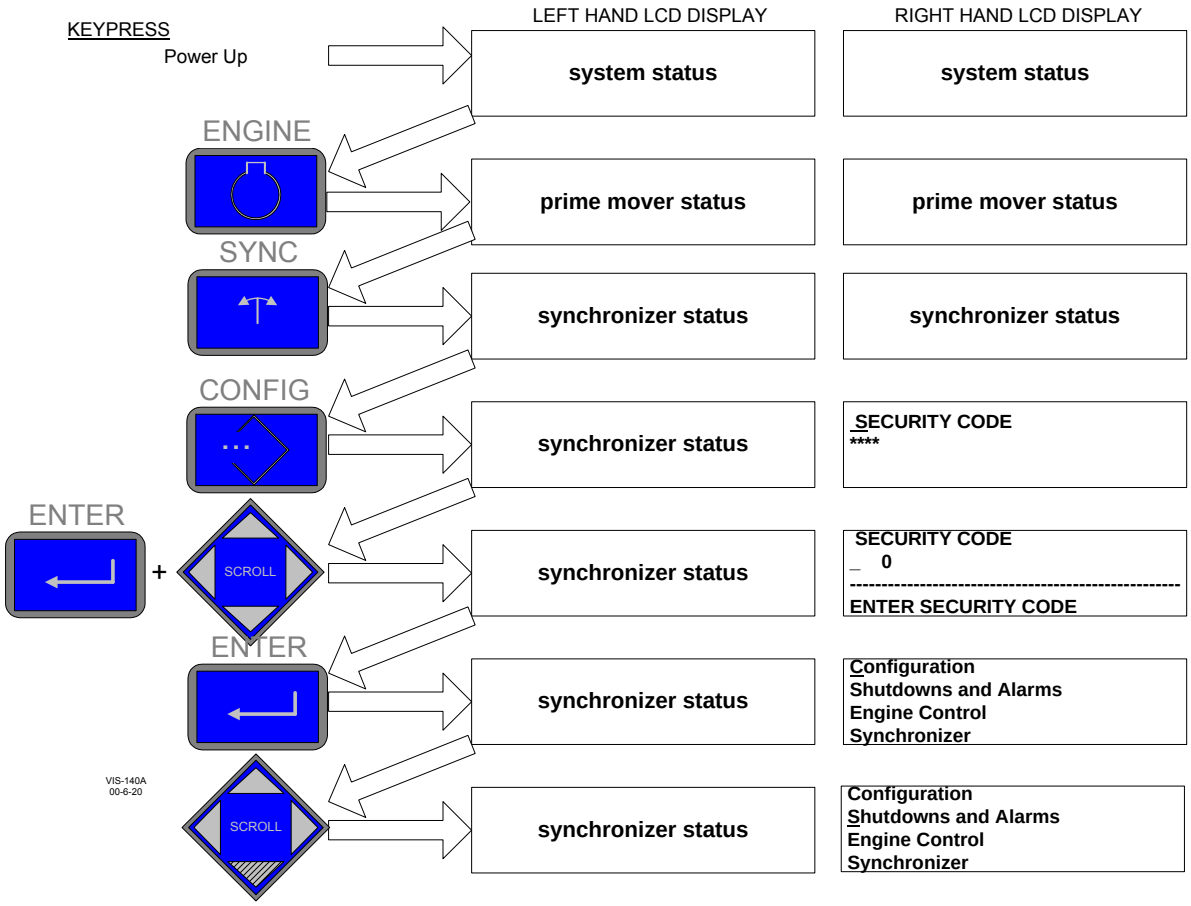


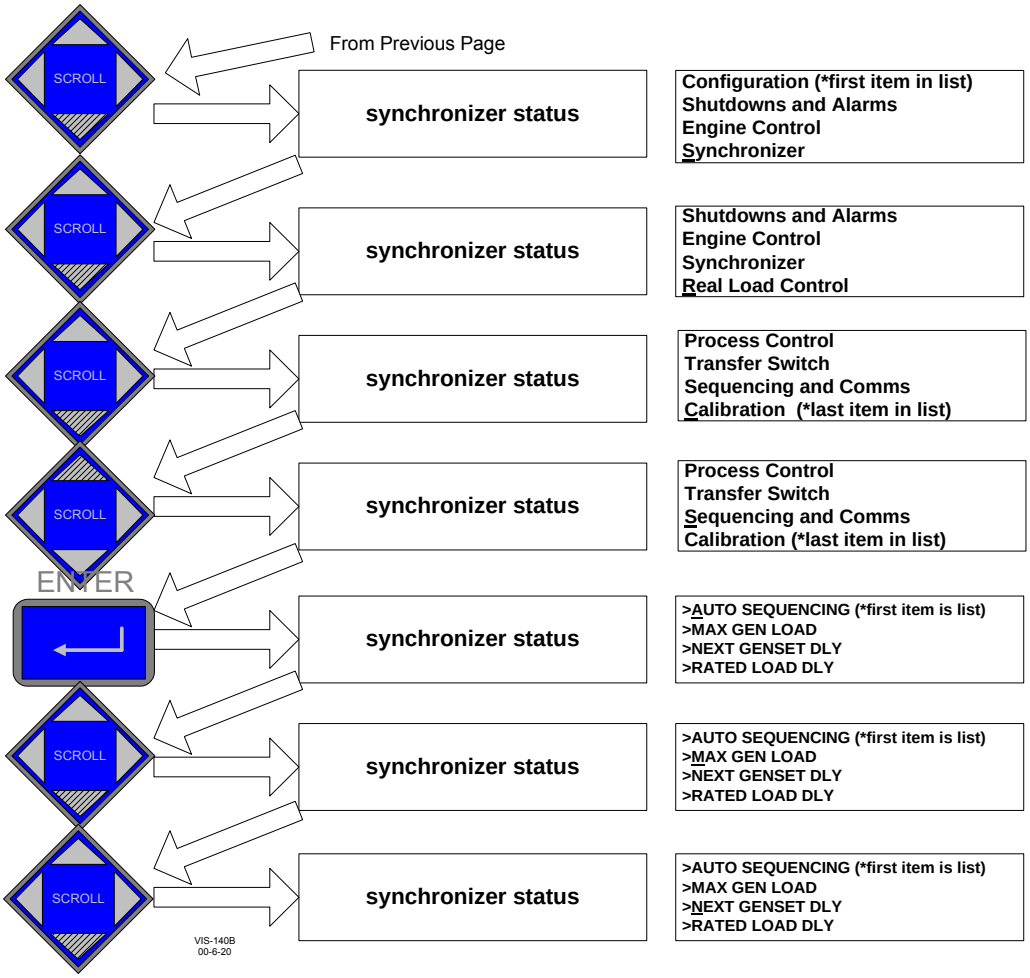
The ATS STATUS key, when pressed, displays the status information for the Automatic Transfer Switch functions.

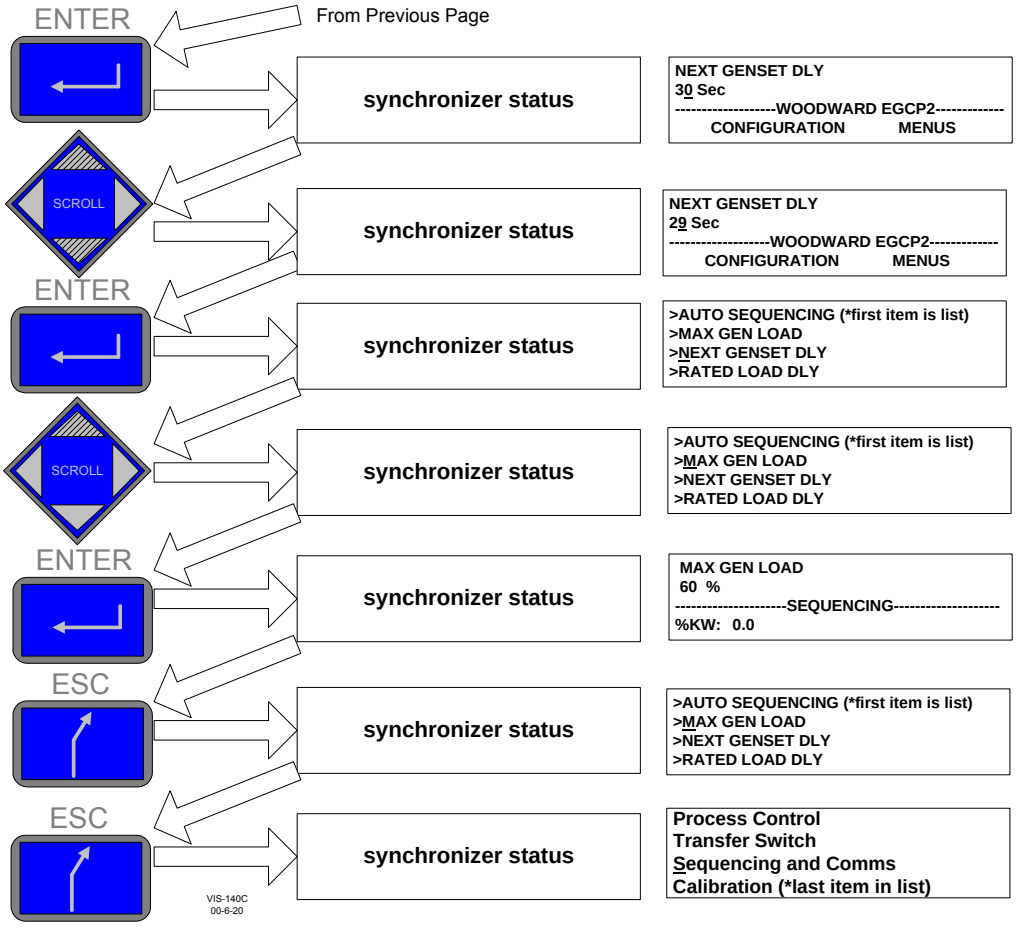
Navigation Procedure

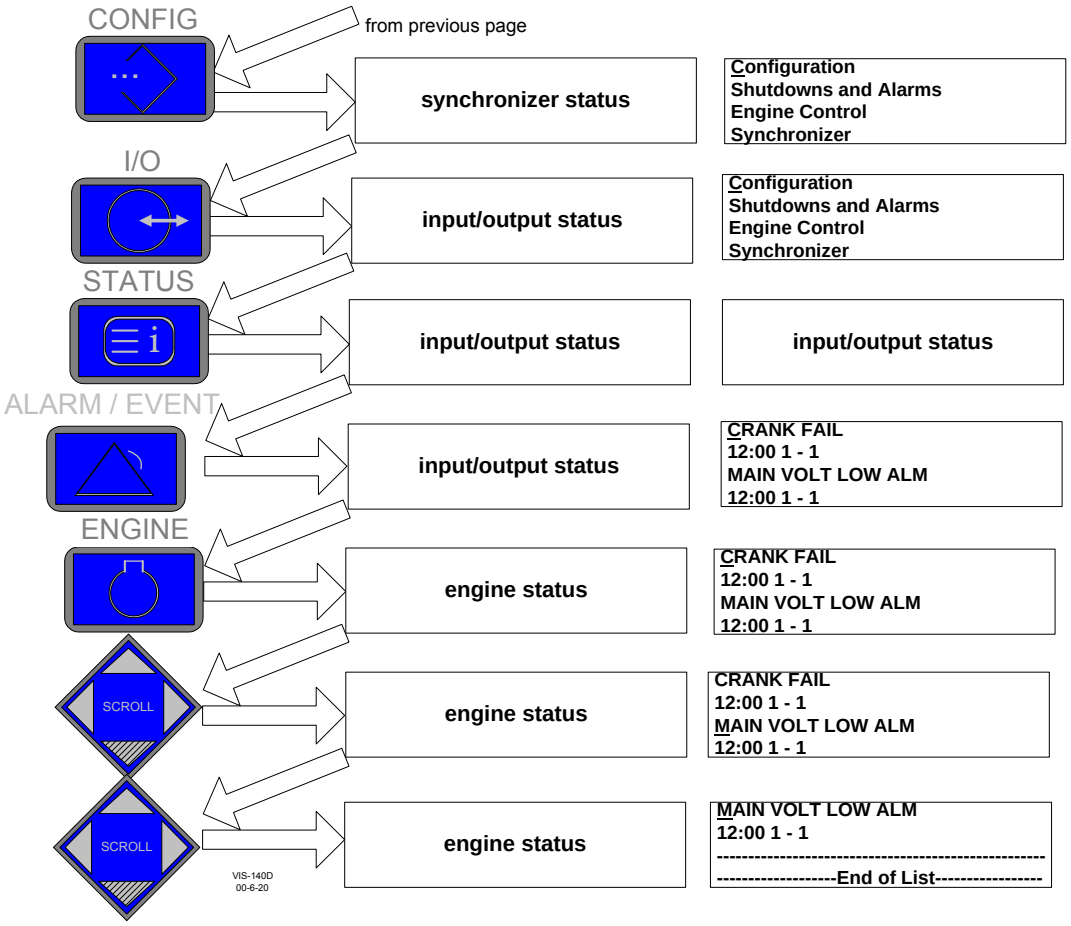
The following drawings detail a step-by-step procedure for navigating through the EGCP-2 software. Additionally, the typical display entries seen at each step are shown.

Figure 2-2. EGCP-2 Navigation
(next five pages)

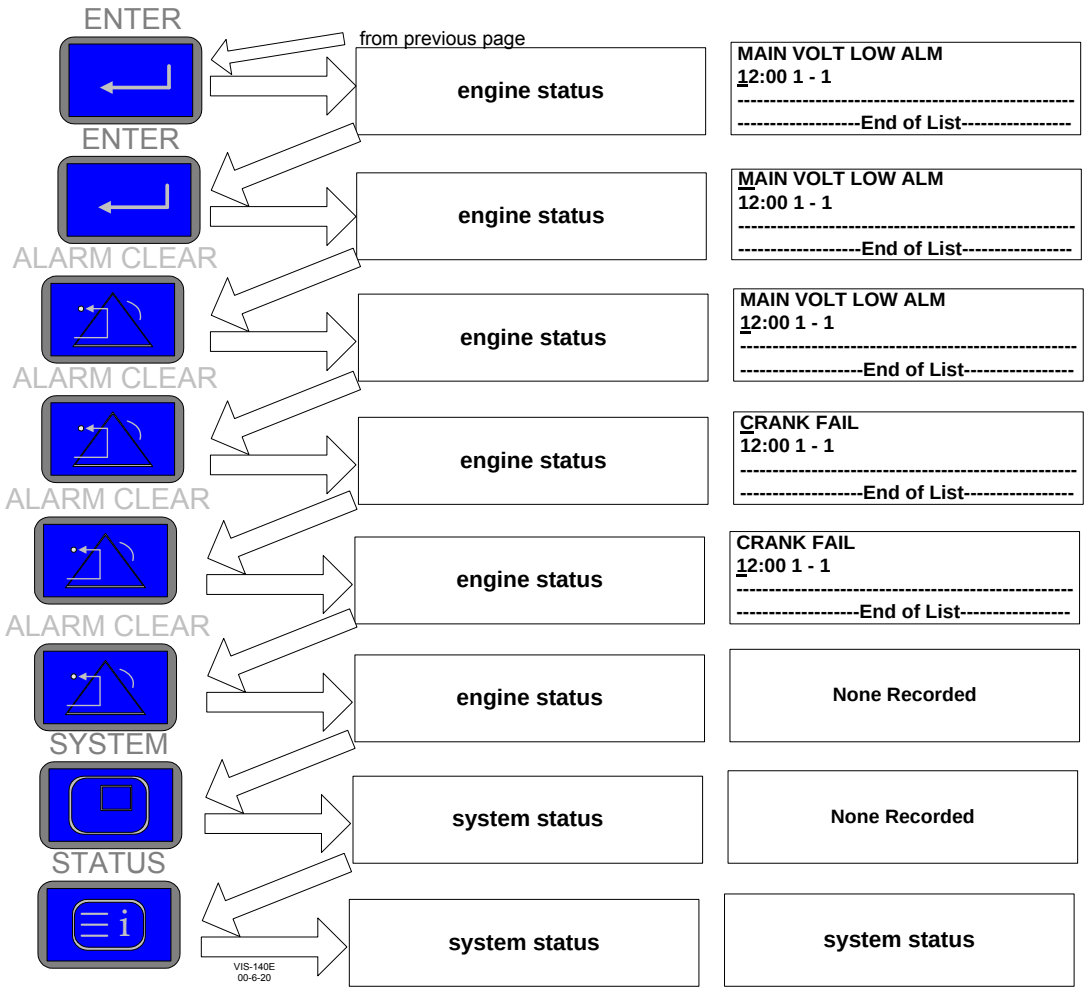



From Previous Page
SCROLL
synchronizer status
Configuration (*first item in list)
Shutdowns and Alarms
Engine Control
Synchronizer
SCROLL
synchronizer status
Shutdowns and Alarms
Engine Control
Synchronizer
Real Load Control
SCROLL
synchronizer status
Process Control
Transfer Switch
Sequencing and Comms
Calibration (*last item in list)
SCROLL
synchronizer status
Process Control
Transfer Switch
Sequencing and Comms
Calibration (*last item in list)
ENTER
synchronizer status
>AUTO SEQUENCING (*first item is list)
>MAX GEN LOAD
>NEXT GENSET DLY
>RATED LOAD DLY
SCROLL
synchronizer status
>AUTO SEQUENCING (*first item is list)
>MAX GEN LOAD
>NEXT GENSET DLY
>RATED LOAD DLY
SCROLL
synchronizer status
>AUTO SEQUENCING (*first item is list)
>MAX GEN LOAD
>NEXT GENSET DLY
>RATED LOAD DLY
VIS-140B
00-6-20


ENTER
From Previous Page
synchronizer status
NEXT GENSET DLY
30 Sec
----------WOODWARD EGCP2----------
CONFIGURATION MENUS
SCROLL
synchronizer status
NEXT GENSET DLY
29 Sec
----------WOODWARD EGCP2----------
CONFIGURATION MENUS
ENTER
synchronizer status
>AUTO SEQUENCING (*first item is list)
>MAX GEN LOAD
>NEXT GENSET DLY
>RATED LOAD DLY
SCROLL
synchronizer status
>AUTO SEQUENCING (*first item is list)
>MAX GEN LOAD
>NEXT GENSET DLY
>RATED LOAD DLY
ENTER
synchronizer status
MAX GEN LOAD
60 %
----------SEQUENCING----------
%KW: 0.0
ESC
synchronizer status
>AUTO SEQUENCING (*first item is list)
>MAX GEN LOAD
>NEXT GENSET DLY
>RATED LOAD DLY
ESC
synchronizer status
Process Control
Transfer Switch
Sequencing and Comms
Calibration (*last item in list)
VIS-140C
00-6-20


CONFIG
from previous page
synchronizer status
Configuration
Shutdowns and Alarms
Engine Control
Synchronizer
I/O
input/output status
Configuration
Shutdowns and Alarms
Engine Control
Synchronizer
STATUS
input/output status
input/output status
ALARM / EVENT
input/output status
CRANK FAIL
12:00 1 - 1
MAIN VOLT LOW ALM
12:00 1 - 1
ENGINE
engine status
CRANK FAIL
12:00 1 - 1
MAIN VOLT LOW ALM
12:00 1 - 1
SCROLL
engine status
CRANK FAIL
12:00 1 - 1
MAIN VOLT LOW ALM
12:00 1 - 1
SCROLL
engine status
MAIN VOLT LOW ALM
12:00 1 - 1

----------End of List----------
VIS-140D
00-6-20


ENTER
ENTER
ALARM CLEAR
ALARM CLEAR
ALARM CLEAR
ALARM CLEAR
SYSTEM
STATUS
VIS-140E
00-6-20
from previous page
engine status
engine status
engine status
engine status
engine status
engine status
system status
system status
MAIN VOLT LOW ALM
12:00 1 - 1
----------End of List----------
MAIN VOLT LOW ALM
12:00 1 - 1
----------End of List----------
MAIN VOLT LOW ALM
12:00 1 - 1
----------End of List----------
CRANK FAIL
12:00 1 - 1
----------End of List----------
CRANK FAIL
12:00 1 - 1
----------End of List----------
None Recorded
None Recorded
system status

Chapter 3.
Software Overview

Introduction

The software used in the EGCP-2 uses state machine logic to operate all modes. State machine logic relies upon discrete inputs, and specific operating conditions to trigger a sequence of operations. The state machine logic uses the following State Machines to operate the generator set:

- Close Mains Breaker
- Open Mains Breaker
- Start Engine
- Off
- Synchronize
- Load Control
- Close Gen Breaker
- Open Gen Breaker

Various inputs and actions determine which state machine is in operation at any given time.

Status Screens

There is a total of nine status menus in the EGCP-2. Use the status keys on the face of the EGCP-2 to access these status menus. The information in the status menus is dynamic, and updates about every 200 milliseconds.

When the EGCP-2 is initially powered up, it will default to the System Status Screen. 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.

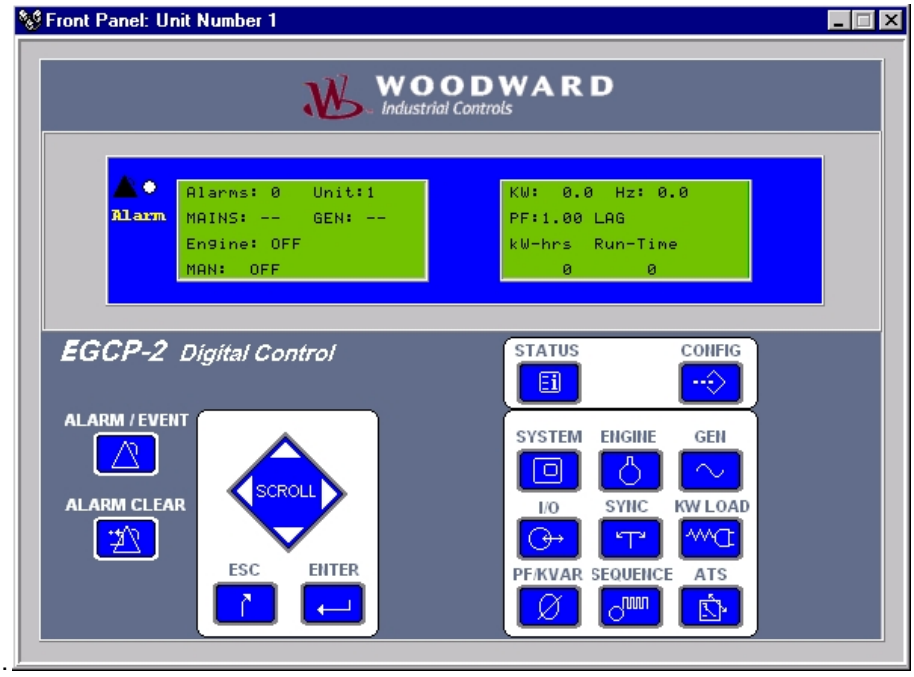


Figure 3-1. System Overview Engine Off Line

The screen displays the following information:
Alarms: Number of active alarms on the unit.
Unit #: The network address of the unit.
Mains: A graphic display of the mains condition. Two minus symbols (--) indicates the mains are out of spec, one plus symbol indicates the mains are in spec, but not declared stable (+-), two plus symbols (++) indicates the mains are in spec and stable.
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 gen is in spec, but not declared stable (+-) two plus symbols (++) indicates the generator is in spec and stable.
Engine: The operating state of the engine.

Engine Control States:

- OFF
- PREGLOW
- CRANK
- RUN
- COOLDOWN
- SPINDOWN
- RETRY

Operating State: Shows if the EGCP-2 is in AUTO or MAN(ual) mode.
Load Control State: Shows the state of the load control logic of the EGCP-2. The load control states are:

Load Control States:

- OFF
- DROOP
- ISOCHRONOUS
- BASELOAD
- PROCESS

KW: The total KW load on the generator.
Hz: The frequency, in Hertz, of the generator set.
PF: The average three phase power factor of the generator set.
KW-Hrs: The total accumulated kW hours produced by the generator set. This display automatically switches to MW-Hrs when the kW-Hour value exceeds 10 000.
Run-Time: The total accumulated run time of the generator set.

All the display information will update automatically as operating modes and conditions to the EGCP-2 change.

This is what the System Status screen would look like with the mains out of spec, the engine running, carrying 100 kW load isochronously, and the generator voltage is within specified limits. This would be a typical screen if the unit was set for loss of mains detection, and the mains had failed.

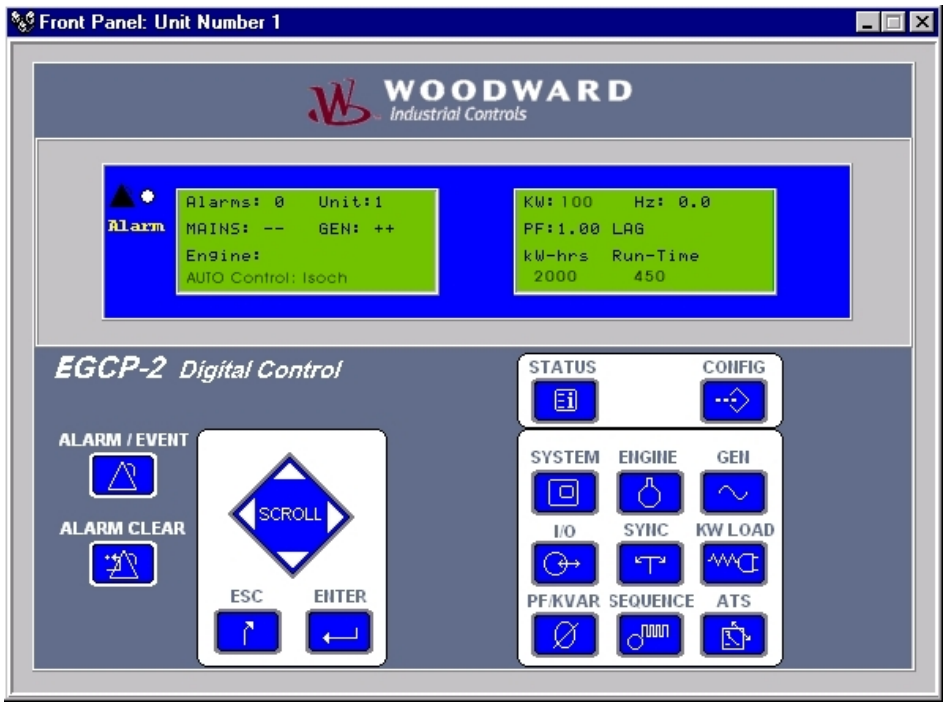


Figure 3-2. System Status Screen—Isochronous

This is what the control overview screen looks like for a generator set that is base loaded to the mains at 500 kW, .80 lagging PF, with one unacknowledged alarm.

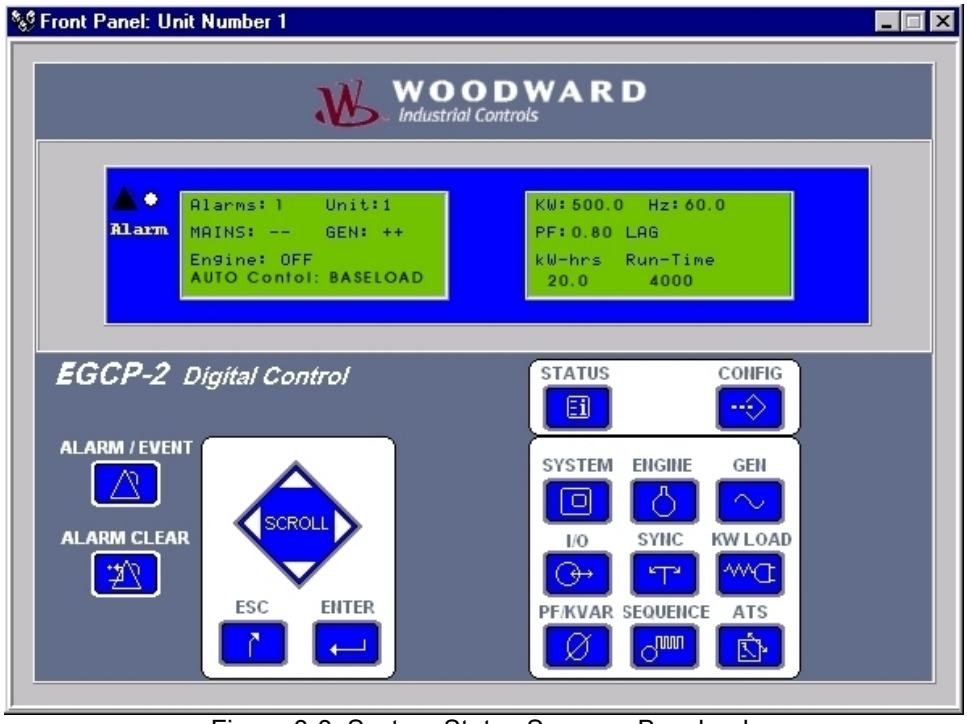


Figure 3-3. System Status Screen—Baseload

The following is an overview of each of the status menu screens, starting with engine overview:

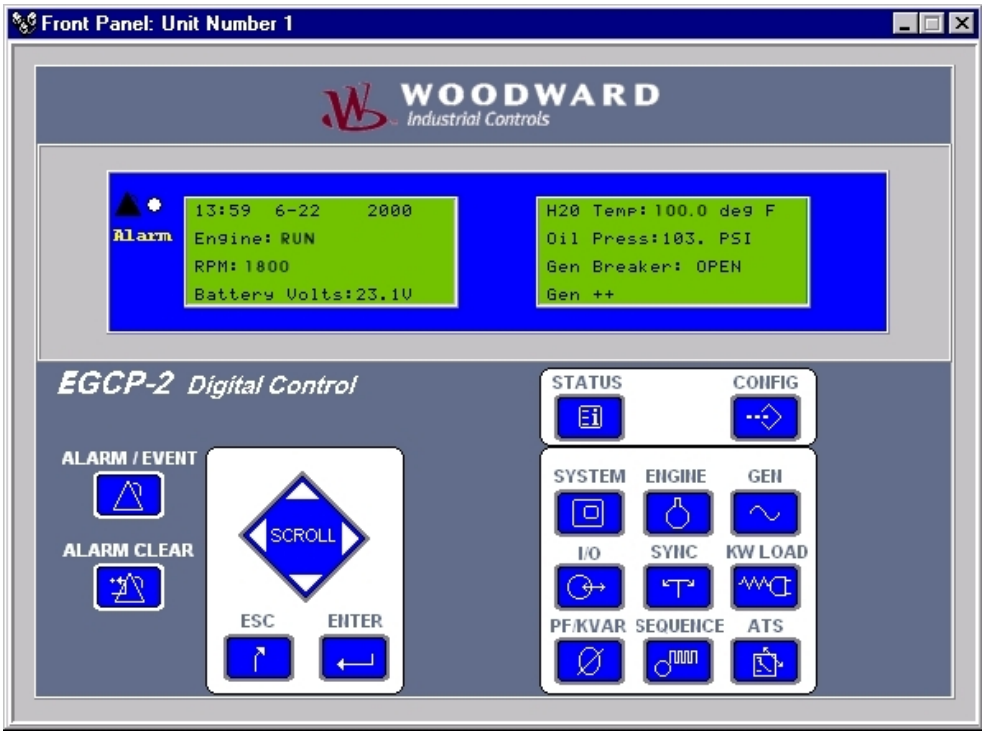


Figure 3-4. Engine Overview

HH:MM: 24 hour clock readout.
MM-DD:Date (MM-DD).
Engine: The state of the engine control function.
RPM: Engine rpm.
Battery Volts: Battery Voltage in Vdc.
H2O Temp: Water Temperature in degrees C or F, depending upon the units selected in configuration.
Oil Press: Oil Pressure in bar, or psi, depending upon the units selected in configuration.
Gen Breaker: The Status of the generator breaker as provided by the gen 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 gen is in spec, but not declared stable (+-) two plus symbols (++) indicates the generator is in spec and stable.

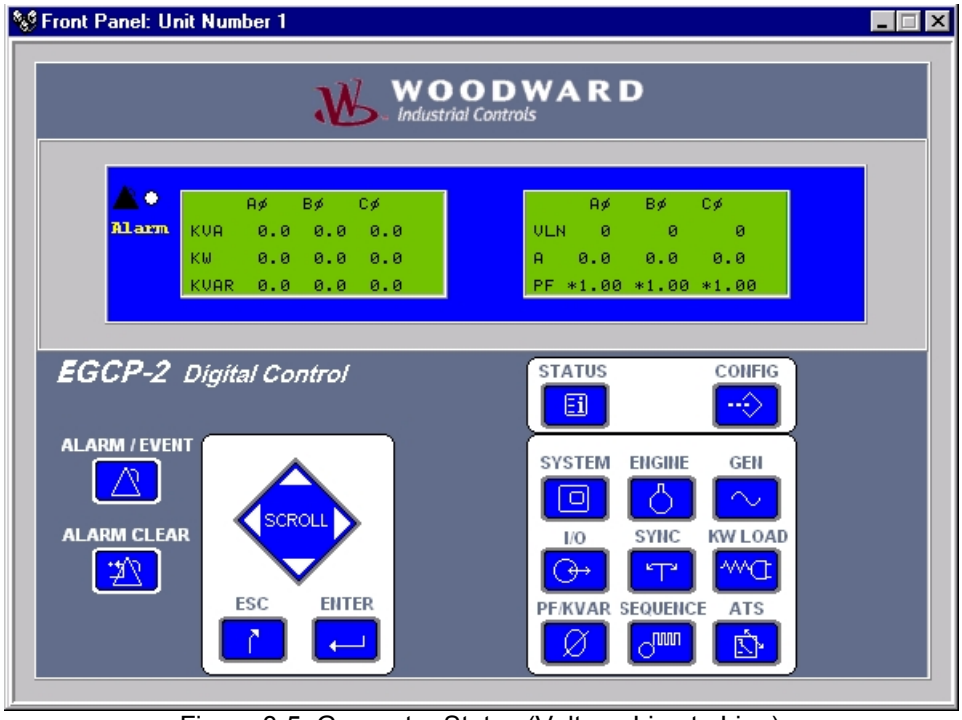


Figure 3-5. Generator Status (Voltage Line to Line)

A B C: Three phase readings for the generator.
KVA: Three phase KVA readings.
KW: Three phase KW readings.
KVR: Three phase KVAR readings.
V: Volts for each phase of the generator.
A: Amps per phase for the generator.
PF: Power Factor for each generator phase.

IMPORTANT

Generator voltage label (VLL or VLN) will automatically switch depending on the voltage input configuration setting. See the configuration menu section of this manual for more detail.

Generator voltage readings and labels will automatically switch from "V" (volts) to "KV" (kilovolts), when the voltage exceeds 9999V for that input.

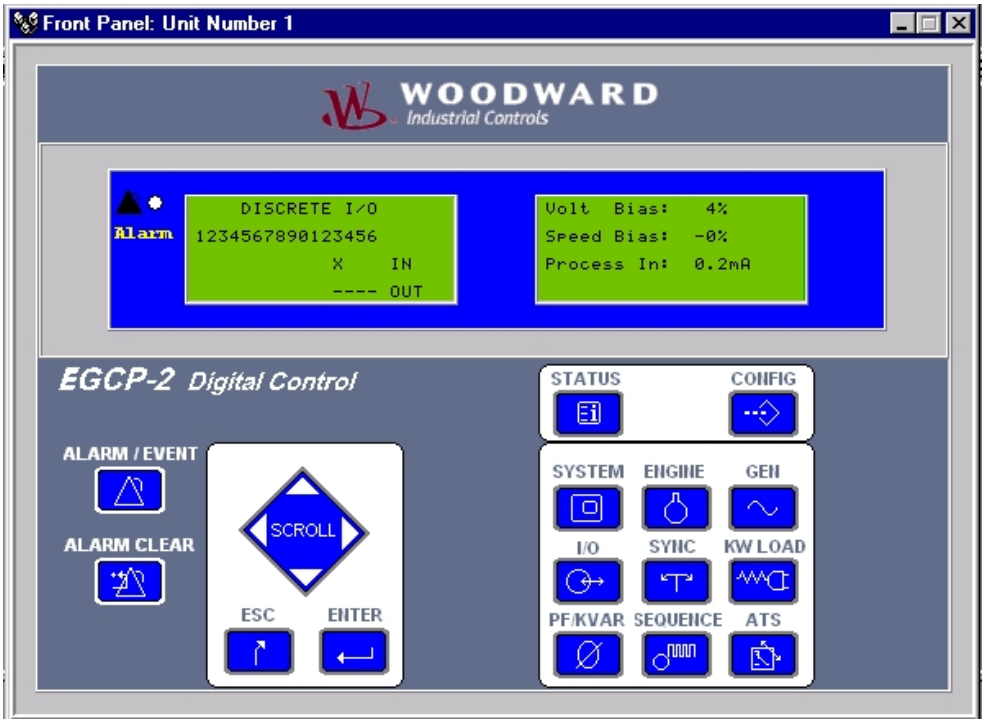


Figure 3-6. I/O Status

DI: Discrete Inputs 1 through 16.
DO: Discrete Outputs 1 through 12.
Volt Bias: % voltage bias output (±100% range).
Speed Bias: % speed bias output (±100% range).
Process In: Process Input in milliamps (mA).

Discrete Inputs
1. Automatic Switch
2. Test Switch
3. Run with Load Switch
4. Volts Raise
5. Volts Lower
6. Speed Raise
7. Speed Lower
8. Gen Circuit Breaker Aux Contact
9. Mains Circuit Breaker Aux Contact
10. Process Switch
11–16. Remote Alarm/Shutdown Inputs

Discrete Outputs
1. Mains Breaker Close/Contactor Close
2. Gen Breaker/Contactor Close
3. Engine Preglow
4. Fuel Solenoid
5. Engine Crank
6. Visual Alarm Relay
7. Local Bus PT Connect
8. Mains PT Disconnect
9. Mains Breaker Trip
10. Gen Breaker Trip
11. Audible Alarm
12. KVA load switch, or Idle/Rated Switch, depending on configuration

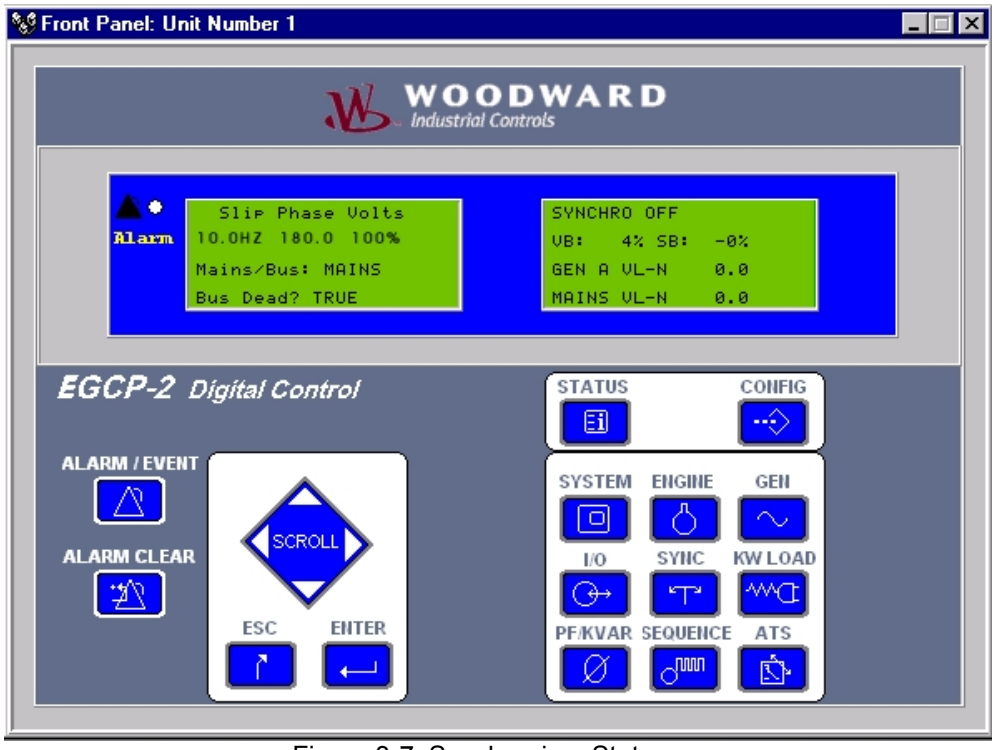


Figure 3-7. Synchronizer Status

Slip: The slip frequency in Hz. of the generator with relationship to the bus or mains it is paralleling to.
Phase: The phase angle difference in degrees between the generator and the bus or mains it is paralleling to.
Volts: The voltage differential in percent between the generator and the bus or mains it is paralleling to.
Mains/Bus: The active PT input being monitored by the EGCP-2.
Dead Bus: Indicates if the PT input (mains or bus) being measured is dead.
Synchronizer Status: Displays the status of the synchronizer. These are as follows:

Close Gen Breaker
Open Gen Breaker
Close Mains Breaker
Open Mains Breaker
Sync. Timer

VB: Voltage Bias Output (%)
SB: Speed Bias Output (%)
GEN A: Voltage of the generator.
MAINS: Voltage of the active PT input being sensed by the synchronizer.

IMPORTANT

Generator and Mains voltage label (VLL or VLN) will automatically switch depending on the voltage input configuration setting. See the configuration menu section of this manual for more detail.

Generator and Mains voltage readings and labels will automatically switch from "V" (volts) to "KV" (kilovolts), when the voltage exceeds 9999V for that input.

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

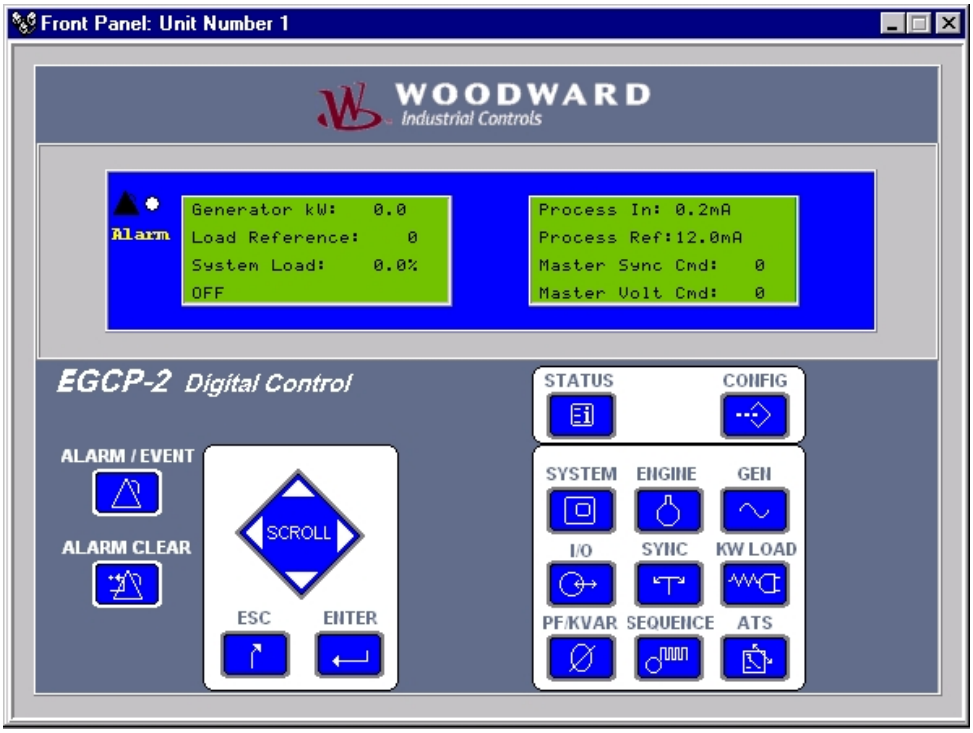


Figure 3-8. KW Load Status

Generator KW: The sum of the three phase generator KW.
Load Reference: The load reference, in KW for the generator.
System Load: The calculated system load for all units operating in isochronous load sharing mode. This reading is only active in load sharing units.
Control: The current load control mode in operation.
Process In: The sensed value of the 4–20 mA or 1–5 Vdc process input.

IMPORTANT

The process input reading is always scaled to mA. If a voltage input is used, the Process In reading multiplied by 243 will convert the mA reading directly to the voltage at the input.

Process Ref: The process reference for the process control.
Master Sync Cmd: The master synchronizing and load control bias command (%).
Master Volt Cmd: The master voltage bias command (%).

IMPORTANT

The master sync and master volt commands are only active in units in AUTO in multiple unit systems.

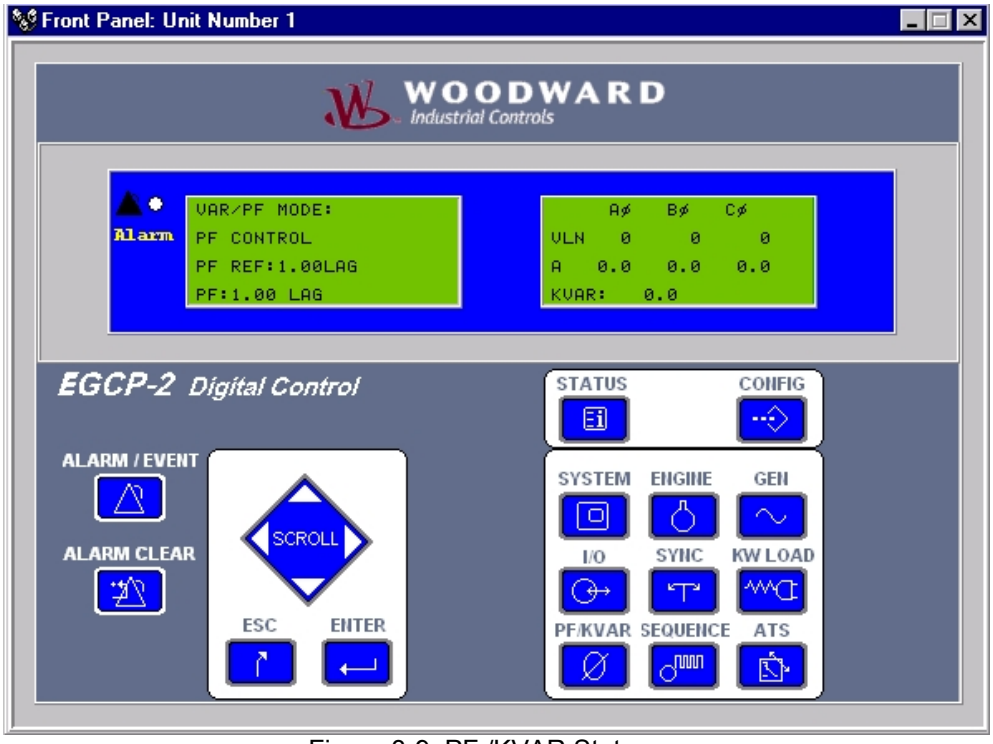


Figure 3-9. PF /KVAR Status

VAR/PF MODE: The configured VAR/PF control mode.
PF REFERENCE: The PF control reference value for the control.

IMPORTANT **Power Factor (PF) reference changes to KVAR REF when in VAR control.**

PF: The average three phase PF of the generator.
A B C: A, B, C phase generator reading indication.
V: Three phase voltage readings for the generator.
A: Three phase current readings for the generator.
KVAR: Total KVAR reading for the generator.

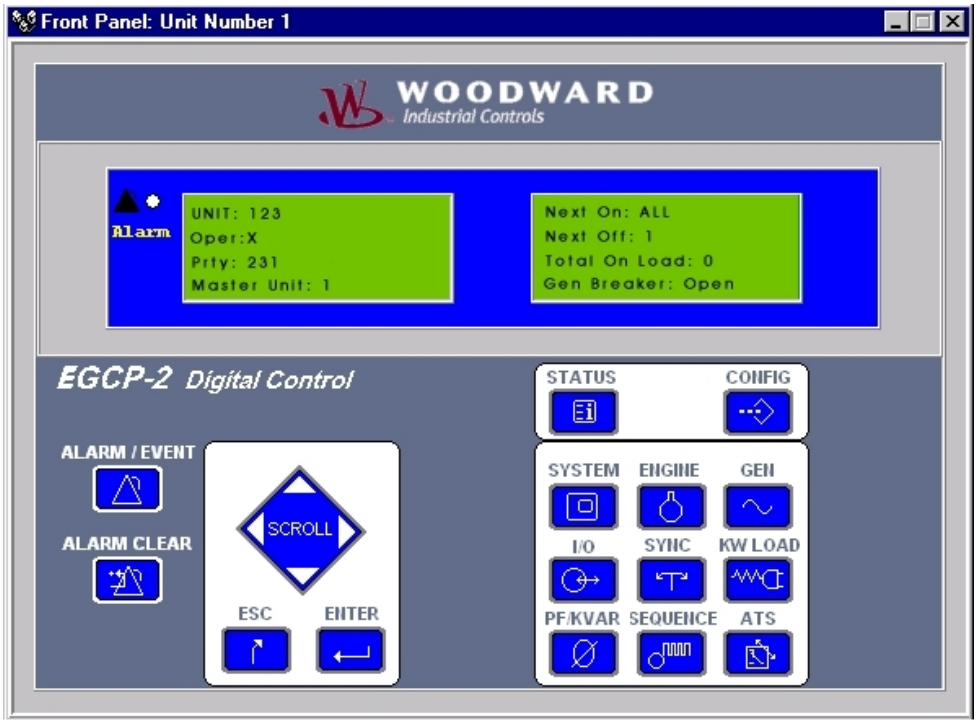


Figure 3-10. Sequencing Menu

Unit: Network Address of all units in Auto on the network.
Oper: Units in auto, and on the network with their breakers closed and on load.
Prty: Network Priority of all units in auto on the network.
Master Unit: The unit with the highest priority (lowest priority number) that is on the network and in auto.
Next On: Network address of next unit to be sequenced onto the network.
Next Off: Network address of next unit to be sequenced off the network.
Total On Load: Total number of load sharing units operating in isochronous load sharing.
Gen Breaker: The status of the generator breaker as determined by the gen cb aux discrete input.

The example below is a typical sequencing screen for a 5 unit system.

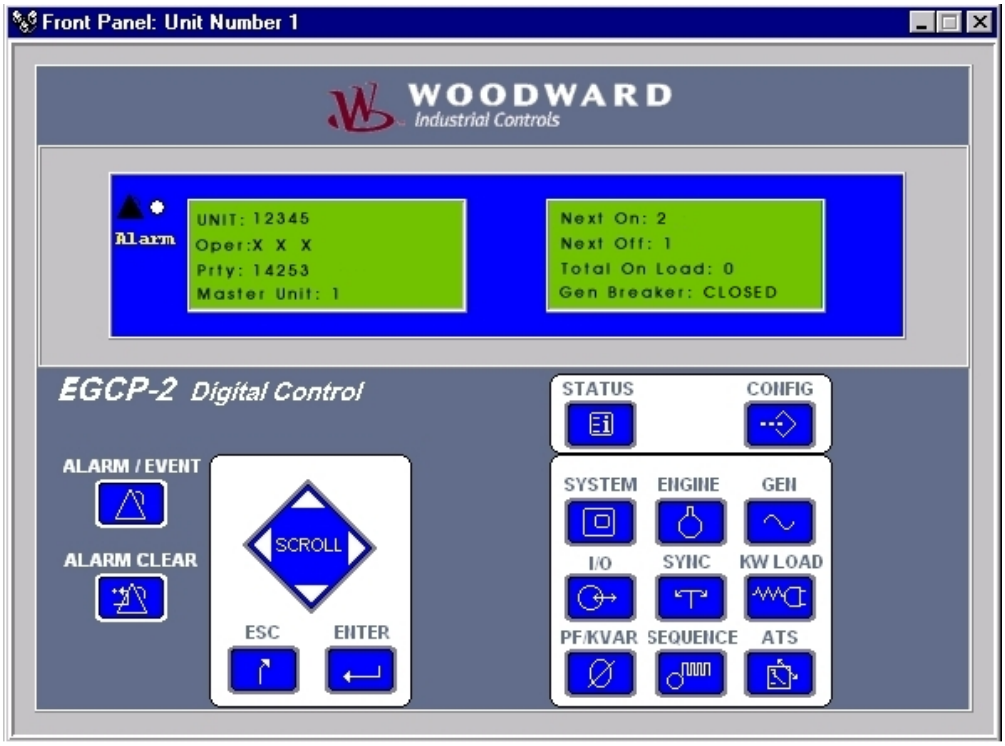


Figure 3-11. Sequencing Menu (Multi-Unit)

As displayed on the sequencing screen:
Units 1 3, and 5 are on load with their generator breakers closed.
Next On is unit number 2, which has a network priority of 4.
Next Off is unit number 5, which has a network priority of 3.
Master Unit in this system is the unit with the highest priority, which is unit number one.

IMPORTANT

The sequencing status display when the unit is in Auto and set for Multiple Units.

Units which have active shutdowns will remove themselves from the sequencing menu until the shutdown condition(s) are cleared.

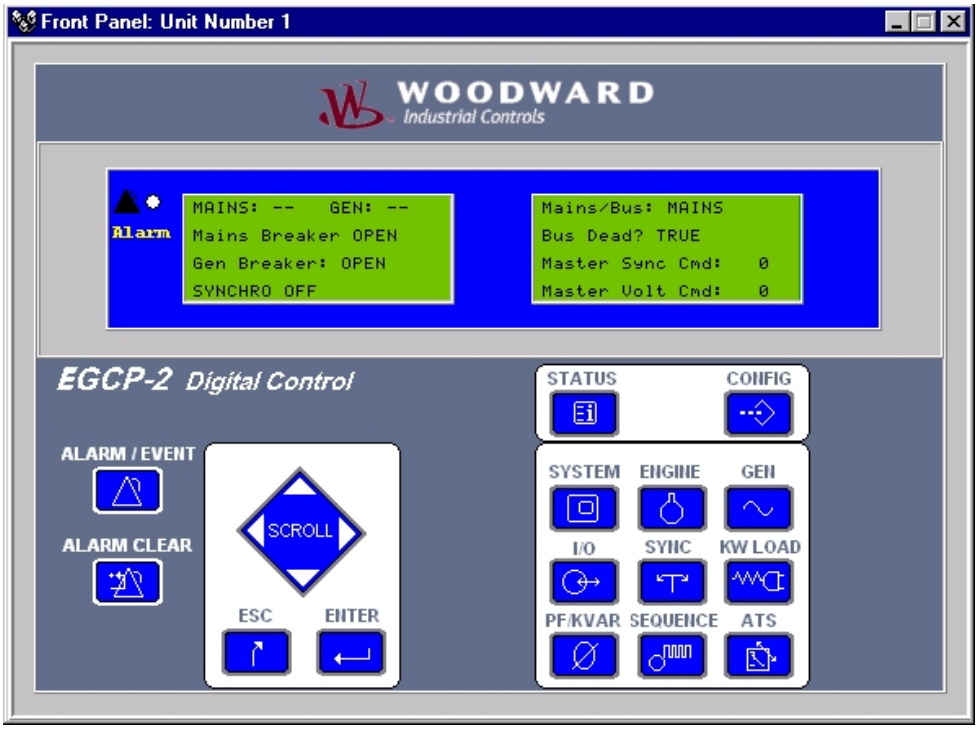


Figure 3-12. ATS (Automatic Transfer Switch) Status.

Mains: A graphic display of the mains condition. Two minus symbols (--) indicates the mains are out of spec, one plus symbol indicates the mains are in spec, but not declared stable (+-) two plus symbols (++) indicates mains are in spec and stable.
Gen: A graphic display of the gen condition. 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 generator is in spec and stable.
Mains Breaker: The state of the mains breaker as determined by the mains cb aux discrete input.
Gen Breaker: The state of the generator breaker as determined by the gen cb aux discrete input.
Synch: The synchronizer control mode.
Mains/Bus: The PT input being sensed by the mains/bus PT input through the mains disconnect, bus connect discrete output logic.
Bus Dead: An indication of a live or dead local bus as determined by the voltage on the bus, and state of the generator and mains breaker inputs.
Master Sync Cmd: The master synchronizing and load control bias command (%).
Master Volt Cmd: The master voltage bias command (%).

IMPORTANT **The master sync and master volt commands are only active in units in AUTO in multiple unit systems.**

Alarm / Event Log

The Alarm / Event button provides access to the EGCP-2's Alarm and Event Log. This log contains up to eight individual warning, alarm, or shutdown items. When the Alarm / Event button is pressed on the EGCP-2 keypad, the right hand LCD screen will switch to the Alarm/Event log. This log displays the following information. For navigation within the Alarm / Event log see the menu navigation section of this manual.

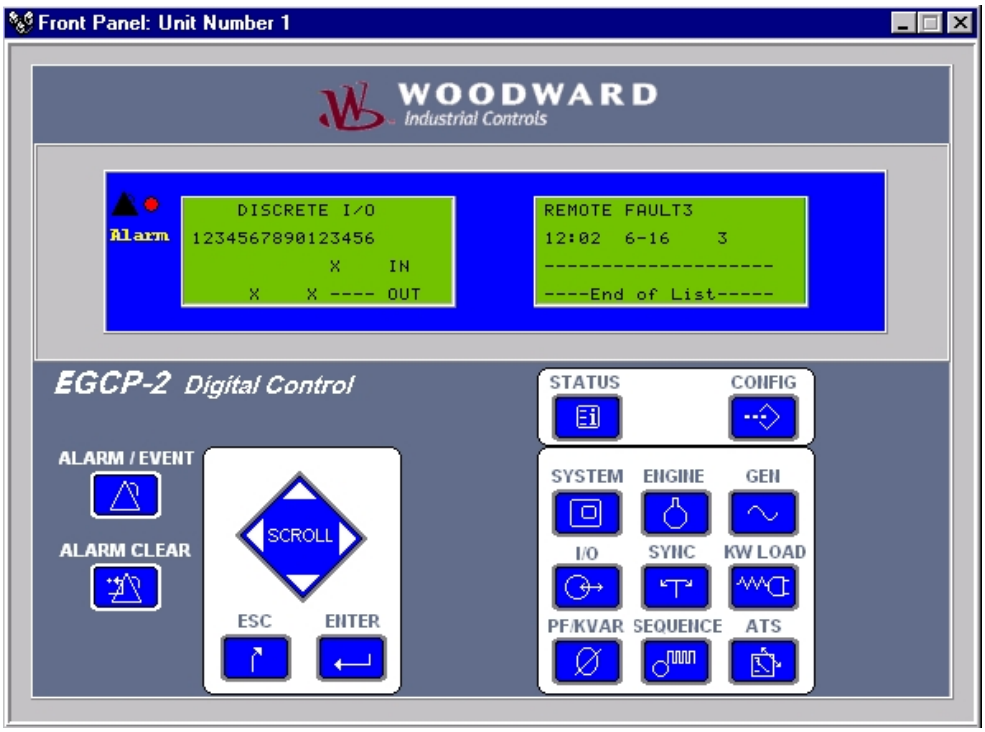


Figure 3-13. Alarm / Event Screen

ALARM NAME: The name, as defined by the particular warning, alarm, or shutdown event.
HH:MM: The hour and minute of the alarm occurrence.
MM-DD: The Month and Day of the alarm occurrence.
####: The value of the input at the time of the alarm. This value is only visible with a supervisor level, or higher, password.

In the event that the Alarm /Event Log key is pressed, and there are no active or logged alarms, the display will look like this:

Figure 3-14. Empty Event Log

The alarms displayed in the alarm / event log are arranged in a first in, last out (FILO) order. The most recent alarms will appear at the top of the list, followed by older alarms. In the event that the total number of logged and unacknowledged alarms exceeds sixteen, the oldest alarms will be dropped off the list to make room for the newer alarm events.

Configuration Menus

If the Config key on the EGCP-2 keypad is pressed, the right had LCD screen will switch to the configuration menus. The first item in this menu is the Security Code. The Security Code value determines which configuration menus are accessed. The Security Code is also used to determine the access level used for the Alarm / Event log.

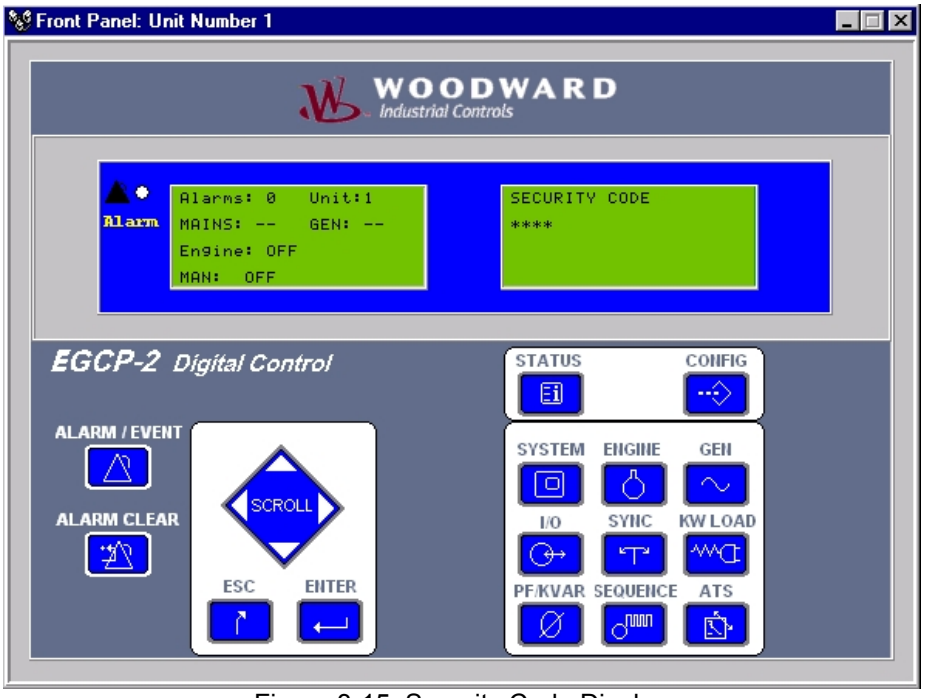


Figure 3-15. Security Code Display

When a valid security code is entered, the configuration menu list will be displayed. The configuration list allows the user to configure, calibrate, and adjust all relative items to the EGCP-2 operation.

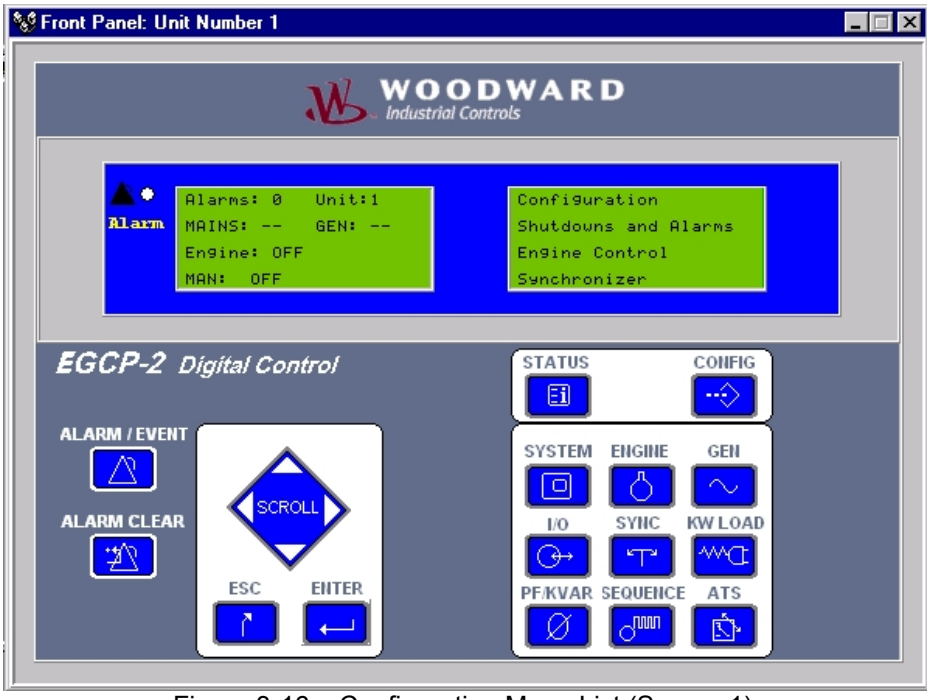


Figure 3-16a. Configuration Menu List (Screen 1)

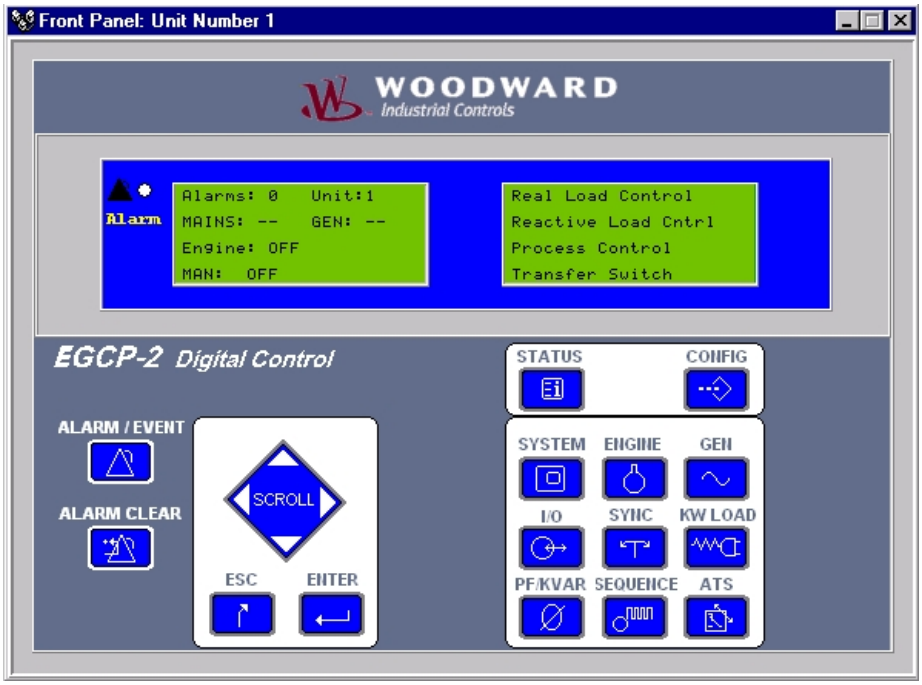


Figure 3-16b. Configuration Menu List (Screen 2)

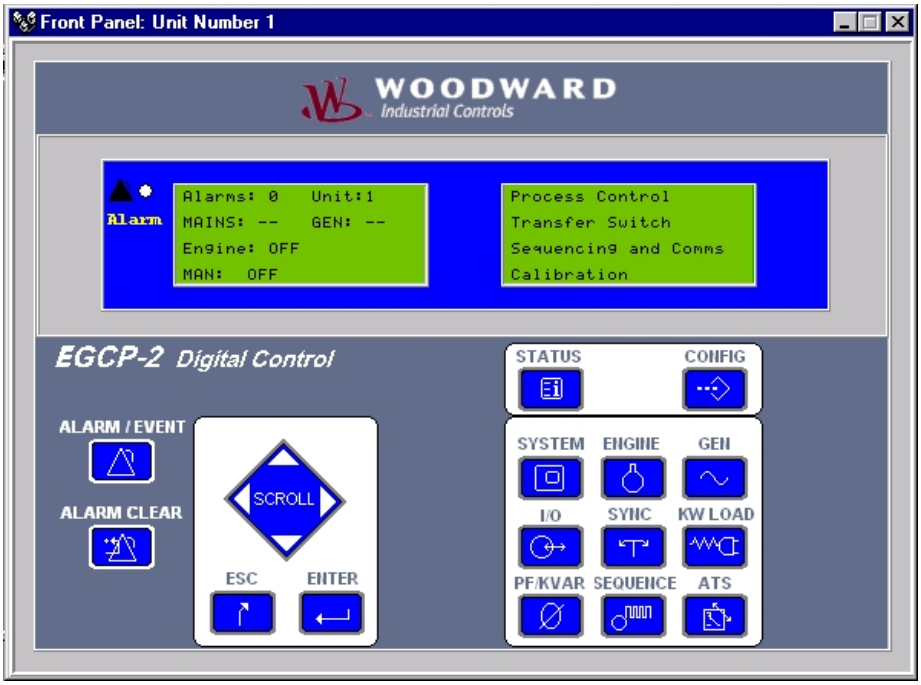


Figure 3-16c. Configuration Menu List (Screen 3)

IMPORTANT **See manual 26108 (included with the control) for security code and access level information.**

Various Security codes access different portions of the configuration screens, depending on the level of security code used. The up and down keys are used to move the blinking cursor to the tuning menu that the user wants to enter. Pressing the enter key will enter that configuration menu. See the Menu Navigation section of this manual for more information on navigating through the configuration menus.

Configuration Menu Items

Security Code Required For Access
A four digit security code is required for access to the configuration menus. If an incorrect code is entered, or a proper code is not entered within 60 seconds, the displays will default to the System Status.

Security Code
Levels Of Access

Monitor (no security code)
Access to all Status Screens, and Alarm / Event Log Display, and ability to clear an Audible Alarm.

Operator
Access to Alarm Log and Network Priority (acknowledge and commit), and all items allowed by the Monitor Security Code.

Supervisor
Allows access to Network Address and Time Set, and all items allowed access by the Operator Security Code.

Technician
Allows access to all setpoints except engine run time and calibration. And all items allowed access by the Supervisor Security Code.
Factory
Allows access to engine run time and calibration settings (Full Access).

Sanity Checks
In order to prevent improper configuration that may damage the generator set when started, the EGCP-2 runs through a series of "sanity checks". The items involved, all in the Configuration menu, for these "sanity checks" are:

1. Numbers of Poles
2. Number of Teeth
3. System Frequency
4. Rated Speed
5. Rated KW
6. Rated KVA
7. Rated KVAR
8. CT Ratio
9. PT Ratio
10. Voltage Input
11. Voltage Ref

The "sanity checks" are performed when in any Configuration menu and the ENTER key is pushed. So as the items in the Configuration menu are entered, sanity checks are performed.

- Items in the Configuration menu that fail the "sanity checks" will be indicated by a pound sign (#). This pound sign will appear on the far right side of the items value on the display screen. If any items have a pound sign, the engine will not be allowed to start and all Alarm and Shutdown conditions are ignored. These items must be changed to be within calculated values (sanity checks) to allow engine, alarm, and shutdown operations.

- All items in the Configuration menu must be Committed before engine operation will be allowed. Uncommitted items will have an asterisk (*) next to items value on the display screen. Typically this step is done at the factory. Asterisks will appear whenever a Setpoint file is downloaded to an EGCP-2. To commit an item it must be ENTERed. Open the Configuration menu and open each item, then ENTER that item. The asterisk will be gone.

The "sanity checks" are:
1. **Calculate MPU frequency** = Rated Speed * Number of Teeth / System Frequency
   - Answer: 500 ≤ calculated MPU frequency ≤ 8000 = Unit OK
2. **Calculate System Frequency** = Rated Speed * Number of Poles / 120
   - Answer: should equal System Frequency's configured value, 50 or 60 Hertz
3. **Calculate Power Factor** = Rated KW / Rated KVA
   - Answer: 0.7 ≤ Calculated Power Factor ≤ 1 = Unit OK
4. **Calculate CT Ratio, Voltage Input is DELTA**
   KVA * 1000 / Voltage Ref * 1.73
   - Answer: If value is ≤ CT Ratio = Unit OK

5. **Calculate CT Ratio, Voltage Input is WYE**
   KVA * 1000 / Voltage Ref * 3
   - Answer: If value is ≤ CT Ratio = Unit OK
6. **Calculate Voltage =** Voltage Ref / PT Ratio
   - Answer: If Calculated Voltage ≤ 500 = Unit OK
7. **Calculate Rated KVA, Voltage Input is DELTA**
   - Answer: Calculated KVA ≤ (Voltage Ref * 1.73) * CT Ratio = Unit OK
8. **Calculated Rated KVA, Voltage Input is WYE**
   - Answer: Calculated KVA ≤ (Voltage Ref * 3) * CT Ratio = Unit OK
9. **Rated KW ≤ Rated KVA**
10. **Rated KVAR ≤ Rated KVA**

If the EGCP-2 is not providing an engine start signal:

- Check for pound signs (#) signs and/or asterisks (*).
- Any item opened in the Configuration menu only, does not pertain to any of the other menus, no start process will be performed until this item is closed by pressing the ENTER or ESC key.

Example—If viewing the “Rated KW” on the display, no start signal will be provided.

Network Address (1 to 8)

- Unique Address for Each Unit in the System.
- Maximum of 8 units on network.

Network Priority (1 to 8)

- Unique Priority for Each Unit in the System.
- Lowest Active Priority is considered Master.
- Maximum of 8 units on network.
- Sequencing effective from lowest to highest priority.
- When priority is reduced below 1, the value will change to “Set All”. If the commit key is pressed when this value is on the display, the display will change to represent all units in auto on the network, and their priority. The network priority of any unit can be changed by using the left/right and up/down keys on the control. Once changes are made, the changes are committed by pressing the commit key twice. Pressing the escape key from within the set all setting will restore the previous priorities.

Number of Poles (numeric)

- Determines Speed/Frequency Relationship.
- Used for Speed/Frequency Mismatch Alarm/Shutdown.

Number of Teeth (numeric)

- Determines rpm Scaling.
- Engine Speed Readouts/Alarms.

System Frequency (50/60 Hz)

- Used as a basis for generator waveform analysis.
- Defines typical operating frequency of generator.

Rated Speed (numeric)

- Synchronous Speed Of Generator Set.
- Used in Speed Calculation to determine “sample” period for MPU input.

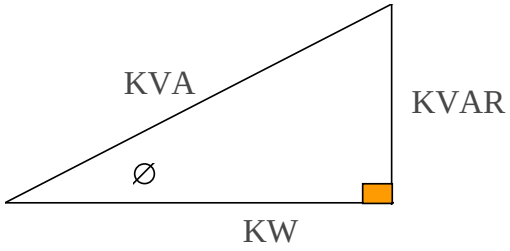
Rated KW (numeric)
- Rated KW of Generator.

Rated KVA (numeric)
- Used to determine Rated Current (I) of Generator for minimum overcurrent level.
- Equation used to determine Rated Current:

Voltage input is DELTA I = $\frac{\text{KVA x 1000}}{\text{Voltage Ref x 1.73}}$

Voltage input is WYE I = $\frac{\text{KVA x 1000}}{\text{Voltage Ref x 3}}$

Rated KVAR (numeric)
- Rated KVAR of Unit.
- Typically 0.6 x Rated KVA.



KW/KVA=PF
COS ∅ =KW/KVA
KVA^2=KW^2+KVAR^2
KVA= $\sqrt{(KW^2 + KVAR^2)}$

Figure 3-17. AC Power Triangle

CT Ratio (numeric :5)
- Scales sensed CT input for Amperage as seen at generator.
- Used for Load Sensing Algorithm.
- (KVA, KW, KVAR, PF)
- Used for Alarms/Shutdowns.
- Over Current, KW Limits, Reverse Current, etc.

PT Ratio (numeric : 1)
- Scales sensed PT input to Voltage Levels as measured at the Generator.
- Used in Load Sensing Algorithm.
- (KVA, KW, KVAR, PF)
- Used for Voltage Matching.
- Used for Generator Frequency Detection.
- Used for Alarm/Shutdown sensing.
- Over/Under Voltage
- KW Limits, etc.

Voltage Input (Wye L-N, Delta L-L)

- Set for sensing/transformer used between generator and EGCP-2.
- Defines which calculations will be used for KW, KVA, KVAR, etc.
- Defines the expected input type for voltage levels in the setpoint menus.
- Sets the label used for all generator and mains voltage Status readings.
- Wye (Star) Generator or Transformer Connection
  4 Wire
  Volts Line to Neutral expected for all setpoint menu items requiring voltage settings.
- Delta Generator or Transformer Connection
  3 Wire
  Volts Line to Line expected for all setpoint menu items requiring voltage settings.

Voltage Reference (numeric)

- Operating Voltage of Generator per Generator Nameplate.
  Used for VAR/PF Sharing as the Reference that multiple generators share reactive load to. This maintains the voltage reference while in Power Factor Sharing or KVAR Control mode on an isolated bus.

Display Units

- **Metric**
  Sets temperature readings to degrees Celsius (C) , and pressure to Bar (BAR).
- **US**
  Sets temperature readings to degrees Fahrenheit (F), and pressure to Pounds per Square Inch (PSI).

Set Date

- Sets the date used by the control for Alarm / Event time stamps, and displays.

Set Time

- Sets the time used by the control for Alarm / Event time stamps, and displays.

Start Sequencing

- **ENABLED or DISABLED to select Start Sequencing Process**
  Enabled
  Uses Preglow time and Engine Crank.
  Must have MPU to function.
  Disabled
  No Preglow Time or Engine Crank
  Will operate without an MPU

Relay #12 Function

- **KVA Load Switch**
  Defines Discrete Output #12 as a KVA load switch.
  Uses KVA High and KVA Low value items in the Load Control Configuration Menu.

- **Idle / Rated Switch**
  Defines Discrete Output #12 as an Idle / Rated speed switch. This output is typically used to automatically send the engine speed control an idle/rated command upon start up.
  Uses the Idle Speed and Idle Time items in the Engine Control Configuration Menu.

Speed Bias Type

- **±3 Vdc (WGC)**
  Sets the speed bias output to ±3 Vdc range. 0 Vdc is zero output,
  –3 Vdc is –100% speed bias output,
  +3 Vdc is +100% speed bias output.
- **0.5 to 4.5 Vdc (DDEC)**
  Sets the speed bias output to 0.5 to 4.5 Vdc range.
  2.5 Vdc is zero,
  0.5 Vdc is –100% speed bias output,
  4.5 Vdc is +80% speed bias output.
- **500 Hz PWM (adem)**
  Sets the speed bias output to 500 Hz Pulse Width Modulated (PWM) range.
  50% duty cycle = 0% speed bias output,
  0% duty cycle = -100% speed bias output,
  100% duty cycle = +100% speed bias output.

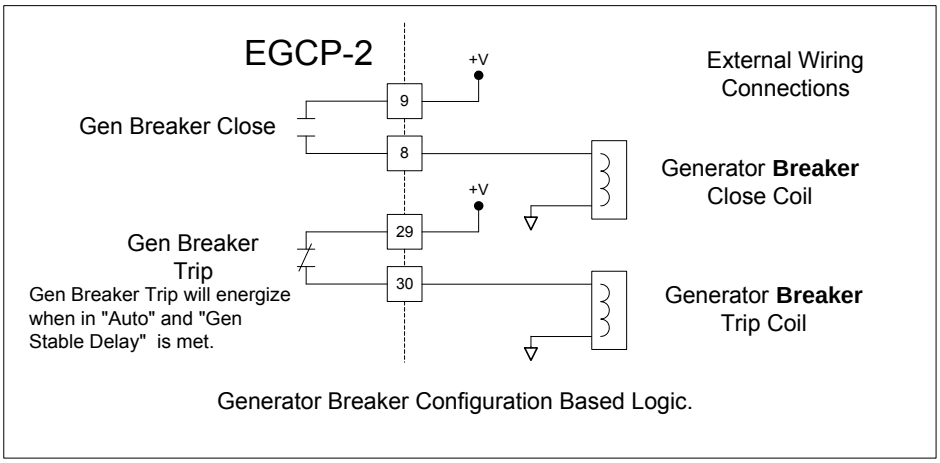
Voltage Bias Type

Sets the voltage bias output voltage range.

- **±9 Vdc Bias**
  0 Vdc = 0% voltage bias
  –9 Vdc = -100% voltage bias
  +9 Vdc = +100% voltage bias
- **±3 Vdc Bias**
  0 Vdc = 0% voltage bias
  –3 Vdc = -100% voltage bias
  +3 Vdc = +100% voltage bias
- **±1 Vdc Bias**
  0 Vdc = 0% voltage bias
  –1 Vdc = -100% voltage bias
  +1 Vdc = +100% voltage bias

Circuit Breaker Control (Breaker/Contactor)

- Defines action of Generator and Mains closure command.
- Breaker issues momentary breaker close signal, and a separate momentary breaker trip (open) signal. Get complete logic for Generator and Mains breaker commands in manual 26076 under “Relay Output Functions.”
- Contactor issues continuous breaker close signal through the breaker close relay output, DO2 for Generator and DO1 for the Mains. Get complete logic for the generator and mains contactor commands in manual 26076 under “Relay Output Functions.”



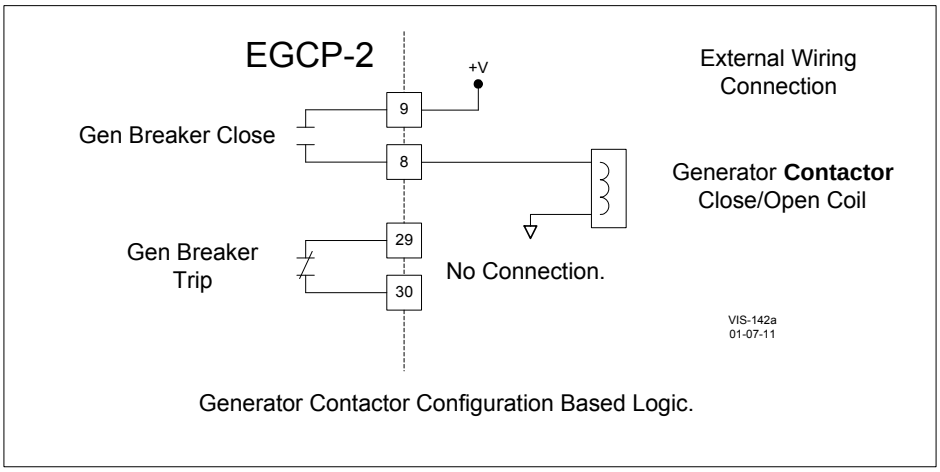


Figure 3-18. Breaker Logic and Contactor Logic

Operating Mode

- Mains Parallel or No Parallel
- **Mains Parallel** will allow the unit to synchronize to the mains, and carry load while in parallel with the mains as well (closed transition).
- **No Parallel** will not allow the unit to operate with load until the mains breaker is sensed as being open (open transition).
- All units operating in a load sharing system must be set for the same parameter (that is, mains parallel, or no parallel).

Number of Units (single, multiple)

- Defines whether unit is part of a multiple unit system or not.
- If **single unit**, there is no auto starting, auto sequencing, load or PF sharing with other units under any circumstances. Unit displays “single unit no sequencing” on sequencing screen. Network Priority and Network Address setpoints are removed from the configuration setpoint menu automatically.
- If **multiple unit**, auto starting, auto sequencing, load and VAR/PF sharing are available between all units in multiple. Unit displays system sequencing information on sequencing screen. Network Priority and Network Address setpoints are added to the configuration setpoint menu automatically. Unit must be in Auto mode to communicate over the inter-control network (RS-485).

Shutdowns and Alarms

Shutdowns and Alarms menu is used to configure the various safety functions of the EGCP-2.

Each alarm setpoint can be set for:

- Disabled
- Warning—LED on control flashes.
- Visual Alarm—LED flashes, and Visual Alarm relay energizes.
- Audible Alarm—LED flashes, Visual and Audible Alarm relays energize.
- Soft Shutdown—LED turns on, Visual and Audible Alarm relays energize, unit soft unloads, Fuel Solenoid relay de-energizes and cycles through cool down timer when applicable. Unit removes itself from auto sequencing order.
- Hard Shutdown--Same as above, but immediately opens generator breaker and de-energizes the fuel solenoid.

Voltage Range Alarm

- Alarm/Shutdown point for an excess of voltage bias signal from the EGCP-2 to AVR.
- Preset to trigger at ±100% voltage bias output.
- Indicates that the AVR is not responding to the voltage bias output as expected.

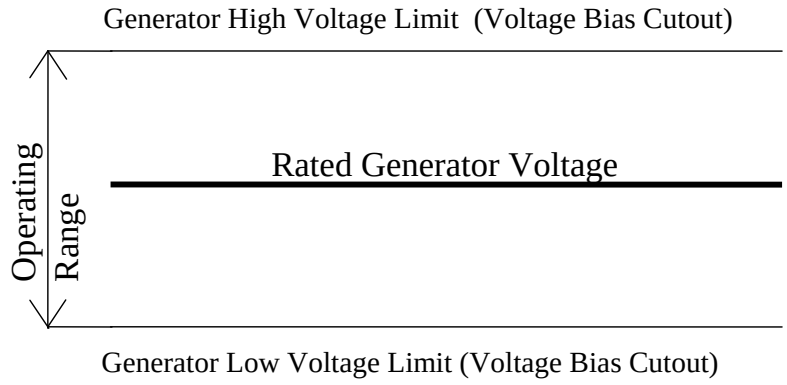


Figure 3-19. Generator High/Low Voltage Alarms

Generator Volt High Limit (numeric)

- Sets maximum allowable generator voltage level.
- If voltage is above High Limit, generator is not considered stable, and is unfit for breaker closure.

Generator Volt Low Limit (numeric)

- Sets minimum allowable generator voltage level.
- If voltage is below Low Limit, generator is not considered stable, and is unfit for breaker closure
- Voltage Bias will not decrease while generator voltage is below the low limit.

Generator High/Low Volt Limit Alarm

- Even if the Alarm Setpoints for the High/Low Limits are Disabled, the Voltage Bias will ***not*** allow adjustment beyond these limits.
- The same is true for the synchronizer, which will not allow a gen breaker closure if the High or Low Voltage limits are met or exceeded for a period of time which exceeds the Gen Volt Timer Setpoint.

Voltage Alarm Delay

- Sets minimum time, in seconds, allowed prior to activating either Generator High/Low Voltage Limit Alarms. This allows for short period transient over/under voltages to occur on the generator without setting off the Generator Voltage Alarms.

Generator Frequency High Limit (numeric)

- Sets maximum allowable generator frequency level.
- If frequency is above High Limit, generator is not considered stable, and is unfit for breaker closure.

Generator Frequency Low Limit (numeric)

- Sets minimum allowable generator frequency level.
- If frequency is below Low Limit, generator is not considered stable, and is unfit for breaker closure.

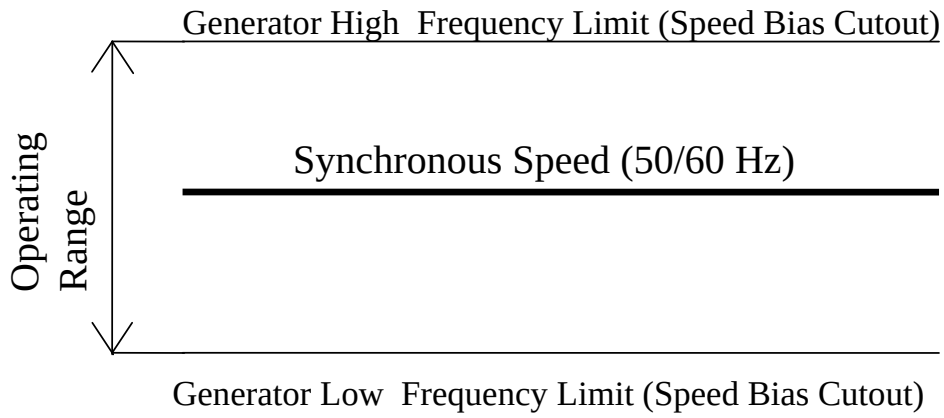


Figure 3-20. Generator Over/Under Frequency

Generator High/Low Frequency Limit Alarm

- Even if the Alarm Setpoints for the High/Low Limits are Disabled, the Speed Bias will not allow adjustment beyond these limits.
- The same is true for the synchronizer, which will ***not*** allow a gen breaker closure if the High or Low Frequency limits are met or exceeded.

Speed/Frequency Mismatch Alarm

- Compares generator frequency to engine rpm and alarms on difference.
- Used to indicate loss of MPU, or Loss of Generator Field Voltage.

Overcurrent Level (numeric)

- Set for per Phase Overcurrent
  3 Phase sensing, selects phase with highest current
- Uses Inverse Time Function as basis for overcurrent detection
  This allows different levels of overcurrent based on time, AMP•SECONDS
  AMP•SECONDS are determined by:
  - Overcurrent Level
  - Overcurrent Delay
- Overcurrent Detection begins when current exceeds “Per Phase Rated Current”.
  Per Phase Rated Current is determined by settings in the Configuration menu
  - Voltage Input—Wye or Delta
  - Rated KVA
  - Voltage Ref

  Per Phase Rated Current equals
  - WYE voltage input: (Rated KVA / Voltage Ref) / 3
  - DELTA voltage input: (Rated KVA / Voltage Ref) / 1.732

Example 1: 480 V L-L system, 277 V L-N system
110 KW Generator, 4:1 PT Ratio

Voltage Input = Delta	Voltage Input = Wye
Rated KVA = 120	Rated KVA = 120
Voltage Ref = 480 V L-L	Voltage Ref = 277 V L-N
(120 000 / 480) / 1.732	(120 000 / 277) / 3
= per Phase Rated Current	= per Phase Rated Current
144 Amps = per Phase Rated Current	144 Amps = per Phase Rated Current

Example 2: 4160 V L-L system, 2400 V L-N system
2000 KW Generator, 35:1 PT Ratio

Voltage Input = Delta	Voltage Input = Wye
Rated KVA = 2400	Rated KVA = 2400
Voltage Ref = 4160 V L-L	Voltage Ref = 2400 V L-N
(2 400 000 / 4160) / 1.732	(2 400 000 / 2400) / 3
= per Phase Rated Current	= per Phase Rated Current
333 Amps = per Phase Rated Current	333 Amps = per Phase Rated Current

Overcurrent Delay (numeric)

- Used with the Overcurrent Level to determine the amount of time (AMP•SECONDS) any current can be greater than rated current before an alarm or shutdown is received.
- Overcurrent Detection begins when current exceeds “per Phase Rated Current”
- AMP•SECONDS
  (Overcurrent Level – Rated Current) x Overcurrent Delay
  - If the Overcurrent Level is set <= Rated Current, Amp•Seconds = 0.
  - This will cause an Alarm or Shutdown when Rated Current is attained.

Amp•Seconds accumulate when current is equal to or greater than the Rated Current
Amp•Seconds reset to 0 when current is less than Rated Current

Example:

Overcurrent Level	= 160	160	160 Amps
Rated Current	= 144	144	144 Amps
Overcurrent Delay	= 1.0	10.0	20.0 Seconds
Overcurrent Time	= 16	160	320 Amp•Seconds

Using Figures 3-21, 3-22, and 3-23 will help you determine where the Overcurrent Level and Overcurrent Delay should be set for any application.

Overcurrent Alarm
If the Overcurrent Alarm is set for DISABLED, the Overcurrent Level and Overcurrent Delay will have no effect.

Overcurrent Delay (Numeric)

Configuration	
Overcurrent Level	= 160 Amps
Rated Current	= 144 Amps
Overcurrent Delay	= 10 Seconds
Amp/Seconds	= 160

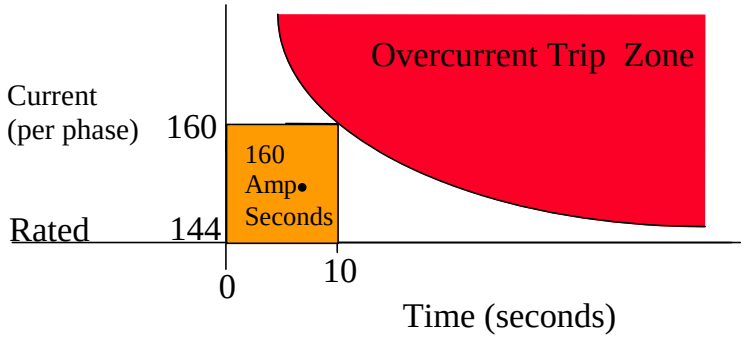


Figure 3-21. Current goes to 160 Amps, an Alarm or Shutdown will be received in 10 seconds

Configuration	
Overcurrent Level	= 160 Amps
Rated Current	= 144 Amps
Overcurrent Delay	= 10 Seconds
Amp/Seconds	= 160

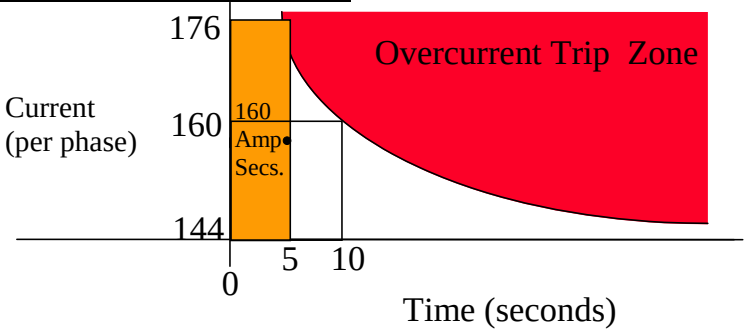


Figure 3-22. Current goes to 176 Amps, an Alarm or Shutdown will be received in 5 seconds

Configuration	
Overcurrent Level	= 160 Amps
Rated Current	= 144 Amps
Overcurrent Delay	= 10 Seconds
Amp/Seconds	= 160

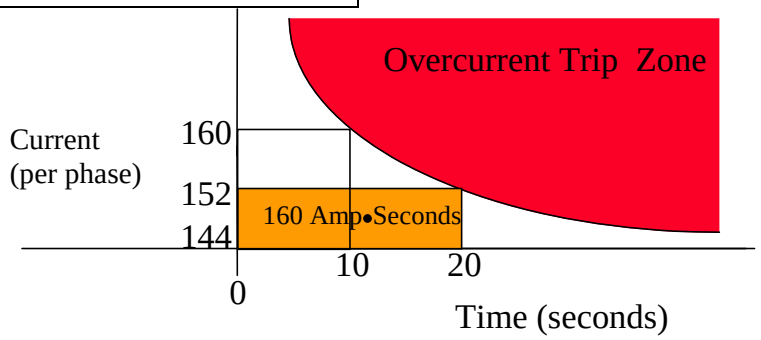


Figure 3-23. Current goes to 152 Amps, an Alarm or Shutdown will be received in 20 seconds

Reverse Power Level (numeric)

- Reverse Power Condition begins when sensed KW on generator goes negative. Reverse Power Trip levels depend upon amplitude and duration of reverse power condition.

Reverse Power Delay (numeric)

- Reverse Power also uses an inverse time function.

Minimum Reverse Pwr (numeric)

- Minimum Reverse Power Level which can trigger a reverse power alarm condition. Reverse power levels below this setpoint will not cause a reverse power alarm condition, regardless of duration. When the reverse power level exceeds this setting, the Reverse power Delay begins, and the accumulation of the reverse power amplitude is monitored by the control.

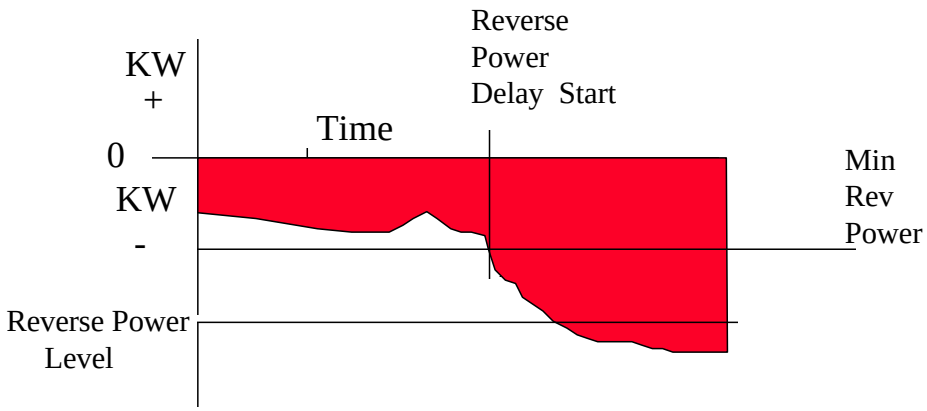


Figure 3-24. Reverse Power

Loss of Excitation (LOE) (numeric)
- Set as a percentage of total KVAR load on the generator that can be applied as a block reactive load to the unit. If control senses changes in KVAR loads instantly applied greater than this value the LOE alarm triggers.
- Used to indicate loss of field excitation to the generator.

Remote Faults #1 through #6
- Each fault is programmable for:
  disabled
  warning
  visual alarm
  audible alarm
  soft shutdown
  hard shutdown

Remote Faults #1 through #6:
- Each alarm has a programmable time delay (0 to 30000 seconds).
- Each alarm can be set for any of the standard alarm or shutdown levels.
- External Faults #1 and #2 do not start time delay until after gen stable period has expired.

Engine Control

Preglow Time
- Time of preglow allowed prior to engine crank cycle.
- Maintained through engine cranking.
- Resets after every crank attempt.

Crank Time
- Maximum Allowable Time for Engine Cranking.

Crank Cutout
- Engine rpm level where crank command is canceled.

Crank Delay
- Time between Engine Crank Attempts.

Crank Repeats
- Number of times EGCP-2 will attempt to re-start engine. Cranking attempts will equal the value of Crank Repeats +1.

Crank Fail
- Alarm Setpoint.
- Activates when Number of Crank Repeats is depleted.

Idle/Rated Speed
- If the Relay #12 output is configured for Idle/Rated switch, this value will set the speed at which the Idle/Rated Time begins.
- Value should be approx. 10% less than the actual idle speed of the generator set.

Idle/Rated Time
- Timer which sets the delay in seconds the EGCP-2 waits once the Idle/Rated Speed setpoint is exceeded. Once the Idle/Rated Time is passed, the EGCP-2 will energize the #12 Discrete Output (if the Relay #12 output is configured for the idle/rated function).

Cooldown Time
- Time allowed for cooldown once engine achieves a stop cycle.
- Must exceed Cooldown Limit (see next display) before activated.

Cooldown Limit
- KVA setpoint at which, when exceeded, will cause the engine to go to a cooldown during a stop cycle.

Engine Run Time
- Hours of Run Time on Engine
- Increments in hours.
- Retained in EE memory—Does not require power to maintain previous value. Updated every 4 hours of operation, and every time the engine is stopped.

MW Hours
- MW Hours on Generator
- Increments in .1 MWH.
- Retained in EE memory. Updated every 4 hours of operation, and every time the engine is stopped.

Overspeed (numeric)
- Set for overspeed limit of engine.
- Typically set for Hard Shutdown for safety.
- Typically set for 10% above Rated Speed of engine.

Battery Volt High Limit (numeric)
- Sensed DC voltage supply to EGCP-2.
- Can be used to detect faulty charging circuit.

Battery Voltage Low Limit (numeric)
- Used to detect weak battery/failed charger.
- Automatically Disabled during engine cranking.

High H2O Temperature (numeric)
- Uses engine mounted temperature sensor.
- Active once Gen is considered stable.
- Display is selectable for degrees F (American) or degrees C (Metric).

Low H2O Temperature (numeric)
- Useful for detection of failed jacket water heater.
- Always active.

High Oil Pressure (numeric)
- Uses Engine mounted pressure sensor.
- Active when generator is stable.
- Display is selectable for PSI (American) or Bar (Metric).

Low Oil Pressure
- Used to sense failure of lube oil system.
- Active when generator is stable.

Synchroscope

Synchronizer Mode

Permissive
- Acts as a synch check device.
- EGCP-2 will not issue speed or voltage bias commands, but if synchronization conditions are within spec (phase and voltage), control will issue a breaker close command.

Check
- Used for checking synchronizer prior to commissioning.
- EGCP-2 control actively synchronizes generator by issuing speed and voltage bias commands, but does not issue breaker closure command.

Run
- Normal operating mode.
- Actively synchronizes and issues breaker closure command.
- EGCP-2 control MUST be in RUN to operate as a dead bus closing device.
- In multiple unit systems EGCP-2 control MUST have AUTO input active to enable breaker control.

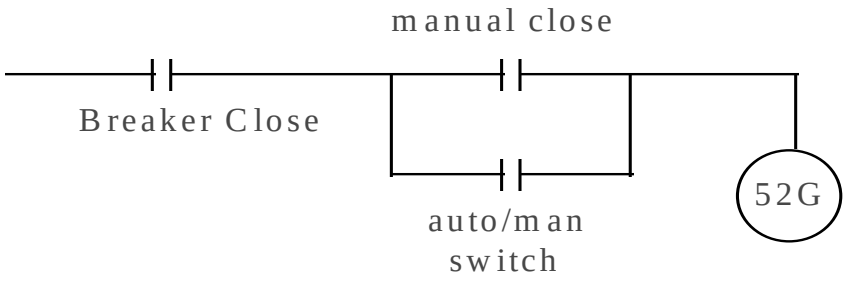


Figure 3-25. Typical Circuit Using Permissive Function and Run for Auto/Manual Synchronizing

Synchronizer Gain
- Sets Gain of Synchronizer speed bias output.

Synchronizer Stability
- Sets Stability of Synchronizer speed bias output.
- Both Gain and Stability are used to tune the synchronizer dynamic response.

Gain
- Gain Multiplier for output signal proportional to phase error.

Stability
- Stability (Integrator dx/dt in seconds per repeat)

Voltage Matching (enabled or disabled)
- Enables/Disables Voltage Matching feature of EGCP-2 control.
- Enables Voltage Window Setpoint.

Voltage Window (numeric)
- Overall percentage of error allowed between generator and bus, or generator and mains.
- EGCP-2 control will not issue a breaker closure if error is greater than voltage window.

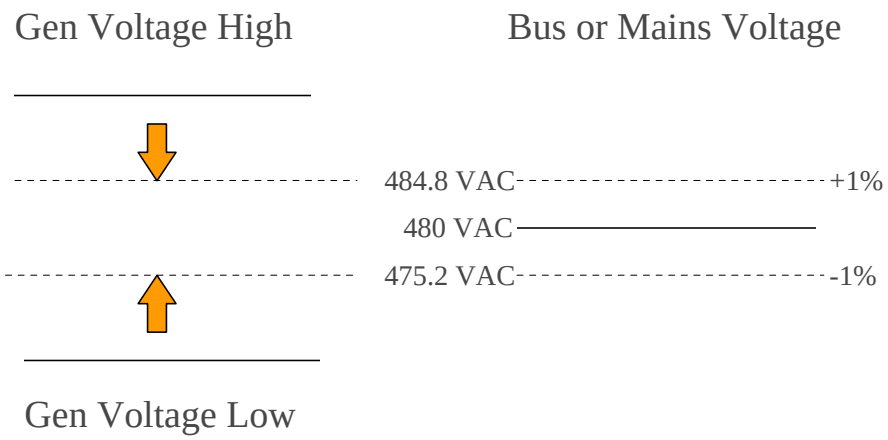


Figure 3-26. Voltage Matching (1% setpoint)

Max. Phase Window
- Maximum allowable phase angle deviation from phase matched condition.
- EGCP-2 Control will not issue breaker closure if phase angle between generator and bus, or generator and mains exceeds this window.

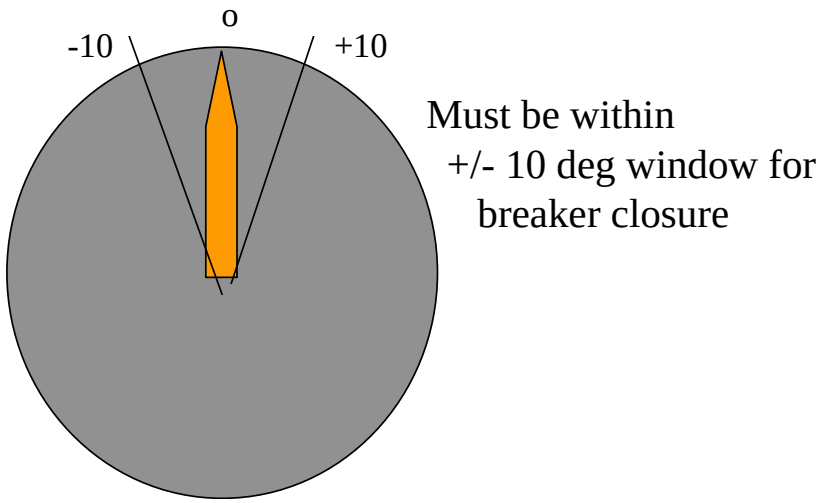


Figure 3-27. Maximum Phase Window = 10 Degrees

Dwell Time (numeric)
- The period of time that the generator must be within the Max. Phase Window for before the EGCP-2 control will issue a breaker closure.
- Longer dwell times will give typically give better stability after the breaker closes.
- Shorter dwell times reduce amount of time required to synchronize unit.

C.B. Hold Time
- Time in Seconds that Breaker/Contactor Close output is held after breaker close command is issued.

Close Attempts
- Number of Close Attempts allowed while synchronizing.
- Close attempt incremented if breaker does not send back continuous CB Aux signal to EGCP-2.

Reclose Delay
- Time in Seconds before EGCP-2 control attempts resynchronization after failed closure attempt.

Synch Reclose Alarm
- Alarm setpoint if number of close attempts is depleted.

Synchronizer Time Out
- Sets time allowed for synchronization in seconds.
- Begins timing when synchronizer activates.
- Active for all gen and mains breaker open and close commands from EGCP-2 control.

A setting of zero (0) seconds disables synch. time-out—infinite synch time allowed.

Synch Time-out Alarm
- Sets alarm mode if synch time-out is exceeded. Shutdown actions are not allowed.

Dead Bus Closure
- Enables/Disables Dead Bus Closing Feature.
- Unit must be within voltage and frequency high/low limits to be considered for dead bus closure.
- Dead Bus Closure uses Token Passing Scheme to assure that only one unit in a networked system will close onto the dead bus at any given time.
- Multiple unit systems must have Auto switch input to allow dead bus closing between networked units.

Real Load Control

Load Control Mode

- **Normal**
  Standard setting for load control and VAR/PF functions.

- **Soft Transfer**
  Standard load control and VAR/PF functions, but unit will issue mains breaker open command while in process control if process reference is reached, or while in base load and base load reference is reached.

- **Droop**
  Manual Load and Voltage Control
  Used primarily for commissioning.

Load Control Gain

- Sets gain response of load control.
- Active in load ramping and base load operations.

Load Share Gain

- Sets gain response of proportional load sharing.
- Active in load sharing operations.

Load Stability

- Sets Stability response of load control.
- Active in load ramping and base load operations.

Load Derivative

- Sets Derivative response of load control.
- Active in load ramping and base load operations.

Load Control Filter

- Low Pass Filter used to attenuate higher frequency transients for better stability.
- Active in proportional load sharing, load ramping, and base load control modes.
- Higher values of filter will tend to make the unit more responsive to small, rapid transients.
- Lower values of filter will tend to make the unit less responsive to small, rapid transients.

Base Load Reference

- Load Level Generator will automatically ramp to when operating in Base Load.

Unload Trip

- Load Level where Generator Breaker/Contactor open command will be issued when EGCP-2 control is off loading generator set.

Load Droop

- Percentage of KW droop used when EGCP-2 control is operating in a droop mode.

Load Time
- Time in Seconds for generator to load from unload trip level to base load level. This rate is applied during any automatic loading function, including ramping to load sharing.

Unload Time
- Time in Seconds for generator to unload from base load level to unload trip level. This ramp rate is applied during any automatic unload functions, including ramping from load sharing.

Raise Load Rate
- Percent Load per Second ramp rate used when the raise load contact input is used during base load operation.

Lower Load Rate
- Percent per Second Ramp Rate used when the load lower input is active in base load control operation.

KW Load High Limit
- Maximum allowed load while operating in Base load or Process control modes.
- Prevents overload of unit.

KW High Limit Alarm
- Sets alarm mode when unit is at or above High Load Limit.
- Active during all load control operations.
- Unit will not exceed High Limit setpoint when operating in Base Load or Process Control Modes.

KW Load Low Limit
- Active during all load control operations.
- Sets alarm mode when unit is at or below Gen Low Load Limit.
- Minimum allowed load while operating in Base load or Process control modes.
- Prevents reverse current of unit.

KW Low Load Limit Alarm
- Sets Alarm Mode when unit is at or below Low Load Limit.
- Active during all load control operations.

KVA Switch Low
- Sets level, which when exceeded, will cause the KVA relay output to energize. Only applicable for units with the relay#12 function configured for KVA Load Switch.

KVA Switch High
- Sets level, which when exceeded, will cause the KVA relay output to de-energize. Only applicable for units with the relay#12 function configured for KVA Load Switch.

Summary of KVA load switch action:
If the relay 12 output is configured for KVA Load Switch action:

If the three phase sum of the generator KVA is greater than the KVA Switch Low setpoint, AND less than the KVA Switch High setpoint, the K12 relay output shall energize. Any other KVA levels relative to the Low and High switch setpoints shall cause the K12 relay output to de-energize.

Reactive Load Control

VAR/PF Mode
- **Disabled**
  Unit does not PF share, or control PF under any circumstances.
- **VAR Control**
  Unit PF shares in isolated bus load sharing mode.
  Unit controls KVAR in Base Load and Process Control Modes.
- **PF Control**
  Unit PF shares in isolated bus load sharing mode.
  Unit controls PF in Base Load and Process Control Modes.

VAR/PF Gain
- Controls Gain Response of unit in VAR/PF control mode.
- NOT active in PF sharing mode.

Voltage Ramp Time
- Ramp time from 0 to ±100% voltage bias output.
- Controls response of units in PF sharing modes.
- Controls ramp time of voltage during synchronization.
- Controls ramp time of voltage during manual voltage adjust.

VAR/PF Sharing Gain
- Controls Gain Response of unit in VAR/PF Sharing Mode.
- Not active in VAR/PF Control Mode.

VAR/PF Stability
- Controls Stability Response of unit in VAR/PF control mode.
- NOT active in PF sharing mode.

KVAR Reference
- When KVAR control mode is selected, this references the amount of KVAR the generator will produce while in Base Load or Process control modes.
- Can be set for generate or absorb levels of KVAR.
- KVAR levels limited by Rated KVAR of unit.

PF Reference
- PF level that will be maintained by the generator while in Base Load or Process control modes.
- Can be set for leading or lagging power factor.
- Scaled from 0 (unity) to -.5 (.5 leading) to +.5 (.5 lagging).

PF Deadband

- ± deadband around PF reference point.
- Set in PF.
- Active in PF and PF sharing modes.
- Can be used to stabilize units at low loads if needed.

Process Control

Process Action (direct, indirect)

- Defines action of speed bias when unit is operating in process control in parallel with the mains.
- Direct action = Unit increases speed bias (fuel) to increase process 4–20 mA input.
- example: Export Power control
- Indirect action = Unit decreases speed bias (fuel) to increase process 4–20 mA input.
- example: Import Power Control

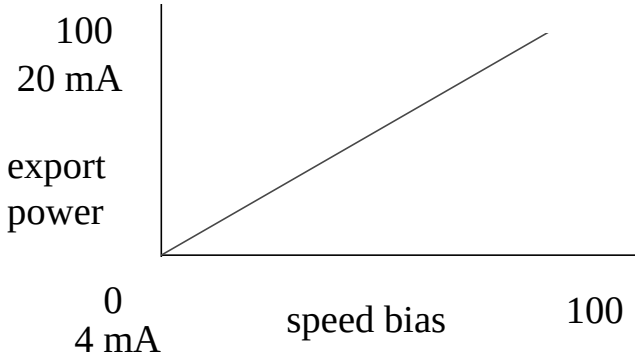


Figure 3-28. Direct (Export) Process Action

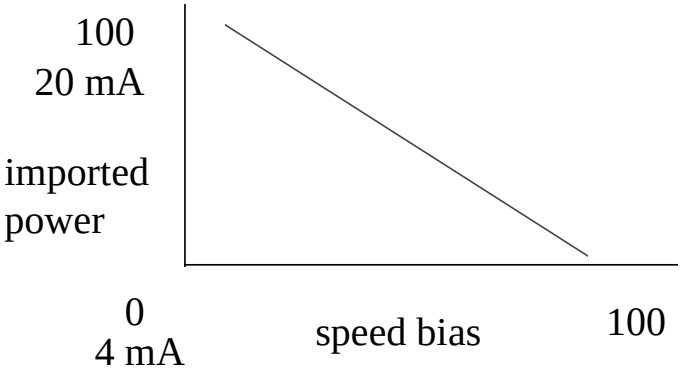


Figure 3-29. Indirect (Import Power) Process Action

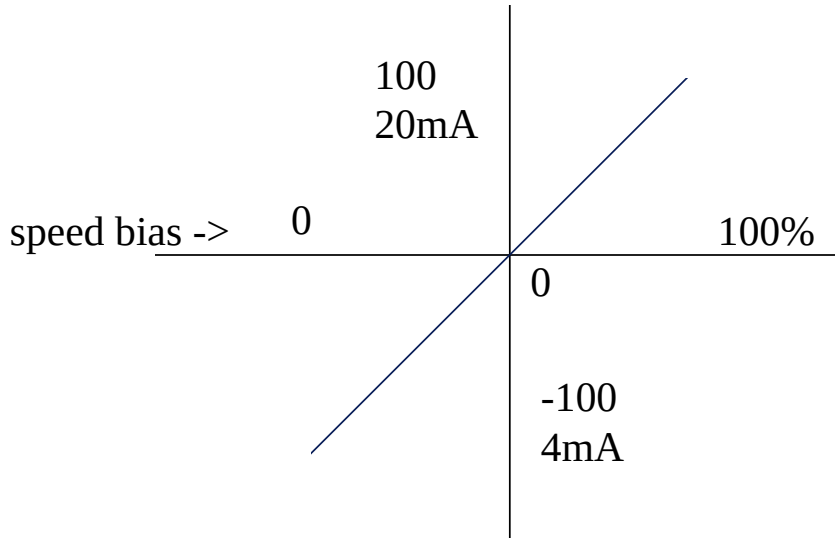


Figure 3-30. Direct (Import/Export) Process Action
(This example is using a 4–12–20 mA transducer.)

Process Import/Export Hardware

- EGCP-2 Control can take a 4–20 mA, or 1–5 Vdc input signal from a transducer. Input signal conditioning is selected by a dip switch on the back of the control, switch position 4, switch number 4. Closing this switch selects the 4–20 mA input hardware. Opening this switch selects the 1–5 Vdc input hardware. See the EGCP-2 layout diagram for switch location on the unit.

SW - 4

1. +5V RS-485
2. 123 ohm RS-485 Termination+
3. 123 ohm RS-485 Termination -
4. 4-20 mA Process Input

Dip Switch # 4

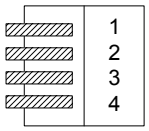


Figure 3-31. EGCP-2 Control Dip Switch

Process Dynamics

- Process Master Uses Process PID to control.
- Gain, Stability, Derivative, Filter, Droop.
- Slaves to the Process Master use Load Control PID Values to track master system load reference.
- Load Gain, Stability, Derivative, Filter.

Process Gain

- Sets system gain response while in process control.
- Effective at active master unit only. Slaves rely on Load Control dynamic settings to control response to master load reference.
- Should be set with maximum number of units operating in process control mode.

Process Stability
- Sets system stability response while in process control.
- Effective at active master unit only. Slaves rely on Load Control dynamic settings to control response to master load reference.
- Should be set with maximum number of units operating in process control mode.

Process Derivative
- Sets system derivative response while in process control.
- Effective at active master unit only. Slaves rely on Load Control dynamic settings to control response to master load reference.
- Should be set with maximum number of units operating in process control mode.

Process Deadband
- ± deadband around process reference point.
- Used to add stability to marginally stable process.

Process Droop
- Introduces negative feedback on the process reference as the process input increases.
- Used to add stability to marginally stable processes.

Process Filter
- Low Pass Filter attenuates higher frequency transients on process 4–20 mA input signal.
- The higher the filter is set, the more active the process control will be to higher frequency process transients.
- The lower the filter is set, the less active, and more stable the process control will be to higher frequency process transients.

Process Reference
- The reference point, in mA, at which the master will control the process input.
- Also used in Soft Transfer modes to set the level of process at which the transfer from mains to generator will occur.

Raise Rate
- Rate, in mA/Sec., at which the process reference will change when the EGCP-2 receives a raise load contact input while operating in process control mode.

Lower Rate
- Rate, in mA/Sec., at which the process reference will change when the EGCP-2 receives a lower load contact input while operating in process control mode.

Process High Limit
- Maximum allowable process reference level. Set in mA.
- Effective on active master unit only.

Process High Limit Alarm
- Sets alarm mode when process High Limit is reached.

Process Low Limit
- Minimum allowable process reference level. Set in mA.
- Effective on active master unit only.

Process Low Limit Alarm
- Sets alarm mode when process reference reaches the Low Limit.

Transfer Switch

Check Mains Breaker (enabled/disabled)
- Used to activate checking of mains C.B. Aux. Discrete input when enabled.
- If disabled, unit relies on other units with this setpoint enabled to broadcast state of mains C.B. Aux. contact over network.
- Units Controlling Mains Breaker must have Check Mains Breaker Enabled.

Fast Transfer Delay
- Time required for a transition in switching from Mains to Generator operations, and from Generator to Mains operations. This includes transition times between bus and mains sensing.

Mains Stable Delay
- Period of time required for the mains to be declared stable (within voltage and frequency limits for the specified time) before transition from generator(s) to mains.

Generator Stable Delay
- Period of time generator must be declared stable (within voltage and frequency limits for the specified time) before transition from Mains to Generator, as well as dead bus closing.

Load Surge (% rated load/sec)
- Used only in Base Load or Process Control. (Mains Parallel Operations)
- Set to trigger at a percent setpoint of total generator load shift per second while operating in Mains Parallel.
- Can be set for Loss of Mains Detection.
- Instantaneous Trigger.

Load Surge Alarm
The load surge condition will cause a response defined by this setpoint. The available responses are:
- Disabled
- Warning
- Loss of Mains
- Loss of Mains with Alarms

Main Volt High Limit (numeric)
- Alarms when Mains Voltage exceeds Alarm Setpoint.
- Alarm can be set for Loss of Mains.
- If Mains Voltage is above High Limit, Mains are not considered stable, and the EGCP-2 control will not issue a mains breaker closure command.

Main Volt High Alms
The Main Volt High condition will cause a response defined by this setpoint. The available responses are:
- Disabled
- Warning
- Loss of Mains
- Loss of Mains with Alarms

Mains Volt Low Limit (numeric)
- Alarms when Mains Voltage drops below setpoint.
- Alarm can be set for Loss of Mains.
- If Mains Voltage is below Low Limit, Mains are not considered stable, and the EGCP-2 control will not issue a mains breaker closure command.

Main Volt Low Alm
The Main Volt Low condition will cause a response defined by this setpoint. The available responses are:
- Disabled
- Warning
- Loss of Mains
- Loss of Mains with Alarms

Main Frequency High Limit (numeric)
- Alarms when Mains Frequency exceeds Alarm Setpoint.
- Alarm can be set for Loss of Mains.
- If Mains Frequency is above High Limit, Mains are not considered stable, and the EGCP-2 control will not issue a mains breaker closure command.

Main Freq High Alm
The Main Frequency High condition will cause a response defined by this setpoint. The available responses are:
- Disabled
- Warning
- Loss of Mains
- Loss of Mains with Alarms

Mains Frequency Low Limit (numeric)
- Alarms when Mains Frequency drops below setpoint.
- Alarm can be set for Loss of Mains.
- If Mains Frequency is below Low Limit, Mains are not considered stable, and the EGCP-2 control will not issue a mains breaker closure command.

Main Freq Low Alm
The Main Frequency Low condition will cause a response defined by this setpoint. The available responses are:
- Disabled
- Warning
- Loss of Mains
- Loss of Mains with Alarms

LOM Action Delay (numeric seconds)
- Sets Time Delay for LOM Action to begin once Loss of Mains is detected.
- Delay time From LOM detection to mains breaker open, and engine start command.
- In applications where the utility bus is somewhat unstable, this setting can be used to prevent momentary disruption of the mains frequency or voltage on from causing unwanted Loss of Mains actions to occur.

Sequencing and Comms (Communications)

Automatic Sequencing (enabled/disabled)
- Enables or Disables Auto Sequencing for that unit.
- Can be used to disable sequencing for a particular unit in a sequencing system if needed.
- Disabling at the master disables all auto sequencing.

Maximum Generator Load
- % system load on all units with gen breakers closed, and on the same network, in Auto, and in Load Sharing or Process control modes, at which active master unit will begin timing to sequence next unit on line.

Next Genset Delay
- Period of time that will pass before master auto sequences an additional generator on line after the Maximum Generator Load Setpoint is exceeded, and remains exceeded.
- Delay is effective only in active master unit.

Rated Load Delay
- Delay when system load exceeds 100%, before master starts next genset in sequence.
- Overload condition fast sequence operation.
- Rated Load Delay function overrides load ramping on unit being sequenced on line. That unit will immediately assume its proportion of the system load.

Maximum Start Time
- Time allowed by master to see next unit to be sequenced on line in an “active” condition, i.e. started and ready to load.
- This is determined by a network flag, which indicates the unit is ready to load, is sent over the network by the unit being sequenced on by the master.
- If master does not detect this flag within the Max. Start Time allowed, it will go to the next lower priority unit and try starting it, or if no other units are available, it will retry the start command on the same unit.

Minimum Generator Load

- % of system load at which active master begins timing to sequence units off line.
- With only two engines operating, the Master unit will NOT sequence off the next unit if the System Load Percentage will increase above the **Max Gen Load Setpoint –10**.

Example: Max Gen Load = 60%; Min Gen Load = 30%

With two engines operating, the Max Gen Load setpoint is viewed as 50%, so the System Load Percentage must be 25% or less to sequence off the next unit. This provides a buffer so that when there is a System Load Percentage that is moving between 29 and 31%, the EGCP-2 will not sequence the unit off and then sequence it back on.

Reduced Load Delay

- Time in seconds which the active master waits before sequencing units off line.
- Delay is effective only on active master unit.
- Lowest priority units are sequenced off line first.

Maximum Stop Time

- Time in seconds allowed by master for slave to sequence off line.
- Master begins sequencing next lowest priority unit off line if system load is still above Min. Gen. Load setpoint at the end of the Max Stop Time Limit.

422 Protocol

- This setting defines the protocol used on the EGCP-2's RS-422 port. Make sure you are familiar with the various settings by reading the Serial Communications section of this manual completely before deciding on which protocol to use. Improperly setting this item may cause a loss of communications with the EGCP-2 on the RS-422 port.

IMPORTANT **Changes in the 422 Protocol setpoint do not take effect until input power is cycled to the control.**

ServLink

- Sets RS-422 Serial Communications to ServLink Protocol

Modbus®

- Sets RS-422 Serial Communications to Modbus RTU Protocol

Upload Setpoints

- Sets RS-422 Serial Communications to Upload Setpoint mode.

Modbus ID

- Sets the Modbus RTU network ID of the Unit. Units can only be Modbus slaves.

Modbus Timeout

- Sets the timeout time for Modbus communications. See the Serial communications section of this manual for details.

Modbus Reset

- Can be used to reset the Modbus error indications for the unit.

Calibration Menu

While each unit will be factory calibrated at Woodward prior to shipment, there are bound to be some inputs/outputs affected by external wiring and/or interfaces (relays, transformers, etc.) that will require calibration at the site during commissioning.

The Calibration Menu allows calibration of all the analog inputs to the EGCP-2, as well as the speed bias and voltage bias outputs.

All calibration points in the EGCP-2 are used to make the actual value of an input, such as generator voltage, read out on the respective display screen of the EGCP-2 the proper value of the signal being monitored.

In order to assist in calibrating the unit, each calibration menu item has the sensed input being calibrated displayed on the lower two lines of the right hand LCD screen. These values are updated every 200 milliseconds. All adjustments in the configuration menus are immediate in their action (that is, values do not need to be entered into memory to have an effect on the sensed input, or control operation).

Example: 380 Vac measured line to line on the generator A-B phase should read 380 Vac in the line to line voltage measurement area of the EGCP-2 “generator status” menu. The EGCP-2 is configured for Line to Line voltage input.

The calibration menu item “PT Phase A Scale” will display the A-B generator phase voltage in the lower to lines of the display. This value will change as the PT Phase A Scale value is adjusted.

Process Input Scale

- Actual Input 4–20 mA, or 1–5 Vdc process signal from external transducer.
- Monitor the Pin (process in) reading in the Load Control Monitor menu.
- Calibrate Process input scale until Pin reads accurately what measured process signal is.
- Engine must be in a test or run mode and operating to observe the Pin value in the lower two lines of the setpoint screen.

Measured vs Monitored

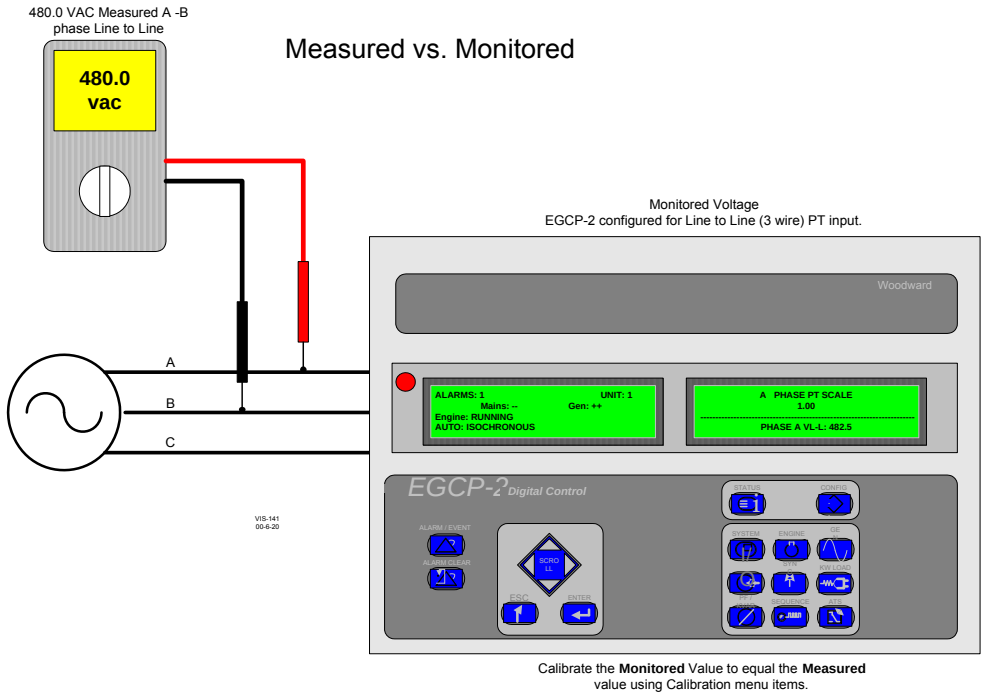


Figure 3-32. Measured vs. Monitored

Speed Bias Offset

- Factory calibrated for 0 Vdc offset on ±3 Vdc range.
- All Woodward Speed controls operate with this bias output, so no calibration should be required.
- Calibration may be required for other manufacturer's speed controls.

Voltage Bias Offset

- Factory set for zero Volts DC.
- Configuration selectable ±1 Vdc, ±3 Vdc, ±9 Vdc range.
- Some regulators require a positive voltage bias offset because they cannot receive a negative voltage bias command. Any bias offset calibrated into the voltage bias will be displayed in the I/O status menu.
- The EGCP-2control will always reset to the voltage bias offset when off line.

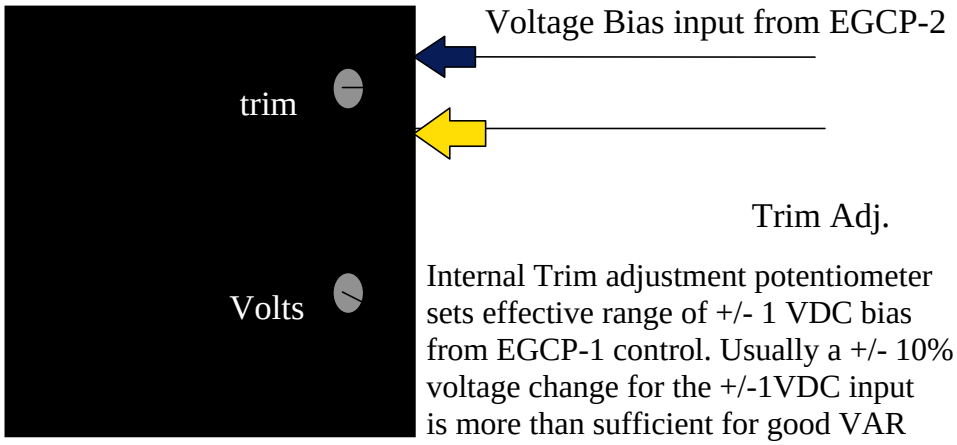


Figure 3-33. Typical AVR with Aux Input (Newage SX-440)

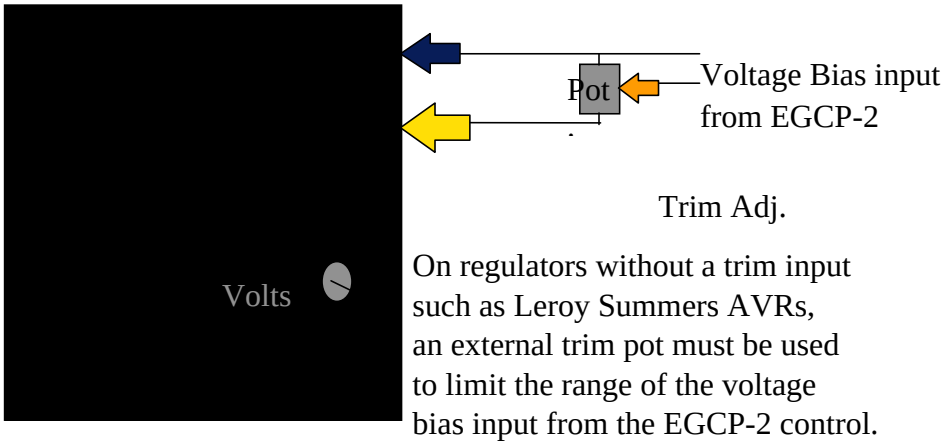


Figure 3-34. Typical AVR with External Voltage Adjust Potentiometer

AVR DROOP

- It is ***highly recommended*** to fit the AVR with a Droop CT input, and utilize a medium droop level on the AVR. This adds stability to the AVR for VAR/PF sharing at low loads.
- Cross current compensation should be disabled in the AVR Droop CT circuit.

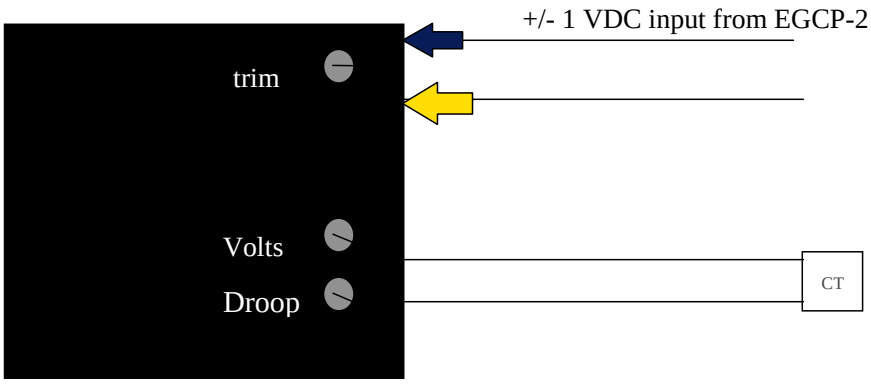


Figure 3-35. AVR Droop

PT Phase A Scale

- Calibrates PT phase A voltage input.
- Adjust PT Phase A scale until these values match measured generator voltage on A phase.

PT Phase B Scale
PT Phase C Scale

- Same as above, but for B and C phases of Gen.

CT Phase A , B and C Offset

- Calibrates CT Phase A , B , Or C input sensing of EGCP-2 at zero current.
- Measure actual gen. currents with clamp on ammeter, or panel ammeter. Verify 0 Amps on the selected phase input.
- Calibrate selected phase CT reading in the calibration window.
- NOTE: The current reading does not go negative. Therefore, make sure when zeroing the value that the offset adjustment is made so the current reading just turns to zero. Verify this by increasing the offset value, seeing a slight positive current reading, and then slowly adjust the offset value in small increments until the current reading just changes from a positive value to zero (0.0).

CT Phase A Scale

- Calibrates CT Phase A sensing of EGCP-2.
- Load generator and monitor gen. currents in phase overview menu.
- Measure actual gen. currents with clamp on ammeter, or panel ammeter.
- Calibrate phase A CT reading in phase overview.

CT Phase B Scale
CT Phase C Scale

- Same as CT setup for phase A.
- If CT polarity is reversed, that phase will read negative KW when loaded in the Phase overview menu.
- If CTs are on the incorrect phases, then KVAR readings in phase overview will be much higher than normal.

Bus PT Scale

- Similar to Gen PT scaling, but this scale is for single phase bus PT input to the EGCP-2.
- Put EGCP-2 synchronizer in “check” mode in synchronizer setup menu.
- Start engine in run/load mode to a live bus (either paralleling to another genset, or the Mains).
- Monitor Synchroscope status menu. Observe and calibrate U: volts reading until measured matches monitored.

Synchronizer

- Calibrates phase angle error detection of EGCP-2.
- Factory calibrated for zero phase angle error between bus and mains A phase (depending on synchronizing operation) and A phase generator inputs.
- With synchronizer in “check” mode, and a live bus, monitor the synchroscope menu of the EGCP-2 for “phase angle”.
- Monitor Voltage across open gen contactor/breaker or panel synchroscope for phase angle error between generator and bus.
- Adjust synchroscope calibration for lowest voltage across gen breaker, or 12 o’clock reading on panel mounted synchroscope.

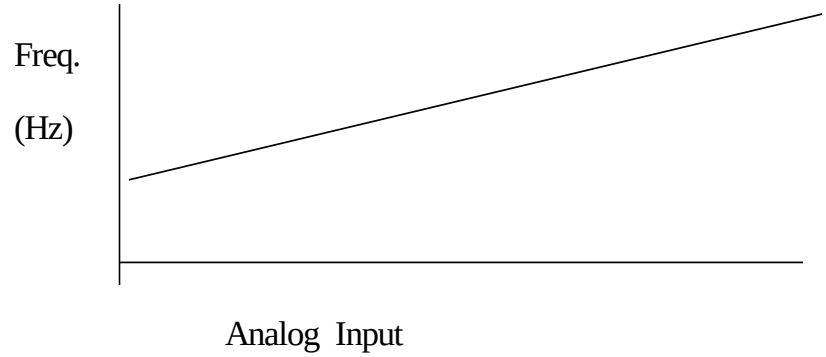


Figure 3-36. Direct proportional input to Water Temp or Oil Pressure Input.

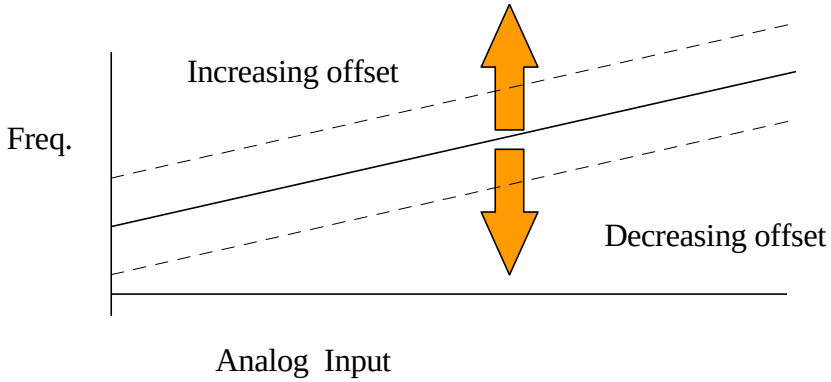


Figure 3-37. Voltage Controlled Oscillators—Effect of Offset

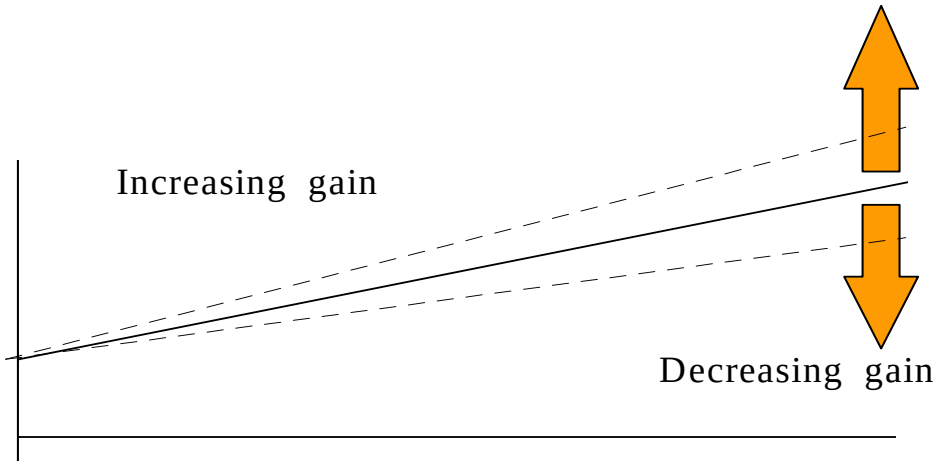


Figure 3-38. Voltage Controlled Oscillators—Effect of Gain

Battery VCO Gain

- Sets slope of battery input over operating range.

Battery VCO Offset

- Sets level, or offset of Battery input over operating range.
- Battery Voltage is a linear increasing type input function.

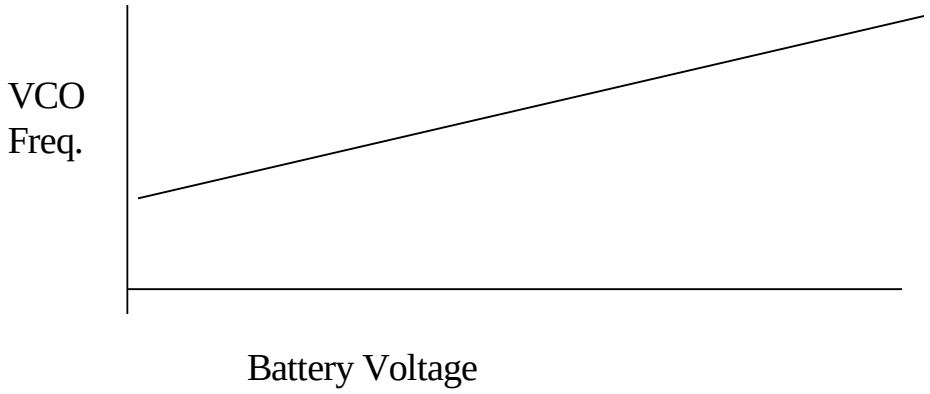


Figure 3-39. Battery VCO

Oil Pressure Gain

- Oil Pressure sensor input.
- Ohm sensor on engine is a direct, mostly linear function.
- Sets slope of oil pressure input.
- Monitor Engine Overview menu of EGCP-2 and compare to measured oil pressure of engine with engine running at rated speed.
- Adjust gain for proper oil pressure reading while engine is operating.

Oil Pressure Offset

- Sets level, or offset of oil pressure input to VCO frequency.
- Set to read 0 psi in Engine Overview menu of EGCP-2 with engine off.
- Gain and Offset DO affect each other, so it is necessary to check adjustments at both ends of the scale (0 psi to operating psi) if an adjustment is made to either gain or offset.

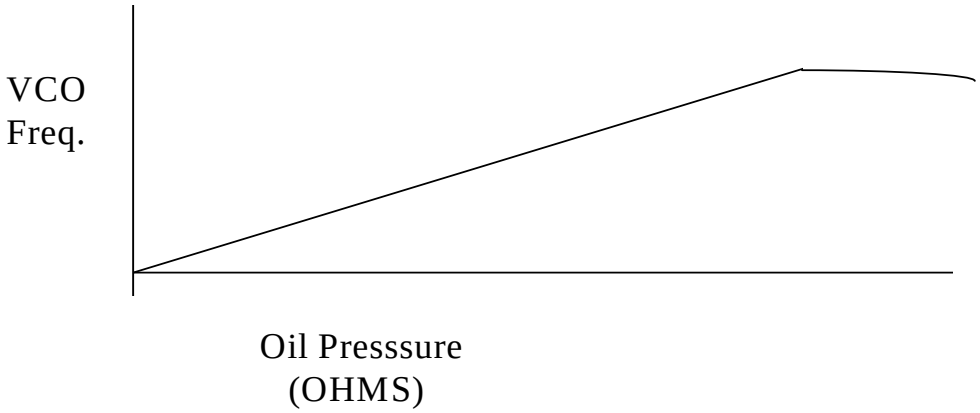


Figure 3-40. Oil Pressure VCO

Water Temperature Gain

- Water Temperature input.
- Inverse, Non-Linear 0–200 Ω engine mounted sensor shown.
- If using a non linear resistive style input, utilize Shunt resistor dip switches on back of EGCP-2 (SW-2, 3 and 4 ON). These resistors help to linearize the sensor input.
- Sets slope of water temp. input.
- Monitor Engine Overview menu of EGCP-2 control and compare to measured water temperature of engine with at low operating temperature.
- Adjust gain for proper water temperature reading while engine is operating.
- Calibration Menu.

Water Temperature Offset

- Sets level, or offset of water temperature input.
- Monitor Engine overview, and with engine operating at normal temperature, adjust Water Temperature offset for proper temperature reading.
- This is an inverse function. Sensor resistance DECREASES as engine temp increases.

Water Temperature

- Testing of a sample of Oil pressure sensors with the EGCP-2 control has shown the typical sensor to require the following gain/offset for Ain1 in the calibration menu:
- Gain 0.0242
- Offset -11.90
- Testing of a sample of Water Temp Sensors has shown the typical temp sensor to require following gain and offset settings:
- Gain -0.0389.
- Offset 246.0.
- Shunt Resistor Switches 3 and 4 closed on SW-2 of EGCP-2 control.

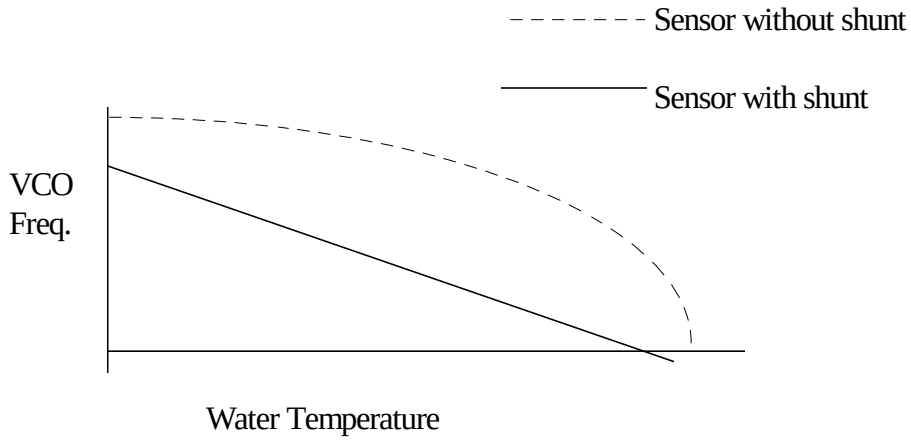


Figure 3-41. Water Temperature VCO

NetComm Dropouts

- The number of lost or corrupted network communications tolerated by the receiving unit.
- Excess numbers of NetComm Dropouts on network due to faulty wiring, improper shielding, or improper setup will result in the unit experiencing the dropouts to flash intermittently in the Sequencing Menu of the EGCP-2. Typically set at 5 to 10 dropouts.

Unit Calibrated (true/false)

- When set for true, indicates unit has been factory calibrated. Requires Level 4 Security code to change.

Chapter 4.
Control Features and Functions

Engine Control

- Programmable Auto Start on Loss of Mains
- All units in Auto Mode with Loss of Mains detection enabled start and assume load.
- Multiple Crank Repeat Setpoint
- Crank Repeat Timer
- Crank Fail Alarm/Shutdown
- Crank Cutout (rpm)
- Preglow
- Idle/Rated Relay

Engine Protection

- Oil Pressure
- Over/Under Alarm/Shutdown Settings
- Water Temperature
- Over/Under Alarm/Shutdown Settings
- Battery Voltage
- Over/Under Alarm/Shutdown Settings
- Overspeed
- Alarm/Shutdown Settings

Generator Voltage and Reactive Load Control

- VAR or Power Factor Load Control in Mains Parallel Operation
- Power Factor Sharing in Load Sharing, No Parallel Operation
- Externally Adjustable VAR/PF Reference
- Manual Voltage Control Capability

Generator Protection

- Over/Under Voltage
- Over Current
- Reverse Current
- Loss of Excitation
- Over/Under Frequency
- Stable Generator Determined by being within Voltage and Frequency Limits for a given period of time.
- KVA Load Switch

Mains Sensing

- Over/Under Voltage
- Over/Under Frequency
- Load Surge
- Programmable for Alarm/Loss of Mains Detect
- Loss of Mains Action Timer
- Stable Mains determined by being within Voltage and Frequency Limits for a given period of time

Synchronizing

- Phase Match Synchronization
- 3 Mode Operation
- run, check, permissive
- Voltage Matching
- Dead Bus Closing
- Synch Timer
- Reclose Attempt/Timer
- Manual Synchronization Capability (permissive mode)

Load Control

- Proportional Load Sharing
- Integrating Base Load and Process Control
- Load Ramping
- Remote Contact Inputs to change Base Load and Process Setpoints with Raise/Lower ramp rates
- Unload Trip point
- Droop Load Control Capability

Sequencing

- Each Unit in the system has an assigned Priority.
- Master (Highest Priority) automatically sequences units on or off line as determined by system load.
- Higher priority units are sequenced on in order of their priority; taken off in reverse of priority.
- System Load setpoint determines percent system load level at which additional units will be brought on, or taken off line.
- Time setpoints determine period of delay for sequencing units on/off line.
- Separate time delay for overload (100% +) system load levels so additional units can be sequenced on line quickly.

Engine Cranking

The EGCP-2 Control is designed to automatically control the cranking functions of the engine generator set. In order to safely control engine cranking the EGCP-2 uses the following setpoints, as found in the Engine Control tuning menu of the software:

Preglow Time	Crank Delay
Crank Time	Crank Repeats
Crank Cutout	

The description of the above items is found in the Tuning Screens section of this manual in the Configuration Menu list.

Starting Sequence:

Upon receiving a start command the following events occur:

1. The Preglow Output Energizes for the given preglow time delay, and remains energized through the crank cycle.
2. After the preglow time expires, the Fuel Solenoid output energizes.
3. 200 ms after the Fuel Solenoid output energizes, the Crank output energizes.

At this point, the engine should be cranking at a certain rpm, and receiving fuel. Typically a start would occur in these conditions. To check if a start does occur, the EGCP-2 monitors the magnetic pickup from the engine. If the magnetic pickup input indicates that the engine is operating above the Crank Cutout speed, the EGCP-2 will remove the Crank and Preglow outputs, leaving the fuel solenoid energized. The engine state in the control overview menu changes from “OFF” to “RUN”.

If for some reason the engine does not reach the crank cutout rpm level, the EGCP-2 will crank the engine for the Crank Time. If the engine fails to rise above the crank cutout level in this time, the EGCP-2 will remove the Crank output signal, wait for the Crank Delay, and if allowed by the number of Crank Repeats, will crank the engine again (RETRY). This sequence will continue until the number of crank repeats is depleted, or until the engine speed rises above the crank cutout rpm setting, whichever comes first. If the number of crank repeats is depleted, the EGCP-2 will activate the Crank Fail Alarm Output based on this Alarm setpoint’s configuration.

IMPORTANT

The preglow output may stay energized between crank attempts if the preglow time is greater than the sum of the Crank Time and Crank Delay timers.

IMPORTANT

Set Crank Repeats to zero when starting the engine for the first time with the EGCP-2. This will prevent starter and ring gear damage to the engine if the MPU input to the control should be faulty. Monitor Engine Overview Status menu on the first start and confirm the rpm readout during cranking. After a successful start is made, the crank repeats may be set to the appropriate value for the application.

IDLE/RATED Relay Output

The EGCP-2 can be configured to provide a relay output which will signal the engine electronic speed control to change from idle to rated speed operation. When configured for this output, Discrete Output 12 will energize to provide the idle to rated indication.

The idle to rated indication takes place after a successful start (generator above crank cutout speed) has occurred, the engine is operating at, or above the idle speed setpoint, and the idle delay time setpoint has expired.

Generator Voltage Control

The EGCP-2 has the ability to control the voltage of the generator set. This ability is used to control four separate operations which require generator voltage adjustment:

1. Manual voltage adjustment
2. Voltage Matching during Synchronization across the generator or mains breaker
3. Reactive load sharing between multiple units on an isolated bus
4. Reactive load control while in parallel with the mains.

The generator voltage, or reactive load (depending on the operation) is adjusted by injecting a voltage bias signal to the Automatic Voltage Regulator. The EGCP-2 can be set for ±1 Vdc, ±3 Vdc, and ±9 Vdc outputs. The span of the output is selected by the “Voltage Bias Type” configuration menu item in the EGCP-2.

Select the proper voltage range input as recommended by the AVR manufacturer.

Generator Voltage can be manually controlled from the Voltage Raise and Voltage Lower Discrete inputs to the EGCP-2. The rate of change for manual voltage adjustment is set in the Reactive Load Control tuning menu, at the Voltage Ramp Time setpoint. The voltage ramp time is the amount of time it will take for the EGCP-2 to send a 0 to 100%, or 0 to –100% voltage bias signal to the AVR.

When operating in the TEST mode, manual voltage adjustment is only allowed through the voltage raise and lower inputs. This allows testing of the Voltage Bias output, and generator voltage levels prior to operation with load on the generator.

When operating in Isoch mode, the EGCP-2 does not allow manual adjustment of the voltage, unless the Load Control setpoint in the Configuration tuning menu is set for “Droop”, or the VAR/PF Control Setpoint in the Reactive Load Control tuning menu is set to “Disabled”. Using either of these settings implies that a manual voltage control will be used, and no automatic reactive load control functions are active.

IMPORTANT

It is highly recommended that the automatic reactive load control in the EGCP-2 be used for proper power conditioning throughout the generator(s) load range. This is achieved by setting the Load Control setpoint in the Configuration tuning menu to Normal, or Soft Transfer (depending on the application), and the VAR/PF Control setpoint in the Reactive Load Control tuning menu to VAR or PF control (depending on the application). For more details on these functions see the Real Load Control and Reactive Load Control sections of this manual.

The percent level of the voltage bias output can be monitored in the I/O Display status screen of the EGCP-2. This is a useful point to monitor during initial start of the unit. By issuing Voltage Raise and Lower inputs to the control while operating in the Test Mode, confirmation of proper generator voltage levels at various voltage bias points can easily be made. Typically the generator voltage should change no more than ±10% for a ±100% voltage bias output from the EGCP-2.

All other modes of generator set operation rely upon the Reactive Load Control functions of the EGCP-2. See the information in the “Reactive Load Control” section of the manual for more details on voltage and reactive load control.

Generator Load Control

Power Sensor Theory of Operation
The digital signal processing (DSP) power measurement technique used by the EGCP-2 control involves periodic sampling of the voltage and current over an integral number of wave forms. The microprocessor computes the product of the voltage and current samples, then sums and averages the products to give a computation of power.

Load Sensor Hardware Description
The digital load sensor gets timing information from the generator A phase voltage signal. Voltages proportional to the voltage and load current for each phase are routed to the sample-and-hold circuits of the A/D converters. The simultaneous sampled values representing voltage and current are held when a conversion-store signal is received from the microprocessor. Each input is then converted and an interrupt is generated when all inputs are converted. The microprocessor then reads the digital values from A/D registers. This procedure is repeated at regular intervals to provide input for further signal processing.

To provide accuracy in the presence of noise and harmonics on the inputs, multiple samples of each wave form over a number of cycles of the input are taken to get the power measurement.

The EGCP-2 Control has four core modes of generator load control operation. These four modes are:

- Droop
- Isochronous Load Sharing
- Base Load
- Process Control

The specific mode of generator control that the unit is in at any given time can be monitored on the Control Overview Menu.

Here is a description of each of these load control modes, and the various operating states that will put the EGCP-2 into each respective load control operation.

Droop

Droop Load Control in the EGCP-2 uses the sensed KW on the generator to provide negative feedback to the speed reference of the speed control governor through the speed bias output. This will result in a decrease in generator frequency as the load is increased while operating as a single unit on an isolated bus. Increasing the Speed Raise input while operating in this manner will increase the speed of the engine gradually, thereby increasing the frequency of the generator set.

While operating in parallel with the mains, droop operation provides KW load control of the generator through the speed raise and speed lower inputs to the EGCP-2. Since the mains determine the frequency of the generator, changing the speed reference while in parallel with the mains causes a change in KW.

Droop load control is typically only utilized during commissioning of the EGCP-2. It allows complete manual control of the generator load while in parallel with the mains.

The EGCP-2 can only be operated in droop if the configuration tuning menu setpoint labeled " Load Control" is changed to the "Droop" value, or if the unit is operated with the Generator CB Aux input open while connected to a load, or to the mains. No other operations, or software setpoints can change the droop load control mode setting.

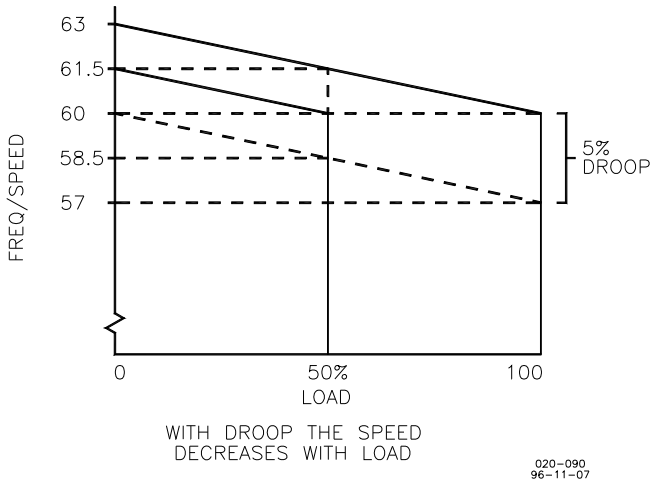


Figure 4-1. Droop Mode

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 4-2. This mode can be used on one generator set running by itself in an isolated system.

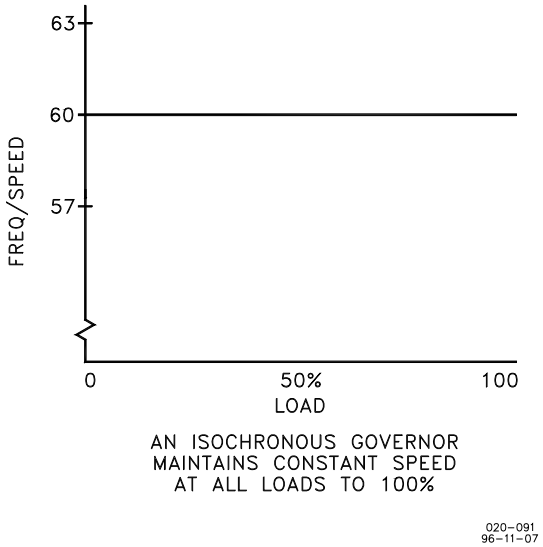


Figure 4-2. Isochronous Mode

The isochronous mode can also be used on a generator set connected in parallel with other generator sets. Unless the generator set controls have the capacity for load sharing and speed control, no more than one of the generator sets operating in parallel can be in the isochronous mode. If two generator sets operating in the isochronous mode without load sharing capability are tied together to the same load, one of the units will try to carry the entire load and the other will shed all of its load. In order to share load with other units, some additional means must be used to keep each generator set from either trying to take all the load or from motorizing.

Droop/Isochronous Load Sharing on an Isolated Bus

Droop/Isochronous combines the first two modes. All generator sets in the system except one are operated in the droop mode. The one unit not in droop is operated in the isochronous mode. It is known as the swing machine. In this mode, the droop machines will run at the frequency of the isochronous unit. The droop and speed settings of each droop unit are adjusted so that each generates a fixed amount of power as illustrated in Figure 4-3. The output power of the swing machine will change to follow changes in the load demand.

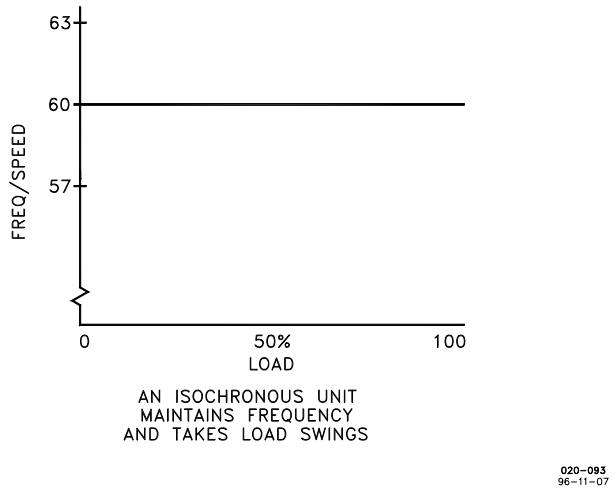


Figure 4-3. Droop/Isochronous Load Sharing

Maximum load for this type of system is limited to the combined output of the swing machine the total set power of the droop machines. The minimum system load cannot be allowed to decrease below the output set for the droop machines. If it does, the system frequency will change, and the swing machine can be motorized.

The machine with the highest output capacity should be operated as the swing machine, so that the system will accept the largest load changes within its capacity.

Isochronous Load Sharing on an Isolated Bus

Isochronous Load Sharing is the most common means of paralleling multiple generators together to a common load on an isolated bus. The EGCP-2 uses Isochronous Load Sharing control when operating in a Multiple Unit mode with the Load Control Mode in either Normal or Soft Transfer. Isochronous load sharing operates all generator sets in a system in the isochronous mode. Load sharing is accomplished by using the load sensor of the EGCP-2 to bias the speed reference of the isochronous governor. The EGCP-2 load sensors are connected by inter-control RS-485 network. In the case of the EGCP-2 control Isochronous Load Sharing is done digitally via this network. Any imbalance in load between units will cause a change to the regulating circuit in each governor. While each unit continues to run at isochronous speed, these changes force each machine to supply a proportional share of power to meet the total load demand on the system.

Base Load Against the Mains

Base Load is a method of setting a base or fixed load on a machine operating in parallel with the mains. The EGCP-2 control operates the generator set in base load whenever the generator is in parallel with the utility, unless a process control mode of operation is selected through the Process discrete input. This is accomplished by using an isochronous load control and providing a reference at which to control the load. The governor will force the generator output to increase or decrease until the output of the load sensor is equal to the reference setting. The base load reference is set in the Real Load Control tuning menu of the EGCP-2. At this point, the system is in balance.

The advantage of base loading over droop is that when separating from a Mains, there is no frequency change. Simply removing the bias signal required to maintain the base load reference on breaking from the Mains (mains CB Aux open) returns the system to isochronous load control.

The EGCP-2 is only allowed to parallel with the mains in a Mains Parallel operating mode. When configured for this type of operation, the EGCP-2 will operate in either a base load or process control mode while in parallel with the mains. The EGCP-2 automatically switches between base load and isochronous operation depending upon whether or not the Mains Breaker CB Aux input is closed at the same time the Generator CB Aux input is closed. If both the Mains and the Generator CB AUX are closed, then the EGCP-2 realizes it is in parallel with the mains, an operates in a base load control mode. The EGCP-2 will operate in a process control mode, which is discussed later in this section, if both the Process and Run with Load discrete inputs are active (on).

Automatic Generator Loading Functions

The automatic generator loading functions of the EGCP-2 control are designed to be used with the speed control to automatically control the loading and unloading of the generator. This accomplishes a bumpless transfer when paralleling the generator to a load sharing or infinite bus system, or when separating a generator from a system.

Process Control Description
The process control function of the EGCP-2 control will control any process where the controlled parameter is determined by the generator load, and the controlled parameter can be monitored as a 4–20 mA or 1–5 Vdc input signal.

The control compares the input signal to the Process Reference setpoint in the Real Load Control tuning menu of the EGCP-2. This setpoint uses milliamps for units so that it is easily related to the 4–20 mA or 1–5 Vdc input signal. The EGCP-2 then adjusts the generator load to maintain the desired set point. The EGCP-2 will only operate in a process control mode if it is configured to be a Mains Parallel unit, and receives an Auto, Run With Load, and Process discrete input. Also, the EGCP-2 can operate in a process soft transfer mode if the Load Control Mode setpoint in the Configuration tuning menu is set for Soft Transfer, and the Test discrete input is closed with the Run with Load and Process discrete inputs. In a soft transfer mode, the EGCP-2 will load the generator or generators (depending on the application) to the process reference level. Upon reaching the reference value on the 4–20 mA or 1–5 Vdc input signal, the EGCP-2 will open the mains breaker. This Soft Transfer mode is used to transfer the supply of power for the load from the mains to the generator.

In process control mode, the Raise Load and Lower Load contact inputs operate on the process control reference. The ramp time for these Raise and Lower Load inputs while operating in process control mode are set in the Real Load Control tuning menu, at the Process Raise and Process Lower Ramp Rate setpoint. This setpoint is scaled in mA per second.

When the process function is initially selected, the reference is set equal to the internal or remote process reference. If the process input and process reference are not equal, the control ramps the load reference in the appropriate direction to reduce the difference error. When the process error reaches zero or the load reference reaches the maximum or minimum values, the process control is enabled.

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 controller is a load reference which is limited by the High and Low Load Limit set points in the Real Load Control tuning screen to prevent overload or reverse power on the generator. The load setting signal is output from the load control to the speed control to set control at the required load to maintain the desired process level.

In a multiple unit, mains parallel configuration, the master unit (lowest numerical priority) operates as the process master as well. The master unit must receive the 4–20 mA, or 1–5 Vdc process input signal. If the master is operating in an auto mode, and is therefore part of the sequencing and control network between units, then the master unit will control all slave units which are in Auto mode to maintain the process reference of the master. The slave units operate in a load sharing type mode where the total system load is equally divided between the units in proportion to their rated load capacity. The master will also automatically sequence slave units on and off load as required to maintain the process reference.

Additional features of the process control are an adjustable process input signal filter and adjustable deadband on the integrator. The adjustable filter allows reducing bandwidth when controlling a noisy process such as experienced in digester gas fuel applications. The deadband is useful in both noisy applications as well as for very slow processes.

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).

Reactive Load Control Description

When a small generator is paralleled with a Mains, the synchronizer voltage matching function adjusts the generator voltage to match that of the Mains. Voltage variations that may occur in the Mains system after paralleling can cause large changes in reactive current in the generator. The VAR/Power Factor Control provides 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.

Voltage adjustment, however, can only affect reactive power when another system is available to accept the reactive load. So the VAR/Power Factor control functions are automatically switched to Power Factor sharing when either single or multiple units are operating in isochronous load sharing mode on an isolated bus (Mains CB Aux is open).

The VAR/PF control mode of operation is selected by setting the VAR/PF Control Mode set point in the Reactive Load Control tuning menu. When either VAR or PF control mode is selected, the control function is enabled whenever the Generator CB Aux contact is closed, and the control is configured for either Normal or Soft Transfer Load Control. VAR/PF control is overridden when the Load Control Mode is set for Droop operation. The VAR/PF control can be disabled by setting the VAR/PF Control Mode setpoint to Disabled. The voltage bias output is reset to 0% when the generator CB Aux input is opened.

IMPORTANT

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 CT must remain connected to the voltage regulator.

VAR Control

The VAR control adjusts generator voltage to maintain a constant reactive power (kVAR) load on the generator throughout the KW operating range while the generator is in parallel with the mains. This assures sufficient excitation of the generator field under all load conditions. A set point is provided to set the desired VARs. The VAR control function may be enabled with VAR/PF Control mode selection set point. The KVAR reference may be changed once the generator is in parallel with the mains by issuing a raise/lower voltage contact input to the EGCP-2. Raising the KVAR reference will raise the voltage bias output to the voltage regulator, which will cause VARs to be exported to the Mains. Lowering the VAR reference will decrease the voltage bias output to the regulator which will cause VARs to be absorbed from the utility.

Power Factor Control

The power factor control adjusts generator voltage to maintain a constant power angle throughout the KW operating range while the generator is in parallel with the mains. A set point is provided to set the desired power factor reference. The power factor control function may be enabled with the VAR/PF Control mode selection set point. The PF reference may be changed once the generator is in parallel with the mains by issuing a raise/lower voltage contact input to the EGCP-2. Raising the PF reference will raise the voltage bias output to the voltage regulator, which will cause the PF to move in an increasing lagging PF angle. Lowering the PF reference will decrease the voltage bias output to the regulator which will cause PF to move in an increasing Leading PF angle.

Power Factor Sharing

When either VAR or Power Factor Control is selected, and the EGCP-2 control is operating in isochronous load sharing mode, power factor sharing is automatically selected. Power factor sharing adjusts the voltage regulators so that all generators carry the same proportion of reactive load by balancing the power factor on all units. A voltage reference set point is provided to define the system operating voltage. Multiple EGCP-2 controls operating in Power Factor Sharing mode will trim their respective voltages to share the reactive load on the isolated bus, and operate around the voltage reference setting.

Synchronizer Description

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

This section describes how generator and bus matching occurs and how all conditions are verified by the synchronizer functions.

Operating Modes

The EGCP-2 control is capable of synchronizing across both the generator and mains breakers, depending on the application of the generator set, and the configuration of the EGCP-2. An EGCP-2 configured for No Parallel operation will never allow the generator and mains breakers to be closed at the same time, and therefore does not synchronize across the mains breaker. Units configured for Mains Parallel operation will actively synchronize the generator, or in the case of a multiple unit system, generators, to the utility before closing the utility tie breaker.

The EGCP-2 monitors the A phase of the generator and compares this with either the A phase of the Bus PT input, or the A phase of the Mains PT input. The Bus PT input is switched through DO7 (local bus connect). The Bus PT is always monitored whenever the EGCP-2 is synchronizing, or dead bus closing across the generator breaker. Bus PT sensing is a momentary condition as the EGCP-2 will always return to sense the Mains PT input by switching to DO8 (Mains Disconnect) whenever generator synchronization is complete. Switching to the Mains Pt allows the EGCP-2 to monitor for a loss of mains condition when operating on a generator that is not synchronizing across its generator breaker.

IMPORTANT

In systems which operate in parallel with the mains, or with loss of mains detection modes, it is recommended that each EGCP-2 unit in that system receive the Mains and Bus PT inputs for proper operation.

The synchroscope tuning menu is used to configure the synchronizing action of the EGCP-2. The software tuning items in the synchroscope menu apply to both the generator breaker/contactor and mains breaker/contactor synchronizing functions.

The operation of the synchronizer is determined by the three different operating modes available in the EGCP-2. The three modes are Run, Check, and Permissive.

Run mode allows normal synchronizer operation and breaker closure signals. The speed bias signal (explained below) is maintained throughout the breaker closure signal. When the specified closure signal time has elapsed and the CB (circuit breaker) Aux contact closure signal is received at the EGCP-2, the synchronizer is disabled. The synchronizer is reset automatically once the generator is taken off load and its generator breaker is opened.

Check mode allows normal synchronizing and voltage matching, but does not issue a breaker closure signal.

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 for the specified dwell time, the synchronizer issues the breaker closure command.

Dead Bus Closing

When a dead bus is detected and dead bus closing mode is enabled in a multiple unit system, the synchronizer will attempt to get an exclusive lock on permission to issue a breaker closure command. This security is required to prevent two or more units from closing their breakers at the same time. To provide this security, a network message requesting the lock is made to all other EGCP-2 controls currently active on the network.

When an EGCP-2 control receives a lock request, it does the following actions:

1. If a dead bus permission request is not also currently being made, a dead bus condition is indicated, and the GENERATOR AUX CONTACT discrete input is inactive (the EGCP-2 control returns a reply message to the requesting unit).

IMPORTANT

The GENERATOR AUX CONTACT open requirement backs up the dead bus condition in the event of a bus PT failure. If a dead bus condition is indicated by lack of bus voltage, but the generator breaker is closed, a reply will not be sent.

2. If a dead bus permission request is also being made and that request sequentially precedes the received request, the received request is retained, otherwise the reply is sent. (In the event of a sequential tie, the unit with the lower assigned network address wins.)

   When all other units have replied verifying that they also indicate a dead bus (bus input less than 40 Vac) and do not hold a lock, the requesting unit then holds lock permission and may attempt to close its circuit breaker. The lock is released automatically after issuing the circuit breaker closure command. This will allow any other unit to get permission to lock if the breaker fails to close.

The dead bus closing function may be enabled or disabled by the user with the Dead Bus Closure setpoint in the Synchroscope tuning menu.

Voltage Matching

The voltages of the generators in a parallel system must be matched within a small percentage to minimize the reactive power flow in the system. If two synchronous generators of unequal voltage are paralleled, the combined voltage will have a value different from the voltage generated by either of the generators. The difference in voltages results in reactive currents flowing in the system with subsequent lowered system efficiency.

If a synchronous generator is paralleled to a larger system such as a Mains, 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 microprocessor then computes the RMS values of the voltages. The processor issues appropriate adjustment of the voltage bias signal if used, to the voltage regulator to bring the generator voltage within the specified window above the bus voltage. To guarantee that reactive power will be generated, window range is from equal to bus voltage to the specified percentage above bus voltage.

The automatic voltage matching function may be enabled or disabled with a set point. 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. When enabled at an EGCP-2 control which is monitoring and controlling the mains breaker, the voltage matching will occur across both the generator and mains breaker prior to the synchronizer issuing a breaker close command when paralleling the generator(s) to the mains.

Phase Matching Synchronizing

The phase matching synchronizing mode corrects the frequency and phase of the generator to lock it to the bus frequency and phase. The microprocessor 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. A PI (proportional, integral) controller provides the correction signal. Gain and Stability adjustments to the PI controller are provided to allow stable operation of the automatic synchronizer function over a wide range of system dynamics.

Synch-check

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 above bus voltage 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. Also, maintaining the phase angle error between the generator and the bus within a specified Max Phase Window for a specific Dwell Time allows the synchronizer to be configured for a wide range of synchronizing conditions. The Max Phase Window and Dwell Time setpoints are found in the Synchroscope tuning menu of the EGCP-2.

A larger Max Phase Window, and Shorter Dwell time would typically be used on emergency standby sets, where rapid synchronization is needed. The larger window and shorter dwell time make the synchronizer less sensitive to transitions in generator frequency and phase angle error when compared to the bus the generator is synchronizing to. When all conditions of voltage and phase are met, then the breaker closure command is given.

A smaller Max Phase Window and Longer Dwell Time would be used on generating systems where smooth and precise synchronization is required, and the time to synchronize is not as critical as would be seen in a standby application. A smaller window and longer dwell time require the generator to be within closer frequency and phase angle error tolerance when compared to the bus the generator is synchronizing to. When all conditions for 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 control provides set points for the number of close tries and the reclosure delay timing. Failure to get closure after the specified number of tries locks out the synchronizer by setting it to the auto-off mode and, if the alarm is enabled, energizing the appropriate alarm relay output. The synchronizer must then be reset by clearing the alarm condition in the Alarm/Event Log. The multiple shot closing function is disabled by setting the reclosing count to one.

Synchronizer Timing

The time line diagrams below illustrate the various timing sequences the synchronizer function uses when paralleling single and multiple units across the generator or mains breaker (depending on application).

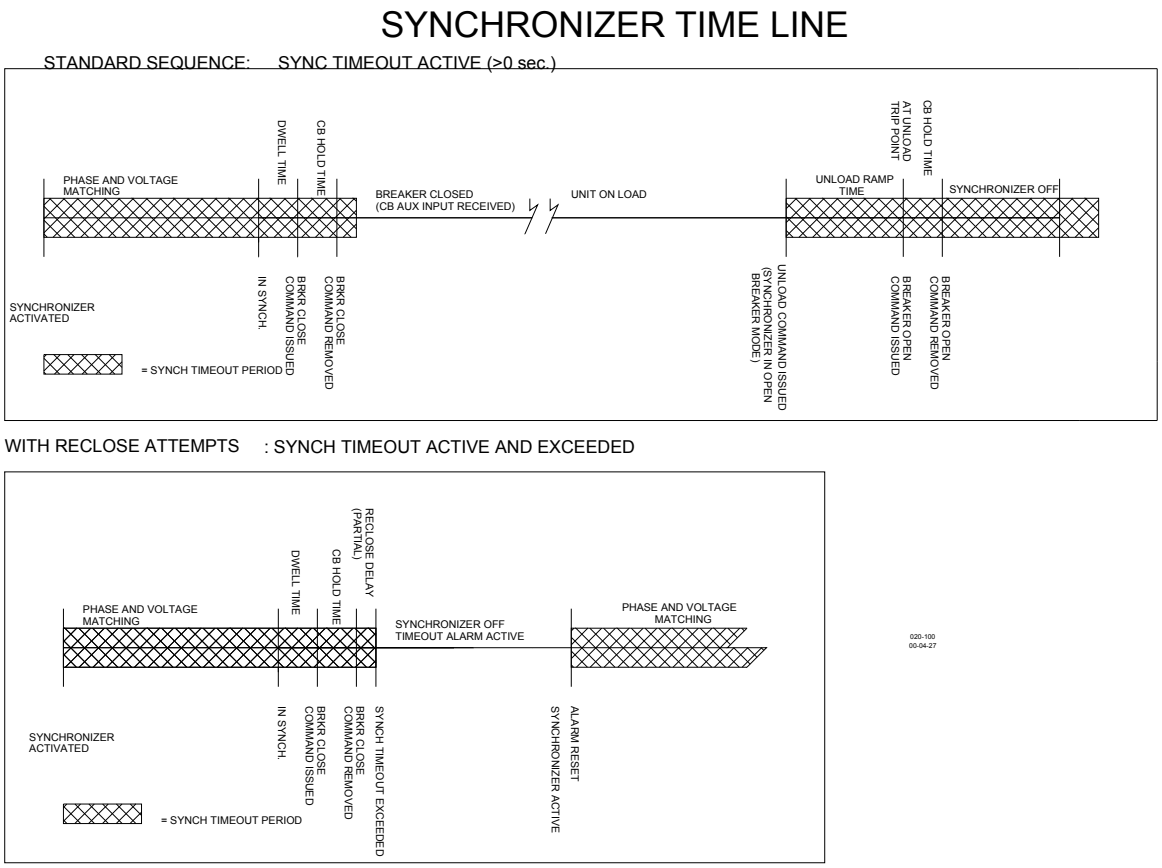


Figure 4-4. Synchronizer Time Line—Standard Sequence

Loss Of Mains Detection and Action

The EGCP-2 can be configured to detect a loss of mains condition, and respond to that condition by isolating the mains from the load, and transferring the supply of power to the load from the mains to on site engine generator sets.

The EGCP-2 can be configured for single or multiple unit, no parallel or mains parallel system operation which will detect a loss of mains. The loss of mains actions are a combination of synchronizing and load control functions of the EGCP-2. These functions allow the EGCP-2 controls to operate effectively upon a loss of mains condition.

Below are timing diagrams for mains parallel and no parallel systems. These time lines apply to the master control in multiple unit systems, or to any single unit application.

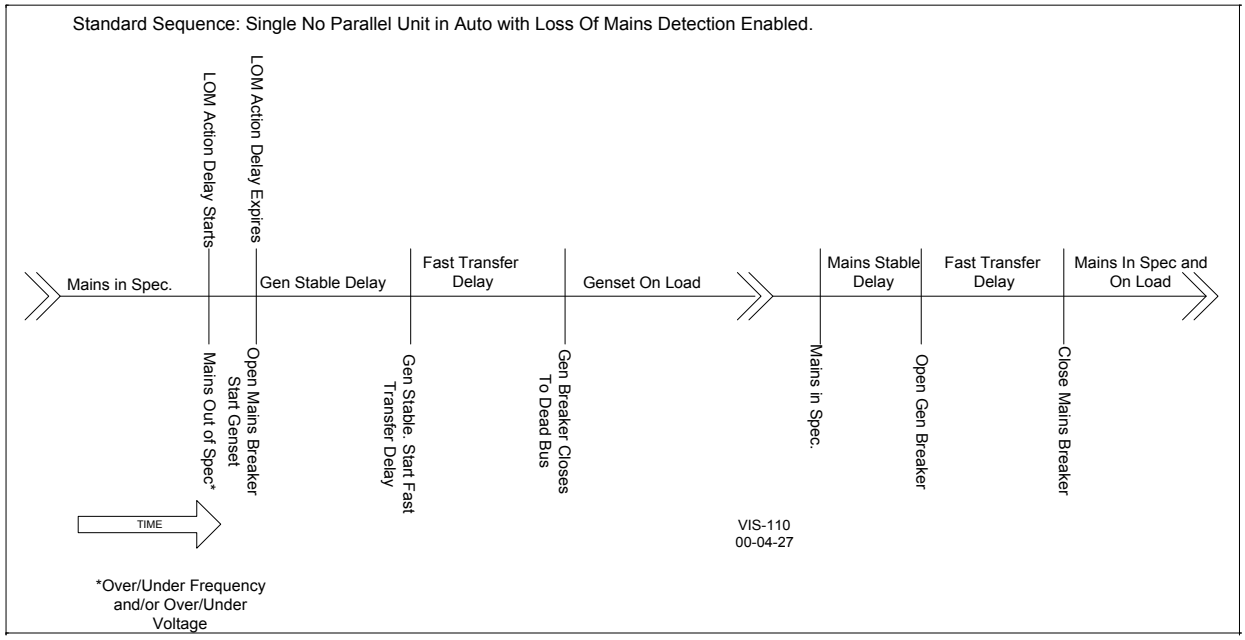


Figure 4-5. Loss of Mains Detection Active

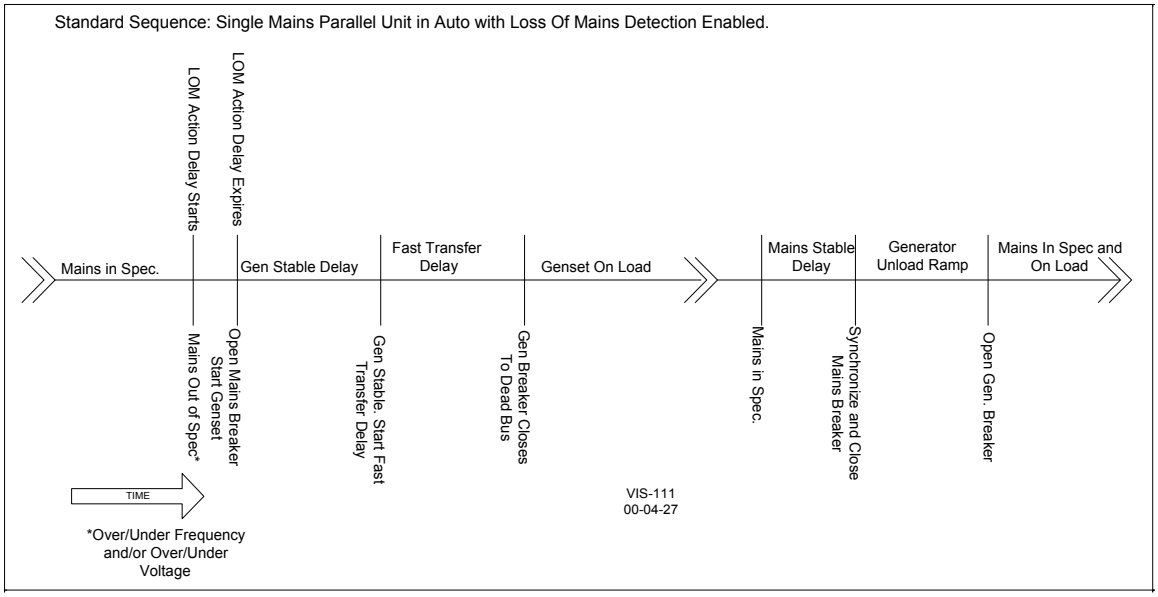


Figure 4-6. Generator Off Line

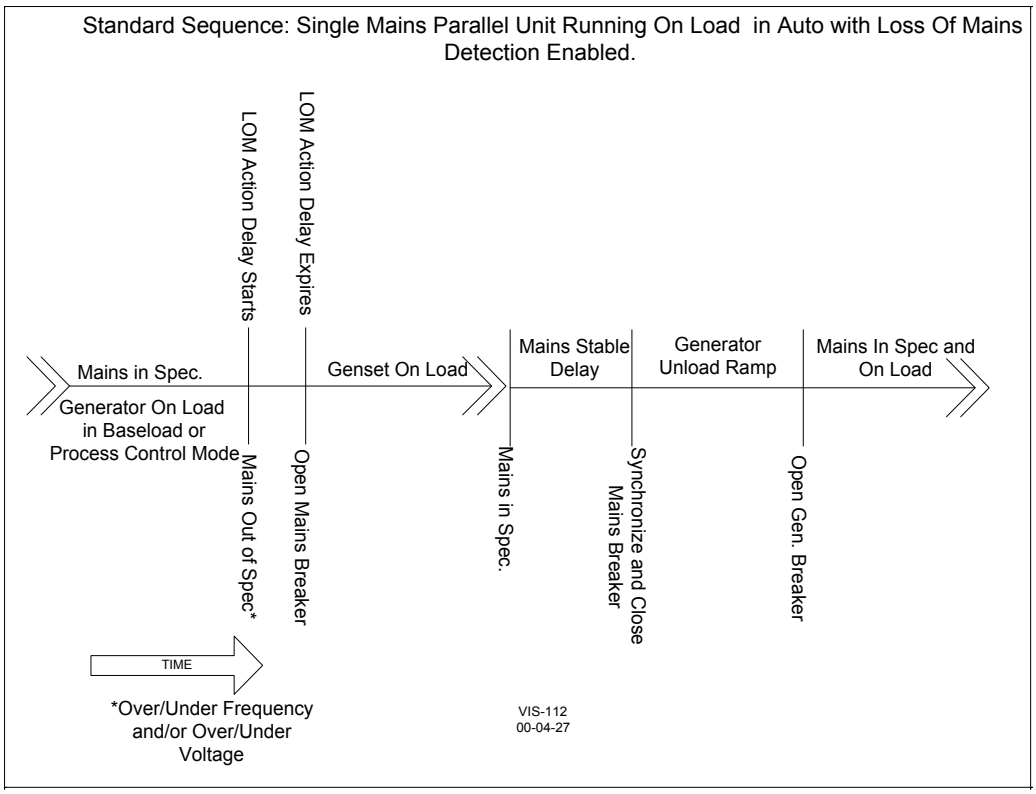


Figure 4-7. Mains Parallel Unit with Voltage/Frequency Detect

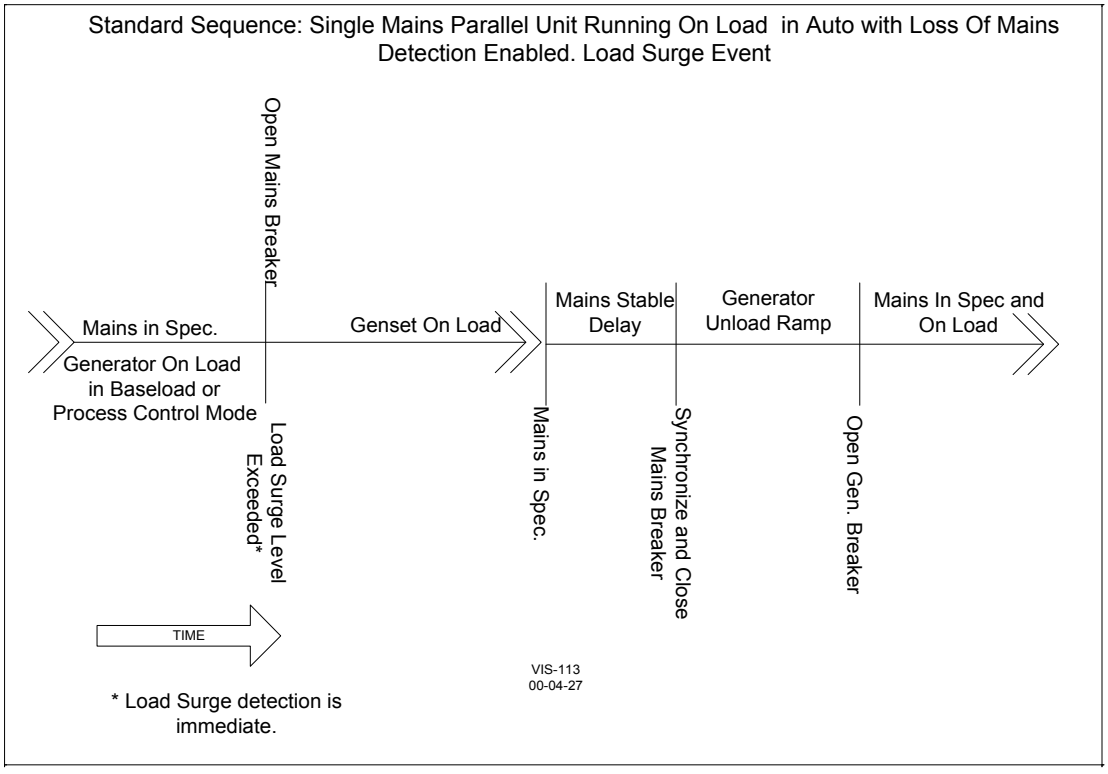


Figure 4-8. Mains Parallel Unit(s) with Load Surge Detect

Generator Sequencing

Generator Sequencing is a capability of the EGCP-2 control to maintain an on line generator capacity to Kilowatt load ratio for a multiple unit setup. In order to activate the automatic sequencing function of the EGCP-2, each unit in a multiple unit system must have the following software setpoints enabled:

Configuration Menu:

Number of Units	Automatic Sequencing
Multiple	Enabled

Each unit in the system must be in the Auto mode (Discrete Input #1 Closed) to be an active part of the sequencing system.

When configured for automatic sequencing, as described above, the Sequencing status screen of the EGCP-2 will show all of the active units on the network in order of their Network Address, and the priority of those units in the sequencing scheme. Units not in Auto mode, or with the Number of Units setpoint set for Single, will display the message “Manual Unit No Sequencing” in the Sequencing Status Screen. Units in Auto mode, and set for Multiple unit operation, but with the Auto Sequencing setpoint Disabled will still appear in the Sequencing status screen, but will not respond to automatic sequencing commands from the Master, and are not capable of operating in a Master control mode.

The EGCP-2 uses calculated system load levels to determine the points at which units are sequenced on or off load by the master. The master may not sequence a unit off load, even though it is at or below the min gen load set point, if this would cause the system load to rise above the max gen load set point.

A typical automatic sequencing routine is shown below. The system represented is composed of three units on an isolated bus feeding varying plant loads which are fed by the generators. The master unit (network priority #1) has the following set points for sequencing in the Real Load Control tuning menu:

Max Gen Load = 65%
Rated Load Delay = 5 seconds
Min Gen Load = 25%
Max Stop Time = 15 seconds
Next Genset Delay = 30 seconds
Max Start Time = 60 seconds
Reduced Gen Dly. = 30 seconds

IMPORTANT **These settings are for demonstration only. Sequencing setpoints may vary depending upon system requirements.**

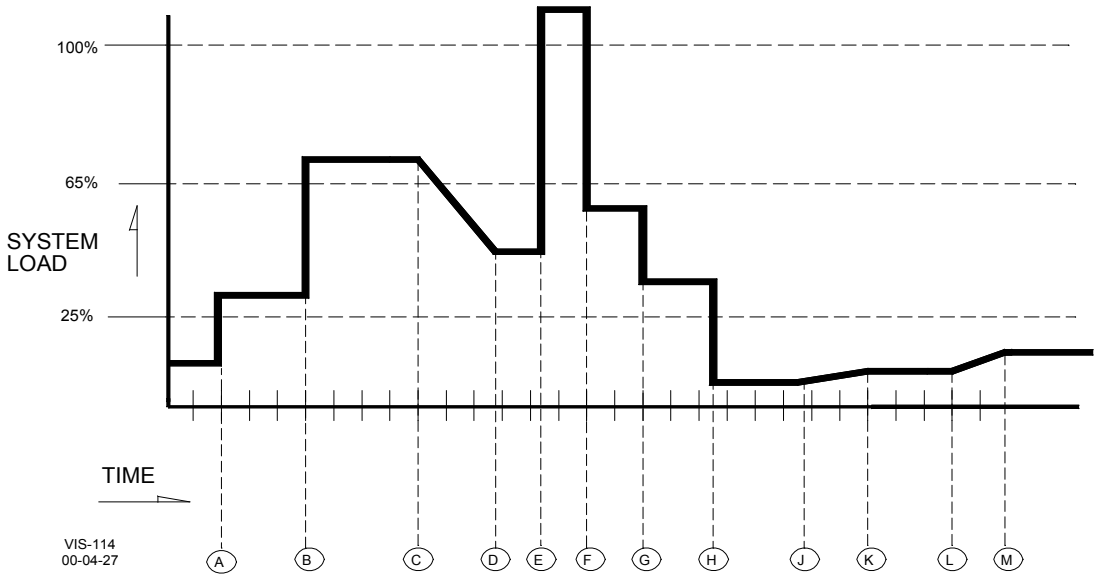


Figure 4-9. Typical Automatic Sequencing Routine

Point A
Master Generator carrying load isochronously on an isolated bus. System load steps from approximately 10% to 30%.

Point B
Master Generator responds to a step load which brings the system load to approximately 70%. This level exceeds the Max. Gen Load setpoint (65%) in the Real Load Control tuning menu. The Master control begins timing for the Next Genset Delay period 30 seconds. After the 30 seconds expires, the load is still above the Max Gen Load setpoint. The master control issues a start command to the next unit on (network priority #2).

Point C
Ten seconds after receiving its start command, network priority #2 unit closes onto the bus and ramps into load sharing with the master.

Point D
System load levels drop to approximately 45% after unit #2 is finished ramping into load sharing.

Point E
A very large step load on the bus loads both generators in excess of 100% of their rated load. The system load reflects these levels. The master unit begins timing to the Rated Load Delay (5 seconds) before starting the third unit.

Point F
The third unit closes its breaker to the two units already on the isolated bus. Since the rated load delay is in effect, and the system load is above 100% of the generating capacity on line, the third unit immediately goes to load sharing, without any load ramping. System load drops immediately to approximately 55% when the third unit closes its breaker to the bus.

Point G
A step load decrease on the bus brings the system load down to approximately 35%. All three generators remain on line in isochronous load sharing.

Point H
A further step load decrease on the isolated bus brings the system load below the Min Gen Load setpoint of 25% to approximately 10%. The master begins timing for the Reduced Gen Dly time of 30 seconds.

Point J
Since the system load is still below 25%, and the master's Reduced Gen Dly timer has expired. The master unit issues a command to Unit 3 (network priority 3) to off load and open its gen breaker. Unit 3 begins to ramp off load. System load begins increasing. The master begins its Max Stop Time delay of 15 seconds before checking to see system load is low enough to allow sequencing of another unit off line.

Point K
Unit 3 reaches its unload trip point and opens its generator breaker. The system load is still below the Min Gen Load setpoint of 25%. The Master's Max Stop Time delay has expired. The master begins timing for the next gen off delay time.

Point L
The system load remains below 25%, and the master issues a command to unit #2 (network priority #2) to off load.

Point M
Unit 2 ramps off load and opens its generator breaker. This leaves the master unit (network priority #1) on line supplying the load. When required the master will sequence units on and off line as shown above and determined by the sequencing setpoints in its Real Load Control tuning menu.

The Master unit in any multiple unit EGCP-2 system is always the unit with the lowest Network Priority setting. All slave units are then sequenced on line in ascending order of their Network Priority settings, and sequenced off line in descending order of their Network Priority Settings. The Master is always responsible for any automatic sequencing of the slave units on and off line.

In order to give the end user of the EGCP-2 the ability to control engine run time levels in a multiple unit system, any EGCP-2 in the system can be used to change the network priority of any of the EGCP-2 units actively on the same network. For a unit to be active on the network, it must have its Auto discrete input closed, be configured for Multiple Unit operation, have its Auto Sequencing setpoint Enabled, and be physically connected to the RS-485 network between units.

The ability to change the priority of any unit on the network has some fundamental rules associated with making changes to the unit priority. These rules have to do with assuming a new master, changing the sequence of on load units, and permissive sequence change states.

Assuming a New Master—All Units Off Load

When a unit's priority is changed in such a manner as to make it the new master on the system, the response of the system to the change of masters depends on the operating state of the system at the time the change is made.

If the system is not on load and the engines are not running, and has not experienced, or is not configured for a loss of mains condition, then switching the priority of the master will have the following effect on the system:

After a maximum of 5 minutes, the Master indication in the Sequencing Status screen will indicate the new master unit.

Shortly after this occurs, the new Master's Sequencing Status screen will re-order the Next On and Next Off slave units to fit the new system priority configuration.

No units will start or go on load under these conditions as a result of the assumption of the new master. See Figure 4-10.

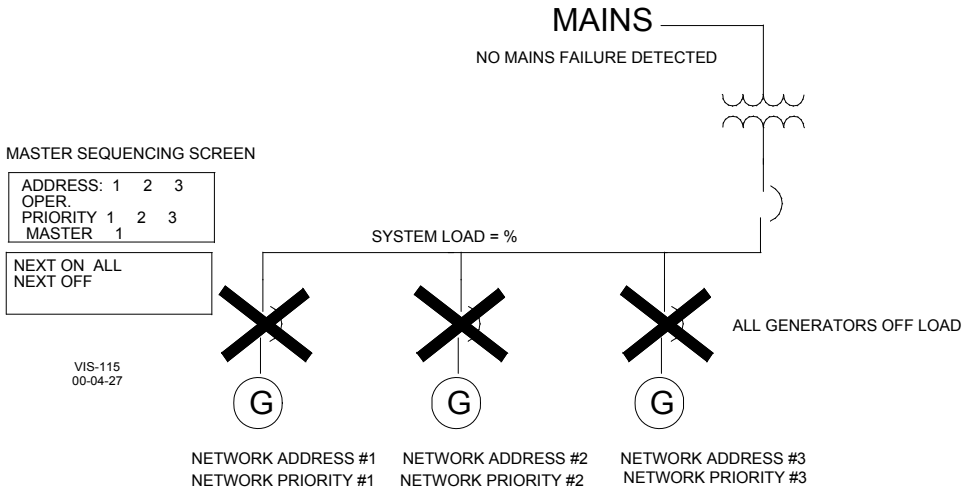


Figure 4-10. Original System Configuration

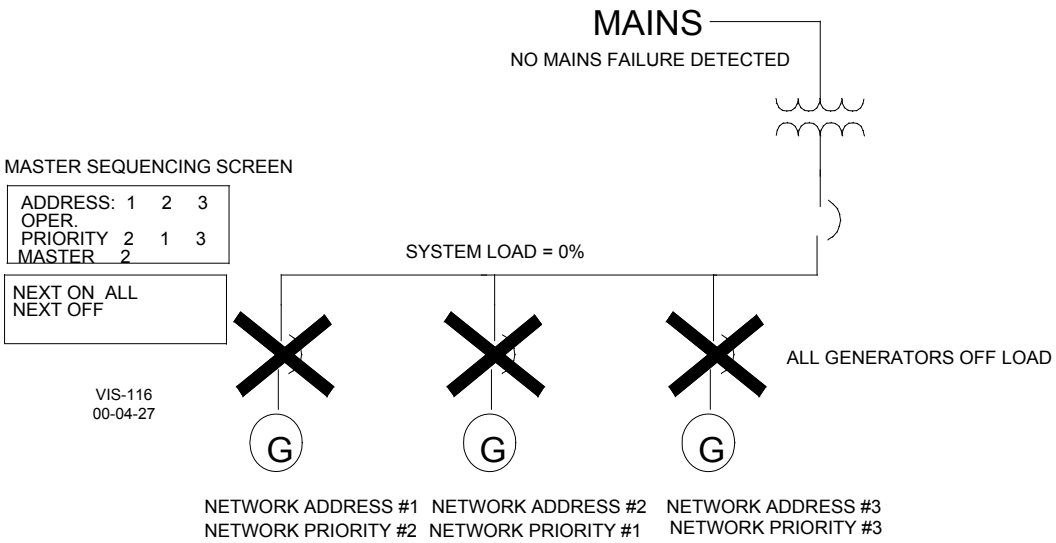


Figure 4-11. After a Change of Priority—Units Not Operating

Assuming a New Master—Master On Load

The next sequencing priority change scenario involves having the master unit on the isolated bus due to a loss of mains condition, or from an auto and run with load input. The two slaves units are off line because the system load does not require them to be sequenced on line. Changing the network priority of the master will establish a new master on the system.

In this system, the master unit will always have a Min Gen Load setting of 25%, and a Max Gen Load setting of 65%. These values will be used through out the remaining on load examples.

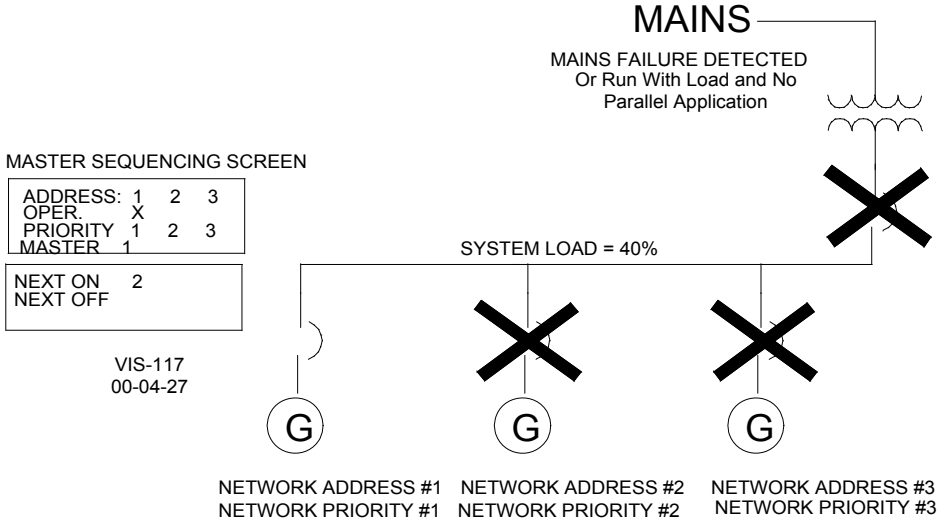


Figure 4-12. Original System Configuration

Within a 5 minute period the sequencing screen on any unit will reflect the change of master from unit one to unit two.

The system load is at a level somewhere between 25 and 65 percent, at which no slave units are sequenced on or off line.

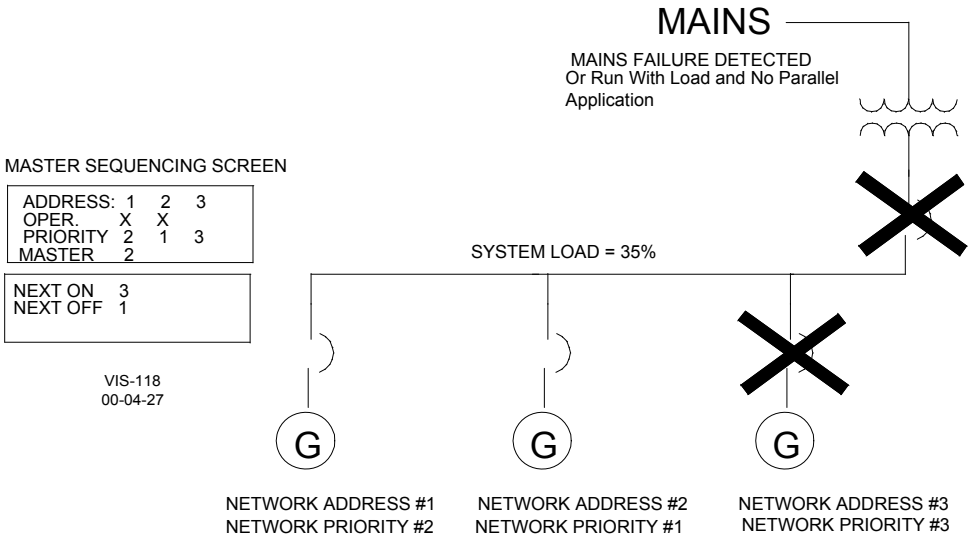


Figure 4-13. A New Master Takes Over—Single Unit Operating on the Isolated Bus

When the sequencing screen displays the new master, the new master engine will begin its start sequence. The new master must start and go on line in order to take over its new role as master, which means to be in control of the load, and of the sequencing control of the slave units.

The new master (Network Address 2) will start and parallel to the previous master (Network Address 1). Load control will be isochronous load sharing between the two units. See Figure 4-13. If the system load is greater than 25%, then both units will remain on line. If the system load drops below 25%, then the new master (Network Address 2) will sequence the slave (Network Address 1) off line.

The new master has fully established itself on the network as the Master.

The above actions take place simply by changing the priority of any given unit so that that unit is the New Master. As long as the unit is in auto mode, configured for multiple unit operation and attached to the network, it will automatically transfer itself to the Master Position.

Units operating in Auto with the Run with Load discrete input closed will effectively transfer, or recognize the transfer of master units. However, being in an auto and run with load mode, those particular units cannot be sequenced off line by the master control.

If a unit is not in auto mode, or is configured for single unit operation, or is not attached to the RS-485 network, then no transfer of master can occur.

Also, for a transfer of master to occur, the units have to be in an auto sequencing mode of operation. This implies either a load sharing, or process mode of load control. Without being in these operating modes, a transfer of master cannot occur because the New Master cannot sequence the Previous master off line. The load control modes which does not support new master transition is the Base Load mode. In Base Load Mode, there is no sequencing between units, and therefore a change of master cannot take place until the units are either taken out of base load mode, or switched to an isochronous load sharing, or process control mode.

IMPORTANT **Master Controls operating in the Process Control Mode must have a 4–20 mA or 1–5 Vdc transducer input to function properly.**

Changing the Priority of a Slave Unit—No Slaves On Load

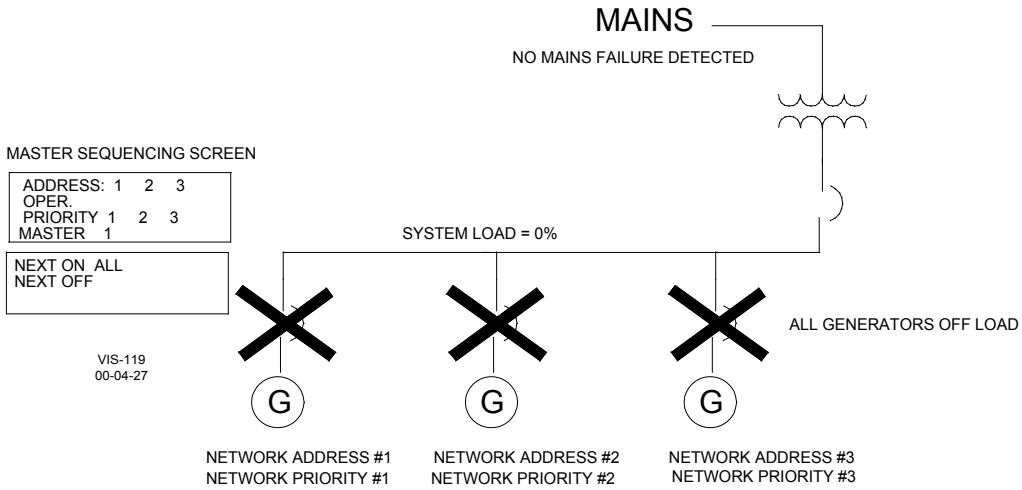


Figure 4-14. Changing the Priority of a Slave Unit

If a slave unit's priority is changed in such a way as to simply shift that slave's place in the sequencing scheme without making the slave a New Master, then one of two things will happen depending on that slaves place in the priority order.

1. The slave will simply take its place in the new sequencing order without having to go on load.
2. The slave will have to go on load in order to properly assume its new priority setting in sequencing system.

Case 1 will occur if the slave's priority is changed either when there are no units running, and no Loss of Mains detection has occurred, or if the slave itself is not running due to system load levels not requiring the unit to be on line, and the priority of the slave is decreased (taken to a higher numerical value).

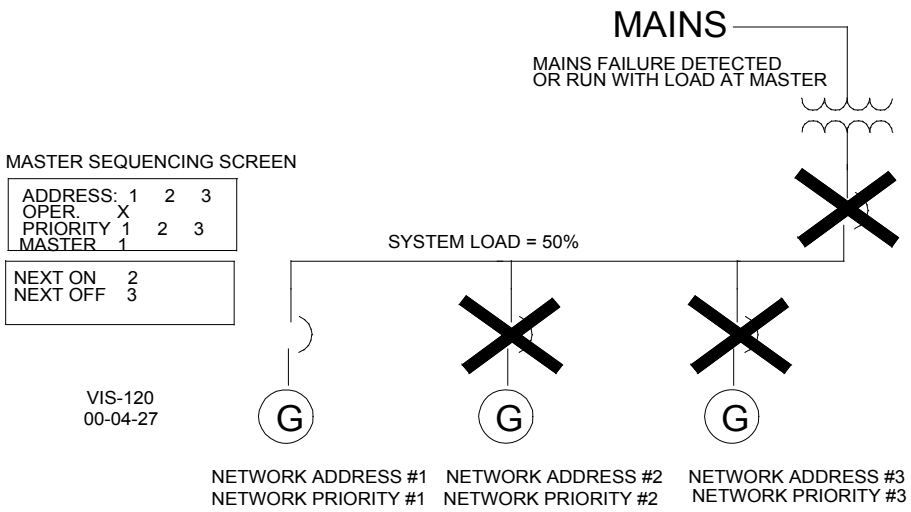


Figure 4-15. Changing the Priority of a Slave Unit

Master running on load against the isolated bus (Figure 4-15). System load level is at 40%, so no slave units are sequenced on line.

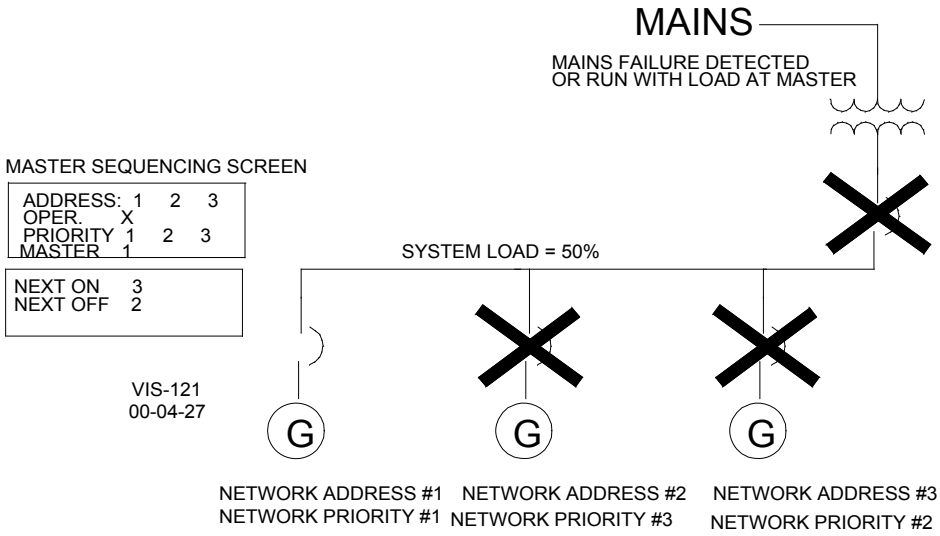


Figure 4-16. Changing the Priority of a Slave Unit

A priority change at units with the network addresses of #2 and #3 switches the network priority between these two units. Since neither unit is operating (only the master is on load) the priority change takes place, and is recognized by the master. The change is seen in the next on /next off display at the master sequencing status screen. See Figure 4-16.

Changing the Priority of a Slave Unit—Slave On Load

Case 2 will occur if the slave unit is not running, and no Loss of Mains detection has occurred, and the slave's priority is increased (taken to a lower numerical value) to a level which replaces another slave which is operating on load.

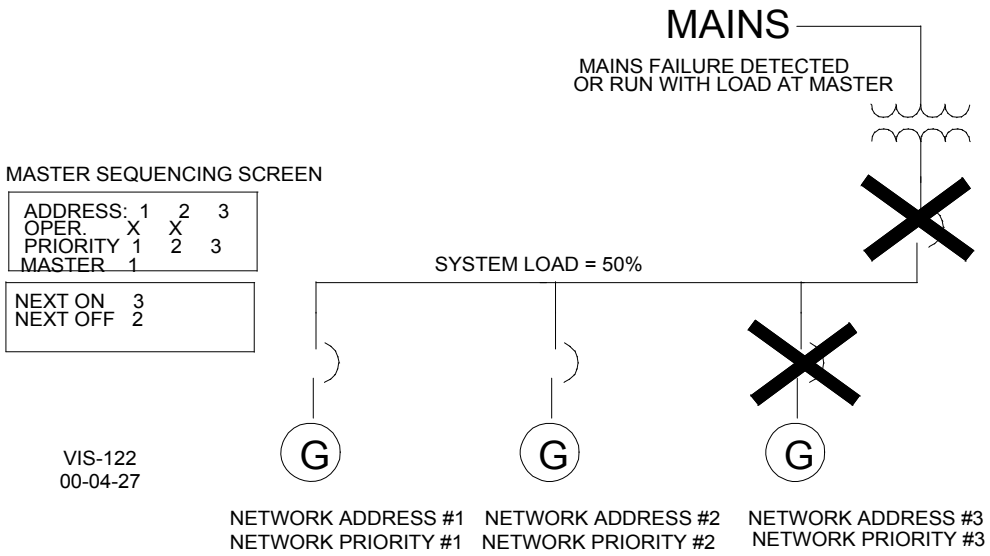


Figure 4-17. Changing the Priority of a Slave Unit

The figure above represents system on load on an isolated bus in load sharing. The master unit has sequenced on the priority 2 slave unit. System load is at 50%.

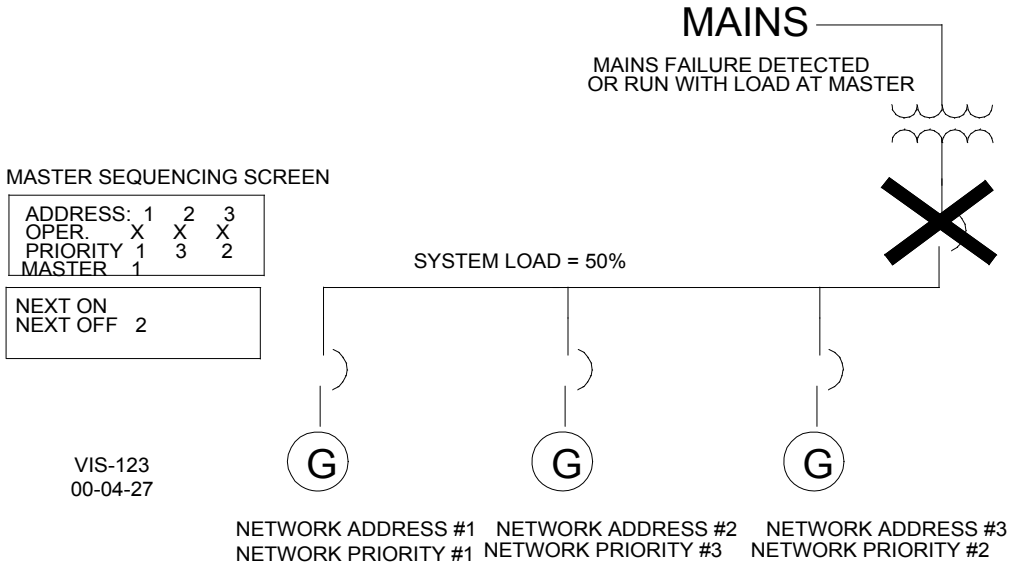


Figure 4-18. Changing the Priority of a Slave Unit

The network priority of the priority 2 and 3 units are switched so now the unit with network address #3 is priority 2, and network address #2 is priority #3. After a time delay of less than 5 minutes, the #3 network address (priority 2) unit is started by the master and paralleled to the bus. Now all three units are on line. See Figure 4-18. The master recognizes the proper on/off sequence for the new priority settings, and will sequence off network address #2 unit when system load levels fall below 25%. See Figure 4-19.

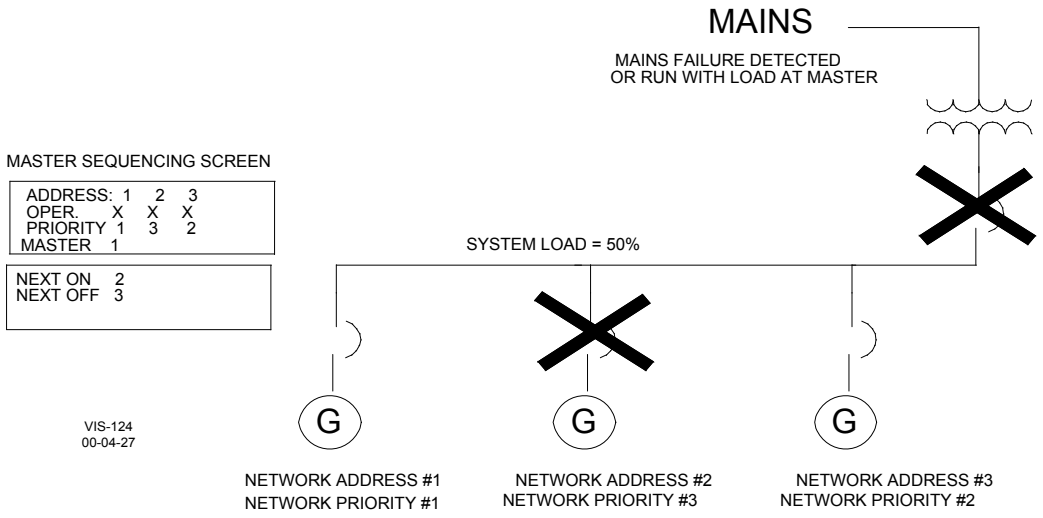


Figure 4-19. Changing the Priority of a Slave Unit

System load levels have dropped below 25%, and the master has sequenced network address #2, priority #3 unit off line. The master has fully recognized the priority change, and the new priority settings are in effect.

The above examples are typical sequencing functions of the EGCP-2. Isolated bus applications were shown for clarity. The EGCP-2 is capable of automatic sequencing while in parallel with the mains in the process control, or process control soft transfer operating modes. The examples shown above for priority changing and its effects are accurate in mains parallel multiple unit process control modes as well.

Inter-control Communications (RS-485 Network)

The EGCP-2 uses a proprietary communication structure to share information between multiple EGCP-2 controls in a system. This communication structure allows accurate load sharing, status, and command messages to be exchanged between up to 8 units. The network uses RS-485 protocol over a standard twisted shielded pair to link the units in the system together. The end units of the network must have the proper network termination switches selected at Switch Location 4. Switches 1, 2, and 3 must be closed to ensure robust inter-control communications, and prevent reflected data from propagating on the network.

The information on the RS-485 network is for communications between controls only and must not be interfaced in any way with external devices. There is an RS-422 port on the EGCP-2 which is used to monitor and control the units remotely.

Remote Control/Monitoring (RS-422)

To facilitate the use of external computer connections, the EGCP-2 has an RS-422 port which allows direct access to the various operating and monitoring functions within the control. The RS-422 network is a multi-drop line which allows connection of an external device at any point on the network. This allows monitoring and control of up to 8 units simultaneously from a PC.

The RS-422 network is dedicated to the control and monitoring of the EGCP-2.

Chapter 5.
Calibration of Control Inputs and Outputs

Introduction

The EGCP-2 can be thought of as a digital metering device which monitors engine, generator, bus, and mains analog signals. Being a digital metering device, the EGCP-2 must be properly calibrated in order to perform its role as a controlling device accurately. This chapter discusses the calibration of these various inputs and outputs of the EGCP-2, and the effects of the calibration on the metering and control functions of the EGCP-2.

The EGCP-2 inputs and outputs are factory calibrated for the best possible tolerance between the input signal, and the signal as sensed by the EGCP-2. All analog signals coming into the EGCP-2 are routed through analog to digital (A/D) converters. These converters have the ability to be “calibrated” so that the input signals sensed by the EGCP-2 software are equal to the true input signal.

While the factory calibration brings the EGCP-2 control within close tolerance of the various inputs as fed into the control, it cannot account for losses in field wiring that are common in power generation applications. Signal loss due to wire length and impedance, transformer primary to secondary losses, and non-linearity of sending devices cannot be calibrated out at the factory. This is why the EGCP-2 must be calibrated upon commissioning.

The intent of calibrating the EGCP-2 is to make the unit read out the various voltages, currents, frequencies, and temperatures in the various status menu display screens as close as possible to what is actually occurring at the true source of these signals.

For example, assume there is a 480 volt line-to-line generator set operating in a system which uses 4:1 voltage transformers to feed the EGCP-2. The input AC line to line voltage at the EGCP-2 is 118 volts due to primary to secondary losses across the voltage transformers. The EGCP-2 Generator Status menu will display a generator voltage of 472 Vac L-L for each phase, which is not truly what the generator is producing. In this case, the Calibration tuning menu would be used to adjust the A/D converters on the three generator voltage transformer inputs until the Generator Status menu reads 480 Vac L-L for each phase. This is how the calibration menu is used to compensate for losses in signal between the source, and the EGCP-2. The calibration menu allows adjustment of all the analog inputs and outputs of the EGCP-2 for this purpose.

Calibration of Generator PTs and CTs

The calibration tuning menu of the EGCP-2 contains calibration points for three phase generator voltage and current calibration. These calibration points are labeled as follows:

PT Phase A Scale

Calibrates the A phase generator PT input.

Menus Affected
Changes in the calibration setpoint will change the generator A phase voltage as read in the Generator Status Menu. Changing this value will also have an effect on generator KW and KVAR levels.

The generator A phase voltage is also used as part of the function which determines when the generator is in spec as shown in the control overview menu by a sinusoidal wave under the GEN label. If the generator A phase PT is not properly calibrated, the level at which the generator is shown as in spec may not be a true indication of an in spec condition.

Operations Affected
The EGCP-2 uses the A phase generator voltage for voltage matching when synchronizing across the generator breaker. Accurate calibration of the Generator A phase PT is critical for proper voltage matching operation.

The sensed generator voltage on the A phase is used in Power Factor/VAR sharing mode when the EGCP-2 is in parallel with other units on an isolated bus. The EGCP-2 uses the Voltage Reference as found in the Configuration tuning menu as a generator voltage reference point when balancing the reactive load on the bus between generators. If the A phase PT voltage is out of calibration at the EGCP-2 the bus voltage may be off of this reference when in Power Factor/VAR sharing mode. Also, poor VAR/PF sharing may occur if the A phase PT is not properly calibrated.

Generator Voltage is also used in real and reactive load calculations. These calculations are used in all real and reactive power control functions.

Alarms Affected
The PT Phase A voltage is used for the Voltage High and Low limit setpoints which are found in the Shutdown and Alarm tuning menu. The voltage limit setpoints can be configured for various alarm indications. Also, if the generator voltage as sensed by the EGCP-2 exceeds the Voltage High limit, or falls below the Voltage Low limit, the voltage bias output will stop moving in the direction which the alarm occurred.

The A phase PT voltage is used in the calculations for KW load, and KVAR load. All alarms monitoring these conditions will be affected if the A phase PT is not properly calibrated.

PT Phase B Scale

Calibrates the B phase generator PT input.

Menus Affected
Changes in the calibration setpoint will change the generator B phase voltage as read in the Generator Status menu. Changing this value will also have an effect on generator KW and KVAR levels.

Operations Affected
Generator Voltage is used in real and reactive load calculations. These calculations are used in all real and reactive power control functions.

Alarms Affected
The B phase PT voltage is used in the calculations for KW load, and KVAR load. All alarms monitoring these conditions will be affected if the B phase PT is not properly calibrated.

PT Phase C Scale

Calibrates the C phase generator PT input.

Menus Affected
Changes in the calibration setpoint will change the generator C phase voltage as read in the Generator Status menu. Changing this value will also have an effect on generator KW and KVAR levels.

Operations Affected
Generator Voltage is used in real and reactive load calculations. These calculations are used in all real and reactive power control functions.

Alarms Affected
The C phase PT voltage is used in the calculations for KW load, and KVAR load. All alarms monitoring these conditions will be affected if the A phase PT is not properly calibrated.

CT Phase A Offset

Calibrates the A phase generator CT input offset (zero current) reading.

Menus Affected
Changes in the calibration value will change the A phase current readout in the Generator Status menu. Changing this value will also have an effect on the generator KVA, KW, and KVAR levels.

Operations Affected
Generator Current is used in real and reactive load calculations. These calculations are used in all real and reactive power control functions.

Alarms Affected
The generator current on A phase is monitored and used as an input for the Overcurrent alarm. The EGCP-2 uses all three phase CT inputs for sensing overcurrent conditions, and selects the phase with the highest current at any given moment. Improperly calibrated A phase CT levels will affect the point of Overcurrent detection on the generator.

The A Phase CT calibration has an affect on KW and KVAR levels for the A phase, and for the sum of all three phases of the generator. The various alarm setpoints which monitor real and reactive load levels are affected by this calibration point.

CT Phase A Scale

Calibrates the A phase generator CT input.

Menus Affected
Changes in the calibration value will change the A phase current readout in both the Generator Status menu. Changing this value will also have an effect on the generator KW and KVAR levels.

Operations Affected
Generator Current is used in real and reactive load calculations. These calculations are used in all real and reactive power control functions.

Alarms Affected
The generator current on A phase is monitored and used as an input for the Overcurrent alarm. The EGCP-2 uses all three phase CT inputs for sensing overcurrent conditions, and selects the phase with the highest current at any given moment. Improperly calibrated A phase CT levels will affect the point of Overcurrent detection on the generator.

The A Phase CT calibration has an affect on KW and KVAR levels for the A phase, and for the sum of all three phases of the generator. The various alarm setpoints which monitor real and reactive load levels are affected by this calibration point.

CT Phase B Offset

Calibrates the B phase generator CT input offset (zero current) reading.

Menus Affected
Changes in the calibration value will change the B phase current readout in the Generator Status menu. Changing this value will also have an effect on the generator KVA, KW, and KVAR levels.

Operations Affected
Generator Current is used in real and reactive load calculations. These calculations are used in all real and reactive power control functions.

Alarms Affected
The generator current on A phase is monitored and used as an input for the Overcurrent alarm. The EGCP-2 uses all three phase CT inputs for sensing overcurrent conditions, and selects the phase with the highest current at any given moment. Improperly calibrated B phase CT levels will affect the point of Overcurrent detection on the generator.

The A Phase CT calibration has an affect on KW and KVAR levels for the B phase, and for the sum of all three phases of the generator. The various alarm setpoints which monitor real and reactive load levels are affected by this calibration point.

CT Phase B Scale

Calibrates the B phase generator CT input.

Menus Affected
Changes in the calibration value will change the B phase current readout in both the Generator Status menu. Changing this value will also have an effect on the generator KW and KVAR levels.

Alarms Affected
The generator current on B phase is monitored and used as an input for the Overcurrent alarm. The EGCP-2 uses all three phase CT inputs for sensing overcurrent conditions, and selects the phase with the highest current at any given moment. Improperly calibrated B phase CT levels will affect the point of Overcurrent detection on the generator.

The B Phase CT calibration has an affect on KW and KVAR levels for the B phase, and for the sum of all three phases of the generator. The various alarm setpoints which monitor real and reactive load levels are affected by this calibration point.

CT Phase C Offset

Calibrates the C phase generator CT input offset (zero current) reading.

Menus Affected
Changes in the calibration value will change the C phase current readout in the Generator Status menu. Changing this value will also have an effect on the generator KVA, KW, and KVAR levels.

Operations Affected
Generator Current is used in real and reactive load calculations. These calculations are used in all real and reactive power control functions.

Alarms Affected
The generator current on C phase is monitored and used as an input for the Overcurrent alarm. The EGCP-2 uses all three phase CT inputs for sensing overcurrent conditions, and selects the phase with the highest current at any given moment. Improperly calibrated A phase CT levels will affect the point of Overcurrent detection on the generator.

The A Phase CT calibration has an affect on KW and KVAR levels for the C phase, and for the sum of all three phases of the generator. The various alarm setpoints which monitor real and reactive load levels are affected by this calibration point.

CT Phase C Scale

Calibrates the C phase generator CT input.

Menus Affected
Changes in the calibration value will change the C phase current readout in both the Generator Status menu. Changing this value will also have an effect on the generator KW and KVAR levels.

Alarms Affected
The generator current on C phase is monitored and used as an input for the Overcurrent alarm. The EGCP-2 uses all three phase CT inputs for sensing overcurrent conditions, and selects the phase with the highest current at any given moment. Improperly calibrated C phase CT levels will affect the point of Overcurrent detection on the generator.

The C Phase CT calibration has an affect on KW and KVAR levels for the B phase, and for the sum of all three phases of the generator. The various alarm setpoints which monitor real and reactive load levels are affected by this calibration point.

Calibration of the Bus PT

The bus PT input to the EGCP-2 plays a “dual role” in that it is used to sense both the bus, and the mains PT voltage sensing. The EGCP-2 automatically switches between the Bus and the Mains PT input when performing mains monitoring, synchronizing and dead bus closing actions.

Bus PT Scale

Calibrates the Bus and Mains Voltage readouts on the EGCP-2.

Menus Affected

Mains Voltage Sensing
The Bus PT input is used as part of the sensing which determines when the mains voltage is within spec as shown in the Control Overview Menu by a sinusoidal wave under the MAINS label. The Bus PT also monitors the mains when paralleling the generator to the mains in mains parallel applications. The U: value in the Synchroscope status menu will reflect the Mains voltage when operating in a Close Mains Breaker mode.

Bus Voltage Sensing
The Bus PT input is used when synchronizing across the generator breaker to the bus (live or dead bus closing). The Synchroscope status menu will display the Bus voltage at the U: value when performing Close Gen Breaker Functions.

Operations Affected
The Bus PT Scale calibration will affect the Voltage matching accuracy when the generator is paralleling to other generators on the isolated bus (Bus PT monitored), or when the generator is paralleling to the mains (Mains PT monitored). Improper calibration of the Bus PT sensing of the EGCP-2 may cause large reactive load swings when paralleling into the bus or mains when the generator breaker closes.

Alarms Affected
The Bus PT scale calibration will affect the Mains High and Low Voltage Limit alarm setpoints in the Shutdown and Alarms tuning menu. If the Bus PT scale is improperly calibrated, the sensed voltage for these high and low alarm setpoints may cause alarms and/or loss of mains action to occur at the wrong voltage levels.

Speed Bias Output

The Speed Bias Offset calibration point sets an offset on the speed bias output of the EGCP-2. This output is fed into the speed control governor to bias the governing speed for synchronization and load control functions. This offset is the starting point from which the EGCP-2 begins all of its speed biasing operations. The Speed Bias Offset value is factory calibrated for 0.0 Vdc.

Usually the speed bias output should remain at the factory calibrated level. The speed control governor is used to set the synchronous speed of the generator, and no additional bias is required.

However, if interfacing the EGCP-2 with speed controls other than those manufactured by Woodward Governor Company, an offset may be required for proper operation.

Increasing the Speed Bias Offset will increase the Speed Bias readout in the I/O Display status menu of the EGCP-2. The speed bias offset imposes an offset in percent of speed bias output. For example a Speed Bias offset of 3% will give a 3% speed bias reading in the I/O Display status menu. Decreasing the Speed Bias Offset has just the opposite effect in that the values will read negative instead of positive.

When initially powered up, the EGCP-2 will always apply the value for the speed bias offset to the speed bias output. With the factory settings, the speed bias output should always go to 0.0 Vdc on initial power up.

Speed bias offset will affect the bus frequency of a single unit machine operating on an isolated bus. Speed bias offset will also affect the load sharing between machines operating on an isolated bus. It is recommended that the speed bias output be calibrated for 0% (0.0 Vdc) when using Woodward Governor speed controls.

Voltage Bias Output

The Voltage Bias Offset in the Calibration menu is used to impose an offset voltage on the voltage bias output to the automatic voltage regulator. 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-2.

Most regulators which 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 this trim input. The voltage is then centered around zero volts offset, or zero Voltage Bias.

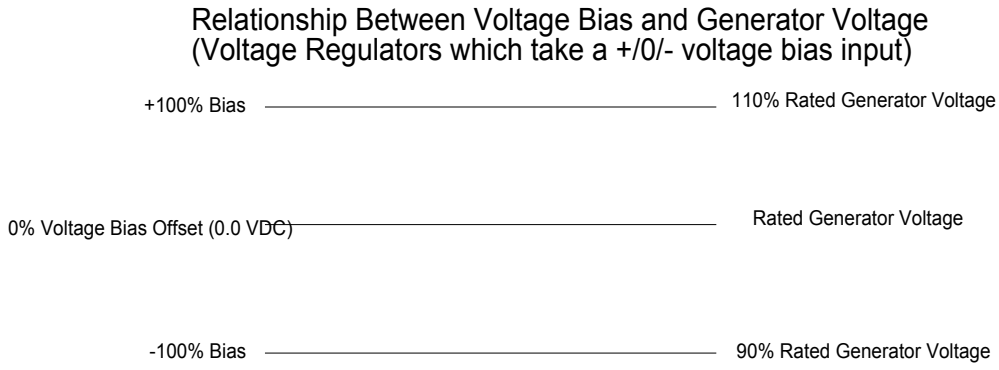


Figure 5-1. Relationship Between Voltage Bias and Generator Voltage

Some regulators cannot accept a ± voltage trim input, and require a voltage bias signal that is only positive (or negative) in value. In cases such as these the Voltage Bias offset can be used to raise the offset of the voltage bias output to a level which allows more positive and less positive voltage adjustment around a positive offset voltage.

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-2 Voltage Bias Offset applied to the regulator.

Chapter 6.
General Startup Instructions

Before Starting the Generator Set

Before starting the generator set, configure the tuning setpoints in the EGCP-2 for values which best match the machines operating and performance characteristics. Double check these values prior to starting the unit.

Verify Proper wiring to the EGCP-2. Check the following items for proper polarity and configuration:

- Power Supply Input
- Generator CT Inputs
- Generator PT Inputs
- Mains and Bus PT Inputs
- Magnetic Pickup Input
- Voltage Bias Output
- Speed Bias Output

Once these items have been checked for proper polarity, check the power supply voltage for proper amplitude. When this is confirmed, apply the power supply to the EGCP-2.

With the EGCP-2 Powered Up the unit will go through a RAM test, and after a self check period, will display the Control Overview Menu. If the Control fails to power up properly, remove the power supply input and re check the polarity and amplitude of the voltage feeding the EGCP-2 Control.

With the EGCP-2 powered, go to the I/O Status Display in the Status menus. This display shows the state of the various discrete inputs and outputs of the control. Monitor this screen and close the discrete inputs to the EGCP-2 that are being used in this particular application. Verify that the EGCP-2 recognizes these inputs in the I/O Status screen.

Verify that the Speed Bias, and Voltage Bias outputs are at zero percent, or the proper levels if there is a bias offset used.

⚠WARNING

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.

Sequence of Startup and Checking Parameters

1. Enter program Setpoints in all menus.
2. Check discrete inputs in I/O status menu.
3. Set crank repeats to 0.
4. Set synchronizer mode to check.
5. Set load control mode to normal.
6. Start engine using test switch of EGCP-2.
7. Check engine overview status screen for engine rpm readout confirm rpm is correct for unit.
8. Check voltage of unit in Generator Status menu—calibrate voltage if needed.
9. Adjust AVR voltage at AVR if needed to achieve rated generator voltage.
10. Check that voltage raise/lower switches operate properly.
    a. Set voltage ramp time if needed.
11. Adjust AVR trim pot. (if equipped) for ±10% of rated voltage for ±100% voltage bias output from EGCP-2. If this range cannot be achieved, shut down the generator set, and select the next highest voltage bias output level on dip switch SW-2 located on the back of the EGCP-2. Repeat steps 9 through 11 until satisfactory results are achieved.
12. Check that load raise/lower switches operate properly.
    a. Set load raise/lower rates if needed.
    b. Verify speed change with raise/lower load inputs.
13. Check mains voltage in synchroscope status menu (if available)—calibrate if needed.
14. Calibrate synchronizer if possible.
15. Remove Test Input. Verify engine shuts down properly.

Loading the Generator Set

⚠WARNING

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.

Mains Parallel Units

Follow these steps if you are configuring a Mains Parallel Master Unit, or a Mains Parallel Slave unit which will operate as a redundant master. Redundant master units must have the Mains CB Aux hardwired into them. All other wiring to the Master and Redundant Master Units must be identical for proper operation of the Redundant units in the event of a loss of master.

1. Start unit with an Auto and Run with Load Input.
    a. Unit will start and attempt to synchronize.
2. Adjust synchronizer dynamics for best control of phase matching (monitor synchroscope status menu to see phase error.).
3. Use voltmeter to check voltage across generator breaker to assure proper phase rotation and mains PT input polarity.

4. Set load/unload ramp times to at least 60 seconds.
5. Set base load level to 30% of rated load.
6. Shut down the unit by removing the Auto and Run with Load Inputs.
7. Set synchronizer to run mode.
8. Start unit with an Auto and Run with Load Input.
9. Monitor synchroscope status menu.
    a. Verify action of synchronizer.

IMPORTANT **If using Process 4–20mA input, Set Process Reference to Proper Level.**

10. After generator breaker closes to the mains, monitor Generator Status menu.
    a. Monitor KW load on unit.
    b. Monitor KVAR/PF on unit.
        1. As set by reactive load control setting.
11. Adjust load control gain, stability, derivative for stable load control.
12. Once satisfied with load control operation, switch to process control (if applicable).
13. Confirm ramp to process reference level.
    a. Tune process control for best response.
14. Remove run with load input to unit.
    a. Verify unload ramping.
    b. Verify unload trip point.
    c. Verify generator breaker opens.
    d. Verify cooldown timer (if reached).
15. Set crank repeats, base load reference, process reference, load ramp times, and load control mode as required for proper operation.

This concludes the Mains Parallel Master Setup.

No Parallel and Slave Setup

Use the following instructions for setup of No Parallel Applications, and Slave unit applications.

1. Set unit for LOM on mains under frequency.
2. Set unit for check mains breaker disabled.
3. Set for dead bus closing enabled.
4. Remove mains PT and mains CB Aux input by opening mains breaker if necessary.
5. Start unit with auto switch input.
6. Unit will start and close generator breaker to bus.
    a. Verify dead bus closing.
    b. Apply load to unit using load bank or plant load as applies.
    c. Calibrate CT readings if needed.
7. If in a multi unit system, repeat previous steps for all units. Set all units to be tested synchronizers to check mode prior to start.
8. The unit currently on the bus carrying the load will act as a synchronizing reference for the other units.
9. Verify voltage matching, phase relationships of additional units by monitoring the synchroscope status menu.
    a. Verify voltage levels across generator breakers.

10. Tune individual synchronizer dynamics.
    a. Calibrate synchronizer if needed.
11. Once satisfied with each synchronizers operation, shut down these units by removing the auto input.
12. Change synch mode settings to run on all units.
    a. This will enable generator breaker closure to live bus.
13. Start one unit in auto and allow it to close to the dead bus.
    a. Verify isochronous operation.
    b. Verify correct voltage level on bus.
14. Start another unit and allow it to parallel to the live bus.
    a. Confirm phase match and synchronizer action.
    b. Verify generator breaker closure.
15. Load Control
    a. Verify load sharing.
    b. Verify VAR/PF sharing.
16. Start additional units and parallel to the bus in the same manner as previous units.
    a. Load must be sufficient to prevent sequencing of lower priority units off line.
    b. Confirm unit address and priority settings.
    c. Adjust load control gain lower if unstable during ramp to load sharing.
    d. Adjust load share gain if unstable in load share.
17. Remove units from isolated bus one at a time by opening the auto input.
    a. Verify unload ramp.
    b. Verify unload trip.
    c. Verify cooldown if unit has exceeded cooldown limit.
18. When all units are off line, close mains breaker if applicable.
    a. Set all units to auto for LOM detection.

This concludes the No Parallel setup.

Chapter 7. Troubleshooting

Control Hardware and I/O

Problem	Probable Cause	Corrective Action
Unit does not power up	No input power supply	Check input power supply on terminals 1 and 2. This input must be 9 to 32 Vdc.
	Input power supply reversed	Ensure proper polarity of power supply to EGCP-2.
Unit powers up and then cycles on and off when cranking	Weak Engine Battery or Engine Battery voltage dropping below 6 Vdc on cranking	Charge Engine Battery, or Replace Engine Battery.
Discrete inputs don't show active in I/O STATUS screen when switches are activated	Faulty wiring of discrete input switches	Verify wiring of discrete input switches.
Displayed generator voltages are very small	Faulty wiring of generator Potential Transformers(PT's)	Verify wiring of generator Potential Transformers (PTs).
	Generator PT inputs are improperly calibrated	Calibrate the appropriate PT input channel(s). See section 1.10 Calibration of Control Inputs and Outputs.
I/O STATUS shows relay(s) is energized, but action(i.e. alarm) does not occur	Faulty wiring of relay output contacts	Verify wiring of relay output contacts.
Generator voltage fluctuates or is unstable at no load on generator	AVR dynamics are improperly set up	Tune the AVR dynamics for stable operation. See AVR manufacturer's instruction manual for more details.
Voltages or currents displayed by EGCP-2 are different than measured parameter	EGCP-2 PT inputs are inaccurately calibrated	Calibrate the appropriate PT input channel(s). See section 1.10 Calibration of Control Inputs and Outputs.

Engine Control/Sensing Parameters

Problem	Probable Cause	Corrective Action
Start command(i.e. test or run with load) does not start engine	Configuration menu has not been accepted or entered properly	Enter the configuration set points in the Configuration menu such that all "*" and "#" symbols are removed from the display. See section 1.3.4 Description of set points for more details.
	An active alarm condition exists	Commit or reset alarm condition(s). See section 1.3.2 Description of Screens.
	Relay output contacts are not properly connected to engine starter, fuel solenoid	Verify wiring of relay output contacts.
Starter motor stays engaged after engine starts	Crank cutout set point in Engine control menu is to large	Set CRANK CUTOUT set point to appropriate value. See description of set points.
	Inadequate MPU signal to EGCP-2 input	Verify MPU wiring, and that adequate MPU signal exists at input to EGCP-2 control.
Engine speed is unstable when unit is at no load	Speed control dynamics are improperly set up	Tune the speed control dynamics for stable operation. See speed control manufacturer's instruction manual for more details.
When crank command is issued, EGCP-2 loses power and conducts a reset and RAM test	Battery is too weak for the current demand of the starter motor	Install a higher capacity battery or a more efficient starter motor.
	Faulty wiring of power supply to the EGCP-2 control	Verify wiring of power supply to the EGCP-2 control.

Synchronization

Problem	Probable Cause	Corrective Action
Unit never adequately matches phase	Synchronizer Mode set point in synchroscope menu set to PERMISSIVE	Set synchronizer Mode to appropriate setting. See description of set points.
	Synchronizer dynamics in synchroscope menu are improperly set up	Tune synchronizer dynamics. See description of set points.
Synchronizer displays small phase difference, but measured phase difference is large	Generator A phase PT input is L-L and bus A phase PT input is L-N or vice versa	Verify that Generator A phase PT input bus A phase PT input are the same form (i.e. L-N or L-L).
	Bus and/or generator PT inputs are not A phase	Verify that Bus and generator PT inputs are A phase.
	synchronizer improperly calibrated	Calibrate synchronizer. See calibration of control inputs and outputs.
Synchronizer matches phase, but never closes breaker/contactor	Synchronizer Mode set point in synchroscope menu is set to CHECK	Set synchronizer Mode to appropriate setting. See description of set points.
	Dwell time set point in synchroscope menu is too large	Reduce Dwell Time set point in synchroscope menu. See description of set points.
Synchronizer displays matched phase, but measured phase difference is ~180 degrees, or when breaker closes it crash parallels the set 180 degrees out of phase	Generator or bus PT is reversed polarity (faulty wiring)	Verify correct polarity of Generator and bus PT inputs.
Unit won't close to dead bus	Multiple unit system with DEADBUS CLOSING set point in configuration menu set to DISABLED	ENABLE DEADBUS CLOSING set point in configuration menu. See description of set points.
	Synchronizer set point is set to CHECK	Set synchronizer Mode to appropriate setting. See description of set points.
Synchronizer won't voltage match	VOLTAGE MATCHING set point in synchroscope menu is DISABLED	ENABLE the VOLTAGE MATCHING set point in synchroscope menu. See description of set points.
Synchronizer does not voltage match within spec.	Generator A phase PT and/or Bus A phase PT input(s) are inadequately calibrated	Calibrate the Generator A phase PT and Bus A phase PT inputs. See calibration of control inputs and outputs.
	Voltage matching tolerance set point in synchroscope menu is too large	Appropriately set the Voltage matching tolerance set point in synchroscope menu. See description of set points.

Breaker Close/Open Control

Problem	Probable Cause	Corrective Action
When generator set is in synchronization, the breaker never closes	Synchronizer set to CHECK	Set synchronizer Mode to appropriate setting. See description of set points.
	Faulty wiring causing the relay output to not make connection to the breaker	Verify wiring of the relay output contacts.
	Dwell time set point in the synchroscope menu is too long	Reduce Dwell time set point in the synchroscope menu. See description of set points.
Contactor closes for a brief moment and then opens	C B CONTROL set point in configuration menu is set for BREAKER	Appropriately set the C B CONTROL set point in configuration menu. See description of set points.
	C B HOLD TIME set point in synchroscope menu is too short	Increase C B HOLD TIME set point in synchroscope menu. See description of set points.
	Faulty wiring on C.B. Aux contacts	Verify wiring of C.B. Aux contacts to EGCP-2 input.
Breaker close relay stays energized when a close command is given and never issues an open command	C B CONTROL set point is set for CONTACTOR	Appropriately set the C B CONTROL set point in configuration menu. See description of set points.

Real Load Control

Problem	Probable Cause	Corrective Action
KW for a phase(s) reads negative.	Current transformer(CT) has reversed polarity	Verify/reverse polarity of current transformer for effected channel(s) ***IMPORTANT*** **Engine generator set must be off to safely open circuit a current transformer.**
Unit carries improper proportion of real load during isochronous load sharing	Rated KW set point in configuration menu set at incorrect value	Appropriately set Rated KW set point in configuration menu. See description of set points.
	A proportional dc speed error exists on the speed control unit (no-load speed not set to match bus frequency)	Adjust speed setting of speed control to match the bus frequency. If unit is carrying too little load, the speed setting needs increased. If unit is carrying too much load, the speed setting needs decreased.
Real load control is unstable when paralleled with the mains source	Real load control dynamics in real load control menu are improperly set up	Tune Real load control dynamics in real load control menu. See description of set points.
Process control operation causes overload or reverse power	PROCESS ACTION set point in process control menu set for incorrect action	Appropriately set PROCESS ACTION set point in process control menu. See description of set points.
Loading and/or unloading is too fast/slow	Load and/or unload ramp rates in the real load control menu are set incorrectly	Appropriately increase/decrease the Load and/or unload ramp rates in the real load control menu. See description of set points.
Engine speed/load has an instability that fluctuates very quickly.	Speed control dynamics are improperly set up	Tune the speed control dynamics for stable operation. See speed control manufacturer's instruction manual for more details.

Reactive Load Control

Problem	Probable Cause	Corrective Action
Phase power factors do not agree. Two of the three phases are extremely far out of range	CT's are connected to incorrect phase inputs	Verify CT's are connected to the appropriate input terminals. **IMPORTANT** **Engine generator set must be off to safely open circuit a current transformer.**
Unit carries improper proportion of reactive load during isochronous load sharing	Rated KVA set point in the configuration menu is set at incorrect value	Appropriately set the Rated KVA set point in the configuration menu. See description of set points.
	Generator A phase PT input(s) are improperly calibrated	Calibrate the Generator A phase PT input(s) of the generator set(s). See calibration of control inputs and outputs.
Reactive load control is unstable when paralleled with the mains source	Reactive load control dynamics in the reactive load control menu are improperly set up	Tune the Reactive load control dynamics in the reactive load control menu. See description of set points.
Unit maintains a constant VAR load rather than a constant power factor when paralleled with the mains source	VAR/PF set point in the reactive load control menu is set to VAR CONTROL	Appropriately set the VAR/PF set point in the reactive load control menu. See description of set points.
Unit maintains a constant power factor load rather than a constant VAR when paralleled with the mains source	VAR/PF set point is set to PF CONTROL	Appropriately set the VAR/PF set point in the reactive load control menu. See description of set points.
Multiple generator sets are unstable when VAR/PF sharing at light loads	VOLTS RAMP TIME set point in reactive load control menu is not adjusted properly	Appropriately set the VOLTS RAMP TIME set point in reactive load control menu. See description of set points.
	Droop Current Transformer not properly connected to AVR	Verify the connection of the Droop Current Transformer to the AVR. See AVR manufacturer's instruction manual for more details.

Sequencing

Problem	Probable Cause	Corrective Action
Unit number(s) does not show up in the sequencing order in the sequencing screen/unit doesn't auto sequence	switch in manual position	Switch unit(s) to the Auto switch active position. See dc inputs/outputs.
	Automatic sequencing set point in the configuration menu set to disabled	ENABLE the Automatic sequencing set point in the configuration menu. See description of set points.
	Unit has an active alarm	Commit or reset alarm condition(s). See description of screens.
	RS-485 Network not connected at unit(s)	Verify that the RS-485 network is connected to all EGCP-2 controls in system.
	RS-485 Network is inadequately terminated	Verify that the RS-485 Network is correctly terminated. See inter-control communications (RS-485).
When system load is large enough to require additional gen-sets, more than one set is sequenced on line	NEXT GENSET DELAY set point in sequencing menu is too short	Increase NEXT GENSET DELAY set point in sequencing menu. See description of set points.
	MAX START TIME set point in sequencing menu is too short	Increase MAX START TIME set point in sequencing menu. See description of set points.
When system load is small enough to take additional sets off line, more than one set is sequenced off line	REDUCED LOAD DELAY set point in sequencing menu is too short	Increase REDUCED LOAD DELAY set point in sequencing menu. See description of set points.
	MAX STOP TIME set point in sequencing menu is too short	Increase MAX STOP TIME set point in sequencing menu. See description of set points.

Mains/Bus Sensing

Problem	Probable Cause	Corrective Action
Unit(s) do not respond to loss of mains	Shutdown/alarm set points for mains sensing not set for LOSS OF MAINS	Appropriately set mains high/low frequency and high/low voltage set points in shutdown/alarm menu. See description of set points.
	Unit(s) do not have an active auto switch input	Switch unit(s) to the Auto switch active position. See dc inputs/outputs.
Unit does not recognize when mains are in spec.	Set points for mains high/low frequency and high/low voltage in shutdown/alarm menu are set too tight for sensing when mains are in spec	Increase Mains high frequency and voltage and decrease mains low frequency and voltage set points in the shutdown/alarm menu. See description of set points.

Communications

Problem	Probable Cause	Corrective Action
A unit number(s) does not show up in the sequencing order in the sequencing screen	RS-485 Network is inadequately terminated	Verify that the RS-485 Network is correctly terminated. See inter-control communications (RS-485).
	RS-485 Network not connected at unit(s)	Verify that the RS-485 Network is connected to the EGCP-2 RS-485 input at all units.
	RS-485 network is connected with reverse polarity at one or more units	Verify the polarity of the RS-485 network on all units.
If a unit with the network termination is powered down, communications become unreliable or completely cease	+5 Vdc power supply is not linked between units (inadequate wiring)	Verify that the +5 Vdc power supply is linked between all units.

Chapter 8.
Definition of Terms

AMF Automatic Mains Failure. The ability of a control to detect, and take action on a mains failure condition. The EGCP-2, which has AMF capabilities, can be programmed to sense a loss of mains condition based on mains voltage, frequency, or a sudden load surge on a generator operating in parallel with the mains. The action taken by the EGCP-2 when it senses a mains failure can be programmed for either an alarm action, or a standby power action where all generators start and tie to the load after the failed mains have been isolated from that load.

Automatic Control A control mode used by the EGCP-2 to activate several automatic functions within the control. These functions, which are dependent upon program setpoints and system configuration, are Loss of Mains detection, Automatic Sequencing, and Automatic dead bus closing, Automatic control also effectively connects those EGCP-2 units in automatic to the Local Operating Network (LON).

Auto Switch A discrete input to the control which will initiate automatic operation of the EGCP-2.

ATS Automatic Transfer Switch. A device which isolates the mains upon a sensed fault in the mains, or through manual operation. The ATS selects a secondary power source, such as a diesel generator to supply the load when the mains have been isolated. The ATS will also re-connect the load to the mains when they are re-established and stable. The EGCP-2 control has ATS functions.

Audible Alarm An alarm condition used by the EGCP-2 for various alarm settings which will cause the audible alarm relay output to energize when reaching or exceeding the alarm parameters.

Automatic Sequencing The automatic addition, or subtraction of generators to/from the load based on predetermined load levels being crossed for specific periods of time. Automatic sequencing is a function of a multiple generator system which is operating in load sharing mode isolated from the mains, of process control mode in parallel with the mains.

AVR Automatic Voltage Regulator. A device which controls the field excitation of an AC generator in such a way as to maintain a specific voltage level over the operating load range of the generator. The EGCP-2 control biases the voltage setting of the AVR to voltage match during synchronization and to control reactive load during load share and mains parallel operation.

Base Load A term used to describe a generator loading condition in which the generator is paralleled to another source of power, typically the mains, and loaded to a fixed KW level. The generator maintains this KW level regardless of load on the Mains.

Breaker A device used to connect one power source to a load, or to another power source. Breakers can be either manually or automatically operated, and will usually contain overcurrent protection. The EGCP-2 controls motorized breakers by issuing a momentary breaker close output to energize the breaker coil, and a separate breaker open output to shunt trip the breaker to open it.

Contactor A device used to connect one power source to a load, or to another power source. Contactors are typically automatic in operation, and are energized for closure from an external source. The EGCP-2 controls contactors by issuing a contactor close output to close the contactor, and removing this output to open the contactor.

CT Current Transformer. A device used to sense current levels on a high current source, such as a generator. The secondary side of the current transformer supplies a lower current signal which is safe to feed into metering and control devices. The EGCP-2 uses 5A secondary current CTs for its current sensing inputs from the three phases of the generator.

Dead Bus Closing The ability of a generator breaker control device to sense, and safely close on to a load which has no other generators or sources of power tied to it. Dead Bus Closing must not allow two generators to attempt closure to the dead bus at the same time, since an out of phase paralleling situation would likely occur. The EGCP-2 uses its Local Operating Network to insure safe dead bus closing among all units tied to this network. The units have a single dead bus token, which allows the unit possessing it to close to the dead bus. Only one token exists on the network, so there is no possibility of multiple units closing to the dead bus simultaneously. Dead Bus Closing is always active in single unit configurations.

Droop A reduction in the reference of a controlled parameter as the amplitude of that parameter increases (negative feedback). The EGCP-2 uses Kilowatt Droop as a manual means of loading the generator when paralleling to another generator, or to the mains. Droop Control is effective only if the LOAD CONTROL MODE setpoint in the Configuration menu is set to DROOP.

Dwell Time A term used to describe the amount of time required during synchronization in which one power source is within a specified phase angle window of another source it is synchronizing to.

Hard Shutdown A shutdown condition used by the EGCP-2 for various alarm settings which will cause the unit to immediately open its generator breaker if on load, and shut down when reaching or exceeding the alarm parameters.

Isochronous A term which is used to describe a generator set which will maintain its frequency at a constant level as the load on that generator changes. The EGCP-2 typically uses Isochronous load control when in load sharing, or when operating as a single unit. This assures a constant frequency under all generator loads which are within the capacity of the generator.

Inverse Time Delay A time delay used for over current and reverse power detection which utilizes both time and amplitude of the condition to determine the active trip level. The inverse time delay accounts for rapid high amplitude conditions to cause a trip, as well as long duration low amplitude conditions.

Isolated Bus A bus which is electrically isolated from the mains.

KVA Kilovolt Amps. The power rating of the generator set KVA is determined by multiplying the rated voltage of the generator by the rated current.

KVAR Kilovolt Amps Reactive. Reactive load is produced by a phase angle differential between the volts and the amps of the generator. KVAR can either be a product of inductive or capacitive loads when operating on an isolated bus, or can be produced by the generator when operating in parallel with another power source such as the mains.

KW Kilowatts. The Watts are the product of the voltage of the generator and the current which is produced within the voltage cycle. KW load is resistive in nature.

Load Typically the KW load on the generator at any given time.

Load Surge A condition in which a step load on the generator ,which is operating in a mains parallel mode (base load or process), above a certain amplitude can be used to trigger a Loss of Mains condition.

Loss of Mains A condition in which the sensed mains PT input to the EGCP-2 falls below certain voltage and/or frequency setpoints for a given period of time. Load Surge can also be used to detect a Loss of Mains condition. The EGCP-2 can be configured to trigger a Loss of Mains (LOM) reaction to these conditions, and provide on site power generation to supplement the load until such time as the mains return and are stable.

Mains Parallel To synchronize and close an operating generator to the mains. The EGCP-2 can be configured for Mains Parallel operation.

Master The Highest Priority unit in an operating automatic system. The Master Control controls load sharing, VAR/PF sharing, sequencing, synchronization to the mains, mains breaker closure/opening, and multiple unit starting.

Manual A switch input to the EGCP-2 which puts the control in a manual operating mode. When in manual, the EGCP-2 does not communicate with other units on the network, and if in a multiple unit system, will not issue a dead bus closing command. Being in manual also cancels any Loss of Mains detection for that particular unit.

Network Address A unique address assigned to each unit which is operating in an automatic system. The network address is that particular units “name” on the network so that it can be properly identified by other units operating on the same network.

Network Priority A unique number assigned to each unit operating in automatic on the network. Network priority defines the sequence in which units will be taken on/off load when operating in an automatic sequencing configuration (load sharing or process control). Automatic sequencing will place units on load as required starting at the highest network priority (lowest numerical value), and adding units of lower priority (higher numerical value) as the load on that system increases above certain defined limits. Automatic sequencing will also remove units from the load in a reverse order of that used for sequencing units on load, that is from lowest priority (highest numerical value) to highest priority (lowest numerical value). In addition to all this, the unit with the highest network priority on the network is considered the master, and all other units with lower priorities are slaves to that master.

No Parallel An operating mode of the EGCP-2 which will not allow the generators to operate in parallel with the mains under any circumstances. All transitions to and from the mains are completed using an open transition action.

Parallel To synchronize and close an operating generator to the mains.

Power Triangle A right triangle which is used to determine the amplitude relationship between KVA, KW, and KVAR.

Process Control A switch input which selects a mode of control used while in parallel with the mains. When operating in process control, the EGCP-2 receives a 4–20 mA, or 1–5 Vdc input from an external transducer. This transducer monitors a variable which is affected by the generator operation. Variables such as imported power to a site, exported power to the mains, exhaust temperature, and fuel gas pressure levels are typical for monitoring with a transducer. The EGCP-2 uses an internal reference level for the process input, and compares this reference to the transducer input. The EGCP-2 then raises or lowers the amount of load on the generator to maintain the process transducer input to the referenced value.

Proportional Load Sharing A mode of load control used by the EGCP-2 while operating multiple units on an isolated bus. Proportional Load Sharing measures the total KVA capacity of all the units on the bus and divides the total KVA load on the bus by this capacity. This value is then sent over the network as a load reference for all units operating in parallel on the bus. The result of this is the ability of various KVA rated units operating at their respective proportion of the total load on the bus. This allows consistent load sharing among units of various sizes throughout their entire operating load range.

PT Potential Transformer. A device which steps down a higher AC voltage to a lower AC voltage. Typically used on generator set applications to step the generator voltage down to an amplitude which is safe for use in metering and control devices.

Run With Load A discrete input to the EGCP-2 which signals the unit to operate the generator on load. The way that the control puts the generator on load depends upon software configuration, and the type of system the EGCP-2 is configured for.

Slave An EGCP-2 with lower network priority (Higher numerical value) than the master.

Soft Shutdown A shutdown condition used by the EGCP-2 for various alarm settings which will cause the unit to softly unload and cooldown when reaching or exceeding the alarm parameters.

Soft Transfer A Load Control Mode of the EGCP-2 which allows the unit, or group of units to transfer power from the mains to the on site generators. Upon reaching either a base load reference, or process control reference level, the EGCP-2 will issue a command to open the mains breaker. This results in a complete transition of power from the mains to the on site generators.

Synchronize To match the frequency, phase angle, and voltage of a generator to another power source such as a generator or the mains. This will allow a safe smooth breaker closure of that generator to the power source. The EGCP-2 uses Phase and Voltage Matching to ensure there is a minimum of potential across the breaker prior to closure.

System Load A variable used in the load control program of the EGCP-2 which is the ratio of total load demand to total generating capacity which is supplying the load. System Load = KW Load/KW Capacity.

Test A discrete input to the EGCP-2 which is used to start the engine for test and initial start check out. The test input is also used with the run with load or process inputs, and a software setpoint, to put the EGCP-2 into a soft transfer mode.

VAR/PF Control The ability to control a level of VAR or PF on a generator while in parallel with the mains. The EGCP-2 has VAR/PF control features which allow the user to set a desired VAR or PF level on the generator while in parallel with the mains. The VAR or PF level is maintained by changing the excitation level of the generator. This is accomplished by changing the voltage reference level of the AVR from the EGCP-2.

VAR/PF Sharing The ability to share the VAR and PF load on multiple units operating on an isolated bus. Like load sharing, the EGCP-2 VAR/PF sharing measures the VARs of the load on the isolated bus, and divides this value by the total VAR capacity of the generators tied to the load. A proportional VAR/PF level is then maintained between all units tied to the load based on their rated VAR capacity.

Chapter 9.
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.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

www.woodward.com/directory

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 authorization 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.

NOTICE

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: **www.woodward.com**.

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

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (0) 21 52 14 51
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Turbine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

You can also locate your nearest Woodward distributor or service facility on our website at:

www.woodward.com/directory

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:

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
Control/Governor #1	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #2	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #3	
Woodward Part Number & Rev. 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.

Appendix A.
EGCP-2 Setpoint Worksheet

Configuration Menu

Item:	Range:	Default:	As Set Value:	Note:
SECURITY CODE	Min: 0 Max: 9999	****		See Password section
NETWORK ADDRESS	Min: 1 Max: 8	1		Only accessible if configured for multiple units
NETWORK PRIORITY	Min: 1 Max: 8	1		Only accessible if configured for multiple units
NUMBER OF POLES	Min: 2 Max: 18	4		
NUMBER OF TEETH	Min: 16 Max: 500	60		
SYSTEM FREQUENCY	Min: 50 Max: 60	60 Hz		
RATED SPEED	Min:100 Max: 5000	1800 RPM		
RATED KW	Min: 1 Max: 30000	0 kW		
RATED KVA	Min: 1 Max: 30000	0 kVA		
RATED KVAR	Min: 1 Max: 30000	0 kVAR		
CT RATIO	Min: 5:5 Max: 30000:5	5:5		
PT RATIO	Min: 1.0:1 Max: 1000.0:1	1.0:1		
VOLTAGE INPUT	Wye line-neutral Delta line-line	Wye (line-neutral))		
VOLTAGE REF	Min: 1 Max: 30000	220 Volts		
DISPLAY UNITS	AMERICAN METRIC	METRIC		
SET DATE	MM-DD-YY	6-16-2000		
SET TIME	HH :MM	12 :00		24 Hr. CLOCK
START SEQUENCING	Enable Disable	Enable		
RELAY #12 FUNCTION	KVA LOAD SWITCH IDLE/ RATED SWITCH	KVA LOAD SWITCH		
SPEED BIAS TYPE	±3 Vdc (WGC) 0.5 TO 4.5 Vdc (DDEC) 500 Hz PWM (adem)	±3 Vdc		
VOLTAGE BIAS TYPE	±1 Vdc BIAS ±3 Vdc BIAS ±9 Vdc BIAS	±1 Vdc BIAS		
CKT BREAKER CONTROL	Breaker Contactor	Breaker		
OPERATING MODE	No Parallel Mains Parallel	No Parallel		
NUMBER OF UNITS	SINGLE MULTIPLE	SINGLE		

Shutdown and Alarms Menu

Item:	Range:	Default:	As Set Value:	Note:
VOLTAGE RNG ALM	Audible Alarm Visual Alarm Warning Disabled	Warning		
GEN VOLT HI LMT	Min: 50 Max: 30000	250.0 volts		
GEN VOLT HI ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Warning		
GEN VOLT LO LMT	Min: 50 Max: 30000	200.0 volts		
GEN VOLT LO ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Warning		
VOLTAGE ALM DLY	Min: 0.1 Max: 30.0	5.0 sec.		
GEN FREQ HI LMT	Min: 40 Max: 75	65 Hz		
GEN FREQ HI ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Warning		
GEN FREQ LO LMT	Min: 40 Max: 75	55 Hz		
GEN FREQ LO ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Warning		
SPD FREQ MISMTCH	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Disabled		
OVERCURRENT LVL	Min: 5.0 Max: 30000.0	30 Amps/phase		
OVERCURRENT DLY	Min: 0.1 Max: 20.0	1.0 second		
OVERCURRENT ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Soft Shutdown		
REVERSE PWR	Min: -50.0 Max: -1.0	-10.0 %		
REV PWR DELAY	Min: 0.1 Max: 20.0	5.0 seconds		
MIN REVERSE PWR	Min: -50.0 Max: -1.0	-5.0 %		

Item:	Range:	Default:	As Set Value:	Note:
REVERSE PWR ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Soft Shutdown		
LOSS OF EXCITE	Min: -100.0 Max: -5.0	-50.0 %		
LOE ALARM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Warning		
REMOTE FAULT1	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Disabled		15 second delay after crank cut out speed. Fault 1 timer can add to this delay.
FAULT1 TIMER	Min: 0.0 Max: 30.0	0.0 seconds		
REMOTE FAULT2	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Disabled		15 second delay after crank cut out speed. Fault 2 timer can add to this delay.
FAULT2 TIMER	Min: 0.0 Max: 30.0	0.0 seconds		
REMOTE FAULT3	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Hard Shutdown		
FAULT3 TIMER	Min: 0.0 Max: 30.0	0.0 seconds		
REMOTE FAULT4	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Disabled		
FAULT4 TIMER	Min: 0.0 Max: 30.0	0.0 seconds		
REMOTE FAULT5	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Disabled		
FAULT5 TIMER	Min: 0.0 Max: 30.0	0.0 seconds		
REMOTE FAULT6	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Disabled		
FAULT6 TIMER	Min: 0.0 Max: 30.0	0.0 seconds		

Engine Control Menu

Item:	Range:	Default:	As Set Value:	Note:
PREGLOW TIME	Min: 0 Max: 1200	5 sec		
CRANK TIME	Min: 0 Max: 240	10 sec		
CRANK CUTOUT	Min: 5 Max: 10000	550 RPM		
CRANK DELAY	Min: 1 Max: 240	30 sec		
CRANK REPEATS	Min: 0 Max: 20	0		
CRANK FAIL	Warning Visual Alarm Audible Alarm	Warning		
IDLE SPEED	Min: 5 Max: 30000	1200 RPM		
IDLE TIME	Min: 1 Max: 240	10 sec		
COOLDOWN TIME	Min: 0 Max: 2400	120 sec		
COOLDOWN LIMIT	Min: 0 Max: 10000	20 kVA		
ENGINE RUN TIME	Min: 0 Max: 32000	0 Hours		
MW HOURS	Min: 0.0 Max: 32000.0	0.0 MW Hrs		
OVERSPEED	Min: 5.0 Max: 30000.0	1980 RPM		
OVERSPEED ALARM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Hard Shutdown		
BATT VOLT HI LMT	Min: 5.0 Max: 50.0	28.5 VOLTS		
BATT VOLT HI ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Warning		
BATT VOLT LO LMT	Min: 5.0 Max: 50.0	10.0 VOLTS		
BATT VOLT LO ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Warning		
HI OIL PRESS LMT	Min: 0.0 Max: 120.0	65 Bar or PSI		
HI OIL PRESS ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Warning		

Item:	Range:	Default:	As Set Value:	Note:
LO OIL PRESS LMT	Min: 0.0 Max: 120.0	15 Bar or PSI		
LO OIL PRESS ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Soft Shutdown		
HI H20 TEMP	Min:75.0 Max: 300.0	212 Deg C or F		
HI H20 TEMP ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Soft Shutdown		
LO H20 TEMP	Min: 0.0 Max: 100.0	20.0 Deg C or F		
LO H20 TEMP ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Disabled		

Synchronizer Menu

Item:	Range:	Default:	As Set Value:	Note:
SYNC MODE	CHECK RUN PERMISSIVE	CHECK		
SYNC GAIN	Min: 0.01 Max: 100.00	0.10		
SYNC STABILITY	Min: 0.00 Max: 20.00	1.00		
VOLTAGE MATCHING	Disabled Enabled	Enabled		
VOLTAGE WINDOW	Min: 0.1 Max: 10.0	1.0 %		
MAX PHASE WINDOW	Min: 2.0 Max: 20.0	10.0 degrees		
DWELL TIME	Min: 0.1 Max: 30.0	.05 sec		
CB HOLD TIME	Min: 0.1 Max: 30.0	1.0 sec		
CLOSE ATTEMPTS	Min: 1 Max: 20	2		
RECLOSE DELAY	Min: 2 Max: 1200	30 seconds		
SYNC RECLOSE ALM	Warning Visual Alarm Audible Alarm	Warning		
SYNC TIMEOUT	Min: 0 Max: 1200	0 seconds		0= NO LIMIT
SYNC TIMEOUT ALM	Warning Visual Alarm Audible Alarm	Warning		
DEADBUS CLOSURE	Disabled Enabled	Disabled		Don’t care setpoint in single unit applications (internally ENABLED).

Real Load Control Menu

Item:	Range:	Default:	As Set Value:	Note:
LOAD CONTROL MODE	Droop Normal Soft Transfer	Normal		
LOAD CTRL GAIN	Min: 0.001 Max: 100.0	0.01		
LOADSHARE GAIN	Min: 0.1 Max2.0	0.72		
LOAD STABILITY	Min: 0.0 Max:20.0	2.00		
LOAD DERIVATIVE	Min: 0.0 Max: 20.0	0.20		
LOAD CTRL FILTER	Min: 0.01 Max: 10.0	1.0 Hz		
BASE LOAD REFERENCE	Min: 0.0 Max: 30000.0	50.0 kW		
UNLOAD TRIP	Min: -10.0 Max: 30000.0	10 kW		
LOAD DROOP	Min: 0.0 Max: 50.0	5.0 %		
LOAD TIME	Min: 1.0 Max: 7200.0	10 seconds		
UNLOAD TIME	Min: 1.0 Max: 7200.0	10 seconds		
RAISE LOAD RATE	Min: 0.01 Max: 100.0	2.00 %/second		
LOWER LOAD RATE	Min: 0.01 Max: 100.0	2.00 %/second		
KW LOAD HIGH LIMIT	Min: 0.0 Max: 30000.0	30 kW		
KW HIGH LIMIT ALARM	Disabled Warning Visual Alarm Audible Alarm	Warning		
KW LOAD LOW LIMIT	Min: 0.0 Max: 30000.0	5 kW		
KW LOW LIMIT ALARM	Disabled Warning Visual Alarm Audible Alarm	Disabled		
KVA SWITCH LOW	Min: 0 Max: 30000	10 KVA		
KVA SWITCH HIGH	Min: 0 Max: 30000	100 KVA		

Reactive Load Control Menu

Item:	Range:	Default:	As Set Value:	Note:
VAR/PF MODE	Disabled PF control VAR	PF control		
VAR/PF GAIN	Min: .01 Max: 20.0	1.00		
VOLTS RAMP TIME	Min: 0 Max: 1000	60 sec		
VAR/PF SHARING GAIN	Min: .01 Max: 20.0	1.00		
VAR/PF STABILITY	Min: 0.0 Max: 20.00	1.00		
KVAR REFERENCE	Min: 0 Max: 30000	10 kVAR		+ = generate - = absorb
PF REF	Min: -0.5 =.5 LEAD Max: +.5 =.5 LAG	0.0= 1.00 LAG		0.0 = UNITY PF + = LAG - = LEAD
PF DEADBAND	Min: 0.0 Max: 1.0	0.005		

Process Control Menu

Item:	Range:	Default:	As Set Value:	Note:
PROCESS ACTION	Direct Indirect	Indirect		
PROCESS GAIN	Min: 0.001 Max: 100.0	0.10		
PROCESS STABILITY	Min: 0.0 Max: 20.0	1.0 sec		
PROCESS DERIVATIVE	Min: 0.0 Max: 20.0	0.1 sec		
PROCESS DEADBAND	Min: 0.0 Max: 20.0	0.05 mA		
PROCESS DROOP	Min: 0.0 Max: 50.0	0.0 %		
PROCESS FILTER	Min: 0.1 Max: 5.0	1.0 Hz		
PROCESS REFERENCE	Min: 4.0 Max: 20.0	12.0 mA		
RAISE RATE	Min: 0.01 Max: 20.0	0.1 mA/sec		
LOWER RATE	Min: 0.01 Max: 20.0	0.1 mA/sec		
PROCESS HIGH LMT	Min: 4.0 Max: 20.0	20.0 mA		
PROC HI LMT ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Disabled		
PROCESS LOW LMT	Min: 4.0 Max: 20.0	4.0 mA		
PROC LO LMT ALM	Disabled Warning Visual Alarm Audible Alarm Soft Shutdown Hard Shutdown	Disabled		

Transfer Switch Menu

Item:	Range:	Default:	As Set Value:	Note:
CHECK MAINS BREAKER	Disabled Enabled	Enabled		
FAST XFER DELAY	Min: 0.1 Max: 30.0	1.0 sec		
MAINS STABLE DLY	Min: 1 Max: 30000	60 second		
GEN STABLE DLY	Min: 1 Max: 30000	10 second		
LOAD SURGE	Min: 25.0 Max: 300.0	100.0 % / sec		
LOAD SURGE ALARM	Disabled Warning Loss of Mains Loss of Mains w/alarms	Warning		
MAIN VOLT HIGH LMT	Min: 50.0 Max: 30000.0	240 volts		
MAIN VOLT HIGH ALARM	Disabled Warning Loss of Mains Loss of Mains w/alarms	Warning		
MAIN VOLT LOW LMT	Min: 50.0 Max: 30000.0	200 volts		
MAIN VOLT LOW ALARM	Disabled Warning Loss of Mains Loss of Mains w/alarms	Warning		
MAIN FREQ HIGH LMT	Min: 40.0 Max: 75.0	61.0 Hz		
MAIN FREQ HIGH ALARM	Disabled Warning Loss of Mains Loss of Mains w/alarms	Warning		
MAIN FREQ LOW LMT	Min: 40.0 Max: 75.0	59.0 Hz		
MAIN FREQ LOW ALARM	Disabled Warning Loss of Mains Loss of Mains w/alarms	Disabled		
LOM ACTION DELAY	Min: 0.1 Max: 30.0	0.1 seconds		

Sequencing and Comms Menu

Item:	Range:	Default:	As Set Value:	Note:
AUTO SEQUENCING	Disabled Enabled	Disabled		
MAX GEN LOAD	Min: 1 Max: 100	60 %		
NEXT GENSET DLY	Min: 1 Max: 1200	30 sec		
RATED LOAD DELAY	Min: 1 Max: 1200	5 sec		
MAX START TIME	Min: 1 Max: 1200	30 sec		
MIN GEN LOAD	Min: 1 Max: 100	30 %		
REDUCED LOAD DLY	Min: 1 Max: 1200	60 sec		
MAX STOP TIME	Min: 1 Max: 1200	60 sec		
422 PROTOCOL	ServLink Modbus® Upload Setpoints	Modbus		
Modbus ID	Min: 1 Max: 247	1		
Modbus Timeout	Min: 0.1 Max: 20.0	3.0 sec		
Modbus Reset	False True	False		

Calibration Menu

Item:	Range:	As Set Value:	Note:
Process In scale	Min: 0.5 Max: 2.0		
Speed Bias offset	Min: -10.0 Max: 10.0		
Volts Bias offset	Min: -25.0 Max: 25.0		
PT Phase A scale	Min: 0.5 Max: 10.0		
PT Phase B scale	Min: 0.5 Max: 10.0		
PT Phase C scale	Min: 0.5 Max: 10.0		
CT Phase A offset	Min: -90.0 Max: 90.0		
CT Phase A scale	Min: 0.5 Max: 5.0		
CT Phase B offset	Min: -90.0 Max: 90.0		
CT Phase B scale	Min: 0.5 Max: 5.0		
CT Phase C offset	Min: -90.0 Max: 90.0		
CT Phase C scale	Min: 0.5 Max: 5.0		
Bus PT scale	Min: 0.5 Max: 10.0		
Synchronizer	Min: -1.0 Max: 1.0		
Battery VCO Gain	Min: -0.1000 Max: 0.1000		
Batt VCO offset	Min : -900.0 Max: 900.0		
Oil Press Gain	Min: -0.1000 Max: 0.1000		
Oil Press Offset	Min: -900.0 Max: 900.0		
WaterTemp Gain	Min: -0.1000 Max: 0.1000		
Water Temp Offset	Min: -900.0 Max: 900.0		
NetComm Dropouts	Min: 0 Max: 50		
Calibrated Unit	False True		Do Not Change

Appendix B.
Download Instructions

Purpose

DOWNLOAD is a DOS-based freeware program that can upload and download configuration files through the EGCP-2's RS-422 serial port. This program is available through the Internet at the following location:

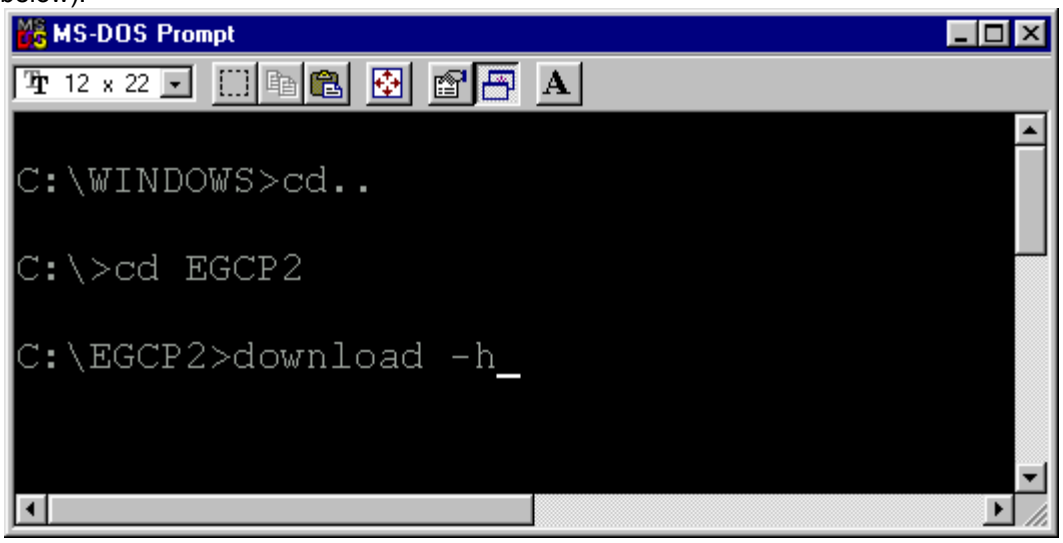
1. Go to **www.woodward.com/software**
2. In the box, select EGCP-2 Tools for all EGCP-2 related software available at present time.

Requirements

- RS-232—RS-422 converter
- EGCP Download Cable
- DOWNLOAD.EXE, part number 9926-113 Rev B or greater

Instructions

Save the DOWLOAD.EXE file to the computer. In the following example this file is saved in a directory called EGCP2 on the c:\ drive. Then using a DOS command prompt, go to the directory where the download file is stored and type DOWNLOAD –h (or –?) for a complete list of the command-line options (see below).



Establishing a Connection:
Connect the RS-232 / RS-422 cable between the EGCP-2 and the computer. See the Communication Ports section of chapter four in the Set Builder manual for more information about this cable interface.

IMPORTANT

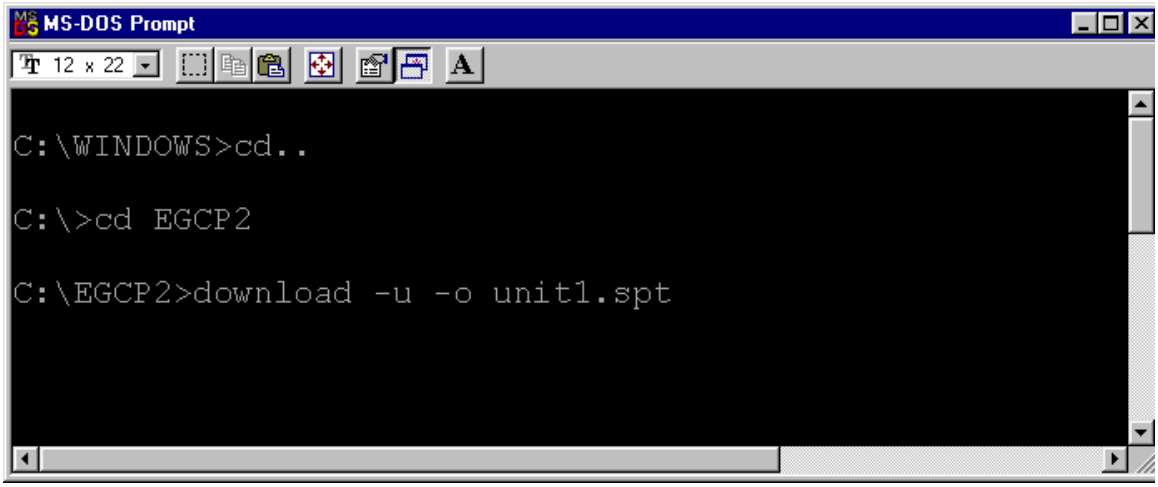
Only one EGCP-2 can be connected to the RS-422 communication network when uploading or downloading setpoints. If a multidrop network has been setup linking more than one EGCP-2 on the RS-422 communication port network, it will be necessary to separate the control from the network in order to upload or download setpoints.

Uploading Setpoints:
Saving the setpoints from the control to a file on the computer.
The following examples assume that COM1 is the available serial port on the PC, and the download.exe program has been saved to the directory, c:\EGCP2.

On the EGCP-2, under the SEQUENCING AND COMMS menu, step to the “422 Protocol” item. Select "Upload Setpoints" and press the Enter key.
Cycle power to the EGCP-2.

When the EGCP-2 passes the self-tests, it will be ready to start uploading setpoints.

Using a DOS command prompt, go to the directory where the DOWNLOAD.EXE file is stored and type "download –u –o unit1.spt" at the DOS command prompt (see below). The –u tells the program to wait for an upload string from the control. The –o specifies that the information should be saved to a file, and unit1.spt is the file which will be created in the same directory. The file name can be any name up to 8 characters long. This command assumes that com port 1 is the com port being used on the computer. If another port is being used add the number of this port to the end of the command, i.e. "download –u –o unit1.spt 2” for com 2, add a 3 for com 3, etc.

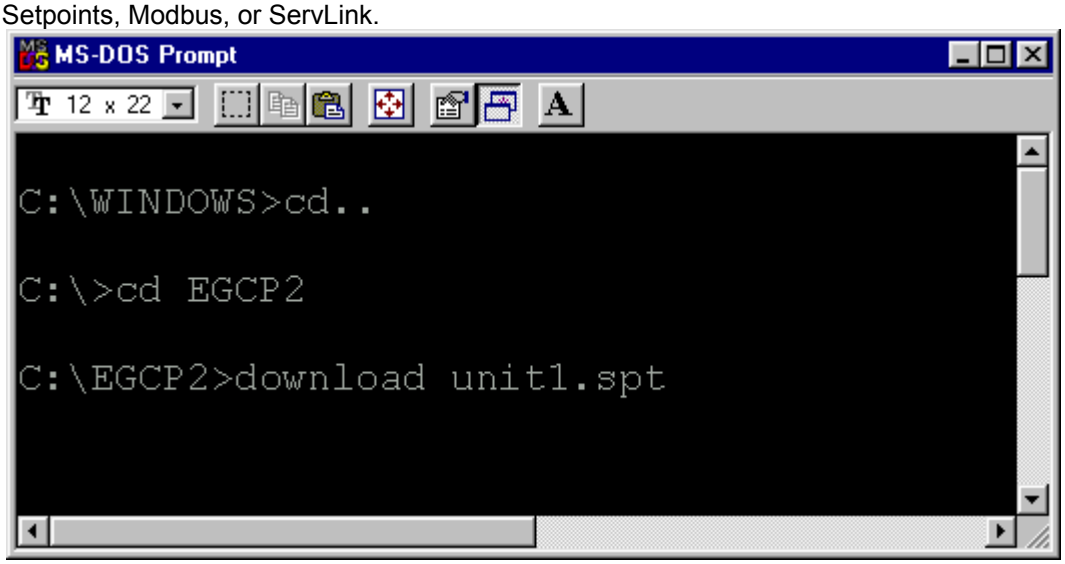


The program will begin uploading setpoints within a few seconds. After the upload is completed the text “Done” will appear on the screen.

When uploading more than one control be sure to use a different name for the .spt files (i.e. Unit1, Unit2…).

Downloading Setpoints:
Loading an existing setpoint file from the computer to the control.

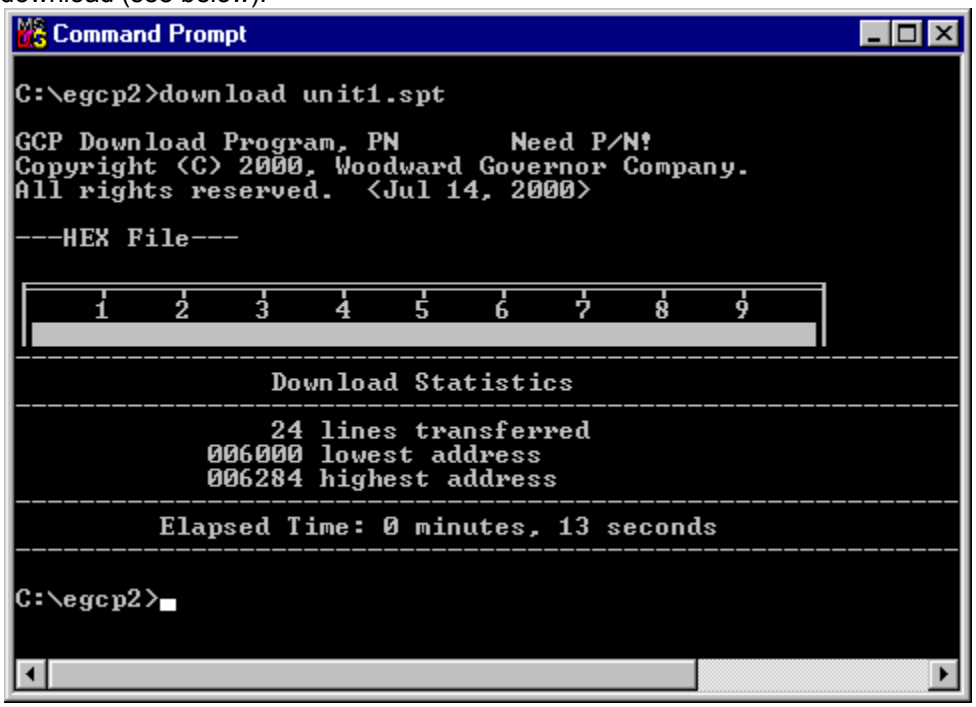
Using a DOS command prompt, go to the directory where the DOWNLOAD.EXE file is stored and type "download unit1.spt" at the DOS command prompt (see below). The 422 Protocol setting can be set to any of the three choices, Upload Setpoints, Modbus, or ServLink.



Cycle power to the EGCP-2.

When the power is restored to the control the download will begin.

A scroll bar will appear on the computer screen showing the progress of the download (see below).



On the EGCP-2 screen the text “SETPOINTS” will be displayed.

After the download is complete press the Config key and enter the proper password. Every item in the Configuration menu will need to be verified by viewing the setpoint and pressing the Enter key on the control. An “*” will be displayed following the setpoint until this value has been committed into the control by pressing the Enter key. This step forces the user to view each setpoint and verify that the value that has just been downloaded is correct for this system’s configuration. This only applies to the Configuration menu, the other menu’s do not need to be committed, although it would be recommended to verify every item.

It is highly recommended that Uploading and Downloading of setpoints only be done between units with the same code revision level. The EGCP-2 will display a warning message and reboot after the self-tests if the setpoints and labels are not compatible with the internal code revision number. This revision number is displayed briefly after the self-tests are complete. It will be displayed on the last line of the lower LCD panel.

EGCP-2 Control Specifications

Woodward Part Numbers:	
8406-115	EGCP-2 Engine Generator Control, 150-300 Vac PT input
8406-116	EGCP-2 Engine Generator Control, 50-150 Vac PT input
Power Supply Rating	9–32 Vdc (SELV) Maximum input voltage range
Power Consumption	less than or equal 13 W nominal, 20 W maximum
Input Supply Voltage	Input Supply Current
12 V (nominal)	1.08 A
24 V (nominal)	542 mA
32 V	406 mA
PT input	50-150 Vac, 8406-116 150-300 Vac, 8406-115
CT input	0–5 Arms
Generator Frequency Range	40–70 Hz
Magnetic Pickup	100–15000 Hz
Discrete Inputs (8)	5 mA source current when CLOSED to Switch Common (65)
Process input	4–20 mA, 1–5 Vdc
Temperature and pressure inputs	0–200 Ω sensors, 4–20 mA transducer, or 0–5 V transducer
Speed Bias	±3 Vdc, .5–4.5 Vdc, 5V peak 500 Hz PWM
Voltage Bias	±1 Vdc, ±3 Vdc, ±9 Vdc
Discrete Outputs (Relay Outputs)	10 A, 250 Vac Resistive 1/3 HP, 125 Vac (7.2 Amp, 0.4-0.5 P.F.) 10 Amp, 30 Vdc Resistive
Communication Ports	RS-485, RS-422
Ambient Operating Temperature	–20 to +70 °C (–4 to +158 °F)(around outside of EGCP-2 Chassis)
Storage Temperature	–40 to +105 °C (–40 to +221 °F)
Humidity	95% at +20 to +55 °C (+68 to +131 °F)
Mechanical Vibration	SV2 5–2000 Hz @ 4 G and RV1 10–2000 Hz @ .04 G^2/Hz
Mechanical Shock	US MIL-STD 810C, Method 516.2, Procedure I (basic design test), Procedure II (transit drop test, packaged), Procedure V (bench handling)
Equipment Classification	Class 1 (grounded equipment)
Air Quality	Pollution Degree II
Installation Overvoltage	Category III
Ingress Protection	Will meet the requirements of IP56 as defined in IEC529 when installed in a suitable atmospherically vented enclosure. Also meets Type 4 requirements.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

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