WOODWARD

Product Manual 26175
(Revision NEW)
Original Instructions

EGCP-2
Engine Generator Control Package

8406-120: 150–300 Vac PT Input, 9–32 Vdc
8406-121: 50–150 Vac PT Input, 9–32 Vdc

Application 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.

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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.

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

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Warnings and Notices

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.

Chapter 1.
Introduction

This manual describes how to apply and operate the Woodward EGCP-2 Engine Generator Control Package, models 8406-120 and 8406-121.
Associated manuals:

26174 – Installation and Operation Manual
26181 – Communications Manual
26108 – Security Levels Guide

The functions and features of the EGCP-2 allow it to be used in many types of applications. The application of the control will determine the configuration of the inputs and outputs and the control setpoints. This manual will be divided into specific sections pertaining to the configuration of the engine generator in the system and then discuss the necessary I/O, setpoint settings, and operation of the EGCP-2.

The four configurations that will be discussed are:

- Single Unit No Parallel
- Single Unit Mains Parallel
- Multiple Units No Parallel
- Multiple Units Mains Parallel

Under each of these configurations, specific applications will be highlighted. Specifically, the following applications will be addressed:

- Standby – Emergency back up
- Prime power – Island mode or Isolated bus
- Soft Transfer – Soft transfer between local power and mains power
- Baseload – Connected to infinite bus with a fixed kW load on the generator
- Process – Connected to infinite bus where the kW load is varied on the generator in order to control a process dependent on kW.

Chapter 2.
Start and Stop Sequences

Over the next several chapters, various control applications will be discussed. Regardless of the application that is used, the basic engine start and stop sequences will be the same.

Start Sequence

There are three conditions where an engine will be started:

1. The Mains has failed and the EGCP-2 is in the Standby mode of operation.
2. The Test or Run with Load Input is closed.
3. A slave unit is commanded to start by a master unit running on the bus.

The EGCP-2 has two types of start sequencing.

1. The local start sequence where the EGCP-2 will control the starter of the engine
2. The remote start sequence where the EGCP-2 will command another device to perform the crank sequence.

This difference is determined by the Configuration setting Start Sequencing. When Start Sequencing is set to Enabled this is the local start sequence; if set to Disabled the EGCP-2 performs the remote start sequence.

Start Sequencing Enabled

With the Start Sequencing setpoint set to Enabled, the EGCP-2 is used to control the engine starter. The EGCP-2 has setpoints to adjust the length of the crank time and the delay time between cranks. In the Configuration menu, the Function of Relay Number 12 can be set as either an Idle/Rated relay or a kVA Load switch. The Idle/Rated relay will switch the speed control from the idle speed to rated speed after an adjustable time delay. If the speed control does not have and idle/rated function, relay twelve should be configured as a kVA Load Switch or the Idle time should be set to zero.

During an engine start, there will not be any voltage on the generator so a magnetic pickup is required to provide the EGCP-2 with the engine speed information. The Crank Cutout speed setting is used to disconnect to the starter from the engine after a successful start.

The EGCP-2 does not have a purge sequence for natural gas engines. However, it may be possible to connect the Preglow relay to the starter instead of the Engine Crank relay. Then a purge time can be created using the Preglow time. The Preglow relay will energize first and will remain energized until the engine reaches the Crank Cutout speed or until the Crank Time has expired. The Preglow relay will close on every start attempt.

The EGCP-2 will skip its Idle warm up time under two conditions. First, on a Loss of Mains start the EGCP-2 will close the Idle/Rated relay immediately. The second is when a master unit has been loaded above it’s rating for the Rated Load delay time and calls for a slave unit. This slave unit will skip its Idle Time when starting.

The EGCP-2 will not close the Engine Crank Relay if it senses the engine is still turning. The RPM must be zero before the Engine Crank Relay will close. This will be indicated on the engine display screen of the EGCP-2 as a SPINDOWN engine mode.

Hardware Connections:

- Preglow Relay
- Engine Crank Relay*
- Fuel Solenoid Relay*
- Idle/Rated Relay
- Magnetic Pickup Input*

*Required

Setpoints:

- Rated Speed
- Number of Teeth
- Preglow Time
- Crank Time
- Crank Cutout
- Crank Delay
- Crank Repeats
- Crank Fail alarm
- Idle Speed
- Idle Time

Start Sequence #1 Loss of Mains start:

1. The EGCP-2 is commanded to start because the Mains has failed.
2. The Preglow relay is closed for the Preglow Time.
3. After the Preglow time has elapsed the Engine Crank and Fuel Solenoid relays close.
4. The control starts the Crank Timer.
5. If the engine speed exceeds the Crank Cutout speed, the Preglow and Engine Crank Relays are opened.
6. The Idle/Rated relay closes.
7. The control will now expect the engine to be operating at Rated Speed and Voltage.
8. The Speed Frequency mismatch alarm is armed.

Start Sequence #2 Discrete Input start:

1. The EGCP-2 is commanded to start from a discrete input.
2. The Preglow relay is closed for the Preglow Time.
3. After the Preglow time has elapsed the Engine Crank and Fuel Solenoid relays close.
4. The control starts the Crank Timer.
5. If the engine speed exceeds the Crank Cutout speed, the Preglow and Engine Crank Relays are opened.
6. The control starts the Idle Time.
7. When the Idle time has expired the Idle/Rated relay will close.
8. The control will now expect the engine to be operating at Rated Speed and Voltage.
9. The Speed Frequency mismatch alarm is armed.

Start Sequence #3 Slave receives start command from the Master:

1. The EGCP-2 is commanded to start from the master control.
2. The Preglow relay is closed for the Preglow Time.
3. After the Preglow time has elapsed the Engine Crank and Fuel Solenoid relays close.
4. The control starts the Crank Timer.

5. If the engine speed exceeds the Crank Cutout speed, the Preglow and Engine Crank Relays are opened.
6. If the Rated Load of the master was exceeded, the Idle/Rated relay closes.
7. If the Maximum Gen Load Level was exceeded, the Idle timer will start and then the Idle/ Rated relay will close.
8. The control will now expect the engine to be operating at Rated Speed and Voltage.
9. The Speed Frequency mismatch alarm is armed.

These sequences describe a normal start where the engine started on the first crank attempt. The EGCP-2 can be programmed to crank the engine multiple times, when the engine does not start, as shown in the following sequence.

1. The EGCP-2 is commanded to start from a discrete input.
2. The Preglow relay is closed for the Preglow Time.
3. After the Preglow time has elapsed the Engine Crank and Fuel Solenoid relays close.
4. The control starts the Crank Timer.
5. If the engine speed does not exceed the Crank Cutout speed, the Preglow, Engine Crank and Fuel Solenoid Relays will remain closed for the Crank Time.
6. After the Crank Time has expired, all three Relays will open.
7. If there are no crank repeats set (Crank Repeats = 0) a Crank Fail alarm will be logged and the control will wait for this alarm to be cleared.
8. If the crank repeats are set to a value greater than zero the control will wait the Crank Delay time and then return to step 2 to close the Preglow relay again.
9. After all of the Crank Repeats have been exhausted a Crank Fail alarm will be logged and the control will wait for this alarm to be cleared.

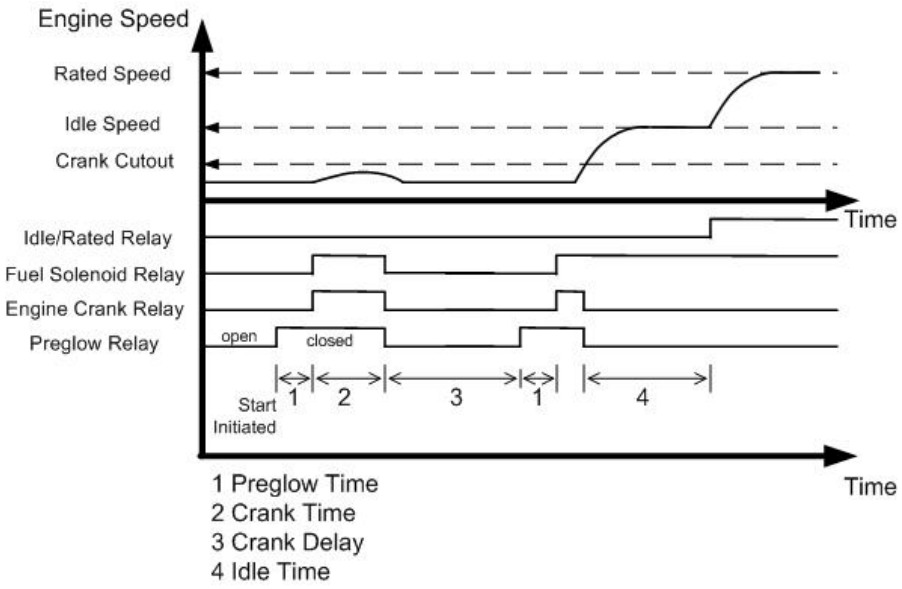


Figure 2-1. Start Sequencing Timers

An illustration of a typical start sequence is given in Figure 2-1. On the first start attempt the engine did not start so a second attempt was needed. If this had been a Loss of Mains start then timer number 4 would have been skipped and the Idle/Rated relay would have closed as soon as the speed went above the Crank Cutout level.

Start Sequencing Disabled

If the generator set already has an engine crank sequence control, the Start Sequencing setpoint can be set to Disabled. The EGCP-2 will close only the Fuel Solenoid Relay to start the engine. This relay is maintained until the EGCP-2 wants the engine to stop and then it will be opened. The Preglow and Engine Crank Relays are not used. The EGCP-2 also does not use the magnetic pickup when Start Sequencing is disabled.

When the EGCP-2 is given a start command, the Fuel Solenoid relay is energized. The control then waits to see a voltage on the PT inputs, before proceeding. The EGCP-2 will wait indefinitely since there is no timer in which it expects to see a start. If Relay Number 12 is set for an Idle/Rated relay, it will close after the voltage is sensed on the PT's and the idle time has expired.

The engine speed will still be shown on the EGCP-2 display, but this is only a calculation based on the Number of Poles setting and the generator frequency. The overspeed setpoint will still be active, but again it is not sensing the actual RPM, it is using the calculated RPM value.

Hardware Connections:
- Fuel Solenoid Relay*
- Idle/Rated Relay

*Required

Setpoints:
- Rated Speed
- Number of Teeth
- Idle Time

The Rated Speed and Number of Teeth setpoints still have to be set to satisfy the configuration sanity checks performed by the EGCP-2 (see the Sanity Checks section of the Installation and Operation manual 26174).

Start Sequence:
1. The EGCP-2 is commanded to start either from a Loss of Mains, a discrete input, or by a master unit over the communication line.
2. The Fuel Solenoid Relay is closed.
3. The control waits to see voltage on the generator PT inputs.
4. The idle time is started.
5. Relay 12 will close after the idle time has elapsed.
6. Once the voltage is sensed, the engine is considered Running.

Stop Sequence

The EGCP-2 stop sequence is quite straightforward. An adjustable load level is used to determine whether the engine needs to run through a cool down time. If the kVA on the generator exceeded the Cool down Level, the cool down time will be started as soon as the circuit breaker is opened.

By setting the Cool down level to zero kVA, the cool down timer will be active after every start. By setting the Cool down time to zero, the cool down sequence can be turned off. The engine can go through a cool down sequence on a Soft Shutdown, but not on a Hard Shutdown.

The EGCP-2 will expect the engine to stop whenever it has opened the Fuel Solenoid relay. The Fuel Solenoid Relay will never open if the EGCP-2 senses that its circuit breaker is closed (Discrete Input 8 is closed). The circuit breaker must be opened first and then the Fuel Solenoid relay will open.

The Stop sequence is the same whether Start Sequencing is Enabled or Disabled.

Chapter 3.
Manual Run Modes

The EGCP-2 has two basic modes of operation for manual control. The Test No Load mode is used to start and run an engine without closing a generator breaker. The Run With Load mode or Manual mode is used to manually adjust the speed and voltage of the generator prior and to manually control the circuit breakers.

These two modes of operation will be the same regardless of the application and the configuration of the EGCP-2. Whenever the Auto input is open, the EGCP-2 will be in the Manual mode.

Test No Load

To run the engine without any load, the Test no Load mode can be used. This mode could be used for monthly maintenance runs, or when troubleshooting problems. When the Test input is closed, the engine will start. The EGCP-2 will be calling for a trip on the Gen breaker. The engine protection, such as low oil pressure alarm and overspeed will be active. The Speed Raise and Lower inputs can be used to adjust the engine speed and the Voltage Raise and Lower inputs can be used to adjust the generator voltage.

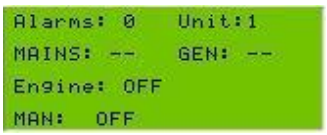
Test No Load Sequence

The sequence begins with the EGCP-2 in Off state. The EGCP-2 will display this information as follows:

I/O Screen

No Inputs are closed.
No Outputs are closed.

System Screen



The MAINS voltage is out of spec shown by --.
The GEN voltage is out of spec shown by --.
The engine is in the OFF state.
The control is in MANual and is in the OFF mode.

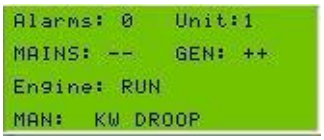
1. To start the engine, close the Test input.
   1.1. The engine is started (see Chapter 2).
2. The Speed Raise and Lower inputs and the Voltage Raise and Lower inputs will both be active to allow a user to adjust the speed or voltage manually.
3. Output 10 will remain de-energized, which is calling for the generator breaker to trip.
4. The engine will run at rated speed as long as the Test input is closed.

This would be displayed like this:

I/O Screen

Input 2 the Test input is closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Output 10 is de-energized to trip the gen breaker.

Status Screen



The MAINS voltage is out of spec shown by --.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in MANual and is in the KW DROOP mode because the Gen CB Aux is open.

5. When the Test input is opened, the engine goes into the stop sequence (see Chapter 2).

Application Questions for Test No Load Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

What if the generator breaker is closed while in Test No Load mode?
The whole time the EGCP-2 is in the Test No Load mode, the control keeps output 10 open, which is calling for a generator circuit breaker trip. If the breaker is closed anyway, the EGCP-2 will have no means of opening the breaker because it is already trying to trip the breaker. If the Gen CB Aux input is closed, the engine will continue to run until the Gen CB Aux input is opened.

Run with Load

To run the engine and manually synchronize the breaker the Run with Load input is used. The engine will start when the Run with Load input is closed. After the Gen Stable delay, the Gen breaker trip will be released so that the breaker can be closed manually. Both the generator and mains breakers are controlled manually in this mode The only exception to this is if the control experiences a hard or soft shutdown while in this mode, the generator breaker will be tripped.

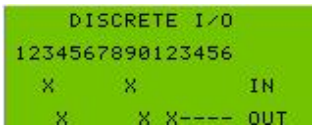
For a No Parallel application the Mains breaker would need to be opened manually as well. The EGCP-2 will not open the mains breaker, even if the generator breaker is closed at the same time because the system is in manual. In the manual mode, the EGCP-2 will not communicate or load share. If multiple units are paralleled together on the bus, the generator circuit breaker aux input should be opened to place the units in the droop mode.
It is not possible to operate as a Process master in manual. The Auto input must be closed to go into the Process master mode. If a Process master is already running on the bus and a unit is closed onto the bus in with only the Run with Load input closed, it will go into the Process Slave mode.

For Contactor operation, the contactor is opened and closed with a single output, the Gen Breaker Close Output relay #2. This relay is not operated in the manual mode. The generator contactor would need to be both opened and closed by another means when operating in the Manual Run with Load mode.

Manual Run with Load Sequence

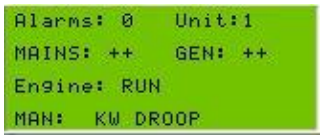
1. When the Run with Load input is closed, the engine will start (see Chapter 2)
2. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   2.1. The generator is declared stable
3. The generator breaker trip signal is released, by energizing relay # 10.
4. The Speed Raise and Lower inputs and the Voltage Raise and Lower inputs will both be active to allow a user to adjust the speed or voltage manually.
5. The display appears like this:

I/O Screen



Inputs 3 & 9, Run w/Load & Mains CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Output 10 is energized to release the gen breaker trip..

Status Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in MANual and is in the KW DROOP mode because the Gen CB Aux is open.

6. All breaker operations are manual at this point.
   6.1. In a No Parallel application the mains breaker would be tripped manually
   6.2. Then the generator breaker would be closed to the deadbus manually.
      6.2.1. Depending on the state of the generator and mains breakers, the configuration in the Real Load control menu, and the presence of a master unit will determine if the control should go into either the kW droop, isochronous, baseload or process mode (see chart below)

Load Control Mode	Gen CB Aux Input	Mains CB Aux Input	Process Master currently running on-line	Load Control Mode Setpoint in the Real Load Control Menu
KW Droop (hardware select)	Open	Don't care	Don't Care	Don't Care
KW Droop (software select)	Closed	Don't Care	Don't Care	KW Droop
Isochronous	Closed	Open	Don't Care	Soft Transfer or Normal
Baseload	Closed	Closed	No master	Soft Transfer or Normal
Process	Closed	Closed	Master on-line	Soft Transfer or Normal

Table 3.1. Manual run

      6.2.2. The EGCP-2 will not prevent paralleling the generator to the mains because the control is in manual.

6.2.3. If multiple units are manually synchronized together, their CB Aux input (terminal 56) should be opened to place the units into the kW Droop mode. The units will not load share in the manual mode. Load sharing is only enabled when the Auto input is closed.

6.3. When the generator is to be taken off-line, the Run with Load input should be opened.

6.4. The Gen Breaker Trip output will open to trip the generator breaker.

6.5. The control will go into the stop sequence (see Chapter 2).

Application Questions for Manual Run

The previous example lists the expected sequence of operation. However, it is important to look at a few "what if" scenarios and note what would happen if the sequence were interrupted.

Will the EGCP-2 open the generator breaker in manual mode if the engine has a shutdown while running on-line?

Yes, this is the one exception where the EGCP-2 will operate the circuit breaker while in the manual mode. For hard and soft shutdowns, the generator breaker will trip and the engine will shutdown. If the mains breaker were open, it will not be closed automatically because the control is in manual.

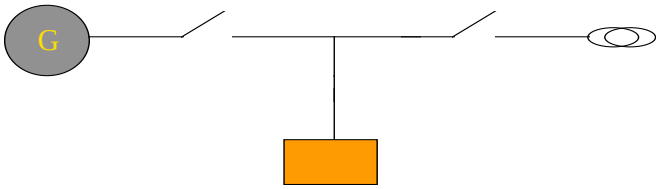
What if the application needs manual synchronization and load sharing?

The Run with Load input should be closed to start the engine. The generator can be manually synchronized. Once the generator circuit breaker is closed, the Auto input needs to be closed as well to activate the load sharing function.

Can manual synchronization be used for a Baseload application?

It is possible to manually synchronize multiple units to the mains and operate them in the baseload mode. However, if the mains breaker were to open, these controls would be in manual and would not load share on the isolated bus. For this reason, it would be recommended that when the generator breaker is closed, the Auto and Run with Load inputs should be closed to the EGCP-2. This will provide a safe situation if the mains breaker were to open. The generator can be synchronized manually and then the once the breaker is closed the mode will be switched to Auto Run Baseload. The same idea applies to the Process mode. If the unit is to go into the process mode after a manually synchronization, the Auto input would need to be closed at the same time that the Generator Circuit Breaker Aux input was closed.

Chapter 4.
Single/ No Parallel



The most basic mode of operation for the EGCP-2 is Single Unit No Parallel. In this configuration, the generator will never parallel with the mains. All operations requiring the generator to be on load will take place with the mains breaker open. The operations that will place the generator on load are either a Loss of Mains detection or an Auto and Run With Load Switch Input. Since the generator will never operate in parallel with the mains, all transitions between mains and generator power to the load are done in an open transition fashion.

This configuration is used for two applications, either standby power, where the EGCP-2 is monitoring the mains or a prime power application. In either case, the generator set must be capable of supplying the entire plant load, as there is no other source. The EGCP-2 over-current and high kW limits, can be used to protect the generator from an over load situation.

Standby No Parallel Application

This section describes a single unit that will not be paralleled with the mains power at any time. When mains power has failed, the generator set will be started and closed to the bus to provide standby (emergency) power. When the mains returns, the EGCP-2 will open the generator breaker, then close the utility breaker in an open transition. Following the Cool down time, the engine will shutdown.

Configuration items

The key configuration points in the EGCP-2 software that need to be configured for a Single Unit No Parallel Standby application are:

	Required settings
Configuration Menu:	
Number of Units:	Single
Operating Mode:	No Parallel
Shutdown and Alarm Menu:	
Gen Volt Hi Lmt	Sets high end of generator voltage stable range
Gen Volt Lo Lmt	Sets low end of generator voltage stable range
Gen Freq Hi Lmt	Sets high end of gen frequency stable range
Gen Freq Lo Lmt	Sets low end of gen frequency stable range
Synchronizer Menu:	
Sync Mode:	Run
Deadbus Closure:	Enabled

Real Load Control Menu:

Load Control Mode:	Normal

Transfer Switch Menu:

Check Mains Breaker:	Enabled
Mains Volt High Lmt:	Sets high end of mains voltage stable range
Mains Volt High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Volt Low Lmt:	Sets Low end of mains voltage stable range
Mains Volt Low Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq High Lmt:	Sets high end of mains frequency stable range
Mains Freq High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq Low Lmt:	Sets low end of mains frequency stable range
Mains Freq Low Alarm:*	Loss of Mains or Loss of Mains with alarms
LOM Action Delay:	The amount of time that the mains power must be out of spec to trigger the Loss of Mains

*At least one of the four Loss of Mains alarms need to be set for Loss of Mains or Loss of Mains with Alarms for the Standby operation to occur.

Suggested Settings

Engine Control Menu:

Preglow Time:	0 sec. If the Preglow relay is not being utilized, setting this time above zero can cause delays when starting the engine.
Reactive Load Menu	
VAR/PF Mode	PF Control or VAR Control This will enable the voltage control of the EGCP-2 to trim the generator voltage to the voltage reference.

Transfer Switch Menu:

Fast Xfer Delay:	1.0 seconds This is the delay time between the opening and closing of the two breakers or contactors.
Gen Stable Dly:	1.0 seconds When the generator is started, how long will the voltage and frequency need to be within spec before the gen breaker can be closed. This may be set to minimum to achieve the fastest breaker closing time.

Discretionary

Configuration Menu:

Network Address
Network Priority

Synchronizer Menu:

Sync Gain
Sync Stability
Voltage Matching
Voltage Window
Max Phase Window
Dwell Time

Real Load Control Menu:

- Load Ctrl Gain
- Loadshare Gain
- Load Stability
- Load Derivative
- Load Ctrl Filter
- Baseload Reference
- Unload Trip
- Load Time
- Unload Time

Reactive Load Control Menu:

- kVAR Reference
- PF Reference
- PF Deadband

Process Control Menu:

Not all items in this menu are applicable to a single unit standby application.

Transfer Switch Menu

- Load Surge
- Load Surge Alarm

Sequencing and Comms Menu

- Auto Sequencing
- Max Gen Load
- Next Genset Dly
- Rated Load Dly
- Max Start Time
- Min Gen Load
- Reduced Load Dly
- Max Stop Time

Control Wiring

Terminal Description	Required	Optional	Not Used	Comment
1+ power supply	✕			
2– power supply	✕			
5 Mains Brkr Close N.O.	✕			
6 Mains Brkr Close Com.	✕			
7 Mains Brkr Close N. C.	✕			
8 Gen Brkr Close N.O.	✕			
9 Gen Brkr Close Com.	✕			
10 Gen Brkr Close N. C.	✕			
11 Engine Preglow		✕		
12 Engine Preglow		✕		
13 Fuel Solenoid	✕			
14 Fuel Solenoid	✕			
15 Crank Engine	✕			Not Required if Start Sequencing is Disabled
16 Crank Engine	✕			“
17 No Connection			✕	
18 Visual Alarm N. O.		✕		
19 Visual Alarm Com.		✕		
20 Visual Alarm N. C.		✕		
21 Bus PT Connect	✕			
22 Bus PT Connect	✕			
23 Mains PT Disconnect	✕			
24 Mains PT Disconnect	✕			
25 Mains Brkr Trip N. O.	✕			
26 Mains Brkr Trip Com.	✕			
27 Mains Brkr Trip N. C.	✕			
28 Gen Brkr Trip N. O.	✕			
29 Gen Brkr Trip Com.	✕			
30 Gen Brkr Trip N. C.	✕			
31 Audible Alarm		✕		
32 Audible Alarm		✕		
33 Audible Alarm		✕		
34 Idle Rated/Load SW		✕		Idle is bypassed on LOM start
35 Idle Rated/Load SW		✕		“
36 No Connection			✕	
37 + Voltage Bias		✕		May be required for Voltage Trim function
38 – Voltage Bias		✕		“
39 Voltage Bias Shield		✕		“
40 Mains/Bus PT Phase A	✕			
41 Mains/Bus PT Phase B or N	✕			
42 Generator PT phase A +	✕			
43 Generator PT phase A –	✕			
44 Generator PT phase B +	✕			

Table 4-1. I/O list for Single Unit No Parallel Standby application

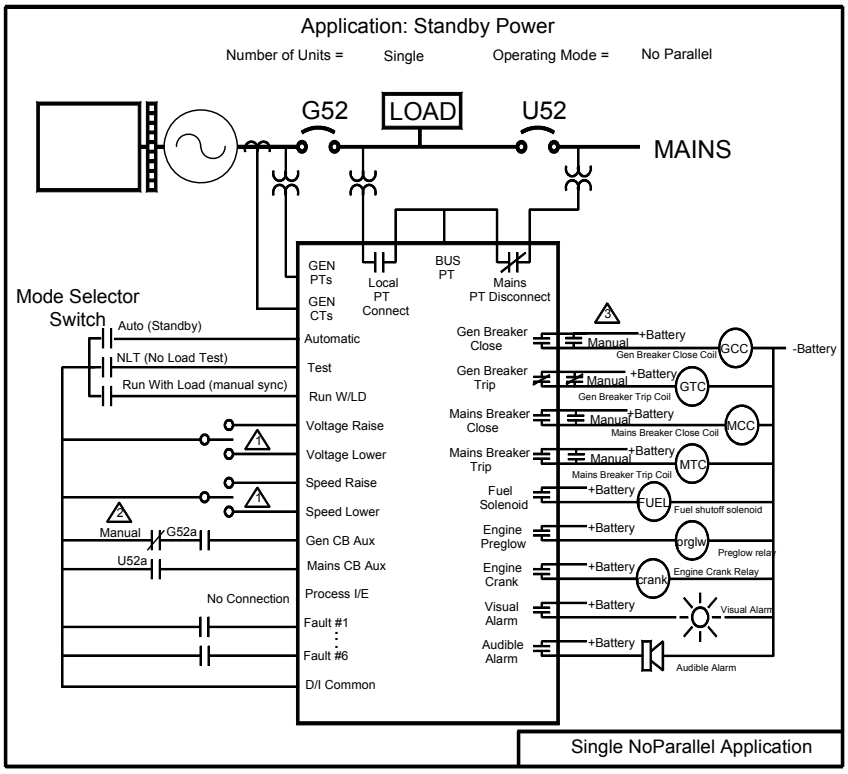
Terminal Description	Required	Optional	Not Used	Comment
45 Generator PT phase B –	✕			
46 Generator PT phase C +	✕			
47 Generator PT phase C –	✕			
49 Auto	✕			
50 Test		✕		
51 Run/Ld		✕		
52 Volt Raise		✕		
53 Volt Lower		✕		
54 Speed Raise		✕		
55 Speed Lower		✕		
56 Gen CB Aux	✕			
57 Mains CB Aux	✕			
58 Process			✕	
59 Fault 1		✕		
60 Fault 2		✕		
61 Fault 3		✕		
62 Fault 4		✕		
63 Fault 5		✕		
64 Fault 6		✕		
65 Switch Common	✕			
66 Temp Sensor +		✕		
67 Temp Sensor –		✕		
68 Pressure Sensor +		✕		
69 Pressure Sensor –		✕		
70 Magnetic Pickup +	✕			Not Required if Start Sequencing is Disabled
71 Magnetic Pickup –	✕			“
72 Magnetic Pickup Shield	✕			“
73 + Speed Bias		✕		Required for Droop or Manual operation
74 – Speed Bias		✕		“
75 Speed Bias Shield		✕		“
76 + 485 Communication			✕	
77 – 485 Communication			✕	
78 485 Shield			✕	
79 NC			✕	
80 Communication Reference			✕	
81 422 Communication RX+		✕		
82 422 Communication RX–		✕		
83 422 Shield		✕		
84 422 Communication TX+		✕		
85 422 Communication TX–		✕		
86 + Process Signal			✕	
87 – Process Signal			✕	
88 Process Signal Shield			✕	

Table 4-1 cont’d

Terminal Description	Required	Optional	Not Used	Comment
89 Gen CT phase A+ Current	X			
90 Gen CT phase A– Current	X			
91 Gen CT phase B+ Current	X			
92 Gen CT phase B– Current	X			
93 Gen CT Phase C+ Current	X			
94 Gen CT Phase C– Current	X			

Table 4-1 cont'd

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1 Only required if the speed and voltage need to be adjusted when Test or Manual is selected. These inputs are ignored in the Auto Mode

2 Opening the Gen CB Aux input will place the EGCP-2 into droop mode

3 Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.

Figure 4-1. Single No Parallel Standby Application

Operation

The EGCP-2 operation is quite straightforward for this application. Using the three mode selector inputs Auto, Test, and Run with Load, the generator set can be placed into the proper mode of operation. The switch configuration would be as follows:

Input: Auto	Test	Run w/Load	Mode of Operation
			Off
X			Standby
	X		Test No Load
		X	Manual Run with Load
	X	X	Manual Run with Load
X	X		Auto Test
X		X	Auto Run
X	X	X	Auto Run

X = Discrete input closed

Table 4-2. Mode Selector Switch Position for Standby Application

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will be in the Standby mode. In the Standby mode the control will monitor the Mains PT input and wait for the mains to fail. Then the engine will be started to supply standby power. When the mains returns the load will be transferred back to the mains and the engine will be shutdown.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Auto Test
The Auto Test mode is the same as Test no Load except it also includes the standby features. If the mains were to fail while exercising the engine, the generator would supply the load. When the mains returns, the engine would run off-line until the Test input was opened.

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Auto Run
To run an engine when the mains power is not failed the Auto Run mode is used. For this no parallel application, the load will be transferred from the mains to the generator through an open transition. An open transition back to the mains will occur when exiting this mode.

Sequence of Operation

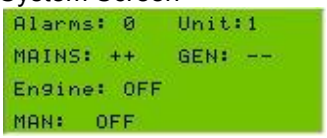
This section will describe the details of operation for the **Standby** application when configured for a **Single No Parallel** control.
One of the best features of the EGCP-2 is the simple operation of the standby mode. By simply closing the Auto, input the EGCP-2 will automatically operate the standby generator set. No other action is needed.

Standby Engine Sequence
The sequence begins with a healthy mains and the EGCP-2 in OFF.
The mains breaker is closed and the mains power is being supplied to the load.
The EGCP-2 will display this information as follows:

I/O Screen

Input 9, the Mains CB Aux is closed.
Inputs 1,2, & 3, the Auto, Test, and Run with Load are all open.
No Outputs are closed.

System Screen



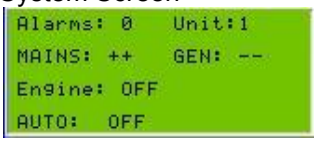
The MAINS voltage is within spec shown by ++.
The GEN voltage is out of spec shown by --.
The engine is in the OFF state.
The control is in MANual and is in the OFF mode.

1. Placing the EGCP-2 into the Standby mode
   1.1. To place the engine in standby the Auto input should be closed.
   1.2. At this point, the EGCP-2 will begin to monitor the Mains PT input. This voltage should be within the Mains Volt High and Low Limits and Mains Frequency High and Low Limit.
   1.3. The displays will be shown like this:

I/O Screen

Input 9, the Mains CB Aux is closed.
Inputs 1, Auto is closed.
No Outputs are closed.

System Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is out of spec shown by --.
The engine is in the OFF state.
The control is in AUTO and is in the OFF mode.

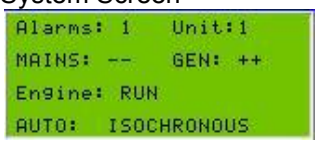
2. Starting the Standby unit on a Loss Of Mains
   2.1. When the mains voltage or frequency travels outside of the acceptable range for the Loss Of Mains Action Delay time, the EGCP-2 will consider the Mains failed.
   2.2. The mains breaker is opened.
   2.3. Then the engine is started. (see Chapter 2 for start sequence information).
   2.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.

2.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
2.6. The generator is declared stable.
2.7. The generator breaker is closed to the deadbus.
2.8. The Mains/Bus PT input will switch back to monitor the Mains.
2.9. This is indicated on the display like this:

I/O Screen

Inputs 1 & 8, Auto & Gen CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Outputs 6 & 11 Visual and Audible Alarm are closed to indicate an Active Alarm.
Output 10 Gen Breaker Trip is a reverse logic contact that will open to trip the breaker. When closed the generator breaker can be closed.

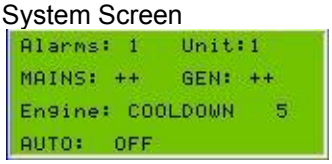
System Screen



The MAINS voltage is out of spec shown by --.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the ISOCHRONOUS mode.

3. The Mains returns
3.1. The mains voltage will need to be within the voltage and frequency high and low limits of the Transfer switch menu, for the Mains Stable Delay time.
3.2. The generator breaker is opened.
3.3. The Fast Xfer Delay timer is started.
3.4. The Mains/Bus PT input will switch to the Bus and verify it is dead.
3.5. Upon completion of the Fast Xfer Delay time, the mains breaker is closed.
3.6. The engine goes into the stop sequence (see Chapter 2 for stop sequence information).
3.7. The Mains/Bus PT will switch back to the Mains and await the next Loss of Mains.
3.8. The display screen will appear like this:

System Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the COOLDOWN state with 5 seconds remaining.
The control is in AUTO and is in the OFF mode.

The sequence is now back at step 2 and would repeat on the next Loss of Mains.

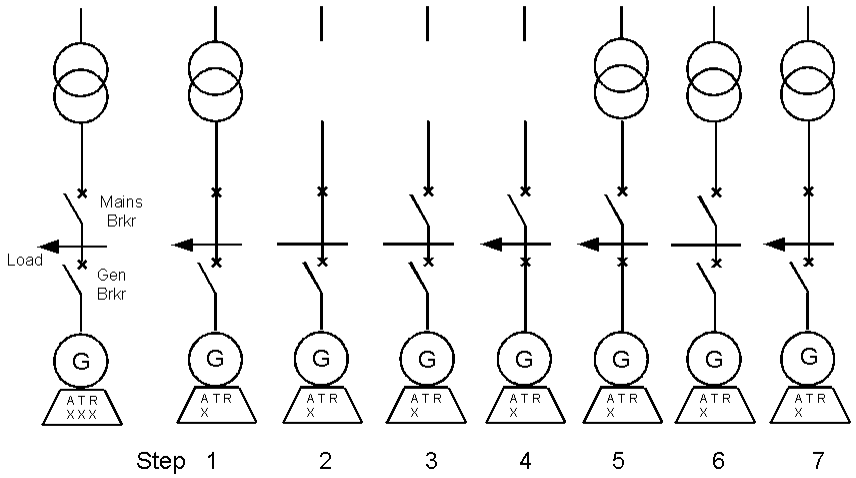


Figure 4-2. Standby mode schematic

EGCP-2 Auto input is closed. Control is in the Standby Mode
1. Mains is supplying the Load
2. Mains fails
3. EGCP-2 Opens Mains Breaker. Generator is started.
4. EGCP-2 closes Generator Breaker
5. Mains Returns
6. EGCP-2 Opens Generator Breaker

EGCP-2 Closes Mains Breaker and shuts down generator

Application Questions for Standby Mode

The previous example lists the expected sequence of operation. However, it is important to look at a few "what if" scenarios and note what would happen if the sequence were interrupted.

Would the EGCP-2 close the generator breaker if the mains breaker would not open when the Loss of Mains was detected?

The answer is no. For safety reasons, the EGCP-2 will not close the generator breaker if it senses a closed mains breaker.

What happens if the engine has a shutdown while it is operating during a Loss of Mains?

For example, if the control had a hard or soft shutdown, such as Low Oil Pressure Alarm, the generator breaker would open and the engine would shutdown. The control is still in Auto, so it is allowed to operate the breakers. The control would open the generator breaker and close the mains breaker, after the mains returns. If the shutdown were reset before the mains returned, the control would go through the Loss of Mains sequence.

What if the engine has a problem and the operator needs to shut it down while the mains are failed?

Opening the Auto input to the EGCP-2 will not cause the engine to shut down if the mains are failed. The operator must open the generator breaker manually after opening the Auto input or give the EGCP-2 a shutdown on one of the Remote Fault Inputs. If the Auto input is opened, the EGCP-2 will be in the manual mode and will not close the mains breaker. This breaker would have to be closed manually.

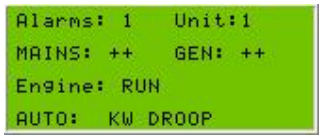
What will happen if the control cannot close the mains breaker when the mains has returned?
In the Synchronizer menu, the Close Attempts setting sets the number of times the control will try to close a breaker, even for a deadbus close. If the generator breaker has opened and the control has finished all of its close attempts trying to close the mains, a Sync Reclose Alarm will be logged. When the breaker problem is corrected, an operator will need to clear the Sync Reclose Alarm from the Alarm Log. After which, the control will try again to close the mains breaker.

Auto Test sequence
With a healthy Mains and the EGCP-2 in Auto.
1. When the Test input is closed, the engine will start (see Chapter 2).
2. The engine will run at rated speed as long as the Test input is closed.
3. The Speed Raise and Lower inputs and the Voltage Raise and Lower inputs will both be active to allow a user to adjust the speed or voltage manually.
4. Output 10 will remain de-energized, which is calling for the generator breaker to trip.
5. The display screens would appear like this:

I/O Screen

Inputs 1,2 & 9, Auto, Test & Mains CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.

Status Screen



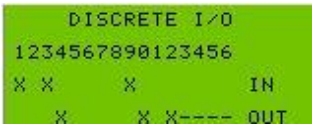
The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the KW DROOP mode because the Gen CB Aux is open.

6. If the Mains were to fail while in this mode,
   6.1. The EGCP-2 would open the Mains breaker and perform the normal Loss of Mains sequence.
   6.2. When the mains has returned and exceeded the Mains Stable Delay time, the EGCP-2 would open the generator beaker
   6.3. Then after the mains breaker has been closed, the engine will continue to run as long as the Test input is closed.
7. When the test input is opened, the engine will go into the stop sequence (see Chapter 2).

Auto Run sequence
With a healthy mains and the EGCP-2 in Auto.
1. The Run with Load input is closed.
2. The engine will start (see Chapter 2)
3. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
4. The generator is declared stable

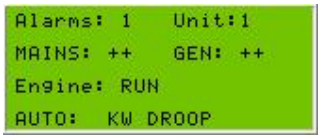
5. The screen display will appear like this:

I/O Screen



Inputs 1, 3, & 9, Auto, Run w/Load & Mains CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Output 10 is energized to release the gen breaker trip.

Status Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in Auto and is in the KW DROOP mode because the Gen CB Aux is open.

6. The mains breaker will open, because the Operating Mode is No Parallel.
7. The Fast Xfer Delay timer is started.
8. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
9. When the Fast Xfer Delay timer has expired, the generator breaker is closed to the deadbus.
10. The Mains/Bus PT input will switch back to monitor the Mains.
11. The generator will supply the isolated load.
12. When the Run with Load input is opened, the generator breaker will open.
13. The Fast Xfer Delay timer will begin.
14. The Mains/Bus PT input will switch to monitor the Bus.
15. When the Fast Xfer Delay has expired, the Mains breaker will be closed.
16. The engine will go into the stop sequence (see Chapter 2).

Application Questions for Auto Run
What happens if the mains were to fail while, the engine was supplying the isolated load in the Auto Run mode?
There is no change initially, the mains breaker is already opened, and the generator is already supplying the load. However, the control now senses a Loss of Mains, so if the Run with Load input were opened, the control would not open the generator breaker. It would treat the situation like a Loss of Mains and remain on the bus waiting for the mains to return.

What if the engine has a shutdown while supplying the load?
For both a hard or soft shutdown, the generator breaker will be tripped. With a soft shutdown, there may be a Cooldown time, for hard shutdown there is not. The Mains breaker will be closed and the engine will shut down.

Prime Power Application

This section describes a single unit that is the only source of power for the load. There is no mains power source.

Configuration items

The key configuration points in the EGCP-2 software, which need to be configured for a Single Unit No Parallel Prime Power application, are:

Required settings

Configuration Menu:

Number of Units:	Multiple*
Operating Mode:	No Parallel

*Only standby applications with one engine generator should be set for Single Unit. For all prime power applications, this should be set to Multiple even if there is only one engine generator.

Shutdown and Alarm Menu:

Gen Volt Hi Lmt	Sets high end of generator voltage stable range
Gen Volt Lo Lmt	Sets low end of generator voltage stable range
Gen Freq Hi Lmt	Sets high end of gen frequency stable range
Gen Freq Lo Lmt	Sets low end of gen frequency stable range

Synchronizer Menu:

Sync Mode:	Run
Deadbus Closure:	Enabled

Real Load Control Menu:

Load Control Mode:	Normal

Transfer Switch Menu:

Check Mains Breaker:	Disabled
Mains Volt High Alarm:	Disabled
Mains Volt Low Alarm:	Disabled
Mains Freq High Alarm:	Disabled
Mains Freq Low Alarm:	Disabled

Suggested Settings

Reactive Load Menu

VAR/PF Mode	PF Control or VAR Control This will enable the voltage control of the EGCP-2 to trim the generator voltage to the voltage reference.

Discretionary

Configuration Menu:

Network Address
Network Priority

Synchronizer Menu:

Sync Gain
Sync Stability
Voltage Matching
Voltage Window
Max Phase Window
Dwell Time

Real Load Control Menu:

Load Ctrl Gain
Loadshare Gain
Load Stability
Load Derivative
Load Ctrl Filter
Baseload Reference
Unload Trip
Load Time
Unload Time

Reactive Load Control Menu:

kVAR Reference
PF Reference
PF Deadband

Process Control Menu:

Not all items in this menu are applicable to a single unit prime power application.

Transfer Switch Menu:

Fast Xfer Delay
Mains Stable Delay
Load Surge
Load Surge Alarm
Main Volt High Lmt
Main Volt Low Lmt
Main Freq High Lmt
Main Freq Low Lmt
LOM Action Delay

Sequencing and Comms Menu:

Auto Sequencing
Max Gen Load
Next Genset Dly
Rated Load Dly
Max Start Time
Min Gen Load
Reduced Load Dly
Max Stop Time

Control Wiring

Terminal Description	Required	Optional	Not Used	Comment
1+ power supply	X			
2– power supply	X			
5Mains Brkr Close N.O.			X	
6Mains Brkr Close Com.			X	
7Mains Brkr Close N. C.			X	
8Gen Brkr Close N.O.	X			
9Gen Brkr Close Com.	X			
10 Gen Brkr Close N. C.	X			
11 Engine Preglow		X		
12 Engine Preglow		X		
13 Fuel Solenoid	X			
14 Fuel Solenoid	X			
15 Crank Engine	X			Not Required if Start Sequencing is Disabled
16 Crank Engine	X			“
17 No Connection			X	
18 Visual Alarm N. O.		X		
19 Visual Alarm Com.		X		
20 Visual Alarm N. C.		X		
21 Bus PT Connect			X	
22 Bus PT Connect			X	
23 Mains PT Disconnect			X	
24 Mains PT Disconnect			X	
25 Mains Brkr Trip N. O.			X	
26 Mains Brkr Trip Com.			X	
27 Mains Brkr Trip N. C.			X	
28 Gen Brkr Trip N. O.	X			
29 Gen Brkr Trip Com.	X			
30 Gen Brkr Trip N. C.	X			
31 Audible Alarm		X		
32 Audible Alarm		X		
33 Audible Alarm		X		
34 Idle Rated/Load SW		X		Idle is bypassed on LOM start
35 Idle Rated/Load SW		X		“
36 No Connection			X	
37 + Voltage Bias		X		May be required for Voltage Trim function
38 – Voltage Bias		X		“
39 Voltage Bias Shield		X		“
40 Mains/Bus PT Phase A			X	
41 Mains/Bus PT Phase B or N			X	
42 Generator PT phase A +	X			
43 Generator PT phase A –	X			
44 Generator PT phase B +	X			
45 Generator PT phase B –	X			
46 Generator PT phase C +	X			
47 Generator PT phase C –	X			

Table 4-3. I/O list for Single Unit No Parallel Standby application

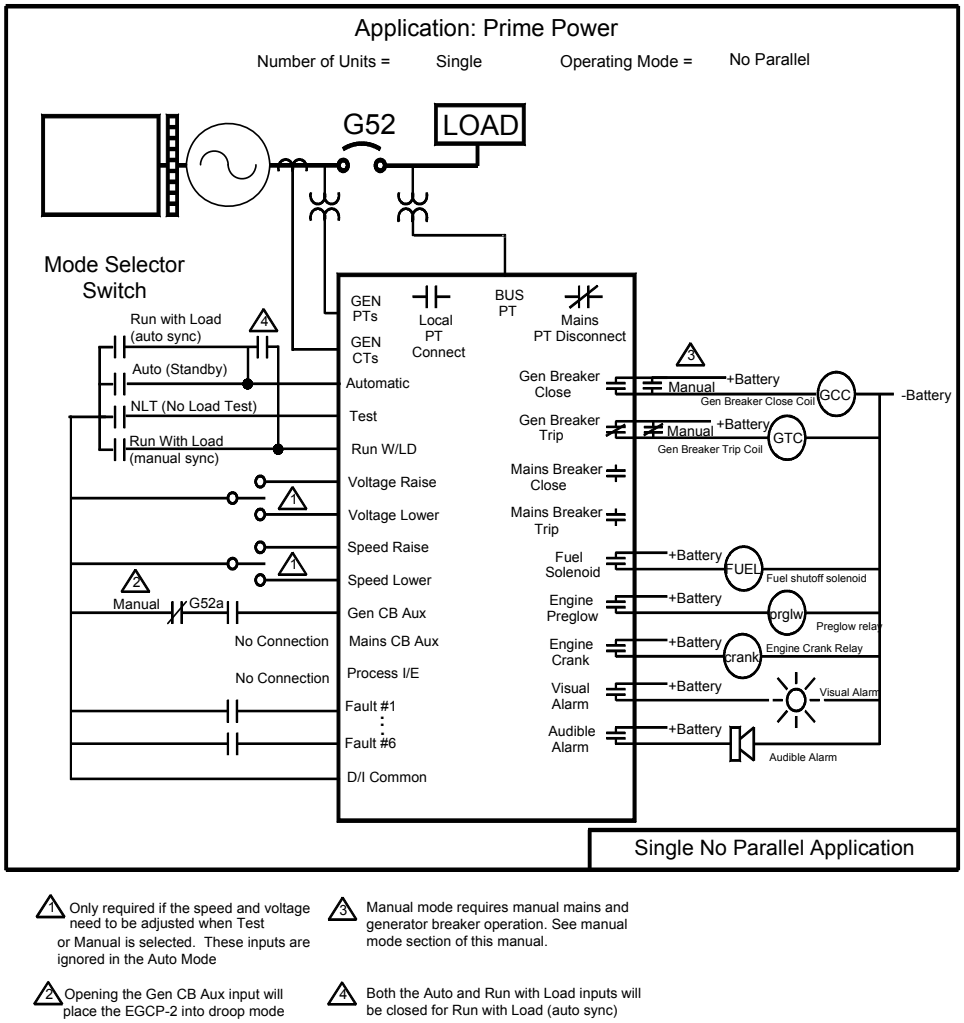
Terminal Description	Required	Optional	Not Used	Comment
49 Auto	✕			
50 Test		✕		
51 Run/Ld	✕			
52 Volt Raise		✕		
53 Volt Lower		✕		
54 Speed Raise		✕		
55 Speed Lower		✕		
56 Gen CB Aux	✕			
57 Mains CB Aux			✕	
58 Process			✕	
59 Fault 1		✕		
60 Fault 2		✕		
61 Fault 3		✕		
62 Fault 4		✕		
63 Fault 5		✕		
64 Fault 6		✕		
65 Switch Common	✕			
66 Temp Sensor +		✕		
67 Temp Sensor –		✕		
68 Pressure Sensor +		✕		
69 Pressure Sensor –		✕		
70 Magnetic Pickup +	✕			Not Required if Start Sequencing is Disabled
71 Magnetic Pickup –	✕			“
72 Magnetic Pickup Shield	✕			“
73 + Speed Bias		✕		Required for Droop or Manual operation
74 – Speed Bias		✕		“
75 Speed Bias Shield		✕		“
76 + 485 Communication			✕	
77 – 485 Communication			✕	
78 485 Shield			✕	
79 NC			✕	
80 Communication Reference			✕	
81 422 Communication RX+		✕		
82 422 Communication RX–		✕		
83 422 Shield		✕		
84 422 Communication TX+		✕		
85 422 Communication TX–		✕		
86 + Process Signal			✕	
87 – Process Signal			✕	
88 Process Signal Shield			✕	
89 Gen CT phase A+ Current	✕			
90 Gen CT phase A– Current	✕			

Table 4-3 cont’d

Terminal Description	Required	Optional	Not Used	Comment
91 Gen CT phase B+ Current	X			
92 Gen CT phase B– Current	X			
93 Gen CT Phase C+ Current	X			
94 Gen CT Phase C– Current	X			

Table 4-3 cont'd

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1. Only required if the speed and voltage need to be adjusted when Test or Manual is selected. These inputs are ignored in the Auto Mode
2. Opening the Gen CB Aux input will place the EGCP-2 into droop mode
3. Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.
4. Both the Auto and Run with Load inputs will be closed for Run with Load (auto sync)

Figure 4-3. Single No Parallel Prime Power Application

Operation

The EGCP-2 operation is quite straightforward for this application. Using the three mode selector inputs Auto, Test, and Run w/Load, the generator set can be placed into the proper mode of operation. The switch configuration would be as follows:

Input: Auto	Test	Run w/Load	Mode of Operation
			Off
X			Auto
	X		Test No Load
		X	Manual Run with Load
	X	X	Manual Run with Load
X	X		Test No Load
X		X	Auto Run
X	X	X	Auto Run

X = Discrete input closed
Modes that are shown in gray are not discussed in this application section.

Table 4-4. Mode Selector Switch Position for Prime Power Application

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will de-energize the Gen CB trip relay to call for a generator breaker trip.

Auto
By closing the Auto input only, the EGCP-2 will do nothing. The Auto input is used in conjunction with the Run with Load input.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Auto Run
To run an engine with the EGCP-2 automatically closing the breaker to the deadbus, the Auto Run mode is used. When stopping the engine both the Auto and Run with Load inputs should be removed. If only one is removed, the engine will keep running on-line.

Sequence of Operation

This section will describe the details of operation for the **Prime Power** application when configured for a **Single No Parallel** control.

Auto Run Sequence

1. When the Auto and Run with Load inputs are closed simultaneously, the engine will start (see Chapter 2).
2. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   2.1. The generator is declared stable
3. The generator breaker is closed to the deadbus.
4. When the Auto and Run with Load inputs are opened, the generator breaker will open.
5. The engine will go into the stop sequence (see Chapter 2).

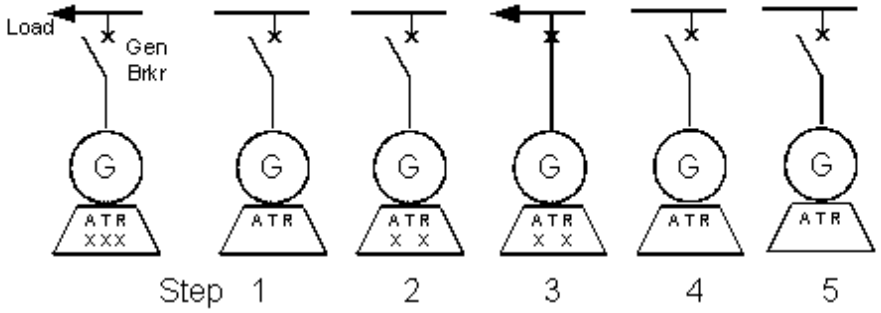


Figure 4-4. Stop sequence step diagram

Application Questions for Auto Run

If the control senses voltage on the bus, will it synchronize to this voltage and close the breaker?
No, this application is expecting a deadbus so it will not close the generator breaker.

What if the engine has a shutdown while supplying the load?
For both a hard or soft shutdown, the generator breaker will be tripped. With a soft shutdown, there may be a Cool down time; for hard shutdown, there is not.

Can the Bus PT input be wired directly to the control, since there is no mains in this application?
No, the Bus Disconnect relay is still needed. After the EGCP-2 closes the generator breaker, it will still switch the Bus/Mains PT to look for the mains. If there is no relay to break the Bus PT from coming into the control, the EGCP-2 will mistake this for the mains and try to return to mains power.

Alternate Sequence of Operation

For the single unit prime power application, it is also possible to treat the generator set as a standby unit that is always in a failed mains situation. By programming either the Mains Volt Low Alm or Mains Freq Low Alm for Loss of Mains, the EGCP-2 will always see that the mains has failed and will run in the standby mode, by closing only the Auto input. The difference between this method and the Auto and Run method, would be the Idle/Rated relay on start up. For a Loss Of Mains start, the Idle time is bypassed. For an Auto Run start, the Idle time would be used, if Relay 12 was programmed as an Idle/Rated switch.

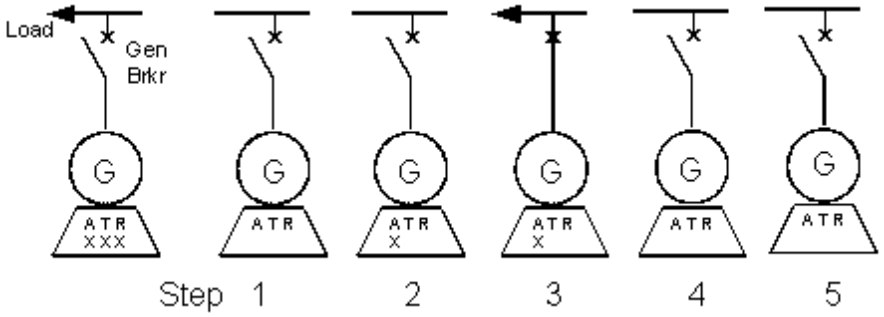
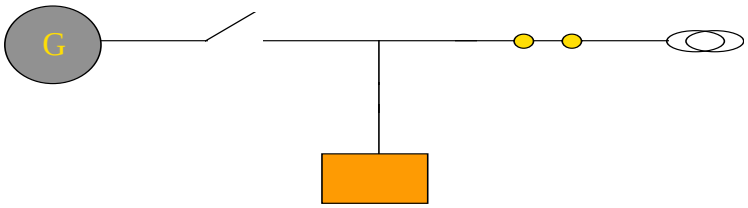


Figure 4-5. Prime power step diagram

1. When the Auto input is closed, the engine will start (see Chapter 2).
2. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   2.1. The generator is declared stable.
3. The generator breaker is closed to the deadbus.
4. When the Auto input is opened, the generator breaker will open.
5. The engine will go into the stop sequence (see Chapter 2).

Chapter 5.
Single/ Mains Parallel



Single Unit Parallel operation of the EGCP-2 control enables the control's ability to synchronize and close to the mains. When paralleling to the mains, the EGCP-2 will operate in either a base load (constant generator KW), or process control mode. This depends on which switch inputs are received at the control. The EGCP-2 will also operate in a Power Factor or VAR control mode while in parallel with the Mains if the VAR/PF control setpoint in the Reactive Load Control tuning menu is set for either PF control or kVAR control.

The EGCP-2 may also be configured for soft transfer operation. Soft Transfer operation is enabled in the configuration menu item labeled "Load Control Mode." Soft transfer refers to an operating mode in which the generator assumes load (either base load or process), and upon reaching a specific base load or process reference point, issues a command to open the mains breaker. This effectively transfers load from the mains to the generator in a smooth fashion.

For the Single Parallel configuration Four applications will be discussed, Standby, Baseload, Process, and Soft Transfer.

Standby Parallel Application

This section describes a single unit that will not run continuously paralleled with the mains. When mains power has failed, the generator set will be started and closed to the bus to provide standby (emergency) power. When the mains has returned, the EGCP-2 will synchronize the generator set with the mains. In this way the loss of power to the load is only experienced once when the mains fails. Upon return of the mains, the load is transferred from the generator to the mains in a closed transition fashion without power interruption.

Configuration items

The key configuration points in the EGCP-2 software that need to be configured for a Single Unit Parallel Standby application are:

Required settings

Configuration Menu:

Number of Units:	Single
Operating Mode:	Mains Parallel

Shutdown and Alarm Menu:

Gen Volt Hi Lmt:	Sets high end of generator voltage stable range
Gen Volt Lo Lmt:	Sets low end of generator voltage stable range
Gen Freq Hi Lmt:	Sets high end of gen frequency stable range
Gen Freq Lo Lmt:	Sets low end of gen frequency stable range

Synchronizer Menu:

Sync Mode:	Run

Real Load Control Menu:

Load Control Mode:	Normal
Baseload Reference:	Used with the Load and Unload Time settings to determine the load ramp rate.
Unload Trip:	When unloading the generator, this is the kW breaker trip command
Load Time:	Sets the load increase ramp time
Unload Time:	Sets the unload ramp time

Transfer Switch Menu:

Check Mains Breaker:	Enabled
Mains Volt High Lmt:	Sets high end of mains voltage stable range
Mains Volt High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Volt Low Lmt:	Sets Low end of mains voltage stable range
Mains Volt Low Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq High Lmt:	Sets high end of mains frequency stable range
Mains Freq High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq Low Lmt:	Sets low end of mains frequency stable range
Mains Freq Low Alarm:*	Loss of Mains or Loss of Mains with alarms
LOM Action Delay:	The amount of time that the mains power must be out of spec to trigger the Loss of Mains

*At least one of the four Loss of Mains alarms need to be set for Loss of Mains or Loss of Mains with Alarms for the Standby operation to occur.

Suggested Settings

Engine Control Menu:

Preglow Time:	0 sec. If the Preglow relay is not being utilized, setting this time above zero can cause delays when starting the engine

Reactive Load Menu

VAR/PF Mode	PF Control or VAR Control This will enable the voltage control of the EGCP-2 to trim the generator voltage to the voltage reference in isolated mode.

Transfer Switch Menu:

Gen Stable Dly:	1.0 seconds When the generator is started, how long will the voltage and frequency need to be within spec before the gen breaker can be closed? This may be set to minimum to achieve the fastest breaker closing time.

Discretionary

Configuration Menu:

Network Address
Network Priority

Process Control Menu:

Not all items in this menu are applicable to a single unit standby application.

Sequencing and Comms Menu:

Auto Sequencing
Max Gen Load
Next Genset Dly
Rated Load Dly
Max Start Time
Min Gen Load
Reduced Load Dly
Max Stop Time

Control Wiring

Terminal Description	Required	Optional	Not Used	Comment
1+ power supply	✕			
2– power supply	✕			
5Mains Brkr Close N.O.	✕			
6Mains Brkr Close Com.	✕			
7Mains Brkr Close N. C.	✕			
8Gen Brkr Close N.O.	✕			
9Gen Brkr Close Com.	✕			
10 Gen Brkr Close N. C.	✕			
11 Engine Preglow		✕		
12 Engine Preglow		✕		
13 Fuel Solenoid	✕			
14 Fuel Solenoid	✕			
15 Crank Engine	✕			Not Required if Start Sequencing is Disabled
16 Crank Engine	✕			“
17 No Connection			✕	
18 Visual Alarm N. O.		✕		
19 Visual Alarm Com.		✕		
20 Visual Alarm N. C.		✕		
21 Bus PT Connect	✕			
22 Bus PT Connect	✕			
23 Mains PT Disconnect	✕			
24 Mains PT Disconnect	✕			
25 Mains Brkr Trip N. O.	✕			
26 Mains Brkr Trip Com.	✕			
27 Mains Brkr Trip N. C.	✕			
28 Gen Brkr Trip N. O.	✕			
29 Gen Brkr Trip Com.	✕			
30 Gen Brkr Trip N. C.	✕			
31 Audible Alarm		✕		
32 Audible Alarm		✕		
33 Audible Alarm		✕		
34 Idle Rated/Load SW		✕		Idle is bypassed on LOM start
35 Idle Rated/Load SW		✕		“
36 No Connection			✕	
37 + Voltage Bias	✕			
38 – Voltage Bias	✕			
39 Voltage Bias Shield	✕			
40 Mains/Bus PT Phase A	✕			

Table 5-1. I/O list for Single Unit Parallel Standby application

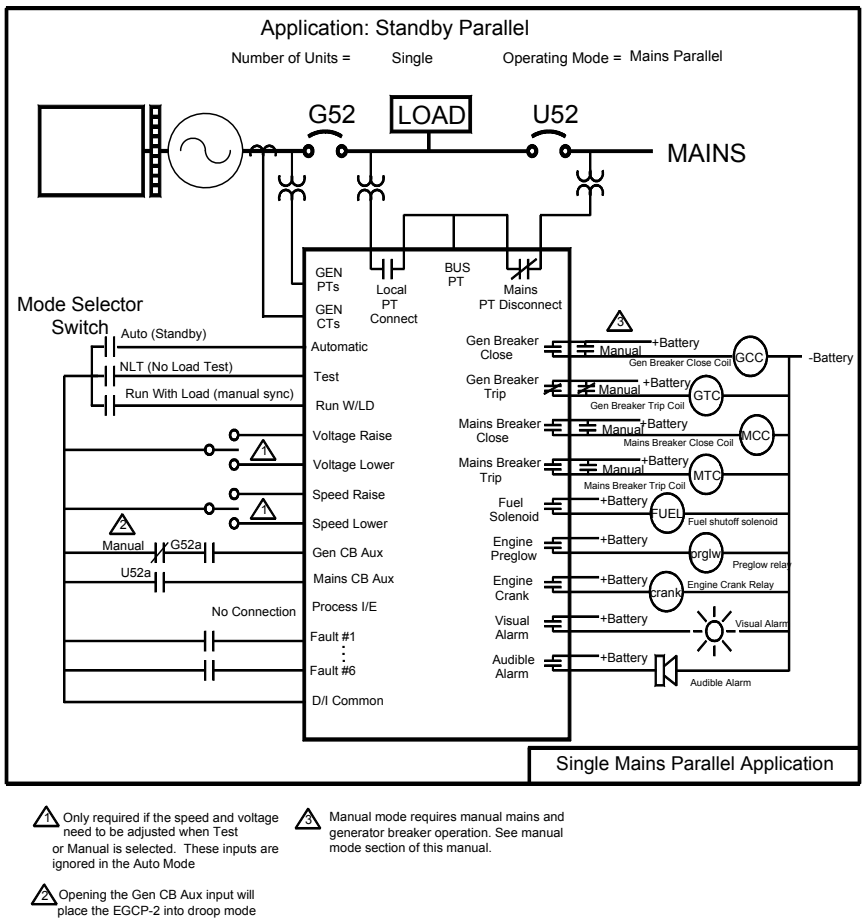
Terminal Description	Required	Optional	Not Used	Comment
41 Mains/Bus PT Phase B or N	✕			
42 Generator PT phase A +	✕			
43 Generator PT phase A –	✕			
44 Generator PT phase B +	✕			
45 Generator PT phase B –	✕			
46 Generator PT phase C +	✕			
47 Generator PT phase C –	✕			
49 Auto	✕			
50 Test		✕		
51 Run/Ld		✕		
52 Volt Raise		✕		
53 Volt Lower		✕		
54 Speed Raise		✕		
55 Speed Lower		✕		
56 Gen CB Aux	✕			
57 Mains CB Aux	✕			
58 Process			✕	
59 Fault 1		✕		
60 Fault 2		✕		
61 Fault 3		✕		
62 Fault 4		✕		
63 Fault 5		✕		
64 Fault 6		✕		
65 Switch Common	✕			
66 Temp Sensor +		✕		
67 Temp Sensor –		✕		
68 Pressure Sensor +		✕		
69 Pressure Sensor –		✕		
70 Magnetic Pickup +	✕			Not Required if Start Sequencing is Disabled
71 Magnetic Pickup –	✕			“
72 Magnetic Pickup Shield	✕			“

Table 5-1 cont’d

Terminal Description	Required	Optional	Not Used	Comment
73 + Speed Bias	✕			
74 – Speed Bias	✕			
75 Speed Bias Shield	✕			
76 + 485 Communication			✕	
77 – 485 Communication			✕	
78 485 Shield			✕	
79 NC			✕	
80 Communication Reference			✕	
81 422 Communication RX+		✕		
82 422 Communication RX–		✕		
83 422 Shield		✕		
84 422 Communication TX+		✕		
85 422 Communication TX–		✕		
86 + Process Signal			✕	
87 – Process Signal			✕	
88 Process Signal Shield			✕	
89 Gen CT phase A+ Current	✕			
90 Gen CT phase A– Current	✕			
91 Gen CT phase B+ Current	✕			
92 Gen CT phase B– Current	✕			
93 Gen CT Phase C+ Current	✕			
94 Gen CT Phase C– Current	✕			

Table 5-1 cont'd

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1. Only required if the speed and voltage need to be adjusted when Test or Manual is selected. These inputs are ignored in the Auto Mode
2. Opening the Gen CB Aux input will place the EGCP-2 into droop mode
3. Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.

Figure 5-1. Single Unit Parallel Application

Operation

Using the three mode selector inputs Auto, Test, and Run with Load, the generator set can be placed into the proper mode of operation. The switch configuration would be as follows:

Input: Auto	Test	Run w/Load	Mode of Operation
			Off
X			Standby
	X		Test No Load
		X	Manual Run with Load
	X	X	Manual Run with Load
X	X		Auto Test
X		X	Auto Run (discussed in the next application section)
X	X	X	Auto Run (discussed in the next application section)

X = Discrete input closed
Modes that are shown in gray are not discussed in this application section.

Table 5-2. Mode Selector Switch Position for Standby

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will be in the Standby mode. In the Standby mode the control will monitor the Mains PT input and wait for the mains to fail. Then the engine will be started to supply standby power. When the mains returns the load will be transferred back to the mains and the engine will be shutdown.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Auto Test
The Auto Test mode is the same as Test no Load except it also includes the standby features. If the mains were to fail while exercising the engine, the generator would supply the load. When the mains returns, the engine would run off-line until the Test input was opened.

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Auto Run
This section of the manual describes only the standby operation. The Auto Run function will be described in the next two application sections, the single baseload, and single process.

Sequence of Operation

This section will describe the details of operation for the **Standby** application when configured for a **Single Parallel** control.
One of the best features of the EGCP-2 is the simple operation of the standby mode. By simply closing the Auto input, the EGCP-2 will automatically operate the standby generator set – no other action is needed.

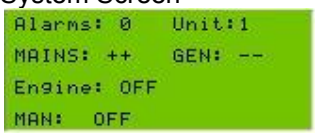
Standby Engine Sequence

The sequence begins with a healthy mains and the EGCP-2 in OFF.
The mains breaker is closed and the mains power is being supplied to the load.
The EGCP-2 will display this information as follows:

I/O Screen

Input 9, the Mains CB Aux is closed.
Inputs 1,2, &3,the Auto, Test, and Run with Load are all open.
No Outputs are closed.

System Screen



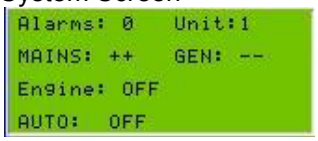
The MAINS voltage is within spec shown by ++.
The GEN voltage is out of spec shown by --.
The engine is in the OFF state.
The control is in MANual and is in the OFF mode.

1. Placing the EGCP-2 into the Standby mode
   1.1. To place the engine in standby the Auto input will be closed.
   1.2. At this point, the EGCP-2 will begin to monitor the Mains PT input. This voltage should be within the Mains Volt High and Low Limits and Mains Frequency High and Low Limit.
   1.3. The displays will be shown like this:

I/O Screen

Input 9, the Mains CB Aux is closed.
Input 1, Auto is closed.
No Outputs are closed.

System Screen



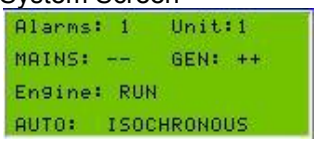
The MAINS voltage is within spec shown by ++.
The GEN voltage is out of spec shown by --.
The engine is in the OFF state.
The control is in AUTO and is in the OFF mode.

2. Starting the Standby unit on a Loss Of Mains
   2.1. When the mains voltage or frequency travels outside of the acceptable range for the Loss Of Mains Action Delay time, the EGCP-2 will consider the Mains failed.
   2.2. The mains breaker is opened.
   2.3. Then the engine is started (see Chapter 2).
   2.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   2.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   2.6. The generator is declared stable.
   2.7. The generator breaker is closed to the deadbus.
   2.8. The Mains/Bus PT input will switch back to monitor the Mains.
   2.9. This is indicated on the display like this:

I/O Screen

Inputs 1 & 8, Auto & Gen CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Outputs 6 & 11 Visual and Audible Alarm are closed to indicate an Active Alarm.
Output 10 Gen Breaker Trip is a reverse logic contact that will open to trip the breaker. When closed the generator breaker can be closed.

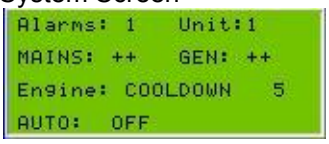
System Screen



The MAINS voltage is out of spec shown by --.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the ISOCHRONOUS mode.

3. The Mains returns
   - 3.1. The mains voltage will need to be within the voltage and frequency high and low limits of the Transfer switch menu, for the Mains Stable Delay time.
   - 3.2. The generator is synchronized to the mains.
   - 3.3. The mains breaker is closed.
   - 3.4. The generator will softly unload to its Unload Trip level, passing the load from the generator to the mains.
   - 3.5. When the generator KW is equal to or less than the Unload Trip level, the generator breaker will trip.
   - 3.6. The engine will go into the stop sequence (see Chapter 2).
   - 3.7. The display screen will appear like this:

System Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the COOLDOWN state with 5 seconds remaining.
The control is in AUTO and is in the OFF mode.

The sequence is now back at step 2 and would repeat on the next Loss of Mains.

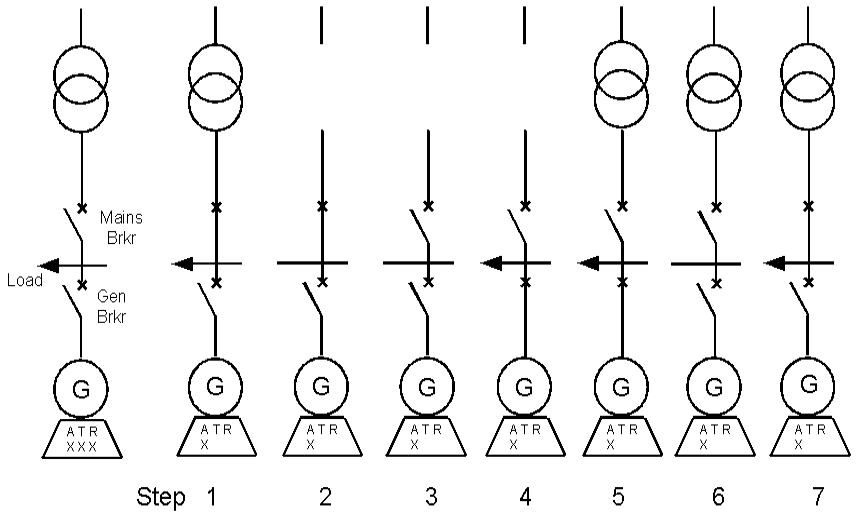


Figure 5-2. Standby parallel step diagram

1. Mains is supplying the Load
2. Mains fails
3. EGCP-2 Opens Mains Breaker. Generator is started
4. EGCP-2 closes Generator Breaker
5. Mains Returns
6. EGCP-2 Synchronizer Mains Breaker
7. EGCP-2 Unloads Generator, Opens Generator Breaker and shuts down generator

Application Questions for Standby Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few "what if" scenarios and note what would happen if the sequence were interrupted.

If the mains breaker would not open when the Loss of Mains was detected, would the EGCP-2 close the generator breaker?
The answer is no. For safety reasons, the EGCP-2 will not close the generator breaker if it senses a closed mains breaker.

What if the engine has a problem and the operator needs to shut it down while the mains are failed?
Opening the Auto input to the EGCP-2 will not cause the engine to shut down if the mains are failed. The operator must open the generator breaker manually after opening the Auto input or give the EGCP-2 a shutdown on one of the Remote Fault Inputs.

What happens if the engine has a shutdown while it is operating during a Loss of Mains?
For example, if the control had a hard or soft shutdown, such as Low Oil Pressure Alarm, the generator breaker would open and the engine would shutdown. The control is still in Auto, so it is allowed to operate the breakers. The control would open the generator breaker and close the mains breaker upon return of the mains voltage. If the shutdown were reset before the mains returned, the control would go through the Loss of Mains sequence.

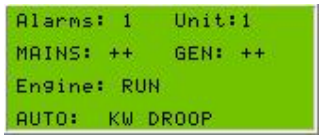
When the mains has returned, what will happen if the control cannot close the mains breaker?
In the Synchronizer menu, the Close Attempts setting sets the number of times the control will try to close a breaker. If the control has finished all of its close attempts trying to close the mains, a Sync Reclose Alarm will be logged. When the breaker problem is corrected, an operator will need to clear the Sync Reclose Alarm from the Alarm Log. After which, the control will try again to synchronize and close the mains breaker.

Auto Test sequence
With a healthy Mains and the EGCP-2 in Auto.
1. When the Test input is closed, the engine will start (see Chapter 2).
2. The engine will run at rated speed as long as the Test input is closed.
3. The Speed Raise and Lower inputs and the Voltage Raise and Lower inputs will both be active to allow a user to adjust the speed or voltage manually.
4. Output 10 will remain de-energized, which is calling for the generator breaker to trip.
5. The display screens would appear like this:

I/O Screen

Inputs 1,2 & 9, Auto, Test & Mains CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.

Status Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the KW DROOP mode because the Gen CB Aux is open.

6. If the Mains were to fail while in this mode,
   6.1. The EGCP-2 would open the Mains breaker and perform the normal Loss of Mains sequence.
   6.2. When the mains has returned and exceeded the Mains Stable Delay time, the EGCP-2 would synchronize and close the mains breaker.
   6.3. The engine would softly unload and open the generator breaker.
   6.4. The engine will continue to run as long as the Test input is closed.
7. When the test input is opened, the engine will go into the stop sequence (see Chapter 2).

Auto Run sequence
This mode is used to run the generator continuously with the mains and is discussed in the next two applications.

Single Unit Baseload Application

This section describes a single unit that will be operated in parallel with the mains. The baseload application only controls the generator load. It does not measure or control the mains import/export load.

Configuration items

The key configuration points in the EGCP-2 software, which need to be configured for a Single Unit Baseload application, are:

Required settings

Configuration Menu:

Number of Units:	Single
Operating Mode:	Mains Parallel

Shutdown and Alarm Menu:

Gen Volt Hi Lmt:	Sets high end of generator voltage stable range
Gen Volt Lo Lmt:	Sets low end of generator voltage stable range
Gen Freq Hi Lmt:	Sets high end of gen frequency stable range
Gen Freq Lo Lmt:	Sets low end of gen frequency stable range

Synchronizer Menu:

Sync Mode:	Run

Real Load Control Menu:

Load Control Mode:	Normal
Baseload Reference:	After the generator breaker is closed the load reference will ramp to this point.
Unload Trip:	When unloading the generator, this is the kW value where the EGCP-2 sends the Generator breaker trip command.
Load Time:	Sets the load increase ramp time
Unload Time:	Sets the unload ramp time

Transfer Switch Menu:

Check Mains Breaker:	Enabled

Suggested Settings

Reactive Load Menu:

VAR/PF Mode:	PF Control or VAR Control This will enable the voltage control of the EGCP-2 when operating in parallel with the mains.
kVAR Reference:	When in VAR control, After the generator breaker is closed the kVAR reference will ramp to this point.
PF Reference:	When In PF control, After the generator breaker is closed the PF reference will ramp to this point.

Transfer Switch Menu:

Mains Volt High Lmt:	Sets high end of mains voltage stable range
Mains Volt High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Volt Low Lmt:	Sets Low end of mains voltage stable range
Mains Volt Low Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq High Lmt:	Sets high end of mains frequency stable range
Mains Freq High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq Low Lmt:	Sets low end of mains frequency stable range
Mains Freq Low Alarm:*	Loss of Mains or Loss of Mains with alarms
LOM Action Delay:	The amount of time that the mains power must be out of spec to trigger the Loss of Mains.

*At least one of the four Loss of Mains alarms need to be set for Loss of Mains or Loss of Mains with Alarms for the Standby operation to occur. If no standby operation is desired, set all of these alarms to Disable.

Discretionary

Configuration Menu:

Network Address
Network Priority

Process Control Menu:

Not all items in this menu are applicable to a single unit prime power application.

Sequencing and Comms Menu

Auto Sequencing
Max Gen Load
Next Genset Dly
Rated Load Dly
Max Start Time
Min Gen Load
Reduced Load Dly
Max Stop Time

Control Wiring

Terminal Description	Required	Optional	Not Used	Comment
1+ power supply	✕			
2– power supply	✕			
5Mains Brkr Close N.O.	✕			
6Mains Brkr Close Com.	✕			
7Mains Brkr Close N. C.	✕			
8Gen Brkr Close N.O.	✕			
9Gen Brkr Close Com.	✕			
10 Gen Brkr Close N. C.	✕			
11 Engine Preglow		✕		
12 Engine Preglow		✕		
13 Fuel Solenoid	✕			
14 Fuel Solenoid	✕			
15 Crank Engine	✕			Not Required if Start Sequencing is Disabled
16 Crank Engine	✕			“
17 No Connection			✕	
18 Visual Alarm N. O.		✕		
19 Visual Alarm Com.		✕		
20 Visual Alarm N. C.		✕		
21 Bus PT Connect	✕			
22 Bus PT Connect	✕			
23 Mains PT Disconnect	✕			
24 Mains PT Disconnect	✕			
25 Mains Brkr Trip N. O.	✕			
26 Mains Brkr Trip Com.	✕			
27 Mains Brkr Trip N. C.	✕			
28 Gen Brkr Trip N. O.	✕			
29 Gen Brkr Trip Com.	✕			
30 Gen Brkr Trip N. C.	✕			
31 Audible Alarm		✕		
32 Audible Alarm		✕		
33 Audible Alarm		✕		
34 Idle Rated/Load SW		✕		Idle is bypassed on LOM start
35 Idle Rated/Load SW		✕		“
36 No Connection			✕	
37 + Voltage Bias	✕			
38 – Voltage Bias	✕			

Table 5-3. I/O list for Single Unit Baseload application

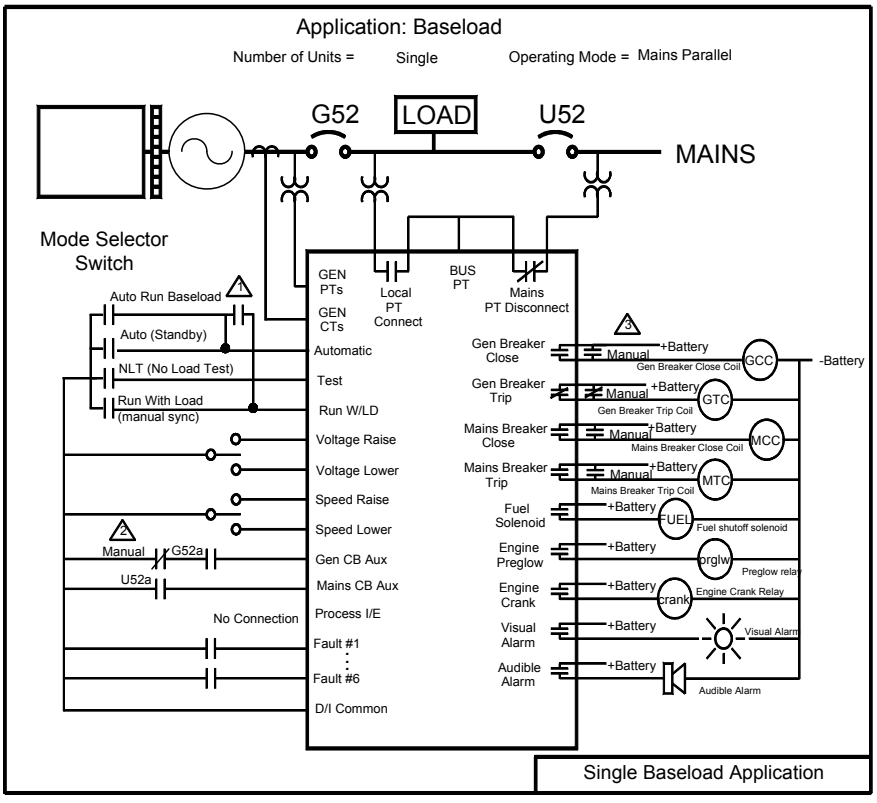
Terminal Description	Required	Optional	Not Used	Comment
39 Voltage Bias Shield	✕			
40 Mains/Bus PT Phase A	✕			
41 Mains/Bus PT Phase B or N	✕			
42 Generator PT phase A +	✕			
43 Generator PT phase A –	✕			
44 Generator PT phase B +	✕			
45 Generator PT phase B –	✕			
46 Generator PT phase C +	✕			
47 Generator PT phase C –	✕			
49 Auto	✕			
50 Test		✕		
51 Run/Ld	✕			
52 Volt Raise		✕		
53 Volt Lower		✕		
54 Speed Raise		✕		
55 Speed Lower		✕		
56 Gen CB Aux	✕			
57 Mains CB Aux	✕			
58 Process			✕	
59 Fault 1		✕		
60 Fault 2		✕		
61 Fault 3		✕		
62 Fault 4		✕		
63 Fault 5		✕		
64 Fault 6		✕		
65 Switch Common	✕			
66 Temp Sensor +		✕		
67 Temp Sensor –		✕		
68 Pressure Sensor +		✕		
69 Pressure Sensor –		✕		
70 Magnetic Pickup +	✕			Not Required if Start Sequencing is Disabled
71 Magnetic Pickup –	✕			“
72 Magnetic Pickup Shield	✕			“
73 + Speed Bias	✕			
74 – Speed Bias	✕			
75 Speed Bias Shield	✕			
76 + 485 Communication			✕	
77 – 485 Communication			✕	
78 485 Shield			✕	
79 NC			✕	
80 Communication Reference			✕	
81 422 Communication RX+		✕		
82 422 Communication RX–		✕		
83 422 Shield		✕		
84 422 Communication TX+		✕		
85 422 Communication TX–		✕		

Table 5-3 cont’d

Terminal Description	Required	Optional	Not Used	Comment
86 + Process Signal			X	
87 – Process Signal			X	
88 Process Signal Shield			X	
89 Gen CT phase A+ Current	X			
90 Gen CT phase A– Current	X			
91 Gen CT phase B+ Current	X			
92 Gen CT phase B– Current	X			
93 Gen CT Phase C+ Current	X			
94 Gen CT Phase C– Current	X			

Table 5-3 cont'd

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1 Both the Auto and Run with Load inputs will be closed when the Mode Selected is Auto Run Baseload

2 Opening the Gen CB Aux input will place the EGCP-2 into droop mode

3 Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.

Figure 5-3. Single Unit Baseload Application

Operation

Using the three mode selector inputs Auto, Test, and Run with Load, the generator set can be placed into the proper mode of operation. The switch configuration would be as follows:

Input: Auto	Test	Run w/Load	Mode of Operation
			Off
X			Standby
	X		Test No Load
		X	Manual Run with Load
	X	X	Manual Run with Load
X	X		Auto Test
X		X	Auto Run Baseload
X	X	X	Auto Run Baseload

X = Discrete input closed
Modes that are shown in gray are not discussed in this application section.

Table 5-4. Mode Selector Switch Position for Single Baseload

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will be in the Standby mode. Please see the previous application Single Standby for an explanation of the operation.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Manual Run Baseload
The Manual Run with Load mode is used for manual synchronization. When the generator breaker is closed, the control will go into the baseload mode if the Gen CB Aux and Mains CB Aux inputs are closed. See Chapter 3 for more information about this mode.

Auto Run Baseload
When both the Auto and Run with Load inputs are closed, the control will perform an automatic synchronization and run with the generator breaker closed. If the mains is present, the control will also close the mains breaker and operate the generator in the baseload mode. If the mains fails, the generator will be operated in the isochronous mode.

Sequence of Operation

This section will describe the details of operation for the **Baseload** application when configured for a **Single Parallel** control.

Auto Run Baseload Sequence

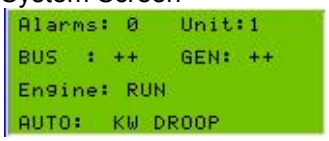
The sequence begins with a healthy mains and the EGCP-2 in OFF. The mains breaker is closed and the mains power is being supplied to the load.

1. Placing the EGCP-2 into the Auto Run mode:
   1.1. To place the engine in Auto Run the Auto and Run with Load inputs will be closed.
   1.2. At this point, the EGCP-2 will start the engine (see Chapter 2).
   1.3. If the mains voltage is stable, and the mains breaker is not closed, the EGCP-2 will close the mains breaker.
   1.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   1.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   1.6. The generator is declared stable. The displays will be shown like this:

I/O Screen

Input 9, the Mains CB Aux is closed.
Inputs 1 & 3, Auto and Run with Load are closed.
Outputs 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated speed.
Outputs 7 & 8 are closed to bring the Bus PT voltage into the Mains/Bus PT input.
Output 10 is closed to remove the Generator Breaker trip signal.

System Screen



The BUS voltage is within spec shown by ++
The GEN voltage is in spec shown by ++
The engine is in the RUN state

The control is in AUTO and is in the KW DROOP mode until the generator breaker is closed.

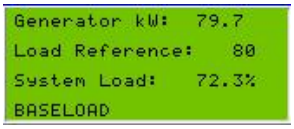
2. Running on-line in Baseload:
   2.1. The EGCP-2 will synchronize the generator to the mains and close the generator breaker.
   2.2. The EGCP-2 will ramp the kW load on the generator to the Baseload reference.
   2.3. If the control is configured for Power Factor control the power factor will be controlled at the Power Factor Reference.
   2.4. If VAR control is configured, the kVARs will be ramped to the VAR Reference.
   2.5. The baseload reference can be adjusted in three ways:
      2.5.1. Using the Raise and Lower Speed discrete inputs.
      Using the Raise and Lower Speed Modbus® * inputs.
      * Modbus is a registered trademark of Schneider Automation Inc.

      2.5.2. Using the Modbus Baseload Reference address 40003. See the EGCP-2 Communications manual 26182, for more detail on the Modbus communications of the EGCP-2.

2.6. The Power Factor or KVAR setpoint can be adjusted in three ways:
  2.6.1. Using the Raise and Lower Voltage discrete inputs.
  2.6.2. Using the Raise and Lower Voltage Modbus inputs.
  2.6.3. Using the Modbus Power Factor Reference address 40005, or KVAR Reference address 40007. (See manual 26182).

2.7. The active KW reference and PF reference can be viewed by pressing the KW LOAD and PF/kVAR buttons on the EGCP-2. The screens will appear like this:

KW LOAD Screen



Three phase kW generated is 79.7 kW.
Baseload reference is 80 kW.
For a 110 kW rated machine the system load percentage is 72.3 %.
The control is in the Baseload mode.

PF / kVAR Screen

The VAR/PF Mode is currently PF CONTROL.
The Power Factor Reference is 0.90 LAG.
The actual Power Factor is 0.895 LAG.

3. Shutting Down the Genset
  3.1. By opening the Auto and Run with Load inputs, the generator load will be ramped down to the Unload Trip load level, passing the load from the generator to the mains.
  3.2. When the generator KW is equal to or less than the Unload Trip level, the generator breaker will trip.
  3.3. The engine will go into the stop sequence (see Chapter 2).
4. Going from Auto Run Baseload to Standby.
  4.1. By opening only the Run with Load input and leaving the Auto input closed, the control will unload to the unload trip level.
  4.2. When the generator KW is equal to or less than the Unload Trip level, the generator breaker will trip.
  4.3. The engine will go into the stop sequence (see Chapter 2).
  4.4. The engine is now in the Standby mode, and will monitor the Mains PT input.
  4.5. If the Mains fails the engine will be started as described in the Standby application section discussed previously in this manual.

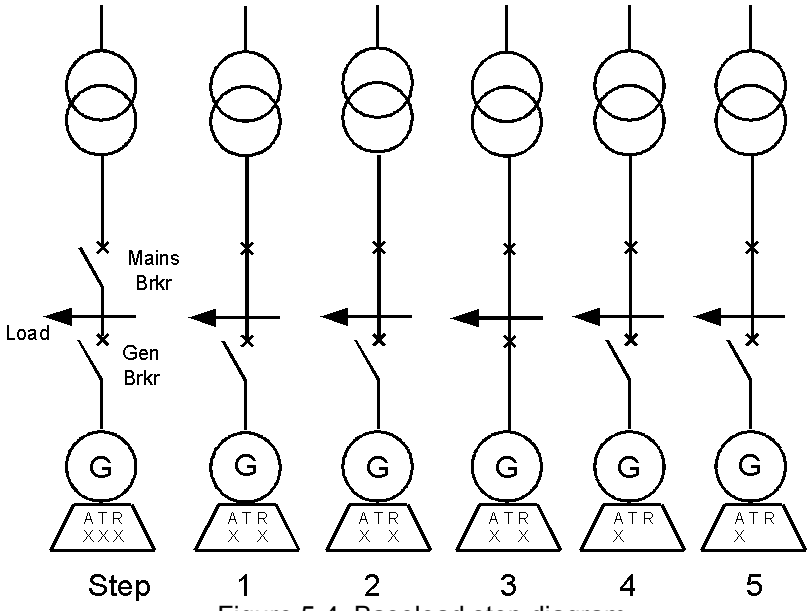


Figure 5-4. Baseload step diagram

1. The Auto and Run with Load inputs are closed.
2. The generator starts and synchronizes to the Mains.
3. The generator breaker is closed and the control ramps the kW on the generator to the baseload reference.
4. When the Run with Load input is opened, the generator is unloaded and the generator breaker is opened.
5. The engine goes through a cooldown period and shuts down.

Application Questions for Auto Run Baseload Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few "what if" scenarios and note what would happen if the sequence were interrupted.

Will the control close the generator breaker if the generator is started and the control senses power on the mains but not on the bus?
No, the EGCP-2 will not close the generator breaker if it senses a closed mains breaker but no power on the Bus PT's.

What will happen if the mains were to fail while the generator is on-line in Baseload mode?
One of many scenarios is possible.
1. The mains fails and the mains protective device trips the mains breaker. For this scenario, the EGCP-2 will recognize the mains breaker is open and switch from baseload mode to isochronous mode.
2. The mains fails, but the generator is supplying power through the mains breaker so the EGCP-2 does not recognize that the mains has failed. The EGCP-2 will remain in the baseload mode and try to maintain its baseload reference. In all likelihood, the actual load on the now isolated bus will be different from the baseload reference so the EGCP-2 will cause the engine to speed up or slow down. At some point, either a mains protective device or the EGCP-2 LOM alarms will see that the mains voltage is out of spec and open the mains breaker. Possibly, the generator breaker would trip on a high or low frequency alarm.

3. The mains fails and the generator picks up the load of the local grid. It is possible that when the mains fails, the EGCP-2 would be supplying power out of the facility to an immeasurable load. In this situation, the breakers would trip on overcurrent and/or the engine would be stopped by the sudden increase in load.

NOTICE

The EGCP-2 is not a protective device for the mains breaker. Additional protective devices should be installed in accordance with the local utility requirements.

What if the mains returns after a Loss of Mains and the generator is on-line?
The EGCP-2 will synchronize the mains breaker. After closing the mains breaker, the control will ramp the kW load to the baseload reference and return to the baseload mode.

Single Unit Process Application

This section describes a single unit that will be operated in parallel with the mains. The Process application will adjust the generator load in order to maintain the process reference. A 4-20 mA transducer is required to provide the process signal input to the EGCP-2. Many types of process variables can be controlled. The requirement for the process variable is that it must have a relationship to the kW output of the generator. For example, in a co-generation application where heat is taken from the engine to produce steam. As the engine produces more power, it produces more heat and thus makes more steam. A transducer that measures steam pressure could be used as the process variable feedback to the EGCP-2. A process reference is programmed into the EGCP-2 to maintain a certain steam pressure. The EGCP-2 can then raise or lower the load on the generator in order to keep the steam pressure at the desired level.

Configuration Items

The key configuration points in the EGCP-2 software, which need to be configured for a Single Unit Process application, are:

	Required settings
Configuration Menu:	
Number of Units:	Single
Operating Mode:	Mains Parallel
Shutdown and Alarm Menu:	
Gen Volt Hi Lmt:	Sets high end of generator voltage stable range
Gen Volt Lo Lmt:	Sets low end of generator voltage stable range
Gen Freq Hi Lmt:	Sets high end of gen frequency stable range
Gen Freq Lo Lmt:	Sets low end of gen frequency stable range
Synchronizer Menu:	
Sync Mode:	Run

Real Load Control Menu:

Load Control Mode:	Normal
Baseload Reference:	Used with the Load and Unload Time settings to determine the load ramp rate.
Unload Trip:	When unloading the generator, this is the kW value where the EGCP-2 sends the Generator breaker trip command.
Load Time:	Sets the load increase ramp time
Unload Time:	Sets the unload ramp time

Reactive Load Control Menu:

VAR/PF Mode:	PF control or VAR control
kVAR Reference:	When in VAR control, the initial kVAR reference that the generator will ramp to after the breaker is closed.
PF Reference:	When In PF control, the initial Power Factor reference that the generator will ramp to after the breaker is closed.

Process Control Menu:

Process Action:	Relationship between the process signal and the generator load
Process Reference:	After the breaker is closed, the process control reference will be ramped to this point.
Process Hi Limit:	Sets high end of process signal input
Process Lo Limit:	Sets low end of process signal input
Raise Rate:	Rate process reference is adjusted by the Raise Speed discrete input.
Lower Rate:	Rate process reference is adjusted by the Lower Speed discrete input.
Process Units:	Selectable for the type of Process that is being used
Process High Value:	Engineering units corresponding to the process high limit (i.e. 20 mA = 1000 kW).
Process Low Value:	Engineering units corresponding to the process low limit (i.e. 4 mA = 0 kW).

Transfer Switch Menu:

Check Mains Breaker:	Enabled

Suggested Settings

Process Control Menu:

Process Deadband:	0.3 %
Process Droop:	0.0 %

Transfer Switch Menu:

Mains Volt High Lmt:	Sets high end of mains voltage stable range
Mains Volt High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Volt Low Lmt:	Sets Low end of mains voltage stable range
Mains Volt Low Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq High Lmt:	Sets high end of mains frequency stable range
Mains Freq High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq Low Lmt:	Sets low end of mains frequency stable range
Mains Freq Low Alarm:*	Loss of Mains or Loss of Mains with alarms
LOM Action Delay:	The amount of time that the mains power must be out of spec to trigger the Loss of Mains.

*At least one of the four Loss of Mains alarms need to be set for Loss of Mains or Loss of Mains with Alarms for the Standby operation to occur. If no standby operation is desired, set all of these alarms to Disable.

Discretionary

Configuration Menu:

Network Address
Network Priority

Sequencing and Comms Menu:

Auto Sequencing
Max Gen Load
Next Genset Dly
Rated Load Dly
Max Start Time
Min Gen Load
Reduced Load Dly
Max Stop Time

Control Wiring

Terminal Description	Required	Optional	Not Used	Comment
1+ power supply	✕			
2– power supply	✕			
5Mains Brkr Close N.O.	✕			
6Mains Brkr Close Com.	✕			
7Mains Brkr Close N. C.	✕			
8Gen Brkr Close N.O.	✕			
9Gen Brkr Close Com.	✕			
10 Gen Brkr Close N. C.	✕			
11 Engine Preglow		✕		
12 Engine Preglow		✕		
13 Fuel Solenoid	✕			
14 Fuel Solenoid	✕			
15 Crank Engine	✕			Not Required if Start Sequencing is Disabled
16 Crank Engine	✕			“
17 No Connection			✕	
18 Visual Alarm N. O.		✕		
19 Visual Alarm Com.		✕		
20 Visual Alarm N. C.		✕		
21 Bus PT Connect	✕			
22 Bus PT Connect	✕			
23 Mains PT Disconnect	✕			
24 Mains PT Disconnect	✕			
25 Mains Brkr Trip N. O.	✕			
26 Mains Brkr Trip Com.	✕			
27 Mains Brkr Trip N. C.	✕			
28 Gen Brkr Trip N. O.	✕			
29 Gen Brkr Trip Com.	✕			
30 Gen Brkr Trip N. C.	✕			
31 Audible Alarm		✕		
32 Audible Alarm		✕		
33 Audible Alarm		✕		
34 Idle Rated/Load SW		✕		Idle is bypassed on LOM start
35 Idle Rated/Load SW		✕		“
36 No Connection			✕	
37 + Voltage Bias	✕			
38 – Voltage Bias	✕			
39 Voltage Bias Shield	✕			
40 Mains/Bus PT Phase A	✕			
41 Mains/Bus PT Phase B or N	✕			
42 Generator PT phase A +	✕			
43 Generator PT phase A –	✕			
44 Generator PT phase B +	✕			
45 Generator PT phase B –	✕			

Table 5-5. I/O list for Single Unit Process application

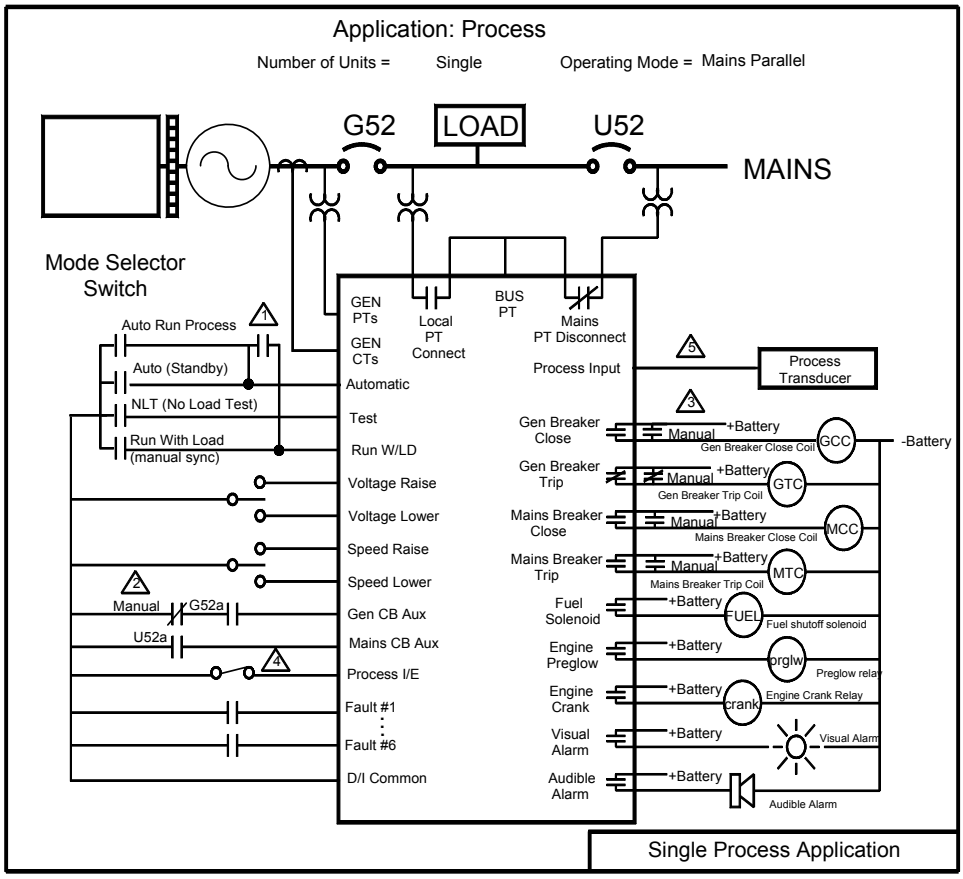
Terminal Description	Required	Optional	Not Used	Comment
46 Generator PT phase C +	✕			
47 Generator PT phase C –	✕			
49 Auto	✕			
50 Test		✕		
51 Run/Ld	✕			
52 Volt Raise		✕		
53 Volt Lower		✕		
54 Speed Raise		✕		
55 Speed Lower		✕		
56 Gen CB Aux	✕			
57 Mains CB Aux	✕			
58 Process	✕			
59 Fault 1		✕		
60 Fault 2		✕		
61 Fault 3		✕		
62 Fault 4		✕		
63 Fault 5		✕		
64 Fault 6		✕		
65 Switch Common	✕			
66 Temp Sensor +		✕		
67 Temp Sensor –		✕		
68 Pressure Sensor +		✕		
69 Pressure Sensor –		✕		
70 Magnetic Pickup +	✕			Not Required if Start Sequencing is Disabled
71 Magnetic Pickup –	✕			“
72 Magnetic Pickup Shield	✕			“
73 + Speed Bias	✕			
74 – Speed Bias	✕			
75 Speed Bias Shield	✕			
76 + 485 Communication			✕	
77 – 485 Communication			✕	
78 485 Shield			✕	
79 NC			✕	
80 Communication Reference			✕	
81 422 Communication RX+		✕		
82 422 Communication RX–		✕		
83 422 Shield		✕		
84 422 Communication TX+		✕		
85 422 Communication TX–		✕		
86 + Process Signal	✕			
87 – Process Signal	✕			
88 Process Signal Shield	✕			
89 Gen CT phase A+ Current	✕			

Table 5-5 cont’d

Terminal Description	Required	Optional	Not Used	Comment
90 Gen CT phase A– Current	X			
91 Gen CT phase B+ Current	X			
92 Gen CT phase B– Current	X			
93 Gen CT Phase C+ Current	X			
94 Gen CT Phase C– Current	X			

Table 5-5 cont'd

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1. Both the Auto and Run with Load inputs will be closed when the Mode Selected is Auto Run Process
2. Opening the Gen CB Aux input will place the EGCP-2 into droop mode
3. The Process Input must be a 1 - 5 VDC or 4-20 mA signal
3. Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.
4. Process Switch input may be wired directly to control if Process Mode is the only mode required. The switch could be opened to place the unit in Baseload mode

Figure 5-5. Single Unit Process Application

Operation

Using the three mode selector inputs Auto, Test, and Run with Load, the generator set can be placed into the proper mode of operation. The Process switch can be permanently closed or, if it is desired, to switch between process control and baseload control a switch can be installed for the Process input. The switch configuration would be as follows:

Input: Auto	Test	Run w/Load	Process	Mode of Operation
			X	Off
X			X	Standby
	X		X	Test No Load
		X	X	Manual Run with Load
	X	X	X	Manual Run with Load
X	X		X	Auto Test
X		X	X	Auto Run Process
X	X	X	X	Auto Run Process
X		X		Auto Run Baseload(see previous application section)
X	X	X		Auto Run Baseload(see previous application section)

X = Discrete input closed
Modes that are shown in gray are not discussed in this application section.

Table 5-6. Mode Selector Switch Position for Single Process

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will be in the Standby mode. Please see the previous application Single Standby for an explanation of the operation.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Auto Test
This mode combines the Standby and Test no load modes. As long as the test input is closed, the engine will start and will continue to run. However, if the mains were to fail, the engines would be closed to the bus to supply the load. Please see the previous application Single Standby for an explanation of the operation.

Manual Run Process
The Manual Run with Load mode is used for manual synchronization. For a Single Unit it is not possible to operate in the Process mode manually. The Auto input must be closed to go into the Process mode. See Chapter 3 for more information about this mode.

Auto Run Process
When the Auto, Run with Load, and Process inputs are closed, the control will perform an automatic synchronization and run with the generator breaker closed. If the mains is present, the control will also close the mains breaker and operate the generator in the Process mode. If the mains is failed, the generator will be operated in the isochronous mode.

Sequence of Operation

This section will describe the details of operation for the **Process** application when configured for a **Single Parallel** control.

Auto Run Process Sequence

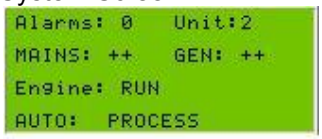
The sequence begins with a healthy mains and the EGCP-2 in OFF. The mains breaker is closed and the mains power is being supplied to the load.

1. Placing the EGCP-2 into the Auto Run Process mode:
   1.1. To place the engine in Auto Run Process the Auto, Run with Load, and Process inputs will be closed.
   1.2. At this point the EGCP-2 will start the engine (see Chapter 2).
   1.3. If the mains voltage is stable, and the mains breaker were not closed, the EGCP-2 would close the mains breaker.
   1.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   1.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   1.6. The generator is declared stable.
2. Running on-line in Process mode:
   2.1. The EGCP-2 will synchronize the generator to the mains and close the generator breaker.
   2.2. The EGCP-2 will ramp the kW load on the generator to the Process reference.
   2.3. If the control is configured for Power Factor control the power factor will be controlled at the Power Factor Reference.
   2.4. If VAR control is configured, the kVARs will be ramped to the VAR Reference.
   2.5. This will be displayed like this:

I/O Screen

Inputs 8& 9, the Gen and Mains CB Aux are closed
Inputs 1, 3, & 10, Auto Run w/Load, and Process are closed.
Outputs 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated speed.
Outputs 7 & 8 are closed to bring the Bus PT voltage into the Mains/Bus PT input.
Output 10 is closed to remove the Generator Breaker trip signal.

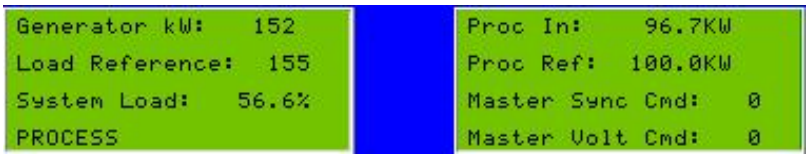
System Screen



The BUS voltage is within spec shown by ++.
The GEN voltage is in spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the KW DROOP mode until the generator breaker is closed.

2.6. The process reference can be adjusted in three ways:
  2.6.1. Using the Raise and Lower Speed discrete inputs.
    2.6.1.1. If the Process has an Indirect relationship with the kW load, by raising the Process input, this will effectively lower the kW load on the unit. Likewise, lowering the process reference will effectively increase the kW load on the unit.
    2.6.1.2. Using the Raise and Lower Speed Modbus inputs.
    2.6.1.3. Using the Modbus Process Reference address 40002. See the EGCP-2 Communications manual 26182, for more detail on the Modbus communications of the EGCP-2
2.7. The Power Factor or KVAR setpoint can be adjusted in three ways:
  2.7.1. Using the Raise and Lower Voltage discrete inputs.
  2.7.2. Using the Raise and Lower Voltage Modbus inputs.
  2.7.3. Using the Modbus Power Factor Reference address 40005, or KVAR Reference address 40007. (See manual 26182)
2.8. The active KW reference and PF reference can be viewed by pressing the KW LOAD or PF/kVAR buttons on the EGCP-2. The screens will appear like this:

KW LOAD Screen



The control is in the Process mode. The generator kW is 152kW
The Process reference is 100 kW and the Process input to the kW is reading 96.7 kW.
Since the generator is producing 152 kW and 96.7 of that power is being exported the local load would be the difference of 55 kW.

PF / kVAR Screen

The VAR/PF Mode is currently PF CONTROL.
The Power Factor Reference is 0.90 LAG.
The actual Power Factor is 0.895 LAG.

IMPORTANT **The EGCP-2 will only measure and control the kVAR or Power Factor of the generator. It cannot measure or control the kVAR of Power Factor of the Mains.**

3. Shutting Down the Genset:
  3.1. By opening the Auto and Run with Load inputs, the generator load will be ramped down to the Unload Trip load level, passing the load from the generator to the mains.
  3.2. When the generator KW is equal to or less than the Unload Trip level, the generator breaker will trip.
  3.3. The engine will go into the stop sequence (see Chapter 2).
4. Going from Auto Run Process to Standby:
  4.1. By opening only the Run with Load input and leaving the Auto input closed, the control will unload to the unload trip level.
  4.2. When the generator KW is equal to or less than the Unload Trip level, the generator breaker will trip.
  4.3. The engine will go into the stop sequence (see Chapter 2).
  4.4. The engine is now in the Standby mode, and will monitor the Mains PT input.

4.5. If the Mains fails the engine will be started as described in the Standby application sections previously in this manual.

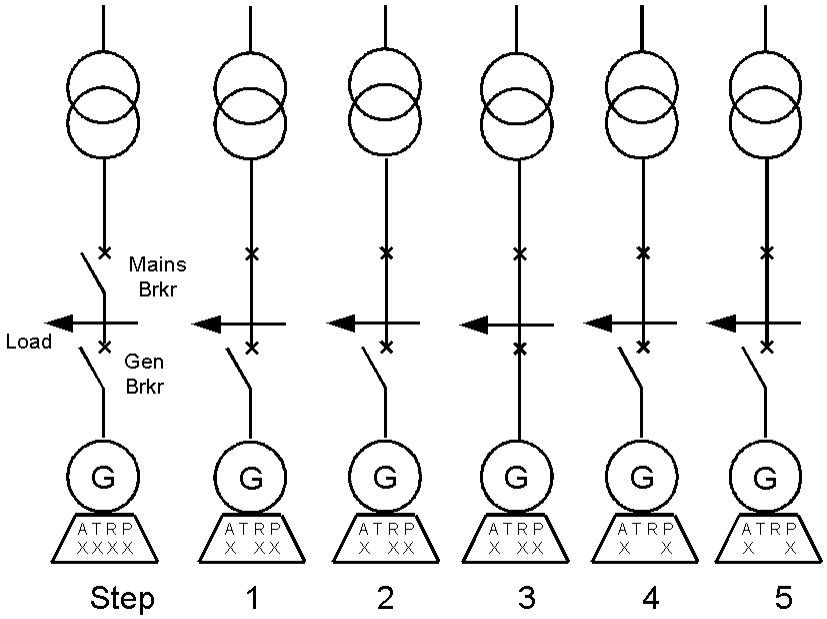


Figure 5-6. Process step diagram

1. The Auto, Run with Load, and Process inputs are closed.
2. The generator starts and synchronizes to the Mains.
3. The generator breaker is closed and the control ramps the kW on the generator to the Process Reference.
4. When the Run with Load input is opened, the generator is unloaded and the generator breaker is opened.
5. The engine goes through a cool down period and shuts down.

Application Questions for Auto Run Process Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

Will the control close the generator breaker if the generator is started and the control senses power on the mains but not on the bus?
No, the EGCP-2 will not close the generator breaker if it senses a closed mains breaker, but no power on the Bus PT’s.

What will happen if the mains were to fail while the generator is on-line in Process mode?
One of many scenarios is possible.

1. The mains fails and the mains protective device trips the mains breaker. For this scenario, the EGCP-2 will recognize the mains breaker is open and switch from process mode to isochronous mode.

2. The mains fails, but the generator is supplying power through the mains breaker so the EGCP-2 does not see that the mains has failed. The EGCP-2 will remain in the process mode and try to maintain its process reference. In all likelihood, the actual load on the now isolated bus will be different from the process reference so the EGCP-2 will cause the engine to speed up or slow down. At some point, either a mains protective device or the EGCP-2 LOM alarms will see that the mains voltage is out of spec and open the mains breaker. Possibly the generator breaker would trip on a high or low frequency alarm.
3. The mains fails and the generator picks up the load of the local grid. It is possible that when the mains fails, the EGCP-2 would be supplying power out of the facility to an immeasurable load. In this situation, the breakers would trip on overcurrent and/or the engine would be stopped by the sudden increase in load.

NOTICE

The EGCP-2 is not a protective device for the mains breaker. Additional protective devices should be installed in accordance with the local utility requirements.

What if the mains returns after a Loss of Mains and the generator is on-line?
The EGCP-2 will synchronize the mains breaker. After closing the mains breaker the control will ramp the kW load to the process reference and return to the process mode.

Will the generator be overloaded if the Process reference is set to export 200 kW, but the generator is only rated at 150 kW?
No. While in the process mode, the EGCP-2 will not allow the load of the generator to be more than the KW Load High Limit in the Real Load Control menu, or lower than the KW Load Low Limit.

Single Soft Transfer Application

This section describes a single unit that will transfer the load from the mains to the generator. The soft transfer can be accomplished in either the Process or the Baseload modes. Both methods will be discussed here. The soft transfer is used for applications where the generator is paralleled briefly to the mains in order to softly transfer the load from the mains to the generator. After which the mains breaker will be opened and the generator will be isolated. The sequence reverses when switching back to the mains. The generator will synchronize to the mains, close the mains breaker, transfer the load from the generator to the mains and then open the generator breaker.

Configuration items

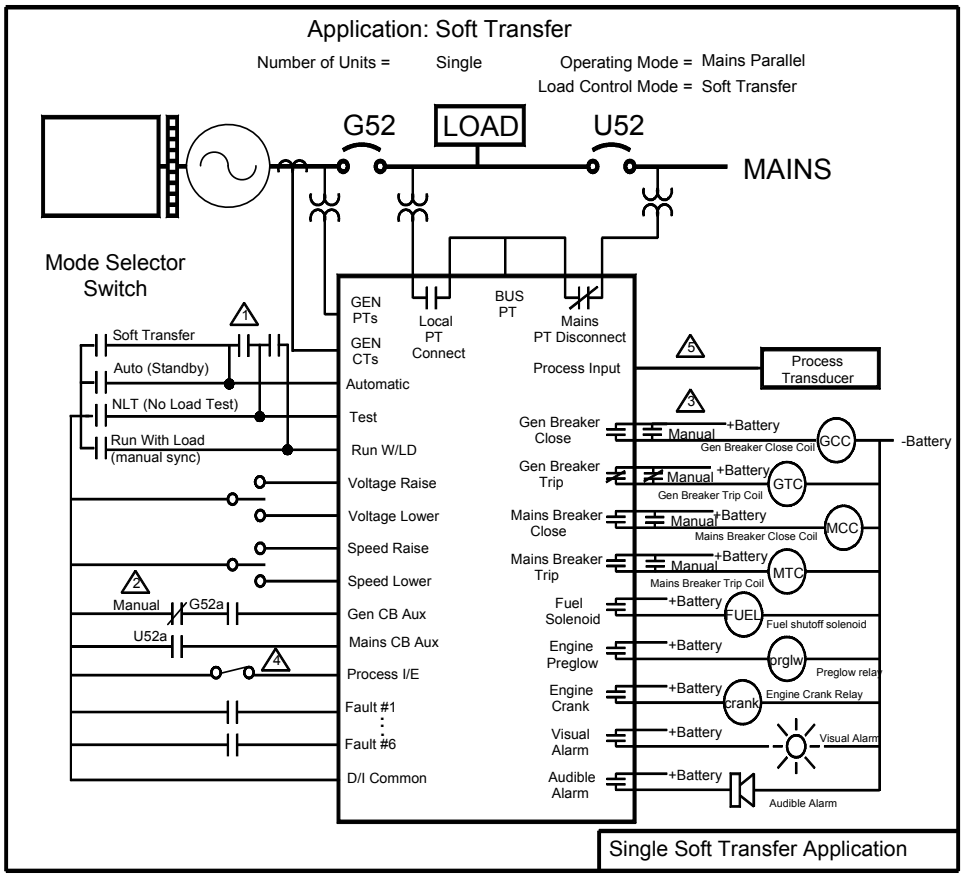
The configuration points in the EGCP-2 software, will match the configuration settings of the baseload and process applications with one exception, the Load Control Mode. All other settings should follow the baseload or process applications discussed previously.

Required settings

Real Load Control Menu:
Load Control Mode: Soft Transfer

Control Wiring

The wiring of the soft transfer application will be the same as the baseload or process applications discussed previously. Please consult these application sections for information on the control wiring.



1. The Auto, Test, and Run with Load inputs will be closed when the Mode Selected is Soft Transfer
2. Opening the Gen CB Aux input will place the EGCP-2 into droop mode
3. Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.
4. Closing this input will activate the Process mode. Opening this input will activate the Baseload mode.
5. The Process Input must be a 1 - 5 VDC or 4-20 mA signal

Figure 5-7. Single Unit Soft Transfer Application

Operation

Using the three mode selector inputs Auto, Test, and Run w/Load, the generator set can be placed into the proper mode of operation. When all three of the inputs are closed and the Load Control Mode is programmed for Soft Transfer, the control will go into the soft transfer mode. Then if the Process input is open, the control will perform a baseload soft transfer. If the Process input is closed, the control will perform a process soft transfer. The switch configuration would be as follows:

Input					Mode of Operation
	Auto	Test	Run w/Load	Process	
					Off
	X				Standby
		X			Test No Load
			X		Manual Run with Load
		X	X		Manual Run with Load
	X	X			Auto Test
	X		X	X	Auto Run Process
	X	X	X	X	**Soft Transfer Process**
	X		X		Auto Run Baseload
	X	X	X		**Soft Transfer Baseload**

X = Discrete input closed
Modes that are shown in gray are not discussed in this application section.

Table 5-7. Mode Selector Switch Position for Soft Transfer

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will be in the Standby mode. Please see the previous application Single Standby for an explanation of the operation.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Manual Run Baseload
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Auto Run Process or Baseload
When the Auto, and Run with Load inputs are closed, the control will perform an automatic synchronization and run with the generator breaker closed. Please see the previous applications for an explanation of the operation.

Soft Transfer Process or Baseload
When the Auto, Test, and Run with Load inputs are closed, the control will perform a soft transfer, where the load will be transferred from the mains to the generator in a controlled closed transition fashion. The generator will then run isolated from the mains until this mode is exited, at which time it will return the load to the mains. The state of the Process input will determine whether the soft transfer is performed in the Baseload or Process mode.

Sequence of Operation

This section will describe the details of operation for the **Soft Transfer** application when configured for a **Single Parallel** control.

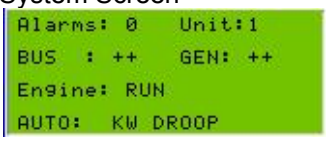
Soft Transfer Process Sequence
The sequence begins with a healthy mains and the EGCP-2 in OFF.
The mains breaker is closed and the mains power is being supplied to the load.

1. Placing the EGCP-2 into the Soft Transfer Process mode
   1.1. To place the engine in Soft Transfer Process the Auto, Test, Run with Load, and Process inputs will be closed.
   1.2. At this point, the EGCP-2 will start the engine (see Chapter 2).
   1.3. If the mains voltage is stable, and the mains breaker were not closed, the EGCP-2 would close the mains breaker.
   1.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus
   1.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   1.6. The generator is declared stable. The displays will be shown like this:

I/O Screen

Input 9, the Mains CB Aux is closed.
Inputs 1,2, 3, & 10 Auto, Test, Run w/Load, and Process are closed to place the control in the Soft Transfer Process mode.
Outputs 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated speed.
Outputs 7 & 8 are closed to bring the Bus PT voltage into the Mains/Bus PT input.
Output 10 is closed to remove the Generator Breaker trip signal.

System Screen



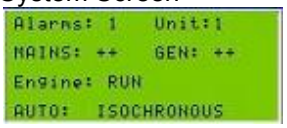
The BUS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the KW Droop mode because the gen circuit breaker is open.

2. Transferring from Mains power to generator power in the Process mode
   2.1. The EGCP-2 will synchronize the generator to the mains and close the generator breaker.
   2.2. The EGCP-2 will ramp the kW load on the generator to the Process reference.
   2.3. If the control is configured for Power Factor control the power factor will be controlled at the Power Factor Reference.
   2.4. If VAR control is configured, the kVARs will be ramped to the VAR Reference.
   2.5. Once the Process signal is equal to the Process reference, the Mains breaker is opened.
   2.6. The EGCP-2 then will operate in the isochronous mode supplying the total load on the bus.
   2.7. This would be displayed like this:

I/O Screen

Input 8 the Gen CB Aux is closed.
Inputs 1,2, 3, & 10 Auto , Test, Run w/Load, and Process are closed to operate the control in the Soft Transfer Process mode.
Outputs 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated speed.
Output 10 is closed to remove the Generator Breaker trip signal.

System Screen



The Mains voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the ISOCHRONOUS mode because the mains circuit breaker is open.

3. Returning to Mains Power
   - 3.1. By opening either the Test, Run with Load, or both inputs the EGCP-2 will resynchronize the Mains breaker.
   - 3.2. The EGCP-2 will already be monitoring the mains so there is no need to switch to look at the Bus PT.
     - 3.2.1. Case 1. Only the Test input is opened
       - 3.2.1.1. The EGCP-2 will resynchronize the Mains breaker.
       - 3.2.1.2. The control will ramp into the Auto Process mode and go into Process control at the Process reference.
     - 3.2.2. Case 2. Only the Run with Load input is opened
       - 3.2.2.1. The EGCP-2 will resynchronize the Mains breaker.
       - 3.2.2.2. The generator will softly unload to its unload trip level, passing the load from the generator to the mains.
       - 3.2.2.3. The generator breaker will be opened.
       - 3.2.2.4. The engine will continue to run in the Auto Test mode
     - 3.2.3. Case 3. Both the Test and Run with Load inputs are opened.
       - 3.2.3.1. The EGCP-2 will resynchronize the Mains breaker.
       - 3.2.3.2. The generator will softly unload to its unload trip level, passing the load from the generator to the mains.
       - 3.2.3.3. The generator breaker will be opened.
       - 3.2.3.4. The engine will go into the stop sequence (see Chapter 2).
     - 3.2.4. Case 4. All three inputs Auto, Test, and Run with Load are opened.
       - 3.2.4.1. The EGCP-2 will resynchronize the Mains breaker.
       - 3.2.4.2. The generator will softly unload to its unload trip level, passing the load from the generator to the mains.
       - 3.2.4.3. The generator breaker will be opened.
       - 3.2.4.4. The engine will go into the stop sequence (see Chapter 2).

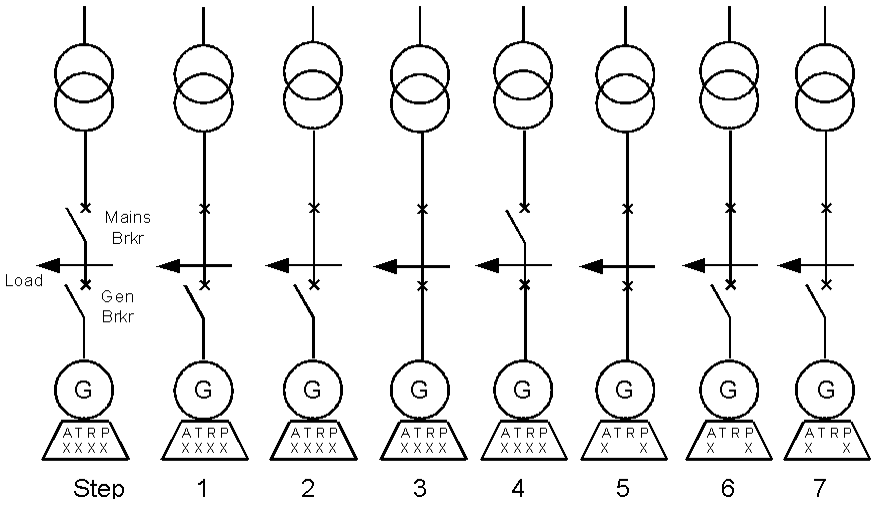


Figure 5-8. Soft transfer process step diagram

1. The Auto, Test, Run with Load, and Process inputs are closed
2. The generator starts and synchronizes to the Mains
3. The generator breaker is closed and the control ramps the kW on the generator to the Process Reference.
4. When the actual process input is equal to the process reference the mains breaker will be opened.
5. When the Test and Run with Load inputs are opened, the generator will synchronize to the mains and close the mains breaker
6. The generator is unloaded and the generator breaker is opened.
7. The engine goes through a cooldown period and shuts down

Application Questions for Soft Transfer Process Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

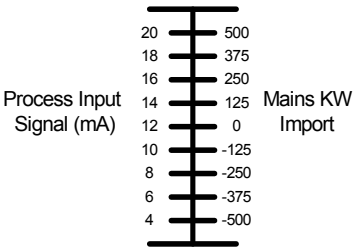
What happens if the generator experiences a hard shutdown while isolated from the mains?
The generator breaker is opened immediately and the engine is stopped. The control will switch from the Mains PT to the Bus PT to verify the bus is dead. Then the Mains breaker will be closed.

What happens if the generator experiences a soft shutdown while isolated from the mains?
The Mains breaker will be synchronized and closed. The generator will be unloaded to the unload trip level, where the generator breaker will be opened. Then the engine will proceed through a cooldown time, if applicable, and then shut down.

What will happen if the mains were to fail while the generator is on-line in Soft Transfer mode?
Since the engine is already running on-line, no change is seen. As long as the Auto input is closed to enable the Standby mode, the generator will remain on-line.

If the load on the bus is more than the generator can produce, will the mains breaker still be opened?

To avoid a possible overload it is very important to set the process reference close to the zero import level. The EGCP-2 will not open the mains breaker unless the process input signal is within the Process Deadband setting of the Process Reference.



Consider an example where a 200 kW generator set is being used in a Soft Transfer mode. The process input signal is 12 mA when the mains import load is 0 and 20 mA when the import load is 500 kW (see chart at right). This example indicates an indirect operation. If the load being supplied by the Mains is 250 kW, the process input would be 16 mA. If the generator were asked to carry this load, its capacity would be exceeded because it is only a 200 kW generator. The process reference should be set 12 mA. Then when the generator is closed on to the bus it will begin to take load from the mains, until it reaches its kW High Load Limit. At this point, the process input signal will be at 12.8 mA. The generator is carrying 200 kW, and the mains is carrying 50 kW. The Process Reference is 12.0 mA and the Process Deadband is 0.3% so the process input signal would need to be below 12.05 mA before the breaker would be opened. The load on the bus would need to be reduced before the mains breaker would be tripped.

If the Process Reference were set at 13.0 mA, the mains breaker would be tripped whenever the mains load was at 63 kW and it is possible that the generator could be overloaded, when the mains breaker was tripped.

Soft Transfer Baseload Sequence

The sequence begins with a healthy mains and the EGCP-2 in OFF. The mains breaker is closed and the mains power is being supplied to the load.

1. Placing the EGCP-2 into the Soft Transfer Baseload mode
   - 1.1. To place the engine in Soft Transfer Baseload the Auto, Test, and Run with Load inputs will be closed. The Process input is open.
   - 1.2. At this point the EGCP-2 will start the engine (see Chapter 2)
   - 1.3. If the mains voltage is stable, and the mains breaker were not closed, the EGCP-2 would close the mains breaker.
   - 1.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus
   - 1.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   - 1.6. The generator is declared stable.
2. Transferring from Mains power to generator power in the Baseload mode
   - 2.1. The EGCP-2 will synchronize the generator to the mains and close the generator breaker.
   - 2.2. The EGCP-2 will ramp the kW load on the generator to the Baseload reference.
   - 2.3. If PF Control is configured, the Power Factor will be ramped to the PF Reference.
   - 2.4. If VAR control is configured, the kVARs will be ramped to the VAR Reference.
   - 2.5. Once the baseload reference reaches the Baseload Reference setpoint, the Mains breaker is opened.
     - 2.5.1. The control uses the Baseload reference only; to determine when to open the Mains breaker, the actual load on the mains is not considered.

2.5.2. The control has no knowledge of how much load is on the bus. The mains breaker will open and whatever load was being supplied by the mains will be dumped on to the generator.

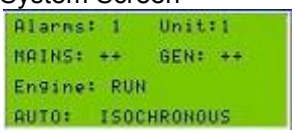
2.6. The EGCP-2 then will operate in the isochronous mode supplying the total load on the bus.

2.7. This would be displayed like this:

I/O Screen

Input 8 the Gen CB Aux is closed.
Inputs 1,2, & 3 Auto, Test, and Run w/Load are closed to operate the control in the Soft Transfer Baseload mode.
Outputs 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated speed.
Output 10 is closed to remove the Generator Breaker trip signal.

System Screen



The Mains voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the ISOCHRONOUS mode because the mains circuit breaker is open.

3. Returning to Mains Power

3.1. By opening the Test, Run with Load, or both inputs the EGCP-2 will resynchronize the Mains breaker.

3.2. The EGCP-2 will already be monitoring the mains so there is no need to switch to look at the Bus PT.

3.2.1. Case 1. Only the Test input is opened

3.2.1.1. The EGCP-2 will resynchronize the Mains breaker.

3.2.1.2. The control will ramp into the Auto Baseload mode and go into Baseload control at the Baseload reference.

3.2.2. Case 2. Only the Run with Load input is opened

3.2.2.1. The EGCP-2 will resynchronize the Mains breaker.

3.2.2.2. The generator will softly unload to its unload trip level, passing the load from the generator to the mains.

3.2.2.3. The generator breaker will be opened.

3.2.2.4. The engine will continue to run in the Auto Test mode

3.2.3. Case 3. Both the Test and Run with Load inputs are opened.

3.2.3.1. The EGCP-2 will resynchronize the Mains breaker.

3.2.3.2. The generator will softly unload to its unload trip level, passing the load from the generator to the mains.

3.2.3.3. The generator breaker will be opened.

3.2.3.4. The engine will go into the stop sequence (see Chapter 2) and remain in the Standby mode to monitor the mains for a mains failure.

3.2.4. Case 4. All three inputs Auto, Test, and Run with Load are opened.

3.2.4.1. The EGCP-2 will resynchronize the Mains breaker.

3.2.4.2. The generator will softly unload to its unload trip level, passing the load from the generator to the mains.

3.2.4.3. The generator breaker will be opened.

3.2.4.4. The engine will go into the stop sequence (see Chapter 2).

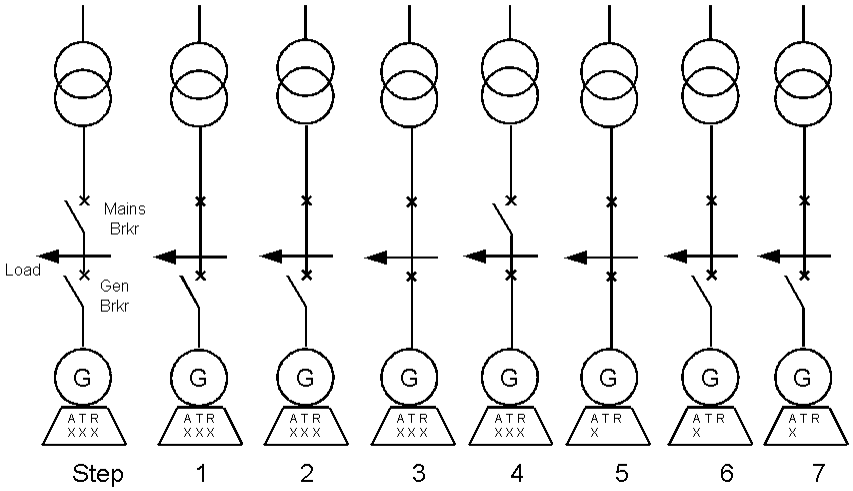


Figure 5-9. Soft transfer baseload step diagram

1. The Auto, Test, and Run with Load inputs are closed
2. The generator starts and synchronizes to the Mains
3. The generator breaker is closed and the control ramps the kW on the generator to the baseload reference.
4. Once the load ramp is completed the mains breaker will be opened.
5. When the Test and Run with Load inputs are opened, the generator will synchronize to the mains and close the mains breaker
6. The generator is unloaded and the generator breaker is opened.
7. The engine goes through a cooldown period and shuts down

Application Questions for Soft Transfer Baseload Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

What if the generator experiences a hard shutdown while isolated from the mains?
The generator breaker is opened immediately and the engine is stopped. The control will switch from the Mains PT to the Bus PT to verify the bus is dead. Then the Mains breaker will be closed.

What if the generator experiences a soft shutdown while isolated from the mains?
The Mains breaker will be synchronized and closed. The generator will be unloaded to the unload trip level, where the generator breaker will be opened. Then the engine will proceed through a cooldown time, if applicable, and then shut down.

What will happen if the mains were to fail while the generator is on-line in Soft Transfer mode?
Since the engine is already running on-line, no change is seen. As long as the Auto input is closed to enable the Standby mode, the generator will remain on-line.

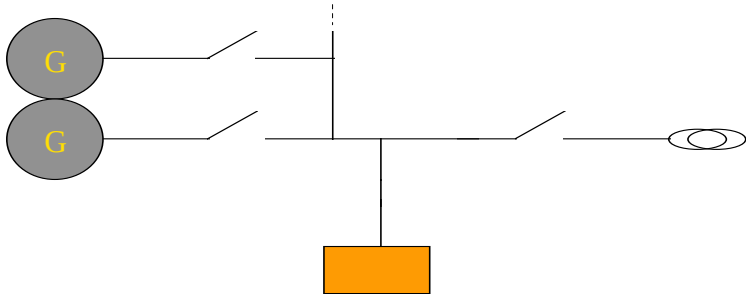
Will the mains breaker still be opened, which could possibly overload the generator, if the load on the bus exceeds the load capacity of the generator?
In the Soft Transfer Baseload mode, the control has no knowledge of how much load was on the bus being supplied by the mains. It is possible that the mains breaker could be opened and the generator could be overloaded. In this situation a load shed scheme would need to be implemented. At a minimum, an operator should verify the load on the bus is less than the generator capacity before placing the control into the Soft Transfer mode

IMPORTANT

For Soft Transfer applications, it is recommended to use the Process control method rather than the Baseload method for the following reasons:

1. **The baseload method does not take into account the load on the bus, it simply opens the breaker and assumes the generator will be capable of supplying the load.**
2. **The process method will use the process input signal to determine if the load has indeed been transferred to the generator before the mains breaker is opened.**
3. **The baseload method may place a large load on the engine if the baseload reference is not close the actual load on the bus.**
4. **The process method can be used to reach a zero power import and thus minimize the load dump on the engine and through the mains breaker.**

Chapter 6.
Multiple/ No Parallel



Multiple no parallel operation combines the generating capacity of multiple units to supply an isolated load. All operations of the generators on load in a multiple no parallel system are accomplished isolated from the mains.

In a system with multiple units, the EGCP-2 control operates in a Master/Slave type configuration. The master role is determined over the inter-control RS-485 network by the unit in Auto mode with the highest network priority (lowest numerical value).

The Mains No Parallel configuration is used for two applications, either standby power, where the EGCP-2 is monitoring the mains or a prime power application. The EGCP-2 then can be programmed to provide automatic generator start / stop sequencing where engines can be started and stopped as the load changes on the bus, with the Auto Sequencing feature. To simplify the explanation of these applications each case will be discussed with and without EGCP-2 Auto Sequencing.

Multiple Standby/No Parallel/No Sequencing

This section describes a system that will not be paralleled with the mains power at any time. When mains power has failed, the generator sets will be started and closed to the bus to provide standby (emergency) power. When the mains returns, the EGCP-2 will open the generator breakers, then close the utility breaker in an open transition. Following the Cooldown time, the engines will then shutdown.

Configuration items

The key configuration points in the EGCP-2 software needing to be configured for a Multiple Unit No Parallel Standby application are:

	Required settings
Configuration Menu:	
Network Address	1 to 8, unique for each unit
Number of Units:	Multiple
Operating Mode:	No Parallel

Shutdown and Alarm Menu:

Gen Volt Hi Lmt	Sets high end of generator voltage stable range
Gen Volt Lo Lmt	Sets low end of generator voltage stable range
Gen Freq Hi Lmt	Sets high end of gen frequency stable range
Gen Freq Lo Lmt	Sets low end of gen frequency stable range

Synchronizer Menu:

Sync Mode:	Run
Deadbus Closing:	Enabled on at least one unit.

Real Load Control Menu:

Load Control Mode:	Normal
Baseload Reference:	Used with the Load and Unload Time settings to determine the load ramp rate.
Unload Trip:	When unloading the generator, this is the kW value where the EGCP-2 sends the Generator breaker trip command
Load Time:	Sets the load increase ramp time
Unload Time:	Sets the unload ramp time

Transfer Switch Menu:

Check Mains Breaker:	Enabled
Mains Volt High Lmt:	Sets high end of mains voltage stable range
Mains Volt High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Volt Low Lmt:	Sets Low end of mains voltage stable range
Mains Volt Low Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq High Lmt:	Sets high end of mains frequency stable range
Mains Freq High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq Low Lmt:	Sets low end of mains frequency stable range
Mains Freq Low Alarm:*	Loss of Mains or Loss of Mains with alarms
LOM Action Delay:	The amount of time that the mains power must be out of spec to trigger the Loss of Mains.

*At least one of the four Loss of Mains alarms need to be set for Loss of Mains or Loss of Mains with Alarms for the Standby operation to occur.

Sequencing and Comms Menu:

Auto Sequencing:	Disabled

Suggested Settings

Engine Control Menu:

Preglow Time:	0 sec. If the Preglow relay is not being utilized, setting this time above zero can cause delays when starting the engine

Reactive Load Menu:

VAR/PF Mode:	PF Control or VAR Control This will enable the power factor sharing function of the EGCP-2.

Transfer Switch Menu:

Gen Stable Dly: 1.0 seconds
When the generator is started, how long will the voltage and frequency need to be within spec before the gen breaker can be closed. This may be set to minimum to achieve the fastest breaker closing time.

Discretionary

Reactive Load Control Menu:

kVAR Reference
PF Reference

Process Control Menu:

Not all items in this menu are applicable to a multiple unit prime power application

Transfer Switch Menu

Fast Transfer Delay
Mains Stable Delay
Load Surge
Load Surge Alarm
Mains Volt High Lmt:
Mains Volt Low Lmt:
Mains Freq High Lmt:
Mains Freq Low Lmt:
LOM Action Delay:

Sequencing and Comms Menu

Max Gen Load
Next Genset Dly
Rated Load Dly
Max Start Time
Min Gen Load
Reduced Load Dly
Max Stop Time

Control Wiring

Terminal Description	Required	Optional	Not Used	Comment
1+ power supply	✕			
2– power supply	✕			
5Mains Brkr Close N.O.	✕			Wiring mains breaker controls to only one unit will compromise sys redundancy
6Mains Brkr Close Com.	✕			“
7Mains Brkr Close N. C.	✕			“
8Gen Brkr Close N.O.	✕			
9Gen Brkr Close Com.	✕			
10 Gen Brkr Close N. C.	✕			
11 Engine Preglow		✕		
12 Engine Preglow		✕		
13 Fuel Solenoid	✕			
14 Fuel Solenoid	✕			
15 Crank Engine	✕			Not Required if Start Sequencing is Disabled
16 Crank Engine	✕			“
17 No Connection			✕	
18 Visual Alarm N. O.		✕		
19 Visual Alarm Com.		✕		
20 Visual Alarm N. C.		✕		
21 Bus PT Connect	✕			
22 Bus PT Connect	✕			
23 Mains PT Disconnect	✕			
24 Mains PT Disconnect	✕			
25 Mains Brkr Trip N. O.	✕			
26 Mains Brkr Trip Com.	✕			
27 Mains Brkr Trip N. C.	✕			
28 Gen Brkr Trip N. O.	✕			
29 Gen Brkr Trip Com.	✕			
30 Gen Brkr Trip N. C.	✕			
31 Audible Alarm		✕		
32 Audible Alarm		✕		
33 Audible Alarm		✕		
34 Idle Rated/Load SW		✕		Idle is bypassed on LOM start
35 Idle Rated/Load SW		✕		“
36 No Connection			✕	
37 + Voltage Bias		✕		Required if EGCP-2 is controlling power factor
38 – Voltage Bias		✕		“
39 Voltage Bias Shield		✕		“
40 Mains/Bus PT Phase A	✕			

Table 6-1. I/O list for Single Unit No Parallel Standby application

Terminal Description	Required	Optional	Not Used	Comment
41 Mains/Bus PT Phase B or N	✕			
42 Generator PT phase A +	✕			
43 Generator PT phase A –	✕			
44 Generator PT phase B +	✕			
45 Generator PT phase B –	✕			
46 Generator PT phase C +	✕			
47 Generator PT phase C –	✕			
49 Auto	✕			
50 Test		✕		
51 Run/Ld		✕		
52 Volt Raise		✕		
53 Volt Lower		✕		
54 Speed Raise		✕		
55 Speed Lower		✕		
56 Gen CB Aux	✕			
57 Mains CB Aux	✕			
58 Process			✕	
59 Fault 1		✕		
60 Fault 2		✕		
61 Fault 3		✕		
62 Fault 4		✕		
63 Fault 5		✕		
64 Fault 6		✕		
65 Switch Common	✕			
66 Temp Sensor +		✕		
67 Temp Sensor –		✕		
68 Pressure Sensor +		✕		
69 Pressure Sensor –		✕		
70 Magnetic Pickup +	✕			Not Required if Start Sequencing is Disabled
71 Magnetic Pickup –	✕			“
72 Magnetic Pickup Shield	✕			“
73 + Speed Bias	✕			
74 – Speed Bias	✕			
75 Speed Bias Shield	✕			

Table 6-1 cont’d

Terminal Description	Required	Optional	Not Used	Comment
76 + 485 Communication	✕			
77 – 485 Communication	✕			
78 485 Shield	✕			
79 NC			✕	
80 Communication Reference			✕	
81 422 Communication RX+		✕		
82 422 Communication RX–		✕		
83 422 Shield		✕		
84 422 Communication TX+		✕		
85 422 Communication TX–		✕		
86 + Process Signal			✕	
87 – Process Signal			✕	
88 Process Signal Shield			✕	
89 Gen CT phase A+ Current	✕			
90 Gen CT phase A– Current	✕			
91 Gen CT phase B+ Current	✕			
92 Gen CT phase B– Current	✕			
93 Gen CT Phase C+ Current	✕			
94 Gen CT Phase C– Current	✕			

Table 6-1 cont'd

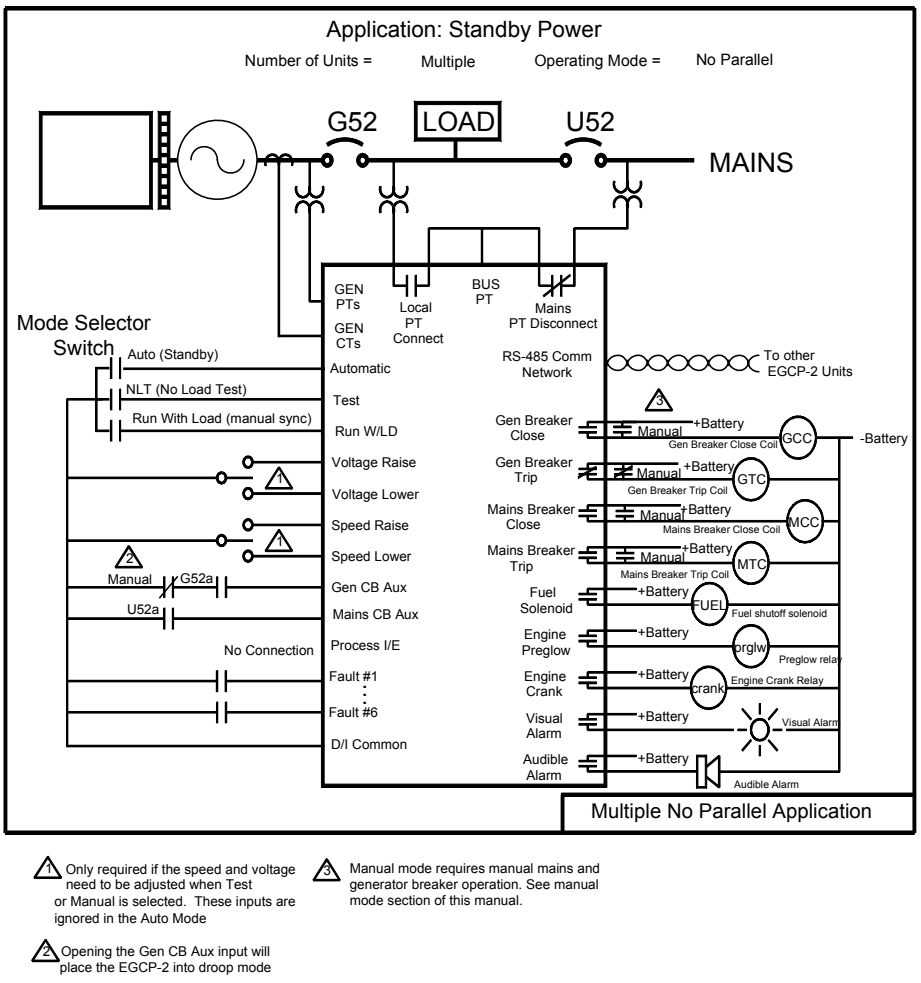
The Mains Circuit Breaker Aux input and Mains Circuit Breaker Trip and Close relays only need to be wired to the master unit. In applications where there is a dedicated master, these signals only have to be connected to that unit. The Check Mains Breaker setpoint in the Transfer Switch menu, will be Enabled on the master and Disabled on each slave unit.

However, wiring the mains breaker controls to only one unit will compromise the system redundancy. If for any reason that unit is not in service, the system will not have any way to operate the mains breaker. It may be necessary to wire these signals to two or more units to provide redundancy. For many standby applications, all the units will be capable of being the master and these signals will need to be wired to each unit. Any unit that could be a master in the system should have the Check Mains Breaker setting Enabled.

IMPORTANT

When operating as standby units there must be at least one unit on the network and in Auto with the mains breaker aux input wired, and the Check Mains Breaker setpoint Enabled at any given time.

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1 Only required if the speed and voltage need to be adjusted when Test or Manual is selected. These inputs are ignored in the Auto Mode

2 Opening the Gen CB Aux input will place the EGCP-2 into droop mode

3 Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.

Figure 6-1. Multiple No Parallel Standby Application

Operation

Using the three mode selector inputs Auto, Test, and Run w/Load, the generator set can be placed into the proper mode of operation. This application has the Auto Sequencing feature Disabled, so the actions of the master and slave units are very similar. The switch configuration would be as follows:

Input			Mode of Operation	
Auto	Test	Run w/Load	Master	Slave
			Off	Off
X			Standby	Standby
	X		Test No Load	Test No Load
		X	Manual Run with Load	Manual Run with Load
	X	X	Manual Run with Load	Manual Run with Load
X	X		Auto Test	Auto Test
X		X	Auto Run	Auto Run
X	X	X	Auto Run	Auto Run

X = Discrete input closed

Table 6-2. Mode Selector Switch Position for Standby Application

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will be in the Standby mode. In the Standby mode the master control will monitor the Mains PT input and wait for the mains to fail. Only the master unit determines that the mains has failed. If the slave unit detects a Loss of Mains, it will ignore it. Once the master determines the mains has failed it issues a start command to all engines that are in the standby mode. The EGCP-2 controls perform a deadbus check, by communication with the each other on the 485 network, then the first available unit will close to the deadbus. The first unit on-line does not have to be the master unit, any unit that has the Deadbus Closure setpoint Enabled will be able to close first. When the mains returns the generator breakers are opened and the mains breaker is closed.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Auto Test
The Auto Test mode is the same as Test no Load except it also includes the standby features. If the mains were to fail while exercising the engine, the generator would supply the load. When the mains returns, the engine would run off-line until the Test input was opened.

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Auto Run
To run an engine when the mains power is not failed the Auto Run mode is used. For this no parallel application, the load will be transferred from the mains to the generator through an open transition. An open transition back to the mains will occur when exiting this mode.

Sequence of Operation

This section will describe the details of operation for the **Standby** application when configured for a **Multiple No Parallel** control.
For the multiple engine sequences, a three-engine system is used to demonstrate the sequence. For systems with more engines, the operation of the slave units is the same.

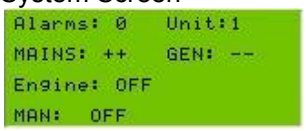
Standby Engine Sequence

1. The sequence begins with a healthy mains and the EGCP-2 in OFF. Initially the EGCP-2 is Off. The mains breaker is closed and the mains power is being supplied to the load. The EGCP-2 will display this information as follows:

I/O Screen

Input 9, the Mains CB Aux is closed.
Inputs 1,2, &3, the Auto, Test, and Run with Load are all open.
No Outputs are closed.

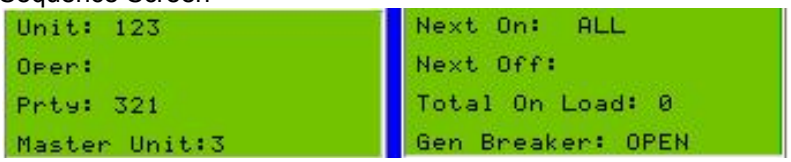
System Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is out of spec shown by --.
The engine is in the OFF state.
The control is in MANual and is in the OFF mode.

3. Placing the EGCP-2 into the Standby mode
   - 3.1. To place the engine in standby the Auto input should be closed.
   - 3.2. At this point, the master EGCP-2 will begin to monitor the Mains PT input. This voltage should be within the Mains Volt High and Low Limits and Mains Frequency High and Low Limit.
   - 3.3. The slave units will not monitor the mains, they wait for a start command from the master.
   - 3.4. The displays will be shown like this:

Sequence Screen



Three units have their Auto input closed and are shown.
None of the units are on-line because the Oper:(operation) field is blank, if the unit were running an X would appear under the unit.
The Prty: (priority) of each unit is shown and because unit 3 has the lowest priority number, it is the master unit.

4. Starting the Standby units on a Loss Of Mains
   - 4.1. When the master determines the mains voltage or frequency has traveled outside of the acceptable range for the Loss of Mains Action Delay time, the EGCP-2 will consider the Mains failed.
   - 4.2. The mains breaker is opened.
   - 4.3. The master unit sends out a start command. All slave units in standby that have the Auto input closed will receive the start command and start their engines (see Chapter 2 for start sequence information)..
   - 4.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   - 4.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   - 4.6. The generator is declared stable.
   - 4.7. The first stable master or slave will ask permission of the other units to close to the deadbus (provided that its Deadbus Closure setpoint is set to Enable).
   - 4.8. In order to receive permission all units must see Inputs 8 and 9, the Gen CB Aux and Mains CB Aux are open and the Bus PT is dead (below 40 VAC). If any unit sees a voltage or a closed breaker, the deadbus permission is denied.
     - 4.8.1. The first unit to close to the bus must be capable of supplying the entire load to the bus.

4.8.2. In some applications, there may be engines of different sizes. To prevent a unit from closing to the deadbus its Deadbus Closure setpoint should be set to Disable.

4.8.3. In some applications the load is greater than one engine can handle so multiple units must be on the bus before the load can be supplied. This logic is not provided in the EGCP-2 and must be provided externally. Another device such as a PLC would need to confirm that there is enough capacity on the emergency bus and then allow a load breaker to be closed.

4.9. After the first unit has closed to the bus, the other units will synchronize to this bus voltage.

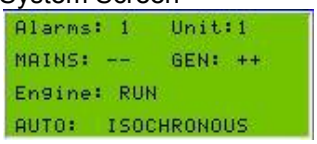
4.10. After synchronizing the generators will softly ramp their load to the system load percentage.

4.11. This is indicated on the display like this:

I/O Screen

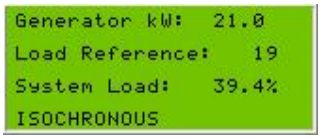
Inputs 1 & 8, Auto & Gen CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Outputs 6 & 11 Visual and Audible Alarm are closed to indicate an Active Alarm.
Output 10 Gen Breaker Trip is a reverse logic contact that will open to trip the breaker. When closed the generator breaker can be closed.

System Screen



The MAINS voltage is out of spec shown by --
The GEN voltage is out of spec shown by ++
The engine is in the RUN state
The control is in AUTO and is in the ISOCHRONOUS mode.

KW Load Screen



The generator is generating 21 kW.
The load setpoint is 19 kW.
In the Isochronous mode.

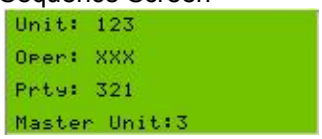
The system load percentage is communicated between each unit for load sharing.
Isochronous mode is the isolated bus Load sharing mode.

PF/kVAR Screen

This unit is in active Power Factor control.
with an actual Power Factor of 0.99 and a Power Factor reference of 0.97.

The Power Factor is communicated between each unit for Power Factor Sharing.
The average power factor of all units becomes the Power Factor Reference.

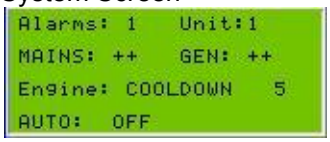
Sequence Screen



All three units are running on the bus shown by the X in the Oper: line.
Unit 3 is the master unit because it has the lowest priority number.

5. The Mains returns
   - 5.1. The mains voltage will need to be within the voltage and frequency high and low limits of the Transfer switch menu, for the Mains Stable Delay time. Only the master unit monitors the mains.
   - 5.2. The master control will open its generator breaker and command all other units on-line in Standby mode to open their breakers.
     - 5.2.1. If a slave unit is in manual (Auto input open), it will not open its generator breaker
   - 5.3. The Mains/Bus PT input will switch to the Bus and verify it is dead.
   - 5.4. The mains breaker is closed.
   - 5.5. The engines go into the stop sequence (see Chapter 2 for stop sequence information).
   - 5.6. The Mains/Bus PT will switch back to the Mains and await the next Loss of Mains.
   - 5.7. This will be displayed like this:

System Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the COOLDOWN state with 5 seconds remaining.
The control is in AUTO and is in the OFF mode.

The sequence is now back at step 2 and would repeat on the next Loss of Mains.

The following table gives a brief Summary of the Sequence for a three-unit system.

	Unit 1	Unit 2	Unit 3
Priority Number	1 (master)	2	3
Discrete Inputs	Auto	Auto	Auto
Mains Fails			
	Opens Mains Brkr		
	Start	Start	Start
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Isochronous Mode	Isochronous Mode	Isochronous Mode
	PF Sharing	PF Sharing	PF Sharing
Mains Returns			
	Open Gen Brkr	Open Gen Brkr	Open Gen Brkr
	Close Mains Brkr	Close Mains Brkr	Close Mains Brkr
	Cooldown	Cooldown	Cooldown
	Shutdown	Shutdown	Shutdown
	Monitor Mains Voltage		

Table 6-3. Standby Sequence Summary

Application Questions for Standby Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

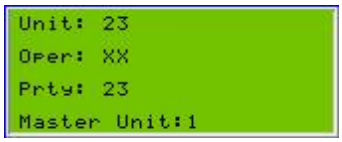
During a Loss of Mains event, while the engine is on-line what will happen if the Auto input is opened?
This scenario needs to be looked at for both a master and a slave.

1. Case 1 Master unit has Auto input opened with at least one slave on the bus:
   1.1. The unit will open its breaker with no unload ramp. The next lowest priority unit will become the new master. The unit will go into the stop sequence (see Chapter 2).
2. Case 2 Master unit has Auto input opened with no slaves on the bus.
   2.1. When the Auto input is opened, the EGCP-2 will open its generator breaker. The mode is now OFF, so the control will not close the mains breaker, even when the mains becomes stable again. In OFF the EGCP-2 will not open or close the breakers.
3. Case 3 Slave unit has Auto input opened.
   3.1. The slave unit will softly unload to the Unload Trip level and open its generator breaker, and then go into the stop sequence (see Chapter 2).

What happens if the engine has a shutdown while it is operating during a Loss of Mains?

1. Case 1 Master unit has a Hard Shutdown.
   1.1. The master unit will immediately open its breaker and then open its fuel solenoid to shutdown. Because the EGCP-2 itself is still functional, this unit will still be the master, and control the mains breaker.

On the sequencing screen this would be shown like this:



Units 2 and 3 are running on-line.
Unit 1 is not available to Run but is still master If the mains were to return, unit 1 would command the other units to open their breaker and then it would close the mains breaker.

2. Case 2 Master units has a Soft Shutdown
   2.1. The master unit would softly unload and then open its generator breaker. The engine would go through a cooldown if programmed and then stop. It would still be the master as in the previous case.
3. Case 3 Slave unit has a Hard Shutdown
   3.1.1. The slave unit would open its breaker and shutdown.
4. Case 4 Slave unit has a Soft Shutdown
   4.1. The slave unit would unload first, open its breaker, go through a cooldown period if programmed, and then shutdown.

When the mains has returned, what will happen if the control cannot close the mains breaker?

In the Synchronizer menu, the Close Attempts setting sets the number of times the control will try to close a breaker, even for a deadbus close. If the generator breaker has opened and the control has finished all of its close attempts trying to close the mains, a Sync Reclose Alarm will be logged. When the breaker problem is corrected, an operator will need to clear the Sync Reclose Alarm from the Alarm Log. After which, the control will try again to close the mains breaker.

Auto Test sequence

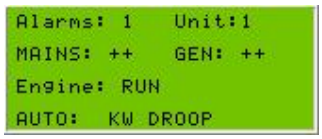
This sequence is the same for a master or a slave unit.
Starting with the Mains stable and the EGCP-2 in Auto.

1. When the Test input is closed, the engine will start (see Chapter 2).
2. The engine will run at rated speed as long as the Test input is closed.
3. The Speed Raise and Lower inputs and the Voltage Raise and Lower inputs will both be active to allow a user to adjust the speed or voltage manually.
4. Output 10 will remain de-energized, which is calling for the generator breaker to trip.
5. The display screens would appear like this:

I/O Screen

Inputs 1,2 & 9, Auto, Test & Mains CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.

Status Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the KW DROOP mode because the Gen CB Aux is open.

6. If the Mains were to fail while in this mode,
   6.1. The master EGCP-2 would open the Mains breaker and perform the normal Loss of Mains sequence.
   6.2. When the mains has returned and exceeded the Mains Stable Delay time, the master would command all of the units to open their generator beakers.
   6.3. Then the master would close the mains breaker. After the breaker was closed, the engines would continue to run as long as the Test input was closed.
7. When the test input was opened, the engine would go into the stop sequence (see Chapter 2).

Auto Run sequence

For this sequence, the Auto Sequencing Feature has been disabled, so the master control will not command slaves to start and stop.

1. Closing the first unit to the bus.
   1.1. With the mains stable, the mains breaker is closed, and the EGCP-2 is in Auto.
   1.2. The Run with Load input is closed (on either the master or slave).
   1.3. The engine will start (see Chapter 2)
   1.4. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
      1.4.1. The generator is declared stable
   1.5. The mains breaker will open, because the Operating Mode is No Parallel.
   1.6. The Fast Xfer Delay timer is started.
   1.7. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   1.8. When the transfer delay has expired, the generator breaker is closed to the deadbus.
   1.9. The Mains/Bus PT input will switch back to monitor the Mains.
   1.10. The generator will supply the isolated load.
2. Closing the next unit to the bus.
   2.1. When a second unit has its Auto and Run with Load inputs closed
   2.2. The engine will start (see Chapter 2)
   2.3. After the Generator Stable Delay, the generator will be declared stable.
   2.4. The mains breaker is already open. Consequently, this unit synchronizes with the generator already on-line.
   2.5. The breaker closes and the load will be ramped from 0 to the system load level. The two units will share the kW load and power factor.
3. Closing the next engine on-line follows the same sequence as step 2.

4. Removing a unit from the bus.
   4.1. By opening the Run with load, the engine will be commanded to unload and shutdown, provided that the Mains has not failed.
   4.2. The Run with Load input is opened on a Master unit. The generator breaker is opened without unloading the unit first.
   4.3. The Run with Load input is opened on a Slave unit. The generator is unloaded first to the unload trip level, then the breaker is opened.
   4.4. The engine goes through the stop sequence (see Chapter 2).
5. Taking the last generator off the bus.
   5.1. When the final unit has its Run with Load input opened
   5.2. The generator breaker will open. There is no unload because there is nothing else on the bus to take the load.
   5.3. The Fast Xfer timer is started.
   5.4. All units that are in Auto and have their Check Mains breaker setpoint enabled will switch their Mains/Bus PT inputs to look at the Bus.
   5.5. After verifying that the bus is dead and that the Fast Xfer timer has elapsed the controls will close the mains breaker.
   5.6. The engine will go through the stop sequence (see Chapter 2)

Action	Unit 1	Unit 2	Unit 3
Priority Number	1 (master)	2	3
Discrete Inputs	Auto	Auto	Auto
Close Run Inputs	Auto & Run	Auto & Run	Auto & Run
	Start	Start	Start
	Opens Mains Brkr	Opens Mains Brkr	Opens Mains Brkr
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Isochronous Mode	Isochronous Mode	Isochronous Mode
	PF Sharing	PF Sharing	PF Sharing
Open Run Input	Auto & Run	Auto & Run	Auto
			Soft Unload
			Open Gen Brkr
			Cooldown
			Shutdown
Open Run Input	Auto	Auto & Run	
	No Unload		
	Open Gen Brkr		
	Close Mains Brkr		
	Cooldown		
	Shutdown		
Open Run Input		Auto	
		No Unload	
		Open Gen Brkr	
		Close Mains Brkr	
		Cooldown	
		Shutdown	

Table 6-4. Auto Run Summary

Application Questions for Auto Run

What happens if the mains were to fail while the engine was supplying the isolated load in the Auto Run mode?

There is no change initially, the mains breaker is already opened, and the generator or generators are already supplying the load. However, the control now senses a Loss of Mains, so if the Run with Load input were opened, the control would not open the generator breaker. It would treat the situation like a Loss of Mains and remain on the bus waiting for the mains to return.

If the loss of Mains was Disabled and the Run with Load input were opened, the control would not open the generator breaker. If the Auto input were removed, it would open the generator breaker and shutdown. With the Auto input closed, if the Mains returned and was stable, it would open the generator breaker then close the mains breaker after the Fast Transfer Delay.

What if the engine has a shutdown while supplying the load?
For a hard shutdown, the generator breaker will be tripped and the unit will shutdown.
If there are multiple units on the bus and one of them has a soft shutdown, the engine load will first be unloaded and then the breaker opened followed by a possible cooldown delay.
The generator breaker is opened when the last unit on-line has a shutdown. Then the mains breaker will be re-closed after the Fast Xfer time has elapsed. With a soft shutdown, there may be a Cooldown time, for hard shutdown there is not then the engine will be shut down.

Standby No Parallel with Sequencing Application

If the EGCP-2 Auto Sequencing feature is enabled, the EGCP-2 will determine when to start and stop units based on generator load. When the controls are operating in either the Standby or Auto Run mode, the master control will determine when the slaves are started and stopped.

Configuration items

The key configuration points that changes from the previous application example.

Sequencing and Comms Menu:

Auto Sequencing:	Enabled
Auto Sequencing Delay:	Time before Sequencing will start
Max Gen Load:	Load % where master unit needs to add a unit
Next Genset Dly:	System Load must be above Max Gen Load for this time delay to a add a unit
Rated Load Dly:	If system Load exceeds 100 % for this time delay, a unit will be added
Max Start Time:	Time allowed for a unit to start before skipping to next priority unit
Min Gen Load:	Load % where master needs to stop a unit
Reduced Load Dly:	System Load must be below Min Gen load for this time delay to stop a unit
Max Stop Time:	After a unit is stopped, the master will wait this time delay before trying to stop the next unit

Control Wiring

The control wiring for this application matches the previous example. See the Control Wiring section for the Standby No Sequencing application.
Table 6-1 and Figure 6-1 will also apply for this application.

Operation

Using the three mode selector inputs Auto, Test, and Run with Load, the generator set can be placed into the proper mode of operation. This application has the Auto Sequencing feature Enabled, so the actions of the master and slave units will be different. The switch configuration would be as follows:

Input				Mode of Operation	
	Auto	Test	Run w/Load	Master	Slave
				Off	Off
	X			Standby	Master Follow
		X		Test No Load	Test No Load
			X	Manual Run with Load	Manual Run with Load
		X	X	Manual Run with Load	Manual Run with Load
	X	X		Auto Test	Auto Test
	X		X	System Run	Auto Run
	X	X	X	System Run	Auto Run

X = Discrete input closed

Table 6-5. Mode Selector Switch Position for Standby Application

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the master EGCP-2 will be in the Standby mode. In the Standby mode the master control will monitor the Mains PT input and wait for the mains to fail. Only the master unit determines that the mains has failed. If the slave unit detects a Loss of Mains, it will ignore it. Once the master determines the mains has failed it issues a start command to all engines that are in the Master Follow mode. When the mains returns the generator breakers are opened and the mains breaker is closed.

Master Follow
By closing the Auto input on a slave unit, the slave is now following the master for start and stop commands. The slave does not monitor the Mains for a failure; that is done by the master. The slave can be started if the Mains fail or if the master issues a system run command.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Auto Test
For a master unit the Auto Test mode is the same as Test no Load except it also includes the standby features. If the mains were to fail while exercising the engine, the generator would supply the load. When the mains returns, the engine would run off-line until the Test input was opened.

For the slave unit, this mode is the same as the master follow mode except that the engine will keep running. The engine would be started but not closed to the bus, if the master required it to close to the bus due to a mains failure or a Sequencing start, the breaker would close. If the load were below the master's Min Gen Load setpoint and this unit was told to sequence off the bus, it would open its breaker but would not shut down because the Test input is closed.

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

System Run
Closing the Auto and Run with Load inputs on the master unit initiates a system start command. The master and all slave units in the master follow mode will start. The mains breaker is opened and then the generator breakers are closed. The master will sequence slaves on and off the bus as needed.

Auto Run
Closing the Auto and Run with Load inputs on a slave unit places the slave into an independent mode where it does not take commands from the master unit. If the master is not running the slave unit will operate the Mains breaker to maintain the No Parallel open transition mode of operation. An open transition back to the mains will occur when exiting this mode.

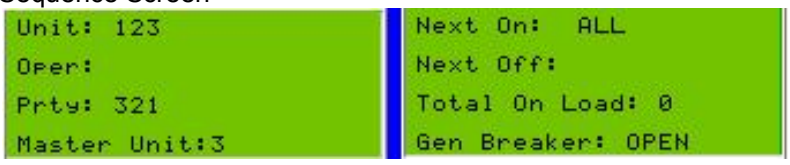
Sequence of Operation

This section will describe the details of operation for the **Standby** application when configured for a **Multiple No Parallel** control.

Standby Engine Sequence
The sequence begins with a healthy mains and the EGCP-2 in OFF. The mains breaker is closed and the mains power is being supplied to the load.

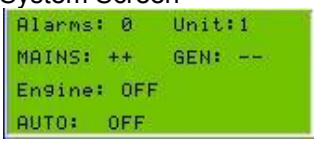
1. Placing the EGCP-2 into the Standby and Master Follow modes
   1.1. When the first Auto input is closed, this control immediately becomes the master and is in the standby mode.
   1.2. When the following controls have their Auto input closed, the unit with the lowest Priority Number will become the master. The slave units go into the Master Follow mode.
   1.3. The master EGCP-2 monitors the Mains PT input. This voltage should be within the Mains Volt High and Low Limits and Mains Frequency High and Low Limit.
   1.4. The slave units will not monitor the mains, they wait for a start command from the master.
   1.5. The displays will be shown like this:

Sequence Screen



Three units have their Auto input closed and are shown.
None of the units are on-line because the Oper:(operation) field is blank, if the unit were running an X would appear under the unit.
The Prty: (priority) of each unit is shown and because unit 3 has the lowest priority number, it is the master unit.

System Screen



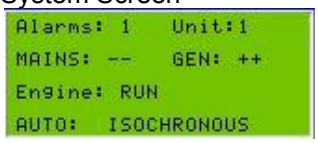
The MAINS voltage is within spec shown by ++.
The GEN voltage is out of spec shown by --.
The engine is in the OFF state.
The control is in AUTO and is in the OFF mod.

2. Starting the Standby units on a Loss Of Mains
   - 2.1. When the master determines the mains voltage or frequency travels outside of the acceptable range for the Loss Of Mains Action Delay time, the EGCP-2 will consider the Mains failed.
   - 2.2. The mains breaker is opened.
   - 2.3. The master unit sends out a start command. All slave units in Master Follow will receive the start command and start their engines (see Chapter 2 for start sequence information).
   - 2.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   - 2.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   - 2.6. The generator is declared stable.
   - 2.7. The first stable master or slave will ask permission of the other units to close to the deadbus (provided that the Deadbus Closure setpoint is set to Enable).
   - 2.8. In order to receive permission all units must see Inputs 8 and 9, the Gen CB Aux and Mains CB Aux are open and the Bus PT is dead (below 40 VAC). If any unit sees a voltage or a closed breaker, the deadbus permission is denied.
     - 2.8.1. The first unit to close to the bus must be capable of supplying the entire load to the bus.
     - 2.8.2. In some applications, there may be engines of different sizes. To prevent a unit from closing to the deadbus its Deadbus Closure setpoint should be set to Disable.
     - 2.8.3. In some applications the load is greater than one engine can generate so multiple units must be on the bus before the load can be supplied. This logic is not provided in the EGCP-2 and must be provided externally. Another device such as a PLC would need to confirm that there is enough capacity on the emergency bus and then allow a load breaker to be closed.
   - 2.9. After the first unit has closed to the bus, the other units will synchronize to this bus voltage.
   - 2.10. After synchronizing the generators will softly ramp their load to the system load percentage.
   - 2.11. This is indicated on the display like this:

I/O Screen

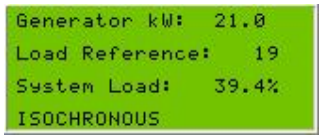
Inputs 1 & 8, Auto & Gen CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Outputs 6 & 11 Visual and Audible Alarm are closed to indicate an Active Alarm.
Output 10 Gen Breaker Trip is a reverse logic contact that will open to trip the breaker. When closed the generator breaker can be closed.

System Screen



The MAINS voltage is out of spec shown by --.
The GEN voltage is out of spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the ISOCHRONOUS mode.

KW Load Screen



The generator is generating 21 kW.
The load setpoint is 19 kW.
In the ISOCHRONOUS mode.

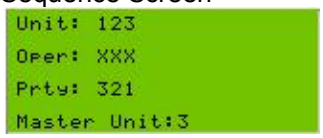
The system load percentage is communicated between each unit for load sharing.
Isochronous mode is the isolated bus Load sharing mode.

PF/kVAR Screen

This unit is in active Power Factor control with an actual Power Factor of 0.99 and a Power Factor reference of 0.97.

The Power Factor is communicated between each unit for Power Factor Sharing.
The average power factor of all units becomes the Power Factor Reference.

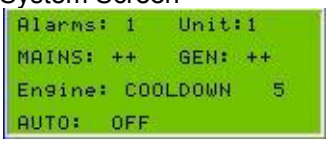
Sequence Screen



All three units are running on the bus shown by the X in the Oper: line.

3. Following the Auto Sequencing Delay time the master unit will start and stop the slave units as needed. See Chapter 8 for more details about the start/stop sequencing.
4. The Mains returns
   - 4.1. The mains voltage will need to be within the voltage and frequency high and low limits of the Transfer Switch menu, for the Mains Stable Delay time. Only the master unit monitors the mains.
   - 4.2. The master control will open its generator breaker and command all other units on-line in Master Follow mode to open their breakers.
     - 4.2.1. If a slave unit is in manual (Auto input open), it will not open its generator breaker. This breaker would need to be opened manually before the mains breaker could be closed.
   - 4.3. The Mains/Bus PT input will switch to the Bus and verify it is dead.
   - 4.4. The mains breaker is closed.
   - 4.5. The engines go into the stop sequence (see Chapter 2 for stop sequence information).
   - 4.6. The Mains/Bus PT will switch back to the Mains and await the next Loss of Mains.
   - 4.7. The display screen will appear like this:

System Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the COOLDOWN state with 5 seconds remaining.
The control is in AUTO and is in the OFF mode.
The sequence is now back at step 2 and would repeat on the next Loss of Mains.

Action	Unit 1	Unit 2	Unit 3
Priority Number	1 (master)	2	3
Discrete Inputs	Auto	Auto	Auto
Mains Fails			
	Opens Mains Brkr		
	Start	Start	Start
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Isochronous Mode	Isochronous Mode	Isochronous Mode
	PF Sharing	PF Sharing	PF Sharing
System Load below Min Gen Load			Master Stop Command
			Soft Unload
			Open Gen Brkr
			Cooldown
			Shutdown
System Load above Max Gen Load			Master Start Command
			Start
			Synchronize
			Close Gen Brkr
			Isochronous Mode
			PF Sharing
Mains Returns			
	Open Gen Brkr	Open Gen Brkr	Open Gen Brkr
	Close Mains Brkr	Close Mains Brkr	Close Mains Brkr
	Cooldown	Cooldown	Cooldown
	Shutdown	Shutdown	Shutdown

Table 6-6. Standby with Unit Sequencing Summary

Application Questions for Standby Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

If the mains breaker would not open when the Loss of Mains was detected, would the EGCP-2 close the generator breaker?
The answer is no. For safety reasons, the EGCP-2 will not close the generator breaker if it senses a closed mains breaker on any unit.

What will happen if the Auto input is opened during a Loss of Mains event, while the engine is on-line?

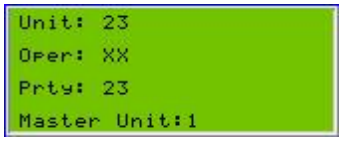
This scenario needs to be looked at for both a master and a slave.

1. Case 1 Master unit has Auto input opened with at least one slave on the bus:
   1.1. The unit will open its breaker with no unload ramp. The next lowest priority unit will become the new master. The unit will go into the stop sequence (see Chapter 2).
2. Case 2 Master unit has Auto input opened with no slaves in Master Follow.
   2.1. When the Auto input is opened, the EGCP-2 will open its generator breaker. The mode is now OFF, so the control will not close the mains breaker, even when the mains becomes stable again. In OFF the EGCP-2 will not open or close the breakers.
3. Case 3 Master unit has Auto input opened with at least one slave in Master Follow that is shut down.
   3.1. If one or more of the slaves had been sequenced off, when the master unit had its Auto input opened, the master would open its generator breaker and go into the stop sequence. The slave would switch its PT's to verify that the bus were dead and then close the Mains breaker.
4. Case 4 Slave unit has Auto input opened.
   4.1. The slave unit will softly unload to the Unload Trip level and open its generator breaker, and then go into the stop sequence (see Chapter 2).

What happens if the engine has a shutdown while it is operating during a Loss of Mains?

1. Case 1 Master unit has a Hard Shutdown with at least one slave running on the bus in Master Follow.
   1.1. The master unit will immediately open its breaker and then open its fuel solenoid to shutdown. Because the EGCP-2 itself is still functional, this unit will still be the master.

On the sequencing screen this would be shown like this:

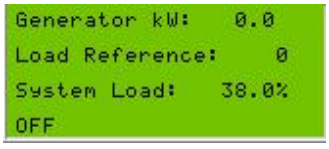


Units 2 and 3 are running on-line.
Unit 1 is not available to Run but is still master.

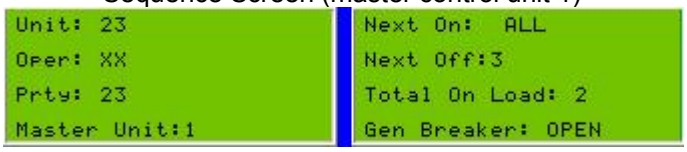
If there were any slaves that were not running, they would be commanded to start by the master.
If the mains were to return, unit 1 would command the other units to open their breaker and then the mains breaker would be closed.

2. Case 2 Master unit has a Hard Shutdown with no slaves running on the bus.
   2.1. The master unit will immediately open its breaker and then open its fuel solenoid to shutdown. The master commands all other units in Master Follow to start. The master EGCP-2 is still functional, only the engine is unable to run, so the master does not switch to a running unit. The master will still make sequencing decisions because it still receives the system load percentage from the other units. This would appear like this:

KW/Load Screen



Sequence Screen (master control unit 1)



The System Load percentage for units 2 and 3 is 38 %. Unit 1, the master unit had a Hard Shutdown, and is not running, but is still the master. Unit 1 will still make sequencing decisions and command unit 3 to start and stop. The master will not command unit 2 to stop.

3. Case 3 Master units has a Soft Shutdown with at least one slave running on the bus in Master Follow.
   3.1. The master unit would softly unload and then open its generator breaker. The engine would go through a cooldown if programmed and then stop. It would still be the master as in the previous case.
4. Case 4 Master unit has a Soft Shutdown with no slaves running on the bus.
   4.1. The master unit will command all slaves to start. The master starts timing the Max Start Time. If a slave unit has closed to the bus to supply the load, the master unit will open its breaker and shutdown. If the Max Start Time has elapsed and still there are no other units on the bus, the master gen breaker will open and the engine will go into the stop sequence. It will remain the master as in Case 2 above.
5. Case 5 Slave unit has a Hard Shutdown
   5.1. The slave unit would open its breaker and shutdown. The master will not tell all other slave units to start. The master will use the standard sequencing logic to determine if another engine is needed.
6. Case 6 Slave unit has a Soft Shutdown
   6.1. The slave unit would unload to its Unload Trip level, open its breaker and go into the stop sequence (see Chapter 2). The master will not tell another slave unit to start. The master will use the standard sequencing logic to determine if another engine is needed.

Auto Test sequence

With a healthy Mains and the EGCP-2 in Auto.

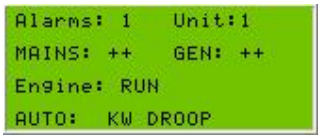
1. When the Test input is closed, the engine will start (see Chapter 2).
2. The sequence is the same for either a master or slave.
3. The engine will run at rated speed as long as the Test input is closed.
4. The Speed Raise and Lower inputs and the Voltage Raise and Lower inputs will both be active to allow a user to adjust the speed or voltage manually.
5. Output 10 will remain de-energized, which is calling for the generator breaker to trip.

The display screens would appear like this:

I/O Screen

Inputs 1,2 & 9, Auto, Test & Mains CB Aux are closed. Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.

Status Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the KW DROOP mode because the Gen CB Aux is open.

6. If the Mains were to fail while in this mode,
   6.1. The EGCP-2 would open the Mains breaker and perform the normal Loss of Mains sequence. See Standby sequence in this chapter.
   6.2. When the mains has returned and exceeded the Mains Stable Delay time, the master would open its generator beaker and command the other units running on-line to open their breakers.

6.3. Then after the mains breaker has been closed, the engines in the Standby or Master Follow mode will go into the stop sequence. Engines in Auto Test will continue to run as long as the Test input is closed.

7. When the test input is opened, the engine will go into the stop sequence (see Chapter 2).

Auto Run sequence

This sequence only applies to slave units.

The sequence begins with the EGCP-2 in Auto. The mains is stable and the mains breaker is closed.

1. The Run with Load input is closed.
2. The engine will start (see Chapter 2)
3. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   3.1. The generator is declared stable
4. The running unit will open the mains breaker, because the Operating Mode is No Parallel.
5. The Fast Xfer Delay timer is started.
6. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
7. When the transfer delay has expired, the generator breaker is closed to the deadbus.
8. The Mains/Bus PT input will switch back to monitor the Mains.
9. The generator will supply the isolated load.
10. If additional slaves are started in the Auto Run mode, they will synchronize to the bus and go into the isochronous load-sharing mode.
11. When the Run with Load input is opened, and there are more than one generators on the bus,
    11.1. The generator will unload to its unload trip level
    11.2. The generator breaker will open.
    11.3. The engine will go into the stop sequence (see Chapter 2)
12. When the Run with Load input is opened, on the last unit on the bus,
    12.1. the generator breaker will open
    12.2. the engine will go into the stop sequence(see Chapter 2)
13. The Fast Xfer Delay timer will begin.
14. The Mains/Bus PT input will switch to monitor the Bus.
15. When the Fast Xfer Delay has expired, the Mains breaker will be closed.
    15.1. If the slave unit that just came off the bus has its setpoint Check Mains Breaker Enabled, the slave unit will close the mains breaker.
    15.2. If the setpoint Check Mains Breaker is Disabled, the master will close the mains breaker.

Application Questions for Auto Run

What happens if the mains were to fail while, the engines were supplying the isolated load in the Auto Run mode?

At least one slave will be running on the bus, so the mains breaker is already open. The master will start and command all other units in Master Follow to start. These units will synchronize to the bus and begin load sharing. The master unit will be able to start and stop any units in Master Follow mode. The master cannot stop the units in Auto Run. By closing the Run With Load input, the slave unit ignores the master start/stop requests, and will remain on the bus supplying the load.

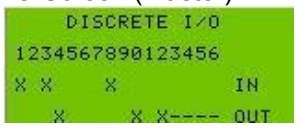
When the mains returns the master and the slaves in Master Follow will unload, open their breakers, and go into the stop sequence. The units in Auto run will continue running until their Run with Load input is opened. When the Run with load input is opened on the last slave, the load will be transferred back to the mains through an open transition.

What if the engine has a shutdown while supplying the load?
For a hard shutdown, the generator breaker will be tripped and the engine will shut down. With a soft shutdown and other units on the bus, the generator load will unload first, then open the breaker. There may be a Cooldown time. The Mains breaker will be closed and the engine will shut down.

System Run Sequence
This sequence applies only to a master unit. Closing the Auto and Run with Load inputs on a slave places the control in the Auto Run mode discussed previously.

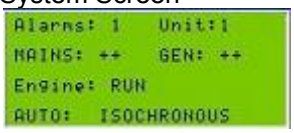
With a healthy mains and the EGCP-2 in Auto.
1. The Run with Load input is closed on only the master unit.
2. The master will start (see Chapter 2) and command all units in Master Follow to start.
3. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   3.1. The generator is declared stable
4. After the first unit is declared stable, it will open the mains breaker, because the Operating Mode is No Parallel.
5. The Fast Xfer Delay timer is started.
6. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   6.1. The first stable master or slave will ask permission of the other units to close to the deadbus (provided that the Deadbus Closure setpoint is set to Enable).
   6.2. In order to receive permission all units must see Inputs 8 and 9, the Gen CB Aux and Mains CB Aux are open and the Bus PT is dead (below 40 VAC). If any unit sees a voltage or a closed breaker, the deadbus permission is denied.
      6.2.1. The first unit to close to the bus must be capable of supplying the entire load to the bus.
      6.2.2. In some applications there may be engines of different sizes. To prevent a unit from closing to the deadbus its Deadbus Closure setpoint should be set to Disable.
      6.2.3. In some applications the load is greater than one engine can generate so multiple units must be on the bus before the load can be supplied. This logic is not provided in the EGCP-2 and must be provided externally. Another device such as a PLC would need to confirm that there is enough capacity on the generator bus and then allow a load breaker to be closed.
7. After the first unit has closed to the bus, the other units will synchronize to this bus voltage.
8. After synchronizing the generators will softly ramp their load to the system load percentage.
   8.1. This is indicated on the display like this:

I/O Screen (master)



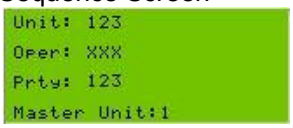
Inputs 1, 3 & 8, Auto, Run with Load & Gen CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Output 10 Gen Breaker Trip is a reverse logic contact that will open to trip the breaker. When closed the generator breaker can be closed.

System Screen



.
The MAINS and GEN voltage are within spec shown by ++. The engine is running on-line in an ISOCHRONOUS loadsharing mode.

Sequence Screen



All three units are running on the bus shown by the X in the Oper: line.

9. Following the Auto Sequencing Delay time the master unit will start and stop the slave units as needed. See Chapter 8 for more details about the start/stop sequencing.
10. Changing masters while running on-line
    - 10.1. The unit priority number can be changed locally from the Front Panel or with Modbus address 40001.
    - 10.2. If the new master is already running on-line it will become the new master and then perform all of the master functions.
    - 10.3. If the new master is not running, it will issue a start command to all units that are not running.
        - 10.3.1. The new master will switch its PT input to monitor the Bus PT. It will synchronize to the old master.
        - 10.3.2. The additional slave units that were just started will also synchronize to the bus.
        - 10.3.3. The new master will begin the start/stop sequencing based on its setpoints in the Sequencing and Comms menu, provided that it has the item Auto Sequencing Enabled.
        - 10.3.4. If Auto Sequencing is Disabled on the new master it will not perform any start/stop sequencing.

The master is not allowed to change if it is in the process of adding or shedding a unit in the system. For example, if the system load percentage is above the Max Gen Load of the current master and there are available slaves waiting. After the master has finished adding or shedding a unit, or if the load returns to a level where no change is needed the master will switch to the unit with the lowest priority number.

Action	Unit 1	Unit 2	Unit 3
Priority Number	1 (master)	2	3
Discrete Inputs	Auto	Auto	Auto
Close Run input on Master	Auto & Run closed		
	Start	Start	Start
	Open Mains Brkr	Open Mains Brkr	Open Mains Brkr
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Isochronous Mode	Isochronous Mode	Isochronous Mode
	PF Sharing	PF Sharing	PF Sharing
System Load below Min Gen Load			Master Stop Command
			Soft Unload
			Open Gen Brkr
			Cooldown
			Shutdown
System Load below Min Gen Load		Master Stop Command	
		Soft Unload	
		Open Gen Brkr	
		Cooldown	
		Shutdown	
System Load above Max Gen Load		Master Start Command	
		Start	
		Synchronize	
		Close Gen Brkr	
		Isochronous Mode	
		PF Sharing	
System Load above Rated Gen Load			Master Start Command
			Start (no idle time)
			Synchronize
			Close Gen Brkr
			Isochronous Mode (no load ramp)
			PF Sharing
Open Run input	Auto only		
	Open Gen Brkr	Open Gen Brkr	Open Gen Brkr
	Close Mains Brkr	Close Mains Brkr	Close Mains Brkr
	Cooldown	Cooldown	Cooldown
	Shutdown	Shutdown	Shutdown

Table 6-7. System Run with Unit Sequencing Summary

Application Questions for System Run

What happens if the mains were to fail while, the engine was supplying the isolated load in the Auto Run mode?

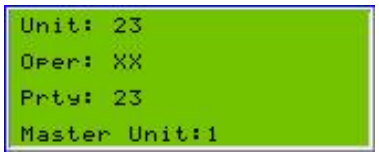
The master unit and possibly a combination of slave units are already running so initially nothing changes. Slave units that had been stopped by the master will not be started again unless, the load increases above the Max Gen Load or Rated Load setpoints.

When the mains returns the master and the slaves will transfer the load back to the mains through an open transition.

What if the engine has a shutdown while supplying the load?
This situation depends on the number of units that were running and whether it was a master or slave that received the shutdown.

1. Case 1 Master unit has a Hard Shutdown with at least one slave running on the bus in Master Follow.
   1.1. The master unit will immediately open its breaker and then open its fuel solenoid to shutdown. Because the EGCP-2 itself is still functional, this unit will still be the master.

On the sequencing screen this would be shown like this:

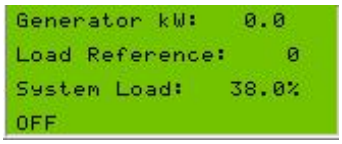


Units 2 and 3 are running on-line.
Unit 1 is not available to Run but is still master.
If there were any slaves that were not running, they would be commanded to start by the master. If the mains were to return unit 1 would command the other units to open their breaker and then the mains breaker would be closed.

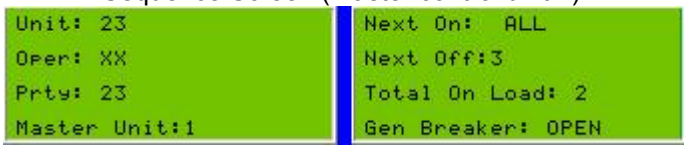
2. Case 2 Master unit has a Hard Shutdown with no slaves running on the bus.
   2.1. The master unit will immediately open its breaker and then open its fuel solenoid to shutdown. The master commands all other units in Master Follow to start. The master EGCP-2 is still functional, only the engine is unable to run, so the master does not switch to a running unit. The master will still make sequencing decisions because it still receives the system load percentage from the other units.

   This would appear like this:

KW/Load Screen



Sequence Screen (master control unit 1)



The System Load percentage for units 2 and 3 is 38 %. Unit 1, the master unit had a Hard Shutdown, and is not running, but is still the master. Unit 1 will still make sequencing decisions and command unit 3 to start and stop. The master will not command unit 2 to stop.

3. Case 3 Master unit has a Soft Shutdown with at least one slave running on the bus in Master Follow.
   3.1. The master unit would softly unload and then open its generator breaker. The engine would go through a cooldown if programmed and then stop. It would still be the master as in the previous case.
4. Case 4 Master unit has a Soft Shutdown with no slaves running on the bus.
   4.1. The master unit will command all slaves to start. The master starts timing the Max Start Time. If a slave unit has closed to the bus to supply the load, the master unit will open its breaker and shutdown. If the Max Start Time has elapsed and still there are no other units on the bus, the master gen breaker will open and the engine will go into the stop sequence. It will remain the master as in Case 2 above.

5. Case 5 Slave unit has a Hard Shutdown
   5.1. The slave unit would open its breaker and shutdown. The master will not tell another slave unit to start. The master will use the standard sequencing logic to determine if another engine is needed.
6. Case 6 Slave unit has a Soft Shutdown
   6.1. The slave unit would unload to its Unload Trip level, open its breaker and go into the stop sequence (see Chapter 2). The master will not tell another slave unit to start. The master will use the standard sequencing logic to determine if another engine is needed.

Prime Power No Sequencing Application

This section describes a multiple unit system that is the only source of power for the load. The EGCP-2 will not be used for unit start/stop sequencing in this application.

Configuration Items

The key configuration points in the EGCP-2 software needing to be configured for a Multiple Unit Prime Power application are:

Required settings

Configuration Menu:

Network Address	1 to 8, unique for each unit
Number of Units:	Multiple
Operating Mode:	No Parallel

Shutdown and Alarm Menu:

Gen Volt Hi Lmt:	Sets high end of generator voltage stable range
Gen Volt Lo Lmt	Sets low end of generator voltage stable range
Gen Freq Hi Lmt	Sets high end of gen frequency stable range
Gen Freq Lo Lmt	Sets low end of gen frequency stable range

Synchronizer Menu:

Sync Mode:	Run
Deadbus Closing:	Enabled on at least one unit.

Real Load Control Menu:

Load Control Mode:	Normal
Baseload Reference:	The initial load reference that the generator will ramp to after the generator breaker is closed
Unload Trip:	When unloading the generator, this is the kW value where the EGCP-2 sends the Generator breaker trip command
Load Time:	Sets the load increase ramp time
Unload Time:	Sets the unload ramp time

Transfer Switch Menu:

Check Mains Breaker:	Disabled
Mains Volt High Alarm:	Disabled
Mains Volt Low Alarm:	Disabled
Mains Freq High Alarm:	Disabled
Mains Freq Low Alarm:	Disabled

Sequencing and Comms Menu:
Auto Sequencing: Disabled

Suggested Settings

Engine Control Menu:
Preglow Time: 0 sec.
If the Preglow relay is not being utilized, setting this time above zero can cause delays when starting the engine

Reactive Load Menu
VAR/PF Mode: PF Control or VAR Control
This will enable the power factor sharing function of the EGCP-2.

Transfer Switch Menu:
Fast Xfer Delay: 1.0 seconds
The delay time between the opening and closing of the two breakers or contactors.

Discretionary

Reactive Load Control Menu:
kVAR Reference
PF Reference

Process Control Menu:
All items in this menu are not applicable to a multiple unit standby application

Transfer Switch Menu
Fast Xfer Delay
Mains Stable Delay
Load Surge
Load Surge Alarm
Main Volt High Lmt
Main Volt Low Lmt
Main Freq High Lmt
Main Freq Low Lmt
LOM Action Delay

Sequencing and Comms Menu:
Max Gen Load
Next Genset Dly
Rated Load Dly
Max Start Time
Min Gen Load
Reduced Load Dly
Max Stop Time

Control Wiring

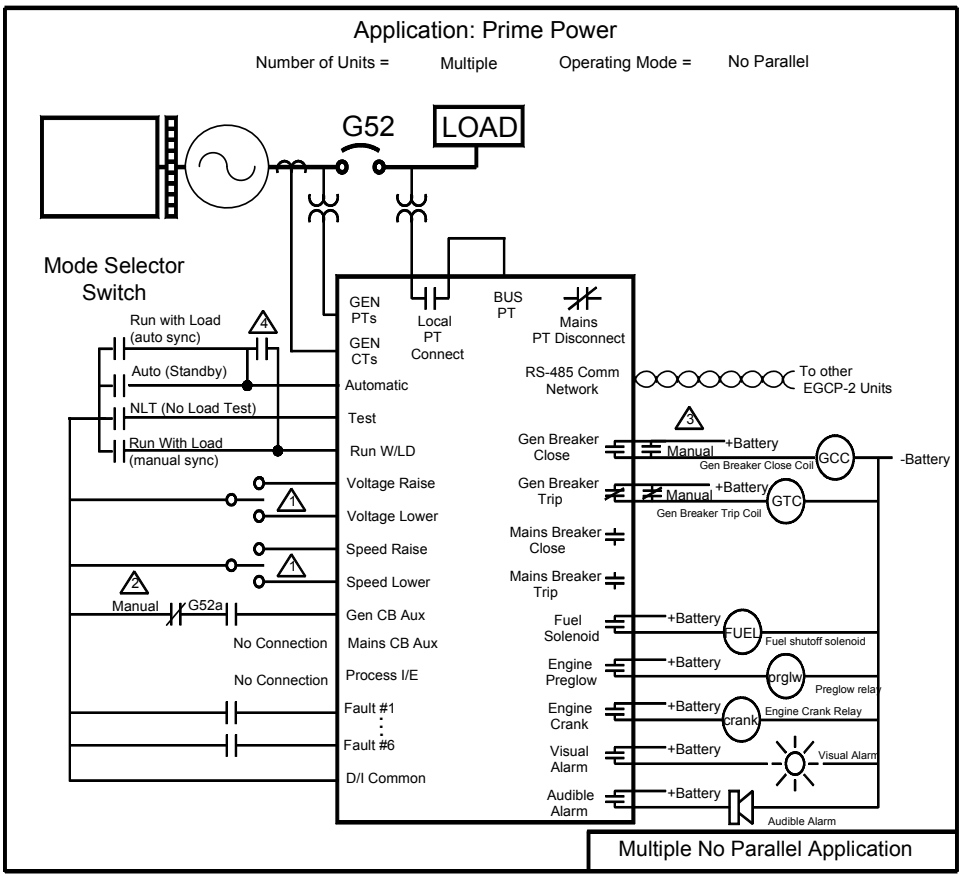
Terminal Description	Required	Optional	Not Used	Comment
1+ power supply	✕			
2– power supply	✕			
5Mains Brkr Close N.O.			✕	
6Mains Brkr Close Com.			✕	
7Mains Brkr Close N. C.			✕	
8Gen Brkr Close N.O.	✕			
9Gen Brkr Close Com.	✕			
10 Gen Brkr Close N. C.	✕			
11 Engine Preglow		✕		
12 Engine Preglow		✕		
13 Fuel Solenoid	✕			
14 Fuel Solenoid	✕			
15 Crank Engine	✕			Not Required if Start Sequencing is Disabled
16 Crank Engine	✕			“
17 No Connection			✕	
18 Visual Alarm N. O.		✕		
19 Visual Alarm Com.		✕		
20 Visual Alarm N. C.		✕		
21 Bus PT Connect	✕			
22 Bus PT Connect	✕			
23 Mains PT Disconnect			✕	
24 Mains PT Disconnect			✕	
25 Mains Brkr Trip N. O.			✕	
26 Mains Brkr Trip Com.			✕	
27 Mains Brkr Trip N. C.			✕	
28 Gen Brkr Trip N. O.	✕			
29 Gen Brkr Trip Com.	✕			
30 Gen Brkr Trip N. C.	✕			
31 Audible Alarm		✕		
32 Audible Alarm		✕		
33 Audible Alarm		✕		
34 Idle Rated/Load SW		✕		Idle is bypassed on LOM start
35 Idle Rated/Load SW		✕		“
36 No Connection			✕	
37 + Voltage Bias		✕		Required if EGCP-2 is controlling power factor
38 – Voltage Bias		✕		“
39 Voltage Bias Shield		✕		“
40 Mains/Bus PT Phase A	✕			Bus PT Only, No Mains
41 Mains/Bus PT Phase B or N	✕			“
42 Generator PT phase A +	✕			
43 Generator PT phase A –	✕			
44 Generator PT phase B +	✕			
45 Generator PT phase B –	✕			
46 Generator PT phase C +	✕			

Table 6-8. I/O list for Multiple Unit Prime Power Application

Terminal Description	Required	Optional	Not Used	Comment
47 Generator PT phase C –	✕			
49 Auto	✕			
50 Test		✕		
51 Run/Ld	✕			
52 Volt Raise		✕		Only active for manual
53 Volt Lower		✕		“
54 Speed Raise		✕		“
55 Speed Lower		✕		“
56 Gen CB Aux	✕			
57 Mains CB Aux			✕	
58 Process			✕	
59 Fault 1		✕		
60 Fault 2		✕		
61 Fault 3		✕		
62 Fault 4		✕		
63 Fault 5		✕		
64 Fault 6		✕		
65 Switch Common	✕			
66 Temp Sensor +		✕		
67 Temp Sensor –		✕		
68 Pressure Sensor +		✕		
69 Pressure Sensor –		✕		
70 Magnetic Pickup +	✕			Not Required if Start Sequencing is Disabled
71 Magnetic Pickup –	✕			“
72 Magnetic Pickup Shield	✕			“
73 + Speed Bias	✕			
74 – Speed Bias	✕			
75 Speed Bias Shield	✕			
76 + 485 Communication	✕			
77 – 485 Communication	✕			
78 485 Shield	✕			
79 NC			✕	
80 Communication Reference			✕	
81 422 Communication RX+		✕		
82 422 Communication RX–		✕		
83 422 Shield		✕		
84 422 Communication TX+		✕		
85 422 Communication TX–		✕		
86 + Process Signal			✕	
87 – Process Signal			✕	
88 Process Signal Shield			✕	
89 Gen CT phase A+ Current	✕			
90 Gen CT phase A– Current	✕			
91 Gen CT phase B+ Current	✕			
92 Gen CT phase B– Current	✕			
93 Gen CT Phase C+ Current	✕			
94 Gen CT Phase C– Current	✕			

Table 6-8 cont’d

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1. Only required if the speed and voltage need to be adjusted when Test or Manual is selected. These inputs are ignored in the Auto Mode
2. Opening the Gen CB Aux input will place the EGCP-2 into droop mode
3. Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.
4. Both the Auto and Run with Load inputs will be closed for Run with Load (auto sync)

Figure 6-2. Multiple Prime Power Application

Operation

Using the three mode selector inputs Auto, Test, and Run w/Load, the generator set can be placed into the proper mode of operation. This application has the Auto Sequencing feature Disabled, so the actions of the master and slave units are very similar. The switch configuration would be as follows:

Input				Mode of Operation	
	Auto	Test	Run w/Load	Master	Slave
				Off	Off
	X			Auto	Auto
		X		Test No Load	Test No Load
			X	Manual Run with Load	Manual Run with Load
		X	X	Manual Run with Load	Manual Run with Load
	X	X		Test No Load	Test No Load
	X		X	Auto Run	Auto Run
	X	X	X	Auto Run	Auto Run

X = Discrete input closed

Table 6-9. Mode Selector Switch Position for Prime Power Application

Off
The off state is used to shut down the generator set. In this state the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Auto
By closing the Auto input only, the EGCP-2 will do nothing. The Auto input is used in conjunction with the Run with Load input.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Auto Run
To run an engine when the mains power is not failed the Auto Run mode is used. For this no parallel application, the load will be transferred from the mains to the generator through an open transition. An open transition back to the mains will occur when exiting this mode.

Sequence of Operation

This section will describe the details of operation for the **Prime Power** application when configured for a **Multiple No Parallel** control.

For the multiple engine sequences, a three-engine system is used to demonstrate the sequence. For systems with more engines, the operation of the slave units is the same.

Auto Run sequence

For this sequence the Auto Sequencing Feature has been disabled, so the master control will not command slaves to start and stop.

The sequence begins with the EGCP-2 in Auto. The mains is stable and the mains breaker is closed.

1. Closing the first unit to the bus.
   - 1.1. The Run with Load input is closed (on either the master or slave).
   - 1.2. The engine will start (see Chapter 2)
   - 1.3. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
     - 1.3.1. The generator is declared stable
   - 1.4. The mains breaker will open, because the Operating Mode is No Parallel.
   - 1.5. The Fast Xfer Delay timer is started.
   - 1.6. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   - 1.7. When the transfer delay has expired, the generator breaker is closed to the deadbus.
   - 1.8. The Mains/Bus PT input will switch back to monitor the Mains.
   - 1.9. The generator will supply the isolated load.
2. Closing the next unit to the bus.
   - 2.1. When a second unit has its Auto and Run with Load inputs closed
   - 2.2. The engine will start (see Chapter 2)
   - 2.3. After the Generator Stable Delay the generator will be declared stable.
   - 2.4. The mains breaker is already open so this unit synchronizes with the generator that is already on-line.
   - 2.5. The breaker closes and the load will be ramped from 0 to the system load level. The two units will share the kW load and power factor.
3. Closing the next engine on-line follows the same sequence as step 2.
4. Removing a unit from the bus.
   - 4.1. By opening the Run with load, the engine will be commanded to unload and shutdown, provided that the Mains has not failed.
   - 4.2. The Run with Load input is opened on a Master unit. The generator breaker is opened without unloading the unit first.
   - 4.3. The Run with Load input is opened on a Slave unit. The generator is unloaded first to the unload trip level, then the breaker is opened.
   - 4.4. The engine goes through the stop sequence (see Chapter 2).
5. Taking the last generator off the bus.
   - 5.1. When the final unit has its Run with Load input opened
   - 5.2. The generator breaker will open. There is no unload because there is nothing else on the bus to take the load.
   - 5.3. The Fast Xfer timer is started.
   - 5.4. All units that are in Auto and have their Check Mains breaker setpoint enabled will switch their Mains/Bus PT inputs to look at the Bus.
   - 5.5. After verifying that the bus is dead and that the Fast Xfer timer has elapsed the controls will close the mains breaker.
   - 5.6. The engine will go through the stop sequence (see Chapter 2)

Action	Unit 1	Unit 2	Unit 3
Priority Number	1 (master)	2	3
Discrete Inputs	Auto	Auto	Auto
Close Run Inputs	Auto & Run	Auto & Run	Auto & Run
	Start	Start	Start
	Opens Mains Brkr	Opens Mains Brkr	Opens Mains Brkr
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Isochronous Mode	Isochronous Mode	Isochronous Mode
	PF Sharing	PF Sharing	PF Sharing
Open Run Input	Auto & Run	Auto & Run	Auto
			Soft Unload
			Open Gen Brkr
			Cooldown
			Shutdown
Open Run Input	Auto	Auto & Run	
	No Unload		
	Open Gen Brkr		
	Close Mains Brkr		
	Cooldown		
	Shutdown		
Open Run Input		Auto	
		No Unload	
		Open Gen Brkr	
		Close Mains Brkr	
		Cooldown	
		Shutdown	

Table 6-10. Auto Run Summary

Application Questions for Auto Run

What if the engine has a shutdown while supplying the load?
For a hard shutdown, the generator breaker will be tripped and the unit will shutdown.
If there are multiple units on the bus and one of them has a soft shutdown, the engine load will first be unloaded and then the breaker opened followed by a possible cool down delay.
When the last unit on-line has a shutdown, the generator breaker is opened. Then the mains breaker will be re-closed after the Fast Xfer time has elapsed. With a soft shutdown, there may be a Cool down time; for hard shutdown there is not then the engine will be shut down.
Auto Sequencing is Disabled so no units will be started if an engine on-line has a shutdown.

Can the Bus PT input be wired directly to the control, since there is no mains in this application?
No, the Bus Disconnect relay is still needed. After the EGCP-2 closes the generator breaker, it will still switch the Bus/Mains PT to look for the mains. If there is no relay to break the Bus PT from coming into the control, the EGCP-2 will mistake this for the mains and try to return to mains power.

Prime Power with Auto Sequencing Application

This section describes a multiple unit system that is the only source of power for the load. The EGCP-2 will be used for unit start/stop sequencing in this application.

Configuration Items

The key configuration points in the EGCP-2 software needing to be configured for a Multiple Unit Prime Power with Auto Sequencing application are the same as the previous application example with no sequencing except for the following setpoints:

Required settings

Transfer Switch Menu:

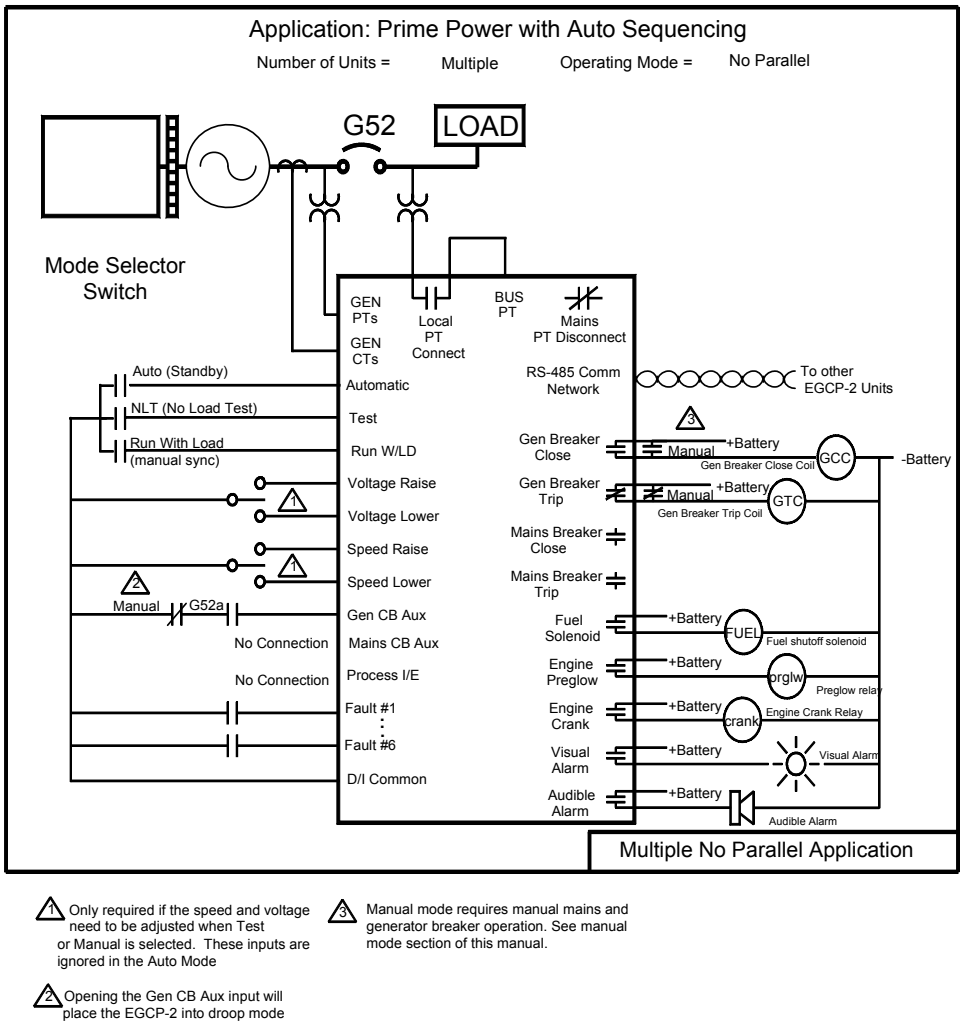
Mains Volt Low Alarm:	Loss of Mains
LOM Action Delay:	0.1

Sequencing and Comms Menu:

Auto Sequencing:	Enabled
Auto Sequencing Delay:	Time before Sequencing will start
Max Gen Load:	Load % where master unit needs to add a unit
Next Genset Dly:	System Load must be above Max Gen Load for this time delay to a add a unit
Rated Load Dly:	If system Load exceeds 100 % for this time delay, a unit will be added
Max Start Time:	Time allowed for a unit to start before skipping to next priority unit
Min Gen Load:	Load % where master needs to stop a unit
Reduced Load Dly:	System Load must be below Min Gen load for this time delay to stop a unit
Max Stop Time:	After a unit is stopped, the master will wait this time delay before trying to stop the next unit

Control Wiring

The control wiring for the Auto Sequencing will match the wiring for the No Sequencing application information found in Table 5-7, with one exception. Terminal 51, the Run with Load input, is optional in this Auto Sequencing application but was required for the No Sequencing application.



1. Only required if the speed and voltage need to be adjusted when Test or Manual is selected. These inputs are ignored in the Auto Mode
2. Opening the Gen CB Aux input will place the EGCP-2 into droop mode
3. Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.

Figure 6-3. Multiple Prime Power Application with Auto Sequencing

Operation

Using the three mode selector inputs Auto, Test, and Run w/Load, the generator set can be placed into the proper mode of operation. This application has the Auto Sequencing feature Enabled, so the actions of the master and slave units will be both displayed. The switch configuration would be as follows:

Input				Mode of Operation	
	Auto	Test	Run w/Load	Master	Slave
				Off	Off
	X			Standby	Master Follow
		X		Test No Load	Test No Load
			X	Manual Run with Load	Manual Run with Load
		X	X	Manual Run with Load	Manual Run with Load
	X	X		Auto Test	Master Follow Test
	X		X	Auto Run	Auto Run
	X	X	X	Auto Run	Auto Run

X = Discrete input closed

Table 6-11. Mode Selector Switch Position for Prime Power Application

Off
The off state is used to shut down the generator set. In this state the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will start and close to the bus. For this application there is no mains available, but the EGCP-2 is setup to detect a Low Mains Voltage fault. Therefore, any time the Auto input is closed the EGCP-2 will be in a Loss of Mains condition and will run as if the engine were operating like in the Standby application.

Master Follow
By closing the Auto input only on a slave unit, this allows the master unit to start and stop the engine as needed.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Master Follow Test
A slave unit that has both the Auto and Test inputs closed will still be commanded by the master to run on-line or off-line. As long as the Test input is closed the engine will continue to run.

Auto Run (master unit)
Closing the Auto input will command the master to run on-line and sequence the slave units as needed. Closing either the test or Run inputs has no affect on the master as long as the Auto input is closed.

Auto Run (slave unit)
Closing the Auto and Run with Load input on a slave unit will start the engine and place that unit on-line. This takes the slave out of Master Follow mode, so it remains on the bus and will not take start/stop commands from the master.

Sequence of Operation

This section will describe the details of operation for the **Prime Power** application when configured for a **Multiple No Parallel** control.

For the multiple engine sequences, a three-engine system is used to demonstrate the sequence. For systems with more engines, the operation of the slave units is the same.

Standby and Master Follow sequence
For this application sequence the Auto Sequencing Feature has been Enabled, so the master control will command all slaves in Master Follow to start and stop.

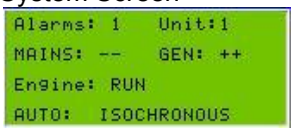
Initially all units are stopped and there is no power being supplied to the load. All inputs to the EGCP-2 should be open.

1. Close the Auto input on all units.
    1.1. The engines will start (see Chapter 2)
    1.2. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
        1.2.1. The generator is declared stable
    1.3. The Mains/Bus PT input will close the bus PT relay to look at the Bus.
    1.4. The first stable master or slave will ask permission of the other units to close to the deadbus (provided that the Deadbus Closure setpoint is set to Enable).
    1.5. In order to receive permission all units must see Inputs 8 and 9, the Gen CB Aux and Mains CB Aux are open and the Bus PT is dead (below 40 VAC). If any unit sees a voltage or a closed breaker, the deadbus permission is denied.
        1.5.1. The first unit to close to the bus must be capable of supplying the entire load to the bus.
        1.5.2. In some applications there may be engines of different sizes. To prevent a unit from closing to the deadbus its Deadbus Closure setpoint should be set to Disable.
        1.5.3. In some applications the load is greater than one engine can handle so multiple units must be on the bus before the load can be supplied. This logic is not provided in the EGCP-2 and must be provided externally. Another device such as a PLC would need to confirm that there is enough capacity on the emergency bus and then allow a load breaker to be closed.
    1.6. After the first unit has closed to the bus, the other units will synchronize to this bus voltage.
    1.7. After synchronizing the generators will softly ramp their load to the system load percentage.
    1.8. This is indicated on the display like this:

I/O Screen

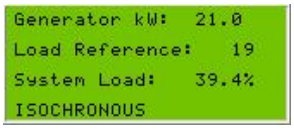
Inputs 1 & 8, Auto & Gen CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Outputs 6 & 11 Visual and Audible Alarm are closed to indicate an Active Alarm.
Output 10 Gen Breaker Trip is a reverse logic contact that will open to trip the breaker. When closed the generator breaker can be closed.

System Screen



The MAINS voltage is out of spec shown by --.
The GEN voltage is out of spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the ISOCHRONOUS mode.

KW Load Screen



The generator is generating 21 kW.
The load setpoint is 19 kW.
In the ISOCHRONOUS mode.

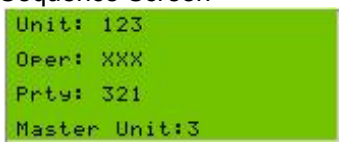
The system load percentage is communicated between each unit for load sharing.
Isochronous mode is the isolated bus Load sharing mode.

PF/kVAR Screen

This unit is in active Power Factor control
with an actual Power Factor of 0.99
and a Power Factor reference of 0.97

The Power Factor is communicated between each unit for Power Factor Sharing.
The average power factor of all units becomes the Power Factor Reference.

Sequence Screen



All three units are running on the bus shown by the X in the Oper: line.

2. Following the Auto Sequencing Delay time the master unit will start and stop the slave units as needed. See Chapter 8 for more details about the start/stop sequencing.
3. The master unit experiences a hard shutdown.
   - 3.1. This unit will immediately open its generator breaker and open its fuel solenoid relay to shutdown.
   - 3.2. Any slave units that were not running will be commanded to start.
   - 3.3. Because the EGCP-2 itself is still functional, this unit will still be the master and still make the sequencing decisions.
   - 3.4. The slave units will synchronize and close to the bus.
   - 3.5. The slave units will load share and power factor share, awaiting commands from the master to stop.
   - 3.6. If the alarm is reset on the master, this unit will re-start and close to the bus and resume operation.

4. The master unit experiences a Soft Shutdown.
   - 4.1. If there is at least one slave unit running on the bus, the master will
     - 4.1.1. unload
     - 4.1.2. open the breaker
     - 4.1.3. go into stop sequence
     - 4.1.4. This unit will remain the master and continue the unit sequencing function.
   - 4.2. If the master is the only engine running it will
     - 4.2.1. start the Max Stop Time timer
     - 4.2.2. command all slaves in Master Follow mode to start
     - 4.2.3. once a slave unit is closed to the bus, the master will unload and go into the stop sequence
     - 4.2.4. If the Max Stop Time elapses before any slaves have closed to the bus, the master will open its breaker leaving the bus black and go into the stop sequence.
   - 4.3. Any slave units that were not running, will be commanded to start.
   - 4.4. Because the EGCP-2 itself is still functional, this unit will still be the master and still make the sequencing decisions.
   - 4.5. The slave units will synchronize and close to the bus.
   - 4.6. The slave units will load share and power factor share, awaiting commands from the master for sequencing.
   - 4.7. If the alarm is reset on the master, this unit will re-start and close to the bus and resume operation.
5. Removing a unit from the bus.
   - 5.1. By opening the Auto input, the engine will be commanded to unload and go into the stop sequence.
     - 5.1.1. The Auto input is opened on a Master unit.
       - 5.1.1.1. The generator breaker is opened without unloading the unit first.
       - 5.1.1.2. The unit with the next lowest priority number will become the new master.
     - 5.1.2. The Run with Load input is opened on a Slave unit. The generator is unloaded first to the unload trip level, then the breaker is opened.
   - 5.2. The engine goes through the stop sequence (see Chapter 2).
6. Taking the last generator off the bus.
   - 6.1. When the final unit has its Auto input opened
   - 6.2. The generator breaker will open. There is no unload because there is nothing else on the bus to take the load.
   - 6.3. The engine will go through the stop sequence (see Chapter 2)

Details	Unit 1	Unit 2	Unit 3
Priority Number	1	2	3
Discrete Inputs	None	None	None
Check Mains Brkr	Disabled	Disabled	Disabled
Auto Sequencing	Enabled	Enabled	Enabled
Close Auto Input	Auto	Auto	Auto
	Start	Start	Start
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Isochronous Load sharing	Isochronous Load sharing	Isochronous Load sharing
	Power Factor sharing	Power Factor sharing	Power Factor sharing
Load % is below Min Gen Load			Unload
			Open Gen Brkr
			Cooldown
			Stop
Load % is below Min Gen Load		Unload	
		Open Gen Brkr	
		Cooldown	
		Stop	
Load % is above Max Gen Load		Start	
		Synchronize	
		Close Gen Brkr	
		Ramp load to System Load Ref	
	Isochronous Load sharing	Isochronous Load sharing	
	Power Factor sharing	Power Factor sharing	
Master unit gets hard shutdown	Open Breaker		Start
	Stop		Synchronize
			Close Gen Brkr
			Ramp load to System Load Ref
		Isochronous Load sharing	Isochronous Load sharing
		Power Factor sharing	Power Factor sharing
Open Auto Input			Soft Unload
			Open Gen Brkr
			Cooldown
			Shutdown
Open Auto Input		Auto	
		No Unload	
		Open Gen Brkr	
		Cooldown	
		Shutdown	

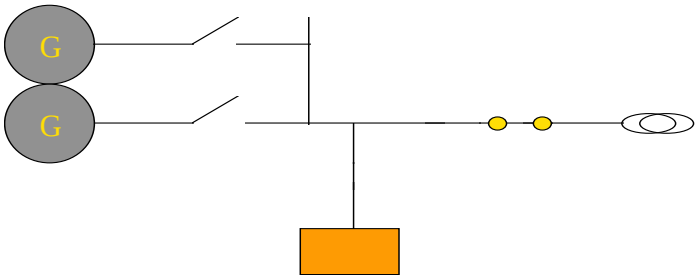
Table 6-12. Auto Run Summary

Application Questions for Auto Run

Why doesn't the master use a soft unload ramp when its Auto input is opened?
The EGCP-2 is designed to always have a master, if there is only one unit on the bus, this unit will become the master. When this unit is taken to off, the EGCP-2 assumes that the last engine is being taken off the bus, so there is no other source to take the load from the generator.

If there are three engines running on the bus and the Auto and Run with load are removed from the master this unit opens its breaker immediately and the next lowest priority unit will become the new master. To achieve a soft unload ramp for any slaves that are started and stopped, the master should always be the last unit on the bus.

Chapter 7.
Multiple/ Mains Parallel



The Multiple Parallel operating mode of the EGCP-2 is the most complex. In this mode, multiple generator sets have the capability to operate as: Standby Units Peak Shaving Units; Process Control Units, and Soft Transfer Units. Since the operating mode implies mains parallel, the generators are allowed to synchronize with the mains under various operating conditions such as:

- Loss of Mains re-transfer to the mains
- Base Load Control, Process Control
- Soft Transfer return to Mains (softly unloads generators and restores mains power feed to the load)
- Soft Transfer from the Mains to the generators (softly loads the generators against the mains before opening the mains breaker).

In a multiple parallel system, automatic sequencing will be effective between all units in the Auto mode with the Auto Sequencing setpoint in the Sequencing and Comms menu set for Enabled. If this setpoint is set for Disabled, that unit will not be a part of the auto-sequencing scheme. Auto Sequencing can be performed in two modes, isolated from the mains, and in the process mode when paralleled with the mains. Chapter 8 discusses the details of the start/stop feature.

Six applications will be discussed for the Multiple Mains Parallel configuration. They are Standby No Sequencing, Standby with Sequencing, Baseload, Process No Sequencing, Process with Sequencing, and Soft Transfer.

Multiple Standby—No Sequencing

This section describes a standby system that will parallel with the Mains after an outage to maintain power delivery to the load. When mains power has failed, the generator sets will be started and closed to the bus to provide standby (emergency) power, kW and kVAR sharing. When the mains returns, the EGCP-2 will synchronize the mains breaker, transfer the load from the generator sets to the mains, open the generator breakers, cooldown, and then shutdown. This application has the Auto Sequencing setpoint set to Disable, so the start/stop sequencing will not be used.

Configuration Items

The key configuration points in the EGCP-2 software, which need to be configured for a Multiple Unit Mains Parallel Standby application, are:

Required settings

Configuration Menu:

Network Address	1 to 8, unique for each unit
Number of Units:	Multiple
Operating Mode:	Mains Parallel

Shutdown and Alarm Menu:

Gen Volt Hi Lmt	Sets high end of generator voltage stable range
Gen Volt Lo Lmt	Sets low end of generator voltage stable range
Gen Freq Hi Lmt	Sets high end of gen frequency stable range
Gen Freq Lo Lmt	Sets low end of gen frequency stable range

Synchronizer Menu:

Sync Mode:	Run
Deadbus Closing:	Enabled on at least one unit.

Real Load Control Menu:

Load Control Mode:	Normal
Baseload Reference:	Used with the Load and Unload Time settings to determine the load ramp rate.
Unload Trip:	When unloading the generator, this is the kW value where the EGCP-2 sends the Generator breaker trip command
Load Time:	Sets the load increase ramp time
Unload Time:	Sets the unload ramp time

Transfer Switch Menu:

Check Mains Breaker:	Enabled
Mains Volt High Lmt:	Sets high end of mains voltage stable range
Mains Volt High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Volt Low Lmt:	Sets Low end of mains voltage stable range
Mains Volt Low Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq High Lmt:	Sets high end of mains frequency stable range
Mains Freq High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq Low Lmt:	Sets low end of mains frequency stable range
Mains Freq Low Alarm:*	Loss of Mains or Loss of Mains with alarms
LOM Action Delay:	The amount of time that the mains power must be out of spec to trigger the Loss of Mains.

*At least one of the four Loss of Mains alarms need to be set for Loss of Mains or Loss of Mains with Alarms for the Standby operation to occur.

Sequencing and Comms Menu:

Auto Sequencing:	Disabled

Suggested Settings

Engine Control Menu:

Preglow Time:	0 sec. If the Preglow relay is not being utilized, setting this time above zero can cause delays when starting the engine

Reactive Load Menu

VAR/PF Mode: PF Control or VAR Control
This will enable the power factor sharing function of the EGCP-2.

Transfer Switch Menu:

Gen Stable Dly: 1.0 seconds
When the generator is started, how long will the voltage and frequency need to be within spec before the gen breaker can be closed. This may be set to minimum to achieve the fastest breaker closing time.

Discretionary

Reactive Load Control Menu:

kVAR Reference
PF Reference

Process Control Menu:

All items in this menu are not applicable to a multiple unit prime power application

Transfer Switch Menu

Fast Transfer Delay
Mains Stable Delay
Load Surge
Load Surge Alarm
Mains Volt High Lmt:
Mains Volt Low Lmt:
Mains Freq High Lmt:
Mains Freq Low Lmt:
LOM Action Delay:

Sequencing and Comms Menu

Max Gen Load
Next Genset Dly
Rated Load Dly
Max Start Time
Min Gen Load
Reduced Load Dly
Max Stop Time

Control Wiring

Terminal Description	Required	Optional	Not Used	Comment
1 + power supply	X			
2 – power supply	X			
5 Mains Brkr Close N.O.	X			Wiring mains breaker controls to only one unit will compromise sys redundancy
6 Mains Brkr Close Com.	X			"
7 Mains Brkr Close N. C.	X			"
8 Gen Brkr Close N.O.	X			
9 Gen Brkr Close Com.	X			
10 Gen Brkr Close N. C.	X			
11 Engine Preglow		X		
12 Engine Preglow		X		
13 Fuel Solenoid	X			
14 Fuel Solenoid	X			
15 Crank Engine	X			Not Required if Start Sequencing is Disabled
16 Crank Engine	X			"
17 No Connection			X	
18 Visual Alarm N. O.		X		
19 Visual Alarm Com.		X		
20 Visual Alarm N. C.		X		
21 Bus PT Connect	X			
22 Bus PT Connect	X			
23 Mains PT Disconnect	X			
24 Mains PT Disconnect	X			
25 Mains Brkr Trip N. O.	X			
26 Mains Brkr Trip Com.	X			
27 Mains Brkr Trip N. C.	X			
28 Gen Brkr Trip N. O.	X			
29 Gen Brkr Trip Com.	X			
30 Gen Brkr Trip N. C.	X			
31 Audible Alarm		X		
32 Audible Alarm		X		
33 Audible Alarm		X		
34 Idle Rated/Load SW		X		Idle is bypassed on LOM start
35 Idle Rated/Load SW		X		"
36 No Connection			X	
37 + Voltage Bias		X		Required if EGCP-2 is controlling power factor
38 – Voltage Bias		X		"
39 Voltage Bias Shield		X		"
40 Mains/Bus PT Phase A	X			
41 Mains/Bus PT Phase B or N	X			
42 Generator PT phase A +	X			
43 Generator PT phase A –	X			
44 Generator PT phase B +	X			
45 Generator PT phase B –	X			
46 Generator PT phase C +	X			
47 Generator PT phase C –	X			
49 Auto	X			
50 Test		X		
51 Run/Ld		X		

Table 7-1. I/O list for Multiple Unit Mains Parallel Standby application

Terminal Description	Required	Optional	Not Used	Comment
52 Volt Raise		X		
53 Volt Lower		X		
54 Speed Raise		X		
55 Speed Lower		X		
56 Gen CB Aux	X			
57 Mains CB Aux	X			
58 Process			X	
59 Fault 1		X		
60 Fault 2		X		
61 Fault 3		X		
62 Fault 4		X		
63 Fault 5		X		
64 Fault 6		X		
65 Switch Common	X			
66 Temp Sensor +		X		
67 Temp Sensor –		X		
68 Pressure Sensor +		X		
69 Pressure Sensor –		X		
70 Magnetic Pickup +	X			Not Required if Start Sequencing is Disabled
71 Magnetic Pickup –	X			“
72 Magnetic Pickup Shield	X			“
73 + Speed Bias	X			
74– Speed Bias	X			
75Speed Bias Shield	X			
76 + 485 Communication	X			
77– 485 Communication	X			
78 485 Shield	X			
79 NC			X	
80 Communication Reference			X	
81 422 Communication RX+		X		
82 422 Communication RX–		X		
83 422 Shield		X		
84 422 Communication TX+		X		
85 422 Communication TX–		X		
86 + Process Signal			X	
87 – Process Signal			X	
88 Process Signal Shield			X	
89 Gen CT phase A+ Current	X			
90 Gen CT phase A– Current	X			
91 Gen CT phase B+ Current	X			
92 Gen CT phase B– Current	X			
93 Gen CT Phase C+ Current	X			
94 Gen CT Phase C– Current	X			

Table 7-1 cont’d

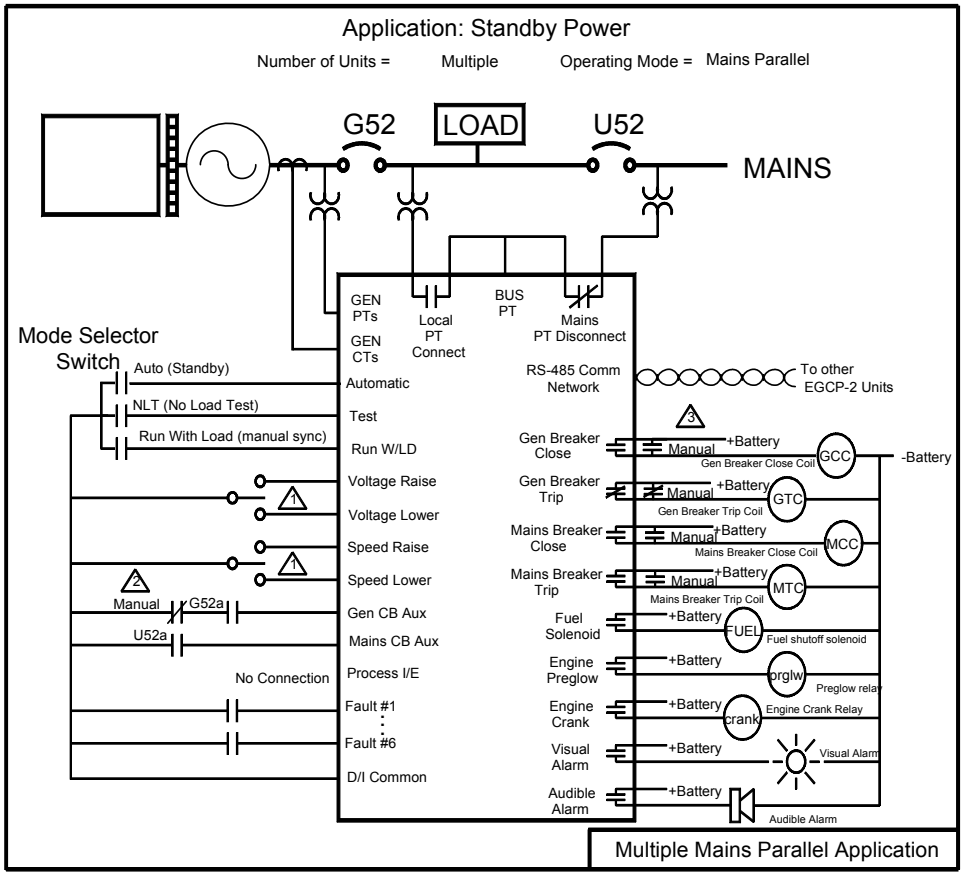
The Mains Circuit Breaker Aux input and Mains Circuit Breaker Trip and Close relays may be wired to the master unit only. In applications where there is a dedicated master these signals only have to be connected to that unit. The Check Mains Breaker setpoint in the Transfer Switch menu, will be Enabled on the master and Disabled on each slave unit.

However, wiring the mains breaker controls to only one unit will compromise the system redundancy. If for any reason that unit is not in service, the system will not have any way to operate the mains breaker. It may be necessary to wire these signals to two or more units to provide redundancy. For many standby applications, all the units will be capable of being the master and these signals will need to be wired to each unit. Any unit that could be a master in the system should have the Check Mains Breaker setting Enabled.

IMPORTANT

When operating as standby units there must be at least one unit on the network and in Auto with the mains breaker aux input wired, and the Check Mains Breaker setpoint Enabled at any given time.

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1 Only required if the speed and voltage need to be adjusted when Test or Manual is selected. These inputs are ignored in the Auto Mode

2 Opening the Gen CB Aux input will place the EGCP-2 into droop mode

3 Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.

Figure 7-1. Multiple Mains Parallel Standby Application

Operation

Using the three mode selector inputs Auto, Test, and Run w/Load, the generator set can be placed into the proper mode of operation. This application has the **Auto Sequencing feature Disabled**, so the actions of the master and slave units are very similar. The switch configuration would be as follows:

Input				Mode of Operation	
	Auto	Test	Run w/Load	Master	Slave
				Off	Off
	X			Standby	Standby
		X		Test No Load	Test No Load
			X	Manual Run with Load	Manual Run with Load
		X	X	Manual Run with Load	Manual Run with Load
	X	X		Auto Test	Auto Test
	X		X	Auto Run	Auto Run
	X	X	X	Auto Run	Auto Run

X = Discrete input closed

Table 7-2. Mode Selector Switch Position for Standby Application

Off
The off state is used to shut down the generator set. In this state the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will be in the Standby mode. In the Standby mode the master control will monitor the Mains PT input and wait for the mains to fail. Only the master unit determines that the mains has failed. If the slave unit detects a Loss of Mains it will ignore it. When the mains returns the generators are synchronized to the mains and the mains breaker is closed. The generators then transfer the load to the mains as they unload. The generator breakers are opened and the units shut down.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Auto Test
The Auto Test mode is the same as Test no Load except it also includes the standby features. If the mains were to fail while exercising the engine, the generator would supply the load. When the mains returns, the engine would run off-line until the Test input was opened.

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Auto Run
To run an engine when the mains power is not failed the Auto Run mode is used. For this mains parallel application, the unit will operate in either the baseload or process mode depending on the state of the process input. The Auto Sequencing function is Disabled in this application example so no unit start/stop sequencing will be performed.

Sequence of Operation

This section will describe the details of operation for the **Standby** application when configured for a **Multiple Mains Parallel** control.
For the multiple engine sequences, a three-engine system is used to demonstrate the sequence. For systems with more engines, the operation of the slave units would be the same.

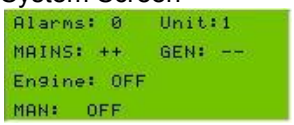
Standby Engine Sequence

The sequence begins with a healthy mains and the EGCP-2 in OFF. The mains breaker is closed and the mains power is being supplied to the load. The EGCP-2 will display this information as follows:

I/O Screen

Input 9, the Mains CB Aux is closed.
Inputs 1,2, &3, the Auto, Test, and Run with Load are all open.
No Outputs are closed.

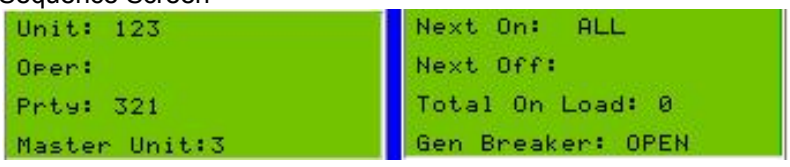
System Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is out of spec shown by --.
The engine is in the OFF state.
The control is in MANual and is in the OFF mode.

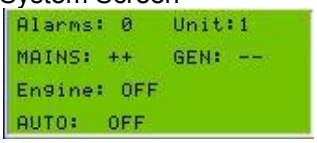
1. Placing the EGCP-2 into the Standby mode
   1.1. To place the engines in standby the Auto inputs should be closed.
   1.2. At this point, the master EGCP-2 will begin to monitor the Mains PT input. This voltage should be within the Mains Volt High and Low Limits and Mains Frequency High and Low Limit.
   1.3. The slave units will not monitor the mains, they wait for a start command from the master.
   1.4. The EGCP-2 will display this information as follows:

Sequence Screen



Three units have their Auto input closed and are shown.
None of the units is on-line because the Oper:(operation) field is blank, if the unit were running an X would appear under the unit.
The Prty: (priority) of each unit is shown and because unit 3 has the lowest priority number, it is the master unit.

System Screen



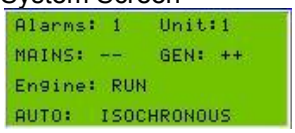
The MAN label has been replaced by the AUTO to show the unit is now in the Auto mode

2. Starting the Standby units on a Loss Of Mains
   - 2.1. When the master determines the mains voltage or frequency has traveled outside of the acceptable range for the Loss Of Mains Action Delay time, the EGCP-2 will consider the Mains failed.
   - 2.2. The mains breaker is opened.
   - 2.3. The master unit sends out a start command. All slave units in standby that have the Auto input closed will receive the start command and start their engines (see Chapter 2 for start sequence information)..
   - 2.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   - 2.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   - 2.6. The generator is declared stable.
   - 2.7. The first stable master or slave will ask permission of the other units to close to the deadbus (provided that the Deadbus Closure setpoint is set to Enable).
   - 2.8. In order to receive permission all units must see Inputs 8 and 9, the Gen CB Aux and Mains CB Aux are open and the Bus PT is dead (below 40 VAC). If any unit sees a voltage or a closed breaker, the deadbus permission is denied.
     - 2.8.1. The first unit to close to the bus must be capable of supplying the entire load to the bus.
     - 2.8.2. In some applications, there may be engines of different sizes. To prevent a unit from closing to the deadbus its Deadbus Closure setpoint should be set to Disable.
     - 2.8.3. In some applications the load is greater than one engine can generate so multiple units must be on the bus before the load can be supplied. This logic is not provided in the EGCP-2 and must be provided externally. Another device such as a PLC would need to confirm that there is enough capacity on the emergency bus and then allow a load breaker to be closed.
   - 2.9. After the first unit has closed to the bus, the other units will synchronize to this bus voltage.
   - 2.10. After synchronizing the generators will softly ramp their load to the system load percentage.
   - 2.11. This is indicated on the display like this:

I/O Screen

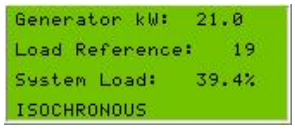
Inputs 1 & 8, Auto & Gen CB Aux are closed
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Outputs 6 & 11 Visual and Audible Alarm are closed to indicate an Active Alarm.
Output 10 Gen Breaker Trip is a reverse logic contact that will open to trip the breaker. When closed the generator breaker can be closed.

System Screen



The MAINS voltage is out of spec shown by --.
The GEN voltage is out of spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the ISOCHRONOUS mode.

KW Load Screen



The generator is generating 21 kW.
The load setpoint is 19 kW in the ISOCHRONOUS mode

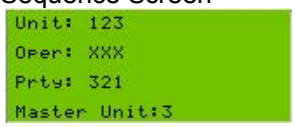
The system load percentage is communicated between each unit for load sharing.
Isochronous mode is the isolated bus Load sharing mode.

PF/kVAR Screen

This unit is in active Power Factor control with an actual Power Factor of 0.99 and a Power Factor reference of 0.97.

The Power Factor is communicated between each unit for Power Factor Sharing. The average power factor of all units becomes the Power Factor Reference.

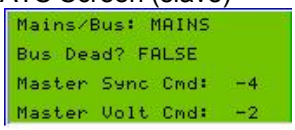
Sequence Screen



All three units are running on the bus shown by the X in the Oper: line.

3. The Mains returns
   - 3.1. The mains voltage will need to be within the voltage and frequency high and low limits of the Transfer switch menu, for the Mains Stable Delay time. Only the master unit monitors the mains.
   - 3.2. The master control synchronizes the generators to the mains.
     - 3.2.1. The master sends commands to the slave units to increase or decrease their voltage or frequency for synchronization.
     - 3.2.2. These signals are shown on the display under the ATS Screen like this:

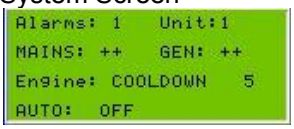
ATS Screen (slave)



The Master Sync Command and Volt Command are sent to every slave to maintain the proper loadsharing and still adjust voltage and frequency to synchronize to the mains.

   - 3.3. The master control will close the mains breaker.
   - 3.4. Each unit will unload to its Unload Trip setpoint at the Unload Time rate.
   - 3.5. Each unit will open its generator breaker.
   - 3.6. Then go into the Stop Sequence (see Chapter 2)
   - 3.7. The master unit will monitor the Mains/Bus PT input for the next Loss of Mains.
   - 3.8. The display screen will appear like this:

System Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the COOLDOWN state with 5 seconds remaining.
The control is in AUTO and is in the OFF mode.

The sequence is now back at step 2 and would repeat on the next Loss of Mains.

The following table gives a brief Summary of the Sequence for a three-unit system.

	Unit 1	**Unit 2**	**Unit 3**
Priority Number	1(master)	2	3
Discrete Inputs	Auto	Auto	Auto
Mains Fails			
	Opens Mains Brkr		
	Start	Start	Start
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Isochronous Mode	Isochronous Mode	Isochronous Mode
	PF Sharing	PF Sharing	PF Sharing
Mains Returns			
	Synchronize MainsBrkr		
	Close Mains Brkr	“In synch”	“In synch”
	Unload Gen	Unload Gen	Unload Gen
	Open Gen Brkr	Open Gen Brkr	Open Gen Brkr
	Cooldown	Cooldown	Cooldown
	Shutdown	Shutdown	Shutdown
	Monitor Mains Voltage		

Table 7-3. Standby Sequence Summary

Application Questions for Standby Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted. Configuration – multiple mains parallel auto sequencing = DISABLED

If the mains breaker would not open when the Loss of Mains was detected, would the EGCP-2 close the generator breaker?
The answer is no. For safety reasons, the EGCP-2 will not close the generator breaker if it senses a closed mains breaker on any unit.

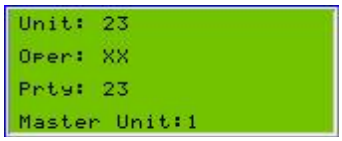
During a Loss of Mains event, while the engines are on-line what will happen if the Auto input is opened?
This scenario needs to be looked at for both a master and a slave.
1. Case 1 Master unit has Auto input opened with at least one slave on the bus:
    1.1. The unit will open its breaker with no unload ramp. The unit will go into the stop sequence (see Chapter 2). The slave unit that is on the will become the master.

2. Case 2 Master unit has Auto input opened with no slaves on the bus.
   2.1. When the Auto input is opened, the EGCP-2 will open its generator breaker. The mode is now OFF, so the control will not close the mains breaker, even when the mains becomes stable again. In OFF the EGCP-2 will not open or close the breakers.
3. Case 3 Slave unit has Auto input opened.
   3.1. The slave unit will softly unload to the Unload Trip level and open its generator breaker, and then go into the stop sequence (see Chapter 2).

What happens if the engine has a shutdown while it is operating during a Loss of Mains?

1. Case 1 Master unit has a Hard Shutdown.
   1.1. The master unit will immediately open its breaker and then open its fuel solenoid to shutdown. Because the EGCP-2 itself is still functional, this unit will still be the master, and control the mains breaker.

   On the sequencing screen this would be shown like this:



Units 2 and 3 are running on-line.
Unit 1 is not available to Run but is still master.

   If the mains were to return, unit 1 would command the other units to open their breaker and then it would close the mains breaker.
2. Case 2 Master unit has a Soft Shutdown
   2.1. The master unit would softly unload and then open its generator breaker. The engine would go through a cooldown if needed and then stop. It would still be the master as in the previous case.
3. Case 3 Slave unit has a Hard Shutdown
   3.1. The slave unit would open its breaker and shutdown.
4. Case 4 Slave unit has a Soft Shutdown
   4.1. The slave unit would unload first, open its breaker, go through a cooldown period if programmed, and then shutdown.

When the mains has returned, what will happen if the control cannot synchronize the mains breaker?

In the Synchronizer menu, the Close Attempts setting sets the number of times the control will try to close a breaker. Likewise, the Sync Timeout is the amount of time that the control will try to synchronize a breaker. If the master unit has finished all of its close attempts trying to close the mains, a Sync Reclose Alarm will be logged, or if the Sync Timeout time has elapsed, a Sync Timeout Alarm will be logged. The engines will continue to run and supply the isolated load. When the problem is corrected, an operator will need to clear the alarm from the Alarm Log. After which, the control will try again to close the mains breaker.

What if the mains breaker is opened externally while the EGCP-2 sees the mains is stable?

The standby units will see that the mains is stable and try to re-close the mains breaker. In most applications the mains breaker will have a protective relay device that could trip the mains breaker. For example, if the mains breaker were tripped due to an overcurrent condition by a protective relay, the EGCP-2 units would not consider this a Loss of Mains because the mains voltage is still within specification.
In order to start the Loss of Mains sequence the mains voltage will need to be opened by an external relay. A contact output from the protective relay should be used to open the mains PT input of the master EGCP-2 so that a Loss of Mains is seen by the master.

Multiple Standby with Sequencing

If the EGCP-2 Auto Sequencing feature is enabled, the EGCP-2 will determine when to start and stop units based on generator load. When the controls are operating in Standby mode, AUTO input closed, the Master control will determine when the slaves are started and stopped. If a slave control has its Auto and Run w/Load input closed, it cannot be sequenced on or off by the Master control.

Configuration Items

The key configuration points that changes from the previous application example.

Configuration Menu:

Network Priority:	Unique for each unit Lowest priority number will be the master

Sequencing and Comms Menu:

Auto Sequencing:	Enabled
Auto Sequencing Delay:	Time before Sequencing will start
Max Gen Load:	Load percentage where master unit needs to add a unit
Next Genset Dly:	System Load must be above Max Gen Load for this time delay to a add a unit
Rated Load Dly:	If system Load exceeds 100 % for this time delay, a unit will be added
Max Start Time:	Time allowed a unit to start before skipping to next priority unit
Min Gen Load:	Load percentage where master needs to stop a unit
Reduced Load Dly:	System Load must be below Min Gen load for this time delay to stop a unit.
Max Stop Time:	After a unit is stopped, the master will wait this time delay before trying to stop the next unit.

Control Wiring

The control wiring for this application matches the previous example. See the Control Wiring section for the Standby No Sequencing application.
Table 7-1 and Figure 7-1 will also apply for this application.

Operation

Using the three mode selector inputs Auto, Test, and Run w/Load, the generator set can be placed into the proper mode of operation. This application has the **Auto Sequencing feature Enabled**, so the actions of the master and slave units will be different. The switch configuration would be as follows:

Input				Mode of Operation	
Auto	Test	Run w/Load		Master	Slave
				Off	Off
X				Standby	Master Follow
	X			Test No Load	Test No Load
		X		Manual Run with Load	Manual Run with Load
	X	X		Manual Run with Load	Manual Run with Load
X	X			Auto Test	Auto Test
X		X		System Run	Auto Run
X	X	X		System Run	Auto Run

X = Discrete input closed

Table 7-4. Mode Selector Switch Position for Standby Application

Off
The off state is used to shut down the generator set. In this state the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the master EGCP-2 will be in the Standby mode. In the Standby mode the master control will monitor the Mains PT input and wait for the mains to fail. Only the master unit determines that the mains has failed. If the slave unit detects a Loss of Mains, it will ignore it. When the mains returns the generator breakers are opened and the mains breaker is closed.

Master Follow
By closing the Auto input on a slave unit, the slave is now following the master for start and stop commands. The slave does not monitor the Mains for a failure, that function is performed by the master. The slave can be started if the Mains fail or if the master issues a system run command.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Auto Test
This mode combines the Standby and Test No Load modes. As long as the test input is closed, the engine will be started and will continue to run. However, if the mains were to fail, the engines would be closed to the bus to supply the load.

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

System Run
Closing the Auto and Run with Load inputs on the master unit initiates a system start command. The master and all slave units in Standby will start. Depending on the state of the Process input the system will operate in either the baseload or process load control mode. These applications are each discussed later in this chapter.

Auto Run
Closing the Auto and Run with Load inputs on a slave unit places the slave into an independent mode where it does not take commands from the master unit. If the master is not running the slave unit will operate in the baseload mode. Closing the Run input on a slave unit while the mains is failed will override the master start/stop sequencing. The slave will continue to run in the isochronous load share mode. This mode is discussed further in the baseload and process sections of this chapter.

Sequence of Operation

This section will describe the details of operation for the **Standby** application when configured for a **Multiple Mains Parallel** control with EGCP-2 Auto Sequencing.
For the multiple engine sequences, a three-engine system is used to demonstrate the sequence. For systems with more engines, the operation of the slave units would be the same.

Standby Engine Sequence
The sequence begins with a healthy mains and the EGCP-2 in OFF.
The mains breaker is closed and the mains power is being supplied to the load.

1. Placing the EGCP-2 into the Standby and Master Follow modes
   - 1.1. When the first Auto input is closed, this control immediately becomes the master and is in the standby mode.
   - 1.2. When the following controls have their Auto input closed, the unit with the lowest Priority Number will become the master. The slave units go into the Master Follow mode.
   - 1.3. The master EGCP-2 monitors the Mains PT input. This voltage should be within the Mains Volt High and Low Limits and Mains Frequency High and Low Limit.
   - 1.4. The slave units will not monitor the mains, they wait for a start command from the master.
2. Starting the Standby units on a Loss Of Mains
   - 2.1. When the master determines the mains voltage or frequency travels outside of the acceptable range for the Loss Of Mains Action Delay time, the EGCP-2 will consider the Mains failed.
   - 2.2. The mains breaker is opened.
   - 2.3. The master unit sends out a start command. All slave units in Master Follow will receive the start command and start their engines (see Chapter 2 for start sequence information).
   - 2.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus.
   - 2.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   - 2.6. The generator is declared stable.
   - 2.7. The first stable master or slave will ask permission of the other units to close to the deadbus (provided that the Deadbus Closure setpoint is set to Enable).
   - 2.8. In order to receive permission all units must see Inputs 8 and 9, the Gen CB Aux and Mains CB Aux are open and the Bus PT is dead (below 40 VAC). If any unit sees a voltage or a closed breaker, the deadbus permission is denied.
     - 2.8.1. The first unit to close to the bus must be capable of supplying the entire load to the bus.
     - 2.8.2. In some applications, there may be engines of different sizes. To prevent a unit from closing to the deadbus its Deadbus Closure setpoint should be set to Disable.

2.8.3. In some applications the load is greater than one engine can handle so multiple units must be on the bus before the load can be supplied. This logic is not provided in the EGCP-2 and must be provided externally. Another device such as a PLC would need to confirm that there is enough capacity on the emergency bus and then allow a load breaker to be closed.

2.9. After the first unit has closed to the bus, the other units will synchronize to this bus voltage.

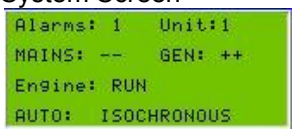
2.10. After synchronizing the generators will softly ramp their load to the system load percentage.

2.11. This is indicated on the display like this:

I/O Screen

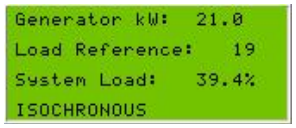
Inputs 1 & 8, Auto & Gen CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated.
Outputs 6 & 11 Visual and Audible Alarm are closed to indicate an Active Alarm.
Output 10 Gen Breaker Trip is a reverse logic contact that will open to trip the breaker. When closed the generator breaker can be closed.

System Screen



The MAINS voltage is out of spec shown by --.
The GEN voltage is out of spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the isochronous mode.

KW Load Screen



The generator is generating 21 kW.
The load setpoint is 19 kW.
In the isochronous mode.

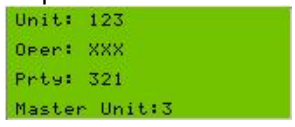
The system load percentage is communicated between each unit for load sharing.
Isochronous mode is the isolated bus Load sharing mode.

PF/kVAR Screen

This unit is in active Power Factor control with an actual Power Factor of 0.99 and a Power Factor reference of 0.97.

The Power Factor is communicated between each unit for Power Factor Sharing. The average power factor of all units becomes the Power Factor Reference.

Sequence Screen



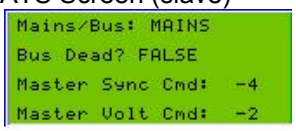
All three units are running on the bus shown by the X in the Oper: line.

Unit three has the lowest priority number so it becomes the master.

3. Following the Auto Sequencing Delay time the master unit will start and stop the slave units as needed. See Chapter 8 for more details about the start/stop sequencing.

4. The Mains returns
   4.1. The mains voltage will need to be within the voltage and frequency high and low limits of the Transfer Switch menu, for the Mains Stable Delay time. Only the master unit monitors the mains.
   4.2. The master control will synchronize the generators to the mains.
      4.2.1. The master sends commands to the slave units to increase or decrease their voltage or frequency for synchronization.
      4.2.2. These signals are shown on the display under the ATS Screen as like this:

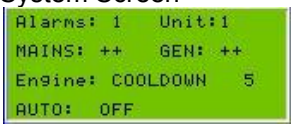
ATS Screen (slave)



The Master Sync Command and Volt Command are sent to every slave to maintain the proper loadsharing and still adjust voltage and frequency to synchronize to the mains.

   4.3. The master control will close the mains breaker.
   4.4. Each unit will unload to its Unload Trip setpoint at the Unload Time rate.
   4.5. Each unit will open its generator breaker.
   4.6. Then go into the Stop Sequence (see Chapter 2)
   4.7. The master unit will monitor the Mains/Bus PT input for the next Loss of Mains.
   4.8. The display screen will appear like this:

System Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the COOLDOWN state with 5 seconds remaining.
The control is in AUTO and is in the OFF mode.

The sequence is now back at step 2 and would repeat on the next Loss of Mains.

Action	Unit 1	Unit 2	Unit 3
Priority Number	1 (master)	2	3
Discrete Inputs	Auto	Auto	Auto
Mains Fails			
	Opens Mains Brkr		
	Start	Start	Start
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Isochronous Mode	Isochronous Mode	Isochronous Mode
	PF Sharing	PF Sharing	PF Sharing
System Load below Min Gen Load			Master Stop Command
			Soft Unload
			Open Gen Brkr
			Cooldown
			Shutdown
System Load above Max Gen Load			Master Start Command
			Start
			Synchronize
			Close Gen Brkr
	Isochronous Mode	Isochronous Mode	Isochronous Mode
	PF Sharing	PF Sharing	PF Sharing
Mains Returns			
	Synchronize Mains Brkr		
	Close Mains Brkr		
	Unload	Unload	Unload
	Open Gen Brkr	Open Gen Brkr	Open Gen Brkr
	Cooldown	Cooldown	Cooldown
	Shutdown	Shutdown	Shutdown

Table 7-5. Standby with Unit Sequencing Summary

Application Questions for Standby Mode

The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

During a Loss of Mains event, while the engine is on-line what will happen if the Auto input is opened?

This scenario needs to be looked at for both a master and a slave.

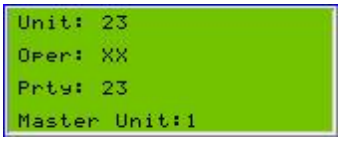
1. Case 1 Master unit has Auto input opened with at least one slave on the bus:
   1.1. The unit will open its breaker with no unload ramp. The next lowest priority unit will become the new master. The unit will go into the stop sequence (see Chapter 2).
2. Case 2 Master unit has Auto input opened with no slaves in Master Follow.
   2.1. When the Auto input is opened, the EGCP-2 will open its generator breaker. The mode is now OFF, so the control will not close the mains breaker, even when the mains becomes stable again. In OFF the EGCP-2 will not open or close the breakers.

3. Case 3 Master unit has Auto input opened with at least one slave in Master Follow that is shut down.
   3.1. If one or more of the slaves had been sequenced off, when the master unit had its Auto input opened, the master would open its generator breaker and go into the stop sequence. The slave would switch its PT's to verify that the bus were dead and then close the Mains breaker.
4. Case 4 Slave unit has Auto input opened.
   4.1. The slave unit will softly unload to the Unload Trip level and open its generator breaker, and then go into the stop sequence (see Chapter 2).

What happens if the engine has a shutdown while it is operating during a Loss of Mains?

1. Case 1 Master unit has a Hard Shutdown with at least one slave running on the bus in Master Follow.
   1.1. The master unit will immediately open its breaker and then open its fuel solenoid to shutdown. Because the EGCP-2 itself is still functional, this unit will still be the master.

   On the sequencing screen this would be shown like this:



Units 2 and 3 are running on-line.
Unit 1 is not available to Run but is still master.

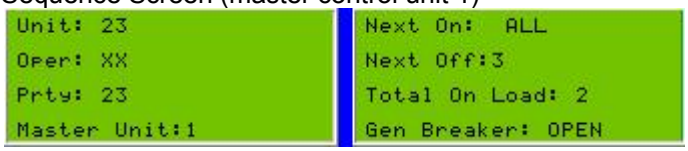
If there were any slaves that were not running, they would be commanded to start by the master.
If the mains were to return, unit 1 would command the other units to open their breaker and then the mains breaker would be closed.

2. Case 2 Master unit has a Hard Shutdown with no slaves running on the bus.
   2.1. The master unit will immediately open its breaker and then open its fuel solenoid to shutdown. The master commands all other units in Master Follow to start. The master EGCP-2 is still functional, only the engine is unable to run, so the master does not switch to a running unit. The master will still make sequencing decisions because it still receives the system load percentage from the other units.

   This would appear like this:

KW/Load Screen

Sequence Screen (master control unit 1)



The System Load percentage for units 2 and 3 is 38 %. Unit 1, the master unit had a Hard Shutdown, and is not running, but is still the master. Unit 1 will still make sequencing decisions and command unit 3 to start and stop. The master will not command unit 2 to stop.

3. Case 3 Master units has a Soft Shutdown with at least one slave running on the bus in Master Follow.
   3.1. The master unit would softly unload and then open its generator breaker. The engine would go through a cooldown if needed and then stop. It would still be the master as in the previous case.

4. Case 4 Master unit has a Soft Shutdown with no slaves running on the bus.
   4.1. The master unit will command all slaves to start. The master starts timing the Max Start Time. If a slave unit has closed to the bus to supply the load, the master unit will open its breaker and shutdown. If the Max Start Time has elapsed and still there are no other units on the bus, the master gen breaker will open and the engine will go into the stop sequence. It will remain the master as in Case 2 above.
5. Case 5 Slave unit has a Hard Shutdown
   5.1. The slave unit would open its breaker and shutdown. The master will not tell all other slave units to start. The master will use the standard sequencing logic to determine if another engine is needed.
6. Case 6 Slave unit has a Soft Shutdown
   6.1. The slave unit would unload to its Unload Trip level, open its breaker and go into the stop sequence (see Chapter 2). The master will not tell another slave unit to start. The master will use the standard sequencing logic to determine if another engine is needed.

Auto Test sequence

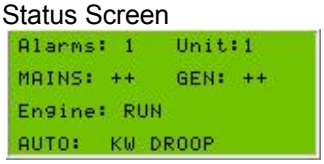
The sequence is the same for either a master or slave.
With a healthy Mains and the EGCP-2 in Auto.

1. When the Test input is closed, the engine will start (see Chapter 2).
2. The engine will run at rated speed as long as the Test input is closed.
3. The Speed Raise and Lower inputs and the Voltage Raise and Lower inputs will both be active to allow a user to adjust the speed or voltage manually.
4. Output 10 will remain de-energized, which is calling for the generator breaker to trip.
5. The display screens would appear like this:

I/O Screen

Inputs 1,2 & 9, Auto, Test & Mains CB Aux are closed.
Output 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated

Status Screen



The MAINS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the KW DROOP mode because the Gen CB Aux is open.

6. If the Mains were to fail while in this mode,
   6.1. The master EGCP-2 would open the Mains breaker and perform the normal Loss of Mains sequence. See Standby sequence in this chapter.
   6.2. When the mains has returned and exceeded the Mains Stable Delay time, the master would synchronize the generators to the mains and close the mains breaker
   6.3. Then after the mains breaker has been closed, the generators will unload
   6.4. When the load on the generator reaches the Unload Trip Level, the generator breaker will be opened.
   6.5. All the engines in the Master Follow mode will go into the stop sequence. Engines in Auto Test will continue to run as long as the Test input is closed.
7. When the test input is opened, the engine will go into the stop sequence (see Chapter 2).

Multiple Unit Baseload Application

In an application where multiple units will be operated in parallel with the mains, the baseload load control mode only controls the generator load. It does not measure or control the mains import/export load.

Configuration Items

The key configuration points in the EGCP-2 software, which need to be configured for a Multiple Unit Baseload application, are:

Required settings

Configuration Menu:

Network Address:	1 to 8, unique for each unit
Number of Units:	Multiple
Operating Mode:	Mains Parallel

Shutdown and Alarm Menu:

Gen Volt Hi Lmt:	Sets high end of generator voltage stable range
Gen Volt Lo Lmt:	Sets low end of generator voltage stable range
Gen Freq Hi Lmt:	Sets high end of gen frequency stable range
Gen Freq Lo Lmt:	Sets low end of gen frequency stable range

Synchronizer Menu:

Sync Mode:	Run

Real Load Control Menu:

Load Control Mode:	Normal
Baseload Reference:	The initial load reference that the generator will ramp to after the generator breaker is closed
Unload Trip:	When unloading the generator, this is the kW value where the EGCP-2 sends the Generator breaker trip command.
Load Time:	Sets the load increase ramp time
Unload Time:	Sets the unload ramp time

Transfer Switch Menu:

Check Mains Breaker:	Enabled

Sequencing and Comms Menu:

Auto Sequencing:	Disabled

Suggested Settings

Reactive Load Menu:

VAR/PF Mode:	PF Control or VAR Control This will enable the voltage control of the EGCP-2 when operating in parallel with the mains.
kVAR Reference:	When in VAR control, the initial kVAR reference that the generator will ramp to after the breaker is closed.
PF Reference:	When In PF control, the initial Power Factor reference that the generator will ramp to after the breaker is closed.

Transfer Switch Menu:

Mains Volt High Lmt:	Sets high end of mains voltage stable range.
Mains Volt High Alarm:*	Loss of Mains or Loss of Mains with alarms.
Mains Volt Low Lmt:	Sets Low end of mains voltage stable range.
Mains Volt Low Alarm:*	Loss of Mains or Loss of Mains with alarms.
Mains Freq High Lmt:	Sets high end of mains frequency stable range.
Mains Freq High Alarm:*	Loss of Mains or Loss of Mains with alarms.
Mains Freq Low Lmt:	Sets low end of mains frequency stable range.
Mains Freq Low Alarm:*	Loss of Mains or Loss of Mains with alarms.
LOM Action Delay:	The amount of time that the mains power must be out of spec to trigger the Loss of Mains.

*At least one of the four Loss of Mains alarms need to be set for Loss of Mains or Loss of Mains with Alarms for the Standby operation to occur. If no standby operation is desired, set all of these alarms to Disable.

Discretionary

Process Control Menu:

Not all items in this menu are applicable to a single unit prime power application.

Sequencing and Comms Menu:

Max Gen Load
Next Genset Dly
Rated Load Dly
Max Start Time
Min Gen Load
Reduced Load Dly
Max Stop Time

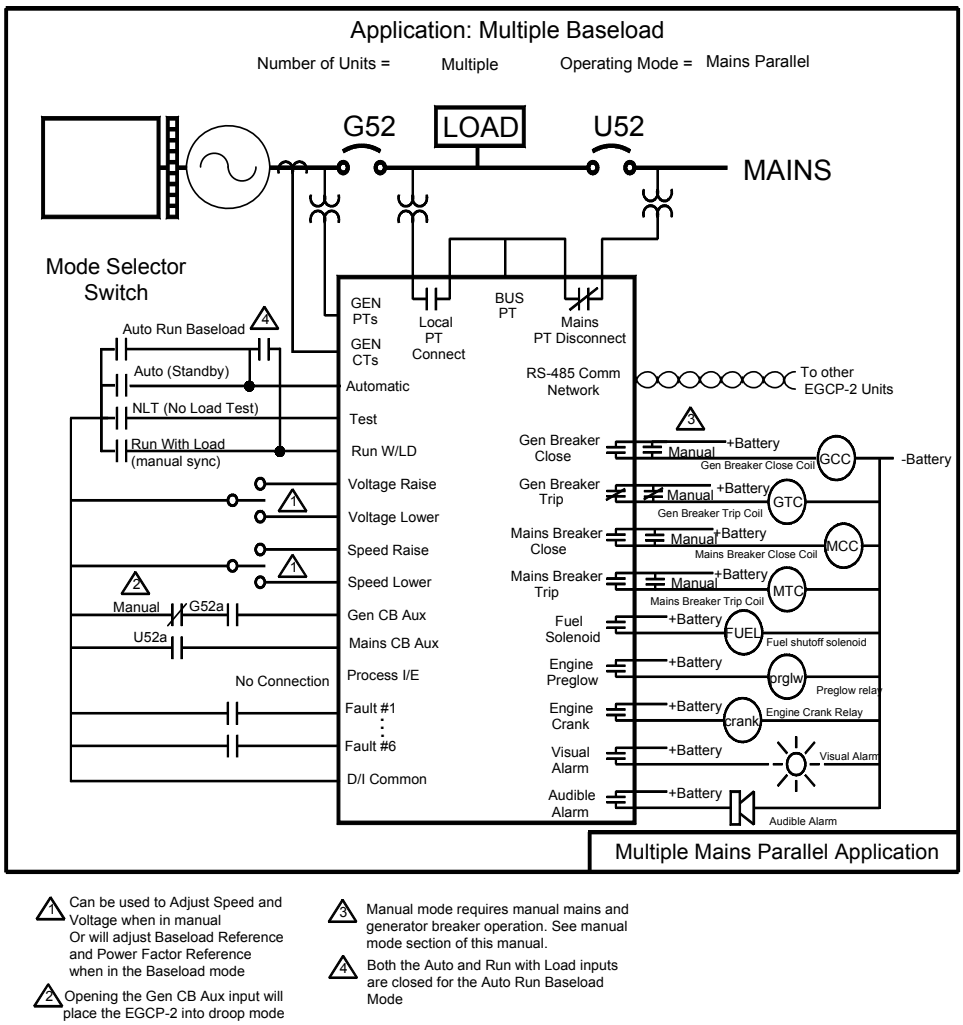
Control Wiring

The control wiring for the Multiple Baseload application will be the same as the Single Baseload application in Chapter 5 with one exception. The RS 485 communication line should be connected between the units. Please consult Table 5-3 for the wiring information.

Terminal Description	Required	Optional	Not Used	Comment
76 + 485 Communication	X			
77 – 485 Communication	X			
78 485 Shield	X			

Table 7-6. I/O list for Multiple Unit Baseload application

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1. Can be used to Adjust Speed and Voltage when in manual Or will adjust Baseload Reference and Power Factor Reference when in the Baseload mode
2. Opening the Gen CB Aux input will place the EGCP-2 into droop mode
3. Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.
4. Both the Auto and Run with Load inputs are closed for the Auto Run Baseload Mode

Figure 7-2. Multiple Unit Baseload Application

Operation

Using the three mode selector inputs Auto, Test, and Run w/Load, the generator set can be placed into the proper mode of operation. For a Multiple Baseload application, the actions are the same for a master or a slave unit. The switch configuration would be as follows:

Input				Mode of Operation	
	Auto	Test	Run w/Load	Master	Slave
				Off	Off
	X			Standby	Standby
		X		Test No Load	Test No Load
	X	X		Auto Test	Auto Test
			X	Manual Run with Load	Manual Run with Load
		X	X	Manual Run with Load	Manual Run with Load
	X		X	Auto Run Baseload	Auto Run Baseload
	X	X	X	Auto Run Baseload	Auto Run Baseload

X = Discrete input closed
Modes that are shown in gray are not discussed in this application section.

Table 7-7. Mode Selector Switch Position for Multiple Baseload

Off
The off state is used to shut down the generator set. In this state the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will be in the Standby mode. Please see the previous application Multiple Standby for an explanation of the operation.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Auto Test
This mode combines the Standby and Test no load modes. As long as the test input is closed, the engine will be started and will continue to run. However, if the mains were to fail, the engines would be closed to the bus to supply the load. Please see the previous application Multiple Standby for an explanation of the operation.

Manual Run Baseload
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Auto Run Baseload
When both the Auto and Run with Load inputs are closed, the control will perform an automatic synchronization and run with the generator breaker closed. If the mains is present, the control will also close the mains breaker and operate the generator in the baseload mode. If the mains is failed the generator will be operated in the isochronous mode.

Sequence of Operation

This section will describe the details of operation for the **Baseload** application when configured for a **Multiple Parallel** control.

Auto Run Baseload Sequence

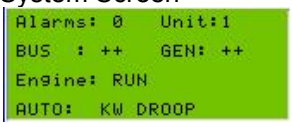
The sequence begins with a healthy mains and the EGCP-2 in OFF. The mains breaker is closed and the mains power is being supplied to the load. This sequence would be the same for a master or slave unit.

1. Placing the EGCP-2 into the Auto Run Baseload mode
   - 1.1. To place the engine in Auto Run Baseload the Auto and Run with Load inputs will be closed. The Process input must be open.
   - 1.2. At this point the EGCP-2 will start the engine (see Chapter 2).
   - 1.3. If the mains voltage is stable, and the mains breaker is not closed, the EGCP-2 will close the mains breaker.
   - 1.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus
   - 1.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   - 1.6. The generator is declared stable. The displays will be shown like this:

I/O Screen

Input 9, the Mains CB Aux is closed.
Inputs 1 & 3, Auto and Run with Load are closed.
Outputs 4 & 7 Fuel Solenoid and Idle/Rated are closed to run the engine at rated speed.
Outputs 7 & 8 are closed to bring the Bus PT voltage into the Mains/Bus PT input .
Output 10 is closed to remove the Generator Breaker trip signal.

System Screen



The BUS voltage is within spec shown by ++.
The GEN voltage is in spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the KW DROOP mode until the generator breaker is closed.

2. Running on-line in Baseload
   - 2.1. The EGCP-2 will synchronize the generator to the mains and close the generator breaker.
   - 2.2. The EGCP-2 will ramp the kW load on the generator to the Baseload reference.
   - 2.3. The baseload reference can be adjusted in three ways.
     - 2.3.1. Using the Raise and Lower Speed discrete inputs.
     - 2.3.2. Using the Raise and Lower Speed Modbus inputs.
     - 2.3.3. Using the Modbus Baseload Reference address 40003. See the EGCP-2 Communications manual 26182, for more detail on the Modbus communications of the EGCP-2
   - 2.4. If the control is configured for Power Factor control the power factor will be controlled at the Power Factor Reference.
   - 2.5. If VAR control is configured, the kVARs will be ramped to the VAR Reference.
   - 2.6. The Power Factor or KVAR setpoint can be adjusted in three ways.
     - 2.6.1. Using the Raise and Lower Voltage discrete inputs.
     - 2.6.2. Using the Raise and Lower Voltage Modbus inputs.

2.6.3. Using the Modbus Power Factor Reference address 40005, or KVAR Reference address 40007. See the EGCP-2 Communications manual 26182

2.7. The active KW reference and PF reference can be viewed by pressing the KW LOAD and PF/kVAR buttons on the EGCP-2. The screens will appear like this:

KW LOAD Screen

Three phase kW generated is 79.7 kW.
Baseload reference is 80 kW.
For a 110 kW rated machine the system load percentage is 72.3 %.
The control is in the BASELOAD mode.

PF / kVAR Screen

The VAR/PF Mode is currently PF CONTROL.
The Power Factor Reference is 0.90 LAG.
The actual Power Factor is 0.895 LAG.

3. Shutting Down the Genset
   - 3.1. By opening the Auto and Run with Load inputs, the generator load will be ramped down to the Unload Trip load level, passing the load from the generator to the mains.
   - 3.2. When the generator KW is equal to or less than the Unload Trip level, the generator breaker will trip.
   - 3.3. The engine will go into the stop sequence (see Chapter 2).
4. Going from Auto Run Baseload to Standby.
   - 4.1. By opening only the Run with Load input and leaving the Auto input closed, the control will unload to the unload trip level.
   - 4.2. When the generator KW is equal to or less than the Unload Trip level, the generator breaker will trip.
   - 4.3. The engine will go into the stop sequence (see Chapter 2).
   - 4.4. The engine is in the Standby mode, and the master will monitor the Mains PT input.
   - 4.5. If the Mains fails the engine will be started as described in the Standby application sections previously in this manual.

	Unit 1	Unit 2	Unit 3
Priority Number	1(master)	2	3
Discrete Inputs	Auto	Auto & Run	Auto
Start unit 2		Start	
		Synchronize	
		Close Gen Brkr	
		Baseload mode	
		PF Control	
Start unit 1	Auto & Run		
	Start		
	Synchronize		
	Close Gen Brkr		
	Baseload mode		
	PF Control		
Stop Unit 2		Auto	
		Unload Gen	
		Open Gen Brkr	
		Cooldown	
		Shut down	
Stop Unit 1	Auto		
	Unload Gen		
	Open Gen Brkr		
	Cooldown		
	Shut down		

Table 7-8. Multiple Baseload Summary

With Auto Sequencing Disabled, the master unit does not affect the starting and stopping of the other units. Each unit is independent in this situation unless the mains were to fail. Then the master would start all units in Master Follow and operate the mains breaker.

Application Questions for Auto Run Baseload Mode

The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

What will happen if the mains were to fail while the generators are on-line in Baseload mode?

One of many scenarios is possible.

1. The mains fails and the mains protective device trips the mains breaker. For this scenario, the EGCP-2 will recognize the mains breaker is open and switch from baseload mode to isochronous mode. If all of the controls on the bus are in Auto, they will share the kW load accordingly. In addition, if the Auto Sequencing feature is enabled, the master EGCP-2 will start and stop the slave units accordingly.
2. The mains fails, but the generator is supplying power through the mains breaker so the master EGCP-2 does not see that the mains has failed. The EGCP-2 will remain in the baseload mode and try to maintain its baseload reference. In all likelihood, the actual load on the now isolated bus will be different from the baseload reference so the EGCP-2 will cause the engine to speed up or slow down. At some point, either a mains protective device or the EGCP-2 LOM alarms will see that the mains voltage is out of spec and open the mains breaker. Possibly the generator breaker would trip on a high or low frequency alarm.

3. The mains fails and the generator picks up the load of the local grid. It is possible that when the mains fails, the EGCP-2 would be supplying power out of the facility to an immeasurable load. In this situation, the breakers would trip on overcurrent and/or the engine would be stopped by the sudden increase in load.

NOTICE

The EGCP-2 is not a protective device for the mains breaker. Additional protective devices should be installed in accordance with the local utility requirements.

What if the mains returns after a Loss of Mains and the generator is on-line?
The master EGCP-2 will synchronize the generators to the mains and close the mains breaker. After closing the mains breaker each control will ramp the kW load to the baseload reference and return to the baseload mode.

Alternate Baseload Sequence

It is also possible to use a master EGCP-2 to start multiple engines and operate in the baseload mode. By enabling the Auto Sequencing on the master unit, the whole system of engines will be started and stopped based on the inputs of the master unit.

Alternate Baseload Operation

Using the three mode selector inputs Auto, Test, and Run w/Load, the generator set can be placed into the proper mode of operation. The switch configuration would be as follows:

Input				Mode of Operation	
	Auto	Test	Run w/Load	Master	Slave
				Off	Off
	X			Standby	Master Follow
		X		Test No Load	Test No Load
	X	X		Auto Test	Auto Test
			X	Manual Run with Load	Manual Run with Load
		X	X	Manual Run with Load	Manual Run with Load
	X		X	System Run Baseload	Auto Run Baseload
	X	X	X	System Run Baseload	Auto Run Baseload

X = Discrete input closed
Modes that are shown in gray are not discussed in this application section.

Table 7-9. Mode Selector Switch Position for Alternate Baseload

With the slave units in the Master Follow mode, by closing the Auto and Run with Load inputs on the master will cause all engines to start and synchronize to the bus in the baseload load control mode. Opening the Run with Load input on the master would cause each unit to unload and open its breaker and shutdown.

	Unit 1	Unit 2	Unit 3
Priority Number	1(master)	2	3
Discrete Inputs	Auto	Auto	Auto
System Start	Auto & Run		
	Start	Start	Start
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Baseload mode	Baseload mode	Baseload mode
	PF Control	PF Control	PF Control
Stop Unit 3			Open Auto input
			Unload
			Open Gen Brkr
			Cooldown
			Shut down
System Stop	Auto		
	Unload	Unload	
	Open Gen Brkr	Open Gen Brkr	
	Cooldown	Cooldown	
	Shut down	Shut down	

Table 7-11. Multiple Baseload Summary

With the Auto Sequencing Setpoint Enabled on the master unit, the whole system of generators can be operated from only the master control. The slave units will follow the actions of the master.

Multiple Unit Process No Sequencing Application

This section describes a Multiple unit system that will be operated in parallel with the mains. The Process application will adjust the generator load in order to maintain the process reference. A 4-20 mA transducer is required to provide the process signal input to the EGCP-2. Only the master unit is required to receive this input, but for system redundancy the process input may be wired to two or more controls.

> Many types of process variables can be controlled. The requirement for the process variable is that it must have a relationship to the kW output of the generator. For example, in a co-generation application where heat is taken from the engine to produce steam. As the engine produces more power, it produces more heat and thus makes more steam. A transducer that measures steam pressure could be used as the process variable feedback to the EGCP-2. A process reference is programmed in the EGCP-2 to maintain a certain steam pressure. The EGCP-2 then can raise or lower the load on the generator in order to keep the steam pressure at the desired level.

For this application the Auto Sequencing Feature of the EGCP-2 has been disabled.

Configuration Items

The key configuration points in the EGCP-2 software, which need to be configured for a Single Unit Process application, are:

	Required settings
Configuration Menu:	
Network Address:	1 to 8, unique for each unit
Network Priority:	1 to 8, unique for each unit Lowest priority number will be the master
Number of Units:	Multiple
Operating Mode:	Mains Parallel
Shutdown and Alarm Menu:	
Gen Volt Hi Lmt:	Sets high end of generator voltage stable range
Gen Volt Lo Lmt:	Sets low end of generator voltage stable range
Gen Freq Hi Lmt:	Sets high end of gen frequency stable range
Gen Freq Lo Lmt:	Sets low end of gen frequency stable range
Synchronizer Menu:	
Sync Mode:	Run
Real Load Control Menu:	
Load Control Mode:	Normal
Unload Trip:	When unloading the generator, this is the kW value where the EGCP-2 sends the Generator breaker trip command.
Load Time:	Sets the load increase ramp time
Unload Time:	Sets the unload ramp time
Reactive Load Control Menu:	
VAR/PF Mode:	PF control or VAR control
kVAR Reference:	When in VAR control, the initial kVAR reference that the generator will ramp to after the breaker is closed.
PF Reference:	When In PF control, the initial Power Factor reference that the generator will ramp to after the breaker is closed.
Process Control Menu:	
Process Action:	Relationship between the process signal and the generator load
Process Reference:	Initial Process Reference that the generator will ramp to after the breaker is closed
Process Hi Limit:	Sets high end of process signal input
Process Lo Limit:	Sets low end of process signal input
Raise Rate:	Rate process reference is adjusted by the Raise Speed discrete input.
Lower Rate:	Rate process reference is adjusted by the Lower Speed discrete input.
Process Units:	Selectable for the type of Process that is being used
Process High Value:	Engineering units corresponding to the process high limit (i.e. 20 mA = 1000 kW)
Process Low Value:	Engineering units corresponding to the process low limit (i.e. 4 mA = 0 kW)

Transfer Switch Menu:
Check Mains Breaker: Enabled

Suggested Settings

Reactive Load Menu:
VAR/PF Mode: PF Control or VAR Control
This will enable the voltage control of the EGCP-2

Process Control Menu:
Process Deadband: 0.3 %
Process Droop: 0.0 %

Transfer Switch Menu:

Mains Volt High Lmt:	Sets high end of mains voltage stable range
Mains Volt High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Volt Low Lmt:	Sets Low end of mains voltage stable range
Mains Volt Low Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq High Lmt:	Sets high end of mains frequency stable range
Mains Freq High Alarm:*	Loss of Mains or Loss of Mains with alarms
Mains Freq Low Lmt:	Sets low end of mains frequency stable range
Mains Freq Low Alarm:*	Loss of Mains or Loss of Mains with alarms
LOM Action Delay:	The amount of time that the mains power must be out of spec to trigger the Loss of Mains.

*At least one of the four Loss of Mains alarms need to be set for Loss of Mains or Loss of Mains with Alarms for the Standby operation to occur. If no standby operation is desired, set all of these alarms to Disable.

Discretionary

Sequencing and Comms Menu:
Auto Sequencing
Max Gen Load
Next Genset Dly
Rated Load Dly
Max Start Time
Min Gen Load
Reduced Load Dly
Max Stop Time

Setting Options
In a Multiple unit Process application only the master unit would be required to monitor the process input and control the mains breaker. The Process Menu settings and Transfer Switch Menu settings only need to be entered on units that could be the master. It is possible that all units in a system could be masters so in this case these menu items need to be set for all units. For applications where only one unit can be the master, these settings would only need to be set for that unit.

Control Wiring

Terminal Description	Required	Optional	Not Used	Comment
1+ power supply	✕			
2– power supply	✕			
5Mains Brkr Close N.O.	✕			
6Mains Brkr Close Com.	✕			
7Mains Brkr Close N. C.	✕			
8Gen Brkr Close N.O.	✕			
9Gen Brkr Close Com.	✕			
10 Gen Brkr Close N. C.	✕			
11 Engine Preglow		✕		
12 Engine Preglow		✕		
13 Fuel Solenoid	✕			
14 Fuel Solenoid	✕			
15 Crank Engine	✕			Not Required if Start Sequencing is Disabled
16 Crank Engine	✕			“
17 No Connection			✕	
18 Visual Alarm N. O.		✕		
19 Visual Alarm Com.		✕		
20 Visual Alarm N. C.		✕		
21 Bus PT Connect	✕			
22 Bus PT Connect	✕			
23 Mains PT Disconnect	✕			
24 Mains PT Disconnect	✕			
25 Mains Brkr Trip N. O.	✕			
26 Mains Brkr Trip Com.	✕			
27 Mains Brkr Trip N. C.	✕			
28 Gen Brkr Trip N. O.	✕			
29 Gen Brkr Trip Com.	✕			
30 Gen Brkr Trip N. C.	✕			
31 Audible Alarm		✕		
32 Audible Alarm		✕		
33 Audible Alarm		✕		
34 Idle Rated/Load SW		✕		Idle is bypassed on LOM start
35 Idle Rated/Load SW		✕		“
36 No Connection			✕	
37 + Voltage Bias	✕			
38 – Voltage Bias	✕			
39 Voltage Bias Shield	✕			
40 Mains/Bus PT Phase A	✕			
41 Mains/Bus PT Phase B or N	✕			
42 Generator PT phase A +	✕			
43 Generator PT phase A –	✕			
44 Generator PT phase B +	✕			
45 Generator PT phase B –	✕			

Table 7-10. I/O list for Multiple Unit Process application

Terminal Description	Required	Optional	Not Used	Comment
46 Generator PT phase C +	X			
47 Generator PT phase C –	X			
49 Auto	X			
50 Test		X		
51 Run/Ld	X			
52 Volt Raise		X		
53 Volt Lower		X		
54 Speed Raise		X		
55 Speed Lower		X		
56 Gen CB Aux	X			
57 Mains CB Aux	X			
58 Process	X			
59 Fault 1		X		
60 Fault 2		X		
61 Fault 3		X		
62 Fault 4		X		
63 Fault 5		X		
64 Fault 6		X		
65 Switch Common	X			
66 Temp Sensor +		X		
67 Temp Sensor –		X		
68 Pressure Sensor +		X		
69 Pressure Sensor –		X		
70 Magnetic Pickup +	X			Not Required if Start Sequencing is Disabled
71 Magnetic Pickup –	X			“
72 Magnetic Pickup Shield	X			“
73 + Speed Bias	X			
74 – Speed Bias	X			
75 Speed Bias Shield	X			
76 + 485 Communication	X			
77 – 485 Communication	X			
78 485 Shield	X			
79 NC			X	
80 Communication Reference			X	
81 422 Communication RX+		X		
82 422 Communication RX–		X		
83 422 Shield		X		
84 422 Communication TX+		X		
85 422 Communication TX–		X		
86 + Process Signal	X			
87 – Process Signal	X			
88 Process Signal Shield	X			
89 Gen CT phase A+ Current	X			

Table 7-10 cont’d

Terminal Description	Required	Optional	Not Used	Comment
90 Gen CT phase A– Current	✕			
91 Gen CT phase B+ Current	✕			
92 Gen CT phase B– Current	✕			
93 Gen CT Phase C+ Current	✕			
94 Gen CT Phase C– Current	✕			

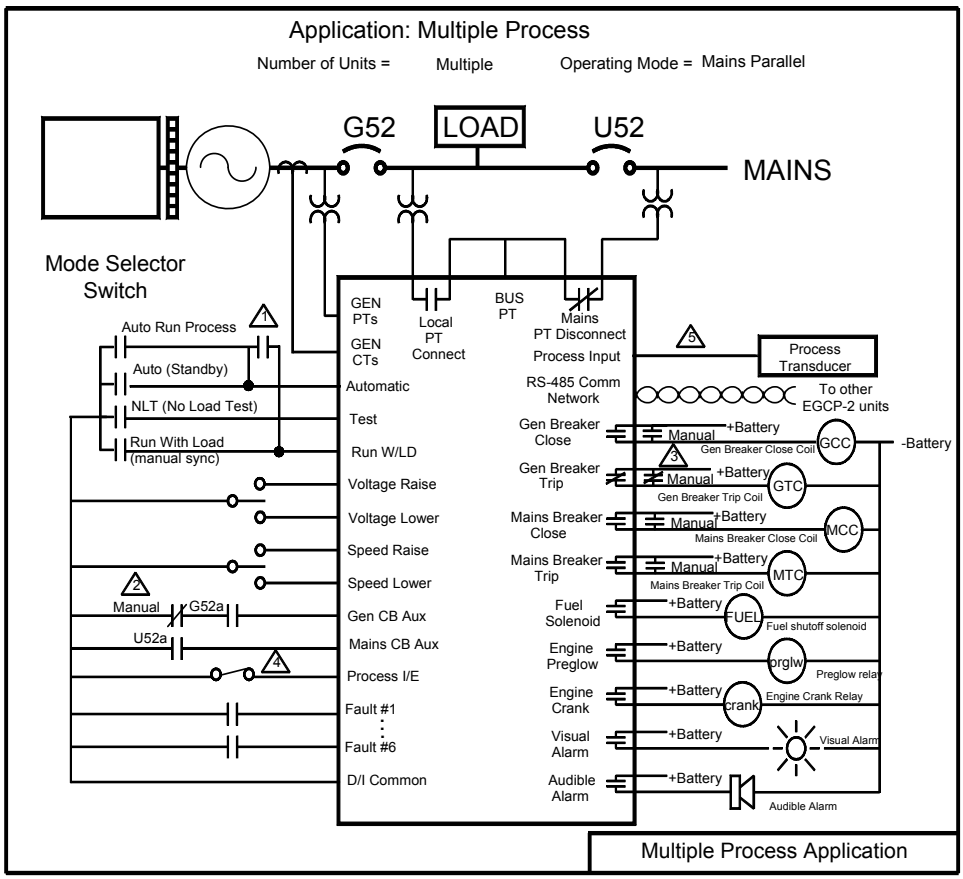
Table 7-10 cont'd

Wiring Options

The Process Input, Mains Circuit Breaker Aux input, and Mains Circuit Breaker Trip and Close relays may be wired to the master unit only. In applications where there is a dedicated master these signals only have to be connected to that unit. The Check Mains Breaker setpoint in the Transfer Switch menu, will be Enabled on the master and Disabled on each slave unit.

However, wiring the inputs to only one unit will compromise the system redundancy. If for any reason that unit is not in service, the system will not have any way to operate the mains breaker. It may be necessary to wire these signals to two or more units to provide redundancy. For many applications, all the units will be capable of being the master and these signals will need to be wired to each unit. Any unit that could be a master in the system should have the Check Mains Breaker setting Enabled.

The Control Wiring section of this manual is intended for quick reference to basic wiring requirements and operational concepts. Consult the Plant Wiring Diagram and Operational Description sections of the Installation and Operation manual 26174, for more detail on the wiring of the EGCP-2.



1. Both the Auto and Run with Load inputs will be closed when the Mode Selected is Auto Run Process
2. Opening the Gen CB Aux input will place the EGCP-2 into droop mode
3. Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.
4. Process Switch input may be wired directly to control if Process Mode is the only mode required. The switch could be opened to place the unit in Baseload mode
5. The Process Input must be a 1 - 5 VDC or 4-20 mA signal

Figure 7-3. Multiple Process Application

Operation

Using the three mode selector inputs Auto, Test, and Run w/Load and the Process input, the generator set can be placed into the proper mode of operation. The Process switch can be permanently closed or if it is desired to switch between process control and baseload control a switch can be installed for the Process input. The switch configuration would be as follows:

Input					Mode of Operation	
	Auto	Test	Run w/Load	Process	Master	Slave
				E	Off	Off
	X			E	Standby	Standby
		X		E	Test No Load	Test No Load
			X	E	Manual Run with Load	Manual Run with Load
		X	X	E	Manual Run with Load	Manual Run with Load
	X	X		E	Auto Test	Auto Test
	X		X		Auto Run Baseload	(see previous application)
	X	X	X		Auto Run Baseload	(see previous application)
	X		X	X	Process Master	Process Slave
	X	X	X	X	Process Master	Process Slave

X = Discrete input closed
E = Input can be Either open or closed
Modes shown in gray are not discussed in this application section of the manual.

Table 7-11. Mode Selector Switch Position for Multiple Process

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the EGCP-2 will be in the Standby mode. Please see the previous application Multiple Standby for an explanation of the operation.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information on this mode of operation.

Manual Run
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information on this mode of operation.

Auto Test
This mode combines the Standby and Test no load modes. As long as the test input is closed, the engine will be started and will continue to run. However, if the mains were to fail, the engines would be closed to the bus to supply the load. Please see the previous application Multiple Standby for an explanation of the operation.

Process Master and Slave
When the Auto, Run with Load, and Process inputs are closed, the control will perform an automatic synchronization and run with the generator breaker closed. If the mains is present, the control will also close the mains breaker and operate the generator in the Process mode. If the mains fails, the generator will be operated in the isochronous mode.

Sequence of Operation

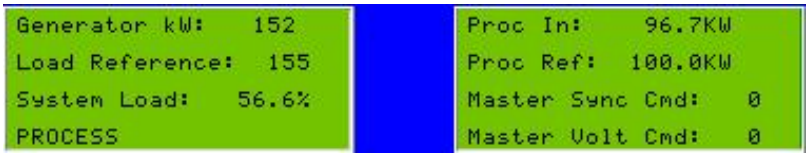
This section will describe the details of operation for the **Process** application when configured for a **Multiple Parallel** control.

Process Master and Slave Sequence

The sequence begins with a healthy mains and the EGCP-2 in OFF. The mains breaker is closed and the mains power is being supplied to the load.

1. Placing the EGCP-2 into the Process Master mode
   - 1.1. The Auto, Run with Load, and Process inputs will be closed.
   - 1.2. At this point the EGCP-2 will start the engine (see Chapter 2)
   - 1.3. If the mains voltage is stable, and the mains breaker were not closed, the EGCP-2 would close the mains breaker.
   - 1.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus
   - 1.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   - 1.6. The generator is declared stable.
2. Running on-line in Process mode
   - 2.1. The EGCP-2 will synchronize the generator to the mains and close the generator breaker.
   - 2.2. The kW load will be ramped on the generator to the Process reference.
   - 2.3. The process reference can be adjusted in three ways.
     - 2.3.1. Using the Raise and Lower Speed discrete inputs.
       - 2.3.1.1. If the Process has an indirect relationship with the kW load, by raising the Process input, this will effectively lower the kW load on the unit, and likewise by lowering the process reference, this will actually increase the kW load on the unit.
       - 2.3.1.2. Using the Raise and Lower Speed Modbus inputs.
       - 2.3.1.3. Using the Modbus Process Reference address 40002. See the EGCP-2 Communications manual 26182, for more detail on the Modbus communications of the EGCP-2
   - 2.4. If the control is configured for Power Factor control the power factor will be controlled at the Power Factor Reference.
   - 2.5. If VAR control is configured, the kVARs will be ramped to the VAR Reference.
   - 2.6. The Power Factor or KVAR setpoint can be adjusted in three ways.
     - 2.6.1. Using the Raise and Lower Voltage discrete inputs.
     - 2.6.2. Using the Raise and Lower Voltage Modbus inputs.
     - 2.6.3. Using the Modbus Power Factor Reference address 40005, or KVAR Reference address 40007. See the EGCP-2 Communications manual 26182
   - 2.7. The active KW reference and PF reference can be viewed by pressing the KW LOAD or PF/kVAR buttons on the EGCP-2. The screens will appear like this:

KW LOAD Screen



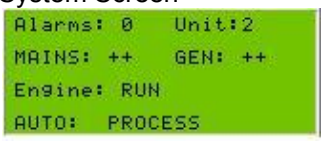
The control is in the Process mode. The generator kW is 152kW
The Process reference is 100 kW and the Process input to the kW is reading 96.7 kW. All slave units will be trying to generate 56.6% of their rated load.

PF / kVAR Screen

The VAR/PF Mode is currently PF CONTROL.
The Power Factor Reference is 0.90 LAG.
The actual Power Factor is 0.895 LAG.

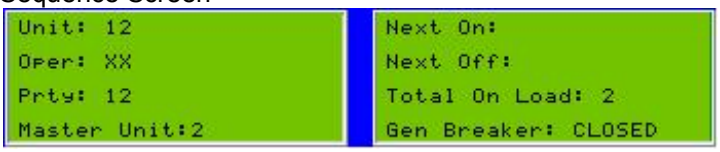
3. Starting Additional units
   - 3.1. Closing the Auto, Run with Load, and Process will start the next unit.
   - 3.2. A process master has already been established, so any additional unit that close to the bus will be Process slaves.
     - 3.2.1. The Priority number does not decide who is the master. In this case, Auto Sequencing is Disabled so the first unit that closes to the bus in Process mode, assumes the Process master.
     - 3.2.2. This is shown on the display like this:

System Screen



Unit 2 was the first unit closed to the bus and is the Process master.
Mains and Gen are stable.
The unit in the Process Mode.

Sequence Screen



Both unit 1 and 2 are running on-line.
Because Auto Sequencing is disabled unit 2 is still the master even though it has a higher priority number because it was on the bus first.

- 3.3. Starting more than one unit at the same time.
  - 3.3.1. If all of the units begin in the Off mode
  - 3.3.2. Closing the Auto, Run, and Process inputs will start the units.
    - 3.3.2.1. The first unit to receive the Auto input will become the master. This may or may not be the unit with the lowest priority number.
    - 3.3.2.2. It is possible that the master flag will switch to the unit with the lowest priority number before a unit closes to the bus. This depends on the timing of how fast the engines start and synchronize to the mains.
    - 3.3.2.3. However, after a master has been established with its breaker closed, it will remain the master until its breaker is opened or its Auto input is opened.

3.3.2.4. In some applications all of the units will work as the master so this is not a concern.
3.3.2.5. In other systems it may be important that the unit with the lowest priority number be the master. To ensure that the correct master is selected this unit should be given its Auto input one second prior to the other units.

4. Shutting Down the Genset
   4.1. By opening the Auto and Run with Load inputs, the generator load will be ramped down to the Unload Trip load level
   4.2. When the generator KW is equal to or less than the Unload Trip level, the generator breaker will trip.
   4.3. The engine will go into the stop sequence (see Chapter 2).
5. Going from Auto Run Process to Standby.
   5.1. By opening only the Run with Load input and leaving the Auto input closed, the control will unload to the unload trip level.
   5.2. When the generator KW is equal to or less than the Unload Trip level, the generator breaker will trip.
   5.3. The engine will go into the stop sequence (see Chapter 2).
   5.4. The engine is in the Standby mode, and will monitor the Mains PT input.
   5.5. If the Mains fails the engine will be started as described in the Standby application sections previously in this manual.

	Unit 1	**Unit 2**	**Unit 3**
Priority Number	1	2	3
Discrete Inputs	Auto	Auto, Run, & Proc	Auto
Start unit 2		Start	
		Synchronize	
		Close Gen Brkr	
		Process mode	
		PF Control	
Start unit 1	Auto, Run, & Proc		
	Start		
	Synchronize		
	Close Gen Brkr		
	Proc Slave mode	Proc Master Mode	
	PF Control		
Stop Unit 2		Auto	
	Proc Master Mode	Unload Gen	
		Open Gen Brkr	
		Cooldown	
		Shut down	
Stop Unit 1	Auto		
	Unload Gen		
	Open Gen Brkr		
	Cooldown		
	Shut down		

Table 7-12. Multiple Process No Sequencing Summary

The first unit that closes to the bus will become the Process master because Auto Sequencing is disabled. The master unit will not command the slaves to start or stop as load conditions change. Only units that have the Auto and Run with Load inputs closed will start, unless the mains were to fail.

Application Questions for Process Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

What will happen if the mains were to fail while the generator is on-line in Process mode?
One of many scenarios is possible.

1. The mains fails and the mains protective device trips the mains breaker. For this scenario, the EGCP-2 will recognize the mains breaker is open and switch from the process mode to the isochronous mode. All units on-line with their Auto input closed will load share with one another.
2. The mains fails, but the generator is supplying power through the mains breaker so the EGCP-2 does not see that the mains has failed.
   The EGCP-2 will remain in the process mode and try to maintain its process reference. In all likelihood, the actual load on the now isolated bus will be different from the process reference so the EGCP-2 will cause the engine to speed up or slow down. At some point, either a mains protective device or the EGCP-2 LOM alarms will see that the mains voltage is out of spec and open the mains breaker. Possibly the generator breaker would trip on a high or low frequency alarm.
3. The mains fails and the generator picks up the load of the local grid.
   It is possible that when the mains fails, the EGCP-2 would be supplying power out of the facility to an immeasurable load. In this situation, the breakers would trip on overcurrent and/or the engine would be stopped by the sudden increase in load.

NOTICE

The EGCP-2 is not a protective device for the mains breaker. Additional protective devices should be installed in accordance with the local utility requirements.

What if the mains returns after a Loss of Mains while the generators are on-line?
The master EGCP-2 will synchronize the mains breaker. After closing the mains breaker the control will ramp the kW load to the process reference and return to the process mode.

Will the generator be overloaded if the Process reference is set to export 200 kW, but the generating capacity is only rated at 150 kW?
No. While in the process mode, the EGCP-2 will not allow the load of the generator to be more than the KW Load High Limit in the Real Load Control menu, or lower than the KW Load Low Limit.

What if a unit experiences a soft or hard shutdown while in the process mode?
This situation depends on the number of units that were running and whether it was a master or slave that received the shutdown.

1. Master unit has a Hard Shutdown with at least one slave running on the bus in Process Slave mode.
   1.1. The master trips its generator breaker and shuts down. The master unit is still the master because the Auto input is still closed. The slave/s on the bus will have a System Load reference of 0% because they are in the Process Slave mode, so the slave's will operate at their Unload Trip Level. To resume the Process the shutdown will need to be reset or a new master has to be selected by opening the Auto input on the original master that shutdown. The slave with the lowest priority number will become the new master.

2. Master unit has a Soft Shutdown with at least one slave running on the bus in Process Slave mode.
   2.1. The master unit will unload to its unload trip level. The slave units will follow the load on the master because they are in the Process Slave mode. The master will open its breaker, but still remain the master. The slaves will run at their Unload Trip Level. To resume the Process, the shutdown will need to be reset or a new master has to be selected by opening the Auto input on the original master that shutdown. The slave with the lowest priority number will become the new master.
3. Slave unit has a Hard or Soft Shutdown
   3.1. For a Hard Shutdown, the slave unit will open its breaker and shutdown immediately. The master unit will try to increase the load on the remaining units to take up this lost capacity. For a Soft Shutdown, the slave unit will unload first then open its breaker and shut down. In a Soft Shutdown, the master unit should have enough time to compensate for the loss in capacity and keep the process variable at the correct level.

Multiple Unit Process with Sequencing Application

This section describes a Multiple unit system that will be operated in parallel with the mains. This application is the same as the previous Process application except that the Auto Sequencing feature is Enabled.

Configuration Items

The configuration items will match the previous application with these exceptions:

Required settings

Sequencing and Comms Menu:

Auto Sequencing:	Enabled
Auto Sequencing Delay:	Time before Sequencing will start
Max Gen Load:	Load percentage where master unit needs to add a unit
Next Genset Dly:	System Load must be above Max Gen Load for this time delay to a add a unit.
Rated Load Dly:	If system Load exceeds 100 % for this time delay, a unit will be added.
Max Start Time:	Time allowed a unit to start before skipping to next priority unit.
Min Gen Load:	Load percentage where master needs to stop a unit
Reduced Load Dly:	System Load must be below Min Gen load for this time delay to stop a unit.
Max Stop Time:	After a unit is stopped, the master will wait this time delay before trying to stop the next unit.

Setting Options

In a Multiple unit Process application only the master unit would be required to monitor the process input and control the mains breaker. The Process Menu settings and Transfer Switch Menu settings only need to be entered on units that could be the master. It is possible that all units in a system could be masters so in this case these menu items need to be set for all units. For applications where only one unit can be the master, these settings would only need to be set for that unit.

Control Wiring

The control wiring for the Auto Sequencing will match the wiring for the No Sequencing application information found in Table 7-12. The wiring diagram figure 7-3 is also the same for this application.

Operation

Using the three mode selector inputs Auto, Test, and Run w/Load and the Process input, the generator set could be placed into the proper mode of operation. The Process switch can be permanently closed or if it is desired to switch between process control and baseload control a switch can be installed for the Process input. With the Auto Sequencing feature enabled the actions of the master and slave units will be different. The switch configuration would be as follows:

Input					Mode of Operation	
	Auto	Test	Run w/Load	Process	Master	Slave
				E	Off	Off
	X			E	Standby	Master Follow
		X		E	Test No Load	Test No Load
			X	E	Manual Run with Load	Manual Run with Load
		X	X	E	Manual Run with Load	Manual Run with Load
	X	X		E	Auto Test	Auto Test
	X		X		Auto Run Baseload	Auto Run Baseload
	X	X	X		Auto Run Baseload	Auto Run Baseload
	X		X	X	System Run Process	Process Slave
	X	X	X	X	System Run Process	Process Slave

X = Discrete input closed
E = Input can be Either open or closed
Items shown in gray are not discussed in this application section of the manual.

Table 7-13. Mode Selector Switch Position for Multiple Processes with Sequencing

Off
The off state is used to shut down the generator set. In this state the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only, the master EGCP-2 will be in the Standby mode. Please see the Multiple Standby with Sequencing section for this application operation.

Master Follow
By closing the Auto input on a slave unit, the slave is now following the master for start and stop commands. The slave does not monitor the Mains for a failure, that function is performed by the master. The slave can be started if the Mains fail or if the master issues a system run command. When the master is placed in Process System Run, all units in Master Follow will start and act as Process slaves.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information on this mode of operation.

Auto Test
This mode combines the Standby and Test No Load modes. As long as the test input is closed, the engine will be started and will continue to run. However, if the mains were to fail, the engines would be closed to the bus to supply the load. Please see the Multiple Standby with Sequencing section for this application operation

Manual Run with Load
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information on this mode of operation.

System Run Process
Closing the Auto, Run with Load, and Process inputs on the master unit initiates a system start command. The master and all slave units in the Master Follow mode will start. All units will synchronize to the bus and operate in the Process mode. The master unit monitors the process signal input and will adjust its load level to maintain the process reference. All of the slave units in Master Follow will adjust their system load percentage to match that of the master so in this way multiple units can be used to maintain the process reference.

Process Slave
Closing the Auto and Run with Load inputs on a slave unit places the slave into a run mode where it does not take start / stop commands from the master unit. A slave in this mode will operate in the same load mode as the master. If the master is in process mode, the slave will follow. If the master is in baseload, the slave will go into baseload, even if its Process input is closed.

Sequence of Operation

This section will describe the details of operation for the **Process** application when configured for a **Multiple Mains Parallel** control with EGCP-2 Auto Sequencing.
For the multiple engine sequences, a three-engine system is used to demonstrate the sequence. For systems with more engines, the operation of the slave units would be the same.

System Run Process and Master Follow Sequence

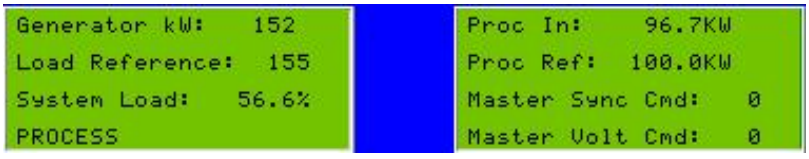
The sequence begins with a healthy mains and the EGCP-2 in OFF. The mains breaker is closed and the mains power is being supplied to the load.

1. Placing the EGCP-2 into the System Run Process mode
   1.1. Closing the auto input on all units will place the master unit in Standby and the slave units into Master Follow mode.

1.2. The whole system of engines can be started by closing the Run with Load input on the master unit only.
1.3. If the Process input is also closed on the master unit, the system will be in the System Run Process mode.
1.4. At this point the all of the engines will start (see Chapter 2)
1.5. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus
1.6. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
1.7. The generator is declared stable.
1.8. Each generator will synchronize to the mains and close its generator breaker.
1.8.1. If a slave unit closes to the bus before the master unit, it will control its load at the unload trip point until the master unit closes its generator breaker.

2. Running on-line in Process mode
2.1. The master EGCP-2 will ramp the kW load on the generator to the Process reference.
2.2. The slave units will match their system load percentage to the value of the master unit, similar to the isochronous load share mode.
2.3. The process reference can be adjusted in three ways.
2.3.1. The process reference only has to be adjusted on the master unit; the slaves will follow the master.
2.3.2. Using the Raise and Lower Speed discrete inputs.
2.3.2.1. If the Process has an Indirect relationship with the kW load, by raising the Process input, this will effectively lower the kW load on the unit, and likewise by lowering the process reference, this will actually increase the kW load on the unit.
2.3.2.2. Using the Raise and Lower Speed Modbus inputs.
2.3.2.3. Using the Modbus Process Reference address 40002. See the EGCP-2 Communications manual 26182, for more detail on the Modbus communications of the EGCP-2
2.4. The power factor control for each unit is done on an individual basis. Each unit controls at its own reference. There is no power factor sharing in Process control.
2.5. The Power Factor or KVAR setpoint can be adjusted in three ways.
2.5.1. Each individual unit will control at its own Power Factor or KVAR setpoint. Adjusting the reference of the master has no affect on the reference of the slaves.
2.5.2. Using the Raise and Lower Voltage discrete inputs.
2.5.3. Using the Raise and Lower Voltage Modbus inputs.
2.5.4. Using the Modbus Power Factor Reference address 40005, or KVAR Reference address 40007. See the EGCP-2 Communications manual 26182
2.6. The active KW reference and PF reference can be viewed by pressing the KW LOAD or PF/kVAR buttons on the EGCP-2. The screens will appear like this:

KW LOAD Screen



The control is in the Process mode. The generator kW is 152kW
The Process reference is 100 kW and the Process input to the kW is reading 96.7 kW.

All of the generators on the bus would be producing 56.6 % of their kW rating because this is the system load percentage.

PF / kVAR Screen

The VAR/PF Mode is currently PF CONTROL.
The Power Factor Reference is 0.90 LAG.
The actual Power Factor is 0.895 LAG.

3. Following the Auto Sequencing Delay time the master unit will start and stop the slave units as needed. See Chapter 8 for more details about the start/stop sequencing.
4. Shutting Down the Genset
   - 4.1. By opening the Auto and Run with Load input on the master unit, the generators load will be ramped down to the Unload Trip load level
   - 4.2. When the generator KW is equal to or less than the Unload Trip level, the generator breakers will trip.
   - 4.3. The engines will go into the stop sequence (see Chapter 2).
5. Going from Auto Run Process to Standby.
   - 5.1. By opening only the Run with Load input and leaving the Auto input closed, the controls will unload to the unload trip level.
   - 5.2. When the generator KW is equal to or less than the Unload Trip level, the generator breakers will trip.
   - 5.3. The engines will go into the stop sequence (see Chapter 2).
   - 5.4. The master will be in the Standby mode, and will monitor the Mains PT input. The slaves return to the Master Follow mode.
   - 5.5. If the Mains fails the engine will be started as described in the Standby application sections previously in this manual.

	Unit 1	Unit 2	Unit 3
Priority Number	1(master)	2	3
Discrete Inputs	Auto	Auto	Auto
System Start	Auto, Run, & Proc		
	Start	Start	Start
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Proc Master Mode	Proc Slave Mode	Proc Slave mode
	PF Control	PF Control	PF Control
System Load below Min Gen Load			Master Stop Command
			Soft Unload
			Open Gen Brkr
			Cooldown
			Shut down
System Load above Max Gen Load			Master Start Command
			Start
			Synchronize
			Close Gen Brkr
	Proc Master Mode	Proc Slave Mode	Proc Slave mode
	PF Control	PF Control	PF Control
System Stop	Auto		
	Unload	Unload	Unload
	Open Gen Brkr	Open Gen Brkr	Open Gen Brkr
	Cooldown	Cooldown	Cooldown
	Shut down	Shut down	Shut down

Table 7-15. Multiple Processes with Sequencing Summary

Application Questions for System Run Process Mode

The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

What will happen if the mains were to fail while the generator is on-line in Process mode?

One of many scenarios is possible.

1. The mains fails and the mains protective device trips the mains breaker. For this scenario, the EGCP-2 will recognize the mains breaker is open and switch from the process mode to the isochronous mode. All units on-line with their Auto input closed will load share with one another.
2. The mains fails, but the generator is supplying power through the mains breaker so the EGCP-2 does not see that the mains has failed.
   The EGCP-2 will remain in the process mode and try to maintain its process reference. In all likelihood, the actual load on the now isolated bus will be different from the process reference so the EGCP-2 will cause the engine to speed up or slow down. At some point, either a mains protective device or the EGCP-2 LOM alarms will see that the mains voltage is out of spec and open the mains breaker. Possibly the generator breaker would trip on a high or low frequency alarm.

3. The mains fails and the generator picks up the load of the local grid. It is possible that when the mains fails, the EGCP-2 would be supplying power out of the facility to an immeasurable load. In this situation, the breakers would trip on overcurrent and/or the engine would be stopped by the sudden increase in load.

NOTICE

The EGCP-2 is not a protective device for the mains breaker. Additional protective devices should be installed in accordance with the local utility requirements.

What if the mains returns after a Loss of Mains while the generators are on-line?
The master EGCP-2 will synchronize the mains breaker. After closing the mains breaker the control will ramp the kW load to the process reference and return to the process mode.

Will the generator be overloaded if the Process reference is set to export 200 kW, but the generating capacity is only rated at 150 kW?
No. While in the process mode, the EGCP-2 will not allow the load of the generator to be more than the KW Load High Limit in the Real Load Control menu, or lower than the KW Load Low Limit.

Multiple Soft Transfer Application

This section describes a system of units that will transfer the load from the mains to the generators. The soft transfer can be accomplished in either the Process or Baseload modes. Both methods will be discussed here. The soft transfer is used for applications where the generators are paralleled briefly to the mains in order to softly transfer the load from the mains to the generators. After which the mains breaker will be opened and the generators will be isolated. The sequence reverses when switching back to the mains. The generators will synchronize to the mains, close the mains breaker, transfer the load from the generators to the mains and then open the generator breakers.

Configuration Items

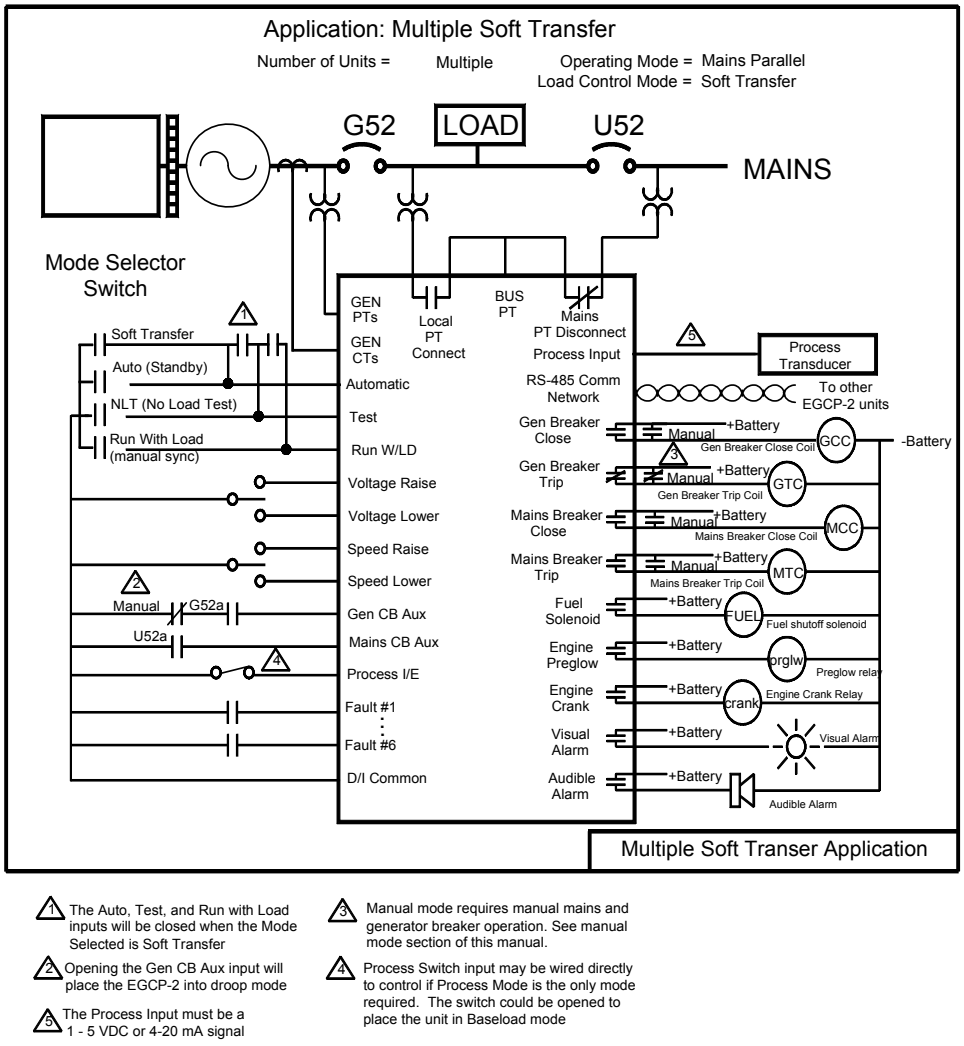
The configuration points in the EGCP-2 software, will match the configuration settings of the baseload and process applications with one exception, the Load Control Mode. All other settings should follow the baseload or process applications discussed previously.

Required settings

Real Load Control Menu:
Load Control Mode: Soft Transfer

Control Wiring

The wiring of the soft transfer application will be the same as the baseload or process applications discussed previously. Please consult these application sections for information on the control wiring.



1. The Auto, Test, and Run with Load inputs will be closed when the Mode Selected is Soft Transfer
2. Opening the Gen CB Aux input will place the EGCP-2 into droop mode
3. The Process Input must be a 1 - 5 VDC or 4-20 mA signal
4. Manual mode requires manual mains and generator breaker operation. See manual mode section of this manual.
5. Process Switch input may be wired directly to control if Process Mode is the only mode required. The switch could be opened to place the unit in Baseload mode

Figure 7-4. Multiple Unit Soft Transfer Application

Operation

Using the three mode selector inputs Auto, Test, and Run with Load and the Process input, the generator set can be placed into the proper mode of operation. When all three of the inputs are closed and the Load Control Mode is programmed for Soft Transfer, the control will go into the soft transfer mode. Then if the Process input is open, the control will perform a baseload soft transfer. If the Process input is closed, the control will perform a process soft transfer. The switch configuration would be as follows:

Input					Mode of Operation	
Auto	Test	Run w/Load	Process		Master	Slave
			E		Off	Off
X			E		Standby	Master Follow
	X		E		Test No Load	Test No Load
		X	E		Manual Run with Load	Manual Run with Load
	X	X	E		Manual Run with Load	Manual Run with Load
X	X		E		Auto Test	Auto Test
X		X			Auto Run Baseload	Auto Run Baseload
X	X	X			Soft Transfer Baseload	Auto Run Baseload
X		X	X		System Run Process	Process Slave
X	X	X	X		Soft Transfer Process	Process Slave

X = Discrete input closed
E = Input can be Either open or closed Modes that are shown in gray are not discussed in this application section.

Table 7-14. Mode Selector Switch Position for Soft Transfer

Off
The off state is used to shut down the generator set. In this state, the EGCP-2 will not energize its Fuel Solenoid output. If the EGCP-2 senses a magnetic pickup input, the Engine state will be displayed as Spindown. The EGCP-2 will call for a generator breaker trip. The control will not open or close the mains breaker in this mode.

Standby
By closing the Auto input only on the master unit, the EGCP-2 will be in the Standby mode. Please see the previous application Single Standby for an explanation of the operation.

Master Follow
By closing the Auto input on a slave unit, the slave is now following the master for start and stop commands. The slave does not monitor the Mains for a failure, that function is performed by the master. The slave can be started if the Mains fail or if the master issues a system run command. When the master is placed in Process System Run, all units in Master Follow will start and act as Process slaves.

Test No Load
To run the engine without any load, the Test no Load mode can be used. See Chapter 3 for more information about this mode.

Manual Run Baseload
The Manual Run with Load mode is used for manual synchronization. See Chapter 3 for more information about this mode.

Auto Run Process or Baseload
When the Auto, and Run with Load inputs are closed, the control will perform an automatic synchronization and run with the generator breaker closed. Please see the previous applications for an explanation of the operation.

Soft Transfer Process or Baseload
When the Auto, Test, and Run with Load inputs are closed, the control will perform a soft transfer, where the load will be transferred from the mains to the generator in a controlled closed transition fashion. The generator will then run isolated from the mains until this mode is exited, at which time it will return the load to the mains. The state of the Process input on the master unit will determine whether the soft transfer is performed in the Baseload or Process mode.

Sequence of Operation

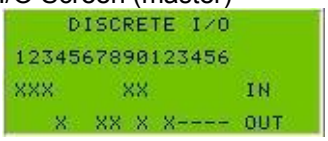
This section will describe the details of operation for the **Soft Transfer** application when configured for a **Single Parallel** control.

Soft Transfer Process Sequence

The sequence begins with a healthy mains and the master EGCP-2 in Standby and the slave units in the Master Follow modes.
The mains breaker is closed and the mains power is being supplied to the load.

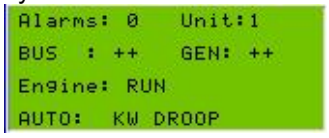
1. Placing the EGCP-2 into the Soft Transfer Process mode
   1.1. To place the engine in Soft Transfer Process the Auto, Test, Run with Load, and Process inputs will be closed on the master unit.
   1.2. At this point all engines will start (see Chapter 2).
   1.3. If the mains voltage is stable, and the mains breaker were not closed, the EGCP-2 would close the mains breaker.
   1.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus
   1.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   1.6. The generator is declared stable. The displays will be shown like this:

I/O Screen (master)



Input 9, the Mains CB Aux is closed.
Inputs 1,2, 3, & 10 Auto, Test, Run w/Load, and Process are closed to place the control in the Soft Transfer Process mode.
Outputs 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated speed.
Outputs 7 & 8 are closed to bring the Bus PT voltage into the Mains/Bus PT input.
Output 10 is closed to remove the Generator Breaker trip signal.

System Screen



The BUS voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the KW Droop mode because the gen circuit breaker is open.

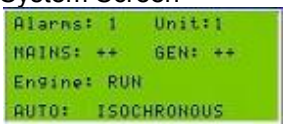
2. Transferring from Mains power to generator power in the Process mode
   2.1. Each generator will synchronize to the mains and close its generator breaker.
      2.1.1. If a slave unit closes to the bus before the master unit, it will control its load at the unload trip point until the master unit closes its generator breaker.

2.2. The master EGCP-2 will ramp the kW load on the generator to the Process reference.
2.3. The slave units will match their system load percentage to the value of the master unit, similar to the isochronous load share mode.
2.4. If the control is configured for Power Factor control the power factor will be controlled at the Power Factor Reference.
2.5. If VAR control is configured, the kVARs will be ramped to the VAR Reference.
2.6. Once the Process signal is equal to the Process reference, the Mains breaker is opened.
2.7. The EGCP-2's then will operate in the isochronous mode supplying the total load on the bus.
2.8. This would be displayed like this

I/O Screen

Input 8 the Gen CB Aux is closed.
Inputs 1,2, 3, & 10 Auto , Test, Run w/Load, and Process are closed to operate the control in the Soft Transfer Process mode.
Outputs 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated speed.
Output 10 is closed to remove the Generator Breaker trip signal.

System Screen



The Mains voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the ISOCHRONOUS mode because the mains circuit breaker is open.

3. If the Auto Sequencing feature is enabled the master unit will start and stop the slave units as needed following the Auto Sequencing Delay. See Chapter 8 for more details about the start/stop sequencing.
4. Returning to Mains Power
   4.1. By opening either the Test input, or both the Test and Run with Load inputs the EGCP-2 will resynchronize the Mains breaker.
   4.2. The EGCP-2 will already be monitoring the mains so there is no need to switch to look at the Bus PT.
      4.2.1. Case 1. Only the Test input is opened
         4.2.1.1. The master EGCP-2 will resynchronize the Mains breaker.
         4.2.1.2. The controls will ramp into the Auto Process mode and go into Process control at the Process reference.
      4.2.2. Case 2. Only the Run with Load input is opened
         4.2.2.1. No change is seen. The master remains in isochronous mode and does not try to resynchronize to the mains.
      4.2.3. Case 3. Both the Test and Run with Load inputs are opened.
         4.2.3.1. The master EGCP-2 will resynchronize the Mains breaker.
         4.2.3.2. The generators will softly unload to their unload trip level, passing the load from the generator to the mains.
         4.2.3.3. The generator breakers will be opened.
         4.2.3.4. The engines will go into the stop sequence (see Chapter 2).
         4.2.3.5. The master control will be in the Standby mode, the slaves remain in the Master Follow mode.

4.2.4. Case 4. All three inputs Auto, Test, and Run with Load are opened.
- 4.2.4.1. In this case, the master unit will no longer be in Auto, so the slave unit with the next lowest priority will become the master.
- 4.2.4.2. The unit that had been master will open its breaker and go into the stop sequence.
- 4.2.4.3. The new master will resynchronize the Mains breaker.
- 4.2.4.4. The generators will softly unload to their unload trip level, passing the load from the generator to the mains.
- 4.2.4.5. The generator breakers will be opened.
- 4.2.4.6. The engine will go into the stop sequence (see Chapter 2).
- 4.2.4.7. If all of the slave units had been stopped by the master and then its Auto input was opened, the slaves will not re-start. The on coming master will recognize that the Mains are stable and close the mains breaker.

	Unit 1	**Unit 2**	**Unit 3**
Priority Number	1(master)	2	3
Discrete Inputs	Auto	Auto	Auto
System Start	Auto, Test, Run, & Process		
	Start	Start	Start
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Proc Master Mode	Proc Slave Mode	Proc Slave mode
	PF Control	PF Control	PF Control
Process Input = Process Reference	Open mains breaker		
	Isochronous	Isochronous	Isochronous
	PF Sharing	PF Sharing	PF Sharing
System Load below Min Gen Load			Master Stop Command
			Soft Unload
			Open Gen Brkr
			Cooldown
			Shut down
System Load above Max Gen Load			Master Start Command
			Start
			Synchronize
			Close Gen Brkr
	Isochronous	Isochronous	Isochronous
	PF Sharing	PF Sharing	PF Sharing
System Stop	Auto		
	Synchronize Mains Breaker		
	Close Mains Brkr		
	Unload	Unload	Unload
	Open Gen Brkr	Open Gen Brkr	Open Gen Brkr
	Cooldown	Cooldown	Cooldown
	Shut down	Shut down	Shut down

Table 7-17. Multiple Process Soft Transfer with Sequencing Summary

Application Questions for Soft Transfer Process Mode

The previous example lists the expected sequence of operation. However, it is important to look at a few "what if" scenarios and note what would happen if the sequence were interrupted.

What happens if the master generator experiences a hard shutdown while isolated from the mains?

The generator breaker is opened immediately and the engine is stopped. The master unit is still in Auto so it remains the master. The slave units will continue to run in Isochronous load sharing mode. To return to the mains the shutdown would have to be reset on the master so that it could restart or the Auto input would have to be removed so that a new master could take control and then synchronize the mains breaker.

What happens if the generator experiences a soft shutdown while isolated from the mains?

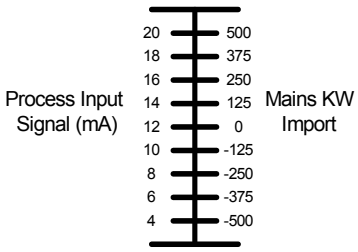
The generator will be unloaded to the unload trip level, where the generator breaker will be opened. Then the engine will proceed through a cooldown time, if applicable, and then shut down. The Auto input is still closed so this unit will remain the master just as in the hard shutdown example above.

What will happen if the mains were to fail while the generator is on-line in Soft Transfer mode?

Since the engines are already running on-line with the Mains breaker open, no change is seen. As long as the Auto input is closed to enable the Standby mode, the generators will remain on-line. Units that have been stopped by the master will not be restarted because the mains has failed, they wait for the load to increase above the Max Gen Load setting.

If the load on the bus is more than the generator can produce, will the mains breaker still be opened?

To avoid a possible overload it is very important to set the process reference close to the zero import level. The EGCP-2 will not open the mains breaker unless the process input signal is within the Process Deadband setting of the Process Reference.



Consider an example where three 100 kW generator sets are being used in a Soft Transfer mode. The process input signal is 12 mA when the mains import load is zero and 20 mA when the import load is 500 kW (see chart at right). If the load being supplied by the Mains is 250 kW, the process input would be 16 mA. If one or even two generators were asked to carry this load, their capacity would be exceeded because together they can only produce 200 kW. All three generators would need to be on-line to take this load. The process reference should be set to 12 mA. Then when the generators are closed on to the bus they will begin to take load from the mains, until they reach their kW High Load Limit. With two generators on the bus, the process input signal will be at 12.8 mA. The generators are carrying 200 kW, and the mains is carrying 50 kW. The Process Reference is 12.0 mA and the Process Deadband is 0.3% so the process input signal would need to be below 12.05 mA before the breaker would be opened. The system will wait until the third generator closes to the bus and then the mains breaker would be tripped.

If the Process Reference were set at 13.0 mA, the mains breaker would be tripped whenever two generators were on the bus that might cause a possible overload.

Soft Transfer Baseload Sequence

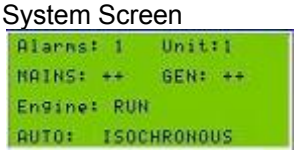
The sequence begins with a healthy mains and the master EGCP-2 in Standby and the slave units in the Master Follow modes.
The mains breaker is closed and the mains power is being supplied to the load.

1. Placing the EGCP-2 into the Soft Transfer Baseload mode
   - 1.1. To place the engine in Soft Transfer Baseload the Auto, Test, and Run with Load inputs will be closed. The Process input is open.
   - 1.2. At this point all engines will start (see Chapter 2).
   - 1.3. If the mains voltage is stable, and the mains breaker were not closed, the EGCP-2 would close the mains breaker.
   - 1.4. The Mains/Bus PT input will switch from looking at the Mains to looking at the Bus
   - 1.5. The generator voltage and frequency must be within the high and low limits of the Shutdown and Alarm menu for the Gen Stable Delay time.
   - 1.6. The generator is declared stable.
2. Transferring from Mains power to generator power in the Baseload mode
   - 2.1. Each generator will synchronize to the mains and close its generator breaker.
     - 2.1.1. If a slave unit closes to the bus before the master unit, it will ramp its load to its baseload setpoint.
     - 2.1.2. It is entirely possible that the master unit could close to the mains first and reach its baseload setpoint before the other units.
   - 2.2. If PF Control is configured, the Power Factor will be ramped to the PF Reference.
   - 2.3. If VAR control is configured, the kVARs will be ramped to the VAR Reference.
   - 2.4. Once the master's baseload reference reaches the Baseload Reference setpoint, the Mains breaker is opened.
     - 2.4.1. The control uses the Baseload reference only; to determine when to open the Mains breaker, the actual load on the mains is not considered.
     - 2.4.2. The control has no knowledge of how much load is on the bus. The mains breaker will open and whatever load was being supplied by the mains will be dumped on to the generator.
     - 2.4.3. The master unit will not wait for other units to close to the bus or reach their baseload setpoint.
   - 2.5. The EGCP-2's then will operate in the isochronous mode supplying the total load on the bus.
   - 2.6. This would be displayed like this

I/O Screen

Input 8 the Gen CB Aux is closed.
Inputs 1,2, & 3 Auto, Test, & Run w/Load are closed to operate the control in the Soft Transfer Baseload mode.
Outputs 4 & 12 Fuel Solenoid and Idle/Rated are closed to run the engine at rated speed.
Output 10 is closed to remove the Generator Breaker trip signal.

System Screen



The Mains voltage is within spec shown by ++.
The GEN voltage is within spec shown by ++.
The engine is in the RUN state.
The control is in AUTO and is in the ISOCHRONOUS mode because the mains circuit breaker is open.

3. If the Auto Sequencing feature is enabled the master unit will start and stop the slave units as needed following the Auto Sequencing Delay. See Chapter 8 for more details about the start/stop sequencing.
4. Returning to Mains Power
   - 4.1. By opening either the Test input, or both the Test and Run with Load inputs the EGCP-2 will resynchronize the Mains breaker.
   - 4.2. The EGCP-2 will already be monitoring the mains so there is no need to switch to look at the Bus PT.
     - 4.2.1. Case 1. Only the Test input is opened
       - 4.2.1.1. The EGCP-2 will resynchronize the Mains breaker.
       - 4.2.1.2. The controls will ramp into the Auto Baseload mode and go into Baseload control at the Baseload reference.
     - 4.2.2. Case 2. Only the Run with Load input is opened
       - 4.2.2.1. No change is seen. The master remains in ISOCHRONOUS mode and does not try to resynchronize to the mains.
     - 4.2.3. Case 3. Both the Test and Run with Load inputs are opened.
       - 4.2.3.1. The master EGCP-2 will resynchronize the Mains breaker.
       - 4.2.3.2. The generators will softly unload to their unload trip level, passing the load from the generator to the mains.
       - 4.2.3.3. The generator breakers will be opened.
       - 4.2.3.4. The engines will go into the stop sequence (see Chapter 2).
       - 4.2.3.5. The master control will be in the Standby mode, the slaves remain in the Master Follow mode.
     - 4.2.4. Case 4. All three inputs Auto, Test, and Run with Load are opened.
       - 4.2.4.1. In this case the master unit will no longer be in Auto, so the slave unit with the next lowest priority will become the master.
       - 4.2.4.2. The unit that had been master will open its breaker and go into the stop sequence.
       - 4.2.4.3. The new master will resynchronize the Mains breaker.
       - 4.2.4.4. The generators will softly unload to their unload trip level, passing the load from the generator to the mains.
       - 4.2.4.5. The generator breakers will be opened.
       - 4.2.4.6. The engine will go into the stop sequence (see Chapter 2).
       - 4.2.4.7. If all of the slave units had been stopped by the master and then its Auto input was opened, the slaves will not re-start. The on coming master will recognize that the Mains are stable and close the mains breaker.

	Unit 1	Unit 2	Unit 3
Priority Number	1(master)	2	3
Discrete Inputs	Auto	Auto	Auto
System Start	Auto, Test, Run		
	Start	Start	Start
	Synchronize	Synchronize	Synchronize
	Close Gen Brkr	Close Gen Brkr	Close Gen Brkr
	Baseload	Baseload	Baseload
	PF Control	PF Control	PF Control
Baseload Ref = Baseload Setpoint	Open mains breaker		
	Isochronous	Isochronous	Isochronous
	PF Sharing	PF Sharing	PF Sharing
System Load below Min Gen Load			Master Stop Command
			Soft Unload
			Open Gen Brkr
			Cooldown
			Shut down
System Load above Max Gen Load			Master Start Command
			Start
			Synchronize
			Close Gen Brkr
	Isochronous	Isochronous	Isochronous
	PF Sharing	PF Sharing	PF Sharing
System Stop	Auto		
	Synchronize Mains Breaker		
	Close Mains Brkr		
	Unload	Unload	Unload
	Open Gen Brkr	Open Gen Brkr	Open Gen Brkr
	Cooldown	Cooldown	Cooldown
	Shut down	Shut down	Shut down

Table 7-18. Multiple Baseload Soft Transfer with Sequencing Summary

Application Questions for Soft Transfer Baseload Mode
The previous example lists the expected sequence of operation. However, it is important to look at a few “what if” scenarios and note what would happen if the sequence were interrupted.

What happens if the master generator experiences a hard shutdown while isolated from the mains?
The generator breaker is opened immediately and the engine is stopped. The master unit is still in Auto so it remains the master. The slave units will continue to run in Isochronous load sharing mode. To return to the mains the shutdown would have to be reset on the master so that it could restart or the Auto input would have to be removed so that a new master could take control and then synchronize the mains breaker.

What happens if the generator experiences a soft shutdown while isolated from the mains?
The generator will be unloaded to the unload trip level, where the generator breaker will be opened. Then the engine will proceed through a cooldown time, if applicable, and then shut down. The Auto input is still closed so this unit will remain the master just as in the hard shutdown example above.

What will happen if the mains were to fail while the generator is on-line in Soft Transfer mode?
Since the engines are already running on-line with the Mains breaker open, no change is seen. As long as the Auto input is closed to enable the Standby mode, the generators will remain on-line. Units that have been stopped by the master will not be restarted because the mains has failed, they wait for the load to increase above the Max Gen Load setting

Will the mains breaker still be opened, which could possibly overload the generator, if the load on the bus exceeds the load capacity of the generator?
In the Soft Transfer Baseload mode, the control has no knowledge of how much load was on the bus being supplied by the mains. It is possible that the mains breaker could be opened and the generator could be overloaded. In this situation a load shed scheme would need to be implemented. At the least an operator should verify the load on the bus is less than the generator capacity before placing the control into the Soft Transfer mode

IMPORTANT

For Soft Transfer applications, it is recommended to use the Process control method rather than the Baseload method for the following reasons:

1. **The baseload method does not take into account the load on the bus, it simply opens the breaker and assumes the generator will be capable of supplying the load.**
2. **The process method will use the process input signal to determine if the load has indeed been transferred to the generator before the mains breaker is opened.**
3. **The baseload method may place a large load on the engine if the baseload reference is not close the actual load on the bus.**
4. **The process method can be used to reach a zero power import and thus minimize the load dump on the engine and through the mains breaker.**

Chapter 8.
Start/Stop Sequencing

The EGCP-2 can perform Start/Stop sequencing in two configurations, isolated from the mains and parallel with the mains in the Process mode. The decisions to start or stop an engine generator set are made by the master unit according to the configuration settings in the Sequencing and Comms menu. For more information about these settings see the Installation and Operation manual 26174 Chapter 5.

In this chapter the basic start/stop sequences of operation are covered as it pertains to the different applications.

With the mains breaker open and multiple engines running on an isolated bus, the master EGCP-2 is capable of starting and stopping units as the load on the bus changes. Isolated bus sequencing could occur in each of the following four applications:
Multiple No Parallel Standby with Sequencing
Multiple Parallel Standby with Sequencing
Multiple Prime Power with Sequencing
Multiple Soft Transfer with Sequencing

In each of these applications, the start/stop sequencing can occur whenever the mains have failed and the generators are providing power to the load.
For a Standby application the mains would be failed.
For a Prime Power application there is no mains so any time the system is in operation, the start/stop sequencing can occur.
For a Soft Transfer or No Parallel application the generators will be supplying power to an isolated bus even though the mains is present.

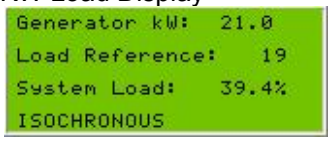
With the generators paralleled to the mains and operating in the Process mode, the master EGCP-2 is capable of starting and stopping units as the load on the generators change to maintain the process. Only one application is capable of this type of unit sequencing, the Multiple Parallel Process with Sequencing application.

Stop Sequence

This sequence begins with at least two generators running on-line.

1. After the master unit closes to the bus, the Auto Sequencing Delay time starts. This timer is used to delay the Sequencing function for a period of time, when loads may be returning to bus or to allow all of the engines a minimum run time.
2. Following the Auto Sequencing Delay, the master unit will monitor its System Load percentage as seen here

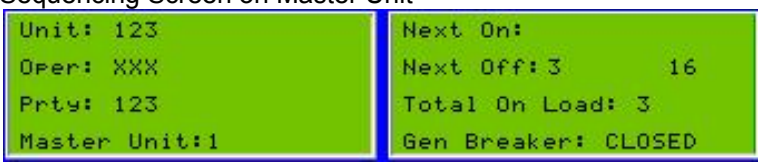
KW Load Display



The generator is supplying 21 kW.
The desired load is 19 kW, which is 39.4 % of its rating 48kW.

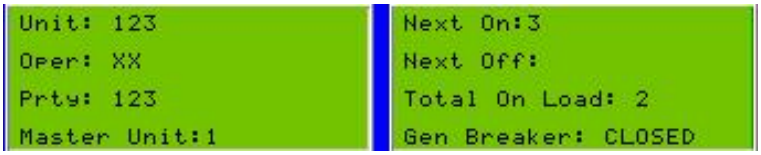
3. If this load percentage is less than the Min Gen Load setting for the Reduced Load Delay timer, the unit with the highest priority number will be commanded to stop.
   3.1. The master will calculate if removing this unit will cause the load to increase to within 10 % of the Max Gen Load where a unit would be needed to start.
   3.2. This 10 % deadband is used to keep units from cycling on and off the bus.
4. This is displayed like this:

Sequencing Screen on Master Unit



Units 1,2, and 3 are running on-line.
Unit 1 is the master unit.
The Next On and Next Off show, on the right display, which units would be the next to be sequenced on and off. No other units are available so the Next On shows none.
The next unit to come off would be unit three. At this time, the system load is below the Min Gen Load so the Reduced Load Delay timer is shown on the far right of the Next Off line. It is counting down and the current value is 16. If the system load is still below the Min Gen Load for the next 16 seconds, unit three will be commanded to be shut down.

5. The slave unit unloads to its unload trip point.
6. Opens its generator breaker
7. Then goes into the stop sequence.
8. The display will appear like this:



Unit three has been sequenced off and will now be the Next On.
The system load is not above the Max Gen Load because the timer is not being shown on the Next On line.

9. The Max Stop Time timer is started. The master unit will wait for the Max Stop time before sequencing another unit off the bus. This delay is used to allow a unit enough time to unload and shutdown, before the master commands the next unit to start or stop.
10. This sequence could occur for each slave on the bus in the Master Follow mode.
11. The master unit will never sequence itself off the bus. It will always run.

Start Sequence

Units that had been stopped by the master, may be commanded to start again if the load were to increase on the bus.
This sequence begins with the at least one slave having been stopped previously by the master.

1. If the system load exceeds the Max Gen Load setpoint for the Next Genset Delay time the Next On engine will be commanded to start.

2. This is displayed like this:

Units 1 and 2 are currently running on-line with unit 1 being the master. Unit three had been sequenced off previously, but now the load has increased above the Max Gen Load setting of the master. This is seen because the Next Genset Delay timer has appeared on the Next On: line, and is currently at 14 seconds. As long as the load remains above the Max Gen Load for the next 14 seconds, unit three will be commanded to start.

3. The Max Start Time timer is started.
   3.1. The master will not command another unit to start until this timer has finished
   3.2. If the unit fails to crank and logs a Fail To Crank alarm, it will be skipped and the next priority unit will be commanded to start, following the Max Start Time.
   3.3. If the Start Sequencing feature has been disabled, the Fail To Crank alarm is overridden and so if the engine did fail to start, the EGCP-2 system needs to be alerted. One of the Remote Fault inputs should be programmed for a Hard Shutdown. If the engine fails to start this hard shutdown input will take that EGCP-2 out of the sequencing group and then the next unit can be commanded to start.
   3.4. If a unit that is commanded to start, does start successfully but fails to synchronize to the bus a Sync Reclose or Sync Timeout alarm will be logged. However, because this unit did start, the master does not skip this unit to go to the next priority unit. The alarm will have to be cleared or the unit will need to be taken out of the Master Follow mode by opening the Auto input to go to the next unit.
4. The engine starts and synchronizes to the bus.
5. The EGCP-2 will ramp its load setpoint from the unload trip level to the System Load percentage of the other generators on-line and begin sharing the load.
6. This sequence could occur for each slave in the system that was previously stopped and is still available.

A special situation occurs if the master is loaded beyond its rated capacity. The EGCP-2 uses the Rated Load Delay time to start an engine sooner if the master becomes overloaded. The Rated Load Delay time is intended to be set to a value less than the Next Genset Delay time.

- If a unit is started because of a Rated Load start, the Idle Rated timer is skipped in the start sequence (see Chapter 2).
- The Load ramp is also skipped. The on-coming unit will try to match the system load percentage after its breaker is closed to add capacity as quickly as possible.

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.

Declarations

DECLARATION OF CONFORMITY
According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	WOODWARD GOVERNOR COMPANY (WGC) Industrial Controls Group
Manufacturer's Address:	1000 E. Drake Rd. P.O. Box 1519 Fort Collins, CO USA 80525-1519
European Representative's Name:	WOODWARD GOVERNOR NEDERLAND BV
European Representative's Address:	Hoofdweg 601 P. O. Box 34 2130 AA Hoofddorp, The Netherlands
Model Name(s)/Number(s):	EGCP-2
Conformance to Directive(s):	89/336/EEC COUNCIL DIRECTIVE of 03 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility. 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.
Applicable Standards:	EN 50081-2, August 1993: EMC Generic Emission Standard, Part 2: Industrial Environment. EN 61000-6-2, April 1999: EMC Compatibility - Generic Standards - Immunity for Industrial Environments EN 50178, October 1997: Electrical equipment for use in power installations.

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Jennifer R. Williams
Signature

Jennifer R. Williams
Full Name

Engineering Project/Process Mng.
Position

WGC, Fort Collins, CO, USA
Place

8-22-00
Date

EGCP-2 Control Specifications

Woodward Part Numbers:	
8406-120	EGCP-2 Engine Generator Control, 150–300 Vac PT input
8406-121	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, 8406-121 150–300 Vac, 8406-120
CT input	0–5 A rms
Generator Frequency Range	40–70 Hz
Magnetic Pickup	100–15 000 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 0–5V transducer
Speed Bias	±3 Vdc, 0.5–4.5 Vdc, 5 V peak 500 Hz PWM
Voltage Bias	±1 Vdc, ±3 Vdc, ±9 Vdc
Discrete Outputs (Relay Outputs)	10 A, 250 Vac Resistive 249 W (1/3 hp), 125 Vac (7.2 A, 0.4–0.5 PF) 10 A, 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 G²/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.

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.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26175.

WOODWARD

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Email and Website—www.woodward.com

**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

Complete address / phone / fax / email information for all locations is available on our website.

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