H-100 Control Panel

TECHNICAL MANUAL

A new standard of reliability
SAVE THESE INSTRUCTIONS – The manufacturer suggests that these rules for safe operation be copied and posted in potential hazard areas. Safety should be stressed to all operators and potential operators of this equipment.

Study these SAFETY RULES carefully before installing, operating, or servicing this equipment. Become familiar with this manual and all literature pertaining to the generator set and related equipment. This equipment can operate safely, efficiently, and reliably only if it is properly installed, operated, and maintained. Many accidents are caused by failing to follow simple and fundamental rules or precautions.

The manufacturer cannot anticipate every possible circumstance that might involve a hazard. The warnings in this manual, and on tags and decals affixed to the equipment, are, therefore, not all inclusive. If using a procedure, work method, or operating technique the manufacturer does not specifically recommend, ensure that it is safe for others. Also make sure the procedure, work method, or operating technique utilized does not render the equipment unsafe.

GENERAL HAZARDS

- For safety reasons, the manufacturer recommends that this equipment be installed and serviced by an Authorized Service Dealer or other qualified electrician or installation technician who is familiar with applicable codes, standards, and regulations. The operator also must comply with all such codes, standards, and regulations.
- When working on this equipment, remain alert at all times. Never work on the equipment when physically or mentally fatigued.
- Inspect the equipment regularly, and promptly repair or replace all worn, damaged or defective parts, using only factory-approved parts.
- Before performing any maintenance on the generator or any related equipment, disconnect the generator’s battery cables and remove panel fuse to prevent accidental startup. Disconnect the cable from the battery post, indicated by a NEGATIVE, NEG, or (–) first. Reconnect that cable last.

ELECTRICAL HAZARDS

- Generators produce dangerous electrical voltages and can cause fatal electrical shock. Avoid contact with bare wires, terminals, connections, etc., while the generator and related equipment are running. Ensure all appropriate covers, guards, and barriers are in place before operating the equipment. If working around an operating unit, stand on an insulated, dry surface to reduce potential shock hazards.
- Do not handle any kind of electrical device while standing in water, while barefoot, or while hands or feet are wet. DANGEROUS ELECTRICAL SHOCK MAY RESULT.
- If people must stand on metal or concrete while installing, operating, servicing, adjusting, or repairing this equipment, place insulative mats over a dry wooden platform. Work on the equipment only while standing on such insulative mats.
- Wire gauge sizes of electrical wiring, cables, and cord sets must be adequate to handle the maximum electrical current (amperage) to which they will be subjected to.
- Before installing or servicing this equipment, make sure that all power voltage supplies are positively turned off at their source. Failure to do so will result in hazardous and possibly fatal electrical shock.
- When installed with an automatic transfer switch, the generator may crank and start anytime, without warning. To prevent injuries caused by sudden start-up, disable the generator’s automatic start circuit before working on, or around, the unit. Then, place a “Do Not Operate” tag on the generator control panel and on the transfer switch.
- In case of an accident caused by electric shock, immediately shut down the source of electrical power. If this is not possible, attempt to free the victim from the live conductor. AVOID DIRECT CONTACT WITH THE VICTIM. Use a nonconducting implement, such as, a rope or board, to free the victim from the live conductor. If the victim is unconscious, apply first aid and get immediate medical help.
- Never wear jewelry when working on this equipment. Jewelry can conduct electricity, resulting in electric shock, or may get caught in moving components, causing injury.

FIRE HAZARDS

- For fire safety, the generator and related equipment must be installed and maintained properly. Installation always must comply with applicable codes, standards, laws, and regulations. Adhere strictly to local, state, and national electrical and building codes. Comply with regulations the Occupational Safety and Health Administration (OSHA) has established. Also, ensure that the equipment is installed in accordance with the manufacturer’s instructions and recommendations. Following proper installation, do nothing that might alter a safe installation and render the unit in noncompliance with the aforementioned codes, standards, laws, and regulations.
NOTE:
The HTS is equivalent to the X-type transfer switch.
INTRODUCTION
The H-100 Control Panel is an electronic control box that functions as an advanced standby generator controller. Its technology is based on the flagship PM-DCP system with all its flexibility included. A familiar user interface in the form of GenLink®-DCP is used to program, monitor and change the parameters in the unit. The interface appears the same as it does for the PM-DCP.

Specialized programs are built into the H-100 Control Panel to allow customers to configure spare I/O to their own needs. For example, built in Integrated Logic Controller (ILC) logic can eliminate the need for ancillary external controllers. Everything can be user customized from measurements to alarms to the screen displays.

Why do we do this? Having one set of control firmware buys us the economy of scale which can be passed on to the customer. It also has great technical advantages. The H-100 Control Panel and all PM-DCP products are built around a common “core” of firmware. This provides EVERY product with the same technical tools. For example, both the H-100 Control Panel and PM-DCP products can call out for assistance via a modem, every product can provide trending data for its measured parameters, any measured value can be setup to create alarms or warnings, each product has a built in ILC, etc. H-100 Control Panel is very flexible.

FEATURES
• Local/remote connection to a PC for GenLink®-DCP communication.
• Interface with up to four HTS Commercial Transfer Switches.
• Interface with up to two Remote Annunciator Panels.
• Customizable display.
• New Generation GenLink.
• Built-in Frequency and Voltage controller.
• External modem option with dialout capability upon alarm.
• Communication via standard CAN bus and Modbus protocols.
• Programmable I/O channel properties.
• Programmable alarm/warnings.
• Alarm and event logging with time stamping.
• Parameter logging and trending both to file and graphical.
• Built-in diagnostics.
• Internal ILC for combinatorial logic functions including analog inputs.
• Spare customer programmable Analog input capacity.
• Spare customer programmable Digital I/O capacity.
• Firmware can be updated via Telephone line.

PANEL SETUP
◆ CHANGING THE CONTROLLER CONFIGURATION
The H-100 Control Panel controller is setup in the factory to match the product it is shipped with and generally no changes are required. For spares purposes the controller can be re-configured in the field using the GenLink software tool and a PC.

If you need to change the function of the panel the best way to get a basic setup for a product is to use GenLink to download a “product file”. This will setup all the basic parameters and just leave customization and calibration to be done. Product files are available on the web site for downloading cross referenced to product serial numbers/generic product types. The manufacturer does not recommend changing the settings individually for a product as this is laborious and prone to human error. Some of the settings require detailed knowledge of things like governor settings which are not easily discernable.

Some configurations are changeable from the H-100 Control Panel touch pad and displays. These configurations will be described later and include:
• Setting Display Contrast
• Setting System Time and Date
• Setting up/Enabling Internal Exercise
• Enabling Interface with HTS Commercial Transfer Switch

◆ CUSTOMIZATION
The controller is designed to be very flexible and allow great levels of customization via the GenLink tool. Once you have customized your controller, you should save the settings away to floppy or hard disk for backup. This can be done during the customization process, or at any time subsequent to customization by uploading the settings from the controller to GenLink and then saving them to disk. The digital outputs can be set to turn on from any one of a list of functions, or they can be used as part of the built-in ILC. The digital inputs can be moved, inverted, renamed, given delay times, made alarms, used in the ILC, logged/not logged, etc. Refer to the section “MEASUREMENT ENGINE” for details. Analog inputs are dealt with in the same section.

There are some parameters which are specific to the product, such as an engine controller or transfer switch. These are all customizable via GenLink. Refer to the relevant section for details.
THE MEASUREMENT "ENGINE"

The measurement "engine" is the key feature of the system. All the inputs to the controller are processed by this module. Each physical input is measured and the result processed by an individual set of rules that are set via a PC and GenLink. Normally, a product is delivered with the inputs and outputs pre-configured and nothing needs to be done, however the manufacturer has provided complete flexibility to each measurement (except where product safety is concerned). The inputs are divided into analog and digital channels.

◆ ANALOG CHANNELS

There are 23 analog channels of which 14 have fixed functions. The remaining 9 channels are split between product specific inputs (such as oil temperature), and customer spares. The exact split depends on the product. Table 1 shows the channel allocation.

Some of the 14 fixed channels are “DERIVED” readings in that they are calculated from the other readings. For example, power is calculated from both voltage and current. These are not real hardware channels, but they result in an analog reading that can be treated as a “fixed channel” just like any other.

◆ ANALOG MATHS

Each of the 23 channels is processed by a set of measuring rules using constants that are set via GenLink. Usually these constants can be changed by the customer. In the following illustration, the measurement is represented by M and the GenLink constants are in italics. The measurement is processed in the following order and the result is then stored for customer display or use.

\[
M = M \times \text{Calibration Factor}
\]

This is used to calibrate out any reading inaccuracies where calibration factor is a number such that 1024 is equivalent to 1, so it’s really \(M \times \text{calibration factor}/1024\). GenLink will hide this computation so you can enter floating point numbers such as 1.1 or 0.987 etc.

THEN

\[
M = M \text{ processed by function } x:
\]

### Table 1

<table>
<thead>
<tr>
<th>CPU Channel No.</th>
<th>Channel Title</th>
<th>Update Rate</th>
<th>Derived Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>User Configurable #1 (Usually Oil Temp)</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>User Configurable #2 (Usually Coolant Temp)</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>9</td>
<td>User Configurable #3 (Usually Oil Pressure)</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>10</td>
<td>User Configurable #4 (Usually Coolant Level)</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>11</td>
<td>User Configurable #5 (Usually Fuel level)</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>User Configurable #6 - Spare -</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>13</td>
<td>User Configurable #7 (Usually throttle position)</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>14</td>
<td>Special Oxygen sensor</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>15</td>
<td>Special Battery charge sensor</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>16</td>
<td>Battery Voltage/ PSU voltages</td>
<td>3.84 ms</td>
<td>No</td>
</tr>
<tr>
<td>1</td>
<td>Generator Phase A RMS Current</td>
<td>Phase A ZERO CROSSING</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Generator Phase B RMS Current</td>
<td>Phase B ZERO CROSSING</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>Generator Phase C RMS Current</td>
<td>Phase C ZERO CROSSING</td>
<td>No</td>
</tr>
<tr>
<td>-</td>
<td>Generator average current</td>
<td>Every Phase ZERO CROSSING</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>Generator Phase A RMS Voltage</td>
<td>Phase A ZERO CROSSING</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>Generator Phase B RMS Voltage</td>
<td>Phase B ZERO CROSSING</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>Generator Phase C RMS Voltage</td>
<td>Phase C ZERO CROSSING</td>
<td>No</td>
</tr>
<tr>
<td>-</td>
<td>Generator average voltage</td>
<td>Every Phase ZERO CROSSING</td>
<td>Yes</td>
</tr>
<tr>
<td>-</td>
<td>Total Generator Power KW</td>
<td>Every Phase ZERO CROSSING</td>
<td>Yes</td>
</tr>
<tr>
<td>-</td>
<td>Total Generator Power Factor</td>
<td>Every Phase ZERO CROSSING</td>
<td>Yes</td>
</tr>
<tr>
<td>-</td>
<td>Generator Frequency</td>
<td>Every Phase ZERO CROSSING</td>
<td>Yes</td>
</tr>
<tr>
<td>-</td>
<td>RPM #1</td>
<td>4 - 8 ms variable (geared)</td>
<td>Yes</td>
</tr>
<tr>
<td>-</td>
<td>Oxygen sensor zero crossings</td>
<td>Every O2 ZERO CROSSING</td>
<td>No</td>
</tr>
</tbody>
</table>
Where x can be:
1. THERMISTOR
2. CURRENT
3. LINEAR
4. PRESSURE
5. UNALTERED
6. POLY_3RD
7. POLY_2ND
8. POLY_1ST
9. POLY_1ST_N1
10. POLY_1ST_N2
11. CAL_SCALE
12. CFM_SENSOR
13. GEN_FP_POLY

The function x may use any of the coefficients 1, 2, 3 and in some cases will use calibration factor as a 4th coefficient (in this case use scaling factor for calibration). The coefficients are used to allow adjustment of the basic functions to cater for future or alternate sensors. They perform different tasks in different functions, see APPENDIX A for further details. Note that if calibration factor is used as a coefficient, it will be shown (and entered) by GenLink as (actual coefficient/1024).

For example, if the coefficient is -378, it will be displayed as -0.36914.

**THEN**

\[ M = M \times \text{Scaling Factor} \]

Where scaling factor is a number such that 1024 is equivalent to 1, so it’s really \( M \times \frac{\text{scaling factor}}{1024} \). GenLink will hide this computation so you can enter floating point numbers such as 2.1 or 0.987 etc.

**ANALOG ALARMS**

Each of the 23 channels is processed by a set of alarm rules using constants that are set via GenLink. Usually these constants can be changed by the customer. Note that all alarms will be entered into the alarm log and will operate the audible alarm. Warnings will operate the audible alarm also, and will be put in the alarm log. The following list shows the alarm properties.

**Types**

This section is used to turn alarms and warnings on or off and define if the input must be greater than a value (GT) or less than a value (LT). There can be up to 2 alarms and 2 warnings, of which there can be a maximum of 2 GT or LT types.

**Setpoints**

There can be up to 4 setpoints to support 2 alarms and 2 warnings, of which there can be a maximum of 2 GT or LT types. The setpoints are in the same units that the measurement is displayed in.

**Delay Time**

There are 2 delay fields that can be set with different times in each. Any or none of these times can be applied to any of the alarms or warnings via GenLink radio buttons.

For example, a measurement may have to be greater than the setpoint for 1 second to cause an alarm, or less than another setpoint for 2 seconds to cause a warning. The resolution of this time interval is 0.1 seconds.

**Hysteresis**

Applied hysteresis in display or final units (for example battery voltage is displayed in units of 1/100ths of a volt). When an alarm/warning has gone active, the hysteresis is subtracted from the GT setpoint or added to the LT setpoint to calculate the modified setpoint needed to make the alarm go inactive.

**Shutdown**

When set, this alarm condition (alarms only, not warnings) has been selected to shutdown the engine.

**Dialout**

When this field is set, the dialout feature is selected. If an alarm or warning occurs for this channel the processor will automatically call for assistance via telephone (if the external modem option is fitted). Dialout can be selected either for warnings, alarms, neither, or both. There is a predefined and prioritized list of 10 phone numbers that will be tried. The controller expects GenLink to answer the call and log the fault. It is possible for the customer to program any Modbus device with a modem to respond to the call.

**Active When**

You can select other criteria to determine when alarms and warnings become active. This is further divided in that you can define these criteria independently for LT and GT alarm types.

**ALWAYS ENABLED** = This alarm or warning is always enabled under every circumstance.

**HOLD OFF** = Alarms/Warnings with this qualification only become active after a programmable hold off time has been met. The hold off timer starts after the engine has started. Stopping the engine cancels the hold off timer.

**IMMEDIATE** = Alarms/Warnings with this qualification only become active immediately after the engine has started.
Sensor Failure Check
When this field is set, the input sensor is checked for short circuit or open circuit failure. Normally each of the inputs are conditioned externally to be 4-20mA current loops. Any currents outside this range indicate a sensor failure. This will cause an alarm to occur. The alarm can be selected to shut down the engine if so desired via the next field. The alarm will be entered in the alarm log.

Shutdown on Sensor Failure
When this field is set, the engine will shut down if there is a sensor failure. If the field is unchecked, the failure will just cause an alarm message to appear and the audible alarm to sound. The alarm will be entered in the alarm log.

◆ OTHER ANALOG OPTIONS

Event Log
When set, the channel measurement is compared to the setpoint with either the GT or LT options. Once the condition is met (e.g., measurement GT setpoint) the event is logged along with a date/time stamp into the volatile memory based event log. Six other parameters that can be chosen by the customer will also be logged. Volatile means that when power is removed from the unit, the memory will be lost.

Analog Outputs
There are no analog outputs available for customization.

◆ ANALOG SENSOR RATINGS

Typically the sensors used by the manufacturer have the following ratings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>35 - 300 deg. F</td>
</tr>
<tr>
<td>Pressure</td>
<td>0 - 150 psi</td>
</tr>
</tbody>
</table>

OUTPUT FUNCTIONS
Output functions are flags that are set/reset by the internal program to indicate a certain status, for example, “Engine Running”. The Measurement Engine allows these flags to be treated as “channels” that can be made into alarms/warnings, display messages, operate real outputs and also be fed as inputs to the ILC. For example, use the “Ready To Start” output function to operate a relay by mapping it to a physical output via GenLink, or you could feed it into the ILC to do combinatorial logic.

See TABLE OF OUTPUT FUNCTIONS in appendix B.

◆ SPARE ANALOG CHANNELS

Depending upon the particular configuration of your product, the following input channels may be available for custom measurements:

<table>
<thead>
<tr>
<th>Channel #</th>
<th>Normal function</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Coolant level</td>
</tr>
<tr>
<td>5</td>
<td>Fuel Level</td>
</tr>
<tr>
<td>6</td>
<td>Spare</td>
</tr>
<tr>
<td>7</td>
<td>Throttle position</td>
</tr>
<tr>
<td>8</td>
<td>Oxygen sensor 0-1Vdc</td>
</tr>
<tr>
<td>9</td>
<td>Battery charge current 0-5Vdc</td>
</tr>
</tbody>
</table>

ENGINE MANAGEMENT
The engine management module is very similar to that used in the manufacturer's other products. It controls engine cranking, engine starting, engine running and engine stopping. These functions are performed to a set of “rules” that can be customized via parameters from GenLink. In turn, the module needs to know certain things about the engine which it expects to be programmed in from GenLink.

◆ GENERATOR PARAMETERS

- Engine Flywheel Teeth — Number of flywheel teeth or pulses per revolution for RPM input. RPM 1 is used for the engine controllers.
- CT Ratio/Generator — Current Transformer ratio for the generator. This value is the result from reducing the CT ratio. E.g. If the CT ratio is 100 amps to 5 amps, the resulting value is 20. Normally, the CT ratio will be x amps to 1 amp on H-100 Control Panels.
- Generator Phase Configuration — Select either single-phase or three-phase configuration depending on how the unit is supplied.
- 60 Hertz RPM — The engine RPM needed to supply 60 Hertz power.
- Quiet-Test® RPM — The engine RPM used when running Quiet-Test®.

<table>
<thead>
<tr>
<th>Number</th>
<th>PARAMETER</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engine Flywheel Teeth</td>
<td>Teeth</td>
</tr>
<tr>
<td>2</td>
<td>CT Ratio - Generator</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Generator Phase Configuration</td>
<td>1 or 3</td>
</tr>
<tr>
<td>4</td>
<td>60 Hertz RPM</td>
<td>RPM</td>
</tr>
<tr>
<td>5</td>
<td>Quiet-Test® RPM</td>
<td>RPM</td>
</tr>
</tbody>
</table>

◆ ENGINE SETTINGS

All of the following times are in seconds:

- Preheat Time — The time preheat is applied for before cranking if enabled.
- Start Detection RPM — The Engine must reach this RPM before disengaging the starter.
- Crank Time — The maximum time in seconds that each crank will last.
- Alarm Hold-off Time — The time after starting at which the hold-off alarms become enabled.
• Engine Warmup Time — The engine will run for at least this time before issuing the “Accept load” signal.
• Target Frequency — The target generator frequency (Hz).
• Target Voltage — The target generator voltage (RMS).
• Preheat Enable — The target generator voltage (RMS).

The Preheat output pin shares its function with the Air/Fuel Solenoid output. You must choose one of the two functions as follows:
- To select Air/Fuel - set the “Diesel” parameter on the governor settings page to “No”. Set Preheat to “Disabled”
- To select Preheat - set the “Diesel Y/N” parameter on the governor settings page to “Yes”. Set Preheat to one of the enable selections.

• Engine Cooldown Time — The generator will run for at least this time after remote start becomes inactive.
• Pause Between Cranks Time — The time between each successive crank operation.
• Number of Start Attempts — The maximum number of times the engine will attempt to start (crank) before faulting out with overcrank.
• Load Accept Frequency — The generator must reach this frequency before issuing the “Accept load” signal.
• Load Accept Voltage — The generator must reach this voltage before issuing the “Accept load” signal.

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### VOLTAGE REGULATOR (OPTION)

All panels include automatic voltage regulation as standard. There are various settings that can be made to the voltage regulator via GenLink. The settings are normally factory preset and are shown here for completeness.

- Voltage KP/KI/KD — Voltage regulation stability constants.
- PMG — YES indicates a Permanent Magnet Excited alternator.
- VF Corner 1 / 2. — These are used for v/f control to reduce the output voltage when a large load is applied that slows down the generator. If the frequency drops below these setpoints, the voltage is reduced proportionally as the frequency drops according to the Volts per Hertz ratio.
- Panel Type — Indicates the panel type that the H-100 Control Panel has been programmed to be. It will normally be H-100.
- Volts per Hertz — Number of volts to reduce the generator voltage for each hertz below VF Corner 1 frequency.
- AVR Dump Improve — Makes the regulator module increase the gain temporarily on a load dump to improve the transient voltage response.
- Unit Rated Power — This is the generator’s rated power in kW.

#### Voltage Regulator (Option) Chart

<table>
<thead>
<tr>
<th>NO.</th>
<th>PARAMETER</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Voltage KP</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Voltage KI</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Voltage KD</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>PMG</td>
<td>Y/N</td>
</tr>
<tr>
<td>5</td>
<td>VF Corner 1 Hertz</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>VF Corner 2 Hertz</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Panel Type</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Volts per Hertz</td>
<td>V/Hertz</td>
</tr>
<tr>
<td>9</td>
<td>AVR Dump Improve</td>
<td>Y/N</td>
</tr>
<tr>
<td>10</td>
<td>Unit Rated Power</td>
<td>kW</td>
</tr>
</tbody>
</table>

---

### GOVERNOR (SPEED REGULATOR) OPTION

All panels include automatic frequency (speed) regulation as standard. There are various settings that can be adjusted for the governor via GenLink, these include the target frequency. The settings are normally factory preset and are shown here for completeness, they do not apply to all governor types.

- Standby KP,KI,KD — Frequency regulation stability constants used for normal mode operation.
- QuietTest® KP,KI,KD — Frequency regulation stability constants used for QuietTest® mode operation.
- Actuator Type — Indicates the type of governor actuator. The following types are available:
  - POWERFLOW — Barber Coleman Powerflow, voltage driven without position feedback
STARTING AND STOPPING - SEQUENCE DIAGRAMS

2-wire Remote Starting and Stopping Sequence

Keyswitch in Auto Position

NOTE: Shutdown Alarms will cause the engine to turn off or not start.

Remote start contacts CLOSED?

Start the Engine

At load accept limits?

Warmup timer expired?

Issue load accept signal

Remote start contacts OPEN?

Cooldown timer expired?

Stop the Engine

Exercise without transfer starting and stopping sequence keyswitch in auto position.

Time to exercise?

Start the Engine

Exercise time expired?

Stop the Engine

Loss of utility with HTS starting and stopping sequence keyswitch in auto position.

HTS indicates loss of Utility?

Start the Engine

At load accept limits?

Warmup timer expired?

Command HTS to transfer to Generator Power

HTS indicates return of Utility?

Cooldown timer expired?

Stop the Engine

NOTE: Shutdown Alarms will cause the engine to turn off or not start.

NOTE: A Remote Start signal will terminate exercise and proceed to normal running mode.

NOTE: Shutdown Alarms will cause the engine to turn off or not start.
- BOSCH GAS — Bosch Butterfly, current driven with position feedback
- LINEAR CURRENT — Linear, Current Driven without position feedback
- DETROIT DIESEL — Detroit diesel PWM Driven
- BOSCH HORIZONTAL DIESEL — Bosch Diesel Arm with Horizontal Connecting Rod and current driven with position feedback
- BOSCH VERTICAL DIESEL — Bosch Diesel Arm with Vertical Connecting Rod and current driven with position feedback

- Actuator Offset — Number corresponding to lowest actuator position (Close Throttle).
- Actuator Fullscale — Number corresponding to highest actuator position (Open Throttle).
- Actuator Normal Start Position — The position the actuator will be parked at from start up until the “Start detection RPM” is reached. If “soft start” is enabled, this is also the maximum position of the throttle until the Target Frequency - 3 Hz is reached. Therefore, if “soft start” is enabled, the actuator start position MUST be high enough to reach, Target Frequency - 3 Hz.
- Actuator QuietTest® Start Position — The position the actuator will be parked at from start up until the “Start detection RPM” is reached. If “soft start” is enabled, this is also the maximum position of the throttle until the QuietTest® Target Frequency - 3 Hz is reached. Therefore, if “soft start” is enabled, the actuator start position MUST be high enough to reach, QuietTest® Target Frequency - 3 Hz.
- Soft Start Time — The time to stay at each soft start step before moving on to the next step. (Only applies if soft start is enabled).
- Soft Start Frequency — An entry of 0 Hz disables soft start. Any other value enables soft start which ramps up the generator frequency at a rate determined by “Soft Start Time” to minimize smoke. This value selects the first frequency to target after start up. Once this frequency is attained, the generator will hold this frequency for the “Soft Start Time” and then move to the next step. Each step is 3 Hz higher with the final step being “Target Frequency” - 3 Hz. Each step is held for the “Soft Start Time”. During soft start, the throttle will not be allowed to exceed the “Actuator Start Position”.
- Diesel — Indicates if this is a diesel powered generator. This modifies such features as frequency control, and others.
- Dump Enable — Indicates if extra load dump governor compensation is desired to reduce increase in frequency caused by drop in load. The following three selections are available:
  - No Dump — No additional compensation.
  - Dump — Reset governor algorithm when load dump detected.
  - Dump & Hold — Same as Dump, but also hold throttle closed until frequency back in range.
- Engine Linearization — Selects engine torque to actuator position translation curve for Bosch Actuators.
  0 = No conversion - torque = position
  1 = Butterfly Actuator with minimum position same as unpowered actuator
  2 = Diesel arm with Horizontal rod
  3 = Diesel arm with Vertical rod
  4 = Same as 1, but minimum position at actuator mechanical stop
  5 = Same as 4, but with limited position resolution of 1
  6 = Same as 4, but with added energy to accommodate throttles that normally operate in the nearly closed position at no load
- Integral limit/Antiwindup — Choose whether to use an integral limit or an anti-windup strategy.
  YES = integral limit
  NO = anti-windup
- Limit/windup parameter — If “Integral Limit” is selected, this is the maximum value the integral is allowed. If “Anti-Windup” is selected, this is the integral value above which the anti-windup algorithm becomes active.
- Pwm Counts per ampx10 — Number of PWM counts required to drive one tenth of an amp into a linear current driven actuator. This only applies to the “Linear Current” actuator type.
- Desynch Offset — Offset of -0.9 to +0.9 Hertz to be applied to the target frequency to improve passive synchronizing by Automatic Transfer Switches. If an in-phase or synchronized transfer is required, use this setting to adjust the generator frequency to 0.1 Hz above nominal Utility frequency.

### Governor (Speed Regulator) Option Chart

<table>
<thead>
<tr>
<th>NO.</th>
<th>PARAMETER</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Standby KP</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Standby KI</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Standby KD</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>QuietTest® KP</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>QuietTest® KI</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>QuietTest® KD</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Actuator Type</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Actuator Offset</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Actuator Fullscale</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Actuator Normal Start Position</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Actuator QuietTest® Start Position</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Soft Start Time</td>
<td>Seconds</td>
</tr>
<tr>
<td>13</td>
<td>Soft Start Frequency</td>
<td>Hz</td>
</tr>
<tr>
<td>14</td>
<td>Diesel</td>
<td>Y/N</td>
</tr>
<tr>
<td>15</td>
<td>Dump Enable</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Engine Linearization</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Integral limit/Antiwindup</td>
<td>Y/N</td>
</tr>
<tr>
<td>18</td>
<td>Limit / windup parameter</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>Pwm Counts per ampx10</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>Desynch Offset</td>
<td>Hz</td>
</tr>
</tbody>
</table>
TRENDING
Just like in the PM-DCP, there are two types of trending available - Remote and Local.

◆ REMOTE TRENDING
GenLink performs remote trending by polling the controller for the selected data at the desired rate. Up to 8 analog channels can be monitored at a 0.3 second rate. If a faster rate is desired, reducing the number of analog channels monitored will allow for a 0.1 second rate. The polling rate can be varied from 0.1 seconds to several hours. GenLink can save the data to a file and/or display it as a near real-time graph. The file is MS Excel compatible ( CSV format ). Examples of things you can trend are the generator frequency response (in 0.1 second steps) to a block load or Generated power over a day.

◆ LOCAL TRENDING
Local trending is done inside the controller where up to 1000 samples can be stored in memory. GenLink provides an interface to select the analog channels to be trended, the rate to be sampled at, and optional triggers to be used to specify when to sample. Up to 6 analog channels can be sampled. However, the 1000 samples are divided by the number of channels. For example, there will be 1000 samples of 1 channel or only 166 samples of each of 6 channels. The analog samples can be sampled at one of three basic polling rates: Low Speed, Mid Speed, and High Speed. For the Low Speed and Mid Speed modes, there are also several settings that can be used to determine when to sample. GenLink can save the data to a file and/or display it as a snap-shot graph. The file is MS Excel compatible ( CSV format ).

◆ GENLINK LOCAL TRENDING SETUP
When setting up the local trending, verify that the “Armed” box is unchecked and press “Apply”. To change the settings with the trending armed may result in corrupted data. Select a rate at which to take samples.

• Low Speed rate samples the processed analog channel values at a rate that is able to be set in increments of 0.1 seconds.
• Mid Speed rate is about 2 milliseconds which captures the new analog channel value as soon as it is processed by the measurement and alarm modules.
• High Speed rate is 0.4 milliseconds and is reserved for the raw AC wave forms of generator voltage and current.

There are 6 pull-down boxes that allow the selection of up to 6 analog channels. All channel pull-down boxes after the first pull-down box with NULL CHANNEL selected are ignored. If High Speed is selected, the pull-down boxes are not used. Instead, there are 6 check boxes that can be used to select which voltage and current lines are to be trended.

The “Capture When” pull-down box allows the trending to be limited to the engine running or engine being stopped. If the “Stop at End of Buffer” box is selected, then the trending will start when the “Capture When” condition is true and stop when the 1000 samples have been taken.

Any digital or analog channel can be used as an event trigger. The event trigger needs to be set up in that channel's setup screen. Checking the “Capture Only When Trigger is True” box will cause the samples to only be taken while the event trigger is true. Checking the “Capture on Shutdown Alarm” will cause the samples to start upon the setting of a shutdown alarm. The event trigger can be used to start sampling, stop sampling, or center the sampling by selecting the appropriate radio button:

No Trigger
The event trigger is ignored and samples are continually being placed into the buffer.

Pre-Trigger
Samples are continually being placed into the buffer until the event trigger becomes true. Then no more samples are placed into the buffer.

Post-Trigger
No samples are placed into the buffer until the event trigger becomes true. Then samples are placed in the buffer until it is full.

Pre- and Post-Trigger
Samples are continually being placed in the buffer until the event trigger becomes true. This point is considered ½ of the buffer. Samples continue to be placed into the buffer until it is full.

Pressing the “View” button will show a graph of the samples in the buffer at the time the button is pressed. The graph has a “Save” button that allows the user to save the data out to a file in a MS Excel compatible ( CSV ) format.

THE ILC
The built-in ILC uses simple combinatorial logic to generate digital outputs and limited generator control. The ILC uses ladder logic for programming, and a separate offline programming tool is available to generate the ILC programs. These are then downloaded via GenLink and are started or stopped by means of a checkbox on the GenLink ILC page. Once downloaded and started, they will remain active unless they are stopped via GenLink, even if power is cycled.

The I/O scan time of the ILC is about 100 ms worst case. This means that all inputs and outputs are scanned within 100 ms. Also, the ILC processes one rung every 5 ms, so 5 rungs will take 25 ms. However, this is in parallel with the I/O scan and not added to it.

The offline tool uses graphic symbols to design the “rungs” of the ladder logic. The rungs are simple and can only have 2 combinatorial elements in them, but by the use of “soft contacts” the output of one rung can be fed into the input of another to provide more combinations. As well as the logical combinations, there are also analog comparisons, counters and timers available for use in the rungs. As an example this allows the following type of logic to be built:
IF (in automatic) AND (engine running) AND (air temperature >25 deg) FOR (20 seconds) THEN OPERATE (output 7).

Generator control is limited to the following output options (referred to as “Hooks”).

1. Use Keyswitch
2. Force Off – cleared with “Use Keyswitch” hook
4. Force Auto – cleared with “Use Keyswitch” hook
5. Force Dialout
6. Halt ILC
7. Force Alarm/Warning #1
8. Force Alarm/Warning #2

For detail in programming the ILC, refer to the ILC manual.

THE FRONT PANEL DISPLAY

The front panel display consists of two LCD displays that are 4 rows of 20 characters each and a key pad with seven buttons and two LEDs.

LEFT DISPLAY PAGES

The left display has five “fixed” parameter pages: System Voltages, System Power, Transfer Switch Mimic Diagram, Generator Frequency Graph, and System Alarm Log. A sixth page is selectable, but has no function at this time. The left display page is determined by selecting the right display menu item, “Left Display”. To change the left display, do the following:

1. Press the “MENU” button.
2. Press the ➔ button to move to the “Left Display” field.
3. Press the “ENTER” button to display the “Left Display” menu page.

The “>…..<” indicates which page is currently displayed on the left display. Use the arrow buttons to move the cursor to the desired page name and press the “ENTER” button. The left display will change to the new page and the “>…..<” will move to the selected page name.

> Volts <

The left display is used to display a “fixed” set of parameter pages and has no cursor or entry fields. The key pad has no direct control of its contents. Its contents are determined by a menu selection on the right display.

RIGHT DISPLAY

The right display has several pages and responds directly to the key pad. There are two “quick” buttons on the key pad that are used to go directly to either the Home page or the Menu page. The Enter button is used to enter and exit edit mode, operate an output override, or select another page. When not in edit mode, the arrow buttons are used to navigate around the page to either an edit field or a control field. When in edit mode, the up/down buttons slew up or down through the available values and the right/left buttons are used to change to a different digit or edit field. Moving off an edit field while in edit mode automatically enters the value displayed. Also, while in edit mode, pressing the Home button will return the parameter to the last value entered.
This is a typical three phase System Voltages page.

**LINE 1:** Phase titles for the voltage and current.

**LINE 2:** Line-to-line voltages in Volts RMS.

**LINE 3:** Line currents in Amps RMS.

**LINE 4:** Generator frequency in Hz and total system power in kilowatts.

<table>
<thead>
<tr>
<th>Phase AB/N</th>
<th>AN/A</th>
<th>BN/B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volts</td>
<td>240</td>
<td>120</td>
</tr>
<tr>
<td>Amps</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hz</td>
<td>60.0</td>
<td>kW</td>
</tr>
</tbody>
</table>

This is a typical single phase System Voltages page.

**LINE 1:** Phase titles for the voltage and current – voltage title/current title.

**LINE 2:** Line-to-line voltage for AB and Line-to-Neutral voltage for A and B in Volts RMS.

**LINE 3:** Neutral current and Line currents in Amps RMS.

**LINE 4:** Generator frequency in Hz and total system power in kilowatts.

> **Switch** <

<table>
<thead>
<tr>
<th>Transfer Switch Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTILITY</td>
</tr>
<tr>
<td>GENERATOR</td>
</tr>
</tbody>
</table>

This is the Transfer Switch Mimic Diagram page. It shows the position of the Utility Switch and the Generator Switch. This depicted display shows the Utility switch closed and the Generator switch open. There can be up to 4 HTS switches connected to the generator.

**LINE 1:** “Transfer Switch Name” indicates which switch inputs are being displayed such as “From HTS #1”. To select a switch to display, select the switch number on the HTS page (refer to the Right Display Pages - Exercise/HTS page). If there are no HTS switches connected, then the Line Power and Generator Power inputs are displayed and the “Transfer Switch Name” is “From Line/Gen Inputs”

**LINE 2:** Title line showing the left side is the Utility switch and the right side is the Generator switch.

**LINE 3:** Character graphics showing the switch states – open or closed.

> **Alrm Log** <

<table>
<thead>
<tr>
<th>01 mm/dd/yy hh:mm:ss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm/Warning msg</td>
</tr>
<tr>
<td>02 00/00/00 00:00:00</td>
</tr>
<tr>
<td>?? (undefined) Lo</td>
</tr>
</tbody>
</table>

This is the System Alarm Log page. It displays the last 20 alarms or warnings that occurred with a time and date stamp. Two records are displayed at a time.

**LINE 1/3:** The record’s alarm or warning number (lowest number being the most recent) followed by the date and time that the alarm or warning occurred.

**LINE 2/4:** The alarm or warning description message. The depicted display shows a basic format in place of the first record and an empty record for the second. The records scroll up at about a 4 second rate.

The message format symbols are explained below:

First 2 characters:
- ?? = Empty slot
- Wr = Warning
- Al = Non-shutdown alarm
- SD = Shutdown alarm

Last 2 characters:
- Sn = Sensor failure
- Hi = Tripped by being greater than threshold
- Lo = Tripped by being less than threshold
  - (blank) Internal alarm or warning

> **Power** <

| Real Pwr | 0 kW |
| React Pwr| 0 kVAR |
| Appar Pwr| 0 kVA |
| Pwr Fact | 1.00 PF |

This is a typical System Power page.

**LINE 1:** Total system real power in kW.

**LINE 2:** Total system reactive power in kVAR.

**LINE 3:** Total system apparent power in kVA.

**LINE 4:** Total system power factor.
This is the Generator Frequency Graph page. This graph provides a coarse representation of the generator frequency. The graph scrolls from right to left at 2 characters per second (last 10 seconds of data on the display). The bottom of the graph is 50 Hz and the top is 70 Hz. There are 32 levels between bottom and top. Therefore, each level is approximately 0.6 Hz.

This is the Other page. At this time, it has no function and serves as a place holder.

The right display is menu based with eight main menu items: System Alarm and Warning pages, Engine Parameter pages, System Status pages, Maintenance Status Pages, Left Display Menu page, Generator Parameter pages, System Diagnostic pages, and Internal Exercise and HTS pages. To select a page for the right display, do the following:

Press the “MENU” button:

Press the “ENTER” button.

Use the arrow keys to move the cursor to the desired menu item and then press the “ENTER” button. Most menu items have multiple pages under them. When that is the case, there is a “More” field at the lower right hand corner of the page where “x” is the page number and “y” is the total number of pages available under this menu item. To move forward or backward through the pages, the cursor is placed on the or character using the arrow buttons and the “ENTER” button is pressed. When a page is first displayed, the cursor normally starts on the character to promote ease of scanning through the pages..

There are three System Alarm and Warning pages. Each page is capable of displaying three alarms or warnings. If there are more than nine total alarms and warnings to list, then only the most recent nine will be visible. All alarms and warnings remain in the list until they are cleared. Warnings clear when they are no longer active. Normal Alarms clear when they are no longer active and have been acknowledged. Shutdown alarms clear only after the key switch has been placed in the OFF position and they are no longer active. There are a few shutdown alarms that will only clear after a power cycle of the controller and they are no longer active. Besides using the menu to get to the alarm pages, the right display immediately changes to the first alarm page when an alarm or warning first becomes active. If a shutdown alarm is active and an alarm or warning is not acknowledged, the displays will flash with the Alarm LED.

Do the following to view the alarm/warnings pages:

Press the “MENU” button.

Press the “ENTER” button.

This is a typical System Alarm and Warning page. The n/a indicates there is not an alarm or warning to display on that line. As depicted, this display indicates a Fuel Pressure alarm for low pressure. This would be a common alarm for a system that has the gas line turned off. The “Al” indicates it is an alarm. The “*” indicates the alarm has not been acknowledged. The “DI2/FUEL PRESS” message indicates it is a fuel pressure alarm (DI2 was included in the text by the user to indicate it is Digital Input #2). The “Lo” indicates the alarm was tripped because the input value fell below a set threshold.

The message format symbols are explained below:

First 2 characters:

Wr – Warning
Al – Non-shutdown alarm
SD – Shutdown alarm

Third Character:

* – Has not been acknowledged
Sn – Sensor failure
Hi – Tripped by being greater than threshold
Lo – Tripped by being less than threshold
(blank) – Internal alarm or warning
Press the “ENTER” button while the cursor is on “ACK” to acknowledge the alarm.

The “*” is now gone since the alarm has been acknowledged.

Turn the gas line on.

The alarm has cleared since the gas pressure is now adequate.
Move the cursor to the ➪ on the bottom line by pressing the ➪ button twice or the ◀ button once.

Press the “ENTER” button to see the next page.

This is a typical first engine parameter page. The three values on this page are not able to be configured as other values.

LINE 1: Oil Temperature (Analog Channel #1) in degrees Fahrenheit.
LINE 2: Oil Pressure (Analog Channel #3) in pounds per square inch.
LINE 3: Coolant Temperature (Analog Channel #2) in degrees Fahrenheit.
LINE 4: “More” field to allow page selection.

If any of these signals are not configured, they will display “n/a” for their value such as the Oil Temperature shown above.

Press the “ENTER” button.

<table>
<thead>
<tr>
<th>Engine RPM 1800 RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery 13.3 V</td>
</tr>
<tr>
<td>BAT CHARGE 2.8 A</td>
</tr>
</tbody>
</table>

More←(2-4)

This is a typical second engine parameter page. The first two values on this page are not able to be configured as other values.

LINE 1: Engine RPM
LINE 2: Battery Voltage in Volts DC.

If any of these signals are not configured, they will display “n/a” for their value.

LINE 3: Normally Battery Charger Current (Analog Channel #9). If it is not configured, the line will be blank.

LINE 4: “More” field to allow page selection.

Press the “ENTER” button.

<table>
<thead>
<tr>
<th>Time Run 37.3 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOLANT LEV 753 Stp</td>
</tr>
</tbody>
</table>

More←(3-4)

This is a typical third engine parameter page.

LINE 1: Total number of hours the engine has run.
LINE 2: Coolant Level Sensor (Analog Channel #4) reading in steps 0 - 1023.
LINE 3: Often the Fuel Level Sensor (Analog Channel #5) reading in %. As depicted, Analog Channel #5 is not configured – leaving the line blank.

LINE 4: “More” field to allow page selection.

Press the “ENTER” button.

This is a typical fourth engine parameter page.

LINE 1: Auxiliary Analog Channel input (Analog Channel #6).
LINE 2: Throttle Position Sensor (Analog Channel #7) reading in steps 0 - 1023.
LINE 3: Emissions Sensor (Analog Channel #8) reading. As depicted, Analog Channels #6 and #8 are not configured – leaving the lines blank.
LINE 4: “More” field to allow page selection.

STATUS

There are two System Status pages. These pages show the system status, system time, and system versions.

Do the following to view the system status pages:

Press the “MENU” button.

Press the ↓ button twice.

This is a typical first System Status page.

<table>
<thead>
<tr>
<th>Alarms Left Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Status</td>
</tr>
<tr>
<td>Generator Diagnostic</td>
</tr>
<tr>
<td>Service Exercise/HTS</td>
</tr>
</tbody>
</table>

Press the “ENTER” button.

Stopped, Key SW Off
Stopped
11:38 Thu 02/09/2006
More←(1-2)

This is a typical first System Status page.

LINE 1: Engine Running Status. It can have the following values:
“Stopped, Key SW Off”
The engine is stopped and the key switch is in the OFF position.
“Running from Manual”
The engine is starting or running and the key switch is in the MANUAL position.
"Running from 2-wire"
The engine is starting or running because the 2-wire start signal was activated and the key switch is in the AUTO position.

"Running from serial"
The engine is starting or running because the GenLink commanded it to start and the key switch is in the AUTO position.

"Running exercise"
The engine is starting or running because internal exercise was activated and the key switch is in the AUTO position.

"Stopped, Key SW Auto"
The engine is stopped and the key switch is in the AUTO position.

"Running, QuietTest"
The engine is starting or running because QuietTest® was activated and the key switch is in the AUTO position.

"Running, HTS Xfer SW"
The engine is starting or running because the HTS(s) indicated a need for the generator power and the key switch is in the AUTO position.

LINE 2: Generator Status. It can have the following values:
"Resetting"
The generator control system is resetting.

"Stopped"
Generator is stopped and not preheating.

"Stopped, Preheating"
Generator is stopped and preheating.

"Cranking"
Generator is starting and not preheating.

"Cranking, Preheating"
Generator is starting and preheating.

"Pause between starts"
Generator is pausing between consecutive start attempts.

" Started, not to speed"
Generator is started, but has not attained normal running speed yet.

"Warming, Alarms Off"
Generator is started and is up to speed, but is waiting for warmup timer to expire.

"Warmed Up, Alarms Off"
Generator is started and warmed up, but the hold-off alarms are not yet enabled.

"Warming, Alarms On"
Generator is started and the hold-off alarms are enabled, but is waiting for warmup timer to expire.

"Warmed Up, Alarms On"
Generator is started, warmed up, and the hold-off alarms are enabled.

"Running, cooling down"
Generator is still running, but waiting for cool down timer to expire.

"Stopping"
Generator is running down after being turned off normally.

"Stopping due to Alrm"
Generator is running down after being turned off due to a shutdown alarm.

"Stopped due to Alarm"
Generator is stopped due to a shutdown alarm.

LINE 3: System Time and Date. It is able to be changed on this page by using the arrow buttons to go from field to field or to modify a field in edit mode and the "ENTER" button to enter and exit edit mode. There are five editable fields: Hours, Minutes, Month, Day, and Year. The day of the week will change as the displayed date is changed. See the "SET DATE AND TIME" section of this manual for details.

LINE 4: "More" field to allow page selection.
Press the "ENTER" button.

This is a typical second System Status page.

LINE 1: Firmware and Hardware release versions.
LINE 2: Configuration File identifier – serial number, model number, or text.
LINE 3: ILC program name. This text string is blank or blocks (as shown above) when there is no ILC program loaded.
LINE 4: ILC program running status followed by the "More" field to allow page selection.

SERVICE
There are four Maintenance Status pages. The first three pages show the status of the scheduled maintenance items. The fourth page allows changing of the display contrast.
Do the following to view the service pages:
Press the "MENU" button.
This is a typical third Maintenance Status page. Each line displays a maintenance item that has been set up via GenLink. The value displayed is the approximate % of life remaining before maintenance should be performed. Refer to the Maintenance setup using GenLink.

Press the "ENTER" button.

This is a typical fourth Maintenance Status page. The first line is the display contrast. The display contrast is able to be changed on this page. However, changing this setting can result in the display becoming non-readable. Use caution. Use the arrow buttons to go to the contrast field. Press the “ENTER” button to enter edit mode. Use the arrow buttons to change the contrast value (range is 00 to 37). Pressing the “HOME” button while in edit mode will return the value to the last entered value. Press the “ENTER” button to exit edit mode.

**GENERATOR**

There are three Generator Parameter pages – voltage parameters, power parameters, and i2t parameters.

Do the following to view the generator parameter pages:

Press the “MENU” button.

Press the ↓ button three times or the ↑ button once.

This is a typical first Maintenance Status page. Each line displays a maintenance item that has been set up via GenLink. The value displayed is the approximate % of life remaining before maintenance should be performed. Refer to the Maintenance setup using GenLink.

Press the “ENTER” button.

This is a typical second Maintenance Status page. Each line displays a maintenance item that has been set up via GenLink. The value displayed is the approximate % of life remaining before maintenance should be performed. Refer to the Maintenance setup using GenLink.

Press the “ENTER” button.

Press the → button and then the ← button.
Press the “ENTER” button.

### Alarms Left Display
- Engine Generator
- Status Diagnostic
- Service Exercise/HTS

Press the “ENTER” button.

### Phase A-B B-C C-A
<table>
<thead>
<tr>
<th>Volts</th>
<th>480</th>
<th>480</th>
<th>480</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amps</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>60.0 Hz More (1-3)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is a typical first Generator Parameter page for a three phase system.

**LINE 1:** Phase titles for the voltage and current.

**LINE 2:** Line-to-Line voltages in Volts RMS.

**LINE 3:** Line currents in Amps RMS.

**LINE 4:** Generator frequency in Hz followed by the “More” field to allow page selection.

The voltages can be converted to values representing the line-to-neutral voltages by changing the title line (first line) using edit mode. Use the arrow buttons to move to one of the title fields – A-B, B-C, or C-A. Press the “ENTER” button to enter edit mode. Use the up or down arrow button to change the display to A-N, B-N, and C-N. Press the “ENTER” button to exit edit mode. The same process is followed to return to line-to-line displays. This also affects the left display voltage page.

### Phase AB/N AN/A BN/B
<table>
<thead>
<tr>
<th>Volts</th>
<th>240</th>
<th>120</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amps</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>60.0 Hz More (1-3)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is a typical first Generator Parameter page for a single phase system.

**LINE 1:** Phase titles for the voltage and current – voltage title/current title.

**LINE 2:** Line-to-Line voltage for AB and Line-to-Neutral voltage for A and B in Volts RMS.

**LINE 3:** Neutral current and Line currents in Amps RMS.

**LINE 4:** Generator frequency in Hz followed by the “More” field to allow page selection.

### Power
| kW  | 0   |
| PF | 1.00 PF |
| % Rated Pwr | 0 % |

More (2-3)

This is a typical second Generator Parameter page for a three phase system.

**LINE 1:** Total system real power in kW.

**LINE 2:** Total system power factor.

**LINE 3:** Percentage of the system rated power being used.

**LINE 4:** The “More” field to allow page selection.

### Phs Tot A-N B-N
| kW | 0 | 0 | 0 |
| PF | 1.00 | 1.00 | 1.00 |

More (2-3)

This is a typical second Generator Parameter page for a single phase system.

**LINE 1:** Phase titles for the power and power factor – Total, A-Neutral, B-Neutral.

**LINE 2:** Real power in kW – Total system, A-Neutral, B-Neutral.

**LINE 3:** Power Factor – Total system, A-Neutral, B-Neutral.

**LINE 4:** The “More” field to allow page selection.

Press the “ENTER” button.

### i2t Limits
% Temp >

More (3-3)

This is a typical third Generator Parameters page. It graphically displays the percent of i²t thermal limit currently attained. If the limit is exceeded, an alarm will be set and the generator will shut-down to protect the alternator. This display will then show % Temp >Over Limit<”. GenLink can provide more information regarding actual limits exceeded. This page is disabled if the i²t function is disabled.
DIAGNOSTICS

There are six System Diagnostic pages. They are digital inputs page, digital outputs page, two analog input pages, RS-232 communications status page, and RS-485 communications status page.

Do the following to view the diagnostics pages:

Press the “MENU” button.

Press the \( \Rightarrow \) button twice and the \( \Rightarrow \) button.

Press the “ENTER” button.

This is a typical first System Diagnostics page. It displays ten of the discrete inputs into the H-100 Control Panel. Inputs to the controller are internally pulled to 5 v, so to activate an input you must short it to ground. The following names are normally assigned to these inputs:

1. Key switch in AUTO position
2. Key switch in MANUAL position
3. Emergency Stop Active
4. Remote 2-wire start Active
5. Battery Charger Failure
6. Rupture Basin or Low Fuel Pressure
7. Transfer Switch in Line Power Position
8. Transfer Switch in Emergency Power Position
9. Modem is connecting or connected
10. Modem is present

Press the “ENTER” button.

Press the “ENTER” button.

This is a typical second System Diagnostics page. It displays ten of the discrete outputs out of the H-100 Control Panel. Outputs from the controller are generally open collector. This means that they sink current through a load and you will NOT see any voltage change on them when they are activated, unless they are connected to a load. These outputs can be temporarily inverted from this page. Extreme caution should be exercised while inverting outputs since it can result in operation of starters, fuel solenoids, etc. To invert an output, use the arrow buttons to position the cursor on the output value to be inverted. Press the “ENTER” button. The output will be inverted for approximately 2 seconds and then return to normal control. Only one output can be inverted at a time and leaving the page cancels all output inversions.

The following names are normally assigned to these outputs:

1. Key switch in AUTO position
2. Activate Starter Relay
3. Activate Fuel Relay
4. Activate Alarm/Warning Relay (Buzzer)
5. Activate Gas Relay on 13.3L Engines
6. Auxiliary Discrete Output #1
7. Auxiliary Discrete Output #2
8. Auxiliary Discrete Output #3
9. Auxiliary Discrete Output #4
10. Activate Ignition Module on 13.3L Engines
12. Activate Emissions Module or Preheat

Press the “ENTER” button.

Press the “ENTER” button.

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8. Transfer Switch in Emergency Power Position
9. Modem is connecting or connected
10. Modem is present

Press the “ENTER” button.

Press the “ENTER” button.

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The following names are normally assigned to these outputs:

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2. Activate Starter Relay
3. Activate Fuel Relay
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8. Auxiliary Discrete Output #3
9. Auxiliary Discrete Output #4
10. Activate Ignition Module on 13.3L Engines
12. Activate Emissions Module or Preheat

Press the “ENTER” button.

Press the “ENTER” button.
The above two pages are typical System Diagnostics Analog Input pages. The analog channel values that are displayed are the “raw” unprocessed data and are 10 bit numbers ranging from 0 - 1023 representing a voltage or current on the analog input channel. The following names are normally assigned to these inputs:

**PAGE 3-6 LINE 2:**
- #1 A current (CT1)
- #2 B current (CT2)
- #3 C current (only three phase) (CT3)

**PAGE 3-6 LINE 3:**
- #4 A-B voltage (A-N if single phase) (Vsense1)
- #5 B-C voltage (B-N if single phase) (Vsense2)
- #6 C-A voltage (only three phase) (Vsense3)

**PAGE 3-6 LINE 4:**
- #7 Oil Temperature (AN1)

**PAGE 4-6 LINE 1:**
- #8 Coolant Temperature (AN2)
- #9 Oil Pressure (AN3)
- #10 Coolant Level (AN4)

**PAGE 4-6 LINE 2:**
- #11 Fuel level (AN5)
- #12 Auxiliary Analog Input (AN6)
- #13 Throttle Position Sensor (AN7)

**PAGE 4-6 LINE 3:**
- #14 Emissions Oxygen Sensor (AN8)
- #15 Battery Charger Current (AN9)
- #16 Battery Voltage

Press the “ENTER” button.

**LINE 1:** Will show the type of port protocol that has been selected. It will also show the Modbus address (if appropriate) and whether the port is RS-232 or RS-485.

**LINE 2:** Will show the settings for the port such as baud rate, bits per character, stop bits, and parity.

**LINE 3:** Shows a live update of counts of messages transmitted, received, and errors.

**LINE 4:** Shows a mimic of LED’s for TX, RX, and ERR. For example, the TX LED lit (T*) means the H-100 Control Panel is transmitting. Not lit (T-) means it is not transmitting.

**EXERCISE/HTS**

There are four pages under this menu item – two for internal exercise and two for HTS. This is where the internal exercise can be setup and enabled (see the Exercise Setup Using Front Panel section) and the HTSs can be enabled and monitored.

Do the following to view the internal exercise and HTS pages:

Press the “MENU” button.

Press the  button.

Press the “ENTER” button.

**LINE 1:** Indicates if internal exercise is enabled. This field is editable.

**LINE 2:** Day of week and time of day to start the exercise weekly. These fields are editable.

This is a typical first Internal Exercise and HTS page.
LINE 3: How much time remains before exercise is completed. It starts with 20 minutes.
LINE 4: The “More” field to allow page selection.
Press the “ENTER” button.

This is a typical second Internal Exercise and HTS page.
LINE 1: Indicates if QuietTest® is enabled. This field is editable.
LINE 2: Can be used to start a 20 minute exercise period right now. This field is editable.
LINE 3: Indicates if the HTS switches should be exercised during normal exercise mode. This field is editable.
LINE 4: The “More” field to allow page selection.
Press the “ENTER” button.

This is a typical third Internal Exercise and HTS page.
LINE 1: The left side shows the HTS switch number that the data on this page applies to. This field is editable in that switch numbers 1 – 4 can be selected. The Switch number selected on this page also selects the switch to use for the Left Display Switch Mimic diagram if that switch is enabled. In addition, it is the selected switch number for the next page, and for the remote annunciator lights for generator power and line power. The right side of the first line is the mode that the HTS is in. It can have the following values:
“Disabled”
This switch is not present in the system.
“Enabled”
This switch is present in the system and operating normally.
“Fast Test”
The “FAST TEST” button on the HTS has been pressed and fast test is being executed.
“Norm Test”
The “TEST” button on the HTS has been pressed and normal test is being executed.
“No Comms”
This switch is present in the system, but not communicating.
“Xfer Exer”
The system is running in exercise and is exercising the HTS as well.
“Exercise”
The system is running in exercise, but is not exercising the HTS.
LINE 2: The left side is the status of the HTS. It can have the following values:
“Idle”
HTS is waiting for conditions to change. No action is being taken.
“Error”
HTS controller has detected an error.
“TDN”
HTS is in Time Delayed Neutral position.
“Synching”
HTS is waiting for Generator and Utility to become synchronized before changing switch position.
“SB4 Xfer”
HTS has activated the “Signal Before Transfer” relay.
“Cls Gen SW”
HTS is closing the Generator side of the switch.
“Cls Util SW”
HTS is closing the Utility side of the switch.
“Opn Gen SW”
HTS is opening the Generator side of the switch.
“Opn Util SW”
HTS is opening the Utility side of the switch.
“No Utl/Coms”
HTS has detected loss of utility and communications with the H-100 Control Panel.
“No Comms”
HTS has detected utility present, but loss of communications with the H-100 Control Panel.
“Pwr Cycled”
HTS has been power cycled and is awaiting reconfiguration commands from H-100 Control Panel.
“SW Disabled”
HTS indicates that it is disabled.
The right side is the Utility frequency from the HTS in Hz.
LINE 3: The HTS backup battery voltage in Volts DC followed by the Utility voltage from the HTS in Volts RMS.
LINE 4: The HTS firmware version number followed by the “More” field to allow page selection.
Press the “ENTER” button.

**HTS #2** Disabled

This is a typical fourth Internal Exercise and HTS page. The left side of the first line shows the HTS switch number that the data on this page applies to. This field is editable in that switch numbers 1 – 4 can be selected. The Switch number selected on this page also selects the switch to use for the Left Display Switch Mimic diagram if that switch is enabled. In addition, it is the selected switch number for the previous page, and for the remote annunciator lights for generator power and line power. The right side of the first line is the enable state of the HTS. It is editable and can have the following values:

“Disabled”
This HTS switch is not included in the system.

“Enabled”
This HTS switch is included in the system.

**NOTE:**
Enabling a switch that is not present will result in a switch communications warning after a few seconds and will switch the display to the Alarms page.

**HOME**
Press the “HOME” button while not editing a field.

- **Oil** 56 Psi n/a°F
- **Water Temp** 190°F
- **Battery** 13.3 V

This is a typical Home page. The contents of this page along with the contents of the default left display page (Volts) were selected such that all the normally desired data would be available for viewing at once.

**LINE 1:** Oil Pressure (Analog Channel #3) in pounds per square inch followed by Oil Temperature (Analog Channel #1) in degrees Fahrenheit.

**LINE 2:** Coolant Temperature (Analog Channel #2) in degrees Fahrenheit.

**LINE 3:** Battery Voltage in Volts DC.

If any of these signals above are not configured, they will display “n/a” for their value such as the Oil Temperature shown above.

**LINE 4:** Often the Fuel Level Sensor (Analog Channel #5) reading in percent. As depicted, Analog Channel #5 is not configured – leaving the line blank.

**THE CONTROL PANEL**
The H-100 Control Panel has some inputs and outputs which have been designated to be connected to a standardized control panel. The format of the control panel will vary from model to model and not all indicators may be present, however the following signals are always available:

- **ALARM LED** output
- **COMMON ALARM** output
- **AUTO/OFF/MAN KEYSWITCH** input
- **NOT IN AUTO LED** output
- **EMERGENCY STOP SWITCH** input

The alarm LED will flash every second if a new alarm occurs. Once this alarm is acknowledged via the touch pad or GenLink, the LED will remain lit until the alarm condition goes away. The LED will flash at least once every 30 seconds to indicate the controller is working properly.

The audible alarm will sound when a new alarm occurs. It will be silenced when it is acknowledged.

The keyswitch in AUTO position allows the system to start automatically, in OFF position prevents the system from operating, and in MANUAL position runs the generator for test purposes only.

The “NOT IN AUTO” LED will flash every second if the keyswitch is not in the AUTO position.

The **EMERGENCY STOP** switch will stop the generator and post an alarm.

**THE ALARM LOG**
The alarm log is a permanent (non volatile) store of the last 20 alarms that occurred. If power is removed from the controller, the log will be retained. When the alarm log is full and a new alarm occurs, the oldest alarm will be removed to create space for the new one.

Each alarm is recorded along with a time/date stamp and up to 6 optional measurements. Two of the six measurements are fixed (via password protection) to be coolant temperature and oil pressure.

The measurements you want to record are selected from a pull down list in GenLink using the alarm/event log menu, they can be analog inputs, digital inputs or output functions. For example you can record the generator voltages, frequency and the state of the transfer switch when an alarm occurs. The alarm log can be viewed via GenLink or the left hand front panel display. Alarms are displayed by GenLink in chronological order, the most recent being at the top of the list.

All alarms/warnings and sensor failures are recorded in the alarm log.
THE EVENT LOG
The event log is similar to the alarm log except that the data is stored in temporary memory (volatile) and will be lost if power is removed. The event log has space to hold up to 20 events. When the event log is full and a new event occurs, the oldest event will be removed to create space for the new one.

The event log, as its name implies, is designed to store events which are programmable from GenLink. Each measurement channel or output function can be set as an event along with a setpoint. For example, if you set Digital Input #1 (the keyswitch in AUTO position) as an event with a setpoint of logical one, each time the keyswitch is in the auto position, an event will be logged. Similarly you can set an analog event with an analog setpoint and a comparison type. For example you can set an event if the oil pressure is less than 10 psi or if power output is greater than 100 kW.

Each event is recorded along with a time/date stamp and up to 6 optional measurements. The measurements you want to record are selected from a pull down list in GenLink using the alarm/event log menu. They can be analog inputs, digital inputs or output functions. The event log can only be displayed via GenLink, it cannot be viewed on the front panel. Events are displayed by GenLink in chronological order, the most recent being at the top of the list.

MAINTENANCE SETTINGS
The controller provides a mechanism to generate multiple warnings based on maintenance intervals. Normally it will be shipped with these warnings turned off. GenLink is used to enable these warnings by setting a maintenance interval for the alarm of choice. The interval can be in engine run hours, a specific engine run hour, number of operations, a specific date or a combination of two of these methods. For example you can set the interval associated with oil life to 6 months or 100 engine hours (whichever occurs first). The transfer switch is one example of where a number of operations, a specific date or a combination of two of these methods. For example you can set the interval associated with oil life to 6 months or 100 engine hours (whichever occurs first). The transfer switch is one example of where a number of operations, a specific date or a combination of two of these methods.

- To disable a maintenance warning, set the “maintenance cycle” field to N/A.
- To set a specific date, set the “installed at” setting to the current date then set “End of life” to the specific date.
- To set a number of operations, set the “installed at” setting to zero then set “End of life” to the number of operations required.
- To set a specific operation number (say at operation 500), set the “installed at” setting to the current number of operations, then set “End of life” to the operation number.
- To set a number of engine run hours, set the “installed at” setting to zero then set “End of life” to the number of engine hours required.
- NEVER set the “Installed at” hours to anything other than zero.

A warning is generated when the maintenance criteria are met. This warning can be cancelled by the acknowledge button but will re-occur after 15 minutes. To permanently cancel the warning you must reset the maintenance interval. This can only be done via GenLink. The audible alarm will NOT sound for each 15 minute re-occurrence of the warning after the first maintenance warning is acknowledged.

The front panel display will show the percentage of life left for each possible maintenance item.

AIR/FUEL RATIO CONTROL (OPTION)
With the addition of an oxygen sensor and a solenoid to control the air fuel mix, the H-100 Control Panel can perform air/fuel ratio control to provide an optimum (stochiometric) mix to reduce emissions. This feature can be turned on or off via GenLink. The air fuel solenoid output pin shares its function with the preheat output. You must choose one of the two functions as follows:

- To select air/fuel - set the “Diesel y/n” setting on the governor page to “No”. Set preheat to “No”
- To select preheat - set the “Diesel y/n” setting on the governor page to “Y”. Set preheat to “Y”

I2T CURRENT MONITORING (OPTION)
Optionally the H-100 Control Panel can apply predictive firmware modeling to give I2T protection for the rotor and stator assembly. Based on parameters entered into the H-100 Control Panel via GenLink, the firmware models the temperature rise and fall of the alternator assembly and limits operation to prevent it being damaged. The entered parameters basically describe the thermal properties of each alternator to the firmware. GenLink allows you to choose the alternator model, and this automatically downloads the appropriate parameters. The H-100 Control Panel will normally be delivered preprogrammed with the appropriate data. GenLink will allow you turn this feature on or off as desired. There is a GenLink display of the allowable temperature limits for the selected alternator (2 limits, one for the stator and one for the rotor) and also a display of the predicted temperatures.

INTERNAL EXERCISE FUNCTION
Generators best maintain their readiness by being exercised once per week. This prevents the machine from stagnating and provides an opportunity to discover any maintenance items that may need service before the unit is actually needed for emergency power. In the past, the generator had to be exercised manually or an external exerciser was attached to the generator or transfer switch to activate the remote start once per week for a period of time long enough for the generator to warm up. With the advent of QT series of generators, that function was moved into the generator controller. This allows the QT series generator to have the QuietTest® mode of exercise as one of its key features. Normal mode exercise can be selected instead which can also exercise an approved Commercial Transfer Switch (HTS) if desired. These features are all standard in the PowerManager® H-100 controller, but require setup by the installer or end user. The internal exercise can be set up using GenLink or by using the front panel displays. This section describes the procedures needed to perform this setup.
The QuietTest® mode and Normal mode of exercise run the generator for approximately 20 minutes starting at a preset day and time once per week when the key switch is in the AUTO position and internal exercise is enabled. If the Normal exercise is used with the option to exercise an HTS selected, the exercise duration may vary based on the HTS settings. QuietTest® cannot exercise the HTS since the lower generator frequency and voltage used to reduce noise levels is incompatible with the standard system loads.

If the generator is needed for emergency power while exercise is running, exercise will be terminated automatically and the system will change to providing emergency power.

NOTE:
If “transfer on exercise” is selected with an HTS that is not a “Closed Transition Transfer Switch”, there will be a momentary (possibly several seconds) interruption in power to the load when switching from Utility to Emergency power and when switching back. For this reason, “transfer on exercise” is normally not selected.

QUIETTEST® SETUP USING GENLINK

Connect to the H-100 control panel. Using the “Configuration” pull down, select “Exercise Configuration” to display the Exercise Configuration screen.

Click on “Select Exercise” to enable internal exercise and allow the changing of the other exercise parameters.
Setup of QuietTest® is now complete. For this example, QuietTest® will start every Wednesday at 10:30 AM and run until about 10:50 AM.

NORMAL EXERCISE SETUP USING GENLINK
Connect to the H-100 control panel. Using the "Configuration" pull down, select "Exercise Configuration" to display the Exercise Configuration screen.

Select the day of week to run the exercise.

Select the time of day to run exercise.

Verify "QuietTest®" is not checked. Press "Apply".

Setup of Normal exercise is now complete. For this example, exercise will start every Wednesday at 10:30 AM and run until about 10:50 AM.

If exercise of the HTS is desired, Click on "Transfer on exercise" to enable transferring of the load to the generator during exercise.

NOTE:
This feature is only available in non-QuietTest® exercise and when an HTS is in the system.

Verify "QuietTest®" is not checked. Press "Apply".

Setup of Normal exercise is now complete. For this example, exercise will start every Wednesday at 10:30 AM and run until about 10:50 AM.

If exercise of the HTS is desired, Click on "Transfer on exercise" to enable transferring of the load to the generator during exercise.

NOTE:
This feature is only available in non-QuietTest® exercise and when an HTS is in the system.
QUIETTEST® SETUP USING FRONT PANEL

Press the "MENU" button.

Press the "ENTER" button.

Move the cursor using the arrow keys to the Exercise/HTS menu item.

Press the "ENTER" button.

Use the up and down arrow keys until a “Y” appears in the field.

Move the cursor to the “Exercise Enabled” field on the first line.

Press the “ENTER” button to enter edit mode.

Move the cursor to the “Exercise Enabled” field on the first line.

Press the “ENTER” button to enter edit mode.

Use the up and down arrow key until the desired day of the week is displayed.
Press the “ENTER” button to exit edit mode.

Y Exercise Enabled  
Time Start Wed 00:00  
Time Remaining :00  
More←→(1-4)

Move the cursor to the “Time Start” time of day hours field on the second line.

Y Exercise Enabled  
Time Start Wed 00:00  
Time Remaining :00  
More←→(1-4)

Press the “ENTER” button to enter edit mode.

NOTE:
In a number field the up/down arrows move the digit up and down while the left/right arrows move to the adjacent digit.

Y Exercise Enabled  
Time Start Wed 10:00  
Time Remaining :00  
More←→(1-4)

Use the up and down arrow key until the desired minute of the hour is displayed.

Y Exercise Enabled  
Time Start Wed 10:30  
Time Remaining :00  
More←→(1-4)

Press the “ENTER” button to exit edit mode.

Y Exercise Enabled  
Time Start Wed 10:30  
Time Remaining :00  
More←→(1-4)

Move the cursor to the “Time Start” time of day minutes field on the second line.

Y Exercise Enabled  
Time Start Wed 10:00  
Time Remaining :00  
More←→(1-4)

Press the “ENTER” button to enter edit mode.

Use the up and down arrow key until the desired minute of the hour is displayed.

Y Exercise Enabled  
Time Start Wed 10:30  
Time Remaining :00  
More←→(1-4)

Move the cursor to the  on the bottom line.

Y Exercise Enabled  
Time Start Wed 10:30  
Time Remaining :00  
More←→(1-4)
Setup of QuietTest® is now complete. For this example, QuietTest® will start every Wednesday at 10:30 AM and run until about 10:50 AM.

While QuietTest® is running, the “Time Remaining” will display the approximate number of minutes left before QuietTest® is completed.

**NOTE:**
Verify that “Xfer On Exercise” field is an “N”. Otherwise, QuietTest® will be overridden with normal exercise.
Move the cursor to the “Exercise Enabled” field on the first line.

**N** Exercise Enabled
Time Start Sun 00:00
Time Remaining :00
More→→(1-4)

Press the “ENTER” button to enter edit mode.

**N** Exercise Enabled
Time Start Sun 00:00
Time Remaining :00
More→→(1-4)

Press the “ENTER” button to enter edit mode.

**N** Exercise Enabled
Time Start Sun 00:00
Time Remaining :00
More→→(1-4)

Press the “ENTER” button to exit edit mode.

**Y** Exercise Enabled
Time Start Sun 00:00
Time Remaining :00
More→→(1-4)

Press the “ENTER” button to exit edit mode.

**Y** Exercise Enabled
Time Start Sun 00:00
Time Remaining :00
More→→(1-4)

Move the cursor to the “Time Start” day of week field on the second line.

**Y** Exercise Enabled
Time Start Sun 00:00
Time Remaining :00
More→→(1-4)

Use the up and down arrow key until the desired day of the week is displayed.

**Y** Exercise Enabled
Time Start Wed 00:00
Time Remaining :00
More→→(1-4)

Press the “ENTER” button to enter edit mode.

**Y** Exercise Enabled
Time Start Wed 00:00
Time Remaining :00
More→→(1-4)

Press the “ENTER” button to exit edit mode.

**Y** Exercise Enabled
Time Start Wed 00:00
Time Remaining :00
More→→(1-4)

Move the cursor to the “Time Start” time of day hours field on the second line.

**Y** Exercise Enabled
Time Start Wed 00:00
Time Remaining :00
More→→(1-4)

Press the “ENTER” button to enter edit mode.

**Y** Exercise Enabled
Time Start Wed 00:00
Time Remaining :00
More→→(1-4)
Use the up and down arrow key until the desired hour of the day is displayed.

**NOTE:**
In a number field the up/down arrows move the digit up and down while the left/right arrows move to the adjacent digit.

<table>
<thead>
<tr>
<th>Y Exercise Enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Start Wed 10:00</td>
</tr>
<tr>
<td>Time Remaining :00</td>
</tr>
<tr>
<td>More←→(1-4)</td>
</tr>
</tbody>
</table>

Press the “ENTER” button to exit edit mode.

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<tr>
<td>Time Remaining :00</td>
</tr>
<tr>
<td>More←→(1-4)</td>
</tr>
</tbody>
</table>

Move the cursor to the “Time Start” time of day minutes field on the second line.

<table>
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<tbody>
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</tr>
<tr>
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</tr>
<tr>
<td>More←→(1-4)</td>
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Press the “ENTER” button to enter edit mode.

<table>
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<th>Y Exercise to Enabled</th>
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<tr>
<td>Time Start Wed 10:00</td>
</tr>
<tr>
<td>Time Remaining :00</td>
</tr>
<tr>
<td>More←→(1-4)</td>
</tr>
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</table>

Use the up and down arrow key until the desired minute of the hour is displayed.

<table>
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<tbody>
<tr>
<td>Time Start Wed 10:30</td>
</tr>
<tr>
<td>Time Remaining :00</td>
</tr>
<tr>
<td>More←→(1-4)</td>
</tr>
</tbody>
</table>

Press the “ENTER” button to exit edit mode.

<table>
<thead>
<tr>
<th>Y Exercise Enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Start Wed 10:30</td>
</tr>
<tr>
<td>Time Remaining :00</td>
</tr>
<tr>
<td>More←→(1-4)</td>
</tr>
</tbody>
</table>

Move the cursor to the “QuietTest Selected” field on the first line.

<table>
<thead>
<tr>
<th>Y QuietTest Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Start Exercise Now</td>
</tr>
<tr>
<td>N Xfer On Exercise</td>
</tr>
<tr>
<td>More←→(2-4)</td>
</tr>
</tbody>
</table>

Press the “ENTER” button to move to the second page.

<table>
<thead>
<tr>
<th>Y QuietTest Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Start Exercise Now</td>
</tr>
<tr>
<td>N Xfer On Exercise</td>
</tr>
<tr>
<td>More←→(2-4)</td>
</tr>
</tbody>
</table>

Press the “ENTER” button to enter edit mode.

<table>
<thead>
<tr>
<th>Y QuietTest Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Start Exercise Now</td>
</tr>
<tr>
<td>N Xfer On Exercise</td>
</tr>
<tr>
<td>More←→(2-4)</td>
</tr>
</tbody>
</table>
Use the up and down arrow key until a “N” appears.

Y QuietTest Selected
N Start Exercise Now
N Xfer On Exercise
 More←→(2-4)

Press the “ENTER” button to exit edit mode.

Y QuietTest Selected
N Start Exercise Now
N Xfer On Exercise
 More←→(2-4)

Setup of Normal Exercise is now complete. For this example, exercise will start every Wednesday at 10:30 AM and run until about 10:50 AM.

While normal exercise is running, the “Time Remaining” will display the approximate number of minutes left before exercise is completed.

Y Exercise Enabled
Time Start Wed 10:30
Time Remaining :00
 More←→(1-4)

If it is desired to exercise the HTS as well during the exercise cycle, then continue with the enabling of “transfer on exercise” described below.

Move the cursor to the “Xfer On Exercise” field on the third line.

Y QuietTest Selected
N Start Exercise Now
N Xfer On Exercise
 More←→(2-4)

Press the “ENTER” button to enter edit mode.

Y QuietTest Selected
N Start Exercise Now
 Y Xfer On Exercise
 More←→(2-4)

Use the up and down arrow key until a “Y” appears.

Y QuietTest Selected
N Start Exercise Now
 Y Xfer On Exercise
 More←→(2-4)

Press the “ENTER” button to exit edit mode.

Y QuietTest Selected
N Start Exercise Now
 Y Xfer On Exercise
 More←→(2-4)

Setup of Normal Exercise with transfer to load during exercise is now complete. For this example, exercise will start every Wednesday at 10:30 AM and run until about 10:50 AM. However, the HTS settings may change this time.

While normal exercise is running, the “Time Remaining” will display the approximate number of minutes left before exercise is completed.

Y Exercise Enabled
Time Start Wed 10:30
Time Remaining :20
 More←→(1-4)
SET DATE AND TIME
The H-100 Control Panel contains a real time clock to keep track of date and time. This is used to schedule internal exercise, time stamp alarm/event log entries, and time stamp reports. The date and time can be changed using either GenLink or the front panel display.

DATE AND TIME SETUP USING GENLINK
Connect to the H-100 control panel.

Connect to the H-100 control panel.

The date and time field is displayed in the lower left corner of the screen.

Using the mouse cursor, click on the date and time field.

Any of the fields are editable. Note that hours are entered as 0 – 23. If the PC being used has reliable date and time settings, pressing the “Synchronize with PC!” button will copy the PC date and time into the H-100 Control Panel. Otherwise, press “Apply” after making changes. The date and time on the GenLink screen may take a few seconds to update.

DATE AND TIME SETUP USING FRONT PANEL
Press the “MENU” button.

Press the “MENU” button.

Press the “MENU” button.

Press the “ENTER” button.

There are 5 editable fields on line 3. They are hours, minutes, month, day, and year. Use the arrow keys to move to each of the fields needing to be changed. Press enter to begin edit mode. Use the up and down arrow keys to slew to the desired value. Press enter to exit edit mode or use the right or left arrow keys to leave the field. The date and time setup is completed.

ADJUST DISPLAY CONTRAST
The display contrast is adjustable to accommodate different viewing environments. The generator is shipped from the factory with the contrast set to 20%. This is optimal for most situations. However, if the user needs to change the contrast, they can do so by editing the value on the last “Service” page. Note that changing the contrast can make the screen nearly unreadable and the contrast setting is saved across power cycles. Caution should be exercised while editing this value.
Do the following to change the display contrast:

Press the “MENU” button.

Press the button three times or the button once.

Press the “ENTER” button.

Press the button.

Press the “ENTER” button.

The contrast is now set and can only be changed by editing the value on this page.

**ENABLE HTS COMMERCIAL TRANSFER SWITCH**

The H-100 Control Panel can control up to four HTSs via the RS-485 communications port. The H-100 Control Panel is shipped without the HTS control enabled. If the user has an HTS in their system, they must enable the HTS via GenLink or the front panel. If the HTS is not enabled, the generator will not operate automatically with loss of utility. If the H-100 Control Panel enables a nonexistent HTS, there will be a warning indicated.

**NOTE:**

Non-HTS switches use the two-wire start interface and do not need enabling by H-100 Control Panel.
HTS SETUP USING GENLINK

Connect to the H-100 control panel.

Using the “Configuration” pull down, select “Transfer Switch Configuration” to display the HTS Configuration screen.

The lower left corner contains the HTS number. Use the “Prev” and “Next” buttons to select the appropriate switch number - 1 through 4. If enabling the switch, check the “Switch Connected” check box in the middle of the screen. If disabling the switch, uncheck the “Switch Connected” check box. The remainder of the settings on this page are described in the HTS manual.

HTS SETUP USING FRONT PANEL

Press the “MENU” button.

Press the button.

Press the “ENTER” button.

This is the HTS enabling/disabling page. The HTS number needs to be selected first.
Press the button to go to the HTS # field.

**HTS #1** Disabled

More→(4-4)

Press the “ENTER” button to enter the edit mode.

**HTS #1** Disabled

More→(4-4)

Select the appropriate HTS number using the up and down arrow buttons.

Press the “ENTER” button to exit the edit mode.

**HTS #1** Disabled

More→(4-4)

Press the button to go to the HTS Enable/Disable field.

Press the “ENTER” button to enter the edit mode.

**HTS #1** Disabled

More→(4-4)

Select the Enabled / Disabled using the up and down arrow buttons.

**HTS #1** Enabled

More→(4-4)

Press the “ENTER” button to exit the edit mode.

**HTS #1** Enabled

More→(4-4)

For this example, HTS number 1 is now enabled. If HTS #1 is not connected or if the HTS is not #1, there will be a communications error indicated.

**COMMUNICATIONS**

There are 2 ports on the H-100 Control Panel, an RS-232 port and an RS-485. Each port can be reconfigured as to its function, however there can only be one master Modbus port. All ports can have their baud rate, parity and stop bits changed. For Modbus ports, the address can also be changed via GenLink, but each address in a connected system must be unique. Normally the RS-232 port will be configured as a Modbus slave to communicate with GenLink and the optional Modem. The RS-485 port will act as a master for connection to up to two remote annunciators/remote relay panels and up to four HTSs. The RS-485 port can be reconfigured via GenLink to be a deep diagnostic port.

**REMOTE ANNUNCIATOR CONNECTION (OPTION)**

The H-100 Control panel RS-485 port is normally configured as Modbus Master, 4800 baud, no parity, and two stop bits. This is the required configuration for the remote annunciator. However, the remote annunciator is often shipped configured as a Modbus Master (active mode). A wire jumper must be added in the remote annunciator to configure it as the Modbus Slave (passive mode). A total of up to two remote annunciators and remote relay panels can be attached to the RS-485 bus. See the remote annunciator/relay panel manual for details.
In an H-100 Control Panel system without HTS switches, the annunciator will indicate Line Power or Generator Power based on two designated H-100 control panel spare inputs Input #7 (Also labeled DI3) and Input #8 (Also labeled DI4). These inputs can be used for other functions as desired, but will always operate the annunciator lights. Input #7 should be connected to Line Power indication. Input #8 should be connected to Generator Power indication.

In an H-100 Control Panel system with HTS switches, the annunciator will indicate Line Power or Generator Power based on the status reported from the selected HTS. The selected HTS is the HTS number that was selected using the H-100 control front panel. The number is selected on either of the Exercise/HTS pages (3-4) or (4-4). The two designated H-100 control panel inputs Input #7 and Input #8 are free to be used for other functions and will not affect the annunciator as long as at least one HTS is connected and enabled.

NEW GENERATION GENLINK (NGG)
An all new version of GenLink has been released for support of the H-100 Control Panel. It uses the industry standard Modbus protocol for communications and acts as a Modbus master. GenLink runs on PC platforms running Windows 98 (but will not support future Internet applications), Windows NT 4.0, Windows 200 and XP. We recommend an Intel Pentium 4 processor (1.0ghz+) with a minimum 64MB memory and 20GB hard drive. plus 56k Zonet PCMCIA based modem. For details about GenLink, refer to the New Generation GenLink manual. Additional features include:

◆ GENLINK RELAY CONTROL
There is a “Radio Button” displayed on the main GenLink display screen. This button will set or reset output function 106 which in turn can be made to drive a relay or any combination of things (via the ILC). The function can be renamed and this new name will appear above the radio button.

◆ SET ENGINE HOURS
In the event that a controller has to be replaced, the engine hours on the new controller can be set to match the controller it is replacing. This can only be done at the factory.

◆ ABSOLUTE MAXIMUM RATINGS
Supply Voltage rating 5 - 30V dc continuous
Power consumption 0.45A typical

◆ ENVIRONMENTAL RATINGS
Temperature 0 - 50 deg. C
Relative humidity 20 - 95%, non condensing
Sealing IP65
ESD As per manufacturer's spec.

2A AND 10A BATTERY CHARGERS
There are two types of battery chargers. A 2 Amp battery charger and a 10 Amp battery charger.

The 2 Amp battery charger is a “float” type charger. A “float” type charger will charge the battery at its maximum output current rating until the battery voltage reaches a “float” voltage and then the charge current will decrease to maintain the battery at that “float” voltage.

The 10 Amp battery charger is an "equalize" type charger. An "equalize" type charger will charge the battery at its maximum output current rating until the battery voltage reaches an "equalize" voltage and then the charge current will decrease to maintain the battery at a lower "float" voltage.

The 2 Amp charger incorporates fuses on both the input AC line and the battery charger output. The input AC line fuse is a Littelfuse 2 Amp, Slo-Blo Fuse, 5x20mm, P/N 218002. The AC line fuse is located on the charger printed-circuit board. The output DC battery fuse is a Littelfuse 5 Amp, Mini-Blade Fuse, P/N 297005. The battery fuse is located on the charger printed-circuit board.

The 10 Amp charger incorporates fuses on both the input AC line and the battery charger output. The input AC line fuse is a Littelfuse 5 Amp, Slo-Blo Fuse, 5x20mm, P/N 218005. The AC line fuse is located on the charger printed-circuit board. The output DC battery fuse is a Littelfuse 15 Amp, ATO Fuse, P/N 257015. The battery fuse is located on the charger printed-circuit board.

These chargers require that the battery be connected to the charger in order to turn on. The battery voltage must also be above a certain “boost” voltage for the charger to turn-on (also called "Undervoltage Shutdown").

The boost voltage required is approximately 11 volts for a 12V system. If the battery open-circuit voltage is less than the above boost voltage, it is recommended that the battery be checked.

If the voltage of the generator’s 12V battery exceeds 15VDC, during normal charging operation, the battery should be checked. Typical battery voltages, when a 12V battery is being charged, should be in the 13VDC to 15VDC range.

The 2 Amp and 10 Amp chargers are UL recognized for use in the R-panel enclosure and are not to be operated outside the R-panel enclosure.

⚠️ DANGER ⚠️
Storage batteries give off explosive hydrogen gas. This gas can form an explosive mixture around the battery for several hours after charging. The slightest spark can ignite the gas and cause an explosion. Such an explosion can shatter the battery and cause blindness or other injury. Any area that houses a storage battery must be properly ventilated. Do not allow smoking, open flame, sparks or any spark producing tools or equipment near the battery.
Battery electrolyte fluid is an extremely corrosive sulfuric acid solution that can cause severe burns. Do not permit fluid to contact eyes, skin, clothing, painted surfaces, etc. Wear protective goggles, protective clothing and gloves when handling a battery. If fluid is spilled, flush the affected area immediately with clear water.

Do not use any jumper cables or booster battery to crank and start the generator engine. If the battery has completely discharged, remove it from the generator for recharging.

Be sure the AUTO/OFF/MANUAL switch is set to the OFF position, before connecting the battery cables. If the switch is set to AUTO or MANUAL, the generator can crank and start as soon as the battery cables are connected.

Be sure the utility power supply to the battery charger is turned off, or sparking may occur at the battery posts as the cables are attached and cause an explosion.

**2A, 12VDC BATTERY CHARGER**

Nominal Input AC Line Voltage ............................................... 120Vac
Operating AC Line Voltage Range ............................................. 108Vac to 132Vac
Input AC Line Frequency .................................................. 50 or 60Hz
AC Line Fuse ............................................................... 2 Amp Slo-Blo, 5x20mm,
                                          Littelfuse P/N 218002
Battery Fuse............................................................... 5 Amp, Littelfuse Mini-Blade Fuse P/N 297005
Nominal Charge Rate ............................................................ 2 Amps
Float Voltage (type) ............................................................ 13.4 Volts
Battery Undervoltage Shutdown (typ) .................................. 11 Volts
LED Indicators
  AC Line Voltage > 108Vac................. Green LED ON
  Battery Connected & Charging............. Yellow LED ON
  (the Green LED must be ON to obtain a valid battery charging indication,
  Yellow LED ON if charge current > approx 0.5 Amps)
Battery Current Drain (AC Power OFF) ................. 30mA (typ)
AC Line Connections ............................................. via terminal block
                                          (AC Hot, AC Neut & GND)
Battery Connections ............................................... via terminal block
                                          (Pos +, Neg -)

**10A, 12VDC BATTERY CHARGER**

Nominal Input AC Line Voltage ............................................... 120Vac
Operating AC Line Voltage Range ............................................. 108Vac to 132Vac
Input AC Line Frequency .................................................. 50 or 60Hz
AC Line Fuse ............................................................... 5 Amp, 5x20mm,
                                          Littelfuse P/N 218005
Battery Fuse............................................................... 15 Amp, Littelfuse ATO
                                          Blade P/N 257015
Nominal Charge Rate ............................................................ 10 Amps
Equalize Voltage (typ) ............................................................ 13.8 Volts
Float Voltage (typ) ............................................................ 13.0 Volts
Current at Equalize to Float Transition (typ) ............... 5 Amps
Battery Undervoltage Shutdown (typ) .................................. 11 Volts
LED Indicators
  AC Line Voltage > 108Vac................. Green LED ON
  Battery Connected & Charging............. Yellow LED ON
  the Green LED must be ON to obtain a valid battery charging indication,
  Yellow LED ON if charge current > approx 2 Amps)
Battery Current Drain (AC Power OFF) ................. 30mA (typ)
AC Line Connections ............................................. via terminal block
                                          (AC Hot, AC Neut & GND)
Battery Connections ............................................... via terminal block
                                          (Pos +, Neg -)
Control Connections ........................................... AC Power Fail Relay,
                                          Form C, 2Amps, 12Vdc
(N.O. Contact closes when ac line voltage is applied)
(N.O. Contact opens when ac line voltage is removed)
APPENDIX A — ANALOG FUNCTIONS

The User Configurable Analog Inputs have several parameters that affect the value interpreted from the A/D reading. In general, the following equation determines the final User Configurable Analog Input result:

\[ \text{Result} = \text{Scale} \left( \text{Function} \left( \text{Calibrate} \left( \text{Raw A/D reading} \right) \right) \right) \]

For functions that require 4 coefficients for a polynomial, the calibration factor has to be incorporated in the polynomial coefficients. In this case, the following equation determines the final User Configurable Analog Input result:

\[ \text{Result} = \text{Scale} \left( \text{Function} \left( \text{Raw A/D reading} \right) \right) \]

The RMS Analog Inputs have a calibration parameter and a scaling parameter that affect the value interpreted from the A/D reading. The following equation determines the final RMS Analog Input result:

\[ \text{Result} = \text{Scale} \left( \text{Calibrate} \left( \text{RMS Function} \left( \text{Raw A/D reading} \right) \right) \right) \]

Although the calibration and scaling adjustments exist for the remaining Analog Inputs (i.e. derived channels), it is unlikely they will be used. The remaining Analog Inputs are derived from other analog inputs that have already been adjusted. If further adjustment is needed, then the following equation determines the final Analog Input result:

\[ \text{Result} = \text{Scale} \left( \text{Calibrate} \left( \text{RMS Function} \left( \text{Raw A/D reading} \right) \right) \right) \]

These derived inputs have more complex interactions with the hardware, so care should be taken if adjustments are used.

The conversion functions are described below. One of these functions is a 16 bit floating point polynomial - GEN_FP_POLY. This function should only be used as an extreme last resort as it is processor time intensive. The other integer polynomial functions should be sufficient for converting the A/D input data.

The coefficients for the conversion functions need to be adjusted for working in the A/D counts realm as opposed to the voltage realm. Multiply A/D reading voltage by 1023/5 to convert to A/D reading counts. Also, the coefficient scaling is in powers of 2 to expedite processing of math operations using shifts instead of multiply and divide. The following types of Analog Input functions are implemented in the firmware.

THERMISTOR:

PRESSURE:

POLY_3RD:

Third order polynomial with 4 coefficients and a scaling factor

\[ X = \text{raw\_analog} \]
\[ (AX^3 + BX^2 + CX + D) \times S \]

Where:

- \( A, B, C, D \) are polynomial coefficients
- \( S \) is the scaling factor
- \( S \) is the scaling factor

\[ \begin{align*}
\text{Coefficient 3} & = A \times 1024^3 \\
\text{Coefficient 2} & = B \times 1024^2 \\
\text{Coefficient 1} & = C \times 1024 \\
\text{Calibration} & = D \\
\text{Scaling} & = S \times 1024
\end{align*} \]

POLY_2ND:

Second order polynomial with 3 coefficients, a scaling factor, and a calibration factor

\[ X = M \times \text{raw\_analog} \]
\[ (AX^2 + BX + C) \times S \]

Where:

- \( M \) is the calibration factor
- \( A, B, C \) are polynomial coefficients
- \( S \) is the scaling factor

\[ \begin{align*}
\text{Calibration} & = M \times 1024 \\
\text{Coefficient 3} & = A \times 1024^2 \\
\text{Coefficient 2} & = B \times 1024 \\
\text{Coefficient 1} & = C \\
\text{Scaling} & = S \times 1024
\end{align*} \]

LINEAR:

POLY_1ST:

First order polynomial with 2 coefficients, a scaling factor, and a calibration factor

\[ X = M \times \text{raw\_analog} \]
\[ (AX + B) \times S \]

Where:

- \( M \) is the calibration factor
- \( A, B \) are polynomial coefficients
- \( S \) is the scaling factor

\[ \begin{align*}
\text{Calibration} & = M \times 1024 \\
\text{Coefficient 3} & = A \times 1024 \\
\text{Coefficient 2} & = B \\
\text{Coefficient 1} & = C \\
\text{Scaling} & = S \times 1024
\end{align*} \]

POLY_1ST_N1:

First order polynomial with 3 coefficients, a scaling factor, and a calibration factor

\[ X = M \times \text{raw\_analog} \]
\[ (A + BX + CX-1) \times S \]
Where:
- $M$ is the calibration factor
- $A, B, C$ are polynomial coefficients
- $S$ is the scaling factor

Calibration = $M \times 1024$
Coefficient 3 = $C$
Coefficient 2 = $B \times 1024$
Coefficient 1 = $A$
Scaling = $S \times 1024$

**POLY_1ST_N2:**
First order polynomial with 4 coefficients and a scaling factor

\[
X = \text{raw\_analog} (A + BX + CX -1 + DX -2) \times S
\]

Where:
- $A, B, C, D$ are polynomial coefficients
- $S$ is the scaling factor
Coefficient 3 = $D$
Coefficient 2 = $C$
Coefficient 1 = $B \times 1024$
Calibration = $A$
Scaling = $S \times 1024$

**CFM_SENSOR:**
First order polynomial with 4 coefficients and a scaling factor

\[
X = \text{raw\_analog} - \text{learned\_offset} (A + BX + CX -1 + DX -2) \times S
\]

Where:
- $A, B, C, D$ are polynomial coefficients
- $S$ is the scaling factor
Coefficient 3 = $D / 32$
Coefficient 2 = $C$
Coefficient 1 = $B \times 32768$
Calibration = $A \times 64$
Scaling = $S \times 1024$

**CURRENT:**
**CAL_SCALE:**
Implements a scaling factor and a calibration factor

\[
X = M \times \text{raw\_analog} \times S
\]

Where:
- $M$ is the calibration factor
- $S$ is the scaling factor
Calibration = $M \times 1024$
Scaling = $S \times 1024$

**GEN_FP_POLY:**
Third order polynomial with 4 coefficients

\[
X = \text{raw\_analog} AX3 + BX2 + CX + D
\]

Where:
- $A, B, C, D$ are 16 bit floating point polynomial coefficients
Coefficient 3 = $A$
Coefficient 2 = $B$
Coefficient 1 = $C$
Calibration = $D$
Amplitudes from 0.00000005961 (256 E-16) to 1,098,437,885,952 (1023 E+15) are possible with this representation with at least 9 significant bits.
# APPENDIX B — H-100 GENERAL I/O AND CONNECTOR INFORMATION

## H-100 ANALOG INPUTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Default Signal Name</th>
<th>Default Signal Name</th>
<th>Type</th>
<th>Connector Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OIL TEMP</td>
<td>Oil Temperature</td>
<td>4-20 ma</td>
<td>J1-9 source, J1-8 return</td>
</tr>
<tr>
<td>2</td>
<td>COOLANT TEMP</td>
<td>Coolant Temperature</td>
<td>4-20 ma</td>
<td>J1-15 source, J1-31 return</td>
</tr>
<tr>
<td>3</td>
<td>OIL PRESSURE</td>
<td>Oil Pressure</td>
<td>4-20 ma</td>
<td>J1-20 source, J1-19 return</td>
</tr>
<tr>
<td>4</td>
<td>COOLANT LEVEL</td>
<td>Coolant Level</td>
<td>4-20 ma</td>
<td>J1-30 source, J1-29 return</td>
</tr>
<tr>
<td>5</td>
<td>USER CFG 05 FUEL LEVEL</td>
<td>Analog Input #5</td>
<td>4-20 ma</td>
<td>J1-7 source, J1-6 return</td>
</tr>
<tr>
<td>6</td>
<td>USER CFG 06 FUEL PRESSURE INLET TEMP</td>
<td>Analog Input #6</td>
<td>4-20 ma</td>
<td>J1-28 source, J1-27 return</td>
</tr>
<tr>
<td>7</td>
<td>USER CFG 07 THROT POS</td>
<td>Analog Input #7</td>
<td>4-20 ma</td>
<td>J1-18 source, J1-17 return</td>
</tr>
<tr>
<td>8</td>
<td>USER CFG 08 EMISSIONS FLUID BASIN</td>
<td>Analog Input #8</td>
<td>0-1 Volt</td>
<td>J1-5 source, J1-5 return</td>
</tr>
<tr>
<td>9</td>
<td>USER CFG 09 BAT CHARGE CUR</td>
<td>Analog Input #9</td>
<td>0-10 Volt</td>
<td>J1-16 return</td>
</tr>
<tr>
<td>10</td>
<td>BATTERY VOLTS</td>
<td>Battery Voltage</td>
<td>0-30 Volt</td>
<td>J1-35 ( + ), J1-12 ( - )</td>
</tr>
<tr>
<td>11</td>
<td>CURRENT PHS A</td>
<td>Phase A Current – single &amp; three phase</td>
<td>0-3 ARMS</td>
<td>J2-12 ( + ), J2-11 ( - )</td>
</tr>
<tr>
<td>12</td>
<td>CURRENT PHS B</td>
<td>Phase B Current – single &amp; three phase</td>
<td>0-3 ARMS</td>
<td>J2-35 ( + ), J2-34 ( - )</td>
</tr>
<tr>
<td>13</td>
<td>CURRENT PHS C</td>
<td>Phase C Current – three phase</td>
<td>0-3 ARMS</td>
<td>J2-10 ( + ), J2-9 ( - )</td>
</tr>
<tr>
<td></td>
<td>CURRENT NEUTRAL</td>
<td>Current in Neutral – single phase</td>
<td>Derived</td>
<td>n/a</td>
</tr>
<tr>
<td>14</td>
<td>AVRG CURRENT</td>
<td>Average System Current</td>
<td>Derived</td>
<td>n/a</td>
</tr>
<tr>
<td>15</td>
<td>VOLT PHS A-B</td>
<td>Line-to-Line AB Voltage – three phase</td>
<td>0-28.8 VRMS</td>
<td>J2-6</td>
</tr>
<tr>
<td></td>
<td>VOLT PHS A-N</td>
<td>Line-to-Neutral AN Voltage – single</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>VOLT PHS B-C</td>
<td>Line-to-Line BC Voltage – three phase</td>
<td>0-28.8 VRMS</td>
<td>J2-29</td>
</tr>
<tr>
<td></td>
<td>VOLT PHS B-N</td>
<td>Line-to-Neutral BN Voltage – single</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>VOLT PHS C-A</td>
<td>Line-to-Line CA Voltage – three phase</td>
<td>0-28.8 VRMS</td>
<td>J2-17</td>
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<tr>
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<td>VOLT PHS A-B</td>
<td>Line-to-Line AB Voltage – single phase</td>
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<tr>
<td>18</td>
<td>AVRG VOLTAGE</td>
<td>Average Line-to-Line System Voltage</td>
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<td>19</td>
<td>TOTAL POWER KW</td>
<td>Total System Real Power</td>
<td>Derived</td>
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<td>20</td>
<td>TOTAL PF</td>
<td>Total System Power Factor</td>
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<td>21</td>
<td>GEN FREQUENCY</td>
<td>Generator Frequency</td>
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<tr>
<td>22</td>
<td>ENGINE RPM</td>
<td>Engine RPM</td>
<td>Hall Affect</td>
<td>J1-24 ( - ), J1-25 ( + )</td>
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<tr>
<td>23</td>
<td>O2 DUTY CYCLE</td>
<td>Oxygen Sensor Measured Duty Cycle</td>
<td>Derived</td>
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# H-100 DIGITAL OUTPUTS

<table>
<thead>
<tr>
<th>H-100 Number</th>
<th>GenLink Number</th>
<th>Signal Description</th>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Starter Relay (reserved)</td>
<td>J1-23</td>
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<td>2</td>
<td>2</td>
<td>Fuel Relay (reserved)</td>
<td>J1-11</td>
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<td>3</td>
<td>Fault Relay (reserved)</td>
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<td>4</td>
<td>4</td>
<td>13.3L Gas Relay (reserved for ILC on 13.3L gas)</td>
<td>J1-22</td>
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<tr>
<td>5</td>
<td>5</td>
<td>Auxiliary #1</td>
<td>J2-23</td>
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<td>Auxiliary #2</td>
<td>J2-22</td>
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<td>7</td>
<td>7</td>
<td>Auxiliary #3</td>
<td>J2-33</td>
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<td>Auxiliary #4</td>
<td>J2-21</td>
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<td>9</td>
<td>9</td>
<td>13.3L Ignition Module (reserved for ILC on 13.3L gas)</td>
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<tr>
<td>10</td>
<td>n/a</td>
<td>Overspeed Shutdown (reserved – no software control)</td>
<td>J1-10</td>
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<tr>
<td>11</td>
<td>28</td>
<td>Throttle Driver PWM (reserved for H-100 governed generators)</td>
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<tr>
<td>12</td>
<td>25</td>
<td>PreHeat Relay – diesel only (reserved)</td>
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<tr>
<td>13</td>
<td>26</td>
<td>Air/Fuel Ratio PWM – gas only (reserved)</td>
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<td>14</td>
<td>31</td>
<td>AVR Field Control (reserved)</td>
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# H-100 DIGITAL INPUTS

<table>
<thead>
<tr>
<th>Number</th>
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<th>Connector Pin</th>
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<tr>
<td>1</td>
<td>AUTO SWITCH</td>
<td>Key Switch in AUTO</td>
<td>J2-5</td>
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<td>2</td>
<td>MANUAL SWITCH</td>
<td>Key Switch in MANUAL</td>
<td>J2-28</td>
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<td>3</td>
<td>EMERGENCY STOP</td>
<td>Emergency Stop Status</td>
<td>J2-16</td>
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<tr>
<td>4</td>
<td>REMOTE START</td>
<td>Remote Start</td>
<td>J2-4</td>
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<tr>
<td>5</td>
<td>DI1/USR CFG 05, BAT CHGRF FAIL</td>
<td>DI-1, Battery Charger Fail</td>
<td>J2-27</td>
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<tr>
<td>6</td>
<td>DI2/USR CFG 06, RUPTURED BASIN</td>
<td>DI-2, Ruptured Basin, PROP GAS LEAK, DI2/FUEL PRESSURE</td>
<td>J2-15</td>
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<td>8</td>
<td>DI4/USR CFG 08, DI4/GEN POWER</td>
<td>DI-4, Generator Power</td>
<td>J2-26</td>
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<tr>
<td>9</td>
<td>MODEM DCD, USR CFG 09</td>
<td>Modem DCD, User configurable (reserved if Modem)</td>
<td>J1-14</td>
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<td>10</td>
<td>MODEM ENABLED</td>
<td>Modem Enable</td>
<td>J1-26</td>
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<td>11</td>
<td>GEN OVERSPEED</td>
<td>Generator Overspeed Detected</td>
<td>Internal</td>
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<td>Number</td>
<td>Default Function Name</td>
<td>Function Description</td>
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<tr>
<td>1</td>
<td>COMMON ALARM</td>
<td>An alarm is active</td>
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<tr>
<td>2</td>
<td>COMMON WARNING</td>
<td>A warning is active</td>
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<tr>
<td>3</td>
<td>GEN RUNNING</td>
<td>Generator is running</td>
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<tr>
<td>4</td>
<td>ALARMS ENABLED</td>
<td>All alarm hold off delays have expired, so all alarms are enabled</td>
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<tr>
<td>5</td>
<td>READY FOR LOAD</td>
<td>Generator is warmed up and ready to accept power loading</td>
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<tr>
<td>6</td>
<td>GEN READY TO RUN</td>
<td>Generator is ready to start</td>
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<tr>
<td>7</td>
<td>GEN STOPPED-ALRM</td>
<td>Generator stopped due to a shutdown alarm</td>
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<tr>
<td>8</td>
<td>GEN STOPPED</td>
<td>Generator is stopped</td>
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<tr>
<td>9</td>
<td>GEN IN MANUAL</td>
<td>Generator in MANUAL mode (key switch in MANUAL or ILC overridden)</td>
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<tr>
<td>10</td>
<td>GEN IN AUTO</td>
<td>Generator in AUTO mode (key switch in AUTO or ILC overridden)</td>
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<tr>
<td>11</td>
<td>GEN IN OFF</td>
<td>Generator in OFF mode (key switch in OFF or ILC overridden)</td>
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<tr>
<td>12</td>
<td>OVERCRANK ALARM</td>
<td>Generator has unsuccessfully tried to start the designated number of times</td>
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<tr>
<td>13</td>
<td>OIL INHIBIT ALRM</td>
<td>Oil pressure too high for a stopped engine</td>
<td></td>
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<tr>
<td>14</td>
<td>ANNUNC SPR LIGHT</td>
<td>ILC controlled; this function operates the spare remote annunciator light</td>
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<tr>
<td>15</td>
<td>OIL TEMP HI ALRM</td>
<td>Oil Temperature has gone above maximum alarm limit</td>
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<tr>
<td>16</td>
<td>OIL TEMP LO ALRM</td>
<td>Oil Temperature has gone below minimum alarm limit</td>
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<tr>
<td>17</td>
<td>OIL TEMP HI WARN</td>
<td>Oil Temperature has gone above maximum warning limit</td>
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<td>19</td>
<td>OIL TEMP FAULT</td>
<td>Oil Temperature sensor exceeds nominal limits for valid sensor reading</td>
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<tr>
<td>20</td>
<td>COOL TMP HI ALRM</td>
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<td>21</td>
<td>COOL TMP LO ALRM</td>
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<td>22</td>
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<td>25</td>
<td>OIL PRES HI ALRM</td>
<td>Oil Pressure has gone above maximum alarm limit</td>
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<td>OIL PRES LO ALRM</td>
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<td>OIL PRES HI WARN</td>
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<td>Oil Pressure sensor exceeds nominal limits for valid sensor reading</td>
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<td>30</td>
<td>COOL_LVL HI ALRM</td>
<td>Coolant Level has gone above maximum alarm limit</td>
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<td>32</td>
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<td>33</td>
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<td>35</td>
<td>ANALOG 5 HI ALRM</td>
<td>Analog Input #5 has gone above maximum alarm limit</td>
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<td>FUEL_LVL HI WARN</td>
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<td>FUEL_LVL FAULT</td>
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<td>FUEL_PRS HI ALRM</td>
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<td>FLUID BS HI ALRM</td>
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<td>Emissions Sensor</td>
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<td>FLUID BS FAULT</td>
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<td>ANALOG 9 HI ALRM</td>
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<td>CHG CURR HI ALRM</td>
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<td>CHG CURR LO ALRM</td>
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<td>CHG CURR HI WARN</td>
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<td>CHG CURR LO Warn</td>
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<td>CHG CURR FAULT</td>
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<td>BAT VOLT HI ALRM</td>
<td>Battery Voltage has gone above maximum alarm limit</td>
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<tr>
<td>61</td>
<td>BAT VOLT LO ALRM</td>
<td>Battery Voltage has gone below minimum alarm limit</td>
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<td>62</td>
<td>BAT VOLT HI WARN</td>
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<tr>
<td>Number</td>
<td>Default Function Name</td>
<td>Function Description</td>
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<td>BAT VOL T LO WARN</td>
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<td>64</td>
<td>AVG CURR HI ALRM</td>
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<td>AVG CURR LO ALRM</td>
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<td>AVG CURR HI WARN</td>
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<td>69</td>
<td>AVG VOLT LO ALRM</td>
<td>Average Voltage has gone below minimum alarm limit</td>
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<tr>
<td>70</td>
<td>AVG VOLT HI WARN</td>
<td>Average Voltage has gone above maximum warning limit</td>
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<td>71</td>
<td>AVG VOLT LO WARN</td>
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<td>72</td>
<td>TOT PWR HI ALRM</td>
<td>Total Real Power has gone above maximum alarm limit</td>
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<tr>
<td>73</td>
<td>TOT PWR LO ALRM</td>
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<td>74</td>
<td>TOT PWR HI WARN</td>
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<td>75</td>
<td>TOT PWR LO WARN</td>
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<td>76</td>
<td>GEN FREQ HI ALRM</td>
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<td>77</td>
<td>GEN FREQ LO ALRM</td>
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<td>78</td>
<td>GEN FREQ HI WARN</td>
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<td>80</td>
<td>GEN FREQ FAULT</td>
<td>Generator Frequency exceeds nominal limits for valid sensor reading</td>
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<tr>
<td>81</td>
<td>ENG RPM HI ALRM</td>
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<td>ENG RPM LO ALRM</td>
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<td>84</td>
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<td>Engine RPM exceeds nominal limits for valid sensor reading</td>
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<td>86</td>
<td>SWITCH IN AUTO</td>
<td>Key Switch in AUTO digital input active</td>
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<td>87</td>
<td>SWITCH IN MANUAL</td>
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<td>E-STOP ACTIVE</td>
<td>Emergency Stop Status digital input active</td>
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<td>REMOTE START ACT</td>
<td>Remote Start digital input active</td>
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<td>DIG INPUT 05 ACT</td>
<td>DI-1, Digital Input #5 active</td>
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<td>BATT CHARGE FAIL</td>
<td>Battery Charger Fail digital input active</td>
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<td>DIG INPUT 06 ACT</td>
<td>DI-2, Digital Input #6 active</td>
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<td>RUTURED BASIN</td>
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<td>PROP LEAK ACT</td>
<td>Propane Gas Leak digital input active,</td>
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<td>LOW FUEL PRS ACT</td>
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<td>DIG INPUT 07 ACT</td>
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<td>LINE POWER ACT</td>
<td>Line Power digital input active</td>
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<td>DIG INPUT 08 ACT</td>
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<td>GEN POWER ACT</td>
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<td>94</td>
<td>DIG INPUT 09 ACT</td>
<td>Digital Input #9 active</td>
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<td>MODEM DCD ACT</td>
<td>Modem Carrier Detect digital input active</td>
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<td>95</td>
<td>MODEM ENAB ACT</td>
<td>Modem Enable digital input active</td>
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<td>96</td>
<td>ILC ALR/WRN #1</td>
<td>ILC controlled: ILC warning or alarm signal # 1</td>
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<td>97</td>
<td>ILC ALR/WRN #2</td>
<td>ILC controlled: ILC warning or alarm signal # 2</td>
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<tr>
<td>98</td>
<td>IN WARM UP</td>
<td>Generator is running, but not fully warmed up yet</td>
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<tr>
<td>99</td>
<td>IN COOL DOWN</td>
<td>Generator is running, but cooling down before shutting off.</td>
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<tr>
<td>100</td>
<td>CRANKING</td>
<td>Generator is starting – the starter is engaged</td>
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<tr>
<td>101</td>
<td>NEED SERVICE</td>
<td>Maintenance item has expired</td>
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<td>102</td>
<td>SHUTDOWN GENSET</td>
<td>Shutdown alarm is active</td>
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<tr>
<td>Number</td>
<td>Default Function Name</td>
<td>Function Description</td>
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<td>103</td>
<td>CHK V PHS ROT</td>
<td>Detected voltage phase rotation as not being A-B-C</td>
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<tr>
<td>104</td>
<td>CHK C PHS ROT</td>
<td>Detected current phase rotation as not being A-B-C and not matching voltage</td>
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<td>105</td>
<td>FAULT RLY ACTIVE</td>
<td>Audible alarm/warning signal is active.</td>
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<td>106</td>
<td>USR CONFIG 106</td>
<td>GenLink controlled: GenLink front panel radio button selected</td>
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<tr>
<td>107</td>
<td>INT EXERCISE ACT</td>
<td>Internal Exercise is active – includes QuietTest®</td>
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<td>108</td>
<td>CHECK FOR ILC</td>
<td>Indicates the ILC is not running</td>
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<tr>
<td>109</td>
<td>USR CONFIG 109</td>
<td>Available for ILC use</td>
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<td>USR CONFIG 110</td>
<td>Available for ILC use</td>
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<td>111</td>
<td>USR CONFIG 111</td>
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## H-100 Connector Pin Descriptions

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<th>Wire</th>
<th>Signal</th>
<th>Description</th>
<th>J2</th>
<th>Wire</th>
<th>Signal</th>
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<td>CAN (rtn)</td>
<td>CAN Bus</td>
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<td>RS485 (-)</td>
<td>Diagnostic/Rem-An/HTS</td>
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<td>CAN (+)</td>
<td>CAN (+)</td>
<td>CAN Bus (+)</td>
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<td>RS232 (tx)</td>
<td>GenLink</td>
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<td>Gnd</td>
<td>Gnd</td>
<td>Modem Power (-)</td>
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<td>IN7</td>
<td>IN (DB) 7</td>
<td>DI-3-Line Power</td>
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<td>AN8 (rtn)</td>
<td>AN8 (rtn)</td>
<td>Emissions Sensor/Fluid Basin Level</td>
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<td>AN8 (+) 0-1V</td>
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<td>575R</td>
<td>AN5 (rtn)</td>
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<td>Vsense 1</td>
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<td>399C</td>
<td>CT3 (-)</td>
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<td>399A</td>
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<td>Phase A Current</td>
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<td>CAN (-)</td>
<td>CAN Bus (-)</td>
<td>12</td>
<td>390</td>
<td>RS485 (+)</td>
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<td>IN (DB) 9</td>
<td>Modern DCD</td>
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<td>396/601</td>
<td>IN (DB) 6</td>
<td>DI-2/Ruptured Basin/Low Fuel Pressure</td>
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<td>68V</td>
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<td>Artificial Coolant Temp</td>
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<td>683</td>
<td>AN9 (+) 0-5V</td>
<td>Battery Charger Cur</td>
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<td>R15</td>
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<td>Vsense 3</td>
<td>Phase CA Voltage</td>
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<td>766V</td>
<td>AN7 (+) 4-20mA</td>
<td>Throttle Position</td>
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<td>+12V (500 mA)</td>
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<td>Gnd</td>
<td>AVR PCB Power (-)</td>
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<td>Oil Pressure</td>
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<td>OUT (OC) 13</td>
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<td>20</td>
<td>221/808 OUT (OC) 12 (PWM)</td>
<td>Preheat/Air/Fuel Solenoid</td>
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<td>OC8</td>
<td>OUT (OC) 8</td>
<td>Auxiliary 4 Output</td>
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<td>21</td>
<td>224 OUT (OC) 4</td>
<td>13.3 Gas Relay</td>
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<td>OUT (OC) 6</td>
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<td>56A</td>
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<td>Starter Relay</td>
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<td>OUT (OC) 5</td>
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<td>RPM sensor (-)</td>
<td>RPM sensor (+)</td>
<td>Engine RPM</td>
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<td>SHLD</td>
<td>RS485 (shield)</td>
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<td>RPM sensor (+)</td>
<td>Engine RPM</td>
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<td>RS232 (com)</td>
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<td>AllR/806/754R</td>
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<td>Fuel Press/Ign. Alarm/Inlet Temp</td>
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<td>505</td>
<td>IN (DB) 5</td>
<td>DI-1/Battery Charger Fail</td>
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<td>OUT (OC) 9</td>
<td>13.3 Ignition Power</td>
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<td>OUT (OC) 11 (PWM)</td>
<td>Throttle Driver</td>
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<td>OUT (OC) 7</td>
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<td>145</td>
<td>OUT (OC) 3</td>
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<td>399B</td>
<td>CT2 (-)</td>
<td>Phase B Current</td>
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<tr>
<td>34</td>
<td>158/220B</td>
<td>+ Batt (12/24V)</td>
<td>Panel Power (+)</td>
<td>35</td>
<td>398B</td>
<td>CT2 (+)</td>
<td>Phase B Current</td>
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</table>

**Key:**

OUT (OC) #1-14 = Digital OUTput, Open Collector (includes PWM Outputs, AVR Gates)  
IN (DB) #1-10 = Digital INput, Buffered (Schnitt Trigger) “Pulled up”

AN #1-7 (+) = Analog 12V (50 mA) source  
AN #1-7 (rtn) = General purpose analog input (4 - 20 mA)  
Vsense #1-3 = Voltage sensing input (0 - 28.8 VAC)  
CT #1-3 = Current Transformer input (0 - 3 A AC)
APPENDIX C — MISCELLANEOUS H-100 INTERNAL ALARMS/WARNINGS

“Strt Inhib:Oil” – Oil pressure is higher than expected for a stopped engine.

“Overcrank” – Generator has attempted to start the designated number of times without success.

“Mult Def Digtl” – More than one Digital Output Function is assigned to the same Digital Output; or A Digital Output Function is assigned to a reserved Digital Output.

“Mult Def Analg” – More than one Analog Input is assigned to the same Analog Output; or An Analog Input is assigned to a reserved Analog Output.

“WatchDog Fail” – Firmware was unable to complete all its tasks in the allotted time.

“HW Overspeed” – Hardware Generator Overspeed circuit has detected a generator overspeed condition.

“System Reset” – Microprocessor has reset unexpectedly.

“i2t Gen Tmp HI” – i2t logic has determined alternator temperature is too high.

“300% Rated Cur” – >300% rated current short present – current is being controlled to 300%.

“Eng Stall RPM” – Engine has stalled unexpectedly.

“No HTS # Comms” – HTS number ‘#’ is not communicating.

“HTS # SW Fault” – HTS number ‘#’ failed in its switching attempt.

“HTS # Not Sync” – HTS number ‘#’ was unable to synchronize with utility in the allotted time.

“HTS # Batt Low” – HTS number ‘#’ battery is weak and possibly needs replacing.

“No HTS # Batt” – HTS number ‘#’ battery is not connected.