GENERAC®

POWER SYSTEMS, INC.

H Panel
Technical Manual

This manual should remain with the unit.

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.

Generac 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 Generac does not specifically recommend, ensure that it is safe for others. Also make sure the procedure, work method, or operating technique chosen does not render the equipment unsafe.

GENERAL HAZARDS

- For safety reasons, Generac recommends that this equipment be installed and serviced by a Generac 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.

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INTRODUCTION

The H 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 PANEL to allow customers to configure spare I/O to their own needs. For example, built in PLC 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 software buys us the economy of scale which can be passed on to the customer. It also has great technical advantages. All of the H PANEL and PM-DCP products are built around a common "core" of software and this provides EVERY product with the same technical tools. For example, both the H 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 PLC, etc. H PANEL is very flexible.

FEATURES

- Local/remote connection to a PC for Genlink®-DCP communication.
- 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 PLC for combinatorial logic functions including analog inputs.
- Spare customer programmable Analog input capacity.
- Spare customer programmable Digital I/O capacity.
- Software can be updated via Telephone line.

PANEL SETUP

◆ CHANGING THE CONTROLLER TYPE

The H 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 P.C.

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 Generac web site for downloading cross referenced to product serial numbers/generic product types. Generac 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.

◆ 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 PLC. The digital inputs can be moved, inverted, renamed, given delay times, made alarms, used in the PLC, 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 Generac 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 16 have fixed functions. The remaining 7 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 16 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 * *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 * *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 processed by function x:

Where x can be:

1. THERMISTOR
2. PRESSURE
3. CFM SENSOR
4. CURRENT
5. CAL_SCALE
6. LINEAR
7. POLY_1ST
8. POLY_2ND
9. POLY_3RD
10. POLY_1ST_N1
11. POLY_1ST_N2
12. GEN_FP_POLY

Table 1

CPU Channel No.	Channel Title	Update Rate	Derived Value
7	User Configurable #1 (Usually Oil Temp)	3.84 ms	No
8	User Configurable #2 (Usually Coolant Temp)	3.84 ms	No
9	User Configurable #3 (Usually Oil Pressure)	3.84 ms	No
10	User Configurable #4 (Usually Coolant Level)	3.84 ms	No
11	User Configurable #5 (Usually Fuel level)	3.84 ms	No
12	User Configurable #6 - Spare -	3.84 ms	No
13	User Configurable #7 (Usually throttle position)	3.84 ms	No
14	Special Oxygen sensor	3.84 ms	No
15	Special Battery charge sensor	3.84 ms	No
16	Battery Voltage/ PSU voltages	3.84 ms	No
1	Generator Phase A RMS Current	Phase A ZERO CROSSING	No
2	Generator Phase B RMS Current	Phase B ZERO CROSSING	No
3	Generator Phase C RMS Current	Phase C ZERO CROSSING	No
-	Generator average current	Every Phase ZERO CROSSING	Yes
4	Generator Phase A RMS Voltage	Phase A ZERO CROSSING	No
5	Generator Phase B RMS Voltage	Phase B ZERO CROSSING	No
6	Generator Phase C RMS Voltage	Phase C ZERO CROSSING	No
-	Generator average voltage	Every Phase ZERO CROSSING	Yes
-	Total Generator Power KW	Every Phase ZERO CROSSING	Yes
-	Total Generator Power Factor	Every Phase ZERO CROSSING	Yes
-	Generator Frequency	Every Phase ZERO CROSSING	Yes
-	RPM #1	4 - 8 ms variable (geared)	Yes
-	Oxygen sensor zero crossings	Every O2 ZERO CROSSING	No

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 * *Scaling Factor*:

Where *scaling factor* is a number such that 1024 is equivalent to 1, so it's really M * *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 (eg 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.

Local Trending Log

When set, this result is selected to be logged in the local trending log in volatile memory (volatile means that when power is removed from the unit, the memory will be lost). Trending will only start when the trigger conditions are met. Up to 6 analog channels can be selected for trending simultaneously. See the section on "TRENDING" for details.

Analog Outputs

There are no analog outputs available for customization.

◆ ANALOG SENSOR RATINGS

Typically the sensors used by Generac have the following ratings:

Temperature	35 - 300 deg. F
Pressure	0 - 150 psi

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 PLC. 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 PLC to do combinatorial logic.

Note that there are no output functions that are operated by digital input alarms/warnings. If you want to drive an output pin from a digital input alarm, you must use the PLC. The digital input functionality is the same as the E panel, but more powerful.

See TABLE OF OUTPUT FUNCTIONS on pages 6 through 8.

◆ SPARE ANALOG CHANNELS

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

Channel #	Normal function
4	Coolant level
5	Fuel Level
6	Spare
7	Throttle position
8	Oxygen sensor 0-1Vdc
9	Battery charge current 0-5Vdc

Number	TYPE	FUNCTION NAME	NOTES
1	Internal status	Common Alarm	
2	Internal status	Common Warning	
3	Internal status	Generator running	
4	Internal status	Generator running, alarms active	
5	Internal status	Ready to accept load	
6	Internal status	Ready to start	
7	Internal status	Generator alarm shutdown	
8	Internal status	Generator stopped	
9	Internal status	In Manual	
10	Internal status	In Auto	
11	Internal status	In Off	
12	Internal status	Failed to start (overcrank)	
13	Internal status	Start inhibit - oil pressure	
14	Internal status	Remote annunciator - spare light	Can be set from plc
15	Analog 4-20ma #1	Analog 1 high alarm	High oil temp
16		Analog 1 low alarm	
17		Analog 1 high warning	
18		Analog 1 low warning	
19		Analog 1 sensor failure	
20	Analog 4-20ma #2	Analog 2 high alarm	High coolant temperature
21		Analog 2 low alarm	
22		Analog 2 high warning	
23		Analog 2 low warning	
24		Analog 2 sensor failure	
25	Analog 4-20ma #3	Analog 3 high alarm	High oil pressure
26		Analog 3 low alarm	
27		Analog 3 high warning	
28		Analog 3 low warning	
29		Analog 3 sensor failure	
30	Analog 4-20ma #4	Analog 4 high alarm	Coolant level
31		Analog 4 low alarm	
32		Analog 4 high warning	
33		Analog 4 low warning	
34		Analog 4 sensor failure	
35	Analog 4-20ma #5	Analog 5 high alarm	Fuel level
36		Analog 5 low alarm	
37		Analog 5 high warning	
38		Analog 5 low warning	
39		Analog 5 sensor failure	
40	Analog 4-20ma #6	Analog 6 high alarm	Spare
41		Analog 6 low alarm	
42		Analog 6 high warning	
43		Analog 6 low warning	
44		Analog 6 sensor failure	
45	Analog 4-20ma #7	Analog 7 high alarm	Governor position

Number	TYPE	FUNCTION NAME	NOTES
46		Analog 7 low alarm	
47		Analog 7 high warning	
48		Analog 7 low warning	
49		Analog 7 sensor failure	
50	Analog Dedicated #8	Analog 8 high alarm	Oxygen sensor, shared with O2 Zero Crossing (#23)
51		Analog 8 low alarm	
52		Analog 8 high warning	
53		Analog 8 low warning	
54		Analog 8 sensor failure	
55	Analog Dedicated #9	Analog 9 high alarm	Battery charging current monitor
56		Analog 9 low alarm	
57		Analog 9 high warning	
58		Analog 9 low warning	
59		Analog 9 sensor failure	
60	Analog Dedicated #10	Analog 10 high alarm	Battery Voltage
61		Analog 10 low alarm	
62		Analog 10 high warning	
63		Analog 10 low warning	
64	Analog Derived #14	Analog 14 high alarm	Average current
65		Analog 14 low alarm	
66		Analog 14 high warning	
67		Analog 14 low warning	
68	Analog Derived #18	Analog 18 high alarm	Average Voltage
69		Analog 18 low alarm	
70		Analog 18 high warning	
71		Analog 18 low warning	
72	Analog Derived #19	Analog 19 high alarm	Average power
73		Analog 19 low alarm	
74		Analog 19 high warning	
75		Analog 19 1ow warning	
76	Analog Derived #21	Analog 21 high alarm	Frequency
77		Analog 21 low alarm	
78		Analog 21 high warning	
79		Analog 21 low warning	
80		Analog 21 sensor failure	
81	Analog Derived #22	Analog 22 high alarm	RPM
82		Analog 22 low alarm	
83		Analog 22 high warning	
84		Analog 22 low warning	
85		Analog 22 sensor failure	
86	Digital input	Digital input 1 active	Maps digital input to digital output .
87	Digital input	Digital input 2 active	"
88	Digital input	Digital input 3 active	" (E. stop)

Number	TYPE	FUNCTION NAME	NOTES
89	Digital input	Digital input 4 active	" (remote start)
90	Digital input	Digital input 5 active	"
91	Digital input	Digital input 6 active	"
92	Digital input	Digital input 7 active	"also used as Line power input
93	Digital input	Digital input 8 active	"also used as Gen. power input
94	Digital input	Digital input 9 active	"
95	Digital input	Digital input 10 active	"
96	PLC	PLC_alarm/warning_1	Set from the plc
97	PLC	PLC_alarm/warning_2	Set from the plc
98	Internal status	Generator Warming Up	
99	Internal status	Generator in Cooldown	
100	Internal status	Generator Cranking	
101	Internal status	Generator Needs Service	
102	Internal status	Generator Shutdown	
103	Internal status	Check Voltage Phase Rotation	
104	Internal status	Check Current Phase Rotation	
105	Internal status	Fault Relay Active	Mirrors Fault Relay output
106	Genlink	Set Genlink Relay	Set from a button on Genlink front panel
107	SPARE		
108	SPARE		
109	SPARE		
110	SPARE		
111	SPARE		
112	SPARE		
113	SPARE		
114	SPARE		
115	SPARE		
116	SPARE		
117	SPARE		
118	SPARE		
119	SPARE		
120	SPARE		

ENGINE MANAGEMENT

The engine management module is very similar to that used in other Generac 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

Number	PARAMETER	UNITS
1	ENGINE Flywheel teeth	teeth
2	CT ratio - generator	-
3	Generator voltage measured phase to neutral?	Y/N
4	Generator phase configuration	-

RPM 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.

Generator Phase to Neutral

Flag determining if the generator measurement configuration is line to line or line to neutral.

Generator Phase Configuration

Select either single or three-phase configuration depending on how the unit is supplied.

◆ ENGINE SETTINGS

All times are in seconds:

- PREHEAT ENABLE — 0 = No preheat.
  1 = Preheat before cranking.
  2 = Preheat before and during cranking.

The Preheat output pin shares its function with the air fuel solenoid output. You must choose one of the two functions as follows:

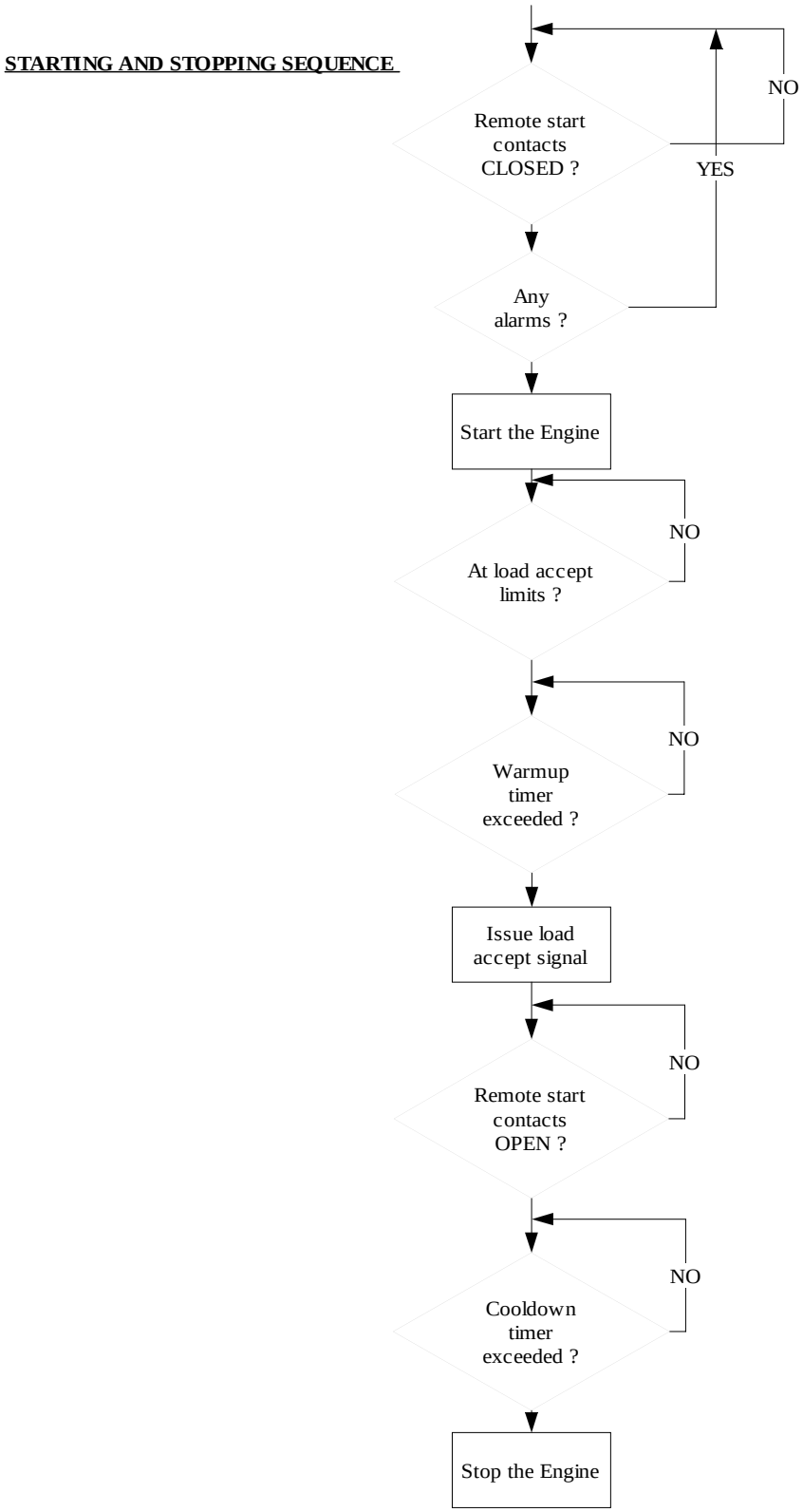
To select air/fuel - set the "Diesel y/n" setting on the governor page to "No". Set preheat to "No"

To select preheat - set the "Diesel y/n" setting on the governor page to "Y". Set preheat to "Y"

- PREHEAT TIME — The time preheat is applied for before cranking.
- RPM STARTED — The Engine must reach this rpm before disengaging the starter.
- CRANKING TIME — The maximum time in seconds that each crank will last
- ALARM HOLD OFF TIME — The time after starting at which the alarms become active.
- WARMUP TIMER — The engine will run for at lest this time before issuing the "Accept load" signal.
- TARGET VOLTS — The target generator voltage (RMS).
- TARGET HZ — The frequency to aim for , e.g. 60Hz (in Hz)
- COOLDOWN TIMER — After the remote start signal is removed, the engine will run for at least this time.
- PAUSE BETWEEN CRANKS — 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.
- LOAD ACCEPT FREQUENCY — The generator must reach this frequency before accepting load.
- LOAD ACCEPT VOLTAGE — The generator must reach this voltage before accepting load.

Number	PARAMETER	UNITS
1	Preheat enable	0/1/2
2	Preheat time	(S)econds
3	Start detection rpm	RPM
4	Cranking time	S
5	Alarm hold off time	S
6	Warmup timer	S
7	Target Hertz	Hz
8	Target Volts	Vrms
9	Cooldown timer	S
10	Pause between cranking time	S
11	Number of start attempts (maximum)	-
12	Load accept frequency	HZ
13	Load accept voltage	Vrms

STARTING AND STOPPING - SEQUENCE DIAGRAM



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, these include the target voltage. The settings are normally factory preset and are shown here for completeness.

- VOLTAGE KP/KI/KD — Voltage stability constants.
- PMG — Selects if we are using a pmg alternator
- VF CORNER 1/2. — This is 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 this setpoint, the voltage is produced proportionally as the frequency drops according to the slope constant.
- VF SLOPE — A constant that is used to reduce the generator voltage as described above. Increasing the constant makes the voltage reduce more.
- 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 units rated power in kW.

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.

Voltage Regulator (Option) Chart

NUMBER	PARAMETER	DEFAULT	UNITS	LIMITS
1	Voltage_KP	200	-	0-65535
2	Voltage_KI	20	-	0-65535
3	Voltage_KD	20	-	0-65535
4	Pmg	Y	-	Y/N
5	VF_Corner1	57	Hz	0-65535
6	VF_Corner2	60	Hz	0-65535
7	VF_Slope	24	V/Hz	0-65535
8	AVR_Dump_Improve	Y	-	Y/N
9	Unit_Rated_Power (In kw. Replaces "power_scale")	400	kW	0-65535
10	Panel_Type	H panel	-	-

Governor (Speed Regulator) Option Chart

NUMBER	PARAMETER	DEFAULT	UNITS	LIMITS
1	Standby_KP	15	-	0-65535
2	Standby_KI	200	-	0-65535
3	Standby_KD	10	-	0-65535
4	Diesel (or Gas)	Y	-	Y/N
5	Dump_Enable	Y	-	Y/N
6	Actuator_Type	2 (linear)	-	0-65535
7	Actuator_start_Position	20 (2 amps)	-	0-65535
8	Offset	5 (0.5 amp)	-	0-65535
9	Full scale	40 (4 amp)	-	0-65535
10	Soft_Start	50	Hz	0-65535
11	Engine_Linearization	1	-	0-65535
12	Integral_Limit_or_Antiwindup	Y	-	Y/N
13	Windup_Parameter (or int. limit)	10000	-	32 bit
14	Pwm_Counts_per_ampx10	114	-	0-65535
15	Soft Start Timer	0	seconds	0-2
16	De-synchronizing Offset	0	Hz	-

- STANDBY KP,KI,KD — Frequency stability constants.
- DIESEL — Used to select a diesel or other fuel
- DUMP ENABLE — Determines weather the integral is dumped during a load dump to improve the transient frequency response
- ACTUATOR TYPE — Allows for the choice of different actuators such as Bosch rotary, linear actuators and Detroit type speed control.
  - 0 = Barber Coleman Powerflow, voltage driven
  - 1 = Bosch gas, current driven with position feedback
  - 2 = Linear, current driven
  - 3 = Detroit diesel
  - 4 = Bosch, horizontal diesel
  - 5 = Bosch, vertical diesel
- ACTUATOR START POSITION — This is where the actuator will be parked at start up and while starting in open loop (ie up to the "generator started rpm"). This will either be in pwm units, or 1/10th of amps for the linear current driven actuators, or a fraction of the full scale (1024) for the Bosch. Currently, for the Bosch, use 90%. For Detroit Diesel, we generate a frequency output with 50% duty cycle. (For Detroit Diesel 22,222=360hz =60hz ie 8mhz/22,222). Actuator start position MUST be big enough so that if "soft start" is selected, we can reach 57Hz with this setting.
- OFFSET — is a number corresponding to the output required to almost move the actuator.

This will be in one of 3 units:

1. PWM units for the Barber Coleman,
2. Equal to -200 for the current driven Bosch actuator.
3. In 1/10th amp units for the Linear current driven actuator.
4. For DD - not used (fixed).

- FULL SCALE — is a number corresponding to the output required to move the actuator to wide open throttle (and then some).

This will be in one of 3 units:

1. PWM units for the Barber Coleman,
2. Equal to 1024 for the current driven Bosch actuator.
3. In 1/10th amp units for the Linear current driven actuator.
4. For DD - not used (fixed).

- SOFT START — selects a base frequency. The generator is started in open loop, with the actuator parked in a position determined by the "Actuator_start_position". When the generator exceeds the soft start frequency, the aiming frequency is slowly ramped up to 57Hz in 3Hz increments, then normal control to the target frequency. (in Hz).
- SOFT START TIMER — The Soft Start Timer introduces timed steps into the ramp-up to prevent overspeeding at start-up. It is mostly applicable to diesel engines.
- ENGINE LINEARISATION — allows for the selection of different curves (as used with the Bosch actuator) for different engines.
- INTEGRAL LIMIT/ANTIWINDUP — Choose weather to use an integral limit or an anti windup strategy.
  - Y = integral limit
  - N = anti windup
- WINDUP PARAMETER — The parameter used in the anti windup system, or if integral limit was chosen, then the integral limit. Normally set to 24 for current driven actuator.
- PWM_COUNTS_PER_AMPX10 — This is the number of pwm counts required to drive one amp in to a current driven actuator. Currently 114 is correct for the 3A driver.

DE-SYNCHRONIZING OFFSET

This setting (in units of Hz), allows the generator to run slightly faster than 60Hz to speed up synchronization with the utility for inphase transfer purposes. It should be set to 0.10 Hz if inphase transfer is required.

TRENDING

Just like in the PM-DCP, there are two types of trending available - Local and Remote.

◆ REMOTE TRENDING

Remote trending is performed exclusively by Genlink itself and is intended to monitor parameters that do not change fast - the fastest monitoring rate is every 0.1 seconds. The slowest is days so Genlink can be set to store data down over a long period of time. Data can be saved to a file and/or displayed in graphical format in near real time. The file can be exported to excel. Examples of things you can trend are the generator frequency response (in 0.1s steps) to a block load OR Generated power over a day.

◆ LOCAL TRENDING

Local trending is intended for high speed events such as AC waveform monitoring of the Generator voltage. The highest monitoring rate is 0.4ms. The data captured in Local trending is data for 1 to 6 analog channels captured as close together as possible in time. This group of 1 to 6 channels is called a "frame". A frame is then put into the next open position in the RAM based trending log. Presently, the trending log can hold 1000 readings of data (the size may change in the future). If a frame consists of just 1 channel,

then 1000 frames will be stored. In the case of a 6 channel frame, 166 frames can be stored. A partial frame is never stored in the trending log which may result in the last few bytes of the log being unused based on the number of channels in the frame.

Based on the trending options programmed by the user, one of 3 trending collections types can occur;

A. A trending collection is considered complete when the trending log has reached the end of the trending log.
B. Can rollover to the start of the trending buffer and overlay earlier frames put into the trending log during the current collection awaiting a triggering condition to stop.
C. Can rollover to the start of the trending buffer and overlay earlier frames put into the trending log indefinitely until commanded to stop by Genlink.

There are two types of analog data that is captured in a frame.

1. The processed analog result for a given channel (there are 23 of these in the H Panel). This data is updated at the rate that the measurement analog loop (MAL) executes which is about 2 mS in the H Panel. The MAL processes the analog channels starting from the lowest number channel and proceeding through the last analog channel. A frame is built during the processing of the MAL. This data can be captured at either the rate that the MAL executes or at a slower rate that is a multiple of 0.1 S.
2. The "raw" analog AC voltage and currents of the generator. These are the "instantaneous" values sampled from the AC waveform approximately every 0.4 mS.

Note that presently, the two analog types can not be mixed in a given collection. A frame must consist entirely of choices from 1) or entirely of choices from 2).

◆ GENLINK TRENDING INTERFACE

Before a trending collection can occur, there are steps required to set up the collection parameters.

The user must select the "speed" of the trending collection.

- Low speed is the processed analog channels collected every programmable multiple of 0.1 S.
- Medium speed is the processed analog channels collected at the rate of execution of the MAL.
- High speed is restricted the to the raw AC values collected approximately every 0.4 mS.

There are additional options regarding triggering, etc. that can be selected which will be explained in detail.

The user must go through the analog configuration data and select which channels are to be part of the trending collection. There is a checkbox for this option on each analog channel's configuration data screen. Note that for the case of selecting the raw AC channels for trending, select the RMS analog channel that the raw value is used to calculate. For example, if the high speed Generator A Voltage is to be trended, then select Generator A Voltage RMS to be trended. Genlink will limit the number of channels selected to a maximum of 6. Also, in the case where the user has selected high speed trending, Genlink will only allow selection of channels for trending that are the raw analog AC channels.

Active When

This is relevant only to low and medium speed trending. This determines if a frame is entered into the log based on the status of the Genset engine running or not.

0 = Always. Make a log entry regardless of the whether the Genset engine is running or not.
1 = Engine Running. Only allow log entries when the Genset engine is running.
2 = Engine Stopped. Only allow log entries when the Genset engine is stopped.

◆ TRIGGER/COLLECTION TYPE

Pre-Trigger

Trending data will be continuously collected at least until the trigger channel event goes TRUE.

Post-Trigger

When the trigger channel event goes TRUE, logging will continue until the end of buffer is reached (if no pre-triggering selected) or until entries equal to ½ of the buffer size are made (if pre-triggering also selected).

Trigger Level Capture (only relevant to low and medium speed trending)

0 = Trigger does not inhibit logging
1 = Only make entries into the log when the trigger level is TRUE.

Stop When Buffer is Full (only relevant to low speed trending)

0 = Collection will not stop at end of collection but will rollover to the beginning of the buffer.
1 = Collection will stop when the end of the buffer is reached.

Trigger on shutdown. (only for medium and low speed trending)

Trigger Channel

The event programmed in the configuration data of this channel is used for the pre-trigger and post-trigger. This is the absolute channel number used for the analog and digital channels, and the output functions. If no trigger is required, this channel should be set to the NULL channel.

THE PLC

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

The scan time of the H PANEL PLC is about 60ms worst case. This means that all inputs and outputs are scanned within 120ms. Also, the PLC processes one rung every 5ms, 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. Override Remote Start
2. Force Off
3. Force Auto
4. Force Manual
5. Use Keyswitch
6. Force dialout
7. Force alarm/warning 1
8. Force alarm/warning 2
9. Halt PLC

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

THE FRONT PANEL DISPLAY

The front panel of the controller has two LCD modules mounted to it (see Figure 1). The left hand display shows a fixed set of information all the time. The right hand display is used to display different "pages" of data via a menu system. By pressing the "Home" key, the combined data on the 2 displays shows all of the key parameters required to monitor the whole system (engine and generator). The fixed, left hand display, can be customized by choosing from a set of available templates. This is accomplished via the menu system on the other display.

The "menu system" and keypad have been ergonomically designed for ease of use. At any time, pressing the "MENU" key on the keypad takes you to the top level menu, where you can choose what type of information to display. Also, at any time, the "HOME" key reverts the display back to the key parameters. To select a menu, use the arrow keys to position the cursor on the menu and then press the "ENTER" key. This will take you to the topic's pages. Each topic may have more than one page to display and the line shown below allows you to navigate the pages.

More < > (1-3)

This shows you are on page one of three . Positioning the cursor on the <> symbols and pressing "ENTER" allows you to move forwards (>) or backwards (<) between the pages. To make this easier, the cursor is automatically place on the forwards symbol so all you have to do is hit "ENTER" to cycle through the pages.

Generally the menus are self explanatory, but some pages require a little more help in understanding them. These menus are described following Figure 1.

Figure 1

Page # 0 – Menus Page

```
Alarms  Left Display
Engine  Generator
Status  Diagnostic
Service Exercise
```

Page # 1 – Home Page

```
Oil ±### Psi±###°F
Water Temp  ±###°F
Battery     ##.# V
FUEL LEVEL  #### %
```

Page # 2 – Engine Page 1 of 4

```
Oil Temp    ±###°F
Oil Press   ±### Psi
Water Temp  ±###°F
         More??(1-4)
```

Page # 3 – Engine Page 2 of 4

```
Engine RPM  #### RPM
Battery     ##.# V
BAT CHARGE  ±### A
         More??(2-4)
```

Page # 4 – Engine Page 3 of 4

```
Hours Run ###### hrs
COOLANT LEV #### ???
FUEL LEVEL  #### %
         More??(3-4)
```

Page # 5 – Engine Page 4 of 4

```
USER CFG 06 ±### N/A
THROT POS   #### Stp
OXYGEN SENS ±### %
         More??(4-4)
```

Page # 6 – Generator Page 1(3 Phase) of 3

```
Phase  A-B  B-C  C-A
Volts #### #### ####
Amps  #### #### ####
##.# Hz  More??(1-3)
```

Page # 7 – Generator Page 1(1 Phase) of 3

```
Phase AB/N AN/A BN/B
Volts #### #### ####
Amps  #### #### ####
##.# Hz  More??(1-3)
```

Page # 8 – Generator Page 2 (3 Phase) of 3

```
Power       ±#### kW
PwrFact     ±#.## PF
% Rated Pwr   ### %
         More??(2-3)
```

Page # 9 – Generator Page 2 (1 Phase) of 3

```
Phs  Tot   A-N   B-N
kW ±#### ±#### ±####
PF ±#.## ±#.## ±#.##
         More??(2-3)
```

Page # 10 – Generator Page 3 of 3 (only if i2t)

```
i2t % Thermal Limit
Stator  >|||||     <
Rotor   >|||       <
         More??(3-3)
```

Page # 11 – Status Page

```
Engine status msg
Generator status msg
##:## ### ##/##/##
Firmware Version
```

Figure 1

Page # 12 – Diagnostic Page 1 of 6

```
        Inputs
1 2 3 4 5 6 7 8 9 10
# # # # # # # # # #
          More??(1-6)
```

Page # 13 – Diagnostic Page 2 of 6

```
        Outputs
1 2 3 4 5 6 7 8 9 12
# # # # # # # # # #
          More??(2-6)
```

Page # 14 – Diagnostic Page 3 of 6

```
        Analogs
1-3 #### #### ####
4-6 #### #### ####
  7 #### More??(3-6)
```

Page # 15 – Diagnostic Page 4 of 6

```
 8-10 #### #### ####
11-13 #### #### ####
14-16 #### #### ####
          More??(4-6)
```

Page # 16 – Diagnostic Page 5 of 6

```
Port 1 Comms Type
Port 1 Baud/Config
Port 1 Statistics
T# R# E# More??(5-6)
```

Page # 17 – Diagnostic Page 6 of 6

```
Port 2 Comms Type
Port 2 Baud/Config
Port 2 Statistics
T# R# E# More??(6-6)
```

Page # 18 – Alarms Page 1 of 3

```
Alarm/Warning msg 01
Alarm/Warning msg 02
Alarm/Warning msg 03
ACK       More??(1-3)
```

Page # 19 – Alarms Page 2 of 3

```
Alarm/Warning msg 04
Alarm/Warning msg 05
Alarm/Warning msg 06
          More??(2-3)
```

Page # 20 – Alarms Page 3 of 3

```
Alarm/Warning msg 07
Alarm/Warning msg 08
Alarm/Warning msg 09
          More??(3-3)
```

Page # 21 – Service Page 1 of 3

```
Oil Life     ±### %
Oil Filter   ±### %
Air Filter   ±### %
          More??(1-3)
```

Page # 22 – Service Page 2 of 3

```
Plugs        ±### %
Battery      ±### %
General      ±### %
          More??(2-3)
```

Page # 23 – Service Page 3 (3 Phase) of 3

```
Contrast      ### %
Voltage Displays L-#

          More??(3-3)
```

Figure 1

Page # 24 – Service Page 3 (1 Phase) of 3

```
Contrast      ### %


          More??(3-3)
```

Page # 25 – Left Display Function Select Page

```
 LEFT DISPLAY PAGE
>Volts    < Power
 Switch     Graph Hz
 Alrm Log   Other
```

Page # 26 – Exercise Page 1 of 2

```
# Exercise Enabled
Time Start ### ##:##
Time remaining:   ##
          More??(1-2)
```

Page # 27 – Exercise Page 2 of 2

```
# Low Speed Exercise
# Exercise Now
# Xfer on exercise
          More??(2-2)
```

Page # 28 – Unused Page

Page # 29 – Unused Page

Page # 30 – Unused Page

Page # 31 – Unused Page

Page # 32 – Unused Page

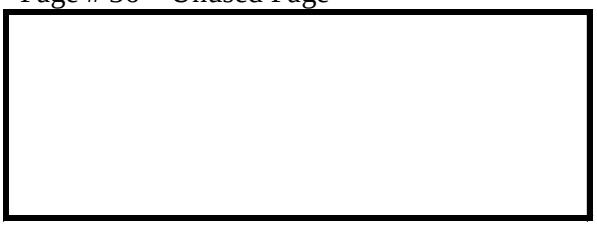
Page # 33 – Unused Page

Page # 34 – Unused Page

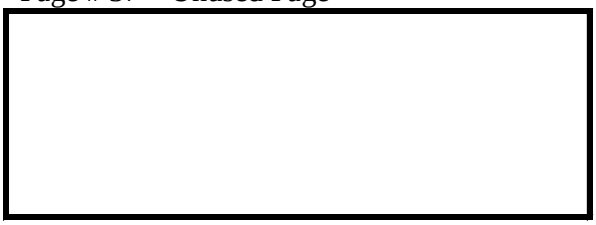
Page # 35 – Unused Page

Figure 1

Page # 36 – Unused Page

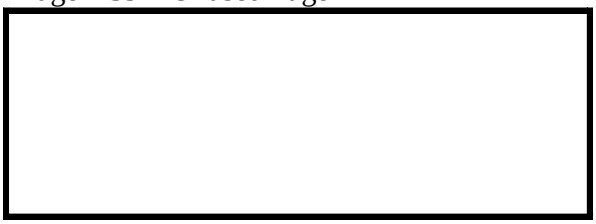


Page # 37 – Unused Page

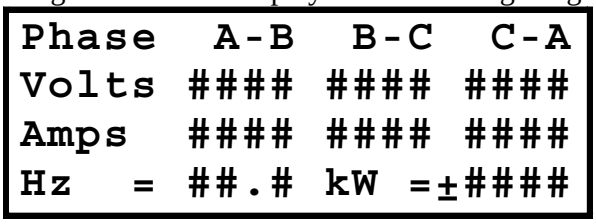


Page # 38 – Unused Page

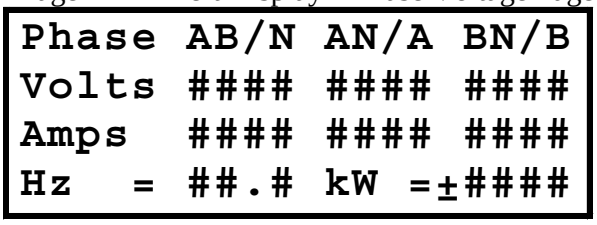
Page # 39 – Unused Page



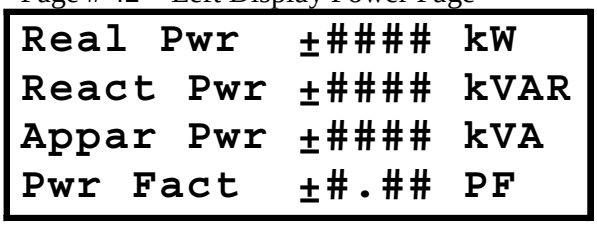
Page # 40 – Left Display 3 Phase Voltage Page



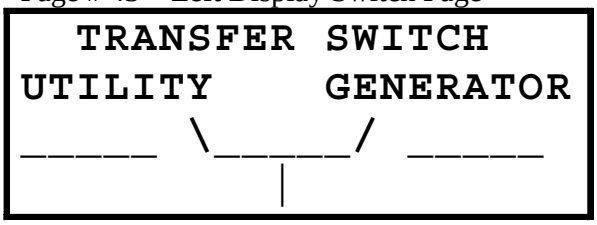
Page # 41 – Left Display 1 Phase Voltage Page



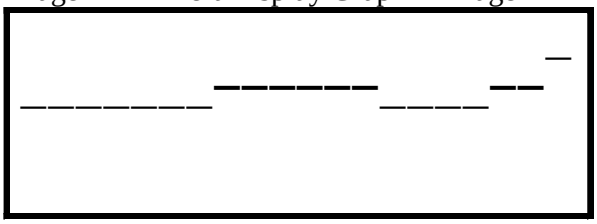
Page # 42 – Left Display Power Page



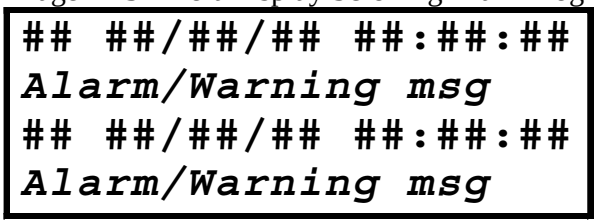
Page # 43 – Left Display Switch Page



Page # 44 – Left Display Graph Hz Page



Page # 45 – Left Display Scrolling Alarm Log



Page # 46 – Left Display Other Page

Page # 47 – Left Display Unused Page

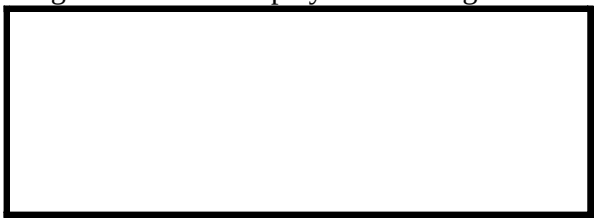
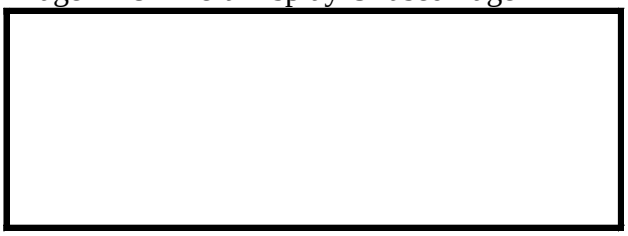


Figure 1

Page # 48 – Left Display Unused Page



Page # 49 – Left Display Unused Page

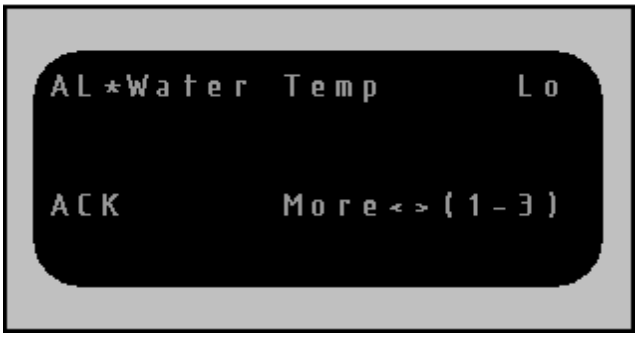
◆ ALARMS

Whenever an alarm occurs, the display changes to show the alarms page. Up to three alarms can be displayed on one page. If more alarms are present, they will be displayed on subsequent pages. The alarms need to be "ACKNOWLEDGED" to silence the alarm horn or buzzer. To facilitate this, there is an "ACK" field on the display and the cursor is placed there automatically. To acknowledge the alarm just press the enter key (see Figure 2).

An alarm message is displayed along with extra associated information along side it. The symbols are explained below:

AL — The message is of type "non shutdown alarm"
WR — The message is of type "warning"
SD — The message is of type "shutdown alarm"
SN — The message is of type "sensor failure"
HI — The quantity is greater than the allowed value (e.g. oil temperature)
LO — The quantity is less than the allowed value
* — This alarm is unacknowledged

Figure 2



DIAGNOSTICS

Generac provides diagnostics through both the front panel display and remotely through Genlink. The following text refers exclusively to the front panel display.

The main diagnostic screen allows access to the sub screens and also acts as the diagnostic screen for digital I/O. All of the raw unprocessed digital inputs are displayed on this screen. Any digital output can be overridden on this screen (Figure 3).

Figure 3

Page # 12 – Diagnostic Page 1 of 6

```
Inputs
1 2 3 4 5 6 7 8 9 10
# # # # # # # # # #
More??(1-6)
```

◆ DIGITAL DIAGNOSTICS

Inputs to the controller are internally pulled to 5v, so to activate an input you must short it to ground. This will be seen as a '1' (meaning active) on the diagnostic screen. To test equipment that is connected to a digital input such as a digital sensor, first display the diagnostics menu shown in Figure 3, then operate the sensor or short it out. One of the inputs should change to a '1'. Inputs are numbered 1-10 to correspond with the circuit diagram. Refer to this diagram to see that the correct input has operated.

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. The main diagnostics display shows the current state of the outputs which will change as the normal control program is still running. For example if the engine cranks as you are viewing this page, you will see some outputs turn on. Note that the update rate for the screen is only about 1-2s, so any fast changing outputs will not be seen. Override the state of an output for a limited time with the "Operate" button. First select which output you want to operate with the aid of the circuit diagram (outputs 1-32) then press the operate button to turn it on or off for 3 seconds. Use this feature to test the crank relay, etc.

◆ ANALOG DIAGNOSTICS

By selecting the analog submenu you can test the sensors connected to each of the analog channels. The reading that is displayed is the "raw" unprocessed data and is a 10 bit number ranging from 0 - 1023 representing a voltage on the input channel. Some channels have different scaling associated with them in hardware. The channels are numbered and scaled as listed in the following chart.

CHANNEL	FUNCTION
1	Generator current sense A
2	Generator current sense B
3	Generator current sense C
4	Generator voltage sense A
5	Generator voltage sense B
6	Generator voltage sense C
7	4 - 20ma User config. channel 1
8	4 - 20ma User config. channel 2
9	4 - 20ma User config. channel 3
10	4 - 20ma User config. channel 4
11	4 - 20ma User config. channel 5
12	4 - 20ma User config. channel 6
13	4 - 20ma User config. channel 7
14	0-1Vdc Oxygen sensor input
15	0-5Vdc Charge current indicator
16	Battery voltage

◆ COMMUNICATIONS DIAGNOSTICS

There are two pages of communications diagnostics, one for each port. The LCD display will show four lines of live information about the port:

LINE 1 - Will show the type of port protocol that has been selected. If this is incorrect it can be changed from the Genlink configuration menu. It will also show the Modbus address (if appropriate) and whether the port is RS232 or RS485.

LINE 2 - Will show the settings for the port i.e. baud rate, bits per character, stop bits and parity. Again this can be changed via Genlink.

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. When data is transmitted, the TX led is lit (and so on for received data).

THE CONTROL PANEL

The H PANEL controller 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
AUDIBLE ALARM	output
AUTO/MANUAL/OFF 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 touchscreen or the optional button, the led will remain lit until the alarm condition goes away.

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

The keyswitch AUTO position means the system will start automatically, OFF means the system will not operate, and MANUAL will run the engine for test purposes only.

The not in auto led will be lit if the keyswitch is not in the AUTO position. It will flash every 30 seconds if the key is in AUTO to indicate the system is still active.

The emergency stop switch will stop the engine 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 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 auto position) as an event with a setpoint of logical one, each time the keyswitch is set 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 100kw.

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 is relevant, spark plug life is not.

- 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. The audible alarm will NOT sound.

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 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"

I^2T CURRENT MONITORING (OPTION)

Optionally the H PANEL can apply predictive software modeling to give I^2T protection for the rotor and stator assembly. Based on parameters entered into the H PANEL via Genlink, the software 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 software. Genlink allows you to choose the alternator model, and this automatically downloads the appropriate parameters. The H 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 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

The generator can be set to exercise from either the front panel or via GenLink. If an external exerciser is used, the internal exerciser should be disabled. “Transfer on Exercise” is only available with a “Generac Intelligent Transfer Switch”.

To set exercise via GenLink, choose the transfer switch configuration page and follow the HELP guide.

To set exerciser from the front panel, select the exercise menu, position the cursor on the field chosen to edit, and press ENTER.

To go into edit mode, the cursor will change to an underline to indicate edit mode. Use the up/down keys to edit the field and press ENTER to store the change.

- **Exercise Enabled** — Select yes or no.
- **Time Start** — Set the time to the exercise start time and day of exercise.
- **Time Remaining** — Displays how much time is left in the current exercise cycle.
- **Low Speed Exercise** — Select yes or no. For a quieter exercise with the engine running at reduced speed.
- **Transfer on Exercise** — Select yes only if a "Generac intelligent transfer switch" is connected and it needs to be exercised.

SET TIME AND DATE

Time and date can be set either from GenLink or via the front panel.

To set from the front panel, go to the status menu. Position the cursor on the field selected to edit and press ENTER to get into edit mode. Use the up/down keys to edit the field, press ENTER to store the change.

ADJUSTING DISPLAY CONTRAST

This can be done the same way as setting the time and date. The contrast setting is found on the last page of the service menu.

COMMUNICATIONS

There are 2 ports on the H PANEL controller, 1 RS232 and 1 RS485. 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 RS232 port will be configured as a Modbus slave to communicate with Genlink and the RS485 port will also act as a slave for connection to a remote annunciator/remote relay panel. The RS485 port can be reconfigured via Genlink to be a deep diagnostic port.

REMOTE ANNUNCIATOR CONNECTION (OPTION)

When a remote annunciator is connected to the H panel, it will indicate line or generator power by designating two spare inputs (7 & 8) for these functions. These inputs can be used for any function in reality but will always operate the lights.

Line power indication should be connected to the designated digital input 7 which triggers a dedicated output function (called "line power") and will also operate the appropriate light on the remote annunciator.

Generator power indication should be connected to the designated digital input 8 which triggers a dedicated output function (called "generator power") and will also operate the appropriate light on the remote annunciator.

The remote annunciator is normally a Modbus Master and runs at 4800 baud with no parity and TWO stop bits only. The RS485 port is normally set to these settings (and as a Modbus slave) on delivery, but can be changed via Genlink. Multiple remote annunciators can be attached to the RS485 bus along with remote relay panels. The rule is that there must be at least one master annunciator or relay panel, all others must be set as slaves, see the annunciator/relay panel manual for details.

When a "Generac intelligent transfer switch" is connected to the RS 485 port, the H panel should be set as a Modbus Master, and the remote annunciator must be set as a Modbus Slave.

UPDATING THE SOFTWARE IN THE H PANEL CONTROLLER

The H PANEL controller has been designed such that it can have its software updated in the field via a laptop or via modem. When new releases become available, it will be a simple matter for the customer or distributor to do this - no tools will be needed. The current version of software running is displayed on the status page of the front panel display.

1. First obtain the software update from Generac and copy anywhere onto a PC with Genlink.
2. The Generator should not be in use at the time and the emergency stop switch should be active.
3. Connect up to the panel via Genlink (either locally or via modem) and choose the "software update" menu. It will be necessary at this time to contact the technical service department for a level 2 password.
4. NOTE that if updating via modem and the connection is lost half way through, you MUST reconnect and finish the process as the original software has been deleted. Unlike the PM-DCP, the H PANEL does not have room to store a back-up copy of the old program.

NEW GENERATION GENLINK (NGG)

An all new version of Genlink has been released for support of the H PANEL controller. 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 Genlink manual. There are some new features that have been added to Genlink as listed below:

◆ GENLINK RELAY CONTROL

There is a new "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 PLC). 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 Generac spec.

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:

Result = Scale (Function (Calibrate (Raw A/D reading)))

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:

Result = Scale (Function (Raw A/D reading))

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:

Result = Scale (Calibrate (RMS Function (Raw A/D reading)))

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:

Result = Scale (Calibrate (RMS Function (Raw A/D reading)))

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 software.

THERMISTOR:

PRESSURE:

POLY_3RD:

Third order polynomial with 4 coefficients and a scaling factor

X = raw_analog

$(AX^3 + BX^2 + CX + D) * S$

Where:

A, B, C, D are polynomial coefficients

S is the scaling factor

Coefficient 3 = $A * 1024^3$
Coefficient 2 = $B * 1024^2$
Coefficient 1 = $C * 1024$
Calibration = D
Scaling = $S * 1024$

POLY_2ND:

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

X = M * raw_analog
$(AX^2 + BX + C) * S$
Where:

M is the calibration factor
A, B, C are polynomial coefficients
S is the scaling factor
Calibration = M * 1024
Coefficient 3 = $A * 1024^2$
Coefficient 2 = B * 1024
Coefficient 1 = C
Scaling = S * 1024

LINEAR:

POLY_1ST:

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

X = M * raw_analog
(AX + B) * S
Where:

M is the calibration factor
A, B are polynomial coefficients
S is the scaling factor
Calibration = M * 1024
Coefficient 2 = A * 1024
Coefficient 1 = B
Scaling = S * 1024

POLY_1ST_N1:

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

X = M * raw_analog
$(A + BX + CX^{-1}) * S$
Where:

M is the calibration factor
A, B, C are polynomial coefficients
S is the scaling factor
Calibration = M * 1024
Coefficient 3 = C
Coefficient 2 = B * 1024
Coefficient 1 = A
Scaling = S * 1024

POLY_1ST_N2:

First order polynomial with 4 coefficients and a scaling factor

X = raw_analog
$(A + BX + CX^{-1} + DX^{-2}) * S$
Where:

A, B, C, D are polynomial coefficients
S is the scaling factor
Coefficient 3 = D
Coefficient 2 = C
Coefficient 1 = B * 1024
Calibration = A
Scaling = S * 1024

CFM_SENSOR:

First order polynomial with 4 coefficients and a scaling factor

X = raw_analog - learned_offset
$(A + BX + CX^{-1} + DX^{-2}) * S$
Where:

A, B, C, D are polynomial coefficients
S is the scaling factor
Coefficient 3 = D/32
Coefficient 2 = C
Coefficient 1 = B * 32768
Calibration = A * 64
Scaling = S * 1024

CURRENT:

CAL_SCALE:

Implements a scaling factor and a calibration factor

X = M * raw_analog
X * S
Where:

M is the calibration factor
S is the scaling factor
Calibration = M * 1024
Scaling = S * 1024

GEN_FP_POLY:

Third order polynomial with 4 coefficients

X = raw_analog
$AX^3 + BX^2 + CX + D$
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.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Signed Mantissa											Signed Power of 4				
sign bit	Mantissa Integer										sign bit	Power of 4			

APPENDIX B — TABLE OF PINOUTS

◆ PINOUT BY FUNCTION

J1	Wire	Signal	Description	J2	Wire	Signal	Description
35	15B/220B	+ Batt (12/24V)	Panel PSU i/p (+)	5	174	IN (DB) 1	Auto Switch
12	0	- Batt (12/24V)	Panel PSU i/p (-)	28	175	IN (DB) 2	Manual Switch
23	56A	OUT (OC) 1	Starter Relay	16	R15	IN (DB) 3	Emergency Stop
11	256	OUT (OC) 2	Fuel Relay	4	183	IN (DB) 4	Remote Start
34	445	OUT (OC) 3	Fault Relay	27	505	IN (DB) 5	DI1/Battery Charge Fail
22		OUT (OC) 4		15	567/601	IN (DB) 6	DI2/Ruptured Basin/Low Fuel Pressure
32		+12V (300mA)	External Modem	3	IN7	IN (DB) 7	DI3/Line Power
3		Gnd	External Modem	26	IN8	IN (DB) 8	DI4/Gen. Power
14		IN (DB) 10	External Modem DCD	23	OC5	OUT (OC) 5	Aux 1 Output
26		IN (DB) 9	External Modem RI	22	OC6	OUT (OC) 6	Aux 2 Output
24	0/shld	RPM sensor (-)	Flywheel	33	OC7	OUT (OC) 7	Aux 3 Output
25	79	RPM sensor (+)	Flywheel	21	OC8	OUT (OC) 8	Aux 4 Output
21	221	OUT (OC) 12 (PWM)	Preheat/ A/F solenoid	32	OC9	OUT (OC) 9	
10	R15B	OUT (OC) 10	O/speed W/dog Sdown	12	398A	CT1+	Generator Phase A
16	803	AN9 (+) 0-10V	Charger current monitor	11	399A	CT1 -	Generator Phase A
33	769	OUT (OC) 11 (PWM)	Throttle driver O/P	35	398B	CT2+	Generator Phase B
18	766V	AN7 (+) 4-20mA	Throttle 1 Position	34	399B	CT2 -	Generator Phase B
17	766R	AN7 (rtn)	Throttle 1 Position	10	398C	CT3+	Generator Phase C
9	523V	AN1 (+) 4-20mA	Oil temp	9	399C	CT3 -	Generator Phase C
8	523R	AN1 (rtn)	Oil temp	18		+12V (500 mA)	Vsense PCB
15	68V	AN2 (+) 4-20mA	Coolant temp	7	227	Gnd	Vsense PCB
31	68R	AN2 (rtn)	Coolant temp	6	224	Vsense 1	Generator Phase A/AB
20	69V	AN3 (+) 4-20mA	Oil pressure	29	225	Vsense 2	Generator Phase B/BC
19	69R	AN3 (rtn)	Oil pressure	17	226	Vsense 3	Generator Phase C/CA
30	573V	AN4 (+) 4-20mA	Coolant Level	20	404	OUT (OC) 13	AVR Gate trigger 'A'
29	573R	AN4 (rtn)	Coolant Level	8	403	OUT (OC) 14	AVR Gate trigger 'B'
7	575V	AN5 (+) 4-20mA	Fuel Level	30	406	AVR Zero crossing I/p	AVR Zero crossing I/p
6	575R	AN5 (rtn)	Fuel Level	31	194	+12V (300 mA)	AVR PCB PSU o/p
28	AI1S	AN6 (+) 4-20mA	Aux Input +	19	405	Gnd	AVR PCB PSU o/p
27	AI1R	AN6 (rtn)	Aux Input -	14	387	RS232 (rx)	Genlink
5	804	AN8 (+) 0-1V	O2 sensor	25	389	RS232 (com)	Genlink
4	805	AN8(rtn)	O2 sensor	2	388	RS232 (tx)	Genlink
2		CAN (+)	CAN Bus	13	390	RS485 (+)	Diagnostic/Rem-An
13		CAN (-)	CAN Bus	24	SHLD	RS485 (shield)	Diagnostic/Rem-An
1		CAN (rtn)	CAN Bus	1	391	RS485 -	Diagnostic/Rem-An

KEY:

OUT(O/C) # = OUTput, Open Collector transistor (includes PWM o/p#, AVR Gates & Gov# outputs) Committed I/O pin
IN(DB) # = INput, Digital, Buffered (Schmitt trigger)
IN(ISO) # = INput, Digital, Opto ISOlated
AN # (+) = Analog 12V (50 mA) source
AN # (rtn) = General purpose analog input (4 - 20 mA)
Vsense # = Voltage sensing input (0 - 5 VAC)
CT # = Current Transformer input (0 - 7.18 A)

◆ PINOUT BY PIN NUMBER

J1	Wire	Signal	Description	J2	Wire	Signal	Description
1		CAN (rtn)	CAN Bus	1	391	RS485 -	Diagnostic/Rem-An
2		CAN (+)	CAN Bus	2	388	RS232 (tx)	Genlink
3		Gnd	External Modem	3	IN7	IN (DB) 7	DI3/Line power
4	805	AN8 (rtn)	O2 sensor	4	183	IN (DB) 4	Remote Start
5	804	AN8 (+) 0-1V	O2 sensor	5	174	IN (DB) 1	Auto Switch
6	575R	AN5 (rtn)	Fuel Level	6	224	Vsense 1	Generator Phase A/AB
7	575V	AN5 (+) 4-20mA	Fuel Level	7	227	Gnd	Vsense PCB
8	523R	AN1 (rtn)	Oil temp	8	403	OUT (OC) 14	AVR Gate trigger 'B'
9	523V	AN1 (+) 4-20mA	Oil temp	9	399C	CT3 -	Generator Phase C
10	R15B	OUT (OC) 10	O/speed W/dog Sdown	10	398C	CT3+	Generator Phase C
11	256	OUT (OC) 2	Fuel Relay	11	399A	CT1 -	Generator Phase A
12	0	- Batt (12/24V)	Panel PSU i/p (-)	12	398A	CT1+	Generator Phase A
13		CAN (-)	CAN Bus	13	390	RS485 +	Diagnostic/Rem-An
14		IN (DB) 10	External Modem DCD	14	387	RS232 (rx)	Genlink
15	68V	AN2 (+) 4-20mA	Coolant temp	15	567	IN (DB) 6	DI2/Ruptured Basin
16	803	AN9 (+) 0-10V	Charger current monitor	16	R15	IN (DB) 3	Emergency Stop
17	766R	AN7 (rtn)	Throttle 1 Position	17	226	Vsense 3	Generator Phase C/CA
18	766V	AN7 (+) 4-20mA	Throttle 1 Position	18		+12V (500 mA)	Vsense PCB
19	69R	AN3 (rtn)	Oil pressure	19	405	Gnd	AVR PCB PSU o/p
20	69V	AN3 (+) 4-20mA	Oil pressure	20	404	OUT (OC) 13	AVR Gate trigger 'A'
21	221	OUT (OC) 12 (PWM)	Preheat/ A/F solenoid	21	OC8	OUT (OC) 8	Aux 4 Output
22		OUT (OC) 4		22	OC6	OUT (OC) 6	Aux 2 Output
23	56A	OUT (OC) 1	Starter Relay	23	OC5	OUT (OC) 5	Aux. 1 Output
24	0/shld	RPM sensor (-)	Flywheel	24	SHLD	RS485 (shield)	Diagnostic/Rem-An
25	79	RPM sensor (+)	Flywheel	25	389	RS232 (com)	Genlink
26		IN (DB) 9	External Modem RI	26	IN8	IN (DB) 8	DI4/Gen. power
27	AI1R	AN6 (rtn)	Aux Input -	27	505	IN (DB) 5	DI1/Battery Charge Fail
28	AI1S	AN6 (+) 4-20mA	Aux Input +	28	175	IN (DB) 2	Manual Switch
29	573R	AN4 (rtn)	Coolant Level	29	225	Vsense 2	Generator Phase B/BC
30	573V	AN4 (+) 4-20mA	Coolant Level	30	406	AVR Zero crossing I/p	AVR Zero crossing I/p
31	68R	AN2 (rtn)	Coolant temp	31	194	+12V (300 mA)	AVR PCB PSU o/p
32		+12V (300mA)	External Modem	32	OC9	OUT (OC) 9	
33	769	OUT (OC) 11 (PWM)	Throttle driver O/P	33	OC7	OUT (OC) 7	Aux 3 Output
34	445	OUT (OC) 3	Fault Relay	34	399B	CT2 -	Generator Phase B
35	15B/220B	+ Batt (12/24V)	Panel PSU i/p (+)	35	398B	CT2+	Generator Phase B

KEY:

OUT(O/C) # = OUTput, Open Collector transistor (includes PWM o/p#, AVR Gates & Gov# outputs) Committed I/O pin

IN(DB) # = INput, Digital, Buffered (Schmitt trigger)

IN(ISO) # = INput, Digital, Opto ISOlated

AN # (+) = Analog 12V (50 mA) source

AN # (rtn) = General purpose analog input (4 - 20 mA)

Vsense # = Voltage sensing input (0 - 5 VAC)

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NOTES

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