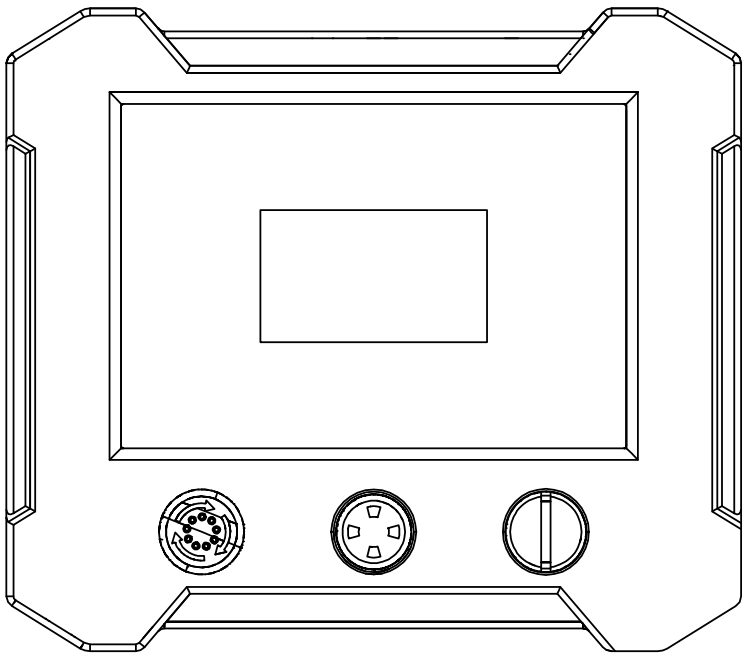
GENERAC®

Owner's Manual

Power Zone® Pro Main Controller



SAVE THIS MANUAL FOR FUTURE REFERENCE

⚠WARNING

CANCER AND REPRODUCTIVE HARM
www.P65Warnings.ca.gov.

(000393a)

Table of Contents

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Section 1 Introduction and Safety

Introduction

Thank you for purchasing a Generac Power Systems, Inc. product. This unit has been designed to provide high performance, efficient operation and years of use when maintained properly.

The information in this manual is accurate based on products produced at the time of publication. The manufacturer reserves the right to make technical updates, corrections, and product revisions at any time without notice.

Read This Manual Thoroughly

⚠WARNING

Consult Manual. Read and understand manual completely before using product. Failure to completely understand manual and product could result in death or serious injury.

(000100a)

If any section of the manual is not understood, contact your nearest Independent Authorized Service Dealer (IASD), or contact Generac Customer Service at 1-888-GENERAC (1-888-436-3722), or ***www.generac.com*** with any questions or concerns. The owner is responsible for proper maintenance and safe use of the equipment.

Save these instructions for future reference. This manual contains important instructions for the controller that should be followed during installation, operation and maintenance of the controller. Always supply this manual to any individual that will use this device.

NOTE: Contact an IASD for manuals referred to within this manual.

IMPORTANT NOTE: Use this manual in conjunction with the appropriate generator owner's manual.

Safety Messages

Throughout this publication and on tags and decals affixed to the unit, DANGER, WARNING, and CAUTION blocks are used to alert personnel to special instructions about a particular operation that may be hazardous if performed incorrectly or carelessly. Observe them carefully. Their definitions are as follows:

⚠DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

(000001)

⚠WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

(000002)

⚠CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

(000003)

NOTE: Notes contain additional information important to a procedure and will be found within the regular text of this manual.

These safety alerts cannot eliminate the hazards that they indicate. Common sense and strict compliance with the special instructions while performing the action or service are essential to preventing accidents.

The operator is responsible for proper and safe use of the equipment. The manufacturer strongly recommends that if the operator is also the owner, to read the owner's manual and thoroughly understand all instructions before using this equipment. The manufacturer also strongly recommends instructing other users on how to properly start and operate the unit. This prepares them if they need to operate the equipment in an emergency.

Safety Rules

Study these safety rules carefully before installing, operating or servicing this equipment. Become familiar with this manual, the owner's manual and the unit. The 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 alerts in this manual and on tags and decals affixed to the unit are not all-inclusive. If using a procedure, work method or operating technique the manufacturer does not specifically recommend, verify it is safe for others and does not render the equipment unsafe.

General Hazards

⚠DANGER

Loss of life. Property damage. Installation must always comply with applicable codes, standards, laws and regulations. Failure to do so will result in death or serious injury. (000190)

⚠WARNING

Equipment damage. Only qualified service personnel may install, operate, and maintain this equipment. Failure to follow proper installation requirements could result in death, serious injury, and equipment or property damage. (000182a)

Environmental Protection
Waste electrical products should not be disposed of with household waste. Please recycle where facilities exist. Check with your Local Authority for a designated collection point or other information related to proper disposal. ISO000589

Electrical Hazards

⚠DANGER

Electrocution. Contact with bare wires, terminals, and connections while generator is running will result in death or serious injury. (000144)

⚠DANGER

Electrocution. Verify electrical system is properly grounded before applying power. Failure to do so will result in death or serious injury. (000152)

⚠DANGER

Electrocution. Do not wear jewelry while working on this equipment. Doing so will result in death or serious injury. (000188)

⚠DANGER

Electrocution. Water contact with a power source, if not avoided, will result in death or serious injury. (000104)

⚠DANGER

Electrocution. In the event of electrical accident, immediately shut power OFF. Use non-conductive implements to free victim from live conductor. Apply first aid and get medical help. Failure to do so will result in death or serious injury. (000145)

⚠WARNING

Electrocution. Potentially lethal voltages are generated by this equipment. Render the equipment safe before attempting repairs or maintenance. Failure to do so could result in death or serious injury. (000187)

⚠WARNING

Electrocution. More than one live high voltage circuit is present. Disconnect all power sources before servicing. Failure to do so could result in death or serious injury. (000563)

⚠WARNING

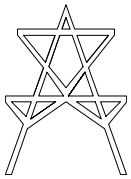
Electric shock. Only a trained and licensed electrician should perform wiring and connections to unit. Failure to follow proper installation requirements could result in death, serious injury, and equipment or property damage. (000155a)

Section 2 General Information

Equipment Description

The Generac Power Zone® Pro Main Controller (Assembly No. 10000033901) is a fully integrated and multipurpose family of controllers for Generac's generator systems.

Symbol Definition

	AC Generator
	Utility
	AC Voltage
	DC Voltage

Acronyms

I^2T - Integration Current Squared Over Time Algorithm
RMS - Root Mean Squared
IP - Internet Protocol
RTU - Remote Terminal Unit
PLC - Programmable Logic Controller
PWM - Pulse Width Modulation
GFI - Ground Fault Indication
TCP - Transmission Control Protocol
CAN - Controller Area Network
UL - Underwriters Laboratories
CE - European Conformity
CSA - Canadian Standards Association
FCC - Federal Communications Commission
ISO - International Standards Organization
I/O - Input/Output
RPM - Revolutions per Minute
AVR - Automatic Voltage Regulator
E-Stop - Emergency Stop Switch
V/F - Voltage per Frequency Algorithm
bps - Bits per Second
ECU - Engine Control Unit
CT - Current Transformer
NFPA - National Fire Protection Association
BMS - Building Management System

Connections

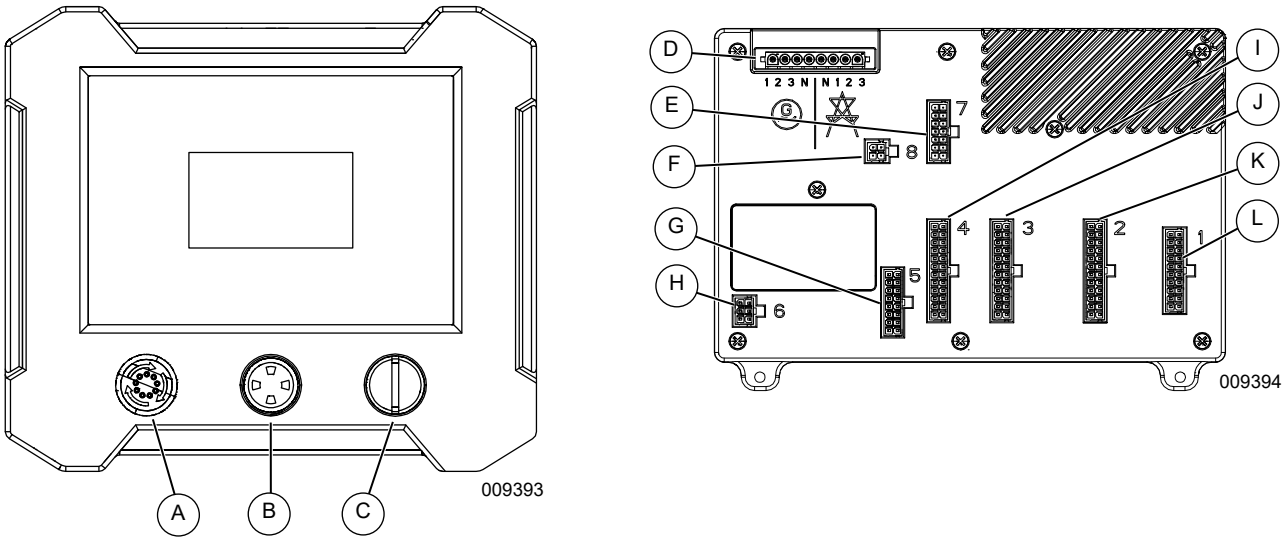
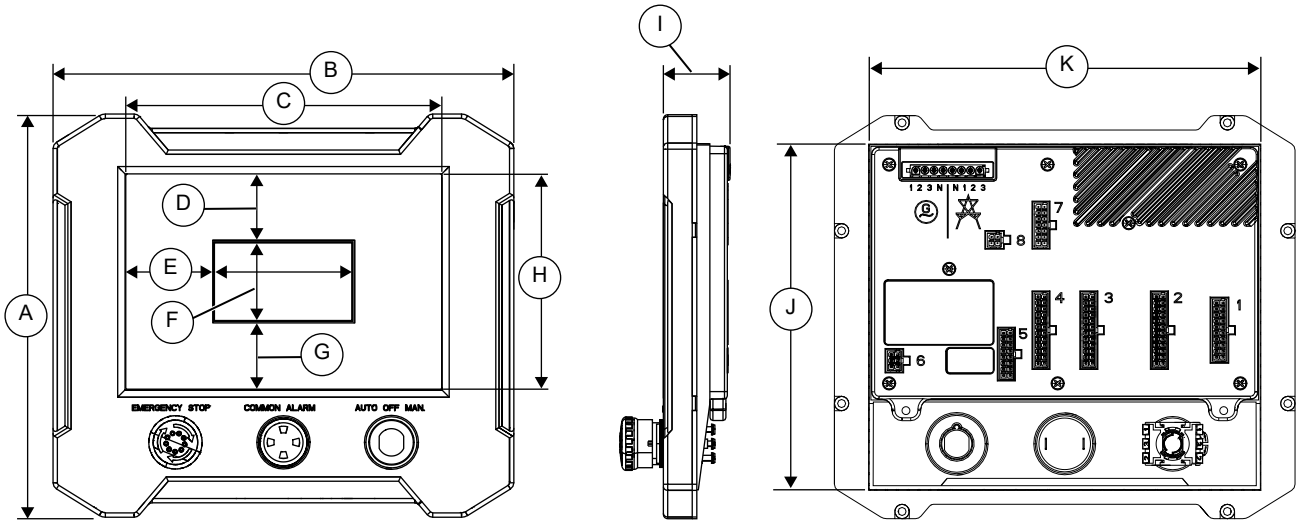


Figure 2-1. Controller Connections

A	Emergency Stop Button	**G**	(BS5) J5 digital inputs
B	Alarm Horn	**H**	(BS6) J6 Connectivity Server power and RS-485
C	AUTO/OFF/MANUAL Keyswitch	**I**	(BS4) J4 analog inputs, 5 V analog reference
D	(BS9) J9 utility sensing generator high voltage sensing connections	**J**	(BS3) J3 CT inputs, analog inputs, analog outputs, analog coolant level input
E	(BS7) J7 Generac CAN, watchdog digital output, peripheral module power	**K**	(BS2) J2 digital outputs
F	(BS8) J8 J1939 CAN	**L**	(BS1) battery connection, 12 V reference, RPM, RS-485

Dimensions



009649

Figure 2-2. Controller Assembly Dimensions

A	11.02 in (280.0 mm)	**G**	1.52 in (38.5 mm)
B	12.60 in (320.0 mm)	**H**	5.91 in (150.0 mm)
C	8.66 in (220.0 mm)	**I**	1.27 in (32.2 mm)
D	1.72 in (43.7 mm)	**J**	9.45 in (240.0 mm)
E	2.24 in (57.0 mm)	**K**	10.71 in (272.1 mm)
F	2.67 in (67.7 mm)		

NOTE: Dimensions shown are for reference only, and may vary depending on generator size and application.

Features

- HMI 4.3 inch Color Touchscreen Display
- System Configurable via the Connectivity server using most Wi-Fi®, Bluetooth® devices, or wired Ethernet connection
- Remote Communication via Modbus® RTU, Modbus TCP/IP, 10/100 Mbs Ethernet IEEE 802.3 or Wi-Fi
- Configurable Analog and Digital I/O
- Configurable Monitoring of Analog I/O, Digital I/O, and Machine State Data
- Configurable Detection and Mitigation of Faults with E-Mail Annunciation
- Configurable Logging of Faults and Events with Associated Data Capture
- Configurable Logging and Trending of Data
- Digitally Controlled Generator Output Voltage and Frequency Regulation
- Customer Programmable Built-in Multichannel PLC Logic Controller
- Alternator I^2T with 300% Current Limiting for Breaker Coordination
- Alternator Ground Fault Indication

Parameters Monitored on Display or Connectivity Server

- Keyswitch Position Monitoring
- Amps per Phase - Generator
- Line to Line and Line to Neutral Volts - Utility and Generator
- Power Factor - Generator
- Real Power - kW - Generator
- Apparent Power - kVA - Generator
- Reactive Power - kVAR - Generator
- Frequency - Utility and Generator
- Engine Speed
- Engine Coolant Temperature
- Engine Oil Pressure
- Engine Oil Temperature
- Battery Voltage
- Shutdown Messages
- Diagnostics
- Maintenance Events/Information
- Engine Run Hours

Voltage Regulation (Single or Three-Phase Module Options)

- Digital Control
- Single-Phase or Three-Phase RMS Sensing with Loss of Sensing Protection
- Variable V/F Slope Settings and Adjustable Gains
- Negative Power Protection
- Soft Start Ramping
- Fault Protection (I^2T Function and GFI)

Electronic Governor

- Electronic Speed Control for Electronically Controlled Compression and Spark Ignited Engines
- Adjustable Gains
- Low Speed Exercise

PLC (Built-In Programmable Logic Controller)

- Configurable Through Software Tool
- Customer Configurable for Non-Standard Options
- Up to 8 Simultaneously Running PLC Programs or in Sequence

Connections

- 21 Digital Outputs Maximum (Open Drain, 35 V⎓ 1.7 A)
- 7 fast PWM capable Outputs, 1 High Current
- 15 Digital Inputs Maximum
- 7 fast PWM capable Inputs
- 12 General Purpose Analog Inputs
- 2 Special Purpose Analog Inputs
- 2 Analog Outputs (0-10 V⎓)
- 1 E-Stop Relay Output
- 3 Current Sense Inputs
- 8 High Voltage Sense Inputs (3-Phase + Neutral)
- 1 Magnetic Pickup Input
- 1 Coolant Level Sensor Input
- 2 CAN bus Channels
- 2 External RS-485 Ports (1 available to customer)
- 2 Switchable 12 V⎓ Power Outputs

NOTE: Actual I/O may vary due to configuration.

Qualification Testing

- Life Test in Environmental Chamber
- Temperature Rating
- Vibration Tested and Protected

Codes and Standards

- UL 6200 Investigation of Controls for Stationary Engine Driven Assemblies
- UL 2200 Standard for Stationary Engine Generator Assemblies
- CSA STD C22.2 No. 14
- IEC/EN 61010-1
- IEC/EN 61000-6-2 EMC Immunity for Industrial Environments
- IEC/EN 61000-6-4 EMC Emissions Standard for Industrial Environments
- NFPA 110 (configurable for Level 1 or 2 with additional optional remote annunciator)
- NFPA 70

Protections

- High/Low Oil Temperature
- High/Low Oil Pressure
- Low Coolant Level
- High/Low Coolant Temperature
- Sender/Sensor Failure
- Over/Under Speed
- Over/Under Voltage
- Over/Under Frequency
- Over Current
- Over Total kW
- High/Low Battery Voltage
- Battery Charge Current
- Phase to Phase and Phase to Neutral Short Circuits. (I^2T Algorithm and GFI)

Control Panel and Touch Screen

- Auto/Manual/Off Key Switch
- Alarm Acknowledge Soft Key
- Audible Alarm
- Emergency Stop

Specifications

Environmental Specifications	
Operating Temperature	-40 °F (-40 °C) to 149 °F (65 °C)
Humidity	2% to 95% Non-Condensing
Enclosure	UL Type 1
Weight	3.3 lbs
Power Supply Requirements	
Power Supply Source	Engine Battery or Battery Charger
Power Supply Voltage	12/24 V⎓ (6 V⎓ to 35 V⎓)
Power Supply Wattage	31 Watts
Power Supply Cable	2 wires - 16 AWG recommended
Cranking Dropout	3.5 V⎓
Reverse Polarity Protection	Yes
Communication (RS-485)	
Number of Ports	2 (1 for customer use, 1 is for internal use only)
Internally Terminated	Yes, 120 Ohms
Communication Link	2 wires - RS-485
Communication Cable	2 wires - shielded twisted pair (i.e. Belden 3105A)
Maximum Cable Length	4,000 ft (1,219 m)
Baud Rate	RS-485-0 115.2 Kbps; RS-485-1 4.8 to 115.2 kbps (selectable parity and stop bits)
Maximum Number of Devices	32
Communication (CAN)	
Number of Ports	2
Internally Terminated	Yes, 120 Ohms
Communication Link	2 wires
Communication Cable	2 wires - shielded twisted pair (i.e. Belden 3105A)
Maximum Cable Length	131 ft (40 m)
Baud Rate	250 kbps and 1 Mbps
Maximum Number of Devices	30
Analog/Digital/Inputs/Outputs (all voltages are DC)	
Ratings	See ***Installation and Operation***.
Digital Input	0 V to 5 V, 1.5 mA max, 100 Hz, inputs are internally pulled up to 5V
Digital Input PWM Capable	0 V to 5 V, 5 mA max, 1 Mhz, inputs are internally pulled up to 5V
Digital Output or PWM capable or Watchdog/Overspeed	0 V to Vopen-drain, Vbattery max, 1 A max sink
Digital Output High Current Capable	0 V to Vopen-drain, Vbattery max, 2 A max sink
General Purpose Analog Input	0 V to 5 V (10 uA max), 0 V to 10 V (10 uA max); 4-20 mA (50 mA max), or Resistive, 1 kHz
Special Analog Input	0 V to 5 V (10 uA max), 0 V to 10 V (10 uA max); Resistive, 500 Hz
Analog Output	0 V to 5 V, 0 V to 10 V, 10 mA max
Others	See ***Installation and Operation***.

Connectivity Server	
Supply voltage	12 V⎓ ± 5%
Maximum operating current	1.5 A
Nominal operating current	700 mA
Short circuit protection	Yes (current limited switch)
12 V Module Power Supplies (4)	
Supply voltage	12 V⎓ ± 5%
Available module current (divided among 4 connector pins)	2.0 A minimum
Typical module operating current	<200 mA
Short circuit protection	Yes (current limited switch)
12 V Analog Sensor Supply - 8 Pins	
Supply voltage	12 V⎓ ± 5%
Available sensor current (divided among 8 connector pins)	1 A minimum
Typical sensor current	20 mA per sensor (pin)
Short circuit protection	Yes (resettable fuse)
5 V Analog Sensor Supply - 8 Pins	
Supply voltage	5 V⎓ ± 5%
Available sensor current (divided among 8 connector pins)	1 A minimum
Typical sensor current	20 mA per sensor (pin)
Short circuit protection	Yes (resettable fuse)
Oxygen Sensor Input (1)	
Number of inputs	1
Input type	Special analog
Maximum voltage	35 V⎓
Voltage range	0-1 V⎓
Circuit Input impedance	1 Mohm
Maximum input current	<1 mA
Sampling Rate	>1 kHz
Coolant Level Special Analog Input (1)	
Number of inputs	1
Input type	Special analog
Sensor impedance, uncovered (typical)	562 Kohm
Maximum sensor current	0.1 mA

AC Voltage Sensing Inputs (6)	
Number of channels	6 + 2 neutral references
Maximum working voltage	600 Vrms ∿ ph-ph
Frequency	50 or 60 Hz
AC Current Sensing Inputs (3)	
Number of channels	3
Nominal current rating	0-1 A rms ∿
Maximum current rating	3.5 A rms ∿
Frequency	50 or 60 Hz
Input impedance	0.1 Ohms
RPM Sensor Inputs (1)	
Number of channels	1
Input type	Variable reluctance magnetic pickup
Maximum sensor voltage	± 250 V∿
Minimum sensor voltage	± 135 mV∿
Maximum input current	10 mA

NOTE: The communications cables should not be run in the same conduit or in the same wire grouping as any high voltage or high current conductors.

NOTE: The communications baud rates should be selected to be compatible with other components connected to the communications bus.

Section 3 Installation and Operation

Mounting and Grounding

⚠DANGER

Loss of life. Property damage. Installation must always comply with applicable codes, standards, laws and regulations. Failure to do so will result in death or serious injury.

(000190)

⚠WARNING

Equipment damage. Only qualified service personnel may install, operate, and maintain this equipment. Failure to follow proper installation requirements could result in death, serious injury, and equipment or property damage.

(000182a)

See ***Figure 2-2*** items J and K. For proper installation the sheet metal opening must be 272.1 x 240.0 mm with 25.4 mm keep-out zone for cabling purposes.

IMPORTANT NOTE: Verify there is at least 60 mm of space behind the controller for proper ventilation.

See ***Figure 3-1***. The Main Controller is mounted to the enclosure through a rectangular opening in the sheet metal and secured by eight M4-8 mm screws and eight #8-M4 lock washers (part no. 022264) around the edge (A). Tighten screws to 6.6 **in-lbs** (0.75 Nm). The gasket (C) and screws help prevent water from entering the module.

To provide proper grounding, use a ground wire and connect it to the Main Controller via a ring terminal. Use the self-tapping grounding screws (B) on either ground tab located on the bottom edge of the diecasting enclosure.

IMPORTANT NOTE: Care should be taken when tightening hardware. If excessive torque is applied, permanent damage may result. If not enough torque is applied, water may enter the panel and cause damage.

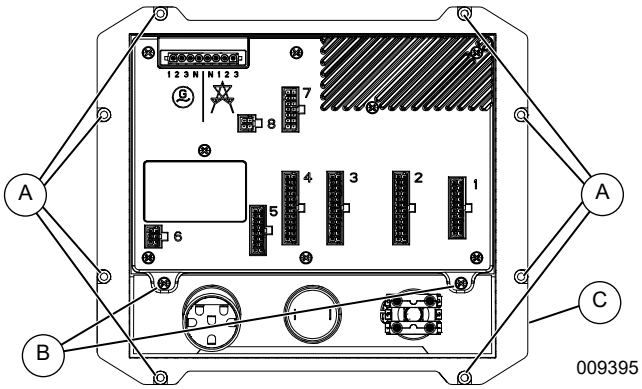


Figure 3-1. Mounting and Grounding

Cleaning

Do not use any cleaning solution to clean the Controller enclosure or cover. Clean with damp cloth or sponge. The Controller contains electronics circuitry. Use extra caution not to drip water inside the Controller when cleaning it around the vent and other holes. If water or other liquid enters the Controller, disconnect power until the Controller dries out completely. Special care should be taken when cleaning the touch screen. Dust off hard particles on the touch screen and use touch screen wipes to clean it.

Connections

Power Supply

The power for the Main Controller normally comes from the engine battery, either 12 or 24 V⎓. It should be fused with a 5 A Time Delay Fuse. The Main Controller has reverse battery protection in case of miswiring. The Main Controller can operate from any voltage supply in the range 6-35 V⎓. #16 gauge wires are recommended for this connection.

Connectivity Server Wiring

Normally the Main Controller will be connected to a Generac supplied Connectivity Server. The Main Controller provides a regulated 12 V⎓, 1.5 A output for the server.

Module CAN Bus Interface

There is a dedicated CAN bus port for connection to Generac's peripheral control modules. Examples of these modules include the Governor, AVR, and Battery Charger. A shielded twisted pair cable should run from the Main Controller to the first module. The rest of the modules are wired using shielded twisted pair cables in a chained fashion. Each end of the CAN bus must be terminated with appropriate resistors. See ***CAN Bus and RS-485 Termination Resistor***.

ECU CAN J1939 Interface

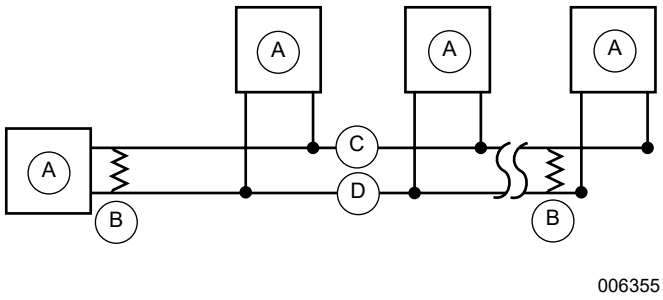
There is a dedicated CAN bus port for connection to J1939 compatible devices such as an Engine Control Unit. The particular interface method for a given J1939 module is selected via the Main Controller configuration settings. A single shielded twisted pair cable should run from the Main Controller to the ECU. The shield should be connected at the Main Controller end only. Each end of the CAN bus must be terminated with appropriate

resistors. The Main Controller end is already terminated. See ***CAN Bus and RS-485 Termination Resistor***.

CAN Bus and RS-485 Termination Resistor

For CAN and RS-485, both ends of the pair of signal wires (High and Low) must be terminated. The termination resistors on a cable should match the nominal impedance of the cable, 120 Ohm differential. If there are multiple devices along the cable, only the devices on the ends of the cable need termination resistors. ***Figure 3-2*** shows an example of how to terminate a network. The Generator Main Controller already contains a termination resistor. Once the other end of the cable is determined, the termination can be placed at that end. If the Governor module is the furthest one on the bus, the termination can be placed close to the Governor on its bus wires.

NOTE: The wires depicted in ***Figure 3-2*** are twisted pair.



A	CAN or RS-485 Device
B	120 Ohm Termination Resistor
C	High
D	Low

Figure 3-2. CAN Bus or RS-485 Bus Network Termination

Module Power Supply Wiring

Each module in the system requires at least one power supply. Some modules with high current requirements such as an ignition module or governor module will also have a separate high current supply wired to the battery. Some modules may only have the high current supply direct to the battery. The Main Controller has the provision to connect four modules directly to its pins. If there are more modules that need to be connected, the power supply pins can be brought out to a common terminal block. #16 gauge wires are recommended for these connections.

Analog Sensor Power Supply Wiring

The Main Controller provides precision voltage supplies for these types of sensors (either 5 V or 12 V), so they can be wired as appropriate per the sensor data sheet. Some sensors do not require a precise voltage supply and can use battery supply directly if appropriate. The precision voltage supplies from the Main Controller are current limited in case of shorting and are capable of supplying a maximum of 1 A per supply. The total current draw of all sensors powered from the 12 V precision supply is limited to a maximum of 1 A. The same is true for the precision 5 V supply. #18 gauge wires are recommended for these connections.

Digital Inputs (DI)

The Main Controller provides the facility to connect to multiple digital inputs. Each digital input is normally a closure to ground (such as a switch). The inputs are pulled up to 5 V on the controller board. Voltages can be applied to the Digital Input provided the voltages obey the limits in ***Specifications***. There are specially designated digital inputs for connections that switch at high speeds (>100 Hz such as a PWM input). #18 gauge wires are recommended for these connections.

Digital Outputs (DO)

The Main Controller provides multiple digital outputs. Each digital output is an electronic switch closure to ground. The voltage at each output is determined by what voltage the load is connected to. This voltage shall not exceed 35 V⎓. There are specially designated digital outputs for connections that switch at high speeds (>100Hz such as PWM outputs). #18 gauge wires are recommended for these connections.

High Current Digital Output

This output is intended to be for air/fuel ratio control. It is a special high current output for driving solenoid valves. #18 gauge wires are recommended for this connection.

General Purpose Analog Inputs (GPAI)

Typically analog sensors can have different types of output: Current Loop 4-20 mA, Voltage (0-5 V or 0-10 V or scalable), or Resistive type. Any of these types of sensors can be wired to the 12 GPAI inputs on the Main Controller. Configuration settings are used to adapt the input to the sensor attached. The GPAI inputs are multiplexed and read relatively slowly. If a faster response is required, use one of the two Special Analog Inputs covered in ***Special Analog Inputs***.

Usually a sensor is either two or three wire. Two wire sensors present a resistance to the Main Controller and are wired between ground and the analog input pin.

Analog ground pins are provided for this purpose. Three wire sensors are usually 4-20 mA or voltage type sensors. #18 gauge wires are recommended for these connections.

Special Analog Inputs

There are two special "fast" analog inputs; one reserved for the input from an oxygen sensor, and another to read a governor feedback signal. These inputs can be used for other purposes when an external CAN type governor is used or an oxygen sensor is not used. The channels are read directly and not multiplexed. #18 gauge wires are recommended for these connections. These inputs do not support 4-20 mA signals.

Oxygen Sensor Special Analog Input

Oxygen sensors produce a 0-1 V input with potentially fast transitions. The oxygen sensor can be selected to be read through channel 2 of the special analog inputs. The resolution is approximately 0.25 mV. The sensor is usually self powered. #18 gauge wires are recommended for this connection.

Coolant Level Special Analog Input

The coolant level sensor needs special treatment to prevent surface electrolysis. Its voltage supply polarity needs to be continually alternated. The circuit is designed to accommodate a two wire resistive sensor (part no. 0H1827) but other resistive sensors can be used if they have a nominal resistance of 562K ± 6K. #18 gauge wires are recommended for this connection.

AC Voltage Sensing Inputs

The high voltage sensing inputs have a separate connector which includes pins for generator voltage sensing, utility voltage sensing, and neutral connections. Wiring to these pins should be routed away from other connectors to reduce the effects of electrical noise. The voltage readings need to be calibrated for maximum accuracy (see ***Voltage and Current Sense Input Calibration***). #18 gauge wires are recommended for these connections.

NOTE: Check the fuses on the voltage sensing wires if there are any voltage sensing issues and replace if necessary.

AC Current Sensing Inputs

The generator current is measured through the use of Current Transformers (CT's). These need to be appropriately sized for the generator. The CT should be rated for 300% of the generator rated current (example: 100 amp CT must be able to measure at least 300 amps) to accommodate the 300% current limiting feature. Care must be taken to correctly install the CT on the proper phase, in the proper orientation, and using the proper sense wire polarity. Failure to do so will cause erroneous power readings. #18 gauge wires are recommended for these connections. Typical connections for a generator installation are shown in the ***AC Voltage Sensing Inputs*** and ***AC Current Sensing Inputs***.

Analog Outputs

There are two analog output signals that can be used for control of 3rd party modules such as AVR's and governors. They can also be used to drive diagnostics, gauges, or other equipment. They can be configured in the configuration files for voltage ranges of 0-10 V. #18 gauge wires are recommended for these connections.

RPM Sensor Input

There is one circuit specially conditioned to accept input from a variable reluctance type RPM sensor. Shielded cable is recommended for this connection. A shield connection pin is provided for this purpose.

Watchdog and Overspeed

There is a hardware watchdog circuit that will activate upon loss of signal from the processor. The overspeed circuit will sense if an overspeed condition occurs in the engine that is not detected by the controller. These circuits provide an independent safety check should the Main Controller processor fail. The output from these circuits is a standard digital output (DO) that can be used to drop out a relay (for example, in series with emergency stop circuit). #18 gauge wires are recommended for this connection.

Voltage and Current Sense Input Calibration

All of the analog channels can be recalibrated but are normally calibrated in the factory. The only channels that are recommended to be recalibrated are the voltage sensing and current sensing channels. The reason for this is to account for installation wiring effects. For example the voltage sensing is performed within the generator enclosure, but there may be voltage drops in the external cabling/switchgear that need to be taken into account.

Pin Map

NOTE: See ***Table 3-1*** through ***Table 3-9***. “(BS1)” through “(BS9)” indicates connector reference designator used in the harness drawing.

Table 3-1. J1 Connector

Pin	Name	Description	Configured Default NA = Not Configurable	Wire # (Default)
(BS1) J1-1	RS-485 (+) #1	RS-485 #1 - RAP, etc.	Modbus® Master	390
(BS1) J1-2	RS-485 (-) #1	RS-485 #1 - RAP, etc.	Modbus Master	391
(BS1) J1-3	12 V⎓	Analog Sensor Supply	NA	
(BS1) J1-4	12 V⎓	Analog Sensor Supply	NA	
(BS1) J1-5	12 V⎓	Analog Sensor Supply	NA	
(BS1) J1-6	12 V⎓	Analog Sensor Supply	NA	
(BS1) J1-7	N.C.	No Connect	NA	
(BS1) J1-8	Battery (+)	Positive Battery Connection	NA	
(BS1) J1-9	Battery (+)	Positive Battery Connection	NA	
(BS1) J1-10	Battery (+)	Positive Battery Connection	NA	15A
(BS1) J1-11	RS-485 Ground Reference #1	RS-485 #1 Ground	Modbus Master	0A
(BS1) J1-12	RS-485 Shield #1	RS-485 #1 Communications Shield	Modbus Master	SHLD
(BS1) J1-13	12 V⎓	Analog Sensor Supply	NA	
(BS1) J1-14	12 V⎓	Analog Sensor Supply	NA	
(BS1) J1-15	Mag Pickup (-)	Primary Mag Pickup Sensor	Engine Speed	0
(BS1) J1-16	Mag Pickup (+)	Primary Mag Pickup Sensor	Engine Speed	79
(BS1) J1-17	Mag Pickup Shield	Primary Mag Pickup Sensor	Engine Speed	SHLD
(BS1) J1-18	Battery (-)	Negative Battery Connection	NA	0
(BS1) J1-19	Battery (-)	Negative Battery Connection	NA	0
(BS1) J1-20	Battery (-)	Negative Battery Connection	NA	0

Table 3-2. J2 Connector

Pin	Name	Description	Configured Default NA = Not Configurable	Wire # (Default)
(BS2) J2-1	DOUT1	Digital Out - Configurable	Start Relay	56A
(BS2) J2-2	DOUT2	Digital Out - Configurable	Fuel Relay	256
(BS2) J2-3	DOUT3	Digital Out - Configurable	Fault Relay	445
(BS2) J2-4	DOUT4	Digital Out - Configurable	Preheat Relay/Dual-Fuel NG Valve	241
(BS2) J2-5	DOUT5	Digital Out - Configurable	Ignition Module Power	25
(BS2) J2-6	DOUT6	Digital Out - Configurable	Secondary Gas Relay/Dual-Fuel LP Valve	242
(BS2) J2-7	DOUT7	Digital Out - Configurable	AUX Out #1	OC1
(BS2) J2-8	DOUT8	Digital Out - Configurable	AUX Out #2	OC2
(BS2) J2-9	DOUT9	Digital Out - Configurable	AUX Out #3	OC3
(BS2) J2-10	DOUT10	Digital Out - Configurable	AUX Out #4	OC4
(BS2) J2-11	DOUT11	Digital Out - Configurable	J1939 ECU Run	256A
(BS2) J2-12	DOUT12	Digital Out - Configurable	MCB Shunt Trip	263
(BS2) J2-13	DOUT13	Digital Out - Configurable	Fuel Type Select	609
(BS2) J2-14	DOUT14	Digital Out - Configurable		
(BS2) J2-15	DOUT15	Digital Out - Configurable	PWMO #1	
(BS2) J2-16	DOUT16	Digital Out - Configurable	Throttle #1 - PWMO #2	769
(BS2) J2-17	DOUT17	Digital Out - Configurable	Throttle #2 - PWMO #3	769A
(BS2) J2-18	DOUT18	Digital Out - Configurable	PWMO #4	
(BS2) J2-19	DOUT19	Digital Out - Configurable	AVR Trigger A - PWMO #5	404
(BS2) J2-20	DOUT20	Digital Out - Configurable	AVR Trigger B - PWMO #6	403
(BS2) J2-21	DOUT21	Digital Out - Configurable	A/F Solenoid/PWMO #7 (2A)	808/A
(BS2) J2-22	N.C.	No Connection		
(BS2) J2-23	12 V⎓	Analog Sensor Supply	NA	
(BS2) J2-24	12 V⎓	Analog Sensor Supply	NA	

Table 3-3. J3 Connector

Pin	Name	Description	Configured Default NA = Not Configurable	Wire # (Default)
(BS3) J3-1	GPAI 1	General Purpose Analog Input - Configurable	Oil Temperature	523
(BS3) J3-2	GPAI 2	General Purpose Analog Input - Configurable	Coolant Temperature #1	68V1
(BS3) J3-3	GPAI 3	General Purpose Analog Input - Configurable	Oil Pressure #1	69S1
(BS3) J3-4	GPAI 4	General Purpose Analog Input - Configurable	Aux Input #1	AI1S
(BS3) J3-5	GPAI 5	General Purpose Analog Input - Configurable	Aux Input #2	AI2S
(BS3) J3-6	GPAI 6	General Purpose Analog Input - Configurable	Oil Pressure #2	69S2
(BS3) J3-7	GPAI 7	General Purpose Analog Input - Configurable	Analog Sensor	
(BS3) J3-8	GPAI 8	General Purpose Analog Input - Configurable	Coolant Temperature #2 (+)	68V2
(BS3) J3-9	Analog Output 1	Configurable Analog Output	GPAO #1	
(BS3) J3-10	Analog Output 2	Configurable Analog Output	GPAO #2	
(BS3) J3-11	Coolant Level (-)	Coolant Level	NA	573A
(BS3) J3-12	Coolant Level (+)	Coolant Level	NA	573
(BS3) J3-13	Generator A CT (+)	Generator Phase A Current Transformer	NA	398A
(BS3) J3-14	Generator A CT (-)	Generator Phase A Current Transformer	NA	399A
(BS3) J3-15	Generator B CT (+)	Generator Phase B Current Transformer	NA	398B
(BS3) J3-16	Generator B CT (-)	Generator Phase B Current Transformer	NA	399B
(BS3) J3-17	Generator C CT (+)	Generator Phase C Current Transformer	NA	398C
(BS3) J3-18	Generator C CT (-)	Generator Phase C Current Transformer	NA	399C
(BS3) J3-19	Ground	Ground for Analog/Digital	Oil Temperature (-)	523A
(BS3) J3-20	Ground	Ground for Analog/Digital	Coolant Temperature #1 (-)	68R1
(BS3) J3-21	Ground	Ground for Analog/Digital	Oil Pressure #1 (-)	69R1
(BS3) J3-22	Ground	Ground for Analog/Digital	Aux Input #1 Sensor (-)	AI1R
(BS3) J3-23	Ground	Ground for Analog/Digital	Aux Input #2 Sensor (-)	AI2R
(BS3) J3-24	Ground	Ground for Analog/Digital	Oil Pressure #2 Sensor (-)	69R2

Table 3-4. J4 Connector

Pin	Name	Description	Configured Default NA = Not Configurable	Wire # (Default)
(BS4) J4-1	GPAI 9	General Purpose Analog Input. Configurable	Throttle Position #2 (+)	465V
(BS4) J4-2	GPAI 10	General Purpose Analog Input. Configurable	Inlet Manifold Temperature	754V
(BS4) J4-3	GPAI 11	General Purpose Analog Input. Configurable	Fuel Level	575V
(BS4) J4-4	GPAI 12	General Purpose Analog Input. Configurable	Battery Charge Current	803
(BS4) J4-5	Ground	Ground for Analog/Digital	Throttle Position #1 (-)	766R
(BS4) J4-6	Ground	Ground for Analog/Digital	Oxygen Sensor (-)	805
(BS4) J4-7	Special Analog Input 1	Analog Input. Configurable	Throttle Position #1 (+)	766V
(BS4) J4-8	Special Analog Input 2	Analog Input. Configurable	Oxygen Sensor	804
(BS4) J4-9	5 V⎓	Analog Sensor Supply		
(BS4) J4-10	5 V⎓	Analog Sensor Supply		
(BS4) J4-11	5 V⎓	Analog Sensor Supply		
(BS4) J4-12	5 V⎓	Analog Sensor Supply		
(BS4) J4-13	Ground	Ground for Analog/Digital	Throttle Position #2 (-)	465R
(BS4) J4-14	Ground	Ground for Analog/Digital	Inlet Manifold Temp Sensor	754R
(BS4) J4-15	Ground	Ground for Analog/Digital	Fuel Level Sensor	575R
(BS4) J4-16	Ground	Ground for Analog/Digital		
(BS4) J4-17	Ground	Ground for Analog/Digital		
(BS4) J4-18	Ground	Ground for Analog/Digital		
(BS4) J4-19	Ground	Ground for Analog/Digital		
(BS4) J4-20	Ground	Ground for Analog/Digital	Coolant Temp Sensor #2 (-)	68R2
(BS4) J4-21	5 V⎓	Analog Sensor Supply	Oil Pressure #1 Supply	69V1
(BS4) J4-22	5 V⎓	Analog Sensor Supply	Oil Pressure #2 Supply	69V2
(BS4) J4-23	5 V⎓	Analog Sensor Supply		
(BS4) J4-24	5 V⎓	Analog Sensor Supply		

Table 3-5. J5 Connector

Pin	Name	Description	Configured Default NA = Not Configurable	Wire # (Default)
(BS5) J5-1	DIN1	Digital Input. Configurable	Auto Switch	174
(BS5) J5-2	DIN2	Digital Input. Configurable	Manual Switch	175
(BS5) J5-3	DIN3	Digital Input. Configurable	Ruptured Basin/Gas Pressure	601
(BS5) J5-4	DIN4	Digital Input. Configurable	E-Stop	R15
(BS5) J5-5	DIN5	Digital Input. Configurable	2-wire Remote Start	183
(BS5) J5-6	DIN6	Digital Input. Configurable	Battery Charger AC Fail	505
(BS5) J5-7	DIN7	Digital Input. Configurable	Aux In #3 (Line Power)	DI3
(BS5) J5-8	DIN8	Digital Input. Configurable	Aux In #4 (Gen Power)	DI4
(BS5) J5-9	DIN9	Digital Input or PWMI 0. Configurable	Aux In #1 PWMI #0	DI1
(BS5) J5-10	DIN10	Digital Input or PWMI 1. Configurable	Aux In #2 PWMI #1	DI2
(BS5) J5-11	DIN11	Digital Input or PWMI 2. Configurable	Aux In #5 PWMI #2	DI5
(BS5) J5-12	DIN12	Digital Input or PWMI 3. Configurable	Aux In #6 PWMI #3	DI6
(BS5) J5-13	DIN13	Digital Input or PWMI 4. Configurable	Aux In #7 PWMI #4	DI7
(BS5) J5-14	DIN14	Digital Input or PWMI 5. Configurable	Aux In #8 PWMI #5	DI8
(BS5) J5-15	DIN15	Digital Input or PWMI 6. Configurable	AVR ZC - PWMI #6	406
(BS5) J5-16	N.C.	No Connection		

Table 3-6. J6 Connector

Pin	Name	Description	Configured Default NA = Not Configurable	Wire # (Default)
(BS6) J6-1	RS-485 (+) #0	RS-485 #0 - Connectivity	Slave	392
(BS6) J6-2	RS-485 (-) #0	RS-485 #0 - Connectivity	Slave	393
(BS6) J6-3	Ground	Connectivity Power	NA	
(BS6) J6-4	12 V⎓	Connectivity Power	NA	
(BS6) J6-5	RS-485 Ground Reference #0	RS-485 #0 - Connectivity	NA	0B
(BS6) J6-6	RS-485 Shield #0	RS-485 #0 - Connectivity	NA	SHLD

Table 3-7. J7 Connector

Pin	Name	Description	Configured Default NA = Not Configurable	Wire # (Default)
(BS7) J7-1	Module CAN Ground	Generac Module's CAN Ground	NA	SHLD
(BS7) J7-2	DOUT	Watchdog/Overspeed output to E-Stop circuit	NA	R15B
(BS7) J7-3	Module Power (-)	Module Power Ground	Governor	
(BS7) J7-4	Module Power (-)	Module Power Ground	AVR	405
(BS7) J7-5	Module Power (-)	Module Power Ground	NA	
(BS7) J7-6	Module Power (-)	Module Power Ground	NA	
(BS7) J7-7	Overspeed Circuit Disable Ground	Disable Overspeed Circuit by connecting to J8-14	NA	
(BS7) J7-8	Module CAN (+)	Generac Module's CAN High	NA	743G
(BS7) J7-9	Module CAN (-)	Generac Module's CAN Low	NA	744G
(BS7) J7-10	Module Power (+)	Module Power 12 V⎓	Governor Module Power	
(BS7) J7-11	Module Power (+)	Module Power 12 V⎓	AVR Module Power	194
(BS7) J7-12	Module Power (+)	Module Power 12 V⎓	NA	
(BS7) J7-13	Module Power (+)	Module Power 12 V⎓	NA	
(BS7) J7-14	Overspeed Circuit Disable	Disable Overspeed Circuit by connecting to J8-7	NA	

Table 3-8. J8 Connector

Pin	Name	Description	Configured Default NA = Not Configurable	Wire # (Default)
(BS8) J8-1	N.C.	No Connection		
(BS8) J8-2	ECU J1939 Ground	ECU J1939 CAN Ground	NA	SHLD
(BS8) J8-3	ECU J1939 CAN (+)	ECU J1939 CAN High	NA	743A
(BS8) J8-4	ECU J1939 CAN (-)	ECU J1939 CAN Low	NA	744A

Table 3-9. HV Connector

Pin	Name	Description	Configured Default NA = Not Configurable	Wire # (Default)
(BS9) HV-G1	Generator A	Generator Phase A Voltage Sense	NA	S1A
(BS9) HV-G2	Generator B	Generator Phase B Voltage Sense	NA	S2A
(BS9) HV-G3	Generator C	Generator Phase C Voltage Sense	NA	S3A
(BS9) HV-GN	Generator N	Generator Neutral Voltage Sense	NA	00
(BS9) HV-UN	Utility N	Utility Neutral Voltage Sense	NA	T00
(BS9) HV-U1	Utility A	Utility Phase A Voltage Sense	NA	T1A
(BS9) HV-U2	Utility B	Utility Phase B Voltage Sense	NA	T2A
(BS9) HV-U3	Utility C	Utility Phase C Voltage Sense	NA	T3A

Operation

The Power Zone Pro Main Controller serves as a single standby generator controller.

Standby Generator Operation

The Main Controller can function as an advanced standby generator controller. The Connectivity Server can be used to monitor and change parameters in the Main Controller. The Main Controller touchscreen display provides a view of all the important parameters and status.

Specialized programs are built into the Main Controller to allow customers to configure spare I/O to their own needs. For example, the built in Programmable Logic Controller can be programmed with PLC like logic to eliminate the need for ancillary external controllers. Everything can be user customized from measurements to alarms for special functionality.

Protections

All generators are shipped with the manufacturer recommended warnings, alarms, and shutdown alarms to protect the generator and attached equipment. These faults can be setup on any Analog or Digital Input channel as well as the Digital Output Function channels. This is done via the appropriate Setup → Protections → Alarms Setup section of the Connectivity Server manual. Disabling manufacturer recommended fault indications is not recommended.

Analog Sensor Failure

Analog sensors can have sensor fault checks enabled. These checks detect a raw analog input value outside of the normally expected values for the sensor. These thresholds and severity of the fault can be changed in the Setup → Protections → Alarms Setup → Analog Input Alarm section of the Connectivity Server.

The Engine Speed RPM input always has the sensor fault enabled and it cannot be disabled. This is to ensure the engine is not damaged in the event of an RPM sensor failure.

Overcurrent I^2T

An I^2T algorithm is implemented for thermal protection of the alternator. Once the output current of the alternator exceeds 110% on any leg, the I^2T algorithm starts integrating the square of the output current over time. Once that normalized value reaches “90”, the generator shuts down for overcurrent. This feature can be enabled/disabled in the Setup → Protections → Thermal Protection Setup section of the Connectivity Server.

Short Circuit

In the event of a short in the customer load, the generator will output up to 300% of rated current unless rated voltage is exceeded. It does this to trip the downstream breaker with the shorted load. After the breaker is tripped, removing the short, the generator can then continue running normally. This feature can be enabled/disabled in the Setup → Protections → Thermal Protection Setup section of the Connectivity Server.

Voltage Regulation (Single or Three-Phase Module Options)

Voltage is regulated and maintained at a target voltage through the Main Controller. The Main Controller monitors and senses the generator voltage and will either produce more or less voltage based on the amount of voltage currently sensed. The Main Controller allows the user to externally bias the target voltage. The user can choose to shift the target voltage up or down by a percentage. This feature is further explained in the Connectivity Server manual.

Either single or three phase voltages can be used and regulated. There is a setting in the Connectivity Server to indicate to the Main Controller which of the two modes the generator is using. Voltage over frequency (V/F), high/low voltage limit, and high power limit are also configurable through the Connectivity Server, although they are set to default values. No additional setup is required for the voltage regulation to function. Any additional customizations can be done through the “Setup” or “Alternator Settings” windows in the Connectivity Server.

Built-In PLC (Programmable Logic Controller)

The built-in PLC uses simple combinatorial logic to generate digital outputs, analog outputs, digital output functions, timers, counters, accumulators, soft contacts and hooks. It uses ladder logic for programming and a separate offline programming tool is available to generate the programs. The I/O scan time of the PLC is about 120 ms worst case. This means all inputs and outputs are scanned at least once within 120 ms. The PLC processes one rung every 5 ms, so 5 rungs will take 25 ms. However, this is in parallel with the scan and not added to the scan time.

Users can create custom configurations via the Power Zone PLC Editor using graphic symbols to design the “rungs” of the ladder logic. The rungs are simple and can only have two 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 AUTO) AND (engine running) AND (coolant temperature >125 deg) FOR (20 seconds) THEN OPERATE (output 7)

For details on PLC programming refer to the Connectivity Server manual or the PLC Editor manual.

I/O Configuration and Programming

The Main Controller can be configured and reprogrammed via the Connectivity Server. See the PLC Editor manual.

Touchscreen Display

The Main Controller is equipped with a small touchscreen color display. The display is used to view all status, alarm, and important parameter information. It is not intended for changing parameters. The changing of parameters and settings functionality is provided by the ***Connectivity Server***. Display screen navigation is facilitated by the use of menu and scroll buttons. The ***Power Zone Pro Menu Map*** is provided at the end of this document to aid in screen navigation.

See ***Figure 3-3***. All screens consist of the ***Top Banner*** (A), the ***Data Area*** (B), and the ***Bottom Banner (Menu Buttons)*** (C).

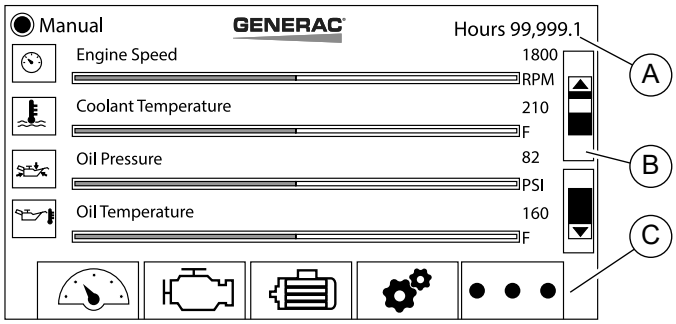


Figure 3-3. Touchscreen Display

Top Banner

See ***Figure 3-4***. The Top Banner is displayed on every page and contains information about the generator's status.

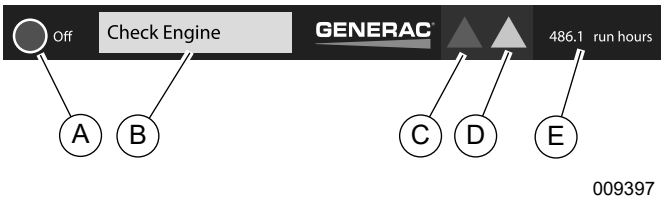


Figure 3-4. Top Banner

A	Shows the keyswitch position as follows: • Red - OFF • Green - AUTO • Orange - MANUAL If the display loses communications, the icon will be flashing and the data will be frozen with the last readings displayed.
B	Indicates an emissions related problem with the engine that requires attention.
C	Represents an alarm (red), and is only displayed when an alarm is present.
D	Represents a warning (yellow), and is only displayed when a warning is present.
E	Indicates the total number of hours the generator has run.

Data Area

The Data Area is the central area that changes depending on which buttons are pressed. The menu buttons are used to navigate to these pages. The right side of the data area shows two arrows. Moving a finger up and down between the arrows scrolls the page up and down to show more data. ***Figure 3-5*** shows how scrolling on the "Engine" page brings up more engine bargraphs.

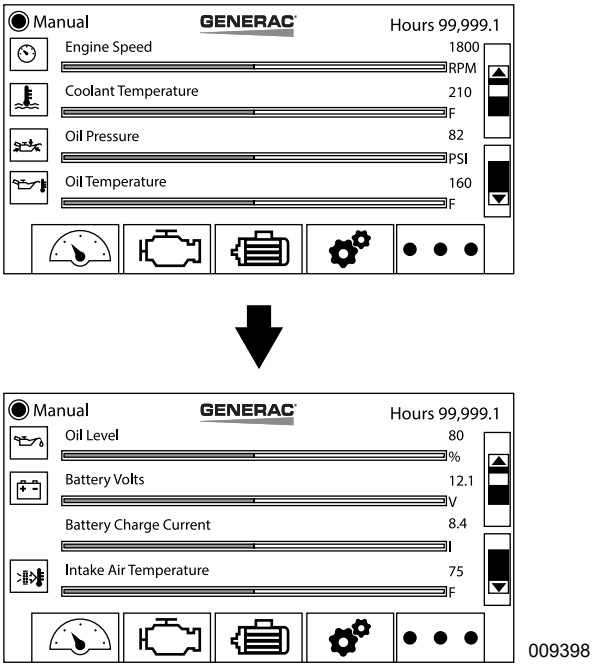


Figure 3-5. Scrolling

Bottom Banner (Menu Buttons)

See ***Figure 3-6***. The Bottom Banner is displayed on every page and is made up of menu buttons. Each menu button navigates to a new page. The "More" button (E) brings up additional menu buttons, shown in ***Figure 3-7***.

NOTE: There is currently one blank (unused) menu button (I).

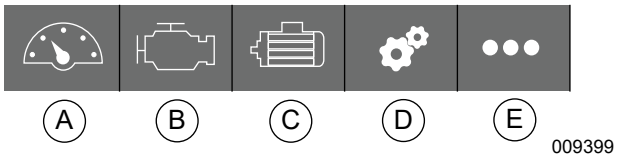


Figure 3-6. First Set of Buttons

A	Dashboard
B	Engine
C	Alternator
D	System Details
E	More

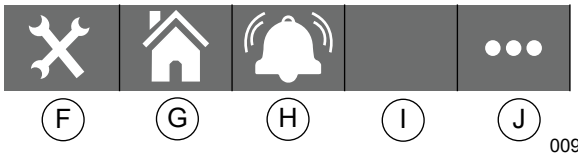


Figure 3-7. Second Set of Buttons

F	Tools
G	Home
H	Display Alarms
I	Blank (unused)
J	More

Bargraphs

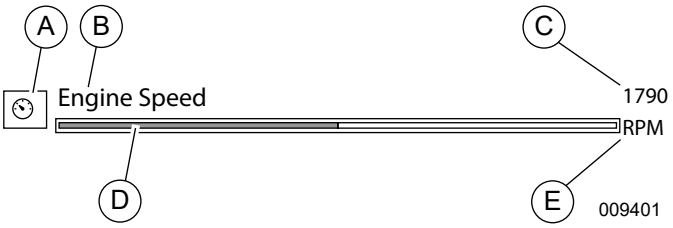


Figure 3-8. Bargraph

A	**Icon -** Representation of the parameter being displayed.
B	**Title -** Description of the measurement being displayed.
C	**Value -** Value of the parameter being displayed. This reading is updated every 0.5 seconds.
D	**Bargraph -** Magnitude of the value being displayed. This reading is updated every 0.5 seconds.
E	**Units -** Unit of measurement.

Alarm and Warning Icons

There are both alarms and warnings in the system (either can be referred to as an “event”). To the display they function the same, but bring up different colored icons: red for an alarm, orange for a warning (see ***Figure 3-4***, items C and D). Both alarms and warnings can be active at the same time.

If an alarm is active, it will be indicated by an alarm icon in the top banner, flashing at a rate of once per second. If a warning is active, it will be indicated by a warning icon in the top banner, flashing at a rate of once per second.

If there is any alarm AND the bottom banner is displaying the set of buttons containing the “Display Alarms” button, then that button will be highlighted red and flashing at a rate of once per second, as shown in ***Figure 3-9***. If there is any warning AND the bottom banner is displaying the set of buttons containing the “Display Alarms” button, then that button will be highlighted orange and flashing at a rate of once per second, as shown in ***Figure 3-10***.

If there are alarms and warnings both active, then alarms take precedence and the button will flash red, as shown in ***Figure 3-9***.

If there are no alarms or warnings, the “Display Alarms” button will return to its normal display.

Figure 3-9. Alarm Button

Figure 3-10. Warning Button

Press the “Display Alarms” button to change the screen data area to a scrollable list of icons and text for up to eight events.

See ***Figure 3-11***. Press the “DTC” button (A) to display the J1939 engine Diagnostic Trouble Code events screen (***Figure 3-12***). The “ACK” button (B) is present on both alarm screens. All events are acknowledged by pressing the “ACK” button. Events that have been acknowledged will change color when the “ACK” button is pressed. Press the “CLR” button (C) to clear the screen. However, alarms and warnings can reoccur.

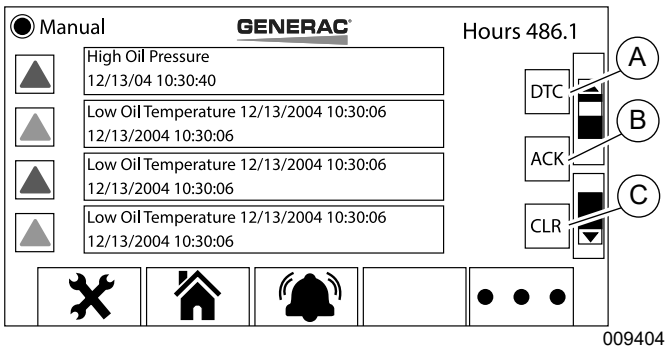


Figure 3-11. Events List

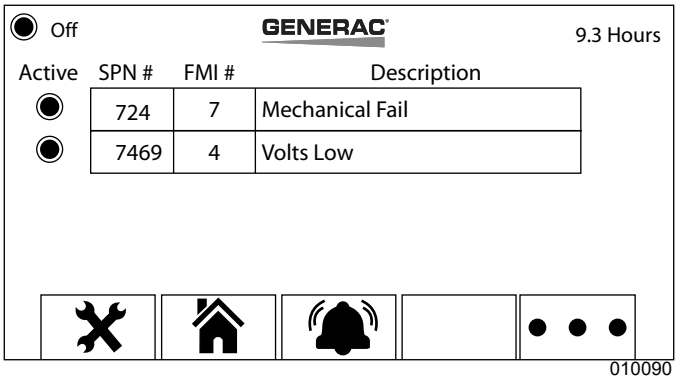


Figure 3-12. DTC Screen

Date and Time Format

The format can be changed from the ***Connectivity Server***.

Units Format

The units format can be changed from the ***Connectivity Server***.

Screen Saver

The screen will turn off if not touched for five minutes. Touch the screen to turn it back on.

Connectivity Server

The Main Controller communicates to the outside world by means of the Connectivity Server. The Connectivity Server provides both viewing and editing capabilities for all generator settings as well as data logging and firmware upgrade capability. See the Connectivity Server manual for more details.

Power Zone Pro Menu Map

NOTE: Menu structure represents the LCD display and does not follow the browser structure completely.

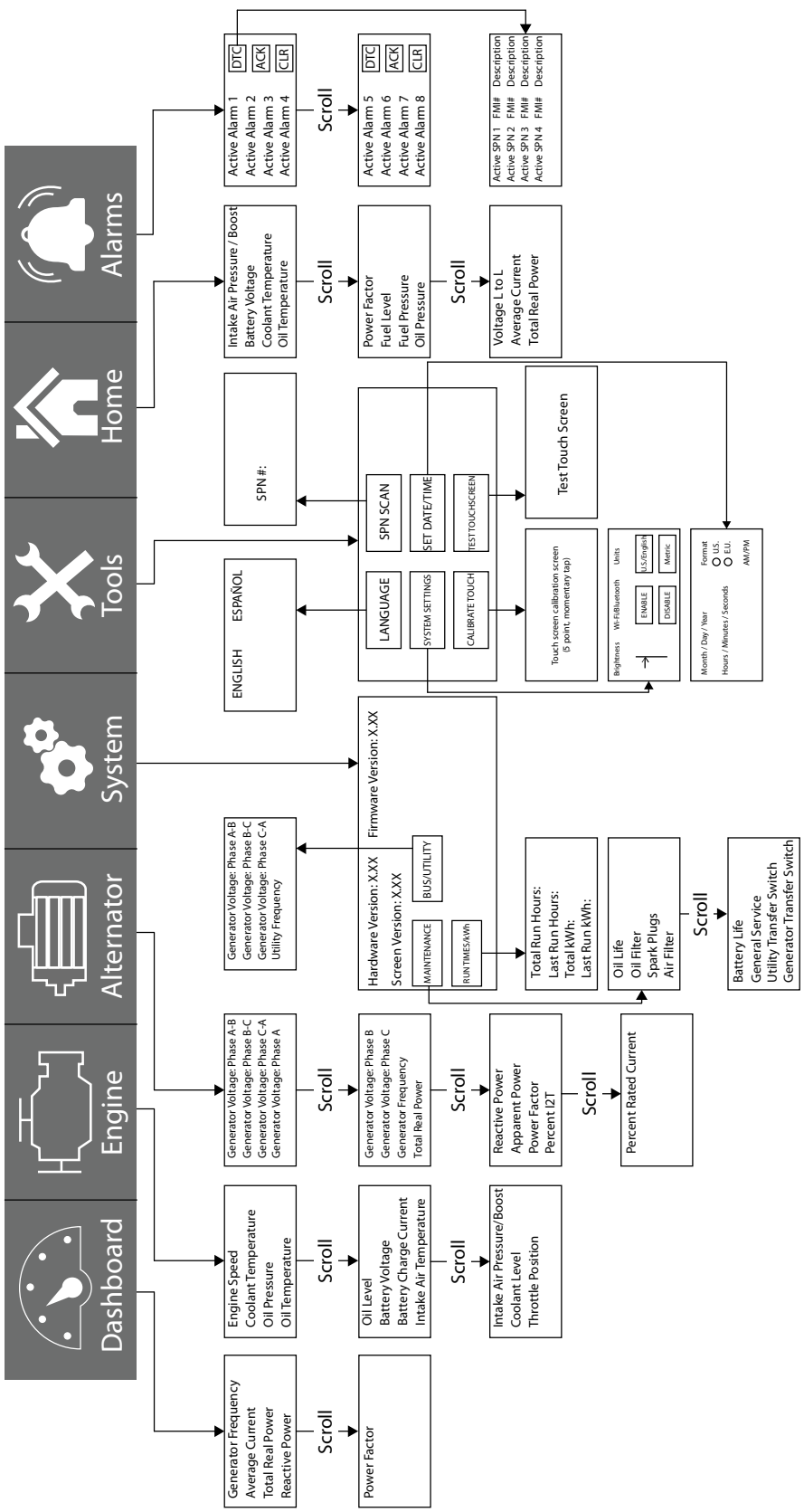


Figure 3-13. Power Zone Pro Menu Map

Section 4 Troubleshooting

Troubleshooting Guide

Symptom	Corrective Action
No screen displayed on the LCD panel	1. Check for a blown fuse in the fuse block that supplies the controller assembly. 2. Verify the battery is connected and is at least at 6V. 3. Verify the connectors are properly seated in Base Board. 4. Press the screen to verify it is not in Sleep Mode.
Comm indicator on LCD screen is blinking	1. Verify cable used is a shielded twisted pair. 2. Verify shield of the RS-485 cable is grounded at one end. 3. Try reversing the Data(+) and Data(-) wires at one connector.
Cannot connect to the system Wi-Fi	1. Verify the Connectivity Server is connected to the Base Board and that the Connectivity Server green light is on.
Engine does not crank when keyswitch is turned to the MANUAL position	1. Verify the Emergency Stop button is disengaged (pulled out). 2. Verify the Emergency Stop is wired properly. 3. Verify the keyswitch is wired properly. 4. Check the touchscreen display for Alarm conditions and acknowledge any active alarms.
Audio alarm can not be heard when an alarm condition exists	1. Verify the horn is wired properly.
Engine ECU does not communicate with the Power Zone Pro	1. Verify the cable connection is a shielded twisted pair. 2. Verify the shield is grounded at one end of the cable.

NOTE: Refer to the Power Zone Pro System manual for additional diagnostic information.

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