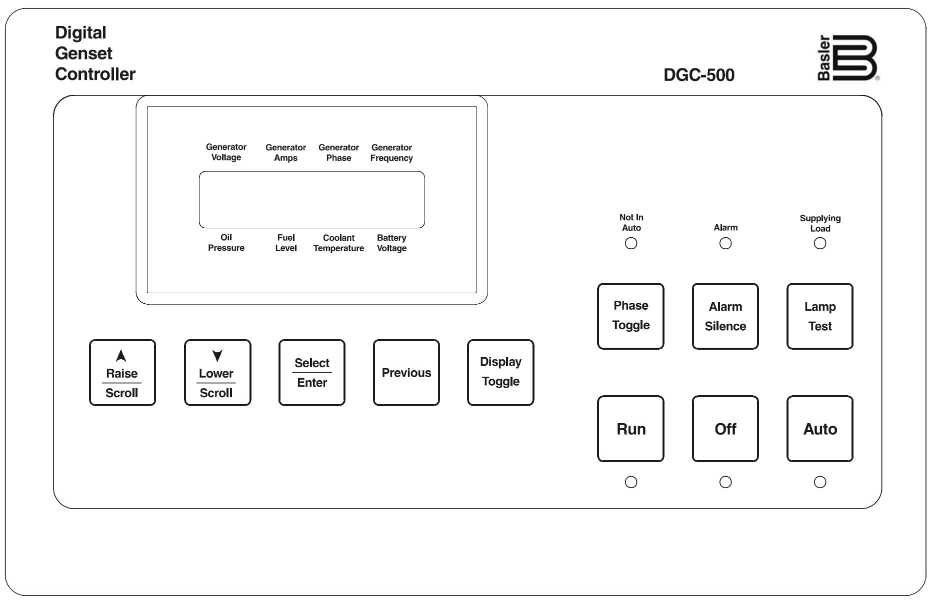
INSTRUCTION MANUAL

for

DGC-500

DIGITAL GENSET CONTROLLER



Basler Electric

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INTRODUCTION

This manual provides information concerning the operation and installation of the Basler DGC-500 Digital Genset Controller. To accomplish this, the following information is provided.

- Specifications
- Functional Description
- Communication Software Description
- Installation Information
- Troubleshooting Information

WARNING!

To avoid personal injury or equipment damage, only qualified personnel should perform the procedures presented in this manual.

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It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Should further information be required, contact Basler Electric.

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PRODUCT REVISION HISTORY

The following information provides a historical summary of the changes made to the embedded firmware, communication software (BESTCOMS), and hardware of this device. The corresponding revisions made to this instruction manual are also summarized. This revision history is separated into four categories: Firmware Version, BESTCOMS Version, Hardware Version, and Manual Version. All revisions are listed in reverse chronological order.

Firmware Version	Summary
2.04.XX - 10/03	• Added Engine Start/Stop Configuration setting to accommodate Volvo Penta EDC applications. Added CANBus Address setting and Genset kW Rating setting.
2.03.XX - 03/03	• Added support for SAE J1939 interface and 400 Hz operation
2.01.XX - 07/02	• Increased the maximum Sender Failure Alarm time delay setting from 10 seconds to 30 seconds.
1.00.XX - 03/02	• Initial release

BESTCOMS Version	Summary
1.03.XX - 10/03	• Added Engine Start/Stop Configuration setting to accommodate Volvo Penta EDC applications. Added CANBus Address setting and Genset kW Rating setting.
1.02.XX - 03/03	• Added settings for support of SAE J1939 interface and 400 Hz operation.
1.01.XX - 07/02	• Increased the maximum setting of the Global Sender Failure Alarm Time Delay from 10 seconds to 30 seconds.
1.00.XX - 03/02	• Initial release

Hardware Version (Standard Order P/N)	Summary
L - 10/03	• Implemented firmware version 2.04.XX and BESTCOMS version 1.03.XX
K - 09/03	• Added reference to instruction manual on parts list
J - 07/03	• Implemented firmware version 2.03.XX and BESTCOMS version 1.02.XX
I	• Not implemented
H - 06/03	• Circuit board layout revised to improve manufacturing process
G - 04/02	• Initial release

Hardware Version (Special Order P/N)	Summary
D - 10/03	• Implemented firmware version 2.04.XX and BESTCOMS version 1.03.XX
C - 09/03	• Added reference to instruction manual on parts list
B - 07/03	• Implemented firmware version 2.03.XX and BESTCOMS version 1.02.XX
A - 06/03	• Circuit board layout revised to improve manufacturing process

Manual Version	Summary
D - 03/04	• Added suitability and warning statements concerning compliance of part numbers 9 3554 00 113 and 9 3554 00 114 with cURus Standard 1604.
C - 09/03	• Added descriptions associated with new settings: CANBus Address, Engine Stop/Start Configuration, and Genset's kW Rating. • Added information pertaining to DGC Isolator Kits. • Added Volvo Penta EDC application information and diagrams. • Updated Pre-Alarm and Alarm information in Section 3, *Functional Description* to include metric equivalents for settings.
B - 03/03	• Revised style chart to show NFPA compliance as standard, J1939 support as optional. • Added coverage for part numbers 9 3554 00 111, 112, 113, and 114. • Added information about J1939 interface, ECU support, and state machine operation where appropriate. • Revised BESTCOMS section to accommodate new ECU settings. • Created new appendix of settings list with range for each setting.
A - 07/02	• Added instructions to Section 3, *Functional Description* for viewing firmware version. • Revised the maximum setting of Sender Failure Alarm Time from 10 seconds to 30 seconds in Tables 3-1 and 3-2. • Replaced actual BESTCOMS version number in Figure 4-2 with generic version number.
— - 02/02	• Initial release

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SECTION 1 • GENERAL INFORMATION

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SECTION 1 • GENERAL INFORMATION

DESCRIPTION

The DGC-500 Digital Genset Controller provides integrated engine-generator set control, protection, and metering in a single package. Microprocessor based technology allows for exact measurement, setpoint adjustment, and timing functions. Front panel controls and indicators enable quick and simple DGC-500 operation. Basler Electric communication software (BESTCOMS-DGC500-32) allows units to be easily customized for each application. Because of the low sensing burden in the DGC-500, neither dedicated potential transformers (PTs) nor current transformers (CTs) are required. A wide temperature-range liquid crystal display (LCD) with backlighting allows the display to be viewed under a wide range of ambient light and temperature conditions.

An optional, SAE J1939 interface provides high-speed communication between the DGC-500 and the engine control unit (ECU) on an electronically controlled engine. This interface provides access to oil pressure, coolant temperature, and engine speed data by reading these parameters directly from the ECU. When available, engine diagnostic data can also be accessed.

FEATURES

DGC-500 Digital Genset Controllers have the following features.

- Resistant to high moisture, salt fog, humidity, dust, dirt, and chemical contaminants
- Resistant to the entrance of insects and rodents
- Suitable for mounting in any top mount enclosure
- Suitable for controlling isolated generating systems or paralleled generating systems
- Serial link communications and BESTCOMS software eases access to setup parameters
- Compliant with National Fire Prevention Association (NFPA) Standard 110
- Optional SAE J1939 interface provides high-speed communication with the ECU on electronically controlled engines

FUNCTIONS

DGC-500 Digital Genset Controllers perform the following functions.

- Engine cranking control
- Generator voltage metering
- Generator frequency metering
- Generator current metering
- Engine coolant temperature metering
- Engine coolant temperature protection
- Engine oil pressure metering
- Engine oil pressure protection
- Fuel level sensing
- Fuel level sender protection
- Fuel leak detector
- Engine cool down
- VA metering
- Engine rpm metering
- Engine run time metering
- Battery voltage metering
- Battery condition monitoring
- Engine maintenance monitoring
- Engine diagnostic reporting

OUTPUTS

Five isolated, form A output contacts are provided: Engine Crank, Fuel Solenoid, Pre-Start, and two user-programmable outputs.

OPTIONAL EQUIPMENT

An optional Remote Annunciation Display Panel (RDP-110) is available for use with the DGC-500.

Applications that require remote annunciation can use the Remote Display Panel, RDP-110. This display panel annunciates all DGC-500 alarms, pre-alarms, and operating conditions.

STYLE AND PART NUMBERS

Standard-order DGC-500 controllers are identified by a style number. Special-order DGC-500 controllers are specified by ten-digit part numbers

Style Numbers

The electrical characteristics and operational features of a standard-order DGC-500 are defined by a combination of letters and numbers that make up the style number. The model number, together with the style number, describe the options included in a specific device. Figure 1-1 illustrates the DGC-500 style number identification chart.

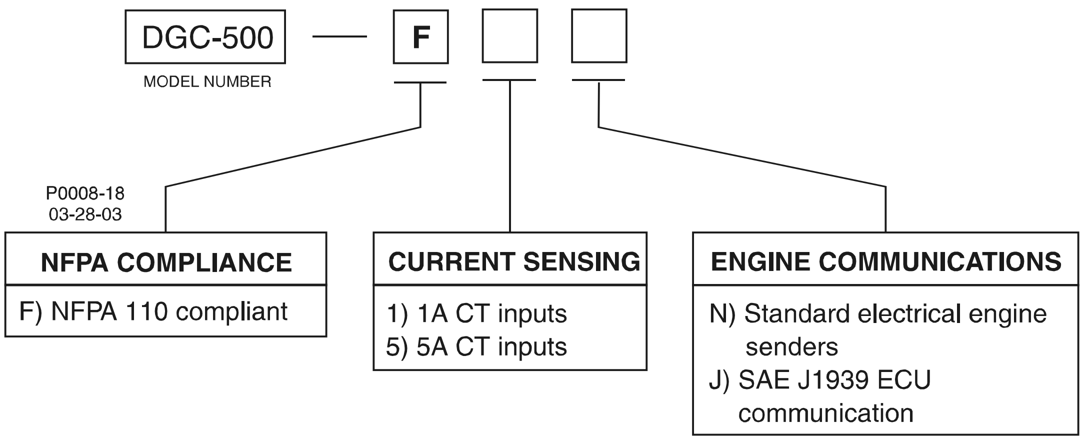

Figure 1-1. DGC-500 Style Number Chart

For example, if a DGC-500 style number is F5J, the device has the following characteristics and operating features.

F . . . . Compliance to NFPA Standard 110
5 . . . . 5 ampere current sensing inputs
J . . . . ECU communication through the SAE J1939 protocol

The DGC-500 style number is printed on a label located on the circuit board near the voltage and current input connections. Upon receipt of a unit, be sure to check the style number against the requisition and the packing list to ensure that they agree.

Part Numbers

A ten-digit part number specifies the electrical characteristics and operational features of special-order DGC-500 controllers. Table 1-1 lists the special-order DGC-500 controllers available along with descriptions of their operating features.

Table 1-1. Special-Order DGC-500 Controllers

Part Number	Style Number	Special Features
9 3554 00 111	F5J	400 Hz nominal frequency
9 3554 00 112	F1J	
9 3554 00 113	F5N	cURus recognized for use in hazardous locations
9 3554 00 114	F1J	

SPECIFICATIONS

Current Sensing

Accuracy:	±1% of full scale or ±2 A, whichever is greater
Burden:	1 VA
Terminals:	P10, P11 (A-phase) P12, P14 (B-phase) P15, P17 (C-phase)

1 Ampere Inputs

Continuous Rating:	0.02 to 1.0 A
1 Second Rating:	2 A

5 Ampere Inputs

Continuous Rating:	0.1 to 5.0 A
1 Second Rating:	10 A

Voltage Sensing

Accuracy:	±1% of full scale or ±2 V, whichever is greater
Burden:	1 VA
Range:	12 to 576 V rms, line-to-line
1 Second Rating:	720 V rms
Terminals:	P23 (A-phase), P26 (B-phase), P29 (C-phase), P30 (Neutral)

Frequency

Accuracy:	±0.25% of reading or ±0.2 Hz, whichever is greater
Display Range:	4 to 70 Hz 4 to 450 Hz (P/N 9355400111, 112 only)

Contact Sensing

Emergency Stop Input

Type:	Normally-closed dry contacts
Terminals:	P35, P39

Programmable Inputs (3)

Type:	Normally-open dry contacts
Terminals:	P2, P21 (Input 1) P3, P21 (Input 2) P4, P21 (Input 3)

Engine System Inputs

✳ Stated accuracies are subject to the accuracy of the senders used.

Fuel Level Sensing

Accuracy:	±3% of indication or ±2% ✳
Range:	33 to 240 Ω nominal
Terminals:	P16, P19 (common)

Coolant Temperature Sensing

Accuracy:	±3% of indication (37°C to 115°C (99°F to 239°F)) ±2°, whichever is greater at 25°C (77°F) ✳
Range:	62.6 to 637.5 Ω nominal
Terminals:	P18, P19 (common)

Oil Pressure Sensing

Accuracy:	±3% of indication (0 to 690 kPa) or ±12 kPa, whichever is greater at 25°C (77°F) ±3% of indication (0 to 100 psi) or ±2 psi, whichever is greater
Range:	34 to 240 Ω nominal
Terminals:	P13, P19 (common)

Battery Voltage Sensing

Accuracy:	±3% of indication or ±0.2 V, whichever is greater
Nominal:	12 or 24 Vdc
Range:	8 to 32 Vdc (battery dip ride-through to 6 Vdc for 0.75 sec)
Burden:	16 W maximum

Magnetic Pickup Sensing

Voltage Range:	3 V to 35 V peak continuous into 13 kΩ (during cranking)
Frequency Range:	32 to 10,000 Hz
Terminals:	P39 (+), P40 (–)

Engine RPM Sensing

Accuracy:	±0.5% of indication or ±2 rpm, whichever is greater at 25°C (77°F)
Range:	750 to 3,600 rpm

Calculated Data

Voltamperes

Accuracy:	±2% of indication or ±2 kVA, whichever is greater
Range:	0 to 9,999 kVA

Engine Run Time

Accuracy:	±0.5% of reading or ±1 hour, whichever is greater at 25°C (77°F)
Range:	0 to 99,999 hours

Maintenance Interval

Accuracy:	±0.5% of reading or ±1 hour, whichever is greater at 25°C (77°F)
Range:	0 to 5,000 hours

Output Contacts

Engine Crank, Fuel Solenoid, and Pre-Start Relays

Rating:	30 A at 28 Vdc, make, break, and carry ✳
Terminals:	K1-N.O., COM (Engine Crank) K2-N.O., COM (Fuel Solenoid) K3-N.O., COM (Pre-Start)

✳ The contact rating is reduced to 3 A for part numbers 9 3554 00 113 and 9 3554 00 114 when used in a hazardous location.

Output Contacts—continued

Programmable Relays (2)

Rating:	2 A at 30 Vdc, make break, and carry
Terminals:	P33, P34 (Output 1) P36, P38 (Output 2)

Horn Output

Voltage:	24 Vdc or battery voltage, whichever is less
Current:	15 mAdc maximum
Compatible Device:	Basler P/N 29760
Terminals:	P24 (+), P25 (–)

Communication Interface

Full Duplex RS-232

Connection:	Female DB-9 connector (J1)
Baud:	1200 or 2400
Data Bits:	8
Parity:	None, Odd, or Even
Stop Bit:	1

SAE J1939 Interface

Differential

Bus Voltage:	1.5 to 3 Vdc
Maximum Voltage:	–32 to 32 Vdc (with respect to negative battery terminal)
Communication Rate:	250 kb/s

Environment

Temperature Range

Operating:	–20°C to 60°C (–4°F – 140°F)
Storage:	–40°C to 85°C (–40°F – 185°F)

Type Tests

Shock

15 G in 3 perpendicular planes

Vibration

Swept over the following ranges for 12 sweeps in each of three mutually perpendicular planes with each 15 minute sweep consisting of the following:

5 to 29 to 5 Hz:	1.5 G peak for 5 min.
29 to 52 to 29 Hz:	0.036" DECS-A for 2.5 min.
52 to 500 to 52 Hz:	5 G peak for 7.5 min.

Salt Fog

Tested per ASTM-117B-1989

Radio Interference

Type tested using a 5 W, hand-held transceiver operating at random frequencies centered around 144 and 440 MHz with the antenna located within 150 mm (6") of the device in both vertical and horizontal planes.

Dielectric Strength

2,352 Vac at 50/60 Hz for 1 second between voltage sensing inputs and all other circuits.

500 Vac at 50/60 Hz for 1 minute between any of the following groups.

- Current Sensing Inputs: 8 mA
- RS-232 Port: 6 mA

UL Recognition

All DGC-500 controllers are UL recognized per Standard 508, *Standard for Industrial Control Equipment* (UL File E97035).

Part Numbers 9 3554 00 113 and 9 3554 00 114

cURus recognized per Standard 1604, *Electrical Equipment for Use in Class I and II, Division 2, and Class III Hazardous (Classified) Locations*, Class I, Division 2, Groups A, B, C, D, Zone 2, Temperature Code T5.

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D, or nonhazardous locations only.

WARNING! – EXPLOSION HAZARD

(9 3554 00 113 and 9 3554 00 114 only)

Substitution of components may impair suitability for Class I, Division 2.

Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

CSA Certification

Certified per Standard CAN/CSA-C22.2, Number 14-95, CSA File LR 23131 (excludes P/N 9 3554 00 113, 114)

NFPA Compliance

All DGC-500 controllers comply with NFPA Standard 110, *Standard for Emergency and Standby Power Systems*.

Physical

Weight:	680 g (1.5 lb)

SECTION 2 • HUMAN-MACHINE INTERFACE

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SECTION 2 • HUMAN-MACHINE INTERFACE

INTRODUCTION

This section describes the components of the DGC-500 human-machine interface (HMI). DGC-500 HMI components are located on the front panel (controls and indicators) and the rear panel (terminals and connectors).

FRONT PANEL

Figure 2-1 illustrates the front panel HMI of the DGC-500. Table 2-1 lists the call-outs of Figure 2-1 along with a description of each HMI component.

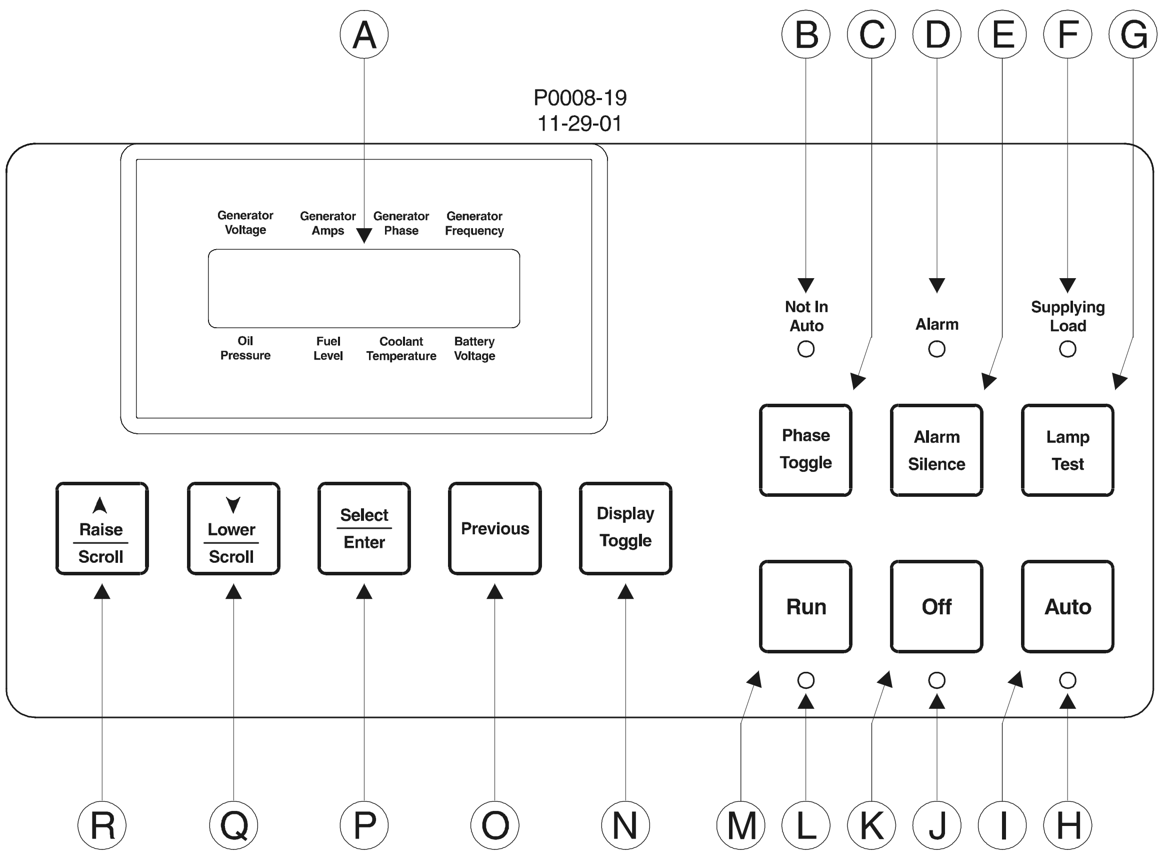

Figure 2-1. DGC-500 Front Panel HMI

Table 2-1. DGC-500 Front Panel HMI Descriptions

Call-Out	Description
A	*Liquid Crystal Display.* The backlit, two line by 16 character LCD is the primary interface for metering, alarms, pre-alarms, and protective functions. The LCD has three standard display modes (Normal, Alternate, and Menu) and one optional display mode (ECU Parameters). In Normal mode, the displayed parameters correspond to one of the eight labels surrounding the LCD. In Alternate mode, the LCD displays parameters and the corresponding labels. In Menu mode, the LCD scrolls through the DGC-500 setup parameters. In the optional ECU Parameters mode, the LCD scrolls through genset parameters (metered from the ECU) and engine configuration parameters.
B	*Not in Auto Indicator.* This red LED lights when the DGC-500 is not operating in Auto mode.
C	*Phase Toggle Pushbutton.* Pressing this control scrolls through the parameters available in Normal display mode.
D	*Alarm Indicator.* This red LED lights continuously during alarm conditions and flashes during pre-alarm conditions.
E	*Alarm Silence Pushbutton.* Pressing this control resets the DGC-500 audible alarm.
F	*Supplying Load Indicator.* This green LED lights when the generator is supplying more than two percent of rated current.
G	*Lamp Test Pushbutton.* Pressing this control tests the DGC-500 indicators by exercising all LCD segments and lighting all LEDS.
H	*Auto Mode Indicator.* This green LED lights when the DGC-500 is operating in Auto mode.
I	*Auto Pushbutton.* Pressing this control places the DGC-500 in Auto mode.
J	*Off Mode Indicator.* This red LED lights when the DGC-500 is in Off mode.
K	*Off Pushbutton.* Pressing this control places the DGC-500 in Off mode.
L	*Run Mode Indicator.* This green LED lights when the DGC-500 is operating in Run mode.
M	*Run Pushbutton.* Pressing this control places the DGC-500 in Run mode.
N	*Display Toggle Pushbutton.* Pressing this control scrolls through the display modes.
O	*Previous Pushbutton.* Pressing this control scrolls through the LCD display modes.
P	*Select/Enter Pushbutton.* This control is pressed to enter menu sub-levels and select setpoints.
Q	*Lower/Scroll Pushbutton.* This control is pressed to scroll backward through menus or decrement setpoints.
R	*Raise/Scroll Pushbutton.* This control is pressed to scroll forward through menus or increment setpoints.

REAR PANEL

All DGC-500 interface terminals are located on the rear panel. DGC-500 units have two types of terminals: quarter-inch, male, quick-connect terminals and a DB9 serial communication connector. Figure 2-2 illustrates the DGC-500 rear-panel HMI. Table 2-2 lists the call-outs of Figure 2-2 along with a description of each rear-panel HMI component.

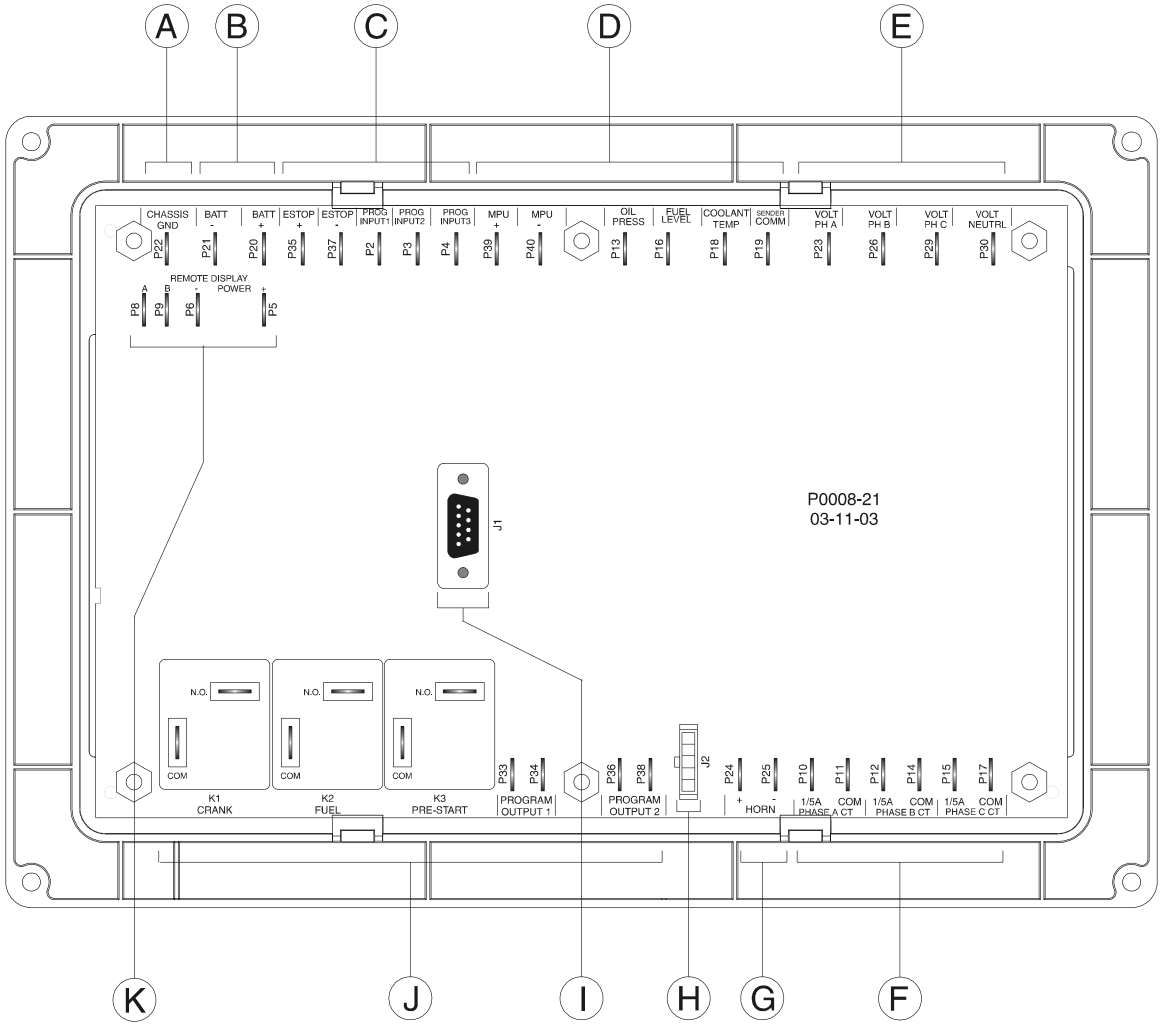

Figure 2-2. DGC-500 Rear Panel HMI

Table 2-2. DGC-500 Rear Panel HMI Descriptions

Call-Out	Terminals	Description
A	P22	*CHASSIS GND.* This terminal provides the chassis ground connection. The DGC-500 must be hard-wired to earth ground with no smaller than 12 AWG copper wire.
B	P20 (+), P21 (–)	*BATT.* DGC-500 operating power is applied to these terminals. The DGC-500 accepts a nominal input of 12 Vdc or 24 Vdc.
C	P35 (+), P37 (–) P2, P3, P4	**Contact Sensing Terminals** *ESTOP.* These terminals function as the Emergency Stop input. Power is removed from all DGC-500 output relays when this input is open. PROG INPUT1, PROG INPUT2, PROG INPUT3. These three inputs can be independently programmed to function as an auto transfer switch input, single-phase override input, low coolant level input, fuel leak detection input, battery charger failure input, or an auxiliary input. The inputs accept normally-open contacts connected between terminals P2 (PROG INPUT1), P3 (PROG INPUT2), or P4 (PROG INPUT3) and terminal P21 (BATT –).

Call-Out	Terminals	Description
D		**Transducer Terminals**
	P39 (+), P40 (–)	*MPU.* These terminals accept the output from a magnetic pickup. Voltage applied to this input is scaled and conditioned for use as a speed signal.
	P13	*OIL PRESS.* The output from an oil pressure transducer is applied to this input. A current signal lower than 5 mA can be applied between terminal P13 and P19 (SENDER COMM).
	P16	*FUEL LEVEL.* The output from a fuel level transducer is applied to this input. The DGC-500 supplies a transducer current signal of less than 30 mA to terminals P13 and P19 (SENDER COMM).
	P18	*COOLANT TEMP.* The output from a coolant temperature transducer is applied to this input. The DGC-500 supplies a transducer current signal of less than 5 mA to terminals P16/P18 and P19 (SENDER COMM).
	P19	*SENDER COMM.* This terminal functions as the common return line for all of the transducer inputs.
E		**Voltage Sensing Terminals**
	P23	*VOLT PH A.* This terminal senses the A-phase generator voltage.
	P26	*VOLT PH B.* This terminal senses the B-phase generator voltage.
	P29	*VOLT PH C.* This terminal senses the C-phase generator voltage.
	P30	*VOLT NEUTRAL.* This terminal connects to the generator Neutral in phase-to-neutral sensing applications.
F		**Current Sensing Terminals**
	P10(1/5A), P11(COM)	*PHASE A CT.* These terminals sense the A-phase generator current.
	P12(1/5A), P14(COM)	*PHASE B CT.* These terminals sense the B-phase generator current.
	P15(1/5A), P17(COM)	*PHASE C CT.* These terminals sense the C-phase generator current.
G	P24 (+), P25(–)	*HORN.* This output supplies power to an external horn. The voltage supplied is 24 Vdc or the battery voltage, whichever is less. A maximum current of 15 mAdc is available.
H	J2	*SAE J1939 Connector.* This connector is enabled on controllers with a style number of FXJ and provides high-speed communication between the DGC-500 and the ECU on an electronically controlled engine.
I	J1	*RS-232 COMMUNICATION PORT.* This DB9 connector uses serial communication to enhance DGC-500 setup. A standard serial cable connects the DGC-500 to a PC.
J		**Output Contact Terminals**
	K1-N.O., K1-COM	*CRANK.* This output is closed when the DGC-500 is initiating engine cranking.
	K2-N.O., K2-COM	*FUEL.* This output closes when engine cranking is initiated and remains closed until a stop command is received by the DGC-500.
	K3-N.O., K3-COM	*PRE-START.* This output closes to energize the glow plugs prior to engine cranking. Depending on system setup, the Pre-Start output may open upon engine startup or stay closed during engine operation.
	P33, P34	*PROGRAM OUTPUT1.* This output closes when a user-programmable condition is detected by the DGC-500.
	P36, P38	*PROGRAM OUTPUT2.* This output closes when a user-programmable condition is detected by the DGC-500.

Call-Out	Terminals	Description
K		**Remote Display Terminals**
	P5 (+), P6 (–)	*Power.* These terminals provide operating power to the optional Remote Display Panel (RDP-110).
	P8 (A), P9 (B)	*Communication.* These terminals provide an RS-485 interface for communication with the optional Remote Display Panel (RDP-110).

SECTION 3 • FUNCTIONAL DESCRIPTION

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SECTION 3 • FUNCTIONAL DESCRIPTION

INTRODUCTION

This section describes how the DGC-500 functions and explains its operating features. A detailed description of each function block is provided in the paragraphs under the heading of *DGC-500 Function Blocks*.

DGC-500 operating features are described under the heading of *Software Operation*.

DGC-500 FUNCTION BLOCKS

To ease understanding, DGC-500 functions are illustrated in the block diagram of Figure 3-1. The following paragraphs describe each function in detail.

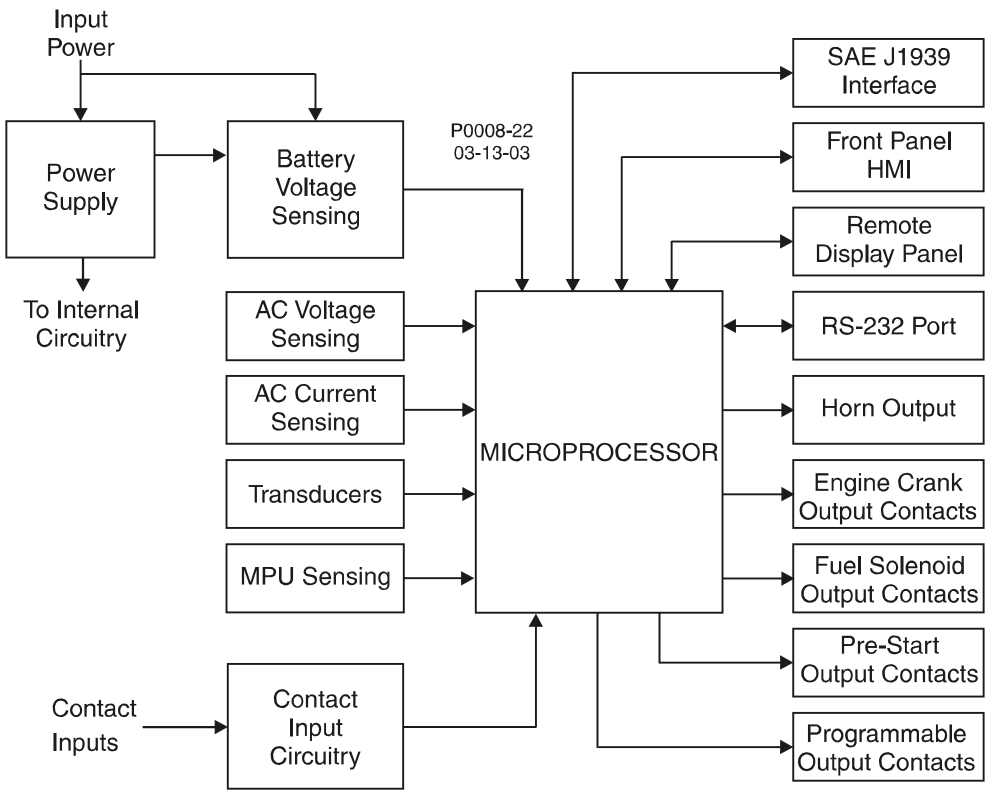

Figure 3-1. DGC-500 Function Block Diagram

Power Supply

The internal, switch-mode power supply uses the applied battery voltage to generate operating power for the internal circuitry of the DGC-500. The power supply accepts a nominal battery voltage of 12 or 24 Vdc and has an operating range of 8 to 32 Vdc. Battery voltage is applied to terminals P20 (+) and P21 (–).

Battery Voltage Sensing

Voltage applied to the power supply is filtered and reduced to a suitable level for sensing by the microprocessor.

Microprocessor

The microprocessor controls the overall functionality of the DGC-500 and makes decisions based on programming and system inputs.

Circuits relating to the microprocessor inputs are described in the following paragraphs.

Zero Crossing Detection

The zero crossing of A-phase to B-phase line voltage is detected and used to calculate the generator frequency.

Analog-to-Digital Converter

Scaled and conditioned signals representing the sensing voltage, sensing current, coolant temperature, fuel level, oil pressure, and battery voltage are digitized by the microprocessor's 10-bit analog-to-digital converter. The digitized information is stored in random access memory (RAM) and used by the microprocessor for all metering and protection functions.

Voltage Sensing Inputs

Generator voltages applied to the voltage sensing inputs are scaled to levels suitable for use by the internal circuitry. Voltage sensing configuration is menu-selectable.

The voltage sensing inputs accept a maximum voltage of 576 Vrms, line-to-line. Sensing voltage is applied to terminals P23 (A-phase), P26 (B-phase), P29 (C-phase), and P30 (Neutral).

Current Sensing Inputs

Generator currents are sensed and scaled to values suitable for use by the internal circuitry. Isolation is provided by internal current transformers (CTs).

DGC-500–X1 units accept a maximum current value of 1 Aac. DGC-500–X5 units accept a maximum current value of 5 Aac. Sensing current is applied to terminals P10 and P11 (A-phase), P12 and P14 (B-phase), and P15 and P17 (C-phase).

Transducer Inputs

Programmable transducer inputs of the give the DGC-500 user the flexibility to select the transducer to be used in an application. Information about programming the transducer inputs is provided in Section 6, *BESTCOMS Software*.

Oil Pressure

A current of less than 30 milliamperes is provided to the oil pressure transducer. The developed voltage is measured and scaled for use by the internal circuitry. Oil pressure transducers that are compatible with the DGC-500 include Isspro model R8919, Stewart-Warner models 279BF, 279C, 411K, and 411M, and VDO models 360025 and 360811. Other senders may be used. BESTCOMS software allows for the programming of sender characteristics. See Section 4, *BESTCOMS Software* for more information.

Oil pressure transducer connections are provided at terminals P13 and P19 (sender common).

Coolant Temperature

A current of less than 1.2 milliamperes is provided to the coolant temperature transducer. The developed voltage is measured and scaled for use by the internal circuitry. Coolant temperature transducers that are compatible with the DGC-500 include Isspro model R8959 and Stewart-Warner 334-P. Other senders may be used. BESTCOMS software allows for the programming of sender characteristics. See Section 4, *BESTCOMS Software* for more information.

Coolant temperature transducer connections are provided at terminals P18 and P19 (sender common).

Fuel Level

A current of less than 5 milliamperes is provided to the fuel level transducer. The developed voltage is measured and scaled for use by the internal circuitry. An open circuit or short circuit across the fuel level transducer terminals will cause the DGC-500 to indicate a failed fuel level transducer. Fuel level transducers that are compatible with the DGC-500 include Isspro model R8925. Other senders may be used. BESTCOMS software allows for the programming of sender characteristics. See Section 4, *BESTCOMS Software* for more information.

Fuel level transducer connections are provided at terminals P16 and P19 (sender common).

Speed Signal Inputs

The DGC-500 uses signals from the voltage sensing inputs and magnetic pickup input to detect machine speed.

Voltage Sensing Inputs

Generator voltage applied to the DGC-500 voltage sensing inputs is used to measure frequency and can be used to measure machine speed.

Sensing voltage is applied to terminals P23 (A-phase), P26 (B-phase), P29 (C-phase), and P30 (Neutral).

Magnetic Pickup Input

The voltage received from the magnetic pickup is scaled and conditioned for use by the internal circuitry as a speed signal source.

Magnetic pickup connections are provided at terminals P39 (+) and P40 (–).

Contact Input Circuitry

The DGC-500 has four contact sensing inputs: Emergency Stop and three programmable inputs.

Emergency Stop Input

This input accepts Form A, dry contacts. An open circuit at this continuously monitored input initiates an emergency stop. An emergency stop removes operating power from all DGC-500 output relays.

Emergency stop contact connections are provided at terminals P35 and P37.

Programmable Inputs

Each programmable input (PROG INPUT1, PROG INPUT2, and PROG INPUT3) can be independently configured as an auto transfer switch input, single-phase override input, low coolant level input, fuel leak detection input, battery charger failure input, or an auxiliary input. By default, each programmable input is disabled.

The programmable inputs accept normally open, Form A contacts. A contact is connected between a programmable input and the negative side of the battery voltage. Through BESTCOMS software, each programmable contact input can be assigned a name (eight characters, maximum) and configured as an alarm input, a pre-alarm input, or neither. The default names for the inputs are AUX IN 1, AUX IN 2, and AUX IN 3. When a programmable contact input is closed, the front panel display shows the name of the closed input if it was programmed as an alarm or pre-alarm input. Alarm inputs are annunciated through the Normal display mode screens of the front panel. Pre-alarm inputs are annunciated through the Alternate display mode screens of the front panel. If neither is programmed, no indication is given. Programming an input as neither is useful when a programmable input is used to close one of the DGC-500's programmable outputs.

Connections for the programmable inputs are provided at terminals P2 (PROG INPUT1), P3 (PROG INPUT2), and P4 (PROG INPUT3). The negative side of the battery voltage (terminal P21) serves as the return connection for the programmable inputs.

Front Panel HMI

The front panel HMI provides a convenient interface for viewing system parameters and for controlling the DGC-500 and generator operation. Front panel HMI components include an LCD (liquid crystal display), LEDS (light emitting diodes), and pushbuttons.

LCD

The backlit LCD provides metering, pre-alarm, and alarm information. Detailed information about the LCD is provided in the *Software Operation* sub-section.

LEDs

The LEDs indicate pre-alarm and alarm conditions along with DGC-500 status and generator status.

Pushbuttons

The pushbuttons are used to scroll through and select parameters displayed on the LCD, change setpoints, start and stop the generator, and reset alarms.

Remote Display Panel

Applications that require remote annunciation can use Basler Electric's Remote Display Panel, RDP-110. Using the RDP-110 with the DGC-500 meets the requirements of NFPA Standard 110. The RDP-110 uses a standard, two-terminal RS-485 interface to communicate with the DGC-500 and receives operating power from the DGC-500. Remote indication of many pre-alarm and alarm conditions is provided by the RDP-110.

The following pre-alarm conditions are indicated by LEDs on the RDP-110 front panel.

- Low coolant temperature
- High coolant temperature
- Low oil pressure
- Low fuel level
- Weak battery
- Battery overvoltage
- Battery charger failure

The following alarm conditions are indicated by LEDs and an audible alarm on the RDP-110 front panel.

- Low coolant level
- High coolant temperature
- Low oil pressure
- Overcrank
- Overspeed
- Emergency stop
- Fuel leak/fuel level sender failure
- Engine sender unit failure

Additionally, the RDP-110 indicates when the DGC-500 is not operating in Auto mode and when the generator is supplying load.

For more information about the RDP-110, request Basler Product Bulletin SNE-2.

RS-232 Communication Port

The communication port, located on the rear panel, consists of an optically isolated female DB-9 connector. The RS-232 connector serves as a communication interface for enhances DGC-500 setup. Communication requires a standard 9-pin serial communication cable connected between the RS-232 communication port and a PC operating with BESTCOMS-DGC500-32. BESTCOMS is a Windows® based communication software package that is supplied with the DGC-500. A detailed description of BESTCOMS is provided in Section 4, *BESTCOMS Software for Windows®* .

SAE J1939 Interface (Optional)

A Controller Area Network (CAN) is a standard interface that allows communication between multiple controllers on a common network using a standard message protocol. DGC-500 controllers with a style number of FXJ have a CAN interface that supports the SAE J1939 message protocol.

Applications using an engine-driven generator set controlled by a DGC-500 may also have an Engine Control Unit (ECU). The CAN interface allows the ECU and DGC-500 to communicate. The ECU reports operating information to the DGC-500 through the CAN interface. Operating parameters and diagnostic information, if supported by the ECU, are decoded and displayed for monitoring.

The primary use of the CAN interface is to obtain engine operating parameters for monitoring speed, coolant temperature, oil pressure, coolant level, and engine hours without the need for direct connection to individual senders. Table 3-1 lists the ECU parameters and Table 3-2 lists the engine configuration parameters supported by the DGC-500 CAN interface. These parameters are transmitted via the CAN interface at preset intervals. The columns labeled *Update Rate* show the parameter transmission rates. This information can also be transmitted upon user request.

Table 3-1. ECU Parameters Obtained from CAN Interface

ECU Parameter	Metric Units	English Units	Update Rate	Decimal Place	✳ SPN
Throttle (accelerator pedal) position	%	%	50 ms	10th	91
Percent load at current rpm	%	%	50 ms	none	92
Actual engine percent torque	%	%	engine speed dependent	none	513
Engine speed	rpm	rpm	engine speed dependent	none	190
Injection control pressure	MPa	psi	500 ms	none	164
Injector Metering Rail Pressure	Mpa	psi	500 ms	none	157
Total engine hours	hours	hours	requested 1.5 s	100th	247
Trip fuel	liters	gallons	requested 1.5 s	none	182
Total fuel used	liters	gallons	requested 1.5 s	none	250
Engine coolant temperature	°C	°F	1 s	none	110
Fuel temperature	°C	°F	1 s	none	174
Engine oil temperature	°C	°F	1 s	10th	175
Engine intercooler temperature	°C	°F	1 s	none	52
Fuel delivery pressure	kPa	psi	500 ms	10th	94
Engine oil level	%	%	500 ms	10th	98
Engine oil pressure	kPa	psi	500 ms	10th	100
Coolant pressure	kPa	psi	500 ms	10th	109
Coolant level	%	%	500 ms	10th	111
Fuel rate	liter/hr	gal/hr	100 ms	100th	183
Barometric pressure	kPa	psi	1 s	10th	108
Ambient air temperature	°C	°F	1 s	10th	171
Air inlet temperature	°C	°F	1 s	none	172
Boost pressure	kPa	psi	500 ms	none	102
Intake manifold temperature	°C	°F	500 ms	none	105
Air filter differential pressure	kPa	psi	500 ms	100th	107
Exhaust gas temperature	°C	°F	500 ms	10th	173
Battery voltage	Vdc	Vdc	1 s	10th	168
Switched battery voltage (at ECU)	Vdc	Vdc	1 s	10th	158

✳ SPN is Suspect Parameter Number

Table 3-2. Engine Configuration Parameters Obtained from CAN Interface

✳ Engine Configuration Parameter	Metric Units	English Units	Update Rate	Decimal Place	SPN
Engine speed at idle point 1	rpm	rpm	5 s	none	188
Percent torque at idle point 1	%	%	5 s	none	539
Engine speed at point 2	rpm	rpm	5 s	none	528
Percent torque at point 2	%	%	5 s	none	540
Engine speed at point 3	rpm	rpm	5 s	none	529
Percent torque at point 3	%	%	5 s	none	541
Engine speed at point 4	rpm	rpm	5 s	none	530
Percent torque at point 4	%	%	5 s	none	542
Engine speed at point 5	rpm	rpm	5 s	none	531
Percent torque at point 5	%	%	5 s	none	543
Engine speed at high idle point 6	rpm	rpm	5 s	none	532
Gain (KP) of endspeed governor	%/rpm	%/rpm	5 s	100^{th}	545
Reference engine torque	Nm	ft-lb	5 s	none	544
Maximum momentary engine override speed point 7	rpm	rpm	5 s	none	533
Maximum momentary engine override time limit	seconds	seconds	5 s	10^{th}	534
Requested speed control range lower limit	rpm	rpm	5 s	none	535
Requested speed control range upper limit	rpm	rpm	5 s	none	536
Requested torque control range lower limit	%	%	5 s	none	537
Requested torque control range upper limit	%	%	5 s	none	538

✳ Press the Select pushbutton to enter the Engine Configuration submenu. Press the Previous pushbutton to exit the submenu.

CAUTION

When the CAN interface is enabled, the DGC-500 will ignore the following sender inputs: oil pressure, coolant temperature, and magnetic pickup.

Diagnostic Trouble Codes (DTCs)

The DGC-500 obtains the diagnostic condition of the transmitting electronic components. The DGC-500 will receive an unsolicited message of a currently active diagnostic trouble code (DTC). Previously active DTCs are available upon request. Active and previously active DTCs can be cleared on request. Table 3-3 lists the diagnostic information that the DGC-500 obtains over the CAN interface.

Table 3-3. Diagnostic Information Obtained Over the CAN Interface

Parameter	Transmission Repetition Rate
Active diagnostic trouble code	1 s
Lamp status	1 s
Previously active diagnostic trouble code	on request
Request to clear previously active DTCs	on request
Request to clear active DTCs	on request

DTCs are reported in coded diagnostic information that includes the Suspect Parameter Number (SPN), Failure Mode Identifier (FMI), and Occurrence Count (OC). All parameters have an SPN and are used to display or identify the items for which diagnostics are being reported. The FMI defines the type of failure detected in the subsystem identified by an SPN. The reported problem may not be an electrical failure but a subsystem condition needing to be reported to an operator or technician. The OC contains the number of times that a fault has gone from active to previously active.

Horn Output

This output connects to a user-supplied audible signal device. A change in operating status or an alarm condition energizes the horn output continuously and a pre-alarm condition pulses the horn output on and off. The annunciation continues until the condition subsides or until the front-panel Alarm Silence pushbutton is pressed.

The horn output supplies 15 mAdc maximum at the lesser of 24 Vdc or the battery voltage level. A horn compatible with the DGC-500 is available from Basler Electric as part number 29760. Horn output connections are located at terminals P24 (+) and P25 (–).

Output Contacts

All output contacts are electrically isolated from each other and from the DGC-500 internal circuitry. Output contact operation is controlled by the operating mode of the DGC-500 and the system. The output contacts are also affected by the status of the Emergency Stop contact input. When the Emergency Stop contact input is open (emergency stop condition), all output contacts open. When the Emergency Stop contact input is closed, all output contacts operate normally.

Five output contacts are available: Pre-Start, Engine Crank, Fuel Solenoid, and two Programmable output contacts.

Pre-Start

This output closes to energize the engine glow plugs. The Pre-Start output can be programmed to close up to 30 seconds prior to engine cranking. The Pre-Start output can also be programmed to open upon engine startup or remain closed as long as the engine is operating.

Crank

This output closes when engine cranking is initiated by the DGC-500. The length of time that the contacts remain closed is determined by the cranking style selected (either continuous or cycle). Cranking continues until the magnetic pickup or generator frequency indicates that the engine has started.

Fuel

This output closes when engine cranking is initiated by the DGC-500. The Fuel output remains closed until an off command is issued and the engine stops.

Programmable

Two programmable outputs (PROGRAM OUTPUT1, 2) can be user-configured to close for a variety of conditions.

Either programmable output can be programmed to close during any of the following operating conditions.

- Cooldown timer active
- EPS supplying load
- Pre-start condition in effect
- Switch not in Auto
- Programmable Input 1 closed
- Programmable Input 2 closed
- Programmable Input 3 closed

Either of the programmable outputs can be configured to give a pre-alarm indication by closing during any of the following pre-alarm conditions.

- Battery charger failure
- Battery overvoltage
- Fuel leak
- Fuel leak/sender failure
- High coolant temperature
- Low battery voltage
- Low coolant level
- Low coolant temperature
- Low fuel
- Low oil pressure
- Scheduled maintenance due
- Weak battery voltage

Either of the programmable outputs can be configured to give an alarm indication by closing during any of the following alarm conditions.

- Battery charger
- Coolant temperature sender failure
- Emergency stop
- Fuel leak
- High coolant temperature
- Loss of voltage sender failure
- Low coolant level
- Low fuel
- Low oil pressure
- MPU speed sender failure
- Oil pressure sender failure
- Overcrank
- Overspeed

SOFTWARE OPERATION

Embedded software controls all aspects of DGC-500 operation. DGC-500 software controls power-up initiation, HMI configuration, engine cranking, contact input monitoring, fault detection and annunciation, system parameter monitoring, output contact control, and communication.

Power-Up Sequence

When battery power is applied, the DGC-500 initiates a power-up sequence. During power-up, DGC-500 memory is checked and the LCD displays the embedded software version. Then, all configuration data stored in nonvolatile EEPROM (electronically erasable programmable read-only memory) is brought into main memory and the DGC-500 begins operating in Normal mode. When operating in Normal mode, all enabled functions are active and all inputs are monitored.

NOTE

The run-time counter and maintenance timer values are updated in volatile memory once per minute. Updated values are saved to nonvolatile memory when the Auto/Off/Run mode of operation is changed. Additionally, while the engine is running, the run-time counter value is saved to nonvolatile memory every 15 minutes. If the battery power source fails during DGC-500 operation, these values are not updated and the changes made after the last save operation to nonvolatile memory are irretrievably lost.

Cranking

The DGC-500 can be programmed for either continuous engine cranking or cycle engine cranking.

Continuous Cranking

If desired, engine cranking can be delayed from zero to 30 seconds after initiating engine startup. When continuous engine cranking is initiated, cranking is sustained for a user-adjustable period of one to 60 seconds. A crank disconnect limit setting (10 to 100% of nominal engine speed) selects the desired engine speed above which cranking is terminated.

Cycle Cranking

If desired, engine cranking can be delayed from zero to 30 seconds after initiating engine startup. When cycle engine cranking is initiated, five to 15 seconds of cranking is followed by an equal number of seconds of rest. A maximum of seven cranking cycles (five cycles for NFPA compliant units) are allowed by the DGC-500. A crank disconnect limit setting (10 to 100% of nominal engine speed) selects the desired engine speed above which cranking is terminated.

Pre-Alarms

A pre-alarm is annunciated when a condition programmed to trigger a pre-alarm is met. When a pre-alarm condition exists, the front panel Alarm indicator flashes on and off and the Horn output (if enabled through BESTCOMS) alternates between an energized and de-energized state. The audible alarm is reset by pressing the front panel Alarm Silence pushbutton.

Active pre-alarms for oil pressure, fuel level, coolant temperature, and battery voltage are displayed on the main display of the LCD. The LCD annunciates an active pre-alarm by alternating between the current parameter value and a blacked-out field for that value. All other pre-alarms are displayed in sequence through the alternate mode display.

Each DGC-500 pre-alarm is described in the following paragraphs.

Low Oil Pressure

A low oil pressure pre-alarm occurs when the engine oil pressure decreases below the setpoint programmed in BESTCOMS. The low oil pressure pre-alarm has a setting range of 3 to 150 psi or 20 to 1,035 kPa. A 10 second activation time delay prevents low oil pressure annunciation during engine startup.

Low Fuel

A low fuel pre-alarm occurs when the fuel level decreases below the setpoint programmed in BESTCOMS. The low fuel pre-alarm has a setting range of 10 to 100 percent.

High Coolant Temperature

A high coolant temperature pre-alarm occurs when the engine coolant temperature exceeds the setpoint programmed in BESTCOMS. The high coolant temperature pre-alarm has a setting range of 100 to 280°F or 38 to 138°C. A 60 second activation time delay prevents high coolant temperature annunciation during system startup.

Low Coolant Temperature

A low coolant temperature pre-alarm occurs when the engine coolant temperature decreases below the setpoint programmed in BESTCOMS. The low coolant temperature pre-alarm has a setting range of 50 to 100°F or 10 to 38°C.

Battery Overvoltage

A battery overvoltage pre-alarm occurs when the battery overvoltage pre-alarm function is enabled in BESTCOMS and the battery voltage level exceeds 30 Vdc for 24 Vdc system or 15 Vdc for 12 Vdc systems.

Low Battery Voltage

A low battery voltage pre-alarm occurs when the battery voltage decreases below the low battery voltage setpoint for the duration of the low battery voltage time delay setting. Both settings are made in BESTCOMS. The low battery voltage setpoint has a setting range of 12 to 24 Vdc for 24 Vdc systems and 6 to 12 Vdc for 12 Vdc systems. The low battery voltage time delay has a setting range of 1 to 10 seconds.

Weak Battery Voltage

A weak battery voltage pre-alarm occurs when the battery voltage decreases below the weak battery voltage setpoint for the duration of the weak battery voltage time delay setting. Both settings are made in BESTCOMS. The weak battery voltage setpoint has a setting range of 8 to 16 Vdc for 24 Vdc systems and 4 to 8 Vdc for 12 Vdc systems. The weak battery voltage time delay has a setting range of 1 to 10 seconds.

Maintenance Interval

A maintenance interval pre-alarm occurs when the DGC-500 maintenance timer counts down to zero from the maintenance interval setting programmed in BESTCOMS. The maintenance interval duration has a setting range of zero to 5,000 hours.

Battery Charger Failure

A battery charger failure pre-alarm occurs when one of the three DGC-500 programmable contact inputs detects a contact closure due to a battery charger failure. In order for a battery charger failure pre-alarm to occur, the battery charger failure pre-alarm function must be enabled in BESTCOMS and one of the three programmable inputs must be programmed as a battery charger failure pre-alarm input. Refer to Section 4, *BESTCOMS Software* for information about configuring the programmable contact inputs.

Fuel Level Sender Failure

A fuel level sender failure pre-alarm occurs when an open circuit or short circuit is detected across the DGC-500 fuel level transducer terminals and a fuel level sender failure is programmed in BESTCOMS to cause a pre-alarm.

MPU Failure

An MPU (magnetic pickup) failure pre-alarm occurs when MPU-GEN is selected as the generator speed signal source, the MPU signal is lost, and the Global Sender Failure Alarm time delay expires.

Active DTC

When CAN and DTC support are both enabled, an “active DTC” pre-alarm may be enabled (through BESTCOMS) to announce the presence of an condition that is causing a DTC to be sent from the ECU to the DGC-500.

CAN Failure

A CAN failure annunciation may be enabled only when the CAN interface is enabled. The CAN interface is enabled through BESTCOMS. When configured to alarm, annunciation occurs when CAN communication stops due to a lost connection between the DGC-500 and ECU, or an ECU malfunction. If CAN communication is lost and the annunciation is a pre-alarm, a screen stating the pre-alarm will appear in the Alternate Display menu. This screen will be viewable only when the pre-alarm is active.

Audible Alarm

A pre-alarm is annunciated through the DGC-500 Horn output when the audible alarm feature is enabled in BESTCOMS. When the audible alarm is enabled, a pre-alarm condition causes the horn output to alternate between an energized and de-energized state.

Alarms

An alarm is annunciated when a condition programmed to trigger an alarm is detected. When an alarm condition exists, the front panel Alarm indicator lights, the Horn output energizes, and the cause of the alarm is displayed on the LCD.

An alarm condition stops the engine by opening the Fuel output contact.

Each DGC-500 alarm is described in the following paragraphs.

Low Oil Pressure

A low oil pressure alarm occurs when the engine oil pressure decreases below the low oil pressure alarm setpoint for the duration of the low oil pressure time delay setting. Both settings are made in BESTCOMS. When a low oil pressure alarm occurs, the LCD indicates LOW OIL PRESSURE and the current low oil pressure alarm setting. A 10 second activation time delay prevents low oil pressure annunciation during engine startup.

The low oil pressure setpoint has a setting range of 3 to 150 psi or 20 to 1,035 kPa and the low oil pressure time delay has a setting range of 5 to 15 seconds.

Low Fuel Level

A low fuel level alarm occurs when the fuel level decreases below the setpoint programmed in BESTCOMS. When a low fuel level alarm occurs, the LCD indicates LOW FUEL LEVEL and the current low fuel level alarm setting.

The low fuel level setpoint has a setting range of zero to 100 percent.

High Coolant Temperature

A high coolant temperature alarm occurs when the coolant temperature exceeds the setpoint programmed in BESTCOMS. When a high coolant temperature alarm occurs, the LCD indicates HIGH COOLANT TEMP and the current high coolant temperature setting. A 60 second activation time delay prevents high coolant temperature annunciation during system startup.

The high coolant temperature setpoint has a setting range of 100 to 280°F or 38 to 138°C.

Overspeed

An overspeed alarm occurs when the engine speed exceeds the overspeed setpoint for the duration of the overspeed time delay. Both settings are made in BESTCOMS. When an overspeed alarm occurs, the LCD indicates OVERSPEED and the current overspeed setting.

The overspeed setpoint has a setting range of 105 to 140 percent and the overspeed time delay has a setting range of zero to 500 milliseconds.

Loss of Generator Voltage

A loss of generator voltage alarm can occur only when the loss of generator voltage alarm is enabled in BESTCOMS. When the sensed generator voltage decreases below 1.5 Vac for the duration of the global sender failure alarm time delay, a loss of generator voltage alarm occurs. The global sender failure alarm time delay is adjustable from 1 to 10 seconds.

Oil Pressure Sender Failure

An oil pressure sender failure alarm occurs when the DGC-500 oil pressure transducer input senses a sender failure for the duration of the global sender failure alarm time delay. The oil pressure sender failure alarm is enabled and the global sender failure alarm time delay is set in BESTCOMS.

Coolant Temperature Sender Failure

A coolant temperature sender failure alarm occurs when the DGC-500 coolant temperature transducer input senses a sender failure for the duration of the coolant temperature alarm delay time. The coolant temperature sender failure alarm is enabled and the coolant temperature alarm delay is set in BESTCOMS. The coolant temperature alarm delay is adjustable from 5 to 30 minutes in 5 minute increments.

Speed Source Failure

A speed source failure can occur for either of two conditions. If MPU (magnetic pickup) is selected as the generator speed signal source and the MPU signal is lost, a speed source failure alarm will occur. If GEN FREQ (generator frequency) is selected as the generator speed signal source and a loss of generator frequency is detected, a speed source failure alarm will occur.

CAN Failure (If Equipped)

A CAN failure annunciation may be enabled only when the CAN interface is enabled. The CAN interface is enabled through BESTCOMS. When configured to pre-alarm, annunciation occurs when CAN communication stops due to a lost connection between the DGC-500 and ECU, or an ECU malfunction. If CAN communication is lost and the annunciation is configured as an alarm, then a normal alarm sequence will occur, including a CANBUS FAILURE message that appears on the HMI display.

DISPLAY OPERATION

The DGC-500 has three standard display modes: Normal, Alternate, and Menu. The optional ECU Parameters mode is present only on controllers with a style number of F1J or F5J. Pressing the **Display Toggle** pushbutton scrolls through the active screen of each available display mode. Figure 3-2 illustrates the top-level screen of the standard and optional display modes.

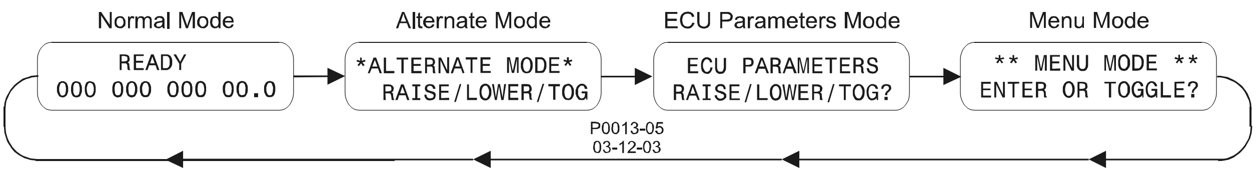

Figure 3-2. Display Mode Navigation

Normal Mode

Normal mode displays various engine and generator parameters. Each parameter is displayed adjacent to the corresponding label on the front panel overlay.

Firmware Version

Normal mode also displays the firmware version of the DGC-500.

The DGC-500 firmware version is viewed in Normal mode by pressing and holding either the **Raise/Scroll** pushbutton or **Lower/Scroll** pushbutton. Releasing either pushbutton returns the display to the current Normal mode screen.

Alternate Mode

Press the **Raise/Scroll** or **Lower/Scroll** pushbuttons while viewing the top-level Alternate mode screen (Figure 3-2) to scroll through the available engine and generator metering values. Figure 3-3 illustrates the Alternate mode screens for a DGC-500 configured for three-phase, line-to-neutral operation. Units configured for three-phase, line-to-line operation do not display the GEN A-N VOLTS, GEN B-N VOLTS, and GEN C-N VOLTS screens. Units configured for single-phase, A-phase to B-phase operation do not display the GEN B-C VOLTS, GEN C-A VOLTS, and GEN C-N VOLTS screens.

Diagnostic Trouble Codes (DTCs)

When the optional SAE J1939 communication is enabled, access to the Diagnostic Trouble Codes (DTCs) is available through the Alternate Display mode. The DTCs are the last two screens in the Alternate mode display list.

If there are no DTCs to be sent to the DGC-500, pressing the **Select/Enter** pushbutton will have no effect, and the messages ACTIVE DTC LIST and NO DTCS TO VIEW will be displayed. If at least one DTC is communicating with the DGC-500, pressing the **Select/Enter** pushbutton will display ACTIVE DTC LIST and VIEW WITH SELECT.

Pressing the **Select/Enter** pushbutton when ACTIVE DTC LIST and VIEW WITH SELECT is displayed places the DGC-500 in DTC mode. The next screen to appear will display the diagnostic lamp status information obtained from the ECU. One of five possible lamp status messages will be displayed. The lamp status messages, in decreasing order of priority, are listed below.

1. ENG STOP LAMP ON
2. WARNING LAMP ON
3. MALFUNC LAMP ON
4. PROTECT LAMP ON
5. NO LAMP IS ON

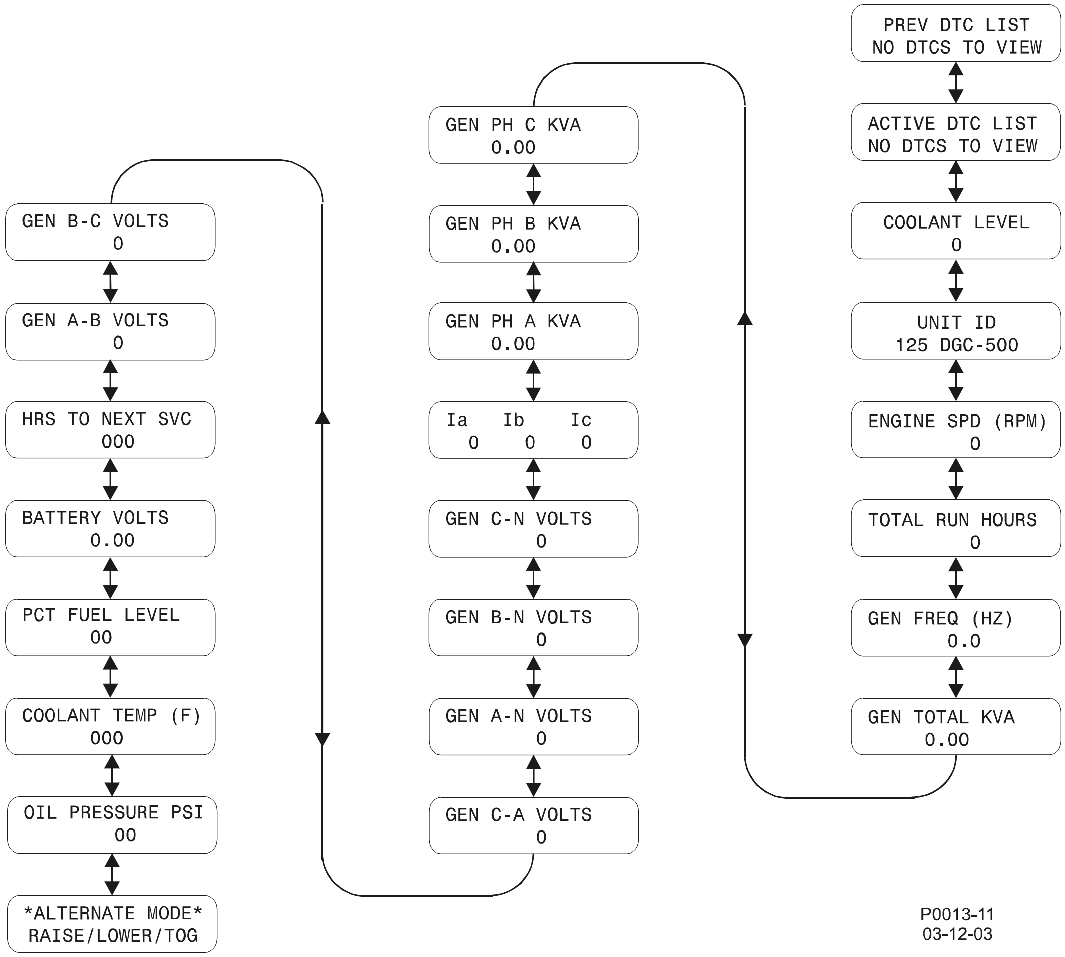

Figure 3-3. Alternate Mode Navigation

Only one lamp status will be displayed on the front panel—the highest priority one that is true. An example of the lamp status screen is shown in Figure 3-4. BESTCOMS may also be used to view the status of all lamps.

Figure 3-4. Lamp Status Screen

To be notified that a lamp status exists, the pre-alarm for active DTCs must be enabled through BESTCOMS. When one or more active DTCs exist in the ECU, a lamp status indicating the severity of the combined DTCs should exist. After the pre-alarm is annunciated (by LED indicator, horn, and/or dial-out), the operator will know to check the lamp status, active system DTCs, and what relationship the DTCs have with the parameters. To check the DTC/parameter relationship at the front panel, access the ECU Parameters menu of the HMI. In BESTCOMS, hover the mouse pointer over the DTC to see its related parameter.

To use the HMI to view the list of active DTCs, press the **Raise/Scroll** pushbutton. The next screen to appear will display the first DTC, the number of DTCs, the Suspect Parameter Number (SPN), the Failure Mode Indicator (FMI) and the Occurrence Count (OC).

NOTE

Always refer to the engine manual for the meaning of SPN and FMI combinations, especially for proprietary DTC descriptions.

In the DTC screen example of Figure 3-5, the first DTC of five is displayed. The SPN is 111 (coolant level), the FMI is 1 (low voltage from the sender, thus we have low coolant level), and the OC is 2 (the engine has had a low coolant level twice before). Refer to the engine manufacturer CAN interface documentation for specific descriptions of codes.

```
1/5  SPN FMI OC
     111  1   2
```

Figure 3-5. DTC Screen Example

After viewing the last DTC, screen 5 of 5, VIEWED ALL ACTIVE and USESELECT TO CLEAR will be displayed. This also applies when viewing previous DTCs.

Clearing the active or previous DTCs, by pressing the **Select/Enter** pushbutton, will give one of four responses.

1. A positive acknowledgment which causes ACTIVE DTC(S) HAVE BEEN ERASED to be displayed.
2. A negative acknowledgment which causes ERROR - NEGATIVE ACK and CANNOT ERASE DTC(S) to be displayed.
3. A timeout for acknowledgment which causes ERROR - ACK TIME OUT and CANNOT ERASE DTC(S) to be displayed. This occurs when approximately two seconds have elapsed with CAN working and no positive or negative acknowledgment received.
4. A CAN communication failure causes ERROR - DISCONNECTED and CANNOT ERASE DTC(S) to be displayed. This occurs when CAN is disconnected or the ECU is not functioning properly.

After viewing the response, the only way to back out of the screen is to press the **Previous** pushbutton. The user is then taken back to the Alternate Display mode. Pressing the **Display Toggle** pushbutton will take the user to the Menu mode screens. This also applies when viewing previous DTCs.

ECU Parameters Mode

When the optional J1939 communication is enabled, access to the ECU Parameters menu is available. This menu displays parameters metered from the ECU. Only parameters related to genset applications are metered from the ECU and displayed here. A submenu for viewing the engine configuration parameters is also accessible from the ECU Parameters menu.

If a parameter is never sent after communication is established, or the ECU has sent information notifying the DGC-500 that the parameter is not supported (non-applicable), then the parameter's screen will be hidden and skipped when scrolling from screen to screen in the ECU Parameters menu.

If a DTC is associated with one of the parameters, then the screens will function like the Pre-Alarm screens of the Alternate mode display. When scrolling through the menu, the user is taken to the new DTC-related screens first. The DTC-related screen will then blink while alternating between the parameter's value and the DTC information.

NOTE

If no ECU support is required, then parameters are updated within the DGC-500 only when "pulsing" the ECU and while the engine is running.

The following list includes all of the engine system monitoring parameters read from the ECU (if supported) in the order in which they appear when pressing the **Raise/Scroll** pushbutton, having started from the ECU Parameters menu.

1. Throttle position
2. Percent load at current rpm
3. Actual engine percent torque
4. Engine speed
5. Injection control pressure
6. Injector metering rail pressure
7. Total engine hours ✳
8. Trip fuel

9. Total fuel used
10. Engine coolant temperature ✳
11. Fuel temperature
12. Engine oil temperature
13. Engine intercooler temperature
14. Fuel delivery pressure
15. Engine oil level
16. Engine oil pressure
17. Coolant pressure
18. Coolant level
19. Fuel rate
20. Barometric pressure
21. Ambient air temperature
22. Air inlet temperature
23. Boost pressure
24. Intake manifold temperature
25. Air filter differential pressure
26. Exhaust gas temperature
27. Battery voltage ✳
28. Battery voltage (at ECU), switched
29. Active diagnostic codes
30. Previously active diagnostic codes

✳ This parameter may be monitored either directly by the DGC-500 itself or by the DGC-500 and the appropriate analog sender when the SAE J1939 interface is disabled.

Figure 3-6 illustrates the screens of the ECU Parameters menu after the DGC-500 has established communication with the ECU.

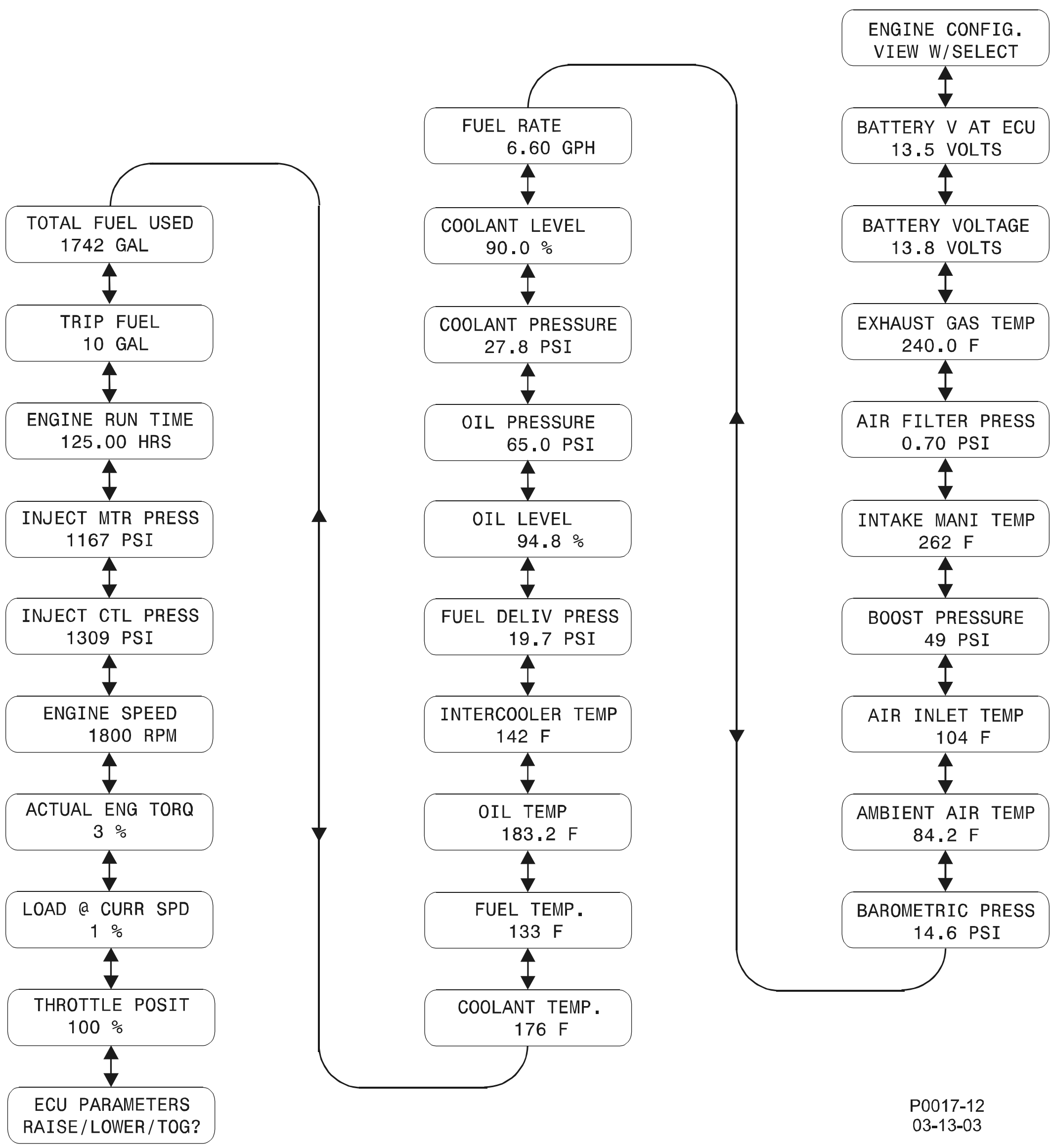

Figure 3-6. ECU Parameters Navigation

Engine Configuration Parameters

Engine configuration parameters can be accessed from the ECU Parameters menu. To view these parameters read from the ECU, press the **Select/Enter** pushbutton while viewing the Engine Configuration (ENGINE CONFIG.) screen. The following list of all engine configuration parameters is presented in the order in which they appear when pressing the **Raise/Scroll** pushbutton.

1. Engine speed at idle, point 1
2. Percent torque at idle, point 1
3. Engine speed at point 2
4. Percent torque at point 2
5. Engine speed at point 3
6. Percent torque at point 3
7. Engine speed at point 4
8. Percent torque at point 4
9. Engine speed at point 5
10. Percent torque at point 5
11. Engine speed at high idle, point 6
12. Gain (KP) of the end-speed governor
13. Reference engine torque
14. Maximum momentary engine override speed, point 7
15. Maximum momentary override time limit
16. Requested speed control range lower limit
17. Requested speed control range upper limit
18. Requested torque control range lower limit
19. Requested torque control range upper limit

Figure 3-7 illustrates the Engine Configuration Parameter menus after the DGC-500 has established communication with the ECU.

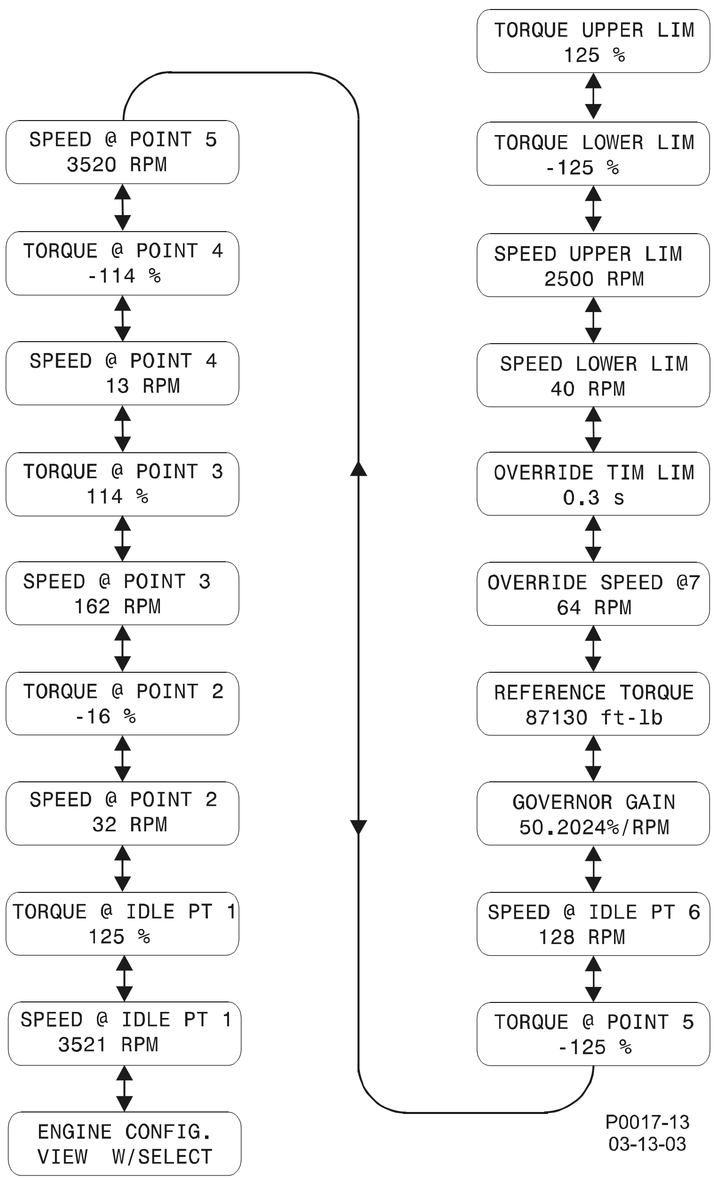

Figure 3-7. Engine Configuration Menu Navigation

Menu Mode

Press the **Select/Enter** pushbutton while viewing the top-level Menu mode screen (shown in Figure 3-2), to access the four menu branches illustrated in Figure 3-8. Press the **Lower/Scroll** or **Raise/Scroll** pushbuttons to view the top of each menu branch. Within Menu 1, 2, 3, or 4, use the **Select/Enter** pushbutton to move right, the **Previous** pushbutton to move left, the **Raise/Scroll** pushbutton to move up, and the **Lower/Scroll** pushbutton to move down.

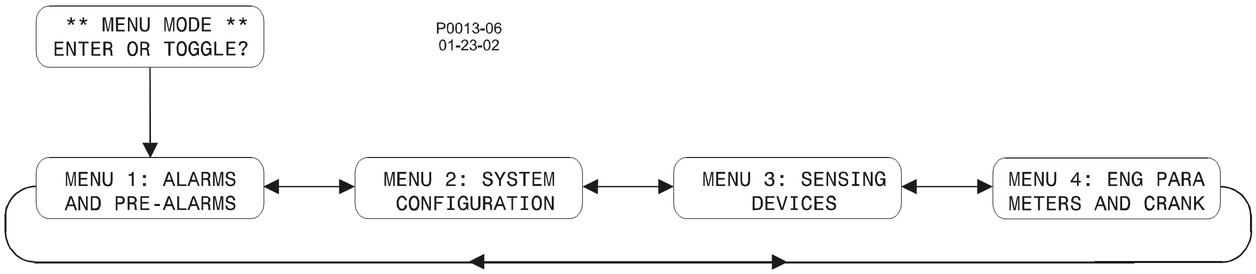

Figure 3-8. Menu Mode Navigation

Menu 1

DGC-500 pre-alarms and alarms are viewed and configured in Menu 1. Figure 3-9 illustrates the Menu 1 screens.

Menu 2

System configuration settings are viewed and configured in Menu 2. Figure 3-10 illustrates the Menu 2 screens.

Menu 3

DGC-500 calibration, transformer ratios, and transducer failure alarms, are viewed and configured in Menu 3. Figure 3-11 illustrates the Menu 3 screens. The menu screens associated with the calibration process are illustrated in Section 5, *Installation, Calibration*.

Menu 4

Engine cool-down time and cranking parameters are viewed and configured in Menu 4. Figure 3-12 illustrates the Menu 4 screens.

Exiting Menu Mode

Pressing the **Display Toggle** pushbutton exits the Menu mode from any level and branch. When the **Display Toggle** pushbutton is used to exit Menu mode, the user's place within the menu tree is saved. The display will return to the same screen the next time that Menu mode is entered. If the **Display Toggle** pushbutton is pressed before a new setting is saved, the existing setting is retained.

Using the **Previous** pushbutton to back out of Menu mode ensures that the top-level Menu mode screen is viewed the next time Menu mode is entered.

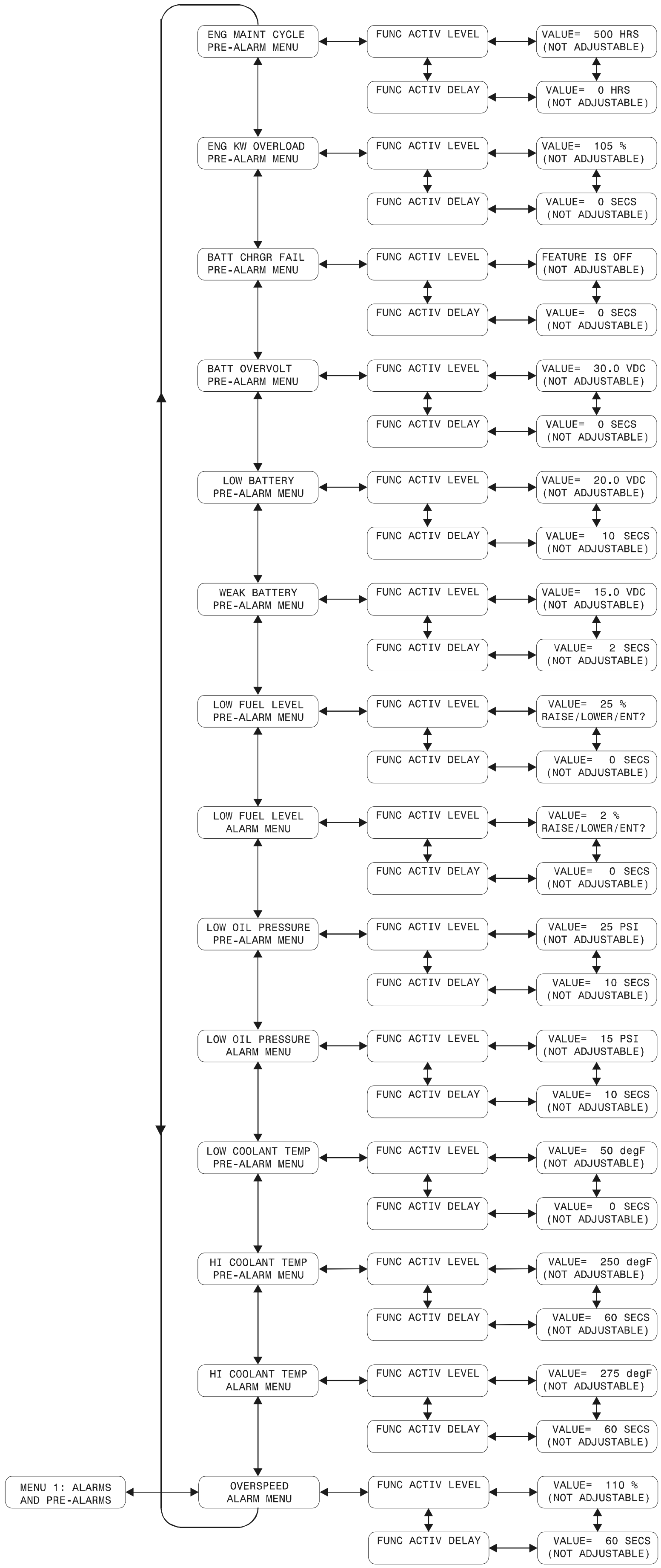

Figure 3-9. Menu 1 Navigation

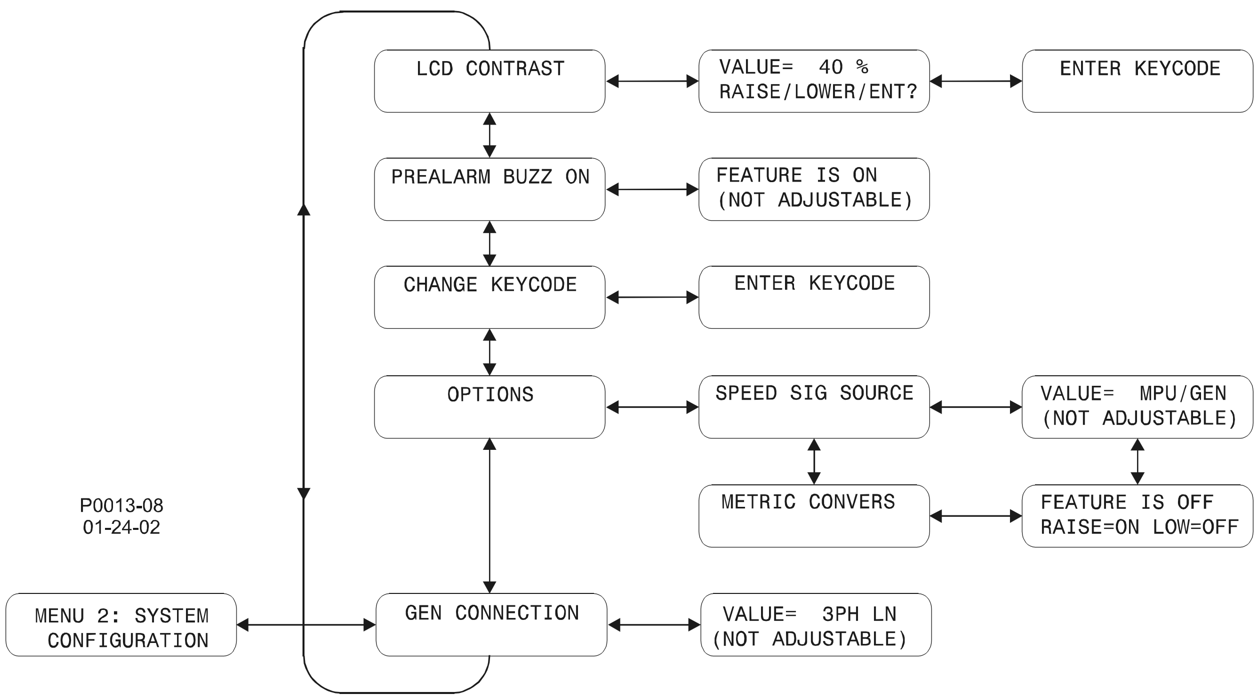

Figure 3-10. Menu 2 Navigation

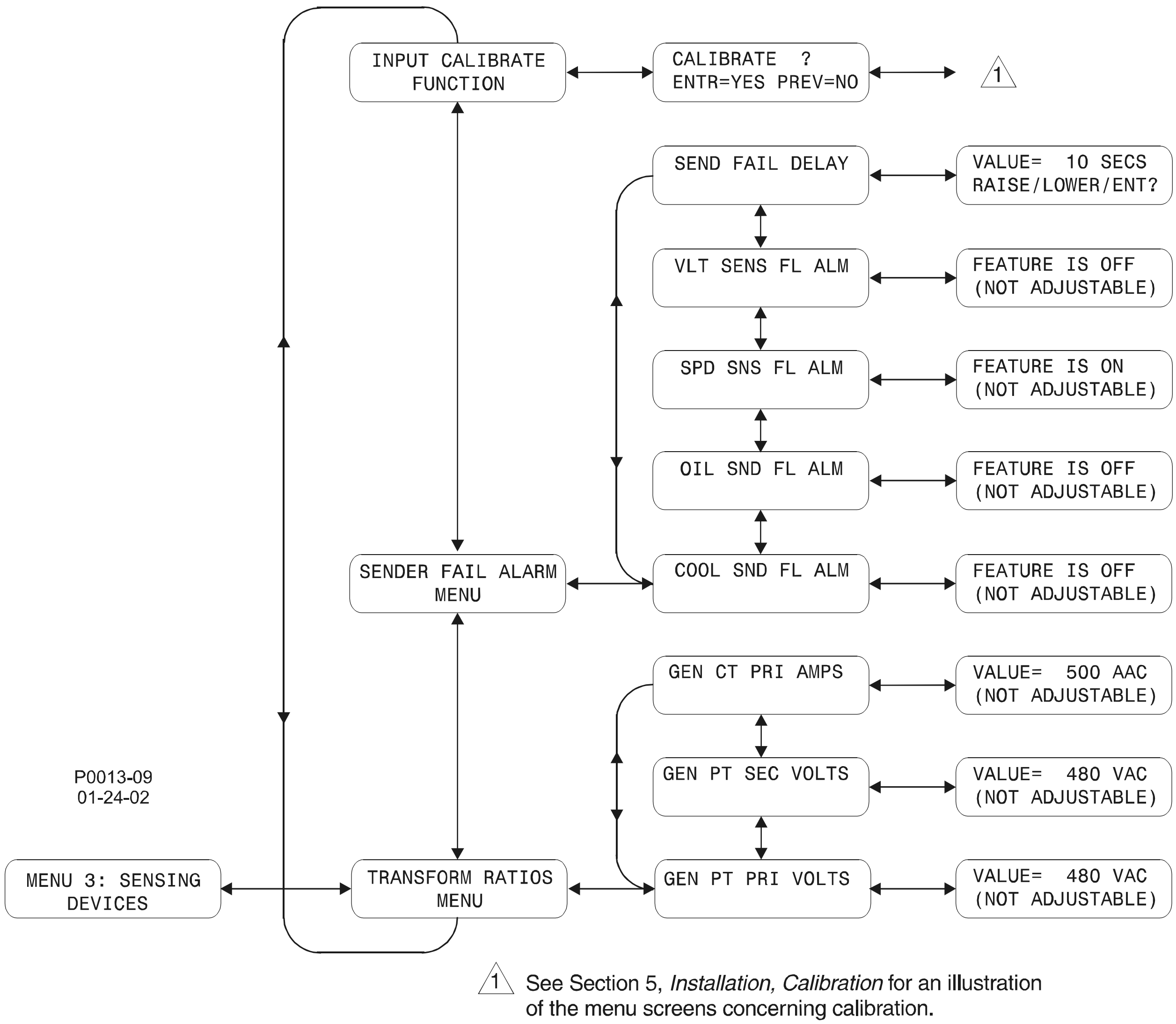

Figure 3-11. Menu 3 Navigation

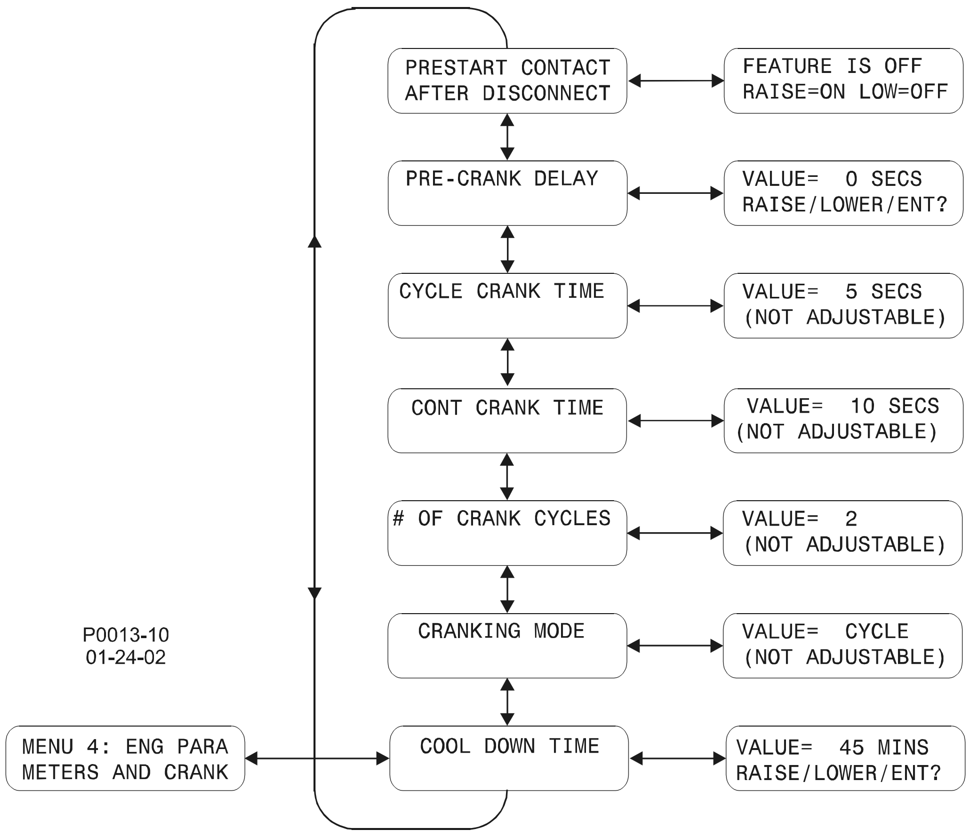

Figure 3-12. Menu 4 Navigation

Changing Settings

A setting change consists of the following steps. The number of each step corresponds to the numbered call-outs in the setting change example of Figure 3-13.

1. Use the HMI pushbuttons to navigate to the screen of the setting to be changed.
2. Press the **Select/Enter** key to access the ENTER KEYCODE screen.
3. Enter the key code by pressing the appropriate HMI pushbuttons in the proper sequence. Key code entries appear as asterisks on the ENTER KEYCODE screen. Refer to the *Key Code* paragraph for details about using key codes.
4. Press the **Select/Enter** pushbutton to access the setting to be changed.
5. Use the **Raise/Scroll** and **Lower/Scroll** pushbuttons to increment and decrement the setting as needed.
6. Press the **Select/Enter** pushbutton to save and view the setting change.

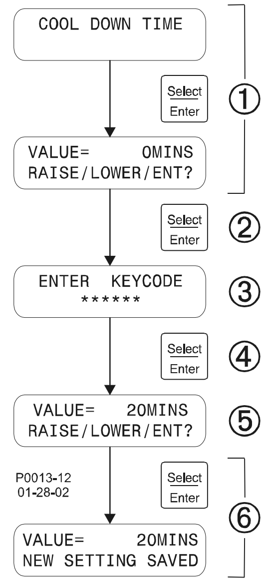

Figure 3-13. Setting Change Example

Key Code

The DGC-500 is delivered with a key code consisting of the following pushbutton sequence.

1. Raise/Scroll
2. Lower/Scroll
3. Select/Enter
4. Previous
5. Display Toggle
6. Select/Enter
7. Select/Enter

The key code can be changed by accessing the CHANGE KEYCODE screen of Menu 2. Observe the following guidelines when changing the key code.

- Allowable key code pushbuttons are Raise/Scroll, Lower/Scroll, Select/Enter, Previous, Display Toggle, Phase Toggle, Alarm Silence, and Lamp Test.
- A key code entry must be followed by two presses of the Select/Enter pushbutton.
- A key code can consist of one to eight presses of the allowable key code pushbuttons.
- A key code cannot contain consecutive presses of the Previous pushbutton.

ENGINE CONTROL UNIT (ECU) SUPPORT

The following paragraphs describe the support provided by the DGC-500 for operation with an engine control unit (ECU).

Enabling ECU Support

To enable ECU support, the user must access the SYST menu in BESTCOMS and select *Enable ECU Support* under the box entitled *CANBus/J1939 Interface*. After resending the settings, the DGC-500 will ignore the analog inputs for coolant temperature, oil pressure and engine speed, and it will no longer calculate engine run-time. Once the DGC-500 establishes communication with an ECU, the engine run-time, coolant level, coolant temperature, oil pressure, and engine speed will be updated with the ECU values.

> NOTE
>
> With *Enable ECU Support* selected, there is a non-programmable Coolant Level Sender Fail alarm that can annunciate when the engine is either off or running.
>
> Coolant level is metered and displayed only when Enable ECU Support is selected in BESTCOMS.

ECU Constraints

An external source cannot always turn the engine off without removing power from the ECU. Removing power from the ECU is the only way to remove fuel from the engine and shut it down. Different ECU manufacturers have their own rpm setpoints for reapplying fuel to an engine. For example, if the ECU is powered up and the engine is still spinning above 60 rpm, the ECU may automatically turn the fuel on.

Not being able to stop the engine without removing power from the ECU causes two problems. The first problem is that the only way to stop the engine is to turn the ECU off and wait for the engine speed to decrease below 60 rpm before reapplying ECU operating power. Otherwise, the engine will resume running. The second problem is that while the ECU is off, you can no longer meter and update coolant level, coolant temperature, oil pressure, and engine speed values, effectively disabling features like low coolant temperature alarm/pre-alarm and crank control.

<u>*The DGC-500 Solution*</u>

The DGC-500 resolves ECU constraints by using four user-programmable timers that are accessed through BESTCOMS. Each timer setting is described in the following paragraphs.

Pulse Cycle Time. This timer setting establishes the time, in minutes, that the DGC-500 waits before pulsing the ECU again.

Response Timeout. This timer setting defines the length of time, in seconds, that the DGC-500 attempts communication with the ECU when the DGC-500 is in the Pulsing state or Connecting state.

Settling Time. This timer setting controls the length of time, in tenths of seconds, that the DGC-500 gathers data after connecting to the ECU during the Pulsing state. This allows all metered values to be sent and ramped up to their steady state values. Metered values are sent out by the ECU at different rates as designated by the J1939 protocol. ECU values initially sent are low and the ECU takes time to average out its own data values.

Engine Shut Down. This timer setting determines the length of time, in seconds, that the DGC-500 remains disconnected from the ECU when going from Running to Shutdown before starting the first pulse. This timer should allow enough time for the engine to slow down so that when the DGC-500 pulses, the ECU will not restart the engine.

Alarms and Pre-Alarms

If ECU communication is not established during the Connecting state or is lost during the Pre-Start, Cranking, Resting, Running or Cooling states, then a non-programmable ECU Communications Fail alarm is annunciated. If the last pulse was unsuccessful (ECU communication was not established), then the ECU Communications Fail pre-alarm will annunciate. The pre-alarm is checked only after the Pulsing state and is annunciated only during the Ready state.

To clear Coolant Level alarms when ECU power support is needed, the user must first correct the condition causing the alarm and then pulse the ECU to update the data. The user may pulse the ECU remotely through BESTCOMS or locally by pressing the front panel pushbuttons in the ordered sequence of Auto, Off.

Fuel Solenoid Relay

Because there is no external fuel solenoid to connect to, the fuel solenoid relay has been designated to control ECU operating power. For example, Detroit Diesel's ECU applies fuel to the engine only after engine speed rises above 60 rpm. The following timers control the fuel solenoid relay when the engine is not running.

- Pulse Cycle Time - fuel solenoid is open
- Response Timeout - fuel solenoid is closed
- Settling Time - fuel solenoid is closed
- Engine Shut Down - fuel solenoid is open

> NOTE
> When ECU support is enabled during Pre-start and Resting, the fuel solenoid is closed.

Display Values (ECU Support Enabled)

The ECU is able to give the DGC-500 in-depth information about the values it sends. This makes it possible for the DGC-500 to display accurate information when metering these values from the ECU. After successfully pulsing the unit, the last values gathered when powering-off the ECU are displayed until the next pulse. The following is a list of display values:

- Value - the actual value is displayed if the last pulse was successful or the engine is running.
- No Communications (abbreviated as NC) - displayed if the last pulse was unsuccessful.
- Not Applicable (abbreviated as NA) - the ECU does not monitor this data value.
- ECU Data Not Sent (abbreviated as NS) - data was not sent in the time designated by the J1939 protocol.
- Sender Failure (abbreviated as SF) - the ECU has determined a sender failure for that metered value.

ECUs with an External Fuel Solenoid

The DGC-500 supports ECUs that are able to cut-off fuel from the engine without powering the ECU off. The DGC-500 requests engine run-time every minute to keep the ECU from going into a sleep mode. After the Pulse Cycle Timer expires, the DGC-500 checks whether ECU communication exists. If so, the DGC-500 will not pulse the ECU. The same goes for Connecting, except that the DGC-500 remembers if it skipped the Connecting state. If it did, then the DGC-500 will also skip the Engine Shutting Down state when it stops the engine.

For ECUs that have an external fuel solenoid, it is recommended that the Engine Shut Down timer be set to its minimum value. This ensures that, if the DGC-500 temporarily loses power while running, the unit will go straight into the Run state and go to the Shutting Down state when the unit goes to Off. It is also recommended that the Response Timeout Timer be set to its minimum value in order to set the ECU Communications Fail pre-alarm as soon as possible.

The HMI screens shown in Figure 3-14 are displayed if the last attempt to pulse the ECU for an information update was unsuccessful.

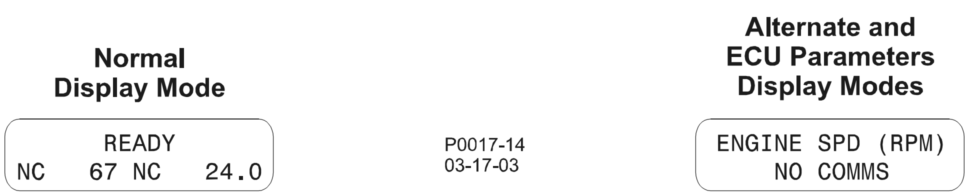

Figure 3-14. Screens Shown Following Unsuccessful Information Update from ECU

STATE MACHINES

A state machine is any device that stores the status of something at a given time. An input change can change the status and/or cause an action or output to occur for any given change. A finite state machine can be used to solve problems and describe the solution for system maintainers. State machine illustration methods range from simple tables to graphically animated illustrations.

The following paragraphs describe how the DGC-500 functions as a state machine.

System Configuration

- RUN, OFF and AUTO are selectable through the front panel HMI and OFF and AUTO are selectable through BESTCOMS. However, for clarity, the term AUTO will not be used in this section. Auto-Run and Auto-Off will be used instead. Auto-Run means the unit is in Auto while the automatic transfer switch (ATS) is closed, or the user started the engine remotely through BESTCOMS. Auto-Off means the unit is in Auto while the ATS is open, or the user stopped the engine remotely through BESTCOMS. The system configuration settings for the DGC-500 are Run, Off, Auto-Run and Auto-Off.
- If BESTCOMS remotely started the engine before a reset occurred or the system configuration goes to Off, then the Remote Start setting in BESTCOMS is set to Stop.
- If ECU support is enabled when the engine is running and the system configuration goes to Off, then the unit will go to the Shut Down state. Otherwise, it will transition to the Ready state and pulse the ECU.
- If ECU support is disabled and system configuration goes to Off, then the unit will always transition to the Ready state.

Operating States

The DGC-500 supports 11 operating states. Each operating state is illustrated by a flowchart later in this section.

- *Restart/Power-Up*. The initial state.
- *Ready*. The DGC-500 is in the Off or Auto-Off mode.
- *Pulsing*. ECU Only—pulses (momentarily powers up) the ECU for updated information.
- *Connecting*. ECU Only—the system configuration just changed to Run or Auto-Run.
- *Pre-Start*. Closes the pre-start relay or pauses the DGC-500 while it is not safe to crank.
- *Cranking*. Cranks the engine until it is above the crank disconnect speed.
- *Resting*. Occurs between crank cycles and does not crank the engine.
- *Running*. The unit is now running and no longer cranking.
- *Cooling*. Cool down running engine if a load is or was applied when going to Auto-Off mode.
- *Shutting Down*. ECU Only—wait for engine to stop rotating before "pulsing".
- *Alarm*. Alarm was triggered, wait for the alarm to clear.

State Transitions

Criteria used for deciding state transitions are based on the following input events.

- System Configuration (Run, Off, in Auto with ATS closed, in Auto with ATS open)
- Analog/ECU sender data (example: Engine Speed)
- Programmable auxiliary inputs
- Switch data (Coolant Level Switch, ATS, Emergency Stop Button)
- ECU-specific data (example clearing/requesting diagnostics)
- Various programmable timers (run-time, cycles, delays, time-out length)
- Programmable I/O settings
- Alarm settings (thresholds, enabling and timers)
- Other settings selectable through BESTCOMS.

Input events are used in deciding the following output events.

- Output relays on the DGC-500 control the generator and other devices connected to the DGC-500.
- LED output is controlled by the system configuration setting, active alarm/pre-alarms, and by the supplying load criteria.
- The LCD is controlled by the value of data being displayed, the state of the DGC-500, and by the viewing mode (Normal, Alternate Display, ECU Parameters, or Menu).
- The horn (or buzzer) is controlled by the Alarm Silence, Run, or Off pushbuttons, and by the Alarm and Pre-Alarm conditions.

Normal Program Control

If an engine does not have an ECU, then ECU Support should be disabled so that the DGC-500 uses analog sender data. An engine with ECU support disabled or ECU support enabled with a constant power supply and accessible fuel solenoid will follow the normal program control flowchart of Figure 3-15.

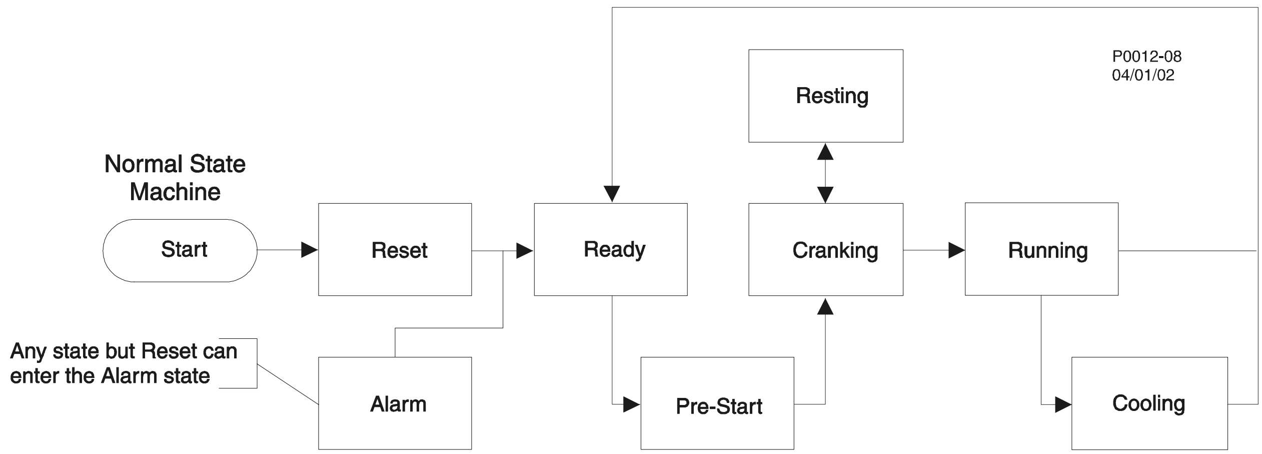

Figure 3-15. Normal Program Control Diagram

ECU Power Support Program Control

If an engine has an ECU, then ECU support should be enabled so that the DGC-500 uses sender data transmitted from the ECU over the J1939 interface. If the engine can be shut down only by powering off the ECU, then the genset will need ECU power support enabled. An engine with ECU support enabled and a need for ECU power support through the fuel solenoid will follow the ECU power support diagram of Figure 3-16.

> NOTE
>
> ECU power support is not a selectable option. The DGC-500 will decide between using the fuel solenoid output relay or controlling the fuel to provide ECU power support. This is derived through the following method.
>
> After the Pulse Cycle timer expires, the DGC-500 checks to see if ECU communication is active. If so, then the DGC-500 will not pulse the ECU. The same goes for Connecting, except the DGC-500 remembers if it skipped the Connecting state. If it did, then it will also skip the Engine Shutting Down state when the DGC-500 stops the engine.

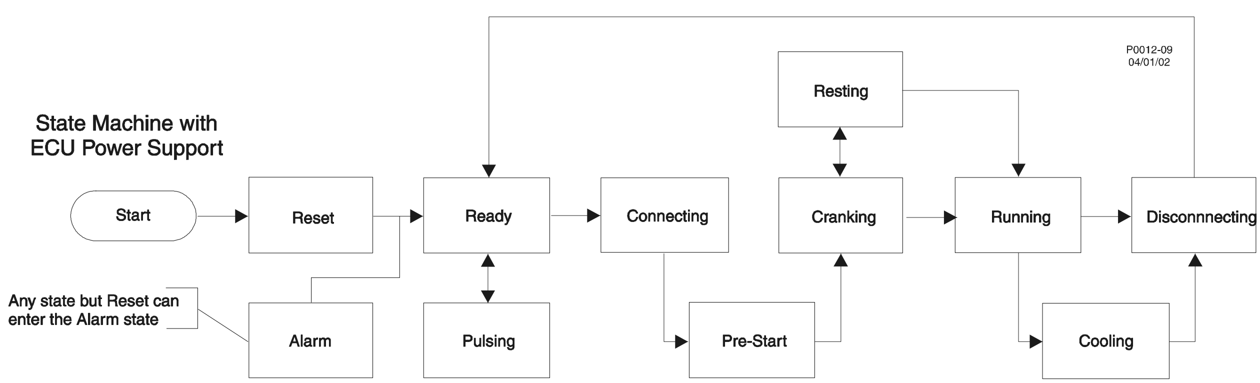

Figure 3-16. ECU Power Support Program Control Diagram

Initial State - Power Up/Reset

This state begins after cycling power to the DGC-500, or after a software reset (i.e. a watchdog timeout) has occurred. The unit will stay in reset for a short time. During this time, the firmware version number appears on the front panel LCD and the DGC-500 averages out enough data counts to calculate accurate analog data. During the Power Up/Reset state, if the previous system configuration was Run or Auto-Run with the ATS closed and ECU support enabled, the fuel solenoid will close. This works to keep the engine running if the unit temporarily losses power, and to gather engine speed data from the ECU to determine if it should go to Off or stay in Run.

After a short time, the old system configuration from the last time the unit was not in reset is checked. If the old system configuration was set to Run or Auto-Run with the ATS closed, then the engine speed is checked against Crank-Disconnect (the rpm value used in deciding when to disengage the starter).

If engine speed is above Crank-Disconnect, then the Power Up/Reset state goes to the Running state.

If the speed is below Crank-Disconnect, the DGC-500 goes to the Ready state and immediately pulses the ECU (if ECU support is enabled). If the previous system configuration was set to RUN, the System configuration will be set to OFF. If the previous system configuration was set to Auto-Run (with the ATS closed), the unit will still go to the Ready state. But then, the Ready state will transition into the Pre-Start state and the Pre-Start state will eventually transition into the Cranking state, and so forth.

Figure 3-17 illustrates the Power Up Reset flowchart.

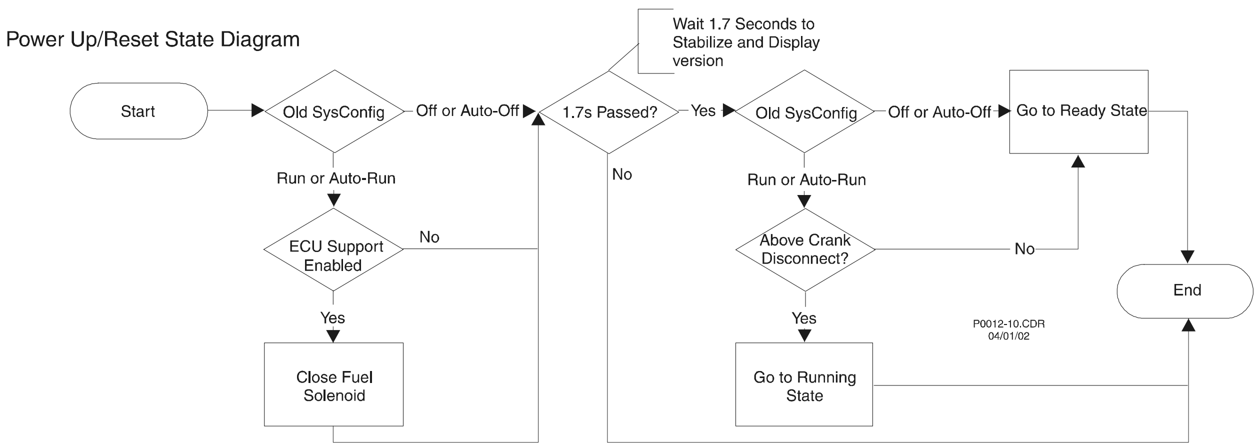

Figure 3-17. Power Up/Reset State Diagram

Ready State

The DGC-500 will be in Ready state when system configuration is Off/Auto-Off. If the system configuration changes to Run/Auto-Run, then it will check to see if it needs to go to the Connecting, Pre-Start or Running state. If ECU support is selected and there is no ECU communication and the Pulse Cycle Timer has expired, the Ready state will transition into Pulsing. The Pulse Cycle Timer can be set to expire and force a Pulsing state. There are three ways to force a pulse.

- When a user logs on to a unit through BESTCOMS, if the unit is in Ready state, a pulse is forced to update the internal variables used to meter ECU data.
- User attempts to clear DTCs from the ECU while the DGC-500 is in Ready (therefore, the ECU is probably powered off).
- Manually force a pulse and update the internal variables. The user can do so in BESTCOMS or locally pulse the ECU by pressing the front panel pushbuttons in the ordered sequence: Auto, Off.

Going to Off or Auto-Off

If the DGC-500 is in the Connecting, Pre-Start, Resting or Cooling state when the unit goes to Off or Auto-Off mode, then the state will transition to the Ready state. If ECU support is enabled, then the unit will go to the Pulsing state immediately after transitioning to the Ready state.

Figure 3-18 illustrates the Ready state flowchart.

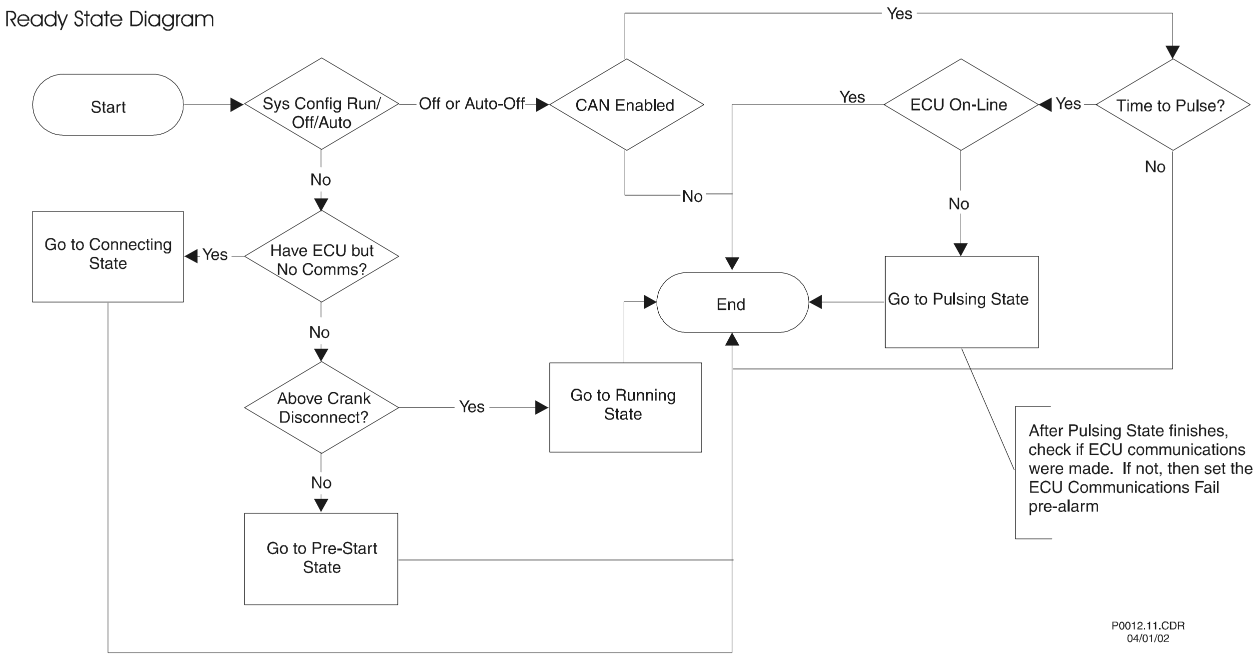

Figure 3-18. Ready State Diagram

Pulsing State

The Pulsing State follows the sequence of events shown in Figure 3-19. The Pulsing state will momentarily power up the ECU to update the DGC-500 internal variables. Once a connection is established with the ECU, GATHERING DATA will appear on the LCD for the duration of the settling time. During settling time, the unit processes any previous request for clearing DTCs from the ECU. The Pulsing state always transitions to the Ready state unless the System configuration changes to Run/Auto-Run. Then, it will transition to the Connecting state as a result of pulsing and will follow the ECU Power Support diagram.

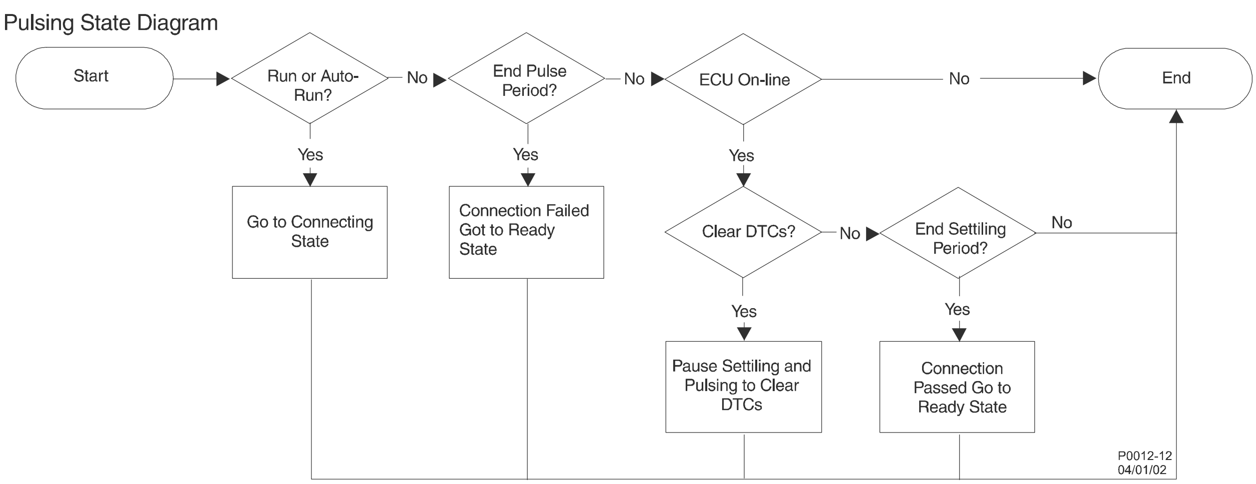

Figure 3-19. Pulsing State Diagram

Connecting State

The Connecting State follows the sequence of events shown in Figure 3-20. If ECU communication is not established by the time the Response Timeout expires, then the ECU Communications Failure Flag is set to trigger the Alarm state. The Connecting state will power up the ECU. Once it reads the engine speed, it checks if it is above Crank-Disconnect. If it is, then it will go to the Running state. Otherwise, it will go to the Pre-Start state.

Connecting State Diagram

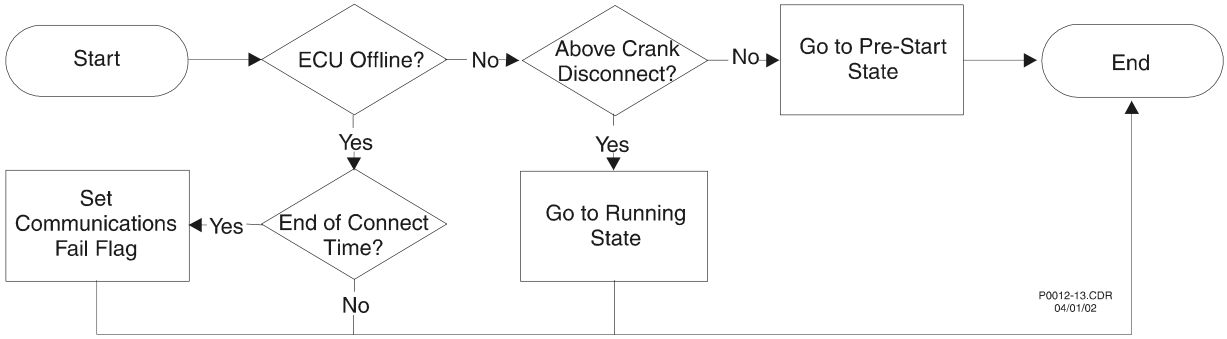

Figure 3-20. Connecting State Diagram

Pre-Start State

This state will transition immediately to the Running state if the engine speed is above Crank-Disconnect. Otherwise, it will wait here and close the Pre-heat relay for the pre-start time delay duration. If engine speed is below Safe-To-Restart (the rpm value used in deciding when to engage the starter) and the Pre-start time delay is expired or set to zero, then it will transition to the Cranking state. If engine speed falls in the range between Crank-Disconnect and Safe-To-Restart, the state will pause and display NOT SAFE TO CRANK along with the rpm value until the engine speed moves out of this range. If it is not safe to crank and there is a pre-start time delay, then the Pre-heat relay will stay closed because it was closed when it was waiting for the pre-start time delay to expire. If Pre-start time delay was set to zero, then the Pre-heat relay was never closed. Therefore, it would remain open while it is not safe to crank. Figure 3-21 illustrates the Pre-Start state flowchart.

Pre-Start State Diagram

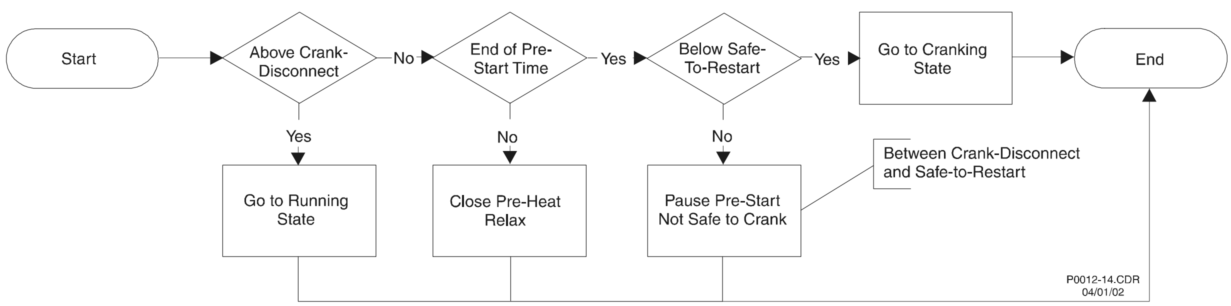

Figure 3-21. Pre-Start State Diagram

Cranking State

This state will engage the starter and transition to the Running state once engine speed is above crank-disconnect. During the Cranking state, the crank-type is checked. If the crank-type is Cycle Crank, then the unit will transition to the Resting state when the crank time expires. If the crank-type is Continuous Crank or is on the last crank cycle when the crank timer expires, then the Over-Crank flag is set to trigger the Alarm state. If system configuration goes to Off/Auto-Off, the unit transitions to the Cooling state. In the Cooling state, if ECU power support is needed, it will go to the Shutting Down state. The Cranking state flowchart is illustrated in Figure 3-22.

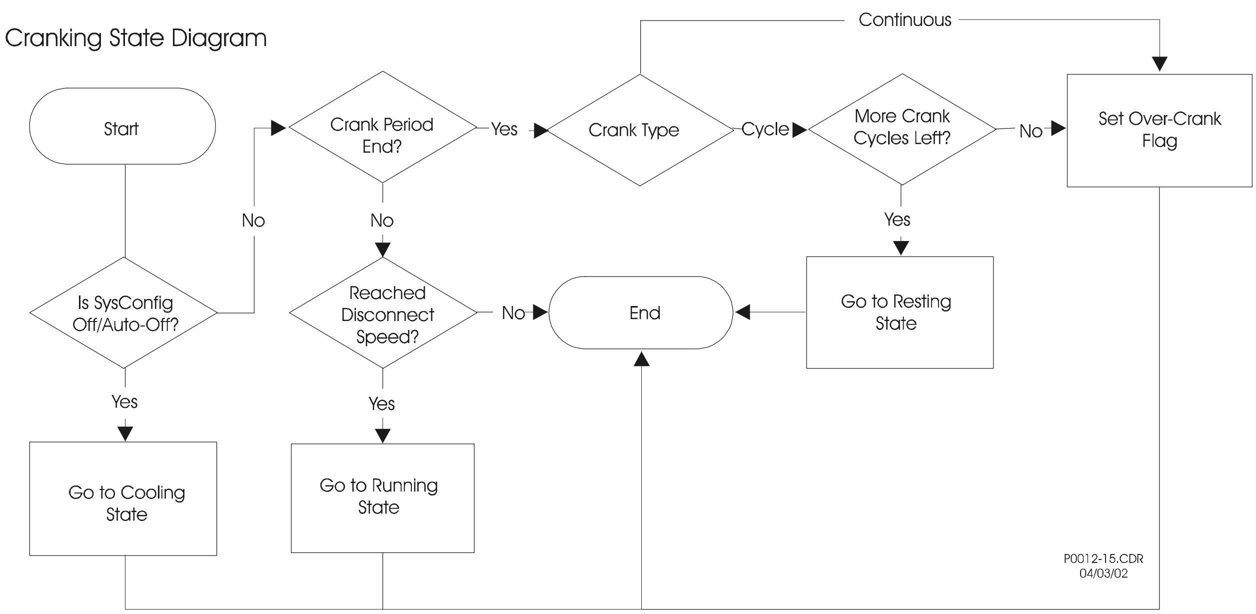

Figure 3-22. Cranking State Diagram

Resting State

If the rest period has ended, the unit will transition back to the Cranking state. If the State Machine is following the ECU Power Support diagram, the Fuel Solenoid relay will be closed during the Resting state. Thus, there is a possibility for the engine to start running during this state. Therefore, when the ECU Power Support diagram is being followed, engine speed is checked to see if it is above crank-disconnect. If it is, the unit will transition into the Running state. Figure 3-23 illustrates the Resting State flowchart.

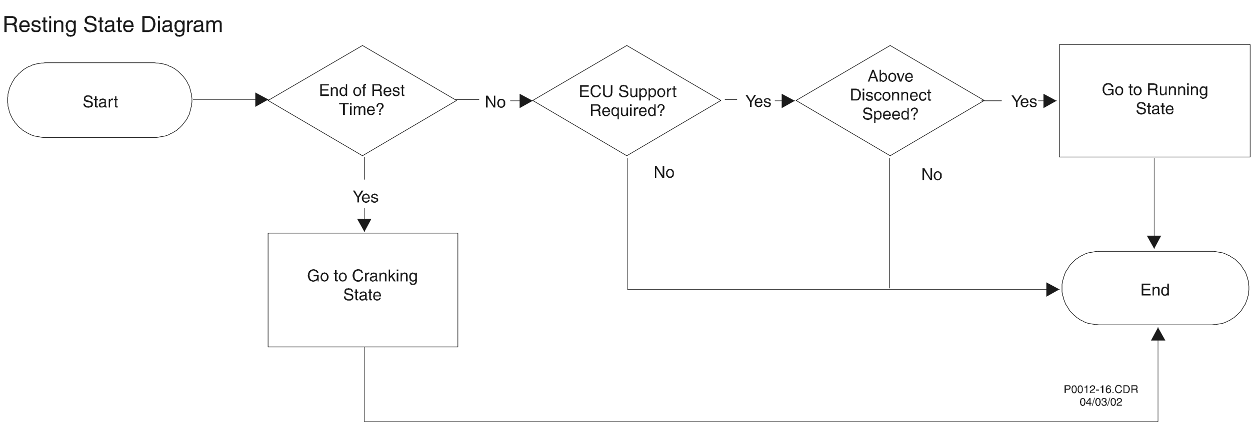

Figure 3-23. Resting State Diagram

Running State

If the System configuration changes to Off/Auto-Off, then the unit transitions to the Cooling state. If System configuration is set to Auto-Run, then the Cool-Down Timer is reset or incremented here if a load is applied and removed from the engine. If Pre-Start Contact After Disconnect was enabled in BESTCOMS, then during the course of this state, the Pre-Start relay will remain closed, otherwise it will be opened. Figure 3-24 illustrates the Running State flowchart.

Running State Diagram

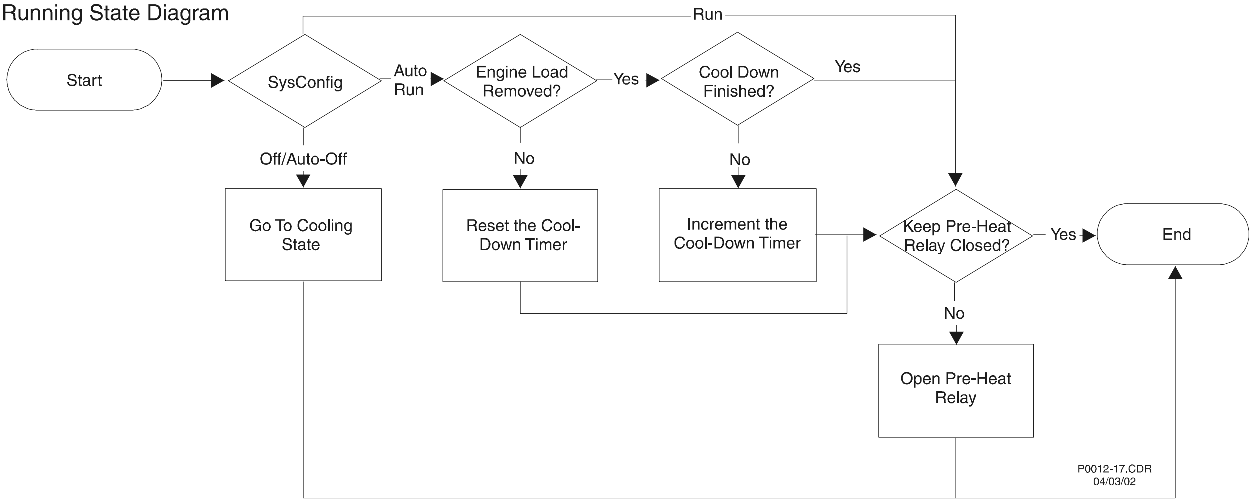

Figure 3-24. Running State Diagram

Cooling State

This state is available only if the unit is in Auto/Off with an unexpired Cool-Down time or if the unit was in the Cranking state when the unit went to Off. If system configuration changes back to Auto-Run, this state will transition straight into the Running state since the engine should already be running while it is in the Cooling state. If System configuration is Off, then the unit was either in the Cranking or Running state and the unit will verify if it should go to the Ready or Shutting Down state. If there is a load applied to the engine or one was applied and then removed, but the engine wasn't running long enough after it was removed to expire the Cool-Down Time, the unit will stay in this state until the Cool-Down timer expires. After the Cool-Down timer expires, if the unit is following the ECU Power Support diagram, the state will transition to the Shutting Down state. Otherwise, it will go to the Ready state. Figure 3-25 illustrates the Cooling state flowchart.

Cooling State Diagram

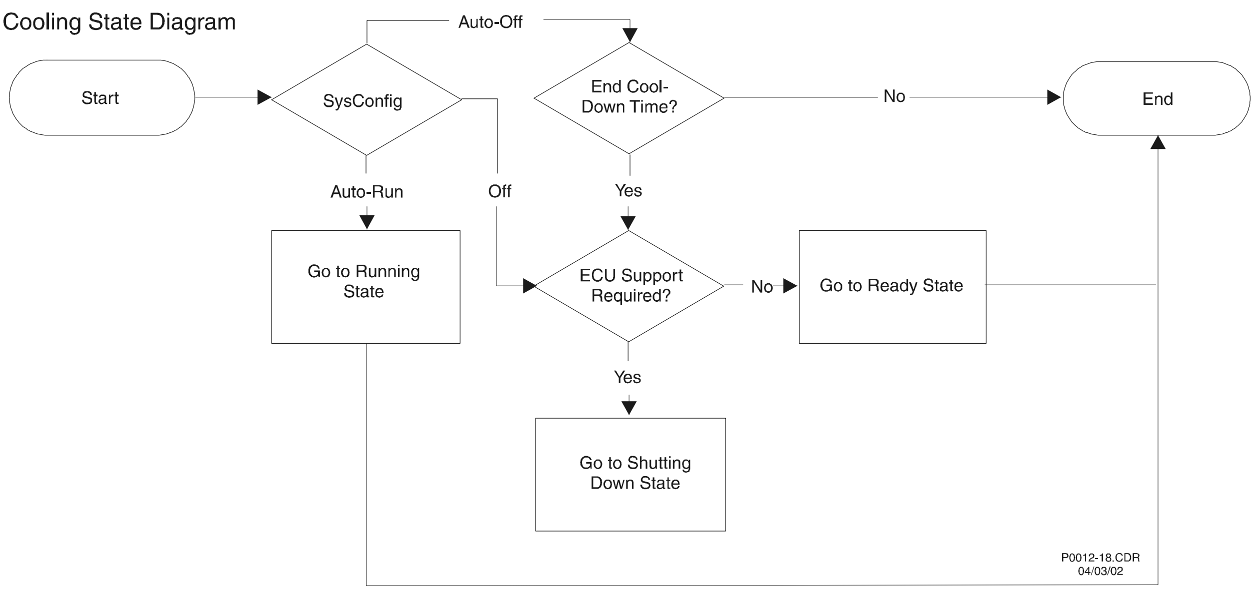

Figure 3-25. Cooling State Diagram

Shutting Down State

The Shutting Down State follows the sequence of events shown in Figure 3-26. If the Engine Shut Down timer expires, the unit transitions to the Ready state. If system configuration changes back to Run/Auto-Run, then this state will transition to the Connecting state, because if the unit is in a Shutting Down state, it will continue to follow the ECU Power Support diagram.

Shutting Down State Diagram

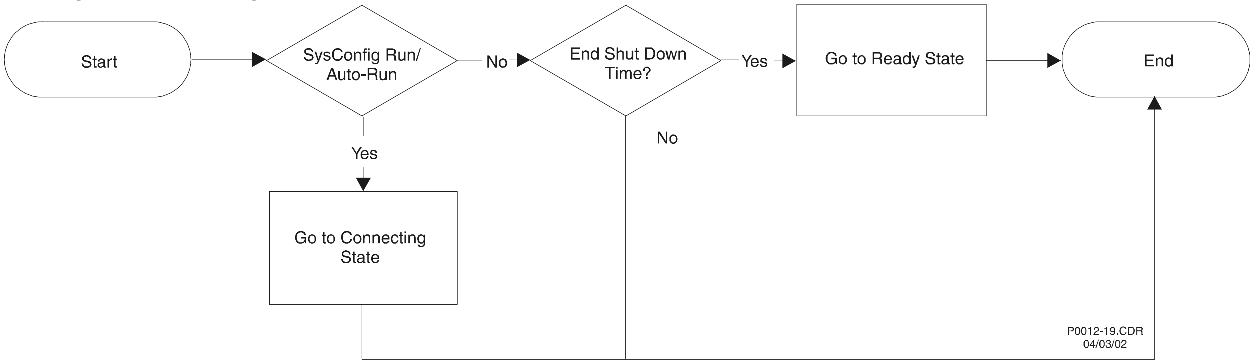

Figure 3-26. Shutting Down State Diagram

Alarm State

All states except Reset can transition to the Alarm state. The State Machine frequently checks for alarms and pre-alarms before running through each state. If an alarm is flagged in the initial alarm check, then the unit goes into an Alarm state and waits there for the alarm to clear. If it is in Run/Auto-Run, then the alarm can be cleared only by going to Off. When the alarm clears, the Alarm state will transition to the Shutting Down state and then go to the Ready state. If ECU Support is enabled, the unit will go to the Pulsing state immediately after transitioning to the Ready state. If in Off/Auto-Off, the alarm can be cleared only if the alarm condition ceases or the user disables the alarm through BESTCOMS. Figure 3-27 illustrates the Alarm State flowchart.

NOTE

With ECU Support enabled, if an alarm was tripped by an ECU value, then it will not clear. This is because in the Alarm state, the fuel solenoid is open, causing the ECU to not have power to update the internal variables. To clear an alarm in this event, the user must remotely put the unit in Off through BESTCOMS or go from Auto-Off to Off via the front panel HMI to force a pulse of the ECU.

Alarm State Diagram

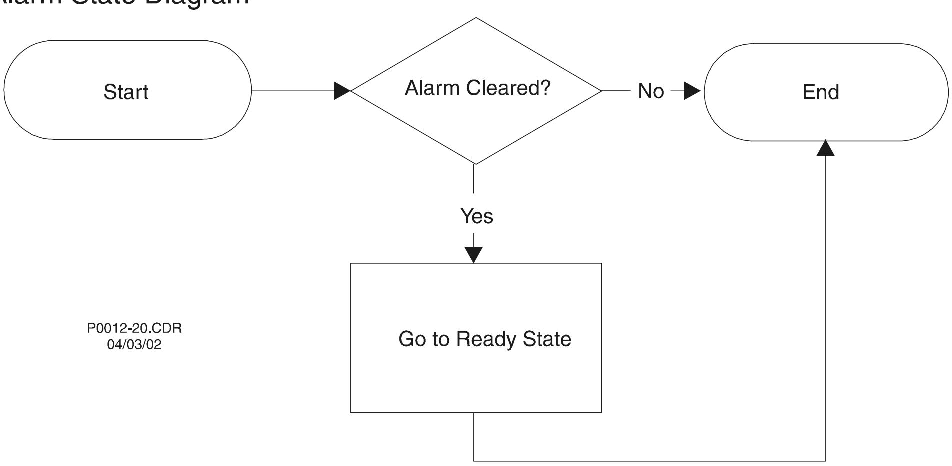

Figure 3-27. Alarm State Diagram

SECTION 4 • BESTCOMS SOFTWARE

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SECTION 4 • BESTCOMS SOFTWARE

INTRODUCTION

BESTCOMS-DGC500-32 software provides a user-friendly communication link between the DGC-500 and the user. An IBM-compatible PC running BESTCOMS can be used to configure the following parameters.

- Sensing transformer ratios
- Programmable contact inputs and programmable outputs
- Engine and system settings
- Engine cranking type and settings
- Pre-alarm and alarm triggers
- Sender data for coolant temperature, oil pressure, and fuel level
- Communication settings

Within BESTCOMS, DGC-500 settings can be saved in a computer file and used later to configure other controllers with the same settings.

INSTALLATION

BESTCOMS-DGC500-32 software operates with IBM compatible personal computers (PCs) using Microsoft® Windows® 95 or later operating systems. The minimum recommended operating requirements are listed below.

- IBM compatible PC, 486DX2 or faster (100 MHz or higher microprocessor is recommended)
- One available serial port
- CD-ROM Drive

Installing BESTCOMS-DGC500-32

BESTCOMS software contains a setup utility that installs the application on your PC. An uninstall utility is loaded with the program and can be used to remove BESTCOMS from your PC if desired. Use the following procedure to install BESTCOMS-DGC500-32.

1. Insert the CD-ROM into the PC CD-ROM drive.
2. When the DGC-500 *Setup and Documentation CD* menu appears, click the Install button for the BESTCOMS PC Program. The setup utility automatically installs BESTCOMS-DGC500-32 on your PC.

When BESTCOMS is installed, a Basler Electric folder is added to the Windows® program menu. This folder is accessed by clicking the **Start** button and pointing to **Programs**. As illustrated in Figure 4-1, the Basler Electric folder contains icons for the BESTCOMS-DGC500-32 program and a utility to remove BESTCOMS.

Figure 4-1. Basler Electric Folder Contents

Connecting the DGC-500 and PC

Connect a communication cable between the rear RS-232 connector of the DGC-500 and the appropriate communication port of the PC. Refer to Figure 2-2 for the location of the DGC-500 RS-232 connector and Figure 5-4 for the required connections between the DGC-500 and a PC.

STARTING BESTCOMS

BESTCOMS is started by clicking the Windows® **Start** button, pointing to **Programs**, the **Basler Electric** folder, and then clicking the **DGC 500** icon. At startup, a dialog box with the program title and version number is displayed briefly (Figure 4-2). After this dialog box is displayed, the Sensing Transformers screen is displayed (Figure 4-3).

Figure 4-2. BESTCOMS Title and Version

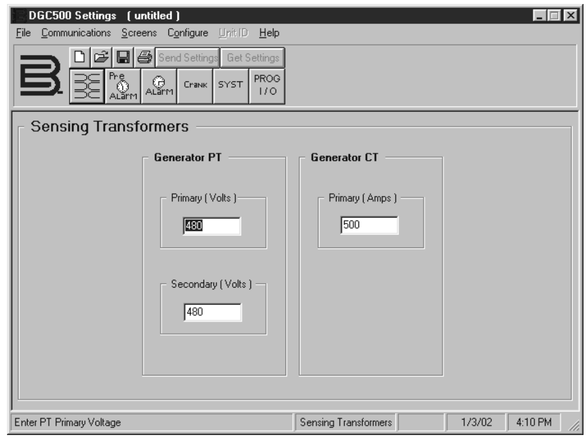

Figure 4-3. Sensing Transformers Screen

Establishing Communication

Communication between BESTCOMS and the DGC-500 must be established before reading or changing settings. BESTCOMS screen settings are updated only after communication is opened or the communication settings have been changed.

Open the DGC-500 communication port by clicking **Communications** on the menu bar and clicking **Open**. When **Open** is selected, the Communication Initiation screen of Figure 4-4 appears. Select the appropriate communication port for your PC (Comm 1, 2, 3, or 4) and click the **Initialize** button. Information about altering the baud and parity settings is provided in the *RS-232 Configuration* sub-section. When the Password dialog box of Figure 4-5 appears, enter the appropriate password and click **OK.** The DGC-500 is delivered with the following default passwords.

- *DGC*. This limited-access password allows all DGC-500 settings to be read, but prevents any changes to settings.
- *DGC500.* This full-access password allows all DGC-500 settings to be read and allows all settings except Engine Runtime to be changed.
- *OEMLVL*. This OEM-access password allows all DGC-500 settings to be read and allows all settings to be changed. It also allows the DGC-500 embedded firmware to be upgraded.

Passwords are case-sensitive; all default passwords are upper-case. More information about passwords is provided in the *Password Protection* sub-section.

The Unit ID number displayed in the password dialog box indicates the identification number of the DGC-500. Information about changing the unit ID for polled communication is provided in the *RS-232 Configuration* sub-section.

Once the password is entered, a dialog box appears and confirms that communication was established and DGC-500 data was received by BESTCOMS.

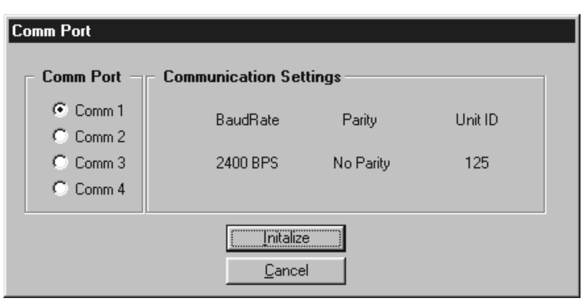

Figure 4-4.Communication Initiation Screen

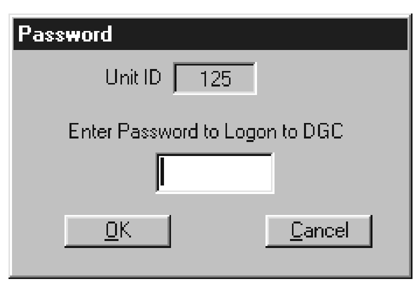

Figure 4-5. Password Dialog Box

CHANGING SETTINGS

DGC-500 settings are arranged into six groups.

- Sensing Transformers
- Pre-Alarms
- Alarms
- Engine Cranking
- System
- Programmable Inputs and Outputs

Each setting group has a corresponding button (shown in Figure 4-3) that can be selected to access that group of settings. The six setting groups can also be accessed by clicking **Screens** on the menu bar and then selecting the desired setting group from the list. Once a setting group is accessed, the individual settings of the group can be viewed and changed.

A setting is changed by clicking within the setting field and typing the new setting. If the new setting is outside the prescribed setting range, a dialog box showing the acceptable range appears when another setting field is accessed or when attempting to send the new setting to the DGC-500. The following paragraphs describe how settings are sent to the DGC-500.

SENDING AND RECEIVING SETTINGS

When communication is enabled, DGC-500 settings can be sent or received through BESTCOMS.

Sending Settings

Setting changes are sent to the DGC-500 by clicking the **Send Settings** button. This causes all settings to become the DGC-500 settings. Settings can also be sent to the DGC-500 by clicking **Communications** on the menu bar and clicking **Send to DGC**.

Receiving Settings

DGC-500 settings are retrieved by clicking the **Get Settings** button. This causes the current settings of the DGC-500 to be loaded into BESTCOMS. Settings can also be received from the DGC-500 by clicking **Communications** on the menu bar and clicking **Get from DGC**. Settings are also automatically retrieved when logging on.

SETTING DEFINITIONS

Each of the six setting groups has a corresponding BESTCOMS screen. The settings of each screen are categorized by one or more tabs. In the following paragraphs, settings are arranged and defined according to the organization of the BESTCOMS screens and tabs.

Sensing Transformers

The button with the transformer icon on it is clicked to access the Sensing Transformers screen. The Sensing Transformers screen can also be accessed by clicking **Screens** on the menu bar and clicking **Sensing Transformers**.

Sensing Transformer settings are shown in Figure 4-6 and are described in the following paragraphs.

Generator PT - Primary (Volts). This setting selects the rating of the primary side of the transformer used to sense generator voltage. The primary voltage setting is adjustable from 1 to 999 Vac.

Generator PT - Secondary (Volts). This setting selects the rating of the secondary side of the transformer used to sense generator voltage. The secondary voltage setting is adjustable from 1 to 480 Vac.

Generator CT - Primary (Amps). This setting selects the rating of the primary side of the transformer used to sense generator current. The primary current setting is adjustable from 1 to 5,000 Aac.

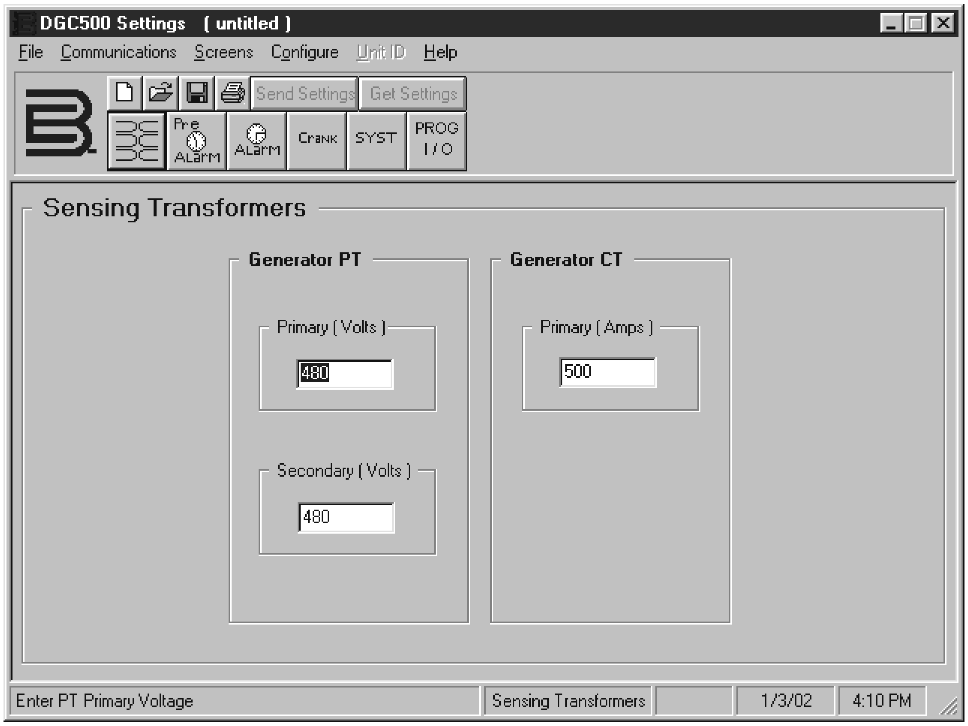

Figure 4-6. Sensing Transformers Screen

Pre-Alarms

Click the **Pre Alarm** button to access the Pre-Alarms screen or click **Screens** on the menu bar and click **Pre-Alarm Settings**.

The Pre-Alarms screen consists of four tabs: Low Fuel-Low Cool-Batt. OverVolt., Low Oil-Low Batt Volt-Weak Batt Volt, Audible-Battery Charger-Fuel Level Sender, and Maint. Interv.-Hi Cool.

Low Fuel-Low Cool-Batt. OverVolt Tab

The Low Fuel-Low Cool-Batt. OverVolt. tab settings of the Pre-Alarms screen are shown in Figure 4-7. Each tab setting is described in the following paragraphs.

Low Fuel Pre-Alarm - Enable. This setting enables and disables annunciation of a low fuel pre-alarm. The Low Fuel Pre-Alarm is deactivated when certain fuel types are selected. The Programmable Senders sub-section provides more information about selecting the fuel type.

Low Fuel Pre-Alarm - Threshold (% Full Tank). This setting selects the fuel level that will trigger a low fuel pre-alarm. A threshold setting of 10 to 100 percent may be entered. The Low Fuel Pre-Alarm is deactivated when certain fuel types are selected. The Programmable Senders sub-section provides more information about selecting the fuel type.

Low Cool Temperature Pre-Alarm - Enable. This setting enables and disables annunciation of a low coolant temperature pre-alarm.

Low Cool Temperature Pre-Alarm - Threshold (Deg F). This setting selects the coolant temperature that will trigger a low coolant temperature pre-alarm. A threshold setting of 50 to 100 degrees Fahrenheit or 10 to 38 degrees Celsius may be entered.

Battery Over Voltage Pre-Alarm - Enable. This setting enables and disables annunciation of a battery overvoltage pre-alarm.

Battery Over Voltage Pre-Alarm - Threshold (Volts). This read-only setting displays the voltage level that will trigger a battery overvoltage pre-alarm. The threshold setting is fixed at 15 Vdc for systems operating at 12 Vdc and 30 Vdc for systems operating at 24 Vdc.

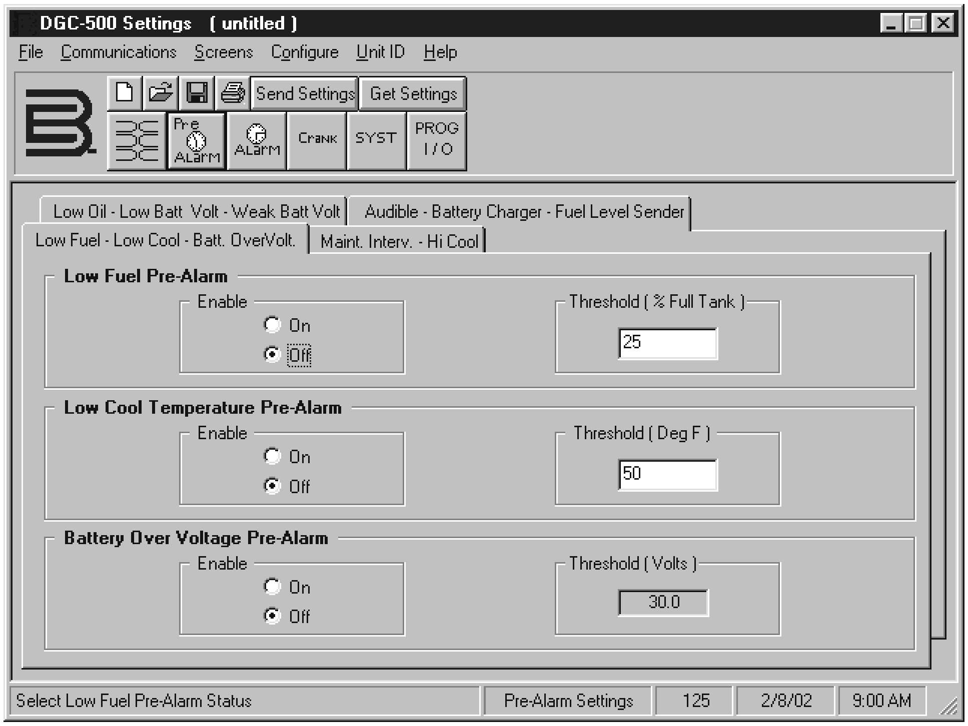

Figure 4-7. Pre-Alarm Screen, Low Fuel-Low Cool-Batt. OverVolt Tab

<u>Low Oil-Low Batt Volt-Weak Batt Volt Tab</u>

The Low Oil-Low Batt Volt-Weak Batt Volt Tab settings are shown in Figure 4-8. Each tab setting is described in the following paragraphs.

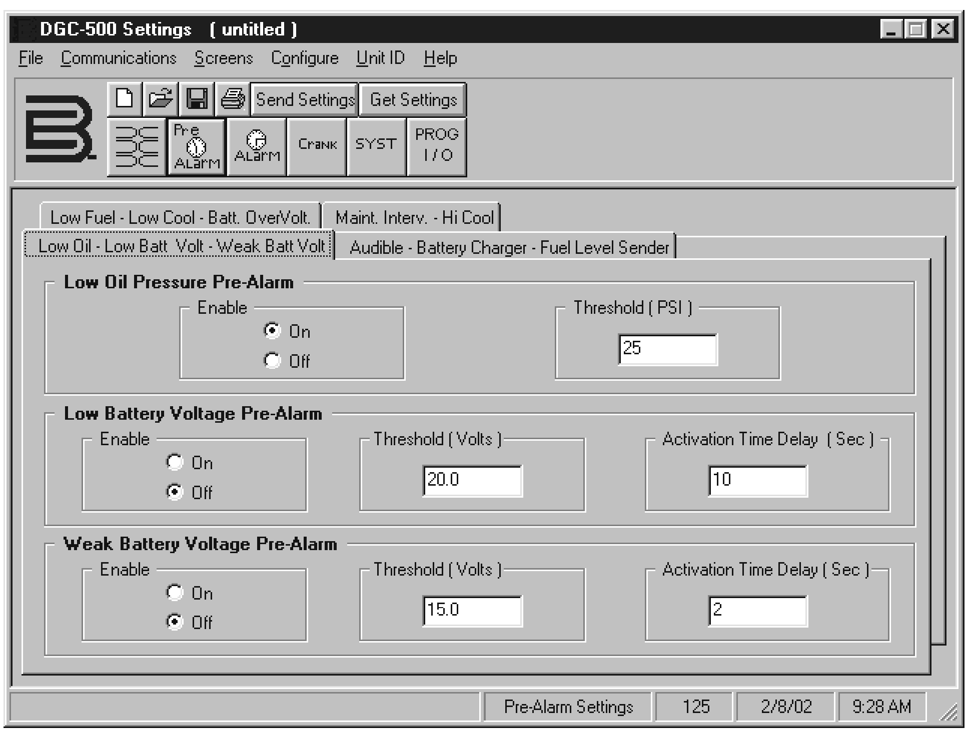

Figure 4-8. Pre-Alarm Screen, Low Oil-Low Batt Volt-Weak Batt Volt Tab

Low Oil Pressure Pre-Alarm - Enable. This setting enables and disables annunciation of a low oil pressure pre-alarm. A 10 second activation time delay prevents low oil pressure annunciation during engine startup.

Low Oil Pressure Pre-Alarm - Threshold (PSI). This setting selects the oil pressure level that will trigger a low oil pressure pre-alarm. A threshold setting of 3 to 150 psi or 20 to 1,035 kPa may be entered. A 10 second activation time delay prevents low oil pressure annunciation during engine startup.

Low Battery Voltage Pre-Alarm - Enable. This setting enables and disables annunciation of a low battery voltage pre-alarm.

Low Battery Voltage Pre-Alarm - Threshold (Volts). This setting selects the voltage level that will trigger a low battery voltage pre-alarm. The threshold setting is adjustable from 6 to 12 Vdc for 12 Vdc systems and 12 to 24 Vdc for 24 Vdc systems.

Low Battery Voltage Pre-Alarm - Activation Time Delay (Sec). This setting selects the time delay from when low battery voltage is detected until a pre-alarm is annunciated. A time delay of 1 to 10 seconds may be entered.

Weak Battery Voltage Pre-Alarm - Enable. This setting enables and disables annunciation of a weak battery voltage pre-alarm.

Weak Battery Voltage Pre-Alarm - Threshold (Volts). This setting selects the voltage level that will trigger a weak battery voltage pre-alarm. The threshold setting is adjustable from 4 to 8 Vdc for 12 Vdc systems and 8 to 16 Vdc for 24 Vdc systems.

Weak Battery Voltage Pre-Alarm - Activation Time Delay (Sec). This setting selects the time delay from when weak battery voltage is detected until a pre-alarm is annunciated. A time delay of 1 to 10 seconds may be entered.

Audible-Battery Charger-Fuel Level Sender Tab

The Audible-Battery Charger-Fuel Level Sender Tab settings are shown in Figure 4-9. Each tab setting is described in the following paragraphs.

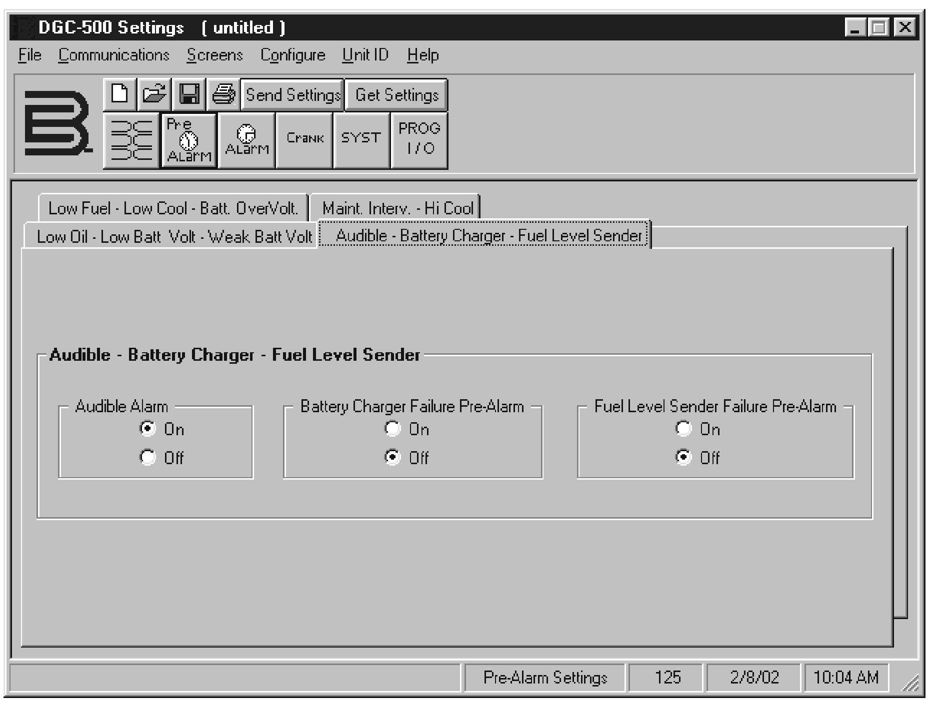

Figure 4-9. Pre-Alarms Screen, Audible-Battery Charger-Fuel Level Sender Tab

Audible Alarm. This setting enables and disables an audible pre-alarm and alarm annunciation.

Battery Charger Failure Pre-Alarm. This setting enables and disables annunciation of a battery charger failure pre-alarm.

Fuel Level Sender Failure Pre-Alarm. This setting enables and disables annunciation of a fuel level sender failure pre-alarm.

Maint. Interv.-Hi Cool Tab

The Maint. Interv.-Hi Cool Tab settings are shown in figure 4-10. Each tab setting is described in the following paragraphs.

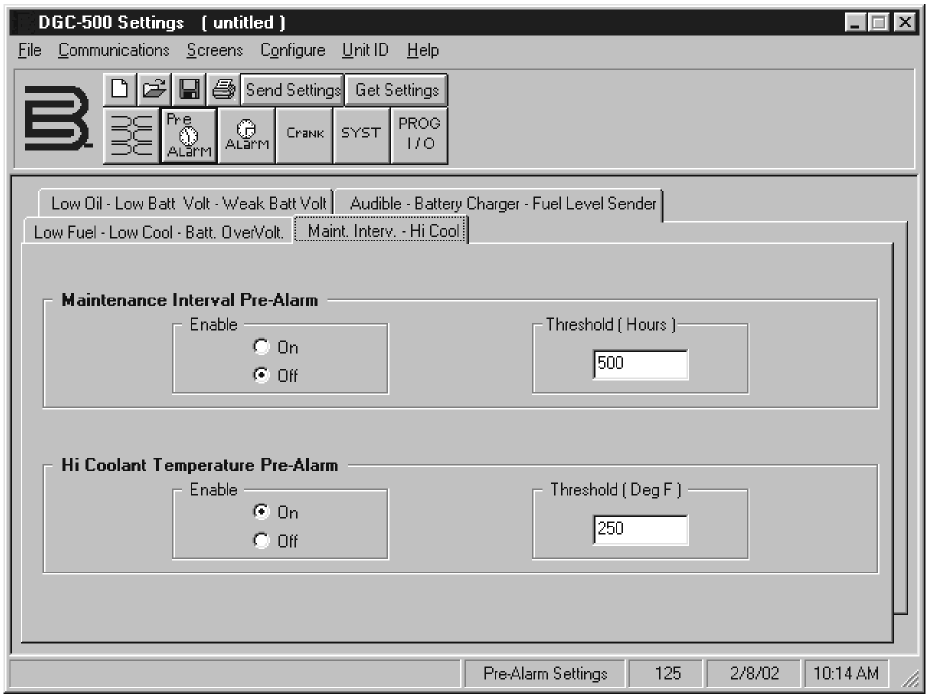

Figure 4-10. Pre-Alarms Screen, Maint. Interv.-Hi Cool Tab

Maintenance Interval Pre-Alarm - Enable. This setting enables and disables annunciation of a maintenance interval pre-alarm.

Maintenance Interval Pre-Alarm - Threshold (Hours). This setting selects the length of the maintenance interval. An interval of zero to 5,000 hours may be selected. Refer to the *Maintenance Interval Timer Reset* paragraph of the *System* sub-section for information about resetting the Maintenance Interval Pre-Alarm.

Hi Coolant Temperature Pre-Alarm - Enable. This setting enables and disables annunciation of a high coolant temperature pre-alarm. A 60 second activation delay prevents a Hi Coolant Temperature Pre-Alarm from occurring at engine startup.

Hi Coolant Temperature Pre-Alarm Threshold (Deg F). This setting selects the coolant temperature that will trigger a high coolant temperature pre-alarm. A threshold setting of 100 to 280 degrees Fahrenheit or 38 to 138 degrees Celsius may be entered. A 60 second activation delay prevents a Hi Coolant Temperature Pre-Alarm from occurring at engine startup.

Alarms

Click the **Alarm** button to access the Alarms screen or click **Screens** on the menu bar and click **Alarm Settings**.

The Alarms screen consists of two tabs: Hi Cool-Low Fuel-Low Oil and Overspeed-Sender Fail.

Hi Cool-Low Fuel-Low Oil Tab

The Hi Cool-Low Fuel-Low Oil Tab settings are shown in Figure 4-11. Each tab setting is described in the following paragraphs.

Hi Cool Temperature Alarm - Alarm Enable. This setting enables and disables annunciation of a high coolant temperature alarm and engine shutdown. A 60 second activation delay prevents a Hi Coolant Temperature Alarm from occurring at engine startup.

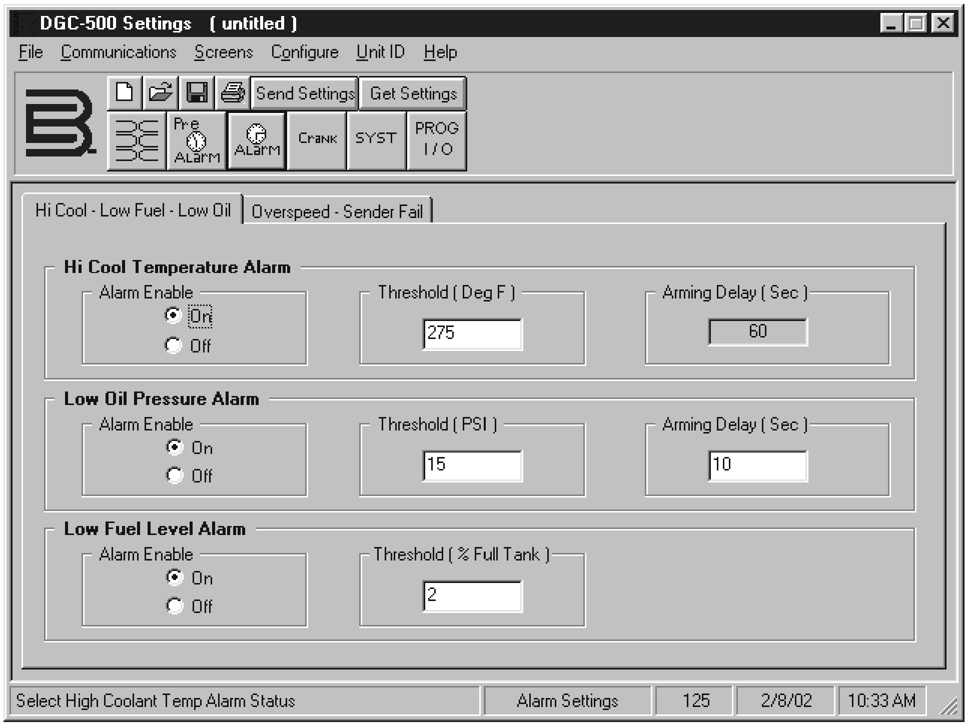

Figure 4-11. Alarms Screen, Hi Cool-Low Fuel-Low Oil Tab

Hi Cool Temperature Alarm - Threshold (Deg F). This setting selects the coolant temperature that will trigger a high coolant temperature alarm. A threshold setting of 100 to 280 degrees Fahrenheit or 38 to 138 degrees Celsius may be entered. A 60 second activation delay prevents a Hi Coolant Temperature Alarm from occurring at engine startup.

Hi Cool Temperature Alarm - Arming Delay (Sec). This read-only setting displays the time delay between when high coolant temperature is detected and an alarm is annunciated and the engine is shut down. The arming delay is fixed at 60 seconds.

Low Oil Pressure Alarm - Alarm Enable. This setting enables and disables annunciation of a low oil pressure alarm and engine shutdown. A 10 second activation time delay prevents low oil pressure annunciation during engine startup.

Low Oil Pressure Alarm - Threshold (PSI). This setting selects the oil pressure level that will trigger a low oil pressure alarm and engine shutdown. A threshold of 3 to 150 psi or 20 to 1,035 kPa may be entered. A 10 second activation time delay prevents low oil pressure annunciation during engine startup.

Low Oil Pressure Alarm - Arming Delay (Sec). This setting selects the time delay between when low oil pressure is detected and an alarm is annunciated and the engine is shut down. A time delay of 5 to 15 seconds may be entered. A 10 second activation time delay prevents low oil pressure annunciation during engine startup.

Low Fuel Level Alarm - Alarm Enable. This setting enables and disables alarm annunciation and engine shutdown for a low fuel level.

Low Fuel Level Alarm - Threshold (% Full Tank). This setting selects the fuel level that will trigger a low fuel level alarm. A threshold of zero to 100 percent may be entered.

<u>Overspeed-Sender Fail Tab</u>

The Overspeed-Sender Fail Tab settings are shown in Figure 4-12. Each tab setting is described in the following paragraphs.

Overspeed Alarm - Alarm Enable. This setting enables and disables alarm annunciation and engine shutdown for an overspeed condition.

Overspeed Alarm - Threshold (% of Rated). This setting selects the percentage of overspeed that triggers an overspeed alarm and engine shutdown. The threshold is adjustable from 105 to 140 % of nominal speed.

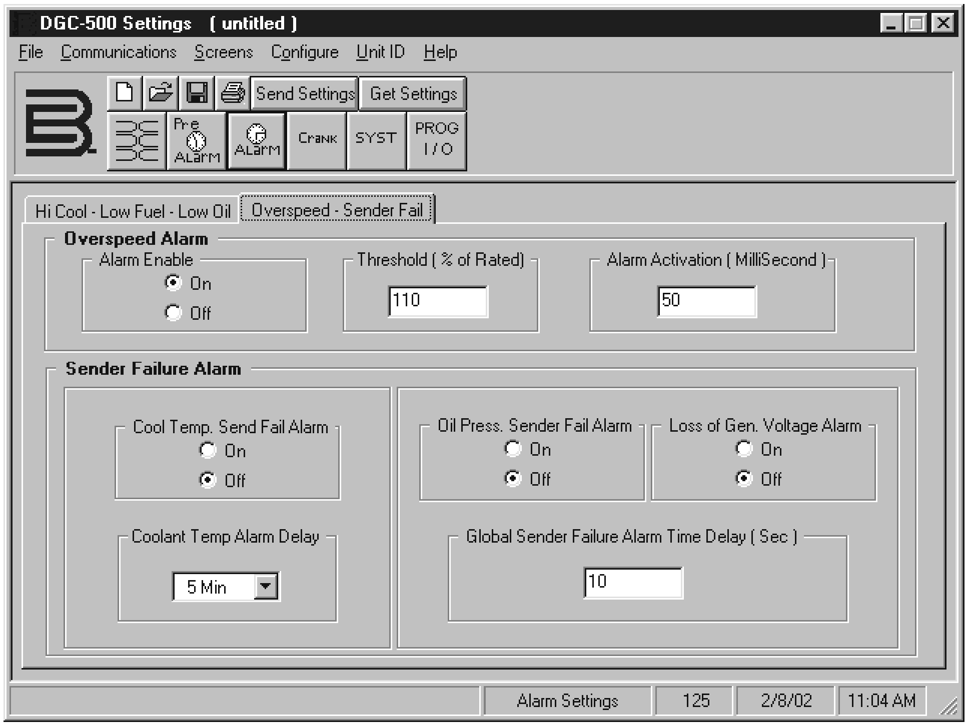

Figure 4-12. Alarms Screen, Overspeed-Sender Fail Tab

Overspeed Alarm - Alarm Activation (MilliSecond). This setting adjusts the time delay from when an overspeed alarm condition is detected until it is annunciated and the engine is shut down. A time delay of zero to 500 milliseconds may be entered.

Sender Failure Alarm - Cool Temp. Send Fail Alarm. This setting enables and disables alarm annunciation and engine shutdown for a coolant temperature sender failure.

Sender Failure Alarm - Coolant Temp Alarm Delay. This setting adjusts the time delay from when a coolant temperature sender failure is detected until it is annunciated and the engine is shut down. A time delay of 5, 10, 15, 20, 25, or 30 minutes may be selected.

Sender Failure Alarm - Oil Press. Sender Fail Alarm. This setting enables and disables alarm annunciation and engine shutdown for an oil pressure sender failure. An oil pressure sender failure alarm is annunciated and engine shutdown is initiated when the Global Sender Failure Alarm Time Delay expires.

Sender Failure Alarm - Loss of Gen. Voltage Alarm. This setting enables and disables alarm annunciation and engine shutdown for a loss of generator voltage. A loss of generator voltage alarm is annunciated when the generator voltage decreases below 1.5 Vac and the Global Sender Failure Alarm Time Delay expires. This setting does not disable a Sender Failure Alarm for the speed signal source when generator frequency is selected as the speed signal source.

Sender Failure Alarm - Global Sender Failure Alarm Time Delay (Sec). This setting selects the time delay between when an oil pressure sender failure, loss of generator voltage failure, or MPU sender failure is detected and alarm annunciation and engine shutdown.

Engine Cranking

Click the **Crank** button to access the Engine Cranking screen or click **Screens** on the menu bar and click **Crank Settings**.

Engine Cranking settings are shown in Figure 4-13 and are described in the following paragraphs.

Cranking Style. This setting selects the cranking method as either continuous or cycle.

Crank Disconnect Limit (% of Rated). This setting selects the percentage of rated engine speed at which cranking is terminated. A disconnect limit of 10 to 100 percent may be entered.

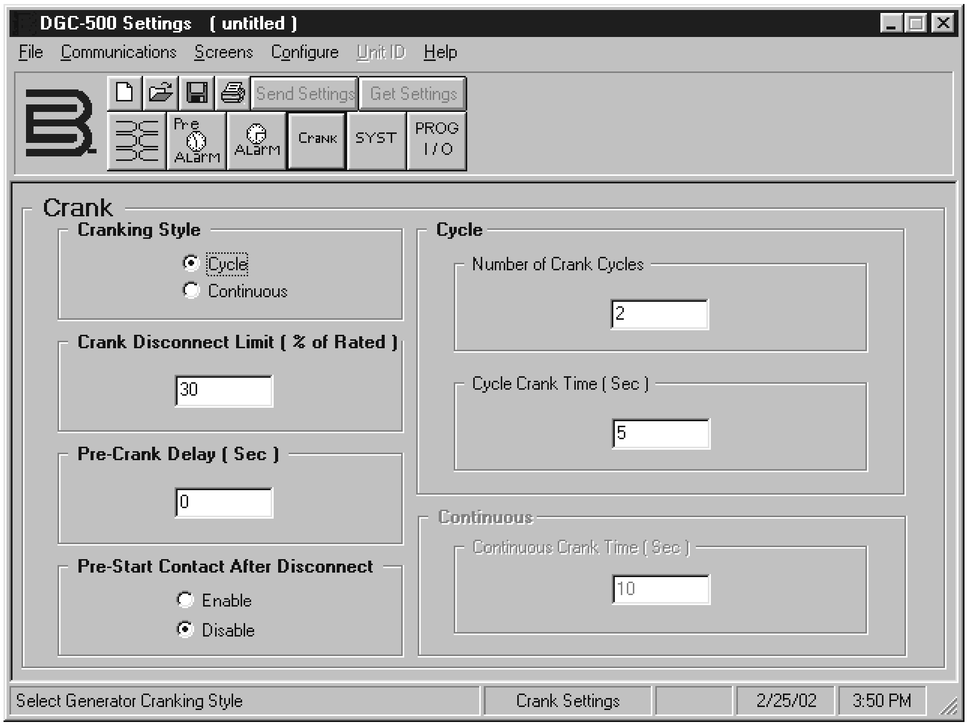

Figure 4-13. Engine Cranking Screen

Pre-Crank Delay (Sec). This setting adjusts the time delay between initiating engine starting and beginning engine cranking. A delay of zero to 30 seconds may be entered.

Pre-Start Contact After Disconnect. This setting selects whether or not the pre-start contact remains closed after disconnect occurs.

Cycle - Number of Crank Cycles. This setting, available only if cycle cranking is selected, selects the number of engine cranking attempts before an overcrank condition occurs and cranking is terminated. The crank cycles setting range is 1 to 7.

Cycle - Cycle Crank Time (Sec). This setting, available only if cycle cranking is selected, controls the duration of each cranking cycle. Each cranking period is separated by a resting period of equal length. A crank time of 5 to 15 may be entered.

Continuous - Continuous Crank Time (Sec). This setting, available only if continuous cranking is selected, selects the duration of a single engine cranking attempt before an overcrank condition occurs. A continuous crank time of 1 to 60 seconds may be entered.

System

Click the **SYST** button to access the System Settings screen or click **Screens** on the menu bar and click **System Settings**.

System settings are shown in Figure 4-14 and are described in the following paragraphs.

Genset's kW Rating. The generator power rating is entered in this field. A genset kW rating of 5 to 9999 may be entered.

Cool Down Time. This setting selects the time delay time for any of the following three conditions.

- The generator load is removed and engine shutdown is permitted.
- The Auto Transfer Switch is opened while operating in Auto mode and engine shutdown occurs.
- A remote shutdown is initiated and engine shutdown occurs.

A cool-down time of zero (0) to 60 minutes may be entered.

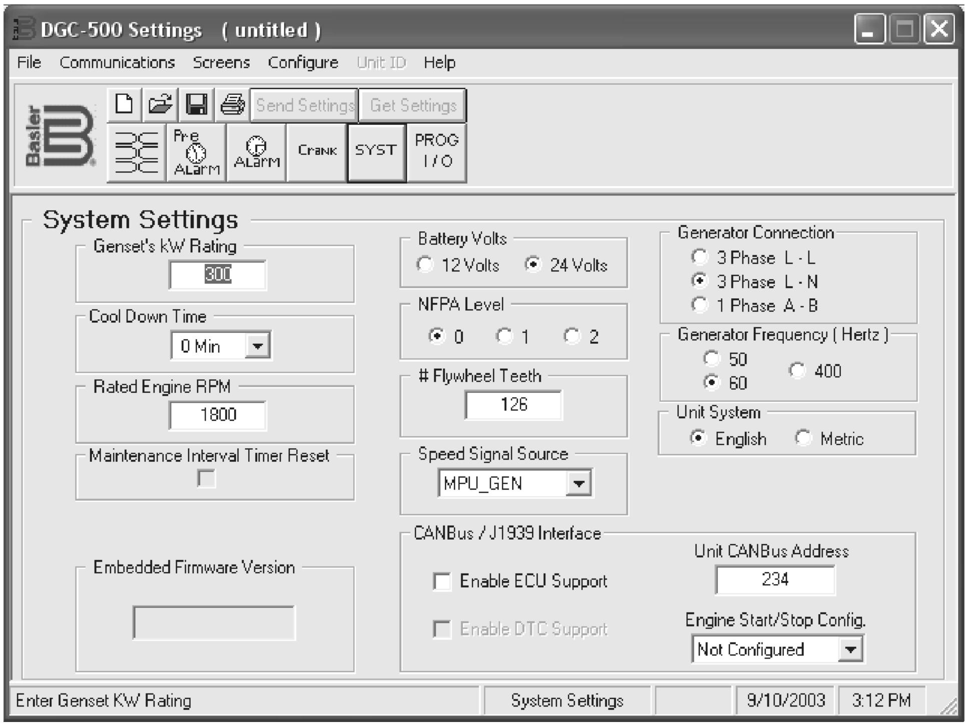

Figure 4-14. System Settings Screen

Rated Engine RPM. This setting selects the rated rotating speed of the engine. A value of 750 to 3,600 rpm may be entered.

Maintenance Interval Timer Reset. Selecting this checkbox terminates the maintenance interval pre-alarm and resets the maintenance interval timer back to the programmed value. The Send Settings button must be clicked for the reset to take effect.

Battery Volts. This setting selects either 12 Vdc or 24 Vdc as the starting battery nominal voltage.

NFPA Level. This setting selects whether or not NFPA requirements are in effect. If NFPA (National Fire Prevention Association) compliance is not required, a setting of zero (0) can be selected to disable the feature. Selecting NFPA level one (1) or two (2) affects DGC-500 operation in the following ways.

- The number of crank cycles is fixed at 3.
- Crank cycle time is fixed at 15 seconds.
- Continuous crank time is fixed at 45 seconds.
- The low coolant temperature pre-alarm setting is fixed at 70°F.

 # Flywheel Teeth. This setting selects the number of teeth on the engine flywheel. A value of 50 to 500 may be entered.

Speed Signal Source. This setting selects from three sources for obtaining the engine speed. The speed signal source can be obtained from the magnetic pickup (MPU), generator frequency, or derived from both the MPU and generator frequency. When both the MPU and generator frequency are selected as the speed signal source, the MPU has priority. If both MPU and generator frequency are selected and the MPU fails, generator frequency is used and a non-programmable MPU sender failure pre-alarm is annunciated.

Embedded Firmware Version. This read-only field displays the firmware version of the DGC-500.

Generator Connection. This setting selects the configuration of the generator voltage sensing circuitry. Either three-phase line-to-line, three-phase line-to-neutral, or single-phase A-phase to B-phase sensing may be selected.

Generator Frequency. This setting selects either 50 hertz or 60 hertz as the nominal generator frequency.

Unit System. This setting selects either the English or Metric unit system for displaying the oil pressure and coolant temperature parameters in BESTCOMS, the DGC-500 HMI, and the optional Remote Annunciation Display Panel (RDP-110).

CANBus/J1939 Interface - Enable ECU Support. This setting enables and disables the DGC-500 CAN interface. When enabled, the CAN interface allows the DGC-500 to communicate with the engine control unit (ECU). This setting must be enabled in order to enable DTC support.

CANBus/J1939 Interface - Enable DTC Support. This setting enables and disables the viewing of diagnostic trouble codes (DTCs) reported by the ECU. Both the Enable ECU Support and Enable DTC Support settings must be enabled to view DTCs.

CANBus/J1939 Interface - Unit CANBus Address. This setting selects the address to be used by the DGC-500 for J1939 communication. A value of 0 to 253 may be entered.

CANBus/J1939 Interface - Engine Start/Stop Config. This setting selects one of two engine start/stop configurations. Selecting Volvo Penta configures the DGC-500 for starting and stopping of the engine using the J1939 communication interface. (The Enable ECU Support setting must be enabled.) Selecting Not Configured disables this feature.

Programmable Inputs and Outputs

Click the **PROG I/O** button to access the Programmable Inputs and Outputs screen or click **Screens** on the menu bar and click **Input/Output Settings**.

The Programmable Inputs and Outputs screen consists of two tabs: Input Setup and Output Setup.

Input Setup Tab

The Input Setup tab settings of the Programmable Inputs and Outputs screen consist of three identical groups of settings for each of the three programmable inputs. Tab settings are shown in Figure 4-15. Each tab setting is described in the following paragraphs.

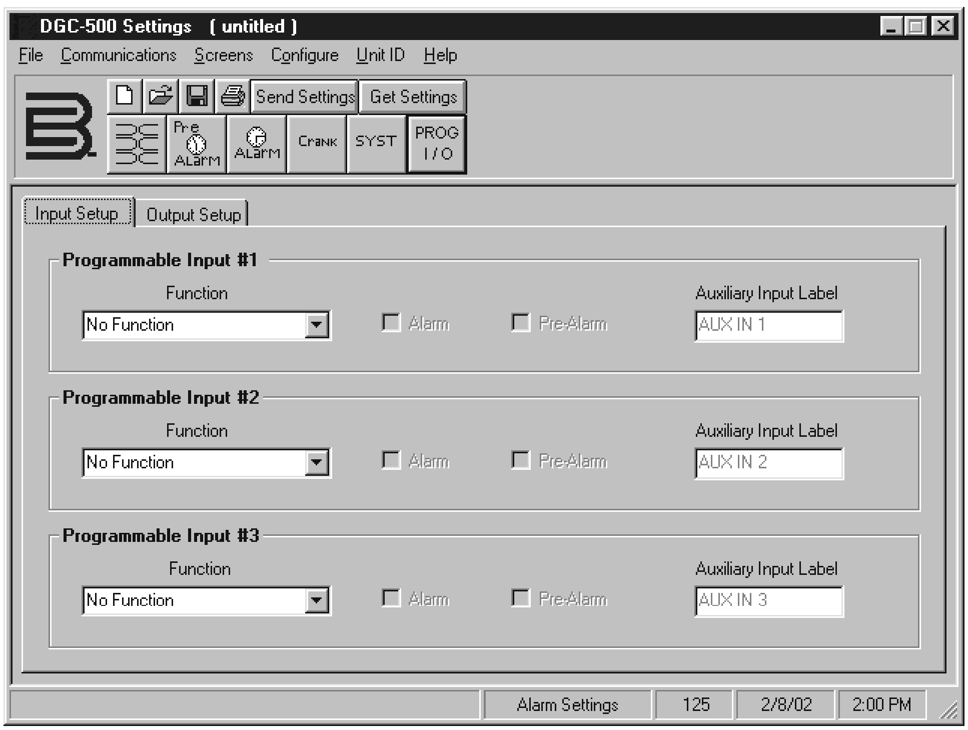

Figure 4-15. Settings Screen, Input Setup Tab

Programmable Input - Function. This setting selects the function type that is used to trigger the corresponding programmable input. The functions available for triggering a programmable input are listed below.

- Auto Transfer Switch
- Auxiliary Input
- Battery Charger Fail
- Fuel Leak Detect
- Low Coolant Level
- No Function
- Single-Phase Override

Programmable Input - Alarm/Pre-Alarm. Either of these check boxes can be selected to annunciate an alarm or pre-alarm when the selected function triggers the programmable input. Alarm or pre-alarm annunciation is available only when one the following functions are selected: Auxiliary Input, Battery Charger Fail, Fuel Leak Detect, or Low Coolant Level.

Programmable Input - Auxiliary Input Label. This setting field is active only when Auxiliary Input is selected as the programmable input function. An user-assigned label (eight characters, maximum) can be entered for the corresponding programmable input.

<u>*Output Setup Tab*</u>

The Output Setup Tab settings of the Settings screen are shown in Figure 4-16. (Not all settings are visible in the illustration.) Each tab setting is described in the following paragraphs.

The Output Setup tab consists of a list of pre-alarms, alarms, and conditions that can be assigned to close either Programmable Output 1 or 2. An output selected by clicking the checkbox in the appropriate row and column. The following pre-alarms, alarms, and conditions can be assigned to one of the two programmable outputs.

- Battery Charger Failure Alarm
- Battery Charger Failure Pre-alarm
- Battery Overvoltage Pre-alarm
- Coolant Temperature Sender Failure Alarm
- Cooldown Timer Active
- Emergency Stop Alarm
- EPS Supplying Load
- Fuel Leak Alarm
- Fuel Leak Pre-alarm
- Fuel Sender Failure Pre-alarm
- High Coolant Temperature Pre-alarm
- High Coolant Temperature Alarm
- Loss of Voltage Sender Failure Alarm
- Low Battery Voltage Pre-alarm
- Low Coolant Level Pre-alarm
- Low Coolant Level Alarm
- Low Coolant Temperature Pre-alarm
- Low Fuel Alarm
- Low Fuel Pre-alarm
- Low Oil Pressure Alarm
- Low Oil Pressure Pre-alarm
- Speed Sender Failure Alarm
- Oil Pressure Sender Failure Alarm
- Overcrank Alarm
- Overspeed Alarm
- Pre-start Condition in Effect
- Programmable Input 1 Closed
- Programmable Input 2 Closed
- Programmable Input 3 Closed
- Scheduled Maintenance Pre-alarm
- Switch Not in Auto
- Weak Battery Voltage Pre-alarm

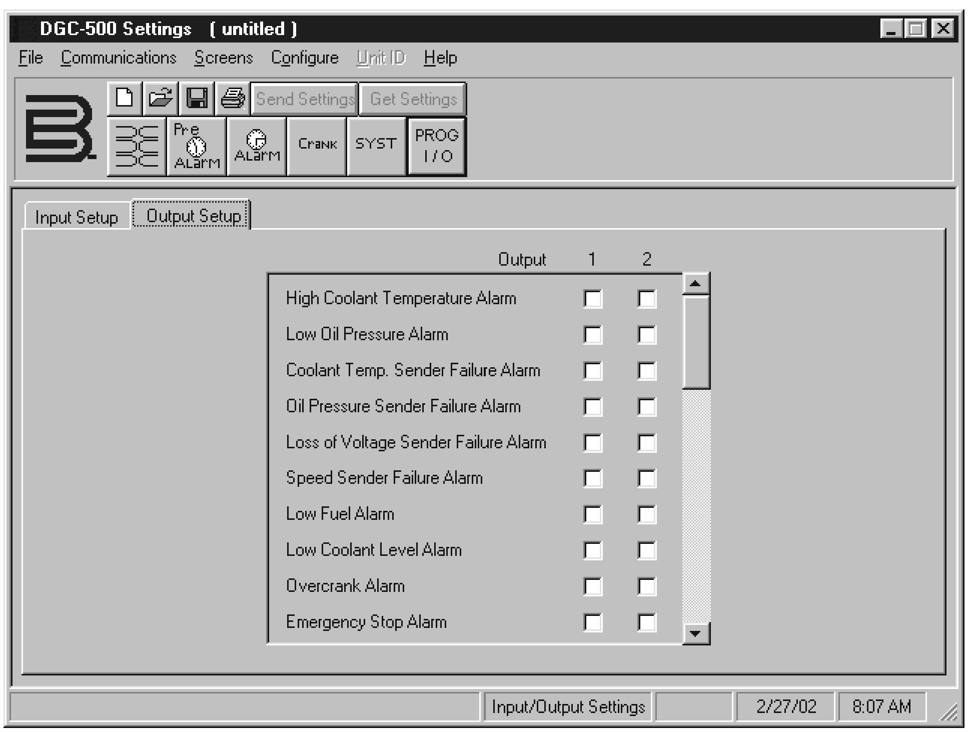

Figure 4-16. Settings Screen, Output Setup Tab

PROGRAMMABLE SENDERS

Click **Configure** on the menu bar and click **Programmable Senders** to access the Programmable Senders screen.

The Programmable Senders screen has three tabs: Coolant Temperature, Oil Pressure, and Percent Fuel Level. Because the setting fields and buttons of each tab are so similar, only the Coolant Temperature tab settings are described here.

The Coolant Temperature tab settings of the Programmable Senders screen are shown in Figure 4-17. Each tab setting is described in the following paragraphs.

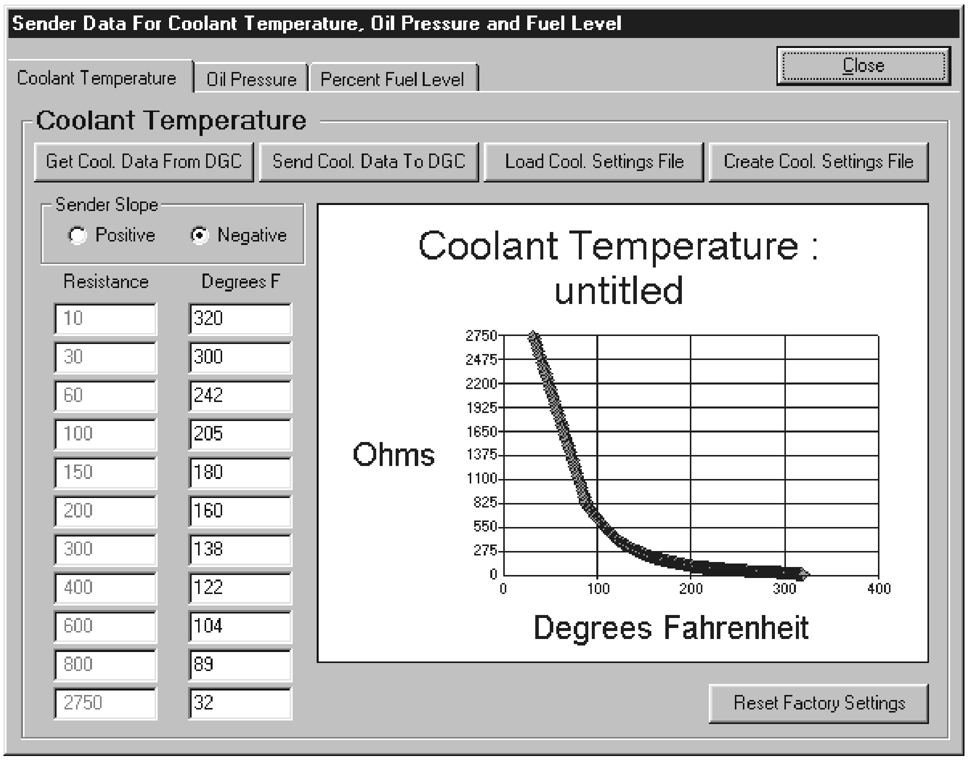

Figure 4-17. Programmable Senders Screen, Coolant Temperature Tab

Get Cool. Data From DGC. If communication with a DGC-500 is enabled, clicking this button retrieves the sender data points from the DGC-500 and refreshes the graph.

Send Cool. Data to DGC. Clicking this button sends the displayed data points to the DGC-500.

Load Cool. Settings File. Clicking this button displays an Open dialog box where a sender file containing sender data points can be retrieved. Some standard data point files for the three senders are included with BESTCOMS. Coolant temperature sender files have a CS5 extension, oil pressure sender files have an OS5 extension, and fuel level sender files have an FS5 extension.

Create Cool. Settings File. Clicking this button displays a Save As dialog box where the transducer data points created in BESTCOMS can be saved in a sender file. While it is possible to create individual sender files for each transducer, it is not necessary. The data for all three senders is automatically saved with the DGC-500 configuration file. The *Settings Files* sub-section contains information about creating DGC-500 configuration files.

Resistance. The 11 resistance points in this column are not adjustable. The DGC-500 has been factory calibrated at these points to maximize accuracy.

Degrees F/Degrees C. Temperature values entered in this column must always maintain a descending order. If English units are used, adjacent coolant temperature points must be separated by at least 2°F. If metric units are used, adjacent oil pressure points must be separated by at least 7 kilopascals. The coolant temperature setting range is 32 to 400°F or 0 to 240°C. The oil pressure setting range is 0 to 250 psi or 0 to 1,725 kilopascals. The fuel level setting range is 0 to 100 percent.

Sender Slope. If a sender requires a positive slope, Positive can be selected to invert the values in the Resistance column.

Reset Factory Settings. Clicking this button restores the factory-default data points in the Degrees F/Degrees C column and graph. This does not update the data points in the DGC-500. The DGC-500 is updated by clicking the Send Cool. Data to DGC button.

> **NOTE**
>
> When metric values are used and changes are made to the oil pressure sender data points, undesirable internal rounding of some data points can occur. For example, select 700 kilopascals for one data point, create a sender file, and the value is rounded to 697. Rounding that occurs will never be greater than 4 kilopascals.

Fuel Level Type

This setting, located on the Percent Fuel Level tab, allows the selection of four fuel types: Percent, Natural Gas, Propane, and Disabled. Selecting a fuel type other than Percent will disable any fuel level indication, alarm, and pre-alarm and disable the percent fuel level values of the Percent Fuel Level tab.

ENGINE RUN TIME

The amount of accumulated running time for an engine can be adjusted by accessing the Run Time dialog box. Click **Configure** on the menu bar and click **Engine Runtime** to view the Run Time dialog box. Unless access is gained by using the OEM-access default password, the **Engine Runtime** selection will not appear under the **Configure** pull-down menu. Enter the accumulated engine running time as hours and minutes in the appropriate fields. The Run Time dialog box is illustrated in Figure 4-18. Click the **Update DGC Accumulated Engine Runtime** button to save the time value to the DGC-500.

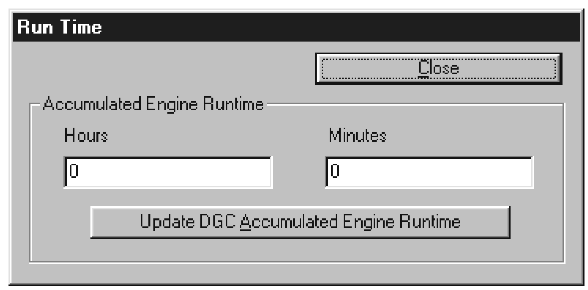

Figure 4-18. Run Time Dialog Box

SETTINGS FILES

BESTCOMS software enables you to print a list of DGC-500 settings, save DGC-500 settings to a file, and open a settings file and upload those settings to a DGC-500.

Printing Settings Files

A printout of DGC-500 settings can be useful for record keeping or comparison purposes. Click the **Print Settings File** button or click **File** on the menu bar and click **Print** to access the Print DGC-500 Settings screen. This print screen contains a print-preview pane and settings for selecting the printer, content of the printout, and the printout orientation. DGC-500 settings are divided into three print sections: General Settings, Programmable I/O Settings, and Input Sender Settings. Any combination of sections can be selected for printing.

New Settings File

Clicking this button resets the settings displayed in BESTCOMS to the factory-default values. If changes to settings have not been saved, you will be given the opportunity to save the changes in a DGC-500 settings file.

Saving Settings Files

Saving DGC-500 settings to a file for uploading to other DGC-500 units saves setup time when configuring multiple units to the same configuration. A settings file can also be created in BESTCOMS without being connected to a DGC-500. The settings of the desired screens can be changed and these settings can then be saved to a file.

A settings file is created by clicking the **Save Settings File** button or clicking **File** on the menu bar and clicking **Save**. A file properties box appears and allows you to enter generator information and other pertinent notes about the settings. Next, a Save As dialog box prompts you to select the name and location of the settings file. All DGC-500 settings files are automatically given a DG5 file extension by BESTCOMS.

Opening Settings Files

To open a DGC-500 settings file, click the **Open Settings File** button or click **File** on the menu bar and click **Open**. An Open dialog box will appear and enable you to select a DGC-500 settings file (DG5 extension) for retrieval into BESTCOMS.

RS-232 CONFIGURATION

When communication is established between a PC and DGC-500, changes in BESTCOMS to the communication configuration settings affect both the PC and DGC-500. When communication between a PC and DGC-500 is closed, changes in BESTCOMS to the communication configuration settings affect only the PC.

The communication configuration settings are viewed and adjusted through the Communications Configure dialog box. This dialog box is accessed by clicking **Configure** on the menu bar and clicking **RS232.** The Communications Configure dialog box settings are illustrated in Figure 4-19 and described in the following paragraphs.

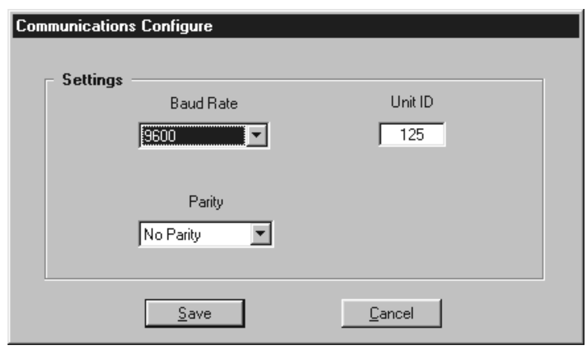

Figure 4-19. Communications Configure Dialog Box

Baud Rate. This setting selects the communication rate. A baud rate of 1200, 2400, or 9600 can be selected.

Parity. This setting enables and disables summation checking of data transmitted between the PC and DGC-500. A setting of No Parity, Odd Parity, or Even Parity can be selected.

Unit ID. This setting allows an identification number to be assigned to a DGC-500 for polled communication. A number between 1 and 247 may be used.

ENGINE CONTROL UNIT (ECU) TIMERS

Four timers are provided to customize the timing of pulsing the ECU for periodic updates. These timers are adjusted through the ECU Timers dialog box. This dialog box is accessed by clicking **Configure** on the menu bar and clicking **ECU Timers** (see Figure 4-20).

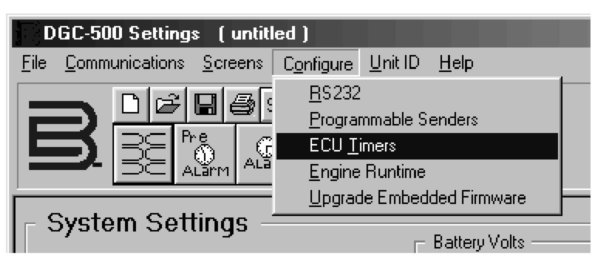

Figure 4-20. ECU Timers Menu Selection

The ECU-related time values of the ECU Timers dialog box are shown in Figure 4-21 and described in the following paragraphs.

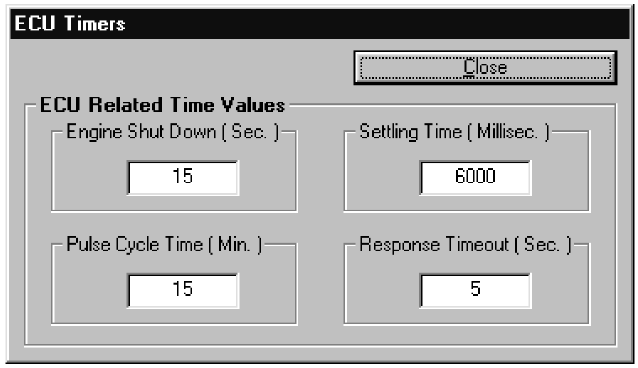

Figure 4-21. ECU Timers Dialog Box

Engine Shut Down (Sec.). When going from Running to Shut Down, this setting adjusts the length of time that the DGC-500 stays disconnected from the ECU before starting the first pulse. The Engine Shut Down setting range is 1 to 60 seconds.

Setting Time (Millisec.). This setting adjusts the time to gather data after connecting to the ECU during the Pulsing state. This allows all metered values to be sent and ramp up. Metered values are sent by the ECU at different rates as designated by the J1939 protocol. Values sent by the ECU may be low initially; the ECU takes time to average its own data. The Setting Time setting range is 5,500 to 30,000 milliseconds.

Pulse Cycle Time (Min.). This setting adjusts the time that the DGC-500 waits to pulse the ECU again. The Pulse Cycle Time setting range is 1 to 60 minutes.

Response Timeout (Sec.). This setting controls the time that communication is attempted with the ECU while the DGC-500 is in the Pulsing or Connecting state. The Response Timeout setting range is 1 to 60 seconds.

PASSWORD PROTECTION

Password protection guards against unauthorized changing of DGC-500 settings. DGC-500 passwords are case-sensitive. Three levels of password protection are available. Each level is described in the following paragraphs.

- *Limited Access.* This password level allows all DGC-500 settings to be read, but prevents any changes to settings. The default, limited-access password is DGC.
- *Full Access.* This password level allows all DGC-500 settings to be read and allows all settings except Engine Runtime to be changed. The default, full-access password is DGC500.
- *OEM Access.* This password allows all DGC-500 settings to be read and allows all settings to be changed. It also allows the DGC-500 embedded firmware to be upgraded. The default, OEM-access password is OEMLVL.

Changing Passwords

Passwords can be changed only after communication between the PC and DGC-500 is established. Changes to passwords are made through the Change Password dialog box. To access the Change Password dialog box, click **Communications** on the menu bar and click **Change Password**.

The content of the Change Password dialog box depends on the password level used when accessing the dialog box. For example, someone logged-in with a full-access password will be able to change only the limited-access and full-access passwords—not the OEM-access password. Figure 4-22 shows the Change Password dialog box with all three access levels shown.

A password is changed by selecting the access level, entering the new password, and then re-entering the new password to confirm the entry.

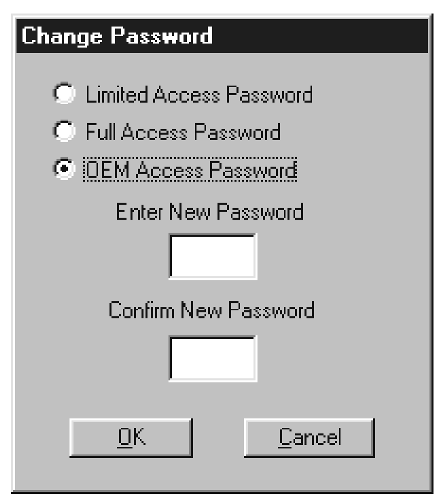

Figure 4-22. Change Password Dialog Box

Once a password is changed, it should be stored in a secure location. If a user-defined password is lost or forgotten, contact Basler Electric for instructions on regaining password access.

TERMINATING COMMUNICATION

DGC-500 communication is terminated by clicking **Communications** on the menu bar and clicking **Close**. If unsaved settings changes were made, you are prompted to save the changes in a new or existing settings file. When you execute the close communication command (with or without saving settings), communication with the DGC-500 is terminated. If you choose to exit BESTCOMS (by clicking **File** on the menu bar and then **Exit**) without first closing communication, you are still given the opportunity to save any settings changes.

EMBEDDED FIRMWARE

Embedded firmware is the operating program that controls the actions of the DGC-500. The DGC-500 stores firmware in nonvolatile flash memory that can be reprogrammed through the RS-232 communication port. It is not necessary to replace EPROM chips when updating the firmware with a newer version.

Updating the Firmware

Future enhancements to DGC-500 functionality may make a firmware update desirable. Because default settings are loaded when DGC-500 firmware is updated, your settings should be saved in a file prior to upgrading firmware. DGC-500 embedded firmware can be updated by performing the following steps.

CAUTION

If power is lost or communication is interrupted during file transfer, the DGC-500 will not recover and will cease operating.

1. Connect a communication cable between the rear RS-232 connector of the DGC-500 and the appropriate communication port of your PC. Start BESTCOMS-DGC500-32, open communication, and gain password access with the OEM-access password.
2. Click **Configure** on the menu bar and click **Upgrade Embedded Firmware**. When **Upgrade Embedded Firmware** is clicked, the Embedded Firmware Upgrade dialog box (Figure 4-23) appears.

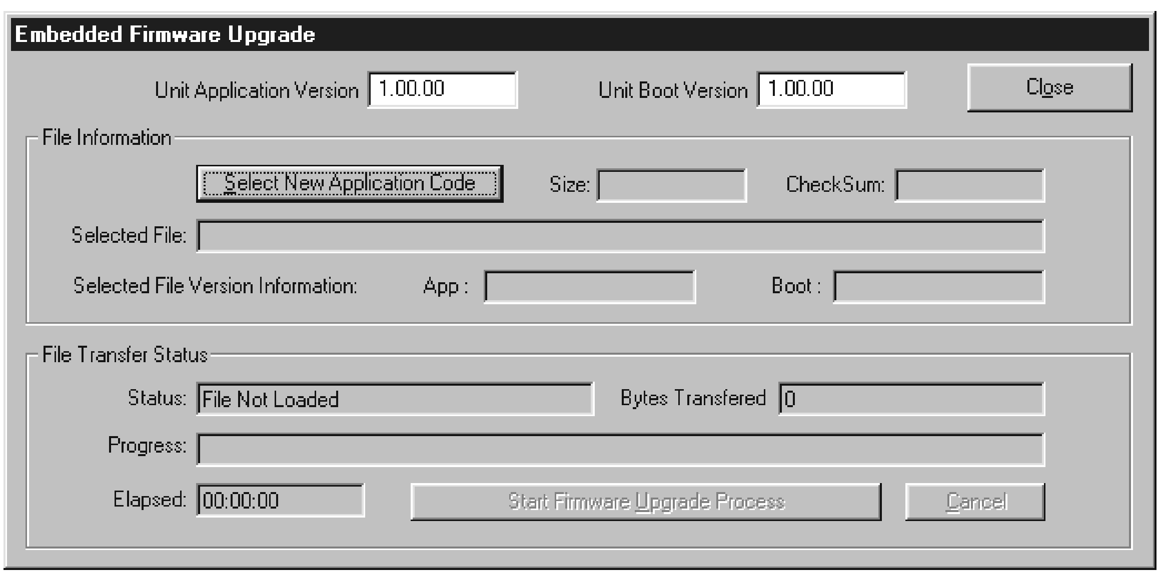

Figure 4-23. Embedded Firmware Upgrade Dialog Box

3. Click the **Select New Application Code** button and then navigate to and select the file (S19 file extension) to be used for updating the DGC-500 firmware. The file details are displayed in the File Information section of the Embedded Firmware Upgrade dialog box (Figure 4-24).

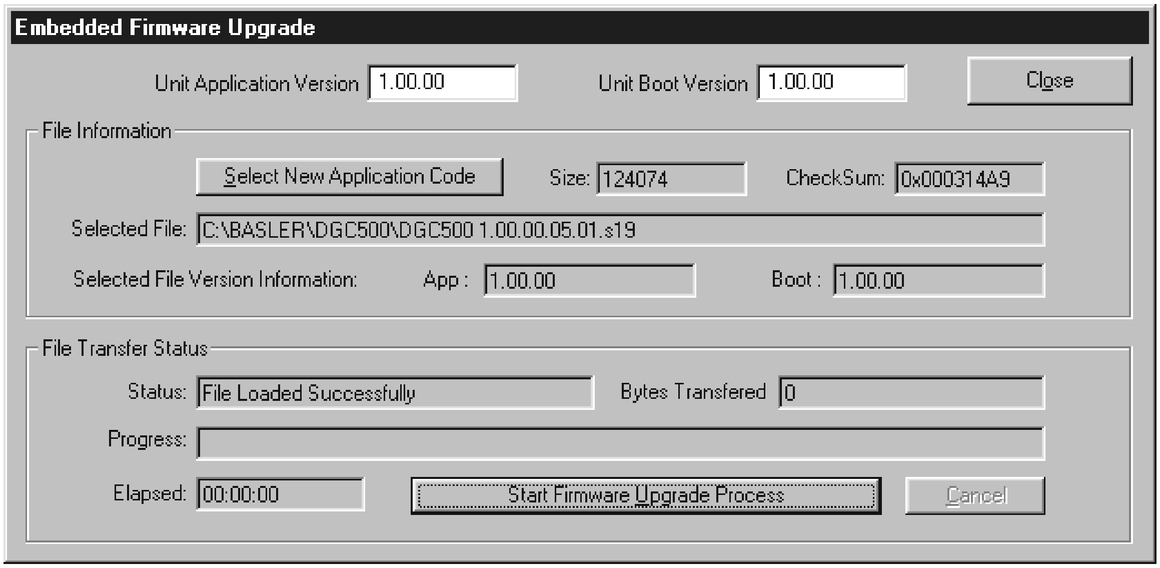

Figure 4-24. Firmware File Information

4. Click the **Start Firmware Upgrade Process** button. The Erase Application Code!!!! and Save Settings Before You Continue!!!! dialog boxes appear and confirm that you want to continue. Click **Yes** in both dialog boxes to begin transferring the firmware file to the DGC-500. The file transfer status is displayed in the Embedded Firmware Upgrade dialog box (Figure 4-25).

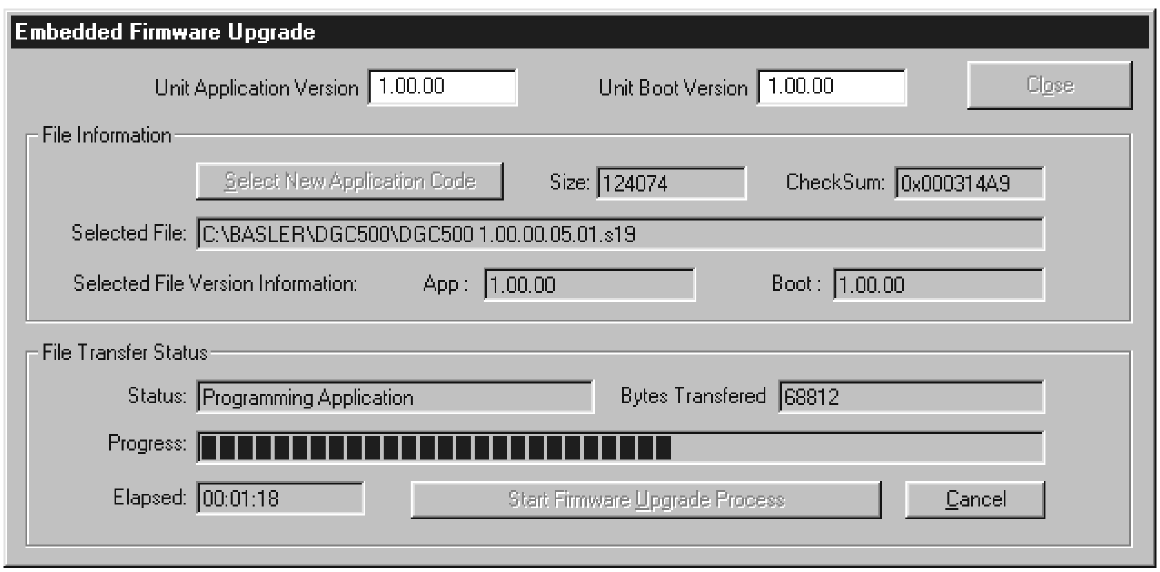

Figure 4-25. File Transfer Status

5. Once the file transfer is complete, close the Embedded Firmware Upgrade dialog box, open communication between the PC and DGC-500, and gain password access to the DGC-500 with the appropriate password.

SECTION 5 • INSTALLATION

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SECTION 5 • INSTALLATION

GENERAL

DGC-500 Digital Genset Controllers are delivered in sturdy cartons to prevent shipping damage. Upon receipt of a system, check the part number against the requisition and packing list for agreement. Inspect for damage, and if there is evidence of such, immediately file a claim with the carrier and notify the Basler Electric Regional Sales Office, your Sales Representative, or a Sales Representative at Basler Electric, Highland, Illinois.

If the device is not installed immediately, store it in the original shipping package in a moisture and dust-free environment.

HARDWARE

DGC-500 controllers are packaged for mounting in any top-mount enclosure. The front panel is resistant to moisture, salt fog, humidity, dust, dirt, and chemical contaminants. It also inhibits insect and rodent entrance. DGC-500 controllers are mounted using the four permanently attached 10-32 studs.

MOUNTING

Case cutout dimensions are shown in Figure 5-1. Overall dimensions are shown in Figures 5-2. All dimensions are shown in inches and millimeters (in parenthesis).

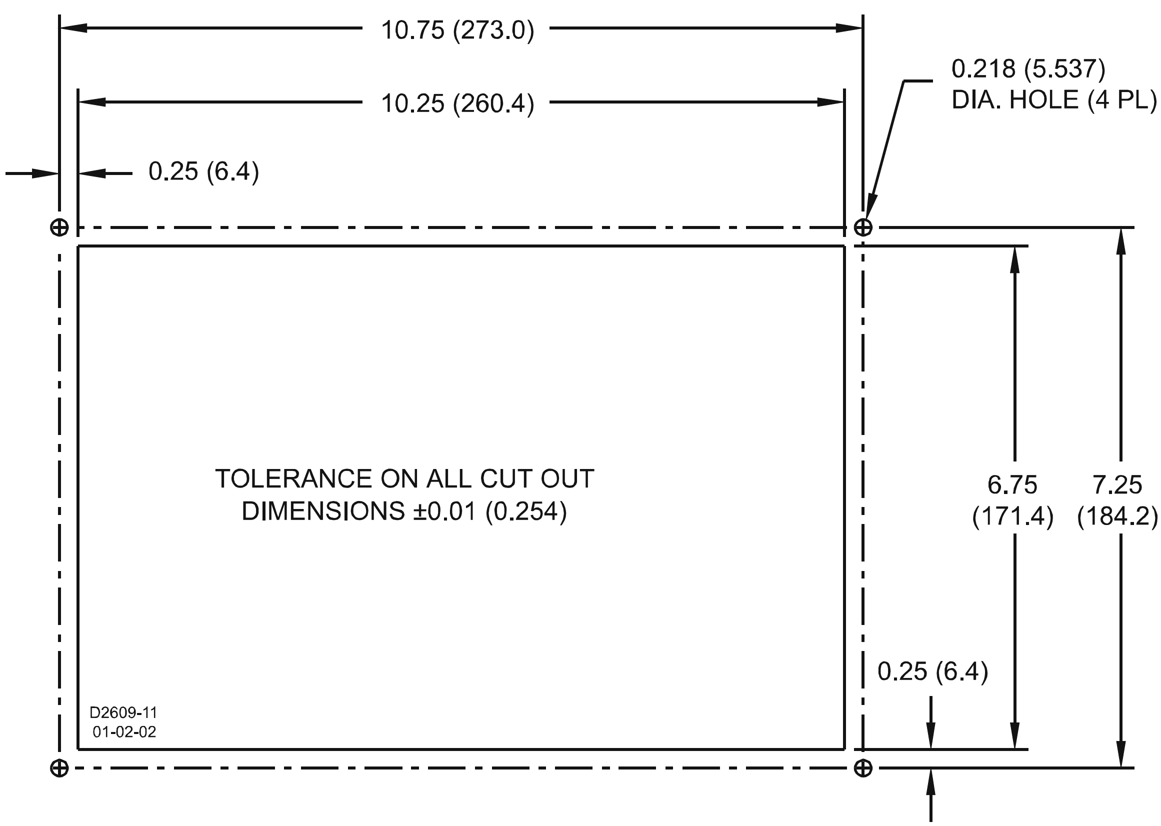


Figure 5-1. DGC-500 Cutout Dimensions

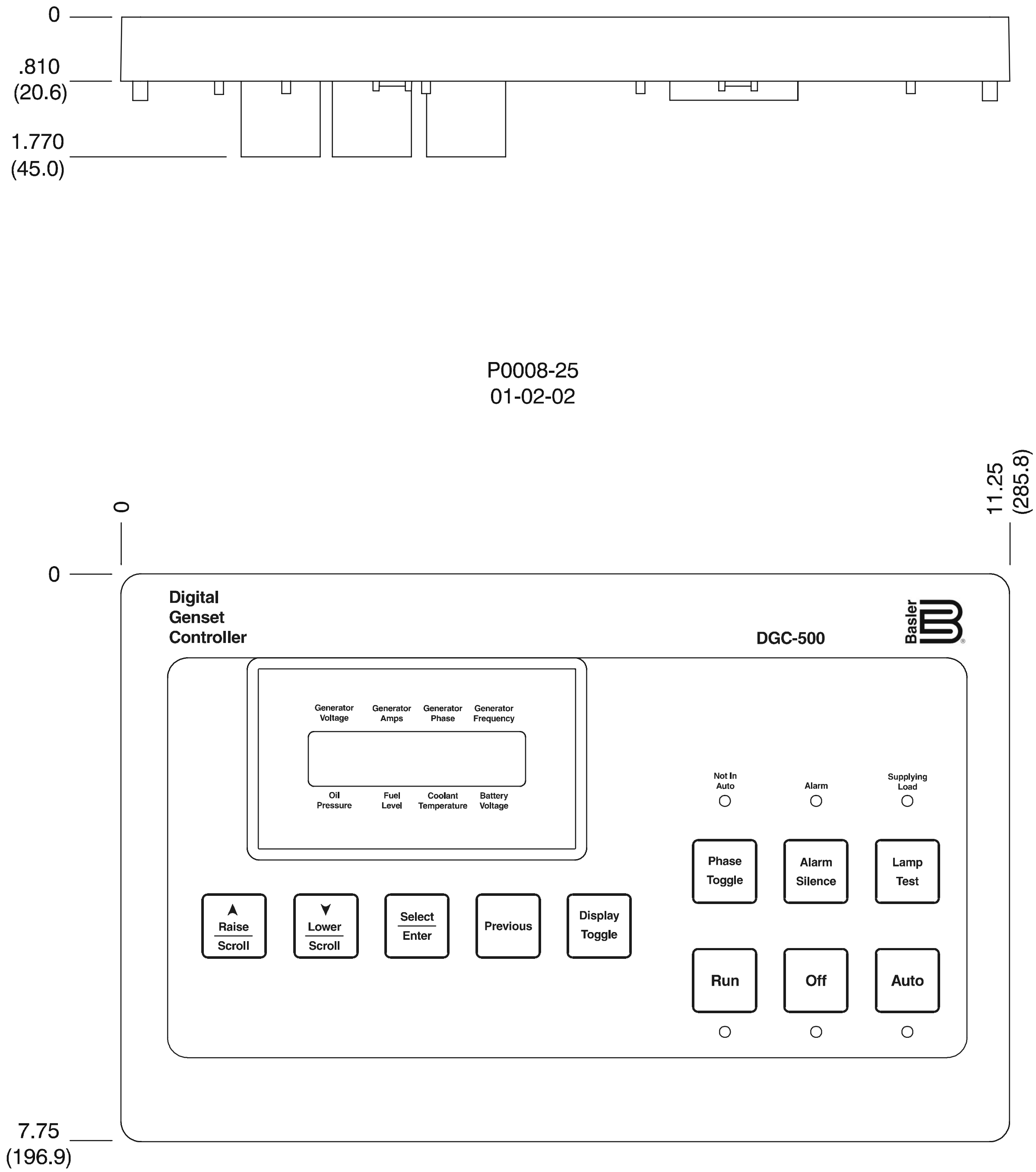


Figure 5-2. DGC-500 Overall Dimensions

DGC-500 Isolator Kit

The optional DGC Isolator Kit provides an economical way to reduce the level of shock and vibration transmitted from a generator to the DGC-500. The DGC Isolator Kit eliminates the need to mount an isolator box on top of the generator conduit box and simplifies wiring considerations. Isolator kits are available with either black- or gray-colored gaskets. Kit part number 9 3554 06 100 is supplied with a black gasket and kit part number 9 3554 06 101 is supplied with a gray gasket.

The DGC Isolator Kit provides vibration dampening at frequencies greater than 48 hertz. Above 90 hertz, vibration transmissibility is less than 10 percent of the input magnitude.

CONNECTIONS

DGC-500 connections are dependent on the application. Incorrect wiring may result in damage to the controller.

> **NOTE**
>
> Be sure that the DGC-500 is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the chassis ground terminal (P22) on the rear of the controller.
>
> Operating power from the battery must be of the correct polarity. Although reverse polarity will not cause damage, the DGC-500 will not operate.

DGC-500 Terminations

All DGC-500 terminals are located on the rear panel of the controller. There are three types of interface terminals.

J1, a DB9 connector, is used as a temporary communication interface with IBM compatible PCs.

J2, a five-terminal header, is an SAE J1939 interface used for high-speed communication with a CAN-enabled engine control unit (ECU). J2 is enabled only on DGC-500 controllers with style numbers of F1J or F5J.

All other connections consist of quarter-inch, quick-connect terminals. Amp part numbers 154718-3 (positive-lock receptacle) and 154719-1 (nylon housing) are the recommended components for making connections at the quick-connect terminals. Wires performing common functions, such as voltage sensing leads, should be grouped together.

All connections (except chassis ground and communication) should be made with wire no smaller than 14 AWG.

Serial Communication Port

The RS-232 port on the rear panel uses a DB9 female connector. Figure 5-3 illustrates the pin assignments of the communication port and Table 5-1 identifies the RS-232 connector pin functions. A standard communication cable terminated with a DB9 male connector is used for PC interface with the DGC-500 as shown in Figure 5-4.

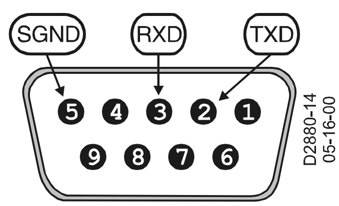


Figure 5-3. DGC-500 Communication Port Pin Assignments

Table 5-1. DGC-500 Communication Port Pin Functions

Pin	Function	Name	Direction
1	N/C	—	N/A
2	Transmit Data	TXD	From DGC-500
3	Receive Data	RXD	To DGC-500
4	N/C	—	N/A
5	Signal Ground	GND	N/A
6, 7, 8, 9	N/C	—	N/A

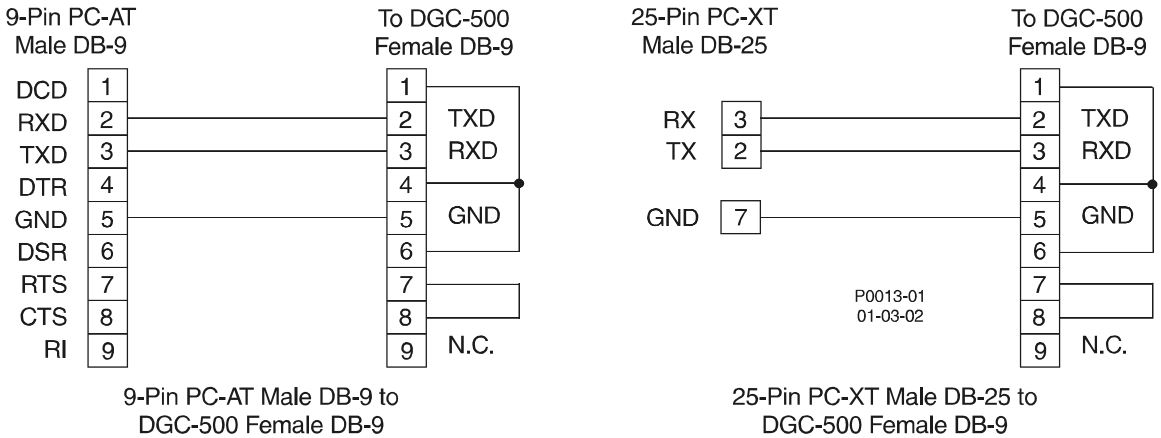


Figure 5-4. Personal Computer to DGC-500 Connections

CAN Connections

The CAN connector (J2) on the rear panel mates with the cable assembly (Basler P/N 9 3589 00 002) provided with the DGC-500. Only units with style numbers F1J AND F5J are supplied with the cable assembly and have connector J2 enabled. The cable assembly is shown in Figure 5-5 and the termination assignments are listed in Table 5-2. Figure 5-6 illustrates typical DGC-500 CAN interface connections.

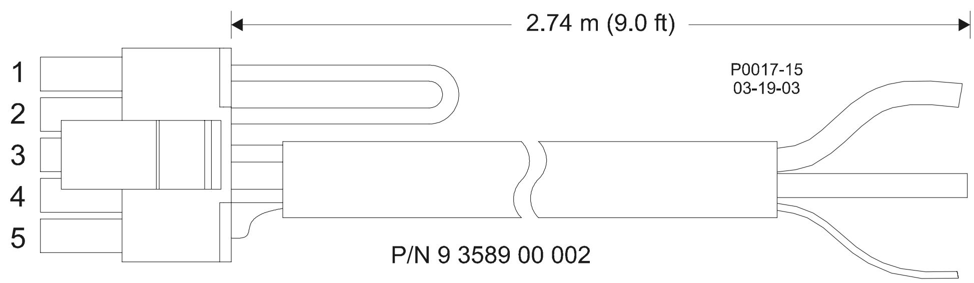


Figure 5-5. CAN Cable Assembly

Table 5-2. CAN Cable Assembly Termination Assignments

J2 Terminations	Function	User Terminations
Pin 1	Termination Resistor	✳
Pin 2		
Pin 3	CAN High	Red Wire
Pin 4	CAN Low	Black Wire
Pin 5	Drain	Uninsulated Wire †

✳ If the DGC-500 is not providing one end of the J1939 backbone, cut the jumper connected across pins 1 and 2 to disconnect the internal terminating resistor.

† The J1939 drain (shield) should be grounded at one point only. If grounded elsewhere, cut the drain connection to the DGC-500.

Note: If the DGC-500 is not part of the J1939 backbone, the stub connecting the DGC-500 to the backbone should not exceed 914 mm (3 ft) in length.

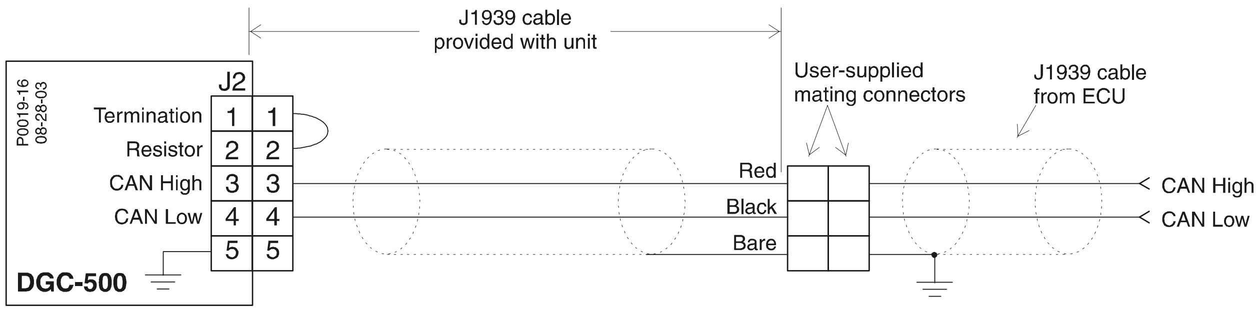


Figure 5-6. Typical DGC-500 CAN Interface Connections

DGC-500 Connections for Typical Applications

Figures 5-7 through 5-9 illustrate typical applications using the DGC-500. Figure 5-7 shows a DGC-500 application using single-phase sensing. Figure 5-8 shows a DGC-500 application using three-phase, delta sensing. Figure 5-9 shows a DGC-500 application using three-phase, wye sensing.

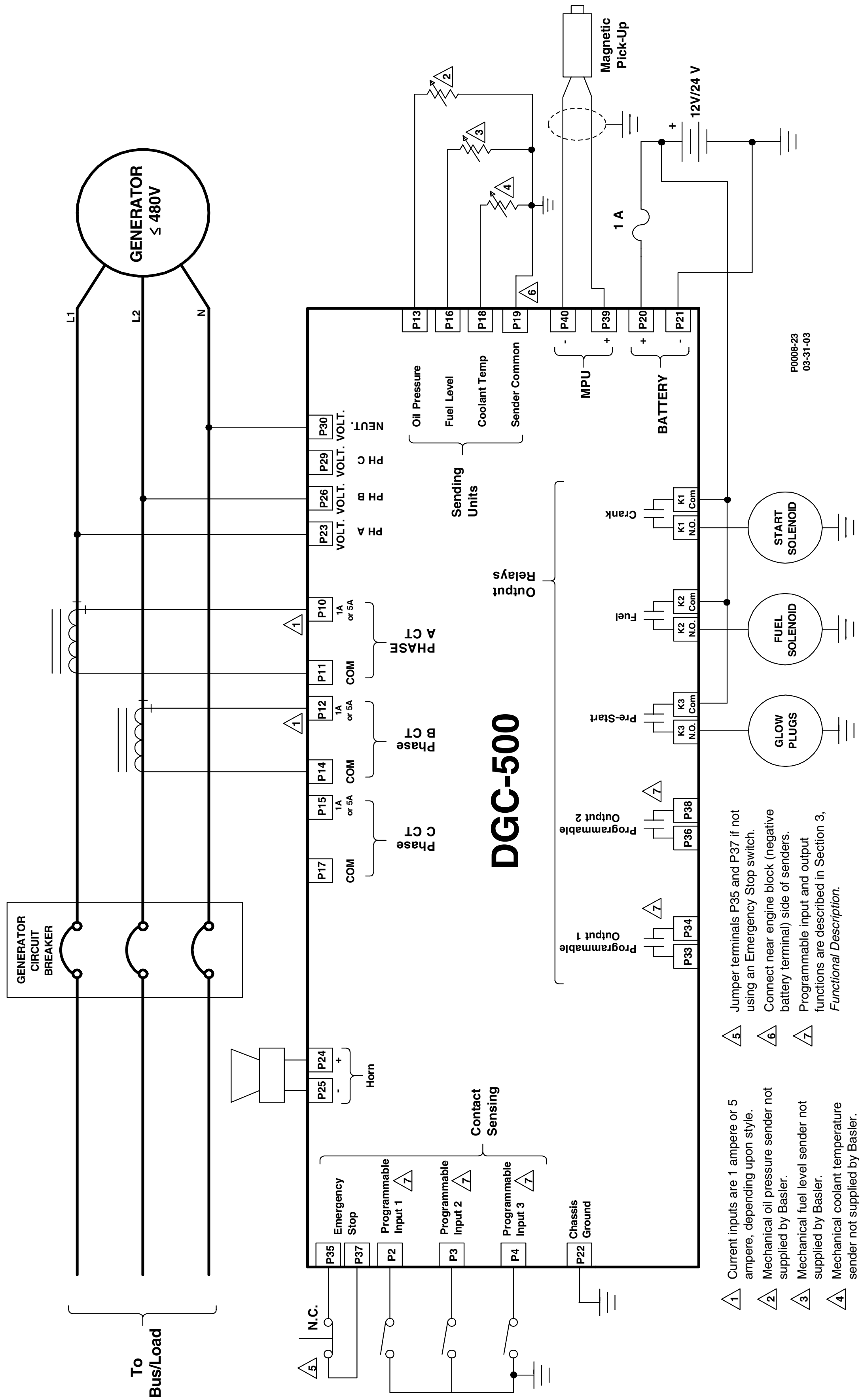


Figure 5-7. Single-Phase DGC-500 Connections

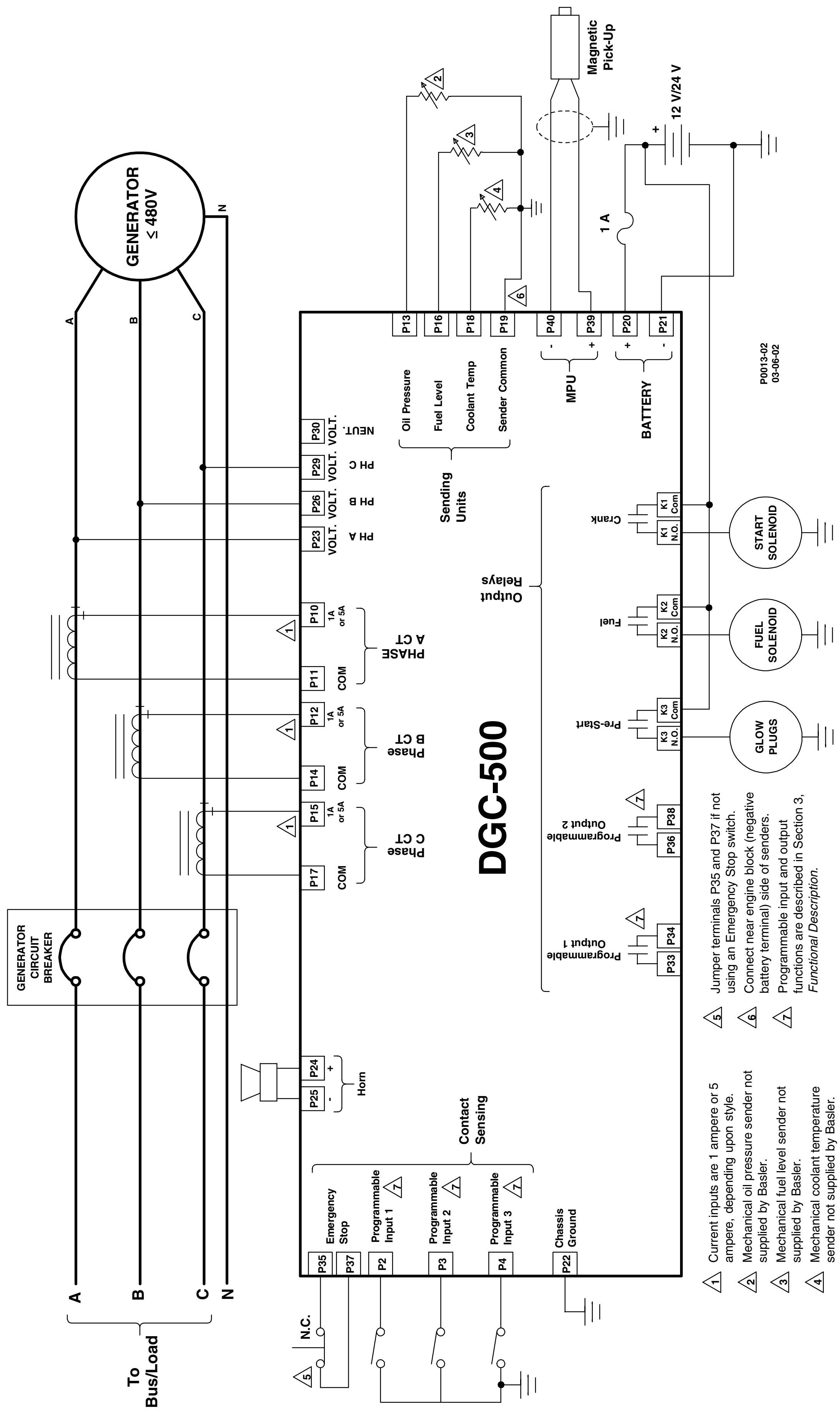


Figure 5-8. Three-Phase Delta DGC-500 Connections

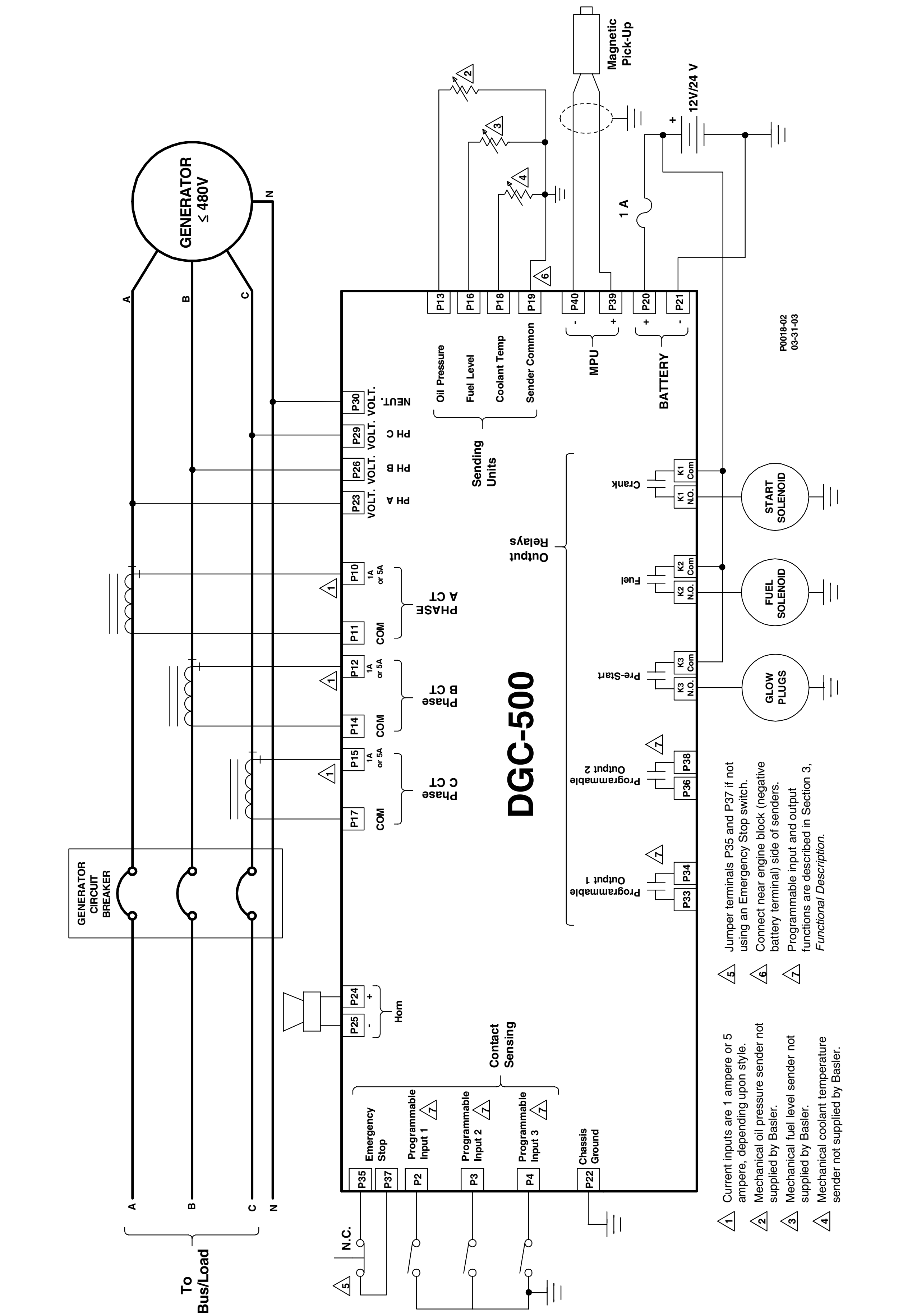


Figure 5-9. Three-Phase Wye DGC-500 Connections

Volvo Penta EDC Applications

Engines equipped with Volvo Penta EDC controllers can receive engine control commands (such as start and stop) from the DGC-500 through the SAE J1939 communication interface. To invoke this feature, the EDC must receive a J1939 message containing engine control information within one second of waking (exiting sleep mode). If the EDC does not receive an engine control message within the prescribed time, it will enter the stand-alone mode and ignore any J1939 control messages. If this occurs, the EDC must be forced back into sleep mode by pressing the auxiliary stop pushbutton on the engine or by momentarily disconnecting EDC power.

The interconnection diagrams of Figures 5-10, 5-11, and 5-12 illustrate the DGC-500 and EDC connections that allow the DGC-500 to awaken the EDC and start the engine, or simply acquire engine status information. Wake-up of the EDC is initiated by using the DGC-500 Fuel output contacts to apply battery power to the EDC. To stop the engine, the DGC-500 issues a sleep command through the J1939 interface to the EDC and opens the Fuel output contacts. This causes the EDC to stop the engine and enter the sleep mode.

In order for the DGC-500 to communicate with the EDC, two DGC-500 settings must be changed from their default values.

- The J1939 address of the DGC-500 must be set at 17
- The engine start/stop configuration setting must be set for Volvo Penta

Both settings are configured on the System Settings screen of BESTCOMS. Section 4, *BESTCOMS Software* has information about adjusting DGC-500 settings through BESTCOMS.

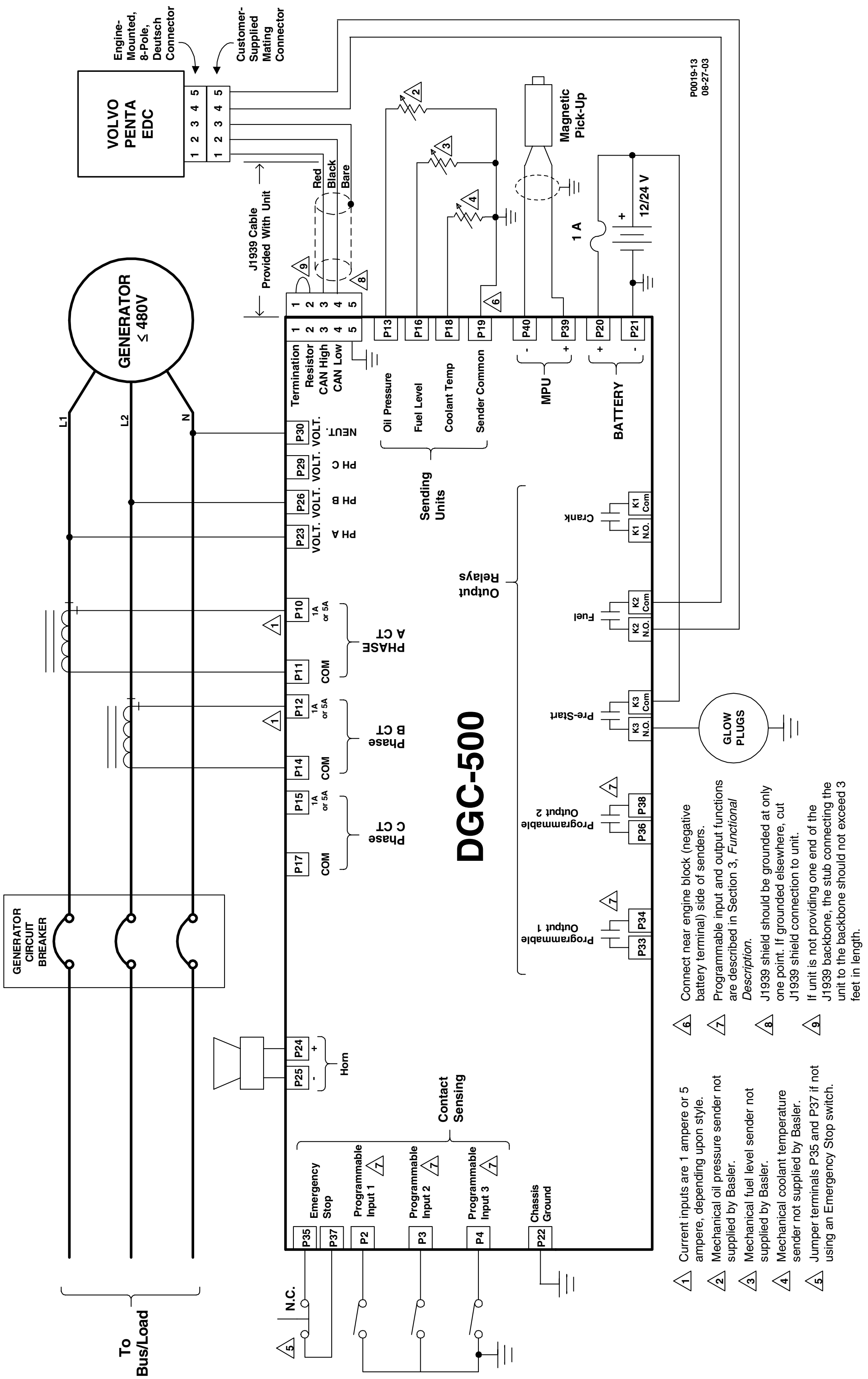


Figure 5-10. Single-Phase Connections, Volvo Penta EDC Application

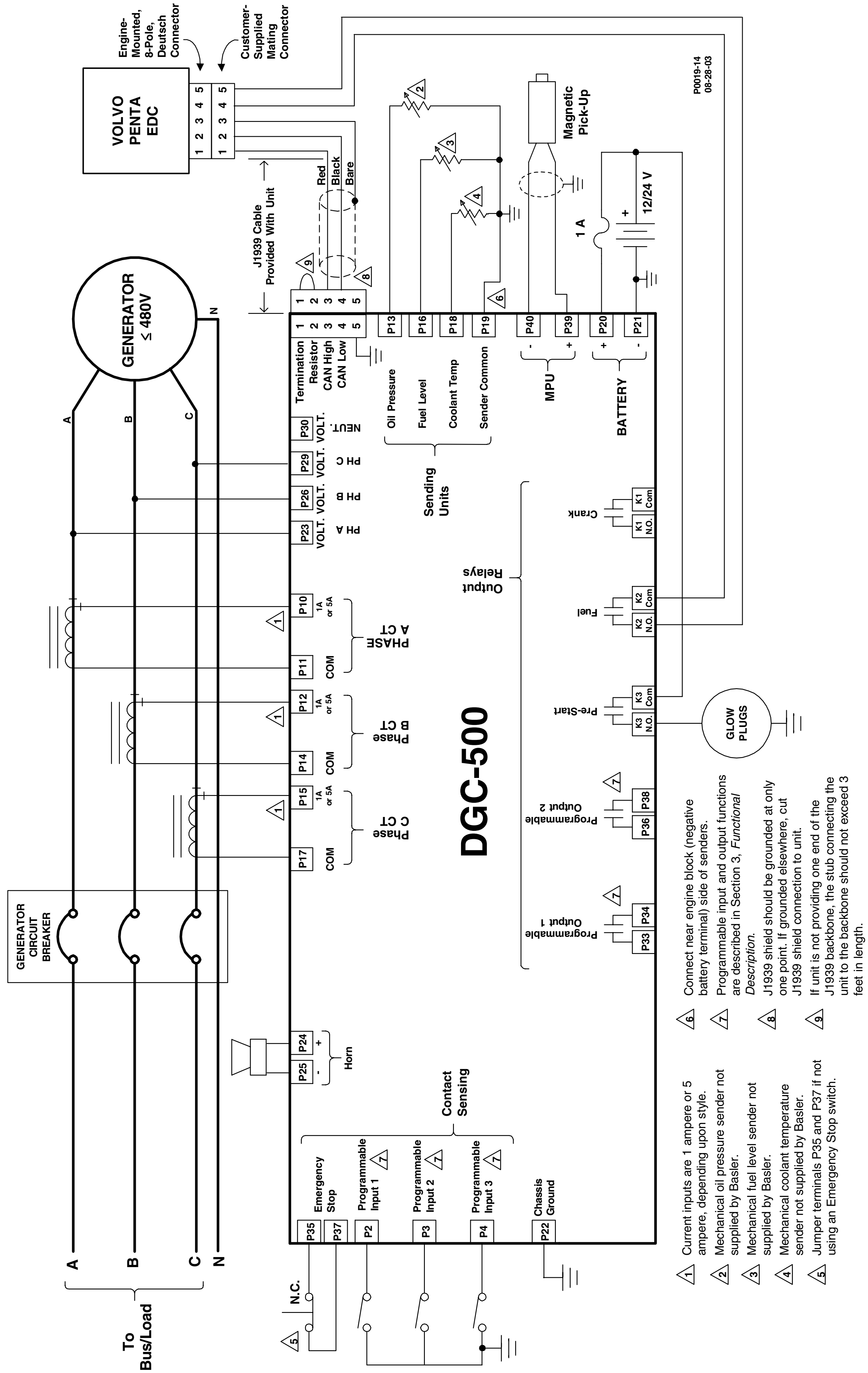


Figure 5-11. Three-Phase, Delta Connections, Volvo Penta EDC Application

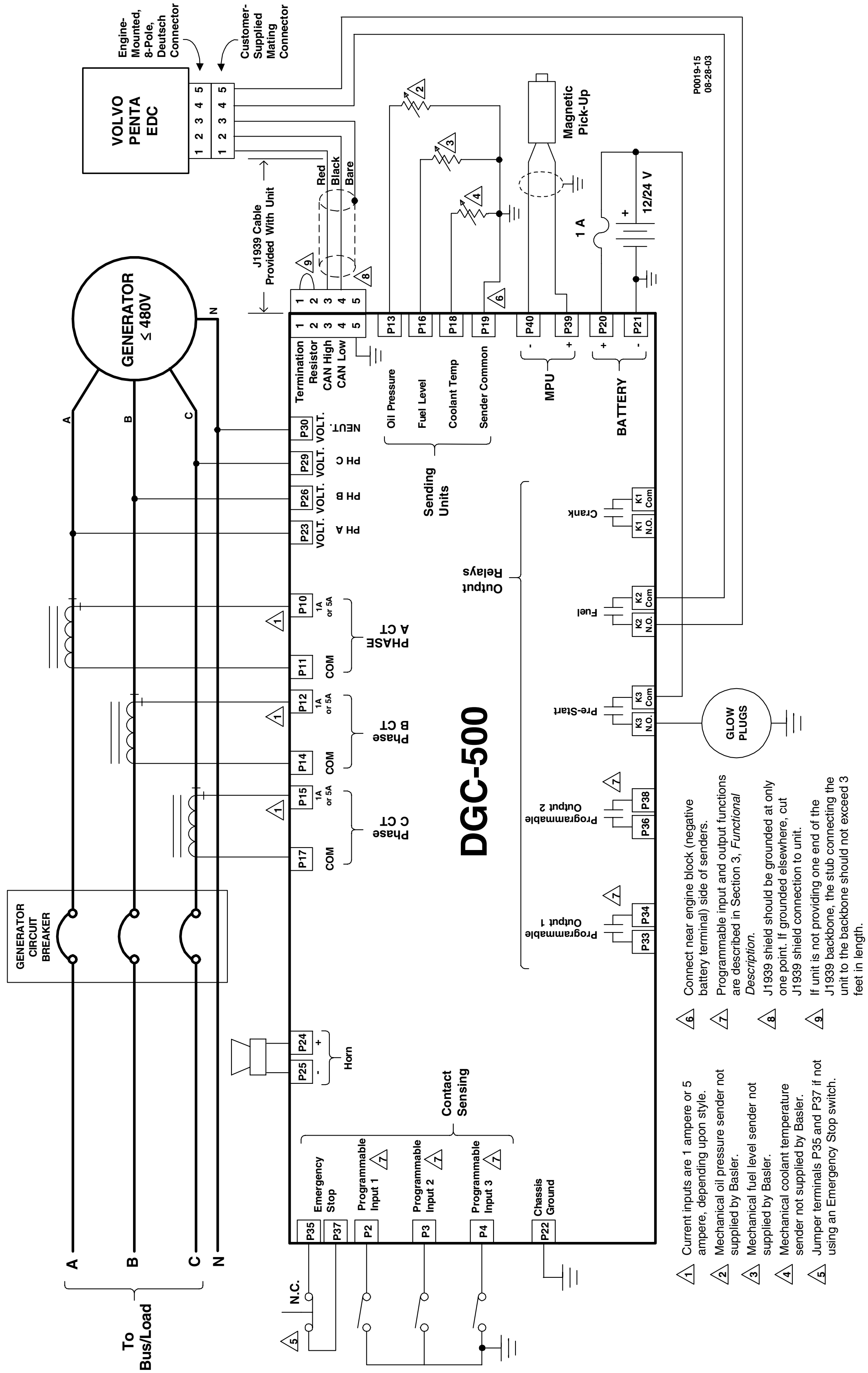


Figure 5-12. Three-Phase, Wye Connections, Volvo Penta EDC Application

CALIBRATION

Prior to delivery, each DGC-500 is factory calibrated and subjected to thorough testing to ensure quality, accuracy, and performance. DGC-500 units should not require field calibration. However, the following procedure is provided for those users desiring to perform field calibration of their DGC-500.

Equipment Required

- Single-phase 240 Vac source
- Single-phase 2 Aac source
- Resistance box, 25 - 800 ohms

Entering Calibration Mode

Calibration is accomplished by performing the instructions called out on each of the HMI calibration menu screens. The calibration menu screens reside in a branch of Menu 3: Sensing Devices. Figure 5-13 illustrates the process of entering the calibration mode and the following steps describe the process.

1. Navigate to Menu 3: Sensing Devices and scroll up or down to the screen labeled INPUT CALIBRATE FUNCTION.
2. Perform the steps illustrated by Figure 5-12 to enable calibration (screen indicates FEATURE IS ON). Use the Select/Enter pushbutton to move right. Use the Raise/Scroll pushbutton to move up.

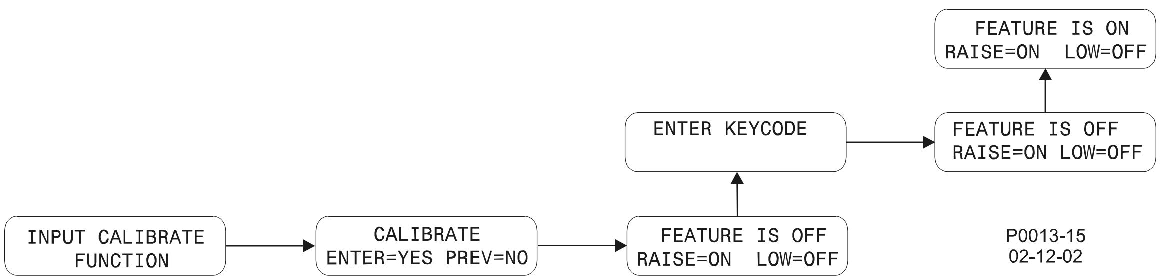


Figure 5-13. Calibration Mode Navigation

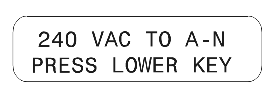
Calibration Procedure

Once calibration is enabled, the following steps are performed to calibrate the DGC-500.

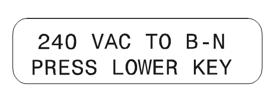
After each calibration step is performed, a screen indicating the success of the previous step is displayed. Figure 5-14 shows the screens resulting from a successful calibration step and an unsuccessful calibration step.

Figure 5-14. Successful and Unsuccessful Calibration Screens

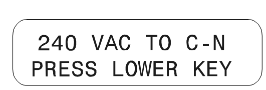
1. While viewing the FEATURE IS ON screen (illustrated in Figure 5-13), press the **Select/Enter** pushbutton to begin the calibration process. The first calibration screen (displayed at right) appears. Apply 240 Vac to the voltage sensing inputs for phase A (terminal P23) and Neutral (terminal P30). Press the **Lower/Scroll** pushbutton.



2. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Apply 240 Vac to the voltage sensing inputs for phase B (P26) and Neutral (P30). Press the **Lower/Scroll** pushbutton.



3. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Apply 240 Vac to the voltage sensing inputs for phase C (P29) and Neutral (P30). Press the **Lower/Scroll** pushbutton.



4. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Apply 2 Aac to the current sensing inputs for phase A (P10 and P11). Press the **Lower/Scroll** pushbutton.

```
2 AAC TO A CT
PRESS LOWER KEY
```

5. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Apply 2 Aac to the current sensing inputs for phase B (P12 and P14). Press the **Lower/Scroll** pushbutton.

```
2 AAC TO B CT
PRESS LOWER KEY
```

6. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Apply 2 Aac to the current sensing inputs for phase V (P15 and P17). Press the **Lower/Scroll** pushbutton.

```
2 AAC TO C CT
PRESS LOWER KEY
```

7. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 30 ohms across the coolant temperature sender input (P18 and P19). Press the **Lower/Scroll** pushbutton.

```
30 OHM TO C-T
PRESS LOWER KEY
```

8. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 60 ohms across the coolant temperature sender input (P18 and P19). Press the **Lower/Scroll** pushbutton.

```
60 OHM TO C-T
PRESS LOWER KEY
```

9. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 100 ohms across the coolant temperature sender input (P18 and P19). Press the **Lower/Scroll** pushbutton.

```
100 OHM TO C-T
PRESS LOWER KEY
```

10. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 150 ohms across the coolant temperature sender input (P18 and P19). Press the **Lower/Scroll** pushbutton.

```
150 OHM TO C-T
PRESS LOWER KEY
```

11. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 200 ohms across the coolant temperature sender input (P18 and P19). Press the **Lower/Scroll** pushbutton.

```
200 OHM TO C-T
PRESS LOWER KEY
```

12. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 300 ohms across the coolant temperature sender input (P18 and P19). Press the **Lower/Scroll** pushbutton.

```
300 OHM TO C-T
PRESS LOWER KEY
```

13. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 400 ohms across the coolant temperature sender input (P18 and P19). Press the **Lower/Scroll** pushbutton.

```
400 OHM TO C-T
PRESS LOWER KEY
```

14. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 600 ohms across the coolant temperature sender input (P18 and P19). Press the **Lower/Scroll** pushbutton.

```
600 OHM TO C-T
PRESS LOWER KEY
```

15. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 800 ohms across the coolant temperature sender input (P18 and P19). Press the **Lower/Scroll** pushbutton.

```
800 OHM TO C-T
PRESS LOWER KEY
```

16. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 25 ohms across the oil pressure sender input (P13 and P19). Press the **Lower/Scroll** pushbutton.

```
25 OHM TO O-P
PRESS LOWER KEY
```

17. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 50 ohms across the oil pressure sender input (P13 and P19). Press the **Lower/Scroll** pushbutton.

```
50 OHM TO O-P
PRESS LOWER KEY
```

18. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 75 ohms across the oil pressure sender input (P13 and P19). Press the **Lower/Scroll** pushbutton.

```
75 OHM TO O-P
PRESS LOWER KEY
```

19. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 100 ohms across the oil pressure sender input (P13 and P19). Press the **Lower/Scroll** pushbutton.

```
100 OHM TO O-P
PRESS LOWER KEY
```

20. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 125 ohms across the oil pressure sender input (P13 and P19). Press the **Lower/Scroll** pushbutton.

```
125 OHM TO O-P
PRESS LOWER KEY
```

21. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 150 ohms across the oil pressure sender input (P13 and P19). Press the **Lower/Scroll** pushbutton.

```
150 OHM TO O-P
PRESS LOWER KEY
```

22. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 175 ohms across the oil pressure sender input (P13 and P19). Press the **Lower/Scroll** pushbutton.

```
175 OHM TO O-P
PRESS LOWER KEY
```

23. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 200 ohms across the oil pressure sender input (P13 and P19). Press the **Lower/Scroll** pushbutton.

```
200 OHM TO O-P
PRESS LOWER KEY
```

24. Press the **Raise/Scroll** pushbutton. The screen at right is displayed. Connect a resistance of 225 ohms across the oil pressure sender input (P13 and P19). Press the **Lower/Scroll** pushbutton.

```
225 OHM TO O-P
PRESS LOWER KEY
```

After step 24 is completed successfully and the Raise/Scroll pushbutton is pressed, the INPUT CALIBRATE FUNCTION screen appears and signals that calibration is complete.

SECTION 6 • MAINTENANCE AND TROUBLESHOOTING

PREVENTATIVE MAINTENANCE

The only preventative maintenance required on the DGC-500 is to periodically check that the connections between the DGC-500 and the system are clean and tight. DGC-500 units are manufactured using state-of-the-art, surface-mount technology. As such, Basler Electric recommends that no repair procedures be attempted by anyone other than Basler Electric personnel.

TROUBLESHOOTING

If you do not get the results that you expect from the DGC-500, first check the programmable settings for the appropriate function. Use the following troubleshooting procedures when difficulties are encountered in the operation of your genset control system.

Incorrect Display of Battery Voltage, Coolant Temperature, Oil Pressure, or Fuel Level

Step 1. Verify that all wiring is properly connected. Refer to Figures 5-5 through 5-7.

Step 2. Confirm that the SENDER COMM terminal (P19) is connected to the negative battery terminal and the engine-block side of the senders. Current from other devices sharing this connection can cause erroneous readings.

Step 3. If the displayed battery voltage is incorrect, ensure that the proper voltage is present between the BATT+ terminal (P20) and the SENDER COMM terminal (P19).

Step 4. Verify that the correct senders are being used.

Step 5. Verify that the correct sender curves are being used.

Step 6. Ensure that the senders are operating properly.

Incorrect Display of Generator Voltage

Step 1. Verify that all wiring is properly connected. Refer to Figures 5-5 through 5-7.

Step 2. Ensure that the proper voltage is present at the DGC-500 voltage sensing inputs (P23, P26, P29, and P30).

Step 3. Verify that the voltage transformer ratio and sensing configuration is correct.

Step 4. Confirm that the voltage sensing transformers are correct and properly installed.

Incorrect Measurement or Display of Generator Current

Step 1. Verify that all wiring is properly connected. Refer to Figures 5-5 through 5-7.

Step 2. Ensure that the proper current is present at the DGC-500 current sensing inputs (P10 - P17).

Step 3. Verify that the current sensing transformer ratios are correct.

Step 4. Confirm that the current sensing transformers are correct and properly installed.

Incorrect Display of Engine RPM

Step 1. Verify that all wiring is properly connected. Refer to Figures 5-5 through 5-7.

Step 2. Verify that the flywheel teeth setting is correct.

Step 3. Confirm the nominal frequency setting.

Step 4. Verify that the prime mover governor is operating properly.

Step 5. Verify that the measured frequency of the voltage at the MPU input (P39 and P40) is correct.

Step 6. If the MPU is shared with the governor, verify that the polarity of the MPU input to the governor matches the polarity of the MPU input to the DGC-500.

Programmable Inputs Do Not Operate as Expected

Step 1. Verify that all wiring is properly connected. Refer to Figures 5-5 through 5-7.

Step 2. Confirm that the inputs are programmed properly.

Step 3. Ensure that the input at the DGC-500 is actually connected to the BATT– terminal (P21).

Programmable Outputs Do Not Operate as Expected

Step 1. Verify that all wiring is properly connected. Refer to Figures 5-5 through 5-7.

Step 2. Confirm that the outputs are programmed properly.

Communication Port Does Not Operate Properly

Step 1. Verify that the proper port of your computer is being used.

Step 2. Confirm that the correct baud rate is being used.

Step 3. Verify that the connection between the computer and the DGC-500 is correct. Ensure that a straight-through serial cable is being used.

APPENDIX A • PARAMETERS AND SETTINGS

INTRODUCTION

This appendix lists all DGC-500 parameters along with the setting range/selections for each parameter.

FRONT PANEL ADJUSTABLE PARAMETERS

Table A-1 lists the DGC-500 settings that can be adjusted through the HMI.

Table A-1. HMI Adjustable Settings

Parameter	Range
Cool-Down Time Delay	0 - 60 min
Engine Maintenance Cycle Hours Pre-Alarm	Reset/Normal
LCD Contrast	25 - 75%
Low Fuel Alarm	0 - 100%
Low Fuel Pre-Alarm	10 - 100%
Metric Conversion	On/Off
Pre-Crank Time Delay	0 - 30 sec
Pre-Start Contact Status After Disconnect	On/Off
Sender Failure Alarm Time	1 - 30 sec

ALL PARAMETERS

Table A-2 lists each DGC-500 parameter in alphabetical order. The setting range or nomenclature used by the HMI and the BESTCOMS interface is listed beside each parameter.

Table A-2 DGC-500 Settings

Parameter	Setting Range
Accumulated Engine Runtime	0 - 99,999 hrs, 59 min
Battery Charger Failure Pre-Alarm Enable	Off or On
Battery Overvoltage Pre-Alarm Enable	On or Off
Battery Overvoltage Pre-Alarm Threshold	Off, 15 Vdc, or 30 Vdc
Battery Voltage	12 Vdc or 24 Vdc
CANBus Address	0 - 253
Communication Baud Rate	1200, 2400, or 9600
Communication Parity	None, Odd, or Even
Continuous Crank Time	1 - 60 sec
Coolant Temperature Sender Fail Alarm Enable	Off or On
Coolant Temperature Sender Fail Alarm Delay	5, 10, 15, 20, 25, or 30 min

Parameter	Setting Range
Crank Disconnect Limit	10 - 100%
Cranking Style	Continuous or Cycle
Cycle Crank Time	5 - 15 sec
DTC Support	On or Off
ECU Pulse Cycle Time	1 - 60 min
ECU Response Time-out	1 - 60 sec
ECU Settling Time	5,500 - 30,000 msec
ECU Support	On or Off
Engine Maintenance Cycle Pre-Alarm Level	0 - 5,000 hrs
Engine Shutdown Time	1 - 60 sec
Engine Start/Stop Configuration	Not Configured or Volvo Penta
Fuel Level Sender Failure Pre-Alarm Enable	On or Off
Generator Connection	3-phase L-L 3-phase L-N 1-phase A-B
Generator CT Primary Amps	1- 5,000 Aac
Generator Frequency	50 Hz or 60 Hz
Generator kW Rating	5 - 9,999 kW
Generator PT Primary Volts	1 - 999 Vac
Generator PT Secondary Volts	1- 480 Vac
Generator Rotation	ABC or ACB
Global Sender Failure Alarm Delay	1 - 30 sec
High Coolant Temperature Alarm Delay	60 sec
High Coolant Temperature Alarm Enable	On or Off
High Coolant Temperature Pre-Alarm Enable	On or Off
High Coolant Temperature Pre-Alarm Threshold	100 - 280°F
High Coolant Temperature Alarm Threshold	100 - 280°F
LCD Contrast	25 -75%
Loss of Generator Voltage Alarm Enable	On or Off
Low Battery Pre-Alarm Delay	1 - 10 sec
Low Battery Voltage Pre-Alarm Enable	On or Off
Low Battery Voltage Pre-Alarm Threshold	6 - 12 Vdc or 12 - 24 Vdc
Low Coolant Temperature Pre-Alarm Enable	On or Off
Low Coolant Temperature Pre-Alarm Threshold	50 - 100°F
Low Fuel Level Alarm Enable	On or Off

Parameter	Setting Range
Low Fuel Level Alarm Threshold	0 - 100%
Low Fuel Level Pre-Alarm Enable	On or Off
Low Fuel Level Pre-Alarm Level	10 - 100%
Low Oil Pressure Arming Delay	5 - 15 sec
Low Oil Pressure Pre-Alarm Enable	On or Off
Low Oil Pressure Pre-Alarm Threshold	3 - 150 psi
Low Oil Pressure Alarm Enable	On or Off
Low Oil Pressure Alarm Threshold	3 - 150 psi
Maintenance Interval Pre-Alarm Enable	On or Off
Maintenance Interval Pre-Alarm Threshold	0 - 5,000 hrs
NFPA Level	0, 1, or 2
No-Load Cool-Down Delay	1 - 60 min
Number of Crank Cycles	1- 7
Number of Flywheel Teeth	50 - 500
Oil Pressure Sender Fail Alarm	Off or On
Overspeed Alarm Delay	0 - 500 msec
Overspeed Alarm Enable	On or Off
Overspeed Alarm Threshold	105 - 140%
Pre-Alarm Buzzer Enable	Off or On
Pre-Crank Time Delay	0 - 30 sec
Pre-Start Contact after Disconnect	Off or On
Rated Engine rpm	750 - 3,600
Sender Failure Alarm Time Delay	1 - 10 sec
Speed Signal Source	MPU, Gen Freq, or MPU-Gen
Unit ID	1 - 247
Unit System	English or Metric
Weak Battery Voltage Pre-Alarm Delay	1 - 10 sec
Weak Battery Voltage Pre-Alarm Enable	On or Off
Weak Battery Voltage Pre-Alarm Threshold	4 - 8 Vdc or 8 - 16 Vdc

APPENDIX B • DGC-500 SETTINGS RECORD

INTRODUCTION

This appendix provides a complete list of DGC-500 settings. This list is provided in the form of a settings record that you can use to record information relative to your application. DGC-500 settings are organized in the following groups.

- Sensing Transformers
- System
- Cranking
- Pre-Alarms
- Alarms
- Serial Communication
- J1939 Interface
- Miscellaneous

DGC-500 SETTINGS RECORD

Genset ID ______________________ **Date** ______________________

DGC-500 Serial Number ______________________ **Firmware Version** ______________________

Sensing Transformer Settings

Parameter	Setting
Generator CT Primary Amps	
Generator PT Primary Volts	
Generator PT Secondary Volts	

System Settings

Battery Voltage	
Generator Connection	
Generator Frequency	
Generator kW Rating	
Generator Rotation	
NFPA Level	
No-Load Cool-Down Delay	
Number of Flywheel Teeth	
Rated Engine RPM	
Speed Signal Source	
Unit System	

Cranking Settings

Parameter	Setting
Crank Disconnect Limit	
Cranking Style	
Cycle Crank Time	
Pre-Crank Time Delay	
Pre-Start Contact after Disconnect	

Pre-Alarm Settings

Parameter	Setting
Battery Charger Failure Pre-Alarm Enable	
Battery Overvoltage Pre-Alarm Enable	
Battery Overvoltage Pre-Alarm Threshold	
Engine Maintenance Cycle Pre-Alarm Level	
Fuel Level Sender Failure Pre-Alarm Enable	
High Coolant Temperature Pre-Alarm Enable	
High Coolant Temperature Pre-Alarm Threshold	
Low Battery Pre-Alarm Delay	
Low Battery Voltage Pre-Alarm Enable	
Low Battery Voltage Pre-Alarm Threshold	
Low Coolant Temperature Pre-Alarm Enable	
Low Coolant Temperature Pre-Alarm Threshold	
Low Fuel Level Pre-Alarm Enable	
Low Fuel Level Pre-Alarm Level	
Low Oil Pressure Pre-Alarm Enable	
Low Oil Pressure Pre-Alarm Threshold	
Maintenance Interval Pre-Alarm Enable	
Maintenance Interval Pre-Alarm Threshold	
Pre-Alarm Buzzer Enable	
Weak Battery Voltage Pre-Alarm Delay	
Weak Battery Voltage Pre-Alarm Enable	
Weak Battery Voltage Pre-Alarm Threshold	

Alarm Settings

Parameter	Setting
Coolant Temperature Sender Fail Alarm Enable	
Coolant Temperature Sender Fail Alarm Delay	
Global Sender Failure Alarm Delay	
High Coolant Temperature Alarm Enable	
High Coolant Temperature Alarm Threshold	
Loss of Generator Voltage Alarm Enable	

Alarm Settings – Continued

Parameter	Setting
Low Fuel Level Alarm Enable	
Low Fuel Level Alarm Threshold	
Low Oil Pressure Alarm Enable	
Low Oil Pressure Alarm Threshold	
Oil Pressure Sender Fail Alarm	
Overspeed Alarm Delay	
Overspeed Alarm Enable	
Overspeed Alarm Threshold	
Sender Failure Alarm Time Delay	

Communication Settings

Parameter	Setting
Baud Rate	
Parity	
Unit ID	

J1939 Interface

Parameter	Setting
CANBus Address	
ECU Support	
DTC Support	
Engine Shutdown Timer	
Engine Start/Stop Configuration	
Settling Time	
Pulse Cycle Time	
Response Timeout	

Miscellaneous Settings

Parameter	Setting
Accumulated Engine Runtime	
LCD Contrast	