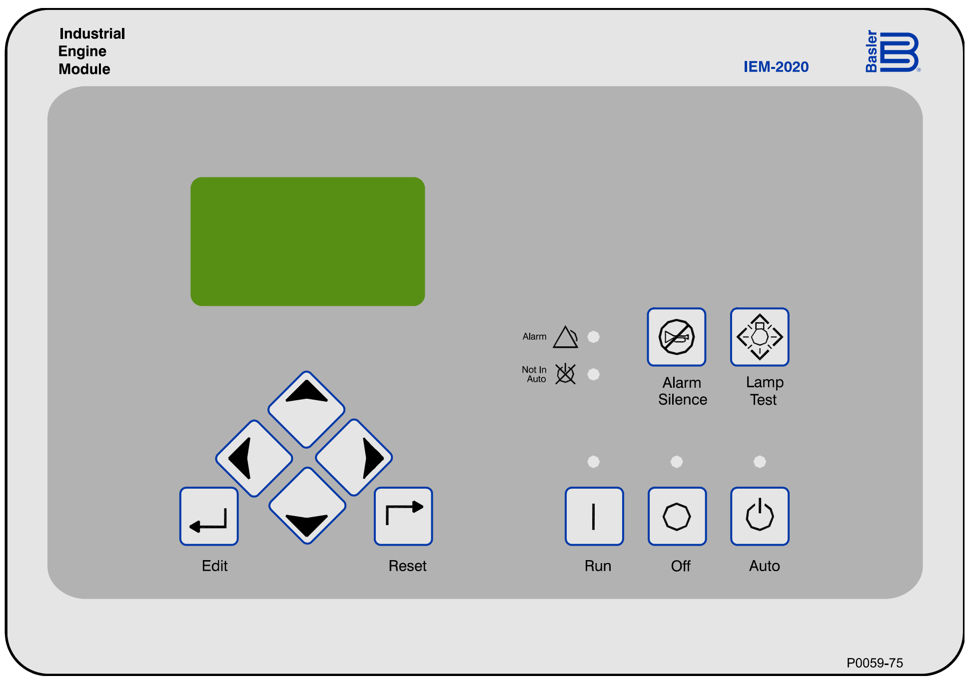
INSTRUCTION MANUAL

FOR

INDUSTRIAL ENGINE MODULE IEM-2020



Basler Electric

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INTRODUCTION

This instruction manual provides information about the operation and installation of the IEM-2020 Industrial Engine Module. To accomplish this, the following information is provided:

- General Information and Specifications
- Controls and Indicators
- Functional Description
- Graphical User Interface Operation
- Installation
- Maintenance and Troubleshooting
- LSM-2020 (Load Share Module)
- CEM-2020 (Contact Expansion Module)
- AEM-2020 (Analog Expansion Module)
- Modbus™ Communication
- Logic Library Files

WARNING!

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

NOTES

IEM-2020 modules are mounted using the four permanently-attached 10-24 studs and the provided self-locking nuts. Failure to use the proper 10-24 locking nuts may damage the stud threads and/or improperly secure the IEM-2020.

Be sure that the module is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the chassis ground terminal on the rear of the unit. When the module is configured in a system with other devices, it is recommended to use a separate lead to the ground bus from each unit.

The IEM-2020 utilizes password protection that guards against unauthorized changing of IEM-2020 settings. Instructions for changing passwords are provided in Section 4, *BESTCOMSPlus Software, General Settings, Device Security Setup.* The default passwords are listed below.

- OEM access level: **OEM**
- Settings access level: **SET**
- Operator access level: **OP**

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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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REVISION HISTORY

The following information provides a historical summary of the changes made to this instruction manual (9441000990), BESTCOMS*Plus* software, firmware package, and hardware of the IEM-2020.

Manual Revision and Date	Change
—, 01/10	• Initial release

BESTCOMS*Plus* Version and Date	Change
2.06.02, 01/10	• Initial release

Firmware Package Version and Date	Change
1.00.00, 01/10	• Initial release

IEM-2020 Hardware Revision and Date	Change
—, 01/10	• Initial release

IEM-2020 / LSM-2020 / CEM-2020 / CEM-2020H / AEM-2020
Firmware Release History

Package File Version	IEM-2020			LSM-2020		CEM-2020	CEM-2020H	AEM-2020
	Application Code	Flash Language Module		CANbus Application	Ethernet Application			
	Version & P/N	Version & P/N	Lang. *	Version & P/N	Version & P/N	Version & P/N	Version & P/N	Version & P/N
1.00.00	1.00.00 11/09/09 9441001001	1.00.00 11/05/09 9441001003	E,C,S	1.00.05 12/09/08 9417501012	1.00.05 12/09/08 9417501013	1.01.00 12/09/08 9421001009	1.01.00 12/09/08 9421001009	1.00.01 12/09/08 9421101009

* E = English, C = Chinese, S = Spanish

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SECTION 1 • GENERAL INFORMATION

DESCRIPTION

The IEM-2020 Industrial Engine Module provides integrated engine 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 IEM-2020 operation. Basler Electric communication software (BESTCOMS*Plus*) allows units to be easily customized for each application. A wide temperature-range liquid crystal display (LCD) with backlighting can be viewed under a wide range of ambient light and temperature conditions.

FEATURES

IEM-2020 Industrial Engine Modules have the following features:

- Local and Remote Engine Control
- Engine Protection
- Programmable Analog Engine Senders
- ECU Communications via SAE J1939
- 16 Programmable Contact Inputs
- Programmable Logic
- Integrated RS485
- Exercise Timer
- Additional modules available to expand the capabilities of the IEM-2020

FUNCTIONS

IEM-2020 Modules perform the following functions:

Engine Protection and Metering

Engine protection features include oil pressure and coolant temperature monitoring, overcrank protection, ECU specific protection elements, and diagnostic reporting.

Metered engine parameters include oil pressure, coolant temperature, battery voltage, speed, fuel level, coolant level (from ECU), ECU specific parameters, and run-time statistics.

Event Recording

An event log retains a history of system events in nonvolatile memory. Up to 30 event types are retained and each record contains a time stamp of the first and last occurrence, and the number of occurrences for each event. Details of the most recent 30 occurrences of each event type are recorded. Thus, details of up to 900 event occurrences are recorded. For more information, see Section 3, *Functional Description, Event Recording.*

Contact Inputs and Output Contacts

IEM-2020 modules have one dedicated emergency stop contact input and 16 programmable contact inputs. All contact inputs recognize dry contacts. The programmable inputs can be configured to initiate a pre-alarm or alarm. A programmable input can be programmed to receive an input from an automatic transfer switch or override IEM-2020 alarms and protection functions. Each programmable input can be assigned a user-defined name for easy identification at the front panel display and in fault records.

Output contacts include three dedicated relays for energizing an engine's glow plugs, fuel solenoid, and starter solenoid. An additional four user-programmable output contacts are provided if the style number is NNAxxxNNH. If the style number is NNBxxxNNH, an additional twelve output contacts are provided.

Additional contact inputs and output contacts can be accommodated with an optional CEM-2020 (Contact Expansion Module). Contact Basler Electric for ordering information.

Communication

Standard IEM-2020 communication features include a standard USB port and SAE J1939 interface. Optional communication features include a dial-out modem and RS-485 communication port.

BESTCOMS*Plus* can communicate with the IEM-2020 through Ethernet via an optional LSM-2020 (Load Share Module). Contact Basler Electric for ordering information.

USB Port

A USB communication port can be used with BESTCOMS*Plus* software to quickly configure an IEM-2020 with the desired settings or retrieve metering values and event log records.

CANbus Interface

A CANbus interface provides high-speed communication between the IEM-2020 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. The CANbus interface supports the following protocols:

- SAE J1939 Protocol - Oil pressure, coolant temperature, and engine speed data are received from the ECU. In addition, DTCs (Diagnostic Trouble Codes) help diagnose any engine or related failures. The engine DTCs are displayed on the front panel of the IEM-2020 and may be obtained using BESTCOMS*Plus* software.
- MTU Protocol - An IEM-2020 connected to an engine equipped with an MTU engine ECU receives Oil pressure, coolant temperature, and engine speed data from the engine controller, along with various alarms and pre-alarms that are MTU specific. In addition, the IEM-2020 tracks and displays the active fault codes issued by the MTU engine ECU.

Dial-Out Modem

The optional dial-out modem enables remote control, monitoring, and setting of the IEM-2020. When an alarm or pre-alarm condition occurs, the IEM-2020 can dial up to four telephone numbers, in sequence, until an answer is received and the condition is annunciated.

RS-485 Port

An optional RS-485 communication port uses the Modbus™ communication protocol and enables remote control and monitoring of the IEM-2020 over a polled network.

AEM-2020 (ANALOG EXPANSION MODULE)

The optional AEM-2020 provides eight remote analog inputs, eight remote RTD inputs, two remote thermocouple inputs, and four remote analog outputs to the IEM-2020. The AEM-2020 communicates with the IEM-2020 through a CANbus interface. Refer to Section 10, *AEM-2020 (Analog Expansion Module),* for more information.

CEM-2020 (CONTACT EXPANSION MODULE)

The optional CEM-2020 provides 10 additional contact inputs and 18 or 24 additional output contacts (depending on module type) to the IEM-2020. The CEM-2020 communicates with the IEM-2020 through a CANbus interface. Refer to Section 9, *CEM-2020 (Contact Expansion Module),* for more information.

LSM-2020 (LOAD SHARE MODULE)

The optional LSM-2020 in conjunction with the IEM-2020 provides The LSM-2020 communicates through an Ethernet port and provides access to the IEM-2020 via Ethernet. Refer to Section 8, *LSM-2020 (Load Share Module),* for more information.

STYLE AND PART NUMBERS

Style Number

Standard-order IEM-2020 modules are identified by a style number which consists of a combination of letters and numbers that define the module's electrical characteristics and operational features. The model number, together with the style number, describes the options included in a specific module. Figure 1-1 illustrates the IEM-2020 style number identification chart.

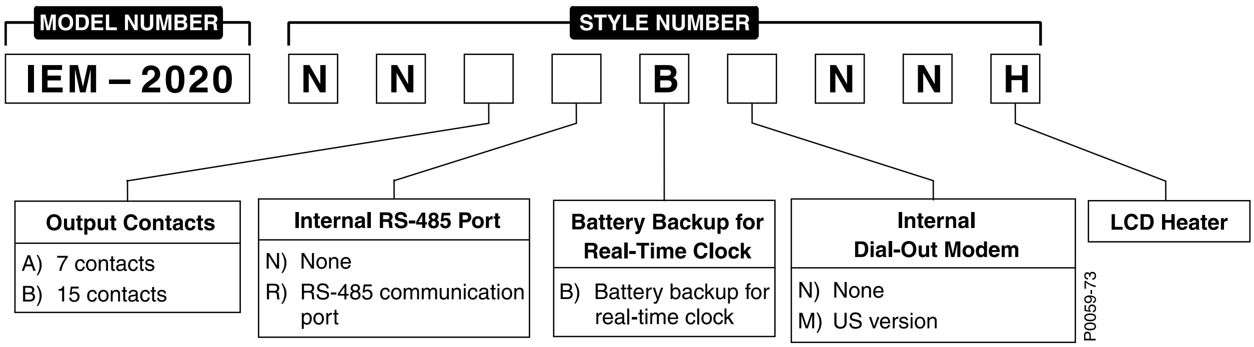

Figure 1-1. IEM-2020 Style Chart

For example, if an IEM-2020 style number were **NNBNBMNNH**, the module would have the following characteristics and operating features.

B Three fixed-function output contacts and 12 programmable output contacts
N No RS-485 communication port
B Battery backup for real-time clock during losses of control power
M Internal dial-out modem—US version
H LCD heater

SPECIFICATIONS

Operating Power

Nominal:	12 or 24 Vdc
Range:	6 to 32 Vdc (Withstands cranking ride-through down to 6 Vdc for 500 ms)
Terminals:	3 (+), 2 (–), 1 (chassis ground)

Power Consumption

Sleep Mode:	5W with all relays non-energized
Normal Operational Mode:	7.9W - Run mode, LCD heater off, 3 relays energized
Maximum Operational Mode:	14.2W - Run mode, LCD heater on, 6 relays energized

Battery Ride Through

Withstands cranking ride-through down to 0 V for 50 ms

Contact Sensing

Contact sensing inputs include 1 emergency stop input and 16 programmable inputs. The emergency stop input accepts normally closed, dry contacts. All programmable inputs accept normally open, dry contacts.

Terminals

Emergency Stop:	46, 47
Programmable	
Input 1:	30, 2
Input 2:	29, 2
Input 3:	28, 2
Input 4:	27, 2
Input 5:	26, 2
Input 6:	25, 2
Input 7:	24, 2
Input 8:	23, 2
Input 9:	22, 2
Input 10:	21, 2
Input 11:	20, 2
Input 12:	19, 2

Input 13:	18, 2
Input 14:	17, 2
Input 15:	16, 2
Input 16:	15, 2

Engine System Inputs

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

Fuel Level Sensing

Resistance Range:	33 to 240 Ω nominal
Terminals:	9, 11 (sender common)

Coolant Temperature Sensing

Resistance Range:	62.6 to 637.5 Ω nominal
Terminals:	10, 11 (sender common)

Oil Pressure Sensing

Resistance Range:	34 to 240 Ω nominal
Terminals:	8, 11 (sender common)

Engine Speed Sensing

Magnetic Pickup

Voltage Range:	3 to 35 V peak (6 to 70 V peak-peak)
Frequency Range:	32 to 10,000 Hz
Terminals:	31 (+), 32 (–)

Output Contacts

PRESTART, START, and RUN Relays

Rating: 30 Adc at 28 Vdc—make, break, and carry

Programmable Relays (12)

Rating: 2 Adc at 30 Vdc—make, break, and carry

Terminals ∗

Output 1:	52, 51 (common)
Output 2:	53, 51 (common)
Output 3:	54, 51 (common)
Output 4:	56, 55 (common)
Output 5:	57, 55 (common)
Output 6:	58, 55 (common)
Output 7:	60, 59 (common)
Output 8:	61, 59 (common)
Output 9:	62, 59 (common)
Output 10:	64, 63 (common)
Output 11:	65, 63 (common)
Output 12:	66, 63 (common)

∗ The number of programmable output contacts provided is determined by the output contacts character of the IEM-2020 style number. Modules with output contacts option A have 4 programmable outputs (Outputs 1, 2, 3, and 4). Modules with output contacts option B have 12 programmable outputs.

The programmable relays share common terminals: terminal 51 is used for outputs 1, 2, and 3, terminal 55 is used for outputs 4, 5, and 6, terminal 59 is used for outputs 7, 8, and 9, 63 is used for outputs 10, 11, and 12.

Metering

Oil Pressure

Metering Range:	0 to 145 psi or 0 to 1,000 kPa
Accuracy:	±3% of actual indication or ±2 psi or ±12 kPa (subject to accuracy of sender)
Display Resolution:	1 psi or 1 kPa

Coolant Temperature

Metering Range:	32 to 410°F or 0 to 204°C
Accuracy:	±3% of actual indication or ±2° (subject to accuracy of sender)

Battery Voltage

Metering Range:	6 to 32 Vdc
Accuracy:	±3% of actual indication or ±0.2 Vdc
Display Resolution:	0.1 Vdc

Engine RPM

Metering Range:	0 to 4,500 rpm
Accuracy: ∗	±2% of actual indication or ±2 rpm
Display Resolution:	2 rpm

∗ When engine speed is below 2% of full-scale, reported rpm is 0.

Engine Run Time

Engine run time is retained in nonvolatile memory.

Metering Range:	0 to 99,999 hours
Update Interval:	6 min
Accuracy:	±1% of actual indication or ±12 min
Display Resolution:	1 minute

Maintenance Timer

Maintenance timer indicates the time remaining until engine service is due. Value is retained in nonvolatile memory.

Metering Range:	0 to 5,000 hours
Update Interval:	6 min
Accuracy:	±1% or actual indication or ±12 min
Display Resolution:	1 minute

Fuel Level

Metering Range:	0 to 100%
Accuracy:	±2% (subject to accuracy of sender)
Display Resolution:	1.0%

Logic Timers

Range	
Hours:	0 to 250
Increment:	1
Minutes:	0 to 250
Increment:	1
Seconds:	0 to 1,800
Increment:	0.1
Accuracy:	±15 ms

Communication Interface

USB

Specification Compatibility:	USB 2.0
Data Transfer Speed:	9600 baud
Connector Type:	Mini-B jack

RS-485 (Optional)

Baud:	9600
Data Bits:	8
Parity:	None
Stop Bits:	1
Terminals:	14 (A), 13 (B), and 12 (shield)

CANbus

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
Terminals:	48 (low), 49 (high), and 50 (shield)

NOTES

1.) If the IEM-2020 is providing one end of the J1939 bus, a 120 Ω, ½ watt terminating resistor should be installed across terminals 48 (CANL) and 49 (CANH).

2.) If the IEM-2020 is not part of the J1939 bus, the stub connecting the IEM-2020 to the bus should not exceed 914 mm (3 ft) in length.

3.) The maximum bus length, not including stubs, is 40 m (131 ft).

4.) The J1939 drain (shield) should be grounded at one point only. If grounded elsewhere, do not connect the drain to the IEM-2020.

Modem (Optional)

Connector Type:	RJ-11 jack

Real-Time Clock

Clock has leap year and selectable daylight saving time correction. Backup capacitor and optional backup battery sustain timekeeping during losses of IEM-2020 operating power.

Resolution:	1 s
Accuracy:	±1.73 s/d at 25°C

Clock Holdup

Battery Holdup Time (Optional):	Approximately 10 yrs
Battery Type:	Rayovac BR2032, lithium, coin-type, 3 Vdc, 195 mAh Basler Electric P/N 38526

CAUTION

Replacement of the backup battery for the real-time clock should be performed only by qualified personnel.

Do not short-circuit the battery, reverse battery polarity, or attempt to recharge the battery. Observe polarity markings on the battery socket while inserting a new battery. The battery polarity must be correct in order to provide backup for the real-time clock.

It is recommended that the battery be removed if the IEM-2020 is to be operated in a salt-fog environment. Salt-fog is known to be conductive and may short-circuit the battery.

NOTE
Failure to replace the battery with Basler Electric P/N 38526 may void the warranty.

Type Tests

Shock and Vibration:	EN60068-2-6
Dielectric Strength:	IEC 255-5
Impulse:	EN60664-1
Transients:	EN61000-4-4
Static Discharge:	EN61000-4-2

Shock

Withstands 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 minutes
29 to 52 to 29 Hz:	0.036 inches (0.914 mm) double amplitude for 2.5 minutes
52 to 500 to 52 Hz:	5 G peak for 7.5 minutes

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.

HALT (Highly Accelerated Life Testing)

HALT is used by Basler Electric to prove that our products will provide the user with many years of reliable service. HALT subjects the device to extremes in temperature, shock, and vibration to simulate years of operation, but in a much shorter period span. HALT allows Basler Electric to evaluate all possible design elements that will add to the life of this device. As an example of some of the extreme testing conditions, the IEM-2020 was subjected to temperature tests (tested over a temperature range of –100°C to +115°C), vibration tests (of 5 to 50 G at +20°C), and temperature/vibration tests (tested at 40 G over a temperature range of –80°C to +90°C). Combined temperature and vibration testing at these extremes proves that the IEM-2020 is expected to provide long-term operation in a rugged environment. Note that the vibration and temperature extremes listed in this paragraph are specific to HALT and do not reflect recommended operation levels. These operational ratings are included in Section 1 of this manual.

Ignition System

Tested in closed proximity to an unshielded, unsuppressed Altronic DISN 800 Ignition System.

Environment

Temperature	
Operating:	–40 to +70°C (–40 to +158°F)
Storage:	–40 to +85°C (–40 to +185°F)
Humidity:	IEC 68-2-38
Salt Fog:	ASTM B 17-73, IEC 68-2-11
Ingress Protection:	IEC IP54 for front panel

UL Approval

“cURus” recognized to UL Standard 508 & CSA Standard C22.2 No. 14.

CAUTION
To follow UL guidelines, replacement of the backup battery for the real-time clock should be performed only by qualified personnel.

CSA Certification

CSA certified to Standard C22.2 No. 14.

CE Compliance

This product complies with the requirements of the following EC Directives:

- Low Voltage Directive (LVD) - 73/23/EEC as amended by 93/68/EEC
- Electromagnetic Compatibility (EMC) - 89/336/EEC as amended by 92/31/EEC and 93/68/EEC

This product conforms to the following Harmonized Standards:

- EN 50178:1997 - *Electronic Equipment for use in Power Installations*
- EN 61000-6-4:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Emission Standard for Industrial Environments*
- EN 61000-6-2:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Immunity for Industrial Environments*

Physical

Weight:	4.40 lb (1.99 kg)
Dimensions:	See Section 6, *Installation*.

SECTION 2 ● HUMAN-MACHINE INTERFACE

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SECTION 2 • HUMAN-MACHINE INTERFACE

INTRODUCTION

This section describes the components of the IEM-2020 human-machine interface (HMI). IEM-2020 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 IEM-2020. Table 2-1 lists the call-outs of Figure 2-1 along with a description of each HMI component.

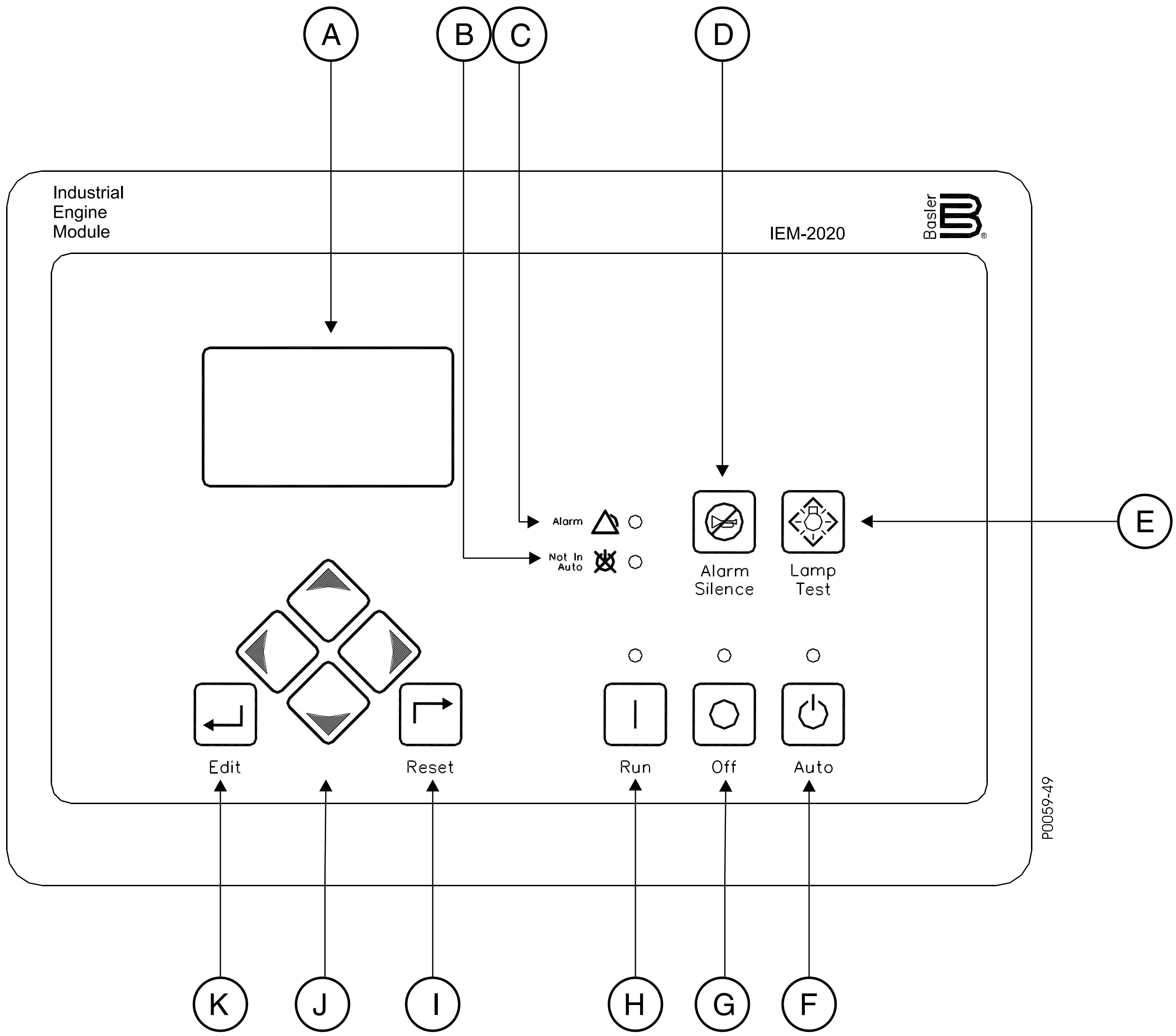

Figure 2-1. Front Panel HMI

Table 2-1. Front Panel HMI Descriptions

Locator	Description
A	*Liquid Crystal Display.* The backlit, 64 by 128 pixel LCD serves as the local information source for metering, alarms, pre-alarms, and protective functions. Display operation is maintained at –40°C.
B	*Not in Auto Indicator.* This red LED lights when the IEM-2020 is not operating in Auto mode.
C	*Alarm Indicator.* This red LED lights continuously during alarm conditions and flashes during pre-alarm conditions.
D	*Alarm Silence Pushbutton.* Pressing this button opens the relay output programmed as the horn output.
E	*Lamp Test Pushbutton.* Pressing this button tests the IEM-2020 indicators by exercising all LCD pixels and lighting all LEDs.
F	*Auto Pushbutton and Mode Indicator.* Pressing the Auto button places the IEM-2020 in Auto mode. The green Auto mode LED lights when Auto mode is active.
G	*Off Pushbutton and Mode Indicator.* Pressing this button places the IEM-2020 in Off mode. The red Off mode LED lights when the IEM-2020 is in Off mode.
H	*Run Pushbutton and Mode Indicator.* Pressing this button places the IEM-2020 in Run mode. The green Run mode LED lights when Run mode is active.
I	*Reset Pushbutton.* This button is pressed to cancel a settings editing session and discard any settings changes. When pressed, this button also resets the Breaker Management Pre-Alarms.
J	*Arrow Pushbuttons.* These four buttons are used to navigate through the front panel display menus and modify settings. The left- and right-arrow buttons are used to navigate through the menu levels. The right-arrow button is pressed to move downward through the menu levels and the left-arrow button is pressed to move upward. Within a level, the up-arrow and down-arrow buttons are used to move among items within the menu level. Pressing the down-arrow button moves to items lower in the list. Pressing the up-arrow button moves to items higher in the list. During a settings editing session, the up- and down-arrow buttons are used to raise and lower the value of the selected setting.
K	*Edit Pushbutton.* Pressing this button starts an editing session and enables changes to IEM-2020 settings. At the conclusion of an editing session, the Edit pushbutton is pressed again to save the setting changes.

DISPLAY OPERATION

The front panel display is used to make settings changes and display metering values. Refer to call-outs I, J, and K in Table 2-1 for information on changing settings through the front panel and navigating through the Metering screens.

Login and Permissions

<u>Login</u>

To login, navigate to the SETTINGS, ENTER PASSWORD screen and press the *Edit* key. Use the *Up/Down* arrow keys to scroll through the characters. Use the *Left/Right* arrow keys to enter more characters. Once the password has been entered, press the *Edit* key to login. A LOGOUT selection now appears in the list of SETTINGS. To logout, navigate to SETTINGS, LOGOUT and press the *Edit* key. The LOGOUT selection is removed from the SETTINGS list.

Permissions

If communications access is active through the modem or USB, the front panel will display REMOTE COMMS, FRONT PANEL IS READ ONLY and the summary screen. This informs the user that the front panel can only be used for viewing metering data and settings information. Remote access must be ended before modifying settings through the front panel.

Summary Screen and Configurable Metering

The summary screen can be set to standard or scrolling. When set to standard, only the following are displayed:

- OIL
- FUEL
- TEMP
- BATT

When the summary screen is set to scrolling, you can select/configure the metering values that are displayed. Up to 20 values can be displayed and these values will scroll at a delay time specified by the user. To select a standard or scrolling summary, navigate to the SETTINGS, GENERAL SETTINGS, FRONT PANEL HMI screen and edit the SUMMARY VIEW. The SCROLL DELAY setting is also found on this screen.

To select the scrolling values, navigate to the SETTINGS, GENERAL SETTINGS, FRONT PANEL HMI screen and edit the CONFIGURABLE METERING. The following items may be selected by the user to be placed in the scrolling summary:

- NONE (Removes a line from the scrolling list)
- BLANK (Shows nothing on this line)
- OIL P
- TEMP
- BATT V
- RPM
- RPM SRC
- FUEL
- RUN HRS
- ALG_IN_X (X = 1 to 8) (with AEM-2020)
- RTD_IN_X (X = 1 to 8) (with AEM-2020)
- THRM_CPL_X (X = 1 to 2) (with AEM-2020)

Sleep Mode

Sleep mode serves as a power saving feature. If the IEM-2020 is in Off mode or Auto mode not running and a key is not pressed for more than 15 minutes, the front panel LCD backlight and LCD heater are turned off. The IEM-2020 resumes normal display operation when any front panel button is pressed or the engine is started remotely via the Auto Start input. The IEM-2020 will not go to sleep while in an Alarm state. If needed, Sleep mode can be permanently disabled via BESTCOMS*Plus* or the front panel.

Changing a Setting

To change a setting, navigate to the setting you want to change and press the *Edit* key. If you are not already logged in, you will be asked to enter your password at this time. Use the *Up/Down* arrows to raise or lower the value. Press the *Edit* key again when finished.

Front Panel Display Structure

The front panel display begins with the SUMMARY SCREEN. Pressing the *Right* arrow key will open the MAIN MENU screen. The MAIN MENU screen consists of METERING and SETTINGS. The METERING screen branches are shown in Figure 2-2. Details of the METERING screen branches follow Figure 2-2. The SETTINGS screen branches are shown in Figure 2-3. Details of the SETTINGS screen branches follow Figure 2-3.

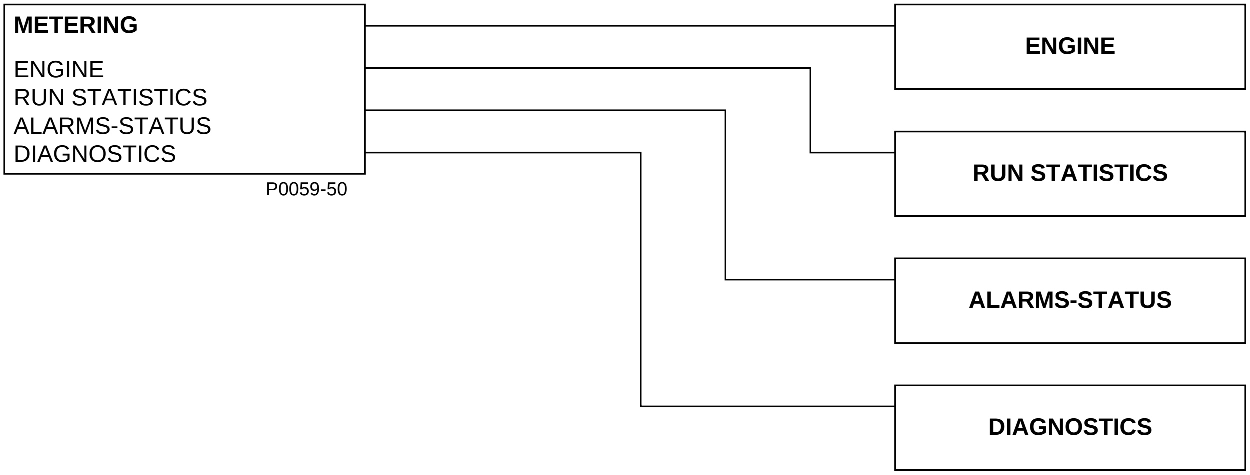

Figure 2-2. Metering Screen Branches

ENGINE

- **OIL PRESSURE**
- **COOLANT TMP**
- **BATTERY VOLT**
- **RPM**
- **SPEED SRC**
- **FUEL LEVEL**
- **COOLANT LEVL (Visible when CANBUS is enabled)**
- **TOTAL RUN TM**
- **HRS TO MAINT**

RUN STATISTICS

- **CUMULATIVE**
  - CUMULATIVE
    - START
    - # STARTS
    - HRS TO MAINT
  - TOTAL RUN TIME
    - HOURS
    - MINUTES
- **SESSION**
  - SESSION
    - START
  - TOTAL RUN TIME
    - HOURS
    - MINUTES

ALARMS-STATUS

- **ALARMS**
- **PRE-ALARMS**
- **MTU FAULT CODES (Visible when ECU is configured for MTU MDEC, MTU ADEC, or MTU ECU7.)**
- **MTU STATUS (Visible when ECU is configured for MTU MDEC, MTU ADEC, or MTU ECU7.)**
  - NMT-ALIVE STATUS (Visible when ECU is configured for MTU MDEC or MTU ECU7.)
    - SPS_NODE
    - SW_TYP
    - SW_VAR
    - SW_ED1
    - SW_ED2
    - REV
    - SW_MOD
  - TRIP FUEL (Visible when ECU is configured for MTU ECU7.)
    - TRIP HRS
    - TRIP IDLE HRS

- FUEL RATE
- TRIP FL RATE
- TOTAL RUN TM
- DAILY FUEL
- TOTAL FUEL

— FUEL (Visible when ECU is configured for MTU ADEC.)
- DAY TANK LVL
- STORE TANK LVL

— ENGINE STATUS (Visible when ECU is configured for MTU ADEC or MTU ECU7.)
- ENG RUNNING
- ENG OPTIMIZED
- CYL CUTOUT CD (Visible when ECU is configured for MTU ECU7.)
- CYL CUTOUT
- RPM (Visible when ECU is configured for MTU ECU7.)
- DROOP % (Visible when ECU is configured for MTU ECU7.)
- ENG OPTIMIZED (Visible when ECU is configured for MTU ECU7.)
- ENG COOL TEMP (Visible when ECU is configured for MTU ECU7.)
- CHRG AIR TMP (Visible when ECU is configured for MTU ECU7.)
- INTRCOOLR TEMP (Visible when ECU is configured for MTU ECU7.)
- ENG OIL TEMP (Visible when ECU is configured for MTU ECU7.)
- FUEL TEMP (Visible when ECU is configured for MTU ECU7.)
- ECU TEMP (Visible when ECU is configured for MTU ECU7.)
- OIL PRESSURE (Visible when ECU is configured for MTU ECU7.)
- CHG AIR P (Visible when ECU is configured for MTU ECU7.)
- FUEL DELV P (Visible when ECU is configured for MTU ECU7.)
- FL RAIL P (Visible when ECU is configured for MTU ECU7.)
- CAMSHAFT RPM (Visible when ECU is configured for MTU ECU7.)
- IDLE RPM (Visible when ECU is configured for MTU ECU7.)
- ECU SHUTDOWN (Visible when ECU is configured for MTU ECU7.)
- TOTAL RUN TM (Visible when ECU is configured for MTU ECU7.)
- LOAD GEN ON (Visible when ECU is configured for MTU ECU7.)
- ECU SUPP VOLTS (Visible when ECU is configured for MTU ECU7.)
- INJCT DBR % (Visible when ECU is configured for MTU ECU7.)
- SPD DMD FL MD (Visible when ECU is configured for MTU ADEC.)
- CURR P DEGREE (Visible when ECU is configured for MTU ADEC.)
- LOAD GEN ON (Visible when ECU is configured for MTU ADEC.)
- PREHT NT RCHD
- PRIME PUMP ON (Visible when ECU is configured for MTU ADEC.)
- RUNUP SPD LO (Visible when ECU is configured for MTU ADEC.)
- IDLE SPD LO (Visible when ECU is configured for MTU ADEC.)
- SPEC TORQUE
- RATED RPM (Visible when ECU is configured for MTU ECU7.)
- INJCT QTY (Visible when ECU is configured for MTU ECU7.)
- RATED KW (Visible when ECU is configured for MTU ECU7.)
- RESRV PWR % (Visible when ECU is configured for MTU ECU7.)
- START SEQ (Visible when ECU is configured for MTU ECU7.)

— SPEED (Visible when ECU is configured for MTU ADEC or MTU ECU7.)
- RATED RPM (Visible when ECU is configured for MTU ECU7.)
- RPM (Visible when ECU is configured for MTU ECU7.)
- CAMSHAFT RPM (Visible when ECU is configured for MTU ECU7.)
- IDLE RPM (Visible when ECU is configured for MTU ECU7.)
- SPD DMD SRC (Visible when ECU is configured for MTU ECU7.)
- SEL SPD DMD (Visible when ECU is configured for MTU ADEC or MTU ECU7.)
- EFF SET SPEED (Visible when ECU is configured for MTU ADEC or MTU ECU7.)
- CAN SPD DMD (Visible when ECU is configured for MTU ADEC or MTU ECU7.)
- ANLG SPD DMD (Visible when ECU is configured for MTU ADEC or MTU ECU7.)
- FREQ RPM DMD (Visible when ECU is configured for MTU ECU7.)
- SPD DMD FL MD (Visible when ECU is configured for MTU ADEC or MTU ECU7.)

— SIGNL FEEDBK (Visible when ECU is configured for MTU ADEC or MTU ECU7.)
- ECU_OVRD_FDBK
- EXT STOP
- SPD UP IN
- SPD DN IN
- CAN MODE FDBK
- CYL CUTOUT (Visible when ECU is configured for MTU ECU7.)
- EXT STOP (Visible when ECU is configured for MTU ECU7.)

- DIAGNOSTICS (Visible when ECU is configured for MTU ECU7.)
  - AL PWR AMP 1
  - AL PWR AMP 2
  - XSTR OUT AL
  - XSTR OUT STS
  - ECU SHUTDOWN
- CANBUS (Visible when ECU is configured for MTU ECU7.)
  - CAN MODE FDBK
  - CAN NODES
  - LOST NODES
- LIMITS (Visible when ECU is configured for MTU ECU7.)
  - OIL PRESSURE
  - LO LIM OILP
  - LOLOLIM OILP
  - ENG COOL TEMP
  - CLNT LMT HI
  - CLNT LMT HIHI
  - CHRG AIR TMP
  - CHG AIR LMT HI
  - ECU SUPP VOLTS
  - L1L ECU VOLTS
  - L2L ECU VOLTS
  - U1L ECU VOLTS
  - U2l ECU VOLTS
  - INTRCOOLR TMP
  - INTCLR LMT HI

- **STATUS**
  - AUTOSTART INPUT (Visible when the Auto Start programmable function is configured to be driven by an input.)
  - BATTLE OVERRIDE (Visible when the Battle Override programmable function is configured to be driven by an input.)
  - LOW COOL LEVEL (Visible when the Low Coolant Level programmable function is configured to be driven by an input.)
  - BATT CHRG FAIL (Visible when the Battery Charger Fail programmable function is configured to be driven by an input.)
  - FUEL LEAK DETECT (Visible when the Fuel Leak Detect programmable function is configured to be driven by an input.)
  - ENG RUNNING
  - CLDN TMR ACTIVE
  - OFF MODE COOLDN
  - COOLDOWN REQ
  - COOL & STOP REQ
  - EXT START DEL
  - START DEL BYPASS
  - LSM CONNECTED
  - CEM CONNECTED
  - AEM CONNECTED
- **INPUTS**
  - INPUT X (X = 1 to 16, (17 to 26 optional))
- **OUTPUTS**
  - START
  - RUN
  - PRESTART
  - OUTPUT X (X = 1 to 4, (5 to 36 optional))
- **LOGIC CTL RELAYS**
  - LCR X (X = 1 to 16)
- **LSM INPUTS (Visible when LSM-2020 is enabled.)**
  - RAW
    - LSM IN
- **ANALOG INPUTS (Visible when AEM-2020 is enabled.)**
  - SCALED
    - ALG IN X (X = 1 to 8)
  - RAW
    - ALG IN X (X = 1 to 8)

- **THERMAL INPUTS (Visible when AEM-2020 is enabled.)**
  - SCALED
    - RTD IN X (X = 1 to 8)
    - THRM CPL X (X = 1 to 2)
  - RAW
    - RTD IN X (X = 1 to 8)
    - THRM CPL X (X = 1 to 2)
- **ANALOG OUTPUTS (Visible when AEM-2020 is enabled.)**
  - SCALED
    - ALG OUT X (X = 1 to 4)
  - RAW
    - ALG OUT X (X = 1 to 4)
- **ANALOG STATUS (Visible when AEM-2020 is enabled.)**
- **CONF ELEMENTS**
  - CONFIG ELEMENT X (X = 1 to 8)
- **CONF PROT STATUS**
- **EVENT LOG**
  - EVENT
    - ACTIVE
    - OCCURRENCE COUNT
    - FIRST DATE
    - FIRST TIME
    - LAST DATE
    - LAST TIME
    - FIRST ENG HRS
    - LAST ENG HRS
    - DETAILS
      - OCCURRENCE (Use the *Edit/Up/Down* keys to change the occurrence.)
      - DATE
      - TIME
      - ENG HRS
- **J1939 DATA (Visible when ECU is configured for Standard or Volvo Penta.)**
  - THROTTLE POSITN
  - LOAD @ CRNT RPM
  - ACTUAL ENG TORQ
  - ENGINE SPEED
  - INJ CNTRL PRESS
  - INJ RAIL PRS
  - ENGINE HOURS
  - TRIP FUEL
  - TOTAL FUEL USED
  - ENG COOLANT TEMP
  - FUEL TEMP
  - ENG OIL TEMP
  - ENG INTCLR TEMP
  - FUEL DELV P
  - ENG OIL LEVEL
  - ENG OIL PRESS
  - COOLANT PRESS
  - COOLANT LEVEL
  - FUEL RATE
  - BAROMETRIC PRESS
  - AMB AIR TEMP
  - BOOST PRESS
  - INTAK MNFLD TEMP
  - AIR FLTR DIF PRS
  - EXHAUSE GAS TEMP
  - BATTERY VOLTAGE
  - ECU INPUT VOLTS
  - TRANS OIL PRESS
  - TRANS OIL TEMP
  - WINDG 1 TEMP
  - WINDG 2 TEMP
  - WINDG 3 TEMP
  - ECU TEMP
  - AUX PRESSURE1
  - AUX PRESSURE2

- RATED KW
- RATED RPM
- EXHAUST TMP A
- EXHAUST TMP B
- CHRG AIR TMP
- FUEL 1 LEAK
- FUEL 2 LEAK
- ALARM RST FDBK
- ECU SHUTDOWN

- **J1939 ENGINE CONFIG (Visible when ECU is configured for Standard or Volvo Penta.)**
  - SPD @ IDLE PNT 1
  - TRQ @ IDLE PNT 1
  - SPD @ IDLE PNT 2
  - TRQ @ IDLE PNT 2
  - SPD @ IDLE PNT 3
  - TRQ @ IDLE PNT 3
  - SPD @ IDLE PNT 4
  - TRQ @ IDLE PNT 4
  - SPD @ IDLE PNT 5
  - TRQ @ IDLE PNT 5
  - SPD @ IDLE PNT 6
  - TRQ @ IDLE PNT 6
  - ENDSPEED GOV KP
  - REF ENG TORQUE
  - O-RIDE SPD PNT 7
  - O-RIDE TIME LMT
  - SPEED LOWER LMT
  - SPEED UPPER LMT
  - TORQUE LOWER LMT
  - TORQUE UPPER LMT
- **J1939 ACTIVE DTC (Visible when DTC support is enabled and any ECU type is selected.)**
  - CLEAR DTCs
- **J1939 PREV DTC Visible when DTC support is enabled and any ECU type is selected.)**
  - CLEAR DTCs

DIAGNOSTICS

- **MODBUS RD**
- **MODBUS WR**
- **FLASH WR**

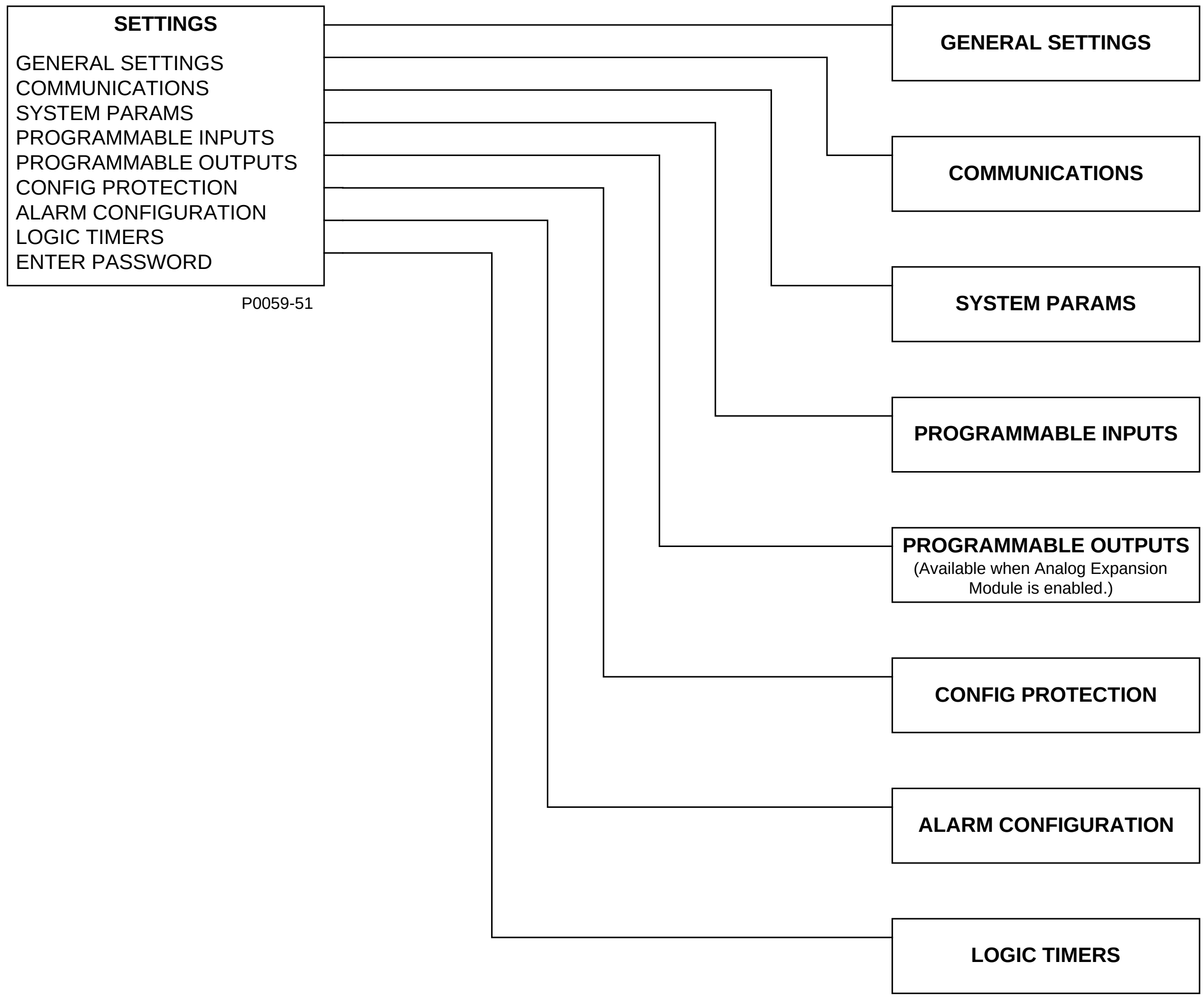

Figure 2-3. Settings Screen Branches

GENERAL SETTINGS

- **FRONT PANEL HMI**
  - — SUMMARY VIEW
  - — SCROLL DELAY
  - — LCD CONTRAST
  - — SLEEP MODE
  - — LANGUAGE
  - — CONFIGURABLE METERING
    - o ITEM X (X = 1 to 20)
- **CONFIGURE DATE/TIME**
  - — YEAR
  - — MONTH
  - — DAY
  - — HOURS
  - — MINUTES
  - — SECONDS
  - — UTC OFFSET
  - — DST ENABLED
  - — CLK NOT SET WRN
- **VIEW DATE/TIME**
- **VERSION INFO**
  - — IEM-2020
    - o FIRMWARE VERSION
    - o BOOT CODE VERSION
    - o SERIAL NUMBER

        - PART NUMBER
        - MODEL NUMBER
        - LANGUAGE VERSION
        - LANGUAGE PART NUM
        - STYLE CODE
    - LSM-2020
        - VERSION INFO
            - FIRMWARE VERSION
            - BOOT CODE VERSION
        - TCP/IP SETTINGS
            - IP ADDRESS
            - SUBNET MASK
            - GATEWAY ADDRESS
            - DHCP ENABLE
    - CEM-2020
        - FIRMWARE VERSION
        - BOOT CODE VERSION
        - SERIAL NUMBER
        - PART NUMBER
        - MODEL NUMBER
        - BUILD DATE
    - AEM-2020
        - FIRMWARE VERSION
        - BOOT CODE VERSION
        - SERIAL NUMBER
        - PART NUMBER
        - MODEL NUMBER
        - BUILD DATE

COMMUNICATIONS

- **CANBUS SETUP**
    - CANBUS SETUP
        - CANBUS ENABLE
        - DTC ENABLE (Visible when CANBUS is enabled.)
        - CANBUS ADDR (Visible when CANBUS is enabled.)
        - ECU OPT SLCT (Visible when CANBUS is enabled.)
        - ECU PULSING (Visible when CANBUS is enabled.)
        - ENG SHTDN TM (Visible when CANBUS is enabled.)
        - PLS CYCL TM (Visible when CANBUS is enabled.)
        - ECU SET TM (Visible when CANBUS is enabled.)
        - RESP TIMEOUT (Visible when CANBUS is enabled.)
    - ECU SETUP (Visible when CANBUS is enabled.)
        - ECU CONF
        - SPEED SELECT PRIMARY (Visible when ECU is configured for Volvo Penta.)
        - ACCEL POSITION (Visible when ECU is configured for Volvo Penta.)
        - MODULE TYPE (Visible when ECU is configured for MTU MDEC or MTU ECU7.)
        - SPD DMAND SRC (Visible when ECU is configured for MTU MDEC.)
        - ENGINE RPM (Visible when ECU is configured for MTU MDEC.)
        - SPEED SETUP (Visible when ECU is configured for MTU ADEC or MTU ECU7.)
            - SPD DMAND SRC
            - ENGNE RPM
            - 50-60 Hz SEL (Visible when ECU is configured for MTU ECU7.
            - TEST OVRSPEED
            - SPEED UP (Visible when ECU is configured for MTU ECU7.)
            - SPEED DN (Visible when ECU is configured for MTU ECU7.)
            - SPD DMD LIMIT (Visible when ECU is configured for MTU ECU7.)
            - INCREASE IDLE (Visible when ECU is configured for MTU ECU7.)
        - ECU SETUP (Visible when ECU is configured for MTU ADEC or MTU ECU7.)
            - TRIP RESET
            - INT OIL PRIME
            - GOV PRM SW (Visible when ECU is configured for MTU ADEC.)
            - ENG STRT PRIME (Visible when ECU is configured for MTU ECU7.)
            - FAN OVERRIDE (Visible when ECU is configured for MTU ECU7.)
            - MODE SWITCH (Visible when ECU is configured for MTU ECU7.)
            - GOV PARAM SET (Visible when ECU is configured for MTU ECU7.)

            - ♦ CAN RATING SW 1 (Visible when ECU is configured for MTU ECU7.)
            - ♦ CAN RATING SW 2 (Visible when ECU is configured for MTU ECU7.)
            - ♦ DIS CYL CUT 1 (Visible when ECU is configured for MTU ECU7.)
            - ♦ DID CYL CUT 2 (Visible when ECU is configured for MTU ECU7.)

- **RS485 SETUP**
    - — COMM BAUD
    - — COMM PARITY
    - — MODBUS ADDR

SYSTEM PARAMS

- **SYSTEM SETTINGS**
    - — RATED RPM
    - — COOLDWN TIME
    - — OFF MODE COOLDN
    - — FUEL LVL TYP
    - — SYSTEM UNITS
    - — BATTERY VOLT
    - — FLYWHL TEETH
    - — MAINT RESET
    - — HORN
    - — NOT IN AUTO HORN
    - — POWER UP DELAY
    - — RELAY CONTROL
        - o START
        - o RUN
        - o PRESTART
- **REMOTE MODULE SETUP**
    - — LSM SETUP
        - o ENABLE
        - o CANBUS ADDR (Visible when LSM-2020 is enabled.)
        - o VERSION INFO (Visible when LSM-2020 is enabled.)
            - ♦ FIRMWARE VERSION
            - ♦ BOOT CODE VERSION
        - o TCP/IP SETTINGS (Visible when LSM-2020 is enabled.)
            - ♦ IP ADDRESS
            - ♦ SUBNET MASK
            - ♦ GATEWAY ADDRESS
            - ♦ DHCP ENABLE
        - o LSM DEBUG (Visible when LSM-2020 is enabled.)
            - ♦ AUX VOLT
            - ♦ AUX CURR
    - — CEM SETUP
        - o ENABLE
        - o OUTPUTS (Visible when CEM-2020 is enabled.)
        - o CANBUS ADDR (Visible when CEM-2020 is enabled.)
        - o VERSION INFO (Visible when CEM-2020 is enabled.)
            - ♦ FIRMWARE VERSION
            - ♦ BOOT CODE VERSION
            - ♦ SERIAL NUMBER
            - ♦ PART NUMBER
            - ♦ MODEL NUMBER
            - ♦ BUILD DATE
        - o CEM DEBUG MENU (Visible when CEM-2020 is enabled.)
            - ♦ IEM TO CEM BP
            - ♦ CEM TO IEM BP
    - — AEM SETUP
        - o ENABLE
        - o CANBUS ADDR (Visible when AEM-2020 is enabled.)
        - o VERSION INFO (Visible when AEM-2020 is enabled.)
            - ♦ FIRMWARE VERSION
            - ♦ BOOT CODE VERSION
            - ♦ SERIAL NUMBER
            - ♦ PART NUMBER
            - ♦ MODEL NUMBER
            - ♦ BUILD DATE

- AEM DEBUG MENU (Visible when AEM-2020 is enabled.)
  - IEM TO AEM BP
  - AEM TO IEM BP
  - ANALOG INPUTS
    - SCALED
      - ALG IN X (X = 1 TO 8)
    - RAW
      - ALG IN X (X = 1 TO 8)
  - THERMAL INPUTS
    - SCALED
      - RTD IN X (X = 1 TO 8
      - THRM CPL X (X = 1 TO 2)
      - AMBIENT
    - RAW
      - RTD IN X (X = 1 TO 8
      - THRM CPL X (X = 1 TO 2)
  - ANALOG OUTPUTS
    - SCALED
      - ALG OUT X (X = 1 TO 4)
    - RAW
      - ALG OUT X (X = 1 TO 4)

- **CRANK SETTINGS**
  - DISCNCT LMIT
  - PRECRNK DELY
  - PRESTRT CNTCT
  - STYLE
  - # CYCLES
  - CYCLE TIME
  - PRESTART REST CONFIG
    - CONF
  - OIL PRS CRANK DISC
    - ENABLE
    - CRANK DISC PRS
- **AUTOMATIC RESTART**
  - ENABLE
  - ATTEMPTS
  - INTERVAL
- **EXERCISE TIMER**
  - MODE
  - START HOUR
  - START MINUTE
  - RUN HOURS
  - RUN MINUTES
- **ENGINE STATISTICS**
  - START YEAR
  - START MONTH
  - START DAY
  - # STARTS
  - HRS TO MAINT
  - TOTAL HRS

PROGRAMMABLE INPUTS

- **CONFIGURABLE INPUTS**
  - INPUT X (X = 1 to 26)
    - ALARM CONFIG
    - ACTIVATN DLY
    - RECOGNITION
- **PROG FUNCTIONS**
  - AUTO START
    - INPUT
    - RECOGNITION (Visible when an INPUT is selected.)
  - BATTLE OVERRIDE
    - INPUT
    - RECOGNITION (Visible when an INPUT is selected.)

- BATT CHRG FAIL
    - INPUT
    - ALARM CONFIG (Visible when an INPUT is selected.)
    - ACTIVATN DLY (Visible when an INPUT is selected.)
    - RECOGNITION (Visible when an INPUT is selected.)
- LOW COOL LEVEL
    - INPUT
    - ALARM CONFIG (Visible when an INPUT is selected.)
    - ACTIVATN DLY (Visible when an INPUT is selected.)
    - RECOGNITION (Visible when an INPUT is selected.)
- FUEL LEAK DETECT
    - INPUT
    - ALARM CONFIG (Visible when an INPUT is selected.)
    - ACTIVATN DLY (Visible when an INPUT is selected.)
    - RECOGNITION (Visible when an INPUT is selected.)

- **LSM INPUTS (Visible when LSM-2020 is enabled.)**
    - ALG IN 1
        - INPUT TYPE
        - MIN VOLTAGE
        - MAX VOLTAGE
        - MIN CURRENT
        - MAX CURRENT
- **ANALOG INPUTS (Visible when AEM-2020 is enabled.)**
    - ALG_IN_X (X = 1 to 8)
        - INPUT TYPE
        - MIN VOLTAGE
        - MAX VOLTAGE
        - MIN CURRENT
        - MAX CURRENT
        - PARAM MIN
        - PARAM MAX
        - OVER 1
            - THRESHOLD
            - ALARM CONFIG
        - OVER 2
            - THRESHOLD
            - ALARM CONFIG
        - UNDER 1
            - THRESHOLD
            - ALARM CONFIG
        - UNDER 2
            - THRESHOLD
            - ALARM CONFIG
        - ARMING DELAY
        - THR1 ACT DLY
        - THR2 ACT DLY
        - HYSTERESIS
        - OOR ALM CFG
- **THERMAL INPUTS (Visible when AEM-2020 is enabled.)**
    - RTD_IN_X (X = 1 to 8)
        - TYPE
        - OVER 1
            - THRESHOLD
            - ALARM CONFIG
        - OVER 2
            - THRESHOLD
            - ALARM CONFIG
        - UNDER 1
            - THRESHOLD
            - ALARM CONFIG
        - UNDER 2
            - THRESHOLD
            - ALARM CONFIG
        - ARMING DELAY
        - THR1 ACT DLY
        - THR2 ACT DLY

- o HYSTERESIS
- o OOR ALM CFG

— THRM_CPL_X (X = 1 to 2)
- o OVER 1
  - ♦ THRESHOLD
  - ♦ ALARM CONFIG
- o OVER 2
  - ♦ THRESHOLD
  - ♦ ALARM CONFIG
- o UNDER 1
  - ♦ THRESHOLD
  - ♦ ALARM CONFIG
- o UNDER 2
  - ♦ THRESHOLD
  - ♦ ALARM CONFIG
- o ARMING DELAY
- o THR1 ACT DLY
- o THR2 ACT DLY
- o HYSTERESIS

PROGRAMMABLE OUTPUTS (Visible when AEM-2020 is enabled)

- **ANALOG OUTPUTS**
  - — ANALOG OUTPUT X (X = 1 to 4)
    - o OUTPUT TYPE
    - o MIN VOLTAGE
    - o MAX VOLTAGE
    - o MIN CURRENT
    - o MAX CURRENT
    - o PARAM MIN
    - o PARAM MAX
    - o OOR ALM CFG
    - o OOR ACT DLY
    - o PARAM

CONFIG PROTECTION

- **CONF PROT X (X = 1 to 8)**
  - — PARAM
  - — OVER 1
    - o THRESHOLD
    - o ALARM CONFIG
  - — OVER 2
    - o THRESHOLD
    - o ALARM CONFIG
  - — UNDER 1
    - o THRESHOLD
    - o ALARM CONFIG
  - — UNDER 2
    - o THRESHOLD
    - o ALARM CONFIG
  - — ARMING DELAY
  - — THR1 ACT DLY
  - — THR2 ACT DLY
  - — HYSTERESIS

ALARM CONFIGURATION

- **PRE-ALARMS**
  - — HIGH COOLANT TEMP
    - o ENABLE
    - o THRESHOLD
  - — LOW COOLANT TEMP
    - o ENABLE
    - o THRESHOLD

- LOW OIL PRESSURE
  - ENABLE
  - THRESHOLD
- LOW FUEL LEVEL
  - ENABLE
  - THRESHOLD
- MAINTENANCE INTERVAL
  - ENABLE
  - THRESHOLD
- BATTERY OVERVOLTAGE
  - ENABLE
  - THRESHOLD
- LOW BATTERY VOLTAGE
  - ENABLE
  - THRESHOLD
  - ACTIVATN DLY
- WEAK BATTERY VOLTAGE
  - ENABLE
  - THRESHOLD
  - ACTIVATN DLY
- HIGH FUEL LEVEL
  - ENABLE
  - THRESHOLD
  - ACTIVATN DLY
- ACTIVE DTC (Visible when DTC is enabled.)
  - ENABLE
- ECU COMMS FAIL (Visible when CANBUS is enabled.)
  - ENABLE
- COOLANT LEVEL (Visible when CANBUS is enabled.)
  - ENABLE
  - THRESHOLD
- LSM COMM FAIL (Visible when LSM-2020 is enabled.)
  - ENABLE
- CEM COMM FAIL (Visible when CEM-2020 is enabled.)
  - ENABLE
- AEM COMM FAIL (Visible when AEM-2020 is enabled.)
  - ENABLE
- CHECKSUM FAIL
  - ENABLE

- **ALARMS**
  - HIGH COOLANT TEMP
    - ENABLE
    - THRESHOLD
    - ARMING DELAY
  - LOW OIL PRESSURE
    - ENABLE
    - THRESHOLD
    - ARMING DELAY
  - LOW FUEL LEVEL
    - ENABLE
    - THRESHOLD
    - ACTIVATN DLY
  - OVERSPEED
    - ENABLE
    - THRESHOLD
    - ACTIVATN DLY
  - COOLANT LEVEL (Visible when CANBUS in enabled.)
    - ENABLE
    - THRESHOLD

NOTE

The HIGH COOLANT TEMP and LOW OIL PRESSURE alarms have an ARMING DLY setting that disables the alarm for the specified time after engine startup.

- **SENDER FAIL**
  - COOL TEMP SENDR FAIL
    - CONFIG TYPE
    - ACTIVATN DLY
  - OIL PRESS SENDR FAIL
    - CONFIG TYPE
    - ACTIVATN DLY
  - FUEL LEVL SENDR FAIL
    - CONFIG TYPE
    - ACTIVATN DLY
  - SPEED SENDR FAIL
    - TIME DELAY

LOGIC TIMERS

- **TIMER X (X = 1 to 10)**
  - HOURS
  - MINUTES
  - SECONDS

ENTER PASSWORD

LOGOUT

REAR PANEL

All IEM-2020 terminals and connectors are located on the rear panel. Rear panel terminals and connectors are illustrated in Figure 2-4. (To show the terminals and connectors, Figure 2-4 shows the IEM-2020 with the rear cover removed.) Table 2-2 lists the call-outs of Figure 2-4 along with a description of each connector type.

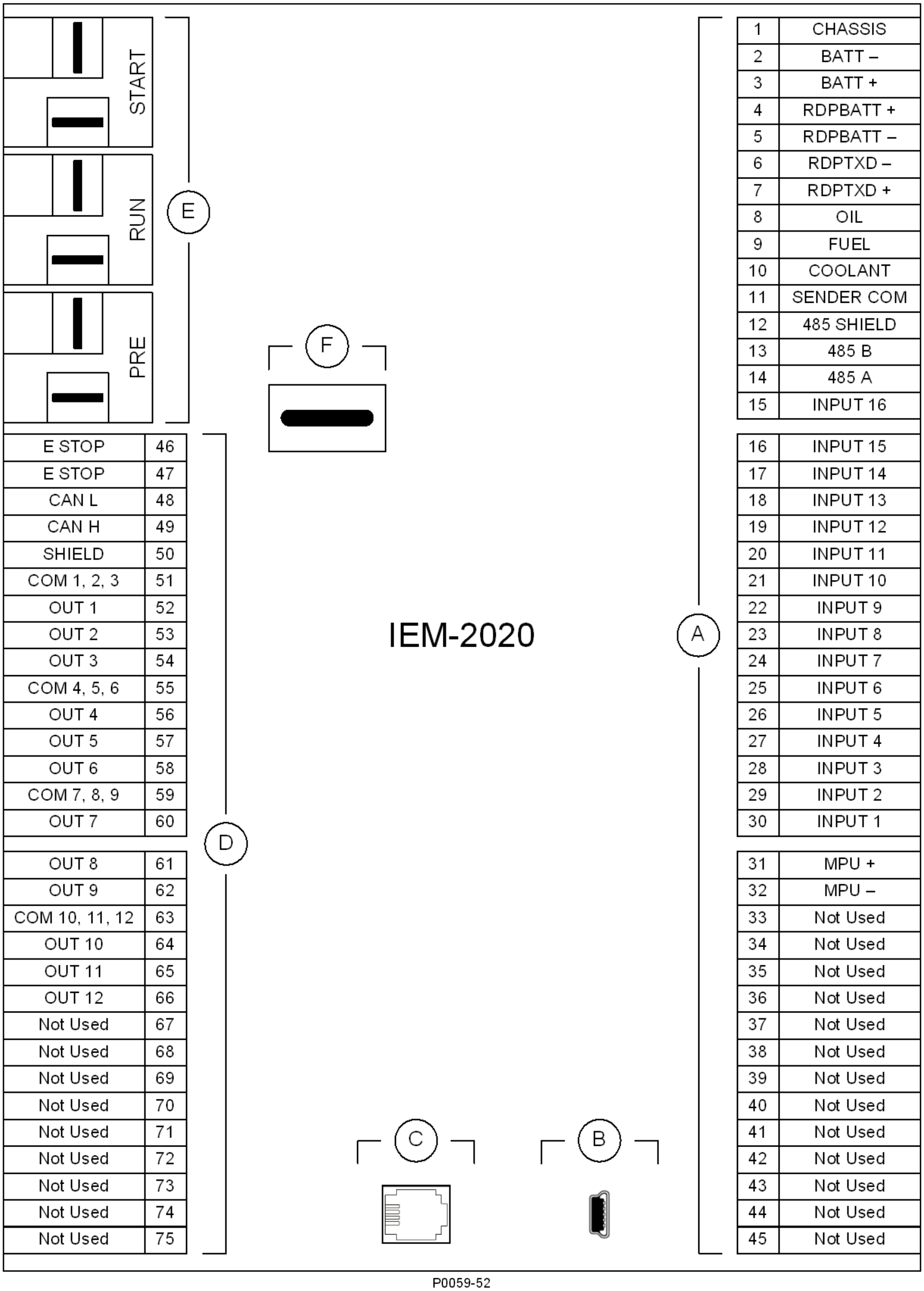

Figure 2-4. Rear Panel

Table 2-2. Rear Panel HMI Descriptions

Locator	Description
A, D	The majority of external, IEM-2020 wiring is terminated at 15-position connectors with compression terminals. These connectors plug into headers on the IEM-2020. The connectors and headers have a dovetailed edge that ensures proper connector orientation. Each connector and header is uniquely keyed to ensure that a connector mates only with the correct header. Connector screw terminals accept a maximum wire size of 12 AWG.
B	The mini-B USB socket mates with a standard USB cable and is used with a PC running BESTCOMS*Plus* software for local communication with the IEM-2020.
C	IEM-2020 modules with an optional, internal, dial-out modem connect to a telephone line through a USOC RJ-11 jack.
E	Connections to the IEM-2020 Start (starter), Run (fuel solenoid), and Pre (glow plug) output contacts are made directly to each relay through quarter-inch, male, quick-connect terminals.
F	An optional battery backup for the real-time clock is available when ordering. See Section 7, *Maintenance and Troubleshooting,* for instructions on replacing the battery. Failure to replace the battery with Basler Electric P/N 38526 may void the warranty.

SECTION 3 • FUNCTIONAL DESCRIPTION

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SECTION 3 • FUNCTIONAL DESCRIPTION

INTRODUCTION

This section describes how the IEM-2020 functions. A detailed description of each function block is provided in the paragraphs under the heading of IEM-2020 Function Blocks.

IEM-2020 operating and metering features are described in Section 4, *BESTCOMSPlus Software.*

IEM-2020 FUNCTION BLOCKS

To ease understanding, IEM-2020 functions are illustrated in the block diagram of Figure 3-1. The following paragraphs describe each function in detail.

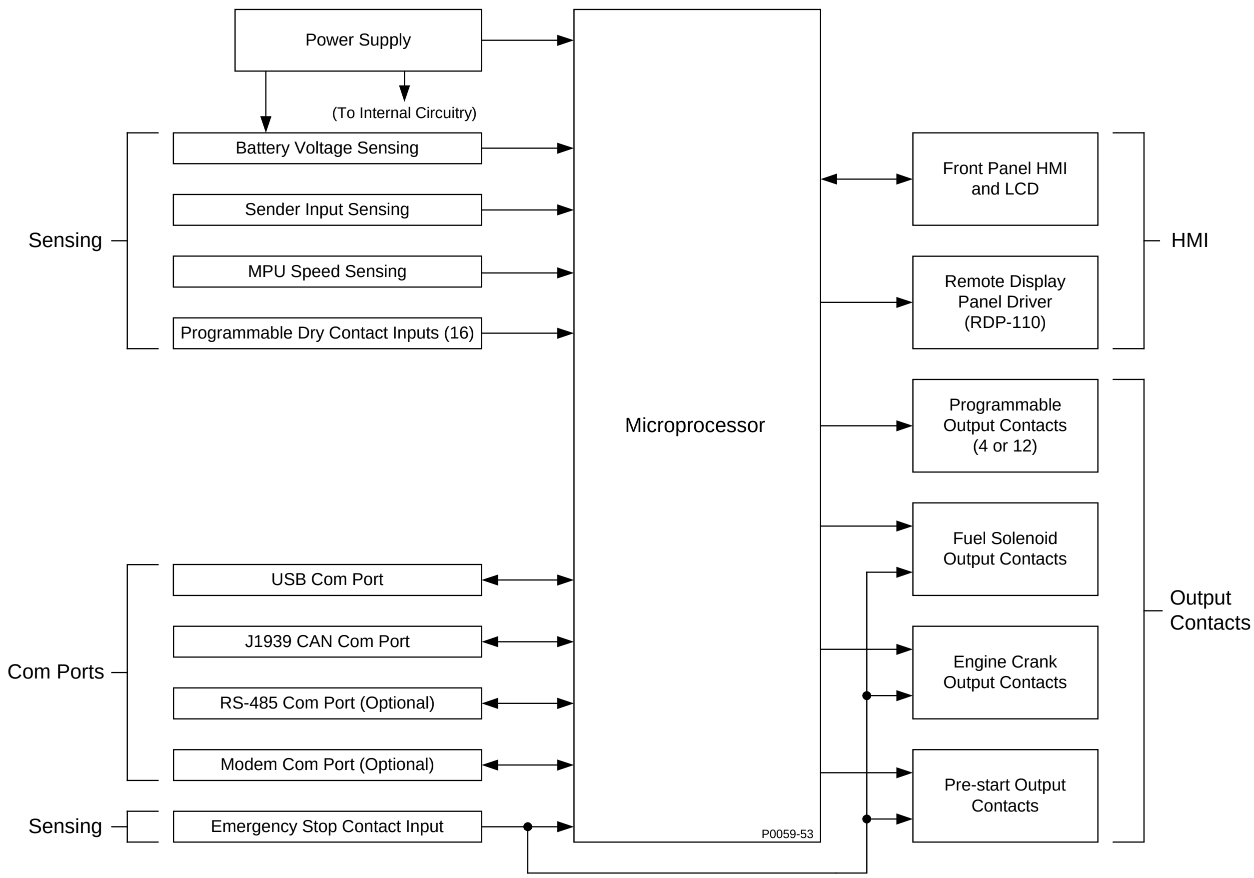

Figure 3-1. Function Block Diagram

Power Supply

The internal, switch-mode power supply uses the applied battery voltage to generate operating power for the internal circuitry of the IEM-2020. The power supply accepts a nominal battery voltage of 12 or 24 Vdc and has an operating range of 6 to 32 Vdc. Battery voltage is applied to terminals 2 (–) and 3 (+). Operating power must be of the correct polarity. Although reverse polarity will not cause damage, the IEM-2020 will not operate.

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 IEM-2020 and makes decisions based on programming and system inputs.

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

Analog-to-Digital Converter

Scaled and conditioned signals representing the coolant temperature, fuel level, oil pressure, and battery voltage are digitized by the microprocessor's 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.

Watchdog Timer

The watchdog timer monitors the firmware executed by the microprocessor. If the firmware ceases normal operation, the watchdog timer will reset the microprocessor. After reset, the microprocessor will resume normal operation if the condition that caused the watchdog reset is no longer present. If the condition is still present, the unit will reset repeatedly until it can resume normal operation.

Analog Engine Sender Inputs

Programmable analog engine sender inputs give the IEM-2020 user the flexibility to select the engine sender to be used in an application. Information about programming the sender inputs is provided in Section 4, *BESTCOMSPlus Software*.

Oil Pressure

A current is provided to the oil pressure sender. The developed voltage is measured and scaled for use by the internal circuitry. An open circuit or short circuit across the oil pressure sender terminals will cause the IEM-2020 to indicate a failed sender. Oil pressure senders that are compatible with the IEM-2020 include Datcon model 02505-00, Isspro model R8919, and Stewart-Warner models 411K and 411M. Other senders may also be used. BESTCOMS*Plus* software allows for the programming of sender characteristics. See Section 4, *BESTCOMSPlus Software*, for more information.

Oil pressure sender connections are made at terminals 8 and 11 (sender common).

Coolant Temperature

A current is provided to the coolant temperature sender. The developed voltage is measured and scaled for use by the internal circuitry. An open circuit or short circuit across the coolant temperature sender terminals will cause the IEM-2020 to indicate a failed sender. Coolant temperature senders that are compatible with the IEM-2020 include Datcon model 02019-00, Faria model TS4042, Isspro model R8959, and Stewart-Warner model 334P. Other senders may be used. BESTCOMS*Plus* software allows for the programming of sender characteristics. See Section 4, *BESTCOMSPlus Software*, for more information.

Coolant temperature sender connections are made at terminals 10 and 11 (sender common).

Fuel Level

A current is provided to the fuel level sender. The developed voltage is measured and scaled for use by the internal circuitry. An open circuit or short circuit across the fuel level sender terminals will cause the IEM-2020 to indicate a failed sender. Fuel level senders that are compatible with the IEM-2020 include Isspro model R8925. Other senders may be used. BESTCOMS*Plus* software allows for the programming of sender characteristics. See Section 4, *BESTCOMSPlus Software*, for more information.

Fuel level sender connections are made at terminals 9 and 11 (sender common).

Speed Signal Input

The IEM-2020 uses the signal from the magnetic pickup input to detect machine speed.

Magnetic Pickup Input (MPU)

Voltage supplied by a magnetic pickup is scaled and conditioned for use by the internal circuitry as a speed signal source. The MPU input accepts a signal over the range of 3 to 35 volts peak and 32 to 10,000 hertz.

Magnetic pickup connections are provided at terminals 31 (+) and 32 (–).

Contact Inputs

The IEM-2020 has seventeen contact sensing inputs: an emergency stop input and 16 programmable inputs. Additional contact inputs can be accommodated with a CEM-2020 (Contact Expansion Module). Contact Basler Electric for availability and ordering information.

Emergency Stop Input

This input accepts Form B, dry contacts. An open circuit at this continuously monitored input initiates an emergency stop. An emergency stop removes operating power from the IEM-2020 Pre-Start, Run, and Fuel output relays.

Emergency stop contact connections are made at terminals 46 and 47.

Programmable Inputs

Each programmable input (Input 1 through Input 16) can be independently configured to perform the following functions. By default, each programmable input is disabled.

- Auto Start
- Battery Charger Fail
- Battle Override
- Fuel Leak Detect
- Low Coolant Level

The programmable inputs accept normally open, Form A contacts. A contact is connected between a programmable input and the negative side of the battery. Through BESTCOMS*Plus*, each programmable contact input can be assigned a name (16 alphanumeric characters, maximum) and configured as an alarm input, a pre-alarm input, or neither. The default names for the inputs are INPUT_x (where x = 1 to 16). 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 pre-alarm metering screen 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 as an input to programmable logic.

Connections for the programmable inputs are provided at terminals 15 (Input 16) through 30 (Input 1). The negative side of the battery voltage (terminal 2) 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 IEM-2020/engine set. Front panel HMI components include an LCD (liquid crystal display), LED (light emitting diodes) indicators, 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.

LED Indicators

The LEDs indicate pre-alarm and alarm conditions along with IEM-2020 status and engine status.

Pushbuttons

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

Remote Display Panel (Optional)

Applications that require remote annunciation can use Basler Electric’s Remote Display Panel, RDP-110. Using the RDP-110 with the IEM-2020 meets the requirements of NFPA Standard 110. The RDP-110 uses a dedicated, four-terminal interface with the IEM-2020. The RDP-110 communicates with the IEM-2020 via terminals 6 (RDP TXD–) and 7 (RDP TXD+) and receives power from terminals 4 (RDP BATT+) and 5 (RDP BATT-). 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:

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

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 sender failure ∗
- Engine sender unit failure

∗ Can be configured in the IEM-2020 as *None, Alarm,* or *Pre-Alarm.* See Section 4, *BESTCOMSPlus, Programmable Inputs, Programmable Functions,* for more information. The light on the RDP-110 will turn on when the input that is assigned to the programmable function is closed, whether the function is configured as *None, Alarm,* or *Pre-Alarm*.

Additionally, the RDP-110 indicates when the IEM-2020 is not operating in Auto mode and when the engine is supplying load. For more information about the RDP-110, request product bulletin SNE.

RDP-110 communication connections are made at IEM-2020 terminals 6 (RDP TXD–) and 7 (RDP TXD+). RDP-110 operating power is supplied at IEM-2020 terminals 4 (RDP BATT+) and 5 (RDP BATT–).

Communication Ports

IEM-2020 communication ports include a USB jack, CAN terminals, optional RS-485 terminals, and an optional modem jack.

USB

The rear-panel, mini-B USB socket enables local communication with a PC running BESTCOMS*Plus* software. The IEM-2020 is connected to a PC using a standard USB cable. BESTCOMS*Plus* is a Windows® based communication software package that is supplied with the IEM-2020. A detailed description of BESTCOMS*Plus* is provided in Section 4, *BESTCOMSPlus Software*.

CANbus

A Controller Area Network (CAN) is a standard interface that enables communication between multiple modules on a common network using a standard message protocol. IEM-2020 modules have a CANbus interface that supports the SAE J1939 protocol and the MTU protocol.

Applications using an engine-driven engine set controlled by an IEM-2020 may also have an Engine Control Unit (ECU). The CANbus interface allows the ECU and IEM-2020 to communicate. The ECU reports operating information to the IEM-2020 through the CANbus interface. Operating parameters and diagnostic information, if supported by the ECU, are decoded and displayed for monitoring.

The primary use of the CANbus 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 IEM-2020 CANbus interface. These parameters are transmitted via the CANbus interface at preset intervals. See the column labeled Update Rate in Table 3-1 for transmission rates. This information can also be transmitted upon user request.

CANbus interface connections are made at 48 (CAN L), 49 (CAN H), and 50 (SHIELD).

Table 3-1. ECU Parameters Obtained from CANbus Interface

ECU Parameter	Metric Units	English Units	Update Rate	∗ SPN
Actual Engine Percent Torque	%	%	Engine Speed Dependent	513
Air Filter Differential Pressure	kPa	psi	500 ms	107
Air Inlet Temperature	kPa	°F	1 s	172
Alarm Reset Feedback	Binary (0 or 1)		1 s	2815
Ambient Air Temperature	°C	°F	1 s	171
Auxiliary Pressure 1	kPa	psi	On Request	1387
Auxiliary Pressure 2	kPa	psi	On Request	1388

ECU Parameter	Metric Units	English Units	Update Rate	* SPN
Barometric Pressure	kPa	psi	1 s	108
Battery Voltage	Vdc	Vdc	1 s	168
Boost Pressure	kPa	psi	500 ms	102
Charge Air Temperature	°C	°F	1 s	2629
Coolant Level	%	%	500 ms	111
Coolant Pressure	kPa	psi	500 ms	109
ECU Temperature	°C	°F	1 s	1136
Engine Coolant Temperature	°C	°F	1 s	110
Engine Intercooler Temperature	°C	°F	1 s	52
Engine Oil Level	%	%	500 ms	98
Engine Oil Pressure	kPa	psi	500 ms	100
Engine Oil Temperature	°C	°F	1 s	175
Engine Speed	rpm	rpm	Engine Speed Dependent	190
Exhaust Gas Temperature	°C	°F	500 ms	173
Exhaust Temperature A	°C	°F	500 ms	2433
Exhaust Temperature B	°C	°F	500 ms	2434
Fuel Delivery Pressure	kPa	psi	500 ms	94
Fuel Leak Filter 1	Binary (0 or 1)		1 s	1239
Fuel Leak Filter 2	Binary (0 or 1)		1 s	1240
Fuel Rate	liter/hr	gal/hr	100 ms	183
Fuel Temperature	°C	°F	1 s	174
Injection Control Pressure	MPa	psi	500 ms	164
Injector Metering Rail Pressure	MPa	psi	500 ms	157
Intake Manifold Temperature	°C	°F	500 ms	105
Percent Load at Current rpm	%	%	50 ms	92
Rated Power	watts	watts	On Request	166
Rated rpm	rpm	rpm	On Request	189
Shutdown from ECU	Binary (0 or 1)		1 s	1110
Switched Battery Voltage (at ECU)	Vdc	Vdc	1 s	158
Throttle (Accelerator Pedal) Position	%	%	50 ms	91
Total Engine Hours	hours	hours	Requested 1.5 s	247
Total Fuel Used	liters	gallons	Requested 1.5 s	250
Transmission Oil Pressure	kPa	psi	1 s	127
Transmission Oil Temperature	°C	°F	1 s	177
Trip Fuel	liters	gallons	Requested 1.5 s	182
Winding 1 Temperature	°C	°F	1 s	1124
Winding 2 Temperature	°C	°F	1 s	1125
Winding 3 Temperature	°C	°F	1 s	1126

* SPN is suspect parameter number.

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

ECU Parameter	Metric Units	English Units	Update Rate	* SPN
Engine Speed at High Idle Point 6	rpm	rpm	5 s	532
Engine Speed at Idle Point 1	rpm	rpm	5 s	188
Engine Speed at Point 2	rpm	rpm	5 s	528
Engine Speed at Point 3	rpm	rpm	5 s	529

ECU Parameter	Metric Units	English Units	Update Rate	∗ SPN
Engine Speed at Point 4	rpm	rpm	5 s	530
Engine Speed at Point 5	rpm	rpm	5 s	531
Gain (Kp) of End Speed Governor	%/rpm	%/rpm	5 s	545
Maximum Momentary Engine Override Speed Point 7	rpm	rpm	5 s	533
Maximum Momentary Engine Override Time Limit	seconds	seconds	5 s	534
Percent Torque at Idle Point 1	%	%	5 s	539
Percent Torque at Point 2	%	%	5 s	540
Percent Torque at Point 3	%	%	5 s	541
Percent Torque at Point 4	%	%	5 s	542
Percent Torque at Point 5	%	%	5 s	543
Reference Engine Torque	N•m	ft-lb	5 s	544
Requested Speed Control Range Lower Limit	rpm	rpm	5 s	535
Requested Speed Control Range Upper Limit	rpm	rpm	5 s	536
Requested Torque Control Range Lower Limit	%	%	5 s	537
Requested Torque Control Range Upper Limit	%	%	5 s	538

∗ SPN is suspect parameter number.

CAUTION

When the CANbus is enabled, the IEM-2020 will ignore the following sender inputs: oil pressure, coolant temperature, and magnetic pickup.

Under certain circumstances, the following strings may be displayed on the front panel HMI and in the Metering Explorer of BESTCOMS*Plus*:

- *NC (Not Connected)* - String displayed for a J1939 parameter when the engine ECU is not connected to the IEM-2020.
- *SF (Sender Fail)* - String displayed for a J1939 parameter when the engine ECU sends a special code indicating a measurement failure for the parameter. For example, if oil sender is determined to be bad by the ECU, it sends a special code in place of the J1939 oil pressure data indicating a sender fail condition.
- *NS (Not Sent)* - String displayed for a J1939 parameter when the J1939 parameter has not been sent to the IEM-2020 by the engine ECU.
- *NA (Not Applicable)* - String displayed for a J1939 parameter when the engine ECU sends a special code for the parameter indicating that the parameter is not implemented or not applicable in the ECU.
- *UF (Unknown Failure)* - String displayed when the J1939 parameter data received by the ECU is not within the valid J1939 data range for the parameter but is not one of the special codes above.

Table 3-3 lists the J1939 data transmitted from the IEM-2020.

Table 3-3. J1939 Data Transmitted from the IEM-2020

ECU Parameter	Update Rate	∗ SPN
Battle Override Switch	100 ms	1237
Speed Request (MTU and GM Only)	10 ms	518
Note: Requests from the DGC-2020 to the Engine ECU for various parameters are made by issuing the request.		
Address Claim Request	Once on power up, and any time a Global Request for Address Claim (GRAC) PGN is received.	NA

ECU Parameter	Update Rate	* SPN
Currently Active Diagnostic Trouble Codes Request	Whenever a refresh of Currently Active Diagnostic Trouble Code Requests is received.	NA
Previously Active Diagnostic Trouble Codes Request	2 s	NA
Clear Currently Active Diagnostic Trouble Codes Request	Whenever a request to reset Currently Active Diagnostic Trouble Code Request is made.	NA
Clear Previously Active Diagnostic Trouble Codes Request	Whenever a request to reset Previously Active Diagnostic Trouble Code Request is made.	NA
Engine Hours/Revolutions Request	2 s	NA
Fuel Consumption Request	2 s	NA
Electronic Engine Controller #4 (Rated Speed and Power) Request	2 s	NA
Auxiliary Analog Information	2 s	N/A

* SPN is suspect parameter number.

Diagnostic Trouble Codes (DTCs)

The IEM-2020 obtains diagnostic engine information from a compatible engine control unit (ECU). The IEM-2020 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 *3-4* lists the diagnostic information that the IEM-2020 obtains over the CANbus interface.

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.

Table 3-4. Diagnostic Information Obtained Over the CANbus 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 active DTCs	On request
Request to clear previously active DTCs	On request

MTU Fault Codes

An IEM-2020 connected to a engine equipped with an MTU engine ECU tracks and displays the active fault codes issued by the MTU engine ECU. Active MTU fault codes can be viewed through BESTCOMS*Plus* by using the Metering Explorer to expand the MTU tree or through the front panel display by navigating to METERING, ALARMS-STATUS, MTU FAULT CODES.

Each fault code is displayed with a fault description and the fault number. If the IEM-2020 does not have descriptive information about a fault number that was received, the fault description will display as “NO TEXT AVAILABLE”. For more detailed information, refer to your MTU documentation.

15V GOODECU DFCT
15V NEGECU DEFCT
15V POSECU DEFCT
AD-TST1ECU DEFCT
AD-TST2ECU DEFCT
AD-TST3ECU DEFCT
AL BATT NOT CHRG
AL CALL FLD SRVC
AL CAN NO PU-DATA
AL CAN POM ND LST
AL CAN PUDATA ERR
AL CAN BAD PARAMS
AL CAN1 BUS OFF
AL CAN1 ERR PASSV
AL CAN1 NODE LOST

AL CAN2 BUS OFF
AL CAN2 ERR PASSV
AL CAN2 NODE LOST
AL CHECK POM FUSE
AL COMB ALM RED
AL COMB ALM YEL
AL CR TRIG ENG ST
AL CRASH REC ERR
AL EMU PARAM ERR
AL ETC SPD DEVIATN
AL ETC2 CUTIN FAIL
AL EXT ENG PROT
AL INTERFACE ECU
AL L1 AUX 1
AL L1 AUX1 PLANT
AL L1 P AUX 1
AL L1 T AUX 1
AL L2 AUX 1
AL L2 AUX1 PLANT
AL L2 P AUX 1
AL L2 T AUX 1
AL LIFE DATA ERR
AL LIFE DATA NA
AL LOW STRTR VOLT
AL MCR EXCEEDED
AL MV WIRING GND
AL NEW POM FOUND
AL OPN LD POM ALT
AL OPN LD DIGIN 1
AL OPN LD DIGIN 2
AL OPN LD DIGIN 3
AL OPN LD DIGIN 4
AL OPN LD DIGIN 5
AL OPN LD DIGIN 6
AL OPN LD DIGIN 7
AL OPN LD DIGIN 8
AL OPN LD E-STOP
AL OVERRIDE ON
AL POM ERROR
AL POWER STAGE HI
AL POWER STAGE LO
AL PRELUBE FAULT
AL RAIL_LEAKAGE
AL SD CAM STOP
AL STOP PWR STG
AL STOP PWR STG 2
AL STOP SD
AL WIRING FRQ OUT
AL WRG POM STRT 1
AL WRG POM STRT 2
AL WIRING PWM CM2
AL WIRING TO 1
AL WIRING TO 2
AL WIRING TO 3
AL WIRING TO 4
AL WIRING TOP 1
AL WIRING TOP 2
AL WIRING TOP 3
AL WIRING TOP 4
AL WIRING TOP 5
AL WIRING TOP 6
AL WRONG POM ID
BANK1 ECU DEFECT
BANK2 ECU DEFECT
CAN LESS MAILBXS
AL CONFIG CHANGED
DUMMY FAULT
EDM NOT VALID
AL ENGHR CTR DEFCT
ENG HRS INVALID 2
ERR REC1 INVALID
ERR REC2 INVALID
HI ECU VOLTS
HI ETC IDLE SPEED
HI ETC1 OVERSPEED
HI ETC2 OVERSPEED
HI WTR FUEL PFLTR
HI LVL LKG FUEL
HI P CHARGE AIR
HI P-CRANKCASE
HI P-DIFF-LUBE OIL
HI P-FUEL RAIL
HI T-CHRG AIR
HI T-COOLANT
HI T COOLANT EMU
HI T COOLNT (R)
HI T-ECU
HI T-EXHAUST A
HI T-EXHAUST B
HI T EXHAUST EMU
HI T-FUEL
HI T-INTERCOOLER
HI T-LUBE OIL
HI T UMBLASSEN
HI U-PDU
HIHI ECU VOLTS
HIHI U-PDU
IDM NOT VALID
AL FUEL CONS DEFCT
INVLD FUEL CNS 2
L BIN-EXTERN 3
L BIN-EXTERN 4
L1 5V BUFFR TEST
L1 P-EXTERN 1
L1 P-EXTERN 2
L1 P-FUELFLT DIF
L1 T-EXTERN 1
L1 T-EXTERN 2
L1 TE BUFFR TEST
L2 LEVEL INTRCLR
L2 P-EXTERN 1
L2 P-EXTERN 2
L2 T-EXTERN 1
L2 T-EXTERN 2
LIM EXT CLNT LEV
LIM INTERCLR LEV
LO COOLANT LEVEL
LO ECU VOLTS
LO LEVEL INTRCLR
LO P-COOLANT
LO P CLNT INTRCLR
LO P-FUEL
LO P-FUEL RAIL
LO P-LUBE OIL
LO P LUBE OIL (R)
LO PREHT TMP
LO T EXHAUST EMU
LO U-PDU
LOLO ECU VOLTS
LOLO U-PDU
MI MODULE FAIL
MI NOT ACTIVE
MODL WRITE LIMIT
AL MULT FDH SLVS
NO FAULTS
NO TEXT AVAILABLE
OPN LD CYLNDR A1
OPN LD CYLNDR A10
OPN LD CYLNDR A2
OPN LD CYLNDR A3
OPN LD CYLNDR A4
OPN LD CYLNDR A5
OPN LD CYLNDR A6
OPN LD CYLNDR A7
OPN LD CYLNDR A8
OPN LD CYLNDR A9
OPN LD CYLNDR B1
OPN LD CYLNDR B10
OPN LD CYLNDR B2
OPN LD CYLNDR B3
OPN LD CYLNDR B4
OPN LD CYLNDR B5
OPN LD CYLNDR B6
OPN LD CYLNDR B7
OPN LD CYLNDR B8
OPN LD CYLNDR B9
SD 15V NEG SPPLY
SD 15V POS SPPLY
SD 5V BUFFR TEST
SD ADTEST1 SPPLY
SD ADTEST2 SPPLY
SD ADTEST3 SPPLY
SD AUX 1
SD AUX 2
SD BANK 1 TEST
SD BANK 2 TEST
SD BIN-EXT3
SD BIN-EXT4
SD CAMSHAFT SPD
SD CAN ALRM RST
SD CAN CYL CUTOUT
SD CAN ENGAGE SIG
SD CAN IDLE REQ
SD CAN IDLE RQ SR
SD CAN LAMP TEST
SD CAN LOCAL
SD CAN NOTCH POS
SD CAN OVERRIDE
SD CANRCS CYL CUT
SD CAN RCS ENGAGE
SD CAN SPD DEMND
SD CAN STOP
SD CAN TRBOSW LCK
SD CAN TST OVRSP
SD CAN UP/DOWN
SD CANRES TRIPFL
SD CHARGER1 SPEED
SD CHARGER2 SPEED
SD COIL CURRENT
SD COOLANT LEVEL
SD CRANKSHFT SPD
SD EXT CLNT LVL

SD FREQNCY INPUT
SD IDLE-END TRQ IN
SD INTERCLER LVL
SD WTR FUEL PFLTR
SD LOAD ANLG FLT
SD LVL INTERCLR
SD LVL LKG FUEL
SD P AMBIENT AIR
SD P-AUX 1
SD P-CHARGE AIR
SD P COOLANT
SD P CLNT INTRCLR
SD P-CRANKCASE
SD P-DIFF LUBEOIL
SD P-EXTERN 1
SD P-EXTERN 2
SD P-FUEL
SD P-HD
SD P-LUBE OIL
SD P LUBE OIL (R)
SD POWER SUPPLY
SD PRE FILT P OIL
SD SPD DEMAND AN
SD SPDMTEST BNCH
SD SPINOUT
SD T-AUX 1
SD T-CHARGE AIR
SD T-CLNT INTERC
SD T-COOLANT
SD T COOLANT (R)
SD T-ECU
SD T-ELECTRONIC
SD T EXHAUST A
SD T EXHAUST B
SD T-EXTERN 1
SD T-EXTERN 2
SD T-FUEL
SD T-INTAKE AIR
SD T-LUBE OIL
SD T UMBLASSEN
SD TE BUFFR TEST
SD TRBO SW LCK SR
SD U-PDU
SENSOR PWR DEFCT
SS COOLANT LEVEL
SS ENGINE OVERSPD
SS ETC1 OVERSPEED
SS ETC2 OVERSPEED
SS IDLE SPEED LOW
SS P CHARGE AIR
SS P-COOLANT
SS P CLNT INTRCLR
SS P CRANKCASE
SS P-DIFF LUBE OIL
SS P-FUEL
SS P-LUBE OIL
SS P LUBE OIL (R)
SS PREHT TMP
SS PWR RED ACT
SS RELEASE SPD LOW
SS ENGINE SPD LOW
SS STARTER SPD LOW
SS T-CHRG AIR
SS T-COOLANT
SS T-COOLANT L3
SS T-COOLANT L4
SS T COOLNT (R)
SS T-EXHAUST A
SS T-EXHAUST B
SS T-FUEL
SS T-INTERCOOLER
SS T-LUBE OIL
SS T UMBLASSEN
AL STRT NT ENGAGE
TBO EXPIRED
TD P LUBE OIL
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TE BUF ECU DEFCT
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WIRING CYLNDR A2
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WIRING CYLNDR A6
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WIRING CYLNDR B1
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WIRING CYLNDR B5
WIRING CYLNDR B6
WIRING CYLNDR B7
WIRING CYLNDR B8
WIRING CYLNDR B9

RS-485 (Optional)

IEM-2020 modules with the optional RS-485 communication port (style number NNxRxxNNH) can be monitored and controlled via a polled network using the Modbus® protocol. The RS-485 port supports a user-selectable baud rate of 1200, 2400, 4800, or 9600. Odd, even, or no parity is supported. Fixed communication settings include the number of data bits (8) and stop bits (1). Modbus register values for the IEM-2020 are listed and defined in Appendix B, *Modbus Communication.* RS-485 port connections are made at IEM-2020 terminals 14 (485A), 13 (485B), and 12 (485 SHIELD).

Modem (Optional)

When equipped with the optional, internal, dial-out modem, the IEM-2020 can be connected to a standard telephone line through its RJ-11 jack. The modem enables the IEM-2020 to dial up to four pager telephone numbers and annunciate conditions selected by the user. These conditions include any IEM-2020 alarm or pre-alarm, closure of any programmable contact input, and an active cooldown timer. The modem accommodates pagers that use seven data bits with even parity or modems using eight data bits with no parity.

Output Contacts

Output contact operation is controlled by the operating mode of the IEM-2020. The state of the Emergency Stop contact input also affects output contact operation. When the Emergency Stop contact input is open (emergency stop condition), the PRESTART, START, and RUN outputs open. When the Emergency Stop input is closed, all output contacts operate normally.

IEM-2020 output contacts include PRESTART, START, and RUN, and up to 12 standard programmable outputs. Additional output contacts can be accommodated with a CEM-2020 (Contact Expansion Module).

PRESTART

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

During the resting state, the PRESTART can be set to Off, On, or Preheat Before Crank. If Preheat Before Crank is selected, the PRESTART output will be closed for a time equal to the Pre-crank delay time prior to re-entering the cranking state. If the Pre-crank delay setting is longer than the rest interval, the PRESTART output will be closed for the entire rest time.

PRESTART output connections are made through terminals located on the PRESTART relay.

START

This output closes when engine cranking is initiated by the IEM-2020 and opens when the magnetic pickup (MPU) or engine frequency indicates that the engine has started. Prior to engine starting, the duration of cranking is determined by the cranking style (cycle or continuous) selected. Cycle cranking permits up to 7 crank cycles with crank cycle duration of 5 to 15 seconds. The continuous crank time is adjustable from 1 to 60 seconds.

START output connections are made through terminals located on the START relay.

RUN

This output closes when engine cranking is initiated by the IEM-2020. The RUN output remains closed until an off command or emergency stop command is received.

RUN output connections are made through terminals located on the RUN relay.

Programmable

IEM-2020 modules with a style number of NNAxxxNNH have four programmable output contacts (OUT 1 through 4). Twelve programmable outputs (OUT 1 through 12) are provided on modules with a style number of NNBxxxNNH.

MODES OF OPERATION

OFF

When in the OFF mode, the IEM-2020 will not start under any circumstance. It cannot be started automatically. Programmable logic functions normally in this mode.

RUN

When in the RUN (manual) mode, the IEM-2020 runs and cannot be shut off automatically.

AUTO

When in the AUTO mode, the IEM-2020 may be started automatically or “self-start” from an automatic starting feature listed in the following paragraphs. If the IEM-2020 is not in AUTO mode, the self-starting modes will have no effect.

Auto Start

The Auto Start programmable function has an input mapped to it from BESTCOMS*Plus*. The unit will start and run when this contact is closed, and will stop when the contact is open. This mode is independent of the other self-starting modes.

Engine Exerciser

The unit will start at the designated time and will run for the specified duration. This mode is independent of the other self-starting modes.

Engine Run Logic Element

When the engine run logic element start input is energized, the unit will start. When the engine run logic element stop input is energized, the unit will cool down and then stop.

EVENT RECORDING

An event log retains history of system events in nonvolatile memory. Thirty event records are retained and each record contains a time stamp of the first and last event occurrence, and the number of occurrences for each event. In addition, each record contains details of the time, date, and engine hours for the most recent 30 occurrences of the event. The number of occurrences stops incrementing at 99. If an event occurs which is of a type that differs from those in the 30 records in memory, the record that has the oldest “last” event occurrence is removed from the log, and the new category takes its place. Since 30 event records with up to 99 occurrences each are retained in memory, a history of nearly 3,000 specific events are retained in the IEM-2020. Detailed occurrence information is retained for the most recent 30 occurrences of each event record, and there are 30 event records; thus the time, date, and engine hours details for up to 900 specific event occurrences are retained in the event log.

BESTCOMS*Plus* can be used to view and/or download the event log. The event log may also be viewed through the front panel HMI by navigating to *Metering, Alarms-Status, Event Log.* Use the Up/Down keys to highlight an event and press the *Right* key to view the summary of that event record. The summary contains the description of the event, the date, time, and engine hours of the first occurrence of the event, along with date, time, and engine hours of the most recent occurrence of the event. To view details of specific event occurrences, press the *Down* key until DETAILS is highlighted and then press the *Right* key. The occurrence number can be changed by pressing the *Edit* key, *Up/Down* keys to select #, and pressing the *Edit* key again to exit. Table 3-5 lists all possible event strings (as shown in the event log).

Table 3-5. Event List

Event String	Event Description	Event Type
AEM COMM FAIL P	AEM-2020 Communications Failure	Pre-Alarm
AEM OUTX OUT RNG (X = 1 to 4)	User Configurable Analog Output X Out of Range (X = 1 to 4)	Status
AEM OUTX OUT RNG A (X = 1 to 4)	User Configurable Analog Output X Out of Range (X = 1 to 4)	Alarm
AEM OUTX OUT RNG P (X = 1 to 4)	User Configurable Analog Output X Out of Range (X = 1 to 4)	Pre-Alarm
AL ECU FAULTY P	ECU Faulty	Pre-Alarm
ALG IN X_O1 (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Status
ALG IN X_O1 A (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Alarm
ALG IN X_O1 P (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Pre-Alarm
ALG IN X_O2 (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Status
ALG IN X_O2 A (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Alarm
ALG IN X_O2 P (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Pre-Alarm
ALG IN X_OOR (X = 1 to 8)	User Configurable Analog Input X Out of Range (X = 1 to 8)	Status
ALG IN X_OOR A (X = 1 to 8)	User Configurable Analog Input X Out of Range (X = 1 to 8)	Alarm
ALG IN X_OOR P (X = 1 to 8)	User Configurable Analog Input X Out of Range (X = 1 to 8)	Pre-Alarm
ALG IN X_U1 (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Status
ALG IN X_U1 A (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Alarm
ALG IN X_U1 P (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Pre-Alarm
ALG IN X_U2 (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Status
ALG IN X_U2 A (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Alarm
ALG IN X_U2 P (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Pre-Alarm
ALT WIRE TMP HI P	Alternator Wiring Temp High	Pre-Alarm
AUTOSTART	Auto Start	Status

Event String	Event Description	Event Type
AUTO RESTART	Automatic Restart in Progress	Status
AUTO RESTART FAIL A	Automatic Restart Fail	Alarm
BATT CHRG FAIL A	Battery Charger Fail	Alarm
BATT CHRG FAIL P	Battery Charger Fail	Pre-Alarm
BATT OVERVOLT P	Battery Overvoltage	Pre-Alarm
BATTLE OVERRIDE	Battle Override	Status
CEM COMM FAIL P	CEM-2020 Communications Failure	Pre-Alarm
CEM HW MISMATCH P	Connected CEM-2020 is wrong type	Pre-Alarm
CHECKSUM FAIL P	Corrupt user settings or firmware code	Pre-Alarm
COMBINED RED A	Combined Red	Alarm
COMBINED YELLOW P	Combined Yellow	Pre-Alarm
CONF PROT X_O1 (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Status
CONF PROT X_O1 A (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Alarm
CONF PROT X_O1 P (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Pre-Alarm
CONF PROT X_O2 (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Status
CONF PROT X_O2 A (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Alarm
CONF PROT X_O2 P (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Pre-Alarm
CONF PROT X_U1 (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Status
CONF PROT X_U1 A (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Alarm
CONF PROT X_U1 P (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Pre-Alarm
CONF PROT X_U2 (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Status
CONF PROT X_U2 A (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Alarm
CONF PROT X_U2 P (X = 1 to 8)	Configurable Protection X (X = 1 to 8)	Pre-Alarm
CONFIG ELEMENT X A (X = 1 to 8)	Configurable Element X (X = 1 to 8)	Alarm
CONFIG ELEMENT X P (X = 1 to 8)	Configurable Element X (X = 1 to 8)	Pre-Alarm
COOL LVL SNDR FL A	Coolant Level Sender Fail	Alarm
COOL SNDR FAIL	Coolant Temperature Sender Fail	Status
COOL SNDR FAIL A	Coolant Temperature Sender Fail	Alarm
COOL SNDR FAIL P	Coolant Temperature Sender Fail	Pre-Alarm
IEM HEARTBEAT FAIL P	IEM Heartbeat Fail	Pre-Alarm
DIAG TRBL CODE P	Diagnostic Trouble Code	Pre-Alarm
DIAL OUT FAILED	Modem Dialout Failed	Status
DIAL OUT SUCCESS	Modem Dialout Success	Status
ECU SHUTDOWN A	ECU Shutdown	Alarm
EMERGENCY STOP A	Emergency Stop	Alarm
ENGINE RUNNING	Engine Running	Status
FUEL LEAK 1 P	Fuel Filter 1 Leak	Pre-Alarm
FUEL LEAK 2 P	Fuel Filter 2 Leak	Pre-Alarm
FUEL LEAK DETECT A	Fuel Leak Detect	Alarm
FUEL LEAK DETECT P	Fuel Leak Detect	Pre-Alarm
FUEL LEVL SENDR FAIL	Fuel Level Sender Fail	Status
FUEL LEVL SENDR A	Fuel Level Sender Fail	Alarm
FUEL LEVL SENDR P	Fuel Level Sender Fail	Pre-Alarm
GLBL SNDR FAIL A	Global Sender Fail	Alarm

Event String	Event Description	Event Type
HI COOLANT TMP A	High Coolant Temp	Alarm
HI COOLANT TMP P	High Coolant Temp	Pre-Alarm
HI DAY TANK LEVEL P	High Day Tank Level	Pre-Alarm
HI PRESSURE IN 1 P	High Pressure Input 1	Pre-Alarm
HI PRESSURE IN 2 P	High Pressure Input 2	Pre-Alarm
HI ECU VOLTS A	High ECU Supply Voltage	Alarm
HI EXHAUST A T P	High Exhaust Temp A	Pre-Alarm
HI EXHAUSE B T P	High Exhaust Temp B	Pre-Alarm
HI SUPPLY VOLTS P	High Voltage Supply	Pre-Alarm
HI T FUEL P	High Fuel Temp	Pre-Alarm
HIGH AMB TEMP P	High Ambient Temp	Pre-Alarm
HIGH CHARGE AIR TEMP A	High Charge Air Temp	Alarm
HIGH CHARGE AIR TEMP P	High Charge Air Temp	Pre-Alarm
HIGH COIL TEMP 1 P	High Temp Coil 1	Pre-Alarm
HIGH COIL TEMP 2 P	High Temp Coil 2	Pre-Alarm
HIGH COIL TEMP 3 P	High Temp Coil 3	Pre-Alarm
HIGH COOLANT TEMP A	High Coolant Temp	Alarm
HIGH COOLANT TEMP P	High Coolant Temp	Pre-Alarm
HIGH ECU TEMPERATURE P	High ECU Temp	Pre-Alarm
HIGH FUEL LEVEL P	High Fuel Level	Pre-Alarm
HIGH FUEL RAIL PRESS P	High Fuel Rail Pressure	Pre-Alarm
HIGH INTRCOOLER TEMP P	High Intercooler Temp	Pre-Alarm
HIGH OIL TERMPERATURE A	High Oil Temp	Alarm
HIGH OIL TEMPERATURE P	High Oil Temp	Pre-Alarm
HIGH STRG TANK LEVEL P	High Storage Tank Level	Pre-Alarm
IDLE SPD LO P	Idle Speed Low	Pre-Alarm
INPUT X A (X = 1 to 40)	User Configurable Input X (X = 1 to 40)	Alarm
INPUT X P (X = 1 to 40)	User Configurable Input X (X = 1 to 40)	Pre-Alarm
LO AFTERCLR COOL LVL A	Low After Cooler Cool Level	Alarm
LO CHG AIR CLNT LVL P	Low Charge Air Coolant Level	Pre-Alarm
LO DAY TANK LEVEL P	Low Day Tank Level	Pre-Alarm
LO FUEL DLV PRESSURE A	Low Fuel Delivery Pressure	Alarm
LO ECU VOLTS P	Low ECU Supply Voltage	Pre-Alarm
LO SUPPLY VOLTS P	Low Voltage Supply	Pre-Alarm
LOGIC OUPUT A	Logic Output	Alarm
LOGIC OUPUT P	Logic Output	Pre-Alarm
LOSS REM COMS P	Loss of Remote Module Communication	Pre-Alarm
LOST ECU COMM A	Loss of ECU Communication	Alarm
LOST ECU COMM P	Loss of ECU Communication	Pre-Alarm
LOW BATT VOLT P	Low Battery Voltage	Pre-Alarm
LOW CHARGE AIR PRESS P	Low Charge Air Pressure	Pre-Alarm
LOW COOL LEVEL A	Low Coolant Level	Alarm
LOW COOL LEVEL P	Low Coolant Level	Pre-Alarm
LOW COOL TMP A	Low Coolant Temperature	Alarm
LOW COOL TMP P	Low Coolant Temperature	Pre-Alarm

Event String	Event Description	Event Type
LOW COOLANT LEVEL P	Low Coolant Level	Pre-Alarm
LOW FUEL DELIV PRESS P	Low Fuel Delivery Pressure	Pre-Alarm
LOW FUEL LEVEL A	Low Fuel Level	Alarm
LOW FUEL LEVEL P	Low Fuel Level	Pre-Alarm
LOW FUEL RAIL PRESS P	Low Fuel Rail Pressure	Pre-Alarm
LOW OIL PRES A	Low Oil Pressure	Alarm
LOW OIL PRES P	Low Oil Pressure	Pre-Alarm
LOW OIL PRESSURE A	Low Oil Pressure	Alarm
LOW OIL PRESSURE P	Low Oil Pressure	Pre-Alarm
LOW STRG TANK LEVEL P	Low Storage Tank Level	Pre-Alarm
LSM AVR OUT LMT P	LSM-2020 AVR Output Limit	Pre-Alarm
LSM COMMS FAIL P	LSM-2020 Communications Failure	Pre-Alarm
LSM GOV OUT LMT P	LSM-2020 GOV Output Limit	Pre-Alarm
LSM HEARTBEAT FAIL P	LSM-2020 Heartbeat Failed	Pre-Alarm
LSM INTERGEN COM FAIL P	LSM-2020 Intergen Communications Failure	Pre-Alarm
MAINT INTERVAL P	Maintenance Interval	Pre-Alarm
MPU FAIL P	Magnetic Pickup Fail	Pre-Alarm
MULTIPLE AEM P	Multiple AEM-2020’s	Pre-Alarm
MULTIPLE CEM P	Multiple CEM-2020’s	Pre-Alarm
MULTIPLE LSM P	Multiple LSM-2020’s	Pre-Alarm
NORM SHUTDOWN	Normal Shutdown	Status
OIL SNDR FAIL	Oil Pressure Sender Fail	Status
OIL SNDR FAIL A	Oil Pressure Sender Fail	Alarm
OIL SNDR FAIL P	Oil Pressure Sender Fail	Pre-Alarm
OVERCRANK A	Overcrank	Alarm
OVERSPEED A	Overspeed	Alarm
OVERSPEED A	Overspeed	Alarm
PRIMING FAULT P	Priming Fault	Pre-Alarm
PROT SHUTDOWN	Protective Shutdown	Status
RTD_IN_X_O1 (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Status
RTD_IN_X_O1 A (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Alarm
RTD_IN_X_O1 P (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Pre-Alarm
RTD_IN_X_O2 (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Status
RTD_IN_X_O2 A (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Alarm
RTD_IN_X_O2 P (X = 1 to 8)	User Configurable Analog Input X Over 1 (X = 1 to 8)	Pre-Alarm
RTD_IN_X_OOR (X = 1 to 8)	User Configurable RTD Input X Out of Range (X = 1 to 8)	Status
RTD_IN_X_OOR A (X = 1 to 8)	User Configurable Analog Input X Out of Range (X = 1 to 8)	Alarm
RTD_IN_X_OOR P (X = 1 to 8)	User Configurable Analog Input X Out of Range (X = 1 to 8)	Pre-Alarm
RTD_IN_X_U1 (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Status
RTD_IN_X_U1 A (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Alarm
RTD_IN_X_U1 P (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Pre-Alarm
RTD_IN_X_U2 (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Status
RTD_IN_X_U2 A (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Alarm
RTD_IN_X_U2 P (X = 1 to 8)	User Configurable Analog Input X Under 1 (X = 1 to 8)	Pre-Alarm
SCREEN ERROR	Screen Error	Status

Event String	Event Description	Event Type
RUNUP SPD LO P	Run Up Speed Low	Pre-Alarm
SPD SNDR FAIL	Speed Sender Fail	Status
SPD SNDR FAIL A	Speed Sender Fail	Alarm
SPEED DMD FL P	Speed Demand Fail	Pre-Alarm
SPEED TOO LOW P	Engine Speed Too Low	Pre-Alarm
SS OVERRIDE ON P	Shutdown Override	Pre-Alarm
START SPEED LOW P	Start Speed Low	Pre-Alarm
THRM_CPL_X_O1 (X = 1 to 2)	User Configurable Thermocouple Input X Over 1 (X = 1 to 2)	Status
THRM_CPL_X_O1 A (X = 1 to 2)	User Configurable Thermocouple Input X Over 1 (X = 1 to 2)	Alarm
THRM_CPL_X_O1 P (X = 1 to 2)	User Configurable Thermocouple Input X Over 1 (X = 1 to 2)	Pre-Alarm
THRM_CPL_X_O2 (X = 1 to 2)	User Configurable Thermocouple Input X Over 1 (X = 1 to 2)	Status
THRM_CPL_X_O2 A (X = 1 to 2)	User Configurable Thermocouple Input X Over 1 (X = 1 to 2)	Alarm
THRM_CPL_X_O2 P (X = 1 to 2)	User Configurable Thermocouple Input X Over 1 (X = 1 to 2)	Pre-Alarm
THRM_CPL_X_OOR (X = 1 to 2)	User Configurable Thermocouple Input X Out of Range (X = 1 to 2)	Status
THRM_CPL_X_OOR A (X = 1 to 2)	User Configurable Thermocouple Input X Out of Range (X = 1 to 2)	Alarm
THRM_CPL_X_OOR P (X = 1 to 2)	User Configurable Thermocouple Input X Out of Range (X = 1 to 2)	Pre-Alarm
THRM_CPL_X_U1 (X = 1 to 2)	User Configurable Thermocouple Input X Under 1 (X = 1 to 2)	Status
THRM_CPL_X_U1 A (X = 1 to 2)	User Configurable Thermocouple Input X Under 1 (X = 1 to 2)	Alarm
THRM_CPL_X_U1 P (X = 1 to 2)	User Configurable Thermocouple Input X Under 1 (X = 1 to 2)	Pre-Alarm
THRM_CPL_X_U2 (X = 1 to 2)	User Configurable Thermocouple Input X Under 1 (X = 1 to 2)	Status
THRM_CPL_X_U2 A (X = 1 to 2)	User Configurable Thermocouple Input X Under 1 (X = 1 to 2)	Alarm
THRM_CPL_X_U2 P (X = 1 to 2)	User Configurable Thermocouple Input X Under 1 (X = 1 to 2)	Pre-Alarm
WEAK BATTERY P	Weak Battery	Pre-Alarm

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SECTION 4 • BESTCOMS*Plus* SOFTWARE

INTRODUCTION

BESTCOMS*Plus* is a Windows®-based, PC application that provides a user-friendly, graphical user interface (GUI) for use with Basler Electric communicating products. The name BESTCOMS*Plus* is an acronym that stands for Basler Electric Software Tool for Communications, Operations, Maintenance, and Settings.

BESTCOMS*Plus* provides the user with a point-and-click means to set and monitor the IEM-2020. The capabilities of BESTCOMS*Plus* make the configuration of one or several IEM-2020 modules fast and efficient. A primary advantage of BESTCOMS*Plus* is that a settings scheme can be created, saved as a file, and then uploaded to the IEM-2020 at the user's convenience.

BESTCOMS*Plus* uses plug-ins allowing the user to manage several different Basler Electric products. The IEM-2020 is a plug-in for BESTCOMS*Plus* and must be activated before use.

The IEM-2020 plug-in opens inside the BESTCOMS*Plus* main shell with the same default logic scheme that is shipped with the IEM-2020. This gives the user the option of developing a custom setting file by modifying the default logic scheme or by building a unique scheme from scratch.

BESTLogic*Plus* Programmable Logic is used to program IEM-2020 inputs and outputs, and alarms. This is accomplished by the drag-and-drop method. The user can drag elements, components, inputs, and outputs onto the program grid and make connections between them to create the desired logic scheme.

Figure 4-1 illustrates the typical user interface components of the IEM-2020 plug-in with BESTCOMS*Plus*.

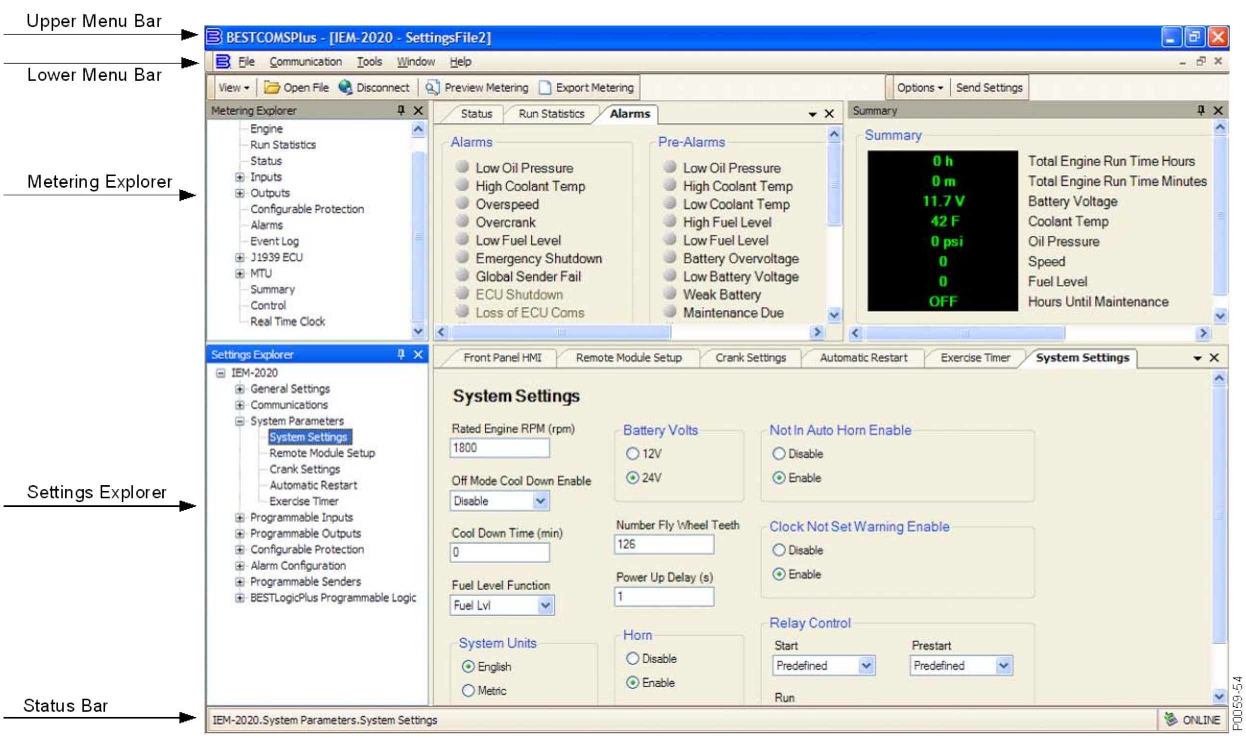


Figure 4-1. Typical User Interface Components

INSTALLATION

BESTCOMS*Plus* software is built on the Microsoft® .NET Framework. The setup utility that installs BESTCOMS*Plus* on your PC also installs the IEM-2020 plug-in and the .NET Framework (if not already installed). BESTCOMS*Plus* operates with IBM-compatible personal computers (PCs) using Windows® 2000, Windows® XP 32-bit SP2/SP3, and Windows® Vista 32-bit (all editions). Microsoft® Internet Explorer 5.01 or later must be installed on your PC before installing BESTCOMS*Plus*. System recommendations for the .NET Framework and BESTCOMS*Plus* are listed in Table 4-1.

Table 4-1. System Recommendations for BESTCOMSPlus and the .NET Framework

Component	Recommendation
Processor	1.0 GHz
RAM	256 MB
Hard Drive	25 MB (if .NET Framework is already installed on PC.)
	250 MB (if .NET Framework is not already installed on PC.)

In order to install and run BESTCOMS*Plus*, a Windows user must have administrator rights. A Windows user with limited rights may not be permitted to save files in certain folders.

Installing BESTCOMS*Plus*

> **NOTE**
>
> Do <u>not</u> connect USB cable until setup completes successfully. Connecting USB cable before setup is complete may result in unwanted or unexpected errors.

1. Insert the BESTCOMS*Plus* CD-ROM into the PC CD-ROM drive.
2. When the BESTCOMS*Plus* Setup and Documentation CD menu appears, click the Install button for the BESTCOMS*Plus* application. The setup utility automatically installs BESTCOMS*Plus*, the .NET Framework (if not already installed), and the IEM-2020 plug-in for BESTCOMS*Plus* on your PC.

When BESTCOMS*Plus* installation is complete, a Basler Electric folder is added to the Windows programs menu. This folder is accessed by clicking the Windows *Start* button and then accessing the Basler Electric folder in the *Programs* menu. The Basler Electric folder contains an icon that, when clicked, starts BESTCOMS*Plus*.

STARTUP AND ACTIVATION

Starting BESTCOMS*Plus*

To start BESTCOMS*Plus*, click the *Start* button, *Programs*, *Basler Electric*, and then the *BESTCOMSPlus* icon. During initial startup, the *BESTCOMSPlus Select Language* screen is displayed (Figure 4-2). You can select to have this screen displayed each time BESTCOMS*Plus* is started, or you can select a preferred language and this screen will be bypassed in the future. Click *OK* to continue. This screen can later be accessed by selecting *<u>T</u>ools* and *<u>S</u>elect Language* from the menu bar.

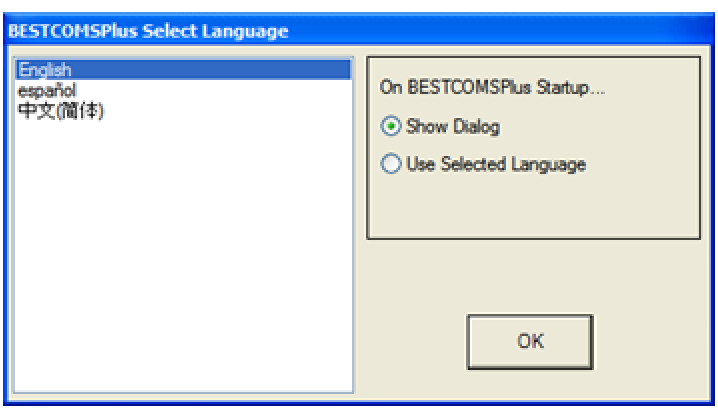


Figure 4-2. BESTCOMSPlus Select Language

The BESTCOMS*Plus* splash screen is shown for a brief time. See Figure 4-3.

Figure 4-3. Splash Screen

The BESTCOMS*Plus* platform window opens. If an IEM-2020 is connected, select *New Connection* from the *Communication* pull-down menu and select *IEM-2020*. See Figure 4-4. The IEM-2020 plug-in is automatically activated after connecting to an IEM-2020.

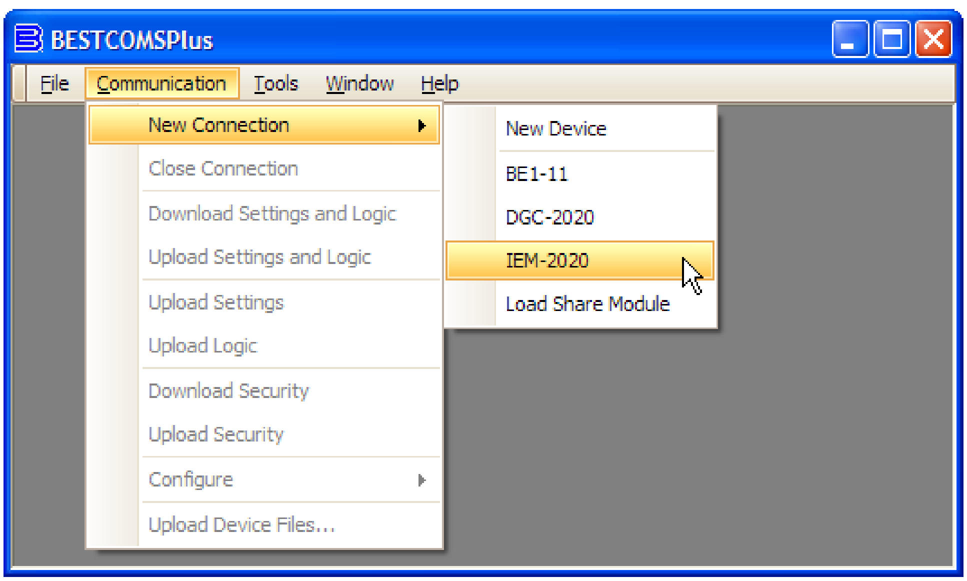


Figure 4-4. Communication Pull-Down Menu

If an IEM-2020 is not connected, select *New* from the *File* pull-down and select *IEM-2020*.

Activating the IEM-2020 Plug-In

The IEM-2020 plug-in must be activated before it can be used to set up an IEM-2020 product. If the IEM-2020 plug-in has already been activated, skip to *Communication*.

Requesting an Activation Key

When initially running the IEM-2020 plug-in, the *Activate Device* pop-up will appear. You must contact Basler Electric for an activation key before you can activate the IEM-2020 plug-in. You may request an activation key through email or the Basler Electric website. Click on either the *Website* or *Email* button.

Click on the *Activate* button when you are ready to enter the activation key you received from Basler Electric. The *Device Needs Activated* pop-up will appear. Refer to Figure 4-5.

Entering an Activation Key

Select the device from the *Device* pull-down menu. Enter your *Email Address* and *Activation Key* provided by Basler Electric. If you received an email containing the *Activation Key*, you can select all of the text in the email and copy it to the Windows® clipboard using normal Windows® techniques. The *Get Data* button will extract the *Device, Email Address,* and *Activation Key* from the Windows® clipboard and paste it into the appropriate fields. Click on the *Activate* button to continue. The *Device Needs Activated* screen is also found by selecting *Activate Device* from the *Tools* pull-down menu of the BESTCOMS*Plus* main shell.

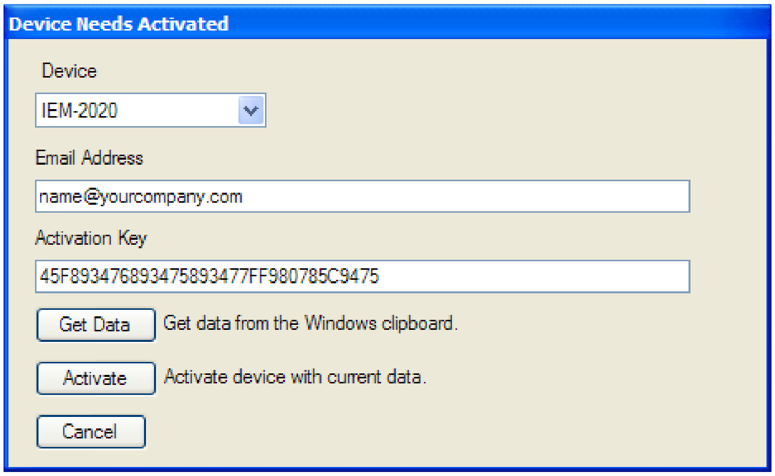


Figure 4-5. Device Needs Activated

COMMUNICATION

If connecting to the IEM-2020 through the USB or modem port, click *Communication* on the menu bar, followed by *New Connection and IEM-2020* as shown in Figure 4-6. The *IEM-2020 Connection* screen shown in Figure 4-7 will appear. If Ethernet communication is desired, skip to *Ethernet Communication.*

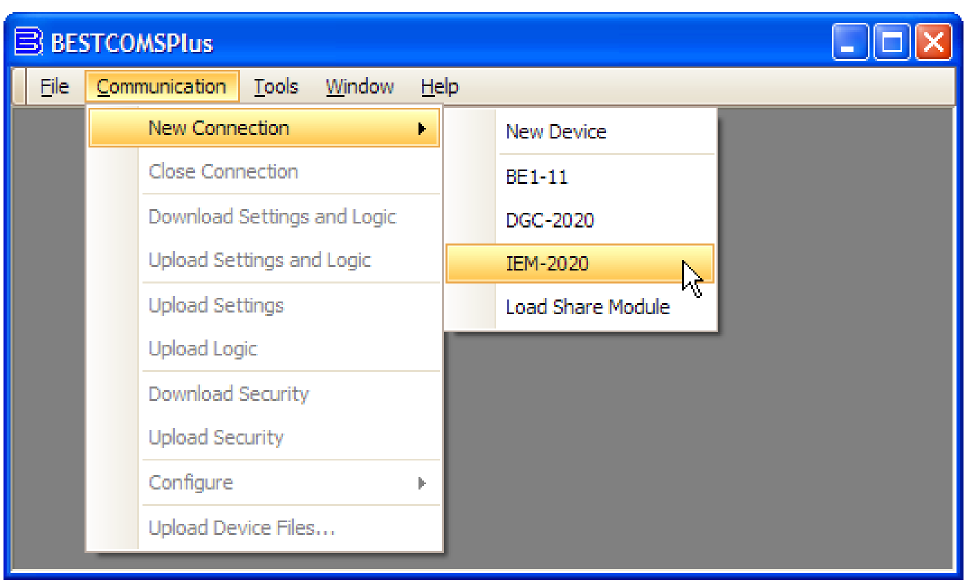


Figure 4-6. Communication, New Connection, IEM-2020

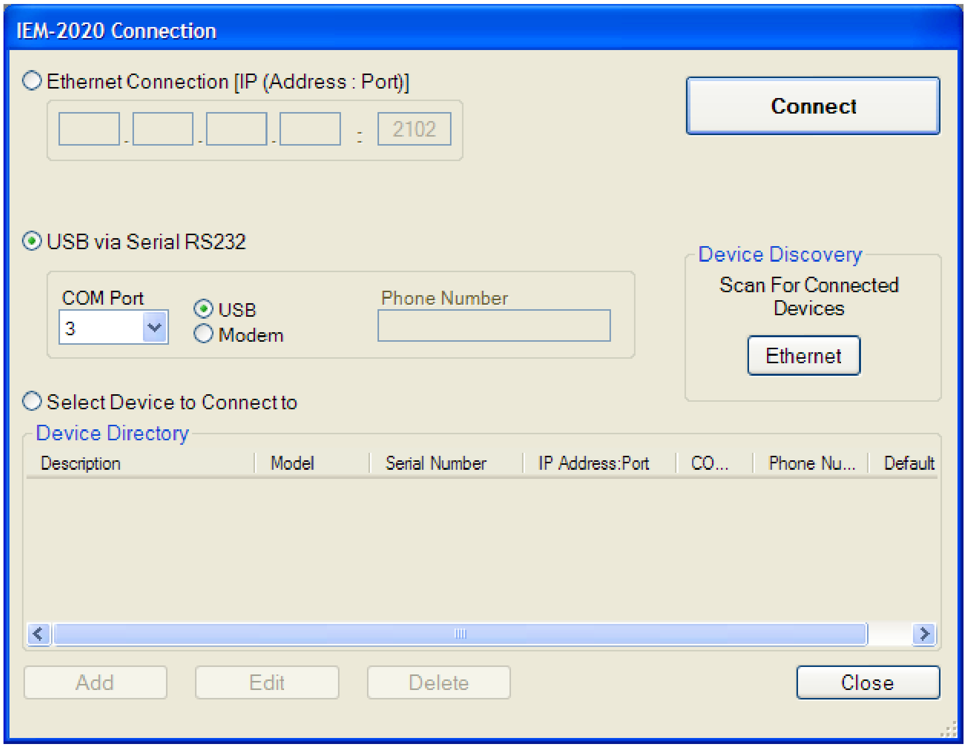


Figure 4-7. IEM-2020 Connection

USB Communication

If connecting to the IEM-2020 through a USB cable, select *USB via Serial RS232, USB,* and enter *COM Port.* The USB drivers are installed automatically during the BESTCOMS*Plus* installation process. To select the correct *COM Port,* open Windows® Device Manager and expand the *Ports (COM & LPT)* branch. Locate the device named *CP2101 USB to UART Bridge Controller (COMx).* The *COM Port* number will be displayed in parenthesis *(COMx).* Be sure operating power is applied to the IEM-2020 and the USB cable is connected before opening the Device Manager. See Figure 4-8.

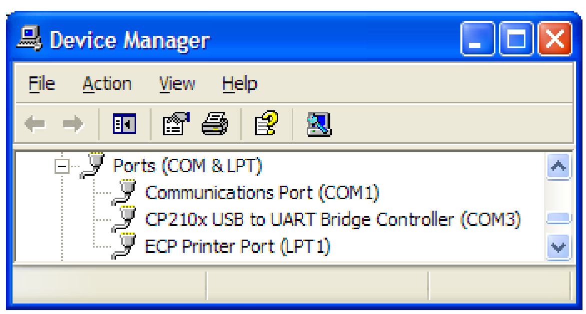


Figure 4-8. Windows® Device Manager

<u>*Installing the USB Driver if Automatic Installation Fails*</u>

To install the USB driver for the IEM-2020:

1. Apply operating power to the IEM-2020 and wait for the boot sequence to complete.
2. Plug the proper end of the USB cable into the PC and the other end into the IEM-2020.
3. The *Found New Hardware Wizard* dialog box appears.
4. Select "**No, not this time**" and select *Next* to continue.
5. Choose to "**Install from a list or specific location (Advanced)**" and select *Next* to continue.
6. Insert the CD-ROM labeled BESTCOMS*Plus* into the PC CD-ROM drive.
7. Browse to the \driver folder on the CD-ROM and select *Next* to continue.

When installation of the driver is complete, you may be asked to restart your computer.

Modem Communication

If connecting to the IEM-2020 through a telephone line, select *USB via Serial RS232, Modem,* and enter *Phone Number.* To select the correct *COM Port,* open Windows® Device Manager and expand the *Modems* branch. Right-click on the modem name and choose *Properties*. Open the *Advanced* tab to view the COM port.

Ethernet Communication

Communication with the IEM-2020 can be made through an optional LSM-2020 (Load Share Module). In order to use the Ethernet capabilities of the LSM-2020, the network settings in the LSM-2020 must first be configured. The settings are configured through the IEM-2020 and sent to the LSM-2020 over the CANbus interface. The following procedure is used to configure LSM-2020 network settings and connect to the IEM-2020 through Ethernet via an LSM-2020.

1. Navigate to the *Settings, System Params, System Settings, LSM Setup* screen on the front panel HMI and verify that the LSM-2020 is enabled with the correct CANbus address so that the IEM-2020 and LSM-2020 are properly linked together. If a USB connection to the IEM-2020 is active, the LSM-2020 enable setting and CANbus address can be found by using the Settings Explorer in BESTCOMS*Plus* to open the *System Parameters, System Settings* tree branch as shown in Figure 4-20. The IEM-2020 will annunciate a pre-alarm if the LSM-2020 is not connected properly when it is enabled. If the connection is valid, the network settings of the LSM-2020 can be configured through the USB interface of the IEM-2020.
2. Connect to the IEM-2020 through the USB port as described under *USB Communication.* Select *Configure, Ethernet* from the *File* pull-down menu. If the LSM-2020 is connected properly, the *Configure Ethernet Port* screen shown in Figure 4-9 will appear.

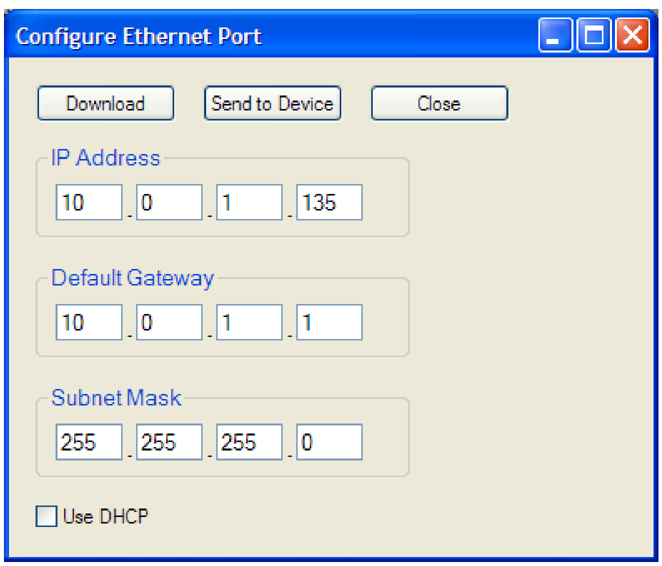


Figure 4-9. Configure Ethernet Port

Configurable options include:

IP Address:	Internet Protocol Address to be used by the LSM-2020.
Default Gateway:	Default host to send data destined for a host not on the network subnet.
Subnet Mask:	Mask used to determine the range of the current network subnet.
Use DHCP:	Automatically configures IP Address, Default Gateway, and Subnet Mask via DHCP. This can be used only if the Ethernet network has a properly configured DHCP server running. The LSM-2020 does not act as a DHCP server.

The values for these options should be obtained from the site administrator if the LSM-2020 is intended to share the network with other devices. If the LSM-2020 is operating on an isolated network, the IP address may be chosen from one of the following ranges as listed in IETF publication RFC 1918, *Address Allocation for Private Networks.*

10.0.0.0 - 10.255.255.255
172.16.0.0 - 172.31.255.255
192.168.0.0 - 192.168.255.255

If the LSM-2020 is operating on an isolated network, the *Subnet Mask* may be left at 0.0.0.0 and the *Default Gateway* can be chosen as any valid IP address from the same range as the LSM-2020 IP address.

3. Click the *Send to Device* button located on the *Configure Ethernet Port* screen. A confirmation popup will be displayed notifying the user that the LSM-2020 will reboot after settings are sent. Click the *Yes* button to allow settings to be sent. After the unit has rebooted and the power-up sequence is complete, the LSM-2020 is ready to be used on a network.
4. If desired, LSM-2020 settings can be verified by selecting *Download Settings and Logic* from the *Communication* pull-down menu. Active settings will be downloaded from the LSM-2020 and IEM-2020. Verify that the downloaded settings match the previously sent settings.
5. Connection to the IEM-2020 can be made through Ethernet via an LSM-2020 with properly configured network settings. When making a new connection to the IEM-2020, the *Ethernet Connection* option shown in Figure 4-7 will allow the user to enter the IP address of the LSM-2020 with which to connect. The *Ethernet* button under *Device Discovery, Scan for Connected Devices,* allows automatic detection of any LSM-2020 devices connected to the local network.

NOTES

The PC running BESTCOMS*Plus* software must be correctly configured to communicate with the LSM-2020. The PC must have an IP address in the same subnet range as the LSM-2020 if the LSM-2020 is operating on a private local network. Otherwise, the PC must have a valid IP address with access to the internet and the LSM-2020 must be connected to a properly configured router. The network settings of the PC depend on the operating system installed. Refer to the operating system manual for instructions. On most Microsoft® Windows® based PCs, the network settings can be accessed through the *Network Connections* icon located inside the Control Panel.

Microsoft Windows® 2000 and XP SP1 contain a potential bug that may prevent device discovery from functioning properly. This issue may present itself if the PC running BESTCOMS*Plus* has more than one network interface card. See Microsoft® KB article 827536 for more information.

Firmware updates to the LSM-2020 are made through the Ethernet port. Firmware updates to the IEM-2020 are only available through the USB port of the IEM-2020.

Establishing Communication

Communication between BESTCOMS*Plus* and the IEM-2020 is established by clicking on the *Connect* button on the *IEM-2020 Connection* screen (see Figure 4-7) or by clicking on the *Connect* button on the lower menu bar of the main BESTCOMS*Plus* screen (Figure 4-1). If you receive an “Unable to Connect to Device” error message, verify that communications are configured properly. If communication is established, BESTCOMS*Plus* will automatically read all settings and logic from the IEM-2020 and load them into BESTCOMS*Plus* memory. See Figure 4-10.

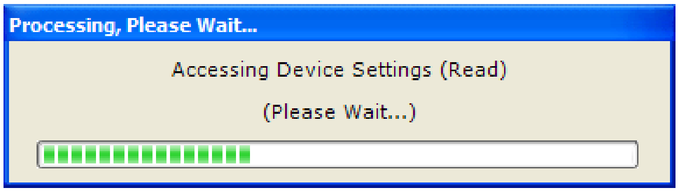


Figure 4-10. Processing, Please Wait…

MENU BARS

The menu bars are located near the top of the BESTCOMS*Plus* screen (see Figure 4-1). The upper menu bar has five pull down menus. With the upper menu bar, it is possible to manage settings files, setup communications, upload and download settings/security files, and compare settings files. The lower menu bar consists of clickable icons. The lower menu bar is used to change BESTCOMS*Plus* views, open a settings file, connect/disconnect, preview metering printout, switch to live mode, and send a settings file to the IEM-2020.

Upper Menu Bar (BESTCOMS*Plus* Shell)

<u>*File*</u>

- New ... Create a new settings file
- Open ... Open an existing settings file
- Open File As Text ... Generic file viewer for ∗.csv, ∗.txt, etc. files
- Close ... Close settings file
- Save ... Save settings file
- Save As ... Save settings file with a different name
- Export To File ... Save settings as a *.csv file
- Print Preview ... Preview a settings file printout
- Print To File ... Save as rich text file type (∗.rtf)
- Print ... Print a settings file
- Properties ... View properties of a settings file
- History ... View history of a settings file
- Recent Files ... Open a previously opened file
- Exit ... Close BESTCOMS*Plus* program

<u>*Communication*</u>

- New Connection ... Choose new device or IEM-2020
- Close Connection ... Close communication connection
- Download Settings and Logic ... Download operational and logic settings from the device
- Upload Settings and Logic ... Upload operational and logic settings to the device
- Upload Settings ... Upload operational settings to the device
- Upload Logic ... Upload logic settings to the device
- Download Security ... Download security settings from the device
- Upload Security ... Upload security settings to the device
- Configure ... Ethernet settings
- Upload Device Files ... Upload a device package (firmware/language module)

<u>*Tools*</u>

- Check For Updates ... Check for BESTCOMS*Plus* updates via the internet
- Select Language ... Select BESTCOMS*Plus* language
- Activate Device ... Activate the product instance (IEM-2020 plug-in)
- Set File Password ... Password protect a settings file
- Compare Settings Files ... Compare settings files
- Event Log - View ... View the BESTCOMS*Plus* event log
- Event Log - Clear ... Clear the BESTCOMS*Plus* event log
- Event Log - Set New File Name ... Set a new file name for event log

Window

- Cascade All .... Cascade all windows
- Tile .... Tile horizontally or vertically
- Maximize All .... Maximize all windows

Help

- About .... View general, detailed build, and system information

Lower Menu Bar (IEM-2020 Plug-In)

View

This clickable icon allows you to view the Metering Panel, Settings Panel, or Show Settings Information.

Open File

This clickable icon is used to open a saved settings file.

Connect/Disconnect

When clicked, the *IEM-2020 Connection* screen opens allowing the user to connect via USB or a modem. This button is also used to disconnect from the device.

Print Preview Metering

Clicking on this icon will bring up the *Print Preview* screen where a preview of the Metering printout is shown. Click on the printer icon to send to a printer.

Export Metering

The *Export Metering* button will allow all metering values to be exported into a *.csv or *.txt file.

Options

When clicked, a drop-down list appears. *Live Mode Settings* puts BESTCOMS*Plus* in *Live* mode where settings are automatically sent to the device in real time as they are changed.

Send Settings

This button is used when BESTCOMS*Plus* is not operating in Live Mode. Click on this button after making a setting change to send the modified setting to the IEM-2020.

SETTINGS EXPLORER

The Settings Explorer is a convenient tool within BESTCOMS*Plus* used to navigate through the various settings screens of the IEM-2020 plug-in as listed in the following paragraphs.

Logic setup will be necessary after making certain setting changes. For more information, refer to Section 5, *BESTLogicPlus Programmable Logic*.

IEM-2020 AND SYSTEM PARAMETERS

Prior to use, the IEM-2020 must be configured for operation in the intended application. The description of these configuration settings is organized as follows:

- General Settings
- Communications
- System Parameters
- Programmable Inputs
- Programmable Outputs
- Configurable Protection
- Alarm Configuration
- Programmable Senders
- BESTLogic*Plus* Programmable Logic

NOTE

In the following descriptions, superscript letters (e.g., setting[X]) mark words and phrases relating to IEM-2020 settings. Each letter references settings illustrated in BESTCOMS*Plus*. Lettered notes at the end of each group of descriptions provide the range and increment for each setting.

GENERAL SETTINGS

General IEM-2020 settings consist of settings controlling the HMI display and indicators. Additional general settings include style number configuration, IEM-2020 identification, IEM-2020 version information, device security setup, and clock setup.

Front Panel HMI

The contrast[A] of the front panel LCD (liquid crystal display) can be adjusted to suit the viewing angle used or compensate for environmental conditions.

A power saving feature, referred to as Sleep mode[B], will turn the front panel LCD backlight and LCD heater off when the IEM-2020 is in Off mode or Auto mode (not in Run mode) and a key is not pressed for more than 15 minutes. Normal display operation is resumed when any front panel button is pressed or the engine is started remotely via the Auto Start. Sleep mode is enabled and disabled in BESTCOMS*Plus*.

Specific language modules can be uploaded into the IEM-2020. When the language module upload is complete, use the Language[C] selector to select the correct language.

When Scrolling Screen is enabled[D], the front panel summary screen will scroll through the list of Scrolling Screen Items[E]. The Scrolling Screen Delay[F] determines the scrolling speed. When this feature is disabled only OIL, FUEL, TEMP, and BATT are shown on the front panel summary screen.

Two custom initializing messages[GH] are displayed on the initial boot screen of the IEM-2020.

BESTCOMS*Plus* front panel HMI settings are illustrated in Figure 4-11.

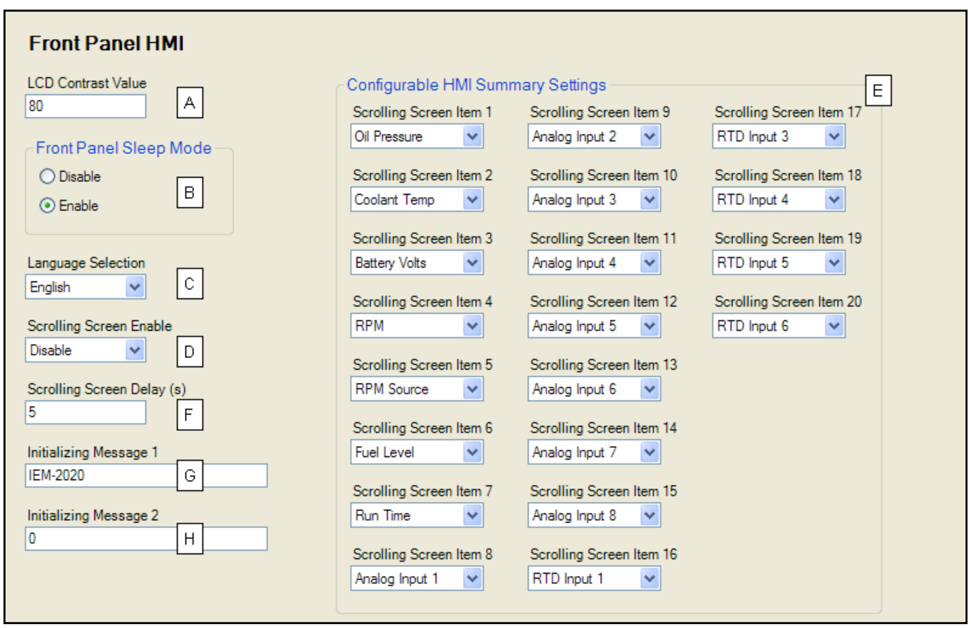


Figure 4-11. Front Panel HMI Settings

[A] *LCD Contrast Value:* Adjustable from 0 to 100 (maximum contrast) in increments of 1.
[B] *Front Panel Sleep Mode:* Enable or Disable.
[C] *Language:* English, Chinese, or Spanish.
[D] *Scrolling Screen Enable:* Enable or Disable.
[E] *Configurable HMI Summary Settings:* Select Scrolling Screen Item 1 through 20.

[F] *Scrolling Screen Delay:* Adjustable from 1 to 120 s in 1 s increments.
[G] *Initializing Message 1:* Accepts an alphanumeric string of up to 16 characters. Displayed on the second line of the initial boot screen.
[H] *Initializing Message 2:* Accepts an alphanumeric string of up to 16 characters. Displayed on the third line of the initial boot screen.

Style Number

When a PC operating BESTCOMS*Plus* is communicating with an IEM-2020, the style number of the IEM-2020 is automatically displayed on the BESTCOMS*Plus* Style Number tab.

When configuring IEM-2020 settings off-line, the style number for the unit to be configured can be entered into BESTCOMS*Plus* to enable configuration of the required settings.

BESTCOMS*Plus* style number selections and definitions are illustrated in Figure 4-12.

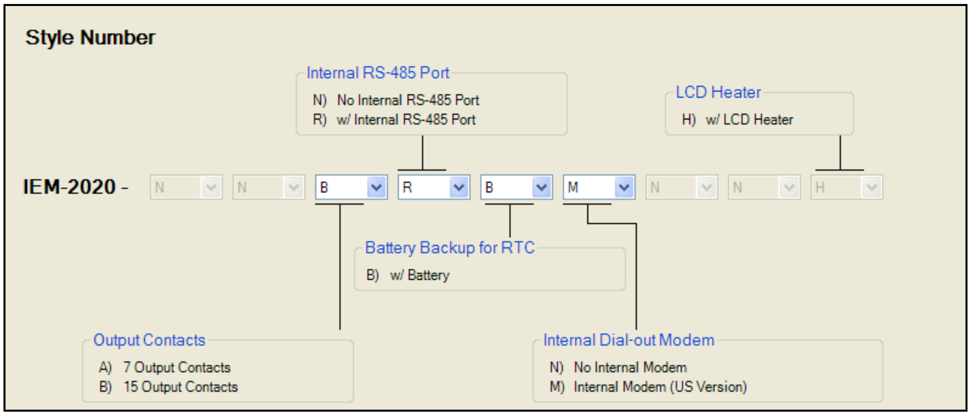


Figure 4-12. IEM-2020 Style Chart Selections and Definitions

Device Info

Information about an IEM-2020, LSM-2020 (Load Share Module), and CEM-2020 (Contact Expansion Module) can be obtained when communicating with BESTCOMS*Plus*.

IEM-2020

Information about an IEM-2020 communicating with BESTCOMS*Plus* can be obtained on the Device Info tab of BESTCOMS*Plus*.

Select application version[A] when configuring IEM-2020 settings off-line. When on-line, read-only information includes the application version[B], boot code version[C], application build date[D], serial number[E], application part number[F], model number[G], Language Module Version[H], and Language Module Part Number[I].

The user can assign site-specific information for the IEM-2020. This label includes a device name[J].

Load Share Module

Information about an LSM-2020 communicating with BESTCOMS*Plus* can also be obtained on the Device Info tab of BESTCOMS*Plus*.

When on-line, read-only information includes the application version[K], boot code version[L], application build date[M], serial number[N], application part number[O], and model number[P]. The *Refresh* button[Q] is used to refresh the screen after connecting an optional LSM-2020.

Contact Expansion Module

Information about a CEM-2020 communicating with BESTCOMS*Plus* can also be obtained on the Device Info tab of BESTCOMS*Plus*.

When on-line, read-only information includes the application version[R], boot code version[S], application build date[T], serial number[U], application part number[V], and model number[W]. The *Refresh* button[X] is used to update the screen after connecting an optional CEM-2020.

BESTCOMS*Plus* device information values and settings are illustrated in Figure 4-13.

Analog Expansion Module

Information about an AEM-2020 communicating with BESTCOMS*Plus* can also be obtained on the Device Info tab of BESTCOMS*Plus*.

When on-line, read-only information includes the application version[Y], boot code version[Z], application build date[AA], serial number[BB], application part number[CC], and model number[DD]. The *Refresh* button[EE] is used to update the screen after connecting an optional AEM-2020.

BESTCOMS*Plus* device information values and settings are illustrated in Figure 4-13.

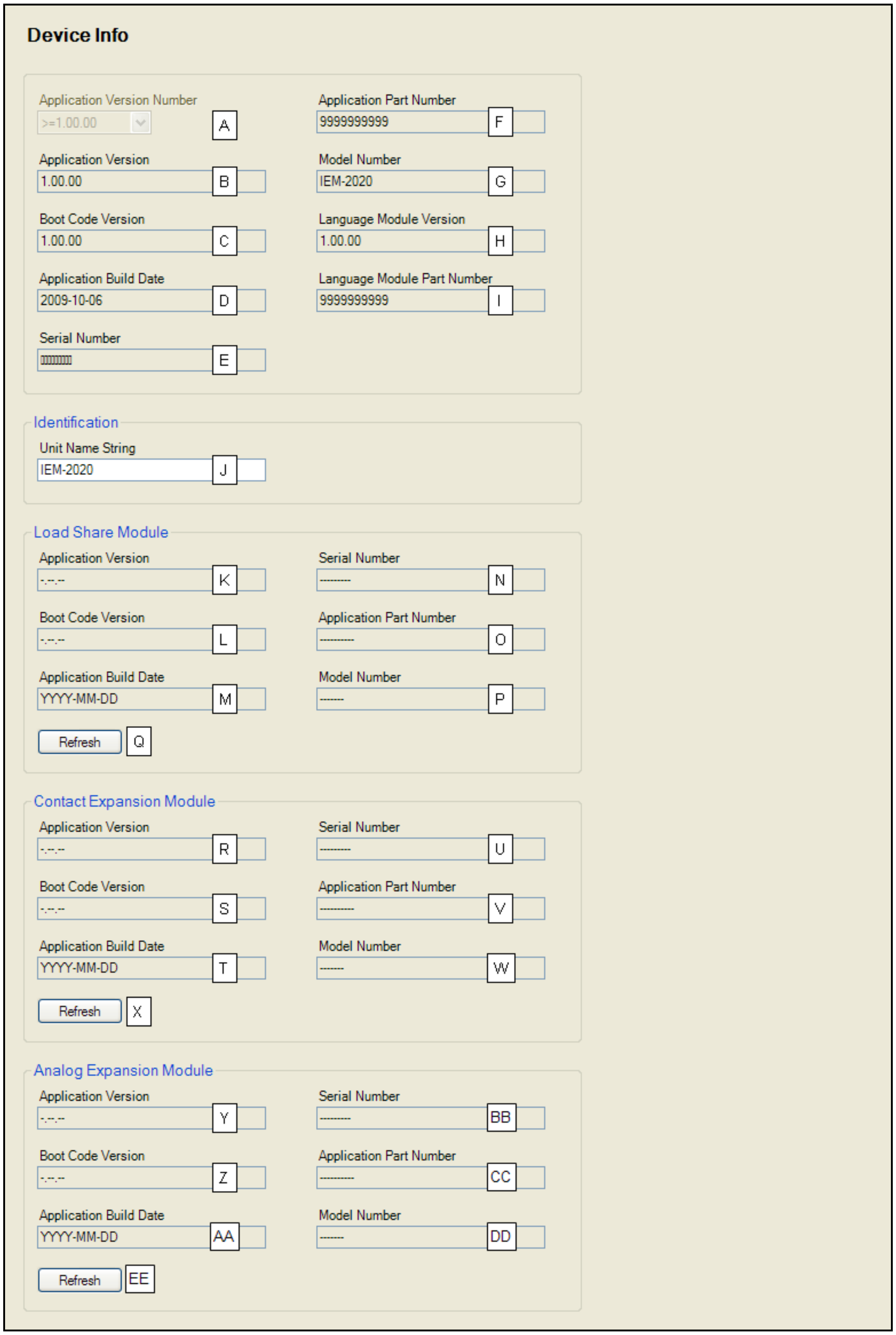


Figure 4-13. Device Info Values and Settings

[A] *Application Version:* When configuring IEM-2020 settings off-line, the application version for the unit to be configured must be selected. Select >=1.00.00.
[B] *Application Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with the IEM-2020.
[C] *Boot Code Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with the IEM-2020.
[D] *Application Build Date:* Read-only value obtained when BESTCOMS*Plus* is communicating with the IEM-2020.
[E] *Serial Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with the IEM-2020.
[F] *Application Part Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with the IEM-2020.
[G] *Model Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with the IEM-2020.
[H] *Language Module Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with the IEM-2020.
[I] *Language Module Part Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with the IEM-2020.
[J] *Device Name:* Accepts an alphanumeric character string of up to 16 characters.
[K] *Application Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional LSM-2020.
[L] *Boot Code Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional LSM-2020.
[M] *Application Build Date:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional LSM-2020.
[N] *Serial Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional LSM-2020.
[O] *Application Part Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional LSM-2020.
[P] *Model Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional LSM-2020.
[Q] *Refresh:* Clicking this button will refresh the screen after connecting an optional LSM-2020.
[R] *Application Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional CEM-2020.
[S] *Boot Code Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional CEM-2020.
[T] *Application Build Date:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional CEM-2020.
[U] *Serial Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional CEM-2020.
[V] *Application Part Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional CEM-2020.
[W] *Model Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional CEM-2020.
[X] *Refresh:* Clicking this button will refresh the screen after connecting an optional CEM-2020.
[Y] *Application Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional AEM-2020.
[Z] *Boot Code Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional AEM-2020.
[AA] *Application Build Date:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional AEM-2020.
[BB] *Serial Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional AEM-2020.
[CC] *Application Part Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional AEM-2020.
[DD] *Model Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with an optional AEM-2020.
[EE] *Refresh:* Clicking this button will refresh the screen after connecting an optional AEM-2020.

Device Security Setup

Password protection guards against unauthorized changing of IEM-2020 settings. IEM-2020 passwords are case sensitive. Three levels of password protection are available. Each level is described in the following paragraphs.

- *OEM Access.* This password level allows access to all settings. The default, OEM-access password is **OEM**.
- *Settings Access.* This password level allows all except uploading of firmware and clearing of device event log. The default, settings-access password is **SET**.
- *Operator Access.* The default, operator-access password is **OP**. This password level allows all settings to be read and allows changes to be made to the following:
    - LCD Contrast
    - Sleep Mode
    - Date/Time
    - All Sender Fail Time Delays
    - Metric Conversion
    - Low Fuel Pre-Alarm Level
    - Low Fuel Alarm Level
    - Pre-Start Contact after Cranking
    - Cooldown Time
    - Pre-Crank Time Delay
    - Reset of Maintenance Interval
    - All controls on the Control screen available via the Metering Explorer in BESTCOMS*Plus*

Changing Passwords

Passwords can be changed only after communication between the PC and IEM-2020 is established. Changes to passwords are made through the *Device Security Setup* screen. Use the Settings Explorer in BESTCOMS*Plus* to open the *General Settings, Device Security Setup* screen.

The content of the *Device Security Setup* screen depends on the password level used when accessing the screen. For example, someone logged in with a settings-access password will be able to change only the settings-access and operator-access passwords - not the OEM-access password. Figure 4-14 illustrates the *Device Security Setup* screen with all three of the access levels shown.

A password is changed by clicking on the access level[A], entering the new password[B], and then clicking on the *Save Password* button[C].

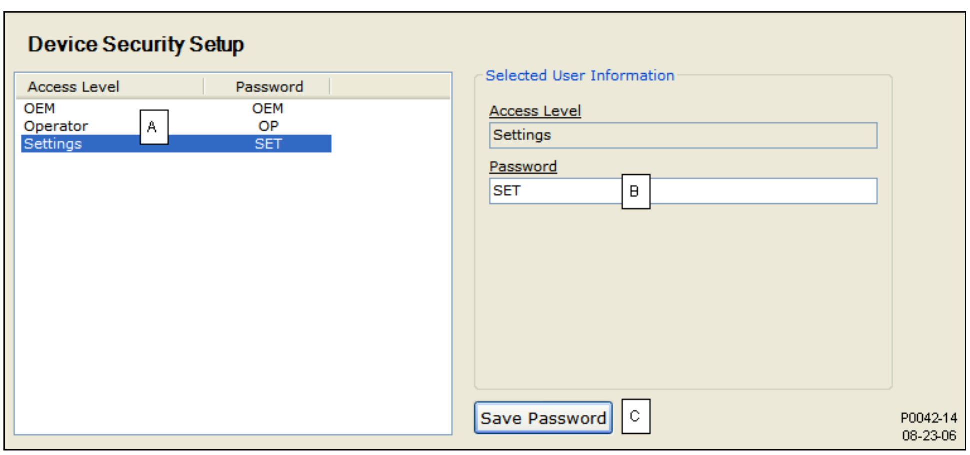


Figure 4-14. Device Security Setup

[A] *Access Level/Password:* Read-only value obtained when BESTCOMS*Plus* is communicating with the IEM-2020.
[B] *Password:* Accepts an alphanumeric character string of up to 16 characters.
[C] *Save Password:* Clicking this button will save the password changes in BESTCOMS*Plus* memory.

Saving Passwords in a IEM-2020 Settings File

The passwords can be modified while BESTCOMS*Plus* is connected to an IEM-2020, then the settings from the BESTCOMS*Plus* session can be saved into a settings file. The settings file will contain the new passwords. Also, the passwords in a settings file can be modified off line, saved with the file, and then later loaded into an IEM-2020.

Saving passwords to a settings file when BESTCOMS*Plus* is connected to an IEM-2020 (on line):

1. When connected to an IEM-2020 with BESTCOMS*Plus*, click on SETTINGS EXPLORER→GENERAL SETTINGS→DEVICE SECURITY SETUP.
2. You will be prompted to enter a password.
3. Enter a password that is of a level as high as or higher than the password you wish to modify. BESTCOMS*Plus* will display all passwords of a level equal to and below the level of the password that was entered.
4. Click on the password you wish to modify. Type in the new password under the "Password" setting that became active when the password to modify was clicked.
5. Click the "Save" button to save the new password into BESTCOMS*Plus* memory (it's not in the IEM-2020 yet).
6. Repeat steps 4 and 5 for all password levels you with to modify.
7. Once all password modifications are complete, in the main menu of BESTCOMS*Plus*, select *Upload Security* from the *Communications* pull-down menu. This is the step where passwords are sent to the IEM-2020. Failure to perform this step may cause all password modifications to be lost.
8. Close the *Device Security Setup* tab in BESTCOMS*Plus*.
9. Re-open the *Device Security Setup* tab in BESTCOMS*Plus*. This will read the passwords back out of the IEM-2020.
10. Verify the passwords obtained from the IEM-2020 are correct.
11. Once all desired settings have been loaded into the IEM-2020, save the settings file. The resulting settings file has the passwords saved as part of the saved settings.
12. At this point, the password information has been successfully saved in the settings file. The process of saving the passwords into the settings file is complete.

Saving passwords to a settings file when working off line:

1. When the settings file is open in BESTCOMS*Plus*, click on SETTINGS EXPLORER→GENERAL SETTINGS→DEVICE SECURITY SETUP.
2. You will be prompted to enter a password.
3. Enter a password that is of a level as high as or higher than the password you wish to modify. BESTCOMS*Plus* will display all passwords of a level equal to and below the level of the password that was entered.
4. Click on the password you wish to modify. Type in the new password under the "Password" setting that became active when the password to modify was clicked.
5. Click the "Save" button to save the new password into BESTCOMS*Plus* memory.
6. Repeat steps 4 and 5 for all password levels you wish to modify.
7. Close the *Device Security Setup* tab in BESTCOMS*Plus*.
8. Save the settings file.
9. Close the settings file by clicking on the X in the upper right-hand corner of the settings file, or close BESTCOMS*Plus*.
10. Restart BESTCOMS*Plus* if you have shut it down.
11. Re-open the settings file that you have saved with the password information.
12. When the settings file is open in BESTCOMS*Plus*, click on SETTINGS EXPLORER→GENERAL SETTINGS→DEVICE SECURITY SETUP.
13. You will be prompted to enter a password.

14. Enter the password for the highest level of password modified; it should be the new modified password.
15. When passwords are shown, verify they are correct.
16. At this point the password information has been successfully saved in the settings file. The process of saving the passwords into the settings file is complete.

Loading Passwords from a Settings File into the IEM-2020

1. Connect to the IEM-2020 with BESTCOMS*Plus*.
2. Once connected, click the “Open File” button that is used to load a settings file into the IEM-2020.
3. You will be prompted asking if you wish to load settings and logic into the IEM-2020. Select *Yes* if you need to upload settings logic. Select *No* if all you need to do is update security. If you select *No*, the settings file opens into BESTCOMS*Plus* memory.
4. Whether you have loaded settings and logic to the IEM-2020 or not, the next step is to select *Upload Security* from the *Communications* pull-down menu.
5. DO NOT try to view the passwords before performing step 4. This would download the existing passwords from the IEM-2020 and they will overwrite the new passwords that were loaded into BESTCOMS*Plus* memory from opening the settings file.
6. If you are prompted for a password, enter a password of a level equal to that of the highest level password you wish to modify.
7. The passwords are uploaded to the IEM-2020.
8. After you have uploaded the new passwords, select GENERAL SETTINGS→DEVICE SECURITY SETUP in the settings explorer of BESTCOMS*Plus.* Verify the passwords are correct.
9. This concludes loading passwords from a settings file into the IEM-2020.

Clock Setup

Configuration of daylight saving time and coordination of the local time with universal time (if desired) is performed on this screen. If required, enter the *UTC (Universal Time Coordinates) Offset*[A]. Choose the type of *DST Configuration*[B] and then set the *Start Day*[C]*, End Day*[D]*,* and *Bias*[E]*.* See Figure 4-15.

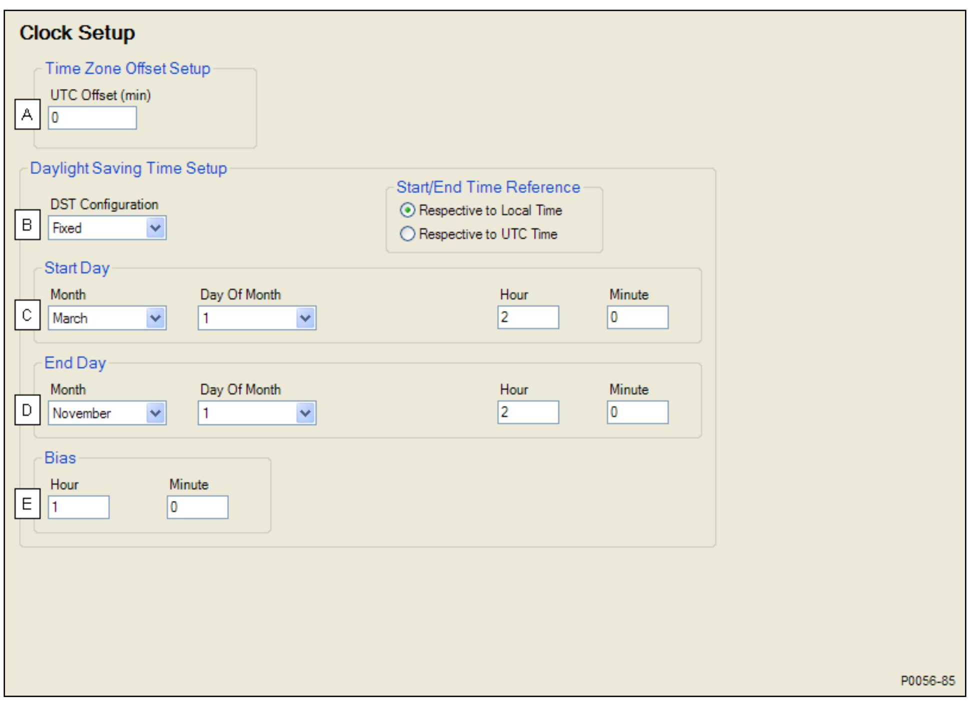


Figure 4-15. Clock Setup

[A] *UTC Offset (min):* Adjustable from -1,440 to 1,440 minutes in increments of 1.
[B] *DST Configuration:* Disabled, Fixed, or Floating.

[C] *Start Day:*

Fixed DST Configuration

Month (January to December), Day of Month (1 to 31 in increments of 1), Hour (0 to 23 in increments of 1), Minute (0 to 59 in increments of 1).

Floating DST Configuration

Month (January to December), Occurrence of Day (First to Fourth, or Last), Weekday (Sunday to Saturday), Hour (0 to 23 in increments of 1), Minute (0 to 59 in increments of 1).

[D] *End Day:*

Fixed DST Configuration

Month (January to December), Day of Month (1 to 31 in increments of 1), Hour (0 to 23 in increments of 1), Minute (0 to 59 in increments of 1).

Floating DST Configuration

Month (January to December), Occurrence of Day (First to Fourth, or Last), Weekday (Sunday to Saturday), Hour (0 to 23 in increments of 1), Minute (0 to 59 in increments of 1).

[E] *Bias:* Hour (0 to 23 in increments of 1), Minute (0 to 59 in increments of 1).

COMMUNICATIONS

IEM-2020 communication settings include setup parameters for CANbus, ECU, modem, and RS-485 communication.

CANbus Setup

The IEM-2020 CANbus interface provides high-speed communication between the IEM-2020 and the engine control unit (ECU) on an electronically controlled engine. When ECU support is enabled[A], the IEM-2020 will ignore the analog coolant temperature, oil pressure, and engine speed inputs and rely upon the ECU for these parameters. The IEM-2020 will also stop calculating engine run time and begin using the run time recorded by the ECU.

When enabled[B], the IEM-2020 will receive and retain unsolicited diagnostic trouble codes (DTCs) from an ECU with DTC capabilities.

An IEM-2020 operating on a CANbus network is identified by a unique address number[C].

In applications where the ECU is not continuously powered, the IEM-2020 has provisions for applying power to the ECU and pulsing the ECU to update its engine monitoring data. Either the IEM-2020 RUN or PRESTART relay output can be used to apply power to the ECU[D]. If the PRESTART contact is selected, the RUN output will still close during cranking and engine operation to provide a separate indication that the engine is running. For applications where pulsing of the ECU is not desired, this pulsing feature[E] may be disabled.

The BESTCOMS*Plus* CANbus Setup screen is illustrated in Figure 4-16.

ECU Limitations

For some ECUs, an external source cannot stop the engine without removing power from the ECU. Turning off power to 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. If the ECU is powered up and the engine is still spinning above 60 rpm, then the ECU will automatically turn the fuel on. Detroit Diesel J1939 ECUs, for example, have a setpoint of 60 rpm.

Not being able to stop the engine without removing ECU power 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 powering the ECU back on. Otherwise, the engine will take off running. The second problem is that while the ECU is off, you can no longer meter and update coolant level, coolant temperature alarm/pre-alarm, and crank control.

The IEM-2020 Solution

The IEM-2020 resolves ECU limitations by using four timers:

- *Engine Shutdown.*[F] The time in seconds to stay 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 IEM-2020 pulses, the ECU will not start the engine.
- *Pulse Cycle Time.*[G] The time in minutes that the module waits before pulsing.

- *Settling Time.*[H] The time in tenths of seconds to gather data after connecting to the ECU during the pulsing state. This allows all the metered values to be sent and ramp as designated by the J1939 protocol. ECU values initially sent are low and the ECU takes time to average out its own data values.
- *Response Timeout.*[I] The time in seconds to attempt communication with the ECU when the IEM-2020 is in the pulsing state or connecting state.

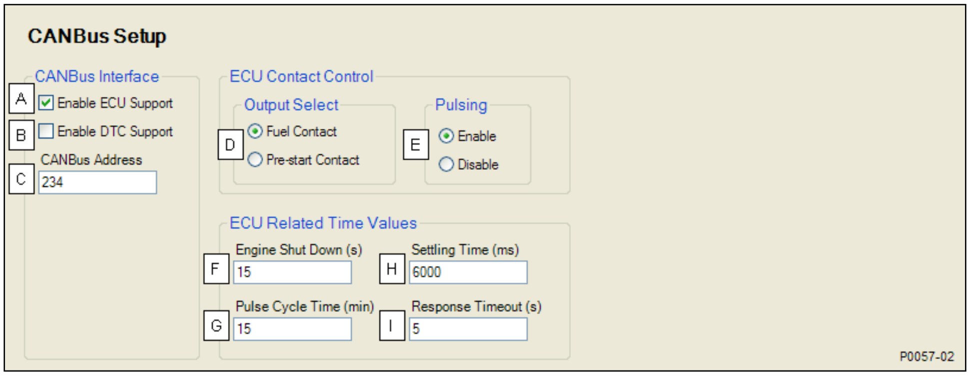


Figure 4-16. CANbus Setup

[A] *Enable ECU Support:* Check box to enable ECU support.
[B] *Enable DTC Support:* Check box to enable DTC support.
[C] *CANbus Address:* Accepts an address number from 1 to 253 in increments of 1.
[D] *Output Select:* Fuel Contact (RUN) or Pre-start Contact.
[E] *Pulsing:* Enable or Disable.
[F] *Engine Shutdown:* Adjustable from 1 to 60 s in 1 s increments.
[G] *Pulse Cycle Time:* Adjustable from 1 to 60 min in 1 min increments.
[H] *Settling Time:* Adjustable from 5,500 to 30,000 ms in 1 ms increments.
[I] *Response Timeout:* Adjustable from 1 to 60 s in 1 s increments.

ECU Setup

The IEM-2020 can be configured for Standard, Volvo Penta∗, MTU MDEC, MTU ADEC, MTU ECU7, or GM[A]. Configuring the IEM-2020 for Volvo Penta necessitates the configuration of two additional settings: Speed Select and Accelerator Position. The Speed Select setting[B] configures the Volvo Penta ECU to operate the engine at the primary or secondary base speed. If the engine is configured by Volvo for 60 Hz applications, the primary base speed is 1,800 rpm and the secondary base speed is 1,500 rpm. If the engine is configured by Volvo for 50 Hz applications, the primary base speed is 1,500 rpm and the secondary base speed is 1,800 rpm. The Accelerator Position setting[C] is expressed as a percentage and tells the Volvo Penta ECU where to set the engine speed (trim) relative to the base speed. The range of the setting is the base speed ±120 rpm. A setting of 0% will cause the engine to run at 120 rpm below the base speed, a setting of 50% will cause the engine to run at the base speed, and a setting of 100% will cause the engine to run at 120 rpm above the base speed. The Accelerator Position setting is linear with a gain of 2.4 rpm/percentage. This setting is not saved in nonvolatile memory and defaults back to 50% after IEM-2020 operating power is cycled.

If the engine is configured as MTU MDEC, the configuration of the following settings is necessary:

- MDEC Module Type[D]
- Speed Demand Switch[E]
- Engine RPM[F]
- NMT Alive Transmit Rate[W] - Specifies the rate at which messages are transmitted to the MTU engine.

If the engine is configured as MTU ADEC, the configuration of the following settings is necessary:

- Speed Demand Switch[E] - Specifies speed demand source for the MTU engine ECU.
- Engine RPM[F] - Requested engine RPM when speed demand source is analog CAN for an MTU ECU.
- Overspeed Test[G] - Temporarily drives an MTU ECU into overspeed for testing overspeed.
- Governor Param Switch Over[H] - Specifies which governor parameters an MTU ECU should use.
- Trip Reset[I] - Resets trip information such as trip fuel used, trip hours, trip idle time, etc.
- Int Oil Prime[J] - Causes an MTU ECU engine to perform an internal lubrication cycle.

If the engine is configured as MTU ECU7, the configuration of the following settings is necessary:

- Speed Demand Switch[E] - Specifies speed demand source for the MTU engine ECU.
- Engine RPM[F] - Requested engine RPM when speed demand source is analog CAN for an MTU ECU.
- Overspeed Test[G] - Temporarily drives an MTU ECU into overspeed for testing overspeed.
- Speed Up[K] - Increases speed of the MTU ECU.
- Speed Down[L] - Decreases speed of the MTU ECU.
- Speed Demand Limit[M] - Turns the speed demand limit on or off.
- Increased Idle[N] - Sets the MTU ECU idle.
- Trip Reset[I] - Resets trip information such as trip fuel used, trip hours, trip idle time, etc.
- MTU 50 Hz 60 Hz Switch Setting[O] - Selects MTU operating frequency.
- Int Oil Prime[J] - Causes an MTU ECU engine to perform an internal lubrication cycle.
- Engine Start Prime[P] - Turns the engine start prime on or off.
- Fan Override[Q] - Turns the fan override on or off.
- Mode Switch[R] - Turns the mode switch on or off.
- Governor Param Switch Over[H] - Specifies which governor parameters an MTU ECU should use.
- Governor Param Set Select[S] - Sets the governor parameter set select.
- CAN Rating Switch 1 & 2[T] - Turns the CAN rating switch 1 & 2 on or off.
- Cylinder Cutout Disable 1 & 2[U] - Turns the cylinder cutout disable 1 & 2 on or off.
- MTU ECU7 Module Type[V] - Specifies ECU7 Module type.
- NMT Alive Transmit Rate[W] - Specifies the rate at which messages are transmitted to the MTU engine.

∗The Volvo Penta ECU configuration is applicable only to the EDC3 and EMS2 models of Volvo Penta engine controllers.

The BESTCOMS*Plus* ECU Setup screen is illustrated in Figure 4-17.

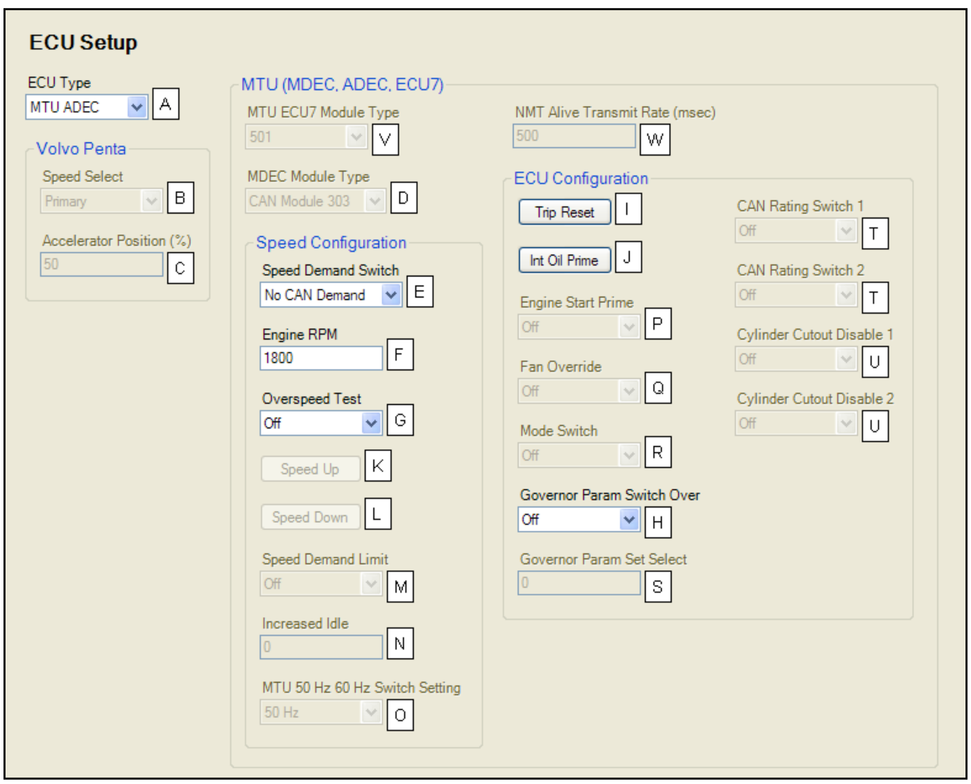


Figure 4-17. ECU Setup

[A] *ECU Type:* Standard, Volvo Penta, MTU MDEC, MTU ADEC, or MTU ECU7.
[B] *Speed Select:* Primary or Secondary.
[C] *Accelerator Position:* Adjustable from 0 to 100% in 1% increments.

[D] *MDEC Module Type:* CAN Module 201, 302, 303, or 304.
[E] *Speed Demand Switch:* Analog CAN, Up Down ECU, Up Down CAN, Analog ECU, Frequency, No CAN Demand.
[F] *Engine RPM:* Adjustable from 1,400 to 2,000 in increments of 1.
[G] *Overspeed Test:* Off or On.
[H] *Governor Param Switch Over:* Off or On.
[I] *Trip Reset:* Press to set.
[J] *Int Oil Prime:* Press to set.
[K] *Speed Up:* Press to set.
[L] *Speed Down:* Press to set.
[M] *Speed Demand Limit:* Off or On.
[N] *Increased Idle:* 0 to 1,000 in increments of 1.
[O] *MTU 50 Hz 60 Hz Switch Setting:* 50 Hz or 60 Hz.
[P] *Engine Start Prime:* Off or On.
[Q] *Fan Override:* Off or On.
[R] *Mode Switch:* Off or On.
[S] *Governor Param Set Select:* 0 to 1,000 in increments of 1.
[T] *CAN Rating Switch 1 & 2:* Off or On.
[U] *Cylinder Cutout Disable 1 & 2:* Off or On.
[V] *MTU ECU7 Module Type:* 501 or 502.
[W] *NMT Alive Transmit Rate:* 100 to 500 ms in 100 ms increments.

Modem Setup (Optional)

IEM-2020 modules with style number NNxxxMNNH are equipped with an internal telephone modem that has dial-in and dial-out capability. The modem gives the IEM-2020 the ability to dial up to four telephone numbers[A] and annunciate user-selected conditions to specified pagers[B]. These user-selected conditions include[C]:

- AEM Comm Failure
- Auxiliary Input X Closed (X = 1 to 16)
- Battery Charger Fail Status
- Battery Overvoltage Pre-Alarm
- CEM Comm Failure
- Config Element X Status (X = 1 to 8)
- Coolant Temp Sender Fail Alarm
- Coolant Temp Sender Fail Pre-Alarm
- Cooldown Timer Active
- Duplicate AEM Pre-Alarm
- Duplicate CEM Pre-Alarm
- Duplicate LSM Pre-Alarm
- Emergency Stop Alarm
- Engine Running
- Fuel Leak Detect Status
- Fuel Level Sender Fail Alarm
- Fuel Level Sender Fail Pre-Alarm
- High Coolant Temperature Alarm
- High Coolant Temp Pre-Alarm
- High Fuel Pre-Alarm
- Loss of ECU Coms Alarm
- Loss of ECU Coms Pre-Alarm
- Low Battery Voltage Pre-Alarm
- Low Coolant Level Status
- Low Coolant Temp Pre-Alarm
- Low Fuel Alarm
- Low Fuel Pre-Alarm
- Low Oil Pressure Alarm
- Low Oil Pressure Pre-Alarm
- LSM Comm Failure

- MPU Speed Sender Fail Alarm
- Oil Pressure Sender Fail Alarm
- Oil Pressure Sender Fail Pre-Alarm
- Overcrank Alarm
- Overspeed Alarm
- Scheduled Maintenance Pre-Alarm
- Switch Not in Auto
- Weak Battery Voltage Pre-Alarm

Dial-Out

The IEM-2020 uses telelocator alphanumeric protocol (TAP) version 1.7 when communicating with paging companies. This data format[D] specifies seven data bits with even parity. If required, eight data bits with no parity may be specified.

The message string sent by the IEM-2020 can be limited to a length supported by the receiving pagers[E]. If a message to be transmitted by the IEM-2020 exceeds the pager message limit, the IEM-2020 will make multiple calls to transmit the complete message.

Dial-out messages are sent by the IEM-2020 at a user-defined interval[F]. This interval gives an operator the opportunity to dial into the IEM-2020. A second user-defined interval[G] determines how frequently dial-out attempts are made following a dial-out failure.

Dial-In

When the IEM-2020 modem shares a line used for voice communication, the number of rings[H] required for the modem to answer can be increased to allow time for an operator to answer an incoming telephone call.

The BESTCOMS*Plus* Modem Setup screen is illustrated in Figure 4-18.

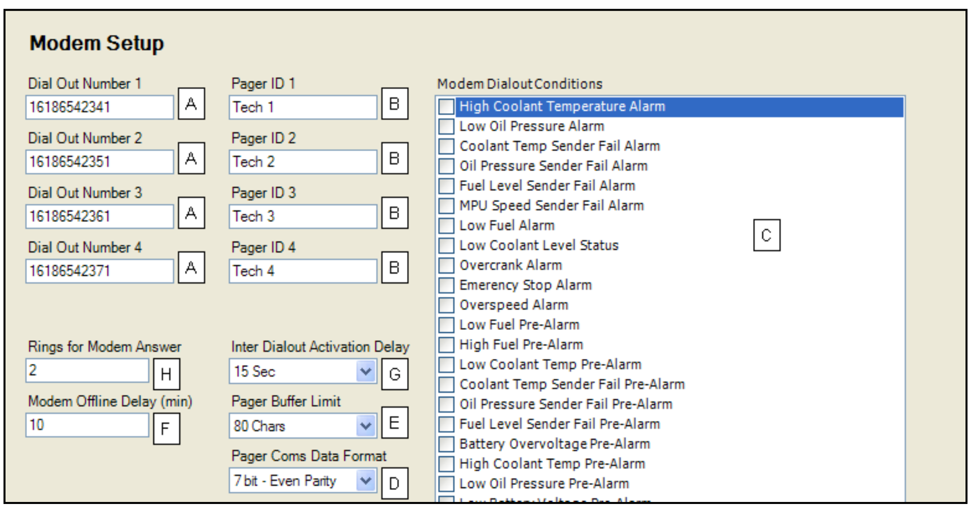


Figure 4-18. Modem Setup

[A] *Dial Out Number:* Accepts a telephone number of up to 16 characters.
[B] *Pager ID:* Accepts a pager identification number of up to 16 characters.
[C] *Modem Dialout Conditions:* Check boxes to select conditions that will initiate a dial-out message.
[D] *Pager Coms Data Format:* 7 bit – Even Parity or 8 bit – No Parity.
[E] *Pager Buffer Limit:* Adjustable from 80 to 200 characters in increments of 40.
[F] *Modem Offline Delay:* Adjustable from 1 to 240 min in 1 min increments.
[G] *Inter Dialout Activation Delay:* A delay of 15, 30, 60, or 120 s may be selected.
[H] *Rings for Modem Answer:* Adjustable from 1 to 9 in increments of 1.

RS-485 Setup (Optional)

IEM-2020 modules with the optional RS-485 communication port (style number NNxRxxNNH) can be monitored and controlled via a polled network using the Modbus protocol. Adjustable RS-485 port settings include the baud rate[A], parity[B], and port address[C]. Fixed RS-485 port settings include the number of data bits (8) and stop bits (1).

Modbus register values for the IEM-2020 are listed and defined in Appendix A, *Modbus Communication*.

BESTCOMS*Plus* RS-485 port settings are illustrated in Figure 4-19.

Figure 4-19. RS-485 Setup

[A] *Baud Rate:* A value of 1200, 2400, 4800, or 9600 may be selected.
[B] *Parity:* No Parity, Odd Parity, or Even Parity.
[C] *Modbus Address:* A value of 1 to 247 may be entered in increments of 1.

SYSTEM PARAMETERS

System parameters configure the IEM-2020 for operation with a specific application and are divided into five categories: System Settings, Remote Module Setup, Crank Settings, Automatic Restart, and Exercise Timer.

System Settings

The following settings are used to configure the IEM-2020 for operation with a specific engine application.

Engine Speed Measurement

The IEM-2020 detects engine speed from a magnetic pickup (MPU).

The IEM-2020 uses the nominal rpm rating[A] and the number of flywheel teeth[B] when calculating engine rpm.

Engine Cooldown

The IEM-2020 can ensure proper engine and turbocharger cooldown by maintaining engine operation for a user-specified duration[C]. The cooldown time delay is initiated for any one of the following conditions:

- Auto Start opens while operating in Auto mode
- Normal shutdown is initiated

Off Mode Cooldown

When Off Mode Cooldown[D] is enabled, pressing the IEM-2020 front panel OFF button one time will cause the unit to go through a cooldown cycle for the duration of the Cooldown Time[C]. At the end of the cool down cycle, the unit will go to OFF mode. If it is desired to stop the machine immediately, pressing the OFF button twice will cause the unit to go to OFF mode immediately. Furthermore, if an Off Mode Cooldown is in progress and the OFF button is pressed, the unit will immediately shut down. If the unit was in RUN mode when the OFF button was pressed, it remains in RUN for the remainder of the cooldown cycle. If the machine was in the AUTO mode when the OFF button was pressed, it remains in AUTO mode until the cooldown and shutdown cycle are completed, or until the OFF button is pressed a second time forcing the unit to OFF mode. The OFF LED will flash to indicate an off mode cooldown is in progress. In addition, the unit will display “OFF MODE COOLDN” while the cooldown timer is displayed.

If the RUN button is pressed while an Off Mode Cooldown is in progress, the cooldown will be aborted and the unit will go to RUN mode.

If the AUTO button is pressed while an Off Mode Cooldown is in progress, the Off Mode Cooldown is cleared and the unit returns to normal AUTO operation. Thus, if conditions exist where the unit would normally run in AUTO, it will resume running in AUTO. If conditions exist where the unit would normally shut down in AUTO, the unit will finish the remaining cooldown cycle then stop and remain in AUTO.

If Off Mode Cooldown is not enabled, pressing the OFF button once at any time will immediately force the unit to OFF mode.

The Off Mode Cooldown feature works from the front panel HMI buttons only. Any OFF command received through BESTLogic*Plus* or BESTCOMS*Plus* control result in an immediate transition of the machine to OFF.

The IEM-2020 can ensure proper engine and turbocharger cooldown by maintaining engine operation for a user-specified duration. The cooldown time delay is initiated for any one of the following conditions:

- Auto transfer switch (ATS) opens while operating in Auto mode
- Remote shutdown is initiated

Measurement/Metering Units

The user can configure the IEM-2020 to display and report engine oil pressure and coolant temperature in English or metric units of measure[E].

Battery Voltage

The nominal voltage[F] of the starter battery is used by the IEM-2020 to detect and annunciate battery overvoltage and low or weak battery voltage.

Horn

An output contact configured (through programmable logic) to energize a horn[G] can be enabled and disabled through BESTCOMS*Plus* or at the IEM-2020 front panel.

Fuel Level Function

This setting[H] allows the selection of four fuel types: Fuel Lvl, Natural Gas, Liquid Propane, or Disabled. Selecting a fuel type other than Fuel Lvl will disable any fuel level indication, alarm, and pre-alarm and disable the Fuel Level value on the Engine screen of the Metering Explorer in BESTCOMS*Plus*.

Power Up Delay

In some cases, the ECU takes longer than the IEM-2020 to power up. The power up delay setting[I] is used to delay the initial pulsing of the ECU for data on IEM-2020 power up.

Not In Auto Horn Enable

This setting[J] allows the horn to annunciate when the IEM-2020 is not in auto mode.

Clock Not Set Warning Enable

When the clock not set warning[K] is enabled, the IEM-2020 will notify the user when the clock is not set.

Relay Control

The default operational setting for the Start[L], Run[M], and Prestart[N] relays is “Predefined” or standard. Any of these relays can be logic driven by selecting the “Programmable” setting. Logic driven (programmable) relays must be set up using BESTLogic*Plus*.

BESTCOMS*Plus* system settings (IEM-2020, System Parameters, System Settings) are illustrated in Figure 4-20.

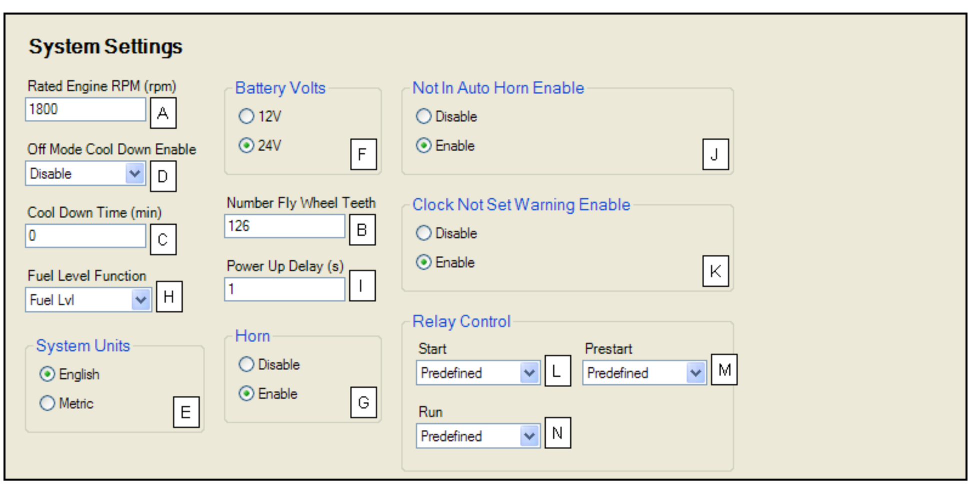


Figure 4-20. System Settings

[A] *Rated Engine RPM:* Adjustable from 750 to 3,600 rpm in 1 rpm increments.
[B] *Number Fly Wheel Teeth:* Adjustable from 50 to 500 in increments of 1.
[C] *Cool Down Time:* Adjustable from 0 to 60 minutes in 1 minute increments.
[D] *Off Mode Cool Down Enable:* Enable or Disable.
[E] *System Units:* English or Metric.
[F] *Battery Volts:* 12 or 24 Vdc.
[G] *Horn:* Enable or Disable.
[H] *Fuel Level Function:* Disable, Fuel Lvl, Natural Gas, or Liquid Propane.
[I] *Power Up Delay:* Adjustable from 0 to 60 seconds in 1 second increments.
[J] *Not In Auto Horn Enable:* Enable or Disable.
[K] *Clock Not Set Warning Enabled:* Enable or Disable.
[L] *Start:* Predefined or Programmable.
[M] *Run:* Predefined or Programmable.
[N] *Prestart:* Predefined or Programmable.

Remote Module Setup

The following settings are used to configure the LSM-2020, CEM-2020, and AEM-2020.

Load Sharing Module

A J1939 Address[A] must be entered when an optional LSM-2020 is enabled[B].

Contact Expansion Module

A J1939 Address[C] must be entered when the optional CEM-2020 is enabled[D]. Select number of CEM-2020 outputs[E].

Analog Expansion Module

A J1939 Address[F] must be entered when the optional AEM-2020 is enabled[G].

BESTCOMS*Plus* system settings (IEM-2020, System Parameters, Remote Module Setup) are illustrated in Figure 4-21.

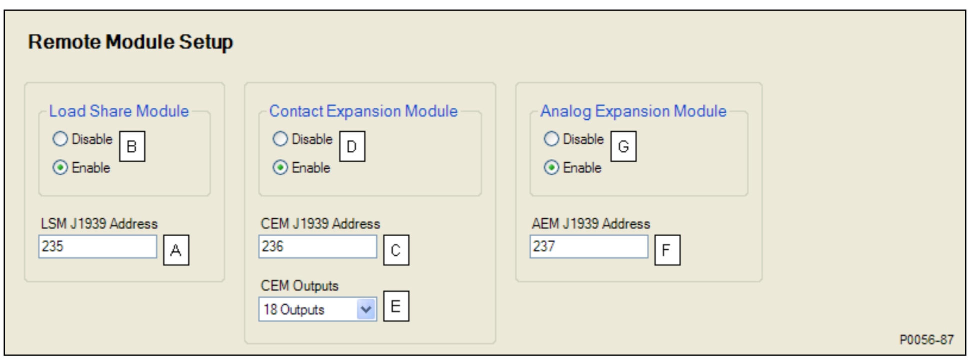


Figure 4-21. Remote Module Setup

[A] *LSM J1939 Address:* Adjustable from 1 to 253 in increments of 1.
[B] *Load Share Module:* Enable or Disable.
[C] *CEM J1939 Address:* Adjustable from 1 to 253 in increments of 1.
[D] *Contact Expansion Module:* Enable or Disable.
[E] *CEM Outputs:* 18 Outputs or 24 Outputs.
[F] *AEM J1939 Address:* Adjustable from 1 to 253 in increments of 1.
[G] *Analog Expansion Module:* Enable or Disable.

Crank Settings

The IEM-2020 can be programmed for either cycle or continuous engine cranking[A]. Cycle cranking provides multiple engine starting attempts[B]. Each starting attempt consists of a fixed interval of engine cranking[C] followed by a rest interval of the same duration. Continuous cranking[D] provides a single, extended engine-starting attempt.

The IEM-2020 uses the engine speed signal (supplied by a magnetic pickup (MPU)) and the Crank Disconnect Limit setting[E] to detect engine startup (and determine when engine cranking can be stopped). The Crank Disconnect Limit setting is expressed as a percentage of the nominal engine speed.

If desired, cycle or continuous cranking can be delayed after initiating engine startup. During this delay[F], the Pre-Start output closes to energize the engine glow plugs or pre-start lubrication pump. The Pre-Start output can be configured to open upon the conclusion of engine cranking or remain closed as long as the engine is running[G].

The Pre-Start can be configured[H] during the resting state. If Preheat Before Crank is selected, the Pre-Start output will be closed for a time equal to the Pre-crank delay time prior to re-entering the cranking state. If the Pre-crank delay setting is longer than the rest interval, the Pre-Start output will be closed for the entire rest time.

Under normal operation, engine rpm is used to determine crank disconnect. The Oil Pressure Crank Disconnect[I] provides a secondary indication that the engine is running so that the starter will be disconnected even if no engine rpm sources are functioning. When enabled, oil pressure is used as a check of whether the engine is running. If the engine oil pressure is above the threshold[J], the starter will be disconnected from the engine.

BESTCOMS*Plus* engine cranking settings (IEM-2020, System Parameters, Crank Settings) are illustrated in Figure 4-22.

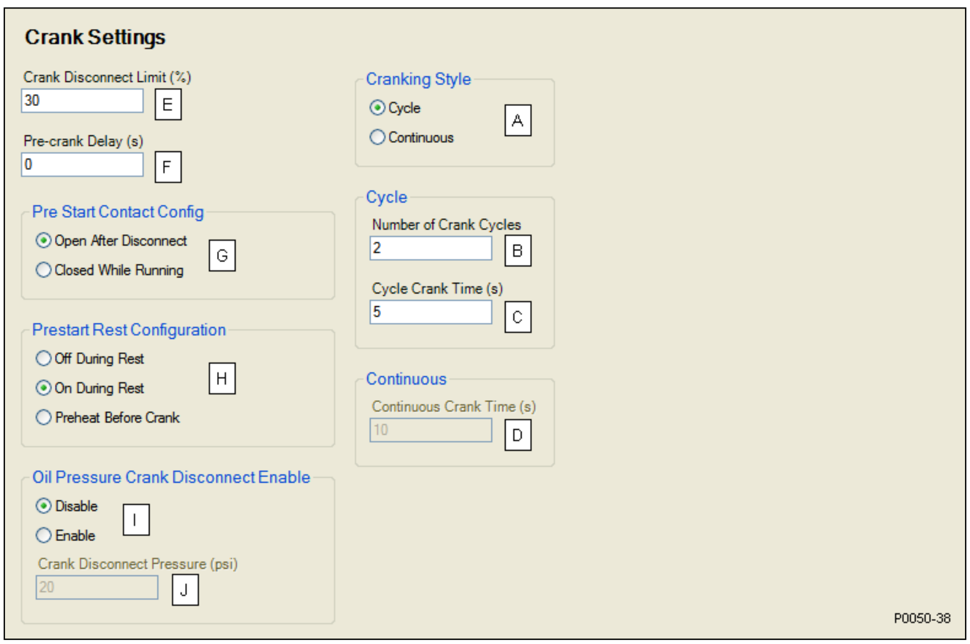


Figure 4-22. Engine Crank Settings

[A] *Cranking Style*: Cycle or Continuous.
[B] *Number of Crank Cycles*: Adjustable from 1 to 7 cycles in 1 cycle increments.
[C] *Cycle Crank Time*: Adjustable over the range of 5 to 15 seconds in 1 second increments.
[D] *Continuous Crank Time*: Adjustable from 5 to 60 seconds in 1 second increments.
[E] *Crank Disconnect Limit*: Adjustable from 10 to 100% of nominal engine speed.
[F] *Pre-Crank Delay*: Adjustable from 0 to 30 seconds in 1 second increments.
[G] *Pre-Start Contact Configuration*: Open After Disconnect or Closed While Running.
[H] *Prestart Rest Configuration:* Off During Rest, On During Rest, or Preheat Before Crank.
[I] *Oil Pressure Crank Disconnect Enable:* Disable or Enable.
[J] *Crank Disconnect Pressure (psi):* Adjustable from 3 to 150 psi in increments of 1 psi.

Automatic Restart

If the IEM-2020 has shut down due to an alarm condition, the automatic restart, when enabled[A], will automatically clear alarms. An attempt to restart the engine is made after a predetermined time delay[B] if the Auto Start contact input is closed. If an Auto Start contact is not present, the unit will remain in READY state with its alarms cleared. A restart will not be attempted if a low fuel alarm or emergency stop is present. The number of restart attempts[C] is programmable. Automatic restart attempts are recorded in the event log.

BESTCOMS*Plus* automatic restart settings (IEM-2020, System Parameters, Automatic Restart) are illustrated in Figure 4-23.

Figure 4-23. Automatic Restart Settings

[A] *Auto Restart Enable:* Enable or Disable.
[B] *Auto Restart Interval:* Adjustable from 0.5 to 30 minutes in 0.5 minute increments.
[C] *Auto Restart Attempts:* Adjustable from 1 to 10 in increments of 1.

Exercise Timer

The exercise timer is used to start the engine at a predetermined time and run for the user-defined period. The mode[A] defines how often the engine will run. If monthly is selected, you must select the day of the month[B] to start. If weekly is selected, you must select the day of the week[C] to start. Settings for Start Hour[D] and Start Minutes[E] may also be defined. The Run Period Hours[F] and Minutes[G] define how long the engine will run each time.

Contact inputs and outputs can be assigned to the function. Refer to Section 5, *BESTLogicPlus Programmable Logic,* for more information.

BESTCOMS*Plus* exercise timer settings (IEM-2020, System Parameters, Exercise Timer) are illustrated in Figure 4-24.

Figure 4-24. Exercise Timer Settings

[A] *Mode:* Monthly, Weekly, or Daily.
[B] *Start Day Of Month:* Adjustable from 1 to 31 in 1 day increments.
[C] *Start Day Of Week:* Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, or Saturday.
[D] *Start Hour:* Adjustable from 0 to 23 in 1 hour increments.
[E] *Start Minute:* Adjustable from 0 to 59 in 1 minute increments.
[F] *Run Period Hours:* Adjustable from 0 to 23 in 1 hour increments.
[G] *Run Period Minutes:* Adjustable from 0 to 59 in 1 minute increments.

PROGRAMMABLE INPUTS

IEM-2020 programmable inputs can be assigned to trigger various functions and, when triggered, annunciate an alarm or pre-alarm. A user-assigned label can be assigned to each input to make identification easier. The description of these settings is organized as follows:

- Contact Inputs
- Programmable Functions
- Remote LSM Inputs (Available with an optional LSM-2020 (Load Share Module).
- Remote Contact Inputs (Available with an optional CEM-2020 (Contact Expansion Module).
- Remote Analog Inputs (Available with an optional AEM-2020 (Analog Expansion Module).
- Remote RTD Inputs (Available with an optional AEM-2020 (Analog Expansion Module).
- Remote Thermocouple Inputs (Available with an optional AEM-2020 (Analog Expansion Module).

Contact Inputs

Each of the 16 contact inputs can be independently configured to annunciate an alarm or pre-alarm[A] when the input senses a contact closure. A user-adjustable time delay[B] can be set to delay generation of an alarm or pre-alarm when the input is configured as an alarm or pre-alarm. The status of the input is available immediately for BESTLogic*Plus* and on the Contact Inputs status screen on the front panel or in BESTCOMS*Plus*. By default, all inputs are configured so that they do not trigger an alarm or pre-alarm.

To make identifying the contact inputs easier, a user-assigned name[C] can be given to each input.

Contacts can be recognized[D] always or while the engine is running only.

The contact inputs are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

Contact input status is available in BESTLogic*Plus* Programmable Logic when "None" is selected for Alarm Configuration.

BESTCOMS*Plus* settings for contact inputs (IEM-2020, Programmable Inputs, Contact Inputs) are illustrated in Figure 4-25.

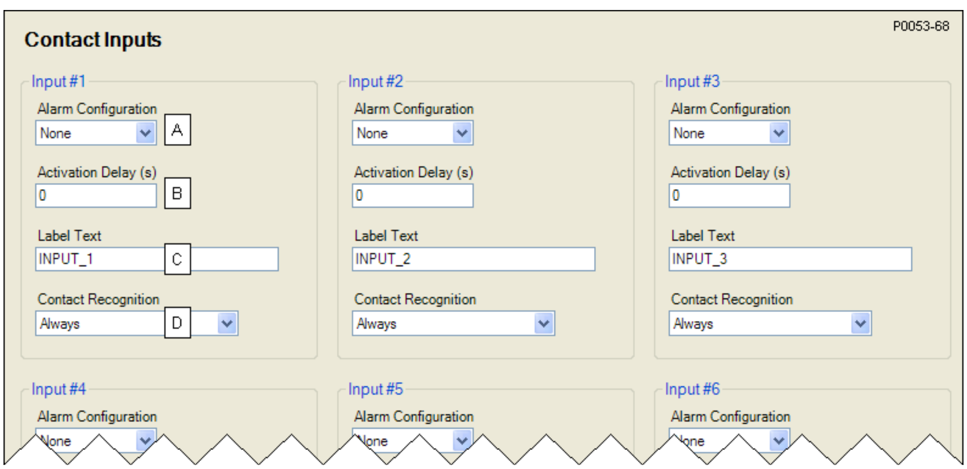


Figure 4-25. Contact Inputs Settings

[A] *Alarm Configuration:* None, Alarm, or Pre-Alarm.
[B] *Activation Delay:* Adjustable from 0 to 300 s in 1 s increments.
[C] *Label Text:* An alphanumeric character string with a maximum of 16 characters.
[D] *Contact Recognition:* Always or While Engine Running Only.

Programmable Functions

Any of the 16 contact inputs can be programmed to recognize any one of five function types:

- Auto Start[A] - Automatically starts the engine.
- Battle Override[B] - The alarms programmed to shut down the unit will be overridden and ignored.
- Battery Charger Fail[C] - When the selected input is invoked, a user selectable pre-alarm or alarm is annunciated after the activation delay.

- Low Coolant Level[D] - When the selected input is invoked, a user selectable pre-alarm or alarm is annunciated after the activation delay.
- Fuel Leak Detect[E] - When the selected input is invoked, a user selectable pre-alarm or alarm is annunciated after the activation delay.

An Alarm Configuration setting of “None” prevents a function from being triggered by a contact input. Programmable function status is available in BESTLogic*Plus* Programmable Logic when “None” is selected.

BESTCOMS*Plus* settings for programmable functions (IEM-2020, Programmable Inputs, Programmable Functions) are illustrated in Figure 4-26.

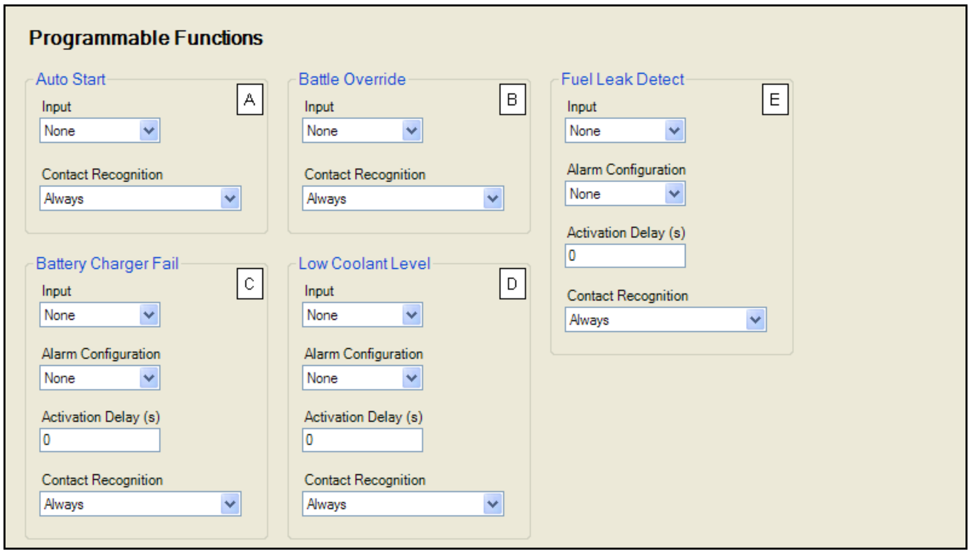


Figure 4-26. Programmable Functions Settings

[A] *Auto Start:* Select Input (None, 1-16) and Contact Recognition (Always or While Engine Running Only).
[B] *Battle Override:* Select Input (None, 1-16) and Contact Recognition (Always or While Engine Running Only).
[C] *Battery Charger Fail:* Select Input (None, 1-16), Alarm Configuration (None, Alarm, Pre-Alarm), Activation Delay (s) (0 to 300 in increments of 1), and Contact Recognition (Always or While Engine Running Only).
[D] *Low Coolant Level:* Select Input (None, 1-16), Alarm Configuration (None, Alarm, Pre-Alarm), Activation Delay (s) (0 to 300 in increments of 1), and Contact Recognition (Always or While Engine Running Only).
[E] *Fuel Leak Detect:* Select Input (None, 1-16), Alarm Configuration (None, Alarm, Pre-Alarm), Activation Delay (s) (0 to 300 in increments of 1), and Contact Recognition (Always or While Engine Running Only).

Remote LSM Inputs

An optional LSM-2020 (Load Share Module) provides one configurable[A] analog input. Settings are provided for min and max input voltage[B], and min and max input current[C].

The remote LSM inputs are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

BESTCOMS*Plus* settings for the remote LSM input (IEM-2020, Programmable Inputs, Remote LSM Inputs) are illustrated in Figure 4-28.

Figure 4-27. Remote LSM Inputs Settings

[A] *Input Type:* Voltage or Current.
[B] *Min/Max Input Voltage:* Adjustable from 0 to 10 volts in 0.1 V increments.
[C] *Min/Max Input Current:* Adjustable from 4 to 20 mA in 0.1 mA increments.

Remote Contact Inputs

An optional CEM-2020 (Contact Expansion Module) provides 10 contact inputs. Each of the 10 contact inputs can be independently configured to annunciate an alarm or pre-alarm[A] when the input senses a contact closure. A user-adjustable time delay[B] can be set to delay recognition of a contact input. By default, all inputs are configured so that they do not trigger an alarm or pre-alarm.

To make identifying the contact inputs easier, a user-assigned name[C] can be given to each input.

Contacts can be recognized[D] always or only while the engine is running.

The remote contact inputs are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

Remote contact input status is available in BESTLogic*Plus* Programmable Logic when "None" is selected for Alarm Configuration.

BESTCOMS*Plus* settings for remote contact inputs (IEM-2020, Programmable Inputs, Remote Contact Inputs) are illustrated in Figure 4-28.

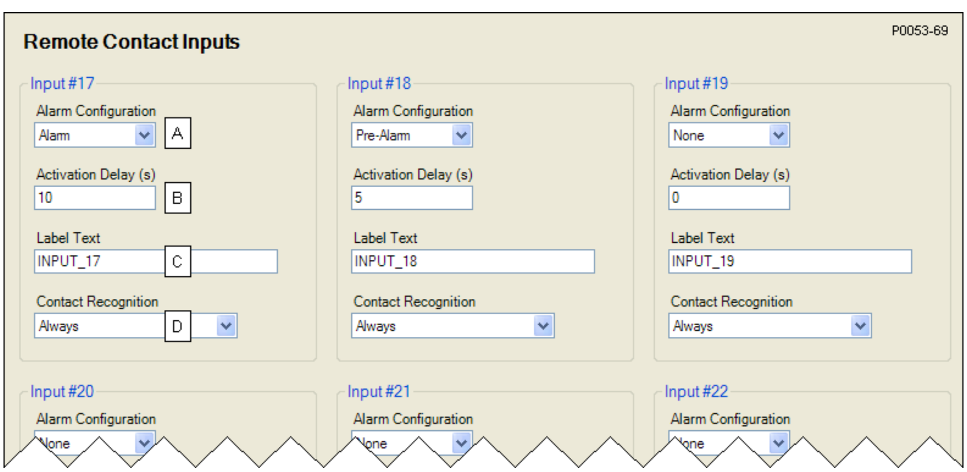


Figure 4-28. Remote Contact Inputs Settings

[A] *Alarm Configuration:* None, Alarm, or Pre-Alarm.
[B] *Activation Delay:* Adjustable from 0 to 300 s in 1 s increments.
[C] *Label Text:* An alphanumeric character string with a maximum of 16 characters.
[D] *Contact Recognition:* Always or While Engine Running Only.

Remote Analog Inputs

An optional AEM-2020 (Analog Expansion Module) provides eight analog inputs. To make identifying the analog inputs easier, a user-assigned name[A] can be given to each input.

Select the input type[B] and amount of hysteresis[C]. The analog inputs are always monitored and their status is displayed on the appropriate metering screens. A user-adjustable arming delay[D] allows configuration of the analog input threshold monitoring in one of two ways. (1) When the arming delay is set to zero, threshold monitoring is performed all the time, whether the engine is running or not. (2) When the arming delay is set to a non-zero value, threshold monitoring is inhibited while the engine is not running or is starting. Threshold monitoring begins when the arming delay time has expired after engine startup is complete. When enabled, an out of range alarm[E] alerts the user of an open or damaged analog input wire.

Ranges must be set for the selected input type. Param Min[F] correlates to Min Input Current[G] or Min Input Voltage[H] and Param Max[I] correlates to Max Input Current[J] or Max Input Voltage[K].

Each analog input can be independently configured to annunciate an alarm, pre-alarm, or status only[L] when the analog input signal falls beyond the threshold[M]. A user-adjustable activation delay[N] setting delays alarm annunciation after the threshold has been exceeded.

The remote analog inputs are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

A remote analog input is disabled when Alarm Configuration is set to “None”. Remote analog input status is available in BESTLogic*Plus* Programmable Logic when “Status Only” is selected.

BESTCOMS*Plus* settings for remote analog inputs (IEM-2020, Programmable Inputs, Remote Analog Inputs) are illustrated in Figure 4-29. Remote Analog Input #1 is shown.

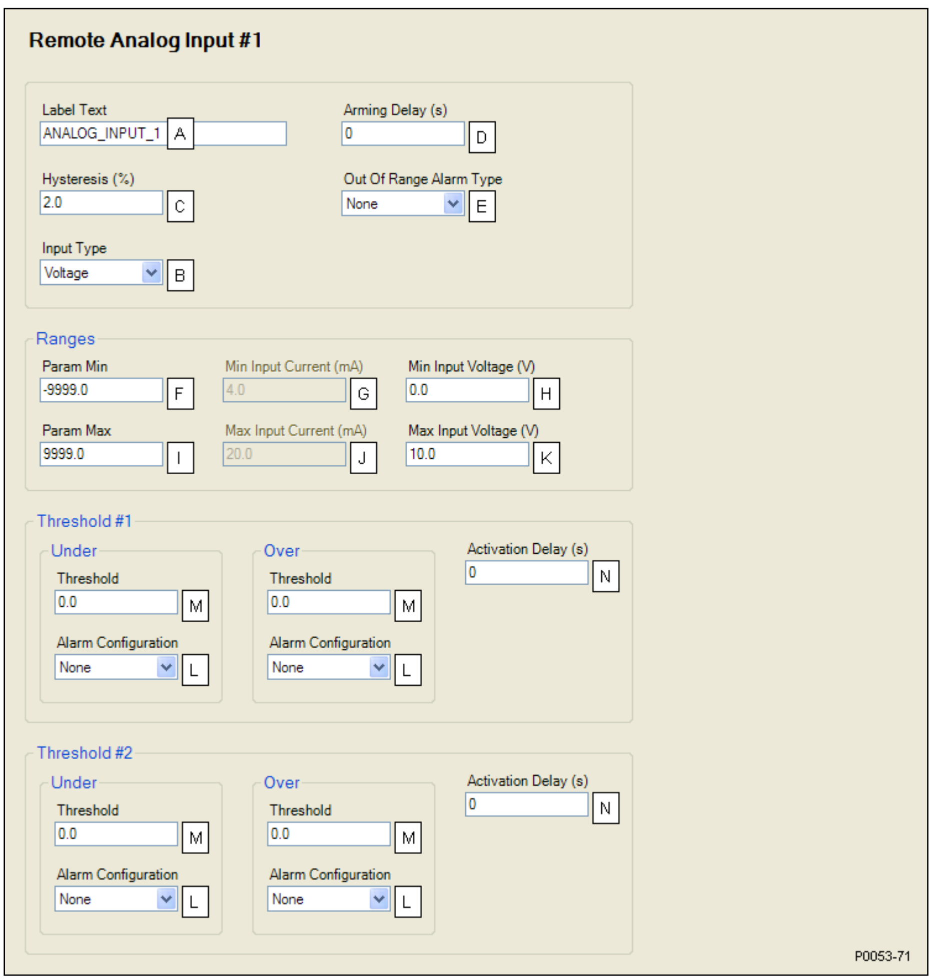


Figure 4-29. Remote Analog Inputs Settings

[A] *Label Text:* An alphanumeric character string with a maximum of 16 characters.
[B] *Input Type:* Voltage or Current.
[C] *Hysteresis:* Adjustable from 0 to 100 percent in increments of 0.1%.
[D] *Arming Delay:* Adjustable from 0 to 300 s in 1 s increments.
[E] *Out of Range Alarm Type:* None, Alarm, Pre-Alarm, or Status Only.
[F] *Param Min:* –9999.0 to +9999.0 in increments of 0.1.
[G] *Min Input Current:* Adjustable from 4 to 20 mA in 0.1 mA increments.
[H] *Min Input Voltage:* Adjustable from 0 to 10 V in 1 V increments.
[I] *Parm Max:* –9999.0 to +9999.0 in increments of 0.1.
[J] *Max Input Current:* Adjustable from 4 to 20 mA in 0.1 mA increments.
[K] *Max Input Voltage:* Adjustable from 0 to 10 V in 1 V increments.
[L] *Alarm Configuration:* None, Alarm, Pre-Alarm, or Status Only.
[M] *Threshold:* –9999.0 to +9999.0 in increments of 0.1.
[N] *Activation Delay:* Adjustable from 0 to 300 s in 1 s increments.

Remote RTD Inputs

An optional AEM-2020 (Analog Expansion Module) provides eight RTD inputs. To make identifying the RTD inputs easier, a user-assigned name[A] can be given to each input.

Select the amount of hysteresis[B] and RTD type[C]. The RTD inputs are always monitored and their status is displayed on the appropriate metering screens. A user-adjustable arming delay[D] allows configuration of the RTD input threshold monitoring in one of two ways. (1) When the arming delay is set to zero, threshold monitoring is performed all the time, whether the engine is running or not. (2) When the arming delay is set to a non-zero value, threshold monitoring is inhibited while the engine is not running or is starting. Threshold monitoring begins when the arming delay time has expired after engine startup is complete. When enabled, an out of range alarm[E] alerts the user of an open or damaged RTD input wire.

Each RTD input can be independently configured to annunciate an alarm, pre-alarm, or status only[F] when the RTD input signal falls beyond the threshold[G]. A user-adjustable activation delay[H] setting delays alarm annunciation after the threshold has been exceeded.

The remote RTD inputs are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

A remote RTD input is disabled when Alarm Configuration is set to “None”. Remote RTD input status is available in BESTLogic*Plus* Programmable Logic when “Status Only” is selected.

BESTCOMS*Plus* settings for remote RTD inputs (IEM-2020, Programmable Inputs, Remote RTD Inputs) are illustrated in Figure 4-30. Remote RTD Input #1 is shown.

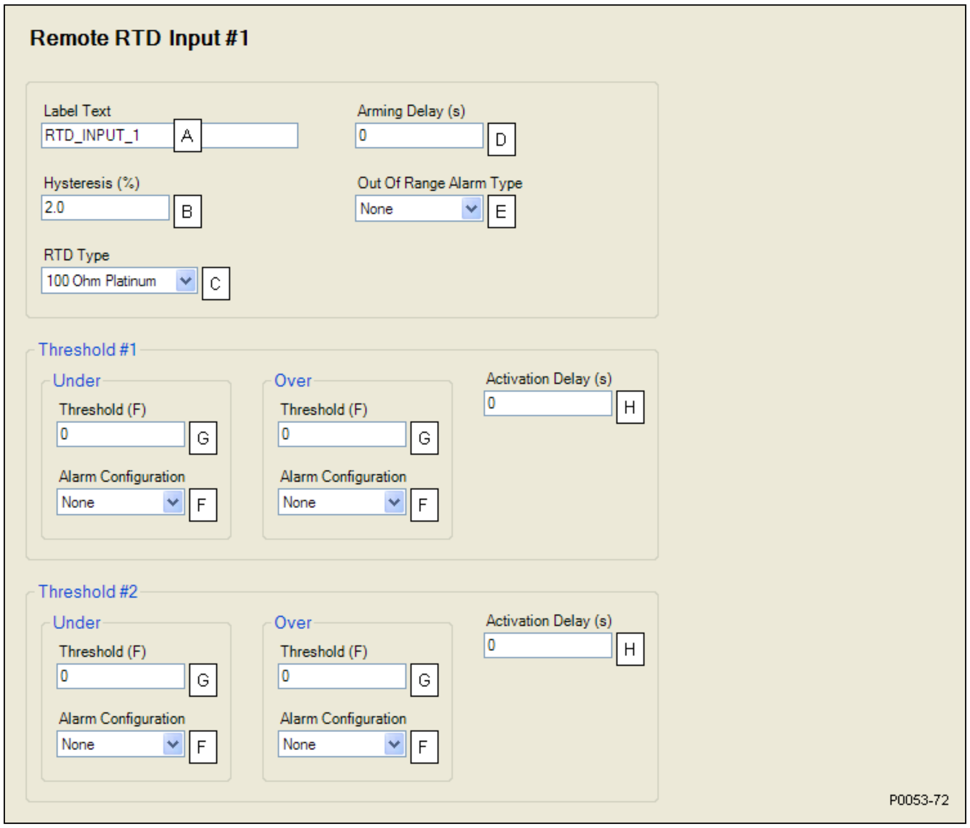


Figure 4-30. Remote RTD Inputs Settings

[A] *Label Text:* An alphanumeric character string with a maximum of 16 characters.
[B] *Hysteresis:* Adjustable from 0 to 100 percent in increments of 0.1%.
[C] *RTD Type:* 100 Ohm Platinum or 10 Ohm Copper.
[D] *Arming Delay:* Adjustable from 0 to 300 s in 1 s increments.
[E] *Out of Range Alarm Type:* None, Alarm, Pre-Alarm, or Status Only.
[F] *Alarm Configuration:* None, Alarm, Pre-Alarm, or Status Only.
[G] *Threshold:* –58 to +482°F in 1°F increments or –50 to +250°C in 1°C increments.
[H] *Activation Delay:* Adjustable from 0 to 300 s in 1 s increments.

Remote Thermocouple Inputs

An optional AEM-2020 (Analog Expansion Module) provides two thermocouple inputs. To make identifying the thermocouple inputs easier, a user-assigned name[A] can be given to each input.

Select the amount of hysteresis[B]. The thermocouple inputs are always monitored and their status is displayed on the appropriate metering screens. A user-adjustable arming delay[C] allows configuration of the thermocouple input threshold monitoring in one of two ways. (1) When the arming delay is set to zero, threshold monitoring is performed all the time, whether the engine is running or not. (2) When the arming delay is set to a non-zero value, threshold monitoring is inhibited while the engine is not running or is starting. Threshold monitoring begins when the arming delay time has expired after engine startup is complete.

Each thermocouple input can be independently configured to annunciate an alarm, pre-alarm, or status only[D] when the thermocouple input signal falls beyond the threshold[E]. A user-adjustable activation delay[F] setting delays alarm annunciation after the threshold has been exceeded.

A remote thermocouple input is disabled when Alarm Configuration is set to “None”.

The remote thermocouple inputs are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

Remote thermocouple input status is available in BESTLogic*Plus* Programmable Logic when “Status Only” is selected.

BESTCOMS*Plus* settings for remote thermocouple inputs (IEM-2020, Programmable Inputs, Remote Thermocouple Inputs) are illustrated in Figure 4-31. Remote Thermocouple Input #1 is shown.

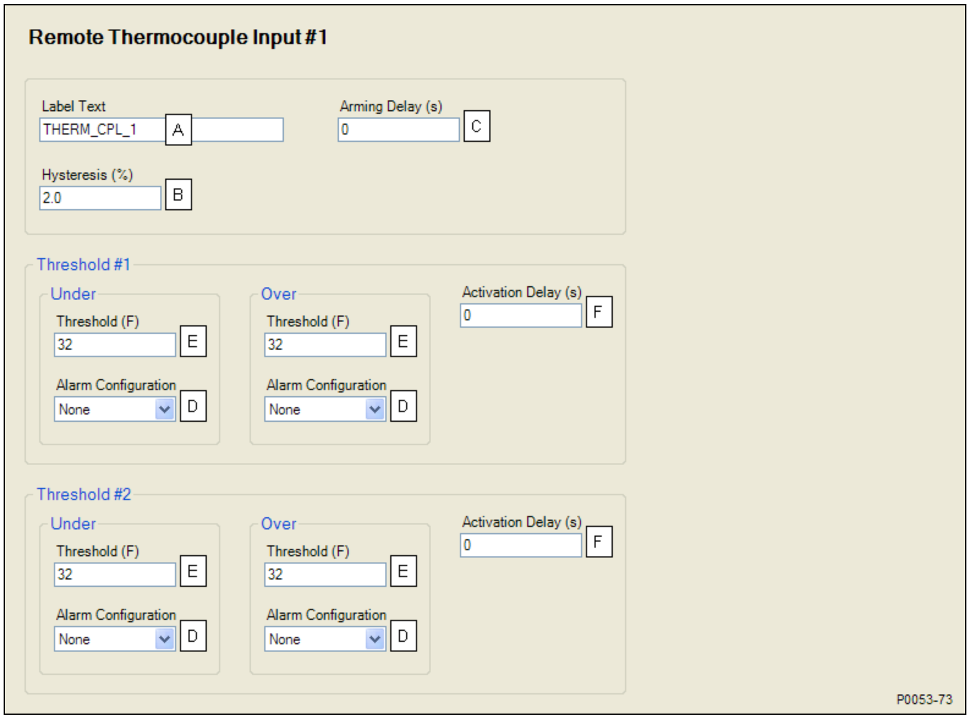


Figure 4-31. Remote Thermocouple Inputs Settings

[A] *Label Text:* An alphanumeric character string with a maximum of 16 characters.
[B] *Hysteresis:* Adjustable from 0 to 100 percent in increments of 0.1%.
[C] *Arming Delay:* Adjustable from 0 to 300 s in 1 s increments.
[D] *Alarm Configuration:* None, Alarm, Pre-Alarm, or Status Only.
[E] *Threshold:* 32 to 2,507°F in 1°F increments or 0 to 1,375°C in 1°C increments.
[F] *Activation Delay:* Adjustable from 0 to 300 s in 1 s increments.

PROGRAMMABLE OUTPUTS

IEM-2020 programmable outputs include four user-programmable contact outputs if the style number is NNAxxxNNH. If the style number is NNBxxxNNH, twelve contact outputs are provided. An additional 24 contact outputs are provided with an optional CEM-2020 (Contact Expansion Module). An optional CEM-2020H (Contact Expansion Module - High Current) provides 18 contact outputs.

Contact Outputs

To make identifying the contact outputs easier, each of the contact outputs can be given a user-assigned name[A].

The contact outputs are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

BESTCOMS*Plus* settings for contact outputs (IEM-2020, Programmable Outputs, Contact Outputs) are illustrated in Figure 4-32.

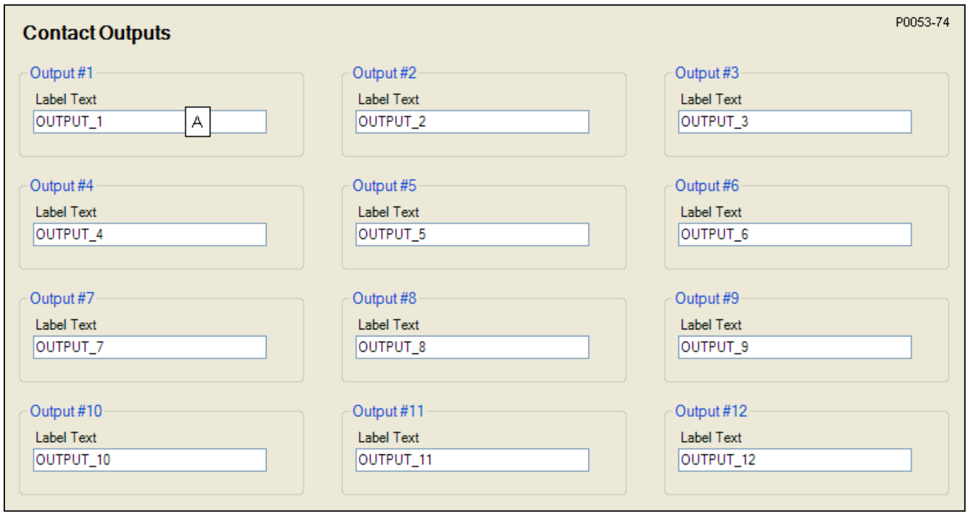


Figure 4-32. Contact Outputs Settings

[A] *Label Text:* An alphanumeric character string with a maximum of 16 characters.

Configurable Elements

Configurable elements are connected to the logic scheme as outputs. The configurable elements are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *Elements* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*. Each of the eight elements can be independently configured to annunciate an alarm or pre-alarm[A]. A user-adjustable time delay[B] can be set to delay recognition of an element. By default, all elements are configured so that they do not trigger an alarm or pre-alarm. To make identifying the element easier, each of the elements can be given a user-assigned name[C]. If used for an alarm or pre-alarm, the user-assigned name is what will appear in the alarm or pre-alarm annunciation and in the IEM-2020 event log. Elements can be recognized[D] always or only while the engine is running. Configurable element status is available in BESTLogic*Plus* Programmable Logic when "None" is selected for Alarm Configuration. Configurable element status can be used as logic inputs to drive other logic in the program, similar to logic control relays. In addition, the configurable element status can be used to generate modem dial outs which display the user-assigned name on modem equipped IEM-2020s.

BESTCOMS*Plus* settings for the elements (IEM-2020, Programmable Outputs, Configurable Elements) are illustrated in Figure 4-33.

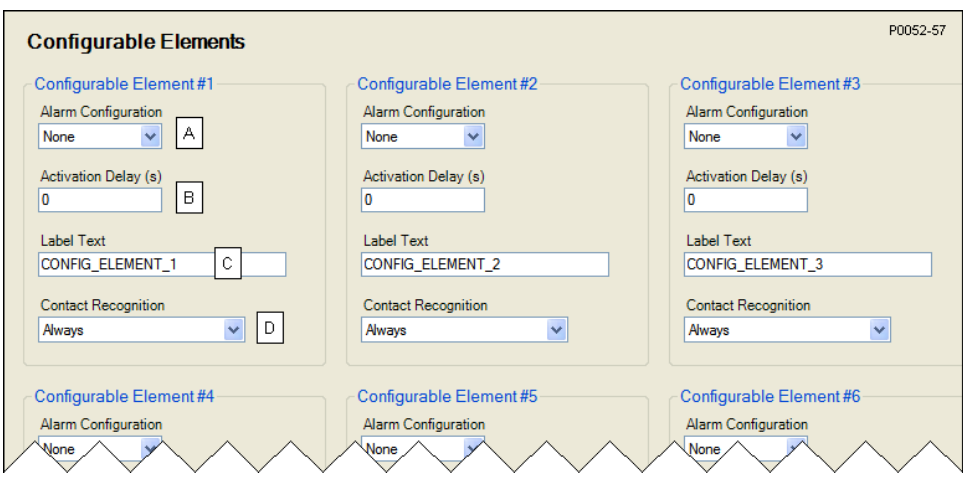


Figure 4-33. Configurable Elements Settings

[A] *Alarm Configuration:* None, Alarm, or Pre-Alarm.
[B] *Activation Delay:* Adjustable from 0 to 300 s in 1 s increments.
[C] *Label Text:* An alphanumeric character string with a maximum of 16 characters.
[D] *Contact Recognition:* Always or While Engine Running Only.

Remote Contact Outputs

To make identifying the contact outputs easier, each of the contact outputs can be given a user-assigned name[A].

The remote contact outputs are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

BESTCOMS*Plus* settings for remote contact inputs (IEM-2020, Programmable Outputs, Remote Contact Outputs) are illustrated in Figure 4-34.

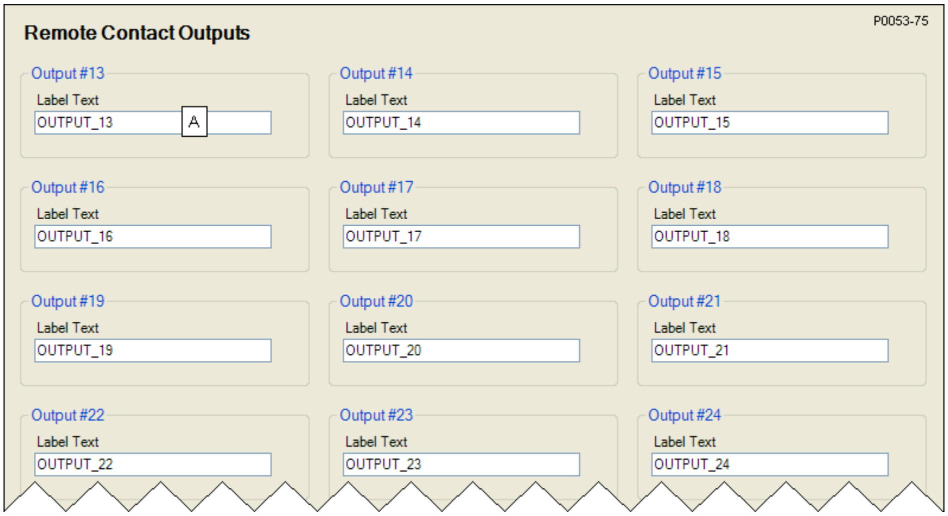


Figure 4-34. Remote Contact Outputs Settings

[A] *Label Text:* An alphanumeric character string with a maximum of 16 characters.

Remote Analog Outputs

An optional AEM-2020 (Analog Expansion Module) provides four analog outputs.

Make a parameter selection[A] and select the output type[B]. When enabled, an out of range alarm[C] alerts the user of an open or damaged analog output wire. An out of range activation delay[D] setting delays alarm annunciation.

Ranges must be set for the selected output type. Param Min[E] correlates to Min Input Current[F] or Min Input Voltage[G] and Param Max[H] correlates to Max Input Current[I] or Max Input Voltage[J].

A remote analog output is disabled when Alarm Configuration is set to "None". Remote analog output status is available in BESTLogic*Plus* Programmable Logic when "Status Only" is selected.

The remote analog outputs are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

BESTCOMS*Plus* settings for remote analog outputs (IEM-2020, Programmable Inputs, Remote Analog Outputs) are illustrated in Figure 4-35. Remote Analog Output #1 is shown.

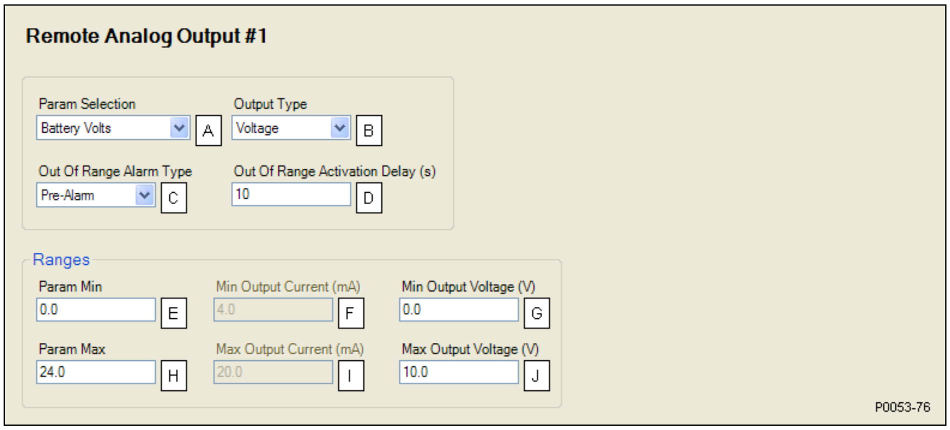


Figure 4-35. Remote Analog Outputs Settings

[A] *Param Selection:* Oil Pressure, Coolant Temp, Battery Volts, RPM, Fuel Level, Analog Input 1-8, RTD Input 1-8, or Thermocouple Input 1-2.
[B] *Output Type:* Voltage or Current.
[C] *Out of Range Alarm Configuration:* None, Alarm, Pre-Alarm, or Status Only.
[D] *Out of Range Activation Delay:* Adjustable from 0 to 300 s in 1 s increments.
[E] *Param Min:* –9999.0 to +9999.0 in increments of 0.1.
[F] *Min Output Current:* Adjustable from 4 to 20 mA in 0.1 mA increments.
[G] *Min Output Voltage:* Adjustable from 0 to 10 V in 1 V increments.
[H] *Parm Max:* –9999.0 to +9999.0 in increments of 0.1.
[I] *Max Output Current:* Adjustable from 4 to 20 mA in 0.1 mA increments.
[J] *Max Output Voltage:* Adjustable from 0 to 10 V in 1 V increments.

CONFIGURABLE PROTECTION

Configurable protection can be used when the standard protection available with the IEM-2020 does not meet the application needs. Eight configurable protection items are provided. To make identifying the items easier, each of the items can be given a user-assigned name[A].

Select a parameter[B] to monitor. A user-adjustable arming delay[C] disables configurable protection during engine startup. If the arming delay is set to zero, the configurable protection is active at all times, including when the engine is not running. If the arming delay is set to a non-zero value, the configurable protection is inactive when the engine is not running, and does not become active until after the engine is started and the arming delay has elapsed. A setting is provided to adjust the hysteresis[D].

Each configurable protection item can be independently configured to annunciate an alarm, pre-alarm, or status only[E] when the parameter selection falls beyond the threshold[F]. A user-adjustable activation delay[G] setting delays alarm annunciation after the threshold has been exceeded.

Configurable protection is disabled when Alarm Configuration is set to "None".

> **NOTE**
>
> The Arming Delay should not be set to zero if *Oil Pressure* or *Battery Volts* is selected for configurable protection and the threshold alarm configuration is set to *Alarm*. Setting the arming delay to zero will cause an immediate alarm and the engine will not start.

The configurable protection items are incorporated into a BESTLogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTLogic*Plus*. For more details, refer to Section 5, *BESTLogicPlus Programmable Logic*.

Configurable Protection status is available in BESTLogic*Plus* Programmable Logic when "Status Only" is selected.

BESTCOMS*Plus* settings for configurable protection (IEM-2020, Programmable Outputs, Configurable Protection) are illustrated in Figure 4-36. Configurable Protection #1 is shown.

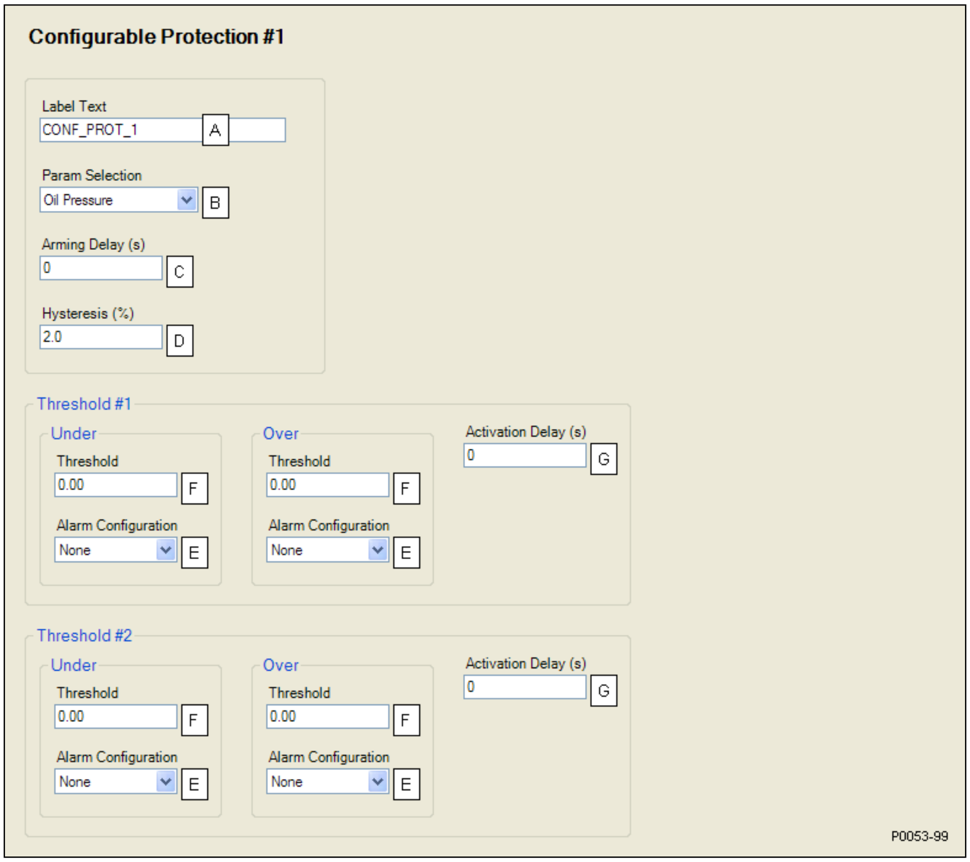


Figure 4-36. Configurable Protection Settings

[A] *Label Text:* An alphanumeric character string with a maximum of 16 characters.
[B] *Param Selection:* Oil Pressure, Coolant Temp, Battery Volts, RPM, Fuel Level, Analog Input 1-8, RTD Input 1-8, or Thermocouple Input 1-2.
[C] *Arming Delay:* Adjustable from 0 to 300 s in 1 s increments.
[D] *Hysteresis:* Adjustable from 0 to 100 percent in increments of 0.1%.
[E] *Alarm Configuration:* None, Alarm, Pre-Alarm, or Status Only.
[F] *Threshold:* -999,999 to 999,999 in increments of 0.01.
[G] *Activation Delay:* Adjustable from 0 to 300 s in 1 s increments.

ALARM CONFIGURATION

IEM-2020 alarms and pre-alarms can be used to annunciate system and engine sender conditions. The description of the alarm configuration settings is organized as follows:

- Pre-Alarms
- Alarms
- Sender Fail

Pre-Alarms

A pre-alarm is annunciated when a condition programmed to trigger a pre-alarm is met. When a pre-alarm condition exists, it is annunciated (flashed) on the LCD, the front panel Alarm indicator flashes on and off and the Horn output (if programmed and enabled) alternates between an energized and de-energized state. The audible alarm is reset by pressing the front panel Alarm Silence pushbutton. When a pre-alarm condition ceases to exist for pre-alarms other than weak battery, all displayed annunciations are reset automatically. A weak battery pre-alarm condition is reset through the front panel by navigating to the *Alarms-Status, Pre-Alarms* screen, scrolling through the list of pre-alarms until “Weak Battery” is displayed, and pressing the *Reset* key.

Active pre-alarms are displayed on the main display of the LCD. The LCD annunciates an active pre-alarm by alternating the pre-alarm message with the normally displayed data. All pre-alarms are individually displayed, in sequence, by scrolling through the LCD pre-alarms list.

Each IEM-2020 pre-alarm is described in the following paragraphs. Pre-alarms may be enabled and adjusted in BESTCOMS*Plus* or through the front panel HMI.

BESTCOMS*Plus* pre-alarm settings (IEM-2020, Alarm Configuration, Pre-Alarms) are illustrated in Figure 4-37.

High Fuel Level

High fuel level pre-alarm settings[A] consist of an enable/disable setting, a threshold setting, and an activation delay. If enabled, a high fuel level pre-alarm occurs when the metered fuel level increases above the threshold setting.

Low Battery Voltage

Low battery voltage pre-alarm settings[B] consist of an enable/disable setting, a threshold setting, and an activation delay. If enabled, a low battery voltage pre-alarm occurs when the battery voltage decreases below the threshold setting for the duration of the activation time delay. The threshold setting range is based on the nominal battery voltage setting on the BESTCOMS*Plus* System Settings tab (IEM-2020, System Parameters, System Settings).

Weak Battery Voltage

Weak battery voltage pre-alarm settings[C] consist of an enable/disable setting, a threshold setting, and an activation time delay. If enabled, a weak battery voltage pre-alarm latches during engine cranking when the battery voltage decreases below the threshold setting for the duration of the activation delay. The threshold setting range is based on the nominal battery voltage setting on the BESTCOMS*Plus* System Settings tab (IEM-2020, System Parameters, System Settings).

A weak battery pre-alarm condition is reset through the front panel by navigating to the *Alarms-Status, Pre-Alarms* screen, scrolling through the list of pre-alarms until “Weak Battery” is displayed, and pressing the *Reset* key.

Battery Overvoltage

Battery overvoltage pre-alarm settings[D] consist of an enable/disable setting and a fixed threshold setting. If enabled, a battery overvoltage pre-alarm occurs when the battery voltage increases above the threshold setting.

Maintenance Interval

Maintenance interval pre-alarm settings[E] consist of an enable/disable setting and a threshold setting. If enabled, a maintenance interval pre-alarm is annunciated when the IEM-2020 maintenance timer counts down to zero from the threshold time setting. The maintenance interval pre-alarm can be reset through the IEM-2020 front panel or by using BESTCOMS*Plus*.

To reset the maintenance interval pre-alarm through the IEM-2020 front panel, navigate to the SETTINGS->SYSTEM PARAMS->SYSTEM SETTINGS->MAINT RESET screen. Operator, Settings, or OEM access level is required to reset the maintenance interval pre-alarm. If the maintenance interval pre-alarm is not enabled, the MAINT RESET parameter is not visible on the front panel.

To reset the maintenance interval pre-alarm by using BESTCOMS*Plus*, use the Metering Explorer to open the Run Statistics screen and click on the Reset Maintenance Interval button.

Low Fuel Level

Low fuel level pre-alarm settings[F] consist of an enable/disable setting and a threshold setting. If enabled, a low fuel level pre-alarm occurs when the metered fuel level decreases below the threshold setting.

High Coolant Temp

High coolant temperature pre-alarm settings[G] consist of an enable/disable setting and a threshold setting. If enabled, a high coolant temperature pre-alarm is annunciated when the engine coolant temperature exceeds the threshold setting for a fixed duration of 60 seconds.

Low Coolant Temp

Low coolant temperature pre-alarm settings[H] consist of an enable/disable setting and a threshold setting. If enabled, a low coolant temperature pre-alarm occurs when the engine coolant temperature decreases below the threshold setting.

Low Coolant Level

Low coolant level pre-alarm settings[I] consist of an enable/disable setting and a threshold setting. If enabled, a low coolant level pre-alarm occurs when the metered coolant level decreases below the threshold setting.

Low Oil Pressure

Low oil pressure pre-alarm settings[J] consist of an enable/disable setting and a threshold setting. If enabled, a low oil pressure pre-alarm is annunciated when the engine oil pressure decreases below the threshold setting for a fixed duration of 10 seconds.

ECU Coms Fail

ECU communication failure pre-alarm settings[K] consist of a single enable/disable setting. If enabled, an ECU communication failure pre-alarm is annunciated when the IEM-2020 detects a communication problem in the J1939 interface linking the IEM-2020 with the ECU (engine control unit).

Active DTC

Active DTC (diagnostic trouble code) pre-alarm settings[L] consist of a single enable/disable setting. If CAN and DTC support are both enabled, an "active DTC" pre-alarm may be enabled to announce the presence of a condition that is causing a DTC to be sent from the ECU to the IEM-2020.

LSM Comm Failure

LSM-2020 communication failure pre-alarm settings[M] consist of a single enable/disable setting. If enabled, an LSM-2020 communication failure pre-alarm is annunciated when communication between an optional LSM-2020 and IEM-2020 is lost.

CEM Comm Failure

CEM-2020 communication failure pre-alarm settings[N] consist of a single enable/disable setting. If enabled, a CEM-2020 communication failure pre-alarm is annunciated when communication between an optional CEM-2020 and IEM-2020 is lost.

AEM Comm Failure

AEM-2020 communication failure pre-alarm settings[O] consist of a single enable/disable setting. If enabled, an AEM-2020 communication failure pre-alarm is annunciated when communication between an optional AEM-2020 and IEM-2020 is lost.

Checksum Failure

The checksum failure pre-alarm will occur whenever one of the internal checksum calculations used for data integrity purposes has failed. This indicates that some of the user settings or firmware code has been corrupted.

The checksum failure pre-alarm can be cleared by pressing the reset button on the front panel. However, the pre-alarm will reoccur the next time the checksum is verified if the data is still corrupted. Some checksum calculations are done only on power up, so this may not occur until the next time the unit's operating power is cycled.

If there are consistent checksum failure pre-alarms, attempt the following actions to correct the problem:

1. Load default settings by holding UP+DOWN on the front panel while cycling power. After loading defaults, upload settings file through BESTCOMS*Plus* if needed.

CAUTION

Loading default settings will erase all custom settings. All reports and events will be cleared. BESTCOMS*Plus* can be used to download settings and save to a file so that settings can be restored later.

2. If the problem still exists, reload the firmware file with BESTCOMS*Plus*.
3. If the problem still exists, contact Basler Electric Technical Support.

The checksum failure pre-alarm can be disabled with the Checksum Failure pre-alarm enable[P] setting. Disabling this setting disables only the annunciation of the pre-alarm and does not correct any error conditions.

The checksum failure pre-alarm may occur after changing firmware versions through BESTCOMS*Plus*. The checksum failure pre-alarm is not indicative of an error in this case. The pre-alarm can be cleared with the reset button or by cycling power to the unit. If the pre-alarm reoccurs, then the pre-alarm is indicative of an error and corrective action should be attempted as described above.

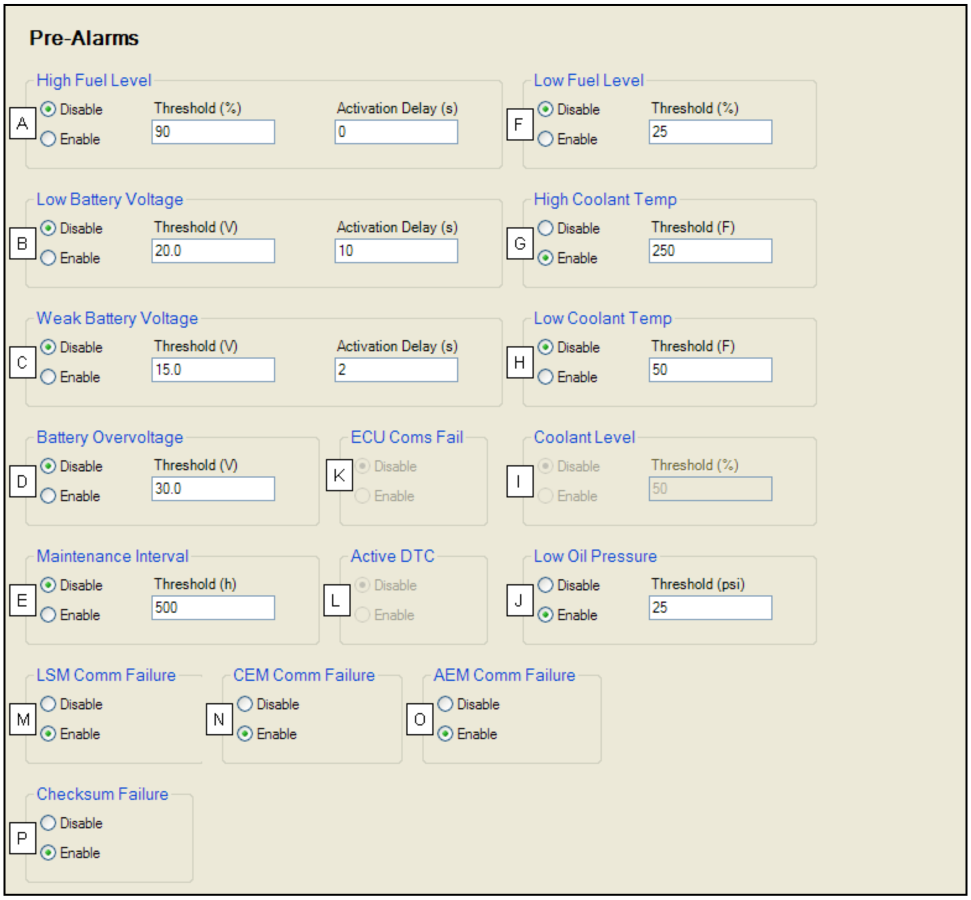


Figure 4-37. Pre-Alarms Configuration

[A] *High Fuel Level:* Enable or Disable, threshold is adjustable from 0 to 150% in 1 % increments.
[B] *Low Battery Voltage:* Enable or Disable, threshold is adjustable from 6 to 12 Vdc (12 Vdc battery) or 12 to 24 Vdc (24 Vdc battery) in 0.1 Vdc increments. Activation delay is adjustable from 1 to 10 s in 1 s increments.
[C] *Weak Battery Voltage:* Enable or Disable, threshold is adjustable from 4 to 8 Vdc (12 Vdc battery) or 8 to 16 Vdc (24 Vdc battery) in 0.1 Vdc increments. Activation time delay is adjustable from 1 to 10 s in 1 s increments.
[D] *Battery Overvoltage:* Enable or Disable, threshold is adjustable from 12 to 32 Vdc in 0.1 increments.
[E] *Maintenance Interval:* Enable or Disable, threshold is adjustable from 0 to 5,000 h in 1 h increments.
[F] *Low Fuel Level:* Enable or Disable, threshold is adjustable from 10 to 100% in 1 % increments.
[G] *High Coolant Temp:* Enable or Disable, threshold is adjustable from 100 to 280°F or 38 to 138°C in 1° increments. Activation time delay is fixed at 60 s.
[H] *Low Coolant Temp:* Enable or Disable, threshold is adjustable from 35 to 151°F or 2 to 66°C in 1° increments.
[I] *Low Coolant Level:* Enable or Disable, threshold is adjustable from 1 to 99% in 1 % increments.
[J] *Low Oil Pressure:* Enable or Disable, threshold is adjustable from 3 to 150 psi or 21 to 1,034 kPa in 7 psi or kPa increments. Activation time delay is fixed at 10 s.
[K] *ECU Coms Fail:* Enable or Disable.
[L] *Active DTC:* Enable or Disable.
[M] *LSM Comm Failure:* Enable or Disable.
[N] *CEM Comm Failure:* Enable or Disable.
[O] *AEM Comm Failure:* Enable or Disable.
[P] *Checksum Failure:* Enable or Disable.

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 (if programmed and enabled) energizes, and the cause of the alarm is displayed on the front panel LCD. An alarm condition stops the engine by opening the RUN output contact. Alarms are reset when the IEM-2020 is set to Off mode.

Each IEM-2020 alarm is described in the following paragraphs. Alarms may be enabled and adjusted in BESTCOMS*Plus* or through the front panel HMI.

BESTCOMS*Plus* alarm settings (IEM-2020, Alarm Configuration, Alarms) are illustrated in Figure 4-38.

High Coolant Temperature

High coolant temperature alarm settings[A] consist of an enable/disable setting and a threshold setting. If enabled, a high coolant temperature alarm is triggered instantaneously when the engine coolant temperature exceeds the threshold setting. The arming delay disables the high coolant temperature alarm function for a user-adjustable time during engine startup.

Low Oil Pressure

Low oil pressure alarm settings[B] include an enable/disable setting, an arming time delay, and a threshold setting. If enabled, a low oil pressure alarm is triggered instantaneously when the engine oil pressure decreases below the threshold setting. The arming delay disables the low oil pressure alarm function for a user-adjustable time during engine startup.

Overspeed

Overspeed alarm settings[C] include an enable/disable setting, an activation delay, and a threshold setting. If enabled, an overspeed alarm occurs when the engine speed (in rpm) exceeds the threshold setting for the duration of the activation time delay.

Low Fuel Level

Low fuel level alarm settings[D] consist of an enable/disable setting, an activation delay setting, and a threshold setting. If enabled, a low fuel level alarm is triggered when the metered fuel level drops below the threshold setting for the duration of the activation time delay.

Low Coolant Level

Low coolant level alarm settings[E] consist of an enable/disable setting and a threshold setting. If enabled, a low coolant level alarm is triggered when the metered coolant drops below the threshold setting.

Note: ECU Support must be enabled on the *Communications, CANbus Setup* screen before this alarm can be configured.

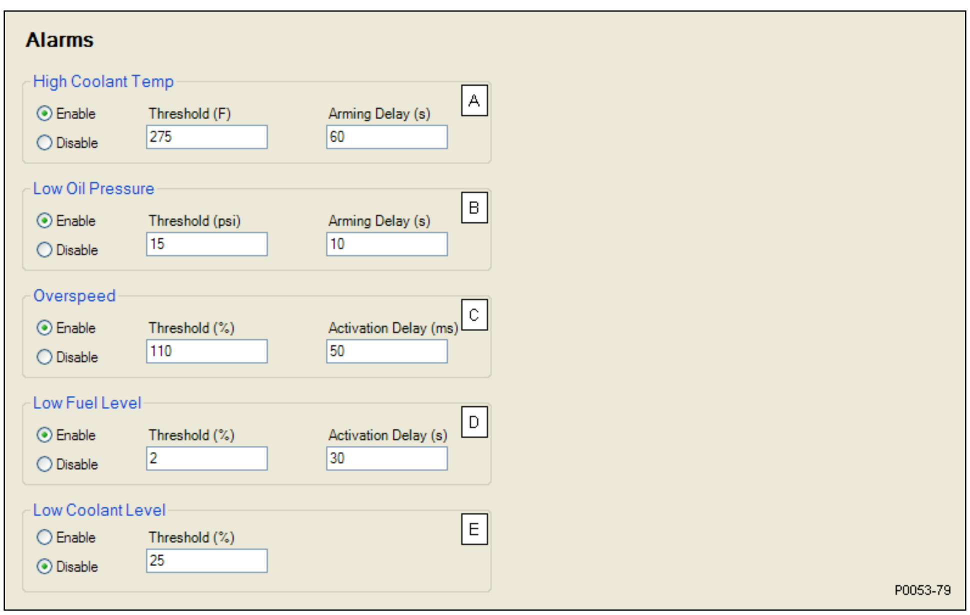


Figure 4-38. Alarms Configuration

[A] *High Coolant Temp:* Enable or Disable, threshold is adjustable from 100 to 280°F or 38 to 138°C in 1° increments. Arming time delay is adjustable from 0 to 150 in 1 s increments.
[B] *Low Oil Pressure:* Enable or Disable, threshold is adjustable from 3 to 150 psi or 21 to 1,034 kPa in 7 psi or 1 kPa increments. Arming time delay is adjustable from 5 to 60 s in 1 s increments.
[C] *Overspeed:* Enable or Disable, threshold is adjustable from 105 to 140% of the rated engine rpm. Activation time delay is adjustable from 0 to 500 s in 1 s increments.
[D] *Low Fuel Level:* Enable or Disable, threshold is adjustable from 0 to 100% in 1% increments. Activation time delay is adjustable from 0 to 30 in 1 s increments.
[E] *Low Coolant Level:* Enable or Disable, threshold is adjustable from 1 to 99% in 1% increments.

Sender Fail

The IEM-2020 can be configured to annunciate a pre-alarm or alarm when a loss of signal is detected at the coolant temperature[A], oil pressure[B], or fuel level sender[C] input. The speed sender fail[D] alarm is always enabled. A user-adjustable time delay is provided for each sender alarm/pre-alarm.

Alarm and pre-alarm annunciations for loss of engine speed signals is not user-programmable and operates as follows. The MPU (magnetic pickup) is the sole engine speed source. If the MPU fails, an alarm (and shutdown) is triggered.

BESTCOMS*Plus* settings for the sender fail functions (IEM-2020, Alarm Configuration, Sender Fail) are illustrated in Figure 4-39.

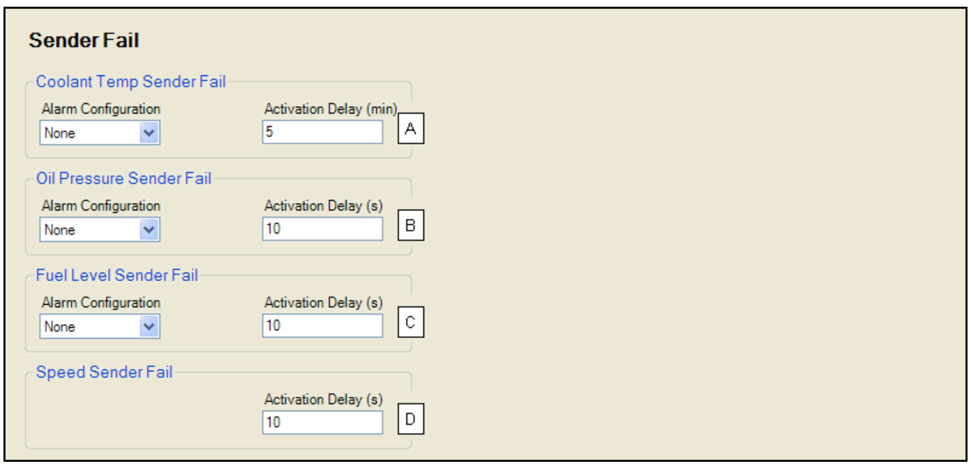


Figure 4-39. Sender Fail Configuration

[A] *Coolant Temp Sender Fail:* None, Alarm, or Pre-Alarm, time delay adjustable from 5 to 30 min in 1 min increments.
[B] *Oil Pressure Sender Fail:* None, Alarm or Pre-Alarm, time delay adjustable from 0 to 300 s in 1 s increments.
[C] *Fuel Level Sender Fail:* None, Alarm, or Pre-Alarm, time delay adjustable from 0 to 300 s in 1 s increments.
[D] *Speed Sender Fail:* Time delay adjustable from 0 to 300 s in 1 s increments.

PROGRAMMABLE SENDERS

The sender inputs of the IEM-2020 can be customized to obtain maximum accuracy from the coolant temperature, oil pressure, and fuel level senders.

The characteristic curve of each sender input can be configured with up to 11 points[A]. Each point can be assigned a resistance input value and a corresponding temperature (coolant temperature sender), pressure (oil pressure sender), or percentage (fuel level sender) value. A sender slope setting[B] automatically orders the values in the resistance column according to whether the sender requires a negative or positive slope. Sender curve points are automatically plotted on a curve[C] in BESTCOMS*Plus*, which can be printed[D].

Sender curve points configured in BESTCOMS*Plus* can be saved in the configuration file[E]. The data for all three senders is automatically saved with the IEM-2020 configuration file.

Any changes made in BESTCOMS*Plus* to the sender points, can be reverted to the factory-default values[F]. A new settings file can also be created[G].

BESTCOMS*Plus* programmable sender settings (IEM-2020, Programmable Senders, Coolant Temperature, Oil Pressure, or Percent Fuel Level) are illustrated in Figure 4-40. (The contents and layout of each BESTCOMS*Plus* programmable sender screen is identical; only the coolant temperature sender screen is illustrated here.)

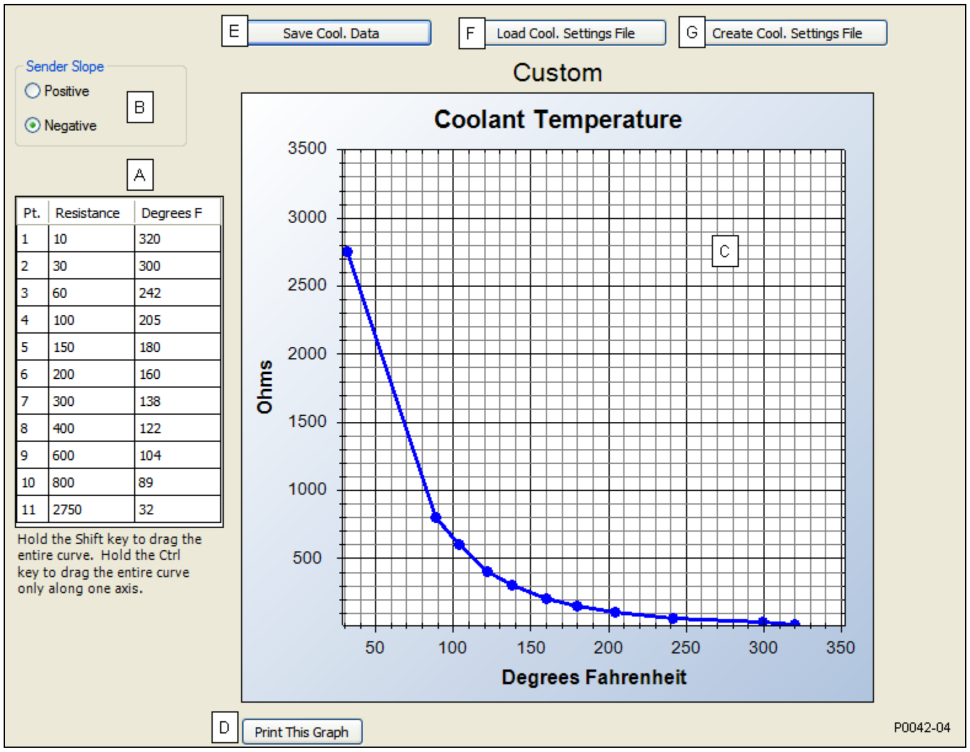


Figure 4-40. Programmable Senders Settings

[A] *Sender Points:* Accepts up to 11 user-defined sender resistance points.
[B] *Sender Slope:* Positive or Negative causes sender points to be sorted and displayed accordingly.
[C] *Sender Point Curve:* Automatic plot of sender points data.
[D] *Print This Graph:* Click to print sender point curve.
[E] *Save Cool. Data:* Click to save file containing sender point data.
[F] *Load Cool. Settings File:* Click to clear all user-defined sender data and revert to the factory-default values.
[G] *Create Cool. Settings File:* Click to create a new settings file by entering sender point data.

BESTLOGIC*PLUS* PROGRAMMABLE LOGIC

BESTLogic*Plus* Programmable Logic is used to set all logic functions in the IEM-2020. For detailed information on using BESTLogic*Plus*, refer to Section 5, *BESTLogicPlus Programmable Logic.*

Logic Timers

Refer to Section 5, *BESTLogicPlus Programmable Logic,* for information on using logic timers.

FILE MANAGEMENT

These paragraphs describe file management of settings files, firmware files, and language module files.

Settings Files

These paragraphs describe the tasks of opening, uploading, downloading, saving, printing, and comparing of settings files. When opening, uploading, downloading, or saving a settings file, operational settings, as well as BESTLogic*Plus* settings are combined together as a whole. When printing a settings file, only the operational settings are shown. There is a separate print option available on the

BESTLogic*Plus* Programmable Logic screen for printing BESTLogic*Plus* settings. For information on solely uploading or downloading BESTLogic*Plus* settings, refer to Section 5, *BESTLogicPlus Programmable Logic.*

A settings file conversion is required when IEM-2020 firmware has been changed so that the settings file is compatible with the firmware. For information on converting settings files, see *Converting Settings Files,* later in this section.

Opening a Settings File

To open a new instance of a settings file into BESTCOMS*Plus*, pull down the *File* menu and choose *Open*. The *Open* dialog box appears. This dialog box allows you to use normal Windows® techniques to select the file that you want to open. Select the file and open it and the file settings have been brought into a new instance in BESTCOMS*Plus*. You may also open a file, by clicking on the *Open File* icon on the lower menu bar. When done in this manner, you will be asked to upload the settings and logic from the file to the current device. You may choose *Yes* or *No*. The settings in the current instance will be overwritten.

Uploading a Settings File

To upload a settings file to the IEM-2020, you must first open the file through BESTCOMS*Plus* or create the file using BESTCOMS*Plus*. Then pull down the *Communication* menu and select *Upload Settings.* You are prompted to enter the password. If the password is correct, the upload begins and the progress bar is shown.

Downloading a Settings File

To download a settings file from the IEM-2020, you must pull down the *Communication* menu and select *Download Settings and Logic*. If the settings in your BESTCOMS*Plus* have changed, a dialog box will open asking you if want to save the current settings changes. You may choose *Yes* or *No*. After you have taken the required action to save or not save the current settings, the downloading is executed.

Saving a Settings File

Select *Save* or *Save As* from the File pull-down menu. A dialog box pops up allowing you to enter a filename and location to save. Select the *Save* button to complete the save.

Printing a Settings File

To view a preview of the printout, select *Print Preview* from the *File* pull-down menu. If you wish to print to a printer, select the printer icon in the upper left corner of the *Print Preview* screen.

You may skip the print preview and go directly to print by pulling down the *File* menu and selecting *Print*. A dialog box, *Print* opens with the typical Windows® choice to setup the properties of printer. Execute this command, as necessary, and then select *Print*.

Comparing Settings Files

BESTCOMS*Plus* has the ability to compare two different settings files. To use this feature, pull down the *Tools* menu and select *Compare Settings Files*. The *BESTCOMSPlus Settings Compare Setup* dialog box appears (Figure 4-41). Select the location of the first file to compare under *Left Settings Source* and select the location of the second file to compare under *Right Settings Source*. If you are comparing a settings file located on your PC hard drive or portable media, click the folder button and navigate to the file. If you want to compare settings downloaded from a unit, click the *Select Unit* button to set up the communication port. Click the *Compare* button to compare the selected settings files.

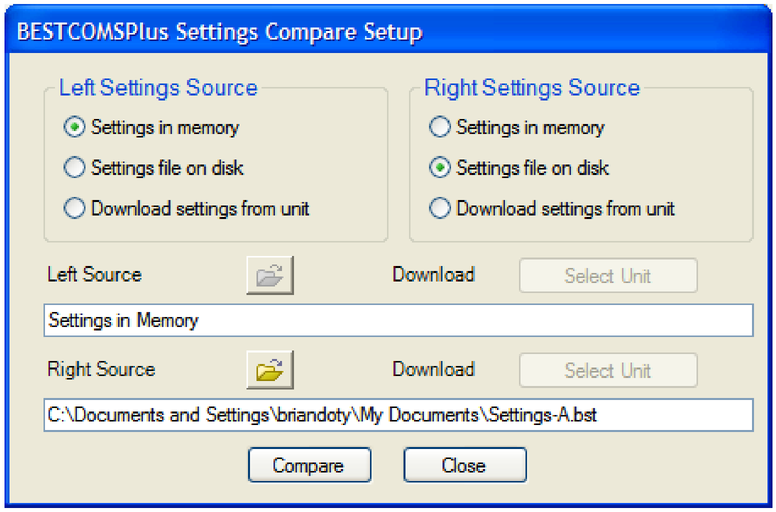


Figure 4-41. BESTCOMSPlus Settings Compare Setup

A dialog box will appear and notify you if any differences were found. The *BESTCOMSPlus Settings Compare* dialog box (Figure 4-42) is displayed where you can view all settings (*Show All Settings*), view only the differences (*Show Settings Differences*), view all logic *(Show All Logic Paths),* or view only logic differences *(Show Logic Path Differences).* Select *Close* when finished.

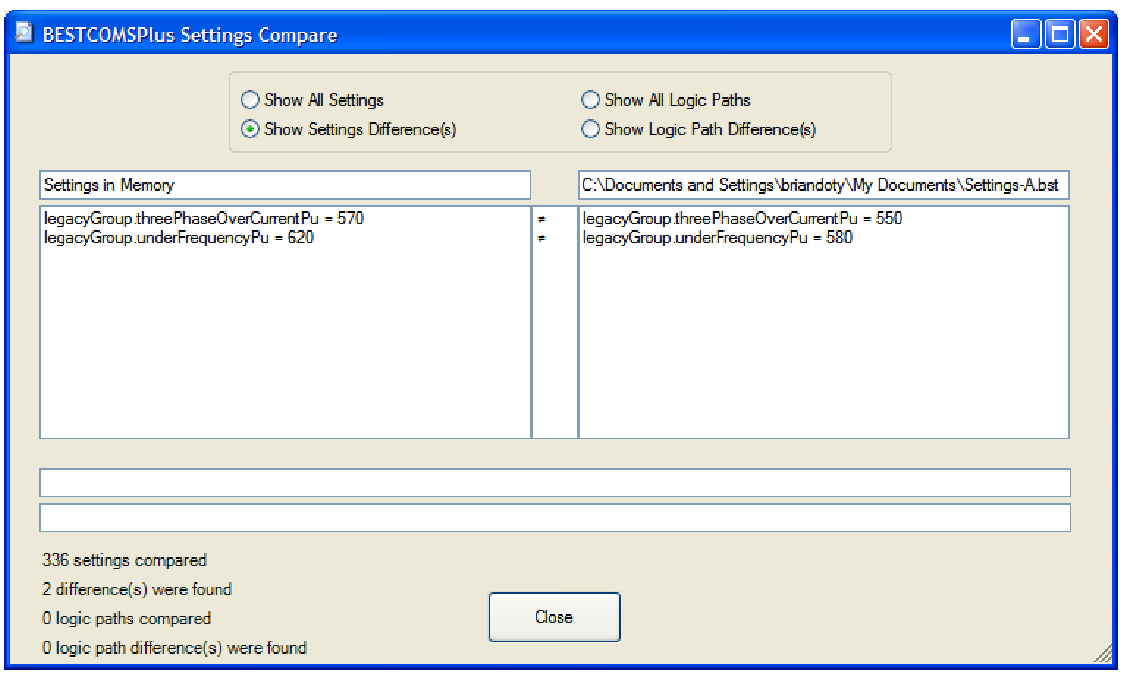


Figure 4-42. BESTCOMSPlus Settings Compare

Upgrading Firmware in IEM-2020 and Expansion Modules

> **NOTE**
>
> The latest version of BESTCOMS*Plus* software should be downloaded from the Basler Electric website and installed before performing a firmware upgrade.

A device package contains firmware and a language module. Embedded firmware is the operating program that controls the actions of the IEM-2020. The IEM-2020 stores firmware in nonvolatile flash memory that can be reprogrammed through the communication ports. It is not necessary to replace EPROM chips when updating the firmware with a newer version.

Future enhancements to the IEM-2020 functionality may make a firmware update desirable. Because default settings are loaded when IEM-2020 firmware is updated, your settings should be saved in a file prior to upgrading firmware.

The language of the front panel LCD can be changed by uploading a different language module into the IEM-2020. The IEM-2020 stores the language module in nonvolatile flash memory; the language module contains all language translations for the IEM-2020. The language module can be reprogrammed through the communications port. In general, any time a firmware upgrade is made to the IEM-2020, the language module should be uploaded as well.

The IEM-2020 may be used in conjunction with several expansion modules that expand the IEM-2020 capabilities. IEM-2020 expansion modules include LSM-2020, CEM-2020, and AEM-2020. When upgrading the firmware in any component of this system, the firmware in ALL of the components of the system should be upgraded to ensure compatibility of communications between the various components.

CAUTION

The order in which the components are upgraded is critical. Assuming a system of an IEM-2020 and expansion modules is in a state where the IEM-2020 is communicating with all of the system expansion modules, **the expansion modules must be upgraded before the IEM-2020.** This is required because the IEM-2020 must be able to communicate to the expansion module before the IEM-2020 can send firmware to it. If the IEM-2020 were upgraded first, and the new firmware included a change in the IEM-2020 to expansion module communication protocol, it is possible that the expansion modules could no longer communicate with the upgraded IEM-2020. Without communications between the IEM-2020 and the expansion modules, upgrading the expansion modules is not possible.

NOTE

If power is lost or communication is interrupted during file transfer to the IEM-2020, the IEM-2020 will cease operating and will not recover automatically. If this occurs or if the front panel HMI becomes blank and all LEDs are flashing at a 2-second rate, the IEM-2020 will not have valid firmware installed and the firmware must be uploaded again. To accomplish this, cycle power to the IEM-2020 and activate the IEM-2020 plug-in in BESTCOMS*Plus*. Select *Upload Device Files* from the *Communication* pull-down menu and proceed normally.

Upgrading Firmware in Expansion Modules

The following procedure is used to upgrade firmware in IEM-2020 expansion modules. This must be completed before upgrading firmware in the IEM-2020. If no expansion modules are present, proceed to *Upgrading Firmware in the IEM-2020.*

1. Place the IEM-2020 in OFF mode. This can be accomplished by clicking the *Off* button on the *Control* screen inside the Metering Explorer or by pressing the *Off* button on the IEM-2020 front panel.
2. Enable the expansion modules that are present in the system. If they have not already been enabled, enable the expansion modules on the SETTINGS->SYSTEM PARAMS->REMOTE MODULE SETUP screen.
3. Verify that the IEM-2020 and all associated expansion modules are communicating. This can be verified by examining the pre-alarm status using the Metering Explorer in BESTCOMS*Plus* or from the front panel by navigating to METERING->ALARMS-STATUS->PRE-ALARMS. There should be no *Loss of Comms* pre-alarms in the pre-alarm status when communications are functioning properly.
4. Connect to the IEM-2020 through the USB port if not already connected. Firmware upgrades cannot be accomplished through the Ethernet port, with the exception of the LSM-2020.
5. Select *Upload Device Files* from the Communication pull-down menu.
6. You will be asked to save the current settings file. Select *Yes* or *No*.

7. When the *Basler Electric Device Package Uploader* screen (Figure 4-43) appears, click on the *Open* button to browse for the device package you have received from Basler Electric. The *Package Files* along with *File Details* are listed. Place a check in the boxes next to the individual files you want to upload.

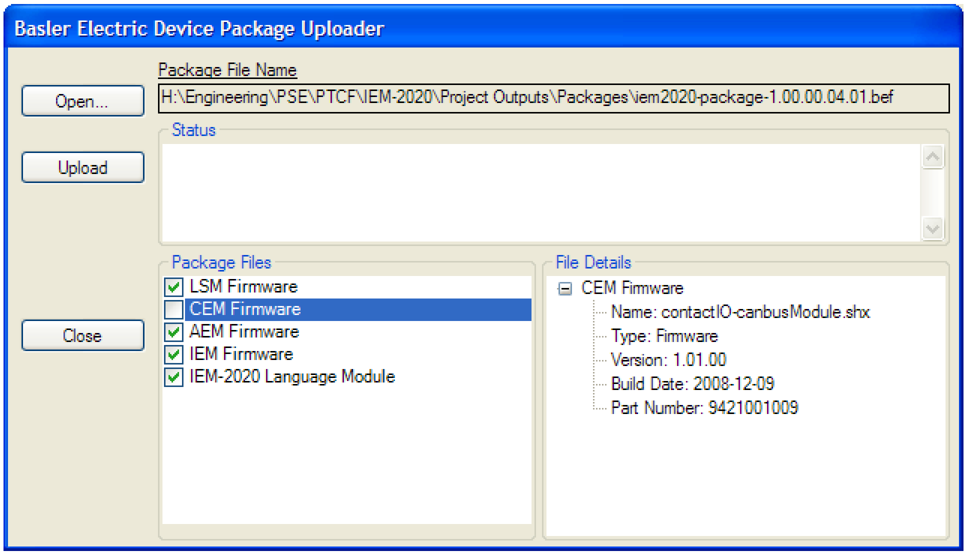


Figure 4-43. Basler Electric Device Package Uploader

8. Click on the *Upload* button and the *Proceed with Device Upload* screen will appear. Select *Yes* or *No*.
9. After selecting *Yes*, the *IEM-2020 Selection* screen will appear. Select the communication port to begin upload. Firmware updating is only possible locally through the USB port. Refer to Figure 4-44.

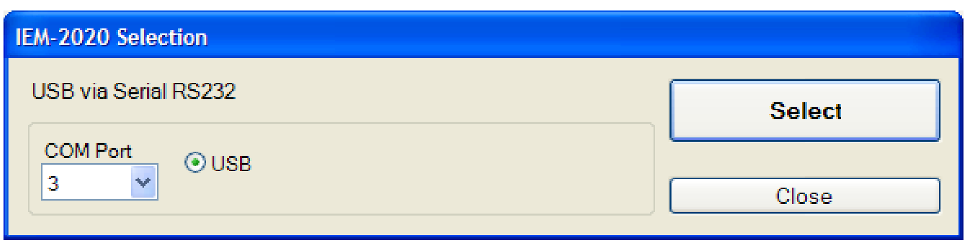


Figure 4-44. IEM-2020 Selection

10. The *Processing, Please Wait…* screen is displayed as file(s) are uploaded. See Figure 4-45.

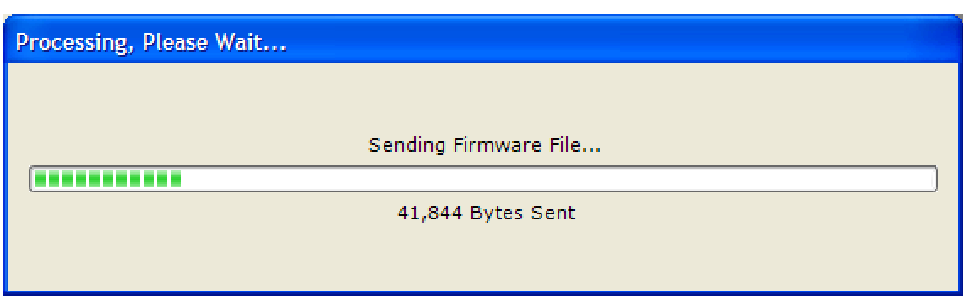


Figure 4-45. Processing, Please Wait…

11. After file(s) have been uploaded, click the *Close* button on the *Basler Electric Device Package Uploader* screen and disconnect communication to the IEM-2020.

Upgrading Firmware in the IEM-2020

Two scenarios are presented: (A) Upgrade IEM-2020 firmware and then load a settings file created with an earlier firmware version, and (B) Save settings file from IEM-2020, upgrade IEM-2020 firmware, and then load settings file back into the IEM-2020.

A. Upgrade IEM-2020 firmware and then load a settings file created with an earlier firmware version.

1. Upgrade the IEM-2020 firmware and language module.
    a. Connect to the IEM-2020 with BESTCOMS*Plus*. Check the firmware Application Version on the GENERAL SETTINGS-> VERSION INFO->IEM-2020 screen.
    b. Select *Upload Device Files* from the *Communication* pull-down menu. You do not have to be connected to the IEM-2020 at this time. Save settings when prompted, if desired.
    c. Open the desired device package file (****IEM-2020-*****_xxyyzz.bef, where **** may be additional descriptive text of varying length, and xx.yy.zz is the version number of the device package file.)
    d. Check the boxes for *IEM-2020 Firmware* and *IEM-2020 Language Module.* Note the version number of the IEM-2020 firmware; this is the version that will be used to set the Application Version in the settings file in a later step. This is NOT the same as the version of the package file that is contained in the fields xx.yy.zz in the package file name.
    e. Click the *Upload* button and follow the instructions that appear to begin the upgrade process.
    f. After the upload is complete, disconnect communication to the IEM-2020.
2. Modify the Application Version in the desired settings file to be compatible with the IEM-2020 Application Version.
    a. Open the desired settings file into BESTCOMS*Plus*.
    b. Change the Application Version in the settings file to the setting that matches the Application Version of the unit. The Application Version is what was noted during the upload process (A1e above), or can be obtained through the IEM-2020 front panel on the SETTINGS->GENERAL SETTINGS->VERSION INFO->IEM-2020 screen
    c. When the number is changed, the *Application Version Number Changed* screen will appear which indicates any settings that it must change because of the version change. These settings should be checked for accuracy after the application version number has been changed.
    d. After changing the Application Version, save the settings file with a new name by selecting *Save As* from the *File* pull-down menu.
3. Modify the programmable logic in the desired settings file to be compatible with the IEM-2020 Application Version.
    a. Open the programmable logic. The logic is accessible under SETTINGS->BESTLOGIC*PLUS* PROGRAMMABLE LOGIC.
    b. Examine the logic scheme by scrolling up/down through the entire logic diagram. Delete any logic elements that have a red X through them; they are invalid elements for the version and style number of the IEM-2020 that is being configured in this settings file. Delete or complete any incomplete logic; all component inputs must be connected to something, or the components must be deleted.
    c. If you have made no logic changes, make a change now by clicking on any component and moving it slightly. BESTCOMS*Plus* will sense that the logic has changed.
    d. Save the Logic Scheme by clicking on *Save* on the BESTLogic*Plus* Programmable Logic toolbar.
    e. Save the settings file again after logic modifications are complete. The file name need not be changed from the name given to it when it was saved after the Application Version was changed.
4. Examine and correct any changes to settings when Application Version was changed.
    a. If the changes were not examined when the Application Version was made, they should be examined prior to loading the settings file into the IEM-2020.

b. Use the BESTCOMS*Plus* Settings Compare tool to compare the settings file from "Before" the application version change to the version "After" the Application Version change.

c. The BESTCOMS*Plus* Settings Compare tool is found by selecting *Compare Settings Files* from the *Tools* pull-down menu.

d. Select the 2 files to compare and check *Show All Settings Differences.*

e. Correct any settings in the "After" file to their correct values.

f. After finishing all corrections, save the settings file again. The file name need not be changed from the name given to it when it was saved after the Application Version was changed.

5. Load the new settings file into the IEM-2020.

   a. Disconnect communication from the IEM-2020.

   b. Close all settings files.

   c. From the *File* pull-down menu, select *New*, *IEM-2020*.

   d. Connect to the IEM-2020.

   e. Once all settings have been read from the IEM-2020, open the new settings file by selecting the file with *File, Open File* in the BESTCOMS*Plus* menu.

   f. When BESTCOMS*Plus* asks if you wish to upload settings and logic to the device, click *Yes*.

   g. The settings should go into the IEM-2020 successfully.

   h. If you are receiving upload failures and indications that the logic is incompatible with the firmware version, check that the IEM-2020 style number in the saved file matches that of the IEM-2020 into which the file is being uploaded. The style number in the settings file is found under GENERAL SETTINGS->STYLE NUMBER in BESTCOMS*Plus*.

   i. If the style number of the settings file does not match that of the IEM-2020 into which it is to be loaded, disconnect from the IEM-2020, then modify the style number in the settings file. Then repeat the steps in the sections titled *Modify the Programmable logic in the desired settings file to be compatible with the IEM-2020 Application version* and *Load the New Settings File into the IEM-2020.*

B. Save settings file from IEM-2020, upgrade IEM-2020 firmware, and then load settings file back into the IEM-2020.

1. Download settings from the IEM-2020.

   a. Connect to the IEM-2020.

   b. After all settings and logic have been downloaded from the IEM-2020 into BESTCOMS*Plus*, save the settings by selecting *Save As* from the *File* pull-down menu.

   c. BESTCOMS*Plus* gives the option of entering additional info and file properties. Enter the information as desired and click *OK*.

   d. Assign a file name and save the file in a location that is available for later retrieval.

2. Upgrade the IEM-2020 firmware and language module.

   a. Follow the steps in the section labeled *Upgrade the IEM-2020 firmware and language module* (A1 above).

3. Modify the Application Version in the desired settings file to be compatible with the IEM-2020 Application Version.

   a. Follow the steps in the section labeled *Modify the Application Version in the desired settings file to be compatible with the IEM-2020 Application Version* (A2 above).

4. Modify the programmable logic in the desired settings file to be compatible with the IEM-2020 Application Version.

   a. Follow the steps in the section labeled *Modify the programmable logic in the desired settings file to be compatible with the IEM-2020 Application Version* (A3 above).

5. Examine and correct any changes to settings when Application Version was changed.

a. Follow the steps in the section labeled *Examine and correct any changes to settings when Application Version was changed* (A4 above).

6. Load the new settings file into the IEM-2020.

    a. Follow the steps in the section labeled *Load the new settings file into the IEM-2020* (A5 above).

METERING EXPLORER

The Metering Explorer is a convenient tool within BESTCOMS*Plus* used to navigate through the following metering screens of the IEM-2020 plug-in.

- Engine
- Run Statistics
- Status
- Inputs
    - Contact Inputs
    - Remote LSM Inputs
    - Remote Contact Inputs
    - Remote Analog Inputs
    - Remote RTD Inputs
    - Remote Thermocouple Inputs
    - Remote Analog Input Values
- Outputs
    - Contact Outputs
    - Configurable Elements
    - Remote Contact Outputs
    - Remote Analog Outputs
- Configurable Protection
- Alarms
- Event Log
- J1939 ECU
    - ECU Data
    - Engine Configuration
    - Active DTC
    - Previously Active DTC
- MTU
    - MTU Alarms
    - MTU Fault Codes
    - MTU Status
    - MTU Engine Status
- Summary
- Control
- Real Time Clock

The Metering Explorer has a “Docking” feature allowing the user to arrange and dock metering screens. A blue transparent square representing the screen being moved, seven arrow buttons, and a tabs button appear when holding down the left mouse button on a metering tab and dragging it out. See Figure 4-46. Table 4-2 explains the call-outs on Figure 4-46.

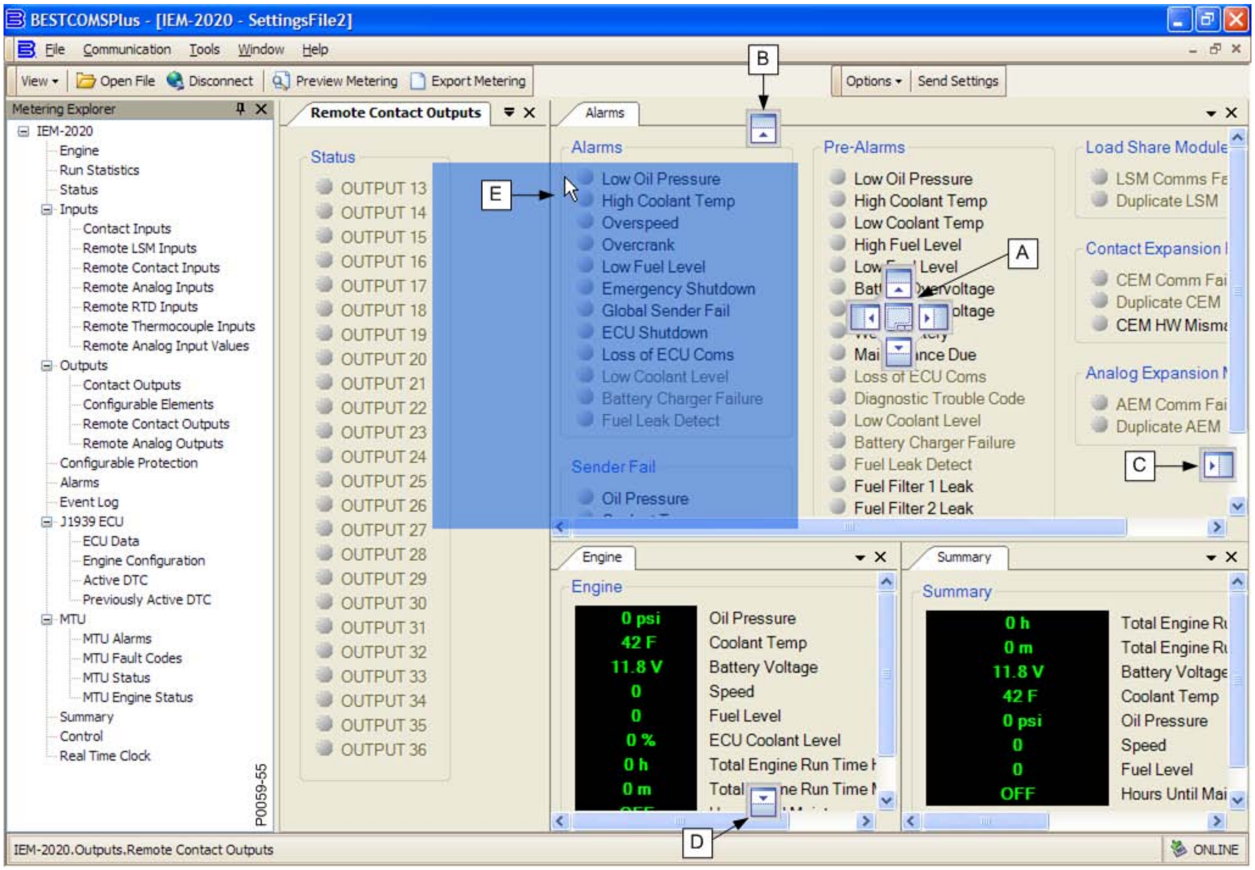
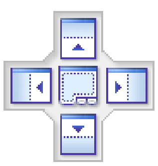
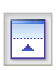
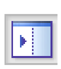
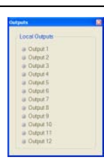


Figure 4-46. Metering, Docking Options

Table 4-2. Explanation of Call-Outs on Figure 4-46

Call-Out	Symbol	Explanation
A		Holding the left mouse button down on a metering tab and dragging it to one of the four arrow boxes will place it inside the selected window on the location selected. To place the metering tab as a tab inside the selected window, drop it on the tabs button in the center of the arrow buttons.
B		Holding the left mouse button down on a metering tab and dragging it to this arrow box will place it across the top of the screen. Click on the (thumbtack) to dock it on the top bar. To display a screen that is docked, simply use the mouse to hover the pointer over the tab on the top bar.
C		Holding the left mouse button down on a metering tab and dragging it to this arrow box will place it across the side of the screen. Click on the (thumbtack) to dock it on the side bar. To display a screen that is docked, simply use the mouse to hover the pointer over the tab on the side bar.
D		Holding the left mouse button down on a metering tab and dragging it to this arrow box will place it across the bottom of the screen. Click on the (thumbtack) to dock it on the bottom bar. To display a screen that is docked, simply use the mouse to hover the pointer over the tab on the bottom bar.
E		Holding the left mouse button down on a metering tab and dragging it to anywhere other than an arrow box will place it as a floating metering screen. This floating screen can later be closed by clicking on the in the upper right corner. It may also be dragged to one of the arrow boxes used for docking.

Engine

This screen provides information and metering of engine components. Refer to Figure 4-47.

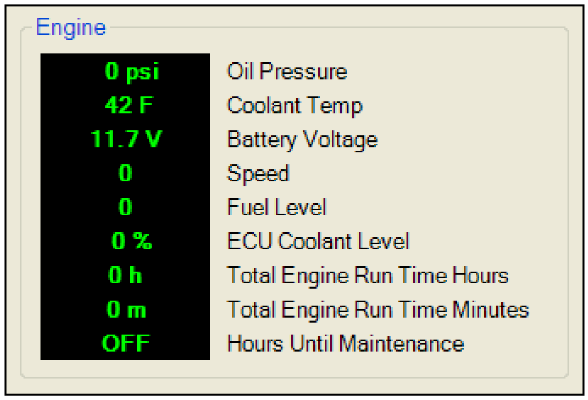


Figure 4-47. Metering, Engine

Run Statistics

This screen provides Cumulative Run Statistics, Session Run Statistics, and Commission Date. Refer to Figure 4-48. The maintenance interval can be reset through this screen.

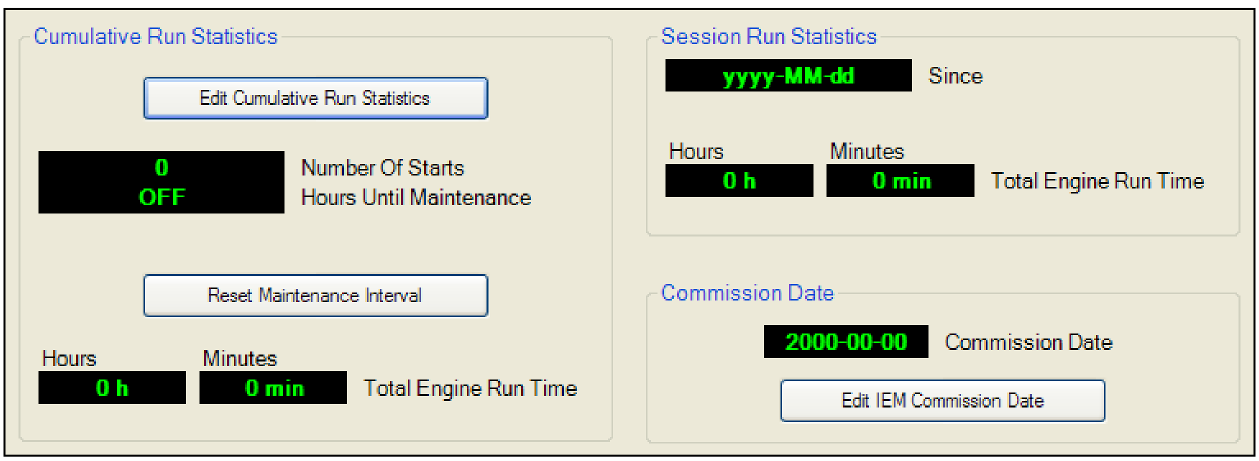


Figure 4-48. Metering, Run Statistics

Status

This screen indicates status of modes and switches. The status is TRUE when the corresponding LED is red. Refer to Figure 4-49.

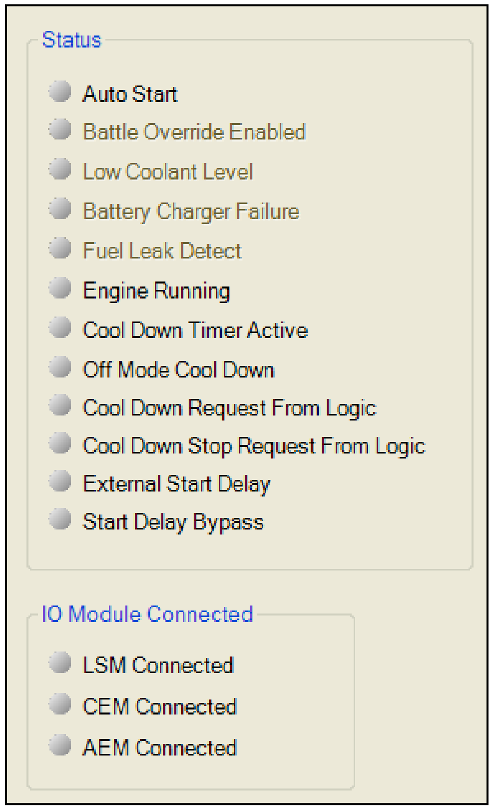


Figure 4-49. Metering, Status

Inputs

Contact Inputs

This screen indicates the status of contact inputs, contact input alarms, and contact input pre-alarms. The status is TRUE when the corresponding LED is red. Refer to Figure 4-50.

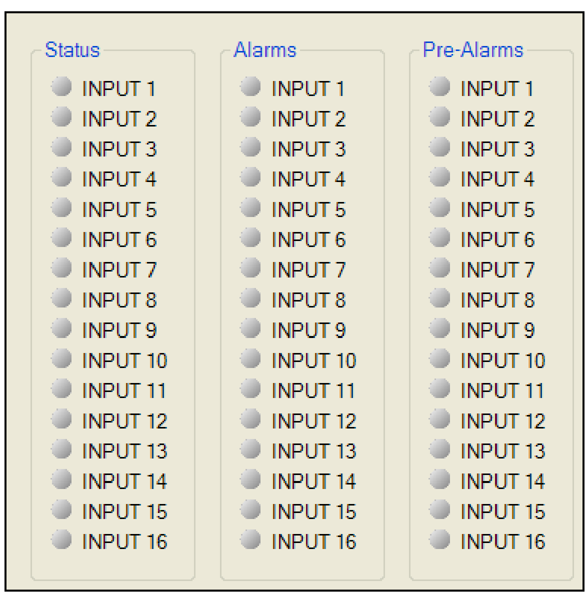


Figure 4-50. Metering, Inputs, Contact Inputs

Remote LSM Inputs

When an optional LSM-2020 (Load Share Module) is connected, the value of the analog inputs is displayed on this screen. Voltage is displayed when the input is configured for voltage and current is displayed when the input is configured for current. Refer to Figure 4-51.

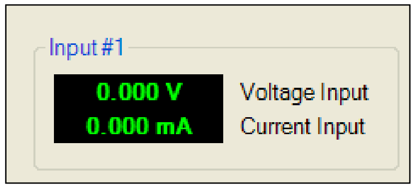


Figure 4-51. Metering, Inputs, Remote LSM Inputs

Remote Contact Inputs

When an optional CEM-2020 (Contact Expansion Module) is connected, the status of the remote contact inputs, configurable remote contact input alarms, and remote contact input pre-alarms are shown on this screen. The status is TRUE when the corresponding LED is red. Refer to Figure 4-52.

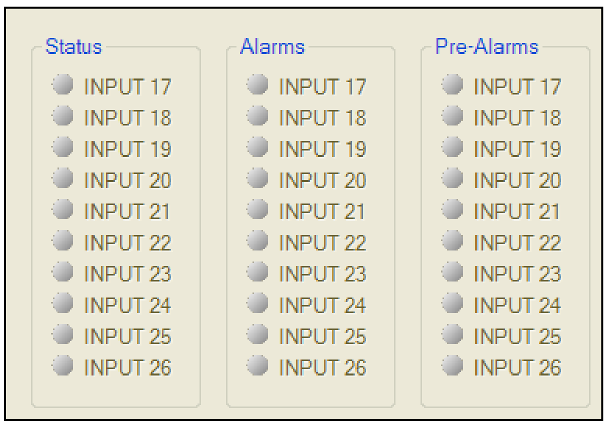


Figure 4-52. Metering, Inputs, Remote Contact Inputs

Remote Analog Inputs

When an optional AEM-2020 (Analog Expansion Module) is connected, the status of the remote analog inputs, remote analog input alarms, and remote analog input pre-alarms are shown on this screen. The status is TRUE when the corresponding LED is red. Refer to Figure 4-53. Remote Analog Input #1 is shown.

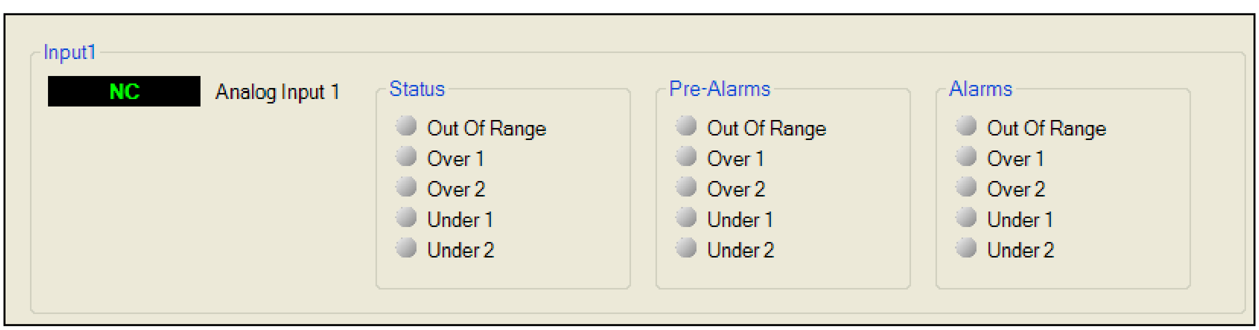


Figure 4-53. Metering, Inputs, Remote Analog Inputs

Remote RTD Inputs

When an optional AEM-2020 (Analog Expansion Module) is connected, the status of the remote RTD inputs, remote RTD input alarms, and remote RTD input pre-alarms are shown on this screen. The status is TRUE when the corresponding LED is red. Refer to Figure 4-54. Remote RTD Input #1 is shown.

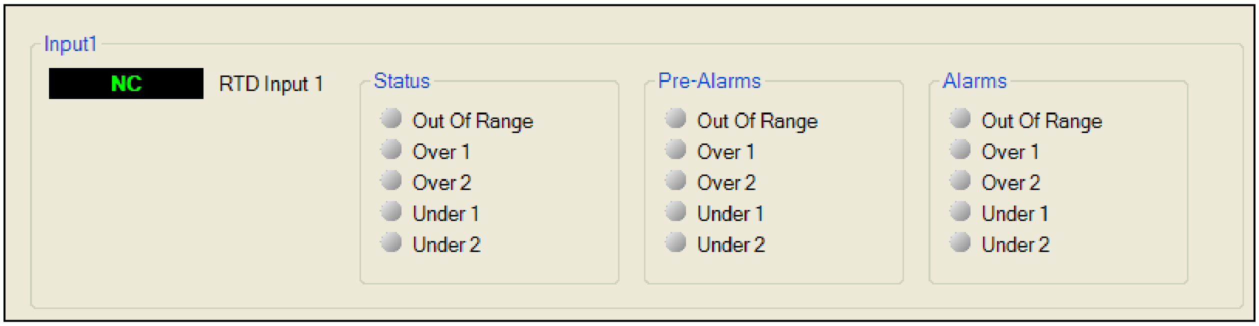


Figure 4-54. Metering, Inputs, Remote RTD Inputs

Remote Thermocouple Inputs

When an optional AEM-2020 (Analog Expansion Module) is connected, the status of the remote thermocouple inputs, remote thermocouple input alarms, and remote thermocouple input pre-alarms are shown on this screen. The status is TRUE when the corresponding LED is red. Refer to Figure 4-55. Remote Thermocouple Input #1 is shown.

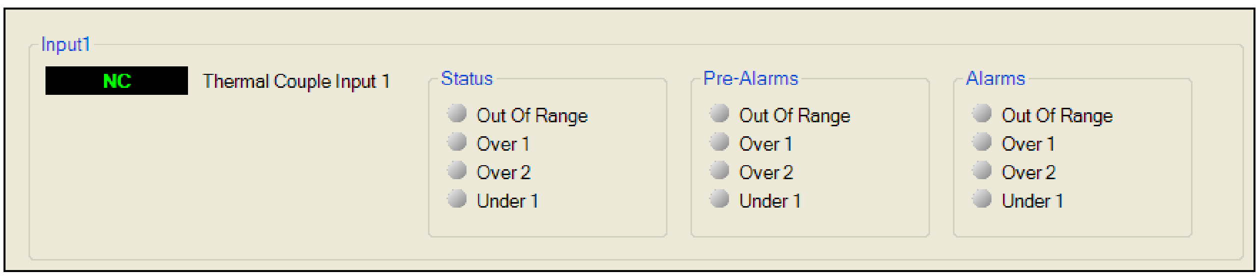


Figure 4-55. Metering, Inputs, Remote Thermocouple Inputs

Remote Analog Input Values

When an optional AEM-2020 (Analog Expansion Module) is connected, the values of the scaled analog inputs, raw analog inputs, RTD input temperatures, raw RTD inputs, thermocouple input temperatures, and raw thermocouple inputs are shown on this screen. Refer to Figure 4-56.

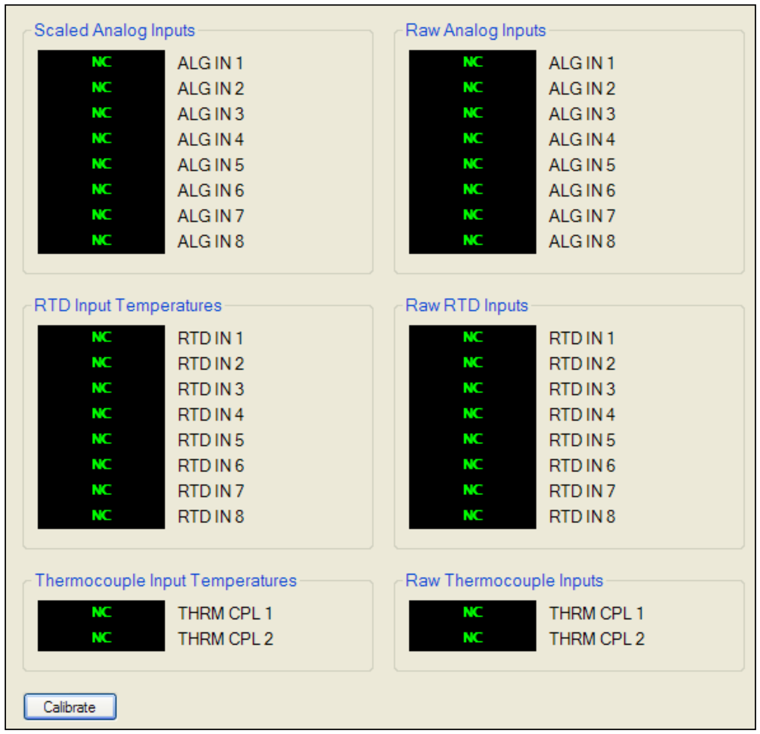


Figure 4-56. Metering, Inputs, Remote Analog Input Values

The *Calibrate* button on the Remote Analog Input Values screen opens the Analog Input Temperature Calibration screen shown in Figure 4-57. This screen is used to calibrate RTD inputs 1 through 8 and thermocouple inputs 1 and 2.

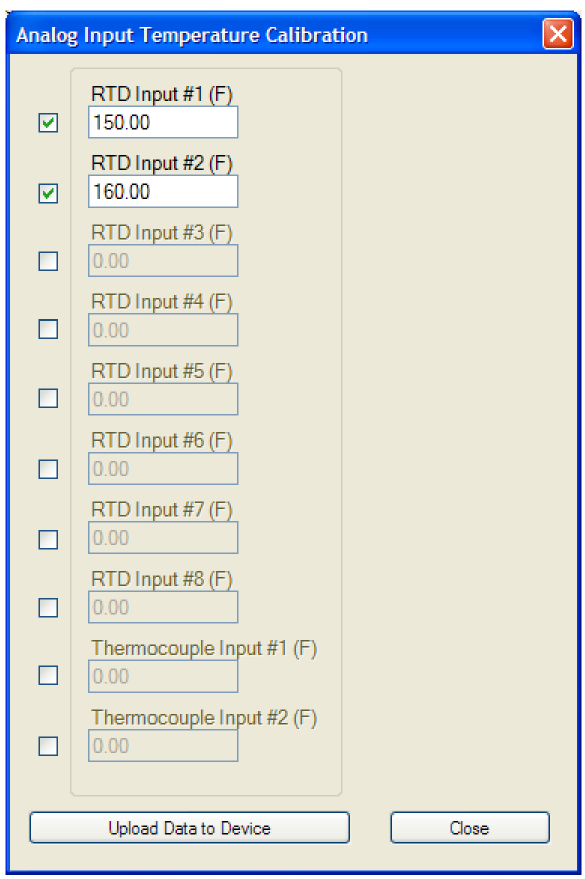


Figure 4-57. Analog Input Temperature Calibration

Logic Control Relays

This screen indicates the status of logic control relays. The status is TRUE when the corresponding LED is green. Refer to Figure 4-58.

Figure 4-58. Metering, Outputs, Logic Control Relays

Outputs

Contact Outputs

This screen indicates the status of contact outputs. The status is TRUE when the corresponding LED is green. Refer to Figure 4-59.

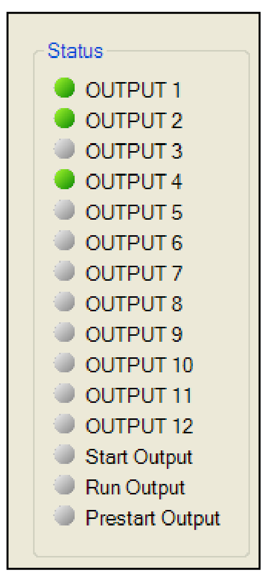


Figure 4-59. Metering, Outputs, Contact Outputs

Configurable Elements

This screen indicates the status of configurable elements. It also indicates alarms and pre-alarms of configurable elements. The status is TRUE when the corresponding LED is green. Refer to Figure 4-60.

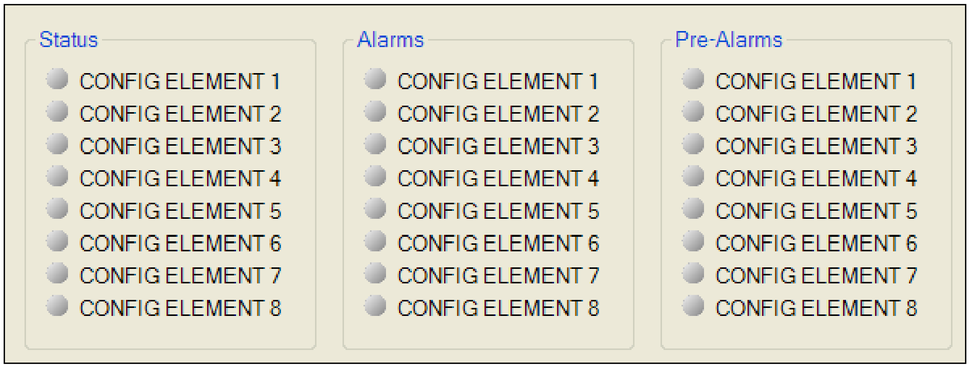


Figure 4-60. Metering, Outputs, Configurable Elements

Remote Contact Outputs

When an optional CEM-2020 (Contact Expansion Module) is connected, the status of the remote contact outputs is shown on this screen. The status is TRUE when the corresponding LED is green. Refer to Figure 4-61.

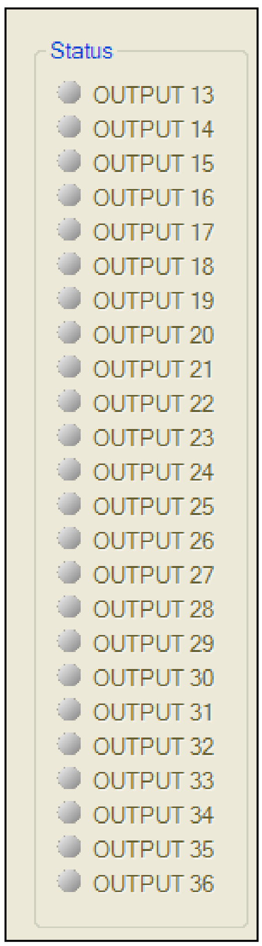


Figure 4-61. Metering, Outputs, Remote Contact Outputs

Remote Analog Outputs

When an optional AEM-2020 (Analog Expansion Module) is connected, the status of the remote analog outputs, scaled analog output values, and raw analog output values are shown on this screen. The status is TRUE when the corresponding LED is red. Refer to Figure 4-62.

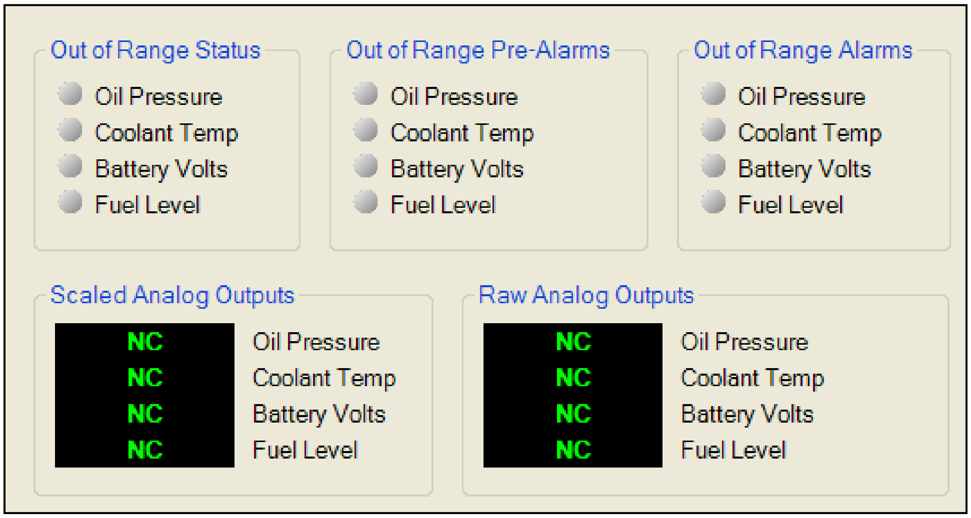


Figure 4-62. Metering, Outputs, Remote Analog Outputs

Configurable Protection

This screen indicates the status of configurable protection. It also indicates Pre-Alarms and Alarms of configurable protection. The status is TRUE when the corresponding LED is red. Refer to Figure 4-63.

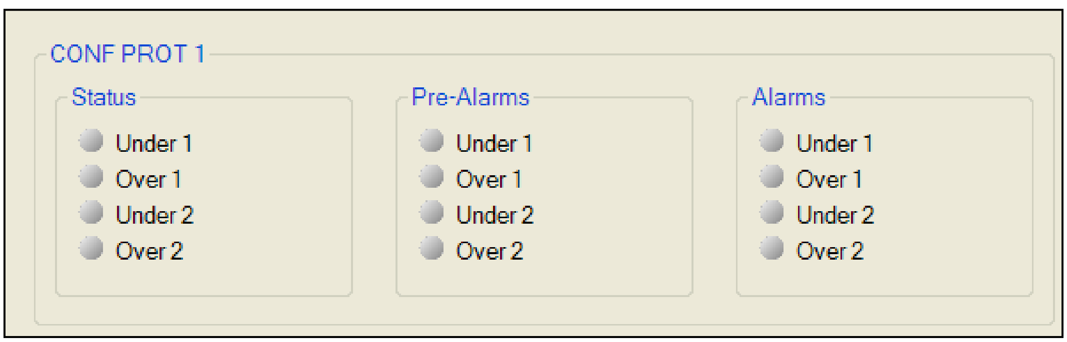


Figure 4-63. Metering, Configurable Protection

Alarms

This screen indicates the status of Alarms, Pre-Alarms, and Sender Fail. The status is TRUE when the corresponding LED is red. Alarms and pre-alarms are reset when the IEM-2020 is set to the Off mode. Refer to Figure 4-64.

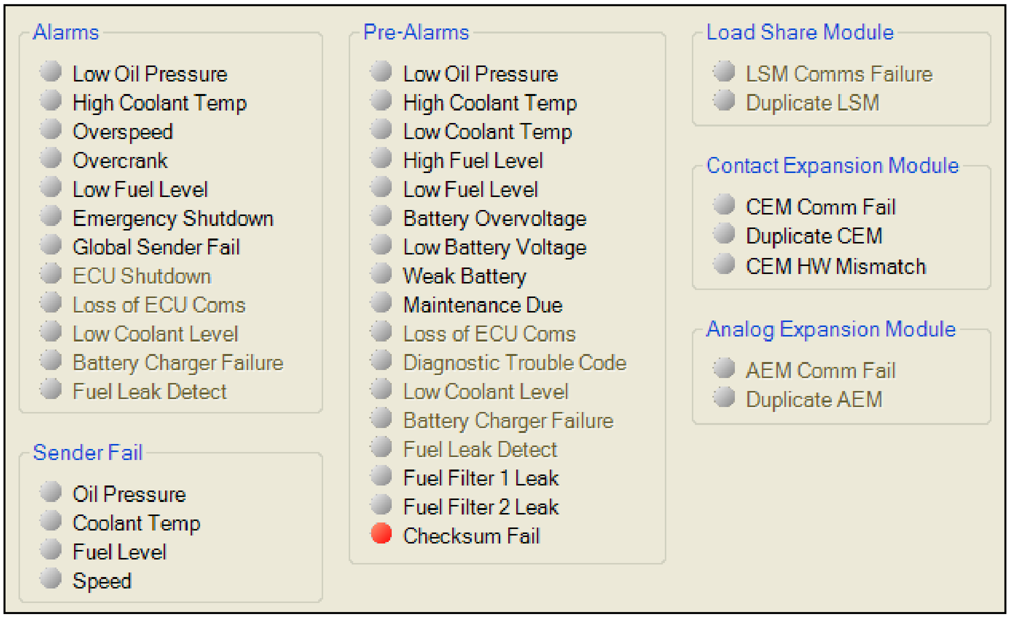
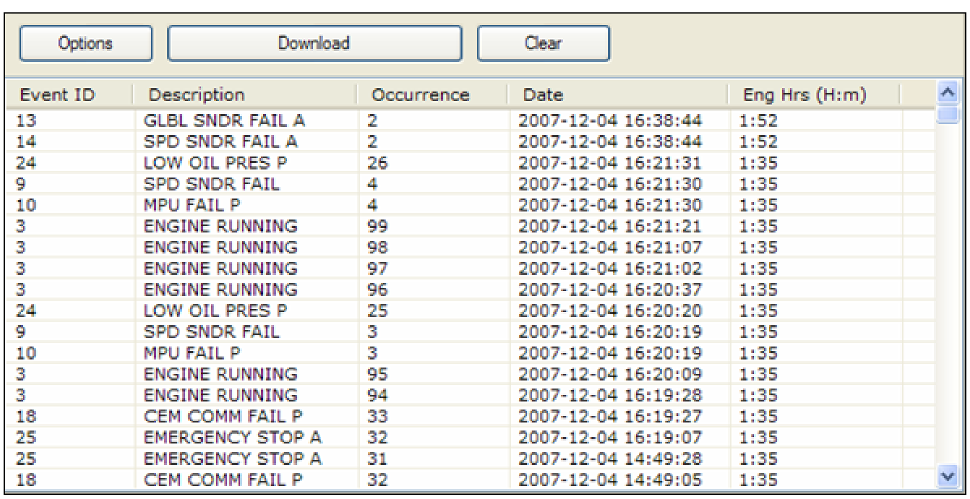


Figure 4-64. Metering, Alarms

Event Log

The event log provides a historical record of event occurrences detected by the IEM-2020. It is saved in nonvolatile memory so that is will not be affected if power is removed. Thirty event records are retained and each record contains a time stamp of the first and last event occurrence, and the number of occurrences for each event. In addition, each record contains details of the time, date, and engine hours for the most recent 30 occurrences of the event. The number of occurrences stops incrementing at 99. If an event occurs which is of a type that differs from those in the 30 records in memory, the record that has the oldest "last" event occurrence is removed from the log, and the new category takes its place. Since 30 event records with up to 99 occurrences each are retained in memory, a history of nearly 3,000 specific events are retained in the IEM-2020. Detailed occurrence information is retained for the most recent 30 occurrences of each event record, and there are 30 event records; thus the time, date and engine hours details for up to 900 specific event occurrences is retained in the event log.

The user can download the event log data into BESTCOMS*Plus* for viewing, and then save the event logs as files. The *Options* button is used to save the entire event log to a file, or to save the list to the computer clipboard making it available for insertion into other software applications. It is possible to copy a portion of the log to the computer clipboard by selecting the desired portion with the mouse then using the Options->Copy Selection feature. The *Download* button refreshes the event log list by performing a fresh download of the list from the IEM-2020. The *Clear* button gives the user the option of clearing selected or all event logs. Refer to Figure 4-65.

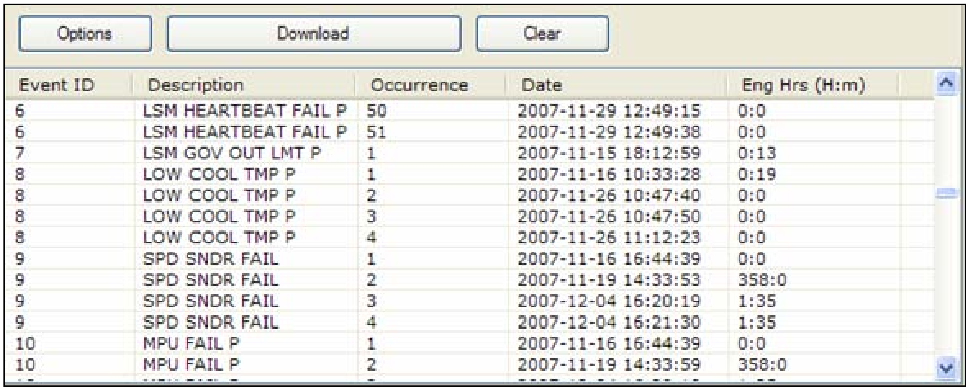


Event ID	Description	Occurrence	Date	Eng Hrs (H:m)
13	GLBL SNDR FAIL A	2	2007-12-04 16:38:44	1:52
14	SPD SNDR FAIL A	2	2007-12-04 16:38:44	1:52
24	LOW OIL PRES P	26	2007-12-04 16:21:31	1:35
9	SPD SNDR FAIL	4	2007-12-04 16:21:30	1:35
10	MPU FAIL P	4	2007-12-04 16:21:30	1:35
3	ENGINE RUNNING	99	2007-12-04 16:21:21	1:35
3	ENGINE RUNNING	98	2007-12-04 16:21:07	1:35
3	ENGINE RUNNING	97	2007-12-04 16:21:02	1:35
3	ENGINE RUNNING	96	2007-12-04 16:20:37	1:35
24	LOW OIL PRES P	25	2007-12-04 16:20:20	1:35
9	SPD SNDR FAIL	3	2007-12-04 16:20:19	1:35
10	MPU FAIL P	3	2007-12-04 16:20:19	1:35
3	ENGINE RUNNING	95	2007-12-04 16:20:09	1:35
3	ENGINE RUNNING	94	2007-12-04 16:19:28	1:35
18	CEM COMM FAIL P	33	2007-12-04 16:19:27	1:35
25	EMERGENCY STOP A	32	2007-12-04 16:19:07	1:35
25	EMERGENCY STOP A	31	2007-12-04 14:49:28	1:35
18	CEM COMM FAIL P	32	2007-12-04 14:49:05	1:35

Figure 4-65. Metering, Event Log, Sorted by Date

When viewed with BESTCOMS*Plus*, the event log can be sorted by Event ID, Description, Occurrence, Date, or Engine Hours. Selecting event log sorted by Date yields a list of all event occurrences in sequential order. This is a view that one would see in a typical “sequence of events” type of event log. Figure 4-65 shows the sequential list resulting from sorting by Date. Sorting by engine hours also results in a sequential list, where the sequence is in terms of engine hours rather than calendar date and time.

Selecting sorting by Event ID or Description allows one to view all the occurrences of a particular event type in their order of occurrence. In this view, one can see at a glance the times and dates of the occurrences of one type of event. For example, from Figure 4-66, if one wanted to know when all occurrences of Speed Sender Failures occurred, the information readily available without having to sift through all the occurrences of unrelated events as would have to be done in a rolling log implementation. This is apparent in Figure 4-65.



Event ID	Description	Occurrence	Date	Eng Hrs (H:m)
6	LSM HEARTBEAT FAIL P	50	2007-11-29 12:49:15	0:0
6	LSM HEARTBEAT FAIL P	51	2007-11-29 12:49:38	0:0
7	LSM GOV OUT LMT P	1	2007-11-15 18:12:59	0:13
8	LOW COOL TMP P	1	2007-11-16 10:33:28	0:19
8	LOW COOL TMP P	2	2007-11-26 10:47:40	0:0
8	LOW COOL TMP P	3	2007-11-26 10:47:50	0:0
8	LOW COOL TMP P	4	2007-11-26 11:12:23	0:0
9	SPD SNDR FAIL	1	2007-11-16 16:44:39	0:0
9	SPD SNDR FAIL	2	2007-11-19 14:33:53	358:0
9	SPD SNDR FAIL	3	2007-12-04 16:20:19	1:35
9	SPD SNDR FAIL	4	2007-12-04 16:21:30	1:35
10	MPU FAIL P	1	2007-11-16 16:44:39	0:0
10	MPU FAIL P	2	2007-11-19 14:33:59	358:0

Figure 4-66. Metering, Event Log, Sorted by Event ID

J1939 ECU

The ECU reports operating information to the IEM-2020 through the CANbus interface when the ECU is configured for Volvo Penta. Operating parameters and diagnostic information, if supported by the ECU, are decoded and displayed on these screens.

ECU Data

This screen displays ECU Lamp Status and ECU Data. The status is TRUE when the corresponding LED is red. Refer to Figure 4-67.

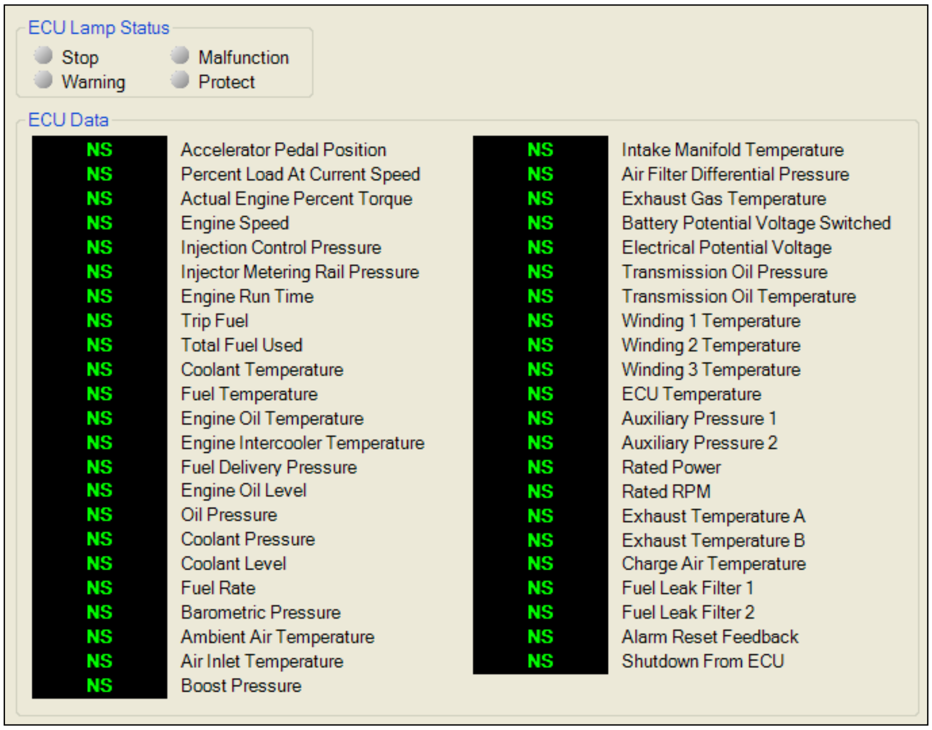


Figure 4-67. Metering, ECU Data

Engine Configuration

This screen displays Engine Configuration. Refer to Figure 4-68.

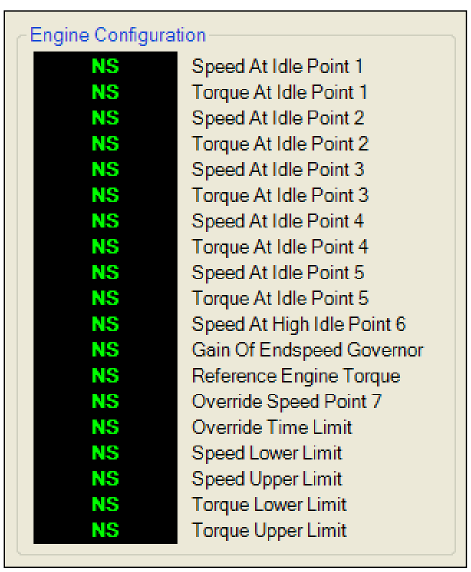
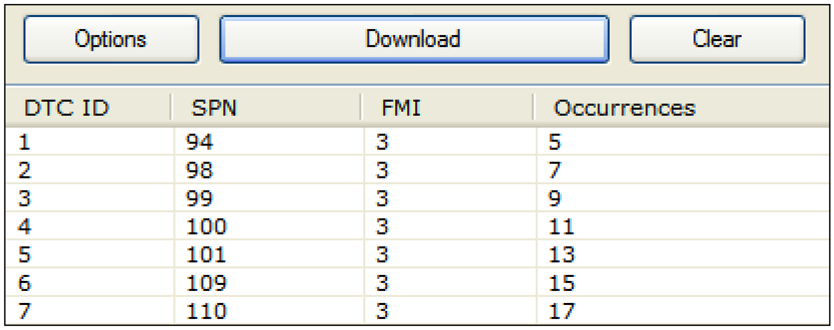


Figure 4-68. Metering, Engine Configuration

Active DTC and Previously Active DTC

This screen is used for viewing, downloading, and clearing DTC (Diagnostic Trouble Codes). Refer to Figure 4-69.



DTC ID	SPN	FMI	Occurrences
1	94	3	5
2	98	3	7
3	99	3	9
4	100	3	11
5	101	3	13
6	109	3	15
7	110	3	17

Figure 4-69. Metering, Download DTC

MTU

The MTU reports operating information to the IEM-2020 through the CANbus interface when the ECU is configured for MTU. Operating parameters and diagnostic information, if supported by the MTU, are decoded and displayed on these screens.

MTU Alarms

MTU Alarms and MTU Pre-Alarms are reported on this screen. The status is TRUE when the corresponding LED is red. Refer to Figure 4-70.

Figure 4-70. Metering, MTU Alarms

MTU Fault Codes

MTU Fault Codes can be viewed and downloaded on this screen. Refer to Figure 4-71.

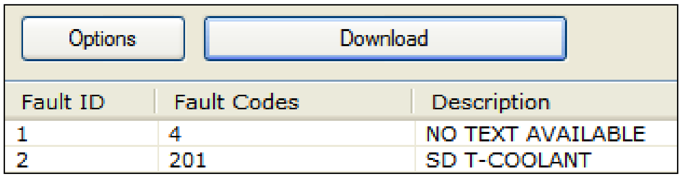


Figure 4-71. Metering, MTU Fault Codes

MTU Status

MTU Status is reported on this screen. The status is TRUE when the corresponding LED is red. Refer to Figure 4-72.

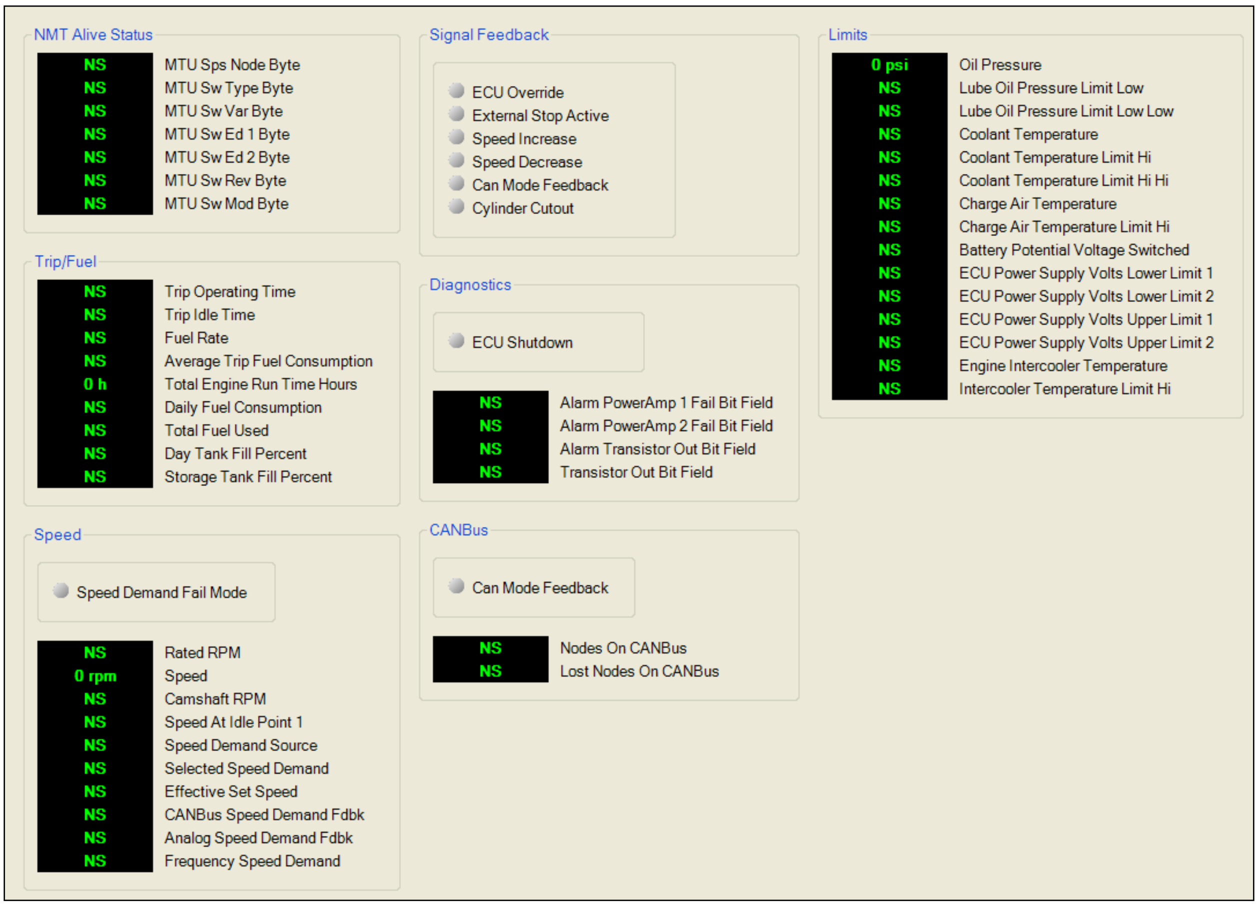


Figure 4-72. Metering, MTU Status

MTU Engine Status

MTU Engine Status is reported on this screen. The status is TRUE when the corresponding LED is red. Refer to Figure 4-73.

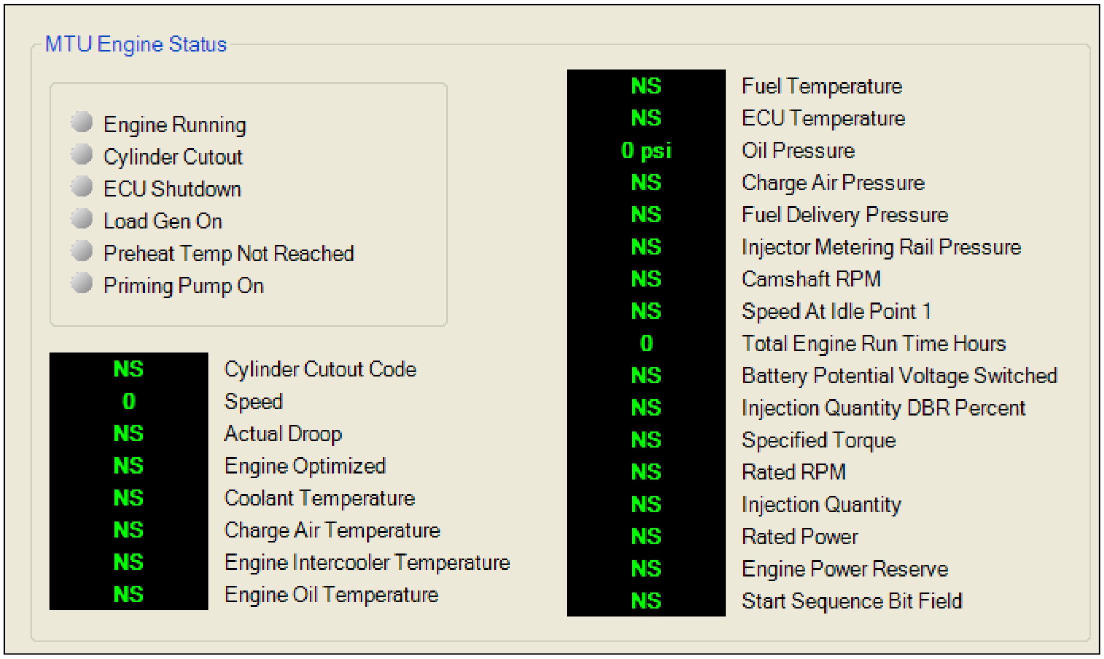


Figure 4-73. Metering, MTU Engine Status

Summary

This screen displays a metering summary. Refer to Figure 4-74.

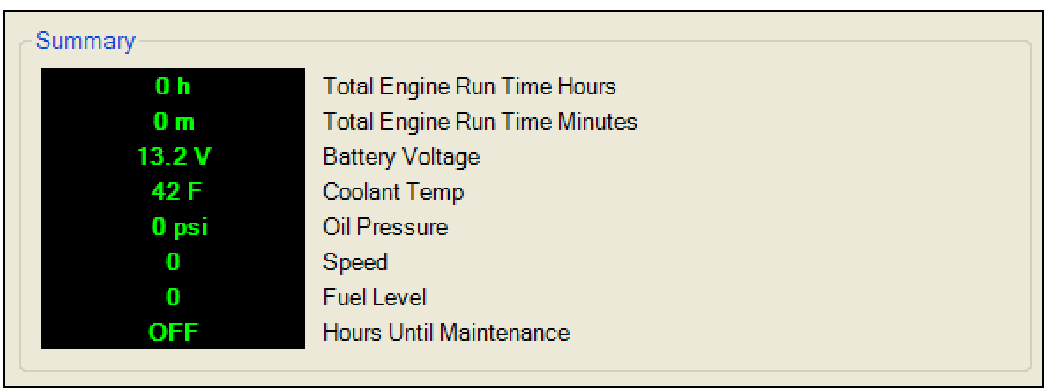


Figure 4-74. Metering, Summary

Control

Controls for stopping/starting the engine, controls for opening/closing breakers, and controls for opening/closing switches are accessed through the *Control* branch.

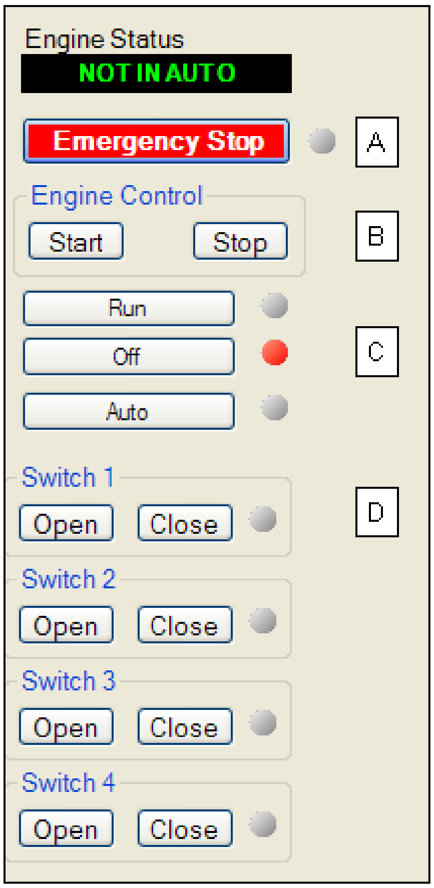


Figure 4-75. Metering, Control

The following controls are available by using the Metering Explorer in BESTCOMS*Plus* to open the *Control* branch. Refer to Figure 4-75.

A. The user has control to stop the engine in case of emergency by clicking on the *Emergency Stop* button.

B. The engine can be started and stopped by clicking on the *Start* and *Stop* buttons.

C. The engine can be set to Run, Auto, or Off.

D. Switches 1 through 4 can be opened or closed by clicking on the *Open* or *Close* buttons. The switch is closed when the corresponding LED is red.

When running BESTCOMS*Plus* in *Live* mode, these buttons will interact with the IEM-2020 in real time.

Real Time Clock

Settings for Date and Time are made here. Refer to Figure 4-76.

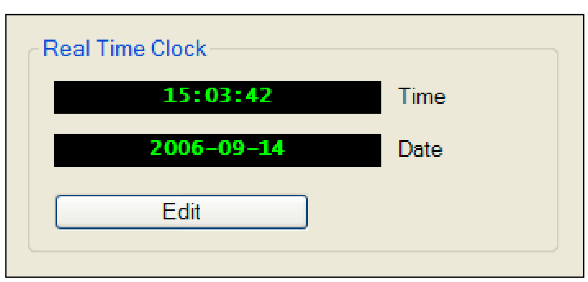


Figure 4-76. Metering, Real Time Clock

UPDATING BESTCOMS*Plus* SOFTWARE

Future enhancements to IEM-2020 functionality may make firmware updates desirable. Enhancements to IEM-2020 firmware typically coincide with enhancements to the IEM-2020 plug-in for BESTCOMS*Plus*. When an IEM-2020 is updated with the latest version of firmware, the latest version of the IEM-2020 plug-in for BESTCOMS*Plus* should also be obtained.

If you obtained a CD-ROM containing firmware from Basler Electric, then that CD-ROM will also contain the corresponding version of the IEM-2020 plug-in with BESTCOMS*Plus* software. The IEM-2020 plug-in with BESTCOMS*Plus* can also be downloaded from the Basler Electric website (http://www.basler.com). An outline form can be completed to obtain a password for downloading the software from the Basler Electric web site. BESTCOMS*Plus* also has a built in tool that will check for program updates if you are connected to the World Wide Web. The *Check for Updates* tool is located in the *Tools* drop-down menu.

CONVERTING SETTINGS FILES

A settings file conversion is required when IEM-2020 firmware has been changed. To make the settings file compatible with the firmware, perform the following:

1. Using BESTCOMS*Plus*, open the settings file to be converted from the top menu bar via *File, Open.* Do not connect to the IEM-2020 at this time.
2. Working offline, use the Settings Explorer to open the *Device Info* screen. Click on the pull-down menu under *Application Version* and select the version of firmware that the IEM-2020 holds.
3. Use the Settings Explorer to open the *BESTLogicPlus Programmable Logic* screen. Verify that the three status LEDs located in the lower right corner are green indicating that the logic is ready to be saved to a file. If all three status LEDs are not green, click on the *Save* button located on the BESTLogic*Plus* toolbar, correct any logic diagram errors, and then click *Save* again. Note that this step saves the logic in BESTCOMS*Plus* memory, not to a file.
4. It is recommended to save the old settings file. From the top menu bar select *File, Save As,* and enter a name for the new settings file.
5. Connect to the IEM-2020 and upload the new settings file.

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SECTION 5 • BESTLogic*Plus* PROGRAMMABLE LOGIC

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SECTION 5 • BESTLogic*Plus* PROGRAMMABLE LOGIC

INTRODUCTION

BESTLogic*Plus* Programmable Logic is a programming method used for managing the input, output, control, monitoring, and reporting capabilities of Basler Electric's IEM-2020 Industrial Engine Module. Each IEM-2020 has multiple, self-contained logic blocks that have all of the inputs and outputs of its discrete component counterpart. Each independent logic block interacts with control inputs and hardware outputs based on logic variables defined in equation form with BESTLogic*Plus*. BESTLogic*Plus* equations entered and saved in the IEM-2020 system's nonvolatile memory integrate (electronically wire) the selected or enabled protection and control blocks with control inputs and hardware outputs. A group of logic equations defining the logic of the IEM-2020 is called a logic scheme.

One default active logic scheme is pre-loaded into the IEM-2020. 12 pre-programmed logic schemes are available in the BESTCOMS*Plus* installation directory on your PC. Detailed information on all pre-programmed logic schemes is available in Appendix B, *Logic Library Files*. These schemes are configured for typical applications and virtually eliminate the need for "start-from-scratch" programming. BESTCOMS*Plus* can be used to open a logic scheme that was previously saved as a file and upload it to the IEM-2020. Any of the logic schemes can also be customized to suit your application.

BESTLogic*Plus* is not used to define the operating settings (modes, thresholds, and time delays) of the individual functions. Operating settings and logic settings are interdependent but separately programmed functions. Changing logic settings is similar to rewiring a panel and is separate and distinct from making the operating settings that control the thresholds and time delays of an IEM-2020. Detailed information about operating settings is provided in Section 4, *BESTCOMSPlus Software*.

OVERVIEW OF BESTLogic*Plus*

Use BESTCOMSPlus to make BESTLogic*Plus* settings. Use the Settings Explorer to open the *BESTLogicPlus Programmable Logic* tree branch as shown in Figure 5-1.

The *BESTLogicPlus Programmable Logic* screen contains a logic library for opening and saving logic files, tools for creating and editing logic documents, and protection settings.

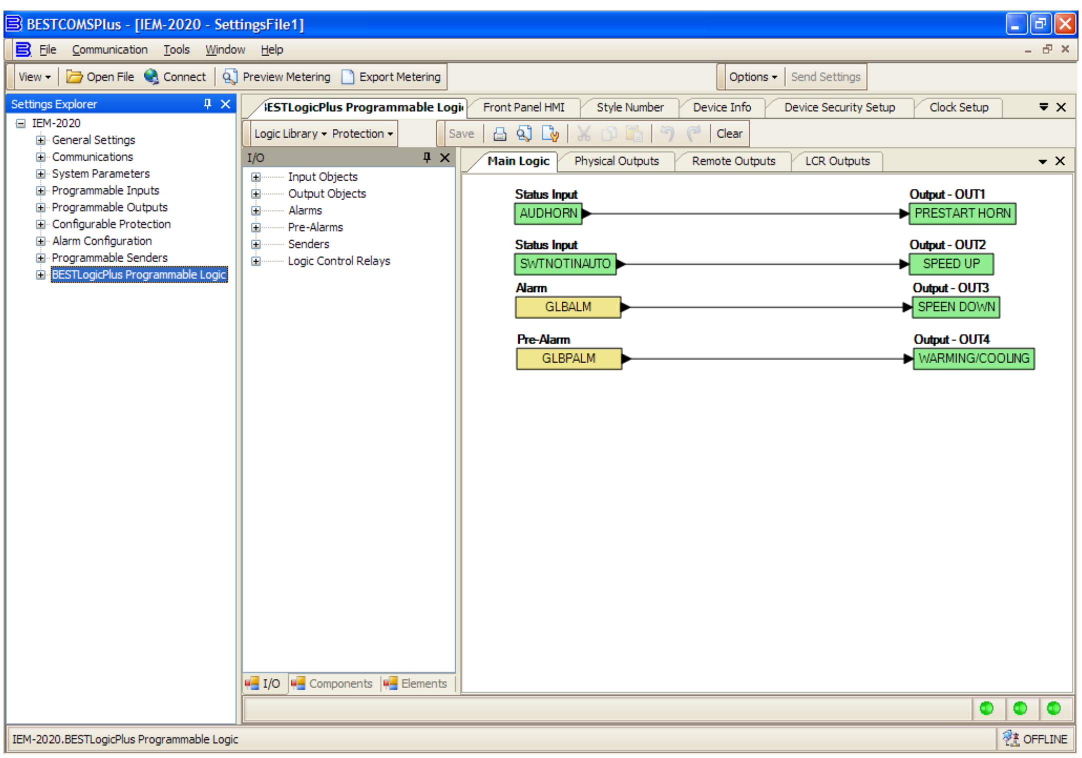


Figure 5-1. BESTLogicPlus Programmable Logic Tree Branch

BESTLogic*Plus* Composition

There are three main groups of objects used for programming BESTLogic*Plus*. These groups are *I/O, Components,* and *Elements.* For details on how these objects are used to program BESTLogic*Plus*, see the paragraphs on *Programming BESTLogicPlus.*

I/O

This group contains Input Objects, Output Objects, Alarms, Pre-Alarms, Senders, and Logic Control Relays. Table 5-1 lists the names and descriptions of the objects in the *I/O* group.

Table 5-1. I/O Group, Names and Descriptions

Name	Description	Symbol
Input Objects		
Logic 0	Always FALSE (Low).	Fixed 0
Logic 1	Always TRUE (High).	Fixed 1
Physical Inputs IN1 - IN16	TRUE when Physical Input x is active.	Input - IN1 INPUT_1
Remote Inputs IN17 - IN26	True when Remote Input x is active. (Available when an optional CEM-2020 is connected.)	Input - IN17 INPUT_17
Virtual Inputs VIN1 - VIN4	TRUE when Virtual Input x is active.	Input - VIN1 VIN1_LABEL
Status Input Analog Expansion Module	Analog Expansion Module Connected. TRUE when an optional AEM-2020 is connected to the IEM-2020.	Status Input AEMCONNECTED
Analog Expansion Module Remote Analog Inputs 1-8	TRUE when Over 1, Over 2, Under 1, Under 2, or Out of Range is configured as Status Only and the threshold has been exceeded. (Over 1 shown.)	Status Input - RALGIN1O1 ANALOG_INPUT_1
Analog Expansion Module Remote Analog Outputs 1-4	TRUE when the analog output connection is open and the Out of Range Alarm Configuration is set to Status Only.	Status Input - RALGOUT1OOR Oil Pressure
Analog Expansion Module Remote RTD Inputs 1-8	TRUE when Over 1, Over 2, Under 1, Under 2, or Out of Range is configured as Status Only and the threshold has been exceeded. (Over 1 shown.)	Status Input - RRTDIN1O1 RTD_INPUT_1
Analog Expansion Module Remote Thermocouple Inputs 1-2	TRUE when Over 1, Over 2, Under 1, Under 2, or Out of Range is configured as Status Only and the threshold has been exceeded. (Over 1 shown.)	Status Input - RTCIN1O1 THERM_CPL_1
Status Input Auto Start Input	TRUE when the Auto Start is TRUE.	Status Input AUTSTRTINSTATUS
Status Input Audible Horn	TRUE when the Audible Horn is active.	Status Input AUDHORN
Status Input Auto Mode	TRUE when the IEM-2020 is in Auto Mode.	Status Input AUTOMODE

Name	Description	Symbol
Status Input Auto Restart	TRUE when the Automatic Restart function is active.	**Status Input** AUTORESTART
Status Input Battery Charger Fail	TRUE when the Battery Charger Fail input is TRUE.	**Status Input** BATTCHRGFAIL
Status Input Battle Override	TRUE when the Battle Override input is TRUE.	**Status Input** BATTLORIDE
Status Input Configurable Elements 1-8	TRUE when the Configurable Element x logic output is TRUE.	**Status Input** CONFIGELEMENT1
Status Input Configurable Protection 1-8	TRUE when the Configurable Protection x Over Threshold #1 is TRUE.	**Status Input - CONFPROT1O1** CONF_PROT_1
Status Input Configurable Protection 1-8	TRUE when the Configurable Protection x Over Threshold #2 is TRUE.	**Status Input - CONFPROT1O2** CONF_PROT_1
Status Input Configurable Protection 1-8	TRUE when the Configurable Protection x Under Threshold #1 is TRUE.	**Status Input - CONFPROT1U1** CONF_PROT_1
Status Input Configurable Protection 1-8	TRUE when the Configurable Protection x Under Threshold #2 is TRUE.	**Status Input - CONFPROT1U2** CONF_PROT_1
Status Input Contact Expansion Module	Contact Expansion Module Connected. TRUE when an optional CEM-2020 is connected to the IEM-2020.	**Status Input** CEMCONNECTED
Status Input Cool Down Timer Active	TRUE when the Cool Down Timer is timing out.	**Status Input** CDOWNTMRACT
Status Input Emergency Stop	TRUE when the Emergency Stop button has been pressed.	**Status Input** EMERGSTOP
Status Input Engine Running	TRUE while the Engine is Running.	**Status Input** ENGRUNNING
Status Input Exercise Test	TRUE while the engine is running in exercise mode.	**Status Input** EXERCTEST
Status Input Front Panel Buttons	TRUE while the *AUTO* front panel button is pressed.	**Status Input** AUTOBUTTON
Status Input Front Panel Buttons	TRUE while the *DOWN* front panel button is pressed.	**Status Input** DOWNBUTTON
Status Input Front Panel Buttons	TRUE while the *EDIT* front panel button is pressed.	**Status Input** EDITBUTTON
Status Input Front Panel Buttons	TRUE while the *LAMP TEST* front panel button is pressed.	**Status Input** LAMPBUTTON
Status Input Front Panel Buttons	TRUE while the *LEFT* front panel button is pressed.	**Status Input** LEFTBUTTON

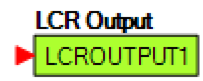
Name	Description	Symbol
Status Input Front Panel Buttons	TRUE while the *OFF* front panel button is pressed.	Status Input OFFBUTTON
Status Input Front Panel Buttons	TRUE while the *RESET* front panel button is pressed.	Status Input RESETBUTTON
Status Input Front Panel Buttons	TRUE while the *RIGHT* front panel button is pressed.	Status Input RIGHTBUTTON
Status Input Front Panel Buttons	TRUE while the *RUN* front panel button is pressed.	Status Input RUNBUTTON
Status Input Front Panel Buttons	TRUE while the *ALARM SILENCE* front panel button is pressed.	Status Input SILENCEBUTTON
Status Input Front Panel Buttons	TRUE while the *UP* front panel button is pressed.	Status Input UPBUTTON
Status Input Fuel Leak	TRUE when the Fuel Leak Detect input is TRUE.	Status Input FUELLEAK
Status Input Global Low Coolant Level	TRUE when the Low Coolant Level input is TRUE.	Status Input GLBLOWCOOLLVL
Status Input Load Share Module	Load Share Module Connected. TRUE when an optional LSM-2020 is connected to the IEM-2020.	Status Input LSMCONNECTED
Status Input Off Mode	TRUE when the IEM-2020 is in Off Mode.	Status Input OFFMODE
Status Input Off Mode Cooldown	TRUE when the DGC-2020 is in Off Mode and cooling down.	Status Input OFFMODECOOL
Status Input Pre Start Condition in Effect	TRUE while in the Pre Start state.	Status Input PRESTCONDINEFFECT
Status Input Prestart Input	TRUE when the IEM-2020 is indicating that the Pre Start relay should be closed.	Status Input PRESTARTINPUT
Status Input Reset Active	TRUE while the Reset button on the HMI is pressed.	Status Input RESETACTIVE
Status Input Run Input	TRUE when the IEM-2020 is indicating that the Run Input should be closed.	Status Input RUNINPUT
Status Input Run Mode	TRUE when the IEM-2020 is in Run Mode.	Status Input RUNMODE
Status Input Switch not in Auto	TRUE when the IEM-2020 is not in Auto Mode.	Status Input SWTNOTINAUTO
Status Input Start Input	TRUE when the IEM-2020 is indicating that the Start relay should be closed to start the engine.	Status Input STARTINPUT

Name	Description	Symbol
Output Objects		
Physical Outputs OUT1 - OUTx	Physical Outputs 1 through 7 (style xxAxxxxx) or 1 through 15 (style xxBxxxxx).	Output - OUT1 OUTPUT_1
Remote Outputs OUT13 - OUT36	Remote Outputs 13 through 36. (Available when an optional CEM-2020 is connected.)	Output - OUT13 OUTPUT_13
Alarms		
Analog Expansion Module Remote Analog Inputs 1-8	TRUE when Over 1, Over 2, Under 1, Under 2, or Out of Range is configured as an Alarm and the threshold has been exceeded. (Over 1 shown.)	Alarm RALGIN1O1ALM
Analog Expansion Module Remote Analog Outputs 1-4	TRUE when the analog output connection is open and the Out of Range Alarm Configuration is set to Alarm.	Alarm RALGOUT1OORALM
Analog Expansion Module Remote RTD Inputs 1-8	TRUE when Over 1, Over 2, Under 1, Under 2, or Out of Range is configured as an Alarm and the threshold has been exceeded. (Over 1 shown.)	Alarm RRTDIN1O1ALM
Analog Expansion Module Remote Thermocouple Inputs 1-2	TRUE when Over 1, Over 2, Under 1, Under 2, or Out of Range is configured as an Alarm and the threshold has been exceeded. (Over 1 shown.)	Alarm RTCIN1O1ALM
Auto Restart Fail	TRUE after the Automatic Restart function fails to restart the engine.	Alarm AUTORSTRTFAILALM
Battery Charger Fail	TRUE when the Battery Charger Fail function is configured as an Alarm and the activation delay has expired.	Alarm BATTCHRGFAILALM
Configurable Protection Protection 1-8	TRUE when Over 1, Over 2, Under 1, or Under 2 is configured as an Alarm and the threshold has been exceeded. (Over 1 shown.)	Alarm - CONFPROT1O1ALM CONF_PROT_1
Coolant Level Sender Fail	TRUE when a low coolant level error status code is received from the ECU. CANbus must be enabled.	Alarm COOLLVLSENDFAILALM
Coolant Temp Sender Fail	TRUE when the Coolant Temp Sender Fail is configured as an Alarm and the activation delay has expired.	Alarm COOLTEMPSENDFAILALM
ECU Comm Loss	TRUE when communication to ECU has been lost.	Alarm LOSSECUCOMMALM
ECU Shutdown	TRUE when ECU has Shutdown the engine.	Alarm ECUSHUTDOWNALM
Emergency Stop	TRUE when the Emergency Stop button has been pressed.	Alarm EMERGSTOPALM
Fuel Leak	TRUE when the Fuel Leak Detect function is configured as an Alarm and the activation delay has expired.	Alarm FUELLEAKALM
Fuel Level Sender Fail	TRUE when the Fuel Level Sender Fail is configured as an Alarm and the activation delay has expired.	Alarm FUELLSENDFAILALM

Name	Description	Symbol
Global Alarm	TRUE when one or more Alarms are set.	Alarm GLBALM
Global Sender Fail	TRUE when one or more of the Sender Fails are configured as Alarms and are TRUE.	Sender Fail GLBSENDFALM
Hi Coolant Temp	TRUE when the High Coolant Temp Alarm settings have been exceeded.	Alarm HITEMPALM
Low Coolant Level	TRUE when the Low Coolant Level function is configured as an Alarm and the activation delay has expired. In addition, TRUE when CANbus is enabled and the Low Coolant Level Alarm threshold has been exceeded.	Alarm LOWCOOLLVLALM
Low Fuel Level	TRUE when the Low Fuel Level Alarm settings have been exceeded.	Alarm LOWFUELLALM
Low Oil Pressure	TRUE when the Low Oil Pressure Alarm settings have been exceeded.	Alarm LOWOILPRALM
Oil Pressure Sender Fail	TRUE when the Oil Pressure Sender Fail is configured as an Alarm and the activation delay has expired.	Alarm OILPRESSENDFAILALM
Overcrank	TRUE when an Overcrank condition exists.	Alarm OCRANKALM
Overspeed	TRUE when the Overspeed Alarm settings have been exceeded.	Alarm OVERSPDALM
Speed Sender Fail	TRUE when the Speed Sender Fail activation delay has expired.	Alarm SPDSENDFAILALM
Pre-Alarms		
Analog Expansion Module Analog Expansion Module Comm Fail	TRUE when communication from the AEM-2020 to the IEM-2020 has been lost.	Pre-Alarm AEMCOMMFPALM
Analog Expansion Module Multiple Analog Expansion Modules Detected	TRUE when more than one AEM-2020 is connected.	Pre-Alarm DUPAEMPALM
Analog Expansion Module Remote Analog Inputs 1-8	TRUE when Over 1, Over 2, Under 1, Under 2, or Out of Range is configured as a Pre-Alarm and the threshold has been exceeded. (Over 1 shown.)	Pre-Alarm RALGIN1O1PALM
Analog Expansion Module Remote Analog Outputs 1-4	TRUE when the analog output connection is open and the Out of Range Alarm Configuration is set to Pre-Alarm.	Pre-Alarm RALGOUT1OORPALM
Analog Expansion Module Remote RTD Inputs 1-8	TRUE when Over 1, Over 2, Under 1, Under 2, or Out of Range is configured as a Pre-Alarm and the threshold has been exceeded. (Over 1 shown.)	Pre-Alarm RRTDIN1O1PALM

Name	Description	Symbol
Analog Expansion Module Remote Thermocouple Inputs 1-2	TRUE when Over 1, Over 2, Under 1, or Under 2 is configured as a Pre-Alarm and the threshold has been exceeded. (Over 1 shown.)	Pre-Alarm RTCIN1O1PALM
Battery Charger Fail	TRUE when the Battery Charger Fail function is configured as a Pre-Alarm and the activation delay has expired.	Pre-Alarm BATTCHRGFAILPALM
Battery Overvoltage	TRUE when the Battery Overvoltage Pre-Alarm threshold has been exceeded.	Pre-Alarm BATOVOLTPALM
Checksum Failure	TRUE when some of the user settings or firmware code has been corrupted. Refer to Section 4, *BESTCOMSPlus Software, Alarm Configuration, Pre-Alarms,* for more details.	Pre-Alarm CHECKSUMFAILPALM
Configurable Protection Protection 1-8	TRUE when Over 1, Over 2, Under 1, or Under 2 is configured as a Pre-Alarm and the threshold has been exceeded. (Over 1 shown.)	Pre-Alarm - CONFPROT1O1PALM CONF_PROT_1
Contact Expansion Module Multiple Contact Expansion Modules Connected	TRUE when more than one CEM-2020 is connected.	Pre-Alarm DUPCEMPALM
Contact Expansion Module Contact Expansion Module Comm Fail	TRUE when communication from the CEM-2020 to the IEM-2020 has been lost.	Pre-Alarm CEMCOMMFPALM
Contact Expansion Module Contact Expansion Modules Hardware Mismatch	TRUE when the connected CEM-2020 does not have the same number of outputs as defined on the *System Parameters, Remote Module Setup* screen in BESTCOMS*Plus*.	Pre-Alarm CEMHWMISMATCHPALM
Coolant Temp Sender Fail	TRUE when the Coolant Temp Sender Fail is configured as a Pre-Alarm and the activation delay has expired.	Pre-Alarm COOLTEMPSENDFAILPALM
Diag Trouble Code	TRUE when a Diagnostic Trouble Code exists.	Pre-Alarm DIAGTRBCODEPALM
ECU Com Loss	TRUE when communication to ECU has been lost.	Pre-Alarm LOSSECUCOMMPALM
Fuel Leak	TRUE when the Fuel Leak Detect function is configured as a Pre-Alarm and the activation delay has expired.	Pre-Alarm FUELLEAKPALM
Fuel Level Sender Fail	TRUE when the Fuel Level Sender Fail is configured as a Pre-Alarm and the activation delay has expired.	Pre-Alarm FUELLSENDFAILPALM
Global Pre-Alarm	TRUE when one or more Pre-Alarms are set.	Pre-Alarm GLBPALM
Hi Coolant Temp	TRUE when the High Coolant Temp Pre-Alarm threshold has been exceeded.	Pre-Alarm HITEMPPALM
High Fuel Level	TRUE when the High Fuel Level Pre-Alarm settings have been exceeded.	Pre-Alarm HIFUELLPALM

Name	Description	Symbol
Load Share Module Load Share Module Comm Fail	TRUE when communication from the LSM-2020 to the IEM-2020 has been lost.	Pre-Alarm LSMCOMMFPALM
Load Share Module Multiple Load Share Modules Detected	TRUE when more than one LSM-2020 is connected.	Pre-Alarm DUPLSMPALM
Low Battery Voltage	TRUE when the Low Battery Voltage Pre-Alarm settings have been exceeded.	Pre-Alarm LOWBATVPALM
Low Coolant Level	TRUE when the Low Coolant Level function is configured as a Pre-Alarm and the activation delay has expired. In addition, TRUE when CANbus is enabled and the Low Coolant Level Pre-Alarm threshold has been exceeded.	Pre-Alarm LOWCOOLLVLPALM
Low Coolant Temp	TRUE when the Low Coolant Temp Pre-Alarm threshold has been exceeded.	Pre-Alarm LOWTEMPPALM
Low Fuel Level	TRUE when the Low Fuel Level Pre-Alarm threshold has been exceeded.	Pre-Alarm LOWFUELLPALM
Low Oil Pressure	TRUE when the Low Oil Pressure Pre-Alarm threshold has been exceeded.	Pre-Alarm LOWOILPRPALM
Maintenance Interval	TRUE when the Maintenance Interval Pre-Alarm threshold has been exceeded.	Pre-Alarm MAINTINTPALM
MPU Fail	TRUE when the MPU has failed.	Pre-Alarm MPUFAILPALM
Oil Pressure Sender Fail	TRUE when the Oil Pressure Sender Fail is configured as a Pre-Alarm and the activation delay has expired.	Pre-Alarm OILPRESSENDFAILPALM
Weak Battery	TRUE when the Weak Battery Voltage Pre-Alarm settings have been exceeded.	Pre-Alarm WEAKBATPALM
Senders		
Coolant Temp Sender Fail	TRUE when the Coolant Temp Sender Fail is configured as either a Pre-Alarm or Alarm and the activation delay has expired.	Sender Fail COOLTEMPSENDFAIL
Fuel Level Sender Fail	TRUE when the Fuel Level Sender Fail is configured as either a Pre-Alarm or Alarm and the activation delay has expired.	Sender Fail FUELLSENDFAIL
Oil Pressure Sender Fail	TRUE when the Oil Pressure Sender Fail is configured as either a Pre-Alarm or Alarm and the activation delay has expired.	Sender Fail OILPRESSENDFAIL
Speed Sender Fail	TRUE when the Speed Sender Fail activation delay has expired.	Sender Fail SPDSENDFAIL

<table>
<tr><td colspan="3">Logic Control Relays
The logic control relays (LCR) consist of LCR outputs and LCR inputs. You can use the output to terminate the “output” end of a logic network, and then use the corresponding input as an input to logic elsewhere in the logic scheme. When a given LCR output is true the corresponding LCR input is true. In other words, when LCR Output N (N being a number from 1 to 16) then LCR Input N is true also.
If you get a “too many logic levels” error while building a logic network, LCR outputs and inputs can be used as a solution to this problem. Place an LCR output on the end of the partial logic network and then use the corresponding LCR input to build more logic than was previously possible.</td></tr>
<tr><td>Inputs
Input 1-16</td><td>Additional logic inputs. TRUE when the associated Logic Control Relay Output is TRUE.</td><td>
</td></tr>
<tr><td>Outputs
Output 1-16</td><td>Additional logic outputs.</td><td>
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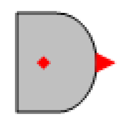
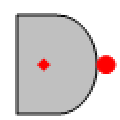
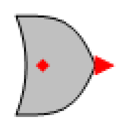
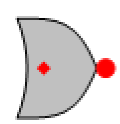
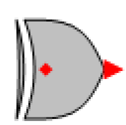
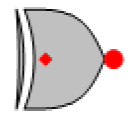
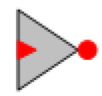
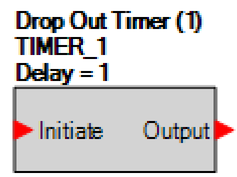
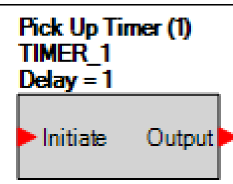
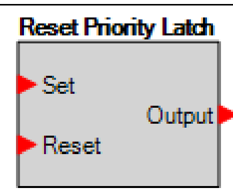
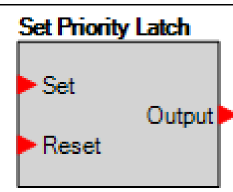
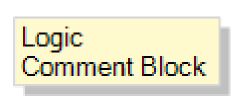
Components

This group contains Logic Gates, Pickup and Dropout Timers, Latches, and Comment Blocks. Table 5-2 lists the names and descriptions of the objects in the *Components* group.

Table 5-2. Components Group, Names and Descriptions

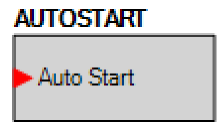
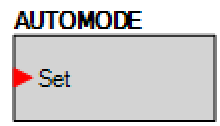
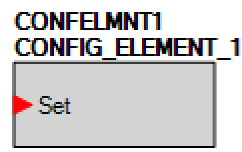
<table>
<tr><th>Name</th><th>Description</th><th>Symbol</th></tr>
<tr><td colspan="3">Logic Gates</td></tr>
<tr><td>AND</td><td><table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td></td></tr>
<tr><td>NAND</td><td><table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table></td><td></td></tr>
<tr><td>OR</td><td><table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td></td></tr>
<tr><td>NOR</td><td><table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table></td><td></td></tr>
<tr><td>XOR</td><td><table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table></td><td></td></tr>
</table>

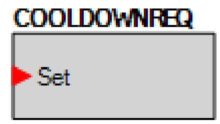
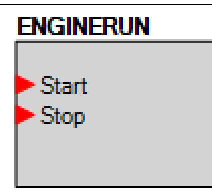
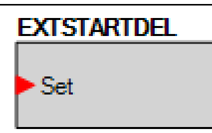
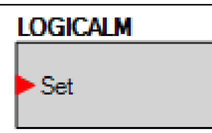
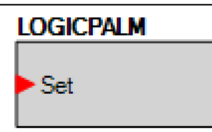
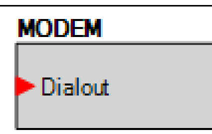
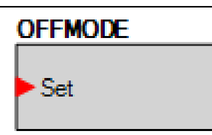
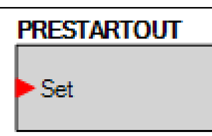
<table>
<tr><th>Name</th><th>Description</th><th>Symbol</th></tr>
<tr><td>XNOR</td><td><table><tr><th colspan="2">Input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td></td></tr>
<tr><td>NOT
(INVERTER)</td><td><table><tr><th>Input</th><th>Output</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td><td></td></tr>
<tr><td colspan="3">Pickup and Dropout Timers</td></tr>
<tr><td>Drop Out Timer</td><td>Used to set a delay in the logic.
For more information, refer to Programming BESTLogicPlus, Pickup and Dropout Timers, later in this section.</td><td>
</td></tr>
<tr><td>Pickup Up Timer</td><td>Used to set a delay in the logic.
For more information, refer to Programming BESTLogicPlus, Pickup and Dropout Timers, later in this section.</td><td>
</td></tr>
<tr><td colspan="3">Latches</td></tr>
<tr><td>Reset Priority Latch</td><td>When the Set input is on and the Reset input is off, the latch will go to the SET (ON) state. When the Reset input is on and the Set input is off, the latch will go to the RESET (OFF) state. If both the Set and Reset inputs are on at the same time, a reset priority latch will go to the RESET (OFF) state.</td><td>
</td></tr>
<tr><td>Set Priority Latch</td><td>When the Set input is on and the Reset input is off, the latch will go to the SET (ON) state. When the Reset input is on and the Set input is off, the latch will go to the RESET (OFF) state. If both the Set and Reset inputs are on at the same time, a set priority latch will go to the SET (ON) state.</td><td>
</td></tr>
<tr><td colspan="3">Other</td></tr>
<tr><td>Comment Block</td><td>Enter user comments.</td><td>
</td></tr>
</table>

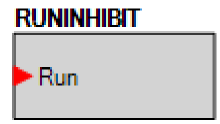
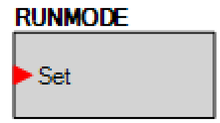
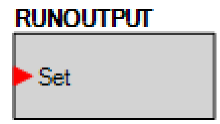
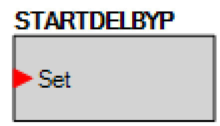
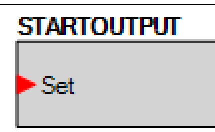
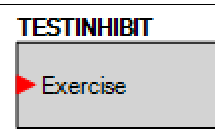
Elements

Table 5-3 lists the names and descriptions of the elements in the *Elements* group.

Table 5-3. Elements Group, Names and Descriptions

Name	Description	Symbol
AUTOSTART	When this logic element is TRUE, and the IEM-2020 is in AUTO mode, the engine will run. This can be used in place of the Auto Start programmable function if it is desired to generate the Auto Start signal as a combination of programmable logic rather than a simple contact input. If either the Auto Start logic element is TRUE <u>or</u> the contact mapped to the Auto Start programmable function is TRUE, <u>and</u> the IEM is in AUTO mode, the engine will run. If <u>both</u> the Auto Start logic element <u>and</u> the Auto Start programmable function are FALSE, and the IEM is in AUTO mode, the engine will cool down and stop.	
AUTOMODE	When this input is TRUE, and the IEM-2020 is in OFF mode, the IEM-2020 will switch to AUTO mode. This is a pulsed input. It does not need to be held after the desired mode switch has occurred.	
CONFELMNTX (X = 1 to 8)	Configurable elements (CONFELMNT1-8) are connected to the logic scheme as outputs. These elements are configurable in BESTCOMS*Plus* under *Programmable Outputs, Configurable Elements.* The user can assign a string of up to 16 characters, configure whether the element should generate an alarm or pre-alarm. If used for alarm or pre-alarm, the user's text is what will appear in the alarm or pre-alarm annunciation and in the IEM-2020 event log. In addition, the configurable element status can be used to generate modem dial outs which display the user's text on modem equipped IEM-2020's.	
COOLSTOPREQ	<u>RUN Mode</u> If the unit is in RUN mode when the Cool Stop Request is received, the unit will go into a cooldown cycle. While in the cooldown cycle, the unit will display “COOL & STOP REQ” in addition to displaying the cooldown timer. After the cooldown timer expires, the unit will go to OFF mode. The Cool Stop Request must be removed before the unit can be run again. If the Cool Stop Request is removed during the cooldown process, the unit will remain running. <u>AUTO Mode</u> If the unit is in AUTO mode when the Cool Stop Request is received, all conditions that would normally cause the unit to run in AUTO mode are cleared. Since all conditions that cause the unit to run have been removed, the unit goes into a cooldown cycle. While in the cooldown cycle, the unit will display “COOL & STOP REQ” in addition to displaying the cooldown timer. After the cooldown timer expires, the unit will shut down, remaining in AUTO. The Cool Stop Request must be removed before the unit can be run again. If the Cool Stop Request is removed during the cooldown process and some condition that would normally cause the unit to run in AUTO mode is true, the unit will remain running.	

Name	Description	Symbol
COOLDOWNREQ	<u>RUN Mode</u> If the unit is in RUN mode when the Cool Down Request is received, the unit is forced to go into a cooldown cycle. While in the cool down cycle, the unit will display “COOLDOWN REQ” in addition to displaying the cooldown timer. After the cooldown timer expires, the unit will remain running in RUN mode. If the Cool Down Request is removed during the cool down process, the unit will remain running in RUN mode. <u>AUTO Mode</u> If the unit is in AUTO mode and the Cool Down Request is received, the unit is forced to go into a cooldown cycle. While in the cooldown cycle, the unit will display “COOLDOWN REQ” in addition to displaying the cooldown timer. After the cool down timer expires, the unit will remain running in AUTO mode, unless there are no conditions that cause the unit to run in AUTO mode, in which case it will shut down and remain in AUTO mode. If the Cool Down Request is removed during the cool down process and some condition that would normally cause the unit to run in AUTO mode is true, the unit will remain running in AUTO mode.	
ENGINERUN	The Start input starts the engine. The Stop input stops the engine. The IEM-2020 only responds to this logic element when in AUTO mode.	
EXTSTARTDEL	If the Set input is TRUE while the IEM-2020 is in the Pre Start state, the IEM-2020 will remain in the Pre Start state until the Set input is FALSE.	
LOGICALM	When this input is TRUE, the IEM-2020 goes into an Alarm condition.	
LOGICPALM	When this input is TRUE, the IEM-2020 goes into a Pre-alarm condition.	
MODEM (Optional)	Connect the input to the output of another logic block. When TRUE, the Modem will dial out.	
OFFMODE	When this input is TRUE, the IEM-2020 will switch to OFF mode. This is a pulsed input. It does not need to be held after the desired mode switch has occurred.	
PRESTARTOUT	This element is used to drive the prestart output relay from logic when the Prestart Output Relay configuration is set to “Programmable”. When the Prestart Output Relay configuration is set to “Programmable”, the prestart relay will not close unless logic is used to drive this element. When the Prestart Output Relay configuration is set to “Predefined”, the prestart relay is closed according to the predefined prestart functionality of the IEM-2020. When the “Predefined” functionality is selected, the relay will not respond to this element.	

Name	Description	Symbol
RUNINHIBIT	When this logic element is TRUE, the IEM-2020 is prevented from starting and running the engine, regardless of any condition that would normally cause the engine to run. If this element is false and there is any condition in effect which will cause the engine to run, the IEM-2020 will start and run the engine.	
RUNMODE	When this input is TRUE, and the IEM-2020 is in OFF mode, the IEM-2020 will switch to RUN mode. This is a pulsed input. It does not need to be held after the desired mode switch has occurred.	
RUNOUTPUT	This element is used to drive the run output relay from logic when the Run Output Relay configuration is set to “Programmable”. When the Run Output Relay configuration is set to “Programmable”, the run relay will not close unless logic is used to drive this element. When the Run Output Relay configuration is set to “Predefined”, the run relay is closed according to the predefined run functionality of the IEM-2020. When the “Predefined” functionality is selected, the relay will not respond to this element.	
STARTDELBYP	This element allows the Pre Start state to be skipped based on logic. For example, a start delay may not be necessary when the engine is warm. This also allows an external device, such as an ECO, to control the pre start interval.	
STARTOUTPUT	This element is used to drive the start output relay from logic when the Start Output Relay configuration is set to “Programmable”. When the Start Output Relay configuration is set to “Programmable”, the start relay will not close unless logic is used to drive this element. When the Start Output Relay configuration is set to “Predefined”, the start relay is closed according to the predefined start functionality of the IEM-2020. When the “Predefined” functionality is selected, the relay will not respond to this element.	
TESTINHIBIT	When this logic element is TRUE, the engine exercise timer cannot start the engine. If the TESTINHIBIT logic function is FALSE during an exercise period, or transitions from TRUE to FALSE at any time during an exercise period, the IEM-2020 will start and run the engine for the duration of the exercise period.	

LOGIC SCHEMES

A logic scheme is a group of logic variables written in equation form that defines the operation of an IEM-2020 Industrial Engine Module. Each logic scheme is given a unique name. This gives you the ability to select a specific scheme and be confident that the selected scheme is in operation. One logic scheme is configured for typical applications and is the default active logic scheme. Only one logic scheme can be active at a given time. In most applications, preprogrammed logic schemes eliminate the need for custom programming. Preprogrammed logic schemes may provide more inputs, outputs, or features than are needed for a particular application. This is because a preprogrammed scheme is designed for a large number of applications with no special programming required. Unneeded logic block outputs may be left open to disable a function or a function block can be disabled through operating settings.

12 pre-programmed logic schemes are available in the BESTCOMS*Plus* installation directory on your PC. Detailed information on all pre-programmed logic schemes is available in Appendix B, *Logic Library Files*.

When a custom logic scheme is required, programming time is reduced by modifying one of the preprogrammed logic schemes.

WARNING!

The logic library files defined in this manual are intended to be used as basic logic configurations on which to build a complete logic scheme suitable for the application. The default logic scheme and logic library files may not be configured with adequate protection, time delays, and/or limits for every application. Carefully review these files and other settings within the IEM-2020 to be certain that they are appropriate for your application.

The Active Logic Scheme

Industrial Engine Modules must have an active logic scheme in order to function. All Basler Electric IEM-2020's are delivered with a default, active logic scheme pre-loaded in memory. If the function block configuration and output logic of the default logic scheme meets the requirements of your application, then only the operating settings (system parameters and threshold settings) need to be adjusted before placing the IEM-2020 in service.

Copying and Renaming Preprogrammed Logic Schemes

Copying a saved logic scheme to the active logic (*Logic Name*) and assigning a unique name is accomplished by loading the saved logic scheme into BESTCOMS*Plus* and then typing over the logic scheme's name. Changes are not activated until the new settings have been saved and uploaded to the device.

Sending and Retrieving Logic Schemes

Retrieving a Logic Scheme from the IEM-2020

To retrieve settings from the IEM-2020, the IEM-2020 must be connected to a computer through a communications port. Once the necessary connections are made, settings can be downloaded from the IEM-2020 by selecting *Download Settings and Logic* on the *Communication* pull-down menu.

Sending a Logic Scheme to the IEM-2020

To send settings to the IEM-2020, the IEM-2020 must be connected to a computer through a communications port. Once the necessary connections are made, settings can be uploaded to the IEM-2020 by selecting *Upload Logic or Upload Settings and Logic* on the *Communication* pull-down menu.

CAUTION

Always remove the IEM-2020 from service prior to changing or modifying the active logic scheme. Attempting to modify a logic scheme while the IEM-2020 is in service could generate unexpected or unwanted outputs.

Modifying a logic scheme in BESTCOMS*Plus* does not automatically make that scheme active in the IEM-2020. The modified scheme must be uploaded into the IEM-2020. See the paragraphs on *Sending and Retrieving Logic Schemes* later in this section.

PROGRAMMING BESTLOGIC*PLUS*

Use BESTCOMS*Plus* to program BESTLogic*Plus*. Using BESTCOMS*Plus* is analogous to physically attaching wire between discrete IEM-2020 terminals. To program BESTLogic*Plus*, use the Settings Explorer within BESTCOMS*Plus* to open the *BESTLogicPlus Programmable Logic* tree branch as shown in Figure 5-1.

The drag and drop method is used to connect a variable or series of variables to the logic inputs, outputs, components, and elements. To draw a wire/link from port to port (triangles), click the left mouse button on a port, pull the wire onto another port, and release the left mouse button. A red port indicates that a connection to the port is required or missing. A black port indicates that a connection to the port is not required. Drawing wires/links from input to input or output to output is not allowed. Only one wire/link can be connected to any one output. If the proximity of the endpoint of the wire/link is not exact, it may attach to an unintended port.

If an element is disabled, it will have a yellow X on it. To enable the element, navigate to the settings page for that element.

The view of the Main Logic, Physical Outputs, and Remote Outputs can be automatically arranged by clicking the right mouse button on the window and selecting *Auto-Layout.*

The following must be met before BESTCOMS*Plus* will allow logic to be uploaded to the IEM-2020:

- A minimum of two inputs and a maximum of four inputs on any multi-port (AND, OR, NAND, NOR, XOR, and XNOR) gate.
- A maximum of five logic levels for any particular path. A path being an input block or an output side of an element block through gates to an output block or an input side of an element block. This is to include any OR gates on the Physical Output or Remote Output tab/pages, but not the matched pairs of Physical Output blocks or Remote Output blocks.
- Only 25 gates per logic level. All output blocks and input sides of element blocks are at the maximum logic level of the diagram. All gates are pushed forward/upwards in logic levels and buffered to reach the final output block or element block if needed. A maximum of 60 gates allowed per diagram.
- At all levels there can only be 96 used link/wired or endpoints. Endpoints being inputs, outputs, both sides of element blocks.

Three status LEDs are located in the lower right corner of the BESTLogic*Plus* window. These LEDs show the *Logic Save Status*, *Logic Diagram Status*, and *Logic Layer Status*. Table 5-4 defines the colors for each LED.

Table 5-4. Status LEDs

LED	Color	Definition
Logic Save Status (Left LED)	Yellow	Logic has changed since last save.
	Green	Logic has NOT changed since last save.
Logic Diagram Status (Center LED)	Red	Requirements NOT met as listed above.
	Green	Requirements met as listed above.
Logic Layer Status (Right LED)	Red	Requirements NOT met as listed above.
	Green	Requirements met as listed above.

Pickup and Dropout Timers

A pickup timer produces a TRUE output when the elapsed time is greater than or equal to the Pickup Time setting after a FALSE to TRUE transition occurs on the Initiate input from the connected logic. Whenever the Initiate input status transitions to FALSE, the output transitions to FALSE immediately.

A drop out timer produces a TRUE output when the elapsed time is greater than or equal to the Dropout Time setting after a TRUE to FALSE transition occurs on the Initiate input from the connected logic. Whenever the Initiate input transitions to TRUE, the output transitions to FALSE immediately.

Refer to Figure 5-2, Pickup and Dropout Logic Timer Blocks.

To program logic timer settings, use the Settings Explorer within BESTCOMS*Plus* to open the *BESTLogicPlus Programmable Logic/Logic Timers* tree branch. Enter a *Name* label that you want to appear on the timer logic block. The *Time Delay* value range is 0 to 250 hours in 1 hour increments, 0 to 250 minutes in 1 minute increments, or 0 to 1,800 seconds in 0.1 second increments.

Next, open the *Components* tab inside the BESTLogic*Plus* window and drag a timer onto the program grid. Right click on the timer to select the timer you want to use that was previously set on the *Logic Timers* tree branch. The *Logic Timer Properties Dialog Box* will appear. Select the timer you want to use.

Timing accuracy is ±15 milliseconds.

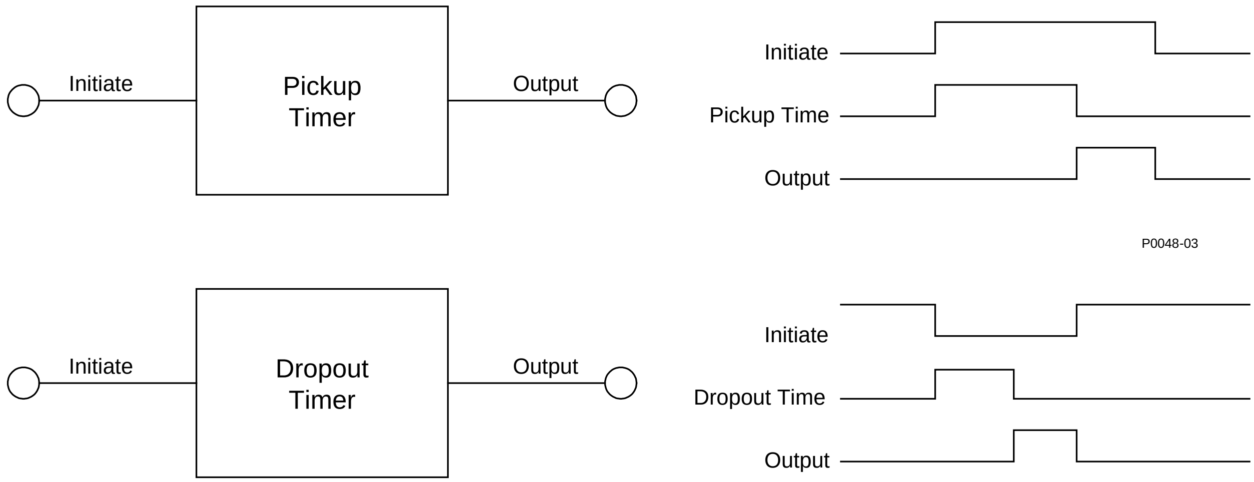


Figure 5-2. Pickup and Dropout Timer Logic Blocks

BESTLogic*Plus* FILE MANAGEMENT

To manage BESTLogic*Plus* files, use the Settings Explorer to open the *BESTLogicPlus Programmable Logic* tree branch. Use the BESTLogic*Plus* Programmable Logic toolbar to manage BESTLogic*Plus* files. Refer to Figure 5-3. For information on Settings Files management, refer to Section 4, *BESTCOMSPlus Software.*

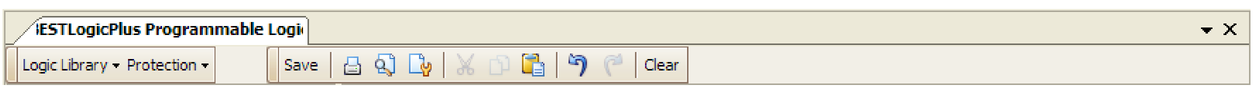


Figure 5-3. BESTLogicPlus Programmable Logic Toolbar

Saving a BESTLogicPlus File

After programming BESTLogic*Plus* settings, click on the *Save* button to save the settings to memory.

Before the new BESTLogic*Plus* settings can be uploaded to the IEM-2020, you must select *Save* from the *File* pull-down menu located at the top of the BESTCOMS*Plus* main shell. This step will save both the BESTLogic*Plus* settings and the operating settings to a file.

The user also has the option to save the BESTLogic*Plus* settings to a unique file that contains only BESTLogic*Plus* settings. Click on the *Logic Library* drop-down button and select *Save Logic Library File.* Use normal windows techniques to browse to the folder where you want to save the file and enter a filename to save as.

Opening a BESTLogicPlus File

To open a saved BESTLogic*Plus* file, click on the *Logic Library* drop-down button on the BESTLogic*Plus* Programmable Logic toolbar and select *Open Logic Library File.* Use normal windows techniques to browse to the folder where the file is located.

To open one of the 12 pre-programmed logic schemes, click on the *Logic Library* drop-down button on the BESTLogic*Plus* Programmable Logic toolbar and select *View Device's Logic Library File.*

Protecting a BESTLogicPlus File

Objects in a logic diagram can be locked so that when the logic document is protected these objects cannot be changed. Locking and protecting is useful when sending logic files to other personnel to be modified. The locked object(s) cannot be changed. To view the lock status of the object(s), select *Show Lock Status* from the *Protection* drop-down menu. To lock object(s), use the mouse to select object(s) to be locked. Right click on the selected object(s) and select *Lock Object(s).* The gold colored padlock next to the object(s) will change from an open to a locked state. To protect a logic document, select *Protect Logic Document* from the *Protection* drop-down button. A password is optional.

Uploading a BESTLogicPlus File

To upload a BESTLogic*Plus* file to the IEM-2020, you must first open the file through BESTCOMS*Plus* or create the file using BESTCOMS*Plus*. Then pull down the *Communication* menu and select *Upload Logic.*

Downloading a BESTLogicPlus File

To download a BESTLogic*Plus* file from the IEM-2020, you must pull down the *Communication* menu and select *Download Logic*. If the logic in your BESTCOMS*Plus* has changed, a dialog box will open asking you if want to save the current logic changes. You may choose *Yes* or *No*. After you have taken the required action to save or not save the current logic, the downloading is executed.

Printing a BESTLogicPlus File

To view a preview of the printout, click on the *Print Preview* icon located on the BESTLogic*Plus* Programmable Logic toolbar. If you wish to print to a printer, select the printer icon in the upper left corner of the *Print Preview* screen.

You may skip the print preview and go directly to print by clicking on the *Printer* icon on the BESTLogic*Plus* Programmable Logic toolbar. A dialog box, *Select Views to Print* opens allowing you to check which views you would like to print. Next, the *Print* dialog box opens with the typical Windows® choice to setup the properties of printer. Execute this command, as necessary, and then select *Print*.

A *Page Setup* icon is also provided on the BESTLogic*Plus* Programmable Logic toolbar allowing you to select *Paper Size, Paper Source, Orientation,* and *Margins.*

Clearing the On-Screen Logic Diagram

Click on the *Clear* button to clear the on-screen logic diagram and start over.

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SECTION 6 • INSTALLATION

GENERAL

IEM-2020 modules are delivered in sturdy cartons to prevent shipping damage. Upon receipt of a unit, 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 USA.

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

PRODUCT REGISTRATION

Registering with Basler Electric enables you to receive important information updates on your product plus new product announcements. Register your product by directing your web browser to www.basler.com.

HARDWARE

IEM-2020 modules are packaged for mounting in any top-mount enclosure. The front panel is resistant to moisture, salt fog, humidity, dust, dirt, and chemical contaminants. IEM-2020 modules are mounted using the four permanently attached 10-24 studs. The torque applied to the mounting hardware should not exceed 25 inch-pounds (2.8 Newton meters).

MOUNTING

Panel cutting and drilling dimensions are shown in Figure 6-1. The horizontal drilling measurement of 10.75 inches has a tolerance of +0.01/-0.01 inches. The horizontal cutout measurement of 10.38 inches has a tolerance of +0.04/-0 inches. The vertical drilling measurement of 7.25 inches has a tolerance of +0.01/-0.01 inches. The vertical cutout measurement of 6.88 inches has a tolerance of +0.04/-0. Figure 6-2 shows overall dimensions. Dimensions are in inches with millimeters in parenthesis.

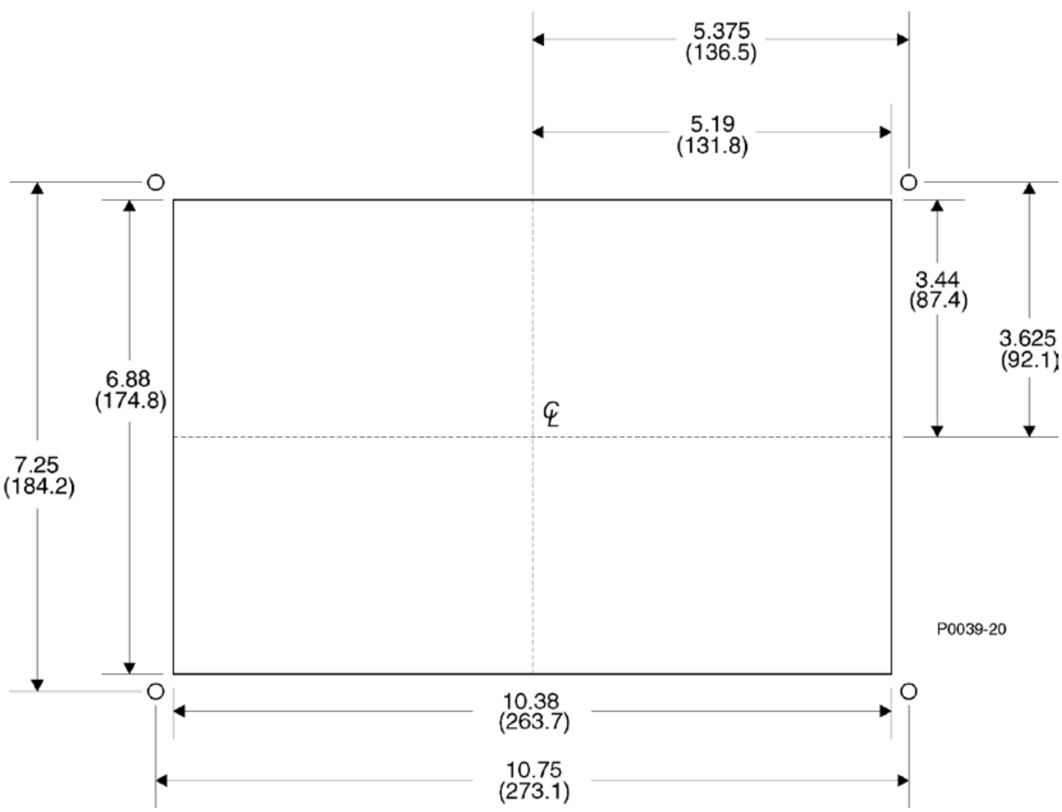

Figure 6-1. Panel Cutting and Drilling Dimensions

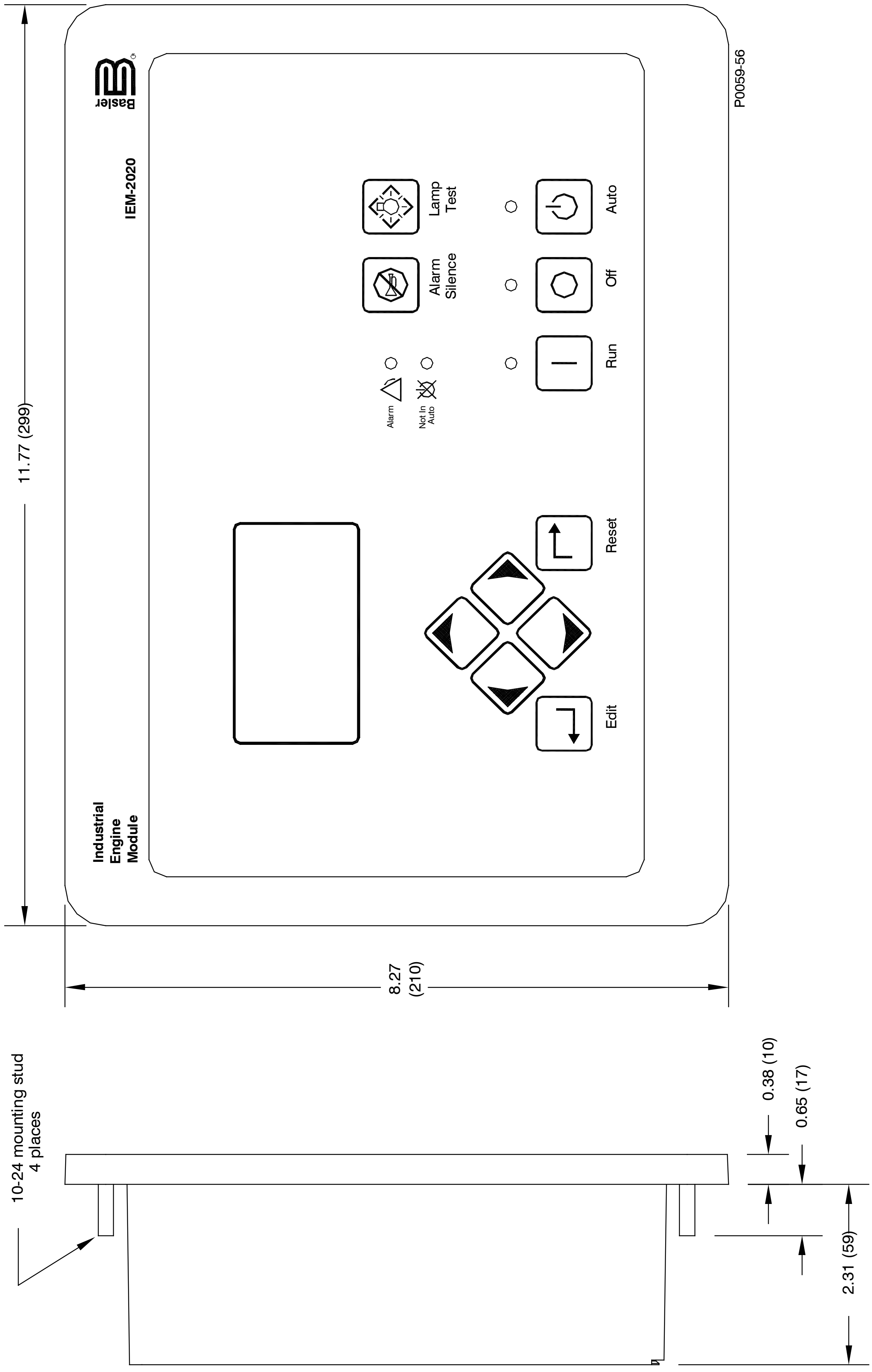

Figure 6-2. Overall Dimensions

CONNECTIONS

IEM-2020 connections are dependent on the application. Incorrect wiring may result in damage to the controller.

> **NOTE**
>
> Be sure that the IEM-2020 is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the chassis ground terminal (terminal 1) 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 IEM-2020 will not operate.

Terminations

All IEM-2020 terminals are located on the rear panel of the controller. There are three types of interface terminals: a mini-B USB socket, plug-in connectors with screw-down compression terminals, and quarter-inch, male, quick-connect terminals. Controllers equipped with the optional, internal dial-out modem have an additional RJ-11 jack.

The mini-B USB socket mates with a standard USB cable and provides local communication between the IEM-2020 and a PC running BESTCOMS*Plus* software.

The majority of IEM-2020 connections are made with 15-position connectors with screw-down compression terminals. These connectors plug into headers on the IEM-2020. The connectors and headers have a dovetailed edge that ensures proper connector orientation. Each connector and header is uniquely keyed to ensure that a connector mates only with the correct header. Connector screw terminals accept a maximum wire size of 12 AWG. Maximum screw torque is 4 inch-pounds (0.45 N•m).

Connections to the IEM-2020 starter, fuel solenoid, and glow plug output contacts are made directly to each relay through quarter-inch, male, quick-connect terminals. Amp part numbers 154718-3 (positive-lock receptacle) and 154719-1 (nylon housing) are the recommended components for making connections at these terminals.

The following paragraphs describe IEM-2020 terminal groups.

<u>Operating Power</u>

The IEM-2020 operating power input accepts either 12 Vdc or 24 Vdc and tolerates voltage over the range of 6 to 32 Vdc. Operating power must be of the correct polarity. Although reverse polarity will not cause damage, the IEM-2020 will not operate. Table 6-1 lists operating power terminals.

Basler Electric recommends adding a fuse for additional protection for the wiring to the battery input of the IEM-2020. A Bussmann ABC-7 fuse or equivalent will help prevent wire damage and nuisance trips due to initial power supply inrush current.

Table 6-1. Operating Power Terminals

Terminal	Description
1 (CHASSIS)	Chassis ground connection
2 (BATT–)	Negative side of operating power input
3 (BATT+)	Positive side of operating power input

<u>Analog Engine Sender Inputs</u>

Inputs are provided for oil pressure, fuel level, and coolant temperature senders.

Oil pressure senders that are compatible with the IEM-2020 include Datcon 02505-00, Isspro model R8919, and Stewart-Warner models 279BF, 279C, 411K, and 411M. Other senders may be used.

Compatible fuel level senders include Isspro model R8925. Other senders may be used.

Coolant temperature senders that are compatible with the IEM-2020 include Datcon 02019-00, Faria TS4042, Isspro model R8959 and Stewart-Warner model 334-P. Other senders may be used.

Sender input terminals are listed in Table 6-2.

Table 6-2. Sender Input Terminals

Terminal	Description
8 (OIL)	Oil pressure sender input
9 (FUEL)	Fuel level sender input
10 (COOLANT)	Coolant temperature sender input
11 (SENDER COM)	Sender return terminal

Emergency Stop Input

The emergency stop input is intended for use with a normally closed switch and recognizes an emergency stop input when the short-circuit across the input is removed. The ESTOP can be up to 75 ft away from the IEM-2020 using a maximum wire length of 150 ft. Emergency stop input terminals are listed in Table 6-3.

Table 6-3. Emergency Stop Input Terminals

Terminal	Description
46 (ESTOP)	Emergency stop contact input
47 (ESTOP)	

Magnetic Pickup Input

The magnetic pickup input accepts a speed signal over the range of 3 to 35 volts peak and 32 to 10,000 hertz. Table 6-4 lists magnetic pickup input terminals.

Table 6-4. Magnetic Pickup Input Terminals

Terminal	Description
31 (MPU+)	Magnetic pickup positive input
32 (MPU–)	Magnetic pickup return input

Contact Sensing Inputs

Contact sensing inputs consist of 1 emergency stop input and 16 programmable inputs.

The programmable inputs accept normally open, dry contacts. Terminal 2 (BATT–) serves as the common return line for the programmable inputs. Section 4, *BESTCOMSPlus Software* provides information about configuring the programmable inputs.

Table 6-5 lists contact sensing input terminals.

Table 6-5. Contact Sensing Inputs

Terminal	Description
2 (BATT–)	Common return line for programmable contact inputs
15 (INPUT 16)	Programmable contact input 16
16 (INPUT 15)	Programmable contact input 15
17 (INPUT 14)	Programmable contact input 14
18 (INPUT 13)	Programmable contact input 13
19 (INPUT 12)	Programmable contact input 12

Terminal	Description
20 (INPUT 11)	Programmable contact input 11
21 (INPUT 10)	Programmable contact input 10
22 (INPUT 9)	Programmable contact input 9
23 (INPUT 8)	Programmable contact input 8
24 (INPUT 7)	Programmable contact input 7
25 (INPUT 6)	Programmable contact input 6
26 (INPUT 5)	Programmable contact input 5
27 (INPUT 4)	Programmable contact input 4
28 (INPUT 3)	Programmable contact input 3
29 (INPUT 2)	Programmable contact input 2
30 (INPUT 1)	Programmable contact input 1

Output Contacts

The IEM-2020 has three sets of fixed-function output contacts: Pre, Start, and Run. The Pre contacts supply battery power to the engine glow plugs, the Start contacts supply power to the start solenoid, and the Run contacts supply power to the fuel solenoid. Connections to the three sets of contacts are made directly at each relay using female, 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 each relay. For the location of the Pre, Start, and Run relays refer to Figure 2-2.

Depending on the style number, the IEM-2020 provides either 4 or 12 sets of programmable output contacts. IEM-2020 modules with a style number of NNAxxxNNH provide four programmable outputs. Modules with a style number of NNBxxxNNH provide 12 programmable outputs. Programmable output contact terminals are listed in Table 6-6.

Table 6-6. Programmable Output Contact Terminals

Terminal	Description
51 (COM 1, 2, 3)	Common connection for outputs 1, 2, and 3
52 (OUT 1)	Programmable output 1
53 (OUT 2)	Programmable output 2
54 (OUT 3)	Programmable output 3
55 (COM 4, 5, 6)	Common connection for outputs 4, 5, and 6
56 (OUT 4)	Programmable output 4
57 (OUT 5)	Programmable output 5
58 (OUT 6)	Programmable output 6
59 (COM 7, 8, 9)	Common connection for outputs 7, 8, and 9
60 (OUT 7)	Programmable output 7
61 (OUT 8)	Programmable output 8
62 (OUT 9)	Programmable output 9
63 (COM 10, 11, 12)	Common connection for outputs 10, 11, and 12
64 (OUT 10)	Programmable output 10
65 (OUT 11)	Programmable output 11
66 (OUT 12)	Programmable output 12

USB Interface

A mini-B USB socket enables local communication with a PC running BESTCOMS*Plus* software. The IEM-2020 is connected to a PC using a standard USB cable equipped with a type A plug on one end (PC termination) and a mini-B plug on the other end (IEM-2020 termination).

RS-485 Communication Port

IEM-2020 modules with the optional RS-485 communication port (style number NNxRxxNNH) are equipped for polled communication over a Modbus™ network. Basler Electric recommends using twisted-pair, shielded cable for RS-485 port connections. Table 6-7 lists RS-485 communication port terminals.

Table 6-7. RS-485 Communication Port Terminals

Terminal	Description
12 (485 SHIELD)	Shield connection for RS-485 cable
13 (485B)	RS-485 send/receive B connection
14 (485A)	RS-485 send/receive A connection

CANbus Interface

These terminals provide communication using the SAE J1939 protocol or the MTU protocol and provide high-speed communication between the IEM-2020 and an MTU engine ECU on an electronically controlled engine. Connections between the MTU engine ECU and IEM-2020 should be made with twisted-pair, shielded cable. Table 6-8 lists CANbus interface terminals. Refer to Figure 6-3 and Figure 6-4.

Table 6-8. CANbus Interface Terminals

Terminal	Description
48 (CAN L)	CAN low connection
49 (CAN H)	CAN high connection
50 (SHIELD)	CAN drain connection

NOTES

1.) If the IEM-2020 is providing one end of the J1939 bus, a 120 Ω, ½ watt terminating resistor should be installed across terminals 48 (CANL) and 49 (CANH).

2.) If the IEM-2020 is not part of the J1939 bus, the stub connecting the IEM-2020 to the bus should not exceed 914 mm (3 ft) in length.

3.) The maximum bus length, not including stubs, is 40 m (131 ft).

4.) The J1939 drain (shield) should be grounded at one point only. If grounded elsewhere, do not connect the drain to the IEM-2020.

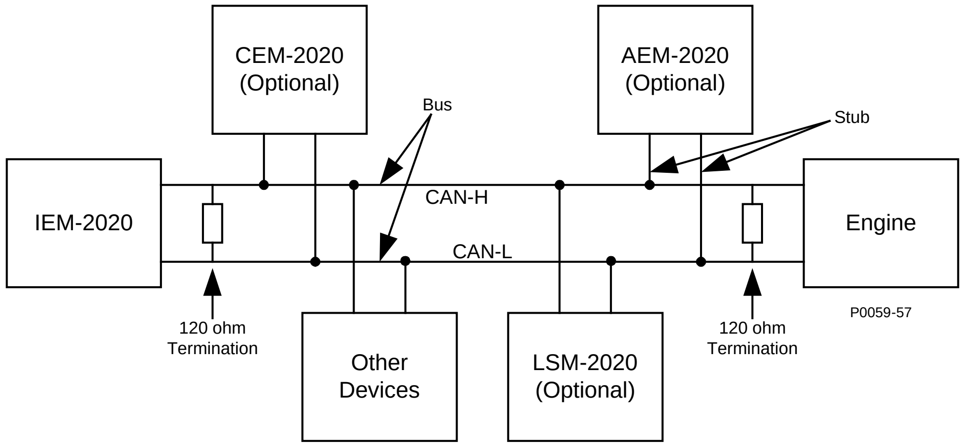

Figure 6-3. CANbus Interface with IEM-2020 providing One End of the Bus

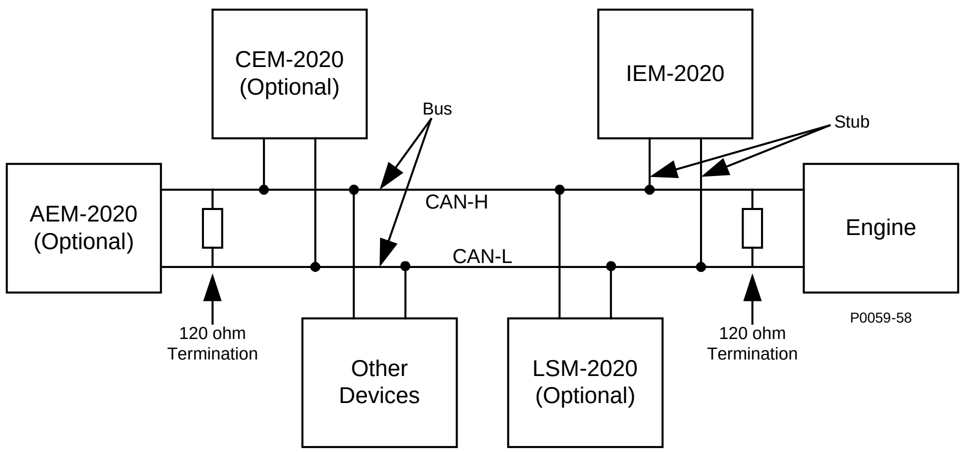

Figure 6-4. CANbus Interface with Optional AEM-2020 providing One End of the Bus

Dial-Out Modem

IEM-2020 controllers with style number NNxxxMNNH have an internal modem with dial-in, dial-out capability. The IEM-2020 connects to a standard-device telephone line through a USOC RJ-11C jack.

RDP-110 Connections

The IEM-2020 provides terminals for connection with the optional RDP-110 remote display panel. These terminals provide dc operating power to the RDP-110 and enable communication between the IEM-2020 and RDP-110. Basler Electric recommends using twisted-pair conductors for connecting the communication terminals of the IEM-2020 and RDP-110.

Table 6-9 lists the IEM-2020 terminals that connect to the RDP-110.

Table 6-9. RDP-110 Interface Terminals

Terminal	Connects To:
4 (RDP BATT+)	RDP-110 terminal 12/24
5 (RDP BATT–)	RDP-110 terminal DC COM
6 (RDP TXD–)	RDP-110 terminal 485–
7 (RDP TXD+)	RDP-110 485+

Connections for Typical Applications

Figure 6-5 shows connections for typical applications.

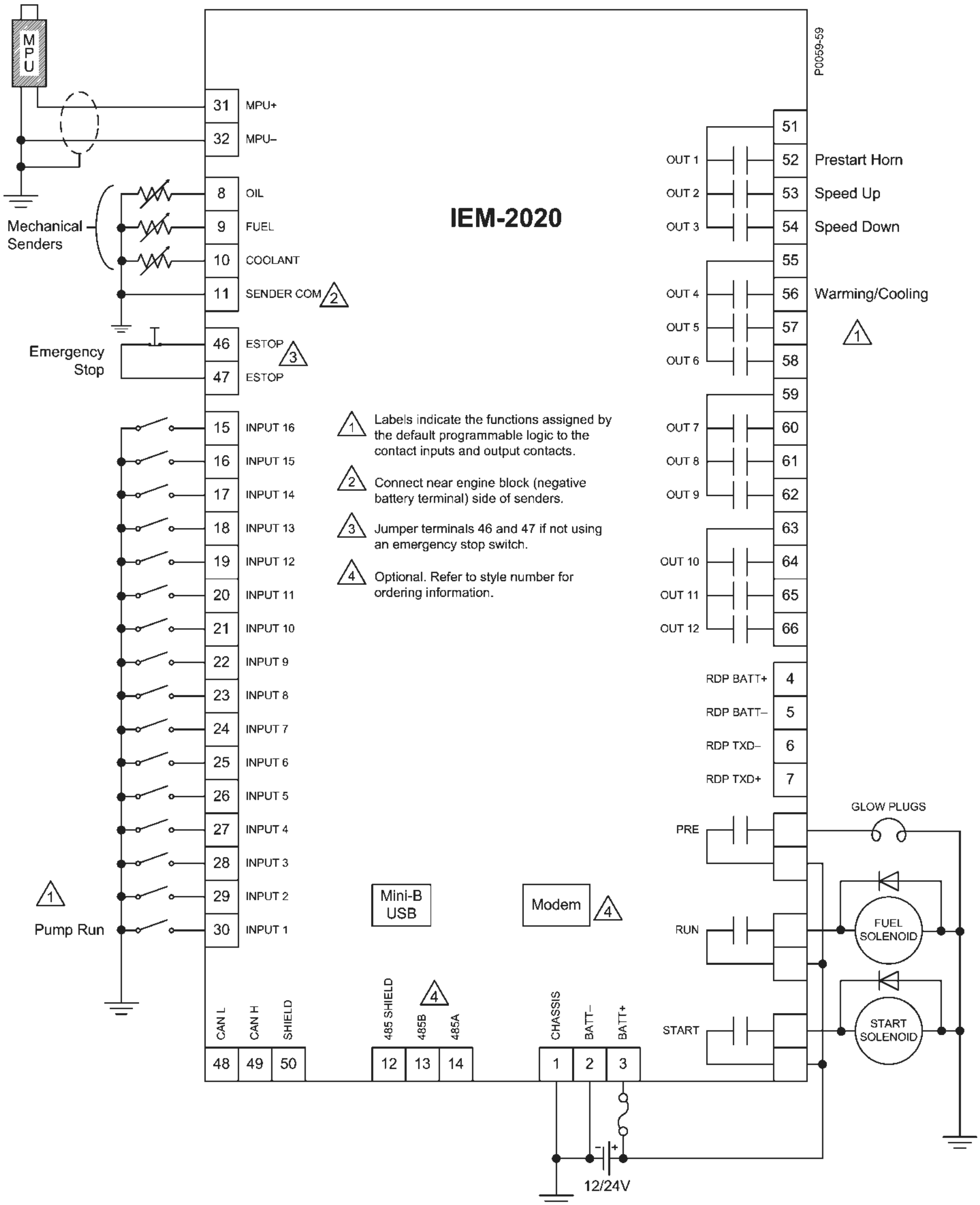

Figure 6-5. Connections for Typical Applications

Connections for Volvo Penta EDC III Applications

Engines equipped with Volvo Penta EDC III controllers will receive engine control commands (such as start and stop) from the IEM-2020 through the SAE J1939 communication interface. To invoke this feature, the EDC III must receive a J1939 message containing engine control information within one second of waking (exiting sleep mode). If the EDC III 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 III must be forced back into sleep mode by pressing the auxiliary stop pushbutton on the engine or by shortly disconnecting EDC power.

The interconnection diagram of Figure 6-6 illustrates the IEM-2020 and EDC III connections that allow the IEM-2020 to awaken the EDC III and start the engine, or simply acquire engine status information. Wake-up of the EDC III is initiated by using the IEM-2020 RUN output contacts to apply battery power to the EDC. To stop the engine, the IEM-2020 sends a sleep command through the J1939 interface to the EDC III and opens the RUN output contacts. This causes the EDC to stop the engine and enter the sleep mode.

In order for the IEM-2020 to communicate with the EDC III, two IEM-2020 settings must be changed from their default values.

- The J1939 address of the IEM-2020 must be set at 17.
- The engine start/stop configuration setting must be set for Volvo Penta.

Both settings are configured on the *CANbus Setup* screen of BESTCOMS*Plus*. Section 4, *BESTCOMSPlus Software* has information about adjusting IEM-2020 settings through BESTCOMS*Plus*.

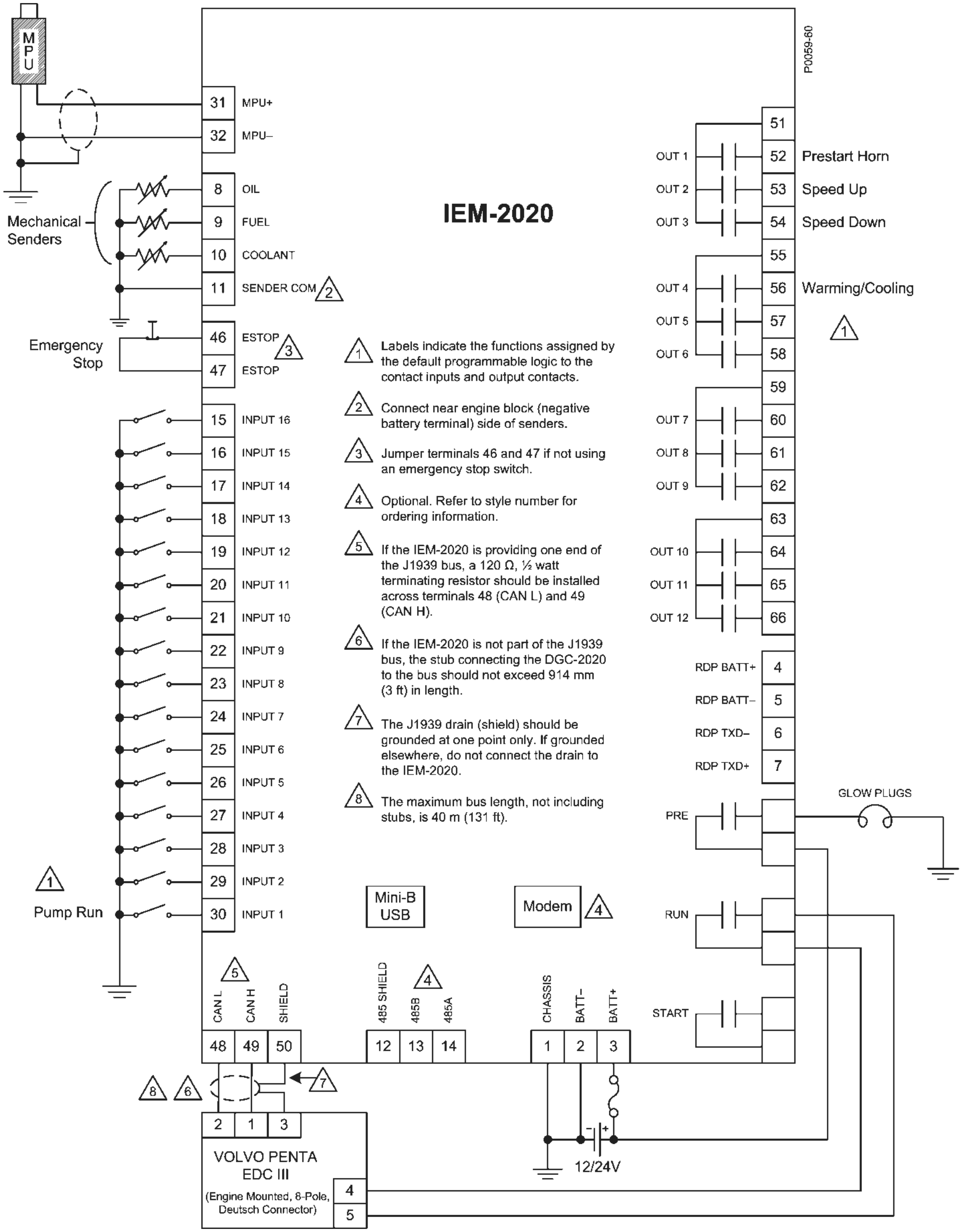

Figure 6-6. Connections for Volvo Penta EDC III Applications

Connections for MTU MDEC ECU Applications

MTU MDEC ECUs, supplied on some MTU engines, will receive engine control commands from the IEM-2020 and transmit engine operating status information to the IEM-2020 through the SAE J1939 communication interface.

In order for the IEM-2020 to communicate with the MTU MDEC ECU, ECU support must be enabled on the CANbus Setup screen of BESTCOMS*Plus* and “MTU MDEC” must be selected as the engine configuration. The appropriate ECU module type, speed demand source, and engine rpm must also be selected.

The MTU MDEC ECU must be configured properly in order for CANbus communication to function correctly. The parameters listed in Table 6-10 must be configured in the ECU with the MTU service tool. Contact MTU if ECU reconfiguration is required and your facility is not equipped to perform this task.

Table 6-10. MTU MDEC ECU Configuration Parameters

MTU Parameter Number	Parameter Name	Description and Value
200	CANbus Interface Config Param	Set to 898 – Indicates one CANbus with PIMS
201.01	CANbus Monitor Nodes 1–16	Binary value indicating which communication devices are on the CANbus network. If a binary representation of this parameter’s value does not have the bit set corresponding to a value of 00100000, take the value in this register, add 32 to it, and rewrite it to the register to set the bit. This informs the MTU MDEC ECU that a third part controller resides on the CANbus.
156.19	CANbus Speed Demand Switch Active	Set to 1 – This is necessary only if it is desired to set the engine speed demand source and speed demand from the IEM-2020. Setting the parameter to zero blocks this capability.

The interconnection diagram of Figure 6-7 illustrates IEM-2020 and MTU MDEC ECU connections.

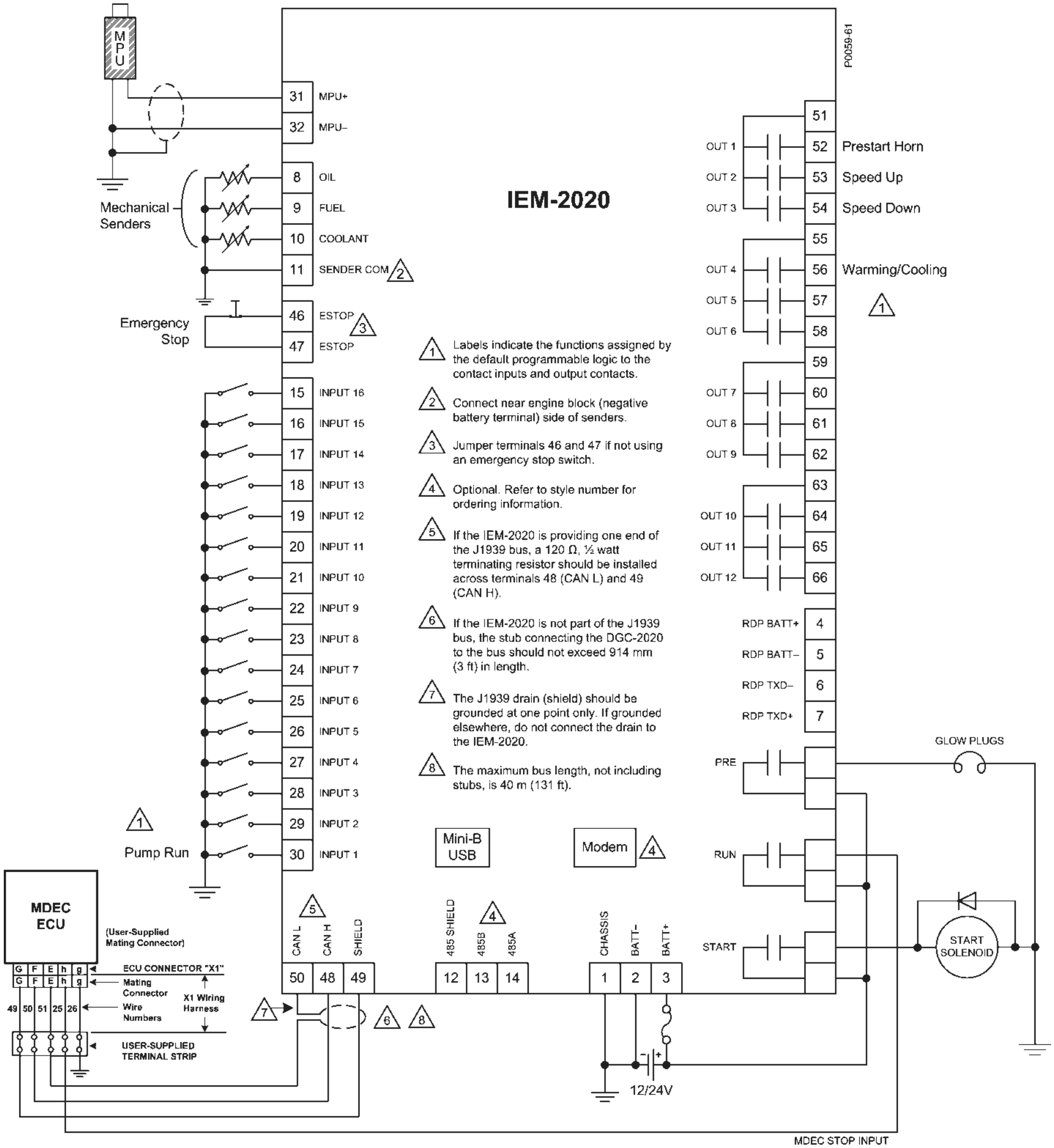

Figure 6-7. Connections for MTU MDEC ECU Applications

Connections with AEM-2020, CEM-2020/H, and LSM-2020

The AEM-2020 (Analog Expansion Module), CEM-2020/H (Contact Expansion Module), and LSM-2020 (Load Share Module) are optional modules that may be installed with the IEM-2020. These modules interface to the IEM-2020 via CANbus, thus the CANBUS terminals are the only common connections (Figure 6-8) between the IEM-2020, AEM-2020, CEM-2020/H, and LSM-2020. Refer to Section 8, *LSM-2020 (Load Share Module),* for independent LSM-2020 connections. Refer to Section 9, *CEM-2020 (Contact Expansion Module),* for independent CEM-2020/H connections. Refer to Section 10, *AEM-2020 (Analog Expansion Module),* for independent AEM-2020 connections. Refer to *Connections, CANbus Interface,* in this section for details on IEM-2020 CANbus connections.

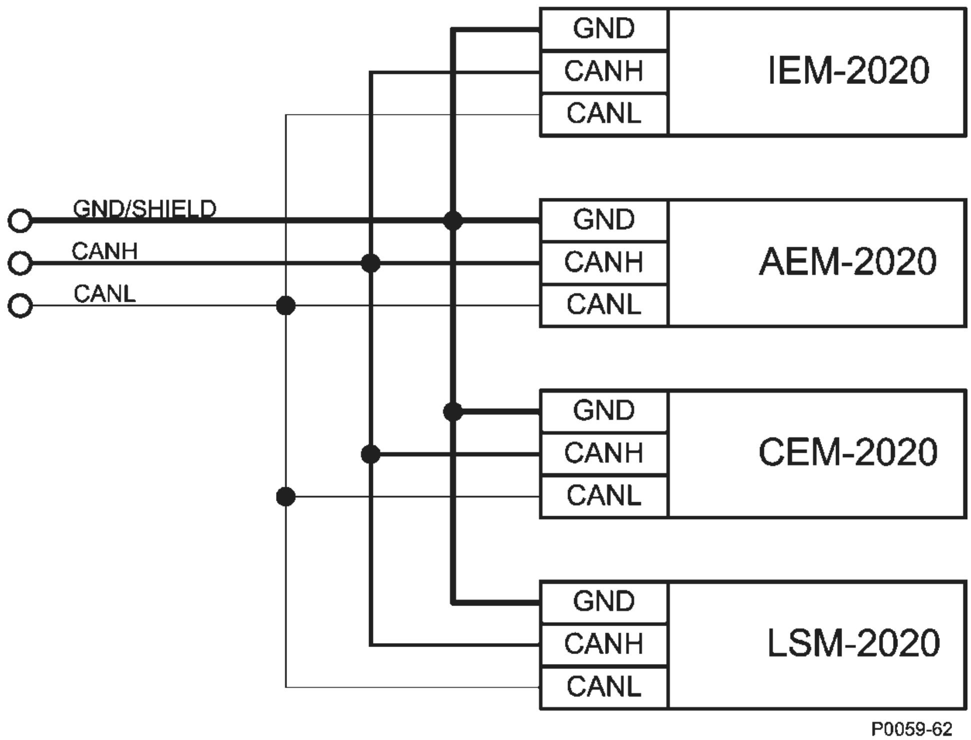

Figure 6-8. IEM-2020, AEM-2020, CEM-2020/H, LSM-2020 CANbus Connections

INSTALLATION IN A SALT FOG ENVIRONMENT

Basler Electric recommends removing the backup battery for the real-time clock before installing the IEM-2020 in a salt-fog environment. Salt fog can be conductive and may short-circuit the battery.

Information on removing the backup battery for the real-time clock is found in Section 7, *Maintenance and Troubleshooting.*

IEM-2020 SETUP

The following paragraphs provide information for initial setup of an IEM-2020.

IEM-2020 Initial Setup

The IEM-2020 provides the desired machine control and protection when the parameters specific to the machine that it is controlling are set up. Configure the following parameters prior to starting the engine. This instruction manual lists the parameters according to how the Settings Explorer in BESTCOMS*Plus* presents them. These parameters can also be set through the front panel of the IEM-2020, but BESTCOMS*Plus* is generally more convenient.

Use BESTCOMS*Plus* to connect to the IEM-2020. After changing settings, click the *Send Settings* button to send the settings to the IEM-2020. Settings information may be lost if the *Send Settings* button is not pressed or if modified settings are not saved to a settings file.

Initial Setup Required to Operate Unit

Prior to running the machine, configure the following parameters in the IEM-2020. Only required parameters are presented in this discussion.

1. General Settings

   a. Style Number

      Use BESTCOMS*Plus* to connect to the IEM-2020. Check the style number of the IEM-2020 to verify that the required features exist for the machine being configured. See Figure 6-9.

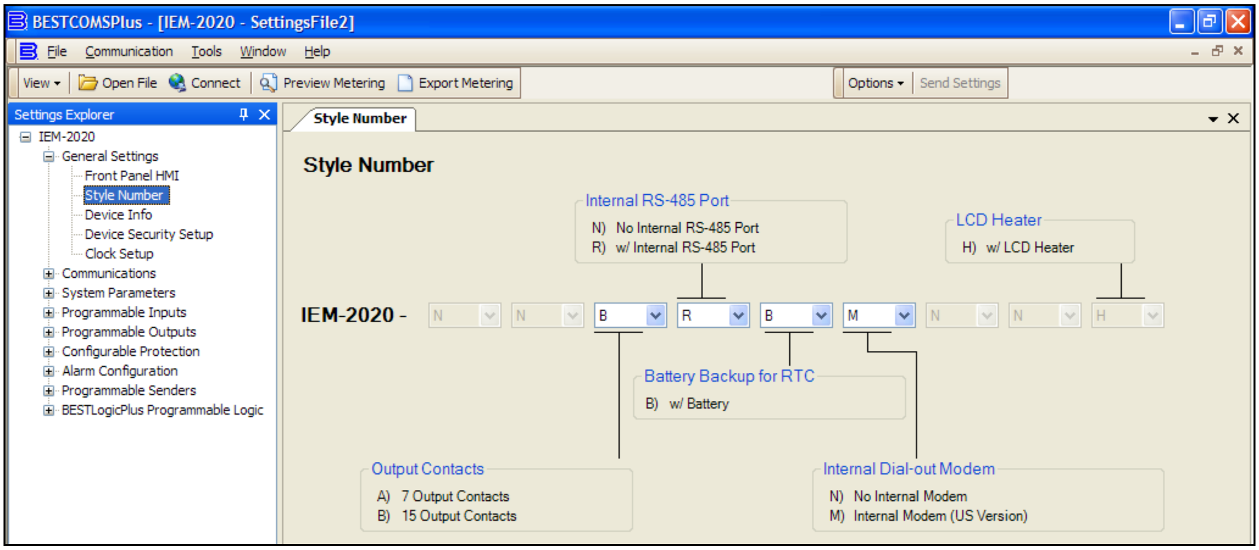

Figure 6-9. Settings Explorer, General Settings, Style Number Screen

2. Communications

   Communications must be set up if the IEM-2020 will communicate with an ECU (engine control unit) that is connected to the engine.

   a. CANBus Setup (Figure 6-10)

      i. Enable ECU Support - Set to Enabled for the IEM-2020 to communicate with the ECU.

      ii. Enable DTC (Diagnostic Trouble Code) Support - If the ECU is a J1939 ECU, enable DTC support. The IEM-2020 will not log diagnostic trouble codes if the ECU does not support them.

      iii. ECU Contact Control - Output Select - Select whether the RUN output relay or the PRE (Prestart) output relay will close to give the ECU its “energize to run” signal. In some implementations, this relay may actually be providing ECU power.

      iv. ECU Contact Control - Pulsing Enable - Select if the ECU is not to be on line at all times. Often ECUs are allowed to go “off line” to conserve battery drain when the engine is not running. The IEM-2020 will “pulse” it periodically to force it to be active to allow the IEM-2020 to read data such as coolant temperature and coolant level. This is required if the IEM-2020 is to report low coolant temperature conditions (which may indicate failure of a block heater), or low coolant level conditions (if a leak occurs while the machine is not running). Pulsing is also used to check the integrity of CANBus communications when the machine is not running.

      v. ECU Related Time Values - Engine Shut Down - Set this parameter for a time longer than the amount of time required to stop the engine after shutting down. The ECU is pulsed after this time expires. If the time is too short, the pulse may occur while the engine is still turning which could cause a brief re-start and possibly damage the flywheel and starter system.

      vi. ECU Related Time Values - Pulse Cycle Time - This parameter sets the desired time between ECU pulse cycles.

vii. ECU Related Time Values - Settling Time - This parameter sets the duration of the "on line" time of the pulse cycle during which the IEM-2020 reads data from the ECU. The settling time should be set long enough so that any ECU parameters that require time to "settle down" after the ECU goes on line can do so. Since the IEM-2020 may use some of the ECU data for alarm or pre-alarm annunciation, it is important that the data have time to settle.

viii. ECU Related Time Values - Response Timeout - This parameter defines the amount of time that the IEM-2020 will wait to receive data from the ECU during a pulse cycle or start attempt. A LOSS OF ECU COMMS pre-alarm is annunciated if data is not received during this time in a pulse cycle. If no data is received in this time during an engine starting attempt, a LOSS OF ECU COMMS alarm is annunciated.

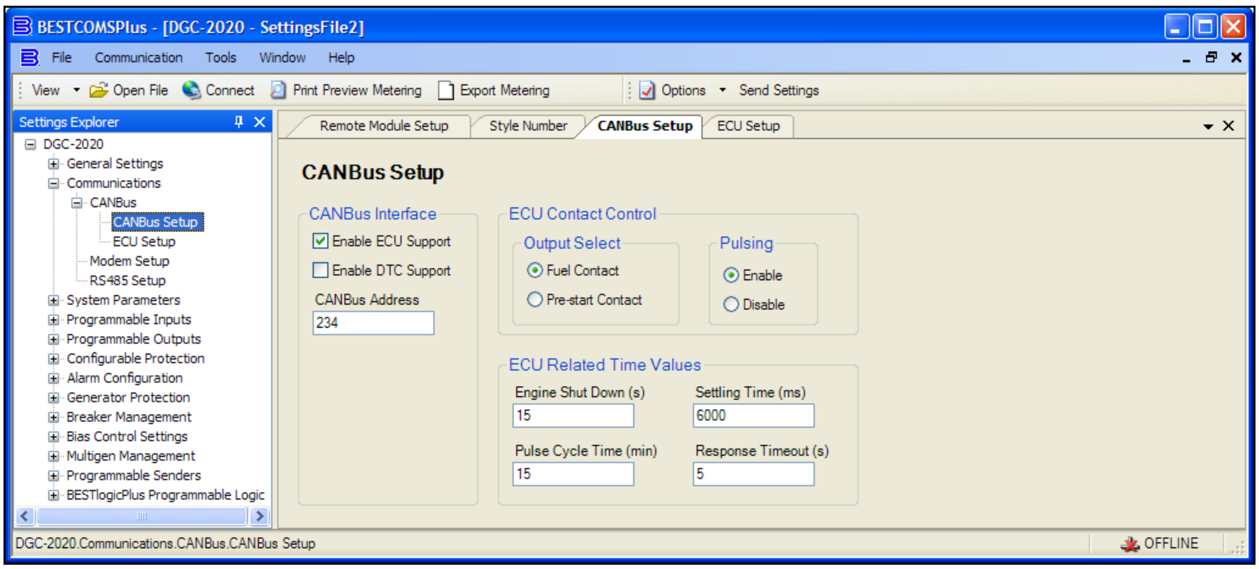

Figure 6-10. Settings Explorer, Communications, CANbus Setup Screen

b. ECU Setup (Figure 6-11)

i. ECU Type - For most engines, select *Standard*. However, there are exceptions. If your engine is a Volvo, select *Volvo-Penta*. If you have an MTU MDEC, ADEC, or ECU-7, make the appropriate selection. Depending on the ECU type selected, some parameters are enabled, allowing you to configure them for the specific engine. Modification of these parameters is not required for the initial setup. Refer to the appropriate paragraphs in Section 4, *BESTCOMSPlus Software*, for additional information.

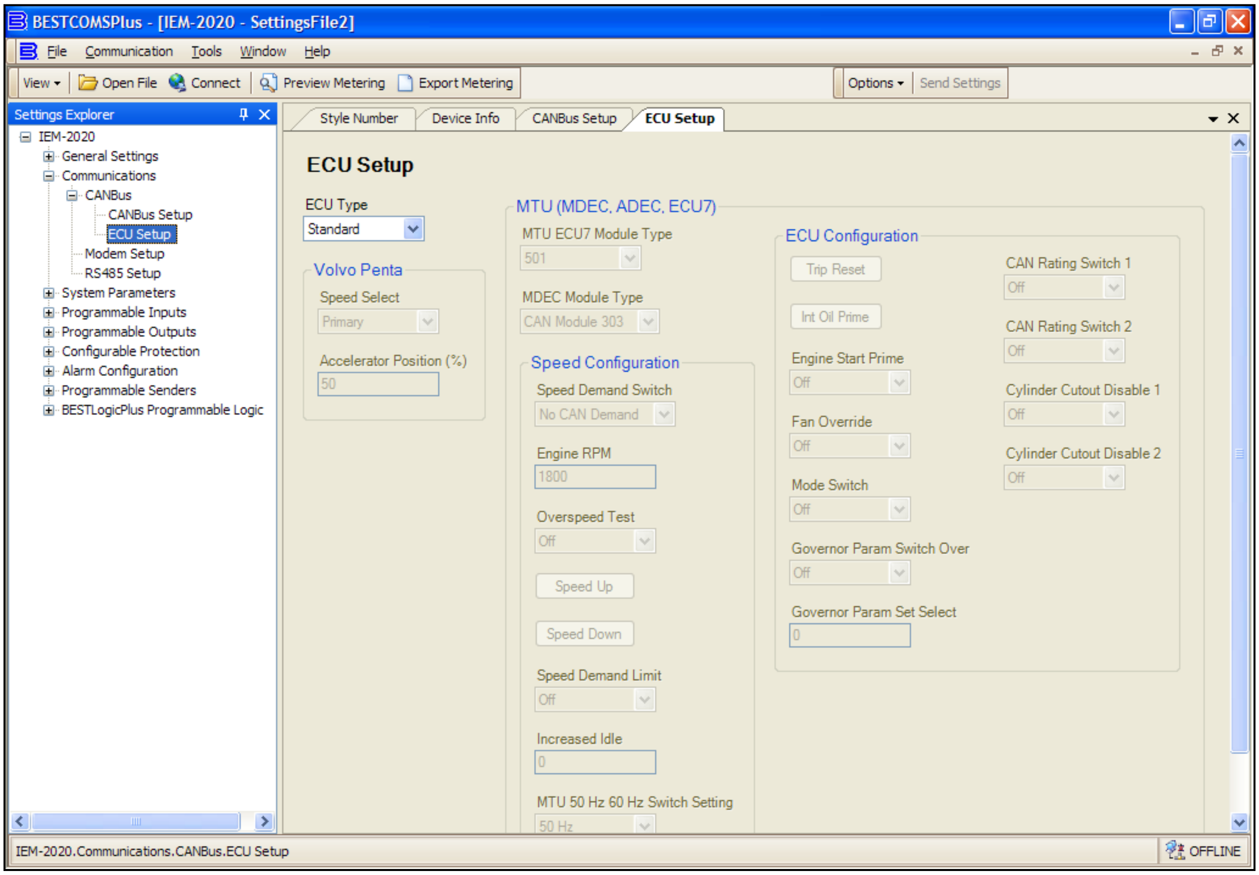

Figure 6-11. Settings Explorer, Communications, ECU Setup Screen

3. <u>System Parameters</u>
   a. System Settings (Figure 6-12)
      i. Rated Engine RPM - This parameter defines the rpm rating of the machine.
      ii. Off Mode Cooldown Enable - When this setting is disabled, pressing the OFF button stops the unit immediately. When enabled, pressing the OFF button once starts a cool down cycle and the RUN LED flashes. The unit completes the cool down cycle and then stops in OFF mode. If the OFF button is pressed a second time, the unit stops immediately.
      iii. Fuel Level Function - This setting defines the fuel type of the machine. If a fuel level sender is available in a tank, set this to *FUEL LVL*. If liquid propane or natural gas is used, set accordingly. When disabled, the IEM-2020 displays N/A for fuel level on the overview screen.
      iv. System Units - This setting defines *English* or *Metric* units.
      v. Battery Voltage - Select *12* or *24*.
      vi. Number of Flywheel Teeth - This setting defines the number of teeth on the flywheel for engines equipped with a magnetic pickup sensor (MPU) which detects engine speed.
      vii. Horn Enable - This setting enables or disables the output for the external alarm horn.
      viii. Relay Control - This parameter specifies if the PRE, START, and RUN relays on the back of the IEM-2020 will operate with their default functionality or be logic usable. In general, most machines will use pre-configured functionality; more advanced users may select logic usable. Refer to the appropriate paragraphs in Section 4, *BESTCOMSPlus Software,* for additional information.

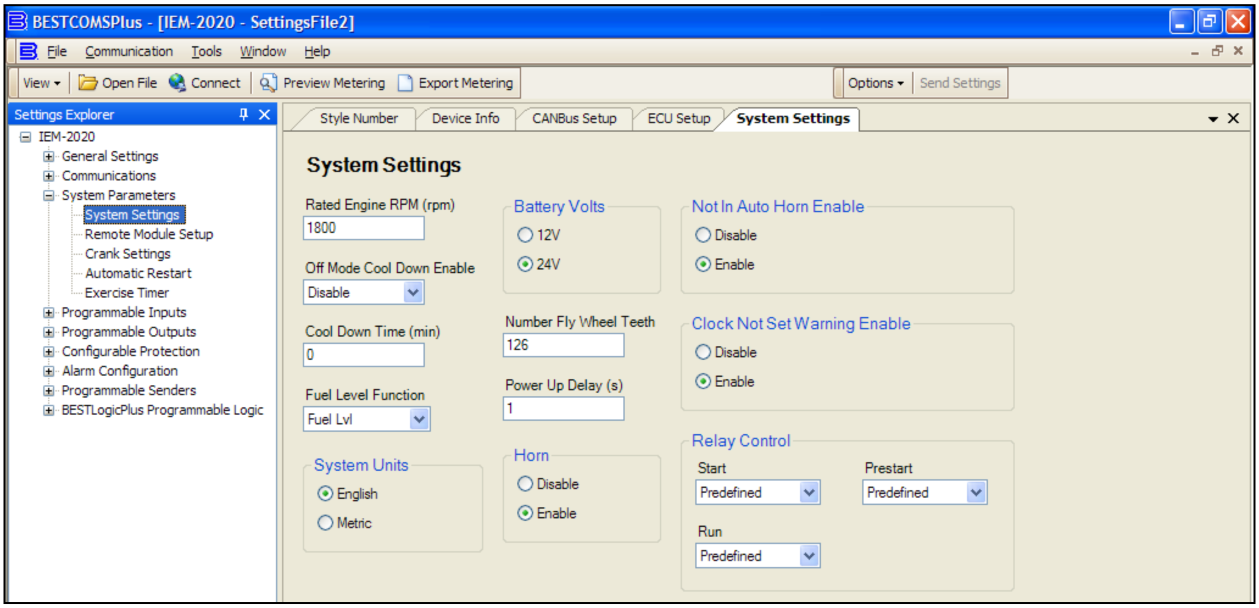

Figure 6-12. Settings Explorer, System Parameters, System Settings Screen

b. Remote Module Setup (Figure 6-13)

Enable the I/O modules that are used with the IEM-2020. Refer to the appropriate sections in the IEM-2020 manual for details regarding the individual I/O modules. Disable all if no modules are present.

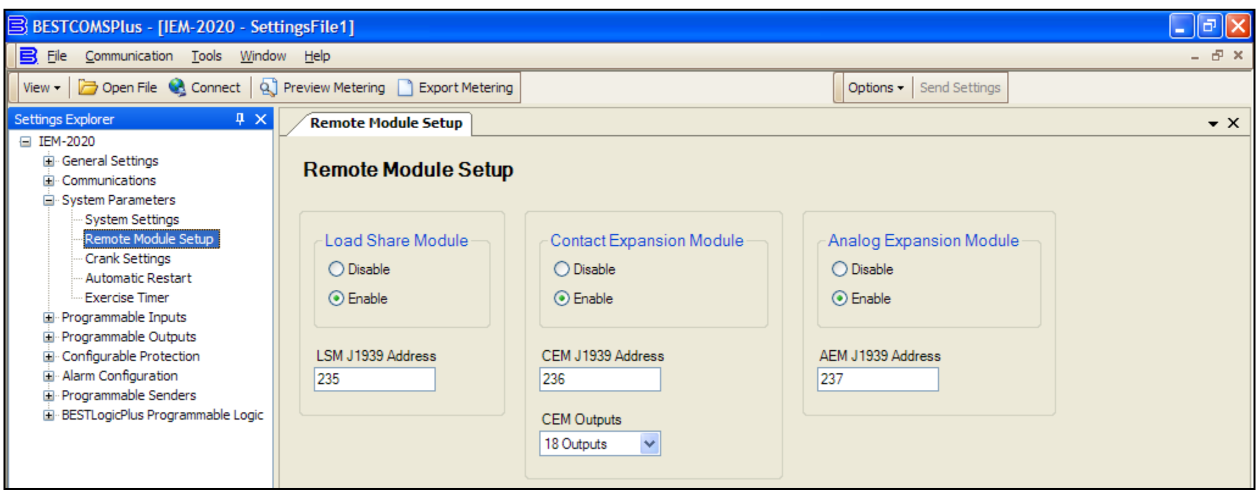

Figure 6-13. Settings Explorer, System Parameters, Remote Module Setup Screen

c. Crank Settings (Figure 6-14)

i. Crank Disconnect Limit - This setting defines the engine rpm threshold in percentage of rated rpm at which crank disconnect should occur.

ii. Pre-Crank Delay - This value specifies the amount of time pre-cranking occurs. The PRE contact output relay will be closed during this time. This is typically used for engine preheat and/or pre-lubrication.

iii. Prestart Contact Config - This parameter defines whether the PRE relay remains closed after the engine starts, or if it should open.

iv. Prestart Rest Configuration - There may be situations where it is desired that the PRE relay be closed during engine cranking but open for all or part of a crank resting cycle. Configure this parameter accordingly. Refer to the appropriate paragraphs in Section 4, *BESTCOMSPlus Software,* for additional information.

v. Oil Pressure Crank Disconnect - This setting provides an alternate method of determining conditions under which crank disconnect should occur. If the machine has no magnetic pick up (MPU) for rpm detection or a failed MPU, it will use oil pressure as criterion for crank disconnect. This will prevent long starter engagement if the engine starts and the IEM-2020 cannot determine engine speed for crank disconnect purposes.

vi. Cranking Style - Cycle cranking or continuous cranking is selected with this setting.

vii. Cycle

1. Number of Crank Cycles - This setting defines the number of crank cycles if *Cycle* is selected as the cranking style.
2. Crank Cycle Time: This setting defines the time duration of the crank cycle if *Cycle* is selected as the cranking style.

viii. Continuous

1. Continuous Crank Time - This setting defines the time duration of the crank cycle if *Continuous* is selected as the cranking style.

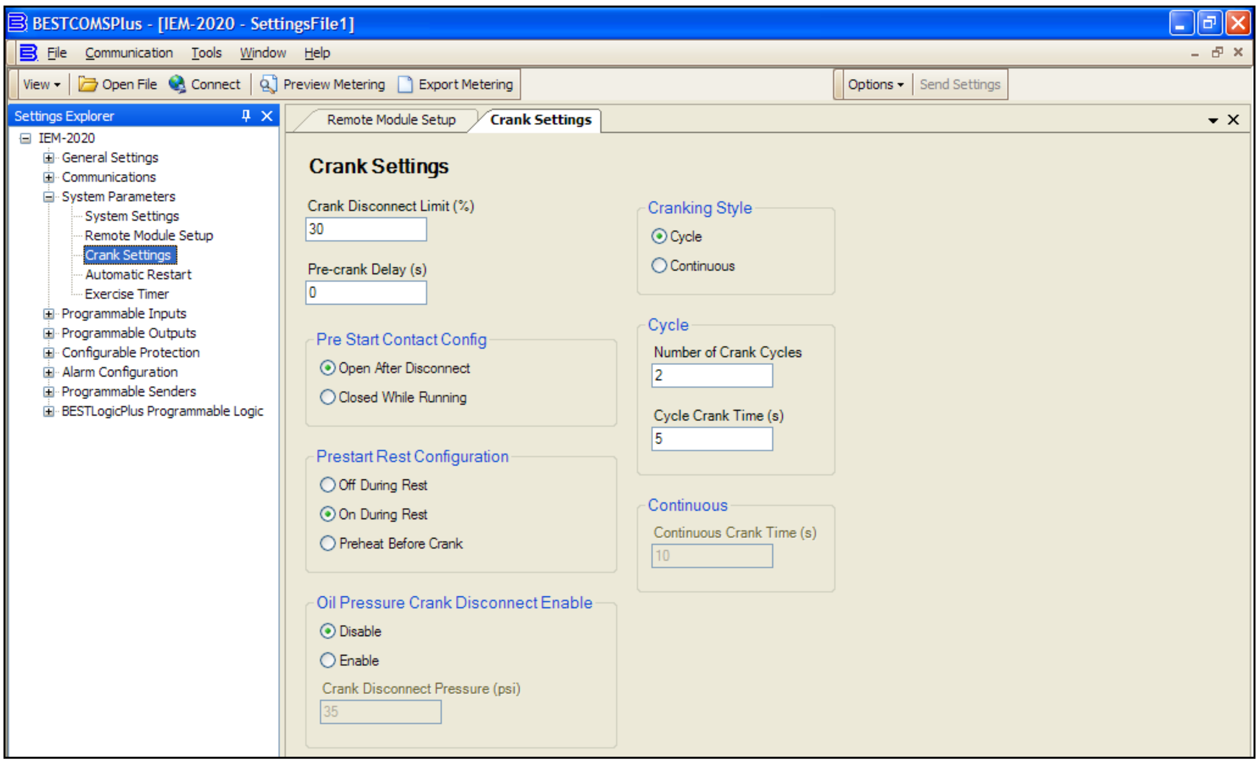

Figure 6-14. Settings Explorer, System Parameters, Crank Settings Screen

4. <u>Alarm Configuration</u>

a. Pre-Alarms - Examine each available pre-alarm. No pre-alarms are required to operate the machine, but they are likely to be desired to provide warnings for machine protection. Enable each pre-alarm as desired and define an appropriate threshold. Set the activation delay where possible; this is the time duration for a condition to remain in effect before it will be annunciated. Refer to the appropriate paragraphs in Section 4, *BESTCOMSPlus Software,* for additional information regarding pre-alarm configuration. See Figure 6-15.

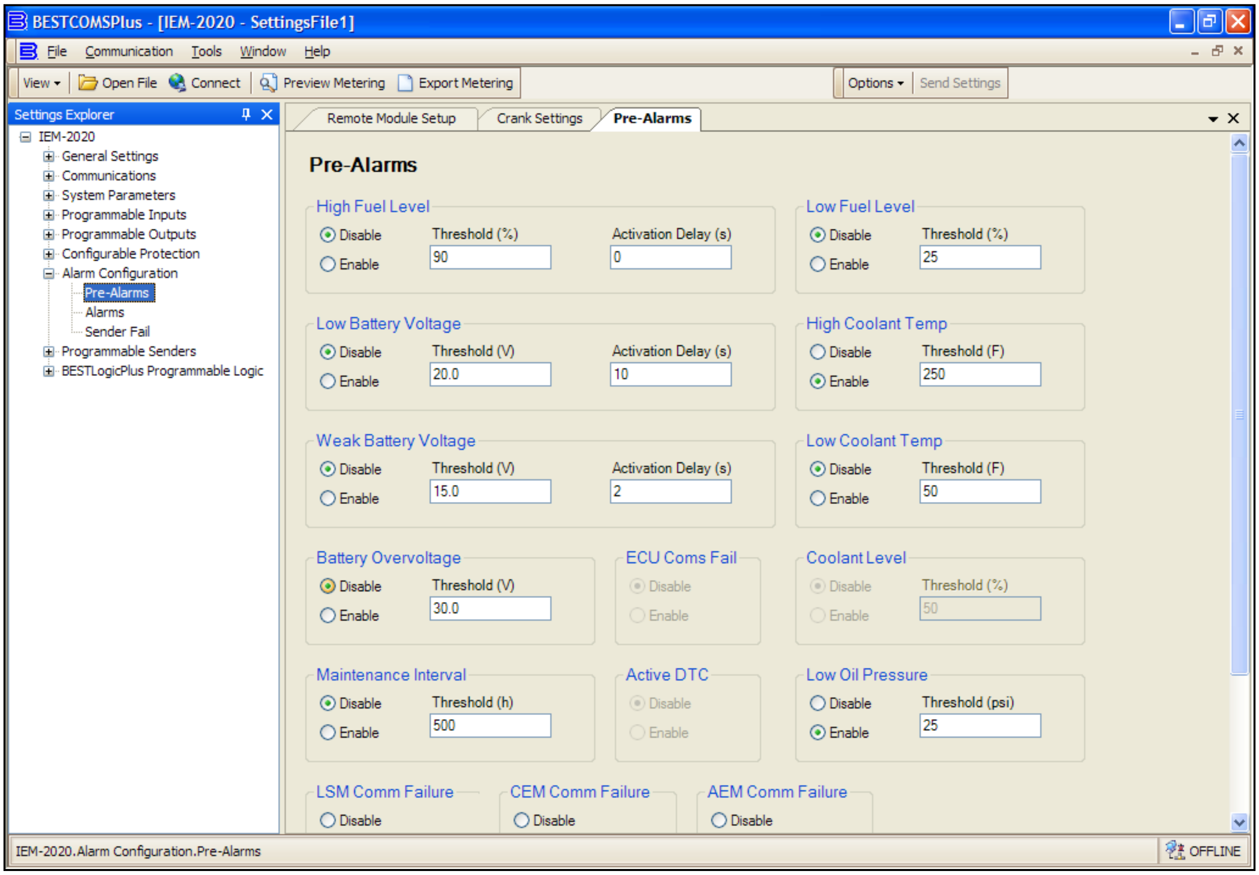

Figure 6-15. Settings Explorer, Alarm Configuration, Pre-Alarms Screen

b. Alarms - Examine each of the available alarms. No alarms are required to operate the machine, but are likely to be desired to provide shutdowns for machine protection. Enable each alarm as desired and define an appropriate threshold. Set the *Activation Delay* where possible; this is the time duration for a condition to remain in effect before it will be annunciated. Refer to the appropriate paragraphs in Section 4, *BESTCOMSPlus Software,* for additional information regarding alarm configuration. See Figure 6-16.

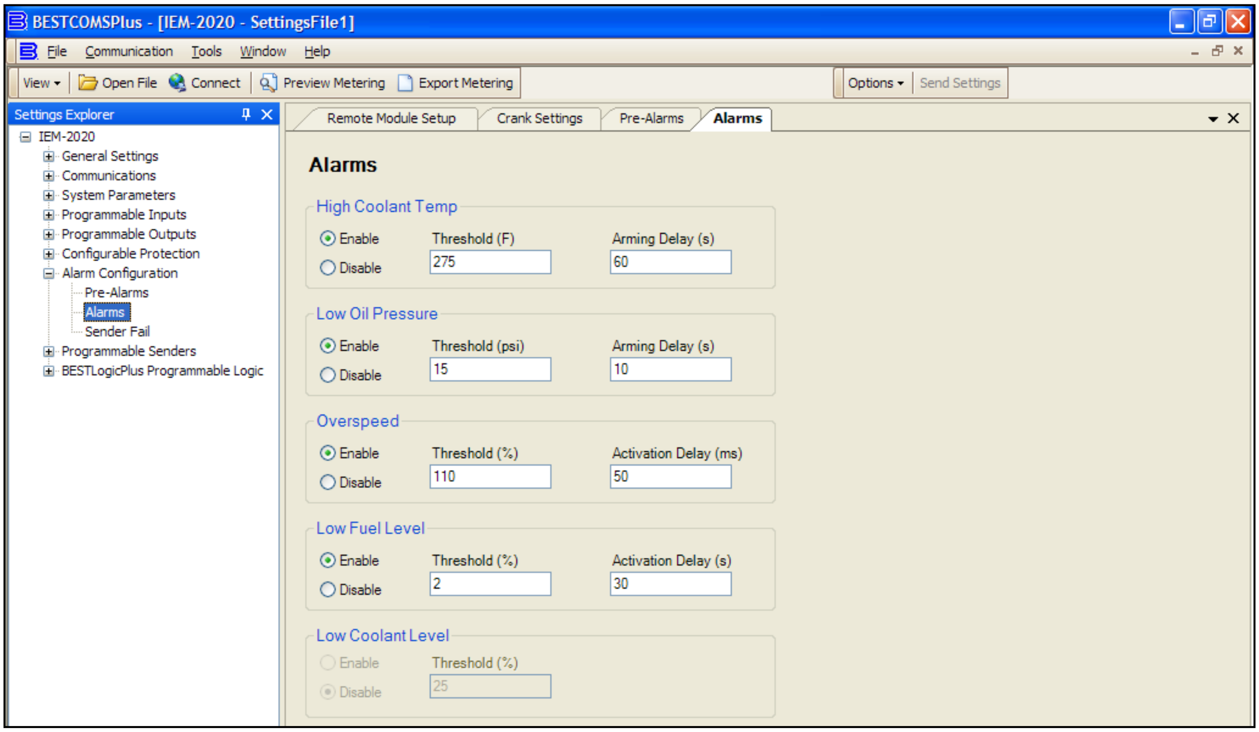

Figure 6-16. Settings Explorer, Alarm Configuration, Alarms Screen

c. Sender Fail - Enable each sender fail type as desired by configuring it as an alarm or pre-alarm. Set an activation delay; this is the time duration for the condition to remain in effect before it will be annunciated. Refer to the appropriate paragraphs in Section 4, *BESTCOMSPlus Software,* for additional information regarding sender fail configuration. If an IEM-2020 is receiving engine information from an engine ECU, the sender fail parameters for coolant temperature and oil pressure are not necessary because they have no effect. These parameters are appropriate for resistive senders only. See Figure 6-17.

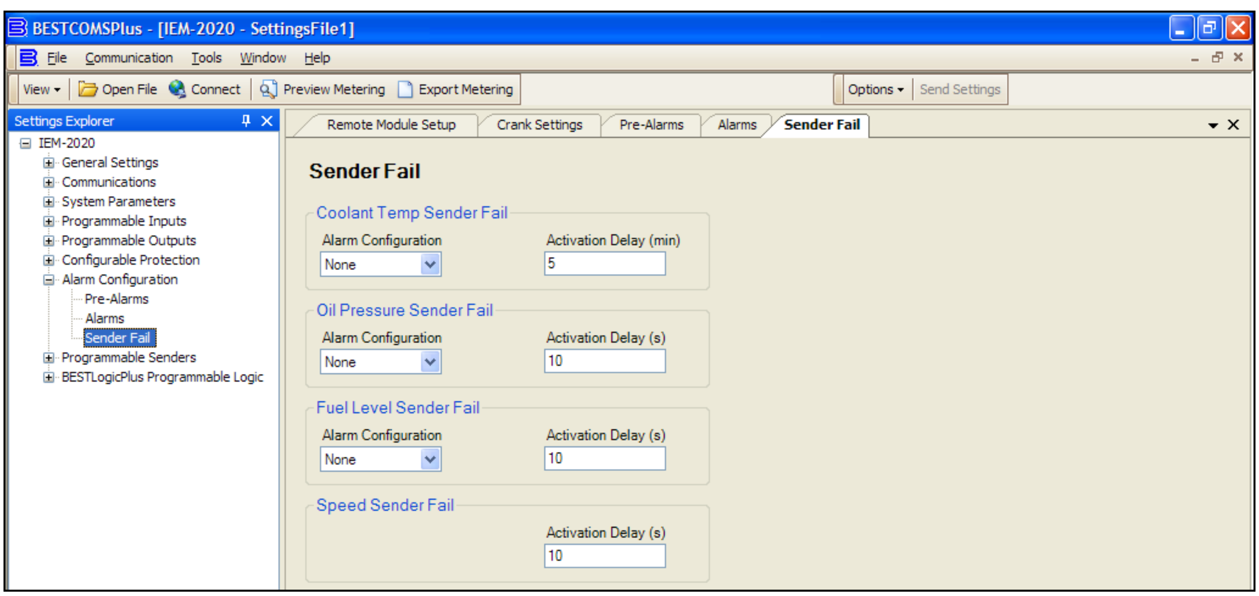

Figure 6-17. Settings Explorer, Alarm Configuration, Sender Fail Screen

5. Programmable Senders

If an IEM-2020 is receiving engine information from an engine ECU, the programmable sender parameters for coolant temperature and oil pressure are not necessary because they have no effect. These parameters are appropriate for resistive senders only.

a. Coolant Temperature (Figure 6-18)

i. The coolant temperature sender is configured by selecting one of the sender types that come as part of the BESTCOMS*Plus* sender library by clicking *Load Cool Settings File* and selecting the appropriate sender.

ii. If no sender file matches the sender being used, the individual points that map resistance points to coolant temperature may be modified by entering numeric values in the table, or dragging the points of the graph to the desired characteristic. Information on sender characteristics should be obtained from the sender manufacturer.

iii. Select *Positive* or *Negative* sender slope as required for the desired sender graph.

iv. Click *Save Cool Data* to save the data in the current settings file.

v. Manually entered sender data will be saved as a sender library file by clicking *Create Cool Settings File* and entering a file name and specifying a location to save the file.

vi. Click *Send Settings* in BESTCOMS*Plus* to send the sender settings to the IEM-2020.

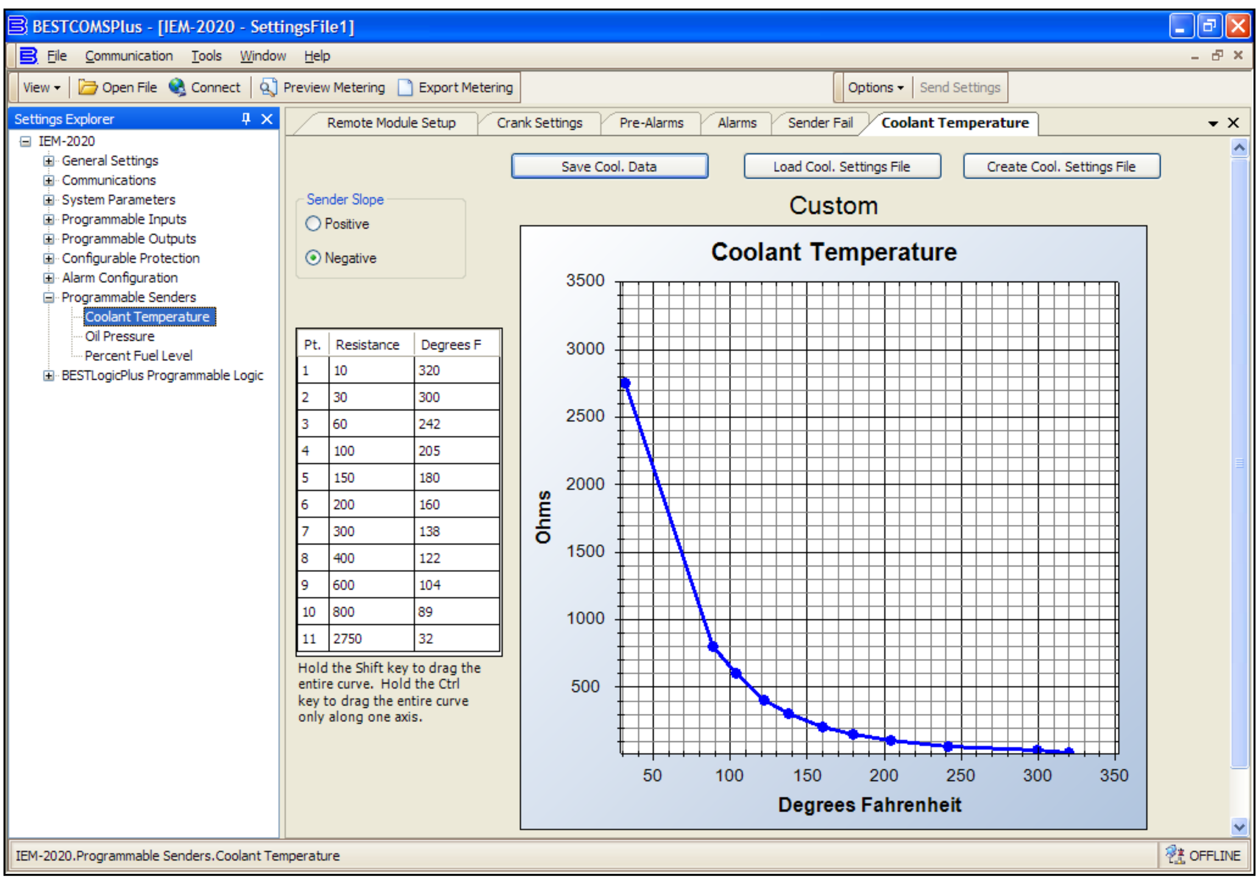

Figure 6-18. Settings Explorer, Programmable Senders, Coolant Temperature Screen

b. Oil Pressure (Figure 6-19)

i. The oil pressure sender is configured by selecting one of the sender types that come as a part of the BESTCOMS*Plus* sender library by clicking *Load Oil Settings File* and selecting the appropriate sender.

ii. If no sender file matches the sender being used, the individual points that map resistance points to oil pressure may be modified by entering numeric values in the table, or dragging the points of the graph to the desired characteristic. Information on sender characteristics should be obtained from the sender manufacturer.

iii. Select *Positive* or *Negative* sender slope as required for the desired sender graph.

iv. Click *Save Oil Data* to save the data in the current settings file.

v. Manually entered sender data will be saved as a sender library file by clicking *Create Oil Settings File* and entering a file name and specifying a location to save the file.

vi. Click *Send Settings* in BESTCOMS*Plus* to send the sender settings to the IEM-2020.

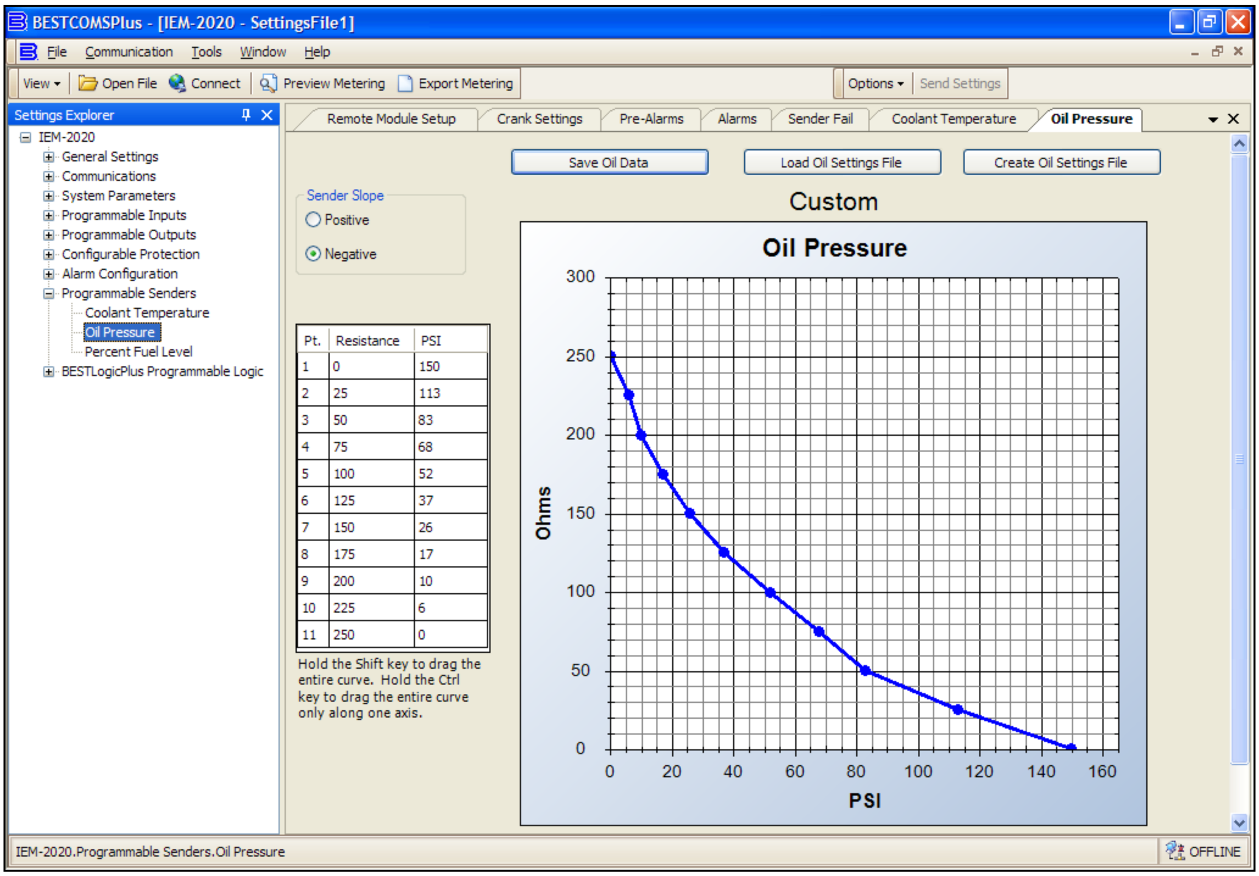

Figure 6-19. Settings Explorer, Programmable Senders, Oil Pressure Screen

c. Percent Fuel Level (Figure 6-20)

i. The percent fuel level sender is configured by selecting one of the sender types that come as a part of the BESTCOMS*Plus* sender library by clicking *Load Fuel Settings File* and selecting the appropriate sender.

ii. If no sender file matches the sender being used, the individual points that map resistance points to fuel level may be modified by entering numeric values in the table, or dragging the points of the graph to the desired characteristic. Information on sender characteristics should be obtained from the sender manufacturer.

iii. Select *Positive* or *Negative* sender slope as required for the desired sender graph.

iv. Click *Save Fuel Data* to save the data in the current settings file.

v. Manually entered sender data will be saved as a sender library file by clicking *Create Fuel Settings File* and entering a file name and specifying a location to save the file.

vi. Click *Send Settings* in BESTCOMS*Plus* to send the sender settings to the IEM-2020.

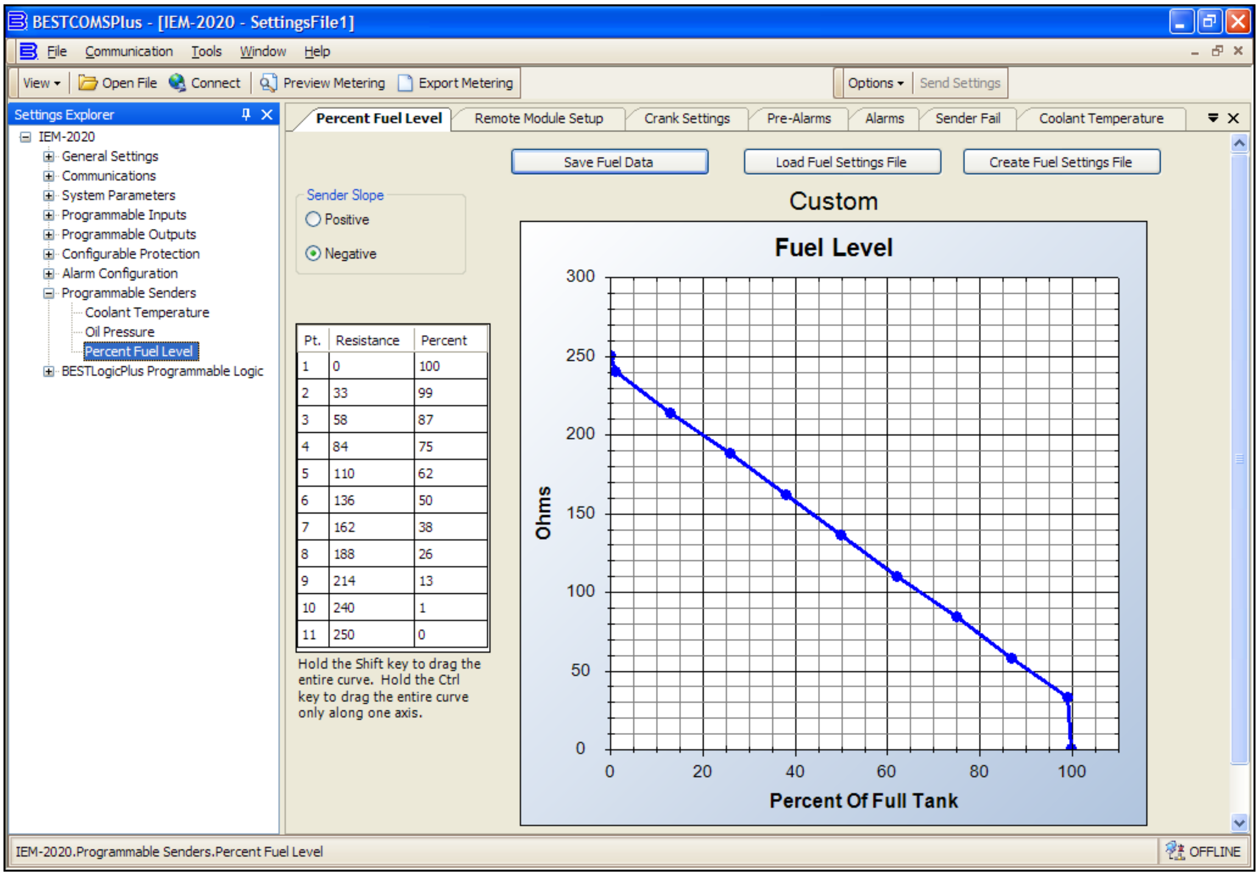

Figure 6-20. Settings Explorer, Programmable Senders, Percent Fuel Level Screen

This completes the discussion of initial IEM-2020 setup parameters that are required prior to running a unit.

<u>Initial Setup (Optional)</u>

This section discusses basic setup parameters that are not required to start and run the unit, but may be set up to further customize the IEM-2020 to a specific application. This discussion only presents some of the basic setup parameters. Advanced users can customize the IEM-2020 through BESTLogic*Plus* Programmable Logic, configurable inputs, configurable protection, configurable elements, and numerous other features designed for IEM-2020 configurability.

The parameters are listed in accordance with the Settings Explorer of BESTCOMSPlus. These parameters can also be set from the front panel of the IEM-2020.

6. <u>General Settings</u>

   a. Front Panel HMI (Figure 6-21)

      i. LCD Contrast - This setting changes the contrast of the LCD.

      ii. Front Panel Sleep Mode - When sleep mode is enabled, the LEDs and LCD backlight turn off after 15 minutes of inactivity on the front panel to minimize battery drain.

      iii. Language Selection - This setting selects the desired language.

      iv. Scrolling Screens - Scrolling screen settings are not accessible via the front panel. If it is desired to change the default overview screen, the user can specify scrolling screens and configure which parameters are to appear on the front panel LCD display by configuring the *Configurable HMI Summary Settings*.

1. Select the *Configurable HMI Summary* screens.
2. Set the *Scrolling Screen Enable* to *Enable*.
3. Define the *Scrolling Screen Scroll Delay*.

v. Initializing Message 1 - This parameter is the first of two programmable lines of text that appear on the front panel of the IEM-2020 as during power up and initializing sequence.

vi. Initializing Message 2 - This parameter the second of two programmable lines of text that appear on the front panel of the IEM-2020 during power up and initializing sequence.

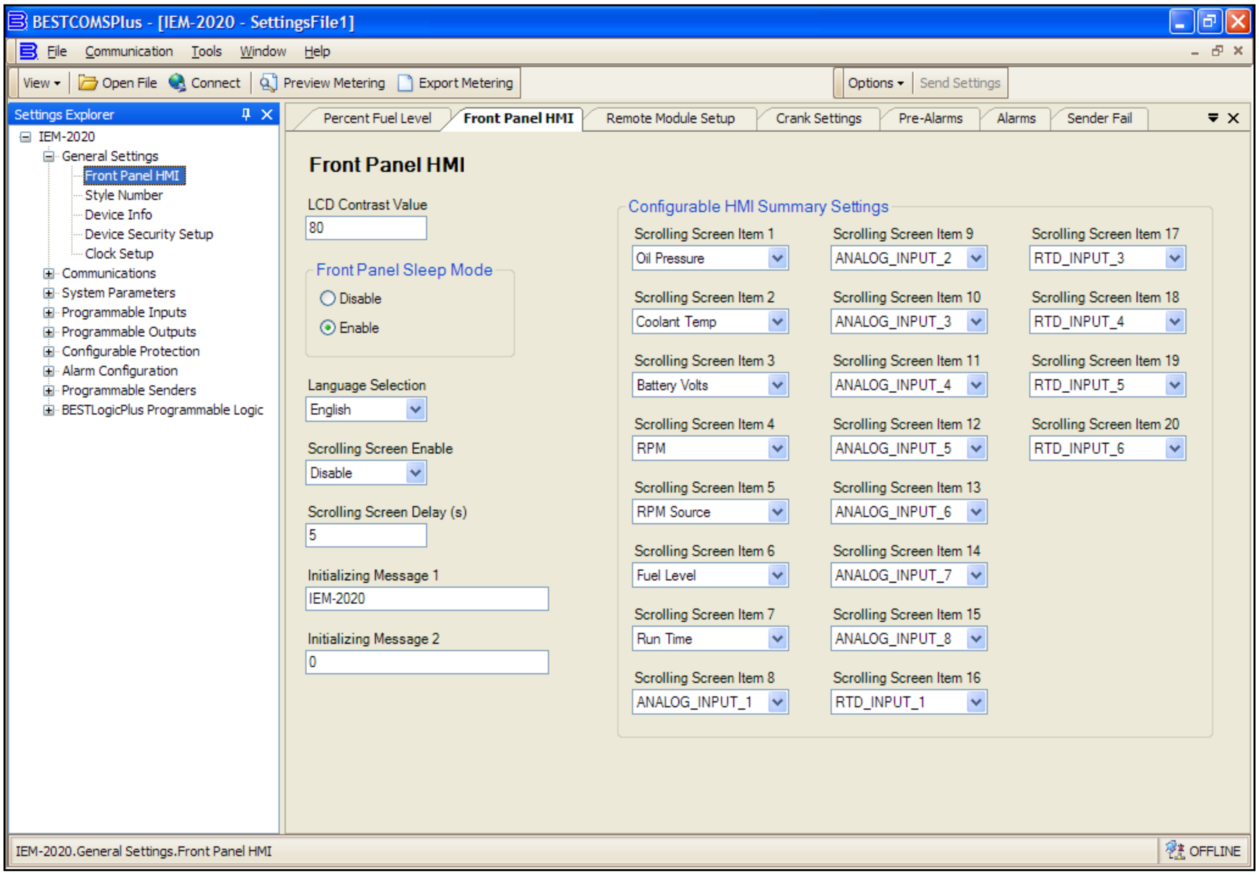

Figure 6-21. Settings Explorer, General Settings, Front Panel HMI Screen

b. Device Security Setup - If changing the default passwords is desired, connect to the IEM-2020 with BESTCOMS*Plus*, enter the passwords on the *Device Security Setup* screen, and click *Upload Security* from the *Communications* pull-down menu to load the passwords. See Figure 6-22.

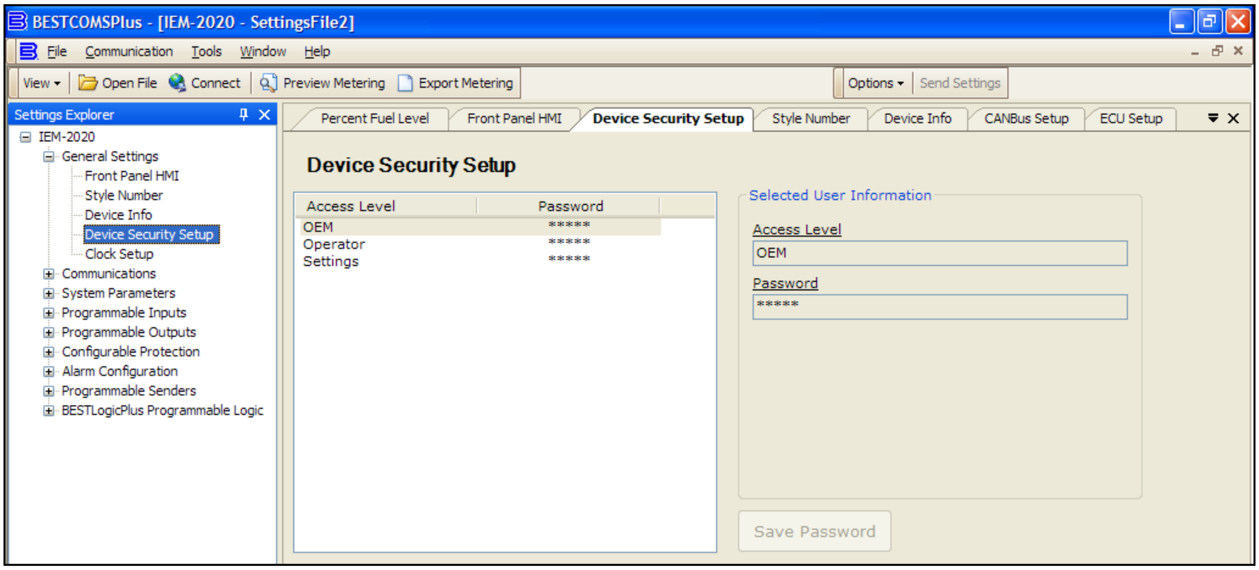

Figure 6-22. Settings Explorer, General Settings, Device Security Setup Screen

c. Clock Setup: This screen configures the date and time for the IEM-2020 and the daylight savings time parameters. See Figure 6-23.

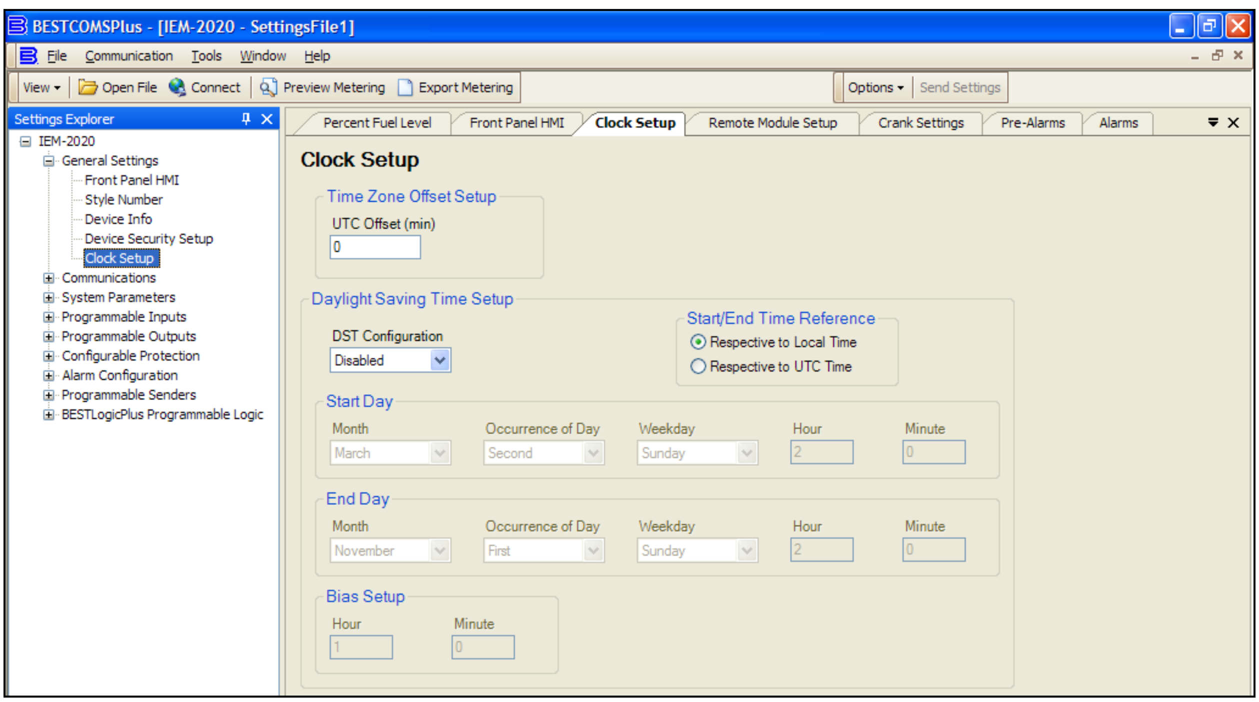

Figure 6-23. Settings Explorer, General Settings, Clock Setup Screen

This completes the discussion of IEM-2020 setup parameters that are optional prior to running a unit. This discussion only presents some of the basic setup parameters. Advanced users can customize the IEM-2020 through BESTLogic*Plus* Programmable Logic, configurable inputs, configurable protection, configurable elements, and numerous other features designed for IEM-2020 configurability.

Setting Up IEM-2020 Programmable Inputs and Outputs

The IEM-2020 along with the CEM-2020/H (Contact Expansion Module) and AEM-2020 (Analog Expansion Module) provides a variety of programmable input and output capabilities. The IEM-2020 and the CEM-2020/H include contact inputs that will be configured as pre-alarms or alarms and are available as inputs to BESTLogic*Plus* Programmable Logic. They also contain dry contact relay outputs which are driven by BESTLogic*Plus* Programmable Logic.

The AEM-2020 has eight analog inputs, eight resistive temperature device (RTD) inputs, two thermocouple inputs, and four analog outputs. Each analog input will be configured for a 4 to 20 mA current input or a 0 to 10 Vdc voltage input to accommodate most readily available industrial transducers; the RTD and thermocouple inputs are pre-configured for temperature measurement. Each analog, RTD, and/or thermocouple input will be programmed with a user adjustable range and assigned a label along with up to four thresholds to implement protective schemes or BESTLogic*Plus* Programmable Logic programming utilizing the measured parameter. This allows for enhanced protection of the engine and protection of external devices.

The analog outputs will be configured as 4 to 20 mA current outputs or 0 to 10 Vdc voltage outputs. Each output can be mapped to metered parameters in the IEM-2020 to implement meter driver functionality or provide signals for analog inputs of other equipment.

Instructions regarding configuration and setup of each type of programmable input and output are presented below, along with instructions for enabling the expansion modules.

Enable LSM-2020, CEM-2020/H, and AEM-2020

The parameters for remote inputs and remote outputs are disabled and cannot be configured in BESTCOMS*Plus* unless the appropriate module has been enabled. Thus, expansion modules connected to the IEM-2020 must be enabled before the parameters associated with them can be modified. See Figure 6-24.

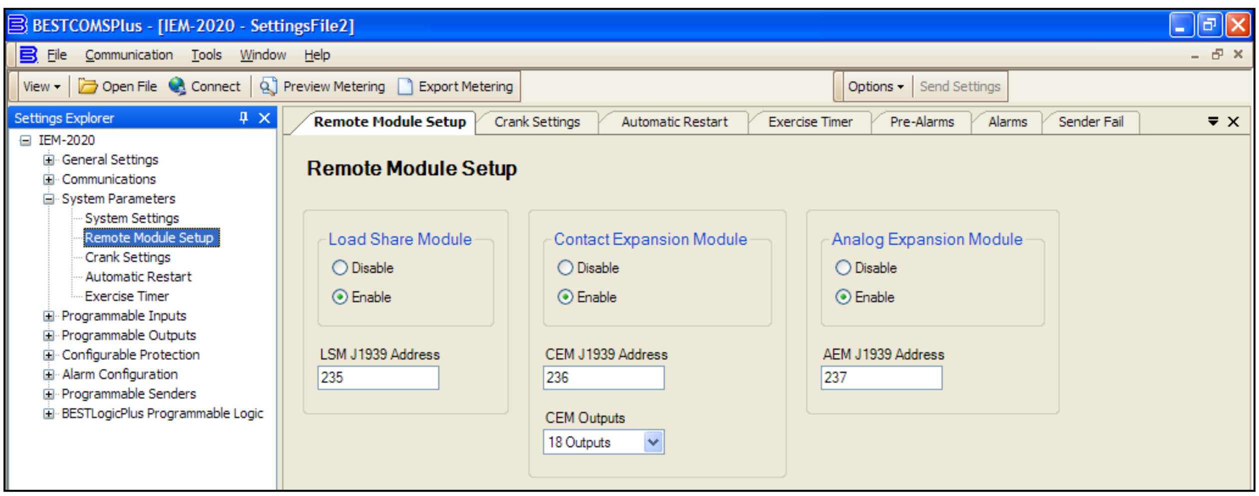

Figure 6-24. Settings Explorer, System Parameters, Remote Module Setup Screen

1. Configure the following parameters:
    a. Load Share Module Enable/Disable - This setting enables the LSM-2020 when connected.
    b. LSM J1939 Address - This setting defines the J1939 address to be used by the LSM-2020. Normally this address will not have to be changed unless it is already in use by another device on the CANBus network.
    c. Contact Expansion Module Enable/Disable - This setting enables the CEM-2020/H when connected.
    d. CEM J1939 Address - This setting defines the J1939 address to be used by the CEM-2020/H. Normally this address will not have to be changed unless it is already in use by another device on the CANbus network.
    e. CEM Outputs - This parameter selects the number of output relays on the CEM-2020/H. The two possibilities are *18* and *24*. Refer to the style chart in Section 1, *General Information*, of the IEM-2020 instruction manual to determine if 18 or 24 output relays are present on the CEM-2020/H.

Programmable Inputs

The programmable inputs consist of:

- Contact inputs on the IEM-2020
- Programmable functions on the IEM-2020. The programmable functions allow mapping of particular inputs to certain functions. For example, an input can be selected for the auto start function, or a low fuel level indication function.
- Remote LSM inputs on the LSM-2020. The LSM-2020 has one analog input.
- Remote contact inputs on the CEM-2020/H.
- Remote analog inputs on the AEM-2020.
- Remote RTD inputs on the AEM-2020.
- Remote thermocouple inputs on the AEM-2020.

Configuration instructions:

1. Configuring contact inputs on the IEM-2020. See Figure 6-25.

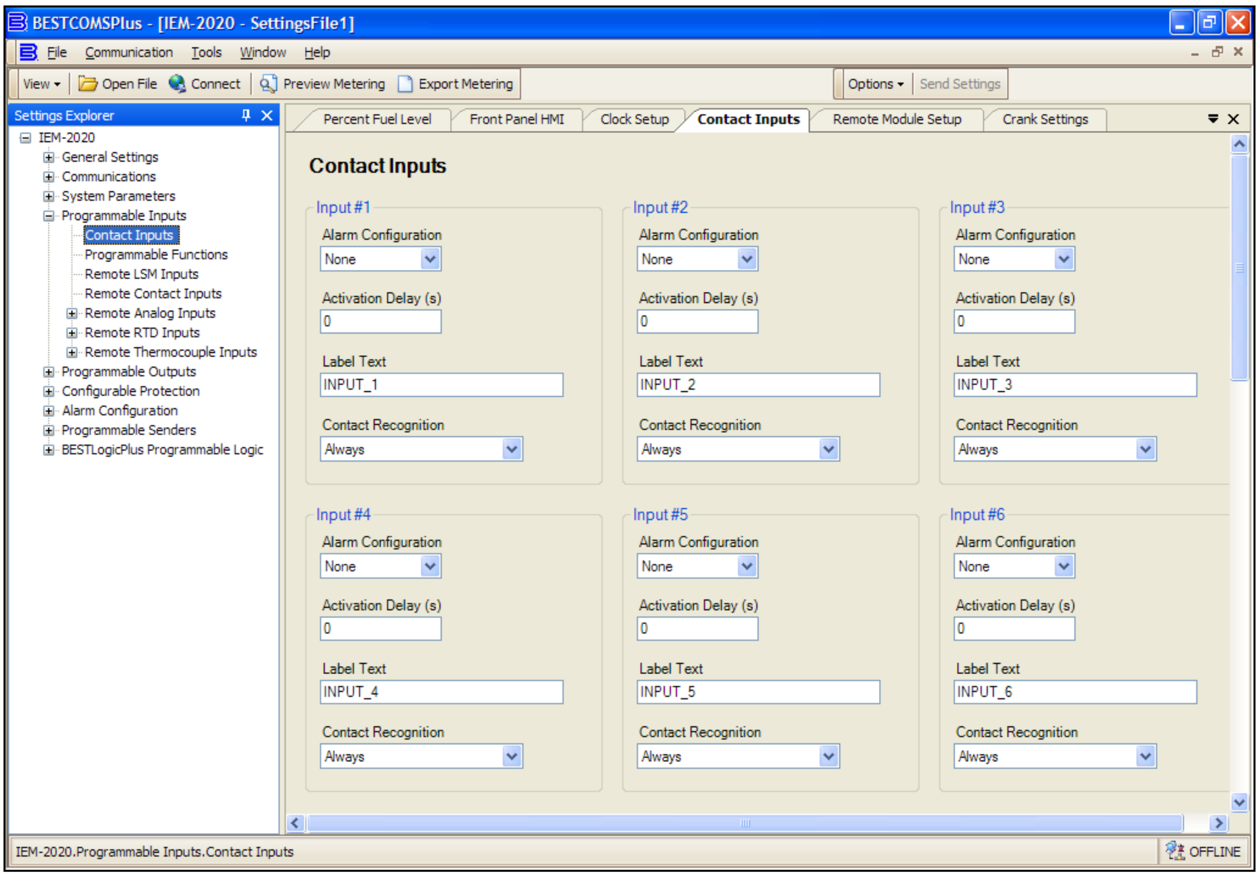

Figure 6-25. Settings Explorer, Programmable Inputs, Contact Inputs Screen

For each contact input, configure the following parameters:

a. Alarm Configuration - Select the alarm configuration of *None, Alarm,* or *Pre-Alarm*. When an alarm occurs, the horn output annunciates with a constant beep and the engine shuts down. When a pre-alarm occurs, the horn output annunciates with an alternating on and off beep and the engine will remain running. If *None* is selected, the input is status only. The status is available to BESTLogic*Plus* Programmable Logic regardless of the setting of the *Alarm Configuration*.

b. Activation Delay - This setting defines the duration that the input remains on before annunciation occurs.

c. Label Text - Enter descriptive text that signifies the use of the input. This text appears next to the input in BESTLogic*Plus* Programmable Logic and in the event log if the input is configured as an alarm or pre-alarm.

d. Contact Recognition - Select whether the contact input should be recognized always, or only while the engine is running. For example, a switch closing when oil pressure is low should be monitored only while the engine is running. This switch would be closed when the engine is not running but a low oil pressure alarm or pre-alarm should not be annunciated unless the switch is closed while the engine is running. A selection of *While Engine Running Only* prevents spurious annunciation when the engine is not running.

2. Configurable Programmable Functions on the IEM-2020. See Figure 6-26.

Programmable functions are pre-defined functions in the IEM-2020 and are initiated by a contact input. An input must be mapped to a programmable function for that function to operate. In addition, some of the programmable functions will be configured as alarms or pre-alarms and cause annunciation to occur on the RDP-110 (Remote Display Panel).

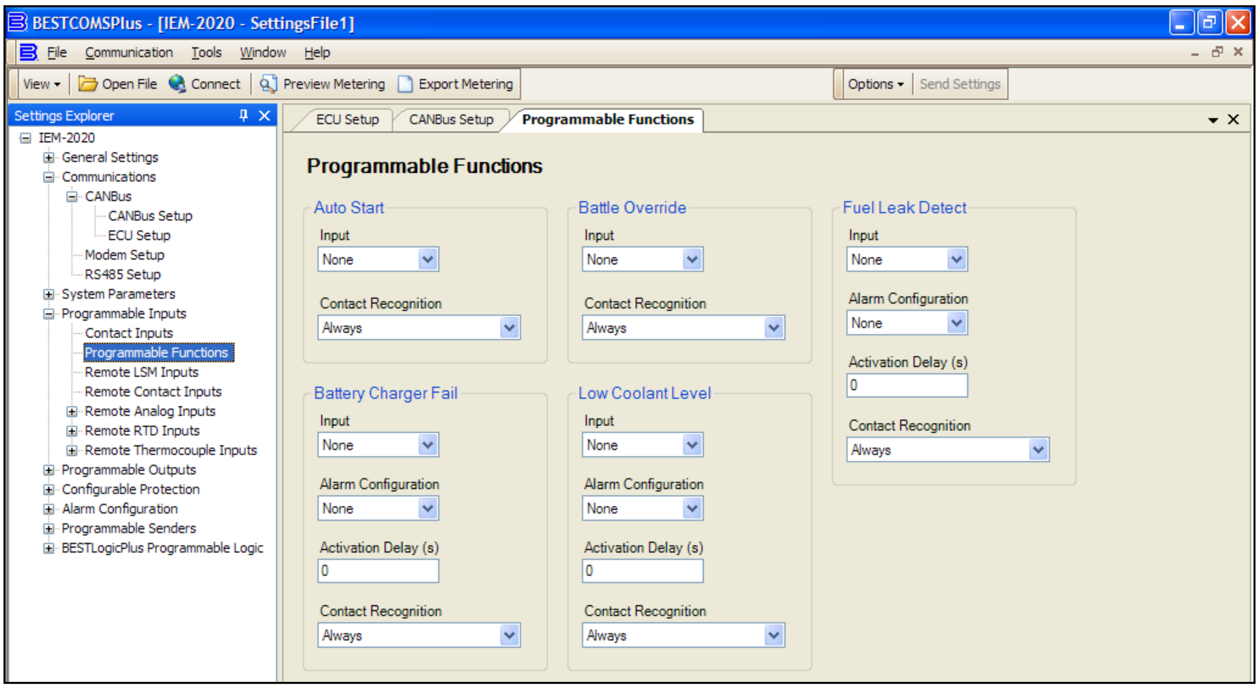

Figure 6-26. Settings Explorer, Programmable Inputs, Programmable Functions Screen

Configure the following parameters:

a. Auto Start

i. Input - This function starts the engine from a contact input when the IEM-2020 is in AUTO mode. Select the desired input or select *None* to disable the auto start programmable function.

ii. Contact Recognition - Selecting *Always* will recognize the contact whether the engine is running or not. Selecting *While Engine Running Only* will recognize the contact only while the engine is running.

b. Battle Override

i. Input - An input should be selected for the battle override function if a battle override initiated from a contact input is required. For some applications, the ability to remove all system shutdowns may be a requirement. Selecting battle override will prevent all alarms from stopping the engine. Caution should be taken before selecting this option as machine warranties could be voided if enabled. Select *None* to disable the programmable function.

ii. Contact Recognition - Selecting *Always* will recognize the contact whether the engine is running or not. Selecting *While Engine Running Only* will recognize the contact only while the engine is running.

c. Battery Charger Fail

i. Input - Select an input for this function to indicate a battery charger failure. When this input is true, an alarm or pre-alarm will be announced based on the alarm configuration, and the *Battery Charger Fail* indicator on the RDP-110 (Remote Display Panel) will illuminate. Select *None* to disable the programmable function.

ii. Alarm Configuration - Select *None, Alarm,* or *Pre-Alarm* for the desired behavior of this function. Regardless of the selection, the indicator on the RDP-110 will illuminate if an input has been assigned and the input is on.

iii. Activation Delay - Set the delay for which the input must be true before the alarm or pre-alarm will be annunciated. This is used to prevent "glitches" on the input from causing spurious annunciation.

iv. Contact Recognition - Selecting *Always* will recognize the contact whether the engine is running or not. Selecting *While Engine Running Only* will recognize the contact only while the engine is running.

d. Low Coolant Level

i. Input - Select an input for this function to indicate a low coolant level. When this input is true, an alarm or pre-alarm will be announced based on the alarm configuration, and the *Low Coolant Level* indicator on the RDP-110 (Remote Display Panel) will illuminate. Select *None* to disable the programmable function.

ii. Alarm Configuration - Select *None, Alarm,* or *Pre-Alarm* for the desired behavior of this function. Regardless of the selection, the indicator on the RDP-110 will illuminate if an input has been assigned and the input is on.

iii. Activation Delay - Set the delay for which the input must be true before the alarm or pre-alarm will be annunciated. This is used to prevent "glitches" on the input from causing spurious annunciation.

iv. Contact Recognition - Selecting *Always* will recognize the contact whether the engine is running or not. Selecting *While Engine Running Only* will recognize the contact only while the engine is running.

e. Fuel Leak Detect

i. Input - Select an input for this function to indicate when a fuel leak has been detected. When this input is true, an alarm or pre-alarm will be announced based on the alarm configuration and the *Fuel Leak* indicator on the RDP-110 (Remote Display Panel) will illuminate. Select *None* to disable the programmable function.

ii. Alarm Configuration - Select *None, Alarm,* or *Pre-Alarm* for the desired behavior of this function. Regardless of the selection, the indicator on the RDP-110 will illuminate if an input has been assigned and the input is on.

iii. Activation Delay - Set the delay for which the input must be true before the alarm or pre-alarm will be annunciated. This is used to prevent "glitches" on the input from causing spurious annunciation.

iv. Contact Recognition - Selecting *Always* will recognize the contact whether the engine is running or not. Selecting *While Engine Running Only* will recognize the contact only while the engine is running.

3. Configuring Remote LSM Inputs on the LSM-2020 (Load Share Module).

The LSM-2020 has a single analog input. The input type (4-20 mA or 0-10 Vdc) and the input range must be set on the *Remote LSM Inputs* screen in BESTCOMS*Plus*. See Figure 6-27.

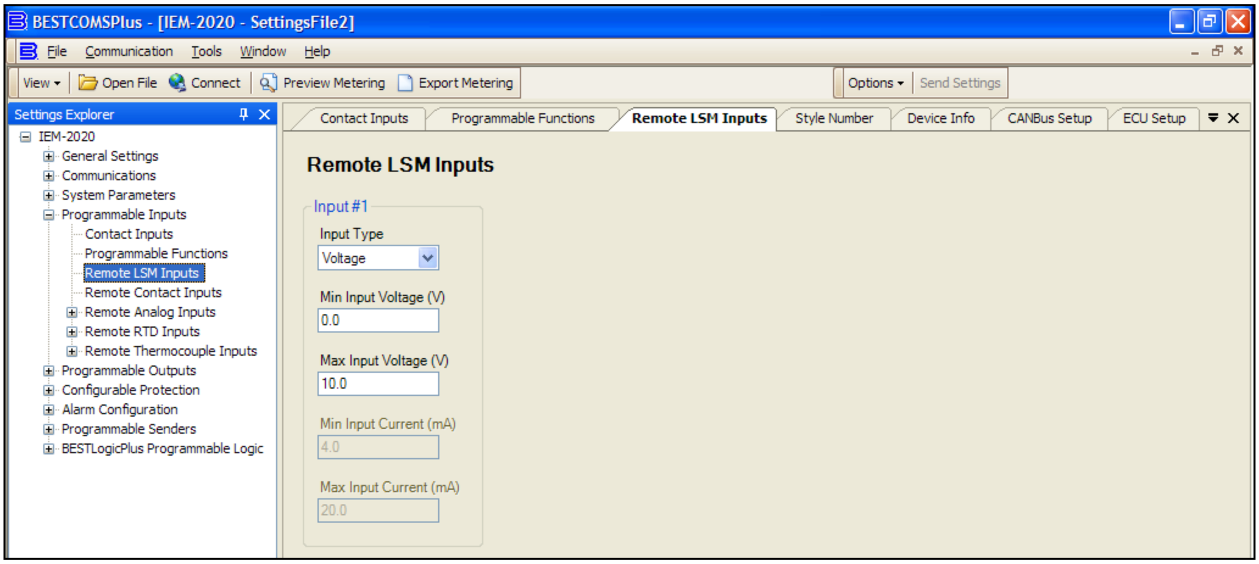

Figure 6-27. Settings Explorer, Programmable Inputs, Remote LSM Inputs Screen

The parameters to be configured are:

a. Input Type - Select *Voltage* for a 0-10 Vdc input or *Current* for a 4-20 mA input.

b. Min Input Voltage (V) - Set this for the minimum valid voltage expected from the transducer or device connected to this input. Voltage below this threshold will be limited to this value. The minimum input voltage can be set only when the *Input Type* parameter is set to *Voltage*.

c. Max Input Voltage (V) - Set this for the maximum valid voltage expected from the transducer or device connected to this input. Voltage above this threshold will be limited to this value. The maximum input voltage can be set only when the *Input Type* parameter is set to *Voltage*.

d. Min Input Current (mA) - Set this for the minimum valid current expected from the transducer or device connected to this input. Current below this threshold will be limited to this value. The minimum input current can be set only when the *Input Type* parameter is set to *Current*.

e. Max Input Current (mA) - Set this for the maximum valid current expected from the transducer or device connected to this input. Current above this threshold will be limited to this value. The maximum input current can be set only when the *Input Type* parameter is set to *Current*.

4. Configuring Remote Contact Inputs on the CEM-2020/H. See Figure 6-28.

The settings of this screen are disabled unless the CEM-2020/H (Contact Expansion Module) has been enabled as previously explained.

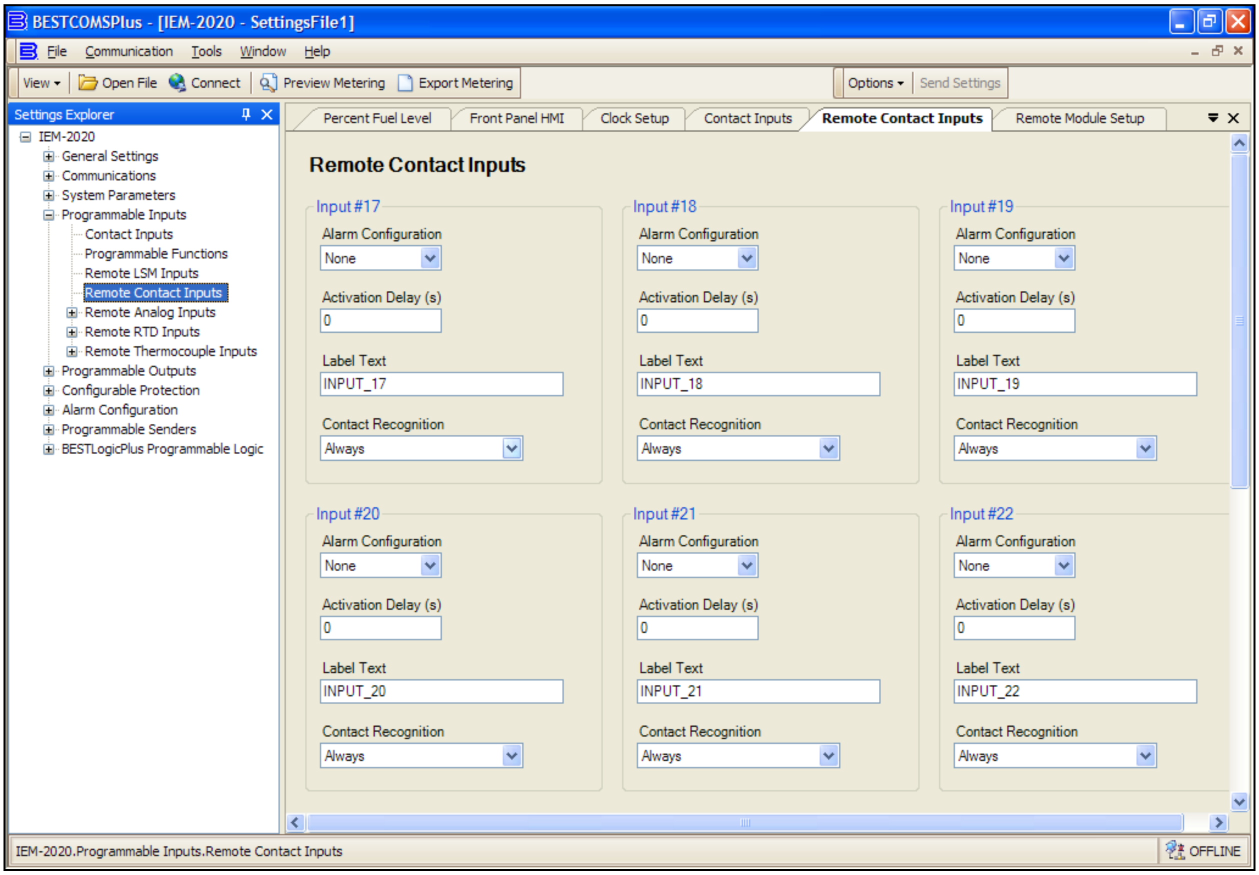

Figure 6-28. Settings Explorer, Programmable Inputs, Remote Contact Inputs Screen

For each contact input, configure the following parameters:

a. Alarm Configuration - Select an alarm configuration of *None, Alarm,* or *Pre-Alarm*. When an alarm occurs, the horn output annunciates with a constant beep and the engine shuts down. When a pre-alarm occurs, the horn output annunciates with an alternating on and off beep and the engine can remain running. If *None* is selected, the input is status only. The status is available to BESTLogic*Plus* Programmable Logic regardless of the setting of the *Alarm Configuration*.

b. Activation Delay - This setting defines the duration that the input should remain on before annunciation occurs.

c. Label Text - Enter descriptive text that signifies the use of the input. This text appears next to the input in BESTLogic*Plus* Programmable Logic and in the event log if the input is configured as an *Alarm* or *Pre-Alarm*.

d. Contact Recognition - Select whether the contact input should be recognized always or only while the engine is running. For example, a switch that closes when the oil pressure is low should only be monitored while the engine is running. This type of switch would be closed when the engine is not running and should be blocked. However, a low oil pressure alarm or pre-alarm should be annunciated when a low oil pressure condition exists and the switch is closed while the engine is running. A selection of *While Engine Running Only* prevents spurious annunciation when the engine is not running.

5. Configuring Remote Analog Inputs on the AEM-2020.

   Each input is configured with a user assignable string and parameter range to map the analog input signal range to a user defined parameter range. Thus, external conditions can be metered and displayed on the IEM-2020. Each input can be configured with up to four thresholds (two over thresholds and two under thresholds) which make their status available to BESTLogic*Plus* Programmable Logic. In addition, each threshold can trigger alarms or pre-alarms to protect the engine and associated equipment based on these measured external conditions. See Figure 6-29.

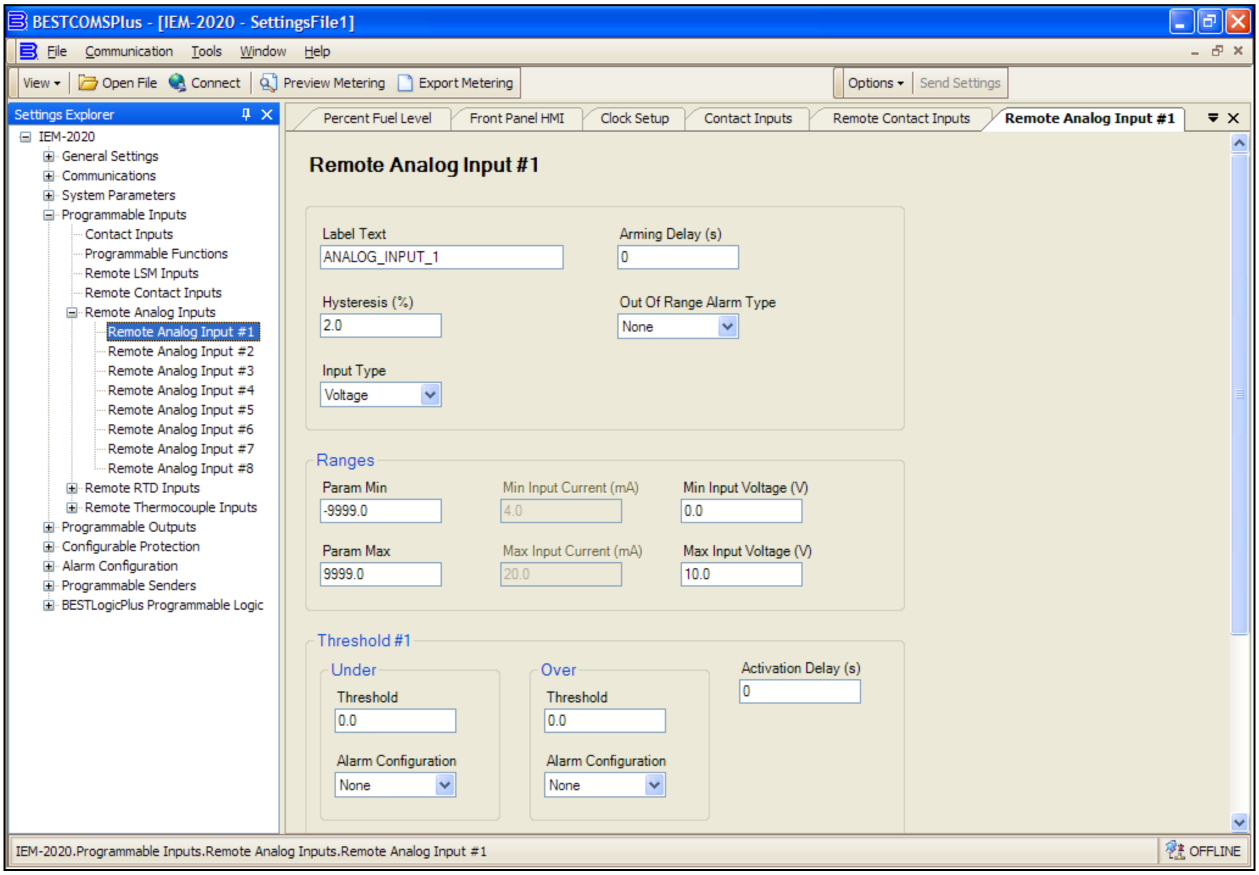

Figure 6-29. Settings Explorer, Programmable Inputs, Remote Analog Inputs Screen

Configure the following parameters:

a. Label Text - Enter descriptive text that signifies the use of the input. This text appears next to the threshold status and associated alarm and pre-alarm status in BESTLogic*Plus* Programmable Logic and in the event log if any of the input thresholds are configured as an *Alarm* or *Pre-Alarm*.

b. Hysteresis (%) - Enter a value for the desired hysteresis for threshold detection. This will help prevent intermittent detection of thresholds.

c. Input Type - Set to *Voltage* for 0-10 Vdc inputs or set to *Current* for 4-20 mA current inputs.

d. Arming Delay - The *Arming Delay* is the wait time after engine startup before input monitoring begins. Set the arming delay to 0 if constant monitoring is desired, including while the engine is not running. Non-zero values will cause the input to be monitored after the programmed time has elapsed after engine startup.

e. Out-of-Range Alarm Type - When the analog input goes outside of its programmed range (as determined by the *Min* and *Max Input* voltage or current settings) an out-of-range indication is can be annunciated. If *Alarm* or *Pre-Alarm* is selected, annunciation will occur. If *Status Only* is selected, the status will be available to BESTLogic*Plus* Programmable Logic but annunciation will not occur.

f. Parameter Minimum (Param Min) - This setting defines the value of the measured parameter when the analog input is at its programmed minimum level. If the analog input is below its programmed minimum level, the measured parameter will be limited to the *Parameter Minimum* setting. However, the raw analog input value will display the actual voltage or current measured at the analog input if it is within the voltage or current range that can be detected by the input circuit.

g. Parameter Maximum (Param Max) - This setting defines the value of the measured parameter when the analog input is at its programmed maximum level. If the analog input is above its programmed maximum level, the measured parameter will be limited to the *Parameter Maximum* setting. However, the raw analog input value will display the actual voltage or current measured at the analog input if it is within the voltage or current range that can be detected by the input circuit.

h. Min Input Current (mA) - This setting defines the minimum input current level expected for the input. When the input current is below this level, the out-of-range condition will be annunciated if it is configured as alarm or pre-alarm. If the *Input Type* is set for *Voltage,* this setting is disabled.

i. Max Input Current (mA) - This setting defines the maximum input current level expected for the input. When the input current is above this level, the out-of-range condition will be annunciated if it is configured as alarm or pre-alarm. If the *Input Type* is set for *Voltage*, this setting is disabled.

j. Min Input Voltage (V) - This setting defines the minimum input voltage level expected for the input. When the input is below this level, the out-of-range condition will be annunciated if it is configured as alarm or pre-alarm. If the *Input Type* is set for *Current*, this setting is disabled.

k. Max Input Voltage (V) - This setting defines the maximum input voltage level expected for the input. When the input is above this level, the out-of-range condition will be annunciated if it is configured as alarm or pre-alarm. If the *Input Type* is set for *Current*, this setting is disabled.

Up to four thresholds can be set for each analog input. There can be two “over” thresholds and two “Under” thresholds. Each threshold can be configured as an *Alarm, Pre-Alarm,* or *as Status Only*. If any type other than *None* is selected, the threshold status is available to BESTLogic*Plus* Programmable Logic. This allows the user to set up an over and under pre-alarm threshold, and over and under alarm threshold.

An *Activation Delay* can be set for the thresholds. Over Threshold 1 and Under Threshold 1 share a common activation delay. Similarly, Over Threshold 2 and Under Threshold 2 share a second activation delay. See Figure 6-30.

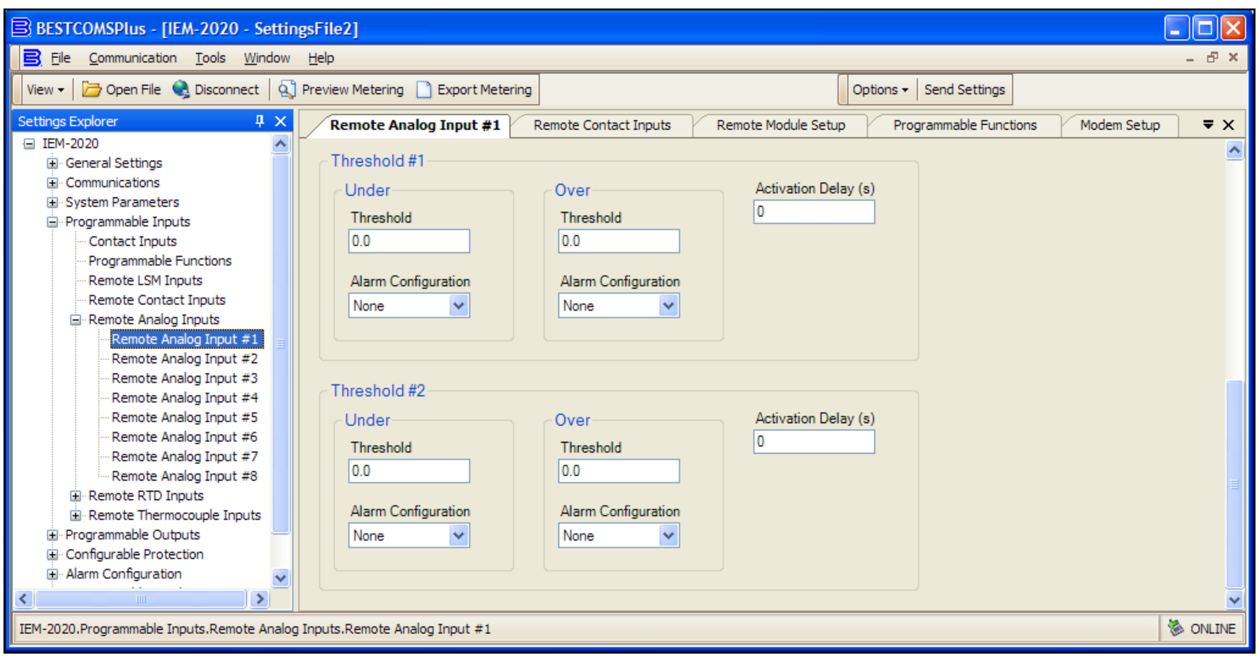

Figure 6-30. Settings Explorer, Programmable Inputs, Remote Analog Inputs Screen

l. Threshold 1

i. Under Threshold - Set a threshold below which Status, Alarm, or Pre-Alarm annunciation is desired.

ii. Under Threshold Alarm Configuration - Select *None* to disable, *Status Only* to make the threshold status available to BESTLogic*Plus* Programmable Logic, *Pre-Alarm* to annunciate a pre-alarm, or *Alarm* to annunciate an alarm.

iii. Over Threshold - Set a threshold above which Status, Alarm, or Pre-Alarm annunciation is desired.

iv. Over Threshold Alarm Configuration - Select *None* to disable, *Status Only* to make the threshold status available to BESTLogic*Plus* Programmable Logic, *Pre-Alarm* to annunciate a pre-alarm, or *Alarm* to annunciate an alarm.

v. Activation Delay(s) - This setting defines the duration that a Threshold 1 condition must be true before an alarm or pre-alarm is annunciated. This time is shared by both Over Threshold 1 and Under Threshold 1 detection.

m. Threshold 2

i. Under Threshold - Set a threshold below which Status, Alarm, or Pre-Alarm annunciation is desired.

ii. Under Threshold Alarm Configuration - Select *None* to disable, *Status Only* to make the threshold status available to BESTLogic*Plus* Programmable Logic, *Pre-Alarm* to annunciate a pre-alarm, or *Alarm* to annunciate an alarm.

iii. Over Threshold - Set a threshold above which Status, Alarm, or Pre-Alarm annunciation is desired.

iv. Over Threshold Alarm Configuration - Select *None* to disable, *Status Only* to make the threshold status available to BESTLogic*Plus* Programmable Logic, *Pre-Alarm* to annunciate a pre-alarm, or *Alarm* to annunciate an alarm.

v. Activation Delay(s) - This setting defines the duration Threshold 2 must be exceeded before an alarm or pre-alarm is annunciated. This time is shared by both Over Threshold 2 and Under Threshold 2 detection.

6. Configuring Remote RTD Inputs on the AEM-2020.

Many of the settings for the Remote RTD Inputs are similar to settings for the Remote Analog Input settings. See Figure 6-31.

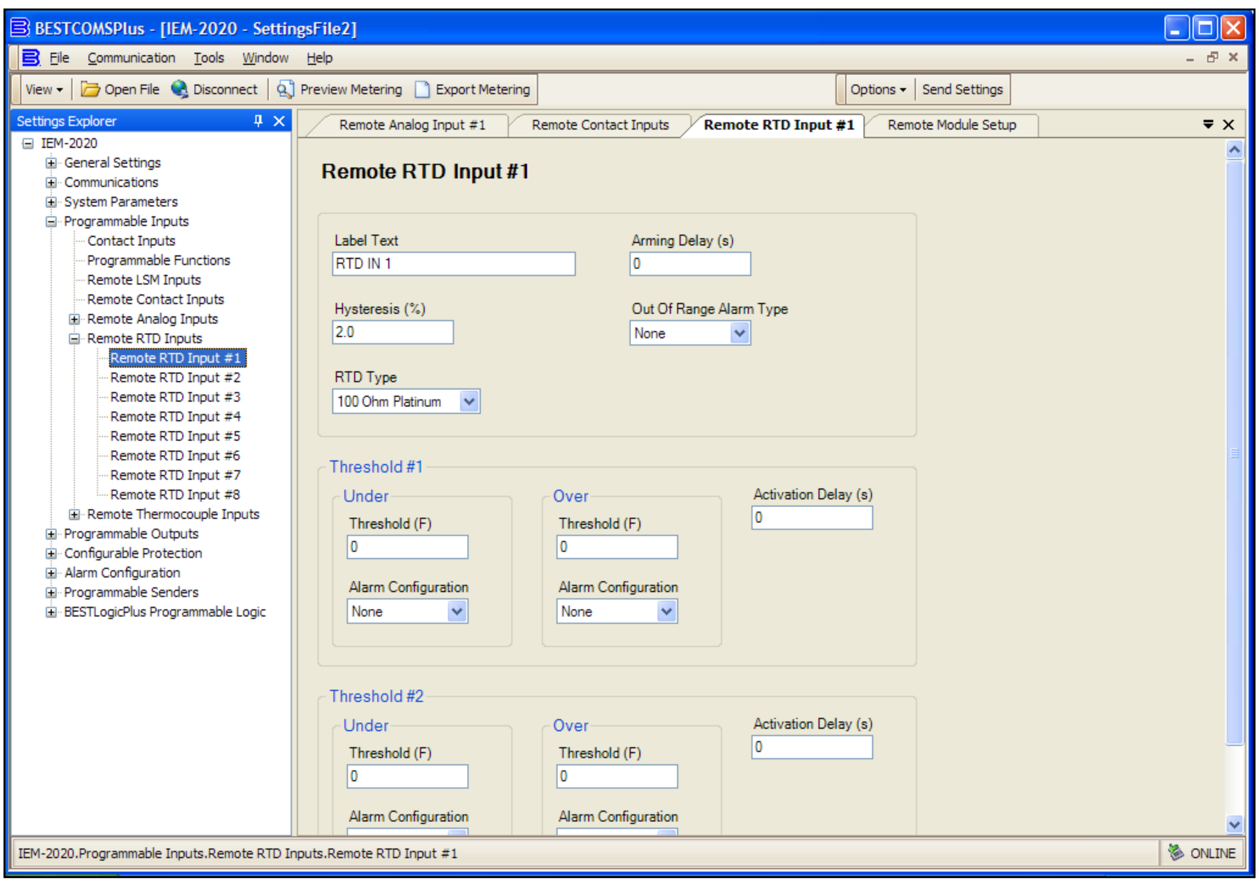

Figure 6-31. Settings Explorer, Programmable Inputs, Remote RTD Inputs Screen

Configure the following parameters:

a. Label Text - Enter descriptive text that signifies the use of the input. This text appears next to the threshold status and associated alarm and pre-alarm status in BESTLogic*Plus* Programmable Logic and in the event log if any of the input thresholds are configured as an *Alarm* or *Pre-Alarm*.

b. Hysteresis (%) - This setting defines the desired hysteresis for threshold detection. This will help prevent intermittent detection of thresholds.

c. RTD Type - Select *100 Ohm Platinum* or *10 Ohm Copper* to match the RTD that is driving the input.

d. Arming Delay - The *Arming Delay* is the wait time after engine startup before the input monitoring begins. Set the arming delay to 0 if constant monitoring is desired, including when the engine is not running. Non-zero values will cause the input to be monitored after the programmed time has elapsed after engine startup.

e. Out-of-Range Alarm Type - An out-of-range condition occurs when the IEM-2020 detects that the input is outside of the normal range of what would be detected for the RTD type. Primarily this provides indication that the RTD circuit is open or shorted. If *Alarm* or *Pre-Alarm* is selected, annunciation will occur. If *Status Only* is selected, the status will be available to BESTLogic*Plus* Programmable Logic but annunciation will not occur.

f. Threshold 1 and Threshold 2 settings - The threshold settings are identical to those for the remote analog inputs. Refer to the setup instructions for the remote analog inputs to configure these thresholds.

7. Configuring Remote Thermocouple Inputs on the AEM-2020.

Many of the settings for the Remote Thermocouple Inputs are similar to the settings for the Remote Analog Inputs. See Figure 6-32.

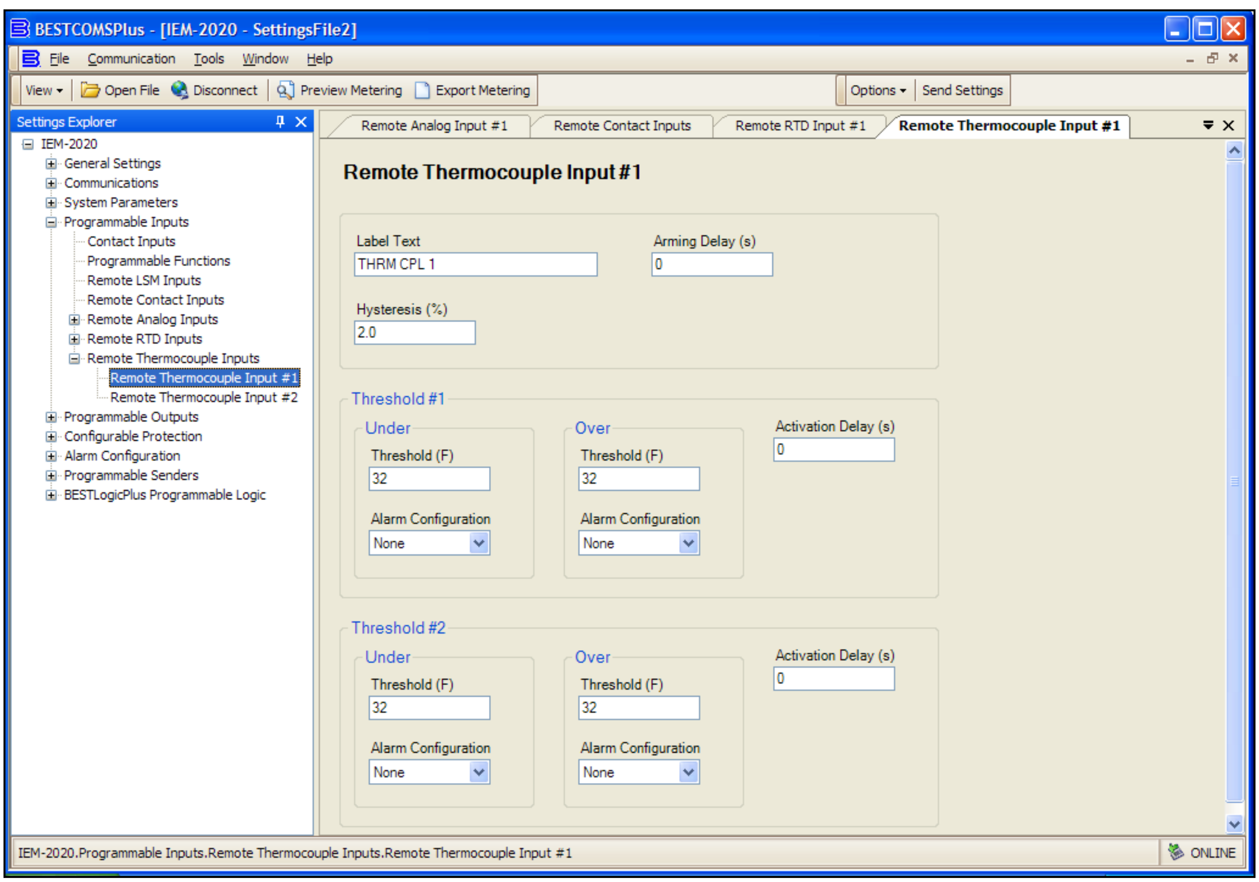

Figure 6-32. Settings Explorer, Programmable Inputs, Remote Thermocouple Inputs Screen

Configure the following parameters:

a. Label Text - Enter descriptive text that signifies the use of the input. This text appears next to the input status and associated alarm and pre-alarm status in BESTLogic*Plus* Programmable Logic and in the event log if any of the input thresholds are configured as an *Alarm* or *Pre-Alarm*.

b. Hysteresis (%) - This setting defines the hysteresis for threshold detection. This will help prevent intermittent detection of thresholds.

c. Arming Delay - The *Arming Delay* is the wait time after engine startup before input monitoring begins. Set the arming delay to 0 if constant monitoring is desired, including when the engine is not running. Non-zero values will cause the input to be monitored after the programmed time has elapsed after engine startup.

d. Threshold 1 and Threshold 2 settings - The threshold settings are identical to those for the remote analog inputs. Refer to the setup instructions in for the remote analog inputs to configure these thresholds.

<u>*Programmable Outputs*</u>

The programmable outputs consist of:

- Contact outputs internal to the IEM-2020
  - o Programmable Contact Outputs
  - o Run Relay, Pre-Start Relay, and Run Relay Outputs
- Remote Contact Outputs on the CEM-2020/H
- Remote Analog Outputs on the AEM-2020
- Configurable Elements in the IEM-2020. The configurable elements make it possible to take an output from BESTLogic*Plus* Programmable Logic and set it up as a pre-alarm or alarm condition, as well as an input for subsequent logic in the PLC program.

Programmable Output Configuration Instructions:

1. Configuring Contact Outputs on the IEM-2020.

   a. Programmable Contact Outputs. See Figure 6-33.

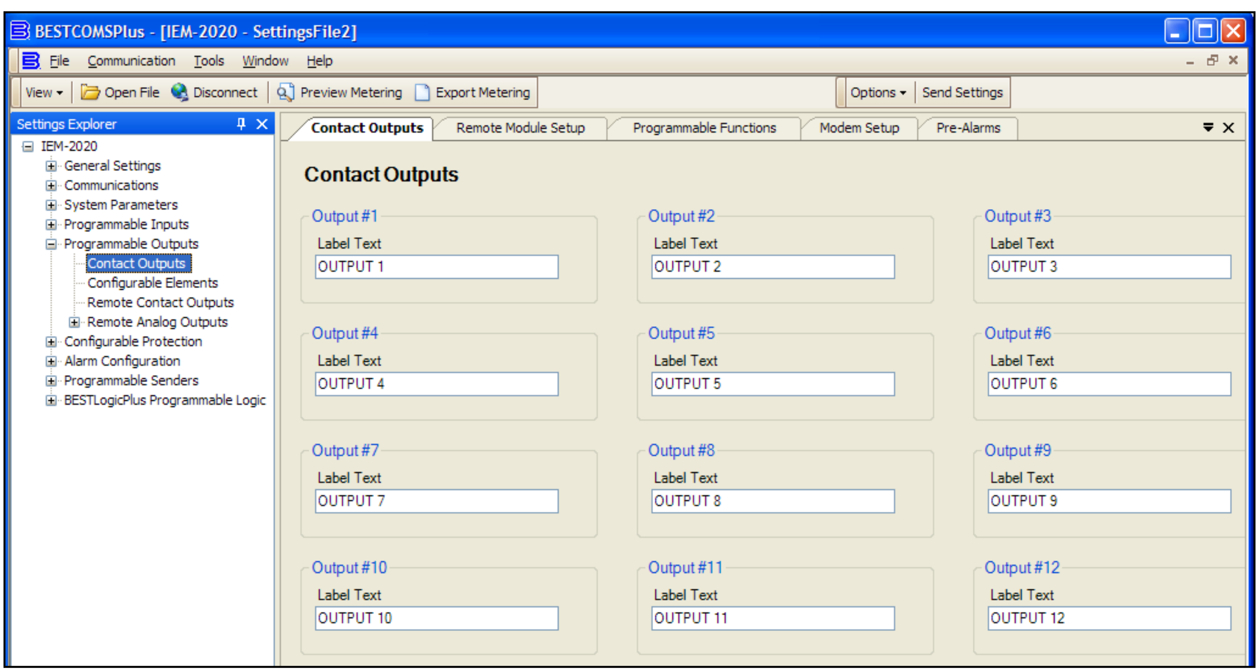

Figure 6-33. Settings Explorer, Programmable Outputs, Contact Outputs Screen

Each output can be programmed with a text label describing its use; this label appears in BESTLogic*Plus* Programmable Logic where the output is used to aid in program clarity and ease of programming.

b. Run Relay, Pre-Start Relay, and Start Relay

In some systems it may be beneficial to modify the standard functionality implemented by the IEM-2020 for the Run, Pre-Start, or Start relays. If your engine does not require a pre-start function, it may be desired to use the 30A relay assigned to it for other purposes. These relays can be configured in one of two ways. The first is to operate under their predefined functionality, making them a dedicated output. The second way is to select them to be programmable, in which case they become available to BESTLogic*Plus* Programmable Logic to be used in the same manner as the programmable relay outputs.

Figure 6-34 shows the *Relay Control* portion of the *System Settings* screen used to set the operation of these relays to predefined or programmable operation.

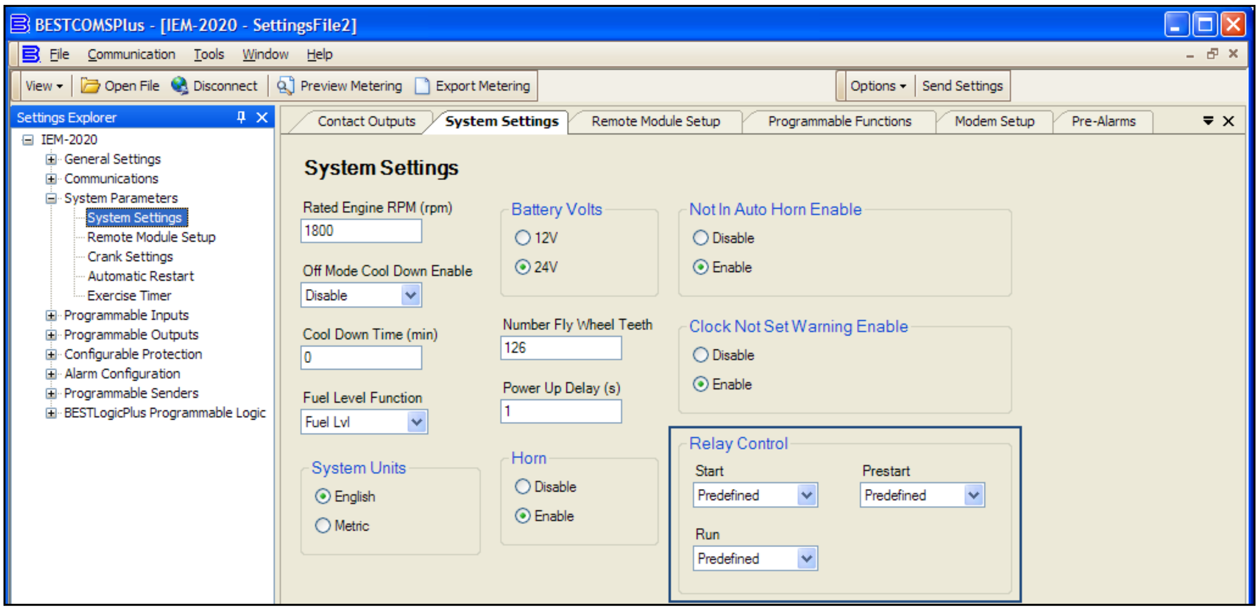

Figure 6-34. Settings Explorer, System Parameters, System Settings Screen

For each relay (Start, Run, and Pre-Start), select whether it should use its predefined functionality or be programmable.

When *Programmable* is selected for a relay, it becomes available to BESTLogic*Plus* Programmable Logic as a logic element. The elements are titled *Start Output, PreStart Out,* and *Run Output*. The predefined functionality is available as an input to the logic. If *Programmable* is selected as the relay control mode, connect the corresponding predefined input function to it. This would behave exactly as if *Predefined* were selected as its relay control type. However, other logic can be combined with it to create more versatile operation. If *Programmable* is selected for a relay, but it is not used in the logic, that relay will never close.

A logic example connecting the predefined inputs directly to the “programmable” relay outputs for all three relays is shown in Figure 6-35.

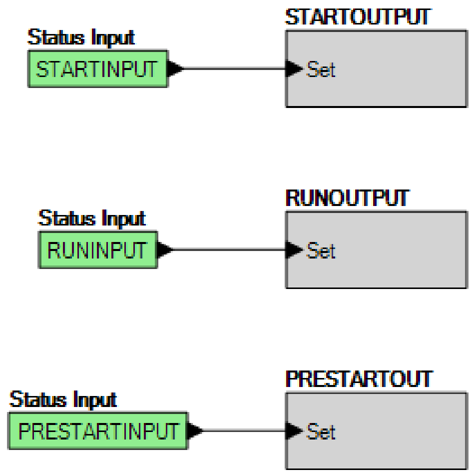

Figure 6-35. Logic Example of Programmable Relays

2. Setting Up Configurable Elements in the IEM-2020.

   Configurable elements are used with the BESTLogic*Plus* Programmable Logic to allow a user to implement logic to cause an alarm or pre-alarm. This can be used to build protection that is not part of the standard protection in the IEM-2020. See Figure 6-36.

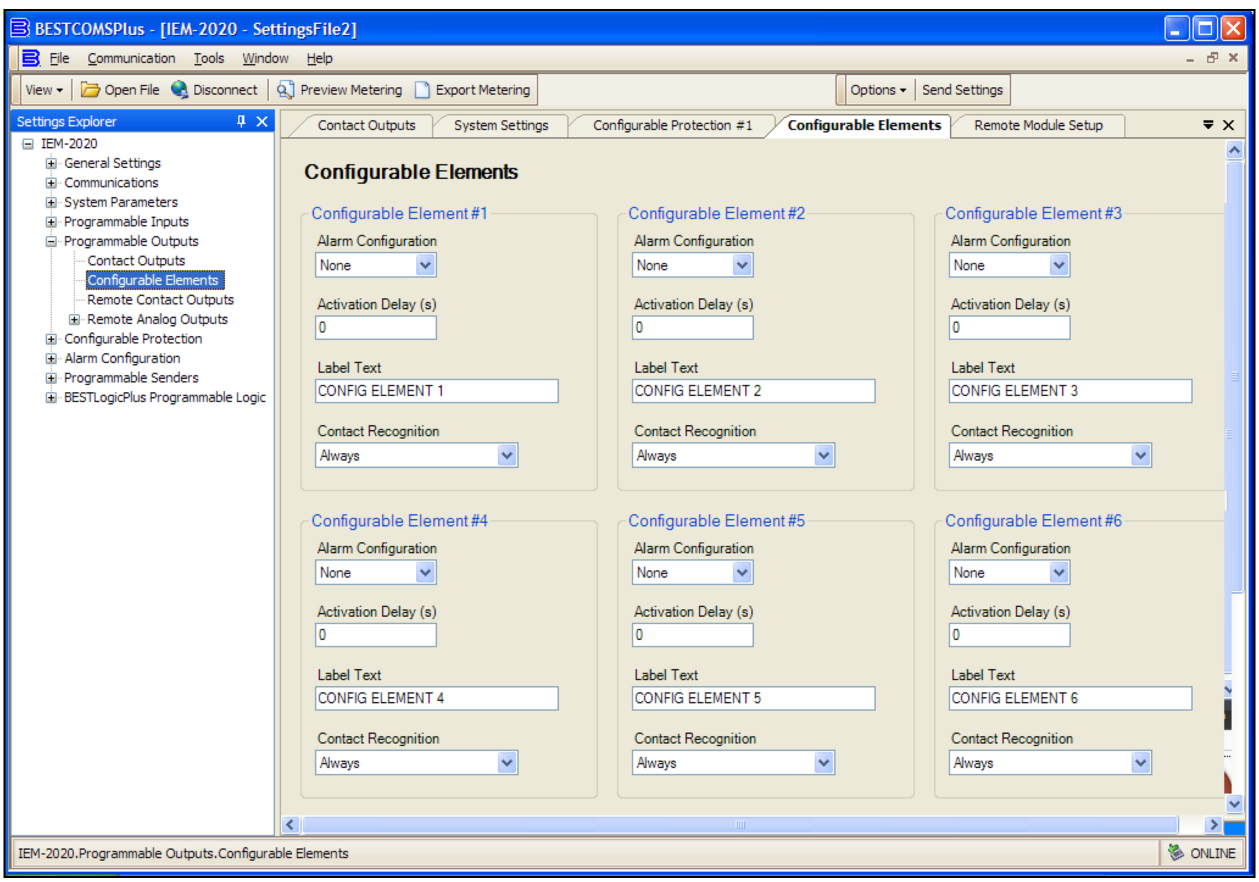

Figure 6-36. Settings Explorer, Programmable Outputs, Configurable Elements Screen

The parameters for each configurable element are similar to those for a programmable input. Set the following parameters for each configurable element:

a. Alarm Configuration - Select the alarm configuration of *None, Alarm,* or *Pre-Alarm*. When an alarm occurs, the horn output annunciates with a constant beep and the engine shuts down.

When a pre-alarm occurs, the horn output annunciates with an alternating on and off beep and the engine can remain running. If *None* is selected, the element is status only. The status is available as an input to BESTLogic*Plus* Programmable Logic regardless of the setting of the *Alarm Configuration.*

b. Activation Delay - This setting defines the duration that the configurable element is true before alarm or pre-alarm annunciation occurs.

c. Label Text - Enter descriptive text to describe how the configurable element functions. This text appears next to the configurable element status in BESTLogic*Plus* Programmable Logic and in the event log if the *Alarm Configuration* is set as an *Alarm* or *Pre-Alarm*.

d. Contact Recognition - Select whether the configurable element should be recognized always, or only while the engine is running. A selection of *While Engine Running Only* prevents spurious annunciation when the engine is not running.

For example, a configurable element could be used when it is desired to have an alarm or pre-alarm occur when the engine room door is opened to alert the control room that someone is inside the engine room. In addition, suppose for safety reasons any running machines should be shut down when someone enters the engine room. Assume Input 5 is labeled to indicate “DOOR OPEN” and it is configured as a *Pre-Alarm*. In BESTLogic*Plus* Programmable Logic, Input 5 could be AND’ed with ENGINE RUNNING to drive Configurable Element 1, which is configured as an alarm. The logic diagram is shown in Figure 6-37.

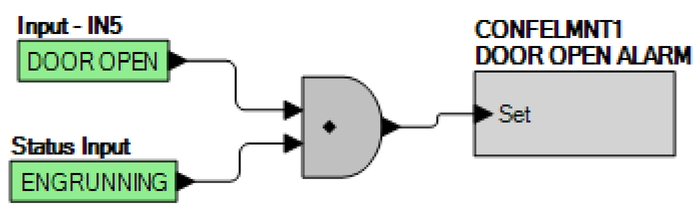

Figure 6-37. Using a Configurable Element Logic Diagram

When Input 5 is configured as a *Pre-Alarm*, it triggers a pre-alarm if the door is opened whether the engine is running or not. When Configurable Element 1 is configured as an *Alarm*, it triggers an alarm if the door was opened while the engine was running.

3. Configuring Remote Contact Outputs on the CEM-2020/H. See Figure 6-38.

Each output can be programmed with a text label describing the function of the output. This label appears in BESTLogic*Plus* Programmable Logic where the output is used to aid in program clarity and ease of programming.

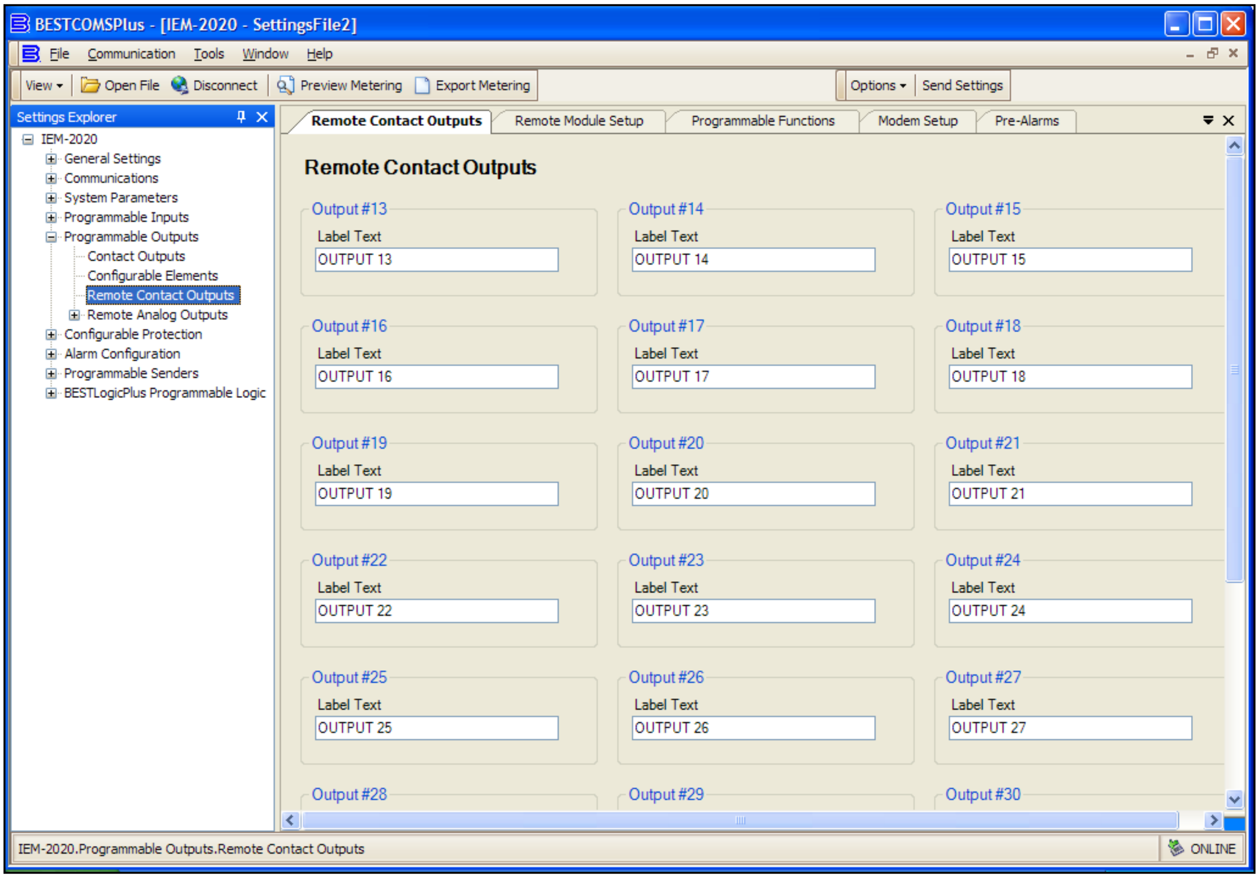

Figure 6-38. Settings Explorer, Programmable Outputs, Remote Contact Outputs Screen

4. Configuring Remote Analog Outputs on the AEM-2020.

   There are four remote analog outputs that are configured on separate screens in BESTCOMS*Plus*. Parameters metered by the IEM-2020 are mapped to these outputs, enabling them to be used as meter drivers or they can drive analog inputs of external equipment. Ranges for the metered parameter and the analog output are set up so that when the metered parameter is at the minimum of the parameter range, the analog output is at the minimum of its output range. Similarly, when the metered parameter is at the maximum of the parameter range, the analog output is at the maximum of its output range. The parameters for Remote Analog Output 1 are shown in Figure 6-39.

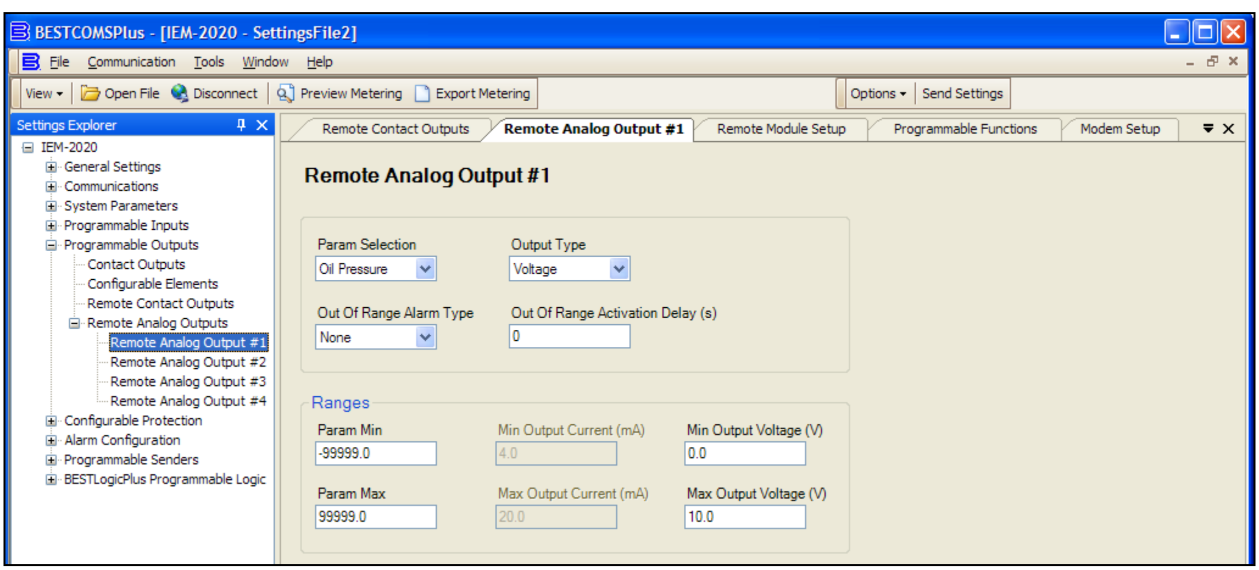

Figure 6-39. Settings Explorer, Programmable Outputs, Remote Analog Outputs Screen

Configure the following parameters:

a. Parameter Selection - This settings defines the metered parameter within the IEM-2020 (e.g. oil pressure, coolant temp, etc.) that is assigned to drive the analog output. The parameter range and the output range are configured so the range of the metered parameter is scaled to the range of the analog output. Thus, when the metered parameter is at the minimum of the parameter range, the analog output is at the minimum of its output range. Similarly, when the metered parameter is at the maximum of the parameter range, the analog output is at the maximum of its output range.

b. Output Type - Select *Voltage* or *Current* as the analog output type.

c. Out-of-Range Alarm Type - This setting specifies whether to annunciate an alarm or pre-alarm if the metered parameter is outside of the range assigned by the parameter minimum and parameter maximum settings.

d. Out-of-Range Alarm Activation Delay - This setting defines the duration that an out-of-range condition must be true before an alarm or pre-alarm is annunciated.

e. Parameter Minimum - This setting defines the minimum value that will be shown for the parameter being metered.

f. Parameter Maximum - This setting defines the maximum value that will be shown for the parameter being metered.

g. Min Output Current (mA) - If the *Analog Output Type* is configured as *Current*, set this to the output current level to be sourced when the metered parameter is at minimum. This setting is disabled when the output type is set to *Voltage*.

h. Max Output Current (mA) - If the *Analog Output Type* is configured as *Current,* set this to the output current level to be sourced when the metered parameter is at maximum. This setting is disabled when the output type is set to *Voltage*.

i. Min Output Voltage (V) - If the *Analog Output Type* is configured as *Voltage*, set this to the output voltage to be sourced when the metered parameter is at minimum. This setting is disabled when the output type is set to *Current*.

j. Max Output Voltage (V) - If the *Analog Output Type* is configured as *Voltage*, set this to the output voltage level to be sourced when the metered parameter is at maximum. This setting is disabled when the output type is set to *Current*.

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SECTION 7 • MAINTENANCE AND TROUBLESHOOTING

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SECTION 7 • MAINTENANCE AND TROUBLESHOOTING

MAINTENANCE

Preventative maintenance consists of periodic replacement of the backup battery (optional) and periodically checking that the connections between the IEM-2020 and the system are clean and tight. IEM-2020 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.

Backup Battery for the Real Time Clock

The backup battery for the real time clock is an option available for the IEM-2020 Industrial Engine Module. A 3.0 Vdc, 195-mAh lithium battery (type Rayovac BR2032) is used to maintain clock function during loss of power supply voltage. The primary battery system that supplies the IEM-2020 power supply may be disconnected for extended periods (weeks, months) between uses. Without battery backup for the real time clock, clock functions will cease if battery input power is removed.

The backup battery has a life expectancy of approximately 10 years. After this time, you should contact Basler Electric to order a new battery, Basler Electric P/N 38526.

Battery access is located on the rear side of the IEM-2020.

CAUTION

Replacement of the backup battery for the real-time clock should be performed only by qualified personnel.

Do not short-circuit the battery, reverse battery polarity, or attempt to recharge the battery. Observe polarity markings on the battery socket while inserting a new battery. The battery polarity must be correct in order to provide backup for the real-time clock.

It is recommended that the battery be removed if the IEM-2020 is to be operated in a salt-fog environment. Salt fog is known to be conductive and may short-circuit the battery.

NOTE

Failure to replace the battery with Basler Electric P/N 38526 may void the warranty.

TROUBLESHOOTING

If you do not get the results that you expect from the IEM-2020, first check the programmable settings for the appropriate function. Use the following troubleshooting procedures when difficulties are encountered in the operation of your engine control system.

Communications

Ethernet Port Does Not Operate Properly

Step 1. Verify that the proper port of your computer is being used. For more information, refer to Section 4, *BESTCOMSPlus Software, Communication*.

Step 2. Verify the network configuration of the LSM-2020 and IEM-2020 are set up properly. For more information, refer to Section 4, *BESTCOMSPlus Software, Communication.*

Step 3. Verify that all Ethernet devices comply with IEC 61000-4 series of specifications for Industrial Ethernet Devices. Commercial devices are not recommended and may result in erratic network communications.

USB Port Does Not Operate Properly

Step 1. Verify that the proper port of your computer is being used. For more information, refer to Section 4, *BESTCOMSPlus Software, Communication*.

CANbus Communication Does Not Operate Properly

Step 1: Verify that there is a 120-ohm termination resistor on each end of the bus section of the wiring, and that there are not any termination resistors at any node connections that are on stubs from the main bus.

Step 2: Check all CANbus wiring for loose connections, and verify that the CAN H and CAN L wires have not gotten switched somewhere on the network.

Step 3: Verify that the cable length of the bus section of the wiring does not exceed 40 meters, and verify that any stubs from the main bus do not exceed 3 meters in length.

Step 4: If the Engine ECU is a Volvo or MTU ECU, verify that the ECU Configuration setting is set to match the ECU configuration.

Inputs and Outputs

Programmable Inputs Do Not Operate as Expected

Step 1. Verify that all wiring is properly connected. Refer to Section 6, *Installation, Connections*.

Step 2. Confirm that the inputs are programmed properly.

Step 3. Ensure that the input at the IEM-2020 is actually connected to the BATT– terminal (2).

Programmable Outputs Do Not Operate as Expected

Step 1. Verify that all wiring is properly connected. Refer to Section 6, *Installation, Connections*.

Step 2. Confirm that the outputs are programmed properly.

Metering/Display

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

Step 1. Verify that all wiring is properly connected. Refer to Section 6, *Installation, Connections.*

Step 2. Confirm that the SENDER COM terminal (11) 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 (3) and the SENDER COM terminal (11).

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

Step 5. Use a voltmeter connected between the BATT-terminal (2) and the SENDER COM terminal (11) on the IEM 2020 to verify that there is no voltage difference at any time. Any voltage differences may manifest themselves as erratic sender readings. Wiring should be corrected so that no differences exist.

Step 6: Check the sender wiring and isolate sender wiring from any of the AC wiring in the system. The sender wiring should be located away from any ignition wiring. Separate conduits should be used for sender wiring and any AC wiring.

Incorrect Display of Engine RPM

Step 1. Verify that all wiring is properly connected. Refer to Section 6, *Installation, Connections*.

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

Step 3. Verify that the prime mover governor is operating properly.

Step 4. Verify that the measured frequency of the voltage at the MPU input (31 and 32) is correct.

Step 5. 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 IEM-2020.

LCD is Blank and all LEDs are Flashing at Approximately 2 Second Intervals

This indicates that the IEM-2020 does not detect that valid application firmware is installed. The unit is running its boot loader program, waiting to accept a firmware upload.

Step 1. Start BESTCOMS*Plus.* Use the top pull-down menu and select FILE→ NEW→ IEM-2020.

Step 2. Select COMMUNICATIONS→ UPLOAD DEVICE FILES and select the device package file that contains the firmware and language you want to upload.

Step 3. Check the boxes for IEM-2020 Firmware and IEM-2020 Language Module. Click the UPLOAD button to start the upload process.

IEM-2020 Front Panel Debug Screens

There are several debug screens in the IEM-2020 that can be useful for debugging and I/O module related issues. The following debug screens are available: LOAD SHARE DEBUG, CEM DEBUG, and AEM DEBUG.

LOAD SHARE DEBUG

This screen is gives visibility into the parameters metered and controlled by the LSM-2020.

The LOAD SHARE DEBUG screen is located on the front panel at SETTINGS→SYSTEM PARAMS→REMOTE MODULE SETUP→LSM SETUP→LOAD SHARE DEBUG.

The following parameters are visible on the LOAD SHARE DEBUG screen:

- AUX VOLT: Voltage the LSM-2020 sees on its analog input. Terminals P2-8 (IN–) and P2-9 (V+).
- AUX CURRENT: Current the LSM-2020 sees on its analog input. Terminals P2-7 (IN+) and P2-8 (IN–).
- LSM_RT_BIN: LSM-2020 Real Time Binary Points. This is a 32-bit, bit packed number representing the binary points transmitted between the LSM-2020 and IEM-2020. Debug at this level is not necessary.

CEM DEBUG

This screen shows the binary data that is being sent between the CEM-2020 (Contact Expansion Module) and the IEM-2020.

The CEM DEBUG screen is located on the front panel at SETTINGS→SYSTEM PARAMS→REMOTE MODULE SETUP→CEM SETUP→CEM DEBUG MENU.

The following parameters are visible on the CEM DEBUG screen:

- IEM_TO_CEM_BP: IEM-2020 to CEM-2020 Binary Points. This is the status of the CEM-2020 output relays being transmitted from the IEM-2020 to the CEM-2020. This is a 32-bit, bit packed number representing the desired states of the CEM-2020 outputs. The left most bit is the first output, etc.
- CEM_TO_IEM_BP: CEM-2020 to IEM-2020 Binary Points. This is the status of the CEM-2020 inputs being transmitted from the CEM-2020 to the IEM-2020. This is a 32-bit, bit packed number representing the metered states of the CEM-2020 inputs. The left most bit is the first input, etc.

AEM DEBUG

This screen shows the binary data that is being sent between the AEM-2020 (Analog Expansion Module) and the IEM-2020.

The AEM DEBUG screen is located on the front panel at SETTINGS→SYSTEM PARAMS→REMOTE MODULE SETUP→AEM SETUP→AEM DEBUG MENU.

The following parameters are visible on the AEM DEBUG screen:

- IEM_TO_AEM_BP: IEM-2020 to AEM-2020 Binary Points. This is a 32-bit, bit packed number representing the binary points transmitted from the IEM-2020 to the AEM-2020. Debug at this level is not necessary.
- AEM_TO_IEM_BP: AEM-2020 to IEM-2020 Binary Points. This is a 32-bit, bit packed number representing the binary points transmitted from the AEM-2020 to the IEM-2020. Debug at this level is not necessary.
- ANALOG INPUTS: For each analog input, the raw metered input value is displayed, and the scaled metered input value. This is useful to check if the AEM-2020 is seeing a valid raw input value (i.e. the raw 0 to 10 volt voltage input or 4 to 20 ma current input). The scaled value is the raw input scaled up

to the range specified by the Parameter Minimum and Parameter Maximum value parameters in the Remote Analog Input settings.

- THERMAL INPUTS: For each RTD input, the resistance in ohms measured by the RTD input is displayed as well as the temperature calculated from the resistance measurement. For each thermocouple input, the voltage in millivolts is displayed as well as the temperature calculated from the resistance measurement.

SECTION 8 • LSM-2020 (LOAD SHARE MODULE)

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SECTION 8 ● LSM-2020 (LOAD SHARE MODULE)

GENERAL INFORMATION

The LSM-2020 is an optional remote auxiliary device.

LSM-2020 – IEM-2020 Interface

The LSM-2020 communicates through an Ethernet port and provides access to the IEM-2020 (Industrial Engine Module) via Ethernet. The LSM-2020 provides an analog input that can be configured to accept voltage or current.

LSM-2020 – DGC-2020 Interface

The LSM-2020 communicates through an Ethernet port and provides access to the DGC-2020 (Digital Genset Controller) via Ethernet. In certain applications the LSM-2020 provides analog outputs to the power system in the form of analog bias signals to the voltage regulator and speed governor. When the breaker is closed and Load Sharing is enabled, the LSM-2020 will share real power load proportionally with the other generators on the Analog Load Share Line.

Refer the DGC-2020 instruction manual for more information.

SPECIFICATIONS

Operating Power

Nominal:	12 or 24 Vdc
Range:	8 to 32 Vdc (Withstands cranking ride-through down to 6 Vdc for 500 ms.)
Maximum Consumption:	4 W
Terminals:	P2-3 (–), P2-2 (+), P2-1 (chassis ground)

Analog Inputs

Voltage Configuration:	0-10 Vdc
Current Configuration:	4-20 mA
Terminals:	P2-7 (IN+), P2-8 (IN–), P2-9 (V+)

Communication Interface

CANbus

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
Terminals:	P2-12 (low), P2-11 (high), and P2-10 (shield)

Ethernet

Rear-panel RJ-45 connector provides remote communications via BESTCOMS*Plus* to the LSM-2020 and to the IEM-2020 that the module is connected to.

Type: 10/100BASE-T

Industrial Ethernet devices designed to comply with IEC 61000-4 series of specifications are recommended.

Type Tests

Shock

Withstands 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" Double Amplitude for 2.5 min.
52 to 500 to 52 Hz:	5 G peak for 7.5 min.

Ignition System

Tested in closed proximity to an unshielded, unsuppressed Altronic DISN 800 ignition system.

HALT (Highly Accelerated Life Testing)

HALT is used by Basler Electric to prove that our products will provide the user with many years of reliable service. HALT subjects the device to extremes in temperature, shock, and vibration to simulate years of operation, but in a much shorter period span. HALT allows Basler Electric to evaluate all possible design elements that will add to the life of this device. As an example of some of the extreme testing conditions, the LSM-2020 was subjected to temperature tests (tested over a temperature range of –80°C to +130°C), vibration tests (of 5 to 50 G at +25°C), and temperature/vibration tests (tested at 10 to 20 G over a temperature range of –60°C to +100°C). Combined temperature and vibration testing at these extremes proves that the LSM-2020 is expected to provide long-term operation in a rugged environment. Note that the vibration and temperature extremes listed in this paragraph are specific to HALT and do not reflect recommended operation levels. These operational ratings are included in Section 8 of this manual.

Environment

Temperature	
Operating:	–40 to +70°C (–40 to +158°F)
Storage:	–40 to +85°C (–40 to +185°F)
Humidity:	IEC 68-2-38

UL Approval

"cURus" recognized to UL Standard 508 & CSA Standard C22.2 No.14

"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, Zone 2, Groups A, B, C, D, Temperature Code - T4.

CSA Certification

CSA certified to Standard C22.2 No. 14.

NFPA Compliance

Complies with NFPA Standard 110, *Standard for Emergency and Standby Power*.

CE Compliance

This product complies with the requirements of the following EC Directives:

- Low Voltage Directive (LVD) - 73/23/EEC as amended by 93/68/EEC
- Electromagnetic Compatibility (EMC) - 89/336/EEC as amended by 92/31/EEC and 93/68/EEC

This product conforms to the following Harmonized Standards:

- EN 50178:1997 - *Electronic Equipment for use in Power Installations*
- EN 61000-6-4:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Emission Standard for Industrial Environments*
- EN 61000-6-2:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Immunity for Industrial Environments*

Physical

Weight:	1.45 lb (657 g)
Dimensions:	See *Installation* later in this section.

FUNCTIONAL DESCRIPTION

Analog Inputs

The analog inputs can be configured to accept voltage or current. The inputs are configured by using the Settings Explorer in BESTCOMS*Plus* to open the *Programmable Input, Remote LSM Inputs screen.*

Communications

The LSM-2020 communication ports include CAN terminals and an Ethernet port.

CANbus

A Control Area Network (CAN) is a standard interface that enables communication between the LSM-2020 and the IEM-2020.

Ethernet Port

An Ethernet port provides communications via BESTCOMS*Plus* to the LSM-2020 and to the IEM-2020 that the module is connected to. Firmware updates to the LSM-2020 are made through the Ethernet port. Firmware updates to the IEM-2020 are only available through the USB port of the IEM-2020. Refer to Section 4, *BESTCOMSPlus,* for information on configuring Ethernet communication and updating firmware in the IEM-2020.

Industrial Ethernet devices designed to comply with IEC 61000-4 series of specifications are recommended.

BESTCOMS*Plus* SOFTWARE

BESTCOMS*Plus* provides the user with a point-and-click means to set and monitor the LSM-2020. Installation and operation of BESTCOMS*Plus* is described in Section 4, *BESTCOMSPlus Software.*

LSM-2020 Plugin for BESTCOMS*Plus*

The setup utility that installs BESTCOMS*Plus* on your PC also installs the LSM-2020 plug-in. Refer to Section 4, *BESTCOMSPlus Software,* for information on activating the plugin.

The LSM-2020 plugin is used to set device security and view device information such as firmware version and serial number.

LSM-2020 operational settings are found in the IEM-2020 plugin for BESTCOMS*Plus*. Refer to Section 4, *BESTCOMSPlus Software,* for a detailed description of each setting.

The LSM-2020 plugin has two screens: *Device Info* and *Device Security Setup.*

Device Info

Information about a LSM-2020 communicating with BESTCOMS*Plus* can be obtained on the Device Info tab of BESTCOMS*Plus*.

Select application version[A] when configuring LSM-2020 settings off-line. When on-line, read-only information includes application version[B], boot code version[C], application build[D], serial number[E], application part number[F], and model number[G].

BESTCOMS*Plus* device information values and settings are illustrated in Figure 8-1.

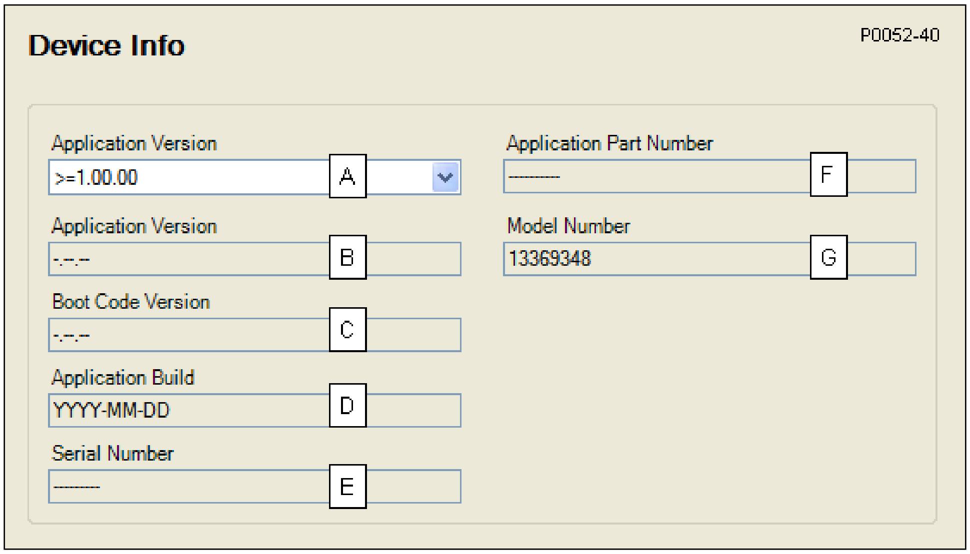

Figure 8-1. Device Info Screen

[A] *Application Version:* When configuring Load Share Module settings off-line, the application version for the unit to be configured must be selected.
[B] *Application Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with the Load Share Module.
[C] *Boot Code Version:* Read-only value obtained when BESTCOMS*Plus* is communicating with the Load Share Module.
[D] *Application Build:* Read-only value obtained when BESTCOMS*Plus* is communicating with the Load Share Module.
[E] *Serial Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with the Load Share Module.
[F] *Application Part Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with the Load Share Module.
[G] *Model Number:* Read-only value obtained when BESTCOMS*Plus* is communicating with the Load Share Module.

Device Security Setup

Password protection guards against unauthorized changing of LSM-2020 communication settings. Passwords are case sensitive. *OEM Access* is the only level of password protection available. This password level allows access to all settings made using the LSM-2020 plugin for BESTCOMS*Plus*. The default, OEM-access password is **OEM**.

Passwords can be changed only after communication between the PC and LSM-2020 is established. A change to the password is made through the *Device Security Setup* screen. Use the Settings Explorer in BESTCOMS*Plus* to open the *General Settings, Device Security Setup* screen. See Figure 8-2.

A password is changed by clicking on the access level[A], entering the new password[B], and then clicking on the *Save Password* button[C].

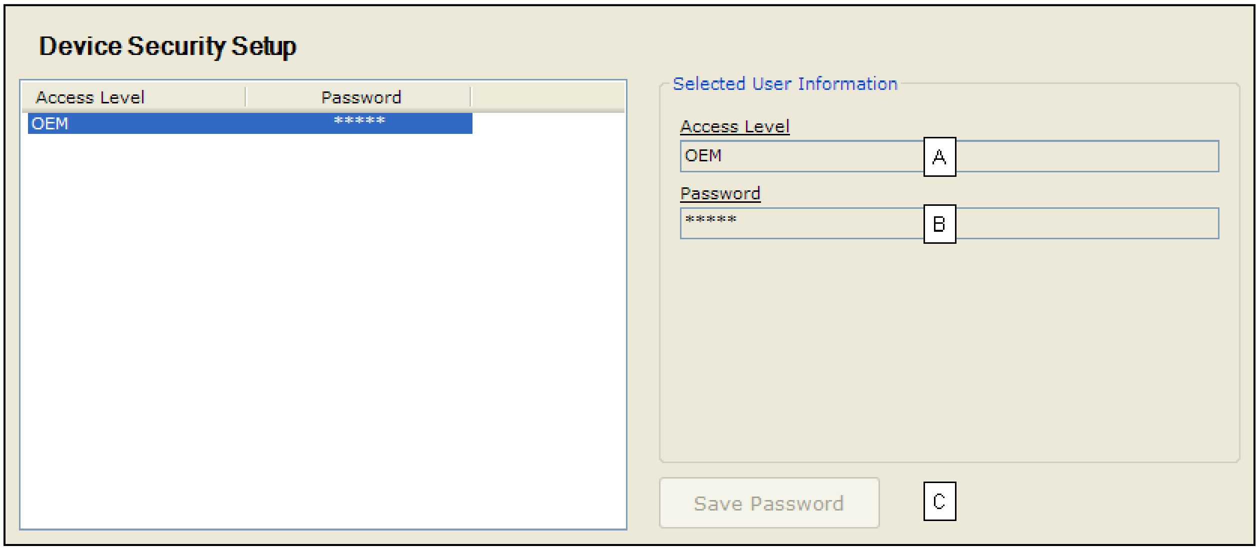

Figure 8-2. Device Security Setup Screen

[A] *Access Level/Password:* Read-only value obtained when BESTCOMSPlus is communicating with the Load Share Module.
[B] *Password:* Accepts an alphanumeric character string of up to 16 characters.
[C] *Save Password:* Clicking this button will save the password changes in BESTCOMSPlus memory.

INSTALLATION

LSM-2020's are delivered in sturdy cartons to prevent shipping damage. Upon receipt of a module, 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 USA.

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

Product Registration

Registering with Basler Electric enables you to receive important information updates on your product plus new product announcements. Register your product by directing your web browser to www.basler.com.

Mounting

LSM-2020's are contained in a potted plastic case and may be mounted in any convenient position. The construction of a LSM-2020 is durable enough to mount directly on a engine using UNF ¼-20 or equivalent hardware. Hardware selection should be based on any expected shipping/transportation and operating conditions. The torque applied to the mounting hardware should not exceed 65 in-lb (7.34 N•m).

See Figure 8-3 for LSM-2020 overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

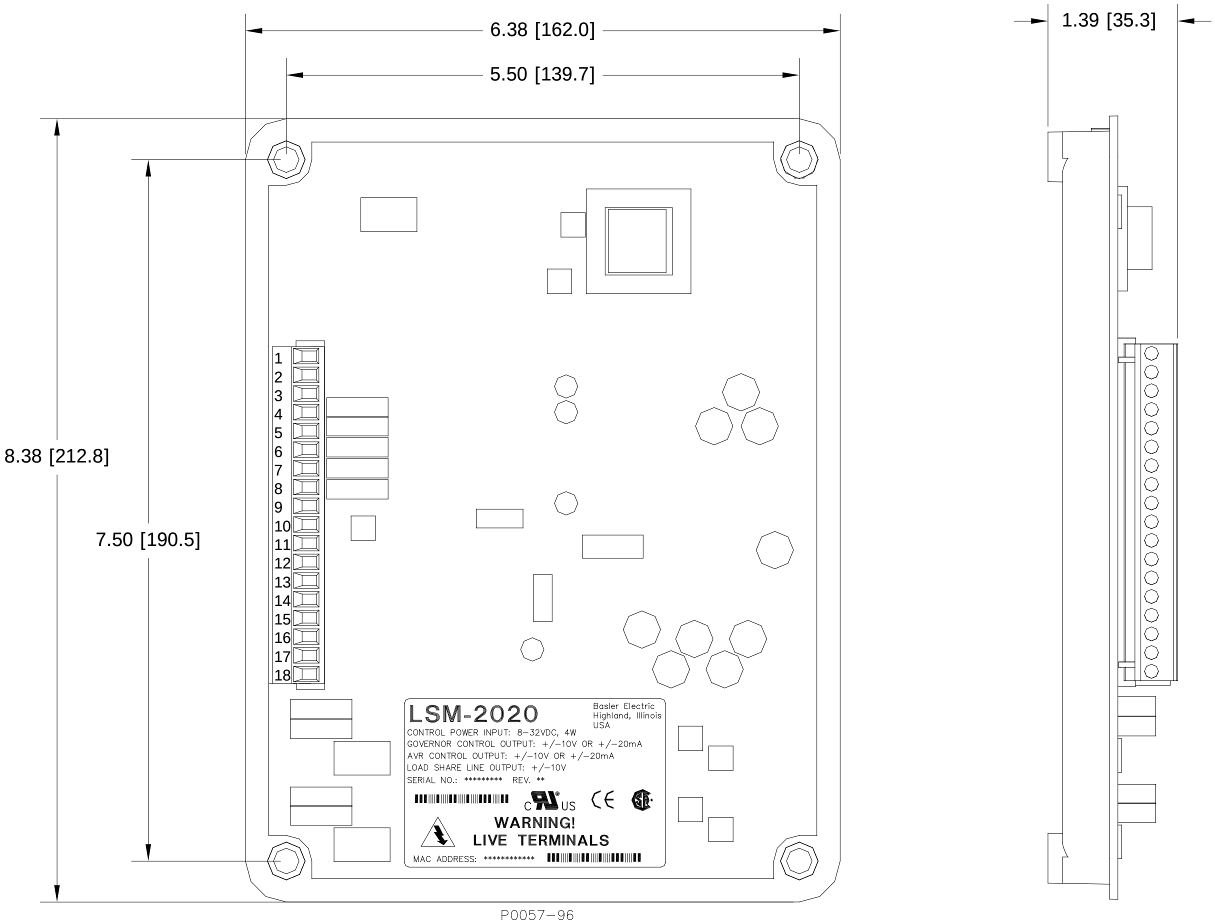

Figure 8-3. LSM-2020 Overall Dimensions

Connections

LSM-2020 connections are dependent on the application. Incorrect wiring may result in damage to the module.

> **NOTE**
>
> Operating power from the battery must be of the correct polarity. Although reverse polarity will not cause damage, the LSM-2020 will not operate.
>
> Be sure that the LSM-2020 is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the chassis ground terminal on the module.

Terminations

There are two types of interface terminals: plug-in connectors with screw-down compression terminals and an RJ-45 socket.

The RJ-45 socket mates with a standard Ethernet cable and provides local communication between the LSM-2020 and a PC running BESTCOMS*Plus* software. This allows for setting of the LSM-2020 and for the IEM-2020 that the module is connected to.

LSM-2020 connections are made with an 18-position connector with screw-down compression terminals. This connector plugs into a header on the LSM-2020. The connector and header have a dovetailed edge that ensures proper connector orientation. The connector and header are uniquely keyed to ensure that the connector mates only with the correct header. Connector screw terminals accept a maximum wire size of 12 AWG. Maximum screw torque is 4 inch-pounds (0.45 N•m).

Operating Power

The LSM-2020 operating power input accepts either 12 Vdc or 24 Vdc and tolerates voltage over the range of 6 to 32 Vdc. Operating power must be of the correct polarity. Although reverse polarity will not cause damage, the LSM-2020 will not operate. Operating power terminals are listed in Table 8-1.

It is recommended that a fuse be added for additional protection for the wiring to the battery input of the LSM-2020. A Bussmann ABC-7 fuse or equivalent is recommended.

Table 8-1. Operating Power Terminals

Terminal	Description
P2-1 (CHASSIS)	Chassis ground connection
P2-2 (BATT+)	Positive side of operating power input
P2-3 (BATT–)	Negative side of operating power input

Analog Inputs

Analog input terminals are listed in Table 8-2. Voltage input connections are shown in Figure 8-4 and current input connections are shown in Figure 8-5.

Table 8-2. Analog Input Terminals

Terminal	Description
P2-9 (V+)	Voltage input
P2-8 (IN–)	Common for voltage or current
P2-7 (I+)	Current input

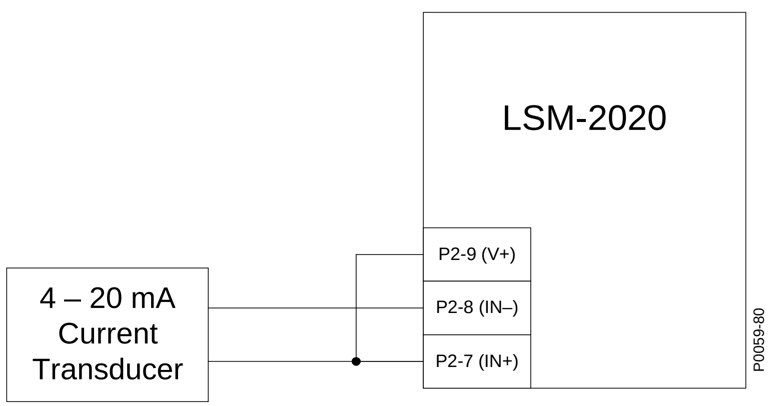

Figure 8-4. Analog Inputs - Voltage Input Connections

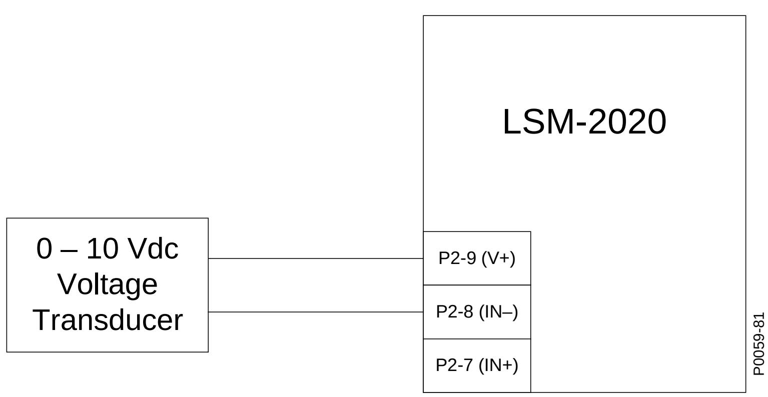

Figure 8-5. Analog Inputs - Current Input Connections

CANbus Interface

These terminals provide communication using the SAE J1939 protocol and provide high-speed communication between the LSM-2020 and the IEM-2020. Connections between the LSM-2020 and IEM-2020 should be made with twisted-pair, shielded cable. CANbus interface terminals are listed in Table 8-3. Refer to Figure 8-6 and Figure 8-7.

Table 8-3. CANbus Interface Terminals

Terminal	Description
P2-12 (CAN L)	CAN low connection (green wire)
P2-11 (CAN H)	CAN high connection (yellow wire)
P2-10 (SHIELD)	CAN drain connection

NOTES

1.) If the LSM-2020 is providing one end of the J1939 bus, a 120 Ω, ½ watt terminating resistor should be installed across terminals P2-12 (CANL) and P2-11 (CANH).

2.) If the LSM-2020 is not part of the J1939 bus, the stub connecting the LSM-2020 to the bus should not exceed 914 mm (3 ft) in length.

3.) The maximum bus length, not including stubs, is 40 m (131 ft).

4.) The J1939 drain (shield) should be grounded at one point only. If grounded elsewhere, do not connect the drain to the LSM-2020.

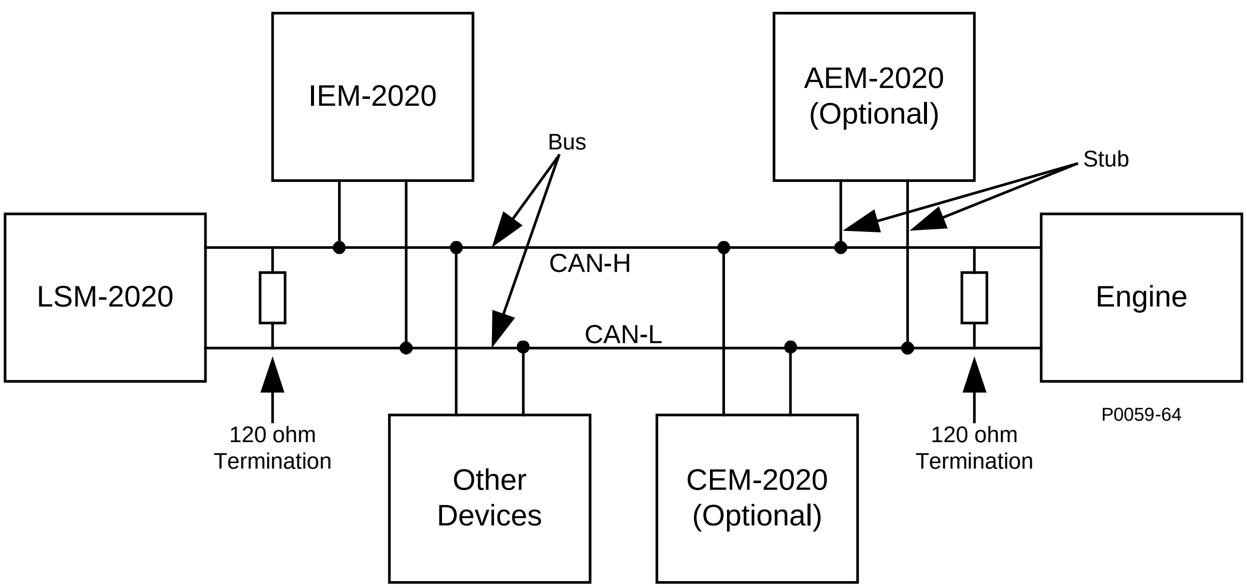

Figure 8-6. CANbus Interface with LSM-2020 providing One End of the Bus

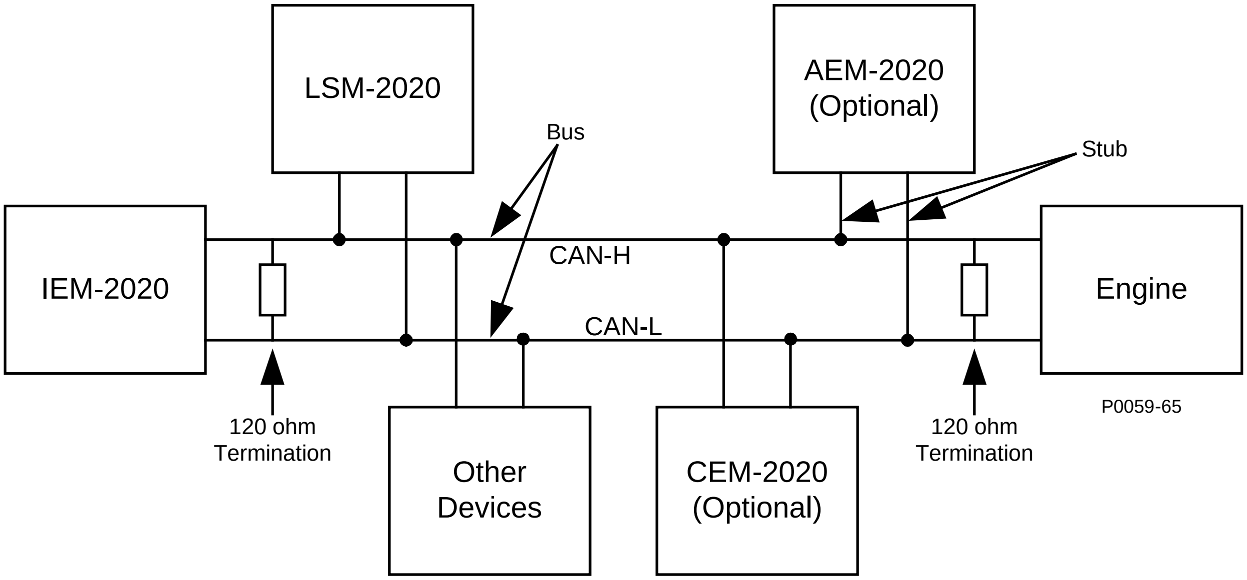

Figure 8-7. CANbus Interface with IEM-2020 providing One End of the Bus

Ethernet Port

The LSM-2020 has Ethernet capability. The LSM-2020 connects to a PC through a RJ-45 jack (J3).

Industrial Ethernet devices designed to comply with IEC 61000-4 series of specifications are recommended.

Connections for Typical Applications

Figure 8-8 illustrates typical LSM-2020 connections.

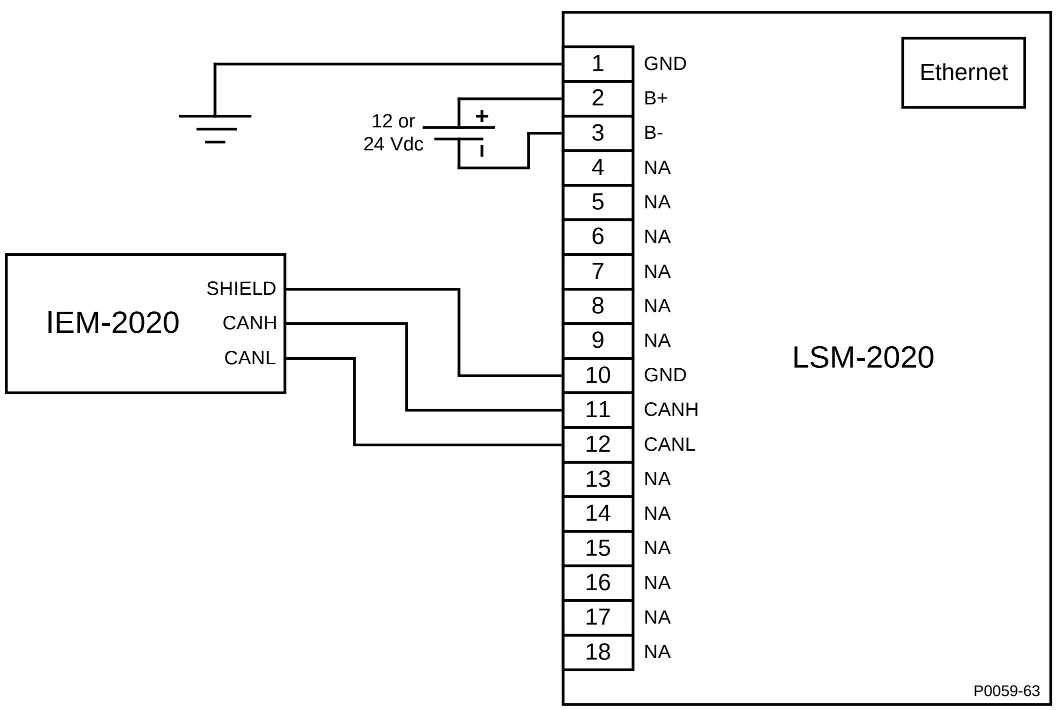

Figure 8-8. Typical LSM-2020 Connections

MAINTENANCE

Preventive maintenance consists of periodically checking that the connections between the LSM-2020 and the system are clean and tight. LSM-2020s 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.

SECTION 9 • CEM-2020 (CONTACT EXPANSION MODULE)

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SECTION 9 • CEM-2020 (CONTACT EXPANSION MODULE)

GENERAL INFORMATION

The optional CEM-2020 is a remote auxiliary device that provides additional IEM-2020 contact inputs and outputs. Two types of modules are available. A low current module (CEM-2020) provides 24 output contacts and a high current module (CEM-2020H) provides 18 output contacts.

FEATURES

CEM-2020s have the following features:

- 10 Contact Inputs
- 18 Output Contacts (CEM-2020H) or 24 Output Contacts (CEM-2020)
- Functionality of Inputs and Outputs assigned by BESTLogic*Plus* programmable logic
- Communications via CANbus

SPECIFICATIONS

Operating Power

Nominal:	12 or 24 Vdc
Range:	8 to 32 Vdc (Withstands cranking ride-through down to 6 Vdc for 500 ms.)
Maximum Consumption	
CEM-2020:	14 W
CEM-2020H:	8 W

Contact Inputs

The CEM-2020 contains 10 programmable inputs that accept normally open and normally closed, dry contacts.

Time from a CEM-2020 input going high to:

Shutdown the engine via an alarm:	700 ms max
Close a relay on board the IEM-2020:	300 ms max

Output Contacts

Ratings

CEM-2020	
Outputs 13 through 24:	1 Adc at 30 Vdc, Form C, gold contacts
Outputs 25 through 36:	4 Adc at 30 Vdc, Form C
CEM-2020H	
Outputs 13 through 24:	2 Adc at 30 Vdc, Form C, gold contacts
Outputs 25 through 30:	10 Adc at 30 Vdc, Form C

Communication Interface

CANbus

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

Type Tests

Shock

Withstands 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” Double Amplitude for 2.5 min.
52 to 500 to 52 Hz:	5 G peak for 7.5 min.

Ignition System

Tested in closed proximity to an unshielded, unsuppressed Altronic DISN 800 ignition system.

HALT (Highly Accelerated Life Testing)

HALT is used by Basler Electric to prove that our products will provide the user with many years of reliable service. HALT subjects the device to extremes in temperature, shock, and vibration to simulate years of operation, but in a much shorter period span. HALT allows Basler Electric to evaluate all possible design elements that will add to the life of this device. As an example of some of the extreme testing conditions, the CEM-2020 was subjected to temperature tests (tested over a temperature range of –80°C to +130°C), vibration tests (of 5 to 50 G at +25°C), and temperature/vibration tests (tested at 10 to 20 G over a temperature range of –60°C to +100°C). Combined temperature and vibration testing at these extremes proves that the CEM-2020 is expected to provide long-term operation in a rugged environment. Note that the vibration and temperature extremes listed in this paragraph are specific to HALT and do not reflect recommended operation levels. These operational ratings are included in Section 9 of this manual.

Environment

Temperature	
Operating:	–40 to +70°C (–40 to +158°F)
Storage:	–40 to +85°C (–40 to +185°F)
Humidity:	IEC 68-2-38

UL Approval (CEM-2020 Only)

“cURus” recognized to UL Standard 508 & CSA Standard C22.2 No. 14.

UL Approval (CEM-2020H Only)

UL recognized to UL Standard 508.

Hazardous Locations

UL 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, Zone 2, Groups A, B, C, D, Temperature Code - T4.

NOTE

To comply with UL guidelines, when using the CEM-2020H in a hazardous location, a UL Listed fuse must be placed in the 2 Adc output contact circuits (outputs 13 through 24) and fusing must be provided in a general-purpose type of enclosure. The suggested fuse size in Adc = (100/Contact Voltage) with a maximum fuse size of 5 Adc.

CSA Certification

CSA certified to Standard C22.2 No.14.

NFPA Compliance

Complies with NFPA Standard 110, *Standard for Emergency and Standby Power*.

CE Compliance

This product complies with the requirements of the following EC Directives:

- Low Voltage Directive (LVD) - 73/23/EEC as amended by 93/68/EEC
- Electromagnetic Compatibility (EMC) - 89/336/EEC as amended by 92/31/EEC and 93/68/EEC

This product conforms to the following Harmonized Standards:

- EN 50178:1997 - *Electronic Equipment for use in Power Installations*
- EN 61000-6-4:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Emission Standard for Industrial Environments*
- EN 61000-6-2:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Immunity for Industrial Environments*

Physical

Weight	
CEM-2020:	2.25 lb (1.02 kg)
CEM-2020H:	1.90 lb (0.86 kg)
Dimensions:	See *Installation* later in this section.

FUNCTIONAL DESCRIPTION

Contact Inputs

The CEM-2020 provides 10 programmable contact inputs with the same functionality as the contact inputs on the IEM-2020.

Output Contacts

CEM-2020

The CEM-2020 provides 24 programmable output contacts with the same functionality as the output contacts on the IEM-2020. Outputs 13 through 24 can carry 1 A. Outputs 25 through 36 can carry 4 A.

CEM-2020H

The CEM-2020H provides 18 programmable output contacts with the same functionality as the output contacts on the IEM-2020. Outputs 13 through 24 can carry 2 A. Outputs 25 through 30 can carry 10 A.

Communications

CANbus

A Control Area Network (CAN) is a standard interface that enables communication between the CEM-2020 and the IEM-2020.

BESTCOMS*Plus* SOFTWARE

BESTCOMS*Plus* provides the user with a point-and-click means to set and monitor the Contact Expansion Module. Installation and operation of BESTCOMS*Plus* is described in Section 4, *BESTCOMSPlus Software.*

INSTALLATION

Contact Expansion Modules are delivered in sturdy cartons to prevent shipping damage. Upon receipt of a module, 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 USA.

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

Product Registration

Registering with Basler Electric enables you to receive important information updates on your product plus new product announcements. Register your product by directing your web browser to www.basler.com.

Mounting

Contact Expansion Modules are contained in a potted plastic case and may be mounted in any convenient position. The construction of a Contact Expansion Module is durable enough to mount directly on a engine using UNF ¼-20 or equivalent hardware. Hardware selection should be based on any expected shipping/transportation and operating conditions. The torque applied to the mounting hardware should not exceed 65 in-lb (7.34 N•m).

See Figure 9-1 for CEM-2020 overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

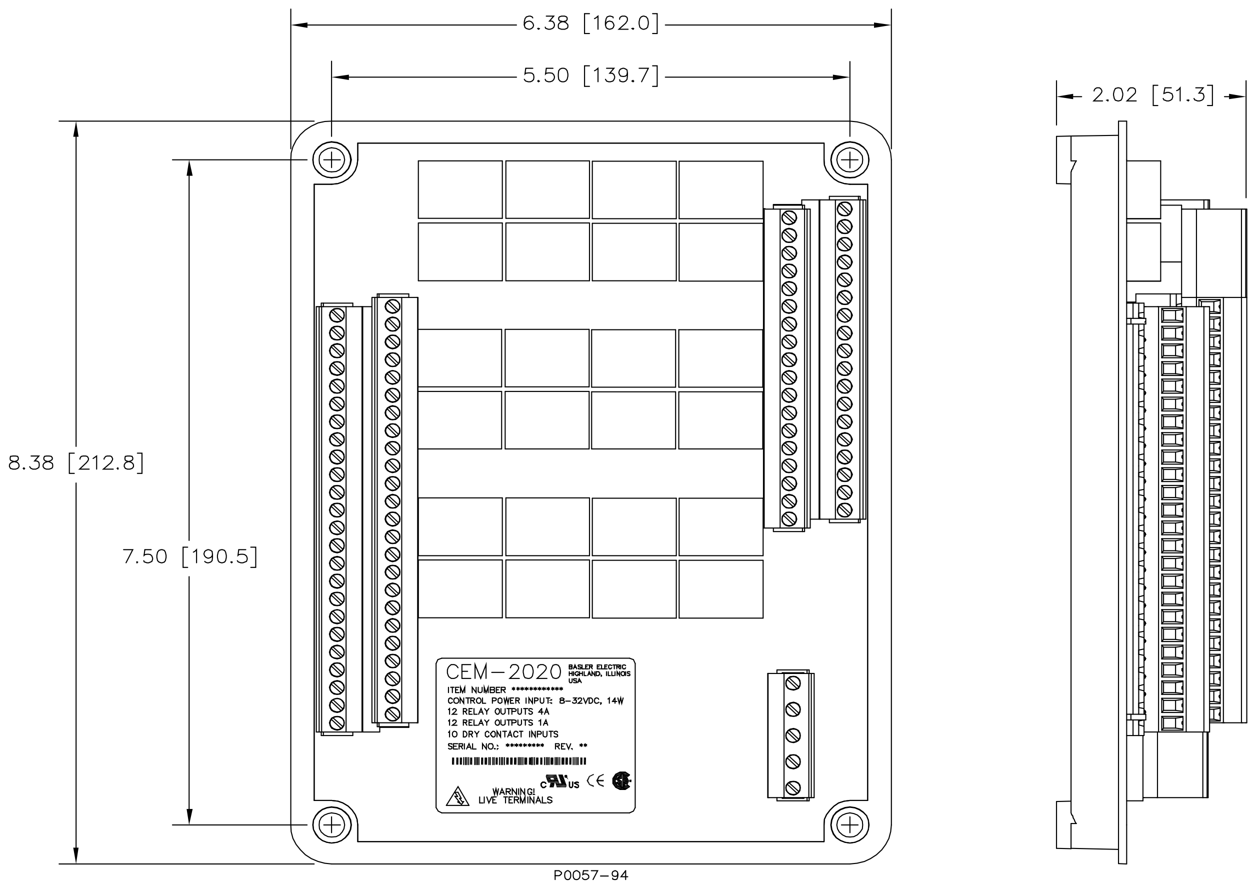

Figure 9-1. CEM-2020 Overall Dimensions

See Figure 9-2 for CEM-2020H overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

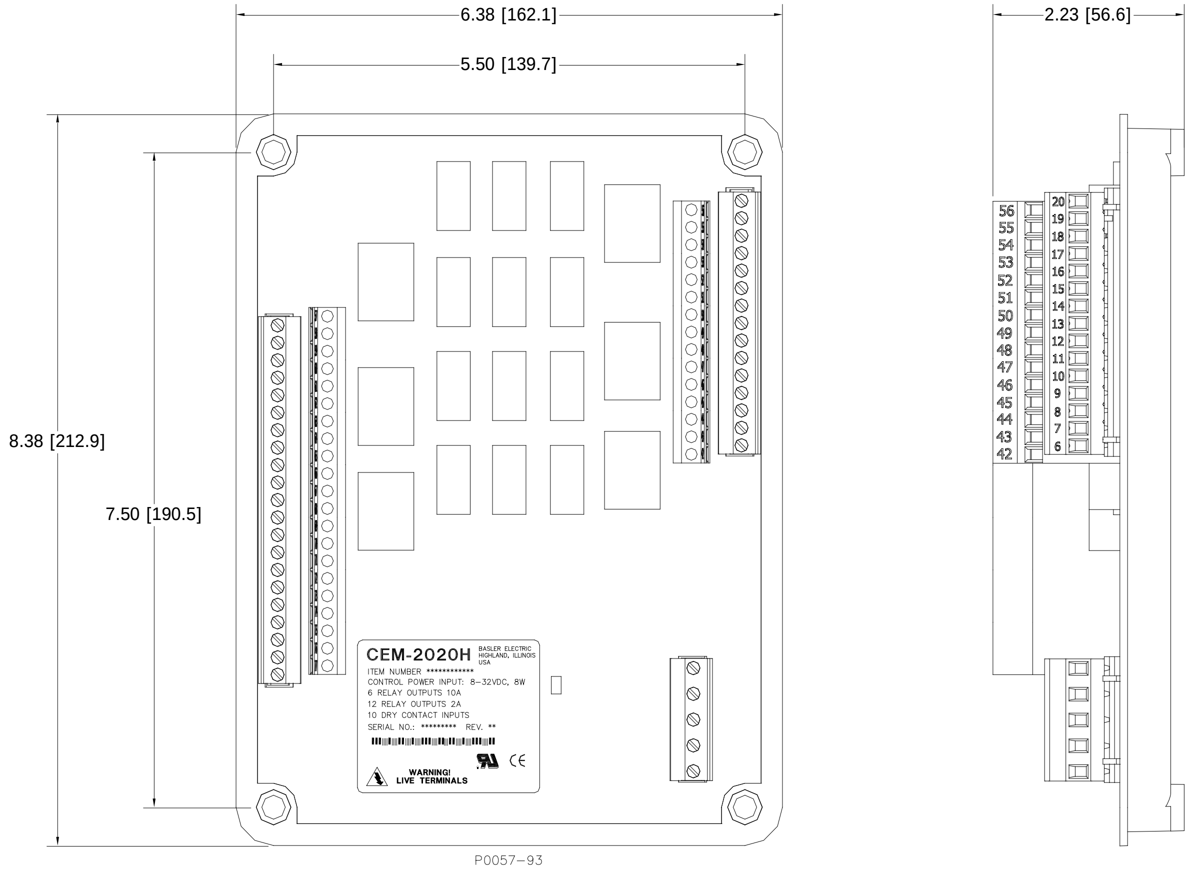

Figure 9-2. CEM-2020H Overall Dimensions

Connections

Contact Expansion Module connections are dependent on the application. Incorrect wiring may result in damage to the module.

> **NOTE**
>
> Operating power from the battery must be of the correct polarity. Although reverse polarity will not cause damage, the CEM-2020 will not operate.
>
> Be sure that the CEM-2020 is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the chassis ground terminal on the module.

Terminations

The terminal interface consists of plug-in connectors with screw-down compression terminals.

CEM-2020 connections are made with one 5-position connector, two 18-position connectors, and two 24-position connectors with screw-down compression terminals. These connectors plug into headers on the CEM-2020. The connectors and headers have dovetailed edges that ensure proper connector orientation. The connectors and headers are uniquely keyed to ensure that the connectors mate only with the correct headers. Connector screw terminals accept a maximum wire size of 12 AWG. Maximum screw torque is 5 inch-pounds (0.56 N•m).

Operating Power

The Contact Expansion Module operating power input accepts either 12 Vdc or 24 Vdc and tolerates voltage over the range of 6 to 32 Vdc. Operating power must be of the correct polarity. Although reverse polarity will not cause damage, the CEM-2020 will not operate. Operating power terminals are listed in Table 9-1.

It is recommended that a fuse be added for additional protection for the wiring to the battery input of the Contact Expansion Module. A Bussmann ABC-7 fuse or equivalent is recommended.

Table 9-1. Operating Power Terminals

Terminal	Description
P1- ⏚ (SHIELD)	Chassis ground connection
P1- – (BATT–)	Negative side of operating power input
P1- + (BATT+)	Positive side of operating power input

Contact Inputs and Output Contacts

The CEM-2020 (Figure 9-3) has 10 contact inputs and 24 output contacts. The CEM-2020H (Figure 9-4) has 10 contact inputs and 18 output contacts.

NOTE

To follow UL guidelines, a fuse must be implemented in the 2Adc contact circuits (Outputs 13 through 24) of the CEM-2020H used in hazardous locations. The suggested fuse size in Adc = (100/Contact Voltage) with a maximum fuse size of 5Adc.

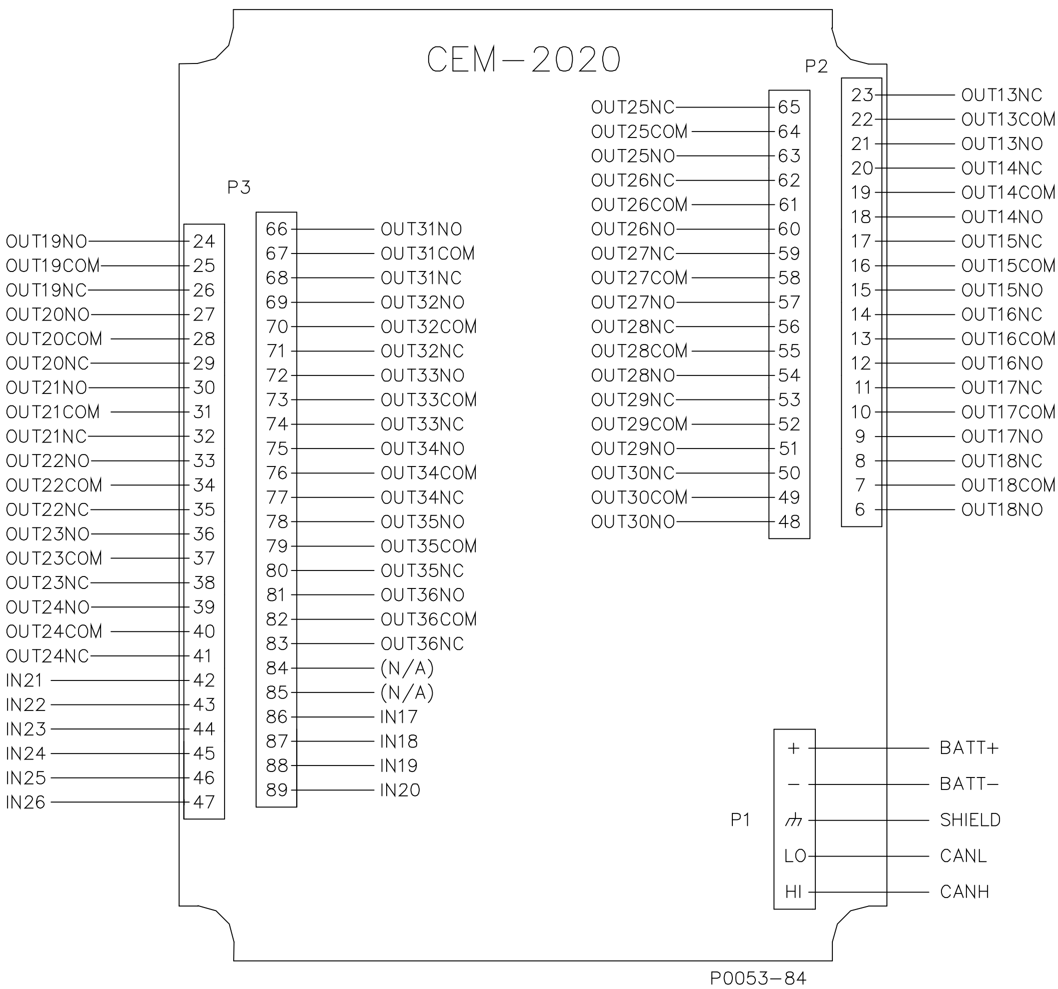

Figure 9-3. CEM-2020 Input Contact and Output Contact Terminals

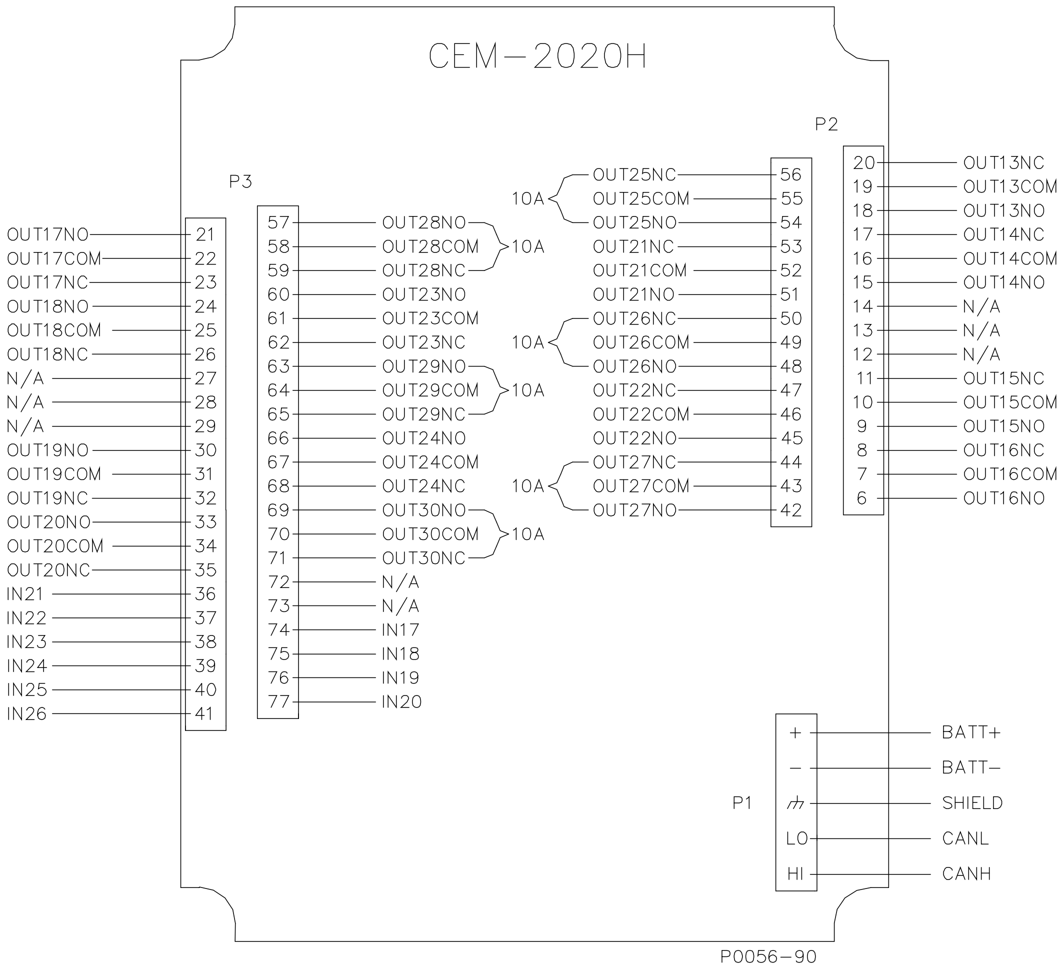

Figure 9-4. CEM-2020H Input Contact and Output Contact Terminals

CANbus Interface

These terminals provide communication using the SAE J1939 protocol and provide high-speed communication between the Contact Expansion Module and the IEM-2020. Connections between the CEM-2020 and IEM-2020 should be made with twisted-pair, shielded cable. CANbus interface terminals are listed in Table 9-2. Refer to Figure 9-5 and Figure 9-6.

Table 9-2. CANbus Interface Terminals

Terminal	Description
P1- HI (CAN H)	CAN high connection (yellow wire)
P1- LO (CAN L)	CAN low connection (green wire)
P1- ⏚ (SHIELD)	CAN drain connection

NOTES

1.) If the CEM-2020 is providing one end of the J1939 bus, a 120 Ω, ½ watt terminating resistor should be installed across terminals P1- LO (CANL) and P1- HI (CANH).

2.) If the CEM-2020 is not part of the J1939 bus, the stub connecting the CEM-2020 to the bus should not exceed 914 mm (3 ft) in length.

3.) The maximum bus length, not including stubs, is 40 m (131 ft).

4.) The J1939 drain (shield) should be grounded at one point only. If grounded elsewhere, do not connect the drain to the CEM-2020.

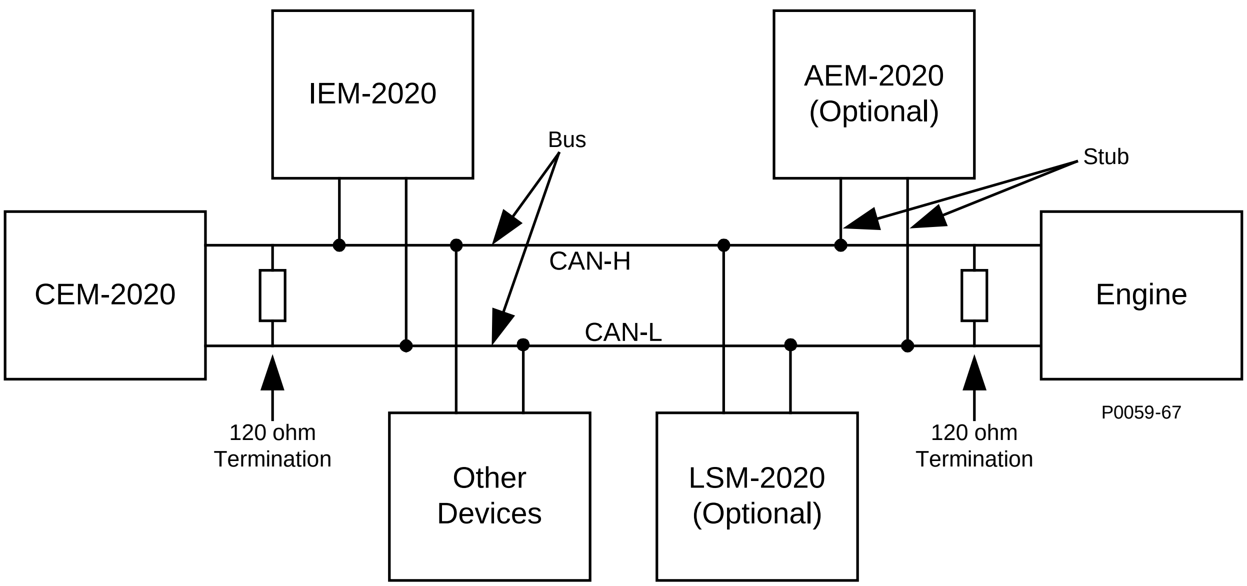

Figure 9-5. CANbus Interface with CEM-2020 providing One End of the Bus

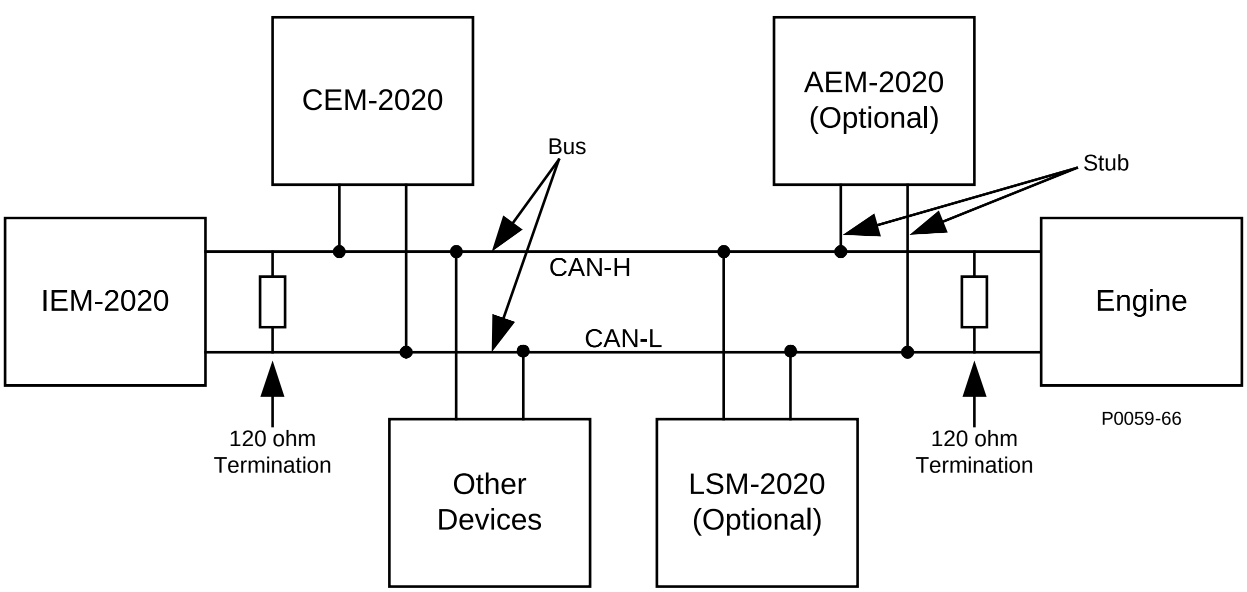

Figure 9-6. CANbus Interface with IEM-2020 providing One End of the Bus

MAINTENANCE

Preventive maintenance consists of periodically checking that the connections between the CEM-2020 and the system are clean and tight. Contact Expansion Modules 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.

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SECTION 10 ● AEM-2020 (ANALOG EXPANSION MODULE)

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SECTION 10 • AEM-2020 (ANALOG EXPANSION MODULE)

GENERAL INFORMATION

The optional AEM-2020 is a remote auxiliary device that provides additional IEM-2020 analog inputs and outputs.

FEATURES

AEM-2020s have the following features:

- 8 Analog Inputs
- 8 RTD Inputs
- 2 Thermocouple Inputs
- 4 Analog Outputs
- Functionality of Inputs and Outputs assigned by BESTLogic*Plus* programmable logic
- Communications via CANbus

SPECIFICATIONS

Operating Power

Nominal:	12 or 24 Vdc
Range:	8 to 32 Vdc (Withstands cranking ride-through down to 6 Vdc for 500 ms.)
Maximum Consumption:	5.1 W

Analog Inputs

The AEM-2020 contains eight programmable analog inputs.

Rating:	4 to 20 mA or 0 to 10 Vdc (user-selectable)

RTD Inputs

The AEM-2020 contains eight programmable RTD inputs.

Rating:	100 Ω Platinum or 10 Ω Copper (user-selectable)
Setting Range:	–50 to +250°C or –58 to +482°F
Accuracy (10 Ω Copper):	+/-0.044 Ω @ 25°C, +/-0.005 Ω/°C drift over ambient temperature
Accuracy (100 Ω Platinum):	+/-0.39 Ω @ 25°C, +/-0.047Ω/°C drift over ambient temperature

Thermocouple Inputs

The AEM-2020 contains two thermocouple inputs.

Rating:	2 K Type Thermocouples
Setting Range:	0 to 1,375°C or 0 to 2,507°F
Display Range:	Ambient to 1,375°C or Ambient to 2,507°F
Accuracy:	+/-40uV @ 25°C, +/-5 uV/°C drift over ambient temperature

Analog Outputs

The AEM-2020 contains four programmable analog outputs.

Rating:	4 to 20 mA or 0 to 10 Vdc (user-selectable)

Communication Interface

CANbus

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

Type Tests

Shock

Withstands 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" Double Amplitude for 2.5 min.
52 to 500 to 52 Hz:	5 G peak for 7.5 min.

Ignition System

Tested in closed proximity to an unshielded, unsuppressed Altronic DISN 800 ignition system.

HALT (Highly Accelerated Life Testing)

HALT is used by Basler Electric to prove that our products will provide the user with many years of reliable service. HALT subjects the device to extremes in temperature, shock, and vibration to simulate years of operation, but in a much shorter period span. HALT allows Basler Electric to evaluate all possible design elements that will add to the life of this device. As an example of some of the extreme testing conditions, the AEM-2020 was subjected to temperature tests (tested over a temperature range of –80°C to +130°C), vibration tests (of 5 to 50 G at +25°C), and temperature/vibration tests (tested at 10 to 20 G over a temperature range of –60°C to +100°C). Combined temperature and vibration testing at these extremes proves that the AEM-2020 is expected to provide long-term operation in a rugged environment. Note that the vibration and temperature extremes listed in this paragraph are specific to HALT and do not reflect recommended operation levels. These operational ratings are included in Section 10 of this manual.

Environment

Temperature	
Operating:	–40 to +70°C (–40 to +158°F)
Storage:	–40 to +85°C (–40 to +185°F)
Humidity:	IEC 68-2-38

UL Approval

"cURus" recognized to UL Standard 508 & CSA Standard C22.2 No.14

"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, Zone 2, Groups A, B, C, D, Temperature Code - T4.

CSA Certification

CSA certified to Standard C22.2 No.14.

NFPA Compliance

Complies with NFPA Standard 110, *Standard for Emergency and Standby Power*.

CE Compliance

This product complies with the requirements of the following EC Directives:

- Low Voltage Directive (LVD) - 73/23/EEC as amended by 93/68/EEC
- Electromagnetic Compatibility (EMC) - 89/336/EEC as amended by 92/31/EEC and 93/68/EEC

This product conforms to the following Harmonized Standards:

- EN 50178:1997 - *Electronic Equipment for use in Power Installations*
- EN 61000-6-4:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Emission Standard for Industrial Environments*
- EN 61000-6-2:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Immunity for Industrial Environments*

Physical

Weight: 1.80 lb (816 g)
Dimensions: See *Installation* later in this section.

FUNCTIONAL DESCRIPTION

A functional description of the AEM-2020's inputs and outputs is provided below.

Analog Inputs

The AEM-2020 provides eight analog inputs that are user-selectable for 4 to 20 mA or 0 to 10 Vdc. Each analog input has under/over thresholds that can be configured as status only, alarm, or pre-alarm. When enabled, an out of range alarm alerts the user of an open or damaged analog input wire. The label text of each analog input is customizable.

RTD Inputs

The AEM-2020 provides eight user-configurable RTD inputs for monitoring engine temperature. Each RTD input can be configured as status only, alarm, or pre-alarm to protect against high or low temperature conditions. When enabled, an out of range alarm alerts the user of an open or damaged RTD input wire. The label text of each RTD input is customizable.

Thermocouple Inputs

The AEM-2020 provides two thermocouple inputs for monitoring engine temperature. Each thermocouple input can be configured as status only, alarm, or pre-alarm to protect against high or low temperature conditions. When enabled, an out of range alarm alerts the user of an open or damaged thermocouple input wire. The label text of each thermocouple input is customizable.

Analog Outputs

The AEM-2020 provides four analog outputs that are user-selectable for 4 to 20 mA or 0 to 10 Vdc. A wide selection of parameters including oil pressure and fuel level can be configured as analog outputs. Refer to Section 4, *BESTCOMSPlus Software,* for a full list of parameter selections.

Communications

CANbus

A Control Area Network (CAN) is a standard interface that enables communication between the AEM-2020 and the IEM-2020.

BESTCOMS*Plus* SOFTWARE

BESTCOMS*Plus* provides the user with a point-and-click means to set and monitor the Analog Expansion Module. Installation and operation of BESTCOMS*Plus* is described in Section 4, *BESTCOMSPlus Software.*

INSTALLATION

Analog Expansion Modules are delivered in sturdy cartons to prevent shipping damage. Upon receipt of a module, 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 USA.

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

Product Registration

Registering with Basler Electric enables you to receive important information updates on your product plus new product announcements. Register your product by directing your web browser to www.basler.com.

Mounting

Analog Expansion Modules are contained in a potted plastic case and may be mounted in any convenient position. The construction of an Analog Expansion Module is durable enough to mount directly on a engine using UNF ¼-20 or equivalent hardware. Hardware selection should be based on any expected shipping/transportation and operating conditions. The torque applied to the mounting hardware should not exceed 65 in-lb (7.34 N•m).

See Figure 10-1 for AEM-2020 overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

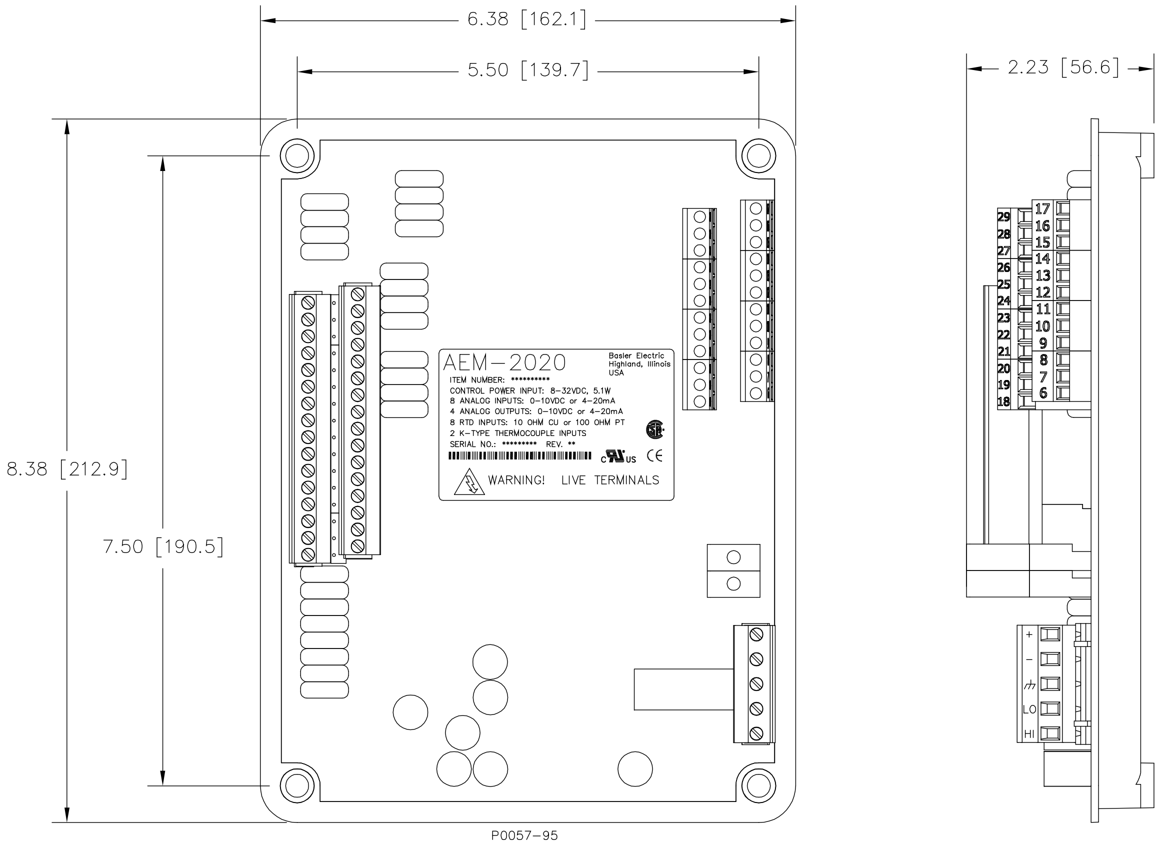

Figure 10-1. AEM-2020 Overall Dimensions

Connections

Analog Expansion Module connections are dependent on the application. Incorrect wiring may result in damage to the module.

> **NOTE**
>
> Operating power from the battery must be of the correct polarity. Although reverse polarity will not cause damage, the AEM-2020 will not operate.
>
> Be sure that the AEM-2020 is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the chassis ground terminal on the module.

Terminations

The terminal interface consists of both plug-in connectors and a permanently mounted connector with screw-down compression terminals.

AEM-2020 connections are made with one 5-position connector, two 12-position connectors, two 16-position connectors, and two 2-position thermocouple connectors. The 16, 5, and 2-position connectors plug into headers on the AEM-2020. The connectors and headers have dovetailed edges that ensure proper connector orientation. The connectors and headers are uniquely keyed to ensure that the connectors mate only with the correct headers. The 12-position connector is not a plug-in connector and is mounted permanently to the board. Connector screw terminals accept a maximum wire size of 12 AWG. Thermocouple connectors accept a maximum thermocouple wire diameter of 0.177 inches (4.5 mm). Maximum screw torque is 5 inch-pounds (0.56 N•m).

Operating Power

The Analog Expansion Module operating power input accepts either 12 Vdc or 24 Vdc and tolerates voltage over the range of 6 to 32 Vdc. Operating power must be of the correct polarity. Although reverse polarity will not cause damage, the AEM-2020 will not operate. Operating power terminals are listed in Table 10-1.

It is recommended that a fuse be added for additional protection for the wiring to the battery input of the Analog Expansion Module. A Bussmann ABC-7 fuse or equivalent is recommended.

Table 10-1. Operating Power Terminals

Terminal	Description
P1- ⏚ (SHIELD)	Chassis ground connection
P1- – (BATT–)	Negative side of operating power input
P1- + (BATT+)	Positive side of operating power input

AEM-2020 Inputs and Outputs

Input and output terminals are shown in Figure 10-2 and listed in Table 10-2.

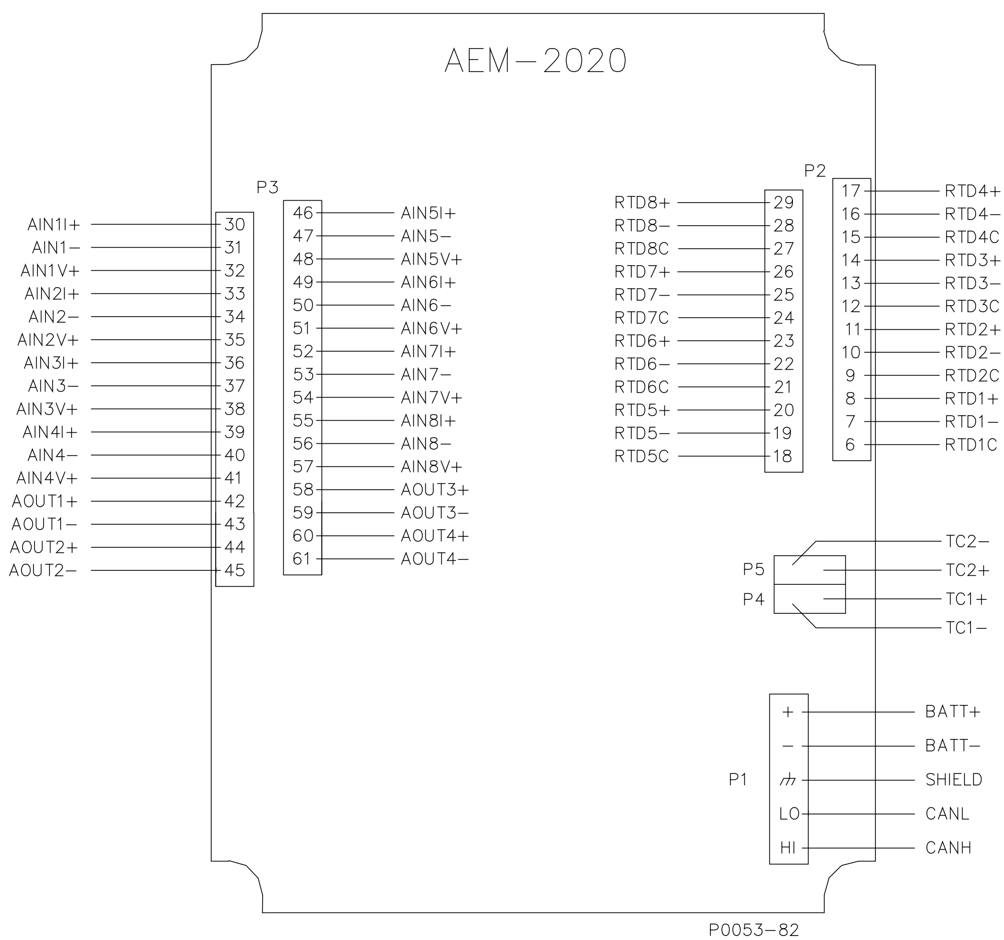

Figure 10-2. Input and Output Terminals

Table 10-2. Input and Output Terminals

Connector	Description
P1	Operating Power and CANbus
P2	RTD Inputs 1 - 8
P3	Analog Inputs 1 - 8 and Analog Outputs 1 - 4
P4	Thermocouple 1 Input
P5	Thermocouple 2 Input

External Analog Input Connections

Voltage input connections are shown in Figure 10-3 and current input connections are shown in Figure 10-4. When using the current input, AIN V+ and AIN I+ must be tied together.

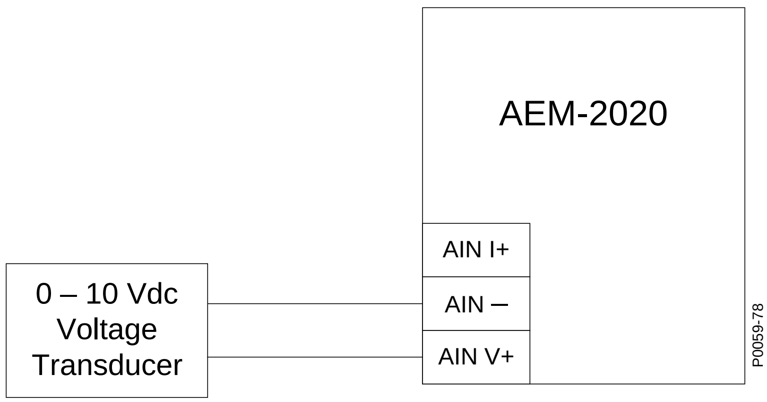

Figure 10-3. Analog Inputs - Voltage Input Connections

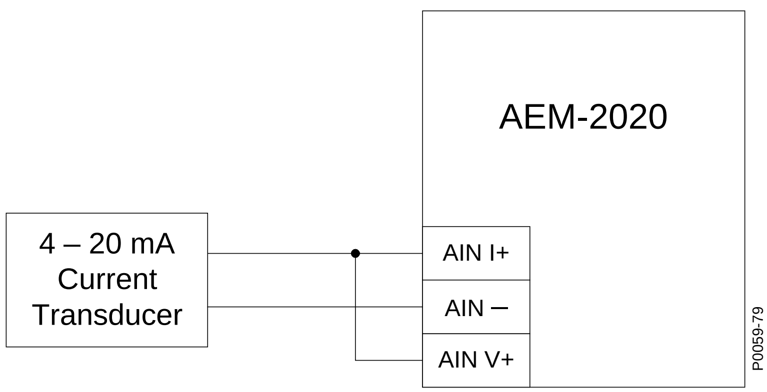

Figure 10-4. Analog Inputs - Current Input Connections

External RTD Input Connections

External 2-wire RTD input connections are shown in Figure 10-5. Figure 10-6 shows external 3-wire RTD input connections.

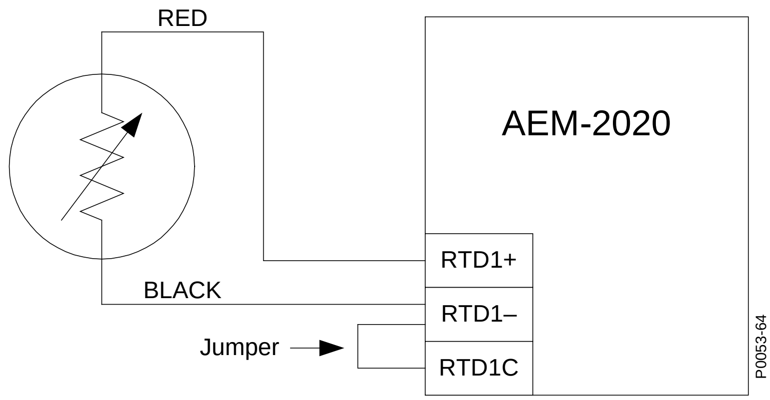

Figure 10-5. External Two-Wire RTD Input Connections

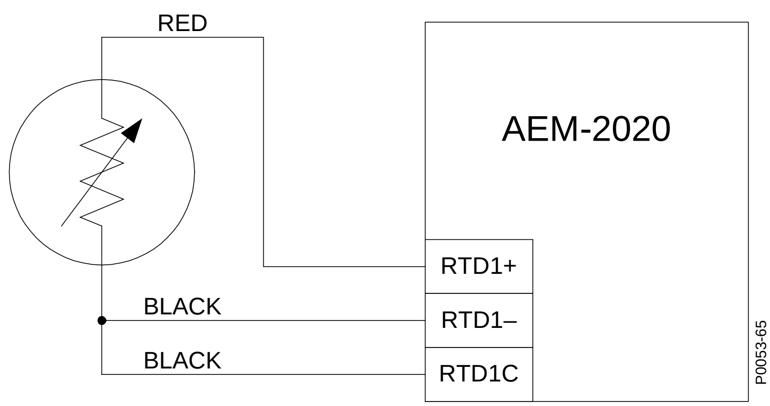

Figure 10-6. External Three-Wire RTD Input Connections

CANbus Interface

These terminals provide communication using the SAE J1939 protocol and provide high-speed communication between the Analog Expansion Module and the IEM-2020. Connections between the AEM-2020 and IEM-2020 should be made with twisted-pair, shielded cable. CANbus interface terminals are listed in Table 10-3. Refer to Figure 10-7 and Figure 10-8.

Table 10-3. CANbus Interface Terminals

Terminal	Description
P1- HI (CAN H)	CAN high connection (yellow wire)
P1- LO (CAN L)	CAN low connection (green wire)
P1- ⏚ (SHIELD)	CAN drain connection

NOTES

1. If the AEM-2020 is providing one end of the J1939 bus, a 120 Ω, ½ watt terminating resistor should be installed across terminals P1- LO (CANL) and P1- HI (CANH).
2. If the AEM-2020 is not part of the J1939 bus, the stub connecting the AEM-2020 to the bus should not exceed 914 mm (3 ft) in length.
3. The maximum bus length, not including stubs, is 40 m (131 ft).
4. The J1939 drain (shield) should be grounded at one point only. If grounded elsewhere, do not connect the drain to the AEM-2020.

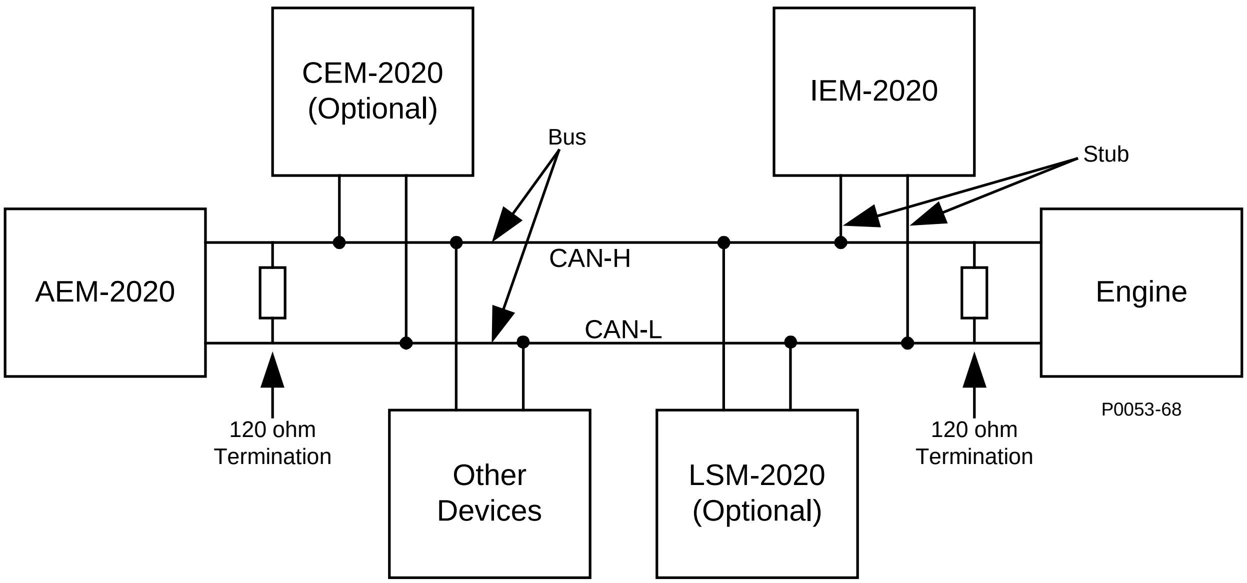

Figure 10-7. CANbus Interface with AEM-2020 providing One End of the Bus

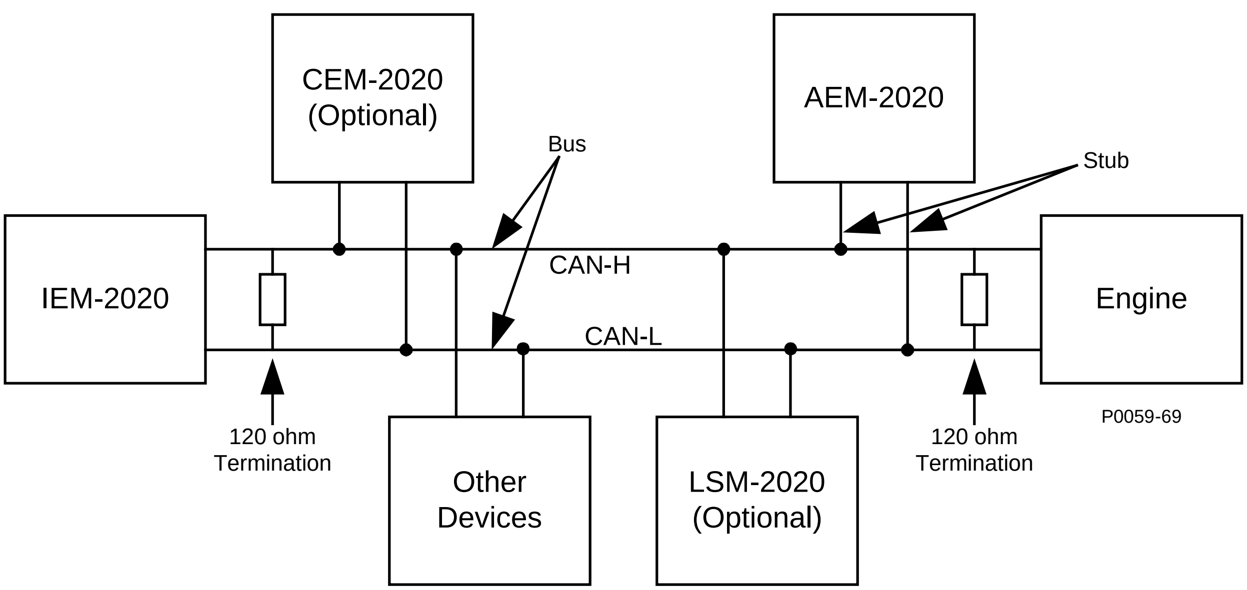

Figure 10-8. CANbus Interface with IEM-2020 providing One End of the Bus

MAINTENANCE

Preventive maintenance consists of periodically checking that the connections between the AEM-2020 and the system are clean and tight. Analog Expansion Modules 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.

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APPENDIX A • MODBUS™ COMMUNICATION

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APPENDIX A • MODBUS™ COMMUNICATION

INTRODUCTION

This document describes the Modbus™ communications protocol employed by IEM-2020 and how to exchange information with IEM-2020 modules over a Modbus™ network. IEM-2020 modules communicate by emulating a subset of the Modicon 984 Programmable Controller.

Modbus™ communications use a master-slave technique in which only the master can initiate a transaction. This transaction is called a query. When appropriate, a slave (IEM-2020) responds to the query. When a Modbus™ master communicates with a slave, information is provided or requested by the master. Information residing in the IEM-2020 is grouped categorically as follows:

- Programmable Senders
- System Configuration and Status
- Control
- Communications
- Alarm Configuration
- Metering
- CANBus and ECU Setup

All supported data can be read as specified in the Register Table. Abbreviations are used in the Register Table to indicate the register type. Register types are:

- Read/Write = RW
- Read Only = R

When a slave receives a query, the slave responds by either supplying the requested data to the master or performing the requested action. A slave device never initiates communications on the Modbus™ and will always generate a response to the query unless certain error conditions occur. The IEM-2020 is designed to communicate on the Modbus™ network only as slave devices.

Message Structure

Device Address Field

The device address field contains the unique Modbus™ address of the slave being queried. The addressed slave repeats the address in the device address field of the response message. This field is 1 byte.

Although Modbus™ protocol limits a device address from 1 - 247. The address is user-selectable at installation and can be altered during real-time operation.

Function Code Field

The function code field in the query message defines the action to be taken by the addressed slave. This field is echoed in the response message and is altered by setting the most significant bit (MSB) of the field to 1 if the response is an error response. This field is 1 byte in length.

The IEM-2020 maps all available data into the Modicon 984 holding register address space (4XXXX) and supports the following function codes:

- Function 03 (03 hex) - read holding registers
- Function 06 (06 hex) - preset single register
- Function 08 (08 hex), subfunction 00 - diagnostics: return query data
- Function 08 (08 hex), subfunction 01 - diagnostics: restart communications option
- Function 08 (08 hex), subfunction 04 - diagnostics: force listen only mode
- Function 16 (10 hex) - preset multiple registers

Data Block Field

The query data block contains additional information needed by the slave to perform the requested function. The response data block contains data collected by the slave for the queried function. An error response will substitute an exception response code for the data block. The length of this field varies with each query. See the paragraphs on *Register Definitions* for interpretation of data.

Error Check Field

The error check field provides a method for the slave to validate the integrity of the query message contents and allows the master to confirm the validity of response message contents. This field is 2 bytes.

MODBUS™ MODES OF OPERATION

A standard Modbus™ network offers the remote terminal unit (RTU) transmission mode for communication through the RS-485 port.

A master can query slaves individually or universally. A universal ("broadcast") query, when allowed, evokes no response from any slave device. If a query to an individual slave device requests actions unable to be performed by the slave, the slave response message contains an exception response code defining the error detected. Exception response codes are quite often enhanced by the information found in the "Error Details" block of holding registers.

The Modbus™ protocol defines a simple Protocol Data Unit (PDU) independent of the underlying communication layers. The mapping of the Modbus™ protocol on specific buses or networks can introduce some additional fields on the Application Data Unit (ADU). See Figure A-1.

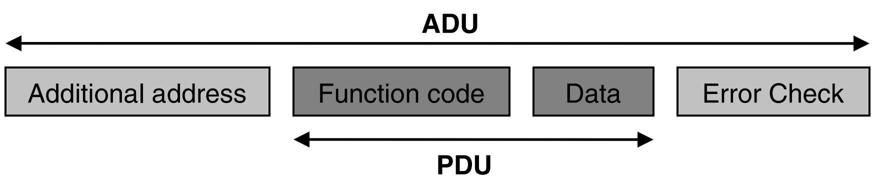

Figure A-1. General Modbus™ Frame

The client that initiates a Modbus™ transaction builds the Modbus™ Application Data Unit. The function code indicates to the server which kind of action to perform.

Modbus™ Over Serial Line

Message Structure

Master initiated queries and IEM-2020 responses share the same message structure. Each message is comprised of four message fields. They are:

- Device Address (1 byte)
- Function Code (1 byte)
- Data Block (n bytes)
- Error Check field (2 bytes)

Each 8-bit byte in a message contains two 4-bit hexadecimal characters. The message is transmitted in a continuous stream with the LSB of each byte of data transmitted first. Transmission of each 8-bit data byte occurs with one start bit and either one or two stop bits. Parity checking is performed, when enabled, and can be either odd or even. The transmission baud rate is user-selectable, and can be set at installation and altered during real-time operation. The IEM-2020 Modbus™ supports baud rates of 1200, 2400, 4800, or 9600. The factory default baud rate is 9600.

IEM-2020 modules support RS-485 compatible serial interfaces. This interface is accessible from the rear panel of the IEM-2020. The RS-485 interface is configured for Modbus™ communication when Option “R” is ordered.

Message Framing and Timing Considerations

When receiving a message via the RS-485 communication port, the IEM-2020 requires an inter-byte latency of 3.5 character times before considering the message complete.

Once a valid query is received, the IEM-2020 waits 10 milliseconds before responding.

Table A-1 provides the response message transmission time (in seconds) and 3.5 character times (in milliseconds) for various message lengths and baud rates.

Table A-1. Timing Considerations

Baud Rate	3.5 Character Time (ms)	Message Tx Time(s)	
		128 Bytes	256 Bytes
2400	16.04	0.59	1.17
4800	8.021	0.29	0.59
9600	4.0104	0.15	0.29

Error Handling and Exception Responses

Any query received that contains a non-existent device address, a framing error, or CRC error is ignored. No response is transmitted. Queries addressed to the IEM-2020 with an unsupported function or illegal values in the data block result in an error response message with an exception response code. The exception response codes supported by the IEM-2020 are provided in Table A-2.

Table A-2. Supported Exception Response Codes

Code	Name	Description
01	Illegal Function	The query Function/Subfunction Code is unsupported; query read of more than 125 registers; query preset of more than 100 registers.
02	Illegal Data Address	A register referenced in the data block does not support queried read/write; query preset of a subset of a numerical register group.
03	Illegal Data Value	A preset register data block contains an incorrect number of bytes or one or more data values out of range.

COMMUNICATIONS HARDWARE REQUIREMENTS

Modbus™ Over RS-485 Communication Requirements

The IEM-2020 optional RS-485 physical interface is three positions of a terminal strip with locations for Send/Receive A (A), Send/Receive B (B) and Signal Ground (C). Refer to Section 6, *Installation*, for further details.

DETAILED MESSAGE QUERY AND RESPONSE FOR RTU TRANSMISSION MODE

A detailed description of IEM-2020 supported message queries and responses is provided in the following paragraphs.

Read Holding Registers

<u>Query</u>

This query message requests a register or block of registers to be read. The data block contains the starting register address and the quantity of registers to be read. A register address of N will read holding register N+1. If the query is a broadcast (device address = 0), no response message is returned.

Device Address
Function Code = 03 (hex)
Starting Address Hi
Starting Address Lo
No. of Registers Hi
No. of Registers Lo
CRC Hi error check
CRC Lo error check

The number of registers cannot exceed 125 without causing an error response with the exception code for an illegal function.

Response

The response message contains the data queried. The data block contains the block length in bytes followed by the data (one Data Hi byte and one Data Lo byte) for each requested register.

Reading an unassigned holding register returns a value of zero.

Device Address
Function Code = 03 (hex)
Byte Count
Data Hi (For each requested register, there is one Data Hi and one Data Lo.)
Data Lo
.
.
Data Hi
Data Lo
CRC Hi error check
CRC Lo error check

Return Query Data

This query contains data to be returned (looped back) in the response. The response and query messages should be identical. If the query is a broadcast (device address = 0), no response message is returned.

Device Address	
Function Code =	08 (hex)
Subfunction Hi =	00 (hex)
Subfunction Lo =	00 (hex)
Data Hi =	xx (don't care)
Data Lo =	xx (don't care)
CRC Hi error check	
CRC Lo error check	

Restart Communications Option

This query causes the remote communications function of the IEM-2020 to restart, terminating an active listen only mode of operation. No effect is made upon primary relay operations. Only the remote communications function is affected. If the query is a broadcast (device address = 0), no response message is returned.

If the IEM-2020 receives this query while in the listen only mode, no response message is generated. Otherwise, a response message identical to the query message is transmitted prior to the communications restart.

Device Address	
Function Code =	08 (hex)
Subfunction Hi =	00 (hex)
Subfunction Lo =	01 (hex)
Data Hi =	xx (don't care)
Data Lo =	xx (don't care)
CRC Hi error check	
CRC Lo error check	

Listen Only Mode

This query forces the addressed IEM-2020 to the listen only mode for Modbus™ communications, isolating it from other devices on the network. No responses are returned.

While in the listen only mode, the IEM-2020 continues to monitor all queries. The IEM-2020 does not respond to any other query until the listen only mode is removed. All write requests with a query to Preset Multiple Registers (Function Code = 16) are also ignored. When the IEM-2020 receives the restart communications query, the listen only mode is removed.

Device Address	
Function Code =	08 (hex)
Subfunction Hi =	00 (hex)
Subfunction Lo =	04 (hex)
Data Hi =	xx (don't care)
Data Lo =	xx (don't care)
CRC Hi error check	
CRC Lo error check	

Preset Multiple Registers

A preset multiple registers query could address multiple registers in one slave or multiple slaves. If the query is a broadcast (device address = 0), no response message is returned.

Query

A Preset Multiple Register query message requests a register or block of registers to be written. The data block contains the starting address and the quantity of registers to be written, followed by the Data Block byte count and data. The IEM-2020 will perform the write when the device address in query is a broadcast address or the same as the IEM-2020 Modbus™ Unit ID (device address).

A register address of N will write Holding Register N+1.

Data will cease to be written if any of the following exceptions occur.

- Queries to write to Read Only registers result in an error response with Exception Code of “Illegal Data Address”.
- Queries attempting to write more than 100 registers cause an error response with Exception Code “Illegal Function”.
- An incorrect Byte Count will result in an error response with Exception Code of “Illegal Data Value”.
- There are several registers that are grouped together to collectively represent a single numerical BE1-11 data value (i.e. - 32-bit integer data). A query to write a subset of such a register group will result in an error response with Exception Code “Illegal Data Address”.
- A query to write a not allowed value (out of range) to a register results in an error response with Exception Code of “Illegal Data Value”.

Device Address	
Function Code =	10 (hex)
Starting Address Hi	
Starting Address Lo	
No. of Registers Hi	
No. of Registers Lo	
Byte Count	
Data Hi	
Data Lo	
.	
.	
Data Hi	
Data Lo	
CRC Hi error check	
CRC Lo error check	

Response

The response message echoes the starting address and the number of registers. There is no response message when the query is a broadcast (device address = 0).

Device Address	
Function Code =	10 (hex)
Starting Address Hi	
Starting Address Lo	
No. of Registers Hi	
No. of Registers Lo	
CRC Hi Error Check	
CRC Lo Error Check	

DATA FORMATS

IEM-2020 modules support the following data types:

- Data types mapped to 2 registers
    - Unsigned Integer 32 (Uint32)
    - Signed Integer 32 (Int32)

Long Integer Data Format (Uint32 and Int32)

The Modbus™ long integer data format uses two consecutive holding registers to represent a 32-bit data value. The first register contains the low-order 16 bits and the second register contains the high-order 16 bits.

Example: The value 95,800 represented in long integer format is hexadecimal 0x00017638. This number will read from two consecutive holding registers as follows:

Holding Register		Value
K	(Hi Byte)	hex 76
K	(Lo Byte)	hex 38
K+1	(Hi Byte)	hex 00
K+1	(Lo Byte)	hex 01

The same byte alignments are required to write.

CRC Error Check

This field contains a two-byte CRC value for transmission error detection. The master first calculates the CRC and appends it to the query message. The IEM-2020 recalculates the CRC value for the received query and performs a comparison to the query CRC value to determine if a transmission error has occurred. If so, no response message is generated. If no transmission error has occurred, the slave calculates a new CRC value for the response message and appends it to the message for transmission.

The CRC calculation is performed using all bytes of the device address, function code, and data block fields. A 16-bit CRC-register is initialized to all 1's. Then each eight-bit byte of the message is used in the following algorithm:

First, exclusive-OR the message byte with the low-order byte of the CRC-register. The result, stored in the CRC-register, will then be right-shifted eight times. The CRC-register MSB is zero-filled with each shift. After each shift, the CRC-register LSB is examined. If the LSB IS a 1, the CRC-register is then exclusive-ORed with the fixed polynomial value A001 (hex) prior to the next shift. Once all bytes of the message have undergone the above algorithm, the CRC-register will contain the message CRC value to be placed in the error check field.

Register	Description	Type	Units	Scaling Factor	R/W	Range
PROGRAMMABLE SENDERS						
43434	Coolant Temperature Sender Fail Configuration Type	Int32	N/A	N/A	RW	0 = None 1 = Alarm 2 = Pre-Alarm
43436	Coolant Temperature Sender Fail Activation Delay	Int32	Minute	N/A	RW	5 - 30
43438	Oil Pressure Sender Fail Configuration Type	Int32	N/A	N/A	RW	0 = None 1 = Alarm 2 = Pre-Alarm
43440	Oil Pressure Sender Fail Activation Delay	Int32	Second	N/A	RW	0 - 300
43442	Fuel Level Sender Fail Configuration Type	Int32	N/A	N/A	RW	0 = None 1 = Alarm 2 = Pre-Alarm
43444	Fuel Level Sender Fail Activation Delay	Int32	Second	N/A	RW	0 - 300
43446-499	RESERVED					
SYSTEM CONFIGURATION AND STATUS						
43500	Pre-Start Contact Config	Int32	N/A	N/A	RW	0 = Open After Disconnect 1 = Closed While Running
43502	System Units	Int32	N/A	N/A	RW	0 = English 1 = Metric
43504	Battery Volts	Int32	N/A	N/A	RW	0 = 12V 1 = 24V
43506	Off Mode Status	Int32	N/A	N/A	R	0 = Disable 1 = Enable
43508	Run Mode Status	Int32	N/A	N/A	R	0 = Disable 1 = Enable
43510	Auto Mode Status	Int32	N/A	N/A	R	0 = Disable 1 = Enable
43512	Virtual Input 1 Status	Int32	N/A	N/A	R	0 = Disable 1 = Enable
43514	Virtual Input 2 Status	Int32	N/A	N/A	R	0 = Disable 1 = Enable
43516	Virtual Input 3 Status	Int32	N/A	N/A	R	0 = Disable 1 = Enable
43518	Virtual Input 4 Status	Int32	N/A	N/A	R	0 = Disable 1 = Enable
43520	RTC Clock Hour	Int32	Hour	N/A	RW	0 - 23
43522	RTC Minute	Int32	Minute	N/A	RW	0 - 59
43524	RTC Second	Int32	Second	N/A	RW	0 - 59
43526	RTC Month	Int32	N/A	N/A	RW	1 - 12
43528	RTC Day	Int32	N/A	N/A	RW	1 - 31
43530	RTC Year	Int32	N/A	N/A	RW	0 - 99
43532	RTC DST Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43534	Cranking Style	Uint32	N/A	N/A	RW	0 = Continuous 1 = Cycle
43536	Number of Crank Cycles	Uint32	N/A	N/A	RW	1 - 7
43538	Cycle Crank Time	Unit32	Second	N/A	RW	5 - 15
43540	Continuous Crank Time	Unit32	Second	N/A	RW	5 - 60
43542	Crank Disconnect Limit	Uint32	Percent	N/A	RW	10 - 100
43546	Rated Engine RPM	Uint32	RPM	N/A	RW	750 - 3600

Register	Description	Type	Units	Scaling Factor	R/W	Range
43548	Cool Down Time	Uint32	Minute	N/A	RW	0 - 60
43550	Fuel Level Function	Uint32	N/A	N/A	RW	0 = Disable 1 = Fuel Lvl 2 = Natural Gas 3 = Propane
43552	Number Flywheel Teeth	Uint32	N/A	N/A	RW	50 - 500
43554	Horn Enable	Int32	N/A	N/A	RW	0 = Disabled 1 = Enabled
43556	RESERVED					
43558	LCD Contrast Value	Uint32	N/A	N/A	RW	0 - 100
43560	Front Panel Sleep Mode	Uint32	N/A	N/A	RW	0 = Disabled 1 = Enabled
43562	RESERVED					
43564	UTC Offset	Int32	Minute	N/A	RW	(-1440) - 1440
43566	DST Configuration	Int32	N/A	N/A	RW	0 = Disabled 1 = Floating 2 = Fixed
43568	Start/End Time Reference	Int32	N/A	N/A	RW	0 = Local Time 1 = UTC Time
43570	DST Bias Hours	Int32	N/A	N/A	RW	0 - 23
43572	DSP Bias Minutes	Int32	N/A	N/A	RW	0 - 59
43574	DST Start Month	Int32	N/A	N/A	RW	1 = January 2 = February 3 = March 4 = April 5 = May 6 = June 7 = July 8 = August 9 = September 10 = October 11 = November 12 = December
43576	DST Start Day	Int32	N/A	N/A	RW	1 - 31
43578	DST Start Week of Month	In32	N/A	N/A	RW	0 = First 1 = Second 2 = Third 3 = Fourth 4 = Last
43580	DST Start Day of Week	Int32	N/A	N/A	RW	0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday
43582	DST Start Hour	Int32	N/A	N/A	RW	0 - 23
43584	DST Start Minute	Int32	N/A	N/A	RW	0 - 59
43586	DST End Month	Int32	N/A	N/A	RW	1 = January 2 = February 3 = March 4 = April 5 = May 6 = June 7 = July 8 = August 9 = September 10 = October 11 = November 12 = December
43588	DST End Day	Int32	N/A	N/A	RW	1 - 31

Register	Description	Type	Units	Scaling Factor	R/W	Range
43590	DST End Week of Month	Int32	N/A	N/A	RW	0 = First 1 = Second 2 = Third 3 = Fourth 4 = Last
43592	DST End Day of Week	Int32	N/A	N/A	RW	0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday
43594	DST End Hour	Int32	N/A	N/A	RW	0 - 23
43596	DST End Minute	Int32	N/A	N/A	RW	0 - 59
43598	Prestart Rest Configuration	Int32	N/A	N/A	RW	0 = Off During Rest 1 = On During Rest 2 = Preheat before Crank
43600	Oil Pressure Crank Disconnect	UInt32	N/A	N/A	RW	0 = Disable 1 = Enable
43602	Crank Disconnect Pressure	Uint32	PSI	N/A	RW	3 - 150
43604	Crank Disconnect Pressure in KPA	Uin32	Kpa	N/A	RW	21 - 1034
43606	Power Up Delay	Uint32	Second	N/A	RW	0 - 60
43608	Start Relay Control	Uint32	N/A	N/A	RW	0 = Predefined 1 = Programmable
43610	Run Relay Control	Uint32	N/A	N/A	RW	0 = Predefined 1 = Programmable
43612	Prestart Relay Control	Uint32	N/A	N/A	RW	0 = Predefined 1 = Programmable
43614	Off Mode Cool Down Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
43616	Not In Auto Horn Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
43618	Clock Not Set Warning Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
43620-748	RESERVED					
CONTROL						
43750	Emergency Stop: Writing a 1 will toggle emergency stop from off to on. Writing a 1 again will toggle emergency stop from on to off	Int32	N/A	N/A	RW	1 = Toggle On/Off
43752	Remote Start	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43754	Remote Stop	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43756	Run Mode	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43758	Off Mode	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43760	Auto Mode	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43762	Alarm Reset	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43764	RESERVED	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43766	Virtual Input 1 Close	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43768	Virtual Input 1 Open	Int32	N/A	N/A	RW	0 = Disable 1 = Enable

Register	Description	Type	Units	Scaling Factor	R/W	Range
43770	Virtual Input 2 Close	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43772	Virtual Input 2 Open	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43774	Virtual Input 3 Close	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43776	Virtual Input 3 Open	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43778	Virtual Input 4 Close	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43780	Virtual Input 4 Open	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
43782	ESTOP Latch Status	Int32	N/A	N/A	R	0 = Disabled 1 = Enabled
43784-4022	RESERVED					
COMMUNICATIONS						

Register	Description	Type	Units	Scaling Factor	R/W	Range
44024	Modem Dialout Conditions 1	Uint32	N/A	N/A	RW	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Auxiliary Input 5 Closed Bit 3 = Auxiliary Input 4 Closed Bit 4 = Auxiliary Input 3 Closed Bit 5 = Auxiliary Input 2 Closed Bit 6 = Auxiliary Input 1 Closed Bit 7 = Cooldown Timer Active Bit 8 = Switch Not in Auto Bit 9 = Scheduled Maintenance Pre-Alarm Bit 10 = Weak Battery Voltage Pre-Alarm Bit 11 = Low Battery Voltage Pre-Alarm Bit 12 = Low Oil Pressure Pre-Alarm Bit 13 = High Coolant Temp Pre-Alarm Bit 14 = Battery Overvoltage Pre-Alarm Bit 15 = Fuel Level Sender Fail Pre-Alarm Bit 16 = Oil Pressure Sender Fail Pre-Alarm Bit 17 = Coolant Temp Sender Fail Pre-Alarm Bit 18 = Low Coolant Temp Pre-Alarm Bit 19 = High Fuel Pre-Alarm Bit 20 = Low Fuel Pre-Alarm Bit 21 = Overspeed Alarm Bit 22 = Emergency Stop Alarm Bit 23 = Overcrank Alarm Bit 24 = Low Coolant Level Bit 25 = Low Fuel Alarm Bit 26 = MPU Speed Sender Fail Alarm Bit 27 = Fuel Level Sender Fail Alarm Bit 28 = Oil Pressure Sender Fail Alarm Bit 29 = Coolant Temp Sender Fail Alarm Bit 30 = Low Oil Pressure Alarm Bit 31 = High Coolant Temperature Alarm

Register	Description	Type	Units	Scaling Factor	R/W	Range
44026	Modem Dialout Conditions 2	Uint32	N/A	N/A	RW	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Engine Running Bit 17 = Battery Charger Fail Bit 18 = Fuel Leak Detect Bit 19 = Loss of ECU Comms Pre-Alarm Bit 20 = Loss of ECU Comms Alarm Bit 21 = Auxiliary Input 16 Closed Bit 22 = Auxiliary Input 15 Closed Bit 23 = Auxiliary Input 14 Closed Bit 24 = Auxiliary Input 13 Closed Bit 25 = Auxiliary Input 12 Closed Bit 26 = Auxiliary Input 11 Closed Bit 27 = Auxiliary Input 10 Closed Bit 28 = Auxiliary Input 9 Closed Bit 29 = Auxiliary Input 8 Closed Bit 30 = Auxiliary Input 7 Closed Bit 31 = Auxiliary Input 6 Closed
44028-30	RESERVED					
44032	CANbus Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44034	DTC Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44036	Rings for Modem Answer	Int32	N/A	N/A	RW	1 - 9
44038	Modem Offline Delay	Int32	Minute	N/A	RW	1 - 240
44040	RS485 Baud Rate	Int32	N/A	N/A	RW	0 = 9600 1 = 4800 2 = 2400 3 = 1200
44042	RS485 Parity	Int32	N/A	N/A	RW	0 = None 1 = Odd 2 = Even
44044	RS485 Modbus Address	Int32	N/A	N/A	RW	1 - 247
44046-064	RESERVED					
44066-248	RESERVED					

ALARM CONFIGURATION						
44500	High Coolant Temp Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44502	High Coolant Temp Alarm Threshold	Uint32	Deg F	N/A	RW	100 - 280
44504	Metric High Coolant Temp Alarm Threshold	Int32	Deg C	N/A	RW	38 - 138
44506	High Coolant Temp Alarm Activation Delay	Uint32	Second	N/A	RW	0 - 150
44508	Low Oil Press. Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44510	Low Oil Press. Alarm Threshold	Uint32	PSI	N/A	RW	3 - 150
44512	Metric Low Oil Press. Alarm Threshold	Int32	Kpa	N/A	RW	21 - 1034
44514	Low Oil Press. Alarm Arming Delay	Uint32	Second	N/A	RW	5 - 15
44516	Overspeed Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44518	Overspeed Alarm Threshold	Uint32	Percent	N/A	RW	105 - 140
44520	Overspeed Alarm Activation Delay	Uint32	Millisecond	Milli	RW	0 - 500
44522	Low Fuel Level Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44524	Low Fuel Level Alarm Threshold	Uint32	Percent	N/A	RW	0 - 100
44526	Low Fuel Level Alarm Activation Delay	Int32	Second	N/A	RW	0 - 30
44528	High Coolant Temp Pre-Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44530	High Coolant Temp Pre-Alarm Threshold	Uint32	Deg F	N/A	RW	100 - 280
44532	Metric High Coolant Temp Pre-Alarm Threshold	Int32	Deg C	N/A	RW	38 - 138
44534	Low Coolant Temp Pre-Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44536	Low Coolant Temp Pre-Alarm Threshold	Uint32	Deg F	N/A	RW	35 - 150
44538	Metric Low Coolant Temp Pre-Alarm Threshold	Int32	Deg C	N/A	RW	2 - 66
44540	High Fuel Level Pre-Alarm Threshold	Int32	Percent	N/A	RW	0 - 100
44542	High Fuel Level Pre-Alarm Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44544	High Fuel Level Pre-Alarm Activation Delay	Int32	Second	N/A	RW	0 - 30
44546	Low Fuel Level Pre-Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44548	Low Fuel Level Pre-Alarm Threshold	Uint32	Percent	N/A	RW	10 - 100
44550	Low Battery Pre-Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44552	Low Battery Pre-Alarm Threshold	Uint32	DeciVolt	Deci	RW	60 - 240
44554	Low Battery Pre-Alarm Activation Delay	Uint32	Second	N/A	RW	1 - 10
44556	Weak Battery Pre-Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44558	Weak Battery Pre-Alarm Threshold	Uint32	DeciVolt	Deci	RW	40 - 160
44560	Weak Battery Pre-Alarm Activation Delay	Uint32	Second	N/A	RW	1 - 10

Register	Description	Type	Units	Scaling Factor	R/W	Range
44562	Battery Overvoltage Pre-Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44564	Low Oil Press. Pre-Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44566	Low Oil Press. Pre-Alarm Threshold	Uint32	PSI	N/A	RW	3 - 150
44568	Metric Low Oil Press. Pre-Alarm Threshold	Int32	Kpa	N/A	RW	21 - 1034
44570	ECU Comms Fail Pre-Alarm Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44572	Active DTC Pre-Alarm Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44574	Maintenance Interval Pre-Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44576	Maintenance Interval Pre-Alarm Threshold	Uint32	Hour	N/A	RW	0 - 5000
44578	Speed Sender Fail Activation Delay	Int32	Second	N/A	RW	0 - 300
44580	ECU Low Coolant Level Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44582	ECU Low Coolant Level Alarm Threshold	Uint32	Percent	N/A	RW	1 - 99
44584	ECU Low Coolant Level Pre-Alarm Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
44586	ECU Low Coolant Level Pre-Alarm Threshold	Uint32	Percent	N/A	RW	1 - 99
44588	Battery Overvoltage Alarm Threshold	Int32	DeciVolt	Deci	RW	120 - 320
44590	LSM Comm Failure Pre-alarm Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44592-94	RESERVED	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44596	CEM Comm Failure Pre-alarm Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44598	AEM Comm Failure Pre-alarm Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44600	Checksum Failure Pre-alarm Enable	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
44602-748	RESERVED					
METERING						
44750	Engine Speed Metering	Uint32	RPM	N/A	R	0 - 65535
44752	Oil Pressure Metering	Int32	PSI	N/A	R	(-32768) - 32767
44754	Battery Voltage Metering	Int32	DeciVolt	N/A	R	(-32768) - 32767
44756	Fuel Level Metering	Int32	N/A	N/A	R	(-32768) - 32767
44758	ECU Coolant Level Metering	Uint32	N/A	N/A	R	0 - 255
44760	Cool Down Time Remaining	Int32	Minute	N/A	R	(-128) - 127

Register	Description	Type	Units	Scaling Factor	R/W	Range
44762	Alarm Metering	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Auto Restart Failure Bit 19 = Fuel Leak Detect Bit 20 = Battery Charger Failure Bit 21 = Transfer Fail Bit 22 = Low Coolant Level Bit 23 = ECU Shutdown Bit 24 = Emergency Shutdown Bit 25 = Overcrank Bit 26 = Loss of ECU Comms Bit 27 = Global Sender Fail Bit 28 = Low Fuel Level Bit 29 = Low Oil Pressure Bit 30 = Hi Coolant Temp Bit 31 = Overspeed

Register	Description	Type	Units	Scaling Factor	R/W	Range
44764	Pre-Alarm Metering	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Serial Flash Read Failure Bit 3 = Checksum Fail Bit 4 = Global Pre-Alarm Bit 5 = Fuel Filter 2 Leak Bit 6 = Fuel Filter 1 Leak Bit 7 = RESERVED Bit 8 = RESERVED Bit 9 = MPU Fail Bit 10 = Fuel Leak Detect Bit 11 = Battery Charger Failure Bit 12 = Low Coolant Level Bit 13 = RESERVED Bit 14 = RESERVED Bit 15 = RESERVED Bit 16 = RESERVED Bit 17 = RESERVED Bit 18 = RESERVED Bit 19 = High Fuel Level Bit 20 = Loss of Rem. Mod. Com Bit 21 = RESERVED Bit 22 = Diagnostic Trouble Code Bit 23 = Loss of ECU Comms Bit 24 = Maintenance Due Bit 25 = Battery Overvoltage Bit 26 = Weak Battery Bit 27 = Low Battery Voltage Bit 28 = Low Coolant Temp Bit 29 = Low Fuel Level Bit 30 = Low Oil Pressure Bit 31 = Hi Coolant Temp

Register	Description	Type	Units	Scaling Factor	R/W	Range
44766	MTU Alarm Metering	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = High ECU Supply Bit 24 = Combined Red Bit 25 = Overspeed Bit 26 = Low Oil Pressure Bit 27 = Low Fuel Delivery Press. Bit 28 = Low Aftercooler Cool. Level Bit 29 = High Coolant Temp Bit 30 = High Oil Temp Bit 31 = High Charge Air Temp

Register	Description	Type	Units	Scaling Factor	R/W	Range
44768	MTU Pre-Alarm Metering	Int32	N/A	N/A	R	Bit 0 = Low Storage Tank Bit 1 = High Storage Tank Bit 2 = High Day Tank Bit 3 = Low Day Tank Bit 4 = Alternator Winding Temp Bit 5 = Idle Speed Bit 6 = Run Up Speed Low Bit 7 = Start Speed Low Bit 8 = Priming Fault Bit 9 = Low Charge Air Coolant Level Bit 10 = High Fuel Temp. Bit 11 = High Exhaust Temp. B Bit 12 = High Exhaust Temp. A Bit 13 = Low ECU Supply Voltage Bit 14 = Engine Speed Too Low Bit 15 = High Voltage Supply Bit 16 = Low Voltage Supply Bit 17 = Speed Demand Fail Bit 18 = ECU Faulty Bit 19 = Combined Yellow Bit 20 = Low Oil Press. Bit 21 = Low Fuel Delivery Press. Bit 22 = Low Charge Air Press. Bit 23 = Low Coolant Level Bit 24 = Low Fuel Rail Press. Bit 25 = High Fuel Rail Press. Bit 26 = Shutdown Override Bit 27 = High Coolant Temp. Bit 28 = High Charge Air Temp. Bit 29 = High Intercooler Temp. Bit 30 = High Oil Temp. Bit 31 = High ECU Temp.

Register	Description	Type	Units	Scaling Factor	R/W	Range
44770	Sender Fail Alarm Metering	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Not Used Bit 25 = Not Used Bit 26 = Not Used Bit 27 = Not Used Bit 28 = Fuel Level Bit 29 = Coolant Temp Bit 30 = Oil Pressure Bit 31 = Speed

Register	Description	Type	Units	Scaling Factor	R/W	Range
44772	Local Input Metering	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Input 16 Bit 17 = Input 15 Bit 18 = Input 14 Bit 19 = Input 13 Bit 20 = Input 12 Bit 21 = Input 11 Bit 22 = Input 10 Bit 23 = Input 9 Bit 24 = Input 8 Bit 25 = Input 7 Bit 26 = Input 6 Bit 27 = Input 5 Bit 28 = Input 4 Bit 29 = Input 3 Bit 30 = Input 2 Bit 31 = Input 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
44774	Local Output Metering	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Pre Start Output Bit 18 = Run Output Bit 19 = Start Output Bit 20 = Output 12 Bit 21 = Output 11 Bit 22 = Output 10 Bit 23 = Output 9 Bit 24 = Output 8 Bit 25 = Output 7 Bit 26 = Output 6 Bit 27 = Output 5 Bit 28 = Output 4 Bit 29 = Output 3 Bit 30 = Output 2 Bit 31 = Output 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
44776	Status Metering	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = RESERVED Bit 11 = RESERVED Bit 12 = Cooldown Timer Active Bit 13 = Engine Running Bit 14 = Fuel Leak Detect Bit 15 = Battery Charger Failure Bit 16 = Low Coolant Level Bit 17 = RESERVED Bit 18 = RESERVED Bit 19 = RESERVED Bit 20 = RESERVED Bit 21 = RESERVED Bit 22 = RESERVED Bit 23 = RESERVED Bit 24 = RESERVED Bit 25 = RESERVED Bit 26 = Battle Override Bit 27 = Auto Start Bit 28 = RESERVED Bit 29 = RESERVED Bit 30 = RESERVED Bit 31 = RESERVED
44778	Hours Until Maintenance	Int32	N/A	N/A	RW	0 - 5000
44780	Cum. Total Engine Run Hrs.	Int32	Hour	N/A	R	0 - 99999
44782	Cum. Total Engine Run Min.	Int32	N/A	N/A	R	0 - 59
44784	Commission Date Month	Uint32	N/A	N/A	RW	1 - 12
44786	Commission Date Day	Uint32	N/A	N/A	RW	1 - 31
44788	Commission Date Year	Uint32	N/A	N/A	RW	0 - 99
44790	Session Total Engine Run Hrs.	Int32	Hour	N/A	R	0 - 99999
44792	Session Total Engine Run Min.	Int32	N/A	N/A	R	0 - 59
44794	Cumulative Number of Engine Starts	Uint32	N/A	N/A	RW	0 - 65535
44796	Session Start Date Month	Uint32	N/A	N/A	RW	1 - 12
44798	Session Start Date Day	Uint32	N/A	N/A	RW	1 - 31
44800	Session Start Date Year	Uint32	N/A	N/A	RW	0 - 99
44802-56	RESERVED					
44856	Cumulative Stats - Total Run Hours	Uint32	Hour	N/A	RW	0 - 5999940
44858	Run Stats - Total Run Hours	Uint32	Hour	N/A	RW	0 - 5999940

Register	Description	Type	Units	Scaling Factor	R/W	Range
44860	LSM Alarm Bits	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Not Used Bit 25 = Duplicate LSM Bit 26 = RESERVED Bit 27 = RESERVED Bit 28 = LSM Comms Failure Bit 29 = RESERVED Bit 30 = RESERVED Bit 31 = RESERVED
44862	Global Alarm	Uint32	N/A	N/A	R	Bit 0 = No system alarms in effect Bit 1 = System alarm(s) in effect
44864	Global Pre-Alarm	Uint32	N/A	N/A	R	Bit 0 = No system pre-alarms in effect Bit 1 = System pre-alarm(s) in effect

Register	Description	Type	Units	Scaling Factor	R/W	Range
44866	Local Configurable Inputs Pre-Alarm Bits	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Input 16 Bit 17 = Input 15 Bit 18 = Input 14 Bit 19 = Input 13 Bit 20 = Input 12 Bit 21 = Input 11 Bit 22 = Input 10 Bit 23 = Input 9 Bit 24 = Input 8 Bit 25 = Input 7 Bit 26 = Input 6 Bit 27 = Input 5 Bit 28 = Input 4 Bit 29 = Input 3 Bit 30 = Input 2 Bit 31 = Input 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
44868	Local Configurable Inputs Alarm Bits	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Input 16 Bit 17 = Input 15 Bit 18 = Input 14 Bit 19 = Input 13 Bit 20 = Input 12 Bit 21 = Input 11 Bit 22 = Input 10 Bit 23 = Input 9 Bit 24 = Input 8 Bit 25 = Input 7 Bit 26 = Input 6 Bit 27 = Input 5 Bit 28 = Input 4 Bit 29 = Input 3 Bit 30 = Input 2 Bit 31 = Input 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
44870	Configurable Elements Status Bits	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Config Element 8 Bit 25 = Config Element 7 Bit 26 = Config Element 6 Bit 27 = Config Element 5 Bit 28 = Config Element 4 Bit 29 = Config Element 3 Bit 30 = Config Element 2 Bit 31 = Config Element 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
44872	Configurable Elements Pre-Alarm Bits	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Config Element 8 Bit 25 = Config Element 7 Bit 26 = Config Element 6 Bit 27 = Config Element 5 Bit 28 = Config Element 4 Bit 29 = Config Element 3 Bit 30 = Config Element 2 Bit 31 = Config Element 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
44874	Configurable Elements Alarm Bits	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Config Element 8 Bit 25 = Config Element 7 Bit 26 = Config Element 6 Bit 27 = Config Element 5 Bit 28 = Config Element 4 Bit 29 = Config Element 3 Bit 30 = Config Element 2 Bit 31 = Config Element 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
44876	Remote Inputs Status Bits	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Remote Input 26 Bit 23 = Remote Input 25 Bit 24 = Remote Input 24 Bit 25 = Remote Input 23 Bit 26 = Remote Input 22 Bit 27 = Remote Input 21 Bit 28 = Remote Input 20 Bit 29 = Remote Input 19 Bit 30 = Remote Input 18 Bit 31 = Remote Input 17

Register	Description	Type	Units	Scaling Factor	R/W	Range
44878	Remote Outputs Status Bits	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Remote Output 36 Bit 9 = Remote Output 35 Bit 10 = Remote Output 34 Bit 11 = Remote Output 33 Bit 12 = Remote Output 32 Bit 13 = Remote Output 31 Bit 14 = Remote Output 30 Bit 15 = Remote Output 29 Bit 16 = Remote Output 28 Bit 17 = Remote Output 27 Bit 18 = Remote Output 26 Bit 19 = Remote Output 25 Bit 20 = Remote Output 24 Bit 21 = Remote Output 23 Bit 22 = Remote Output 22 Bit 23 = Remote Output 21 Bit 24 = Remote Output 20 Bit 25 = Remote Output 19 Bit 26 = Remote Output 18 Bit 27 = Remote Output 17 Bit 28 = Remote Output 16 Bit 29 = Remote Output 15 Bit 30 = Remote Output 14 Bit 31 = Remote Output 13

Register	Description	Type	Units	Scaling Factor	R/W	Range
44880	CEM Alarm Bits	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Not Used Bit 25 = Not Used Bit 26 = Not Used Bit 27 = Not Used Bit 28 = Not Used Bit 29 = CEM Hardware Mismatch Bit 30 = Duplicate CEM Bit 31 = CEM Comm Fail

Register	Description	Type	Units	Scaling Factor	R/W	Range
44882	Remote Configurable Inputs Pre-Alarm Bits	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Remote Input 26 Bit 23 = Remote Input 25 Bit 24 = Remote Input 24 Bit 25 = Remote Input 23 Bit 26 = Remote Input 22 Bit 27 = Remote Input 21 Bit 28 = Remote Input 20 Bit 29 = Remote Input 19 Bit 30 = Remote Input 18 Bit 31 = Remote Input 17

Register	Description	Type	Units	Scaling Factor	R/W	Range
44884	Remote Configurable Inputs Alarm Bits	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Remote Input 26 Bit 23 = Remote Input 25 Bit 24 = Remote Input 24 Bit 25 = Remote Input 23 Bit 26 = Remote Input 22 Bit 27 = Remote Input 21 Bit 28 = Remote Input 20 Bit 29 = Remote Input 19 Bit 30 = Remote Input 18 Bit 31 = Remote Input 17

Register	Description	Type	Units	Scaling Factor	R/W	Range
44886	AEM Alarm Bits	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Not Used Bit 25 = Not Used Bit 26 = Not Used Bit 27 = Not Used Bit 28 = Not Used Bit 29 = Not Used Bit 30 = Duplicate AEM Bit 31 = AEM Comm Fail

Register	Description	Type	Units	Scaling Factor	R/W	Range
44888	MDEC Pre-Alarms	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = High Fuel Filter Diff Pressure Bit 25 = Overspeed Test On Bit 26 = Ambient Temp Bit 27 = High Temp Coil 3 Bit 28 = High Temp Coil 2 Bit 29 = High Temp Coil 1 Bit 30 = High Pressure Input 2 Bit 31 = High Pressure Input 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
44890	MTU Status	Int32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = ECU Shutdown Bit 21 = Priming Pump ON Bit 22 = CAN Mode Feedback Bit 23 = Preheat Temp Not Reached Bit 24 = Load Gen On Bit 25 = Cylinder Cutout Bit 26 = Engine Running Bit 27 = Speed Decrease Bit 28 = Speed Increase Bit 29 = Speed Demand Fail Mode Bit 30 = External Stop Active Bit 31 = ECU Override
44892	Coolant Temp. Metering	Int32	Deg F	N/A	R	(–32768) - 32767
44892-999	RESERVED					

Register	Description	Type	Units	Scaling Factor	R/W	Range
45000	ECU Lamp Status	Int32	N/A	N/A	R	Bit 0 = Protect Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Warning Bit 4 = Stop Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Malfunction Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Not Used Bit 25 = Not Used Bit 26 = Not Used Bit 27 = Not Used Bit 28 = Not Used Bit 29 = Not Used Bit 30 = Not Used Bit 31 = Not Used
45002	Number of DTC's	Int32	N/A	N/A	R	(-32768) - 32767
45004-248	RESERVED					
CANBus and ECU SETUP						
45250	CANbus Enabled	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
45252	DTC Enabled	Int32	N/A	N/A	RW	0 = Disable 1 = Enable
45254	J1939 Source Address	Int32	N/A	N/A	RW	1 - 253
45256	ECU Control Output	Uint32	N/A	N/A	RW	0 = Fuel Relay Controls 1 = Preheat Relay Controls
45258	ECU Pulsing Enable	Uint32	N/A	N/A	RW	0 = Disable 1 = Enable
45260	MTU ECU7 Module Type	Uint32	N/A	N/A	RW	1 = CAN Module 201 2 = CAN Module 302 3 = CAN Module 303 4 = CAN Module 304
45262	MTU Speed Demand Switch	Uint32	N/A	N/A	RW	0 = Analog CAN 1 = Up/Down ECU 2 = Up/Down CAN 3 = Analog ECU 4 = Frequency 5 = No CAN Demand
45264	MTU Engine RPM	Uint32	N/A	N/A	RW	1400 - 2000
45266	Volvo Penta Accelerator Position	Int32	N/A	N/A	RW	0 - 100
45268	Volvo Penta Speed Select	Uint32	N/A	N/A	RW	0 = Primary 1 = Secondary

Register	Description	Type	Units	Scaling Factor	R/W	Range
45270	ECU Type	Uint32	N/A	N/A	RW	0 = Standard 1 = Volvo Penta 2 = MTU MDEC 3 = MTU ADEC 4 = MTU ECU7 5 = GM
45272	ECU Settling Time	Uint32	Millisecond	Milli	RW	5500 - 30000
45274	ECU Pulse Cycle Time	Uint32	Minute	N/A	RW	1 - 60
45276	ECU Engine Shut Down	Uint32	Second	N/A	RW	1 - 60
45278	ECU Response Timeout	Uint32	Second	N/A	RW	1 - 60
45280	MTU Overspeed Test	Uint32	N/A	N/A	RW	0 = Off 1 = On
45282	MTU Governor Param Switch Over	Uint32	N/A	N/A	RW	0 = Off 1 = On
45284	MTU Intermittent Oil Prime Request	Uint32	N/A	N/A	RW	0 = Off 1 = On
45286	MTU Trip Reset Request	Uint32	N/A	N/A	RW	0 = Off 1 = On
45288	MTU Speed Up Request	Uint32	N/A	N/A	RW	0 = Off 1 = On
45290	MTU Speed Down Request	Uint32	N/A	N/A	RW	0 = Off 1 = On
45292	MTU Speed Demand Limit	Uint32	N/A	N/A	RW	0 = Off 1 = On
45294	MTU Mode Switch	Uint32	N/A	N/A	RW	0 = Off 1 = On
45296	MTU Increased Idle	Uint32	N/A	N/A	RW	0 - 1000
45298	MTU Governor Param Set Select	Uint32	N/A	N/A	RW	0 - 1000
45300	MTU Fan Override	Uint32	N/A	N/A	RW	0 = Off 1 = On
45302	MTU Engine Start Prime	Uint32	N/A	N/A	RW	0 = Off 1 = On
45304	MTU CAN Rating Switch 1	Uint32	N/A	N/A	RW	0 = Off 1 = On
45306	MTU CAN Rating Switch 2	Uint32	N/A	N/A	RW	0 = Off 1 = On
45308	MTU Cylinder Cutout Disable 1	Uint32	N/A	N/A	RW	0 = Off 1 = On
45310	MTU Cylinder Cutout Disable 2	Uint32	N/A	N/A	RW	0 = Off 1 = On
45312	MTU ECU7 Module Type	Int32	N/A	N/A	RW	0 = 501 1 = 502
45314	MTU 50 Hz 60 Hz Switch Setting	Int32	N/A	N/A	RW	0 = 50 Hz 1 = 60 Hz
45316	NMT Alive Transmit Rate	Int32	N/A	N/A	RW	100 - 500
45318-499	RESERVED					
METERING						
45500	Analog Input 1 Metering Value	Int32	DeciUnit	Deci	R	(-99990) - 99990
45502	Analog Input 2 Metering Value	Int32	DeciUnit	Deci	R	(-99990) - 99990
45504	Analog Input 3 Metering Value	Int32	DeciUnit	Deci	R	(-99990) - 99990
45506	Analog Input 4 Metering Value	Int32	DeciUnit	Deci	R	(-99990) - 99990
45508	Analog Input 5 Metering Value	Int32	DeciUnit	Deci	R	(-99990) - 99990
45510	Analog Input 6 Metering Value	Int32	DeciUnit	Deci	R	(-99990) - 99990
45512	Analog Input 7 Metering Value	Int32	DeciUnit	Deci	R	(-99990) - 99990
45514	Analog Input 8 Metering Value	Int32	DeciUnit	Deci	R	(-99990) - 99990
45516	RTD Input 1 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999

Register	Description	Type	Units	Scaling Factor	R/W	Range
45518	RTD Input 2 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999
45520	RTD Input 3 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999
45522	RTD Input 4 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999
45524	RTD Input 5 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999
45526	RTD Input 6 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999
45528	RTD Input 7 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999
45530	RTD Input 8 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999
45532	Thermocouple Input 1 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999
45534	Thermocouple Input 2 Metering Value	Int32	CentiDeg F	Centi	R	(-9999999) - 9999999

Register	Description	Type	Units	Scaling Factor	R/W	Range
45536	AEM Input Threshold Status Bits Reg 1	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Analog Input 6 Under 2 Bit 3 = Analog Input 6 Under 1 Bit 4 = Analog Input 6 Over 2 Bit 5 = Analog Input 6 Over 1 Bit 6 = Analog Input 6 Out of Range Bit 7 = Analog Input 5 Under 2 Bit 8 = Analog Input 5 Under 1 Bit 9 = Analog Input 5 Over 2 Bit 10 = Analog Input 5 Over 1 Bit 11 = Analog Input 5 Out of Range Bit 12 = Analog Input 4 Under 2 Bit 13 = Analog Input 4 Under 1 Bit 14 = Analog Input 4 Over 2 Bit 15 = Analog Input 4 Over 1 Bit 16 = Analog Input 4 Out of Range Bit 17 = Analog Input 3 Under 2 Bit 18 = Analog Input 3 Under 1 Bit 19 = Analog Input 3 Over 2 Bit 20 = Analog Input 3 Over 1 Bit 21 = Analog Input 3 Out of Range Bit 22 = Analog Input 2 Under 2 Bit 23 = Analog Input 2 Under 1 Bit 24 = Analog Input 2 Over 2 Bit 25 = Analog Input 2 Over 1 Bit 26 = Analog Input 2 Out of Range Bit 27 = Analog Input 1 Under 2 Bit 28 = Analog Input 1 Under 1 Bit 29 = Analog Input 1 Over 2 Bit 30 = Analog Input 1 Over 1 Bit 31 = Analog Input 1 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45538	AEM Input Threshold Status Bits Reg 2	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = RTD Input 4 Under 2 Bit 3 = RTD Input 4 Under 1 Bit 4 = RTD Input 4 Over 2 Bit 5 = RTD Input 4 Over 1 Bit 6 = RTD Input 4 Out of Range Bit 7 = RTD Input 3 Under 2 Bit 8 = RTD Input 3 Under 1 Bit 9 = RTD Input 3 Over 2 Bit 10 = RTD Input 3 Over 1 Bit 11 = RTD Input 3 Out of Range Bit 12 = RTD Input 2 Under 2 Bit 13 = RTD Input 2 Under 1 Bit 14 = RTD Input 2 Over 2 Bit 15 = RTD Input 2 Over 1 Bit 16 = RTD Input 2 Out of Range Bit 17 = RTD Input 1 Under 2 Bit 18 = RTD Input 1 Under 1 Bit 19 = RTD Input 1 Over 2 Bit 20 = RTD Input 1 Over 1 Bit 21 = RTD Input 1 Out of Range Bit 22 = Analog Input 8 Under 2 Bit 23 = Analog Input 8 Under 1 Bit 24 = Analog Input 8 Over 2 Bit 25 = Analog Input 8 Over 1 Bit 26 = Analog Input 8 Out of Range Bit 27 = Analog Input 7 Under 2 Bit 28 = Analog Input 7 Under 1 Bit 29 = Analog Input 7 Over 2 Bit 30 = Analog Input 7 Over 1 Bit 31 = Analog Input 7 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45540	AEM Input Threshold Status Bits Reg 3	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Thermocouple 2 Under 2 Bit 3 = Thermocouple 2 Under 1 Bit 4 = Thermocouple 2 Over 2 Bit 5 = Thermocouple 2 Over 1 Bit 6 = Thermocouple 2 Out of Range Bit 7 = Thermocouple 1 Under 2 Bit 8 = Thermocouple 1 Under 1 Bit 9 = Thermocouple 1 Over 2 Bit 10 = Thermocouple 1 Over 1 Bit 11 = Thermocouple 1 Out of Range Bit 12 = RTD Input 8 Under 2 Bit 13 = RTD Input 8 Under 1 Bit 14 = RTD Input 8 Over 2 Bit 15 = RTD Input 8 Over 1 Bit 16 = RTD Input 8 Out of Range Bit 17 = RTD Input 7 Under 2 Bit 18 = RTD Input 7 Under 1 Bit 19 = RTD Input 7 Over 2 Bit 20 = RTD Input 7 Over 1 Bit 21 = RTD Input 7 Out of Range Bit 22 = RTD Input 6 Under 2 Bit 23 = RTD Input 6 Under 1 Bit 24 = RTD Input 6 Over 2 Bit 25 = RTD Input 6 Over 1 Bit 26 = RTD Input 6 Out of Range Bit 27 = RTD Input 5 Under 2 Bit 28 = RTD Input 5 Under 1 Bit 29= RTD Input 5 Over 2 Bit 30 = RTD Input 5 Over 1 Bit 31 = RTD Input 5 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45542	AEM Input Threshold Status Bits Reg 4	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Not Used Bit 25 = Not Used Bit 26 = Not Used Bit 27 = Not Used Bit 28 = Analog Output 4 Out of Range Bit 29 = Analog Output 3 Out of Range Bit 30 = Analog Output 2 Out of Range Bit 31 = Analog Output 1 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45544	AEM Input Threshold Alarm Bits Reg 1	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Analog Input 6 Under 2 Bit 3 = Analog Input 6 Under 1 Bit 4 = Analog Input 6 Over 2 Bit 5 = Analog Input 6 Over 1 Bit 6 = Analog Input 6 Out of Range Bit 7 = Analog Input 5 Under 2 Bit 8 = Analog Input 5 Under 1 Bit 9 = Analog Input 5 Over 2 Bit 10 = Analog Input 5 Over 1 Bit 11 = Analog Input 5 Out of Range Bit 12 = Analog Input 4 Under 2 Bit 13 = Analog Input 4 Under 1 Bit 14 = Analog Input 4 Over 2 Bit 15 = Analog Input 4 Over 1 Bit 16 = Analog Input 4 Out of Range Bit 17 = Analog Input 3 Under 2 Bit 18 = Analog Input 3 Under 1 Bit 19 = Analog Input 3 Over 2 Bit 20 = Analog Input 3 Over 1 Bit 21 = Analog Input 3 Out of Range Bit 22 = Analog Input 2 Under 2 Bit 23 = Analog Input 2 Under 1 Bit 24 = Analog Input 2 Over 2 Bit 25 = Analog Input 2 Over 1 Bit 26 = Analog Input 2 Out of Range Bit 27 = Analog Input 1 Under 2 Bit 28 = Analog Input 1 Under 1 Bit 29 = Analog Input 1 Over 2 Bit 30 = Analog Input 1 Over 1 Bit 31 = Analog Input 1 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45546	AEM Input Threshold Alarm Bits Reg 2	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = RTD Input 4 Under 2 Bit 3 = RTD Input 4 Under 1 Bit 4 = RTD Input 4 Over 2 Bit 5 = RTD Input 4 Over 1 Bit 6 = RTD Input 4 Out of Range Bit 7 = RTD Input 3 Under 2 Bit 8 = RTD Input 3 Under 1 Bit 9 = RTD Input 3 Over 2 Bit 10 = RTD Input 3 Over 1 Bit 11 = RTD Input 3 Out of Range Bit 12 = RTD Input 2 Under 2 Bit 13 = RTD Input 2 Under 1 Bit 14 = RTD Input 2 Over 2 Bit 15 = RTD Input 2 Over 1 Bit 16 = RTD Input 2 Out of Range Bit 17 = RTD Input 1 Under 2 Bit 18 = RTD Input 1 Under 1 Bit 19 = RTD Input 1 Over 2 Bit 20 = RTD Input 1 Over 1 Bit 21 = RTD Input 1 Out of Range Bit 22 = Analog Input 8 Under 2 Bit 23 = Analog Input 8 Under 1 Bit 24 = Analog Input 8 Over 2 Bit 25 = Analog Input 8 Over 1 Bit 26 = Analog Input 8 Out of Range Bit 27 = Analog Input 7 Under 2 Bit 28 = Analog Input 7 Under 1 Bit 29 = Analog Input 7 Over 2 Bit 30 = Analog Input 7 Over 1 Bit 31 = Analog Input 7 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45548	AEM Input Threshold Alarm Bits Reg 3	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Thermocouple 2 Under 2 Bit 3 = Thermocouple 2 Under 1 Bit 4 = Thermocouple 2 Over 2 Bit 5 = Thermocouple 2 Over 1 Bit 6 = Thermocouple 2 Out of Range Bit 7 = Thermocouple 1 Under 2 Bit 8 = Thermocouple 1 Under 1 Bit 9 = Thermocouple 1 Over 2 Bit 10 = Thermocouple 1 Over 1 Bit 11 = Thermocouple 1 Out of Range Bit 12 = RTD Input 8 Under 2 Bit 13 = RTD Input 8 Under 1 Bit 14 = RTD Input 8 Over 2 Bit 15 = RTD Input 8 Over 1 Bit 16 = RTD Input 8 Out of Range Bit 17 = RTD Input 7 Under 2 Bit 18 = RTD Input 7 Under 1 Bit 19 = RTD Input 7 Over 2 Bit 20 = RTD Input 7 Over 1 Bit 21 = RTD Input 7 Out of Range Bit 22 = RTD Input 6 Under 2 Bit 23 = RTD Input 6 Under 1 Bit 24 = RTD Input 6 Over 2 Bit 25 = RTD Input 6 Over 1 Bit 26 = RTD Input 6 Out of Range Bit 27 = RTD Input 5 Under 2 Bit 28 = RTD Input 5 Under 1 Bit 29= RTD Input 5 Over 2 Bit 30 = RTD Input 5 Over 1 Bit 31 = RTD Input 5 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45550	AEM Input Threshold Alarm Bits Reg 4	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Not Used Bit 25 = Not Used Bit 26 = Not Used Bit 27 = Not Used Bit 28 = Analog Output 4 Out of Range Bit 29 = Analog Output 3 Out of Range Bit 30 = Analog Output 2 Out of Range Bit 31 = Analog Output 1 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45552	AEM Input Threshold Pre-Alarm Bits Reg 1	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Analog Input 6 Under 2 Bit 3 = Analog Input 6 Under 1 Bit 4 = Analog Input 6 Over 2 Bit 5 = Analog Input 6 Over 1 Bit 6 = Analog Input 6 Out of Range Bit 7 = Analog Input 5 Under 2 Bit 8 = Analog Input 5 Under 1 Bit 9 = Analog Input 5 Over 2 Bit 10 = Analog Input 5 Over 1 Bit 11 = Analog Input 5 Out of Range Bit 12 = Analog Input 4 Under 2 Bit 13 = Analog Input 4 Under 1 Bit 14 = Analog Input 4 Over 2 Bit 15 = Analog Input 4 Over 1 Bit 16 = Analog Input 4 Out of Range Bit 17 = Analog Input 3 Under 2 Bit 18 = Analog Input 3 Under 1 Bit 19 = Analog Input 3 Over 2 Bit 20 = Analog Input 3 Over 1 Bit 21 = Analog Input 3 Out of Range Bit 22 = Analog Input 2 Under 2 Bit 23 = Analog Input 2 Under 1 Bit 24 = Analog Input 2 Over 2 Bit 25 = Analog Input 2 Over 1 Bit 26 = Analog Input 2 Out of Range Bit 27 = Analog Input 1 Under 2 Bit 28 = Analog Input 1 Under 1 Bit 29 = Analog Input 1 Over 2 Bit 30 = Analog Input 1 Over 1 Bit 31 = Analog Input 1 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45554	AEM Input Threshold Pre-Alarm Bits Reg 2	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = RTD Input 4 Under 2 Bit 3 = RTD Input 4 Under 1 Bit 4 = RTD Input 4 Over 2 Bit 5 = RTD Input 4 Over 1 Bit 6 = RTD Input 4 Out of Range Bit 7 = RTD Input 3 Under 2 Bit 8 = RTD Input 3 Under 1 Bit 9 = RTD Input 3 Over 2 Bit 10 = RTD Input 3 Over 1 Bit 11 = RTD Input 3 Out of Range Bit 12 = RTD Input 2 Under 2 Bit 13 = RTD Input 2 Under 1 Bit 14 = RTD Input 2 Over 2 Bit 15 = RTD Input 2 Over 1 Bit 16 = RTD Input 2 Out of Range Bit 17 = RTD Input 1 Under 2 Bit 18 = RTD Input 1 Under 1 Bit 19 = RTD Input 1 Over 2 Bit 20 = RTD Input 1 Over 1 Bit 21 = RTD Input 1 Out of Range Bit 22 = Analog Input 8 Under 2 Bit 23 = Analog Input 8 Under 1 Bit 24 = Analog Input 8 Over 2 Bit 25 = Analog Input 8 Over 1 Bit 26 = Analog Input 8 Out of Range Bit 27 = Analog Input 7 Under 2 Bit 28 = Analog Input 7 Under 1 Bit 29 = Analog Input 7 Over 2 Bit 30 = Analog Input 7 Over 1 Bit 31 = Analog Input 7 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45556	AEM Input Threshold Pre-Alarm Bits Reg 3	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Thermocouple 2 Under 2 Bit 3 = Thermocouple 2 Under 1 Bit 4 = Thermocouple 2 Over 2 Bit 5 = Thermocouple 2 Over 1 Bit 6 = Thermocouple 2 Out of Range Bit 7 = Thermocouple 1 Under 2 Bit 8 = Thermocouple 1 Under 1 Bit 9 = Thermocouple 1 Over 2 Bit 10 = Thermocouple 1 Over 1 Bit 11 = Thermocouple 1 Out of Range Bit 12 = RTD Input 8 Under 2 Bit 13 = RTD Input 8 Under 1 Bit 14 = RTD Input 8 Over 2 Bit 15 = RTD Input 8 Over 1 Bit 16 = RTD Input 8 Out of Range Bit 17 = RTD Input 7 Under 2 Bit 18 = RTD Input 7 Under 1 Bit 19 = RTD Input 7 Over 2 Bit 20 = RTD Input 7 Over 1 Bit 21 = RTD Input 7 Out of Range Bit 22 = RTD Input 6 Under 2 Bit 23 = RTD Input 6 Under 1 Bit 24 = RTD Input 6 Over 2 Bit 25 = RTD Input 6 Over 1 Bit 26 = RTD Input 6 Out of Range Bit 27 = RTD Input 5 Under 2 Bit 28 = RTD Input 5 Under 1 Bit 29= RTD Input 5 Over 2 Bit 30 = RTD Input 5 Over 1 Bit 31 = RTD Input 5 Out of Range

Register	Description	Type	Units	Scaling Factor	R/W	Range
45558	AEM Input Threshold Pre-Alarm Bits Reg 4	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Not Used Bit 25 = Not Used Bit 26 = Not Used Bit 27 = Not Used Bit 28 = Analog Output 4 Out of Range Bit 29 = Analog Output 3 Out of Range Bit 30 = Analog Output 2 Out of Range Bit 31 = Analog Output 1 Out of Range
45560	Analog Output 1 Metering Value	Int32	CentiUnit	Centi	R	(-999990) - 999990
45562	Analog Output 2 Metering Value	Int32	CentiUnit	Centi	R	(-999990) - 999990
45564	Analog Output 3 Metering Value	Int32	CentiUnit	Centi	R	(-999990) - 999990
45566	Analog Output 4 Metering Value	Int32	CentiUnit	Centi	R	(-999990) - 999990

Register	Description	Type	Units	Scaling Factor	R/W	Range
45568	Configurable Protection Threshold Status Bits	Uint32	N/A	N/A	R	Bit 0 = Conf Protection 8 Under 2 Bit 1 = Conf Protection 8 Under 1 Bit 2 = Conf Protection 8 Over 2 Bit 3 = Conf Protection 8 Over 1 Bit 4 = Conf Protection 7 Under 2 Bit 5 = Conf Protection 7 Under 1 Bit 6 = Conf Protection 7 Over 2 Bit 7 = Conf Protection 7 Over 1 Bit 8 = Conf Protection 6 Under 2 Bit 9 = Conf Protection 6 Under 1 Bit 10 = Conf Protection 6 Over 2 Bit 11 = Conf Protection 6 Over 1 Bit 12 = Conf Protection 5 Under 2 Bit 13 = Conf Protection 5 Under 1 Bit 14 = Conf Protection 5 Over 2 Bit 15 = Conf Protection 5 Over 1 Bit 16 = Conf Protection 4 Under 2 Bit 17 = Conf Protection 4 Under 1 Bit 18 = Conf Protection 4 Over 2 Bit 19 = Conf Protection 4 Over 1 Bit 20 = Conf Protection 3 Under 2 Bit 21 = Conf Protection 3 Under 1 Bit 22 = Conf Protection 3 Over 2 Bit 23 = Conf Protection 3 Over 1 Bit 24 = Conf Protection 2 Under 2 Bit 25 = Conf Protection 2 Under 1 Bit 26 = Conf Protection 2 Over 2 Bit 27 = Conf Protection 2 Over 1 Bit 28 = Conf Protection 1 Under 2 Bit 29 = Conf Protection 1 Under 1 Bit 30 = Conf Protection 1 Over 2 Bit 31 = Conf Protection 1 Over 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
45570	Configurable Protection Alarm Bits	Uint32	N/A	N/A	R	Bit 0 = Conf Protection 8 Under 2 Bit 1 = Conf Protection 8 Under 1 Bit 2 = Conf Protection 8 Over 2 Bit 3 = Conf Protection 8 Over 1 Bit 4 = Conf Protection 7 Under 2 Bit 5 = Conf Protection 7 Under 1 Bit 6 = Conf Protection 7 Over 2 Bit 7 = Conf Protection 7 Over 1 Bit 8 = Conf Protection 6 Under 2 Bit 9 = Conf Protection 6 Under 1 Bit 10 = Conf Protection 6 Over 2 Bit 11 = Conf Protection 6 Over 1 Bit 12 = Conf Protection 5 Under 2 Bit 13 = Conf Protection 5 Under 1 Bit 14 = Conf Protection 5 Over 2 Bit 15 = Conf Protection 5 Over 1 Bit 16 = Conf Protection 4 Under 2 Bit 17 = Conf Protection 4 Under 1 Bit 18 = Conf Protection 4 Over 2 Bit 19 = Conf Protection 4 Over 1 Bit 20 = Conf Protection 3 Under 2 Bit 21 = Conf Protection 3 Under 1 Bit 22 = Conf Protection 3 Over 2 Bit 23 = Conf Protection 3 Over 1 Bit 24 = Conf Protection 2 Under 2 Bit 25 = Conf Protection 2 Under 1 Bit 26 = Conf Protection 2 Over 2 Bit 27 = Conf Protection 2 Over 1 Bit 28 = Conf Protection 1 Under 2 Bit 29 = Conf Protection 1 Under 1 Bit 30 = Conf Protection 1 Over 2 Bit 31 = Conf Protection 1 Over 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
45572	Configurable Protection Pre-Alarm Bits	Uint32	N/A	N/A	R	Bit 0 = Conf Protection 8 Under 2 Bit 1 = Conf Protection 8 Under 1 Bit 2 = Conf Protection 8 Over 2 Bit 3 = Conf Protection 8 Over 1 Bit 4 = Conf Protection 7 Under 2 Bit 5 = Conf Protection 7 Under 1 Bit 6 = Conf Protection 7 Over 2 Bit 7 = Conf Protection 7 Over 1 Bit 8 = Conf Protection 6 Under 2 Bit 9 = Conf Protection 6 Under 1 Bit 10 = Conf Protection 6 Over 2 Bit 11 = Conf Protection 6 Over 1 Bit 12 = Conf Protection 5 Under 2 Bit 13 = Conf Protection 5 Under 1 Bit 14 = Conf Protection 5 Over 2 Bit 15 = Conf Protection 5 Over 1 Bit 16 = Conf Protection 4 Under 2 Bit 17 = Conf Protection 4 Under 1 Bit 18 = Conf Protection 4 Over 2 Bit 19 = Conf Protection 4 Over 1 Bit 20 = Conf Protection 3 Under 2 Bit 21 = Conf Protection 3 Under 1 Bit 22 = Conf Protection 3 Over 2 Bit 23 = Conf Protection 3 Over 1 Bit 24 = Conf Protection 2 Under 2 Bit 25 = Conf Protection 2 Under 1 Bit 26 = Conf Protection 2 Over 2 Bit 27 = Conf Protection 2 Over 1 Bit 28 = Conf Protection 1 Under 2 Bit 29 = Conf Protection 1 Under 1 Bit 30 = Conf Protection 1 Over 2 Bit 31 = Conf Protection 1 Over 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
45574	Logic Control Relay (LCR) Bits	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = LCR 16 Bit 17 = LCR 15 Bit 18 = LCR 14 Bit 19 = LCR 13 Bit 20 = LCR 12 Bit 21 = LCR 11 Bit 22 = LCR 10 Bit 23 = LCR 9 Bit 24 = LCR 8 Bit 25 = LCR 7 Bit 26 = LCR 6 Bit 27 = LCR 5 Bit 28 = LCR 4 Bit 29 = LCR 3 Bit 30 = LCR 2 Bit 31 = LCR 1

Register	Description	Type	Units	Scaling Factor	R/W	Range
45576	I/O Module Connected	Uint32	N/A	N/A	R	Bit 0 = Not Used Bit 1 = Not Used Bit 2 = Not Used Bit 3 = Not Used Bit 4 = Not Used Bit 5 = Not Used Bit 6 = Not Used Bit 7 = Not Used Bit 8 = Not Used Bit 9 = Not Used Bit 10 = Not Used Bit 11 = Not Used Bit 12 = Not Used Bit 13 = Not Used Bit 14 = Not Used Bit 15 = Not Used Bit 16 = Not Used Bit 17 = Not Used Bit 18 = Not Used Bit 19 = Not Used Bit 20 = Not Used Bit 21 = Not Used Bit 22 = Not Used Bit 23 = Not Used Bit 24 = Not Used Bit 25 = Not Used Bit 26 = Not Used Bit 27 = Not Used Bit 28 = Not Used Bit 29 = AEM Connected Bit 30 = CEM Connected Bit 31 = LSM Connected
45578-750	RESERVED					
45752	pc Emergency Stop	Uint32	N/A	N/A	RW	0 = Stop 1 = Start
45754	pc Relay Closed: Runs when in Auto mode	Uint32	N/A	N/A	RW	0 = Stop 1 = Start
45756	Test Buttons Image	Uint32	N/A	N/A	RW	0 - 255
45758-6118	RESERVED					

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APPENDIX B • LOGIC LIBRARY FILES

INTRODUCTION

This appendix discusses application of the IEM-2020 Industrial Engine Module using the logic library files. The *Details of Logic Library Files* subsection describes each logic library file and how they combine to create an industrial engine module for a variety of pump applications. Any scheme can be modified if necessary to fit a particular application.

The logic library files are designed to accommodate most common pump applications. The engineer can choose a logic library file that most closely meets his application practices and adapt it by changing the function block operation and settings. This eliminates the need to create a custom logic scheme.

> **WARNING!**
>
> The logic library files defined in this manual are intended to be used as basic logic configurations on which to build a complete logic scheme suitable for the application. The default logic scheme and logic library files may not be configured with adequate protection, time delays, and/or limits for every application. Carefully review these files and other settings within the IEM-2020 to be certain that they are appropriate for your application.

The following Logic Library Files are available:

- Maintain Speed with Constant Outputs
- Maintain Speed with Pulsed Outputs
- Maintain Pressure with Constant Outputs
- Maintain Pressure with Pulsed Outputs
- Maintain Speed with Time Based Valve Control and Constant Outputs
- Maintain Speed with Time Based Valve Control and Pulsed Outputs
- Maintain Speed with Contact Feedback Valve Control with Constant Outputs
- Maintain Speed with Contact Feedback Valve Control with Pulsed Outputs
- Maintain Pressure with Time Based Valve Control and Constant Outputs
- Maintain Pressure with Time Based Valve Control and Pulsed Outputs
- Maintain Pressure with Contact Feedback Valve Control with Constant Outputs
- Maintain Pressure with Contact Feedback Valve Control with Pulsed Outputs

All of the above logic library files implement the following start and stop characteristics:

- AUTO START – The run session begins when Contact Input 1 is closed and runs until Contact Input 1 is opened. Then a cool down and stop sequence is initiated.
- AUTO STOP – The run session is started when Contact Input 2 is pulsed. The unit will run for the time delay programmed into Logic Timer 1.
- SINGLE FLOAT – The engine runs while the FLOAT switch is closed and begins its cool down and stop sequence when the FLOAT switch opens. This is can be implemented by connecting the FLOAT switch to Contact Input 1.
- TWO FLOAT – The engine starts when a HIGH FLOAT input is closed and runs until a LOW FLOAT switch closes. Then a cool down and stop sequence is initiated. This can be implemented by connecting the HIGH FLOAT to Contact Input 3 and the LOW FLOAT to Contact Input 4.

The operating modes of the logic library files fall into two categories: (1) Maintain speed for applications where it is desired to maintain engine RPM and (2) Maintain pressure where it is necessary to keep pressure within a range defined by a low pressure and high pressure contact input.

Two types of raise and lower contact output characteristics are implemented. (1) Constant on outputs hold the raise or lower contact on continuously when it is desired to apply a raise or lower input to the engine. (2) Pulsed schemes are used when the engine's slew rate on the throttle is too high when a constant or lower input is applied. The pulsing effectively implements a lower slew rate. The IEM-2020 can be configured to provide pulsed raise and lower signals. The pulse on and off times are configurable through logic timers.

Two types of valve control are implemented. (1) Time based valve control schemes keep the engine at the desired speed for valve open or close for a user specified time implemented by individual logic timers. (2) Contact feedback based valve control schemes maintain the engine at the desired speed for valve open or close until a contact input indicates an open or closed valve.

Logic library files can be loaded into BESTCOMS*Plus* memory by selecting *View Device's Logic Library Files* from the *Logic Library* drop-down menu in BESTLogic*Plus*. See Figure B-1.

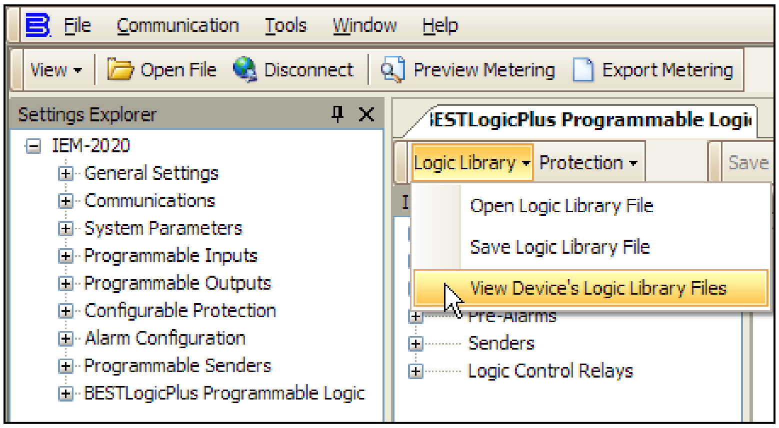

Figure B-1. View Device's Logic Library Files

DETAILS OF LOGIC LIBRARY FILES

Each logic library file is described in detail in the following paragraphs. Engine start and stop are implemented according to the preceding paragraphs that describe the start and stop characteristics for all schemes.

Default Settings and Logic

Default IEM-2020 logic provides annunciation of alarm, pre-alarm, and not in auto indications. An audible horn can be connected to Output 1 to allow the horn to sound continuously for alarm or not in auto indication, and beep in an alternating on- off pattern for pre-Alarm indication. Output 2 is closed when the unit is not in the AUTO mode. Output 3 is closed when any alarm is in effect and Output 4 is closed when any pre-alarm is in effect.

Maintain Speed with Constant Contact Outputs (Logic Library File #1)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
3. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
4. Logic Timer 3 specifies the duration of engine warm up in Step 3.
5. Configurable Protection Element 1, Threshold 2 specifies the upper speed limit that the engine should maintain at during normal operation.
6. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
7. Logic Timer 4 specifies the duration of engine cool down in Step 6.

After cooldown, the machine shuts down and remains ready to be activated the next time it receives a start indication.

Refer to Figures B-2 and B-3 for main logic diagrams of Logic Library File #1.

INPUT 1 PUMP ON - RUN PUMP WHILE INPUT IS ON. PUMP RUNS UNTIL THE INPUT IS OFF.

INPUT 2 START TIMED RUN - PULSE INPUT 2 TO START A TIMED RUN SESSION.
THE TIME IS SET BY LOGIC TIMER 1

INPUT 3 - HIGH FLOAT FOR TWO FLOAT APPLICATIONS. INPUT 3 STARTS PUMP

INPUT 4 - LOW FLOAT FOR TWO FLOAT APPLICATIONS. INPUT4 STOPS PUMP THAT
WAS STARTED BY INPUT 3.

SINGLE FLOAT APPLICATIONS SHOULD USE INPUT 1 CONTROLLED BY FLOAT CONTACTS.
WHEN THE CONTACTS ARE CLOSED THE PUMP RUNS. IT RUNS UNTIL THE CONTACTS
ARE OPENED.

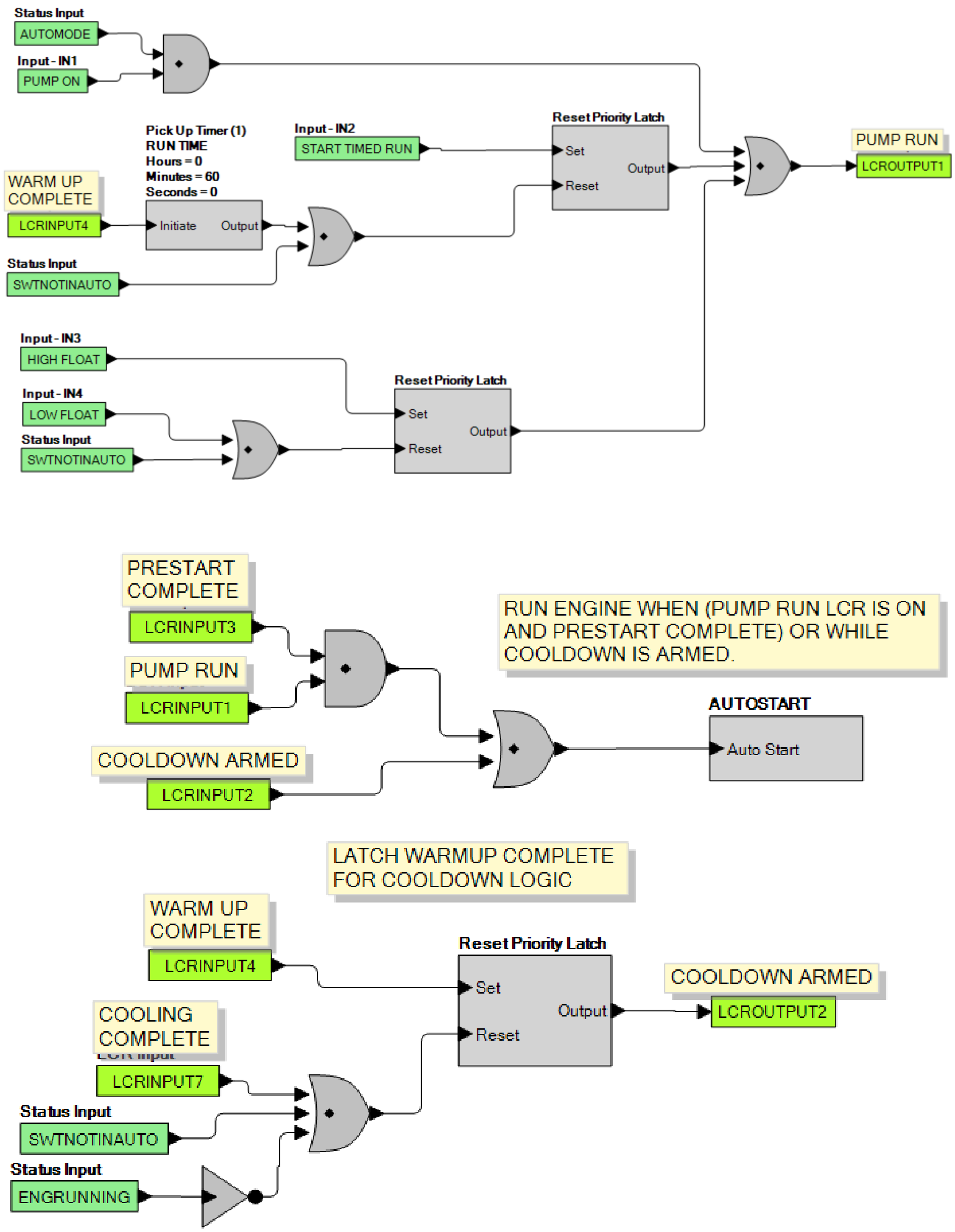

Figure B-2. Logic Library File #1 Main Logic (1 of 2)

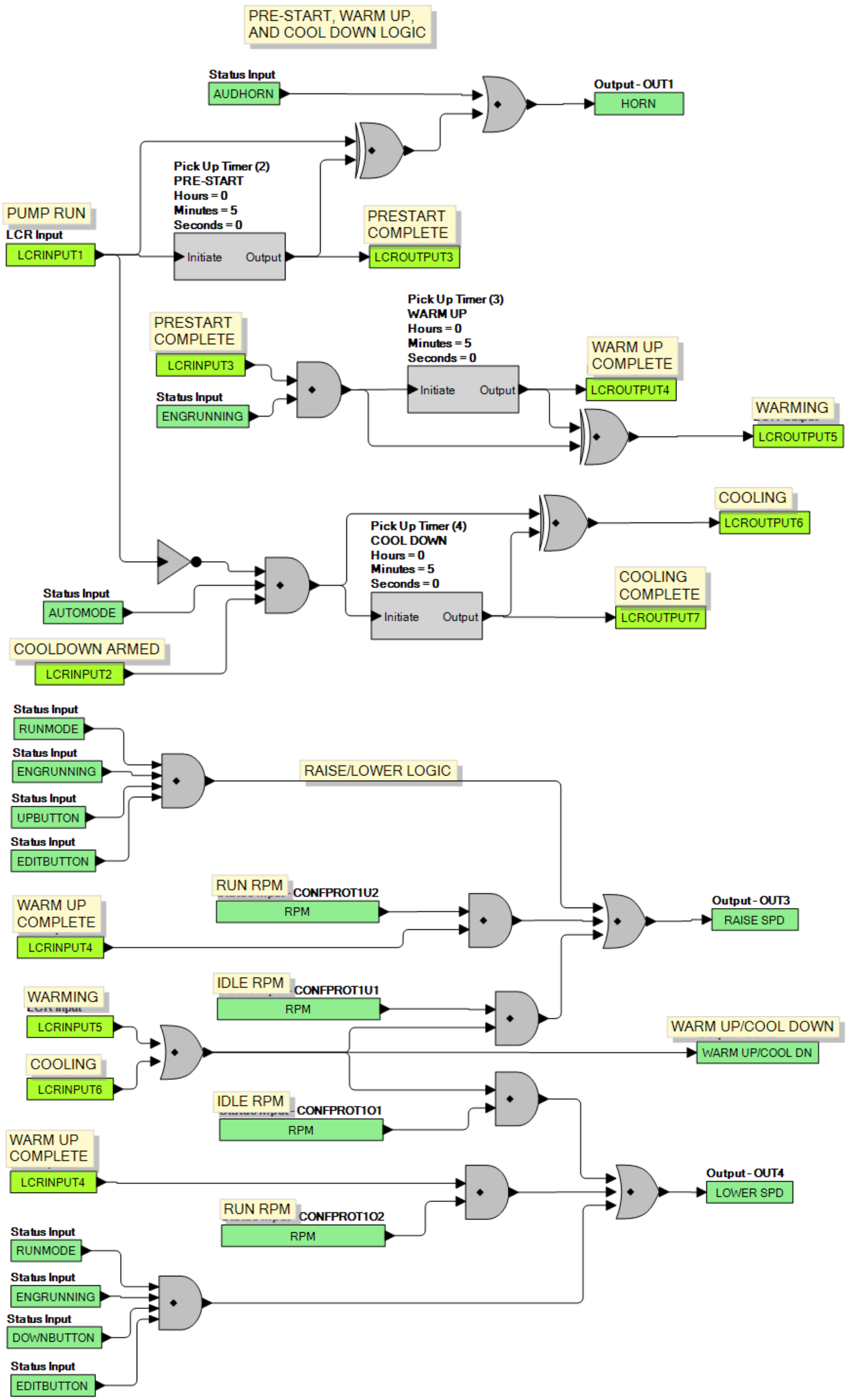

Figure B-3. Logic Library File #1 Main Logic (2 of 2)

Maintain Speed with Pulsed Contact Outputs (Logic Library File #2)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timers 5 and 6 specify the on and off times for the raise and lower outputs. Raise and Lower outputs are pulsed in this scheme. Pulsed schemes are used when the engine's slew rate on the throttle is too high when a constant raise or lower input is applied. The pulsing effectively implements a lower slew rate.
3. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
4. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
5. Logic Timer 3 specifies the duration of engine warm up in Step 3.
6. Configurable Protection Element 1, Threshold 2 specifies the upper speed limit that the engine should maintain during normal operation.
7. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
8. Logic Timer 4 specifies the duration of engine cool down in Step 7.

After cooldown, the machine shuts down and remains ready to be activated the next time is receives a start indication.

Refer to Figures B-4 through B-6 for main logic diagrams of Logic Library File #2.

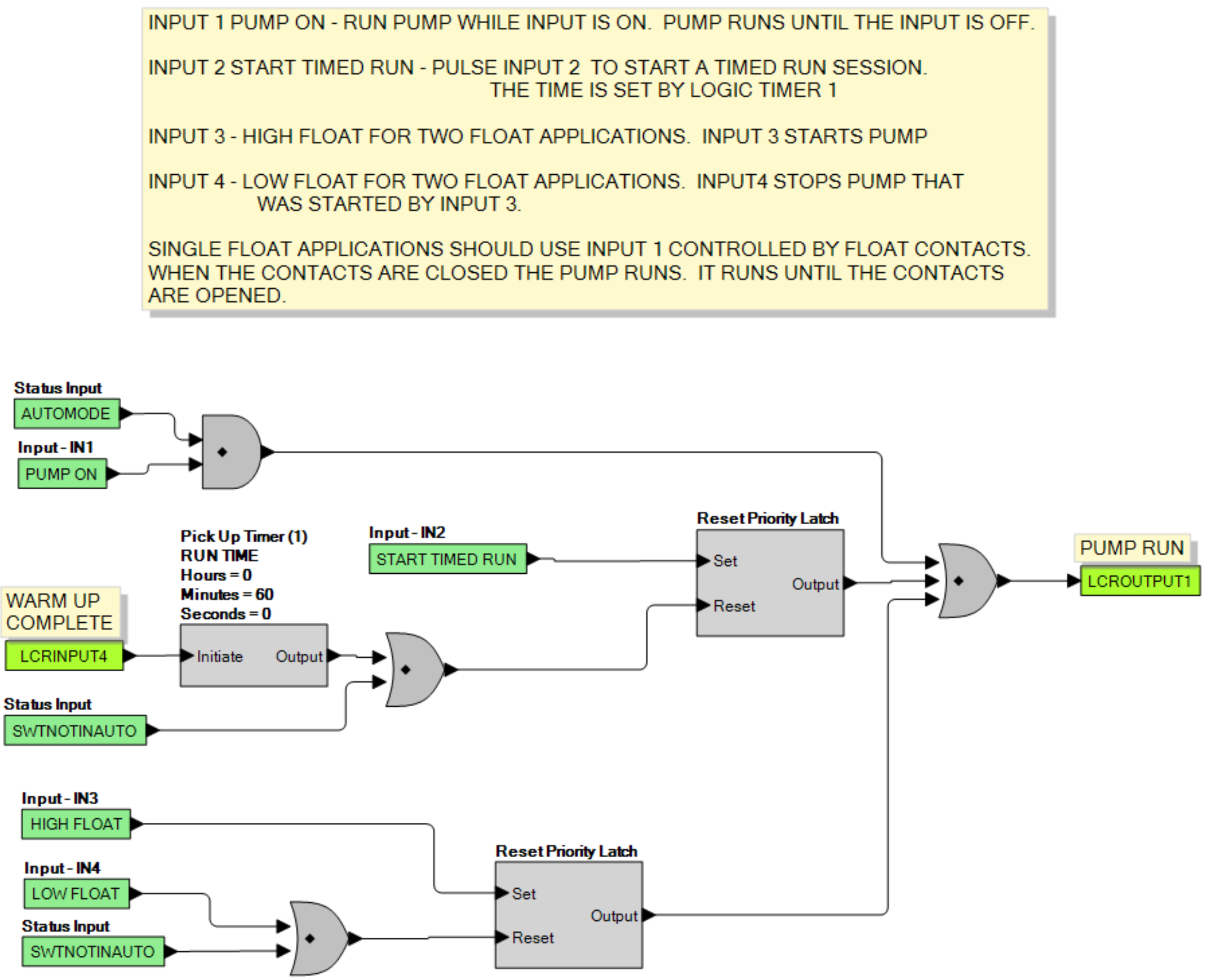

Figure B-4. Logic Library File #2 Main Logic (1 of 3)

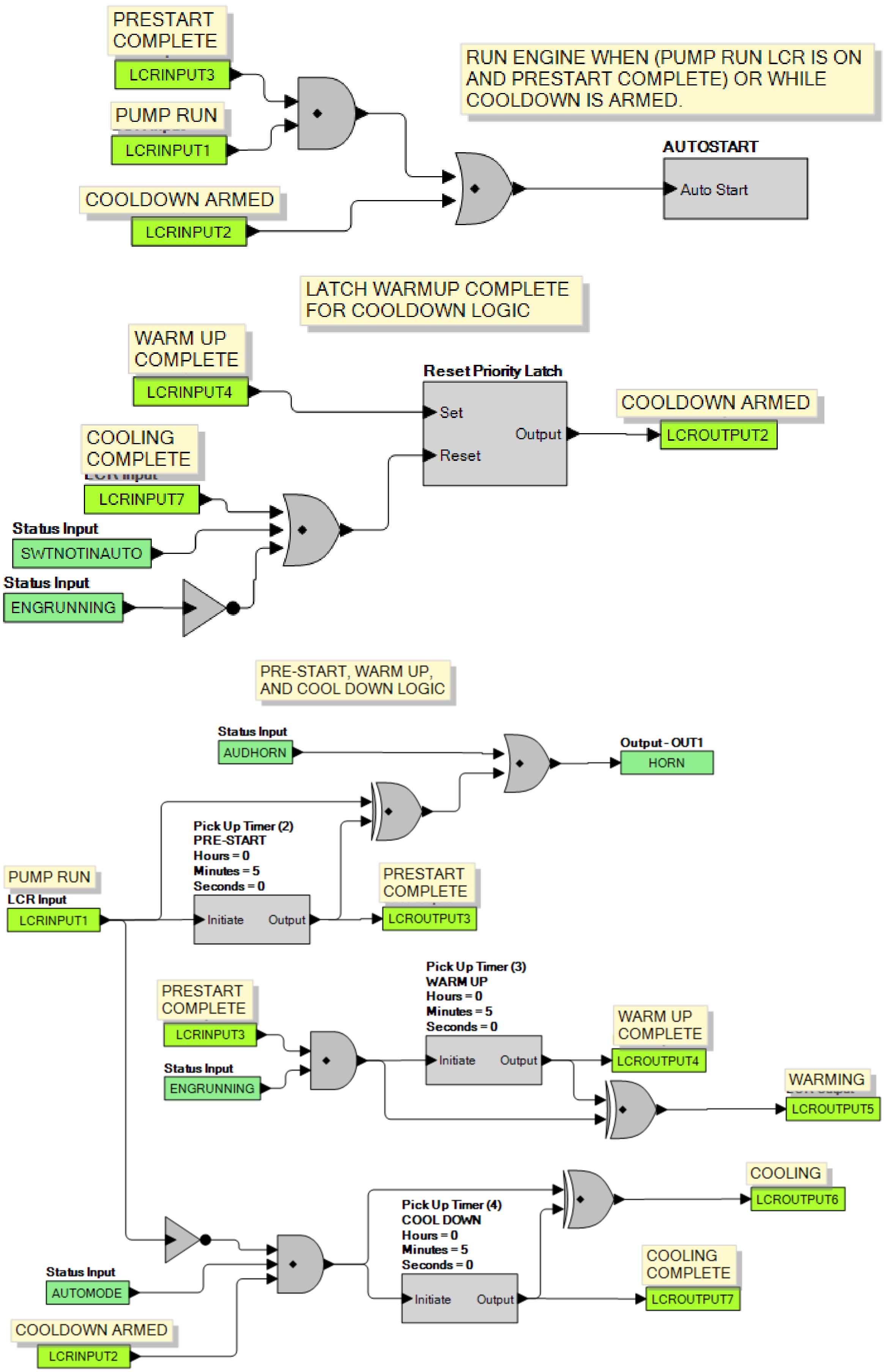

Figure B-5. Logic Library File #2 Main Logic (2 of 3)

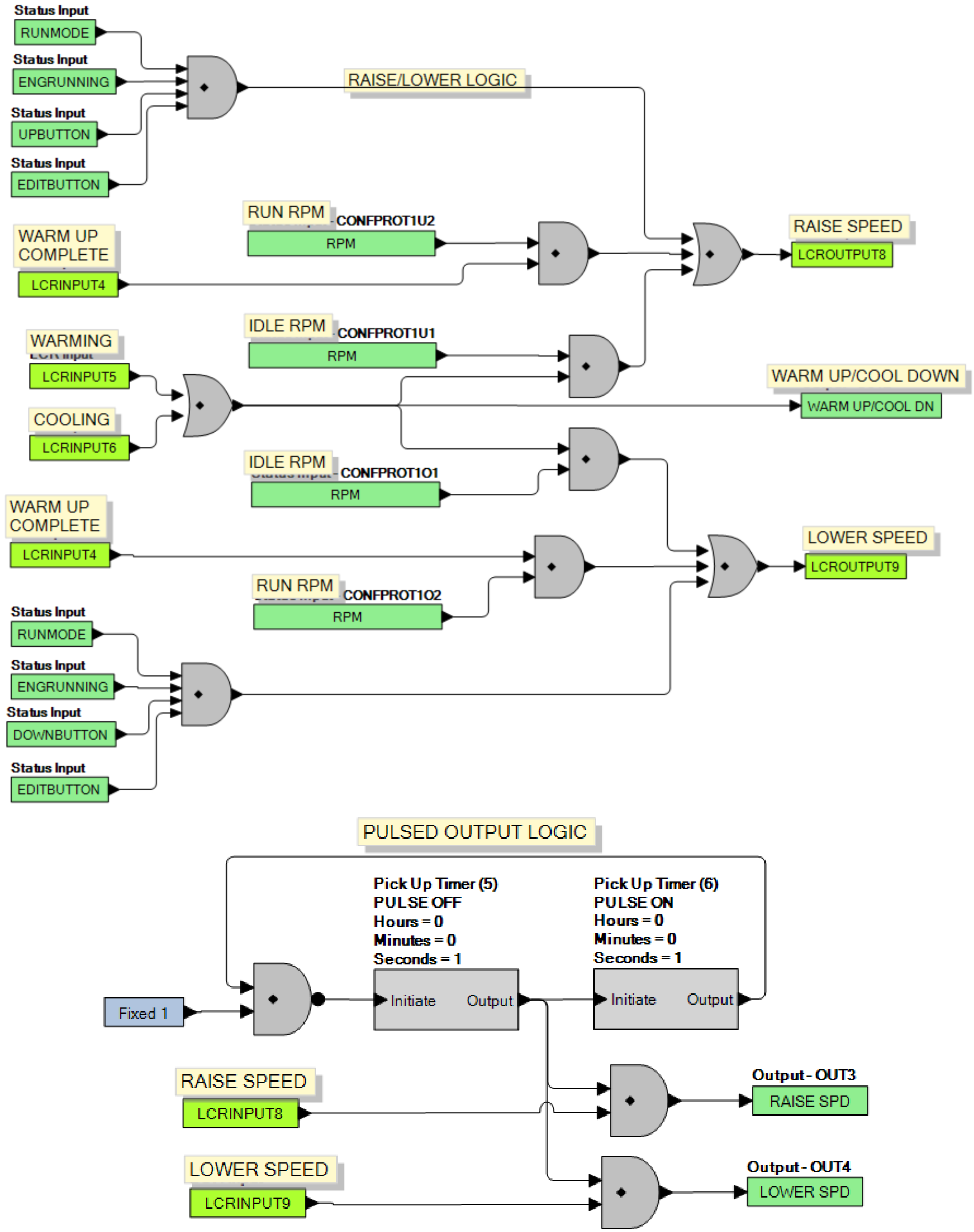

Figure B-6. Logic Library File #2 Main Logic (3 of 3)

Maintain Pressure with Constant Outputs (Logic Library File #3)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
3. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
4. Logic Timer 3 specifies the duration of engine warm up in Step 3.
5. Contact Input 5 (Low Pressure Input) and Contact Input 6 (High Pressure Input) specify the pressure limits that the engine should maintain during normal operation.
6. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
7. Logic Timer 4 specifies the duration of engine cool down in Step 6.

After cooldown, the machine shuts down and remains ready to be activated the next time it receives a start indication.

Refer to Figures B-7 through B-9.

INPUT 1 PUMP ON - RUN PUMP WHILE INPUT IS ON. PUMP RUNS UNTIL THE INPUT IS OFF.

INPUT 2 START TIMED RUN - PULSE INPUT 2 TO START A TIMED RUN SESSION.
THE TIME IS SET BY LOGIC TIMER 1

INPUT 3 - HIGH FLOAT FOR TWO FLOAT APPLICATIONS. INPUT 3 STARTS PUMP

INPUT 4 - LOW FLOAT FOR TWO FLOAT APPLICATIONS. INPUT4 STOPS PUMP THAT
WAS STARTED BY INPUT 3.

SINGLE FLOAT APPLICATIONS SHOULD USE INPUT 1 CONTROLLED BY FLOAT CONTACTS.
WHEN THE CONTACTS ARE CLOSED THE PUMP RUNS. IT RUNS UNTIL THE CONTACTS
ARE OPENED.

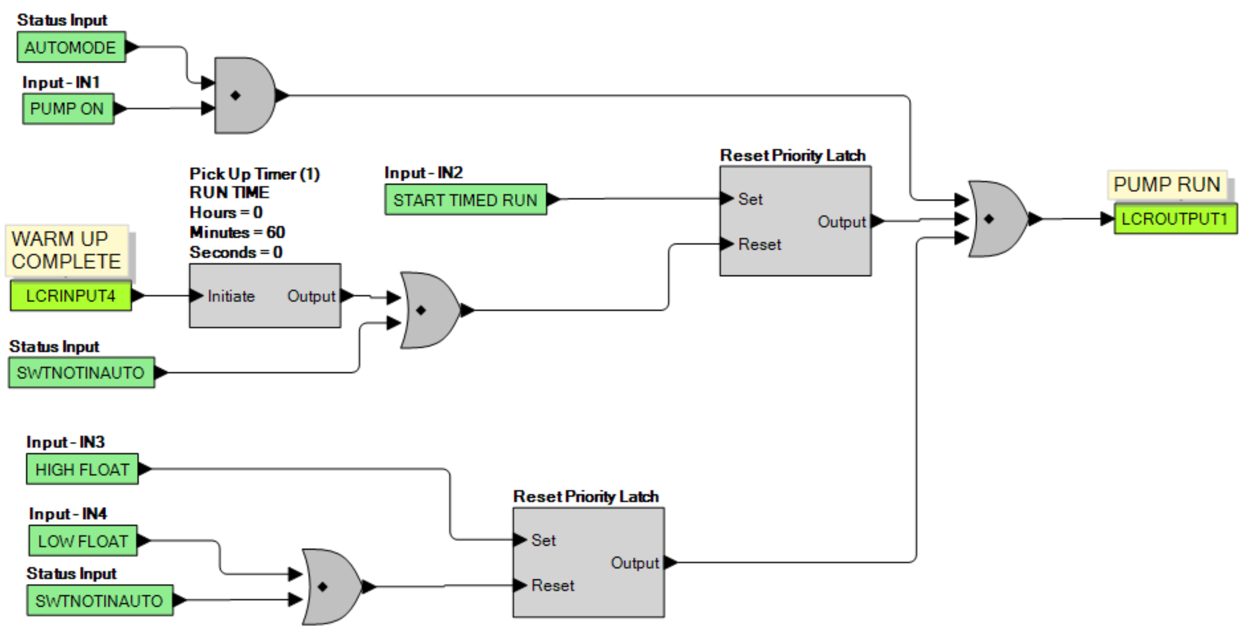

Figure B-7. Logic Library File #3 Main Logic (1 of 3)

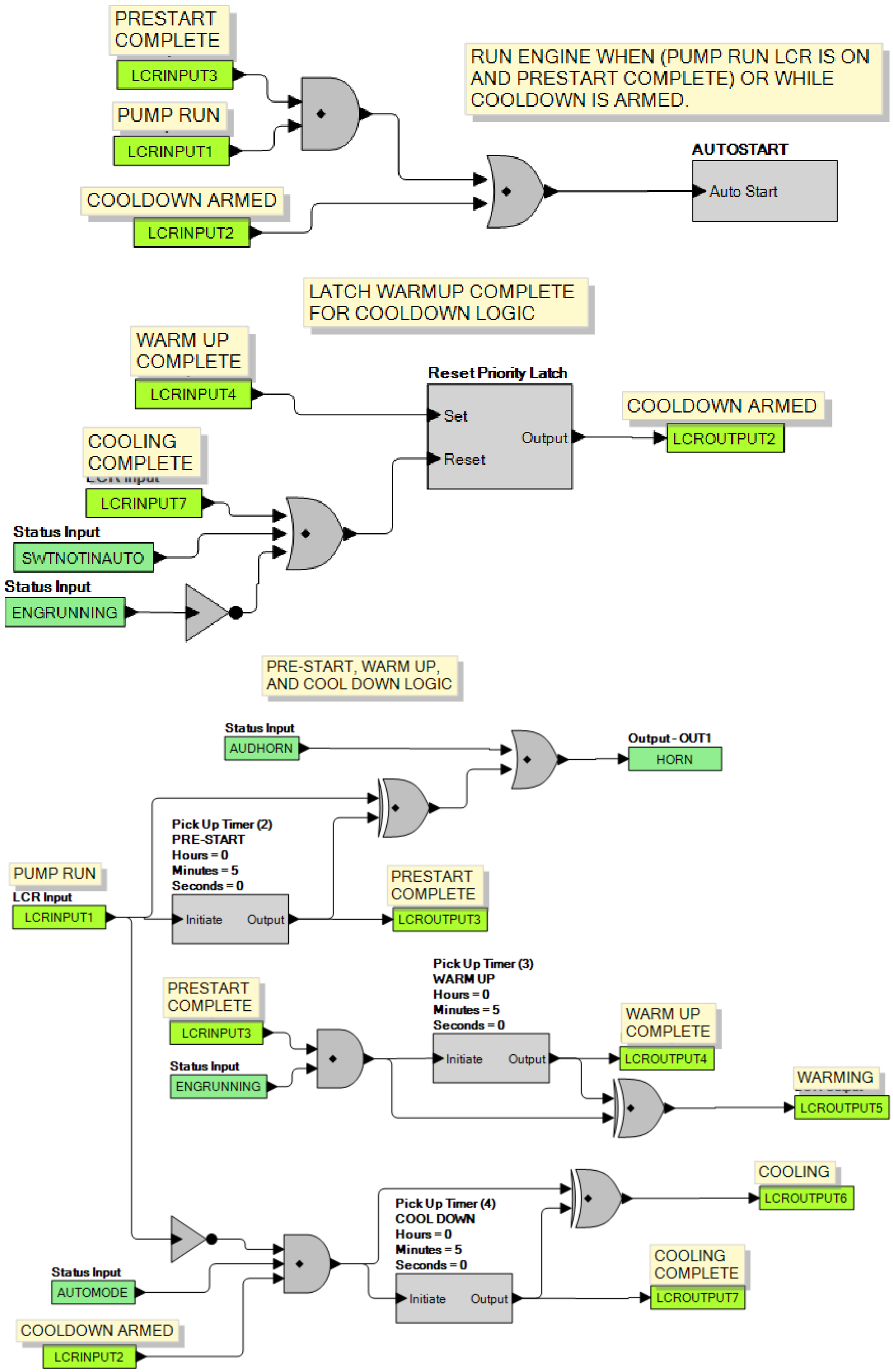

Figure B-8. Logic Library File #3 Main Logic (2 of 3)

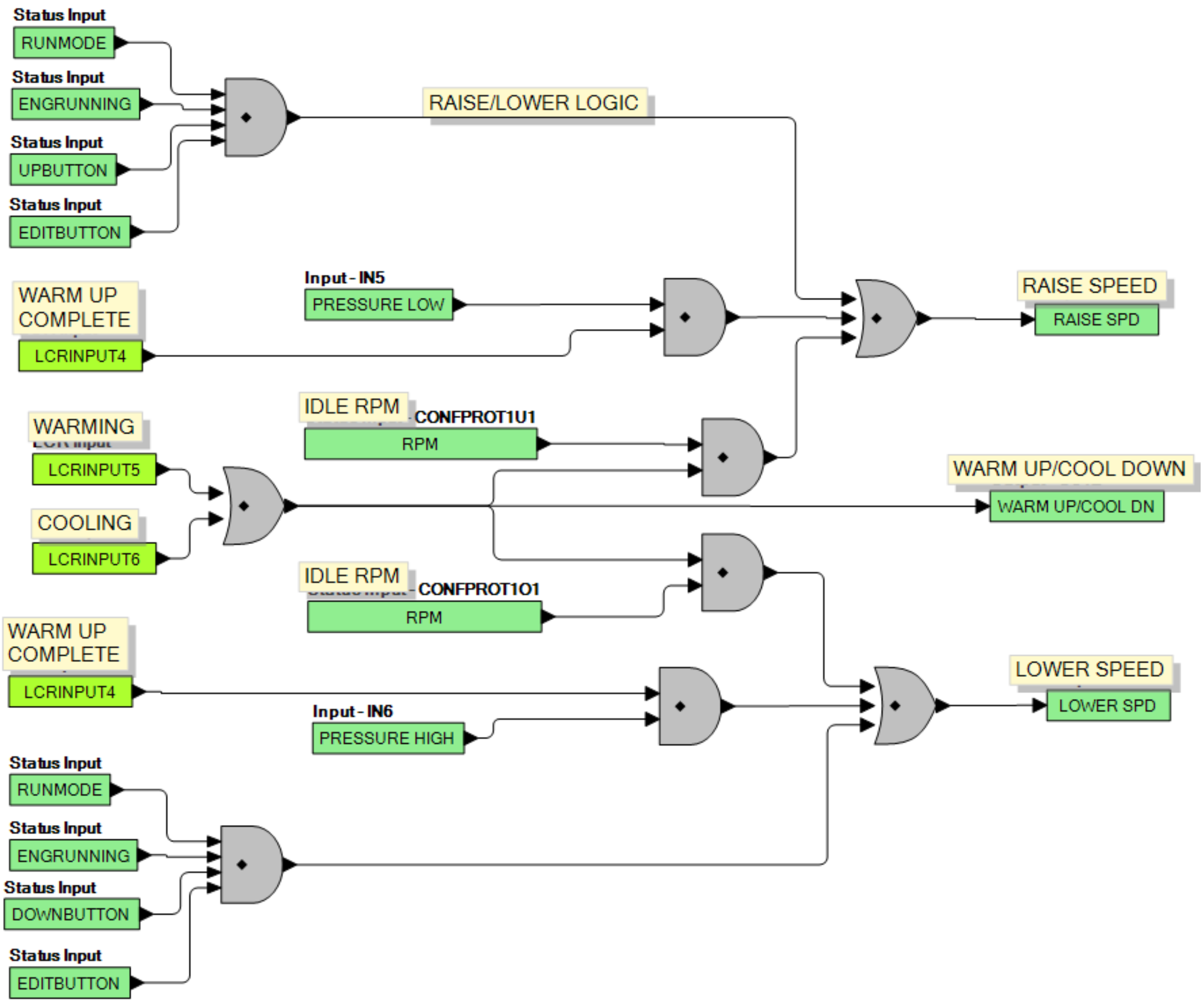

Figure B-9. Logic Library File #3 Main Logic (3 of 3)

Maintain Pressure with Pulsed Outputs (Logic Library File #4)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timers 5 and 6 specify the on and off times for the raise and lower outputs. Raise and Lower outputs are pulsed in this scheme. Pulsed schemes are used when the engine's slew rate on the throttle is too high when a constant raise or lower input is applied. The pulsing effectively implements a lower slew rate.
3. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
4. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
5. Logic Timer 3 specifies the duration of engine warm up in Step 4.
6. Contact Input 5 (Low Pressure Input) and Contact Input 6 (High Pressure Input) specify the pressure limits that the engine should maintain during normal operation.
7. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
8. Logic Timer 4 specifies the duration of engine cool down in Step 7.

After cooldown, the machine shuts down and remains ready to be activated the next time it receives a start indication.

Refer to Figures B-10 through B-12 for main logic diagrams of Logic Library File #4.

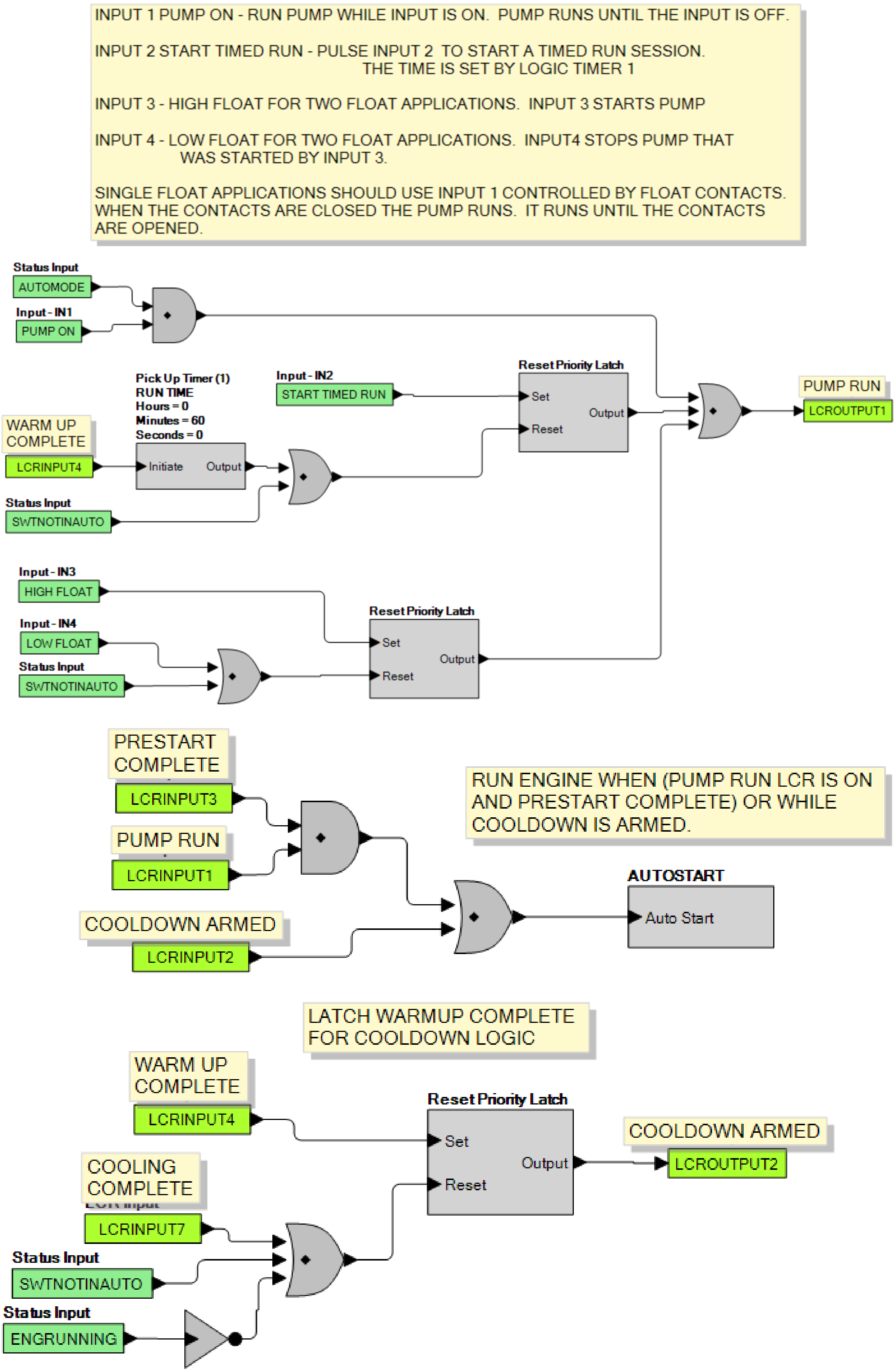

Figure B-10. Logic Library File #4 Main Logic (1 of 3)

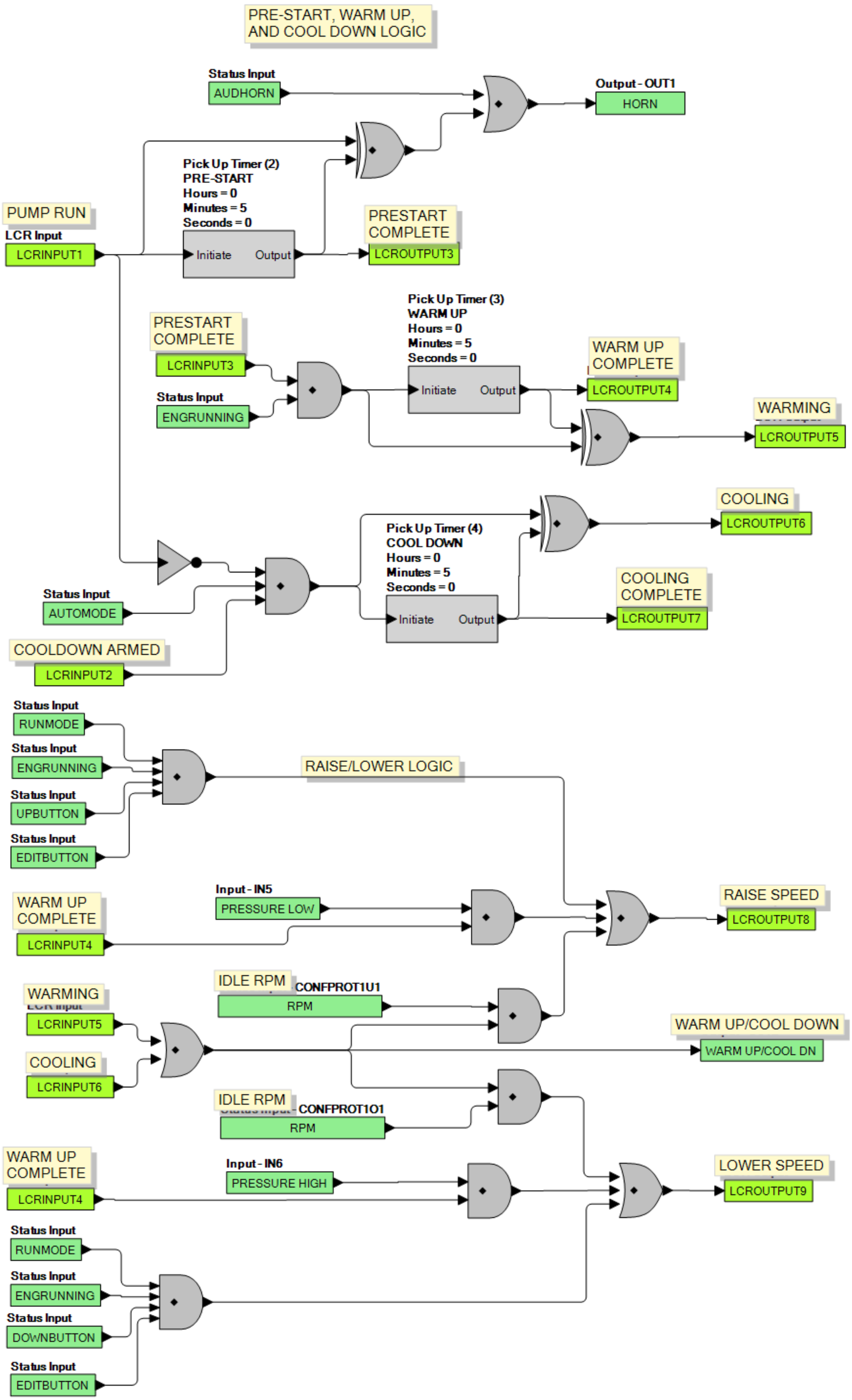

Figure B-11. Logic Library File #4 Main Logic (2 of 3)

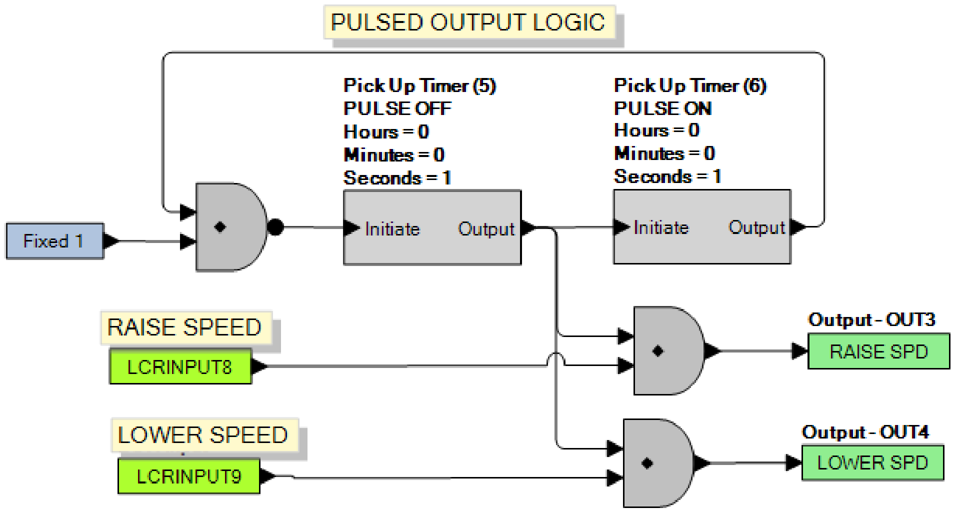

Figure B-12. Logic Library File #4 Main Logic (3 of 3)

Maintain Speed with Time Based Valve Control and Constant Outputs (Logic Library File #5)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
3. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
4. Logic Timer 3 specifies the duration of engine warm up in Step 3.
5. Configurable Protection Element 2, Threshold 1 specifies the RPM that the engine should be held at while the valve is being closed.
6. Logic Timer 5 specifies the duration of the valve closing process in Step 5.
7. Configurable Protection Element 1, Threshold 2 specifies the upper speed limit that the engine should maintain during normal operation.
8. Configurable Protection Element 2, Threshold 2 specifies the RPM that the engine should slow down to while the valve is being opened. This takes place when the engine is no longer required to run.
9. Logic Timer 6 specifies the duration of the valve opening process in Step 8.
10. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
11. Logic Timer 4 specifies the duration of engine cool down in Step 10.

After cooldown, the machine shuts down and remains ready to be activated the next time is receives a start indication.

Refer to Figures B-13 through B-15 for main logic diagrams of Logic Library File #5.

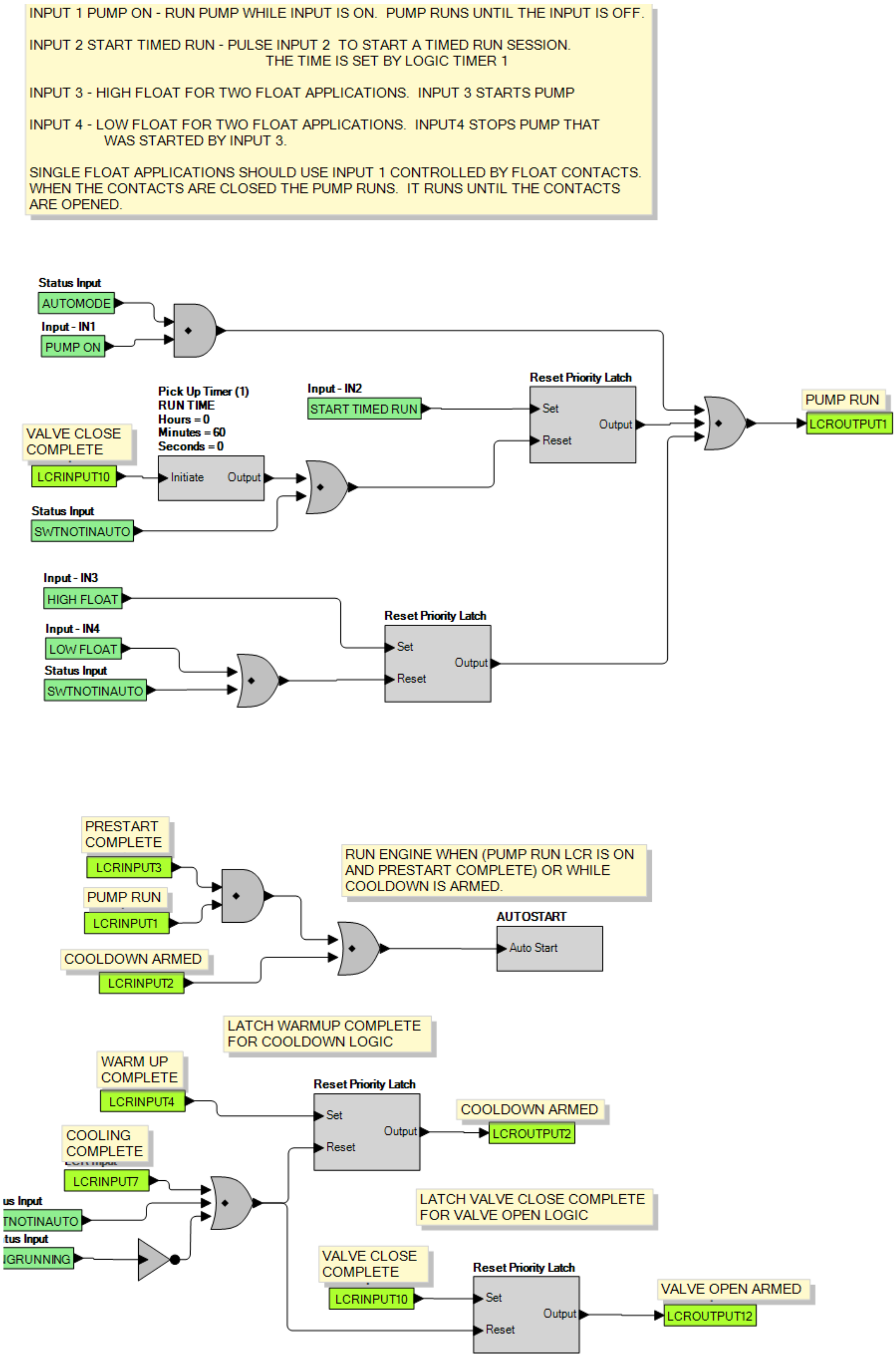

Figure B-13. Logic Library File #5 Main Logic (1 of 3)

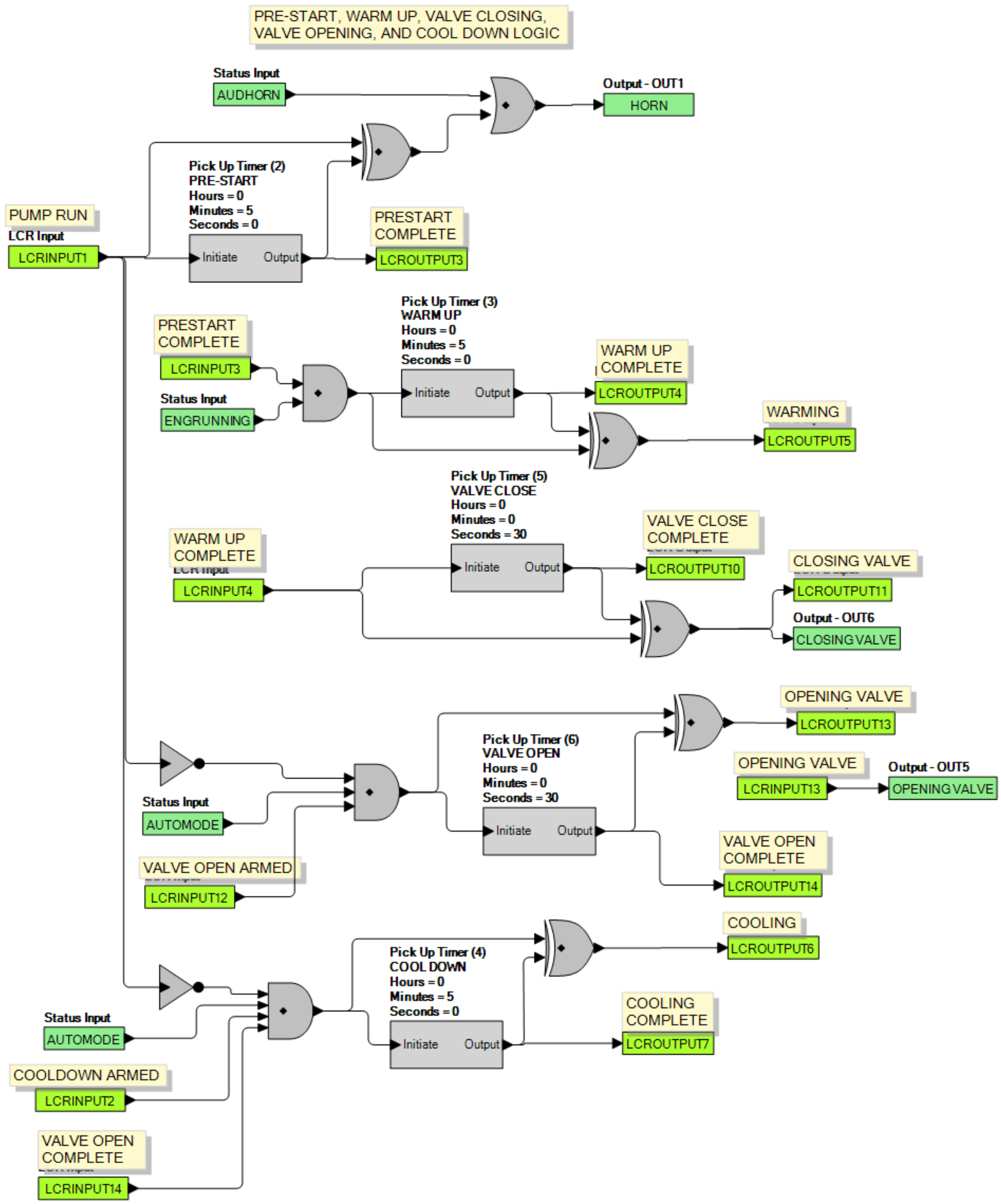

Figure B-14. Logic Library File #5 Main Logic (2 of 3)

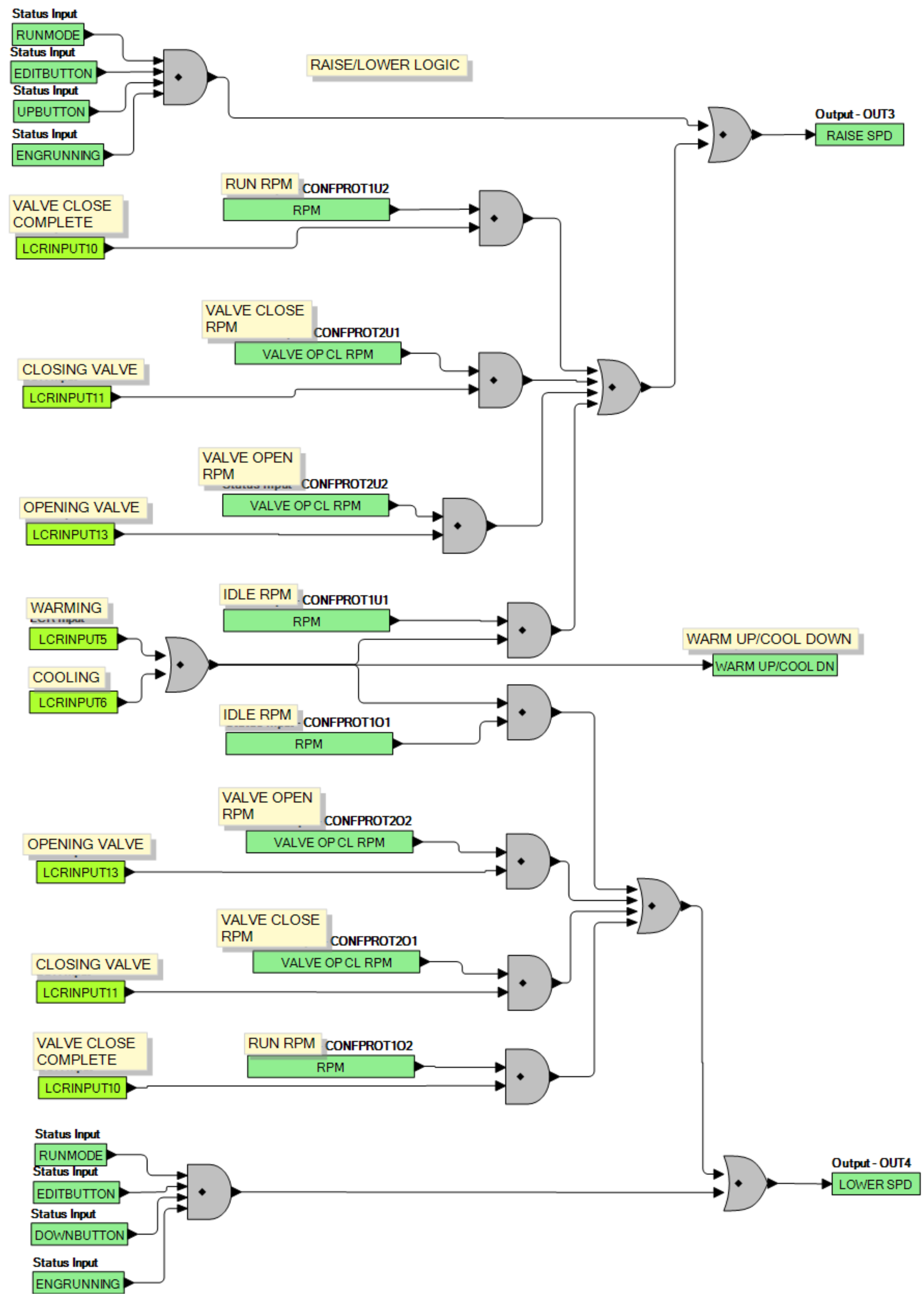

Figure B-15. Logic Library File #5 Main Logic (3 of 3)

Maintain Speed with Time Based Valve Control and Pulsed Outputs (Logic Library File #6)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timers 7 and 8 specify the on and off times for the raise and lower outputs. Raise and Lower outputs are pulsed in this scheme. Pulsed schemes are used when the engine's slew rate on the throttle is too high when a constant raise or lower input is applied. The pulsing effectively implements a lower slew rate.
3. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
4. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
5. Logic Timer 3 specifies the duration of engine warm up in Step 4.
6. Configurable Protection Element 2, Threshold 1 specifies the RPM that the engine should be held at while the valve is being closed.
7. Logic Timer 5 specifies the duration of the valve closing process in Step 6.
8. Configurable Protection Element 1, Threshold 2 specifies the upper speed limit that the engine should maintain during normal operation.
9. Configurable Protection Element 2, Threshold 2 specifies the RPM that the engine should slow down to while the valve is being opened. This takes place when the engine is no longer required to run.
10. Logic Timer 6 specifies the duration of the valve opening process in Step 9.
11. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
12. Logic Timer 4 specifies the duration of engine cool down in Step 11.

After cooldown, the machine shuts down and remains ready to be activated the next time is receives a start indication.

Refer to Figures B-16 through B-18 for main logic diagrams of Logic Library File #6.

INPUT 1 PUMP ON - RUN PUMP WHILE INPUT IS ON. PUMP RUNS UNTIL THE INPUT IS OFF.

INPUT 2 START TIMED RUN - PULSE INPUT 2 TO START A TIMED RUN SESSION.
THE TIME IS SET BY LOGIC TIMER 1

INPUT 3 - HIGH FLOAT FOR TWO FLOAT APPLICATIONS. INPUT 3 STARTS PUMP

INPUT 4 - LOW FLOAT FOR TWO FLOAT APPLICATIONS. INPUT4 STOPS PUMP THAT
WAS STARTED BY INPUT 3.

SINGLE FLOAT APPLICATIONS SHOULD USE INPUT 1 CONTROLLED BY FLOAT CONTACTS.
WHEN THE CONTACTS ARE CLOSED THE PUMP RUNS. IT RUNS UNTIL THE CONTACTS
ARE OPENED.

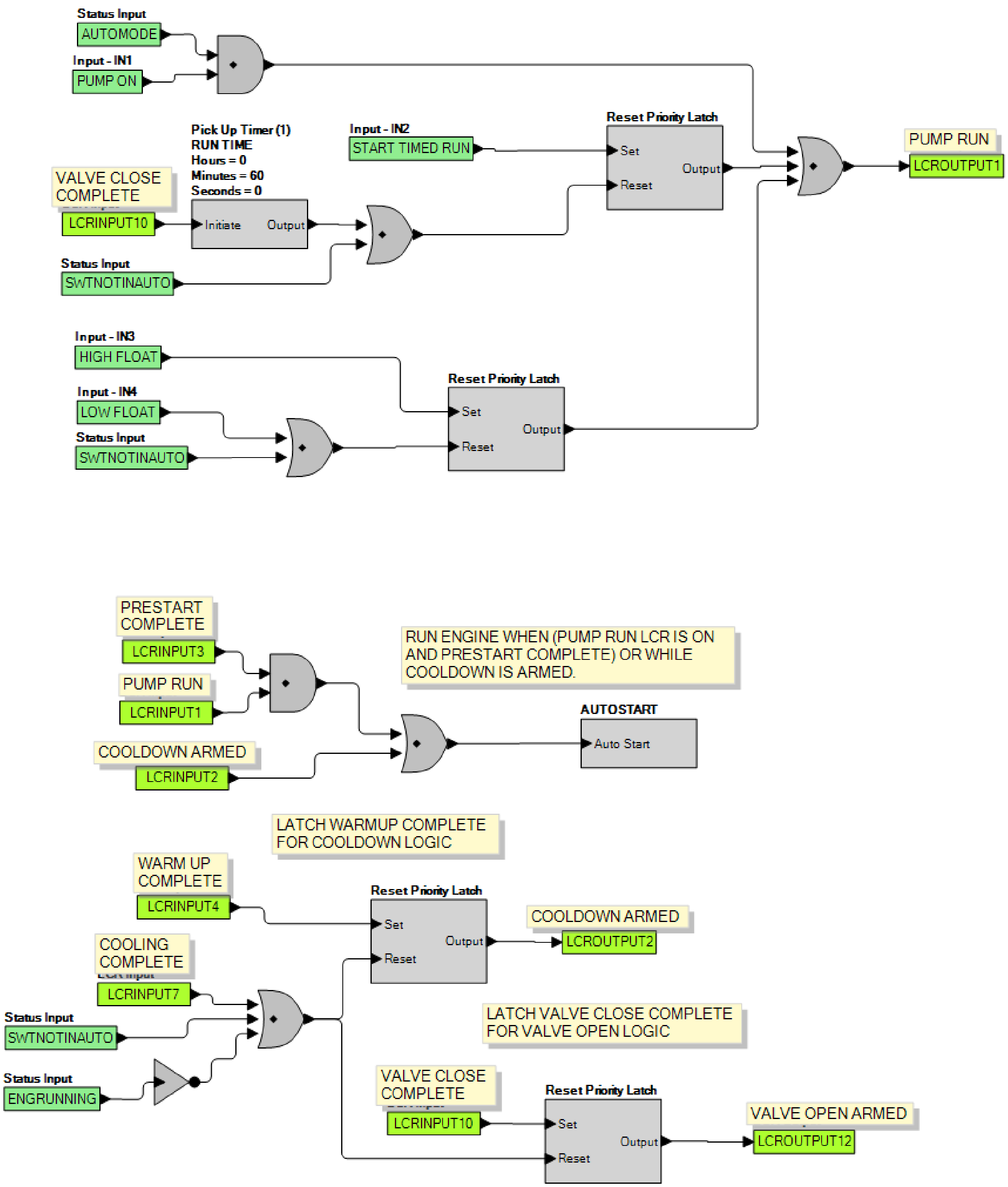

Figure B-16. Logic Library File #6 Main Logic (1 of 3)

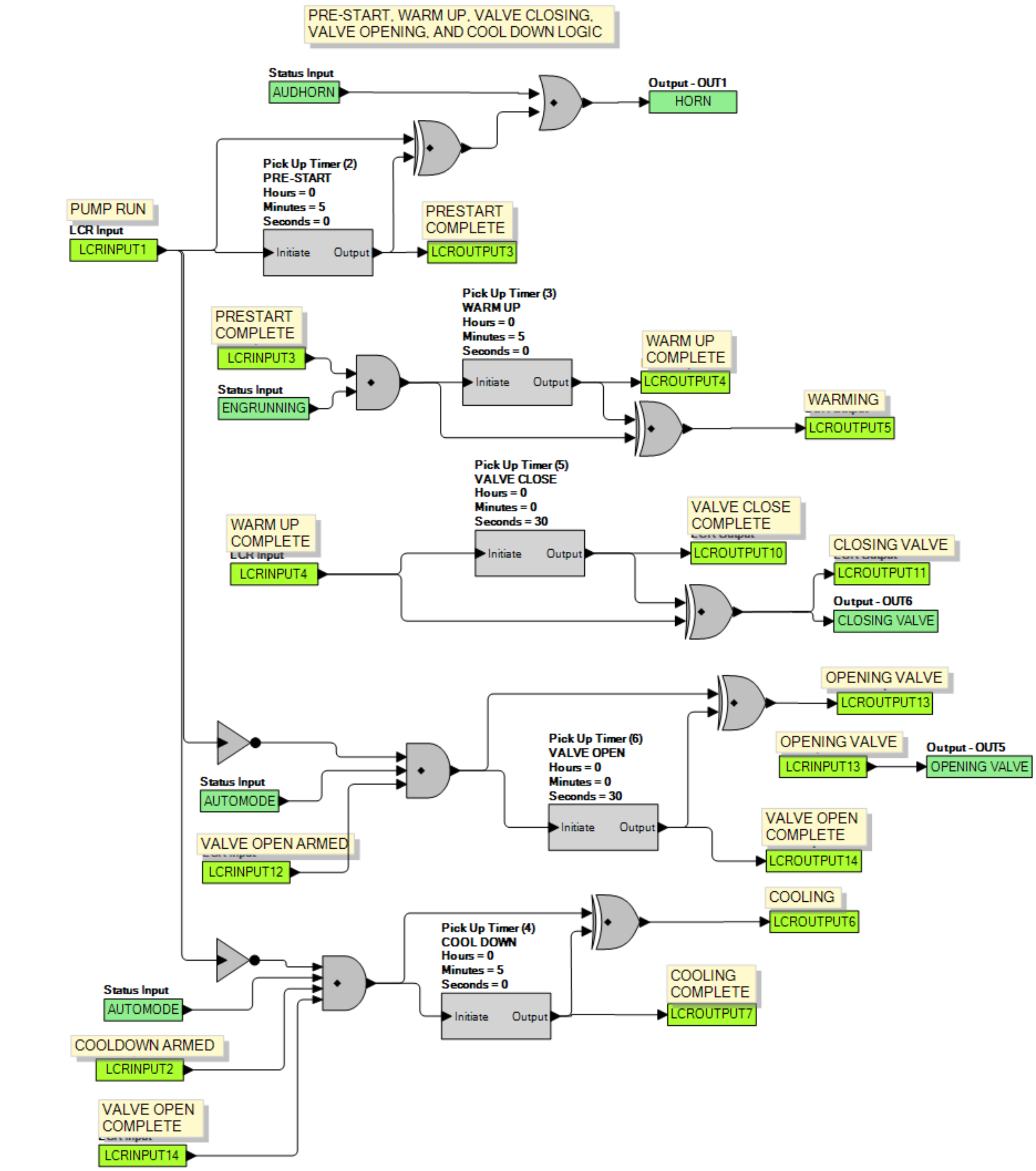

Figure B-17. Logic Library File #6 Main Logic (2 of 3)

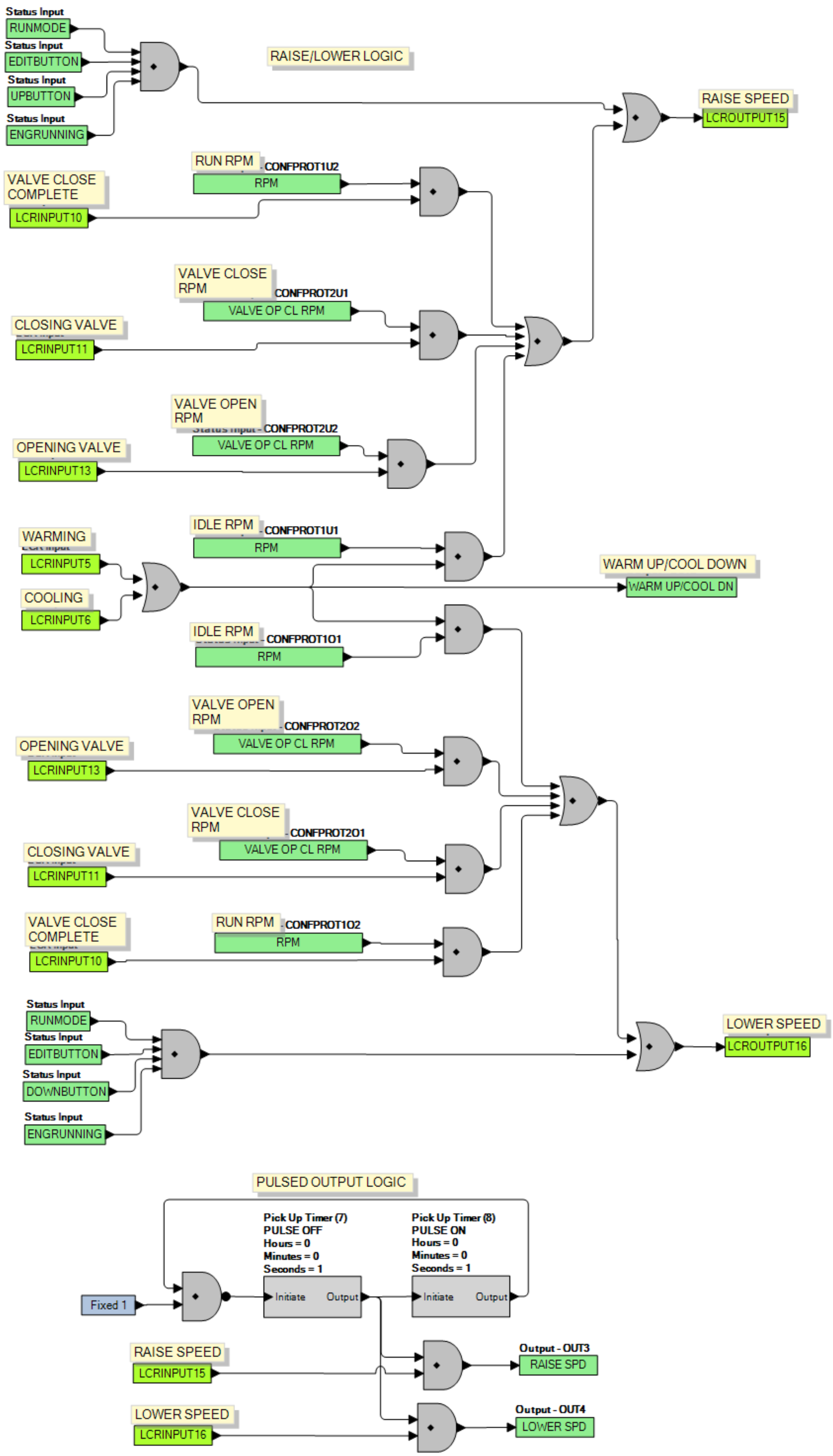

Figure B-18. Logic Library File #6 Main Logic (3 of 3)

Maintain Speed with Contact Feedback Valve Control with Constant Outputs (Logic Library File #7)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
3. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
4. Logic Timer 3 specifies the duration of engine warm up in Step 3.
5. Configurable Protection Element 2, Threshold 1 specifies the RPM that the engine should be held at while the valve is being closed. The machine remains in this state until it receives a closure on Contact Input 5 indicating a closed valve.
6. Configurable Protection Element 1, Threshold 2 specifies the upper speed limit that the engine should maintain during normal operation.
7. Configurable Protection Element 2, Threshold 2 specifies the RPM that the engine should slow down to while the valve is being opened. This takes place when the engine is no longer required to run. The machine remains in this state until it receives a closure on Contact Input 6 indicating an open valve.
8. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
9. Logic Timer 4 specifies the duration of engine cool down in Step 8.

After cooldown, the machine shuts down and remains ready to be activated the next time is receives a start indication.

Refer to Figures B-19 through B-21 for main logic diagrams of Logic Library File #7.

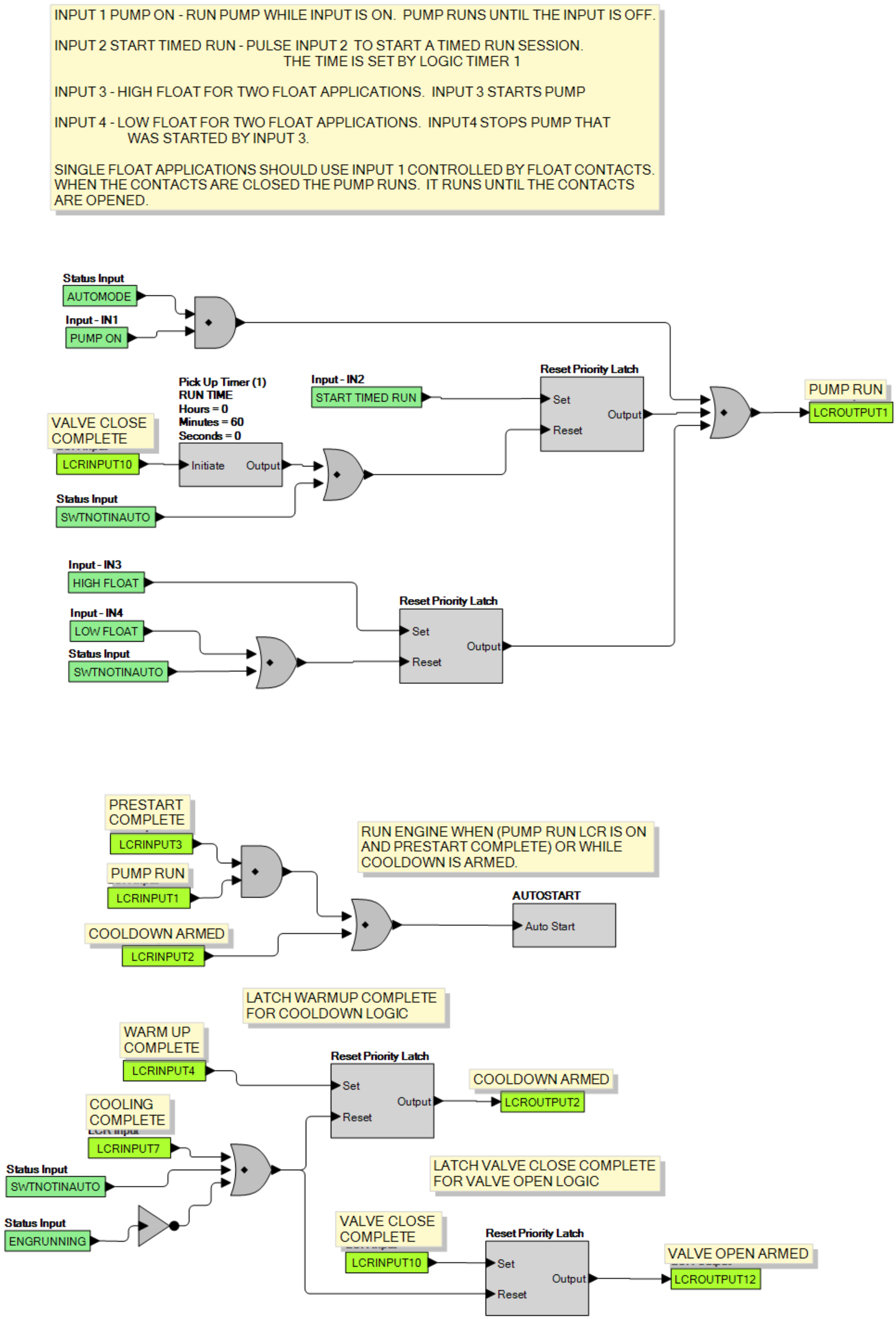

Figure B-19. Logic Library File #7 Main Logic (1 of 3)

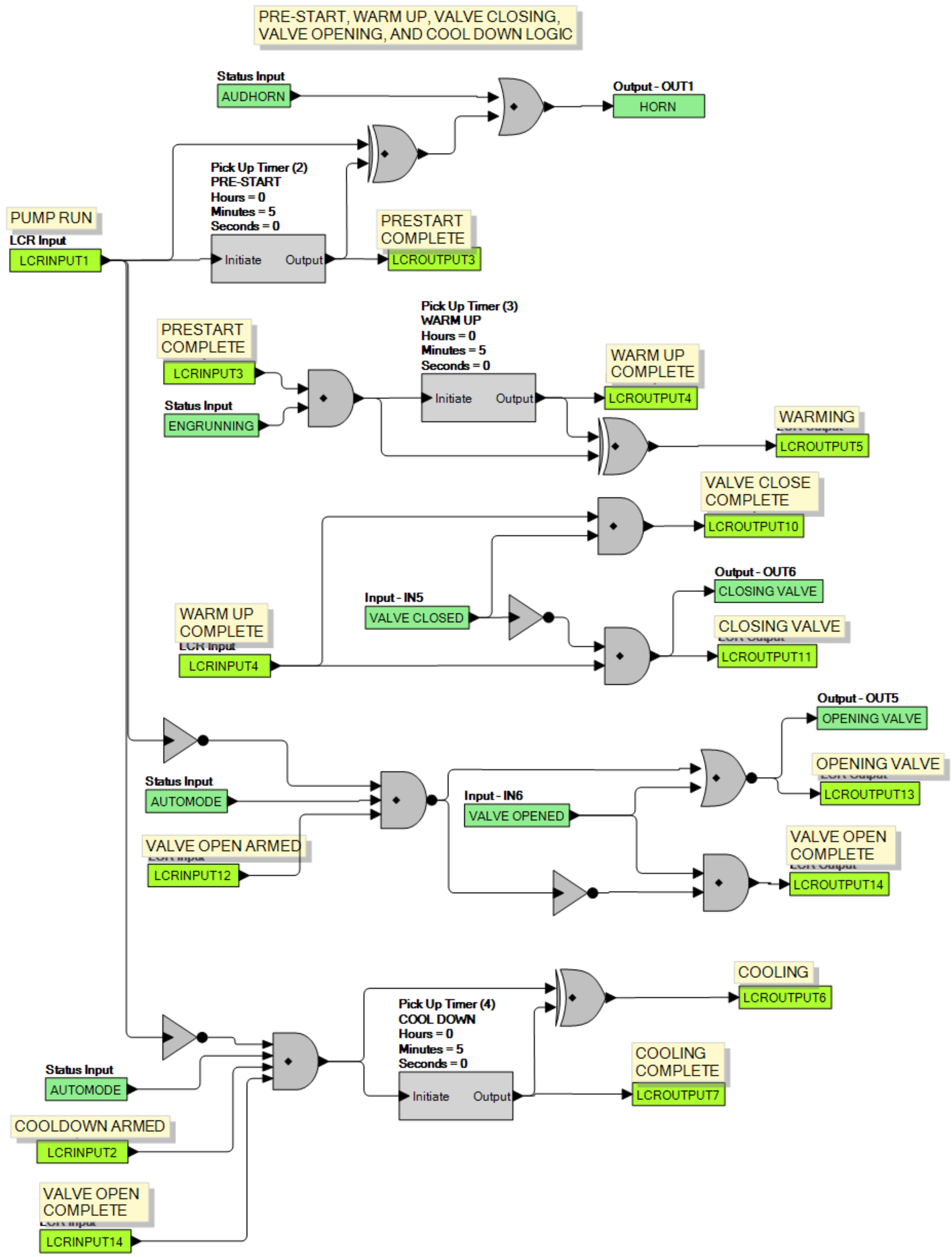

Figure B-20. Logic Library File #7 Main Logic (2 of 3)

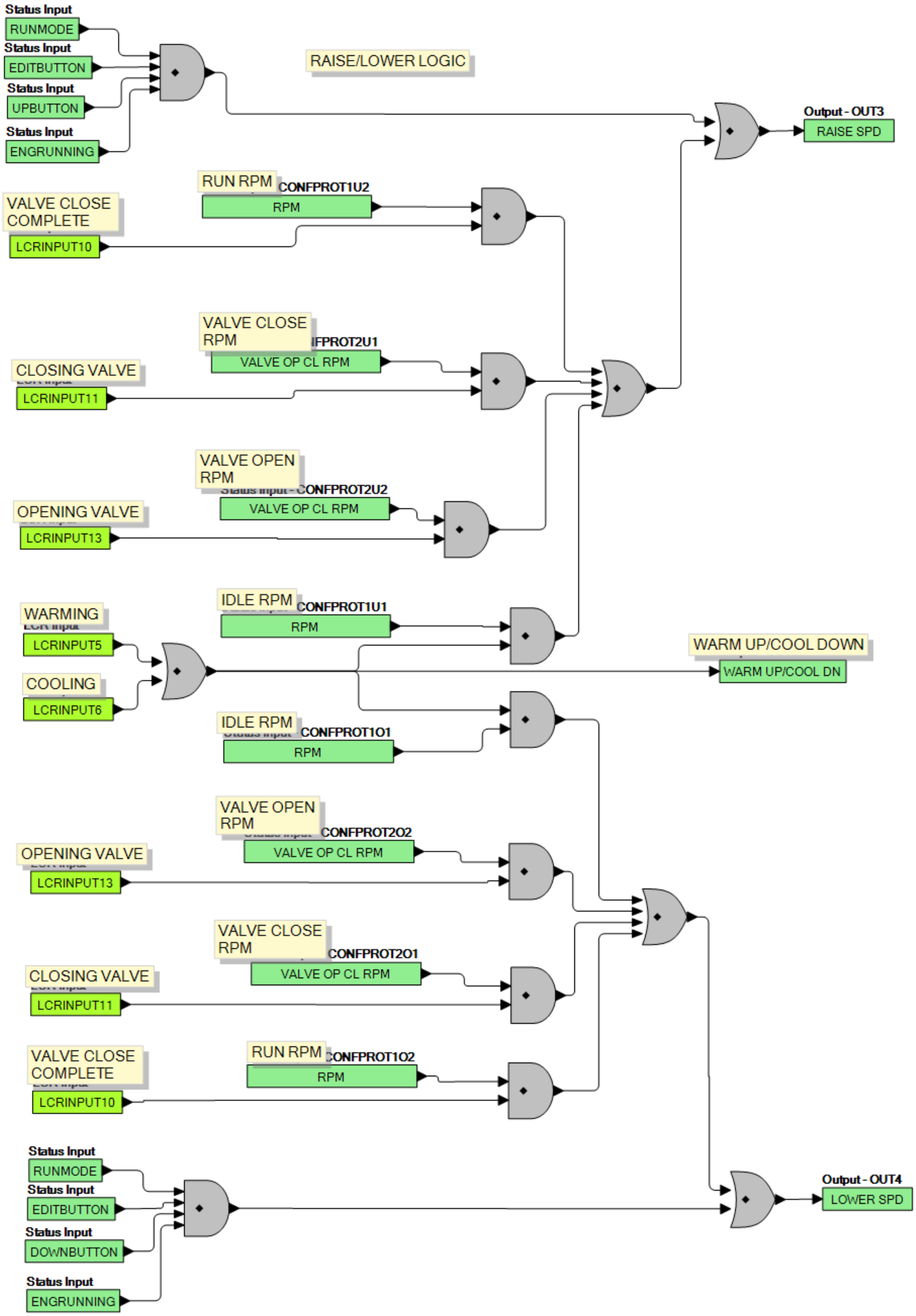

Figure B-21. Logic Library File #7 Main Logic (3 of 3)

Maintain Speed with Contact Feedback Valve Control with Pulsed Outputs (Logic Library File #8)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timers 5 and 6 specify the on and off times for the raise and lower outputs. Raise and Lower outputs are pulsed in this scheme. Pulsed schemes are used when the engine's slew rate on the throttle is too high when a constant raise or lower input is applied. The pulsing effectively implements a lower slew rate.
3. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
4. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
5. Logic Timer 3 specifies the duration of engine warm up in Step 4.
6. Configurable Protection Element 2, Threshold 1 specifies the RPM that the engine should be held at while the valve is being closed. The machine remains in this state until it receives a closure on Contact Input 5 indicating a closed valve.
7. Configurable Protection Element 1, Threshold 2 specifies the upper speed limit that the engine should maintain during normal operation.
8. Configurable Protection Element 2, Threshold 2 specifies the RPM that the engine should slow down to while the valve is being opened. This takes place when the engine is no longer required to run. The machine remains in this state until it receives a closure on Contact Input 6 indicating an open valve.
9. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
10. Logic Timer 4 specifies the duration of engine cool down in Step 9.

After cooldown, the machine shuts down and remains ready to be activated the next time is receives a start indication.

Refer to Figures B-22 through B-24 for main logic diagrams of Logic Library File #8.

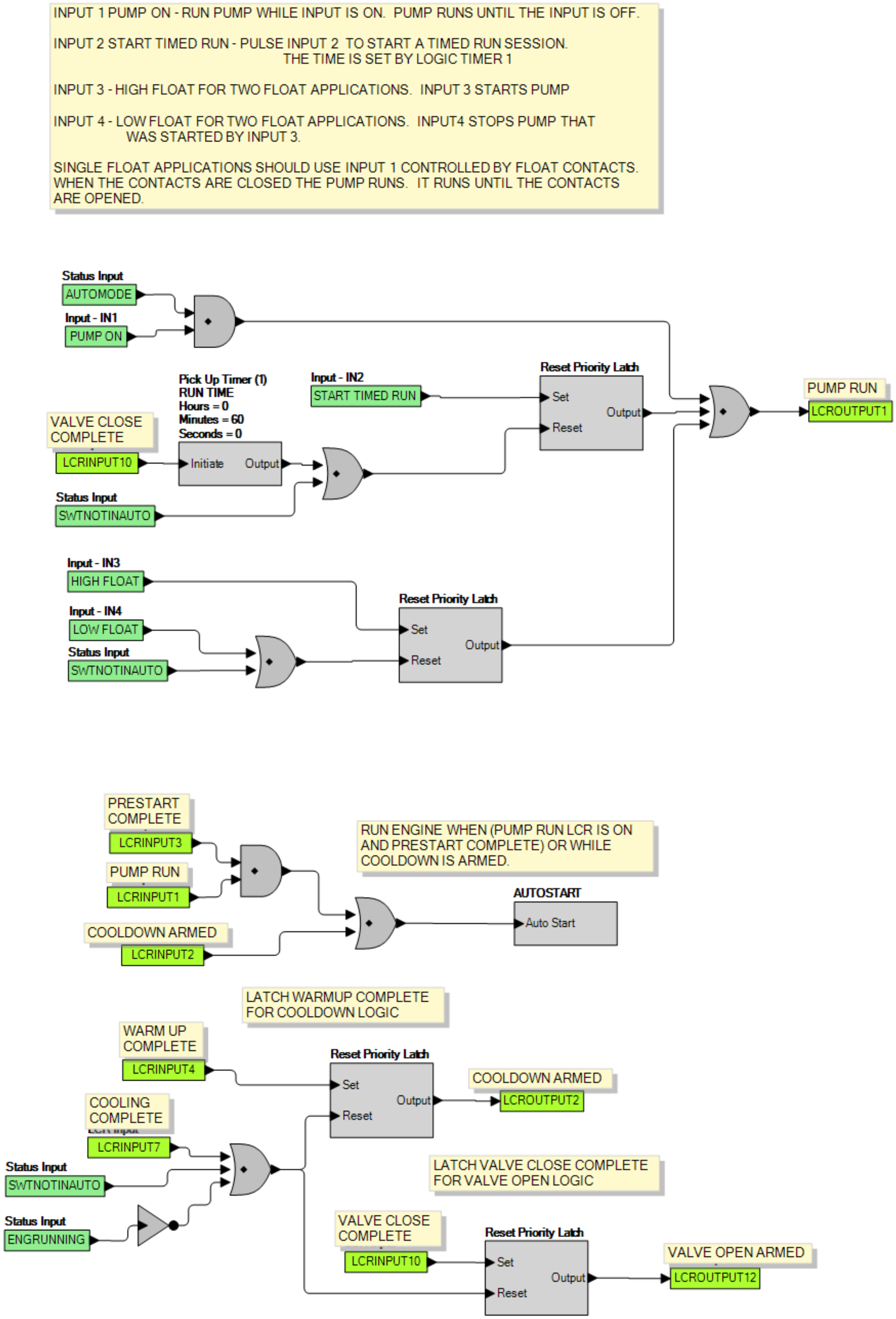

Figure B-22. Logic Library File #8 Main Logic (1 of 3)

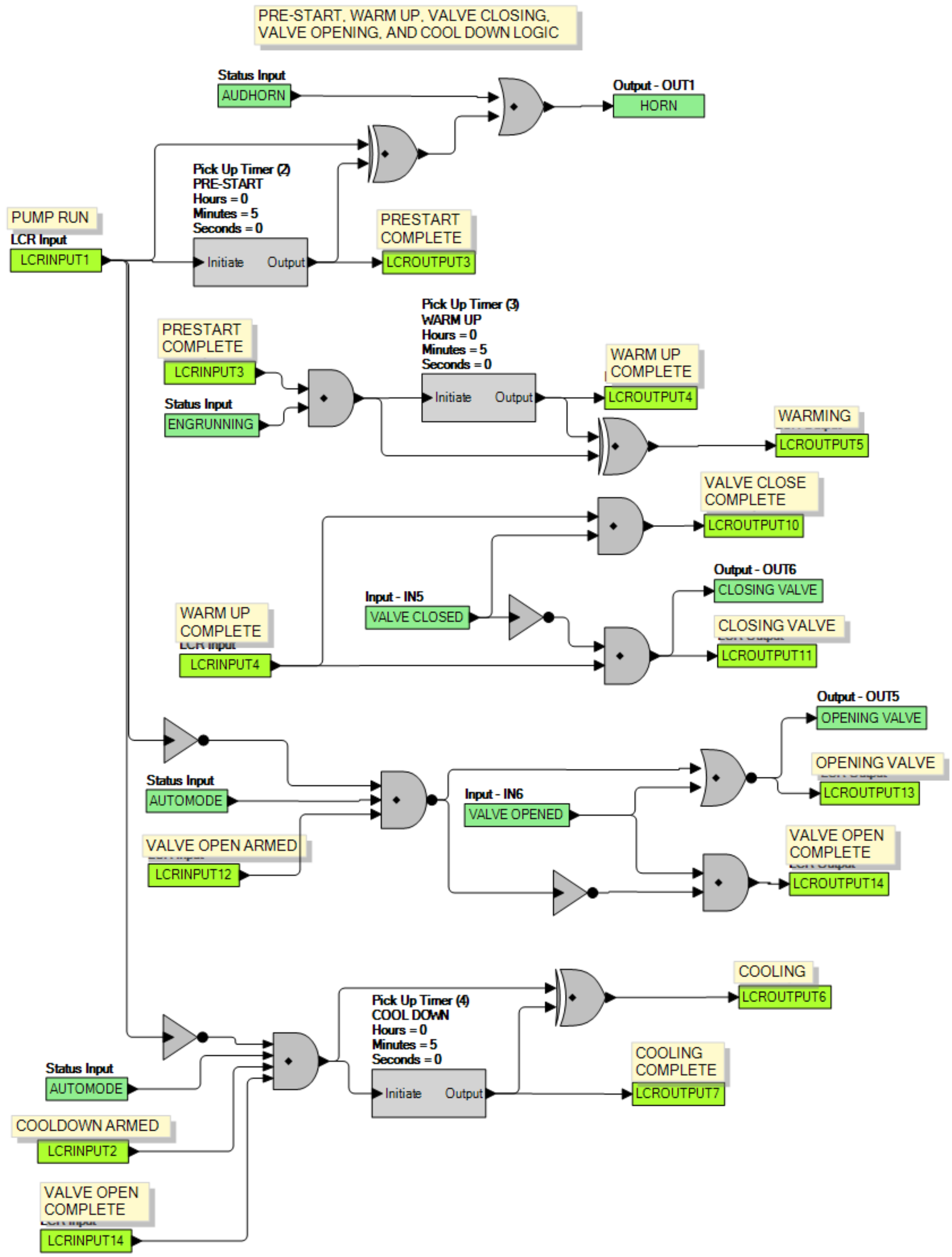

Figure B-23. Logic Library File #8 Main Logic (2 of 3)

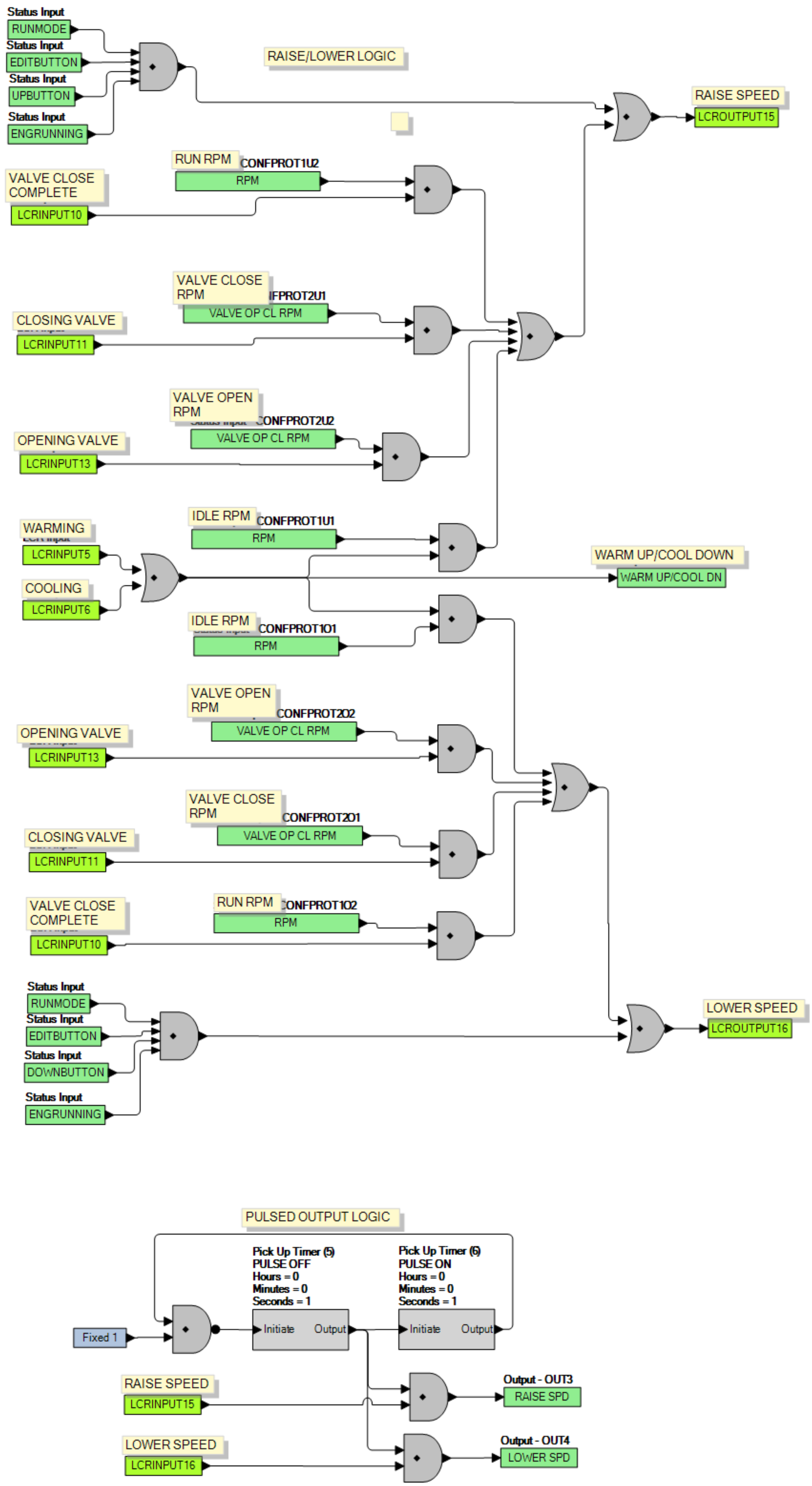

Figure B-24. Logic Library File #8 Main Logic (3 of 3)

Maintain Pressure with Time Based Valve Control and Constant Outputs (Logic Library File #9)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
3. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
4. Logic Timer 3 specifies the duration of engine warm up in Step 3.
5. Configurable Protection Element 2, Threshold 1 specifies the RPM that the engine should be held at while the valve is being closed.
6. Logic Timer 5 specifies the duration of the valve closing process in Step 5.
7. Contact Input 5 (Low Pressure Input) and Contact Input 6 (High Pressure Input) specify the upper and lower limits that the engine should stay between during normal operation.
8. Configurable Protection Element 2, Threshold 2 specifies the RPM that the engine should slow down to while the valve is being opened. This takes place when the engine is no longer required to run.
9. Logic Timer 6 specifies the duration of the valve opening process in Step 8.
10. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
11. Logic Timer 4 specifies the duration of engine cool down in Step 10.

After cooldown, the machine shuts down and remains ready to be activated the next time is receives a start indication.

Refer to Figures B-25 through B-27 for main logic diagrams of Logic Library File #9.

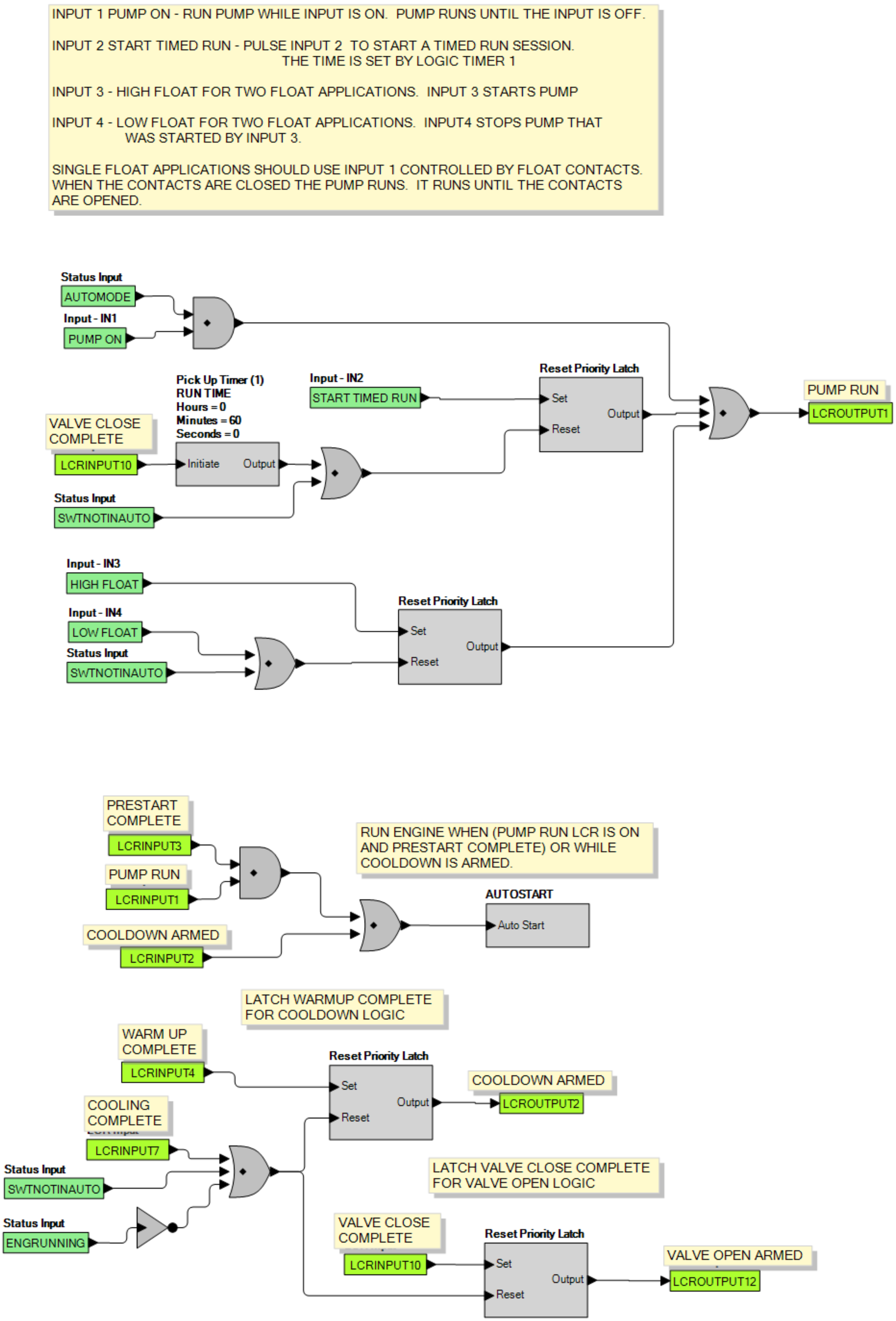

Figure B-25. Logic Library File #9 Main Logic (1 of 3)

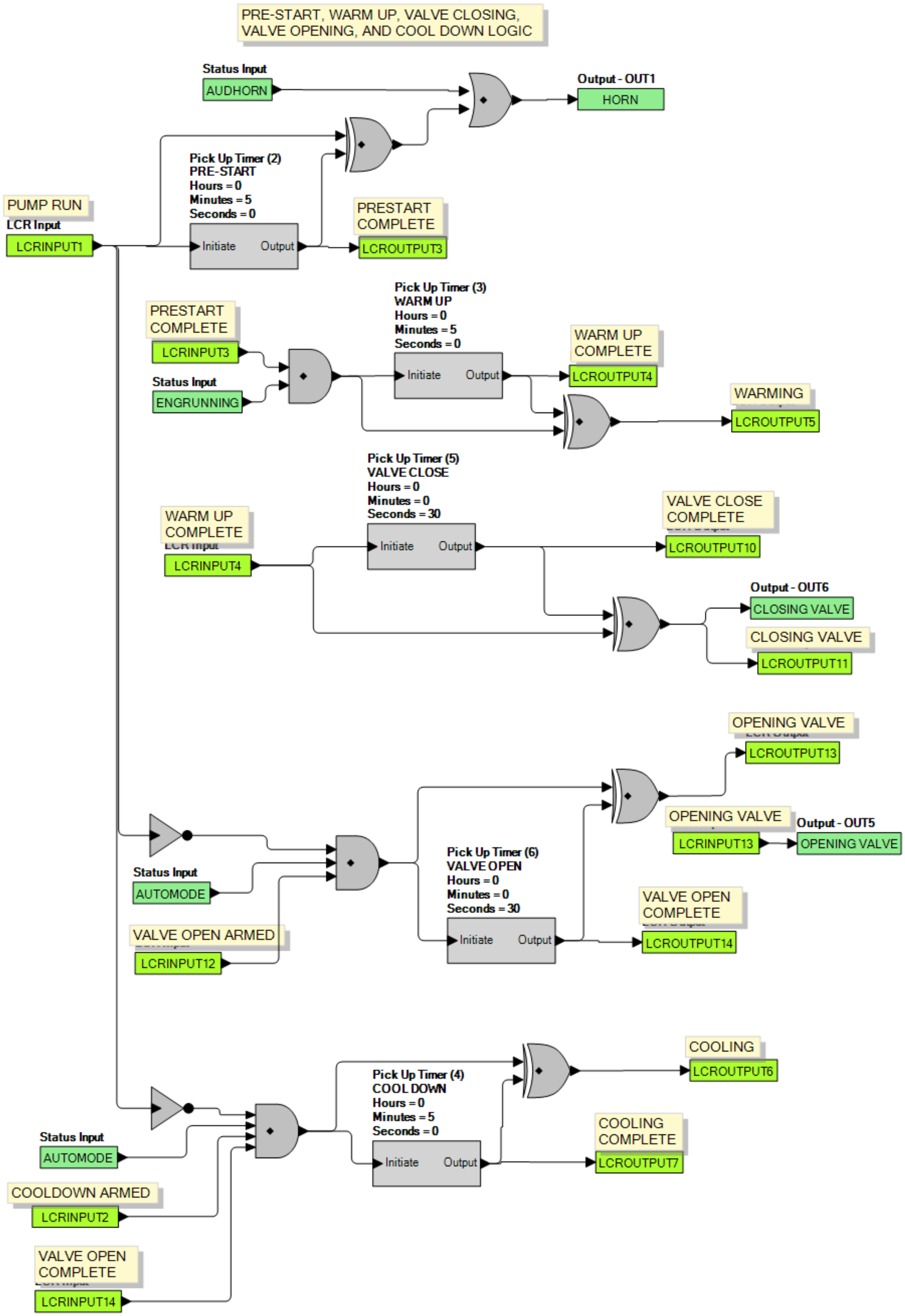

Figure B-26. Logic Library File #9 Main Logic (2 of 3)

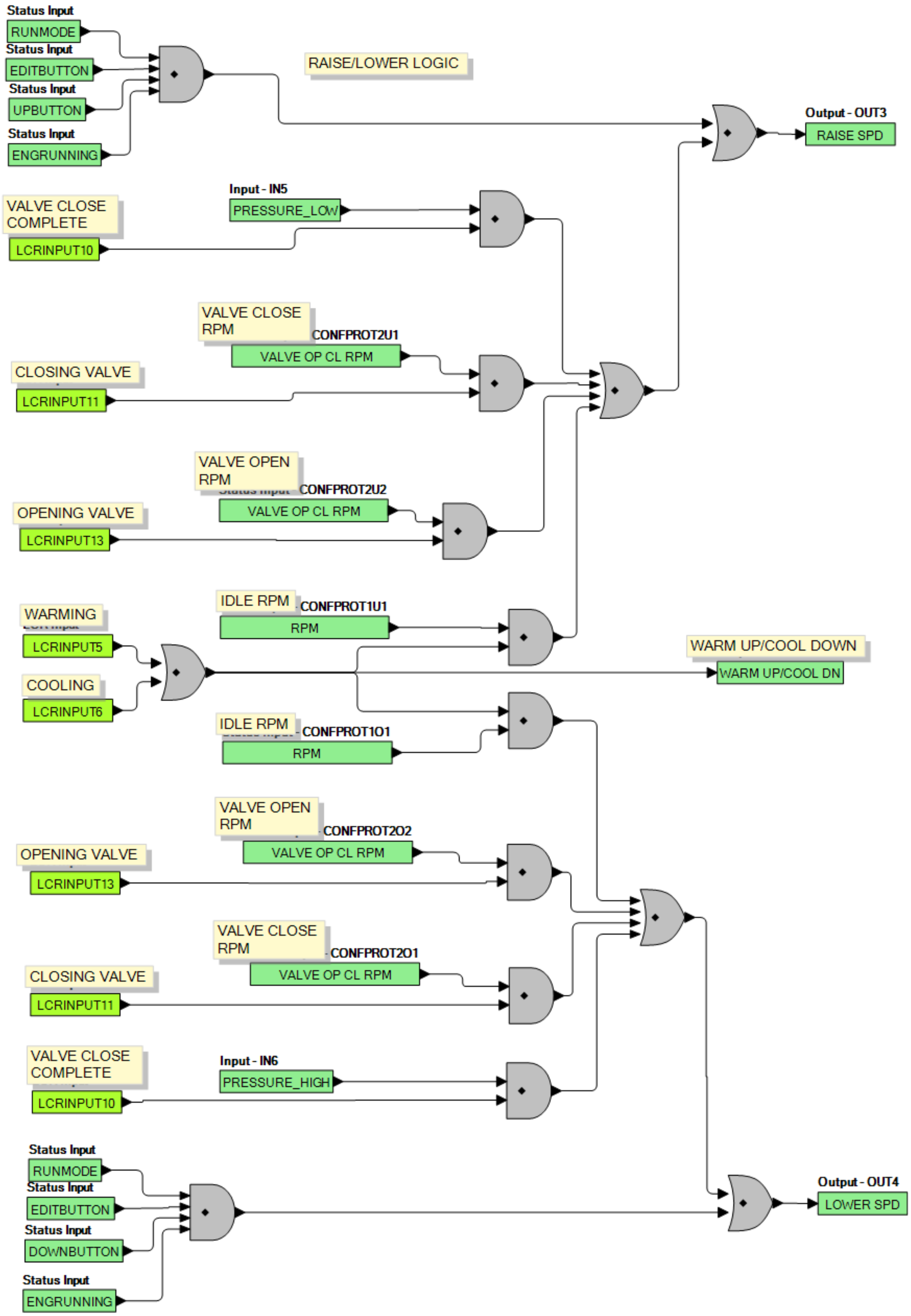

Figure B-27. Logic Library File #9 Main Logic (3 of 3)

Maintain Pressure with Time Based Valve Control and Pulsed Outputs (Logic Library File #10)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timers 7 and 8 specify the on and off times for the raise and lower outputs. Raise and Lower outputs are pulsed in this scheme. Pulsed schemes are used when the engine's slew rate on the throttle is too high when a constant raise or lower input is applied. The pulsing effectively implements a lower slew rate.
3. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
4. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
5. Logic Timer 3 specifies the duration of engine warm up in Step 4.
6. Configurable Protection Element 2, Threshold 1 specifies the RPM that the engine should be held at while the valve is being closed.
7. Logic Timer 5 specifies the duration of the valve closing process in Step 6.
8. Contact Input 5 (Low Pressure Input) and Contact Input 6 (High Pressure Input) specify the upper and lower limits that the engine should stay between during normal operation.
9. Configurable Protection Element 2, Threshold 2 specifies the RPM that the engine should slow down to while the valve is being opened. This takes place when the engine is no longer required to run.
10. Logic Timer 6 specifies the duration of the valve opening process in Step 9.
11. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
12. Logic Timer 4 specifies the duration of engine cool down in Step 10.

After cooldown, the machine shuts down and remains ready to be activated the next time is receives a start indication.

Refer to Figures B-28 through B-30 for main logic diagrams of Logic Library File #10.

INPUT 1 PUMP ON - RUN PUMP WHILE INPUT IS ON. PUMP RUNS UNTIL THE INPUT IS OFF.

INPUT 2 START TIMED RUN - PULSE INPUT 2 TO START A TIMED RUN SESSION.
THE TIME IS SET BY LOGIC TIMER 1

INPUT 3 - HIGH FLOAT FOR TWO FLOAT APPLICATIONS. INPUT 3 STARTS PUMP

INPUT 4 - LOW FLOAT FOR TWO FLOAT APPLICATIONS. INPUT4 STOPS PUMP THAT
WAS STARTED BY INPUT 3.

SINGLE FLOAT APPLICATIONS SHOULD USE INPUT 1 CONTROLLED BY FLOAT CONTACTS.
WHEN THE CONTACTS ARE CLOSED THE PUMP RUNS. IT RUNS UNTIL THE CONTACTS
ARE OPENED.

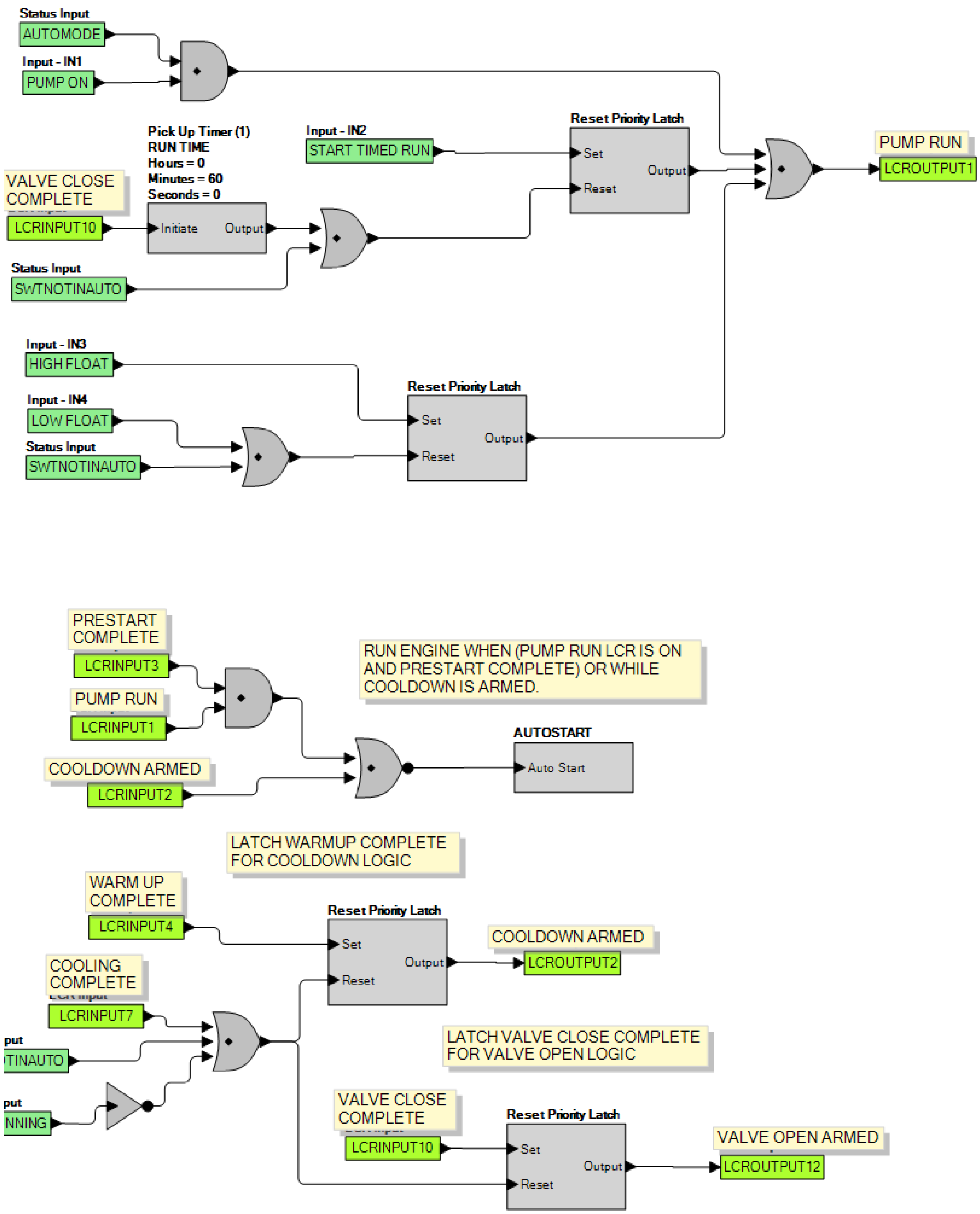

Figure B-28. Logic Library File #10 Main Logic (1 of 3)

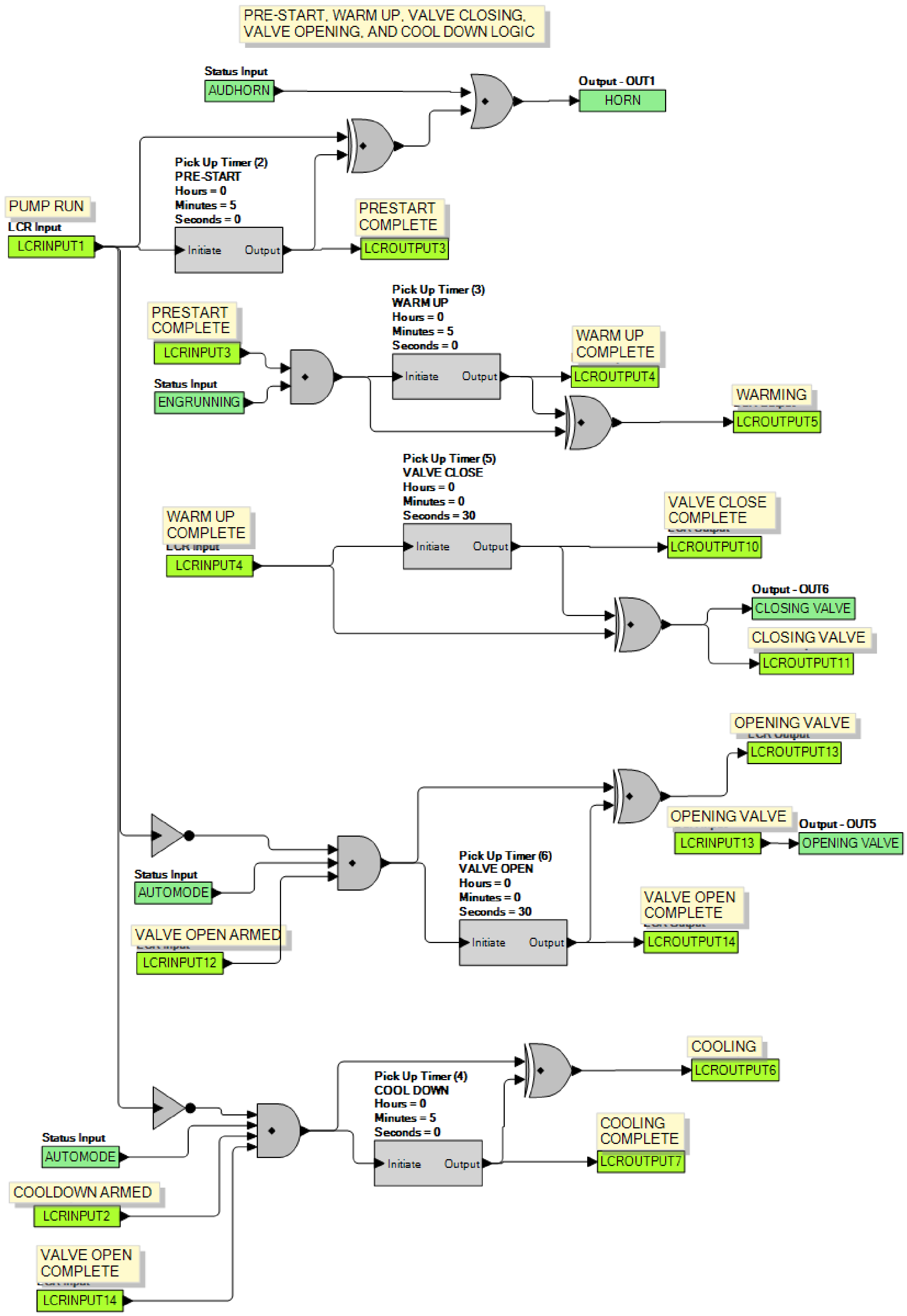

Figure B-29. Logic Library File #10 Main Logic (2 of 3)

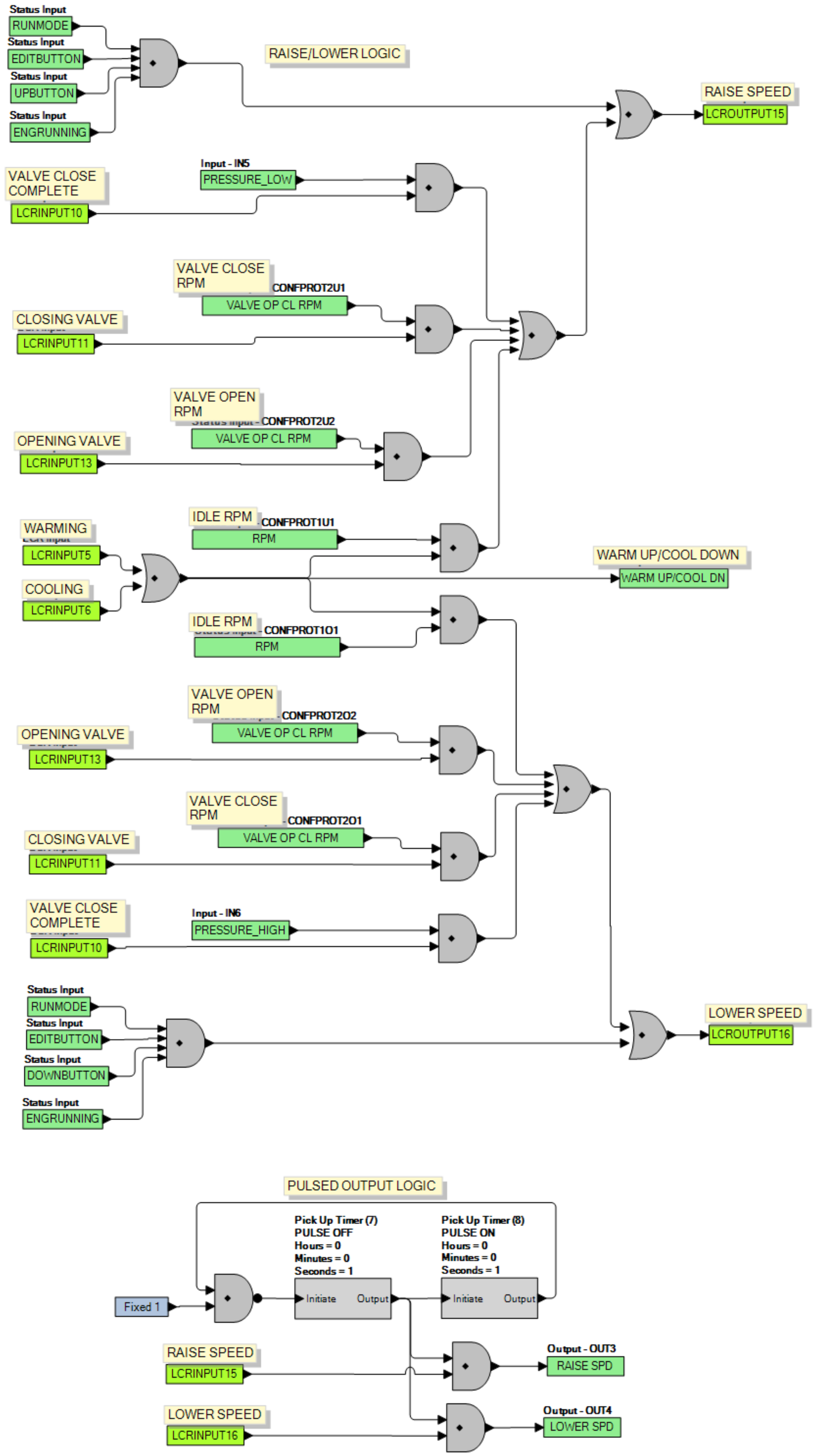

Figure B-30. Logic Library File #10 Main Logic (3 of 3)

Maintain Pressure with Contact Feedback Valve Control with Constant Outputs (Logic Library File #11)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
3. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
4. Logic Timer 3 specifies the duration of engine warm up in Step 3.
5. Configurable Protection Element 2, Threshold 1 specifies the RPM that the engine should be held at while the valve is being closed. The machine remains in this state until it receives a closure on Contact Input 5 indicating a closed valve.
6. Contact Input 5 (Low Pressure Input) and Contact Input 6 (High Pressure Input) specify the upper and lower limits that the engine should stay between during normal operation.
7. Configurable Protection Element 2, Threshold 2 specifies the RPM that the engine should slow down to while the valve is being opened. This takes place when the engine is no longer required to run. The machine remains in this state until it receives a closure on Contact Input 6 indicating an open valve.
8. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
9. Logic Timer 4 specifies the duration of engine cool down in Step 8.

After cooldown, the machine shuts down and remains ready to be activated the next time is receives a start indication.

Refer to Figures B-31 through B-33 for main logic diagrams of Logic Library File #11.

INPUT 1 PUMP ON - RUN PUMP WHILE INPUT IS ON. PUMP RUNS UNTIL THE INPUT IS OFF.

INPUT 2 START TIMED RUN - PULSE INPUT 2 TO START A TIMED RUN SESSION.
THE TIME IS SET BY LOGIC TIMER 1

INPUT 3 - HIGH FLOAT FOR TWO FLOAT APPLICATIONS. INPUT 3 STARTS PUMP

INPUT 4 - LOW FLOAT FOR TWO FLOAT APPLICATIONS. INPUT4 STOPS PUMP THAT
WAS STARTED BY INPUT 3.

SINGLE FLOAT APPLICATIONS SHOULD USE INPUT 1 CONTROLLED BY FLOAT CONTACTS.
WHEN THE CONTACTS ARE CLOSED THE PUMP RUNS. IT RUNS UNTIL THE CONTACTS
ARE OPENED.

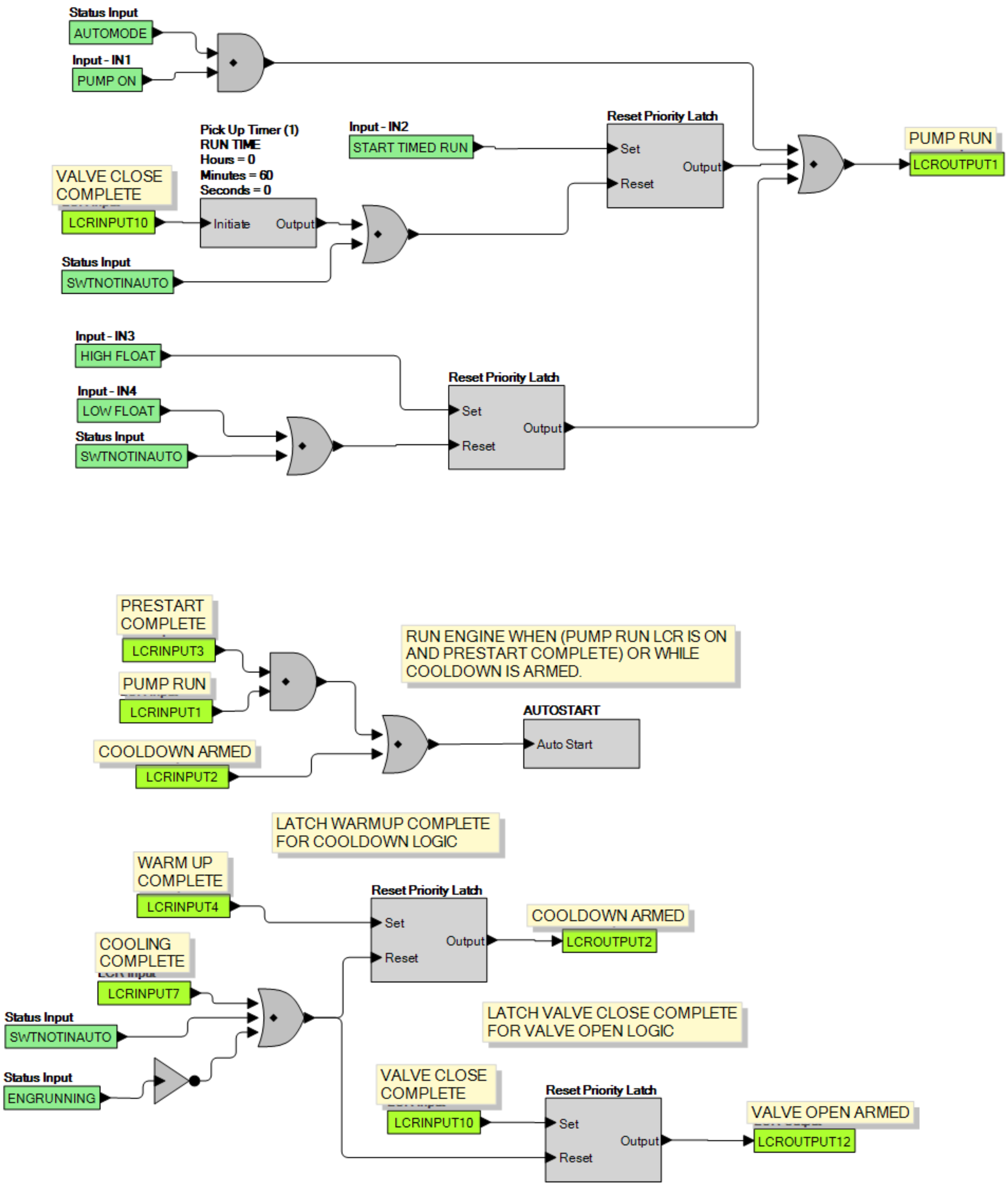

Figure B-31. Logic Library File #11 Main Logic (1 of 3)

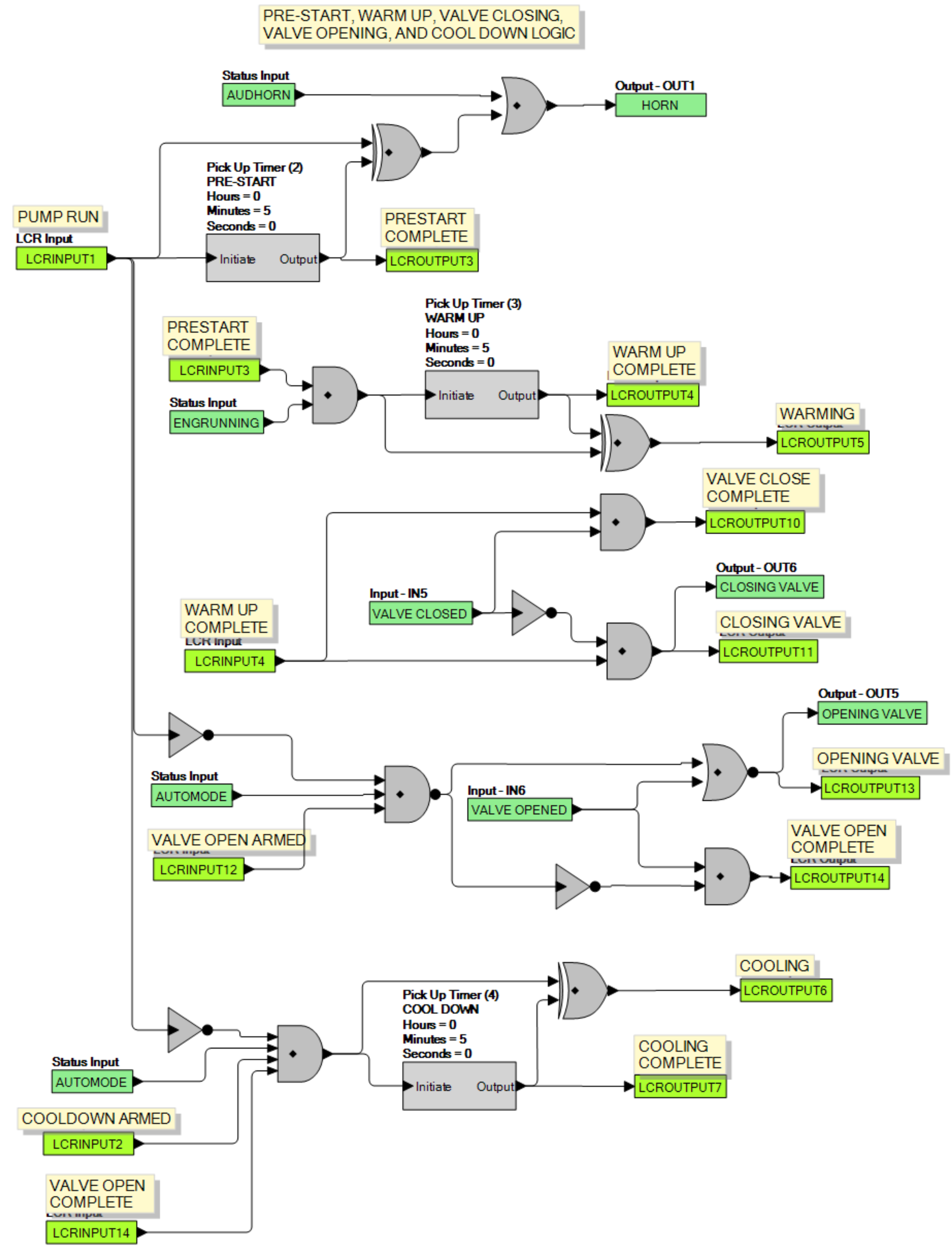

Figure B-32. Logic Library File #11 Main Logic (2 of 3)

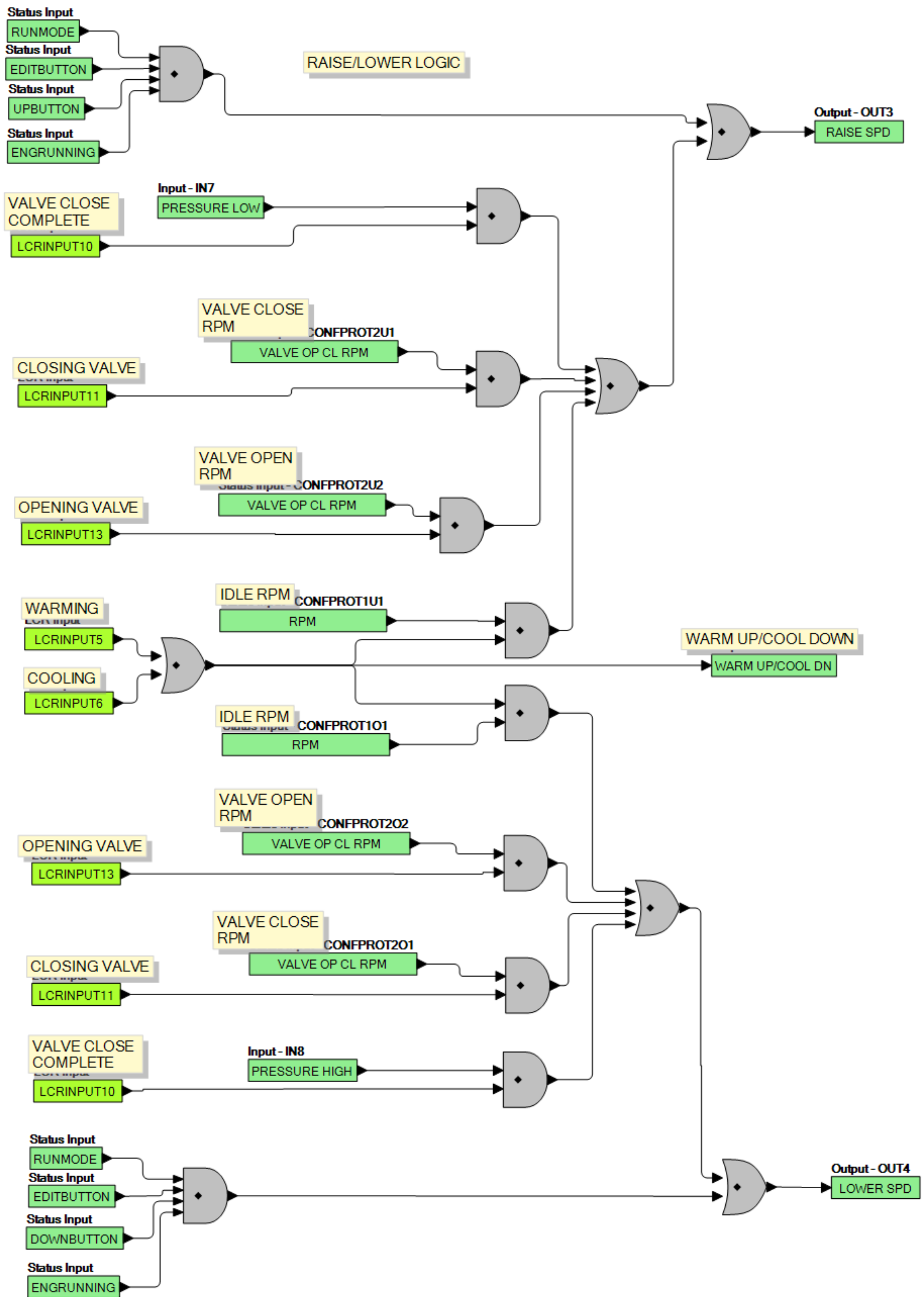

Figure B-33. Logic Library File #11 Main Logic (3 of 3)

Maintain Pressure with Contact Feedback Valve Control with Pulsed Outputs (Logic Library File #12)

1. Logic Timer 1 specifies the duration of the run session when a time based AUTO STOP scheme is desired.
2. Logic Timers 5 and 6 specify the on and off times for the raise and lower outputs. Raise and Lower outputs are pulsed in this scheme. Pulsed schemes are used when the engine's slew rate on the throttle is too high when a constant raise or lower input is applied. The pulsing effectively implements a lower slew rate.
3. Logic Timer 2 specifies the duration of horn annunciation during engine startup.
4. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to warm up.
5. Logic Timer 3 specifies the duration of engine warm up in Step 4.
6. Configurable Protection Element 2, Threshold 1 specifies the RPM that the engine should be held at while the valve is being closed. The machine remains in this state until it receives a closure on Contact Input 5 indicating a closed valve.
7. Contact Input 5 (Low Pressure Input) and Contact Input 6 (High Pressure Input) specify the upper and lower limits that the engine should stay between during normal operation.
8. Configurable Protection Element 2, Threshold 2 specifies the RPM that the engine should slow down to while the valve is being opened. This takes place when the engine is no longer required to run. The machine remains in this state until it receives a closure on Contact Input 6 indicating an open valve.
9. Configurable Protection Element 1, Threshold 1 specifies the RPM that the engine should run at idle to cool down.
10. Logic Timer 4 specifies the duration of engine cool down in Step 9.

After cooldown, the machine shuts down and remains ready to be activated the next time is receives a start indication.

Refer to Figures B-34 through B-36 for main logic diagrams of Logic Library File #12.

INPUT 1 PUMP ON - RUN PUMP WHILE INPUT IS ON. PUMP RUNS UNTIL THE INPUT IS OFF.

INPUT 2 START TIMED RUN - PULSE INPUT 2 TO START A TIMED RUN SESSION.
THE TIME IS SET BY LOGIC TIMER 1

INPUT 3 - HIGH FLOAT FOR TWO FLOAT APPLICATIONS. INPUT 3 STARTS PUMP

INPUT 4 - LOW FLOAT FOR TWO FLOAT APPLICATIONS. INPUT4 STOPS PUMP THAT
WAS STARTED BY INPUT 3.

SINGLE FLOAT APPLICATIONS SHOULD USE INPUT 1 CONTROLLED BY FLOAT CONTACTS.
WHEN THE CONTACTS ARE CLOSED THE PUMP RUNS. IT RUNS UNTIL THE CONTACTS
ARE OPENED.

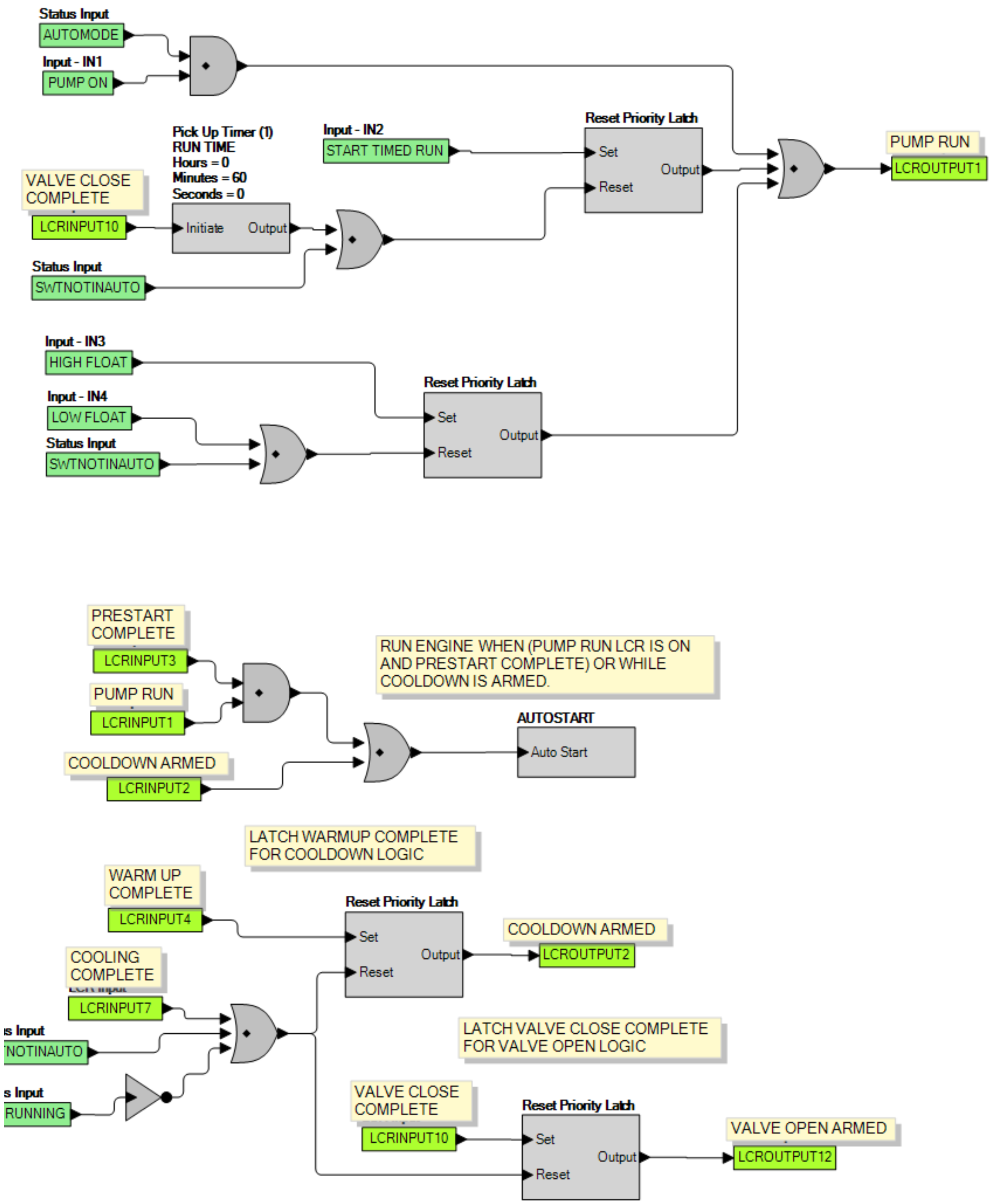

Figure B-34. Logic Library File #12 Main Logic (1 of 3)

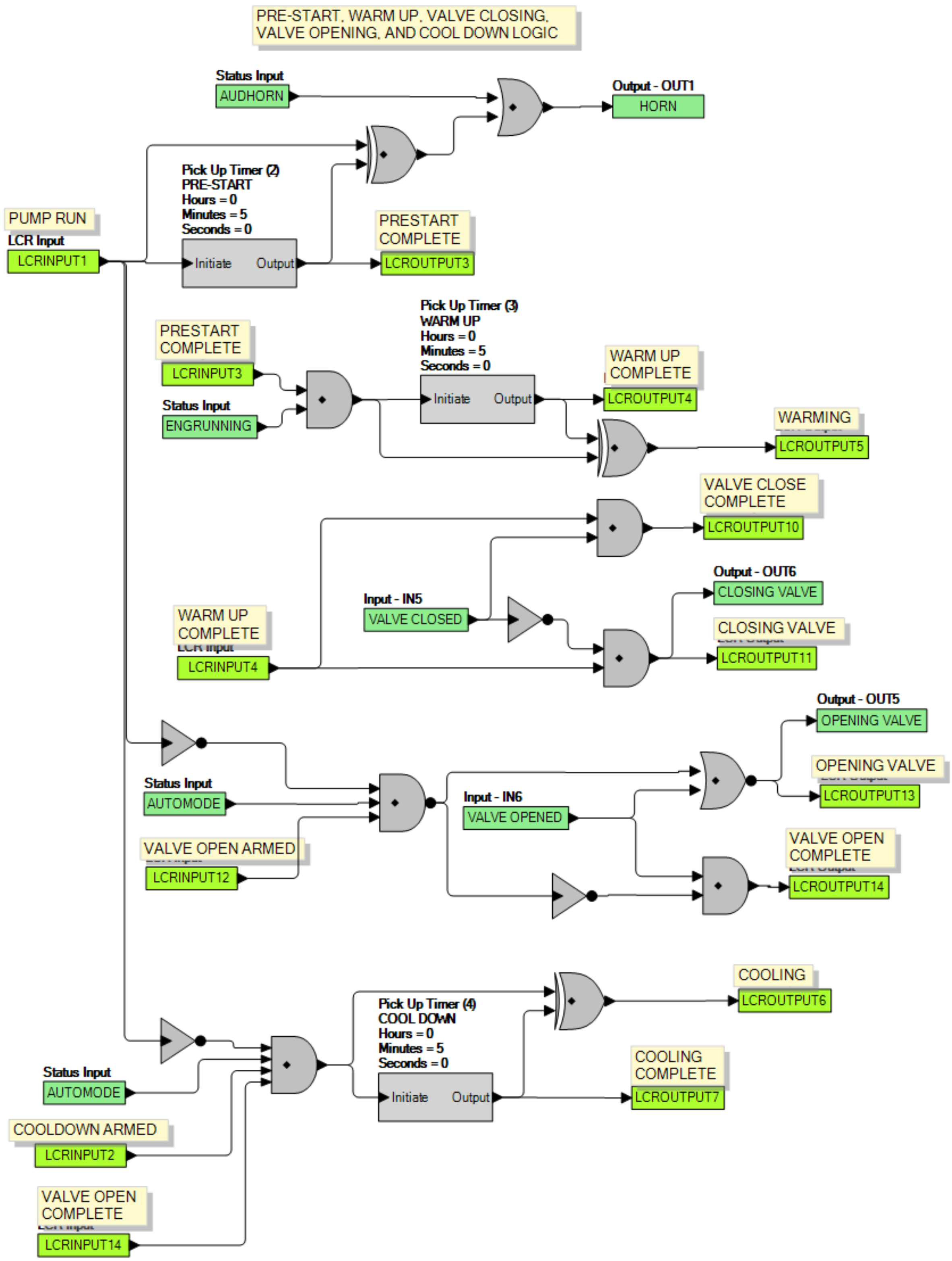

Figure B-35. Logic Library File #12 Main Logic (2 of 3)

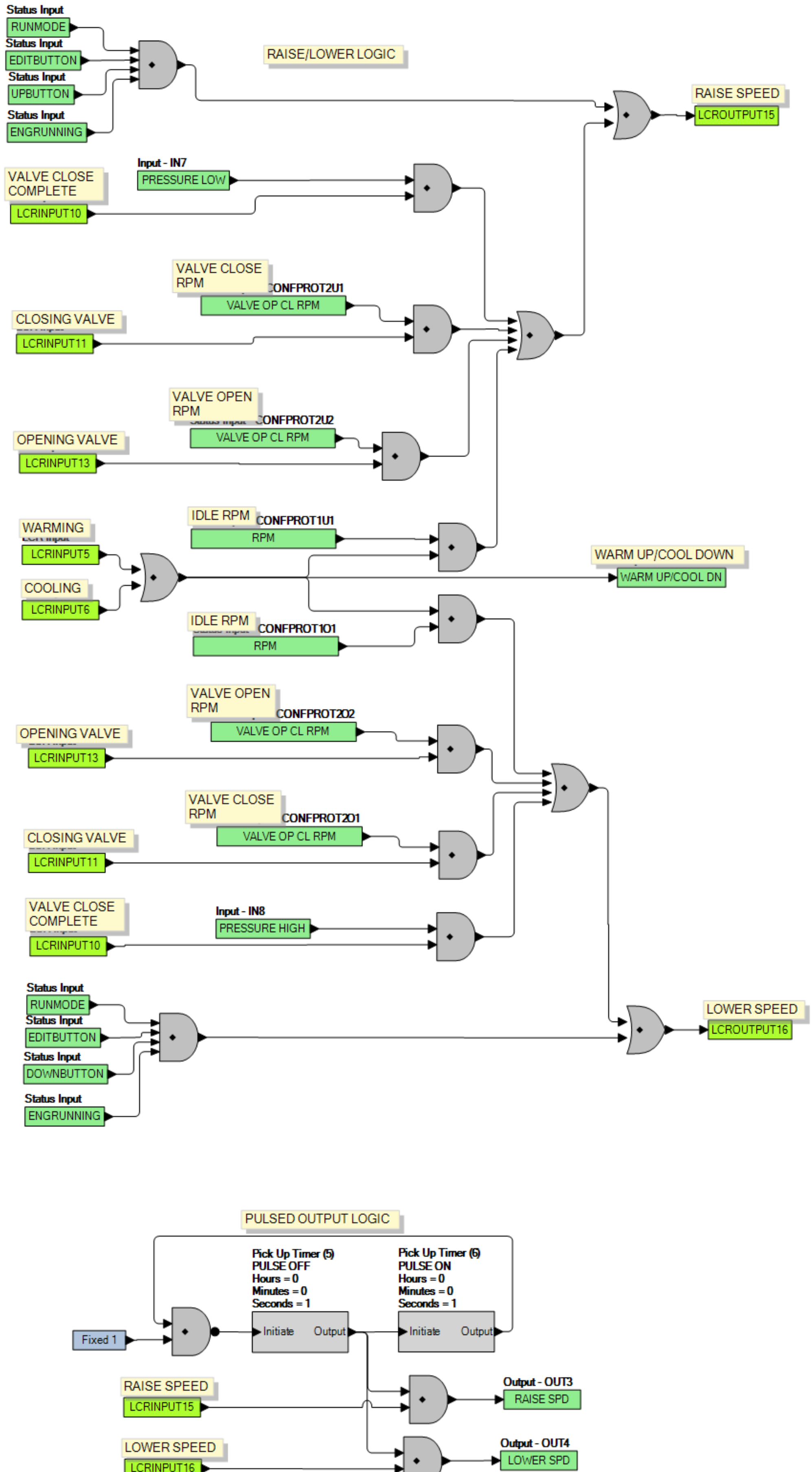

Figure B-36. Logic Library File #12 Main Logic (3 of 3)

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