CATTRON

CANplus™ CP1000

Control Panel Operation Manual

9M02-1000-A059-EN

CONNECT. CONTROL. PROTECT.

Revision History

VERSION	DATE	NOTES
1.0	12/2019	
2.0	12/2020	Document rebranded and contact information updated

Contents

1 Important Safety and Emissions Information

1.1 Safety Notation

This manual uses the following conventions to present IMPORTANT SAFETY INFORMATION to you. Please read and follow ALL SAFETY INSTRUCTIONS.

	**WARNING**
	IMPORTANT AND URGENT SAFETY INFORMATION – A HAZARD THAT WILL, IF NOT AVOIDED, CAUSE SERIOUS INJURY OR LOSS OF LIFE.

	**CAUTION**
	IMPORTANT SAFETY INFORMATION – A HAZARD THAT MIGHT CAUSE SERIOUS INJURY OR LOSS OF LIFE.

Note: Additional Important Information

1.2 Safety Instructions

Please read and follow all safety instructions.

	**CAUTION**
	THIS DOCUMENT MUST BE COMPLETELY READ AND UNDERSTOOD PRIOR TO INSTALLING, TESTING OR OPERATING THE EQUIPMENT DESCRIBED WITHIN. FURTHER, THIS DOCUMENT MUST BE RETAINED FOR CURRENT AND FUTURE USERS OF THIS EQUIPMENT. FAILURE TO STRICTLY FOLLOW THE WARNINGS AND DANGERS PRESENTED WITHIN THIS DOCUMENT COULD RESULT IN DAMAGE TO EQUIPMENT, DAMAGE TO PROPERTY, BODILY INJURY OR DEATH.

	**CAUTION**
	CANPLUS™ PRODUCTS ARE NOT DESIGNED OR APPROVED FOR USE AS CRITICAL COMPONENTS OF ANY SAFETY DEVICE OR SYSTEM THAT IS INTENDED TO PREVENT BODILY INJURY, PROTECT LIFE OR PREVENT PROPERTY DAMAGE.

	**CAUTION**
	THE SPECIFYING ORIGINAL EQUIPMENT MANUFACTURER (OEM) AND/OR INSTALLER OF ANY CANPLUS™ PANEL IS RESPONSIBLE FOR ALL SAFETY LABELING AND OPERATOR EDUCATION REGARDING THE SAFE OPERATION OF THIS PANEL AND THE OPERATION OF THE SPECIFIC MACHINE THAT THIS PANEL IS INSTALLED UPON, INCLUDING CONFORMANCE TO EXHAUST EMISSIONS REGULATIONS.

⚠	**CAUTION** CANPLUS™ PRODUCTS ARE NOT DESIGNED FOR, OR INTENDED FOR USE ON, APPLICATIONS REQUIRING EXPLOSIVE PROOF COMPONENTS. FURTHER, CANPLUS™ PRODUCTS ARE NOT DESIGNED FOR, OR INTENDED FOR APPLICATION WITHIN, HAZARDOUS OR EXPLOSIVE ENVIRONMENTS.

⚠	**CAUTION** THE INSTALLER OF THIS CANPLUS™ PRODUCT IS SOLELY RESPONSIBLE FOR ENSURING THAT ALL OSHA, ANSI, CE OR OTHER APPLICABLE STANDARDS ARE MET WITH RESPECT TO CANPLUS™ PANEL APPLICABILITY, MACHINE GUARDING, GENERAL SAFETY GUIDELINES, LABELING AND WARNINGS.

⚠	**CAUTION** THE INSTALLER OF THIS CANPLUS™ PANEL AND/OR CANPLUS™ HARNESS IS RESPONSIBLE FOR THE CORRECT SIZING AND INTEGRATION OF A SUITABLE FUSE/BREAKER ON THE UNSWITCHED DC CIRCUIT SUPPLYING POWER TO THE CANPLUS™ PANEL.

⚠	**CAUTION** ONLY TRAINED AND QUALIFIED PERSONS MAY PERFORM INSTALLATION, TESTING, SERVICE OR REPAIR WORK ON THE CANPLUS™ PRODUCT.

Note: The seller hereby expressly disclaims all warranties, either expressed or implied, including any implied warranty of merchantability or fitness for a particular purpose, and neither assumes nor authorizes any other person to assume for it any liability in connection with the sale of such products.

1.3 Auxiliary Engine Stop Disclaimer

This panel or harness may include an optional Auxiliary Engine Stop feature. **Please note that the Auxiliary Engine Stop feature is NOT intended to function as the machine/equipment Emergency Stop or to be purposed as an Emergency Stop for safety purposes.** The machine manufacturer must provide a separate Emergency Stop switch to meet safety mandates or emergency machine shutdown functionality. The sole design intent of the Auxiliary Engine Stop feature is to provide for engine shutdown in the event of a keyswitch malfunction. The panel key/lever switch should always be used as the primary engine shutdown method.

1.4 General Emissions Disclaimer

This panel may include provision(s) for operator input such as FORCE REGENERATION, INHIBIT REGENERATION, INTERLOCK and others specific to US and International emissions regulations. Responsibility for emissions-related inputs and compliance with emissions regulations is solely that of the owner and/or operator of the machine/engine on which this panel is connected.

1.5 Exhaust Emissions Compliance Disclaimer

This panel is equipped with operator-programmable parameters. The engine/machine as a function of the emissions system can/could initiate, via the engine ECU (Engine Control Unit), certain required emissions operations such as regeneration of the DPF (Diesel Particulate Filter), or other emissions system maintenance, while the engine is running. The owner/operator of the engine/machine is solely responsible for any adverse effects or damage to the engine, engine emissions system or other damage that could occur as a result of starting or stopping the engine/machine during any ECU initiated emissions event.

2 Overview

The CANplus™ CP1000 control panel is a manual and autostart platform for EPA Tier 3, EPA Tier 4 (interim), EPA Tier 4 and EU Stage V electronically governed diesel or natural gas engines. It can also control mechanically governed diesel engines. Graphical quad-gauge pages are displayed on the 4.3” diagonal WQVGA (480x272 pixels) LCD. Virtually any SAE J1939 parameter reported by the ECU (Engine Control Unit) can be displayed, including, but not limited to the following: RPM, coolant temperature, oil pressure, engine hours, voltage, exhaust emissions system state and diagnostic codes. The backlit display is clearly readable in both bright sunlight and total darkness and is housed in a rugged IP66 rated housing. The CP1000 has three bright LEDs to indicate Faults and Warnings, Emission-Related Alerts and Autostart active. The Panel has five display keys that are associated with the dynamic Display Key bar as well as eight control buttons.

The CP1000 panel features advanced automatic start/stop control which can meet almost any requirement. Building on the functionality of the CP750 series platform, this next generation panel offers many new start/stop modes using a very powerful, yet easily configured Event Manager, which can start or stop based on any of the eight digital inputs, six 4-20 mA analog transducer inputs, Real Time Clock, or combinations of date/time and analog or digital inputs. With the use of a transducer, the panel has a “cruise control” feature that automatically throttles the engine to maintain a configurable level. The panel can be configured to use any one of the transducer inputs for the maintain/cruise control feature, regardless of whether that input is also being used as a start or stop event.

All components are installed in a heavy-duty, vibration-isolated metal or NEMA-rated plastic enclosure designed to withstand the most extreme industrial applications. External weather-resistant switches and controls facilitate convenient operator inputs/controls. Active fault conditions are displayed in plain language on popup messages and can be viewed in the fault list. Various diagnostic screens allow detailed investigation of the CAN bus data stream.

All diagnostic and emissions-related messages displayed on the CP1000 are generated by the engine ECU or other attached devices. The operator must be familiar with the engine manufacturer ECU messages and icons in order to react accordingly with respect to emissions compliance, service and diagnostic message response.

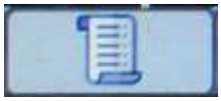
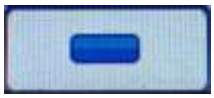
3 Display

The CANplus™ display is a robust, sunlight-viewable 4.3” WQVGA color display with five integrated backlit display buttons and eight large control buttons housed in a rugged, water-tight IP66 rated enclosure. The five display keys simplify and enhance the user interface by providing positive tactile feedback when pressed. The display can show virtually any SAE J1939 parameter reported by the ECU, including RPM, engine temperature, oil pressure and diagnostic codes. It can be easily configured to customer preference, including gauge type (analog or digital), gauge arrangements, gauge size, units and language.

Note: Different software versions may have slightly different displays.

3.1 Button Bar

Pressing any of the first five soft keys on the display will prompt the “button bar” key function legend to appear at the bottom of the display above the keys. The button bar will show an icon above the button which corresponds to its current function, as shown below.

Button 1	Button 2	Button 3	Button 4	Button 5
				
Analog Gauge Pages Each press cycles through the four pages of analog gauges	**Digital Gauge Pages** Displays the Database Viewer	**Single Analog Gauge** Displays Emission Control menus	**Active Alarm Page** Displays active alarms including plain language description	**Menus** Opens Menus

3.2 Gauge Pages

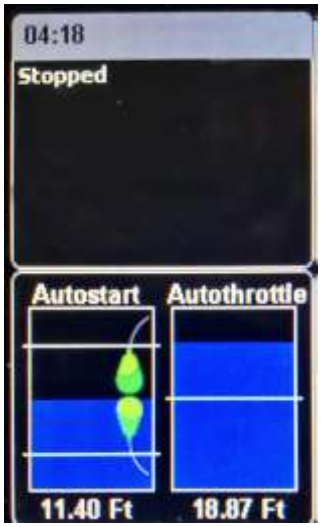
There are four independently configurable pages of analog gauges. To enable Analog Gauge Pages, press any of the first four buttons to show the top level button bar and then press button 1 to cycle through the pages. The current page is indicated by the number in the center of the screen, as shown below.

Note: Some items like Engine Hours are displayed only as a digital value.

All 16 gauges may be configured to create an application-specific view of the data. With Tech or Admin level access, the four gauge pages can be configured using the following menu: **Configuration → Display → Gauges → Quad Gauge Pages**.

3.3 Status and Autostart Gauge

To the left of the configurable gauges are the Status gauge (top left) and the Autostart gauge (bottom left), as shown below.



The Status gauge shows the status of many of the emissions-related features as well as date, time and signal strength.

The Autostart gauge shows the start and stop events or levels on the left and the maintain/cruise control level on the right.

3.4 Autostart and Throttling Dashboards

3.4.1 Autostart

Click here to view the autostart dashboard video.

When the Dashboard-1 button  is pressed, the display will change to the full screen Autostart dashboard, as shown below.

When the Dashboard-1 button is pressed again, the display will revert back to the gauge page.

3.4.2 Throttling

When the Dashboard-2 button  is pressed, the display will change to the dashboard, as shown below.

Pressing the Dashboard-2 button again will cause the display to revert back to the gauge page.

3.5 Active Alarms

When an active alarm is received, a flashing popup window is overlaid on the current screen. The popup includes a plain language description in addition to the standard SPN/FMI (Suspect Parameter Number/Failure Mode Indicator) pair defined by the SAE J1939 standard. Additionally, if enabled, the beeper sounds as an audible cue.

Note: Standard J1939 abbreviations are used for alarms, as follows:
MS = Most Severe
MOD = Moderately Severe
LS = Least Severe

3.6 Alarm List

The Alarm List is accessed by pressing any button while an alarm popup is displayed or by pressing any of the first four buttons to show the button bar and then button 4. Alarms not yet acknowledged are shown in white text on a red background, while acknowledged alarms are shown in white on black. The list also indicates when the alarm occurred if engine hours are available. The most recent alarm is displayed at the top of the list. The list can be scrolled using buttons 1 and 2 and alarms acknowledged by pressing button 3. The Alarm List can be closed by pressing button 5 once the alarms are acknowledged.

An alarm indicator is displayed near the upper right corner of the display as long as alarms are active. The indicator and alarm messages in the list are automatically removed when the alarm has not been received for a few seconds.

Once an alarm is silenced using the center display button, a QR-code icon will appear on this button. This button provides access to the Equipment Fault Code Diagnostic Information system (additional information is available at www.cattron.com/resources/cattron-patents). Pressing this button again displays a QR-code specific to this alarm. The QR-code can be scanned using the camera on most smart phones. When scanned, the phone will give an option to automatically jump to the RemoteIQ (RiQ) Fault website. The website will automatically pull up the details for this particular fault and list possible remedies.

Note: Only active faults are displayed in the alarm list. Once a fault is corrected, it is automatically removed from the list. To view previously active faults, press the “STORED” button.

3.7 Service Timers

The panel’s display provides 16 service timers to alert the operator of required maintenance. The time interval for each timer can be adjusted in increments of 10 hours. A popup message is displayed after completion of the display’s self-test if a timer (or timers) has expired, alerting the user that service is required. The message is displayed on each power-up until the elapsed timer is disabled or reset. The service timers can have their respective names customized to monitor engine and machine-related parameters. All 16 service timers can be monitored via wireless telemetry.

3.8 Menus

The menu pages can be accessed by pressing button 5. The top-level menu page will then appear. From there the functions of the five display buttons change to allow navigation and selecting and modifying parameters.

Button 1	Button 2	Button 3	Button 4	Button 5
 Scroll Up	 Scroll Down	[Intentionally Blank]	 Go into Selected Submenu	 Return to Previous Menu
		 Decrement Value or Previous Selection	 Increment Value or Next Selection	

3.8.1 Menu Tree

The menu tree is shown below. Some menus items are suppressed based on the access level currently allowed. The color of the text in the tree indicates the minimum access level required for this particular item to be available for displaying.

Black = User

Green = Tech

Red = Admin

Display

- Language
- Units
  - Distance
  - Pressure
  - Volume
  - Temperature
- Gauges

  - Quadrant Page 1-4
    * Top Left
    * Top Right
    * Bottom Left
    * Bottom Right
- Power Timeout

System Setup

- Restore Defaults
- Set Date & Time
- Import Configuration
- Export Configuration
- Load Firmware
- Bootloader Update
- PINs
  - Elevate Access Level
  - Change
  - Entry Off/On
- Engine
- Engine Specific Settings
  - Starter
    * Running Threshold
    * Max Starter On (s)
    * Min Starter On (ms)
    * Dropout RPM
    * Restart Delay (s)
    * Restart Attempts
  - Engine Data Sources
    * Tachometer
    * Engine Hours
    * Coolant Temp
    * Oil Pressure
  - Mechanical Engines
    * Calibrate Tach
    * Actuator Setup
    * Preheat
      · Mode
      · Duration
      · After Glow
      · Enabled During Cranking

  - Yanmar
  - CAT / Perkins
  - [Future Engines]
- About

Telemetry

Emission Control

- Request Force Regen
- Inhibit Regen Disable/Enable

Throttle

- Minimum RPM
- Idle RPM
- Maximum RPM
- Switch/Rotary
  - Switch RPM
  - Increment
  - Rotary RPM
  - Increment
  - Max RPM
  - Change / sec

Autostart

- Behavior
  - Operation
    - High→Low
    - Low→High
  - Start-Stop With
    - Dual Switch, Single Switch, Transducer, Transducer w/ Backup Switches, Scheduler Only, Timed Run, Cycle Run, Single Start/Stop, Remote Control, Pressure Washer
  - Start Enable Delay (s)
  - Stop Enable Delay (s)
  - Maintain Transducer
    - Maintain Function
      - Disable
      - Low→High
      - High→Low
    - Auto Throttle Input

        - Transducer 1,2,3,4,5,6
    - Target Point
    - Throttle Aggressiveness
    - Error Operation
        - Controlled Stop, Immediate Stop, Go to Run, Derate

- Ramp Profile
  - RPM Settings
    - Intermediate RPM
    - Run RPM
  - Time Profile
    - Warm Up Time (s)
    - Ramp Up (s)
    - Intelligent Intermediate
    - Intermediate (s)
    - Ramp to Run (s)
    - Ramp Down (s)
    - Cool Down (s)
- Transducer
  - Autostart Trigger
    - Autostart Trigger
        - Transducer 1, 2, 3, 4, 5, 6
    - High Set Point
    - Low Set Point
  - Setup
    - Transducer 1-6
        - Low Warning Alarm
        - Low Shutdown Alarm
        - High Warning Alarm
        - High Shutdown Alarm
        - Type & Range
- Scheduler
  - Method
    - Allowed Times, Disabled, Override
  - Schedule A-P
    - Days of the Week
    - Start Time hh:mm
    - Stop Time hh:mm
- Timed Run
  - Default Time hh:mm
  - Switch Adjustment hh:mm

- Cycle Time
  - Default State
    - Stopped, Running
  - Run Time hh:mm
  - Stop Time hh:mm
- Auto Battery Recharge
  - Auto Battery Enabled
    - Off/On
  - Recharge Run Speed
  - Enable Delay (m)
  - Recharge Time (m)
  - Delay Between Recharge (m)
  - Low Battery Threshold (V)

Input / Output Setup

- Outputs
  - Output Events
    - Alarm Output
    - At Speed Output
  - Aux Out 1-4, Low Side Out 11-14, High Side Out 1-2
    - Armed When
      - Always, Never, Autostart, Manual Start
    - Engine Condition
      - Always, Stopped, Running
    - Active When
    - Running Ignore Delay (s)
    - Enable Delay (s)
    - Disable Delay (s)
- Inputs
  - Event Manager
    - Oil Pressure
    - Coolant Temp
    - Fuel Level
    - Battery Voltage
    - Engine Speed
  - Aux Switch 1-6
    - Armed When
      - Always, Never, Autostart, Manual Start
    - Engine Condition

- Always, Stopped, Running

* Switch Type
* Engine Stop
  - Controlled Stop, Immediate Stop, Go to Run, Derate
* Running Ignore Delay (s)
* Enable Delay (s)
* Disable Delay (s)
* SPN
* FMI
* LED Select
  - Red, Amber
* LED Flash Rate
  - Slow, Fast, Solid

Communications

- CAN bus Settings
  - TSC1 Address
  - Panel Address
  - CM1 Address
  - Interlock Address
  - Config Address
  - Termination
- Modbus
  - Baud
  - Parity
  - Address
  - Master/Slave

3.8.2 Access Levels

The available menu items are dependent upon the current access level. The current access level is shown in the upper right corner while in the menus. The CP1000 supports up to three independent PINs that are configurable. The standard CANplus™ configuration has the following PINs settings:

- User = 1000
- Tech = 1111
- Admin = 2222
- Menu PIN Required = OFF

Elevate Access Level

When the panel is turned on, the access level reverts to the User level. To gain access to the Tech or Admin levels, use the Elevate Access Level menu, as follows: **Configuration → System → PIN Settings → Elevate Access Level**.

The panel will prompt for a PIN input. User, Tech or Admin level access will be granted based on which PIN is entered. For example, if the Tech level PIN is entered, Tech level access will be granted, and similarly if Admin or User level PINs are entered. If the entered PIN does not match User, Tech or Admin, then “Incorrect PIN” is displayed and the access level reverts to User.

Once elevated, the access level stays in effect until the panel is turned off.

PIN Change

PINs can be changed via the Menu as follows: **Configuration → System → PIN Settings → PIN change**.

The PIN that is changed is the PIN for the current access level. For example, at the User level, only the User PIN can be changed. To change the Tech PIN, use the Elevate Access Level menu and enter the correct Tech PIN. Then go to the PIN Change menu to change the Tech PIN.

Menu PIN Required OFF

- Accessing the menu is allowed with no PIN input required
- Only User access level items are displayed
- Use the Elevate Access Level menu to access the Tech or Admin menu items

Menu PIN Required ON

- PIN is required to access the menu
- User, Tech or Admin level access will be granted based on which PIN is entered. If the PIN does not match the User, Tech or Admin PIN, then the panel will display “Invalid PIN”

Once an access level is granted, that level is retained until the key is turned off. When the key is turned back to the ON position, the access level reverts back to User and follows the Menu PIN Required setting.

3.8.3 Quick Access Menu

The Quick Access Menu can accessed by pressing the menu control button  . This menu contains commonly accessed menu items. All access levels open this menu and it is not affected by the Menu PIN Required setting. The following is the Quick Access Menu tree:

- Start-Stop with
- Operation
- Maintain Function
- Language
- Distance units
- Pressure units
- Volume units
- Temperature units
- High Set Point
- Low Set Point
- Target Point
- Autostart Dashboard

4 Engine Setup

Setting up the panel for a particular engine can be done through the menus. However, some engines require changes to multiple parameters. For this reason, using the CANplus™ Customizer is highly recommended for creating configurations for a particular engine as it will automatically create configurations with the necessary parameter changes, as well as populate commonly used gauges for the particular engine.

All of the following panel menu actions described in this section require Admin-level privileges.

4.1 Electronically Governed Engines

To configure the panel to a particular engine, first go to the **System → Engine Type** menu and select the appropriate engine.

Some engines require additional configurations. After selecting the engine type, check to see if the particular engine selected needs additional configurations by navigating to the **System → Engine Specific Settings** menu. If the engine selected is listed, enter that sub-menu to configure the additional parameters. If the selected engine is not in the list, no further configurations are required.

Finally, set the Minimum, Idle and Maximum RPMs in the Throttling Menu.

4.2 Mechanically Governed Engines

To configure the panel for a mechanical engine, first go to the **System → Engine Type** menu and select the mechanical engine. Next, navigate to the **System → Engine Specific Settings → Mechanical Engines** menu.

The following steps should be performed in order:

1. Calibrate the tachometer by selecting Calibrate Tach.
    a) With the engine at idle, measure the RPM using a photo-tachometer or handheld tachometer. Better RPM accuracy is achieved if the engine is allowed to warm up.
    b) Enter the measured RPM into the panel while the engine is still running at the measured RPM.
2. Mount the Actuator.
    a) Select the Actuator Setup menu and then Mounting and Setup.
    b) The actuator can now be physically mounted to the engine. The display buttons can be used to Extend or Retract the actuator as needed to ensure full travel of the throttle arm.
3. Use the Extend or Retract controls to adjust the throttle arm to its Minimum point and select Set Min Travel Point on the panel. The engine does not need to be running.
4. Use the Extend or Retract controls to adjust the throttle arm to its Maximum point and select Set Max Travel Point on the panel. The engine does not need to be running.
5. Crank up the engine. Better RPM accuracy is achieved if the engine is allowed to warm up before proceeding.
6. Select Start Calibration.

Finally, set the Minimum, Idle and Maximum RPMs in the Throttling Menu.

5 Manual Operation

Use the following steps for manual operation:

1. Ensure that the Auxiliary Engine Stop (if fitted) is not activated.
2. Turn the keyswitch to the run position.
3. Press and hold the Run button.
4. Release button when engine starts.

5.1 Throttle Control

The ECU determines how the engine responds to the throttle requests and will not allow the engine speed to fall below the ECU minimum RPM or go above the ECU maximum RPM. The ECU minimum and maximum RPM values are determined by the ECU "payload" and typically require the engine manufacturer's configuration tool to adjust them. The ECU will honor RPM requests that are above the ECU's minimum RPM as well as RPM requests that are below the ECU's maximum RPM.

Therefore, to avoid confusion, it is best not to set the panel's Minimum Requested RPM below the ECU's minimum RPM or set the panel's Maximum Requested RPM above the ECU's maximum RPM.

For example, the panel's Minimum Requested RPM is set to 800 RPM, yet the ECU payload defines the engine minimum speed to be 900 RPM. In this case, the engine will not run at 800 RPM despite the control panel requesting a lower engine speed. The ECU will ignore all RPM requests that are below 900 RPM, resulting in a minimum speed of 900 RPM.

Note: The panel's Minimum Requested RPM and Maximum Requested RPM can be configured using the CANplus™ Software Suite, or via menus within the display (if enabled by PIN). See the Configuration section for more information.

5.2 Ramp Throttle

The standard Ramp Throttle uses a momentary rocker switch to adjust the requested engine speed. All throttle requests are sent directly to the engine using CAN throttle control.

Note: Throttle control requires CAN throttling to be enabled in the ECU. CAN throttling is also known as Torque Speed Control or TSC1.

When first started, the requested engine speed is Idle RPM.

- Pressing and releasing the rabbit icon increases the speed by the switch/rotary increment value (default = 50 RPM)
- Pressing and holding the rabbit icon causes the speed to increase (ramp) until the maximum speed is achieved
- Pressing and releasing the turtle icon decreases the speed by the switch increment value (default = 25 RPM)
- Pressing and holding the turtle icon causes the speed to decrease (ramp) until the minimum speed is achieved
- The CP1000 will smoothly ramp the RPM up and down using the Max RPM change / s value (default = 500). This value can be changed in the **Throttle → Switch/Rotary → Max Change / s** menu.

5.3 Rotary Throttle Control

The optional Digital Rotary Throttle uses a rotary switch to simulate the operation of a throttle. When the engine is first started, the requested engine speed is always Idle RPM. Turning the throttle knob clockwise increases the requested engine speed by the switch/rotary increment value (default = 50 RPM). Turning the throttle knob counter-clockwise decreases the requested engine speed.

5.4 Stopping the Engine

To stop the engine, simply press the “OFF” button. Do not use the Auxiliary Engine Stop (if fitted) or the keyswitch to stop the engine under normal conditions.

6 Autostart Operation

6.1 Prerequisites

The CP1000 is capable of starting and stopping the engine based on external triggers and/or timed schedules.

Note: It is important to note that the engine may start without warning or notice.

The CP1000 is equipped with an Autostart warning alarm.

- It is SOLELY the responsibility of the owner/installer/operator to provide warning labels, visible warnings and audible warnings to notify the operator of an impending start-up
- ALWAYS use lock-out/tag-out procedures prior to performing ANY service or configuration operations
- DO NOT configure operator programmable features while the panel is in “AUTO” mode (green Autostart light is illuminated)

6.2 Enabling Autostart

To place the panel in Autostart mode, turn the keyswitch clockwise to the ON position and press the AUTO button. The Autostart ICON will illuminate, indicating the panel is in the Autostart mode. CAN bus values will show “- - -” since the ECU is not energized at this time. The display will power down after two minutes to reduce battery drain but the Autostart light will stay illuminated. The power-down time can be configured using the Customizer software tool. When the selected start condition occurs, the control panel will power up and attempt to start the engine after sounding the Autostart warning alarm. When the engine has successfully started, the panel will control the engine speed following the configurable throttle control profile (see the Ramp Profile section). The flexible throttle profile includes various speeds and times for a variety of scenarios. When a stop condition exists, the panel will reduce the engine speed as per the throttle profile and stop the engine. If the configured start condition returns before the shutdown process is complete, the engine will not stop but rather will return to the required speed.

	**WARNING**
	AUTOMATIC START/STOP WARNING! WHEN THE AUTOSTART MODE IS ACTIVE AND A START CONDITION EXISTS, THE PANEL WILL START IMMEDIATELY! DO NOT CONFIGURE THE PANEL WHEN THE AUTOSTART MODE IS ACTIVE! ALWAYS USE LOCK-OUT/TAG-OUT PROCEDURES WHEN SERVICING AUTOSTART EQUIPMENT!

6.3 Autostart Menu

The CP1000 has two switch inputs dedicated for use as Autostart inputs. The transducer input can also be selected to control a start/stop set point.

6.4 Behavior

The following links to videos show how to set up the panel for sample applications:

Click here to view Dual Float Empty.

Click here to view Transducer with Backup Switches.

6.4.1 Configuring Operation

Configuring Autostart begins with selecting the desired behavior. The two choices are as follows:

1. High to low, examples:
   - High water level to low water level
   - High pressure to low pressure
   - High temperature to low temperature
2. Low to high, examples:
   - Low water level to high water level
   - Low pressure to high pressure
   - Low temperature to high temperature

6.4.2 Configuring Start and Stop Events

The next step is to define the start and stop events. The choices are as follows:

- Single switch
- Cycle Run
  - Start upon entering Autostart modes
  - Stops after x minutes
  - Restarts after y minutes
- Pressure Washer
  - Manually started and stopped
  - Switched input toggles between idle and Intermediate RPM
- Remote Control
  - Start and stop via switch
  - Throttle up and down via two other switches
  - Single start/stop
- Dual switch
  - Start and stop via dual (high and low) switches
- Transducer
  - Start and stop via transducer level
- Transducer with backup switches
  - Start and stop via transducer level
  - Switches as backup start and stop if there is a transducer failure
- Scheduler
- Timed run
  - Manually started
  - Automatically stopped by countdown timer
  - Can maintain a level while running

The following table describes the Start/Stop events when behavior operation is set to “High to Low” (switches/floats are normally open):

Start/Stop Events	Engine Starts When	Engine Stops When
Single Switch	SW1 is closed	SW1 is open
Dual Switch	SW1 and SW2 are both closed	SW1 and SW2 are both open
Transducer	Input is above high set point	Input is below low set point
Transducer with Backup Switches	Input is above high set point; Dual Switch mode if Transducer fault is detected	Input is below low set point; Dual Switch mode if Transducer fault is detected
Scheduler	Date and Time occurs	Date and Time occurs
Timed Run	Autostart switch pressed	Timer expires

The following table describes the Start/Stop events when behavior operation is set to “Low to High” (switches/floats are normally open):

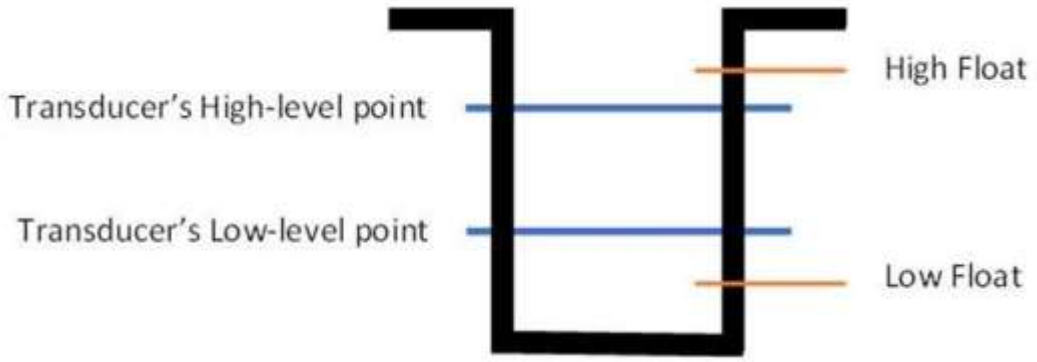
Start/Stop Events	Engine Starts When	Engine Stops When
Single Switch	SW1 is open	SW1 is closed
Dual Switch	SW1 and SW2 are both open	SW1 and SW2 are both closed
Transducer	Input is below low set point	Input is above high set point
Transducer with Backup Switches	Input is below low set point; Dual Switch mode if Transducer fault is detected	Input is above high set point; Dual Switch mode if Transducer fault is detected
Scheduler	Date and Time occurs	Date and Time occurs
Timed Run	Autostart switch pressed	Timer expires

Transducer Fault Detection using Backup Switches

When configured and equipped with transducer and back up switches, the panel will use the transducer to determine the primary start and stop events. The switches are used to detect transducer faults; when a fault is detected, the panel will automatically adjust to use the switches to detect the start and stop events. The panel will alert to the fault but normal operation will continue with the exception that the switches will be used instead of the faulty transducer.

For proper operation and fault detection, the switches must be configured such that the high-switch opens/closes at a level above the transducer’s high-level point and the low-switch opens/closes at a level below the transducer’s low-level point, as illustrated in the fluid pumping example diagram below.

As an example, consider the following situation. When pumping fluid, the setup should be similar to the following diagram. Typically, floats function as an Open switch when not floating and a Closed switch when floating.



Faults

Transducer Level	Low-Level Switch	High-Level Switch	Result
Above Low-Level Point	Open	—	Transducer is within normal operating range but value is incorrect (too high) because low-level float should be closed
Below High-Level Point	—	Closed	Transducer is within normal operating range but value is incorrect (too low) because high-level float is closed
Out of Range (Low)	—	—	Transducer value is below the normal operating range (severe)
Out of Range (High)	—	—	Transducer value is above the normal operating range (severe)

6.4.3 Configuring the Transducer

With a transducer connected, the CP1000 can be configured to throttle the engine so as to maintain a specific transducer level much like a car's cruise control. If this cruise control feature is desired, the Maintain Transducer Level should be set to Enabled. The other choice is Disabled, which follows the Ramp Profile described in the Ramp Profile section.

The transducer's cruise control function can be independently set to either Low to High or High to Low.

Function	Throttles Up When	Throttle Down When
Low to High	Input is below the target point	Input is above the target point
High to Low	Input is above the target point	Input is below the target point

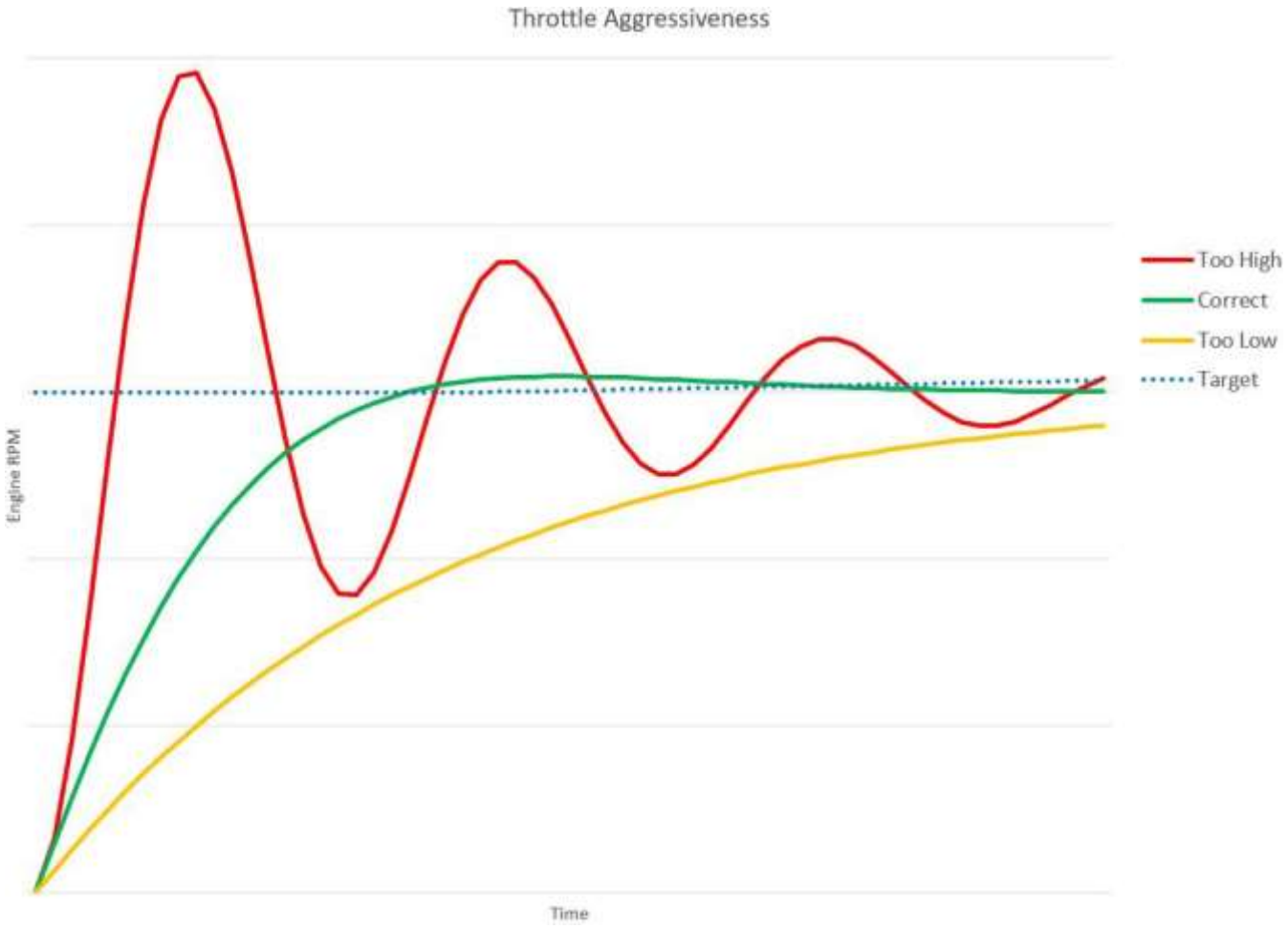
To see or change the transducer target point, go to the **Autostart → Maintain Transducer Level → Target Point** menu.

Some applications are slow to respond to throttle changes while others are fast. An analogy is a car's cruise control and how the car reacts going downhill or uphill. Going downhill, a car will quickly speed up when just a little more throttle is applied. In this case, the throttle adjustment should be less aggressive. On the other hand, a car going uphill will speed up slowly and therefore needs more aggressive throttling. To adjust how quickly the

control panel ramps the throttle up or down for a particular application, go to the **Autostart → Behavior → Maintain Transducer Level → Throttle Aggressiveness** menu. The higher the number, the more aggressive or quicker the control panel ramps the throttle up or down to maintain the level.

When adjusting the Throttle Aggressiveness, it is best to understand how responsive the system is to changes. Similar to the analogy of the car going downhill, a small water tank with a large pump is an example of a system that will respond quickly to changes when throttling the water level. Alternatively, a large tank with a small pump will respond more slowly.

The following figure demonstrates the responsiveness of a system to adjustments in Throttle Aggressiveness. A fast-responding system will need a lower aggressiveness value. Otherwise, the engine RPMs will overshoot and undershoot the target value as depicted in the graph by the red “Too High” throttle aggressiveness line. Ideally, the engine’s RPM should quickly ramp up and home in on a small RPM range to maintain the target value as depicted in the graph by the green “Correct” throttle aggressiveness line. However, if the gain is set too low, the engine’s RPM may never get to the proper range to maintain the target value as depicted in the graph by the yellow “Too Low” throttle aggressiveness line. The full screen Throttling Line Graph (see the Throttling section) can be utilized to observe the behavior to determine if the throttling aggressiveness is correct.



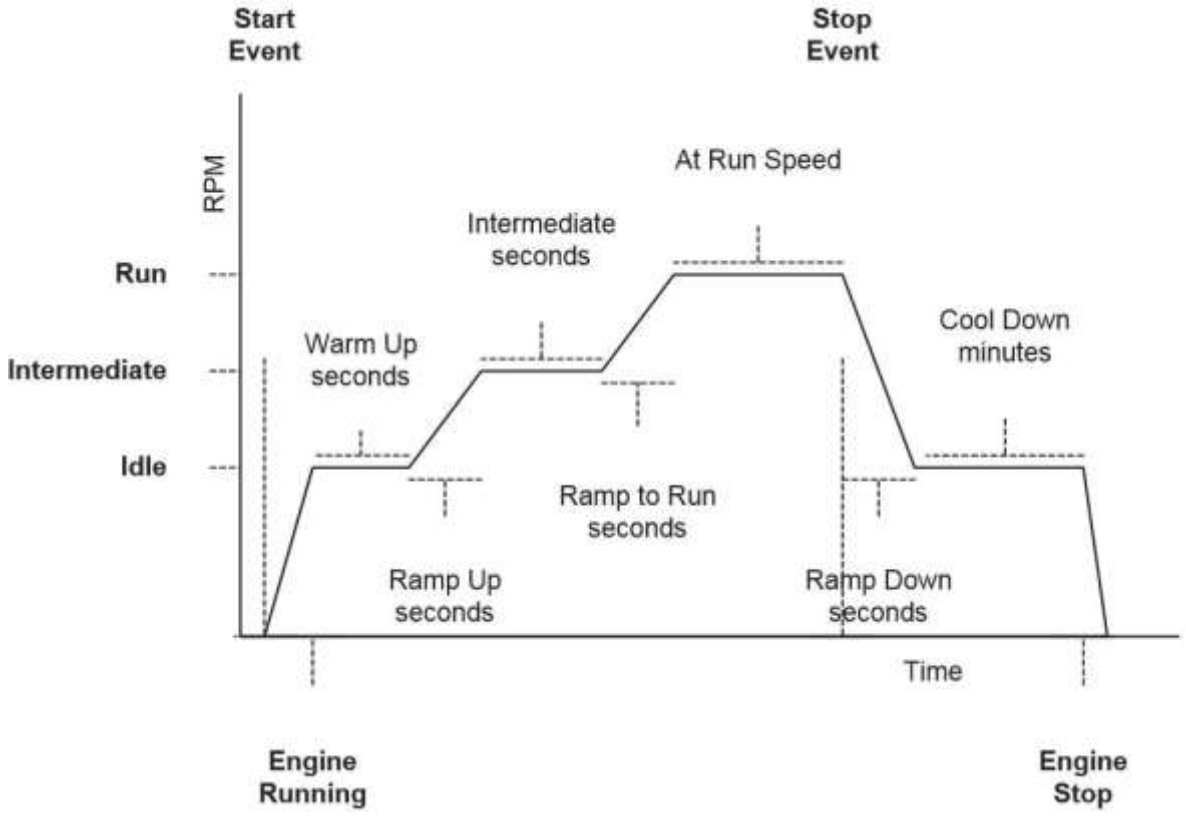
6.4.4 Configuring Start and Stop Delays

In situations where start or stop conditions may be met briefly, yet repeated start/stop cycles of the engine need be avoided, two settings allow a delay to be added before a specific input condition is recognized. An example of such use is where a float switch is installed in choppy water. The float switch may repeatedly open and close based on the water's surface waves. Rather than repeated engine start and stop cycles, it is better to wait for the float switch to be continuously closed for a specified duration before the start or stop event is declared.

The Start and Stop Delays can be configured by going to the **Autostart → Behavior → Start Delay or Stop Delay** menu.

6.4.5 Ramp Profile

The Autoramp™ profile allows the use of configurable warm up and cool down profiles to help protect engines and other assets such as plumbing, or to ensure proper ramp up and down of pressure or flow. An example is shown below.



6.4.6 Configuring RPM and Time Profile Settings

Setting	Description
Idle RPM	Selects the RPM that the control system will request for idle speed. If the engine is started, it will always begin running at Idle speed.
Intermediate RPM	Selects the RPM that the control system will request for intermediate speed. Intermediate speed is a specific speed point at which the engine will pause during the ramping up cycle. The intermediate speed can be used to prime a pump or charge lines.
Run RPM	Selects the RPM that the control system will request for run speed. The run speed is the normal operating speed. If the Maintain Transducer Level "cruise control" is enabled, the control panel will dynamically throttle the engine to maintain the level using the Run RPM as the max.
Warm Up Time	The time (in seconds) the engine will stay at the Idle RPM after starting.
Ramp to Intermediate Time	The time (in seconds) the engine will take to ramp from the Idle RPM to the Intermediate RPM.
Intermediate Time	The time (in seconds) the engine will stay at the Intermediate RPM.
Ramp to Run Time	The time (in seconds) the engine will take to ramp from the Intermediate RPM to the Run RPM. If the Maintain Transducer Level is enabled, the panel will not ramp to the Run RPM but will start dynamically throttling the engine to maintain the level.
Ramp to Cooldown Time	The time (in seconds) the engine will take to ramp from the Run RPM to the Cooldown RPM.
Cooldown Time	The time (in minutes) the engine will stay at the Cooldown RPM before turning off the engine.

Instead of a time-based system, the ramp profile can wait for event to occur before Ramping to Run. These events can be one of the following, for example:

- Pump is primed
- Clutch/gearbox is enabled

6.5 Transducers

The transducers can be configured for Autostart levels, scaled values, units of measure for setup and display, calibration, warning and fault levels.

6.5.1 Autostart Triggers

The low and high Autostart trigger levels can be set via the **Autostart → Transducer → Autostart Triggers** menu.

6.5.2 Setup

There are a number of parameters that must be configured for proper operation of the transducer. These configurations can be set via the **Autostart → Transducer → Setup** menu.

- Type and Range
  - 4 mA Scaled Value
    - Value in setup units represented by a 4 mA reading
  - 20 mA Scaled Value
    - Value in setup units represented by a 20 mA reading
  - Setup Units
    - Units used to setup the 4 mA and 20 mA scaled values
  - Display Units
    - Units that are displayed on the gauges
  - Calibration Zero Offset
    - Offset to calibrate the 4 mA value (plus or minus 5%)
- Low Warning Alarm
  - Value in display units that will generate a Low warning
- Low Shutdown Alarm
  - Value in display units that will generate a Low shutdown
- High Warning Alarm
  - Value in display units that will generate a High warning
- High Shutdown Alarm
  - Value in display units that will generate a High shutdown

6.6 Scheduler

Setting the “Start/Stop with” to be “Scheduler Only” causes the engine to be started and stopped based on the schedule defined by the **Autostart → Behavior → Start/Stop with → Scheduler Only** menu.

Next, set the Scheduler Method to Override by going to the **Autostart → Scheduler → Method** menu. Using the Override method will override any autostart settings.

The Scheduler mode starts and stops the engine based on time and date. Up to 16 unique scheduled run cycles can be configured offering multiple run cycles per day, and those run cycles can differ depending on the day of the week.

The Scheduler has another method called Allowed Times. Unlike the Override method, this method marries the Autostart setting with the Scheduler, allowing the autostart to only occur during the allowed times. For example, with this method the panel can be configured to only autostart on Mondays, Wednesdays and Fridays between the times of 12:00 p.m. and 3:00 p.m. Up to 16 unique allowed times can be configured.

6.7 Timed Run

The Timed Run mode allows for a manually-initiated start with the stop event being automatically triggered based on running time. This mode allows the operator to walk away from a running system knowing that it will automatically stop after a predetermined amount of time. There are no automatic restarts in this mode. All starts are manually initiated by pressing the Autostart switch.

7 Configuration

The CP1000 has been preloaded with factory default configurations, or optionally a custom OEM-specific configuration, to ensure easy start-up and commissioning. To support the diversity of applications, the control panel is easily configured on demand. Accessing configurable settings can be accomplished in three ways:

- Display Menu
- CANplus™ Customizer Software Suite and CANplus™ Config Kit
- CANplus™ Customizer Software Suite and a USB drive

7.1 Display Menu

Most commonly accessible parameters can be changed onsite or in a facility by navigating the display using the soft keys to find the appropriate menu page and data field. The available menu items are dependent upon the current access level (see the Menu Tree section for available menu items). Easy to follow menu navigation diagrams are located throughout the user manual and accompany each section which describes a configurable operation or setting.

7.2 CANplus™ Customizer Software Suite and CANplus™ Config Kit

In situations where multiple units must be reconfigured, or in the case of a single unit which requires complete reconfiguration, using the CANplus™ Customizer Software Suite, which is proprietary configuration software, is highly recommended. The software suite is meticulously maintained and regularly updated. These free updates include software enhancements and new functionality, and they ensure compatibility with evolving technologies. Please see the Resources section at www.cattron.com/cp1000.

The CANplus™ Config Kit (Part Number 010-6750-01) includes the following:

- An adapter harness that connects to the panel's engine interface connector
- An AC power supply
- A USB to CAN bus hardware adapter

With this kit, a panel's configuration can be read from the panel or written to the panel via CAN bus. During read or write operations, the panel must be the only CAN bus device. Using the included adapter harness ensures proper operation during configuration read or writes.

7.3 CANplus™ Customizer Software Suite and a USB Drive

The CP1000 introduces the ability to import and export configurations using a USB drive, avoiding the need to purchase and have onsite a CANplus™ Config Kit as well as the need to disconnect the panel from the engine. The panel's USB port is located on the front of the panel under the keyswitch. It is recommended that the dirt and dust rubber plug be inserted into the USB port when this port is not in use. Additionally, the port can be used to charge a phone if desired.

Install the USB drive in the panel's USB port. The current configuration can be exported by going to the **System → Export Config.** menu. To import a new configuration, the menu access level must be at the Tech or Admin level (see the Access Levels section). A new configuration is imported by going to the **System → Import Config.** menu. New configuration changes take effect immediately. Therefore, the engine should not be running when importing a new configuration.

When finished with exporting or importing configurations, remove the USB drive and reinstall the dirt and dust rubber plug.

8 Firmware Update

The CP1000 introduces the ability to update the application firmware using a USB drive.

8.1 Updating via USB Drive

8.1.1 Preparation

Copy the update file into the root directory of an empty USB stick, which has been formatted with FAT32.

8.1.2 Procedure

Verify that the unit is turned on. Insert the USB Stick into the USB Port of the unit and navigate to the **System → Configurations & Updates** menu. The panel will show the available update files that are currently on the drive. After selecting the appropriate file, the update process will begin. There will be on-screen information during the update process. **The update process may take a few minutes to complete.**

9 Miscellaneous

9.1 Emissions System Functionality

Note: GENERAL EMISSIONS DISCLAIMER This panel may include provision(s) for operator input such as FORCE REGENERATION, INHIBIT REGENERATION, INTERLOCK, and others specific to US and International emissions regulations. Responsibility for emissions-related inputs and compliance with emissions regulations is solely that of the owner and/or operator of the machine/engine on which this panel is connected.

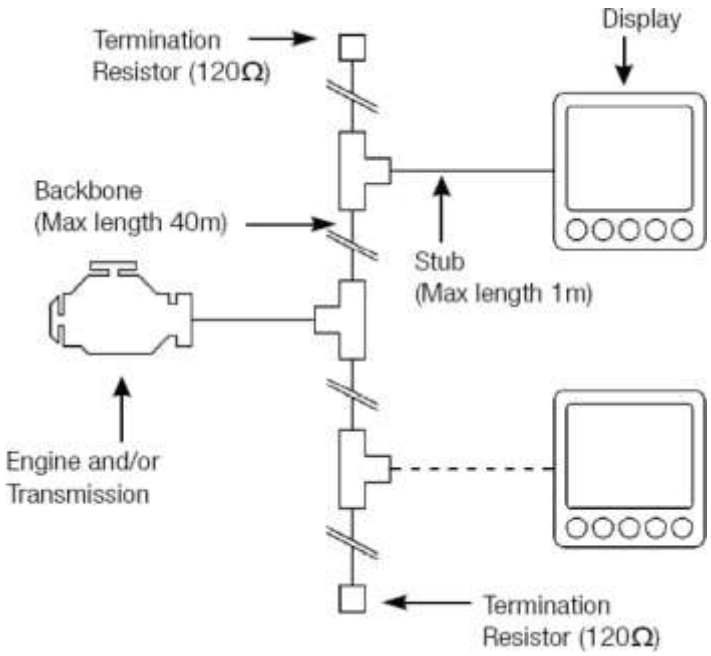
	**CAUTION**
	CAREFULLY READ AND UNDERSTAND THE ENGINE MANUFACTURER OWNER/OPERATOR MANUAL. YOUR ENGINE MANUFACTURER PROVIDES SPECIFIC INFORMATION REGARDING THE EXHAUST EMISSION SYSTEM OF YOUR ENGINE. THIS INFORMATION IS MAINTENANCE, PROCEDURAL AND SAFETY RELATED. FAILURE TO EXACTLY FOLLOW THE ENGINE MANUFACTURER INSTRUCTIONS AND SCHEDULES COULD POTENTIALLY RESULT IN HARM OR INJURY TO YOU AND/OR OTHERS. FURTHER, FAILURE TO EXACTLY FOLLOW THE ENGINE MANUFACTURER INSTRUCTIONS AND SCHEDULES COULD RESULT IN DAMAGE TO YOUR ENGINE AND/OR EQUIPMENT.

The CANplus™ display reports emissions messages received from the engine ECU. Depending on the received message, icons or symbols may be displayed on the screen. Some messages/icons are displayed as an overlay (inhibit symbol shown at left). Other symbols/icons may cover most of the screen. The operator MUST respond to the indications on the display following engine manufacturer recommended procedures/actions. Please note that indications shown by the display may vary with respect to engine manufacturer and may vary between engine models from the same manufacturer.

9.2 CP1000 Panel Wiring

Most electronically governed engine installations include a harness with a built-in J1939 backbone. Use twisted shielded pair with a drain wire for CAN wiring terminated with 120 Ω resistors at each end. The maximum length for the CAN bus is 131 ft (40 m) and stubs should not exceed 39 in (1 m) in length.

9.2.1 Typical J1939 Wiring Topology



9.2.2 Engine Harness Connector

Connection to the engine is provided by a Deutsch/TE 21 pin connector (Part Number HDP24-24-21PE). The mating connector is Deutsch/TE (Part Number HDP26-24-21SE).

Signals are shown in Table 1.

Table 1: Engine Harness Connection

Pin	Signal Description	Direction	Notes
A	Preheat In/Out	In/Out	10 A Maximum Output
B	Battery Supply	In	Connect direct to battery '+' via 30 A Fuse
C	Ground	N/A	Connect direct to battery '-'
D	Starter	Out	10 A Maximum
E	Ground	N/A	Connect direct to battery '-'
F	CAN Shield	N/A	
G	ECU/Solenoid	Out	10 A Maximum
H	Temperature Sender	In	Resistive
J	Alternator Excitation	Out	5 A Maximum
K	Tach	In	Alternator or single ended mag-pickup
L	No Connect	N/A	
M	Auxiliary Switch 2	In	Ground Input
N	Temperature Switch	In	Ground Input

Pin	Signal Description	Direction	Notes
P	Oil Pressure Sender	In	Resistive
R	Throttle Switch	In	Connected to 'S' via 390 Ω resistor
S	Throttle Switch Return	Out	
T	Oil Pressure Switch	In	Ground Input
U	CAN Low	In/Out	J1939
V	CAN High	In/Out	J1939
W	Auxiliary Switch 1	In	Ground Input
X	Fuel Sender	In	Resistive

9.2.3 Sealed Connectors

The provided Deutsch sealed weather-proof plug includes a locking ring device which must be turned counter clockwise to separate the connectors. To positively seat the connectors, the locking ring is turned clockwise.

⚠	**CAUTION** CATTRON DOES NOT RECOMMEND USING DIELECTRIC GREASE OR SEALANT WITH SEALED CONNECTORS. THESE CHEMICALS MAY CAUSE SEAL DAMAGE AND ALLOW WATER ENTRY. USE CATTRON PROVIDED CAVITY PLUGS TO SEAL THE CONNECTOR IF WIRES ARE REMOVED.

9.2.4 Unsealed Connectors

For unsealed connectors exposed to the elements, Cattron recommends using dielectric grease to protect the contacts.

⚠	**CAUTION** CATTRON DOES NOT RECOMMEND USING SEALANT WITH UNSEALED CONNECTORS. SEALANT TRAPS MOISTURE IN THE CONNECTOR AND ENCOURAGES CORROSION.

9.2.5 Harness Routing

The minimum routing radius of the wiring harnesses should be at least two times the diameter of the wiring harness. Bends should be avoided within 1 in (25 mm) of any connector in order to avoid seal distortion allowing moisture to enter the connector.

9.3 Engine Starter Excitation Connection

9.3.1 Starter Relay

General Starter Relay Specifications		
Minimum Starter Relay (Continuous) Rating	60 A @ 12 V	30 A @ 24 V
Maximum Starter Relay Excitation Current Draw	5 A @ 12 V	3 A @ 24 V

Cattron provides suitable heavy duty relays and generic starter relay wiring kits in both 12 V and 24 V; please contact your LOFA reseller for more information.

9.3.2 Battery Circuit Requirements

	**CAUTION** IMPROPER WIRING CAN CAUSE ELECTRICAL NOISE OR UNRELIABLE OPERATION AND MAY DAMAGE THE CONTROL SYSTEM OR OTHER COMPONENTS. ALL POWER CONNECTIONS MUST BE FREE FROM FOREIGN MATERIALS, INCLUDING PAINT, WHICH MAY INTERFERE WITH PROPER CONNECTION. A RELIABLE 30 A MAXIMUM FUSED POWER CIRCUIT MUST BE PROVIDED FOR THE CONTROL SYSTEM. CATTRON RECOMMENDS THE POWER CONNECTION BE MADE DIRECTLY TO THE BATTERY WITH THE FUSE ELECTRICALLY CLOSE TO THE BATTERY. GROUNDING THROUGH FRAME MEMBERS IS NOT RECOMMENDED. ALL CIRCUIT PATHS MUST BE CAPABLE OF CARRYING ANY LIKELY FAULT CURRENTS WITHOUT DAMAGE. DO NOT REVERSE THE BATTERY POLARITY. ATTEMPTING TO CRANK THE ENGINE WHEN THE POLARITY OF THE BATTERY CONNECTIONS IS REVERSED MAY DAMAGE THE CONTROL SYSTEM.

9.3.3 Battery Positive Connection

The electronic control system operates on either 12 VDC or 24 VDC electrical systems. The unswitched battery positive connection to the control system is made at the weather proof connector. The control system provides switched positive battery protected by solid-state MOSFETs. These outputs include integral protection against overloads and short circuits.

Powering the control system through a 30 A fused dedicated circuit reduces the possibility of system damage.

	**CAUTION** DISCONNECTING THE BATTERY WHILE THE ENGINE IS RUNNING MAY RESULT IN DAMAGE TO ELECTRICAL COMPONENTS. WHEN USING A BATTERY DISCONNECT SWITCH, CATTRON RECOMMENDS USING A TWO POLE SWITCH TO DISCONNECT BOTH THE BATTERY AND ALTERNATOR OUTPUT.

Note: A maximum of three ring terminals should be connected to a power stud in order to ensure integrity of the connection. The use of more than three terminals can cause the connection to become loose.

9.3.4 Voltage Drop

If control system voltage drops below 6 V for more than 0.1 s, the control system may reset, causing the self-test to reactivate. Resetting the control system is equivalent to quickly turning the keyswitch to OFF and then back to run without starting the engine. Voltage drops can be caused by a discharged battery, transients from external equipment, improper wire sizes, faulty wiring or nearby lightning strikes.

9.3.5 Suppression of Voltage Transients (Spikes)

	**CAUTION** THE INSTALLATION OF VOLTAGE TRANSIENT SUPPRESSION AT THE TRANSIENT SOURCE IS REQUIRED. CATTRON FOLLOWS SAE RECOMMENDED ELECTRICAL ENVIRONMENT PRACTICES.

Inductive devices such as relays, solenoids and motors generate voltage transients and noise in electrical circuits. Unsuppressed voltage transients can exceed SAE specifications and damage electronic controls.

Relays and solenoids with built-in voltage transient suppression diodes are recommended whenever possible. Ensure the proper installation of diodes when built-in voltage transient suppression is not available.

Locate inductive devices as far as possible from the components of the electronic control system. When using electric motors it may also be necessary to add isolation relays to eliminate voltage transients, noise and prevent back feed.

9.3.6 Welding on Equipment with Electronic Controls

Proper welding procedures should be observed to avoid damage to electronic controls, sensors and associated components. The component should be removed for welding when possible.

The following procedure must be followed if the component must be welded while installed on equipment with electronic controls. This procedure will minimize the risk of component damage.

	**CAUTION** DO NOT GROUND THE WELDER TO ELECTRICAL COMPONENTS SUCH AS THE CONTROL GROUND OR SENSORS. IMPROPER GROUNDING CAN CAUSE DAMAGE TO ELECTRICAL COMPONENTS. CLAMP THE GROUND CABLE FROM THE WELDER TO THE COMPONENT BEING WELDED. PLACE THE CLAMP AS CLOSE AS POSSIBLE TO THE WELD TO REDUCE THE POSSIBILITY OF DAMAGE.

1. Stop the engine. Turn the keyswitch to the OFF position.
2. Disconnect the negative battery cable from the battery.
3. Open any installed battery disconnect switch.
4. Unplug the control system if possible.
5. Connect the welding ground cable as close as possible to the area to be welded.
6. Protect the wiring harness from welding debris and spatter.
7. Use standard welding methods to weld the materials.

9.4 Control System Troubleshooting

Control system does not perform self-test

Possible Cause	Possible Remedy
Tripped overcurrent protection	Correct fault, replace or reset overcurrent protection
Faulty connection to battery	Correct battery connections (see the Battery Circuit Requirements section)
Faulty control system	Repair or replace control system

Control system performs normal self-test, engine cranks, runs and shuts down

Possible Cause	Possible Remedy
Engine Stop LED illuminated	Correct ECU stop condition, use ECU diagnostics

Display does not display data

Possible Cause	Possible Remedy
Display lost power	Turn on key, verify display plugged into harness
Engine Source address incorrect	Change Engine Address in Configuration
Display Address incorrect	Change Display Address to 40 (default)
Display configuration problem	Reset display using Restore Defaults
CAN failure	Check CAN (see the Testing CAN section)
ECU not sending data	Repair or replace ECU

Display shows Bad or Corrupt Configuration

Possible Cause	Possible Remedy
Configuration file does not match firmware version	Reload configuration file from the config program with matching version

9.4.1 Testing a Warning or Shutdown

Shutdown simulation with ECU controlled engines requires using the ECU diagnostic tool. Refer to the diagnostic tool documentation to simulate a warning or shutdown.

9.4.2 Testing CAN

Most information provided to the CANplus™ display is sent by the ECU via the CAN bus. CAN is an international data bus used to support SAE J1939. If this connection is broken or improperly terminated, the CANplus™ display cannot show ECU parameters such as engine hours, oil pressure and diagnostic codes. The following test procedure helps identify the problem location:

1. Disconnect the battery.
2. Identify the engine diagnostic plug. Connect an ohmmeter across the CAN pins of the diagnostic plug.
3. A reading of 60±5 Ω indicates both ends of the bus are correctly terminated and the bus is intact.
4. A reading of 120±10 Ω indicates only one end of the bus is terminated.

> **Note:** The CP1000 has switchable termination via software. Please see the CAN bus settings in the Tech menus for more information.

An ohmmeter reading of around 120 Ω indicates the bus to the terminator in the panel is complete and the problem is between the panel and the engine terminator.

An open circuit ohmmeter reading indicates the bus to the engine terminator is complete and the problem is between the panel and the diagnostic plug.

5. Reinstall the terminator resistor and reconnect the battery.

   If the ECU diagnostic tool is available, use it to verify that the ECU is transmitting CAN data. Refer to the ECU documentation to identify and correct the error.

   If another panel is available for testing, replace the panel to determine if the error is in the panel.

9.5 Diagnostic Trouble Codes (DTC)

CAN Diagnostic Trouble Codes are a pair of numbers, the SPN (Suspect Parameter Number) and the FMI (Failure Mode Indicator). The SPN indicates the faulting subsystem and the FMI identifies the type of failure.

9.5.1 Typical SPNs

Standard SPN codes are defined by SAE J1939-71. Not all standard codes are provided by ECUs. Manufacturers may add additional SPN codes beyond the codes identified in J1939-71. Refer to the ECU documentation for supported SPNs. Table 2 describes some example SPNs.

Table 2: Example SPN

SPN	Description
51	Throttle Position
91	Accelerator Pedal Position
94	Fuel Delivery Pressure
98	Engine Oil Level
100	Engine Oil Pressure
110	Engine Coolant Temperature
111	Coolant Level

9.5.2 FMI

FMI codes are defined by SAE J1939-71. Refer to the ECU documentation for correct interpretation of the FMI codes for a specific SPN. Table 3 describes each FMI.

Table 3: FMI Descriptions

FMI	Description
0	Data valid but above normal operational range
1	Data valid but below normal operational range
2	Data erratic, intermittent or incorrect
3	Voltage above normal or shorted high
4	Voltage below normal or shorted low
5	Current below normal or open circuit
6	Current above normal or grounded circuit
7	Mechanical system not responding properly

FMI	Description
8	Abnormal frequency, pulse width or period
9	Abnormal update rate
10	Abnormal rate of change
11	Failure mode not identifiable
12	Bad intelligent device or component
13	Out of calibration
14	Special instructions
15	Data valid but above normal operational range (least severe)
16	Data valid but above normal operational range (moderately severe)
17	Data valid but below normal operational range (least severe)
18	Data valid but below normal operational range (moderately severe)
19	Received network data in error
20 through 30	Reserved for future assignment
31	Not available or condition exists

10 Certifications

10.1 FCC Part 15 Certification

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

	**WARNING**
	CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.

This equipment uses the following Antennas and may not be used with other antenna types or with antennas of higher gain:

Mfg.: Pegasus Wireless Products

Type: Dipole

Gain: 3 dBi

This equipment complies with FCC RF Exposure requirements and should be installed and operated with a minimum distance of 20 cm between the radiator and any part of the human body.

10.2 Industry Canada Certification

Note: These statements are required to be listed in both English and French Languages.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

This equipment complies with the ICES RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and any part of the human body.

Cet équipement est conforme aux limites d'exposition aux radiations ICES définies pour un environnement non contrôlé . Cet équipement doit être installé et utilisé à une distance minimale de 20 cm entre le radiateur et une partie de votre corps.

11 Technical Support

For remote and communication control systems support, parts and repair, or technical support, visit us online at: www.cattron.com/contact.

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