CANplus™ CP500
User Manual

9M02-1000-A500-EN | Rev-E

CONNECT. CONTROL. PROTECT.

Revision History

VERSION	DATE	NOTES
A	May 2024	Initial Release
B	August 2024	Updates from v1.02.00
C	November 2024	Various updates throughout the document
D	March 2025	Updates from v1.04.00
E	April 2025	Updates from v1.05.00

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1. Important Safety and Emissions Information

1.1 Safety Notation

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

⚠	**WARNING**
	IMPORTANT AND URGENT SAFETY INFORMATION – A HAZARD THAT <u>WILL</u>, 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 thoroughly read and understood before 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 regarding 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 key switch 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 because of starting or stopping the engine/machine during any ECU initiated emissions event.

2. Overview

The CANplus™ CP500 control panel offers both manual and auto-start options for controlling electronically governed diesel or natural gas engines compliant with EPA Tier 4 and EU Stage V regulations. It is also compatible with mechanically governed engines. The panel features a 2.8" diagonal QVGA (320x240 pixel) LCD screen, which displays various engine parameters such as RPM, coolant temperature, oil pressure, engine hours, voltage, exhaust emissions system status, and diagnostic codes through the SAE J1939 protocol from the Engine Control Unit (ECU).

The CP500's display is designed for visibility in all lighting conditions, housed in a durable IP67-rated enclosure, and equipped with a bright LED that signal faults, warnings, emission-related alerts, and autostart activation.

This panel is highly adaptable with 3 digital inputs, 3 analog sensors, 3 digital outputs, and real-time clock. There is an advanced and versatile Event Manager for configuring numerous start/stop scenarios and output activation. Additionally, an analog sensor enables a cruise control feature that adjusts engine speed to maintain or reach a set parameter.

The CP500 is encased in a robust, vibration-isolated enclosure, built to endure severe industrial conditions. It includes external, weather-resistant switches and controls for easy operation. Faults are displayed directly on the panel through clear popup messages and a detailed fault list. It also provides comprehensive diagnostic screens for in-depth analysis of the CAN bus data.

All diagnostic and emissions-related messages from the ECU or connected devices are clearly displayed on the CP500. Operators should be familiar with the engine manufacturer's ECU and related icons to appropriately respond to emissions compliance, service, and diagnostic messages. The panel also incorporates QR-Assist technology, which generates a QR code linked to diagnostic trouble codes for quick access to troubleshooting steps and detailed diagnostic information.

3. Display

The CANplus™ display is a robust, sunlight-viewable 2.8" QVGA color display with 6 large control buttons housed in a rugged, watertight IP67-rated enclosure. The 6 buttons provide 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.

The CP500 controller's LCD display is the primary source of information from the controller. It allows the user to view and monitor the status of sensors and other engine peripherals. This automotive-grade display adheres to the ToughSeries rugged standards by maintaining functionality to -20 °C throughout use and -40 °C with the backlight active. The controller shown below illustrates the controls used to navigate and change the on-screen information and subsequently use the controller.

3.1 Front Controller and Buttons

3.2 Analog Gauge pages, Digital Gauge page, Autostart Dashboard, & Big Gauge

There are four independently configurable pages of analog gauges. Each page has 6 configurable analog gauges. Pressing and releasing the ENTER button will toggle through the four pages. After the fourth analog gauge page, pressing and releasing the ENTER button will advance to the Digital Gauge Page, which shows the values of 12 different parameters. Pressing and releasing the ENTER button again will show the Autostart Dashboard, which shows the current Autostart configuration; start and stop events and condition, as well as the Maintain function and status. Finally, pressing and releasing the ENTER button while the Autostart Dashboard is showing will rotate the display back to the first analog gauge page.

All 24 gauges may be configured to create an application-specific data view. With Tech or Admin level access, the four pages of gauges can be configured using the following menu: **Display → Gauges → Quadrant Page #**.

The Big Gauge displays a single measurement, with a selectable icon and optional label.

Gauge Page 1 → Gauge Page 2 → Gauge Page 3 → Gauge Page 4

Big Gauge ← Autostart Dashboard ← Tabular Page

3.3 Autostart Dashboards

Stop Condition with Delay time countdown

Start Condition with Delay time countdown

Level & Start/Stop lines

Maintain Mode and Point

Maintain Level and Point line

Backup: Switches Closed   Backup: Switches Open   Maintain: 11.53 ft

Autostart not active

8.88 ft   8.88 ft
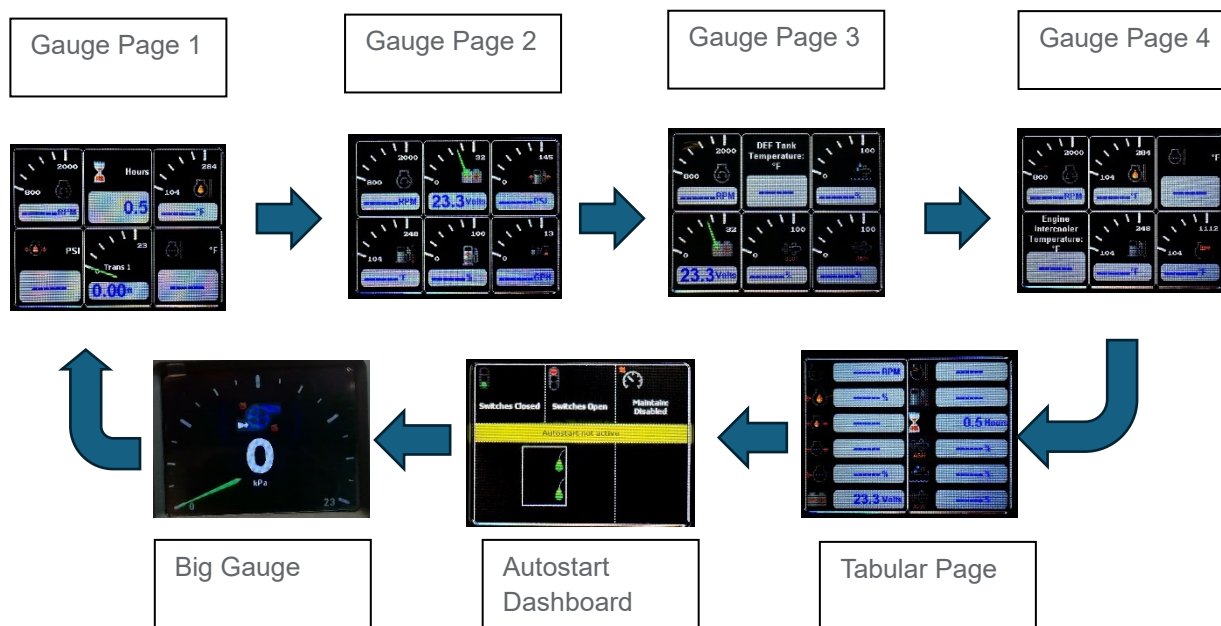
3.4 Enable/Disable Display Pages

As stated earlier, there are four Gauge Pages, one Digital Tabular Dashboard, and one Autostart Dashboard. Any of these pages and Dashboards can be disabled. Example: Gauge Page 2, 3, & 4 can be disabled as well as the Autostart Dashboard resulting only Gauge Page 1 and the Digital Tabular Dashboard being displayed.

Navigate with at least a TECH level access to System→Display→Gauges→Available Gauge Pages
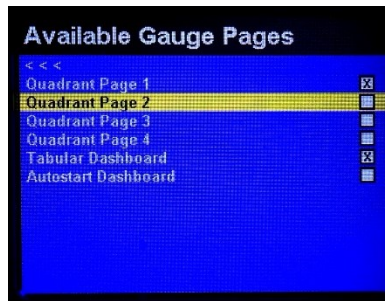
3.5 Status Gauge

There is a special gauge, called the System Status Gauge. It can be added to any or all of the four Gauge Pages.
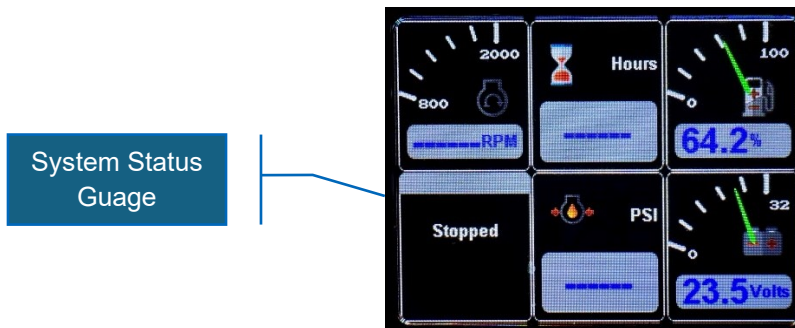
Below are only a few examples that the System Status will display.

- Stopped
- Preheat
- Cranking
- Ramping to Run
- Running
- Ramp Down
- Cool Down
- Remote Control
- DPF Cooldown

3.6 Active Alarms

When an active alarm is received, a 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

3.7 Alarm List

The Alarm List is accessed by pressing the ENTER button while an alarm popup is displayed. 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.
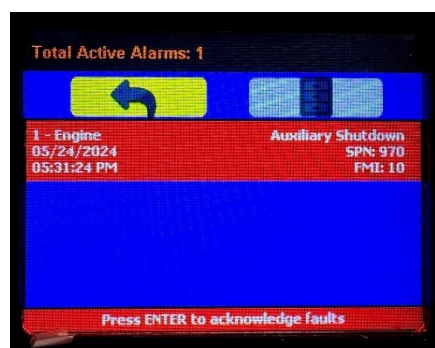
The list can be scrolled using the RABBIT and TURTLE buttons and alarms acknowledged by pressing the ENTER button, which will bring up the Alarm details. In the bottom right, is a QR-code that if scanned will take the user to the QR-Assist website for more details on the alarm (see the QR-Assist™ section).
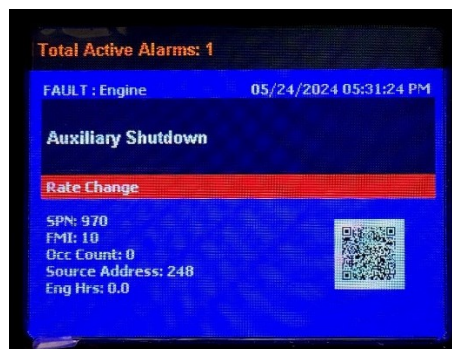
Stored Faults can be displayed by using the RABBIT and TURTLE buttons to highlight the Stored Faults icon then pressing Enter. The list shows all the controller-generated faults. The controller will also send a request to retrieve the ECU stored faults and list those as well. Alarm messages in the list are automatically removed when the alarm has not been received for a few seconds.

The Alarm List can be closed by using the RABBIT and TURTLE buttons to highlight the Exit icon.
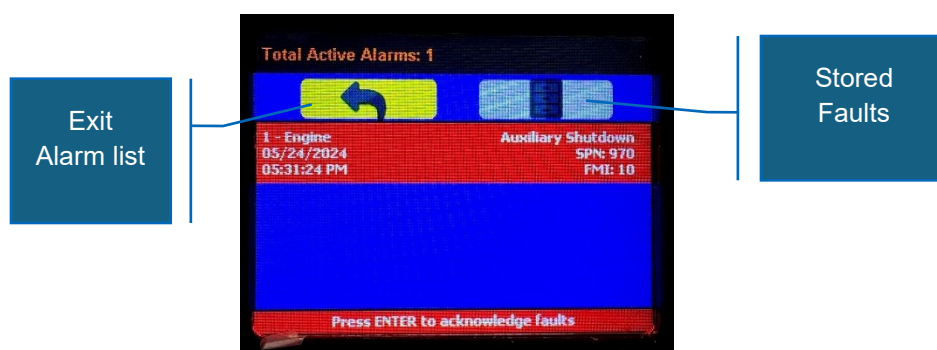
3.8 Menus

The menu pages can be accessed by pressing and holding the ENTER button. The top-level menu page will then appear. Once in the menu, the RABBIT and TURTLE buttons are used to navigate up and down through the menus, respectively. The ENTER button is used to select a menu item. On every menu at the top is the <<< item. Selecting the <<< will navigate back through the menus and ultimately out to the last displayed gauge page or Autostart Dashboard. As a shortcut, the ENTER button can also be held down to back up one menu level.

Select <<< to Navigate Backward

Menu Access Level
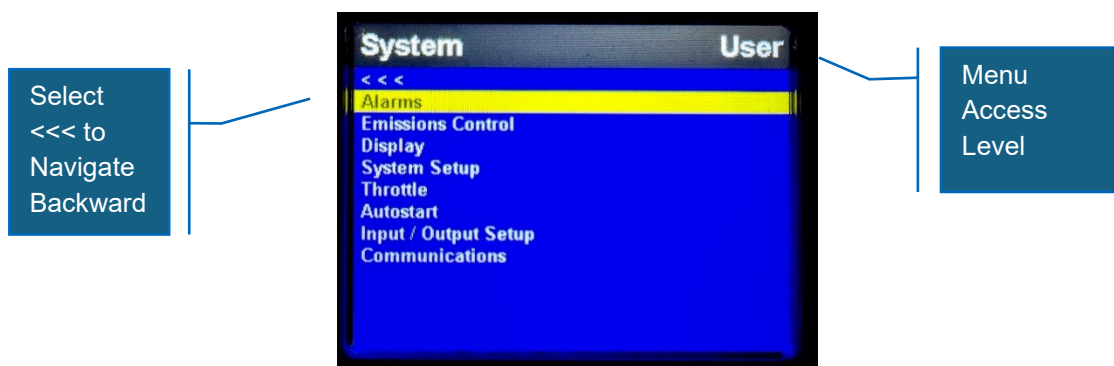
3.8.1 Entering Numerical Values

To enter numerical values such as Minimum RPM, a popup window will appear.
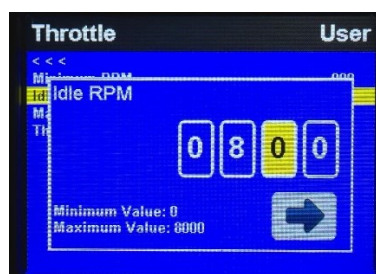
Use the RABBIT and TURTLE buttons to navigate to the desired digit to be changed, then press ENTER.

A + and – will appear above the digit being changed. Use the RABBIT and TURTLE buttons to increment or decrement the digit. Press the ENTER button to accept the new value. When all done, use the RABBIT and

TURTLE buttons to highlight the to accept the change.

3.8.2 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 item to be available for displaying. Blue = Guest, Black = User, Green = Tech, Red = Admin.

— Elevate Access

— Alarms

— Emissions Control
—— Request Force
—— Cancel Regen
—— Inhibit
—— Emissions Status
—— Inhibit Status

— Display
—— Language
—— Units
——— Distance
——— Pressure
——— Volume
——— Temperature
—— Gauges
——— Available Gauge Pages
——— Quadrant Page 1-4
———— Top Left
———— Top Middle
———— Top Right
———— Bottom Left
———— Bottom Middle
———— Bottom Right
——— Big Gauge Page
———— Display
———— Icon
———— Big Gauge Text
——— HOME
——— Gauge Timeout
—— Power Timeout s
—— Brightness

— System Setup
—— Configuration & Updates
——— Restore Defaults
——— Import Configuration
——— Export Configuration
——— Load Firmware
—— Set Date & Time
——— Month
——— Day
——— Year
——— Current Time
——— UTC Offset
—— PINs
——— Entry
——— User Pin
——— Tech Pin
——— Admin Pin
—— Engine
—— Remote Display Only
—— Engine Specific Settings

—— Starter
——— Running Threshold
——— Max Starter On (s)
——— Min Starter On (ms)
——— Dropout RPM
——— Restart Delay (s)
——— Restart Attempts
——— Mechanical Engines
——— Calibrate Tach
——— Tooth Count
——— Actuator Setup
——— Set Idle Position
——— Actuator Tracking
——— Crank at Full Throttle
——— Preheat
———— Duration
———— Afterglow Duration
———— Enabled During Crank
——— Change Engine Hours
——— Engine Data Source
——— Tachometer
——— Engine Hours
——— Coolant Temp
——— Oil Pressure
——— Fuel Level
—— PE854 / CAT3.4
——— Oil Life Reset
—— FPT F34
——— Oil Life Reset
——— Engine Shutdown
— About
— Legal and Regulatory

— Throttle
—— Minimum RPM
—— Idle RPM
—— Maximum RPM
—— Throttle Control
—— Switch RPM Increment
—— Max RPM Change / sec
—— Pause at Run RPM
—— Manual Throttle Mode
—— Manual Maintain Mode
—— Maintain Function
—— Start Point
—— Maximum Level
—— Minimum Level

— Autostart
—— Behavior
—— Operation
——— Start-Stop with
——— Autostart Delay
——— Stop Disable Delay (s)
——— Cycle Delay
——— Maintain Transducer

─────── Maintain Function
─────── Auto Throttle Input
─────── Auto Throttle Backup
─────── Target Point
─────── Throttle Aggressiveness
──── Ramp Profile
──── RPM Settings
─────── Intermediate PRM
─────── DPF Cooldown
─────── Run RPM
──── Time Profile
─────── Warm Up (s)
─────── Ramp Up (s)
─────── Intelligent Intermediate
─────── Intermediate (s)
─────── Ramp To Run (s)
─────── DPF Cooldown
─────── Ramp Down (s)
─────── Cool Down (m)
──── Transducer
──── Autostart Trigger
─────── Autostart Trigger
─────── Autostart Trigger Backup
─────── High Set Point
─────── Low Set Point
──── Setup
─────── Transducer 1
───────── Type & Range
─────────── 4mA Scaled Value
─────────── 20mA Scaled Value
─────────── Setup Units
─────────── Display Units
─────────── Calibrate Zero Offset
─────── Pulse Flow Meter 1
─────── Pulse 1 Flow
─────────── Maximum Frequency
─────────── Maximum Flow Rate
─────────── Setup Units
─────────── Display Units
─────────── Pulse Flowmeter 1 Total
─────────── Pulses Per Unit
─────────── Setup Units
─────────── Display Units
─────────── Reset Pulse
──── Sample Period (s)
──── Power On Time (s)
── Timed Run
──── Default Time (hh:mm)
──── Switch Adjustment (hh:mm)
── Cycle Time
──── Default State
──── Run Time (hh:mm)
──── Stopped Time (hh:mm)

─ Input / Output Setup
──── Inputs
──── Assignments
─────── Switch Input 1-3
───────── Input # Signal
───────── Active Level #
───────── Input # Delay
─────── Analog Input 1-3
───────── Analog Function

─────── Aux Input 1-3
─────── Operating State
─────── Run State
─────── Engine Running Delay
─────── Disable Delay
──── Engine Parameters
─────── Oil Pressure
─────── Oil Pressure
─────── Oil Pressure Scale
─────── Low-Pressure Pre-Alarm
─────── Low Pressure Alarm
─────── Coolant Temp
─────── Coolant Temp
─────── Coolant Sender
─────── High Temp Pre Alarm
─────── High Temp Alarm
─────── Fuel Level
─────── Fuel Sender
─────── High Temp Pre Alarm
─────── High Temp Alarm
─────── Battery Voltage
─────── Low Battery Pre Alarm
─────── Overspeed
─────── Overspeed Alarm
─────── DPF Status
─────── DPF Status
─────── Warning Alarm
─────── Shutdown Alarm
──── Button 2 Function (Auto)
── Outputs
──── Output 1 Source
──── Output 2 Source
──── Output 3 Source
──── Output Events
──── Alarm Output
─────── Pre-Start Duration
─────── Audible Self-Test
─────── Self-Test Duration
─────── Alarm Timeout
─────── At Speed Output
─────── At Speed Trigger
─────── Low Speed Disable
─────── High Speed Disable
──── Pump Events
─────── Pump Priming
─────── Detection Method
─────── Debounce time
─────── Switch Input
─────── Discharge Transducer
─────── Discharge Threshold
──── Aux Output 3
─ Communications
── CANbus Settings
──── Termination Resistor
──── Throttle Source Address (Set to 254 to disable)
──── Panel Address
──── CM1 Address (Set to 254 to disable)
──── SPN Version
── Modbus
──── Termination Resistor
──── Baud Rate
──── Parity
──── Address

3.8.3 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 CP500 supports up to three independent PINs that are configurable. The standard configuration has the following PINs settings:

- User = 0001
- Tech = 1111
- Admin = 2222
- Menu PIN Required = OFF

3.8.4 Elevate Access Level

When the controller 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 controller 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 controller is turned off or the display times out (see display Power Timeout).

3.8.5 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.

3.8.6 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.

3.8.7 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 controller will display "Invalid PIN".

Once an access level is granted, that level is retained until the controller is turned off or the display times out (see display Power Timeout).

When the controller is turned back to the ON position, the access level reverts to User and follows the Menu PIN Required setting.

4. Engine Setup

4.1 Engine Setup

Setting up the panel for a particular engine can be done through the menus. However, some engines require changes to multiple parameters, see section 4.2 and 4.4.

4.2 Electronically Governed Engines

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

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

Some engines require additional configurations. After selecting the engine type, check to see if the engine selected needs additional configurations by navigating to the **System Setup → Engine Specific Settings** menu. If the selected engine is listed, enter that sub-menu to configure the additional parameters.

Finally, set the Minimum, Idle and Maximum RPMs in the Throttling Menu. The intermediate RPM is located in Autostart → Ramp Profile → RPM Settings and must be /set between Minimum and Maximum RPM.

4.3 Typical D21 Pinout for Electronically Governed Engine

Deutsch Connector	Pin Description	Notes	Configurations/notes (**BOLD** = Default)
a	Pre-Heat	1A Configurable Aux Output	Pre-Heat, typically not needed **Alarm Active**
b	Battery + (B+)	Main Battery +	
c	Sensor Return	Sensor Ground	Sensor Ground
d	Starter	10A Configurable Output Aux Out	Used to control starter
e	Battery -	Main Ground	Power Ground
f	Can Shield	Can Shield	Can Shield (not a ground)
g	ECU/SOL	10A Configurable Aux Output	ECU power
h	Temp Sender	High Impedance Resistive	Coolant Temp, Normally not needed
j	Ignition	(same as pin G)	Ignition Excitation
k	Tach	Tach, Mag pickup input	Normally not needed
L	Modbus (A)	Modbus (A)	Modbus (A)
m	AUX Switch 2	Autostart SW-2/Ext-Turtle/**AUX SW in 2**	
n	Key Switch Power	1A Key Switch Power signal Available as Transducer Power	for indicating unit is keyed ON. Differs from ECU-Fuel, which times out with the display
p	Oil Pressure Sender	Analog In 3	0-5VDC/**4-20mA**/Low Impedance Resistive/High Impedance Resistive/Switch to Ground
r	AUX Switch 3	Aux SW in 3	
s	Tach GND	Tach Ground	Normally not needed

Deutsch Connector	Pin Description	Notes	Configurations/notes (BOLD = Default)
t	Modbus (B)	Modbus (B)	Modbus (B)
u	CAN L	CAN L	
v	CAN H	CAN H	
w	AUX Switch 1	Autostart SW-1/Ext-Rabbit/**AUX SW in 1**	
x	Fuel Sender	Low Impedance Resistive	Fuel Level if ECU does not report it

4.4 Mechanically Governed Engines

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

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

The following steps should be performed in order:

1. Calibrate the tachometer by selecting Calibrate Tach.
    a. 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 (if throttle control is required)
    a. Select the Actuator Setup menu, and press Enter when ready
    b. The procedure will have the actuator will measure its full range
    c. Use the Rabbit and Turtle buttons to move the actuator to the idle position, then press enter
3. Configure additional actuator options
    a. Set Idle Position: The idle position can be set numerically after initial Setup.
        i. If the idle position is >5% of less than 95% the actuator will be moved past the idle position while attempting to stop the engine
    b. Actuator Tracking: If the engine RPM is within this range, the position is not adjusted
        i. The actuator itself ignores small changes in the requested position.
    c. Crank at full throttle: If enabled, the actuator is moved to the full throttle position before and while the starter is engaged.

4.5 Typical D21 Pinout for Mechanically Governed Engine

Deutsch Connector	Pin Description	Notes	Configurations/notes (BOLD = Default)
a	Pre-Heat	1A Configurable Hi-side Output	**Alarm** or Preheat
b	Battery + (B+)	Main Battery +	
c	Sensor Return	Sensor Ground	Sensor Ground
d	Starter	10A Configurable Output	Starter
e	Battery -	Main Ground	Power Ground
f	Can Shield	Can Shield	Can Shield (not a ground)
g	ECU/SOL	10A Configurable Output	Fuel Solenoid
h	Temp Sender	High Impedance Resistive	Coolant Temp sensor
j	Ignition	Aux OUT 1 (same as pin G)	Ignition Excitation
k	Tach	Alternator, Mag pickup speed sensing input	
L	Modbus (A)	Modbus (A)	Modbus (A)
m	AUX Switch 2	Autostart SW-2/Ext-Turtle/AUX SW in 2/**Float 2**	
n	Key Switch Power	1A Key Switch Power signal Available as Transducer Power	
p	Oil Pressure Sender	Low Impedance Sender	Oil Pressure
r	AUX Switch 3	**AUX SW in 3/**Preheat Request	
s	Tach GND	Tach Ground	Not a ground, User must provide a negative reference near RPM signal source
t	Modbus (B)	Modbus (B)	Modbus (B)
u	CAN L	CAN L	
v	CAN H	CAN H	
w	AUX Switch 1	Autostart SW-1/Ext-Rabbit/AUX SW in 1/**Float 1**	
x	Fuel Sender	Low Impedance Resistive	Fuel Level sensor

4.6 Remote Display

A CP500 can be a remote display for a controller installed closer to the engine. In the menu, configure the Engine controller, then enable **System → Remote Display**. The remote display should be configured with the same settings as the local, with two exceptions.

1. The Remote Display Option, and second, is the configured engine.
2. The Configured engine

a. If the engine is electronically controlled both the local and remote should be set to the corresponding electronic engine type.
b. If the local is a DynGen 200 or CP500 connected to a mechnical engine the remote should be set to Generic T3 Before and the local set to Mechanical.
c. Finally, if the local controller is a DynaGen ToughSeries, the remote should set the Engine to DynaGenMimic

A controller acting as a remote display will not generate any faults and does not broadcast periodic messages. It will display faults broadcast from the Engine or main controller.

The CP500 implements the DynaGen Remote Control PGNs detailed in the DynaGen™ TOUGH Series™ J1939 Reference Manual.

A remote CP500 will display the state based on the status messages broadcast from the primary controller. If the configured engine is a DynaGen controller, the CP500 can approximate the status messages shown on a DynaGen ToughSeries controller.

A remote controller cannot issue trigger a manual start if the local controller is a CP500 or DynaGen 200, the local must be in auto.

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 key switch to the run position.
3. Press and hold the Run button.
4. Release the button when the engine or electric motor starts.

System Setup →Engine Specific Settings → Starter → Min starter on ms, Max Start On s and Running threshold must be properly configured.

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 controller's Minimum Requested RPM below the ECU's minimum RPM or set the controller's Maximum Requested RPM above the ECU's maximum RPM.

For example, the controller'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 controller 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.

5.2 Ramp Throttle

The standard Ramp Throttle uses the rabbit and turtle buttons to adjust the requested engine or motor speed. All throttle requests are sent directly to the engine using CAN throttle control or over Modbus to the VFD.

> **Note:** Throttle control requires CAN throttling to be enabled in the ECU, or a mechanical engine with compatible actuator. CAN throttling is also known as Torque Speed Control or TSC1.

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

- Pressing and releasing the rabbit 🐇 icon increases the speed by the Switch RPM 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 = 50 RPM).
- Pressing and holding the turtle 🐢 icon causes the speed to decrease (ramp) until the minimum speed is achieved.
- The CP500 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 Stopping the Engine

To stop the engine or motor, simply press the "OFF" button. The speed will be reduced in a control fashion and then the engine or motor will be stopped. Holding the button for more than 3 seconds will cause the engine or

motor to be stopped immediately. Do not use the Auxiliary Stop (if fitted) or the key switch to stop the engine or motor under normal conditions.

6. Autostart Operation

6.1 Prerequisites

The CP500 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 or motor may start without warning or notice.

The controller 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 controller is in "AUTO" mode (green Autostart light is illuminated).

6.2 Enabling Autostart

To place the controller in Autostart mode, turn the key switch (if fitted) clockwise to the ON position and press the AUTO button. The Autostart Dashboard will indicate that Autostart is active. 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 is still active. The power-down time can be adjusted through the Display menu with an Admin level access. When the selected start condition occurs, the controller will power up and attempt to start the engine after sounding the Autostart warning alarm. When the engine has successfully started, the controller will control the 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 controller will reduce the 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 controller will start immediately! Do not configure the controller when the Autostart mode is active! Always use lock-out/tag-out procedures when servicing autostart equipment!

6.3 Autostart Menu

The CP500 has two switch inputs that can be used 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 controller for sample applications:

Click here to view Dual Float Empty.

Click here to view Click here 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
* 2-State, Single Switch
  * Manually started and stopped
  * Switched input toggles between idle (open) and Intermediate RPM (closed)
* 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
  * Start and stop via Date and Time
  * If the scheduler mode is set to Override, a scheduled start can occur in any auto-start mode
* Timed run
  * Manually started
  * Automatically stopped by countdown timer
  * Can maintain a level while running

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

Table 1 High to Low Start Stop Events

START / STOP EVENTS	ENGINE OR MOTOR STARTS WHEN	ENGINE OR MOTOR STOPS WHEN
Single Switch	SW1 is active	SW1 is inactive
Dual Switch	SW1 and SW2 are both active	SW1 and SW2 are both inactive

START / STOP EVENTS	ENGINE OR MOTOR STARTS WHEN	ENGINE OR MOTOR STOPS WHEN
Transducer	Input is above the high set point	Input is below the 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/Cycle Run	Autostart switch pressed	Timer expires

The following table describes the Start/Stop events when the behavior operation is set to "Low to High":

**Table 2 Low to High Start Stop Events**

START / STOP EVENTS	ENGINE OR MOTOR STARTS WHEN	ENGINE OR MOTOR STOPS WHEN
Single Switch	SW1 is active	SW1 is inactive
Dual Switch	SW1 and SW2 are both active	SW1 and SW2 are both inactive
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/Cycle Run	Autostart switch pressed	Timer expires

6.4.2.0 Transducer Fault Detection Using Backup Switches

When configured and equipped with transducer and back up switches, the controller 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 controller will automatically adjust to use the switches to detect the start and stop events. The controller 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 like the following diagram. Typically, floats function as an Open switch when not floating and a Closed switch when floating.
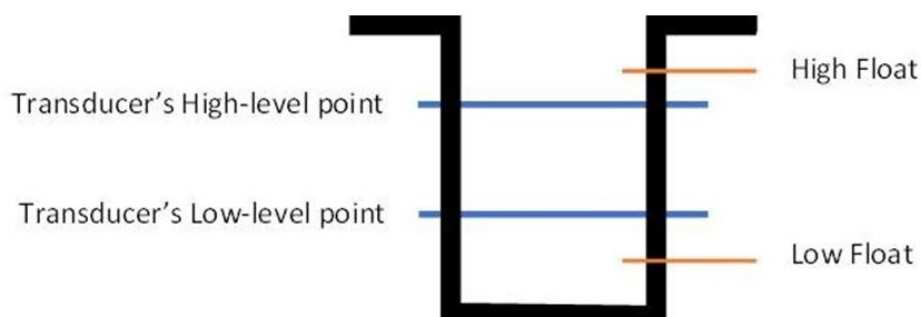
6.4.2.1 Faults

TRANSDUCER	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 CP500 can be configured to throttle the engine or motor 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 to Disable the Maintain Transducer Level, 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	THROTTLES 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 controller 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 controller 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. Like 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 RPMs will overshoot and undershoot the target value as depicted in the graph by the red "Too High" throttle aggressiveness line. Ideally, the 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 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 can be utilized to observe the behavior to determine if the throttling aggressiveness is correct.
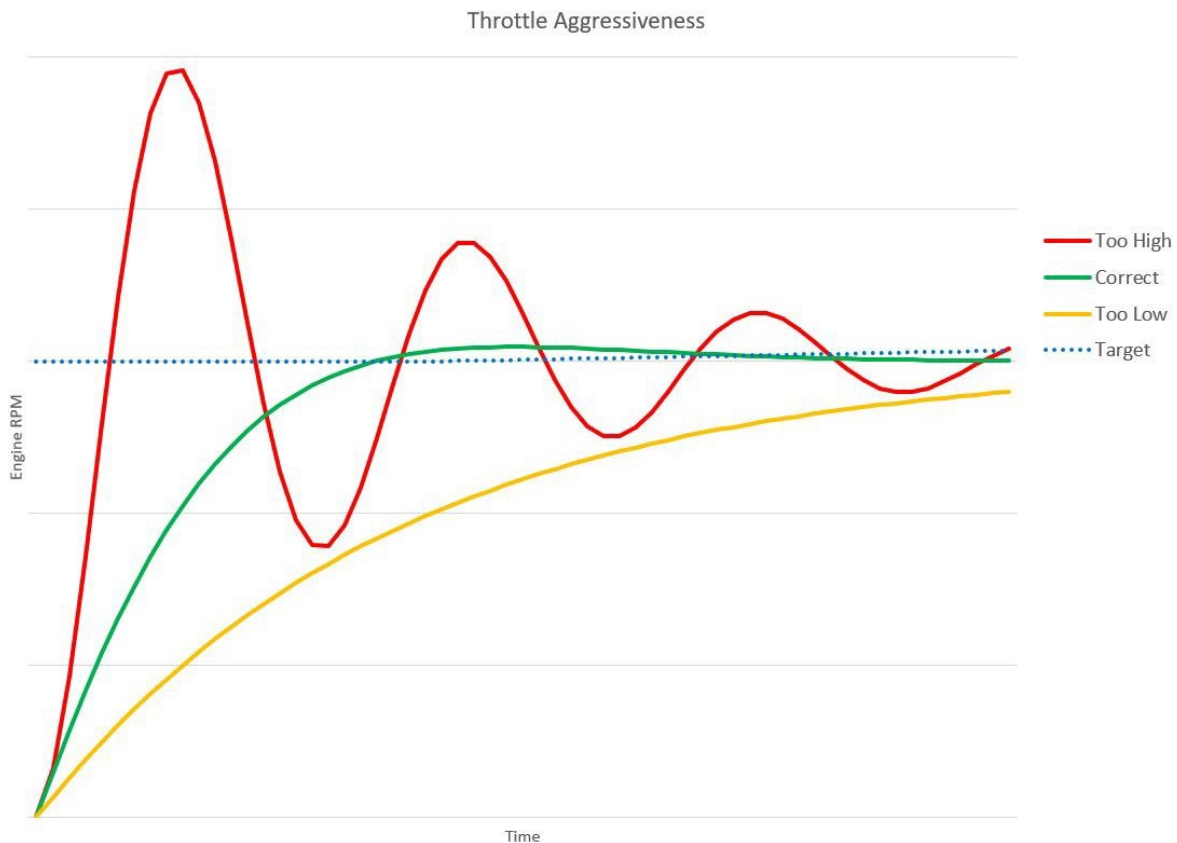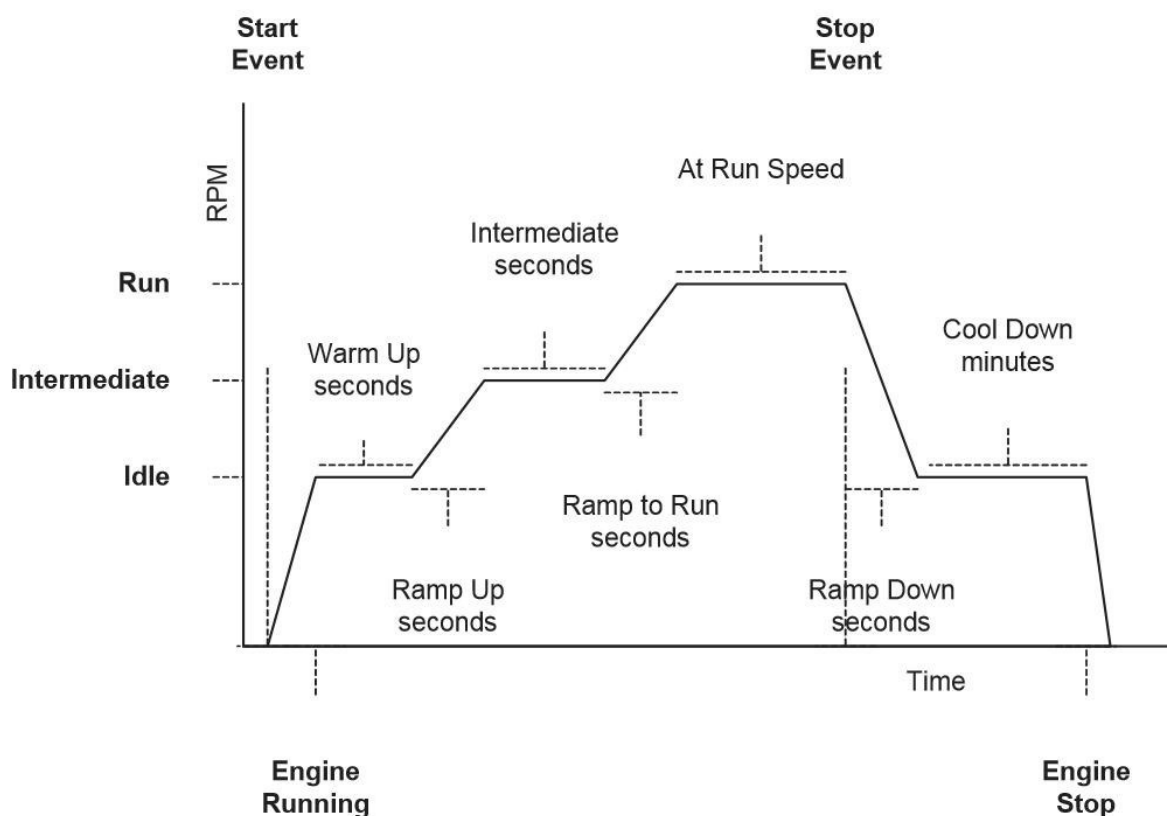

6.4.4 Configuring Start and Stop Delays

In situations where start or stop conditions may be met briefly, repeated start/stop cycles should 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 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 Auto ramp profile allows the use of configurable warm up and cool down profiles to help protect the equipment 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 or motor 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 or motor 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 controller will dynamically throttle the engine or motor to maintain the level using the Run RPM as the max.

Warm Up Time	The time (in seconds) the engine or motor will stay at the Idle RPM after starting.
Ramp to Intermediate Time	The time (in seconds) the engine or motor will take to ramp from the Idle RPM to the Intermediate RPM.
Intermediate Time	The time (in seconds) the engine or motor will stay at the Intermediate RPM.
Ramp to Run Time	The time (in seconds) the engine or motor will take to ramp from the Intermediate RPM to the Run RPM. If the Maintain Transducer Level is enabled, the controller will not ramp to the Run RPM but will start throttling the engine or motor to maintain the level.
Ramp to Cooldown Time	The time (in seconds) the engine or motor will take to ramp from the Run RPM to the Cooldown RPM.
Cooldown Time	The time (in <u>minutes</u>) the engine or motor will stay at the Cooldown RPM before shutting down engine or motor

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

- Pump is primed

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 few 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

If the Scheduler Method is set to Override by going to the **Autostart → Scheduler → Method** menu, it will override any Autostart settings.

The Scheduler mode starts and stops the engine or motor 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 controller 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. CANplus™ Control

The CP500 has expanded throttle capabilities, which provides users with more options to control electronically governed engines, electrical motors, or mechanically governed engines when equipped with the Cattron Throttle Actuator.

CANplus™ Control Throttling Options:

- Dynamic Throttling
- Pause at Run speed
- Throttle by Maintain Point
- Controlled Off
- Linear Throttling
- Auto/Manual mode Toggle
- Momentary Rabbit/Turtle Keys
- Auto ramp
- Autostart
- Auto throttle Maintain Point

7.1 Pause at Run speed

At Run Speed Single press and hold to ramp to the configurable run RPM and pause to allow throttling adjustments from that point

Click here for a video showing Setup and Demonstration on another CANplus™ controller or go to https://youtu.be/j6WimkphzsY.

7.2 Throttle by Maintain Point

Throttle by Maintain Point Live adjustments of the maintain point using the rabbit and turtle buttons.

Click here for a video showing Setup and Demonstration on another CANplus™ controller or go to https://youtu.be/MSitdFR5pkU.

7.3 Controlled Off

Controlled Off Single click to ramp the engine or motor down automatically and smoothly to idle and shut it off.

Pressing the OFF button for 3 seconds, will cause the engine or motor to immediately shutdown.

Click here for a video showing Setup and Demonstration on another CANplus™ controller or go to https://youtu.be/-vGmPeS2mdc.

7.4 Linear Throttling

Linear Throttling Allows an external device to control the throttle using a 4-20 mA input.

Click here for a video showing Setup and Demonstration on another CANplus™ controller or go to https://youtu.be/3HILfk1TSV8.

7.5 Auto/Manual mode Toggle

Auto/Manual Mode Toggle allows switching between modes without shutdown the engine or motor.

7.6 Momentary Rabbit/Turtle Keys

Momentary Rabbit/Turtle Keys Throttle adjustment via momentary rocker switch.

7.7 Autoramp

Autoramp Configurable seven-stage RPM profile.

7.8 Autostart

Configurable start and stop events for AutoStart switch inputs, 4-20 mA transducer (level, pressure, flow, etc.), 24x7 schedule run and countdown-to-off timer.

7.9 Autothrottle Maintain Point

Configurable 4-20 mA transducer and pulse flow meter target values to dynamically throttle the engine or motor to maintain a level.

8. QR-Assist™

The CP500 has built-in QR-Assist technology that dynamically generates a diagnostic QR-Code that is tied to diagnostic trouble codes for the Controller, Engine, VFD, Pump, or Machine. In addition to the trouble code itself, the dynamically generate QR Codes also contain valuable details about the machine at the time the trouble code occurs. Scanning this code with a typical smart phone automatically links to RemoteIQ QR-Assist website, which displays the details of the issue along with helpful trouble-shooting steps. Scan the code below for an example or Click here for a video showing Setup and Demonstration on another controller or go to https://youtu.be/00rD_Q8CWag

Some SPN/FMI combinations are proprietary codes. SPN/FMI combinations can easily be added by contacting support.lofa@cattron.com.
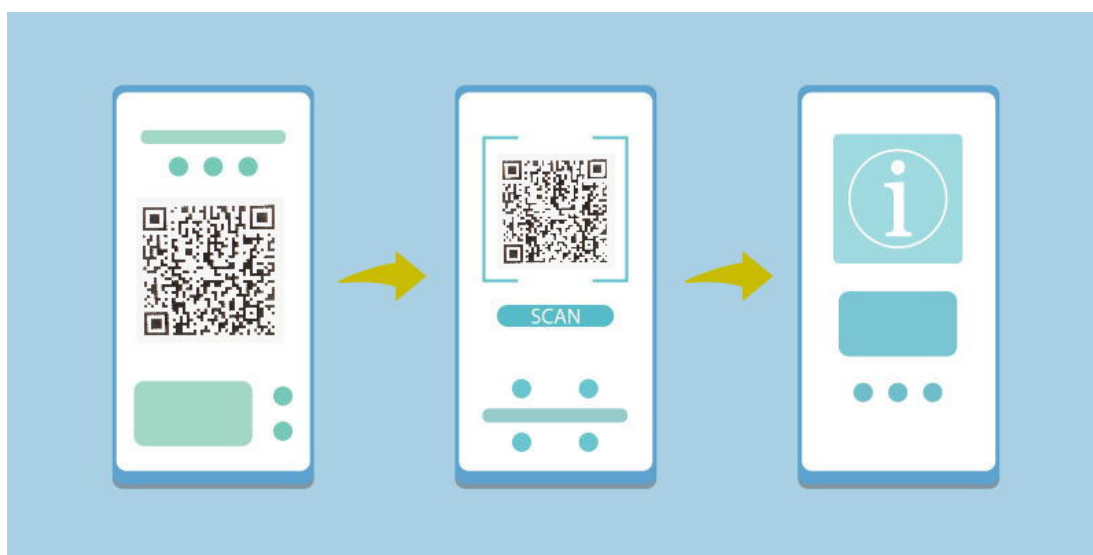
9. Configuration Info

The CP500 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
- Customizer Software using a USB-A to USB-A cable or a USB drive.

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

9.1 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.

9.2 Customizer Software

In situations where multiple units must be reconfigured, or in the case of a single unit which requires complete reconfiguration, using the Customizer Software, 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: https://www.cattron.com/products/CANplus/CANplus-cp500/

9.3 Customizer Software and a USB Drive

The CP500 includes the ability to import and export configurations using a USB drive. The panel's USB port is located on the front of the panel under the key switch. 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 Setup → Configurations & Updates → Export Configuration** menu. To import a new configuration, the menu access level must be at the Tech or Admin level (see 3.8.4 Elevate Access Level). A new configuration is imported by going to the **System Setup → Configurations & Updates → Import Configuration** menu. New configuration changes take effect immediately. Therefore, the engine should not be running when importing a new configuration.

10. Firmware Update

The CP500 either connects to the Customizer Software suite on a computer with a USB-A to A cable or firmware may be placed on a USB drive.

10.1 Customizer Software

On main page on Customizer select the Update button (shown below).
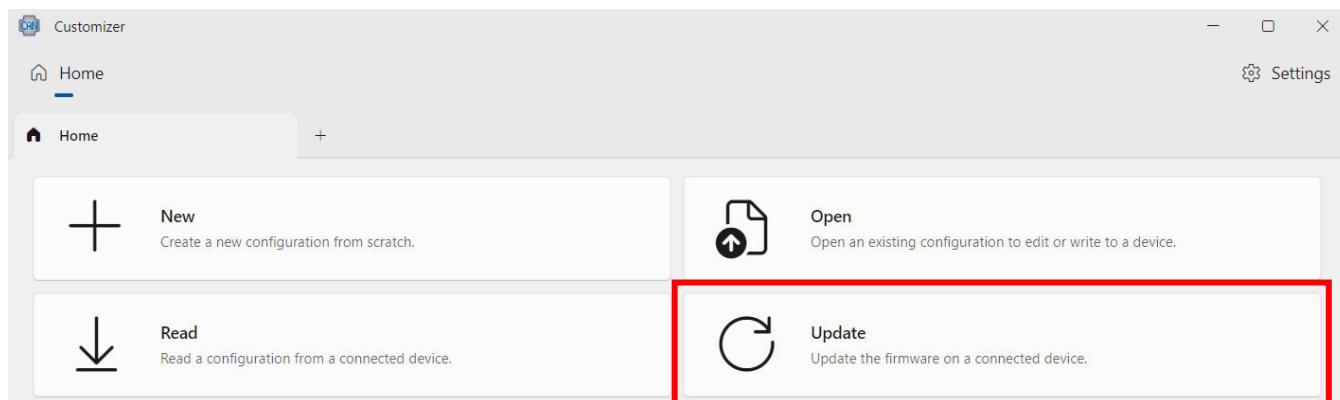
Then select the Update button referring to the CP500 connected to the computer. A drop-down menu will display the current version(s) of the firmware. If unsure, select the most recent. The firmware will automatically start downloading.

10.2 USB Drive

10.2.1 Preparation

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

10.2.2 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 and select **Load Firmware**. The controller 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.

11. Miscellaneous

11.1 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 or motor 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.

11.2 CP500 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 39in (1m) in length.

11.2.1 Typical J1939 Wiring Topology
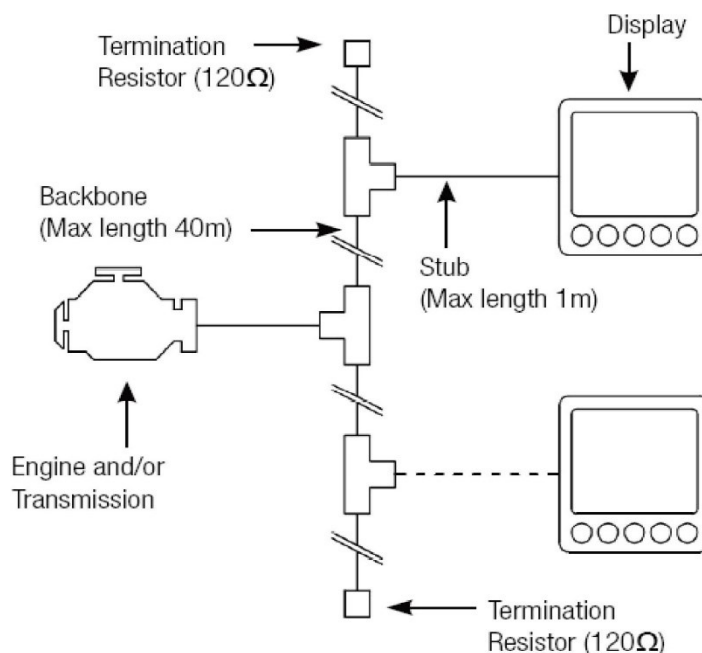
11.2.2 Engine Harness Connector

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 3: Engine Harness Connection

PIN	SIGNAL DESCRIPTION	DIRECTION	NOTES
A	Preheat Out	Out	10 A Maximum Output
B	Battery Supply	In	Connect direct to battery '+' via 30 A Fuse
C	Sender Return	In	Connect to Sender ground or as close as possible
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	RS485A	In/Out	Modbus

M	Auxiliary Switch 2	In	Ground Input
N	Key Switch Power	Out	1A Key Switch Power signal
P	Oil Pressure Sender	In	Resistive
R	Auxiliary Switch 3	In	Ground Input
S	Tach GND	In	Connect to Tach ground or as close as possible
T	RS485B	In/Out	Modbus
U	CAN Low	In/Out	J1939
V	CAN High	In/Out	J1939
W	Auxiliary Switch 1	In	Ground Input
X	Fuel Sender	In	Resistive

11.2.3 Sealed Connectors

The provided Deutsch sealed weather-proof plug includes a locking ring device which must be turned counterclockwise 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.

11.2.4 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.

11.2.5 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 to avoid seal distortion allowing moisture to enter the connector.

11.3 Engine Starter Excitation Connection

11.3.1 Starter Relay

GENERAL STARTER RELAY SPECIFICATIONS		
Minimum Starter Relay (Continuous) Rating	60 A @ 12 V	30 A @ 24 V

GENERAL STARTER RELAY SPECIFICATIONS		
Minimum 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 12 V and 24 V. Please contact your LOFA reseller for more information.

11.3.2 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.

11.3.3 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 weatherproof 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 to ensure integrity of the connection. The use of more than three terminals can cause the connection to become loose.

11.3.4 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 key switch 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.

11.3.5 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.

11.3.6 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 key switch 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.

11.4 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 or motor cranks, runs and shuts down:

POSSIBLE CAUSE	POSSIBLE REMEDY
Engine Stop LED illuminated	Correct ECU or FVD 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
Engine Stop LED illuminated	Correct ECU or FVD stop condition, use ECU diagnostics

11.4.1 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.

11.4.2 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 and the panel.
2. Connect an ohmmeter across the green and yellow CAN pins (pins u & v) of the D21 connector.
3. A reading of near 0 ohms indicates the other end of the bus is not correctly terminated or not intact.
4. A reading of 120±10 Ω indicates the other end of the bus is terminated correctly and that the CP500's software configurable termination resistor should be turned on.
5. A reading of 60±5 Ω indicates that the bus is already terminated at both ends and that the CP500's software configurable termination resistor should be turned off.

Note: The CP500 has switchable termination via software. Please see the CAN bus settings in the Tech or Admin menus for more information.

11.5 Diagnostic Trouble Codes (DTC)

CAN Diagnostic Trouble Codes be 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.

11.5.1 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 4 describes some example SPNs.

Table 4: Example SPN

SPN	DESCRIPTION
100	Engine Oil Pressure
110	Engine Coolant Temperature
111	Coolant Level

11.5.2 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 5 describes each FMI.

Table 5: 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
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

12. Certifications

12.1 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.

12.2 Industry Canada Certification

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

This device complies with Industry Canada license-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.

13. Technical Support

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

14. Icons Glossary

14.1 Gauge Icons

ICON	SPN	DESCRIPTION	ICON	SPN	DESCRIPTION
	94	Fuel Pressure		172	Inlet Air Temperature
	96	Fuel Level		173	Exhaust Gas Temperature
	97	Water in Fuel		174	Fuel Temperature
	98	Engine Oil Level		175	Engine Oil Temperature
	100	Engine Oil Pressure		177	Transmission Oil Temperature
	106	Inlet Air Pressure		183	Fuel Consumption Rate
	109	Engine Coolant Pressure		190	Engine Speed
	110	Engine Coolant Temperature		247	Total Engine Hours
	111	Engine Coolant Level		1761	SCR Fluid Level
	123	Clutch Pressure		2437	Magnetic Pickup / Input Frequency
	127	Transmission Oil Pressure		3719	Soot Percentage
	168	Battery Voltage		3720	Ash Percentage

14.2 Status Gauge Icons

NOTE: Not all engine templates use the icons on this page. Icon requirements are defined by the engine manufacture.

ICON	DESCRIPTION	ICON	DESCRIPTION
	Preheat Active / Wait to Start		Aftertreatment Fault - Lease Severe
	Regeneration Needed		Aftertreatment Fault - Intermediate Severe
	Low SCR Fluid		Aftertreatment Fault - Most Severe
	High Exhaust Temperatures Active	LIM	Engine Derate Active
	Regeneration Inhibited by Panel or other reasons	STOP ENGINE	Stop Engine
	Regeneration Needed - Most Severe	CHECK ENGINE	Check Engine
	Regeneration Needed - Least Severe		Malfunction Indicator
	Water in Fuel		

14.3 Autostart Dashboard Icons

ICON	DESCRIPTION	ICON	DESCRIPTION
	AutoStart - AutoStart Switch Active		AutoStart - Start Event Requirements

	AutoStart - AutoStart Switch Inactive		AutoStart - Stop Event Requirements
	AutoStart - Maintain Throttle Mode		

Due to continuous product improvement, the information provided in this document is subject to change without notice.

Tech Support
Contact a technical support specialist at 877.399.2937 for 24-hour support. Or visit cattron.com/contact for additional contact details.

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