Software Release CFG: 50-33-3941 rev J

ENOVATION CONTROLS®
A HELIOS COMPANY

VRU Pro™ Controller

Sequence of Operation Manual

C SA® US

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Section 50

Software Release CFG: 50-33-3941 rev J

Warranty – A limited warranty on materials and workmanship is given with this Enovation Controls product. A copy of the warranty may be viewed or printed by going to https://www.enovationcontrols.com/warranty.

BEFORE BEGINNING INSTALLATION OF THIS ENOVATION CONTROLS PRODUCT:

- Read and follow all installation instructions.
- Visually inspect this product before installation for any damage during shipping.
- Disconnect all electrical power to the machine. Failure to do this before welding can result in damage to the panel and/or its components.
- It is your responsibility to have a qualified technician install the unit and make sure the installation conforms to local codes including but not limited to double insulation and fire containment.
- Observe all Warnings and Cautions in each section of these instructions.
- Device shall be wired in accordance with Class I, Division 2 wiring methods.
- This equipment is suitable for use in Class I, Division 2, Groups B, C and D hazardous areas.
- WARNING–Explosion Hazard–Substitution of components may impair suitability for Class I, Division 2.

Contact Enovation Controls Technical Support if you have any questions or concerns at: +1 918-317-4100.

IMPORTANT! Improper use and operation of electronic products can be dangerous. It is required that point-of-operation guarding devices be installed and maintained. All such devices must meet OSHA and ANSI Machine safety standards. The manufacturer shall not accept any responsibility for installation, application or safety of systems.

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Introduction

The control system discussed in this document is the VRU Pro™ Controller designed for use in Class I, Division 2 hazardous areas, powered by user-supplied 120 VAC†, 12 VDC or 24 VDC. The controller will monitor various analog and switch inputs and automatically start and stop the compressor package as noted in this document.

† – with panel mounted AC/DC power supply

Dedicated Analog Outputs for Capacity Control

Compressor capacity may be controlled using Suction Pressure, Discharge Pressure and Motor Amps or Engine Intake Manifold Pressure PID loops to control a Recycle Valve and Desired Speed analog output. The variable requiring most unload (Low Value Selector) will limit the compressor capacity.

Dedicated Discrete Outputs for Capacity Control

Bypass Valve – Closes Bypass Valve to load machine after the warm-up cycle is complete.

Capacity PWM – The Pulse Width Modulation controlling two discrete outputs for Load and Unload of screw compressor slide valve. The control will use the Suction Pressure, Discharge Pressure and Motor Amps or Engine Intake Manifold Pressure PID setpoint and deadband settings and will work in conjunction with the Desired Speed and Recycle Valve analog outputs*. The variable requiring most unload (Low Value Selector) will limit the compressor capacity.

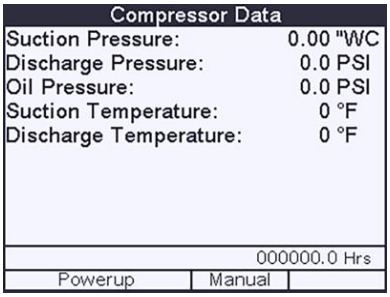
1 Load Step – Energize or de-energize a single discrete output with time in between. Control based on Suction, Discharge and Motor Amps or Engine Intake Manifold Pressure PID setpoint and deadband settings and will work in conjunction with the Desired Speed and Recycle Valve analog outputs*. The variable requiring most unload (Low Value Selector) will limit the compressor capacity.

2 Load Step – Energize or de-energize two discrete outputs with time in between. Control based on Suction, Discharge and Motor Amps or Engine Intake Manifold Pressure PID setpoint and deadband settings and will work in conjunction with the Desired Speed and Recycle Valve analog outputs*. The variable requiring most unload (Low Value Selector) will limit the compressor capacity.

*Standalone setpoint operation optional

Home Screen

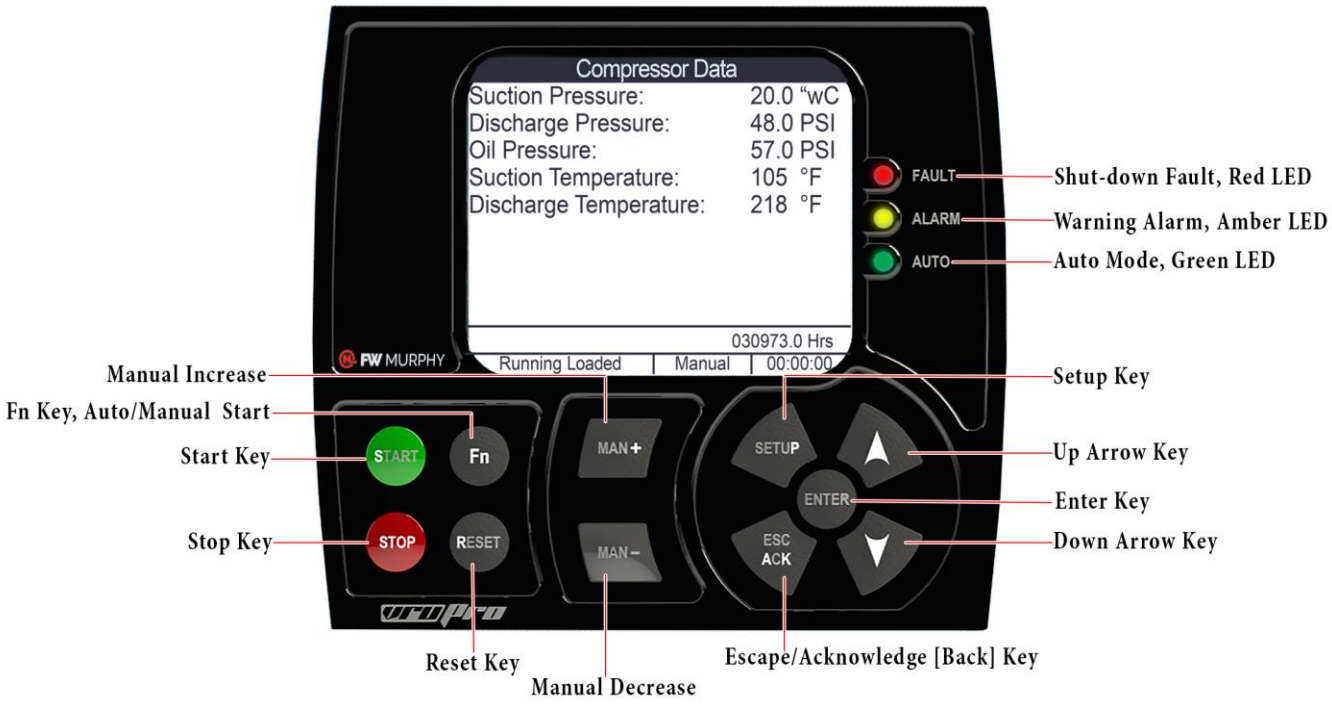
The Compressor Data screen is the default home screen and displays current data for the operator to view. See Operational Screens for details.



General Operating Instructions

Upon power up, the display will momentarily show a boot up screen and default to the Home screen as programmed. Use the navigation keys to maneuver within the display.

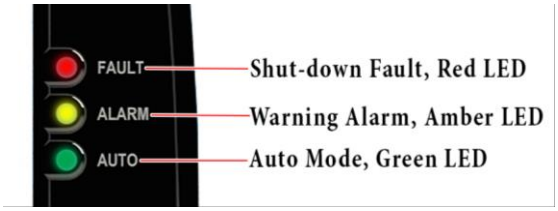
Some keys have multiple functions depending on the screen being displayed or state of the application.



Navigation Key	Description and Actions
Man + Key	Increases Manual Control Loop output when available
Fn Key	Toggles panel mode from MANUAL start mode to AUTO start mode except when noted on the display. On the Timers page, this toggles the TEST mode. On Recycle Valve Page and Desired Speed Page, this toggles the Control loop mode between Auto and Manual.
Start Key	Initiate the start sequence (Press and hold for 2 seconds)
Stop Key	Initiate the stop sequence (Press and hold for 2 seconds)
Reset Key	Press to reset fault condition after corrective actions are complete, and return to Ready To Start condition
Man - Key	Decreases Manual Control Loop output when available
Esc/Ack Key	Acknowledges any alarm or shut-down fault messages May use to go back a screen
Down Arrow Key	Navigates down through the menu and page backward in the same screen
Enter Key	Selects a highlighted field or numeral May use to save Upon power up press enter to display any active alarm or shut-down fault banners that have been acknowledged
Up Arrow Key	Navigates up through the menu and page forward in the same screen
Setup Key	Opens password screen to access set-up menus

LEDs

The LEDs quickly provide a visual response indicating modes of boot, faults and other specific occurrences.



Indicator	Description
Fault	Red LED, a shut-down fault has occurred
Alarm	Amber LED, a warning is active
Auto	Green LED, shows program is in Auto mode, flashes during Auto Start Delay timing to signal in impending auto start

LED Blink Codes

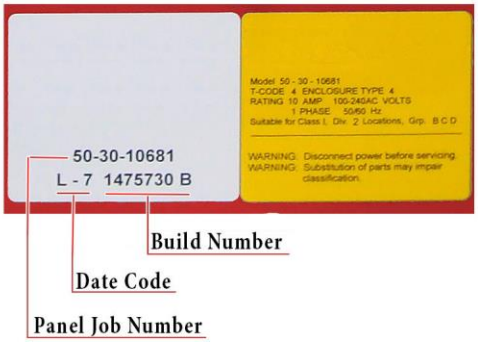
- At startup:
  - Upon entering boot, all LEDs are on
  - Upon exiting boot, all LEDs are off
- Red + Amber + Green flashing:
  - Staying in boot due to user request (holding down arrow and esc/ack buttons during power up)
- Amber flashing:
  - In boot
- Amber + Red Flashing, Green ON:
  - USB Programming Complete
- Red + Amber flashing:
  - Static flash block bad, contact Enovation Controls Technical Support at +1 918-317-4100*
- Amber flashing, Red ON:
  - Invalid application, contact Enovation Controls Technical Support*
- Amber flashing, Green ON
  - Invalid configuration, contact Enovation Controls Technical Support*
- Amber flashing, Green + Red ON
  - Invalid application and configuration, contact Enovation Controls Technical Support*

Audible Buzzer

The Buzzer will sound at 1hz during Auto Start delay to signal impending automatic start.

Panel Identification for Service Support

Please locate the numbers on your panel before calling Technical Services for support. Your panel identification number is located on the sticker on the front panel. The software number will remain the same; its revision letter will change with each software update.

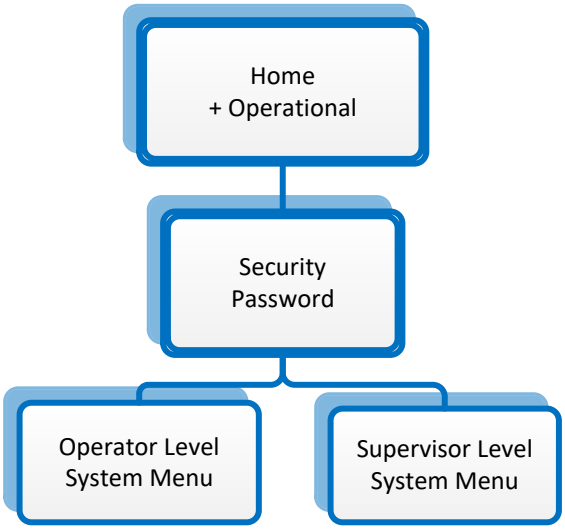


Panel Identification	Description
Panel Job Number	The panel job number is necessary to support the product. It identifies the structural, electrical and configuration setup of the panel as built by the manufacturer.
Date Code	Manufactured date code for the panel L = 2015 7 = July (7th month)
Manufacturer Build Number	For internal use ONLY

Accessing the System Menu Screen for Setup and Settings

Screen Hierarchy

This is intended to be used as a visual aid to show the highest levels in the program. The Operational Screens are all on the top level but are not individually listed in this example. Refer to section Operational Screens (Home) to view them separately.



Password Screen

Press the Setup

key. The Security Password screen appears, requiring log in.

Use the Enter

key and the Up Down arrow keys to maneuver in this screen.

Operator level password is 0164.

Supervisor level password is 0133.

After successful log in, the System Menu will appear.

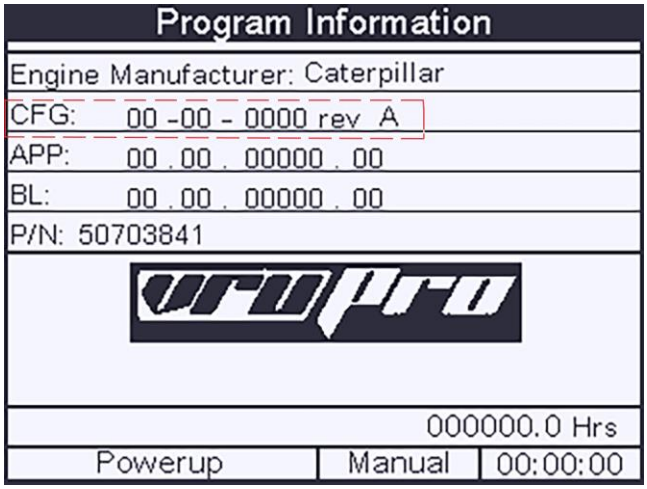
Quick Start Set-up Guide

Firmware Verification

Always verify that your Operations Manual is current with the firmware shipped in your controller.

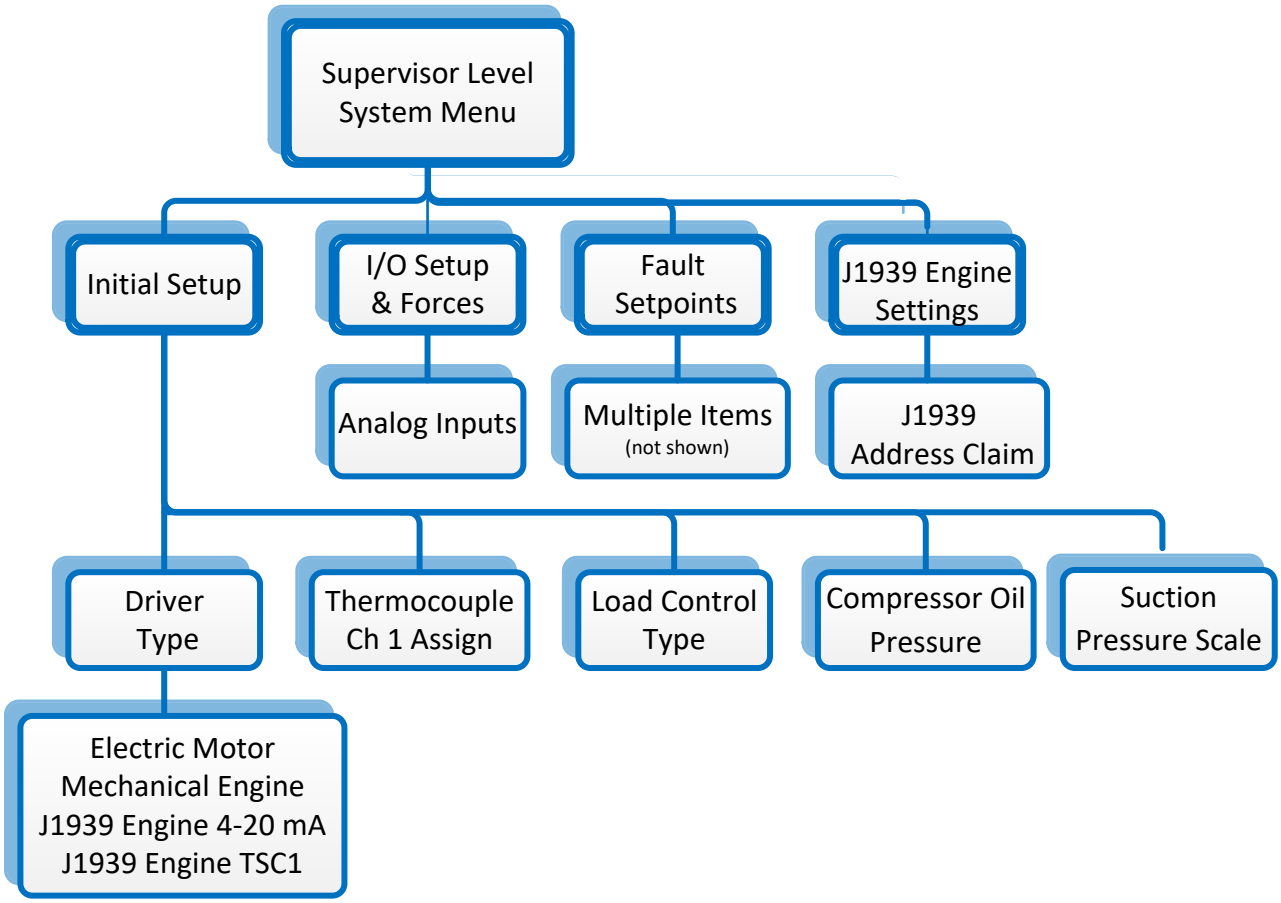
From the Home/Compressor Data screen, press the Down arrow key to scroll to the Program Information screen.

Verify the CFG (configuration) number and revision letter displayed on the screen. The numbers should match the Software Release numbers shown in the top left of this document.



Screen Hierarchy for Setup Guide

This is intended to be used as a visual aid during Setup. Some screens are not listed. Read and follow steps in the Setup Guide.



Setup Guide

Listed below are the minimum set-up steps required to set up and run Enovation Controls' VRU Pro panel. Please note that some of the items may be preconfigured at the factory.

Perform and verify the steps in order listed to ensure correct setup.

> **NOTE:** If the Factory Default is the correct setting for your application, you may skip that step. Refer to the section Supervisor Level Setpoints and Settings for the [Factory Default] setting listed in the charts.

1. Press the Setup

key and enter the code 0133. This will open the System Menu Screen under the Supervisor level access. The system will remove this security level in a short period of no response time. If you are timed out, you must enter the code again.

> **NOTE:** Some screens have multiple pages; use the Down arrow to search for a specific listed item on the second page.

2. Verify the Driver Type is set for your application. (Factory default: Mechanical Engine)
   - Navigate to: System Menu / Initial Setup / Driver Type
3. Choose desired Suction Pressure Scale.
   - Navigate to: System Menu / Initial Setup / Suction Pressure Scale
4. Choose desired label text for Thermocouple #1.
   - Navigate to: System Menu / Initial Setup / Thermocouple #1
5. Choose the function of the discrete outputs for load control, if you require a load command for a bypass valve, capacity slide or capacity poppet.
   - Navigate to: System Menu / Initial Setup / Load Control Type
6. Choose whether the compressor has oil pressure monitoring.
   - Navigate to: System Menu / Initial Setup / Compressor Oil Pressure
7. Verify the Transmitter scaling. Locate the transmitter data sheet and verify the data on the screen matches it. The engineering units must match the actual transmitter scale.
   - Navigate to: System Menu / I/O Setup & Forces / Analog Inputs
8. Verify Fault Setpoints. Refer to the compressor manufacturer information to set low and high suction, discharge and compressor oil pressure limits. (May also be changed on the operator security level.)

   > NOTE: Choose the fault settings to protect the compressor and driver.

   - Navigate to: System Menu / Fault Setpoints/ Select Each Item
9. Refer to the driver manufacturer information to set the low and high limits for fluid temps, speeds or amperage as applicable. (May also be changed on the operator security level.)
   - Navigate to: System Menu / Fault Setpoints/ Select Each Item
10. **J1939 Engines with TSC1 ONLY:** Verify the Address Claim setting required for your engine to accept TSC1 speed commands. Common settings are 3, 39 or 234 but vary by engine manufacturer.
    - Navigate to: System Menu / J1939 Engine Settings/J1939 Address Claim

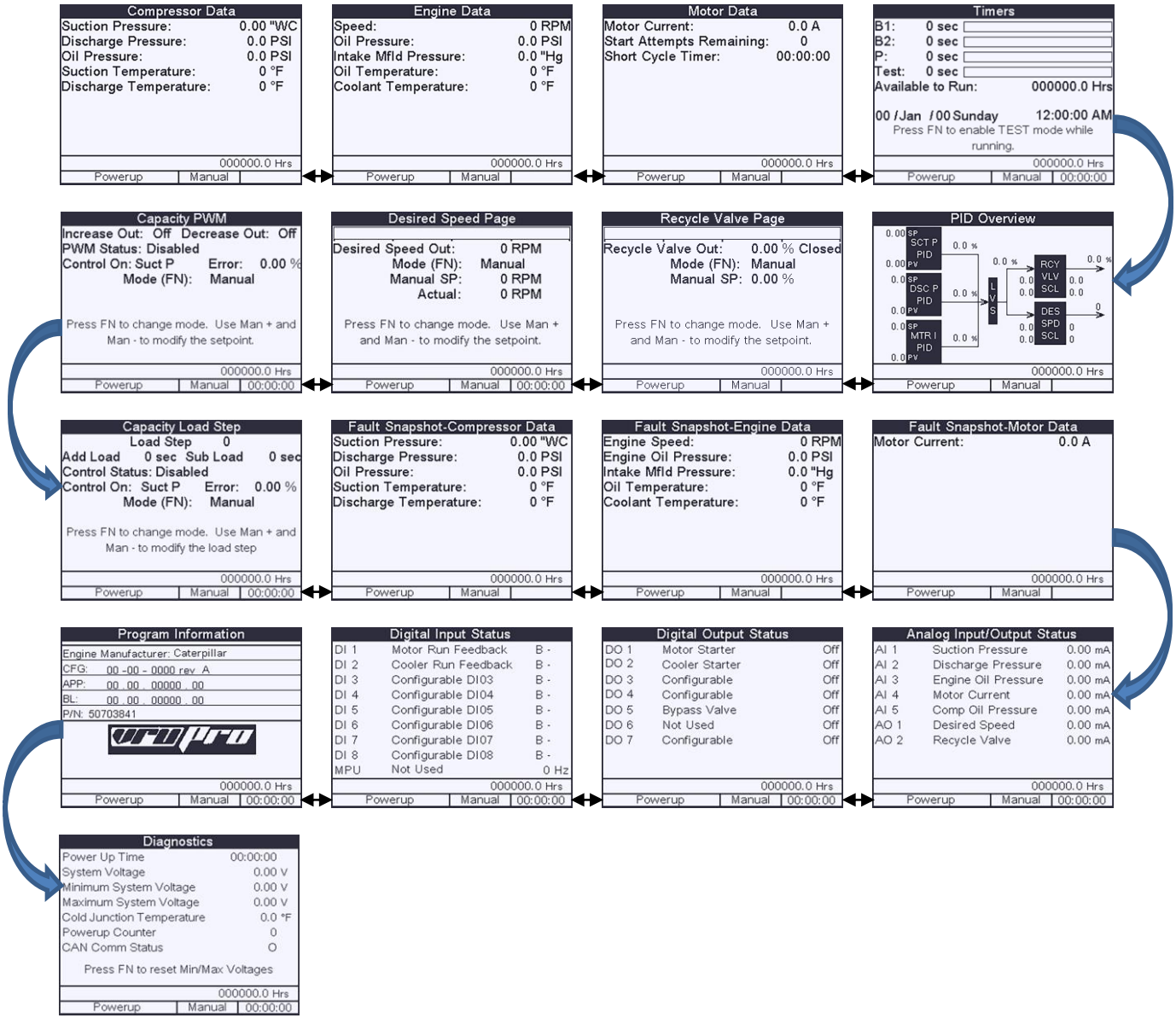
Operational Screens (Home)

Maneuvering

The Operational screens can be viewed without entering a password. The default Home screen is the Compressor Data screen.

From the Home/Compressor Data screen, press the Up Down arrow keys to navigate forward and backward.

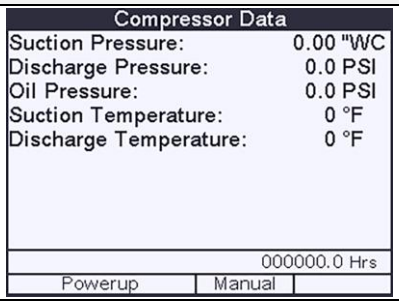
The illustration shows available screens on the controller. You will only see the screens applicable to your setup. Any remaining screens are hidden from view.

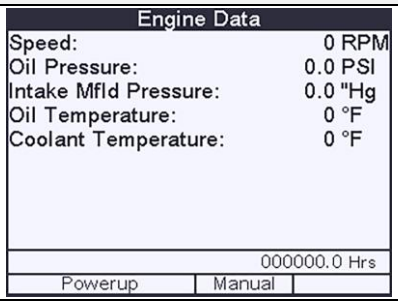


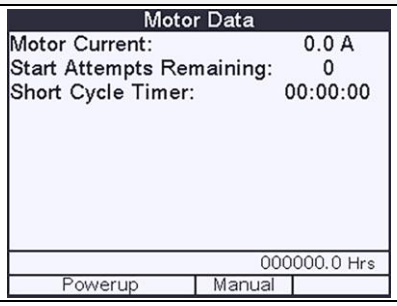
Operational Screens Description and Action

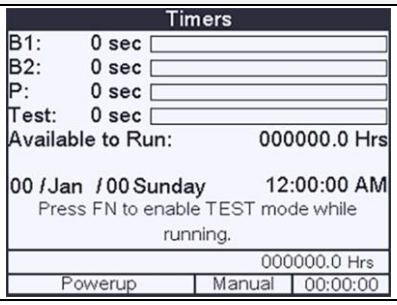
Each Operational Screen is illustrated with a description and any action that may be available from that screen.

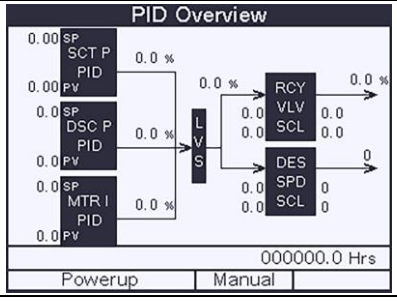
> **NOTE:** The controller displays screens applicable to the Driver Type and Load Control selections entered.

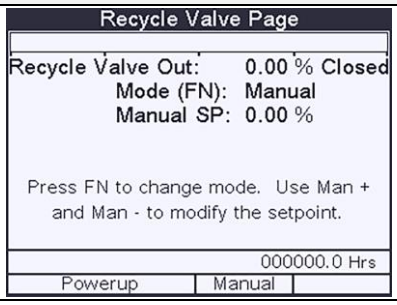
Compresser Data Screen	Description / Actions
	The HOME screen. Contains Compressor Data. Press the Fn key to toggle start mode on this screen.

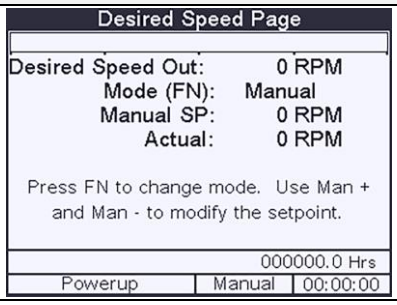
Engine Data Screen	Description / Actions
	The Engine Data Screen is visible only if ENGINE is selected as the Drive Type.

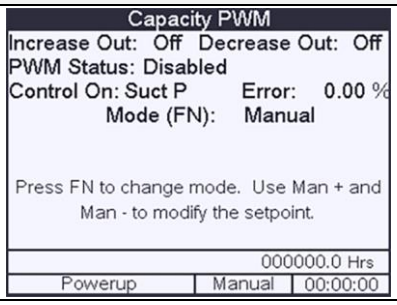
Motor Data Screen	Description / Actions
	The Motor Data screen is visible only if MOTOR is selected as the Drive Type. This will indicate the number of starts per hour remaining and the hour time remaining before regaining a start attempt.

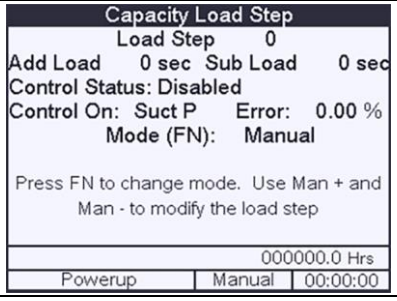
Timers Screen	Description / Actions
	Displays fault lockout time remaining, Test timer, real time clock and total unit time available to run i.e. not in fault condition. Press Fn key to enter TEST mode while running.

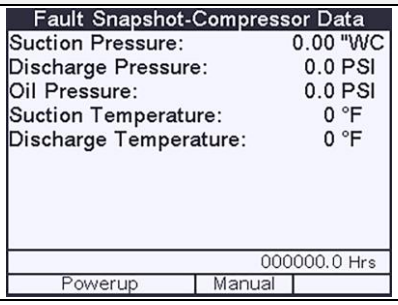
PID Overview Screen	Description / Actions
	Displays Suction Pressure PID, Discharge Pressure PID and AMPS/MFLD P PID. The LVS is the lowest value output of the three, which will be used to control load. LVS output is used to scale Recycle Valve % Closed and Desired Speed output. All scaling values are visible here.

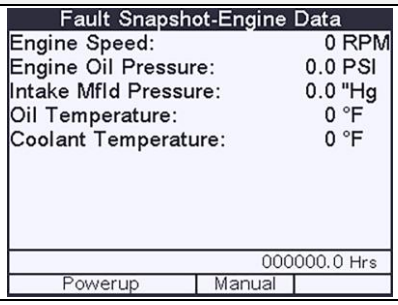
Recycle Valve Page Screen	Description / Actions
	A manual operation page. Press Fn key to toggle to MANUAL or AUTO mode. Use MAN + and MAN – to bump the output manually. Set the amount per manual keypress in the Control Loop Tuning Menu.

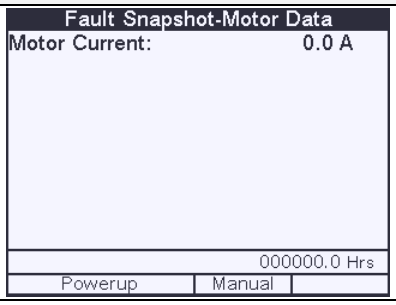
Desired Speed Page Screen	Description / Actions
	A manual operation page. Press Fn key to toggle to MANUAL or AUTO mode. Use MAN + and MAN – to bump the output manually. Set the amount per manual keypress in the Control Loop Tuning Menu.

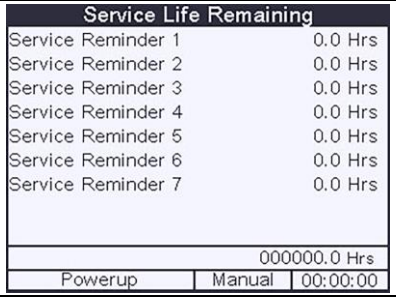
Capacity PWM Screen	Description / Actions
	Displays PWM control status, and which feedback variable is being used to control the PWM outputs. Press the Fn key to toggle to MANUAL or AUTO mode. Use MAN + and MAN – to manually bump the capacity load and unload outputs.

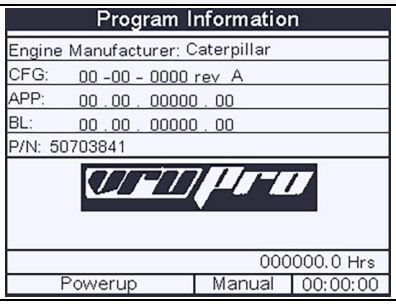
Capacity Load Step Screen	Description / Actions
	Displays Load Step control status, and which feedback variable is being used to control the Load Step outputs. Timers to add or subtract load step are also displayed. Press Fn key to toggle to MANUAL or AUTO mode. Use MAN + and MAN – to increase or decrease the load step.

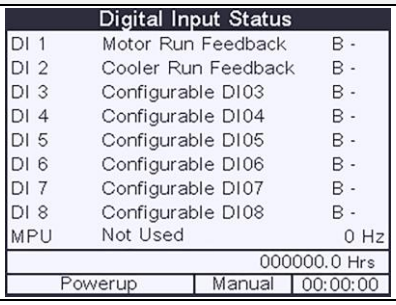
Fault Snapshot – Compressor Data Screen	Description / Actions
	Displays a snapshot of faults at time of last shutdown.

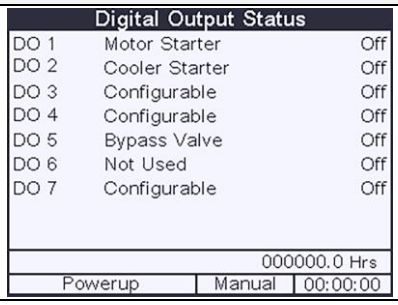
Fault Snapshot – Engine Data Screen	Description / Actions
	Displays a snapshot of faults at time of last shutdown.

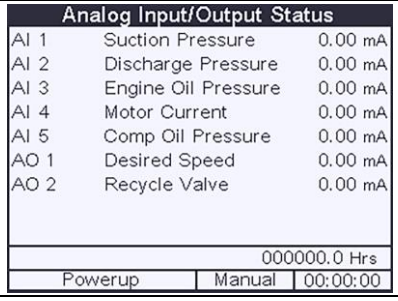
Fault Snapshot – Motor Data Screen	Description / Actions
	Displays a snapshot of faults at time of last shutdown.

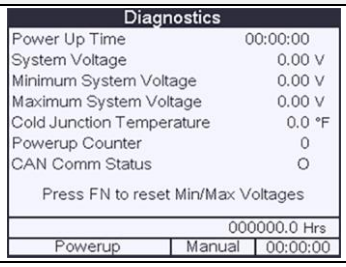
Service Life Remaining Screen	Description / Actions
	Displays the time remaining before the next scheduled service is due (run hours only).

Program Information Screen	Description / Actions
	Program firmware version and number information.

Digital Input Status Screen	Description / Actions
	Discrete input status page. Use to troubleshoot and verify sensors and actuators.

Digital Output Status Screen	Description / Actions
	Discrete output status page. Use to troubleshoot and verify sensors and actuators.

Analog Input/Output Status Screen	Description / Actions
	Use to troubleshoot and verify sensor signals and verify actuators.

Diagnostics Screen	Description / Actions
	Volatile timer for the amount of time that power has been applied, minimum and maximum system voltage seen, diagnostic count for number of power cycles and CAN communication status.

Initial Configuration of Software Features

The VRU Pro controller has many software configurable features, and this Sequence of Operation Manual will refer to many of them which may or may not be in use. This controller was configured specifically for your application at the factory.

To view the factory defaults, refer to the charts in the section Supervisor Level Setpoints and Settings. The charts list a description, available Range and [Factory Default] of the settings. Also, refer to the charts in the section Operator Level Setpoints and Settings.

Configurable Discrete Inputs

There are six Configurable Discrete Inputs. These inputs may be configured from the display to be normally open, normally closed to DC+ or normally closed to DC-. Normal refers to the non-fault, running condition.

- The discrete inputs may be configured as Class A, B1, B2, C or P shutdowns. The text displayed on the VRU Pro may be also configured as a string up to 18 characters long. The factory default class types and string settings will match the VRU Pro Sequence of Operation document.

  > **NOTE:** If ENGINE DRIVER TYPE is selected, two additional spare discrete inputs may be configured (DI1 and DI2).

- Each discrete input has a fault debounce timer to configure a persist time required before a fault is triggered.
- May also be optionally configured to control up to three configurable discrete outputs. They may be set up to either turn on and off the output based on input state, or they may be set up to only turn on and only turn off the outputs.

Configurable Analog/Thermocouple

The Recycle valve analog output may be configured as fail-open or fail-closed to set the default shelf position and adjust the control logic to drive the valve to the commanded position as needed. This will change the PID loop direction and the commanded output during non-running states accordingly.

Optional Compressor Oil Pressure

Analog input 5 may be either enabled or disabled for reading and faults for the Compressor Oil Pressure.

One Configurable Thermocouple Input

Thermocouple Channel 1 can be configured as Suction Temperature, Compressor Oil Temperature or Discharge #2 Temperature.

Configurable Driver Types

Set the Driver Type as Electric Motor or Engine to determine the correct driver start-up logic.

- Electric Motor
- Mechanical Engine
    - J1939 Engine w/4-20 Speed
    - J1939 Engine w/TSC1

Electric Motor

Electric Motor operation will control the Main Motor and Cooler Motor starter outputs. Run confirmation for each motor will be monitored through discrete input.

The following Motor specific instrumentation will be enabled.

- DI1 – Main Motor Running
- DI2 – Cooler Motor Running
- AI4 – Main Motor Current

> NOTE: If Motor Amps transducer is not needed, zero out its MIN and MAX raw count settings to disable this sensor.

Mechanical Engine

The Mechanical Engine operation will control the Crank and Ignition outputs to the engine and monitor a magnetic pickup for run confirmation.

The following Engine specific instrumentation will be enabled.

- MPU – Magnetic Pickup
- AI3 – Engine Oil Pressure
- AI4 – Engine Manifold Vacuum / Pressure
- TC3 – Engine Oil Temperature
- TC4 – Engine Coolant Temperature

J1939 Engine 4-20mA

The J1939 Engine 4-20 mA operation will control the Crank and ECU Enable outputs to the engine and monitor speed for run confirmation. The engine ECU run hourmeter will replace the VRU Pro internal run hourmeter.

The following J1939 Engine data will be monitored at ECU Source Address 0.

- PGN65253 SPN247 – Total Engine Hours

Each of the following signals below may be individually selected to be monitored via J1939 at ECU Source Address 0 or hardwired input. J1939 is the default selection.

- Engine Speed – PGN61444 SPN190 or MPU
- Engine Oil Pressure – PGN65263 SPN100 or AI3
- Engine Manifold Vacuum/Prs – PGN65270 SPN102 or AI4
- Engine Oil Temperature – PGN65262 SPN175 or TC3
- Engine Coolant Temperature – PGN65262 SPN110 or TC4

If selected as J1939, the faults for Engine speed, Engine Oil Pressure, Engine Boost Pressure, Engine Oil Temperature and Engine Coolant Temperature will be handled by the engine ECU and are disabled in the VRU Pro. If selected as hardwire signals, the faults are enabled in VRU Pro.

The following J1939 Engine data will be monitored at ECU Source Address 0.

- PGN61444 SPN190 – Engine Speed
- PGN65263 SPN100 – Engine Oil Pressure
- PGN65270 SPN106 or SPN102 – Selectable between Air Inlet Pressure or Engine Manifold Pressure #1
- PGN65262 SPN175 – Engine Oil Temperature
- PGN65262 SPN110 – Engine Coolant Temperature
- PGN65253 SPN247 – Total Engine Hours

The following J1939 Engine commands will be broadcast.

- PGN65226 – Request Active DTCs
- PGN65227 – Request Historic DTCs

The Display will include ability to read DM1 fault messages and a show a pop-up for the Active DM1 fault codes, Failure Mode Indicator (FMI) and Occurrence Counts (OC).

The Lamp Status will be used to trigger an alarm or fault message on the display.

A Red Stop Lamp will trigger a first-out fault on the VRU Pro, which will require reset.

J1939 Engine TSC1

The J1939 Engine TSC1 operation is the same as above with one addition to broadcast of TSC1 for the Engine Requested Speed to vary engine speed over J1939.

The following J1939 Engine commands will be broadcast

- PGN65226 – Request Active DTCs
- PGN65227 – Request Historic DTCs
- PGN0 SPN 898 – Engine Requested Speed

Configurable Outputs

Set the operation for discrete load outputs (DO5 and DO6) to function as Bypass Valve, Capacity Pulse Width Modulation (PWM), 1 Load Step or 2 Load Step operation.

- Bypass Valve operation will energize a single Load discrete output to load and unload the compressor. The discrete output may be configured as fail open or fail closed to set the default shelf position of the valve and adjust the control logic to drive the valve to the commanded position as needed.
- PWM operation will attempt to control slide valve capacity by pulsing two discrete outputs to drive the capacity slide valve to maintain a desired suction or discharge pressure setpoint. Pulse width modulation will be used to adjust the on and off times for the slide travel.
- 1 Load Step operation will turn on and off DO5 to drive a single load solenoid. Load Step 0 will have the output de-energized. Load Step 1 will have the output energized.
- 2 Load Step operation will turn on and off DO5 and DO6 to drive 2 load solenoids. Load Step 0 will have the both outputs de-energized. Load Step 1 will have the DO5 output energized. Load Step 2 will have DO5 and DO6 energized.

Three configurable discrete outputs (DO3, DO4 and DO7) are available that may be user-configured for desired logic. Use the outputs to control fuel valve, auxiliary valves, pumps or other devices as needed. Two modes are available: State Control or Discrete Input Control.

STATE CONTROL will energize or de-energize based on machine operating state. The output may be set up to either be ON or OFF in any of the controller operating states using a Logic Map for the output. The user may configure the logic map based on a configuration word bitmap representing each of the operating states.

- This mode is enabled as long as none of the configurable discrete inputs is set up as a TON, TOF or DOx CONTROL mode for the output.
- Each state is represented by a bit in the Logic Map. Enter the total of the Value in the Logic Map setting for the configurable output.

Value	State
1	Ready to Start
2	Unloading
4	Starting Motors (Motor Drive Only)
8	Spindown (Engine Drive Only)
16	Cranking (Engine Drive Only)
32	Crank Rest (Engine Drive Only)
64	Warm-up Timing
128	Wait on Temp Permissive (Engine Drive Only)
256	Wait on Spd Load Perm
512	Load Control
1024	Cooldown Tmg
2048	Shutdown

DISCRETE INPUT CONTROL allows for any of the six configurable discrete inputs to be set up to turn on, turn off or turn on and off (single input for both) the output.

- This mode is enabled if any of the configurable discrete inputs is set up as a TON, TOF or DOx CONTROL mode for the output.
- TON will turn on the output if the input is true.
- TOF will turn off the output if the input is true.
- DOx CTRL will turn on the output if the input is true and turn off the output if the input is false.
- The State Control Logic map will function as an enabler for the Digital Input control. For example, if the output must remain off in a Fault Shut-down condition, regardless of the discrete input switch command, a bit value of 0 in the shut-down state should be entered to force the output off. To enable the control all the time, add up all the states (1+2+4+8, etc…) to get a value of 4095 as the logic map word.

Each configurable discrete output will have a user-settable ON delay to energize and OFF delay to de-energize the output. These additional time delays can offer greater flexibility to the operation of these two discrete outputs.

Automatic Stop on Capacity Unload

If the panel is operating in AUTOMATIC START/STOP mode while the three Capacity control PID loops are active, the unit will auto stop if the lowest value PID remains at 0% and the PID loops is requiring additional unload (not in the deadband). The Capacity Stop Delay will begin timing, and if this expires, a normal stop to the controller will be issued. This feature may be disabled by setting the preset time to 0 minutes. The display will indicate UNLD AUTOSTOP on the alarm banner display.

An automatic start requirement will reset the message and restart the compressor.

Imperial / Metric Unit Configuration

Use the System Settings Menu (supervisor level) to modify pressure and temperature units. These options may be changed individually for the measurements listed below.

- Discharge and Oil Pressure Units
- Manifold Pressure Units
- Temperature Units

The scales listed in this document are imperial do not increase/decrease in range, but will be converted on the display to the new unit automatically.

Starting Sequence

> **NOTE:** For a definition of Class A, B1, B2, C, P and ESD faults, please see Shutdown / Alarm Message List in this manual.

Ready to Start State

When power is first applied and if no class A shut-down conditions exist, the controller will be in the READY TO START state. A Unit Available hourmeter will start counting hours that the machine is available to run at all times that no fault shutdown is detected. This timer is visible on the timer's main page.

The Control Outputs are in the following power up condition.

Description	Status
Main Motor Start (DO1)	Off
Cooler Motor Start (DO2)	Off
Engine Starter (DO1)	Off
Engine Ignition (DO2)	Off
J1939 Engine ECU Enable (DO2)	Off
Load Pulse (DO5)	Auto=Off or Man Ctl
Unload Pulse (DO6)	Auto=Off or Man Ctl
Bypass Valve Command (DO5)	Closed
Load/Unload (DO5)	Off
Load Step 1 (DO5)	Off
Load Step 2 (DO6)	Off
Desired Speed To Driver	4mA
Recycle Valve	100 % Closed

Start Modes

The unit can be started either in AUTO or MANUAL modes. Press the Fn

key while on the HOME page to change the start mode.

- AUTO – The suction pressure must rise above the auto start setpoint. The display will show START DELAY TIMING on the alarm banner, and the internal buzzer will pulse to signal an impending automatic start. When the Auto Start delay expires, a start command is issued.
- MANUAL – Press the Start

Key for 2 seconds.
- MODBUS START/STOP – The controller will accept momentary Modbus commands if desired for start and stop which are programmed in parallel to the AUTO mode above. The controller monitors for a rising edge trigger of the Modbus start command. To only Start and Stop through Modbus, the Suction Pressure must never fall below the Auto Stop Pressure setpoint or rise above the Auto Start Pressure setpoint.

Start Signal

After a valid start signal is seen, the following sequence will occur:

1. Compressor Unload

a. The Compressor Unload state delay will begin timing.

b. The Recycle Valve is commanded to ramp open.

c. PWM is enabled. The Unload Pulse output will energize to unload the compressor if the Capacity Control Mode is in Auto mode.

d. Bypass Valve is enabled. The Bypass Valve is commanded to open.

e. The J1939 ECU Enable output will energize to power up the Engine ECU.

f. When the Compressor Unload state delay expires, the start sequence will advance.

2. Driver Start (Engine)

a. The Engine RPM is monitored for 0 RPM to ensure the engine is not spinning prior to engaging the starter. The display will read Spindown.

b. After 0 RPM is confirmed, the Starter output will energize, and the Crank delay begins timing.

   i. The Engine RPM is monitored to confirm that the engine is cranking. If the Crank delay expires and no RPM signal is seen, a shutdown will occur on FAILURE TO CRANK.

   ii. The Ignition ON delay will begin timing. The Ignition output will energize after this time to allow the engine to be purged of any unspent fuel from a previous run cycle.

c. The Engine RPM is continually monitored for running confirmation. If the RPM rises above the Crank Disconnect setpoint, the engine is considered running and the Starter will be immediately de-energized. The start sequence will advance to RUNNING SEQUENCE.

d. If the engine does not start before the Crank delay expires, the Starter and Ignition outputs are de-energized. The Rest delay will begin timing.

   i. When the Rest delay expires, the controller will return to the Crank Stop state and repeat the cycle until the engine starts or until the Number of Crank Attempts setpoint is exceeded. If this occurs, a shutdown will occur on DRIVER START FAILURE.

3. Driver Start (Motor)

a. The Cooler Motor Stagger delay will immediately begin timing.

b. The Main Motor output will energize to start the Main motor. The controller will monitor the Main Motor Run signal for a run feedback. If no feedback is received before the MAIN MOTOR FAIL DLY state expires, a shutdown will occur on MAIN MOTOR RUN FAIL.

c. When the Cooler Motor Stagger delay expires, the Cooler Motor output will energize to start the cooler motor. The status display will read STARTING COOLER MOTOR. The controller will monitor the Cooler Motor run signal for a run feedback. If no feedback is received before the COOLER FAIL DLY expires, a shutdown will occur on COOLER MOTOR RUN FAIL.

d. Upon each motor start attempt where feedback is received, the controller accumulates the start attempt and begins a 1-hour time window. The Short Cycle setting is used to limit the number of start attempts per hour on the motor to protect the motor windings from overheating. After 1 hour has elapsed from each start, the number of attempts allowed is decremented by 1 to regain that attempt. If the number of start attempts within 1 hour exceeds the Short Cycle setpoint, a fault shutdown occurs on MOTOR SHORT CYCLE. The number of start attempts remaining and the 1 hour timer are shown on the display Motor Data page.

> **NOTE:** If the short cycle fault is not desired, set the Max Starts Per Hour setpoint to 0 on the Motor Setpoints Page.

e. When Main Motor run feedback is received, the start sequence will advance to RUNNING SEQUENCE.

Running Sequence

Warm-up State

The Control Outputs are in the following running condition upon entering the WARM-UP STATE.

Description	Status
Main Motor Start (DO1)	On
Cooler Motor Start (DO2)	On
Engine Starter (DO1)	Off
Engine Ignition (DO2)	On
J1939 Engine ECU Enable (DO2)	On
Load Pulse (DO5)	Auto=Off or Man Ctl
Unload Pulse (DO6)	Auto=On or Man Ctl
Bypass Valve Command (DO5)	Open
Load/Unload (DO5)	Off
Load Step 1 (DO5)	Off
Load Step 2 (DO6)	Off
Desired Speed to Driver	Warm-up RPM SP
Recycle Valve	0 % Closed

The Internal Hour meter begins to record running hours. The Class B1 and B2 lockout and Warm-up delays will begin timing. Unit state will read WARM-UP TIMING.

When the adjustable preset Class B1 Lockout delay expires, all Class B1 shutdowns and alarms become activated. When the adjustable preset Class B2 Lockout delay expires, all Class B2 shutdowns and alarms become activated.

When the Warm-up timer expires, the state will advance to the TEMPERATURE LOAD PERMISSIVE state.

Temperature Load Permissive

MOTOR – This state will be skipped. The state will advance to SPEED LOAD PERMISSIVE.

ENGINE – The Engine Coolant Temperature and Engine Oil Temperature are monitored to be above their respective Load Permissive Setpoints. The state message will indicate which conditions have not yet been met. When both temperatures are above the Load Permissive temperature Setpoints, the state will advance to the SPEED LOAD PERMISSIVE state. Set the permissive to 0 on the engine Setpoints menu if either the oil or coolant temperature is not available on your engine or if you don't want the signal.

Speed Load Permissive

The Desired Speed to Driver analog output will ramp to the MIN LOAD RPM setpoint.

MOTOR – When the Desired Speed to Driver analog output reaches the MIN PID RPM setpoint, the state will advance to LOAD CONTROL. (Note: If the control is set to Manual, this step is skipped.)

ENGINE – When the engine speed rises above the Load Permissive RPM setpoint and the Desired Speed to Driver analog output reaches the MIN PID RPM setpoint, the state will advance to LOAD CONTROL. (Note: If the control is set to Manual, only the Load Permissive RPM is monitored.)

Load Control

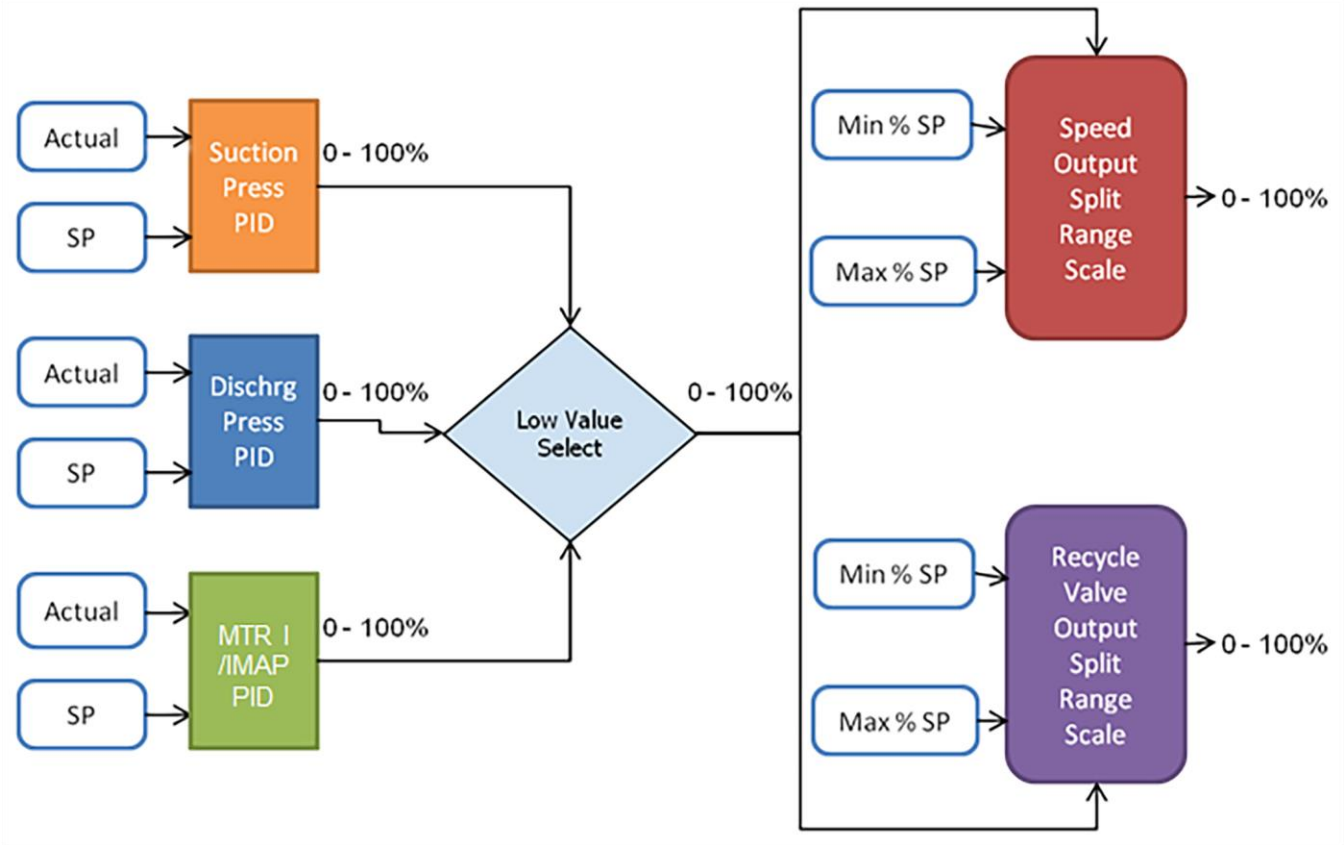
The Class P lockout timer will begin timing to allow arming of the Class P faults, and the Class C faults are allowed to arm.

The Bypass valve is closed to load the compressor.

The Control Outputs are in the following running condition upon entering LOAD CONTROL.

Description	Status
Main Motor Start (DO1)	On
Cooler Motor Start (DO2)	On
Engine Starter (DO1)	Off
Engine Ignition (DO2)	On
J1939 Engine ECU Enable (DO2)	On
Load Pulse (DO5)	PWM Active
Unload Pulse (DO6)	PWM Active
Bypass Valve Command (DO5)	Closed
Load/Unload (DO5)	PID Active
Load Step 1 (DO5)	PID Active
Load Step 2 (DO6)	PID Active
Desired Speed to Driver	PID Active
Recycle Valve	PID Active

The Capacity control is enabled using the control strategy detailed below.



Suction Pressure PID

The Suction Pressure will be controlled by a PID loop calculation to maintain the desired suction pressure setpoint. If the suction pressure is below the setpoint minus the deadband, the Suction Pressure PID % output will decrease. If the Suction Pressure is above the setpoint plus the deadband, the Suction Pressure PID % output will increase. PID Tuning parameters can be adjusted in the setpoint pages. If suction pressure is not desired to limit compressor capacity, set the PID setpoint to -999 to ensure the PID remains at 100% output.

Discharge Pressure PID

The Discharge Pressure will be controlled by a PID loop calculation to maintain the desired discharge pressure setpoint. If the discharge pressure is below the setpoint minus the deadband, the Discharge Pressure PID % output will increase. If the Discharge Pressure is above the setpoint plus the deadband, the Discharge Pressure PID % output will decrease. PID Tuning parameters can be adjusted in the setpoint pages. If discharge pressure is not desired to limit compressor capacity, set the PID setpoint to 3276.0 PSI to ensure the PID remains at 100% output.

Motor Current PID (Optional)

The Main Motor Amps will be controlled by a PID loop calculation to maintain the desired Motor Amps setpoint. If the Motor Amps are below the setpoint minus the deadband, the Motor Amps PID % output will increase. If the Motor Amps are above the setpoint plus the deadband, the Motor Amps PID % output will decrease. PID Tuning parameters can be adjusted in the setpoint pages. Use this loop to limit compressor capacity using FLA settings of the motor. If motor current is not desired to limit compressor capacity, set the PID setpoint to 1000.0 AMPS to ensure the PID remains at 100% output.

Engine Manifold Pressure PID (Optional)

The Engine Manifold Pressure will be controlled by a PID loop calculation to maintain the desired Manifold Pressure setpoint. If the Manifold Pressure is below the setpoint minus the deadband, the Manifold Pressure PID % output will increase. If the Manifold Pressure is above the setpoint plus the deadband, the Manifold Pressure PID % output will decrease. PID Tuning parameters can be adjusted in the setpoint pages. Use this loop to limit compressor capacity using engine HP/MAP ratings. If Engine Manifold Pressure is not desired to limit compressor capacity, set the PID setpoint to 1000.0 "Hg to ensure the PID remains at 100% output.

The lowest value of the Suction PID, Discharge PID and Amps/MAP will be used to control the compressor capacity. This Low Value Selector (LVS) ensures that all three process variables are simultaneously monitored, and the most restrictive variable assumes control over capacity. If any loop is not desired, simply change its setpoint so that it never needs to unload based on that variable.

Recycle Valve

The Recycle Valve analog output control will have independent AUTO and MANUAL modes of operation selectable on the display.

Manual Mode: The 4-20mA Recycle Valve will be ramped to the Manual Recycle Valve setpoint entered on the VRU Pro Recycle Valve Page on the main displays. The setting can be changed on the Recycle Valve Control Page. The rate of ramping and ramp interval is adjustable in the Recycle Valve Control set-up pages.

Auto PID Mode: The LVS output is scaled linearly to Min and Max Recycle Valve output Setpoints. Upon transfer from Manual to Automatic, the output will ramp from the Manual Setpoint to the correct % output based on the LVS output.

Desired Speed to Driver

The Desired Speed analog output control will have independent AUTO and MANUAL modes of operation selectable on the display.

Manual Mode: The 4-20 mA Speed Control will be ramped to the Manual Speed Control Setpoint entered into the VRU Pro. The setting can be changed on the Speed Control Page. The rate of ramping and ramp interval is adjustable in the Speed Control setup pages.

Auto PID Mode: The LVS output is scaled linearly to a MIN PID RPM and MAX PID RPM setpoint to limit the speed range while loaded. Upon transfer from Manual to Automatic, the output will ramp from the Manual Setpoint to the correct RPM output based on the Capacity PIDs.

Capacity PWM Control

The Capacity Control will have independent AUTO and MANUAL modes of operation selectable on the display.

Manual Mode: Pressing Man + and Man – keys on the display while on the Capacity control page will energize the LOAD and UNLOAD outputs respectively to drive the capacity slide to the desired position.

Auto Mode: The PWM can be setup to be integrated with the Desired Speed / Recycle Valve control strategy, or as standalone operation in the Setup Menu.

Control Setpoint = LVS (Low Value PID Selector)

The same three PIDs loops used for capacity control will be examined and the lowest error will be used to modulate the LOAD and UNLOAD discrete outputs. The Capacity LVS will control to maintain the PID setpoint +/- deadband. The PWM control is enabled when the LVS output is between the Capacity PWM Enable Range Low % setpoint and Capacity PWM Enable Range High % setpoint. If the LVS output is below the Low setpoint, the LOAD output will be de-energized, and the UNLOAD output will be energized. If the LVS output is above the High setpoint, the LOAD output will be energized, and the UNLOAD output will be de-energized.

Control Setpoint = Standalone

New control setpoints and deadband for Suction Pressure, Discharge Pressure, and Manifold Pressure / Motor amps will be available in the setup menu. These unique setpoints are isolated from the Desired Speed and Recycle Valve control, and the lowest error will be used to modulate the LOAD and UNLOAD discrete outputs in the same LVS control strategy. The PWM outputs will control to maintain the variable requiring most unload within the setpoint +/- deadband.

When the control variable is inside the deadband, both outputs will remain off. When loading is needed, the LOAD output will energize for the duration of the calculated ON time based on % error x INCREASE REACTION TIME. It will turn off and remain off for the duration of the INCREASE SAMPLE TIME. Decrease will also have similar settings.

Load Step Control

The Capacity Control will have independent AUTO and MANUAL modes of operation selectable on the display.

Manual Mode: Pressing Man + and Man – keys on the display while on the Capacity control page will change the load step to drive the load solenoid(s).

Auto Mode: The Load Step Control can be setup to be integrated with the Desired Speed / Recycle Valve control strategy, or as standalone operation in the Setup Menu.

Control Setpoint = LVS (Low Value PID Selector)

The same three PIDs loops used for capacity control will be examined and the lowest error will be used to energize the LOAD output(s) in succession. The Capacity LVS will control to maintain the PID setpoint +/- deadband.

The Load Step control is enabled when the LVS output is between the Load Step Enable Range Low % setpoint and Load Step Enable Range High % setpoint. If the LVS output is below the Low setpoint, the Load Step will remain at 0. If the LVS output is above the High setpoint, the Load Step will remain at max load step.

Control Setpoint = Standalone

New control setpoints and deadband for Suction Pressure, Discharge Pressure, and Manifold Pressure / Motor amps will be available in the setup menu. These unique setpoints are isolated from the Desired Speed and Recycle Valve control, and the lowest error will be used to energize the LOAD output(s) in succession. The Load Step output(s) will control to maintain the variable requiring most unload within the setpoint +/- deadband.

Each time a change in load occurs, the Add Load and Sub Load time delays are reset. When the control variable is inside the deadband, the Add Load and Sub Load time delays are reset.

Test Mode

While the unit is running, a test mode feature will be available on the TIMERS page. It is recommended that the unit be in the state where all Class B1, B2 and P are already expired prior to going into Test Mode. When the Fn key on the display is pressed, all functions identified as Class A, B1, B2, C and P shutdowns will be able to be tested without shutting down the Unit for the duration of the Test timer. The test mode can be ended by pressing the Fn button again.

Each tested point is logged on the ACTIVE ALARMS and also the EVENTS page along with the time stamp. Multiple points can be tested incrementally to save time testing a unit, and each is logged in incremental order.

If additional test time is required during the process of testing points, more time can be added to the Test Timer by depressing the RESET Key again. Doing so resets the TEST Timer back to its preset test time, and the test timer will restart counting down so that additional points can be tested.

Important: All shutdowns must be clear and the reset key must be pressed before the test timer expires or prior to exiting the test mode else a shutdown will occur.

Engine Oil Low Pressure Shut-down Calculation

While the unit is running if the Driver Type is selected as Mechanical Engine or a J1939 engine is selected with hardwired Engine Oil Pressure source, the LoLo Engine Oil Pressure shutdown setting and Lo Engine Oil Pressure alarm setting will be calculated by using the Engine RPM and the Setpoints for Low and High RPM.

This feature enables a lower fault setpoint to be used if the engine is running at lower speeds and a higher fault setpoint to be used if the engine is running at higher speeds.

Normal Stop Sequence

Stop Modes

The unit can be stopped either in AUTO or MANUAL modes:

AUTO – The suction pressure must fall below the auto stop setpoint. The display will show STOP DELAY TIMING on the alarm banner. When this expires, a stop command is issued. In Automatic, pressing the Stop Key on the display for 2 seconds will issue a MANUAL STOP normal shutdown. This will require RESET to allow a restart.

> If enabled, a capacity automatic stop may also occur if the Low Value Selector PID output is at 0 % and additional unload is needed. See AUTOMATIC STOP ON CAPACITY UNLOAD in this manual.

MANUAL – Press the Stop

key for 2 seconds.

MODBUS STOP – The controller will accept a momentary Modbus Stop command, which is programmed in parallel to the AUTO and MANUAL modes above. A Stop Command will override a Start if both are seen simultaneously.

Digital inputs may be configured as Class A, B1, B2, C or P Stops. If any stop is seen, the machine will stop. If the stop signal is clear, a restart may be attempted, and this will automatically reset the pop-up banner for the cause of the digital input stop.

Stop Signal

After a valid stop signal is seen, the following sequence will occur:

Cool-Down:

The Class C and P faults are disarmed.

The Desired Speed to Driver analog output will ramp to the Cool-Down RPM setpoint.

The Recycle Valve will be ramped open.

PWM enabled: The Unload Pulse output will energize to unload the compressor.

Bypass Valve enabled: The Bypass Valve is commanded to open.

The Cool-Down state delay will begin timing. The Control Outputs are in the following condition.

Description	Status
Main Motor Start (DO1)	On
Cooler Motor Start (DO2)	On
Engine Starter (DO1)	Off
Engine Ignition (DO2)	On
J1939 Engine ECU Enable (DO2)	On
Load Pulse (DO5)	Auto=Off or Man Ctl
Unload Pulse (DO6)	Auto=On or Man Ctl
Bypass Valve Command (DO5)	Open
Load/Unload (DO5)	Off
Load Step 1 (DO5)	Off
Load Step 2 (DO6)	Off
Desired Speed to Driver	Cool-Down RPM SP
Recycle Valve	0 % Closed

If while in Cool-Down a start command is received again as described in Start Modes, the controller will return to the Temperature Load Permissive state and automatically reload the compressor when all load permissives are met. When the Cool-Down state delay expires, the state will advance to DRIVER STOP.

Driver Stop (Motor)

The Main Motor and Cooler Motor discrete outputs will be de-energized.

The controller will display READY TO START and await the next start signal.

Driver Stop (Engine)

The Engine Ignition output will be de-energized.

The Engine ECU Enable will be de-energized.

The controller will display READY TO START and await the next start signal.

Fault Shut-down Sequence

Fault Shutdown

Upon a fault shutdown, the control outputs will be in the following condition.

Description	Status
Main Motor Start (DO1)	Off
Cooler Motor Start (DO2)	Off
Engine Starter (DO1)	Off
Engine Ignition (DO2)	Off
J1939 Engine ECU Enable (DO2)	Off
Load Pulse (DO5)	Auto=Off or Man Ctl
Unload Pulse (DO6)	Auto=Off or Man Ctl
Bypass Valve Command (DO5)	Closed
Load/Unload (DO5)	Off
Load Step 1 (DO5)	Off
Load Step 2 (DO6)	Off
Desired Speed to Driver	4mA
Recycle Valve	100 % Closed

The Class B1, B2, C and P shutdowns are disarmed.

The unit state will read SHUTDOWN.

The cause of the shut-down event is stored in the Events List with a date and time stamp. The shut-down condition is only cleared by pressing the RESET key.

After the shutdown has been reset and the condition has been cleared, the System will return to the READY TO START state.

Controller Inputs / Outputs

Discrete Inputs

PIN #	IN #	DESCRIPTION
33	1	Motor Run Feedback (Motor) or Configurable Spare Fault (Engine)
63	2	Cooler Run Feedback (Motor) or Configurable Spare Fault (Engine)
34	3	High Scrubber Level (Configurable Input)
64	4	Oil Level SD (Configurable Input)
35	5	Compressor Vibration SD (Configurable Input)
65	6	Motor Vibration SD (Configurable Input)
36	7	Hi Oxygen Level SD (Configurable Input)
68	8	Spare SD (Configurable Input)

Discrete Outputs

PIN #	IN #	DESCRIPTION
48	1	Motor Starter / Engine Crank
49	2	Cooler Starter / Engine Ignition / J1939 ECU Enable
50	3	Configurable Output-Fuel Valve Open Command
51	4	Configurable Output
52	5	Load Valve Pulse / Bypass Valve / Load Step 1
53	6	Unload Valve Pulse / Load Step 2
54	7	Configurable Output-Common Fault Output

Analog Inputs

PIN #	IN #	DESCRIPTION
3	1	Suction Pressure
4	2	Discharge Pressure
5	3	Engine Oil Pressure (MECH Engine or optional for J1939 Engine)
6	4	Motor Amps / Engine Intake Manifold Pressure (MECH Engine or optional for J1939 Engine)
7	5	Compressor Oil Pressure (Optional)

Analog Outputs

PIN #	IN #	DESCRIPTION
21	AO-1	Desired Driver Speed
25	AO-2	Recycle Valve Control

Thermocouple Inputs

PIN #	IN #	DESCRIPTION
8	1	Suction Temperature / Compressor Oil Temperature / Discharge 2 Temperature (Selectable)
9	2	Discharge Temperature
10	3	Engine Oil Temperature (MECH Engine or optional for J1939 Engine)
11	4	Engine Coolant Temperature (MECH Engine or optional for J1939 Engine)

Magnetic Pickup

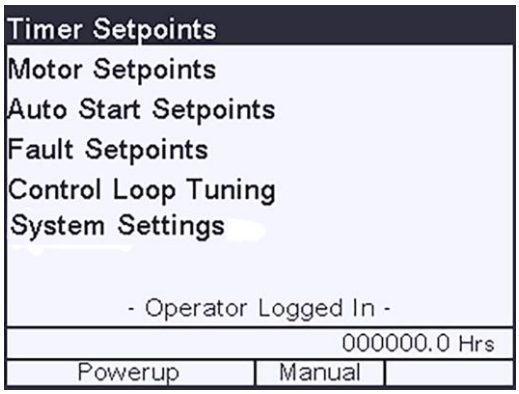
PIN#	DESCRIPTION
11	Engine Speed (MECH Engine or optional for J1939 Engine)

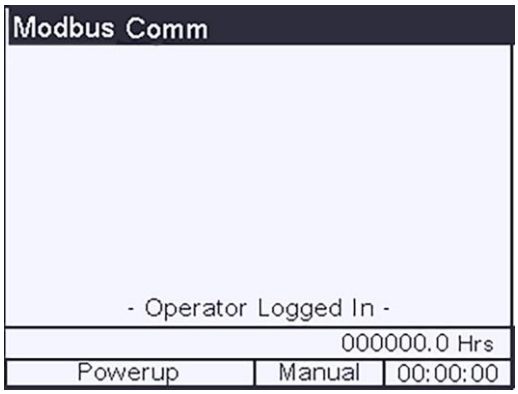
Operator Level Setpoints and Settings

To access the System Menu screen at the operator security level, press the Setup key, and use the password code 0164. Press the Enter key.

The System Menu Screen is the main menu for setpoints and settings.

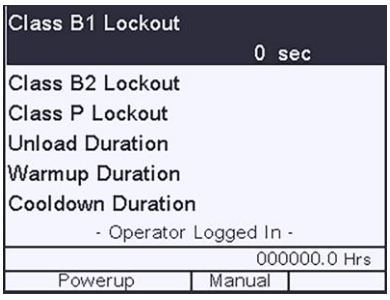
Your controller will only display the screens that pertain to the Driver Type and Load Control selections entered. The example screens in this section will differ with Driver Types.

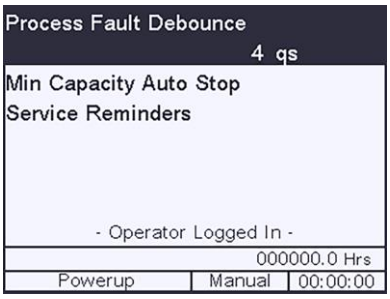




Timer Setpoints Screen

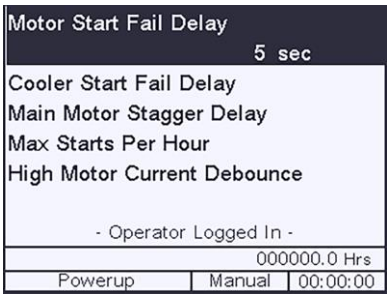
From the System Menu screen, select Timer Setpoints.

Description	Range [Factory Default]	Timer Setpoints Screen Example Page 1of 2
Class B1 Lockout: The duration of the Class B1 shut-down lockout timer.	0 – 60 sec [10]	
Class B2 Lockout: The duration of the Class B2 shut-down lockout timer.	0 – 300 sec [30]	
Class P Lockout: The duration of the Class P shut-down lockout timer.	0 – 9999 sec [1800]	
Unload Duration: Duration of the unload delay prior to driver start	0 – 900 sec [10]	
Warmup Duration: The duration of the warm-up cycle.	0 – 1800 sec [180]	
Cooldown Duration: The duration of the cool-down cycle upon a normal stop.	0 – 1800 sec [30]	

Description	Range [Factory Default]	Timer Setpoints Screen Example page 2
Process Fault Debounce Timer: This is a debounce for the Low and High Suction Pressure and Discharge Pressure fault shutdowns in quarter seconds.	0 – 20 qs [4]	
Min Capacity Auto Stop Timer: The unit will auto stop if the Capacity Control output remains at 0% for this amount of time. Set to 0 to disable the automatic stop based on capacity unload control feature.	0 – 60 min [0]	
Service Reminder 1: The interval for the service reminder.	0 – 10000 Hrs. [250]	
Service Reminder 1 Ack: Select Yes to Acknowledge and Reset the service reminder.	No – Yes [na]	
Service Reminder 2:	0 – 10000 Hrs. [250]	
Service Reminder 2 Ack:	No – Yes [Na]	
Service Reminder 3:	0 – 10000 Hrs. [750]	
Service Reminder 3 Ack:	No – Yes [na]	
Service Reminder 4:	0 – 10000 Hrs. [1000]	
Service Reminder 4 Ack:	No – Yes [NA]	
Service Reminder 5: The interval for the service reminder.	0 – 10000 Hrs. [1500]	
Service Reminder 5 Ack:	No – Yes [NA]	
Service Reminder 6: The interval for the service reminder.	0 – 10000 Hrs. [2000]	
Service Reminder 6 Ack:	No – Yes [NA]	
Service Reminder 7: The interval for the service reminder.	0 – 10000 Hrs. [3000]	
Service Reminder 7 Ack:	No – Yes [NA]	

Motor Setpoints

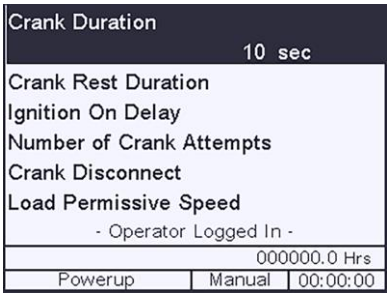
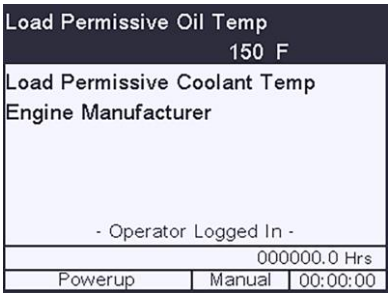
From the System Menu screen, select Motor Setpoints.

DESCRIPTION	RANGE [Factory default]	Motor Setpoint Screen Example
Main Motor Start Fail Delay: The amount of time after the Main Motor output energized before the unit shuts down if the Motor Run Confirmation input is not seen.	1 – 30 sec [5]	
Cooler Start Fail Delay: The amount of time after the Cooler Motor output energized before the unit shuts down if the Cooler Motor Run Confirmation input is not seen.	1 – 30 sec [5]	
Main Motor Stagger Delay: The amount of time after the Main Motor output is energized before the Cooler Motor output is energized. Use this delay to reduce inrush current imposed on the line.	0 – 10 sec [3]	
Max Starts Per Hour (Short Cycle): The number of start attempts allowed in 1-hour time period. Set to 0 to disable the Max Starts Per Hour shut-down limit.	0 – 16 [16]	
High Motor Current Debounce: Debounce time delay for the High Motor Amps fault shutdown.	0 – 20 qs [8]	

> **NOTE:** The measurement qs (quarter seconds) is equal to 250 milliseconds. A setting of 4 would be equal to 1 second.

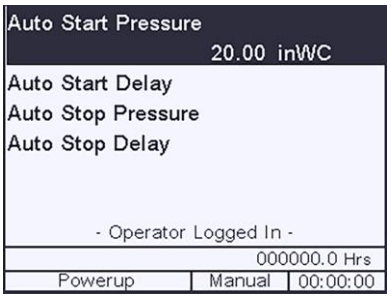
Engine Setpoints

From the System Menu screen, select Engine Setpoints.

DESCRIPTION	RANGE [Factory Default]	Engine Setpoints Screen Example page 1
Crank Duration: Duration of the engine crank cycle.	0 – 45 sec [15]	
Crank Rest Duration: Duration of the engine crank rest delay between cranking attempts.	0 – 45 sec [10]	
Ignition On Delay: On delay after RPM is seen > 0 before the Ignition is enabled.	0 – 10 sec [2]	
Number of Crank Attempts: The number of repeated crank cycles before Driver Start fault.	1 – 16 [1]	
Crank Disconnect: RPM above which the engine is considered running.	0 – 5000 [250]	
Load Permissive Speed: RPM above which the compressor is allowed to load.	0 – 5000 [1500]	
		Example page 2
Load Permissive Engine Oil Temp: Engine specific permissive to load.	0 – 150° F [150]	
Load Permissive Coolant Temp: Engine specific permissive to load.	0 – 150° F [120]	
Engine Manufacturer: This setting is used for the TSC1 J1939 Engine Requested Speed Broadcast.	Caterpillar Cummins JohnDeere Deutz Kubota Yanmar JCB Volvo FPT Isuzu GM EICS [Other]	

Auto Start Setpoints

From the System Menu screen, select Auto Start Setpoints.

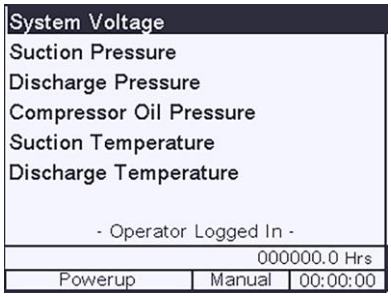
DESCRIPTION	RANGE [Factory Default]	Auto Start Setpoints Screen Example
Auto Start Pressure: Pressure at which the unit will automatically start.	-3276.7 – 3276.7 “WC, OSI, PSI, kPa, bar [20.0]	
Auto Start Delay: The amount of time before the unit will signal to start automatically.	0 – 300 sec [5]	
Auto Stop Pressure: Pressure at which the unit will automatically stop.	-3276.7 – 3276.7 “WC, OSI, PSI, kPa, bar [1.0]	
Auto Stop Delay: The amount of time before the unit will signal to stop automatically.	0 – 300 sec [5]	

Fault Setpoints (Motor and Engine)

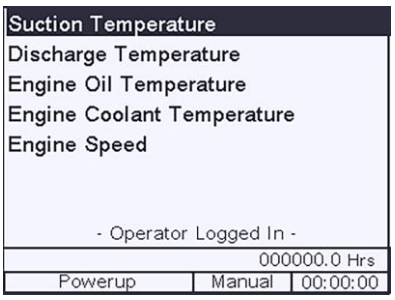
From the System Menu screen, select Fault Setpoints.

The System Volts Fault set up allows for 0.0; however, if this fault is disabled or set below the minimum controller voltage requirements, unreliable faults might occur due to low voltage conditions i.e transmitter fails, crank fails, etc.

DESCRIPTION	RANGE [Factory Default]	Fault Setpoints Screen Example I of 2 pages
System Volts – LoLo: LoLo shut-down setpoint.	0.0 – 36.0 VDC [18.0]	
System Volts – Lo: Lo alarm setpoint.	0.0 – 36.0 VDC [20.0]	
System Volts – Hi: Hi alarm setpoint.	0.0 – 36.0 VDC [28.0]	
System Volts – HiHi: HiHi shut-down setpoint.	0.0 – 36.0 VDC [30.0]	
Suction Pressure – LoLo:	-3276.7 – 3276.7 “WC, OSI, PSI, kPa, bar [0.0]	
Suction Pressure – Lo:	-3276.7 – 3276.7 “WC, OSI, PSI, kPa, bar [0.5]	
Suction Pressure – Hi:	-3276.7 – 3276.7 “WC, OSI, PSI, kPa, bar [22.0]	
Suction Pressure – HiHi:	-3276.7 – 3276.7 “WC, OSI, PSI, kPa, bar [25.0]	
Discharge Pressure – LoLo:	0.0 – 3276.7 PSI [10.0]	
Discharge Pressure – Lo:	0.0 – 3276.7 PSI [15.0]	
Discharge Pressure – Hi:	0.0 – 3276.7 PSI [75.0]	
Discharge Pressure – HiHi:	0.0 – 3276.7 PSI [80.0]	
Compressor Oil Pressure – LoLo:	0.0 – 300.0 PSI [30.0]	
Compressor Oil Pressure – Lo:	0.0 – 300.0 PSI [35.0]	
Compressor Oil Pressure – Hi:	0.0 – 300.0 PSI [75.0]	
Compressor Oil Pressure – HiHi:	0.0 – 300.0 PSI [90.0]	
Engine Oil Pressure Low RPM: This is used to scale the fault settings between low and high speed.	0 – 5000 RPM [1200]	
Engine Oil Pressure – LoLo @ Low RPM:	0.0 – 100.0 PSI [30.0]	
Engine Oil Pressure – Lo @ Low RPM:	0.0 – 100.0 PSI [35.0]	

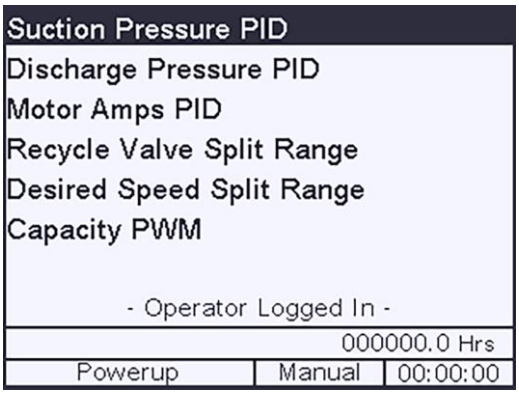


DESCRIPTION	RANGE [Factory Default]	Fault Setpoints Screen Example I of 2 pages
Engine Oil Pressure High RPM: This is used to scale the fault settings between low and high speed.	0 – 5000 RPM [1200]	
Engine Oil Pressure – LoLo @ High RPM:	0.0 – 100.0 PSI [30.0]	
Engine Oil Pressure – Lo @ High RPM:	0.0 – 100.0 PSI [35.0]	
Engine Intake Manifold Vacuum/Pressure – LoLo: LoLo Pressure shut-down setpoint (a smaller number is more vacuum, higher pressure). For naturally aspirated engines, this is a very low negative number. For turbocharged engines, this will remain positive.	-30.0 – 100.0 “HG [-22.0]	
Engine Intake Manifold Vacuum/Pressure – Lo:	-30.0 – 100.0 “HG [-20.0]	
Engine Intake Manifold Vacuum/Pressure – Hi:	-30.0 – 100.0 “HG [-5.0]	
Engine Intake Manifold Vacuum/Pressure – HiHi: HiHi Pressure shut-down setpoint (a larger number is less vacuum, higher pressure). For naturally aspirated engines, this is a number approaching 0 indicating engine overload. For turbocharged engines, this will be a positive boost overload pressure.	-30.0 – 100.0 “HG [-2.0]	
		Example Page 2
TC1 Temperature – Hi (is selectable as either Suction, Compressor Oil or Discharge 2 Temperature).	0 – 500 F [125]	
TC1 Temperature – HiHi (is selectable as either Suction, Compressor Oil or Discharge 2 Temperature).	0 – 500 F [130]	
Discharge Temperature -Hi:	0 – 500 F [180]	
Discharge Temperature -HiHi:	0 – 500 F [190]	
Engine Oil Temperature – Hi:	0 – 250 F [175]	
Engine Oil Temperature – HiHi:	0 – 250 F [180]	
Engine Coolant Temperature – Hi:	0 – 250 F [205]	
Engine Coolant Temperature – HiHi:	0 – 250 F [210]	
Engine Speed – LoLo.	0 – 5000 RPM [1000]	
Engine Speed – Lo.	0 – 5000 RPM [1100]	
Engine Speed – Hi.	0 – 5000 RPM [2400]	
Engine Speed – HiHi.	0 – 5000 RPM [2500]	
Motor Amps – Hi:	0.0 – 500.0 AMPS [90.0]	
Motor Amps – HiHi:	0.0 – 500.0 AMPS [100.0]	

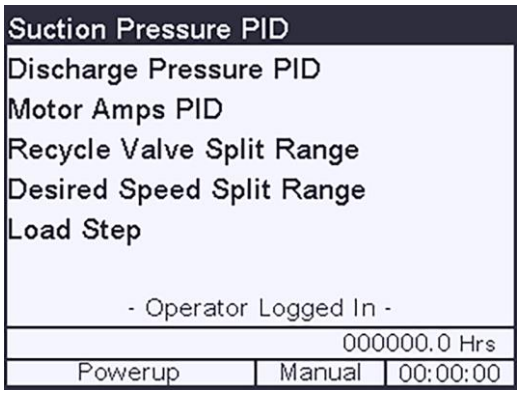


Control Loop Tuning Submenu (Motor and Engine)

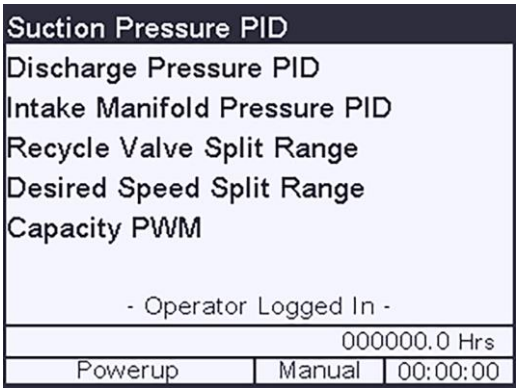
From the System Menu screen, select Control Loop Tuning.



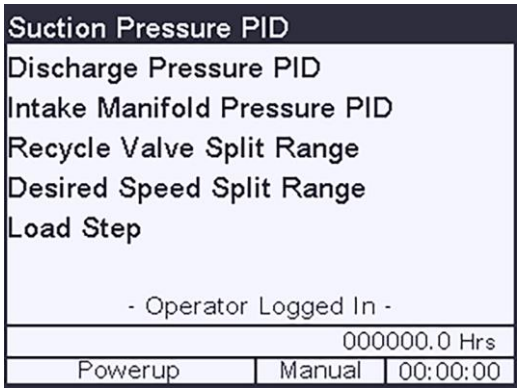
Control Loop Tuning (Motor) Page 1



Control Loop Tuning (Motor) Page 2



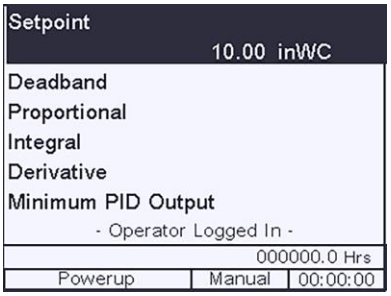
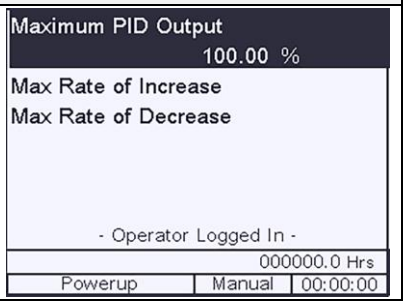
Control Loop Tuning (Engine) Page 1



Control Loop Tuning (Engine) Page 2

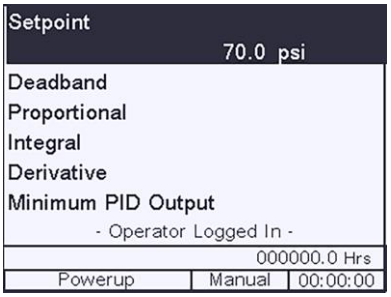
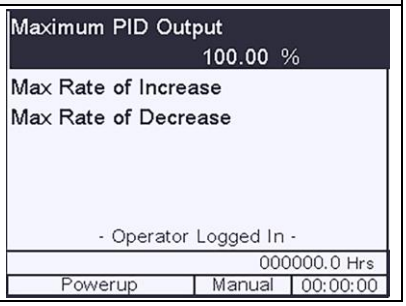
Suction Pressure PID

From the Control Loop Tuning screen, select Suction Pressure PID.

DESCRIPTION	RANGE [Factory Default]	Suction Pressure PID Screen Example page 1
Setpoint: The automatic pressure setpoint that will be maintained by the PID loop calculation.	-3276.7 – 3276.7 "WC, OSI, PSI, kPa, bar [10.0]	
Deadband: No change in output will occur if PV is inside this window around setpoint.	1.0 – 999.0 "WC, OSI, PSI, kPa, bar [0.5]	
Proportional: This is a multiplier for the error (pressure minus setpoint) and will determine how the error will directly affect the amount of change in output. Too low a number here will result in sluggish action of the PID loop. Too high a number here will result in overshoot and oscillation of the PID loop.	0.00 – 100.00 [15.00]	
Integral: This is a multiplier for the amount of time the error (pressure minus setpoint) has been above or below setpoint. The more time that passes before the loop does not reach its setpoint will directly affect the amount of change in output. Too low a number here will take out the Integral part of control of the PID loop. Too high a number here will result in oscillation of the PID loop.	0.0 – 100.00 %/s [10.00]	
Derivative: This is a multiplier for how fast the error (pressure minus setpoint) is changing. The faster the pressure or setpoint changes will directly affect the amount of change in output. Too low a number here will take out the derivative part of control of the PID loop. Too high a number here will result in oscillation of the PID loop.	0.00 – 100.00 %xs [0.00]	
Min Output: Minimum output the PID is allowed to calculate.	0.00 – 100.00 % [0.00]	
		Example Page 2
Max Output: Maximum output the PID is allowed to calculate.	0.00 – 100.00 % [100.00]	
Max Rate Of Increase: Set the maximum change in output allowed while in automatic mode per scan.	0.00 – 100.00 % [25.00]	
Max Rate Of Decrease: Set the maximum change in output allowed while in automatic mode per scan.	0.00 – 100.00 % [25.00]	

Discharge Pressure PID

From the Control Loop Tuning screen, select Discharge Pressure PID.

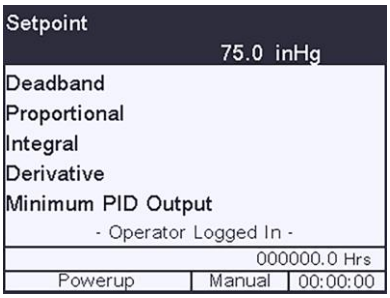
DESCRIPTION	RANGE [Factory Default]	Discharge Pressure PID Screen Example page 1
Setpoint: The automatic pressure setpoint that will be maintained by the PID loop calculation.	-3276.7 – 3276.7 PSI [70.0]	
Deadband: No change in output will occur if PV is inside this window around setpoint.	0 – 1000.0 PSI [0.5]	
Proportional: This is a multiplier for the error (pressure minus setpoint) and will determine how the error will directly affect the amount of change in output. Too low a number here will result in sluggish action of the PID loop. Too high a number here will result in overshoot and oscillation of the PID loop.	0.00 – 100.00 [15.00]	
Integral: This is a multiplier for the amount of time the error (pressure minus setpoint) has been above or below setpoint. The more time that passes before the loop does not reach its setpoint will directly affect the amount of change in output. Too low a number here will take out the integral part of control of the PID loop. Too high a number here will result in oscillation of the PID loop.	0.00 – 100.00 %/s [10.00]	
Derivative: This is a multiplier for how fast the error (pressure minus setpoint) is changing. The faster the pressure or setpoint changes will directly affect the amount of change in output. Too low a number here will take out the Derivative part of control of the PID loop. Too high a number here will result in oscillation of the PID loop.	0.00 – 100.00 %xs [0.00]	
Min Output: Minimum output the PID is allowed to calculate.	0.00 – 100.00 % [0.00]	
		Example page 2
Max Output: Maximum output the PID is allowed to calculate.	0.00 – 100.00 % [100.0]	
Max Rate Of Increase: Set the maximum change in output allowed while in automatic mode per scan.	0.00 – 100.00 % [25.00]	
Max Rate Of Decrease: Set the maximum change in output allowed while in automatic mode per scan.	0.00 – 100.00 % [25.00]	

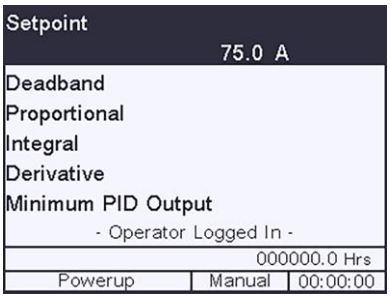
Intake Manifold Pressure / Motor Amps PID

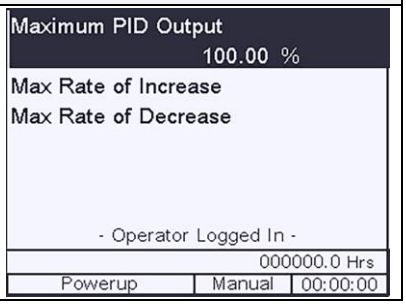
From the Control Loop Tuning screen, select Manifold Pressure PID (engine) or Motor Amps PID (motor).

> **NOTE:** This will be either MOTOR AMPS or INTAKE MANIFOLD PRESSURE based on DRIVER TYPE.

DESCRIPTION	RANGE [Factory Default]	Intake Manifold Pressure (inHg) / Motor Amps PID (A) Screens Examples page 1
Setpoint: The automatic pressure setpoint that will be maintained by the PID loop calculation.	-3276.7 – 3276.7 Hg or AMPS [75]	
Deadband: No change in output will occur if PV is inside this window around setpoint.	0 – 100.0 Hg or AMPS [2.0]	
Proportional: This is a multiplier for the error (pressure minus setpoint) and will determine how the error will directly affect the amount of change in output. Too low a number here will result in sluggish action of the PID loop. Too high a number here will result in overshoot and oscillation of the PID loop.	0.00 – 100.00 [15.00]	
Integral: This is a multiplier for the amount of time the error (pressure minus setpoint) has been above or below setpoint. The more time that passes before the loop does not reach its setpoint will directly affect the amount of change in output. Too low a number here will take out the Integral part of control of the PID loop. Too high a number here will result in oscillation of the PID loop.	0.00 – 100.00 %/s [10.00]	
Derivative: This is a multiplier for how fast the error (pressure minus setpoint) is changing. The faster the pressure or setpoint changes will directly affect the amount of change in output. Too low a number here will take out the Derivative part of control of the PID loop. Too high a number here will result in oscillation of the PID loop.	0.00 – 100.00 %xs [0.00]	
Min Output: Minimum output the PID is allowed to calculate.	0.00 – 100.00 % [0.00]	
		Example page 2
Max Output: Maximum output the PID is allowed to calculate.	0.00 – 100.00 % [100.00]	
Max Rate Of Increase: Set the maximum change in output allowed while in automatic mode per scan.	0.00 – 100.00 % [25.00]	
Max Rate Of Decrease: Set the maximum change in output allowed while in automatic mode per scan.	0.00 – 100.00 % [25.00]	

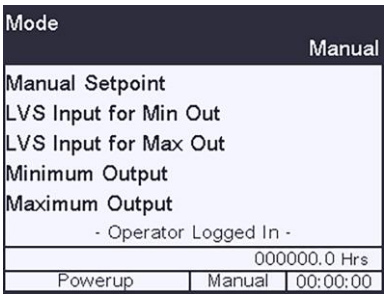
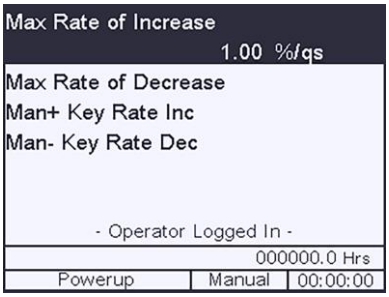






Recycle Valve Split Range

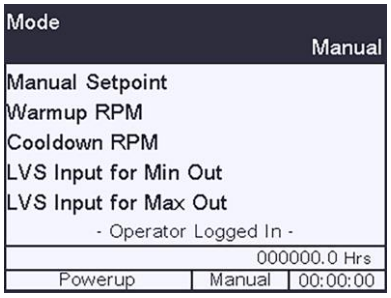
From the Control Loop Tuning screen, select Recycle Valve Split Range.

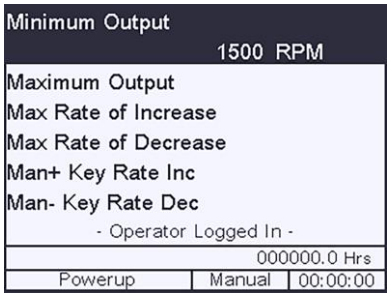
DESCRIPTION	RANGE [Factory Default]	Recycle Valve Split Range Screen Example page1
Mode:	Manual/Auto [Manual]	
Manual Setpoint: The manual Recycle Valve % Closed during Manual Mode.	0.00 – 100.00 % [na]	
LVS Input For Min Out: The minimum LVS input to the output scale block for the final output value.	0.00 – 100.00 % [0.00]	
LVS Input For Max Out: The maximum LVS input to the output scale block for the final output value.	0.00 – 100.00 % [75.00]	
Minimum Output: When the LVS value is at the input scale minimum, this is the amount that the valve will be driven closed. A linear scale will follow as the LVS value increases to the input scale maximum.	0.00 – 100.00 % [0.00]	
Maximum Output: When the LVS value is at the input scale maximum, this is the amount that the valve will be driven closed.	0.00 – 100.00 % [100.00]	
Rate Increase: The output ramping rate during Manual Mode or upon initial switchover from Manual to Automatic. After the LVS OUT has been captured, there is no ramp.	1.00 – 100.00 %/QS [1.00]	
Rate Decrease: The output ramping rate during Manual Mode or upon initial switchover from Manual to Automatic. After the LVS OUT has been captured, there is no ramp.	1.00 – 100.00 %/QS [1.00]	
		Example page 2
Max Rate Of Increase: The output ramping rate during Manual Mode or upon initial switchover from Manual to Automatic. After the LVS OUT has been captured, there is no ramp.	1.00 – 100.00 %/QS [1.00]	
Max Rate Of Decrease: The output ramping rate during Manual Mode or upon initial switchover from Manual to Automatic. After the LVS OUT has been captured, there is no ramp.	1.00 – 100.00 %/QS [1.00]	
Man+ Key Rate Of Increase: The amount of setpoint change per 250mS while the MAN+ key is held down.	1.00 – 100.00 %/QS [1.00]	
Man- Key Rate Of Decrease: The amount of setpoint change per 250mS while the MAN+ key is held down.	1.00 – 100.00 %/QS [1.00]	

Desired Speed Split Range

From the Control Loop Tuning screen, select Desired Speed Split Range.

DESCRIPTION	RANGE [Factory Default]	Desired Speed Split Range Screen Example page 1
Mode:	Manual/Auto [Manual]	
Manual Setpoint: The manual output during MANUAL mode of operation.	0 – 5000 RPM [na]	
Warm-Up Rpm: The Desired Speed output during Warm-up cycle if in AUTO mode.	0 – 5000 RPM [900]	
Cool-Down Rpm: The Desired Speed output during Cool-down cycle if in AUTO mode.	0 – 5000 RPM [900]	
LVS Input For Min Out: The minimum LVS input to the output scale block for the final output value.	0.00 – 100.00 % [25.00]	
LVS Input For Max Out: The maximum LVS input to the output scale block for the final output value.	0.00 – 100.00 % [100.00]	
		Example page 2
Minimum Output: When the LVS value is at the input scale minimum, this is the lowest RPM output. A linear scale will follow as the LVS value increases to the input scale maximum.	0 – 5000 RPM [1500]	
Maximum Output: When the LVS value is at the input scale maximum, this is highest RPM output.	0 – 5000 RPM [2000]	
Max Rate Increase: The output ramping rate during Manual Mode or upon initial switchover from Manual to Automatic. After the LVS OUT has been captured, there is no ramp.	1 – 999 RPM/QS [5]	
Max Rate Decrease: The output ramping rate during Manual Mode or upon initial switchover from Manual to Automatic. After the LVS OUT has been captured, there is no ramp.	1 – 999 RPM/QS [5]	
Man+ Key Rate Of Increase: The amount of setpoint change per 250mS while the MAN+ key is held down.	1 – 999 RPM/QS [10]	
Man- Key Rate Of Decrease: The amount of setpoint change per 250mS while the MAN+ key is held down.	1 – 999 RPM/QS [10]	

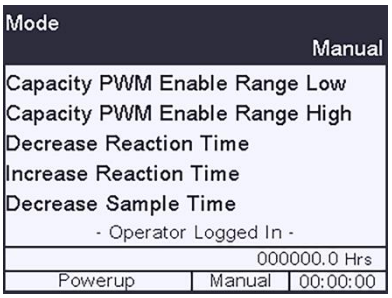


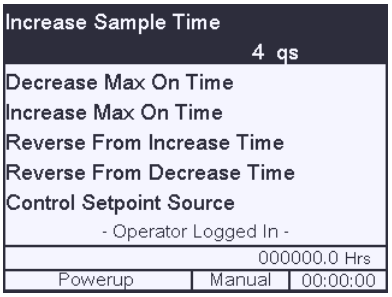


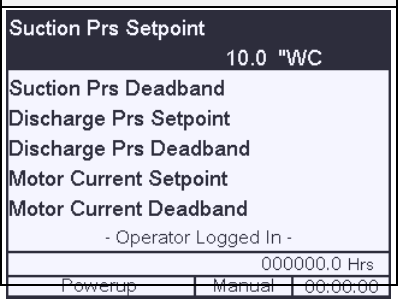
Capacity PWM Tuning

From the Control Loop Tuning screen, select Capacity PWM Tuning.

DESCRIPTION	RANGE [Factory Default]	Capacity PWM Tuning Screen Example
MODE:	Manual/Auto [Manual)	
Capacity PWM Enable Range Low: The LVS OUT above which PWM is enabled. Below this point the UNLOAD output will remain on steady.	0.00 – 100.00 % [0.00]	
Capacity PWM Enable Range High: The LVS OUT below which PWM is enabled. Above this point the LOAD output will remain on steady.	0.00 – 100.00 % [100.0]	
Decrease Reaction Time: This is a multiplier for the control reaction. It is multiplied by the error to calculate the on time for the pulse.	1 – 999 1/20th sec [1]	
Increase Reaction Time: This is a multiplier for the control reaction. It is multiplied by the error to calculate the on time for the pulse.	1 – 999 1/20th sec [1]	
Decrease Sample Time: The fixed pulse off time to allow settling of the process variable.	1 – 999 QS [4]	
		Example page 2
Increase Sample Time: The fixed pulse off time to allow settling of the process variable.	1 – 999 QS [4]	
Decease Max On Time: Clipping factor for the calculated max on time.	1 – 999 1/20th sec [20]	
Increase Max On Time: Clipping factor for the calculated max on time.	1 – 999 1/20th sec [20]	
Reverse From Increase On Time: This is a one-time increase pulse that is generated after the decrease has been pulsing. This is used to prime the hydraulic controls to change direction.	1 – 999 1/20th sec [8]	
Reverse From Decrease On Time: This is a one-time increase pulse that is generated after the decrease has been pulsing. This is used to prime the hydraulic controls to change direction.	1 – 999 1/20th sec [8]	
Control Setpoint Source: Choose setpoints to be integrated to Capacity PIDs for Desired Speed / Recycle Valve control, or standalone operation.	Cap PIDs / Standalone [Cap PIDs]	
		Example page 3
Standalone Suction Prs Setpoint: The automatic pressure setpoint that will be maintained by the control loop calculation.	-3276.7 – 3276.7 "WC, OSI, PSI, kPa, bar [10.0]	
Standalone Suction Prs Deadband: No change in output will occur if PV is inside this window around setpoint.	1.0 – 999.0 "WC, OSI, PSI, kPa, bar [0.5]	
Standalone Discharge Prs Setpoint: The automatic pressure setpoint that will be maintained by the control loop calculation.	-3276.7 – 3276.7 PSI [70.0]	





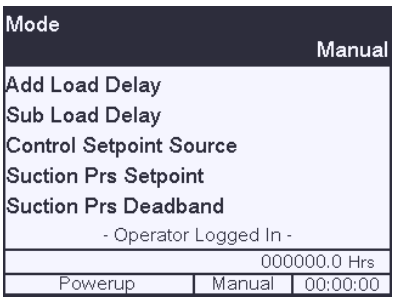


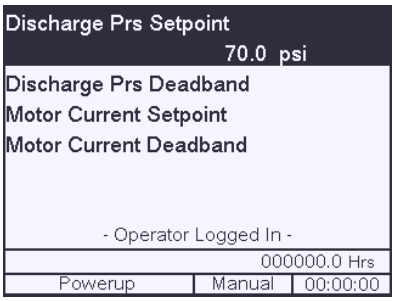
Standalone Discharge Prs Deadband: No change in output will occur if PV is inside this window around setpoint.	0 – 1000.0 PSI [0.5]	
Standalone Manifold Pressure / Motor Current Setpoint: The automatic pressure setpoint that will be maintained by the control loop calculation.	-3276.7 – 3276.7 Hg or AMPS [75]	
Standalone Manifold Pressure / Motor Current Deadband: No change in output will occur if PV is inside this window around setpoint.	0 – 100.0 Hg or AMPS [2.0]	

Load Step Setpoints

From the Control Loop Tuning screen, select Load Step Setpoints.

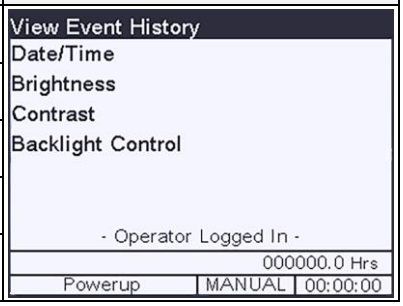
DESCRIPTION	RANGE [Factory Default]	Load Step Setpoint Screen Example
Mode:	Manual/Auto [Manual]	
Add Load Delay: Time between increasing load step if the LVS ERROR is positive.	1 – 999 1sec [15]	
Sub Load Delay: Time between decreasing load step if the LVS ERROR is negative.	1 – 999 1sec [15]	
Control Setpoint Source: Choose setpoints to be integrated to Capacity PIDs for Desired Speed / Recycle Valve control, or standalone operation.	Cap PIDs / Standalone [Cap PIDs]	
Standalone Suction Prs Setpoint: The automatic pressure setpoint that will be maintained by the control loop calculation.	-3276.7 – 3276.7 “WC, OSI, PSI, kPa, bar [10.0]	
Standalone Suction Prs Deadband: No change in output will occur if PV is inside this window around setpoint.	1.0 – 999.0 “WC, OSI, PSI, kPa, bar [0.5]	
		Example page 3
Standalone Discharge Prs Setpoint: The automatic pressure setpoint that will be maintained by the control loop calculation.	-3276.7 – 3276.7 PSI [70.0]	
Standalone Discharge Prs Deadband: No change in output will occur if PV is inside this window around setpoint.	0 – 1000.0 PSI [0.5]	
Standalone Manifold Pressure / Motor Current Setpoint: The automatic pressure setpoint that will be maintained by the control loop calculation.	-3276.7 – 3276.7 Hg or AMPS [75]	
Standalone Manifold Pressure / Motor Current Deadband: No change in output will occur if PV is inside this window around setpoint.	0 – 100.0 Hg or AMPS [2.0]	





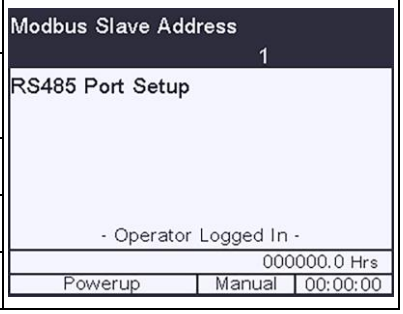
System Settings

From the System Menu screen, select System Settings.

DESCRIPTION	RANGE [Factory Default]	System Settings Screen Example
View Event History Select to see the last 32 Event History entries.	–	
Date/Time Set the internal real-time clock for event history logging.	–	
Brightness Set the display backlight brightness.	0 – 100 % [90]	
Contrast Set the display contrast.	140 – 180 [160]	
Backlight Control Enable or disable the display backlight.	Enable / Disable [Enable]	

Modbus Comm

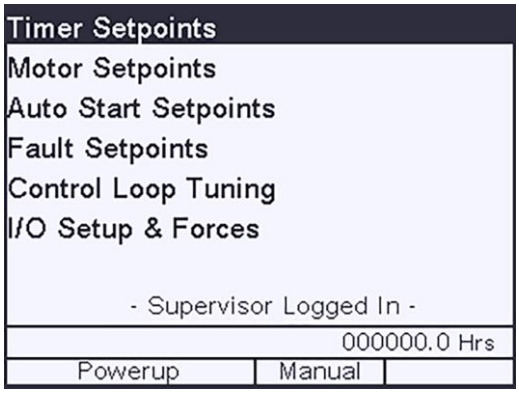
From the System Menu screen, select Modbus Comm.

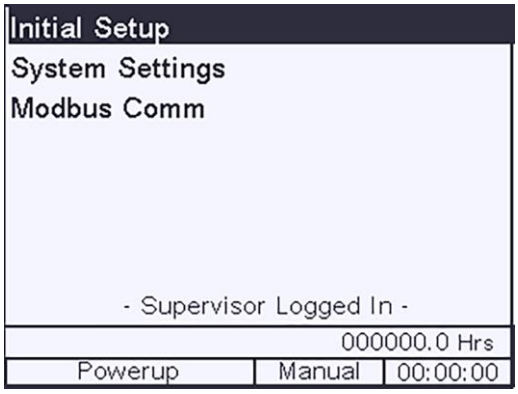
DESCRIPTION	RANGE [Factory Default]	Modbus Comm Screen Example
Slave Address.	1 253 [1]	
RS485 Port Setup-Baud Rate Set the baud rate for the Modbus RTU RS485 slave port.	9600, 19200, 38400, 57600, 115200 [9600]	
RS485 Port Setup-Stop Bits.	1, 2 [1]	
RS485 Port Setup-Parity.	None, Even, Odd [None]	
RS485 Terminating Resistor (changing this setting requires reboot).	Disabled, Enabled [Disabled]	

Supervisor Level Setpoints and Settings

To access the System Menu screen at the Supervisor security level, press the Setup key, and use passcode 0133. Press the Enter Key.

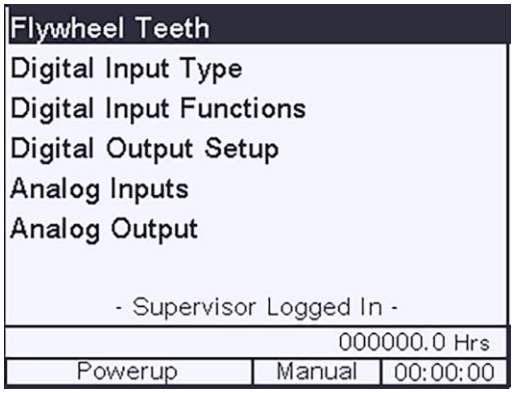
The System Menu Screen is the main menu for Setpoints and settings.



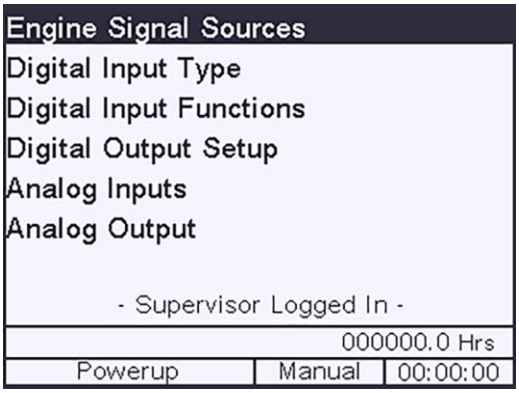


I/O Setup and Forces

From the System Menu screen, select the I/O Setup and Forces screen.



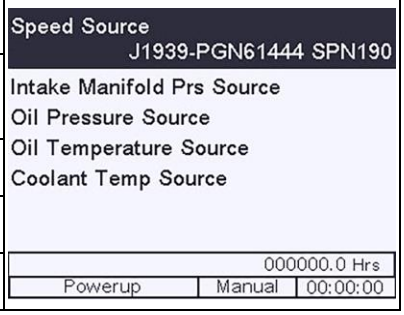
Factory Default: Mechanical Engine as Driver Type



J1939 Engine as Driver Type

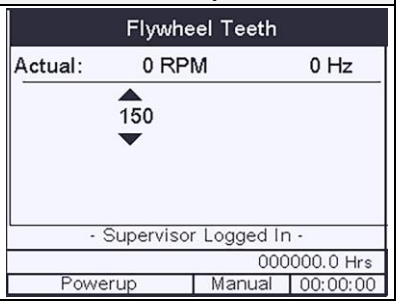
Engine Signal Source (J1939 Engine as Driver Type)

From the I/O Setup and Forces, select Engine Signal Source.

DESCRIPTION	RANGE [Factory Default]	Engine Signal Source Screen Example
Speed Source – select either J1939 communication or MPU for the engine speed.	J1939-PGN61444 SPN190 / Hardwire [J1939-PGN61444 SPN190]	
Intake Manifold Pressure Source – select either J1939 communication or AI4 for the engine intake manifold pressure.	J1939-PGN65270 SPN106 / J1939-PGN65270 SPN102 / Hardwire [J1939-PGN65270 SPN106]	
Oil Pressure Source – select either J1939 communication or AI3 for the engine oil pressure.	J1939-PGN65263 SPN100 / Hardwire [J1939-PGN65263 SPN100]	
Oil Temperature Source – select either J1939 communication or TC3 for the engine oil pressure.	J1939-PGN65262 SPN175 / Hardwire [J1939-PGN65262 SPN175]	
Coolant Temperature Source – select either J1939 communication or TC4 for the engine oil pressure.	J1939-PGN65262 SPN110 / Hardwire [J1939-PGN65262 SPN110]	

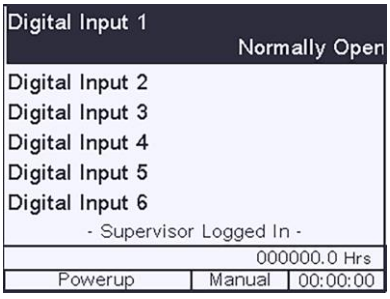
Flywheel Teeth

From the I/O Setup and Forces, select Flywheel Teeth.

DESCRIPTION	RANGE [Factory Default]	Flywheel Teeth Screen Example
Magnetic Pickup – Pulses Per Revolution Calibration factor for the RPM reading.	1 – 327 Pulses/Rev [60]	

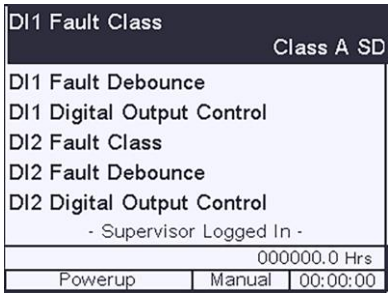
Digital Input Type

From I/O Setup and Forces, select Digital Input Type.

DESCRIPTION	RANGE [Factory Default]	Digital Input Type Screen Example 1 of 2 pages
DI1 Type: (only available if Engine Drive type selected). Set the normal condition of Spare DI1 input.	Normally Open Normally Closed DC+, Normally Closed DC- [Normally Open]	
DI2 Type: (only available if Engine Drive type selected).	(same as DO1) [Normally Open]	
DI3 Type		
DI4 Type		
DI5 Type		
DI6 Type		
DI7 Type		
DI8 Type		

Digital Input Functions

From the I/O Setup and Forces, select Digital Input Functions.

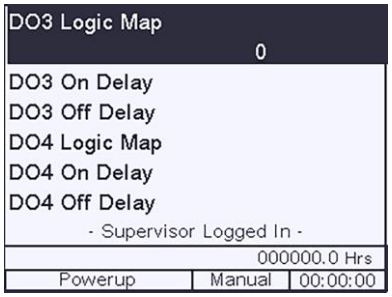
DESCRIPTION	RANGE [Factory Default]	Digital Input Functions Screen Example 1 of 4 pages
DI1 Fault Class: (only available if Engine Drive type selected) Set the fault class type for this sensor. If set to a TON, TOF or DOx CTRL, it will act as a control for a discrete output as well.	Class ESD Class A SD Class B1 SD Class B2 SD Class C SD Class P SD Class A AL Class B1 AL Class B2 AL Class C AL Class P AL Class A Stop Class B1 Stop Class B2 Stop Class C Stop Class P Stop Ignore [Class A SD]	
DI1 Fault Debounce: (only available if Engine Drive type selected). Set a debounce timer on the fault if desired.	0 – 255 QS [0]	
DI1 Digital Output Control: (only available if Engine Drive type selected). Select optional control function for Digital output. Control: Input = Output, TON: Input if true, will energize output, if false leave in last state. TOFF: Input if true, will de-energize output, if false leave in last state.	None DO 3 Control DO3 TON DO3 TOFF DO4 Control DO4 TON DO4 TOFF DO7 Control DO7 TON DO7 TOFF [None]	
DI2 Fault Class: (only available if Engine Drive type selected) Set the fault class type for this sensor. If set to a TON, TOF or TONOF, it will act as a control for a discrete output as well.	(same as DI1)	
DI2 Fault Debounce: (only available if Engine Drive type selected). Set a debounce timer on the fault if desired.	0 – 255 QS [0]	
DI2 Digital Output Control: (only available if Engine Drive type selected). Select optional control function for Digital output. Control: Input = Output, TON: Input if true, will energize output, if false leave in last state. TOFF: Input if true, will de-energize output, if false leave in last state.	(same as DI1)	

DESCRIPTION	RANGE [Factory Default]	Digital Input Functions Screen Example 1 of 4 pages
DI3 Fault Class: Set the fault class type for this sensor. If set to a TON, TOF or TONOF, it will act as a control for a discrete output as well.	(same as DI1)	
DI3 Fault Debounce Set a debounce timer on the fault if desired.	0 – 255 QS [8]	
DI3 Digital Output Control Select optional control function for Digital output. Control: Input = Output, TON: Input if true, will energize output, if false leave in last state. TOFF: Input if true, will de-energize output, if false leave in last state.	None DO 3 Control DO3 TON DO3 TOFF DO4 Control DO4 TON DO4 TOFF DO7 Control DO7 TON DO7 TOFF [None]	
DI4 Fault Class (see DI3 description)	[Class A SD]	
DI4 Fault Debounce (see DI3 description)	[0]	
DI4 Digital Output Control (see DI3 description)	[None]	
DI5 Fault Class (see DI3 description)	[Class A SD]	
DI5 Fault Debounce (see DI3 description)	[0]	
DI5 Digital Output Control (see DI3 description)	[None]	
DI6 Fault Class (see DI3 description)	[Class A SD]	
DI6 Fault Debounce (see DI3 description)	[0]	
DI6 Digital Output Control (see DI3 description)	[None]	
DI7 Fault Class (see DI3 description)	[Class A SD]	
DI7 Fault Debounce (see DI3 description)	[0]	
DI7 Digital Output Control (see DI3 description)	[None]	
DI8 Fault Class (see DI3 description)	[Class A SD]	
DI8 Fault Debounce (see DI3 description)	[0]	
DI8 Digital Output Control (see DI3 description)	[None]	

Digital Output Setup

From the I/O Setup and Forces, select Digital Output Setup.

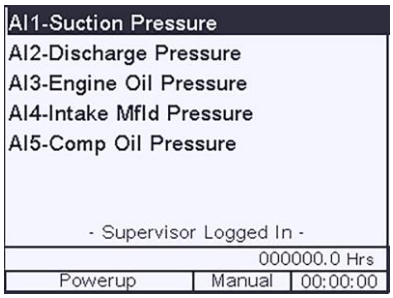
VALUE	STATE
1	Ready to Start
2	Unloading
4	Starting Motors (Motor Drive Only)
8	Spindown (Engine Drive Only)
16	Cranking (Engine Drive Only)
32	Crank Rest (Engine Drive Only)
64	Warm-up Timing
128	Wait on Temp Permissive (Engine Drive Only)
256	Wait on Spd Load Perm
512	Load Control
1024	Cool-down Tmg
2048	Shutdown

DESCRIPTION	RANGE [Factory Default]	Digital Output Setup Screen Example 1 of 2 pages
DO3 Logic Map: Determine which states you require DO3 to be energized. Add up the Values for each selected state and enter the total here. For example…if you want the output to energize in a SHUTDOWN state, use a value of 2048. If you want the output to be energized in UNLOADING and COOL-DOWN state, use a value of 2+1024 = 1026.	0 – 4095 [2000]	
DO3 On Delay: Time delay to turn on the output when the selected state is true.	0 – 999 sec [0]	
DO3 Off Delay: Time delay to turn off the output when the selected state is false.	0 – 999 sec [0]	
DO4 Logic Map: Determine which states you require DO4 to be energized. Add up the Values for each selected state and enter the total here.	0 – 4095 [0]	
DO4 On Delay: Time delay to turn on the output when the selected state is true.	0 – 999 sec [0]	
DO4 Off Delay Time delay to turn off the output when the selected state is false.	0 – 999 sec [0]	
DO7 Logic Map: Determine which states you require DO7 to be energized. Add up the Values for each selected state and enter the total here.	0 – 4095 [0]	
DO7 On Delay: Time delay to turn on the output when the selected state is true.	0 – 999 sec [0]	
DO7 Off Delay: Time delay to turn off the output when the selected state is false.	0 – 999 sec [0]	

Analog Inputs

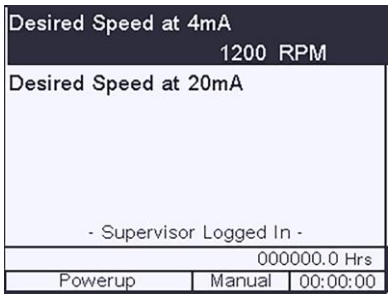
From the I/O Setup and Forces, select Analog Inputs.

DESCRIPTION	RANGE [Factory Default]	Analog Inputs Screen Example
Suction Pressure – Min The minimum range of the transmitter	-3276.7 – 3276.7 (“WC, OSI, PSI, kPa, bar) [-30.0]	
Suction Pressure – Max The maximum range of the transmitter	-3276.7 – 3276.7 (“WC, OSI, PSI, kPa, bar) [30.0]	
Analog Input 1 – Min mA	0.00 – 25.00 mA [4.00]	
Analog Input 1 – Max mA	0.00 – 25.00 mA [20.00]	
Discharge Pressure – Min The minimum range of the transmitter	-3276.7 -3276.7 PSI [0.0]	
Discharge Pressure – Max The maximum range of the transmitter	-3276.7 -3276.7 PSI [200.0]	
Analog Input 2 – Min mA	0.00 – 25.00 mA [4.00]	
Analog Input 2 – Max mA	0.00 – 25.00 mA [20.00]	
Engine Oil Pressure – Min The minimum range of the transmitter	-3276.7 -3276.7 PSI [0.0]	
Engine Oil Pressure – Max The maximum range of the transmitter	-3276.7 -3276.7 PSI [200.0]	
Analog Input 3 – Min mA	0.00 – 25.00 mA [4.00]	
Analog Input 3 – Max mA	0.00 – 25.00 mA [20.00]	
Intake Mfld Pressure – Min The minimum range of the transmitter	-3276.7 -3276.7 Hg [-30.0]	
Intake Mfld Pressure – Max The maximum range of the transmitter	-3276.7 -3276.7 Hg [60.0]	
Analog Input 4 – Min mA	0.00 – 25.00 mA [4.00]	
Analog Input 4 – Max mA	0.00 – 25.00 mA [20.00]	
Motor Current – Min The minimum range of the transmitter	-3276.7 -3276.7 AMPS [0.0]	
Motor Current – Max The maximum range of the transmitter	-3276.7 -3276.7 AMPS [400.0]	
Analog Input 4 – Min mA	0.00 – 25.00 mA [4]	
Analog Input 4 – Max mA	0.00 – 25.00 mA [20.00]	
Compressor Oil Pressure – Min The minimum range of the transmitter	-3276.7 -3276.7 PSI [0]	
Compressor Oil Pressure – Max The maximum range of the transmitter	-3276.7 -3276.7 PSI [200]	
Analog Input 5 – Min mA	0.00 – 25.00 mA [4.00]	
Analog Input 5 – Max mA	0.00 – 25.00 mA [20.0]	



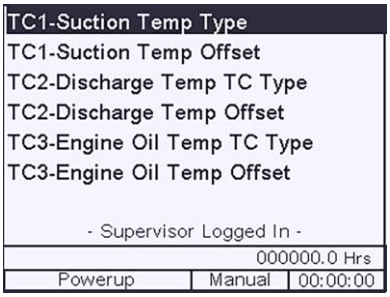
Analog Outputs

From the I/O Setup and Forces, select Analog Outputs.

DESCRIPTION	RANGE [Factory Default]	Analog Outputs Screen Example
Desired RPM Output at 4mA: Analog output scaling for the desired RPM. Set this to match the motor VFD/ engine speed governor input.	0 – 9999 RPM [1200]	
Desired RPM Output at 20mA: Analog output scaling for the desired RPM. Set this to match the motor VFD/ engine speed governor input.	0 – 9999 RPM [2000]	

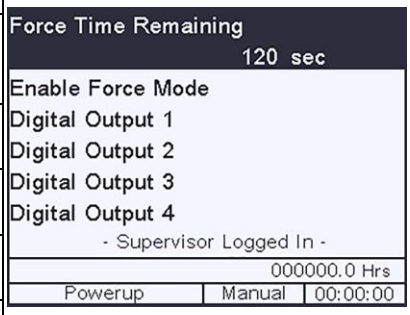
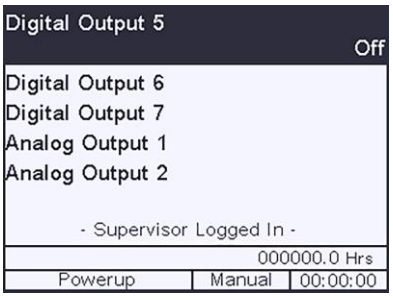
Thermocouple Inputs

From the I/O Setup and Forces, select Thermocouple Inputs.

DESCRIPTION	RANGE [Factory Default]	Thermocouple Inputs Screen Example 1 of 2 pages
TC1 Temperature – Type (selectable as either Suction, Compressor Oil or Discharge 2 Temperature) Set the thermocouple type.	J or K [K]	
TC1 Temperature – Offset (selectable as either Suction, Compressor Oil or Discharge 2 Temperature) Calibration factor to add to subtract from the thermocouple reading.	-20 – 20 F [0]	
TC2-Discharge Temperature – Type Set the thermocouple type.	J or K [K]	
TC2-Discharge Temperature – Offset Calibration factor to add to subtract from the thermocouple reading.	-20 – 20 F [0]	
TC3-Engine Oil Temperature – Type Set the thermocouple type.	J or K [K]	
TC3-Engine Oil Temperature – Offset Calibration factor to add to subtract from the thermocouple reading.	-20 – 20 F [0]	
TC4-Engine Coolant Temperature – Type Set the thermocouple type.	J or K [K]	
TC4-Engine Coolant Temperature – Offset Calibration factor to add to subtract from the thermocouple reading.	-20 – 20 F [0]	

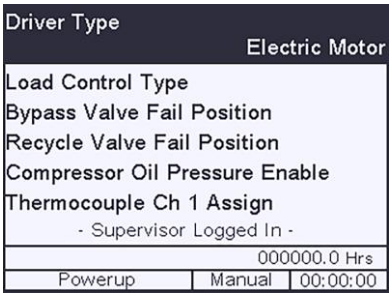
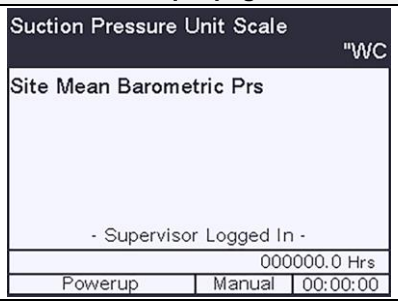
Force Menu Functions

From the I/O Setup and Forces, scroll to the second page and select Force Menu.

DESCRIPTION	RANGE [Factory Default]	Force Menu Functions Screen Example page 1
Force Time Remaining	NA [NA]	
Enable Force Mode: Set this to ON to enable digital and analog output force mode. This can only be activated in Shut-down or Ready-To-Start state.	Off / On [NA]	
Digital Output 1	Off / On [Off]	
Digital Output 2	Off / On [Off]	
Digital Output 3	Off / On [Off]	
Digital Output 4	Off / On [Off]	
		Example page 2
Digital Output 5	Off / On [Off]	
Digital Output 6	Off / On [Off]	
Digital Output 7	Off / On [Off]	
Analog Output 1	0.00-100.00 % [0.00]	
Analog Output 2	0.00-100.00 % [0.00]	

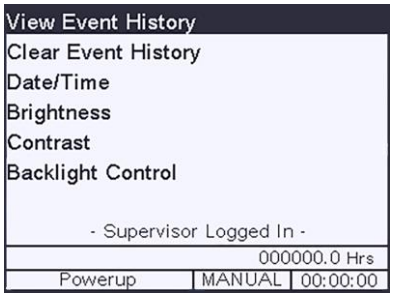
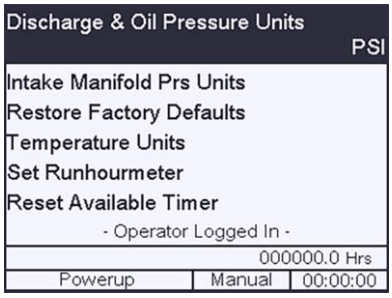
Initial Setup

From the System Menu screen, scroll to the second page and select Initial Setup.

DESCRIPTION	RANGE [Factory Default]	Initial Setup Screen Example page 1
Driver Type: Set the prime mover type. This setting changes the operational logic and I/O assignments for the controller.	Elect Motor / Mech Engine / J1939 Eng 420mA / J1939 Eng TSC1 [Elect Motor]	
Load Control Type: Set the type of Load Discrete Outputs. PWM uses two pulsed outputs to move a capacity slide valve. Bypass Valve is a single output that energizes upon reaching a LOAD CONTROL state. 1 and 2 Step load turn on DO5 and DO6 (2 step) to load and unload the machine with time delays in between.	Bypass VLV / Capacity PWM / 1 Step Load / 2 Step Load [Bypass VLV]	
Bypass Valve Fail Position: This setting will invert the control action of the Bypass Valve. Fail Open is an energize to Close output. Fail Open is an energize to Open output.	Open / Closed [Open]	
Recycle Valve Fail Position: This setting will invert the control action of the Recycle Valve. Fail Open will assume 4mA is open and 20mA is closed. Fail Closed will assume 4mA is closed and 20mA is open.	Open / Closed [Open]	
Compressor Oil Pressure Enable: Select whether the analog input shall be displayed and faults enabled for AI5.	Disabled, Enabled [Enabled]	
Thermocouple Channel 1 Assignment: Select the desired text label for thermocouple 1.	Suction Tmp, Comp Oil Tmp, Discharge 2 Tmp [Suction Tmp]	
		Example page 2
Suction Pressure Unit Scale: Select the engineering units for the suction pressure readings.	“WC, OSI, PSI, kPa, bar [“WC]	
Site Mean Barometric Pressure: Set the atmospheric pressure for J1939 Engine Manifold reading conversion from absolute to gauge pressure.	0.0 – 35.0 “Hg [29.92]	

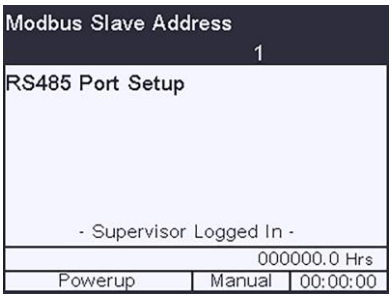
System Settings

From the System Menu screen, scroll to the second page and select System Settings.

DESCRIPTION	RANGE [Factory Default]	System Settings Screen Example page 1
View Event History: Select to see the last 32 event history items.		
Clear Event History: Only allowed at supervisor level, this erases the event history log.		
Date/Time: Set the internal real-time clock for event history logging.		
Brightness: Set the display backlight brightness.	0 – 100 % [90]	
Contrast: Set the display contrast.	140 – 180 [160]	
Backlight Control: Enable or disable the display backlight.	Enable / Disable [Enable]	
		Example page 2
Discharge & Oil Pressure Units	PSI, kPa, bar [PSI]	
Intake Manifold Pressure Units	“Hg, PSI, "WC, cmHG, kPa, bar [“Hg]	
Restore Factory Defaults: Only visible if unit is in Ready-to-Start. Select yes to reload factory defaults settings. RECORD ALL USER SETTINGS BEFORE PRESSING THIS BUTTON. ALL USER SETTINGS WILL BE LOST.	No / Yes [NA]	
Temperature Units	Fahrenheit / Celsius [Fahrenheit]	
Set Runhourmeter: Set or preset the internal run hour meter value	0.0 – 999999.0 Hrs. [0.0]	
Reset Available Timer: Reset or preset the unit available timer	0.0 – 999999.0 Hrs. [0.0]	

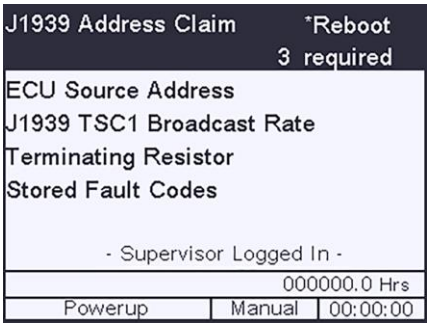
Modbus Comm

From the System Menu screen, scroll to the second page and select Modbus Comm.

DESCRIPTION	RANGE [Factory Default]	Modbus Comm Screen Example
Slave Address	1 -253 [1]	
RS485 Port Setup: Set the baud rate for the Modbus RTU RS485 slave port.	9600, 19200, 38400, 57600, 115200 [9600]	
RS485 Port Setup-Stop Bits	1, 2 [1]	
RS485 Port Setup-Parity	None, Even, Odd [None]	
RS485 Terminating Resistor (changing this setting requires reboot).	Disabled, Enabled [Disabled]	

J1939 Engine Settings

From the System Menu screen, scroll to the second page and select J1939 Engine Settings.

DESCRIPTION	RANGE [Factory Default]	J1939 Engine Settings Screen Example
J1939 Address Claim: Set the VRU Pro's CAN address on the J1939 link. Certain engine manufacturers may require specific address for TSC1 message for speed control.	0 – 253 [3]	
ECU Source Address: Set the Engine ECU's expected address for receiving J1939 data from the engine.	0 – 253 [0]	
J193 TSC1 Broadcast Rate: Set the rate of the TSC1 broadcast if TSC1 speed control is used.	1000ms, 750ms, 500ms, 250ms, 100ms, 50ms, 20ms 10ms [10ms]	
Terminating Resistor: Enable or disable the CAN bus terminating resistor inside the VRU Pro. CAN networks must be terminated at each end of the network to work reliably.	Disabled, Enabled [Enabled]	
Stored Fault Codes: Select this option to retrieve DM2 history log from the engine ECU.		

Shutdown / Event Code List

#	Driver Type Enable	Class Type	SD, AL, MSG	Message	Modbus Register	BIT	SD Code (40018)
01	ENG & J19	*	SD	Spare DI01 *configurable	40076	0	01
02	ENG & J19	*	SD	Spare DI02 *configurable	40076	1	02
03	ALL	*	SD	High Scrubber Level SD *configurable	40076	2	03
04	ALL	*	SD	Oil Level SD *configurable	40076	3	04
05	ALL	*	SD	Compressor Vibration SD *configurable	40076	4	05
06	ALL	*	SD	Motor Vibration SD *configurable	40076	5	06
07	ALL	*	SD	High Oxygen Level SD *configurable	40076	6	07
08	ALL	*	SD	Spare DI08 *configurable	40076	7	08
09	MTR	S	SD	Driver Start Failure	40076	8	09
10	MTR	S	SD	Cooler Start Failure	40076	9	10
11	MTR	S	SD	Motor Short Cycle	40076	10	11
12	ENG & J19	S	SD	Failure To Crank	40076	11	12
13	MTR	S	SD	Lost Motor Run Signal	40076	12	13
14	MTR	S	SD	Lost Cooler Run Signal	40076	13	14
15	J19	S	SD	Lost Engine J1939 Comm	40076	14	15
16	ALL	A	SD	Modbus Shutdown	40076	15	16
17				Reserved	40077	0	
18				Reserved	40077	1	
19				Reserved	40077	2	
20				Reserved	40077	3	
21	*ENG	A+2s dbnc	SD	Lost Speed Signal/Engine Stall	40077	4	21
22	ALL	A+2s dbnc	SD	Lost Suction Pressure Xmtr	40077	5	22
23	ALL	A+2s dbnc	SD	Lost Discharge Pressure Xmtr	40077	6	23
24	*ENG	A+2s dbnc	SD	Lost Engine Oil Pressure Xmtr	40077	7	24
25	MTR	A+2s dbnc	SD	Lost Motor Amps Xmtr	40077	8	25
26	ALL	A+2s dbnc	SD	Lost Compressor Oil Pressure Xmtr	40077	9	26
27	*ENG	A+2s dbnc	SD	Lost Intake Manifold Pressure Xmtr	40077	10	27
28				Reserved	40077	11	
29	ALL	A+5s dbnc	SD	Cold Junction TC Wiring Fault	40077	12	29
30	ALL	A+5s dbnc	SD	Thermocouple CH1 TC Wiring Fault	40077	13	30
31	ALL	A+5s dbnc	SD	Discharge Temperature TC Wiring Fault	40077	14	31
32	*ENG	A+5s dbnc	SD	Engine Oil Temperature TC Wiring Fault	40077	15	32
33	*ENG	A+5s dbnc	SD	Engine Coolant Temperature TC Wiring Fault	40078	0	33
34	*ENG	B2	SD	LoLo Engine Speed	40078	1	34
35	*ENG	B2	AL	Lo Engine Speed	40078	2	
36	*ENG	A	AL	Hi Engine Speed	40078	3	

#	Driver Type Enable	Class Type	SD, AL, MSG	Message	Modbus Register	BIT	SD Code (40018)
37	*ENG	ESD	SD	HiHi Engine Speed	40078	4	37
38	ALL	A	SD	LoLo System Voltage	40078	5	38
39	ALL	A	AL	Lo System Voltage	40078	6	
40	ALL	A	AL	Hi System Voltage	40078	7	
41	ALL	A	SD	HiHi System Voltage	40078	8	41
42	ALL	P+dbnc	SD	LoLo Suction Pressure	40078	9	42
43	ALL	P+dbnc	AL	Lo Suction Pressure	40078	10	
44	ALL	A+dbnc	AL	Hi Suction Pressure	40078	11	
45	ALL	A+dbnc	SD	HiHi Suction Pressure	40078	12	45
46	ALL	P+dbnc	SD	LoLo Discharge Pressure	40078	13	46
47	ALL	P+dbnc	AL	Lo Discharge Pressure	40078	14	
48	ALL	A+dbnc	AL	Hi Discharge Pressure	40078	15	
49	ALL	A+dbnc	SD	HiHi Discharge Pressure	40079	0	49
50	*ENG	B1	SD	LoLo Engine Oil Pressure	40079	1	50
51	*ENG	B1	AL	Lo Engine Oil Pressure	40079	2	
52				Reserved	40079	3	
53				Reserved	40079	4	
54				Reserved	40079	5	
55				Reserved	40079	6	
56	MTR	A+dbnc	SD	Hi Motor Current	40079	7	
57	MTR	A+dbnc		HiHi Motor Current	40079	8	57
58	ALL	B1	SD	LoLo Compressor Oil Pressure	40079	9	58
59	ALL	B1	AL	Lo Compressor Oil Pressure	40079	10	
60	ALL	A	AL	Hi Compressor Oil Pressure	40079	11	
61	ALL	A	SD	HiHi Compressor Oil Pressure	40079	12	61
62	*ENG	B1	SD	LoLo Intake Manifold Pressure	40079	13	62
63	*ENG	B1	AL	Lo Intake Manifold Pressure	40079	14	
64	*ENG	B1	AL	Hi Intake Manifold Pressure	40079	15	
65	*ENG	B1	SD	HiHi Intake Manifold Pressure	40080	0	65
66				Reserved	40080	1	
67				Reserved	40080	2	
68				Reserved	40080	3	
69				Reserved	40080	4	
70				Reserved	40080	5	
71				Reserved	40080	6	
72				Reserved	40080	7	
73	ALL	A	AL	Hi Suction Temperature	40080	8	
74	ALL	A	SD	HiHi Suction Temperature	40080	9	74
75				Reserved	40080	10	
76				Reserved	40080	11	
77	ALL	A	AL	Hi Discharge Temperature	40080	12	
78	ALL	A	SD	HiHi Discharge Temperature	40080	13	78
79				Reserved	40080	14	
80				Reserved	40080	15	
81	*ENG	A	AL	Hi Engine Oil Temperature	40081	0	

#	Driver Type Enable	Class Type	SD, AL, MSG	Message	Modbus Register	BIT	SD Code (40018)
82	*ENG	A	SD	HiHi Engine Oil Temperature	40081	1	82
83				Reserved	40081	2	
84				Reserved	40081	3	
85	*ENG	B2	AL	Hi Engine Coolant Temperature	40081	4	
86	*ENG	B2	SD	HiHi Engine Coolant Temperature	40081	5	86
87				Reserved	40081	6	
88				Reserved	40081	7	
89				Reserved	40081	8	
90				Reserved	40081	9	
91	ALL	A	AL	Hi Comp Oil Temperature	40081	10	
92	ALL	A	SD	HiHi Comp Oil Temperature	40081	11	92
93	ALL	A	AL	Hi Discharge 2 Temperature	40081	12	
94	ALL	A	SD	HiHi Discharge 2 Temperature	40081	13	94
95	ALL	A	SD	Manual Stop In Auto	40081	14	95
96	ALL	A	MSG	Unload Autostop	40081	15	
97	ALL	A	MSG	Service Reminder 1 Expired			
98	ALL	A	MSG	Service Reminder 2 Expired			
99	ALL	A	MSG	Service Reminder 3 Expired			
100	ALL	A	MSG	Service Reminder 4 Expired			
101	ALL	A	MSG	Service Reminder 5 Expired			
102	ALL	A	MSG	Service Reminder 6 Expired			
103	ALL	A	MSG	Service Reminder 7 Expired			
104				Reserved			

Driver Type Enable

ALL – Any Driver Type Selection
MTR – Electric Motor Drive Only
ENG – Engine Drive Only
J19 – J1939 Engine Drive Only
*ENG – Engine Drive or J1939 Engine + Hardwire Selected as Engine Source

Class Shutdowns

* – User Configurable From Display
A – Always Armed
B1 – Armed When the Start Lockout Delay Timer (B1) Expires
B2 – Armed When the Start Lockout Delay Timer (B2) Expires
C – Armed in Loaded State After Clear First Time for 2 Seconds
P – Armed in Loaded State After the Process Lockout Delay Timer (P) Expires
S – Armed by a Special Timer or Condition Described in Sequence of Operation
Esd – Armed Always, Even in Test Mode

Modbus Address List (RS485)

The Controller supports Modbus RTU slave protocol and is programmed as a slave device. The RTU address is set in the setup MENU. Readings will be shown with no decimal place as signed 16 bit data unless indicated otherwise. Reference the Resolution column to determine the proper number of decimals for the readings.

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
RAW DATA				
40001	Reserved	Raw	1	Factory Use
40002	Modbus Slave Address	Raw	1	Factory Use
40003	Config Version 1	Raw	1	Factory Use
40004	Config Version 2	Raw	1	Factory Use
40005	Config Version 3	Raw	1	Factory Use
40006	Config Version Unique Id	Raw	1	Factory Use
40007	Application Version 1	Raw	1	Factory Use
40008	Application Version 2	Raw	1	Factory Use
40009	Application Version 3	Raw	1	Factory Use
40010	Application Version 4	Raw	1	Factory Use
40011	Bootloader Version 1	Raw	1	Factory Use
40012	Bootloader Version 2	Raw	1	Factory Use
40013	Bootloader Version 3	Raw	1	Factory Use
40014	Bootloader Version 4	Raw	1	Factory Use
40015	DM1 SPN (32 Bit Long INT MSW-LSW)	Raw	1	Factory Use
40017	DM1 FMI	Raw	1	Factory Use
40018+19	Total Time Powered Up (32 Bit Long INT MSW-LSW)	Seconds	1	Factory Use
40020	Reserved	Raw	1	Factory Use
40021	Analog Output 1	mA	0.01	Factory Use
40022	Analog Output 2	mA	0.01	Factory Use
40023	Frequency Input	Hz	1	Factory Use
40024	Digital Inputs 1-8	Raw	1	Factory Use
40025	Reserved	Raw	1	Factory Use
40026	Digital Outputs 1-7, Test, Arm Status Bits	Raw	1	Factory Use
40027	Reserved	Raw	1	Factory Use
40028	Analog Input 1	mA	0.01	Factory Use
40029	Analog Input 2	mA	0.01	Factory Use
40030	Analog Input 3	mA	0.01	Factory Use
40031	Analog Input 4	mA	0.01	Factory Use
40032	Analog Input 5	mA	0.01	Factory Use
40033	Di1 Type	Raw	1	0 NO, 1 NC DC+, 2 NC DC-
40034	Di2 Type	Raw	1	0 NO, 1 NC DC+, 2 NC DC-
40035	Di3 Type	Raw	1	0 NO, 1 NC DC+, 2 NC DC-
40036	Di4 Type	Raw	1	0 NO, 1 NC DC+, 2 NC DC-
40037	Di5 Type	Raw	1	0 NO, 1 NC DC+, 2 NC DC-
40038	Di6 Type	Raw	1	0 NO, 1 NC DC+, 2 NC DC-
40039	Di7 Type	Raw	1	0 NO, 1 NC DC+, 2 NC DC-
40040	Di8 Type	Raw	1	0 NO, 1 NC DC+, 2 NC DC-
40041	TC Wiring Fault Bitmap	Raw	1	Factory Use
40042	Cold Junction Temperature	F	1	Factory Use
40043	TC5 Cold Junction Temperature	C	0.01	Factory Use

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Raw Data				
40044	Thermocouple Input 1	C	0.01	Factory Use
40045	Thermocouple Input 2	C	0.01	Factory Use
40046	Thermocouple Input 3	C	0.01	Factory Use
40047	Thermocouple Input 4	C	0.01	Factory Use
40048	DI1 Status	Raw	1	Factory Use
40049	DI2 Status	Raw	1	Factory Use
40050	DI3 Status	Raw	1	Factory Use
40051	DI4 Status	Raw	1	Factory Use
40052	DI5 Status	Raw	1	Factory Use
40053	DI6 Status	Raw	1	Factory Use
40054	DI7 Status	F	1	Factory Use
40055	DI8 Status	Raw	1	Factory Use
40056	Brightness	%	1	Factory Use
40057	Contrast	Raw	1	Factory Use
40058	Blacklight Control	Raw	1	Factory Use (0=Disable, 1=Enable)
40059	Temperature Units	Raw	1	Factory Use (0=Fahrenheit, 1=Celsius)
40060	Analog Output 1 Type	Raw	1	Factory Use
40061	Analog Output 2 Type	Raw	1	Factory Use
40062	Discharge Pressure Units	Raw	1	Factory Use (0=PSI, 1=kPa, 2=bar)
40063	Intake Manifold Pressure Units	Raw	1	Factory Use (0="Hg, 1=PSI, 2="WC, 3=cmHG, 4=kPa, 5=bar)
40064	Digital Output 1-7 Force Bitmap	Raw	1	Factory Use
40065	Reserved	Raw	1	Factory Use
40066	Analog Output 1 Force	%	0.01	Factory Use
40067	Analog Output 2 Force	%	0.01	Factory Use
40068	Reserved	Raw	1	Factory Use
40069	Thermocouple Input 1-5 Type Bitmap	Raw	1	Factory Use (0=J,1=K)
40070	Reserved	Raw	1	Factory Use
40071	Configurable Output 3 State Bitmap	Raw	1	Factory Use
40072	Configurable Output 4 State Bitmap	Raw	1	Factory Use
40073	Configurable Output 7 State Bitmap	Raw	1	Factory Use
40074	Reserved	Raw	1	Factory Use
40075	Reserved	Raw	1	Factory Use
40076	Alarm Bitmap 1-16	Raw	1	Alarm, SD, Message Bitmaps
40077	Alarm Bitmap 17-32	Raw	1	Alarm, SD, Message Bitmaps
40078	Alarm Bitmap 33-48	Raw	1	Alarm, SD, Message Bitmaps
40079	Alarm Bitmap 49-64	Raw	1	Alarm, SD, Message Bitmaps
40080	Alarm Bitmap 65-80	Raw	1	Alarm, SD, Message Bitmaps
40081	Alarm Bitmap 81-96	Raw	1	Alarm, SD, Message Bitmaps
40082	Real-Time Clock Seconds (32 Bit Long INT MSW-LSW)	Raw	1	
40084	Reserved	Raw	1	
40085	Real-Time Clock Day	Raw	1	
40086	Real-Time Clock Month	Raw	1	
40087	Real-Time Clock Year	Raw	1	
40088	Real-Time Clock Day Of Week	Raw	1	
40089	Reserved	Raw	1	
40090	Reserved	Raw	1	

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Raw Data				
40091	Modbus Shutdown	Raw	1	Momentary 1 To Shutdown
40092	Modbus Start Command	Raw	1	Momentary 1 To Start, Rising Edge Trigger
40093	Modbus Stop Command	Raw	1	Momentary 1 To Stop
40094	Modbus Reset Command	Raw	1	Momentary 1 to Reset, Rising Edge Trigger
40095	Reserved	Raw	1	
40096	Reserved	Raw	1	
40097	Reserved	Raw	1	
40098	Reserved	Raw	1	
40099	Reserved	Raw	1	
40100	Reserved	Raw	1	
Scaled Engineering Unit Data				
40101	Engine RPM	RPM	1	
40102	System Voltage	V	0.1	
40103	Suction Pressure	"WC, OSI, PSI, kPa, bar	0.1	
40104	Discharge Pressure	PSI	0.1	
40105	Engine Oil Pressure	PSI	0.1	
40106	AI4 Scaled (Intake Manifold Pressure/Motor Current)	"hg/amps	0.1	Selected By Driver Type
40107	Compressor Oil Pressure	PSI	0.1	
40108	Reserved	Raw	1	
40109	Reserved	Raw	1	
40110	TC1 Scaled (Suction Temp/Comp Oil Temp/Discharge 2 Temp)	F	1	Selected By Initial Setup Page
40111	Discharge Temperature	F	1	
40112	Engine Oil Temperature	F	1	
40113	Engine Coolant Temperature	F	1	
40114	Reserved	Raw	1	
40115	Reserved	Raw	1	
40116	Run Hourmeter (32 Bit Long INT MSW-LSW)	Hour	0.1	
40118	Common Shutdown Enumeration	Raw	1	Code For Cause Of Firstout Fault
40119	State Enumeration	State	1	See Below
				0= Powerup
				1= ReadyToStart
				2= Unload
				3= MotorStart
				4= Spindown
				5= Crank
				6= Crank_Rest
				7= Warmup
				8= WaitOnEWT
				9= RampToRatedRPM
				10= Loaded
				11= Cooldown
				12= Shutdown
				13= WaitOnEOT
				14= WaitOnEOTEWT
				15= WaitOnLoad RPM

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Scaled Engineering Unit Data				
40120	Load Step Status	Raw	1	0 = Disabled, 1 = Enabled, 2 = LVS output not in range
40121	Electric Motor Start Attempts Remaining	Raw	1	
40122	Electric Motor Short Cycle Timer Remaining	Seconds	1	
40123	Recycle Valve Output Percent Closed	%	0.01	
40124	Suction Pressure PID Output	%	0.01	
40125	Discharge Pressure PID Output	%	0.01	
40126	Intake Manifold Pressure / Motor Amps PID Output	%	0.01	
40127	PID Low Value Selector Index	Raw	1	0-SUCT,1-DISC,2-MAP/AMPS
40128	Recycle Valve Output	%	0.01	Actual Output in Percent
40129	Desired Speed Output	RPM	1	Actual Output in RPM
40130	PID Low Value Selector Output	%	0.01	The Lowest PID Output
40131	Capacity Control Low Value Selector Error Index	Raw	1	0-SUCT,1-DISC,2-MAP/AMPS
40132	Capacity Control Low Value Selector Error	%	0.01	The Lowest PID Error
40133	Load Step	Raw	1	
40134	Test Timer Remaining	Sec	1	
40135	Force Timer Remaining	Sec	1	
40136	Reserved	Raw	1	
40137	Class B1 Timer Remaining	Seconds	1	
40138	Class B2 Timer Remaining	Seconds	1	
40139	Class P Timer Remaining	Seconds	1	
40140	State Timer Remaining	Seconds	1	
40141	Add Load Step Timer Remaining	Seconds	1	
40142	Subtract Load Step Timer Remaining	Seconds	1	
40143	Reserved	Raw	1	
40144	Reserved	Raw	1	
40145	Reserved	Raw	1	
40146	Service Reminder 1 Remain	Hour	0.1	
40147	Service Reminder 2 Remain	Hour	0.1	
40148	Service Reminder 3 Remain	Hour	0.1	
40149	Service Reminder 4 Remain	Hour	0.1	
40150	Service Reminder 5 Remain	Hour	0.1	
40151	Service Reminder 6 Remain	Hour	0.1	
40152	Service Reminder 7 Remain	Hour	0.1	
40153	Reserved	Raw	1	
40154	Reserved	Raw	1	
40155	Reserved	Raw	1	
40156	Reserved	Raw	1	
40157	Reserved	Raw	1	
40158	Reserved	Raw	1	
40159	Reserved	Raw	1	
40160	Reserved	Raw	1	
40161	Reserved	Raw	1	
40162	Reserved	Raw	1	
40163	Reserved	Raw	1	

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Scaled Engineering Unit Data				
40164	Reserved	Raw	1	
40165	Reserved	Raw	1	
40166	Reserved	Raw	1	
40167	Reserved	Raw	1	
40168	Reserved	Raw	1	
40169	Reserved	Raw	1	
40170	Reserved	Raw	1	
40171	Reserved	Raw	1	
40172	Reserved	Raw	1	
40173	Reserved	Raw	1	
40174	Reserved	Raw	1	
40175	Reserved	Raw	1	
40176	Reserved	Raw	1	
40177	Common Shutdown Enumeration Snapshot	Raw	1	Snapshot of Readings at Time of Fault
40178	Engine RPM Snapshot	RPM	1	Snapshot of Readings at Time of Fault
40179	System Voltage Snapshot	V	0.1	Snapshot of Readings at Time of Fault
40180	Suction Pressure Snapshot	“WC, OSI, PSI, kPa, bar	0.1	Snapshot of Readings at Time of Fault
40181	Discharge Pressure Snapshot	PSI	0.1	Snapshot of Readings at Time of Fault
40182	Engine Oil Pressure Snapshot	PSI	0.1	Snapshot of Readings at Time of Fault
40183	Motor Current Snapshot	A	0.1	Snapshot of Readings at Time of Fault
40184	Intake Manifold Pressure Snapshot	inhg	0.1	Snapshot of Readings at Time of Fault
40185	Compressor Oil Pressure Snapshot	PSI	0.1	Snapshot of Readings at Time of Fault
40186	TC1 Scaled Snapshot (Suction Temp/Comp Oil Temp/Discharge 2 Temp)	F	1	Snapshot of Readings at Time of Fault
40187	Discharge Temperature Snapshot	F	1	Snapshot of Readings at Time of Fault
40188	Engine Oil Temperature Snapshot	F	1	Snapshot of Readings at Time of Fault
40189	Engine Coolant Temperature Snapshot	F	1	Snapshot of Readings at Time of Fault
40190	Desired Speed Output Snapshot	RPM	1	Snapshot of Readings at Time of Fault
40191	Recycle Valve Percent Closed Snapshot	%	0.01	Snapshot of Readings at Time of Fault
40192	Maximum System Voltage Recorded	V	0.1	Diagnostic Reading
40193	Minimum System Voltage Recorded	V	0.1	Diagnostic Reading
40194	Powerup Counter	Raw	1	Diagnostic Reading
40195	Panel Mode	Raw	1	0=Manual Start/Stop.1=Auto Start/Stop
40196	Reserved	Raw	1	
40197	Reserved	Raw	1	
40198	Reserved	Raw	1	
40199	Reserved	Raw	1	
40200	Reserved	Raw	1	

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Setpoints				
40201	Driver Type	Raw	1	0=Motor, 1=Engine, 2=J1939 Engine W 4-20mA,3=J1939 Engine With TC1 Throttle
40202	Load Control Type	Raw	1	0=Bypass VLV,1=Capacity PWM, 2=1 Step Load, 3=2 Step Load
40203	TC1 Channel Type	Raw	1	0=SUCT T,1=COMP OIL T, 2=DISC 2 T
40204	Bypass Valve Fail Position	Raw	1	0=Fail Open, 1=Fail Closed
40205	Recycle Valve Fail Position	Raw	1	0=Fail Open, 1=Fail Closed
40206	Electric Motor Max Starts Per Hour	Raw	1	
40207	Engine Number Of Crank Attempts	Raw	1	
40208	Crank Disconnect RPM	RPM	1	
40209	Unload Autostop Delay	Min	1	
40210	Auto Start Pressure	“WC, OSI, PSI, kPa, bar	0.1	
40211	Auto Stop Pressure	“WC, OSI, PSI, kPa, bar	0.1	
40212	Engine Oil Load Permissive Temperature	F	1	
40213	Engine Coolant Load Permissive Temperature	F	1	
40214	Engine Load Permissive Speed	RPM	1	
40215	Warmup RPM	RPM	1	
40216	Cooldown RPM	RPM	1	
40217	Mean Site Barometric PRS	inhg	1	
40218	Suction Pressure Scale	Raw	1	0 = “WC, 1 = OSI, 2 = PSI, 3=kPa, 4=bar
40219	Compressor Oil Pressure Enable	Raw	1	0=Disabled / 1 = Enabled
40220	Reserved	Raw	1	
40221	Lolo System Volts	V	0.1	Fault Setpoints
40222	Lo System Volts	V	0.1	Fault Setpoints
40223	Hi System Volts	V	0.1	Fault Setpoints
40224	Hihi System Volts	V	0.1	Fault Setpoints
40225	Lolo Engine RPM	RPM	1	Fault Setpoints
40226	Lo Engine RPM	RPM	1	Fault Setpoints
40227	Hi Engine RPM	RPM	1	Fault Setpoints
40228	Hihi Engine RPM	RPM	1	Fault Setpoints
40229	Lolo Suction Pressure	“WC, OSI, PSI, kPa, bar	0.1	Fault Setpoints
40230	Lo Suction Pressure	“WC, OSI, PSI, kPa, bar	0.1	Fault Setpoints
40231	Hi Suction Pressure	“WC, OSI, PSI, kPa, bar	0.1	Fault Setpoints
40232	Hihi Suction Pressure	“WC, OSI, PSI, kPa, bar	0.1	Fault Setpoints
40233	Lolo Discharge Pressure	PSI	0.1	Fault Setpoints
40234	Lo Discharge Pressure	PSI	0.1	Fault Setpoints
40235	Hi Discharge Pressure	PSI	0.1	Fault Setpoints
40236	Hihi Discharge Pressure	PSI	0.1	Fault Setpoints
40237	Lolo Engine Oil Pressure at Low RPM	PSI	0.1	Fault Setpoints

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Setpoints				
40238	Lo Engine Oil Pressure at Low RPM	PSI	0.1	Fault Setpoints
40239	Lolo Engine Oil Pressure at High RPM	PSI	0.1	Fault Setpoints
40240	Lo Engine Oil Pressure at High RPM	PSI	0.1	Fault Setpoints
40241	Lo Engine Oil Pressure Low RPM	RPM	1	Fault Setpoints
40242	Lo Engine Oil Pressure High RPM	RPM	1	Fault Setpoints
40243	Lolo Intake Manifold Pressure	inHg	0.1	Fault Setpoints
40244	Lo Intake Manifold Pressure	inHg	0.1	Fault Setpoints
40245	Hi Intake Manifold Pressure	inHg	0.1	Fault Setpoints
40246	Hihi Intake Manifold Pressure	inHg	0.1	Fault Setpoints
40247	Reserved	Raw	1	Fault Setpoints
40248	Reserved	Raw	1	Fault Setpoints
40249	Hi Motor Current	A	0.1	Fault Setpoints
40250	Hihi Motor Current	A	0.1	Fault Setpoints
40251	Lolo Compressor Oil Pressure	PSI	0.1	Fault Setpoints
40252	Lo Compressor Oil Pressure	PSI	0.1	Fault Setpoints
40253	Hi Compressor Oil Pressure	PSI	0.1	Fault Setpoints
40254	Hihi Compressor Oil Pressure	PSI	0.1	Fault Setpoints
40255	Hi TC1 Temperature (Suction Temp/Comp Oil Temp/Discharge 2 Temp)	F	1	Fault Setpoints
40256	Hihi TC1 Temperature (Suction Temp/Comp Oil Temp/Discharge 2 Temp)	F	1	Fault Setpoints
40257	Hi Discharge Temperature	F	1	Fault Setpoints
40258	Hihi Discharge Temperature	F	1	Fault Setpoints
40259	Hi Engine Oil Temperature	F	1	Fault Setpoints
40260	Hihi Engine Oil Temperature	F	1	Fault Setpoints
40261	Hi Engine Coolant Temperature	F	1	Fault Setpoints
40262	Hihi Engine Coolant Temperature	F	1	Fault Setpoints
40263	Reserved	Raw	1	
40264	Reserved	Raw	1	
40265	Reserved	Raw	1	
40266	Reserved	Raw	1	
40267	Reserved	Raw	1	
40268	Reserved	Raw	1	
40269	Reserved	Raw	1	
40270	Reserved	Raw	1	
40271	Suction Pressure PID Setpoint	“WC, OSI, PSI, kPa, bar	0.1	PID Setpoints
40272	Suction Pressure PID Deadband	“WC, OSI, PSI, kPa, bar	0.1	PID Setpoints
40273	Suction Pressure PID Minimum Output	%	0.01	PID Setpoints
40274	Suction Pressure PID Maximum Ouptut	%	0.01	PID Setpoints
40275	Suction Pressure PID Max Rate Of Decrease	%	0.01	PID Setpoints

Vru Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Setpoints				
40276	Suction Pressure PID Max Rate of Increase	%	0.01	PID Setpoints
40277	Suction Pressure PID Proportional	Raw	0.01	PID Setpoints
40278	Suction Pressure PID Integral	Raw	0.01	PID Setpoints
40279	Suction Pressure PID Derivative	Raw	0.01	PID Setpoints
40280	Discharge Pressure PID Setpoint	PSI	0.1	PID Setpoints
40281	Discharge Pressure PID Deadband	PSI	0.1	PID Setpoints
40282	Discharge Pressure PID Minimum Output	%	0.01	PID Setpoints
40283	Discharge Pressure PID Maximum Ouptut	%	0.01	PID Setpoints
40284	Discharge Pressure PID Max Rate of Decrease	%	0.01	PID Setpoints
40285	Discharge Pressure PID Max Rate of Increase	%	0.01	PID Setpoints
40286	Discharge Pressure PID Proportional	Raw	0.01	PID Setpoints
40287	Discharge Pressure PID Integral	Raw	0.01	PID Setpoints
40288	Discharge Pressure PID Derivative	Raw	0.01	PID Setpoints
40289	Intake Manifold PRS / Motor Current PRS PID Setpoint	inHg / A	0.1	PID Setpoints
40290	Intake Manifold PRS / Motor Current PRS PID Deadband	inHg / A	0.1	PID Setpoints
40291	Intake Manifold PRS / Motor Current PRS PID Minimum Output	%	0.01	PID Setpoints
40292	Intake Manifold PRS / Motor Current PRS PID Maximum Ouptut	%	0.01	PID Setpoints
40293	Intake Manifold PRS / Motor Current PRS PID Max Rate Of Decrease	%	0.01	PID Setpoints
40294	Intake Manifold PRS / Motor Current PRS PID Max Rate Of Increase	%	0.01	PID Setpoints
40295	Intake Manifold PRS / Motor Current PRS PID Proportional	Raw	0.01	PID Setpoints
40296	Intake Manifold PRS / Motor Current PRS PID Integral	Raw	0.01	PID Setpoints
40297	Intake Manifold PRS / Motor Current PRS PID Derivative	Raw	0.01	PID Setpoints
40298	Desired Speed Mode	Raw	1	0=Manual, 1=Auto
40299	Desired Speed Manual Setpoint	RPM	1	Output Scaling Setpoints
40300	Desired Speed Manual Setpoint Rate Of Decrease	RPM	1	Output Scaling Setpoints
40301	Desired Speed Manual Setpoint Rate Of Increase	RPM	1	Output Scaling Setpoints
40302	Desired Speed Output Max Rate of Decrease	RPM	1	Output Scaling Setpoints
40303	Desired Speed Output Max Rate of Increase	RPM	1	Output Scaling Setpoints
40304	Desired Speed Input Minimum	%	0.01	Output Scaling Setpoints
40305	Desired Speed Input Maximum	%	0.01	Output Scaling Setpoints

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Setpoints				
40306	Desired Speed Output Minimum	RPM	1	Output Scaling Setpoints
40307	Desired Speed Output Maximum	RPM	1	Output Scaling Setpoints
40308	Desired Speed RPM at 4ma Output	RPM	1	Output Scaling Setpoints
40309	Desired Speed RPM at 20ma Output	RPM	1	Output Scaling Setpoints
40310	Recycle Valve Mode	Raw	1	0=Manual, 1=Auto
40311	Recycle Valve Manual Setpoint	%	0.01	Output Scaling Setpoints
40312	Recycle Valve Manual Setpoint Rate Of Decrease	%	0.01	Output Scaling Setpoints
40313	Recycle Valve Manual Setpoint Rate Of Increase	%	0.01	Output Scaling Setpoints
40314	Recycle Valve Output Max Rate of Decrease	%	0.01	Output Scaling Setpoints
40315	Recycle Valve Output Max Rate of Increase	%	0.01	Output Scaling Setpoints
40316	Recycle Valve Input Minimum	%	0.01	Output Scaling Setpoints
40317	Recycle Valve Input Maximum	%	0.01	Output Scaling Setpoints
40318	Recycle Valve Output Minimum	%	0.01	Output Scaling Setpoints
40319	Recycle Valve Output Maximum	%	0.01	Output Scaling Setpoints
40320	Reserved	Raw	1	
40321	Reserved	Raw	1	
40322	Capacity Control Mode	Raw	1	0=Manual, 1=Auto
40323	PWM Control LVS Output Enable Low	%	0.01	PWM Tuning
40324	PWM Control LVS Output Enable High	%	0.01	PWM Tuning
40325	PWM Control Decrease Max on Time	Raw	1	PWM Tuning
40326	PWM Control Decrease Reaction Time	Raw	1	PWM Tuning
40327	PWM Control Decrease Sample Time	Raw	1	PWM Tuning
40328	PWM Control Reverse From Decrease Pulse	Raw	1	PWM Tuning
40329	PWM Control Increase Max on Time	Raw	1	PWM Tuning
40330	PWM Control Increase Reaction Time	Raw	1	PWM Tuning
40331	PWM Control Increase Sample Time	Raw	1	PWM Tuning
40332	PWM Control Reverse From Increase Pulse	Raw	1	PWM Tuning
40333	Load Step Control Add Load Delay	Seconds	1	Load Step Timers
40334	Load Step Control Subtract Load Delay	Seconds	1	Load Step Timers
40335	Reserved	Raw	1	
40336	Reserved	Raw	1	
40337	Reserved	Raw	1	
40338	Reserved	Raw	1	
40339	Reserved	Raw	1	
40340	Reserved	Raw	1	Timer Presets
40341	Class B1 Lockout	Seconds	1	Timer Presets

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Setpoints				
40342	Class B2 Lockout	Seconds	1	Timer Presets
40343	Class P Lockout	Seconds	1	Timer Presets
40344	Warmup Delay	Seconds	1	Timer Presets
40345	Cooldown Delay	Seconds	1	Timer Presets
40346	Electric Motor Start Fail Delay	Seconds	1	Timer Presets
40347	Cooler Motor Stagger Delay	Seconds	1	Timer Presets
40348	Cooler Start Fail Delay	Seconds	1	Timer Presets
40349	Crank Delay	Seconds	1	Timer Presets
40350	Rest Delay	Seconds	1	Timer Presets
40351	Ignition On Delay	Seconds	1	Timer Presets
40352	Auto Start Delay	Seconds	1	Timer Presets
40353	Auto Stop Delay	Seconds	1	Timer Presets
40354	Unload State Delay	Seconds	1	Timer Presets
40355	Reserved	Raw	1	Timer Presets
40356	Process Debounce Delay	QS	1	Timer Presets
40357	Hi Motor Current Debounce Delay	QS	1	Timer Presets
40358	Reserved	Raw	1	Timer Presets
40359	Configurable Output 3 off Delay	Seconds	1	Timer Presets
40360	Configurable Output 3 on Delay	Seconds	1	Timer Presets
40361	Configurable Output 4 off Delay	Seconds	1	Timer Presets
40362	Configurable Output 4 on Delay	Seconds	1	Timer Presets
40363	Configurable Output 7 off Delay	Seconds	1	Timer Presets
40364	Configurable Output 7 on Delay	Seconds	1	Timer Presets
40365	Reserved	Raw	1	
40366	Reserved	Raw	1	
40367	Reserved	Raw	1	
40368	Reserved	Raw	1	
40369	Reserved	Raw	1	
40370	Reserved	Raw	1	
40371	Rs485 Baud Rate	Raw	1	
40372	Engine Flywheel Teeth	Raw	1	Input Setup
40373	Suction Pressure Min	mA	0.01	Input Setup
40374	Suction Pressure Max	mA	0.01	Input Setup
40375	Suction Pressure Min	“WC, OSI, PSI, kPa, bar	0.1	Input Setup
40376	Suction Pressure Max	“WC, OSI, PSI, kPa, bar	0.1	Input Setup
40377	Discharge Pressure Min	mA	0.01	Input Setup
40378	Discharge Pressure Max	mA	0.01	Input Setup
40379	Discharge Pressure Min	PSI	0.1	Input Setup
40380	Discharge Pressure Max	PSI	0.1	Input Setup
40381	Engine Oil Pressure Min	mA	0.01	Input Setup
40382	Engine Oil Pressure Max	mA	0.01	Input Setup
40383	Engine Oil Pressure Min	PSI	0.1	Input Setup
40384	Engine Oil Pressure Max	PSI	0.1	Input Setup
40385	Intake Manifold Pressure Min	mA	0.01	Input Setup
40386	Intake Manifold Pressure Max	mA	0.01	Input Setup
40387	Intake Manifold Pressure Min	inHg	0.1	Input Setup

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Setpoints				
40388	Intake Manifold Pressure Max	inHg	0.1	Input Setup
40389	Motor Current Min	mA	0.01	Input Setup
40390	Motor Current Max	mA	0.01	Input Setup
40391	Motor Current Min	A	0.1	Input Setup
40392	Motor Current Max	A	0.1	Input Setup
40393	Compressor Oil Pressure Min	mA	0.01	Input Setup
40394	Compressor Oil Pressure Max	mA	0.01	Input Setup
40395	Compressor Oil Pressure Min	PSI	0.1	Input Setup
40396	Compressor Oil Pressure Max	PSI	0.1	Input Setup
40397	Reserved	Raw	1	Input Setup
40398	Reserved	Raw	1	Input Setup
40399	Reserved	Raw	1	Input Setup
40400	Reserved	Raw	1	Input Setup
40401	TC1 Channel Offset	F	1	Input Setup
40402	TC2 Channel Offset	F	1	Input Setup
40403	TC3 Channel Offset	F	1	Input Setup
40404	TC4 Channel Offset	F	1	Input Setup
40405	Reserved	Raw	0.1	
40406	Spare DI1 Class Type	Raw	1	0=ESD,1=ASD,2=B1SD,3=B2SD,4=CSD,5=PSD,6=Ignore
40407	Spare DI2 Class Type	Raw	1	"
40408	Spare DI3 Class Type	Raw	1	"
40409	Spare DI4 Class Type	Raw	1	"
40410	Spare DI5 Class Type	Raw	1	"
40411	Spare DI6 Class Type	Raw	1	"
40412	Spare DI7 Class Type	Raw	1	"
40413	Spare DI8 Class Type	Raw	1	"
40414	Spare DI1 Fault Debounce	QS	1	
40415	Spare DI2 Fault Debounce	QS	1	
40416	Spare DI3 Fault Debounce	QS	1	
40417	Spare DI4 Fault Debounce	QS	1	
40418	Spare DI5 Fault Debounce	QS	1	
40419	Spare DI6 Fault Debounce	QS	1	
40420	Spare DI7 Fault Debounce	QS	1	
40421	Spare DI8 Fault Debounce	QS	1	
40422	Spare DI1 Output Control	Raw	1	0=Not Used,1=DO3 Control, 2=DO3 On, 3=DO3 Off, 4=DO4 Control, 5=DO4 On, 6=DO4 Off, 7=DO7 Control, 8=DO7 On, 9=DO7 Off
40423	Spare DI2 Output Control	Raw	1	"
40424	Spare DI3 Output Control	Raw	1	"
40425	Spare DI4 Output Control	Raw	1	"
40426	Spare DI5 Output Control	Raw	1	"
40427	Spare DI6 Output Control	Raw	1	"
40428	Spare DI7 Output Control	Raw	1	"

VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Setpoints				
40429	Spare DI8 Output Control	Raw	1	"
40430	J1939 Engine MFR	Raw	1	0 Caterpillar 1 Cummins 2 JohnDeere 3 Deutz 4 Kubota 5 Yanmar 6 JCB 7 Volvo 8 FPT 9 ISUZU 10 GM 11 EICS 12 Other
40431	Service Reminder 1 Preset	Hours	1	
40432	Service Reminder 2 Preset	Hours	1	
40433	Service Reminder 3 Preset	Hours	1	
40434	Service Reminder 4 Preset	Hours	1	
40435	Service Reminder 5 Preset	Hours	1	
40436	Service Reminder 6 Preset	Hours	1	
40437	Service Reminder 7 Preset	Hours	1	
40438	J1939 Address Claim	Raw	1	
40439	J1939 Term Resistor Enable	Raw	1	
40440	ECU Source Address	Raw	1	
40441	RS485 Baud Rate	Raw	1	0 9600 1 19200 2 38400 3 57600 4 115200
40442	RS485 Parity	Raw	1	0 None 1 Odd 2 Even
40443	RS485 Stop Bits	Raw	1	
40444	RS485 Term Resistor Enable	Raw	1	
40445	J1939 TSC1 Transmit Rate	Raw	1	0 1000ms 1 750ms 2 500ms 3 250ms 4 100ms 5 50ms 6 20ms 7 10ms
40446	J1939 Engine Speed Source	Raw	1	0 J1939 1 Hardwire
40447	J1939 Engine Intake Manifold Pressure Source	Raw	1	0 J1939-PGN65270 SPN106 1 J1939-PGN65270 SPN102 2 Hardware
40448	J1939 Engine Oil Pressure Source	Raw	1	0 J1939 1 Hardwire
40449	J1939 Engine Oil Temperature Source	Raw	1	
40450	J1939 Engine Coolant Temperature Source	Raw	1	
40451	Reserved			
40452	Reserved			
40453	Reserved			
40454	Reserved			
40455	Reserved			
40456	Reserved			

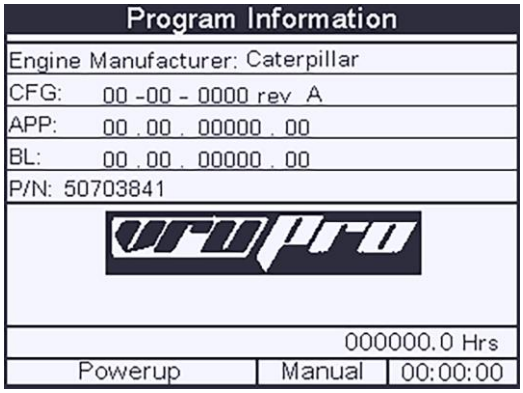
VRU Pro Modbus Address List				
Address	Variable Name	Units	Resolution	Description
Setpoints				
40457	Reserved			
40458	Reserved			
40459	Reserved			
40460	Reserved			
40461	PWM / Load Step Setpoint Source	Raw	1	0 = Cap PIDs, 1 = Standalone
40462	PWM / Load Step Standalone Suction Pressure Setpoint	"WC, OSI, PSI, kPa, bar	0.1	Standalone Control Setpoints
40463	PWM / Load Step Standalone Suction Pressure Deadband	"WC, OSI, PSI, kPa, bar	0.1	Standalone Control Setpoints
40464	PWM / Load Step Standalone Discharge Pressure Setpoint	PSI	0.1	Standalone Control Setpoints
40465	PWM / Load Step Standalone Discharge Pressure Deadband	PSI	0.1	Standalone Control Setpoints
40466	PWM / Load Step Standalone Intake Manifold PRS / Motor Current PRS Setpoint	inHg / A	0.1	Standalone Control Setpoints
40467	PWM / Load Step Standalone Intake Manifold PRS / Motor Current PRS Deadband	inHg / A	0.1	Standalone Control Setpoints
40468	Reserved			
40469	Reserved			
40470	Reserved			

Update Software on Controller

Verify Configuration Firmware on Controller

Check the current configuration version.

1. From the Home/Compressor Data screen, press the Up Down keys to navigate to the Program Information screen.



2. Verify the firmware version (CFG 00-00-0000 rev _) matches the latest release published.

3. If you need to download a new configuration:

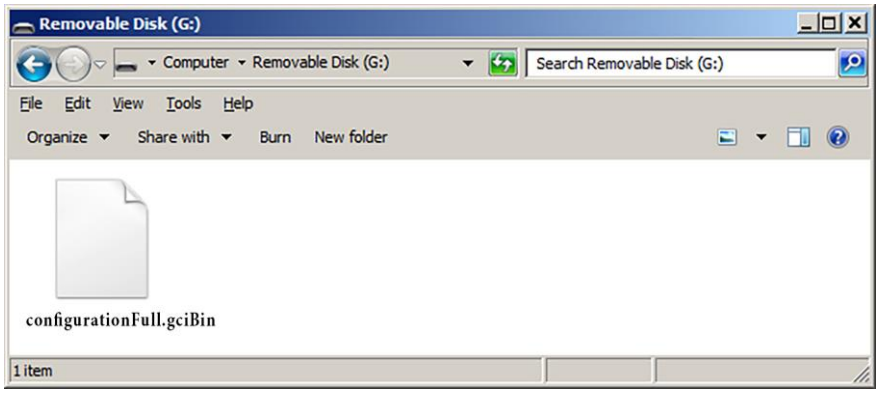
    a. Select a USB flash drive formatted FAT or FAT32 and is 16 Gb or smaller.

IMPORTANT: Some USB flash drives come with preinstalled self-launching software that may interfere with the VRU Pro's ability to read the configuration file. The following examples are USB flash drives that work with the VRU Pro.

Example – USB Flash Drives Compatible with VRU Pro			
Picture	**Description**	**Size**	**Format**
	SanDisk Cruzer Fit CZ33	16 Gb	FAT32
	Kingston DataTraveler 100 G3		
	HP v125w USB Flash Drive	4 Gb	
	Generic	2 Gb	FAT

b. Download the update file from the website to the USB flash drive.

> **Note:** We recommend the update file be the only file on the root directory of the USB flash drive.



c. Power off the VRU Pro.

d. Press and hold both the ESC/ACK

and Down arrow keys while powering up the VRU Pro.

e. The red, yellow and green LEDs will flash. This indicates bootloader mode.

f. Once the LEDs start flashing, release your hold on the keys.

g. Insert the USB flash drive containing the update file into the USB port on the harness.

If a file configurationFull.gcibin is found on the USB flash drive, it will be read and installed into the unit. When complete, the green LED will be solid. This process takes less than 15 seconds. If this exceeds 15 seconds, then the USB flash drive was not successfully read, and you must repeat the process ensuring the file is the only file on the flash drive.

h. Wait for the green LED to be solid.

i. Remove the USB stick. The controller will automatically reboot.

4. Press the Up Down keys to navigate to the Program Information screen and verify the firmware version matches the latest release published.

Specifications

Electrical

Display: 3.8 in. monochrome, transflective, white backlight LCD

Operating Voltage: 12 or 24 VDC, protected against reverse battery polarity and load-dump

Power Consumption:

18 W max without two 2 A High-sides active

146 W max with two 2 A High-sides active

Communications

1-CAN: J1939

USB: 2.0B (Only supported for programming)

RS485: Modbus RTU slave

Connection: Delphi SICMA 90 way connector, 1.5 mm

Keyboard: 11 tactile feedback buttons

Inputs

8-Digital Inputs: Active high (+DC) or Active low (DC-)

5-Analog Inputs: 4-20 mA

4-Thermocouple Inputs: Type J or K

1-Frequency Input: Supporting magnetic pickup (2 Hz – 10 KHz, 3.6 VAC – 120 VAC)

Outputs

7-FET Outputs: 1.5 A DC- (sinking)

2-Analog Output: 4-20 mA

Real-Time Clock: With battery backup

Environmental

Operating Temperature: -40° F to 185° F (-40° C to 85° C)

Storage Temperature: -40° F to 185° F (-40° C to 85° C)

Protection: IP67 front and back, when using accessory gasket and properly mounted the panel seal retains IP66

Emissions: SAE J1113

Immunity: SAE J1113

Vibration: Random vibration, 7.86 Grms (5-2000 Hz), 3 axes

Shock: ± 50 G in axis

Mechanical

Case Material: Polycarbonate/ABS

Keypad/Gasket Material: Silicone

Approvals

CSA, Class 1, Division 2, Groups B, C and D certifications

Notes

Notes

Software Release CFG: 50-33-3941 rev J

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