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TG410 User Manual



TOUGHSeries
Digital Generator Controllers



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User Guide

1 Introduction

The TOUGH series controllers are designed to provide complete control, protection, AC metering, and engine instrumentation for both standard and electronic engines. The module is easily configured using either the front panel buttons or our DYNAGEN Configurator software. TOUGH series controllers are ideally suited for severe duty applications where reliability is critical such as mobile and stationary generators.



Tier 4 Ready



Features and Functions:

- 5 Year Warranty
- SAE J1939 CAN Bus Protocol
- RPM via J1939, Magnetic Pickup, or Generator
- Speed control offset for electronic engines
- Autostart on low battery and other sensors
- Trim feature for AC monitoring and sensors
- Maintenance counter
- Exerciser Clock
- 150 Event Log
- Conformally coated for protection against moisture
- Gasket for water ingress protection resistance
- Free RapidCore Configuration Software
- Fast and rugged installation clips
- Passcode protected
- Automatic shutdowns and warnings
- Manual and Remote start
- Momentary Start / Stop inputs
- Pre-heat and many other configurable timers
- Accepts common senders (VDO, Datcon, S&W)
- Custom senders configurable with DYNAGEN Configurator

Displays:


- Engine Temperature
- Oil Pressure
- Fuel Level
- Engine Speed
- AC Metering
- Battery Voltage
- Real Time Clock
- Engine Hours
- Time to Maintenance
- J1939 DTCs + Custom Text
- Custom Senders
- Warnings and Failures

| Feature | Included |
|--|-------------------|
| DPF / DEF Ready | ✓ |
| J1939 CAN Bus | ✓ |
| Isolated RS485 Modbus | ✓ |
| Magnetic Pickup Input | ✓ |
| 150 Event Log | ✓ |
| Clock / Exerciser | ✓ |
| Generator Voltage Metering | Single or 3-Phase |
| Generator Current Metering (with IDMT and Load Imbalance features) | Single or 3-Phase |
| Configurable Switched Inputs | 5 |
| Resistive Sensors (1 High Ohm, 1 Low Ohm) | 2 |
| Universal Sensor (Resistive, 0-5V, 4-20mA) | 2 |
| 5V Sensor Output for Electronic Sensors | ✓ |
| Configurable Switched Outputs | 6 |

1.1 Specifications

The TOUGH Series controllers were rigorously tested to ensure durability, reliability and functionality. The following specifications are a brief summary of the standards to which the controller has been tested. For complete details on the testing performed please contact DYNAGEN.

Testing Specifications

| Specification | Rating |
|---------------------------|---|
| Electrical Transients | SAE1113-11 |
| Thermal Shock and Cycling | SAE1455 |
| Vibration Profiles | SAE1455 |
| Electric Static Discharge | SAE1113-13 |
| UL |  UL 6200 recognized component. Consult factory for UL conditions of acceptability. |

Physical Specifications

| Specification | Rating |
|--|--|
| Operating Temperature | -40 to +158°F (-40 to +70°C) |
| LCD Viewing Temperature | -4 to +158°F (-20 to +70°C) (Optional heater available, call factory) |
| Weight Weight w/ RelayPak | 0.83lb (0.38kg) 1.32lb (0.60kg) |
| Dimensions - no gasket - no gasket and relay pack - with gasket and relay pack | 4.17" x 6.50" x 1.38" (10.59cm x 16.51cm x 3.51cm) 4.41" x 6.79" x 1.38" (10.59cm x 16.51cm x 8.46cm) 4.41" x 6.79" x 3.33" (11.20cm x 17.25cm x 8.46cm) |

Electrical Specifications

| Specification | Rating |
|---------------------------|--|
| Operating Voltage | 5.5 ~ 36 VDC |
| Standby Current | 60mA @ 12V 38mA @ 24V |
| Switched Inputs | +Battery, Ground, Open |
| Switched Outputs | +Battery @ 1A Max |
| Low Resistance Sensors | 0 ~ 750Ohm |
| High Resistance Sensors | 0 ~ 7,500Ohm |
| Universal Sensors | 0 ~ 750Ohm, 0 ~ 7,500Ohm, 0 ~ 5 VDC, 4 ~ 20mA |
| Magnetic Pickup | 10 ~ 10,000Hz at 1 ~ 50 VAC |
| AC Voltage (Line-To-Line) | 50 ~ 600 VAC True RMS, Accuracy: 2% Full Scale. Do not connect more than 600VAC to the controller. Damage may result. |
| AC Current (TG410 only) | 0 ~ 5A (Current Transformer), Accuracy: 1% Full Scale |
| Communications | SAE J1939 (Tier II, III, IV) Isolated RS485 (Slave Modbus RTU) |

2 Installation

Generator systems contain high voltage circuitry and precautions to protect against electrical shock should be taken. Failing to power down and lock out equipment can cause damage, injury or death.



WARNING: Wiring of this controller should be performed by qualified electricians only.

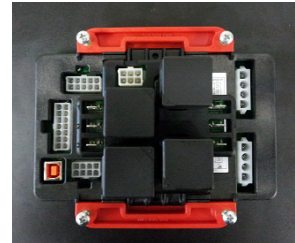
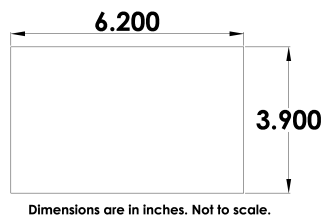
The following general electrical safety precaution should be followed:

- Do a thorough inspection of the area before performing any maintenance.
- Keep fluids away from electrical equipment.

- Unplug connectors by pulling on the plug and not the cord.
- Use fuses where appropriate.
- Ensure all equipment is properly grounded.
- Provide support to wires to prevent stress on terminals.

To ensure proper and safe operation, caution must be taken at the installation site to make sure it is free from excessive moisture, fluctuating temperature, dust and corrosive materials. Choose a mounting surface with the least amount of vibration and not more than **0.125" (3.175mm)** thick.

- 1) Choose a suitable mounting location based on the criteria above.
- 2) Create a rectangular cutout in the panel that is minimum 3.9" (99mm) high and 6.2" (158mm) wide.
- 3) Place the controller into the panel cutout so that the LCD screen and buttons are facing out.
- 4) Place the mounting clips into the designated slots on the top and bottom of the controller.
- 5) Tighten the screws on the clips until the controller is snug against the panel. Do not overtighten, the bottom of the screws should angle very slightly away from the controller.
- 6) If applicable, snap the RelayPak (RP100) to the back of the controller. Place one side of the RP100's tabs into the slot on the back of the controller and, without pushing on the relays, snap the other tab into place.



2.1 General Wiring Notes

The following important wiring guidelines should be followed:

1. Use a minimum of 18AWG wire for all connections.
2. Battery + and Battery - connections on the controller should be run directly to the positive and negative terminals on the battery to prevent voltage drops from negatively impacting the controller.
3. Limit the wire length to 20ft (6.1m) to any I/O on the controller (e.g. Switched Input, Switched Outputs, AC Sensing, and Analog Inputs).
4. It is good practice to run the AC voltage sensing wiring to the controller in a separate conduit from the AC current sensing wiring. If the AC voltage is especially noisy (e.g. variable frequency drives) then they MUST be run separately.
5. The Tough Series contains a TVS to protect the I/O and internals from a transient on the main battery (the battery the controller is powered from). If you have I/O connected to other batteries or power supplies those I/O must contain their own voltage transient protection. Otherwise the I/O and/or controller can be damaged if the transient exceeds the maximum rated voltage of the I/O. A device that provides this kind of protection is known as a TVS or a varistor.
6. Fusing
 - a. A fuse should be placed inline with the battery + wire going to the controller power. A 10A fuse is suggested.
 - b. The AC Voltage A, B, and C lines should be fused near the source of AC voltage with a 1A fuse. This protects personnel if any of these lines become disconnected and short or touch items or personnel.
 - c. If using the RelayPak the power going to the relay commons should be fused.
7. For noisy environments some guidelines are:
 - a. Replace speed sensing wire with twisted pair from the sensor to the controller.
 - b. Consider using isolated sensors (i.e. two terminal) and use twisted pair wiring to connect from engine to controller.

The following enclosure guidelines should be followed:

1. It is recommended to use vibration mounts.
2. For outdoor applications, it is recommended to use a sealed enclosure.

2.2 Terminal Descriptions

Main Connector (J4)

| Terminal | Name | Description |
|----------|-------------------|--|
| J4-1 | +Battery | Provides power to the controller from the battery |
| J4-2 | +Battery | Provides power to the controller from the battery |
| J4-3 | Ground | Provides ground return for the controller |
| J4-4 | Ground | Provides ground return for the controller |
| J4-5 | Switched Input A | Configurable to detect +Battery, Ground, or Open |
| J4-6 | Switched Input B | Configurable to detect +Battery, Ground, or Open |
| J4-7 | Switched Input C | Configurable to detect +Battery, Ground, or Open |
| J4-8 | Switched Output A | Outputs +Battery voltage when active (Max Current: 1A) |
| J4-9 | Switched Output C | Outputs +Battery voltage when active (Max Current: 1A) |
| J4-10 | Switched Output B | Outputs +Battery voltage when active (Max Current: 1A) |
| J4-11 | Sensor Ground | Provides ground return for 2-wire (isolated) sensors |
| J4-12 | Sensor Input A | High impedance sensor input (0 - 7,500Ohm) |
| J4-13 | Sensor Input B | Low impedance sensor input (0 - 750Ohm) |
| J4-14 | Sensor Input C | Universal sensor input (0 - 750Ohm, 0 - 7,500Ohm, 0 - 5 VDC, 4 - 20mA). See Universal Sensor section for more information. |

Expansion Connector (J3)

| Terminal | Name | Description |
|----------|------------------|--|
| J3-1 | Switched Input D | Configurable to detect +Battery, Ground, or Open |

| Terminal | Name | Description |
|----------|-------------------|---|
| J3-2 | Switched Input E | Configurable to detect +Battery, Ground, or Open |
| J3-3 | Switched Output D | Outputs +Battery voltage when active (Max Current: 1A) |
| J3-4 | Switched Output E | Outputs +Battery voltage when active (Max Current: 1A) |
| J3-5 | Switched Output F | Outputs +Battery voltage when active (Max Current: 1A) |
| J3-6 | Sensor 5V | Provides 5 VDC for electronics sensors. |
| J3-7 | Sensor Ground | Provides ground return for 2-wire sensors |
| J3-8 | Sensor Input D | Universal sensor input (0 - 750Ohm, 0 - 7,500Ohm, 0 - 5 VDC, 4 - 20mA) See Universal Sensor section for more information. |

Communications Connector (J6)

| Terminal | Name | Description |
|----------|-----------------|--|
| J6-1 | RS485-A | Communications line for Modbus (RS485) |
| J6-2 | RS485-B | Communications line for Modbus (RS485) |
| J6-3 | No Connection | No Connection |
| J6-4 | CAN-H | Communications line for CAN Bus (J1939) |
| J6-5 | CAN-L | |
| J6-6 | CAN-Shield | Connect the shield of the twisted pair cable to this terminal |
| J6-7 | Speed Sensing A | Connect to a magnetic pickup, tachometer, or a flywheel alternator. Not polarity sensitive and not required if using AC voltage terminals for speed sensing. |
| J6-8 | Speed Sensing B | Connect to a magnetic pickup, tachometer, or a flywheel alternator. Not polarity sensitive and not required if using AC voltage terminals for speed sensing. |
| J6-9 | No Connection | No Connection |
| J6-10 | RS485-Common | Common line for Modbus (RS485) |

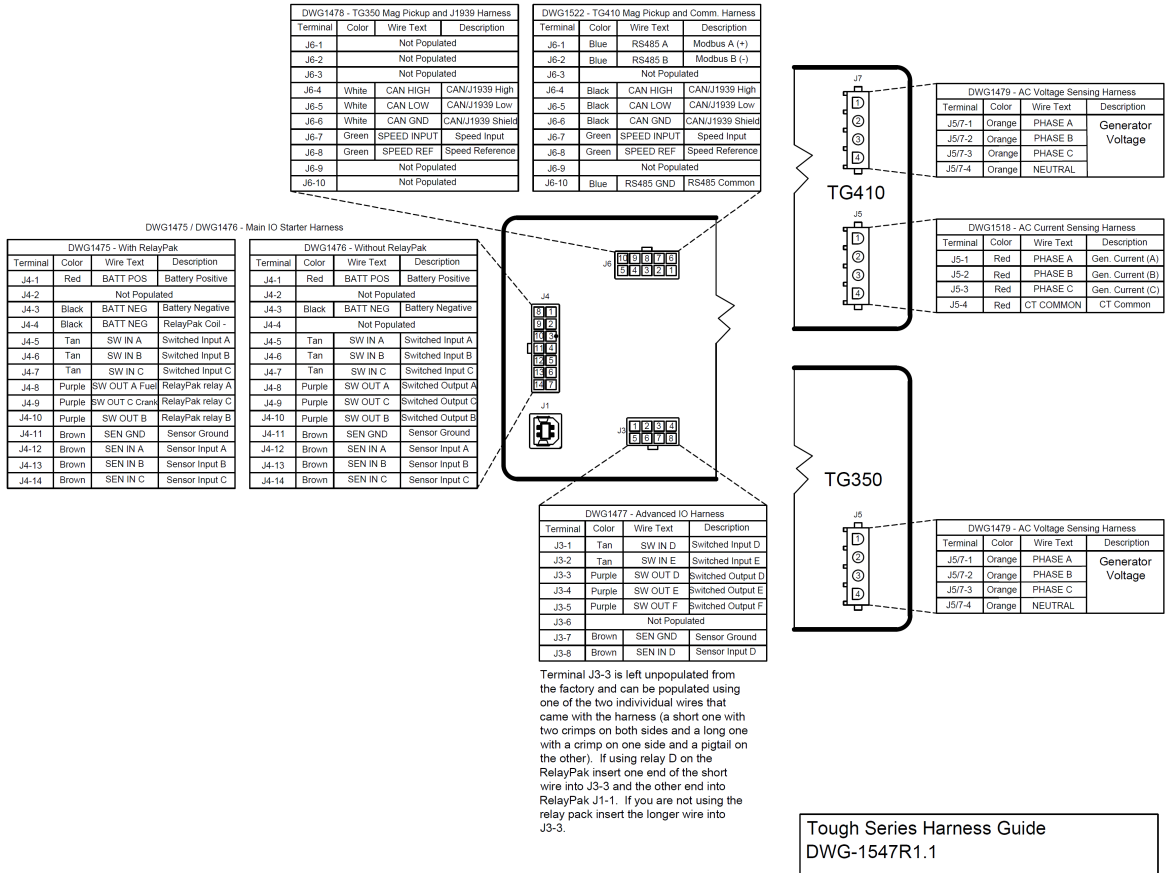
Generator AC Voltage (J7)

| Terminal | Name | Description |
|----------|---------|-------------------------------------|
| J7-1 | Phase A | Connect to Phase A of the generator |
| J7-2 | Phase B | Connect to Phase B of the generator |
| J7-3 | Phase C | Connect to Phase C of the generator |
| J7-4 | Neutral | Connect to neutral. |

Generator AC Current (J5)

| Terminal | Name | Description |
|----------|-----------|---|
| J5-1 | Phase A | Connect to current transformer for Phase A of the generator |
| J5-2 | Phase B | Connect to current transformer for Phase B of the generator |
| J5-3 | Phase C | Connect to current transformer for Phase C of the generator |
| J5-4 | CT Common | Connect to the commons of the current transformers |

2.3 Wiring Harnesses



2.4 Typical Wiring Diagram

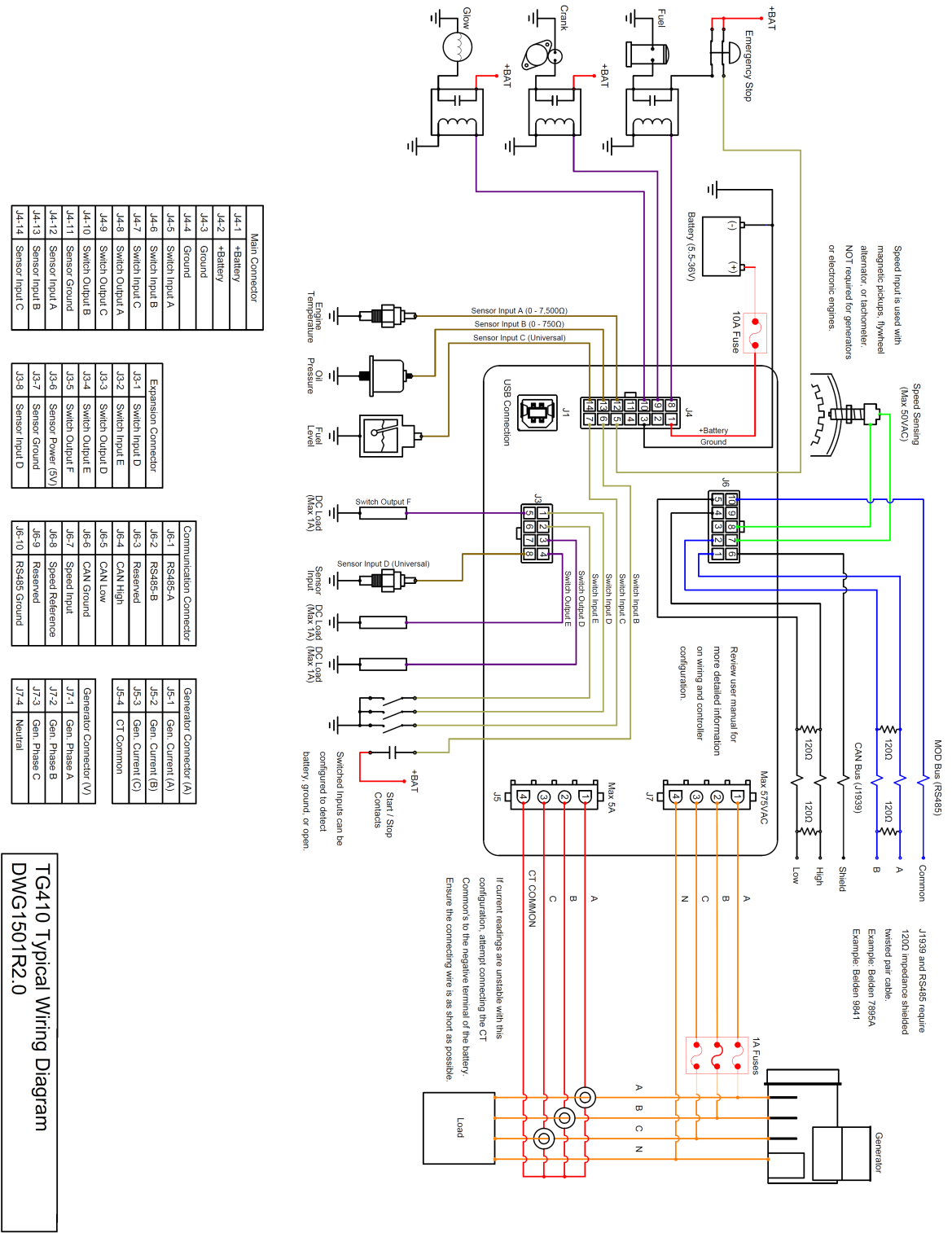
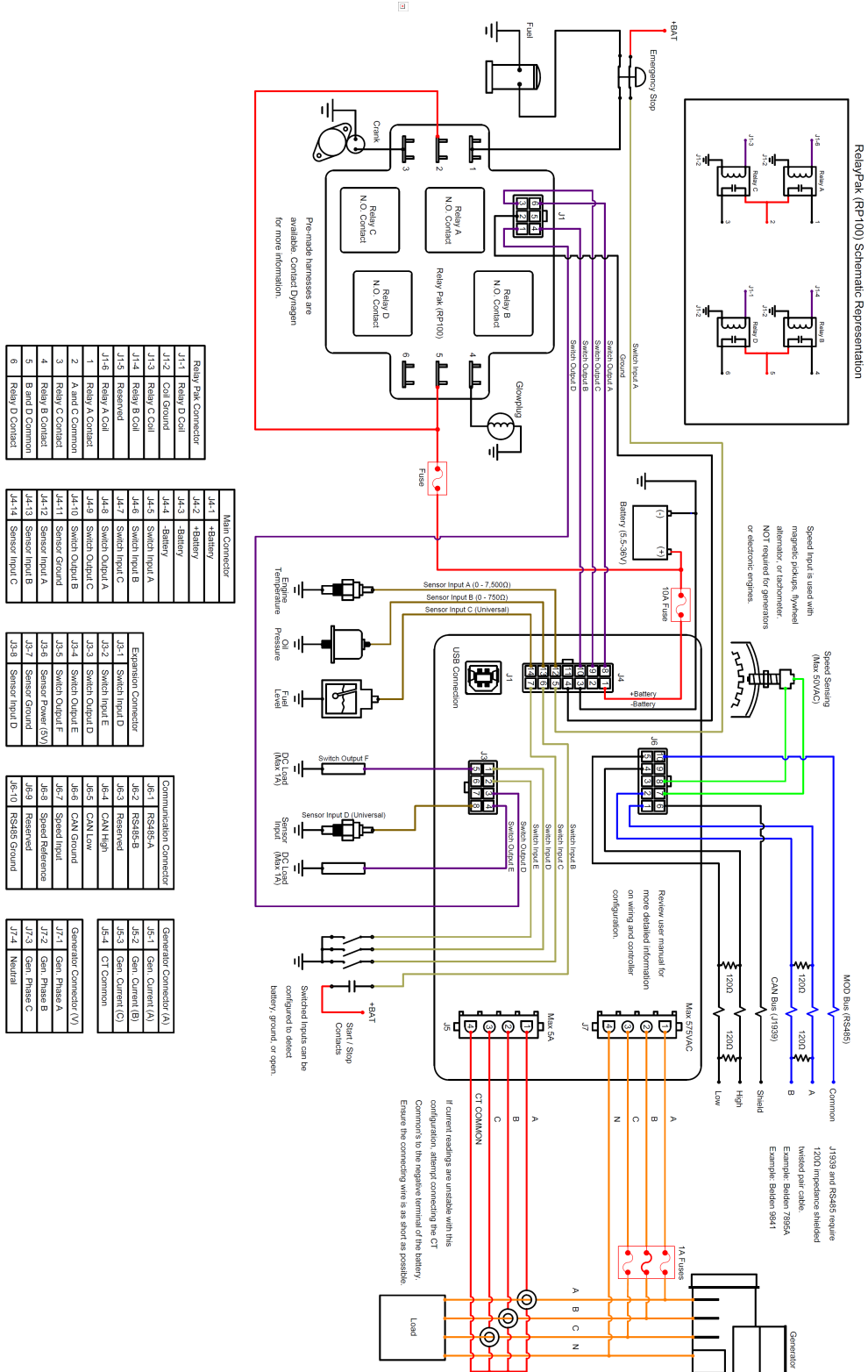


Diagram showing the typical wiring for a TG410 generator system, including connections for the battery, sensors, switches, generator, and load.

2.5 Typical Wiring Diagram with RelayPak



| RelayPak Connector | Main Connector |
|-----------------------|-----------------------|
| J1-1 Relay D Coil | J4-1 +Battery |
| J1-2 Coil Ground | J4-2 -Battery |
| J1-3 Relay C Coil | J4-3 -Battery |
| J1-4 Relay B Coil | J4-4 -Battery |
| J1-5 Relay A Coil | J4-5 Switch Input A |
| J1-6 Relay A Contact | J4-6 Switch Input B |
| J1-7 Relay A Contact | J4-7 Switch Input C |
| J1-8 Relay A Contact | J4-8 Switch Input A |
| J1-9 Relay B Contact | J4-9 Switch Input B |
| J1-10 Relay B Contact | J4-10 Switch Input C |
| J1-11 Relay C Contact | J4-11 Switch Output A |
| J1-12 Relay C Contact | J4-12 Switch Output B |
| J1-13 Relay D Contact | J4-13 Sensor Input A |
| J1-14 Relay D Contact | J4-14 Sensor Input B |

| Expansion Connector | Communication Connector |
|-----------------------|-------------------------|
| J3-1 Switch Input D | J5-1 RS485-A |
| J3-2 Switch Input E | J5-2 RS485-B |
| J3-3 Switch Output A | J5-3 Reserved |
| J3-4 Switch Output B | J5-4 CAN High |
| J3-5 Switch Output C | J5-5 CAN Low |
| J3-6 Switch Output D | J5-6 CAN Ground |
| J3-7 Switch Output E | J5-7 Special Input |
| J3-8 Sensor Power (V) | J5-8 Speed Reference |
| J3-9 Sensor Input A | J5-9 Reserved |
| J3-10 Sensor Input B | J5-10 RS485 Ground |

| Generator Connector (A) |
|-------------------------|
| J7-1 Gen. Current (A) |
| J7-2 Gen. Current (B) |
| J7-3 Gen. Current (C) |
| J7-4 CT Common |

| Generator Connector (V) |
|-------------------------|
| J7-1 Gen. Phase A |
| J7-2 Gen. Phase B |
| J7-3 Gen. Phase C |
| J7-4 Neutral |

TG410 Example w/ RP100
DWG1525R2.0

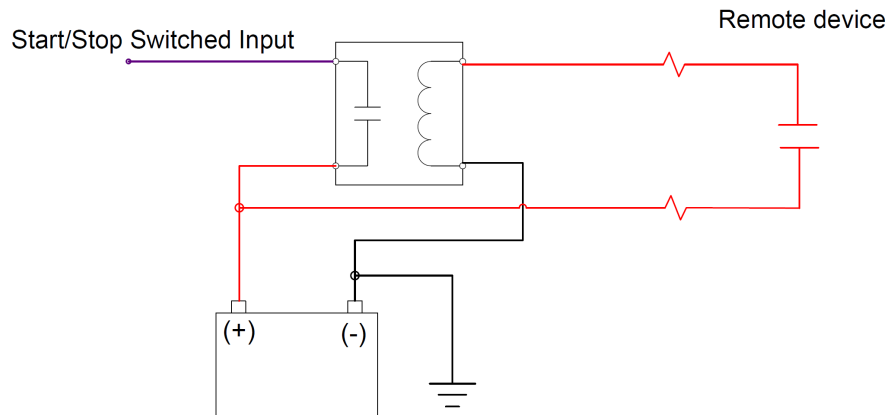
2.6 Wiring Considerations

The following sections are meant to describe certain wiring configurations and are for illustrative purposes only. Not all applications are the same. Please ensure you modify these examples to fit your unique system requirements.

2.6.1 Remote Start Contact (Start/Stop)

As of Firmware version 1.60 the start/stop is factory defaulted to switch input B (changeable) and the trigger factory defaulted to Close +BAT. For older firmware versions you must set Start/Stop to Switched Input B or as desired and set the trigger mode to Close +BAT. The trigger can be set to any of four options but Close +BAT gives the best immunity to noise.

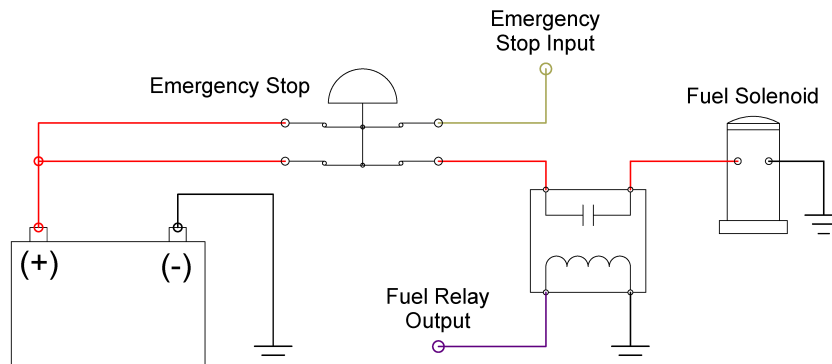
For runs over 20ft (6.1m) especially in noisy environments Dynagen recommends connecting the Start/Stop to an external relay. The relay needs to be located as close to the controller as possible.



2.6.2 Emergency Stop Wiring

If Emergency Stop functionality is required, it is mandatory to install an external mushroom style switch wired in series with the fuel or ignition supply to ensure reliable and immediate shutdown upon activation.

Shown below is an example wiring diagram of a double pull, single throw switch being used to activate the e-stop input and cut power to the fuel solenoid. In this configuration, the e-stop is activated when there is an open circuit to the switched input and inactive when the input detects +Battery voltage.

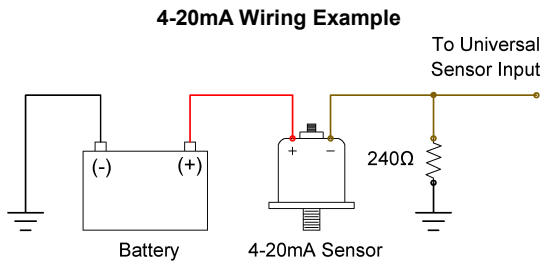


2.6.3 Universal Sensor

Universal Sensors have the ability to be configured to detect different sender types (0 - 750Ohm, 0 - 7,500Ohm, 0 - 5 VDC, 4 - 20mA). The examples shown below are advanced applications of the universal sensor.

NOTE: Custom Sensor tables are required for the universal sender to work with these examples. See the [Custom Sender Table](#) section for more information.

Example #1: The following example shows the correct way for wiring a 4-20mA sensor. The 240Ohm resistor is required to transform the 4-20mA current into the 0-5V voltage range required by the controller.

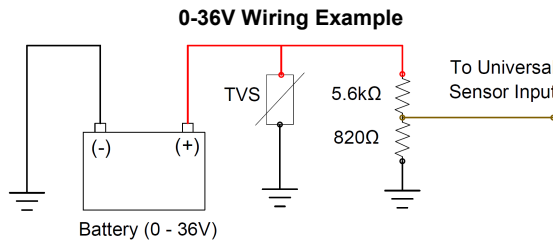


Example #2: Sometimes it is required to measure voltages outside the 0-5V range allowed by the controller. To do this you must use a voltage divider with appropriate scaling resistors. The equation to calculate the resistor values is as follows:

$$V_{out} = \left(\frac{R1}{R1 + R2} \right) \times V_{in}$$

$V_{out} = 5V$
 $V_{in} = \text{Maximum Voltage to Read}$
 $R1 = \text{Common Resistor Value} > 10k\Omega$
 $R2 = \text{Calculated Resistor Value (Select closest common resistor value)}$

The following diagram shows the typical wiring of a voltage divider. The resistors' values have been selected to allow the controller to read up to 36V from an external battery bank.



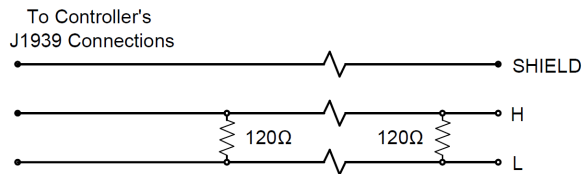
NOTE: A TVS (i.e. varistor) is required if the battery is different than the battery the controller is powered from. The controller's TVS cannot protect the sensor input from transients in this case.

2.6.4 CAN Bus Wiring

The following table outlines some items that must be taken into consideration when connecting to a CAN bus engine.

| Consideration | Description |
|-----------------|--|
| Bus Termination | Each end of the bus must be terminated from CAN H to CAN L with 120Ohm +/- 10 Ohm resistors. The resistor must be able to handle at least 400mW of power disipation. |
| Cable Selection | A twisted pair 120Ohm cable is required for communications. For better protection a shielded twisted pair cable is recommended. Examples are: 1. Belden 9841 - One twisted pair, 24AWG 2. Belden 7895A - Two twisted pair, 20AWG, second pair can be used for power |
| Shielding | If using a shielded cable the shield must be connected to ground on one end of the bus only. This prevents loss of data from electromagnetic interference. |

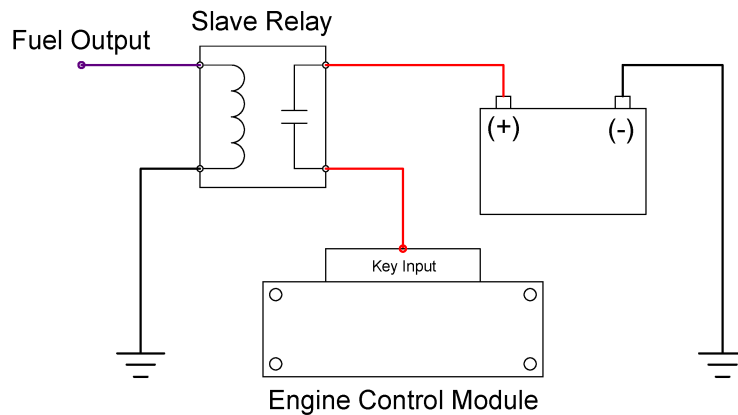
Communications Wiring



It is common practice to use the fuel output to trigger the ECM key input to enable the ECM before cranking. For some ECMs to function, they must be powered/enabled for a certain period before cranking to allow time for the ECM to boot up. There are two ways to provide this time:

- Set a preheat time or increase the preheat time to allow longer time for the ECM to boot up before cranking. The fuel output turns on at the start of preheat.
- Enable the Auto Power ECM setting in the Communications -> CAN Bus (J1939) menu will cause the fuel output to turn on in Auto mode and stay on.

ECM Wiring

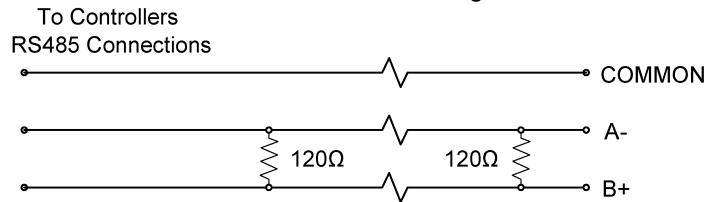


2.6.5 Modbus Wiring

The following table outlines some items that must be taken into consideration when connecting up a Modbus system.

| Consideration | Description |
|-----------------------------|---|
| Bus Termination | Each end of the bus must be terminated from A to B with 120Ohm resistors. If the controller is a device that is not at the end of the bus, it does not require a terminating resistor. |
| Cable Selection | RS485 twisted pair 120Ohm cables are required for communications. It is recommended that the sheild drain wire (if using a shielded cable) NOT be used for the RS485 common. If the cable doesn't have a spare wire run a separate wire at least 24AWG. Examples: 1. Belden 9841 - One twisted pair, 24AWG. A separate wire must be run for RS485 common. 2. Belden 7895A - Two twisted pair, 20AWG, second pair can be used for the RS485 common. |
| Distance (Power and Ground) | If running power and ground from the battery of your system to a remote device, use the following guidelines for the gauge of the power and ground wires. 1. Up to 450ft (137.2m) - 22AWG 2. Up to 700ft (213.4m) - 20AWG 3. Up to 1125ft (342.9m) - 18AWG 4. Up to 1800ft (548.6m) - 16AWG 5. Up to 2800ft (853.4m) - 14AWG |

Communications Wiring

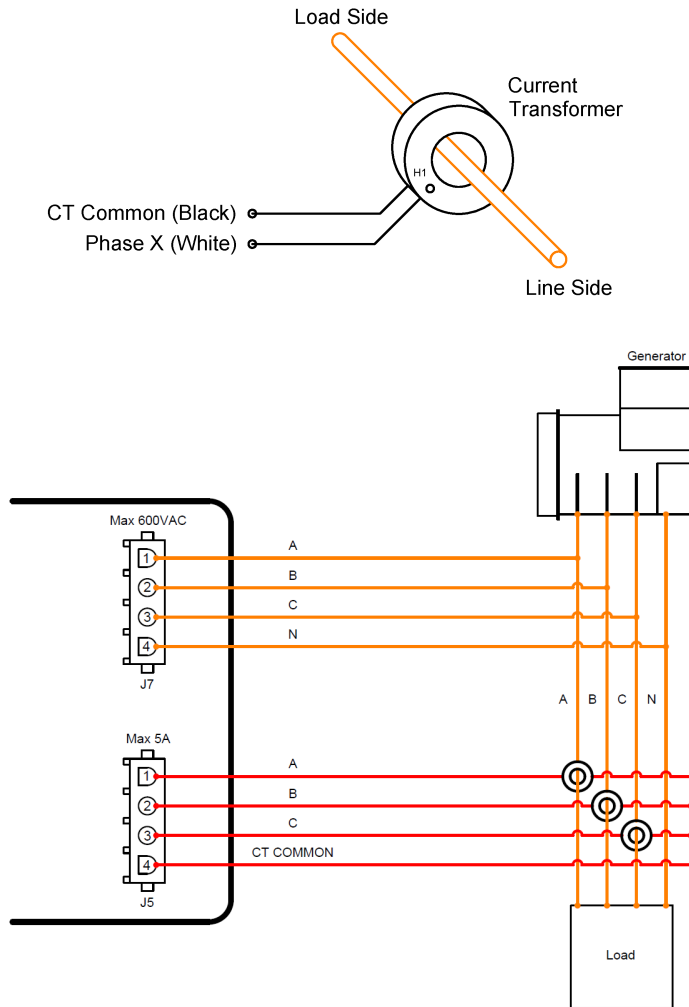


2.6.6 Current Transformers

When wiring current transformers into the system you must follow these considerations:

1. The current transformer of each phase must be facing the same direction. See below.
2. The CT Common connection must be connected to the black wire on each current transformer.
3. The wires from the current transformers to the controller should be as short as possible.
4. The CT wires should be run in a separate conduit from the AC voltage wires.


NOTE: If readings are unstable with the configuration shown below, attempt connecting the CT Common's black wire to the negative terminal of the battery. Ensure the connecting wire is as short as possible.



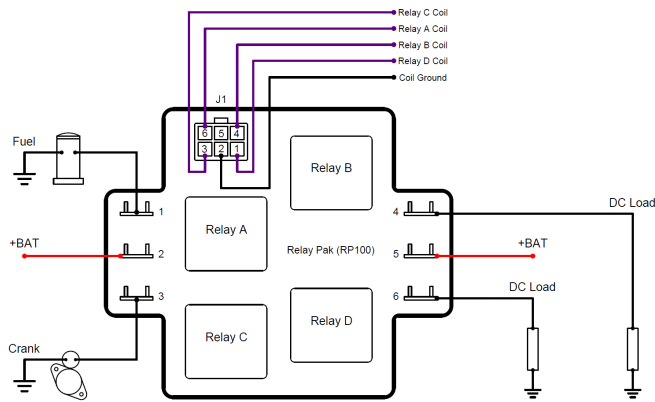
2.6.7 RelayPak (Optional)

The RelayPak is used to provide built-in slave relays in a compact and easy to wire package. This allows the low current outputs of the controller to switch on high current relays on the RelayPak.

Electrical Specifications

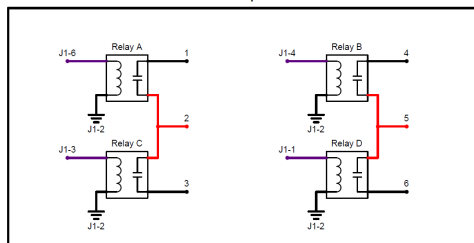
| Specification | Rating |
|--------------------------|---|
| Operating Voltage | 12V / 24V |
| Output Pilot Duty Rating | 5.83A Per Relay @ 12V |
| Output Resistive Rating | 10A Continuous Per Relay @ 12V 40A Momentary Per Relay @ 12V |
| Relay Style | Automotive Cube |
| Standards |  UL 6200 recognized component. Consult factory for UL conditions of acceptability. |

WARNING: You must use relays in the RelayPak that are suitable for the system voltage. Example: 12V relays in a 12V system and 24V relays in a 24V system.



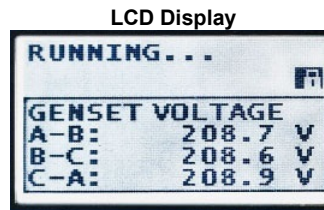
Schematic Representation

| Relay Pak Connector | |
|---------------------|-----------------|
| J1-1 | Relay D Coil |
| J1-2 | Coil Ground |
| J1-3 | Relay C Coil |
| J1-4 | Relay B Coil |
| J1-5 | Relay A Coil |
| J1-6 | Relay A Contact |
| 1 | A and C Common |
| 2 | Relay C Contact |
| 3 | Relay B Contact |
| 4 | Relay D Contact |
| 5 | B and D Common |
| 6 | Relay D Contact |



3 Using the Controller

The LCD display is the primary source of information from the controller. It allows you to view/change settings and monitor the status of sensors and other engine peripherals.



Using the Menu System

| Task | Description |
|-------------------|--|
| Entering Menu | When in the OFF mode, press the enter button to bring up the menu. |
| Navigating Menu | Once in the menu, use the up and down arrows to navigate. Pressing enter will move you into that menu. |
| Change a Setting | Scroll to the desired value and press enter to select. A check mark should appear beside that item. Press enter again to save the setting and return to the previous screen. |
| Scroll Parameters | When in Auto or Running mode, pressing the up and down arrows will scroll through the parameter pages. |
| Lock Screen | When in Auto or Running mode, the screen can be locked to a certain parameter page by pressing enter and unlocked by pressing enter again. |
| Events History | Once in the menu, select Events History to view the most recent controller event. Use the up and down arrows to navigate to other events. The controller can store up to 150 events. If more than 150 events occur, the oldest event is deleted to make room for the next event. |

Front Panel Items

| Item | Name | Description |
|------|---------------|---|
| | Off Button | Used for turning off the engine or exiting out of Auto mode. This is not intended to function as an Emergency Stop as there are conditions in which it will not shut down the engine. See the OFF Button Function section for more information. |
| | Auto Button | Used for placing the controller into AUTO mode. Once in AUTO mode, the controller waits for a start command to be received. |
| | Run Button | Used to start the engine manually. The Off button must be used to shut down the engine if it has been started using the front panel. |
| | Up Button | Used for moving around in the menu, changing a setting's value, or changing the currently displayed parameter page. |
| | Enter Button | Used for entering the menu system, accepting settings, or locking the LCD screen when viewing parameters. |
| | Down Button | Used for moving around in the menu, changing a setting's value, or changing the currently displayed parameter page. |
| | Generator LED | Green = Engine running with no issues Amber = Engine running with warnings Red = Engine shut down on failure |

3.1 Modes, Starting and Stopping

The following table describes the different operating modes of the controller:

Modes

| Mode / State | Description |
|--------------|--|
| OFF | When in the OFF mode, the engine cannot be remotely started. |
| Auto | When in the Auto mode, the engine waits to receive a start command. |
| Running | When engine is Running, the controller monitors engine parameters and waits to receive a stop command. |
| Failure | When a failure occurs, the controller shuts down the engine and displays the reason for failure. The unit must be reset using the front panel OFF button with the exception of Modbus. |

| Mode / State | Description |
|--------------|--|
| Menu | When in the menu mode, settings can be changed and the events history may be viewed. |

The following table describes the different methods for starting a controller. Unless using the Manual Run method to start the controller, the controller must be in AUTO mode.

Starting Methods

| Methods | Description |
|---|---|
| Manual Run | Pressing the Run button will start the engine. You must press the OFF button to shut down the engine. |
| Start / Stop Switched Input | When this input is active the engine will start. When the input becomes inactive the engine will shut down. |
| Momentary Switched Inputs | Switched inputs Momentary Start and Momentary Stop can be used for starting and stopping of the engine. Unlike other inputs, they only have to be activated for a short period of time. |
| Battery Recharge | When the battery voltage drops below a certain level the engine will start and run for a predetermined amount of time. |
| Exerciser | When the scheduled exerciser interval occurs the engine will start and run for a predetermined amount of time. |
| Auxiliary Sensors | When a properly configured Auxiliary sensor falls below / rises above a certain point the engine will start as determined by the Auxiliary Sensors -> Mode Select settings. |
| Loss of Mains (TG350AMF only) | When loss of mains power is detected the engine will start to provide power to the load. All the appropriate settings in regards to Auto Mains Failure must be set properly. |
| Modbus Start (TG410 only) | When a certain command is sent to the controller over Modbus the engine will start. See the Modbus Reference Manual for more information. |
| J1939 Start | Start/stop command send over the J1939 CANbus. For example from the TR100 or a remote telemetry device. |



WARNING: See the [Using Cooldown Mode](#) section for more information on how it affects starting and stopping.

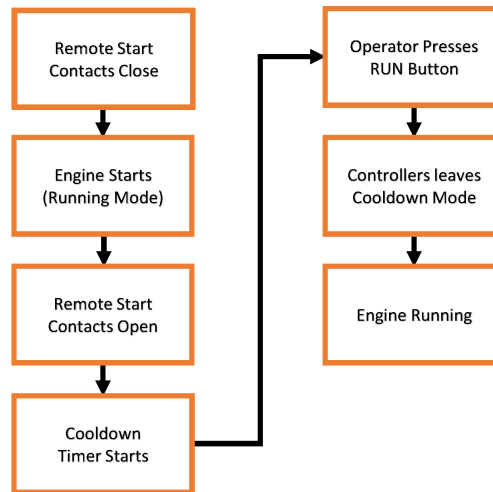
3.2 Using Cooldown Mode

When the controller is configured to have a cooldown period (See [Engine Logic](#) section) for the engine, there is some special functionality that must be considered.

The cooldown period is special in that during this time, it will accept a Start Command. This means if the engine is cooling down and a start command is received, the controller will be placed back into a running mode and will not shut down.

Example: The following is an example of how the cooldown functionality works.

1. Remote Start contacts close
2. Engine starts and is in the running mode
3. Remote Start contacts open
4. Engine starts cooldown period
5. User presses RUN button on the front panel
6. Engine moves back into running mode and does not shut down
7. Engine can now only be shut down by using the OFF button or Emergency Stop input



3.3 Failures

Failures are conditions that cause the controller to shutdown to prevent damage to the engine or generator. These get enabled/disabled when you enable/disable various settings in the controller.

Notable failures are given in the below table.

| Failure Name | Enabled Condition(s) | Description |
|---------------------------|---|---|
| ECM Communication Failure | Enabled if loss of ECM communication is enabled. See CAN Bus (J1939) . J1939 feature. | If the controller has not received messages from the ECM for 6s. |
| Failure To Stop | Disabled when ETS On Duration is set to 0 seconds. Otherwise it is enabled. ETS should be set to at least 2 to 3s otherwise this failure may not occur. Engine Speed feature. | After ETS countdown is finished if the speed was greater than 50RPM for the previous 2s then the controller triggers this failure. |
| Load Imbalance | See Load Imbalance . AC Current feature. | Generator load imbalance. Excessive AC current on one or more of the three phases. |
| Exception* | Always enabled. | Occurs when there is an issue that the controller cannot recover from. For example EMI can cause the microcontroller to become in a bad state or a software bug could cause the code to hang triggering the watchdog. In these cases the controller will reset and enter the failure state. *The name is configurable so may not match what is here. |

4 Settings

The following section relates to settings that can be changed to alter the way the controller performs its functions. Read and review these sections carefully to ensure your settings are set correctly for your engine.

4.1 Operator Setup

The following settings are used to change the way the user interacts with the controller. They are not password protected and can be changed by anyone from the front panel.

| Name | Range | Description |
|----------------------------------|---|--|
| Lamp Test | Function | Performs a lamp test on the LEDs when selected. |
| Display -> LCD Reverse | Function | Reverses the white and black pixels when selected. |
| Display -> LCD Contrast | 5 ~ 95% | Changes the contrast of the LCD. |
| Display -> Page Scroll | 1 ~ 10 seconds | Amount of time between each auto scroll of the parameter pages. |
| Display -> Message Pop-Up | 1 ~ 10 seconds | Amount of time each message is displayed on the screen before displaying next message in the buffer. |
| Display -> DPF/DEF Display Time | 0 ~ 10 seconds | See DPF/DEF aftertreatment in the J1939 Reference Manual for more information. |
| Display -> LCD Backlight Timeout | 10 ~ 600 seconds | Amount of time the LCD Backlight stays on after button activity stops. |
| Date / Time -> Date Change | 1 ~ 31 days 1 ~ 12 months 2000 ~ 2099 years | Sets the date. |
| Date / Time -> Time Change | 0 ~ 23 hours 0 ~ 59 minutes 0 ~ 59 seconds | Sets the time. |
| Date / Time -> Daylight Savings | Enable ~ Disable | Turns Daylight Savings Time on or off. This applies to North America only. Disable for other locations. |
| Units -> Temperature Unit | °F or °C | Selects the temperature display format. |
| Units -> Pressure Unit | PSI or kPa | Selects the oil pressure display format. |
| Run from OFF | Enable ~ Disable | When enabled, allows a user to start the engine using the run button while in the OFF mode. When disabled the controller must be placed in AUTO mode before the run button can start the engine. |

4.2 Switched Inputs

The controller has switched inputs which cause the controller to perform a function when activated.

Settings

| Name | Range | Description |
|--------------|------------------|--|
| Functions | List - See Below | The function that the switched input performs when active. |
| Active Modes | List - See Below | Determines the operating conditions under which the switched input can be active. Multiple selections are allowed. |
| Trigger | List - See Below | The state of the input determining if it is active or inactive. |

Functions

| Name | Active Mode | Description |
|----------------------------|---------------|--|
| Disabled | N/A | Input is disabled and has no function. |
| Start / Stop | Auto, Running | Starts the engine when active, stops the engine when deactivated. It is recommended to set the Trigger mode to Close +BAT for better noise tolerance. WARNING: The Triggers are different from the regular triggers for this function. See the Start / Stop (Momentary Function) section for more information. |
| Emergency Stop | Global | Shuts down the engine when active and displays 'Emergency Stop.' |
| Idle Mode | Running | Controller ignores under speed, voltage and frequency warnings and failures when active. If using J1939, the controller will broadcast TSC1 as the Idle Speed parameter found in the Engine Speed section. |
| Voltage Select 1 | Auto | Used for changing the systems voltage configuration. See Voltage Select for more information. |
| Voltage Select 2 | Auto | Used for changing the systems voltage configuration. See Voltage Select for more information. |
| Battery Charger Fault | Global | Controller displays 'Charger Fault' warning when active. |
| Momentary Start | Auto | Starts the engine when momentarily active (Approximately 2 seconds). |
| Momentary Stop | Running | Stops the engine when momentarily active (Approximately 2 seconds). |
| Configurable Warning 1 | Configurable | Controller displays a warning with configurable text* when active. |
| Configurable Warning 2 | Configurable | Controller displays a warning with configurable text* when active. |
| Configurable Failure 1 | Configurable | Controller displays a warning with configurable text* and shuts down engine when active. |
| Configurable Failure 2 | Configurable | Controller displays a warning with configurable text* and shuts down engine when active. |
| Configurable Failure 3 | Configurable | Controller displays a warning with configurable text* and shuts down engine when active. |
| Air Pressure Failure | Cranking | Controller displays 'Air Pressure Failure' and shuts down engine when active. |
| Hydraulic Pressure Failure | Cranking | Controller displays 'Hydraulic Pressure Failure' and shuts down engine when active. |
| Low Oil Pressure Warning | Running | Controller displays 'Oil Pressure Warning' when active. |
| Low Coolant Level Failure | Global | Controller displays 'Coolant Level Failure' and shuts down engine when active. |
| High Fuel Warning | Global | Controller displays 'High Fuel Level' warning when active. |
| Lamp Test | Global | Controller performs lamp test when active. |
| Fuel In Basin | Global | Controller displays 'Fuel In Basin' warning when active. |
| Battle Mode | Running | Controller ignores all warnings and failures when active. If a failure occurs during Battle Mode it is 'latched' and the engine will shutdown on failure when the controller leaves Battle Mode. |
| Start Inhibit | Auto | Controller ignores all start commands and the engine cannot start when active. Once Start Inhibit becomes inactive, starting is enabled again. If the engine is running, activating this input will shut down the engine. |

| Name | Active Mode | Description |
|--|-------------|---|
| Primary RPM / 60Hz - Secondary RPM / 50Hz Select | Auto | Used for changing between Primary and Secondary RPM for an engine or 50Hz / 60Hz for a generator. See RPM / Frequency Select for more information. |
| Preheat Signal | Cranking | When the Preheat Mode setting in the Engine Logic menu is set to Switched Input, it uses this input to determine to control the preheat time. |
| Remote Reset | Global | Allows the controller to be reset from a failure mode. Momentary action for 3 - 5s in FAILURE mode will place the controller in OFF mode. Momentary action for 3 - 5s in OFF mode will place the controller in AUTO mode. |

*The RapidCore Configuration Software must be used to change the text.

Active Modes

| Name | Description |
|----------------|---|
| Disable | Input cannot be triggered. |
| Global | Input can be triggered at any time. |
| OFF Mode | Input can be triggered while in the OFF mode. |
| AUTO Mode | Input can be triggered while in the AUTO mode. |
| Running | Input can be triggered after a start command is received until shut down (cooldown not included). |
| Cranking | Input can be triggered during cranking. |
| After Cranking | Input can be triggered after engine has started until shut down. |
| Cooldown | Input can be triggered while cooldown timer is active. |



NOTE: More than one Active Mode can be selected.

The active modes is only configurable for the configurable switched input functions. It is fixed for all other functions.

Triggers

| Name | Description |
|----------------|---|
| Close +BAT | Input is active when +Battery is present at the terminal. |
| Close GND | Input is active when Ground is present at the terminal |
| Close +BAT/GND | Input is active when either +Battery or Ground is present at the terminal. |
| Open | Input is active when neither +Battery or Ground is present at the terminal. |



NOTE: When running wires over long distances (over 20ft / 6.1m), it is recommended to use +BATTERY as the trigger method.

4.2.1 Voltage Select

The controller has the ability to automatically change its AC voltage display mode and its associated warnings and failures through use of switched inputs. The AC Metering -> Generator Voltage -> Voltage Configuration setting **must** be set to Auto Selection. When using voltage select, the controller will continue to monitor the inputs for 10 seconds after crank success. Once that time expires, the controller will then display the selected voltage configuration.

The table below shows the correspondence between the switched inputs status and the voltage configuration.

| Volt Select 1 Input | Volt Select 2 Input | Voltage Configuration |
|---------------------|---------------------|-----------------------|
| Inactive | Inactive | 3-Wire Single Phase |
| Active | Inactive | 3-Phase (1) |
| Inactive | Active | 3-Phase (2) |
| Active | Active | 3-Phase (3) |



NOTE: Both Voltage Select 1 and Voltage Select 2 must be assigned to switched inputs for the feature to function properly.

The following settings are affected by the Voltage Select Inputs:

1. AC Monitor -> Generator Voltage -> Auto Nominal
2. AC Monitor -> Generator Voltage -> Auto Scaling Factor
3. AC Monitor -> Generator Current -> Auto Rated Amps
4. AC Monitor -> Generator Current -> Auto Scaling Factor

4.2.2 RPM / Frequency Select

The controller has the ability to change between Primary RPM / 60Hz and Secondary RPM / 50Hz through the use of a switched input. The AC Metering -> Generator Frequency -> Frequency Source setting must be set to RPM Switch for this feature to work. This setting is only monitored before a start signal has been received.

The following settings must be set in order for this feature to function:

- Switched Input X -> Primary RPM / 60Hz - Secondary RPM / 50Hz Select
- AC Metering -> Generator Frequency -> Frequency Source -> RPM Switch
- Sensors -> Engine Speed -> Auto RPM Nominal -> Primary RPM / 60Hz
- Sensors -> Engine Speed -> Auto RPM Nominal -> Secondary RPM / 50Hz

The table below shows the correspondence between the switched input status and the RPM / Frequency.

| Switched Input | Frequency |
|----------------|----------------------|
| Inactive | Primary RPM / 60Hz |
| Active | Secondary RPM / 50Hz |



NOTE: If enabled, the TSC1 PGN will be broadcasted according to the selected speed. Otherwise only the warning and failure setpoints are affected by this function.

4.2.3 Configurable Inputs

These inputs are used to create custom warnings and failures. Using the DYNAGEN Configurator you can change the text displayed when the warning or failure occurs. If you select one of these inputs without changing the text it will default to 'Config Warn X' and 'Config Fail X.'

There are also timers associated with the configurable inputs which can be found in the menu under *Timers -> Trigger Delays*. These timers change the amount of time the input has to be active before the controller registers the warning or failure.



NOTE: If the switched input becomes inactive before the trigger delay time expires, the warning or failure will not occur.

Example: The user wants a pump to turn on 30 seconds after a high water level switch is tripped and remain on until the level switch turns off.

The level switch is connected to Switched Input C and closes to ground when the water level is too high. The words 'Water Pumping' are also required to be displayed on the controller's LCD screen. The pump is connected to a slave relay which is controlled by Switched Output D on the controller.

Relevant Settings

| Setting | Value |
|------------------------------------|------------------------|
| Switched Input C -> Function | Configurable Warning 1 |
| Switched Input C -> Active Mode | Global |
| Switched Input C -> Trigger | Close GND |
| Configurable Warning 1 Custom Text | Water Pumping |
| Switched Output D -> Warnings | Configurable Warning 1 |

4.2.4 Momentary Start/Stop

The switched input functions **Mom. Start** and **Mom. Stop** allow the user to wire separate inputs for start and stop or to use a push button instead of a toggle switch. The switched input trigger modes have different meanings for the momentary start and momentary stop inputs than other inputs.

The following table describes the trigger mode functionality.

| Trigger | Description |
|----------------------------|---|
| Close to +Battery | Input active when +Battery is applied. |
| Close to Ground | Input active when ground is applied. |
| Close to +Battery / Ground | Input active when +Battery or ground is applied for approximately 2 seconds then deactivated. |
| Open | Input active when neither +Battery or ground is applied for approximately 2 seconds then deactivated. |

These trigger modes changes allow the user to wire a single push button to be used for both start and stop.

4.2.5 Idle Inhibit

Use this feature to prevent start up while in Idle mode.

| Name | Range | Description |
|--------------------------------------|------------------|---|
| Start / Stop Switched Input Inhibit | Enable ~ Disable | Prevent the remote start switch input from starting the engine when the idle switch is active. |
| Aux 1,2,3,4 Sensor Autostart Inhibit | Enable ~ Disable | Prevent Auxiliary 1, 2, 3, and 4 sensors autostart feature from starting the engine when the idle switch is active. |

If the engine is in the IDLE mode because of the [automatic idle](#) feature, the remote start (start/stop) and auxiliary sensors autostart can still start the engine.

4.3 Switched Outputs

The controller has switched outputs that are turned on under certain conditions to perform a function. The outputs turn on to +Battery voltage to drive the load when active. The following items are the available functions for switched outputs.



WARNING: Switched outputs have a floating voltage of approximately 8V when off. If using the outputs for digital logic, it will be necessary to put a pull-down resistor (1 kOhm) from the output to ground to ensure a low logic level when output is off.

Event Functions

| Name | Active Mode | Description |
|--|------------------------------|---|
| Fuel | Cranking, Running | Active during cranking and running to supply fuel to engine. |
| Crank | Cranking | Active during cranking to start the engine. |
| Pull Coil | Cranking | See Pull and Hold Coil section for more information. |
| LCD Backlight | Global | Active when LCD Backlight is active. |
| Voltage Regulator | Running | Active when engine is starting/running and is not in Idle Mode. |
| ETS (Energize to Stop) | ETS Timer | Active during Energize to Stop timer. |
| Off Mode (Not In Auto) | Off | Active when the controller is in the OFF mode. |
| Idle Mode | Idle Mode | Active when Idle Mode switched input is active. |
| Battle Mode | Battle Mode | Active when Battle Mode switched input is active. |
| System OK (System Ready) | Auto | Active when controller is in Auto mode and no warnings or failures are present. |
| Delay to Start | Delay to Start Timer | Active when the Delay to Start timer is active. |
| Glowplug | Preheat, Midheat, Postheat | Active during the Preheat, Midheat and Postheat timers. |
| Warmup | Warmup Timer | Active after Warmup timer has expired to apply load to engine. |
| Cooldown | Cooldown Timer | Active when Cooldown timer is active. |
| Engine Running | Cranking, Running | Active when engine is cranking or running. |
| Exercising | Exercise Timer | Active during the engine exercising cycle. |
| Batt. Recharge (Battery Recharge) | Battery Recharge Timer | Active during the battery recharge cycle. |
| Maintenance (Maintenance Required) | Global | Active when Maintenance timer has expired. |
| LowBat InCrank (Low Battery During Cranking) | Cranking | Active when Low Battery During Cranking warning is displayed. |
| Aux Sensor 1 | Auxiliary Settings Dependent | Active dependent upon settings in the Auxiliary sensor section. |
| Aux Sensor 2 | Auxiliary Settings Dependent | Active dependent upon settings in the Auxiliary sensor section. |
| Aux Sensor 3 | Auxiliary Settings Dependent | Active dependent upon settings in the Auxiliary sensor section. |
| Aux Sensor 4 | Auxiliary Settings Dependent | Active dependent upon settings in the Auxiliary sensor section. |

| Name | Active Mode | Description |
|----------------|-------------------|--|
| Force Regen | User Controlled | When user triggers a Force Regeneration, output is active for 20 seconds then switches off. |
| Regen Inhibit | User Controlled | When user triggers a Regeneration Inhibit, output is active for 20 seconds then switches off. |
| Common Failure | Any Failure | Active when any failure occurs. |
| RPM Increment | Running | Output is used to to trigger inputs on an ECM to control speed. See Front Panel Speed Control section for more information. |
| RPM Decrement | Running | Output is used to to trigger inputs on an ECM to control speed. See Front Panel Speed Control section for more information. |
| DEF Fluid Pump | Running | Active when DEF Fluid Level falls below the DEF Low Level and stays active until the level rises above the DEF High Level. See CAN Bus (J1939) section for more information. |
| Genset Disable | Global | Disables the generator during a stationary Regen on Kubota engines (see Aftertreatment in the J1939 User Manual) or also during an engine IDLE condition from the IDLE switched input. Automatic idle is ignored. If the generator voltage is not below the under voltage setpoint in 10s, the controller will shut down the engine on "Generator Disable Failure." |
| Dummy Load | Running | Output is controlled by the dummy load feature. |
| Breaker Trip | Running | Output is controlled by the Over Current Failure or IDMT features and by the Load Imbalance feature. |
| Auto Idle | Warm-up, Cooldown | Active when the warm-up or cooldown idle is active. See Warm-up Idle and Cooldown Idle in Engine Logic . This does to react to the Idle switched input. |

Warning Functions

| Functions | | | |
|-------------------------|-------------------------|--|-----------------------|
| Low Engine Temperature | High Engine Temperature | Low Oil Pressure | Under Speed |
| Over Speed | Low Fuel Level | High Fuel Level | Low Battery Voltage |
| High Battery Voltage | Under Frequency | Over Frequency | AC Under Voltage |
| AC Over Voltage | Over Current | Fuel In Basin | Battery Charger Fault |
| Configurable Warning 1 | Configurable Warning 2 | Auxiliary Sensor 1 | Auxiliary Sensor 2 |
| Auxiliary Sensor 3 | Auxiliary Sensor 4 | | |
| Name | Active Mode | Description | |
| Load Imbalance | Running | AC current phases do not match. (More Information) | |
| DTC Received. (DTC/MIL) | Running | Active when controller receives a DM1 from the ECM. | |

Failure Functions

| Functions | | | |
|------------------------|---------------------------|--|-------------------------|
| Overcrank | Engine Failed to Stop | DM1 Stop Lamp | High Engine Temperature |
| Low Oil Pressure | Low Fuel Level | Under Speed | Over Speed |
| Low Battery Voltage | High Battery Voltage | Low Coolant Level | Low Air Pressure |
| Low Hydraulic Pressure | Under Frequency | Over Frequency | AC Under Voltage |
| AC Over Voltage | Over Current (TG410 only) | ECM Communication Failure | Configurable Failure 1 |
| Configurable Failure 2 | Config Fail 3 | Auxiliary Sensor 1 | Auxiliary Sensor 2 |
| Auxiliary Sensor 3 | Auxiliary Sensor 4 | | --- |
| Name | Active Mode | Description | |
| Load Imbalance | Running | AC current phases do not match. (More Information) | |
| Exception Fault* | All | When the controller encounters an unhandled exception or lockup (watchdog triggered) it will reset and enter the failure | |

| | | |
|--|--|---|
| | | mode as an exception fault. *The name of this fault is configurable form the Configuration Software. |
|--|--|---|

4.3.1 Group Outputs

Group functions have been designed to allow multiple output functions to be bundled together and assigned to a single switched output pin. The definition of a group output follows:

When any of the functions in a group is active (OR logic), the assigned switched output will be active.

Group Functions

| Name | Active Mode | Description |
|----------|-----------------|---|
| Group #1 | Group Dependent | Must be set from DYNAGEN Configurator software. |
| Group #2 | Group Dependent | Must be set from DYNAGEN Configurator software. |
| Group #3 | Group Dependent | Must be set from DYNAGEN Configurator software. |
| Group #4 | Group Dependent | Must be set from DYNAGEN Configurator software. |

Example: Low AC Frequency, High AC Frequency are bundled in 'Group #1' and assigned to Switched Output D. This output is connected to an external indicator lamp labeled 'AC Frequency Warnings', allowing one output to indicate there is a warning with the AC frequency. The following table shows the output state based on the warnings status.

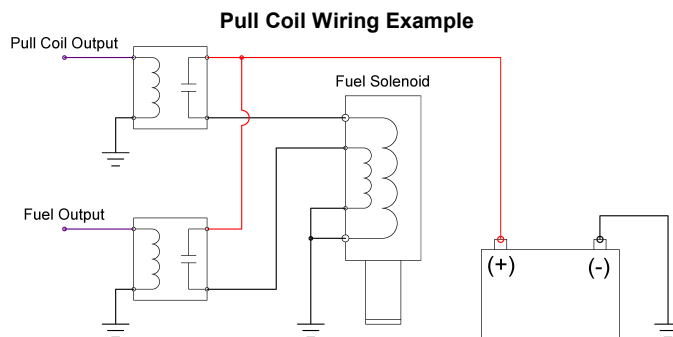
| Low AC Frequency Warning | High AC Frequency Warning | Switched Output State |
|--------------------------|---------------------------|-----------------------|
| Inactive | Inactive | OFF |
| Inactive | Active | ON |
| Active | Inactive | ON |
| Active | Active | ON |

4.3.2 Pull and Hold Coil

On some engine systems the fuel pump has two coils. This is because the initial power on of the fuel solenoid requires substantial current (Pull Coil), but only needs a small amount of current to hold it in place (Hold Coil).

1. Hold Coil (Fuel) is energized.
2. Pull Coil is energized for 2 seconds before cranking.
3. Repeat if engine cranking failed.

Configuring a switched output to Pull Coil automatically configures the engine logic necessary for a Pull Coil system.



4.4 Sensors

The controller has sensor ports which can be connected to a variety of different sensor types (Temperature, Pressure, Level, etc). See the [Terminal Descriptions](#) section for more information regarding terminal / sensor compatibility (Low Ohm, High Ohm, 0-5V or 4-20mA).

Most sensors are used to monitor for warnings and failures but the [Auxiliary](#) sensors can be used to perform special functions (Example: Starting engine on low temperature).

4.4.1 Engine Temperature

Use the following settings' configurations to allow the controller to read and interpret data from the engine temperature sensor.

| Name | Range | Description |
|---------------------------|--|---|
| Signal Source | Sensor Port X J1939 Bus | The source from which the sensor data is attained. |
| Sensor Type | DAT DAH* VDO 250F* (custom sender)** Close = Warning Open = Warning Close = Failure Open = Failure | DAT DAH supports all Datcon type DAH (high range) temperature sensors. VDO 250F supports the VDO 323-420 or equivalent temperature sensor. *Note: DAT DAH and VDO 250F can only be used if the Signal Source is set to Port A, C, or D. If using a switch it must close to ground. It can be normally open or normally closed. "Open" means open circuit. **A custom table can also be created using the RapidCore Configuration Software. (custom sender) will be replaced with the custom text you choose. |
| Trim Offset | -50.0 ~ 50.0°F (-10 ~ 10°C) | Calibrate a sensor by using the offset to correct errors. |
| Setpoints -> Bypass Time | 0 ~ 90 seconds | Amount of time to bypass warnings and failures after engine has started. |
| Setpoints -> Low Warning | 32 ~ 200°F (0 ~ 93.3°C) | Reading at which a warning occurs. |
| Setpoints -> High Warning | 50 ~ 300°F (10 ~ 148.9°C) | Reading at which a warning occurs. |
| Setpoints -> High Failure | 50 ~ 300°F (10 ~ 148.9°C) | Reading at which a failure occurs. |

Note: All temperature settings are entered in terms of Fahrenheit.

4.4.2 Oil Pressure

Use the following settings' configurations to allow the controller to read and interpret data from the oil pressure sensor.

| Name | Range | Description |
|--------------------------|--|--|
| Signal Source | Sensor Port X J1939 Bus | The source from which the sensor data is attained. |
| Sensor Type | Sensor Table X Close = Warning Open = Warning Close = Failure Open = Failure | Select one of the pre-configured sensor tables or one of the switch functions. A custom table can also be created using the RapidCore Configuration Software. Close = Ground Open = Open Circuit |
| Trim Offset | -50.0 ~ 50.0 psi (-344.7 ~ 344.7kPa) | Calibrate a sensor by using the offset to correct errors. |
| Setpoints -> Bypass Time | 0 ~ 90 seconds | Amount of time to bypass warnings and failures after engine has started. |
| Setpoints -> Low Warning | 0.1 ~ 99.0 psi (0.7 ~ 682.6kPa) | Reading at which a warning occurs. |
| Setpoints -> Low Failure | 0.1 ~ 99.0 psi (0.7 ~ 682.6kPa) | Reading at which a failure occurs. |

Note: All pressure settings are entered in terms of psi.

4.4.3 Fuel Level

Use the following settings' configurations to allow the controller to read and interpret data from the fuel level sensor.

| Name | Range | Description |
|---------------------------|--|--|
| Signal Source | Sensor Port X | The source from which the sensor data is attained. |
| Sensor Type | Sensor Table X Close = Warning Open = Warning Close = Failure Open = Failure | Select one of the pre-configured sensor tables or one of the switch functions. A custom table can also be created using the RapidCore Configuration Software. Close = Ground Open = Open Circuit |
| Trim Offset | -50.0 ~ 50.0% | Calibrate a sensor by using the offset to correct errors. |
| Setpoints -> Bypass Time | 0 ~ 90 seconds | Amount of time to bypass warnings and failures after engine has started. |
| Setpoints -> Low Warning | 1 ~ 90% | Reading at which a warning occurs. |
| Setpoints -> Low Failure | 1 ~ 90% | Reading at which a failure occurs. |
| Setpoints -> High Warning | 1 ~ 125% | Reading at which a warning occurs. |

4.4.4 Engine Speed

Use the following settings' configurations to allow the controller to read and interpret speed sensing data.

| Name | Range | Description |
|--|---|---|
| Signal Source | J1939 Bus Mag Pickup Genset Voltage | The source from which the sensor data is attained. |
| Speed Settings -> Rated RPM | 500 ~ 4000 | Speed at which the engine runs under normal operating conditions. Warning and failure setpoints are calculated from this setting. |
| Speed Settings -> Idle RPM | 300 ~ 2000 | Speed at which the engine runs when it is idling. |
| Speed Settings -> Tooth Count | 1 ~ 600 | Number of teeth on the flywheel (Mag Pickup only). |
| Setpoints -> Low Warn (UnderSpeed Warning) | 20 ~ 99% | Reading at which a warning occurs. |
| Setpoints -> Low Fail (UnderSpeed Failure) | 20 ~ 99% | Reading at which a failure occurs. |
| Setpoints -> High Warn (OverSpeed Warning) | 101 ~ 150% | Reading at which a warning occurs. |
| Setpoints -> High Fail (OverSpeed Failure) | 101 ~ 150% | Reading at which a failure occurs. |
| Front Panel Speed Control Settings | N/A | See Front Panel Speed Control section for more information on these settings. |
| RPM Switch -> Secondary RPM / 50Hz | 500 ~ 4000 | The Rated RPM when the Secondary RPM / 50Hz is selected. See RPM / Frequency Select section for more information. |
| RPM Switch -> Primary RPM / 60Hz | 500 ~ 4000 | The Rated RPM when the Primary RPM / 60Hz is selected. See RPM / Frequency Select section for more information. |




NOTE: When using J1939 or Genset Signal as a signal source, connections to the speed sensing terminals are not required.

4.4.4.1 Front Panel Speed Control

The operator is able to adjust the speed of the engine by using the controller's front panel. This section describes the two methods available for implementing speed control, the settings and parameters to be used, as well as the necessary instructions allowing the operator to control the speed.

Speed Control Methods

| Setting | Description |
|--|---|
| Front Panel Speed Control using J1939 TSC1 | The controller can instruct the ECM of an electronic engine to adjust its speed by broadcasting the TSC1 command. Refer to the J1939 Manual for more information. |
| Front Panel Speed Control using Switched Outputs | The controller can instruct the ECM of an electronic engine to adjust its speed by using switched outputs on the controller set to RPM Increment and RPM Decrement to interface with digital inputs on the ECM. When the speed is changed, the corresponding switched output will be on for 1 second each time increment or decrement is pressed. See the rest of this section for more information. |
| Aux 4 Speed Control | The Auxiliary sensor 4 is used to determine the setpoint speed. The speed is adjusted with the TSC1 J1939 command. Refer to the J1939 Manual for more information. |

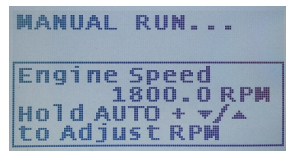
 **WARNING:** Switched outputs have a floating voltage of approximately 8V when off. If using the outputs for digital logic, it will be necessary to put a pull-down resistor (1kOhm, 1 Watt) from the output to ground to ensure a low logic level when output is off.

Speed Control Settings (in Engine Speed menu)

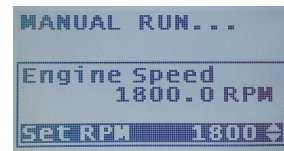
| Name | Parent Menu | Range | Description |
|----------------------|---|---|---|
| Speed Control Enable | Configuration Software only. Engine Speed menu. | Enable ~ Disable | Enables or disables front panel speed control. |
| RPM Display | Sensors > Engine Speed | Nothing / Blank AC Frequency Auxiliary Sensor 1 Auxiliary Sensor 2 | Parameter to display when adjusting speed from front panel. This is used to provide operator feedback in the case that the engine RPM affects another parameter such as AC Frequency or an Auxiliary Sensor (Example: Flow rate of pump). |
| Limit Method | Configuration Software only. Engine Speed menu. | Speed Bias Min RPM / Max RPM | The method in which the minimum and maximum speeds the operator is allowed to adjust is determined. |
| Speed Bias | Sensors > Engine Speed > RPM Control | 0 ~ 600 | The minimum or maximum RPM that the engine speed can be adjusted around the Rated RPM. Example: Rated RPM is 1800 and Speed Bias is 150. The minimum RPM will be 1650 and maximum RPM will be 1950. Only valid when the correct limit method is chosen. |
| Min Speed | | 500 ~ 4000 | The minimum RPM that can be set using speed control. Only valid when the correct Limit Method is chosen. |
| Max Speed | | 500 ~ 4000 | The maximum RPM that can be set using speed control. Only valid when the correct Limit Method is chosen. |

Speed Control Instructions

When the controller is running and there are other functions occurring, the controller will scroll through its display parameters as usual. When the speed control page is displayed, it will show the Engine Speed as well as the following instructions: Hold AUTO + Up/Down to Adjust RPM.



Speed Control Parameter Page



Speed Control Adjust Page

Pressing and holding the AUTO button will display the screen to the right. If a 'Display Adjust Parameter' is set, it will also be displayed underneath the Engine Speed. While still holding the AUTO key, press the up or down arrows to adjust the RPM. The Engine Speed display should update as the engine physically changes its speed to accommodate the speed request.

NOTE: When using switched outputs for speed control, the Set RPM will display '---' instead of the set speed.

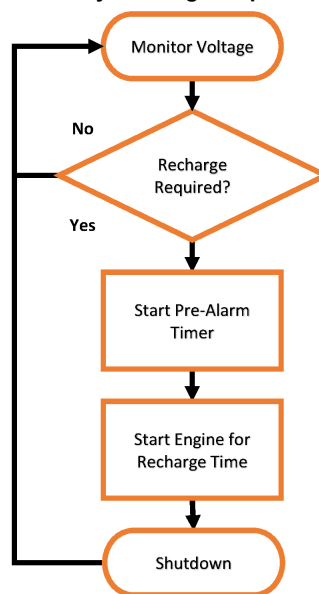
4.4.5 Battery Level

Use the following settings' configurations to allow the controller to read and interpret the battery voltage level.

| Name | Range | Description |
|-----------------------------|------------------|---|
| Battery Recharge | Enable ~ Disable | Enables or disables the ability to have the engine start on low battery voltage in order to charge it. |
| Recharge Setup -> Level | 6.0 - 30.0V | Voltage level at which the controller starts the engine to recharge the battery. |
| Recharge Setup -> Pre-Alarm | 1 ~ 30 minutes | Amount of time to display a warning before starting the engine. |
| Recharge Setup -> Duration | 10 ~ 900 minutes | Amount of time to run the engine. |
| Setpoints -> Low Warning | 6.0 ~ 24.0V | Reading at which a warning occurs. |
| Setpoints -> Low Failure | 6.0 ~ 24.0V | Reading at which a failure occurs. |
| Setpoints -> High Warning | 12.0 ~ 32.0V | Reading at which a warning occurs. |
| Setpoints -> High Failure | 12.0 ~ 32.0V | Reading at which a failure occurs. |
| Crank Low Batt | 6.0 ~ 24.0V | Screen displays a 'Low Voltage During Cranking' warning if voltage dips below this level during cranking. |

NOTE: When the engine is running, the battery voltage will equal the alternator charging voltage. The actual open-circuit battery voltage may be lower than displayed.

Battery Recharge Sequence



4.4.6 Auxiliary Sensors

The Auxiliary sensors on the controller are used for performing functions based on sensor readings. There are two different ways the auxiliary sensors may be utilized:

Scenario #1 - Custom Sensors

Use the auxiliary sensors to create custom sensors (Current, Voltage, etc.) that are not supported by the controller by default (engine temperature, oil pressure, fuel level).

Scenario #2 - Add-On Functionality

Double up the auxiliary sensor onto the same Sensor Port that is currently being used by one of the other sensors (engine temperature, oil pressure, fuel level). This allows you to use the special functions (Start on Low, Output on High, etc.) in conjunction with those sensors.



NOTE: You must set the auxiliary sensor port and sensor table to the same values as the other sensor.

| Name | Range | Description |
|---|---|--|
| Signal Source | Sensor Port X | The source from which the sensor data is attained. |
| Display | Enable ~ Disable | Determines if the sensor's value is displayed on the screen when the engine is running. |
| Active Mode | Disable Global Not In Auto Auto State Running Cranking After Cranking Cooldown | Determines under which operating conditions the Auxiliary Sensor is monitored. Multiple selections are allowed. Does not apply to "Start on Low" or "Start on High"; for those selections the active mode is always "Not In Auto". Refer to the examples in the following pages for information on specific mode functions. |
| Func. Select | Fault Monitor Output on Low Output on High Start on Low Start on High | Determines how the controller responds to the readings of the auxiliary sensor Refer to the examples in the following pages for more information on specific mode functions. |
| Trim Offset | -50.0 ~ 50.0 units | Calibrate a sensor by using the offset to correct errors. |
| Mode Settings -> Bypass Time | 0 ~ 90 seconds | The amount of time to ignore the sensor input after the selected active mode is entered. Once triggered the bypass time does not apply again until the device resets (for example transitioning from RUN to the OFF or AUTO state) or on power-up. |
| Mode Settings -> Active Time ¹ | 1 ~ 600 minutes | The amount of time to turn on the auxiliary switched output or engine before turning off. |
| Mode Settings -> Start Level ¹ | Sensor Table Dependent | The level at which the auxiliary switched output or engine turns on. |
| Mode Settings -> Stop Level ¹ | Sensor Table Dependent | The level at which the auxiliary switched output or engine turns off. |
| Setpoints -> Low Warning | Sensor Table Dependent | Reading at which a warning occurs. |
| Setpoints -> Low Failure | Sensor Table Dependent | Reading at which a failure occurs. |
| Setpoints -> High Warning | Sensor Table Dependent | Reading at which a warning occurs. |
| Setpoints -> High Failure | Sensor Table Dependent | Reading at which a failure occurs. |

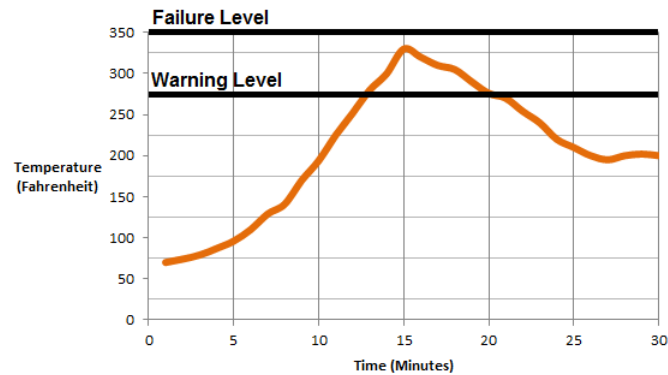
¹ Refer to the sections below for more information on how these settings affect the auxiliary sensors.

4.4.6.1 Fault Monitor Example

In this example, a sensor is monitoring the temperature of an engine block. If the temperature rises above 275°F, a warning message is displayed. If the temperature rises above 350°F, the engine shuts down and a failure message is displayed.

Relevant Settings

| Setting | Value |
|---------------------------|--|
| Signal Source | Same as Engine Temperature |
| Display | Disable (If enabled, controller will display Engine Temperature twice) |
| Sensor Type | Same as Engine Temperature |
| Sensor Table Name | Engine Temp. |
| Active Range | Running |
| Mode Select | Fault Monitor |
| Setpoints -> Low Warning | Disabled |
| Setpoints -> Low Failure | Disabled |
| Setpoints -> High Warning | 275°F |
| Setpoints -> High Failure | 350°F |



The chart above shows the connection between engine temperature and time. At approximately 13 minutes run time, the temperature rises above the 275°F warning threshold, activating the warning display. The engine will continue to run because it has not reached the 350°F failure threshold. At 20 minutes run time, the temperatures falls below the warning threshold and the warning disappears.

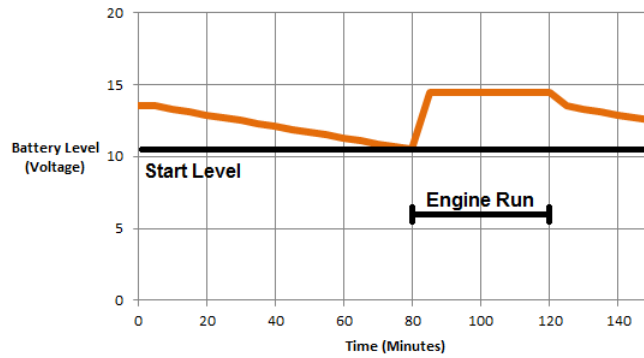
4.4.6.2 Start on Low / High Example

In this example, a sensor is monitoring the voltage of an external battery bank. If the voltage falls below 10.5V, the engine will start and run for 40 minutes to charge the battery.

Relevant Settings

| Setting | Value |
|--|--|
| Signal Source | Sensor Port X |
| Display | Enable |
| Sensor Type | Custom |
| Sensor Table Name | Battery Bank |
| Active Range | N/A (These ranges are fixed for Start on Low / High) |
| Mode Select | Start on Low |
| Mode Settings -> Active Time | 40 minutes |
| Mode Settings -> Start Level | 10.5V |
| Mode Settings -> Stop Level ¹ | Disabled |

¹ Stop Level needs to be disabled when the engine is running because the battery voltage will equal the alternator charging voltage. Having this disabled will force the engine to run for the entire duration of the active time.



The chart above shows the connection between a battery bank and time. At approximately 80 minutes time, the voltage falls below the 10.5V start threshold causing the engine to start. The engine runs for the 40 minutes active time regardless of the voltage reading and then shuts down.

4.4.6.3 Output on Low / High Example

In this example, a sensor is monitoring the temperature of an engine. If the temperature rises above 325°F, a fan will turn on to cool the engine. Once the temperature drops to below 200°F the fan will turn off.

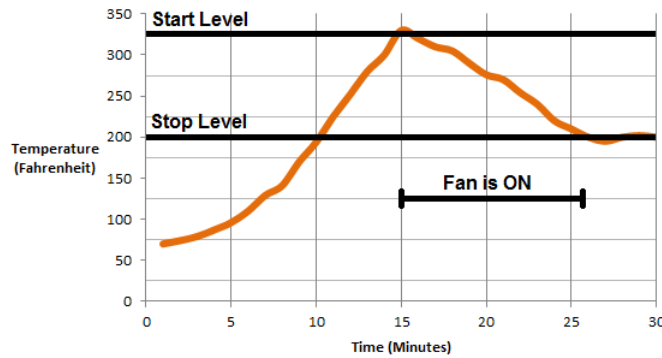
Relevant Settings (Auxiliary Sensor)

| Setting | Value |
|---|--|
| Signal Source | Same as Engine Temperature |
| Display | Disable (If enabled, controller will display Engine Temperature twice) |
| Sensor Type | Same as Engine Temperature |
| Sender Table Name | Engine Temp. |
| Active Range | Global |
| Mode Select | Output on High |
| Mode Settings -> Active Time ¹ | Disabled |
| Mode Settings -> Start Level | 325°F |
| Mode Settings -> Stop Level | 200°F |

¹ Active time is disabled because the fan needs to stay on indefinitely or until 200°F is reached.

Relevant Settings (Switched Outputs)

| Setting | Value |
|-------------------|---|
| Switched Output X | Auxiliary Sensor X (Choose based on which Auxiliary Sensor is being used) |



The chart above shows the connection between engine temperature and time. At approximately 10 minutes run time, the temperature rises above the 325°F start threshold and the fan turns on. The fan continues to run as the temperature declines. When the temperature falls below the 200°F stop threshold, the fan turns off.

4.4.7 Custom Sensor Tables

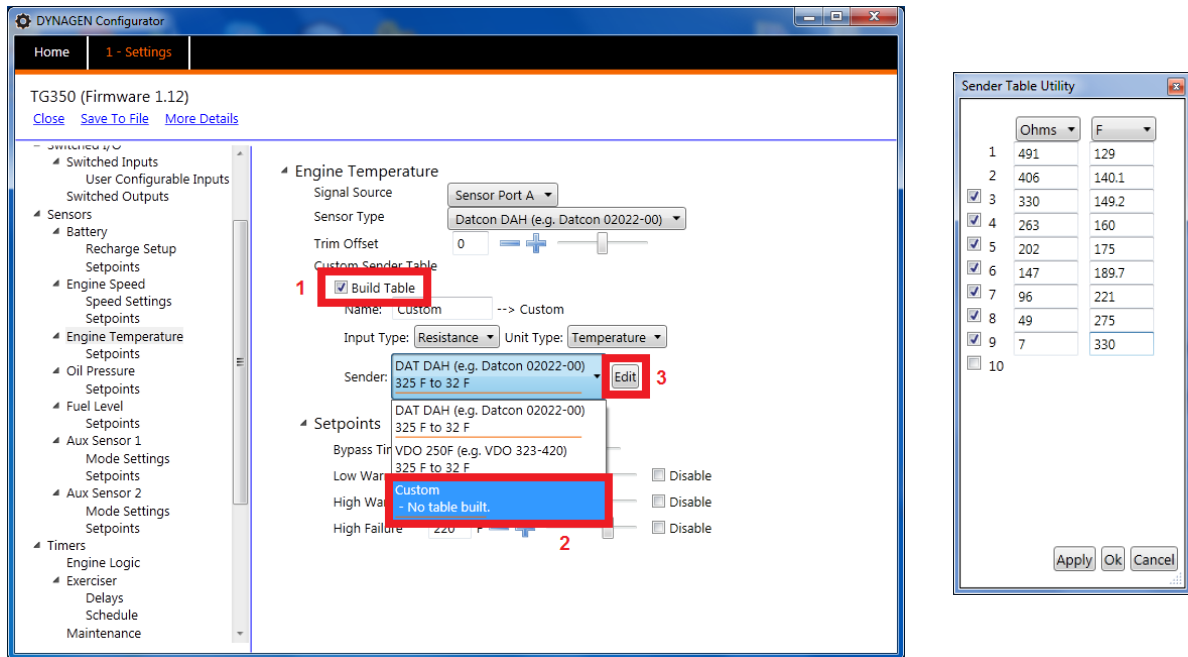
Custom Sensor Tables are created using the RapidCore Configuration Software when using a sensor that is not supported by DYNAGEN. The configurator has the ability to create these custom tables, allowing the controller to properly read the sensor data.

NOTE: Custom sender tables can only be created when using the configuration software.

| Parameter | Description |
|------------|---|
| Name | The label that will be displayed in the controller (Engine Temp, Oil Pressure, etc.) |
| Input Type | Choose resistance, voltage or current based on the sensor type. Use the Terminal Descriptions section to determine if your sensor is compatible with a sensor port. |
| Unit Type | Choose temperature, pressure, voltage, current or percentage based on the sensor. This defines what unit of measurement will be displayed on the front panel (°F, psi, V, A, %). |

The following example outlines the steps for creating a custom sensor table:

1. Navigate to the sensor input that will be using your custom sensor table.
2. Select a Name, Input Type and Unit Type for the controller (Definitions in table above).
3. Click the check box next to 'Build Table' (Image Step 1).
4. From the 'Sender' drop down menu, select 'Custom' (Image Step 2).
5. Click the 'Edit' button next to the drop down menu (Image Step 3).
6. Enter the sensor values. Once entered, click Apply then OK.



4.5 Timers

The controller has an internal clock which is used not only to keep time, but to ensure programmed events happen at the correct times. The following sections are used to configure settings associated with timing functions.



NOTE: The controller has an on-board backup battery to keep time even when main power is not supplied to the unit. This battery has an unpowered (no main power) lifetime of approximately five years.

4.5.1 Engine Logic

The following settings determine how the controller starts and stops the engine. It gives the user the functionality to add delays and timers to the sequences. Most of the settings have a switched output associated with them that must be set in the [Switched Outputs](#) settings.



NOTE: Setting a timer's value to 0 seconds will disable the timer. Example: If Delay to Start is set to 0 seconds, the controller will not perform a Delay to Start when starting the engine.


| Name | Range | Description |
|---|--|---|
| Delay to Start | 0 ~ 90 seconds | Amount of time to delay the starting of the engine after receiving a command to start. |
| DTS Manual Run (Delay to Start on Manual Run) | Enable ~ Disable | Determines if the the Delay to Start timer is used when the front panel RUN button is used to start the engine. |
| Preheat Mode | Preheat Timer Switched Input J1939 | Determines the method used to control enabling the glowplug output. See the Preheat Mode section for more information. |
| Preheat Time | 0 ~ 90 seconds | Amount of time the Glowplug output is active before cranking the engine. Used on diesel engines to warm the engine before cranking. |
| Crank Time | 3 ~ 30 seconds | Amount of time the Crank output is active before going to crank rest. This timer immediately expires upon successful cranking. |
| Midheat Time | 0 ~ 90 seconds | Keeps Glowplug output turned on while cranking but not during crank rest. Output will turn off upon crank failure, crank success or midheat time expiration. |
| Crank Rest Time | 1 ~ 90 seconds | Amount of time to delay between each attempt to start the engine. |
| Crank Attempts | 1 ~ 20 | Number of attempts to start the engine before going to an overcrank failure. |
| Fuel In Rest (Fuel Crank Rest) | Fuel ON Fuel OFF | Determines if the fuel output stays on during the crank rest time. |
| RPM Disconnect | 100 ~ 2000 rpm | Speed at which controller determines the engine has started successfully and turns off the Crank output . |
| Postheat Time | 0 ~ 90 seconds | Amount of time the Glowplug output remains on after crank success and the engine is running. |
| False Restart (Restart on False Start) | Enable ~ Disable | (Only applies to remote start.) Determines if the controller will monitor for false starts and attempt a restart. Controller will only attempt restarting the engine as many times as determined by Crank Attempts. |
| False Check (False Restart Detect Time) | 5 ~ 30 seconds | (Only applies to remote start.) Amount of time after successful cranking to monitor for a false restart. If this time expires and the engines stalls out, the controller will not attempt a restart. |
| Warmup Time | 0 ~ 600 seconds | After successful cranking, engine delays this amount of time before turning on the Warmup output . This allows the engine to warm up before applying any load to it. The output will turn off when the controller enters the Cooldown Delay . |
| OFF Button Function | Cooldown Shutdown Force Cooldown | The function the OFF button on the front panel performs while engine is running. See the OFF Button Function section for more information. |
| Cooldown Time | 0 ~ 600 seconds | Amount of time to cool down the engine after a stop command has been received. During this time the Warmup output turns off and the Cooldown output turns on. If another |

| Name | Range | Description |
|------------------------------------|--|---|
| | | start command is received during cool down, the controller will return to running mode. |
| ETS On Duration (Energize to Stop) | 0 ~ 30 seconds | Amount of time the Energize to Stop output is on after the engine has shut down. If controller still detects speed (RPM) after this time expires, it goes to a ' Failed to Stop ' failure. Time must be greater than 0 seconds for the Energize to Stop function to work. |
| Warm-up Idle | Idle during warm-up option. See the Warm-up Idle section for more information. | |
| Idle Settings | | |
| Cooldown Idle | Disable ~ Enable | Idle during cooldown. |

4.5.1.1 Preheat Mode

The controller has the ability to control the length of the preheat time through 3 different methods. The table below describes each method:


| Mode | Description |
|----------------|--|
| Preheat Timer | This mode uses the Preheat Timer setting in the Engine Logic menu. |
| Switched Input | This mode uses a switched input set to Preheat Signal. |
| J1939 | This mode uses commands sent from the ECM over J1939. |

 **NOTE:** During preheat the Glowplug switched output is on.

4.5.1.2 OFF Button Function

The OFF button on the front panel of the controller can be configured to function in 3 different ways while the engine is running. The table below describes each of these functions:

| Function | Description |
|----------------|--|
| Cooldown | This function causes the controller to go into cooldown. Pressing the OFF button again will cause the engine to shut down. |
| Shutdown | This function bypasses Cooldown and causes the engine to shut down. |
| Force Cooldown | This function causes the controller to activate the cooldown process. Pressing the OFF button will have no affect as the controller is forcing the engine to perform a full cool down. |

 **WARNING:** If the controller receives a command to start from the remote start or front panel run button while in Cooldown, it will leave the Cooldown mode and go back to Running mode.

4.5.1.3 Warm-up Idle

This section explains the Idle during warm-up feature.

| Name | Parent Menu | Range | Description |
|--------------|---------------------------------------|---|---|
| Warm-up Idle | Timers > Engine Logic | Disable Warm-up Timer Oil Temp. Engine Temp. | If enabled the engine is placed in Idle mode during the warm-up period. <u>Warm-up Timer</u> -- The engine idles during the duration of the warm-up timer countdown. <u>Oil Temp.</u> -- The oil temperature over J1939 is used to determine the extent of the warm-up / Idle period. <u>Engine Temp.</u> -- Same as Oil Temp. but the engine temperature is used. The engine temperature can come locally or from J1939. The oil temp and engine temp selections use the Debounce, Low Point, and High Point settings below. |
| Debounce | Timers > Engine Logic > Idle Settings | 1 to 10s, 1s increments | If the temperature remains between the "Low Point" and "High Point" settings for this time exit the warm-up / idle. |
| Low Point | Timers > Engine Logic > Idle Settings | 1 to 100°F, 1°F increments | Continue to idle when the temperature is below this setting. Ignore the Debouce. |
| High Point | Timers > Engine Logic > Idle Settings | 1 to 100°F, 1°F increments | Always exit idle when the temperature is above this setting. |

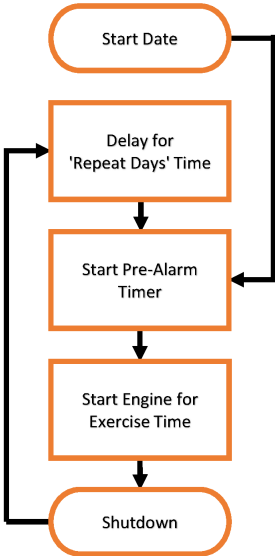
4.5.2 Exerciser

The Exerciser function is used to start and run the engine periodically. The following settings configure the Exerciser function.

Exerciser Settings (in Timers menu)

| Name | Range | Description |
|-------------------------|-------------------|--|
| Enable | Enable ~ Disable | Enables the exerciser feature. |
| Delays -> Pre-Alarm | 1 ~ 20 minutes | Amount of time to display a warning before starting the engine. |
| Delays -> Run Time | 10 ~ 1500 minutes | Amount of time to run the engine. |
| Schedule -> Start Date | 1 ~ 31 | The day of the month and the time for the first exerciser run. This setting is only used to set the first exerciser run. All subsequent exerciser runs use the Repeat Days setting to determine when they should run. |
| Schedule -> Start Hour | 0 ~ 23 | If the date and hour selected is already in the past for the current month then the exerciser will be started on the next month with that date and hour. Also if the date is not yet in the past but the current month does not have that date (e.g. February 21 and a date of 31 is selected) the exerciser will run on the next month to have that date (e.g. 31rst of March) at the hour specified. |
| Schedule -> Repeat Days | 1 ~ 28 days | Number of days between each exerciser cycle. This setting is applied to all subsequent exerciser starts after the first start. |

Exerciser Sequence



If the controller is in the OFF mode, if the emergency stop is activated, or if the start inhibit is active then the exerciser will not run. The event, "Bypass Exerciser", will be logged in the event log and the exerciser will run again at the next scheduled time as determined by the "Repeat Days" setting.

4.5.3 Maintenance

The controller has the ability to count down the time between scheduled maintenance events. Once maintenance is required, the controller will alert the operator via the LCD screen and a switched output (if enabled) wired to a lamp / horn / buzzer. The following settings are used to configure the maintenance timer.

| Name | Range | Description |
|------------------|------------------|--|
| Reset Counter | Enable ~ Disable | Once the maintenance count interval expires, use this setting to reset the time and turn off the switched output (if enabled). |
| Enable Counter | Enable ~ Disable | Enables or disables the maintenance function. |
| Counter Interval | 10 ~ 9990 hours | Determines the number of hours between required maintenance. A switched output can be configured to turn on once the count interval expires. |

To determine the amount of time until the next scheduled maintenance, follow these menu steps:

Main Menu -> Device Info. -> Maintenance


Maintenance counter is disabled if '----' is displayed. A negative number indicates the amount of time since maintenance timer expired.

4.6 AC Monitor

The controller has the ability to monitor AC voltage and current from a generator. The following sections are used to configure settings associated with AC monitoring.

4.6.1 Generator Voltage

The following settings are used to configure the controller's response to voltage measurements.

| Name | Range | Description |
|--------------------------------|---|--|
| Voltage Source | Disable 2-Wire Single 3-Wire Single 3-Wire 3-Phase 4-Wire 3-Phase 4-Wire Delta Auto Selection | The wiring configuration of the generator. Selecting Auto Selection will use the Voltage Select inputs to determine which wiring configuration is implemented and displayed. |
| Scaling Factor | 0.500 ~ 2.500 | Scaling factor at which the voltage is read into the controller. See below for more information. |
| Nominal Volts | 50 ~ 800 VAC* | Voltage at which the generators run when operating under normal running conditions. |
| Auto Nominal -> 1-Phase 3-Wire | 50 ~ 800 VAC* |  *NOTE: 800 VAC applies to software logic only. Do not exceed 600 VAC on the AC Voltage terminals. |
| Auto Nominal -> 3-Phase (1) | 50 ~ 800 VAC* | |
| Auto Nominal -> 3-Phase (2) | 50 ~ 800 VAC* | |
| Auto Nominal -> 3-Phase (3) | 50 ~ 800 VAC* | |
| Auto Ratios -> 1-Phase 3-Wire | 0.500 ~ 2.500 | Scaling Factor when using the Voltage Select inputs. |
| Auto Ratios -> 3-Phase (1) | 0.500 ~ 2.500 | |
| Auto Ratios -> 3-Phase (2) | 0.500 ~ 2.500 | |
| Auto Ratios -> 3-Phase (3) | 0.500 ~ 2.500 | |
| Auto Single | A-C Phase A-B Phase | For 1-Phase 3-Wire when using the Voltage Select inputs. This determines which phases the voltage is read from. |
| V Setpoints -> Low Warning | 50 ~ 99% | Reading at which a warning occurs. |
| V Setpoints -> Low Failure | 50 ~ 99% | Reading at which a failure occurs. |
| V Setpoints -> High Warning | 101 ~ 150% | Reading at which a warning occurs. |
| V Setpoints -> High Failure | 101 ~ 150% | Reading at which a failure occurs. |

Application Note: Scaling Factor

The scaling factor setting can be used to calibrate the AC voltage if there are discrepancies between the reading and the actual value. It can also be used if transformers are used to step up / down the voltage. The scaling factor applies to all phases in a system.

Example: The voltage source is a 3-Wire 3-Phase system with a nominal voltage of 208 VAC. The controller is reading 206.3 VAC but a calibrated multimeter gives 208.3 VAC. Use the formula below to determine the scaling factor.

1. Scaling Factor = Multimeter Reading / Controller Reading
2. Scaling Factor = 208.4 VAC / 206.3 VAC
3. Scaling Factor = 1.010

4.6.2 Generator Frequency

The following settings are used to configure the controller's responses to frequency measurements.

Frequency Settings (in AC Monitor > Genset Freq.)

| Name | Range | Description |
|--|--|---|
| Freq. Source | Nominal 50Hz Nominal 60Hz Auto Selection | This is the wiring configuration of the generator. Selecting Auto Selection will use the Frequency Select input to determine which frequency is used. |
| Setpoints > Low Warn (Under-Frequency Warning) | 20 ~ 99% | Reading at which a warning occurs. |
| Setpoints > Low Fail (Under-Frequency Failure) | 20 ~ 99% | Reading at which a failure occurs. |
| Setpoints > High Warn (Over-Frequency Warning) | 101 ~ 150% | Reading at which a warning occurs. |
| Setpoints > High Fail (Over-Frequency Failure) | 101 ~ 150% | Reading at which a failure occurs. |

4.6.3 Generator Current

The following settings are used to configure the controller response to current measurements.

| Name | Range | Description |
|-----------------------------------|---|---|
| Current Source | Enable ~ Disable | Enables or disables current metering. |
| Turns Ratio | 5 ~ 5000A : 5A | The turns ratio of the current transformers. |
| Scaling Factor | 0.500 ~ 1.250 | Scaling factor at which the voltage is read into the controller. See below for more information. |
| Volt Sel Inputs -> 1-Phase 3-Wire | 5 ~ 5000A : 5A | Rated Amps when using the Voltage Select inputs. |
| Volt Sel Inputs -> 3-Phase (1) | 5 ~ 5000A : 5A | |
| Volt Sel Inputs -> 3-Phase (2) | 5 ~ 5000A : 5A | |
| Volt Sel Inputs -> 3-Phase (3) | 5 ~ 5000A : 5A | |
| Volt Sel Ratios -> 1-Phase 3-Wire | 0.500 ~ 2.250 | Scaling Factor when using the Voltage Select inputs. |
| Volt Sel Ratios -> 3-Phase (1) | 0.500 ~ 2.250 | |
| Volt Sel Ratios -> 3-Phase (2) | 0.500 ~ 2.250 | |
| Volt Sel Ratios -> 3-Phase (3) | 0.500 ~ 2.250 | |
| Setpoints -> Rated Amps | 5 ~ 5000A | Maximum current draw the generator can provide when operating under normal running conditions. |
| Setpoints -> High Warning | 1 ~ 125%, Disable | See Basic Alarms . |
| Setpoints -> High Failure | 1 ~ 125%, Disable | |
| Breaker Trip Failure | Enable ~ Disable | Shuts down the generator if the generator circuit breaker fails to trip. If the Breaker Trip switched output is active - due to IDMT or Load Imbalance - and if after 10s the measured generator current is still above 10% of the Rated Current the generator will shut down. |
| IDMT Mode | Disable; Breaker Trip Shutdown Trip | See IDMT for more information. |
| TDS (Time Dial Setting) | 0.1 ~ 30 | |
| Reset Time | 1 to 600s | |
| Load Imbalance Mode | Disable Breaker Trip Shutdown Trip | See Load Imbalance for more information. |
| Load Imbalance % | 1 ~ 200% | |
| Load Imbalance Delay | 1 ~ 600s | |

| Name | Range | Description |
|----------|--------------------|--|
| Bypass | Disabled, 1 ~ 120s | See Dummy Load for more information. |
| Load On | Disabled, 1 ~ 500A | |
| Load Off | Disabled, 1 ~ 500A | |



4.6.3.1 Basic Alarms

The controller can give a warning and/or shutdown on over current. If **IDMT** is enabled then it overrides the High Failure shutdown but the warning is still active.

| Name | Range | Description |
|---------------------------|----------|---|
| Setpoints -> High Warning | 1 ~ 125% | Reading at which a warning occurs. Percentages based on the Rated Amps value. |
| Setpoints -> High Failure | 1 ~ 125% | Reading at which a failure occurs. Percentages based on the Rated Amps value. |

4.6.3.2 IDMT

Sets an inverse time trip curve for over-current. When set this overrides the [Over Current Failure](#).

| Name | Range | Description |
|-------------------------|--|--|
| IDMT Mode | Disable Breaker Trip Shutdown Trip | <p>Disable: Disables the IDMT feature.</p> <p>Breaker Trip: If IDMT is active the Breaker Trip switched output is activated to switch off the main generator breaker. This is a latching feature. The operator must press the  and  keys to reset the feature.</p> <p>Shutdown Trip: shuts down the engine.</p> |
| TDS (Time Dial Setting) | 0.1 ~ 30 | Sets the slope of the IDMT curve. This controls the sensitivity of the trip to over current. |
| Reset Time | 1 ~ 600 seconds | How long the current must drop and stay below the rated current to reset the IDMT. |

The equation for the IDMT is given as:

$$(t_r)_m = \frac{TDS * 13.5}{\frac{I}{I_s} - 1}$$

Where,

TDS is the time dial setting above.

I_s is the [Rated Current](#) (A).

I is the actual current measured by the controller (A).

(t_r)_m is the trip time in seconds.

For example with a Rated Current of 100A and a TDS of 0.1 the IDMT will trigger in:



0.15s if the actual generator current is 1000A.

1.35s if the actual generator current is 200A.

6.75s if the actual generator current is 120A.

4.6.3.3 Load Imbalance

Load imbalance provides protection against differences in phase currents.

| Name | Range | Description |
|---------------------|--|--|
| Load Imbalance Mode | Disable Breaker Trip Shutdown Trip | <p>Disable: Disables the Load Imbalance feature.</p> <p>Breaker Trip: If Load Imbalance is active the Breaker Trip switched output is activated to switch off the main generator breaker. This is a latching feature. The operator must press the  and  keys to reset the latch.</p> <p>Shutdown Trip: shuts down the engine.</p> |

| Name | Range | Description |
|----------------------|-----------------|---|
| Load Imbalance % | 1 ~ 200% | The percentage of rated current that any phase must exceed the other phases by to trigger a load imbalance. |
| Load Imbalance Delay | 1 ~ 600 seconds | The length of time to allow an imbalance before triggering (trip, shutdown). |

The load imbalance formula is given as:

For three phase:

$$\max\{|I_A - I_B|, |I_A - I_C|, |I_B - I_C|\} > \text{Rated Amps} \times \text{Phase_Imbalance_Threshold}(\%)$$

For single phase:

$$|I_1 - I_2| > \text{Rated Amps} \times \text{Phase_Imbalance_Threshold}(\%)$$

Where,

$I_A, I_B,$ and I_C are the actual current measured by the controller.

Note: Phase Imbalance is the same as load imbalance.

4.6.3.4 Dummy Load

The dummy load feature can be enabled to prevent wet stacking.

| Name | Range | Description |
|----------|---------------------------|--|
| Bypass | Disabled, 1 ~ 120 seconds | The amount of time to delay before applying the dummy load. |
| Load On | Disabled, 1 ~ 500A | The threshold below which the dummy load is applied. There is a 4s debounce time. The bypass time must expire before the load is applied. All phases must drop below this threshold to trigger dummy load. |
| Load Off | Disabled, 1 ~ 500A | The threshold above which the dummy load is removed. Dummy load is turned off if one phase rises above this threshold. |

One of the [switched outputs](#) must also be set to dummy load. The output is only turned on when the engine is running.

4.7 Communications

The controller has the ability to communicate with other systems over communication buses. The following sections relate to settings associated with communications.

4.7.1 CAN Bus (J1939)

For detailed information about J1939 settings and functions please use the J1939 Reference Manual. The manual can be found at www.dynagen.ca/support.

| Name | Range | Description |
|---------------------------|--|--|
| ECM Model | Generic J1939 John Deere JDEC Volvo EMS This is not a complete list. See the J1939 User Manual for the full list. | Choose one of the compatible ECM modules from the list. |
| ECM Communication Failure | Enable ~ Disable | If no CAN messages are received for more than 6 seconds, the controller shuts down the engine. |

| Name | Range | Description |
|-------------------------|-------------------------------------|--|
| DTC Display | Enable ~ Disable | Enables or disables active fault messages (DM1) monitoring. |
| Active DTC Log | Enable ~ Disable | Enables or disables the storing of active faults (DM1). |
| Read Stored DTC | Enable ~ Disable | Enables or disables the ability to request stored fault codes from the ECM (DM2). |
| Auto Power ECM | Enable ~ Disable | When enabled, the fuel relay is enabled in Auto mode so that the ECM is already booted up and initialized before the user decides to start the engine. |
| ECM Power Delay | 5 ~ 30 seconds | Used in conjunction with Auto Power ECM. When the engine shuts down, the controller waits for the time specified by the ECM Power Delay before turning on the fuel relay. This prevents unwanted start ups due to the engine not being completely shut down. |
| Cummins PGNs | Enable ~ Disable | Enables or disables the broadcasting of PGNs required by Cummins engines. |
| SPN Conversion | Version 1 Version 2 Version 3 | Select the SPN conversion method. |
| EMS2B Frequency Select | Primary Secondary | For Volvo EMS2B Engine Control Modules only. |
| EMS2B Accelerator Pedal | 40.0 ~ 60.0% | For Volvo EMS2B Engine Control Modules only. |

4.7.2 MOD Bus (RS485)

The Modbus functionality on the controller provides interface ability to PLCs, SCADA and building management systems. For detailed information about the Modbus registers and their interpretations please use the Modbus Reference Manual. The manual can be found at www.dynagen.ca/support.

| Name | Description | Range / Values |
|------------------------------|---|---------------------------|
| Device Address | The device address of the controller. | 1 ~ 247 |
| Baud Rate (BPS) | The speed at which the controller (slave) communicates with the master. | 9600, 19200, 38400, 57400 |
| Communication Protocol | The controller always communicates in Modbus RTU. | Modbus RTU (Fixed) |
| Slave / Master Configuration | The controller is always the slave and must be queried by the master. | Slave (Fixed) |

5 Troubleshooting

If you are having issues with your controller, please refer to the table below for a solution before contacting technical support.

| Issue | Solution |
|--|---|
| Engine starts but the crank output does not turn off | The controller is not receiving a speed signal. 1. Verify the Sensors -> Engine Speed -> Signal Source setting is set correctly. 2. Verify the Timers -> Engine Logic -> RPM Disconnect setting is set correctly. 3. Ensure the correct wiring to the controller. For magnetic pickup, Speed Sensing A and B terminals are used. For generator voltage, the AC voltage connections are used. |
| Sensor always displays its lowest or highest value | The sensor could either be open (not connected) or shorted to ground. Verify your connections and ensure the correct sender table is loaded. |

Contacting DYNAGEN can be done by any of the methods below. Technical support is offered Monday - Friday, 8:00am - 4:00pm (EST). If you are unable to contact one of our engineers, please leave a message and they will return your call as soon as possible.

| Type | Information |
|--------------|--|
| Website | www.dynagen.ca/support |
| Email | support@dynagen.ca |
| Phone Number | (902) 406-0133 |
| Twitter | @DynaGenTech |
| Facebook | www.facebook.com/DYNAGEN |
| Address | 3 Spectacle Lake Drive, Unit B105 Dartmouth, NS B3B1W8, Canada |