Cascade CD101 Auto-Start Controller
Installation and Operations Manual Version: 2.00

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Effective 10-07
Section 40 & 75

Please read the following information before installing. A visual inspection of this product for damage during shipping is recommended before mounting. It is your responsibility to have a qualified person install this unit and make sure it conforms to NEC and local codes.

GENERAL INFORMATION

WARNING

BEFORE BEGINNING INSTALLATION OF THIS MURPHY PRODUCT

- ✔ Disconnect all electrical power to the machine.
- ✔ Make sure the machine cannot operate during installation.
- ✔ Follow all safety warnings of the machine manufacturer.
- ✔ Read and follow all installation instructions.

Description

The Cascade controller offers automatic start/stop control with easy configuration for a broad number of engine driven applications.

Specifications

Power input: 9-35VDC continuous - operates during total blackout for 2 sec. min.
Power consumption: Sleep Mode (Manual): 1mA typical;(Automatic) 4mA typical. Running Mode (Manual): 20mA typical; (Automatic): 24mA typical.
Operating/Storage temperature: -40 to 85°C; (-40 to 185°F).
Humidity: 0-100%, non-condensing.
Housing: UV stabilized black polycarbonate and epoxy encapsulation. Weather tight and includes sealing gasket to keep moisture and debris out of enclosure. Properly mounted controller will maintain NEMA4 / IP65 rating of enclosure.
Vibration: Rated to 6G.
Impact: Rated to 10G.
Inputs: Dedicated digital inputs for low oil pressure, high engine temperature, remote start, DC charge fail/Alternator fail. Two aux inputs are configurable for multiple functions.
Outputs: 7 – 4 auxiliary, configurable (1A DC protected). 3 dedicated outputs for Crank, Fuel/ECU, Alternator excitation.
Crank attempts: 3, 5, 10, Continuous.
Crank Rest: 5-60 seconds, adjustable.
Shutdown lockout time delay: 5, 10, 15, 20, 25, 30 seconds.
Crank disconnect speed setting: Field settable 0-9999 RPM (16-60Hz AC freq input).
Overspeed/underspeed trip point setting: ±5 to 50% of nominal.
Speed sensing inputs: Magnetic pickup (5-120VAC RMS / 0-10 kHz) & AC frequency (30-600VAC RMS / 16-80 Hz).
CANbus interface: Directly reads engine speed, & engine status data* from SAE-J1939 enabled engines.
MODbus interface: In J1939 applications drives PVA series analog gages
**Engine status data limited to low oil pressure, high engine temperature, "Wait to start" status, Warning & Fault lamp information, and communication error.*

To Install, You Will Need:

#2 Phillips (cross head) head screwdriver
Nut driver to fit #6-32x1/2" machine nuts
Wire for hook-up (rising cage clamp suitable for 14-24 gage wire).

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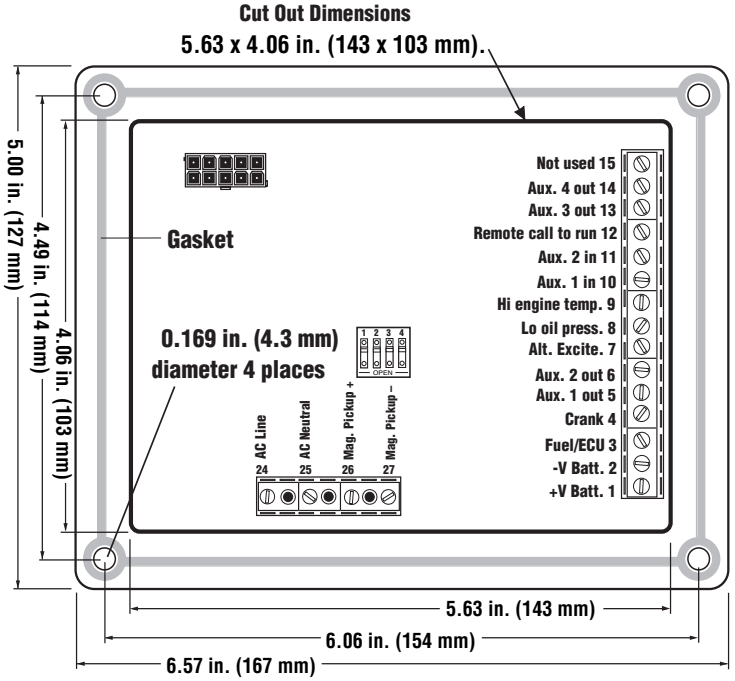
Mounting the Cascade

Cut a 5.63 x 4.06 in. (143 x 103mm) mounting hole, and drill four 0.169 in.(4.3 mm) diameter holes for the mounting screws. See Schematic below:



Recommended Wiring Practices

Warning: The CASCADE is designed for pilot-duty use and its outputs are for control only. Wire the CASCADE controller with 18 gage stranded wire.
Important: For applications involving automatic start equipment, we strongly recommend the installation of an appropriate Emergency Stop device.

1. To help prevent electrical noise and voltage drop to the controller during cranking and preheat, wire the controller DC power connections directly to the cranking battery. This will also help improve "Low battery" starting capability.
2. When using a battery charger, it should be connected directly to the battery to help prevent electrical noise which could cause an engine ECU or associated equipment to operate erratically.
3. Never route low voltage DC wiring in the same conduit as high voltage AC wiring. Noise from electrical loads such as motors and variable frequency drives can be coupled into the engine ECU, governor, or associated equipment and may cause erratic operation.
4. Always use twisted shielded pair wires for the magnetic pickup wiring. Ground one end of the shield only.
5. In spark ignited engine applications, always use resistive spark plugs and spark plug wires, as these greatly reduce the amount of radiated noise.
6. Always place a snubbing diode (sometimes also called an anti-flyback, anti-kick-back or reverse bias diode) directly across any inductive load. This helps eliminate a common source of electrical noise, as well as increases the operating lifetime of any solid state output.
7. Always use twisted shielded pair communications wiring for RS-485, and SAE standard wire for J1939. Make sure that terminating resistors (if required) have the correct rating and are installed properly.

LED Status Lights

Eleven LEDs separated into two banks (see "**Fig. 1**") are provided on the faceplate. The LEDs Bank 1 includes 6 LEDs and Bank 2 includes 5. In Setup mode, these banks form a binary code to indicate either the controller setup configuration or error status, which is indicated by the last 8 (red) LEDs. Refer to Tables 1, 2, 3 and 4 for configuration and status listings.

One LED is located next to the "AUTO" button to indicate that the controller is waiting for the remote start input to become active.

The LED status light are (from top to bottom) see "**Fig. 1**":

Engine running - If the green LED is ON, then the unit is receiving a speed signal, indicating that the engine is above the crank cut speed.

ECU status - If the green LED is on solid, it indicates that in a J1939 application the ECU and the unit are communicating properly. If the LED is blinking slowly the ECU is broadcasting a "wait to start" message. If the LED is blinking fast, the ECU is NOT communicating properly.

Remote Start/ Crank Rest - If the green LED is on, then the remote start input is active and if the system is in AUTO mode, it will try to start. If the LED is blinking, the crank cycle has ended and is now in crank rest cycle.

Low oil pressure - If the red LED is on, the controller has caused the engine to shutdown and lockout. If the LED is blinking, the engine ECU has transmitted a SPN for an oil pressure related condition.

High Engine Temperature - If the red LED is on, the controller has caused the engine to shutdown and lockout. If the LED is blinking, the engine ECU has transmitted a SPN for an engine temperature related condition.

Overspeed - If the red LED is on, the controller has caused the engine to shutdown and lock out due to engine speed exceeding the setpoint.

Underspeed - If the red LED is on, the controller has caused the engine to shutdown and lock out due to engine speed falling below the minimum needed for proper operation.

Overcrank - If the red LED is on, the controller has exceeded the set number of start attempts without receiving a valid speed signal indicating that engine speed is above crank disconnect. This causes the engine to shutdown and lockout.

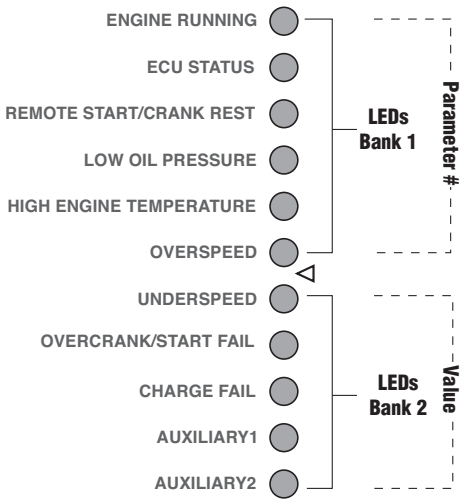
Charge Fail - If the red LED is on it indicates that the battery charging alternator is not charging the cranking batteries, or that the battery charger fail output is on.

Aux 1 - If the red LED is on it indicates that this custom-configured input is active. On an ECU (ECM) equipped engine, if this LED is blinking slowly, it indicates that one or more engine parameters are near exceeding engine manufacturer's setpoints. If the LED is blinking fast, it indicates that one or more engine parameters have exceeded setpoints, the ECU has issued a fault - and most likely the engine has shut down.

Aux 2 - If the red LED is on it indicates that this custom-configured input is active.

Overspeed & Underspeed - If these two LED's are both blinking, the controller has lost its speed signal.

Fig. 1 **LED's**



Setting Up the Cascade

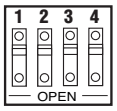


Fig. 2

- To enter the **SETUP MODE** first remove DC power to the Cascade controller for approximately 10 seconds.
- On the back of the controller are four DIP switches, set switch #1 to ON (see schematic at right) then restore DC power. The AUTO mode LED will blink to indicate that the Cascade is in the **SETUP MODE**.
- When in the "SETUP" mode, pressing the "MAN" (Manual) button steps up thru the entire list of parameters. The pattern of the top six LEDs, **LEDs Bank 1** (see "**Fig. 1**"), is used to indicate which parameter is selected. The pattern will change once each time the "MAN" button is pressed.
- Pressing the "OFF" button steps up thru all the available values for each parameter. The pattern of the bottom five LEDs, **LEDs Bank 2** (see "**Fig. 1**"), is used to indicate which value is selected. The pattern will change once each time the OFF button is pushed.
- Pressing the "AUTO" button stores the displayed value.
- If any value is changed, it will blink until stored, except a value of zero. If any value is changed but not stored, and then the parameter is changed, the value will still be what was shown originally.
- If you accidentally go past a desired parameter or value, you can step back by pressing the down arrow button.
- The parameter/value list and corresponding LED indication are shown on Table 1.

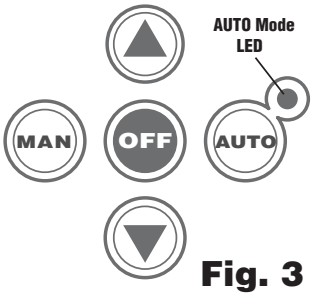


Fig. 3

- When you are finished with setup, set switch #1 to in the Normal Operating Position (OPEN), remove DC power for 10 seconds, then restore DC power.

Operating the Cascade

When power is first applied, all LEDs will flash indicating a Lamp Test function.

- To manually start the engine, press the "MAN" (Manual) button. The controller will initiate a normal start sequence.
- To manually stop the engine (or turn off the controller) press the "OFF" button.
- To place the controller in automatic mode, press the button labeled "AUTO". The LED next to the "AUTO" button should come on to indicate that the controller is waiting for the remote start input to become active to initiate a start sequence.
- To reset the controller, press the "OFF" button. Then correct the cause of the shutdown. This will clear all faults except when the aux inputs are programmed for either shutdown immediate or warning immediate, or if the engine ECU is broadcasting a shutdown fault.

In the event of a fault that causes the engine to shutdown, the cause of the event will be indicated on one of the 11 status lights on the right hand side of the controller. When the cause of shutdown is corrected,the controller can resume normal operation.

Modes of Operation

Setup Mode (See "Setting Up The Cascade" section, above and "**Table 1**").

Normal Operating Mode (Engine Control Mode)

The DIP switch #1 must be in the open position in order to enter this mode upon power up. The "**Table** 2" shows the meaning of each LED state for this mode.

Error Mode

Upon power up, when the DIP switch #1 is in the Normal Operating Position (open position) and an error is detected in the user configuration, the Error mode will be accessed. The LEDs will Blink Fast indicating the error. To correct the errors before the unit can operate in Engine Control mode, the user will need to go back to Setup mode. "**Tables 3 and 4**" show the meaning of each LED state and configuration for the Error mode.

Table 1. Parameter Values and Corresponding LED Indication

LEDs shown here form a binary code indicating the configuration value. Shown from Top to bottom the LEDs read from Left to Right (see Fig.1). A filled dot means LED is ON.

Parameter # Description	LED Bank 1	Value (*= default)	LED Bank 2
1 Engine Speed Source	○○○○○●	Magnetic Pickup*	○○○○○
		Generator AC	○○○○●
		J1939 (ECU)	○○○●○
2 Crank Attempts	○○○○●○	3*	○○○○○
		5	○○○○●
		10	○○○●○
		Continuous	○○○●●
3 Crank Timer	○○○○●●	5 Sec	○○○○○
		10 Sec	○○○○●
		15 Sec*	○○○●○
		20 Sec	○○○●●
		25 Sec	○○●○○
		30 Sec	○○●○●
		45 Sec	○○●●○
		60 Sec	○○●●●
4 Crank Rest Timer	○○○●○○	5 Sec	○○○○○
		10 Sec	○○○○●
		15 Sec*	○○○●○
		20 Sec	○○○●●
		25 Sec	○○●○○
		30 Sec	○○●○●
		45 Sec	○○●●○
		60 Sec	○○●●●
5 Start Delay Timer (auto mode only)	○○○●○●	0 Sec*	○○○○○
		5 Sec	○○○○●
		10 Sec	○○○●○
		15 Sec	○○○●●
		30 Sec	○○●○○
		60 Sec	○○●○●
6 Stop Delay Timer (auto mode only)	○○○●●○	0 Sec*	○○○○○
		5 Sec	○○○○●
		10 Sec	○○○●○
		15 Sec	○○○●●
		30 Sec	○○●○○
		60 Sec	○○●○●
7 Preheat Timer	○○○●●●	0 Sec*	○○○○○
		5 Sec	○○○○●
		10 Sec	○○○●○
		15 Sec	○○○●●
		20 Sec	○○●○○
		25 Sec	○○●○●
		30 Sec	○○●●○
		45 Sec	○○●●●
		60 Sec	○●○○○
8 Extended Preheat during Crank (only used if preheat timer is also set to a non-zero value) (must be less than or equal to crank timer)	○○●○○○	0 Sec*	○○○○○
		5 Sec	○○○○●
		10 Sec	○○○●○
		15 Sec	○○○●●
		20 Sec	○○●○○
		25 Sec	○○●○●
		30 Sec	○○●●○
		45 Sec	○○●●●
		60 Sec	○●○○○
9 Warmup Timer	○○●○○●	0 min.*	○○○○○
		1 min.	○○○○●
		5 min.	○○○●○
		10 min.	○○○●●
10 Cooldown Timer	○○●○●○	0 min.*	○○○○○
		1 min.	○○○○●
		5 min.	○○○●○
		10 min.	○○○●●
11 Bypass Timer	○○●○●●	0 Sec	○○○○○
		5 Sec	○○○○●
		10 Sec*	○○○●○
		15 Sec	○○○●●
		20 Sec	○○●○○
		25 Sec	○○●○●
		30 Sec	○○●●○
12 Energize to Stop Timer	○○●●○○	15 Sec*	○○○○○
		30 Sec	○○○○●

Parameter # Description	LED Bank 1	Value (*= default)	LED Bank 2
13 Aux Input Bypass Timer	○○●●○●	30 Sec*	○○○○○
		1 Min	○○○○●
		2 Min	○○○●○
		3 Min	○○○●●
		4 Min	○○●○○
		5 Min	○○●○●
		6 Min	○○●●○
		7 Min	○○●●●
		8 Min	○●○○○
		9 Min	○●○○●
		10 Min	○●○●○
		15 Min	○●○●●
		20 Min	○●●○○
		25 Min	○●●○●
		30 Min	○●●●○
		35 Min	○●●●●
		40 Min	●○○○○
		45 Min	●○○○●
		50 Min	●○○●○
		55 Min	●○○●●
		1 Hr	●○●○○
14 Cranking Motor Abutment Protection Delay (Current crank attempt is aborted if an RPM greater than 10 is not detected after this delay from start of crank has expired) (MPU and J1939 speed source only)	○○●●●○	Disabled*	○○○○○
		1.00 s	○○○○●
		1.25 s	○○○●○
		1.50 s	○○○●●
		1.75 s	○○●○○
		2.00 s	○○●○●
		2.25 s	○○●●○
		2.50 s	○○●●●
		2.75 s	○●○○○
		3.00 s	○●○○●
		3.25 s	○●○●○
		3.50 s	○●○●●
		3.75 s	○●●○○
		4.00 s	○●●○●
		4.25 s	○●●●○
		4.50 s	○●●●●
		4.75 s	●○○○○
		5.00 s	●○○○●
15 Remote Start Signal Type	○○●●●●	Maintained*	○○○○○
		Momentary	○○○○●
16 Digital Input 1	○●○○○○	Lo Oil Press (Open/Fault)	○○○○○
		Lo Oil Press (Close/Fault)*	○○○○●
17 Digital Input 2	○●○○○●	Hi Eng Temp (Open/Fault)	○○○○○
		Hi Eng Temp (Close/Fault)*	○○○○●
18 Digital Input 3 (Auxiliary Input 1)	○●○○●○	Not Used*	○○○○○
		Winter/Summer	○○○○●
		Momentary Stop	○○○●○
		Immediate Warning	○○○●●
		Delayed Warning	○○●○○
		Immediate Shutdown	○○●○●
		Delayed Shutdown	○○●●○
		Delayed Aux Input Shtdwn	○○●●●
		Run/Idle (Line Fill)	○●○○○
		Auxiliary Crank Disconnect	○●○○●
		Remote Reset (Clear Faults)	○●○●○
19 Digital Input 4 (Auxiliary Input 2)	○●○○●●	Not Used*	○○○○○
		Winter/Summer	○○○○●
		Momentary Stop	○○○●○
		Immediate Warning	○○○●●
		Delayed Warning	○○●○○
		Immediate Shutdown	○○●○●
		Delayed Shutdown	○○●●○
		Delayed Aux Input Shtdwn	○○●●●
		Run/Idle (Line Fill)	○●○○○
		Auxiliary Crank Disconnect	○●○○●
		Remote Reset (Clear Faults)	○●○●○
22 Fuel Relay Control (non ECU Engines) Note: On ECU engines, fuel relay is used for ECU power	○●○●●○	Energized to Run*	○○○○○
		Energized to Stop	○○○○●

Table 1. Parameter Values and Corresponding LED Indication *(continued)*

LEDs shown here form a binary code indicating the configuration value. Shown from Top to bottom the LEDs read from Left to Right (see Fig.1). A filled dot means LED is ON.

Parameter # Description	LED Bank 1	Value (*= default)	LED Bank 2
23 Auxiliary Output 1	○●○●●●	Not Used*	○○○○○
		Warmup	○○○○●
		Cooldown	○○○●○
		Warmup/Cooldown	○○○●●
		Preheat	○○●○○
		Engine Running	○○●○●
		At Load	○○●●○
		Lo Oil Press Shutdown	○○●●●
		Hi Eng Temp. Shutdown	○●○○○
		Overspeed Shutdown	○●○○●
		Overcrank Shutdown	○●○●○
		Alternator Fail/Battery	
		High/Low/Weak	○●○●●
		Engine Speed Up	○●●○○
		Engine Speed Down	○●●○●
		Common Alarm	○●●●○
		Controller in	
		AUTO mode	○●●●●
		Shutdown	●○○○○
		Loss of Speed	
		Signal Fault	●○○○●
		Underspeed Fault	●○○●○
24 Auxiliary Output 2	○●●○○○	Not Used*	○○○○○
		Warmup	○○○○●
		Cooldown	○○○●○
		Warmup/Cooldown	○○○●●
		Preheat	○○●○○
		Engine Running	○○●○●
		At Load	○○●●○
		Lo Oil Press Shutdown	○○●●●
		Hi Eng Temp. Shutdown	○●○○○
		Overspeed Shutdown	○●○○●
		Overcrank Shutdown	○●○●○
		Alternator Fail/Battery	
		High/Low/Weak	○●○●●
		Engine Speed Up	○●●○○
		Engine Speed Down	○●●○●
		Common Alarm	○●●●○
		Controller in	
		AUTO mode	○●●●●
		Shutdown	●○○○○
		Loss of Speed	
		Signal Fault	●○○○●
		Underspeed Fault	●○○●○
25 Auxiliary Output 3	○●●○○●	Not Used*	○○○○○
		Warmup	○○○○●
		Cooldown	○○○●○
		Warmup/Cooldown	○○○●●
		Preheat	○○●○○
		Engine Running	○○●○●
		At Load	○○●●○
		Lo Oil Press Shutdown	○○●●●
		Hi Eng Temp. Shutdown	○●○○○
		Overspeed Shutdown	○●○○●
		Overcrank Shutdown	○●○●○
		Alternator Fail/Battery	
		High/Low/Weak	○●○●●
		Engine Speed Up	○●●○○
		Engine Speed Down	○●●○●
		Common Alarm	○●●●○
		Controller in	
		AUTO mode	○●●●●
		Shutdown	●○○○○
		Loss of Speed	
		Signal Fault	●○○○●
		Underspeed Fault	●○○●○
26 Auxiliary Output 4	○●●○●○	Not Used*	○○○○○
		Warmup	○○○○●
		Cooldown	○○○●○
		Warmup/Cooldown	○○○●●
		Preheat	○○●○○
		Engine Running	○○●○●
		At Load	○○●●○

Parameter # Description	LED Bank 1	Value (*= default)	LED Bank 2
		Lo Oil Press Shutdown	○○●●●
		Hi Eng Temp. Shutdown	○●○○○
		Overspeed Shutdown	○●○○●
		Overcrank Shutdown	○●○●○
		Alternator Fail/Battery	
		High/Low/Weak	○●○●●
		Engine Speed Up	○●●○○
		Engine Speed Down	○●●○●
		Common Alarm	○●●●○
		Controller in	
		AUTO mode	○●●●●
		Shutdown	●○○○○
		Loss of Speed	
		Signal Fault	●○○○●
		Underspeed Fault	●○○●○
28 Initial Power-Up Mode	○●●●○○	Power-Up in Manual*	○○○○○
		Power-Up in Automatic	○○○○●
29 Oil Pressure Crank Disconnect Delay (non-ECU engines only)	○●●●○●	Not Used*	○○○○○
		0 s	○○○○●
		0.25 s	○○○●○
		0.50 s	○○○●●
		0.75 s	○○●○○
		1.00 s	○○●○●
		1.25 s	○○●●○
		1.50 s	○○●●●
		1.75 s	○●○○○
		2.00 s	○●○○●
		2.25 s	○●○●○
		2.50 s	○●○●●
		2.75 s	○●●○○
		3.00 s	○●●○●
		3.25 s	○●●●○
		3.50 s	○●●●●
		3.75 s	●○○○○
		4.00 s	●○○○●
		4.25 s	●○○●○
		4.50 s	●○○●●
		4.75 s	●○●○○
		5.00 s	●○●○●
30 Nominal Generator Frequency (genset only)	○●●●●○	50 Hz	○○○○○
		60 Hz*	○○○○●
31 Crank Disconnect Freq (Generator AC speed source only) (10's digit)	○●●●●●	0	○○○○○
		1	○○○○●
		2*	○○○●○
		3	○○○●●
		4	○○●○○
		5	○○●○●
		6	○○●●○
32 Crank Disconnect Freq. (Generator AC speed source only) (1's digit)	●○○○○○	0*	○○○○○
		1	○○○○●
		2	○○○●○
		3	○○○●●
		4	○○●○○
		5	○○●○●
		6	○○●●○
		7	○○●●●
		8	○●○○○
		9	○●○○●
33 Crank Disconnect RPM (ECU or MPU speed source only) (1000's digit)	●○○○○●	0*	○○○○○
		1	○○○○●
		2	○○○●○
		3	○○○●●
		4	○○●○○
		5	○○●○●
		6	○○●●○
		7	○○●●●
		8	○●○○○
		9	○●○○●
34 Crank Disconnect RPM (ECU or MPU speed source only)	●○○○●○	0	○○○○○
		1	○○○○●
		2	○○○●○

Table 1. Parameter Values and Corresponding LED Indication *(continued)*

LEDs shown here form a binary code indicating the configuration value. Shown from Top to bottom the LEDs read from Left to Right (see Fig.1). A filled dot means LED is ON.

Parameter # Description	LED Bank 1	Value (*= default)	LED Bank 2
(100's digit)		3	○○○●●
		4	○○●○○
		5*	○○●○●
		6	○○●●○
		7	○○●●●
		8	○●○○○
		9	○●○○●
35 Crank Disconnect RPM (ECU or MPU speed source only) (10's digit)	●○○○●●	0	○○○○○
		1	○○○○●
		2	○○○●○
		3	○○○●●
		4*	○○●○○
		5	○○●○●
		6	○○●●○
		7	○○●●●
		8	○●○○○
		9	○●○○●
36 Crank Disconnect RPM (ECU or MPU speed source only) (1's digit)	●○○●○○	0*	○○○○○
		1	○○○○●
		2	○○○●○
		3	○○○●●
		4	○○●○○
		5	○○●○●
		6	○○●●○
		7	○○●●●
		8	○●○○○
		9	○●○○●
37 Overspeed Setpoint (% above run speed)	●○○●○●	5%	○○○○○
		10%*	○○○○●
		15%	○○○●○
		20%	○○○●●
		25%	○○●○○
		30%	○○●○●
		35%	○○●●○
		40%	○○●●●
		45%	○●○○○
		50%	○●○○●
38 Underspeed Setpoint (% below run speed	●○○●●○	5%	○○○○○
		10%	○○○○●
		15%	○○○●○
		20%*	○○○●●
		25%	○○●○○
		30%	○○●○●
		35%	○○●●○
		40%	○○●●●
		45%	○●○○○
		50%	○●○○●
39 Underspeed Response	●○○●●●	None	○○○○○
		Warning*	○○○○●
		Shutdown	○○○●○
40 Lo Oil Press Shutdown Setpoint (ECU eng. only)	●○●○○○	Disabled (no shutdown)	○○○○○
		0 PSI	○○○○●
		5 PSI	○○○●○
		10 PSI	○○○●●
		15 PSI	○○●○○
		20 PSI	○○●○●
		25 PSI	○○●●○
		30 PSI*	○○●●●
		35 PSI	○●○○○
		40 PSI	○●○○●
		45 PSI	○●○●○
		50 PSI	○●○●●
		55 PSI	○●●○○
		60 PSI	○●●○●
41 Hi Eng Temp. Shutdown Setpoint (ECU engines only)	●○●○○●	Disabled (no shutdown)	○○○○○
		190 deg F	○○○○●
		195 deg F	○○○●○
		200 deg F	○○○●●
		205 deg F	○○●○○
		210 deg F	○○●○●
		215 deg F	○○●●○
		220 deg F	○○●●●
		225 deg F	○●○○○
		230 deg F*	○●○○●
		235 deg F	○●○●○
		240 deg F	○●○●●
		245 deg F	○●●○○
		250 deg F	○●●○●
42 Lo Batt Voltage Setpoint.	●○●○●○	Warning Disabled	○○○○○
		8.5V	○○○○●
		9.0V	○○○●○
		9.5V	○○○●●
		10.0V	○○●○○
		10.5V*	○○●○●
		11.0V	○○●●○
		11.5V	○○●●●
		18.0V	○●○○○
		19.0V	○●○○●
		20.0V	○●○●○
		21.0V	○●○●●
		22.0V	○●●○○
		22.5V	○●●○●
		23.0V	○●●●○
		23.5V	○●●●●
43 Hi Batt Voltage Setpoint.	●○●○●●	Warning Disabled	○○○○○
		12.5V	○○○○●
		13.0V	○○○●○
		13.5V	○○○●●
		14.0V	○○●○○
		14.5V*	○○●○●
		15.0V	○○●●○
		16.0V	○○●●●
		24.5V	○●○○○
		25.0V	○●○○●
		25.5V	○●○●○
		26.0V	○●○●●
		26.5V	○●●○○
		27.0V	○●●○●
		28.0V	○●●●○
		29.0V	○●●●●
		30.0V	●○○○○
		31.0V	●○○○●
44 Weak Battery Voltage Setpoint	●○●●○○	Warning disabled	○○○○○
		6.0 V	○○○○●
		6.5 V	○○○●○
		7.0 V	○○○●●
		7.5 V	○○●○○
		8.0 V	○○●○●
		8.5 V	○○●●○
		9.0 V	○○●●●
		9.5 V	○●○○○
		10.5 V*	○●○○●
		12.0 V	○●○●○
		13.0 V	○●○●●
		14.0 V	○●●○○
		15.0 V	○●●○●
		16.0 V	○●●●○
		17.0 V	○●●●●
		18.0 V	●○○○○
		19.0 V	●○○○●
		20.0 V	●○○●○
48 Flywheel Tooth Count (MPU speed source only) (100's digit)	●●○○○○	0	○○○○○
		1*	○○○○●
		2	○○○●○
		3	○○○●●
49 Flywheel Tooth Count (MPU speed source only) (10's digit)	●●○○○●	0	○○○○○
		1	○○○○●
		2	○○○●○
		3	○○○●●
		4	○○●○○
		5	○○●○●
		6*	○○●●○
		7	○○●●●
		8	○●○○○
		9	○●○○●

Parameter #	Description	LED Bank 1	Value (*= default)	LED Bank 2
50	Flywheel Tooth Count (MPU speed source only) (1's digit)	●●○○●○	0 1 2 3 4 5 6 7 8* 9	○○○○○ ○○○○● ○○○●○ ○○○●● ○○●○○ ○○●○● ○○●●○ ○○●●● ○●○○○ ○●○○●
51	Run Speed (ECU or MPU speed source only) (1000's digit)	●●○○●●	0 1* 2 3 4	○○○○○ ○○○○● ○○○●○ ○○○●● ○○●○○
52	Run Speed (ECU or MPU speed source only) (100's digit)	●●○●○○	0 1 2 3 4 5 6 7 8* 9	○○○○○ ○○○○● ○○○●○ ○○○●● ○○●○○ ○○●○● ○○●●○ ○○●●● ○●○○○ ○●○○●

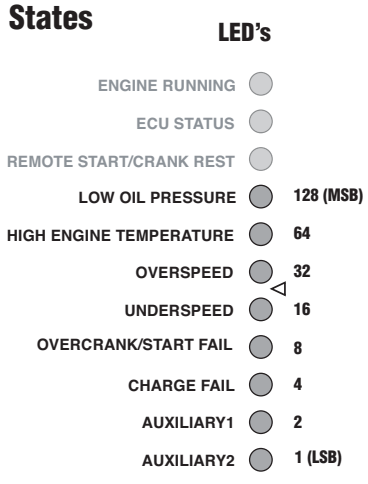
Parameter #	Description	LED Bank 1	Value (*= default)	LED Bank 2
53	Run Speed (ECU or MPU speed source only) (10's digit)	●●○●○●	0* 1 2 3 4 5 6 7 8 9	○○○○○ ○○○○● ○○○●○ ○○○●● ○○●○○ ○○●○● ○○●●○ ○○●●● ○●○○○ ○●○○●
54	Run Speed (ECU or MPU speed source only) (1's digit)	●●○●●○	0* 1 2 3 4 5 6 7 8 9	○○○○○ ○○○○● ○○○●○ ○○○●● ○○●○○ ○○●○● ○○●●○ ○○●●● ○●○○○ ○●○○●
59	Fault Code SPN Conversion Method (ECU Eng. only) **Note:** if the ECU is using version 4, any of these options will work.	●●●○●●	Version 1 & 4 * Version 2 & 4 Version 3 & 4	○○○○○ ○○○○● ○○○●○

NOTE: Not all configuration parameters are used. Some are skipped because they are reserved for future expansion.

Table 2. LED States for Normal Operating Mode

LED	OFF	ON	Slow Blink	Fast Blink
AUTO	Manual Start Mode	Auto Start Mode		
Engine Running	Engine is not Running	Engine is Running		
ECU Status	Non-ECU configuration	Valid CAN Activity (no errors, Error Active state)	Wait-to-Start	Bus Off/Error Passive/Failed Address Claim
Remote Start/Crank Rest	Remote start input is inactive and manual start has not been initiated	Remote Start active	In Crank Rest or one of the prestart states (startdelay, preheat, waitecu, wait rpm)	
Low Oil Pressure	Pressure is above setpoint or low oil pressure input is inactive	Pressure is below setpoint or low oil pressure input active	Fault code SPN 100 received AND ECU warning/shutdown active	No pressure data (ECU only)
High Engine Temperature	Temperature is below setpoint or high engine temperature input is inactive	Temperature is above setpoint or high engine temperature input is active	Fault code SPN 110 received AND ECU warning/shutdown active	No temperature data (ECU only)
Overspeed	Engine speed below overspeed setpoint	Engine speed above overspeed setpoint		No speed data (ECU) or loss of speed (non-ECU)
Underspeed	Engine speed above underspeed setpoint	Engine speed below underspeed setpoint		No speed data (ECU) or loss of speed (non-ECU)
Overcrank/Start Fail	Failure to start has not occurred	Overcrank start failure (crank attempts exceeded)	Start Condition Failure (RPM not below 10 or crank disconnect input is on before attempting crank)	Start Condition Failure (ECU-related) CAN Hw Bus Error preventing start
Charge Fail	Alternator warning lamp terminal voltage is above threshold or charge fail input is inactive	Alternator warning lamp terminal voltage is below threshold or charge fail input is active	Battery Voltage is below low voltage warning setpoint	Battery Voltage is above high voltage warning setpoint
Auxiliary 1	Auxiliary input 1 is inactive	Auxiliary input 1 is active	ECU Warning (malfunction or Amber lamps on)	ECU Shutdown (Red Stop or Protect lamps on)
Auxiliary 2	Auxiliary input 2 is inactive	Auxiliary input 2 is active		

Table 3. Error Codes LED States



Obtain the error code parameter by adding all lit LED'S. See Table 1 for the corresponding parameter.

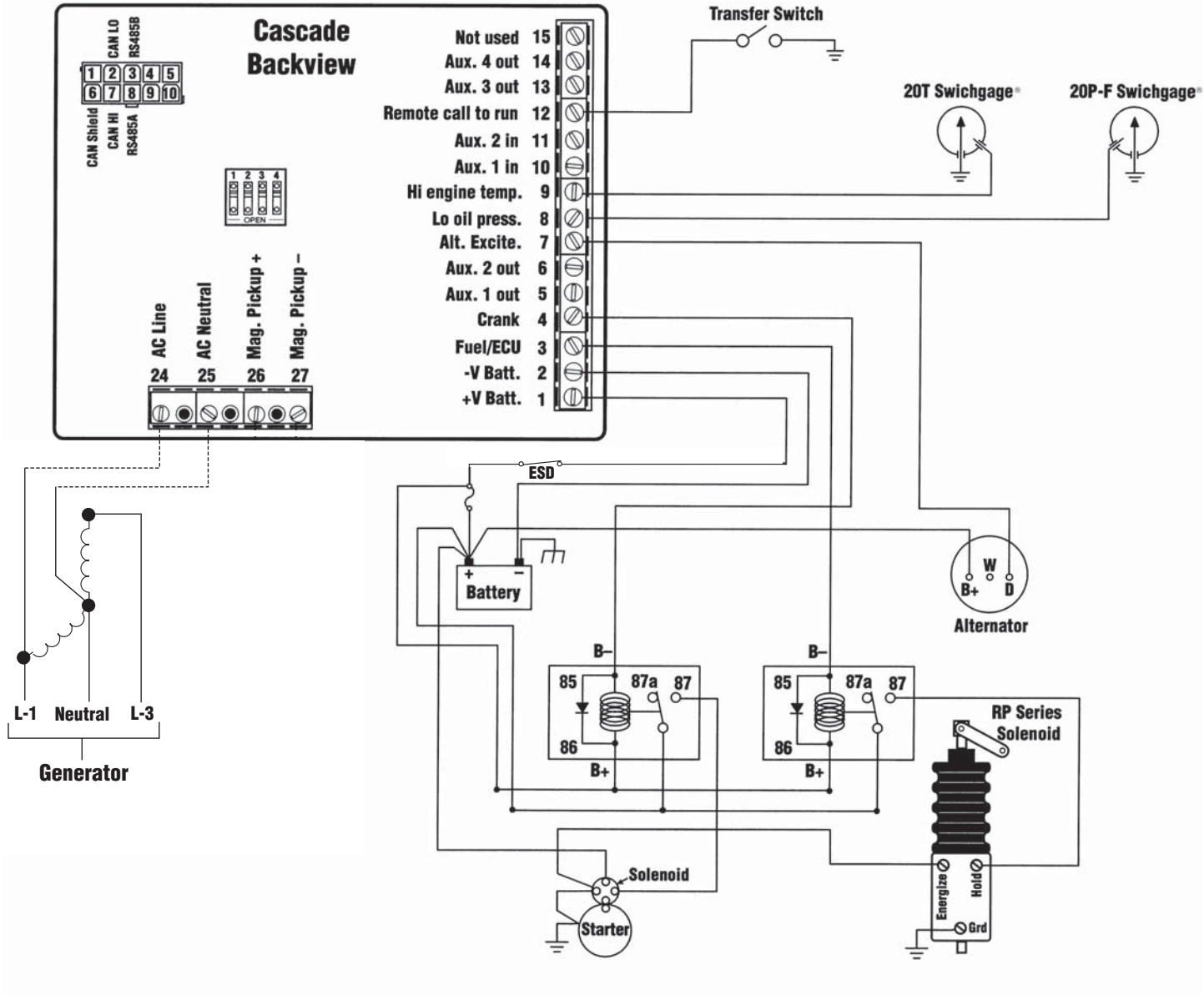
Table 4. Configuration Error Codes

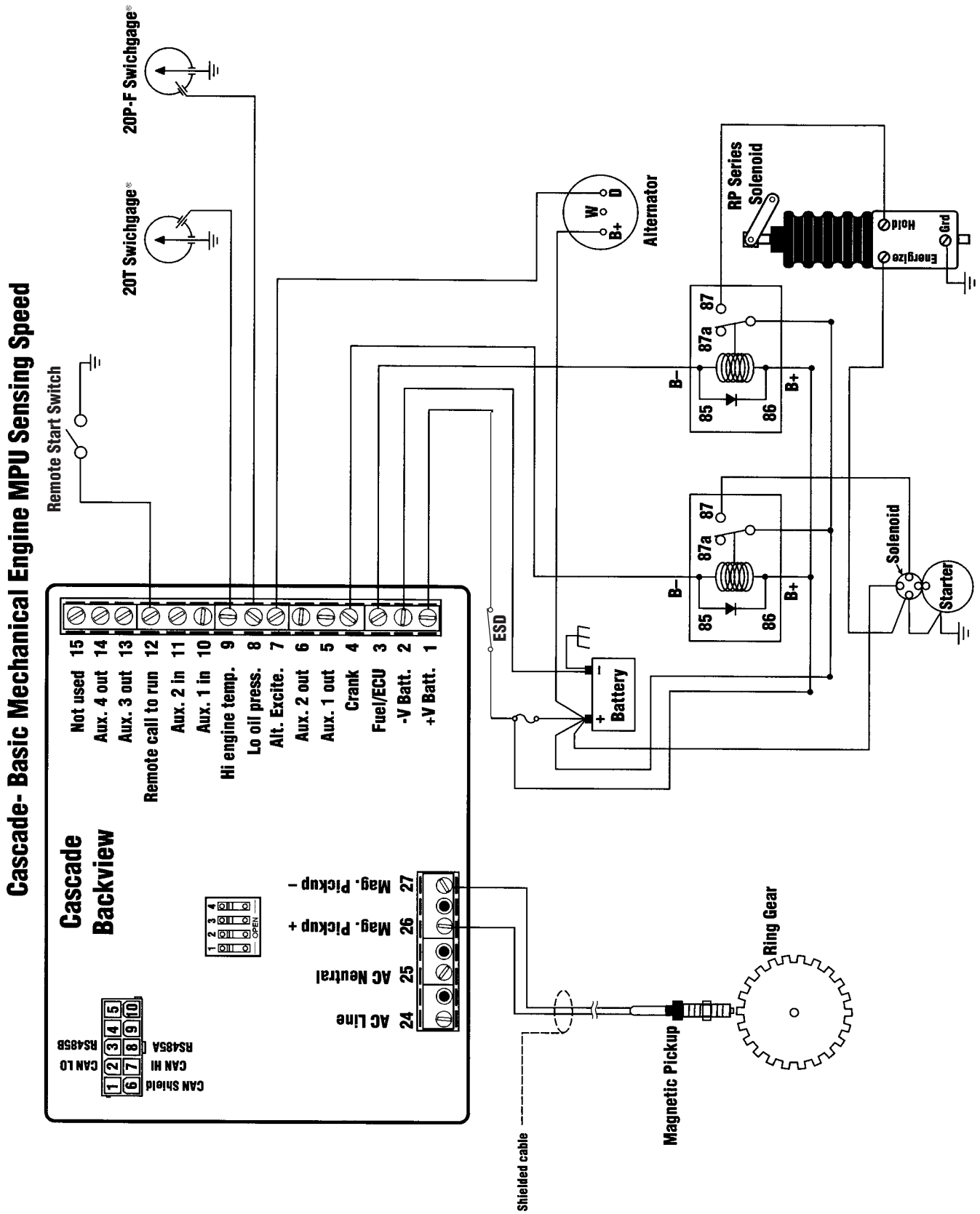
The eight LEDs shown in the table below form an 8-bit binary error code to indicate the type of configuration error detected The following error codes are currently defined:

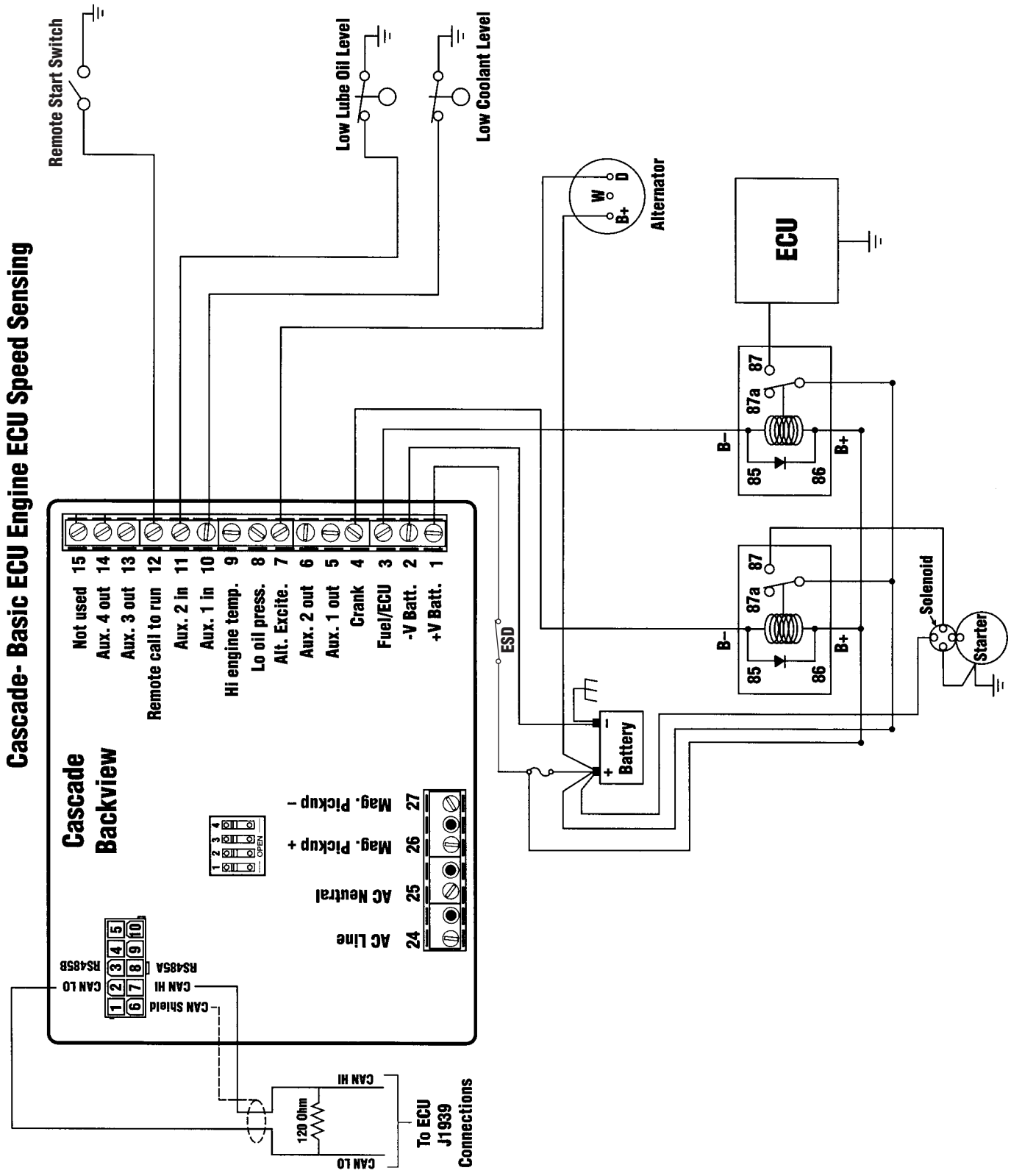
Error Code(s)	LED Indication	Error
1 – 63	(varies)	Individual configuration parameter number is out of range. The number flashed indicates the configuration parameter number that is in error (see Table 1.)
128	●○○○○○○○	Configuration memory CRC error. The user will need to go back to configuration mode and resave at least one configuration parameter.
129	●○○○○○○●	All three digits of flywheel tooth count are zero. This is not allowed.
130	●○○○○○●○	Remote Start Signal Type is set to MOMENTARY but no auxiliary input is configured for MOMENTARY STOP.
131	●○○○○○●●	One of the Aux outputs is configured for “SPEED UP” or “SPEED DOWN” but none of the other Aux outputs is configured for the opposite setting
132	●○○○○●○○	Speed source is set to AC Frequency and Crank Disconnect Frequency is set to less than 10 Hz. Crank disconnect frequency must be greater than 10 Hz.
133	●○○○○●○●	Speed source set to Mag Pickup and Crank Disconnect RPM < 10 RPM. Crank disconnect RPM must be greater than 10 RPM.
134	●○○○○●●○	Run speed is less than or equal to crank disconnect RPM (non-genset engines)

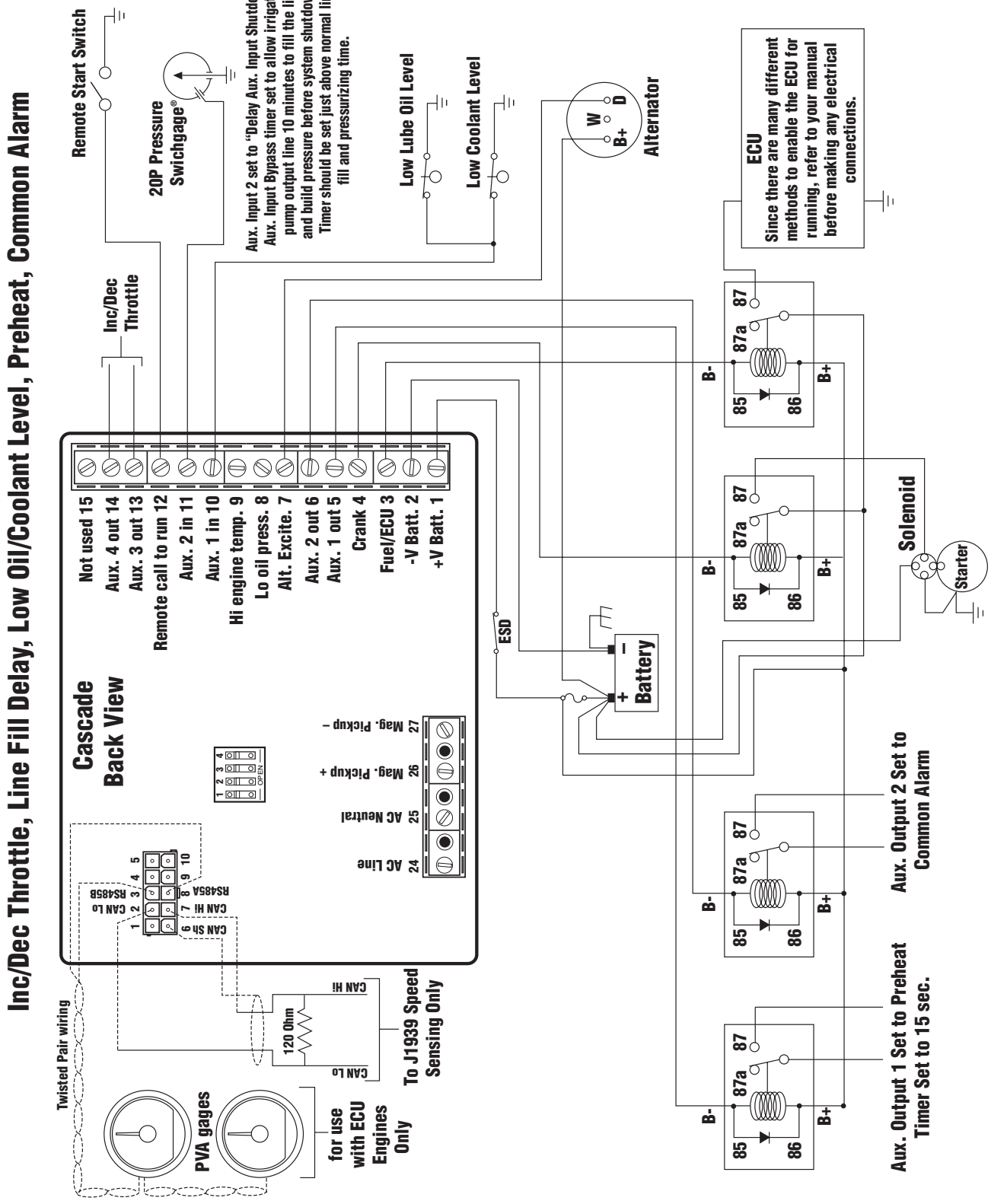
Typical Wiring Diagrams

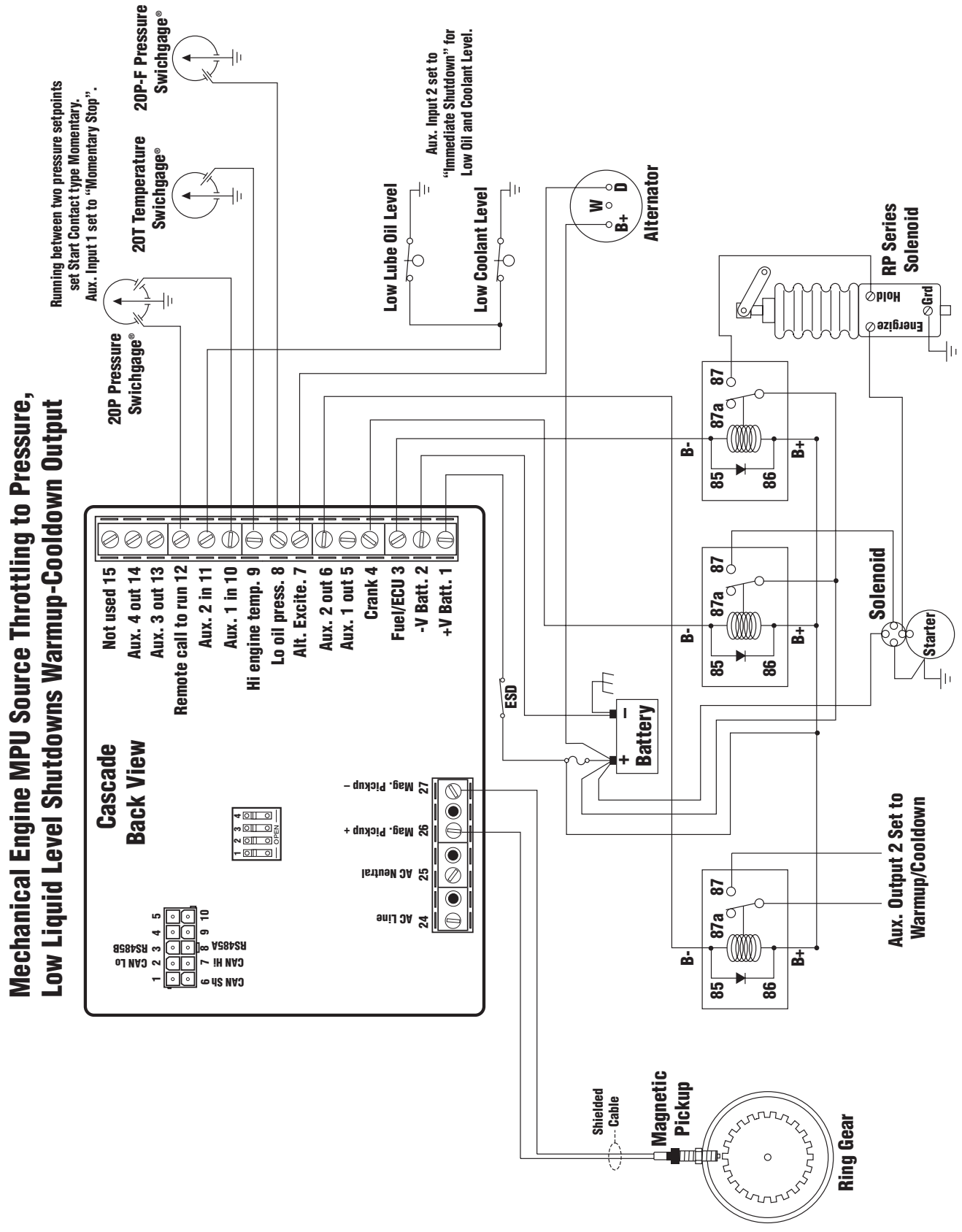
Cascade- Basic Engine AC Sensing Speed



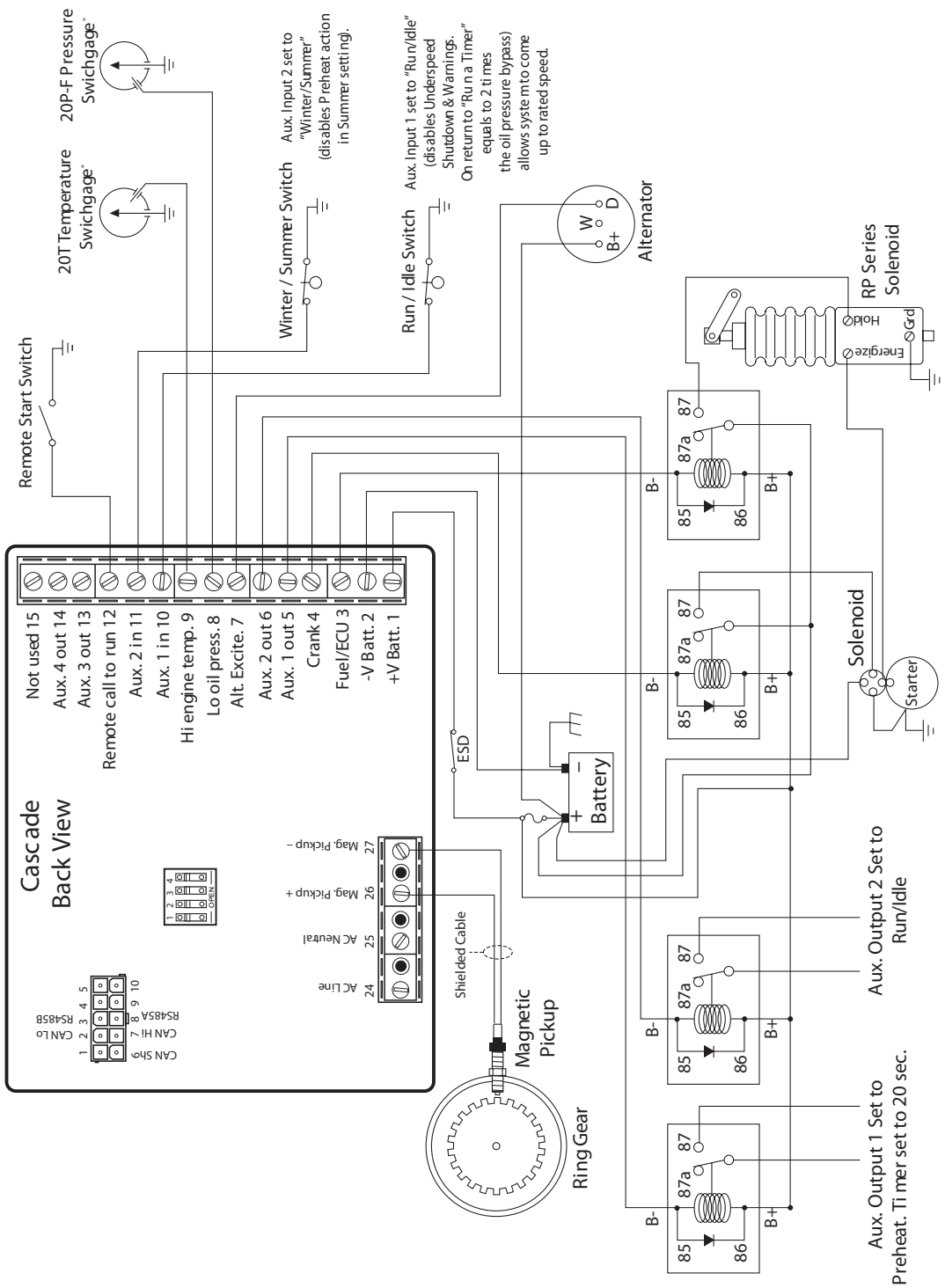

Cascade- Basic Mechanical Engine MPU Sensing Speed
Remote Start Switch
20P-F Swichgage®
20T Swichgage®
Alternator
W
D
B+
RP Series Solenoid
Hold
Grd
Energize
87
87a
85
86
B–
B+
ESD
Battery
Solenoid
Starter
Cascade Backview
Not used 15
Aux. 4 out 14
Aux. 3 out 13
Remote call to run 12
Aux. 2 in 11
Aux. 1 in 10
Hi engine temp. 9
Lo oil press. 8
Alt. Excite. 7
Aux. 2 out 6
Aux. 1 out 5
Crank 4
Fuel/ECU 3
-V Batt. 2
+V Batt. 1
Mag. Pickup – 27
Mag. Pickup + 26
AC Neutral 25
AC Line 24
OPEN
CAN Shield
CAN HI
CAN LO
RS485A
RS485B
Ring Gear
Magnetic Pickup
Shielded cable


Cascade- Basic ECU Engine ECU Speed Sensing
Remote Start Switch
Low Lube Oil Level
Low Coolant Level
Alternator
W
D
B+
ECU
Cascade
Backview
Not used 15
Aux. 4 out 14
Aux. 3 out 13
Remote call to run 12
Aux. 2 in 11
Aux. 1 in 10
Hi engine temp. 9
Lo oil press. 8
Alt. Excite. 7
Aux. 2 out 6
Aux. 1 out 5
Crank 4
Fuel/ECU 3
-V Batt. 2
+V Batt. 1
Mag. Pickup – 27
Mag. Pickup + 26
AC Neutral 25
AC Line 24
1 2 3 4
OPEN
RS485A
RS485B
CAN LO
CAN HI
CAN Shield
1 2 6 7 3 4 8 9 5 10
ESD
Battery
87
87a
85
86
B–
B+
Solenoid
Starter
CAN HI
120 Ohm
CAN LO
To ECU
J1939
Connections


Inc/Dec Throttle, Line Fill Delay, Low Oil/Coolant Level, Preheat, Common Alarm
Remote Start Switch
20P Pressure Switchgage®
Aux. Input 2 set to "Delay Aux. Input Shutdown"
Aux. Input Bypass timer set to allow irrigation pump output line 10 minutes to fill the line and build pressure before system shutdown.
Timer should be set just above normal line fill and pressurizing time.
Low Lube Oil Level
Low Coolant Level
W
D
B+
Alternator
ECU
Since there are many different methods to enable the ECU for running, refer to your manual before making any electrical connections.
Inc/Dec Throttle
Cascade Back View
Not used 15
Aux. 4 out 14
Aux. 3 out 13
Remote call to run 12
Aux. 2 in 11
Aux. 1 in 10
Hi engine temp. 9
Lo oil press. 8
Alt. Excite. 7
Aux. 2 out 6
Aux. 1 out 5
Crank 4
Fuel/ECU 3
-V Batt. 2
+V Batt. 1
Mag. Pickup –
Mag. Pickup +
AC Neutral
AC Line
CAN Lo
RS485B
RS485A
CAN Hi
CAN Sh
OPEN
ESD
Battery
Solenoid
Starter
B-
B+
85
86
87
87a
Aux. Output 2 Set to Common Alarm
Aux. Output 1 Set to Preheat Timer Set to 15 sec.
Twisted Pair wiring
120 Ohm
CAN Hi
CAN Lo
To J1939 Speed Sensing Only
PVA gages
for use with ECU Engines Only


Mechanical Engine MPU Source Throttling to Pressure,
Low Liquid Level Shutdowns Warmup-Cooldown Output
Running between two pressure setpoints set Start Contact type Momentary.
Aux. Input 1 set to "Momentary Stop".
20P Pressure Swichgage®
20T Temperature Swichgage®
20P-F Pressure Swichgage®
Low Lube Oil Level
Low Coolant Level
Aux. Input 2 set to "Immediate Shutdown" for Low Oil and Coolant Level.
Alternator
W
D
B+
RP Series Solenoid
Energize
Hold
Grd
Cascade
Back View
Not used 15
Aux. 4 out 14
Aux. 3 out 13
Remote call to run 12
Aux. 2 in 11
Aux. 1 in 10
Hi engine temp. 9
Lo oil press. 8
Alt. Excite. 7
Aux. 2 out 6
Aux. 1 out 5
Crank 4
Fuel/ECU 3
-V Batt. 2
+V Batt. 1
Mag. Pickup –
Mag. Pickup +
AC Neutral
AC Line
CAN Sh
CAN Hi
CAN Lo
RS485A
RS485B
OPEN
ESD
Battery
B-
B+
87
87a
85
86
Solenoid
Starter
Aux. Output 2 Set to Warmup/Cooldown
Shielded Cable
Magnetic Pickup
Ring Gear

Mechanical Engine Winter/Summer Switch, Preheat Output & Timer Run & Idle Switch Output



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