



Operator Manual

Our energy working for you.™



**Power
Generation**

X2.5 Engine with PowerStart 0500 Control

C17 D5
C22 D5
C28 D5
C12 D6
C16 D6
C20 D6



FOREWORD

The purpose of this manual is to provide basic, Operator-level, information relevant to an engine when used as part of a stand-by generator set assembly. Should you require further, more detailed, information regarding the engine, please contact your authorised distributor.

This manual should be read in conjunction with the relevant PowerStart Control Manual supplied with the generator set documentation pack. It contains additional, generator set specific, information and should form part of the documentation package supplied with the generator set.

The information contained within this manual is based on information available at the time of going to print. In line with Cummins Power Generation Limited policy of continuous development and improvement, information may change at any time without notice. The Operators should therefore ensure that before commencing any work, they have the latest information available.

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SECTION 1 – ENGINE DATA

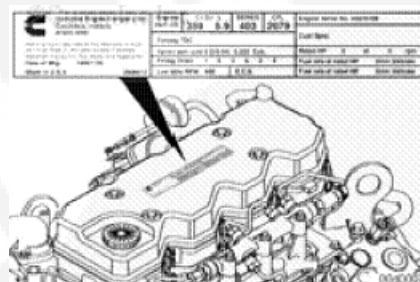
1. Engine Data

1.1 Engine Identification Plate

Each engine is provided with a Data Plate as shown below. This provides information unique to the engine.

The engine data plate shows specific information about your engine.

The Engine Serial Number (ESN) (1) and Control Parts List (CPL) provide information for ordering parts and service needs.




Note:

The engine data plate must not be changed unless approved by Cummins Engine Company Inc.

1

Engine Model	:	
Rated HP	:	@ RPM
Engine Sr. No.	:	
Month & Year of Mfg.	:	
Shop Order No.	:	

 Mfg. By.
Cummins Power Generation 0099-2598

1.2 Engine Diagrams

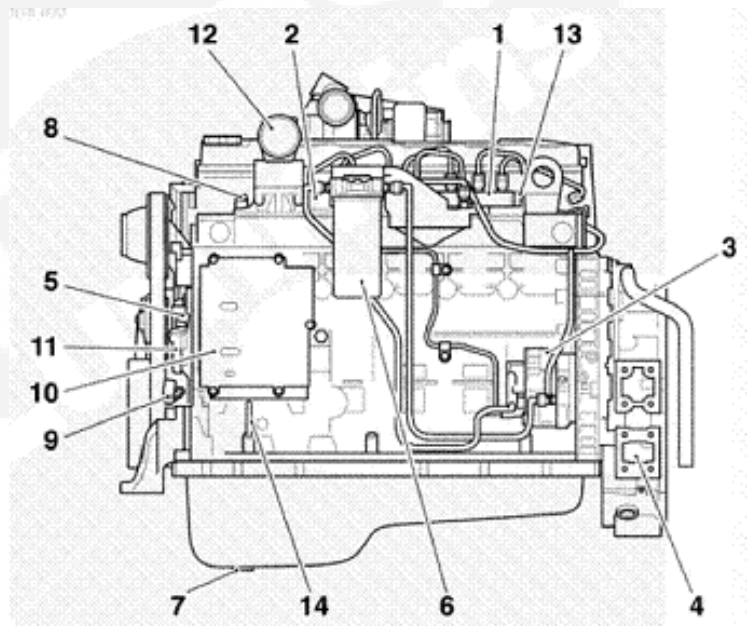
The following illustrations show the locations of the major external engine components, filters, and other service and maintenance points of a typical engine. Some external components will be at different locations for different engine models.

1.2.1 Engine Views

1.2.1.1 Intake Side

KEY

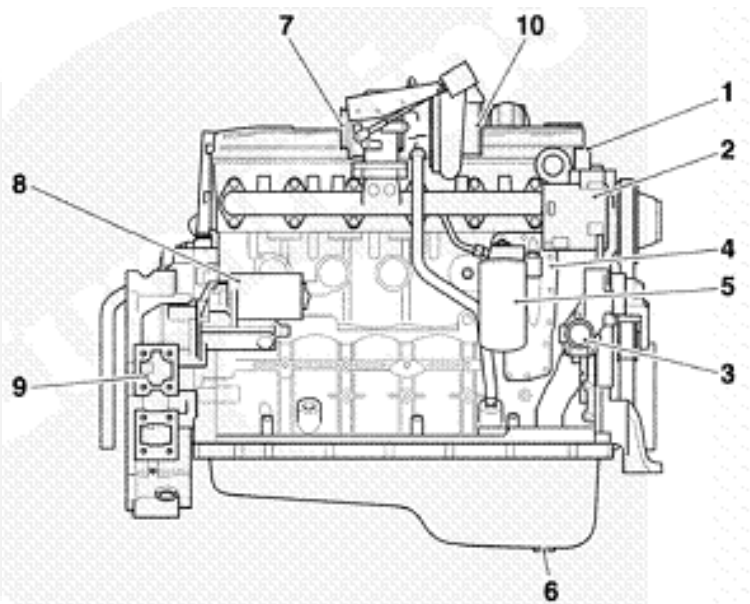
1. Fuel Rail
2. Intake Pressure and Temp Sensor
3. Fuel Pump
4. Flywheel Housing
5. Oil Pressure Switch
6. Fuel Filter
7. Oil Pan Drain Plug
8. Barometric Pressure Sensor
9. Engine Speed Sensor (crankshaft)
10. Electronic Control Module
11. Engine Position Sensor (camshaft)
12. Air Intake Inlet
13. Rail Pressure Sensor
14. Dipstick



1.2.1.2 Exhaust Side

KEY

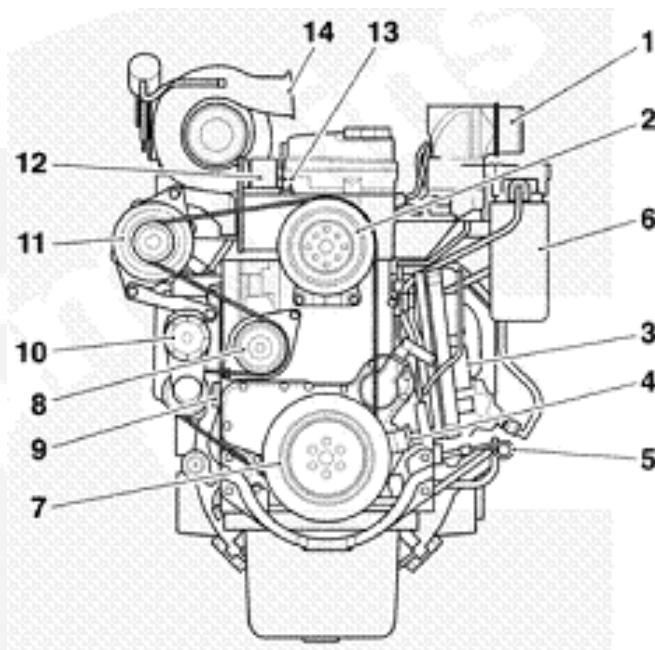
1. Coolant Outlet
2. Alternator
3. Coolant Inlet
4. Lubricating Oil Cooler
5. Oil Filter
6. Oil Pan Drain Plug
7. Turbocharger Exhaust Outlet
8. Starter
9. Flywheel Housing
10. Turbocharger Compressor Inlet



1.2.1.3 Front View

KEY

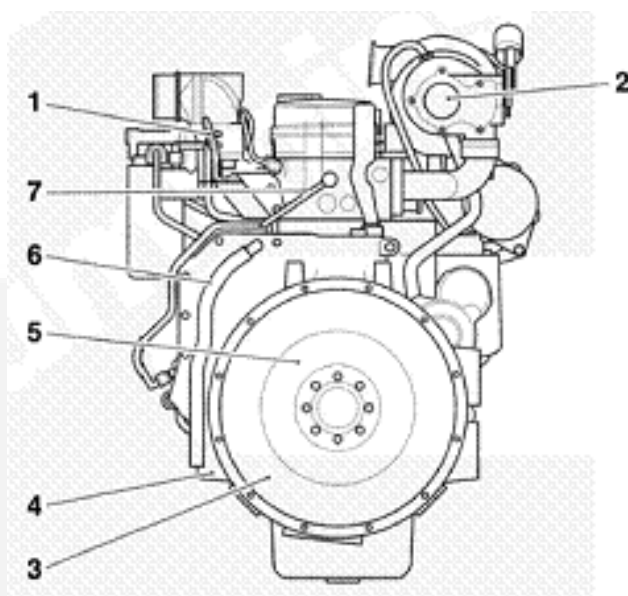
1. Air Inlet
2. Fan Drive
3. Electronic Control Module
4. Engine Speed Sensor (crankshaft)
5. Dipstick
6. Fuel Filter
7. Vibration Damper
8. Water Pump
9. Starter
10. Belt Tensioner
11. Alternator
12. Coolant Outlet
13. Coolant Temperature Sensor
14. Turbocharger Air Outlet



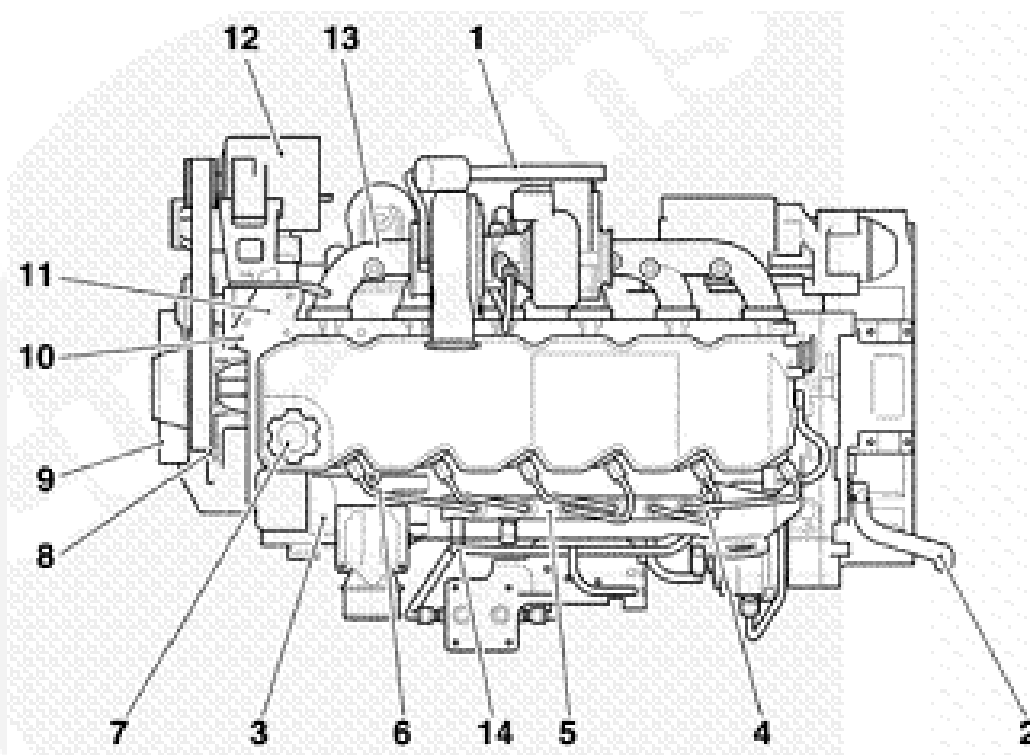
1.2.1.4 Rear View

KEY

1. Rear Engine Lifting Bracket
2. Turbocharger Exhaust Outlet
3. Clutch Mounting Holes
4. Flywheel Housing
5. Flywheel/flexplate
6. Crankcase Breather Tube
7. Injector Drain Line



1.2.1.5 Top View



KEY

- | | |
|------------------------------------|--------------------------------|
| 1. Turbocharger Wastegate | 8. Tone Wheel |
| 2. Crankcase Breather | 9. Vibration Damper |
| 3. Barometric Pressure/temp Sensor | 10. Coolant Temperature Sensor |
| 4. Fuel Rail Pressure Sensor | 11. Coolant Outlet |
| 5. Fuel Rail | 12. Alternator |
| 6. High-pressure Fuel Lines | 13. Exhaust Manifold |
| 7. Oil Fill Cap | 14. Rail Pressure Relief Valve |

1.3 Acoustic Information (1500 rpm)

MODEL	C17 D5	C22 D5	C28 D5
ENGINE	X2.5G2	X2.5G2	X2.5G2
Enclosed Set Acoustic Data – LWA (Based on using a standard Cummins' canopy, and set operating with doors closed) ^{1, 2}	90	90	90
Open Set Acoustic Data – dB(A) at 1m ³ – SPL ⁴ (or enclosed set with doors open)	105	105	105
^{1.} Doors closed figures are measured using 2000/14/EC guaranteed sound power levels ^{2.} Based on 75% load ^{3.} Based on 110% load ^{4.} For Noise Spectrum Figures refer also to Health and Safety Manual (0908-0110-00) Inline with the CPGK policy of continuous improvement these figures are subject to change.			

1.4 Acoustic Information (1800 rpm)

MODEL	C12 D6	C16 D6	C20 D6
ENGINE	X2.5G4	X2.5G4	X2.5G4
Enclosed Set Acoustic Data – LWA (Based on using a standard Cummins' canopy, and set operating with doors closed) ^{1, 2}	91	91	91
Open Set Acoustic Data – dB(A) at 1m ³ – SPL ⁴ (or enclosed set with doors open)	105	105	105
^{5.} Doors closed figures are measured using 2000/14/EC guaranteed sound power levels ^{6.} Based on 75% load ^{7.} Based on 110% load ^{8.} For Noise Spectrum Figures refer also to Health and Safety Manual (0908-0110-00) Inline with the CPGK policy of continuous improvement these figures are subject to change.			

1.5 Engine Performance Data

X2.5			Fuel Consumption
Engine Performance Data at 50Hz			Prime (L/Hr)
C17 D5	X2.5G2		8
C22 D5	X2.5G2		8
C28 D5	X2.5G2		8
Engine Performance Data at 60Hz			
C12 D6	X2.5G4		6.5
C16 D6	X2.5G4		6.5
C20 D6	X2.5G4		6.5
Inline with the CPGI policy of continuous improvement these figures are subject to change.			

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SECTION 2 – GENERATOR SET INFORMATION (POWERSTART 0500 CONTROL)

2. Generator Set Information (PowerStart 0500 Control)

2.1 Scope

This section describes the additional information required for the operation and maintenance of the X2.5 Series generator set.

The main components of a typical generator set are shown below.

For installation specific drawings refer to drawings supplied with the generator set documentation package.

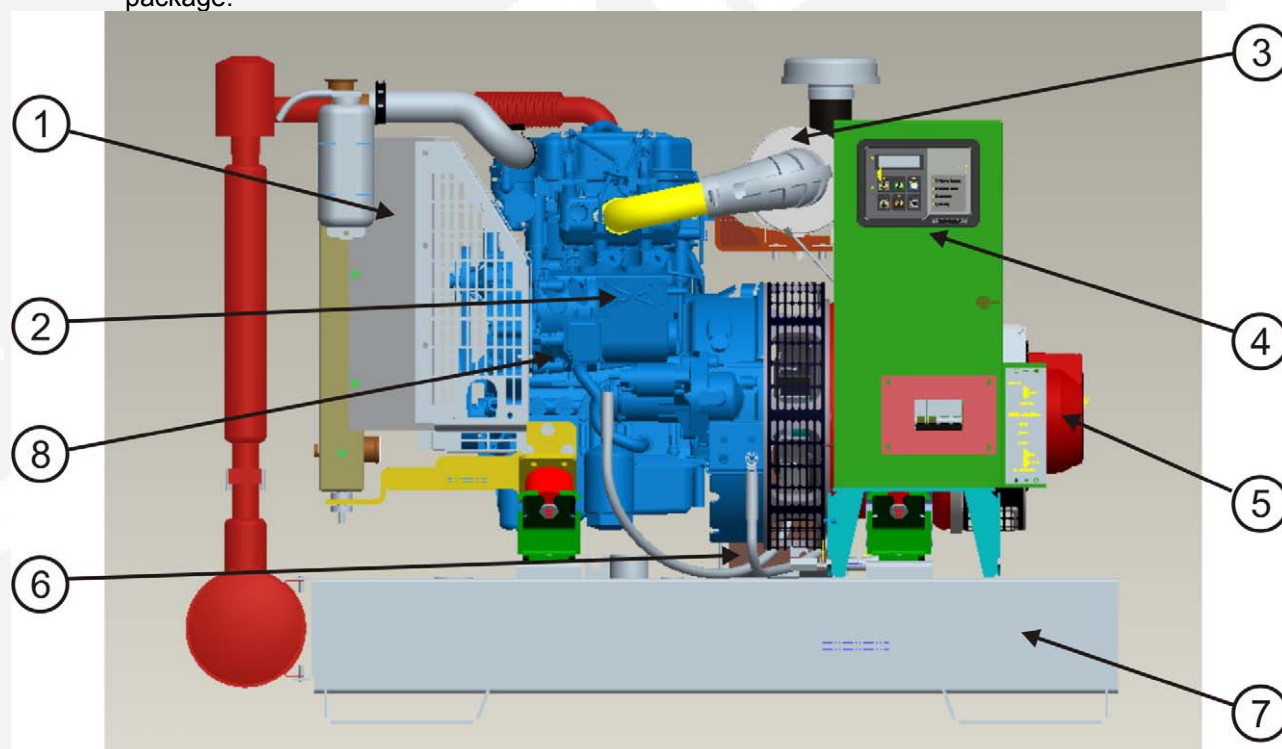


Figure 1 Typical Generator Set

KEY

- | | |
|----|------------|
| 1. | Radiator |
| 2. | Engine |
| 3. | Air Filter |
| 4. | Controller |
| 5. | Alternator |
| 6. | Battery |
| 7. | Bed Frame |
| 8. | Dipstick |

OPTIONS

- | |
|-----------------------|
| Battery and Tray |
| Battery Charger |
| Engine Coolant Heater |

2.1.1 Control Housing

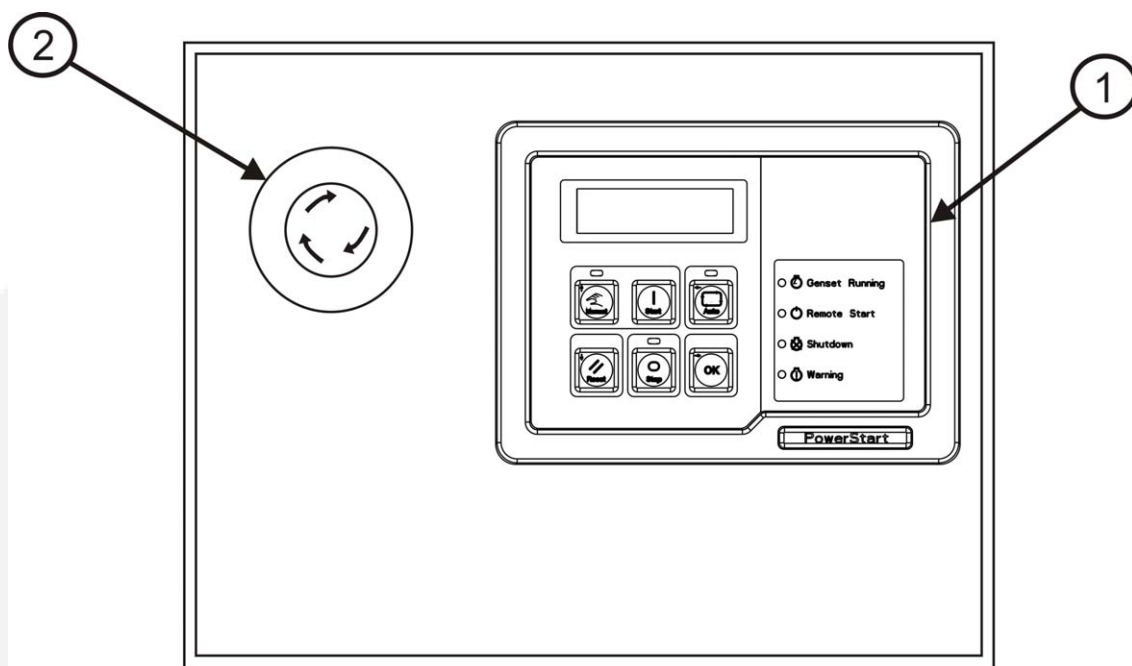


Figure 2 Typical Control Panel

KEY

1. Display Module
2. Emergency Stop Button

2.2 Fault/Status Codes



WARNING: MANY TROUBLESHOOTING PROCEDURES PRESENT HAZARDS THAT CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH. ONLY QUALIFIED SERVICE PERSONNEL WITH KNOWLEDGE OF FUELS, ELECTRICITY, AND MACHINERY HAZARDS SHOULD PERFORM SERVICE PROCEDURES. ACCIDENTAL STARTING OF THE GENERATOR SET WHILE WORKING ON IT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. PREVENT ACCIDENTAL STARTING BY DISCONNECTING THE STARTING BATTERY LEADS (NEGATIVE [-] FIRST).

The fault codes have been divided into five categories to help you determine what corrective action to take for safe operation of the generator set. Use Table 1 to find the category (CTG) and fault description for all codes.



Note: *Gaps in the code numbers are for codes that do not apply to this generator set. Some of the codes listed are feature dependent and will not be displayed by this control.*

Category A Fault Codes:

Pertain to engine or alternator shutdown faults that require immediate repair by trained and experienced service personnel (generator set non-operational). The control prevents the set from being re-started if a shutdown fault has not been corrected.

Category B Fault Codes:

Consists of faults that can affect generator set performance or can cause engine, alternator, or connected equipment damage. Operate the set only when it is powering critical loads and cannot be shut down. Requires repair by trained and experienced service personnel.

Category C Fault Codes:

Consists of faults that do not affect generator set performance, but require repair by trained and experienced service personnel. These codes indicate a defective harness or wiring problem.

These codes can also indicate a defective engine sensor, leaving no engine protection. (Without this protection, engine damage can occur without detection).



Caution: *Continued operation may void generator set warranty if damage occurs that relates to fault condition.*

Category D Fault Codes:

Consist of faults that are repairable by site personnel. Service will be required by trained and experienced service personnel if site personnel cannot resolve the problem after taking the corrective actions suggested in Table 4.

Category E Fault Codes:

Indicates non-critical operational status of the generator set, external faults, or customer fault inputs. These faults require repair by trained and experienced service personnel.

Table 1 Fault Codes

CTG	CODE	LAMP	DESCRIPTION
C	141	Warning	Indicates the oil pressure sensor output is out of range (OOR), low.
B	143**	Warning	Indicates the engine oil pressure is approaching an unacceptable level.
C	144	Warning	Indicates the coolant temperature sensor output is out of range (OOR), low.
C	146**	Warning	Indicates that the engine is operating near cooling system capacity. Increase in load or higher ambient temperature may cause High Coolant Temp (code 151) shutdown.
D	151**	Shutdown	Indicates that the engine coolant temperature is above normal and has reached the Shutdown trip point.
D	359	Shutdown	The system has failed to start after a set number of crank attempts. This indicates a possible fuel system or air induction problem (engine cranks but fails to start).
A	415**	Shutdown	Indicates the engine oil pressure has dropped below normal and has reached the shutdown trip point.
D	441**	Warning	Indicates battery voltage supply to the control is approaching a low level at which unpredictable operation can occur.
D	442**	Warning	Indicates battery voltage supply to the control is approaching a high level at which damage to the control can occur.
B	1123*	Shutdown	A shutdown fault occurred while the Battle Short mode was enabled.
D	1131*	Warning	Indicates that the control is in Battle Short mode – used to bypass several fault shutdowns for generator set operation during emergencies.
E	1312	Configurable	The nature of the fault is an optional customer selection.
B	1416*	Warning	Indicates that a shutdown fault is active, but is being bypassed by Battle Short.
D	1434	Shutdown	Indicates a Remote Emergency Stop has been activated.
D	1435**	Warning	Indicates that the engine coolant temperature is below the adjusted setpoint. This may indicate that the coolant heater is not operating or is not circulating coolant.
D	1442**	Warning	Indicates that the generator set battery voltage is below battery thresholds during cranking.
A	1446**	Shutdown	Indicates that one or more measured AC output voltages have exceeded the threshold for longer than a specified time limit. The threshold and time limits are 130% of nominal for zero seconds or 110% of nominal for ten seconds.

CTG	CODE	LAMP	DESCRIPTION
A	1447**	Shutdown	Indicates that the measured AC output voltage is below the threshold for longer than a specified time limit. The threshold and time limits are 85% of nominal for ten seconds.
A	1448**	Shutdown	Indicates that the alternator frequency is 6 Hertz under the nominal frequency.
A	1449**	Shutdown	Indicates that the alternator frequency is 6 Hertz above the nominal frequency.
A	2335	Shutdown	Indicates that a loss of voltage or frequency sensing from the generator has occurred.
A	2677	Shutdown	The generator set continues to run after receiving a stop command from the controller.
<p>* These will not appear during normal operation. PowerStart 0500 Control does not support customer selectable Battle Short operation. But Service technicians may invoke battle short operation for troubleshooting using a service tool.</p> <p>** Any values listed in the Description column for these faults are default values. If authorized, these values can be changed using the Genset Setup menus</p>			

2.2.1 Customer Input Faults

Dependent on Customer Options specified, the Customer Input Faults may indicate the following:

ACTUAL TEXT SHOWN	^{10.} TRANSLATION
Cust Flt I/P	Low Fuel

Table 2 Troubleshooting Procedures for Fault Codes

FAULT CODE		CORRECTIVE ACTION – *(IF IN DOUBT, CALL YOUR AUTHORISED SERVICE ENGINEER)
CODE:	143	Indicates engine oil pressure has dropped below the warning trip point. If generator is powering critical loads and cannot be shut down, wait until next shutdown period and then follow the fault code 415 procedure.
LAMP:	Warning	
MESSAGE:	PRE-LOW OIL PRESSURE	
CODE:	146	Indicates engine is operating near cooling system capacity. Increase in load or higher ambient temperature may cause High Coolant Temp (151) shutdown. Review fault code 151 correction list for other possible causes.
LAMP:	Warning	
MESSAGE:	PRE-HIGH COOL TEMP	
CODE:	151	Indicates engine has overheated (coolant temperature has risen above the shutdown trip point). Allow engine to cool down completely before proceeding with the following checks: a) Look for possible coolant leakage points and repair if necessary. Check coolant level and replenish if low b) Check for obstructions to cooling airflow and correct as necessary c) Check fan belt and repair or tighten if necessary d) Check blower fan and circulation pumps on remote radiator installations e) Reset control and restart after locating and correcting problem.
LAMP:	Shutdown	
MESSAGE:	HIGH COOLANT TEMP	
CODE:	359	Indicates possible fuel system or air induction problem. (Engine cranks but fails to start). Allow engine to cool down completely before proceeding with the following checks: f) Check for empty fuel tank, fuel leaks, or blocked fuel lines and correct as required g) Check for dirty fuel filter and replace if necessary h) Check for dirty or blocked air filter and replace if necessary i) Reset control and restart after correcting the problem.
LAMP:	Shutdown	
MESSAGE:	Fail to Start	
CODE:	415	Indicates engine oil pressure has dropped below the shutdown trip point. Allow engine to cool down completely before proceeding with the following checks: j) Check the oil level, lines and filters k) If the oil system is OK but the oil level is low, replenish l) Reset control and restart after locating and correcting problem.
LAMP:	Shutdown	
MESSAGE:	LOW OIL PRESSURE	
CODE:	441	Indicates battery voltage supply to the control is approaching a low

FAULT CODE		CORRECTIVE ACTION – *(IF IN DOUBT, CALL YOUR AUTHORISED SERVICE ENGINEER)
LAMP:	Warning	level at which unpredictable operation will occur. If engine can be stopped allow engine to cool down completely before proceeding: m) Poor battery cable connections. Clean the battery cable terminals and tighten all connections n) Check battery charge voltage float level if applicable (raise float level) o) Discharged or defective battery Check the battery charger fuse Recharge or replace the battery.
MESSAGE:	LOW BAT VOLTAGE	
CODE:	442	Indicates battery voltage supply to the control is approaching a high level at which damage to the control can occur. If engine can be stopped allow engine to cool down completely before proceeding: p) Poor battery cable connections. Clean the battery cable terminals and tighten all connections q) Check battery charge float level if applicable (lower float level).
LAMP:	Warning	
MESSAGE:	HIGH BAT VOLTAGE	Indicates that the control is in Battle Short mode – used to bypass several fault shutdowns therefore allowing generator set operation during emergencies.
CODE:	1131	
LAMP:	Warning	
MESSAGE:	BATTLE SHORT ACTIVE	The nature of the fault is an optional customer selection. Example inputs: Low Fuel Day Tank, Water In Fuel, Ground Fault, etc. Each of the fault functions can be programmed (using InPower service tool or access to Setup menu), as follows: r) Event , Warning or Shutdown level if Function Select = Fault Input s) Change display name using up to 32 characters
CODE:	1311, 1312, 1317, 1318	
LAMP:	Configurable	
MESSAGE:	CONFIGURABLE INPUT 1, 2, 3, 4	The generator set continues to run after receiving a shutdown command from the controller. The Battle Short feature is enabled – this is used to bypass several critical fault shutdowns therefore allowing generator set operation during emergencies.
CODE:	1416	
LAMP:	Warning	
MESSAGE:	FAIL TO SHUTDOWN	Indicates local or remote Emergency Stop. Emergency Stop shutdown status can be reset only at the local control panel. After locating and correcting problem, reset the local/remote Emergency Stop button as follows: t) De-activate (disable) emergency stop button u) Press the O (Off) button v) Select the desired operating mode (manual or remote).
CODE:	1433/1434	
LAMP:	Shutdown	
MESSAGE:	E-STOP - LOCAL E-STOP - REMOTE	Indicates engine coolant heater is not operating or is not circulating
CODE:	1435	

FAULT CODE		CORRECTIVE ACTION – *(IF IN DOUBT, CALL YOUR AUTHORISED SERVICE ENGINEER)
LAMP:	Warning	<p>coolant. If engine can be stopped allow engine to cool down completely before proceeding with the following checks:</p> <p>w) The coolant heater not connected to power supply. Check for blown fuse or disconnected heater cable and correct as required</p> <p>x) Look for possible coolant leaks and repair as required Check for low coolant level and replenish if required.</p> <p>Set is not operating. Warning occurs when engine coolant temperature is 21°C (70°F) or lower.</p> <p>NOTE: In applications where the ambient temperature falls below 4oC (40oF), Low Coolant Temp may be indicated even though the coolant heaters are operating.</p>
MESSAGE:	LOW COOLANT TEMP	
CODE:	1442	<p>Indicates that during cranking, the battery voltage is at, or below, the weak battery warning trip point for a time greater than, or equal to, the weak battery set time.</p> <p>See code 441 for corrective action</p>
LAMP:	Warning	
MESSAGE:	WEAK BATTERY	
CODE:	1448	<p>Indicates that the generator set frequency has dropped below 90% of nominal for approximately ten seconds. Allow engine to cool down completely before proceeding with the following checks:</p> <p>y) Check the fuel supply</p> <p>z) Check the air intake supply</p> <p>aa) Check the load and correct any overload.</p>
LAMP:	Shutdown	
MESSAGE:	UNDER FREQUENCY	

