

Operator Manual

Our energy working for you.™



**Power
Generation**

with PowerCommand™ Control 3201

FOREWORD

The purpose of this manual is to provide the users with sound, general information. It is for guidance and assistance with recommendations for correct and safe procedures. Cummins Power Generation Limited cannot accept any liability whatsoever for problems arising as a result of following recommendations in this manual.

The information contained within the 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 users should therefore ensure that before commencing any work, they have the latest information available.

Users are respectfully advised that it is their responsibility to employ competent persons to carry out any installation work in the interests of good practice and safety. Consult your Authorised Distributor for further installation information. It is essential that the utmost care is taken with the application, installation and operation of any diesel engine due to their potentially dangerous nature. Careful reference should also be made to other Cummins Power Generation Limited literature, in particular the Health and Safety Manual (0908-0110-00) and the Engine Manual.

Should you require further assistance contact: -

Cummins Power Generation
1400 73rd Avenue NE
Minneapolis
MN 55432
USA

Tel: +1 (763) 574-5000
Fax: +1 (763) 574-5298

e-mail: pgamail@cummins.com

Web: www.cumminspower.com

Cummins Power Generation
35A/1/2, Erandawana
Pune 411 038
India

Tel.: (91 020) 3024 8600
Fax: (91 020) 6602 8090

e-mail:
cpgiservicesupport@cummins.com

Web: www.cumminspower.com

Cummins Power Generation
Columbus Avenue
Manston Park
Manston
Ramsgate
Kent CT12 5BF
United Kingdom

Tel: +44 (0) 1843 255000
Fax: +44 (0) 1843 255902

e-mail: cpgk.uk@cummins.com

Web: www.cumminspower.com

Cummins Power Generation
Rua Jati, 310 - Cumbica
Guarulhos –SP
Brazil
CEP: 07180-900

Tel.: (55 11) 2186 4195
Fax: (55 11) 2186 4729

e-mail: falecom@cumminspower.com.br

Web: www.cumminspower.com

Cummins Power Generation
10 Toh Guan Road #07-01
TT International Tradepark
Singapore 608838

Tel: (65) 6417 2388
Fax: (65) 6417 2399

e-mail: cpg.apmktg@cummins.com

Web: www.cumminspower.com



This is a Blank Page



CONTENTS

Section	Title	Page
Schedule of Abbreviationsi		
1	Safety 1-1	
1.1	Warning, Caution and Note Styles Used In This Manual.....	1-1
1.2	Warnings.....	1-1
1.3	General Information.....	1-1
1.4	Generator Plant Safety Code.....	1-1
2	Introduction..... 2-1	
2.1	General2-1	
2.2	Generating Set Identification.....	2-1
2.3	After Sales Services.....	2-2
2.3.1	Maintenance.....	2-2
2.3.2	Warranty.....	2-2
2.3.3	Spares.....	2-2
2.3.4	Overseas.....	2-2
2.3.5	Additional Literature.....	2-2
3	System Overview..... 3-1	
3.1	Generator Components – Typical Generator Set.....	3-1
3.1.1	AC Supply and Isolation.....	3-2
3.1.2	Control System.....	3-2
3.1.3	Engine.....	3-2
3.1.4	Alternator.....	3-2
3.1.5	Generator Rating.....	3-2
3.1.6	Generator Set Construction.....	3-2
3.1.7	Fuel System.....	3-3
3.1.8	Cooling System.....	3-3
3.1.9	Engine Exhaust (Option).....	3-3
3.1.10	DC Electrical System.....	3-3
3.1.11	Alarm Module (Option).....	3-4
3.1.12	Sensors/Senders.....	3-4
3.2	Heaters3-5	
3.2.1	Heater Supply and Isolation.....	3-5
3.2.2	Engine Heater (Option).....	3-5
3.2.3	Alternator Heater (Option).....	3-5
3.2.4	Control Panel Heater (Option).....	3-5
3.3	Mains Powered Battery Charger (Option).....	3-6
3.3.1	Operation.....	3-6
3.3.2	Boost Charge (Option).....	3-6
4	Control System..... 4-1	
4.1	Control System Description.....	4-1
4.1.1	Control Panel Power ON/OFF Modes.....	4-2
4.1.2	Control Panel - Front Panel.....	4-3
4.1.3	Control Panel - Operator Panel.....	4-4
4.1.4	Control Panel - Switch Panel.....	4-4
4.2	Menu Display and Switches.....	4-6
4.2.1	Graphical Display.....	4-6
4.2.2	Menu Buttons.....	4-6
4.3	Menu Units Selection.....	4-7
4.3.1	Local/Remote Field.....	4-7
4.4	Main Menu.....	4-8
4.4.1	Adjust Button.....	4-8

4.4.2	Set-up Button	4-8
4.4.3	_ Button (Paralleling applications only).....	4-9
4.4.4	Power Trans Button (PTC applications only).....	4-9
4.5	Engine Data Submenus	4-10
4.6	Alternator Data Submenus	4-11
4.6.1	Voltage L–L and L–N	4-11
4.6.2	Amps	4-11
4.6.3	Frequency	4-11
4.6.4	AVR Duty Cycle	4-11
4.6.5	kW, kVA and PF	4-11
4.7	Control Submenu	4-12
4.7.1	Local Control Submenu Function	4-12
4.7.2	Remote Control Submenu Functions.....	4-13
4.7.3	Local/Remote Control Submenu Function.....	4-13
4.8	History/About Submenus.....	4-14
4.8.1	History	4-14
4.8.2	About.....	4-14
4.8.3	Fault History	4-14
4.9	Adjust Sub-menu	4-16
4.10	Parallel Data Submenu	4-17
4.10.1	Parallel Data Status Line	4-17
4.11	Password Menu.....	4-18
4.12	Power Transfer Main Menu	4-19
4.12.1	PTC Status Line.....	4-20
4.12.2	Utility (PWR TRAN) Submenus	4-21
4.12.3	Status (PWR TRAN) Submenus.....	4-22
4.12.4	Transfer Control (PWR TRAN) Submenu.....	4-23
4.12.5	Generator Set (PWR TRAN) Submenus	4-24
5	Operation 5-1	
5.1	Safety 5-1	
5.2	Introduction.....	5-1
5.3	Maintenance	5-1
5.4	Operating Recommendations.....	5-2
5.4.1	Running-in.....	5-2
5.4.2	No Load Operation.....	5-2
5.4.3	Exercise Period.....	5-2
5.4.4	Low Operating Temperatures	5-2
5.4.5	High Operating Temperatures	5-2
5.4.6	Operating Conditions for Prime, Standby and Continuous Power Ratings.	5-3
5.4.7	De-Rating Factors.....	5-4
5.5	Generator Set Operation	5-5
5.5.1	Sequence of Operation	5-5
5.6	Starting 5-5	
5.6.1	Pre-start Checks	5-6
5.6.2	Starting at Switch Panel (Manual Mode)	5-8
5.6.3	Starting at Remote Operator Panel (Auto Mode)	5-10
5.6.4	Starting from Remote Location (Switch or Device) (Auto Mode).....	5-10
5.6.5	Exercise Start.....	5-11
5.6.6	Cold Starting with Loads	5-11
5.7	Running at Idle (Manual)	5-12
5.8	Stopping	5-13
5.8.1	Emergency Stop (Code 1434)	5-13
5.8.2	Stopping at Switch Panel (Manual Mode).....	5-13
5.8.3	Stopping at Remote Operator Panel (Auto Mode).....	5-13
5.8.4	Stopping from Remote Location (Switch or Device) (Auto Mode).....	5-14
5.9	Optional Power Transfer Control (PTC) Operation	5-15
5.9.1	PCC3201/PTC – Normal Operation Sequences	5-15
5.9.2	Test Switch	5-15

6	Maintenance	6-1
6.1	Locking the Generator Set Out of Service	6-2
6.1.1	Introduction	6-2
6.1.2	Immobilising the Generator Set for Safe Working	6-3
6.2	General	6-3
6.3	Daily or Refuelling Maintenance Procedures	6-6
6.3.1	General Information	6-6
6.3.2	Engine Operation Report	6-6
6.4	Cooling System	6-6
6.4.1	Coolant Level - Check	6-7
6.4.2	Cooling Fan - Inspect	6-8
6.4.3	Drive Belt - Inspect	6-8
6.4.4	Radiator - Check	6-8
6.5	Engine Oil	6-9
6.5.1	Engine Oil Level – Check	6-9
6.6	Fuel System	6-10
6.6.1	Fuel Level	6-10
6.6.2	Fuel/Water Separator - Drain	6-10
6.7	Fluid Containment	6-11
6.8	Hoses and Fuel Lines - Check	6-11
6.9	Exhaust System	6-12
6.10	Generator Set Output - AC Electric System	6-12
6.11	DC Electrical System	6-12
7	Troubleshooting	7-1
7.1	Introduction	7-1
7.2	Control Unit DC Power Supply	7-1
7.3	Safety Considerations	7-2
7.4	Fault Finding	7-3
7.5	Status Indicators	7-3
7.5.1	Not In Auto Indicator	7-3
7.5.2	Shutdown Status Indicator	7-3
7.5.3	Warning Status Indicator	7-3
7.6	Reading Fault Codes	7-4
7.6.1	Reading Fault Codes Using Graphical Display (Optional)	7-4
7.6.2	Reading Fault Codes Using Warning/Shutdown Indicators	7-4
7.7	Line Circuit Breaker (Optional)	7-6
7.8	Control and Diagnostics Via Network or PC (Laptop)	7-6
7.9	Fault Codes	7-6
7.9.1	Category A Fault Codes	7-6
7.9.2	Category B Fault Codes	7-6
7.9.3	Category C Fault Codes	7-6
7.9.4	Category D Fault Codes	7-6
7.9.5	Category E Fault Codes	7-6

CONTENTS (continued)

Illustrations

Figure	Title	Page
Figure 2-1	Typical Generator Set Rating Plate.....	2-1
Figure 3-1	Typical Generator Set (C450 to C550).....	3-1
Figure 3-2	Alarm Module Front Panel.....	3-4
Figure 4-1	Control Panel Assembly (Full Featured)	4-3
Figure 4-2	Graphical Display and Menu Selection Buttons	4-6
Figure 4-3	Units Submenu	4-7
Figure 4-4	System Control Main Menus A and B	4-8
Figure 4-5	Engine Data Sub-menus	4-10
Figure 4-6	Alternator Data Sub-menus	4-11
Figure 4-7	Local Control Sub-menu.....	4-12
Figure 4-8	Control Sub-menu	4-13
Figure 4-9	History/About Sub-menus	4-15
Figure 4-10	Adjust Sub-menu.....	4-16
Figure 4-11	Bus Data Sub-menu	4-17
Figure 4-12	Password Menu.....	4-18
Figure 4-13	Power Transfer Main Menu	4-19
Figure 4-14	Utility Sub-menu	4-21
Figure 4-15	Status (PWR TRANS) Submenus	4-22
Figure 4-16	Transfer Control Submenus	4-23
Figure 4-17	Genset Submenus.....	4-24
Figure 5-1	Normal Start/Run/Stop Sequences	5-9
Figure 7-1	Front Control Panel (Full-Featured)	7-5

Tables

Table No.	Title	Page
Table 5-1	Manual Run	5-16
Table 5-2	Utility Power Fail.....	5-17
Table 5-3	Exercise with load	5-18
Table 7-1	Warning and Shutdown Fault Codes	7-7
Table 7-2	Troubleshooting Procedures for Fault Codes	7-10

Supplementary Publications

The Supplementary Publications appropriate to your system will also be supplied with the system. Where appropriate the corresponding Instruction Manual(s) will also be supplied with any accessory that you order.

Title	Publication No
Lead Acid Battery	0908-0101-00
Battery Charger	0908-0102-00
Radiator Information	0908-0107-00
Health and Safety (Diesel Generator sets)	0908-0110-00

Schedule of Abbreviations

AC	Alternating Current	MCB	Miniature Circuit Breaker
ACB	Air Circuit Breaker	MCCB	Moulded Case Circuit Breaker
ACH	Anti-Condensation Heaters	MF	Mains Failed
ATS	Automatic Transfer Switch	MFSS	Master First Start Sensor
AVR	Automatic Voltage Regulator	MR	Mains Returned
		MST	Mains Sensing Transformer
BHP	Brake Horsepower	MSU	Mains Sensing Unit
BMS	Building Management System	MV	Medium Voltage
BST	Busbar Sensing Transformer		
		NEC	Neutral Earthing Contact
CB	Circuit Breaker		
CCA	Cold Cranking Amps	PCC3201	PowerCommand™ Control System
CHP	Combined Heat and Power	PF	Power Factor
COP	Continuous Power Rating	PFC	Power Factor Controller
CT	Current Transformer	PLC	Programmable Logic Controller
		PMG	Permanent Magnet Generator
dB(A)	Unit of noise level	PRP	Prime Power Rating
DC	Direct Current	PSU	Power Supply Unit
DIP	Dual In-line Package	PT/CT	Potential Transformer /Current Transformer
DMC	Digital Master Control	PTC	Power Transfer Control
DMSU	Demand Load Standby Unit		
EMCU	Engine Monitoring and Control Unit	QCC	Quadrature Current Control
EMF	Electromotive Force		
EPU	Engine Protection Unit	RFI	Radio Frequency Interference
		RMS	Root Mean Square
FSS	First Start Sensor	RPM	Revolutions Per Minute
		RTD	Resistance Temperature Detector
GCP	Generator Control Panel	V	Volts
Genset	Generator Set	VAC	Volts, Alternating Current
GKWT	Global Kilowatt Transducer	VCB	Vacuum Circuit Breaker
		VDC	Volts, Direct Current
HV	High Voltage	VF	Volt-free
		VT	Voltage Transformer
IC	Integrated Circuit		
I/O	Input / Output		
kVA	Apparent Power		
kVAR	Reactive Power		
kW	Active / Real Power		
kWh	Unit of electrical energy or work		
LED	Light-Emitting Diode		
LTA	Low Temperature Aftercooling		
LTP	Limited Time Power Rating		
LV	Low Voltage		

This is a Blank Page



SECTION 1 – PRELIMINARY AND SAFETY

1 Safety

1.1 Warning, Caution and Note Styles Used In This Manual

The following safety styles found throughout this manual indicate potentially hazardous conditions to the operator, service personnel or the equipment.

WARNING: WARNS OF A HAZARD THAT MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

Caution: Warns of a hazard or an unsafe practice that can result in product or property damage.

Note: A short piece of text giving information that augments the current text.

1.2 Warnings

WARNING: IT IS IMPORTANT TO READ AND UNDERSTAND ALL SAFETY NOTICES PROVIDED IN THIS MANUAL. IMPROPER OPERATION OR MAINTENANCE COULD RESULT IN A SERIOUS ACCIDENT OR DAMAGE TO THE EQUIPMENT, CAUSING INJURY OR DEATH.

1.3 General Information

This manual should form part of the documentation package supplied by Cummins Power Generation Limited with specific generator sets. In the event that this manual has been supplied in isolation please refer to the other Cummins Power Generation Limited literature, in particular the Health and Safety Manual (0908-0110-00) and the engine manual relevant to your generator set.

Note: It is in the user's interest to read and understand all Health and Safety information together with all Warnings and Cautions contained within the documentation relevant to the generator set and its operation and maintenance.

1.4 Generator Plant Safety Code

Before operating the generator set, read this manual and become familiar with it and the equipment. Safe and efficient operation can be achieved only if the equipment is properly operated and maintained. Many accidents are caused by failure to follow fundamental rules and precautions.

WARNING: LIFTING AND REPOSITIONING ON THE GENERATOR SET MUST ONLY BE CARRIED OUT USING SUITABLE LIFTING EQUIPMENT, SHACKLES AND SPREADER BARS IN ACCORDANCE WITH LOCAL GUIDELINES AND LEGISLATION BY SUITABLY TRAINED AND EXPERIENCED PERSONNEL. INCORRECT LIFTING CAN RESULT IN SEVERE PERSONAL INJURY, DEATH AND/OR EQUIPMENT DAMAGE. FOR MORE INFORMATION CONTACT YOUR AUTHORISED DISTRIBUTOR.

This is a Blank Page



SECTION 2 - INTRODUCTION

2 Introduction

2.1 General

Before any attempt is made to operate the generator set, the user should take time to read this manual and to familiarise him or herself with the Warnings and Operating Procedures.

A generator set must be operated and maintained properly if you are to expect safe and reliable operation. The manual includes a maintenance schedule and a troubleshooting guide.

The engine manual is included with the set. Where there is conflicting information, this manual takes precedence over the engine manual.

2.2 Generating Set Identification

Each generating set is provided with a Generating Set Rating Plate similar to that shown below. This provides information unique to the set.


Model No.	51DGCB
Serial No.	C02K235250
IMPORTANT ! Model & Serial No. Required When Ordering Parts.	
 Power Generation	
Manston Park, Columbus Avenue, Ramsgate, Kent. England. CT12 5BF	
Made in the United Kingdom	
YEAR OF MANUFACTURE	2002
RATED POWER	PRIME
RATED (kW)	30
POWER FACTOR	0.8
VOLTAGE	400
RATED CURRENT (Amps)	188
FREQUENCY (Hz)	50
ROTATING SPEED (RPM)	1500
BATTERY VOLTS	12
GENSET MAX MASS (kg)	940
CONTROL SYSTEM	PCC
SITE ALTITUDE BEFORE DERATE	150mASL
SITE AMBIENT TEMP. BEFORE DERATE	40°C
OPTIONS:	
L037	KN58
R029	KM66
H578	KCP01
KCM01	C179
E082	C127
D041	L028
B463	KEX04
B184	KEX06
H536	KEX07
KMF01	A367
KPB01	KAC01
KPB02	
KBC01	
H074	

Figure 2-1

Typical Generator Set Rating Plate

2.3 After Sales Services

We offer a full range of after sales services as follows:

2.3.1 Maintenance

WARNING: INCORRECT SERVICE OR PARTS REPLACEMENT CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE TRAINED AND EXPERIENCED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

For customers who wish to have their generator sets expertly serviced at regular intervals the Customer Service Department offers a complete maintenance contract package. This covers all items subject to routine maintenance and includes a detailed report on the condition of the generator set. In addition, this can be linked to a 24-hour call-out arrangement, providing assistance 365 days a year if necessary. Specialist engineers are available to maintain optimum performance levels from customer's generator sets, and it is recommended that maintenance tasks are only undertaken by trained and experienced engineers provided by the Customer Service Department

2.3.2 Warranty

All generator sets have a twelve months warranty from the commissioning date as standard. Extended warranty coverage is also available. In the event of a breakdown prompt assistance can normally be given by factory trained service engineers with facilities to undertake all minor and many major repairs to equipment on site.

For further warranty details contact your authorised distributor.

2.3.3 Spares

An extensive Spare Parts Department is available for any emergency breakdown and for the engineer who carries out his own routine maintenance. Please contact your authorised Cummins Distributor.

Please quote Plant Nos., Serial Nos., and Part Nos. when ordering spares.

2.3.4 Overseas

Agents and representatives in almost 100 countries throughout the world offer installation and after sales service for the equipment provided. Your authorised distributor can provide the name and address of the agent for your specific location.

2.3.5 Additional Literature

Should you require further, more detailed information regarding the engine or alternator please contact your authorised distributor.

Please quote Plant Nos. and Serial Nos.

SECTION 3 – SYSTEM OVERVIEW

3 System Overview

3.1 Generator Components – Typical Generator Set

The main components of a Typical Generator Set are shown below and referred to within this section. Refer to the Engine Manual for location of other components, e.g. oil filler, dipstick, etc.

Data sheets are also available if additional, specific information is required. Contact your authorised distributor.

Various options are listed although they may not be available for all models.

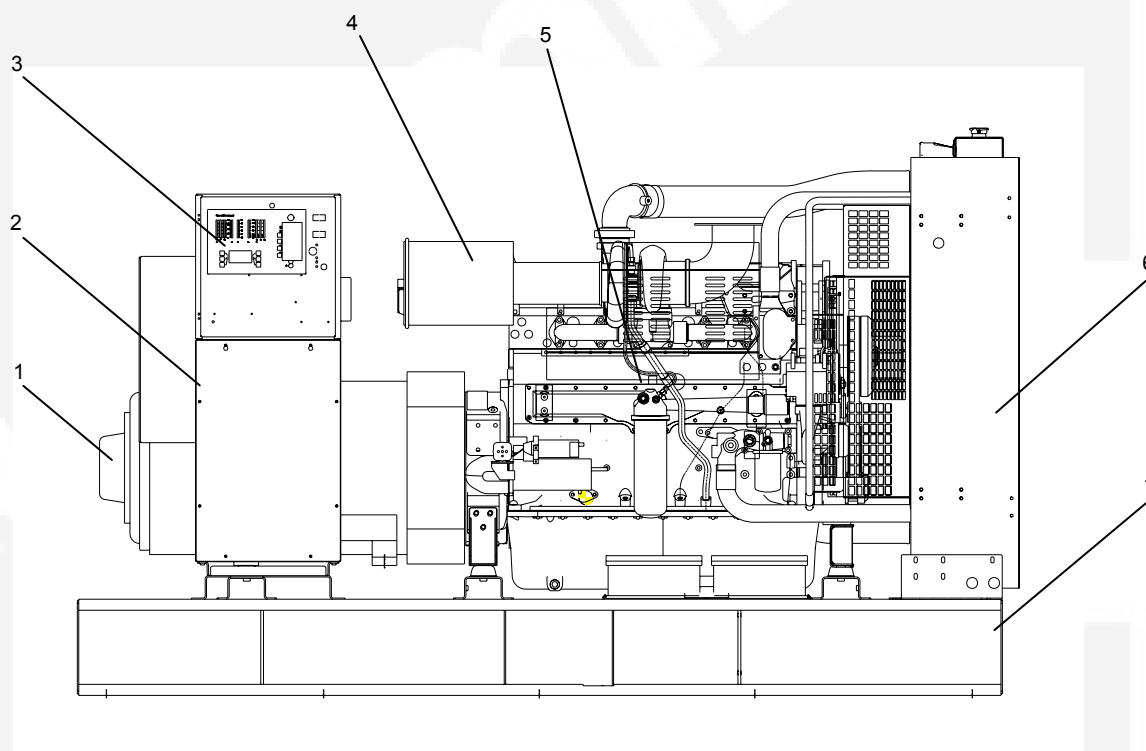


Figure 3-1 Typical Generator Set (C450 to C550)

KEY

- 1. Alternator
- 2. Control Housing
- 3. Control Panel
- 4. Air Cleaner
- 5. Engine
- 6. Radiator
- 7. Bed Frame

OPTIONS

- Batteries and Tray
- Circuit Breaker Entrance Box
- Electric Fuel Transfer Pump
- Engine Coolant Heater
- Sump Drain Pump

3.1.1 AC Supply and Isolation

It is the sole responsibility of the customer to provide the AC power supply and the means to isolate the AC input to the terminal box. Refer to the wiring diagram supplied with the generator set.

Note: *A separate disconnecting device is required by BS EN 12601:2001.*

<p><u>WARNING:</u> THE DISCONNECTING DEVICE IS NOT PROVIDED AS PART OF THE GENERATOR SET AND CUMMINS POWER GENERATION LIMITED ACCEPTS NO RESPONSIBILITY FOR PROVIDING THE MEANS OF ISOLATION.</p>
--

3.1.2 Control System

The control system is a micro-processor based control unit for monitoring and protecting the generator set (see Section 4) and can provide automatic paralleling. All indicators, control switches/buttons and the digital display are on the face of the control panel as illustrated in Figure 4-1.

The control system provides fuel control and engine speed governing, main alternator voltage output regulation, and complete generator set control and monitoring. The control also monitors the health of the engine, alternator and auxiliary systems continuously, via an array of sensors and senders located on the generator set, and will affect an Automatic Shutdown if a serious fault occurs.

3.1.3 Engine

All generator sets employ a 4-stroke, water-cooled engine and incorporate a governor control and full engine protection system. Refer to the Generating Set Rating Plate for engine type and rating details.

For further information refer to the engine manual supplied with this manual.

3.1.4 Alternator

All generator sets use AC alternators of a brushless, rotating field design, which eliminates the maintenance associated with slip rings and brushes. Refer to the Generating Set Rating Plate for alternator type and rating details.

3.1.5 Generator Rating

For details of your generator rating refer to the Generating Set Rating Plate.

3.1.6 Generator Set Construction

Most generator sets are constructed as a single module with the engine and alternator connected through a coupling chamber with resilient mountings to form one unit. The engine and alternator are mounted on a bedframe on resilient mounts. This results in one unit of immense strength and rigidity, with accurate alignment between the engine and alternator, and effective damping of engine vibration.

3.1.7 Fuel System

A fuel tank incorporated into the base frame can be provided. Alternately free standing main tanks with stands providing 450, 900 and 1350 litre capacity are available as options.

Note: *Where spillage containment is not part of Cummins supply, it is the responsibility of the installer to provide the necessary containment to prevent contamination of the environment, especially water courses/sources.*

3.1.7.1 Fuel Transfer Pumps (Option)

Free standing fuel tanks can be filled manually using an optional hand fuel transfer pump.

Alternatively, fuel tanks can be filled automatically using an electrical fuel transfer pump. This pump, which is supplied complete with starter, operates under the control of Low and High Fuel Level switches fitted to the tank.

On automatically filled systems, the tank filler cap is replaced with an overflow/breather connection to allow piping to a safe area or return to a bulk tank.

3.1.7.2 Fuel / Water Separators

Set-mounted fuel/water separators are fitted as standard to provide protection for the engine fuel injection system as water-free fuel supplies cannot be guaranteed.

3.1.8 Cooling System

The engine cooling system consists of a radiator and pusher fan, mechanically driven water pump and a thermostat. The fan drives air through the radiator and removes surface heat from the engine and alternator.

The alternator has its own internal cooling fan.

3.1.9 Engine Exhaust (Option)

WARNING: EXHAUST PIPES AND CHARGE AIR PIPES ARE VERY HOT AND THEY CAN CAUSE SEVERE PERSONAL INJURY OR DEATH FROM DIRECT CONTACT OR FROM FIRE HAZARD.

Exhaust systems, which are optional and supplied in loose form, reduce engine noise to acceptable levels and pipe exhaust gases to an area where they will not present a hazard. Industrial and residential types are available as options. Flexible bellows are also available as an option.

3.1.10 DC Electrical System

A 24 volt battery system provides multi-attempt engine starting and DC power for the generator set control system.

3.1.10.1 Battery System

Battery type, size and voltage are selected to suit the generator set capacity and application on ordering.

3.1.10.2 Charge Alternator

An engine driven charge alternator is provided as standard to maintain the battery in a charged condition when the engine is running.

3.1.10.3 Mains Powered Battery Charger (Option)

Optional single phase, mains powered battery chargers, which can be panel or wall mounted, are available to maintain the battery in a charged condition when the generator set is not running.

3.1.11 Alarm Module (Option)

The front panel comprises a warning horn, three indicator lights, and one toggle-switch, and has the ability to provide warnings audibly and/or visually.

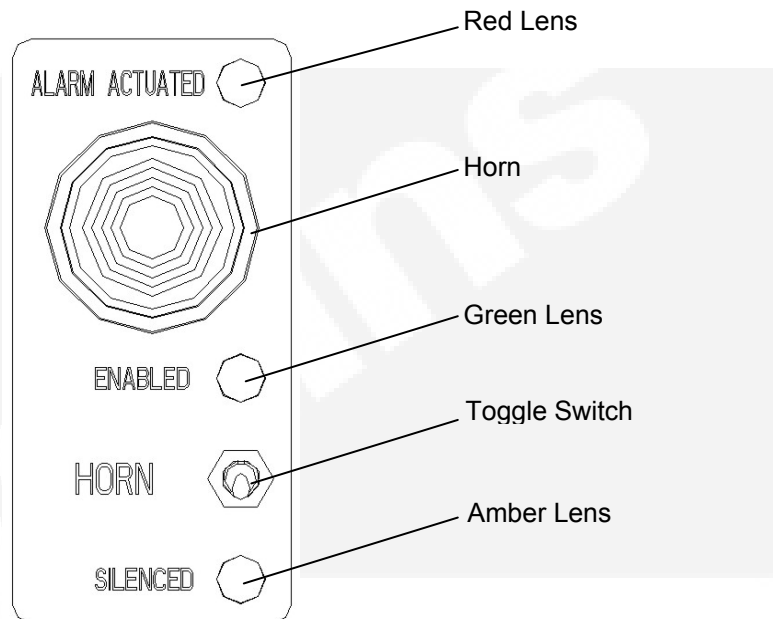


Figure 3-2 Alarm Module Front Panel

The toggle-switch provides the user with the ability to enable or silence the horn. The green or the amber LED will illuminate to indicate the active mode of the toggle-switch, whilst the red LED will illuminate if the alarm has been activated.

The three indicator lights provide the following information:

LED	Label Text	English
Red	Alarm Actuated	Alarm Actuated
Green	Enabled	Enabled
Amber	Silenced	Silenced

3.1.12 Sensors/Senders

Various generator set parameters are measured by sensors, senders, RTDs etc. and the resulting signals are received by the control.

Engine mounted sensors are able to monitor the following systems:

- Cooling system
- Fuel
- Lube oil
- Miscellaneous areas

Optional alternator mounted sensors are able to monitor the following parameter:

- Winding temps

3.2 Heaters

Caution: *Heater(s) must not be energised if the coolant system has been drained.*

3.2.1 Heater Supply and Isolation

A heater supply is required for the operation of the engine and alternator heaters. See Section 3.1.1.

A separate disconnecting device is required by BS EN 12601:2001.

Note: *This disconnecting device is not provided as part of the generator set.*

Note: *It is the sole responsibility of the customer to provide the power supply and the means to isolate the AC input to the terminal box. Cummins Power Generation Limited accepts no responsibility for providing the means of isolation.*

WARNING: THE AC SUPPLY TO THE TERMINAL BOX MUST BE ISOLATED BEFORE ATTEMPTING TO GAIN ACCESS TO THE TERMINAL BOX.

Caution: *Remove AC power to the heater before disconnecting battery leads. Heater will run continuously without DC power and can overheat and damage heater.*

3.2.2 Engine Heater (Option)

The engine heater is designed to keep the engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine, reducing start-up time and engine wear caused by cold starts. The heater is controlled by an associated thermostat, but is locked out at engine start.

WARNING: ALWAYS ISOLATE THE SUPPLY TO THE ENGINE HEATER / THERMOSTAT BEFORE CARRYING OUT ANY MAINTENANCE ON THE ENGINE. ALWAYS ISOLATE THE GENERATOR SET PRIOR TO ANY MAINTENANCE.

Caution: *The engine heater is in no way intended to protect the engine and cooling system from freezing in sub zero conditions. If there is any danger from freezing, then a suitable antifreeze agent must be added to the cooling system.*

3.2.3 Alternator Heater (Option)

The alternator heater is designed to keep the alternator free of condensation when the generator set is not running. During cool and humid conditions, condensation can form within the alternator, which can result in insulation degradation, leading to failure, and a possible shock hazard. The heater is locked out at engine start.

WARNING: ALWAYS ISOLATE THE ALTERNATOR HEATER FROM THE AC SUPPLY BEFORE WORKING ON THE ALTERNATOR OR HEATER.

3.2.4 Control Panel Heater (Option)

The control panel heater provides a means of humidity/temperature control within the control box interior. It protects the components and ensures their effectiveness when the generator set is subjected to varying ambient air conditions during extended periods of non-use. The heater is locked out at engine start.

WARNING: ALWAYS ISOLATE THE CONTROL PANEL HEATER FROM THE AC SUPPLY BEFORE WORKING ON THE CONTROL PANEL OR HEATER.

3.3 Mains Powered Battery Charger (Option)

<u>Caution:</u> <i>Isolate the charger before disconnecting the battery</i>
--

3.3.1 Operation

This unit maintains the battery in a fully charged condition without over-charging. The unit also provides rapid charging, when necessary, at a current up to the rated output.

The charger's electronic control circuit allows the charger to be left in circuit during engine cranking and to operate in parallel with the charge alternator.

The charger will supply current to the battery system when the battery terminal voltage is equal to the set float voltage, at which point only a trickle charge current is present. When the battery becomes discharged due to a load being present and the terminal voltage falls, the charger will again supply current to restore the voltage of the battery to the float voltage.

Should a charge fail condition occur for longer than ten seconds then the charge fail relay will energise, and its contact close. Charger operation is indicated by a red LED.

Note: *The LED will light even if the charger output fuse is blown.*

3.3.2 Boost Charge (Option)

During trickle charging, not all cells in the battery receive the same charge and over a period of several months this may affect battery performance. It is therefore normal to give batteries a regular charge at their **full rate** to return all cells to full capacity. This is referred to as Boost Charging (also known as equalise charging).

If the charger is fitted with a Boost Charge switch, the Boost position should be selected at intervals detailed by the battery manufacturer (normally around every six months).

<u>Caution:</u> <i>Batteries should not be left on Boost Charge for extended periods as this will result in excessive water consumption and gassing and may impair battery performance.</i>
--

SECTION 4 – CONTROL SYSTEM

4 Control System

4.1 Control System Description

The main control panel consists of two panels, the Operator Panel and the Switch Panel. These and their associated equipment are located in the Control Housing, which is mounted at the rear of the generator set.

Dependent on site requirements the Operator Panel may be mounted in the control panel assembly (full-featured) as shown in Figure 4-1, or it may be contained in a separate enclosure and mounted remotely of the control panel assembly. In this latter case, the panel may be situated up to 1.2km (4,000ft) away from the generator set.

Note: *The function of several buttons on the Operator Panel will vary dependent on the location of the Operator Panel (remote or local of the Control Panel assembly). If the function differs, it is noted as either Remote or Local Operator Panel in the description.*

The control system is a micro-processor based control unit for monitoring and protecting the generator set and can provide automatic paralleling. All indicators, control switches/buttons and the digital display are on the face of the control panel as illustrated in Figure 4-1.

The control system provides fuel control and engine speed governing, main alternator voltage output regulation, and complete generator set control and monitoring. The control also monitors the health of the engine, alternator and auxiliary systems continuously, via an array of sensors and senders located on the generator set, and will affect an Automatic Shutdown if a serious fault occurs.

There are two fault level signals generated by the control system as follows:

1. **Warning:** signals an imminent or non-fatal fault for the engine. The control provides an indication only for this condition.
2. **Shutdown:** signals a potentially fatal fault for the engine. The control will automatically take the engine off-load and shut it down immediately, without a cooling down run.

The control system operates on 24V DC battery power. The auxiliary equipment operates on LV AC power. The history data is stored in non-volatile memory and will not be deleted due to loss of battery power.

In addition to the many control and annunciation functions, the PCC 3201 can be easily upgraded to communicate over a PowerCommand™ Network, or to work as part of a paralleling system.

4.1.1 Control Panel Power ON/OFF Modes

The power on/off modes of the control panel and operating software are Power On, Screen Saver and Sleep/Awake.

Power On Mode

In this mode, power is continuously supplied to the control panel. The control's operating software and control panel LEDs/graphical display will remain active until the Screen Saver mode is activated.

Screen Saver Mode

Power to the graphical display will be removed after ten minutes (generator set not running or running). The ten minute timer resets and begins after each control panel action (any button or switch selection) or signal received by the operating software. The bottom LEDs of the Analogue AC Metering Panel (bar graphs) may remain on during Screen Saver mode, indicating that the operating software is active (Awake mode).

When a Warning signal is sensed by the control, (for example, Low Coolant Temp), a warning message will be displayed. The control will remain active until the Fault Acknowledge button is pressed to clear the warning message and start the ten minute timer.

Sleep/Awake Mode

In the Sleep mode, the control's operating software is inactive and the LEDs and the graphical display on the control panel are all off. Sleep mode is a feature that is used to reduce battery power consumption when the control is in the Auto mode and is not being used.

When all conditions are met (i.e., no unacknowledged faults, Screen Saver Mode is active, and Off/Manual/Auto switch is in the Auto position) the Sleep mode will be activated.

The operating software is initialised and the control panel LEDs and graphical display are turned on in response to one of the following:

- Moving/pressing any control panel switch/button
- A remote start input signal (generator set in Auto mode)
- Customer fault 2 or 3 only (Shutdown or Warning indicator is on)

To activate the control and view the menu display without starting the generator set, press any button on the control panel.

The InPower service tool is required to enable or disable the Sleep mode. When shipped from the factory, the Sleep mode is disabled. When disabled, the operating software will always remain active (Awake mode) when the control is in Auto mode.

Note: *The InPower service tool is required in order to select the desired mode. Contact your authorised distributor for assistance.*

4.1.2 Control Panel - Front Panel

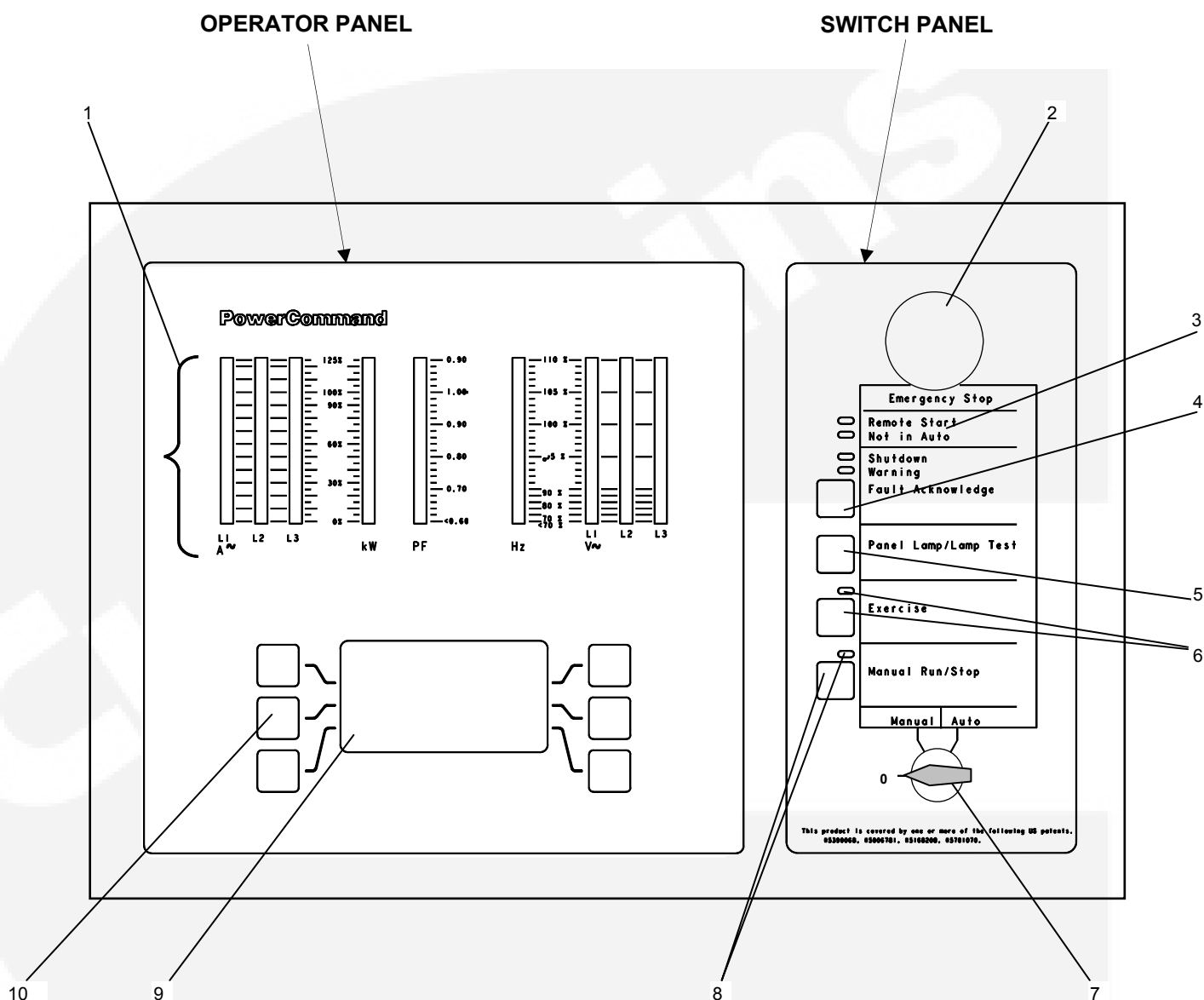


Figure 4-1 Control Panel Assembly (Full Featured)

- | | |
|--------------------------------|---|
| 1. Analogue AC metering panel | 7. Off/Manual/Auto switch (mode switch)
(This is a Key Switch) |
| 2. Emergency stop push switch | 8. Manual Run/Stop button & indicator |
| 3. Status indicators | 9. Graphical display |
| 4. Fault acknowledge button | 10. Display menu selection buttons (1 of 6) |
| 5. Panel lamp/lamp test button | |
| 6. Exercise button & indicator | |

4.1.3 Control Panel - Operator Panel

The operator panel contains the following components:

Analogue AC Metering Panel:

This panel simultaneously displays 3-phase line-to-line AC volts and current, kW, power factor and frequency.

The meter panel is composed of a series of LEDs that are configured in bar graphs for each function. The LEDs are colour coded, with green indicating normal range values, amber for Warning levels and red for Shutdown conditions.

Scales for each function are in % of nominal values. Resolution is 1% for values close to nominal, and increases for values further from nominal.

Graphical Display:

The graphical display is capable of displaying up to nine lines of data with approximately 27 characters per line. The display is used to view the menus of the menu-driven operating system. (Refer to the menu trees later in this section). The display is also used to show Warning and Shutdown messages/error codes, modes of operation (Figure 4-2) and system actions, such as Warning, De-rate, Shutdown, etc.

Display Menu Selection Buttons:

Six momentary buttons—three on each side of the graphical display window—are used to navigate through the system control menus and to adjust generator set parameters. The button is active when the message adjacent to the button is highlighted (displayed in inverse video).

4.1.4 Control Panel - Switch Panel

WARNING: SOME PANEL INTERNAL COMPONENTS MAY HAVE LIVE EXPOSED TERMINATIONS EVEN IF THE GENERATOR SET IS NOT RUNNING. ISOLATE ALL EXTERNAL ELECTRICAL SUPPLIES PRIOR TO ACCESS OF THE CONTROL PANEL.

The switch panel contains the following components:

Emergency Stop Button:

Push the button in for Emergency Shutdown of the engine. If the engine is not running, pushing the button in will prevent the starting of the engine, regardless of the start signal source (local or remote).

To reset:

- Pull, or twist and pull, the button out.
- Turn the Off/Manual/Auto switch to Off (O).
- Press the front panel Fault Acknowledge button.
- Select Manual or Auto, as required.

Caution: *Ensure that the cause of the emergency is fully investigated and remedied before an emergency stop Reset, and generator set Start are attempted.*

Note: *Emergency Stop shutdown status can be reset only at the operator control panel.*

Remote Start Indicator:

This green lamp is lit whenever the control is receiving a Remote Run signal. When this lamp is flashing, it indicates a load demand stop mode.

Not in Auto Indicator:

This red lamp flashes continuously when the Off/Manual/Auto switch is not in the Auto position. (If it is in the Auto position and the lamp is flashing, this indicates that a service is required).

Shutdown Status Indicator:

This red lamp is lit whenever the control detects a Shutdown condition. The generator set cannot be started when this lamp is on. After the condition is corrected, Shutdown indicators can be reset by turning the Off/Manual/Auto switch to the Off (O) position, and pressing the Fault Acknowledge button.

Dependent upon the specific fault that occurs, the engine may or may not shut down immediately. A fault that could cause engine damage causes an immediate engine shutdown (bypasses engine cool-down sequence). All other faults would allow the engine to run during the cool-down sequence before engine shutdown. In this case, the Shutdown Status Indicator blinks during the cooldown period.

Warning Status Indicator:

This yellow lamp is lit whenever the control detects a Warning condition. After the condition is corrected, warning indicators can be reset by pressing the Fault Acknowledge button. (It is **not** necessary to stop the generator set if the fault becomes inactive during generator set operation).

Fault Acknowledge:

Press this button to acknowledge Warning and Shutdown messages after the fault has been corrected.

To acknowledge a Warning message, the Off/Manual/Auto switch can be in any position. (It is **not** necessary to stop the generator set to acknowledge an inactive Warning condition). To acknowledge a Shutdown message with this button, the Off/Manual/Auto switch must be in the Off (O) position.

This button is also used to blink a fault code if the Shutdown or Warning Status Indicator is lit. (This function is used when the control does not contain a graphical display). Refer to Reading Fault Codes in Section 7 -Troubleshooting, which describes how to use this button for interpreting fault codes.

Panel Lamp/Lamp Test Button:

Press this button to turn the panel lamp on or off.

Press and hold down this button for a minimum of three seconds to turn all control panel LEDs on, to make sure all lamps illuminate. The illumination will shut off after releasing the button.

Exercise Button:

Press this button to initiate a pre-programmed exercise sequence. The Off/Manual/Auto switch is used in conjunction with this button to enable this function (refer to Section 5.6.5 Exercise Start).

Manual Run/Stop Button:

This button starts and stops the set locally and will bypass Time Delay to Start and Stop sequences. The Off/Manual/Auto switch must be in the Manual position to enable this button.

Off/Manual/Auto Switch:

Manual position enables the use of the switch panel Manual Run/Stop button.

Auto position enables start/stop control of the engine from a remote location. (Disables the use of the switch panel Manual Run/Stop button).

Off (O) position prevents the starting of the generator set (local or remote). If moved to Off (O) during set operation, an immediate engine shutdown will be initiated (bypasses cool-down timers). This hot shutdown should be avoided, if possible, to help reduce unnecessary engine wear. Hot shutdowns are logged by the system software.

A key function is provided to prevent unauthorised operation of the switch.

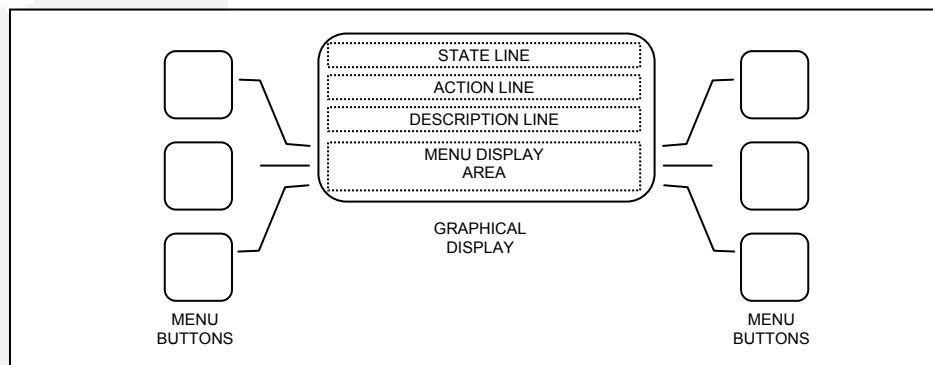
4.2 Menu Display and Switches

Figure 4-2 shows the graphical display and the menu selection buttons.

4.2.1 Graphical Display

The graphical display is capable of displaying up to nine lines of data with approximately 27 characters per line. The display is used to view the menus of the menu-driven operating system. (Refer to the menu trees later in this section). The display is also used to show the following system information:

- **State Line** - modes of operation, such as Stopped, Time Delay to Start, Warm Up at Idle, etc. (see Figure 4-1), and paralleling operations, such as Standby, Dead BUS Close, Synchronise, etc.
- **Action Line** - system actions, such as Warning, De-rate, Shutdown Cool-down and Shutdown, and fault codes.



- **Description Line** - Fault code/status messages.

Figure 4-2


Graphical Display and Menu Selection Buttons

4.2.2 Menu Buttons

Six momentary buttons - three on each side of the graphical display window - are used to navigate through the system control menus and to adjust generator set parameters. The button is active when the message or symbol adjacent to the switch is highlighted (displayed in inverse video). The displayed message or symbol indicates the function of the button.

Note: In the graphical display, the ▼ symbol indicates that selecting the adjacent button causes the operating program to go to the next menu display—as shown in the menu diagrams.

In the graphical display, the ▲ symbol indicates that selecting the adjacent button causes the operating program to go back to the previous menu display.

In the graphical display, the  symbol indicates that selecting the adjacent button causes the operating program to go back to Main Menu A (Figure 4-4).

4.3 Menu Units Selection

During any control panel operation, you can change how units are displayed by pressing the two lower menu buttons (one on each side of display). When pressing these two buttons simultaneously, the unit's submenus will appear (Figure 4-3). After selecting the desired units, press the **ENTER** button in this submenu to change and save the selections.

Note: Use the **+** button to select the desired option for each field. Use the arrow (→) button to move to the next field. Selected field is highlighted.

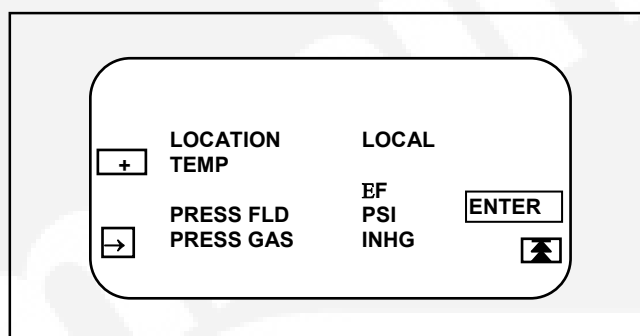


Figure 4-3 Units Submenu

4.3.1 Local/Remote Field

This selection must be set to Local, when the graphical display is mounted on the generator set front control panel, or Remote when mounted remotely from the generator set.

The Local/Remote selection determines which buttons in the Control submenu (Section 4.7) are active (displayed).

Temp:	Used to select °F or °C for temperature readings.
Pressure Fluid:	Used to select PSI, KPa, BAR or IN for pressure readings.
Pressure Gas:	Used to select INHG or MMHG for pressure readings.
Flow Air:	Used to select CFM or CMM for airflow readings.

4.4 Main Menu

Figure 4-4 shows the main menus (Menu A and Menu B) of the system control. The two main menus are used to divide the system submenus into major categories, such as, Engine Data, Alternator Data, Control, etc.

To view system data, simply press the appropriate menu button to select the category. After pressing the desired menu button, refer to the following pages for detailed information related to the selected category.

Note: The numerical information shown in the following figures is for example only. They do not necessarily reflect the information for your specific generator set.

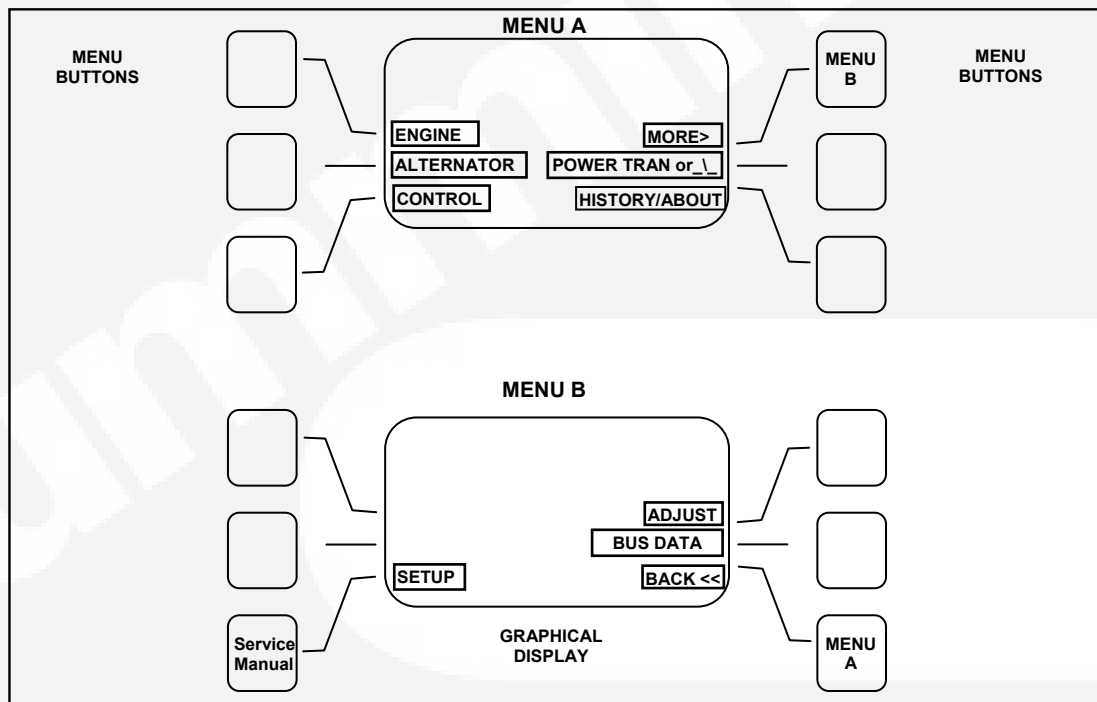


Figure 4-4 System Control Main Menus A and B

Note: In the following figures, the boxed/highlighted field indicates that the adjacent menu button is active. Also, the submenus are shown in the order in which they are displayed when scrolling up ▲, or down ▼.

4.4.1 Adjust Button

The Adjust submenu is intended for competent site personnel only. Note that a password may be assigned to allow only authorised operators to modify this data.

4.4.2 Set-up Button


The Set-up submenu is described in the Service manual and is intended for competent service personnel only. For this reason, a password must be entered before this data can be modified.


Note: PTC – The PTC Setup submenu is intended for qualified service and site personnel only. Password is provided, but can be changed after installation to prevent unauthorised modifications,

Note: The Adjust and Set-up submenus can be viewed, but not modified without entering the correct passwords.

4.4.3 Button (Paralleling applications only)

When displayed, indicates that the feature for generator set paralleling applications is enabled. This button is used to open and close the generator set circuit breaker (CB). The symbol indicates if the CB is opened or closed.

Opened , push to close.

Closed , push to open.

With the control panel Off/Manual/Auto switch in the Auto position, the opening and closing of the CB is controlled by the control system software. The CB symbol will indicate an open or closed CB, but the button will be inactive when the control is in Auto.

In the Manual position, the CB can only be closed by using this button. When manually closed and the CB opens, it must be closed again by using this button. To close the CB, press and hold the button until the symbol indicates a closed CB. (CB close will occur only when set-up conditions allow - dead bus or generator set synchronised with bus).

4.4.4 Power Trans Button (PTC applications only)

When displayed, indicates that the Power Transfer Control feature is enabled.

Refer to Section 4-12 for submenu description.

4.5 Engine Data Submenus

If you press the Engine Data button in Menu A, the Engine Data submenus will appear (Figure 4-5).

The first submenu displays general information that applies to all generator sets (coolant temp, oil pressure, etc.) The data in the remaining submenu(s) will vary according to the type and number of sensors provided with the engine.

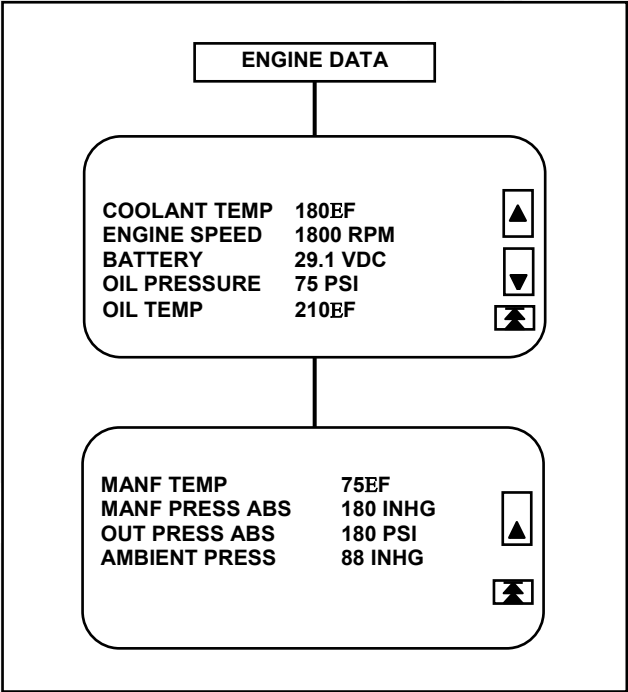


Figure 4-5 Engine Data Sub-menus

4.6 Alternator Data Submenus

If the Alternator Data button in Menu A is pressed, the Alternator Data submenus will appear (Figure 4-6).

4.6.1 Voltage L–L and L–N

Indicates voltage Line-to-Line, and Line-to-Neutral. Note that the Line-to-Neutral column will not be displayed for a 3-phase/3-wire system. Accuracy 1%.

The voltages Line-to-Line (L1, L2 and L3) are measured between L1 to L2, L2 to L3 and L3 to L1, respectively.

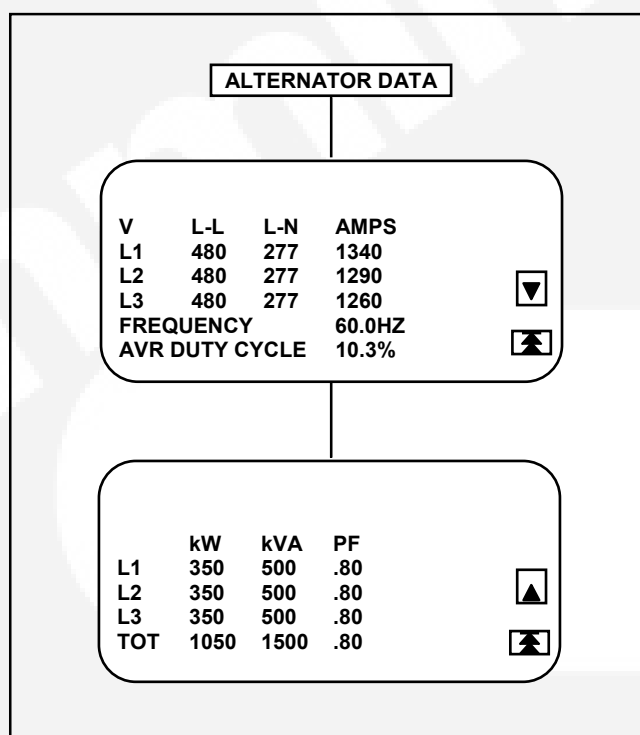


Figure 4-6 Alternator Data Sub-menus

4.6.2 Amps

All phases. Accuracy 1%.

4.6.3 Frequency

Generator set output frequency.

4.6.4 AVR Duty Cycle

Displays voltage regulator (drive) level in percentage of maximum.

4.6.5 kW, kVA and PF

Displays generator set kW and kVA output (average and individual phase, and direction of flow) and power factor with leading/lagging indication. Accuracy 5%.

Note: The PF reading will contain an asterisk if the power factor is leading (e.g., *.30).

4.7 Control Submenu

If the Control button in Menu A is pressed, the Control submenu will appear (Figure 4-7).

4.7.1 Local Control Submenu Function

When the Operator panel (Figure 4-1) is mounted on the control panel assembly, the Run Mode Idle/Rated button is active (displayed).

Note: In remote applications (Figure 4-8) this button is not displayed.

The shaded area in Figure 4-7 displays the selected/active mode of operation, (Idle or Rated).

Note: Run Mode Idle/Run at Rated Button: Refer to Section 5.7 for a complete description of the Run at Idle mode.

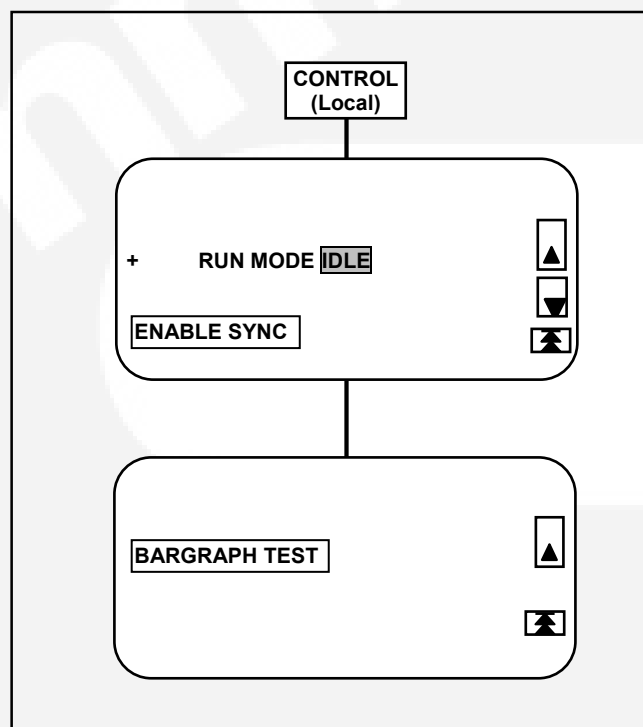


Figure 4-7 Local Control Sub-menu

4.7.2 Remote Control Submenu Functions

When the Operator panel is mounted remotely of the control panel assembly, the menu buttons in the Control submenu are used to perform the following remote operations. (To activate these menu buttons for Remote/Local use, refer to Section 4.3.1).

Note: *The Off/Manual/Auto switch must be in the Auto position to activate the Remote Menu Buttons of the Control submenu.*

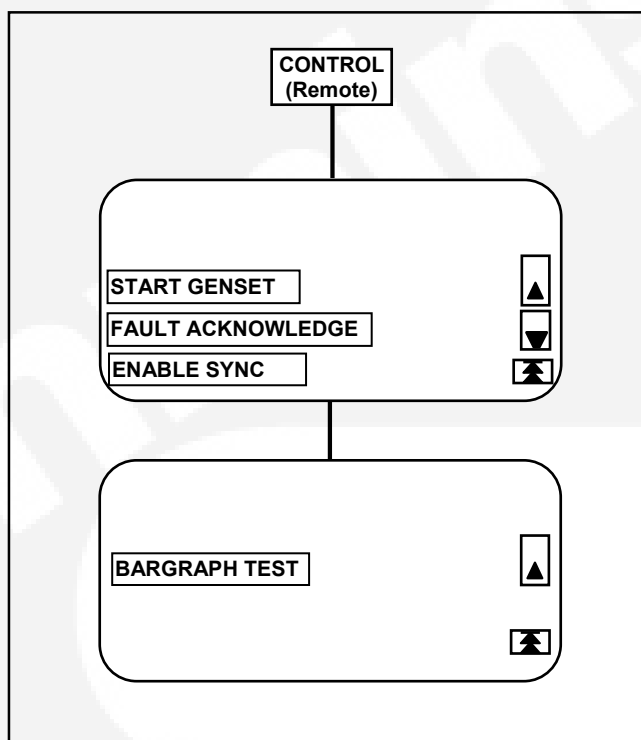


Figure 4-8

Control Sub-menu

4.7.2.1 Remote Start or Stop Button:

This button is used to Start and Stop the generator set when the operator panel is mounted in a remote location. For additional information refer to the Starting at Remote Operator Panel (Section 5.6.3) and Stopping at Remote Operator Panel (Section 5.8.3).

When the generator set is operating, Stop will be displayed for this button and Start will be displayed when the set is not operating.

4.7.2.2 Fault Acknowledge Button:

Used to reset inactive Warning messages, not Shutdown messages.

4.7.3 Local/Remote Control Submenu Function

4.7.3.1 Bargraph Test:

The function of this button remains the same and is not dependent on operator panel location. This button sequentially lights the LEDs to test the bar graph display.

4.7.3.2 Enable Sync:

Displayed in paralleling applications only. Intended for service personnel to turn off the synchroniser for troubleshooting/testing purposes.

4.8 History/About Submenus

Pressing the History/About button in Menu A will reveal the History/About submenus (Figure 4-9).

4.8.1 History

The control maintains a data log of the number of engine starts and number of operating hours for the engine and control, and the megawatt and maximum torque hours of the generator set. This information is stored in non-volatile memory and will not be deleted due to loss of battery power.

4.8.2 About

The About submenus provide the following generator set information:

- Generator set model and wattage (kW/MW)
- Output voltage and WYE, DELTA or SINGLE
- Frequency 50 or 60 Hz
- Rating: Standby, Prime or Base
- Version level of the controller and panel operating software

4.8.3 Fault History

The control maintains a data log of all fault conditions as they occur, and time stamps them with the control and engine operating hours.

Up to 32 (unacknowledged) fault codes can be stored in control panel memory. Following Fault acknowledgement and correction, it is deleted from the control panel memory. However, it remains in a data log that maintains the fault code history. (The InPower service tool is required to view this data log).

The Fault History display line: 1 of 24 indicates that 24 faults are recorded and that the most recent fault (1) detected by the controller is displayed.

The Occurrences display line: In this example, 5 indicates that this is the fifth occurrence of this fault. (The InPower service tool is required to review the last four faults of this code).

Note: *The Occurrences number is incremented for each new occurrence of the same fault. The controller must detect that the original sensed fault is corrected before it will increment the occurrence number for that fault.*

For example, when a Low Oil Pressure fault is detected, the controller will increment the Occurrences number by 1. This fault will remain active until the controller detects that the fault is corrected. An active fault will prevent the controller from incrementing the Occurrences number each time the engine is started. When the controller detects that the oil pressure is normal the fault will become inactive, allowing the occurrences number to be incremented for the next detected Low Oil Pressure fault.

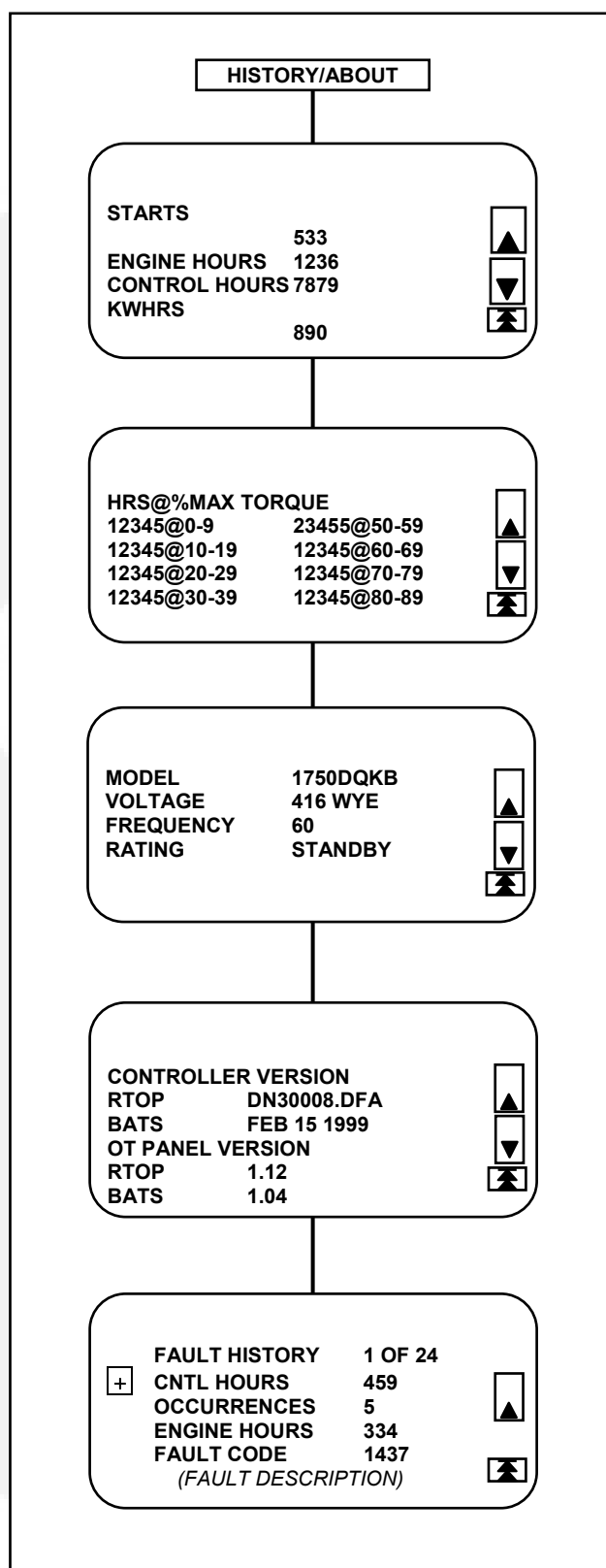


Figure 4-9

History/About Sub-menus

4.9 Adjust Sub-menu

If the Adjust button in Menu B is pressed, the Adjust submenu will appear (Figure 4-10).

The Adjust submenu is intended for qualified service personnel and site personnel only and may require a *USER* password. If a password is required, the *USER* password menu will appear when you try to modify the Adjust submenu. (Refer to Password Menu in Section 4.11 to enter password).

Changes are automatically saved when you exit this menu.

Note: Use the + and - buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Selected field is highlighted.

- **START DELAY:** This delay applies only to remote starting in the Auto mode. The Start Delay adjustment range is 0 to 300 seconds.
- **STOP DELAY:** This delay applies only to remote stopping in the Auto mode. The Stop Delay adjustment range is 0 to 600 seconds.
- **VOLTAGE:** Used to adjust the output voltage $\pm 5\%$.
- **FREQUENCY:** Used to adjust the frequency ± 3 Hz.
- **VOLTAGE/SPEED DROOP:** These two sub-menus apply to a generator set that has the paralleling option enabled and is configured to operate in droop mode. These adjustments must be performed by technically qualified personnel only.

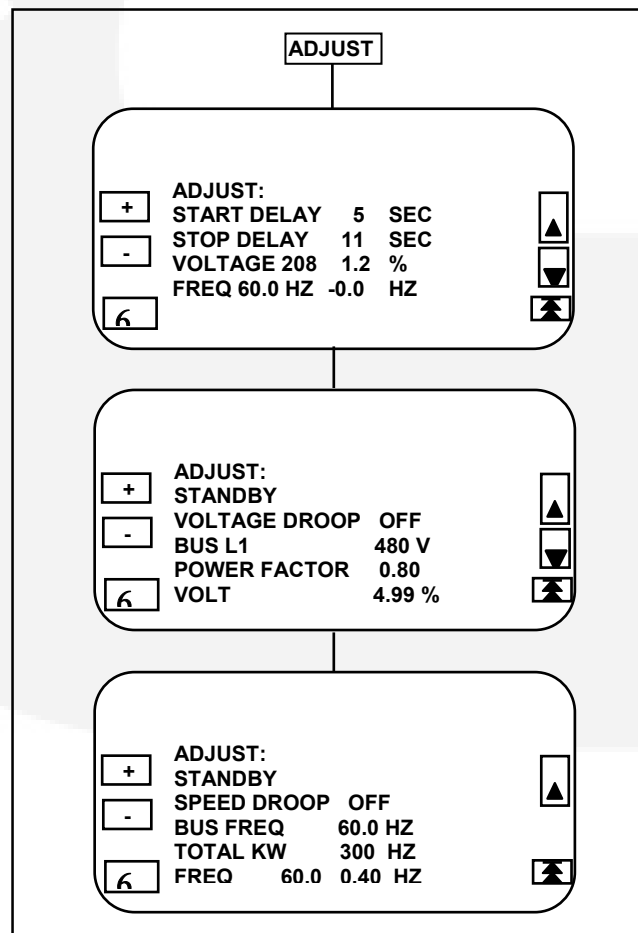


Figure 4-10

Adjust Sub-menu

4.10 Parallel Data Submenu

If the Parallel Data button in Menu B is pressed, the Parallel Data submenu will appear (Figure 4-11). This menu is displayed in paralleling applications only.

4.10.1 Parallel Data Status Line

The top line of the graphical display is used to indicate the following Parallel Data status:

- **STANDBY:** Indicates no paralleling activity is occurring.
- **DEAD BUS CLOSE:** Indicates first generator set in system to close to bus.
- **SYNCHRONISE:** Generator set is synchronising to bus.
- **LOAD SHARE:** Generator set has closed to bus and is sharing load with other generator sets in system.
- **LOAD GOVERN:** Generator set closed to bus in parallel with utility (mains).

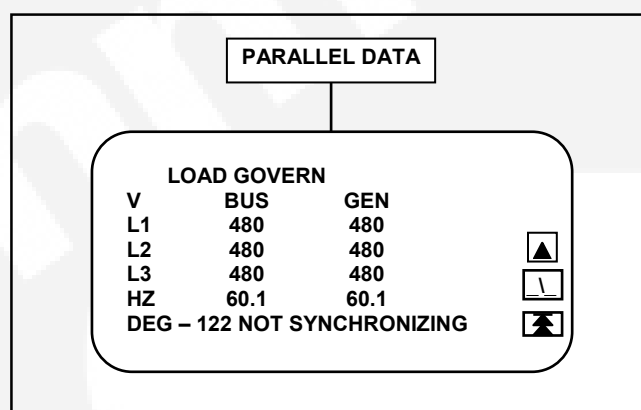


Figure 4-11 Bus Data Sub-menu

BUS Voltage L-L: The BUS voltage Line-to-Line (L1, L2 and L3) is measured between L1 to L2, L2 to L3 and L3 to L1, respectively.

BUS/GEN HZ: BUS/GEN hertz.

BUS/GEN SYNC STATUS: The bottom line of the graphical display is used to indicate the following BUS/GEN Sync status:

- **NOT SYNCHRONIZING:** Generator set is in service mode that does not allow auto sync feature.
- **SYNCHRONIZING:** Generator set is synchronising to bus.
- **READY TO CLOSE:** In manual mode, push circuit breaker close button to close breaker.
- **_/_ Button:** (Paralleling applications only). Used to open and close the generator set circuit breaker (CB). The symbol indicates if the CB is opened or closed.
Opened _/_ , push to close.
Closed _/_ , push to open.

With the control panel Off/Manual/Auto switch in the Auto position, the opening and closing of the CB is controlled by the control system software. The CB symbol will indicate an open or closed CB, but the button will be inactive when the control is in Auto.

In the Manual position, the CB must be closed by this button. When manually closed and the CB opens, it must be closed again by using this button. To close the CB, press and hold the button until the symbol indicates a closed CB. (CB close will occur only when set-up conditions allow - dead bus or generator synchronised with bus).

4.11 Password Menu

When viewing the Adjust submenu, pressing either the + or - button will display the Password menu (Figure 4-12) if a User password is assigned to this field. After entering the correct password, the system will allow you to modify the submenu. To prevent unauthorised adjustment, the entered password is valid for only ten minutes after the last button is pressed.

Note: *Application Password is intended only for competent service personnel to allow adjustment of Set-up submenu parameters.*

To enter the password:

1. Display Adjust submenu.
2. Press either the + or - button within the displayed submenu. The Password menu appears. (Adjustment is allowed if Password menu does not appear).
3. Press the + and - button to select the first character of the User password (A-Z or 0-9).
4. Press the → button to select the next character field. Selected character field is highlighted.
5. Repeat steps 3 and 4 to enter remaining password characters.
6. Press the Enter button after entering the password. The Adjust submenu will re-appear.
7. Exit Adjust submenu to save changes.

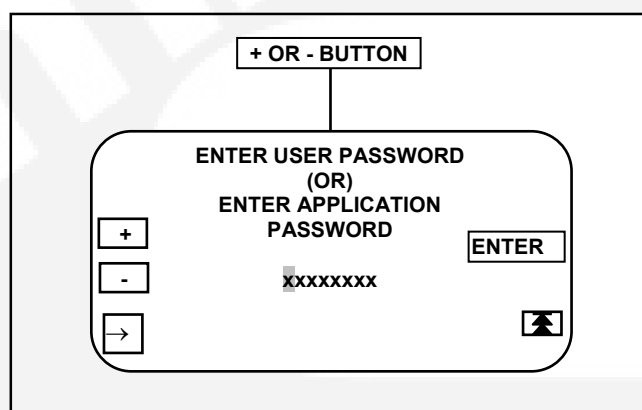


Figure 4-12 Password Menu


4.12 Power Transfer Main Menu

If you press the Power Trans button in Menu A, the Power Transfer main menu will appear (Figure 4–13).

Note: The Power Transfer Control (PTC) feature must be enabled to display this menu.

The PTC feature enables the PCC3201 to monitor the utility voltage (mains) and frequency for failure, and control the opening and closing of the contacts (circuit breakers) for the utility (S1) and the generator set (S2).

If utility fails, the control will initiate the starting sequence (Figure 5–1), open S1 and close S2 to the load. When utility returns, the load is retransferred to the utility (S1 closes and S2 opens) and the control initiates the generator set shutdown sequence.

The  symbol displayed in the middle of the Power Transfer main menu indicates which breaker (utility or generator set) is closed/opened to the load. The symbol shown in Figure 4-13 indicates that the utility breaker is closed and supplying power to the load.

The Power Transfer main menu also indicates if the utility and the generator set are available to accept load. When the control detects that either source is ready to accept load, Utility and/or Genset will be displayed in inverse video.

The Power Transfer main menu has four submenu groups:

- Utility
- Status
- Transfer Control
- Genset

To view system data, simply press the appropriate menu button to select the category. After pressing the desired menu button, refer to the following pages for detailed information related to the selected category.

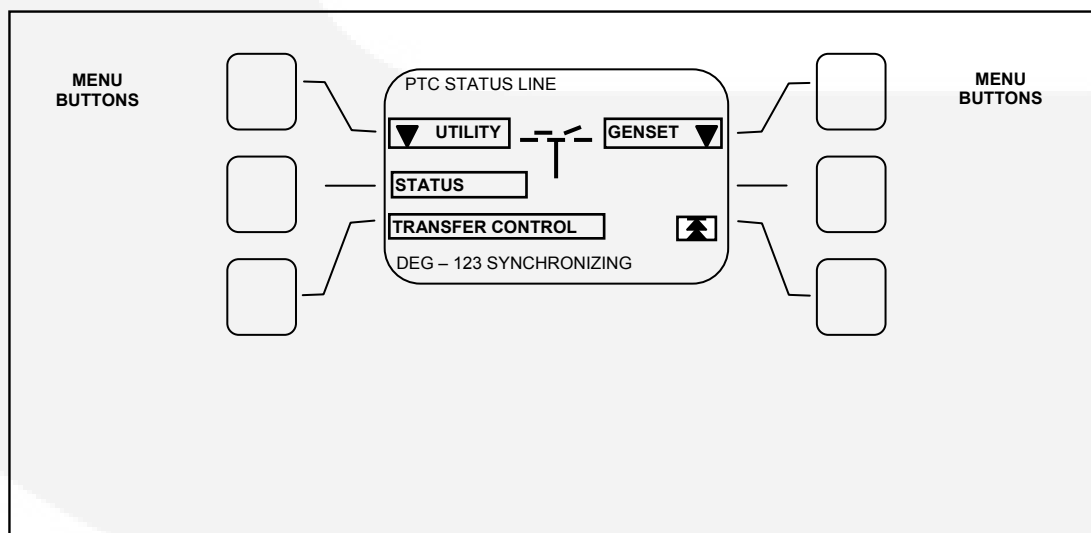


Figure 4-13 Power Transfer Main Menu

4.12.1 PTC Status Line

The top line of the graphical display is used to indicate the following PTC status:

- **NOT ENABLED:** PTC is not enabled. Control panel switch in O (Off) position.
- **MANUAL:** Control panel switch is in Manual position. All PTC actions or generator set start/stop actions are manually controlled.
- **NORMAL UTIL:** Load is connected to the utility.
- **RETRAN:** Retransfer of load to utility.
- **RETRAN OVRD:** Immediate retransfer of load to utility due to generator set fault (e.g., warning, derate, or shutdown with cooldown fault). The retransfer timer is ignored as is the retransfer inhibit.
- **EMERG TEST:** Emergency Test sequence initiated through Remote Start switch with emergency start sequence enabled (TB8–3 terminal opened). Emergency test mode means that the generator set will continue to run even if a generator set warning or derate fault occurs. This test can be performed with or without load (refer to Section 5.9). See Table 5–3 for sequence of operation.
- **TEST:** Test sequence initiated through Remote Start switch with emergency start sequence disabled (TB8–3 terminal closed). Test mode is non-emergency, which means that a retransfer to utility will occur if any problems occur with the generator set while testing with load. This test can be performed with or without load (refer to Section 5.9). See Table 5–3 for sequence of operation.
- **EXERCISE:** Exercise sequence initiated through control panel. This test can be performed with or without load (refer to Section 5.9). A retransfer to utility will occur if any problems occur with the generator set during the exercise sequence. See Table 5–3 for sequence of operation.
- **UTILITY FAIL:** Utility has failed. (Initiates transfer of load to generator set if Off/Manual/Auto switch is in Auto.)

4.12.2 Utility (PWR TRAN) Submenus

If the Utility button in the Power Transfer Main menu is pressed, the Utility submenu will appear (Figure 4–14).

- **Voltage L–L and L–N:** Indicates utility voltage Line-to-Line and Line-to-Neutral. Note that the Line-to-Neutral column will not be displayed for a 3 phase/3 wire system. Accuracy 1%. The voltage Line-to-Line (L1, L2 and L3) are measured between L1 to L2, L2 to L3 and L3 to L1, respectively.
- **Amps:** L2 only. Accuracy 1%.
- **Frequency:** Utility frequency.
- **kW, kVA and PF:** Displays (L2 only) utility kW and kVA output (average and direction of flow) and power factor with leading/lagging indication. Accuracy 5%.

Note: The PF reading will contain an asterisk if the power factor is leading (for example, *.30).

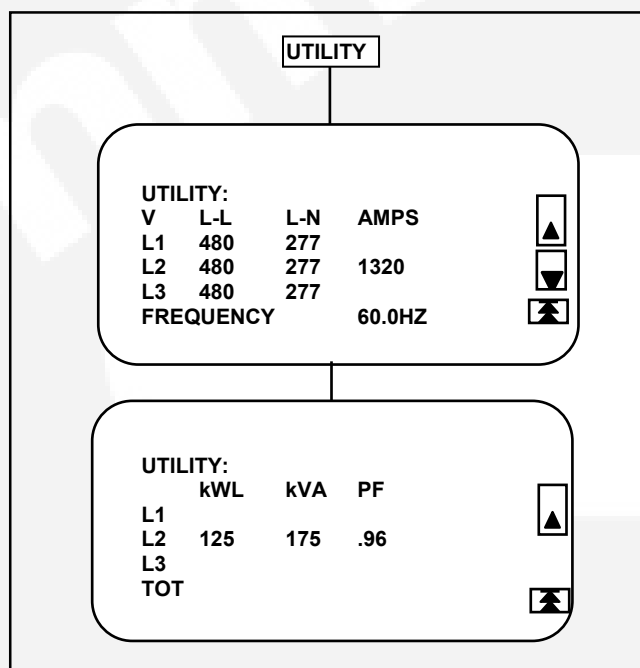


Figure 4-14 Utility Sub-menu

4.12.3 Status (PWR TRAN) Submenus

If the Status button in the Power Transfer Main menu is pressed, the Status submenus will appear (Figure 4–15).

- **Connected:** Indicates which source(s) is connected to the load.
- **Available:** Indicates when the corresponding sources have acceptable output voltage and frequency. Both can be available simultaneously.
- **Volt L12:** Indicates utility and generator set Line 1 to Line 2 voltage.
- **HZ:** Utility and generator set output frequency.
- **KW L2:** Utility and generator set Phase B (L2) kW output.
- **Transfer Inhibit:** This feature is used to control load transfer to the generator set. When activated, load transfer to the generator set will not take place if the utility fails. Transfer inhibit is controlled by connecting a remote contact between TB3–57 and TB3–58. Closing the contact enables the feature and opening the contact disables it. When enabled, the event is displayed on the graphical display.
- **Retransfer Inhibit:** This feature is used to prevent the PTC from automatically transferring the load back to the utility. When activated, load transfer will not take place unless the generator set fails (Retransfer Inhibit is ignored if the generator set fails). Retransfer inhibit is controlled by connecting a remote contact between TB3–64 and TB3–65. Closing the contact enables the feature and opening the contact disables it. When enabled, the event is displayed on the graphical display.

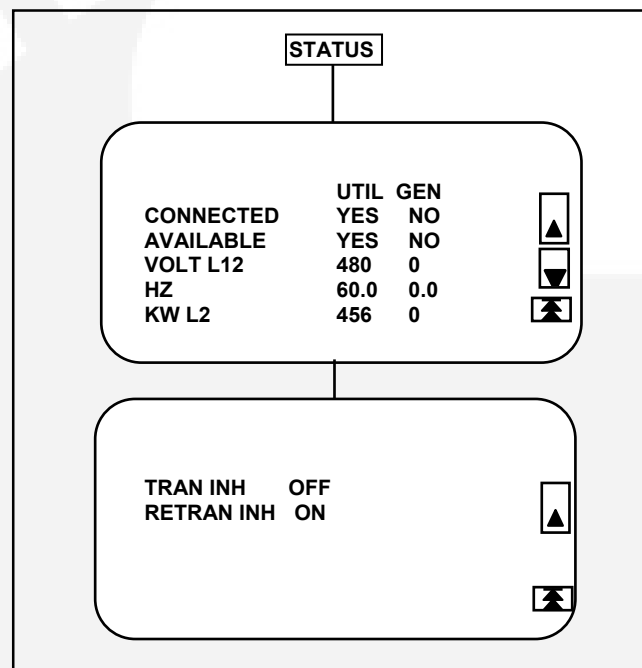



Figure 4-15 Status (PWR TRANS) Submenus

4.12.4 Transfer Control (PWR TRAN) Submenu

If the Transfer Control button in the Power Transfer Main menu is pressed, the Transfer Control submenu will appear (Figure 4–16).

The  symbol displayed in the middle of the Transfer Control submenu indicates which breaker (utility or generator set) is closed/opened to the load. The symbol shown in Figure 4-16 indicates that the utility breaker is closed and supplying power to the load.

During generator set operation in the manual mode, you can manually transfer/retransfer load between the utility and the generator set. To transfer load, press the appropriate CB Enable button (Utility or Genset).

Example (Figure 4–16)

In the example in Figure 4–16, the CB Enable button for Utility was pressed. (If the CB Enable button for the generator set was pressed, Enable Gen CB would be displayed in the second submenu, allowing you to open or close the generator set circuit breaker.)

After pressing the Utility CB Enable button, the second submenu will be displayed allowing you to either Cancel or Enable the entered selection.

Pressing the Cancel button will return the display to the previous menu.

Pressing the Enable button will display the third submenu. With this submenu displayed you can return to the second submenu without opening the utility circuit breaker (press <<Back) or you can press the Open Util button.

Pressing the Open Util button will display the fourth submenu, indicating that the utility circuit breaker is now opened.

Note that the fourth submenu displays Close Util. Pressing this button will close the utility circuit breaker and redisplay the third submenu.

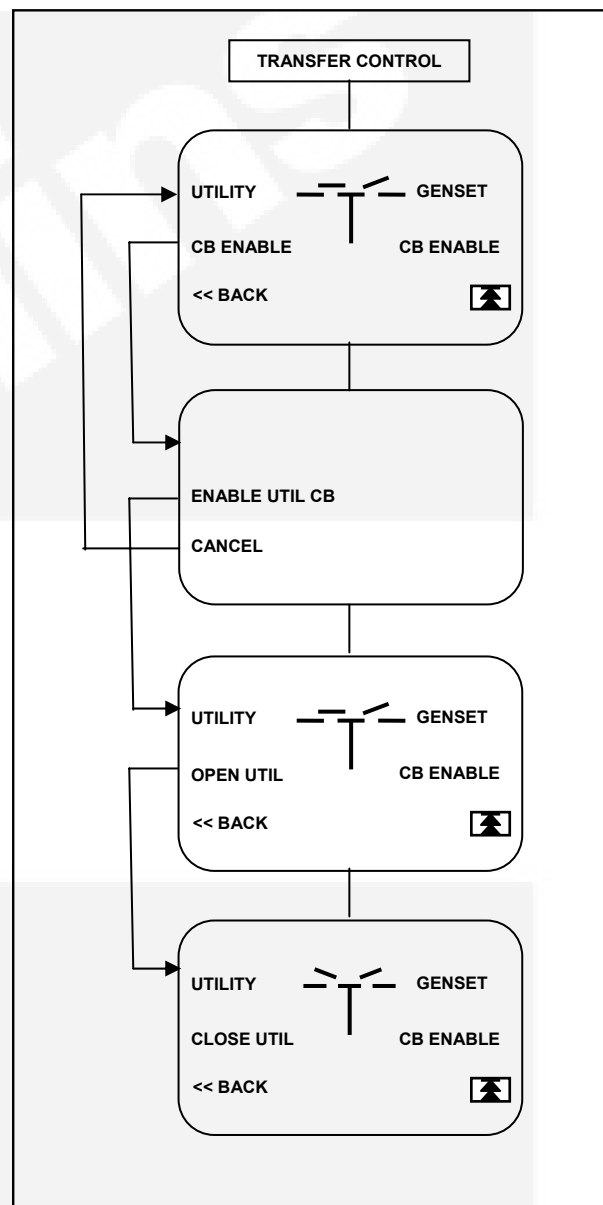


Figure 4-16 Transfer Control Submenus

4.12.5 Generator Set (PWR TRAN) Submenus

If the Genset button in the Power Transfer Main menu is pressed, the Genset submenus will appear (Figure 4–17).

- **Voltage L–L and L–N:** Indicates voltage Line-to-Line and Line-to-Neutral. Accuracy 1%. The voltage Line-to-Line (L1, L2 and L3) is measured between L1 to L2, L2 to L3 and L3 to L1, respectively.

Note: Note that the Line-to-Neutral column will not be displayed for a 3 phase/3 wire system.

- **Amps:** All phases. Accuracy 1%.
- **Frequency:** Generator set output frequency.
- **kW, kVA and PF:** Displays generator set kW and kVA output (average and individual phase, and direction of flow) and power factor with leading/lagging indication. Accuracy 5%.

Note: The PF reading will contain an asterisk if the power factor is leading (for example, *.30).

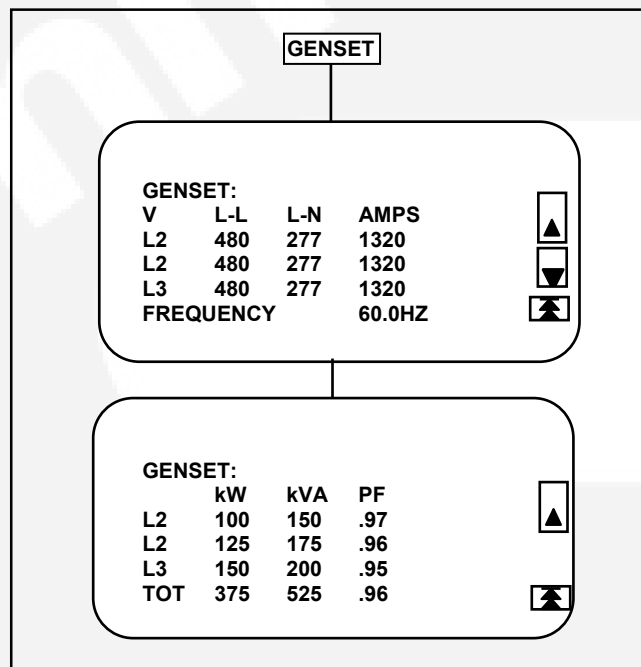


Figure 4-17 Genset Submenus

SECTION 5 – SYSTEM OPERATION

5 Operation

5.1 Safety

Only suitably qualified and experienced personnel should carry out generator set operations. Before operating the system, the operator should become familiar with Section 1 of this manual – Preliminary and Safety instructions - together with the Health and Safety Manual (0908-0110-00). Observe all of the WARNINGS and CAUTIONS at all times.

WARNING: BEFORE OPERATING THE PLANT BECOME FAMILIAR WITH THE EQUIPMENT AND HOW IT IS OPERATED (INCLUDING ALL CONTROLS, MANUALLY OPERATED VALVES AND ALARM DEVICES). SAFE AND EFFICIENT OPERATION CAN ONLY BE ACHIEVED IF THE PLANT IS OPERATED CORRECTLY.

WARNING: CONTACTING HIGH VOLTAGE COMPONENTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH BY ELECTROCUTION. DO NOT OPEN THE GENERATOR OUTPUT BOX WHILE THE GENERATOR SET IS RUNNING. READ AND OBSERVE ALL WARNINGS AND CAUTIONS IN YOUR GENERATOR SET MANUALS.

Caution: Only technically qualified personnel should open the PCC 3201 front panel. Voltages are present which can cause electrical shock, resulting in personal injury.
Even with power removed, improper handling of components can cause electrostatic discharge and damage circuit board components.

5.2 Introduction

This section describes the operation of the PCC3201 generator set control, covering pre-start checks, starting and stopping, and operating the generator set. The text should be read in conjunction with the System Description, Control System Operation, and the engine manual.

All indicators, control switches/buttons and graphical display are located on the face of the Control Panel as illustrated in Figure 4-1.

5.3 Maintenance

To secure maximum performance and reliability from your generator set it is essential that certain components are inspected periodically and, where necessary, maintenance procedures carried out as detailed in Section 6 - Maintenance.

5.4 Operating Recommendations

5.4.1 Running-in

Drain and replace the crankcase oil after the first 50 hours of operation on new generator sets. Refer to the Maintenance section of this manual for the recommended procedures.

5.4.2 No Load Operation

Periods of off-load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a load of at least 30% rated load, but not to exceed rated load. Such a load could consist of heater element or load bank.

5.4.3 Exercise Period

Generator sets on continuous standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts.

Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts, and in general helps provide reliable engine starting.

Exercise the generator set at least once a week, for a minimum of 30 minutes with load, so the engine reaches normal operating temperatures.

5.4.4 Low Operating Temperatures

Use a coolant heater if a separate source of power is available. The optional heater available from Cummins will help provide reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating.

5.4.5 High Operating Temperatures

Refer to the generator set nameplate for the maximum ambient operating temperature, if applicable.

5.4.6 Operating Conditions for Prime, Standby and Continuous Power Ratings.

Note: *All generator sets supplied by the Company must be run under the following operating conditions.*

5.4.6.1 Continuous Power rating (COP) for constant load applications

The Continuous Power Rating is applicable to utility parallel and other non-variable load applications for supplying power continuously to a load of up to 100% of the continuous rating for an unlimited number of hours per year between the stated maintenance intervals and under stated ambient conditions. All maintenance must be carried out as prescribed in The Company Manuals. No sustained overload capability is available at this rating. This rating is applicable for utility base load operation. In these applications, generator sets are operated in parallel with a utility source and run under constant loads for extended periods of time.

5.4.6.2 Prime Power Rating

The Prime Power Rating is the maximum power available during a variable load sequence which may be run for an unlimited number of hours per year, between the stated maintenance intervals and under the stated ambient conditions. All maintenance must be carried out as prescribed in The Company Manuals. Prime Power applications fall into one of the following categories:

a) Unlimited Time Prime Power (for variable load applications)

Prime power is available for an unlimited number of annual operating hours in variable load applications. The permissible average power output under variable load shall not exceed a 70% average of the prime power rating during any operation of 250 hours. The total operating time at 100% prime power shall not exceed 500 hours per year. A 10% overload capability is available for a period of one hour within a twelve hour period of operation, in accordance with ISO 3046-1. Total operating time at the 10% overload power shall not exceed 25 hours per year.

b) Limited Running Time Prime Power (for constant load applications)

Prime power is available for a limited number of hours in a non-variable load application. It is intended for use in situations where power outages are contracted, such as utility power curtailment. Generators may be operated in parallel with the public utility up to 750 hours per year at power levels never to exceed the prime power rating. No sustained overload capability is available at this rating. The Customer should be aware, however, that the life of any generator set will be reduced by constant high load operation. Any operation exceeding 750 hours per year at the prime power rating should use the Continuous Power Rating.

5.4.6.3 Standby power rating (for variable load applications)

The Standby Power Rating is applicable for supplying emergency power for the duration of a utility power interruption, between the stated maintenance intervals and under the stated ambient conditions. All maintenance must be carried out as prescribed in The Company Manuals. No overload capability is available for this rating and utility parallel operation is not permitted at the standby power rating. For applications requiring sustained utility parallel operation the limited time prime power rating or continuous power rating must be utilised as applicable.

This rating is applicable to installations served by a reliable normal utility source. Generators should be sized for a maximum average load factor of 80% of the standby power rating with a maximum of 200 hours of operation per year, which includes less than 25 hours per year at the standby power rating. In installations served by unreliable utility sources (where outages last longer, or occur more frequently), where operation is likely to exceed 200 hours per year, the Prime Power rating should be applied. The Standby Power rating is only applicable for emergency and standby applications where the generator set serves as the back-up to the normal utility source. Negotiated power outages are not considered as emergencies.

5.4.6.4 Notes applicable to all ratings

The following notes are applicable to all ratings, unless otherwise agreed by the Regional Sales Manager of the Company in writing:

1. When determining the actual average power of a variable power sequence in any of the ratings above, power of less than 30% of the emergency standby power shall be taken as 30% and the time at standstill shall not be counted.
2. Variable load is calculated in accordance with methods and formulae given in ISO 8528-1:1993.
3. All 3-phase generators are rated for 0.8 power factor lag. Single-phase generators are rated for 1.0 power factor.
4. All ratings are based on the following reference conditions:
 - a) Ambient temperature – 27°C (81°F)
 - b) Altitude above sea level – 150 metres (492 feet)
 - c) Relative humidity – 60%
 - d) Output Power may be subjected to de-rate if the above conditions are exceeded.
5. If any of the above conditions are not satisfied, the operational life of the generator set may be reduced.
6. Short term parallel operation with the utility, for load transfer purposes only, is permitted with all ratings.

5.4.7 De-Rating Factors

For de-rating factors applicable at specific sites, please contact your authorised distributor.

5.5 Generator Set Operation

5.5.1 Sequence of Operation

The generator set is run Automatically using a Remote Start signal, or Manually using the switch panel controls. Generator set indications are provided on the control panels. If a fault is sensed at Start-up, the engine is locked out and will not start.

When the PCC 3201 is put in the Manual mode and the Manual Run button is pressed, the generator set performs an automatically sequenced manual start. First, the PCC 3201 initiates a starter cranking signal and verifies that the engine is rotating. Then it provides sufficient fuel for the engine to accelerate up to start-disconnect speed.

After the initial start procedure, the control system ramps the generator set to rated speed and voltage. The Ready to Load output is activated when the AC voltage and frequency exceeds 90% of nominal.

5.6 Starting

Caution: *One operator should be in complete charge, or working under the direction of someone who is. Remember that, upon starting the engine, cables and switchgear will become energised, possibly for the first time. Furthermore, equipment that does not form part of the generator set installation may become electrically charged. Only authorised and competent personnel should carry out this work.*

Caution: *Do not use an Emergency Stop switch to shut down an engine unless a serious fault develops. The Emergency Stop push-switch must not be used for a normal shut-down, as this will prevent a cooling down run in which the lubricating oil and engine coolant carry heat away from the engine combustion chamber and bearings in a safe manner.*

Caution: *Avoid off-load running for other than short periods. A minimum loading of 30% is recommended. This loading will help to prevent the build up of carbon deposits in the injectors, due to unburnt fuel, and reduce the risk of fuel dilution of the engine lubricating oil. The engine must be shut down as soon as possible after the appropriate functions have been checked.*

Before attempting to start the generator set, the operator should read through this entire section and become familiar with the Engine Manual. It is essential that the operator be completely familiar with the generator set and the PCC 3201 control.

The following headings cover the systems used to start the generator set. Figure 5-1 provides a flow chart for each of the three Start/Run/Stop sequences.

Before starting the generator set, make sure that exhaust and fuel fittings are tight and properly positioned, and that proper maintenance and pre-start checks have been performed.

During starting automatic checks are carried out for the integrity of various protection systems. The PCC 3201 will not allow the generator set to continue the starting sequence if the integrity of a sensor is considered to be in doubt.

The generator set can be configured for a number of starting cycles (one to seven) with set times for crank and rest periods for all starting modes (manual/remote). The default setting is for three start cycles, composed of fifteen seconds of cranking and fifteen seconds of rest.

Note: *The InPower service tool is required to change the number of starting cycles, and the crank and rest times. Contact an authorised distributor for assistance.*

5.6.1 Pre-start Checks

WARNING: GENERATOR SET VOLTAGE PRESENTS SPECIAL HAZARDS OF SEVERE PERSONAL INJURY OR DEATH. EVEN AFTER GENERATOR SET SHUTDOWN, AN ELECTRICAL SHOCK HAZARD MAY STILL EXIST CAUSED BY INDUCED OR RESIDUAL VOLTAGE WITHIN THE ALTERNATOR OR CABLES. SERVICE PERSONNEL MUST BE WELL-TRAINED/QUALIFIED TO WORK WITH DISTRIBUTION VOLTAGES.

WARNING: WINDINGS OF HIGH VOLTAGE, 601 TO 15,000 VOLTS, GENERATOR SETS MUST BE DRY BEFORE THE GENERATOR SET IS OPERATED. FAILURE TO ENSURE DRY WINDINGS BEFORE START-UP MAY RESULT IN CATASTROPHIC FAILURE, SEVERE PERSONAL INJURY AND DEATH.

Before starting, be sure competent personnel have made the following checks to ensure that the unit is ready for operation:

- Generator Set Grounding Procedure – This must be followed prior to performing service or inspection procedures that may expose personnel to conductors normally energized with voltages greater than 600 volts. Contact your authorised distributor.
- Megger and Insulation Testing – This must be performed on all high voltage (601 to 15,000 volts) generator sets before initial start-up and after the generator set Grounding Procedure has been completed. Insulation testing for low voltage (less than 600 volts) generator sets is recommended by Cummins Power Generation Limited.

Note: *These tests are used to verify that the windings are dry before the generator set is operated, and to develop a base line for future test comparisons. Contact your authorised distributor.*

Caution: *When Megger testing an alternator, failure to protect the voltage regulator, control and diodes could result in permanent damage to one or more of the electronic components.*

- Lubrication - Check the engine lubrication oil level and ensure that the level is always maintained as detailed in the engine manual.

Note: *Generator sets may be shipped dry. They must be filled with the correct type and quantity of oil before use. Be sure to check oil level before initial start.*

- Coolant - Check the engine coolant level and ensure that the level is always maintained at the coolant expansion tank. Fill the cooling system to the bottom of the fill neck in the radiator fill or expansion tank. Do not check while the engine is hot. Ensure that there are no leaks and that all fittings are tight.

Note: *Some radiators have two fill necks, both of which **must** be filled when the cooling system is drained*

Caution: *Do not attempt to remove a radiator pressure cap while the generator is running, or is stationary but hot. Always allow it to cool before removing.*

Note: *Generator sets may be shipped dry. They must be filled with the correct type and quantity of coolant before use. Be sure to check coolant level(s) before initial start.*

- Cooling Air Inlet / Outlets - Ensure that the cooling air inlets/outlets are unobstructed. Remove all loose debris from surrounding area of generator set. Air flow from the radiator fan can blow loose items around and into ventilation openings.
- Exhaust Outlet - Ensure that exhaust components are secured and not warped; that the exhaust outlet is unobstructed; that no combustible materials are near the system, and gases are discharged away from building openings. Ensure that there are no leaks and that all fittings are tight.
- Fuel Supply - Ensure that the fuel tank is filled to the normal level and that the fuel system is primed and all the valves required for operation are open. Ensure that there are no leaks and that all fittings are tight.
- Batteries – Ensure that the batteries are charged, that the electrolyte is at the correct level and that all connections are correct.
- Auxiliary AC Supplies - Ensure that all auxiliary equipment is receiving power from the Load Terminal Box.
- Emergency Stop/Fire Detection Equipment - Ensure that all related equipment is fully operational.

5.6.2 Starting at Switch Panel (Manual Mode)

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE SET UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

Caution: One operator should be in complete charge, or working under the direction of someone who is. Remember that, upon starting the engine, cables and switchgear will become energised, possibly for the first time. Furthermore, equipment that does not form part of the generator installation may become electrically charged. Only authorised and competent personnel should carry out this work.

Caution: Do not use an Emergency Stop switch to shut down an engine unless a serious fault develops. The Emergency Stop push-switch must not be used for a normal shut-down, as this will prevent a cooling down run in which the lubricating oil and engine coolant carry heat away from the engine combustion chamber and bearings in a safe manner.

Caution: Avoid off-load running for other than short periods. A minimum loading of 30% is recommended. This loading will help to prevent the build up of carbon deposits in the injectors, due to unburnt fuel, and reduce the risk of fuel dilution of the engine lubricating oil. The engine must be shutdown as soon as possible after the appropriate functions have been checked.

Note: PTC: With the Optional Power Transfer Control (PTC) feature enabled, the function and sequence of operation for the Start command differs due to the transfer and re-transfer of load. Refer to Power Transfer Control Operation, later in this section, for the Start/Run/Stop PTC sequences.

Turn the Off/Manual/Auto switch to the Manual position and press the Manual Run/Stop button. This will activate the engine control system and the starting system. The starter will begin cranking, and after a few seconds the engine will start and the starter will disconnect.

In the Manual position, the control will not complete the Time Delay to Start or Time Delay to Stop (Figure 5-1), but will complete the Warm-up at Idle and Cool-down at Rated/Idle. (See Table 5-1 for the PTC sequence of operation).

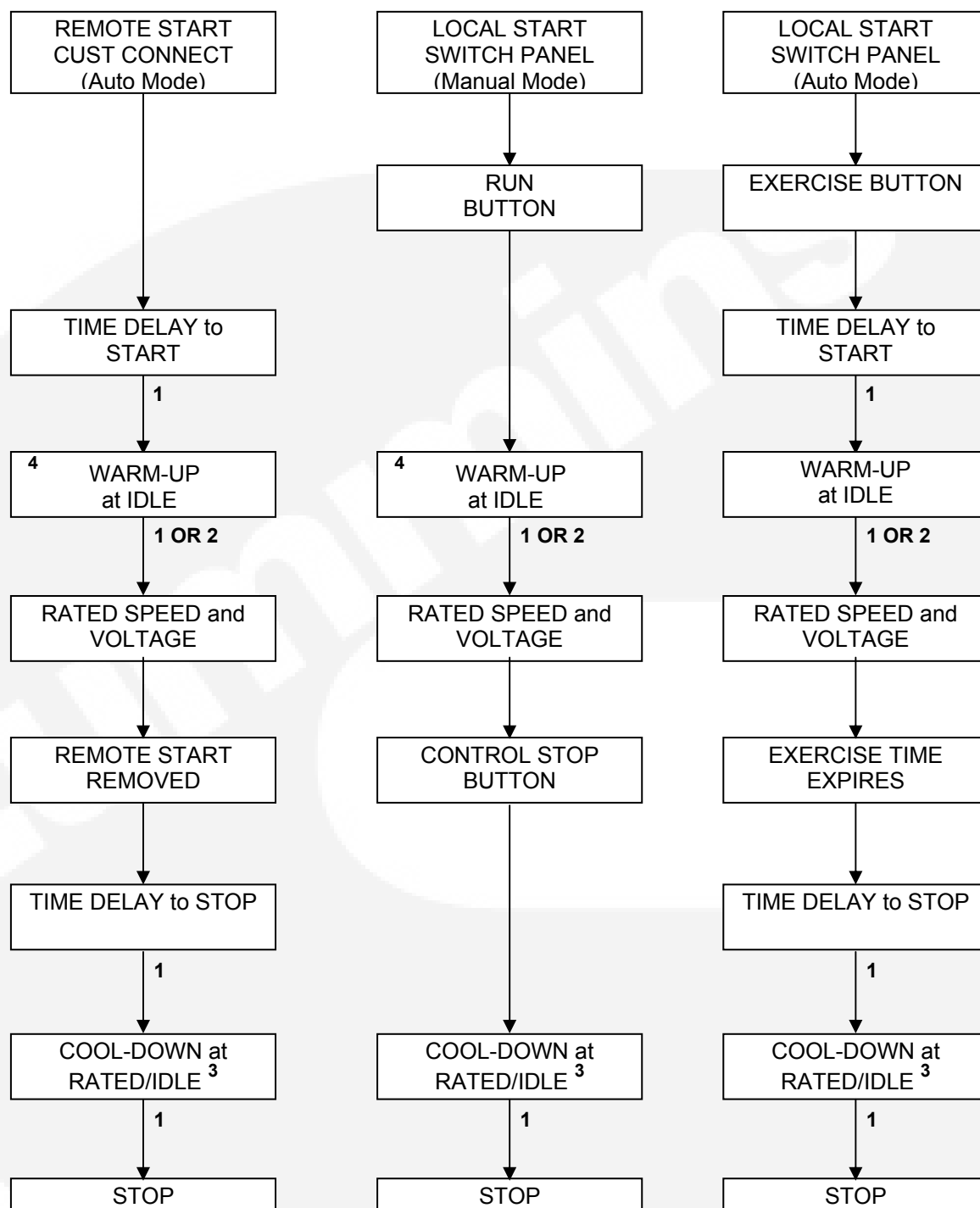
When the coolant reaches operating temperature or the Warm-up at Idle Time Delay is reached (0 to 300 seconds), whichever occurs first, the generator set will ramp to rated speed and voltage.

Note: PTC: To manually transfer the load between the utility and the generator set during generator set operation, refer to Transfer Control (PWR TRAN) Submenu in this section.

If the engine does not start, the starter will disengage after a specified period of time and the control will indicate an Overcrank Shutdown.

To clear a Fail to Start Shutdown, place the Off/Manual/Auto switch in the Off (O) position and press the Fault Acknowledge button. Wait a minimum of two minutes for the starter motor to cool and then repeat the starting procedure. If the engine does not run after a second attempt, refer to Section 7 -Troubleshooting.

When the switch is in the Manual position, the generator set can be operated in the Idle mode (used for maintenance, troubleshooting etc.).



Notes:

1. Timer expires.
2. Coolant temperature reaches operating level.
3. Cool-down can be at rated speed and/or idle with different time-outs for each.
4. Only when non-emergency feature enabled (TB8-3 closed).

Figure 5-1 Normal Start/Run/Stop Sequences

5.6.3 Starting at Remote Operator Panel (Auto Mode)

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE SET UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

When the operator panel is mounted remotely of the control panel assembly, the Start button of the Control submenu can also be used to start the generator set. The function of this Start button is identical to the following section, Starting from Remote Location. Refer to Control Submenu (Section 4.7) for additional information.

Note: *The Off/Manual/Auto switch must be in the Auto position to activate the Remote Menu Buttons of the Control submenu.*

5.6.4 Starting from Remote Location (Switch or Device) (Auto Mode)

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE SET UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

Place the Off/Manual/Auto switch in the Auto position. This allows the generator set to be started from a remote switch or device (e.g., transfer switch or the optional Power Transfer Control feature).

Note: *With the PTC feature activated, the Remote Start input (TB8-4/5) will function as a Test mode switch for the PTC. Refer to Section 5.9.*

There are two Start modes that are selectable for the Remote Start input, one for non-emergency start and the other for emergency start. In the non-emergency mode, the control will complete the warm-up at Idle. In the Emergency mode, the generator set will omit the Warm-up stage and will proceed directly to rated speed and voltage.

The Emergency start feature is controlled by connecting a remote contact between TB8-3 and TB8-5. Open the contact for emergency start and close the contact for non-emergency start.

In response to the Remote Run signal, or the control detects the loss of the utility voltage detected through the PTC, the control lights the Remote Start indicator and initiates the starting sequence described in the previous heading (Starting at Switch Panel), except for the following:

- In the Auto position, the control will complete the Time Delay to Start (0 to 300 seconds) and the Time Delay to Stop (0 to 600 seconds).

Note: *Refer to Adjust submenu (Section 4.9) to change the Time Delay settings.*

5.6.5 Exercise Start

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE SET UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

Turn the Off/Manual/Auto switch to the Auto position and press and hold down the Exercise button. Turn the Off/Manual/Auto switch from Auto to Manual and back to Auto.

This will activate the engine control system to complete a pre-programmed exercise sequence. The sequence (Figure 5-1) will vary according to the settings/selections of the system control parameters. The default setting is for Exercise Without Load.

Note: *The InPower service tool is required to modify these parameters. Contact an authorised distributor for assistance.*

Note: *PTC – for PTC Exercise sequence refer to Section 5.9.*

The exercise sequence may include running at idle speed, ramping to rated speed, running for a predetermined period of time and timed shutdown. During the exercise operation, the LED lamp adjacent to the Exercise button will light. To manually stop the exercise operation before completion, press the Exercise button. The set will complete its normal cool-down sequence. The control will indicate that the set is in a cool-down mode by flashing the exercise LED.

Note: *PTC – If exercising with load, cool-down mode is activated after retransfer of load to utility. (See Table 5-3 for PTC Exercise sequence).*

Note: *All exercise functions are disabled when a remote start signal is received by the control.*

5.6.6 Cold Starting with Loads

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE SET UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

Use a coolant heater if a separate source of power is available. The optional heater available from Cummins Power Generation Limited will help provide reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating.

Cummins Power Generation Limited recommends equipping diesel standby generator sets (life safety systems) with engine water jacket coolant heaters to maintain the coolant at a minimum of 32°C (90°F) and, for most applications, accept the emergency load in ten seconds or less. Although most Cummins Power Generation Limited generator sets will start in temperatures down to -32°C (-25°F) when equipped with engine water jacket coolant heaters, it might take more than ten seconds to warm the engine up before a load can be applied when ambient temperatures are below 4°C (40°F).

To advise the user of a possible delay in accepting the load, the Engine Cold (Code 1435) message, in conjunction with illumination of the Warning LED, is provided. The engine cold sensing logic initiates a warning when the engine water jacket coolant temperature falls below 21°C (70°F). In applications where the ambient temperature falls below 4°C (40°F), a cold engine may be indicated even though the coolant heaters are connected and functioning correctly. Under these conditions, although the generator set may start, it may not be able to accept load within ten seconds. When this condition occurs, check the coolant heaters for correct operation. If the coolant heaters are operating correctly, other precautions may be necessary to warm the engine before applying a load.

5.7 Running at Idle (Manual)

Caution: *Avoid off-load running for other than short periods. A minimum loading of 30% is recommended. This loading will help to prevent the build up of carbon deposits in the injectors, due to unburnt fuel, and reduce the risk of fuel dilution of the engine lubricating oil. The engine must be shutdown as soon as possible after the appropriate functions have been checked.*

Caution: *If the engine coolant temperature becomes too low, 60°C (140°F), raw fuel from incomplete combustion will wash the lubricating oil off the cylinder walls and dilute the crankcase oil. Under these conditions, not all the moving parts of the engine will receive the correct amount of lubrication.*

Note: *The Run at Idle mode is selectable only when the Operator Panel is mounted on the control panel assembly.*

The Run Mode can be set to Rated or Idle with the set running or not running. To manually select the engine Idle function, the Off/Manual/Auto switch must be in the Manual position. Once selected and the set is manually started, the control will limit the engine idle time to ten minutes. When the ten-minute Idle cycle is complete, the generator set will ramp to rated speed.

To activate the Idle function, refer to Section 4.7.1-Local Control Submenu Function.

When the engine Idle function is enabled, the control automatically sets lower oil pressure Warning and Shutdown trip points to reflect the lower operating speed. When the engine Idle function is removed and the set reverts to normal operating speed, the control automatically resets oil pressure Warning and Shutdown trip points to the normal settings.

5.8 Stopping

5.8.1 Emergency Stop (Code 1434)

The emergency stop button is located on the upper right side of the control panel (Figure 4-1). Push the button in for emergency stop. The red Shutdown status LED will light and the graphical display message will be:

EMERGENCY STOP
1434 - SHUTDOWN

To reset:

1. Pull, or twist and pull, the button out.
2. Turn the Off/Manual/Auto switch to Off (O).
3. Press the front panel Fault Acknowledge button.
4. Select Manual or Auto, as required.

Caution:	<i>Ensure that the cause of the emergency is fully investigated and remedied before an emergency stop Reset, and generator set Start are attempted.</i>
-----------------	---

Note: *Emergency Stop shutdown status can be reset only at the operator control panel.*

5.8.2 Stopping at Switch Panel (Manual Mode)

If the generator set was started at the switch panel (Off/Manual/Auto switch in the Manual position), pressing the Manual Run/Stop button will cause the set to complete its normal (Local Start) shutdown sequence (Figure 5-1).

Note: *PTC: See Table 5-1 for PTC sequence of operation.*

The pre-set Cool-down time (at rated speed) can vary dependent on the kW output. That is if, prior to shutdown, the kW is 10% or less of rated, the control software considers this output as Cool-down and will subtract this time from the pre-set Cool-down Timer.

The set will stop after the Cool-down at Idle Timer (zero to ten minutes) has timed out. (If necessary, the set will continue to run after time-out until coolant reaches normal operating temperature).

Moving the Off/Manual/Auto switch to the Off (O) position will cause an immediate engine shutdown (bypass Cool-down At Idle) and display a Cool-down Interrupted Warning message. This hot shutdown should be avoided, if possible, to help prolong the reliability of the engine.

Hot shutdowns are logged in the system software.

5.8.3 Stopping at Remote Operator Panel (Auto Mode)

When the Operator Panel is mounted remotely of the control panel assembly, the Stop button of the Control submenu can also be used to stop the generator set (Off/Manual/Auto switch in the Auto position).

The function of this Stop button is identical to the Stopping from Remote Location (non-emergency sequence, Figure 5-1). Refer to Control Submenu for additional information.

Note: *The Off/Manual/Auto switch must be in the Auto position to activate the Remote Menu Buttons of the Control submenu.*

5.8.4 Stopping from Remote Location (Switch or Device) (Auto Mode)

If the control receives a Remote Stop signal or the control detects the return of the utility voltage through the PTC, the set will complete its normal shutdown sequence. (The remote Stop signal is actually the removal of the remote Start signal to the control).

The set will stop after completing the following Cool-down sequence:

- Time Delay To Stop (zero to 300 seconds)
- Cool-down At Idle (zero to ten minutes) or longer, if necessary, to obtain normal operating temperature before shutdown.

Note: Refer to Section 4.9 Adjust Submenu to change the Time Delay to Stop setting. The InPower service tool is required to modify the Cool-down At Idle setting. If necessary, contact an authorised distributor for assistance.

5.9 Optional Power Transfer Control (PTC) Operation

The following table describes the function and operation of the PCC3201 with the optional PTC feature enabled. With the PTC feature enabled, the control performs two functions: generator set operation and transfer of load between utility and generator set.

The following table describes how the generator set/PTC operates when the control switch is in the Off, Manual and Auto positions.

Control Switch Position	Result
Off	<ul style="list-style-type: none"> • PCC3201/PTC Not in Auto (1222) warning fault active. • Generator set will not start • Loads will not transfer/retransfer
Manual (see also Table 5-1 for sequence of operation)	<ul style="list-style-type: none"> • PCC3201/PTC Not in Auto (1222) warning fault active • Generator set can only be started manually via control panel Manual Run/Stop button • Load must be transferred manually (see Figure 4-16) • Synchronizing and load ramping will occur automatically • Enforcement of max parallel time will occur automatically
Auto (see also Table 5-2 for sequence of operation)	<ul style="list-style-type: none"> • PCC3201/PTC in auto mode • Generator set will start automatically as required • Loads will transfer/retransfer automatically as required

5.9.1 PCC3201/PTC – Normal Operation Sequences

The following tables show the normal operating sequence of events for each of the four possible running modes (utility power failure, exercise, test or manual run). The sequences are further defined by generator set application type i.e. Open transition, Closed transition-momentary, or Closed transition-soft loading.

The previous Start, Exercise and Stop information (Figure 5-1) also applies/remains the same with the exception of the PTC transfer and re-transfer of load after the generator set or utility voltage/frequency stabilize.

The PCC3201/PTC Exercise Without Load is identical to the standard PCC3201 exercise sequence shown in Figure 5-1. The PCC3201/PTC Exercise With Load is shown in Table 5-3. The default setting is without load. Contact an authorised distributor to change this parameter.

5.9.2 Test Switch

With the PTC feature enabled, the Remote Start input (TB8-4/5) will function as a Test mode switch for the PTC. The PTC Test sequence is identical to the Exercise sequence (with or without load), except that the generator set will continue to run until the Test switch is de-activated. The default is without load. Contact an authorised distributor to change this parameter.

Table 5-1 Manual Run

	OPEN TRANSITION	CLOSED TRANSITION – MOMENTARY	CLOSED TRANSITION – SOFT LOADING
1	Manual Run switch activated	Manual Run switch activated	Manual Run switch activated
2	Generator set starts	Generator set starts	Generator set starts
3	Warm-up at Idle	Warm-up at Idle	Warm-up at Idle
4	Generator set available	Generator set available	Generator set available
5		Synchronises to Utility	Synchronises to Utility
6	Open Utility CB (Operator)		
7	Time Delay programmed transition		
8	Close generator set CB (Operator)	Close generator set CB (Operator)	Close generator set CB (Operator)
9		<100msec overlap	Generator set ramp loads
10			Utility unloaded
11		Utility CB opens (Auto by control)	Open Utility CB (*Operator)
12	GENERATOR SET SUPPLYING LOAD	GENERATOR SET SUPPLYING LOAD	GENERATOR SET SUPPLYING LOAD
13	Open generator set CB (Operator)		
14	Time Delay programmed transition	Synchronises to Utility	Synchronises to Utility
15	Close Utility CB (Operator)	Close Utility CB (Operator)	Close Utility CB (Operator)
16		<100msec overlap	Generator set ramp unloads
17			Generator set unloaded
18		Generator set CB opens (by control)	Open generator set CB (*Operator)
19	UTILITY SUPPLYING LOAD	UTILITY SUPPLYING LOAD	UTILITY SUPPLYING LOAD
20	Manual Run switch de-activated	Manual Run switch de-activated	Manual Run switch de-activated
21	Cool down	Cool down	Cool down
22	Generator set stopped	Generator set stopped	Generator set stopped
* Maximum parallel time is enforced in Manual mode. Breaker operation will be automatic if maximum parallel time is exceeded.			

Table 5-2 Utility Power Fail

	OPEN TRANSITION	CLOSED TRANSITION – MOMENTARY	CLOSED TRANSITION – SOFT LOADING
1	Utility failure	Utility failure	Utility failure
2	Time Delay to Start	Time Delay to Start	Time Delay to Start
3	Generator set starts	Generator set starts	Generator set starts
4	Generator set available	Generator set available	Generator set available
5	Time Delay to Transfer	Time Delay to Transfer	Time Delay to Transfer
6	Utility CB opens	Utility CB opens	Utility CB opens
7	Time Delay programmed transition	Time Delay programmed transition	Time Delay programmed transition
8	Generator set CB closes	Generator set CB closes	Generator set CB closes
9	GENERATOR SET SUPPLYING LOAD	GENERATOR SET SUPPLYING LOAD	GENERATOR SET SUPPLYING LOAD
10	Utility available	Utility available	Utility available
11	Time Delay retransfer	Time Delay retransfer	Time Delay retransfer
12		Synchronises to Utility	Synchronises to Utility
13		Utility CB Closes	Utility CB Closes
14		<100msec overlap	Generator set ramp unloads
15			Generator set unloaded
16	Generator set CB opens	Generator set CB opens	Generator set CB opens
17	Time Delay programmed transition		
18	Utility CB closes		
19	UTILITY SUPPLYING LOAD	UTILITY SUPPLYING LOAD	UTILITY SUPPLYING LOAD
20	Time Delay to Stop/Cooldown	Time Delay to Stop/Cooldown	Time Delay to Stop/Cooldown
21	Generator set stopped	Generator set stopped	Generator set stopped

Table 5-3 Exercise with load

	OPEN TRANSITION	CLOSED TRANSITION – MOMENTARY	CLOSED TRANSITION – SOFT LOADING
1	Exercise start activated	Exercise start activated	Exercise start activated
2	Time Delay to Start	Time Delay to Start	Time Delay to Start
3	Generator set starts	Generator set starts	Generator set starts
4	Warm-up at Idle	Warm-up at Idle	Warm-up at Idle
5	Generator set available	Generator set available	Generator set available
6	Time Delay to transfer	Time Delay to transfer	Time Delay to transfer
7	Utility CB opens	Synchronises to Utility	Synchronises to Utility
8	Time Delay programmed transition		
9	Generator set CB closes	Generator set CB closes	Generator set CB closes
10		<100msec overlap	Generator set ramp loads
11			Utility unloaded
12		Utility CB opens	Utility CB opens
13	GENERATOR SET SUPPLYING LOAD	GENERATOR SET SUPPLYING LOAD	GENERATOR SET SUPPLYING LOAD
14	Exercise timer expires	Exercise timer expires	Exercise timer expires
15	Time Delay retransfer	Time Delay retransfer	Time Delay retransfer
16	Generator set CB opens	Synchronises to Utility	Synchronises to Utility
17	Time Delay programmed transition		
18	Utility CB closes	Utility CB closes	Utility CB closes
19		<100msec overlap	Generator set ramp unloads
20			Generator set unloaded
21		Generator set CB opens	Generator set CB opens
22	UTILITY SUPPLYING LOAD	UTILITY SUPPLYING LOAD	UTILITY SUPPLYING LOAD
23	Time Delay to Stop/Cooldown	Time Delay to Stop/Cooldown	Time Delay to Stop/Cooldown
24	Generator set stopped	Generator set stopped	Generator set stopped

SECTION 6 – GENERAL MAINTENANCE

6 Maintenance

All maintenance tasks must be assessed for health and safety risks, the preventative measures identified must be actioned. Accompaniment is required for tasks where the presence of someone else will add significantly to the safety of the task.

Read, understand and comply with all Caution and Warning notes in this section, those contained within Section 1 - Preliminary and Safety, and those contained within the Health and Safety Manual (0908-0110-00). Refer also to the Operator's engine specific manual supplied as part of the generator set documentation pack. This latter manual will contain further information regarding the running and care of the generator set and also specific equipment instructions that may differ from the standard generator set.

Ensure adequate lighting and staging (where required) are installed.

Caution: *Maintenance. must only be carry out by authorised and qualified maintenance engineers, who are familiar with the equipment and its operation.*

WARNING: **DEPENDENT UPON THE CONTROL SYSTEM FITTED, THIS UNIT MAY OPERATE AUTOMATICALLY AND COULD START WITHOUT WARNING.**

Caution: *Before carrying out any maintenance work, become familiar with the Generator Plant Safety Code given in Section 1 of this manual, together with the Health and Safety Manual (0908-0110-00).*

Caution: *Always disconnect a battery charger from its AC source before disconnecting the battery leads. Failure to do so can result in voltage spikes high enough to damage the DC control circuits of the generator set.*

WARNING: **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).**

ENSURE BATTERY AREA HAS BEEN WELL-VENTILATED BEFORE SERVICING THE BATTERY. SPARKS OR ARCING CAN IGNITE EXPLOSIVE HYDROGEN GAS GIVEN OFF BY BATTERIES, CAUSING SEVERE PERSONAL INJURY. ARCING CAN OCCUR WHEN LEADS ARE REMOVED OR REPLACED, OR WHEN THE NEGATIVE (-) BATTERY LEAD IS CONNECTED AND A TOOL USED TO CONNECT OR DISCONNECT THE POSITIVE (+) BATTERY LEAD TOUCHES THE FRAME OR OTHER GROUNDED METAL PART OF THE GENERATOR SET.

**INSULATED TOOLS MUST BE USED WHEN WORKING IN THE VICINITY OF THE BATTERIES.
ALWAYS REMOVE THE NEGATIVE (-) LEAD FIRST AND RECONNECT LAST.**

ENSURE HYDROGEN FROM THE BATTERY, ENGINE FUEL AND OTHER EXPLOSIVE FUMES ARE FULLY DISSIPATED. THIS IS ESPECIALLY IMPORTANT IF THE BATTERY HAS BEEN CONNECTED TO A BATTERY CHARGER.

WARNING: TO COMPLETE MAINTENANCE TASKS AT HEIGHT REFER TO LOCAL LEGISLATIVE REQUIREMENTS. SUITABLE EQUIPMENT FOR PERFORMING THESE TASKS MUST BE USED IN ACCORDANCE WITH THE LOCAL GUIDELINES AND LEGISLATION. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH.

WARNING: DO NOT USE THE SKID (BEDFRAME) OR ANY PART OF THE GENERATOR SET AS A MEANS OF ACCESS. USE OF THE GENERATOR SET AS ACCESS MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH AND/OR PROPERTY AND EQUIPMENT DAMAGE.

WARNING: BEFORE CARRYING OUT ANY MAINTENANCE WORK, LOCK OFF FOR SAFE WORKING:

1. PRESS THE OFF MODE SWITCH ON THE GENERATOR SET CONTROL PANEL.
2. AS AN ADDITIONAL PRECAUTION, PRESS THE EMERGENCY STOP BUTTON, AND HOLD IN FOR 30 SECONDS.
3. ISOLATE ALL SUPPLIES TO THE GENERATOR SET.
4. ISOLATE THE BATTERY CHARGER.
5. DISCONNECT THE BATTERY.
6. REMOVE THE STARTER CONTROL WIRES.
7. A SUITABLE WARNING PLATE STATING 'MAINTENANCE IN PROGRESS' SHOULD BE DISPLAYED PROMINENTLY.

WARNING: SOME PANEL INTERNAL COMPONENTS MAY HAVE LIVE EXPOSED TERMINATIONS EVEN IF THE GENERATOR SET IS NOT RUNNING. ISOLATE (LOCK AND TAG) ALL EXTERNAL ELECTRICAL SUPPLIES PRIOR TO ACCESS OF THE CONTROL PANEL.

6.1 Locking the Generator Set Out of Service

6.1.1 Introduction

Before any work is carried out for maintenance, etc., the plant must be immobilised. Even if the plant is put out of service by pressing the Off switch on the control panel, the plant cannot be considered safe to work on until the engine is properly immobilised as detailed in the following procedures.

Caution: *Refer also to the Operator's engine specific manual included in the documentation package supplied with the generator set. This manual will contain specific equipment instructions that may differ from the standard generator set.*

WARNING: BEFORE CARRYING OUT ANY MAINTENANCE, ISOLATE ALL SUPPLIES TO THE GENERATOR SET AND ANY CONTROL PANELS. RENDER THE SET INOPERATIVE BY DISCONNECTING THE PLANT BATTERY.


Caution: *If the engine has been running recently explosive gases (given off during battery charging) may be present in the vicinity of the batteries. Ensure the area is well ventilated before disconnecting batteries.*

6.1.2 Immobilising the Generator Set for Safe Working

Note: *Shutdown the engine first, as described in Section 5.7 - Stopping.*

To immobilise the engine:

1. Press the Off Mode switch on the display panel.
2. Press the Emergency Stop Button, (and hold in for 30 seconds). This will prevent the starting of the generator set regardless of the Start signal source and will therefore provide an additional safety step for immobilising the generator set. (See also Section 5.7).

Note: *When this Stop Button is pressed the display panel will indicate the Shutdown condition by illuminating the red Shutdown status LED  and displaying the following message on the graphical LCD display:*

**Fault Number: 1433
EMERGENCY STOP**

or

**Fault Number: 1434
REMOTE EMERGENCY STOP**

Note: *This Fault will affect the Fault History memory bank.*

3. As an additional precaution, thoroughly ventilate the plant room before disconnecting any leads.
4. Isolate and lock off the supply to the heater, where fitted.
5. Isolate and lock off the supply to the battery charger, where fitted.
6. Isolate the fuel supply to the engine.
7. Disconnect the starting batteries and control system batteries, (if separate). Disconnect the negative (-) lead first. Attach a padlock through one of the battery leads and tag for safe working.
8. Fit warning notices at each of the above points to indicate Maintenance in Progress - Plant Immobilised for Safe Working.

6.2 General

The maintenance procedures covered in this manual are intended for Operator-level service only and must be performed at whichever interval occurs first. At each scheduled maintenance interval, perform all previous maintenance checks that are due for scheduled maintenance.

Table 1 covers the recommended service intervals for a generator set on Standby service. If the generator set will be subjected to Prime usage or extreme operating conditions, the service intervals should be reduced accordingly. Consult your authorised distributor.

Some of the factors that can affect the maintenance schedule are:

- Use for continuous duty (prime power)
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water
- Exposure to windblown dust or sand.

Consult with an authorised distributor if the generator set will be subjected to any extreme operating conditions and determine a suitable schedule of maintenance. Use the running time meter to keep an accurate log of all service performed for warranty support. Perform all service at the time period indicated, or after the number of operating hours indicated, whichever comes first.

Use Table 1 to determine the maintenance required and then refer to the sections that follow for the correct service procedures.

Refer also to the Operator's engine manual supplied with the generator set.



Table 4 Periodic Maintenance Schedule

MAINTENANCE ITEMS		Daily or after 8 Hours	Weekly or after 50 Hours ⁷	Monthly or after 100 Hours ⁷	3 Months or after 250 Hours ^{5, 7}
Perform maintenance tasks as specified using Daily or Hourly periods – whichever is the sooner					
Check :	Fuel tank level	■			
	Fuel lines and hoses	■ ¹			
	Bedframe fluid containment (where fitted), drain if necessary	■ ⁸			
	Engine oil level	■ ¹	■ ⁶		
	Coolant level of radiator(s) (water jacket & LTA)	■ ⁴			
	Coolant lines and radiator hoses for wear and cracks	■ ¹			
	Cooling fan blades	■			
	All exhaust components, and hardware (fittings, clamps, fasteners, etc.)	■ ¹			
	Drive belt, condition and tension		■ ²		
	Air cleaner restriction indicator (where fitted)	■			
	Air intake system for leaks	■			
	Electrical connections (battery, starter motor and alternator connections)		■		
	Safety controls and alarms	■			
	Operation of Emergency Stop Button		■		
Drain:	Water from fuel pre-filter (where fitted)	■ ³			
Clean:	Radiator matrix			■ ^{4,5}	

■1 – Check for oil, fuel, coolant and exhaust system leaks. Check exhaust system audibly and visually with generator set running. (Refer to [Sections 6.8](#) and [6.9](#)).

■2 – Visually check belt for evidence of wear or slippage. Replace if hard or brittle (to be undertaken by a Service Engineer).

■3 – Drain one cup, or more, of fuel to remove water and sediment.

■4 – Refer to Section 6.4 of this manual and to the Radiator Information Manual 0908-0107-00 supplied with this generator set.

■5 – To be undertaken by a Service Engineer. Please refer to your Authorised Distributor.

■6 – Engine oil and filter must be replaced after the initial running-in period of 50 hours. Please refer to your authorised distributor.

■7 – All maintenance checks and inspections listed at lesser maintenance intervals must also be carried out at this time.

■8 – For generator sets with QSB7 engines refer to Engine Operators manual for that model.

6.3 Daily or Refuelling Maintenance Procedures

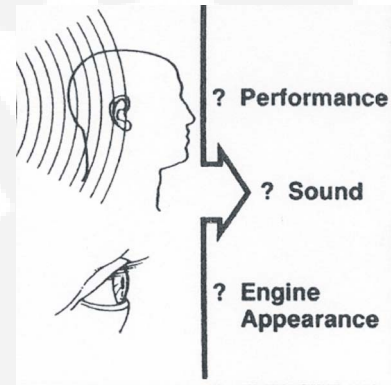
Monitor fluid levels, oil pressure, and coolant temperature frequently. During operation, be alert for mechanical problems that could create unsafe or hazardous conditions. The following sections cover areas that must be frequently inspected for continued safe operation.

6.3.1 General Information

Preventative maintenance begins with day-to-day awareness of the condition of the generator set.

Before starting the generator set check the oil and coolant levels and look for:

- Leaks
- Loose or damaged parts
- Worn or damaged belts
- Any change in engine or generator set appearance.



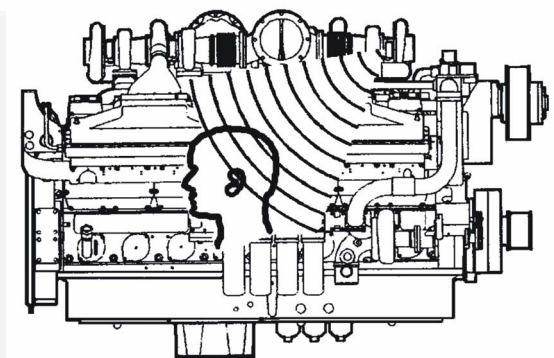
6.3.2 Engine Operation Report

The engine must be maintained in good mechanical condition if the operator is to obtain optimum satisfaction from its use. Running reports are necessary to enable programmed or emergency servicing to be carried out.

Comparison and intelligent interpretation of the running report, together with a practical follow-up action will eliminate most failures and emergency repairs.

Most engine problems give an early warning. Look and listen for changes in engine performance, sound, or appearance that can indicate service or repair is needed. Some engine changes to look for and report on are:

- Low lubricating oil pressure
- Low power
- Abnormal water or oil temperature
- Unusual engine noise
- Excessive exhaust smoke
- Excessive use of coolant, fuel or lubricating oil
- Any coolant, fuel or lubricating oil leaks.
- Misfire
- Vibration



6.4 Cooling System

WARNING: CONTACT WITH HOT COOLANT CAN RESULT IN SERIOUS SCOLDING. ALLOW COOLING SYSTEM TO COOL BEFORE RELEASING PRESSURE AND REMOVING WATER JACKET RADIATOR CAP OR LTA EXPANSION TANK CAP.

Caution: Loss of coolant can allow engine to overheat without protection of shutdown device, and cause severe damage to the engine. Maintain coolant level for proper operation of high engine temperature shutdown system.

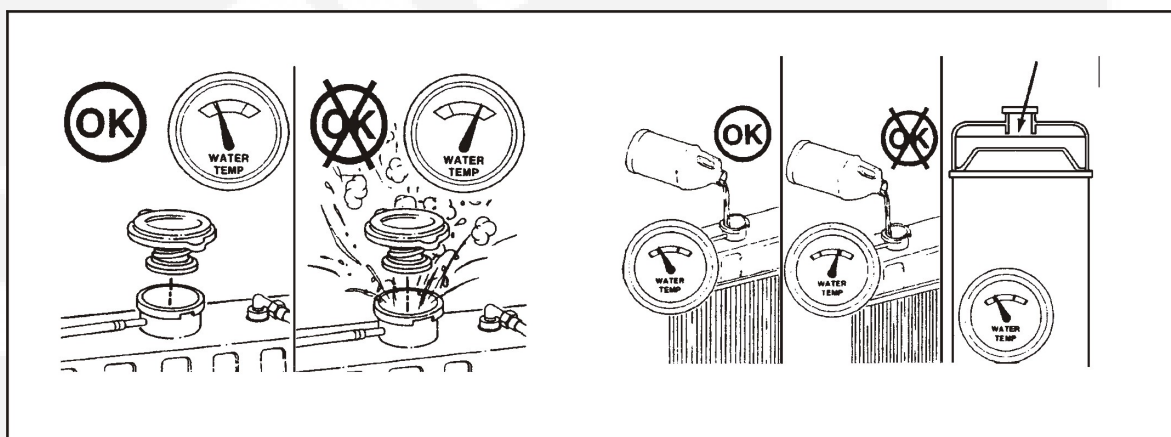
6.4.1 Coolant Level - Check

WARNING: DO NOT REMOVE THE RADIATOR CAP FROM A HOT ENGINE; WAIT UNTIL THE TEMPERATURE IS BELOW 50°C (122°F) BEFORE REMOVING PRESSURE CAP. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY FROM HEATED COOLANT SPRAY OR STEAM. REMOVE FILLER CAP SLOWLY TO RELEASE COOLANT SYSTEM PRESSURE.

Caution: Avoid prolonged or repeated skin contact with antifreeze. Refer to the Health and Safety Manual 0908-0110-00 for handling and disposal of antifreeze.

Note: Never use a sealing additive to stop leaks in the coolant system. This can result in a blocked coolant system and inadequate coolant flow causing the engine to overheat.

Coolant level must be checked daily. The standard coolant concentration is either 25% or 50% Ethylene Glycol and water, this concentration must be maintained. Warranty claims for damage will be rejected if the incorrect mix of anti-freeze has been used. Consult your authorised distributor for the correct anti-freeze specifications and concentration for your operating conditions. The recommended antifreeze is Fleetguard® Compleat ES which is a low-silicate antifreeze, or its equivalent.



Caution: Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool to below 50°C (122°F) before adding coolant.

Note: On applications that use a coolant recovery system, check to ensure the coolant is at the appropriate level on the coolant recovery tank dependent on engine temperature.

Fill the cooling system with coolant to the bottom of the fill neck in the radiator or expansion tank, with the coolant temperature at 50°C (122°F) or lower.

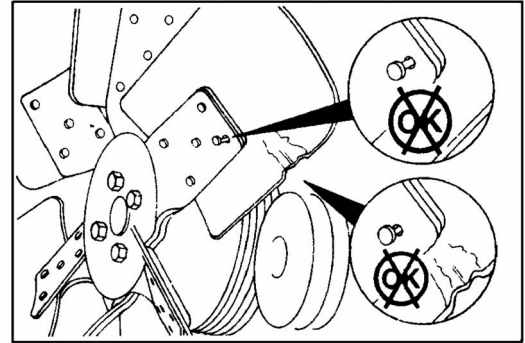
Note: Some radiators have two fill necks, both of which must be filled. Refer to the generator set specific drawings supplied with the set.

6.4.2 Cooling Fan - Inspect

WARNING: PERSONAL INJURY CAN RESULT FROM A FAN BLADE FAILURE. NEVER PULL OR PRY ON THE FAN, THIS CAN DAMAGE THE FAN BLADE(S) AND CAUSE FAN FAILURE.

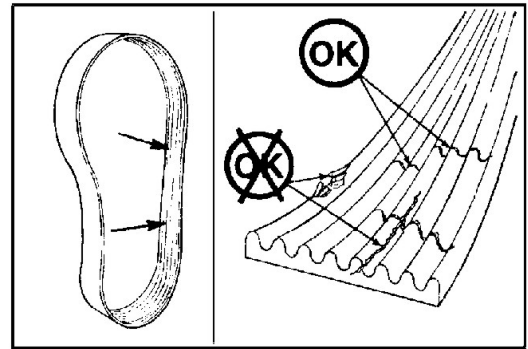
A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure it is securely mounted.

Contact your authorised distributor if the fan is damaged.



6.4.3 Drive Belt - Inspect

Visually inspect the belt through the guarding, checking for intersecting cracks. Small transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are NOT acceptable. Contact your authorised distributor if the belt is frayed or has pieces of material missing.

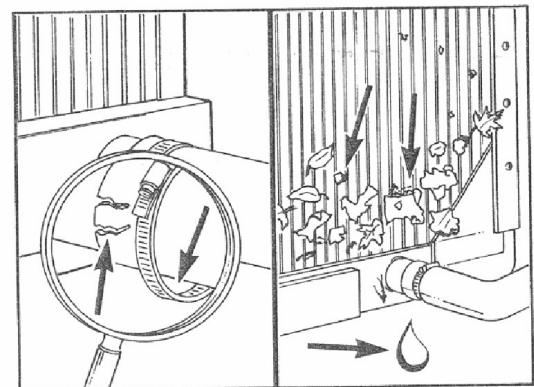


6.4.4 Radiator - Check

Check for damaged hoses, and loose and damaged hose clamps.

Inspect the exterior of the radiator (through the guarding) for obstructions. During the service life of a radiator a build up of foreign matter can obstruct the flow of air through the radiator cores, reducing the cooling capability. To ensure the continued efficiency of the radiator, the core will require cleaning.

Refer to the Radiator Information Manual 0908-0107-00 for further details on cleaning the radiator.



6.5 Engine Oil

6.5.1 Engine Oil Level – Check

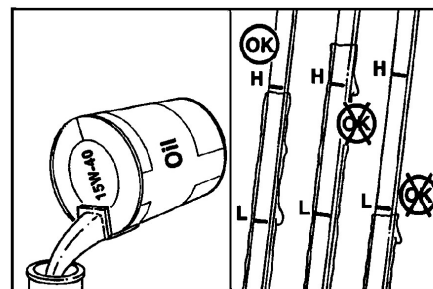
WARNING: CRANKCASE PRESSURE CAN BLOW OUT HOT OIL AND CAUSE SEVERE BURNS. DO NOT CHECK OIL WHILE THE GENERATOR SET IS OPERATING.

Caution: Do not operate the engine with the oil level below the low mark or above the high mark. Overfilling can cause foaming or aeration of the oil while operation below the low mark may cause loss of oil pressure.

Caution: Prolonged and repeated skin contact with used engine oils can cause skin disorders or other bodily injury.
Refer to the Health and Safety Manual (0908-0110-00) supplied with your generator set for precautions when handling or disposing of used engine oil.

Check the engine oil level during engine shutdown periods at the intervals specified in the Maintenance Table 1.

Never operate the engine with the oil level below the L (Low) mark, or above the H (High) mark. Wait at least fifteen minutes, after shutting off the engine, before checking the oil level. This allows time for the oil to drain back to the oil pan.



Note: Use high-quality 15W-40 multi-viscosity lubricating oil such as Cummins Premium Blue® or its equivalent. Consult your authorised distributor for the correct lubricating oil for your operating conditions.



6.6 Fuel System

WARNING: IGNITION OF FUEL CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH BY FIRE OR EXPLOSION. DO NOT PERMIT ANY FLAME, CIGARETTE, OR OTHER IGNITER NEAR THE FUEL SYSTEM, OR IN AREAS SHARING VENTILATION.

WARNING: ENGINE FUEL ACTUATORS CAN OPERATE AT VOLTAGES UP TO 140 VOLTS DC.

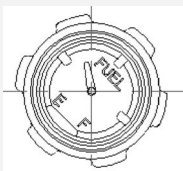
WARNING: DO NOT MIX GASOLINE OR ALCOHOL WITH DIESEL FUEL. THIS MIXTURE CAN CAUSE AN EXPLOSION AND DAMAGE TO THE ENGINE – GASOLINE AND ALCOHOL HAVE INFERIOR LUBRICITY.

Caution: *Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzles.*

Use ASTM No. 2D fuel with a minimum Cetane number of 40. No. 2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 are often needed in high altitudes, or extremely low ambient temperatures, to prevent misfires and excessive smoke. Contact your authorised distributor for your operating conditions.

Note: *A diesel fuel to BS 2869:2006; (Fuel oils for agricultural, domestic and industrial engine and boilers), conforming to the requirements and test methods of that specification would be an acceptable alternative to ASTM No. 2D.*

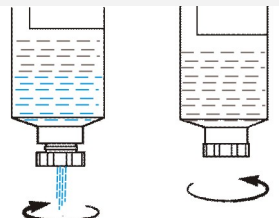
6.6.1 Fuel Level



To avoid condensation problems, keep fuel supply tanks as full as possible by filling up each time the engine is used. Condensation (water) can cause clogging of the fuel filters as well as possible freezing problems. In addition, water mixing with the sulphur in the fuel forms acid which can corrode and damage engine parts.

A base fuel tank may be incorporated into the bedframe. This tank is fitted with a large filler cap with in-built coarse filter, and provides a minimum of eleven hours operation at a nominal 100% load.

6.6.2 Fuel/Water Separator - Drain



Drain the water and sediment from the separator daily.

Set-mounted fuel/water separators are fitted to provide protection for the engine fuel injection system as water-free fuel supplies cannot be guaranteed.

Turn the valve counterclockwise, four complete turns, until the valve drops down one inch. Drain the filter sump of water until clear fuel is visible.

Push the valve up and turn the valve clockwise to close drain valve.

Caution: *Do not over tighten the valve. Over tightening can damage the threads.*

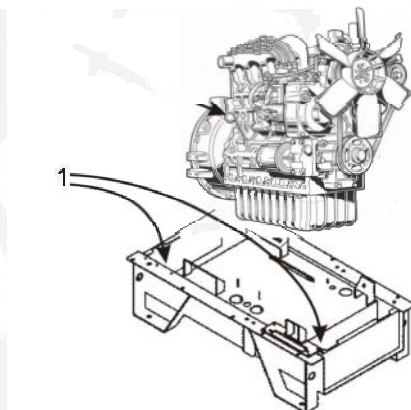
Note: *If more than 2 oz is drained, refilling of the filter is required to prevent hard starting.*

6.7 Fluid Containmentment

The bedframe fluid containment area (if applicable) must be inspected at regular intervals and any liquid must be drained off and disposed off in line with local health and safety regulations. (Refer also to Health and Safety manual 0908-0110-00). Failure to perform this action may result in spillage of liquids likely to contaminate the surrounding area.

KEY

1. Containment Area

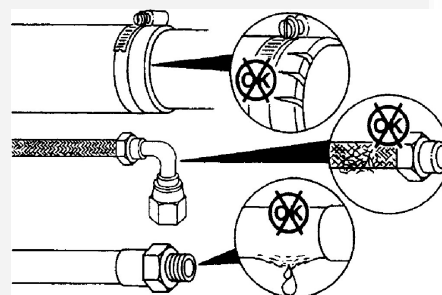


Any other fluid containment area must also be checked and emptied, as above.

6.8 Hoses and Fuel Lines - Check

WARNING: MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION AROUND HOT MANIFOLDS, MOVING PARTS, ETC..
TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT METAL PARTS SUCH AS RADIATOR, TURBOCHARGER AND EXHAUST SYSTEM.

With the generator set operating, inspect the supply lines, return lines, filters, and fittings for leaks. Check any flexible sections for cuts, cracks and abrasions and ensure they are not rubbing against anything that could cause breakage. If any leaks are detected, shut down the generator set (if possible), contact your authorised distributor and have the leaks corrected immediately.



6.9 Exhaust System

WARNING: EXHAUST COMPONENTS BECOME VERY HOT WHEN THE GENERATOR SET IS IN USE AND REMAIN HOT FOR A PERIOD OF TIME AFTER THE GENERATOR SET HAS BEEN SHUT DOWN. THESE COMPONENTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH FROM CONTACT. ALLOW THESE COMPONENTS TO COOL COMPLETELY BEFORE PERFORMING ANY MAINTENANCE TASKS.

WARNING: INHALATION OF EXHAUST GASES CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH. BE SURE DEADLY EXHAUST GAS IS PIPED OUTSIDE AND AWAY FROM WINDOWS, DOORS OR OTHER INLETS TO BUILDINGS. DO NOT ALLOW TO ACCUMULATE IN HABITABLE AREAS.

WARNING: MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION AROUND HOT MANIFOLDS, MOVING PARTS, ETC..

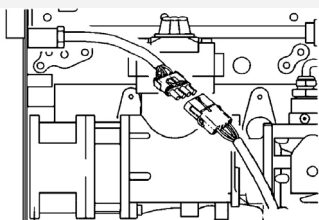
With the generator set operating, inspect the exhaust system visually and audibly where possible checking for leaks within the system, with out removing guarding and panels. If any leaks are detected, shut down the generator set, contact your authorized distributor and have the leaks corrected immediately.

6.10 Generator Set Output - AC Electric System

Check the following while the generator set is operating:

- Frequency: The generator set frequency should be stable and the reading should be the same as the generator set nameplate rating (50Hz/1500RPM or 60Hz/1800RPM).
- AC Voltage: At no load, the line-to-line voltage(s) should be the same as the generator set nameplate rating.
- AC Ammeter: At no load, the current readings should be zero. With a load applied, each line current should be similar.
- Panel Lamps: When the Operating Panel is first connected to the DC supply, the system runs a check by illuminating each of the indicator lamps in turn.

6.11 DC Electrical System



ignite explosive battery gases.

Check the terminals on the batteries for clean and tight connections. Loose or corroded connections create resistance, which can hinder starting. Use insulated tools when disconnecting battery cables. Clean and reconnect the battery cables if loose. Always disconnect both ends of the negative battery cable. Reconnect one end of the cable to the negative battery terminal and the other end to ground. This will ensure that any arcing will be away from the battery and least likely to

WARNING: IGNITION OF EXPLOSIVE BATTERY GASES CAN CAUSE SEVERE PERSONAL INJURY. DO NOT SMOKE, DO NOT USE NAKED FLAMES OR CAUSE SPARKS WHILE SERVICING BATTERIES.

Refer to Supplementary Publication 0908-0101-00 for cleaning and safety precautions of the battery

This is a Blank Page



SECTION 7 – TROUBLESHOOTING

7 Troubleshooting

7.1 Introduction

Fault code tables together with Warning and Shutdown code tables are provided in this section to assist in locating and identifying the possible causes of faults in the generator set system.

7.2 Control Unit DC Power Supply

The generator set control continuously monitors engine sensors for abnormal conditions, such as low oil pressure and high coolant temperature. If any of these conditions occur, the control will light a yellow Warning lamp or a red Shutdown lamp and display a message on the graphical display panel.

In the event of an engine shutdown fault (red Shutdown lamp), the control will stop the engine immediately; for an alternator shutdown fault, the engine will stop after the Cool-down Timer has timed out. If the generator set is stopped for this reason, the operator can restart the set after making the necessary adjustments or corrections. This section lists the Warning and Shutdown codes/messages (Table 7-1), and suggests troubleshooting procedures (Table 7-2).

Note: *Displayed error codes that are not listed in Table 7-2 will require an authorised service representative to correct the fault. Contact an authorised distributor for assistance.*

7.3 Safety Considerations

Fault finding work, particularly in confined areas, should be carried out by two engineers working together. Read, understand and comply with all safety precautions listed within Section 1 – Preliminary and Safety – and observe all instructions and precautions throughout this manual and the Health and Safety Manual (0908-0110-00).

The installation of a generator set can be designed for remote starting. When troubleshooting a generator set that is shutdown ensure that the set cannot be accidentally re-started. Refer to Section 6.4 – Locking the Generator Set out of Service.

WARNING: HIGH VOLTAGES ARE PRESENT WHEN THE GENERATOR SET IS RUNNING. DO NOT OPEN THE OUTPUT BOX WHILE THE SET IS RUNNING.

WARNING: SOME PANEL INTERNAL COMPONENTS MAY HAVE LIVE EXPOSED TERMINATIONS EVEN IF THE GENERATOR SET IS NOT RUNNING. ISOLATE ALL EXTERNAL ELECTRICAL SUPPLIES PRIOR TO ACCESS OF THE CONTROL PANEL.

WARNING: CONTACTING HIGH VOLTAGE COMPONENTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH BY ELECTROCUTION. KEEP THE OUTPUT BOX COVERS IN PLACE DURING TROUBLESHOOTING. ONLY PERSONNEL QUALIFIED TO PERFORM ELECTRICAL SERVICING SHOULD CARRY OUT TESTING AND/OR ADJUSTMENTS.

Caution: *Always disconnect a battery charger from its AC source before disconnecting the battery leads. Failure to do so can result in voltage spikes high enough to damage the DC control circuits of the generator set.*

WARNING: VENTILATE BATTERY AREA BEFORE WORKING ON OR NEAR BATTERY – WEAR GOGGLES – STOP GENERATOR SET AND DISCONNECT CHARGER BEFORE DISCONNECTING BATTERY CABLES – DISCONNECT NEGATIVE (-) CABLE FIRST AND RECONNECT LAST

WARNING: IGNITION OF EXPLOSIVE BATTERY GASES CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. ARCING AT BATTERY TERMINALS, LIGHT SWITCH OR OTHER EQUIPMENT, FLAME, PILOT LIGHTS AND SPARKS, CAN IGNITE BATTERY GAS. DO NOT SMOKE, OR SWITCH TROUBLE LIGHT ON OR OFF NEAR BATTERY. DISCHARGE STATIC ELECTRICITY FROM BODY BEFORE TOUCHING BATTERIES BY FIRST TOUCHING A GROUNDED METAL SURFACE.

WARNING: 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).

7.4 Fault Finding

Should a fault condition occur during operation follow the procedures in the following tables to locate and correct the problem. For any symptom not listed, contact an authorised service centre for assistance.

Before starting any fault finding, ensure that the following basic checks are carried out:

- All switches and controls are in their correct positions
- The fuel oil level is correct
- The lubricating oil level is correct
- The coolant level is correct
- The radiator matrix is free from obstruction
- The battery charge condition is satisfactory and the connections are secure
- The generator set electrics and alternator connections are secure
- The panel connections are secure
- The protection circuits have been reset
- Blown fuses have been replaced
- Tripped contactors or circuit breakers have been reset

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.
REVIEW SAFETY PRECAUTIONS LISTED WITHIN SECTION 1 - PRELIMINARY AND SAFETY SECTION - OF THIS MANUAL TOGETHER WITH THE HEALTH AND SAFETY MANUAL (0908-0110-00).

7.5 Status Indicators

7.5.1 Not In Auto Indicator

This red lamp flashes continuously when the Off/Manual/Auto switch is not in the Auto position (Figure 7-1).

7.5.2 Shutdown Status Indicator

This red lamp is lit whenever the control detects a Shutdown condition. After the condition has been corrected, the Shutdown indicator can be reset by turning the Off/Manual/Auto switch to the Off (O) position, and pressing the Fault Acknowledge button. The generator set cannot be started when this lamp is on.

7.5.3 Warning Status Indicator

This yellow lamp is lit whenever the control detects a Warning condition. After the condition has been corrected, the Warning indicator can be reset by pressing the Fault Acknowledge button. (It is **not** necessary to stop the generator set if the fault becomes inactive during generator set operation).

7.6 Reading Fault Codes

If the generator set contains the optional graphical display and a fault occurs, the fault code/message will be displayed in the graphical display Description Line (Figure 7–1). If the control does not contain the graphical display, the fault code is read from the Warning and Shutdown status indicators.

After the fault is acknowledged and corrected, the recorded fault will be deleted from the control panel memory, but will remain in a data log to maintain a fault code history.

Note: *The InPower service tool is required to view this data log.*

7.6.1 Reading Fault Codes Using Graphical Display (Optional)

The top three lines of the graphical display contain the following control information in the order described:

- **State Line:** Modes of operation, such as Stopped, Time Delay to Start, Warm Up at Idle, etc. (see Figure 7–1), and paralleling operations, such as Standby, Dead BUS Close, Synchronise, etc.
- **Action Line:** System actions, such as Warning, De-rate, Shutdown Cool-down and Shutdown, and Fault codes.
- **Description Line:** Fault code messages.

Refer to History/About Submenus in Section 4.8, which describes how to view fault codes using graphical display.

7.6.2 Reading Fault Codes Using Warning/Shutdown Indicators

If the Warning or Shutdown status indicator is lit, press and hold the Fault Acknowledge button for a minimum of ten seconds. After ten seconds, the Shutdown lamp will begin to blink the active fault code(s) as follows:

The Warning lamp is used to indicate the start of a new code. The Warning lamp will remain on for two seconds, followed by the Shutdown lamp blinking the fault code. This sequence occurs three times for each code. The fourth flash of the Warning lamp indicates the beginning of the second fault code.

There are distinct pauses between repetitions of the code blink transmissions of the Shutdown lamp.

A three-digit fault code is indicated by three sets of blinks separated by a two-second pause. The first set corresponds to the hundreds position, the second to the tens position, and the third to the ones digit. Example for Code No. 213:

Shutdown LED: blink–blink–pause–blink–pause–blink–blink–blink

Warning LED: blink (two seconds)

The light will display the fault codes (active or inactive) in succession, starting with the most recent. Up to 32 (unacknowledged) fault codes can be stored in control panel memory.

To return the control to the most recent fault code, press and release the Fault Acknowledge button (less than one second) and repeat procedure.

When the fault code is acknowledged and the fault condition is corrected, the fault code will be removed from the LED fault log.

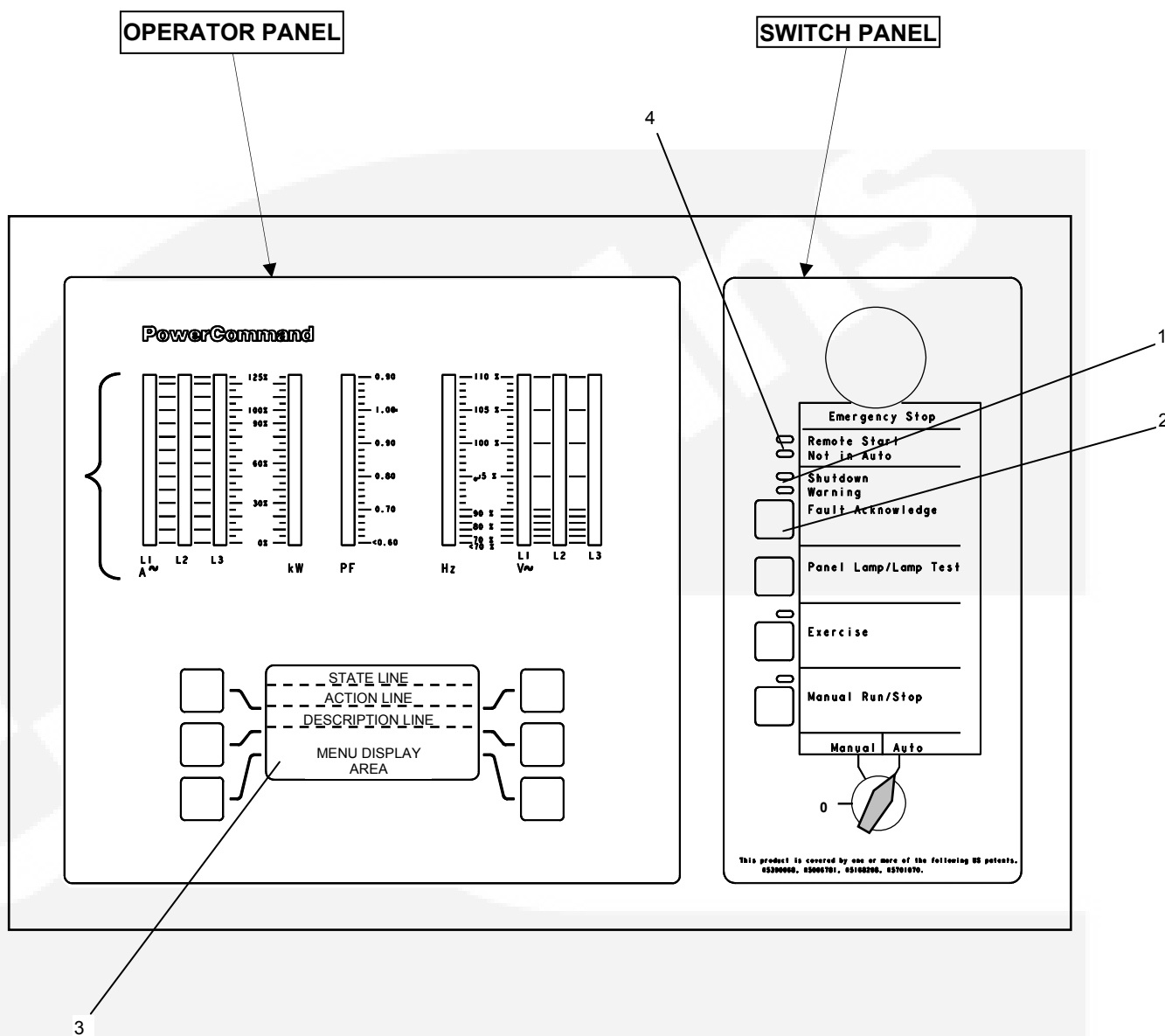


Figure 7-1 Front Control Panel (Full-Featured)

1. Shutdown, Warning Status Indicators
2. Fault Acknowledge Button
3. Graphical Display
4. Not in Auto Indicator

7.7 Line Circuit Breaker (Optional)

The optional line circuit breaker mounts on the generator set output box. If the load exceeds the generator current rating, the line circuit breaker will open, preventing the generator set from being overloaded. If the circuit breaker trips, locate the source of the overload and correct as necessary. Manually reset the breaker to reconnect the load to the generator set.

7.8 Control and Diagnostics Via Network or PC (Laptop)

See your authorised Cummins dealer regarding software, hardware and network requirements for control and diagnostics via network or PC.

7.9 Fault Codes

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 7–1 to find the category (CAT) 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 are feature dependent and will not be displayed by the generator set control.*

7.9.1 Category A Fault Codes

Relate to engine or alternator Shutdown faults that require immediate repair by competent service personnel (generator set non-operational). The Control unit prevents the generator set from being restarted.

7.9.2 Category B Fault Codes

Consist of faults that can affect generator set performance or cause **engine, alternator, or connected equipment damage**. Continue operation of the generator set **only** when it is powering critical loads and cannot be shut down. Requires repair by competent service personnel.

7.9.3 Category C Fault Codes

Consist of faults that do not affect generator set performance but require competent service personnel to repair. These codes indicate a defective sensor or harness, leaving no engine protection. (Engine damage may therefore occur without detection).

Note: *Continued operation may void generator set warranty if damage occurs that relates to any of these category faults.*

7.9.4 Category D Fault Codes

Consist of faults that are repairable by site personnel. Service will be required by competent service personnel if site personnel cannot resolve the problem after taking the corrective actions suggested in Table 7–2.

7.9.5 Category E Fault Codes

Indicates non-critical operational status of generator set, external faults, or customer fault inputs. May require repair by qualified service personnel.

Table 7-1 Warning and Shutdown Fault Codes

CAT	CODE	LAMP	DISPLAYED MESSAGE	CAT	CODE	LAMP	DISPLAYED MESSAGE
A	111	Shtdn	Internal ECM error	A	254	Shtdn	Fuel shutoff valve
A	112	Shtdn	Actuator not responding	C	259	Wrng	Fuel shutoff valve
B	113	Wrng	Actuator sensor fault	C	261	Wrng	Fuel temperature sensor
A	115	Shtdn	No speed signal	C	263	Wrng	Fuel temperature sensor
A	116	Shtdn	Time press sensor high	C	265	Wrng	Fuel temperature sensor
A	117	Shtdn	Time press sensor low	A	266	Shtdn	Fuel temperature
B	118	Wrng	Pump press sensor high	B	316	Wrng	Fuel supply pump
B	119	Wrng	Pump press sensor low	B	318	Wrng	Fuel supply pump
C	121	Wrng	No engine speed signal	D	326	Wrng	Oil level warning
B	122	Wrng	Manifold air press sensor	B	343	Wrng	Internal ECM error
B	123	Wrng	Manifold air press sensor	D	359	Wrng	Engine failed to start
C	135	Wrng	Oil pressure sensor	A	378	Wrng	Fuelling actuator #1
C	141	Wrng	Oil pressure sensor	A	379	Wrng	Fuelling actuator #1
B	143	Wrng	Low oil pressure	A	394	Wrng	Fuelling actuator #1
C	144	Wrng	Coolant temperature sensor	A	395	Wrng	Fuelling actuator #1
C	145	Wrng	Coolant temperature sensor	A	396	Wrng	Fuelling actuator #2
D	146	Wrng	High coolant temp warning	A	397	Wrng	Fuelling actuator #2
C	151	Shtdn	High coolant temp alarm	A	398	Wrng	Fuelling actuator #2
D	152	Wrng	Low coolant temp	A	399	Wrng	Fuelling actuator #2
C	153	Wrng	Manifold air temp sensor	B	415	Shtdn	Low oil pressure alarm
C	154	Wrng	Manifold air temp sensor	B	421	Wrng	High oil temperature
A	155	Shtdn	Manifold air temp alarm	B	423	Wrng	Fuel timing
D	197	Wrng	Coolant level warning	D	441	Wrng	Low battery voltage
C	212	Wrng	Oil temperature sensor	D	442	Wrng	High battery voltage
C	213	Wrng	Oil temperature sensor	B	449	Wrng	High fuel supply pressure
A	214	Shtdn	High oil temperature	B	451	Wrng	Fuel rail pressure sensor
C	221	Wrng	Air pressure sensor	B	452	Wrng	Fuel rail pressure sensor
C	222	Wrng	Air pressure sensor	A	455	Shtdn	Fuel control valve sensor
A	228	Shtdn	Low coolant pressure	B	467	Wrng	Timing rail act sensor
C	231	Wrng	Coolant pressure sensor	B	468	Wrng	Fuel rail actuator sensor
C	232	Wrng	Coolant pressure sensor	D	471	Wrng	Low oil level
A	233	Wrng	Coolant pressure warning	B	482	Wrng	High fuel supply pressure
A	234	Shtdn	Overspeed	B	488	Wrng	High intake manifold temp
D	235	Shtdn	Coolant level alarm	C	498	Wrng	Oil level sensor
A	236	Shtdn	Position sensor	C	499	Wrng	Oil level sensor
D	253	Shtdn	Oil level alarm	A	514	Shtdn	Fuel control valve

Table 7-1 Warning and Shutdown Fault Codes (continued)

CAT	CODE	LAMP	DISPLAYED MESSAGE	CAT	CODE	LAMP	DISPLAYED MESSAGE
B	546	Wrng	Fuel pressure sensor	B	1319	Wrng	High alternator temp
B	547	Wrng	Fuel pressure sensor	C	1321	Wrng	Common warning driver
B	554	Wrng	Fuel rail pressure sensor	A	1322	Shtdn	LOAD GOV KW SETPOINT OOR HI
B	555	Wrng	Blowby pressure	A	1323	Shtdn	LOAD GOV KW SETPOINT OOR LO
A	556	Shtdn	Blowby pressure	B	1324	Wrng	Load gov kVAR oor hi
A	586	Shtdn	Run/Stop switch	B	1325	Wrng	Load gov kVAR oor lo
A	587	Shtdn	Run/Stop switch	B	1326	Wrng	Backup starter disconnect
D	611	Wrng	Engine hot	A	1327	Shtdn	Load gov kW analog oor
D	688	Shtdn	High oil level alarm	D	1328	Wrng	Genset CB tripped
B	689	Wrng	Crank shaft sensor	B	1329	Wrng	AVR DC power failure
B	719	Wrng	Blowby pressure sensor	A	1331	Shtdn	AVR driver shorted
B	729	Wrng	Blowby pressure sensor	A	1332	Shtdn	Manual switch oor lo
B	731	Wrng	Cam/Crank misalignment	A	1333	Shtdn	Manual switch oor hi
B	778	Wrng	Camshaft sensor	A	1334	Shtdn	Critical scaler oor
C	1118	Wrng	Prelube relay driver	B	1335	Wrng	Non critical scaler oor
A	1121	Shtdn	Failed to disconnect	E	1336	Shtdn	Cooldown complete
C	1219	Wrng	Utility CB tripped	E	1337	None	Network wink
C	1222	Wrng	Power transfer not in auto	E	1341	Shtdn	Load demand stop
C	1223	Wrng	Utility frequency sensor	A	1342	Shtdn	Slot 0 card
C	1224	Wrng	Gen over voltage sensor	A	1343	Shtdn	Slot 1 card
C	1225	Wrng	Gen under voltage sensor	A	1345	Shtdn	Slot 3 card
C	1226	Wrng	Genset frequency sensor	A	1346	Shtdn	Slot 4 incorrect
E	1311	Shtdn/ Wrng	Customer input #1	C	1351	Wrng	Slot 4 / network enabled
E	1312	Shtdn/ Wrng	Customer input #2	C	1414	Wrng	Run relay contact
E	1313	Shtdn/ Wrng	Network Fault 1	C	1415	Wrng	Run relay driver
E	1314	Shtdn/ Wrng	Network Fault 2	D	1416	Wrng	Fail to shutdown
E	1315	Shtdn/ Wrng	Network Fault 3	D	1417	Wrng	Power down error
E	1316	Shtdn/ Wrng	Network Fault 4	B	1419	Wrng	Fuel rail driver
E	1317	Shtdn/ Wrng	Customer input #3	B	1421	Wrng	Timing rail driver #1
E	1318	Shtdn/ Wrng	Customer input #4	B	1422	Wrng	Timing rail driver #2
				C	1424	Wrng	High side driver
				C	1427	Wrng	Overspeed relay driver
				C	1428	Wrng	LOP shutdown relay driver
				D	1433	Shtdn	Emergency stop - local

Table 7-1 Warning and Shutdown Fault Codes (continued)

CTG	CODE	LAMP	DISPLAYED MESSAGE	CTG	CODE	LAMP	DISPLAYED MESSAGE
D	1434	Shtdn	Emergency stop - remote	B	1471	Wrng	High current
D	1435	Wrng	Engine cold	A	1472	Shtdn	Overcurrent
B	1436	Wrng	PT fuel system drivers	A	1473	Shtdn	Watchdog failure
A	1437	Shtdn	E-stop path fuse blown	A	1474	Shtdn	SOFTWARE VERSION MISMATCH
D	1438	Wrng	Fail to crank	C	1475	Wrng	First start backup
D	1439	Wrng	Fuel level low in day	C	1476	Wrng	LonWorks card
D	1441	Wrng	Fuel level low in main	C	1477	Wrng	Crank relay contact
D	1442	Wrng	Battery is weak	C	1478	Wrng	Crank relay driver
D	1443	Wrng	Battery is dead	A	1481	Shtdn	AVR driver open
B	1444	Wrng	kW overload	E	1483	None	Common alarm status
A	1445	Shtdn	Alternator short circuit	A	1485	Shtdn	EFC driver shorted
A	1446	Shtdn	AC output voltage is high	A	1486	Shtdn	EFC driver open
A	1447	Shtdn	AC output voltage is low	C	1487	Wrng	Auto acknowledge driver
A	1448	Shtdn	AC output frequency low	C	1488	Wrng	Warning LED driver
A	1449	Wrng	AC output frequency high	C	1489	Wrng	Shutdown LED driver
B	1451	Wrng	Gen/Bus voltage differ	C	1491	Wrng	Ready to load relay driver
A	1452	Shtdn	Gen CB failed to close	C	1492	Wrng	Load dump relay driver
A	1453	Shtdn	Gen CB failed to open	C	1493	Wrng	Display control driver
C	1454	Wrng	Gen CB position contact	C	1494	Wrng	Modem power relay driver
A	1455	Shtdn	Util CB contact	C	1495	Wrng	Common shutdown2 driver
E	1456	Wrng	Bus out of range	C	1496	Wrng	Auto mode relay driver
E	1457	Wrng	Fail to synchronise	C	1497	Wrng	Manual run LED driver
E	1458	Wrng	Phase rotation	C	1498	Wrng	Exercise run LED driver
A	1459	Shtdn	Reverse kW	C	1499	Wrng	Remote start LED driver
A	1461	Shtdn	Loss of field	C	2111	Wrng	Aftercooler temp sensor
B	1462	Wrng	High ground current	C	2112	Wrng	Aftercooler temp sensor
E	1463	None	Not in Auto	B	2113	Wrng	High aftercooler temp
E	1464	None	Load dump	A	2114	Shtdn	High aftercooler temp
E	1465	None	Ready to load	C	2331	Wrng	Utility under volt sensor
C	1466	Wrng	Modem failure	C	2358	Wrng	Utility over volt sensor
C	1467	Wrng	Unable to connect modem	C	2396	Wrng	Utility CB failed to close
C	1468	Wrng	Network error	C	2397	Wrng	Utility CB failed to open

WARNING: MANY TROUBLESHOOTING PROCEDURES PRESENT HAZARDS WHICH CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH. ONLY COMPETENT SERVICE PERSONNEL WITH KNOWLEDGE OF FUELS, ELECTRICITY, AND MECHANICAL HAZARDS SHOULD PERFORM SERVICE PROCEDURES.
REVIEW SAFETY PRECAUTIONS LISTED WITHIN SECTION 1 - PRELIMINARY AND SAFETY SECTION - OF THIS MANUAL TOGETHER WITH THE HEALTH AND SAFETY MANUAL (0908-0110-00).

Table 7-2 Troubleshooting Procedures for Fault Codes

SYMPTOM	CORRECTIVE ACTION
CODE: 146 LAMP: WARNING MESSAGE: HIGH COOLANT TEMP WARNING	Indicates engine has begun to overheat and engine coolant temperature has risen to an unacceptable level. If generator set is powering non-critical and critical loads and cannot be shut down, use the following: a) Reduce load if possible by turning off non-critical loads. b) Check air inlets and outlets and remove any obstructions to airflow. If engine can be stopped, follow 151 High Coolant Temp Alarm procedure.
CODE: 151 LAMP: SHUTDOWN MESSAGE: HIGH COOLANT TEMP ALARM	Indicates engine has overheated (water jacket coolant temperature has risen above the shutdown trip point or the coolant level is low). Allow engine to cool down completely before proceeding with the following checks: a) Check water jacket coolant level and replenish if low. Look for coolant leakage and repair if necessary. b) Check for obstructions to cooling airflow and correct as necessary. c) Check fan belt and repair if necessary. d) Reset control and restart after locating and correcting problem.
CODE: 152 LAMP: WARNING MESSAGE: LOW COOLANT TEMP	Indicates engine coolant heater is not operating or is not circulating coolant. Set is in standby mode but is not operating. Warning occurs when engine water jacket coolant temperature is 21°C (70°F) or lower. NOTE: In applications where the ambient temperature falls below 4°C (40°F, Low Coolant Temp may be indicated even though the coolant heaters are operating. Check for the following conditions: a) Check that both ball valves in coolant heater system are open. b) Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cord and correct as required. c) Check for low water jacket coolant level and replenish if required. Look for possible coolant leakage points and repair as required.
CODE: 197 LAMP: WARNING MESSAGE: COOLANT LEVEL WARNING	Indicates engine water jacket coolant level has fallen to an unacceptable level. If generator set is powering critical loads and cannot be shut down, wait until next shutdown period, then follow 235 Coolant Level Alarm procedure. If engine can be stopped, follow 235 procedure.

SYMPTOM	CORRECTIVE ACTION
CODE: 235 LAMP: SHUTDOWN MESSAGE: COOLANT LEVEL ALARM	Indicates engine water jacket coolant level has fallen below the alarm trip point. Allow engine to cool down completely before proceeding. a) Check water jacket coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. b) Reset control and restart after locating and correcting problem.
CODE: 359 LAMP: WARNING MESSAGE: ENGINE FAILED TO START	Indicates possible fault with control or starting system. Check for the following conditions: a) Poor battery cable connections. Clean the battery cable terminals and tighten all connections. b) Discharged or defective battery. Recharge or replace the battery.
CODE: 441 LAMP: WARNING MESSAGE: LOW BATTERY VOLTAGE	Indicates battery voltage is below 24 VDC. a) Discharged or defective battery. Check the battery charger fuse. Recharge or replace the battery. b) Poor battery cable connections. Clean the battery cable terminals and tighten all connections. c) Check engine DC alternator. Replace engine DC alternator if normal battery charging voltage (24 to 26 VDC) is not obtained. d) Check float level if applicable (raise float level).
CODE: 442 LAMP: WARNING MESSAGE: HIGH BATTERY VOLTAGE	Indicates battery voltage exceeds 32 VDC. a) Check float level on battery charger if applicable (lower float level). b) Check engine DC alternator. Replace engine DC alternator if normal battery charging voltage (24 to 26 VDC) is not obtained.
CODE: 611 LAMP: WARNING MESSAGE: ENGINE HOT	Indicates that an engine hot shutdown has occurred (cool-down timers were bypassed). This condition will occur when the operator presses the Emergency Switch or moves the Off/Manual/Auto switch to the Off (O) position before the generator set completes the cooldown operation. (Generator set should run at 10% or less load for three minutes before engine shutdown). This type of shutdown should be avoided; it can cause possible loss of performance and engine damage.
CODE: 1311 THROUGH 1318 LAMP: SHUTDOWN/WARNING MESSAGE: CUSTOMER DEFINED FAULT	When any one of these customer defined inputs is detected by the control, the corresponding fault message is displayed. The nature of the fault is an optional customer selection. These fault functions can be programmed to initiate a shutdown or warning as indicated by the Warning or Shutdown lamp. Note: Customer fault messages are editable. The message displayed for the code shown (1311 through 1318) is determined by the customer.
CODE: 1416 LAMP: WARNING MESSAGE: FAIL TO SHUTDOWN	Status - indicates that the Fault Bypass mode is enabled. This mode is primarily used by service personnel for troubleshooting purposes. In this mode the generator set ignores the majority of system shutdown faults.
CODE: 1417 LAMP: WARNING MESSAGE: POWER DOWN ERROR	Indicates that the control cannot power down due to some unknown condition. Possible drain on battery. Contact an authorised service centre for service.

SYMPTOM	CORRECTIVE ACTION
CODE: 1433 / 1434 LAMP: SHUTDOWN MESSAGE: EMERGENCY STOP - LOCAL / EMERGENCY STOP - REMOTE	Indicates local or remote Emergency Stop. Emergency Stop shutdown status can be reset only at the local control panel. To reset the local/remote Emergency Stop button: a) Pull, or twist and pull, the button out. b) Move the Off/Manual/Auto switch to Off (O). c) Press the front panel Fault Acknowledge button. d) Select Manual or Auto, as required.
CODE: 1438 LAMP: WARNING MESSAGE: FAIL TO CRANK	Indicates possible fault with control or starting system. Check for the following conditions: a) Poor battery cable connections. Clean the battery cable terminals and tighten all connections. b) Discharged or defective battery. Recharge or replace the battery.
CODE: 1439 LAMP: WARNING MESSAGE: FUEL LEVEL LOW IN DAY	Indicates fuel supply is running low. Check fuel supply and replenish as required.
CODE: 1441 LAMP: WARNING MESSAGE: FUEL LEVEL LOW IN MAIN	Indicates fuel supply is running low. Check fuel supply and replenish as required.
CODE: 1442 LAMP: WARNING MESSAGE: BATTERY IS WEAK	Indicates battery voltage drops below 14.4 volts for two seconds, during starting. a) Discharged or defective battery. b) See Warning message 441 Low Battery Voltage .
CODE: 1443 LAMP: WARNING MESSAGE: BATTERY IS DEAD	Indicates battery has dropped below generator set operating range (3.5 volts when cranking) to power the starter and the control circuitry. a) See Warning message 441 Low Battery Voltage .

Cummins Power Generation
1400 73rd Avenue NE
Minneapolis
MN 55432
USA

Tel: +1 (763) 574-5000
Fax: +1 (763) 574-5298

e-mail: pgamail@cummins.com

Web: www.cumminspower.com

Cummins Power Generation
Columbus Avenue
Manston Park
Manston
Ramsgate
Kent CT12 5BF
United Kingdom

Tel: +44 (0) 1843 255000
Fax: +44 (0) 1843 255902

e-mail: cpgek.uk@cummins.com

Web: www.cumminspower.com

Cummins Power Generation
10 Toh Guan Road #07-01
TT International TradePark
Singapore 608838

Tel: (65) 6417 2388
Fax: (65) 6417 2399

e-mail: cpg.apmktg@cummins.com

Web: www.cumminspower.com

Cummins Power Generation
35A/1/2, Erandawana
Pune 411 038
India

Tel.: (91 020) 3024 8600
Fax: (91 020) 6602 8090

e-mail:
cpgiservicesupport@cummins.com

Web: www.cumminspower.com

Cummins Power Generation
Rua Jati, 310 - Cumbica
Guarulhos –SP
Brazil
CEP: 07180-900

Tel.: (55 11) 2186 4195
Fax: (55 11) 2186 4729

e-mail: falecom@cumminspower.com.br

Web: www.cumminspower.com

Cummins®, the “C” logo, and “Our energy working for you.”
are trademarks of Cummins Inc.

©2009 Cummins Power Generation, Inc. All rights reserved

