Service Manual

Generator Set

VTA28-G5 Engine with PowerCommand® 1.1 Control

C600 D6

English
Original Instructions 6-2014 A047H770 (Issue 1)

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1 Important Safety Instructions

SAVE THESE INSTRUCTIONS — This manual contains important instructions that should be followed during installation and maintenance of the generator set.

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.

1.1 Warning, Caution, and Note Styles Used In This Manual

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

⚠ DANGER
Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

⚠ WARNING
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

⚠ CAUTION
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE
Indicates information considered important, but not hazard-related (e.g., messages relating to property damage).

1.2 Safety Precautions

1.2.1 General Safety Precautions

⚠ WARNING
Coolant under pressure. ***Hot coolants under pressure can cause severe scalding.*** ***Do not open a radiator or heat exchanger pressure cap while the engine is running. Let the engine cool down before removing the coolant pressure cap. Turn the cap slowly and do not open it fully until the pressure has been relieved.***

⚠ WARNING
Moving parts. ***Can cause severe personal injury or death.*** ***Make sure all protective guards are properly in place before starting the generator set.***

⚠ WARNING

Used engine oils.
Have been identified by some state and federal agencies to cause cancer or reproductive toxicity.
Do not ingest, breathe the fumes, or contact used oil when checking or changing engine oil. Wear protective gloves.

⚠ WARNING

Operation of equipment.
Is unsafe when mentally or physically fatigued.
Do not operate equipment in this condition, or after consuming any alcohol or drug.

⚠ WARNING

Substances in exhaust gases.
Have been identified by some state and federal agencies to cause cancer or reproductive toxicity.
Do not breathe in or come into contact with exhaust gases.

⚠ WARNING

Flammable liquids.
Can cause fire or explosion.
Do not store fuel, cleaners, oil, etc. near the generator set.

⚠ WARNING

Generator sets in operation mode emit noise.
Exposure to noise can cause hearing damage
Wear appropriate ear protection at all times.

⚠ WARNING

Hot metal parts.
Can cause severe burns.
Avoid contact with the radiator, turbo charger, and exhaust system.

⚠ WARNING

Maintaining or installing a generator set.
Can cause severe personal injury.
Wear personal protective equipment such as safety glasses, protective gloves, hard hats, steel-toed boots, and protective clothing when working on equipment.

⚠ WARNING

Ethylene glycol.
Used as engine coolant, is toxic to humans and animals.
Clean up coolant spills and dispose of used antifreeze in accordance with local environmental regulations.

⚠ WARNING

Starting fluids, such as ether.
Can cause explosion and generator set engine damage.
Do not use.

⚠ WARNING

Accidental or remote starting.
Accidental starting of the generator set while working on it can cause severe personal injury or death.
To prevent accidental or remote starting while working on the generator set, disconnect the negative (–) battery cable at the battery using an insulated wrench.

⚠ CAUTION

Cleaning materials.
Loose cleaning materials can become entangled in moving parts or cause a fire hazard.
Make sure that all cleaning materials are removed from the generator set before operating the generator.

⚠ CAUTION

Combustible materials.
A build up of combustible materials under the generator set can present a fire hazard.
Make sure the generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.

⚠ CAUTION

Accumulated grease and oil.
Can cause overheating and engine damage presenting a potential fire hazard.
Keep the generator set clean and makes sure oil leaks are repaired promptly.

⚠ CAUTION

Maintenance and service procedures.
Service access doors on generator sets can be heavy.
Before performing maintenance and service procedures on enclosed generator sets, make sure the service access doors are secured open

⚠ CAUTION

Obstructions.
Articles left against the generator set or close by may restrict the air flow and cause over heating or a fire hazard.
Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.

NOTICE

Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth. Class B fires involve combustible and flammable liquid fuels and gaseous fuels. Class C fires involve live electrical equipment. (Refer to NFPA No. 10 in applicable region.)

NOTICE

Stepping on the generator set can cause parts to bend or break, leading to electrical shorts, or to fuel, coolant, or exhaust leaks. Do not step on the generator set when entering or leaving the generator room.

1.3 Generator Set Safety Code

Before operating the generator set, read the manuals and become familiar with them 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
Improper operation and maintenance. ***Can lead to severe personal injury, or loss of life and property, by fire, electrocution, mechanical breakdown, or exhaust gas asphyxiation.*** ***Read and follow all Safety Precautions, Warnings, and Cautions throughout this manual and the documentation supplied with your generator set***

⚠ WARNING
Lifting and repositioning of the generator set. ***Incorrect lifting can result in severe personal injury, death, and/or equipment damage.*** ***Lifting 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. For more information, contact your authorized distributor.***

1.3.1 Moving Parts Can Cause Severe Personal Injury Or Death

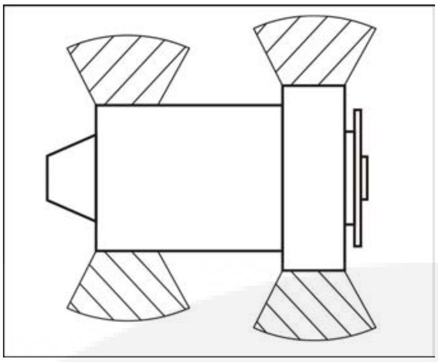
- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect the battery charger from its AC source, then disconnect the starting batteries using an insulated wrench, negative (**–**) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps; keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts.
- If any adjustments must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

1.3.2 Positioning of Generator Set - Open Sets

The area for positioning the set should be adequate and level and the area immediately around the set must be free of any flammable material.

1.3.3 Alternator Operating Areas

⚠ WARNING
Catastrophic failure. ***In the event of catastrophic failure, machine parts may be ejected from the alternator air inlet/outlet (shaded regions of diagram) that may cause personal injury or equipment damage.*** ***Do not place controls near the air inlet/outlet and keep personnel from these regions during machine running.***



1.4 Electrical Shocks and Arc Flashes Can Cause Severe Personal Injury or Death

⚠ WARNING

Energized circuits.

Any work with exposed energized circuits with potentials of 50 Volts AC or 75 Volts DC or higher poses a significant risk of electrical shock and electrical arc flash. These silent hazards can cause severe injuries or death.

Refer to standard NFPA 70E or equivalent safety standards in corresponding regions for details of the dangers involved and for the safety requirements.

Guidelines to follow when working on de-energized electrical systems:

- Use proper PPE. Do not wear jewelry and make sure that any conductive items are removed from pockets as these items can fall into equipment and the resulting short circuit can cause shock or burning. Refer to standard NFPA 70E for PPE standards.
- De-energize and lockout/tagout electrical systems prior to working on them. Lockout/Tagout is intended to prevent injury due to unexpected start-up of equipment or the release of stored energy. Please refer to **Section 1.4.1** (lockout/tagout) for more information.
- De-energize and lockout/tagout all circuits and devices before removing any protective shields or making any measurements on electrical equipment.
- Follow all applicable regional electrical and safety codes.

Guidelines to follow when working on energized electrical systems:

NOTICE

It is the policy of Cummins Inc. to perform all electrical work in a de-energized state. However, employees or suppliers may be permitted to occasionally perform work on energized electrical equipment only when qualified and authorized to do so and when troubleshooting, or if de-energizing the equipment would create a greater risk or make the task impossible and all other alternatives have been exhausted.

NOTICE

Exposed energized electrical work is only allowed as per the relevant procedures and must be undertaken by a Cummins authorized person with any appropriate energized work permit for the work to be performed while using proper PPE, tools and equipment.

In summary:

- Do not tamper with or bypass interlocks unless you are authorized to do so.

- Understand and assess the risks - use proper PPE. Do not wear jewelry and make sure that any conductive items are removed from pockets as these items can fall into equipment and the resulting short circuit can cause shock or burning. Refer to standard NFPA 70E for PPE standards.
- Make sure that an accompanying person who can undertake a rescue is nearby.

1.4.1 Locking the Generator Set Out of Service

⚠ WARNING

Explosive gases.

Explosive gases (given off during battery charging) may be present in the vicinity of the batteries. Ignition of battery gases can cause severe personal injury.

Make sure the area is well ventilated before disconnecting batteries.

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

NOTICE

Refer also to the Operator's engine specific manual. This manual contains specific equipment instructions that may differ from the standard generator set.

NOTICE

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.

1.4.2 AC Supply and Isolation

NOTICE

Local electrical codes and regulations (for example BS EN 12601:2010 Reciprocating internal combustion engine driven generating sets. Safety) may require the installation of a disconnect means for the generator set, either on the generator set or where the generator set conductors enter a facility.

NOTICE

The AC supply must have the correct over current and earth fault protection according to local electrical codes and regulations. This equipment must be earthed (grounded).

It is the sole responsibility of the customer to provide AC power conductors for connection to load devices and the means to isolate the AC input to the terminal box; these must comply to local electrical codes and regulations. Refer to the wiring diagram supplied with the generator set.

The disconnecting device is not provided as part of the generator set, and Cummins Power Generation accepts no responsibility for providing the means of isolation.

1.4.3 AC Disconnect Sources

⚠ WARNING

Hazardous voltage.

The equipment may have more than one source of electrical energy. Disconnecting one source without disconnecting the others presents a shock hazard that can result in severe personal injury or death.

Before working on the equipment, disconnect and verify that all sources of electrical energy have been removed.

1.5 Fuel And Fumes Are Flammable

Fire, explosion, and personal injury or death can result from improper practices.

- DO NOT fill fuel tanks while the engine is running, unless the tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Be sure all fuel supplies have a positive shutoff valve.
- Be sure the battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.

1.5.1 Spillage

Any spillage that occurs during fueling or during oil top-off or oil change must be cleaned up before starting the generator set.

1.5.2 Fluid Containment

NOTICE

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

If fluid containment is incorporated into the bedframe, it must be inspected at regular intervals. Any liquid present should be drained out and disposed of in line with local health and safety regulations. Failure to perform this action may result in spillage of liquids which could contaminate the surrounding area.

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

1.5.3 Do Not Operate in Flammable and Explosive Environments

Flammable vapor can cause an engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury, and death. Do not operate a generator set where a flammable vapor environment can be created, unless the generator set is equipped with an automatic safety device to block the air intake and stop the engine. The owners and operators of the generator set are solely responsible for operating the generator set safely. Contact your authorized Cummins Power Generation distributor for more information.

1.6 Exhaust Gases Are Deadly

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust daily system for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

1.6.1 Exhaust Precautions

⚠ WARNING
Hot pipes. ***Hot exhaust pipes and charge air pipes can cause severe personal injury or death from direct contact, or from fire hazard.*** ***Wear appropriate PPE when working on hot equipment and avoid physical contact where possible.***

⚠ WARNING
Hot exhaust gases. ***Can cause burns resulting in severe personal injury.*** ***Wear personal protective equipment when working on equipment.***

⚠ WARNING
Inhalation of exhaust gases. ***Breathing exhuast fumes 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
Contaminated insulation. ***Is a fire risk which can result in severe personal injury and equipment damage.*** ***Remove any contaminated insulation and dispose of in accordance with local regulations.***

The exhaust outlet may be sited at the top or bottom of the generator set. Make sure that the exhaust outlet is not obstructed. Personnel using this equipment must be made aware of the exhaust position. Position the exhaust away from flammable materials - in the case of exhaust outlets at the bottom, make sure that vegetation is removed from the vicinity of the exhaust.

The exhaust pipes may have some insulating covers fitted. If these covers become contaminated they must be replaced before the generator set is run.

To minimize the risk of fire, make sure the following steps are observed:

- Make sure that the engine is allowed to cool thoroughly before performing maintenance or operation tasks.
- Clean the exhaust pipe thoroughly.

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2 Introduction

⚠ WARNING
Hazardous voltage.   ***Can cause severe personal injury or death and equipment damage.***   ***Generator electrical output connections must be made by a trained and experienced electrician in accordance with the installation instructions and all applicable codes.***

⚠ WARNING
Electrical generating equipment.   ***Can cause severe personal injury or death.***   ***Generator sets must be installed, certified, and operated by trained and experienced person in accordance with the installation instructions and all applicable codes.***

2.1 About This Manual

This manual provides troubleshooting and repair information for the Generator Sets listed on the front cover. Additional Engine and alternator service and maintenance instructions are contained within the applicable engine and alternator service manuals. Operating and basic maintenance instructions are in the applicable Generator Set Operator 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 policy of continuous development and improvement, information may change at any time without notice. The users should therefore make sure that before commencing any work, they have the latest information available. The latest version of this manual is available on QuickServe Online (https://qsol.cummins.com/info/index.html).

This manual contains basic (generic) wiring diagrams and schematics that are included to help in troubleshooting. The wiring diagrams and schematics that are maintained with the unit should be updated when modifications are made to the unit.

Read **Chapter 1 on page 1** and carefully observe all instructions and precautions in this manual.

2.2 Test Equipment

To perform the test procedures in this manual, the following test equipment must be available

- True RMS meter for accurate measurement of small AC and DC voltages.
- Grounding wrist strap to prevent circuit board damage due to electrostatic discharge (ESD).
- Battery Hydrometer
- Jumper Leads
- Tachometer or Frequency Meter
- Wheatstone Bridge or Digital Ohmmeter
- Variac
- Load Test Panel
- Megger or Insulation Resistance Meter

- PCC Service Tool Kit (Harness Tool and Sensor Tool)
- InPower Service Tool (PC based Generator Set Service Tool)

2.3 Schedule of Abbreviations

This list is not exhaustive. For example, it does not identify units of measure or acronyms that appear only in parameters, event/fault names, or part/accessory names.

AmpSentry, INSITE, and InPower are trademarks of Cummins Inc. PowerCommand is a registered trademark of Cummins Inc.

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
AC	Alternating Current	LCT	Low Coolant Temperature
AMP	AMP, Inc., part of Tyco Electronics	LED	Light-emitting Diode
ANSI	American National Standards Institute	MFM	Multifunction Monitor
ASTM	American Society for Testing and Materials (ASTM International)	Mil Std	Military Standard
ATS	Automatic Transfer Switch	NC	Normally Closed
AVR	Automatic Voltage Regulator	NC	Not Connected
AWG	American Wire Gauge	NFPA	National Fire Protection Agency
CAN	Controlled Area Network	NO	Normally Open
CB	Circuit Breaker	NWF	Network Failure
CE	Conformité Européenne	OEM	Original Equipment Manufacturer
CFM	Cubic Feet per Minute	OOR	Out of Range
CGT	Cummins Generator Technologies	OORH / ORH	Out of Range High
CMM	Cubic Meters per Minute	OORL / ORL	Out of Range Low
CT	Current Transformer	PB	Push Button
DC	Direct Current	PCC	PowerCommand® Control
DEF	Diesel Exhasut Fluid	PGI	Power Generation Interface
DPF	Diesel Particulate Filter	PGN	Parameter Group Number
ECM	Engine Control Module	PI	Proportional/Integral
ECS	Engine Control System	PID	Proportional/Integral/Derivative
EMI	Electromagnetic interference	PLC	Programmable Logic Controller
EN	European Standard	PMG	Permanent Magnet Generator
EPS	Engine Protection System	PT	Potential Transformer
E-Stop	Emergency Stop	PTC	Power Transfer Control
FAE	Full Authority Electronic	PWM	Pulse-width Modulation
FMI	Failure Mode Identifier	RFI	Radio Frequency Interference
FSO	Fuel Shutoff	RH	Relative Humidity
Genset	Generator Set	RMS	Root Mean Square
GCP	Generator Control Panel	RTU	Remote Terminal Unit
GND	Ground	SAE	Society of Automotive Engineers

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
HMI	Human-machine Interface	SCR	Selective Catalytic Reduction
IC	Integrated Circuit	SPN	Suspect Parameter Number
ISO	International Organization for Standardization	SW_B+	Switched B+
LBNG	Lean-burn Natural Gas	UL	Underwriters Laboratories
LCD	Liquid Crystal Display	UPS	Uninterruptible Power Supply

2.4 Related Literature

Before any attempt is made to operate the generator set, the operator should take time to read all of the manuals supplied with the generator set, and to familiarize themselves with the warnings and operating procedures.

⚠ CAUTION

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

The Health and Safety manual must be read in conjunction with this manual for the safe operation of the generator set:

- Health and Safety Manual (0908-0110)

The relevant manuals appropriate to your generator set are also available, the document numbers below are English language versions (other languages are available):

- Operator Manual for VTA28-G5 C600 D6 with PC 1.1 (A047F195)
- Installation Manual for VTA28-G5 C600 D6 with PC 1.1 (A047F193)
- Generator Set Service Manual for VTA28-G5 C600 D6 with PC 1.1 (A047H770)
- Engine Operation & Maintenance Manual for VTA28 (3379052)
- Application Manual T-030, *Liquid Cooled Generator Sets* (For application information)
- Parts Manual for VTA28-G5 with PC 1.1 (A047H394)
- Recommended Spares List (RSL) for C600 D6 (A046V193)
- Standard Repair Times - BL Family (0900-0900)
- Warranty Manual (A040W374)
- Global Commercial Warranty Statement (A028U870)

Contact your authorized distributor for more information regarding related literature for this product.

2.5 After Sales Services

Cummins Power Generation offers a full range of maintenance and warranty services.

2.5.1 Maintenance

⚠ WARNING

Electrical generating equipment

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 expert generator set service at regular intervals, contact your local distributor. Each local distributor offers a complete maintenance contract package covering all items subject to routine maintenance, including a detailed report on the condition of the generator set. In addition, this can be linked to a 24-hour call-out arrangement, providing year-round assistance if necessary. Specialist engineers are available to maintain optimum performance levels from generator sets. Maintenance tasks should only be undertaken by trained and experienced technicians provided by your authorized distributor.

2.5.2 Warranty

For details of the warranty coverage for your generator set, refer to the *Global Commercial Warranty Statement* listed in the Related Literature section.

Extended warranty coverage is also available. In the event of a breakdown, prompt assistance can normally be given by factory trained service technicians with facilities to undertake all minor and many major repairs to equipment on site.

For further warranty details, contact your authorized distributor.

NOTICE

Damage caused by failure to follow the manufacturers recommendations will not be covered by the warranty. Please contact your authorized distributor.

2.5.2.1 Warranty Limitations

For details of the warranty limitations for your generator set, refer to the warranty statement applicable to the generator set.

3 Specifications

3.1 Generator Set Specifications

TABLE 1. C600 D6 SPECIFICATIONS

MODELS	C600 D6
Engine Cummins Diesel Series	VTA28-G5
Generator kW Rating	See generator set nameplate for rating information.
Engine Fuel Connection Inlet/Outlet Thread Size	Refer to generator get outline drawing supplied
Maximum Weight	3180 kg (7012 lb) wet - Open Set
Fuel Max. Fuel Inlet Restriction Max. Fuel Return Restriction Fuel Pump Flow Rate	 102 mmHg (4 inHg) 165 mmHg (6.5 inHg) 337 L/hr (89 US gal/hr)
Exhaust Outlet Size Max. Allowable Back Pressure Exhaust Flow at Rated Load Exhaust Gas Temperature	 1800 RPM 5 in. NB 76mmHg (3inHg) 5040 cfm (2379 L/s at standby) 935 °C (1715 °F)
Electrical System Starting Voltage Battery Group Number CCA (minimum) Cold Soak @ 0 °F (-18 °C)	 24 Volts DC 31 1200 1400 A at 0 °F to 32 °F (-18 °C to 0 °C)
Cooling System Capacity with Standard Radiator	140 L (37 US gal)
Lubricating System Oil Capacity with Filters	84 L (22.3 US gal)

3.2 Engine Fuel Consumption

TABLE 2. ENGINE FUEL CONSUMPTION L/HR (GAL/HR) AT 1800 RPM (60 HZ)

Model	C600 D6
Engine	**VTA28-G5**
Engine Performance Data at 60Hz - Prime/Full Load	**154 L (40.7 US gal))**
Engine Performance Data at 60Hz - Standby/Full Load	**172.99 L (45.7 US gal)**
Refer to Data Sheets for other applications. In line with the CPGK policy of continuous improvement these figures are subject to change.	

3.3 HC Winding Resistances

Alternator	Resistance of windings at 20 °C (measured values should be within 10%)									
	Main Stator Windings, L-N (leads) (ohms)						Exciter Stator (ohms)	Exciter Rotor, L-L (ohms)	Main Rotor (ohms)	PMG Stator, L-L (ohms)
	311 (1 & 2) (5 & 6)	312 (1 & 2)	07 (1 & 2) 17 (1 & 2) (5 & 6)	13 (1 & 2) 14 (1 & 2) (5 & 6)	25 (1 & 2) (5 & 6) 26 (1 & 2)	27 (1 & 2) (5 & 6) 28 (1 & 2)				
HC434C	0.0083	n/a	0.0115	0.0055	0.002	0.0154	18	0.136	0.92	2.6
HC434D	0.0062	n/a	0.01	0.0045	0.016	0.013	18	0.136	1.05	2.6
HC434E	0.0045	n/a	0.0075	n/a	0.014	0.01	18	0.136	1.19	2.6
HC434F	0.0037	n/a	0.0055	0.006	0.0105	0.0075	18	0.136	1.37	2.6
HC444C	0.0083	n/a	0.0115	0.0055	0.002	0.0154	18	0.136	0.92	n/a
HC444D	0.0062	n/a	0.01	0.0045	0.016	0.013	18	0.136	1.05	n/a
HC444E	0.0045	n/a	0.0075	n/a	0.014	0.01	18	0.136	1.19	n/a
HC444F	0.0037	n/a	0.0055	0.006	0.0105	0.0075	18	0.136	1.37	n/a
HC534C	0.0033	n/a	0.0053	0.0026	0.01	0.0065	17	0.184	1.55	2.6
HC534D	0.0025	n/a	0.004	0.0021	0.0075	0.0005	17	0.184	1.77	2.6
HC534E	0.0022	n/a	0.0034	0.0013	0.013	0.0044	17	0.184	1.96	2.6
HC534F	0.0019	n/a	0.0025	0.0013	0.005	0.0041	17	0.184	2.46	2.6
HC544C	0.0033	n/a	0.0053	0.0026	0.01	0.0065	17	0.184	1.55	n/a
HC544D	0.0025	n/a	0.004	0.0021	0.0075	0.0005	17	0.184	1.77	n/a
HC544E	0.0022	n/a	0.0034	0.0013	0.013	0.0044	17	0.184	1.96	n/a
HC544F	0.0019	n/a	0.0025	0.0013	0.005	0.0041	17	0.184	2.46	n/a
HC634G	0.0017	0.0034	0.0055	0.0002	0.009	0.0075	17	0.158	1.75	5.6
HC634H	0.0013	0.0025	0.0036	0.0019	0.008	n/a	17	0.158	1.88	5.6
HC634J	0.0011	0.0022	0.003	0.0015	0.006	n/a	17	0.158	2.09	5.6
HC634K	0.00085	0.0017	0.0026	0.001	0.0045	0.003	17	0.158	2.36	5.6
HC636G	0.0045	0.009	0.015	n/a	n/a	n/a	17	0.2	1.12	5.6
HC636H	0.0032	0.0063	0.01	n/a	n/a	n/a	17	0.2	1.33	5.6
HC636J	n/a	0.0049	0.007	n/a	n/a	n/a	17	0.2	1.5	5.6
HC636K	0.002	0.0039	0.006	n/a	n/a	n/a	17	0.2	1.75	5.6

4 Engine Performance Troubleshooting

4.1 Engine Does Not Crank in Manual Mode (No Fault Message)

Logic: The PCC has not received or recognized a manual start signal.

Possible causes:

1. No power is supplied to the control. (Control Alive indicator on the base board is not flashing).
2. The base board is not properly calibrated or the calibration is corrupt (the Control Alive indicator on the base board is flashing every 0.5 seconds).
3. The Emergency Stop switch or wiring is defective.
4. The Manual input is not getting from the Manual Select Switch (S12) to the base board.
5. The Manual Run/Stop button, harness, or the base board is defective.

4.1.1 Engine Does Not Crank in Manual Mode - Diagnosis and Repair

1. No power is supplied to the control. (The Control Alive indicator on the base board is not flashing).
   - Poor battery cable connections. Clean the battery cable terminals and tighten all connections using an insulated wrench.
   - Remove F4 and check continuity. If open, replace the fuse with one of the same type and amp rating (5 Amps).
     - If F4 is OK, remove connector P7 and check for B+ at P7-1 through P7-4 and GND at P7-5 through P7-8.
     - If B+ or ground missing, isolate to the harness and the TB BAT terminal mounted on the engine block.
     - If B+ and ground check OK, the base board may be defective. Cycle power to the base board by reconnecting P7.
2. The base board is not properly calibrated or the calibration is corrupt. (The Control Alive indicator flashes every ½ second.)
   - Confirm that the installed calibration part number matches the serial plate information. Re-enter a calibration file if necessary. (When properly installed, the Control Alive indicator flashes once every second.)
3. The Emergency Stop switch or wiring is defective.
   - With the Emergency Stop push button not activated, remove connector P1 and check for continuity between P1-1 (ESTOP-NC1) and P1-2 (ESTOP-NC2). (If the circuit is open, the control will detect a local E-Stop condition but will not display the E-Stop condition.) If the circuit is open, isolate to the Emergency Stop switch and wiring.
   - If there is continuity, go to the next step.

4. The Manual input is not getting from the Manual select switch (S12) to the base board indicating that S12, the base board, or the harness is defective.
   - With S12 in the Manual position, remove connector P1 from the base board and check for continuity from P1-6 (MAN) to P1-9 (GND). If there is no continuity, isolate the switch and wiring.
   - If there is continuity, go to the next step.
5. The Manual Run/Stop button, harness, or the base board is defective.
   - Remove connector P3 from the base board and check for continuity from P3-9 (MAN RUN/STOP) to P3-10 (GND). If there is no continuity when pressing the Manual Run/Stop button, replace the front membrane panel.

4.2 Engine Does Not Crank in Remote Mode (No Fault Message)

Logic:

PCC has not received or recognized a remote start signal.

Possible Cause:

1. The remote start switch or customer wiring is faulty.
2. The Auto mode input is not getting from the Auto select switch (S12) to the base board indicating that S12 or the harness is defective.

4.2.1 Engine Does Not Crank in Remote Mode - Diagnosis and Repair

1. The remote start switch or customer wiring is faulty.
   - Reset the control. Attempt to start and check for ground at TB1-1.
     - If ground is not present, isolate to the remote switch or customer wiring. Repair as necessary.
     - If ground is present, go to next step.
2. The Auto mode input is not getting from the Auto select switch (S12) to the base board, indicating that the S12 switch or the harness is defective.
   - With S12 in the Auto position, remove connector P1 from the base board and check for continuity from P1-5 (Auto) to P1-9 (GND).
     - If no continuity exists, isolate to the switch or the wiring harness.

4.3 Engine Does Not Crank in Manual Mode (No Fault Message)

Logic: The PCC has not received or recognized a manual start signal.

Possible causes:

1. No power is supplied to the control. (Control Alive indicator on the base board is not flashing).
2. The base board is not properly calibrated or the calibration is corrupt (the Control Alive indicator on the base board is flashing every 0.5 seconds).
3. The Emergency Stop switch or wiring is defective.

4. The Manual input is not getting from the Manual Select Switch (S12) to the base board.
5. The Manual Run/Stop button, harness, or the base board is defective.

4.3.1 Engine Does Not Crank in Manual Mode - Diagnosis and Repair

1. No power is supplied to the control. (The Control Alive indicator on the base board is not flashing).
   - Poor battery cable connections. Clean the battery cable terminals and tighten all connections using an insulated wrench.
   - Remove F4 and check continuity. If open, replace the fuse with one of the same type and amp rating (5 Amps).
     - If F4 is OK, remove connector P7 and check for B+ at P7-1 through P7-4 and GND at P7-5 through P7-8.
     - If B+ or ground missing, isolate to the harness and the TB BAT terminal mounted on the engine block.
     - If B+ and ground check OK, the base board may be defective. Cycle power to the base board by reconnecting P7.
2. The base board is not properly calibrated or the calibration is corrupt. (The Control Alive indicator flashes every ½ second.)
   - Confirm that the installed calibration part number matches the serial plate information. Re-enter a calibration file if necessary. (When properly installed, the Control Alive indicator flashes once every second.)
3. The Emergency Stop switch or wiring is defective.
   - With the Emergency Stop push button not activated, remove connector P1 and check for continuity between P1-1 (ESTOP-NC1) and P1-2 (ESTOP-NC2). (If the circuit is open, the control will detect a local E-Stop condition but will not display the E-Stop condition.) If the circuit is open, isolate to the Emergency Stop switch and wiring.
   - If there is continuity, go to the next step.
4. The Manual input is not getting from the Manual select switch (S12) to the base board indicating that S12, the base board, or the harness is defective.
   - With S12 in the Manual position, remove connector P1 from the base board and check for continuity from P1-6 (MAN) to P1-9 (GND). If there is no continuity, isolate the switch and wiring.
   - If there is continuity, go to the next step.
5. The Manual Run/Stop button, harness, or the base board is defective.
   - Remove connector P3 from the base board and check for continuity from P3-9 (MAN RUN/STOP) to P3-10 (GND). If there is no continuity when pressing the Manual Run/Stop button, replace the front membrane panel.

4.4 Engine Does Not Crank in Remote Mode (No Fault Message)

Logic:

PCC has not received or recognized a remote start signal.

Possible Cause:

1. The remote start switch or customer wiring is faulty.
2. The Auto mode input is not getting from the Auto select switch (S12) to the base board indicating that S12 or the harness is defective.

4.4.1 Engine Does Not Crank in Remote Mode - Diagnosis and Repair

1. The remote start switch or customer wiring is faulty.
   - Reset the control. Attempt to start and check for ground at TB1-1.
     - If ground is not present, isolate to the remote switch or customer wiring. Repair as necessary.
     - If ground is present, go to next step.
2. The Auto mode input is not getting from the Auto select switch (S12) to the base board, indicating that the S12 switch or the harness is defective.
   - With S12 in the Auto position, remove connector P1 from the base board and check for continuity from P1-5 (Auto) to P1-9 (GND).
     - If no continuity exists, isolate to the switch or the wiring harness.

4.5 Engine is Difficult to Start or Does Not Start (Exhaust Smoke)

Possible Causes:

1. Battery voltage
2. Starting procedure/aid
3. Fuel system issue(s)
4. Air intake or exhaust issue(s)
5. Sensor issue(s)
6. Other issue(s)

4.5.1 Engine is Difficult to Start or Does Not Start (Exhaust Smoke) - Diagnosis and Repair

1. Battery voltage
   - Battery voltage is low, interrupted, or open.
     - Check the batteries connections, unswitched battery supply circuit, and fuses.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Starting procedure/aid
   - Starting procedure is not correct.
     - Verify the correct starting procedure.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Starting aid is necessary for cold weather or starting aid is malfunctioning.
  - Check for the correct operation of the starting aid.
  - Refer to the manufacturer's instructions.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Fuel system issue(s)
   - Inspect fuel lines, fuel connections and fuel filters for leaks.
     - Repair if leaks found.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank.
     - Add fuel to the fuel tank if the fuel level is found to be low.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Manual fuel shutoff valve is closed.
     - Check the OEM fuel shutoff valves.
     - Verify that the fuel tanks are open.
   - Fuel shutoff valve solenoid or circuit is malfunctioning.
     - Check the fuel shutoff valve solenoid and circuit.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Check for air in the fuel system.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Check for the fuel inlet restriction.
     - Check the fuel inlet lines for restriction.
     - Check for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Check for fuel drain line restriction.
     - Check the fuel drain lines for restriction.
     - Clear or replace the fuel lines, check valves, or tank vents as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Fuel system restriction is above specification.
     - Check all fuel system lines for restrictions or debris.
     - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Gear pump is malfunctioning.
  - Check the gear pump output pressure.
  - Replace the gear pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Air intake or exhaust issue(s)
   - Air intake system restriction is above specification.
     - Check the air intake system for restriction.
     - Clean or replace the air filter and inlet piping as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Exhaust system restriction is above specification.
     - Check the exhaust system for restrictions.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Sensor issue(s)
   - Fuel system pressure sensors (fueling/timing) are malfunctioning.
     - Check the fuel system pressure sensors (fueling/timing).
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Intake manifold pressure sensor is malfunctioning.
     - Check the intake manifold pressure sensor.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Ambient air pressure sensor is malfunctioning.
     - Check the ambient air pressure sensor.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
6. Other issue(s)
   - Engine parasitics are excessive.
     - Check engine-driven units for correct operation.
     - Check the cooling fan for correct operation and cycle time.
     - Refer to the OEM specifications.
   - Overhead adjustments are not correct.
     - Adjust the overhead settings.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Base engine problem.
  - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Injector O-rings are damaged or missing.
  - Remove and check the injectors.
  - Replace the injector O-rings.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.6 Engine is Difficult to Start or Does Not Start (No Exhaust Smoke)

Possible Causes:

1. Emergency stop/remote emergency stop
2. Battery voltage
3. Run/stop circuit issue
4. Fuel system issue(s)
5. Air intake or exhaust issue(s)
6. Sensor issue(s)
7. Other issue(s)

4.6.1 Engine is Difficult to Start or Does Not Start (No Exhaust Smoke) - Diagnosis and Repair

1. Emergency stop/remote emergency stop
   - Emergency Stop/Remote Emergency Stop circuit energized.
     - Verify that either the Emergency Stop or the Remote Emergency Stop circuit is not energized.
2. Battery voltage
   - Battery voltage is low, interrupted, or open.
     - Check the battery connections, un-switched battery supply circuit, and fuses.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Run/Stop circuit issue
   - Run/Stop circuit is malfunctioning.
     - Check the generator Run/Stop circuit.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Fuel system issue(s)
    - Inspect fuel lines, fuel connections, and fuel filters for leaks.
        - Repair if leaks found.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank.
        - Add fuel to the fuel tank if the fuel level is found to be low.
    - Manual fuel shutoff valve is closed.
        - Check the OEM fuel shutoff valves.
        - Verify that the fuel tanks are open.
    - Fuel shutoff valve solenoid or circuit is malfunctioning.
        - Check the fuel shutoff valve solenoid and circuit.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - In-line check valve(s) are installed backwards or have incorrect part number.
        - Inspect the check valve(s) for correct installation and part number.
    - Check for air in the fuel system.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Check for fuel inlet restriction.
        - Check the fuel inlet lines for restriction.
        - Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Check for fuel drain line restriction.
        - Check the fuel drain lines for restriction.
        - Clear or replace the fuel lines, check valves, or tank vents as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Fuel system restriction is above specification.
        - Check all fuel system lines for restrictions or debris.
        - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Gear pump is malfunctioning.
        - Check the gear pump output pressure.
        - Replace the gear pump if necessary.

        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

5. Air intake or exhaust issues
    - Air intake system restriction is above specification.
        - Check the air intake system for restriction.
        - Clean or replace the air filter and inlet piping as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Exhaust system restriction is above specification.
        - Check the exhaust system for restrictions.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
6. Sensor issue(s)
    - Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Intake manifold pressure sensor is malfunctioning.
        - Check the intake manifold pressure sensor.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Ambient air pressure sensor is malfunctioning.
        - Check the ambient air pressure sensor.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
7. Other issue(s)
    - Overhead adjustments are not correct.
        - Adjust the overhead settings.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Internal engine damage.
        - Analyze the oil and inspect the filters, pistons, camshaft, and other parts to locate an area of probable damage.

4.7 Engine Experiences Low Power, Poor Acceleration, or Poor Response

1. Excessive load
2. Fuel system issue(s)
3. Air intake or exhaust issue(s)
4. Sensor issue(s)
5. Other issue(s)

4.7.1 Engine Experiences Low Power, Poor Acceleration, or Poor Response - Diagnosis and Repair

1. Excessive load(s)
   - Ensure that the load on the generator set does not exceed the generator set KW rating.
     - Revisit the generator set sizing process to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system.
     - Refer to the T−030 manual for proper generator set sizing and application.
2. Fuel system issue(s)
   - Inspect fuel lines, fuel connections, and fuel filters for leaks.
     - Repair if leaks found.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank.
     - Add fuel to the fuel tank if the fuel level is found to be low.
   - Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
     - Operate the engine from a tank of high-quality fuel.
     - Refer to Fuel for Cummins Engines, Bulletin 3379001.
   - Check for air in the fuel system.
     - Refer to procedure in the troubleshooting and repai manual for the specific engine.
   - Check for fuel inlet restriction.
     - Check the fuel inlet lines for restriction.
     - Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Check for fuel drain line restriction.
     - Check the fuel drain lines for restriction.
     - Clear or replace the fuel lines, check valves, or tank vents as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Fuel system restriction is above specification.
     - Check all fuel system lines for restrictions or debris.
     - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Gear pump is malfunctioning.
  - Check the gear pump output pressure.
  - Replace the gear pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel pump overflow valve is malfunctioning.
  - Check the overflow valve.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine..
- Fuel lift pump is malfunctioning.
  - Check the fuel lift pump for correct operation.
  - Check the pump output pressure.
  - Replace the fuel lift pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel injection pump is malfunctgioning.
  - Remove and test the fuel injection pump.
  - Replace the pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for injector malfunction.
  - Perform the cylinder performance test.
  - Replace injectors as necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Air intake or exhaust issue(s)
   - Air intake system restriction is above specification.
     - Check the air intake system for restriction.
     - Clean or replace the air filter and inlet piping as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Air intake or exhaust leaks.
     - Inspect the air intake and exhaust systems for air leaks.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Turbocharger is malfunctioning.
     - Monitor the turbocharger boost pressure with an INSITE electronic service tool.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Exhaust system restriction is above specification.
    - Check the exhaust system for restrictions.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Sensor issue(s)
    - Coolant temperature sensor is malfunctioning.
        - Use InPower or INSITE service tool(s) to check the coolant temperature sensor.
        - Refer to the procedure in the troubleshooting and repair manual for the specific engine.
    - Intake manifold pressure sensor is malfunctioning.
        - Check the intake manifold pressure sensor.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Ambient air pressure sensor is malfunctioning.
        - Check the ambient air pressure sensor.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Other issue(s)
    - Engine is operating above recommended altitude.
        - Engine power decreases above recommended altitude.
        - Refer to the Engine Data Sheet for the specific engine for specifications.
    - Engine parasitics are excessive.
        - Check engine-driven units for correct operation.
        - Check the cooling fan for correct operation and cycle time.
        - Refer to the OEM specifications.
    - Overhead adjustments are not correct.
        - Adjust the overhead settings.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Base engine problem.
        - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.8 Engine Runs Rough or Misfires

1. Air intake or exhaust issue(s)
2. Fuel system issue(s)
3. Sensor issue(s)
4. Other issue(s)

4.8.1 Engine Runs Rough or Misfires - Diagnosis and Repair

1. Air intake or exhaust issue(s)
   - Air intake system restriction is above specification.
     - Check the air intake system for restriction.
     - Clean or replace the air filter and inlet piping as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Exhaust system restriction is above specification.
     - Check the exhaust system for restrictions.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Fuel system issue(s)
   - Inspect fuel lines, fuel connections, and fuel filters for leaks.
     - Repair if leaks found.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
     - Operate the engine from a tank of high-quality fuel.
     - Refer to Fuel for Cummins Engines, Bulletin 3379001.
   - Check for air in the fuel system.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Check for fuel inlet restriction.
     - Check the fuel inlet lines for restriction.
     - Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Check for fuel drain line restriction.
     - Check the fuel drain lines for restriction.
     - Clear or replace the fuel lines, check valves, or tank vents as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Fuel system restriction is above specification.
     - Check all fuel system lines for restrictions or debris.
     - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Gear pump is malfunctioning.
  - Check the gear pump output pressure.
  - Replace the gear pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel pump overflow valve is malfunctioning.
  - Check the overflow valve.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for injector malfunction.
  - Perform the cylinder performance test.
  - Replace injectors as necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel lift pump is malfunctioning.
  - Check the fuel lift pump for correct operation.
  - Check the pump output pressure.
  - Replace the fuel lift pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel injection pump is malfunctioning.
  - Remove and test the fuel injection pump.
  - Replace the pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Sensor issue(s)
   - Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Fuel system pressure sensors (fueling/timing) are malfunctioning.
     - Check the fuel system pressure sensors (fueling/timing).
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Coolant temperature sensor is malfunctioning.
     - Use InPower service tool to check the coolant temperature sensor.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Intake manifold pressure sensor is malfunctioning.
     - Check the intake manifold pressure sensor.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Ambient air temperature sensor is malfunctioning.
  - Check the ambient air temperature sensor.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Other issue(s)
   - Engine parasitics are excessive.
     - Check engine-driven units for correct operation.
     - Check the cooling fan for correct operation and cycle time.
     - Refer to the OEM specifications.
   - Engine mounts are worn, damaged, loose, or not correct.
     - Verify the condition of the mounts.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Overhead adjustments are not correct.
     - Adjust the overhead settings.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Base engine problem.
     - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.9 Engine Shuts Off Unexpectedly or Dies During Deceleration

1. Emergency Stop/Remote Emergency Stop
2. Fuel system issue(s)
3. Electronic control module related issue(s)
4. Other issue(s)

4.9.1 Engine Shuts Off Unexpectedly or Dies During Deceleration - Diagnosis and Repair

1. Emergency Stop/Remote Emergency Stop
   - Emergency Stop/Remote Emergency Stop circuit energized.
     - Verify that either the Emergency Stop or the Remote Emergency Stop circuit is not energized.
2. Fuel system issue(s)
   - Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank.
     - Add fuel to the fuel tank if the fuel level is found to be low.

- Manual fuel shutoff valve is closed.
  - Check the OEM fuel shutoff valves.
  - Verify that the fuel tank isolation valves are open.
- Fuel shutoff valve solenoid or circuit is malfunctioning.
  - Check the fuel shutoff valve solenoid and circuit.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for air in the fuel system.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for fuel inlet restriction.
  - Check the fuel inlet lines for restriction.
  - Check for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for fuel drain line restriction.
  - Check the fuel drain lines for restriction.
  - Clear or replace the fuel lines, check valves, or tank vents as necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel system restriction is above specification.
  - Check all fuel system lines for restrictions or debris.
  - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Gear pump is malfunctioning.
  - Check the gear pump output pressure.
  - Replace the gear pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel lift pump is malfunctioning.
  - Check the fuel lift pump for correct operation.
  - Check the pump output pressure.
  - Replace the fuel lift pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Electronic control module related issue(s)
   - Battery voltage supply to the electronic control module has been lost.
     - Check the battery connections.

        - Check the un-switched battery supply circuit.
        - Refer to the operation and maintenance manual, for the specific engine.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Electronic control module is not grounded correctly.
        - Check the electronic control module for correct placement of star washers.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Electronic control module is malfunctioning.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Other issue(s)
    - Base engine problem.
        - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.10 Engine Speed Surges at High or Low Idle

1. Fuel system issue(s)
2. Sensor issue(s)
3. Other issue(s)

4.10.1 Engine Speed Surges at High or Low Idle - Diagnosis and Repair

1. Fuel system issue(s)
    - Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank.
        - Add fuel to the fuel tank if the fuel level is found to be low.
    - Check for air in the fuel system.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Check for fuel inlet restriction.
        - Check the fuel inlet lines for restriction.
        - Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Check for fuel drain line restriction.
        - Check the fuel drain lines for restriction.
        - Clear or replace the fuel lines, check valves, or tank vents as necessary.

    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel lift pump is malfunctioning.
    - Check the fuel lift pump for correct operation.
    - Check the pump output pressure.
    - Replace the fuel lift pump if necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel system restriction is above specification.
    - Check all fuel system lines for restrictions or debris.
    - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Gear pump is malfunctioning.
    - Check the gear pump output pressure.
    - Replace the gear pump if necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for injector malfunction.
    - Perform the cylinder performance test.
    - Replace injectors as necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel pump overflow valve is malfunctioning.
    - Check the overflow valve.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel injection pump is malfunctioning.
    - Remove and test the fuel injection pump.
    - Replace the pump if necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

2. Sensor issue(s)
    - Crankshaft or camshaft speed or position sensor(s) reading incorrectly.
        - Refer to the troubleshooting procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Fuel system pressure sensors (fueling/timing) are malfunctioning.
        - Check the fuel system pressure sensors (fueling/timing).
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Other issue(s)
    - Engine parasitics are excessive.
        - Check engine-driven units for correct operation.
        - Check the cooling fan for correct operation and cycle time.
        - Refer to the OEM specifications.
    - Base engine problem.
        - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Alternator is malfunctioning.
        - Temporarily disconnect the alternator and test-run the engine.
        - Replace the alternator if necessary.
        - Refer to the OEM service manuals.

4.11 Engine Speed Surges Under Load or in Operating Range

Possible Causes:

1. Parameter(s) configured incorrectly
2. Alternator paralleling control
3. Fuel system issue(s)
4. Sensor issue(s)
5. Other issue(s)

4.11.1 Engine Speed Surges Under Load or in Operating Range - Diagnosis and Repair

1. Parameter(s) configured incorrectly
    - With the InPower service tool verify that all of the configurable parameters that can affect the engine operation are set correctly.
        - Adjust parameter(s) accordingly only when found to be configured incorrectly.
2. Alternator paralleling control
    - Alternator paralleling controls are sending inconsistent or incorrect commands to the engine electronic control system.
        - Verify that the alternator paralleling controls are functioning correctly.
        - Refer to the paralleling controls user manual for specifications.
3. Fuel system issue(s)
    - Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
        - Operate the engine from a tank of high-quality fuel.
        - Refer to Fuel for Cummins Engines, Bulletin 3379001.

- Check for air in the fuel system.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for fuel inlet restriction.
  - Check the fuel inlet lines for restriction.
  - Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for fuel drain line restriction.
  - Check the fuel drain lines for restriction.
  - Clear or replace the fuel lines, check valves, or tank vents as necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel system restriction is above specification.
  - Check all fuel system lines for restrictions or debris.
  - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Gear pump is malfunctioning.
  - Check the gear pump output pressure.
  - Replace the gear pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for injector malfunction.
  - Perform the cylinder performance test.
  - Replace injectors as necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Sensor issue(s)
   - Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.
     - Refer to the troubleshooting procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Fuel system pressure sensors (fueling/timing) are malfunctioning.
     - Check the fuel system pressure sensors (fueling/timing).
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Other issue(s)
   - Moisture in the wiring harness connectors.
     - Dry the connectors with Cummins electronic cleaner, Part Number 3824510.

- Base engine problem.
  - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Alternator is malfunctioning.
  - Temporarily disconnect the alternator and test-run the engine.
  - Replace the alternator if necessary.
  - Refer to the OEM service manuals.

4.12 Engine Starts But Will Not Keep Running

Possible Causes:

1. Parameter(s) configured incorrectly
2. Battery voltage
3. Run/Stop circuit issue(s)
4. Fuel system issue(s)
5. Other issue(s)

4.12.1 Engine Starts But Will Not Keep Running - Diagnosis and Repair

1. Parameter(s) configured incorrectly
   - With the InPower or INSITE service tool(s) verify that engine idle speed is not set too low.
     - Verify the correct idle speed setting.
     - Increase the idle speed if necessary.
2. Battery voltage
   - Battery voltage is low, interrupted, or open.
     - Check the battery connections, un-switched battery supply circuit, and fuses.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Run/Stop circuit issue(s)
   - Run/Stop circuit is malfunctioning.
     - Check the alternator Run/Stop circuit.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Fuel system issue(s)
   - Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank.
     - Add fuel to the fuel tank if the fuel level is found to be low.

- Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
  - Operate the engine from a tank of high-quality fuel.
  - Refer to Fuel for Cummins Engines, Bulletin 3379001.
- Fuel system restriction is above specification.
  - Check all fuel system lines for restrictions or debris.
  - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

5. Other issue(s)
   - Engine parasitics are excessive.
     - Check engine-driven units for correct operation.
     - Check the cooling fan for correct operation and cycle time.
     - Refer to the OEM specifications.
   - Base engine problem.
     - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine..

4.13 Poor Engine Transient Response

Possible Causes:

1. Excessive load(s)
2. Fuel system issue(s)
3. Air intake or exhaust issue(s)
4. Sensor issue(s)
5. Other issue(s)

4.13.1 Poor Engine Transient Response - Diagnosis and Repair

1. Excessive load(s)
   - Ensure that the load on the generator set does not exceed the generator set KW rating.
     - Re-visit the generator set sizing process to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system.
     - Refer to the T−030 manual for proper generator set sizing and application.
2. Fuel system issue(s)
   - Inspect fuel lines, fuel connections, and fuel filters for leaks.
     - Repair if leaks found.

    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
    - Operate the engine from a tank of high-quality fuel.
    - Refer to Fuel for Cummins Engines, Bulletin 3379001.
- Low or no fuel pressure at the fuel filters (primary pressure).
    - Use an electronic service tool to measure the fuel pressure at the fuel filter.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for air in the fuel system.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for fuel inlet restriction.
    - Check the fuel inlet lines for restriction.
    - Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel system restriction is above specification.
    - Check all fuel system lines for restrictions or debris.
    - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for fuel drain line restriction.
    - Check the fuel drain lines for restriction.
    - Clear or replace the fuel lines, check valves, or tank vents as necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Gear pump is malfunctioning.
    - Check the gear pump output pressure.
    - Replace the gear pump if necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for injector malfunction.
    - Perform the cylinder performance test.
    - Replace injectors as necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Air intake or exhaust issues
   - Air intake or exhaust leaks.
     - Inspect the air intake and exhaust systems for air leaks.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Air intake system restriction is above specification.
     - Check the air intake system for restriction.
     - Clean or replace the air filter and inlet piping as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Exhaust system restriction is above specification.
     - Check the exhaust system for restrictions.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Turbocharger is malfunctioning.
     - Monitor the turbocharger boost pressure.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Sensor issue(s)
   - Intake manifold air temperature is below specification.
     - Refer to the coolant temperature below normal symptom tree in the troubleshooting and repair manual for the specific engine.
   - Fuel system pressure sensors (fueling/timing) are malfunctioning.
     - Check the fuel system pressure sensors (fueling/timing).
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Coolant temperature sensor is malfunctioning.
     - Use InPower service tool(s) to check the coolant temperature sensor.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Intake manifold pressure sensor is malfunctioning.
     - Check the intake manifold pressure sensor.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Ambient air temperature sensor is malfunctioning.
     - Check the ambient air temperature sensor.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Other issue(s)
   - Engine is operating above recommended altitude.
     - Engine power decreases above recommended altitude.

        - Refer to the specific engine Engine Data Sheet for specifications.
    - Engine parasitics are excessive.
        - Check engine-driven units for correct operation.
        - Check the cooling fan for correct operation and cycle time.
        - Refer to the OEM specifications.
    - Overhead adjustments are not correct.
        - Adjust the overhead settings.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Base engine problem.
        - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.14 Engine Will Not Reach Rated Speed (RPM)

Possible Causes:

1. Excessive load(s)
2. Air intake or exhaust issue(s)
3. Fuel system issue(s)
4. Sensor issue(s)
5. Other issue(s)

4.14.1 Engine Will Not Reach Rated Speed (RPM) - Diagnosis and Repair

1. Excessive load(s)
    - Ensure that the load on the generator set does not exceed the generator set KW rating.
        - Re-visit the generator set sizing process to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system.
        - Refer to the T−030 manual for proper generator set sizing and application.
2. Air intake or exhaust issue(s)
    - Air intake system restriction is above specification.
        - Check the air intake system for restriction.
        - Clean or replace the air filter and inlet piping as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Exhaust system restriction is above specification.
        - Check the exhaust system for restrictions.

        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Fuel system issue(s)
    - Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
        - Operate the engine from a tank of high-quality fuel.
        - Refer to Fuel for Cummins Engines, Bulletin 3379001.
    - Check for air in the fuel system.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Fuel system restriction is above specification.
        - Check all fuel system lines for restrictions or debris.
        - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Gear pump is malfunctioning.
        - Check the gear pump output pressure.
        - Replace the gear pump if necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Sensor issue(s)
    - Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Fuel system pressure sensors (fueling/timing) are malfunctioning.
        - Check the fuel system pressure sensors (fueling/timing).
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Intake manifold pressure sensor is malfunctioning.
        - Check the intake manifold pressure sensor.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Ambient air temperature sensor is malfunctioning.
        - Check the ambient air temperature sensor.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Other issue(s)
    - Engine parasitics are excessive.
        - Check engine-driven units for correct operation.
        - Check the cooling fan for correct operation and cycle time.

    - Refer to the OEM specifications.
  - Engine is operating above recommended altitude.
    - Engine power decreases above recommended altitude.
    - Refer to the specific engine Engine Data Sheet for specifications.
  - Overhead adjustments are not correct.
    - Adjust the overhead settings.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
  - Injector O-rings are damaged or missing.
    - Remove and check the injectors.
    - Replace the injector O-rings.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
  - Base engine problem.
    - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.15 Engine Will Not Shut Off

Possible Causes:

1. Run/Stop circuit issue
2. Fumes in the intake air
3. Fuel system issue(s)
4. Turbocharger seal leak
5. Other issue(s)

4.15.1 Engine Will Not Shut Off - Diagnosis and Repair

1. Run/Stop circuit issue
   - Run/Stop circuit is malfunctioning.
     - Check the alternator Run/Stop circuit.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Fumes in the intake air
   - Engine is running on fumes drawn into the air intake.
     - Check the air intake ducts.
     - Locate and isolate the source of the fumes.
     - Repair as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Fuel system issue(s)
    - Fuel shutoff valve solenoid or circuit is malfunctioning.
        - Check the fuel shutoff valve solenoid and circuit.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Check for injector malfunction.
        - Perform the cylinder performance test.
        - Replace injectors as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Turbocharger seal leak
    - Turbocharger oil seal is leaking.
        - Check the turbocharger for oil seals and for leaks.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Other issue(s)
    - Base engine problem.
        - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.16 Fuel Consumption is Excessive

Possible Causes:

1. Excessive load(s)
2. Maintenance, repair, or environment effect(s)
3. Air intake or exhaust issue(s)
4. Fuel system issue(s)
5. Sensor issue(s)
6. Other issue(s)

4.16.1 Fuel Consumption is Excessive - Diagnosis and Repair

1. Excessive load(s)
    - Ensure that the load on the generator set does not exceed the generator set KW rating.
        - Re-visit the generator set sizing process to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system.
        - Refer to the T−030 manual for proper generator set sizing and application.

2. Maintenance, repair, or environment effect(s)
    - Fuel consumption has increased after an engine repair.
        - Evaluate the engine repair to determine its effect on fuel consumption.
        - Check part numbers to make sure the correct parts were used.
    - Lubricating oil level is above specification.
        - Check the oil level.
        - Verify the dipstick calibration and oil pan capacity.
        - Fill the system to the specified level.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Environmental factors are affecting fuel consumption.
        - Consider altitude and ambient air temperature when evaluating fuel consumption.
        - Refer to the specific engine Engine Data Sheets for altitude derate information.
3. Air intake or exhaust issue(s)
    - Air intake or exhaust leaks.
        - Inspect the air intake and exhaust systems for air leaks.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Air intake system restriction is above specification.
        - Check the air intake system for restriction.
        - Clean or replace the air filter and inlet piping as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Exhaust system restriction is above specification.
        - Check the exhaust system for restrictions.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Turbocharger is not correct.
        - Check the turbocharger part number and compare it to the control parts list.
        - Replace the turbocharger if necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Fuel system issue(s)
    - Inspect fuel lines, fuel connections and fuel filters for leaks.
        - Repair if leaks found.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
  - Operate the engine from a tank of high-quality fuel.
  - Refer to Fuel for Cummins Engines, Bulletin 3379001.
- Gear pump is malfunctioning.
  - Check the gear pump output pressure.
  - Replace the gear pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Check for injector malfunction.
  - Perform the cylinder performance test.
  - Replace injectors as necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel pump overflow valve is malfunctioning.
  - Check the overflow valve.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel lift pump is malfunctioning.
  - Check the fuel lift pump for correct operation.
  - Check the pump output pressure.
  - Replace the fuel lift pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Fuel injection pump is malfunctioning.
  - Remove and test the fuel injection pump.
  - Replace the pump if necessary.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

5. Sensor issue(s)
   - Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.
     - Refer to the troubleshooting procedure in the troubleshooting and repair manual for specific engine.
   - Fuel system pressure sensors (fueling/timing) are malfunctioning.
     - Check the fuel system pressure sensors (fueling/timing).
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
6. Other issue(s)
   - Engine parasitics are excessive.
     - Check engine-driven units for correct operation.
     - Check the cooling fan for correct operation and cycle time.

    - Refer to the OEM specifications.
  - Overhead adjustments are not correct.
    - Adjust the overhead settings.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
  - Base engine problem.
    - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.17 Fuel in the Coolant

Possible Causes:

1. Coolant is contaminated
2. Cracked cylinder head

4.17.1 Fuel in the Coolant - Diagnosis and Repair

1. Coolant is contaminated
   - Bulk coolant supply is contaminated.
     - Check the bulk coolant supply.
     - Drain the coolant and replace with non-contaminated coolant.
     - Replace the coolant filters.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Cracked cylinder head
   - Cylinder head is cracked or porous.
     - Remove intake and exhaust manifolds.
     - Check for evidence of coolant leak.
     - If necessary, operate engine at low idle.
     - Pressure-test the cylinder head.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.18 Fuel in the Lubricating Oil

Possible Causes:

1. Oil is contaminated
2. Excessive idle time
3. Fuel system leaks
4. Cracked cylinder head
5. Engine problem

4.18.1 Fuel in the Lubricating Oil - Diagnosis and Repair

1. Oil is contaminated
   - Bulk oil supply is contaminated.
     - Check the bulk oil supply.
     - Drain the oil and replace with non-contaminated oil.
     - Replace the oil filters.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Excessive idle time
   - Engine idle time is excessive.
     - Low oil and coolant temperatures can be caused by long idle time (greater than 10 minutes).
     - Shut off the engine rather than idle for long periods.
     - If idle time is necessary, raise the idle speed.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Fuel system leaks
   - Fuel pump or injector is leaking fuel.
     - Perform the fluorescent dye tracer test.
     - Check the fuel pump.
     - Check the overhead for an injector leak.
     - Replace the fuel pump or injector(s) if necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Check for injector malfunction.
     - Perform the cylinder performance test.
     - Replace injectors as necessary.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Cracked cylinder head
   - Cylinder head is cracked or porous.
     - Remove intake and exhaust manifolds.
     - Check for evidence of oil leak.
     - If necessary, operate engine at low idle.
     - Pressure-test the cylinder head.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

5. Engine problem
    - Base engine problem.
        - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.19 Excessive Smoke - Black

Possible Causes:

1. Air intake or exhaust issue(s)
2. Sensor issue(s)
3. Fuel system issue(s)
4. Other issue(s)

4.19.1 Excessive Smoke - Black - Diagnosis and Repair

1. Air intake or exhaust issue(s)
    - Air intake system restriction is above specification.
        - Check the air intake system for restriction.
        - Clean or replace the air filter and inlet piping as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Exhaust system restriction is above specification.
        - Check the exhaust system for restrictions.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Air intake or exhaust leaks.
        - Inspect the air intake and exhaust systems for air leaks.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Turbocharger is malfunctioning.
        - Monitor the turbocharger boost pressure with an INSITE electronic service tool.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Sensor issue(s)
    - Intake manifold pressure sensor is malfunctioning.
        - Check the intake manifold pressure sensor.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Intake manifold temperature sensor is malfunctioning.
        - Check the intake manifold temperature sensor.

        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Fuel system pressure sensors (fueling/timing) are malfunctioning.
        - Check the fuel system pressure sensors (fueling/timing).
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Ambient air temperature sensor is malfunctioning.
        - Check the ambient air temperature sensor.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Fuel system issue(s)
    - Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
        - Operate the engine from a tank of high-quality fuel.
        - Refer to Fuel for Cummins Engines, Bulletin 3379001.
    - Check for fuel inlet restriction.
        - Check the fuel inlet lines for restriction.
        - Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine..
    - Check for fuel drain line restriction.
        - Check the fuel drain lines for restriction.
        - Clear or replace the fuel lines, check valves, or tank vents as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Fuel system restriction is above specification.
        - Check all fuel system lines for restrictions or debris.
        - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Check for injector malfunction.
        - Perform the cylinder performance test.
        - Replace injectors as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Other issue(s)
    - Turbocharger oil seal is leaking.
        - Check the turbocharger oil seals for leaks.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Overhead adjustments are not correct.
  - Adjust the overhead settings.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Base engine problem.
  - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.20 Excessive Smoke - White

Possible Causes:

1. Cold ambient conditions
2. Sensor issue(s)
3. Fuel system issue(s)
4. Other issue(s)

4.20.1 Excessive Smoke - White - Diagnosis and Repair

1. Cold ambient conditions
   - Engine is cold.
     - Starting aid is necessary for cold weather or starting aid is malfunctioning.
     - Check for the correct operation of the starting aid.
     - Refer to the OEM manufacturer's instructions.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Sensor issue(s)
   - Coolant temperature sensor is malfunctioning.
     - Use InPower service tool(s) to check the coolant temperature sensor.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Intake manifold temperature sensor is malfunctioning.
     - Check the intake manifold temperature sensor.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Fuel system pressure sensors (fueling/timing) are malfunctioning.
     - Check the fuel system pressure sensors (fueling/timing).
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Ambient air temperature sensor is malfunctioning.
     - Check the ambient air temperature sensor.

    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Fuel system issue(s)
    - Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
        - Operate the engine from a tank of high-quality fuel.
        - Refer to Fuel for Cummins Engines, Bulletin 3379001.
    - Check for air in the fuel system.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Check for fuel inlet restriction.
        - Check the fuel inlet lines for restriction.
        - Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Check for fuel drain line restriction.
        - Check the fuel drain lines for restriction.
        - Clear or replace the fuel lines, check valves, or tank vents as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Fuel system restriction is above specification.
        - Check all fuel system lines for restrictions or debris.
        - Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Check for injector malfunction.
        - Perform the cylinder performance test.
        - Replace injectors as necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Fuel pump overflow valve is malfunctioning.
        - Check the overflow valve.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
    - Fuel lift pump is malfunctioning.
        - Check the fuel lift pump for correct operation.
        - Check the pump output pressure.
        - Replace the fuel lift pump if necessary.
        - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

- Injector protrusion is not correct.
  - Check the injector protrusion.
  - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Other issue(s)
   - Coolant level is below specification.
     - Check the coolant level and for air in the coolant system.
     - Completely bleed air from the coolant system.
     - Refer to the operation and maintenance manual for the specific engine.
   - Overhead adjustments are not correct.
     - Adjust the overhead settings.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Raw fuel in the intake manifold.
     - Check the intake manifold for fuel.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Intake manifold is contaminated with lubricating oil.
     - Check the intake manifold for oil.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Base engine problem.
     - Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.21 Engine Noise is Excessive

Possible Causes:

1. Lubrication issue(s)
2. Cooling issue(s)
3. Air intake or exhaust leaks
4. Worn mounts
5. Turbocharger noise
6. Mechanical or internal component wear or damage

4.21.1 Engine Noise is Excessive - Diagnosis and Repair

1. Lubricating issue(s)
   - Lubricating oil level is below specification.
     - Check the oil level.

    - Verify the dipstick calibration and the oil pan capacity.
    - Fill the system to the specified level.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
  - Lubricating oil pressure is below specification.
    - Check the oil pressure.
    - If the pressure is low, refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
  - Lubricating oil is thin or diluted.
    - Analyze the oil.
    - Refer to Cummins Engine Oil Recommendations, Bulletin 3810340.

2. Cooling issue(s)
   - Coolant temperature is above specification.
     - Check the coolant level.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Fan drive belt is loose, tight, or not in alignment.
     - Check the fan drive belt.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Air intake or exhaust leaks
   - Inspect the air intake and exhaust systems for air leaks.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Worn mounts
   - Engine mounts are worn, damaged, or incorrect.
     - Check the engine mounts.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Turbocharger noise
   - Inspect the turbocharger(s) for excessive mechanical noise.
     - Replace if necessary.
     - Refer to the Engine Noise Excessive - Turbocharger symptom tree.
6. Mechanical or internal component wear or damage
   - Overhead adjustments are not correct.
     - Measure and adjust the overhead settings.
     - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
   - Overhead components are damaged.
     - Inspect the rocker levers, rocker shafts, cam followers or tappets, push rods, and valves for damage or excessive wear.

    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Exhaust valve to piston contact.
    - Inspect the rocker levers, rocker shafts, crossheads, valves, and pistons for damage.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Injector is malfunctioning.
    - Perform the cylinder performance test.
    - Replace injectors as necessary.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Vibration damper is damaged.
    - Inspect the vibration damper.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Gear train backlash is excessive or the gear teeth are damaged.
    - Check the gear backlash and the gear teeth.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Main bearing or connecting rod bearing noise.
    - Refer to the Engine Noise Excessive - Main Bearing symptom tree (engine specific manual).
- Flywheel or flexplate cap screws are loose or broken.
    - Check the flywheel or flexplate and the mounting cap screws.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
- Piston, piston rings, or cylinder liner is worn or damaged.
    - Refer to the Engine Noise Excessive – Piston symptom tree (engine specific manual).
- Internal engine damage.
    - Analyze the oil and inspect the filters to locate an area of probable damage.
    - Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4.22 Engine Does Not Crank in Manual Mode

Logic:

This indicates that the control has not received or recognized a manual start signal.

Possible Causes:

- No power supplied to the control.
- Control not properly calibrated or corrupt calibration.

- The Emergency Stop switch or wiring is defective.
- Oil pressure switch or wiring is defective.
- Oil pressure sender, setup on wiring is defective.

Diagnosis and Repair:

1. No power supplied to the control.
   a. Check if the control is in Manual mode and when the Start button is pressed, and that there are no shutdown faults present.
   b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections.
   c. Check for brown fuses.
   d. Remove connector P16 and check for B+ at P16-2 and GND at P16-5. If B+ or ground missing, check the harness. If B+ and ground check OK, cycle power to control by reconnecting P16. Press Reset button to wake the control up. And retry operation.
2. Control not properly calibrated or corrupt calibration.
   a. Confirm that the installed calibration part number matches the serial plate information. Re-enter calibration file if necessary.
3. The Emergency Stop switch or wiring is defective.
   a. With Emergency Stop push button not activated (switch closed), remove leads from TB2-5 and B- and check for continuity between these two leads. If circuit is open, isolate to Emergency Stop switch and wiring. If there is continuity, go to next step.
4. Oil pressure switch or wiring is defective.
   a. Remove P16 connection and check wiring between P16-9 and P16-11 to the switch.
   b. Verify control is configured for the type of sensor installed.
   c. Verify proper operation of the switch.
5. Oil pressure sender, setup on wiring is defective.
   a. Remove P16 connection and check wiring between P16-9, P16-11 to the sender. Verify control is configured for the type of sender. Verify operation of the sender.

4.23 Engine Does Not Crank in Remote Mode

Logic:

This indicates that the PS0500 control has not received or recognized a remote start signal.

Possible Causes:

1. The remote start switch or wiring is faulty.

Diagnosis and Repair:

1. The remote start switch or wiring is faulty.
   a. Check if the control is in Auto mode and there are no shutdown faults present. Attempt to start, and check for ground at TB2-1.
      - If ground level is not present, isolate to the remote switch or wiring. Repair as necessary.

- If ground level is present then the control is bad. Replace the control.

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5 Troubleshooting - General

5.1 Control System

The generator set control system 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 will display a message on the graphical display panel. In the event of an engine shutdown fault (red Shutdown LED), the control will stop the engine immediately.

NOTICE
Refer to the control service manual listed in the Related Literature section for control troubleshooting.

5.2 Safety Considerations

⚠ WARNING
Troubleshooting procedures.   ***Many troubleshooting procedures present hazards that can result in severe personal injury or death.***   ***Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the safety precautions in*** ***Chapter 1 on page 1***

⚠ WARNING
High voltage.   ***Contacting high voltage components can cause electrocution, resulting in severe personal injury or death.***   ***Keep the output box covers in place during troubleshooting.***

High voltages are present when the generator set is running. Do not open the generator output box while the generator set is running.

⚠ WARNING
Battery gases.   ***Ignition of explosive battery gases can cause severe personal injury or death.***   ***Arching at battery terminals, a light switch or other equipment, flame, pilot lights, and sparks can ignite battery gases, that can cause servere personal injury or death.***   ***Do not smoke or switch a trouble light ON or OFF near a battery. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface. Ventiate the battery area before working on or near a battery. Using an insulated wrench, disconnect the negative (-) cable first and reconnect it last.***

⚠ WARNING
Accidental starting.   ***Accidental starting of the generator set can cause severe personal injury or death.***   ***Prevent accidental starting by disconnecting the negative (−) cable from the battery terminal with an insulated wrench.***

NOTICE

Disconnect the battery charger from the AC source before disconnecting the battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the generator set.

When troubleshooting a generator set that is shut down, make certain the generator set cannot be accidentally restarted as follows:

1. Make sure the generator set is in the Off mode.
2. Turn off or remove AC power from the battery charger.
3. Using an insulated wrench, remove the negative (−) battery cable from the generator set starting battery.

5.3 InPower Service Tool

The InPower™ service tool can be used in troubleshooting to perform tests, verify control inputs and outputs, and test protective functions. Refer to the InPower User's Guide, provided with the InPower software for test procedures.

InPower, when used improperly, can cause symptoms like warnings and shutdowns that appear to be a defective base board. When these problems occur, always verify that a self-test or fault simulation (override) have not been left enabled with InPower. If you do not have InPower, or the enabled fault simulation(s) cannot be found using InPower, disconnect battery power to disable the test or override condition.

Make sure that parameter adjustments and time delays, related to the fault condition, have been appropriately set for the application. It may be necessary to write the initial capture file to the device or update the calibration file.

Updating a calibration file requires the InPower Pro version. Confirm that the installed calibration part number matches the serial plate information.

NOTICE

Using the wrong calibration file can result in equipment damage. Do not swap base boards from another generator set model.

Some features are not available until the hardware for that feature is installed and InPower Pro is used to update (enable) that feature. Confirm that the feature is installed and enabled prior to troubleshooting the base board for symptoms related to a feature.

5.4 Network Applications and Customer Inputs

In applications with networks and remote customer inputs, the generator set may start unexpectedly or fail to crank as a result of these inputs. These symptoms may appear to be caused by the base board. Verify that the remote input is not causing the symptom or isolate the control from these inputs before troubleshooting the control.

5.5 Test Equipment

To perform the test procedures in this manual, the following test equipment must be available:

- True RMS digital multi-meter for accurate measurement of resistance, AC voltage (0-1000 VAC), and DC voltage.

- Current probe(s).
- Battery hydrometer.
- Jumper leads.
- Tachometer.
- Megger or insulation resistance meter.
- InPower service tool (PC-based service tool)
- Newest InPower InCal files (calibration for control) from the InCal web site (**www.cumminspower.com** under “Services", “Software Updates", “InCal Quick Links").
- PC-based service tool connector (Cummins Power Generation Part number 0541-1199).
- Inline 4 / Inline 5 adapter or newer (Cummins Power Generation Part number 0491-8416).
- Inline 4 / Inline 5 drivers (available via kit or online at **http://inline.cummins.com/**).
- Basic electrical test lead set, with very small probe tips. Fluke test leads “TL80A" (part number 0541-1627) are recommended.
- 316289800 - Pressure/Temperature sensor breakout cable
- 382477400 - Pressure sensor breakout cable
- 382477600 - Pressure sensor breakout cable
- 316475200 - DanfossTM pressure sensor breakout cable TM pressure sensor breakout cable
- 382275800 - Male Deutsch/AMP/Metri-Pack test lead
- 382291700 - Female Deutsch/AMP/Metri-Pack test lead
- 382481200 - Deutsch socket pin test lead
- 382481100 - Deutsch pin test lead

5.6 Voltage/Continuity Testing

Voltage and continuity tests are required in the following tables. In some cases, it is necessary to remove a plug to complete the test.

The following corrective actions will mention when it is necessary to remove a plug for testing. In other cases, the plug must not be removed for testing. When plug removal is not mentioned, testing must be performed by inserting a narrow meter probe into the back of the plug.

5.7 CT Ratio Calculator

InPower has a built-in CT ratio calculator which allow you to determine the required CT size and CT ratio.

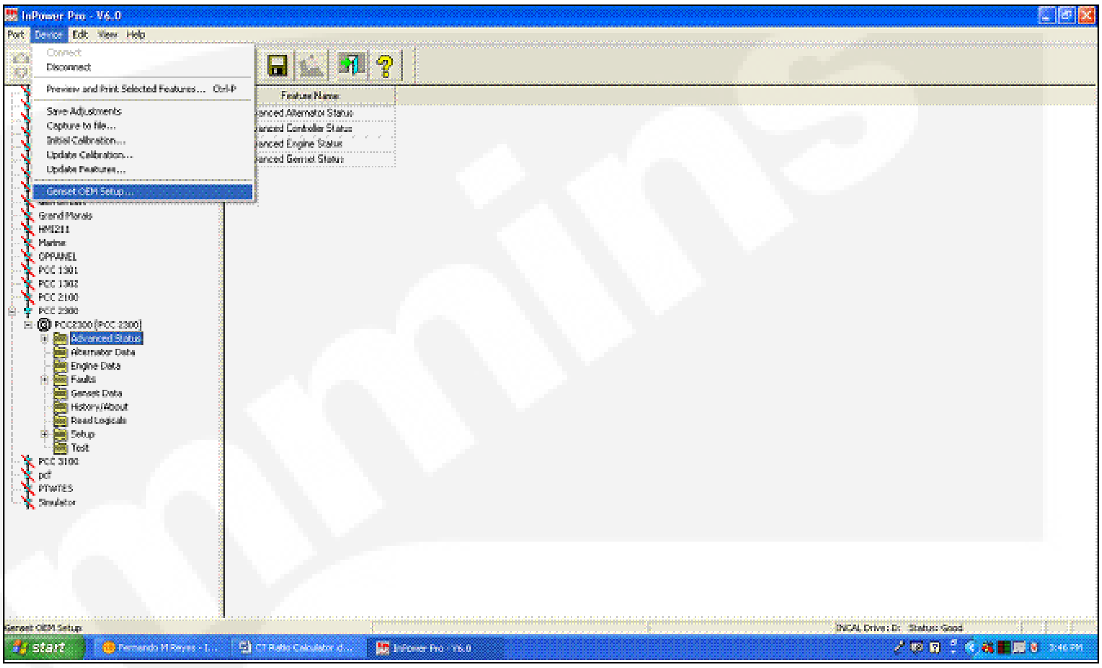
The following generator set information is required to calculate the CT ratio:

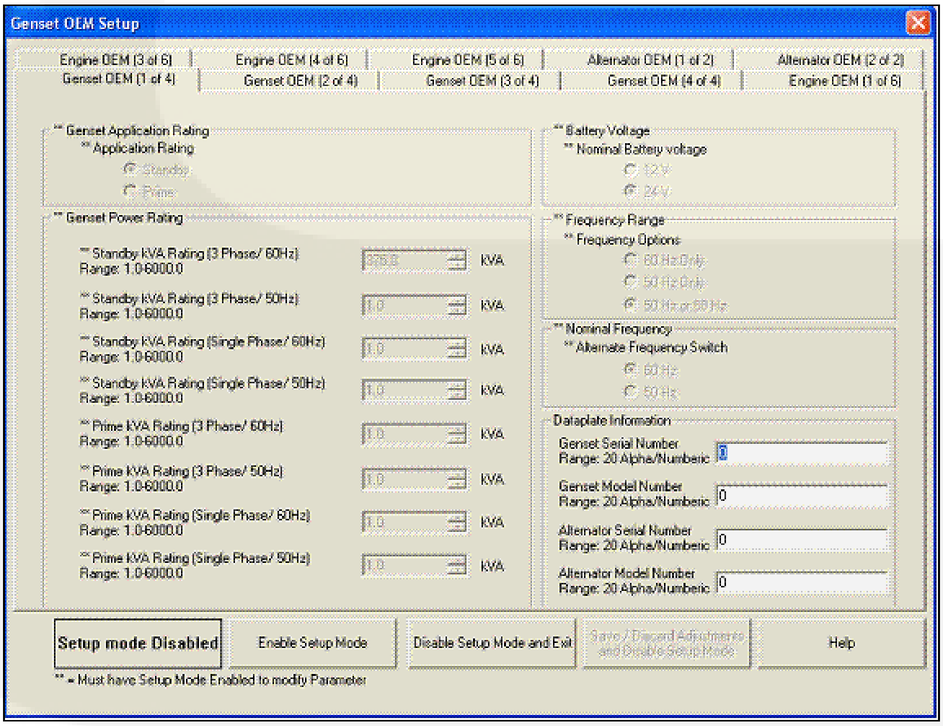
- Generator set power ratings
- Frequency range
- Nominal frequency

- Nominal voltage Limits
- Secondary CT ratio value

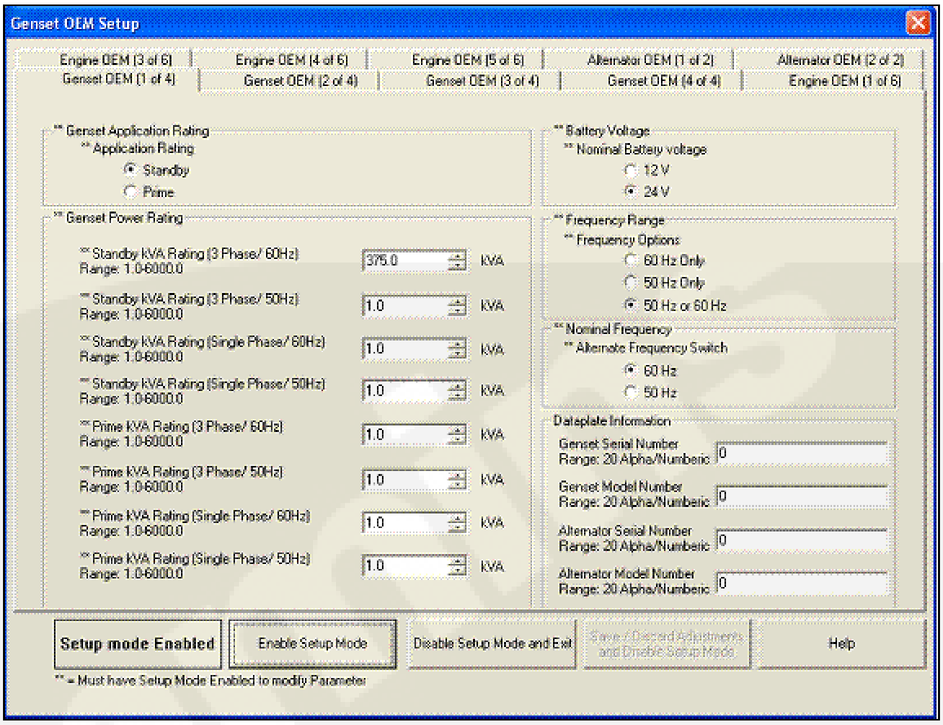
Follow these steps to use the CT ratio calculator in InPower.

1. Connect to the PCC and highlight any of the folders under the PCC connection (such as Advanced Status). Right click on the folder, and click on Genset OEM Setup...

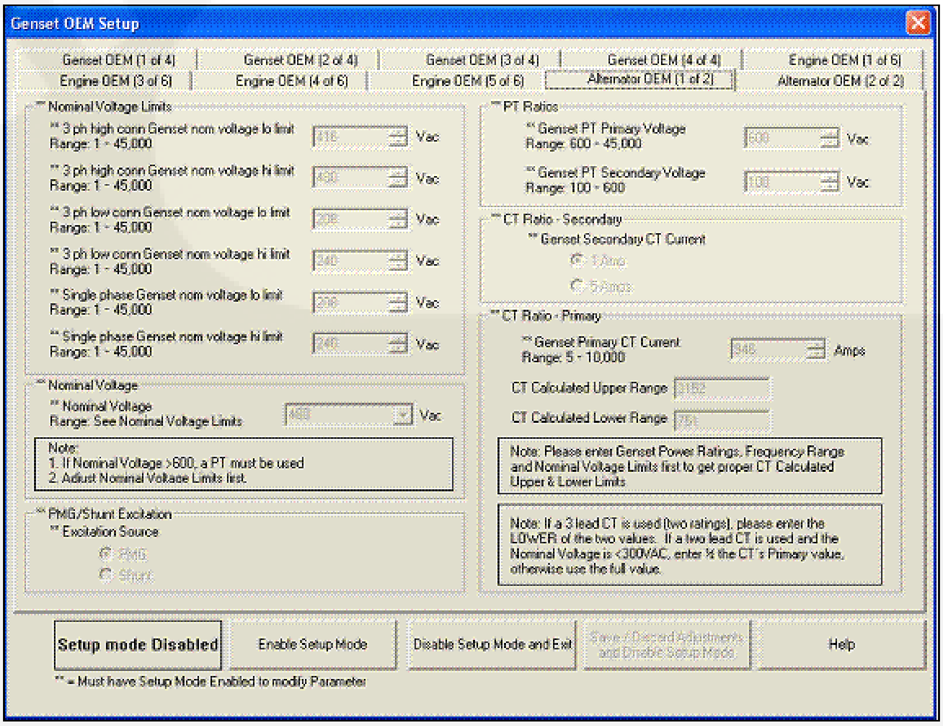




2. Click on Enable Setup Mode in order to enable the menu.
3. Enter the generator set information under Genset Power Ratings, Frequency Range, and Nominal Frequency.
4. Click on Save/Discard Adjustments and Disable Setup Mode in order to save the generator set settings. This step is required.



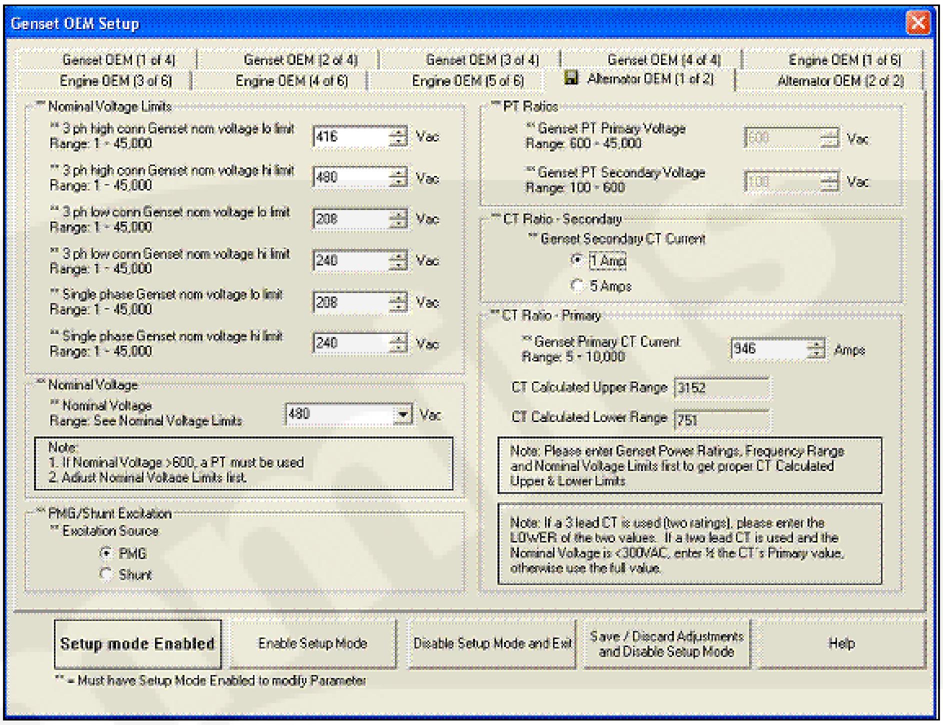
5. Open the Genset OEM Setup again.
6. Click on the Alternator OEM (1 of 2) tab to display the settings below.



7. Click on Enable Setup Mode in order to enable the menu.
8. Enter the generator set information under Nominal Voltage Limits and CT Ratio –Secondary. After all the information is entered, InPower will calculate the required Genset Primary CT Ratio limits. The primary CT Ratio needs to be between the CT Calculated Upper Range and the CT Calculated Lower Range.

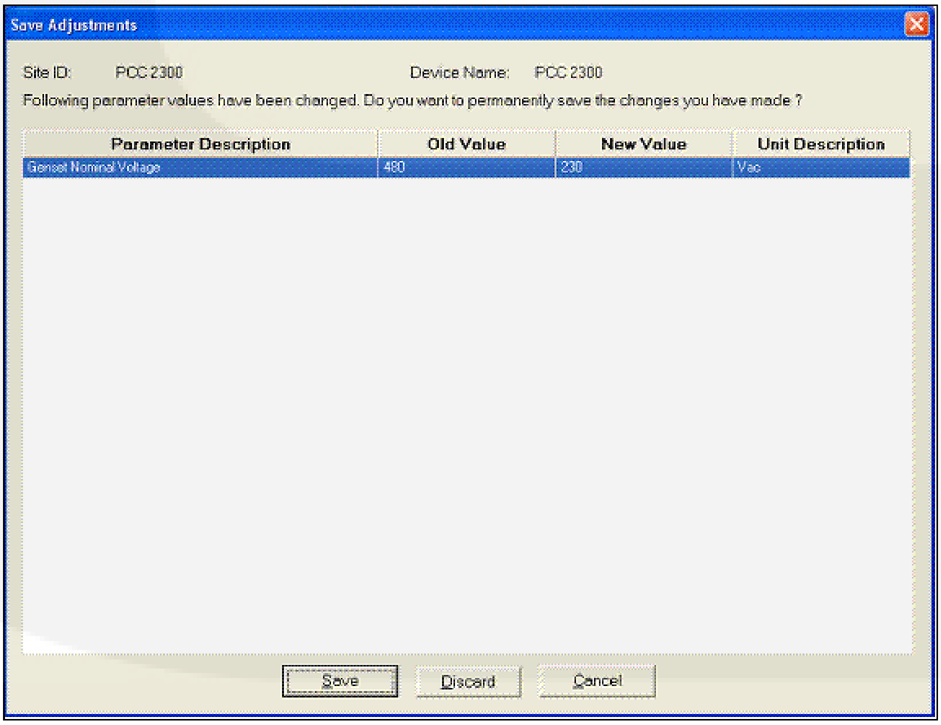
   The CTs and the CT ratio setting in the PCC require a primary CT ratio between the CT Calculated Upper Range and the CT Calculated Lower Range.

The alternator CT ratio is required to have a secondary CT Ratio equal to the setting under the CT Ratio – Secondary.



9. To exit the setup mode and save changes, click on Save / Discard Adjustments and Disable Setup Mode.

   To exit the setup mode without saving changes, click on Disable Setup Mode and Exit. Then, click on Discard when the Save Adjustments Screen pops up.



5.8 Reading Fault Codes

When a fault occurs, the graphical display on the HMI will display the fault code/message.

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

5.9 Troubleshooting Procedures

The following list of troubleshooting procedures are a guide to help you evaluate problems with the generator set. You can save time if you read through the manual ahead of time and understand the system.

⚠ CAUTION

Always set the generator set to off mode before disconnecting or connecting harness connectors. Otherwise, disconnecting the harness connectors can result in voltage spikes high enough to damage the DC control circuits of the set.

⚠ CAUTION

Electrostatic discharge will damage circuit boards. Always wear a wrist strap when handling circuit boards or when disconnecting or connecting harness connectors. See the Circuit Board Removal/Replacement procedure in the controller Service Manual.

NOTICE

The troubleshooting procedures for ECM-related faults and engine-related faults are in the engine service manual.

NOTICE

Each fault code “warning" can be changed to a “shutdown" using InPower. Default settings are used in this manual. It is recommended that all changes to settings be recorded at each site to aid in the troubleshooting of the generator set.

If you are troubleshooting a fault that does not appear in the graphical display, look at the SA field in the Faults screens to identify the source of the fault. If this field is blank, the PCC is the source of this fault.

Try to think through the problem. Go over what was done during the last service call. The problem could be as simple as a loose wire, an opened fuse, or a tripped circuit breaker.

This section contains the following information:

- How to troubleshoot a local/remote failure to crank problem when the control panel does not indicate any fault condition.
- How to troubleshoot engine problems that are not within the detectable range of the PC control.
- How to troubleshoot a Check Engine lamp fault for generator sets that contain the low emissions option.
- Descriptions of each status, warning, and shutdown code; warning and shutdown limits where applicable; and basic corrective actions, such as checking fluid levels, control reset functions, battery connections, etc.
- Detailed troubleshooting procedures. In the following list of troubleshooting procedures, the fault codes are arranged in numeric order.

5.10 Fault Reset Signal

This signal may come from any of these sources:

- PCC Fault Reset connection (typically, the Reset button on the Operator Panel)
- Reset button on the Operator Panel
- Modbus networks
- PC-based service tool, such as InPower

This signal becomes active for one second when any of these sources changes from inactive to active. Then, the signal remains inactive until any of these sources changes from inactive to active again.

5.11 Delayed Shutdown

The PCC provides advance warning of an impending shutdown if all of these conditions are met:

- *Delayed Shutdown Enable* is set to Enable.
- The ECM is set to enable Battle Short mode (Core 2 ECMs only).
- A non-critical shutdown fault occurs, and there are no critical shutdown faults.

When these conditions are met, the PCC generates warning fault 1124 (Delayed Shutdown) and waits *Delayed Shutdown Time Delay* before it initiates the stop sequence.

6 Troubleshooting Fault Codes

6.1 Types of Events/Faults

The PCC generates these types of events/faults.

6.2 Event/Fault List Definition

Faults and events that appear in the table that do not have a troubleshooting procedure in this manual are engine driven faults/events. To troubleshoot these faults, consult the engine Service manual, engine Troubleshooting and Repair manual, and/or QuickServe OnLine.

6.3 Events

The PCC generates events to notify external devices when certain conditions are met. The PCC may send notifications any of these ways:

- Configurable outputs.
- PCCNet devices (For example, events might control a LED or a configurable output on a PCCNet device.)

It is up to the external devices to respond to an event when they are notified about one. Events do not appear in any screen in the Operator Panel.

6.4 Warning Faults

The PCC generates warning faults to warn the operator when unsafe conditions are occurring.

When the PCC generates a warning fault, the warning fault becomes active. However, active warning faults have no effect on generator set operation. The generator set can start, continue running, and stop as usual.

Active warning faults appear in the Warning Faults screen. In addition, the PCC provides these indications as long as there is an active warning fault:

- The Warning LED on the Operator Panel is on.
- Event 1540 (Common Warning) is active.
- Event 1483 (Common Alarm) is active.

Follow these steps to clear a warning fault.

1. Correct the condition(s) that caused the fault.
2. Activate the fault reset signal.

Faults that have been cleared appear in the Fault History screen.

6.5 Derate Events

Derate events are warning faults in which the PCC also requests a reduction in the kW output level of the generator set.

If a derate event is active, *Derate Request* (This Parameter is not available in the Operator Panel, refer to parameters table) is the percentage of the current kW output level the PCC would like to have removed. Each derate event has this percentage associated with it. If two or more derate events are active at the same time, the PCC considers only the maximum percentage requested by each derate event. The PCC does not add the percentages together. For example, if one derate event requests a 10% reduction and a second derate event requests a 20% reduction, *Derate Request (This Parameter is not available in the Operator Panel, refer to parameters table)* is 20%, not 30%.

The PCC is running in Load Govern paralleling state, the PCC requests that *Genset % Standby Total kW* be no more than 100% - *Derate Request (This Parameter is not available in the Operator Panel, refer to parameters table)*. This becomes a limitation for *Load Govern kW Target*.

If the PCC is not running in Load Govern paralleling state, the PCC generates warning fault 1464 (Load Dump Fault). If *Load Dump/Configurable Output #11 Output Function Pointer* is set to Default, the Load Dump connection is active. The PCC does not do anything else to reduce the kW output level. It is up to external devices to reduce the load.

If *LBNG Genset Enable* is set to Enable, the PCC recognizes derate requests from the engine control module (ECM) only if all of these conditions are met.

- *LBNG Derate Enable* is set to Enable.
- The AUX 101's Derate Authorization connection is active.

6.6 Shutdown Faults

The PCC generates shutdown faults to prevent damage to the generator set. The PCC shuts down the generator set immediately.

When the PCC generates a shutdown fault, the shutdown fault becomes active. The PCC initiates a Shutdown Without Cooldown sequence.

Active shutdown faults appear in the Shutdown Faults screen. In addition, the PCC provides these indications as long as there is an active shutdown fault:

- The Shutdown LED on the Operator Panel is on.
- Event 1541 (Common Shutdown) is active.
- Event 1483 (Common Alarm) is active.

You cannot start the generator set until you clear the shutdown fault. Follow these steps to clear a shutdown fault.

1. Correct the condition(s) that caused the fault.
2. Make sure the emergency stop buttons are inactive, and change the PCC to Off mode.

NOTICE
If Remote Fault Reset Enabled is set to Enable, you can also clear shutdown faults in Auto mode. In this case, change the PCC to Auto mode , and make sure the exercise signal and the remote start signal are inactive. The PCC generates event 2941 (Remote Shutdown Fault Reset Occurrence) when shutdown faults are reset in Auto mode.

3. Activate the fault reset signal.

Faults that have been cleared appear in the Fault History screen.

6.6.1 Shutdown with Cooldown Faults

Shutdown with cooldown faults are shutdown faults in which the PCC has time to cool down the generator set.

When the PCC generates a shutdown with cooldown fault, the shutdown with cooldown fault becomes active. If the PCC is running in Load Govern paralleling state, it initiates a Manual Stop sequence and starts running the load govern kW ramp unload process. If the PCC is not running in Load Govern paralleling state, it initiates a Controlled Shutdown sequence. When the stop sequence has finished, the PCC generates shutdown fault 1336 (Cooldown Complete).

If a shutdown with cooldown fault is active and the engine speed is greater than zero, warning fault 1132 (Controlled Shutdown) is active. You can assign this event/fault to a configurable output, so that the PCC notifies an external device that is going to shut down the generator set.

In other ways, shutdown with cooldown faults are the same as shutdown faults.

6.6.2 Critical Shutdown Faults vs. Non-critical Shutdown Faults

The PCC always shuts down the generator set when a critical shutdown fault is generated. Non-critical shutdown faults do not prevent the PCC from starting or running the generator set when Battle Short mode is active. The PCC also responds to critical shutdown faults and non-critical shutdown faults differently if Delayed Shutdown is set up .

NOTICE
This discussion applies to shutdown with cooldown faults as well as shutdown faults.

The table below identifies the critical shutdown faults.

TABLE 3. CRITICAL SHUTDOWN FAULTS

Event/Fault Code	Description
115	Eng Crank Sensor Error
234	Crankshaft Speed High
236	Both Engine Speed Signals Lost
359	Fail To Start
781	CAN Data Link Failure
1245	Engine Shutdown Fault
1247	Unannounced Engine Shutdown
1336	Cooldown Complete
1433	Local Emergency Stop
1434	Remote Emergency Stop
1438	Fail To Crank
1992	Crankshaft Sensor High
2335	AC Voltage Sensing Lost (Excitation Fault)
2914	Genset AC Meter Failed

All other shutdown faults are non-critical shutdown faults. The PCC still provides the usual indications that a shutdown fault has occurred, even if it overrides a non-critical shutdown fault.

6.7 Fault Codes

This table identifies the faults codes and events that the PCC can generate depending on it's configuration.

NOTICE
InPower can be used to raise the response/severity of an event or fault. For example, an event can be changed to a warning fault or a warning fault to a shutdown fault. The response/severity of an event or fault (except event/fault 1452 (Genset Breaker Fail to Close)) cannot be set lower than its default value, and the severity cannot be changed of any fault or event with an asterisk (**).

Codes marked with * are generator related fault codes. For all other codes for the possible cause, failure and diagnosis refer to the relevant engine service manual.

TABLE 4. FAULT CODES

Code	Event/Lamp	Displayed Message
111	Shutdown	Internal ECM Failure
115	Shutdown	Eng Crank Sensor Error
118	Warning	Fuel Pressure OOR High
119	Warning	Fuel Pressure Sensor OOR Low
121	Shutdown	Loss of Speed Sense
122	Warning	Manifold 1 Press High
123	Warning	Manifold 1 Press Low
124	Warning	Manifold 1 Press High
135	Warning	High Oil Rifle 1 Pressure
141	Warning	Low Oil Rifle 1 Pressure
143	Warning	Low Oil Rifle Pressure
144	Warning	High Coolant 1 Temp
145	Warning	Low Coolant 1 Temp
146	Derate	Pre-High Engine Coolant Temperature
151	Shutdown	High Coolant Temp
153	Warning	High Intake Manf 1 Temp
154	Warning	low Intake Manf 1 Temp
155	Shutdown	High Intake Manf 1 Temp
187	Warning	Sensor Supply 2 Low
195	Warning	High Coolant 1 Level
196	Warning	Low Coolant 1 Level
197*	Warning	Low Coolant Level
212	Warning	High Oil 1 Temperature
213	Warning	Low Oil 1 Temperature

Code	Event/Lamp	Displayed Message
214	Shutdown	High Oil 1 Temp
219	Warning	Eng Oil Level Remote Reservoir: Least Severe Level
221	Warning	Air Pressure Sensor High
222	Warning	Air Pressure Sensor Low
223	Warning	Oil Burn Valve Sol Low
224	Warning	Oil Burn Valve Sol High
227	Warning	Sensor Supply 2 Low
228	Shutdown	Low Coolant Pressure
231	Warning	High Coolant Pressure
232	Warning	Low Coolant Pressure
233	Warning	HT Coolant Pressure Moderate Low
234*	Shutdown	Crankshaft Speed High
235*	Shutdown	Low Coolant Level
236*	Shutdown	Both Engine Speed Signals Lost
238	Warning	Sensor Supply 3 Low
239	Warning	Main Supply High
245	Warning	Fan Control Low
254	Shutdown	FSO PWM High Contorl Error
255	Warning	FSO PWM Low Control Error
259	Warning	Engine Fuel Shutoff Valve Stuck Open
261	Warning	High Fuel Temperature
263	Warning	High Fuel 1 Temperature
265	Warning	Low Fuel 1 Temperature
266	Shutdown	High Fuel Temperature
271	Warning	Low Fuel Pump Press
272	Warning	High Fuel Pump Press
277		Fuel Control Valve Out of Adj
281	Warning	Cylinder Press Imbalance
284	Warning	Eng Speed/Position Sensor: Voltage Below Normal
285	Warning	CAN Mux PGN Rate Error
286	Warning	CAN Mux Calibration Error
287	Warning	CAN Mux Accel Data Error
295	Warning	Key On Air Pressure Error
311	Warning	ACT1 FF Shorted HS TO LS Error
312	Warning	ACT5 Shorted HS TO LS Error
313	Warning	ACT3 RF Shorted HS TO LS Error
314	Warning	ACT6 Shorted HS TO LS Error
315	Warning	ACT2 FT Shorted HS TO LS_Error
319	Warning	RTC PWR Intr: Data Erratic Intermittent or Wrong
321	Warning	ACT4 RT Shorted HS TO LS Error
322	Warning	Inj 1 Solenoid Low Curr

Code	Event/Lamp	Displayed Message
323	Warning	Inj 5 Solenoid Low Curr
324	Warning	Inj 3 Solenoid Low Curr
325	Warning	Inj 6 Solenoid Low Curr
331	Warning	Inj 2 Solenoid Low Curr
332	Warning	Inj 4 Solenoid Low Curr
341	Warning	Engine Control Module Data Lost
342	Shutdown	Calibration Code Fail
343	Warning	ECM Hardware Failure
351	Warning	Injector Supply Failure
352	Warning	Sensor Supply 1 Low
359*	Shutdown	Fail to Start
378	Warning	Elect Fuel Inj Cntrl Valve Ckt: Curr Below Normal
379	Warning	Elect Fuel Inj Cntrl Valve Ckt: Curr Above Normal
386	Warning	Sensor Supply 1 High
394	Warning	Eng Timing Actuator Driver: Curr Below Normal
395	Warning	Eng Timing Actuator Driver: Curr Above Normal
396	Warning	Fuel Cntl Valve Solenoid Driver 2 Sensor Ckt: OC
397	Warning	Fuel Cntl Valve Solenoid Driver 2 -
398	Warning	Eng Timing Actuator Driver 2 Circuit: OC
399	Warning	Eng Timing Actuator Driver 2: Grounded Ckt
415	Shutdown	Low Oil Rifle Press
418	Warning	High H2O in Fuel
419	Warning	Intake Manifold Pres Bank Imbalance: Data Erratic
421*	Derate	High Oil Temperature
422	Warning	Coolant Level Data Error
425	Warning	Oil Temperature Error
426*	Event	J1939 Datalink: Data Erratic/Intermittent/Wrong
427*	Warning	CAN Data Link Degraded
433	Warning	Intake Manifold Press Sensor Ckt: Data Erratic
435	Warning	Oil Pressure Switch Error
441*	Warning	Low Battery 1 Voltage
442*	Warning	High Battery 1 Voltage
449	Shutdown	Inj Metering 1 Press High
451	Warning	Inj Metering 1 Press High
452	Warning	Inj Metering 1 Press Low
482	Warning	Fuel Press Low: Valid But Below Normal: Mod Severe
488*	Derate	High Intake Manf 1 Temp
496	Warning	Eng Speed Sensor 2 Supply Volt: Root Cause Unknown
546	Warning	Fuel Delivery Press High
547	Warning	Fuel Delivery Press Low
553	Warning	APC Pressure High

Code	Event/Lamp	Displayed Message
554	Warning	APC Pressure Error
556	Shutdown	Crankcase Pressure High
559	Warning	Inj Metering 1 Press Low
611*	Warning	Engine Hot Shut Down
686	Warning	Turbo 1 Speed Incorrect
689	Warning	Crankshaft Speed Error
697	Warning	ECM Temperature High
698	Warning	ECM Temperature Low
731	Warning	Crankshaft Mech Misalign
757	Warning	All Persistent Data Lost Error
778	Warning	EPS Backup Lost Sync Error
781*	Shutdown	CAN Data Link Failure
782	Warning	SAE J1939 Data Link 2 Engine Network No Data Received – Condition Exists
783	Shutdown	Intake Manf 1 Rate Error
1117	Warning	Power Lost With Ignition On
1121*	Warning	Fail To Disconnect
1122*	Event	Rated To Idle Delay
1123*	Shutdown	Shutdown After Battle Short (Shutdown)
1124*	Warning	Delayed Shutdown
1131*	Warning	Battle Short Active
1132*	Warning	Controlled Shutdown
1139	Warning	UFD Injector 1 Error
1141	Warning	UFD Injector 2 Error
1142	Warning	UFD Injector 3 Error
1143	Warning	UFD Injector 4 Error
1144	Warning	UFD Injector 5 Error
1145	Warning	UFD Injector 6 Error
1219*	Warning	Utility Breaker Tripped
1223*	Warning	Utility Frequency
1224*	Warning	Genset Overvoltage
1225*	Warning	Genset Undervoltage
1226*	Warning	Genset Frequency
1243*	Derate	Engine Derated
1244*	Shutdown	Engine Normal Shutdown
1245*	Shutdown	Engine Shutdown Fault
1246*	Warning	Unknown Engine Fault
1247*	Shutdown	Unannounced Engine Shutdown
1248*	Warning	Engine Warning
1256	Warning	Ctrl Mod ID In State Error
1257	Shutdown	Ctrl Mod ID In State Fail

Code	Event/Lamp	Displayed Message
1312*	Event	Configurable Input # 2
1317*	Event	Configurable Input # 13
1318*	Event	Configurable Input # 14
1322*	Warning	kW Load Setpoint OOR High
1323*	Warning	kW Load Setpoint OOR Low
1324*	Warning	kVAR Load Setpoint OOR High
1325*	Warning	kVAR Load Setpoint OOR Low
1328*	Warning	Genset Breaker Tripped
1336*	Shutdown	Cooldown Complete
1357	Warning	Oil Remote Level Low
1363	Warning	Intake Manf 1 Press Low
1367	Warning	High Prefilter Oil Press
1368	Warning	Low Prefilter Oil Press
1376	Warning	Camshaft Speed Error
1411	Warning	High Out Freq Adjust Pot
1412	Warning	High Droop Adjust Pot
1416*	Warning	Fail To Shutdown
1417*	Warning	Power Down Failure
1418	Warning	High Gain Adjust Pot
1427	Warning	Overspeed Relay Error
1428	Warning	LOP Relay Error
1429	Warning	HET Relay Error
1431	Warning	Pre-LOP Relay Error
1432	Warning	Pre-HET Relay Error
1433*	Shutdown	Local Emergency Stop
1434*	Shutdown	Remote Emergency Stop
1435*	Warning	Low Coolant Temperature
1438*	Shutdown	Fail To Crank
1439*	Warning	Low Day Tank Fuel Switch
1441*	Warning	Low Fuel Level
1442*	Warning	Weak Battery
1443*	Shutdown	Dead Battery
1444*	Warning	Overload
1445*	Shutdown	Short Circuit
1446*	Shutdown	High AC Voltage
1447*	Shutdown	Low AC Voltage
1448*	Shutdown	Under Frequency
1449*	Warning	Over Frequency
1451*	Warning	Gen/Bus Voltages Out of Calibration
1452*	Warning	Genset Breaker Fail To Close
1453*	Warning	Genset Breaker Fail To Open

Code	Event/Lamp	Displayed Message
1454*	Warning	Genset Breaker Position Contact
1455*	Warning	Utility Breaker Position Contact
1456*	Warning	Bus Out Of Synchronizer Range
1457*	Warning	Fail To Synchronize
1458*	Warning	Sync Phase Rotation Mismatch Overfrequency
1459*	Shutdown	Reverse Power
1461*	Shutdown	Loss of Field (Reverse kVAR)
1463**	Event	Not In Auto
1464**	Warning	Load Dump Fault
1465**	Event	Ready To Load
1469*	Warning	Speed/Hz Mismatch
1471*	Warning	Over Current
1472*	Shutdown	Over Current
1475*	Warning	First Start Backup
1483*	Event	Common Alarm
1517	Shutdown	Failed Module Shutdown
1518	Warning	Failed Module Warning
1519	Warning	At Least One Module Has: Least Severe Fault
1540*	Event	Common Warning
1541*	Event	Common Shutdown
1548	Warning	Inj 7 Solenoid Low Curr
1549	Warning	Inj 8 Solenoid Low Curr
1551	Warning	Inj 7 Solenoid Low Curr
1552	Warning	Inj 7 Solenoid Low Curr
1553	Warning	Inj 7 Solenoid Low Curr
1554	Warning	Inj 7 Solenoid Low Curr
1555	Warning	Inj 7 Solenoid Low Curr
1556	Warning	Inj 7 Solenoid Low Curr
1557	Warning	Inj 7 Solenoid Low Curr
1573*	Event	Configurable Input #1
1597	Warning	ECM Device/Component
1622	Warning	Inj 9 Solenoid Low Curr
1689*	Warning	Real Time Clock Power
1695	Warning	Sensor Supply 5 High
1696	Warning	Sensor Supply 5 Low
1794*	Shutdown with Cooldown	Fire Detected
1843	Warning	Crankcase Press High
1844	Warning	Crankcase Press Low
1845	Warning	H2O In Fuel Sens High
1846	Warning	H2O In Fuel Sens Low

Code	Event/Lamp	Displayed Message
1847*	Shutdown w/Cooldown	Eng Coolant Temp - Shutdown w/Cool
1852*	Warning	Pre-High H2O In Fuel
1853*	Warning	Annunciator Input 1 Fault
1854*	Warning	Annunciator Input 2 Fault
1855*	Warning	Annunciator Input 3 Fault
1866	Warning	EGR DP Autozero Error
1891	Warning	Change Oil
1893	Warning	CAN EGR Valve Comm
1894	Warning	CAN VGT Comm Error
1895	Warning	EGA DL Mismatch Error
1896	Warning	EGR DL Valve Stuck
1899	Warning	Low EGR Dif Pressure
1911	Warning	Inj Metering 1 Press High
1912*	Warning	Utility Loss Of Phase
1913*	Warning	Genset Loss Of Phase
1914*	Warning	Utility Phase Rotation
1915*	Warning	Genset Phase Rotation
1916*	Event	Sync Check OK
1917*	Warning	Fuel Level High
1918*	Shutdown	Fuel Level Low
1933	Warning	High EGR Data Link Volt
1934	Warning	Low EGR Data Link Volt
1935	Warning	EGR DL Cmd Source Err
1942	Warning	THD AZ Error
1944*	Warning	HMI 113 Out Config Error
1961	Warning	High EGR DL EDU Temp
1974	Warning	Crankcase Press High
1978*	Warning	Speed Bias OOR Hi
1979*	Warning	Speed Bias OOR Lo
1992*	Shutdown	Crankcase Sensor High
1999*	Warning	Maximum Parallel Time
2185	Warning	Sensor Supply 4 High
2186	Warning	Sensor Supply 4 Low
2215	Warning	Fuel Pump Press Low
2249	Warning	APC 2 Pressure Low
2261	Warning	Fuel Pump Press High
2262	Warning	Fuel Pump Press Low
2265	Warning	High Fuel Lift Pump Volt
2266	Warning	Low Fuel Lift Pump Volt
2272	Warning	EGR DL POS Sensor Error

Code	Event/Lamp	Displayed Message
2273	Warning	EGR Delta P OOR High Error
2274	Warning	EGR Delta P OOR Low Error
2292	Warning	APC Flow high
2293	Warning	APC Flow Low
2311	Warning	EFI Control Valve Fail
2328*	Event	Utility Available
2331*	Warning	Utility Undervoltage
2332*	Event	Utility Connected
2333*	Event	Genset Connected
2335*	Shutdown	AC Voltage Sensing Lost (Excitation Fault)
2336*	Shutdown	Bad Checksum
2342*	Warning	Too Long In Idle
2349	Warning	EGR DL Motor Open Error
2351	Warning	EGR DL Motor Short Error
2357	Warning	EGR DL Motor Lock Error
2358*	Warning	Utility Overvoltage
2359	Warning	EGR Delta P IR High Error
2375	Warning	EGR Orifice TMPTR OOR High Error
2376	Warning	EGR Orifice TMPTR OOR Low Error
2377	Warning	High Fan Control Voltage
2396*	Warning	Utility Breaker Fail To Close
2397*	Warning	Utility Breaker Fail To Open
2448	Warning	Coolant Level Moderately Low
2539*	Warning	High Voltage Bias
2541*	Warning	Low Voltage Bias
2544	Shutdownw/Cooldown	Over Temperature (ECM Internal temperature Data valid but above normal opertional range Most severe level)
2545*	Warning	Keysw Reset Required
2555	Warning	Low GHC 1 Voltage
2556	Warning	High GHC 1 Voltage
2619*	Warning	Aux101 0 Input 1 Fault
2621*	Warning	Aux101 0 Input 2 Fault
2622*	Warning	Aux101 0 Input 3 Fault
2623*	Warning	Aux101 0 Input 4 Fault
2624*	Warning	Aux101 0 Input 5 Fault
2625*	Warning	Aux101 0 Input 6 Fault
2626*	Warning	Aux101 0 Input 7 Fault
2627*	Warning	Aux101 0 Input 8 Fault
2628	Warning	Aux102 0 Expansion Input 9 Fault
2629	Warning	Aux102 0 Expansion Input 10 Fault
2631	Warning	Aux102 0 Expansion Input 11 Fault

Code	Event/Lamp	Displayed Message
2632	Warning	Aux102 0 Expansion Input 12 Fault
2653*	Warning	Exhaust St 2 Temp High
2657*	Warning	Exhaust St 1 Temp High
2661	Shutdown	At Least One Unacknowledged Most Severe Fault 0 Condition Exists
2662	Warning	At Least One acknowledged: Most Severe Fault
2677*	Shutdown	Fail to Stop (Shutdown)
2678*	Warning	Charging Alternator Fail
2727	Warning	Critical CEN Not Accessible Error
2738	Warning	Ether INJ Low CTRL Error
2739	Warning	Ether INJ High CTRL Error
2774	Warning	EGR DP Clogged Tubes Error
2779*	Event	Utility Unloaded Event
2814*	Shutdown	Genset CT Ratio Low
2815*	Warning	Genset CT Ratio High
2816*	Shutdown	Genset PT Ratio Low
2817*	Warning	Genset PT Ratio High
2818*	Warning	Bus PT Ratio Low
2819*	Warning	Bus PT Ratio High
2821*	Warning	Utility PT Ratio Low
2822*	Warning	Utility PT Ratio High
2882*	Warning	Aux101 1 Input 1 Fault
2883*	Warning	Aux101 1 Input 2 Fault
2884*	Warning	Aux101 1 Input 3 Fault
2885*	Warning	Aux101 1 Input 4 Fault
2886*	Warning	Aux101 1 Input 5 Fault
2887*	Warning	Aux101 1 Input 6 Fault
2888*	Warning	Aux101 1 Input 7 Fault
2889*	Warning	Aux101 1 Input 8 Fault
2891*	Warning	Aux102 1 Expansion Input 9 Fault
2892*	Warning	Aux102 1 Expansion Input 10 Fault
2893*	Warning	Aux102 1 Expansion Input 11 Fault
2894*	Warning	Aux102 1 Expansion Input 12 Fault
2895*	Warning	PCCNet Device Failed
2896*	Shutdown	Critical PCCnet Dev Fail
2914*	Shutdown	Genset AC Meter Failed
2915*	Warning	Gen Bus AC Meter Failed
2916*	Warning	Utility AC Meter Failed
2917*	Warning	Gen Bus Voltage OOR Hi
2918*	Warning	Utility Voltage OOR Hi
2919*	Warning	Utility Current OOR Hi

Code	Event/Lamp	Displayed Message
2921*	Warning	Gen Bus Current OOR Hi
2922*	Warning	High Genset Neutral Curr
2923*	Warning	Gen Bus kW OOR Hi
2924*	Warning	Gen Bus kVAR OOR Hi
2925*	Warning	Gen Bus kVA OOR Hi
2926*	Warning	Utility kW OOR Hi
2927*	Warning	Utility kVAR OOR Hi
2928*	Warning	Utility kVA OOR Hi
2931*	Shutdown	Aux101 Device ID Fault
2934*	Warning	High Ambient Temp
2935*	Warning	Low Ambient Temp
2936*	Warning	Fuel Level High
2937*	Warning	Fuel Level Low
2938*	Warning	Earth/Ground Fault
2939*	Warning	Modbus Failure
2941*	Event	Remote Shutdown Fault Reset Occurrence
2942*	Warning	Shutdown Override Fail
2943*	Warning	Manual Sw Config Fail
2944*	Warning	Auto Switch Config Fail
2945*	Warning	Rupture Basin Switch
2946*	Warning	Exhaust St 2 Temp Low
2947*	Warning	Exhaust St 1 Temp Low
2948*	Warning	Exhaust St 2 Temp High
2949*	Warning	Exhaust St 1 Temp High
2951*	Warning	Alternator 1 Temp High
2952*	Warning	Alternator 1 Temp Low
2953*	Warning	Alternator 1 Temp High
2954*	Warning	Alternator 2 Temp High
2955*	Warning	Alternator 2 Temp Low
2956*	Warning	Alternator 2 Temp High
2957*	Warning	Alternator 3 Temp High
2958*	Warning	Alternator 3 Temp Low
2959*	Warning	Alternator 3 Temp High
2962	Warning	EGR RPM Derate Error
2965*	Event	Genset Available
2967*		Governor Fault
2968*		AVR Fault Failure and Diagnosis
2969*		LON Failure failure and Diagnosis
2971*	Warning	Test/Exercise Fault
2972*	Shutdown	Field Overload
2973	Warning	Charge Press IR Error

Code	Event/Lamp	Displayed Message
2977*	Warning	Low Coolant Level 2 Sw
2978*	Warning	Low Intake Manf 1 Temp
2979*	Warning	High Alternator Temp Sw
2981*	Warning	High Drive Bearing Temp
2982*	Warning	Low Drive Bearing Temp
2983*	Warning	High Drive Bearing Temp
2984*	Warning	High Free Bearing Temp
2985*	Warning	Low Free Bearing Temp
2986*	Warning	High Free Bearing Temp
2992*	Warning	High Intake Manf 1 Temp
2993*	Warning	Battery Charger Sw Fail
3131*	Shutdown	Secondary Engine Overspeed
3226*	Event	Genset is paralleled to utility in base load operation
3397*	Shutdown	Low Gearbox Oil Pressure – Condition Exists
3398*	Shutdown	High Gearbox Oil Pressure – Condition Exists
3399*	Shutdown	Differential Fault – Condition Exists
3411*	Warning	DC Power Supply Fault – Condition Exists
3412*	Warning	GIB Isolator Open Fault – Condition Exists
3413*	Warning	Radiator Fan Trip Fault – Condition Exists
3414*	Warning	Ventilator Fan Trip Fault – Condition Exists
3415*	Warning	Louvres Closed Fault – Condition Exists
3416*	Warning	Start System Fault – Condition Exists
3417*	Warning	Alternator Heater Trip Fault – Condition Exists
3457*	Warning	Loss of Bus Voltage Sensing
3479*	Warning	Start-Inhibit Warning Fault Event
3481*	Warning	Start-Inhibit Warning Fault Event
3482*	Shutdown	Start-Inhibit Shutdown Fault
3483*	Shutdown	High Alternator Temperature 1 Shutdown Fault
3484*	Shutdown	High Alternator Temperature 2 Shutdown Fault
3485*	Shutdown	High Alternator Temperature 3 Shutdown Fault
3486*	Shutdown	High Drive End Bearing Temperature Shutdown Fault
3487*	Shutdown	High Non-Drive End Bearing Temp Shutdown Fault
3513*	Warning	Negative Sequence Overcurrent
3599*	Warning	Ground Current OOR Warning
3611*	Warning	Custom Overcurrent Fault
3629*	Warning	Device Calibration Update Recommended
3631*	Shutdown	Device Calibration Update Required
3641*	Shutdown	Start Enable1 Shutdown Fault
3642*	Shutdown	Start Enable2 Shutdown Fault
3643*	Warning	Start Enable3 Shutdown Fault
4358*	Warning	SetUp Mode Run Fault

Code	Event/Lamp	Displayed Message
4761*	Warning	Genset Voltage Sensing MCB Protection
4766*	Warning	Customer Gas Valve Close
4767*	Warning	Customer Gas Valve Close
4872*	Warning	System Network Failure
4873*	Warning	Genset Failed to Come Online
4874*	Warning	Load Demand SW Version Incompatibility
4875*	Warning	Genset Ineligible for Load Demand
4876*	Warning	Genset Lost on System Network
4877*	Warning	System Settings not Synchronized
4878*	Warning	Check System Network Installation
4879*	Warning	Load Demand Setup Error
4881*	Warning	System Genset ID Conflict
4882*	Warning	Genset Bus Overload
5135*	Warning	Overload Shutdown Fault
5145*	Warning	Load Demand Genset Bus Failure
9945	Warning	Injector 6 Circuit 2 Error
9946	Warning	Injector 5 Circuit 2 Error
9947	Warning	Injector 4 Circuit 2 Error
9948	Warning	Injector 3 Circuit 2 Error
9949	Warning	Injector 2 Circuit 2 Error
9951	Warning	Injector 1 Circuit 2 Error
9954*	Warning	Differential Fault
9955*	Warning	DC Power Supply Fault
9956*	Warning	GIB Isolator Fault
9957*	Warning	Radiator Dan Trip Fault
9958*	Warning	Vent Fan Trip Fault
9959*	Warning	Louvres Closed Fault
9960*	Warning	Start System Fault
9961*	Warning	Alt Heater Trip Fault
9971*	Warning	ECM Derate Fault
9973*	Warning	Watchdog Reset Fault

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7 Alternator Performance Troubleshooting

7.1 No Voltage (No Load)

Possible Causes:

1. Faulty permanent magnet generator, stator or rotor
2. Insulation failure to earth (ground) on permanent magnet stator
3. Voltmeter faulty
4. Loose, broken, or corroded connections
5. Automatic voltage regulator high excitation protection circuit activated, collapsing output voltage
6. Main rectifier diodes short circuit
7. Open circuit in exciter stator windings
8. Faulty automatic voltage regulator
9. Winding fault, open circuit, or short circuit

7.1.1 No Voltage (No Load) - Diagnosis and Repair

1. Faulty permanent magnet generator, stator or rotor
   - Disconnect the permanent magnet generator leads from automatic voltage regulator terminals P2, P3, and P4.
     - Check voltage across leads with a multimeter, with the set running at correct speed.
     - For 50 Hz, voltage should be approximately 160 to 180 VAC.
     - For 60 Hz, voltage should be approximately 190 to 210 VAC.
2. Insulation failure to earth (ground) on permanent magnet stator
   - Disconnect leads P2, P3, P4 and, use insulation test meter to measure the resistance value of the insulation to earth (ground).
3. Voltmeter faulty
   - Check and verify voltage at generator output terminals with a multimeter.
4. Loose, broken, or corroded connections
   - Check all connections, repair and replace where necessary.
5. Automatic voltage regulator high excitation protection circuit activated, collapsing output voltage
   - Automatic voltage regulator protection circuit is factory set to trip at +70 VDC across automatic voltage regulator output, X+ (F1) and XX- (F2), after pre-set time delay.
     - Shut down the alternator, start and run alternator up again. If the voltage builds up normally but collapses again, the protection circuit has operated.

        - Run alternator again and check the excitation voltage across automatic voltage regulator output. If greater than 70 VDC, the protection circuit is operating correctly.

6. Main rectifier diodes short circuit
    - Check diodes.
        - Test diodes on the main rotating rectifier assembly with a multimeter.
7. Open circuit in exciter stator windings
    - Remove external leads from generator. Check the resistance value of the exciter stator across these two leads (approximately 18 to 30 ohms) with a multimeter. Refer to the procedure(s) in the troubleshooting and repair manual for the specific alternator for correct values.
8. Faulty automatic voltage regulator
    - Replace automatic voltage regulator and re-test.
9. Winding fault, open circuit, or short circuit
    - Remove external leads from the alternator.
        - Use appropriate metering equipment (Wheatstone bridge or Kelvin bridge). Measure the low resistance winding of the main rotor and stator.

7.2 Low Voltage (No Load)

Possible Causes:

1. Engine speed low, under frequency roll-off
2. Voltage sensing is faulty
3. Automatic voltage regulator voltage adjustment trim is configured incorrectly
4. Faulty automatic voltage regulator

7.2.1 Low Voltage (No Load) - Diagnosis and Repair

1. Engine speed low, under frequency roll-off
    - Under frequency roll-off protection is activated, indicating low engine speed.
        - Adjust or correct engine speed to an acceptable nominal.
2. Voltage sensing is faulty
    - Check and verify voltage at generator output terminals with a multimeter.
3. Automatic voltage regulator voltage adjustment trim is configured incorrectly
    - With the InPower service tool adjust nominal voltage parameter to the appropriate value for the application level.
4. Faulty automatic voltage regulator
    - Replace automatic voltage regulator and re-test.

7.3 High Voltage (No Load)

Possible Causes:

1. Automatic voltage regulator voltage adjustment trim is configured incorrectly

2. Low sensing supply from main stator
3. Faulty automatic voltage regulator

7.3.1 High Voltage (No Load) - Diagnosis and Repair

1. Automatic voltage regulator voltage adjustment trim is configured incorrectly
   - With the InPower service tool adjust nominal voltage parameter to the appropriate value for the application level.
2. Low sensing supply from main stator
   - Check sensing supply at all of leads of the alternator.
     - Open circuit or low sensing signal will cause the automatic voltage regulator to produce high excitation, this will produce a high output voltage.
3. Faulty automatic voltage regulator
   - Replace automatic voltage regulator and re-test.

7.4 Unstable Voltage (No Load)

Possible Causes:

1. Engine speed hunting (unstable)
2. Automatic voltage regulator parameters configured incorrectly
3. Loose or corroded connections
4. Intermittent earth (ground) on machine

7.4.1 Unstable Voltage (No Load) - Diagnosis and Repair

1. Engine speed hunting (unstable)
   - Check with a frequency meter or tachometer for speed variations due to hunting, or cyclic irregularities in the engine.
     - This may improve as load is applied.
2. Automatic voltage regulator parameters configured incorrectly
   - Adjust automatic voltage regulator gain and/or damping trims to the appropriate value(s).
     - Check again when loaded.
3. Loose or corroded connections
   - Check push on terminals on automatic voltage regulator.
     - Check auxiliary terminals for loose connections.
     - Repair or replace as necessary.
4. Intermittent earth (ground) on machine
   - Use insulation test meter to test all the windings including the exciter stator.
     - Low insulation resistance can affect the automatic voltage regulator.

7.5 Unbalanced Voltage (No Load)

Posible Causes:

1. Fault in the main stator winding

7.5.1 Unbalanced Voltage (No Load) - Diagnosis and Repair

1. Fault in the main stator winding
   - Disconnect all external leads to the alternator and re-test.
     - Separately excite alternator by connecting DC battery supply to the exciter stator leads X+ (F1) and XX- (F2).
     - A winding short will get hot, and engine will sound slightly loaded.
     - Shut down the set and check by hand for hot spots.

7.6 Unbalanced Voltage (With Load)

Possible Causes:

1. Single-phased load current unevenly distributed over the three phases

7.6.1 Unbalanced Voltage (No Load) - Diagnosis and Repair

1. Fault in the main stator winding
   - Disconnect all external leads to the alternator and re-test.
     - Separately excite alternator by connecting DC battery supply to the exciter stator leads X+ (F1) and XX- (F2).
     - A winding short will get hot, and engine will sound slightly loaded.
     - Shut down the set and check by hand for hot spots.

7.7 Unstable Voltage (With Load)

Possible Causes:

1. Engine governing hunting (unstable)
2. Leading power factor load created by power factor correction capacitors
3. Non-linear loads causing interaction between dynamic closed loop control systems
4. Fluctuations in load current (motor starting or reciprocating loads)
5. Automatic voltage regulator parameters configured incorrectly

7.7.1 Unstable Voltage (With Load) - Diagnosis and Repair

1. Engine governing hunting (unstable)
   - Check with frequency meter or tachometer for engine governor hunting, or cyclic irregularities in the engine.
2. Leading power factor load created by power factor correction capacitors
   - Isolate the power factor correction capacitors until sufficient motor load has been applied to counteract the leading power factor.

3. Non-linear loads causing interaction between dynamic closed loop control systems
    - The interaction of the alternator and the engine closed loop systems controls the load.
        - Instability is caused by oversensitive control settings.
        - Adjust automatic voltage regulator to high gain (stability) and load drive system to low gain.
        - Increase engine speed droop to stabilize engine.
        - Contact factory for further advice regarding non-linear loads.
4. Fluctuations in load current (motor starting or reciprocating loads)
    - Check the load current on a stable supply, i.e. mains or separately excite the machine.
        - A variable DC supply is required for on load separate excitation tests.
5. Automatic voltage regulator parameters configured incorrectly
    - With the InPower service tool adjust AVR control parameters, until voltage is stable.

7.8 Poor Voltage Regulation (With Load)

Possible Causes:

1. Large speed droop on engine
2. Unbalanced load
3. Automatic voltage regulator parameters configured incorrectly
4. Voltage drop between alternator and load, caused by losses in supply cable (power losses)
5. Fault on main rectifier or excitation winding
6. Under frequency roll-off protection activated

7.8.1 Poor Voltage Regulation (With Load) - Diagnosis and Repair

1. Large speed droop on engine
    - Check that the speed droop from no load to full load is no greater than 4%.
2. Unbalanced load
    - Check voltage and load current on all phases.
        - If unbalanced, redistribute the load more evenly across the phases.
3. Automatic voltage regulator parameters configured incorrectly
    - With the InPower service tool, adjust automatic voltage regulator control parameters until voltage is stable.
4. Voltage drop between alternator and load, caused by losses in supply cable (power losses)
    - Check the voltage at both ends of the cable run at full load.
        - Large differences in voltages indicate a large volts drop along the cable.
        - A larger diameter cable is required in severe cases.

5. Fault on main rectifier or excitation winding
    - Check the no load excitation voltage across automatic voltage regulator X+ (F1) and XX- (F2).
        - Voltage should be no higher than 12 VDC.
6. Under frequency roll-off protection activated
    - Under frequency roll-off protection is activated, indicating low engine speed.
        - Adjust or correct engine speed to an acceptable nominal.

7.9 Poor Response to Load Surges or Motor Starting (With Load)

Possible Causes:

1. Engine performance
2. Load current surges significantly exceed the full load of the generator
3. Under frequency roll-off protection on automatic voltage regulator operational
4. Voltage drop between alternator and load, caused by power losses in supply cable. This will be worse during current surges (motor starting and etc)
5. Automatic voltage regulator stability controls incorrectly set
6. Fault on windings or rotating rectifier
7. Fault in automatic voltage regulator

7.9.1 Poor Response to Load Surges or Motor Starting (With Load) - Diagnosis and Repair

1. Engine performance
    - Check performance of the engine during application of load.
2. Load current surges significantly exceed the full load of the generator
    - Check surges with clip-on ammeter.
        - Check with factory for advice on voltage dips for motor starting.
3. Under frequency roll-off protectio on automatic voltage regulator operational
    - Check engine speed dip on load application.
        - Low engine speed will activate under frequency roll-off protection circuit.
4. Voltage drop between alternator and load caused by power losses in supply cable. This will be worse during current surges (motor starting and etc)
    - Check the voltage at both ends of the cable run at full load.
        - Differences in voltages indicate a volts drop along the cable.
        - A larger diameter cable may be required in severe cases.
        - This will be worse during current surges (motor starting and etc).
5. Automatic voltage regulator stability controls incorrectly set
    - Automatic voltage regulator gain and/or damping trims to the appropriate value(s).
        - Check again when loaded.

6. Fault on windings or rotating rectifier
   - Check the no load excitation voltage across automatic voltage regulator X+ (F1) and XX- (F2).
     - Voltage should be no higher than 12 VDC.
7. Fault in automatic voltage regulator
   - Replace automatic voltage regulator and re-test when loaded.

7.10 Voltage Collapses (With Load)

Possible Causes:

1. Protection circuit in automatic voltage regulator activated, due to high excitation condition across automatic voltage regulator output, X+ (F1) and XX- (F2)
2. Protection circuit in automatic voltage regulator operated, due to fault in alternator windings or diodes
3. Malfunction of protection circuit in automatic voltage regulator
4. Severe overload or short circuit on across phases

7.10.1 Voltage Collapses (With Load) - Diagnosis and Repair

1. Protection circuit in automatic voltage regulator activated, due to high excitation condition across automatic voltage regulator output, X+ (F1) and XX- (F2)
   - Automatic voltage regulator protection circuit is factory set to trip at +70 VDC across automatic voltage regulator output X+ (F1) and XX- (F2), after pre-set time delay.
     - Shut down and restart the alternator. If the voltage builds up normally but collapses again, the protection circuit has operated.
     - With alternator running, check the excitation voltage across sautomatic voltage regulator output X+ (F1) and XX- (F2). If greater than 70 VDC, the protection circuit is operating correctly.
     - Check load current for overload.
2. Protection circuit in automatic voltage regulator operated, due to fault in alternator windings or diodes
   - Shut down and restart the alternator. If voltage returns as normal, but collapses again when loaded, protection circuit is activated due to high excitation.
     - Remove external leads from the alternator.
     - Use appropriate metering equipment (Wheatstone bridge or Kelvin bridge). Measure the low resistance winding of the main rotor and stator.
     - Check diodes.
     - Test diodes on the main rotating rectifier assembly with a multimeter.
3. Malfunction of protection circuit in automatic voltage regulator
   - Replace automatic voltage regulator and re-test when loaded.
4. Severe overload or short circuit on across phases
   - Check load current with clip-on ammeter.

7.11 High Voltage (With Load)

Possible Causes:

1. Unbalanced load
2. Leading power factor
3. Faulty automatic voltage regulator

7.11.1 High Voltage (With Load) - Diagnosis and Repair

1. Unbalanced load
    - Check voltage on all three phases. If unbalanced, re-distribute loading over the three phases.
2. Leading power factor
    - Check for capacitive (leading) PF load (i.e. kVA correction fluorescent lights).
        - Apply motor (lagging) PF load, or switch off capacitors.
        - A leading power factor load will give abnormally low DC excitation volts across X+ (F1) and XX-(F2).
3. Faulty automatic voltage regulator
    - Replace automatic voltage regulator and re-test.

7.12 Low Voltage (With Load)

Possible Causes:

1. Engine speed droop greater than 4%
2. Under frequency roll-off protection circuit operational
3. Faulty permanent magnet generator stator or rotor
4. Automatic voltage regulator faulty
5. Fault on winding or rotating diodes
6. Voltage drop between alternator and load, due to power losses in the cable

7.12.1 Low Voltage (With Load) - Diagnosis and Repair

1. Engine speed droop greater than 4%
    - Check engine speed at no load and full load.
        - Engine speed droop should be within + 4% and –1% of nominal speed.
        - Reset as necessary.
2. Under frequency roll-off protection circuit operational
    - Under frequency roll-off protection is activated, indicating low engine speed.
        - Adjust or correct engine speed to an acceptable nominal.
3. Faulty permanent magnet generator stator or rotor
    - Disconnect the permanent magnet generator leads from automatic voltage regulator terminals P2, P3, and P4.
        - Check voltage across leads with a multimeter, with the set running at correct speed.

- For 50 Hz, voltage should be approximately 160 to 180 VAC.
- For 60 Hz, voltage should be approximately 190 to 210 VAC.

4. Automatic voltage regulator faulty
   - Replace automatic voltage regulator and re-test.
5. Fault on winding or rotating diodes
   - Any fault in this area will appear as high excitation voltage across X+ (F1) and XX- (F2).
     - Remove external leads from the alternator.
     - Use appropriate metering equipment (Wheatstone bridge or Kelvin bridge). Measure the low resistance winding of the main rotor and stator.
     - Check diodes.
     - Test diodes on the main rotating rectifier assembly with a multimeter.
6. Voltage drop between alternator and load, due to power losses in the cable
   - Check the voltage at both ends of the cable run at full load.
     - Differences in voltage levels indicate a voltage drop along the cable.
     - In severe cases, a larger diameter cable is required.
     - This will be worse during current surges (motor starting and etc).

7.13 Alternator Troubleshooting - HC

7.13.1 Generator Fault Finding

7.13.1.1 Technical Data

NOTICE
Compare measurements with the test certificate supplied with the alternator.

7.13.1.2 Without AVR

NOTICE
Do tests in order, unless stated otherwise. Do method steps in order. Achieve result before doing the next step, unless action (in bold) states otherwise.

TABLE 5. FAULTFINDING: WITHOUT AVR

TEST	METHOD		RESULT and ACTION
1 External Excitation	1	Disconnect the exciter stator positive X+ (F1) lead from the AVR.	-
	2	Disconnect the exciter stator negative XX- (F2) lead from the AVR.	-
	3	Test the resistance across the exciter stator winding between positive and negative leads, with a multimeter.	Resistance of exciter stator winding greater than minimum values (see **Section 7.13.1.1 on page 91**)
	4	Connect an external 24 V variable d.c. source to the exciter stator leads, positive to positive, negative to negative. Test the voltage.	Measured excitation is 12 V d.c. (15 V d.c. for P80) ±10% error.
	5	Run the alternator with no load connected. Test the speed.	Measured speed is within 4% of rated speed.
	6	Test the phase-to-phase and phase-to-neutral voltage at output terminals. Adjust variable d.c. source.	Measured output equal to rated voltage (with same error as excitation), balanced across phases within 1%. Main & exciter stators, main & exciter rotors, and rectifier diodes are functioning correctly. **Go to test 7 AVR Sensing and Power Supply** If unbalanced by more than 1%, **Go to test 2 Main Stator** If balanced within 1%, but output voltage is more than 10% below rated voltage, and test 3 **not** yet done, **Go to test 3 Rectifier** If balanced within 1%, but output voltage is more than 10% below rated voltage, and test 3 already done, **Go to test 4 Exciter Rotor**
2 Main Stator	A fault in the main stator will produce short circuit currents between turns in the windings. Test for symptoms to confirm diagnosis.		
	1	Disconnect main stator leads to exclude external components from the test.	-
	2	Test phase to neutral resistances of main stator windings with a micro ohmmeter.	Resistances of main stator windings dissimilar, and/or less than minimum values (see **Section 7.13.1.1 on page 91**)
	3	Run up the alternator within 4% of nominal speed, no load or excitation. Connect battery to exciter stator (see test 1).	When battery connected to excite alternator, short circuit fault creates heat and burning smell. Engine sound changes with extra slight loading.
	4	-	**Repair or replace faulty main stator winding**
	5	Re-connect main stator leads	**Go to test 1 External Excitation**
3 Rectifier	1	Test the rectifier varistors (see **Section 18.11.6 on page 321**)	Both varistors functioning correctly.
	2	Test the rectifier diodes (see **Section 18.11.6 on page 321**)	All diodes functioning correctly. **Go to test 1 External Excitation**

TEST	METHOD		RESULT and ACTION
4 Exciter Rotor	1	Inspect windings and insulation	Windings are not burnt or damaged.
	2	Disconnect the 6 exciter rotor leads from the a.c. connection studs on the rectifier.	-
	3	Taking 3 leads that were connected to the same rectifier plate, Test the phase-to-phase resistance, with a milliohm meter or micro ohmmeter.	Resistance of each phase pair greater than minimum values (see **Section 7.13.1.1 on page 91**)
	4	Re-connect the exciter rotor leads.	**Go to test 5 Main Rotor**
5 Main Rotor	1	Disconnect a main rotor lead from the connection stud on one of the rectifier plates.	**-**
	2	Test the resistance across the main rotor winding between positive and negative leads, with a multimeter or milliohm meter.	Resistance of main rotor greater than minimum value (see **Section 7.13.1.1 on page 91**)
	3	Re-connect the main rotor lead.	**Go to test 6 Exciter Stator Insulation**
6 Exciter Stator Insulation	Poor insulation of the exciter stator winding can affect AVR performance.		
	1	Test the electrical insulation of the exciter stator winding (see **Section 18.11.8 on page 325**)	Resistance of exciter stator winding to earth is greater than minimum value. **Go to test 7 AVR Sensing and Power Supply**
7 AVR Sensing And Power Supply	Output voltage is sensed at the AVR for closed loop control of the excitation voltage. The alternator wiring diagram shows how sensing leads 6, 7 & 8 (E1, E2, E3) at the output terminals are connected to the AVR, via transformers (as required). AVR power is also taken from the sensing leads or from a permanent magnet generator (PMG).		
	1	Disconnect the sensing and power supply(ies) from the AVR	-
	2	Follow the method of Test 1 to run the alternator with excitation from a battery.	Alternator runs within 4% of rated speed, 10% of rated output voltage, balanced within 1% across phases.
	3	Test the sensing voltage feedback at the AVR terminals. Check circuit between output terminals and AVR.	Measured voltage within range (see AVR instructions), balanced across phases. No wiring or transformer faults.
	4	Disconnect battery, re-connect AVR and run alternator.	**See Faultfinding: self-excited AVR or** **Faultfinding: separately-excited AVR.**

7.13.1.3 Self-excited AVR - OFF LOAD

TABLE 6. FAULTFINDING: SELF-EXCITED AVR - OFF LOAD

SYMPTOM	CAUSE	ACTION
NO VOLTAGE (NO LOAD)	Panel voltmeter is faulty or not connected.	Test voltage at alternator terminals with a multimeter.
	Connections loose, broken or corroded.	Inspect all auxiliary board terminals. Inspect AVR push-on terminals. Repair or renew where necessary.
	No residual magnetism of the laminated steel core of the exciter stator. As alternator starts, residual magnetism gives excitation to provide sufficient sensing voltage (at least 3.5 V) to power a self-excited AVR. Residual magnetism can be lost after • extended storage • reversed magnetic field by 'flashing' with wrong battery polarity • exciter stator rewind • mechanical shock.	Restore magnetism:- 1. run alternator at rated speed, no load 2. attach leads to a 12 volt d.c. battery with a diode in one lead 3. Briefly (maximum one second) connect positive lead to AVR terminal X+ (F1) and negative lead to AVR terminal XX- (F2). • NOTICE: AVR will be destroyed if connected with wrong polarity and no diode.
	Poor electrical insulation of exciter stator	Test the insulation resistance of exciter stator windings. (see **Section 18.11.8 on page 325**)
	Poor electrical insulation of main stator	Test the insulation resistance of main stator windings. (see **Section 18.11.8 on page 325**)
	Short circuit of varistor on rotating rectifier	Test varistors. (see **Section 18.11.6 on page 321**)
	Short circuit of diode(s) on rotating rectifier	Test diodes. (see **Section 18.11.6 on page 321**)
	Winding fault. Open circuit or short circuit on any winding in the machine	Faultfinding without AVR (see **on page 91**)
	AVR fault	Replace AVR and re-test.
	Load applied to machine during run up of engine	The voltage may not build up until the load is disconnected from the machine. Open circuit breaker and re-test.
	No power to AVR from main stator	Test the AVR sensing supply feedback in Faultfinding without AVR (see **on page 91**)

SYMPTOM	CAUSE	ACTION
LOW VOLTAGE (NO LOAD)	Engine speed low.	Test speed with tachometer. Adjust governor control to nominal speed.
	Under frequency protection (UFRO) circuit activated.	Inspect UFRO LED at AVR. If lit, UFRO is activated, indicating low speed. Adjust engine speed, to within -1% to +4% of nominal.
	AVR volts control, or external hand trimmer incorrectly set.	1. Test engine speed is correct with tachometer, and UFRO is OFF. 2. Adjust voltage by AVR volts control, or remote trimmer.
	Panel voltmeter faulty or sticking.	Test voltage at alternator terminals with a multimeter.
	AVR fault.	Replace AVR and re-test.
	Loose broken or corroded connections.	Inspect the wiring for poor connections. Repair or replace where necessary.
	Faulty power to AVR from main stator.	Test the AVR sensing supply feedback in Faultfinding without AVR (see on page 91)
HIGH VOLTAGE (NO LOAD)	Voltage sensing input to AVR is open circuit or too low.	Test the AVR sensing supply feedback in Faultfinding without AVR (see on page 91)
	AVR volts control or external hand trimmer incorrectly set.	1. Test engine speed is correct with tachometer. 2. Adjust voltage by AVR volts control, or remote trimmer.
	Faulty sensing supply circuit transformer (4 or 6 wire alternators) or sensing module (PCB).	Test the AVR sensing supply feedback in Faultfinding without AVR (see on page 91)
	AVR fault.	Replace AVR and re-test.
	Connections loose, broken or corroded.	Inspect all auxiliary board terminals. Inspect AVR push-on terminals. Repair or renew where necessary.
UNSTABLE VOLTAGE (NO LOAD)	Engine governor unstable (hunting).	Test engine speed stability with a frequency meter or tachometer. Sometimes this problem will clear when load is applied.
	AVR stability control incorrectly set.	Inspect AVR stability links, adjust stability potentiometer.
	Connections loose or corroded.	Inspect all auxiliary board terminals. Inspect AVR push-on terminals. Repair or renew where necessary.
	Intermittent earth (low resistance of windings insulation).	Test the insulation resistance of all windings in Faultfinding without AVR (see on page 91)
	AVR components broken or corroded.	Replace AVR and re-test
	Panel voltmeter faulty or vibrating.	Test voltage at alternator terminals with a multimeter.
UNBALANCED VOLTAGE (NO LOAD)	Fault on main stator windings.	Test the main stator windings in Faultfinding without AVR (see on page 91)

7.13.1.4 Self-excited AVR - ON LOAD

TABLE 7. FAULTFINDING: SELF-EXCITED AVR - ON LOAD

SYMPTOM	CAUSE	ACTION
LOW VOLTAGE (ON LOAD)	Engine speed low.	Test speed with tachometer. Adjust governor control to nominal speed.
	Under frequency protection (UFRO) circuit activated.	Inspect UFRO LED at AVR. If lit, UFRO is activated, indicating low speed. Adjust engine speed, to within -1% to +4% of nominal.
	Fault in AVR power supply from main stator.	Separately excite machine as described in Faultfinding without AVR. Test voltage across AVR terminals P2, P3, P4, or 7 & 8. Voltage should be between 190 to 240 V a.c.
	AVR fault.	Replace AVR and re-test.
	Fault on winding or rotating diodes.	Any fault in this area will appear as high excitation voltage across X+ (F1) and XX- (F2). If higher than voltage table, follow Faultfinding without AVR.
	Voltage drop between alternator and load, due to I^2R losses in the cable. This will be worse during current surges (e.g. motor starting).	Test the voltage at both ends of the cable at full load. In severe cases, a larger diameter cable is required.
HIGH VOLTAGE (ON LOAD)	Unbalanced load.	Test voltages on all phases. If unbalanced, re-distribute loading between phases.
	Leading power factor load (capacitor banks).	Test excitation volts across X+, (F1) and XX- (F2). A leading power factor will give an abnormally LOW d.c. excitation. Remove power factor correction capacitors from system at low load.
	Parallel droop current transformer reversed.	Check for droop reversal in Faultfinding Parallel Operation (see Section 7.13.1.7 on page 104)
UNSTABLE VOLTAGE (ON LOAD).	Engine governor unstable (hunting)	Test engine speed stability with a frequency meter or tachometer for governor hunting, or cyclic irregularities in the engine.
	Leading power factor load created by power factor correction capacitors.	Isolate the power factor correction capacitors until sufficient inductive load has been applied.
	Fluctuations in load current (motor starting, or reciprocating loads).	Test the load current on a stable supply, i.e. mains, or Faultfinding without AVR (see on page 91) using a variable d.c. supply.
	Non-linear load creating waveform distortion. (Contact factory for further information on non-linear loads).	Use a separately-excited AVR control system.
	AVR stability control incorrectly adjusted.	Adjust AVR control, until voltage is stable.
UNBALANCED VOLTAGE (ON LOAD)	Single-phase loads (phase - neutral) unevenly distributed over the three phases.	Test current in each phase with clamp ammeter. The full load rated current must NOT be exceeded on any individual phase. Re-distribute load if necessary.

SYMPTOM	CAUSE	ACTION
POOR VOLTAGE REGULATION (ON LOAD)	Large speed droop on engine. AVR UFRO protection activated.	Test the speed droop from no load to full load is no greater than 4%. Inspect AVR LED, if LIT increase engine speed.
	Unbalanced load.	Test voltage and load current on all phases. If unbalanced, redistribute the load more evenly across the phases.
	Parallel droop circuit incorrectly adjusted, or requires shorting switch for single running.	The droop circuit will give additional voltage droop of -3% at full load 0.8 power factor. For single running machines this can be removed by fitting a shorting switch across the droop CT input, (S1 – S2), on the AVR.
	Voltage drop between alternator and load, due to I^2R losses in the cable. This will be worse during current surges (e.g. motor starting).	Test the voltage at both ends of the cable when run at full load. In severe cases, a larger diameter cable is required.
	Fault on rectifier or excitation winding.	Test the no load excitation volts across AVR X+ (F1) and XX- (F2). If higher than 12V d.c., see Faultfinding without AVR (see on page 91)
	AVR Under frequency protection circuit (UFRO) activated.	Inspect UFRO LED at AVR. If lit, UFRO is activated, indicating low speed. Test speed with tachometer and adjust to correct nominal speed, (or frequency).

SYMPTOM	CAUSE	ACTION
POOR VOLTAGE RESPONSE TO LOAD SURGES OR MOTOR STARTING	Engine governor sticking or slow to respond. AVR 'UFRO' protection activated.	Check performance of engine during application of load. Check if AVR LED is lit during motor starting. Check if AVR 'DIP' or 'DWELL' circuits are activated. Adjust as necessary. (See AVR instruction sheet).
	AVR 'UFRO' protection activated.	Test the speed droop from no load to full load is no greater than 4%. Inspect AVR LED. If lit, increase engine speed.
	Parallel droop circuit incorrectly set.	Too much droop will increase voltage dips when motor starting. Fit shorting switch for single running alternators. See Faultfinding Parallel Operation (Section 7.13.1.7 on page 104)
	Load surges cause current to exceed 2.5 times the full load current.	Test current with a clamp ammeter. Voltage dip may be excessive if the current exceeds 2.5 times full load. Refer to factory for motor starting calculations.
	Voltage drop between alternator and load, due to I^2R losses in the cable. This will be worse during current surges (e.g. motor starting).	Test the voltage at both ends of the cable at full load. In severe cases, a larger diameter cable is required.
	Motor contactors dropping out during starting, (large current surges, voltage dips greater than 30%).	All causes and actions in this section may apply to this problem. Refer to factory for typical voltage dips.
	AVR stability control incorrectly adjusted.	Set AVR stability control for optimum performance. Adjust anticlockwise until voltage is unstable, then slightly clockwise until stable.
	Fault on windings or rotating rectifier.	Any fault in this area will appear as high excitation voltage across X+ (F1) and XX- (F2) in Faultfinding without AVR (see on page 91)
	Engine relief circuit activated during motor starting.	Check if AVR 'DIP' or 'DWELL' engine relief circuits are activated. Adjust as necessary. See AVR instructions for details.
	AVR fault.	Replace and re-test on load.

7.13.1.5 Separately-Excited AVR - OFF load

TABLE 8. FAULTFINDING: SEPARATELY-EXCITED AVR - OFF LOAD

SYMPTOM	CAUSE	ACTION
NO VOLTAGE (NO LOAD)	Faulty permanent magnet generator (PMG), stator or rotor .	Disconnect the PMG leads from AVR terminals P2, P3, P4. Run the alternator at rated speed. Test the phase-to-phase voltage at P2, P3 & P4 leads of the PMG with an r.m.s. measuring instrument. Measured voltage 170 to 195 V a.c. (at 50 Hz), 204 to 234 V a.c. (at 60 Hz), balanced within 5% across phases. (Refer to factory for latest voltage ranges in design data specification DD-15590) Test the phase-to-phase resistance of the PMG stator windings with a multimeter. Resistance to be within 10% of expected value (see **Section 7.13.1.1 on page 91**), balanced across phases. Replace or re-test according to PMG Fault Diagnosis table below.
	Insulation failure to earth (ground) on PMG stator.	Test the insulation resistance of PMG stator windings. (see **Section 18.11.8 on page 325**)
	Panel voltmeter faulty.	Test voltage at alternator terminals with a multimeter.
	Connections loose, broken or corroded.	Inspect AVR push-on terminals. Repair or renew where necessary.
	AVR high excitation protection circuit activated, collapsing output voltage. AVR protection circuit is factory set to trip (refer to AVR data sheet for voltage set point) across AVR output X+ (F1), & XX- (F2), after pre-set time delay.	Check AVR LED. If lit, protection circuit is activated. Shut down engine, and re-start. If the voltage builds up normally but collapses again, the protection circuit has operated, & AVR LED will be lit. Run again & check the excitation voltage across AVR X+ (F1) and XX- (F2). If greater than voltage set point, the protection circuit is operating correctly. Follow Faultfinding without AVR see (**Section 7.13.1.2**) to find cause of high excitation volts.
	Short circuit of varistor on rotating rectifier	Test varistors. (see **Section 18.11.6 on page 321**)
	Short circuit of diode(s) on rotating rectifier.	Test diodes. (see **Section 18.11.6 on page 321**)
	Open circuit in exciter stator windings	Faultfinding without AVR (see **Section 7.13.1.2 on page 91**
	AVR fault	Replace AVR and re-test.
	Winding fault. Open circuit or short circuit on any winding in the machine	Faultfinding without AVR (see **Section 7.13.1.2 on page 91**)

SYMPTOM	CAUSE	ACTION
LOW VOLTAGE (NO LOAD)	Engine speed low	Test speed with tachometer. Adjust governor control to nominal speed.
	Under frequency protection (UFRO) circuit activated	Inspect UFRO LED at AVR. If lit, UFRO is activated, indicating low speed. Adjust engine speed to within –1% to +4% of nominal.
	AVR volts control or external hand trimmer incorrectly set	1. Test engine speed is correct with tachometer, and UFRO is OFF. 2. Adjust voltage by AVR volts control, or remote trimmer.
	Panel voltmeter faulty or 'sticking'	Test voltage at alternator terminals with a multimeter.
	AVR fault.	Replace AVR and re-test.
HIGH VOLTAGE (NO LOAD)	AVR volts control or external trimmer incorrectly set.	1. Test engine speed is correct with tachometer, and UFRO is OFF. 2. Adjust voltage by AVR volts control, or remote trimmer.
	Voltage sensing input to AVR is open circuit or too low.	Test the AVR sensing supply feedback in Faultfinding without AVR (see Section 7.13.1.2 on page 91)
	Faulty AVR.	Replace AVR and retest.
UNSTABLE VOLTAGE (NO LOAD)	Engine speed hunting (unstable).	Test engine speed stability with a frequency meter or tachometer. Sometimes this problem will clear when load is applied.
	AVR stability control incorrectly adjusted.	Inspect AVR stability links or selection, adjust stability potentiometer. Check again on load.
	Connections loose or corroded.	Inspect all auxiliary board terminals. Inspect AVR push-on terminals. Repair or renew where necessary.
	Intermittent earth (ground) (low resistance of windings insulation).	Test the insulation resistance of all windings in Faultfinding without AVR (see Section 7.13.1.2 on page 91)
UNBALANCED VOLTAGE (NO LOAD)	Fault in main stator winding.	Test the main stator windings in Faultfinding without AVR (see Section 7.13.1.2)

TABLE 9. PMG FAULT DIAGNOSIS

PMG stator voltage		PMG stator phase-to-phase resistance	
		In range & balanced	Out of range or unbalanced
In range	Balanced	No fault	Re-test resistance
	Unbalanced	Check connector	Replace PMG stator
Out of range	Balanced	Replace PMG rotor	Replace PMG stator
	Unbalanced	Check connector	Replace PMG stator

7.13.1.6 Separately-Excited AVR - ON load

TABLE 10. FAULTFINDING: SEPARATELY-EXCITED AVR - ON LOAD

SYMPTOM	CAUSE	ACTION
LOW VOLTAGE (ON LOAD)	Engine speed low.	Test speed with tachometer. Adjust governor control to nominal speed.
	Under frequency protection (UFRO) circuit activated .	Inspect UFRO LED at AVR. If lit, UFRO is activated, indicating low speed. Adjust engine speed, to within -1% to +4% of nominal.
	Faulty permanent magnet generator (PMG) stator or rotor.	Disconnect the PMG leads from AVR terminals P2, P3, P4. Check voltage across leads with a Multimeter, with the set running at correct speed. For 50Hz, Voltage across P2, P3 and P4 should be approx. 160VAC – 180VAC. For 60Hz, Voltage is approx. 190VAC – 210VAC.
	AVR fault.	Replace AVR and re-test.
	Fault on winding or rotating diodes.	Any fault in this area will appear as high excitation voltage across X+ (F1) and XX- (F2). See Faultfinding without AVR (see **Section 7.13.1.2 on page 91**)
	Voltage drop between alternator and load, due to I^2R losses in the cable. This will be worse during current surges (e.g. motor starting).	Test the voltage at both ends of the cable at full load. In severe cases, a larger diameter cable is required.
HIGH VOLTAGE (ON LOAD)	Unbalanced load.	Test voltages on all phases. If unbalanced, re-distribute loading between phases.
	Leading Power Factor Load.	Test excitation volts across X+, (F1) and XX- (F2). A leading power factor will give an abnormally LOW d.c. excitation. Remove power factor correction capacitors from system at low load.
	Parallel droop transformer reversed.	Check for droop reversal. See Faultfinding Parallel Operation (**Section 7.13.1.7 on page 104**)

SYMPTOM	CAUSE	ACTION
UNSTABLE VOLTAGE (ON LOAD)	Engine governing unstable (hunting)	Test engine speed stability with a frequency meter or tachometer for governor hunting, or cyclic irregularities in the engine.
	Leading power factor load created by power factor correction capacitors.	Isolate the power factor correction capacitors until sufficient motor load has been applied.
	Non linear loads, causing interaction between dynamic closed loop control systems.	Interaction of closed loop systems controlling the load, the alternator and the engine. Instability is caused by oversensitive control settings. Try different settings of AVR stability, including changing the link to a smaller of larger kW range. Involve designers of the non-linear load to modify their control loop settings. Increase engine speed 'droop' to stabilize engine. Contact factory for further advice regarding non-linear loads.
	Fluctuations in load current, (motor starting, or reciprocating loads).	Test the load current on a stable supply, i.e. mains, or see Faultfinding without AVR using a variable d.c. supply (**Section 7.13.1.2 on page 91**)
	AVR stability control incorrectly adjusted.	Adjust AVR stability control, until voltage is stable.
UNBALANCED VOLTAGE (ON LOAD)	Single-phase loads (phase - neutral) unevenly distributed over the three phases.	Test current in each phase with clamp ammeter. The full load rated current must NOT be exceeded on any individual phase. Re-distribute load if necessary.
POOR VOLTAGE REGULATION (ON LOAD)	Large speed droop on engine. AVR UFRO protection activated.	Test the speed droop from no load to full load is no greater than 4%. Inspect AVR LED. If lit, increase engine speed.
	Unbalanced load.	Check voltage and load current on all phases. If unbalanced, redistribute the load more evenly across the phases.
	Parallel droop circuit incorrectly adjusted, or requires shorting switch for single running.	The droop circuit will give additional voltage droop of -3% at full load 0.8 power factor. For single running machines this can be improved by fitting a shorting switch across the droop CT input, (S1 – S2), on the AVR.
	Voltage drop between alternator and load, caused by losses in supply cable, (I^2R losses).	Test the voltage at both ends of the cable run at full load. In severe cases, a larger diameter cable is required.
	AVR stability control incorrectly adjusted.	Adjust AVR control, until voltage is stable.
	Fault on rectifier or excitation winding.	Test the no load excitation volts across AVR X+ (F1) and XX- (F2). If higher than 12V dc, see Faultfinding without AVR (**Section 7.13.1.2**)
	Under frequency protection (UFRO) activated.	Inspect UFRO LED at AVR. If lit, UFRO is activated, indicating low speed. Test speed with tachometer and adjust to correct nominal speed, (or frequency).

SYMPTOM	CAUSE	ACTION
POOR VOLTAGE RESPONSE TO LOAD SURGES OR MOTOR STARTING	Engine governor sticking or slow to respond.	Check performance of engine during application of load. Check if AVR LED is lit during motor starting. Check if AVR 'DIP' or 'DWELL' circuits are activated. Adjust as necessary. (See AVR instruction sheet).
	AVR 'UFRO' protection activated.	Test the speed droop from no load to full load is no greater than 4%. Inspect AVR LED. If lit, increase engine speed.
	Parallel droop circuit incorrectly set.	Too much droop will increase voltage dips when motor starting. Fit shorting switch for single running alternators. See Faultfinding Parallel Operation (**Section 7.13.1.7 on page 104**)
	Load surges cause current to exceed 2.5 times the full load current.	Test current with a clamp ammeter. Voltage dip may be excessive if the current exceeds 2.5 times full load. Refer to factory for motor starting calculations.
	Voltage drop between alternator and load, caused by I^2R losses in supply cable. This will be worse during current surges (e.g. motor starting).	Test the voltage at both ends of the cable at full load. In severe cases, a larger diameter cable is required.
	Motor contactors dropping out during starting, (large current surges, voltage dips greater than 30%).	All causes and actions in this section may apply to this problem. Refer to factory for typical voltage dips.
	AVR stability control incorrectly adjusted.	Set AVR stability control for optimum performance. Adjust anticlockwise until voltage is unstable, then slightly clockwise until stable.
	Fault on windings or rotating rectifier.	Any fault in this area will appear as high excitation voltage across X+ (F1) and XX- (F2). If higher than 12V d.c., see Faultfinding without AVR (**Section 7.13.1.2 on page 91**)
	Engine relief circuit activated during motor starting.	Check if AVR 'DIP' or 'DWELL' engine relief circuits are activated. Adjust as necessary. See AVR instructions for details.
	AVR fault.	Replace and re-test on load.
VOLTAGE COLLAPSES (ON LOAD)	Protection circuit in AVR activated, due to high excitation condition across AVR output, (X+ (F1) and XX- (F2).	Excitation volts higher than 70V d.c. Test voltage across X+ (F1) and XX- (F2) on load. Ensure engine speed is correct at full load. Check output voltage, ensure it does not exceed the rated voltage. Check load current for overload.
	Protection circuit in AVR operated, due to fault in alternator windings or diodes.	Check AVR LED. if lit, protection circuit is activated. Shut down engine, and re-start. If voltage returns as normal, but collapses again on load, protection circuit is activated, due to high excitation. Follow Faultfinding without AVR to find cause of high excitation volts.
	AVR fault.	Replace AVR and re-test on load.
	Severe overload or short circuit across phases.	Check load current with clamp ammeter.

7.13.1.7 Parallel Operation

TABLE 11. FAULTFINDING: PARALLEL OPERATION

SYMPTOM	CAUSE	ACTION
CIRCUIT BREAKER WILL NOT CLOSE WHEN ATTEMPTING PARALLEL OPERATION	Circuit breaker fitted with ‘Check Synchronizing’ protection, which prevents out of phase synchronizing.	Ensure that the synchroscope is indicating that machines are IN PHASE, or close to the eleven o'clock position, (when rotating in a clockwise direction). Ensure that the speed difference between the incoming set and the bus bar is small enough to prevent rapid rotation of the synchroscope, (or rapid fluctuations of the lights), before closing circuit breaker.
	Phase rotation of alternators differs.	DO NOT ATTEMPT TO PARALLEL until the phase rotation of all alternators are identical. Check the phase rotation of each alternator. Exchange the connections of two of the phases to reverse the phase rotation of an alternator.
	Voltage difference too high between the incoming alternator and the bus bar.	The voltage on the incoming set can be up to 4% higher than the bus bar voltage. THIS IS NORMAL. Do not adjust original no-load Voltage settings. If difference is greater than 4%, check for excessive droop on the loaded alternator(s).
UNSTABLE IN-PHASE CONDITION, BEFORE SYNCHRONIZING	Governor drift on one or more of the engines.	Let engines warm up and stabilize before paralleling. If speed is still drifting check governors and engine condition.
	Load variation on the bus bar causing speed/ frequency changes on the loaded alternator when synchronizing.	Disconnect any rapidly varying load. Check that there is no likelihood of a motor or automatic load starting when attempting to synchronize. DO NOT attempt to parallel if the load current is unstable.
UNSTABLE FREQUENCY IN PARALLEL WHEN ON LOAD	Engine speed droop too ‘tight’ or cyclic irregularities (instability) between the engines. (Check kW meters for rapid shifting of kW power between sets).	Increase the engine governor speed droop to 4% (no load to full load). Check for "sticky" governors on a new engine. Check engines for cyclic problems, (firing, out of balance, etc),
STABLE VOLTAGE BEFORE AND AFTER BUT UNSTABLE WHILE SYNCHRONIZING	Usually results from ‘pick- up’ through the synchronizing panel and/or earth leakage protection circuits that can form a temporary ‘closed loop’ link between the alternators during synchronisation.	The fluctuation will decay when the alternators approach synchronizm, (almost identical speeds), and will disappear completely when the circuit breaker is closed. The synchronizing equipment, earth leakage protection, and/or wiring circuits in the switchboard can produce temporary pickup problems.

SYMPTOM	CAUSE	ACTION
CURRENT UNCONTROLLED, RISES FAST WHEN CIRCUIT BREAKER CLOSED	Parallel droop equipment reversed on one of the alternators.	Check the droop CTs for reversal. Reverse lead S1-S2 on the droop CT. Test excitation volts - the alternator with reversed droop will have highest excitation volts.
STABLE CIRCULATING CURRENT ON ALL ALTERNATORS, NOT REDUCED BY VOLTAGE ADJUSTMENT	Parallel droop reversed on ALL alternators.	Check droops for reversal. Reverse leads S1–S2 to correct. This repeated wiring error will result in a stable circulating current which cannot be adjusted out by normal means.
STABLE CIRCULATING CURRENT ON BOTH ALTERNATORS AT NO LOAD	Voltage difference (excitation level) between the alternators.	Check Voltages at no load, (identical frequencies), and ensure all alternators have identical voltages. Do not adjust when load sharing.
	Parallel droop equipment reversed on BOTH alternators. (Unlike ONE droop reversal, which is a highly UNSTABLE condition).	Check ALL droop CTs for reversal.
	Incorrect setting of parallel droop equipment.	Check settings of droop trimmers. Check droop CTs are in correct phase. Check CT output to AVR S1-S2 is correct.
UNBALANCED POWER ON KILOWATT METERS	Engines not sharing the power (kW) equally.	Adjust the governor droop of the engines to equalize the kilowatt sharing.
UNBALANCED CURRENT ON AMMETERS AFTER EQUILIZING KILOWATTS	Voltage difference (excitation levels) between the machines.	Test the machines individually for exact voltage at no load.
	Parallel droop equipment incorrectly adjusted.	Adjust as stated in previous text.
UNBALANCED POWER AS LOAD INCREASED OR DECREASED	Engine governors are incompatible, or new governors 'sticking', causing unequal kW sharing over load range variations.	The engine governors must be adjusted to give similar no load to full load characteristics. Check for 'sticky' governors on new or repainted engines. Electronic governors should be set with a minimum 2% speed droop to ensure satisfactory kilowatt load sharing. If tighter speed regulation is required, an Isochronous Load Sharing system should be installed.
INCREASING UNBALANCED CURRENT AS LOAD INCREASED	Difference in parallel droop level settings. Difference in no load to full load voltage regulation of AVRs. These settings are the major contributing factors to the load/voltage characteristics of the machine, and therefore must be set to give equal characteristics to the machines with which it is paralleled.	Run each alternator individually, and apply load at approximately 25%, 50% & 100% of full load. Test voltage at each load and compare values with the other alternators. Adjust control systems to remove regulation differences. Repeat method with as much inductive load as possible i.e. motors, transformers etc. Adjust the parallel droop trimmers, to achieve equal inductive load sharing.

SYMPTOM	CAUSE	ACTION
POOR VOLTAGE REGULATION WHEN MACHINE RUNNING ALONE	Excess amount of parallel droop in circuit.	For normal voltage regulation as a single running machine, a shorting switch should be fitted across the parallel droop transformer. (S1-S2). This should be clearly marked 'Single' and 'Parallel' operation on the panel.
UNBALANCED POWER, ENGINES 'ROCK' ON MOUNTS	Electronic engine governor speed 'droop' characteristics are set too tight.	At least 2% engine droop is essential for kW (Active current) sharing. If 1% or less speed regulation is required, an electronic governing and Isochronous Load Sharing system should be installed.

7.13.1.8 AVR Fault Finding

This section has general advice to diagnose faults on AVRs. Further troubleshooting guidance is given in the Specification, Installation and Adjustments instructions or the Instruction Manual specific to the AVR model. The AVR has a protection circuit which operates under fault conditions after about 8 seconds (exact delay depends on AVR type). The circuit removes the alternator excitation, causing output voltage to collapse, and latches until the alternator is stopped and restarted. The system designer must make sure that this feature is compatible with the overall system protection.

Symptom	Action
VOLTAGE DOES NOT INCREASE WHEN STARTING	Check link K1:K2 on AVR or auxiliary terminals. Replace if necessary and restart.
VOLTAGE INCREASES WHEN STARTING TO WRONG VALUE	Check AVR volts control potentiometer setting. Correct if necessary. Check 'Hand Trimmer' if fitted. Adjust if necessary. Check alternator speed. Correct if necessary and restart. Check AVR 'UFRO' indicator. If illuminated, see UFRO Setting Procedure.
VOLTAGE INCREASES VERY SLOWLY WHEN STARTING	Check alternator accelerates as expected. Correct if necessary and restart. Check setting of adjustable ramp. Correct if necessary and restart.
VOLTAGE INCREASES TO HIGH VALUE WHEN STARTING	Check AVR wiring with wiring diagram.
VOLTAGE INCREASES TO HIGH VALUE THEN FALLS TO LOW VALUE WHEN STARTING	Check AVR wiring with wiring diagram.
VOLTAGE NORMAL THEN FALLS TO LOW VALUE WHEN RUNNING	Check alternator loading Check rectifier system (see Service and Maintenance chapter)
VOLTAGE UNSTABLE EITHER WHEN RUNNING NO-LOAD OR ON-LOAD	Check that the alternator speed is stable. Correct if necessary and restart. Check AVR wiring with wiring diagram. Adjust the AVR stability control slowly clockwise until steady.
VOLTAGE FALLS TO LOW VALUE WHEN LOAD APPLIED	Check alternator speed is not dropping as load is applied. Correct if necessary and restart. Check AVR 'UFRO' indicator. If it illuminates as load is applied, see UFRO Setting Procedure.

If all the tests and checks listed above fail to locate the alternator fault then it must be assumed that the AVR is faulty. There are no serviceable items in the AVR.

The AVR should be replaced only by a genuine STAMFORD part.

7.13.1.8.1 UFRO Setting Procedure

1. Stop the alternator.
2. Check that the AVR UFRO selection link is set for the required operation frequency.
3. Start the alternator set and run it with no load at rated speed.
4. If the voltage is now correct and the UFRO indicator is not illuminated, return to the fault finding procedure.
5. If the UFRO LED indicator is illuminated, continue as follows.
6. Adjust the UFRO control fully clockwise.
7. Set the alternator speed to the desired UFRO threshold (typically 95% of rated speed).
8. Adjust the UFRO control slowly counter-clockwise until the UFRO indicator illuminates.
9. Return the control slightly clockwise until the indicator turns off.
10. The UFRO setting is now correct - return to the fault finding procedure.

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8 Auxilliary Codes-101

8.1 Code 1667 – AUX 101 Exhaust Temperature OOR (Warning)

Logic:

Exhaust gas temperature sensor signal is out of range – shorted high.

Possible Causes:

1. Faulty exhaust gas temperature sensor connections
2. Faulty exhaust gas temperature sensor
3. Faulty engine harness
4. Faulty extension harness
5. Verify the calibrations in the ECM and the PCC control

Diagnosis and Repair:

1. Faulty exhaust gas temperature sensor connections
    a. Inspect the exhaust gas temperature sensor and the engine harness connector pins.
        a. Disconnect the engine harness connector from the exhaust gas temperature sensor.
        b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
        c. Inspect for evidence of moisture in or on the connector.
        d. Inspect for missing or damaged connector seals.
        e. Inspect for dirt or debris in or on the connector pins.
2. Faulty exhaust gas temperature sensor
    a. Active Sensor.
        a. Check the exhaust gas temperature sensor supply voltage.
            a. Disconnect the engine harness connector from the exhaust gas temperature sensor.
            b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.
            c. Measure the supply voltage by connecting the breakout cable's supply and return connectors to the multimeter. If the reading is between 4.75 and 5.25 VDC, then the supply voltage is correct.
        b. Check exhaust gas temperature sensor signal (sense) voltage.
            a. Disconnect the engine harness connector from the exhaust gas temperature sensor.
            b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.

c. Measure the signal voltage by connecting the breakout cable's signal and return connectors to the multimeter. If the reading is between 0.46 and 4.56 V, then the signal voltage is correct. If not, sensor is faulty.

3. Faulty engine harness
   a. Inspect the engine harness and the connector pins.
      a. Disconnect the engine harness connector from the extension harness.
      b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
      c. Inspect for evidence of moisture in or on the connector.
      d. Inspect for missing or damaged connector seals.
      e. Inspect for dirt or debris in or on the connector pin.
   b. Check for a short circuit from pin to pin.
      a. Disconnect the engine harness from the extension harness.
      b. Disconnect the engine harness connector from the exhaust gas temperature sensor.
      c. Disconnect the engine harness from all sensors that have a shared supply or return with the fuel pressure sensor.
      d. Measure the resistance from the exhaust gas temperature 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.
      e. Measure the resistance from the exhaust gas temperature sensor pin on the engine harness inline connector to all other pins in the engine harness inline connector.
      f. Measure the resistance from the exhaust gas temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
      g. If all measurements are greater than 100k ohms, then the resistance is correct.
   c. Check for an open circuit.
      a. Disconnect the engine harness from the extension harness.
      b. Disconnect the engine harness connector from the exhaust gas temperature sensor.
      c. Measure the resistance from the exhaust gas temperature return pin on the engine harness inline connector to the exhaust gas temperature return pin on the engine harness sensor connector.
      d. If the measurement is less than 10 ohms, then the resistance is correct.
4. Faulty extension harness
   a. Inspect the extension harness and the control connector pins.
      a. Disconnect the extension harness connector from the control.
      b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
      c. Inspect for evidence of moisture in or on the connector.
      d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pins.

b. Check for an open circuit.

a. Disconnect the extension harness connector from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the exhaust gas temperature return pin on the extension harness connector to the exhaust gas temperature return pin on the extension harness inline connection.

d. If the measurement is less than 10 ohms, then the resistance is correct.

c. Check for a short circuit from pin to pin.

a. Disconnect the extension harness connector from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the exhaust gas temperature 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the exhaust gas temperature return pin on the extension harness connector to all other pins in the extension harness connector.

e. Measure the resistance from the exhaust gas temperature signal pin on the extension harness connector to all other pins in the extension harness connector.

f. If all measurements are greater than 100k ohms, then the resistance is correct.

5. Verify the calibrations in the ECM and the PCC control

a. Using the display or the InPower Service tool, verify the calibration in the PCC control.

a. If the calibration in the PCC control matches the latest calibration on the InCal website, then the calibration is correct. If it does not, update the calibration to the latest.

b. Using the InSite Service tool, verify the calibration in the ECM.

a. If the calibration in the ECM matches the latest calibration on QSOL, then the calibration is correct. If it does not, update the ECM to the latest calibration.

8.2 Code 2112 – AUX 101 Coolant Inlet Temperature ORR (Warning)

Logic:

Coolant temperature sensor voltage is out of range.

Possible Causes:

1. Faulty coolant temperature sensor connections
2. Faulty coolant temperature sensor
3. Improper wiring
4. Verify controller calibrations

Diagnosis and Repair:

1. Faulty coolant temperature sensor connections
   a. Inspect the coolant temperature sensor and the engine harness connector pins.
      a. Disconnect the engine harness connector from the coolant temperature sensor.
      b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
      c. Inspect for evidence of moisture in or on the connector.
      d. Inspect for missing or damaged connector seals.
      e. Inspect for dirt or debris in or on the connector pins.
2. Faulty coolant temperature sensor
   a. Check the resistance of the sensor
      a. Disconnect the engine harness connector from the coolant temperature sensor.
      b. Measure the resistance between the coolant temperature sensor signal pin and the coolant temperature sensor return pin.
3. Improper wiring
   a. Check wiring. Ensure wiring from the coolant temperature sensor is connected to the correct Aux 101 input.
   b. Check wires for breaks or abrasions.
   c. Check wires for moisture and debris at connection points.
4. Verify controller calibrations
   a. Using the display or the InPower Service tool, verify the calibration in the PCC control.
      a. If the calibration in the PCC control matches the latest calibration on the InCal website, then the calibration is correct. If it does not, update the calibration to the latest.
   b. Using the InSite Service tool, verify the calibration in the ECM.
      a. If the calibration in the ECM matches the latest calibration on QSOL, then the calibration is correct. If it does not, update the ECM to the latest calibration.

8.3 Fault Code 2224 - AUX 101 Fuel Level ORR (Warning)

Fuel level sensor voltage is out of range.

Possible Causes:

1. Faulty fuel level sensor connections
2. Faulty fuel level sensor
3. Improper wiring
4. Verify controller calibrations

8.4 Code 2398 – AUX 101 Ambient Temperature ORR (Warning)

Logic:

Ambient temperature sensor voltage is out of range.

Possible Causes:

1. Faulty ambient temperature sensor connections
2. Faulty ambient temperature sensor
3. Improper wiring
4. Verify controller calibrations

Diagnosis and Repair:

1. Faulty ambient temperature sensor connections
    a. Inspect the ambient temperature sensor and the engine harness connector pins.
        a. Disconnect the engine harness connector from the ambient temperature sensor.
        b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
        c. Inspect for evidence of moisture in or on the connector.
        d. Inspect for missing or damaged connector seals.
        e. Inspect for dirt or debris in or on the connector pins.
2. Faulty ambient temperature sensor
    a. Check the resistance of the sensor.
        a. Disconnect the engine harness connector from the ambient temperature sensor.
        b. Measure the resistance between the ambient temperature sensor signal pin and the ambient temperature sensor return pin.
3. Improper wiring
    a. Check wiring. Ensure wiring from the coolant temperature sensor is connected to the correct Aux 101 input.
    b. Check wires for breaks or abrasions.
    c. Check wires for moisture and debris at connection points.
4. Verify controller calibrations
    a. Using the display or the InPower Service tool, verify the calibration in the PCC control.
        a. If the calibration in the PCC control matches the latest calibration on the InCal website, then the calibration is correct. If it does not, update the calibration to the latest.
    b. Using the InSite Service tool, verify the calibration in the ECM.
        a. If the calibration in the ECM matches the latest calibration on QSOL, then the calibration is correct. If it does not, update the ECM to the latest calibration.

8.5 Code 2542 – AUX 101 Voltage Bias ORR (Warning)

Logic:

Fuel level sensor voltage is out of range.

Possible Causes:

1. Faulty fuel level sensor connections
2. Faulty fuel level sensor
3. Improper wiring
4. Verify controller calibrations

Diagnosis and Repair:

1. Faulty fuel level sensor connections
    a. Inspect the fuel level sensor and the engine harness connector pins.
        a. Disconnect the engine harness connector from the fuel level sensor.
        b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
        c. Inspect for evidence of moisture in or on the connector.
        d. Inspect for missing or damaged connector seals.
        e. Inspect for dirt or debris in or on the connector pins.
2. Faulty fuel level sensor
    a. Check the resistance of the sensor.
        a. Disconnect the engine harness connector from the fuel level sensor.
        b. Measure the resistance between the fuel level sensor signal pin and the fuel level sensor return pin.
3. Improper wiring
    a. Check wiring. Ensure wiring from the coolant temperature sensor is connected to the correct Aux 101 input.
    b. Check wires for breaks or abrasions.
    c. Check wires for moisture and debris at connection points.
4. Verify controller calibrations
    a. Using the display or the InPower Service tool, verify the calibration in the PCC control.
        a. If the calibration in the PCC control matches the latest calibration on the InCal website, then the calibration is correct. If it does not, update the PCC to the latest calibration.
    b. Using the InSite Service tool, verify the calibration in the ECM.
        a. If the calibration in the ECM matches the latest calibration on QSOL, then the calibration is correct. If it does not, update the ECM to the latest calibration.

8.6 Code 2619 – AUX 101 Input #1 Fault

Logic:

Analog input #1 fault is active.

Possible Causes:

1. Condition for which "Analog Input #1" is configured is active
2. "Analog Input #1 Active State Selection" parameter is configured incorrectly
3. Incorrectly wired; or open circuit or short circuit in the wiring

Diagnosis and Repair:

1. Condition for which "Analog Input #1" is configured is active
    a. Check the condition for which "Analog Input #1" has been configured for. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.
2. "Analog Input #1 Active State Selection" parameter is configured incorrectly
    a. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Analog Input #1. Ensure that the switch input setting is correctly set. If “Analog Input #1 Sensor Type" parameter is set to active low, an active high will invert the logic, causing this fault code to go active.
3. Incorrectly wired; or open circuit or short circuit in the wiring
    a. Check the wiring at J11-1 (reference input 1) and J11-2 (switch input) for an open circuit, short circuit, or a miswired condition.

8.7 Code 2621 – AUX 101 Input #2 Fault

Logic:

Analog input #2 fault is active.

Possible Causes:

1. Condition for which "Analog Input #2" is configured is active
2. "Analog Input #2 Active State Selection" parameter is configured incorrectly
3. Incorrectly wired; or open circuit or short circuit in the wiring

Diagnosis and Repair:

1. Condition for which "Analog Input #2" is configured is active
    a. Check the condition for which "Analog Input #2" has been configured for. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.
2. "Analog Input #2 Active State Selection" parameter is configured incorrectly
    a. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Analog Input #2. Ensure that the switch input setting is correctly set. If “Analog Input #2 Sensor Type" parameter is set to active low, an active high will invert the logic, causing this fault code to go active.
3. Incorrectly wired; or open circuit or short circuit in the wiring
    a. Check the wiring at J11-3 (reference input 1) and J11-4 (switch input) for an open circuit, short circuit, or a miswired condition.

8.8 Code 2622 – AUX 101 Input #3 Fault

Logic:

Analog input #3 fault is active.

Possible Causes:

1. Condition for which "Analog Input #3" is configured is active
2. "Analog Input #3 Active State Selection" parameter is configured incorrectly
3. Incorrectly wired; or open circuit or short circuit in the wiring

Diagnosis and Repair:

1. Condition for which "Analog Input #3" is configured is active
   a. Check the condition for which "Analog Input #3" has been configured for. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.
2. "Analog Input #3 Active State Selection" parameter is configured incorrectly
   a. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Analog Input #3. Ensure that the switch input setting is correctly set. If “Analog Input #3 Sensor Type" parameter is set to active low, an active high will invert the logic, causing this fault code to go active.
3. Incorrectly wired; or open circuit or short circuit in the wiring
   a. Check the wiring at J11-5 (reference input 1) and J11-6 (switch input) for an open circuit, short circuit, or a miswired condition.

8.9 Code 2623 - AUX 101 Input #4 Fault

Analog input #4 fault is active.

Possible Causes:

1. Condition for which "Analog Input #4" is configured is active
2. "Analog Input #4 Active State Selection" parameter is configured incorrectly
3. Incorrectly wired; or open circuit or short circuit in the wiring

8.10 Code 2624 – AUX 101 Input #5 Fault

Logic:

Analog input #5 fault is active.

Possible Causes:

1. Condition for which "Analog Input #5" is configured is active
2. "Analog Input #5 Active State Selection" parameter is configured incorrectly
3. Incorrectly wired; or open circuit or short circuit in the wiring

Diagnosis and Repair:

1. Condition for which "Analog Input #5" is configured is active
   a. Check the condition for which "Analog Input #5" has been configured for. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.

2. "Analog Input #5 Active State Selection" parameter is configured incorrectly
   a. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Analog Input #5. Ensure that the switch input setting is correctly set. If “Analog Input #5 Sensor Type" parameter is set to active low, an active high will invert the logic, causing this fault code to go active.
3. Incorrectly wired; or open circuit or short circuit in the wiring
   a. Check the wiring at J11-9 (reference input 1) and J11-10 (switch input) for an open circuit, short circuit, or a miswired condition.

8.11 Code 2625 – AUX 101 Input #6 Fault

Logic:

Analog input #6 fault is active.

Possible Causes:

1. Condition for which "Analog Input #6" is configured is active
2. "Analog Input #6 Active State Selection" parameter is configured incorrectly
3. Incorrectly wired; or open circuit or short circuit in the wiring

Diagnosis and Repair:

1. Condition for which "Analog Input #6" is configured is active
   a. Check the condition for which "Analog Input #6" has been configured for. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.
2. "Analog Input #6 Active State Selection" parameter is configured incorrectly
   a. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Analog Input #6. Ensure that the switch input setting is correctly set. If “Analog Input #6 Sensor Type" parameter is set to active low, an active high will invert the logic, causing this fault code to go active.
3. Incorrectly wired; or open circuit or short circuit in the wiring
   a. Check the wiring at J11-11 (reference input 1) and J11-12 (switch input) for an open circuit, short circuit, or a miswired condition.

8.12 Code 2626 – AUX 101 Input #7 Fault

Logic:

Analog input #7 fault is active.

Possible Causes:

1. Condition for which "Analog Input #7" is configured is active
2. "Analog Input #7 Active State Selection" parameter is configured incorrectly
3. Incorrectly wired; or open circuit or short circuit in the wiring

Diagnosis and Repair:

1. Condition for which "Analog Input #7" is configured is active
   a. Check the condition for which "Analog Input #7" has been configured for. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.

2. "Analog Input #7 Active State Selection" parameter is configured incorrectly
   a. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Analog Input #7. Ensure that the switch input setting is correctly set. If “Analog Input #7 Sensor Type" parameter is set to active low, an active high will invert the logic, causing this fault code to go active.
3. Incorrectly wired; or open circuit or short circuit in the wiring
   a. Check the wiring at J11-13 (reference input 1) and J11-14 (switch input) for an open circuit, short circuit, or a miswired condition.

8.13 Code 2627 – AUX 101 Input #8 Fault

Logic:

Analog input #8 fault is active.

Possible Causes:

1. Condition for which "Analog Input #8" is configured is active
2. "Analog Input #8 Active State Selection" parameter is configured incorrectly
3. Incorrectly wired; or open circuit or short circuit in the wiring

Diagnosis and Repair:

1. Condition for which "Analog Input #8" is configured is active
   a. Check the condition for which "Analog Input #8" has been configured for. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.
2. "Analog Input #8 Active State Selection" parameter is configured incorrectly
   a. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Analog Input #8. Ensure that the switch input setting is correctly set. If “Analog Input #8 Sensor Type" parameter is set to active low, an active high will invert the logic, causing this fault code to go active.
3. Incorrectly wired; or open circuit or short circuit in the wiring
   a. Check the wiring at J11-15 (reference input 1) and J11-16 (switch input) for an open circuit, short circuit, or a miswired condition.

8.14 Code 2729 - IO Module Lost (Warning)

Logic:

Indicates an intermittent data link between the I/O module and the PCC control (Aux 101 I/O Module option) and no input fault levels were set to Shutdown.

Possible Causes:

1. Incorrect wiring
2. I/O settings misconfigured

Diagnosis and Repair:

1. Incorrect Wwring
   a. The connection between AUX 101 and PCC 1302 is incorrect. Ensure proper wiring.
      - PCC 1302 TB1-1 – PCC Net A (+) to AUX 101 J1-3

- PCC 1302 TB1-2 – PCC Net B (-) to AUX 101 J1-4
- PCC 1302 TB1-3 – B+ Return to AUX 101 J14-2
- PCC 1302 TB1-5 – Customer Used B+ to AUX 101 J14-1
- PCC 1302 TB15-5 – System Wake-up to AUX 101 J1-5

2. I/O settings misconfigured
   a. If no AUX 101 is connected to PCC 1302, connect to InPower. Under **Adjustments > System I/O Adjustment > Output Relays**, ensure System IO Board Enable is disabled.
   b. If no AUX 101 is connected to PCC 1302, connect to InPower. Under **Adjustments > System I/O Adjustment**, ensure no inputs or outputs are configured as enabled.

8.15 Code 2731 - IO Module Lost (Shutdown)

Logic:

Indicates an intermittent data link between the I/O module and the PCC control (Aux 101 I/O Module option) and at least one input fault level was set to Shutdown.

Possible Causes:

1. Incorrect wiring
2. I/O settings misconfigured

Diagnosis and Repair:

1. Incorrect wiring
   a. The connection between AUX 101 and PCC 1302 is incorrect. Ensure proper wiring.
      - PCC 1302 TB1-1 – PCC Net A (+) to AUX 101 J1-3
      - PCC 1302 TB1-2 – PCC Net B (-) to AUX 101 J1-4
      - PCC 1302 TB1-3 – B+ Return to AUX 101 J14-2
      - PCC 1302 TB1-5 – Customer Used B+ to AUX 101 J14-1
      - PCC 1302 TB15-5 – System Wake-up to AUX 101 J1-5
2. I/O settings misconfigured
   a. If no AUX 101 is connected to PCC 1302, connect to InPower. Under **Adjustments > System I/O Adjustment > Output Relays**, ensure System IO Board Enable is disabled.
   b. If no AUX 101 is connected to PCC 1302, connect to InPower. Under **Adjustments > System I/O Adjustment**, ensure no inputs or outputs are configured as enabled.

8.16 Fault Code 2882 - AUX 101 (1) Input #1 Fault

Logic:

AUX 101 1 Analog/Switch input #1 fault is active.

Possible Causes:

1. Condition for which Analog/Switch Input #1 is configured for is active

2. Aux 101 1 Analog Input #1 active state selection parameter is configured incorrectly
3. Faulty switch unit
4. Faulty switch connector(s)
5. Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board

8.17 Fault Code 2882 - AUX 101 (1) Input #1 Fault - Diagnosis and Repair

- Condition for which Analog/Switch Input #1 is configured for is active
  - Verify the condition for which Analog/Switch Input #1 has been configured. After the issue is resolved press the Reset button on the operator panel in order to clear the fault.
    - If the fault does not clear go to the Aux 101 1 Analog Input #1 active state selection parameter is configured incorrectly step below.
- Aux 101 1 Analog Input #1 active state selection parameter is configured incorrectly
  - With the InPower service tool or through the operator panel verify the switch input setting (active closed or active open) for Analog/Switch Input #1. Go to: **Setup > Aux 101 Setup.**
    - Verify that the switch input setting is set correctly.
    - If Aux 101 1 Analog/Switch Input #1 Sensor Type parameter is set to active close, an active open will invert the logic, causing this fault code to go active.
- Faulty switch unit
  - Visually inspect the switch for proper operation, intended range of movement, and functionality. If any defects or a physical damage are detected the switch unit should be replaced.
  - Measure the resistance of the switch, if the switch is reading incorrectly (shorted or open circuit), replace the switch (< 10 ohms for closed; > 100K ohms for open).
- Faulty switch connector(s)
  - Check the switch unit’s connection at the plug for an adequate connection, short circuit, open circuit, or a wiring mismatch at the switch connector end.
  - Inspect the switch and the harness connector pins for:
    - Bent or broken pins, pushed back, or expanded pins
    - Evidence of moisture or corrosion in or on the connector
    - Missing or damaged connector seals
    - Dirt or debris in or on the connector pins
- Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board
  - Check the wiring at J11-1 (reference input) and J11-2 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 101 input side.
  - Verify the wiring harness running from the switch plug to the AUX 101 board for shorted low condition at the J11- 2 (switch input) side for an active closed parameter fault setting activation.
    - With the switch disconnected measure the resistance from the J11- 2 input pin to the engine block ground; value should be more than 100k ohms.

- Disconnect the wiring harness.
  - Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
  - Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

8.18 Fault Code 2883 - AUX 101 (1) Input #2 Fault

Logic:

AUX 101 1 Analog/Switch input #2 fault is active.

Possible Causes:

1. Condition for which Analog/Switch Input #2 is configured for is active
2. Aux 101 1 Analog Input #2 active state selection parameter is configured incorrectly
3. Faulty switch unit
4. Faulty switch connector(s)
5. Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board

8.19 Fault Code 2883 - AUX 101 (1) Input #2 Fault - Diagnosis and Repair

- Condition for which Analog/Switch Input #2 is configured for is active
  - Verify the condition for which Analog/Switch Input #2 has been configured. After the issue is resolved press the Reset button on the operator panel in order to clear the fault.
    - If the fault does not clear go to the Aux 101 1 Analog Input #2 active state selection parameter is configured incorrectly step below.
- Aux 101 1 Analog Input #2 active state selection parameter is configured incorrectly
  - With the InPower service tool or through the operator panel verify the switch input setting (active closed or active open) for Analog/Switch Input #2. Go to: **Setup > Aux 101 Setup.**
    - Verify that the switch input setting is set correctly.
    - If Aux 101 1 Analog/Switch Input #2 Sensor Type parameter is set to active close, an active open will invert the logic, causing this fault code to go active.
- Faulty switch unit
  - Visually inspect the switch for proper operation, intended range of movement, and functionality. If any defects or a physical damage are detected the switch unit should be replaced.
  - Measure the resistance of the switch, if the switch is reading incorrectly (shorted or open circuit), replace the switch (< 10 ohms for closed; > 100K ohms for open).
- Faulty switch connector(s)
  - Check the switch unit's connection at the plug for an adequate connection, short circuit, open circuit, or a wiring mismatch at the switch connector end.

- Inspect the switch and the harness connector pins for:
  - Bent or broken pins, pushed back, or expanded pins
  - Evidence of moisture or corrosion in or on the connector
  - Missing or damaged connector seals
  - Dirt or debris in or on the connector pins
- Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board
  - Check the wiring at J11-3 (reference input) and J11-4 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 101 input side.
  - Verify the wiring harness running from the switch plug to the AUX 101 board for shorted low condition at the J11-4 (switch input) side for an active closed parameter fault setting activation.
    - With the switch disconnected measure the resistance from the J11-4 input pin to the engine block ground; value should be more than 100k ohms.
  - Disconnect the wiring harness.
    - Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
    - Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

8.20 Fault Code 2884 - AUX 101 (1) Input #3 Fault

Logic:

AUX 101 1 Analog/Switch input #3 fault is active.

Possible Causes:

1. Condition for which Analog/Switch Input #3 is configured for is active
2. Aux 101 1 Analog Input #3 active state selection parameter is configured incorrectly
3. Faulty switch unit
4. Faulty switch connector(s)
5. Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board

8.21 Fault Code 2884 - AUX 101 (1) Input #3 Fault - Diagnosis and Repair

Logic:

AUX 101 1 Analog/Switch input #3 fault is active.

Possible Causes:

1. Condition for which Analog/Switch Input #3 is configured for is active
2. Aux 101 1 Analog Input #3 active state selection parameter is configured incorrectly
3. Faulty switch unit
4. Faulty switch connector(s)

5. Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board

8.22 Fault Code 2885 - AUX 101 (1) Input #4 Fault

Logic:

AUX 101 1 Analog/Switch input #4 fault is active.

Possible Causes:

1. Condition for which Analog/Switch Input #4 is configured for is active
2. Aux 101 1 Analog Input #4 active state selection parameter is configured incorrectly
3. Faulty switch unit
4. Faulty switch connector(s)
5. Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board

8.23 Fault Code 2885 - AUX 101 (1) Input #4 Fault - Diagnosis and Repair

- Condition for which Analog/Switch Input #4 is configured for is active
    - Verify the condition for which Analog/Switch Input #4 has been configured. After the issue is resolved press the Reset button on the operator panel in order to clear the fault.
        - If the fault does not clear go to the Aux 101 1 Analog Input #4 active state selection parameter is configured incorrectly step below.
- Aux 101 1 Analog Input #4 active state selection parameter is configured incorrectly
    - With the InPower service tool or through the operator panel verify the switch input setting (active closed or active open) for Analog/Switch Input #4. Go to: **Setup > Aux 101 Setup.**
        - Verify that the switch input setting is set correctly.
        - If Aux 101 1 Analog/Switch Input #4 Sensor Type parameter is set to active close, an active open will invert the logic, causing this fault code to go active.
- Faulty switch unit
    - Visually inspect the switch for proper operation, intended range of movement, and functionality. If any defects or a physical damage are detected the switch unit should be replaced.
    - Measure the resistance of the switch, if the switch is reading incorrectly (shorted or open circuit), replace the switch (< 10 ohms for closed; > 100K ohms for open).
- Faulty switch connector(s)
    - Check the switch unit's connection at the plug for an adequate connection, short circuit, open circuit, or a wiring mismatch at the switch connector end.
    - Inspect the switch and the harness connector pins for:
        - Bent or broken pins, pushed back, or expanded pins
        - Evidence of moisture or corrosion in or on the connector
        - Missing or damaged connector seals
        - Dirt or debris in or on the connector pins

- Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board
  - Check the wiring at J11-7 (reference input) and J11-8 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 101 input side.
  - Verify the wiring harness running from the switch plug to the AUX 101 board for shorted low condition at the J11-8 (switch input) side for an active closed parameter fault setting activation.
    - With the switch disconnected measure the resistance from the J11-8 input pin to the engine block ground; value should be more than 100k ohms.
  - Disconnect the wiring harness.
    - Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
    - Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

8.24 Fault Code 2886 - AUX 101 (1) Input #5 Fault

Logic:

AUX 101 1 Analog/Switch input #5 fault is active.

Possible Causes:

1. Condition for which Analog/Switch Input #5 is configured for is active
2. Aux 101 1 Analog Input #5 active state selection parameter is configured incorrectly
3. Faulty switch unit
4. Faulty switch connector(s)
5. Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board

8.25 Fault Code 2886 - AUX 101 (1) Input #5 Fault - Diagnosis and Repair

- Condition for which Analog/Switch Input #5 is configured for is active
  - Verify the condition for which Analog/Switch Input #5 has been configured. After the issue is resolved press the Reset button on the operator panel in order to clear the fault.
    - If the fault does not clear go to the Aux 101 1 Analog Input #5 active state selection parameter is configured incorrectly step below.
- Aux 101 1 Analog Input #5 active state selection parameter is configured incorrectly
  - With the InPower service tool or through the operator panel verify the switch input setting (active closed or active open) for Analog/Switch Input #5. Go to: **Setup > Aux 101 Setup.**
    - Verify that the switch input setting is set correctly.
    - If Aux 101 1 Analog/Switch Input #5 Sensor Type parameter is set to active close, an active open will invert the logic, causing this fault code to go active.

- Faulty switch unit
  - Visually inspect the switch for proper operation, intended range of movement, and functionality. If any defects or a physical damage are detected the switch unit should be replaced.
  - Measure the resistance of the switch, if the switch is reading incorrectly (shorted or open circuit), replace the switch (< 10 ohms for closed; > 100K ohms for open).
- Faulty switch connector(s)
  - Check the switch unit's connection at the plug for an adequate connection, short circuit, open circuit, or a wiring mismatch at the switch connector end.
  - Inspect the switch and the harness connector pins for:
    - Bent or broken pins, pushed back, or expanded pins
    - Evidence of moisture or corrosion in or on the connector
    - Missing or damaged connector seals
    - Dirt or debris in or on the connector pins
- Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board
  - Check the wiring at J11-9 (reference input) and J11-10 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 101 input side.
  - Verify the wiring harness running from the switch plug to the AUX 101 board for shorted low condition at the J11-10 (switch input) side for an active closed parameter fault setting activation.
    - With the switch disconnected measure the resistance from the J11-10 input pin to the engine block ground; value should be more than 100k ohms.
  - Disconnect the wiring harness.
    - Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
    - Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

8.26 Fault Code 2887 - AUX 101 (1) Input #6 Fault

Logic:

AUX 101 1 Analog/Switch input #6 fault is active.

Possible Causes:

1. Condition for which Analog/Switch Input #6 is configured for is active
2. Aux 101 1 Analog Input #6 active state selection parameter is configured incorrectly
3. Faulty switch unit
4. Faulty switch connector(s)
5. Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board

8.27 Wiring Harness Incorrectly Wired, Open Circuit, Or Short Circuit To The AUX 101 Board

1. Check the wiring at J11-11 (reference input) and J11-12 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 101 input side.
2. Verify the wiring harness running from the switch plug to the AUX 101 board for shorted low condition at the J11-12 (switch input) side for an active closed parameter fault setting activation.
   a. With the switch disconnected measure the resistance from the J11-12 input pin to the engine block ground; value should be more than 100k ohms.
3. Disconnect the wiring harness.
   a. Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
   b. Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

8.28 Fault Code 2888 - AUX 101 (1) Input #7 Fault

Logic:

AUX 101 1 Analog/Switch input #7 fault is active.

Possible Causes:

1. Condition for which Analog/Switch Input #7 is configured for is active
2. Aux 101 1 Analog Input #7 active state selection parameter is configured incorrectly
3. Faulty switch unit
4. Faulty switch connector(s)
5. Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board

8.29 Wiring Harness Incorrectly Wired, Open Circuit, Or Short Circuit To The AUX 101 BoarD

1. Check the wiring at J11-13 (reference input) and J11-14 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 101 input side.
2. Verify the wiring harness running from the switch plug to the AUX 101 board for shorted low condition at the J11-14 (switch input) side for an active closed parameter fault setting activation.
   a. With the switch disconnected measure the resistance from the J11-14 input pin to the engine block ground; value should be more than 100k ohms.
3. Disconnect the wiring harness.
   a. Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
   b. Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

8.30 Fault Code 2889 - AUX 101 (1) Input #8 Fault

Logic:

AUX 101 1 Analog/Switch input #8 fault is active.

Possible Causes:

1. Condition for which Analog/Switch Input #8 is configured for is active
2. Aux 101 1 Analog Input #8 active state selection parameter is configured incorrectly
3. Faulty switch unit
4. Faulty switch connector(s)
5. Wiring harness incorrectly wired, open circuit, or short circuit to the AUX 101 board

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9 Auxilliary Codes-105

9.1 Code 3629 - Device Calibration Update Recommended

Logic:

The PCC may have setup parameters that the AUX 105 does not have.

Possible Causes:

1. Incorrect calibration file in the PCC.
2. Incorrect calibration file in AUX 105.

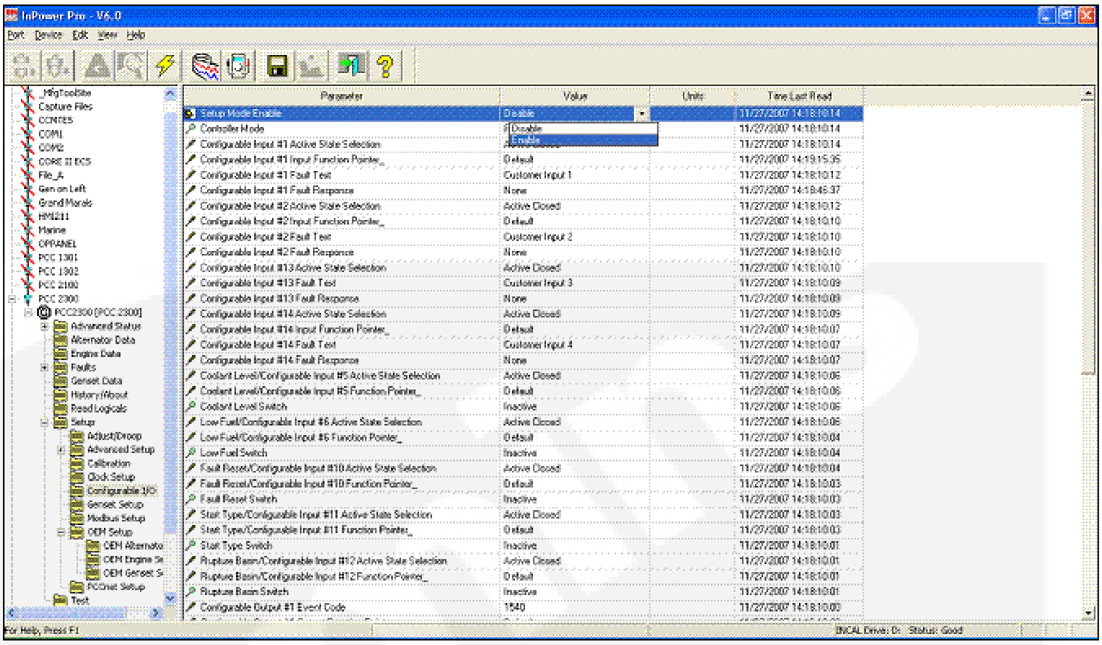
Diagnosis and Repair:

1. Verify the calibration files for the PCC.
    a. Connect InPower to the PCC.
    b. Download the latest calibration to the PCC.
2. Verify the calibration files for the AUX 105.
    a. Connect InPower to the AUX 105.
    b. Download the latest calibration to the AUX 105.

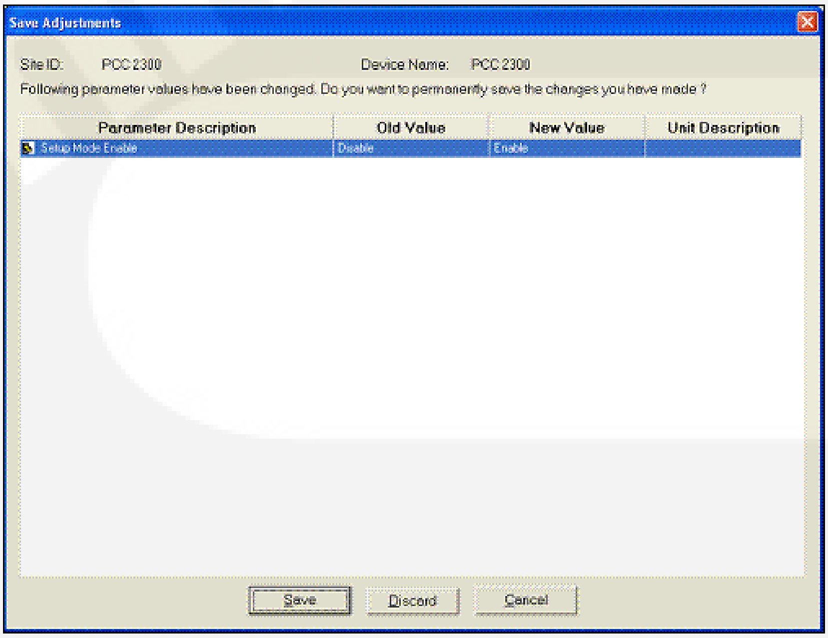
9.2 Map a Configurable Input to Battle Short Switch

After Battle Short mode is enabled in the ECM and the PCC, you have to map a configurable input to the Battle Short Switch.

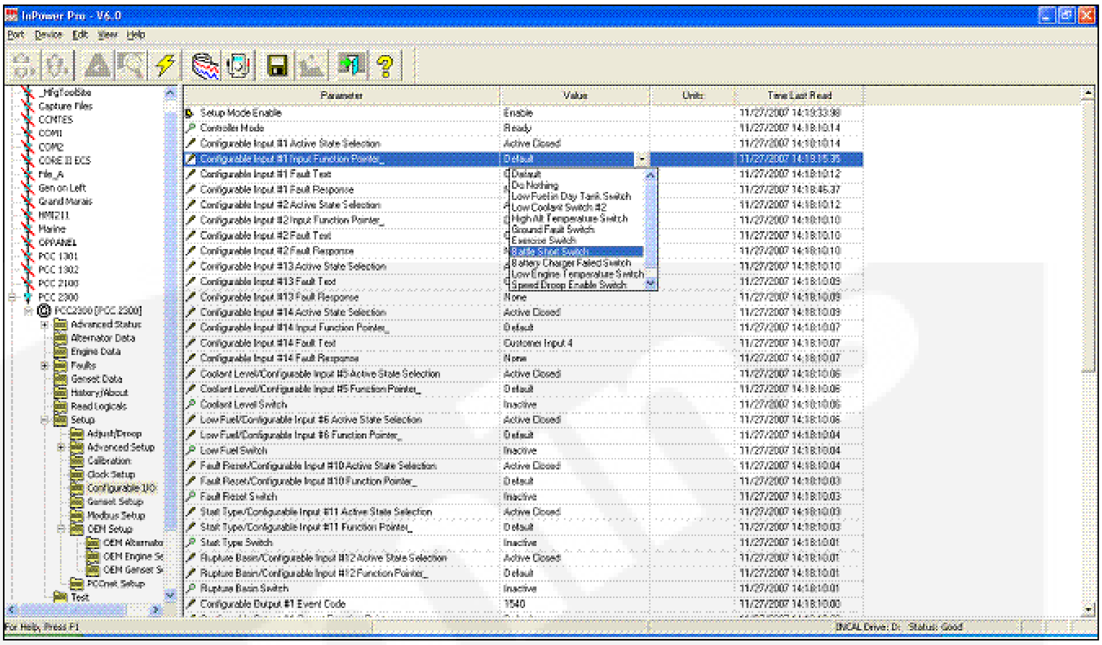
1. Put the PCC in Off mode.
2. Use the PC-based service tool harness to connect the computer to TB15 on the PCC base board.
3. Open InPower (make sure that the security dongle is attached to the computer) and click on the control (PCC 2300 in this example) in the left side of the window.
4. Click on the Setup >Configurable I/O folders.
5. Set the Setup Mode Enable parameter to Enable in order to enter Setup mode, as shown below.



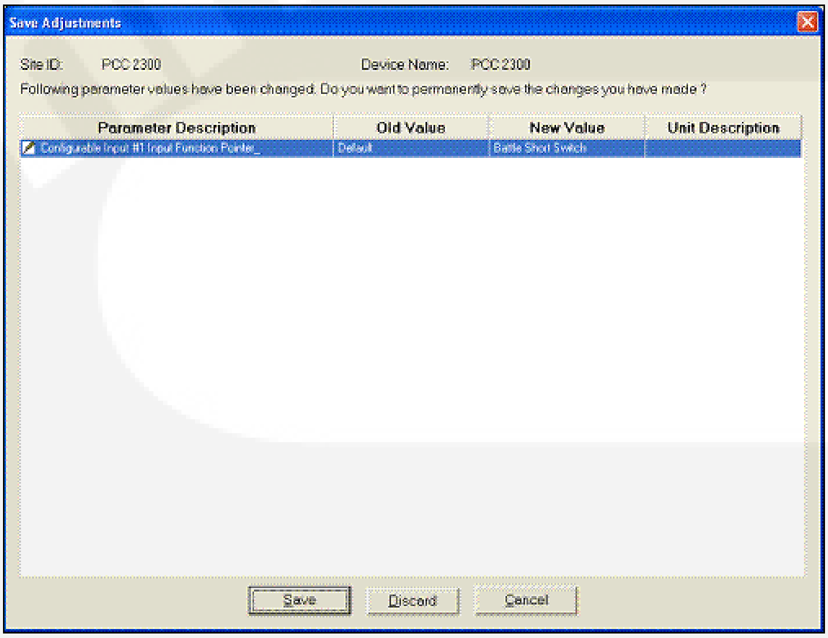
6. Click on Save, as shown below.



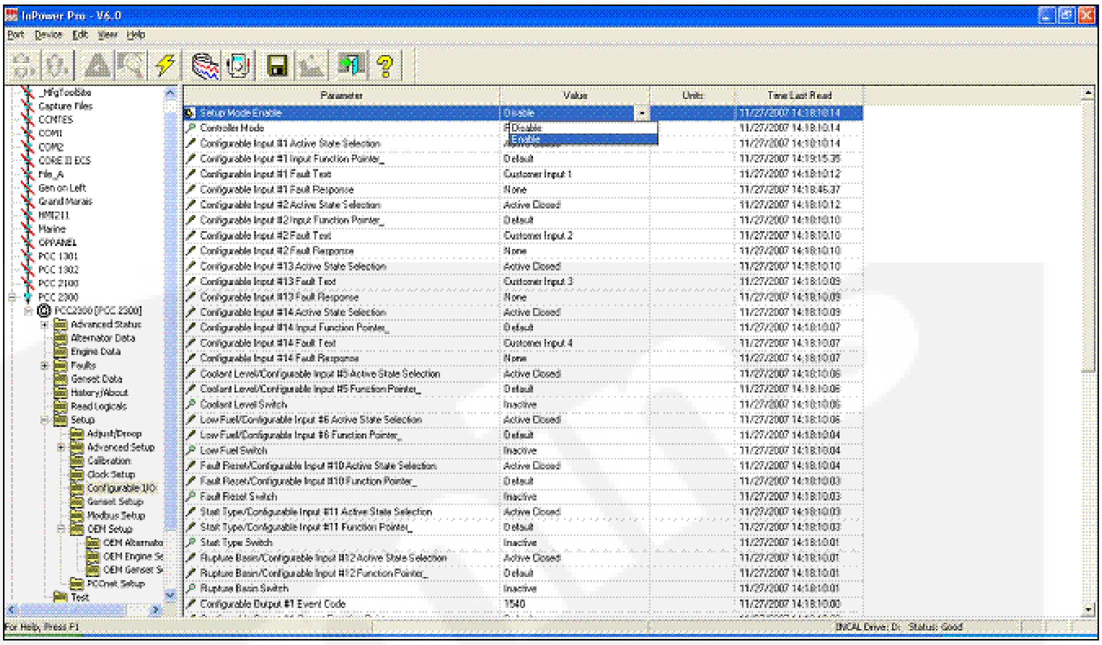
7. Any configurable input can be mapped to Battle Short Switch. Choose one of them. For example, set Configurable Input #1 Input Function Pointer parameter to Battle Short Switch, as shown below.



8. Click on Save, as shown below.



9. Set the Setup Mode Enable parameter to Disable, and click on Save in order to exit Setup mode.



9.3 Code 3631 - Device Calibration Update Required

Logic:

The AUX 105 did not receive a setup parameter from the PCC.

Possible Causes:

1. Incorrect calibration file in the PCC.
2. Incorrect calibration file in AUX 105.

Diagnosis and Repair:

1. Verify the calibration files for the PCC.
   a. Connect InPower to the PCC.
   b. Download the latest calibration to the PCC.
2. Verify the calibration files for the AUX 105.
   a. Connect InPower to the AUX 105.
   b. Download the latest calibration to the AUX 105.

10 Battle Short Procedures

10.1 Battle Short Mode Procedures

All of the following procedures are required to activate Battle Short mode.

These procedures require the equipment identified in the table below.

TABLE 12. REQUIRED EQUIPMENT FOR BATTLE SHORT MODE PROCEDURES

Part Description	Part Number
InPower Pro service tool	0998-0077-02 (existing user) 0988-0077-04 (new user)
INLINE 4 product kit	4918190
INLINE 5 product kit	4918416
PC-based service tool harness	0541-1199

10.2 Battle Short Mode

⚠ **WARNING**

Battle Short mode feature.
Can cause a fire or electrical hazard, resulting in severe personal injury or death and/or property and equipment damage.
Operation of the set must be supervised during Battle Short operation.

The purpose of Battle Short mode is to satisfy local code requirements, where necessary. To use this feature, the necessary software must be installed at the factory when a PowerCommand® 1.1 control is purchased.

Battle Short mode is a generator set mode of operation that prevents the generator set from being shutdown by all but a few, select, critical shutdown faults.

NOTICE

All shutdown faults, including those overridden by Battle Short, must be acted upon immediately to ensure the safety and well being of the operator and the generator set.

⚠ **WARNING**

Battle Short mode feature.
Use of the Battle Short mode feature can cause a fire or electrical hazard, resulting in severe personal injury or death and/or property and equipment damage.
Operation of the set must be supervised during Battle Short operation.

This feature must only be used during supervised, temporary operation of the generator set. The faults that are overridden when in Battle Short mode can affect generator set performance, or cause permanent engine, alternator, or connected equipment damage.

Only trained and experienced service personnel should enable this feature. When shipped from the factory, this feature is disabled.

NOTICE

If this mode of operation is selected, the protection of load devices is disabled.
Cummins Power Generation will not be responsible for any claim resulting from the use of this mode.

Battle Short is turned on or off with an external switch connected to one of the two customer configured inputs or a soft switch on the operator panel.

NOTICE

The Battle Short feature can only be enabled or disabled using the PC service tool.

When enabled, Battle Short switch input can be set using a Setup menu. To turn Battle Short mode on using the soft switch in the Operator Panel, Battle Short must be set to Operator Panel and enabled using the InPower service tool (default is Inactive).

When Battle Short mode is enabled, the Warning status indicator lights, and code 1131 – Battle Short Active – is displayed.

When Battle Short mode is enabled and an overridden shutdown fault occurs, the shutdown lamp remains lit even though the set continues to run. Fault code 1416 – Fail to Shutdown – is displayed. If the ▲, ▼ or ◀ button is pressed to acknowledge the fault, the fault message is cleared from the display but remains in the Fault History file with an asterisk sign (* indicates an active fault) as long as Battle Short mode is enabled.

Battle Short is suspended and a shutdown occurs immediately if any of the following critical shutdown faults occur:

- Speed Signal Lost (Loss of Speed Sense) Fault code 121
- Overspeed Fault code 234
- Local Emergency Stop Fault code 1433
- Remote Emergency Stop Fault code 1434
- Excitation Fault (Loss of Voltage Sense) Fault code 2335

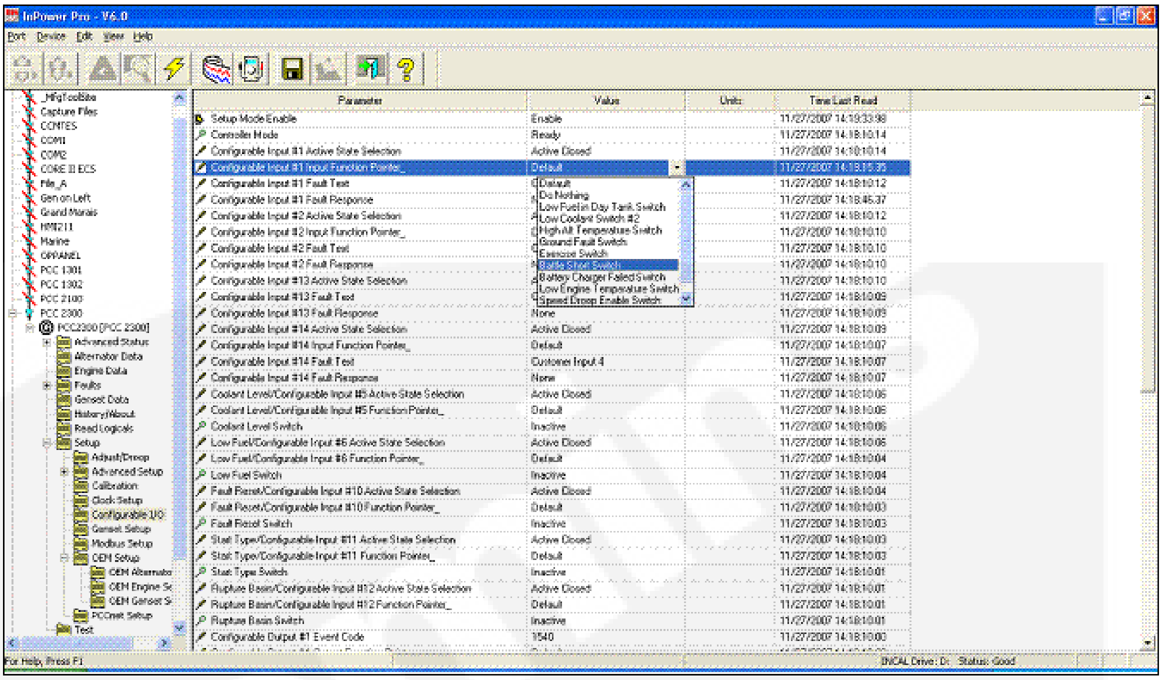
  Or

- The Battle Short feature is disabled after an overridden shutdown fault occurred while in Battle Short mode. Fault code 1123 – Shutdown After Battle Short – is then displayed.

10.3 Activate Battle Short Mode

Each configurable input can be Active Open or Active Closed. Check the value of the configurable input that was configured to Battle Short Switch, and activate the configurable input accordingly.

For example, Configurable Input #1 Active State Selection is set to Active Closed below. In order to activate Battle Short mode, Configurable Input #1 (TB-12 and TB13) has to be closed (connected together).



If Configurable Input #1 Active State Selection were set to Active Open, Configurable Input #1 (TB-12 and TB13) has to be an open contact (disconnected) to activate Battle Short mode.

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11 Battery Troubleshooting

11.1 Code 2993 - Battery Charger Failed

Indicates that the battery charger has failed.

11.2 Fault Code 379 - Over Current

Logic:

Charger output current is too high

Possible Causes:

1. Output current is excessive. Charger control may be failing.

11.2.1 Fault Code 379 - Diagnosis and Repair

1. Cycle through the Setup menus to try and clear the fault.

- If the fault returns, the charger control may have failed.

11.2.1.1 Clearing the Fault Code

NOTICE
Fault code can only be cleared by: • **Disconnect the charger harness plug,** • **Cycle completely through the setup menus,** **Or** • **Recycling the power.**

11.3 Fault Code 441 - Low Battery Voltage

Logic:

Battery voltage is low

Possible Causes:

1. No battery connected.
2. Output breaker is in the “Off” (down) position.
3. A 12 V battery is connected but the charger is set for 24 V charging.
4. Battery can no longer maintain charge.
5. The wire between the charger and the battery is loose or broken

11.3.1 Fault Code 441 - Diagnosis and Repair

1. No battery connected.
    - Connect the battery.

2. Output breaker is in the “Off” (down) position.
   - Verify the output breaker is in “On” (up) position.
3. A 12V battery is connected but the charger is set for 24V charging.
   - Attach a 24V battery or set the charger for 12V charging.
4. Battery can no longer maintain charge.
   - Replace the battery.
5. The wire between the charger and the battery is loose or broken.
   - Check the wire.

11.4 Fault Code 2358 - High AC Voltage

Logic:

AC input voltage is more than 10% above nominal rated voltage.

Possible Causes:

1. AC input voltage is more than 10% above nominal rated voltage.

11.4.1 Fault Code 2358 - Diagnosis and Repair

1. AC input voltage is more than 10% above nominal rated voltage.
   - Check level of input voltage.

     Charger will not operate with voltage 10% or more above nominal.

11.5 Fault Code 442 - High Battery Voltage

Logic:

Battery voltage is high.

Possible Causes:

1. A 24 V battery is connected but the charger is set for 12 V charging.
2. Large load dump may have caused momentary voltage rise.

11.5.1 Fault Code 442 - Diagnosis and Repair

1. 24V battery is connected but the charger is set for 12 V charging.
   - Attach a 12 V battery or set the charger for 24 V charging.
2. Large load dump may have caused momentary voltage rise.
   - Cycle through the Setup menus to clear the fault and restart charging.

11.5.1.1 Clearing the Fault Code

NOTICE

Fault code can only be cleared by:

- **Disconnect the charger harness plug,**
- **Cycle completely through the setup menus,**

Or

- **Recycling the power.**

11.6 Code 1442 - Weak Battery

Logic:

This fault occurs when the engine is starting (cranking) and the voltage of the battery drops below the “Weak Battery Voltage threshold" for the time set in the “Weak Battery Voltage Set Time".

Possible Causes:

1. Weak or discharged battery.
2. Battery connections are loose or dirty.
3. “Weak battery" voltage threshold parameter is set too high.
4. Insufficient battery charging voltage.
5. Faulty engine DC alternator.
6. Faulty harness.

Diagnosis and Repair:

1. Weak or discharged battery.
   a. Measure the voltage of the battery with a voltmeter. Battery voltage should be 12 VDC or greater in a 12 V system or 24 VDC or greater in a 24 VDC system. If the battery voltage is low, check the electrolyte level in the battery. Replenish the electrolyte level if low and recharge the battery; the specific gravity for a fully charged lead acid battery is approximately 1.260 at 80 °F (27 °C).
   b. If the battery cannot hold adequate voltage, then replace the battery.
2. Battery connections are loose or dirty.
   a. Clean and tighten battery terminals and battery cable connectors. If the battery cable connectors are cracked or worn out, then replace.
3. "Weak battery" voltage threshold parameter is set too high.
   a. Ensure that the Weak Battery Voltage parameter is set to an appropriate voltage value that takes into account voltage drop during cranking (refer to the parameter list to see the default value). To access the battery voltage setup menu from the operator panel, go to **Setup > OEM Setup > OEM Engine Setup > Weak Battery** and change the weak battery voltage parameter of the control accordingly.

4. Insufficient battery charging voltage.
    a. Ensure that the battery charger is charging the battery at an acceptable rate. Adjust the charge rate if the rate is below the recommendation of the manufacturer.
    b. If the battery located far from the battery charger, ensure that a proper wire size is used to compensate for voltage drop.
5. Faulty engine DC alternator.
    a. Check the engine DC alternator. If normal charging voltage is not 12 to 14 VDC in a 12 V system or 24 to 26 VDC in a 24 V system then replace the DC alternator.
6. Faulty harness.
    a. Measure the battery voltage at the battery terminals, then measure the battery voltage at the base board input. Measure the voltage at B+ (J20–9, J20–10, J20-20, J20–21) and B- (negative) input (J20– 2, J20–4, J20–7, J20–12).
        - If the voltage at the battery terminals and the control is not the same then check the harness and replace if necessary.

11.7 Code 1443 - Dead Battery

Logic:

During cranking, the battery voltage drops below the operating voltage of the control, which resets the control. After the control has reset three consecutive times, event/fault code 1443 will become active.

Possible Causes:

1. Weak or discharged battery.
2. Battery connections are loose or dirty.
3. Insufficient battery charging voltage.
4. Faulty engine DC alternator.
5. Faulty harness.

Diagnosis and Repair:

1. Weak or discharged battery.
    a. Measure the voltage of the battery with a voltmeter. Battery voltage should be 12 VDC or greater in a 12 V system or 24 VDC or greater in a 24 VDC system. If the battery voltage is low, check the electrolyte level in the battery. Replenish the electrolyte level if low and recharge the battery; the specific gravity for a fully charged lead acid battery is approximately 1.260 at 80 °F (27 °C).
    b. If the battery cannot hold adequate voltage, then replace the battery.
2. Battery connections are loose or dirty.
    a. Clean and tighten battery terminals and battery cable connectors. If the battery cable connectors are cracked or worn out, then replace.
3. Insufficient battery charging voltage.
    a. Ensure that the battery charger is charging the battery at an acceptable rate. Adjust the charge rate if the rate is below the recommendation of the manufacturer.

   b. If the location of the battery is a far distance from the battery charger, ensure that a proper wire size is used to compensate for voltage drop.

4. Faulty engine DC alternator.

   a. Check the engine DC alternator. If normal charging voltage is not 12 to 14 VDC in a 12 V system or 24 to 26 VDC in a 24 V system then replace the DC alternator.

5. Faulty harness.

   a. Measure the battery voltage at the battery terminals while the genset is cranking, then measure the battery voltage at the base board input while the genset is cranking. Measure the voltage at B+ (J20–9, J20–10, J20-20, J20–21) and B- (negative) input (J20–2, J20–4, J20–7, J20–12).

      - If the voltage at the battery terminals and the control is not the same then check the harness and replace if necessary.

11.8 Fault Code 2331 - Low AC Voltage

Logic:

AC input voltage is more than 10% below nominal rated voltage.

Possible Causes:

1. AC input voltage is more than 10% below nominal rated voltage.

11.8.1 Fault Code 2331 - Diagnosis and Repair

1. AC input voltage is more than 10% below nominal rated voltage.

   - Check level of input voltage.

     Charger will not operate with voltage 10% or more below nominal.

11.9 Fault Code 2263 - High Battery Temperature

(FOR INSTALLATIONS THAT INCLUDE THE OPTIONAL BATTERY TEMP SENSOR)

Logic:

Battery temperature is above 55 degrees C

Possible Causes:

1. Battery’s ambient temperature is too high.
2. Possible shorted cells within the battery is causing an excessive battery temperature increase.

11.9.1 Fault Code 2263 - Diagnosis and Repair

1. Battery’s ambient temperature is too high.

   - Move the battery into a cooler location.

     Charger will automatically begin charging again after the battery temp lowers.

2. Possible shorted cells within the battery is causing an excessive battery temperature increase.

   - Replace the battery.

11.10 Fault Code 2544 - Over Temperature

Logic:

Charger is overheating

Possible Causes:

1. Charger's ambient temperature is too high.
2. Charger's internal cooling fan is blocked, failed, or air inlets are covered.

11.10.1 Fault Code 2544 - Diagnosis and Repair

1. Charger's ambient temperature is too high.
    - Move the charger to a cooler location.

      The charger will automatically begin charging again after the internal temp lowers.
2. Charger's internal cooling fan is blocked, failed, or air inlets are covered.
    - Verify that the charger's air inlets on the side of the charger are not blocked and nothing is interfering with fan rotation.

11.11 Fault Code 9115 - Battery Fail

Logic:

Battery has failed.

Possible Causes:

1. The battery can no longer hold a charge or has been damaged excessively due to extremely deep discharge.

11.11.1 Fault Code 9115 - Diagnosis and Repair

1. Replace the battery and cycle through the Setup menus to clear the fault.

11.11.1.1 Code 2993 - Battery Charger Failed

Indicates that the battery charger has failed.

11.11.1.2 Clearing the Fault Code

NOTICE
Fault code can only be cleared by: • **Disconnect the charger harness plug,** • **Cycle completely through the setup menus,** **Or** • **Recycling the power.**

11.12 No DC Output (No Fault Message)

Logic:

Charger cannot sense any DC output.

Possible Cause:

1. Tripped DC circuit breaker.
2. Blown AC fuse(s) (on 277, 380, 416 and 600 VAC battery chargers).
3. Tripped AC circuit breaker(s) (on 120, 208 and 240 VAC battery chargers).

11.12.1 No DC Output (No Fault Message) - Diagnosis and Repair

1. Tripped DC circuit breaker.
   - Correct the possible overload and reset the circuit breaker.
2. Blown AC fuse(s) (on 277, 380, 416 and 600 VAC battery chargers).
   - Correct the possible overload and replace the fuse(s).
3. Tripped AC circuit breaker(s) (on 120, 208 and 240 VAC battery chargers).
   - Correct the possible overload and reset the circuit breaker.

11.13 Low DC Output (No Fault Message)

Logic:

Charger senses low DC output.

Possible Cause:

1. Faulty battery.
2. Charger failure.

11.13.1 Low DC Output (No Fault Message) - Diagnosis and Repair

1. Faulty battery
   - Replace the battery.
2. Charger failure.
   - Arrange for a replacement charger.

11.14 High DC Output (No Fault Message)

Logic:

Charger senses high DC Output.

Possible Cause:

1. Charger failure.

11.14.1 High DC Output (No Fault Message) - Diagnosis and Repair

1. Arrange for a replacement charger.

11.14.1.1 Code 2335 - Excitation Fault

Logic:

The control has detected the simultaneous loss of all phases of sensing.

Possible Causes:

1. Incorrectly configured or wiring issue.

Diagnosis and Repair:

1. Incorrectly configured or wiring issue.
    a. Ensure that the configuration of the “Lost AC Voltage Threshold" parameter is set appropriately for the application. To access the Lost AC Voltage Threshold configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > Lost AC Voltage Threshold** and set the “Lost AC Voltage Threshold" parameter appropriately for the application. Refer to the parameter list to see the default value for “Lost AC Voltage Threshold".
    b. All the connections that are used to calculate voltage and current by the control have been lost (either by disconnection or no voltage, current, frequency input into the control, etc.) Check the voltage sensing (L1: J22 -1; L2: J22 -2, L3: J22-3, L4: J22-4) and current sensing (L1: J12-1, J12-4; L2: J12-2, J12-5; L3: J12-3, J12-6;) connections into the control and ensure that voltage and current are available at these connections when the genset is running. If using a PT also check the inputs and outputs of the PT.

11.14.1.2 Code 2336 - Checksum Fault

Logic:

Integrity check has found corrupted memory block(s) in the PCC.

Possible Causes:

1. PCC has corrupted memory block(s).

Diagnosis and Repair:

1. PCC has corrupted memory block(s).
    a. The PCC has corrupted memory block(s), this is indicated by all of the LEDs on the base board flashing. Perform an initial calibration on the base board with the newest Incal files. If the Incal update does not resolve the issue, then replace the base board.

12 CAN Datalink Troubleshooting

12.1 Fault Code 427 - CAN Datalink Lost Message

Logic:

Important data was lost between the Base Board and the ECM or keyswitch to ECM was removed during genset operation.

Possible Cause:

1. Power removed from ECM (keyswitch) during genset operation.
   - O pressed on control during genset operation.
2. Defective Datalink harness assembly.

12.1.1 Fault Code 427 - Diagnosis and Repair

1. Power removed from ECM (keyswitch) during genset operation.
   - O pressed on control during genset operation.

   Reset control by pressing Fault Reset buttion with O/Manual/Auto switch in O (off) position.
2. Defective Datalink harness assembly.
   - Inspect the Datalink harness between P10 and P41 connector pins.
     - Repair or Replace as necessary.
   - Check for resistive circuit in lead P10-1 to P41-N and P10-2 to P41-P (10ohms or less = ok).
   - Check terminating resistors. With connectors P10 and P41 removed, measure resistance between pins P10-1 and P10-2 (60 ohms = ok).

12.2 Fault Code 781 - CAN Datalink Lost Messages

Logic:

Important data was lost between the Base board and the ECM or keyswitch to ECM was removed during genset operation.

12.2.1 Fault Code 781 - Diagnosis and Repair

Refer to fault code **427**

12.3 Fault Code 1245 - CAN - Engine Shutdown

Logic:

The PCC received a shutdown message from the ECM

Possible Cause:

1. ECM/Engine fault

12.3.1 Fault Code 1245 - Diagnosis and Repair

1. ECM/Engine fault.
   - Refer to the E-Controls service tool and the engine service manual.

12.4 Fault Code 1246 - CAN - Unknown Engine Fault

Logic:

The PCC received an unknown message from the ECM

Possible Cause:

1. ECM/Engine fault

12.4.1 Fault Code 1246 - Diagnosis and Repair

1. ECM/Engine fault.
   - Refer to the E-Controls service tool and the engine service manual.

12.5 Fault Code 1247 - CAN - Engine Unannounced Fault

Logic:

The PCC received an unknown message from the ECM.

Possible Cause:

1. ECM/Engine fault

12.5.1 Fault Code 1247 - Diagnosis and Repair

1. ECM/Engine fault.
   - Refer to the E-Controls service tool and the engine service manual.

12.6 Fault Code 1248 - CAN - Engine Warning Fault

Logic:

The PCC received an unknown message from the ECM.

Possible Cause:

1. ECM/Engine fault

12.6.1 Fault Code 1248 - Diagnosis and Repair

1. ECM/Engine fault.
   - Refer to the E-Controls service tool and the engine service manual.

13 Troubleshooting_Hydramechanical Fault Codes

13.1 No Code - The Operator Panel Is Unavailable After Changing the PCCNet Network

Logic:

The Operator Panel was working until a PCCNet device was added or removed from the PCCNet network.

Possible Causes:

1. Bad installation of PCCNet device.
2. Faulty base board.

Diagnosis and Repair:

1. Bad installation of PCCNet device.
   a. Check the installation of the PCCNet device, in particular the connection at TB1. J25 and TB1 share the same electrical connection. If the PCCNet device is installed incorrectly, the Operator Panel on J25 stops working. Make sure the PCCNet device is connected correctly and is functioning properly.
2. Faulty base board.
   a. Replace faulty base board.

13.2 Code 135 - Oil Pressure Sensor OOR High

Logic:

Engine oil pressure sensor signal is out of range – shorted high.

NOTICE
This warning will only occur if the genset is equipped with an oil pressure sensor.

Possible Causes:

1. Faulty oil pressure sensor connections.
2. Faulty oil pressure sensor.
3. Faulty engine harness.
4. Faulty extension harness.

NOTICE
Part Number 316289800 - Pressure/Temperature sensor breakout cable
Part Number 382477400 - Pressure sensor breakout cable
Part Number 382477600 - Pressure sensor breakout cable
Part Number 316475200 - Danfoss™ pressure sensor breakout cable
Part Number 382275800 - Male Deutsch/AMP/Metri-Pack test lead
Part Number 382291700 - Female Deutsch/AMP/Metri-Pack test lead
Part Number 382481200 - Deutsch socket pin test lead
Part Number 382481100 - Deutsch pin test lead

Diagnosis and Repair:

1. Oil pressure sensor connections.

   Inspect the oil pressure sensor and the engine harness connector pins.

   a. Disconnect the engine harness connector from the oil pressure sensor.

   b. Inspect for corroded pins, bent or broken pins, and pushed back or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

   d. Inspect for missing or damaged connector seals.

   e. Inspect for dirt or debris in or on the connector pins.

2. Faulty sensor/switch.

   Active Sensor

   a. Check the oil pressure sensor supply voltage.

      a. Disconnect the engine harness connector from the oil pressure sensor.

      b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.

      c. Measure the supply voltage by connecting the breakout cable's supply and return connectors to the multimeter. If the reading is between 4.75 and 5.25 VDC, then the supply voltage is correct.

   b. Check the oil pressure sensor signal (sense) voltage.

      a. Disconnect the engine harness connector from the oil pressure sensor.

      b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.

      c. Measure the signal voltage by connecting the breakout cable's signal and return connectors to the multimeter. If the reading is between 0.46 and 4.56 V, then the signal voltage is correct. If not, the sensor is faulty.

   Passive Sensor

   Check the resistance of the sensor.

   a. Disconnect the engine harness connector from the oil pressure sensor.

   b. Measure the resistance between the oil pressure signal pin and the oil pressure return pin.

   c. Refer to the troubleshooting and repair manual for the specific engine platform for oil pressure ranges.

   Switch

   a. Check genset manual to determine if switch should be normally open or normally closed.

  b. Ensure physical switch is of same type.

3. Faulty engine harness.
  a. Inspect the engine harness and the connector pins.
    a. Disconnect the engine harness connector from the extension harness.
    b. Inspect for corroded pins, bent or broken pins, and pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pin.
  b. Check for a short circuit from pin to pin.
    a. Disconnect the engine harness from the extension harness.
    b. Disconnect the engine harness connector from the oil pressure sensor.
    c. Disconnect the engine harness from all sensors that have a shared supply or return with the oil pressure sensor.
    d. Measure the resistance from the oil pressure 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    e. Measure the resistance from the oil pressure return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    f. Measure the resistance from the oil pressure signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    g. If all measurements are greater than 100k ohms, then the resistance is correct.
  c. Check for an open circuit.
    a. Disconnect the engine harness from the extension harness.
    b. Disconnect the engine harness connector from the oil pressure sensor.
    c. Measure the resistance from the oil pressure return pin on the engine harness inline connector to the oil pressure return pin on the engine harness sensor connector.
    d. If the measurement is less than 10 ohms, then the resistance is correct.
4. Faulty extension harness.
  a. Inspect the extension harness and the AUX 105 connector pins.
    a. Disconnect the extension harness connector from the AUX 105.
    b. Inspect for corroded pins, bent or broken pins, and pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.
  b. Check for an open circuit.
    a. Disconnect the extension harness connector from the AUX 105.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the oil pressure return pin on the extension harness connector to the oil pressure return pin on the extension harness inline connection.

d. If the measurement is less than 10 ohms, then the resistance is correct.

c. Check for a short circuit from pin to pin.

a. Disconnect the extension harness connector from the AUX 105.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the oil pressure 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the oil pressure return pin on the extension harness connector to all other pins in the extension harness connector.

e. Measure the resistance from the oil pressure signal pin on the extension harness connector to all other pins in the extension harness connector.

f. If all measurements are greater than 100k ohms, then the resistance is correct.

13.3 Code 141 - Oil Pressure Sensor OOR Low

Logic:

Engine oil pressure sensor signal is out of range – shorted low.

NOTICE
This warning will only occur if the genset is equipped with an oil pressure sensor.

Possible Causes:

1. Fault simulation feature is enabled.
2. Faulty oil pressure sensor connections.
3. Faulty oil pressure sensor.
4. Faulty engine harness.
5. Faulty extension harness.

NOTICE
Part Number 316289800 - Pressure/Temperature sensor breakout cable **Part Number 382477400 - Pressure sensor breakout cable** **Part Number 382477600 - Pressure sensor breakout cable** **Part Number 316475200 - Danfoss™ pressure sensor breakout cable (Danfoss is a trademark of Danfoss A/S.)** **Part Number 382275800 - Male Deutsch/AMP/Metri-Pack test lead** **Part Number 382291700 - Female Deutsch/AMP/Metri-Pack test lead** **Part Number 382481200 - Deutsch socket pin test lead** **Part Number 382481100 - Deutsch pin test lead**

Diagnosis and Repair:

1. Verify that the fault simulation feature for the sensor is not enabled.
    a. Connect InPower.
    b. Verify that the fault simulation is NOT enabled for the intake manifold temperature sensor by connecting to the PCC via InPower. If the fault simulation is disabled, there is no problem.
2. Oil pressure sensor connections.

    Inspect the oil pressure sensor and the engine harness connector pins.
    a. Disconnect the engine harness connector from the oil pressure sensor.
    b. Inspect for corroded, bent, broken, pushed back, expanded, or loose pins
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.
3. Faulty sensor/switch.

    Active Sensor
    a. Check the oil pressure sensor supply voltage.
        a. Disconnect the engine harness connector from the oil pressure sensor.
        b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.
        c. Measure the supply voltage by connecting the breakout cable's supply and return connectors to the multimeter. If the reading is between 4.75 and 5.25 VDC, then the supply voltage is correct.
    b. Check the oil pressure sensor signal (sense) voltage.
        a. Disconnect the engine harness connector from the oil pressure sensor.
        b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.
        c. Measure the signal voltage by connecting the breakout cable's signal and return connectors to the multimeter. If the reading is between 0.46 and 4.56 V, then the signal voltage is correct. If not, the sensor is faulty.

    Passive Sensor

    Check the resistance of the sensor.
    a. Disconnect the engine harness connector from the oil pressure sensor.
    b. Measure the resistance between the oil pressure signal pin and the oil pressure return pin.
    c. Refer to the troubleshooting and repair manual for the specific engine platform for oil pressure ranges.

    Switch
    a. Check genset manual to determine if switch should be normally open or normally closed.
    b. Ensure physical switch is of same type.

4. Faulty engine harness.
    a. Inspect the engine harness and the connector pins.
        a. Disconnect the engine harness connector from the extension harness.
        b. Inspect for corroded pins, bent or broken pins, and pushed back or expanded pins.
        c. Inspect for evidence of moisture in or on the connector.
        d. Inspect for missing or damaged connector seals.
        e. Inspect for dirt or debris in or on the connector pin.
    b. Check for a short circuit from pin to pin.
        a. Disconnect the engine harness from the extension harness.
        b. Disconnect the engine harness connector from the oil pressure sensor.
        c. Disconnect the engine harness from all sensors that have a shared supply or return with the oil pressure sensor.
        d. Measure the resistance from the oil pressure 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.
        e. Measure the resistance from the oil pressure return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
        f. Measure the resistance from the oil pressure signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
        g. If all measurements are greater than 100k ohms, then the resistance is correct.
    c. Check for a short circuit to engine block ground.
        a. Disconnect the extension harness from the AUX 105.
        b. Disconnect the extension harness from the engine harness.
        c. Measure the resistance from the oil pressure signal pin on the extension harness connector to the engine block ground.
        d. Measure the resistance from the oil pressure 5 VDC pin on the extension harness connector to the engine block ground.
        e. If the measurement is more than 100k ohms, then the resistance is correct.
    d. Check for an open circuit.
        a. Disconnect the engine harness connector from the extension harness.
        b. Disconnect the engine harness from the oil pressure sensor.
        c. Measure the resistance from the oil pressure return pin on the engine harness inline connector to the oil pressure return pin on the engine harness sensor connector.
        d. If the measurement is less than 10 ohms, then the resistance is correct.
5. Faulty extension harness.
    a. Inspect the extension harness and the AUX 105 connector pins.
        a. Disconnect the extension harness connector from the AUX 105.

   b. Inspect for corroded pins, bent or broken pins, and pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

b. Check for a short circuit from pin to pin.
   a. Disconnect the extension harness connector from the AUX 105.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the oil pressure 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.
   d. Measure the resistance from the oil pressure return pin on the extension harness connector to all other pins in the extension harness connector.
   e. Measure the resistance from the oil pressure signal pin on the extension harness connector to all other pins in the extension harness connector.
   f. If all measurements are greater than 100k ohms, then the resistance is correct.

c. Check for a short circuit to engine block ground.
   a. Disconnect the extension harness from the AUX 105.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the oil pressure signal pin on the extension harness connector to the engine block ground.
   d. Measure the resistance from the oil pressure 5 VDC pin on the extension harness connector to the engine block ground.
   e. If the measurement is more than 100k ohms, then the resistance is correct.

d. Check for an open circuit.
   a. Disconnect the extension harness connector from the AUX 105.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the engine oil temperature return pin on the extension harness connector to the engine oil temperature return pin at the extension harness inline connector.
   d. Measure the resistance from the engine oil temperature signal pin on the extension harness connector to the engine oil temperature signal pin at the extension harness inline connector.
   e. If the measurement is less than 10 ohms, then the resistance is correct.

13.4 Code 143 - Low Oil Rifle Pressure

Logic:

Engine oil pressure is below the low oil pressure warning threshold.

NOTICE
This warning will only occur if the genset is equipped with an oil rifle pressure sensor.

Possible Causes:

1. The engine oil pressure has dropped below the shutdown trip point.
2. Oil pressure sensor is inaccurate.
3. Fault simulation is enabled.
4. Threshold is set too high.

Diagnosis and Repair:

1. Check engine oil.
   a. Allow the engine to cool down completely.
   b. Check the oil lines to make sure they are not leaking.
   c. Check the oil filters and replace if defective or dirty.
   d. Check the oil level and replenish if low.
   e. Reset the control and restart. Verify that there are no oil leaks.
2. Check the oil pressure sensor accuracy with a mechanical oil pressure gauge.
   a. Connect a mechanical oil pressure gauge of known quality and calibration to the engine at one of the plugs on top of the oil filter head.
   b. Connect InPower.
   c. While the engine is stopped, compare the oil pressure reading on the service tool to the reading on the mechanical oil pressure gauge.
   d. Only proceed if engine troubleshooting has been completed. Do not attempt to start the engine if there is doubt about the oil pressure.

⚠ CAUTION
Do not attempt to start the engine if there is any doubt about the oil pressure, or the generator set may be damaged.

   e. Start the generator set.
   f. Compare the oil pressure reading on the service tool to the reading on the mechanical oil pressure gauge.
   g. Refer to the troubleshooting and repair manual for the specific engine platform for oil pressure ranges.
3. Fault simulation is enabled.

   Connect to the control with InPower, and make sure that fault simulation for LOP is not enabled.
4. Threshold is set too high.

   Using the electronic service tool, verify that the fault threshold is NOT within the normal operating range for the oil pressure sensor. Refer to the appropriate base engine manual for normal operating range.

13.5 Code 144 - Engine Coolant Temperature OOR High

Logic:

Engine coolant temperature signal voltage is out of range - shorted high

Possible Causes:

1. The engine has overheated (the coolant temperature has risen above the shutdown trip point).
2. Fault simulation feature is enabled.
3. Faulty coolant temperature sensor connections.
4. Faulty coolant temperature sensor.
5. Faulty engine harness.
6. Faulty extension harness.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. The engine has overheated (the coolant temperature has risen above the shutdown trip point).
   a. Allow the engine to cool down completely.
   b. Look for possible coolant leakage points and repair as necessary.
   c. Check the coolant level and replenish if low.
   d. Check for obstructions to cooling airflow and correct as necessary.
   e. Check the fan belt and repair or tighten if necessary.
   f. Check the blower fan and circulation pumps on remote radiator installations.
   g. Reset the control and restart.
2. Verify that the fault simulation feature is not enabled.
   a. Connect InPower.
   b. Verify that the fault simulation is NOT enabled for the intake manifold temperature sensor by connecting to the PCC via InPower. If fault simulation is disabled, there is no problem.
3. Coolant temperature sensor connections.

   Inspect the coolant temperature sensor and the harness connector pins.
   a. Disconnect the engine harness connector from the coolant temperature sensor.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.
4. Faulty sensor.

   Check the resistance of the sensor.
   a. Disconnect the engine harness connector from the coolant temperature sensor.
   b. Measure the resistance between the coolant temperature signal pin and the coolant temperature return pin.

c. Refer to the troubleshooting and repair manual for the specific engine platform for coolant temperature ranges.

5. Faulty engine harness.

   Inspect the engine harness and the extension harness connector pins.

   a. Disconnect the engine harness connector from the extension harness.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

   Check for a short circuit from pin-to-pin.

   a. Disconnect the engine harness connector from the extension harness.
   b. Disconnect the engine harness from the coolant temperature sensor.
   c. Disconnect the engine harness from all sensors that have a shared return with the coolant temperature sensor.
   d. Measure the resistance from the coolant temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   e. Measure the resistance from the coolant temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   f. If all measurements are greater than 100K ohms, then the resistance is correct.

   Check for an open circuit.

   a. Disconnect the engine harness connector from the extension harness.
   b. Disconnect the engine harness from the coolant temperature sensor.
   c. Measure the resistance from the coolant temperature return pin on the engine harness inline connector to the coolant temperature return pin on the engine harness sensor connector.
   d. Measure the resistance from the coolant temperature signal pin on the engine harness inline connector to the coolant temperature signal pin on the engine harness sensor connector.
   e. If the measurements are less than 10 ohms, then the resistance is correct.

6. Faulty extension harness.

   Inspect the extension harness and the AUX 105 connector pins.

   a. Disconnect the engine harness connector from the AUX 105.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

   Check for an open circuit.

   a. Disconnect the extension harness from the AUX 105.
   b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the coolant temperature return pin on the extension harness connector to the coolant temperature return pin on the extension harness inline connector.

d. Measure the resistance from the coolant temperature signal pin on the extension harness to the coolant temperature signal pin on the extension harness inline connector.

e. If the measurements are less than 10 ohms, then the resistance is correct.

Check for a short circuit from pin-to-pin.

a. Disconnect the extension harness from the AUX 105.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the coolant temperature return pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the coolant temperature signal pin on the extension harness connector to all other pins in the engine harness connector.

e. If all measurements are greater than 100K ohms, then the resistance is correct.

13.6 Code 145 - Engine Coolant Temperature OOR Low

Logic:

Engine coolant temperature signal voltage is out of range - shorted low

Possible Causes:

1. The coolant level is low.
2. A fault simulation is enabled or the threshold is set too high.
3. There is a faulty or incorrectly configured PCCNet Annunciator.
4. The coolant heater(s) is/are not operating properly.
5. The ambient temperature is low.
6. Faulty coolant temperature sensor connections.
7. Faulty coolant temperature sensor.
8. Faulty engine harness.
9. Faulty extension harness.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. Check the coolant level.
   a. If low, add coolant to the radiator.
2. Check to see if a fault simulation is enabled or the threshold is set too high.
   a. Connect with InPower™ and make sure that the fault simulation for LCT is not enabled. If InPower is not available, use the following procedure to cycle power to the control:
      a. Press the Emergency Stop button and wait 30 seconds.

   b. Disconnect/disable the battery charger.

   c. Disconnect the battery (disconnect negative first).

   d. Leave the controller without power for one minute.

   e. Reconnect the battery, enable the battery charger, pullout the E-Stop button, and Reset the control (in this order).

  b. Check the LCT Warning Threshold parameter and verify it is set to an appropriate threshold. To access the LCT Warning Threshold parameter from the display, go to Setup -> Genset Setup -> LCT Warning Threshold.

3. Check to see if there is faulty or incorrectly configured PCCNet Annunciator.

   a. If a PCCNet Annunciator is not used, go to step 4. If a PCCNet Annunciator is used, check the wiring from the back of the PCCNet Annunciator at TB2-8 to the Low Coolant Temperature sender and make sure that an open circuit or short circuit does not exist in the wiring.

   b. Since inputs can be configured to Active Open or Active Closed, refer to the PCCNet Annunciator Operator's Manual (P/N 0900-0301) to make sure that the Annunciator is configured correctly. Then check the input on the back of the PCCNet Annunciator at TB2-8 and make sure that the input signal into the PCCNet Annunciator is properly configured.

4. Check to see if the coolant heater(s) is/are not operating properly.

   a. Make sure that the coolant heater(s) is/are connected properly to a power supply, and check for open circuits in the wiring. Make sure that the power supply of the coolant heater is working properly.

   b. Measure the temperature of the coolant heater(s) using a proper temperature measuring device. If the ambient temperature is above 40 degrees F, the measured temperature of the coolant heater(s) should be above close to 90 degrees F (dependent on ambient temperature). If the temperature of the coolant heater(s) is close to the ambient temperature, replace the coolant heater(s). If the ambient temperature is very low, do not replace the coolant heaters; go to step 5.

5. Check to see if the ambient temperature is low.

   a. If the coolant heaters are working properly and the radiator has enough coolant, but the ambient temperature around the generator set is very cold (less than 40 degrees F), the coolant heaters might not have the capability to keep the coolant temperature above 70 degrees F. This could be application issue and will need to be further investigated.

6. Coolant temperature sensor connections. Inspect the coolant temperature sensor and the harness connector pins.

   a. Disconnect the engine harness connector from the coolant temperature sensor.

   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

   d. Inspect for missing or damaged connector seals.

   e. Inspect for dirt or debris in or on the connector pins.

7. Faulty sensor.

   a. Check the resistance of the sensor.

   b. Disconnect the engine harness connector from the coolant temperature sensor.

c. Measure the resistance between the coolant temperature signal pin and the coolant temperature return pin.

d. Refer to the troubleshooting and repair manual for the specific engine platform for coolant temperature ranges.

8. Faulty engine harness.

Inspect the engine harness and the extension harness connector pins.

a. Disconnect the engine harness connector from the extension harness.

b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins or expanded pins.

c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pins.

Check for a short circuit from pin-to-pin.

a. Disconnect the engine harness connector from the extension harness.

b. Disconnect the engine harness from the coolant temperature sensor.

c. Disconnect the engine harness from all sensors that have a shared return with the coolant temperature sensor.

d. Measure the resistance from the coolant temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

e. Measure the resistance from the coolant temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

f. If all measurements are greater than 100K ohms, then the resistance is correct.

Check for a short circuit to engine block ground.

a. Disconnect the extension harness from the AUX 105.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the coolant temperature signal pin on the extension harness connector to the engine block ground.

d. If the measurement is greater than 100K ohms, then the resistance is correct.

Check for an open circuit.

a. Disconnect the engine harness connector from the extension harness.

b. Disconnect the engine harness from the coolant temperature sensor.

c. Measure the resistance from the coolant temperature return pin on the engine harness inline connector to the coolant temperature return pin on the engine harness sensor connector.

d. Measure the resistance from the coolant temperature signal pin on the engine harness inline connector to the coolant temperature signal pin on the engine harness sensor connector.

e. If the measurements are less than 10 ohms, then the resistance is correct.

9. Faulty extension harness.

Inspect the extension harness and the AUX 105 connector pins.

a. Disconnect the extension harness connector from the AUX 105.

b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins or expanded pins.
c. Inspect for evidence of moisture in or on the connector.
d. Inspect for missing or damaged connector seals.
e. Inspect for dirt or debris in or on the connector pins.

Check for a short circuit to engine block ground.

a. Disconnect the extension harness from the AUX 105.
b. Disconnect the extension harness from the engine harness.
c. Measure the resistance from the coolant temperature signal pin on the extension harness connector to the engine block ground.
d. Measure the resistance from the coolant temperature return pin on the extension harness connector to the engine block ground.
e. If all measurements are greater than 100K ohms, then the resistance is correct.

Check for a short circuit from pin-to-pin.

a. Disconnect the extension harness from the AUX 105.
b. Disconnect the extension harness from the engine harness.
c. Measure the resistance from the coolant temperature return pin on the extension harness connector to all other pins in the extension harness connector.
d. Measure the resistance from the coolant temperature signal pin on the extension harness connector to all other pins in the engine harness connector.
e. If all measurements are greater than 100K ohms, then the resistance is correct.

Check for an open circuit.

a. Disconnect the extension harness from the AUX 105.
b. Disconnect the extension harness from the engine harness.
c. Measure the resistance from the coolant temperature return pin on the extension harness connector to the coolant temperature return pin on the extension harness inline connector.
d. Measure the resistance from the coolant temperature signal pin on the extension harness to the coolant temperature signal pin on the extension harness inline connector.
e. If the measurements are less than 10 ohms, then the resistance is correct.

13.7 Code 146 - Engine Coolant Temperature Moderately Above Normal (Derate)

Logic:

The engine is operating near cooling system capacity. An increase in load or higher ambient temperature may cause a High Coolant Temperature Shutdown (Fault Code 151)

Possible Causes:

1. Review the Diagnosis and Repair list in Fault Code 151 for possible causes and repair as necessary.

13.8 Code 151 - Engine Coolant Temperature High - Critical

Logic:

Engine coolant temperature has exceeded the alarm (shutdown) threshold for high coolant temperature.

Possible Causes:

1. The engine has overheated (the coolant temperature has risen above the shutdown trip point).
2. Inaccurate engine temperature sensor.
3. Fault simulation feature is enabled.
4. Incorrect threshold setting.

Diagnosis and Repair:

1. The engine has overheated.
   a. Allow the engine to cool down completely.
   b. Look for possible coolant leakage points and repair as necessary.
   c. Check the coolant level and replenish if low.
   d. Check for obstructions to cooling airflow and correct as necessary.
   e. Check the fan belt and repair or tighten if necessary.
   f. Check the blower fan and circulation pumps on remote radiator installations.
   g. Reset the control and restart.
2. Verify the sensor accuracy with a thermocouple or similar temperature probe.
   a. Connect the temperature probe to the engine near the coolant temperature sensor.
   b. Connect InPower.
   c. Compare the coolant temperature reading from the service tool to the reading from the temperature sensor. If the two readings are reasonably close, then the sensor is reading correctly.
3. Verify that the fault simulation feature is not enabled.
   a. Connect InPower.
   b. Verify that the fault simulation is NOT enabled for the coolant temperature sensor by connecting to the PCC via InPower. If fault simulation is disabled, there is no problem.
4. Check threshold settings.
   a. Connect InPower.
   b. Verify that the fault threshold is within the normal operating range for the coolant temperature sensor. Refer to the engine manual for correct threshold values, and make the appropriate changes using InPower.

13.9 Code 153 - Intake Manifold Temperature OOR - High

Logic:

Engine intake manifold temperature sensor signal is out of range - shorted high.

Possible Causes:

1. Faulty intake manifold temperature sensor connections.
2. Faulty intake manifold temperature sensor.
3. Faulty engine harness.
4. Faulty extension harness.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. Intake manifold temperature sensor connections

   Inspect the intake manifold temperature sensor and the harness connector pins.

   a. Disconnect the engine harness connector from the intake manifold temperature sensor.

   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

   d. Inspect for missing or damaged connector seals.

   e. Inspect for dirt or debris in or on the connector pins.

2. Faulty sensor.

   Check the resistance of the sensor.

   a. Disconnect the engine harness connector from the intake manifold temperature sensor.

   b. Measure the resistance between the intake manifold temperature signal pin and the intake manifold temperature return pin.

   c. Refer to the troubleshooting and repair manual for the specific engine platform for intake manifold temperature ranges.

3. Faulty engine harness.

   Inspect the engine harness and the extension harness connector pins.

   a. Disconnect the engine harness connector from the extension harness.

   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

   d. Inspect for missing or damaged connector seals.

   e. Inspect for dirt or debris in or on the connector pins.

Check for a short circuit from pin-to-pin.

a. Disconnect the engine harness connector from the extension harness.
b. Disconnect the engine harness from the intake manifold temperature sensor.
c. Disconnect the engine harness from all sensors that have a shared return with the intake manifold temperature sensor.
d. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
e. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
f. If all measurements are greater than 100K ohms, then the resistance is correct.

Check for an open circuit.

a. Disconnect the engine harness connector from the extension harness.
b. Disconnect the engine harness from the intake manifold temperature sensor.
c. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to the intake manifold temperature return pin at the engine harness sensor connector.
d. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to the intake manifold temperature signal pin at the engine harness sensor connector.
e. If all measurements are less than 10 ohms, then the resistance is correct.

4. Faulty extension harness.

Inspect the extension harness and the AUX 105 connector pins.

a. Disconnect the extension harness connector from the AUX 105.
b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
c. Inspect for evidence of moisture in or on the connector.
d. Inspect for missing or damaged connector seals.
e. Inspect for dirt or debris in or on the connector pins.

Check for an open circuit.

a. Disconnect the extension harness connector from the AUX 105.
b. Disconnect the extension harness from the engine harness.
c. Measure the resistance from the intake manifold temperature return pin on the extension harness connector to the intake manifold temperature return pin at the extension harness inline connector.
d. Measure the resistance from the intake manifold temperature signal pin on the extension harness connector to the intake manifold temperature signal pin at the extension harness inline connector.
e. If all measurements are less than 10 ohms, then the resistance is correct.

Check for a short circuit from pin-to-pin.

a. Disconnect the extension harness from the AUX 105.
b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the intake manifold temperature return pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the intake manifold temperature signal pin on the extension harness connector to all other pins in the extension harness connector.

e. If all measurements are greater than 100K ohms, then the resistance is correct.

13.10 Code 154 - Intake Manifold Temperature OOR - Low

Logic:

Engine intake manifold temperature sensor signal is out of range - shorted low.

Possible Causes:

1. Faulty intake manifold temperature sensor connections.
2. Faulty intake manifold temperature sensor.
3. Faulty engine harness.
4. Faulty extension harness.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. Intake manifold temperature sensor connections

   Inspect the intake manifold temperature sensor and the harness connector pins.

   a. Disconnect the engine harness connector from the intake manifold temperature sensor.

   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

   d. Inspect for missing or damaged connector seals.

   e. Inspect for dirt or debris in or on the connector pins.

2. Faulty sensor.

   Check the resistance of the sensor.

   a. Disconnect the engine harness connector from the intake manifold temperature sensor.

   b. Measure the resistance between the intake manifold temperature signal pin and the intake manifold temperature return pin.

   c. Refer to the troubleshooting and repair manual for the specific engine platform for intake manifold temperature ranges.

   Check for a short circuit to engine block ground.

   a. Disconnect the engine harness connector from the intake manifold temperature sensor.

   b. Measure the resistance from one of the pins of the intake manifold temperature sensor connector to engine block ground. If the resistance is more than 100K ohms, the sensor is operating correctly.

3. Faulty engine harness.

   Inspect the engine harness and the connector pins.

   a. Disconnect the engine harness connector from the extension harness.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

   Check for a short circuit from pin-to-pin.

   a. Disconnect the engine harness connector from the extension harness.
   b. Disconnect the engine harness from the intake manifold temperature sensor.
   c. Disconnect the engine harness from all sensors that have a shared return with the intake manifold temperature sensor.
   d. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   e. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   f. If all measurements are greater than 100K ohms, then the resistance is correct.

   Check for a short circuit to engine block ground.

   a. Disconnect the extension harness from the AUX 105.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the intake manifold temperature signal pin on the extension harness connector to engine block ground.
   d. If the resistance is more than 100K ohms, the sensor is operating correctly.

   Check for an open circuit.

   a. Disconnect the engine harness connector from the extension harness.
   b. Disconnect the engine harness from the intake manifold temperature sensor.
   c. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to the intake manifold temperature return pin at the engine harness sensor connector.
   d. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to the intake manifold temperature signal pin at the engine harness sensor connector.
   e. If all measurements are less than 10 ohms, then the resistance is correct.

4. Faulty extension harness.

   Inspect the extension harness and the AUX 105 connector pins.

   a. Disconnect the extension harness connector from the AUX 105.

b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.

c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pins.

Check for a short circuit to engine block ground.

a. Disconnect the extension harness from the AUX 105.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the intake manifold temperature signal pin on the extension harness connector to engine block ground.

d. Measure the resistance from the intake manifold temperature return pin on the extension harness connector to engine block ground.

e. If the resistance is more than 100K ohms, the sensor is operating correctly.

Check for a short circuit from pin-to-pin.

a. Disconnect the extension harness from the AUX 105.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the intake manifold temperature return pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the intake manifold temperature signal pin on the extension harness connector to all other pins in the extension harness connector.

e. If all measurements are greater than 100K ohms, then the resistance is correct.

Check for an open circuit.

a. Disconnect the extension harness connector from the AUX 105.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the intake manifold temperature return pin on the extension harness connector to the intake manifold temperature return pin at the extension harness inline connector.

d. Measure the resistance from the intake manifold temperature signal pin on the extension harness connector to the intake manifold temperature signal pin at the extension harness inline connector.

e. If all measurements are less than 10 ohms, then the resistance is correct.

13.11 Code 155 - Intake Manifold Temperature High - Critical

Logic:

Engine intake manifold temperature has exceeded the alarm (shutdown) threshold for high intake manifold temperature.

Possible Causes:

1. Large load or high ambient temperature.
2. Inaccurate engine temperature sensor.
3. Fault simulation feature is enabled.

4. Incorrect threshold setting.

Diagnosis and Repair:

1. Large load or high ambient temperature.
   a. Allow the engine to cool down completely.
   b. Look for possible coolant leakage points and repair as necessary.
   c. Check the coolant level and replenish if low.
   d. Check for obstructions to cooling airflow and correct as necessary.
   e. Check the fan belt and repair or tighten if necessary.
   f. Check the blower fan and circulation pumps on remote radiator installations.
   g. Reset the control and restart.
2. Verify the sensor accuracy with a thermocouple or similar temperature probe.
   a. Connect the temperature probe to the engine near the intake manifold temperature sensor.
   b. Connect InPower.
   c. Compare the intake manifold temperature reading from the service tool to the reading from the temperature sensor. If the two readings are reasonably close, then the sensor is reading correctly.

NOTICE
Only proceed if engine troubleshooting has been completed. Do not attempt to start the engine if there is doubt about the intake manifold temperature, or the generator set may be damaged.

   d. Start the generator set.
   e. Compare the intake manifold temperature reading from the service tool to the reading from the temperature sensor. If the two readings are reasonably close, then the sensor is reading correctly.
3. Verify that the fault simulation feature is not enabled.
   a. Connect InPower.
   b. Verify that the fault simulation is NOT enabled for the intake manifold temperature sensor by connecting to the PCC via InPower. If fault simulation is disabled, there is no problem.
4. Check threshold settings.
   a. Connect InPower.
   b. Verify that the fault threshold is within the normal operating range for the intake manifold temperature sensor. Refer to the engine manual for correct threshold values, and make the appropriate changes using InPower.

13.12 Code 196 – Coolant Level Sensor OOR Low (Warning)

Logic:

Coolant level sensor signal is out of range – shorted high.

Possible Causes:

1. Coolant level low
2. Faulty coolant level sensor connections
3. Faulty coolant level sensor
4. Faulty engine harness
5. Faulty extension harness

NOTICE
Part Number 3822758 - Male Deutsch/AMP/Metri-Pack test lead **Part Number 3822917 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. Replenish coolant level
   a. Look for possible coolant leakage points and repair if necessary.
   b. Check the coolant level and replenish if low.
   c. Reset the control and restart the generator set.
2. Faulty coolant level sensor connections
   a. Inspect the coolant level sensor and the harness connector pins.
      a. Disconnect the engine harness connector from the coolant level sensor.
      b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
      c. Inspect for evidence of moisture in or on the connector.
      d. Inspect for missing or damaged connector seals.
      e. Inspect for dirt or debris in or on the connector pins.
3. Faulty coolant level sensor
   a. Check the resistance of the sensor
      a. Disconnect the engine harness connector from the coolant level sensor.
      b. Measure the resistance between the coolant level sensor signal pin and the coolant level sensor return pin.
   b. Check for a short circuit to engine block ground.
      a. Disconnect the engine harness connector from the coolant level sensor.
      b. Measure the resistance from one of the pins of the coolant level sensor connector to engine block ground. If the resistance is more than 100k ohms, the sensor is operating correctly.
4. Faulty engine harness
   a. Inspect the engine harness and the connector pins.
      a. Disconnect the engine harness from the extension harness.
      b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
      c. Inspect for evidence of moisture in or on the connector.
      d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pins.

b. Check for a short circuit from pin to pin.

a. Disconnect the engine harness connector from the extension harness.

b. Disconnect the engine harness from the coolant level sensor.

c. Disconnect the engine harness from all sensors that have a shared return with the coolant level sensor. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

e. If all measurements are greater than 100k Ohms, then the resistance is correct.

c. Check for a short circuit to engine block ground.

a. Disconnect the extension harness.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from coolant level sensor signal pin on the extension harness connector to the engine block ground.

d. If the measurement is more than 100k ohms, then the resistance is correct.

d. Check for an open circuit.

a. Disconnect the engine harness connector from the extension harness.

b. Disconnect the engine harness from the coolant level sensor.

c. Measure the resistance from the coolant level sensor return pin on the engine harness inline connector to the coolant level sensor return pin at the engine harness sensor connector.

d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to coolant level sensor signal pin at then engine harness sensor connector.

e. If the measurement is less than 10 ohms, then the resistance is correct.

5. Faulty extension harness

a. Inspect the extension harness pins.

a. Disconnect the extension harness.

b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.

c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pins.

b. Check for a short circuit to engine block ground.

a. Disconnect the extension harness from the engine harness.

b. Measure the resistance from coolant level sensor signal pin on the extension harness connector to engine block ground.

c. Measure the resistance from the coolant level sensor return pin on the extension harness connector to engine block ground.

d. If all measurements are greater than 100k ohms, then the resistance is correct.

c. Check for a short circuit from pin to pin.

a. Disconnect the extension harness from the engine harness.

b. Measure the resistance from coolant level sensor return pin on the extension harness connector to all other pins in the extension harness connector.

c. Measure the resistance from the coolant level sensor signal pin on the extension harness connector to all other pins in the extension harness connector.

d. If all measurements are greater than 100k ohms, then the resistance is correct.

13.13 Code 197 - Low Coolant Level

Logic:

Low Coolant Level input is active and the threshold response is set to “Warning".

Possible Causes:

1. Low coolant.
2. Faulty sensor or wiring.
3. PCCNet Annunciator (if fitted).
4. Faulty base board.

Diagnosis and Repair:

1. Low coolant.
   a. Visually inspect that the engine coolant is at the correct level.
   b. Remove the radiator cap and check that the coolant is at the correct level.
   c. If coolant is below 2.5 cm (1 in) from the top add manufacture's prescribed coolant.
2. Faulty sensor or wiring.
   a. Disconnect the signal leads at the sensor, so the sensor is no longer connected to the control; then reset the control by pressing the Reset button. If event/fault code 197 clears and does not reappear, then replace the low coolant level sensor.
   b. If event/fault code 197 reappears then check for a short in the wiring between the low coolant level sensor and the input to the control (at J20-17: Input and J20-5: Ground). A ground input into J20-17 will activate the alarm at the control.
3. PCCNet Annunciator.
   a. If a PCCNet Annunciator is not used, go to step 4. If a PCCNet Annunciator is used, check the wiring on the back of the PCCNet Annunciator at TB1-6 to the Low Coolant Level sender. Ensure that an open circuit or short circuit does not exist in the wiring.
   b. Refer to the PCCNet Annunciator Operator's Manual to ensure that the Annunciator is configured correctly; since inputs can be configured to Active Open or Active Closed. Then check the input on the back of the PCCNet Annunciator at TB1–6 and ensure that the input signal into the PCCNet Annunciator is properly configured.

4. Faulty base board.
    a. Replace faulty base board.

13.14 Code 212 - Engine Oil Temperature OOR High

Logic:

Engine oil temperature is out of range - shorted high.

Possible Causes:

1. Faulty engine oil temperature sensor connections.
2. Faulty engine oil temperature sensor.
3. Faulty engine harness.
4. Faulty extension harness.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. Engine oil temperature sensor connections

    Inspect the engine oil temperature sensor and the harness connector pins.

    a. Disconnect the engine harness connector from the engine oil temperature sensor.
    b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.

2. Faulty sensor.

    Check the resistance of the sensor.

    a. Disconnect the engine harness connector from the engine oil temperature sensor.
    b. Measure the resistance between the engine oil temperature signal pin and the engine oil temperature return pin.
    c. Refer to the troubleshooting and repair manual for the specific engine platform for engine oil temperature ranges.

3. Faulty engine harness.

    Inspect the engine harness and the extension harness connector pins.

    a. Disconnect the engine harness connector from the extension harness.
    b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.

Check for a short circuit from pin-to-pin.

a. Disconnect the engine harness connector from the extension harness.
b. Disconnect the engine harness from the engine oil temperature sensor.
c. Disconnect the engine harness from all sensors that have a shared return with the engine oil temperature sensor.
d. Measure the resistance from the engine oil temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
e. Measure the resistance from the engine oil temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
f. If all measurements are greater than 100K ohms, then the resistance is correct.

Check for an open circuit.

a. Disconnect the engine harness connector from the extension harness.
b. Disconnect the engine harness from the engine oil temperature sensor.
c. Measure the resistance from the engine oil temperature return pin on the engine harness inline connector to the engine oil temperature return pin at the engine harness sensor connector.
d. Measure the resistance from the engine oil temperature signal pin on the engine harness inline connector to the engine oil temperature signal pin at the engine harness sensor connector.
e. If all measurements are less than 10 ohms, then the resistance is correct.

4. Faulty extension harness.

Inspect the extension harness and the AUX 105 connector pins.

a. Disconnect the extension harness connector from the AUX 105.
b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
c. Inspect for evidence of moisture in or on the connector.
d. Inspect for missing or damaged connector seals.
e. Inspect for dirt or debris in or on the connector pins.

Check for an open circuit.

a. Disconnect the extension harness connector from the AUX 105.
b. Disconnect the extension harness from the engine harness.
c. Measure the resistance from the engine oil temperature return pin on the extension harness connector to the engine oil temperature return pin at the extension harness inline connector.
d. Measure the resistance from the engine oil temperature signal pin on the extension harness connector to the engine oil temperature signal pin at the extension harness inline connector.
e. If all measurements are less than 10 ohms, then the resistance is correct.

Check for a short circuit from pin-to-pin.

a. Disconnect the extension harness from the AUX 105.
b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the engine oil temperature return pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the engine oil temperature signal pin on the extension harness connector to all other pins in the extension harness connector.

e. If all measurements are greater than 100K ohms, then the resistance is correct.

13.15 Code 213 - Engine Oil Temperature OOR Low

Logic:

Engine oil temperature is out of range - shorted low.

Possible Causes:

1. Faulty engine oil temperature sensor connections.
2. Faulty engine oil temperature sensor.
3. Faulty engine harness.
4. Faulty extension harness.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. Engine oil temperature sensor connections

   Inspect the engine oil temperature sensor and the harness connector pins.

   a. Disconnect the engine harness connector from the engine oil temperature sensor.

   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

   d. Inspect for missing or damaged connector seals.

   e. Inspect for dirt or debris in or on the connector pins.

2. Faulty sensor.

   Check the resistance of the sensor.

   a. Disconnect the engine harness connector from the engine oil temperature sensor.

   b. Measure the resistance between the engine oil temperature signal pin and the engine oil temperature return pin.

   c. Refer to the troubleshooting and repair manual for the specific engine platform for engine oil temperature ranges.

3. Faulty engine harness.

   Inspect the engine harness and the extension harness connector pins.

   a. Disconnect the engine harness connector from the extension harness.

   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seals.
e. Inspect for dirt or debris in or on the connector pins.

Check for a short circuit from pin-to-pin.

a. Disconnect the engine harness connector from the extension harness.
b. Disconnect the engine harness from the engine oil temperature sensor.
c. Disconnect the engine harness from all sensors that have a shared return with the engine oil temperature sensor.
d. Measure the resistance from the engine oil temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
e. Measure the resistance from the engine oil temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
f. If all measurements are greater than 100K ohms, then the resistance is correct.

Check for a short circuit to engine block ground.

a. Disconnect the extension harness from the AUX 105.
b. Disconnect the extension harness from the engine harness.
c. Measure the resistance from the oil temperature signal pin on the extension harness connector to the engine block ground.
d. If the measurement is more than 100K ohms, then the resistance is correct.

Check for an open circuit.

a. Disconnect the engine harness connector from the extension harness.
b. Disconnect the engine harness from the engine oil temperature sensor.
c. Measure the resistance from the engine oil temperature return pin on the engine harness inline connector to the engine oil temperature return pin at the engine harness sensor connector.
d. Measure the resistance from the engine oil temperature signal pin on the engine harness inline connector to the engine oil temperature signal pin at the engine harness sensor connector.
e. If all measurements are less than 10 ohms, then the resistance is correct.

4. Faulty extension harness.

Inspect the extension harness and the AUX 105 connector pins.

a. Disconnect the extension harness connector from the AUX 105.
b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
c. Inspect for evidence of moisture in or on the connector.
d. Inspect for missing or damaged connector seals.
e. Inspect for dirt or debris in or on the connector pins.

Check for a short circuit to engine block ground.

a. Disconnect the extension harness from the AUX 105.
b. Disconnect the extension harness from the engine harness.
c. Measure the resistance from the oil temperature signal pin on the extension harness connector to the engine block ground.

d. Measure the resistance from the oil temperature return pin on the extension harness connector to the engine block ground.

e. If the measurement is more than 100K ohms, then the resistance is correct.

Check for an open circuit.

a. Disconnect the extension harness connector from the AUX 105.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the engine oil temperature signal pin on the extension harness connector to the engine oil temperature signal pin at the extension harness inline connector.

d. Measure the resistance from the engine oil temperature return pin on the extension harness connector to the engine oil temperature return pin at the extension harness inline connector.

e. If all measurements are less than 10 ohms, then the resistance is correct.

Check for a short circuit from pin-to-pin.

a. Disconnect the extension harness from the AUX 105.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the engine oil temperature return pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the engine oil temperature signal pin on the extension harness connector to all other pins in the extension harness connector.

e. If all measurements are greater than 100K ohms, then the resistance is correct.

13.16 Code 214 - Engine Oil Temperature High - Critical

Logic:

The control has detected the engine oil temperature has exceeded the warning threshold.

Possible Causes:

1. High ambient temperature
2. Radiator blocked
3. Louvers are closed or damaged
4. Charge air cooler fins or radiator fins are damaged or obstructed
5. Coolant level is below specification
6. Fan shroud is damaged or air recirculation baffles are damaged
7. Fan belt is broken or loose
8. Fan drive or fan controls are malfunctioning
9. Thermostat is faulty
10. Cooling system hose is collapsed, restricted or leaking
11. Intake manifold air temperature is above specification
12. Water pump is malfunctioning
13. Oil temperature sensor is inaccurate or faulty
14. Fault simulation is enabled

15. Threshold is set too high

Diagnosis and Repair:

1. High ambient temperature
   a. Using thermocouple verify air temperature entering intake louver of generator.
   b. Reduce loads or recirculation of discharge air to generator in elevated ambient.
2. Radiator blocked
   a. Inspect radiator for debris or blockages.
   b. Remove blockage or winter front as applicable.
3. Louvers are closed or damaged
   a. Inspect louvers for proper operation.
   b. Repair or replace if damaged.
   c. Check louver motor for proper operation.
   d. If louver motor is operational, verify louver shutter thermostat is operational.
4. Charge air cooler fins or radiator fins are damaged or obstructed
   a. Inspect for dirt, debris or obstructions.
   b. Clean if necessary.
5. Coolant level is below specification
   a. Inspect the engine, cooling system, and surrounding area for external coolant leaks.
   b. Repair as required.
   c. Inspect the coolant level is correct via the sight glass.
   d. Add coolant as necessary .
6. Fan shroud is damaged or air recirculation baffles are damaged
   a. Inspect shroud and baffles for damage and clearance.
   b. Repair or replace if damaged.
7. Fan belt is broken or loose
   a. Inspect belt(s) for damage, wear, and proper tension.
   b. Repair or replace if damaged or worn.
8. Fan drive or fan controls are malfunctioning
   a. Inspect pullies and belt tensioner for damage or wear.
   b. Repair or replace if damaged or worn.
9. Thermostat is faulty
   a. Remove thermostat and inspect/test for proper operation.
   b. Replace if damaged or malfunctioning.
10. Cooling system hose is collapsed, restricted or leaking
    a. Inspect upper and lower radiator hoses for collapse, distortion, or fluid leaks.
    b. Replace if damaged or worn.
11. Intake manifold air temperature is above specification
    a. Use the thermocouple to verify manifold air temperature.

   b. Repair or replace faulty after cooler components.

12. Water pump is malfunctioning
    a. Inspect water pump for proper operation.
    b. Replace if damaged or worn.

13. Oil temperature sensor is inaccurate or faulty
    a. Use a thermocouple or similar device to measure oil temperature near sender and compare to oil temperature displayed.
    b. Verify the temperature sender resistance and compare to specifications called out in the engine manual.
    c. Verify continuity from temperature sender. Harness resistance should be less than 5 Ohms.
    d. Repair or replace faulty components or wiring.

14. Fault simulation is enabled
    a. Connect InPower.
    b. Reconfigure generator and disable fault overrides.

15. Threshold is set too high
    a. Verify fault threshold settings and compare to the specifications called out in the engine manual.
    b. Verify PCC calibration number and revision is correct.
    c. Reset the threshold settings.

13.17 Code 234 - Engine Speed High - Critical

Logic:

Engine speed signals indicate the engine speed is greater than the shutdown threshold.

Possible Causes:

1. Fault simulation feature is enabled.
2. Incorrect threshold setting.
3. Incorrect fuel type setting.
4. Faulty engine speed sensor connections.
5. Faulty engine harness.
6. Faulty extension harness.
7. Faulty engine speed/position sensor.

Diagnosis and Repair:

1. Verify that the fault simulation feature is not enabled.
   a. Connect InPower.
   b. Verify that the fault simulation is NOT enabled for the engine speed sensor by connecting to the PCC via InPower. If fault simulation is disabled, there is no problem.
2. Check threshold settings.
   a. Connect InPower.

   b. Verify that the fault threshold is set correctly for the normal operating range for the engine overspeed sensor. Refer to the engine manual for correct threshold values, and make the appropriate changes using InPower.

3. Check for the correct fuel type setting.
   a. Connect InPower.
   b. Verify the fuel source set in InPower is the same fuel used by the generator set.
4. Engine speed sensor connections.

   Inspect the engine speed sensor and the harness connector pins.
   a. Disconnect the engine harness connector from the engine speed sensor.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.
5. Faulty engine harness.

   Inspect the engine harness and the connector pins.
   a. Disconnect the engine harness connector from the extension harness.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.
6. Faulty extension harness.

   Inspect the extension harness and the AUX 105 connector pins.
   a. Disconnect the extension harness connector from the AUX 105.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.
7. Faulty engine speed/position sensor.

   Inspect the engine speed/position sensor.
   a. Disconnect the engine speed/position sensor from the engine and engine harness.
   b. Inspect sensor for bent, corroded, or loose pins.
   c. Inspect the sensor for structural deficiencies.

13.18 Code 235 - Low Coolant Level

Logic:

Low Coolant Level input is active and the threshold response is set to “Shutdown".

Possible Causes:

1. The radiator coolant level is low.
2. Faulty sensor or wiring.
3. PCCNet Annunciator.
4. The base board is faulty.

Diagnosis and Repair:

1. Check the radiator coolant level to see if it is adequate.
   a. Add coolant to the radiator, if coolant level is low.
2. Faulty sensor or wiring.
   a. Disconnect the signal leads at the sensor, so the sensor is no longer connected to the control; then reset the control by pressing the Reset button. If event/fault code 197 clears and does not reappear, then replace the low coolant level sensor.
   b. If event/fault code 197 reappears, check for a short in the wiring between the low coolant level sensor and the input to the control (at J20-17: Input and J20-5: Ground). A ground input into J20-17 will activate the alarm at the control.
3. PCCNet Annunciator.
   a. If a PCCNet Annunciator is not used, go to step 4. If a PCCNet Annunciator is used, check the wiring on the back of the PCCNet Annunciator at TB1-6 to the Low Coolant Level sender. Ensure that an open circuit or short circuit does not exist in the wiring.
   b. Refer to the PCCNet Annunciator Operator's Manual to ensure that the Annunciator is configured correctly; since inputs can be configured to Active Open or Active Closed. Then check the input on the back of the PCCNet Annunciator at TB1 – 6 and ensure that the input signal into the PCCNet Annunciator is properly configured.
4. The base board is faulty.
   a. If the wiring and hardware are not found to be faulty, replace the base board.

13.19 Code 236 - Engine Speed/Position Sensor Circuit

Logic:

Engine speed/position sensor signal is not detected.

Possible Causes:

1. Inaccurate engine speed/position sensor.
2. Faulty engine speed sensor connections.
3. Faulty engine harness.
4. Faulty extension harness.
5. Faulty engine speed/position sensor.

If the generator set stalls after starting, this is not a control issue.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. Inaccurate engine speed/position sensor.

   Check the sensor gap.

   a. Measure the sensor gap.

   b. Refer to the engine manual for appropriate gap size, and adjust as necessary.

2. Engine speed sensor connections

   Inspect the engine speed sensor and the harness connector pins.

   a. Disconnect the engine harness connector from the engine speed sensor.

   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

   d. Inspect for missing or damaged connector seals.

   e. Inspect for dirt or debris in or on the connector pins.

3. Faulty engine harness.

   Inspect the engine harness and the extension harness connector pins.

   a. Disconnect the engine harness connector from the extension harness.

   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

   d. Inspect for missing or damaged connector seals.

   e. Inspect for dirt or debris in or on the connector pins.

   Check for a short circuit from pin-to-pin.

   a. Disconnect the engine harness connector from the extension harness.

   b. Disconnect the engine harness from the engine speed sensor.

   c. Disconnect the engine harness from all sensors that have a shared return with the engine speed sensor.

   d. Measure the resistance from the engine speed return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

   e. Measure the resistance from the engine speed signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

   f. If all measurements are greater than 100K ohms, then the resistance is correct.

   Check for an open circuit.

   a. Disconnect the engine harness connector from the extension harness.

   b. Disconnect the engine harness from the engine speed sensor.

   c. Measure the resistance from the engine speed return pin on the engine harness inline connector to the engine speed return pin at the engine harness sensor connector.

   d. Measure the resistance from the engine speed signal pin on the engine harness inline connector to the engine speed signal pin at the engine harness sensor connector.

   e. If all measurements are less than 10 ohms, then the resistance is correct.

4. Faulty extension harness.

   Inspect the extension harness and the AUX 105 connector pins.

   a. Disconnect the extension harness connector from the engine extension harness.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

   Check for an open circuit.

   a. Disconnect the extension harness connector from the AUX 105.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the engine speed signal pin on the extension harness connector to the engine speed signal pin at the extension harness inline connector.
   d. Measure the resistance from the engine speed return pin on the extension harness connector to the engine speed return pin at the extension harness inline connector.
   e. If all measurements are less than 10 ohms, then the resistance is correct.

   Check for a short circuit from pin-to-pin.

   a. Disconnect the extension harness from the AUX 105.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the engine speed return pin on the extension harness connector to all other pins in the extension harness connector.
   d. Measure the resistance from the engine speed signal pin on the extension harness connector to all other pins in the extension harness connector.
   e. If all measurements are greater than 100K ohms, then the resistance is correct.

5. Faulty sensor.

   Inspect the engine speed sensor.

   a. Disconnect the engine speed/position sensor from the engine and engine harness.
   b. Inspect the sensor for bent, corroded, or loose pins.
   c. Inspect the sensor for structural deficiencies.

13.20 Code 359 - Fail To Start

Logic:

Engine has failed to start after the last crank cycle.

Possible Causes:

1. There is an insufficient fuel level.
2. There is a restricted fuel supply.
3. The fuel solenoid does not energize.
4. Faulty glow relay or glow plug settings.

5. Faulty ignition relay.
6. Incorrect flywheel teeth setting.
7. Incorrect starter disconnect speed.
8. Faulty engine harness or extension harness.

Diagnosis and Repair:

1. Check to see if there is an insufficient fuel level.
   a. Add fuel to the fuel tank if fuel level is low.
2. Check to see if there is a restricted fuel supply.
   a. Open any closed shutoff valves in the fuel line supplying the engine.
   b. Service clogged fuel injectors; refer to the Engine Service Manual.
   c. Bleed the air in the fuel system; refer to the Engine Service Manual.
   d. Correct any fuel leaks; replace dirty fuel filters and dirty or plugged air filters.
3. Check to see if the fuel solenoid does not energize.
   a. Check the fuse (20 amp) on J20-21. Replace if open.
   b. Measure the voltage at the input of the Fuel Solenoid Relay (E-Stop B+ (B+) and J20-14 (negative)) and attempt to start the engine.
      - If B+ is not available, check the wiring for an open circuit from the base board to the Fuel Solenoid Relay; correct if there is an open circuit. If the wiring is not faulty, replace the base board.
      - If B+ is properly supplied to the relay but not found at the output, replace the Fuel Solenoid Relay.

Glow Plugs

1. Check the glow plug relay at J11-6 and J11-7. When active, J11-6 should have B+, and J11-7 should be ground.
2. Connect to the control via InPower.
   - Make sure *Glow Plug Enable* is Enabled.
   - Make sure *Max Preheat Temperature* and *Min Preheat Temperature* are set appropriately. *Min Preheat Temperature* should be less than *Max Preheat Temperature*.
   - Make sure *Max Glow Time* is set appropriately.

Ignition Relay

Check the ignition relay at J11-6 and J11-7. When normal operation, J11-6 should have B+, and J11-7 should be ground.

Flywheel Teeth

Connect to the control via InPower. Make sure *Teeth Pulses Per Revolution* matches the actual number of flywheel teeth.

Starter Disconnect

Connect to the control via InPower. Make sure *Starter Disconnect Speed* is set to a reasonable value. Check the engine manual.

Governor

Faulty engine harness.

1. Inspect the engine harness and the connector pins.
   a. Disconnect the engine harness connector from the extension harness.
   b. Inspect for corroded pins, bent or broken pins, and pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pin.
2. Check for a short circuit from pin to pin.
   a. Disconnect the engine harness from the extension harness.
   b. Disconnect the engine harness connector from the oil pressure sensor.
   c. Disconnect the engine harness from all sensors that have a shared supply or return with the oil pressure sensor.
   d. Measure the resistance from the oil pressure 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   e. Measure the resistance from the oil pressure return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   f. Measure the resistance from the oil pressure signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   g. If all measurements are greater than 100k ohms, then the resistance is correct.
3. Check for an open circuit.
   a. Disconnect the engine harness from the extension harness.
   b. Disconnect the engine harness connector from the oil pressure sensor.
   c. Measure the resistance from the oil pressure return pin on the engine harness inline connector to the oil pressure return pin on the engine harness sensor connector.
   d. If the measurement is less than 10 ohms, then the resistance is correct.

Faulty extension harness.

1. Inspect the extension harness and the AUX 105 connector pins.
   a. Disconnect the extension harness connector from the AUX 105.
   b. Inspect for corroded pins, bent or broken pins, and pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.
2. Check for an open circuit.
   a. Disconnect the extension harness connector from the AUX 105.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the oil pressure return pin on the extension harness connector to the oil pressure return pin on the extension harness inline connection.
   d. If the measurement is less than 10 ohms, then the resistance is correct.

3. Check for a short circuit from pin to pin.
   a. Disconnect the extension harness connector from the AUX 105.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the oil pressure 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.
   d. Measure the resistance from the oil pressure return pin on the extension harness connector to all other pins in the extension harness connector.
   e. Measure the resistance from the oil pressure signal pin on the extension harness connector to all other pins in the extension harness connector.
   f. If all measurements are greater than 100k ohms, then the resistance is correct.

13.21 Code 415 - Engine Oil Pressure Low - Critical

Logic:

Voltage signal indicates oil pressure has dropped below the shutdown threshold.

Diagnosis and Repair:

See Fault Code 143.

13.22 Code 421 – Engine Oil Temperature High (Warning)

Logic:

The control has detected the engine oil temperature has exceeded the warning threshold.

Possible Causes:

1. High ambient temperature
2. Radiator blocked
3. Louvers are closed or damaged
4. Charge air cooler fins or radiator fins are damaged or obstructed
5. Coolant level is below specification
6. Fan shroud is damaged or air recirculation baffles are damaged
7. Fan belt is broken or loose
8. Fan drive or fan controls are malfunctioning
9. Thermostat is faulty
10. Cooling system hose is collapsed, restricted or leaking
11. Intake manifold air temperature is above specification
12. Water pump is malfunctioning
13. Oil temperature sensor is inaccurate or faulty
14. Fault simulation is enabled
15. Threshold is set too high

Diagnosis and Repair:

1. High ambient temperature
   a. Using thermocouple verify air temperature entering intake louver of generator.
   b. Reduce loads or recirculation of discharge air to generator in elevated ambient.
2. Radiator blocked
   a. Inspect radiator for debris or blockages.
   b. Remove blockage or winter front as applicable.
3. Louvers are closed or damaged
   a. Inspect louvers for proper operation.
   b. Repair or replace if damaged.
   c. Check louver motor for proper operation.
   d. If louver motor is operational, verify louver shutter thermostat is operational.
4. Charge air cooler fins or radiator fins are damaged or obstructed
   a. Inspect for dirt, debris or obstructions.
   b. Clean if necessary.
5. Coolant level is below specification
   a. Inspect the engine, cooling system, and surrounding area for external coolant leaks.
   b. Repair as required.
   c. Inspect the coolant level is correct via the sight glass.
   d. Add coolant as necessary .
6. Fan shroud is damaged or air recirculation baffles are damaged
   a. Inspect shroud and baffles for damage and clearance.
   b. Repair or replace if damaged.
7. Fan belt is broken or loose
   a. Inspect belt(s) for damage, wear, and proper tension.
   b. Repair or replace if damaged or worn.
8. Fan drive or fan controls are malfunctioning
   a. Inspect pullies and belt tensioner for damage or wear.
   b. Repair or replace if damaged or worn.
9. Thermostat is faulty
   a. Remove thermostat and inspect/test for proper operation.
   b. Replace if damaged or malfunctioning.
10. Cooling system hose is collapsed, restricted or leaking
    a. Inspect upper and lower radiator hoses for collapse, distortion, or fluid leaks.
    b. Replace if damaged or worn.
11. Intake manifold air temperature is above specification
    a. Use the thermocouple to verify manifold air temperature.
    b. Repair or replace faulty after cooler components.

12. Water pump is malfunctioning
    a. Inspect water pump for proper operation.
    b. Replace if damaged or worn.
13. Oil temperature sensor is inaccurate or faulty
    a. Use a thermocouple or similar device to measure oil temperature near sender and compare to oil temperature displayed.
    b. Verify the temperature sender resistance and compare to specifications called out in the engine manual.
    c. Verify continuity from temperature sender. Harness resistance should be less than 5 Ohms.
    d. Repair or replace faulty components or wiring.
14. Fault simulation is enabled
    a. Connect InPower.
    b. Reconfigure generator and disable fault overrides.
15. Threshold is set too high
    a. Verify fault threshold settings and compare to the specifications called out in the engine manual.
    b. Verify PCC calibration number and revision is correct.
    c. Reset the threshold settings.

13.23 Code 441 - Low Battery Voltage

Logic:

Low battery voltage.

Possible Causes:

1. Damaged battery cable connections.
2. Low battery voltage.
3. Bad battery ground connection.
4. Damaged accessory wiring at B+.
5. Damaged OEM battery harness.
6. Damaged engine harness.
7. Discharged or defective battery.
8. Alternator not functioning properly.
9. Incorrect battery setting.
10. The control board or harness is faulty.

NOTICE
Part Number 382275800 - Male Deutsch/AMP/Metri-Pack test lead   **Part Number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. Inspect the battery cable connections.
   a. Inspect connections for corrosion.
   b. Inspect connections for loose connections.
2. Measure the battery voltage.
   a. Measure the battery voltage from the positive (+) terminal to the negative (-) terminal. If the voltage is between 17.3 and 34.7 V on a 24 VDC system, then the voltage is within normal range.
3. Inspect the battery ground connection.
   a. Disconnect the engine harness.
   b. Measure the resistance from the negative (-) battery terminal to the engine block ground. If the resistance is less than 10 ohms, then there exists proper grounding. If the resistance is greater than 10 ohms, then the battery ground connection is in need of repair.
4. Check for add-on or accessory wiring at the positive (+) terminal of the battery.
   a. Starting at the positive (+) terminal, follow any add-on or accessory wiring and examine the wire(s) for damaged insulation or installation error that can cause supply wire to be shorted to the engine block.
5. Damaged OEM battery harness.

   Inspect the OEM battery harness and the Inline E connector pins.
   a. Disconnect the OEM battery harness from the Inline E connector.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt and debris in or on the connector pins.

   Check for an open circuit.
   a. Disconnect the OEM battery harness from the engine.
   b. Disconnect the positive (+) battery terminal.
   c. Measure the resistance from all pins being supplied by unswitched battery on the OEM battery harness at the Inline E connector to the positive (+) battery terminal connector. If the resistance is less than 10 ohms, then there is not an open circuit. If the resistance is greater than 10 ohms, then there is an open circuit that is in need of repair.

   Check for a short circuit from pin to pin.
   a. Disconnect the engine harness.
   b. Disconnect the positive (+) battery terminal.
   c. Measure the resistance from all unswitched battery pins on the Inline E connector to all other pins on the Inline E connector. If the resistance is more than 100k ohms, then there is not a short circuit. If the resistance is less than 100k ohms, then there is a short circuit that is in need of repair.
6. Damaged engine harness.

   Inspect the engine harness fuse connection. Inspect that it is installed correctly.

Check the engine harness fuse.

a. Disconnect the 20 amp fuse from the OEM harness.

b. Inspect that the 20 amp to verify the fuse is not blown.

Inspect the engine harness and the extension harness inline connector pins.

a. Disconnect the engine harness.

b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.

c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seals.

e. Inspect for dirt and debris in or on the connector pins.

Check for an open circuit.

a. Disconnect the OEM battery harness from the engine connector.

b. Disconnect the positive (+) battery terminal.

c. Measure the resistance from all pins being supplied by unswitched battery on the OEM battery harness at the Inline E connector to the positive (+) battery terminal connector. If the resistance is less than 10 ohms, then there is not an open circuit. If the resistance is greater than 10 ohms, then there is an open circuit that is in need of repair.

Check for a short circuit from pin to pin.

a. Disconnect the engine harness.

b. Disconnect the positive (+) battery terminal.

c. Measure the resistance from all unswitched battery pins on the Inline E connector to all other pins on the Inline E connector. If the resistance is more than 100k ohms, then there is not a short circuit. If the resistance is less than 100k ohms, then there is a short circuit that is in need of repair.

7. Weak or discharged battery. If the battery cannot hold adequate voltage, then replace the battery

   a. Measure the voltage of the battery with a voltmeter. Battery voltage should be 24 VDC or greater in a 24 V system. If the battery voltage is low, check the electrolyte level. Replenish the electrolyte level if low and recharge the battery; the specific gravity of a fully charged lead acid battery is approximately 1.260 at 80 F (27 C).

   b. If the battery cannot hold adequate voltage, then replace the battery.

8. Check engine DC alternator.

   a. Check the engine DC alternator. If charging voltage is not 12-14 VDC for a 12 V system, or 24-26 VDC in a 24 V system, replace the alternator.

9. Check battery voltage setting.

   a. Verify that the battery voltage (12V or 24V) matches calibration.

10. Check to see if the control board or harness is faulty.

    a. Measure the battery voltage at the battery terminals; then measure the battery voltage at the base board input. Measure the voltage at B+ (J20-9, J20-10, J20-20, J20-21) and B- (negative) input (J20-2, J20-4, J20-7, J20-12).

       - If the voltage at the battery terminals and the control is not the same, check the harness and replace if necessary.

- If the voltage at the battery terminals and the control are the same, replace the base board.

13.24 Code 442 - High Battery Voltage

Logic:

High battery voltage.

Possible Causes:

1. Incorrect battery voltage setup
2. The voltage of the battery is above the high battery voltage threshold.
3. Battery charger is overcharging the battery.
4. Faulty engine DC alternator.

NOTICE
Part Number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part Number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Diagnosis and Repair:

1. Incorrect battery voltage setup
   a. Measure the voltage of the battery with a voltmeter. Battery voltage of lead acid batteries should be between 12-14 VDC in a 12 VDC system or 24-28 VDC in a 24 VDC system. Verify that the battery voltage matches the voltage that the control is calibrated for. If the genset has a 24 V battery, but the control is calibrated to 12 V, the high battery voltage alarm will activate. In these cases, change the voltage on the control to 24 V. To access the battery voltage setup menu from the operator panel, go to **Setup > OEM Setup > OEM Engine Setup > Nominal Battery Voltage**. You can also use InPower.
2. The voltage of the battery is above the high battery voltage threshold.
   a. Voltage of the battery is above the “High Battery" threshold for the time set in the “High Battery Set Time" parameter. To access the battery voltage setup menu from the operator panel, go to **Setup > OEM Setup > OEM Engine Setup > Nominal Battery Voltage** and change the battery voltage setup of the control accordingly. You can also use InPower.
3. Battery charger is overcharging the battery.
   a. Ensure that the battery charger is charging the battery at an acceptable rate and not overcharging the battery. Adjust the charge rate of the battery charger if the charge rate is above the recommendation of the manufacturer.
   b. Refer to the battery charger manual, if available.
4. Faulty engine DC alternator.
   a. Check the engine DC alternator for overcharging conditions. If charging voltage is not 12-14 VDC in a 12 V system or 24-28 VDC in a 24 V system, replace the DC alternator.

13.25 Code 488 - Intake Manifold Temperature Moderately Above Normal

Logic:

Intake manifold temperature has exceeded the warning threshold for high intake manifold temperature.

Possible Causes:

1. Large load or high ambient temperature.
2. Inaccurate intake manifold temperature sensor.
3. Fault simulation feature is enabled.
4. Threshold setting too low.

Diagnosis and Repair:

1. Large load or high ambient temperature.
    a. Allow the engine to cool down completely.
    b. Look for possible coolant leakage points and repair as necessary.
    c. Check the coolant level and replenish if low.
    d. Check for obstructions to cooling airflow and correct as necessary.
    e. Check the fan belt and repair or tighten if necessary.
    f. Check the blower fan and circulation pumps on remote radiator installations.
    g. Reset the control and restart.
2. Verify the sensor accuracy with a thermocouple or similar temperature probe.
    a. Connect the temperature probe to the engine near the intake manifold temperature sensor.
    b. Connect InPower.
    c. Compare the intake manifold temperature reading from the service tool to the reading from the temperature probe. If the two readings are reasonably close, then the sensor is reading correctly.
3. Verify that the fault simulation for the sensor is not enabled.
    a. Connect InPower.
    b. Verify that the fault simulation is NOT enabled for the intake manifold temperature sensor by connecting to the PCC via InPower. If the fault simulation is disabled, there is no problem.
4. Check threshold settings.
    a. Connect InPower.
    b. Verify that the fault threshold is within the normal operating range for the intake manifold temperature sensor. Refer to the engine service manual for correct threshold values, and make the appropriate changes using InPower.

13.26 Code 611 - Engine Hot Shut Down

Logic:

Engine shutdown hot without a proper cooldown run period.

Possible Causes:

1. Critical Shutdown fault.
2. Emergency shutdown.
3. Incorrect shutdown of genset.

Diagnosis and Repair:

1. Critical Shutdown fault.
   a. A critical shutdown fault (e.g., overspeed) has caused the engine to shut down immediately without allowing the engine to complete the proper cooldown process. Troubleshoot the other shutdown fault(s) that are causing the genset to shut down.
2. Emergency shutdown.
   a. An Emergency Stop command has immediately shutdown the engine, which has bypassed the proper cooldown process for the engine.
3. Incorrect shutdown of genset.
   a. The genset has been shut down without allowing the proper cooldown process for the engine (control switched to OFF manually by user/operator).

13.27 Code 1121 - Fail To Disconnect

Logic:

If the “Fail To Disconnect Enable" parameter is set to enable, and the Genset CB and Utility CB Fail to Open Faults are both active, the genset control will display event/fault code 1121.

Possible Causes:

1. Event/fault code 1221 is mapped to a configurable output and event/fault code 1453 and event/fault code 2397 are active.

Diagnosis and Repair:

1. Event/fault code 1221 is mapped to a configurable output and event/fault code 1453 and event/fault code 2397 are active.
   a. Event/fault code 1221 can be mapped to send an external notification thru a configurable customer output relay on the base board to an external device that the Genset CB and Utility CB have failed to open. This fault will become active if the “Fail To Disconnect Enable" parameter is set to enable, event/fault code 1221 is mapped to a configurable output, and if event/fault code 1453 and event/fault code 2397 are active. Troubleshoot event/fault code 1453 and event/fault code 2397 to resolve this issue.

      To disable event/fault code 1221 go to **Setup > Paralleling Setup > Power Transfer Control > Fail to Disc En** on the display and set the “Fail To Disconnect Enable" parameter to Disable, then determine which configurable output is set to activate when event/fault code 1221 is active and go to: **Setup > Configurable I/O** on the display and remove the mapping of event/fault code 1221 to that output.

13.28 Code 1122 - Delayed Rated To Idle Transition

Logic:

If the "Rated to Idle Transition Delay" is greater than zero, event/fault code 1122 will become active when the genset transitions from rated to idle.

Possible Causes:

1. The genset is transitioning from rated to idle mode.

Diagnosis and Repair:

1. Event/fault code 1122 is set to “Warning" or “Shutdown" and the genset is transitioning from rated to idle mode.
    a. This event/fault code can be mapped to a configurable customer output relay in order to send external notification via the relay on the base board to users so that proper action can be taken in the time given before the genset transitions to idle. This fault can be disabled by setting the "Rated to Idle Transition Delay" to 0 seconds. To access the setup menu through the Operator Panel, go to **Setup > Genset Setup > Rated to Idle Delay** and set appropriately.

13.29 Fault Code 1123 - Shutdown After Battle Short

Lamp: Warning

Corrective Action: A shutdown fault occurred while Battle Short was enabled and Battle Short transitioned from enabled to disabled. Review the Fault History and perform corrective action.

13.30 Code 1124 - Delayed Shutdown

Logic:

Provides advance warning of an impending genset shutdown to loads which cannot handle sudden losses of power.

Possible Causes:

1. A shutdown fault.

Diagnosis and Repair:

1. A shutdown fault.
    a. Event/fault code 1124 is activated as a result of another non-critical shutdown fault. Troubleshoot the other non-critical shutdown fault(s) that is(are) causing the genset to shutdown. This event/fault code was designed to send an external notification through a configurable customer output relay on the base board to loads which cannot handle a sudden loss of power. The genset base board will send a signal to critical loads and will wait for the amount of time in the “Delayed Shutdown Time" parameter before shutting down the genset. go to **Setup > Genset Setup > Delayed shutdown delay** from the operator panel and set appropriately.

13.31 Code 1131 - Battle Short Active

Logic:

Battle Short has been enabled.

Possible Causes:

1. Battle Short enabled.

Diagnosis and Repair:

1. Disable Battle Short.
    a. The purpose of this fault is to provide a record in the fault history and fault occurrence list that the Battle Short feature is activate. The Battle Short fault becomes active when all of the following are true:
        - The Battle Short parameter is Enabled.
        - One of the configurable inputs on the base board is configured for Battle Short.
        - The configurable input configured for Battle Short becomes Active.

13.32 Code 1132 - Controlled Shutdown

Logic:

A fault set to Shutdown with Cooldown is active and has put the genset in a controlled shutdown.

Possible Causes:

1. A fault set to Shutdown with Cooldown is active.

Diagnosis and Repair:

1. A fault is set to Shutdown with Cooldown is active.
    a. Event/fault code 1132 is activated by another active event/fault that is set to "Shutdown with Cooldown". Troubleshoot the other shutdown fault(s) that are causing the genset to shutdown. A controlled shutdown of the system allows first for loads to be transferred or ramped off, and then for a proper cooldown of the genset to take place before shutting down. Go to **Setup > Genset Setup > Ctrld Shutdown Advance** from the Operator Panel in order to appropriately set the Controlled Shutdown Advanced Notice Delay.

13.33 Code 1219 - Utility CB Tripped

Logic:

The Utility CB has tripped.

Possible Causes:

1. Overload, Short Circuit, or Ground Fault.
2. Incorrectly wired or short circuit.
3. CB Trip solenoid is incorrectly configured or faulty.

4. Faulty Utility CB.

Diagnosis and Repair:

1. Overload, Short Circuit, or Ground Fault.
   a. Check the load of the application, load cables, and the ground fault relay if available. Repair if necessary.
2. Incorrectly wired or short circuit.
   a. Verify the wiring from the Utility CB to the Utility CB Tripped status input on the base board. The Utility CB Tripped status input is a Normally Open contact at TB10-5 and TB10-1 (B+ Return). Ensure that the connection from the Utility CB to TB10-5 on the base board is not shorted to ground.
3. CB Trip solenoid is incorrectly configured or faulty.
   a. Utility CB Trip settings are configured to trip at a low over-current threshold. Check other settings on the Utility CB that might cause it to trip since circuit breakers can have multiple trip settings. Configure the Utility CB Trip Solenoid to trip at adequate trip settings for the application; refer to the CB Service Manual.
   b. Faulty Trip solenoid, refer to the CB Service Manual for troubleshooting instructions.
4. Faulty Utility CB.
   a. Refer to the Utility CB Service Manual.

13.34 Code 1223 - Utility Frequency Error

Logic:

In Power Transfer Control (PTC) Operation, if the “Utility Frequency Sensor Enable" parameter is enabled and the utility frequency exceeds the “Utility Frequency Upper Drop-Out Threshold", or is below the “Utility Frequency Lower Drop-Out Threshold", or is Out of Range Low, for the “Utility Frequency Drop-Out Delay", fault code 1223 will become active.

Possible Causes:

1. Utility Frequency drop-out thresholds are incorrectly set.
2. The frequency of the Utility is not stable.

Diagnosis and Repair:

1. Utility Frequency drop-out thresholds are incorrectly set.
   a. This fault will become active when the Utility Frequency goes above or below the drop-out thresholds. Drop-out threshold are dependent of the following parameters:
      - Utility Center Frequency.
      - Utility Frequency Pick-Up Bandwidth.
      - Utility Frequency Drop-Out Bandwidth.

      To Modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Center Frequency** or **Pick-Up BW** or **Drop-out BW** or **Drop-Out Delay** and set appropriately. Refer to the PTC section for setup information and instructions.

b. To disable this function, set the “Utility Frequency Sensor Enable" parameter to disable. On the display go to: **Setup > Paralleling Setup > Power Transfer Control > Enable** and set appropriately. Refer to the PTC section for more information.

2. The frequency of the Utility is not stable.

   a. The frequency of the utility is unstable, check with your utility company.

13.35 Code 1224 - High Genset Voltage

Logic:

In Power Transfer Control (PTC) Operation, if the “Genset Overvoltage Sensor Enable" parameter is set to enable, and the genset voltage goes above the “Genset Overvoltage Drop-Out Threshold", for the “Genset Overvoltage Drop-Out Delay" time, fault code 1224 will become active.

Possible Causes:

1. Genset High AC Voltage fault.
2. Genset Overvoltage drop-out thresholds are incorrectly set.
3. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Genset High AC Voltage fault.

   a. If the High AC Voltage fault is active on the display, refer to the troubleshooting procedures for High AC Voltage, fault code 1446.

2. Genset Overvoltage drop-out thresholds are incorrectly set.

   a. This fault will become active when the Genset voltage goes above the “Genset Overvoltage Drop-Out Threshold" for the “Genset Overvoltage Drop-Out Delay" time. The genset overvoltage drop-out threshold is dependent of the following parameters:

      - Genset Overvoltage Drop-out percentage.
      - Genset Overvoltage Drop-out Delay.

      To Modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Drop out** or **Drop-Out Delay** and set appropriately. Refer to the PTC section for setup information and instructions.

   b. To disable this function, set the “Genset Overvoltage Sensor Enable" parameter to disable. On the display go to: **Setup > Paralleling Setup > Power Transfer Control > Enable** and set appropriately. Refer to the PTC section for more information.

13.36 Code 1225 - Low Genset Voltage

Logic:

In Power Transfer Control (PTC) Operation, if the genset voltage drops below the “Genset Undervoltage Drop-Out Threshold", for the “Genset Undervoltage Drop-Out Delay" time, fault code 1225 will become active.

Possible Causes:

1. Genset Low AC Voltage fault.
2. Genset Undervoltage drop-out thresholds are incorrectly set.
3. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Genset Low AC Voltage fault.
   a. If the Low AC Voltage fault is active on the display, refer to the troubleshooting procedures for Low AC Voltage, fault code 1447.
2. Genset Undervoltage drop-out thresholds are incorrectly set.
   a. This fault will become active when the Genset voltage drops below the “Genset Undervoltage Drop-Out Threshold" for the “Genset Undervoltage Drop-Out Delay" time. The genset Undervoltage drop-out threshold is dependent of the following parameters:
      - Genset Undervoltage Drop-out percentage.
      - Genset Undervoltage Drop-out Delay.

      To Modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Drop out** or **Drop-Out Delay** and set appropriately. Refer to the PTC section for setup information and instructions.

13.37 Code 1226 - Genset Frequency Error

Logic:

In Power Transfer Control (PTC) Operation, if the “Genset Frequency Sensor Enable" parameter is enabled and the genset frequency exceeds the “Genset Frequency Upper Drop-Out Threshold", or is below the “Genset Frequency Lower Drop-Out Threshold", or is Out of Range Low, for the “Genset Frequency Drop-Out Delay", fault code 1226 will become active.

Possible Causes:

1. Genset Frequency drop-out thresholds are incorrectly set.
2. The frequency of the Genset is not stable.
3. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Genset Frequency drop-out thresholds are incorrectly set.
   a. This fault will become active when the Genset Frequency goes above or below the drop-out thresholds. Drop-out threshold are dependent of the following parameters:
      - Genset Center Frequency.
      - Genset Frequency Pick-Up Bandwidth.
      - Genset Frequency Drop-Out Bandwidth.

To Modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Center Frequency** or **Pick-Up BW** or **Drop-out BW** or **Drop-Out Delay** and set appropriately. Refer to the PTC section for setup information and instructions.

2. The frequency of the Genset is not stable.
   a. If the genset frequency is not stable or the genset is hunting/oscillating while it is running, refer to the troubleshooting procedures for fault codes 1448 and 1449.

13.38 Code 1243 - Engine Derated

Logic:

Event/fault code 1243 will become active if the engine has gone into a derate mode to protect itself from a shutdown, and if there are no other active derate events on the PCC.

Possible Causes:

1. A derate condition has been initiated.

Diagnosis and Repair:

1. A derate condition has been initiated.
   a. Event/fault code 1243 is activated by another active engine fault. Determine the fault(s) that caused the engine to derate by checking the operator panel or using InPower. Troubleshoot the event/fault(s) and resolve the issue(s) (Reference the Engine Service Manual). After the issue is resolved, press the Reset button on the genset control to allow the genset to return to a normal mode of operation. If the issue is not resolved when the Reset button is pressed, the engine will stay in derated mode.

13.39 Code 1244 - Engine Normal Shutdown

Logic:

A normal shutdown request has been received by the engine and no active Shutdown with Cooldown faults exist.

Possible Causes:

1. The genset is going through a normal shutdown.

Diagnosis and Repair:

1. The genset is going through a normal shutdown.
   a. The genset is going through a normal shutdown and there are no active shutdown faults.

13.40 Code 1245 - Engine Shutdown Fault

Logic:

Engine shutdown fault has occurred.

Possible Causes:

1. Engine shutdown fault.

Diagnosis and Repair:

1. Engine shutdown fault.
    a. Event/fault code 1245 is activated by another active shutdown fault. Troubleshoot the shutdown fault(s) (Reference the Engine Service Manual).

13.41 Code 1246 - Unknown Engine Fault

Logic:

An unrecognized engine fault has been received over the datalink.

Possible Causes:

1. The genset control has received an unknown event/fault.

Diagnosis and Repair:

1. The genset control has received an unknown event/fault.
    a. Troubleshoot the fault(s) that are causing the genset to display event/fault code 1246 (Reference the Engine Service Manual).

13.42 Code 1248 - Engine Warning

Logic:

An engine warning fault has occurred.

Possible Causes:

1. An engine warning fault is active.

Diagnosis and Repair:

1. An engine warning fault is active.
    a. Event/fault code 1248 is activated by another active warning fault. Troubleshoot the warning fault(s) (Reference the Engine Service Manual).

13.43 Code 1312 - Config Input #2 Fault

Logic:

Configurable input #2 fault is active.

Possible Causes:

1. Condition for which "Configurable Input #2" is configured for is active.
2. “Configurable Input #2 Active State Selection" parameter is configured incorrectly.
3. Incorrectly wired; or open circuit or short circuit in the wiring.
4. The base board is faulty.

Diagnosis and Repair:

1. Condition for which "Configurable Input #2" is configured for is active.
   a. Check the condition for which "Configurable Input #2" has been configured for; ex. if "Configurable Input #2" was configured to become active when the fuel level is low, check the fuel level and add fuel if needed. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to step 2.
2. “Configurable Input #2 Active State Selection" parameter is configured incorrectly.
   a. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Configurable Input #2. Ensure that the switch input setting is correctly set. If “Configurable Input #2 Input Function Pointer" parameter is set to default and if “Configurable Input #2 Active State Selection" parameter is set to “active closed", input 2 (event/fault code 1312) will become active when TB1-14 (input 2) and TB1-15 (ground) are connected (shorted) together.

      If “Configurable Input #2 Input Function Pointer" parameter is set to default and if “Configurable Input #2 Active State Selection" parameter is set to “active open", input 2 (event/fault code 1312) will become active when there is an open circuit between TB1-14 (input 2) and TB1-15 (ground).

      To access the input configuration on the operator panel go to **Setup > Configurable I/O > Config Input #2 Menu > Active** and set this parameter appropriately for the application.
3. Incorrectly wired; or open circuit or short circuit in the wiring.
   a. Check the wiring at TB1-14 (input 2) and TB1-15 (ground) for an open circuit, short circuit, or a miswired condition.
4. The base board is faulty.
   a. If the previous steps do not reveal any problems but event/fault code 1312 is still active, replace the base board.

13.44 Code 1317 - Config Input #13 Fault

Logic:

Configurable input #13 (input # 3) fault is active.

Possible Causes:

1. Condition for which "Configurable Input #3" is configured for is active.
2. “Configurable Input #13 (input #3) Active State Selection" parameter is configured incorrectly.
3. Incorrectly wired; or open circuit or short circuit in the wiring.
4. Faulty base board.

Diagnosis and Repair:

1. Condition for which "Configurable Input #3" is configured for is active.
   a. Check the condition for which "Configurable Input #3" has been configured for; ex. if "Configurable Input #3" was configured to become active when the fuel level is low, check the fuel level and add fuel if needed. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to step2.

2. “Configurable Input #13 (input #3) Active State Selection" parameter is configured incorrectly.
   a. With InPower or through the operator panel check the switch input setting (active closed or active open) for Configurable Input #3. Ensure that the switch input setting is correctly set. If “Configurable Input #13 (input #3) Input Function Pointer" parameter is set to default and if “Configurable Input #13 (input #3) Active State Selection" parameter is set to “active closed", (Input 3, event/fault code 1317) will become active when TB8-7 (input 3) and TB8-12 (ground) are connected (shorted) together.

      If “Configurable Input #13 (input #3) Input Function Pointer" parameter is set to default and if “Configurable Input #13 (input #3) Active State Selection" parameter is set to “active open", (Input 3, event/fault code 1317) will become active when there is an open circuit between TB8-7 (input 3) and TB8-12 (ground).

      To access the input configuration on the operator panel go to **Setup > Configurable I/O > Config Input #13 Menu > Active** and set this parameter appropriately for the application.
3. Incorrectly wired; or open circuit or short circuit in the wiring.
   a. Check the wiring at TB8-7 (input 3) and TB8-12 (ground) for an open circuit, short circuit, or a miswired condition.
4. The base board is faulty.
   a. If the previous steps do not reveal any problems but event/fault code 1317 is still active, replace the base board.

13.45 Code 1318 - Config Input #14 Fault

Logic:

Configurable input #14 (input #4) fault is active.

Possible Causes:

1. Condition for which "Configurable Input #4" is configured for is active.
2. “Configurable Input #14 (input #4) Active State Selection" parameter is configured incorrectly.
3. Incorrectly wired; or open circuit or short circuit in the wiring.
4. The base board is faulty.

Diagnosis and Repair:

1. Condition for which "Configurable Input #4" is configured for is active.
   a. Check the condition for which "Configurable Input #4" has been configured for; ex. if "Configurable Input #4" was configured to become active when the fuel level is low, check the fuel level and add fuel if needed. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to step 2.

2. “Configurable Input #14 (input #4) Active State Selection" parameter is configured incorrectly.
   a. With InPower or through the operator panel, check the switch input setting (active closed or active open) for Configurable Input #4. Ensure that the switch input setting is correctly set. If “Configurable Input #14 (input #4) Input Function Pointer" parameter is set to default and if “Configurable Input #14 (input #4) Active State Selection" parameter is set to “active closed", (Input 4, event/fault code 1318) will become active when TB8-8 (input 4) and TB8-13 (ground) are connected (shorted) together.

      If “Configurable Input #14 (input #4) Input Function Pointer" parameter is set to default and if “Configurable Input #14 (input #4) Active State Selection" parameter is set to “active open", (Input 4, event/fault code 1318) will become active when there is an open circuit between TB8-8 (input 4) and TB8-13 (ground).

      To access the input configuration on the operator panel go to **Setup > Configurable I/O > Config Input #14 Menu > Active** and set this parameter appropriately for the application.
3. Incorrectly wired; or open circuit or short circuit in the wiring.
   a. Check the wiring at TB8-8 (input 4) and TB8-13 (ground) for an open circuit, short circuit, or a miswired condition.
4. The base board is faulty.
   a. If the previous steps do not reveal any problems but event/fault code 1318 is still active, replace the base board.

13.46 Code 1322 - kW Setpoint OOR Hi

Logic:

If the “KW Load Setpoint OOR Check Enable" is enabled and the “KW Load Setpoint OOR High Limit" has been exceeded for the time that is registered in the “KW Load Setpoint OOR Time" the genset control will display event/fault code 1322.

Possible Causes:

1. Wiring issue.
2. “Load Govern KW Setpoint RC Enable" is incorrectly set.
3. The base board is faulty.

Diagnosis and Repair:

1. Wiring issue.
   a. Ensure that the KW Load Setpoint analog input (configurable analog Input #1) is not shorted high or disconnected. On the control, the KW Load Setpoint analog input is located at:

      TB9 – 1 Sense

      TB9 – 2 Return

2. "Load Govern KW Setpoint RC Enable" is incorrectly set.
   a. The "Load Govern KW Setpoint RC Enable" limits the KW Load Govern voltage input from 0 - 5 volts, when set to "Enable" (at TB9-1 and TB9-2); if the voltage input into the KW Load Govern input exceeds 5 VDC, the genset control locks the KW output to zero since the control logic states that the voltage input is out of range, and displays event/fault code 1322. When the "Load Govern KW Setpoint RC Enable" parameter is set to "Disable" a greater input voltage than 5 VDC is recognized; a 24 VDC input is treated as a 5 VDC input. To change the "Load Govern KW Setpoint RC Enable" parameter appropriately for the application, on the display go to: **Setup > Paralleling Setup > Basic > Load Govern KW Setpoint RC Enable** and set appropriately.
3. Check to see if the base board is faulty.
   a. Using a voltmeter, monitor the analog voltage input at the kW load setpoint input. If the voltage input into the control is within the acceptable kW load setpoint voltage range that the control is set up for and the fault does not clear when the Fault Reset button is pressed, replace the base board.

13.47 Code 1323 - kW Setpoint OOR Lo

Logic:

If the “KW Load Setpoint OOR Check Enable" is enabled and the KW Load Setpoint analog input is below the “KW Load Setpoint OOR Low Limit" for the time that is registered in the “KW Load Setpoint OOR Time" the genset control will display event/fault code 1323.

Possible Causes:

1. Wiring issue.
2. KW Load Setpoint input voltage is too low.
3. The base board is faulty.

Diagnosis and Repair:

1. Wiring issue.
   a. Ensure that the KW Load Setpoint analog input (configurable analog Input #1) is not shorted low, or disconnected. On the control, the speed bias analog input is located at:

      TB9 – 1 Sense

      TB9 – 2 Return
2. KW Load Setpoint input voltage is too low.
   a. If the voltage input at TB9-1 and TB9-2 is below the “KW Load Setpoint OOR Low Limit", the control will register that input as shorted low. Ensure that the voltage input at TB9-1 and TB9-2 is greater than “KW Load Setpoint OOR Low Limit". To verify the voltage value of the “KW Load Setpoint OOR Low Limit" check the parameter section.
3. Check to see if the base board is faulty.
   a. Using a voltmeter, monitor the analog voltage input at the kW load setpoint input. If the voltage input into the control is within the acceptable kW load setpoint voltage range that the control is set up for and the fault does not clear when the Fault Reset button is pressed, replace the base board.

13.48 Code 1324 - kVAR Setpoint OOR Hi

Logic:

If the “KVAR Load Setpoint OOR Check Enable" is enabled and the KVAR Load Setpoint analog input exceeds the “KVAR Load Setpoint OOR High Limit" parameter for the time that is registered in the “KVAR Load Setpoint OOR Time"; the genset control will display event/fault code 1324.

Possible Causes:

1. Wiring issue.
2. “Load Govern KVAR Setpoint RC Enable" is incorrectly set.
3. The base board is faulty.

Diagnosis and Repair:

1. Wiring issue.
    a. Ensure that the KVAR Load Setpoint analog input (configurable analog Input #2) is not shorted high or disconnected. On the control, the voltage bias analog input is located at:

       TB9 – 3 Sense

       TB9 – 2 Return
2. "Load Govern KVAR Setpoint RC Enable" is incorrectly set.
    a. The "Load Govern KVAR Setpoint RC Enable" limits the KVAR Load Govern voltage input from 0 - 5 volts, when set to "Enable" (at TB9-3 and TB9-2); if the voltage input into the KVAR Load Govern input exceeds 5 VDC, the genset control locks the KVAR output to zero since the control logic states that the voltage input is out of range, and displays event/fault code 1324. When the "Load Govern KVAR Setpoint RC Enable" parameter is set to "Disable" a greater input voltage than 5 VDC is recognized; a 24 VDC input is treated as a 5 VDC input. To change the "Load Govern KVAR Setpoint RC Enable" parameter appropriately for the application, on the display go to: **Setup > Paralleling Setup > Basic > Load Govern KVAR Setpoint RC Enable** and set appropriately.
3. Check to see if the base board is faulty.
    a. Using a voltmeter, monitor the analog voltage at the kVAR load setpoint input. If the voltage input into the control is within the acceptable kVAR load setpoint range that the control is set up for and the fault does not clear when the Fault Reset button is pressed, replace the base board.

13.49 Code 1325 - kVAR Setpoint OOR Lo

Logic:

If the “KVAR Load Setpoint OOR Check Enable" is enabled and the KVAR Load Setpoint analog input is below the “KVAR Load Setpoint OOR Low Limit" for the time that is registered in the “KVAR Load Setpoint OOR Time", the genset control will display event/fault code 1325.

Possible Causes:

1. Wiring issue.
2. KVAR Load Setpoint input voltage is too low.

3. The base board is faulty.

Diagnosis and Repair:

1. Wiring issue.
   a. Ensure that the KVAR Load Setpoint analog input (configurable analog Input #2) is not shorted low. On the control, the KVAR Load Setpoint analog input is located at:

      TB9 – 3 Sense

      TB9 – 2 Return
2. KVAR Load Setpoint input voltage is too low.
   a. If the voltage input at TB9-3 and TB9-2 is below the “KVAR Load Setpoint OOR Low Limit", the control will register that input as shorted low. Ensure that the voltage input at TB9-3 and TB9-2 is greater than “KVAR Load Setpoint OOR Low Limit". To verify the voltage value of the “KVAR Load Setpoint OOR Low Limit" check the parameter section.
3. Check the base board to see if it is faulty.
   a. Using a voltmeter, monitor the analog voltage at the kVAR load setpoint input. If the voltage input into the control is within the acceptable kVAR load setpoint range that the control is set up for and the fault does not clear when the Fault Reset button is pressed, replace the base board.

13.50 Code 1328 - Genset CB Tripped

Logic:

The Genset CB has tripped.

Possible Causes:

1. Correct any active genset faults.
2. Incorrectly wired or short circuit.
3. CB Trip solenoid is incorrectly configured or faulty.
4. Faulty Genset CB.

Diagnosis and Repair:

1. Correct any active genset faults.
   a. Check for active genset faults on the display (especially Overload, Short Circuit, or Ground Faults); then correct these faults.
2. Incorrectly wired or short circuit.
   a. Verify the wiring from the Genset CB to the Genset CB Tripped status input on the base board. The Genset CB Tripped status input is a Normally Open contact at TB10-10 and TB10-2 (B+ Return). Ensure that the connection from the Genset CB to TB10-10 on the base board is not shorted to ground.
3. CB Trip solenoid is incorrectly configured or faulty.
   a. Genset CB Trip settings are configured to trip at a low over-current threshold. Check other settings on the Genset CB that might cause it to trip since circuit breakers can have multiple trip settings. Configure the Genset CB Trip Solenoid to trip at adequate trip settings for the application; refer to the CB Service Manual.

b. Faulty Trip solenoid, refer to the CB Service Manual for troubleshooting instructions.

4. Faulty Genset CB.

    a. Refer to the Genset CB Service Manual.

13.51 Code 1336 - Cooldown Complete

Logic:

Provides a record in the fault history that the engine cooldown period has been completed successfully during a Shutdown with Cooldown condition and fault code 1336 (shutdown) active.

Possible Causes:

1. Cooldown period has been completed after an active shutdown with cooldown fault.

Diagnosis and Repair:

1. Cooldown period has been completed after an active shutdown with cooldown fault.

    a. Event /fault code 1336 is activated as a result of another active fault that is set to "Shutdown with Cooldown." Connect with InPowere service tool to determine the actual shutdown fault(s) and then troubleshoot the shutdown fault(s).

13.52 Code 1416 - Fail To Shutdown

Logic:

To provide a record in the fault history that genset shutdown faults were bypassed while the control was in Battle Short mode.

Possible Causes:

1. A shutdown fault was bypassed while the Battle Short feature was enabled on the control.

Diagnosis and Repair:

1. A shutdown fault was bypassed while the Battle Short feature was enabled on the control.

    a. Event/fault code 1416 is activated because of an active “Shutdown fault" while the control is operating in battle-short mode. Troubleshoot the other shutdown fault(s) that are causing the genset to display event/fault code 1416.

13.53 Code 1417 - Power Down Failure

Logic:

The control has failed to go to sleep.

Possible Causes:

1. Faulty base board.

Diagnosis and Repair:

1. Faulty base board.
   a. Remove power (B+) from the control for 5-10 seconds and reconnect B+ to the control. If the control fails to go to sleep after power is cycled from the control and the control shows event/fault code 1417 again, replace the base board.

13.54 Code 1433 - Local E-Stop

Logic:

The Local Emergency Stop has been activated.

Possible Causes:

1. The Local Emergency Stop button has been activated.
2. Faulty connection or faulty Emergency Stop switch.
3. The base board is faulty.

Diagnosis and Repair:

1. The Local Emergency Stop button has been activated.
   a. Reset the Local Emergency Stop:
      1. Pull the Local Emergency stop button out.
      2. Press the Off button.
      3. Press the Reset button.
      4. Select Manual or Auto as required.
2. Faulty connection or faulty Emergency Stop switch.
   a. Check the Emergency Stop button, and verify that it is working properly. The Emergency Stop button is a closed relay when it is pulled out (not active), and open relay when depressed (active).
   b. Verify that the connection/wiring from the Local Emergency Stop switch to the control for an open circuit condition. A ground connection to the Local E-Stop control input (J25 - 2 Input; J25 - 6 Ground) disables the emergency stop alarm. An open circuit should activate the Emergency stop alarm.

      J25 - 2 Input

      J25 - 6 Ground
3. Check to see if the base board is faulty.
   a. Replace the base board.

13.55 Code 1434 - Remote E-Stop

Logic:

The Remote Emergency Stop has been activated.

Possible Causes:

1. The Remote Emergency stop button has been activated.
2. Faulty connection or faulty Emergency Stop switch.

3. The base board is faulty.

Diagnosis and Repair:

1. The Remote Emergency stop button has been activated.
    a. Reset the Remote Emergency Stop:
        1. Pull the Remote Emergency stop button out.
        2. Press the Off button.
        3. Press the Reset button.
        4. Select Manual or Auto as required.
    b. If the Remote Emergency Stop is not used, then install a jumper between:

        TB1 – 16 Input

        TB1 – 15 Ground

        And repeat step 1a.
2. Faulty connection or faulty Emergency Stop switch.
    a. Check the Emergency Stop button, and verify that it is working properly. The Emergency Stop button is a closed relay when it is pulled out (not active), and open relay when depressed (active).
    b. Verify that the connection/wiring from the Remote Emergency Stop switch to the control for an open circuit condition. A ground connection to the Remote E-Stop control input (TB1 – 16 Input; TB1 – 15 Ground) disables the emergency stop alarm. An open circuit should activate the Emergency stop alarm.

        TB1 – 16 Input

        TB1 – 15 Ground.
3. Check to see if the base board is faulty.
    a. If the base board is faulty, replace it.

13.56 Code 1435 - Low Coolant Temperature

Logic:

Engine coolant temperature is below the low coolant temperature warning threshold.

See Fault Code 145.

13.57 Code 1438 - Fail to Crank

Logic:

The engine has failed to crank when given a start signal.

Possible Causes:

1. Low battery voltage or weak battery.
2. The starter is faulty.
3. There is a faulty Emergency Stop switch or a faulty connection.
4. Either the base board or relays are faulty.

Diagnosis and Repair:

1. Low battery voltage or weak battery.
   a. During cranking if the battery voltage goes below the minimum operating voltage, event/fault code 1438 will become active. Refer to event/fault code 441 and 1442.
2. Check to see if the starter is faulty.
   a. Reset the control by pressing the Fault Reset button on the display. Then test for B+ at the starter while attempting to start the generator set. If there is B+ at the starter and the starter does not crank, then the starter could be faulty. Test the starter (see Engine Service Manual) and replace it, if faulty. If B+ is not present at the starter, go to the next step.
3. Check to see if there is a faulty Emergency Stop switch or a faulty connection.
   a. If the emergency stop is pressed (engaged), the control will not provide voltage to the start pilot relay or the starter control relay. Make sure that the emergency stop button is functioning correctly, measure the outputs of the E-Stop (Normally Open and Normally Closed contacts) and make sure that the outputs switch state correctly when engaged and disengaged. If the switch is faulty, replace it.
   b. Check the wiring from the base board (E-Stop B+ and J20-14 (negative)) to the FSO relay for short or open circuits. If short or open circuits are found, correct the wiring.
   c. Check the wiring from the base board (E-Stop B+ and J20-15 (negative)) to the Starter Control Relay for short or open circuits. If short or open circuits are found, correct the wiring.
4. Check to see if the is a faulty base board or relays.
   a. Make sure that the control board is sending a signal to the FSO control relay. Measure the voltage at E-Stop B+ and J20-14 (negative) while cranking the generator set; if a B+ signal is not available, the base board is faulty and must be replaced. If a B+ signal is available at the input of the FSO control relay, go to the next step.
   b. The FSO relay is a normally open relay. Make sure that B+ is available to the relay and then measure the voltage output. If there is a B+ at both the input and output of the FSO control relay, the relay is not faulty. If B+ is noted at the input but not at the output of the FSO control relay, replace the relay.
   c. Make sure that the control board is sending a signal to the starter control relay. Measure the voltage at E-Stop B+ and J20-15 (negative) while cranking the generator set; if a B+ signal is not available, the base board is faulty and must be replaced. If a B+ signal is available at the input of the starter control relay, go to the next step.
   d. The starter control relay is a normally open relay. Make sure that B+ is available to the input of the relay and then measure the voltage output. If there is a B+ at both the input and output of the starter control relay, the relay is not faulty. If B+ is noted at the input but not at the output of the starter control relay, replace the relay.

13.58 Code 1439 - Low Day Tank Fuel

Logic:

Indicates day tank fuel supply is running low.

Possible Causes:

1. The fuel level has dropped below the low fuel level trip point.
2. Fuel sender incorrectly wired.
3. Faulty fuel sender.
4. The “Configurable Input Active State Selection" parameter is configured incorrectly.
5. The control board is faulty.

Diagnosis and Repair:

1. Check to see if the fuel level has dropped below the low fuel level trip point.
   a. Check the fuel level in the day tank, if the fuel level is low, then add fuel and clear the warning fault by pressing the Fault Acknowledge button on the display. If the fuel level is not low, then go to step 2.
2. Fuel sender incorrectly wired.
   a. Check the wiring for improper wiring, a short or open circuit from the fuel sensor to the discrete configurable input on the base board that was configured for the “Low Day Tank Fuel Level". If a short or open circuit or improper wiring is found, correct the wiring.
3. Faulty fuel sender.
   a. Measure the resistance of the fuel sender at the day tank. If the sender is reading incorrectly (Shorted or Open Circuit), replace the fuel sender.
4. The "Configurable Input Active State Selection" parameter is configured incorrectly.
   a. With InPower or through the operator panel, check the switch input setting (active closed or active open) for the configurable input that was configured to “Low Fuel in Day Tank Switch". Ensure that the switch input setting is correctly set. If the “Configurable Input Function Pointer" parameter is set to “Low Fuel in Day Tank Switch" and the “Configurable Input Active State Selection" parameter is set to “active closed", event/fault code 1439 will become active when the configurable input that was configured to “Low Fuel in Day Tank Switch" is connected to ground.

      If the “Configurable Input Function Pointer" parameter is set to “Low Fuel in Day Tank Switch" and the “Configurable Input Active State Selection" parameter is set to “active open", event/fault code 1439 will become active when the configurable input that was configured to “Low Fuel in Day Tank Switch" is an open circuit.

      To access the input configuration on the operator panel go to **Setup > Configurable I/O >** and set the “Configurable Input Active State Selection" parameter appropriately for the configurable input that was configured to “Low Fuel in Day Tank Switch".
5. Check to see if there is a faulty control board.
   a. Manually change the state of the configurable input that was configured to "Low Fuel in Day Tank Switch". Disconnect the input of the "Low Fuel in Day Tank" sender from the base board. Press the Fault Acknowledge button in order to reset the control. If the fault clears, go back to step 1.

      Make a jumper and connect the configurable input that was configured to "Low Fuel in Day Tank Switch" to a ground input on the base board. If the fault clears, go back to step 1. If the fault does not clear, replace the base board.

13.59 Code 1441 - Low Fuel Level

Logic:

The "Fuel level % (AUX 101)" input has gone below the "Low Fuel Level Threshold (AUX 101)" setting for the time in the "Low Fuel Level Time (AUX 101)" setting.

Possible Causes:

1. The fuel level has dropped below the low fuel level trip point.
2. Fuel sender incorrectly wired.
3. Faulty fuel sender.
4. The “Low Fuel Set/Clear Time" parameter is configured incorrectly.
5. The base board is faulty.

Diagnosis and Repair:

1. Check to see if the fuel level has dropped below the low fuel level trip point.
   a. Check the fuel level in the fuel tank. If the fuel level is low, add fuel and clear the warning fault by pressing the Fault Acknowledge button on the display. If the fuel level is OK (not low), then go to step 2.
2. Check the wiring of the fuel sensor.
   a. Ensure that the sender is correctly wired to the base board. Check the wiring for a short circuit from the fuel sensor to the input on the base board that is configured for the “Fuel Level". If a short circuit is found, correct the wiring.
3. Faulty fuel sender.
   a. Measure the resistance between the fuel level signal pin and the fuel level return pin. The resistance should be between 600 Ohms to 2500 Ohms when the tank is full. Replace the sender if the resistance value is below the recommended threshold when the fuel tank is full.
4. The "Low Fuel Set/Clear Time" parameter is configured incorrectly.
   a. Check the low fuel level setup parameter. To access the input configuration on the operator panel go to **Setup > Genset Setup** and set the "Low Fuel Set/Clear Time" parameter appropriately for the application.
5. Check to see if the base board is faulty.
   a. If the previous steps did not reveal any problems, replace the base board.

13.60 Code 1442 - Weak Battery

Logic:

This fault occurs when the engine is starting (cranking) and the voltage of the battery drops below the “Weak Battery Voltage threshold" for the time set in the “Weak Battery Voltage Set Time".

Possible Causes:

1. Weak or discharged battery.
2. Battery connections are loose or dirty.
3. “Weak battery" voltage threshold parameter is set too high.

4. Insufficient battery charging voltage.
5. Faulty engine DC alternator.
6. The base board or harness is faulty.

Diagnosis and Repair:

1. Weak or discharged battery.
    a. Measure the voltage of the battery with a voltmeter. Battery voltage should be 12 VDC or greater in a 12 V system or 24 VDC or greater in a 24 VDC system. If the battery voltage is low, check the electrolyte level in the battery. Replenish the electrolyte level if low and recharge the battery; the specific gravity for a fully charged lead acid battery is approximately 1.260 at 80 F (27 C).
    b. If the battery cannot hold adequate voltage, then replace the battery.
2. Battery connections are loose or dirty.
    a. Clean and tighten battery terminals and battery cable connectors. If the battery cable connectors are cracked or worn out, then replace.
3. "Weak battery" voltage threshold parameter is set too high.
    a. Ensure that the Weak Battery Voltage parameter is set to an appropriate voltage value that takes into account voltage drop during cranking (refer to the parameter list to see the default value). To access the battery voltage setup menu from the operator panel, go to **Setup > OEM Setup > OEM Engine Setup > Weak Battery** and change the weak battery voltage parameter of the control accordingly.
4. Insufficient battery charging voltage.
    a. Ensure that the battery charger is charging the battery at an acceptable rate. Adjust the charge rate if the rate is below the recommendation of the manufacturer.
    b. If the battery located far from the battery charger, ensure that a proper wire size is used to compensate for voltage drop.
5. Faulty engine DC alternator.
    a. Check the engine DC alternator. If normal charging voltage is not 12 to 14 VDC in a 12 V system or 24 to 26 VDC in a 24 V system then replace the DC alternator.
6. Check to see if the base board or harness is faulty.
    a. Measure the battery voltage at the battery terminals and then measure the battery voltage at the base board input. Measure the voltage at B+ (J20-9, J20-10, J20-20, J20-21) and B- (negative) input (J20-2, J20-4, J20-7, J20-12).
    - If the voltage at the battery terminals and the control is the same, replace the base board.
    - If the voltage at the battery terminals and the control is not the same, check the harness and replace if necessary.

13.61 Code 1443 - Dead Battery

Logic:

During cranking, the battery voltage drops below the operating voltage of the control, which resets the control. After the control has reset three consecutive times, event/fault code 1443 will become active.

Possible Causes:

1. Weak or discharged battery.
2. Battery connections are loose or dirty.
3. Insufficient battery charging voltage.
4. Faulty engine DC alternator.
5. The base board or harness is faulty.

Diagnosis and Repair:

1. Weak or discharged battery.
   a. Measure the voltage of the battery with a voltmeter. Battery voltage should be 12 VDC or greater in a 12 V system or 24 VDC or greater in a 24 VDC system. If the battery voltage is low, check the electrolyte level in the battery. Replenish the electrolyte level if low and recharge the battery; the specific gravity for a fully charged lead acid battery is approximately 1.260 at 80 F (27 C).
   b. If the battery cannot hold adequate voltage, then replace the battery.
2. Battery connections are loose or dirty.
   a. Clean and tighten battery terminals and battery cable connectors. If the battery cable connectors are cracked or worn out, then replace.
3. Insufficient battery charging voltage.
   a. Ensure that the battery charger is charging the battery at an acceptable rate. Adjust the charge rate if the rate is below the recommendation of the manufacturer.
   b. If the location of the battery is a far distance from the battery charger, ensure that a proper wire size is used to compensate for voltage drop.
4. Faulty engine DC alternator.
   a. Check the engine DC alternator. If normal charging voltage is not 12 to 14 VDC in a 12 V system or 24 to 26 VDC in a 24 V system then replace the DC alternator.
5. Check to see if the base board or harness is faulty.
   a. Measure the battery voltage at the battery terminals while the generator set is cranking and then measure the battery voltage at the base board input while the generator set is cranking. Measure the voltage at B+ (J20-9, J20-10, J20-20, J20-21) and B- (negative) input (J20-2, J20-4, J20-7, J20-12).
      - If the voltage at the battery terminals and the control is not the same, check the harness and replace if necessary.
      - If the voltage input at the base board is above 8 VDC during cranking, replace the base board.

13.62 Code 1444 - kW Overload

Logic:

The "Overload Threshold" has been exceeded for the time that is registered in the "Overload Set Time" parameter.

Possible Causes:

1. The "Overload Threshold" parameter is set too low.

2. Short in the load or load cables.
3. Incorrect CT Ratio, CTs, or CT connections.
4. Incorrect PT Ratio, PTs, or PT connections.

Diagnosis and Repair:

1. The "Overload Threshold" parameter is set too low.
   a. To access the input configuration on the operator panel go to **Setup > Genset Setup** and set the "Overload Threshold" parameter appropriately for the application. Refer to the parameter section to see the default value for Overload (Setting the overload threshold too high can cause damage to the alternator).
2. Short in the load or load cables.
   a. Check the load and load cables. Repair if necessary.
3. Incorrect CT Ratio, CTs, or CT connections.
   a. Check the CT Ratio, CTs, and CT connections, reference event/fault code 2814.
4. Incorrect PT Ratio, PTs, or PT connections.
   a. Check the PT Ratio, PTs, and PT connections, reference event/fault code 2816.

13.63 Code 1445 - Short Circuit

Logic:

The generator output current has exceeded 175% of rated current.

NOTICE
This fault remains active and cannot be reset until the Alternator Overheat Integral time has expired (which takes up to five minutes). The Alternator Overheat Integral time allows the alternator to cool down before allowing a restart.

Possible Causes:

1. Short in the load or load cables.
2. Faulty CTs, incorrect CT ratio, CTs, CT connections.
3. The base board is faulty.

Diagnosis and Repair:

1. Short in the load or load cables.
   a. Check the load and load cables. Repair if necessary.
2. Faulty CTs, incorrect CT ratio, CTs, CT connections.
   a. Verify the CT connections are correct from the CTs to the input of the base board.
   b. Ensure the control is set up for the correct CT ratio. Reference event/fault code 2814 for CT ratio troubleshooting information.
   c. Check the current going into the CT input on the control board (use a current probe to check the secondary output of the CT). This should be the value that the control secondary is calibrated with. (e.g. If the control is calibrated with a CT Ratio of 1000:5, the current input into the base board should not be more than 5 A.)

d. If previous steps check out ok, replace the base board.

3. The base board is faulty.

   a. If the previous steps did not identify any faulty component, replace the control board.

13.64 Code 1446 - High AC Voltage

Logic:

One or more of the phase voltages has exceeded the high AC voltage threshold.

Possible Causes:

1. Fault simulation is enabled.
2. The High AC Voltage Trip parameter is incorrectly set for the application.
3. The High AC Voltage threshold is set too low for the application.
4. Faulty PTs, incorrect PT ratio, PTs, PT connections.
5. Faulty AVR.
6. Faulty PMG.
7. Governor preload offset percentage too high.
8. The base board is faulty.
9. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Fault simulation is enabled.

   a. Connect with InPower and ensure that the fault simulation for High AC Voltage is not enabled. If InPower is not available, cycle power to the control:

      1. Depress the Emergency Stop button and wait 30 seconds.

      2. Disconnect/disable the battery charger.

      3. Disconnect the battery (disconnect negative first).

      4. Leave the controller without power for 1 minute.

      5. Reconnect the battery, enable the battery charger, pullout the E-Stop button, and reset the control (in this order).

2. The High AC Voltage Trip parameter is incorrectly set for the application.

   a. Ensure that the High AC voltage parameter is set correctly for the application.

      If the control is set up as “Inverse time", it will be more sensitive to voltage spikes and will trip more rapidly; “Inverse time" follows the “Instantaneous High AC Voltage Threshold".

      If the control is set to “Fixed Time", it will allows a greater time delay until shutdown when voltage overshoots; when trying to start a large motor, the “Fixed time" setting is recommended. This parameter works with the “High AC Voltage Delay" parameter.

      To access the configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > High AC Voltage Trip** and set the “High AC Voltage Trip" parameter appropriately for the application.

3. The High AC Voltage threshold is set too low for the application.
    a. To access the High AC Voltage configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > High AC Voltage Threshold** and set the “High AC Voltage Threshold" parameter appropriately for the application. Refer to the parameter list to see the default value for High AC Voltage.
4. Faulty PTs, incorrect PT ratio, PTs, PT connections.
    a. Check the connections from the alternator to the PT, and from the PT to the base board. (Three phase inputs on the base board: L1 = J22-1, L2 = J22-2, L3 = J22-3, LN = J22-4; for single phase use L1, L2 and LN). If the wires are incorrectly connected, or there is an open circuit, correct the wiring issue. (If the voltage input is less than 600 VAC, a PT is not required.)
    b. Ensure that the control is set up with the correct PT ratio (primary vs. secondary). Reference event/fault code 2816 for troubleshooting information on the PT ratio. To access the PT Ratio configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > PT Primary or PT Sec** and set the PT ratio appropriately for the application.
    c. Measure the voltage going into the PT from the alternator.

⚠ WARNING
High voltages are present in this step. Special equipment and training is required to work on or around high-voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures may result in severe personal injury or death.

    Then measure the voltage output of PT to the base board. (Three phase inputs on the base board: L1 = J22-1, L2 = J22-2, L3 = J22-3, LN = J22-4; for single phase use L1, L2 and LN). The control calibrated PT ratio (PT voltage input: PT voltage output) should match the voltage input into and output of the PT.
    d. If the control calibrated PT ratio matches the voltage input into the PT, but does not match the voltage output (e.g., control calibrated PT ratio is 13,500:480, the voltage input into the PT is 13,500 VAC, but the output of the PT is 589 VAC instead of 480 VAC), replace the PT module.
5. Faulty AVR.
    a. Measure the output of the AVR at J17-1 and J17-2. The output should be at 9-12 VDC when the genset is operating at “No Load". If the voltage output of J17-1 and J17-2 is constantly high, then the AVR portion of the base board is faulty. Replace the base board.
    b. Using a True RMS meter, measure the PWM at J19-2 (AVR PWM +) and J19-9 (AVR PWM -) while turning the genset “ON". This is a 2.5 VDC max output from the base board to the AUX 103 AVR; if the voltage at J19-2 and J19-9 is continuously 2.0-2.5 VDC, without any change, then replace the base board.
    c. Measure the output of the AUX 103 AVR at J17-1 and J17-2, the output should be at 9-12 VDC when the genset is operating at “No Load", if the voltage output of J17-1 & J17-2 is constantly high, then the AUX 103 AVR is faulty replace the AUX 103 AVR.
6. Faulty PMG.
    a. Start the genset and run at rated speed. Measure the voltages at the AVR terminals P2 (J18-1), P3 (J18-2), and P4 (J18-3). These should be balanced and within the following ranges:

50Hz generators - 170-180 Volts

60Hz generators - 200-216 Volts

Should the voltages be unbalanced, stop the genset, remove the PMG sheet metal cover from the non drive end bracket and disconnect the multi-pin plug in the PMG output leads. Check leads P2, P3, and P4 for continuity. Check the PMG stator resistances between output leads. These should be balanced and within +/- 10% of 2.3 Ohms. If resistances are unbalanced and/or incorrect the PMG stator must be replaced. If the voltages are balanced but low and the PMG stator winding resistances are correct the PMG rotor must be replaced.

7. Governor preload offset percentage too high.

   If this fault code occurs during startup,

   a. Connect with InPower.
   b. Check the governor preload offset percentage. The higher the percentage, the larger the overshoot. Lower the governor preload offset.

8. The base board is faulty.

   a. If the previous steps did not identify a faulty component, replace the control.

13.65 Code 1447 - Low AC Voltage

Logic:

Voltage has decreased below the “Low AC Voltage Threshold" for the time that is registered in the “Low AC Voltage Delay" parameter.

Possible Causes:

1. Fault simulation is enabled.
2. The Low AC Voltage threshold is set too high.
3. Faulty PTs, incorrect PT ratio, PTs, PT connections.
4. Faulty AVR.
5. Faulty PMG.
6. Faulty rotating rectifier assembly.
7. The base board is faulty.
8. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Fault simulation is enabled.

   a. Connect with InPower and ensure that the Fault simulation for Low AC Voltage is not enabled. If InPower is not available, cycle power to the control:

      1. Depress the Emergency Stop button and wait 30 seconds.

      2. Disconnect/disable the battery charger.

      3. Disconnect the battery (disconnect negative first).

      4. Leave the controller without power for 1 minute.

      5. Reconnect the battery, enable the battery charger, pullout the E-Stop button, and reset the control (in this order).

2. The Low AC Voltage threshold is set too high.

    a. To access the Low AC Voltage configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > Low AC Voltage Threshold** and set the “Low AC Voltage Threshold" Parameter appropriately for the application. Refer to the parameter list to see the default value for Low AC Voltage.

3. Faulty PTs, incorrect PT ratio, PTs, PT connections.

    a. Check the connections from the alternator to the PT and from the PT to the base board. (Three phase inputs on the base board: L1 = J22-1, L2 = J22-2, L3 = J22-3, LN = J22-4; for single phase use L1, L2 and LN). If the wires are incorrectly connected, or there is an open or short circuit correct the wiring issue. (If the voltage input is less than 600 VAC, a PT is not required.)

    b. Ensure that the control is set up with the correct PT ratio (primary vs. secondary). Reference event/fault code 2817 for troubleshooting information on the PT ratio. To access the PT Ratio configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > PT Primary or PT Sec** and set the PT ratio appropriately for the application.

    c. Measure the voltage going into the PT from the alternator.

⚠ WARNING
High voltages are present in this step. Special equipment and training is required to work on or around high-voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures may result in severe personal injury or death.

    Then measure the voltage output of PT to the base board. (Three phase inputs on the base board: L1 = J22-1, L2 = J22-2, L3 = J22-3, LN = J22-4; for single phase use L1, L2 and LN.) The control calibrated PT ratio (PT voltage input: PT voltage output) should match the voltage input into the PT and voltage output of the PT. If the control calibrated PT ratio matches the voltage input into the PT, but does not match the voltage output (e.g., control calibrated PT ratio is 13,500:480, the voltage input into the PT is 13,500 VAC, but the output of the PT is 320 VAC instead of 480 VAC), replace the PT module.

4. Faulty AVR.

    a. Measure the output of the AVR at J17 -1 and J17-2, the output should be at least 9-12 VDC when the genset is operating at “No Load". If the voltage output of J17-1 and J17-2 is constantly zero or less than 9-12 VDC, then the AVR portion of the PCC is faulty. To double-check, disconnect the J17-1 and J17-2 connection from the AVR board (the AVR board will no longer be connected to the field wires) and place a 9-12 VDC power supply (Depending on the alternator) to the field wires (J17-1 is positive, and J17-2 is negative). If the genset produces adequate voltage (Nominal Voltage or Greater), the AVR portion of the base board is faulty, replace the base board.

    b. Check the Power Supply to the AVR. Ensure that the 10 Amp fuses at J18-1 and J18-2 are not open, replace if open circuit. Make sure that the AVR has sufficient power at:

        - J18-1 and J18-2 if it is a Shunt application or
        - J18-1, J18-2, and J18-3 if it is a PMG application

          If the AVR has no power, you will need to troubleshoot the power supply connections.

c. Using a True RMS meter, measure the PWM at J19-2 (AVR PWM +) and J19-9 (AVR PWM -) while turning the genset “ON". This is a 0-2.5 VDC max output from the base board to the AUX 103 AVR; if the voltage at J19-2 and J19-9 is continuously 0 VDC, without any change, check the wiring between J26-16 and J19-2 and between J26-3 and J19-9 to ensure than a short circuit does not exist. Correct the wiring if a short circuit exists in the wiring. If the wiring is OK, but there is no voltage from the base board to the AUX 103 AVR, then replace the base board.

d. Measure the output of the AVR at J17-1 and J17-2, the output should be at least 9-12 VDC when the genset is operating at “No Load", if the voltage output of J17-1 & J17-2 is constantly zero or less than 9-12, then the AUX 103 AVR is faulty. To double check, disconnect the J17-1 and J17-2 connection from the AUX 103 AVR (the AVR board will no longer be connected to the field wires) and place a 9-12 VDC power supply (Depending on the alternator) to the field wires (J17-1 is positive, and J17-2 is negative). If the genset produces adequate voltage (Nominal Voltage or Greater) with the power supply connected to the field wires, the AUX 103 AVR is faulty, replace the AUX 103 AVR.

5. Faulty PMG.

   a. Start the genset and run at rated speed. Measure the voltages at the AVR terminals P2 (J18-1), P3 (J18-2), and P4 (J18-3). These should be balanced and within the following ranges:

   50Hz generators - 170-180 Volts

   60Hz generators - 200-216 Volts

   Should the voltages be unbalanced:

   1. Stop the genset.

   2. Remove the PMG sheet metal cover from the non drive end bracket and disconnect the multi-pin plug in the PMG output leads.

   3. Check leads P2, P3, and P4 for continuity. Check the PMG stator resistances between output leads. These should be balanced and within +/-10% of 2.3 Ohms.

   4. If resistances are unbalanced and/or incorrect the PMG stator must be replaced.

   5. If the voltages are balanced but below the voltage range noted above, and the PMG stator winding resistances are correct - the PMG rotor must be replaced.

6. Faulty rotating rectifier assembly.

   a. This procedure is carried out with leads J17-1 and J17-2 disconnected at the AVR or transformer control rectifier bridge and using a 12 volt D.C. supply to leads J17-1 and J17-2 (J17-1 is positive, and J17-2 is negative).

   1. Start the set and run at rated speed.

   2. Measure the voltages at the main output terminals L1, L2 and L3.

   3. If voltages are balanced but below the voltage range in step 5, there is a fault in the rotating diode assembly or the main excitation windings (Refer to Servicing the Generator section in the manual to troubleshoot the main excitation windings).

4. The diodes on the main rectifier assembly can be checked with a multimeter. The flexible leads connected to each diode should be disconnected at the terminal end, and the forward and reverse resistance checked. A healthy diode will indicate a very high resistance (infinity) in the reverse direction, and a low resistance in the forward direction. A faulty diode will give a full deflection reading in both directions with the test meter on the 10,000 Ohms scale, or an infinity reading in both directions. On an electronic digital meter a healthy diode will give a low reading in one direction, and a high reading in the other. Replace diode(s) if faulty.

7. The base board is faulty.
   a. If the previous steps did not identify a faulty component, replace the control.

13.66 Code 1448 - Underfrequency

Logic:

The frequency has dropped below the “Underfrequency Threshold" for the time set in the “Underfrequency Delay" parameter.

Possible Causes:

1. Fault simulation is enabled.
2. Underfrequency threshold is set too high.
3. There are fuel or air delivery problems.
4. Overload.
5. The base board is faulty.
6. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Fault simulation is enabled.
   a. Connect with InPower and ensure that the Fault simulation for Low Frequency is not enabled. If InPower is not available, cycle power to the control:

      1. Depress the Emergency Stop button and wait 30 seconds.

      2. Disconnect/disable the battery charger.

      3. Disconnect the battery (disconnect negative first).

      4. Leave the controller without power for 1 minute.

      5. Reconnect the battery, enable the battery charger, pullout the E-Stop button, and reset the control (in this order).
2. Underfrequency threshold is set too high.

   A. To access the Underfrequency configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > Underfrequency Threshold** and set the “Underfrequency Threshold" Parameter appropriately for the application. Refer to the parameter list to see the default value for Underfrequency.
3. Check to see if there are any fuel or air delivery problems.
   a. Refer to the Engine Service Manual.

4. Overload.
   a. Ensure that the load on the genset does not exceed the Genset KW Rating. If the genset is producing correct frequency with no load, but shutting down on underfrequency when the genset picks up certain loads, the underfrequency shutdowns are being cause by the load. Motors, Uninterruptible Power Supply (UPS), Variable Frequency Drive (VFD), Medical Diagnostic Imagining Equipment, Fire Pumps and certain types of lighting have a considerable and different influence on a generator and might require starting these loads when there is a minimum load on the genset. Revisit the genset sizing process to ensure that the genset is correctly sized for the application, especially if new loads have been introduced into the system (reference the T-030 manual).
5. The base board is faulty.
   a. If the previous steps did not identify a faulty component, replace the control board.

13.67 Code 1449 - Overfrequency

Logic:

Frequency has gone above the "Overfrequency Threshold" for the time that is registered in the "Overfrequency Delay" parameter.

Possible Causes:

1. Fault simulation is enabled.
2. Overfrequency threshold is set too low.
3. There are fuel or air delivery problems.
4. The base board is faulty.
5. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Fault simulation is enabled.
   a. Connect with InPower and ensure that the Fault simulation for Overfrequency Enable is not enabled. If InPower is not available, cycle power to the control:

      1. Depress the Emergency Stop button and wait 30 seconds.

      2. Disconnect/disable the battery charger.

      3. Disconnect the battery (disconnect negative first).

      4. Leave the controller without power for 1 minute.

      5. Reconnect the battery, enable the battery charger, pullout the E-Stop button, and reset the control (in this order).
2. Overfrequency threshold is set too low.
   a. To access the Overfrequency configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > Overfrequency Threshold** and set the "Overfrequency Threshold" Parameter appropriately for the application. Refer to the parameter list to see the default value for Overfrequency.
3. Check to see if there are fuel or air delivery problems.
   a. Refer to the Engine Service Manual.

4. The base board is faulty.
   a. If the previous steps did not identify a faulty component, replace the control board.

13.68 Code 1451 - Genset/Bus V Mismatch

Logic:

Five seconds after the Genset circuit breaker (CB) closes, the base board continuously verifies whether the genset and bus voltages are within 5% of each other; if the difference between the genset and bus voltage is greater than 5%, event/fault code 1451 becomes active.

Possible Causes:

1. The genset and bus voltages are not properly setup or calibrated.
2. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. The genset and bus voltages are not properly calibrated.
   a. Calibrate the genset and bus voltage (all phases) in order to improve the voltage match performance, as well as the metering accuracy. Refer to the calibration section.
   b. If the voltage is greater than 600 VAC, ensure that the PT ratio is correctly set. To change the Utility PT ratio parameter appropriately for the application, go to: **Setup > Paralleling Setup > Power Transfer Control > PT Primary or PT Secondary** and set appropriately. To change the Genset PT ratio parameter appropriately for the application, go to: **Setup > OEM Setup > OEM Alt Setup > PT Primary or PT Secondary** and set appropriately.

13.69 Code 1452 - Genset CB Fail To Close

Logic:

Genset circuit breaker (CB) has failed to close for the time that is registered in the “Gen CB Fail to Close Time Delay" parameter.

Possible Causes:

1. Incorrectly wired.
2. Faulty Genset Circuit Breaker (CB).
3. The base board is faulty.
4. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Incorrectly wired.
   a. The base board is sending the Genset CB a close command, but the Genset CB Position Status remains open. Correct the wiring from the CB Close Control output on the base board at TB5-1 and TB5-2 to the Genset breaker; check for an open circuit at the circuit breaker. The Genset CB Close control output is a NO Relay at TB5-1 and TB5-2 (Relay Common) on the base board. When the relay on the

base board is closed, the Genset Breaker should be closed. The output of TB5-2 and TB5-3 should match the status of the Genset CB Close command; go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Genset Breaker Position Contacts** and ensure that the status of the CB close position command at the display matches the output.

b. Verify the wiring of the CB position status from the Genset breaker to the base board. The CB position sensing can be set up as single or dual sensing in the base board; check the display if the base board is setup as single or dual sensing. To access the CB position sensing, go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Genset Breaker Position Contacts**

- If the CB position sensing is set up as single, verify the connection at CB A (NO) status at TB10-7 and the Return at TB10-2.
- If the CB position sensing is set up as dual, verify the connection at CB A (NO) status at TB10-7 and the Return at TB10-2 and also verify the connection at CB B (NC) status at TB10-8 and TB10-2 (Return). The input status at CB A (NO) and CB B (NC) should be opposite; one input will be open while the other is closed, if they are the same check the wiring between the Genset breaker and the CB status input on the base board.

  Ensure that the connections on the base board are correctly connected and that a short and/or open circuit does not exist. The physical connection to the base board should match the status of the CB position; go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Genset Breaker Position Contacts** and ensure that the status of the CB position matches the connection.

2. Faulty Genset CB.
   a. Refer to the Genset CB Service Manual.
3. The base board is faulty.
   a. If the wiring and generator set CB are not found to be faulty, replace the base board.

13.70 Code 1453 - Genset CB Fail To Open

Logic:

Genset circuit breaker (CB) has failed to open for the time that is registered in the “Gen CB Fail to Open Time Delay" parameter.

Possible Causes:

1. Incorrectly wired.
2. Faulty Genset Circuit Breaker (CB).
3. Faulty base board.

Diagnosis and Repair:

1. Incorrectly wired.
   a. The base board is sending the Genset CB an open command, but the Genset CB Position Status remains closed. Correct the wiring from the CB Open Control output on the base board at TB5-5 and TB5-4 to the Genset breaker; check for a short circuit. The Genset CB Open control output is a NC Relay at TB5-5 and TB5-4 (Relay Common) on the base board. When the relay is closed the Genset Breaker is closed. The output of TB5-4 and TB5-5 should match the status of the Genset CB Open position command; go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Genset Breaker Position Contacts**, and ensure that the status of the CB Open position command at the display matches the output.
   b. Verify the wiring of the CB position status from the Genset breaker to the base board. The CB position sensing can be set up as single or dual sensing in the base board; check the display if the base board is setup as single or dual sensing. To access the CB position sensing, go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Genset Breaker Position Contacts**
      - If the CB position sensing is set up as single, verify the connection at CB A (NO) status at TB10-7 and the Return at TB10-2.
      - If the CB position sensing is set up as dual, verify the connection at CB A (NO) status at TB10-7 and the Return at TB10-2 and also verify the connection at CB B (NC) status at TB10-8 and TB10-2 (Return). The input status at CB A (NO) and CB B (NC) should be opposite; one input will be open while the other is closed, if they are the same check the wiring between the Genset breaker and the CB status input on the base board.

        Ensure that the connections on the base board are correctly connected and that a short and/or open circuit does not exist. The physical connection to the base board should match the status of the CB position; go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Genset Breaker Position Contacts**, and ensure that the status of the CB position matches the connection.
2. Faulty Genset CB.
   a. Refer to the Genset CB Service Manual.
3. Faulty base board.
   a. If the wiring and Genset CB are not found to be faulty, then replace the base board.

13.71 Code 1454 - Genset CB Pos Error

Logic:

A mismatch in the Genset position status exists.

Possible Causes:

1. Mismatch in the Genset position sensing.
2. Faulty Genset CB.
3. Faulty base board.

Diagnosis and Repair:

1. Mismatch in the Genset position sensing.
   a. Verify the wiring of the CB position status from the Genset breaker to the base board. The CB position sensing can be set up as single or dual sensing in the base board; check the display if the base board is setup as single or dual sensing. To access the CB position sensing, go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Genset Breaker Position Contacts**
   b. When the Genset Breaker Position contact is set to Single, the base board monitors current going thru the Genset CB (Amps going thru the CB means it is closed) and CB A position status to determine the position of the Genset CB. If there is a mismatch between the current-based breaker position and CB A position sensing, fault code 1454 will occur. Verify the connection at CB A (NO) status at TB10-7 and the Return at TB10-2, and ensure that an open/short circuit does not exist.
   c. If the CB position sensing is set up as dual, verify the connection at CB A (NO) status at TB10-7 and the Return at TB10-2 and also verify the connection at CB B (NC) status at TB10-8 and TB10-2 (Return). The input status at CB A (NO) and CB B (NC) should be opposite; one input will be open while the other is closed, if they are the same, check the wiring between the Genset breaker and the CB status input on the base board. Ensure that the connections on the base board are correctly connected and that a short and/or open circuit does not exist. The physical connection to the base board should match the status of the CB position; go to: **Paralleling Status > Paralleling Status-Iso Bus Sc 1 > Genset CB Pos > Genset CB Position Status**, and ensure that the status of the CB position matches the connection.
2. Faulty Genset CB.
   a. Refer to the Genset CB Service Manual.
3. Faulty base board.
   a. If the wiring and Genset CB are not found to be faulty, then replace the base board.

13.72 Code 1455 - Utility CB Pos Error

Logic:

A mismatch in the Utility position status exists.

Possible Causes:

1. Utility Single Mode Verify Switch is Inactive.
2. Mismatch in the Utility position sensing.
3. Faulty Utility CB.
4. Faulty base board.

Diagnosis and Repair:

1. Utility Single Mode Verify Switch is Inactive.
   a. Event/fault code 1455 will become active, if the genset is setup to operate in the following genset application types; Utility Single, Utility Multiple, or PTC, and the Utility Single Mode Verify Switch is not active, The base board will not close the Utility breaker until the Utility Single Mode Verify Switch input is activated. This procedure is to ensure that the whole system has been rechecked before allowing the base board to close the Utility Breaker. To activate the Utility Single Mode Verify Switch, make a connection between TB10-12 (Single Mode Verify Input) and TB10-16 (Return); then press the fault reset button on the display to clear the fault.
2. Mismatch in the Utility position sensing.
   a. Verify the wiring of the CB position status from the Utility breaker to the base board. The CB position sensing can be set up as single or dual sensing in the base board; check the display if the base board is setup as single or dual sensing. To access the CB position sensing, go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Utility Breaker Position Contacts**.
   b. When the Utility Breaker Position contact is set to Single, the base board monitors current going thru the Utility CB (Amps going thru the CB means it is closed) and CB A position status to determine the position of the Utility CB. If there is a mismatch between the current-based breaker position and CB A position sensing, fault code 1455 will occur. Verify the connection at CB A (NO) status at TB10-3 and the Return at TB10-1, and ensure that an open/short circuit does not exist.
   c. If the CB position sensing is set up as dual, verify the connection at CB A (NO) status at TB10-3 and the Return at TB10-1 and also verify the connection at CB B (NC) status at TB10-4 and TB10-1 (Return). The input status at CB A (NO) and CB B (NC) should be opposite; one input will be open while the other is closed, if they are the same check the wiring between the Utility breaker and the CB status input on the base board. Ensure that the connections on the base board are correctly connected and that a short and/or open circuit does not exist. The physical connection to the base board should match the status of the CB position; go to: **Paralleling Status > Paralleling Status-PTC Sc 1 > Util CB Pos > Utility CB Position Status**, and ensure that the status of the CB position matches the connection.
3. Faulty Utility CB.
   a. Refer to the Utility CB Service Manual.
4. Faulty base board.
   a. If the wiring and Utility CB are not found to be faulty, then replace the base board.

13.73 Code 1456 - Bus Out Of Sync Range

Logic:

The Synchronizer cannot be enabled because the Bus Voltage and/or Frequency are not within 60 – 110% of nominal.

Possible Causes:

1. System bus voltage cables are incorrectly wired or open circuit to the paralleling breaker.
2. System bus voltage sensing connections are incorrectly wired at the base board.

3. Faulty PT.
4. Faulty base board.

Diagnosis and Repair:

1. System bus voltage cables are incorrectly wired or open circuit to the paralleling breaker.

⚠ WARNING
High voltages are present in this step. Special equipment and training is required to work on or around high-voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures may result in severe personal injury or death.

   a. The system bus has lost a phase, using a phase rotation meter or a synchronizing light; verify that the phase rotation of the system bus at the paralleling breaker is correct; in synchronization with the generator set phase rotation. For proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation check shows that a phase is missing, check for blown fuses, and an open circuit at the system bus voltage cables connected to the paralleling breaker.

2. System bus voltage sensing connections are incorrectly wired at the base board.

   a. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.

      - Measure the phase rotation and voltage input into the base board from the System bus at: L1, TB7-1; L2, TB7-2; and L3, TB7-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring.

   b. If the nominal voltage is over 600 VAC, check the voltage sensing connections from the base board to the PT and the PT to the System bus.

      - Measure the phase rotation and voltage input into the base board from the PT (Potential Transformer) at: L1, TB7-1; L2, TB7-2; and L3, TB7-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the base board to the PT.
      - Measure the phase rotation and voltage input into the TB8 - 5 and TB8 – 1

3. Faulty PT.

   a. With a calibrated Voltage meter, measure the voltage input and output of the PT. The Input and output of the PT should be proportional; ex. Inputs: L1 = 4160, L2 = 4160, L3 = 4160; Outputs: L1 = 120, L2 = 120, L3 = 120. If the inputs and outputs of the PT are not proportional, replace the PT.

4. Faulty base board.

   a. If the phase rotation and the system bus voltage sensing connections are correct at the input of the base board, L1, TB7-1; L2, TB7-2; L3, TB7-3; but the display shows incorrect bus voltage and phase rotation, replace the base board. To check the System bus voltage and phase rotation on the display go to: **Paralleling Status - Iso Bus Sc 1 > Bus Avg Voltage** and **Paralleling Status > Phase Rot.**

13.74 Code 1457 - Fail To Synchronize

Logic:

Synchronizer has not met the synch check conditions within the “Fail To Synchronize Time" parameter

Possible Causes:

1. Improper adjustment of bus or generator set voltage.
2. Faulty PT.
3. Permissive window parameters are set too tight.
4. The engine is unstable.

Diagnosis and Repair:

1. Improper adjustment of bus or generator set voltage.
   a. Ensure that that the base board is calibrated correctly by checking that the generator set is operating at proper voltage and frequency. With a calibrated Frequency and Voltage meter, measure the frequency and voltage output of the genset at the alternator; while thru the display, ensuring that the base board is displaying the same voltage and frequency that is shown on the meter. (Go to the Servicing the Generator section in the manual)
   b. Ensure that that the base board is calibrated correctly by checking the System bus voltage and frequency. With a calibrated Frequency and Voltage meter, measure the frequency and voltage of the System bus; while thru the display, ensuring that the base board is displaying the same voltage and frequency that is shown on the meter. To view and adjust the Bus Voltage, go to: **Setup > Calibration > L12 (L23, L31) Adjust > Genset Bus L1L2 (L2L3, L3L1) Voltage Calibration** and if appropriate, change the Bus Voltage to reflect the voltage that is shown on the meter. To view and adjust the Bus Frequency go to: **Setup > Adjust > Frequency Calibration > Frequency Calibration** and if appropriate, change the Bus Frequency to reflect the frequency that is shown on the meter.
2. Faulty PT.
   a. With a calibrated Voltage meter, measure the voltage input and output of the PT. The Input and output of the PT should be proportional; ex. Inputs: L1 = 4160, L2 = 4160, L3 = 4160; Outputs: L1 = 120, L2 = 120, L3 = 120. If the inputs and outputs of the PT are not proportional, replace the PT.
3. Permissive window parameters are set too tight.
   a. The synch check function monitors the genset and bus voltage, frequency, and phase rotation, to determine whether the two sources can be paralleled. The difference in voltage, frequency, and phase rotation between the genset and system bus must be smaller than the Permissive parameter windows. Set the following parameters appropriately for the application:
      - Permissive Frequency Window
      - Permissive Voltage Window
      - Permissive Window Time
      - Permissive Phase Window

      To access the Permissive Parameters Window setup menu from the display, . Refer to the parameter section for the default value, and limits.

b. Synchronizer has failed to synchronize the Generator set to the System bus within the “Fail To Synchronize Time" parameter. To increase the “Fail To Synchronize Time" parameter from the display, go to: Setup > Paralleling Setup > Basic > Sync Time and change the “Fail To Synchronize Time" parameter of the control appropriately. Refer to the parameter section for the default value, and limits.

4. Check to see if the engine is unstable.

   a. Check the engine:

      - Fuel filters, which can trap air in the heads if recently replaced.
      - Fuel line routing for overhead loops which can trap air in the fuel system.
      - Air filters to see if they are clogged.

   Refer to the engine service manual.

13.75 Code 1458 - Sync Ph Rot Mismatch

Logic:

Mismatch in phase rotation between the generator set output and the system bus.

Possible Causes:

1. Generator set or system bus voltage cables are incorrectly wired to the paralleling breaker.
2. Generator set or system bus voltage sensing connections are incorrectly wired at the base board.
3. The base board is faulty.
4. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Generator set or system bus voltage cables are incorrectly wired to the paralleling breaker.

⚠ WARNING
High voltages are present in this step. Special equipment and training is required to work on or around high-voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures may result in severe personal injury or death.

   a. Using a phase rotation meter or a synchronizing light; verify that the phase rotation of the generator set output relative to the system bus. Energize the system bus and start the generator set in question in Manual mode, but do not close the paralleling breaker. First check the phase rotation of the system bus with the phase rotation meter. Then check the phase rotation of the generator set. The generator set and the system bus should have the same phase rotation, L1–L2–L3. For proper phase rotation measurement procedures, refer to the phase rotation meter instructions. Correct the wiring if the phase rotation between the generator set and system bus is different. If the phase rotation check shows that a phase is missing, check for blown fuses and an open circuit at the system bus voltage cables and the generator set voltage cables connected to the paralleling breaker.

2. Generator set or system bus voltage sensing connections are incorrectly wired at the base board.

   a. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.

      - Measure the phase rotation at base board from the system bus at: L1, TB7-1; L2, TB7-2; L3, TB7-3. The phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation is not correct, re-check the wiring.
      - Measure the phase rotation at base board from the Generator set at: L1, J22-1; L2, J22-2; L3, J22-3. The phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation is not correct, re-check the wiring.

   b. If the nominal voltage is over 600 VAC, check the voltage sensing connections from the base board to the PT and the PT to the System bus.

⚠ WARNING
High voltages are present in this step. Special equipment and training is required to work on or around high-voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures may result in severe personal injury or death.

      - Measure the phase rotation at the input of the PT (Potential Transformer) from the system bus. The phase rotation at the input of the PT should match the phase rotation at the input of the base board. The phase rotation (“L1 – L2 –L3") at the input of the PT should be the same as the phase rotation at the input of the base board at L1, TB7-1; L2, TB7-2; L3, TB7-3; if the phase rotation does not match, correct the wiring from the System bus to the PT and/or from the PT the base board.
      - Measure the phase rotation at the input of the PT (Potential Transformer) from the generator set. The phase rotation at the input of the PT should match the phase rotation at the input of the base board. The phase rotation (“L1 – L2 –L3") at the input of the PT should be the same as the phase rotation at the input of the base board at J22-1; L2, J22-2; L3, J22-3; if the phase rotation does not match, correct the wiring from the Generator set to the PT and/or from the PT the base board.

3. Check to see if the base board is faulty.

   a. To check the generator set phase rotation on the display, go to Advanced Status -> Adv Genset Status -> Phase Rotation -> Genset Phase Rotation and check the phase rotation while the generator set is running. If the phase rotation sensing connections are correct at the input of the base board (L1, J22-1; L2, J22-2; L3, J22-3) but the display shows incorrect generator set phase rotation, replace the base board.

   b. To check the System bus phase rotation on the display, go to Paralleling Status -> Phase Rot and check the phase rotation of the system bus. If the phase rotation sensing connections are correct at the input of the base board (L1, TB7-1; L2, TB7-2; L3, TB7-3) but the display shows incorrect System bus phase rotation, replace the base board.

13.76 Code 1459 - Reverse Power

Logic:

The “Reverse KW threshold" has been exceeded for the time that is registered in the “Reverse KW time delay" setting.

Possible Causes:

1. CTs are incorrectly connected or installed.
2. There are fuel or air delivery problems.
3. Reverse KW threshold is set too low.
4. Loading issue.
5. The generator set and/or Bus voltage and frequency are incorrectly calibrated.
6. kW load share lines.
7. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. CTs are incorrectly connected or installed.
   a. If event/fault code 1459 becomes active as soon as the genset picks up load, check the genset operator panel under the **Alternator Data** menu and view the **L1 KW, L2 KW, and L3 KW** parameters when the genset picks up load (right before the genset shuts down). If L1 KW, L2 KW, or L3 KW is a negative value, it is likely that the CT connected to the negative KW value has an incorrect orientation or is connected backwards. Verify the CT orientation and CT wiring at L1: J12-1 and J12-4, L2: J12-2 and J12-5, L3: J12-3 and J12-6, correct if miswired.
2. Check for fuel or air delivery problems.
   a. Refer to the engine service Manual.
3. Reverse KW threshold is set too low.
   a. To access the Reverse KW threshold configuration menu on the operator panel go to **Setup > Genset Setup > Reverse KW Threshold** and set the “Reverse KW Threshold" Parameter appropriately for the application. Refer to the parameter list to see the default value for Reverse KW.
4. Loading issue.
   a. Ensure that the load on the genset does not exceed the Genset KW Rating. Motors, Uninterruptible Power Supply (UPS), Variable Frequency Drive (VFD), Medical Diagnostic Imagining Equipment, and Fire Pumps have a considerable and different influence on a generator. Revisit the genset sizing process to ensure that the genset is correctly sized for the application, especially if new loads have been introduced into the system (reference the T-030 manual).

⚠ CAUTION
Increasing the KW threshold or time delay may have adverse effects on the alternator. Always check the capability of the alternator.

5. Check to see if the generator set and/or Bus voltage and frequency are incorrectly calibrated.
   a. Verify that the generator set voltage and frequency is the same as the Bus voltage and frequency. If the Bus voltage and frequency is greater than the generator set voltage and frequency, the generator set is no longer exporting power to the electric bus, but is rather drawing power from the electric bus. This condition is called reverse kW. Calibrate the generator set and bus voltage and frequency; refer to the Calibration section of the PowerCommand 3.x Service Manual (900-0670).
6. kW load share lines.
   a. Make sure the kW load share lines are wired correctly.

      Negative: TB9-7 to TB9-7

      Positive: TB9-8 to TB9-8

      Shield: TB9-9 to TB9-9
   b. Disconnect the kW load share lines wires, including the shield. Check the continuity of the each kW load share line. The resistance should be less than 10 ohms.

13.77 Code 1461 - Loss of Field

Logic:

The “Reverse KVAR threshold" has been exceeded for the time that is registered in the “Reverse KVAR time delay" setting.

Possible Causes:

1. Improper voltage calibration of the genset.
2. There are fuel or air delivery problems.
3. Load sharing lines incorrectly connected.
4. Improperly set Leading Power Factor.
5. kVAR load share lines.

Diagnosis and Repair:

1. Improper voltage calibration of the genset.
   a. If the genset is not operating in droop paralleling mode, go to step 2. Using a voltmeter measure the AC voltage of the Electric Bus that the genset is paralleled to (voltage of the Genset Bus or the Utility). Then measure the output voltage of the genset and ensure that the genset output voltage is +3 VAC/-0 VAC that of the source which the genset is paralleled to. Event/fault code 1461 is a result of the genset not matching or exceeding the voltage of the electric bus, which causes the genset to import current from the electric bus (Reverse KVAR). To access the voltage calibration menu on the operator panel go to **Setup > Adjust > Voltage Calibration** and increase the genset output voltage.

b. Using a volt-meter measure the AC voltage of the Electric Bus that the genset is paralleled to (voltage of the Genset Bus or the Utility). Then measure the output voltage of the genset and ensure that the genset output voltage is +3 VAC/-0 VAC that of the source which the genset is paralleled to. Event/fault code 1461 is a result of the generator set not matching or exceeding the voltage of the electric bus, which causes the genset to import current from the electric bus (Reverse KVAR). To access the voltage calibration configuration menu on the display go to: **Setup > Adjust > Voltage Calibration** and increase the genset output voltage.

2. Check to see if there are fuel or air delivery problems.
   a. Refer to the engine service Manual.
3. Load sharing lines incorrectly connected.
   a. Ensure that the orientation of the load sharing connections is correct, and that the shield is only grounded at one point. Check for damaged or disconnected wires at TB9-8, KW+ ; TB9-7, KW- ; TB9-10, KVAR+ ; TB9-11, KVAR- ; TB9-9, Shield (shield should be grounded at only one genset). Correct connections if faulty.
4. Improperly set Leading Power Factor.
   a. If Loss of excitation occurs when the genset is lightly loaded, a leading power factor may be the cause. Leading Power factor can be caused by operation of filters and power factor correction capacitors when the KW load level on the genset is low. Motors, Uninterruptible Power Supply (UPS), Variable Frequency Drive (VFD), Medical Diagnostic Imaging Equipment, Fire Pumps and certain types of lighting have a considerable and different influence on a generator and can also cause a leading power factor. Leading power factor loads can cause the genset to lose control of the output voltage of the genset. To access the Power Factor menu on the operator panel go to **Alternator Data** and view the value of L1 PF, L2 PF, L3 PF, and Total PF, right before the genset shuts down on event/fault code 1461. Revisit the genset sizing process if the power factor is leading to ensure that the genset is correctly sized for the application, especially if new loads have been introduced into the system (reference the T-030 manual).

⚠ CAUTION
Increasing the KVAR threshold or time delay may have adverse effects on the alternator. Always check the capability of the alternator.

5. kVAR load share lines.
   a. Make sure the kVAR load share lines are wired correctly.

      Negative: TB9-11 to TB9-11

      Shield: TB9-9 to TB9-9

      Positive: TB9-10 to TB9-10
   b. Disconnect the kVAR load share lines wires, including the shield. Check the continuity of the each kVAR load share line. The resistance should be less than 10 ohms.

13.78 Code 1463 - Not In Auto

Logic:

The control switch position is not in Auto.

Possible Causes:

1. The control is not in Auto mode.

Diagnosis and Repair:

1. Check to see in the control is in Auto mode.
   a. Press the "Auto" button on the display panel. If the light above the Auto button is on solid, the control is in Auto mode.
   b. If the light above the Auto button is blinking, this indicates that the display has lost communication with the base board. Check the wiring between the display (J29-6 and J29-4) and the base board (J25-10 and J25-11) for an open circuit.

13.79 Code 1464 - Load Dump

Logic:

If the "Load Dump" parameter is enabled and the genset KW output exceeds the "Overload Threshold" for the "Overload Set Time" or the output frequency of the genset drops below the "Under-frequency Offset" for the "Under-frequency Set Time"; the genset will dump its electrical load.

Possible Causes:

1. Active fault code is set to Derate.
2. The "Overload Threshold" is set too low.
3. The "Under-frequency Offset" is set too low.
4. The "Overload Set Time" or "Under-frequency Set Time" is set too low.
5. There are fuel or air delivery problems.
6. Incorrect CTs or CT Connections.
7. The base board is faulty.
8. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Active fault code is set to Derate.
   a. Event/fault code 1464 can be activated as a result of another active fault that is set to "Derate". Troubleshoot the other active fault(s) that are set to Derate.
2. The "Overload Threshold" is set too low.
   a. To access the Overload Threshold configuration menu on the operator panel go to **Setup > Genset Setup** and set the "Overload Threshold" parameter appropriately for the application. Refer to the parameter list to see the default value for "Overload Threshold".
3. The "Under-frequency Offset" is set too low.
   a. To access the Under-frequency Offset configuration menu on the operator panel go to **Setup > Genset Setup** and set the "Under-frequency Offset" parameter appropriately for the application. Refer to the parameter list to see the default value for "Under-frequency Offset".

4. The "Overload Set Time" or "Under-frequency Set Time" is set too low.
    a. To access the "Overload Set Time" and "Under-frequency Set Time" configuration menu on the operator panel go to **Setup > Genset Setup** and set the "Overload Set Time" and "Under-frequency Set Time" Parameters appropriately for the application. Refer to the parameter list to see the default values for "Overload Set Time" and "Under-frequency Set Time".
5. Check to see if there are incorrect CTs, CT connections, or CT ratio.
    a. Check the CTs, CT connections, and the CT ratio. For installation instructions, refer to the section on Current Transformer Installation or reference event/fault code 2814 and event/fault code 2815.
6. Incorrect CTs, CT Connections, or CT ratio.
    a. Check the CTs, CT Connections, and CT ratio. For installation instructions, refer to the section on Current Transformer Installation or reference event/fault code 2814 and event/fault code 2815.
7. The base board is faulty.
    a. If the previous steps did not identify any problems, replace the control board.

13.80 Code 1469 - Speed/Hz Mismatch

Logic:

Engine speed and genset output frequency do not match.

Possible Causes:

1. Fly wheel teeth number is incorrectly set.
2. Faulty Magnetic Pick-up.
3. Incorrect engine speed.
4. A new alternator was installed with a different number of poles.
5. Load induced.
6. Speed/frequency mismatch threshold set too low.
7. Speed/frequency mismatch fault time.
8. Frequency-to-speed gain select.
9. Gearbox teeth incorrect.

Diagnosis and Repair:

1. Fly wheel teeth number is incorrectly set.
    a. For a hydro-mechanical genset, access the Flywheel Teeth setup screen through the Operator Panel and ensure that the PCC is set up with the correct number of engine flywheel teeth.
2. Faulty Magnetic Pick-up
    a. For a Hydro-mechanical application, inspect the MPU wires/connector pins for shorts and open circuits. Remove the MPU connectors and check for 3.5 to 15 VAC at the MPU while cranking. If the MPU tests satisfactorily, then check the voltage output of the board at J11-9 (MPU +) and J11-10 (MPU -).

3. Incorrect engine speed.
   a. Refer to the engine service manual to correct.

      Correct Speeds

      1800 RPM at 60 Hz

      1500 RPM at 50 Hz
4. A new alternator was installed with a different number of poles.
   a. If a new alternator with a different number of poles replaced an original alternator, then the speed and frequency ratio is inaccurate. Go to **Setup > OEM Setup >OEM Engine Setup > Freq/Speed** and adjust the "Frequency to Speed Gain Select" parameter accordingly to the alternator. To calculate the Frequency to Speed value use the following equation:

      Frequency to Speed = 120 / Number of poles of the Alternator
5. Load induced.
   a. Non-linear loads like Uninterruptible Power Supply (UPS) and certain types of lighting have a considerable and different influence on a generator which can cause significant frequency fluctuations that do not match measured engine speed; ex: a UPS causes 62 Hz at 1800 RPM. This is an application issue; correct the application issue and refer to the T030 manual.
6. Speed/frequency mismatch threshold set too low.
   a. Connect with InPower.
   b. Make sure the speed/frequency mismatch threshold is set within 0.1-20 Hz.
7. Speed/frequency mismatch fault time.
   a. Connect with InPower.
   b. Make sure the speed/frequency mismatch threshold time is set within 0.2-10 sec.
8. Frequency-to-speed gain select.
   a. Connect with InPower.
   b. Make sure the frequency-to-speed gain select is set properly.
9. Gearbox teeth incorrect.

   In the case of gearbox setup, make sure the settings are correct.
   a. Connect with InPower.
   b. Make sure the flywheel teeth parameter is set to the number of teeth of the gearbox.

13.81 Code 1471 - High Current Warning

Logic:

Genset output current has exceeded 110% for 60 seconds.

Possible Causes:

1. Overload.
2. Incorrect CT Ratio, CTs, or CT connections.
3. The base board is faulty.

4. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Overload.
   a. Reference the first 2 steps of event/fault code 1444.
2. Incorrect CT Ratio, CTs, or CT connections.
   a. Check the CT Ratio, CTs, and CT connections, reference event/fault code 2814.
3. The base board is faulty.
   a. If the previous steps did not identify any problems, replace the control board.

13.82 Code 1472 - High Current Shutdown

Logic:

The AmpSentry High Current Shutdown threshold has been exceeded.

NOTICE
This fault remains active and cannot be reset until the Alternator Overheat Integral time has expired (which takes up to five minutes). The Alternator Overheat Integral time allows the alternator to cool down before allowing a restart.

Possible Causes:

1. Short or overload.
2. Incorrect CT Ratio, CTs, or CT connections.
3. The base board is faulty.
4. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Short or overload.
   a. Check the load and load cables. Repair if necessary.
2. Incorrect CT Ratio, CTs, or CT connections.
   a. Check the CT Ratio, CTs, and CT connections, reference event/fault code 2814.
3. The base board is faulty.
   a. If the previous steps did not identify any problems, replace the control board.

13.83 Code 1475 - First Start Backup Fail

Logic:

Genset has not received permission to close the Genset CB to a dead bus from the First Start Input within the “First Start Back up time" parameter.

Possible Causes:

1. Wiring issue at the First Start Arbitration input.
2. The base board is faulty.

Diagnosis and Repair:

1. Wiring issue at the First Start Arbitration input.
   a. The First Start Arbitration input is incorrectly wired between generator sets or an open circuit exists at the First Start Arbitration input. Check the wiring at TB3-11 (First Start Arbitration) and TB3-12 (Return) between this and all gensets that are interconnected, and ensure that the wiring is correct.
2. The base board is faulty.
   a. If previous steps do not reveal any problems, replace the base board.

13.84 Code 1483 - Common Alarm

Logic:

The control has detected a warning fault and/or shutdown fault.

Possible Causes:

1. A warning fault and/or shutdown fault is active.

Diagnosis and Repair:

1. A warning fault and/or shutdown fault is active.
   a. This fault is activated as a result of another warning or shutdown fault. Troubleshoot the other fault(s) that are causing the genset to generate this event/fault code.

13.85 Code 1540 - Common Warning

Logic:

The control has detected a warning fault.

Possible Causes:

1. Active warning fault.

Diagnosis and Repair:

1. Active warning fault.
   a. This fault is activated as a result of another warning fault. Troubleshoot the other warning fault(s) that are causing the genset to generate a warning fault.

13.86 Code 1541 - Common Shutdown

Logic:

The control has detected a shutdown fault.

Possible Causes:

1. Active shutdown fault.

Diagnosis and Repair:

1. Active shutdown fault.
   a. This fault is activated as a result of another shutdown fault. Troubleshoot the other shutdown fault(s) that are causing the genset to shut down.

13.87 Code 1573 - Config Input #1 Fault

Logic:

Configurable input #1 fault is active.

Possible Causes:

1. Condition for which "Configurable Input #1" is configured for service.
2. "Configurable Input #1 Active State Selection" parameter is configured incorrectly.
3. Incorrectly wired; or open circuit or short circuit in the wiring.
4. The base board is faulty.

Diagnosis and Repair:

1. Condition for which "Configurable Input #1" is configured for service.
   a. Check the condition for which "Configurable Input #1" has been configured for; ex. if "Configurable Input #1" was configured to become active when the fuel level is low, check the fuel level and add fuel if needed. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to step 2.
2. "Configurable Input #1 Active State Selection" parameter is incorrectly configured.
   a. With InPower or through the operator panel check the switch input setting (active closed or active open) for Configurable Input #1. Ensure that the switch input setting is correctly set. If "Configurable Input #1 Input Function Pointer" parameter is set to default and if "Configurable Input #1 Active State Selection" parameter is set to "active closed", input 1 (event/fault code 1573) will become active when TB1-12 (input 1) and TB1-13 (ground) are connected (shorted) together.

      If "Configurable Input #1 Input Function Pointer" parameter is set to default and if "Configurable Input #1 Active State Selection" parameter is set to "active open", input 1 (event/fault code 1573) will become active when there is an open circuit between TB1-12 (input 1) and TB1-13 (ground).

      To access the input configuration on the operator panel go to **Setup > Configurable I/O > Config Input #1 Menu > Active** and set this parameter appropriately for the application.
3. Incorrectly wired; or open circuit or short circuit in the wiring.
   a. Check the wiring at TB1-12 (input 1) and TB1-13 (ground) for an open circuit, short circuit, or a miswired condition.
4. The base board is faulty.
   a. If the previous steps did not reveal and problems but event/fault code 1573 is still active, replace the base board.

13.88 Code 1689 - Reset Real Time Clock

Logic:

Power to the Real Time Clock (RTC) chip on the base board has been lost and the clock is no longer accurate.

Possible Causes:

1. Battery power has been lost.
2. The base board is faulty.

Diagnosis and Repair:

1. Battery power has been lost.
    a. The RTC chip requires little, but constant, power to keep the control's internal clock accurate. It has an internal capacitor that keeps the RTC operating for up to 1 hour when the battery is disconnected or dead. If battery power is lost for over 1 hour, the RTC will stop functioning. When battery power is supplied to the control again, the control will display event/fault code 1689, because the RTC is no longer accurate. If the fault clears after being acknowledged, then the control is OK. To set the real time clock, on the operator panel go to **Setup > Clock Setup** and set the RTC clock appropriately.
2. The base board is faulty.
    a. If the generator set battery voltage is satisfactory, but the fault is constantly displaying on the control and cannot be cleared, replace the base board.

13.89 Code 1847 - Engine Coolant Temperature High

Logic:

Engine coolant temperature has exceeded the alarm (shutdown with cooldown) threshold for high coolant temperature.

Possible Causes:

1. The engine has overheated (the coolant temperature has risen above the shutdown trip point).
2. Inaccurate engine temperature sensor.
3. Fault simulation feature is enabled.
4. Threshold setting too low.

Diagnosis and Repair:

1. The engine has overheated.
    a. Allow the engine to cool down completely.
    b. Look for possible coolant leakage points and repair as necessary.
    c. Check the coolant level and replenish if low.
    d. Check for obstructions to cooling airflow and correct as necessary.
    e. Check the fan belt and repair or tighten if necessary.
    f. Check the blower fan and circulation pumps on remote radiator installations.
    g. Reset the control and restart.

2. Verify the sensor accuracy with a thermocouple or similar temperature probe.
   a. Connect the temperature probe to the engine near the coolant temperature sensor.
   b. Connect InPower.
   c. Compare the coolant temperature reading from the service tool to the reading from the temperature probe. If the two readings are reasonably close, then the sensor is reading correctly.
3. Verify that the fault simulation for the sensor is not enabled.
   a. Connect InPower.
   b. Verify that the fault simulation is NOT enabled for the coolant temperature sensor by connecting to the PCC via InPower. If the fault simulation is disabled, there is no problem.
4. Check threshold settings.
   a. Connect InPower.
   b. Verify that the fault threshold is within the normal operating range for the coolant temperature sensor. Refer to the engine service manual for correct threshold values, and make the appropriate changes using InPower.

13.90 Code 1912 - Utility Loss Of Phase

Logic:

In Power Transfer Control (PTC) Operation, if the phase angle between phases drops below 90 degrees or exceeds 150 degrees, for the “Utility Loss of Phase Drop-Out Delay" time parameter, fault code 1912 will become active.

Possible Causes:

1. Open circuit at the utility voltage sensing inputs.
2. Utility voltage or frequency is unstable.
3. The base board is faulty.

Diagnosis and Repair:

1. Open circuit at the utility voltage sensing inputs.
   a. The phase angle between phases L1-L2, L2-L3, and L3-L1 should be 120 degrees. At least one connection point that is used to calculate phase angle has been lost. Check the voltage sensing connections at L1: TB7-1; L2: TB7-2, L3: TB7-3 for an open circuit, and ensure that voltage and phase angle is correct. If using a PT also check the inputs and outputs of the PT.
2. Utility phase angle is unstable.
   a. Check with your utility company.
3. The base board is faulty.
   a. Replace the base board if the phase angle at L1: TB7-1; L2: TB7-2, L3: TB7-3 is correct, but the display does not register correct values.

13.91 Code 1913 - Genset Loss Of Phase

Logic:

In Power Transfer Control (PTC) Operation, if the phase angle between phases drops below 90 degrees or exceeds 150 degrees, for the “Genset Loss of Phase Drop-Out Delay" time parameter, fault code 1913 will become active.

Possible Causes:

1. Correct any active genset faults.
2. Open circuit at the genset voltage sensing inputs.
3. The base board is faulty.
4. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Correct any active genset faults.
   a. Correct any active genset faults on the display, especially faults that might cause the engine to hunt/oscillate.
2. Open circuit at the genset voltage sensing inputs.
   a. The phase angle between phases L1-L2, L2-L3, and L3-L1 should be 120 degrees. At least one connection point that is used to calculate phase angle has been lost. Check the voltage sensing connections at L1, J22-1; L2, J22-2; L3, J22-3 for an open circuit, and ensure that voltage and phase angle is correct. If using a PT also check the inputs and outputs of the PT.
3. The base board is faulty.
   a. Replace the base board if the phase angle at L1, J22-1, L2, J22-2, L3, J22-3 is correct, but the display does not register correct values.

13.92 Code 1914 - Utility Ph Rotation Error

Logic:

Utility Phase rotation is incorrect.

Possible Causes:

1. Utility voltage sensing connections are incorrectly wired at the base board.
2. The base board is faulty.
3. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Utility voltage sensing connections are incorrectly wired at the base board.

   a. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.

   - Measure the phase rotation and voltage input into the base board from the Utility bus at: L1, TB7-1; L2, TB7-2; L3, TB7-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring.

   b. If the nominal voltage is over 600 VAC, measure the voltage sensing connections from the base board to the PT and the PT to the Utility bus.

⚠ WARNING
High voltages are present in this step. Special equipment and training is required to work on or around high-voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures may result in severe personal injury or death.

   - Measure the phase rotation and voltage input into the base board from the PT (Potential Transformer) at: L1, TB7-1; L2, TB7-2; L3, TB7-3, L4, TB7-4. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the base board to the PT and correct if necessary.
   - Measure the phase rotation and voltage input into the PT (Potential Transformer) from the Utility bus. The voltage into the PT should match the Utility bus voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the PT to the Utility bus and correct if necessary.

2. The base board is faulty.

   a. If the phase rotation and the Utility bus voltage sensing connections are correct at the input of the base board, L1, TB7-1; L2, TB7-2; L3, TB7-3; but the display shows incorrect Utility bus voltage and phase rotation, replace the base board. To check the Utility bus voltage and phase rotation using the display, go to Paralleling Status - Paralleling Status-PTC Sc 1 -> Bus Avg Voltage -> Utility LL Average Voltage and Paralleling Status -> Phase Rot -> Utility Phase Rotation.

13.93 Code 1915 - Genset Phase Rotation

Logic:

Genset Phase rotation is incorrect.

Possible Causes:

1. Genset voltage sensing connections are incorrectly wired at the base board.
2. The base board is faulty.
3. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Genset voltage sensing connections are incorrectly wired at the base board.
   a. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.
      - Measure the phase rotation and voltage input into the base board from the Generator set at: L1, J22-1; L2, J22-2; L3, J22-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring.

   b. If the nominal voltage is over 600 VAC, measure the voltage sensing connections from the base board to the PT and the PT to the Generator set.

⚠ WARNING
High voltages are present in this step. Special equipment and training is required to work on or around high-voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures may result in severe personal injury or death.

   - Measure the phase rotation and voltage input into the base board from the PT (Potential Transformer) at: L1, J22-1; L2, J22-2; L3, J22-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the base board to the PT and correct if necessary.
   - Measure the phase rotation and voltage input into the PT (Potential Transformer) from the Generator set. The voltage into the PT should match the Generator set voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the PT to the Generator set and correct if necessary.

2. The base board is faulty.
   a. If the phase rotation and the generator set voltage sensing connections are correct at the input of the base board, L1, J22-1; L2, J22-2; L3, J22-3; but the display shows incorrect generator set voltage and phase rotation, replace the base board. To check the generator set voltage and phase rotation using the display, go to Advanced Status -> Adv Genset Status.

13.94 Code 1999 - Maximum Parallel time

Logic:

In Power Transfer Control (PTC) Operation, if the genset remains paralleled to the utility for a time that is longer than the "Maximum Parallel Time" parameter, fault code 1999 will become active.

Possible Causes:

1. "Maximum Parallel Time" parameter is set too low.

Diagnosis and Repair:

1. "Maximum Parallel Time" parameter is set too low.
   a. Fault code 1999 becomes active when the genset remains paralleled to the utility for a time that is longer than the "Maximum Parallel Time" parameter. Check the setting of the Maximum Parallel Time parameter and ensure that it is set to an appropriate value for the application. To modify the "Maximum Parallel Time" parameter on the display, go to: **Setup > Paralleling Setup > Power Transfer Control > Max Parallel** and set appropriately for the application.

13.95 Code 2331 - Low Utility Voltage

Logic:

In Power Transfer Control (PTC) Operation, if the utility voltage is below the “Utility Undervoltage Drop-Out Threshold", for the “Utility Undervoltage Drop-Out Delay", fault code 2331 will become active.

Possible Causes:

1. Utility undervoltage drop-out thresholds are incorrectly set.
2. The voltage of the utility is low and/or unstable.

Diagnosis and Repair:

1. Utility undervoltage drop-out thresholds are incorrectly set.
   a. This fault will become active when the Utility voltage goes below the “Utility undervoltage drop-out threshold" for the “Utility Undervoltage Drop-Out Delay". Utility undervoltage drop-out threshold is dependent of the following parameters:
      - Utility Undervoltage Drop-out percentage.
      - Utility Undervoltage Drop-out Delay.

        To Modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Drop out or Drop-Out Delay** and set appropriately. Refer the PTC section for setup information and instructions.
2. The voltage of the utility is low and/or unstable.
   a. The voltage of the utility is low and/or unstable, check with your utility company.

13.96 Code 2335 - Excitation Fault

Logic:

The control has detected the simultaneous loss of all phases of sensing.

Possible Causes:

1. Incorrectly configured or wiring issue.
2. The base board is faulty.
3. Refer to Generator troubleshooting.

Diagnosis and Repair:

1. Incorrectly configured or wiring issue.
   a. Ensure that the configuration of the “Lost AC Voltage Threshold" parameter is set appropriately for the application. To access the Lost AC Voltage Threshold configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > Lost AC Voltage Threshold** and set the “Lost AC Voltage Threshold" parameter appropriately for the application. Refer to the parameter list to see the default value for “Lost AC Voltage Threshold".
   b. All the connections that are used to calculate voltage and current by the control have been lost (either by disconnection or no voltage, current, frequency input into the control, etc.) Check the voltage sensing (L1: J22 -1; L2: J22 -2, L3: J22-3, L4: J22-4) and current sensing (L1: J12-1, J12-4; L2: J12-2, J12-5; L3: J12-3, J12-6;) connections into the control and ensure that voltage and current are available at these connections when the genset is running. If using a PT also check the inputs and outputs of the PT.
2. The base board is faulty.
   a. If the previous steps did not reveal any problems, replace the base board.

13.97 Code 2336 - Checksum Fault

Logic:

Integrity check has found corrupted memory block(s) in the PCC.

Possible Causes:

1. PCC has corrupted memory block(s).
2. The base board is faulty.

Diagnosis and Repair:

1. PCC has corrupted memory block(s).
   a. The PCC has corrupted memory block(s), this is indicated by all of the LEDs on the base board flashing. Perform an initial calibration on the base board with the newest Incal files. If the Incal update does not resolve the issue, then replace the base board.
2. The base board is faulty.
   a. If the correct checksum and feature codes are entered but the control does not calibrate, replace the control.

13.98 Fault Code 2341 - High Control Temperature

Lamp: Warning

Corrective Action: The control temperature is above normal (158° F [70° C]) for a time greater than the control temperature set time. Check the generator set room air flow.

13.99 Code 2342 - Too Long In Idle

Logic:

The engine has been running at Low Speed Idle for a time longer than the "Max Idle Time" parameter.

Possible Causes:

1. "Idle Time" parameters are configured incorrectly.
2. The Coolant Heater(s) is/are faulty.

Diagnosis and Repair:

1. Idle Time parameters are configured incorrectly.
   a. If the genset has been running in Idle and displays event/fault code 2342, ensure that the genset is not configured to run in idle for more that 10 min. Long periods of engine idling (more than 10 min) can eventually affect engine performance and may not be covered by the engine warranty. Set the **"Idle Warmup Time"** and **"Idle Cooldown Time"** to an appropriate value. To access these parameters, on the operator panel go to **Setup > Genset Setup > Idle Warmup Time** or **Idle Cooldown Time** and set these parameter appropriately for the application. Refer to the parameter list to see the default value for "Idle Warmup Time" and "Idle Cooldown Time".
   b. The "Max Idle Time" parameter might be set too low. To access the Max Idle Time configuration menu on the operator panel go to **Setup > Genset Setup > Max Idle Time** and set the "Max Idle Time" parameter appropriately for the application. Refer to the parameter list to see the default value for "Max Idle Time" parameter.
   c. If the "Idle Warmup Coolant Temp" is set too high, the genset will idle for a longer period of time until the temperature of the engine reaches this set point. To access the Idle Warmup Coolant Temp configuration menu on the operator panel go to **Setup > Genset Setup > Idle Warmup Coolant Temp** and set the "Idle Warmup Coolant Temp" parameter appropriately for the application. Refer to the parameter list to see the default value for "Idle Warmup Coolant Temp" parameter.
2. The Coolant Heater(s) is/are faulty.
   a. With the generator set in the Off position, check the wiring and make sure that there is AC voltage available to the coolant heaters. If voltage is not available, correct the wiring. If voltage is available, go to step b.
   b. Measure the temperature of the coolant heater(s) using a proper temperature measuring device. If the ambient temperature is above 40 degrees F, the measured temperature of the coolant heater(s) should be above close to 90 degrees F (dependent on the ambient temperature). If the temperature of the coolant heater(s) is close to the ambient temperature, replace the coolant heater(s).

13.100 Code 2358 - High Utility Voltage

Logic:

In Power Transfer Control (PTC) Operation, if the “Utility Overvoltage Sensor Enable" parameter is set to enable, and the utility voltage goes above the “Utility Overvoltage Drop-Out Threshold", for the “Utility Overvoltage Drop-Out Delay" time, fault code 2358 will become active.

Possible Causes:

1. Utility Overvoltage drop-out thresholds are incorrectly set.
2. The voltage of the Utility is not stable.

Diagnosis and Repair:

1. Utility Overvoltage drop-out thresholds are incorrectly set.
   a. This fault will become active when the Utility voltage goes above the “Utility Overvoltage Drop-Out Threshold" for the “Utility Overvoltage Drop-Out Delay" time. The utility overvoltage drop-out threshold is dependent of the following parameters:
      - Utility Overvoltage Drop-out percentage.
      - Utility Overvoltage Drop-out Delay.

        To Modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Drop out or Drop-Out Delay** and set appropriately. Refer the PTC section for setup information and instructions.

   b. To disable this function, set the “Utility Overvoltage Sensor Enable" parameter to disable. On the display go to: **Setup > Paralleling Setup > Power Transfer Control > Enable** and set appropriately. Refer the PTC section for more information.
2. The voltage of the utility is very high and/or unstable.
   a. The voltage of the utility is very high and/or unstable, check with your utility company.

13.101 Fault Code 2967 - Governor Fault

Lamp: Warning

Corrective Action: Governor hardware drive circuitry contains a fault condition.

13.102 Code 2396 - Utility CB Fail To Close

Logic:

Utility circuit breaker (CB) has failed to close for the time that is registered in the “Util CB Fail to Close Time Delay" parameter.

Possible Causes:

1. Incorrectly wired.
2. Faulty Utility Circuit Breaker (CB).
3. The base board is faulty.

Diagnosis and Repair:

1. Incorrectly wired.
   a. The base board is sending the Utility CB a close command, but the Utility CB Position Status remains open. Correct the wiring from the CB Close Control output on the base board at TB5-6 and TB5-7 to the Utility breaker; check for an open circuit at the Utility breaker. The Utility CB Close control output is a NO Relay at TB5-6 and TB5-7 (Relay Common) on the base board. When the relay on the base board is closed, the Utility Breaker should be closed. The output of TB5-6 and TB5-7 should match the status of the Utility CB Close command; go to: **Advanced Status > Advanced Controller Status**, and ensure that the status of the CB close position command at the display matches the output.
   b. Verify the wiring of the CB position status from the Utility breaker to the base board. The CB position sensing can be set up as single or dual sensing in the base board; check the display if the base board is setup as single or dual sensing. To access the CB position sensing, go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Utility Breaker Position Contacts**
      - If the CB position sensing is set up as single, verify the connection at CB A (NO) status at TB10-3 and the Return at TB10-1.
      - If the CB position sensing is set up as dual, verify the connection at CB A (NO) status at TB10-3 and the Return at TB10-1 and also verify the connection at CB B (NC) status at TB10-4 and TB10-1 (Return). The input status at CB A (NO) and CB B (NC) should be opposite, one input will be open while the other is closed, if they are the same check the wiring between the Utility breaker and the CB status input on the base board.

        Ensure that the connections on the base board are correctly connected and that a short and/or open circuit does not exist. The physical connection to the base board should match the status of the CB position; go to: **Paralleling Status > Paralleling Status-PTC Sc 1 > Util CB Pos > Utility CB Position Status**, and ensure that the status of the CB position matches the connection.
2. Faulty Utility CB.
   a. Refer to the Utility CB Service Manual.
3. The base board is faulty.
   a. If the wiring and utility CB are not found to be faulty, replace the base board.

13.103 Code 2397 - Utility CB Fail To Open

Logic:

Utility circuit breaker (CB) has failed to open for the time that is registered in the “Utility CB Fail to Open Time Delay" parameter.

Possible Causes:

1. Incorrectly wired.
2. Faulty Utility Circuit Breaker (CB).
3. The base board is faulty.

Diagnosis and Repair:

1. Incorrectly wired.
   a. The base board is sending the Utility CB an open command, but the Utility CB Position Status remains closed. Correct the wiring from the CB Open Control output on the base board at TB5-8 and TB5-9 to the Utility breaker; check for a short circuit. The Utility CB Open control output is a NO Relay at TB5-8 and TB5-9 (Relay Common) on the base board. When the relay is closed the Utility Breaker is closed. The output of TB5-8 and TB5-9 should match the status of the **Utility CB Open position command**; go to: **Advanced Status > Advanced Controller Status**, and ensure that the status of the Utility CB Open position command at the display matches the output.
   b. Verify the wiring of the CB position status from the Utility breaker to the base board. The CB position sensing can be set up as single or dual sensing in the base board; check the display if the base board is setup as single or dual sensing. To access the CB position sensing, go to: **Setup > Paralleling Setup > Basic > Pos Contacts > Utility Breaker Position Contacts.**
      - If the CB position sensing is set up as single, verify the connection at CB A (NO) status at TB10-3 and the Return at TB10-1.
      - If the CB position sensing is set up as dual, verify the connection at CB A (NO) status at TB10-3 and the Return at TB10-1 and also verify the connection at CB B (NC) status at TB10-4 and TB10-1 (Return). The input status at CB A (NO) and CB B (NC) should be opposite, one input will be open while the other is closed, if they are the same check the wiring between the Utility breaker and the CB status input on the base board.

        Ensure that the connections on the base board are correctly connected and that a short and/or open circuit does not exist. The physical connection to the base board should match the status of the Utility CB position; go to: **Paralleling Status > Paralleling Status-PTC Sc 1 > Util CB Pos > Utility CB Position Status**, and ensure that the status of the Utility CB position matches the connection.
2. Faulty Utility CB.
   a. Refer to the Utility CB Service Manual.
3. The base board is faulty.
   a. If the wiring and utility CB are not found to be faulty, replace the base board.

13.104 Code 2678 - Charging Alternator Fail

Logic:

Battery charging alternator is not charging.

Possible Causes:

1. Faulty engine DC alternator or open circuit.

Diagnosis and Repair:

1. Faulty engine DC alternator or open circuit.
   a. Check the wiring of the alternator for open circuits. If the wiring is satisfactory, measure the output voltage of the alternator to the battery while the engine is running. Normal charging voltage is 12-14 VDC in a 12 V system or 24-26 VDC in a 24 V system. If the appropriate output is not observed, replace the DC alternator.

13.105 Code 2814 - Genset CT Ratio Low

Logic:

The genset CT ratio (primary vs. secondary) is too small for the control to function properly for the voltage and KW rating of this genset.

Possible Causes:

1. Incorrect CT ratio setup (or feature code).
2. The CTs are incorrectly sized.
3. Incorrect voltage or kW rating setup.

Diagnosis and Repair:

1. Incorrect CT ratio setup (or feature code).
   a. The control uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the genset. Use the CT ratio calculator in InPower to determine the correct CT ratio for this genset. Then enter the correct CT ratio via InPower or through the operator panel. To access the Genset CT ratio configuration menu on the operator panel go to **Setup > OEM Setup > OEM Alt Setup > Genset CT Ratio** and set the “Genset CT Ratio primary" and “Genset CT Ratio secondary" parameters appropriately for the application.
2. The CTs are incorrectly sized.
   a. Change the CTs to the correct size.
3. Incorrect voltage or kW rating setup.
   a. The PCC uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the genset. If the voltage or kW setup is incorrect, event/fault code 2814 can become active. Use the CT calculator in InPower to determine the correct voltage and kW rating for this genset. To access the genset voltage and kW rating setup on the Operator Panel, go to **Setup > OEM Setup > OEM Alt Setup > Genset Nominal Voltage** and **Setup > OEM Setup > OEM Genset Setup** and set the parameters appropriately for the application.

13.106 Code 2815 - Genset CT Ratio High

Logic:

The ratio of the genset CT is too large for this genset. The genset CT ratio (primary vs. secondary) is too large for the control to calculate current accurately at the voltage and KW ratings for this genset.

Possible Causes:

1. The control is set up with the incorrect CT ratio (or feature code).

2. The CTs are incorrectly sized.
3. Incorrect voltage or kW rating setup.

Diagnosis and Repair:

1. The control is set up with the incorrect CT ratio (or feature code).
   a. The control uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the genset. Use the CT ratio calculatorin InPower to determine the correct CT ratio for this genset. Then enter the correct CT ratio via InPower or through the operator panel. To access the Genset CT ratio configuration menu on the operator panel go to **Setup > OEM Setup > OEM Alt Setup >** and set the “Genset CT Ratio primary" and “Genset CT Ratio secondary" parameters appropriately for the application.
2. The CTs are incorrectly sized.
   a. Change the CTs to the correct size.
3. Incorrect voltage or kW rating setup.
   a. The PCC uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the genset. If the voltage or kW setup is incorrect, event/fault code 2815 can become active. Use the CT calculator in InPower to determine the correct voltage and kW rating for this genset. To access the Genset voltage and kW rating setup on the Operator Panel go to **Setup > OEM Setup > OEM Alt Setup > Genset Nominal Voltage** and Setup > OEM Setup > OEM Genset Setup and set the parameters appropriately for the application.

13.107 Code 2816 - Genset PT Ratio Low

Logic:

The genset PT ratio is too small for the genset rating. The genset PT ratio (primary vs. secondary) is too small and will cause high voltage readings.

Possible Causes:

1. The control is set up with the incorrect PT ratio.
2. The PTs are incorrectly sized.

Diagnosis and Repair:

1. The control is set up with the incorrect PT ratio.
   a. The control uses nominal voltage and the PT ratio in order to determine if the PT ratio is correct for proper operation of the genset. Voltage input into the control board should not exceed 600 VAC, whether an external PT is used or not. Use the following equation to determine if you have the correct PT ratio: If (Genset Nominal Voltage / Genset PT Primary voltage) * Genset PT Secondary voltage > 600 VAC, your PT ratio is too small.

      Then configure the control with the correct PT Ratio. To access the genset PT ratio configuration menu on the operator panel go to **Setup > OEM Setup > OEM Alt Setup >** and set the “Genset PT Ratio primary" and “Genset PT Ratio secondary" parameters appropriately for the application.

2. The PTs are incorrectly sized.
   a. Use the following equation to determine if the correct PT for the application is installed: (Genset Nominal Voltage / Genset PT Primary voltage) * Genset PT Secondary voltage > 600 VAC, your PT ratio is too small.
   b. Check the voltage input into the control board. When the genset is running the voltage input between L1 and L2 (J22-1 and J22-2) or L2 and L3 (J22-2 and J22-3) should not be more that 600 VAC.

13.108 Code 2817 - Genset PT Ratio High

Logic:

The genset PT ratio is too large, which causes an inaccurate reading of nominal voltage during normal operation; when the genset PT is used (above 600 VAC).

Possible Causes:

1. The control is set up with the incorrect PT ratio.
2. The PTs are incorrectly sized.

Diagnosis and Repair:

1. The control is set up with the incorrect PT ratio.
   a. The control uses nominal voltage and the PT ratio in order to determine if the PT ratio is correct for the operation of the genset. Voltage input into the control board should exceed 50% of the nominal voltage to allow the control to obtain an accurate voltage reading, whether an external PT is used or not. Use the following equation to determine if you have the correct PT ratio: If (Genset Nominal Voltage / Genset PT Primary voltage) * Genset PT Secondary voltage < (Nominal voltage *.5), the PT ratio is too large.

      Then configure the control with the correct PT ratio. To access the genset PT ratio configuration menu on the operator panel go to **Setup > OEM Setup > OEM Alt Setup >** and set the “Genset PT Ratio primary" and “Genset PT Ratio secondary" parameters appropriately for the application.
2. The PTs are incorrectly sized.
   a. Use the following equation to determine if you have the correct PT for the application: (Genset Nominal Voltage / Genset PT Primary voltage) * Genset PT Secondary voltage < (Nominal voltage *.5), your PT ratio is too large.

      B. Check the voltage input into the control board. When the genset is running the voltage input between L1 and L2 (J22-1 and J22-2) or L2 and L3 (J22-2 and J22-3) should be greater than (Genset Bus Nominal Voltage *.5) VAC.

13.109 Code 2818 - Bus PT Ratio Low

Logic:

The Genset Bus PT ratio is too small for the Genset Bus rating. The Bus PT ratio (primary vs. secondary) is too small and will cause high voltage readings

Possible Causes:

1. The control is set up with the incorrect PT Ratio.
2. The PT's are incorrectly sized.

Diagnosis and Repair:

1. The control is set up with the incorrect PT Ratio.
   a. The control uses nominal voltage and the PT ratio in order to determine if the PT ratio is correct for proper operation of the bus. Voltage input into the control board should not exceed 600 VAC, whether an external PT is used or not. Use the following equation to determine if you have the correct PT Ratio: If (Genset Bus Nominal Voltage / Genset Bus PT Primary voltage) * Genset Bus PT Secondary voltage > 600 VAC, your PT Ratio is too small.

      Then configure the control with the correct PT Ratio. To access the Bus PT ratio configuration menu on the display go to: **Setup > Paralleling Setup > Basic > PT Primary and PT Secondary** and set the “Genset Bus PT Primary Voltage" and “Genset Bus PT Secondary Voltage" parameters appropriately for the application.
2. The PT's are incorrectly sized.
   a. Use the following equation to determine if the correct PT for the application is installed: If (Genset Bus Nominal Voltage / Genset Bus PT Primary voltage) * Genset Bus PT Secondary voltage > 600 VAC, your PT Ratio is too small.
   b. Check the voltage input into the control board between L1 & L2 (J22-1 & J22-2) or L2 & L3 (J22-2 & J22-3) the voltage reading should not be more that 600 VAC.

13.110 Code 2819 - Bus PT Ratio High

Logic:

The Genset Bus PT ratio is too large, which causes an inaccurate reading of Genset Bus Nominal voltage during normal operation; when the Genset PT is used (above 600 VAC)

Possible Causes:

1. The control is set up with the incorrect Genset Bus PT Ratio.
2. The PT's are incorrectly sized.

Diagnosis and Repair:

1. The control is set up with the incorrect Genset Bus PT Ratio.
   a. The control uses Genset Bus Nominal voltage and the PT ratio in order to determine if the PT ratio is correct for the operation of the genset. Voltage input into the control board should exceed 50% of the Genset Bus Nominal voltage (up to 600 VAC), to allow the control to obtain an accurate voltage reading, whether an external PT is used or not. Use the following equation to determine if you have the correct PT Ratio: If (Genset Bus Nominal Voltage / Genset Bus PT Primary voltage) * Genset Bus PT Secondary voltage < (Genset Bus Nominal voltage *.5), the PT Ratio is too large.

      Then configure the control with the correct PT Ratio. To access the Genset Bus PT ratio configuration menu on the display go to: **Setup > Paralleling Setup > Basic > PT Primary and PT Secondary** and set the "Genset Bus PT Primary Voltage" and "Genset Bus PT Secondary Voltage" parameters appropriately for the application.
2. The PT's are incorrectly sized.
   a. Use the following equation to determine if you have the correct PT for the application: If (Genset Bus Nominal Voltage / Genset Bus PT Primary voltage) * Genset Bus PT Secondary voltage < (Genset Bus Nominal voltage *.5), the PT Ratio is too large.

b. Check the voltage input into the control board between L1 & L2 (J22-1 & J22-2) or L2 & L3 (J22-2 & J22-3) the voltage should be greater than (Genset Bus Nominal Voltage *.5) VAC.

13.111 Code 2821 - Utility PT Ratio Low

Logic:

The Utility PT ratio is too small for the Utility rating. The Utility PT ratio (primary vs. secondary) is too small and will cause high voltage readings

Possible Causes:

1. The control is set up with the incorrect PT Ratio.
2. The PT's are incorrectly sized.

Diagnosis and Repair:

1. The control is set up with the incorrect PT Ratio.
   a. The control uses nominal utility voltage and the PT ratio in order to determine if the PT ratio is correct for proper operation of the utility. Voltage input into the control board should not exceed 600 VAC, whether an external PT is used or not. Use the following equation to determine if you have the correct PT Ratio: If (Utility Nominal Voltage / Utility PT Primary voltage) * Utility PT Secondary voltage > 600 VAC, your PT Ratio is too small.

      Then configure the control with the correct PT Ratio. To access the utility PT ratio configuration menu on the display go to: **Setup > Paralleling Setup > Basic > PT Primary and PT Secondary** and set the “Utility PT Primary Voltage" and “Utility PT Secondary Voltage" parameters appropriately for the application.
2. The PT's are incorrectly sized.
   a. Use the following equation to determine if the correct PT for the application is installed: If (Utility Nominal Voltage / Utility PT Primary voltage) * Utility PT Secondary voltage > 600 VAC, your PT Ratio is too small.
   b. Check the voltage input into the control board between L1 & L2 (J22-1 & J22-2) or L2 & L3 (J22-2 & J22-3) the voltage reading should not be more that 600 VAC.

13.112 Code 2822 - Utility PT Ratio High

Logic:

The Utility PT ratio is too large, which causes an inaccurate reading of Utility Nominal voltage during normal operation; when the Genset PT is used (above 600 VAC)

Possible Causes:

1. The control is set up with the incorrect Utility PT Ratio.
2. The PT's are incorrectly sized.

Diagnosis and Repair:

1. The control is set up with the incorrect Utility PT Ratio.
    a. The control uses Utility Nominal voltage and the PT ratio in order to determine if the PT ratio is correct for the operation of the genset. Voltage input into the control board should exceed 50% of the Utility Nominal voltage (up to 600 VAC), to allow the control to obtain an accurate voltage reading, whether an external PT is used or not. Use the following equation to determine if you have the correct PT Ratio: If (Utility Nominal Voltage / Utility PT Primary voltage) * Utility PT Secondary voltage < (Utility Nominal voltage *.5), the PT Ratio is too large.

       Then configure the control with the correct PT Ratio. To access the Utility PT ratio configuration menu on the display go to: **Setup > Paralleling Setup > Basic > PT Primary and PT Secondary** and set the “Utility PT Primary Voltage" and “Utility PT Secondary Voltage" parameters appropriately for the application.
2. The PT's are incorrectly sized.
    a. Use the following equation to determine if you have the correct PT for the application: If (Utility Nominal Voltage / Utility PT Primary voltage) * Utility PT Secondary voltage < (Utility Nominal voltage *.5), the PT Ratio is too large.
    b. Check the voltage input into the control board between L1 & L2 (J22-1 & J22-2) or L2 & L3 (J22-2 & J22-3) the voltage should be greater than (Utility Nominal Voltage *.5) VAC.

13.113 Code 2895 - PCCnet Device Failed

Logic:

A non-critical PCCNet device has failed.

Possible Causes:

1. PCCNet communication has been lost or PCCNet device is faulty.

Diagnosis and Repair:

1. PCCNet communication has been lost or PCCNet device is faulty.
    a. If a PCCNet device has lost network communication, the network status light for that device will turn RED. Locate the device with the red network status LED to identify the affected device.
    b. Ensure that the network device has sufficient voltage (12-24 V), as measured at the input of the device, not at the source or battery. Also verify that the device is awake and has a heartbeat. A heartbeat is a LED on the PCCNet device that blinks every 1 second to inform the operator that the device is functioning.
    c. Check the network cable connections of the device(s) and ensure that there are no open or short circuits. The PCCNet network devices are polarity sensitive. For example: Control (RS485+) to Annunciator (RS485+) and Control (RS485-) to Annunciator (RS485-). If the connections are incorrect, the devices will not properly communicate over the network. Ensure that the shield is grounded at one point ONLY. Refer to the respective PCCNet device manual for line limitations and cable requirements.
    d. If previous steps are satisfactory, replace the network device.

e. If replaced device is still exhibiting network issues, this can be due to a grounding loop or ground referencing for remotely mounted and powered network, incorrect network wire, or a noise (EMI) issue. As a test, connect the PCCNet device close (2-5 FT) to the base board, using the power supply from the base board (TB1-5, B+ and TB1-3 ground) and use the required network wire. If the network device functions appropriately, correct the grounding issue, EMI issue, or replace the network wire with the required network wire.

13.114 Code 2896 - Critical PCCnet Dev Fail

Logic:

A critical PCCNet device has failed and has caused the genset to shutdown.

Possible Causes:

1. PCCNet communication has been lost or PCCNet device is faulty.

Diagnosis and Repair:

1. PCCNet communication has been lost or PCCNet device is faulty.
   a. If a PCCNet device has lost network communication, the network status light for that device will turn red. Locate the device with the red network status LED to identify the affected device.
   b. Ensure that the network device has sufficient voltage (12-24 V), as measured at the input of the device, not at the source or battery. Also verify that the device is awake and has a heartbeat. A heartbeat is a LED on the PCCNet device that blinks every 1 second to inform the operator that the device is functioning.
   c. Check the network cable connections of the device(s) and ensure that there are no open or short circuits. The PCCNet network devices are polarity sensitive. For example: Control (RS485+) to Annunciator (RS485+) and Control (RS485-) to Annunciator (RS485-). If the connections are incorrect, the devices will not properly communicate over the network. Ensure that the shield is grounded at one point ONLY. Refer to the respective PCCNet device manual for line limitations and cable requirements.
   d. If previous steps are satisfactory, replace the network device.
   e. If replaced device is still exhibiting network issues, this can be due to a grounding loop or ground referencing for remotely mounted and powered network, incorrect network wire, or a noise (EMI) issue. As a test, connect the PCCNet device close (2-5 FT) to the base board, using the power supply from the base board (TB1-5, B+ and TB1-3 ground), and use the required network wire. If the network device functions appropriately, correct the grounding issue, EMI issue, or replace the network wire with the required network wire.

13.115 Code 2914 - Genset AC Meter Failed

Logic:

Metering chip has failed and can no longer accurately monitor genset current and voltage.

Possible Causes:

1. An over-voltage/-current condition has damaged the metering chip.
2. The base board is faulty.

Diagnosis and Repair:

1. An over-voltage or over-current condition has damaged the metering chip.
    a. Measure the voltage (L1: J22 -1; L2: J22 -2, L3: J22-3, L4: J22-4) and current (L1: J12-1, J12-4; L2: J12-2, J12-5; L3: J12-3, J12-6;) input into the control. Voltage input into the board should not exceed 600 VAC, (damage to board occurs at 750 VAC). Current input into the board should not exceed 5 Amps. If a short circuit or an over-voltage/-current issue exists, correct the problem(s).
2. The base board is faulty.
    a. If the previous step did not reveal any problems, replace the base board.

13.116 Code 2915 - Gen Bus AC Meter Failed

Logic:

Metering chip has failed and can no longer accurately monitor genset bus current and voltage.

Possible Causes:

1. An over-voltage/-current condition has damaged the metering chip.
2. The base board is faulty.

Diagnosis and Repair:

1. An over-voltage or over-current condition has damaged the metering chip.
    a. Measure the voltage using a volt-meter at L1: TB7-1; L2: TB7-2, L3: TB7-3, L4: TB7-4; and the current using a current probe at CT1, CT2, and CT3. Voltage input into the board should not exceed 600 VAC, (damage to board occurs at 750 VAC). Current input into the board should not exceed 5 Amps. If a short circuit or over-voltage/-current condition exists, correct the problem.
2. The base board is faulty.
    a. If the previous step did not reveal any problems, replace the base board.

13.117 Code 2916 - Utility AC Meter Failed

Logic:

Metering chip has failed and can no longer accurately monitor utility current and voltage.

Possible Causes:

1. An over-voltage/-current condition has damaged the metering chip.
2. The base board is faulty.

Diagnosis and Repair:

1. An over-voltage or over-current condition has damaged the metering chip.
    a. Measure the voltage using a volt-meter at L1: TB7-1; L2: TB7-2, L3: TB7-3, L4: TB7-4; and the current using a current probe at CT1, CT2, and CT3. Voltage input into the board should not exceed 600 VAC, (damage to board occurs at 750 VAC). Current input into the board should not exceed 5 Amps. If a short circuit or over-voltage/-current condition exists, correct the problem.

2. The base board is faulty.
    a. If the above steps do not reveal any problems, replace the base board.

13.118 Code 2917 - Gen Bus Voltage OOR HI

Logic:

If the Paralleling Application parameter is set to “Genset Bus", and the Genset Bus Voltage sensing input into the base board exceeds 1020 VAC for the time that is registered in the “Genset Bus Voltage OOR Delay; the genset control will display event/fault code 2917.

Possible Causes:

1. The control is set up with the incorrect Genset Bus PT Ratio or the PT's are incorrectly sized.
2. The voltage of the Genset Bus is too high and/or unstable.
3. The base board is faulty.

Diagnosis and Repair:

1. The control is set up with the incorrect Genset Bus PT Ratio or the PT's are incorrectly sized.
    a. Refer to event/fault code 2819.
2. The voltage of the Genset Bus is too high and/or unstable.
    a. Ensure that the voltage of the Genset Bus is at nominal or stable; high genset bus voltage can also damage the base board.
3. Check to see if the base board is faulty.
    a. Using a voltmeter, monitor the voltage at L1: TB7-1; L2: TB7-2, L3: TB7-3. If the voltage input into the control is within the acceptable voltage bias range that the control is set up for and the fault does not clear when the Fault Reset button is pressed, replace the board.

13.119 Code 2918 - Utility Voltage OOR Hi

Logic:

If the Paralleling Application parameter is set to “Utility", and the Utility Voltage sensing input into the base board exceeds 1020 VAC for the time that is registered in the “Utility Voltage OOR Delay; the genset control will display event/fault code 2918.

Possible Causes:

1. The control is set up with the incorrect Utility PT Ratio or the PT's are incorrectly sized.
2. The voltage of the Utility is too high and/or unstable.
3. The base board is faulty.

Diagnosis and Repair:

1. The control is set up with the incorrect Utility PT Ratio or the PT's are incorrectly sized.
    a. Refer to event/fault code 2819.

2. The voltage of the Utility is too high and/or unstable.
   a. Check with your utility company.
3. Check to see if the base board is faulty.
   a. Using a voltmeter, monitor the voltage at L1: TB7-1; L2: TB7-2, L3: TB7-3. If the voltage input into the control is within the acceptable voltage bias range that the control is set up for and the fault does not clear when the Fault Reset button is pressed, replace the board.

13.120 Code 2919 - Utility Current OOR Hi

Logic:

If the Paralleling Application parameter is set to “Utility", and the Utility Current sensing input into the base board exceeds 140% for the time that is registered in the “Utility Current OOR Delay; the genset control will display event/fault code 2919.

Possible Causes:

1. The control is set up with the incorrect Utility CT Ratio or the CT's are incorrectly sized.
2. Short Circuit
3. The Current of the Utility is too high and/or unstable.
4. The base board is faulty.

Diagnosis and Repair:

1. The control is set up with the incorrect Utility CT Ratio or the CT's are incorrectly sized.
   a. If this fault becomes active during the commissioning processes, verify the sizing of the CT's and the setup of the Utility CT Ratio. The Utility secondary CT ratio can be set to 1 or 5 Amps; Fault code 2919 will become active when the Utility secondary CT current going into the base board is 1.4 amps or 7 amps. Ensure that the Maximum Utility primary CT current, Full Load Amps (FLA) of the building/application is correct.

      Use the following equation to determine the FLA:

      - FLA (one phase) = Maximum KW / Voltage
      - FLA (three phases) = Maximum KW / Voltage * (1.732)
      - Primary CT : Secondary CT = (FLA * 1.1) : (1 or 5 Amps).

        Ex. The maximum building load is 100KW, at 480 VAC, three phase.

        FLA = 100000 / 480*1.73 = 120.42

        The Utility primary CT size and CT Ratio should be at least 121 * (1.1) = 133 (1.1 is used as a buffer)

        Primary CT: Secondary CT = 133 : (1 or 5 Amps).

   b. To change the Utility CT Primary Current and Utility CT Secondary Current ratio parameter appropriately for the application, go to: **Setup > Paralleling Setup > Basic > CT Primary or CT Secondary** and set appropriately.
2. Check for a short circuit.
3. The current of the Utility is too high and/or unstable.
   a. Check with your utility company.

4. Check to see if the base board is faulty.
   a. Using a ammeter, monitor the current at CT1, CT2, and CT3. If the current going thru the CTs on the base board is within the acceptable current range (below 1 amp or below 5 amps) that the control is set up for and the fault does not clear when the Fault Reset button is pressed, then replace the board.

13.121 Code 2921 - Gen Bus Current OOR Hi

Logic:

If the Paralleling Application parameter is set to “Genset bus", and the Genset bus Current sensing input into the base board exceeds 140% for the time that is registered in the “Genset bus Current OOR Delay; the genset control will display event/fault code 2921.

Possible Causes:

1. The control is set up with the incorrect Genset bus CT Ratio or the CT's are incorrectly sized.
2. The Current of the Genset bus is too high and/or unstable.
3. The base board is faulty.

Diagnosis and Repair:

1. The control is set up with the incorrect Genset bus CT Ratio or the CT's are incorrectly sized.
   a. If this fault becomes active during the commissioning processes, verify the sizing of the CT's and the setup of the Genset bus CT Ratio. The Genset bus secondary CT ratio can be set to 1 or 5 Amps; Fault code 2919 will become active when the Genset bus secondary CT current going into the base board is 1.4 amps or 7 amps. Ensure that the Maximum Genset bus primary CT current, Full Load Amps (FLA) of the building/application is correct.
      - Use the following equation to determine the FLA:
      - FLA (one phase) = Maximum KW / Voltage
      - FLA (three phases) = Maximum KW / Voltage * (1.732)

      Primary CT : Secondary CT = (FLA * 1.1) : (1 or 5 Amps).

      Ex. The maximum building load is 100KW, at 480 VAC, three phase.

      FLA = 100000 / 480*1.73 = 120.42

      The Genset bus primary CT size and CT Ratio should be at least 121 * (1.1) = 133 (1.1 is used as a buffer)

      Primary CT: Secondary CT = 133 : (1 or 5 Amps).
   b. To change the Genset bus CT Primary Current and Genset bus CT Secondary Current ratio parameter appropriately for the application, go to: **Setup > Paralleling Setup > Basic > CT Primary or CT Secondary** and set appropriately.
2. The current of the Genset bus is too high and/or unstable.
   a. Ensure that the current of the Genset Bus is at nominal or stable; high genset bus current can also damage the base board.

3. Check to see if the base board is faulty.
    a. Using an ammeter, monitor the current at CT1, CT2, and CT3. If the current going through the CTs on the base board is within the acceptable current range (below 1 amp or below 5 amps) that the control is set up for and the fault does not clear when the Fault Reset button is pressed, replace the base board.

13.122 Code 2922 - Genset Neutral Curr OOR Hi

Logic:

The Genset Neutral current is above the “Genset Neutral Current Calibration" parameter for the time in the “Genset Neutral Current OOR Delay" time parameter.

Possible Causes:

1. CT ratio is too small or the CTs are not sized correctly for the genset voltage and kW rating.
2. Genset Neutral current is above the “Genset Neutral Current Calibration" parameter.
3. Faulty CT.

Diagnosis and Repair:

1. CT ratio is too small or the CTs are not sized correctly for the genset voltage and kW rating.
    a. Please see event/fault code 2814.
2. Genset Neutral current is above the “Genset Neutral Current Calibration" parameter.
    a. Measure the Genset Neutral current input into the control board with a current probe at J22-4. The maximum value of current going into the control CTs should not be more than the value of the “Genset CT Secondary Current" value that the control is calibrated for. For example, if secondary setting in the control is 1 Amp, current going into the control should not be more than 1 Amp. To access the Genset CT Secondary Current configuration menu on the operator panel go to **Setup > OEM Setup > OEM Alt Setup > CT Sec** and set the “Genset CT Secondary Current" parameter appropriately for the application.
3. Faulty CT.
    a. If the above is satisfactory, check the CT and replace if faulty.

13.123 Code 2923 - Gen Bus kW OOR Hi

Logic:

If the Paralleling Application parameter is set to “Genset Bus", and the Genset Bus KW exceeds 32,767 KW or is below -32768 KW for the time that is registered in the “Genset Bus KW OOR Delay; the genset control will display event/fault code 2923.

Possible Causes:

1. Incorrect application or setup.
2. The base board is faulty.

Diagnosis and Repair:

1. Incorrect application or setup.
   a. Genset is being used in an incorrect application in which the power monitoring is out of range. Ex. If there are 25 paralleled gensets operating at 2 MW and 13.8 KV, the genset will not be able to monitor power above 32.767 MW and will display event/fault code 2923. This application will require external switchgear to monitor power.
   b. Genset Bus CT Ratio is incorrectly set, refer to event/fault code 2921.
   c. Genset Bus PT Ratio is incorrectly set, refer to event/fault code 2917.
2. The base board is faulty.
   a. If previous steps do not reveal any problems, replace the base board.

13.124 Code 2924 - Gen Bus kVAR OOR Hi

Logic:

If the Paralleling Application parameter is set to “Genset Bus", and the Genset Bus KVAR exceeds 32,767 KVAR or is below -32768 KVAR for the time that is registered in the “Genset Bus KVAR OOR Delay; the genset control will display event/fault code 2924.

Possible Causes:

1. Incorrect application or setup.
2. The base board is faulty.

Diagnosis and Repair:

1. Incorrect application or setup.
   a. Genset is being used in an incorrect application in which the power monitoring is out of range. Ex. If there are 25 paralleled gensets operating at 2 MVAR and 13.8 KV, the genset will not be able to monitor power above 32.767 MVAR and will display event/fault code 2924. This application will require external switchgear to monitor power.
   b. Genset Bus CT Ratio is incorrectly set, refer to event/fault code 2921.
   c. Genset Bus PT Ratio is incorrectly set, refer to event/fault code 2917.
2. The base board is faulty.
   a. If previous steps do not reveal any problems, replace the base board.

13.125 Code 2925 - Gen Bus kVA OOR Hi

Logic:

If the Paralleling Application parameter is set to “Genset Bus", and the Genset Bus KVA exceeds 65,535 KVA for the time that is registered in the “Genset Bus KVA OOR Delay; the genset control will display event/fault code 2925.

Possible Causes:

1. Incorrect application or setup.
2. The base board is faulty.

Diagnosis and Repair:

1. Incorrect application or setup.
   a. Genset is being used in an incorrect application in which the power monitoring is out of range. Ex. If there are 35 paralleled gensets operating at 2 MVA and 25 KV, the genset will not be able to monitor power above 65.535 MVA and will display event/fault code 2925. This application will require external switchgear to monitor power.
   b. Genset Bus CT Ratio is incorrectly set, refer to event/fault code 2921.
   c. Genset Bus PT Ratio is incorrectly set, refer to event/fault code 2917.
2. The base board is faulty.
   a. If previous steps do not reveal any problems, replace the base board.

13.126 Code 2926 - Utility kW OOR Hi

Logic:

If the Paralleling Application parameter is set to “Utility", and the Utility KW exceeds 32,767 KW or is below -32768 KW for the time that is registered in the “Utility KW OOR Delay; the genset control will display event/fault code 2926.

Possible Causes:

1. Incorrect application or setup.
2. The base board is faulty.

Diagnosis and Repair:

1. Incorrect application or setup.
   a. Genset is being used in an incorrect application in which the power monitoring is out of range. Ex. If the Utility power is 40 MW, the genset will not be able to monitor power above 32.767 MW and will display event/fault code 2926. This application will require external switchgear to monitor power.
   b. Utility CT Ratio is incorrectly set, refer to event/fault code 2919.
   c. Utility PT Ratio is incorrectly set, refer to event/fault code 2918.
2. The base board is faulty.
   a. If previous steps do not reveal any problems, replace the base board.

13.127 Code 2927 - Utility kVAR OOR Hi

Logic:

If the Paralleling Application parameter is set to “Utility", and the Utility KVAR exceeds 32,767 KVAR or is below -32768 KVAR for the time that is registered in the “Utility KVAR OOR Delay; the genset control will display event/fault code 2927.

Possible Causes:

1. Incorrect application or setup.
2. The base board is faulty.

Diagnosis and Repair:

1. Incorrect application or setup.
    a. Genset is being used in an incorrect application in which the power monitoring is out of range. Ex. If the Utility power is 40 MVAR, the genset will not be able to monitor power above 32.767 MVAR and will display event/fault code 2927. This application will require external switchgear to monitor power.
    b. Utility CT Ratio is incorrectly set, refer to event/fault code 2919.
    c. Utility PT Ratio is incorrectly set, refer to event/fault code 2918.
2. The base board is faulty.
    a. If the previous steps do not reveal any problems, replace the base board.

13.128 Code 2928 - Utility kVA OOR Hi

Logic:

If the Paralleling Application parameter is set to “Utility", and the Utility KVA exceeds 65,535 KVA for the time that is registered in the “Utility KVA OOR Delay; the genset control will display event/fault code 2928.

Possible Causes:

1. Incorrect application or setup.
2. The base board is faulty.

Diagnosis and Repair:

1. Incorrect application or setup.
    a. Genset is being used in an incorrect application in which the power monitoring is out of range. Ex. If the Utility power is 70 MVAR, the genset will not be able to monitor power above 65.535 MVA and will display event/fault code 2928. This application will require external switchgear to monitor power.
    b. Utility CT Ratio is incorrectly set, refer to event/fault code 2919.
    c. Utility PT Ratio is incorrectly set, refer to event/fault code 2918.
2. The base board is faulty.
    a. If the previous steps do not reveal any problems, replace the base board.

13.129 Code 2938 – Earth/Ground Fault

Logic:

Short to ground in the external wiring.

Possible Causes:

1. "Configurable Input Active State Selection" parameter is incorrectly configured for Ground Fault.
2. Incorrectly wired; open or short circuit in the wiring.
3. Faulty ground fault alarm relay.

Diagnosis and Repair:

1. "Configurable Input Active State Selection" parameter is incorrectly configured for Ground Fault.
   a. Through the operator panel, check the switch input setting (active closed or open) for the Configurable Input setup for Ground Fault. Ensure that the switch input setting is correctly set. If "Configurable Input Function Pointer" parameter is set to Ground Fault and if "Configurable Input Active State Selection" parameter is set to "active closed", event/fault code 2938 will become active when the input is a ground input.

      If "Configurable Input Function Pointer" parameter is set to Ground Fault and if "Configurable Input Active State Selection" parameter is set to "active open", event/fault code 2938 will become active when the input is an open circuit.

      To access the input configuration on the operator panel go to **Setup > Configurable I/O > Config Input Menu > Active** and set the "Configurable Input Active State Selection" parameter appropriately for the application.
2. Incorrectly wired; open or short circuit in the wiring.
   a. Depending on the "Configurable Input Active State Selection" parameter setting, check the wiring for an open/short circuit, or mis-wired condition from the genset (L1, J22-1; L2, J22-2; L3, J2-3; LN, J22-4) to the Ground Fault Alarm Relay (Input 6 and 8), correct if faulty.
3. Faulty ground fault alarm relay (refer to instruction sheet C648a).
   a. Ensure that the input voltage to the Ground Fault Alarm Relay is 24 VDC, at input 1 and 2.
   b. Verify that the Trip Current and Time Delay settings on the Ground Fault Alarm Relay are set appropriately for the application.
   c. If the previous steps are satisfactory, replace the Ground Fault Alarm Relay.

13.130 Code 2939 - MODBUS Failure

Logic:

If any of the Modbus parameters are Active, and the Modbus device stops communicating with the base board for a time period longer than in the “Modbus Failure Time Delay", event/fault code 2939 becomes active.

Possible Causes:

1. Active Modbus fault or wiring issue.
2. Faulty Modbus device.
3. The base board is faulty.

Diagnosis and Repair:

1. Active Modbus fault or wiring issue.
   a. Check the following parameters for an “Active" Modbus state. If any of the below listed Modbus parameters are Active and have stopped communicating with the base board for a time period longer than in the “Modbus Failure Time Delay", event/fault code 2939 becomes active. Communication with these items will need to be restored.
      - Exercise Switch

- Remote Start Switch
- Load Demand Stop
- Start Type
- Fault Reset
- Battle Short Switch
- Genset CB Inhibit Switch
- Utility CB Inhibit Switch
- Synch Enable Switch
- Ramp Load Unload Switch
- Speed Droop Enable Switch
- Voltage Droop Enable Switch
- Genset CB Tripped Switch
- Utility CB Tripped Switch
- Extended Parallel Switch
- PTC Mode Switch

b. Check the Modbus connection from the parameters listed above to that base board connection at TB15-3 (RS485+) and TB15-4 (RS485-) for open/short circuits or miswiring. There should be a 120 Ohm terminating resistor at each end of the Modbus network (a resistor at the PCC TB15-3 (RS485+) and TB15-4 (RS485-) and at the last device of the Modbus network). Also ensure that the shield is grounded at TB15-1. the shield should be grounded at ONLY this point.

2. Faulty Modbus device.

   a. Check the Modbus device that is transmitting information to the base board. If this device is faulty and/or has stopped communicating with the base board, event/fault code 2939 becomes Active. If the external Modbus device is faulty then repair or replace.

3. Faulty base board.

   a. If previous steps do not reveal any problems, replace the base board.

13.131 Code 2942 - Shutdown Override Fail

Logic:

The genset has failed to transition to Battle Short mode or Delayed Shutdown mode.

Possible Causes:

1. Battle Short or Delayed Shutdown is not enabled in the genset control.

Diagnosis and Repair:

1. Battle Short or Delayed Shutdown is not enabled in the genset control.

   a. Through the operator panel, verify that the “Battle Short" parameter is set to enable. To access the “Battle Short" configuration menu on the operator panel go to **Setup > OEM Setup > OEM Genset Setup > Battle Short** and set the parameter to enable, if the battle short mode is required by the customer.

b. Ensure that one of the configurable inputs is set up to activate Battle Short mode (e.g., Configurable Input #1 = Battle Short). Battle Short may now be enabled by activating the configurable input that was set up for Battle Short (e.g., Enable Configurable Input #1 with a ground input).

c. Through the operator panel, verify that the “Delayed Shutdown" parameter is set to enable. To access the “Delayed Shutdown" configuration menu on the operator panel go to **Setup > OEM Setup > OEM Genset Setup > Delayed Shutdown** and set the parameter to enable, if the Delayed Shutdown mode is required by the customer.

13.132 Code 2943 - Manual Sw Config Fail

Logic:

Event/fault code 2943 is activated when the control receives an active Manual input from both the operator panel and the PCCNet network at the same time for two seconds or more.

Possible Causes:

1. Two Manual command inputs that are active at the same time.

Diagnosis and Repair:

1. Two Manual command inputs that are active at the same time.
   a. Ensure there is only one Manual switch input to the control that is active, either through the operator panel or PCCNet Network (PCCNet DIM) but not both at the same time.

13.133 Code 2944 - Auto Switch Config Fail

Logic:

Event/fault code 2944 is activated when the control receives an active Auto input from both the operator panel and the PCCNet network at the same time for two seconds or more.

Possible Causes:

1. Two Auto command inputs that are active at the same time.

Diagnosis and Repair:

1. Two Auto command inputs that are active at the same time.
   a. Ensure there is only one Auto switch input to the control that is active, either through the operator panel or through PCCNet Network (PCCNet DIM) but not both at the same time.

13.134 Code 2972 - Field Overload

Logic:

If the time that the Field AVR Duty Cycle is operating at maximum output is longer than the time in the “Max Field Time" parameter, event/fault code 2972 will become active.

Possible Causes:

⚠ WARNING
Excessive voltage is possible during testing. Make sure your meter can handle alternator full voltage.

1. Max Field Time Delay is set too low.
2. Voltage sensing into the base board is too low, or there is an open/short circuit.
3. Application issue.
4. The base board is faulty.

Diagnosis and Repair:

1. Max Field Time Delay is set too low.
    a. Through the operator panel, check the “Max Field Time" parameter setting. Verify that the “Max Field Time" is not set to zero. The “Max Field Time" parameter may require adjustment to a value more appropriate for the application. To access the Max Field Time configuration menu on the operator panel go to **Setup > OEM Setup > OEM Alt Setup > Max Field Time** and set the “Max Field Time" parameter appropriately for the application. Refer to the parameter list to see the default value for “Max Field Time".
2. Voltage sensing into the base board is too low, or there is an open/short circuit.
    a. Measure the voltage going into the base board at L1 = J22-1, L2 = J22-2, L3 = J22-3, and LN = J22-4 (for single phase applications use L1, L2 and LN). If the genset control is not sensing voltage, it will try to overcompensate by maxing out the AVR output. If the voltage going into the control board is zero, or less than the voltage that the control was calibrated for (Nominal Voltage), then check the wiring from the alternator to the base board for an open circuit or short circuit.
    b. If the genset is over 600 VAC, check connections from the alternator to the PT, and from the PT to the base board. If there is voltage going into the PT, but not coming out of the PT, replace the PT.
    c. Measure the output of the AVR at J17 -1 and J17-2 while turning the genset on. The output should be at least 300 VDC when the genset is starting, but the voltage should decrease significantly when the genset builds up voltage. If the output of J17-1 and J17-2 is constantly high or is locked in, then the AVR portion of the PCC is faulty. Replace the base board if the AVR is faulty.
    d. Using a True RMS meter, measure the PWM at J19-2 (AVR PWM +) and J19-9 (AVR PWM -) while turning the genset “ON". This is a 2.5 VDC max output from the base board to the AUX 103 AVR; if the voltage at J19-2 and J19-9 is continuously 2.0-2.5 VDC, without any change, then replace the base board.
    e. Measure the output of the AUX 103 AVR at J17-1 and J17-2, the output should be at 9-12 VDC when the genset is operating at “No Load", if the voltage output of J17-1 & J17-2 is constantly high, then the AUX 103 AVR is faulty replace the AUX 103 AVR.
3. Application issue.
    a. If the genset runs adequately with no load or some load but as soon as additional load is applied, the genset shuts down on “Field Overload"; then this might be an application issue (load issue, genset undersized, etc.).

4. The base board is faulty.
   a. If the previous steps do not reveal any problems, replace the base board.

13.135 Code 2977 - Low Coolant Level 2

Logic:

Low Coolant Level switch #2 indicates that the coolant level is low in the second radiator.

Possible Causes:

1. The radiator coolant level is low.
2. Coolant sender incorrectly wired.
3. Faulty coolant level sender.
4. The "Configurable Input Active State Selection" parameter is configured incorrectly.
5. The base board is faulty.

Diagnosis and Repair:

1. Check the radiator coolant level.
   a. Check the coolant level at the second radiator and add coolant if low. Clear the warning fault by pressing the Reset button on the operator panel.
2. Coolant sender incorrectly wired.
   a. Check for improper wiring, such as a short or open circuit from the coolant sensor to the discrete configurable input on the base board that was configured for the "Low Coolant Level 2 Switch". If a short/open circuit or improper wiring is found, correct the wiring.
3. Faulty coolant level sender.
   a. Measure the resistance of the coolant level sender at the radiator that is full of coolant, if the sender is short or open circuit, replace the coolant sender.
4. The "Configurable Input Active State Selection" parameter is configured incorrectly.
   a. Through the operator panel, check the switch input setting (active closed or active open) for the Configurable Input that was configured to "Low Coolant Level 2 Switch". Ensure the setting is correct. If the "Configurable Input Function Pointer" parameter is set to "Low Coolant Level 2 Switch" and the "Configurable Input Active State Selection" parameter is set to "active closed", event/fault code 2977 will become active when the Configurable Input that was configured to "Low Coolant Level 2 Switch" is connected to ground.

      If the "Configurable Input Function Pointer" parameter is set to "Low Coolant Level 2 Switch" and the "Configurable Input Active State Selection" parameter is set to "active open", event/fault code 2977 will become active when the Configurable Input that was configured to "Low Coolant Level 2 Switch" is an open circuit.

      To access the input configuration on the operator panel go to **Setup > Configurable I/O >** and set the "Configurable Input Active State Selection" parameter appropriately for the Configurable Input that was configured to "Low Coolant Level 2 Switch".
5. The base board is faulty.
   a. If the previous steps did not reveal any problems, replace the base board.

13.136 Code 2979 - High Alternator Temp

Logic:

Indicates that the alternator temperature is high.

Possible Causes:

1. Alternator temperature sender incorrectly wired.
2. Faulty alternator temperature sender.
3. The "Configurable Input Active State Selection" parameter is configured incorrectly.
4. Faulty base board.

Diagnosis and Repair:

1. Alternator temperature sender incorrectly wired.
   a. Check for improper wiring or a short/open circuit from the alternator temperature sender to the discrete configurable input on the base board that was configured for the "High Alternator Temp Switch". If a short/open circuit or improper wiring is found, correct the wiring.
2. Faulty alternator temperature sender.
   a. Measure the resistance between the alternator temperature signal pin and return pin. The resistance should be between 530 Ohms to 2214 Ohms. Replace the sender if the resistance value is out of specification.
3. The "Configurable Input Active State Selection" parameter is configured incorrectly.
   a. Through the operator panel, check the switch input setting (active closed or open) for the Configurable Input that was configured to "High Alternator Temp Switch". Ensure the setting is correct. If the "Configurable Input Function Pointer" parameter is set to "High Alternator Temp Switch" and the "Configurable Input Active State Selection" parameter is set to "active closed", event/fault code 2979 will become active when the Configurable Input that was configured to "High Alternator Temp Switch" is connected to ground.

      If the "Configurable Input Function Pointer" parameter is set to "High Alternator Temp Switch" and the "Configurable Input Active State Selection" parameter is set to "active open", event/fault code 2979 will become active when the Configurable Input that was configured to "High Alternator Temp Switch" is an open circuit.

      To access the input configuration on the operator panel go to **Setup > Configurable I/O >** and set the "Configurable Input Active State Selection" parameter appropriately for the Configurable Input that was configured to "High Alternator Temp Switch".
4. Faulty base board.
   a. If the previous steps did not reveal any problems, then replace the base board.

13.137 Code 2993 - Battery Charger Failed

Logic:

Indicates that the battery charger has failed.

Possible Causes:

1. Faulty battery charger.

2. Battery Charger switch incorrectly wired.
3. Faulty switch.
4. The "Configurable Input Active State Selection" parameter is configured incorrectly.
5. The base board is faulty.

Diagnosis and Repair:

1. Faulty battery charger.
   a. Check the output voltage of the battery charger. If the battery charger is overcharging, or not charging the batteries at all, then repair or replace the battery charger.
2. Battery Charger switch incorrectly wired.
   a. Check for improper wiring, a short circuit, or an open circuit from the Battery Charger switch to the discrete configurable input on the base board that was configured for the "Battery Charger Switch Fail". If a short circuit, open circuit or improper wiring is found, correct the wiring.
3. Faulty switch.
   a. Measure the resistance of the battery charger switch, if the switch is shorted or open circuit, replace the switch.
4. The "Configurable Input Active State Selection" parameter is configured incorrectly.
   a. Through the operator panel, check the switch input setting (active closed or active open) for the Configurable Input that was configured to "Battery Charger Switch Fail". Ensure that the switch input setting is correctly set. If the "Configurable Input Function Pointer" parameter is set to "Battery Charger Switch Fail" and the "Configurable Input Active State Selection" parameter is set to "active closed", event/fault code 2993 will become active when the Configurable Input that was configured to "Battery Charger Switch Fail" is connected to ground.

      If the "Configurable Input Function Pointer" parameter is set to "Battery Charger Switch Fail" and the "Configurable Input Active State Selection" parameter is set to "active open", event/fault code 2993 will become active when the Configurable Input that was configured to "Battery Charger Switch Fail" is an open circuit.

      To access the input configuration on the operator panel go to **Setup > Configurable I/O >** and set the "Configurable Input Active State Selection" parameter appropriately for the Configurable Input that was configured to "Battery Charger Switch Fail".
5. The base board is faulty.
   a. If the previous steps do not reveal any problems, replace the base board.

13.138 Fault Code 2968 - AVR Fault

Lamp: Warning

Corrective Action: Indicates AVR hardware contains a fault condition.

13.139 Fault Code 2969 - LON Failure

Lamp: Warning

Corrective Action: Indicates no communications with the LonWorks board.

13.140 Fault Code 2972 - Field Overload

Logic:

If the Field AVR Duty Cycle is operating at a maximum output for a period of time that is longer than the time registered in the Max Field Time parameter the fault code 2972 (shutdown) becomes active.

Lamp: Shutdown

Possible Causes:

⚠ WARNING
High voltages are present in this step. Special equipment and training is required to work on or around high-voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures may result in severe personal injury or death.

1. Max Field Time Delay parameter configured incorrectly
2. Voltage sensing into the base board is too low or an open or short circuit
3. Alternator or application issue

13.141 Code 3411 - DC Power Supply Fault

Logic:

⚠ WARNING
Due to AUX101 sensed DC power supply unit (PSU) state is below inactive threshold lower limit for the duration of DC PSU Dwell Time.

Possible Causes:

1. Inadequate DC PSU Dwell Time.
2. Faulty or poor DC power supply.
3. Faulty DC power supply to AUX101 wiring.
4. Faulty AUX101.

Diagnosis and Repair:

1. Inadequate DC PSU Dwell Time.
   a. Via InPower, verify and adjust DC PSU Dwell Time (default = 5 seconds) to permit surge power recovery or battery charger engagement to attain voltage within inactive threshold limits. Note that a high DC PSU Dwell Time may mask DC power supply issues.
2. Faulty or poor DC power supply.
   a. Check source state of charge and physical condition as faulty or poor component state has resulted in voltage below AUX101 inactive threshold lower limit. Clean and replace as necessary.
3. Faulty DC power supply to AUX101 wiring.
   a. Check for continuity in powered mode, between DC PSU and AUX101 (including but not limited to fuses and key switches) as failed component resulted in voltage below AUX101 inactive threshold lower limit. Repair as necessary.

4. Faulty AUX101.
   a. AUX101 isn't communicating DC PSU properly and/or is falsely presenting DC PSU state as below inactive threshold lower limit to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to DC PSU.

13.142 Code 3413 - Radiator Fan Trip

Logic:

⚠ WARNING
Due to AUX101 sensed active radiator fan circuit protection state during fan run command active from PCC.

⚠ WARNING
To prevent personal injury, turn off and remove power to the radiator fan while investigating and repairing it.

Possible Causes:

1. Inadequate circuit protection.
2. Faulty fan motor or wiring.
3. Faulty AUX101.

Diagnosis and Repair:

1. Inadequate circuit protection.
   a. Check fan wiring and circuit protection device(s) are sized to suit circuit's current capability as faulty component resulted in active circuit protection. Replace as necessary.
2. Faulty fan motor or wiring.
   a. Check the wiring for loose connections, short circuits or stuck motors resulting in active circuit protection. Replace and repair as necessary.
3. Faulty AUX101.
   a. AUX101 isn't communicating radiator fan circuit protection state properly and/or is falsely presenting circuit protection state as active to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to fan circuit protection.

13.143 Code 3414 - Ventilator Fan Trip

Logic:

⚠ WARNING
Due to AUX101 sensed active ventilator fan circuit protection state during fan run command active from PCC.

⚠ **WARNING**

To prevent personal injury, turn off and remove power to the ventilator fan while investigating and repairing it.

NOTICE

Ventilator fans are site-specific, not genset-specific; be sure to refer to plant wiring diagrams when available.

Possible Causes:

1. Inadequate circuit protection.
2. Faulty ventilator motor or wiring.
3. Faulty AUX101.

Diagnosis and Repair:

1. Inadequate circuit protection.
   a. Check fan wiring and circuit protection device(s) are sized to suit circuit's current capability as faulty component resulted in active circuit protection. Replace as necessary.
2. Faulty ventilator motor or wiring.
   a. Check the wiring for loose connections, short circuits, or stuck motors resulting in active circuit protection. Replace and repair as necessary.
3. Faulty AUX101.
   a. AUX101 isn't communicating ventilator fan circuit protection state properly and/or is falsely representing circuit protection state as active to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to ventilator circuit protection.

13.144 Code 3415 - Louvres Closed

Logic:

⚠ **WARNING**

Due to AUX101 sensed active ventilation louvres closed switch state for the duration of the Louvres Closed Dwell Time.

Possible Causes:

1. Louvres didn't open.
2. Faulty louvre position switch or wiring.
3. Inadequate Louvre Closed Dwell Time.
4. Faulty AUX101.

Diagnosis and Repair:

1. Louvres didn't open.
   a. Clear obstruction and/or fix damaged louvres and movement driving mechanisms to ensure unrestricted movement beyond the louvre position switch inactive threshold.

   b. Verify wiring and connections between louvre motor control relay and louvre motor are proper to enable movement beyond the louvre position switch inactive threshold; Repair as needed.

2. Faulty louvre position switch or wiring.
   a. Check wiring between AUX101 and louvre position switch for short circuits that may mimic position below switch inactive threshold. Replace and/or repair as needed.
   b. Correspond switch active/inactive states with louvre position via resistance measurement across switch terminals.
      a. Disconnect all connections to louvre position switch.
      b. Attach DVOM test leads to louvre position switch terminals to measure electrical resistance.
      c. Prepare DVOM to measure electrical resistance.
      d. Measure and note switch resting resistance (louvres closed) = active resistance.
      e. Open louvres beyond louvre position switch inactive threshold.
      f. Measure and note switch resistance (louvres open) = inactive resistance.
      g. Replace switch if active resistance = inactive resistance.
3. Inadequate Louvre Closed Dwell Time.
   a. Via InPower, verify/adjust Louvre Closed Dwell Time (default - 100 seconds) so-as to permit position switch to attain inactive and stable state. Mind time required for complete louvre opening. Note that a high Louvre Closed Dwell Time may mask louvre mechanism issues.
4. Faulty AUX101.
   a. AUX101 isn't communicating Louvre position switch state properly and/or is falsely representing state to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to louvres closed protection.

13.145 Code 3416 - Start System

See the troubleshooting procedures for fault code 359 or 1438.

13.146 Code 3417 - Alternator Heater Trip

Logic:

⚠ WARNING
Due to AUX101 sensed active alternator heater circuit protection state during alternator heater control active from PCC.

Possible Causes:

1. Inadequate circuit protection.
2. Faulty alternator heater or wiring.
3. Faulty alternator heater relay.
4. Faulty AUX101.

Diagnosis and Repair:

1. Inadequate circuit protection.
   a. Check heater wiring, heater relays and circuit protection device(s) are sized to suit circuit's current capability as faulty component resulted in current greater than heater circuit protection active threshold. Replace as necessary.
2. Faulty alternator heater or wiring.
   a. Check the following circuits, repair as needed:
      - AUX101 to alternator heater relay input for loose connections and short circuit between wires as fault will result in failure to deliver the electrical current required to close the alternator heater relay switch and mimic alternator heater current greater than circuit protection active threshold.
      - AUX101 to alternator heater relay sense for loose connections and short circuit between wires as fault will result in failure to report alternator heater circuit current and mimic alternator heater current greater than circuit protection active threshold.
      - Alternator heather circuit protection to alternator heater relay for short to ground as fault will result in alternator heater current greater than circuit protection active threshold.
3. Faulty alternator heater relay.
   a. Check that the alternator heater relay for closure when AUX 101 input is applied by measuring resistance of relay's high current circuit; replace if open as fault will mimic circuit protection active.
4. Faulty AUX101.
   a. AUX101 isn't communicating alternator heater circuit current properly and/or is falsely representing state to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to alternator heater circuit protection.

13.147 Code 3457 - Loss of Bus Voltage Sensing

Logic:

An open circuit condition exists in all 3 phases of the bus voltage sensing in Isolated Bus or Utility Multiple applications.

Possible Causes:

1. Genset bus voltage sensing connections are open circuit or incorrectly wired at the base board.
2. kW load share and kVAR lines are switched.
3. Faulty PT.
4. The base board is faulty.

Diagnosis and Repair:

1. Genset bus voltage sensing connections are open circuit or incorrectly wired at the base board.
   a. The purpose of this event/fault code is to prevent closing the genset circuit breaker to a bus which is actually live, but which appears to the controller to be dead. Check and ensure that the following are OK: TB7 is securely connected to the base board, bus fuses have been re-closed after troubleshooting/maintenance procedures, blow bus fuses have been checked and replaced as needed, and disconnected medium voltage set of PTs have been reconnected.
   b. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.
      - Measure the phase rotation, frequency, and voltage input into the base board from the Genset bus at: L1, TB7-1; L2, TB7-2; and L3, TB7-3. The voltage and frequency should match the Genset bus nominal voltage and frequency. The phase rotation should be "L1-L2-L3" at TB7-1, TB7-2, and TB7-3 on the base board; for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation, voltage and/or frequency are not correct, re-check the wiring.
   c. If the nominal voltage is over 600 VAC, check the voltage sensing connections from the base board to the PT and the PT to the Genset bus.
      - Measure the phase rotation, frequency, and voltage input into the base board from the PT (Potential Transformer) at: L1, TB7-1; L2, TB7-2; and L3, TB7-3. The voltage input into the base board should match the secondary voltage of the PT (for example, if the PT ratio is 13,800:240, the voltage measured at the base board should be 240 VAC). The phase rotation at TB7-1, TB7-2, and TB7-3 should be "L1-L2-L3" for proper phase rotation measurement procedures; refer to the phase rotation meter instructions. The frequency should match the Genset bus nominal frequency. If the phase rotation, frequency, and/or voltage are not correct at the base board, correct the wiring from the base board to the PT.
2. kW load share and kVAR lines are switched.
   a. Ensure kW load share line on genset 1 is connected to kW load share line on genset 2 and kVAR load share is connected to kVAR it will cause this FC.
3. Faulty PT.
   a. With a calibrated voltage meter, measure the voltage input and output of the PT. The input and output of the PT should be proportional; ex. Inputs: L1 = 13,800, L2 = 13,800, L3 = 13,800; Outputs: L1 = 240, L2 = 240, L3 = 240. If the inputs and outputs of the PT are not proportional, replace the PT.
4. The base board is faulty.
   a. If the previous steps did not reveal any problems, replace the base board.

13.148 Code 3629 - Device Calibration Update Recommended

Logic:

The PCC may have setup parameters that the AUX 105 does not have.

Possible Causes:

1. Incorrect calibration file in the PCC.

2. Incorrect calibration file in AUX 105.

Diagnosis and Repair:

1. Verify the calibration files for the PCC.
   a. Connect InPower to the PCC.
   b. Download the latest calibration to the PCC.
2. Verify the calibration files for the AUX 105.
   a. Connect InPower to the AUX 105.
   b. Download the latest calibration to the AUX 105.

13.149 Code 3631 - Device Calibration Update Required

Logic:

The AUX 105 did not receive a setup parameter from the PCC.

Possible Causes:

1. Incorrect calibration file in the PCC.
2. Incorrect calibration file in AUX 105.

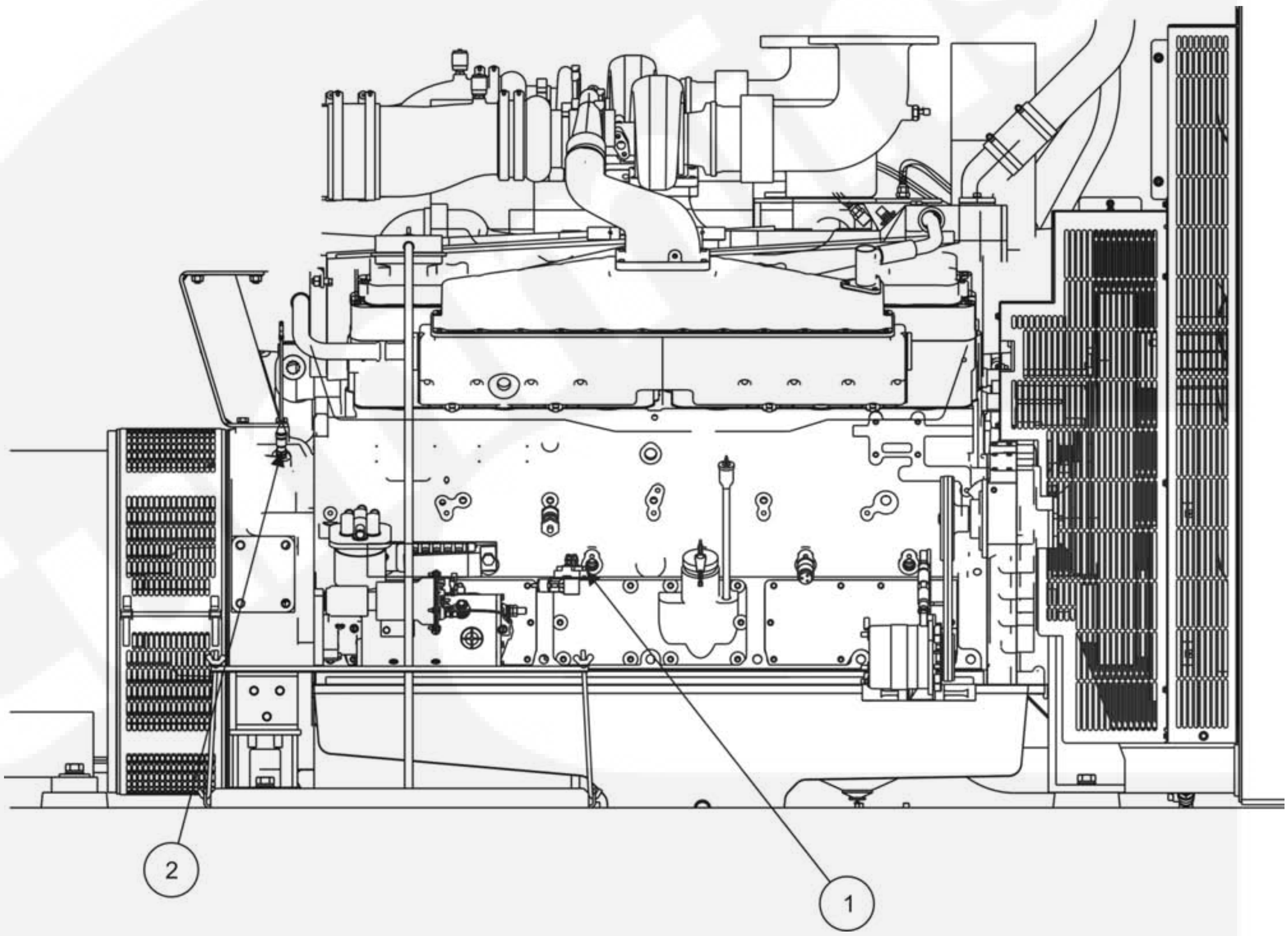
Diagnosis and Repair:

1. Verify the calibration files for the PCC.
   a. Connect InPower to the PCC.
   b. Download the latest calibration to the PCC.
2. Verify the calibration files for the AUX 105.
   a. Connect InPower to the AUX 105.
   b. Download the latest calibration to the AUX 105.

14 Engine Sensors

The figure below shows the locations of the Magnetic Pick Up and oil pressure sender to which the PCC responds for the engine.

The oil pressure sender functions by converting the sensed oil pressure to voltage which varies the supplied 5 VDC to the sender. The output signal of the sender is approximately 0.5 VDC at 0 psi (0 kPa) and 4.5 VDC at 100 psi (689.5 kPa).



No.	Description	No.	Description
1	Oil Pressure Sender	3	Speed Sensor (Mag Pickup)

FIGURE 1. ENGINE SENSOR LOCATIONS

14.1 Magnetic Speed Pickup Unit (MPU) Installation

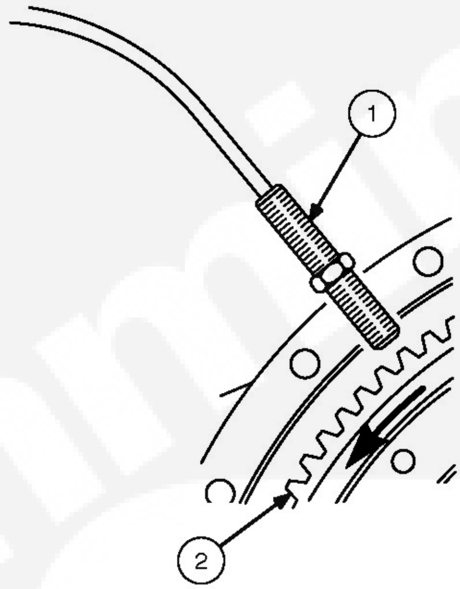
Measure the resistance of the magnetic speed pickup (MPU). Replace the MPU if the resistance is over 1,000 ohms.

With the MPU removed from the generator set, bar the engine until a gear tooth on the flywheel lines up in the center of the mounting hole. Thread the sensor in gently by hand until it just touches the gear tooth. Back it out 1/4 turn and set the locknut.

NOTICE

Do not use fan blade to bar over the engine. That can damage blades and cause property damage and personal injury.

After adjustment, make sure output voltage of the MPU is correct. Replace the MPU if output voltage at cranking speed is less than 1.5 VAC.



No.	Description	No.	Description
1	MPU Sensor	2	Engine Flywheel Ring Gear

FIGURE 2. MPU SENSOR

14.2 Oil Pressure Sensor

The engine oil pressure sensor is an analog sensor. The engine oil pressure and warning limits are based on engine speed. The ECM sends an engine shutdown command when the engine oil pressure falls below the shutdown limit.

15 Air Intake System

15.1 Air Cleaner Service Indicator

⚠ WARNING

Hot exhaust components.

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

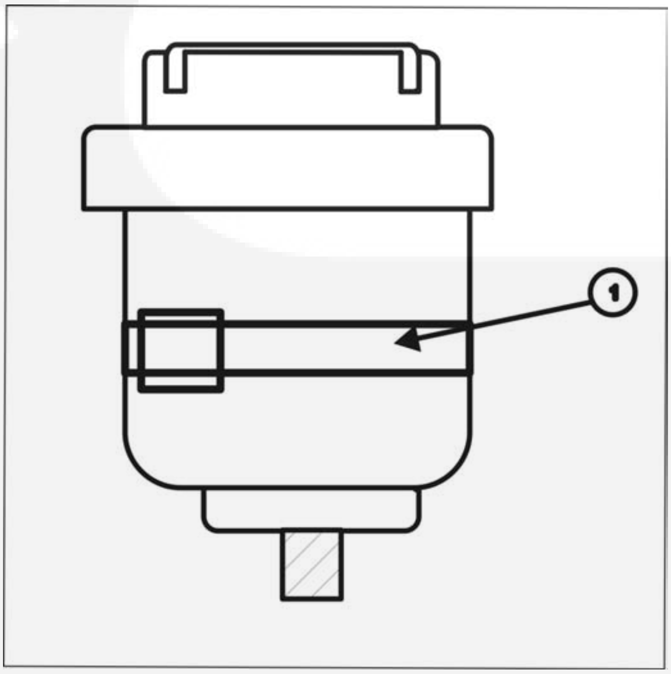
Moving parts.

Moving parts can cause severe personal injury or death.

Use extreme caution around hot manifolds, moving parts, etc.

The Air Cleaner Service Indicator is located either on the the Air Cleaner Assembly or beteween the assembly and the inlet side of the turbocharger.

Check the air cleaner service indicator. If the gauge has crossed the red mark (1), replace the filter.



No	Description
1	Red Mark

FIGURE 3. AIR CLEANER SERVICE INDICATOR

15.2 Normal Duty Air Cleaner

This shows the normal duty air cleaner.

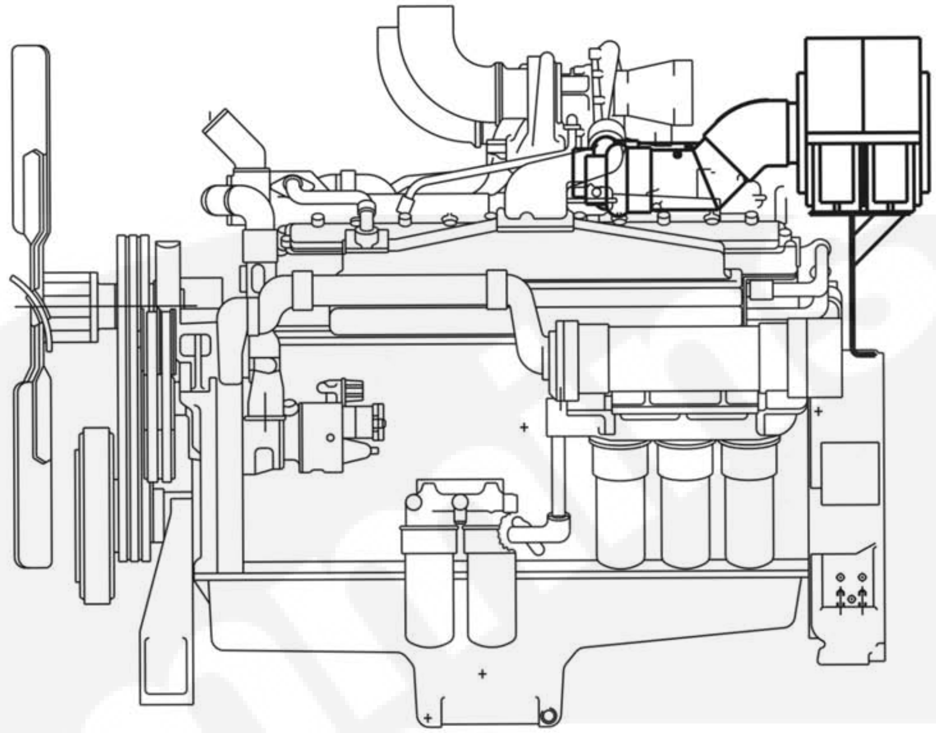


FIGURE 4. NORMAL AIR CLEANER ASSEMBLY

15.2.1 Air Cleaner Assembly Removal

⚠ CAUTION

Holes, loose-end seals, dented sealing surfaces, corrosion of pipes, and other forms of damage render the air cleaner inoperative and require immediate replacement or engine damage can occur.

NOTICE

Cummins Inc. does not recommend cleaning paper-type air cleaner elements. Elements that have been cleaned will clog, and airflow to the engine will be restricted.

NOTICE

The air cleaner housing and element are a complete unit and replacement of the filter element is not possible.

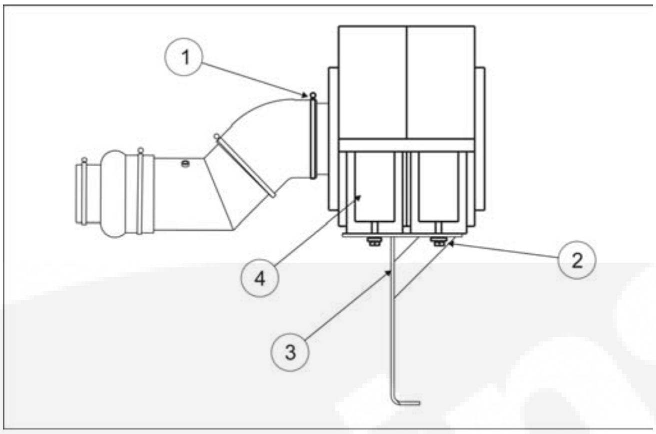


FIGURE 5. AIR CLEANER ASSEMBLY

1. Release the clamp (1).
2. Remove the 4 air cleaner assembly retaining bolts (2) from the bracket (3).
3. Remove the air cleaner assembly (4).

15.2.2 Air Cleaner Element Installation

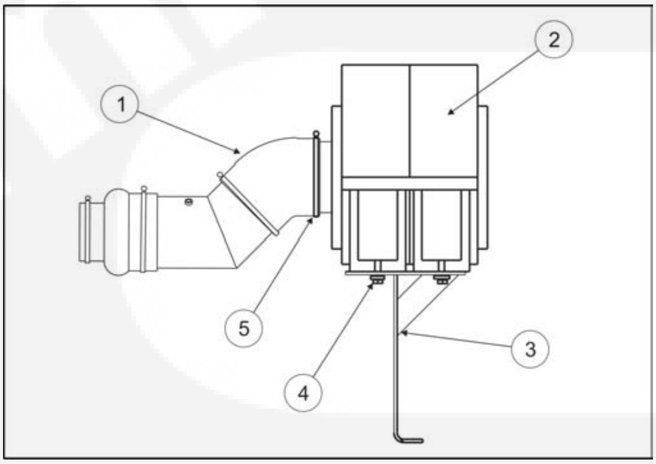


FIGURE 6. AIR CLEANER ASSEMBLY

1. Using Hellirine lubricate the hose (1).
2. Using the 4 bolts, nuts and washers (4) secure the air filter assembly (2) to the the bracket (3). Tighten the nuts to
3. Slide the hose (1) over the air filter assembly and tighten the clamp (5).

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16 Exhaust System

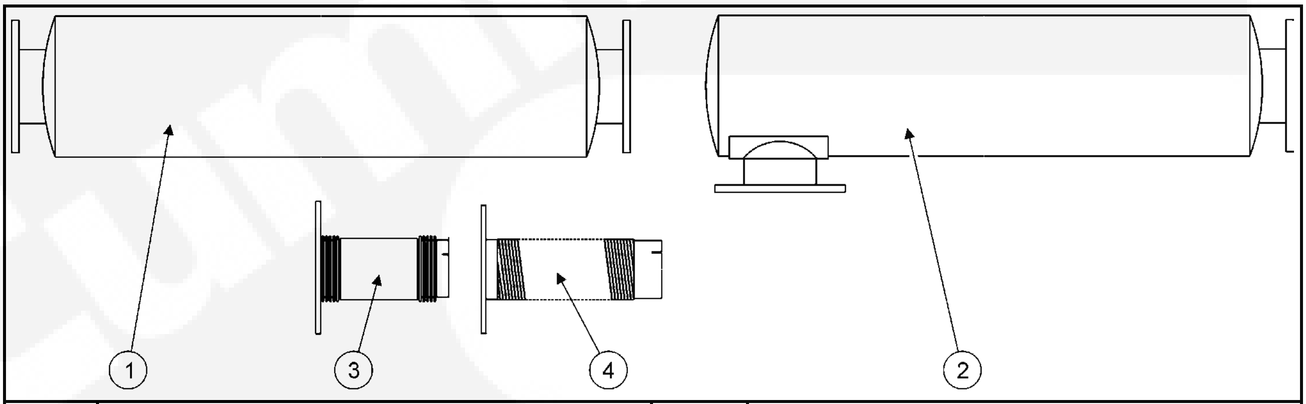
16.1 Overview

NOTICE
Read the warranty statement provided with the generator set for US Environmental Protection Agency (EPA) restrictions on servicing specific components.

The exhaust system is comprised of up to three active components - the turbocharger (if equipped), the oxygen sensor, and the muffler/catalytic converter (if equipped) - in addition to manifold(s) and piping connecting the components.

16.2 Exhaust System Graphic

The exhaust system used is dependent on the generator set system design and application.



No.	Description	No.	Description
1	Muffler - Inline	3	Exhaust Bellows (Option)
2	Muffler - Side Entry	4	Exhaust Flex (Option)

FIGURE 7. TYPICAL EXHAUST SYSTEM COMPONENTS

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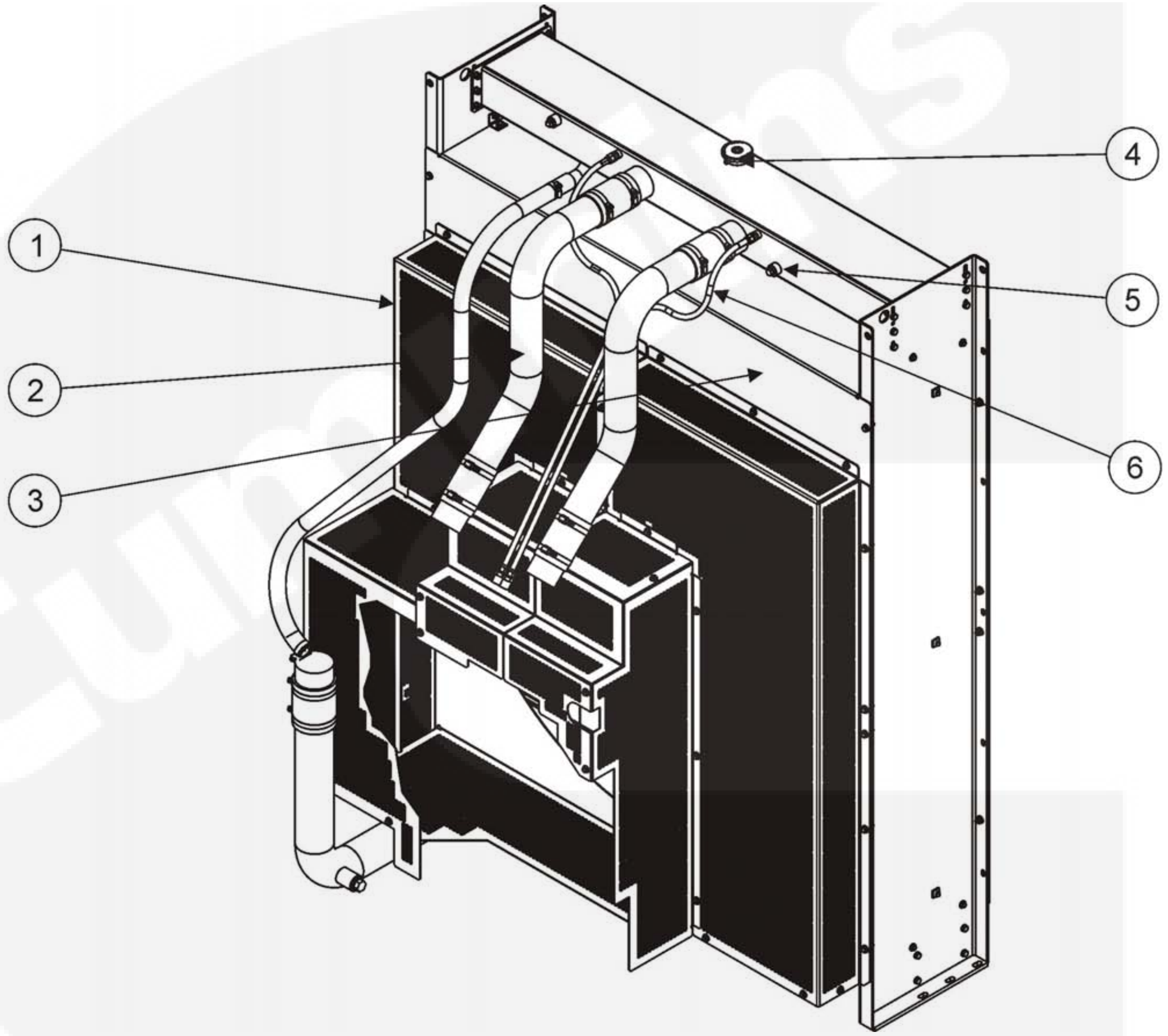
17 Cooling System

17.1 Cooling System Components



No.	Description	No.	Description
1	Fan Guard	4	Radiator Cap
2	Coolant Pipes	5	Coolant Level Sensor (½" NPT)
3	Radiator Core	6	Vent Hose

FIGURE 8. TYPICAL COOLING SYSTEM FOR GENERATOR SET WITH VTA28 ENGINE

17.2 Cooling System Maintenance

This section provides information on cleaning the radiator and updated information regarding bearings has been provided by our supplier to enable efficient and prolonged life of the equipment.

NOTICE

The following information regarding the correct choice and fitting of hose clamps has also been provided by our supplier to assist and guide the user.

17.2.1 Replacing Hoses

Regularly inspect all hoses and pipes for damage, wear and leaks. When replacing hoses, wear appropriate PPE for the task (safety glasses, gloves, overalls, safety boots etc.). Follow all safety notices when servicing generator sets where fluids may be under pressure or at high temperatures. Allow the engine to cool before performing any service tasks.

1. Perform the lockout tagout procedure.
2. Isolate and drain the system into a suitable container.
3. Remove and replace the damaged/worn hose(s).
4. Clean any contaminated areas and secure using new clamps/fixings.
5. Fill and bleed/vent the system.
6. Secure the hose as previously installed. Inspect for leaks and correct as necessary.

17.2.2 Hose Clamp Installation

This section provides general installation guidelines for the correct positioning, orientation and torque figures required when fitting hose clamps. Recommended hose and clamp combinations are also included.

17.2.2.1 Choosing the Right Hose Size

The recommended fit for hose to pipe is a 0.8mm interference fit, i.e. the inner diameter of the hose should be 0.5 mm smaller than the overall diameter of the pipe.

17.2.2.2 Types of Hose Clamps

There are three main types of hose clamps:

- Constant Torque Clamps
- T-Clamps
- Worm Drive Clamps

17.2.2.2.1 Constant Torque Clamps

DIA. RANGE (mm)	BOLT SIZE	PIPE DIA. (mm)	HOSE TYPE	INSTALLATION TORQUE
25.4 – 44.4	3/8”	25.4	EPDM RUBBER	8 Nm
31.7 – 54.1	3/8”	38.1	APT THICK WALL	14 Nm
31.7 – 54.1	3/8”	38.1	EPDM RUBBER	14 Nm
31.7 – 54.1	3/8”	38.1	SILICONE NOMEX	14 Nm
57.1 – 79.5	3/8”	57.1	EPDM RUBBER	14 Nm
57.1 – 79.5	3/8”	57.1	APT THICK WALL	14 Nm
69.8 – 92.2	3/8”	76.2	APT THICK WALL	14 Nm
69.8 – 92.2	3/8”	76.2	SILICONE NOMEX	14 Nm
69.8 – 92.2	3/8”	76.2	EPDM RUBBER	14 Nm
82.5 – 104.9	3/8”	88.9	APT THICK WALL	14 Nm
95.2 – 117.65	3/8”	101.6	APT THICK WALL	14 Nm
95.2 – 117.65	3/8”	101.6	SILICONE NOMEX	14 Nm
95.2 – 117.65	3/8”	101.6	EPDM RUBBER	14 Nm
133.3 – 155.7	3/8”	127	APT THICK WALL	14 Nm

17.2.2.2.2 T-Clamps

DIA. RANGE (mm)	BOLT SIZE	PIPE DIA. (mm)	HOSE TYPE	INSTALLATION TORQUE
43 – 47	M6 X 50	38.1	SILICONE NOMEX	4 Nm
63 – 68	M7 X 60	57.1	EPDM RUBBER	4 Nm
68 – 73	M8 X 80	63.5	EPDM RUBBER	12 Nm
97 -104	M8 X 80	88.9	SILICONE NOMEX	12 Nm
121 – 130	M8 X 80	114.3	EPDM RUBBER	12 Nm
121 – 130	M8 X 80	114.3	SILICONE NOMEX	12 Nm
130 – 140	M8 X 80	127	EPDM RUBBER	12 Nm
130 – 140	M8 X 80	127	SILICONE NOMEX	12 Nm
162 - 174	M10 X 110	152.4	SILICONE NOMEX	30 Nm

17.2.2.2.3 Worm Drive Clamps

DIA. RANGE (mm)	INSTALLATION TORQUE	SOCKET REQUIRED	HOSE TYPE
8 - 16	3 Nm	7 mm	EPDM Rubber
12 - 20	3 Nm	7 mm	EPDM Rubber
16 - 25	4.5 Nm	7 mm	EPDM Rubber
25 - 40	4.5 Nm	7 mm	EPDM Rubber
20 - 32	4.5 Nm	7 mm	EPDM Rubber
32 - 50	4.5 Nm	7 mm	EPDM Rubber
40 - 60	4.5 Nm	7 mm	EPDM Rubber
50 - 70	4.5 Nm	7 mm	EPDM Rubber
60 - 80	4.5 Nm	7 mm	EPDM Rubber
70 - 90	4.5 Nm	7 mm	EPDM Rubber
80 - 100	4.5 Nm	7 mm	EPDM Rubber
90 - 110	4.5 Nm	7 mm	EPDM Rubber
100 - 120	4.5 Nm	7 mm	EPDM Rubber
120 - 140	4.5 Nm	7 mm	EPDM Rubber

17.2.3 Cleaning

17.2.3.1 General Cleaning

The Cleaning Of Radiator Cores Using Pressurized Water Equipment:

NOTICE
In specific dust laden environments, this procedure should not be used as the initial cleaning operation; it should follow Cleaning - Dust Laden Environments.

On enclosed generator sets with removable end panel(s), remove the end panel(s) to assist in the cleaning of the radiator.

Inspect the exterior of the radiator 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.

For thorough cleaning, pressure wash in the opposite direction to the airflow. A suitable proprietary degreasing additive (as recommended by the manufacturer of the pressure washer) should be applied via the pressure washer but this must not contain ammonia as it will corrode the core.

The recommended equipment for cleaning a radiator core is an industrial pressure washer, but it must be used in the correct manner as misuse can reduce the performance of the core. Protect the generator set from any over spray during this procedure.

To be effective, it is recommended that a hot water washer be used.

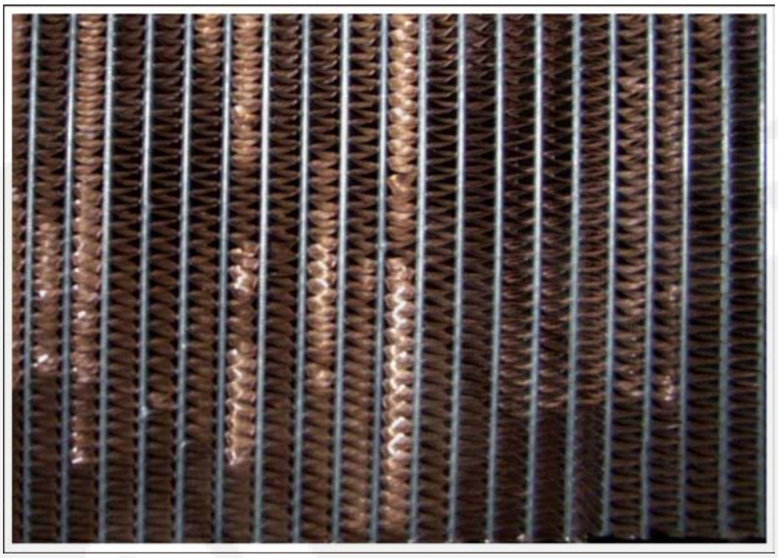


FIGURE 9. FINS DAMAGED BY PRESSURE WASHING AT ACUTE ANGLES TO CORE FACE

NOTICE

With the pressures involved it is important that the distance between the core face and the nozzle is a minimum of 450 mm (18 inches); any closer and damage may occur.

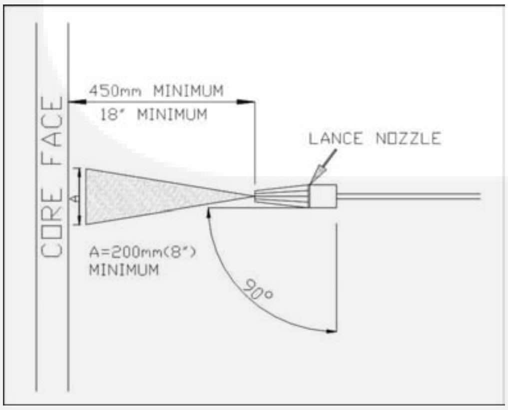


FIGURE 10. PRESSURE WASHER NOZZLE POSITIONING

NOTICE

Most Industrial pressure washers work at pressures of around 1500 psi to 3000 psi (103 bar to 206 bar). It is very important that, when washing a core in this way, the lance must be kept at a right angle to the core

NOTICE

If your pressure washer works above 3000 psi, then the gap between the nozzle and the core face must be increased or fin damage will occur.

NOTICE

Always follow pressure washer Manufacturer's Health and Safety Guidelines.

Replace the end panel(s) where necessary.

17.2.3.2 Dust Laden Environments

Specific Instructions for the Cleaning of Radiator Cores Used in an Environment Subjected to Crushed Aggregate or Ceramic Dust Contamination:

On enclosed generator sets with removable end panel(s), remove the end panel(s) to assit in the cleaning of the radiator.

Inspect the exterior of the radiator 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 continue the efficiency of the radiator the core will require cleaning.

Unless the radiator can be dismantled and the core treated in a professional caustic immersion cleaning system, the radiator should not be “wet” cleaned. This is because of the tendency of this type of contamination to coalesce and become extremely difficult to remove.

The correct procedure is to regularly blow through the entire core area with low pressure compressed air (against the direction of cooling airflow). It is very important to ensure that resultant debris blown from the core is subsequently removed and disposed of before engine start-up. An industrial vacuum cleaner will achieve this requirement. In most installations it will necessary to remove cowls and guarding.

To prevent damage to fins and resultant loss of cooling, it is important to ensure that the air gun used is maintained at right angles to the core face.

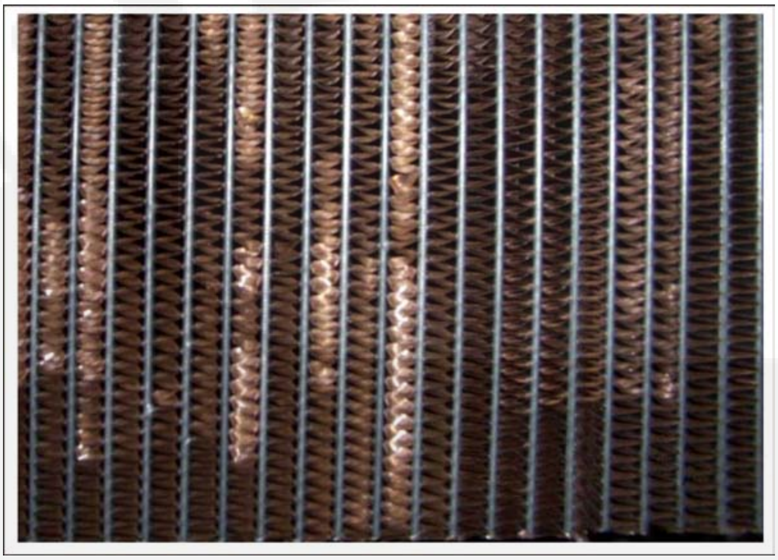


FIGURE 11. FINS DAMAGED BY COMPRESSED AIR AT ACUTE ANGLES TO CORE FACE

Immediately after this procedure has been effectively carried out with only the lightest of dust remaining, if deemed essential, it may be followed by cleaning the radiator cores using pressurized water equipment.

Replace the end panel(s) where necessary.

NOTICE
It is vitally important that the core is thoroughly dried before start-up.

17.2.4 Bearing Health Check

The following information is relevant to both Interference Fit and Non-Interference Fit bearings.

Determine if there are any sounds emanating from the shaft/bearing assembly which may be indicative of failure, or imminent failure.

17.2.5 Bearing and Grease Change

The fan drive and design has been changed to improve serviceability of the bearing set-up, both in terms of greasing and fitting.

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18 Alternator

18.1 General Description

HC alternators are of brushless rotating field design, available up to 690V, 50Hz (1000 RPM, 6 pole and 1500 RPM, 4 pole) or 60Hz (1200 RPM, 6 pole and 1800 RPM, 4 pole), and built to meet BS5000 Part 3 and international standards.

HC alternators are available self-excited, where excitation power is from the main output windings, or separately-excited, where a permanent magnet generator (PMG) supplies excitation power.

18.2 Environment

STAMFORD alternators are protected to IP23 as standard. IP23 is not adequate protection for use outdoors without additional measures.

Ambient Temperature	-15 °C to 40 °C
Relative Humidity	< 60%
Altitude	< 1000 m

The alternator has been designed for the environment shown in the table. The alternator can operate outside these conditions if it is rated accordingly: The nameplate gives details. If the operating environment is changed after purchase, refer to the factory for a revised alternator rating.

18.3 Air Flow

TABLE 13. MINIMUM AIR FLOW AND MAXIMUM PRESSURE DROP

Alternator model and frequency	**50 Hz**	**60 Hz**	**Maximum intake to outlet pressure drop, mm (in) water gauge**
	Minimum Air flow, m^3/s (ft^3/min)		
HC4	0.8 (1700)	0.99 (2100)	6 (0.25)
HC5	1.04 (2202)	1.31 (2780)	6 (0.25)
HCK5	1.23 (2615)	1.59 (3366)	6 (0.25)
HC6	1.62 (3420)	1.96 (4156)	6 (0.25)

Make sure that the air inlets and outlets are not blocked while the alternator is running.

18.4 Airborne Contaminants

Contaminants such as salt, oil, exhaust fumes, chemicals, dust and sand will reduce the effectiveness of the insulation and the life of the windings. Consider using air filters and an enclosure to protect the alternator.

18.5 Air Filters

Air filters trap airborne particulates above 5 microns. The filters must be cleaned or replaced regularly, depending on site conditions. Check the filters frequently to establish an appropriate service interval.

Alternators with factory-fitted filters are rated to account for the reduced flow rate of cooling air. If filters are retrofitted, the alternator rating must be reduced by 5%.

Air filters do not remove water. Keep the filters dry with additional protection. Wet filters further restrict airflow, causing the alternator to overheat and leading to premature failure of the insulation.

18.6 Humid Conditions

The water carrying capacity of air depends on temperature. If the air temperature falls below its saturation point, dew may form on the windings reducing the electrical resistance of the insulation. In humid conditions additional protection may be required, even if the alternator is fitted inside an enclosure. Anti-condensation heaters are supplied on request.

18.7 Anti-condensation Heaters

⚠ WARNING
Power to the anti-condensation heater is supplied from a separate source. Before doing any work on the heater, make sure the power is isolated and locked off.

Anti-condensation heaters raise the air temperature around the windings to deter condensation forming in humid conditions when the alternator is not operating. Best practice is to energize the heaters automatically when the alternator is off.

18.8 Vibration

STAMFORD alternators are designed to withstand the vibration levels encountered on generator sets built to meet the requirements of ISO 8528-9 and BS 5000-3. (Where ISO 8528 is taken to be broad band measurements and BS5000 refers to the predominant frequency of any vibrations on the generator set).

NOTICE
Exceeding either of the above specifications will have a detrimental effect on the life of the bearings and other components, and may invalidate the alternator warranty.

NOTICE
The terminal box is designed to support the fitted busbars or terminals, transformers, load cables and auxiliary terminal box. Additional mass could cause excessive vibration and lead to failure of the terminal box enclosure and mounting. Refer to Section 18.8.1 on page 297 to connect the load cables to the terminal box. Refer to CGT before fixing any additional mass to the terminal box.

18.8.1 Electrical Connections

⚠ WARNING

Incorrect electrical installation and system protection can cause personal injury. Installers must be qualified to perform electrical installation work and are responsible for meeting the requirements of any inspectorate, local electricity authority and site safety rules.

NOTICE

The terminal box is designed to support the fitted busbars or terminals, transformers, load cables and auxiliary terminal box. Additional mass could cause excessive vibration and lead to failure of the terminal box enclosure and mounting. Refer to CGT before fixing any additional mass to the terminal box.

18.8.2 Definition of BS5000–3

Alternators shall be capable of continuously withstanding linear vibration levels with amplitudes of 0.25mm between 5Hz and 8Hz and velocities of 9.0mm/s r.m.s. between 8 Hz and 200 Hz, when measured at any point directly on the carcass or main frame of the machine. These limits refer only to the predominant frequency of vibration of any complex waveform.

18.8.3 Definition of ISO 8528-9

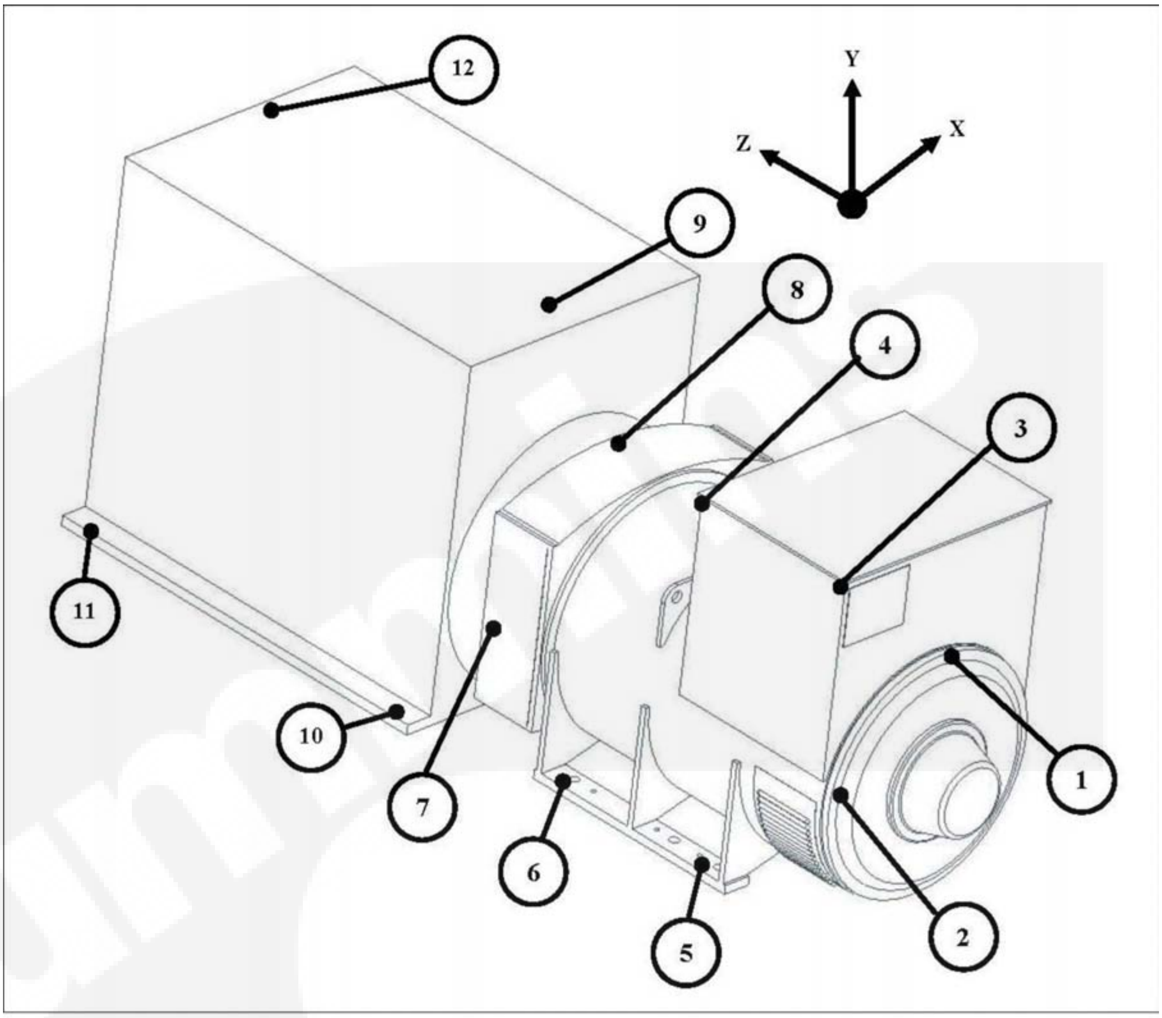
ISO 8528-9 refers to a broad band of frequencies; the broad band is taken to be between 10 Hertz and 1000 Hertz. The table below is an extract from ISO 8528-9 (Table C.1, value 1). This simplified table lists the vibration limits by kVA and speed for acceptable operation of standard generator set designs.

18.8.4 Linear Vibration Limits

Linear Vibration Levels As Measured On The Alternator - HC				
Engine Speed RPM (min^{-1})	Power Output S (kVA)	Vibration Displacement r.m.s. (mm)	Vibration Velocity r.m.s. (mm/s)	Vibration Acceleration r.m.s. (mm/s^2)
1300 ≤ RPM ≤ 2000	250 < S	0.32	20	13
720 ≤ RPM < 1300	250 < S ≤ 1250	0.32	20	13
The broad band is taken as 10 Hz - 1000 Hz				

18.8.5 Linear Vibration Monitoring

We recommend using vibration analyzing equipment to measure vibration at the positions shown below. Check that vibration of the generator set is below the limits stated in the standards. If vibration is above the limits, the generator set builder should investigate the root causes and eliminate them. Best practice is for the generator set builder to take initial readings as a reference and for the user to periodically monitor vibration, according to the recommended service schedule, to detect a deteriorating trend.



18.8.6 Excessive Vibration

⚠ WARNING
Excessive vibration can cause catastrophic failure of the alternator, which could cause personal injury.

If the measured vibration of the generator set is not within the limits:

1. The generator set manufacturer should change the generator set design to reduce the vibration levels as much as possible.
2. Contact Cummins Generator Technologies to assess the impact on bearing and alternator life expectancy.

18.9 Bearings

18.9.1 Re-greasable Bearings

Each bearing housing is connected by a grease pipe to an external grease nipple. A label gives the grease type and quantity, and frequency for re-greasing. The recommended grease is a high specification synthetic compound that must not be mixed with grease of a different specification. Refer to the Service and Maintenance chapter for detailed instructions.

18.9.2 Bearing Life

Factors that reduce bearing life or lead to bearing failure include:

- Adverse operating conditions and environment
- Stress caused by misalignment of the generator set
- Vibration from the engine that exceeds the limits in BS 5000-3 and ISO 8528-9
- Long periods (including transportation) where the alternator is stationary and subjected to vibration can cause false brinelling wear (flats on the balls and grooves on the races)
- Very humid or wet conditions that cause corrosion and deterioration of the grease by emulsification.

18.9.3 Health Monitoring of the Bearings

We recommend that the user checks the bearing condition, using vibration monitoring equipment. Best practice is to take initial readings as a reference and periodically monitor the bearings to detect a deteriorating trend. It will then be possible to plan a bearing change at an appropriate generator set or engine service interval.

18.9.4 Bearing Service Life Expectancy

Bearing manufacturers recognize that service life of bearings depends on factors that are outside their control: Rather than quote a service life, practicable replacement intervals are based on the L10 life of the bearing, the type of grease and the recommendations of the bearing and grease manufacturers.

For general-purpose applications; if the correct maintenance is carried out, vibration levels do not exceed the levels stated in ISO 8528-9 and BS5000-3, and the ambient temperature does not exceed 50°C, plan to replace the bearings within 30,000 hours of operation.

If in doubt about any aspect of bearing life on STAMFORD alternators, contact your nearest supplier of STAMFORD alternators or the Stamford factory.

18.10 Installation into the Generator Set

18.10.1 Lifting the Alternator

⚠ CAUTION
The alternator lifting points are designed to lift the alternator only. Do not lift the complete generator set (alternator coupled to motive power source) by the alternator lifting points. Keep the alternator horizontal when lifting. Fit the transit bar to single bearing alternators to keep the main rotor in the frame.

Lift the alternator by hooks or shackles attached to the lifting points (lugs or eyes) provided. A label attached to a lifting point shows the correct lifting arrangement. Use chains of sufficient length, and a spreader bar if necessary, to make sure that the chains are vertical when lifting. Make sure that the capacity of the lifting equipment is sufficient for the alternator mass shown on the label.

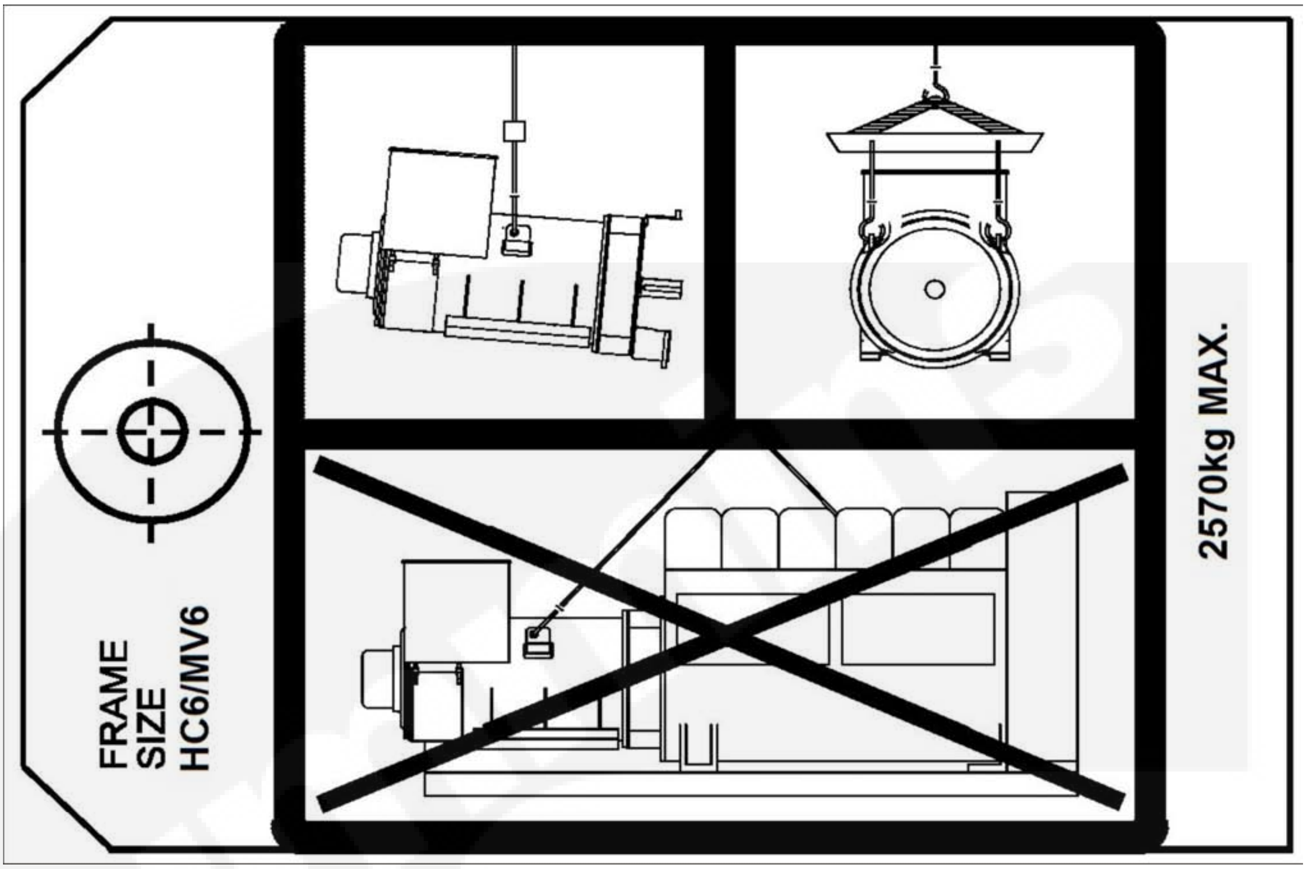


FIGURE 12. LIFTING LABEL

18.10.2 Storage

If the alternator is not to be used immediately, it must be stored in a clean, dry, vibration free environment. We recommend the use of anti-condensation heaters, when available.

Refer to Service and Maintenance section (Section 18.11 on page 309) of this manual for further instructions for the bearings of stored alternators.

18.10.2.1 After Storage

After a period of storage, carry out the pre-running checks to determine the condition of the windings. If the windings are damp or the insulation resistance is low, follow one of the drying out procedures (see Section 18.11 on page 309).

- For re-greasable bearings that have been rotated during storage and have been in storage for between 6 months and 2 years, regrease the bearings before first use of the alternator.
- For re-greasable bearings that have not been rotated during storage and have been in storage for more than 12 months, replace the bearings before first use of the alternator.
- For sealed bearings that have been in storage for more than 12 months, replace the bearings before first use of the alternator.

18.10.3 Vibration Frequencies

The main vibration frequencies produced by the alternator are as follows:

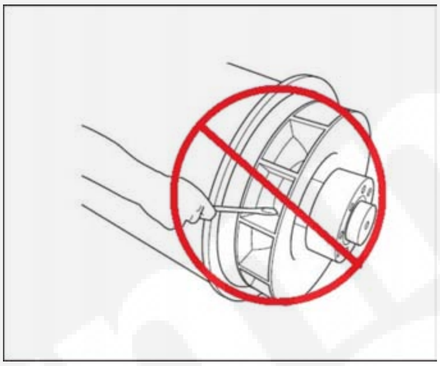
- 6-pole 1000 RPM 16⅔ Hz
- 6-pole 1200 RPM 20 Hz

- 4-pole 1500 RPM 25 Hz
- 4-pole 1800 RPM 30 Hz

Vibrations induced in the alternator by the engine are complex. It is the responsibility of the generator set designer to ensure that the alignment and stiffness of the bedplate and mountings do not allow vibration to exceed BS5000 part 3 and ISO 8528 part 9 limits.

18.10.4 Generator Set Coupling

NOTICE
Do not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan. The fan is not designed to withstand such forces and will be damaged.



Efficient operation and long component life depend on minimizing mechanical stresses on the alternator. When coupled in a generator set, misalignment and vibration interactions with the prime mover engine can cause mechanical stress.

Generator sets need a substantial flat continuous bedplate to suit the installation site floor loading, with engine and alternator mounting pads to make a firm base for accurate alignment. The height of all mounting pads must be within 0.25 mm for skid mounting, 3 mm for non-adjustable anti-vibration mounts (AVM) or 10 mm for adjustable height AVMs. Use shims to achieve level. The rotational axes of alternator rotor and engine output shaft must be coaxial (radial alignment) and perpendicular to the same plane (angular alignment). The axial alignment of the alternator and engine coupling must be within 0.5 mm, to allow for thermal expansion without unwanted axial force on the bearings at operating temperature.

Vibration can occur by flexing of the coupling. The alternator is designed for a maximum bending moment not exceeding 140 kgm (1000 lbs ft) for frame sizes 4 and 5, and not exceeding 275 kgm (2000 lbs ft) for frame size 6. Check the maximum bending moment of the engine flange with the engine manufacturer.

Close-coupling of alternator and engine can increase the rigidity of the generator set. Both single and two bearing alternators can be close-coupled. The generator set builder must supply guarding for open-coupled applications.

To prevent rust during transit and storage, the alternator frame spigot, rotor coupling plates and shaft extension have been treated with a rust preventative coating. Remove this before coupling the generator set.

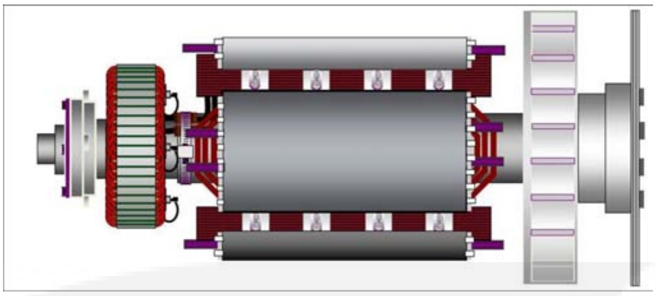


FIGURE 13. SINGLE BEARING ALTERNATOR ROTOR SHOWING COUPLING DISCS BOLTED TO DRIVE END COUPLING HUB (AT RIGHT)

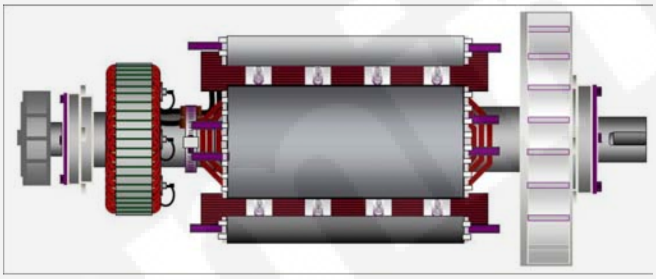


FIGURE 14. TWO BEARING ALTERNATOR ROTOR SHOWING SHAFT WITH KEYWAY FOR FLEXIBLE COUPLING (AT RIGHT)

18.10.4.1 Single Bearing

1. Remove the drive end transit bracket that keeps the rotor in place during transport.

⚠ CAUTION
Keep the alternator horizontal to keep the rotor in place

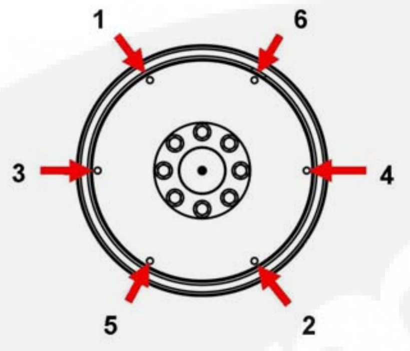
2. Remove the air outlet covers from the drive end of the alternator to access the coupling and adaptor bolts.
3. Make sure the coupling discs are concentric with the adaptor.
4. Fit two alignment dowels into flywheel bolt holes 180 degrees apart to help align the disc and the flywheel.
5. Lift and offer the alternator to the engine, barring the engine over by hand to align discs and flywheel.
6. Engage the alignment dowels into coupling disc bolt holes and push the alternator towards the engine until the coupling discs are against the flywheel face.

⚠ CAUTION
Do not pull the alternator to the engine using bolts through the flexible discs.

7. Fit the adaptor bolts, using heavy gauge washers under the heads. Tighten the adapter bolts evenly around the adapter.
8. Check the torque of each bolt in a clockwise direction around the bolt circle to ensure all the bolts are tight. Refer to the engine manufacturer’s manual for correct tightening torque.

⚠ CAUTION
Failure to secure bolts can lead to excessive vibration, which in turn can lead to catastrophic alternator failure.

9. Remove the alignment dowels. Fit the coupling bolts, using heavy gauge washers under the heads.



10. Tighten the bolts to fix the coupling disc to the flywheel in the sequence shown above.
11. Check the torque of each bolt in a clockwise direction around the bolt circle to ensure all the bolts are tight.
12. Remove the rotor support bracket, if supplied.
13. Replace all covers.

18.10.4.2 Two Bearing

A flexible coupling, designed to suit the specific engine/alternator combination, is recommended to minimise torsional vibration effects.

If a close coupling adaptor is used the alignment of machined faces must be checked by offering the alternator up to the engine. Shim the alternator feet if necessary.

18.10.5 Pre-Running Checks

Before starting the generator set, test the insulation resistance of windings, check all connections are tight and in the correct location. Ensure the alternator air path is clear of obstructions. Replace all covers.

18.10.6 Insulation Resistance Test

NOTICE
Disconnect the AVR and voltage transformers (if fitted) before this test. Disconnect and earth all RTD and Thermistor temperature sensors (if fitted) before this test.

The resistance test must be carried out by a qualified person.

Alternator Voltage (kV)	Test Voltage (V)	Minimum Insulation Resistance (MΩ)	
		In Service Alternator	New Alternator
Up to 1	500	5	10

You must dry out the alternator windings if the measured insulation resistance is less than the minimum value. See the Service & Maintenance section (Section 18.11 on page 309) of this manual.

18.10.6.1 Insulation Resistance with Temperature

Minimum insulation resistance values are given for windings at 20 °C ambient, but insulation resistance may be measured at a higher temperature, T. For comparison with minimum values, multiply the measured insulation resistances $(IR)_T$ by the appropriate factor from the table below to give the equivalent values at 20 °C, $(IR)_{20}$.

Winding Temperature, T (°C) for measured $(IR)_T$	Equivalent Insulation Resistance at 20°C, $(IR)_{20}$ (MΩ)
20	1 x $(IR)_T$
30	2 x $(IR)_T$
40	4 x $(IR)_T$
50	8 x $(IR)_T$
60	16 x $(IR)_T$
70	32 x $(IR)_T$
80	64 x $(IR)_T$

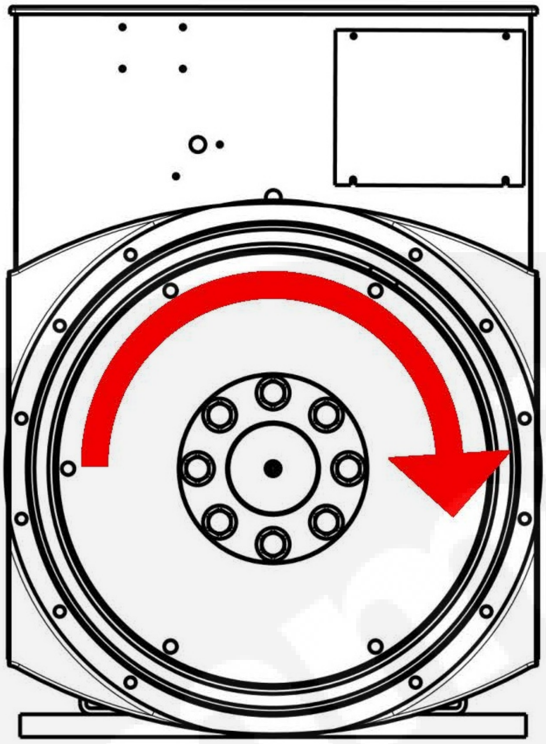
18.10.6.2 High Voltage Test

NOTICE

Windings have been tested at high voltage during manufacture. Repeated high voltage tests may degrade the insulation and reduce operating life. If a further test is required at installation for customer acceptance, it must be done at a reduced voltage, V = 0.8 x (2 x Rated Voltage + 1000). Once in service, any further tests for maintenance purposes must be done after passing visual checks and insulation resistance tests, and at a reduced voltage, V = (1.5 x Rated Voltage).

18.10.7 Direction of Rotation

The fan is designed for clockwise rotation, as viewed from the drive end of the alternator (unless otherwise specified when ordered). If the alternator must run counter-clockwise, please seek advice from Cummins Generator Technologies.



18.10.8 Phase Rotation

Main stator output is connected for a phase sequence of U V W when the alternator runs clockwise, as viewed from the drive end. If the phase rotation must be reversed, the customer must re-connect the output cables in the terminal box. Ask Cummins Generator Technologies for a circuit diagram of ‘reverse phase connections’.

18.10.9 Voltage and Frequency

Check that the voltage and frequency shown on the alternator rating plate meet the requirements of the generator set application.

18.10.10 AVR Settings

The AVR is factory set for initial running tests. Check that the AVR settings are compatible with your required output. Refer to detailed instructions in the AVR manual for on- and off-load adjustments.

Fault current curves and alternator reactance values are available on request from the factory so that the system designer can calculate the necessary fault protection and/or discrimination.

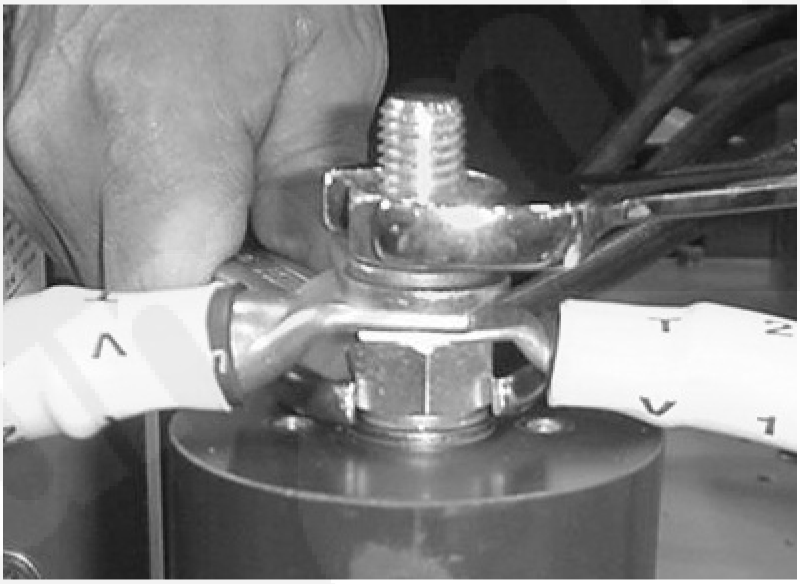
The installer must check that the alternator frame is bonded to the generator set bedplate, and must bond to site earth. If anti-vibration mounts are fitted between the alternator frame and its bedplate, a suitably-rated earth conductor must bridge across the anti-vibration mount.

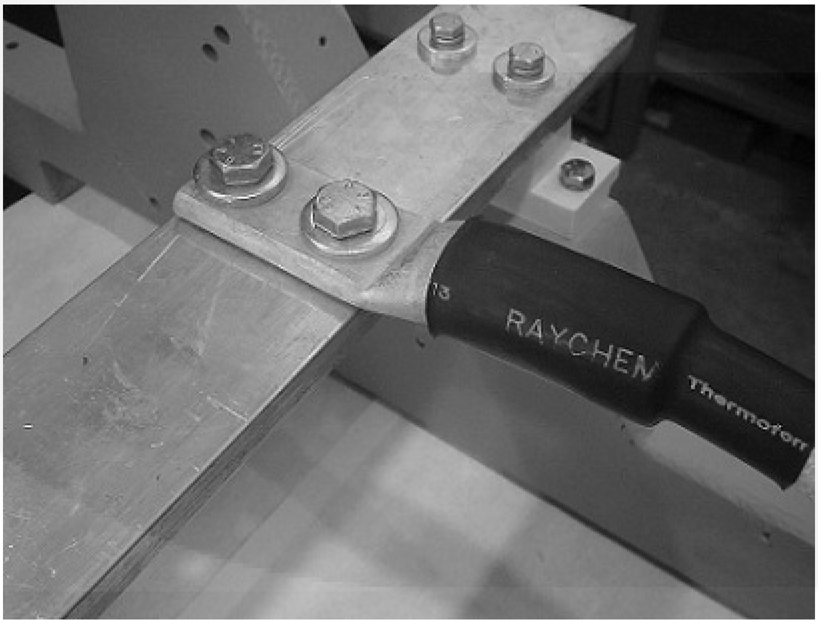
Refer to wiring diagrams for electrical connection of the load cables. Electrical connections are made in the terminal box, constructed with removable panels to suit site-specific cable entry and glanding. Route single core cables through the insulated or non-magnetic gland plates supplied. Panels must be removed to be drilled or cut to prevent swarf entering the terminal box or alternator. After wiring, inspect the terminal box, remove all debris using a vacuum cleaner if necessary and check that no internal components are damaged or disturbed.

As standard, the alternator neutral is not bonded to the alternator frame. If required, neutral may be connected to the earth terminal in the terminal box, by a conductor of at least one half of the sectional area of a phase lead.

Load cables must be supported appropriately to avoid a tight radius at the point of entry into the terminal box, clamped at the terminal box gland, and allow at least ±25 mm movement by the alternator set on its anti-vibration mountings, without causing excessive stress to the cables and alternator load terminals.

The palm (flattened part) of load cable lugs must be clamped in direct contact with the main stator output conductors so that the whole palm area conducts the output current, as shown below in typical arrangements for insulated terminals and busbar. The tightening torque of M12 fasteners is 70 Nm (main nut) and 45 Nm (lock nut) on insulated terminals, or 80 Nm on busbars. As specified when ordering, cable lugs can be fixed to top or bottom of the busbar, and by one or two fasteners.





18.10.12 Grid Connection: Voltage Surges and Micro-Interruptions

Take precautions to prevent transient voltages generated by the connected load and/or the distribution system from causing damage to the alternator components.

To identify any possible risk, all aspects of the alternator's proposed application should be considered, especially the following:

- Loads with characteristics that result in large load step changes.
- Load control by switchgear, and power control by any method likely to generate transient voltage spikes.
- Distribution systems susceptible to external influences, such as lightning strikes.
- Applications involving parallel operation to a mains supply, where the risk of a mains disturbance in the form of a micro-interruption could occur.

If the alternator is at risk from voltage surges or micro-interruptions, include adequate protection into the generation system, usually with surge arrestors and suppressors, to meet regulations and installation requirements.

Surge protection must reduce the peak voltage at the alternator of a transient pulse of 5 µs rise time to less than 1.25 x √2 x (2 x rated output voltage + 1000 V). Best practise is to fit protective devices close to the output terminals. Refer to guidance from professional bodies and specialist equipment suppliers for further advice.

18.10.13 Varying Load

Under certain conditions, load variations can reduce alternator life.

Identify any possible risk, especially the following:

- Large capacitive loads (for example Power Factor Correction equipment) can affect alternator stability and cause pole slip.
- Stepped grid voltage variation (for example Tap Changing).

If the alternator is at risk from varying load, include adequate protection into the generator set system by under-excitation protection.

18.10.14 Synchronization

18.10.14.1 Parallel or Synchronizing Alternators

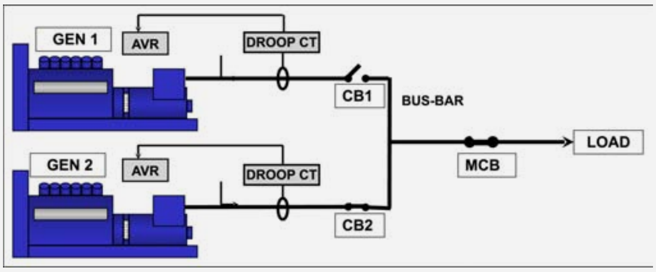


FIGURE 15. PARALLEL OR SYNCHRONIZING ALTERNATORS

The quadrature droop current transformer (Droop CT) gives a signal proportional to reactive current; the AVR adjusts excitation to reduce circulating current and allow each alternator to share reactive load. A factory-fitted droop CT is pre-set for 5% voltage drop at full-load zero power factor. Refer to the supplied AVR manual for droop adjustment.

- The synchronizing switch/breaker (CB1, CB2) must be of a type that will not cause “contact bounce” when it operates.
- The synchronizing switch/breaker must be adequately rated to withstand the continuous full load current of the alternator.

- The switch/breaker must be able to withstanding the rigorous closing cycles during synchronizing and the currents produced if the alternator is paralleled out of synchronizm.
- The closing time of the synchronizing switch/breaker must be under the control of the synchronizer settings.
- The switch/breaker must be capable of operation under fault conditions such as short circuits. Alternator data sheets are available.

NOTICE
The fault level may include a contribution from other alternators as well as from the grid/mains utility.

The method of synchronizing should be either automatic, or by check synchronizing. The use of manual synchronizing is not recommended. The settings on the synchronizing equipment should be such that the alternator will close smoothly.

⚠ **CAUTION**
Synchronizing outside the following parameters may result in catastrophic failure of the alternator.

The Phase sequence must match	
Voltage difference	+/- 0.5%
Frequency difference	0.1 Hz/sec
Phase angle	+/- 10°
C/B closing time	50 ms

The settings for the synchronizing equipment to achieve this must be within these parameters.

The voltage difference when paralleling with the grid/mains utility is +/- 3% .

18.10.15 Regreasable bearings

After long storage periods grease in the exit port may become hard. To ensure correct function of machine remove any hard grease and refill with correct fresh grease. Refer to the Re-grease Bearings section (Section 18.11.2.3 on page 311) of the Service and Maintenance chapter in this manual.

18.10.16 Service and Maintenance

18.11 Service and Maintenance

TABLE 14. ALTERNATOR SERVICE SCHEDULE

System	SERVICE ACTIVITY X = required * = if necessary	Alternator running	TYPE: Inspect	TYPE: Test	TYPE: Clean	TYPE: Replace	SERVICE LEVEL: Commission	Post Commission	250 hrs / 0.5 year	Level 1	1000 hrs / 1 year	Level 2	10,000 hrs / 2 years	Level 3	30,000 hrs / 5 years
Alternator	Alternator rating		X				X								
	Bedplate arrangement		X				X								
	Coupling arrangement		X				X					*		X	
	Environmental conditions and cleanliness		X				X	X		X		X		X	
	Ambient temperature (inside & outside)			X			X	X		X		X		X	
	Complete machine - damage, loose parts & earth bonds		X				X	X		X		X		X	
	Guards, screens, warning and safety labels		X				X	X		X		X		X	
	Maintenance access		X				X								
	Electrical nominal operating conditions & excitation	X		X			X	X		X		X		X	
	Vibration	X		X			X	X		X		X		X	
Windings	Condition of windings		X				X	X		X		X		X	
	Insulation resistance of all windings (PI test for MV/HV)			X			X	*		*		X		X	
	Insulation resistance of rotor, exciter and PMG			X				X		X					
	Temperature sensors	X		X			X	X		X		X		X	
	Customer settings for temperature sensors		X				X								

System	SERVICE ACTIVITY X = required * = if necessary	Alternator running	TYPE: Inspect	TYPE: Test	TYPE: Clean	TYPE: Replace	SERVICE LEVEL: Commission	SERVICE LEVEL: Post Commission / 250 hrs / 0.5 year	SERVICE LEVEL: Level 1 / 1000 hrs / 1 year	SERVICE LEVEL: Level 2 / 10,000 hrs / 2 years	SERVICE LEVEL: Level 3 / 30,000 hrs / 5 years
Bearings	Condition of bearings		X				X				X
	Grease exhaust & trap				X			X	X	X	X
	Grease in re-greasable bearing(s)	X				X		every 4000 to 4500 hours			
	Sealed bearing(s)		X					every 4000 to 4500 hours			
	Re-greasable & sealed bearing(s)					X				*	X
	Temperature sensors	X		X			X	X	X	X	X
	Customer settings for temperature sensors		X				X				
Terminal Box	All alternator/customer connections and cabling		X				X	X	X	X	X
Controls & Auxiliaries	Initial AVR & PFC set up	X		X			X				
	AVR & PFC settings	X		X				X	X	X	X
	Customer connection of auxiliaries			X			X		X	X	X
	Function of auxiliaries			X			X	X	X	X	X
	Synchronization settings		X				X				
	Synchronization	X		X			X	X	X	X	X
	Anti condensation heater					X				*	X
Rectifier	Diodes and varistors		X				X	X	X	X	
	Diodes and varistors					X					X
Cooling	Air inlet temperature	X		X			X	X	X	X	X
	Air flow (rate & direction)	X	X				X				
	Condition of fan		X				X	X	X	X	X
	Condition of air filter (where fitted)			X			X	X	X	X	X
	Air filters (where fitted)				X	X			*	*	*

18.11.2 Bearings

18.11.2.1 Introduction

The alternator rotor is supported by a bearing at the non-drive end (NDE) and by either a bearing or a coupling to the prime mover at the drive end (DE).

- Refer to guidelines for bearings in the alternator applications (Section 18.9 on page 298) and storage (Section 18.10.2) sections of this manual.
- Lubricate each re-greasable bearing according to the recommended service schedule with the correct quantity and type of grease, also shown on a label fitted at the grease nipple.
- Inspect each sealed bearing according to the recommended service schedule. Seek advice from CGT if grease has leaked out of the bearing, notifying the bearing type and quantity leaked.
- Replace each bearing according to the recommended service schedule by one of identical type (stamped on the bearing), sourced from the original equipment manufacturer (OEM), containing the correct initial quantity and type of grease. Contact CGT for advice if an exact replacement is not available.

18.11.2.2 Safety

⚠ DANGER
Safety guards must be removed to replace bearings. To prevent injury, isolate the generator set from all energy sources and remove stored energy. Use lock and tag safety procedures before starting work.

⚠ WARNING
External surfaces may be very hot. Exposed skin can suffer serious and permanent burns, depending on the temperature and contact time. Avoid contact or wear protective gloves.

⚠ CAUTION
Grease can cause contact dermatitis. Avoid contact with the hands by wearing suitable PPE.

NOTICE
Do not overfill a bearing with grease; the bearing may be damaged. **Do not mix lubricant types. Change gloves to handle different lubricant** **Assemble bearings in static- and dust-free conditions while wearing lint free gloves.** **Store removed parts and tools in static- and dust-free conditions, to prevent damage or contamination.** **A bearing is damaged by the axial force needed to remove it from the rotor shaft. Do not reuse a bearing.** **A bearing is damaged if the insertion force is applied through the bearing balls. Do not press fit the outer race by force on the inner race, or vice versa.** **Do not try to turn the rotor by levering against the cooling fan vanes. The fan will be damaged.**

18.11.2.3 Re-grease Bearings

18.11.2.3.1 Requirements

Personal Protective Equipment (PPE)	Wear mandatory site PPE

Consumables	Lint-free cleaning cloths
	Thin disposable gloves
Parts	CGT recommended grease
Tools	Grease gun (calibrated for volume or mass)

18.11.2.3.2 Re-grease Method

TABLE 15. REGREASING: GREASE QUANTITY

Bearing Type	Quantity of recommended grease	
	Volume (cm^3)	**Mass (g)**
Drive End (HC6)	**75**	**66**
Non-drive End (HC6)	**60**	**53**
Drive End (HC5)	**46**	**41**
Non-drive End (HC5)	**33**	**29**

1. For each bearing, identify grease nipple, re-greasing label and bearing type.
2. Make sure the new grease is not contaminated. It must be a uniform whitish-beige colour of stiff consistency throughout.
3. Clean the grease gun nozzle and grease nipple.
4. Clean the grease exhaust.
5. Fit the grease gun to the grease nipple and add the correct quantity of grease.
6. Run the alternator for at least 60 minutes, off- or on-load.
7. Clean the grease exhaust.
8. Inspect the colour and consistency of grease expelled from the exhaust and compare with new grease - whitish-beige of stiff consistency.
9. Replace the bearing if the expelled grease is severely discoloured or absent.

18.11.2.4 Replace Bearings

Follow the steps below, in order:

1. Follow the **Remove Non-Drive End** section to access NDE bearing
2. If the DE bearing is to be replaced, follow the **Remove Drive End** section to access DE bearing.
3. Assemble and fit the new NDE bearing (and DE bearing, as required) onto the rotor shaft, following the **Assemble Bearing** section .
4. If the DE bearing has been replaced, follow the **Assemble Drive End** section to refit DE components.
5. Follow the **Assemble Non-Drive End** section to refit NDE components.

18.11.2.4.1 Requirements

Re-greasable bearings

Personal Protective Equipment (PPE)	Wear mandatory site PPE. Wear heat-resistant gloves for handling heated parts.

Consumables	Lint-free cleaning cloths
	Thin disposable gloves
	Washing fluid
	Large plastic bags (to store parts)
	White anti-static assembly surface
Parts	NDE bearing
	DE bearing (if fitted)
	CGT recommended grease
	CGT recommended anti-fretting paste
	O rings (if fitted)
	Wavy Washer
	Grease Flinger
Tools	Grease gun (calibrated for volume or mass)
	Washing bowl and brush
	Induction heater (with protective sleeve on bar)
	Torque wrench
	Bearing removal tooling (see Spares and After Sales Service chapter)
	Rotor support packing (nylon strips 4 mm x 60 mm x core length)
	Hydraulic Cylinder Jack and Pump
	M10 x 120 guide studs x 2

18.11.2.4.2 Remove Non-Drive End

NOTICE

Delicate exciter leads and temperature sensor leads may be fixed to the inside of the NDE bracket. Note the routing of leads and locations of all fasteners. Detach the leads carefully and keep all fasteners for re-use during assembly. Take care not to damage the leads when removing and storing the NDE bracket.

1. Turn off the anti-condensation heater (if fitted) and isolate from supply.
2. Remove the PMG cover.
3. Remove the lower air inlet cover.
4. Remove the terminal box lid and side panel (left hand, viewed from NDE)
5. Unplug the PMG control cable.
6. Disconnect the grease pipe (if fitted) from the bearing cartridge and the NDE bracket.
7. Disconnect the heater.
8. Use a 10 mm open spanner to disconnect the RTD sensor for bearing temperature (if fitted) from the bearing.
9. Remove the PMG stator and PMG rotor together as an assembly.
10. Put the PMG assembly into a plastic bag. Seal the bag to protect the parts from debris.
11. Remove the PMG rotor location pin from the end of the rotor shaft, or use a bolt with a spacer inserted in the PMG rotor thread to prevent damage to the pin.
12. Remove the NDE bearing cap assembly.

13. Turn the main rotor so that the NDE keyway is at the top of the rotor shaft. In this position, the lowest rotor pole is vertical and will support the rotor weight when the bearing is removed. If the rotor cannot be turned and no rotor pole is vertical, fit two rotor support packing pieces (see below) to support the lower two poles.
14. Disconnect F1 (red) and F2 leads at the AVR, cut cable ties and withdraw the leads to the exciter stator.
15. Remove fasteners from the NDE bearing cartridge.
16. Fix two threaded guide studs at least 120 mm long into the NDE bearing cartridge.
17. Remove fasteners from NDE bracket.
18. Insert two M10 jacking bolts part way into threaded holes on the NDE bracket horizontal centreline to open a gap for a shackle between the NDE bracket and the frame – approximately 10mm movement.
19. Fix a shackle to the NDE bracket and support with a crane sling.
20. Insert the jacking bolts fully to release the NDE bracket from the frame.
21. For alternators with a DE bearing, insert a rotor support packing piece into the air gap between the lowest rotor pole and the stator, along the full length of the rotor pole. When the NDE bearing is removed, the packing will keep the rotor near-horizontal to reduce non-radial loading on the other bearing.
22. Gently lower the crane sling or jack to put the rotor weight onto the support packing and remove the sling.
23. Carefully slide the NDE bracket away from the alternator along the guide studs to avoid damaging the exciter stator windings on the exciter rotor.
24. Set aside the NDE bracket flat on the floor on wooden bearers, with the exciter stator face up.
25. Remove the guide studs.

18.11.2.4.3 Remove Drive End

1. Remove NDE components first, following **Remove Non-Drive End**.
2. Remove the DE air outlet screen and DE louvres.
3. Disconnect the alternator from the prime mover.
4. Disconnect the grease tube (if fitted).
5. Disconnect the RTD sensor for bearing temperature (if fitted).
6. Remove the DE bearing cap.
7. Remove fasteners from the DE bearing cartridge.
8. Fix two threaded guide studs at least 120 mm long into the DE bearing cartridge.
9. Use a crane sling and lifting hooks fitted into the air outlet ducts to support the DE bracket.
10. Remove fasteners from the DE bracket.
11. Release the DE bracket from the frame by tapping with a mallet away from the frame
12. Gently lower the crane sling to put the rotor weight onto the support packing.
13. Carefully slide the DE bracket away from the alternator along the guide studs.
14. Remove the guide studs.

18.11.2.4.4 Assemble a Re-greasable Bearing

TABLE 16. INITIAL GREASING: GREASE QUANTITY

Bearing Type	Cartridge		Bearing		Bearing Cap		**TOTAL**	
	Volume (cm^3)	Mass (g)	Volume (cm^3)	Mass (g)	Volume (cm^3)	Mass (g)	**Volume (cm^3)**	**Mass (g)**
Drive End (HC6)	78	69	156	139	78	69	**312**	**277**
Non-drive End (HC6)	63	56	121	111	63	56	**247**	**223**
Drive End (HC5)	46	41	92	82	46	41	**184**	**164**
Non-drive End (HC5)	33	29	65	58	33	29	**131**	**116**

Quantity of recommended grease

1. Remove and discard the wavy washer (NDE only).
2. Use the tooling and jack to remove the grease flinger.
3. Remove the circlip (NDE only).
4. Use the tooling and jack to remove the bearing and cartridge assembly from the main rotor shaft.
5. Prepare for assembly, by cleaning:
   a. Wipe clean the anti-static assembly surface, using solvent on lint free cloth.
   b. Wash the bearing cartridge, wavy washer and the bearing cap and inspect for contamination.
   c. Wipe off excess washing fluid with a lint free cloth and place all components on the clean anti-static assembly surface.
   d. Thoroughly clean the external surface of the grease gun nozzle using a lint free cloth.
6. Prepare the bearing:
   a. Remove the bearing from its packaging.
   b. Wipe off the preservative oil with a lint free cloth from the surface of the inner and outer rings.
   c. Place the bearing on the clean anti-static assembly surface, with the bearing type identification markings face down.
7. Grease and assemble the bearing components:
   a. Fit a new O ring in the groove in the bearing housing (NDE only).
   b. Apply the specified quantity of grease to the back face of the bearing cartridge.
   c. Apply a small amount of grease to the grooved sealing surface in the cartridge.
   d. Without rubbing in, use a lint free cloth to smear anti-fretting paste in a thin coherent layer to the bearing housing circumference.
   e. Apply half the specified quantity of grease to the upper face of the bearing (without the bearing designation markings).

f. Press the grease into the bearing, ensuring good penetration into the raceways and between the balls.

g. Assemble the bearing into the bearing cartridge, greased side first, by pressing **ONLY** on the bearing outer race. Ensure the bearing outer race contacts the location shoulder.

h. Apply the remaining half of the specified quantity of grease to the exposed side of the bearing.

i. Press the grease into the bearing, ensuring good penetration into the raceways and between the balls.

j. Apply the specified quantity of grease to the inside face of the bearing cap.

k. Fill the grease exhaust slot, with grease.

l. Apply a small amount of grease to the grooved sealing surface in the bearing cap.

m. Fill the grease pipe and grease nipple with grease.

8. Fit the bearing components:

   a. Expand the bearing and cartridge assembly by heating to 100 to 110 ºC in the induction heater.

   b. Slide the bearing and cartridge assembly over the rotor shaft, pushing it firmly against the seating shoulder.

   c. Oscillate the assembly (including inner race) 45 degrees in both directions, to ensure bearing is seated. Hold the bearing in place while it cools and contracts onto the rotor shaft.

   d. Refit the circlip (NDE only) into the main rotor shaft groove.

   e. Expand the grease flinger by heating to 110 °C in the induction heater.

   f. Slide the grease flinger over the rotor shaft and push it firmly against the bearing assembly. Hold the flinger in place while it cools and contracts onto the rotor shaft.

   g. Fit the wavy washer (NDE only).

   h. Wait for the bearing and cartridge assembly and flinger to cool to ambient temperature.

   i. Fit the bearing cap over the grease flinger and fix to the bearing cartridge.

9. Record bearing change on the Service Report.

18.11.2.4.5 Assemble Drive End

1. Attach suitable lifting equipment and slide the DE bracket onto the rotor shaft and locate over the DE bearing assembly.
2. Use a crane sling to lift the rotor and DE bracket at the drive end a small amount, to support the weight.
3. Refit the DE bracket onto the frame.
4. Refix the DE bearing cartridge to the DE bracket.
5. Refit the DE bearing cap.
6. Reconnect the grease pipe.
7. Reconnect the RTD sensor (if fitted).
8. Recouple the alternator to the prime mover.
9. Refit the DE air outlet screen and DE louvres.

18.11.2.4.6 Assemble Non-Drive End

NOTICE
Route the delicate exciter leads and temperature sensor leads carefully, and fix securely to the inside of the NDE bracket. Take care not to damage the leads when fitting the NDE bracket.

1. Fix the threaded guide studs into the NDE bearing cartridge.
2. Slide the NDE bracket onto the rotor shaft, guide onto the studs and locate over the NDE bearing assembly.
3. Use a crane sling to lift the rotor and NDE bracket a small amount, to support the weight.
4. Remove the rotor support packing piece(s).
5. Fix the NDE bracket to the frame.
6. Remove the guide studs.
7. Fix the NDE bearing cartridge to the NDE bracket.
8. Gently lower the crane sling to put the rotor weight onto the bearing and remove the sling.
9. Turn the rotor by hand to check bearing alignment and free rotation.
10. Refit the NDE bearing cap assembly.
11. Refit the PMG rotor and the PMG stator.
12. Reconnect the control cable plug.
13. Reconnect the grease pipe.
14. Reconnect the RTD sensor (if fitted).
15. Secure the heater and exciter stator leads inside the alternator with heat stabilised cable ties.
16. Secure the leads with cable ties to the main stator leads and reconnect to the AVR.
17. Refit the PMG cover and lower air inlet cover.
18. Refit terminal box side panel and lid.
19. Reconnect the supply to the anti-condensation heater (if fitted).

18.11.3 Controls

18.11.3.1 Introduction

An operating alternator is a harsh environment for control components. Heat and vibration can cause electrical connections to loosen and cables to fail. Routine inspection and test can identify an issue before it becomes a failure that incurs unplanned downtime.

18.11.3.2 Safety

⚠ DANGER
This method involves removing safety covers to expose potentially live electrical conductors. Risk of serious injury or death by electrocution. To prevent injury, isolate the generator set electrically and prevent accidental mechanical movement. Disconnect the prime mover engine battery. Use lock and tag safety procedures and prove that the generator set is isolated from all energy sources before starting work.

18.11.3.3 Requirements

Personal Protective Equipment (PPE)	Wear mandatory site PPE
Consumables	
Parts	
Tools	Multimeter
	Torque wrench

18.11.3.4 Inspect and Test

1. Remove the terminal box lid
2. Check the tightness of fasteners securing the load cables.
3. Check that cables are firmly clamped at the terminal box gland, and allow ±25 mm movement by an alternator on anti-vibration mounts.
4. Check that all cables are anchored and unstressed within the terminal box.
5. Check all cables for signs of damage.
6. Check that AVR accessories and current transformers are correctly fitted, and cables pass centrally through current transformers.
7. If an anti-condensation heater is fitted
   a. Isolate the supply and measure the electrical resistance of the heater element(s). Replace the heater element if open circuit.
   b. Test the supply voltage to the anti-condensation heater at the heater connection box. 120 V or 240 V a.c. (depending on cartridge option and shown on a label) should be present when the alternator is stopped.
8. Check that AVR and AVR accessories fitted in the terminal box are clean, securely fitted on anti-vibration mounts, and the cable connectors are firmly attached to the terminals.
9. For parallel operation, check that the synchronization control cables are securely connected.
10. Refit and secure the terminal box lid.

18.11.4 Cooling System

18.11.4.1 Introduction

Stamford alternators are designed to meet standards supporting EU Safety Directives, and are rated for the effect of operating temperature on winding insulation.

BS EN 60085 (≡ IEC 60085) Electrical insulation – Thermal Evaluation and Designation classifies insulation by the maximum operating temperature for a reasonable service life. Although chemical contamination and electrical and mechanical stresses also contribute, temperature is the dominant aging factor. Fan cooling maintains a stable operating temperature below the insulation class limit.

If the operating environment differs from the values shown on the rating plate, rated output must be reduced by

- 3% for class H insulation for every 5°C that the temperature of the ambient air entering the cooling fan exceeds 40 °C, up to a maximum of 60 °C
- 3% for every 500m increase in altitude above 1000m, up to 4000 m, due to the reduced thermal capacity of lower density air, and
- 5% if air filters are fitted, due to restricted air flow.

Efficient cooling depends on maintaining the condition of the cooling fan, air filters and gaskets.

18.11.4.2 Safety

⚠ DANGER
Safety screens must be removed to inspect the cooling fan. To prevent injury, isolate the generator set from all energy sources and remove stored energy. Use lock and tag safety procedures before starting work.

⚠ WARNING
External surfaces may be very hot. Exposed skin can suffer serious and permanent burns, depending on the temperature and contact time. Avoid contact or wear protective gloves.

⚠ CAUTION
Where fitted, air filters remove particles above 5 microns from the alternator cooling air inlet. High concentrations of these particles can be released when handling the filters, causing breathing difficulties and eye irritation. Wear effective respiratory and eye protection.

NOTICE
Do not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan. The fan is not designed to withstand such forces and will be damaged.

NOTICE
Filters are designed to remove dust, not moisture. Wet filter elements can cause reduced air flow and overheating. Do not allow filter elements to get wet.

18.11.4.3 Requirements

Personal Protective Equipment (PPE)	Wear mandatory site PPE
	Wear eye protection
	Wear respiratory protection
Consumables	Lint-free cleaning cloths
	Thin disposable gloves

Parts	Air filters (if fitted)
	Air filter sealing gaskets (if fitted)
Tools	

18.11.4.4 Inspect and Clean

1. Inspect the fan for damaged vanes and cracks.
2. Remove air filters (at the fan and terminal box, if fitted) from their frames.
3. Wash and dry the air filters and gaskets to remove contaminant particles.
4. Inspect the filters and gaskets for damage and replace, as necessary.
5. Install the filters and gaskets.
6. Reinstate the generator set for running.
7. Make sure the air inlets and outlets are not blocked.

18.11.5 Coupling

18.11.5.1 Introduction

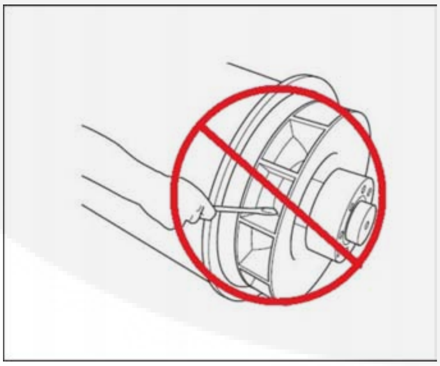
Efficient operation and long component life rely on minimizing mechanical stresses on the alternator. When coupled in a generator set, misalignment and vibration interactions with the prime mover engine can cause mechanical stress.

The rotational axes of alternator rotor and engine output shaft must be coaxial (radial and angular alignment).

Torsional vibration can cause damage to internal combustion engine shaft-driven systems, if not controlled. The generator set manufacturer is responsible for assessing the effect of torsional vibration on the alternator: Rotor dimensions and inertia, and coupling details are available on request.

18.11.5.2 Safety

NOTICE
Do not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan. The fan is not designed to withstand such forces and will be damaged.



18.11.5.3 Requirements

Personal Protective Equipment (PPE)	Wear mandatory site PPE

Consumables		
Parts		
Tools	Dial gauge	
	Torque wrench	

18.11.5.4 Inspect Mounting Points

1. Check the generator set bedplate and mounting pads are in good condition, not cracked
2. Check that rubber in anti-vibration mounts has not perished
3. Check vibration monitoring historical records for a trend of increasing vibration

18.11.5.4.1 Single Bearing Coupling

1. Remove the DE adapter screen and cover to access the coupling
2. Check that the coupling discs are not damaged, cracked or distorted, and the coupling disc holes are not elongated. If any are damaged, replace the complete set of discs.
3. Check tightness of bolts fixing the coupling discs to the engine flywheel. Tighten in the sequence shown for alternator coupling in the Installation chapter, to the torque recommended by the engine manufacturer.
4. Replace the DE adapter screen and drip proof cover.

18.11.6 Rectifier System

18.11.6.1 Introduction

The rectifier converts alternating current (a.c.) induced in the exciter rotor windings into direct current (d.c.) to magnetize the main rotor poles. The rectifier comprises two semicircular annular positive and negative plates, each with three diodes. In addition to connecting to the main rotor, the dc output of the rectifier also connects to a matched pair of varistors (one at each end of the plates). These additional components protect the rectifier from voltage spikes and surge voltages that may be present on the rotor under various loading conditions of the alternator.

Diodes provide a low resistance to current in one direction only: Positive current will flow from anode to cathode, or another way of viewing it is that negative current will flow from cathode to anode.

The exciter rotor windings are connected to 3 diode anodes to form the positive plate and to 3 diode cathodes to form the negative plate to give full wave rectification from a.c. to d.c. The rectifier is mounted on, and rotates with, the exciter rotor at the non-drive end (NDE).

18.11.6.2 Safety

⚠ DANGER
This method involves removing safety covers to expose live electrical conductors. Risk of serious injury or death by electrocution from contact with conductors.
This method involves removing safety screens to expose rotating parts. Risk of serious injury from entrapment. To prevent injury, isolate the generator set electrically and prevent mechanical movement.
Interlock the prime mover start system.
Use lock and tag safety procedures and prove that the generator set is isolated from all energy sources before starting work.

NOTICE
Do not tighten a diode above the stated torque. The diode will be damaged.

18.11.6.3 Requirements

Personal Protective Equipment (PPE)	Wear appropriate PPE.
Consumables	Loctite 241 thread locking adhesive
	Midland silicone heat sink compound type MS2623 or similar
Parts	Full set of three anode lead diodes and three cathode lead diodes (all from the same manufacturer)
	Two metal-oxide varistors (same type, same manufacturer, same voltage grading: A, B, C, D, E, F)
Tools	Multimeter
	Insulation Tester
	Torque wrench

18.11.6.4 Test and Replace Varistors

1. Inspect both varistors.
2. Record varistor as faulty if there are signs of overheating (discoloration, blisters, melting) or disintegration. Check for loose connectors vs. varistor body.
3. Disconnect one varistor lead. Store fastener and washers.
4. Measure the resistance across each varistor. Good varistors have a resistance greater than 100 MΩ.
5. Record varistor as faulty if the resistance is short circuit or open circuit in either direction.
6. If either varistor is faulty, replace both varistors with a matched pair (same type, same manufacturer and same voltage grading: A, B, C, D, E, F) and replace all diodes.
7. Reconnect and check that all leads are secure, washers fitted and fasteners tight.

18.11.6.5 Test and Replace Diodes

1. Disconnect the lead of one diode where it joins the windings at the insulated terminal post. Store fastener and washers.
2. Measure the voltage drop across the diode in the forward direction, using the diode test function of a multimeter.
3. Measure the resistance across the diode in the reverse direction, using the 1000 V d.c. test voltage of an insulation tester.
4. Diode is faulty if the voltage drop in the forward direction is outside the range 0.3 to 0.9 V, or the resistance is below 20 MΩ in the reverse direction.
5. Repeat the tests for the five remaining diodes.
6. If any diode is faulty, replace the full set of six diodes (same type, same manufacturer):
   a. Remove diode(s).
   b. Apply a small amount of heat sink compound **only** to the base of the replacement diode(s), not the threads.
   c. Check polarity of diode(s).

d. Screw each replacement diode into a threaded hole in the rectifier plate.

e. Apply 4.06 to 4.74 N m (36 to 42 lb in) torque to give good mechanical, electrical and thermal contact.

f. Replace both varistors with a matched pair (same type, same manufacturer and same voltage grading: A, B, C, D, E, F)

7. Reconnect and check that all leads are secure, washers fitted and fasteners tight.

18.11.7 Temperature Sensors

18.11.7.1 Introduction

Stamford alternators are designed to meet standards supporting EU Safety Directives, and recommended operating temperatures. Temperature sensors (where fitted) detect abnormal overheating of the main stator windings and bearing(s). Sensors are of two types - Resistance Temperature Detector (RTD) sensors, with three wires, and Positive Temperature Coefficient (PTC) thermistors, with two wires – which are connected to a terminal block in the auxiliary or main terminal box. The resistance of Platinum (PT100) RTD sensors increases linearly with temperature.

TABLE 17. RESISTANCE (Ω) OF PT100 SENSOR BETWEEN 40 TO 180 °C

Temperature (°C)		+1 °C	+ 2 °C	+3 °C	+ 4 °C	+ 5 °C	+ 6 °C	+ 7 °C	+ 8 °C	+ 9 °C
40.00	115.54	115.93	116.31	116.70	117.08	117.47	117.86	118.24	118.63	119.01
50.00	119.40	119.78	120.17	120.55	120.94	121.32	121.71	122.09	122.47	122.86
60.00	123.24	123.63	124.01	124.39	124.78	125.16	125.54	125.93	126.31	126.69
70.00	127.08	127.46	127.84	128.22	128.61	128.99	129.37	129.75	130.13	130.52
80.00	130.90	131.28	131.66	132.04	132.42	132.80	133.18	133.57	133.95	134.33
90.00	134.71	135.09	135.47	135.85	136.23	136.61	136.99	137.37	137.75	138.13
100.00	138.51	138.88	139.26	139.64	140.02	140.40	140.78	141.16	141.54	141.91
110.00	142.29	142.67	143.05	143.43	143.80	144.18	144.56	144.94	145.31	145.69
120.00	146.07	146.44	146.82	147.20	147.57	147.95	148.33	148.70	149.08	149.46
130.00	149.83	150.21	150.58	150.96	151.33	151.71	152.08	152.46	152.83	153.21
140.00	153.58	153.96	154.33	154.71	155.08	155.46	155.83	156.20	156.58	156.95
150.00	157.33	157.70	158.07	158.45	158.82	159.19	159.56	159.94	160.31	160.68
160.00	161.05	161.43	161.80	162.17	162.54	162.91	163.29	163.66	164.03	164.40
170.00	164.77	165.14	165.51	165.89	166.26	166.63	167.00	167.37	167.74	168.11
180.00	168.48									

PTC thermistors are characterised by a sudden increase in resistance at a reference “switching” temperature. Customer-supplied external equipment may be connected to monitor the sensors and generate signals to raise an alarm and to shutdown the generator set.

BS EN 60085 (≡ IEC 60085) Electrical insulation – Thermal Evaluation and Designation classifies insulation of windings by the maximum operating temperature for a reasonable service life. To avoid damage to windings, signals should be set, appropriate to the insulation class shown on the alternator rating plate.

TABLE 18. ALARM AND SHUTDOWN TEMPERATURE SETTINGS FOR WINDINGS

Windings insulation	Max. Continuous temperature (°C)	Alarm temperature (°C)	Shutdown temperature (°C)
Class B	130	120	140
Class F	155	145	165
Class H	180	170	190

To detect overheating of bearings, control signals should be set according to the following table.

TABLE 19. ALARM AND SHUTDOWN TEMPERATURE SETTINGS FOR BEARINGS

Bearings	Alarm temperature (°C)	Shutdown temperature (°C)
Drive end bearing	45 + maximum ambient	50 + maximum ambient
Non-drive end bearing	40 + maximum ambient	45 + maximum ambient

18.11.7.2 Safety

⚠ DANGER

The main terminal box cover must be removed to test temperature sensors. Risk of serious injury or death by electrocution from contact with live electrical conductors. To avoid injury; isolate the generator set from all energy sources and remove stored energy. Use lock and tag safety procedures before starting work.

⚠ WARNING

External surfaces may be very hot. Exposed skin can suffer serious and permanent burns, depending on the temperature and contact time. Avoid contact or wear protective gloves.

18.11.7.3 Test RTD Temperature Sensors

1. Remove the terminal box lid.
2. Identify the sensor leads at the terminal block and where each sensor is fitted
3. Measure the resistance between the white and each red wire of one sensor
4. Calculate the sensor temperature from the measured resistance
5. Compare calculated temperature with temperature indicated by external monitoring equipment (if available)
6. Compare alarm and shutdown signal settings (if available) with recommended settings
7. Repeat steps 3 to 7 for each sensor
8. Refit the terminal box lid.
9. Contact Cummins Customer Service Help Desk to replace faulty sensors.

18.11.7.4 Test PTC Temperature Sensors

1. Remove the auxiliary terminal box lid.
2. Identify the sensor leads at the terminal block and where each sensor is fitted.
3. Measure the resistance between the two wires.
4. Sensor is faulty if resistance shows open circuit (infinity Ω) or short circuit (zero Ω).

5. Repeat steps 3 to 5 for each sensor.
6. Stop the alternator and inspect the change in resistance as the stator winding cools.
7. Sensor is faulty if resistance does not change or change is not smooth.
8. Repeat step 8 for each sensor.
9. Refit the auxilliary terminal box lid.
10. Contact Cummins Customer Service Help Desk to replace faulty sensors.

18.11.8 Windings

18.11.8.1 Safety

⚠ DANGER
Safety guards must be removed to test windings. To prevent injury, isolate the generator set from all energy sources and remove stored energy. Use lock and tag safety procedures before starting work.

⚠ WARNING
The winding keeps an electrical charge after the insulation resistance test. Risk of electric shock if the winding leads are touched. After each test, ground the winding to earth with an earth rod for five minutes to remove the charge.

NOTICE
The Automatic Voltage Regulator (AVR) contains electronic components which would be damaged by high voltage applied during insulation resistance tests. The AVR must be disconnected before doing any insulation resistance test. Temperature sensors must be grounded to earth before doing any insulation resistance test. **Damp or dirty windings have a lower electrical resistance and could be damaged by insulation resistance tests at high voltage. If in doubt, test the resistance at low voltage (500 V) first**

18.11.8.2 Requirements

Personal Protective Equipment (PPE)	Wear mandatory site PPE
Consumables	
Parts	
Tools	Insulation Test Meter
	Multimeter
	Milliohm Meter or Micro Ohmmeter
	Clamp Ammeter
	Infrared thermometer

18.11.8.3 Test the Insulation Resistance of Windings

TABLE 20. TEST VOLTAGE AND MINIMUM ACCEPTABLE INSULATION RESISTANCE FOR NEW AND IN-SERVICE ALTERNATORS

	Test Voltage (V)	Minimum Insulation Resistance at 1 minute (MΩ)	
		New	In-service
Main stator	500	10	5
PMG stator	500	5	3
Exciter stator	500	10	5
Exciter rotor, rectifier & main rotor combined	500	10	5

1. Inspect the windings for mechanical damage or discoloration from overheating. Clean the insulation if there is hygroscopic dust and dirt contamination.
2. For main stators:
   a. Disconnect the neutral to earth conductor (if fitted).
   b. Connect together the three leads of all phase windings (if possible).
   c. Apply the test voltage from the table between any phase lead and earth.
   d. Measure the insulation resistance after 1 minute (IR_{1min}).
   e. Discharge the test voltage with an earth rod for five minutes.
   f. If the measured insulation resistance is less than the minimum acceptable value, dry the insulation, then repeat the method.
   g. Reconnect neutral to earth conductor (if fitted).
3. For PMG and exciter stators, and combined exciter and main rotors:
   a. Connect together both ends of the winding (if possible).
   b. Apply the test voltage from the table between the winding and earth.
   c. Measure the insulation resistance after 1 minute (IR_{1min}).
   d. Discharge the test voltage with an earth rod for five minutes.
   e. If the measured insulation resistance is less than the minimum acceptable value, dry the insulation, then repeat the method.
   f. Repeat the method for each winding.
   g. Remove the connections made for testing.

18.11.8.4 Dry the Insulation

Use the methods below to dry the insulation of the main stator windings. To prevent damage as water vapor is expelled from the insulation, make sure the winding temperature does not increase faster than 5 ºC per hour or exceed 90 ºC.

Plot the insulation resistance graph to show when drying is complete.

18.11.8.4.1 Dry with Ambient Air

In many cases, the alternator can be dried sufficiently using its own cooling system. Disconnect the cables from the X+ (F1) and XX- (F2) terminals of the AVR so there is no excitation voltage supply to the exciter stator. Run the generator set in this de-excited state. Air must flow freely through the alternator to remove the moisture. Operate the anti-condensation heater (if fitted) to assist the drying effect of the air flow.

After drying is complete, re-connect the cables between the exciter stator and AVR. If the generator set is not put into service immediately, turn on the anti-condensation heater (if fitted) and retest the insulation resistance before use.

18.11.8.4.2 Dry with Hot Air

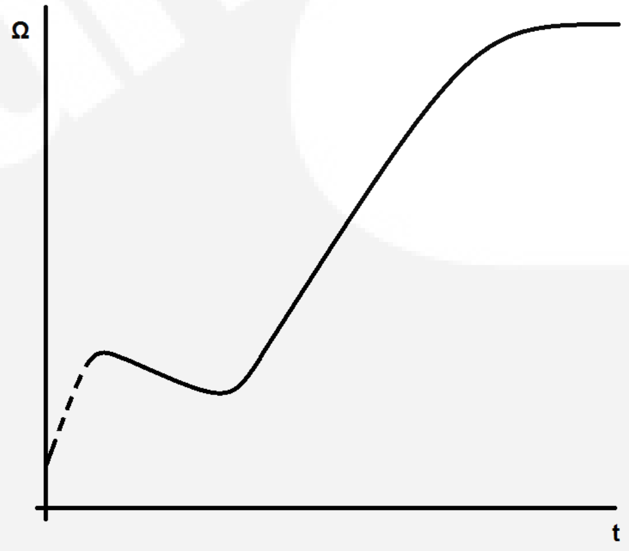
Direct the hot air from one or two 1 to 3 kW electrical fan heaters into the alternator air inlet. Make sure each heat source at least 300mm away from the windings to avoid scorching or over-heating damage to the insulation. Air must flow freely through the alternator to remove the moisture.

After drying, remove the fan heaters and re-commission as appropriate.

If the generator set is not put into service immediately, turn on the anti-condensation heaters (where fitted) and retest the insulation resistance before use.

18.11.8.4.3 Plot IR Graph

Whichever method is used to dry out the alternator, measure the insulation resistance and temperature (if sensors fitted) of the main stator windings every 15 to 30 minutes. Plot a graph of insulation resistance, IR (y axis) against time, t (x axis).



A typical curve shows an initial increase in resistance, a fall and then a gradual rise to a steady state; if the windings are only slightly damp the dotted portion of the curve may not appear. Continue drying for another hour after steady state is reached.

NOTICE
The alternator must not be put into service until the minimum insulation resistance is achieved.

18.11.8.5 Clean the Insulation

Remove the main rotor to gain access to the main stator windings to remove dirt contamination. Use clean warm water without detergents. Methods to remove and assemble the drive end (DE) and non-drive end (NDE) support are given in the Replace Bearing section of Service and Maintenance chapter.

18.11.8.5.1 Remove Main Rotor

NOTICE

The rotor is heavy, with a small clearance to the stator. Windings will be damaged if the rotor drops or swings in the crane sling and hits the stator or frame. To avoid damage, fit support packing and carefully guide the rotor ends throughout. Do not allow the sling to touch the fan.

NOTICE

To remove the main rotor safely and easily, use the following special tools: a rotor extension stub shaft, a rotor extension tube (of similar length to the rotor shaft) and a height-adjustable V roller extension tube support. Refer to the factory for the availability and specification of these tools.

1. Remove non-drive end bracket, see **Remove Non-Drive End** section.
2. For a two bearing alternator, remove drive end bracket, see **Remove Drive End** section.
3. For a one bearing alternator, remove drive end adapter as follows:
   a. Disconnect the alternator from the prime mover.
   b. Remove the DE adapter.
4. Fix the rotor shaft extension stub shaft to the main rotor at the non-drive end.
5. Fix the extension tube to the stub shaft.
6. Position the V roller support underneath the shaft extension tube, close to the alternator frame.
7. Raise the V roller support to lift the extension tube a small amount, to support the weight of the main rotor at the non-drive end.
8. Use a crane sling to lift the rotor at the drive end a small amount, to support its weight.
9. Carefully move the crane sling away so that the rotor withdraws from the alternator frame, as the extension tube rolls on the V rollers, until the rotor windings are fully visible.
10. Support the rotor on wooden blocks to prevent it rolling and damaging the windings.
11. Tightly bind the crane sling near the middle of the main rotor windings, near the rotor center of gravity.
12. Use a crane sling to lift the rotor a small amount, to test the rotor weight is balanced. Adjust the crane sling as necessary.
13. Carefully move the crane sling away so that the rotor withdraws completely from the alternator frame.
14. Lower the rotor onto wooden block supports and prevent it rolling and damaging the windings.
15. Remove the extension tube and stub shaft, as necessary.

16. Mark the position of the sling (to assist re-assembly) and remove the crane sling, as necessary.

18.11.8.5.2 Install Main Rotor

NOTICE
The rotor is heavy, with a small clearance to the stator. Windings will be damaged if the rotor drops or swings in the crane sling and hits the stator or frame. To avoid damage, fit support packing between the rotor and stator and carefully guide the rotor ends throughout. Do not allow the sling to touch the fan.

NOTICE
To install the main rotor safely and easily, use the following special tools: a rotor extension stub shaft, a rotor extension tube (of similar length to the rotor shaft) and a height-adjustable V roller extension tube support. Refer to the factory for the availability and specification of these tools.

1. Fix the rotor shaft extension stub shaft to the main rotor at the non-drive end (or to the NDE bearing cartridge on some alternator models).
2. Fix the extension tube to the stub shaft.
3. Tightly bind the crane sling near the middle of the main rotor windings near the rotor center of gravity.
4. Use a crane sling to lift the rotor a small amount, to test the rotor weight is balanced. Adjust the crane sling as necessary.
5. Position the V roller support at the non-drive end, close to the alternator frame.
6. Carefully use the crane sling to insert the rotor into the alternator frame, extension tube first.
7. Guide the extension tube onto the V roller support. Adjust the height of the V roller support as necessary.
8. Insert the rotor into the alternator frame, until the crane sling meets the frame.
9. Lower the rotor onto wooden blocks to prevent it rolling and damaging the windings.
10. Reposition the crane sling at the drive end of the rotor shaft.
11. Use the crane sling to lift the rotor at the drive end a small amount, to support its weight.
12. Carefully move the crane sling towards the alternator frame, as the extension tube rolls on the V rollers, until the rotor windings are fully inserted.
13. Gently lower the crane sling to put the rotor weight onto the support packing and remove the sling.
14. For a two bearing alternator, refit drive end bracket, see **Assemble Drive End** section.
15. For a one bearing alternator, assemble the drive end as follows:
    a. Refit the DE adapter
    b. Couple the alternator to the prime mover.
    c. Refit the upper and lower air outlet screen covers.
16. Refit the non-drive end bracket, see **Assemble Non-Drive End** section.
17. Remove the rotor shaft extension tube.

18. Remove the rotor shaft extension stub shaft.
19. Remove the V roller support.

18.11.9 Parts Identification

18.11.9.1 Generator Parts Identification

For specific parts identification, refer to the alternator Parts Manual listed in **Chapter 2 on page 11**.

19 Manufacturing Facilities

NORTH AMERICA	EMEA, CIS	ASIA PACIFIC
Cummins Power Generation Limited 1400 73rd Ave. NE Minneapolis, MN 55432 USA	Cummins Power Generation Limited Columbus Avenue Manston Park Manston, Ramsgate Kent CT12 5BF United Kingdom	Cummins Power Generation Limited 10 Toh Guan Road #07-01 TT International Tradepark Singapore 608838
Phone +1 763 574 5000 Toll Free +1 800 888 6626 Fax +1 763 574 5298	Phone +44 1843 255000 Fax +44 1843 255902	Phone +65 6417 2388 Fax +65 6417 2399
BRAZIL	**CHINA**	**INDIA**
Rua Jati, 310, Cumbica Guarulhos, SP 07180-900 Brazil	Cummins Power Generation 2 Rongchang East Street, Beijing Economic – Technological Development Area Beijing 100176, P.R.China	35A/1/2, Erandawana Pune 411 038 India
Phone +55 11 2186 4195 Fax +55 11 2186 4729	Phone +86 10 5902 3000 Fax +86 10 5902 3199	Phone +91 020 6602 7525 Fax +91 020 6602 8090
LATIN AMERICA	**MEXICO**	
3350 Southwest 148th Ave. Suite 205 Miramar, FL 33027 USA	Eje 122 No. 200 Zona Industrial San Luis Potosi, S.L.P. 78395 Mexico	
Phone +1 954 431 551 Fax +1 954 433 5797	Phone +52 444 870 6700 Fax +52 444 824 0082	

19.1 How to Obtain Service

When a product requires servicing, contact your nearest Cummins Power Generation distributor. To locate your local Cummins Power Generation distributor, refer to www.cumminspower.com and select Distributor Locator. When contacting your distributor, always supply the complete model, specification, and serial number as shown on the nameplate.

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Appendix A. Wiring Diagrams

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The drawings included in this section are representative. For current complete information, refer to the drawing package that was shipped with the unit.

A.1 VTA28-G5 Wiring Diagram with PowerCommand 1.1 Control

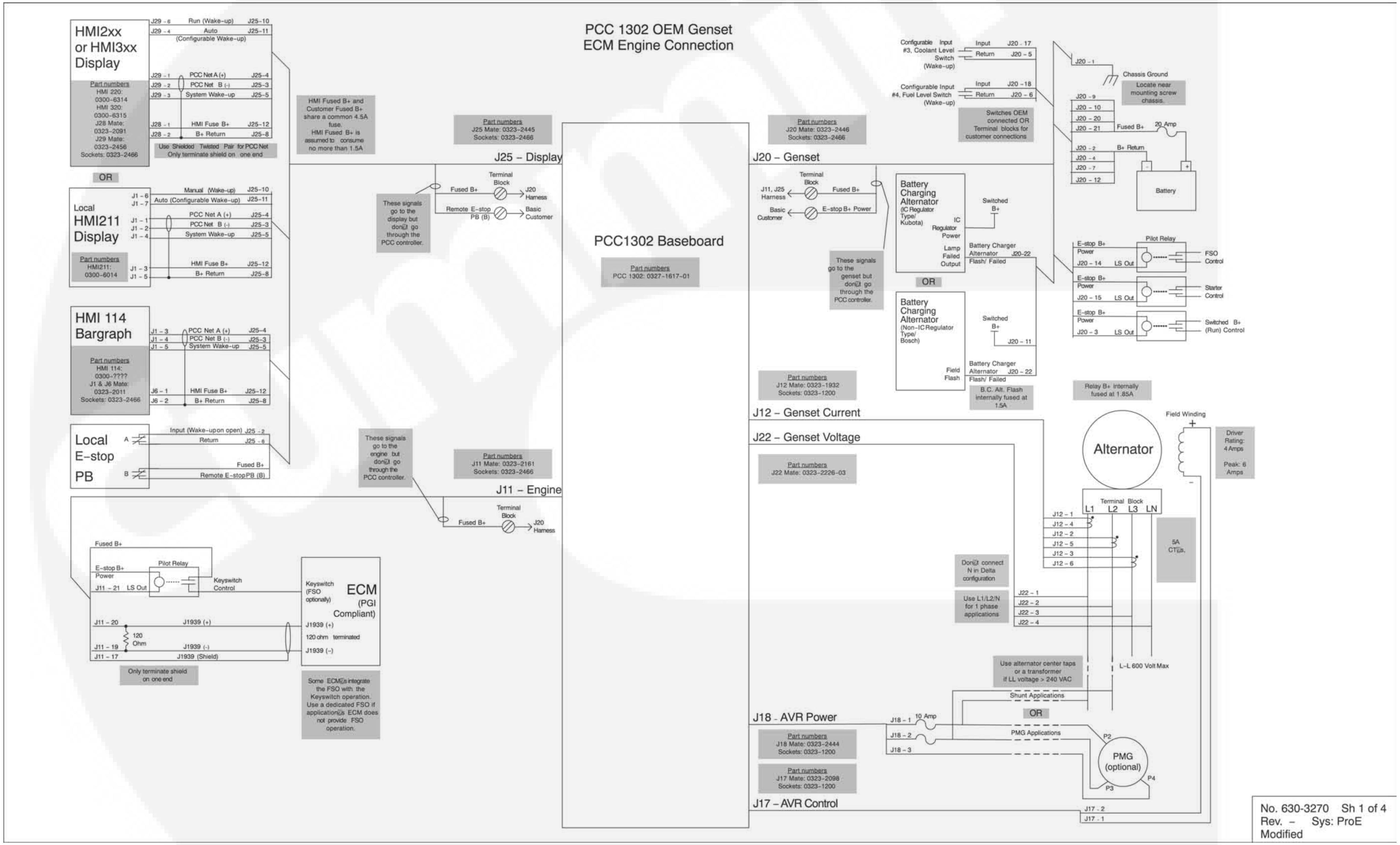

FIGURE 16. SHEET 1 OF 4

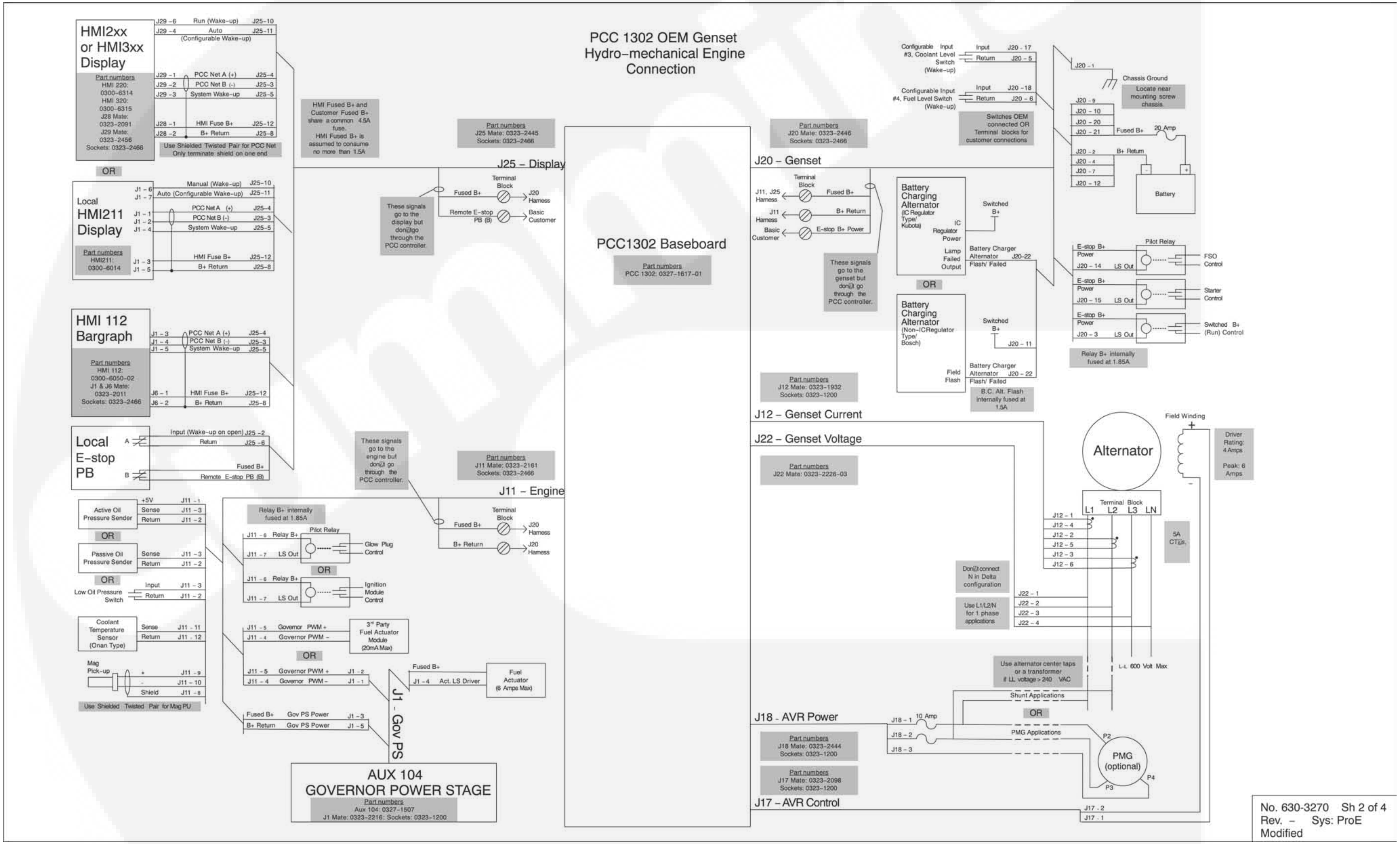

FIGURE 17. SHEET 2 OF 4

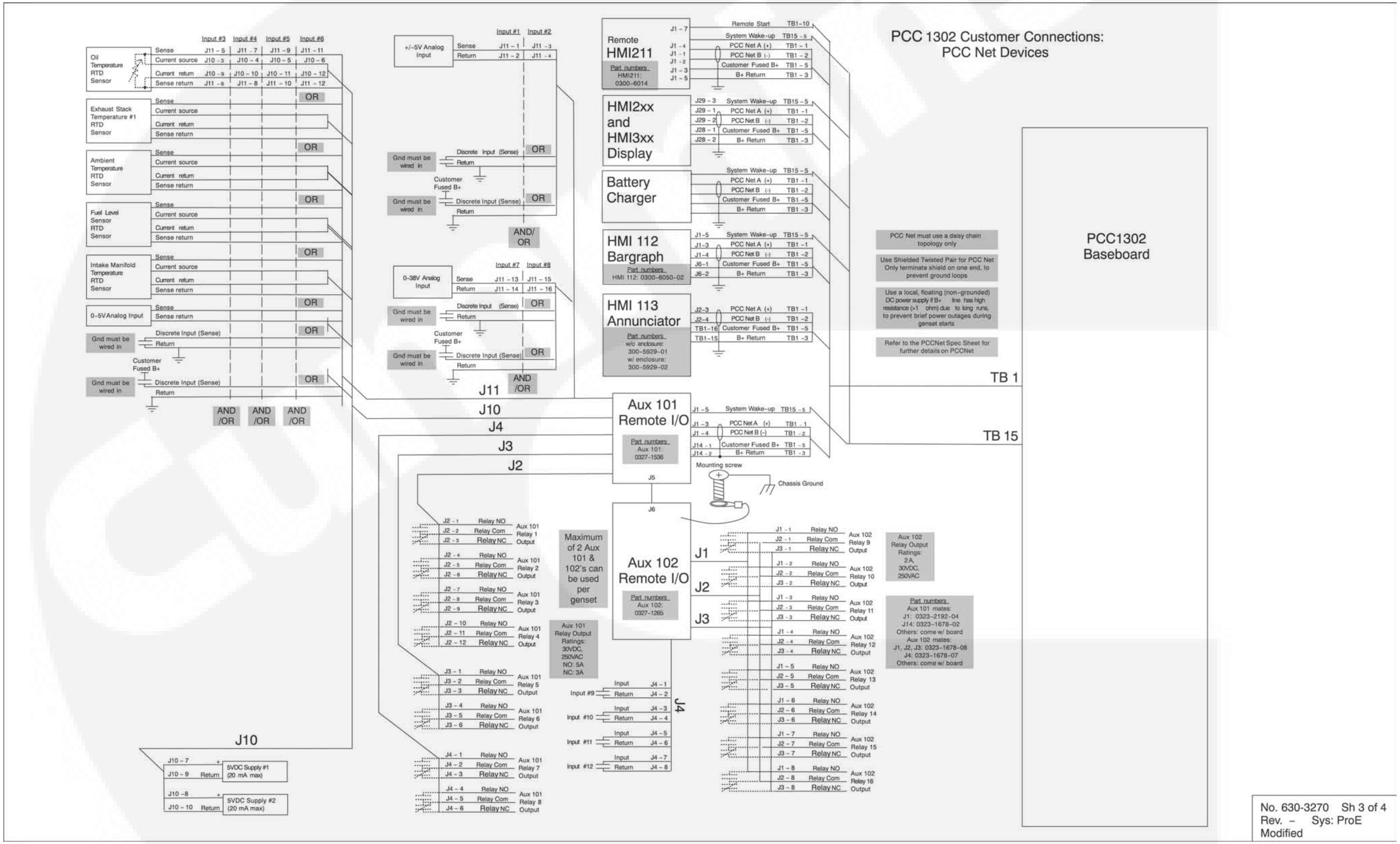

FIGURE 18. SHEET 3 OF 4

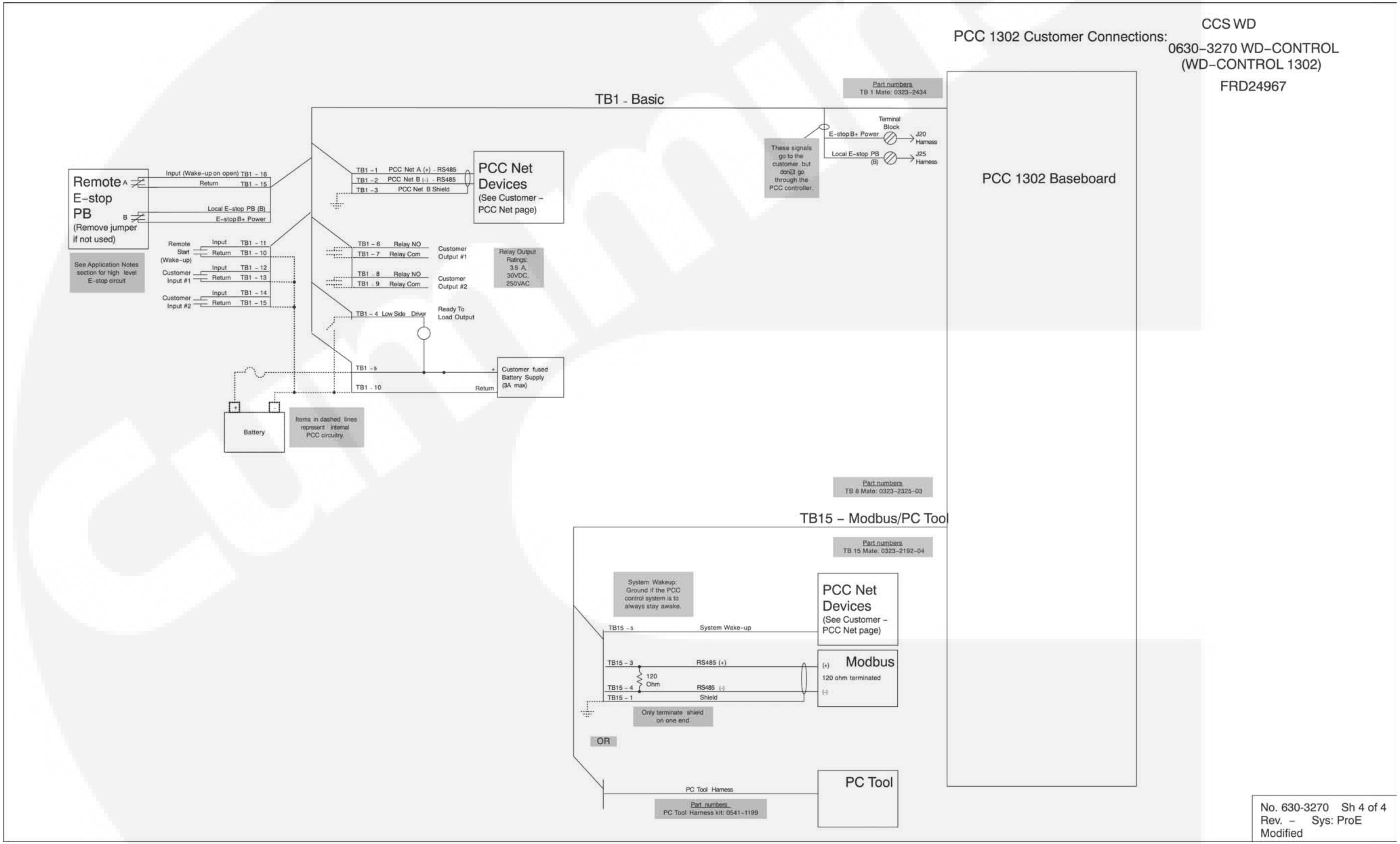

FIGURE 19. SHEET 4 0F 4

Appendix B. Alternator Reconnect Drawing

Table of Contents

The drawings included in this section are representative. For current complete information, refer to the drawing package that was shipped with the unit.

B.1 XE7200 Reconnect

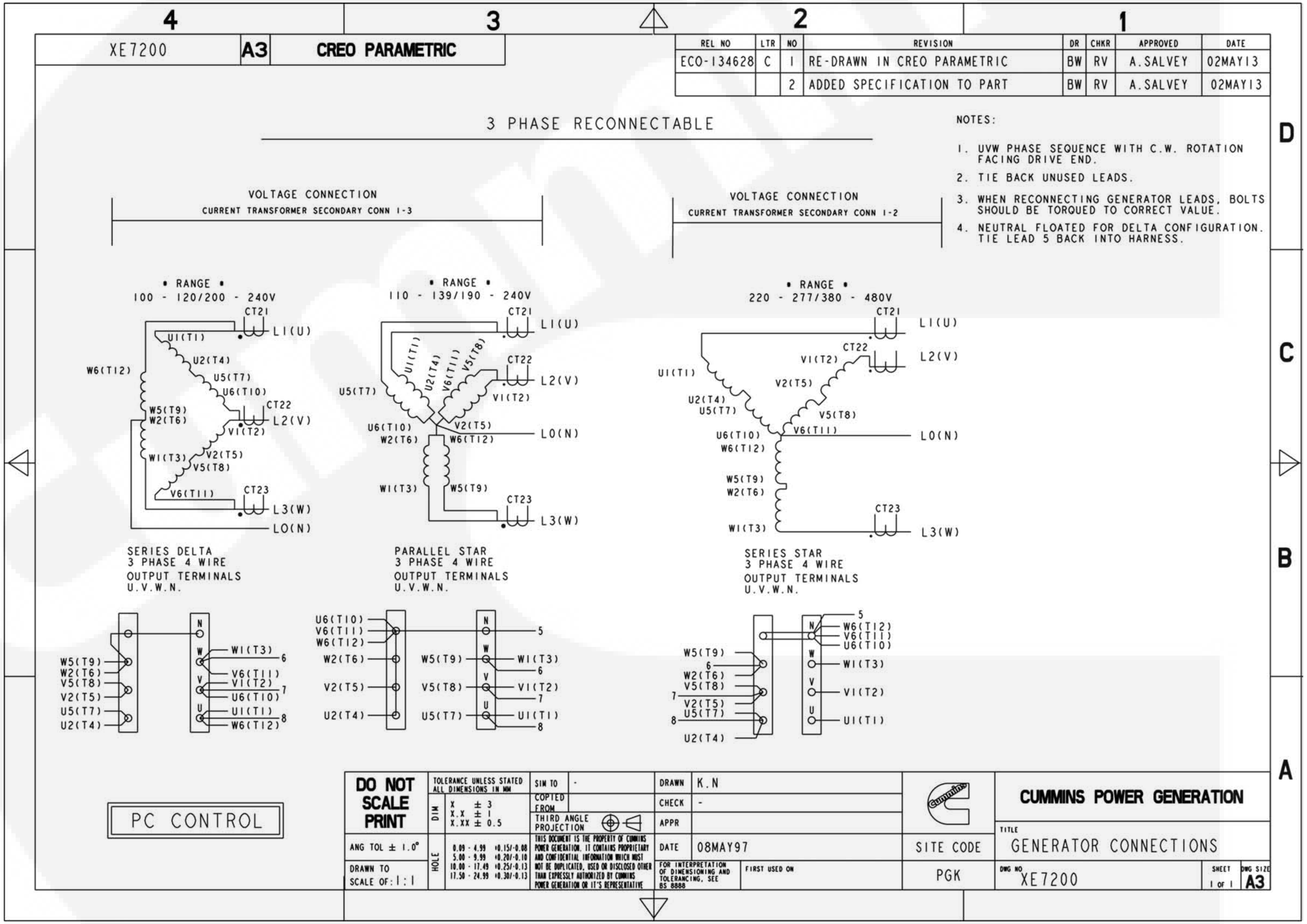

FIGURE 20. SHEET 1 OF 1

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Appendix C. Outline Drawings

Table of Contents

The drawings included in this section are representative. For current complete information, refer to the drawing package that was shipped with the unit.

C.1 VTA28-G5 Outline Drawing

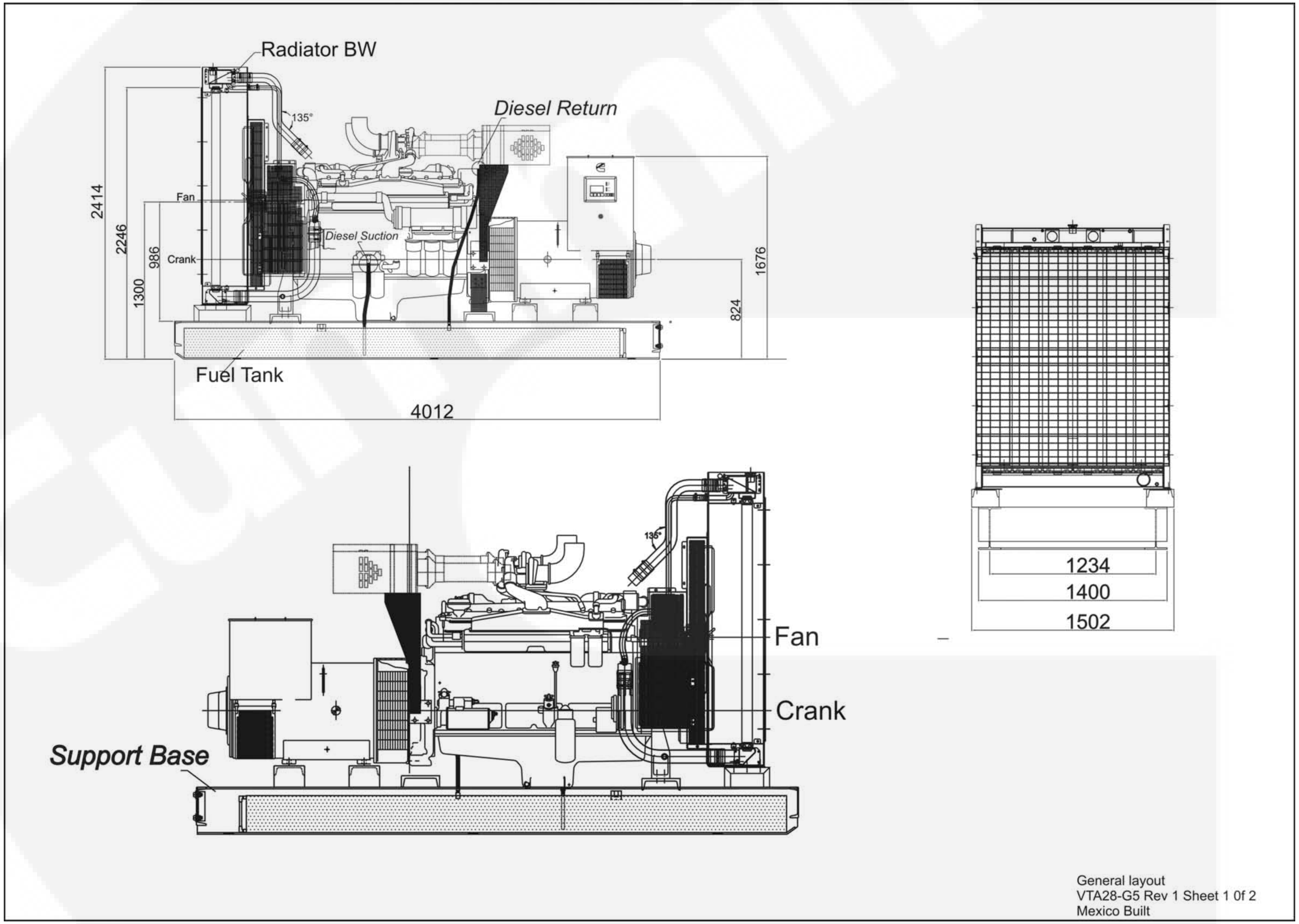

FIGURE 21. GENERATOR SET SHEET 1 OF 2

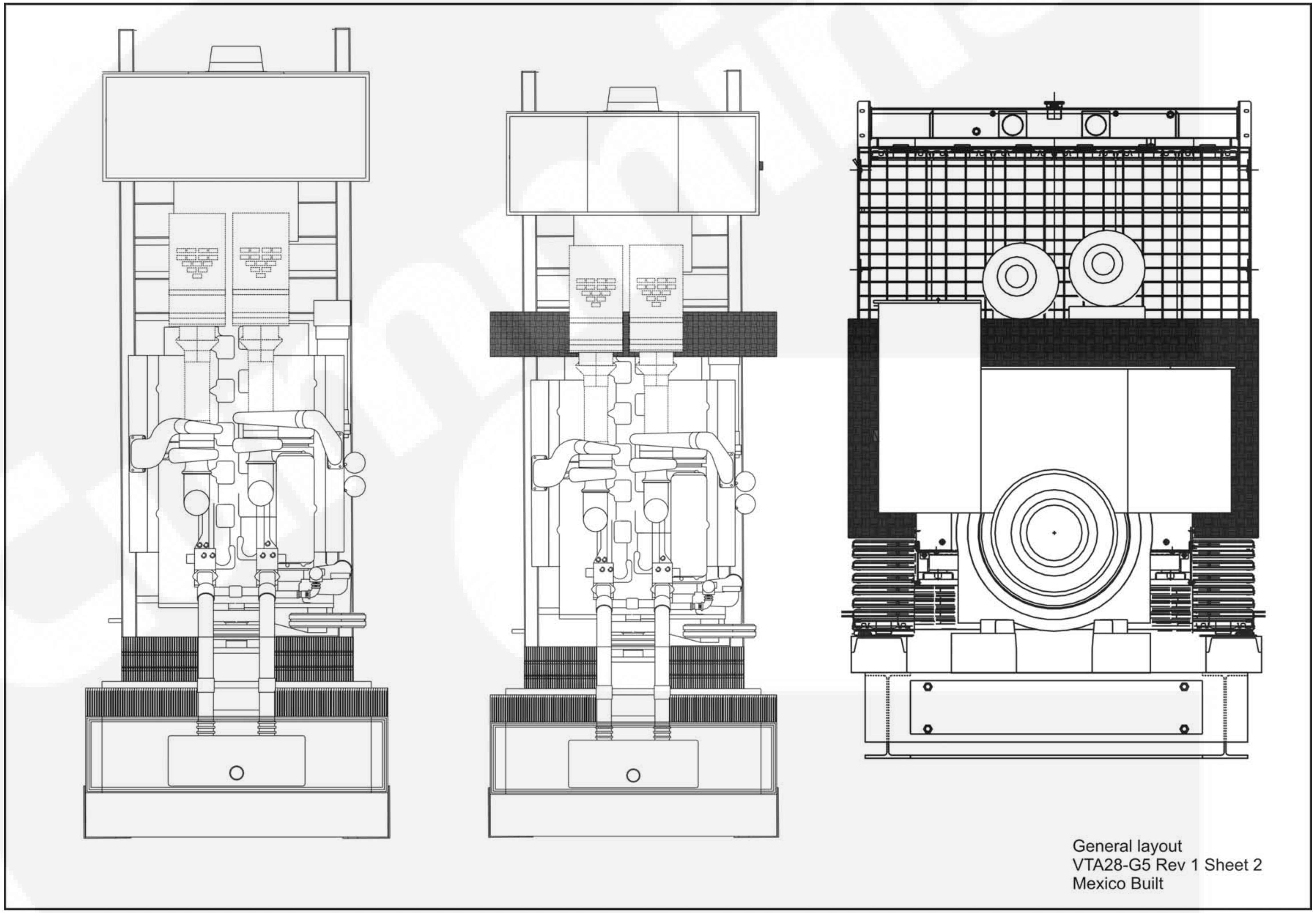

FIGURE 22. GENERATOR SET SHEET 2 OF 2

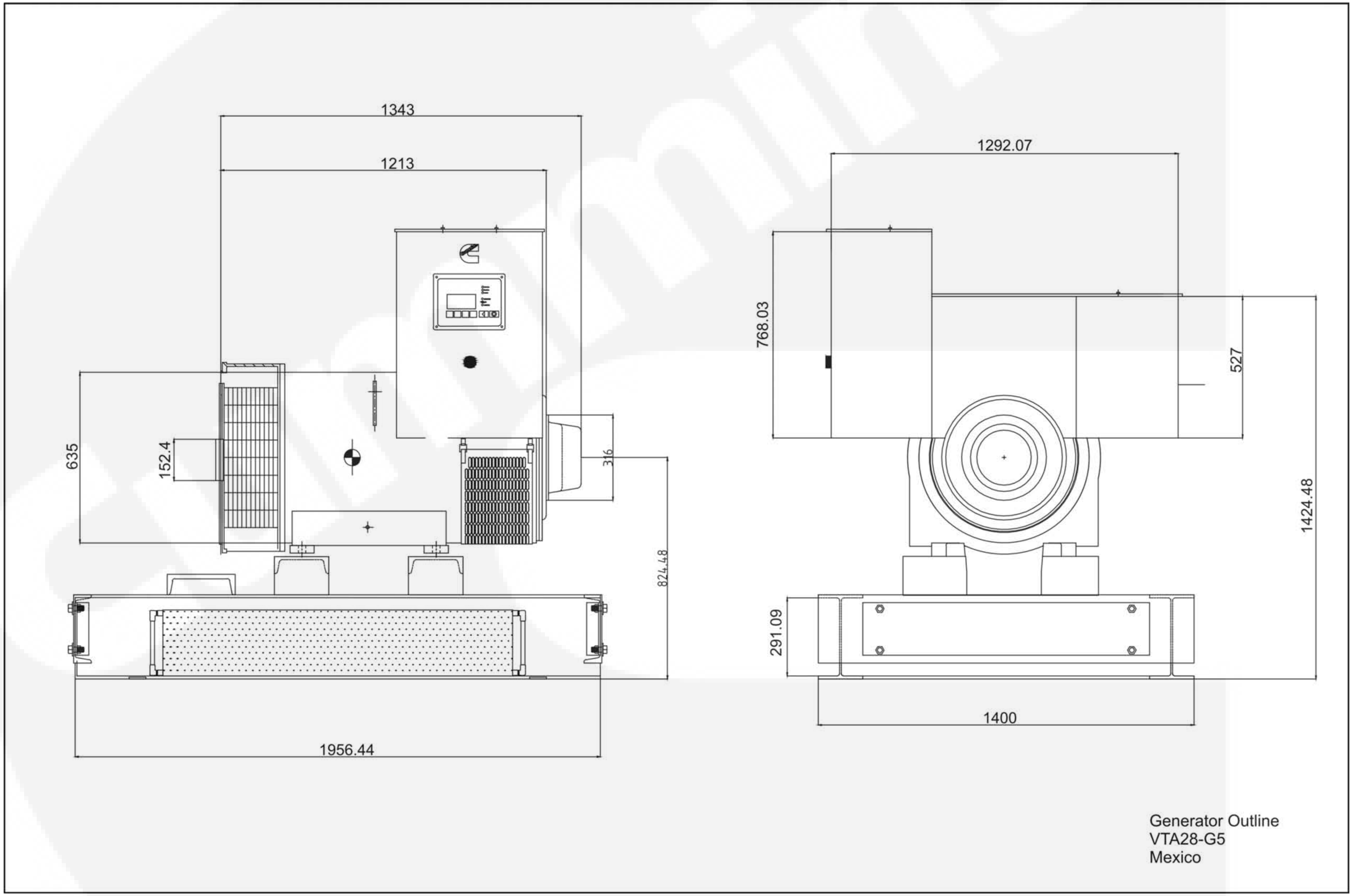

FIGURE 23. GENERATOR OUTLINE

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