



Service Manual

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**Power
Generation**

Controller

PowerCommand 3.3

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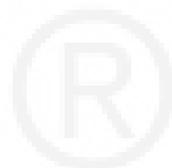
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1 Important Safety Instructions

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

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: Warns of a hazard that will result in severe personal injury or death.



WARNING: Warns of a hazard that may result in severe personal injury or death.



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



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

1.2 General Information

This manual should form part of the documentation package supplied by Cummins Power Generation with specific generator sets. In the event that this manual has been supplied in isolation please contact your authorized distributor.



NOTE: It is in the Operator's interest to read and understand all Warnings and Cautions contained within the documentation relevant to the generator set, its operation and daily maintenance.

1.2.1 General Safety Precautions



WARNING: Coolants under pressure have a higher boiling point than water. **DO NOT** open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first. To prevent severe scalding, 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: Benzene and lead, found in some fuels, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline (if applicable to your product), take care not to ingest, breathe the fumes, or contact gasoline.



WARNING: Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.



NOTE: 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. (ref. NFPA No. 10)



CAUTION: Make sure that rags are not left on or near the engine.



CAUTION: Make sure the generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.



CAUTION: Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.



CAUTION: 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.



WARNING: Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.



WARNING: Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breathe, ingest, or come into contact with exhaust gases.



WARNING: Do not store any flammable liquids, such as fuel, cleaners, oil, etc., near the generator set. A fire or explosion could result.



WARNING: Wear hearing protection when going near an operating generator set.



WARNING: To prevent serious burns, avoid contact with hot metal parts such as the radiator, the turbo charger, and the exhaust system.



WARNING: Use personal protective equipment when maintaining or installing the generator set. Examples of personal protective equipment include but are not limited to: safety glasses, protective gloves, hard hats, steel-toed boots, and protective clothing.



WARNING: Do not use starting fluids that evaporate. They are highly explosive.



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



CAUTION: To prevent accidental or remote starting while working on the generator set, disconnect the negative (-) battery cable at the battery.



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



WARNING: Moving parts can cause severe personal injury or death. Hot exhaust parts can cause severe burns. Make sure all protective guards are properly in place before starting the generator set.

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 must only be carried out using suitable lifting equipment, shackles, and spreader bars, in accordance with local guidelines and legislation, by suitably trained and experienced personnel. Incorrect lifting can result in severe personal injury, death and/or equipment damage. For more information, contact your 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, 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

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.



CAUTION: *On an enclosed generator set, the canopy doors must be locked before re-positioning and they must remain locked during transportation and sitting.*

1.3.3 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.

1.4 Electrical Shock Can Cause Severe Personal Injury Or Death

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment. Do not wear jewelry. Jewelry can short out electrical contacts and cause shock or burning.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.

- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag and lock open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

1.4.1 AC Supply and Isolation

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.



NOTE: Local local electrical codes and regulations (for example BS EN 12601:2001) 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.



NOTE: 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).

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.

1.4.2 Medium Voltage Equipment (601 V to 15 kV)

- Medium voltage acts differently than low voltage. Special equipment and training is required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and experienced to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Due to the nature of medium voltage electrical equipment, induced voltage remains even after the equipment is disconnected from the power source. Plan the time for maintenance with authorized personnel so that the equipment can be de-energized and safely grounded.

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 Gaseous Fuels

- Natural gas is lighter than air, and will tend to gather under hoods. Propane is heavier than air, and will tend to gather in sumps or low areas. NFPA code requires all persons handling propane to be trained and qualified.

1.5.2 Spillage

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

1.5.3 Fluid Containment

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.



NOTE: *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/sources.*

1.5.4 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 by fuel spill, leak, etc., 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 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.



WARNING: *Engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.*

1.6.1 Exhaust Precautions



WARNING: *Exhaust pipes and charge air pipes are very hot and they can cause severe personal injury or death from direct contact or from fire hazard.*



WARNING: Hot exhaust gas can cause burns resulting in severe personal injury.

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.



WARNING: Inhalation of exhaust gases can result in serious personal injury or death. Be sure deadly exhaust gas is piped outside and away from windows, doors, or other inlets to buildings. Do not allow to accumulate in habitable areas.

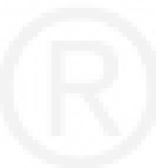


WARNING: Contaminated insulation is a fire risk which can result in severe personal injury.

The exhaust pipes may have some insulating covers fitted. If these covers become contaminated by fuel or oil, 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 topping off the oil or draining the fuel filters.
- Clean the exhaust pipe thoroughly.



2 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 and InPower are trademarks of Cummins Inc. PowerCommand is a registered trademark of Cummins Inc.

ACRONYM	DESCRIPTION	ACRONYM	DESCRIPTION
AC	Alternating Current	LED	Light-emitting Diode
AMP	AMP, Inc., part of Tyco Electronics	Mil Std	Military Standard
ASTM	American Society for Testing and Materials (ASTM International)	MMHG	Millimeters of Mercury
ATS	Automatic Transfer Switch	NC	Not Connected
AVR	Automatic Voltage Regulator	NC	Normally Closed
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	PSI	Pounds per square inch
DC	Direct Current	PB	Push Button
ECM	Engine Control Module	PC	Personal Computer
ECS	Engine Control System	PCC	PowerCommand® Control
EMI	Electromagnetic interference	PGI	Power Generation Interface
EN	European Standard	PGN	Parameter Group Number
EPS	Engine Protection System	PI	Proportional/Integral
E-Stop	Emergency Stop	PID	Proportional/Integral/Derivative
FAE	Full Authority Electronic	PLC	Programmable Logic Controller
FMI	Failure Mode Identifier	PMG	Permanent Magnet Generator
FSO	Fuel Shutoff	PT	Potential Transformer
Genset	Generator Set	PTC	Power Transfer Control
GCP	Generator Control Panel	PWM	Pulse-width Modulation
GND	Ground	RFI	Radio Frequency Interference
HMI	Human-machine Interface	RH	Relative Humidity
IC	Integrated Circuit	RMS	Root Mean Square
INHG	Inches of Mercury	RTU	Remote Terminal Unit
ISO	International Organization for Standardization	SAE	Society of Automotive Engineers

ACRONYM	DESCRIPTION	ACRONYM	DESCRIPTION
kPA	kilo-Pascal	SPN	Suspect Parameter Number
LBNG	Lean-burn Natural Gas	SW_B+	Switched B+
LCD	Liquid Crystal Display	UL	Underwriters Laboratories
LCL	Low Coolant Level	UPS	Uninterruptible Power Supply
LCT	Low Coolant Temperature		

3 Glossary

Term	Definition
Accessory Part	A part comes standard with the product. An accessory is optional and provides additional interfaces or functionality.
Active Inactive	General terms to describe the states for inputs, signals, or outputs that have only two states (like true/false or 1/0). For example, a low coolant level switch is either on (active) or off (inactive). The Ready to Load output is either on (active) or off (inactive). Usually, the expected state is inactive. For events/faults, this term describes the time the PCC generates the event/fault through the time the event/fault is cleared.
Active-closed Active-open	Some inputs and outputs use resistance to distinguish between active and inactive. If an input or output is active-closed, the input or output is active if there is no resistance between two pins. If an input or output is active-open, the input or output is active if there is infinite resistance between two pins.
Active-high Active-low	Some inputs and outputs use voltage differential to distinguish between active and inactive. If an input or output is active-high, a high voltage differential means the input or output is active, and a low voltage differential means the input or output is inactive. If an input or output is active-low, a low voltage differential means the input or output is active, and a high voltage differential means the input or output is inactive.
Configurable analog input Configurable input	"Configurable input" refers to discrete inputs (for example, open or closed). "Configurable analog input" refers to analog inputs (for example, 0-5 VDC).
Configurable analog output Configurable output	"Configurable output" refers to discrete outputs (for example, open or closed). "Configurable analog output" refers to analog outputs (for example, 0-5 VDC).
Connection	A connection between two devices. A connection might be as simple as one pin-to-pin connection, or it might require several pins as well as additional components such as relays, fuses, etc. This term also includes some settings that refer to the physical (for example, normally-closed vs. normally-open) or electrical (for example, active-high vs. active-low) characteristics of the connection.
Connector	This term has no meaning if you do not have access to the PCC control board or the back panel of the Operator Panel. One or more pins that are in the same housing. Many times, the pins are related by function (for example, pins that are connected to the engine) or by electrical characteristics (for example, relay outputs). This term also refers to the end of a wire or harness that is plugged into the housing.
Event Fault	Used to notify the operator or external devices whether or not certain conditions are true. Each event or fault has two sets of conditions. When the first set of conditions becomes true, the event or fault becomes active. This might turn on or turn off a light or LED, display a warning on the PCC, shut down the genset, or so on. When the second set of conditions becomes true, the event or fault becomes inactive and can be cleared. The PCC generates a fault when the conditions indicate a more serious problem; the PCC generates an event only for information purposes.
Low-side driver	When this output is active, it provides a path to ground. When this output is inactive, it blocks the path to ground.
Mode Mode of operation	A term to describe certain states that affect the PCC's behavior. The PCC is either in a particular mode or not in a particular mode, and the PCC's behavior changes accordingly. Sometimes, the PCC is always in one mode out of a set of two or more modes. For example, the PCC is always in one of the modes of operation: Off mode, Auto mode, or Manual mode.
Mounting	The physical placement and installation of the PCC or the Operator Panel.

Term	Definition
Normally-closed Normally-open	Some inputs and outputs use open circuits and short circuits to distinguish between active and inactive. If an input or output is normally-closed, an open circuit means the input or output is active, and a short circuit means the input or output is inactive. If an input or output is normally-open, a short circuit means the input or output is active, and an open circuit means the input or output is inactive.
Parameter	Refers to monitored values or settings in the PCC or the Operator Panel that can be looked at and, in some cases, adjusted. Some parameters are protected by passwords. In this manual, italics are used to identify a specific parameter by name.
Pin	A specific point on the PCC or the Operator Panel to which it is acceptable to connect a specific point on an external device. For example, a B+ pin might be connected to the positive terminal on the battery. It takes more than one pin to connect an external device to the PCC. For example, it takes B+ and Ground to connect the battery to the PCC. Depending on the access you have to the controller, you might see a specific pin on the PCC control board, the terminal at the end of a harness, a wire that runs between the PCC and the external device, or nothing at all.
Sensor	Refers to a device that measures something and reports one of many (or unlimited) values. For example, a coolant level sensor reports the current level of coolant.
Sequence of operation	A term used to describe the steps the PCC follows when it starts the genset or when it stops the genset.
Signal	A term used for convenience to talk about two or more connections as a single input. Usually, all of these connections have the same effect on the PCC's behavior, and it does not matter which connection is active. For example, the term "remote start signal" is used frequently. In Auto mode, the PCC starts the genset when the remote start signal is active. The remote start signal may come from any of several connections: a switch connected to the remote start pin, the Operator Panel, a PLC (programmable logic controller) connected on Modbus, InPower, etc. It is not important between these connections when explaining the way the remote start signal affects the PCC's decisions to start and stop the genset. It is only important whether or not any of them are active.
Switch	Refers to a device that measures something and reports one of two states, active or inactive, about something. For example, a low coolant level switch is active when the coolant level is too low, but the low coolant level switch does not report what the coolant level really is. In some cases, this may refer to a physical switch (similar to a light switch) instead.
Trim	Refers to the subset of parameters that can be adjusted, as opposed to parameters that can only be monitored.

4 System Overview

Read **Safety Precautions**, and carefully observe all of the instructions and precautions in this manual. Keep this manual with the other genset and/or controller manuals.

4.1 About this Manual

You should have a basic understanding of generators and power generation before you read this manual.

This is the Service Manual for the PowerCommand 3.x. It is not the Service Manual for the generator set ("genset") or any accessories.

4.2 Components (Applications with Engine Control Modules)

The PowerCommand 3.x consists of these parts.

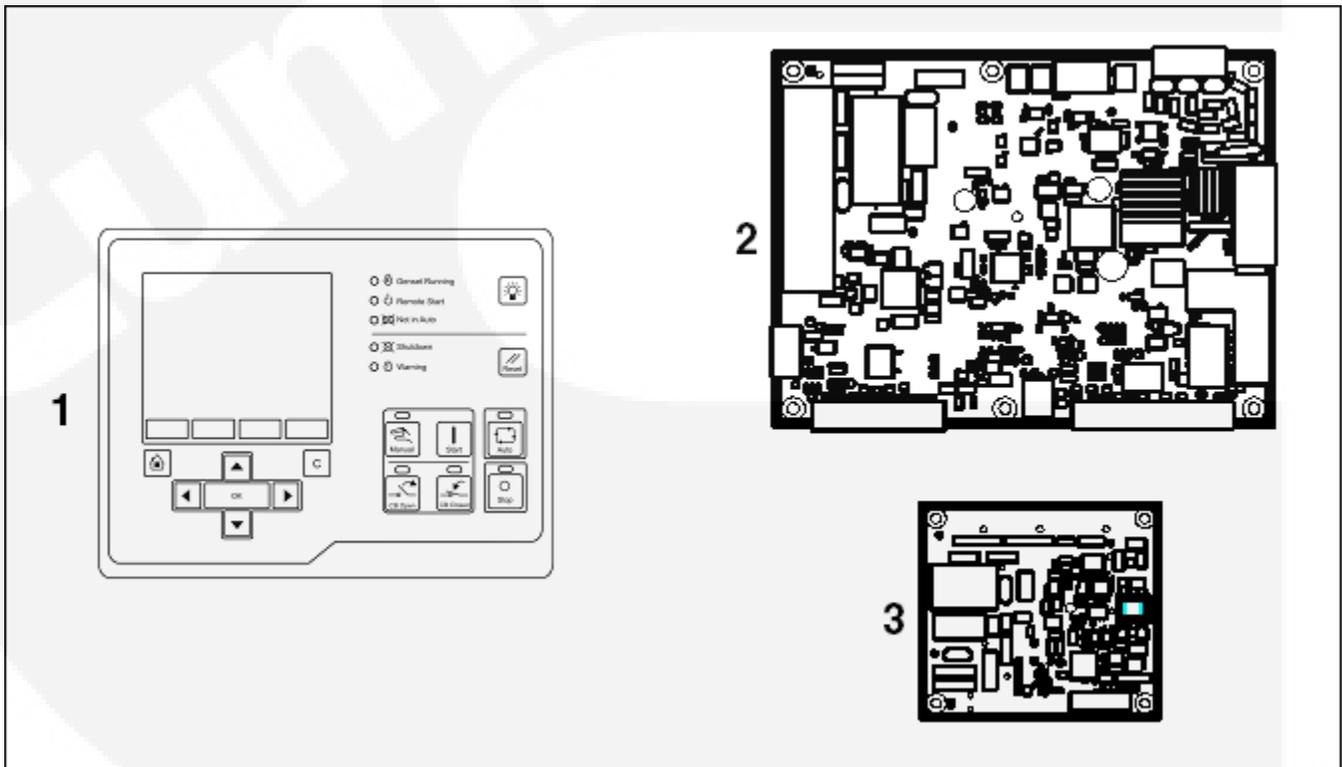


FIGURE 1. POWERCOMMAND 3.3 (APPLICATIONS WITH ENGINE CONTROL MODULES)

TABLE 1. POWERCOMMAND 3.3 (APPLICATIONS WITH ENGINE CONTROL MODULES)

PART DESCRIPTION	PART NUMBER
1: HMI 320 ("Operator Panel")	0300-6315-02
2: PCC 3300 Controller ("PCC")	0327-1601

PART DESCRIPTION	PART NUMBER
3: AUX 103 AVR power stage	0327-1593

4.3 Components (Applications with Hydromechanical Engines)

The PowerCommand 3.x consists of these parts.

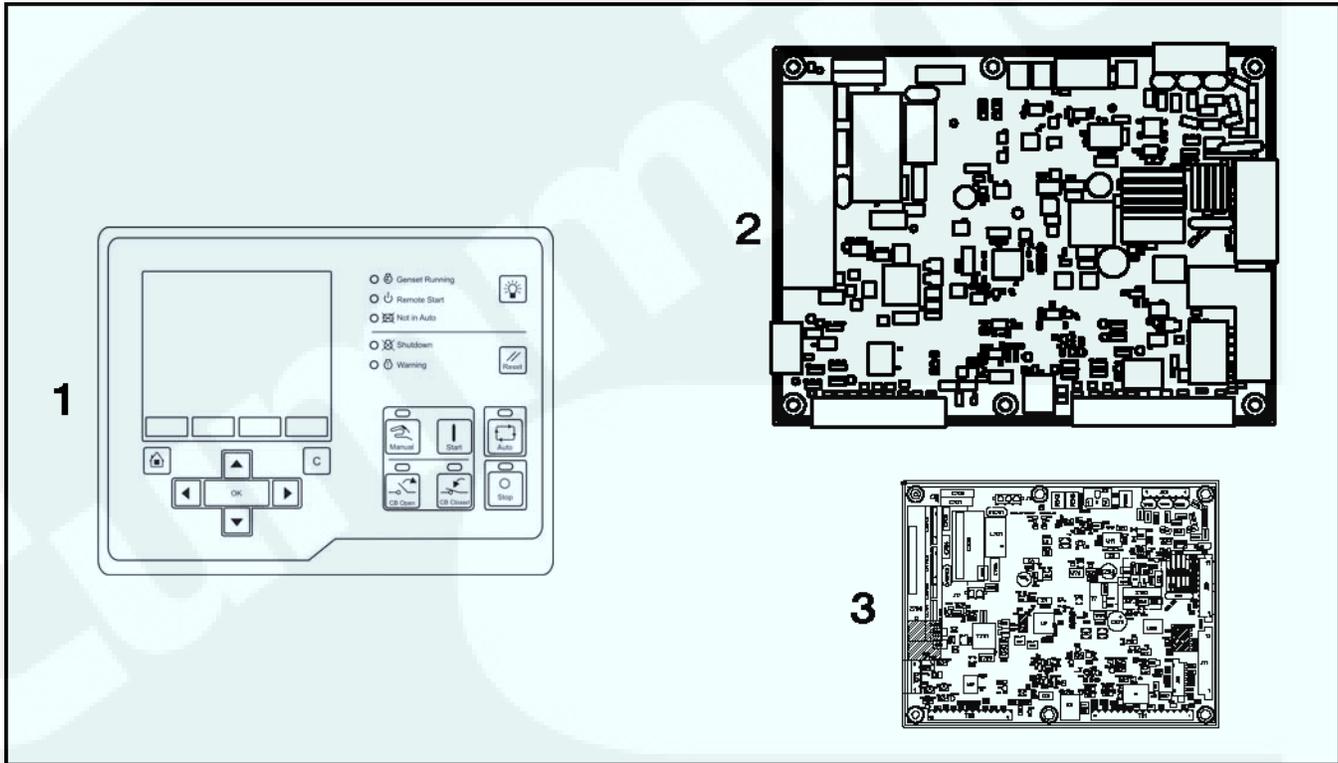


FIGURE 2. POWERCOMMAND 3.3 (APPLICATIONS WITH HYDROMECHANICAL ENGINES)

TABLE 2. POWERCOMMAND 3.3 (APPLICATIONS WITH HYDROMECHANICAL ENGINES)

PART DESCRIPTION	PART NUMBER
1: HMI 320 ("Operator Panel")	0300-6315-02
2: PCC 3300 Controller ("PCC")	0327-1601-01
3: AUX 105 HM ECM and AVR power stage	A028T766

4.4 PowerCommand 3.x

The PowerCommand 3.x is suitable for paralleling generator sets ("gensets") in standby or prime-power applications.

The PCC is a microprocessor-based controller that has these abilities:

- Control the genset to maintain a specified genset voltage and genset frequency
- Warn the operator when unsafe conditions are occurring

- Shut down the genset to prevent damage
- Provide a way for other devices (such as the Operator Panel) to monitor, manage, and control the genset



NOTE: The PCC should be installed where it can be accessed only by authorized service representatives. Unauthorized personnel, including an operator, should not have access to it.

4.5 Operator Panel

The Operator Panel is one way to monitor, manage, and control the genset. An operator can use the Operator Panel to do these things:

- Look at the status of the genset.
- Adjust settings that affect genset behavior.
- Start and stop the genset.



NOTE: In addition to the Operator Panel, other devices can monitor, manage, and control the genset too. Such devices might be as simple as a switch or a push button or as sophisticated as other controllers or computers. This manual introduces the ways the PCC can interact with other devices, but this manual cannot identify all of the devices that might be used in every application.

4.6 AUX 103

The AUX 103 helps the PCC maintain a specified genset voltage.

In this manual, "PCC" may refer to "PCC and AUX 103" without explicitly stating this. Distinction is made when necessary.



NOTE: The AUX 103 should be installed where it can be accessed only by authorized service representatives. Unauthorized personnel, including an operator, should not have access to it.

4.7 AUX 105

The AUX 105 acts like an engine control module and helps the PCC maintain a specified genset voltage.

In this manual, "PCC" may refer to "PCC and AUX 105" without explicitly stating this. Distinction is made when necessary.



NOTE: The AUX 105 should be installed where it can be accessed only by authorized service representatives. Unauthorized personnel, including an operator, should not have access to it.

4.8 Remote Operator Panel (Optional)

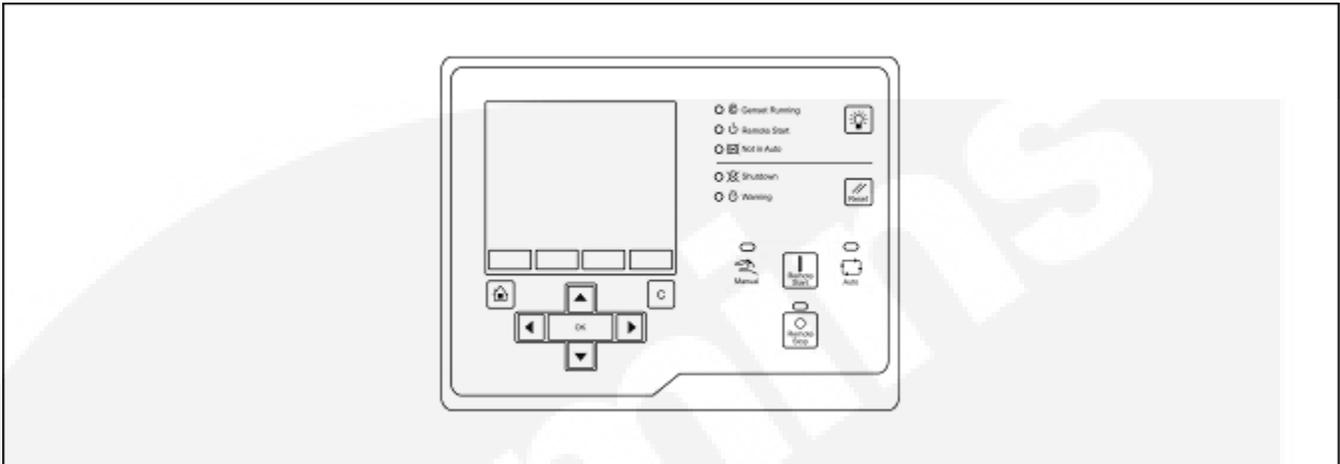


FIGURE 3. REMOTE OPERATOR PANEL (OPTIONAL)

TABLE 3. REMOTE OPERATION PANEL (OPTIONAL)

PART DESCRIPTION	PART NUMBER
Remote HMI 320 ("Operator Panel")	0300-6315-03

4.9 Genset Specifications

TABLE 4. GENSET SPECIFICATIONS

CATEGORY	CHARACTERISTIC
Paralleling	Three-Phase operation Dead bus close First start arbitration (with compatible controllers) Droop (speed droop and voltage droop) Synchronization Load share (with compatible controllers) Load govern Power transfer control
Genset Output	Single-phase or three-phase operation 50 Hz or 60 Hz operation 190-45,000 VAC line-to-line (genset) 110-600 VAC line-to-line (PCC input from genset; if the genset voltage is 600-45,000 VAC line-to-line, potential transformers are required) 5-10,000 A (external CTs required)
Alternator	Reconnectable or non-reconnectable alternator (voltage selectable) PMG or self-excitation

CATEGORY	CHARACTERISTIC
Engine	Diesel or lean-burn natural gas (LBNG) 12-V or 24-V battery (operating range: 8-30 VDC) Battery-charging alternator (IC type and non-IC type) Controlled Area Network (CAN) J1939 communication (limited) Power Generation Interface (PGI)-compliant engine control module (ECM). PGI is Cummins' implementation of SAE J1939. Hydromechanical
Communication	PCCNet Modbus PC-based service tool
Connector Seals	J11: AMP 794758-1 J12: AMP 794275-1 interface seal and AMP 794276-1 wire seal
Wires/Cables	0.8 sq. mm. (18 AWG) wires (except where specified otherwise)
Other	Up to four HMI 113 (daisy-chain)

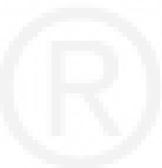
4.10 Certifications

The PCC meets or exceeds the requirements of these codes and standards:

- UL 508 Recognized
- CSA marked
- C282 compliant
- 22.2 compliant
- NFPA 99 compliant
- NFPA 110 compliant
- Requires HMI 113
- MS 202C, Method 101 compliant
- IEEE C62.41 compliant
- IEEE C37.90 compliant
- BS ISO 8528-4:2005
- BS EN 50081-1:1992
- BS EN 61000-6-2:2001
- BS EN 61000-6-3:2001
- BS EN 61000-6-4:2001
- CE Marking: The control system is suitable for use on generator sets to be CE-marked.

The Operator Panel is UL508 listed.

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5 Hardware

This section introduces the hardware that makes up the PCC and Operator Panel. It does not introduce the hardware in the rest of the genset.



WARNING: *Incorrect service or replacement of parts can result in severe personal injury, death, and/or equipment damage. Service personnel must be trained and experienced to perform electrical and mechanical service. Read Safety Precautions , and carefully observe all of the instructions and precautions in this manual.*

See [Appendix A](#) for schematics.

In this section, italics are used to identify a specific parameter by name.

5.1 Safety Precautions



CAUTION: *Electrostatic discharge will damage circuit boards. To prevent this damage, always wear a grounding wrist strap when handling circuit boards or socket-mounted ICs.*



CAUTION: *Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the battery cables can result in voltage spikes high enough to damage the DC control circuits of the set.*



WARNING: *Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).*



WARNING: *Make certain battery area has been well-ventilated before servicing battery. Arcing can ignite explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur when cable is removed or reconnected, or when negative (-) battery cable is connected and a tool used to connect or disconnect positive (+) battery cable touches frame or other grounded metal part of the set. Always remove negative (-) cable first, and reconnect it last. Make certain hydrogen from battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if battery has been connected to battery charger.*

To prevent circuit board damage due to electrostatic discharge, a grounding wrist strap must be worn when handling circuit boards or socket-mounted ICs. (The wrist strap does not provide a direct short to ground but is typically rated at approximately 1 megohm to ground.)

The connector seals ([Table 4](#)) for some connectors must meet the specified standards for the PCC to meet or exceed the certifications.

5.2 PCC Base Board

TABLE 5. PCC BASE BOARD PART NUMBERS

Part Description	Part Number
PCC 3300 controller	0327-1601

This circuit board ([Figure 4](#)) contains the microprocessor and the operational software for the PCC.

This circuit board is potted to provide resistance to dust and moisture. It is specifically designed and tested for resistance to RFI / EMI, and it also includes transient voltage surge suppression to provide compliance with referenced standards.

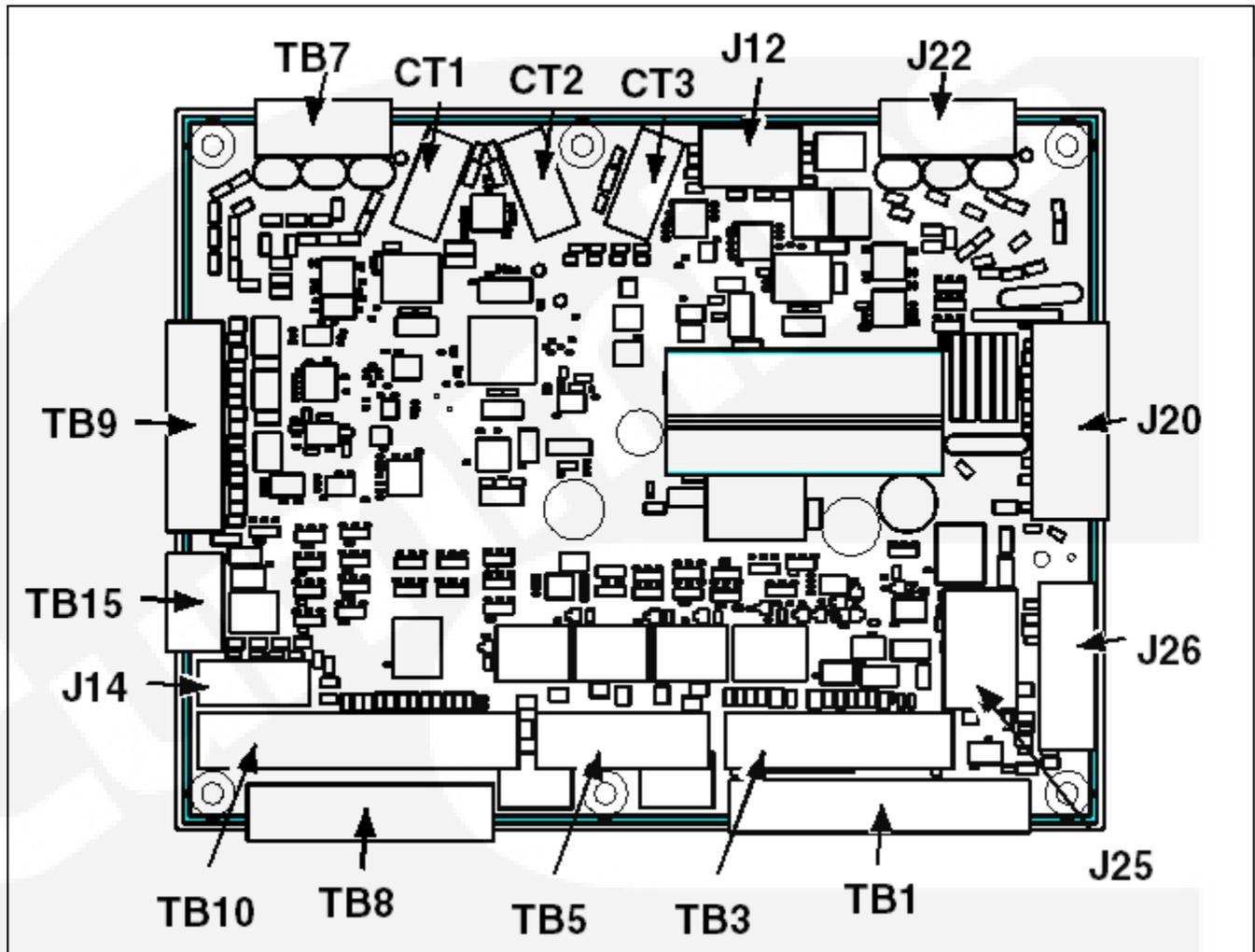


FIGURE 4. PCC BASE BOARD

5.2.1 LEDs



NOTE: DSx, where x is a number, is the typical way to indicate that a hardware component is a light (LED or incandescent).

The LEDs are located next to CT2 and CT3.

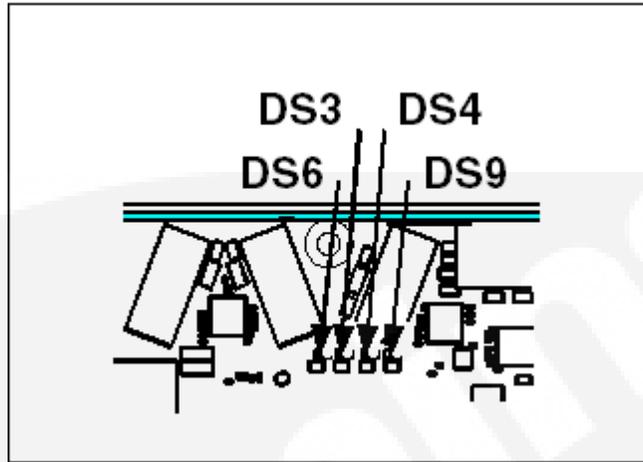


FIGURE 5. PCC BASE BOARD LEDS

TABLE 6. PCC BASE BOARD LEDS

LED	Color	Description
DS3 (Heartbeat)	Green	This LED blinks regularly (once every two seconds) when the PCC has power and is not in power-down mode.
DS4		This is reserved for future use.
DS6	Amber	This LED is on if event 1483 (Common Alarm) is active.
DS9	Amber	This LED is on while the PCC is changing between MON protocol and Modbus protocol on TB15. If <i>Protocol Mode</i> is Modbus, this LED is on when the PCC is receiving or transmitting data through the Modbus connection. If <i>Protocol Mode</i> is MON, this LED is off. If the PCC is using Modbus on TB15, this LED is on when the PCC is receiving or transmitting data through the Modbus connection. If the PCC is using MON on TB15, this LED is off.

5.2.2 Connections

[Table 7](#) provides an overview of the connections on this circuit board.

TABLE 7. PCC CONNECTIONS OVERVIEW

Connection	Description	Housing	Pins
CT1	Genset bus/utility L1 current sensing		
CT2	Genset bus/utility L2 or genset neutral current sensing		
CT3	Genset bus/utility L3 current sensing		
J11	Engine input and output	0323-2161	0323-2466
J12	CT input	0323-1932	0323-1200
J14	PC-based service tool interface (no calibrations)		
J17	AVR control	0323-2098	0323-1200
J18	AVR input	0323-2444	0323-1200

Connection	Description	Housing	Pins
J20	Genset input and output	0323-2446	0323-2466
J22	PT input	0323-2226-03	
J25	Accessories input and output	0323-2445	0323-2466
J26	Interconnect (J11 and AUX 103)	0323-2454	0323-2466
TB1	Customer input and output	0323-1678-15	
TB3	Customer input and output	0323-2498	
TB5	Circuit breaker control	0323-2499	
TB7	Genset bus/utility voltage sensing	0323-2476	
TB8	Customer input and output	0323-2325-03	
TB9	Analog input and output	0323-2501	
TB10	Circuit breaker status	0323-2502	
TB15	Modbus, PC-based service tool interface	0323-2192-04	

Configurable Inputs

[Table 8](#) identifies all of the configurable inputs.

TABLE 8. CONFIGURABLE INPUT CONNECTIONS

Description	PCC
Configurable Input #1	TB1-12, TB1-13
Configurable Input #2	TB1-14, TB1-15
Configurable Input #5	J20-17, J20-5
Configurable Input #6	J20-18, J20-6
Configurable Input #10	TB8-5, TB8-1
Configurable Input #11	TB8-6, TB8-2
Configurable Input #12	J20-19, J20-8
Configurable Input #13	TB8-7, TB8-12
Configurable Input #14	TB8-8, TB8-13
Configurable Input #20	TB3-9, TB3-1
Configurable Input #21	TB3-10, TB3-12
Configurable Input #23	TB10-4, TB10-1
Configurable Input #24	TB10-5, TB10-1
Configurable Input #25	TB10-6, TB10-9
Configurable Input #26	TB10-8, TB10-2
Configurable Input #27	TB10-10, TB10-2
Configurable Input #28	TB10-11, TB10-9
Configurable Input #29	TB10-12, TB10-16
Configurable Input #30	TB10-13, TB10-17
Configurable Input #31	TB10-14, TB10-17

Description	PCC
Configurable Input #32	TB10-15, TB10-16

Configurable Analog Inputs

[Table 9](#) identifies all of the configurable analog inputs.

TABLE 9. CONFIGURABLE ANALOG INPUT CONNECTIONS

Description	PCC
Configurable Analog Input #1	TB9-1, TB9-2
Configurable Analog Input #2	TB9-3, TB9-2

Configurable Outputs

[Table 10](#) identifies all of the configurable outputs.

TABLE 10. CONFIGURABLE OUTPUT CONNECTIONS

Description	PCC
Configurable Output #1 Relay	TB1-6, TB1-7
Configurable Output #2 Relay	TB1-8, TB1-9
Customer Fused B+	TB1-5
Configurable Output #3	TB8-10
Configurable Output #4	TB8-9
Configurable Output #5	TB1-4
Relay B+	J11-6, J20-13
Configurable Output #6	J20-16
Configurable Output #7	J25-1
Configurable Output #8	J11-7
Configurable Output #10	TB8-3
Configurable Output #11	TB8-11
Configurable Output #20	TB3-5
Configurable Output #21	TB3-6
Configurable Output #22	TB3-8

Configurable Analog Outputs

[Table 11](#) identifies all of the configurable analog outputs.

TABLE 11. CONFIGURABLE ANALOG OUTPUT CONNECTIONS

Description	PCC
Configurable Analog Output #1	TB9-5, TB9-6
Configurable Analog Output #2	TB9-4, TB9-6

5.2.3 CT1 Connections

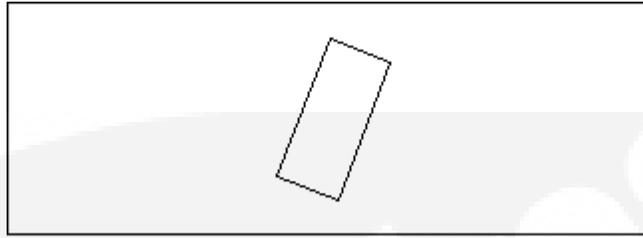


FIGURE 6. CT1

This connector is oriented the same way it is oriented in [Figure 4](#).

TABLE 12. CT1: GENSET BUS/UTILITY L1 CURRENT SENSING

Coupling	Description	Function / Connects to
CT1 1	Genset Bus L1 Current OR Utility L1 Current	Genset bus or utility L1 current measurement. Route external CT secondary wiring through CT such that current flows through the onboard CT entering at 1 when the measured source is providing power.

5.2.4 CT2 Connections

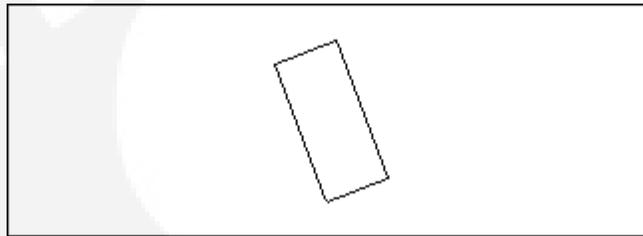


FIGURE 7. CT2

This connector is oriented the same way it is oriented in [Figure 4](#).

TABLE 13. CT1: GENSET BUS/UTILITY L2 OR GENSET NEUTRAL CURRENT SENSING

Coupling	Description	Function / Connects to
CT2 1	Genset Bus L2 Current OR Utility L2 Current OR Genset Neutral Current	Genset bus/utility L2 or genset neutral current measurement. Route external CT secondary wiring through CT such that current flows through the onboard CT entering at 1 when the measured source is providing power.

5.2.5 CT3 Connections

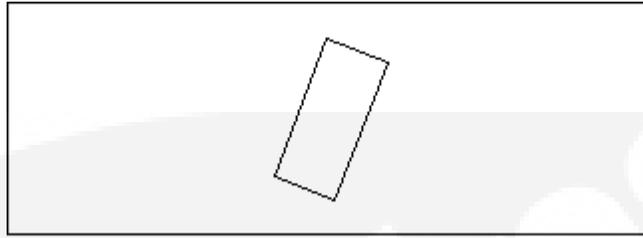


FIGURE 8. CT3

This connector is oriented the same way it is oriented in [Figure 4](#).

TABLE 14. CT1: GENSET BUS/UTILITY L3 CURRENT SENSING

Coupling	Description	Function / Connects to
CT3 1	Genset Bus L3 Current OR Utility L3 Current	Genset bus or utility L3 current measurement. Route external CT secondary wiring through CT such that current flows through the onboard CT entering at 1 when the measured source is providing power. Alternatively, you can use CT3 to measure ground current, in which case the PCC can generate fault code 2938 (Earth/Ground Fault).

5.2.6 J12 Connections

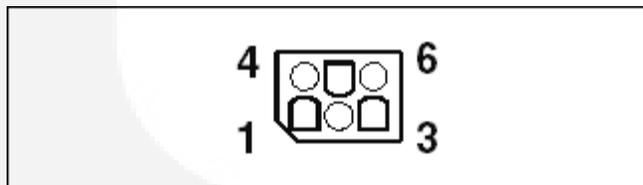


FIGURE 9. J12 PINS

This connector is oriented the same way it is oriented in [Figure 4](#).

TABLE 15. J12 PIN ASSIGNMENTS: CT CONNECTIONS

Pin	Description	Function / Connects to
J12-1	CT1	CT1-X1
J12-2	CT2	CT2-X1
J12-3	CT3	CT3-X1
J12-4	CT1 COMMON	CT1-X2/X3
J12-5	CT2 COMMON	CT2-X2/X3
J12-6	CT3 COMMON	CT3-X2/X3

Genset Delta/Wye Connection and *Single/3 Phase Connection* specify the alternator configuration.

See Appendix [A](#) for detailed examples of these connections with various alternator configurations.

CT connections should use three wires, minimum 1 sq. mm. (16 AWG).

Use the CT ratio calculator to determine the proper CT specifications for the genset.

Set the CT ratio in *Genset Primary CT Current* (actual genset current) and *Genset CT Secondary Current* (reduced genset current). If the PCC is connected to the main alternator, set these parameters to the same value. (Set the CT ratio to one.)



NOTE: If Genset Nominal Voltage is less than 300 VAC, the PCC assumes the genset is using the center tap on the CT and automatically doubles the CT ratio.

Genset Current Transformer Installation

Follow these guidelines to install a CT:

Each CT has a polarity dot on one side. Polarity refers to the instantaneous direction the CT primary current has the respect to the CT secondary current. It is important to install the CT polarity dot in the correct orientation to assure correct current metering and prevent control errors.

- Normal practice is to have the CT installed around each alternator phase load-side leads; in this case, the polarity dot faces towards the alternator.
- In some cases, the CT is installed on the alternator neutral leads due to space limitations; in this case the polarity dot faces the neutral terminal or bur bar.

It is important to refer to the genset reconnection diagram(s) to make sure you install CTs properly for various alternator configurations.

CT labeling:

- CT1 senses the current in “U” (A phase) leads.
- CT2 senses the current in “V” (B phase) leads.
- CT3 senses the current in “W” (C phase) leads.

There are two types of CTs used on gensets. These types are referred to as two-terminal secondary CTs and three-terminal secondary CTs.

Two-terminal CTs (X1, X2) are used on non-reconnectable alternators.

Three-terminal CTs (X1, X2, X3) are used on reconnectable alternators, and, in some cases, also on non-reconnectable alternators.

X1 and X2 are used for line to line voltages greater than 300 volts. X1 and X3 are used for line to line voltages less than 300 volts.