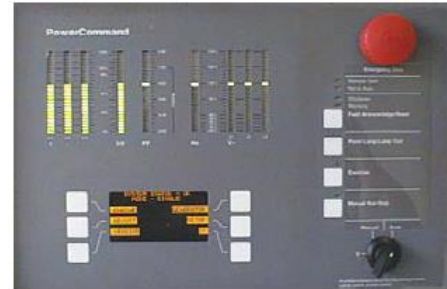




# PowerCommand<sup>®</sup> 3201 digital generator set control



## Description

The PowerCommand 3201 control is a microprocessor-based generator set monitoring, metering and control system. The control provides an operator interface to the genset, digital voltage regulation, digital governing and generator set protective functions. It may incorporate optional automatic digital paralleling controls and/or power transfer controls. The integration of all the functions into a single control system provides enhanced reliability and performance compared to conventional control systems.

The PowerCommand control is designed for mounting on the generator set and is suitable for use on generator sets ranging in size from 20 kW to 4000 kW. It will directly read AC voltages up to 600 VAC and can be configured for any frequency, voltage and power connection configuration from 120 to 13,800 VAC. The operator panel may be remote-mounted from the generator set and connected via an RS485 network connection.

The control offers a wide range of standard control and digital display features so custom control configurations are not needed to meet application requirements and system reliability is not compromised by use of untested special components. Power for PowerCommand Control is usually derived from the generator set starting batteries. It functions over a voltage range from 8 VDC to 35 VDC.

## Features

**Digital full authority electronic engine controls** - Provide engine monitoring, protection and governing. These functions are integrated with voltage regulation and paralleling functions for optimum system performance.

**Digital voltage regulation** - Provides fast, controlled response to load changes and high levels of immunity to the effects of non-linear loads.

**AmpSentry™ protective relay** - UL listed, true alternator overcurrent protection.

**AC output metering** - Includes analog and digital display.

**Battery monitoring system** - Senses and warns against weak battery condition that is not detected by conventional DC over and undervoltage monitoring.

**Message display** - Digital alarm and status.

**Generator set monitoring** - Displays status of all critical engine and alternator generator set functions.

**Smart starting control system** - Integrated fuel ramping to limit black smoke and frequency overshoot, in addition to optimized cold weather starting.

**Advanced serviceability** - Utilizes InPower™, a PCbased software service tool.

**Digital power transfer control** - Optional control functions that allow operation in open transition, closed transition or soft (ramping) transfer modes.

**PowerCommand LonWorks® network** - Optional network interface providing expanded input/output capability, remote monitoring and control by annunciators and other equipment, and easier installation.

**Warranty** - Backed by a comprehensive warranty and worldwide distributor service network.

## Operator panel

The operator panel provides the user with a complete package of easy to view and use information. It includes an enhanced graphical operator panel that allows the user to view up to 9 lines of information, as well as graphical displays of system data. Connections to the operator panel are sealed, locking plug interfaces for reliable, vibration-resistant interconnection to the generator set wiring harness.

## Control switches and functions



**Off/manual/auto mode control switch** - The *not in auto* lamp will flash when the control is in the *manual* or *off* mode. In the *auto* mode, the generator set can be started using the exercise push-button or with a start signal from a remote device, such as automatic transfer switches.

**Manual run/stop control switch and indicating LED** - When the mode control switch is in the *manual* position and the *manual run/stop* switch is pressed, the generator set will start, bypassing all time delay starts. (Time delay idle can also be bypassed with another control action.) If the generator set is running in the *manual* mode, pressing the *run/stop* switch will cause the generator set to shut down. An LED (light emitting diode) lamp adjacent to the switch will light to indicate the generator set is in manual mode.

**Exercise control switch and indicating LED** - When the mode control switch is in the *auto* position the *exercise* control switch is used to complete a pre-programmed exercise sequence. All exercise functions are disabled when an emergency start command is received by the control. An LED lamp adjacent to the switch will light to indicate the generator set is in exercise mode.

**Panel lamp/lamp test control switch.**

**Fault acknowledge/reset switch** - The control includes a fault acknowledge function to allow the operator to reset the fault condition. If the fault condition is not corrected, the fault will reappear, but will not be logged as a separate event. Multiple faults can be logged and displayed at one time.

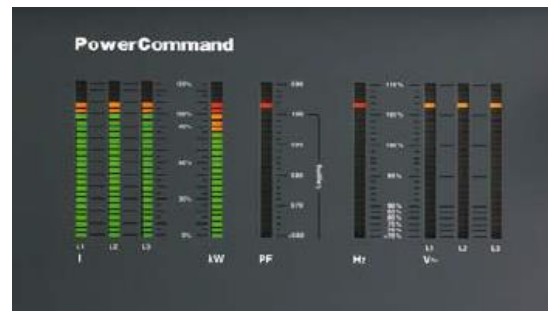
**Emergency stop control switch.**

**Operator adjustments** - The control includes provisions for many set up and adjustment functions via raise/lower switches on the operator panel. Functions that can be adjusted by the operator include:

- Time delay start (0-300 seconds)
- Time delay stop (0-600 seconds)
- Alternator voltage (+5%)
- Alternator frequency (+3 Hz)

The operator panel can be configured to require an access code prior to adjusting these values. A second access code is used to protect the control from unauthorized service level adjustments. Voltage and frequency adjustments are disabled during operation in parallel with a system bus to prevent inadvertent misadjustment of the paralleling load sharing functions.

## Analog AC metering panel



The PowerCommand control is equipped with an analog AC metering panel that simultaneously displays 3-phase Line-to-Line AC volts and current, kW, power factor and frequency.

The meter panel is composed of a series of LEDs configured in bar graphs for each function. The LEDs are color coded with green indicating normal range values, amber for warning levels and red for shutdown conditions. Scales for each function are in % of nominal rated values.

## Graphical display panel



The PowerCommand control is provided with a graphical display capable of displaying up to 9 lines of data with approximately 27 characters per line. The graphical display is accompanied by a set of six tactile-feel membrane switches that are used by the operator to navigate through control menus and to make control adjustments. Display is configurable for multiple languages. It is configurable for units of measurement. The display incorporates three levels of operation and adjustability. All data on the control can be viewed by scrolling through screens with the navigation keys. The top three lines of the display are allocated to mode and status messages that continuously display the operating mode of the control system, as well as any faults or warning conditions that may be present on the controller. If more than one fault or warning message is present, the messages will scroll to allow the operator to view all active messages in the system.

**Screen-saver mode** - The operator panel can be programmed to automatically switch off to reduce battery voltage drain when the control is not being used and the generator set is not running. Depressing any button on the operator panel, new fault conditions or receipt of a remote signal at the control will "wake up" the control.

### Generator set data

**Generator set hardware data** - Generator set rating in kVA, complete generator set model number and serial number, engine model and serial number and alternator model and serial number. The control also displays the part number of the control and the software version present in the control.

**Data logs** - Number of start attempts and number of start attempts since reset. Number of times generator set has run and number of times since reset. Duration of generator set running time and duration of running time since last reset. Generator set kWh produced and kWh produced since last reset.

**Adjustment history** - Record of adjustment and setting changes made on the control, identifies whether adjustment was made via the operator panel or with a service tool. If a service tool is used, the control provides a record of the serial number of the tool used. This information is read with InPower.

**Fault history** - Record of the most recent fault conditions with time stamp, along with the number of times each fault has occurred. At least 20 events are stored in the control memory.

**Load profile data** - Data indicating the total operating hours at percent of load in 10% increments and since reset.

### Generator set AC data

**Generator set output frequency, voltage and current** - All phases (Line-to-Line and Line-to-Neutral for voltage. Accuracy 1%.

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

**Generator set kWh energy output** - Total kWh produced and total produced since last reset with time stamp of time of last reset.

**Digital synchroscope** - Bus voltage and frequency, generator set bus voltage and frequency, the phase angle displacement and a signal indicating "ready to close". A breaker control switch is included on this panel for convenient operation of the equipment without switching between viewing screens.

### Engine data

**Basic engine data** - Engine starting battery voltage, engine lube oil pressure and engine coolant temperature.

**Engine service data** - Varies with engine used, but typically includes: Engine coolant pressure, engine fuel rail temperature and pressure, engine fuel input and output temperature, intake manifold temperature and pressure, ambient air pressure, crankcase blowby flow and aftercooler inlet coolant temperature.

**Engine fuel consumption** - The fuel consumed by the engine is calculated by the control based on fuel flow into the engine and returned by the engine, and the temperature of the two flow streams. Accuracy is + 5% over 500 hours of operation. Data provided includes overall average fuel consumed and consumption since reset. This information is read with InPower.

**Engine exhaust temperature (optional).**

### Power transfer control data (optional)

**Utility (mains) source data** - Displays Line-to-Line and Line-to-Neutral voltage of utility (mains) source, frequency and estimated amps, and kW and kVA supplied by utility (mains) source (optional when power transfer control is used).

**System status information** - Provides graphical system status display showing availability of sources and positions of each contactor.

**System control** - Allows operator to view status of system and manually control operation of the system. Provides manual adjustment capability for time delay start, stop, transfer and retransfer, as well as time delays for program transition (when used) and power transfer overlap time.

### Internal control functions

#### General functions

**System control voltage** - The control operates on 24 VDC from the generator set starting batteries. Control functions are fully operational over a voltage range of 8 VDC to 36 VDC.

**Emergency start mode** - PowerCommand accepts a ground signal from remote devices or a network signal to automatically start the generator set and immediately accelerate to rated speed and voltage.

PowerCommand includes a smart starting system that is designed to quickly start the engine, minimize black smoke, minimize voltage and frequency overshoot, and oscillations on starting. The control system does this by careful simultaneous control of the engine fuel system and alternator excitation system.

**Non-emergency start mode** - The control is provided with a separate remote start input or a network signal to start the generator set via the programmable idle control. Using the non-emergency mode, the generator set takes longer to start, but there is less wear on the engine. In this start mode, the generator set will start, operate at idle speed for a predefined time period or until the engine reaches operating temperature (whichever time is shorter), and then ramp to rated speed and voltage. Time delay is adjustable from 0-300 seconds and default is 10 seconds. The control also monitors and records the source of start signals, when that information is available. The control automatically exits idle mode if an emergency remote start signal is received at the control.

**Data logging** - The control maintains a record of manual control operations, warning and shutdown conditions and other events. It uses the control "on" time as the timestamp means when a real time clock is not included with the control. The control also stores critical engine and alternator data before and after a fault occurs, for use by InPower and the technician in evaluating the root causes for the fault condition.

**Fault simulation mode** - PowerCommand, in conjunction with InPower software, will accept commands to allow a technician to verify the proper operation of critical protective functions of the control by simulating failure modes or by forcing the control to operate outside of its normal operating ranges. InPower also provides a complete list of faults and settings for the protective functions of the specific generator set it is communicating with.

**Built in test** - The control system automatically tests itself, and all the sensors, actuators and harnesses in the control system, on a startup signal. The test can also be initiated from InPower and can be accomplished either locally to the generator set or remotely.



## Engine control

**Engine starting** - The control operates a factory-supplied fuel valve that enables engine starting.

**Cycle cranking** - Configurable for number of starting cycles (1 to 7) and duration of crank and rest periods. Control includes starter protection algorithms to prevent the operator from specifying a starting sequence that might be damaging. Default setting is for (3) start cycles composed of 15 seconds of cranking and 15 seconds of rest.

**Programmable idle speed control** - In this mode the generator set would start and run to idle speed. It would operate at that speed for a programmed time period, then ramp to rated speed. When the control gets a signal to stop, it will ramp to idle, operate for the programmed period at idle and then shut down. During idle mode, engine protective functions are adjusted for the lower engine speed and alternator function is disabled.

**Time delay start and stop (cool down)** - Configurable for time delay of 0-300 seconds prior to starting after receiving a remote start signal in normal operation modes and for time delay of 0-600 seconds prior to ramp-to-idle or shutdown after signal to stop in normal operation modes. The generator set control will monitor the load during operation of the generator set, and if the total load on the set is less than 10% of rated it will reduce the operation time for the time delay stop in order to prevent extended operation of the engine at very light load levels. Default for both time delay periods is 0 seconds.

## Engine governing

**Isochronous governing** - Controls engine speed within  $\pm 0.25\%$  for any steady state load from no load to full load. Frequency drift will not exceed  $\pm 0.5\%$  for a 33 °C (60 °F) change in ambient temperature over an 8 hour period.

**Droop governing** - Control can be adjusted to droop from 0 to 10% from no load to full load, using InPower.

**Temperature dynamics** - Modifies the engine fuel system control parameters as a function of engine temperature. Allows engine to be more responsive when warm and more stable when operating at lower temperature levels.

**Isochronous load sharing control** - See *Paralleling Functions/Load sharing controls*.

**Droop load sharing control** - See *Paralleling Functions/Load sharing controls*.

**Idle mode** - Engine governing can be regulated at an idle speed for a programmed period on start or stop of the engine. When the engine is operating at idle speed, the alternator excitation is automatically switched off.

## Alternator control

**Digital output voltage regulation** - PowerCommand will regulate output voltage to within 0.5% for any loads between no load and full load. Voltage drift will not exceed  $\pm 0.5\%$  for a 33 °C (60 °F) change in temperature in an 8 hour period. On engine starting, or sudden load acceptance, voltage is controlled to a maximum of 5% overshoot over nominal level.

**Torque-matched V/Hz overload control** - The voltage roll-off set point and rate of decay (i.e., the slope of the V/Hz curve) is adjustable in the control. This function is automatically disabled when the control is in a synchronizing mode.

**Fault current regulation** - PowerCommand will regulate the output current on any phase to a maximum of 3 times rated current under fault conditions for both single phase and three phase faults. In conjunction with a permanent magnet generator, it will provide 3 times rated current on

all phases for motor starting and short circuit coordination purposes.

**Isochronous (kVar) load sharing control** - See *Paralleling Functions/Load sharing controls*.

**Droop (kVar) load sharing control** - See *Paralleling Functions/Load sharing controls*.

## Protective functions

On a warning condition, the control will indicate a fault by lighting the warning LED on the control panel and displaying the fault name and code on the operator display panel. The nature of the fault and time of occurrence are logged in the control. The service manual and InPower service tool provide service keys and procedures based on the service codes provided.

On a shutdown condition, the control will light the shutdown LED on the control panel, display the fault name and code, initiate shutdown and lock out the generator set. The shutdown sequence of the generator set includes programmable cooldown at idle for fault conditions that do not endanger the engine. The control maintains a data log of all fault conditions as they occur and time stamps them with the controller run time and engine operating hours data. Adjustments to most set points are made using the InPower service tool.

The control system includes a “*fault bypass*” mode that forces the system to function regardless of the status of protective functions. In this mode, the only protective functions that are operational are over speed, loss of both speed sensors, moving the control switch to the *off* position or pressing the *emergency stop* switch. The control maintains a record of the time that the mode is enabled and of all warning or shutdown conditions that have occurred while in the “*fault bypass*” mode.

Many protective functions within the control system are configurable for warning, shutdown or both (2 levels). Exceptions to this include functions such as over speed conditions, and loss of speed sensing. In addition, some warning functions can incorporate control functions as a consequence of a fault.

## System protective functions:

**Ground fault warning (option - 600 VAC class generator sets)** - Ground (earth) fault sensing is adjustable over a range of 100-1200 amps with time delays of 0-1 second. May be configured for shutdown rather than alarm.

**Configurable alarm and status inputs** - PowerCommand will accept up to four alarm or status inputs (contact closed to ground) to indicate customer-specified conditions. The control is programmable for warning, shutdown or status indication and for labelling the input (up to 24 characters). Sixteen additional faults can be input to the control via the network.

**Breaker fail to close and breaker auxiliary contact warning or shutdown** - When the paralleling control signals a circuit breaker to close, it will monitor the breaker auxiliary contacts and verify that the breaker has connected the generator set to the system bus. If the control does not sense a breaker closure within 0.5 second of the close signal, the control will monitor the phase relationship between the generator set and the bus. If this indicates that the generator set is not closed to the bus, the “*breaker fail to close*” alarm will be indicated, the breaker will be opened and the generator set shut down. If the phase relationship monitor indicates that the generator set is in parallel with the bus, “*circuit breaker auxiliary contact failure*” will be indicated and the generator set will continue to run in normal operation mode.

**Breaker fail to open warning** - The control system monitors the operation of breakers that have been signalled to open. If the breaker does not open within 1 second of initiation of signal, a “breaker fail to open” warning is initiated. The control will logically allow the generator set to continue to run if shutdown of the generator set with the breaker closed will cause potential damage or operating problems.

**Bus or generator set PT input calibration error** - The control system monitors the sensed voltage from the bus and generator set output voltage-potential transformers. When the paralleling breaker is closed, it will indicate a warning condition when they read different values.

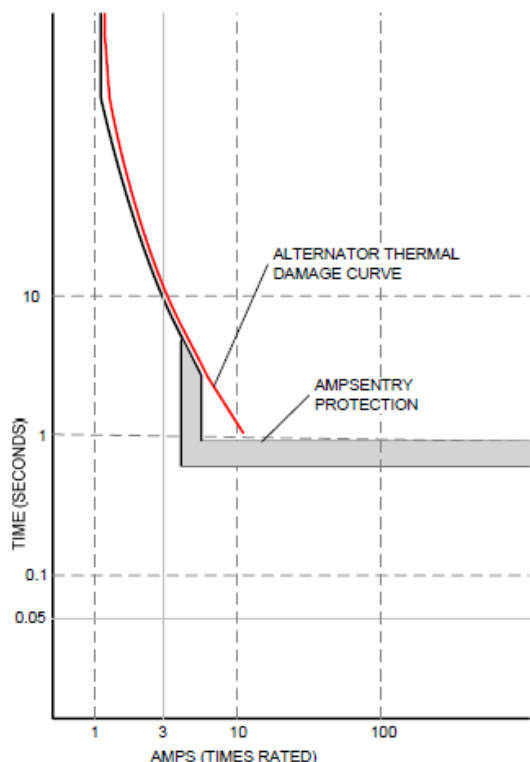
**Emergency stop** - Annunciated whenever the local or remote emergency stop signal is received. Alarm panel distinguishes between local or remote operation.

### AmpSentry protective relay:

AmpSentry protective relay is a UL Listed comprehensive monitoring and control system integral to the PowerCommand Control System that guards the electrical integrity of the alternator and power system by providing protection against a wide array of fault conditions in the generator set or in the load. It also provides single and three phase fault current regulation so that downstream protective devices have the maximum current available to quickly clear fault conditions without subjecting the alternator to potentially catastrophic failure conditions. See document R1053 below for a full size time over current curve. The control does not include protection required for interconnection to a utility (mains) service.

**Over current warning** - Output current on any phase at more than 110% of rating for more than 60 seconds.

**Over current shutdown (51V)** - Output current on any phase is more than 110%, less than 175% of rating and approaching thermal damage point of alternator. Control includes algorithms to protect alternator from repeated over current conditions over a short period of time. The control does not include instantaneous trip functions, as they are not necessary for alternator protection and complicate short circuit coordination (discrimination).



**Short circuit shutdown (51)** - Output current on any phase is more than 175% of rating at time of shutdown. The control replicates the function of a 51V relay by discriminating between short circuit conditions and shutdown conditions, and shutting down the genset as fast as is necessary on a short circuit condition while operating as long as is possible on an overload condition. Control includes algorithms to protect alternator from repeated over current conditions over a short time.

**High AC voltage shutdown (59)** - Output voltage on any phase exceeds preset values. Time to trip is inversely proportional to amount above threshold. Values adjustable from 105-125% of nominal voltage, with time delay adjustable from 0.25-10 seconds. Default value is 110% for 10 seconds.

**Low AC voltage shutdown (27)** - Voltage on any phase has dropped below a preset value. Adjustable over a range of 50-95% of reference voltage, time delay 2-10 seconds. Default value is 85% for 10 seconds. Function tracks reference voltage. Control does not nuisance trip when voltage varies due to the control directing voltage to drop, such as during a voltage roll-off during synchronizing.

**Under frequency shutdown (81u)** - Generator set output frequency cannot be maintained. Settings are adjustable from 0-10 Hz below nominal governor set point, for a 0-20 second time delay. Default: 6 Hz, 10 seconds. Under frequency protection is disabled when excitation is switched off (such as when engine is operating in idle speed mode or the synchronizer is enabled).

**Over frequency shutdown/warning (81o)** - Generator set is operating at a potentially damaging frequency level. Defaults: Disabled.

**Over load (kW) warning** - Provides a warning indication when engine is operating at a load level over a set point. Adjustment range: 80-140% of rated kW, 0-120 second delay. Defaults: 105%, 60 seconds.

**Reverse power shutdown (32)** - Adjustment range: 5-20% of standby kW rating, delay 1-15 seconds. Defaults: 10%, 3 seconds.

**Sync check (25)** - Verifies that the generator set is operating in synchronism with the system bus prior to allowing the paralleling breaker to close. Includes dead bus sensing capability.

**Fail to synchronize warning or shutdown** - Indicates that the generator set could not be brought to synchronization with the system bus. Configurable for warning or shutdown and adjustable for time delay of 10-120 seconds. Default is 120 seconds.

**Phase sequence sensing shutdown** - Verifies that the generator set phase sequence matches the bus prior to allowing the paralleling breaker to close. The generator set will shutdown if the generator set and bus phase sequence do not match.

**Reverse Var shutdown** - Shutdown level is adjustable: 15-50% of rated Var output, delay 10-60 seconds. Defaults: 20%, 10 seconds.

**High alternator temperature (option).**

### Engine protection

**Over speed shutdown** - Default setting is 115% of nominal.

**Low lube oil pressure shutdown** - Level is preset to match the capabilities of each engine. Control includes time delays to prevent nuisance shutdown signals.

**Low lube oil pressure warning** - Level is preset to match the capabilities of each engine. Control includes time delays to prevent nuisance shutdown signals.

**High coolant temperature shutdown.**

**High coolant temperature warning.**

**Low coolant pressure warning/shutdown.**

**Low coolant level warning/shutdown.**

**Low coolant temperature warning** - Indicates that engine temperature may not be high enough for a 10 second start or proper load pickup.

**Low and high battery voltage warning** - Indicates battery charging system failure by continuously monitoring battery voltage and indicating a problem when voltage is outside a preset acceptance band.

**Discharged battery protection** - When DC voltage is below a preset threshold, the control will shut down to avoid completely discharging the battery.

**Weak battery warning** - The control system will test the battery bank each time the generator set is signalled to start and indicate a warning if the generator set battery indicates impending failure.

**Fail to start (overcrank) shutdown.**

**Fail to crank shutdown** - Control has signalled starter to crank engine but engine does not rotate.

**Redundant starter disconnect.**

**Redundant speed sensors** - Loss of one sensor results in a mag pickup sensor warning. Loss of both sensors results in mag pickup failure.

**Low fuel day tank and low fuel main tank warning.**

**Cranking lockout** - The control will not allow the starter to attempt to engage or to crank the engine when the engine is rotating.

**Sensor failure indication** - All analog sensors are provided with sensor failure logic to indicate if the sensor or interconnecting wiring has failed. Separate indication is provided for fail high or low.

**High crankcase blowby level warning.**

**High fuel temperature warning.**

**High intake manifold temperature/pressure.**

**Aftercooler cooler inlet over temperature.**

### **Paralleling functions (optional)**

**First Start Sensor™ System** - PowerCommand provides a unique control function that positively prevents multiple generator sets from simultaneously closing to an isolated bus under black start conditions. The First Start Sensor system is a communication system between generator sets that allows the generator sets to work together to determine which generator set in a system should be the first to close to the bus. The system includes an independent backup function, so that if the primary system is disabled the required functions are still performed.

**Synchronizer** - PowerCommand incorporates a digital synchronizing function to force the generator set to match the phase relationship and voltage of the generator set output with the system bus or utility grid. The synchronizer includes provisions to provide proper operation even with highly distorted bus voltage waveforms. The synchronizer includes adjustments for phase angle window (5°-20°) and time delay (0.5-5 seconds). The synchronizer is 3-phase sensing, and includes controls to directly operate a paralleling breaker. The breaker controls include fail to open and fail to close protection.

**Load sharing controls** - The generator set control includes an integrated load sharing control system for both real (kW) and reactive (kVar) loads when the generator set(s) are operating on an isolated bus. The control system determines kW load on the engine and kVar load on the alternator as a percent of generator set capacity, and then

regulates fuel and excitation systems to maintain system and genset at the same percent of load without impacting voltage or frequency regulation. The control can also be configured for operation in droop mode for kW or kVar load sharing.

**Load govern controls** - When PowerCommand receives a signal indicating that the generator set is paralleled with an infinite source such as a utility (mains) service, the generator set will operate in load govern mode. In this mode the generator set will synchronize and close to the bus, ramp to a pre-programmed kW and kVar load level, and then operate at that point. Control is adjustable for kW values from 0-100% of standby rating, and 0.7-1.0 power factor (leading). Default setting is 80% of standby and 1.0 power factor. The control includes inputs to allow independent control of kW and kVar load sharing level by a remote device while in the load govern mode. The rate of load increase and decrease is also adjustable in the control.

**Load demand control** - The control system includes the ability to respond to an external signal to initiate load demand operation. On command, the generator set will ramp to no load, open its paralleling breaker, cool down, and shut down. On removal of the command, the generator set will immediately start, synchronize, connect, and ramp to its share of the total load on the system.

### **Power transfer control (optional)**

The Power transfer control feature allows PowerCommand to provide integrated automatic power transfer functions including source availability sensing and transfer device (circuit breaker) monitoring and control. The control is configurable for open transition, fast transfer (100 mS), or soft (ramping) sequences of operation. Standard functions include:

- 3-phase (Line-to-Neutral) close differential under voltage sensing for utility (mains) service. Sensing for pickup in an adjustable range from 85-100% of nominal, with default at 95% of dropout setting. Dropout is configurable 75-98% of pickup, with default at 85%.
- 3-phase over voltage sensing for normal utility service adjustable for pickup at 95-105% of dropout and dropout configurable for 105-135% of nominal. Time delay is adjustable in a range of 0.5-120 seconds. Default is disabled and is enabled using InPower.
- Under frequency sensing for normal utility service. Adjustment range is 80-95% of nominal. Default is disabled and is enabled using InPower.
- Configurable sequence of operation with or without adjustable program-transition capability. Adjustment range is 0-60 seconds.
- Remote exercise feature accepts a remote signal to initiate with or without load testing, or testing can be initiated by the operator. Test sequence may include a programmed idle period prior to acceleration to rated voltage and frequency, and after cool down. Test may be configured to be performed with load or without load.
- Time delay start and stop as described in this document; time delay transfer adjustable in a range of 0-120 seconds and retransfer in a range of 0-1800 seconds; all in 1-second increments.
- Fail to disconnect timer is adjustable in a range of 0.1 to 120 seconds.



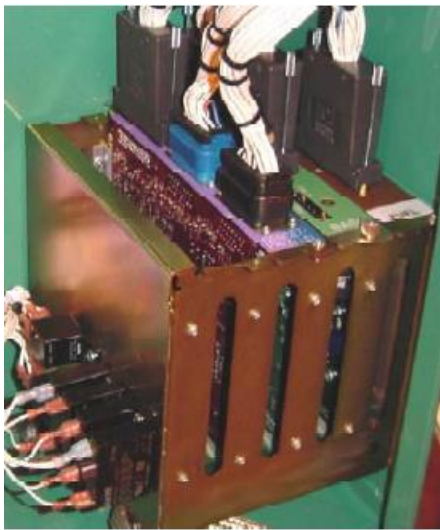
## Environment

The control is designed for proper operation without recalibration in ambient temperatures from -40 °C to +70 °C (-40 °F to +158 °F) and for storage from -40 °C to +80 °C (-40 °F to +176 °F). Control will operate with humidity up to 95%, non-condensing and at altitudes up to 5000 m (13,000 ft).

The operator control panel has a single membrane surface which is impervious to the effects of dust, moisture, oil and exhaust fumes. The panel uses sealed membrane or oil-tight switches to provide long reliable service life in harsh environments.

The control system is specifically designed for resistance to RFI/EMI and to resist the effects of vibration to provide a long reliable life when mounted on a generator set. The control includes transient voltage surge suppression to provide compliance to referenced standards.

The control is mounted on a vibration-isolated structure attached to the generator set skid and includes all generator set wiring factory-installed.



## Control interface

**Input signals to the PowerCommand control include:**

**Remote start signal** - May be connected via either discrete signal or Lon<sup>®</sup> Network or both for premium reliability. Discrete signal is normally open contact to ground or normally closed contact that opens to indicate start signal. Separate signal inputs available for emergency start and non-emergency start.

**Remote emergency stop.**

**Low main or day tank fuel level warning.**

**Remote alarm reset.**

**Load demand stop.**

**Utility parallel (load govern) mode command.**

**Configurable customer inputs** - Control includes provisions for (4) input signals from customer discrete devices. (16) additional input signals can be implemented with the use of external network modules.

**Output signals from the control include:**

**Generator set running signal** - Fused normally open contact rated 5 A at 30 VDC/180 VAC, closes to indicate generator set is running.

**Generator set common shutdown signal** - Self-protected relay driver.

**Load shed signal** - Self-protected relay driver. Operation is configurable for under frequency or over kW load or both. Adjustment range is 80-140% of standby rating with time delay of 0-120 seconds. Default settings are overload 105%, 60 sec, and under frequency 3 Hz below governor reference for 3 seconds.

**Ready to load signal** - Self-protected relay driver. Operates when the generator set has reached 90% of rated speed and voltage and latches until generator set is switched to off or idle mode.

**Modem control signal** - Self-protected relay driver.

**Paralleling breaker interface** - Fused normally open relay contact (5 A, 30 VDC/180 VAC) for parallel breaker close signal and normally open contact for parallel breaker open signal.

Control power for auxiliary devices is available from the controller.

**Network connections include:**

**Serial interface** - This communication port is to allow the control to communicate with a personal computer running InPower service and maintenance software.

**Echelon<sup>®</sup> LonWorks interface (option)** - System allows for fast, effective incorporation of auxiliary I/O, remote annunciation, redundant start commands from Cummins transfer switches, and other control functions.

## Software

**InPower** - An optional PC-based software service tool that is designed to directly communicate to PowerCommand generator sets and transfer switches to facilitate service and monitoring of these products.

**PowerCommand for Windows<sup>®</sup>** - An optional software tool that is used to remotely monitor and control generator sets, transfer switches and other on-site power system devices.

## Certifications

PowerCommand meets or exceeds the requirements of the following codes and standards:

**NFPA110:** For Level 1 systems

**UL508:** Recognized or Listed and suitable for use on UL 2200 Listed generator sets

**CSA C282-M:** 1999 compliance

**CSA 22.2 No. 14 M91:** Industrial Controls

**ISO 8528-4:** 1993 compliance, Controls and Switchgear

**NFPA99:** Standard for Health Care Facilities

**CE Mark**

**EN 50081-1:** Residential, Commercial, Light Industrial

**EN 50081-2:** Industrial

**EN 50082-1:** Residential, Commercial, Light Industrial

**EN 50082-2:** Industrial

**ISO 7637, pulses #2b, 4:** DC Supply Surge Voltage Test

**Mil Std 202C, Method 101:** Salt Fog Test

**ANSI C62.41:** Surge Withstand

**IEC 801.2, 3, 4, 5**

**ISO9001:** PowerCommand control systems and generator sets are designed and manufactured in ISO9001 certified facilities.

## Warranty

PowerCommand control systems are a part of complete power systems provided by Cummins and are covered by a one year limited warranty as a standard feature.

Extended warranty options are available for coverage up to 10 years.

## Options and accessories

- Isolated bus paralleling. Provides all automatic and manual paralleling functions for systems that operate isolated from the utility service.
- Full function paralleling. Provides all paralleling functions, including automatic and manual operation, protection, and other features described in this document.
- Open transition power transfer control. Control will operate two circuit breakers to provide power transfer between a normal source and a generator in a “break before make” sequence.
- Fast closed transition power transfer control. Control will operate two circuit breakers to provide power transfer between a normal source and generator in a “make before break” sequence between live sources, and “break before make” from a failed source. Overlap between sources is 100 mS or less.
- Closed transition (ramping) power transfer control. Control will operate two circuit breakers to provide power transfer between a normal source and generator in a “make before break” sequence between live sources, and “break before make” from a failed source. Overlap time between sources is configurable, and control ramps load from source to source to minimize disturbances on transfer.
- Key-type mode select switch.
- Ground fault alarm module.
- Exhaust temperature monitoring.
- Alternator temperature monitoring.
- Network Interface Module
- Digital remote annunciator. (See S-1343)
- Digital output relay module (See S-1431)
- Modbus<sup>®</sup> interface. (See S-1471)
- Cummins iWatch™ remote monitoring system (S-1518)
- Cummins iWatch Wireless™ remote monitoring system (S-1572)
- ILSI (isochronous load sharing interface). Allows PowerCommand to share real load with other load sharing systems that incorporate analog load sharing lines. See document C604 for more information.
- Utility protective relaying. Gensets can be provided with power switching mechanisms and utility grade protective relaying to meet local grid protection requirements.

**For more information contact your local Cummins distributor  
or visit [power.cummins.com](http://power.cummins.com)**

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