

Digital generator set control PowerCommand® 3100



> Specification sheet

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Description

The PowerCommand® 3100 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. 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 a wide range of generator sets in non-paralleling applications. The PowerCommand Control will directly read AC voltages up to 600 VAC and can be configured for any frequency, voltage and power connection configuration from 120-600 VAC. It functions over a voltage range from 8 VDC to 35 VDC.

The control offers a wide range of standard control and digital display features so custom control configurations are not needed to meet application specifications. System reliability is not compromised by use of untested special components.

Power for PowerCommand control is usually derived from the generator set starting batteries.

Features

Digital engine speed governing controls - Provide isochronous frequency regulation.

Digital voltage regulation - 3-phase sensing.

AmpSentry™ protective relay - True alternator over current protection.

Analog and digital AC output metering.

Battery monitoring system - Senses and warns against a weak battery condition.

Digital alarm and status message display.

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 PC-based software service tool.

PowerCommand network (optional) - Provides LonMark interface to external devices through a twisted pair wire.

Certifications - Suitable for use on generator sets that are designed, manufactured, tested, and certified to relevant UL, NFPA, ISO, IEC, and CSA standards.

Warranty and service - 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. Connections to the operator panel are locking plug interfaces for reliable, vibration-resistant interconnection to the generator set wiring harness.

Control switches and functions

Run/off/auto mode control switch - The *not in auto* lamp will flash when the control is in the run or off mode. In the *auto* mode, the generator set can be started with a start signal from a remote device, such as an automatic transfer switch. In the *run* position the generator set will start and accelerate to rated speed and voltage. In the *run* mode, the control can be configured to operate at idle speed with the excitation switched off.

Panel lamp control switch - Depressing the *panel lamp* switch will cause the panel illumination to operate for approximately 8 minutes.

Emergency stop control switch - Pressing the *emergency stop* switch will cause the generator set to immediately shut down. The generator set is prevented from running or cranking with the switch pressed in.

Reset switch - Clears the digital display and status panel and allows the generator set to be started after a fault has been corrected.

Self test switch - Prompts the control to perform a self-test of the system and displays all fault messages.

Phase select switch - Controls the phase that is displayed on the analog AC Instrumentation.

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 ($\pm 5\%$)
- Alternator frequency ($\pm 5\%$)

Indicating lamps

The operator panel includes a series of LED indicating lamps to allow the operator to view the general status of the generator set. Functions displayed include:

Red (flashing) lamp to indicate *not-in-auto* mode and a red lamp to indicate common shutdown.

Amber lamp for common warning.

Phase and scale indication. Indicates the phase that is displayed on the analog AC instruments.

Analog AC metering panel

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

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Analog metering on the control panel provides clear indication of generator set stability including the magnitude of displacement and rate of change during lead transients which cannot be viewed clearly with digital metering equipment. These meters are also ideal for “walk-by” status checks by the operator. All meters are 63.5 mm (2.5 in), 90-degree scale. Meter faces UV protected against discoloration from exposure to sunlight. The kilowatt meter and ammeter are scaled in percent of AC output for easy recognition of generator set status and load level (0-90% of rating: green; 90-100% of rating: amber; >100% of rating: red).

Percent kilowatt meter - Indicates 3-phase AC power output as a percent of rated load. Provides a true indication of total kW load on the generator set, regardless of the load power factor. Scale is 0-125%. Accuracy is $\pm 5\%$.

Frequency meter - Indicates generator set output frequency in hertz. Calculated frequency is based on engine speed and alternator voltage zero-crossing and is not affected by voltage waveform distortion caused by non-linear loads. Scale is 45-65 Hz. Accuracy is ± 0.5 Hz.

AC voltmeter - Dual scale AC voltmeter indicates alternator output voltage. Accuracy: $\pm 2\%$. Scales: 0-300 VAC, 0-600 VAC; 0-400 VAC, 0-750 VAC; 0-5260 VAC; or 0-15,000 VAC.

% AC ammeter - Indicates current output in percent of maximum rated standby current. Accuracy: $\pm 2\%$. Scale: 0-125%.

Alphanumeric display panel

The PowerCommand control is provided with an alphanumeric display capable of displaying 2 lines of data with approximately 20 characters per line. The 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. (There are no rotary potentiometers in the control. All adjustments are made via the display panel or InPower). Display is configurable for multiple languages. It is configurable for units of measurement.

All data on the control can be viewed by scrolling through screens with the navigation keys.

The control displays all active fault conditions with the latest displayed first. Active and inactive faults are displayed.

The display panel includes a screen-saver timer that will turn off the display after 10 minutes of inactivity. Touching any key will turn the screen back on.

Generator set hardware data - Generator set rating in kVA, generator set model number. The control stores the software version present in the control.

Data logs - Number of start attempts and duration of generator set running time. Generator set kWh produced.

Fault history - Provides a record of the most recent fault conditions with time stamp. Up to 20 events are stored in the control non-volatile memory.

Load profile data - Control logs data indicating the operating hours at percent of rated kW load in 10% increments. InPower is used to read this.

Generator set output voltage - All phases, line-to-line and line-to-neutral, accuracy 1%. Data for all phases is displayed simultaneously to allow viewing of voltage balance.

Generator set output current - All phases, accuracy 1%. Data for all phases is displayed simultaneously to allow viewing of load balance.

Generator set output frequency.

Generator set power output - PowerCommand displays generator set kW and power factor with leading/lagging indication. Accuracy 5%.

Generator set kWh power output - Displays total kilowatt-hours produced by the generator set.

Engine starting battery voltage.

Engine lube oil pressure.

Engine coolant temperature.

Engine lube oil temperature.

Engine exhaust temperature (option).

Service adjustments - The operator panel includes provisions for adjustment and set up of all control functions in the generator set. The operator panel includes an access code that is used to protect the control from unauthorized service level adjustments.

Internal control functions

Engine control

Remote 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 control of the engine fuel system and alternator excitation system.

The control can incorporate a time delay start and a warm-up period at idle speed. See *Engine governing* for details.

Sleep mode - PowerCommand can be configured to include a sleep mode. When enabled, and when the mode select switch is in the *off* position, the control will revert to a low power consumption mode until a control switch on the operator panel is operated or a remote signal is received.

Fault simulation mode - PowerCommand, in conjunction with InPower software, will accept commands to allow a technician to verify the proper operation of all protective functions of the control by simulating failure modes or by forcing the control to operate outside of its normal operating ranges.

Engine starting - The control system automatically controls the engine starter and provides proper engine fueling and alternator control to provide fast and efficient 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.

Time delay start and stop (cool down) -

Configurable for time delay of 0-300 seconds prior to starting after receiving a remote start signal; and for time delay of 0-600 seconds prior to ramp-to-idle or shutdown after signal to stop in normal operation modes. Default for both time delay periods is 0 seconds.

Engine governing

The PowerCommand control includes integrated digital governing capability to directly drive an engine fuel control valve. Features of the governing system (when enabled) include:

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.

Temperature dynamics - Modifies the engine fuel system (governing) 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.

Idle mode - The control system accepts a signal to control engine speed to a preset, adjustable idle speed when operating in the *run* mode.

Alternator control

PowerCommand includes an integrated 3-phase line-to-neutral sensing voltage regulation system that is compatible with either shunt or PMG type excitation systems. The voltage regulation system is full wave rectified and has a PWM output for good motor starting capability and stability when powering non-linear loads. Major system features include:

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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. Control is configurable for operation of self-excited or separately-excited alternators.

Torque-matched V/Hz overload control - The rate of decay (i.e., the slope of the v/Hz curve) is adjustable in the control.

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. The regulation system will drive a permanent magnet generator (PMG) to provide 3 times rated current on all phases for motor starting and short circuit coordination purposes.

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

Some protective functions within the control system are configurable for warning or shutdown.

PowerCommand provides the following system protective functions:

Ground fault warning (option - 600 VAC class generator sets with solid ground) - Ground 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 (configurable contact closed to ground or open) to indicate customer-specified conditions. The control is programmable for warning or shutdown and for labeling the input.

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

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

High coolant temperature warning - Level is preset to match the capabilities of each engine. Control includes time delays to prevent nuisance shutdown signals.

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.

Weak battery warning - The control system will test the battery bank each time the generator set is signaled 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 signaled starter to crank engine but engine does not rotate.

Redundant starter disconnect.

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.

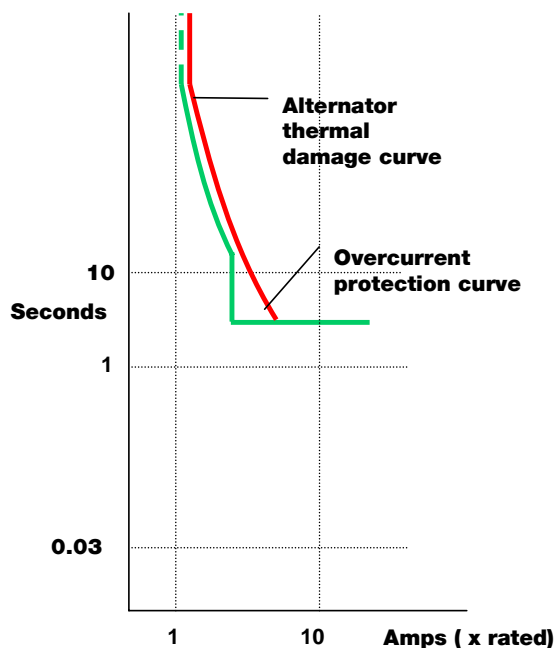
AmpSentry protective relay

A 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

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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 for a full size time overcurrent curve.



R1053

Functions include:

Over current warning - Output current on any phase at more than 110% of rating for more than 60 seconds or more than 400% for more than 1 second.

Over current shutdown (51) - 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.

Short circuit shutdown - Output current on any phase is more than 110%, more 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.

High AC voltage shutdown (59) - Output voltage on any phase exceeds preset values. Time to trip is inversely proportional to amount above threshold. Setting is more than 110% for 10 seconds or instantaneous at more than 130% of nominal voltage.

Low AC voltage shutdown (27) - Voltage on any phase has dropped below a preset value. Setting is 85% for 10 seconds.

Under frequency shutdown (81u) - Generator set output frequency cannot be maintained. Settings are 10% nominal governor set point with a 20 second time delay.

Over load (kW) warning - Provides a warning indication when engine is operating at a load level over 100% for more than 5 seconds. A dedicated output relay is provided for use by the customer for load shedding.

High alternator temperature (option).

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 -55 °C to +80 °C (-67 °F to +176 °F). Control will operate with humidity up to 95%, non-condensing and at altitudes up to 5000 m (13,000 feet).

The control system is housed in a NEMA 1/IP23 enclosure. 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 and tested 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.

Control interface

Input signals to the PowerCommand control include:

Remote start signal - May be connected via either discrete signal or Lon™ Network, or both for premium reliability.

Remote emergency stop.

Configurable customer inputs - Control includes (4) input signals from customer discrete devices that are configurable for warning, shutdown or status indication, as well as message displayed.

Low fuel level input.

Remote alarm reset.

Output signals from the control include:

Auxiliary “run” relays - (up to 3 optional) Each relay provides three sets of Form C contacts rated 2 A @ 30 VDC.

Generator set common shutdown signal - Form C relay contact (1 normally open and 1 normally closed contact with common) rated 2 A @ 30 VDC/180 VAC.

Load shed signal - Form A relay contact, rated 2 A @ 30 VDC/180 VAC. Operation is configurable for under frequency or over kW load, or both.

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Ready to load signal - Form A relay contact, rated 2 A @ 30 VDC/180 VAC. Operates when the generator sets has reached 90% of rated speed and voltage and latches until generator set is switched to off or idle mode.

NFPA110 alarm relays - One form A contact for each condition, each rated 2 A @ 30 VDC/180 VAC.

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 software.

Echelon LonWorks™ interface (optional) - PowerCommand generator sets incorporating this option are LonMark compliant.

Software

InPower - A 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® - A software tool that is used to remotely monitor and control generator sets, transfer switches and other on-site power system devices.

Warranty

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

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

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-M1999: 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 50081-2: Industrial Emissions

EN 50082-2: Industrial Susceptibility

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.

Options and accessories

- Key-type mode select switch
- Ground fault alarm module
- Exhaust temperature monitoring
- Alternator temperature monitoring
- Digital remote annunciator
- Digital output relay module
- LON interface
- Digital paralleling controls - functions can be field retrofitted to this basic control

See your distributor for more information

Cummins Power Generation

Americas

1400 73rd Avenue N.E.
Minneapolis, MN 55432 USA
Phone: 763 574 5000
Fax: 763 574 5298

Europe, CIS, Middle East and Africa

Manston Park Columbus Ave.
Manston Ramsgate
Kent CT 12 5BF United Kingdom
Phone 44 1843 255000
Fax 44 1843 255902

Asia Pacific

10 Toh Guan Road #07-01
TT International Tradepark
Singapore 608838
Phone 65 6417 2388
Fax 65 6417 2399

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building electrical except through an approved device or after building main breaker is open.