

PowerCommand

Digital Generator Set Control



Description

The PowerCommand™ Control (3100) 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.

PowerCommand generator set controls are suitable for use on a wide range of generator sets in non-paralleling applications. The PowerCommand Control will directly read AC voltages up to 600VAC, and can be configured for any frequency, voltage, and power connection configuration from 120-600VAC.

The PowerCommand control is designed for mounting on the generator set.

Control power for PowerCommand is usually derived from the generator set starting batteries. The control functions over a voltage range from 8VDC to 35VDC.

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.

Features

Major Control Features Include:

- **Digital Engine Speed Governing Controls** to provide isochronous frequency regulation.
- **Digital Voltage Regulation**, 3-phase sensing
- **AmpSentry™ Protection** for true alternator overcurrent protection.
- **Analog and Digital AC Output Metering.**
- **Battery Monitoring System** to sense and warn 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** using 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 (plus or minus 5%)
 - Alternator frequency (plus or minus 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.

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 as clearly with digital metering equipment. These meters are also ideal for “walk-by” status checks by the operator. All meters are 2.5-inch (63.5mm), 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).

- **% 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: 0-300VAC, 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 five 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 (total power), 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, and 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 start 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 (cooldown) -

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 shut down 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 plus or minus 0.25% for any steady state load from no load to full load. Frequency drift will not exceed plus or minus 0.5% for a 60F (33C) 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:

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 plus or minus 0.5% for a 60F (33C) 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 Volts/Hz Overload Control - The rate of decay (i.e., the slope of the volts/hertz 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, and initiate shut down 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:

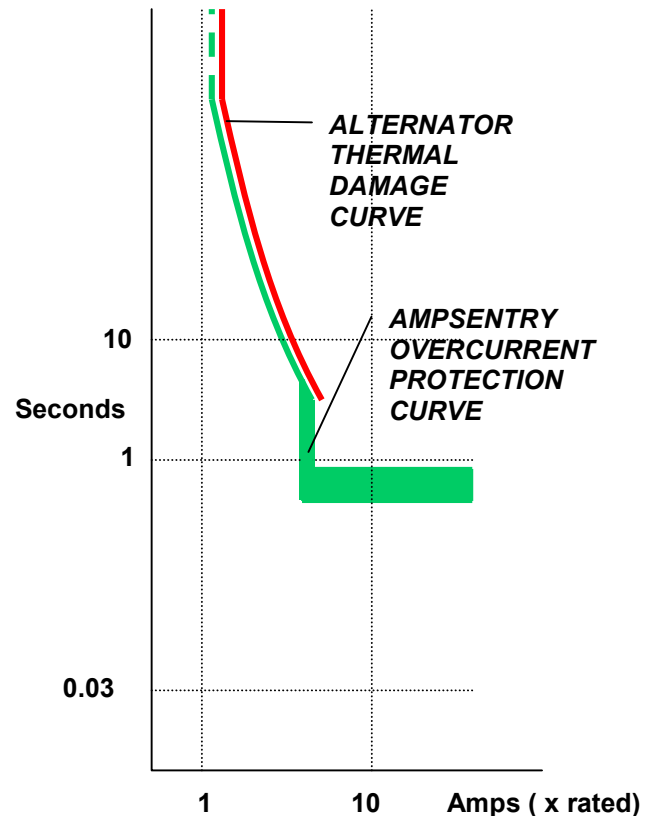
- **Ground Fault Warning (option- 600VAC class generator sets with solid ground)** - Ground fault sensing is adjustable over a range of 100-1200 amps, with time delays of 0-1 second. May be configured for shutdown rather than alarm.
- **Configurable Alarm And Status Inputs** - PowerCommand will accept 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

- **Overspeed 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™

AmpSentry is a comprehensive monitoring and control system integral to the PowerCommand control 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 3-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.



Functions included:

- **Over Current Warning** - Output current on any phase at more than 110% of rating for more than 60 seconds, or more that 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. 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.
- **Under Frequency Shutdown (81u)** - Generator set output frequency cannot be maintained. Settings are adjustable from 0-10 hertz below nominal governor set point, for a 0-20 second time delay. Default: 6Hz, 10 seconds.
- **Over Load (kW) Warning** - Provides a warning indication when engine is operating at a load level over a set point. Defaults: 105%, 60 seconds.
- **High Alternator Temperature (Option)**

Environment

The control is designed for proper operation without recalibration in ambient temperatures from -40C to +70C, and for storage from -55C to +80C. Control will operate with humidity up to 95%, non-condensing, and at altitudes up to 13,000 feet (5000 meters).

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.

Certifications

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

- **NFPA110** for level 1 systems.
- **UL508** Listed, Category NIWT7 for US and Canada.
- **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
- **EC Marking**
- **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**

PowerCommand control systems and generator sets are designed and manufactured in ISO9001 certified facilities. The control is suitable for use on generator sets that are UL2200 listed.

Software

InPower

InPower is 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

PowerCommand for Windows is a software tool that is used to remotely monitor and control generator sets, transfer switches, and other on-site power system devices.

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 2A @ 30VDC.
- **Generator Set Common Shutdown signal.** Form C relay contact (1 normally open and 1 normally closed contact with common) rated 2A @ 30VDC/180VAC.
- **Load Shed signal.** Form A relay contact, rated 2A @ 30VDC/180VAC. Operation is configurable for under frequency or over kW load, or both.
- **Ready to Load signal.** Form A relay contact, rated 2A @ 30VDC/180VAC. 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.
- **NFPA110 Alarm Relays –** One form A contact for each condition, each rated 2A @ 30VDC/180VAC.

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.

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.** Control functions can be field retrofitted to this basic control.

Warranty

All components and subsystems are covered by an express limited one-year warranty. Other optional and extended factory warranties and local distributor maintenance agreements are available. Contact your distributor/dealer for more information.

Certifications



ISO9001 - This product set was designed and manufactured in facilities certified to ISO9001.



CSA - This product is CSA certified.



PTS - The Prototype Test Support (PTS) program verifies the performance integrity of a generator set design. Products bearing the PTS symbol have been subjected to demanding tests in accordance to NFPA 110 to verify the design integrity and performance under both normal and abnormal operating conditions.



UL - The generator set is UL508 listed and suitable for use on generator sets that are listed to UL2200, Stationary Engine Generator Assemblies. The PowerCommand control is Listed to UL508 - Category NITW7 for U.S. and Canadian usage.

CE - This product is suitable for use on generator sets that are CE marked.

See your distributor for more information



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Important: Backfeed to a utility system can cause electrocution and/or property damage. Do not connect generator sets to any building electrical system except through an approved device or after building main switch is open.