Generator set control
PowerCommand®
MCM3320

Description
The PowerCommand® Master Control Module (MCM3320) is a microprocessor-based system control component that is optimized for use with PowerCommand Digital Paralleling genset controls. The MCM3320 integrates master functions into a single control system, providing enhanced reliability and performance compared to conventional control systems.

The MCM3320 is configurable for a number of different operating arrangements. A Power Transfer Control function provides load transfer operation in open transition, closed transition or soft (ramping) transfer modes in a similar fashion to automatic transfer switch controls. The control includes extended parallel/peak shave functions. System topologies supported include transfer pair, common bus (no gen main breaker) and isolated bus with and without logically controlled generator main.

The MCM3320 will directly read AC voltages up to 480 VAC, and can be configured for any frequency, voltage and power connection configuration from 110 to 35,000 VAC.

The MCM3320 is designed for switchgear mounting, but is environmentally protected for operation in severe applications.

Control power for the MCM3320 is typically derived from the generator set starting batteries. The module can be connected to two independent DC sources for redundancy. The control functions over a voltage range from 9 VDC to 32 VDC and requires less than 1 amp for operation.

PowerCommand controls are supported by a worldwide network of independent distributors who provide parts, certified service and warranty support.

Features

Bus synchronizing - Allows one or more gensets with PowerCommand digital paralleling controls operating on a common bus to be actively synchronized to another system bus. Synchronizing function provides for frequency/phase angle and voltage matching.

Dual source bus AC metering - Provides simultaneous metering of the genset bus and secondary bus for voltage, frequency, power and energy functions.

Test mode - Starts gensets with option to transfer the load to the genset bus (with load or without load test).

Real time clock with scheduler - Provides 12 programs and 6 exceptions for automatically initiating a test without load, test with load or a base load or peak shave session.

Load demand - Controls the number of generators sets operating to optimize system operating cost.

Load add/shed control - Provides signals to control remote loads so that bus overload is avoided on black start or due to system overloads while in operation.

Sync check - The sync check function has adjustments for phase angle window, voltage window, frequency window and time delay.

Diagnostics - A full suite of built-in diagnostics allows accurate and quick system troubleshooting.

Modbus RTU Interface - Allows easy system monitoring by many 3rd party devices.

Optional operator panels - Analog meter displays and auxiliary relay panels allow customization to meet specific site requirements with cost effective standard modules.

Advanced serviceability - Utilizing InPower™, a PC-based software service tool, as well as a comprehensive package of visual condition displays that are integrated onto the control board.
**Construction**

The MCM3320 is a single board, potted control module that interfaces to external components through locking plug-in terminal blocks suitable for wiring up to 2.5 mm (12 ga).

**Status Indicators**

The MCM3320 includes a series of integrated operator display functions.

On-board LEDs provide the following status indications:

- Control operating (green flashing)
- Utility connected (green)
- Utility available (green)
- Generator bus connected (amber)
- Generator bus available (amber)
- Common warning (amber)
- Not in auto (red flashing)
- Fail to synchronize (red)
- Synchronizing (green flashing)
- Sync check OK (green)

An on-board alphanumeric coded display provides the following status indications:

- Timing to start
- Timing to stop
- Timing program transition
- Timing to transfer
- Timing to retransfer
- Synchronizing
- OK to close
- Base load mode
- Peak shave mode
- Ramping load on
- Ramping load off
- Manual mode
- Standby mode
- Utility failed
- Test mode

The display also provides fault information to the user.

**Functions**

**Bus synchronizing** - Control incorporates a digital master synchronizing function to force a bus of connected generator sets to match the frequency, phase and voltage of another source such as a utility grid. The synchronizer includes provisions for proper operation even with highly distorted bus voltage waveforms and will accommodate up to a minimum of 20 gensets. The synchronizer can match other sources over a range of 90-110% of nominal voltage and up to ±3 Hz and is configurable for units of measurement and has adjustable screen contrast and brightness.

The synchronizer function is configurable for slip frequency synchronizing for applications requiring a known direction of power flow at instant of breaker closure or for applications where phase synchronization performance is otherwise inadequate.

**Sync check** - The sync check function decides when permissive conditions have been met to allow breaker closure. Adjustible criteria are: phase difference from 0.1-20°, frequency difference from 0.001-1.0 Hz, voltage difference from 0.5-10% and a dwell time from 0.5-5.0 seconds. Internally, the sync check is used to perform closed transition operations. An external sync check output is also available. In Master Sync only applications, sync check can also be configured individually to activate in live-dead, dead-live and dead-dead bus conditions.

**Dual source bus AC metering** - The control provides comprehensive three phase AC metering functions for both monitored sources, including: 3-phase voltage (line to-line and line-to-neutral) and current, frequency, phase rotation, individual phase and totalized values of kW, kVar, kVA and power factor; totalized positive and negative kW-hours, kVar-hours and kVA-hours. Three wire or four wire voltage connection with direct sensing of voltages to 480 V, and up to 35 kV with external transformers. Current sensing is accomplished with either 5 amp or 1 CT secondaries and with up to 10,000 amps primary. Maximum power readings are 32,000 kW/kVar/ kVA.

**Power transfer control** - Provides integrated automatic power transfer functions including source availability sensing, gensets start/stop and transfer pair monitoring and control. The transfer/retransfer is configurable for open transition, fast closed transition (less than 100 msec interconnect time) or soft closed transition (load ramping) sequences of operation. Utility source failure will automatically start gensets and transfer load, retransferring when utility source returns. Test will start gensets and transfer load if test with load is enabled.

**Sensors and timers include:**

- **Under voltage sensor:** 3-phase L-N or L-L under voltage sensing adjustable for pickup from 85-100% of nominal. Dropout adjustable from 75-98% of pickup. Dropout delay adjustable from 0.1-30 sec
- **Over voltage sensor:** 3-phase L-N or L-L over voltage sensing adjustable for pickup from 95-99% of dropout. Dropout adjustable from 105-135% of nominal. Dropout delay adjustable from 0.5-120 seconds. Standard configuration is disabled, and is configurable to enabled in the field using the optional operator panel or InPower service tools
- **Over/under frequency sensor:** Center frequency adjustable from 45-65Hz. Dropout bandwidth adjustable from 0.3-5% of center frequency beyond pickup bandwidth. Pickup bandwidth adjustable from 0.3-20% of center frequency. Field configurable to enable
- **Loss of phase sensor:** Detects out of range voltage phase angle relationship. Field configurable to enable
- **Phase rotation sensor:** Checks for valid phase rotation of source. Field configurable to enable

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Breaker tripped: If the breaker tripped input is active, the associated source will be considered as unavailable.

Genset online capacity sensor: Optionally enabled sensor. Use to require minimum kW capacity online before closing generator bus main breaker.

Timers: Control provides adjustable start delay from 0-3600 sec, stop delay from 0-3600 sec, transfer delay from 0-120 sec, retransfer delay from 0-1800 sec, programmed transition delay from 0-60 sec and maximum parallel time from 0-1800 sec.

Breaker control - Utility main and genset main breaker interfaces include separate relays for opening and closing breaker, as well as inputs for both 'a' and 'b' breaker position contacts and tripped status. Breaker diagnostics include contact failure, fail to close, fail to open, fail to disconnect and tripped. Upon breaker failure, appropriate control action is taken to maintain system integrity.

Extended paralleling - In extended paralleling mode (when enabled) the controller will start gensets and parallel to a utility source and then govern the real and reactive power output of the gensets based on the desired control point. Function will support up to 20 gensets with a total rating of up to 32000 kW. The control point for the real power (kW) can be configured for either the genset bus metering point ("base load") or the utility metering point ("peak shave"). The control point for the reactive power (kVar or power factor) can also be independently configured for either the genset bus metering point or the utility metering point. This flexibility would allow base kW load from the gensets while maintaining the utility power factor at a reasonable value to avoid penalties due to low power factor. The system always operates within genset ratings. The control point can be changed while the system is in operation. Set points can be adjusted via hardwired analog input or adjusted through an operator panel display or service tool.

Scheduler - The scheduler (when enabled) allows the system to be operated at preset times in either test without load, test with load, or extended parallel mode. A real time clock is built in. Up to 12 different programs can be set for day of week, time of day, duration, repeat interval and mode. For example, a test with load for 1 hour every Tuesday at 2 AM can be programmed. Up to 6 different exceptions can also be set up to block a program from running during a specific date and time period.

Load demand - Load demand (when enabled) will attempt to match generating capacity to load, typically for the conservation of fuel or optimizing of generator set life. The load demand function will support from 2 to 4 gensets. Shutdown sequence can either be a fixed sequence or can be based on running hours. With fixed sequence method, the sequence can be changed while the system is in operation. Running hours method will attempt to equalize genset hours over time by exchanging stopped and running gensets. To protect system integrity, load demand will restart all gensets whenever an overload condition is detected. The minimum amount of capacity to maintain online is adjustable. Initial delay for load demand to begin operation is adjustable from 1-60 minutes. Shutdown threshold is adjustable from 20-100% of online capacity minus one. Shutdown delay is adjustable from 1-60 minutes. Restart threshold is adjustable from 20-100% of online capacity. Run hours differential is adjustable from 1-500 hours.

Load add/shed - Load add and shed (when enabled) will control and monitor up to 6 load step levels (such as feeder breaker or automatic transfer switches) in any combination. Up to 6 levels of load add and up to 6 levels of load shed may be defined. The loads add/shed function will support up to 4 gensets. Loads can be added as gensets come online as well as on a timed basis. Loads are shed on a timed basis when an overload condition is detected, protecting system integrity. Shed loads can be restored through operator action. Manual load add and shed is also provided. Load add delay is adjustable from 1-60 sec. Load shed delay is adjustable from 1-10 sec.

System topologies - Controller is configured to operate in one of five possible system topologies.

These topologies can be used in combinations in larger systems with coordination by external device. Topologies that may be selected in the control include:

- **Transfer pair**: System consists of a breaker pair - one a generator bus main and the other a utility main.

MCM3320 controls both breakers in open transition, fast closed transition or ramping closed transition modes. It can also be programmed to exercise the generator set bus in parallel with the utility or operate at a programmable output level.

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Common bus: system consists of a utility main breaker, but no genset main breaker (only individual genset paralleling breakers)

Fault simulation mode - The MCM3320 in conjunction with InPower software, will accept commands to allow a technician to verify the proper operation of the control and its interface 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 provided by the controller.

Protective functions - PowerCommand provides the following system protective functions for each breaker or bus. Note that each protective function will cause the control to take intelligent corrective action to best resolve the problem until an operator can address it. See the Intelligent protective action section for details.

Diagnostics can be mapped to any of 8 configurable low-side driver outputs for external use such as driving relays, lamps or as signals to other system devices.

Breaker fail to close warning: When the MCM3320 signals a circuit breaker to close, it will monitor the breaker auxiliary contacts and verify that the breaker has closed. If the control does not sense a breaker closure within an adjustable time period after the close signal, the fail to close warning will be initiated.

Breaker position contact warning: The controller will monitor both ‘a’ and ‘b’ position contacts from the breaker. If the contacts disagree as to the breaker position, the breaker position contact warning will be initiated.

Breaker fail to open warning: The control system monitors the operation of breakers that have been signaled to open. If the breaker does not open within an adjustable time delay, a breaker fail to open warning is initiated.

Breaker tripped warning: The control accepts inputs to monitor breaker trip/bell alarm contact and will initiate a breaker tripped warning if it should activate.

Fail to disconnect warning: If the controller is unable to open either breaker, a fail to disconnect warning is initiated. Typically this would be mapped to a configurable output, allowing an external device to trip a breaker.

Fail to synchronize warning: Indicates that the generator set bus could not be brought to synchronization with the system bus. Configurable for adjustable, time delay of 10-120 seconds.

Bus overload warning: The control monitors genset bus load relative to the online capacity. It also monitors bus frequency. On a configurable basis, control will initiate a bus overload warning if the bus kW load exceeds an adjustable threshold (80-140%) for an adjustable delay (0-120 s) or the bus frequency falls below an adjustable threshold (0.1-10 Hz) for an adjustable delay (0-20 s). Option to select either or both kW and frequency as triggers.

Protective functions and diagnostics

Data logging - The control maintains a record of control operations, warning conditions and other events. Records are time stamped.

Master synchronize only: controller will only perform metering, synchronizing, sync check and Modbus functions. Intended for use in systems where the only functions desired are metering and synchronizing.

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Maximum parallel time warning: During closed transition load transfers, control independently monitors paralleled time. If time is exceeded, warning is initiated and genset bus is disconnected.

**Intelligent protective action**

When abnormal situations are diagnosed by the control, it will provide as much corrective action as possible to keep the system operating.

**Utility main breaker fail to close warning** - Control will start the gensets and transfer load to the genset bus and remain there until operator resets the fault condition and resolves the problem.

**Genset main breaker fail to close warning** - Control will return to the utility source and will not retry until operator resets the fault condition and resolves the problem.

**Breaker position contact warning** - Control will check for current above a threshold on all 3 phases. If criteria is met, control will remain on the source. If not, control will attempt to transfer to other source.

**Fail to synchronize warning** - If control is trying to perform a closed transition retransfer, but fail to sync occurs, optionally, the control can be configured to perform the retransfer using open transition.

**Control interface**

**Inputs**

- **Synchronize enable** - manual mode sync on/off.
- **Utility source failure** - use with external protective relay.
- **Transfer inhibit** - prevents transfer to gensets.
- **Retransfer Inhibit** - prevents retransfer to utility*.
- **Override** - overrides delays and transfer/retransfer inhibit.
- **Manual** - prevents automatic breaker operation.
- **Test** - initiates a test (with or without load as configured).
- **Extended parallel** - initiates a base load or peak shave.
- **Reset faults** - resets latched faults.
- **Main breaker positions (2/4)** - ‘a’ or ‘a/b’ position inputs.
- **Main breaker tripped (2)** - from breaker bell alarm.
- **Main breaker inhibits (2)** - open/inhibit close of breakers.
- **Genset breaker positions (4)** - monitor gensets online.
- **KiloWatt set point** - 0-5 V for base load/peak shave.
- **kVar/PF set point** - 0-5 V for kVar or power factor.
- **3-phase voltages (2)** - 3 or 4 wire voltage sensing.
- **3-phase currents (2)** - 5 amp or 1 amp scale.

* Except in case of genset bus failure.

**Outputs**

**Configurable customer outputs** - Control includes (8) output signals (low-side relay drivers) for use by external equipment. These may be mapped to any control warning or event. Defaults settings are: common warning, fail to sync, gen bus available, util bus available, fail to disconnect, sync check OK, sync output limit and hardware failure. External relays can be powered from control.

**Generator set signals** - For each generator set in the system, the control provides start command, load demand, load govern enable, paralleling breaker inhibit and fuel rate and excitation control signals.

**Genset main and utility main breaker interfaces** - Dedicated separate relays are provided for breaker open and breaker close circuits.

**Network connections**

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

**Modbus RTU interface** - Provides a standard register map of system data, for use in monitoring by a remote device. Controller is a Modbus RTU slave device capable of communication on either RS232 or RS485. Modbus address is configurable allowing multiple MCM3320 slaves on a single RS485 bus. Baud rates up to 19200 are supported. A complete array of system control, adjustments and monitoring data are available and are documented in a published register map.

**PCCNet** - Proprietary serial interface to operator panel displays, auxiliary IO module and bar graph displays.

**Optional remote inputs/outputs**

To utilize the load add and load shed feature, the AUX101 and AUX102 modules are required. These modules provide the relay outputs and switch position inputs for controlling and monitoring up to 6 sets of load feeder breakers or 6 sets of transfer switches. The modules communicate with the MCM3320 over PCCNet.
Optional Operator Interface (HMI211)

The control is available with an optional operator panel that may be either locally or remotely mounted. Up to two panels may be used with a single MCM3320 control. The display is composed of a backlit LCD display, with a series of 6 status LED lamps. The display is accompanied by six tactile-feel membrane switches that are used by the operator to navigate through menus for system control, monitoring and adjustments. A main screen one-line diagram with AC data gives a quick overview of current system status. Control and adjustments are password protected. The graphical display is capable of displaying up to 9 lines of data with approximately 27 characters per line. It is adjustable for screen contrast and brightness.

LED indicating lamps - The optional display panel includes LED indicating lamps for the following functions:
- Utility parallel
- Lockout
- Warning
- Remote start
- Auto
- Manual

Home screen - The home screen provides information in a one-line format relevant to the current system operating state. Information includes source availability, source connected status, voltage, frequency and power data. Faults can also be reset from the home screen.

System status - The top line provides the current system status as well as countdown of any timer that is currently in effect such as a retransfer timer.

System control - The control menus allow initiating a test, base load, or peak shave operation as well as easy access to adjustments for relevant operating set points.

Adjustments - The adjustment screens allow complete configuring, setup and fine tuning of the controller settings.

Optional bar graph interface (HMI112)

The control is available with optional bar graph displays. Two displays are used with one MCM3320 control. One bar graph will be dedicated to the utility source, and the other to the genset bus. Bar graphs provide the following readings for each source:
- L1 current percent
- L2 current percent
- L3 current percent
- Total kW percent
- Power factor
- Frequency percent
- L1 L2 voltage percent
- L2 L3 voltage percent
- L3 L1 voltage percent
- Load add/shed modules

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 control system is specifically designed for resistance to RFI/EMI, and to resist the effects of vibration to provide a long reliable life when installed in harsh environment. The control includes transient voltage surge suppression to provide compliance to referenced standards.

The optional display panel is designed for proper operation in ambient temperatures from -20 °C to +70 °C (-4 °F to +158 °F) and for storage from -30 °C to +80 °C (-22 °F to +176 °F).
Certifications
PowerCommand SYNC1320 meets or exceeds the requirements of the following codes and standards:

UL508 recognized
CE Mark
EN 61000-6-2
EN 61000-6-4
ISO 7637, pulses #2, 3a, 3b, 5, 7
ISO9001 - PowerCommand control systems are designed and manufactured in ISO9001 certified facilities.

Software
InPower is a PC-based software service tool that is designed to directly communicate to PowerCommand products to facilitate setup, service and monitoring of these products.

Part numbers
MCM3320 (control) 0327-1520-01
HMI211 (operator panel) 0300-6090
Operator panel harness 0338-4747
HMI112 (bar graph) 0300-6050-01
AUX101/2 (load add shed) 0541-1342
Interconnect wiring diagram 0630-3133

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.

Dimensions