Specification sheet

PowerCommand® DMC8000

Description

The DMC8000 is a system level controller designed to interface directly with Cummins Power Generation PowerCommand® paralleling generator sets. The DMC8000, in conjunction with PowerCommand® genset controls, is a fully automatic, distributed logic controller suitable for unattended applications, which allows for a simpler and more reliable installation.

The control system is capable of controlling many power system architectures, including Isolated Bus, Common Bus, Transfer Pair, Multiple Transfer Pair, Redundant PLCs, Redundant I/O and Remote Screens.

The system is capable of various types of power transfer modes like open transition, 100ms closed transition, and ramping closed transition. The DMC8000 also includes utility paralleling functions for peak-shaving and base load operations. The DMC8000 incorporates a broad range of operational diagnostic functions to greatly enhance system reliability.

The DMC8000 features an easy-to-use, full-function resistive touch screen with multiple levels of operator access to ensure secure control.

Features

Load control – Load control, also known as "Load Add / Shed", is the process of staging load on to the system after power to the loads has been interrupted. This staging of load ensures that power quality is maintained and generators do not become overloaded during the application of load to the generators.

In addition to the orderly addition of load, the load control system also monitors the generators and will remove load from the system if the generators become overloaded.

Scheduler – The system scheduler is intended to allow automatic operation of the power system on a pre-defined schedule. The scheduler comes with twelve programmable schedules and six exception periods that block the periodic schedules from operating on a specific occasion.

Load demand – The load demand feature is used to match generating capacity to the load to optimize fuel efficiency and prolong generator set life while maintaining correct reserve capacity for the customer's application.

The DMC offers the flexibility in deciding between generator set operating percentages and facility load steps to determine the number of generators to run for a specific load.

Trending – Allows the operator to view the system operation over time. The operator can add up to 8 parameters to the trend at any one time. Both the scale for each parameter and the duration of the trend are adjustable. Available parameters can be selected via user friendly drop down menus.

Building management system interface – A Modbus® TCIP register map is provided for customer use in configuring third-party controls to monitor the system.

Reports and emailing – The DMC8000 can be configured to generate several reports to assist customers in producing documentation required by some regulating bodies. The DMC8000 also gives the customers the ability to conveniently email the reports when completed or on demand.

Warranty and service – Products are backed by a comprehensive warranty and a worldwide network of distributors with factory-trained service technicians.

Breaker control – Utility main and generator set 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. If a breaker fails, appropriate control action is taken to maintain system integrity.

Scheduler – Allows the system to be operated at preset times in 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 can be scheduled to run for one hour every Tuesday at 2 a.m. Up to six different exceptions can be set up to block a program from running during a specific time period.

Load demand – Load demand 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 an unlimited number of generator sets, even across multiple generator buses. 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 generator set hours over time by exchanging stopped and running generator sets. To protect system integrity, load demand will restart all generator sets 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 generator set. 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 control – The DMC considers a load to be a transfer switch or feeder breaker. The number and type of loads is customized to a customer’s system. Each load device has a set of control relays associated to it so that the load can be controlled individually by the DMC and so the control priority for the load can be adjustable programmatically. Additionally, each load has a set of status contacts associated with it. Typically this is hardwired except when a network connection is available on the ATS. In addition, each load can be given a custom name via the touch screen.

True RMS bus metering – Full-function true RMS bus AC metering (generator bus and utility bus).

Typical sequence of operation

PowerCommand® digital paralleling systems can be configured for nearly any logical sequence. The following description provides details of typical operation for the system components.

Synchronizing and paralleling

Normal Starting Sequence - System level controller or transfer switches signal each generator set to start in an emergency or test/exercise mode. When signaled, each generator set control automatically and independently starts each generator, accelerates to rated frequency and builds up to rated voltage. The integrated First Start Sensor System in each control monitors this process, and on finding a generator set at 90% of rated voltage and frequency, automatically disables all other units from closing to the bus and closes the ready unit to the generator bus. After the first unit is closed to the bus, the remaining generators sense availability of bus voltage and the synchronizer in each generator set control automatically switches on. Simultaneously, the synchronizer(s) cause each generator set to synchronize with the system bus and then close it at the proper time. As each unit closes to the bus, the unit assumes its proportional share of the total load on the bus.

Normal Stopping Sequence - When system start commands are removed from the generator sets, each generator set opens its paralleling breaker and the generator set performs its time delay stop and/or cool-down sequence. As each generator set completes its cool-down sequence, it is automatically switched off.

If a system start signal is received at the generator sets during the cool-down period, one generator set will immediately close to the system bus and all other units will synchronize to it, as described in ‘‘Loss of normal power’’ below.

Failure of a unit to start or synchronize - If a generator set fails to start, after the fail-to-start time delay (in the generator set control) has expired, the unit will be shut down and an alarm will sound. If a generator set fails to synchronize, after a preset time delay an alarm will sound but the unit will continue to attempt to synchronize until signaled to stop by manual operation of the control switches on the generator set.

Power Transfer Control

Loss of Normal Power - The power transfer control system continuously monitors the availability of each power source (utility service or generator bus) and automatically connects the system loads to the best available source based on settings programmable by the operator. On loss of normal power, each power transfer control executes a short time delay, then initiates generator system starting by issuing start commands to each generator set. When the first generator set has closed to the bus, the power transfer control system will sense the availability of generator capacity and begin transfer of loads to the generator bus by disconnecting the utility source and connecting the generator bus to system loads. The DMC may inhibit operation of some power transfer devices until adequate capacity is available to serve the connected loads. A manual control system is available to the operator to control sequence of operation of the power transfer controls.

For further information see ‘‘Load and capacity Management’’.

Return of Normal Power - When the power transfer control system has sensed that normal source power has returned and is within programmed limits and a time delay re-transfer period is completed, each power transfer control will begin a re-transfer process in either an open or closed transition mode, as selected by the operator. If running in the closed transition mode, the system synchronizes the generator bus to the first utility source, and closes to the utility source. If the system is designed for ‘‘soft’’ transfer between live sources, it ramps down load on the generator bus to a minimum value, and then opens the connection to the generator source. If the system is operating in a ‘‘fast’’ transfer mode, the ramping function is not used and the system will operate from source to source as quickly as possible, typically in 100 milliseconds or less. The transfer process is repeated sequentially across each power transfer point. If running in the open transition mode, the system sequentially transfers back to the utility by opening the connection to the generator bus at each transfer pair, then closing its associated utility connection at an operator-programmed time period. This process is completed at each power transfer point in the system, by each power transfer control. When all loads have been transferred back to the utility, power transfer control system removes the start commands from generator sets.

System Test or Exercise

Generator set exercise (test) without load - The system allows testing of the generator sets at no load. In this operation mode the generator sets will start, build up to rated speed and voltage, synchronize and close to the generator bus, but system loads will not automatically transfer to the generator system. If a power failure occurs during a test period, loads will immediately close into the system on a priority basis. When the system is operating in the closed transition mode, it will always transfer between ‘‘good’’ sources without a power interruption to the load.

Exercise (test) with load mode - The system will allow the generator sets to be tested by transfer of the system loads to the generator sets. Sequence of operation in this mode shall be similar to that described for a power failure condition, except that if the system is configured to perform closed transition transfer operations it will transfer the loads without interruption of power to the loads.

Load and Capacity Management

The load control system in the DMC automatically controls the addition of system loads to the generator bus and the number of generator sets operating on the system. The sequence may utilize automatic transfer switches or feeder breakers to control the load adding and shedding in the system. When all the generator sets are closed to the bus the system will sequence remaining loads on to the system in a timed sequence that is configurable by the operator. Loads may also be manually controlled (added or shed from the system) via the system touchscreen.

Bus overload - If a bus overload occurs for any reason, a signal will be generated to initiate load shedding in the system. If the bus does not return to proper frequency within a predetermined period of time (adjustable via the HMI), additional load shed signals will be generated until the generator set bus returns to normal frequency. Loads that are shed due to overload require manual reset via the HMI.

Load demand mode - When the system is running in the emergency mode with the "load demand" switch in the HMI in the "on" position, controls continuously monitor the total load on the bus. If the total load on the bus falls below preset limits for a period of 15 minutes (adjustable via the HMI), the controller will automatically shut down generator sets in an operator predetermined order until the minimum number of generators required to operate the load remain on the bus. On sensing that the available bus capacity is being approached, the standby units will automatically be restarted (in the reverse order of which they were shut down) and paralleled with the bus to assume their proportional share of system load. As each load parallels to the bus, load ramps to load share level. The system automatically compensates for generator sets of different sizes.

Construction

The control system is housed in a rigid, freestanding, NEMA1/IP40, metal enclosed structure designed to require front access only. Framework is constructed of minimum 2.0 mm (12 ga) steel sheet metal. The framework and all other sheet metal components of the system are primed with a rust-inhibiting primer and finished with satin finish ANSI 61 gray enamel. Control components are completely isolated from power-carrying components by metal or insulating barriers. All components and surfaces operating at more than 50 volts are shielded to prevent inadvertent contact. All control wiring is 105 °C (221 °F), 600 volt rated and sized as required for safe, reliable operation. Each wire, device and functional component is identified by silk-screen or similar permanent identification. Terminal blocks are provided for all field connections on DIN-rail mounted devices. The DMC may be integrated into the paralleling switchgear or provided in a separate, freestanding panel. Free-standing panels should be located within 100 meters (350 feet) of the switchgear. (Consult factory if longer distance is required.)

Operator panel

The easy-to-see operator panel provides the user with a complete range of easy-to-use information.

Touchscreen operator panel

A full color high-resolution 19 inch (diagonal) touchscreen operator interface panel (HMI) allows the operator to monitor and control the on-site power system. All data is configurable for display in either U.S. standard or metric indications. Screens are configured in a typical Windows® format. Each screen includes navigation buttons to allow quick access to other screens that are logically connected with the screen being displayed. Access to screens that impact on system settings or sequence of operation are controlled by a multi-level password system.

The HMI typically includes the following screens and/or functions:

One line diagram

The one-line diagram screen displays system status by a combination of animation, changing screen color, text messages, and pop-up indicators. Conditions visible on the screen include:

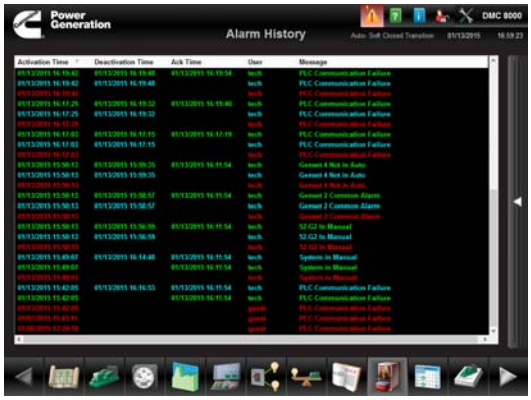
- Generator set(s) and bus configuration with generator set, parallel breaker and bus energized/de-energized indication (red indicating energized, green indicating deenergized).
- Generator set designation, with control data, and performance summary screens accessible through hot keys (links) located on or adjacent to the generator set icon.
- Generator set mode (run/off/auto).
- Generator set status (normal/warning/shutdown/load demand stop).
- Paralleling breaker status (open/closed/tripped/racked out). Optional status and condition displays of other breakers and devices can be supplied where required.
- Bus condition (energized or de-energized) Clicking on the bus icon provides access to a bus AC data screen.

For applications which include automatic transfer switches (ATS), the DMC provides a depiction of the ATS in the one line, indicating source availability and switch position. It also is available with detailed information access to each ATS in the system.

System Control

The system control screen provides the operator with the ability to enable or disable load demand operation, view timer values and the load demand sequence; initiate test (with or without load); control the shutdown sequence for the generator sets in the load demand mode; set the load demand time delays; set the load demand operation set points; and display and modify the automatic load add and shed sequence. The screen also allows setting of the source availability settings and sequence timing for power transfer. This screen is password-protected to prevent access to the configuration functions by unauthorized users.

System alarm history



The master control touchscreen records the date, time and nature of all alarm and shutdown conditions reported on the system. This log includes all alarms reported on the generator set and all master control and network connected functions.

Generator set and transfer switches retain a detailed independent log of their perspective operating histories, allowing the user to not only understand system level operation conditions, but also view details of operation of any component in the system.

Generator set status and control

The generator set status summary provides an analog and graphical display of critical generator set operating parameters for each generator set in the system. The screen includes generator set state display (stopped, time delay start, idle speed state, rated volts/hertz, synchronizing, load share or load govern); analog AC metering for generator set (3-phase, AC volts and current, frequency, kW and power factor); and three-phase AC bus voltage and frequency. The screen provides a complete display of engine and alternator data present in the generator set control. The screen also shows status of the generator set breaker. Hot buttons are provided for this data on all generator sets in the system, including system equipment provided by third parties.

Trending

The touchscreen provides real-time trend charts for AC output parameters and continuously monitors average voltage, frequency, total kilowatts, and average amperage. Scales of values displayed are field configurable.

Alarms

Any alarm on any generator set or in the system will cause an alarm bar and warning condition display to appear on the touchscreen. Touching the bar displays a pop-up screen describing the equipment where the fault has occurred, and the name of the fault. The screen allows the operator to attempt to reset warning conditions from the HMI.

Service information

System information and service information, including the name, address and phone number for the local service point for the equipment, is provided on the main menu screen for the system.

Operating modes

Test without Load

The Test without load mode of operation is used to ensure the operation of the generator sets, up to the point where the DMC would normally transfer power to the generators.

Test with Load

Test with load is a mode of operation that allows the operator to transfer the facility load to the generators.

The Test with load mode of operation can be triggered by an operator via the HMI, by an Input from a SCADA system, or periodically using the system scheduler. When a test is triggered the DMC looks at the selections for Transition Mode and Transfer pair selection to determine the test sequence to perform.

- Transition mode
  - Open transition
  - Hard closed transition (optional)
  - Soft closed transition (optional)
- Multiple transfer pairs (optional)
- Regulating Real Power
  - Genbus Percent
  - Genbus kW
  - Genbus kW with Utility Constraint
  - Utility Bus kW
- Regulating Reactive Power
  - Genset Controlled
  - Genbus Percent
  - Genbus Power Factor
  - Genbus kVAR
  - Utility Bus VAR
  - Utility Bus Power Factor
- Genset Limits
- Load Demand
- Protective Relays
  - Reverse Power Disable

Control interface - outputs

Generator set signals– For each generator set in the system, the control provides start command, load demand control, and control of the generator set excitation and fuel control systems for load control while paralleled with the utility service (mains).

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

Network connections

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. A complete array of system control, adjustments and monitoring data are available and are documented in a published register map.

Control power

Control power for the system is derived from the generator set 24 VDC starting batteries. A solid-state, no-break "best battery" selector system is provided so that control voltage is available from any generator set battery bank in the system. All incoming battery banks are isolated to prevent the failure of one battery bank from disabling the entire system. The core system control has redundant control power inputs for added reliability, as well as separate high/low DC voltage monitoring.

The PowerCommand® controls mounted on every generator set in the system continually monitors the battery charging system for low and high DC voltage and runs a battery load test every time the engine is started.

Functions and messages on the generator paralleling control include:

- Low DC voltage (battery voltage less than 24 VDC, except during engine cranking)
- High DC voltage (battery voltage greater than 32 VDC)

Software

DMC8000 is serviced with the following:

- Indusoft Studio 7.1
- Unity 8.1

Certifications

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

- CSA C282-M1999 Emergency Electrical Power Supply for Buildings
- CSA 22.2 No. 14 M91 Industrial Controls
- CE Marked
- EN 61439-2 Low Voltage Switchgear and Control Gear
- NFPA 70: U.S. National Electrical Code
- PowerCommand® controls are suitable for use in emergency, critical and standby applications, as defined in articles 700, 701, and 702.
- NFPA 99: Standard for Health Care Facilities
- NFPA 110 for level 1 systems
- UL 891 Listed, Category NIWT7 for U.S. and Canada.
- PowerCommand® control systems and generator sets are designed and manufactured in ISO9001 certified facilities
- IBC – all Risk Categories I to IV structures, shake testing qualified
- OSHPD – all California Building Code Risk Category I to IV structures, shake testing qualified

Environment

The control is designed for proper operation without recalibration in ambient temperatures from 0 °C to +45 °C (32 °F to 113 °F) and for storage from -20 °C to +70 °C (-4 °F to 158 °F). Control will operate with humidity up to 95%, non-condensing, and at altitudes up to 5000 meters (10,000 feet).

Warranty

As components of a Cummins Power Generation system, PowerCommand® controls are covered by a standard one-year limited warranty. Warranty options are available; consult your local distributor for details.

See your distributor for more information

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