



Arecibo Observatory Switchgear

KEEP THIS MANUAL NEAR THE SYSTEM CONTROLS

Supplied and serviced by

Cummins Caribbean, LLC
C/1 G/1 Palmas Industrial Park
Catania, PR 00922
(787) 275-2000

Manufactured by

Cummins Power Generation
1400 73rd Avenue
Fridley MN 55432-3702
(763) 574-5000

Order number

7071681

System model

PCIL2004R-772F

SPCL9999R-780A

www.cumminspower.com

Operation & Maintenance Manual

THIS PAGE LEFT INTENTIONALLY BLANK

Introduction		IN-1
Safety and Maintenance		1
Major Components		2
Control Interface		3
Construction		4
Certifications		5
Safety Precautions		SP-1
Operation		
Sequence of Operation		SO-1
Screen Operation		TO-1
Digital MasterControl		1
Main Menu		2
Touchscreen Security System Operation		3
Auto Logout Feature		5
Main Oneline		7
Genset Oneline		9
Genset Manual Control		11
Genset Summary		12
System Control		13
Load Control		16
Analog Meters		18
AC Metering		19
Current Alarms		20
Alarm History		21
Real-Time Trending		22
Set-up		23

Periodic Maintenance	PM-1
System Maintenance Schedule	1
Operation of a Protective Device	2
Periodic Running Test of Power System Equipment	3
System Test	3
Weekly Preventative Maintenance	3
Monthly Preventative Maintenance	4
Annual Preventative Maintenance	4
Maintenance Logs	
Troubleshooting	TS-1
Alarms	2
Lamps, Meters, Gauges, and Starter Solenoid	10
Wiring Diagrams	DR-1
Appendix: Supporting Documentation	SD-1
Cummins Power Generation	2
Network Information	3
Vendor Documentation	4
Recommended Spare Parts List	
Tests and Settings	

Cummins Power Generation of Fridley, Minnesota, supplied the electrical power equipment for this project. This manual provides a description of the major components, their operation, maintenance, and troubleshooting.

Safety and Maintenance

This equipment is designed to provide emergency/backup power to a facility. The system must be operated by trained personnel only. Severe injury, including death and property and equipment damage may result from failure to read and follow all safety precautions, maintenance instructions, and other details of operation.

Significant information throughout this manual is highlighted using these symbols.



Indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury



Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury



Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate personal injury or damage to product or property. May also be used to alert against unsafe practices.



Relates to, expands on, or highlights a particular fact or procedure

Major Components

The Cummins Power Generation integrated control system includes the following major components.

Digital MasterControl (DMC)

The PowerCommand DMC is a microprocessor-based paralleling system component, designed to interface directly with Cummins PowerCommand Paralleling generator sets. The DMC is designed for use in low- or medium-voltage isolated bus (not utility paralleled) applications.

The performance, environmental and physical characteristics of the power-generating and switching system components include:

- **Ambient temperature**
 - Operating: 32° to 122° F (0° to 50°C)
 - Storage: -22° to 158° F (-30° to 70°C)
 - Relative humidity: up to 95%, noncondensing
- **Dimensions**
 - 30 x 90 x 30 inches

Advantech 15" LCD touchscreen

Operating: 32° to 122° F (0° to 50°C)
Storage: -4° to 140°F (-20° to 60°C)
Relative humidity: up to 95%, noncondensing
Maximum resolution: 1024 x 768 (XGA)
Maximum colors: 256K
Backlight life time: 50,000 hours

NOTE

Bright or dark pixels on the LCD are a result of the production of the LCD. The LCD manufacturer claims that this is normal.

Programmable Logic Controller (PLC)

The PLC provides all system logic and control.

Paralleling Switchgear

Refer to the *Wiring Diagrams* chapter of this manual for system configuration.

Master First-start Sensor

The master first-start sensor provides interlocks and signals to individual genset paralleling breakers to prevent accidental closure of two gensets to a dead bus during system startup.

Genset and System Circuit Breakers

All circuit breakers operated by this system are located on the main switchboard. A (manual) load isolation circuit breaker is located on the genset.

Annunciator Panel (optional)

The remote annunciator(s) provide lights and a horn to annunciate the operating status and fault conditions of an emergency power system.

Network

The DMC includes network communications over a Cummins PowerCommand Network. The network utilizes Echelon Lonworks technology and is suitable for local or remote (optional) control and monitoring functions.

Control Interface

All control interconnections in the DMC are provided on standardized terminal block assemblies. Interconnections to external equipment include:

- **Load Add and Load Shed Relays (optional):** Each relay includes Form-C contacts (a normally open and a normally closed contact with common return) rated 10 A @ 600 VAC.
- **Paralleling Breaker Control Relays (optional):** Relays are driven directly by the genset control and mounted on the DMC for interconnection convenience.
- **Bus Voltage Connection:** The control includes fused 3-phase, 4-wire connections up to 600 VAC and provides a bus voltage reference signal to the genset control.
- **System Remote Start Command:** This allows for remote (with load) system testing.

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 2.5-mm/12-gauge (minimum) steel sheet metal. The framework and all other sheet metal components of the system are primed with a rust-inhibitor and finished with satin finish ANSI 61 gray enamel.

Control components are isolated from power-carrying components by metal or insulating barriers. All components and surfaces operating at more than 50 V are shielded to prevent accidental contact.

All control wiring is 105°C, 600 V rated, and sized as required for safe, reliable operation. Each wire, device, and functional component is identified by permanent identification.

Fuses are installed in DIN-rail mounted safety-type fuse holders. Terminal blocks are provided for all field connections on DIN-rail mounted devices.

Certifications

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

- CSA C282-M1999 Compliance
- CSA 22.2 No. 14 M91 Industrial Controls
- IEC 801.2: Electrostatic Discharge Test
- IEC 801.3: Radiated Susceptibility
- IEC 801.4: Electrically Fast Transient
- IEC 801.5: Radiated Emissions
- IEEE 587: Surge Immunity
- ISO 8528-4: 1993 Compliance, Control Systems for Reciprocating Engine-driven Generator Sets
- Mil Std 461: Electromagnetic Emission and Susceptibility Requirements
- NFPA 70: US National Electrical Code. PowerCommand controls is suitable for use in Emergency, Critical, and Standby applications, as defined in articles 700,701, and 702
- NFPA99: Standard for Health Care Facilities
- NFPA110 for level 1 systems
- UL508 Listed, Category NIWT7 for US and Canada

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



INTRODUCTION

THIS PAGE LEFT INTENTIONALLY BLANK

SAFETY PRECAUTIONS

The Cummins Power Command integrated control system generates and utilizes high voltage, which presents a serious burn and shock hazard that can result in injury or death. Observe all danger, warning, and caution notations within this manual and obey all safety placards on the equipment.



Arc flash and shock hazard appropriate personal protective equipment (PPE) is required. Do not operate controls or open covers without appropriate PPE. Failure to comply may result in injury or death. Refer to NFPA 70E for minimum PPE requirements.

Read this manual before operating or performing any maintenance procedures on this equipment.

- Keep the area surrounding the equipment clean and free of obstructions. Remove any unused equipment, tools, or debris and keep the room clean and dry.
- Know the locations of fire extinguishers and be aware of the uses of different types of extinguishers.
- Insure all guards, fasteners, supports, doors, and panels are in place and secure.
- Do not work around this equipment when mentally or physically fatigued or after using alcohol or other drugs that may affect mental or physical abilities.

SAFETY PRECAUTIONS

Advantech Touchscreen

- The openings on the enclosure are for air convection. Protect the equipment from overheating—do not cover the openings.
- Never pour any liquid into an opening. This may cause fire or electrical shock.
- For safety reasons, only qualified service personnel should open the equipment.
- If one of the following situations arises, have the equipment checked by Cummins service personnel:
 - The power cord or plug is damaged.
 - Liquid has entered the equipment or the equipment has been exposed to moisture.
 - The equipment has obvious signs of breakage.



A danger of explosion exists if the battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer, and discard used batteries according to the manufacturer's instructions.

SAFETY PRECAUTIONS

Equipment Cabinets

High voltage is present in the equipment cabinets, the generator sets, and the switchgear bus bars and cabling.



High voltage can cause severe burns or shock resulting in serious injury or death. Avoid contact with body parts, clothing, jewelry, and damp surfaces.

- Keep equipment cabinet panel doors closed and locked. Make sure that only trained, authorized personnel have keys.
- Before performing maintenance or adjustments to any system equipment, observe that all equipment cabinet key locks are off and the engine control panel switch is in the **Stop/Off** position.
- Disconnect the battery charger prior to removing the negative battery cable from the battery as arcing could occur. Disconnect engine batteries negative contact first.
- Use insulated mats on dry wood platforms over metal or concrete floors when working on any system equipment.
- Do not wear jewelry, damp clothing or shoes, or allow wet skin surfaces to contact the system equipment.
- Keep away from the generator set while it is running, except to use the control panel.

Moving Parts



Maintain a safe clearance between all moving parts and body parts. Do not wear loose clothing or jewelry around generator sets. Contact may result in severe electric shock or mutilation causing personal injury or death.

Before performing any maintenance on the generator sets:

- Only qualified, trained personnel should perform maintenance.
- The generator set engine control panels must be in the Stop/Off position.
- To prevent arcing, disconnect the battery charger prior to removing the negative battery cable from the battery.
- Disconnect the negative contact first on engine batteries.



Always disconnect a battery charger from its power source before removing the battery cables. Disconnecting the cables can result in voltage spikes high enough to damage the DC control circuit of the set.

SAFETY PRECAUTIONS

Generator Sets

⚠ WARNING

High voltage present in the generator sets may result in severe electric shock or mutilation causing personal injury or death. Only qualified, trained personnel should perform maintenance. Maintain a safe clearance between all moving parts and body parts.

Before performing any maintenance on the generator sets:

- The generator set engine control panels must be in the **Stop/Off** position.
- To prevent arcing, disconnect the battery charger prior to removing the negative battery cable from the battery.
- Disconnect the negative contact first on engine batteries.

⚠ CAUTION

Always disconnect a battery charger from its POWER source before removing the battery cables. Disconnecting the cables can result in voltage spikes high enough to damage the DC control circuit of the set.

Engine Fuel System

⚠ WARNING

Fuel and oil leaks can create risk of fire and explosion that can cause serious injury or death. In case of a leak or spill, stop the generator set and clean up immediately.

- Do not smoke, use an open flame or pilot light, or allow any electrical arc-producing equipment or switches in the area of the engine fuel tanks or fuel system components.
- Do not fill fuel tanks while the engine is running, unless they are located outside of the equipment room.
- Some states or federal governments list fuel and oil as carcinogens. Avoid contact, ingestion, and inhalation.

SAFETY PRECAUTIONS

Engine Exhaust

The generator set engine exhaust, coolant systems, and starting batteries present risks of asphyxiation, burns, and explosions. Read and follow engine manual instructions.



Engine exhaust contains carbon monoxide gas, an odorless, colorless, and poisonous gas that can cause illness, unconsciousness, and/or death.



Contact with used engine oil can cause cancer or reproductive toxicity. When checking or changing oil, take care not to ingest, breathe the fumes or contact used oil.

When experiencing any of the following symptoms, shut down the generator set, and get into fresh air immediately:

- Dizziness
- Throbbing in temples
- Nausea
- Muscular twitching
- Headache
- Vomiting
- Weakness/sleepiness
- Inability to think coherently

To prevent exhaust leaks, take the following actions:

- Check the exhaust system regularly for leaks. Shut down the generator set and repair leaks immediately.
- Make sure exhaust manifolds are secure. Tighten if necessary.
- Make sure engine areas are well ventilated.
- Do not use exhaust gases to heat any compartment.

Engine Coolant System





Engine coolant system liquid is extremely hot and may cause serious injury.

Always wait for the system to cool, and then bleed the system pressure before removing the pressure cap to check or add liquid to the system.

SAFETY PRECAUTIONS

Engine and Station Batteries

 **WARNING** *Engine coolant system liquid is extremely hot and may cause serious injury.*

 **WARNING** *Hydrogen gas is highly explosive and can cause serious injury to personnel.*

- Do not smoke, use an open flame, or allow any electrical arc-producing equipment or switches in the area of the batteries.
- Be sure there is sufficient ventilation to remove battery hydrogen gas.
- Disconnect the battery charger before removing the negative battery cable from the battery as arcing could occur. Always remove the negative cable first and replace it last.



OPERATION

Type 6 PCIL200 Feeder Control

Revision: AS-BUILT

Date: 07/22/2010

Normal Conditions

System consists of four generator paralleling breakers 52-G1 through 52-G4, feeder breakers 52-F1 and 52-F2.

Under normal conditions, the generator sets are in standby mode (gensets in auto mode with the gensets not running). The generator breakers 52-G1 through 52-G4, feeder breakers 52-F2 is open and 52-F1 is open. The loads are supplied by the utility source through the transfer switches.

Loss of Normal Power

When the system receives a signal to start via a hardwired signal from a utility monitoring device, all gensets start automatically and independently, accelerate to rated frequency, and build up to rated voltage. The first-start system monitors this process. If it detects a genset at 90% of rated voltage and frequency, it disables all other units from closing to the bus, and then closes the ready unit to the bus. Loads are added using normal load control.

After the first unit closes to the bus, control of the remaining units switches to the synchronizer in each generator paralleling control, which causes the genset to synchronize with the system bus, then close to it at the proper time. 52-F1 closes after the first genset is online.

Normal Load Control

Eight load add and eight load shed relays are provided in the DMC to control future loads. The load add feature allows the operator to assign each feeder breaker an add level in the range of 1 to 8. Multiple feeder breakers may be assigned to the same add level. The highest priority load add level is level 1, which adds when the first genset comes online. Additional add levels come online as the remaining gensets parallel and close to the emergency bus. For example, when the second genset closes to the emergency bus, load add level 2 is picked up. When the third genset closes to the emergency bus, load add level 3 is picked up. This continues until all gensets in the system close to the emergency bus. When all gensets successfully parallel to the emergency bus, additional load add levels beyond the number of gensets add on a timed basis (52-F1 and 52-F1 are not controlled by the load add/shed scheme).

OPERATION

If one or more gensets fails to connect, the system turns on only as many load add levels, as there are connected gensets. At this time, override the automatic load control by adding the remaining load add levels manually at the Load Control screen while monitoring the spare capacity. If an overload occurs while adding levels, the automatic load control takes over and sheds levels until the overload signal clears.

The load shed feature allows the operator to assign a shed level to each feeder breaker in the range of 0 to 7. Load shed level 1 is the first level to be shed. Load shed level 0 loads are not shed. The feeder breakers are shed when an overload signal is received from the generator. At this time, levels begin shedding on a timed basis until the overload condition clears. When the overload is cleared, re-add levels manually via the Load Control screen, provided sufficient spare capacity exists.

Failure of a Unit to Start or Synchronize

If a unit fails to start, after the overcrank time delay (in the genset control) expires, the unit shuts down and an alarm sounds.

If a unit fails to synchronize, after a preset time delay, an alarm sounds and the unit continues attempting to synchronize until signaled to stop via operation of the off switch or emergency stop button on the genset.

Genset Bus Overload

If a bus overload occurs on an operational unit, a bus overload alarm initiates. Bus overload conditions occur when an operational gensets is either at or below 57 Hz for three seconds or at 105% of load for 60 seconds.

▲ NOTE *A genset shuts down on underfrequency if the genset frequency remains below 90% of nominal for 10 seconds.*

Load Demand Mode

Load demand permits the gensets to operate closer to their rated capacities, thus decreasing fuel consumption and reducing wear on the system.

Set up load demand on the System Control – Page 2 screen. In the Load Demand Mode section, select the **On** checkbox.

Two time delays are associated with load demand: Initial time delay is the time the system runs with full genset capacity before monitoring the system load; shutdown time delay is the time the system monitors the system load in comparison to the load demand settings before shutting down a genset. The load demand shutdown sequence determines the order in which the gensets shut down and restart, based on system load.

NOTE

The lead unit never shuts down.

The load demand settings determine the levels at which gensets are shut down and started. The kW pickup percent is the percent load on the running gensets that must be exceeded to start an additional genset. The kW dropout percentage is the percent of kW capacity of the remaining gensets that the load must be under for the next genset in the load demand sequence to shut down.

Return of Normal Power

Upon return of normal power, the ATS transfer back to the utility after the retransfer time delay, which is set at the ATS. The start signals from the ATS is removed from the generator sets, the generator set paralleling breakers open, and the generator sets operate at no load for a cooldown period. 52-F1 opens. Simultaneously, the load add relays for the load shed relays for the feeder breakers energize until the feeder breakers are open. When the cooldown period programmed into the PCC is complete, the generator sets shut down.

If a system start signal is received during the cooldown period, one generator set immediately closes to the system bus and all other units synchronize to it, as described in *Loss of Normal Power*.

System Test with Load

On the System Control screen, select the **Test with Load** checkbox. All gensets start and parallel to the bus as described in *Loss of Normal Power*. 52-F1 closes. Load add relays for the feeder breakers energize using normal load control. Because the normal source on the ATS is good, the ATS do not transfer from the normal to the emergency source during this test. If Load Demand Mode is on, the MasterControl monitors the system load and operates as described in *Load Demand Mode*.

To terminate a test with load, select the **Off** checkbox in the System Test section on the System Control screen. The generators shut down and the loads shed as described in *Return of Normal Power*, then return to standby mode.

System Test without Load

On the System Control screen, select the **Test w/o Load** checkbox. All generators start and parallel to the bus as described in *Loss of Normal Power*. At this time, no loads are added and the load add relays are not energized. If Load Demand Mode is on, the MasterControl monitors the system load and operates as described in *Load Demand Mode*.

To terminate a Test without Load, select the **Off** checkbox in the System Test section on the System Control screen. The generators shut down as described in *Return of Normal Power*, then return to standby mode.

Operation with Transmitters

On the System Control screen, select the **Operation with Transmitters** checkbox. Selected gensets (selectable on the HMI) start and parallel to the bus as described in *Loss of Normal Power*. When all the selected gensets are online, 52-F2 closes.

To terminate operation with transmitters, select the **Off** checkbox on the System Control screen. 52-F2 breaker opens and generators shut down.

If normal power fails during operation with transmitters, fourth genset automatically starts parallels and closes to the bus. After all the gensets are online, 52-F1 closes. If a bus overload is sensed under these conditions, 52-F1 opens.

To terminate operation with transmitters with normal power failure, select the **Off** checkbox on the System Control screen. 52-F2 breaker opens. Gensets continue to feed the load downstream. If Load Demand Mode is **ON** while the system is operating in transmitter mode and normal power has failed, the MasterControl monitors the system load and operates as described in *Load Demand Mode* but would shutdown only one generator as minimum three generators are required for transmitter operation.

Manual System Operation

Manual Mode from the Touchscreen

On the Generator Control screen, select the **Manual** checkbox in the Control Mode section. This allows the operator to start/stop each genset and open/close each generator breaker. During this operation, all genset protection is active to prevent starting the genset or closing the generator breaker in an unsafe condition. If a loss-of-normal-power condition occurs while the system is in manual, all gensets start, but the generator breakers do not close until the operator touches the **Press to Close** button in the Breaker Control section. Returning the system to Automatic – Open Transition allows the system to operate in normal mode.

OPERATION

Manual Mode from the PowerCommand Control (PCC)

NOTE *This mode should only be used if the PLC fails and it is necessary to transfer to the emergency source before a normal source failure.*

NOTE *To prevent an underfrequency shutdown, do not allow the anticipated load to exceed the capacity of one genset.*

Before starting the gensets and connecting them to the emergency bus, shed noncritical and high-inrush feeder breaker loads by pressing the **Open** button on the front of each feeder breaker.

Start each genset manually and close the generator breaker to a live or dead bus from the PCC. (For specific instructions, refer to the genset operating manual.)

When the gensets are connected to the emergency bus, add additional loads if sufficient capacity exists.



OPERATION

THIS PAGE LEFT INTENTIONALLY BLANK

Digital MasterControl

The Digital MasterControl is the system controller for paralleling gensets to the emergency bus. The front panel features a high-resolution LCD touchscreen.



High voltage in the Digital MasterControl may cause severe burns or shock resulting in serious injury or death. Avoid contact with body parts, clothing, jewelry, and damp surfaces.

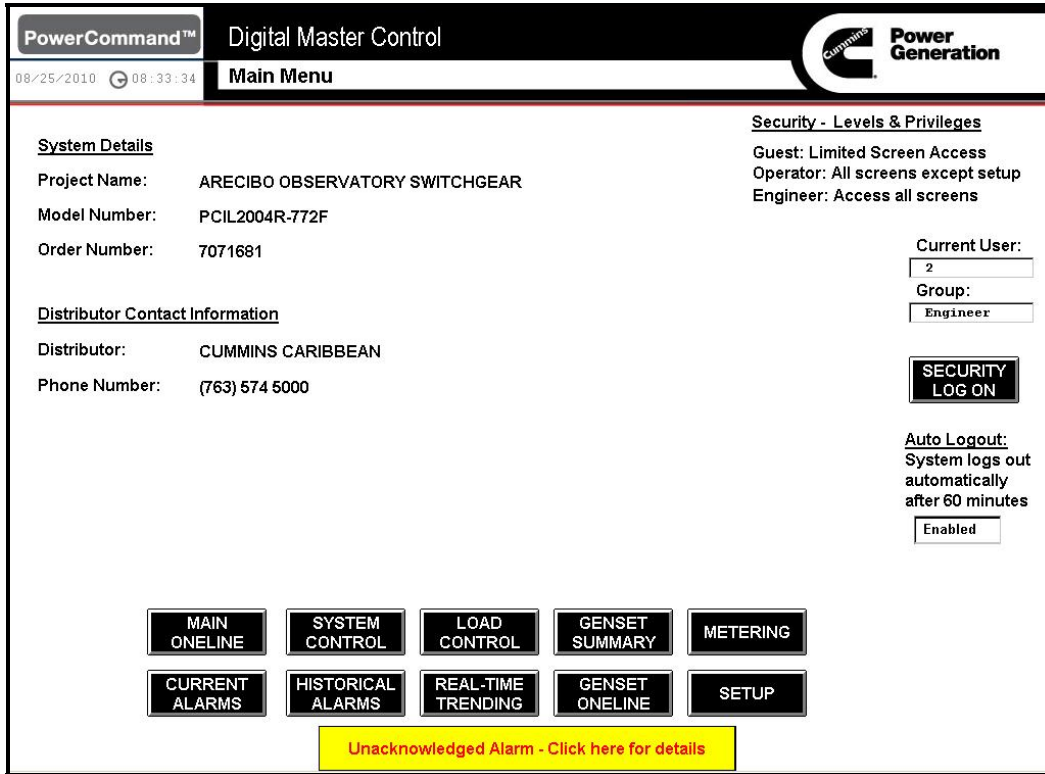


This chapter describes elements found on a typical touchscreen.



The screens shown in this chapter are typical and may not reflect the exact configuration of a specific project.

Main Menu

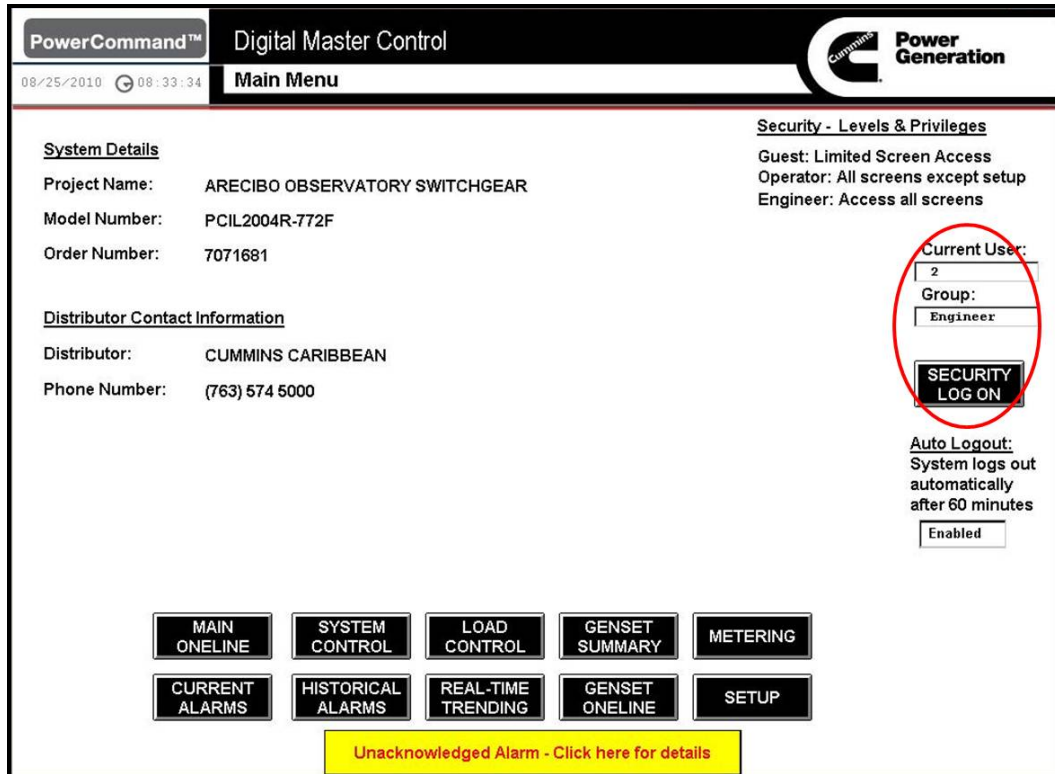


The Main Menu screen is the designated startup screen and main navigation tool. This screen also provides security and user information that is described in detail at the end of this chapter.

Access other screens by touching the appropriate navigation button on the lower part of this display graphic. For example, touch the **Current Alarms** button to cause the Current Alarms screen to appear.

See *Changing Security Levels* for instructions for changing the current user's security level.

Touchscreen Security System Operation



Security Log On

The DMC features three levels of security: Guest (level 0), OPR (level 1), and Engineer (level 2). The default security level is Guest, which permits limited screen access with no control. The System Control and Set-up screens are not accessible at level 0.

Level 1 allows access to all screens except the Set-up screen, and Level 2 allows access to all screens.

The current user and security level display on the right side of the Main Menu screen.

Changing Security Levels

Change security levels by touching the **Security Log On** button on the Main Menu screen. This causes a log-on box to pop up.

Touch the **User Name** field; a keypad appears.

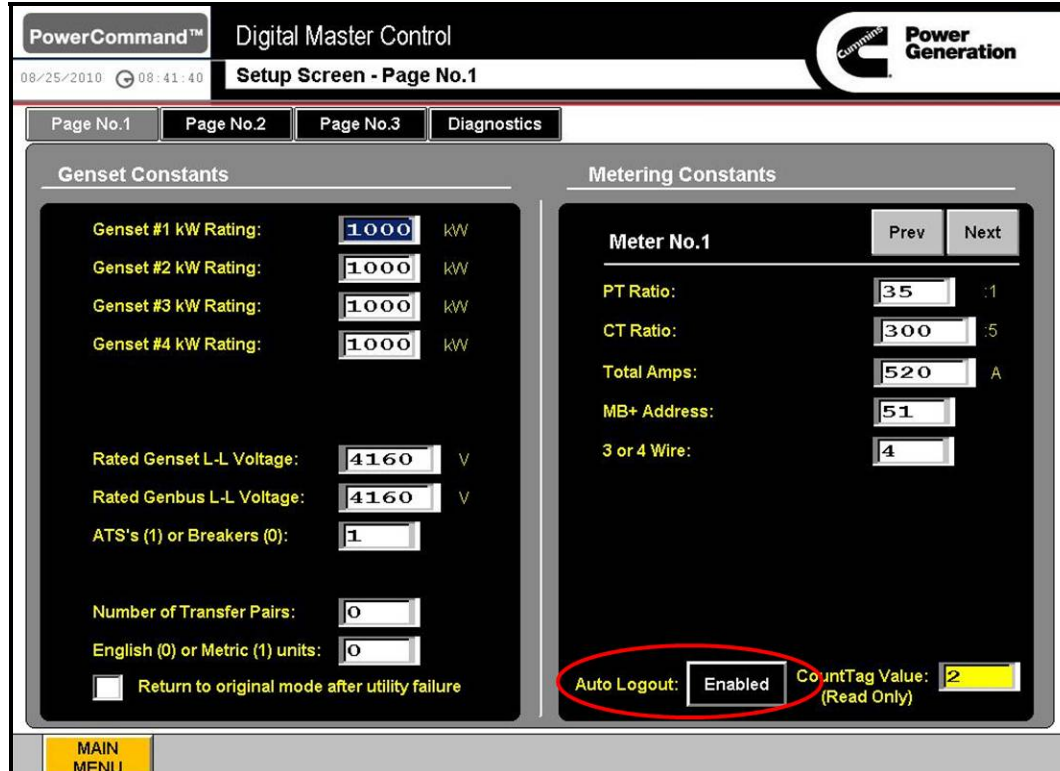
Enter OPR or engineer, using the next arrow on the keypad to scroll through the alphabet. Touch the **OK** button on the keypad.

Touch the **Password** field; the keypad appears again. Enter the password that corresponds to the security level, then touch the **OK** button on the keypad.

Touch the **OK** button on the log-on box.


Contact an authorized Cummins distributor for lost or forgotten passwords.

Auto Logout Feature



The DMC touchscreen includes an auto logout feature. When enabled, this feature causes the system to return to the Main Menu and relog the system in at Guest security level 60 minutes (regardless of system activity) after logging in as OPR or Engineer. This assures that critical screens are not accessed if an authorized person leaves the system without logging out.

Enabling/Disabling the Auto Logout Feature

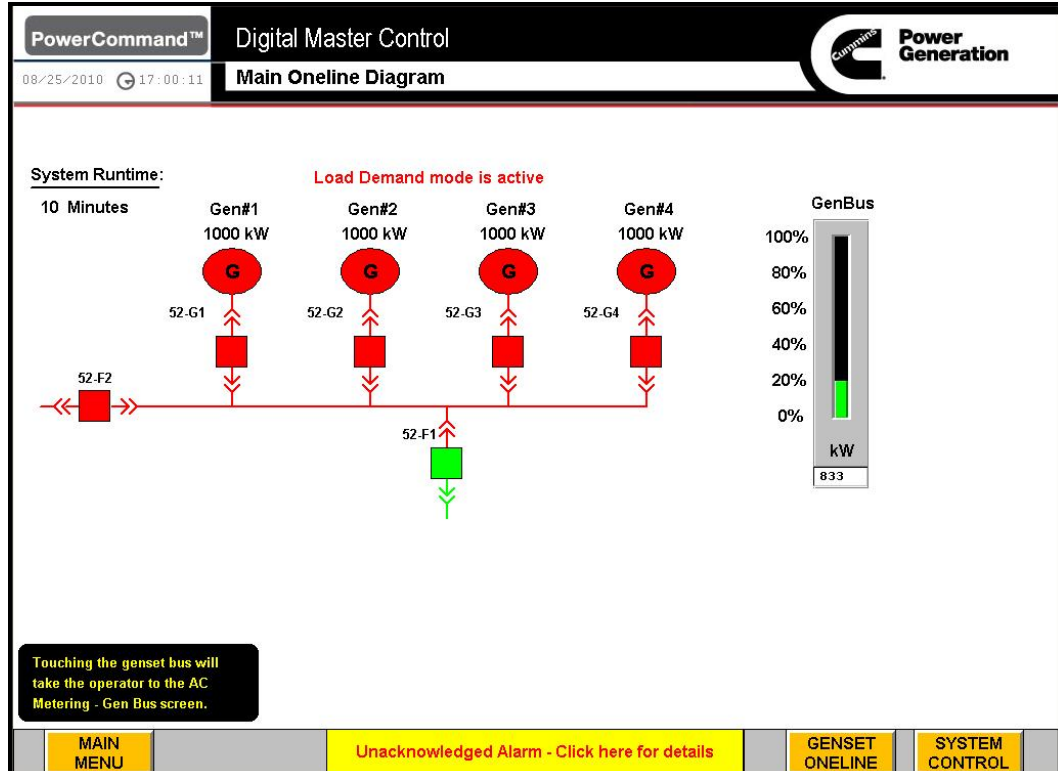
 **NOTE**

Enabling and disabling the Auto Logout feature should only be done by an authorized Cummins service technician.

1. From the Main Menu screen, log into the system as Engineer, then touch the **Setup** button.
2. On the Set-up screen, toggle between **Enable** and **Disable**. When Auto Logout is enabled, the count tag value may be used to determine where the scheduler is in the auto-logout count. Each count is equal to four seconds; when the count value is 15, one minute has elapsed.


For informational purposes, an auto logout Enabled/Disabled status box displays on the Main Menu.

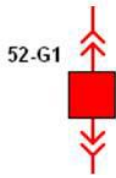
Main Oneline



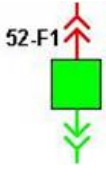
This screen provides information on Cummins-provided components. System status displays a combination of animation, changing screen colors, text messages, and pop-up indicators.

Touching a symbol opens the AC Metering screen.

-  **Genset symbol (running/stopped)**
 This symbol indicates whether the generators are running (red) or stopped (green).



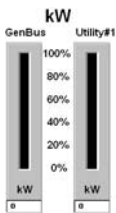
Breaker status for utility mains, gen mains, and gensets
 (open/closed/tripped/racked in/racked out)
 Red indicates energized; green indicates de-energized.



Breaker status for feeders (open/closed/tripped)
 Red indicates energized; green indicates de-energized.



Bus conditions (energized/de-energized)
 Red indicates energized; green indicates de-energized.



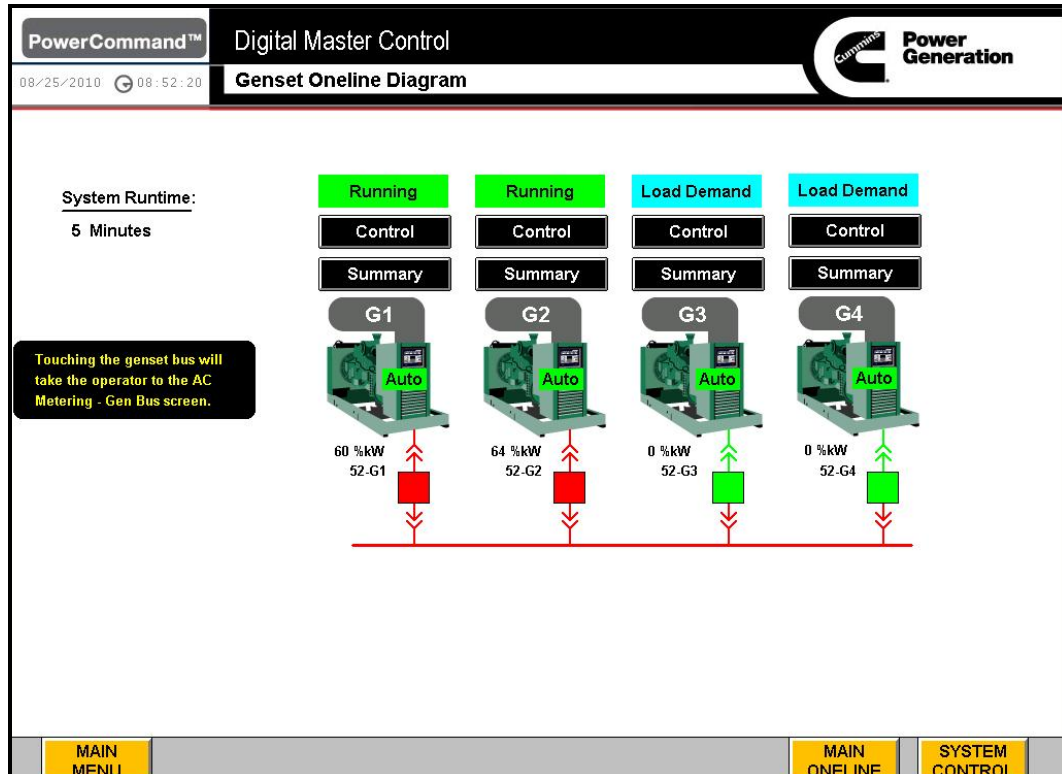
UM/GM kW displays
 These meters show the percentage of kW the utility and genbus are using.

System Runtime: System Runtime

10 Minutes

This indicates the time (in minutes) the gensets have been online.

Genset Oneline



The Genset Oneline Diagram screen gives a graphical display of the power system components directly controlled by the Cummins Power Generation paralleling system.

System status is displayed via a combination of animation, changing screen colors, text messages, and pop-up indicators.

Touching a symbol opens the AC Metering screen.



Genset symbol

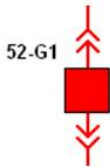
Control, data, and performance summary screens are accessible through links located on or adjacent to this icon.

Genset mode message (run/off/auto)

TOUCHSCREEN OPERATION

Running

Genset status (normal/warning/shutdown/load demand stop)



Breaker status (open/closed/tripped/racked-in/racked-out)
The status and condition of customer-supplied breakers and devices is optional.

Red indicates energized; green indicates de-energized.



Bus condition (energized/de-energized)

Red indicates energized; green indicates de-energized.



Touch the **Summary** or **Control** buttons to launch the associated screens.



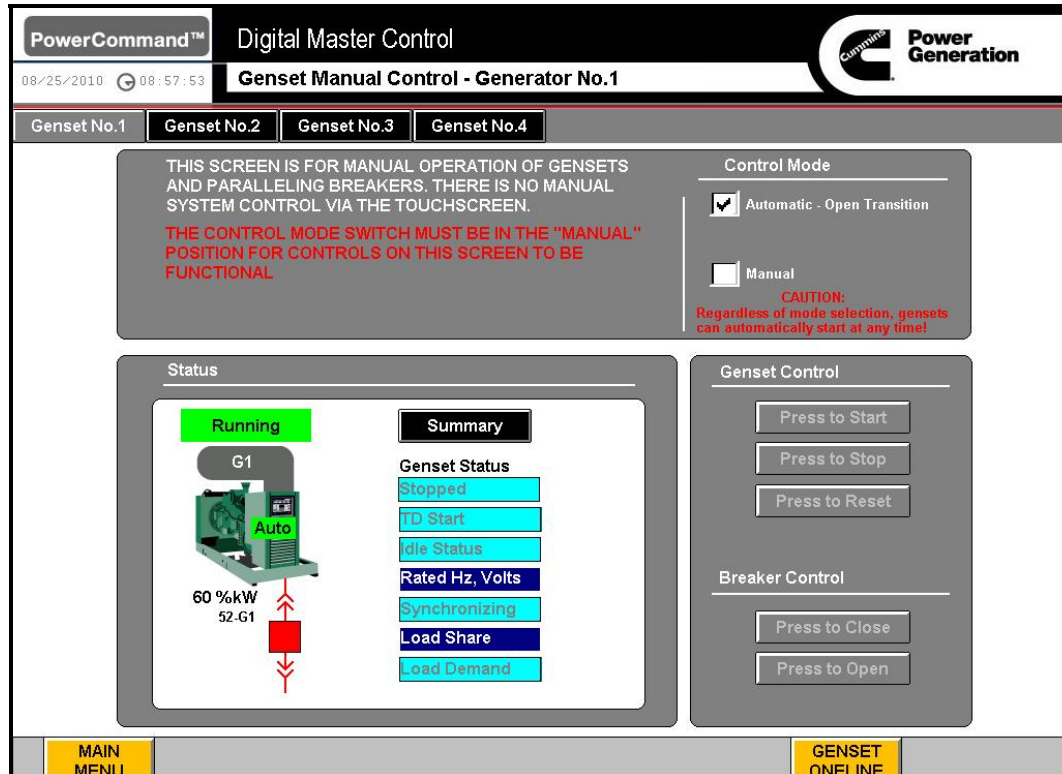
System Runtime:

10 Minutes

System Runtime

This indicates the time (in minutes) the gensets have been online.

Genset Manual Control

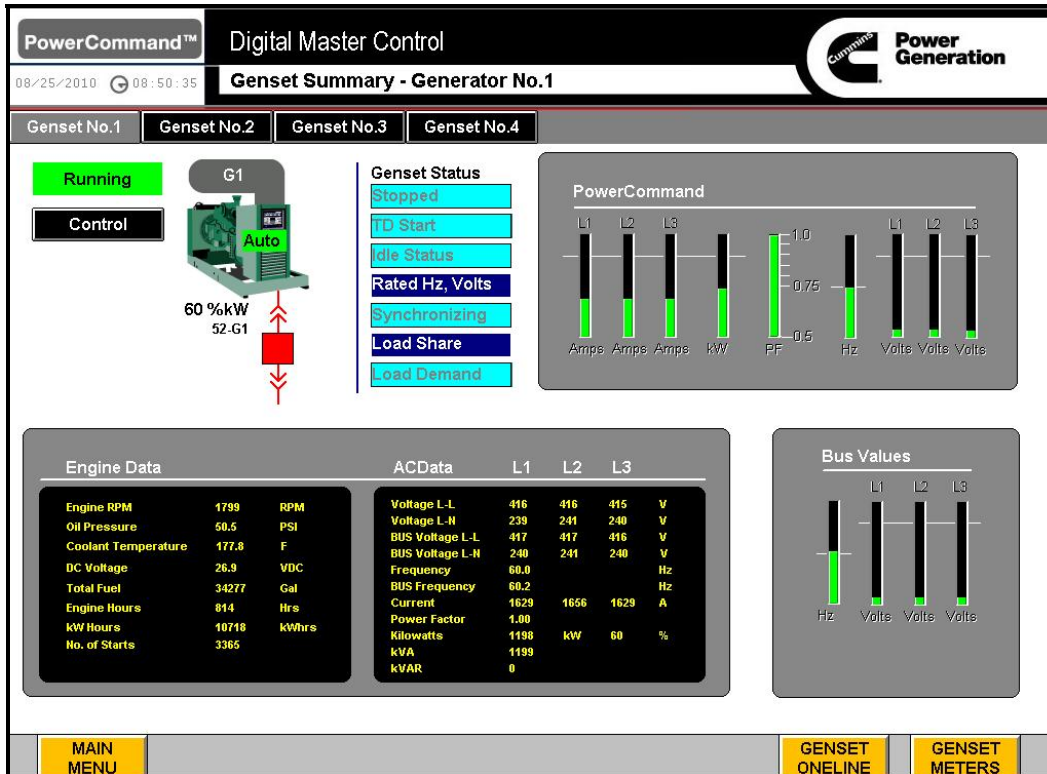


The Genset Manual Control screen allows manual operation of each genset and corresponding paralleling circuit breaker. The buttons below the page header allow the user to choose which genset to control. The control mode switch on this screen must be in the Manual position for controls to be functional. The system will not function in any automatic modes until the control mode switch returns to Automatic – Open Transition mode or Automatic – Closed Transition mode.

The user must be logged in as an Operator (level 1) or higher to access this screen.

Tabs at the top of the screen display for each existing genset. These allow the user to choose which genset to control.

Genset Summary

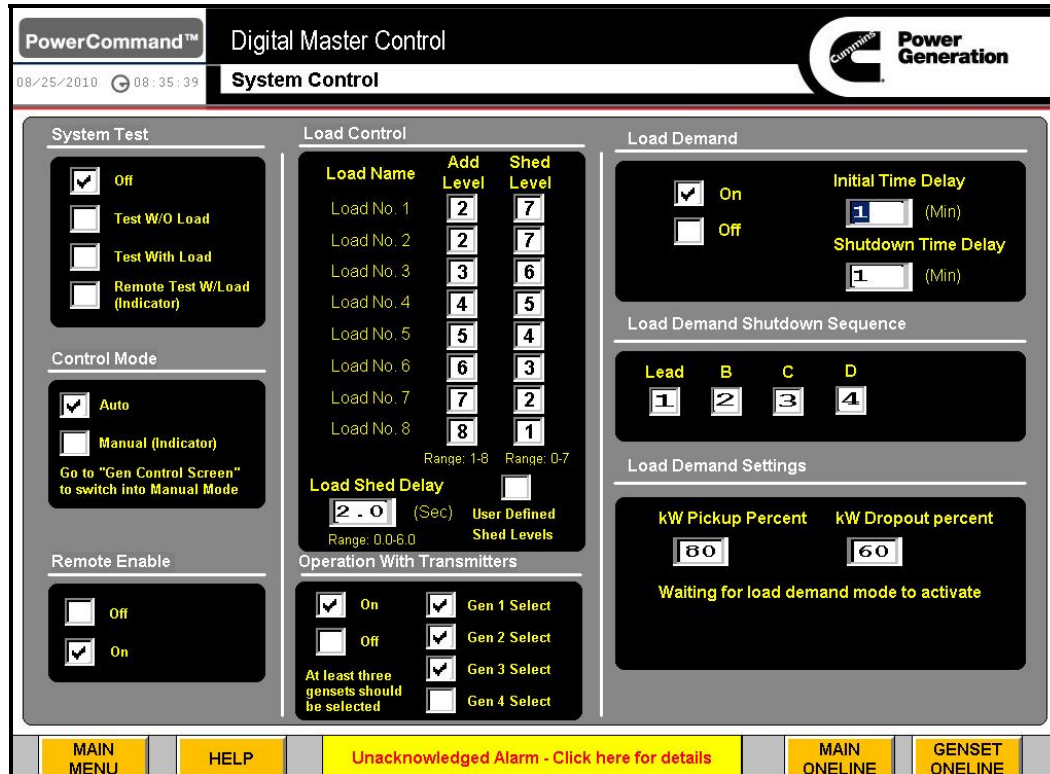


The Genset Summary screen provides analog and graphical displays of critical operating parameters for each genset, including:

- Genset status flags (stopped, time delay start, idle speed, rated volts/Hz, synchronizing, load share/load govern, and load demand)
- AC metering for gensets (3-phase AC volts and current, frequency, kW, power factor, and 3-phase AC bus voltage and frequency)
- A comprehensive display of engine data from the genset control
- Animation of the genset breaker and load bus

Tabs at the top of the screen display for each existing genset. These allow the user to choose which genset to monitor.

System Control



The System Control screen allows for control of load transfer and demand and the load add/load shed system.

The user must be logged in as a Level 1 (Operator) or higher to access this screen.

Control Mode

Control mode allows the operator to set the source transfer mode for the system. Auto – Closed Transition allows for closed transition transfers between the genset source and the utility source, when possible. Auto—Open Transition causes the system to perform open transition transfers between the genset source and the utility source. The manual indicator shows when the system is in manual from the Generator Manual Control screen.

System Test

System Test allows the operator to test the system in several ways. The control mode selection determines the method of transfer, when applicable.

Remote Enable

Remote enable allows peak shave and test modes to be started and stopped through customer inputs. Selecting this checkbox also disables local commands.

Time Delay Settings

Time delay settings permit customization of the timing of source transfers. The transfer time delay sets the period the system waits before transferring to the genset source. This allows the utility to come back from a momentary power outage. The Retransfer time delay is the period the system waits for the utility to remain stable when it returns before retransferring back. Program transition time delay is the period both sources remain open during open transition transfers. This allows for spinning loads to decay to prevent damage due to out-of-phase closing. During the retransfer operation, a button and time-remaining indicator appear, allowing the operator to bypass the retransfer time delay.

Load Displays

Load displays shows the kW values for loads associated with the system.

Load Transfer Control

The operator may change the sequence in which loads are added to and shed from the source. Up to eight levels of load add (1–8) and load shed (0–7) and multiple loads may be assigned to the same level. Select the **User Defined Shed Levels** checkbox to customize shed level assignments. If this box is unselected, the system automatically assigns shed levels in the reverse order of the add levels.

The Load Shed Delay Timer is the period of time the system waits before shedding loads in the event of a bus overload condition.

Load Demand


The Load Demand feature permits the operator to set up the system to automatically start up and shut down gensets based on the facility load when the system is in standby mode. Turn the load demand function on or off by selecting the appropriate checkbox in the Load Demand section.

Initial Time Delay refers to the period the system waits after the gensets start and come online before monitoring the load demand settings. This gives the system time to stabilize on the genset source.

Shutdown Time Delay refers to the period the system waits before shutting down a genset if the facility load is sufficiently low.

Load Demand Shutdown Sequence

Load Demand Shutdown Sequence defines the order in which the gensets shut down and start up.

 **NOTE** *The lead unit never shuts down.*

Load Demand Settings

These settings select the KW levels for load demand pickup and dropout points when the system load decreases.

See the *Sequence of Operation* section in this manual for more details concerning these modes.

Load Control



The Load Control screen allows the operator to monitor genset capacity, as well as what levels of load are added or shed. It also allows for manually shedding or adding loads.

The total load, as a percentage of online generation capacity, displays on a bar graph. The actual system load also displays.

Set the add and shed level for each distribution device on the System Control screen.

Level 1 Add is the first load connected to the bus; Level 8 Add is the last . Level 1 Shed is the first load to shed from the bus and Level 7 Shed is the last. Level 0 Shed never sheds.

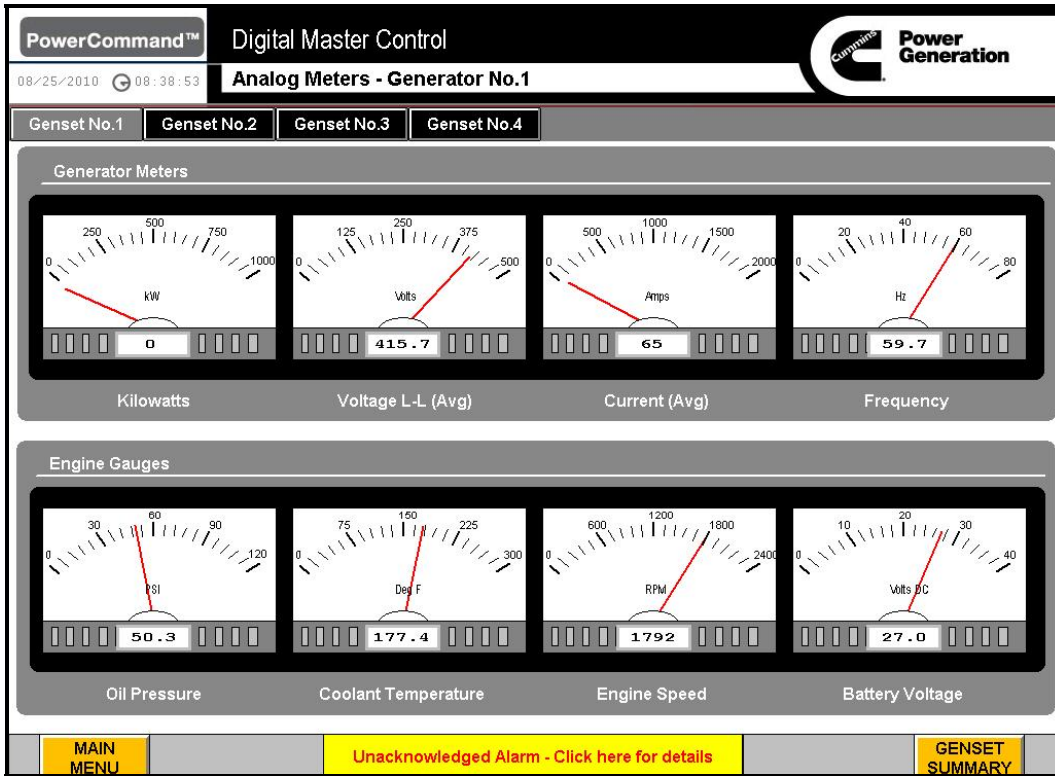
Loads add automatically to the system based on the number of gensets online. If all gensets are successfully running on the bus, the system automatically continues adding loads up to level 8 or until a bus overload occurs.



TOUCHSCREEN OPERATION

If genset capacity is sufficiently greater than the loads added, add additional loads using the manual **Press to Add** buttons. If loads shed due to insufficient system capacity, restore them manually using the Restore buttons. Shed loads manually using the Press to Shed buttons.

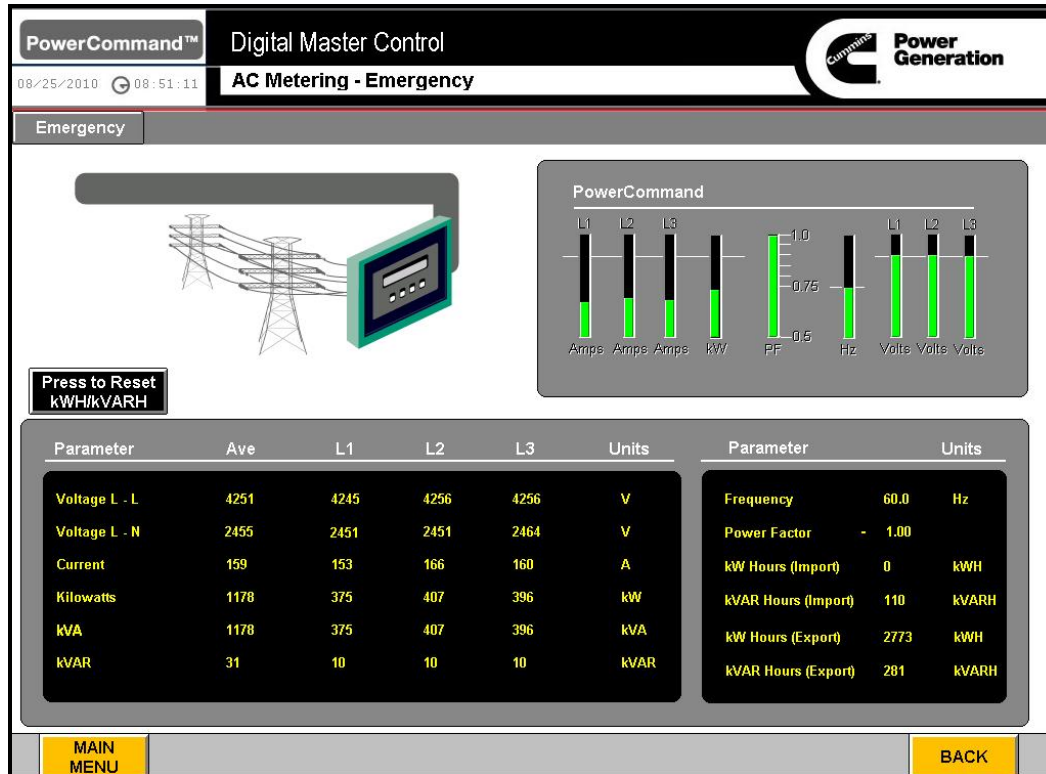
Analog Meters



Four predefined AC meters and four predefined engine gauges are displayed for each genset in paralleling system.

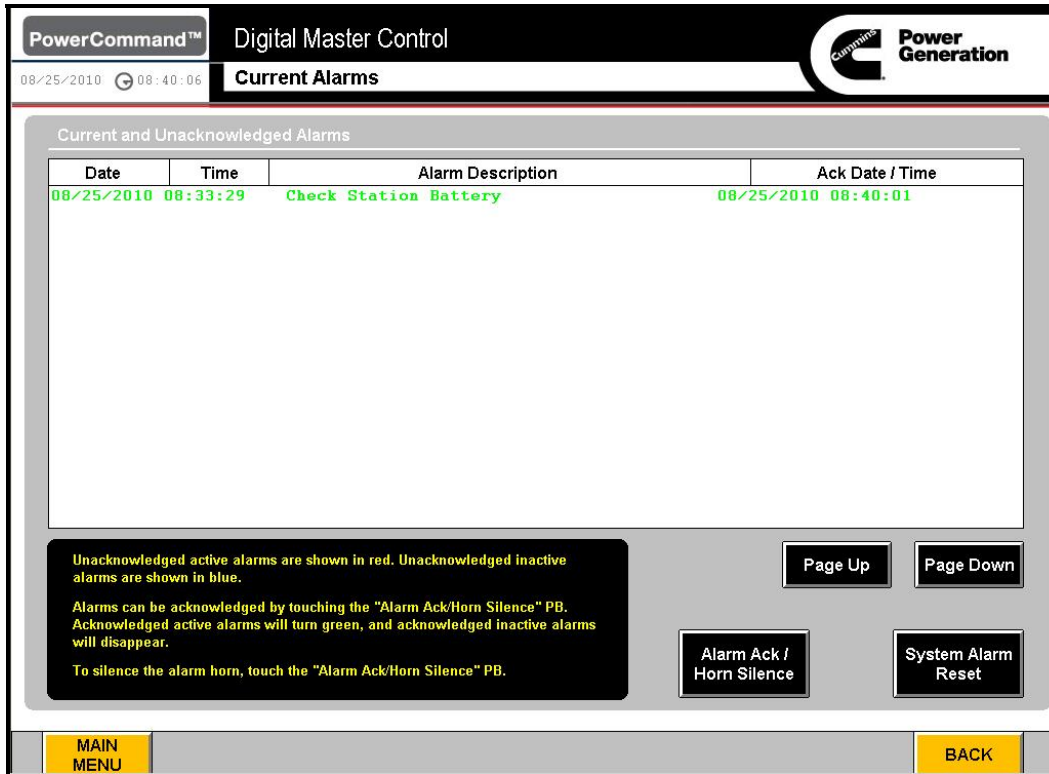
Tabs at the top of the screen display for each existing genset. These allow the user to choose which genset to monitor.

AC Metering



The AC Metering screen provides an analog and graphical display of AC metering data, including 3-phase AC volts and current, frequency, kW, and power factor for each monitored bus.

Current Alarms



The Current Alarms screen displays the date, time, alarm description, and acknowledged date and time for genset and system alarms.

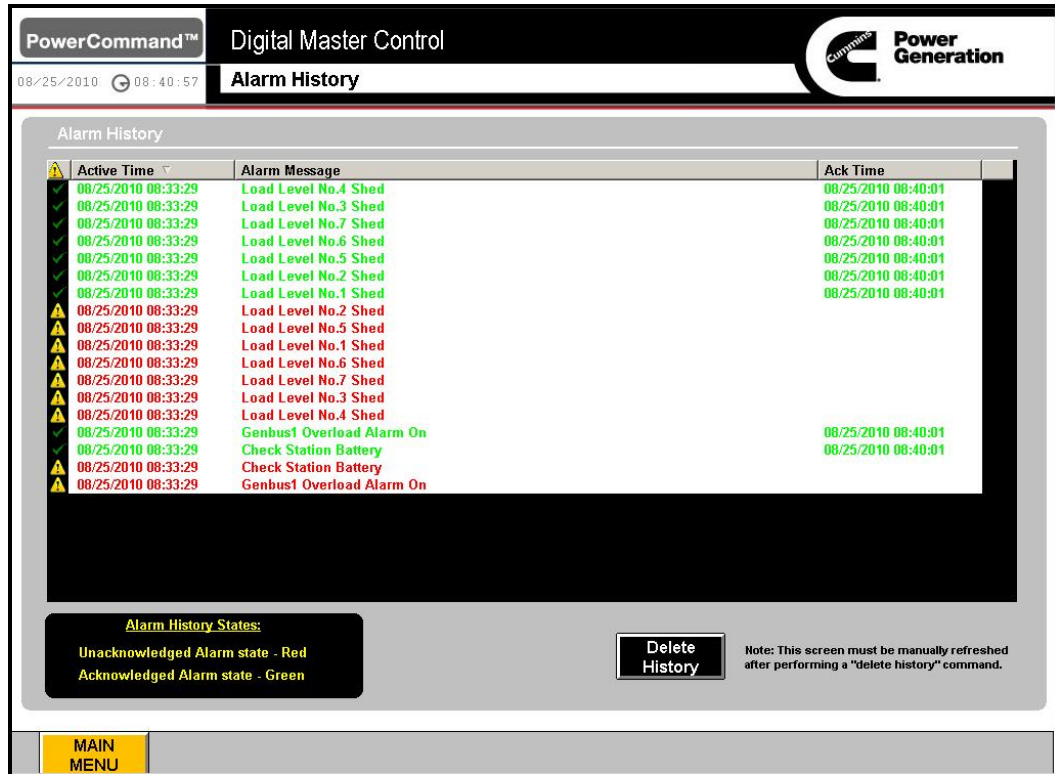
Unacknowledged active alarms are shown in **red**; unacknowledged inactive alarms are displayed in **blue**.

Acknowledge alarms and silence the horn by touching the **Alarm Ack/Horn Silence** button. Acknowledged alarms turn **green**; acknowledged inactive alarms disappear.

Reset the PLC system alarm by touching the **System Alarm Reset** button.

Use the **Page Up** and **Page Down** buttons to scroll through the screens.

Alarm History



Active Time	Alarm Message	Ack Time
08/25/2010 08:33:29	Load Level No.4 Shed	08/25/2010 08:40:01
08/25/2010 08:33:29	Load Level No.3 Shed	08/25/2010 08:40:01
08/25/2010 08:33:29	Load Level No.7 Shed	08/25/2010 08:40:01
08/25/2010 08:33:29	Load Level No.6 Shed	08/25/2010 08:40:01
08/25/2010 08:33:29	Load Level No.5 Shed	08/25/2010 08:40:01
08/25/2010 08:33:29	Load Level No.2 Shed	08/25/2010 08:40:01
08/25/2010 08:33:29	Load Level No.1 Shed	08/25/2010 08:40:01
08/25/2010 08:33:29	Load Level No.2 Shed	
08/25/2010 08:33:29	Load Level No.5 Shed	
08/25/2010 08:33:29	Load Level No.1 Shed	
08/25/2010 08:33:29	Load Level No.6 Shed	
08/25/2010 08:33:29	Load Level No.7 Shed	
08/25/2010 08:33:29	Load Level No.3 Shed	
08/25/2010 08:33:29	Load Level No.4 Shed	
08/25/2010 08:33:29	Genbus1 Overload Alarm On	08/25/2010 08:40:01
08/25/2010 08:33:29	Check Station Battery	08/25/2010 08:40:01
08/25/2010 08:33:29	Check Station Battery	
08/25/2010 08:33:29	Genbus1 Overload Alarm On	

Alarm History States:
 Unacknowledged Alarm state - Red
 Acknowledged Alarm state - Green

Delete History

Note: This screen must be manually refreshed after performing a "delete history" command.

MAIN MENU

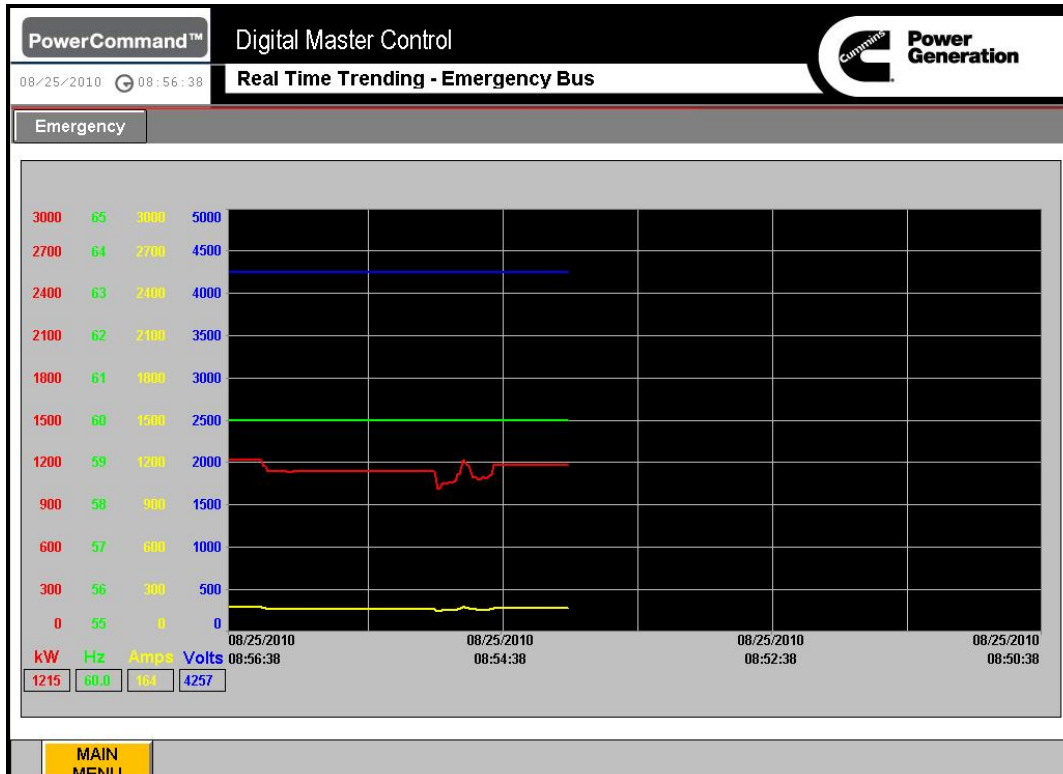
The Alarm History screen provides the operator with an ongoing history of system and genset alarms. Included are fields for date, time, alarm description and acknowledge date/time.

The alarm history states are color-coded as follows:

- Unacknowledged active alarm state (red)
- Acknowledged active alarm state (green)
- Unacknowledged inactive alarm state (blue)

The alarm history log is set to automatically clear data that is more than two weeks old.

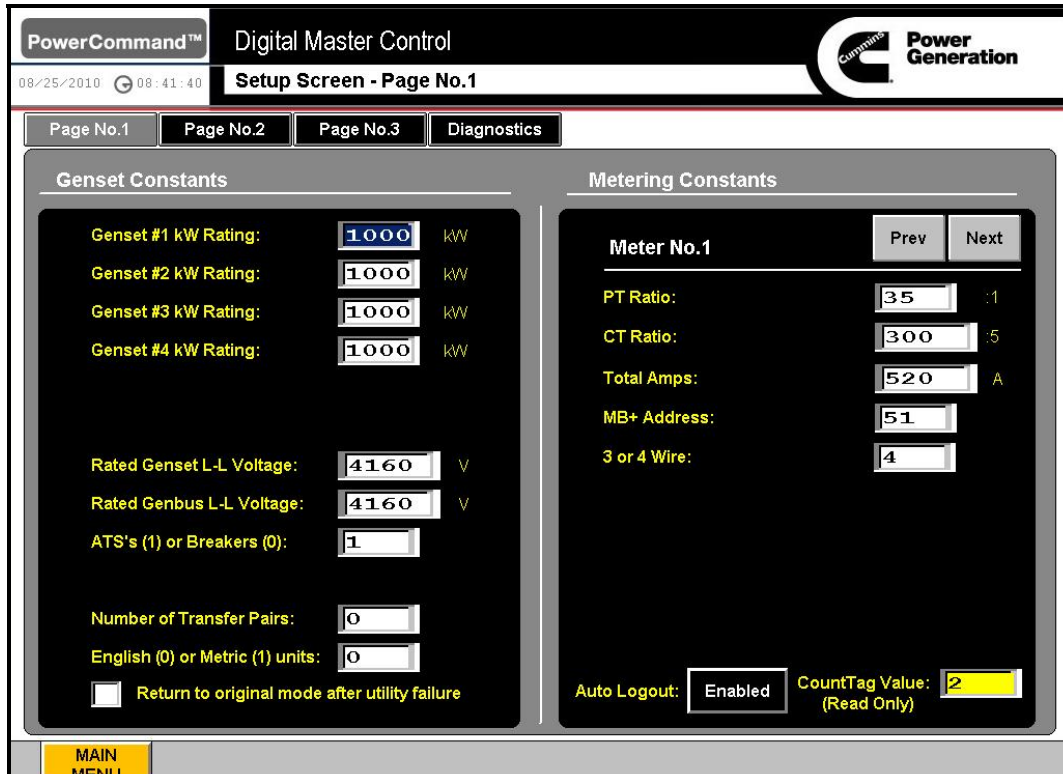
Real-Time Trending



The Real Time Trending screen allows the operator to view the last six minutes of historical data concerning voltage, current, power, and frequency. The instantaneous values of these variables are also displayed in digital format directly below the scales.

Real-time trending is available for the generator bus and for any utility source that may be associated with the system.

Setup Screen- Page No.1



PowerCommand™ Digital Master Control
08/25/2010 08:41:40 **Setup Screen - Page No.1**

Page No.1 | Page No.2 | Page No.3 | Diagnostics

Genset Constants

- Genset #1 kW Rating: kW
- Genset #2 kW Rating: kW
- Genset #3 kW Rating: kW
- Genset #4 kW Rating: kW
- Rated Genset L-L Voltage: V
- Rated Genbus L-L Voltage: V
- ATS's (1) or Breakers (0):
- Number of Transfer Pairs:
- English (0) or Metric (1) units:
- Return to original mode after utility failure

Metering Constants

Meter No.1

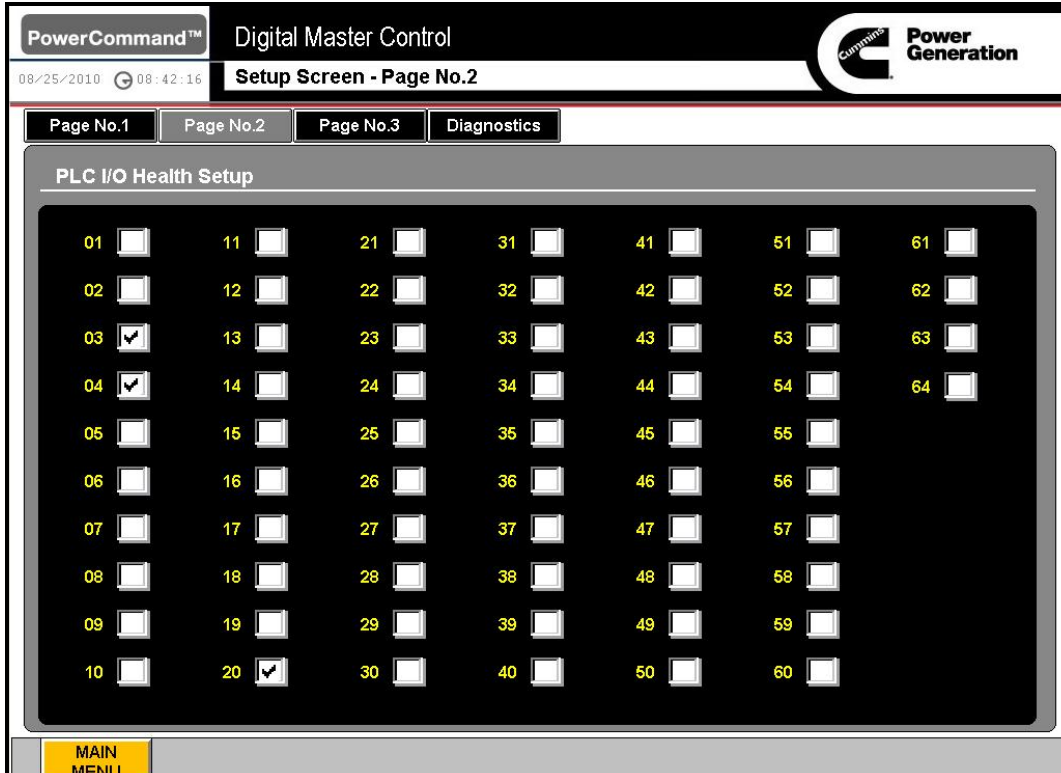
- PT Ratio: :1
- CT Ratio: :5
- Total Amps: A
- MB+ Address:
- 3 or 4 Wire:
- Auto Logout: CountTag Value: (Read Only)

Use the Set-up screen to enter programmable logic control (PLC) program constants. These constants are typically set at the factory during static testing.

See the Factory Settings sheet for actual settings.

CAUTION Do not make changes to this screen unless authorized by the factory.

Setup Screen- Page No. 2



See the Factory Settings sheet for actual settings.

CAUTION Do not make changes to this screen unless authorized by the factory.

Setup Screen- Page No. 3



PowerCommand™ Digital Master Control **Cummins Power Generation**

08/25/2010 08:42:41 **Setup Screen - Page No.3**

Page No.1 | Page No.2 | **Page No.3** | Diagnostics

Project Details

Project Name: ARECIBO OBSERVATORY SWITCHGEAR Project Details

Model Number: PCIL2004R-772F

Order Number: 7071681

Distributor Name: CUMMINS CARIBBEAN User Alarms

Distributor Phone Number: (763) 574 5000

Gen Meters Max kW: 1000 Note: Genset Meter Scales should be divisible by 4

Gen Meters Max Amps: 2000 System Meter Scales Should be divisible by 10

Gen Meters Max Volts (L-L): 500 Click on the "Save Configuration" button to save changes.

System Meters Max kW: 3000

System Meters Max Amps: 3000

System Meters Max Volts (L-L): 500 System Frequency: 50Hz 60Hz Save Configuration

MAIN MENU

See the Factory Settings sheet for actual settings.

⚠ CAUTION Do not make changes to this screen unless authorized by the factory.

Setup Screen- Page No. 4 Diagnostics



PowerCommand™ Digital Master Control
08/25/2010 08:43:21 Setup Screen - Diagnostics

Page No.1 Page No.2 Page No.3 Diagnostics

PLC Input and Output State

PLC Heartbeat 3

Prev Next

4x Register 3

Input # 737	OFF	Input # 753	OFF	Output # 737	OFF	Output # 753	OFF	4x0000	0
Input # 738	OFF	Input # 754	OFF	Output # 738	OFF	Output # 754	OFF	4x0001	0
Input # 739	OFF	Input # 755	OFF	Output # 739	OFF	Output # 755	OFF	4x0002	0
Input # 740	OFF	Input # 756	OFF	Output # 740	OFF	Output # 756	OFF	4x0003	0
Input # 741	OFF	Input # 757	OFF	Output # 741	OFF	Output # 757	OFF	4x0004	0
Input # 742	OFF	Input # 758	OFF	Output # 742	OFF	Output # 758	OFF	4x0005	0
Input # 743	OFF	Input # 759	OFF	Output # 743	OFF	Output # 759	OFF	4x0006	0
Input # 744	OFF	Input # 760	OFF	Output # 744	OFF	Output # 760	OFF	4x0007	0
Input # 745	OFF	Input # 761	OFF	Output # 745	OFF	Output # 761	OFF	4x0008	0
Input # 746	OFF	Input # 762	OFF	Output # 746	OFF	Output # 762	OFF	4x0009	0
Input # 747	OFF	Input # 763	OFF	Output # 747	OFF	Output # 763	OFF	4x0010	0
Input # 748	OFF	Input # 764	OFF	Output # 748	OFF	Output # 764	OFF	4x0011	0
Input # 749	OFF	Input # 765	OFF	Output # 749	OFF	Output # 765	OFF	4x0012	0
Input # 750	OFF	Input # 766	OFF	Output # 750	OFF	Output # 766	OFF	4x0013	0
Input # 751	OFF	Input # 767	OFF	Output # 751	OFF	Output # 767	OFF	4x0014	0
Input # 752	OFF	Input # 768	OFF	Output # 752	OFF	Output # 768	OFF	4x0015	0

MAIN MENU

See the Factory Settings sheet for actual settings.



Do not make changes to this screen unless authorized by the factory.

PERIODIC MAINTENANCE

The recommended schedule for maintaining this equipment is based on our experience with these types of installations. Cummins recommends a maintenance schedule based on calendar lapsed time as applied to the entire paralleling system.



This power system presents risks of serious injury or death from asphyxiation, shock, burns, or strangulation. Both utility and genset power must be disconnected from the equipment while maintenance is performed.

System Maintenance Schedule

Maintenance item	Weekly	Monthly	Annual
Clean cabinet exteriors	Wipe down the entire system using a soft, lint-free cloth.		
Clean operator interface panel (touchscreen)	Disconnect this equipment from its power source before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.		
Check power system equipment documentation	Manuals, maintenance charts, and logs must be accessible to operations and maintenance personnel.		
Operate running system test	See page PM-3.		
Check batteries and chargers		See page PM-4.	
Clean and inspect switchgear			See page PM-4.

PERIODIC MAINTENANCE

Operation of a Protective Device



Use of this test procedure will cause a momentary power failure to the loads in the system that is connected to the transfer switches being tested. Before proceeding, ensure sure that this power outage will not cause personal injury or property damage.

Operation of a protective device to interrupt normal power to one or more transfer switches causes the transfer switch to sense a normal power failure and signal the paralleling system to start. When the gensets close to the bus, the transfer switches connect their loads to the emergency bus exactly as they would during a normal power failure.

Transfer switches may be wired to close to the bus in priority sequence. If not all gensets in the system start, transfer switches feeding low-priority loads may not be automatically transferred to the paralleling system. System controls include provisions for manually adding loads to the system.

On reclosure of the protective device feeding the transfer switch, the transfer switch signals the paralleling system that normal power has returned and begins timing to retransfer to the normal bus.

When all transfer switches are retransferred to normal power, the paralleling breakers open and the gensets operate for a cooldown period, and then shut down.

When the system is up and running, record information on the appropriate maintenance log.

PERIODIC MAINTENANCE

Periodic Running Test of Power System Equipment

The power system equipment should be run periodically to maintain the operational reliability of the system. Failure to do so can increase maintenance and reduce the reliability of the equipment.



Testing can expose personnel to hazards that can result in serious injury or death. Make sure that all persons are clear of the equipment and are aware of this test. Some of these tests will momentarily disrupt power to the loads. Be sure to alert all areas requiring power prior to running tests to prevent an emergency.

System Test

The paralleling system equipment should be operated on a weekly basis to enhance the operational integrity of the system. Failure to do so may increase maintenance costs and reduce the reliability of the equipment. It is recommended that the system be operated under load for a running test of the equipment.

The system test can be accomplished by three separate control actions. (The first two selections may be used when the power system includes transfer switches.)

- Open the potential test switches feeding the normal side of one or more of the transfer switches in the system.
- Select manual transfer mode then start the genset and initiate transfer to the genset from the Manual Control screen.
- Select the **Test Control Mode** on the System Control screen.

The first two options cause a momentary power failure to the loads in the facilities that are fed by the transfer switches used for testing. Momentary power failure occurs on initiation of the test sequence and on return of the loads to the normal utility service.



Alert all appropriate areas requiring power before running tests to prevent causing an emergency.

Weekly Preventative Maintenance

Weekly preventative maintenance must be performed to maintain the operational reliability of the paralleling switchboards, station batteries, and battery charger.

PERIODIC MAINTENANCE

Monthly Preventative Maintenance

Service the batteries to provide proper charge. Maintain clean and tightened battery terminals and battery cables.

See the *Appendix* of this manual for maintenance logs.

Annual Preventative Maintenance

Yearly preventative maintenance insures operational reliability of the paralleling equipment. The permanent equipment log must contain a record of the work performed and the date, together with comments on the condition of the system and system components.

Perform the following procedure:

1. De-energize the power system and disable operational capability of the gensets by doing the following:
 - a. Make sure the genset Run/Off/Auto switch is set to **off**.
 - b. Disconnect the battery charger prior to removing the negative battery cable from the battery. Disconnect battery cables, negative cable first.
 - c. Make sure all circuit breakers feeding the system are open.
 - d. Open service to the DMC from other locations. Lock out the service to prevent accidental energizing while service is being performed.
2. Clean the equipment
 - a. Thoroughly dust and vacuum all controls, meters, circuit breakers, and bus compartments.
 - b. Wash cabinet surfaces and meter faces using mild detergent and a damp sponge. Do not allow excess water to enter meters or cabinets; components could short circuit and become inoperable.
3. Inspect the equipment
 - a. Visually inspect system buswork and supports for carbon tracking, cracks, corrosion, or other signs of deterioration.
 - b. Check system buswork hardware for loose connections.
 - c. Visually inspect all control wiring and power cables for signs of wear and/or deterioration, especially wiring between hinged doors.
 - d. Check all control wiring and power cables for loose connections. Tighten if necessary.
 - e. Check system cabinets for loose or missing hardware.

PERIODIC MAINTENANCE

4. Perform preventive maintenance
 - a. Tighten all system buswork and cabinet hardware, as well as all control wiring and power cables.
 - b. Service or replace station batteries.
 - c. Verify proper operation of the station battery charger.
5. Check operations
 - a. Energize the power system and enable the operational capability of the gensets.
 - b. Run the system test (if available) and operate all controls while observing meters and indicator lights.
 - c. Check the operational capability of all protective circuits and devices while observing meters and indicator lights.

See the *Appendix* of this manual for maintenance logs.

If service is required or problems arise relating to this system, contact a Cummins service representative.



PERIODIC MAINTENANCE

THIS PAGE LEFT INTENTIONALLY BLANK



Battery and Battery Charger Maintenance Log

The permanent equipment log must contain a record of the checks and the date performed, together with corrective measures taken to maintain the system. In the chart provided, mark each applicable week of the month when the batteries and battery charger are checked.

Month	Batteries					Battery charger				
January	1	2	3	4	5	1	2	3	4	5
February	1	2	3	4	5	1	2	3	4	5
March	1	2	3	4	5	1	2	3	4	5
April	1	2	3	4	5	1	2	3	4	5
May	1	2	3	4	5	1	2	3	4	5
June	1	2	3	4	5	1	2	3	4	5
July	1	2	3	4	5	1	2	3	4	5
August	1	2	3	4	5	1	2	3	4	5
September	1	2	3	4	5	1	2	3	4	5
October	1	2	3	4	5	1	2	3	4	5
November	1	2	3	4	5	1	2	3	4	5
December	1	2	3	4	5	1	2	3	4	5



**Power
Generation**

Annual Maintenance Log

Annual preventative maintenance insures operational reliability of the paralleling equipment. The permanent equipment log must contain a record of the work performed and the date, together with comments on the condition of the system and system components.

Clean the equipment

1. Thoroughly dust and vacuum all controls, meters, circuit breakers, and bus compartments.
2. Wash cabinet surfaces and meter faces using mild detergent and a damp sponge.

Date

Observations

Actions taken



**Power
Generation**

Inspect the equipment

1. Visually inspect system buswork and supports for carbon tracking, cracks, corrosion, or other signs of deterioration.
2. Check system buswork hardware for loose connections.
3. Visually inspect all control wiring and power cables for signs of wear and/or deterioration, especially wiring between hinged doors.
4. Check all control wiring and power cables for loose connections. Tighten if necessary.
5. Check system cabinets for loose or missing hardware.

Date

Observations

Actions taken



**Power
Generation**

Perform preventive maintenance

1. Tighten all system buswork and cabinet hardware, as well as all control wiring and power cables.
2. Service or replace station batteries.
3. Verify proper operation of the station battery charger.

Date

Observations

Actions taken



Power Generation

Check operations

1. Energize the power system and enable the operational capability of the gensets.
2. Run a system test (if available) and operate all controls while observing meters and indicator lights.
3. Check the operational capability of all protective circuits and devices while observing meters and indicator lights.

Date


Observations


Actions taken


TROUBLESHOOTING

This section of the manual describes troubleshooting procedures and alarm descriptions. Issues may occur that are not included in these procedures. Contact a Cummins service representative for any problem not addressed in this manual. To troubleshoot gensets and transfer switches, refer to the appropriate equipment manuals.

Observe the following safety information when troubleshooting this equipment.

 **WARNING** *Troubleshooting procedures present hazards that may result in severe injury or death. Only qualified personnel should perform service.*

 **WARNING** *During the following procedures, do not release the circuit breaker charging handle until the entire charging operation is complete. Releasing the handle earlier may cause the handle to move upward with enough velocity and force to cause injury.*

 **CAUTION** *The springs are fully charged when a metallic click is heard and the spring charge indicator reads Charged. Do not force the handle beyond this point or the circuit breaker may be damaged.*


Alarms

CB Fault/Fail Alarm

Five conditions could cause these alarms to become active:

- a breaker overcurrent condition, which is a hardwired input
- a breaker ground fault condition, which is a hardwired input
- a failure to close, which is true if the control sends a close command and the breaker does not close within one second
- a failure to open, which is true if the control sends an open command and the breaker does not open within one second
- An auxiliary contact failure, which is true if the hardwired A and B contacts are in the same position for greater than two seconds.

If this alarm is active and has not been reset, the breaker is inhibited from closing. When the alarm is reset and conditions are corrected, the breaker attempts to close. Breaker opening is not inhibited by a breaker failure alarm.

 **NOTE** *This only applies to systems with generator main and utility main breakers.*

TROUBLESHOOTING

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then check the following:

- Locate the paralleling breaker for the genset with the Breaker Fail to Close alarm. If “spring discharged” displays in the breaker status window, consider a faulty charging motor or circuit.
- If the breaker tripped due to a fault condition, determine if the circuit breaker has a manual reset fault indicator.
- On a low-voltage system, check the undervoltage release voltage.

If the issue cannot be resolved, contact a Cummins service representative.

CB Trip (Bell Alarm)

This alarm becomes active with a positive hardwired input from the device monitoring current through the appropriate circuit breaker. Input is positive when the device senses current through the breaker is not within acceptable limits. In a low-voltage breaker, this is the trip unit integral to the breaker; in a medium-voltage breaker, a protective relay performs this function.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the Alarm Ack/Horn Silence button, and then reset the relay.

If the issue cannot be resolved, contact a Cummins service representative.

Check Genset Alarm

This is a common alarm for each genset indicating that a genset parameter is outside of the acceptable range and should be investigated. Genset parameters with individual alarming capability are:

- Gen *n* Charger AC Failure
- Gen *n* Emergency Stop
- Gen *n* Fail to Close
- Gen *n* Fail to Start
- Gen *n* Fail to Sync
- Gen *n* Ground Fault
- Gen *n* High AC Voltage
- Gen *n* Low AC Voltage
- Gen *n* High Battery Voltage
- Gen *n* Low Battery Voltage
- Gen *n* Pre High Engine Temp and Gen *n* High Engine Temp
- Gen *n* Low Coolant Temp
- Gen *n* Pre Low Oil Pressure and Gen *n* Low Oil Pressure
- Gen *n* Low Coolant Level
- Gen *n* Low Fuel Level
- Gen *n* Not in Auto
- Gen *n* Overcurrent
- Gen *n* Overload
- Gen *n* Overspeed
- Gen *n* Reverse KVAR
- Gen *n* Reverse Power
- Gen *n* Short Circuit
- Gen *n* Under Frequency

Refer to the genset manual for a more in-depth explanation of individual genset alarms.

Check Station Battery Alarm

The DMC control voltage is continuously monitored by a voltage relay; if it drops below 18 VDC for at least one-half second, the alarm becomes active.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then check the following:

- Open the door on the DMC and locate the station battery assembly in the lower corner of the control. Confirm the power LED on the charger is lit.
- Check the voltage (120 VAC) on TB-BAT terminals 1 and 2.
- Make sure the charger is plugged in.
- Check the relay settings. The marks on the knobs should match up with the black marks on the relay housing.

If the issue cannot be resolved, contact a Cummins service representative.

GM in Manual Mode

See Transfer Pair in Manual Mode Alarm.

Illegal Load Demand Shutdown Sequence Alarm

The processor continuously checks the load demand genset order shutdown sequence and determines the sequence is illegal if any genset is entered in the sequence more than once. An active illegal sequence alarm takes the system out of and/or keeps it from entering load demand mode. A 30-second delay from the time an illegal sequence is sensed to when it becomes active allows for changes to the shutdown sequence while the system is in load demand mode.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button. On the System Control screen, view the Load Demand Shutdown Sequence area and confirm that no genset numbers are repeated.

If the issue cannot be resolved, contact a Cummins service representative.

Load Shed Is On/Load Bus Shed Level n Is On Alarm

This alarm becomes active when a load shed level is activated due to a system overload condition.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then re-add the loads when the overload clears.

If the issue cannot be resolved, contact a Cummins service representative.

Low Fuel Main Tank Alarm

This alarm becomes active with a positive hardwired input from an external fuel level—monitoring device supplied by others.

Touch the yellow alarm tab to display the Current Alarms screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then check the following:

- Confirm there is fuel in the tank.
- Check the tank sensor for proper function.

If the issue cannot be resolved, contact a Cummins service representative.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then check the breakers and fuses.

If the issue cannot be resolved, contact a Cummins service representative.

Minimum Number of Gensets Not Online Alarm

The system requires a minimum number of gensets to be connected to the emergency bus before it connects to the load bus by closing the gen main breaker. This is so the emergency source is not overloaded before adequate generation is available to pick up the connected load. The minimum number setpoint is adjustable from the Setup screen. The system has 30 seconds from the initiation of the start signal to get the minimum number of gensets online before this alarm becomes active.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ask/Horn Silence** button, and then start another generator.

If the issue cannot be resolved, contact a Cummins service representative.

Overload Alarm On

This alarm becomes active when the total load on the load bus exceeds the available capacity of the source. It is only enabled when the load is being supplied by the emergency source (gensets). In the standard program, it is triggered by the load dump input that is hardwired from each genset and a true input from any genset activates it. As long as this condition is true, the system continues to shed the lowest priority loads until it clears. The load dump signal initiated at the genset is based on the load bus frequency dropping 3 Hz for 5 seconds or the load on the genset exceeding 100% of its standby rating for two minutes. These settings can be modified at the genset control.

TROUBLESHOOTING

Touch the yellow alarm tab to display the Current Alarms screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then do the following:

- Touch the System Alarm Reset button.
- On the Load Control screen, use the Restore buttons to re-add loads that were shed.

If the issue cannot be resolved, contact a Cummins service representative.

PLC Battery Low Alarm

This is an output from a self-diagnostic performed in the PLC. It indicates that the battery integral to the PLC CPU is no longer capable of maintaining the program in the CPU if the PLC loses its main power supply. Battery life is typically five years.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then make sure the battery is plugged in. If it is, change the battery.

If the issue cannot be resolved, contact a Cummins service representative.

PLC I/O Failure Alarm

The PLC processor continuously checks communication to and the health of each of the distributed I/O devices. This alarm becomes active whenever a device fails to respond to the communication check or the health check.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then check the following:

- I/O connections
- Power to the I/O

If the issue cannot be resolved, contact a Cummins service representative.

PLC to Touchscreen Comm Failure Alarm

A watchdog timer is set up to monitor touchscreen/PLC communication. Every 17 seconds, the PLC sends a command to the touchscreen requesting a specific response. The touchscreen has 10 seconds to respond before a failure counter begins. The counter resets if it is not incremented for 60 seconds. If the counter reaches a count of four failures before it is reset, the communication failure alarm becomes active, sounding an audible alarm. The touchscreen has its own communication fail alarm where it monitors the communication with the PLC from its side. It displays the communication alarm if there is no data refresh in a continuous 60-second period.

NOTE

Indications of possible modbus communications malfunction:

- Screens do not update
- Question marks in screen data display fields

Check if the modbus cable or Ethernet cable have come unplugged or are loose. If the issue cannot be resolved, contact a Cummins service representative.

Protective Relay Failure Alarm

This is a hardwired output from the protective relay that becomes true when it fails a self-diagnostic health check. The system responds to this condition by taking the system out of extended parallel mode.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then check the protective relay power supply.

If the issue cannot be resolved, contact a Cummins service representative.

PU% Must Exceed DO% by 20 Alarm

There must be at least a 20% load difference between the load demand drop out and pick up setpoints. This keeps the system from cycling gensets on and off. An active Range Bad alarm will take the system out of and/or keep it from entering the load demand mode. There is a 10-second delay from the time a bad range is sensed to when the alarm becomes active to allow for changes to the setpoints while the system is in the load demand mode.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button. On the System Control screen, view the Load Demand Settings area and confirm that there is a 20% difference between the kW pickup percentage and the kW dropout percentage.

If the issue cannot be resolved, contact a Cummins service representative.

System/Touchscreen Manual Mode Alarm

This operator-initiated mode inhibits the system from any automatic control actions, including starting gensets, changing operating modes, issuing breaker control commands, or issuing load control commands. Many systems have hardwired genset start commands on a normal source failure; these are not inhibited in system manual mode. In this mode, manual genset starting and paralleling breaker control from the touchscreen are enabled.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button.

This is an indication-only alarm.

Transducer Comm Failure Alarm

This alarm becomes active if the processor does not receive an update from the metering transducers within five seconds or if any transducer fails a self-diagnostic health check.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button, and then check the following:

- The *Modbus Plus* status light blinks rapidly during normal communications.
- Confirm the transducer is receiving power.
- Make sure the transducer fuse is not blown.

If the issue cannot be resolved, contact a Cummins service representative.

Transfer Pair in Manual Mode Alarm

This is a hardwired input from the manual/auto switch indicating that the switch is in the manual position. With the switch in the manual position, the PLC does not issue control commands to the main breakers regardless of the condition of any of the power sources. Full manual control of the breakers is enabled through the breaker open/close switches.

Touch the yellow alarm tab to display the Current Alarm screen. Acknowledge the alarm with the **Alarm Ack/Horn Silence** button.

This is an indication-only alarm.

Lamps, Meters, Gauges, and Starter Solenoid

A blown DC fuse could cause the system to malfunction and/or keep the genset from starting or running. Metering and other controls could malfunction if any fuse is blown.

DRAWINGS

This section contains the following drawings. These are also located in electronic format in the *Drawings* folder on the accompanying CD.

Cummins Power Generation drawing number	Number of pages	Revision	Description
A030P929	3	A	Bill of material
A030S835	2	A	
A030S863	4	A	Switchgear outline
A030S864	7	A	WD–interconnection
A030S865	61	A	Schematic–switchgear

Square D Drawing Number	Number of pages	Description
27086157-001	30	Drawings package

THIS PAGE LEFT INTENTIONALLY BLANK



SUPPORTING DOCUMENTATION

Hard copies of these items are found in this section.

- Spare parts list
- Certificate(s) of test
- Settings sheets
- 0900-0293 PowerCommand FT-10 Network LonWorks System Annunciator Manual
- 0901-0107 Operator Manual: 15 A @ 12 V and 12 A @ 24V Battery Chargers



SUPPORTING DOCUMENTATION

The items identified below are found on the accompanying CD.

Cummins Power Generation

Annunciators

0900-0293 PowerCommand FT-10 Network LonWorks System Annunciator Manual

Battery Chargers

15 Amp @ 12 Volts and 12 Amp @ 24 Volts Battery Charger Kits instruction sheet

Distributor Directory

Worldwide Distributor Sales and Service Directory

HMI Software

Operator interface (HMI) application software

Maintenance Docs

Maintenance logs

Mapping Template

HMI to PLC mapping template

PLC Software

PLC application software

Tests & Settings

Tests and settings documents

Warranty

Global Commercial Warranty Statement Commercial Generating Set

Global Power Electronics Warranty Statement Paralleling System Transfer Switch

www.cumminspower.com

Operation & Maintenance Manual

Network Information

The CD associated with this project contains the PowerCommand network support files (these are the same as those found on Cummins P/N 0326-5706 distributed with ModLon II Kit 0541-1149). The files in this folder may not be associated with this project.

These files include:

- Cummins plug-ins
- Application files
- Visio stencils
- Installation/application manuals for PCC3201, PCC3100, PCC3200, CCMG, CCMT, DIM, annunciator, PCATS, ModLon, and ModLon II



This information is intended for use by Cummins DFSE, technicians, networks/ systems groups and internal engineers using LonMaker™ for Windows to build network. Do not make changes to the network unless authorized by the factory.



These network devices may or may not be included with this project.



SUPPORTING DOCUMENTATION

Vendor Documentation

Advantech

TPC-1570H

Bitronics

Bitronics PowerPlex Modbus Plus Interface Option Manual

Bitronics PowerPlex RT & RTH 3-Phase Multifunction Digital Transducer User Manual

Control Solutions, Inc.

Modlon Gateway (Cummins Legacy# 0300-5926)

Phoenix Contact

Ethernet Modem 2313300

Saft

A10.1 Series Float Battery Chargers

Two-tier Battery Rack RSL37N1-2

Sealed VRLA Battery 12SLA50

Schweitzer Engineering Laboratories

SEL-300G Instruction Manual

SEL-551 Instruction Manual

Schneider Electric/Square D

www.cumminspower.com

Operation & Maintenance Manual

SD-4



SUPPORTING DOCUMENTATION

Modicon

Modicon Quantum Automation Series 140 CPU 434 12A, 534 14A Instruction Sheet

Momentum M1 Processor Adapter and Option Adapter User Guide

Modicon TSX Momentum Interbus Communication Adapter User Guide

Modicon Quantum Automation Platform 140 DDI 35310 /140 DRA84000

Modicon Quantum 140 NOE 771

Modicon Quantum 140 NOM 21100

Switchgear

Masterclad Metal-clad Indoor Switchgear, 4.76-15 kV, Series 5, With Type VR Vacuum Circuit Breakers Instruction Bulletin

www.cumminspower.com

Operation & Maintenance Manual

SD-5



SUPPORTING DOCUMENTATION

THIS PAGE LEFT INTENTIONALLY BLANK



**Power
Generation**

Digital MasterControl Recommended Spare Parts List

Part No.	Description	Quantity
0321-0363-03	Fuse-.8A 600 V	4
0321-0363-28	Fuse-10A	1
0321-0363-30	Fuse-15A	1
0307-2861-06	Relay-control	2
0307-2721	Relay-control	2