Picture shown may not reflect actual configuration

EMCP 4.4 GENERATOR SET CONTROLLER

The Cat® EMCP 4.4 offers fully featured power metering, protective relaying and engine and generator control and monitoring. Engine and generator controls, diagnostics, and operating information are accessible via the control panel keypads; diagnostics from the EMCP 4 optional modules can be viewed and reset through the EMCP 4.4.

World wide product support

- Cat dealers provide extensive pre and post sale support.
- Cat dealers have over 1,600 dealer branch stores operating in 200 countries

Features

- A 480 x 320 pixel, 5.5 inch, white backlit graphical display denotes text alarm/event descriptions, set points, engine and generator monitoring, and is visible in all lighting conditions.
- Textual display with support for 16 languages
- Paralleling functions, including automatic and manual synchronizing, dead bus arbitration, load sharing, and load sense/load demand (LSLD).
- Paralleling up to 16 generator sets (MGDL operation) or up to 8 generator sets (hard wired operation)
- Automatic transfer/ Auto mains failure (AMF) functionality
- Single generator to utility paralleling operation for temporary and extended utility paralleling operation.
- Advanced engine monitoring is available on systems with an ADEM™ controller.
- Integration with the CDVR and IVR provides enhanced system performance.
- Fully featured power metering, protective relaying, engine and generator parameter viewing, and expanded AC metering are all integrated into this controller.
- Real-time clock allows for date and time stamping of diagnostics and events in the control's logs as well as service maintenance reminders based on engine operating hours or calendar days. Up to 40 diagnostic events are stored in the non-volatile memory.

Features

- Real-time clock also allows for the creation of a status event log. This log holds the last 500 control events such as ECS Position, Circuit Breaker Closure, LSLD Operations, etc.
- Ability to view and reset diagnostics on EMCP 4 optional modules via the control panel removes the need for a separate service tool for troubleshooting.
- Set points and software stored in non-volatile memory, preventing loss during a power outage.
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- Five levels of security allow for configurable operator privileges
- Programmable security levels for groups of set points.
- Programmable kW relays (3)
- Programmable weekly exerciser timer
- Dealer configurable resistive maps
- Default overview screen
- Load histogram
- Auto mains failure (AMF)
- Programmable logic functionality
- Selectable units
    - Temperature: °C or °F
    - Pressure: psi, kPa, bar
    - Fuel Consumption: Liter/hr or Gal/hr (U.S. or U.K.)

Standard Features

Generator Monitoring

- Voltage (L-L, L-N)
- Current (Phase)
- Average Volt, Amp, Frequency
- kW, kVAr, kVA (Average, Phase, %)
- Power Factor (Average, Phase)
- kW-hr, kVAr-hr (total)
- Excitation voltage and current (with CDVR)
- Desired Voltage, Excitation Command, Operating Mode (with IVR)
- Generator stator and bearing temp (with optional module)
- kW load histogram

Generator Protection

- Generator phase sequence
- Over/Under voltage (27/59)
- Over/Under frequency (81 O/U)
- Reverse Power (kW) (32)
- Reverse Reactive Power (kVAr) (32RV)
- Overcurrent (50/51)
- Current Balance (46)

Engine Monitoring

- Coolant temperature
- Oil pressure
- Engine speed (RPM)
- Battery voltage
- Run hours
- Crank attempt and successful start counter
- Enhanced engine monitoring (with electronic engines)

Engine Protection

- Control switch not in auto (alarm)
- High coolant temp (alarm and shutdown)
- Low coolant temp (alarm)
- Low coolant level (alarm)
- High engine oil temp (alarm and shutdown)
- Low, high, and weak battery voltage
- Overspeed
- Overcrank

Control

- Run / Auto / Stop control
- Speed and voltage adjust
- Local and remote emergency stop
- Remote start/stop
- Cycle crank

Inputs & Outputs

- Eight dedicated digital inputs
- Four analogue inputs
- Twelve programmable digital inputs
- Seventeen programmable digital outputs

Communications

- Primary and accessory CAN data links
- RS-485 annunciator data link
- Modbus TCP (10BT Ethernet)
- Modbus RTU (RS-485 Half duplex)
- Webserver

Language Support

Arabic, Chinese, Danish, Dutch, English, Finnish, French, German, Greek, Italian, Japanese, Polish, Portuguese, Russian, Spanish, Swedish, Turkish

Environmental

- Control module operating temperature: -40°C to 70°C
- Display operating temperature: -20°C to 70°C
- Humidity: 100% condensing 30°C to 60°C
- Storage temperature: -40°C to 85°C
- Vibration: Random profile, 24-1000 Hz, 6.0G rms

Utility / Bus monitoring

- Voltage (L–L, L–N)
- Average Voltage (L–L, L–N)
- Frequency

Standards

- UL Recognized
- CSA C22.2 No.100,14, 94
- Complies with all necessary standards for CE Certification
    - 98/37/EC Machinery Directive
    - BS EN 60204-1 Safety of Machinery 89/336/EEC EMC Directive
    - BS EN 50081-1 Emissions Standard
    - BS EN 50082-2 Immunity Standard 73/23/EEC Low Voltage Directive
    - EN 50178 LVD Standard
- IEC529, IEC60034-5, IEC61131-3
- MIL STND 461

Paralleling Functions

Methods of parallel connection

The EMCP 4.4 affords two methods of conducting parallel operation.
One of these two methods must be selected during operation and serve to provide the site application with different operating advantages:

- **Hard Wired:** In this configuration, separate hard wired lines are run between paralleled generator sets for each of the featured synchronizing and paralleling functions: Dead Bus Arbitration, Load Sharing and Load Sense Demand. This mode allows for gen to gen paralleling for similarly configured EMCP 4.4 units as well as paralleling controls utilizing either 0-10VDC or 0-3VDC real (kW) load sharing lines.
- **Multiple Genset Data Link (MGDL):** This configuration utilizes an Ethernet based communication protocol to accomplish the synchronizing and paralleling functions of the EMCP 4.4. This advanced communication methodology provides enhanced feature sets of the installed paralleling system, including Feeder Breaker Control and advanced system monitoring and increased load sense demand features.

Dead bus arbitration

The EMCP 4.4 incorporates true dead bus arbitration to determine and select the primary generator set to close to a dead bus, allowing only one unit to close to the dead bus. The dead bus arbitration control minimizes the time for the first generator set to close to the dead bus. This feature is available with Hard Wired or MGDL paralleling.

Synchronizing

The EMCP 4.4 monitors all three phases of the generator and main bus. The proprietary synchronizing algorithms drive the generator output frequency, voltage, and phase to match another source, and close the generator circuit breaker when conditions have been met. This feature is available with hardwired or MGDL paralleling.

Load shed/load add

The EMCP 4.4 provides a configurable load add signal as generator set capacity becomes available. In the event of generator capacity becoming unavailable during operation, a configurable load shed signal is provided. Enhanced load shed/add capability is available with the feeder breaker control option as part of the MGDL operation feature sets enhancements.

Load sharing

The EMCP 4.4 actively monitors the real (kW) and reactive (kVAr) load requirement of all paralleled generator sets, and adjusts output of the generator set to maintain a balanced loading of all generator sets.

Soft Load/Unload

When load sharing, soft loading and soft unloading reduces instability and risk to equipment by increasing or decreasing load in a controlled manner before closing or opening the generator breaker.

Load sense/load demand (LSLD)

This feature is priority based for hard wired load sense/load demand, but can also be engine hour based for MGDL load sense load demand. Additional LSLD features available with MGDL include engine hour offset and N+X redundant units.

Feeder breaker control

Feeder breaker control for connecting a generator bus and a load bus is included with EMCP 4.4 MGDL operation. For this feature set, a programmable digital output is configured for a "Feeder Breaker Close Command" and/or "Feeder Breaker Trip Command" based on minimum real/reactive power required set points. The advanced programming capability of this feature allows for the controlled sequencing of multiple load shed/add stages.

Modes of Operation

Multi-generator set paralleling

The EMCP 4.4 can operate as a multi-generator set paralleling controller, with up to 16 generator sets synchronized and controlled on a common bus. Support is provided for both emergency standby and prime power operation. Features include automatic paralleling, dead bus arbitration, load sharing, and load sense-load demand.

Single Unit Utility Paralleling

The EMCP 4.4 can operate as a single generator set paralleling to a single utility. Support is provided for controlling both a generator circuit breaker and utility circuit breaker. Features provided include Emergency, Baseload, Import, Export, Peak Lopping Open Transition and Peak Lopping Closed Transition. Soft loading during closed transitions is automatically provided. Support is not available for multiple sources connecting to the bus beyond the single generator set and single utility connection.

- **Baseload:** TThe EMCP 4.4 generator set will provide a programmed kW level at a programmed power factor to the utility.
  - o The EMCP 4.4 is also capable of operating as a single controller paralleling to the utility across a single intertie circuit breaker. When operating in this mode, support for baseload of real power and Power Factor is provided.

- **Import:** The EMCP 4.4 will adjust provided kW to meet a programmed kW and programmed power factor as measured across the utility breaker being imported into the system.

- **Export:** The EMCP 4.4 will adjust provided kW to meet a programmed kW and programmed power factor. as measured across the utility breaker being exported from the system.

- **Peak Lopping Closed Transition:** The EMCP 4.4 will parallel the generator set to the utility and soft load the generator set to the programmed utility disconnect level and then open the utility breaker. When leaving this mode, the generator set will parallel back to the utility and soft unload the generator set to the programmed disconnect level.

- **Peak Lopping Open Transition:** The EMCP 4.4 will open the utility circuit breaker and close the generator breaker after a programmed time delay and take over the load. When leaving this mode, the EMCP 4.4 opens the generator circuit breaker and closes the utility breaker after a programmed time delay.

Automatic paralleling

In the automatic paralleling mode, the EMCP 4.4 controller automatically adjusts the voltage and frequency of the generator set. When the generator output is synchronized with the second source, the EMCP 4.4 controller closes the generator circuit breaker.

Manual paralleling

In the manual paralleling mode, the operator will manually adjust the voltage and frequency of the generator set. When the generator set is synchronized with the second source, the operator will initiate a generator circuit breaker close command. A 3-phase sync check function is also included to prevent out of phase paralleling.

Sync check mode

In the sync check mode, the EMCP 4.4 controller automatically adjusts the voltage and frequency of the generator set without closing the generator circuit breaker. When the generator set is synchronized with the second source, the operator will initiate a generator circuit breaker close command. A 3-phase sync check function is also included to prevent out of phase paralleling.

Enhanced Control Features

Advanced overcurrent protection

The EMCP 4.4 provides advanced overcurrent detection for protection of the generator set system. The Generator Inverse Definite Minimum Time Curve type selection allows for additional configuration of the overcurrent protective scheme. Selections include: Normally Inverse, Very Inverse and Extremely Inverse. Respectively, these curves have progressively slower trip times for the same conditions and configurations.
A fourth selection entitled Thermal Damage Curve is available that is specific to the generator design, causing an overcurrent shutdown after a defined trip time expires.

Integrated programmable logic controller (PLC)

This feature set of the EMCP 4.4 allows the user to create custom logic functions in similar fashion to that of the capability of a PLC controller. These logic functions allow for increased capability of the EMCP 4.4 through interaction and control of internal signals within the control software as well as the programmable inputs/outputs of the device.

Programmable kW relay

The EMCP 4.4 includes three programmable kW relay outputs configured based on the % kW of the generator set. The configurable set points of the kW relay include: trigger condition, percentage threshold, hysteresis percentage and trip activation & deactivation delay time. These output functions may also be used to trigger events, recordable within the event log and included in the remote monitoring of the generator set.

Programmable cycle timer

The programmable cycle timer (PCT) feature allows for programming of seven independent times, when tasks (called PCT outputs), will be activated or deactivated automatically during the week. This is useful for exercising generator sets, or cases where two or more generators are required to automatically share the duty of supplying a load throughout the week. Using the PCT, each generator set can be programmed to start and stop at pre-set times. The PCT can handle a seven-day sequence with seven independent starts happening one or more times each week. Each of the seven timers has the following set points: activation day of the week, activation start time, active time and includes three (3) independent activation outputs.

Real (kW) load histogram

The EMCP 4.4 is equipped with a real (kW) load histogram. This feature keeps track of the amount of time the generator percent kW is within certain predefined ranges. The four ranges include:

1. Time spent below 30% load
2. Time spent greater than or equal to 90% load and less than 100% load
3. Time spent greater than or equal to 100% load and less than 110% load
4. Time spent greater than or equal to 110% load

Webserver

The EMCP 4.4 controller includes an embedded web server. The embedded web server allows the operator to view basic event status, engine overview, and generator overview over an Ethernet connection to a local and/or remote viewing station.

## Optional Modules

CAN annunciator

The EMCP 4 CAN annunciator serves to display generator set system alarm conditions and status indications.
The annunciator has been designed for use on the accessory communication network and may be used in either local (package mounted) or remote (up to 800 feet) application. A maximum of four annunciators may be used with a single EMCP 4.4.

RS-485 annunciator

The EMCP 4 RS-485 Annunciator serves to display generator set system alarm conditions and status indications. The annunciator has been designed for use on the long distance annunciator datalink and is used for remote (up to 4000 feet) applications.

Remote monitoring software
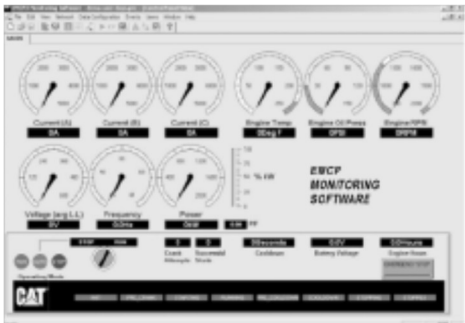
The EMCP remote monitoring software package is a PC based program which allows the user to monitor and control a generator set, and can run on a Windows based operating system. The remote monitoring software allows the user to configure data monitoring and data acquisition processes for monitoring, graphing, and logging of generator set data.

Digital input/output module

The Digital input/output (DI/O) module serves to provide expandable Input and Output event capability of the EMCP 4 and can read 12 digital inputs and setting 8 relay outputs. The DI/O module has been designed for use on the accessory communication network and may be used in either local (package mounted) or remote (up to 800 feet) application.

RTD module

The RTD module serves to provide expandable generator temperature monitoring capability of the EMCP 4 and can read up to eight type 2-wire, 3-wire and 4-wire RTD inputs. The RTD module has been designed for use on the accessory communication network and may be used in either local (package mounted) or remote (up to 800 feet) application. A maximum of one RTD Module may be used with a single EMCP 4.4.

Optional Modules (continued)

Thermocouple module

The thermocouple module serves to provide expandable engine and generator temperature monitoring capability of the EMCP 4 and can read up to twenty type J or K thermocouple inputs. The thermocouple module has been designed for use on the primary communication network for engine information and the accessory communication Network for generator information. It may be used in either local (package mounted) or remote (up to 800 feet) application. A maximum of one thermocouple modules may be used with a single EMCP 4.4 on each datalink.

Optional Control Panels

EMCP 4.4 Supervisory Control Panel (SCP)

The EMCP 4.4 SCP is a wall-mountable control panel which adds 16-stage load add and load shed functionality to an EMCP 4.4 island mode system (non-utility paralleling). Based on the proven reliability and serviceability of the EMCP 4, the SCP controller is fully integrated with each generator set mounted EMCP 4.4 via the MGDL paralleling network.

EMCP 4.4 Master Control Panel (MCP)

The EMCP 4.4 MCP is a wall-mountable system that monitors and controls EMCP 4.4 equipped generator sets, providing centralized controls and communications through an intuitive graphical interface. Featuring a 15" color touch screen, the MCP is available for both emergency standby (EGP) and parallel with utility (XLM) applications.

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