

DMC 1500

PowerCommand[®] Digital Master Control



The PowerCommand Digital Master Control is a microprocessor-based paralleling system product designed to directly interface with Cummins Power Generation PowerCommand paralleling generator sets and switchgear. The DMC 1500 is designed for use in low or medium voltage isolated bus (not utility paralleled) and infinite bus (utility paralleled) applications.

The DMC 1500 provides flexibility to meet specific application requirements, and is configurable via the user-friendly touch-screen interface. The system control has been extensively prototype tested to ensure optimum system reliability.

Features

- **Color touch-screen:** 15-inch color display with 1024x768, 18-bit color graphics.
- **Supports four system topologies:** Configurable for isolated bus, isolated bus with generator main, single utility common bus and single utility transfer pair.
- **Standard generator set interface:** Includes interface for four generator sets with optional add-on for up to eight.
- **Trending (real-time and historical):** Collects and displays total kW, total kVAR, average amps and average voltage data from the generator bus and utility bus (if applicable).
- **Operator control panel:** Includes full system AC metering, one-line diagram, system status, alarm history, system configuration and setup, and password-protected access to adjustable system operating parameters.
- **Extended paralleling:** Configurable for either the generator set metering point (base-load) or utility metering point (peak-shave).

DMC 1500 digital master control

- **Configurable:** DMC 1500 can be used in a variety of power system architectures, including standby, prime power, and applications that require control of a normal source main circuit breaker, or circuit breaker transfer pair.
- **Open or closed transition:** When the power transfer function is used, the control is configurable for open transition (load break) transfer and closed transition (utility/mains parallel) operation in both fast (100 ms) and ramping situations. The control system also includes utility paralleling functions for peak-shaving and base-loading.
- **Operator-friendly:** DMC 1500 incorporates a broad range of operational diagnostic functions to greatly enhance system reliability.
- **Unattended applications :** DMC 1500, in conjunction with PowerCommand generator set controls, is a fully automatic, distributed logic system suitable for unattended applications.
- **True RMS bus metering:** Full-function true RMS bus AC metering (generator bus and utility bus).
- **Load-add and load-shed sequence control:** Automatic, re-configurable load sequencing to prevent overloading the generator bus.
- **Load demand control system:** Switches generator sets off in a user-configurable sequence to conserve fuel and maximize generator set life.
- **Complete product line:** Cummins Power Generation offers a wide range of equipment, accessories and services to suit virtually any backup power application.
- **Warranty and service:** Products are backed by a comprehensive warranty and a worldwide network of distributors with factory-trained service technicians.

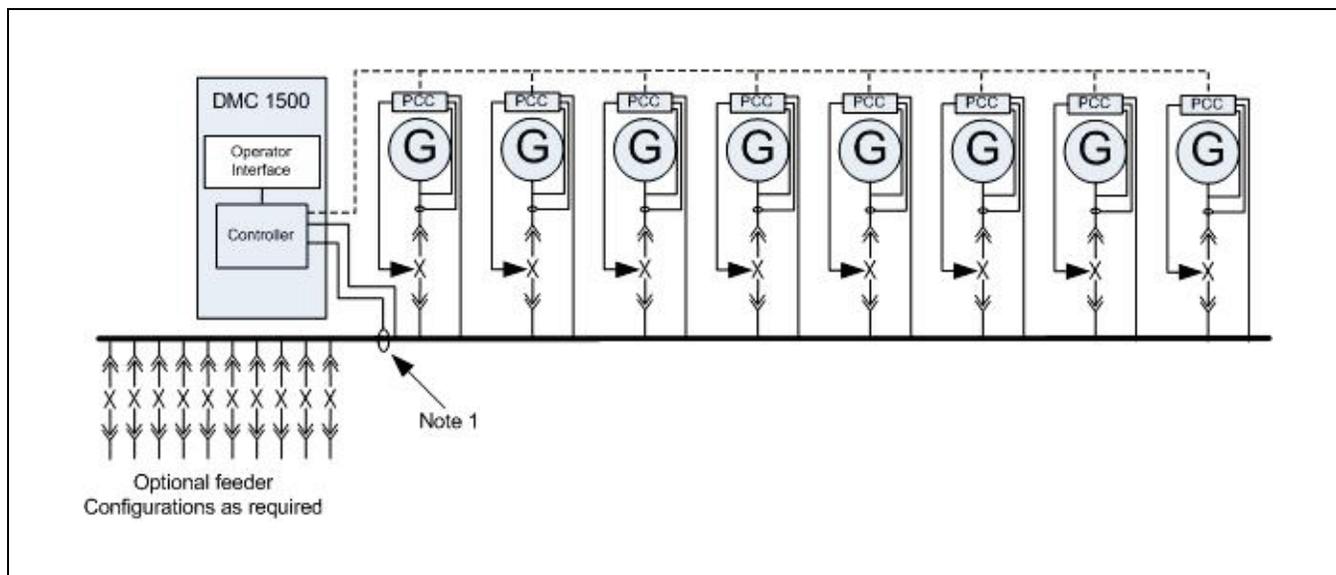


Common system configurations

The DMC 1500 provides advanced supervisory functions for the generator sets, generator bus AC metering, utility bus AC metering, system status and power transfer functions.

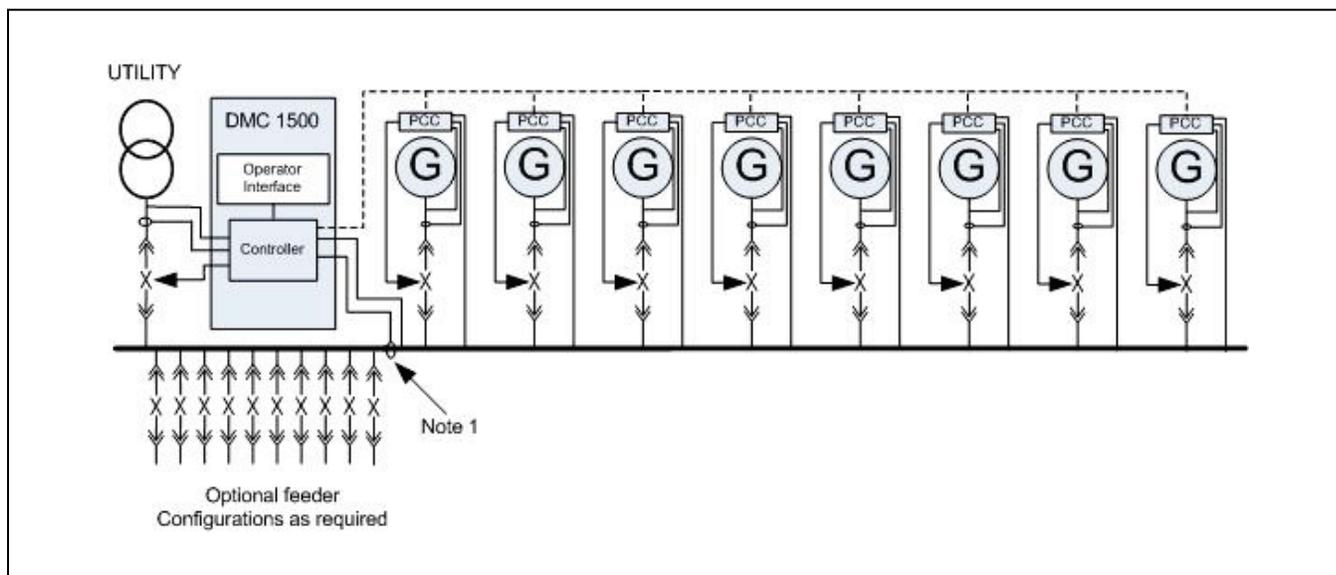
Isolated bus with or without generator set main:

System consists of an isolated bus and may include a generator set main breaker. The system controls generator set main breaker as a programmable function of bus capacity when required.



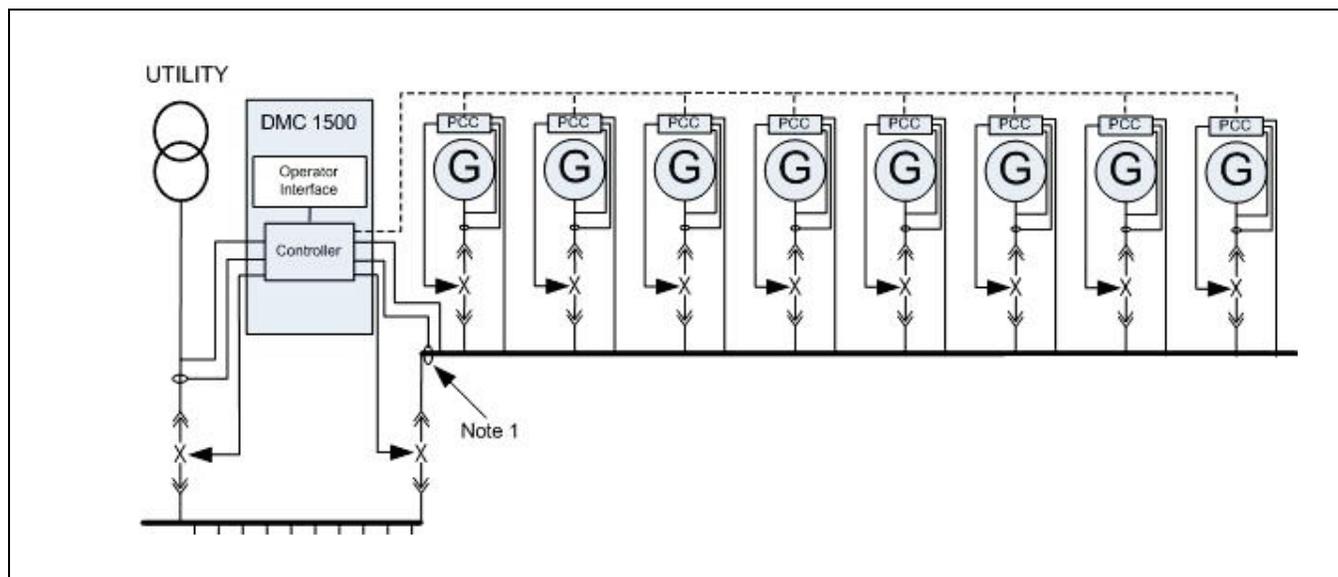
Common bus:

System consists of a utility main breaker, but no generator main breaker (only individual generator set paralleling breakers). The system controls utility main breaker and generator set paralleling breakers. Operation sequences are configurable for open transition transfer and ramping closed transition transfer. The system is suitable for use in peak-shaving and base-loading applications. (Fast closed transition is not available with common bus configurations). Utility interconnection relay and DC station battery system provided with closed transition transfer applications.



Transfer Pair:

System consists of a breaker pair including a generator bus main and a utility main. DMC 1500 control both breakers in open transition, fast closed transition, or ramping closed transition modes. It can also be programmed to exercise the generator set bus in parallel with the utility in either peak-shave or base-load modes.



NOTE 1: Current transformer (CT) sizing and location must be considered as part of the design and physical layout of the power section. The generator bus CT connection presented in the one-line diagrams above represents totalized generator bus current output.

Protective functions

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

Any alarm on any generator set or in the system will cause the ALARM icon to appear at the center-bottom of the touch-screen. Click on the icon to navigate to the Alarm screen that describes the equipment where the fault has occurred, and the name of the fault. The screen allows the operator to attempt to reset the fault from the HMI.

- **Breaker fail-to-close warning:** When the controller signals a circuit breaker to close, it will monitor the breaker auxiliary contacts and verify that the breaker has closed. If the control does not sense a breaker closure within an adjustable

time period after the close signal, the fail-to-close warning will be initiated. If the utility main breaker fails to close, the controller starts the generators and transfers load to them until the operator resets the fault condition and resolves the problem.

- **Breaker position contact warning:** The controller will monitor both A and B position contacts from the breaker. If the contacts disagree as to the breaker position, the breaker position contact warning will be initiated. If this warning and breaker fail-to-open warning register, then the controller will check for current above a threshold on all three phases. If criteria are met, the controller will remain on the source. If not, the controller will attempt to transfer to the alternate source.

- **Breaker fail-to-open warning:** The control system monitors the operation of breakers that have been signaled to open. If the breaker does not open within an adjustable time delay, a breaker fail to open warning is initiated.
- **Breaker tripped warning:** The control accepts inputs to monitor breaker trip/bell alarm contact and will initiate a breaker tripped warning if it should activate.
- **Fail to disconnect warning:** If the controller is unable to open either breaker, a fail to disconnect warning is initiated.
- **Fail to synchronize warning:** Indicates that the generator bus could not be brought to synchronization with the system bus. Configurable for adjustable time delay of 10-120 seconds. If the control is trying to perform a closed transition re-transfer, but fail-to-sync occurs, the control can be configured to perform the re-transfer using open transition.
- **Bus overload warning:** The control monitors bus frequency and generator bus load relative to the online capacity. When configured, the control will initiate a bus overload warning if the bus kW load exceeds an adjustable threshold (80-140%) for an adjustable delay (0-120 sec), or both.
- **Maximum parallel time warning:** During closed transition load transfers, the controller independently monitors the time the utility and generator sources are connected. If time is exceeded, warning is initiated and the generator bus is disconnected.
- **Generator set main breaker fail-to-close warning:** Returns to the utility source and will not retry until the operator resets the fault condition and resolves the problem.

Sensors and adjustable timers

Under-voltage sensor: 3-phase L-N or L-L

- Pickup from 85-100% of nominal
- Dropout adjustable from 75-98% of pickup
- Dropout delay adjustable from 0.1-30 sec

Over-voltage sensor: 3-phase L-N or L-L

- Pickup from 95-100% of dropout
- Dropout adjustable from 105-135% of nominal
- Dropout delay adjustable from 0.5-120 sec
- Default setting is disabled

Over/under frequency sensor:

- Center frequency from 45-65 Hz
- Dropout bandwidth from 0.3-5% of center
- Pickup bandwidth adjustable from 0.3-20% of center frequency
- Default setting is disabled

Loss of phase sensor:

- Detects out-of-range voltage phase angle
- Default setting is disabled

Phase rotation sensor:

- Checks for valid phase rotation of source
- Default setting disabled

Breaker tripped:

- If activated, the associated source is unavailable

Generator set online capacity sensor:

- Requires minimum kW capacity online before closing generator bus main breaker

Adjustable timers:

- Start delay: 0-3600 sec
- Stop delay: 0-3600 sec
- Transfer delay: 0-120 sec
- Re-transfer delay: 0-1800 sec
- Programmed transition delay: 0-60 sec
- Maximum parallel time: 0-800 sec

Operator panel

A full color high-resolution (1024x768) 15-inch touch-screen operator interface panel (HMI) is provided to allow the operator to monitor and control the onsite power system. The operator panel provides the user with a complete package of easy-to-view and useful HELP and INFORMATION screens.

All data is configurable for the display in either Imperial standard or metric indications. Screen navigation icons are located along the bottom of the screen with the MAIN MENU icon always in the lower left corner.

The standard viewing and basic control operator screens include:

- MAIN MENU
- ONE-LINE DIAGRAM
- GENERATOR SET SUMMARY
- GENERATOR SET GAUGES
- METERING
- TRENDING
- ALARMS
- EVENT LOG
- SCHEDULER

Languages

The HMI is configurable for up to six languages, including:

- English
- Brazilian Portuguese
- Chinese
- French
- Spanish
- Russian

One-line diagram

The ONE-LINE DIAGRAM screen displays system status using a combination of animation, changing screen color, text messages, and indicators.

Generator set summary

The GENERATOR SET SUMMARY provides an analog and graphical display of critical generator set operating parameters. 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 3-phase AC bus voltage and frequency. The screen provides a complete display of all engine and alternator data present in the generator set control. The screen also shows status of the bus and generator set breaker.

Load control

The LOAD CONTROL screen provides a digital display of system load as a percent of available capacity of the generator sets that are operating in parallel on the bus. The screen provides an alphanumeric display of this data. It also displays the name, status and priority of each load block (whether on or off) and the total load of that block. The screen allows the operator to manually add and shed loads in any sequence desired.

True RMS bus metering

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

Trending

Trending function collects and displays total kW, total kVAR, average amps, and average voltage data from the generator bus and utility bus (if applicable).

Real-time trend properties:

- Refresh rate: On data change or every 2 seconds
- Buffering for extra data: 360 data points
- Continuous scrolling (FIFO)
- Time span: 6 minutes
- Maximum and minimum scale values: Selectable by operator via HMI

Historical trend properties:

- Continuous scrolling with pause and sliding time
- Time span on display: 8 hours (normal view)
- Time span on display: 2 hours (zoom view)
- Maximum capacity of history: 26 days
- USB data storage: 1 year (with minimum 1 GB)
- Print screen function
- Zoom function

Diagnostic screens:

- Operator panel diagnostics
- Communications processor diagnostics
- Primary controller diagnostics

Optional screens:

- Generator set manual control
- Network ATS summary
- Plant test report (JCAHO)

Control functions

The DMC 1500 is fully configurable and provides all core system functions in a flexible, reliable, prototype-tested configuration.

Sync check: Independently determines when permissive conditions have been met to allow breaker closure. Adjustable criteria include:

- Phase difference: 0.1-20 degrees
- Frequency difference: 0.001-1.0 Hz
- Voltage difference: 0.5-10%
- Dwell time: 0.5-5.0 seconds

Internally the sync check is used to perform closed transition operations.

Dual source bus AC metering: Provides comprehensive 3-phase AC metering functions for both monitored sources, including:

- 3-phase voltage (L-L and L-N) and current
- Frequency and phase rotation
- Individual phase and totalized values of kW, kVAR, KVA, and power factor
- Totalized positive and negative kW hours, kVAR hours and kVA hours.

Voltage connection: DMC 1500 accepts three-wire or four-wire voltage connection with direct sensing of voltage to 480V and up to 35kV with external transformers. Current sensing is accomplished with either 5 amp or 1 amp CT secondary and up to 25,000 amp primary.

Power transfer control: Provides integrated automatic transfer functions including:

- Source availability sensing
- Generator set start/stop and
- Transfer pair monitoring and control

Transfer pair: System consists of a breaker pair including a generator bus main and a utility main. The DMC 1500 controls both breakers in open transition, fast closed transition or ramping closed transition modes. Configurable for open transition, fast closed transition (less than 100ms interconnect time) or soft closed transition (load ramping) sequences of operation. Utility source failure will automatically start generators and transfer load, re-transferring when utility source returns.

Test will start generator sets and transfer load if test with load is enabled.

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 (max 30 VDC, 10 amp, or 250VAC, 10 amp).

Extended paralleling: Starts generator sets and parallels to a utility source, then governs the real and reactive power output. The control point for the real power (kW) can be configured for either the generator set bus metering point (base-load) or the utility metering point (peak-shave). The control point for the reactive power (kVAR or power factor) can be independently configured for either the generator set bus metering point or the utility metering point. Allows base kW load from the generator sets while maintaining the utility power factor at a reasonable value to avoid penalties due to low power factor. The system always operates within generator set ratings. The control point can be changed while the system is in operation. Set points can be adjusted via operator panel display or service tool.

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. Up to six different exceptions can be set up to block a program from running during a specific time period.

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 from two to eight generator sets. 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. Shutdown delay is adjustable from 1-60 minutes. Re-start threshold is adjustable from 20-100% of online capacity. Run hours differential is adjustable from 1-500 hours.

Load add/shed: Will control and monitor up to 10 loads step levels (such as feeder breaker or automatic transfer switches) in any combination. Up to 10 levels of load-add, and up to 9 levels of load-shed may be defined. The load add/shed function will support up to eight generator sets. Loads can be added as generator sets come online, as well as on a timed basis. Loads are shed on a timed basis when an overload condition is detected, protecting system integrity. Shed loads can be restored through operator action. Manual load-add and shed is also provided. Load-add delay is adjustable from 1-60 sec. Load-shed delay is adjustable from 1-10 sec.

Neutral earth relay control: Used to restrict earth fault protection for multiple operating power generation sources. This option provides control of the contactor in the neutral (neutral contactor) to earth of each generator. Neutral contactors are interlocked so that only one contactor can remain closed during parallel operation. During independent operation of any generator, its neutral contactor will be closed.

Generator set manual control: Allows the operator to start and stop each individual generator set from the DMC 1500, as well as open and close each generator set paralleling breaker. During this operation, generator set protection is active to prevent starting the generator set or closing the generator set paralleling breaker in an unsafe condition. If a loss-of-normal power condition occurs while the system is in manual, all generator sets start, but the generator set paralleling breakers do not close until the operator pushes the breaker close button.

Data logging: Data logging collects generator and utility system data including: total kW, total kVAR, average amps, and average LL voltage. In addition, the system is also collecting individual generator set data: power factor, kVA, kW, kVAR, voltage AB,

voltage BC, voltage CA, amperage A, amperage B, and amperage C.

- Collection rate: 60 seconds
- New CSV file each day
- USB data storage: 1 year (with minimum 1 GB)

Fault simulation mode: The control, in conjunction with InPower™ software, will accept commands to allow a technician to verify the proper operation of the control and its interface by simulating failure modes or by forcing the control to operate outside of its normal operating ranges. InPower also provides a complete list of faults and settings for the protective functions provided by the controller. The DMC 1500 provides advanced supervisory functions for the generator sets, generator bus AC metering, utility bus AC metering, system status and power transfer functions.

Specifications

	UL/CSA configuration
Control wiring	105°C/600V
Approval	UL 891 listed CSA certified
Operating temperature range	32°F (0°C) to 122°F (50°C)
Storage temperature range	-4°F (-20°C) to 158°F (70°C)
Humidity	Up to 95% humidity (non-condensing)
Altitude	Up to 6,500 feet
Enclosure type	NEMA 1

Certifications



UL 891 listed, Category NIWT7 for U.S. and Canada.



PowerCommand control systems are designed and manufactured in ISO 9001 certified facilities.

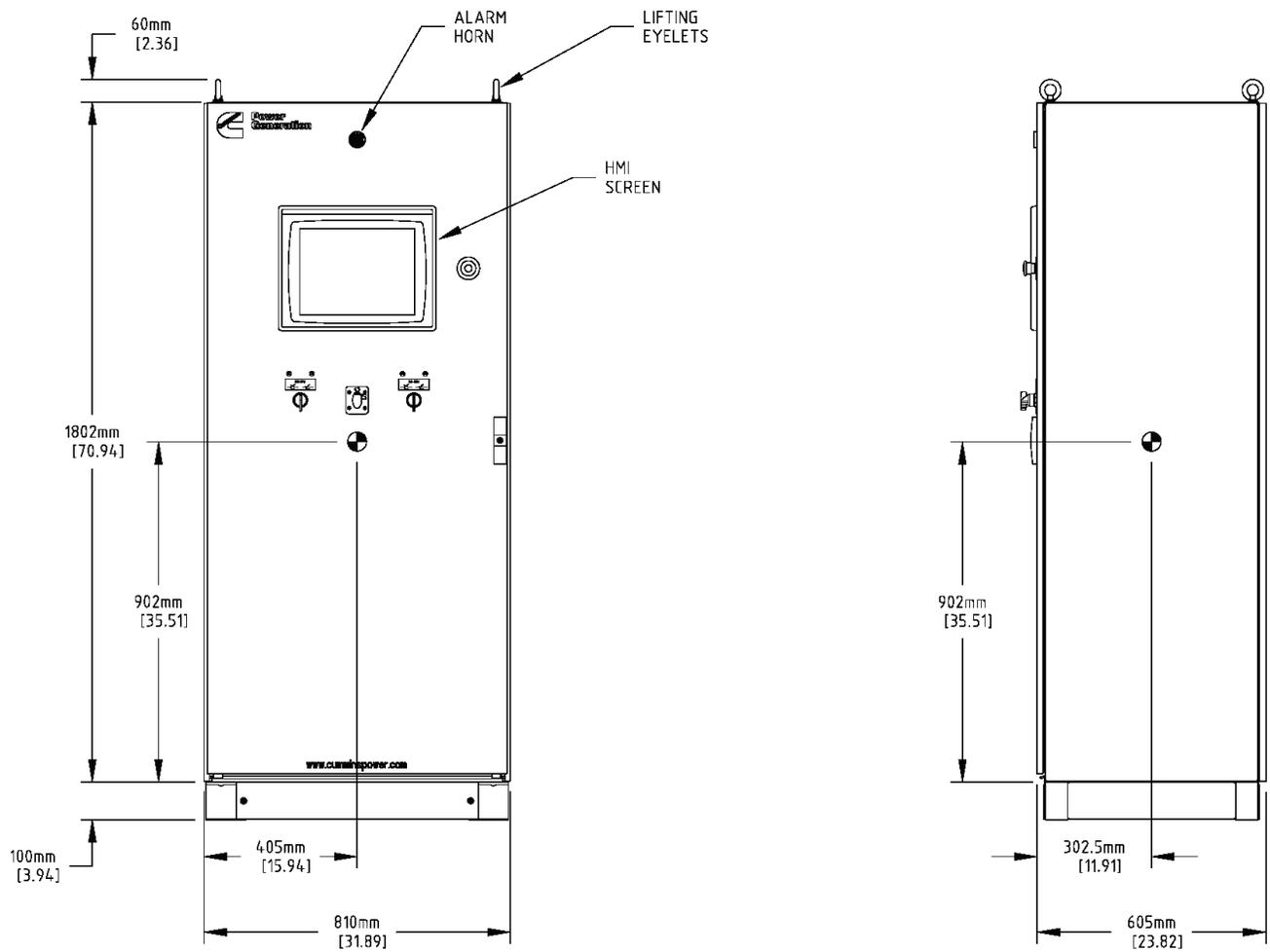


Suitable for use in emergency, legally required and standby applications per NEC 700, 701 and 702.

Enclosure

Height		Width		Depth				Weight	
				Door closed		Door open			
in	mm	in	mm	in	mm	in	mm	lb	kg
77.24	1962	31.89	810	23.82	605	55.71	1415	650	295

Elevations



Submittal detail

System capacity

- T970-7 4 Generator sets
- T971-7 8 Generator sets

System certification

- T721-7 CSA/UL
- T881-7 Seismic

System voltage type

- T891-7 Low voltage ($\leq 600\text{VAC}$)
- T892-7 Medium voltage ($> 600\text{VAC}$)

Language

- L050-7 English
- L051-7 Spanish
- L052-7 French
- L057-7 Chinese
- L100-7 Brazilian Portuguese

System application

- T731-7 Isolated bus
- T732-7 Isolated bus with generator main
- T733-7 Single utility common bus
- T734-7 Single utility transfer pair
-

System transition mode

- T741-7 Open transition
- T742-7 Closed hard transition
- T743-7 Closed soft loading or extended parallel

System load quantity

- T781-7 0 Load add/shed devices
- T787-7 6 Load add/shed devices
- T791-7 10 Load add/shed devices

System distribution type

- T801-7 ATS only
- T802-7 ATS and/or breaker type

System HMI data options

- T811-7 ATS network data
- T812-7 Generator set manual control and plant test report
- T814-7 BMS Connectivity MB TCPIP
- T815-7 BMS Connectivity MB RTU

System protection options

- T831-7 Neutral earth control

System wire

- T871-7 Three-wire
- T872-7 Four-wire

System frequency

- A045-7 50Hz
- A044-7 60Hz

System secondary CT ratio

- T931-7 1 Amp secondary CT ratio
- T932-7 5 Amp secondary CT ratio

Accessories

- A034W270 BMS Connectivity, MB TCPIP, UL/CSA
- A042U403 BMS Connectivity, MB RTU, UL
- A034W262 ATS network data, UL/CSA
- A035A291 Load add/shed, ATS, 10 devices, UL/CSA
- A034W250 Load add/shed, LV breaker, 10 devices, UL/CSA
- A034W258 Load add/load shed, MV breaker, 10 devices, UL/CSA
- A035A298 8 Generator set expansion, LV, UL/CSA
- A035A304 8 Generator set expansion, MV, UL/CSA
- A034W266 Generator set manual control, UL/CSA



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