

CATERPILLAR®



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Image shown may not reflect actual package

**POWER MODULE
STANDBY 2000 kW
PRIME 1825 kW
50/60 Hz**

Frequency	Voltage	Standby kW (kVA)	Prime kW (kVA)
60	480/277	2000 (2500)	1825 (2281)
50	400	1800 (2250)	1600 (2000)

FEATURES

Incorporates a wide range of rugged features. Factory designed, certified prototype tested with torsional analysis. Production tested and delivered in a package ready to be connected to your fuel and power lines. Supported 100% by your Caterpillar® dealer with warranty on parts and labor. Extended warranty available in some areas. The generator set is designed and manufactured in an ISO 9001:2000 compliant facility. Generator set and components meet or exceed the following specifications: AS1359, AS2789, ABGSM TM3, BS4999, DIN6271, DIN6280, EGSA101P, JEM1359, IEC 34/1, ISO3046/1, ISO8528, NEMA MG1-22

RELIABLE, FUEL EFFICIENT DIESEL ENGINE

The compact, four-stroke-cycle Caterpillar 3516B turbocharged-aftercooled diesel engine combines durability with minimum weight while providing dependability and economy. The fuel system operates on a variety of fuels.

CATERPILLAR SR4B GENERATOR

Single bearing, wye-connected, static regulated, brushless, permanent magnet excited, Caterpillar SR4B 826 frame generator designed to match the performance and output characteristics of the Caterpillar diesel engine driving it.

CATERPILLAR COOLING SYSTEM

Sized compatible to rating with energy efficient fan and core. Cooling system 43C ambient operating & vertical discharge radiator for close proximity to buildings.

CATERPILLAR SWITCHGEAR

Provides single unit and/or multi-unit/utility paralleling capability. Operational modes are standby, load sense/load demand, import, export, and base load modes.

Can be equipped with optional Basler Utility Multi-function Relay (UMR) IPS-100.

EXCLUSIVE CATERPILLAR DIGITAL VOLTAGE REGULATOR (CDVR)

Three-phase sensing and adjustable Volts-per-Hertz regulation give precise control, excellent block loading, and constant voltage in the normal operating range.

SOUND ATTENUATED CONTAINER

Provides ease of transportation and protection. Meets 75 dB(A) at 15 meters or below per SAE J1074 measurement procedure at 110% prime load.

FACTORY INSTALLED STANDARD EQUIPMENT

SYSTEM	STANDARD EQUIPMENT
Engine	<p>Caterpillar 3516B heavy duty diesel engine Heavy duty air cleaner with service indicator 60-Amp charging alternator Fuel filters – primary and duplex secondary with integral water separator and change-over valve Spin on, full flow oil filters with water cooled oil cooler. Requires API CF-4 lube oil Lubricating oil system including oil drain lines routed to engine rail Jacket water heater Fuel cooler and priming pump Electronic ADEM™ A3 controls 24V electric starting motors with battery rack and cables</p>
Generator	<p>SR-4B brushless, permanent magnet excited, three-phase with Caterpillar digital voltage regulator (CDVR), space heater, 6-lead design, Class H insulation operating at Class F temperature for extended life, winding temperature detectors and anti-condensation space heaters (120/240V 1.2 kW)</p>
Containerized Module	<p>40' ISO high cube container, CSC certified 3-axle, 40' ISO container chassis Four (4) sound attenuated air intake louvers and 3 lockable personnel doors with panic release Interior walls and ceilings insulated with 100 mm of acoustic paneling Floor of container insulated with acoustic glass and covered with galvanized steel Side bus bar access door, external access load connection bus bars Shore power connection via distribution block connections for jacket water heater, battery charger, space heaters, and generator condensate heaters Standard lighting 3 AC/4 DC, and one (1) single duplex service receptacle, 1,250 gal fuel tank, UL listed, double wall, 9 hr runtime @ 100 % prime rating External lockable connections for fuel Sound attenuated 75 dB(A) @ 50 ft Four (4) oversized maintenance-free batteries, battery rack and 20-Amp battery charger Critical grade exhaust silencer with side inlet and end outlet Vibration isolators, corrosion resistant hardware and hinges External drain access to standard fluids Two 4.5 kg (10lb) carbon dioxide fire extinguishers Standard Cat rental decals and painted standard Cat power module white</p>
Cooling	<p>Standard cooling provides 43° C ambient capability (60 Hz) at prime +10% rating Horizontally mounted radiator with vertical air discharge</p>
Generator Controls and Protection	<p>Custom switchgear control with EMCP 3.3 genset mounted controller and wall-mounted paralleling controls Automatic start/stop with cool down timer Reverse compatibility module provided for interface to legacy power modules 3000A generator circuit breaker Touch screen controls with event log Multi-mode operation (island, multi-island and utility parallel), load sharing (multi-unit only) Import & export control (utility parallel only), manual and automatic paralleling capability Touch screen display (status and alarms) Metering display: voltage, current, frequency, power factor, kW, WHM, kVAR, and synchroscope Optional Utility Multi-function Relay protections: 25,27/59, 32, 47, 50/51, 62, 67, 81 O/U UMR is IEEE 1547-2003 compliant in most applications</p>
Quality	<p>Standard genset and package factory tested UL, NEMA, ISO and IEEE standards O&M manuals</p>

SPECIFICATIONS

GENERATOR	CAT 3516B DIESEL ENGINE
Frame Size 826	3516B, 4-Stroke diesel
Pitch 0.6667	Bore – mm (in) 170 (6.7)
No. of poles 4	Stroke – mm (in) 190 (7.5)
Excitation Static regulated brushless PM excited	Displacement – L (cu in) 69 (4,210)
Constructions Ingle bearing, close coupled	Compression ratio. 15:1
Insulation. Class H	Aspiration. TA
Enclosure Drip proof IP22	Fuel system EUI
Alignment. Pilot shaft	Governor type Caterpillar ADEM™ A3 Control System
Overspeed capability – % of rated 125% of rated	
Voltage regulator 3 phase sensing with Volts-per-Hertz	
Voltage regulation. Less than ± ½% voltage gain	
Wave form deviation Less than 5% deviation	
Telephone Influence Factor (TIF). Less than 50	
Harmonic Distortion (THD). Less than 5%	

TECHNICAL DATA

Materials and specifications are subject to change without notice.

Generator Set Technical Data		50 Hz		60 Hz	
		Standby	Prime	Standby	Prime
Power Rating	kW (kVA)	1800 (2250)	1600 (2000)	2000 (2500)	1825 (2281)
Lubricating System	L (U.S. gal)	401.3 (106)			
Fuel System					
Generator set fuel consumption	L/hr (gal/hr)	450.5 (119.0)	402 (106.2)	540.6 (142.8)	487.9 (128.9)
100% Load	L/hr (gal/hr)	338.7 (89.5)	303.9 (80.3)	400.4 (105.8)	369 (97.5)
75% Load	L/hr (gal/hr)	232.4 (61.4)	209.9 (55.5)	278.8 (73.7)	258.6 (68.3)
50% Load	L (U.S. Gal)	4731 (1250)	4731 (1250)	4731 (1250)	4731 (1250)
Fuel Tank Capacity					
Running Time @ 75% of rating	hours	>13	>12	>10	>11
Cooling System					
Radiator Capacity	L (U.S. gal)	770 (203)			
Air Requirements					
Combustion air flow	m³/min (cfm)	144.2 (5110)	132.2 (4683)	172.4 (6092)	167.8 (5926)
Maximum air cleaner restriction	kPa (in H ₂ O)	6.2 (24.91)	6.2 (24.91)	6.2 (24.91)	6.2 (24.91)
Exhaust System					
Exhaust flow at rated	m³/min (cfm)	360.0 (12763)	326.4 (11471)	453.8 (16065)	418.2 (14769)
Exhaust temperature at rated kW – dry exhaust	°C (°F)	469.1 (876.6)	456.5 (852.4)	508.7 (950.7)	469.6 (877.3)
Generator Set Noise Rating* with enclosure at 15 meters (50 feet)]	dBA	74	74	75	74

RATING DEFINITIONS

Standby – Applicable for supplying continuous electrical power (at variable load) in the event of a utility power failure. No overload is permitted on these ratings. The generator on the generator set is peak prime rated (as defined in ISO852) at 30° C (86° F).

Prime – Applicable for supplying continuous electrical power (at variable load) in lieu of commercially purchased power. There is no limitation on the annual hours of operation and the generator can supply 10% overload.

Model	Length in (mm)	Width in (mm)	Height in (mm)	Weight with Lube oil and Coolant lb (kg)	Weight with fuel, lube oil and coolant (kg)
XQ2000 w/o chassis	480 (12,192)	97.5 (2,438)	114 (2,896)	64,000 (29,021)	73,000 (33,106)
XQ2000 w/ Chassis	480 (12,192)	97.5 (2,438)	168 (4,267)	74,000 (33,638)	83,000 (37,641)
Center of gravity	x = +4,913 +/- 300 mm (from rear of container); y = +788 mm +/- 300 mm (from container floor); z = 0 +/- 150 mm (centerline)				

STANDARD FEATURES

GENERATOR SET EMCP 3.3 LOCAL CONTROL PANEL

- Generator mounted EMCP 3.3 provides power metering, protective relaying and engine and generator control and monitoring.
- Provides MODBUS datalink to paralleling control for monitoring of engine parameters.
- Convenient service access for Caterpillar service tools (not included).
- Integration with the CDVR provides enhanced system monitoring.
- Ability to view and reset diagnostics of all controls networked on J1939 datalink.
- Network modules via the control panel removes the need for a separate service tool for troubleshooting.
- Real-time clock allows for date and timestamping of diagnostics and events.

EMCP 3.3 ENGINE OPERATOR INTERFACE

- Graphical display with positive image, transfective LCD, adjustable white backlight/contrast.
- Two LED status indicators (1 red, 1 amber).
- Three engine control keys and status indicators (Run/Auto/Stop).
- Lamp test key.
- Alarm acknowledgement key.
- Display navigation keys.
- Two shortcut keys: Engine Operating Parameters and Generator Operating Parameters.
- Fuel level monitoring and control.

CIRCUIT BREAKER

- 3000A fixed type, 3 poles, genset mounted, electrically operated, insulated case circuit breaker.
- Solid state trip unit for overload (time overcurrent) and fault (instantaneous) overcurrent protection.
- Includes DC shunt trip coil activated on any monitored engine or electrical fault, 100 KA-interrupting capacity at 480 VAC.

VOLTAGE REGULATION AND POWER FACTOR CONTROL CIRCUITRY

- Generator mounted automatic voltage regulator, microprocessor based.
- Manual raise/lower voltage adjust capability and VAR/power factor control circuitry for maintaining constant generator power factor while paralleled with the utility. Voltage and power factor adjustments are performed on the setting screen of the HMI touch screen
- Includes RFI suppression, exciter limiter and exciter diode monitoring.

FUEL TANK

- UL Listed 1250 gallon double walled.
- Fuel transfer system

CURRENT TRANSFORMERS

- CT's rated 3000:5 with secondaries wired to shorting terminal strips.

POTENTIAL TRANSFORMERS

- 4:1 ratio with primary and secondary fuse protection.

BUS BARS

- Three phase, plus full rated neutral, bus bars are sized for full load capacity at 0.8 PF, constructed of tin-plated copper with NEMA standard hole pattern for connection of customer load cables and generator cables.
- Includes ground bus, tin-plated copper, for connection to the generator frame ground and field ground cable.

AC DISTRIBUTION

- Transformer distributes utility voltage for the 16 spaces (minimum) Power Module AC panel board.
- Provides 240 VAC for all module accessories.
- Includes controls to de-energize jacket water heaters and generator space heater when the engine is running.

SHORE POWER TWO (2)

- One (1) shore power connection distribution block for jacket water heaters.
- One (1) for generator space, battery charger, and fuel pump.

INTERNAL LIGHTING

- Four (4) internal DC lights with one (1) timer and two switches installed at each side of the container door.
- Three (3) internal AC lights.
- One (1) single duplex service receptacle.

BATTERY CHARGER AND BATTERIES

- 24 VDC/20A battery charger with float/equalize modes and charging ammeter.
- Maintenance free batteries.

STANDARD PARALLELING CONTROL

GENERATOR PARALLELING CONTROLS

The switchgear includes:

- Single unit island mode.
- Multiple unit island mode.
- Load Sense/Load Demand control.
- Load sharing capability provided via network communication.
- Single unit utility parallel mode. Selectable for Import/Export control. If import or export control is selected a 4-12-20mA signal is required (provided by others) scalable to the utility contribution.
- 6 inch black and white HMI touch screen.
- Reverse compatibility module provided for interface to legacy designed Power Module Switchgear. Includes PLC, load share and voltage droop.

Incoming Utility Breaker Status Circuit – Circuit to accept customer's contact from remote utility disconnect device. Customer to provide a normally open form 'a' contact to indicate when the local load network is connected to the utility grid.

Utility Transfer Trip Circuit – Circuit accepts input (normally open dry contact) from customer's system protective relay(s) or other controlling device. Operation of contacts causes tripping of the generator circuit breaker via the generator (software) 86 lock-out function and places the engine in cooldown mode. Circuit is disabled when operating in single unit or multiple unit island.

GENERATOR PARALLELING CONTROLS OPERATOR INTERFACE

Graphical mimic one line diagram that shows generator with its respective circuit breaker in a one-line representation of the system. The graphics utilize black and white indicators and bar graphs while actively displaying the following information:

- Utility CB Open/Closed. Input contacts provided by others.
- Utility kW 4-12-20mA signal required and provided by customer that is scalable to the utility contribution.
- Generator CB Open/Closed/Tripped.
- Generator Volts/Amps/kW/Frequency.
- Engine Stopped/Running/Cooldown/Pre-Alarm/Shutdown.
- Engine ECS Position Stop/Auto/Run.
- Utility Output kW.
- System Summary Alarm.

GENERATOR METERING AND PROTECTION

Generator metering that will graphically display 3Ø Voltage, 3Ø Current, Frequency, Power Factor, kW, kVAR and a Synchroscope Display of EMCP 3.3 faults, CDVR or ADEM 3 will be provided via Modbus RTU interface to EMCP 3.3.

Optional Generator/Intertie Protective Relaying includes:

- Device 27/59 – Under/Over Voltage.
- Device 81O/U – Under/Over Frequency.
- Device 40 – Loss of Excitation.
- Device 32 – Reverse Power.
- Device 25 – Synchronizing Check.
- Device 15 – Auto Synchronizer.
- Device 65 – Governor Load Sharing, Soft Loading Control.
- Device 90 – VAR/PF and Cross Current Compensation Controller.

PROGRAMMING AND DIAGNOSTICS

Includes field programmable set points for engine control and monitoring variables and self-diagnosis of the EMCP 3.3 system component and wiring failures.

ENGINE CONTROL SWITCH

Keypad selectable, four (4) positions – Off, Auto, Man, Cool:

- Off for engine shutdown and resetting faults.
- Auto for local or remote automatic operation when initiated by switch operation or contact closure.
- Man for local starting and manual paralleling.
- Cool for normal engine shutdown with timed cool-down cycle.

CIRCUIT BREAKER CONTROL SWITCH

Heavy duty, three- (3) position spring return to center with momentary trip and close position and slip contacts for automatic closing. Includes circuit breaker position indicating lamps.

EMERGENCY STOP PUSHBUTTON

• Mushroom head, twist to reset, causes engine shutdown and tripping of the generator circuit breaker. Prevents engine starting when depressed.

STANDARD PARALLELING CONTROL (continued)

ELECTRONIC LOAD SHARING GOVERNOR

- Includes speed adjustment, and auto load share capability when in parallel with legacy power modules.

ALARM MODULE

- Dedicates annunciator screens for warning and shutdown faults. Includes external mounted horn and acknowledge push-button.

AUTOMATIC/MANUAL PARALLELING

- Automatically synchronizes and parallels the generator with another power source.
- Includes provisions for manual permissive paralleling.

HUMAN MACHINE INTERFACE (HMI)

HIGHLIGHTS

- Engine/Generator function is performed thru the 6" HMI touch screen interface.

MODES OF OPERATION

Caterpillar utility paralleling controls are intended for automatic or manual paralleling with a utility power source as a load management system, with provisions for standby operation feeding an isolated load network. Load management operation involves microprocessor-based automatic loading controls with soft loading, base load, Import/Export control and soft unloading. For Standby operation, the generator operates as an isochronous machine isolated from the utility supply. The controls allow for automatic operation, initiated locally or remotely by the customer's SCADA system. Detailed modes of operation are listed below:

SINGLE UNIT ISLAND AND MULTI-UNIT ISLAND OPERATION

1. Utility Standby Mode (Normal)
 - a. The utility is providing power for the plant loads.
 - b. The Power Module Generator breaker is open.
 - c. The PM is in automatic standby mode to respond to a utility failure.
2. Emergency Mode (Emergency)
 - a. The customer protective relaying senses a utility abnormal condition.
 - b. A run request is sent to the PM plant
 - c. The first PM Generator to reach rated voltage and frequency is closed to the bus.
 - d. In Multi-Unit Island Mode, the remaining Power Module Generators are paralleled to the bus as they reach rated voltage and frequency. This function is performed via the ModBus Plus data link connected between the Power Modules.
 - e. Plant load is transferred to the Power Modules, which share load equally via ModBus Plus data link.

GENERATOR DEMAND PRIORITY CONTROL

The System Controls include a Generator Demand Priority Control function to automatically match the on-line PM Generator capacity to the load to avoid unnecessary operation of all the PM Generators when the plant loads are low.

The following controls are provided for each Power Module Generator:

1. User-settable Generator Priority Selector
2. Status indicator for the Generator Priority selected
3. Status indicator for Power Module Generator on-line or off-line
4. Generator Demand Priority Control Switch (On/Off)

5. User-settable Generator Remove Level (% as a function of single generator capacity)
 6. User-settable Generator Remove Time Delay
 7. User-settable Generator Add Level (% as a function of single generator capacity)
 8. User-settable Generator Add Time Delay
- Upon entrance into Emergency Mode, all generators will be started and paralleled to the bus. After the Remove Time Delay, PM Generators will be removed from the bus as a function of the generator percentage load.

Should the generator percentage load increase to the user-selected Generator Add Level after the user-selected Generator Add Time Delay, the next priority generator will be started, synchronized and paralleled to the bus. Should the PM generator plant ever reach 100% loading, the next priority generator will be started and added to the bus, bypassing the Generator Add Time Delay.

SINGLE UNIT IMPORT, EXPORT OR BASE LOAD OPERATION

During periods of peak demand the system may be placed in operation using the operator interface panel on the front of the switchgear.

1. Entry – Local

- a. The operator places the System Control Switch into Load Management.
- b. The operator selects Import, Export or Base Load Operation.
- c. The Load Management Setpoint is the amount of power Imported, Exported or Base-Loaded. A 4-12-20mA signal is provided by the customer and is linearly proportional to the utility load, with 12mA equaling 0 kW. The 4-12-20mA utility load signal is wired to one and only one PM. If the PM selected for Load Management is not available, the 4-12-20mA signal will be routed to a different PM.
- d. The operator sets the Load Management Setpoint and Power Factor Setpoint.
- e. A Run request signal is received by the Single Unit PM.
- f. The PM Generator is started and will run for a predetermined warm-up time before it is synchronized and paralleled to the utility.

- g. When the generator is on the bus, it is soft-ramp-loaded until the generator output reaches the Load Management Setpoint.
- h. The generator output is dynamically adjusted to maintain the Load Management Setpoint.
- i. Should the utility fail during Load Management Operation, the Protective Relay will cause the Paralleling Circuit Breaker 52G to open and be locked out until the Lockout Relay is manually reset by an operator on site. The generator is allowed to run for the duration of the cooldown time.

2. Exit – Local

- a. The Run Request signal is removed from the power module.
- b. The generator is soft-ramp-unloaded until the plant load is fully supported by the utility.
- c. The Paralleling Circuit Breaker 52G is opened.
- d. The generator is allowed to run for the duration of the cooldown time.

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