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Salesforce O# 734966

BMS # 465138

Customer PO# SQ/4770

Rev_0

Serving Cummins Customers

Cummins power solutions are supported by the largest and best-trained worldwide-certified sales/distributor network in the industry. This network will help you select and install the critical power solution to meet the requirements of your specific application. This same network provides experts with advanced technology to make your life easier while providing a seamless support experience.

IMPORTANT: The critical power solution information and specifications included in this pdf can be used by the site contractor(s) and/or engineer(s) to assist with planning for and accomplishing the overall power solution installation. Please forward this document to the appropriate personnel, as necessary.

It is the obligation of the electrical contractor and reviewing engineer to determine that the item quantities and accuracy of this submittal is correct as required for the job. Any inaccuracies or deviations must be addressed with Cummins Inc. before release to manufacturing. Any releases of material to manufacturing by the above parties constitute an acceptance of the accuracy of the submittal. Any changes after release will be viewed as a change order, subject to pricing changes. Please take the time to review this package for accuracy to prevent any after-shipment problems that could cause delay in energization.

Cummins certifies that these drawings, material lists, specification and datasheets have been checked prior to submittal and they:

- accurately depict the proposed equipment
- provide current information to the date of the submittal and
- present true and accurate equipment information.

This Approval Drawing Package is submitted as our interpretation of the project requirements and/or the specifications for this job. Please note that issuance of these submittals shall not be deemed or interpreted as performance nor acceptance of your purchase order terms and conditions.

For questions or comments regarding this submittal, please contact the Cummins Project Manager listed on the title page.



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SECTION 1 PROJECT INFORMATION



Project: CSDG - C1500D6e 07-17-25 Generator Replacement (Negotiated) **Quotation:** Q-392833-08152025–13:41

Bill of Material

Feature Code	Description	Qty
C1500D6e	C1500D6e SO# 257605 C1500D6E Diesel Genset, 1500kW, 60Hz C1500D6E Commercial Diesel Generator Set, 1500kW Standby 60Hz A293-2 Heater-Alternator, 240V A331-2 Duty Rating-Standby Power A333-2 BATTERY CHARGING ALTERNATOR-NO A334-2 ENGINE STARTER-24 VDC MOTOR A338-4 Packing-None B731-2 Alt-60Hz, Wye, 380-480V, 125/105C-S/P BE11-2 Stator Temperature Rise - 125C C325-2 Fuel Filters-Engine, Standard, Ship Loose C333-2 Fuel hoses D041-2 ENGINE AIR CLEANER-NORMAL DUTY DC02-2 Air Cleaner Restriction Indicator - Mechanical E169-2 240VAC Heater Options E170-2 40C/104F ambient capability H244-2 Gauge-Exhaust Gas Temp H389-2 Shutdown-Low Coolant Lvl H479-2 Eng Oil Htr-208/240V,1Ph H536-2 Display Language-English H545-2 Warming-Low Fuel Pressure H606-2 Meters-AC Output,Analog H607-2 Filters-Eng Oil,Full Flow/Bypass H678-2 Display-Control, LCD H679-2 Control Mounting-Front Facing H704-2 GENSET CONTROL-POWERCOMMAND 3.3 H720-2 AmpSentry™ Protective Relay H756-2 Water in Fuel (WiF) Sensor K020-2 RUNNING TIME METER KA08-2 Alarm-Audible,EngShutdown KB72-2 CB or EB or TB-Bottom Entry, Right K873-2 CB or EB or TB-Bottom Entry, Left K781-2 Ckt Brkr Access-Right Side K789-2 Ckt Brkr Access-Right Side K789-2 Ckt Brkr Access-Right Side K789-2 Ckt Brkr Access-Right Side K788-2 Ckt Brkr Access-Right Side K788-2 Ckt Brkr Access-Right Side K788-2 Ckt Brkr Access-Right Side K789-2 Ckt Brkr Access-Right Side	
Miscellaneous	20A Battery Charger SO# 257605	1
Miscellaneous	Remote Annunciator SO# 257605	1

Sales notes have been removed from BOM.

Quotation: Q-392833 - 08152025 - 13:41

SECTION 2 GENERATOR SPECIFICATIONS

C1250D6E C1500D6E

DIESEL GENERATOR SET SPECIFICATION SHEET

QSK38 ENGINE, 1250-1500 kWe, 60 Hz, EPA TIER 2 NSPS CERTIFIED (STATIONARY EMERGENCY)

DESCRIPTION

Cummins commercial generator sets are fully integrated power generation systems for stationary standby power and data center applications.

The Centum™ Series meets the demand for efficient and sustainable power with performance, flexibility, and commitment – for the next generation of power.

FEATURES

Cummins Heavy-Duty Engine: Rugged, four-cycle industrial diesel delivers reliable power, low emissions, and fast response to load changes.

Alternator: Several alternator sizes offer selectable motor starting capability with low reactance 2/3 pitch windings, low waveform distortion with non-linear loads, fault clearing short-circuit capability and class H insulation.

ISO 8528-5 G3 Capable: Consult factory for site and configuration specific transient performance information.

HVO Fuel Compatible: Approved for use with paraffinic fuels (EN15940), including Hydrotreated Vegetable Oil (HVO), which has a very low life cycle carbon emission.

Data Center Continuous (DCC): Applicable for supplying power continuously to a constant or varying electrical load for unlimited hours in a data center application.

Uptime compliant: Meets the requirement of a Tier III and IV data center site by being rated to run for unlimited hours of operation when loaded to 'N' demand for the engine generator set.



Permanent Magnet Generator (PMG): Offers enhanced motor starting and fault clearing short circuit capability.

Control System: The PowerCommand[®] digital control is standard equipment and provides total genset system integration including automatic remote starting/stopping, precise frequency and voltage regulation, alarm, and status message display, AmpSentry[™] protective relay, output metering, auto-shutdown at fault detection and NFPA 110 Level 1 compliance.

Cooling System: High ambient (40 °C) and enhanced high ambient (50 °C), integral set-mounted radiator systems, designed and tested for rated ambient temperatures, simplifies facility design requirements for rejected heat.

NFPA: Capable of meeting NFPA 110 Type 10 for Level 1 Emergency or Standby Power Supply Systems (EPSSs) when installed and operated per Cummins and NFPA guidelines.

Warranty and Service: Backed by a standard three-year warranty and worldwide distributor network,

MODELS				
	Emergency Standby Power (ESP) Rating ¹ kWe (kVA)	Prime Power (PRP) Rating ^{1,2} kWe (kVA)	Data Center Continuous (DCC) Rating ^{1,2} kWe (kVA)	Data Sheet
C1250D6E	1250 (1563)	1136 (1420)	1136 (1420)	NAD-6630
C1500D6E	1500 (1875)	1364 (1705)	1364 (1705)	NAD-6631

All ratings include radiator fan losses.

² Prime rating and DCC at standby power rating available subject to Cummins' site-specific assessment; contact your Cummins distributor.





GENERATOR SET SPECIFICATIONS	
Performance class	Genset models have been tested in accordance with ISO 8528-5. Consult factory for transient performance information
Voltage regulation, no load to full load	± 0.5%
Random voltage variation	± 1.0%
Frequency regulation	Isochronous
Random frequency variation	± 0.25%
Electromagnetic compatibility performance	Emissions to EN 61000-6-2:2005 Immunity to EN 61000-6-4:2007+A1:2011 Complies with FCC PART 15 subpart B and ICES-002

ENGINE SPECIFICATIONS	
Bore	159 mm (6.26 in.)
Stroke	159 mm (6.26 in.)
Displacement	37.8 liters (2307 in3)
Configuration	Cast iron, V 12 cylinder
Battery capacity	1800 amps minimum at ambient temperature of -18 °C (0 °F)
Battery charging alternator	100A
Starting voltage	24 volts, negative ground
Fuel system	Cummins YZ Modular Common Rail System (MCRS)
Fuel filter	Two-stage, spin-on fuel filter and water separator system. Stage 1: remote mounted, 5 µm duplex filter with two priming pumps. Stage 2: engine mounted, 3 µm triple element filter
Air cleaner	Dry replaceable element
Lube oil filter	Four spin-on, combination full flow filter and bypass filters
Standard cooling system	High ambient cooling system

ALTERNATOR SPECIFICATIONS	
Design	Brushless, 4-pole, drip proof, revolving field
Stator	2/3 pitch
Rotor	Single bearing, flexible disc
Insulation system	Class H
Standard temperature rise	125 °C standby
Exciter type	Permanent Magnet Generator (PMG)
Phase rotation	A (U), B (V), C (W)
Alternator cooling	Direct drive centrifugal blower fan
AC waveform total harmonic distortion (THDV)	< 5% no load to full linear load

AVAILABLE VOLTAGES (60 Hz LINE-TO-NEUTRAL / LINE-TO-LINE)3

225/440 220/380 2400/4160 3810/6600 6350/11000 277/480 347/600 3637/6300

³ Additional voltages may be available; contact your Cummins distributor 3983/6900

GENERATOR SET OPTIONS AND ACCESSORIES⁴

Generator Set

- Oil sampling valve
- 20A battery charger
- Set mounted circuit breakers up to 3200 Amps •
- Circuit breaker aux and trip contacts
- Anti-vibration mounts
- Battery temperature sensor
- **IBC** Certification
- **HCAI** Certification

Engine

- 240V thermo-statically controlled coolant heater
- 120/240V 500W lube oil heaters
- Heavy duty air cleaner
- Remote duplex fuel filter
- Engine oil filters full flow with bypass
- Automatic oil make up system and monitoring Exhaust System
- Engine toolkit

Control Panel

- Masterless load demand
- Multiple language support
- 120/240V 100W control anti- condensation heater

- Exhaust pyrometer
- Ground fault indication
- Paralleling relay package
- Shutdown alarm relay package
- Mechanical hour meter
- 6x user-configurable relays
- 8 additional I/O relays

Alternator

- 80°C/105°C /125°C/150°C rise
- Stator winding temp sensor 2 RTDs/phase
- Bearing temp sensor RTDs
- 1-hole or <mark>2-hole lug output terminal</mark>
- Cable entrance box set mounted top or bottom •
- 120/240V 225W anti- condensation heater
- Generator Louvres

- Industrial grade silencer
- Residential grade silencer
- Critical grade silencer

Cooling System

- · Enhanced high ambient temperature (50 °C)
- · Low coolant level warning

Coolant heater

Data Center options

- Automatic oil make up system
- Closed crank ventilation system
- Oil sampling valve
- Propylene glycol coolant
- Customized testing

Miscellaneous

- Multilingual manuals
- 3-year extended warranty
- 5-year extended warranty
- 10-year extended warranty
- Witness testing
- Virtual witness test
- · Tier 4 compliant aftertreatment kits shipped loose
- ⁴ Some options may not be available on all models; contact your Cummins distributor.

Data Center options are available through RFQ with the Custom Applications Group and could result in additional lead-times. Please consult with the Custom Applications Group to understand feasibility.





PowerCommand® 3.3

CONTROL SYSTEM DESCRIPTION

The PowerCommand® 3.3 is an integrated, microprocessor-based, generator set control system providing voltage regulation, engine protection, alternator protection, operator interface and isochronous governing. Refer to document S-1570 for more detailed information on the control.

AmpSentry™: Includes integral AmpSentry™ protection, which provides a full range of alternator protection functions that are matched to the alternator provided.

Power Management: Control function provides battery monitoring and testing features and smart starting control system.

Advanced Control Methodology: Three phase sensing, full wave rectified voltage regulation, with a PWM output for stable operation with all load types.

Communications Interface: Control comes standard with PCCNet and Modbus interface.

Service: InPower™ PC-based service tool available for detailed diagnostics, setup, data logging and fault simulation.

Easily Upgradeable: PowerCommand® controls are designed with common control interfaces.

Reliable Design: The control system is designed for reliable operation in harsh environment.

Multi-Language Support

OPERATOR PANEL FEATURES

Operating/Display Functions

- Displays paralleling breaker status
- Provides direct control of the paralleling breaker
- 320 x 240 pixels graphic LED backlight LCD
- Auto, manual, start, stop, fault reset and lamp test/panel lamp switches
- Alpha-numeric display with pushbuttons
- LED lamps indicating genset running, remote start, not in auto, common shutdown, common warning, manual run mode, auto mode and stop

Paralleling Control Functions

- First Start Sensor[™] system selects first genset to close to bus
- Phase lock loop synchronizer with voltage matching
- Sync check relay
- Isochronous kW and kVAR load sharing
- Load govern control for utility paralleling
- Extended paralleling (base load/peak shave) mode
- Digital power transfer control, for use with a breaker pair to provide open transition, closed transition, ramping closed transition, peaking and base load functions

Alternator Data

- Line-to-Neutral and Line-to-Line AC volts
- 3-phase AC current
- Frequency
- kW, kVAR, power factor kVA (three-phase and total)

Engine Data

- DC voltage
- Engine speed
- · Lube oil pressure and temperature
- Coolant temperature
- Comprehensive FAE data (where applicable)



OPERATOR PANEL FEATURES (CONT.)

Other Data

- Genset model data
- · Start attempts, starts, running hours, kWh
- Load profile (operating hours at #load in 5% increments)
- Fault history
- Data logging and fault simulation (requires InPower™)

STANDARD CONTROL FEATURES

Digital Governing

- Integrated digital electronic isochronous governor
- Temperature dynamic governing

Digital Voltage Regulation

- Integrated digital electronic voltage regulator
- 3-phase, 4-wire Line-to-Line sensing
- Configurable torque matching

AmpSentry™ AC Protection

- AmpSentry™ protective relay
- · Over current and short circuit shutdown
- Over current warning
- Single and three phase fault regulation
- Over and under voltage shutdown
- Over and under frequency shutdown
- Overload warning with alarm contact
- Reverse power and reverse Var shutdown
- Field overload shutdown

Engine Protection

- Battery voltage monitoring, protection, and testing
- Overspeed shutdown
- Low oil pressure warning and shutdown
- High coolant temperature warning and shutdown
- Low coolant level warning or shutdown
- Fail to start (overcrank) shutdown
- Fail to crank shutdown
- Cranking lockout
- Sensor failure indication
- Full authority electronic engine protection

Control Functions

- · Time delay start and cool down
- Real time clock for fault and event time stamping
- Exerciser clock and time of day start/stop
- Data logging
- Cycle cranking
- Load shed
- Configurable inputs and outputs (4)
- Remote emergency stop

Options

Auxiliary output relays (2)





RATING DEFINITIONS

Emergency Standby Power (ESP)

Applicable for supplying power to varying electrical loads for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Data shown above represents gross engine performance and capabilities as per ISO 3046-1, obtained and corrected in accordance with ISO 15550.

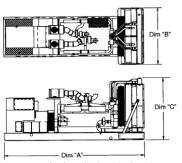
Prime Power (PRP)

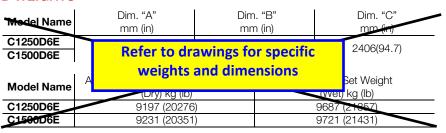
Prime Power for Stationary Emergency ratings apply to installations served by a reliable utility source. Applicable for supplying power to varying electrical loads for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046-1. Data shown above represents aross engine performance and capabilities as per ISO 3046-1, obtained and corrected in accordance with ISO 15550.

Data Center Continuous (DCC)

Applicable for supplying power continuously to a constant or varying electrical load for unlimited hours in a data center application. Designed to comply with Uptime Institute® Tier III and IV data center site requirements by being rated to run for unlimited hours of operation when loaded to 'N' demand for the engine generator set.

GENERATOR SET DIMENSIONS AND WEIGHTS⁵





⁵ Do not use for installation design. Longest alternator (G-core) used for dimension "A". All weights are approximate and represent a generator set with standard features and heaviest alternator (low voltage G-core). "As Shipped Set Weight (No Cooling System)" includes weight from engine oil. "Installed Set Weight (Wet)" includes weight from engine oil and coolant. See respective model data sheet for specific model outline drawing number that contains weights of other configurations.

CODES AND STANDARDS⁶ This product was manufactured in a facility whose UL Listing to UL 2200, "Stationary Engine ISO 9001 Generator Assemblies" is available for this genset quality management system is certified to ISO ISO 14001 9001 and its Health Safety Environmental model. The PowerCommand® control is listed to ISO 45001 Management Systems certified to ISO 14001 and UL 508 - Category NITW7 for U.S. and Canadian ISO 45001. usage. The Prototype Test Support (PTS) program verifies Engine certified to Stationary Emergency U.S. EPA the performance integrity of the generator set New Source Performance Standards (NSPS), 40 design. Cummins products bearing the PTS CFR 60 subpart IIII Tier 2 exhaust emission levels. symbol meet the prototype test requirements of U.S. applications must be applied per this EPA NFPA 110 for Level 1 systems. regulation. The generator set package is available certified for All genset models are available as CSA certified to seismic application in accordance CSA C22.2 No. 100. International Building Code.





⁶ Codes or standards compliance may not be available with all model configurations; contact your Cummins distributor.

C1500D6E

DIESEL GENERATOR SET DATA SHEET

MODEL: C1500D6E FREQUENCY: 60 Hz **FUEL TYPE:** DIESEL

RATING: 1500 kWe (1875 kVA) EMERGENCY STANDBY POWER (ESP)1

1364 kWe (1705 kVA) PRIME POWER (PRP)^{1,2}

1364 kWe (1705 kVA) DATA CENTER CONTINUOUS (DCC)^{1,2}

EMISSIONS CERTIFICATION: EPA NSPS STATIONARY EMERGENCY TIER 2

GENERATOR SET PUBLICATIONS					
Exhaust emission data sheet	EDS-3087				
Exhaust emission compliance statement	EPA-2066				
Sound data sheet	MSP-4122				
Cooling system data sheet	MCP-2177				
Seismic certificate of compliance	VMA-53914-01C				
Prototype test support data sheet	PTS-717 / PTS-718				
Genset outline drawing	A062V279				
Genset wiring schematic diagram	A065D445				

ENGINE SPECIFICATIONS					
		Emergency Standby Power (ESP)	Prime Power (PRP)	Data Center Continuous (DCC)	
Manufacturer		Cummins Inc.			
Model			QSK38-G18		
Configuration			Cast iron, V12 cylinder		
Aspiration		Turbo	charged and Charge Air C	Cooled	
Gross engine power output	kWm (bhp)	1659 (2225)	1500 (2011)	1500 (2011)	
Brake mean effective pressure at set rated load	kPa (psi)	5853 (849)	5240 (760)	5240 (760)	
Bore	mm (in)		159 (6.26)		
Stroke	mm (in)		159 (6.26)		
Displacement	L (in³)		37.8 (2307)		
Rated speed	rpm		1800		
Piston speed at rated speed	m/s (ft/min)		9.54 (1878)		
Compression ratio		14.7:1			
Lube oil capacity	L (US gal)	117 (30.9)			
Overspeed limit	rpm	2070			
Regenerative power	kWm (hp)	124 (166)			

FUEL CONSUMPTION													
Rating	kWe (kVA)		1500	(1875)			1364	(1705)			1364	(1705)	
Load		25%	50%	75%	<mark>100%</mark>	25%	50%	75%	100%	25%	50%	75%	100%
Fuel Consumption	US gph	31.7	56.8	81.9	102.5	29.5	51.8	75.1	95.3	29.5	51.8	75.1	95.3
Fuel Consumption	L/h	120	215	310	388	112	196	285	361	112	196	285	361

¹ Generator set ratings include radiator fan losses

² Prime rating and DCC at standby power available subject to Cummins' site-specific assessment; contact your Cummins distributor





		Emergency Standby Power (ESP)	Prime Power (PRP)	Data Center Continuous (DCC
Maximum fuel flow	L/h (US gph)	i over (Lor)	800 (211)	Continuous (DCC)
Maximum fuel inlet restriction	kPa (inHg)		25 (7.4)	
Maximum fuel inlet temperature	°C (°F)		70 (158)	
Maximum fuel return temperature	°C (°F)		120 (248)	
AIR SYSTEM				
Combustion air flow (at set rated load)	m³/min (scfm)	125 (4408)	122 (4303)	122 (4303)
Maximum air cleaner restriction (dirty filter)	kPa (inH2O)		3.7 (15)	
Alternator cooling air flow	m³/min (scfm)		195 (6886)	
EXHAUST SYSTEM				
Exhaust flow (at set rated load)	m³/min (cfm)	301 (10631)	290 (10235)	290 (10235)
Exhaust temperature (at set rated load)	°C (°F)	499 (930)	486 (908)	486 (908)
Maximum back pressure	kPa (inH₂O)		10.1 (40.6)	
COOLING SYSTEM (SET MOUNT	ED) – HIGH	AMBIENT		
Ambient design (limiting ambient temp.)	°C (°F)		40.0 (104)	
Fan load	kWm (hp)		66 (88.5)	
Coolant capacity (engine + radiator)	L (US gal)		272 (72)	
Cooling system air flow (at max. restriction)	m ³ /min (acfm)		994.5 (35121)	
Total heat rejection to radiator	MJ/min (Btu/min)	64.4 (61041)	59.31 (56215)	59.31 (56215)
Nominal air flow static restriction	kPa (inH₂O)		0.12 (0.5)	
Maximum fuel return line restriction	kPa (in Hg)		33.8 (10)	
COOLING SYSTEM (SET MOUNT	ED) – ENHA	NCED HIGH AMBIE	NT	
Ambient design (limiting ambient temp.)	°C (°F)		50.0 (122)	
Fan load	kWm (hp)		73.5 (3 6.6)	
Coolant capacity (engine + radiator)	L (US gal)		272 (72)	
Cooling system air flow (at max. restriction)	m³/min (acfm)		1377 (48615)	
Total heat rejection to radiator	MJ/min (Btu/min)	64.4 (61041)	59.31 (56215)	59.31 (56215)
Nominal air flow static restriction	kPa (inH₂O)		0.12 (0.5)	
Maximum fuel return line restriction	kPa (in Hg)		33.8 (10)	
GENERATOR SET WEIGHTS ³		Defended to		• 6•
			rawings for spec	
C1500D6E kg	(lb)	weights	and dimensions	5

³ All weights are approximate and represent a generator set with standard features and heaviest alternator (low voltage G-core). "As Shipped Set Weight (No Cooling System)" includes weight from engine oil. "Installed Set Weight (Wet)" includes weight from engine oil and coolant. See respective model data sheet for specific model outline drawing number that contains weights of other configurations.





GENERATOR S	ET DERATING FACTORS ⁴
Emergency Standby Power (ESP)	High Ambient Cooling System: Full rated power available up to 1463 m (4800 ft) elevation at ambient temperatures up to 40 °C (104 °F). Enhanced High Ambient Cooling System: Full rated power available up to 671 m (2200 ft) elevation at ambient temperatures up to 50 °C (122 °F).
Prime Power (PRP)	High Ambient Cooling System: Full rated power available up to 1707 m (5600 ft) elevation at ambient temperatures up to 40 °C (104 °F). Enhanced High Ambient Cooling System: Full rated power available up to 853 m (2800 ft) elevation at ambient temperatures up to 50 °C (122 °F).
Data Center Continuous (DCC)	High Ambient Cooling System: Full rated power available up to 1707 m (5600 ft) elevation at ambient temperatures up to 40 °C (104 °F). Enhanced High Ambient Cooling System: Full rated power available up to 853 m (2800 ft) elevation at ambient temperatures up to 50 °C (122 °F).

⁴ Note: Ambient operating temperature is defined as the air temperature measured at the room (or enclosure) inlet, assuming a temperature rise of 3 °C to the turbocharger compressor inlet.

	RATING DEFINITIONS				
Emergency Standby Power (ESP)	Prime Power (PRP)	Data Center Continuous (DCC)			
Applicable for supplying power to varying electrical loads for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Data shown above represents gross engine performance and capabilities as per ISO 3046-1, obtained and corrected in accordance with ISO 15550.	Prime Power for Stationary Emergency ratings apply to installations served by a reliable utility source. Applicable for supplying power to varying electrical loads for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046-1. Data shown above represents gross engine performance and capabilities as per ISO 3046-1, obtained and corrected in accordance with ISO 15550.	Applicable for supplying power continuously to a constant or varying electrical load for unlimited hours in a data center application. Designed to comply with Tier III and IV data center site requirements by being rated to run for unlimited hours of operation when loaded to 'N' demand for the engine generator set.			

FORMULAS						
Calculating Power Factor	Calculating Full Load Current (Three Phase AC Output)	Calculating Full Load Current (Single Phase AC Output)				
$\cos \theta = \frac{Active (True, Real) Power}{Apparent Power} = \frac{P_{(kW)}}{ S _{(kVA)}}$	$I = \frac{ S _{(kVA)}}{\sqrt{3} \times V} = \frac{1000 \times P_{(kW)}}{\sqrt{3} \times V \times \cos \theta}$	$I = \frac{ S _{(kVA)}}{V} = \frac{1000 \times P_{(kW)}}{V \times \cos \theta}$				
Power Factor = 0.8 (industry standard)	\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\	V V X COS O				







PowerCommand® 3.3 Generator Set Digital Integrated Control System





Bargraph Optional

Introduction

The PowerCommand® 3.3 control system is a microprocessor-based generator set monitoring, metering, and control system, which is comprised of PowerCommand® Control 3300 and the Human Machine Interface 320. PCC3300 supports multiple operation modes including:

- Standalone,
- Synchronization only,
- Isolated bus paralleling,
- Utility single generator set paralleling,
- Utility multiple generator set paralleling,
- Utility single generator set paralleling with power transfer control (automatic mains failure),
- Isolated bus paralleling with Masterless Load Demand

PowerCommand® Control 3300 is designed to meet the exacting demands of the harsh and diverse environments of today's typical power generation applications for Full Authority Electronic or Hydromechanical engine power generator sets.

Offering enhanced reliability and performance over more conventional generator set controls via the integration of all generator control functions into a single system, PCC3300 is your Power of One generator set control solution.

Benefits and Features

- 320 x 240 pixels graphical LED backlit LCD
- Multiple languages supported
- AmpSentry[™] protection provides industryleading generator overcurrent protection
- Digital Power Transfer Control (Automatic Mains Failure) provides load transfer operation in open transition, closed transition, or soft (ramping) transfer modes

- Extended Paralleling (Peak Shave/Base Load) regulates the genset real and reactive power output while paralleled to the utility.
 Power can be regulated at either the genset or utility bus monitoring point
- Digital frequency synchronization and voltage matching
- Isochronous Load Sharing
- Droop kW and kVAr control
- Real time clock for fault and event time stamping
- Exerciser clock and time of day start/stop initiate a test with or without load, or a Base Load or Peak Shave session
- Digital automatic voltage regulation is provided using three phase sensing and full wave FET type regulator, which is compatible with either shunt or PMG excited systems with a standard AUX103 AVR or an option for a more powerful high-current field drive capability AUX106 AVR
- Digital engine speed governing is provided on applicable platforms
- Generator set monitoring (including metering) and protection with PCC3300 measuring voltage, current, kW and kVAr offering a measurement accuracy of 1%
- Utility / AC Bus metering and protection with PCC3300 voltage, current, kW and kVAr offering a measurement accuracy of 1%
- 12 V (DC) and 24 V (DC) battery operation
- RS-485 Modbus® interface for interconnecting to customer equipment
- Warranty and service Cummins Power Generation offers a comprehensive warranty and worldwide distributor service network
- Global regulatory certification and compliance: PCC3300 is suitable for use on gensets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std., UKCA, and CE standards

PowerCommand® Generator Set Digital Control System PCC 3300



Introduction

PCC3300 is an industry-leading digital generator set control suitable for usage on a wide range of diesel and lean burn natural gas generator sets in both standalone as well as paralleling applications.

PowerCommand® is compatible with either shunt or PMG excitation, and is suitable for usage with reconnectable or non-reconnectable generators. Configuration for any frequency, voltage and power connection from 120 V (AC) to 600 V (AC) line-to-line or 601 V (AC) to 45k V (AC) with an external PT is supported. The PCC3300 derives its own power from the generator set starting batteries and functions over a voltage range of 8 V (DC) to 30 V (DC).

Features

- PCC3300 supports configurable control features via software download using InPower PC-compatible software
- 12 V (DC) and 24 V (DC) battery operation
- Digital automatic voltage regulation is provided using three phase sensing and full wave FET type regulator, which is compatible with either shunt or PMG excited systems with a standard AUX103 AVR or an option for a more powerful high-current field drive capability AUX106 AVR
- Digital engine speed governing on applicable platform is provided, which is capable of providing isochronous frequency regulation
- Full authority J1939 CANBus® prime mover communications and control is provided for platforms with an Engine Control Module (ECM)
- AmpSentry" protection provides industry-leading alternator overcurrent protection:
 - Time-based generator protection applicable to both line-to-line and line-to-neutral, that can detect an unbalanced fault condition and swiftly react appropriately. Balanced faults can also be detected by AmpSentry and appropriate acted upon.
 - Reduces the risk of Arc Flash due to thermal overload or electrical faults by inverse time protection

- Generator set monitoring offers status information for all critical prime mover and generator functions
- AC and DC digital generator set metering is provided. AC measurements are configurable for single or three phase sensing with PCC3300 measuring voltage, current, kW and kVAr offering a measurement accuracy of 1%
- Battery monitoring system continually monitors the battery output and warns of the potential occurrence of a weak battery condition
- Relay drivers for prime mover starter, fuel shutoff (FSO), glow plug/spark ignition power and switched B+ applications are provided
- Integrated generator set protection is offered to protect the prime mover and generator
- Real time clock for fault and event time stamping
- Exerciser clock and time of day start/stop initiate a test with or without load, or a Base Load or Peak Shave session
- Digital Power Transfer Control (Automatic Mains Failure) provides load transfer operation in open transition, closed transition, or soft (ramping) transfer modes
- Extended Paralleling (Peak Shave/Base Load) regulates the genset real and reactive power output while paralleled to the utility. Power can be regulated at either the genset or utility bus monitoring point
- Digital frequency synchronization and voltage matching
- Isochronous Load Sharing
- Droop kW and kVAr Control
- The synchronization check function provides adjustments for phase angle window, voltage window, frequency window and time delay
- Utility / AC Bus metering and protection with PCC3300 voltage, current, kW and kVAr offering a measurement accuracy of 1%
- Advanced serviceability is offered via InPower[™], a PC-based software service tool
- PCC3300 is designed for reliable operation in harsh environments with the unit itself being a fully encapsulated module
- RS-485 ModBus interface for interconnecting to customer equipment
- Native on PCC3300: Four discrete inputs, two dry contact relay outputs and two low-side driver outputs are provided and are all configurable.
 - Optional extra PCC3300 input and output capability available via AUX101
- Warranty and service Cummins Power Generation offers a comprehensive warranty and worldwide distributor service network
- Global regulatory certification and compliance: PCC3300 is suitable for use on gensets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std., UKCA and CE standards

Base Control Functions

HMI capability

Options: Local and remote HMI320 options are available

<u>Operator adjustments</u>: The HMI320 includes provisions for many set up and adjustment functions.

<u>Genset hardware data</u>: Access to the control and software part number, genset rating in kVA and genset model number is provided from the HMI320 or InPower.

<u>Data logs</u>: Information concerning all of the following parameters is periodically logged and available for viewing; engine run time, controller on time, number of start attempts, total kilowatt hours, and load profile. (Control logs data indicating the operating hours at percent of rated kW load, in 5% increments. The data is presented on the operation panel based on total operating hours on the generator.)

<u>Fault history</u>: Provides a record of the most recent fault conditions with control date and time stamp. Up to 32 events are stored in the control non-volatile memory.

Alternator data

- Voltage (single or three phase line-to-line and line-to-neutral)
- Current (single or three phase)
- kW, kVAr, Power Factor, kVA (three phase and total)
- Frequency

For Lean Burn Natural Gas Engine applications:

- Alternator heater status
- Alternator winding temperature (per phase) as well as alternator drive end and non-drive end bearing

Utility/AC bus data

- Voltage (three phase line-to-line and line-to-neutral)
- · Current (three phase and total)
- kW, kVAR, Power Factor, kVA (three phase and total)
- Frequency

AmpSentry: 3x current regulation for downstream tripping/motor inrush management. Thermal damage curve (3-phase short) or fixed timer (2 sec for 1-Phase Short or 5 sec for 2-Phase short).

Engine data

- Starting battery voltage
- Engine speed
- Engine temperature
- · Engine oil pressure
- Engine oil temperature
- Intake manifold temperature
- Coolant temperature
- Comprehensive Full Authority Engine (FAE) data (where applicable)

Lean Burn Natural Gas (LBNG) application parameters include:

- Safety shutoff valve status
- Valve proving status
- Downstream gas pressure
- Gas inlet pressure
- Gas mass flow rate
- Control valve position
- Gas outlet pressure
- · Manifold pressure and temperature
- Throttle position
- Compressor outlet pressure
- Turbo speed
- · Compressor bypass position
- Cylinder configuration (e.g., drive end and non-drive end configurations)
- Coolant pressure 1 and 2 as well as coolant temperature 1 and 2 for both HT/LT respectively
- Exhaust port temperature (up to 18 cylinders)
- Pre-filter oil pressure
- Exhaust back pressure
- Parent ECM internal temperature and isolated battery voltage
- Speed bias
- Child ECM internal temperature and isolated battery voltage
- Knock level, spark advance, and knock count (for up to 18 cylinders)
- Auxiliary supply disconnector status
- Engine heater status
- · Coolant circulating pump status
- Lube oil priming pump status
- Lube oil status
- Oil heater status
- · Derate authorization status
- Start system status
- Ventilator fan status
- Ventilation louvre status
- Radiator fan status
- DC PSU status
- Start inhibit/enable status and setup

<u>Service adjustments</u> – The HMI320 includes provisions for adjustment and calibration of genset control functions. Adjustments are protected by a password. Functions include:

- Engine speed governor adjustments
- Voltage regulation adjustments
- Cycle cranking
- · Configurable fault set up
- Configurable input and output set up
- Meter calibration
- Paralleling setup
- Display language and units of measurement

Prime Mover Control

<u>SAE-J1939 CAN</u> interface to full authority ECMs (where applicable). Provides data transfer between genset and engine controller for control, metering and diagnostics.

12 V (DC) or 24 V (DC) nominal battery voltage is supported by PCC3300 for normal operation.

Temperature dependant prime mover governing dynamics: This function is supported enabling the engine to be responsive when warm and more stable when operating at lower temperature via providing control and modification over electronic governing parameters as a function of engine temperature.

<u>Isochronous governing</u> is provided in order to control prime mover speed within $\pm 0.25\%$ of nominal rated speed for any steady state load from no load to full load. During operation frequency drift should not exceed $\pm 0.5\%$ of nominal frequency given a 33°C (or 60°F) chance in ambient temperature within an eight-hour period.

<u>Droop electronic speed is governing</u> capability is natively offered by PCC3300 to permit droop from 0% to 10% between no load to full load.

Remote start capability is built into the PCC3300 as the unit accepts a ground signal from remote devices to automatically command the starting of the generator set as well as the reaching of rated speed, voltage and frequency or otherwise run at idle speed until prime mover temperature is adequate. The presence of a remote start signal shall cause the PCC3300 to leave sleep mode and return to normal power mode. PCC3300 supports an option for delayed start or stop.

Remote Start Integrity: In compliance with NEC2017 Start Signal Integrity standard – NFPA70 Article 700.10(D)(3), the remote start circuit from ATS to PCC3300 is continuously monitored for signal disturbance due to broken, disconnected or shorted wires via a configurable input. Loss of signal integrity results in activation of a remote start signal.

Remote and local emergency stopping capability: PCC3300 accepts ground signal from a locally or remoted mounted emergency stop switch to cause the generator set to immediately shutdown. The generator set is prevented from either running or cranking with the emergency stop switch engaged. If PCC3300 is in sleep mode, then the activation of any emergency stop switch shall return PCC3300 is normal powered state along with the activation of the corresponding shutdown and runprevention states.

<u>Sleep mode:</u> PowerCommand 3.3 supports a configurable low current draw state, which is design with consideration to the needs of prime applications or others application without a battery charger (in order to minimize battery current drain).

<u>Automatic prime mover starting:</u> Any generator set controlled by PCC3300 is capable of automatic starting achieved via either magnetic pickup or main alternator output frequency. PCC3300 additionally supports

configurable glow plug control where applicable.

<u>Prime mover cycle cranking:</u> PCC3300 supports configurable starting cycles and rest periods. Built in starter protection are incorporated to prevent the operator from specifying a starting sequence that may be damaging.

<u>Configurable time delay functionality:</u> PCC3300 supports time delayed generator set starting and stopping (for cooldown). Permissible time delays are as follows (noting a default setting is 0 seconds):

- 1. Start delay: 0 seconds to 300 seconds prior to starting after receiving a remote start signal.
- 2. Stop delay: 0 seconds to 600 seconds prior to shut down after receiving a signal to stop in normal operation modes.

Lean Burn Natural Gas application specific parameters

<u>PCC3300</u> supports prime mover inhibiting in order to permit application-specific processes (i.e. Auxiliaries) to be started first.

Generator Control

PCC3300 performs both Genset voltage sensing and Genset voltage regulation as follows:

- Voltage sensing is integrated into PCC3300 via three phase line-to-line sensing that is compatible with shunt or PMG excitation systems
- Automatic voltage regulation is accomplished by using a three phase fully rectified input and has a FET output for good motor starting capability.

Major features of generator control include:

<u>Digital output voltage regulation</u> - Capable of regulating output voltage to within +/-1.0% for any loads between no load and full load. Voltage drift will not exceed +/-1.5% for a 40 °C (104 °F) change in temperature in an eight-hour period. On engine starting or sudden load acceptance, voltage is controlled to a maximum of 5% overshoot over nominal level.

The automatic voltage regulator feature can be disabled to allow the use of an external voltage regulator.

<u>Droop voltage regulation</u> - Control can be adjusted to droop from 0-10% from no load to full load.

<u>Torque-matched V/Hz overload control</u> - The voltage roll-off set point and rate of decay (i.e. the slope of the V/Hz curve) is adjustable in the control.

<u>Fault current regulation</u> - PowerCommand[®] will regulate the output current on any phase to a maximum of three times rated current under fault conditions for both single phase and three phase faults. In conjunction with a permanent magnet generator, it will provide three times rated current on all phases for motor starting and short circuit coordination purpose.

<u>Cylinder Cut-off System (CCS)</u>: PCC 3300 supports Cylinder Cut-off System which is used to operate the engines on half bank at no load and light load conditions. CCS has below benefits on engine

performance- improved emission standards, improved fuel efficiency, reduced hydrocarbons, reduced white smoke, reduced wet stacking and higher exhaust temperature at light loads to improve turbocharger operations and catalyst performance.

Step Timing Control (STC): PCC 3300 supports STC functionality which is used to advance the engine timing of a hydro-mechanical engine during start up and light load conditions. During ADVANCED injection timing, it:

- Improves cold weather idling characteristics
- · Reduces cold weather white smoke
- Improves light load fuel economy
- Reduces injector carboning

Paralleling Functions

First Start Sensor™ system — PowerCommand® provides a unique control function that positively prevents multiple gensets from simultaneously closing to an isolated bus under black start conditions. The First Start Sensor system is a communication system between the gensets that allows the gensets to work together to determine which genset is a system should be the first to close to the bus. The system includes an independent backup function, so that if the primary system is disabled the required functions are still performed.

Synchronizing — Control incorporates a digital synchronizing function to force the genset to match the frequency, phase and voltage of another source such as a utility grid. The synchronizer includes provisions to provide proper operation even with highly distorted bus voltage waveforms. The synchronizer can match other sources over a range of 60-110% of nominal voltage and -24 to +6 hertz. The synchronizer function is configurable for slip frequency synchronizing for applications requiring a known direction of power flow at instant of breaker closure or for applications where phase synchronization performance is otherwise inadequate.

Load sharing control – The genset control includes an integrated load sharing control system for both real (kW) and reactive (kVar) loads when the genset(s) are operating on an isolated bus. The control system determines kW load on the engine and kVar load on the alternator as a percent of genset capacity, and then regulates fuel and excitation systems to maintain system and genset at the same percent of load without impacting voltage or frequency regulation. The control can also be configured for operation in droop mode for kW or Kvar load sharing.

Load govern control— When PowerCommand[®] receives a signal indicating that the genset is paralleled with an infinite source such as a utility (mains) service, the genset will operate in load govern mode. In this mode the genset will synchronize and close to the bus, ramp to a pre-programmed kW and kVar load level, and then operate at that point. Control is adjustable for kW

values from 0-100% of standby rating, and 0.7-1.0 power factor (lagging). Default setting is 80% of standby and 1.0 power factor. The control includes inputs to allow independent control of kW and kVar load level by a remote device while in the load govern mode. The rate of load increase and decrease is also adjustable in the control. In addition, the control can be configured for operation in kW or kVAR load govern droop.

Load demand control – The control system includes the ability to respond to an external signal to initiate load demand operation. On command, the genset will ramp to no load, open its paralleling breaker, cool down, and shut down. On removal of the command, the genset will immediately start, synchronize, connect, and ramp to its share of the total load on the system.

Sync check – The sync check function decides when permissive conditions have been met to allow breaker closure. Adjustable criteria are: phase difference from 0.1-20 deg, frequency difference from 0.001-1.0 Hz, voltage difference from 0.5-10%, and a dwell time from 0.5-5.0 sec. Internally the sync check is used to perform closed transition operations. An external sync check output is also available.

Genset and utility/AC bus source AC metering – The control provides comprehensive three phase AC metering functions for both monitored sources, including: 3-phase voltage (L-L and L-N) and current, frequency, 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. Three wire or four wire voltage connection with direct sensing of voltages to 600V, and up to 45kV with external transformers. Current sensing is accomplished with either 5 amp or 1 CT secondaries and with up to 10,000 amp primary. Maximum power readings are 32,000kW/kVAR/kVA.

Power transfer control – provides integrated automatic power transfer functions including source availability sensing, genset start/stop and transfer pair monitoring and control. The transfer/retransfer is configurable for open transition, fast closed transition (less than 100msec interconnect time), or soft closed transition (load ramping) sequences of operation. Utility source failure will automatically start genset and transfer load, retransferring when utility source returns. Test will start gensets and transfer load if test with load is enabled. Sensors and timers include:

<u>Under voltage sensor</u>: 3-phase L-N or L-L under voltage sensing adjustable for 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 over voltage sensing adjustable for pickup from 95-99% of dropout. Dropout adjustable from 105-135% of nominal. Dropout delay adjustable from 0.5-120 sec. Standard configuration is disabled and is configurable to enabled in the field using the HMI or InPower service tools.

Over/Under frequency sensor: Center frequency adjustable from 45-65 Hz. Dropout bandwidth adjustable from 0.3-5% of center frequency beyond pickup bandwidth. Pickup bandwidth adjustable from 0.3-20% of center frequency. Field configurable to enable.

<u>Loss of phase sensor:</u> Detects out of range voltage phase angle relationship. Field configurable to enable.

<u>Phase rotation sensor:</u> Checks for valid phase rotation of source. Field configurable to enable.

<u>Breaker tripped:</u> If the breaker tripped input is active, the associated source will be considered as unavailable.

<u>Timers:</u> Control provides adjustable start delay from 0 - 300sec, stop delay from 0 - 800sec, transfer delay from 0-120sec, retransfer delay from 0-1800sec, programmed transition delay from 0-60sec, and maximum parallel time from 0-1800sec.

<u>Negative Sequence Current Protection:</u> PCC3300 supports this protection natively in order to determine if the generator is at any point was running subject to negative phase sequencing.

Breaker control – Utility and Genset 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. Upon breaker failure, appropriate control action is taken to maintain system integrity.

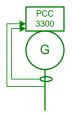
Exerciser clock –The exerciser clock (when enabled) allows the system to be operated at preset times in either test without load, test with load, or extended parallel mode. A Real Time Clock is built in. Up to 12 different programs can be set for day of week, time of day, duration, repeat interval, and mode. For example, a test with load for 1 hour every Tuesday at 2AM can be programmed. Up to 6 different exceptions can also be set up to block a program from running during a specific date and time period.

Extended paralleling – In extended paralleling mode (when enabled) the controller will start the genset and parallel to a utility source and then govern the real and reactive power output of the genset based on the desired control point. The control point for the real power (kW) can be configured for either the genset metering point ("Base Load") or the utility metering point ("Peak Shave"). The control point for the reactive power (kVAR or Power Factor) can also be independently configured for either the genset metering point or the utility metering point. This flexibility would allow base kW load from the genset while maintaining the utility power factor at a reasonable value to avoid

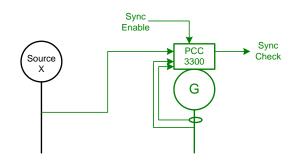
penalties due to low power factor. The System always operates within genset ratings. The control point can be changed while the system is in operation. Set points can be adjusted via hardwired analog input or adjusted through an operator panel display or service tool.

Application types – Controller is configured to operating in one of six possible application types. These topologies are often used in combinations in larger systems, with coordination of the controllers in the system either by external device or by interlocks provided in the control. Topologies that may be selected in the control include:

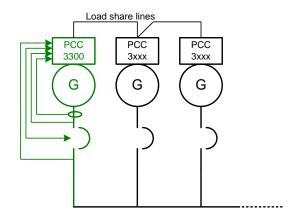
<u>Standalone:</u> Control provides monitoring, protection and control in a non-paralleling application.



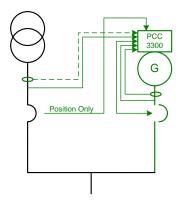
<u>Synchronizer only:</u> control will synchronize the genset to other source when commanded to either via a hardwired or Modbus driven input.



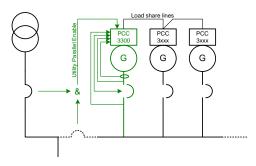
<u>Isolated Bus:</u> allows the genset to perform a dead bus closure or synchronize to the bus and isochronously share kW and kVAR loads with other gensets.



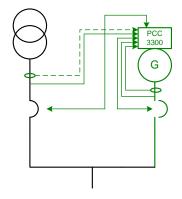
<u>Utility Single:</u> Control monitors one genset and utility. The control will automatically start and provide power to a load if the utility fails. The control will also resynchronize the genset back to the utility and provides extended paralleling capabilities.



<u>Utility Multiple:</u> Supports all functionality of Isolated Bus and provides extended paralleling to the utility. Extended paralleling load set points follow a constant setting; dynamically follow an analog input, Modbus register or HMI.



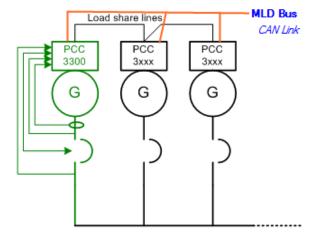
<u>Power Transfer Control</u>: Control operates a single genset/single utility transfer pair in open transition, fast closed transition, or soft closed transition. Extended paralleling functionality also provides base load and peak shave options.



Masterless Load Demand (Optional Feature):

PowerCommand[®] 3.3 with Masterless Load Demand (MLD) technology enables generator sets to start/stop automatically based on load demand. Masterless Load Demand-capable generators are equipped with an additional s-CAN network connection that allows sharing of information amongst paralleled generator sets. MLD has been designed for hassle-free installation, commissioning and operation. MLD functionality. Integrated on-board system logic provides the MLD topology control without the need for any additional system.





PCC3300 External Voltage and Frequency Biasing Inputs

PCC3300 supports externally driven voltage and frequency biasing capability in order to permit external paralleling (if intending to use this feature please contact your local distributor for further information).

Protective Functions

On operation of a protective function the control will indicate a fault by illuminating the appropriate status LED on the HMI, as well as display the fault code and fault description on the LCD. The nature of the fault and time of occurrence are logged in the control. The service manual and InPower service tool provide service keys and procedures based on the service codes provided. Protective functions include:

Battle short mode

When enabled and the *battle short* switch is active, the control will allow some shutdown faults to be bypassed. If a bypassed shutdown fault occurs, the fault code and description will still be annunciated, but the genset will not shutdown. This will be followed by a *fail to shutdown* fault. Emergency stop shutdowns and others that are critical for proper operation (or are handled by the engine ECM) are not bypassed. Please refer to the Control Application Guide or Manual for list of these faults.

Derate

The Derate function reduces output power of the genset in response to a fault condition. If a Derate command occurs while operating on an isolated bus, the control will issue commands to reduce the load on the genset via contact closures or Modbus. If a Derate command occurs while in utility parallel mode, the control will actively reduce power by lowering the base load kW to the derated target kW.

Configurable alarm and status inputs

The control accepts up to four alarm or status inputs (configurable contact closed to ground or open) to indicate a configurable (customer-specified) condition.

The control is programmable for warning, derate, shutdown, shutdown with cooldown or status indication and for labeling the input.

Emergency stop

Annunciated whenever either emergency stop signal is received from external switch.

General prime mover protection

<u>Low and high battery voltage warning</u> - Indicates status of battery charging system (failure) by continuously monitoring battery voltage.

Weak battery warning - The control system will test the battery each time the genset is signaled to start and indicate a warning if the battery indicates impending failure.

<u>Low coolant level warning</u> – Can be set up to be a warning or shutdown.

<u>Low coolant temperature warning</u> – Indicates that engine temperature may not be high enough for a 10 second start or proper load acceptance.

<u>Fail to start (overcrank) shutdown</u> - The control system will indicate a fault if the genset fails to start by the completion of the engine crack sequence.

<u>Fail to crank shutdown</u> - Control has signaled starter to crank engine but engine does not rotate.

<u>Cranking lockout</u> - The control will not allow the starter to attempt to engage or to crank the engine when the engine is rotating.

<u>Fault simulation</u> –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.

For Lean Burn Natural Gas Engine applications:

Off load running (protection) – This feature protects the engine in the event the genset is being called to go off load for too long.

Hydro Mechanical fuel system engine protection:

<u>Overspeed shutdown</u> – Default setting is 115% of nominal

<u>Low lube oil pressure warning/shutdown</u> – Level is preset (configurable with InPower or HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance alarms.

<u>High lube oil temperature warning/shutdown</u> – Level is preset (configurable with InPower or HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance alarms.

<u>High engine temperature warning/shutdown</u> – Level is preset (configurable with InPower or HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance alarms.

<u>Low coolant temperature warning</u> – Indicates that engine temperature may not be high enough for a 10 second start or proper load acceptance.

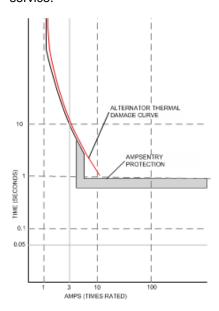
<u>High intake manifold temperature shutdown</u> – Level is preset (configurable with InPower or HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance alarms.

Full authority electronic engine protection:

Engine fault detection is handled inside the engine ECM. Fault information is communicated via the SAE-J1939 data link for annunciation in the HMI.

Alternator Protection

AmpSentry protective relay - A comprehensive monitoring and control system integral to the PowerCommand® Control System that guards the electrical integrity of the alternator and power system by providing protection against a wide array of fault conditions in the genset or in the load. It also provides single and three phase fault current regulation (3x Current) so that downstream protective devices have the maximum current available to quickly clear fault conditions without subjecting the alternator to potentially catastrophic failure conditions. Thermal damage curve (3 phase short) or fixed timer (2sec for 1P short, 5sec for 2P short). See document R1053 for a full-size time over current curve. The control does not included protection required for interconnection to a utility (mains) service.



AmpSentry Maintenance Mode (AMM) - Instantaneous tripping, if AmpSentry Maintenance mode is active (50mS response to turn off AVR excitation/shutdown genset) for arc flash reduction when personnel are near genset.

High AC voltage shutdown (59) - Output voltage on any phase exceeds preset values. Time to trip is inversely proportional to amount above threshold. Values adjustable from 105-125% of nominal voltage, with time delay adjustable from 0.1-10 seconds. Default value is 110% for 10 seconds.

Low AC voltage shutdown (27) - Voltage on any phase has dropped below a preset value. Adjustable over a range of 50-95% of reference voltage, time delay 2-20 seconds. Default value is 85% for 10 seconds. Function tracks reference voltage. Control does not nuisance trip when voltage varies due to the control directing voltage to drop, such as during a V/Hz roll-off or synchronizing.

<u>Under frequency shutdown (81 u)</u> - Genset output frequency cannot be maintained. Settings are adjustable from 2-10 Hz below reference governor set point, for a 5-20 second time delay. Default: 6 Hz, 10 seconds. Under frequency protection is disabled when excitation is switched off, such as when engine is operating in idle speed mode.

Over frequency shutdown/warning (810) - Genset is operating at a potentially damaging frequency level. Settings are adjustable from 2-10 Hz above nominal governor set point for a 1-20 second time delay. Default: 6 Hz, 20 seconds, disabled.

Overcurrent warning/shutdown (51) - Implementation of the thermal damage curve with instantaneous trip level calculated based on current transformer ratio and application power rating.

<u>Loss of sensing voltage shutdown</u> - Shutdown of genset will occur on loss of voltage sensing inputs to the control.

<u>Field overload shutdown</u> - Monitors field voltage to shutdown genset when a field overload condition occurs.

Over load (kW) warning - Provides a warning indication when engine is operating at a load level over a set point. Adjustment range: 80-140% of application rated kW, 0-120 second delay. Defaults: 105%, 60 seconds.

Reverse power shutdown (32) - Adjustment range: 5-20% of standby kW rating, delay 1-15 seconds. Default: 10%, 3 seconds.

Reverse Var shutdown (40) - Shutdown level is adjustable: 15-50% of rated Var output, delay 10-60 seconds. Default: 20%. 10 seconds.

Short circuit protection - Output current on any phase is more than 175% of rating and approaching the thermal damage point of the alternator. Control includes algorithms to protect alternator from repeated over current conditions over a short period of time.

Negative sequence overcurrent warning (46) – Control protects the generator from damage due to excessive imbalances in the three phase load currents and/or power factors.

<u>Custom overcurrent warning/shutdown (51)</u> – Control provides the ability to have a custom time overcurrent protection curve in addition to the AmpSentry protective relay function.

Ground fault overcurrent (51G) – Control detects a ground fault either by an external ground fault relay via a contact input or the control can measure the ground current from an external current transformer. Associated time delays and thresholds are adjustable via InPower or HMI.

Paralleling Protection

Breaker fail to close Warning: When the control 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.

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 and adjustable time delay, a Breaker Fail to Open warning is initiated.

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.

<u>Breaker tripped warning:</u> The control accepts inputs to monitor breaker trip / bell alarm contact and will initiate a breaker tripped warning if it should activate.

<u>Fail to disconnect warning:</u> In the controller is unable to open either breaker, a fail to disconnect warning is initiated. Typically, this would be mapped to a configurable output, allowing an external device to trip a breaker.

<u>Fail to synchronize warning:</u> Indicates that the genset could not be brought to synchronization with the bus. Configurable for adjustable time delay of 10 -900 seconds, 120 default.

<u>Phase sequence sensing warning:</u> Verifies that the genset phase sequence matches the bus prior to allowing the paralleling breaker to close.

Maximum parallel time warning (power transfer control mode only): During closed transition load transfers, control independently monitors paralleled time. If time is exceeded, warning is initiated and genset is disconnected.

Bus or genset PT input calibration warning: The control system monitors the sensed voltage from the bus and genset output voltage potential transformers. When the paralleling breaker is closed, it will indicate a warning condition if the read values are different.

Field Control Interface

Input signals to the PowerCommand[®] control include:

- Coolant level (where applicable)
- Fuel level (where applicable)
- Remote emergency stop
- Remote fault reset
- Remote start
- Rupture basin
- Start type signal
- Battle short
- Load demand stop
- Synchronize enable
- Genset circuit breaker inhibit
- Utility circuit breaker inhibit
- Single mode verify
- Transfer inhibit prevent transfer to utility (in power transfer control mode)
- Retransfer inhibit prevent retransfer to genset (in power transfer control mode)
- kW and kVAR load setpoints

Configurable inputs - Control includes (4) input signals from customer discrete devices that are configurable for warning, shutdown or status indication, as well as message displayed

Input signals for Lean Burn Natural Gas Engine applications:

- Gearbox oil pressure/temperature protection
- Fire fault
- Earth fault support as a discrete input via an appropriate secondary detection device
- Differential fault
- DC power supply fault
- Genset Interface Box (GIB) isolator open fault
- Start inhibit/enable (x3)
- Radiator fan trip
- Ventilator fan trip
- Ventilation louvers closed
- Start system trip
- Alternator heater trip
- Alternator heater status
- Alternator winding temperature (PT100 RTDx3)
- Alternator drive end bearing temperature (PT100 RTD)
- Alternator non-drive end bearing temperature (PT100 RTD)

Output signals from the PowerCommand[®] control include:

- Load dump signal: Operates when the genset is in an overload condition.
- Delayed off signal: Time delay-based output which will continue to remain active after the control has removed the run command. Adjustment range: 0 - 120 seconds. Default: 0 seconds.

- Configurable relay outputs: Control includes (4) relay output contacts (3 A, 30VDC). These outputs can be configured to activate on any control warning or shutdown fault as well as ready to load, not in auto, common alarm, common warning and common shutdown.
- Ready to load (genset running) signal: Operates when the genset has reached 90% of rated speed and voltage and latches until genset is switched to off or idle mode.
- Paralleling circuit breaker relays outputs: Control includes (4) relay output contacts (3.5A, 30 VDC) for opening and closing of the genset and utility breakers.

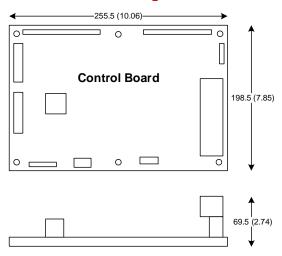
Output Signals for Lean Burn Natural Gas Engine applications:

- Start inhibit/enable event
- Emergency stop event
- Ventilator fan run control
- Louvre control
- Radiator fan control
- Alternator heater control
- Engine at idle speed event

Communications connections include:

- PC tool interface: This RS-485 communication port allows the control to communicate with a personal computer running InPower software.
- Modbus RS-485 port: Allows the control to communicate with external devices such as PLCs using Modbus protocol.
 - Note An RS-232 or USB to RS-485 converter is required for communication between PC and control.
- Networking: This RS-485 communication port allows connection from the control to the other Cummins Power Generation products.

Mechanical Drawing



PowerCommand® Human Machine Interface HMI320



Description

This control system includes an intuitive operator interface panel that allows for complete genset control as well as system metering, fault annunciation, configuration and diagnostics. The interface includes five genset status LED lamps with both internationally accepted symbols and English text to comply with customer's needs. The interface also includes an LED backlit LCD display with tactile feel soft-switches for easy operation and screen navigation. It is configurable for units of measurement and has adjustable screen contrast and brightness.

The *run/off/auto* switch function is integrated into the interface panel.

All data on the control can be viewed by scrolling through screens with the navigation keys. The control displays the current active fault and a time-ordered history of the five previous faults.

Features:

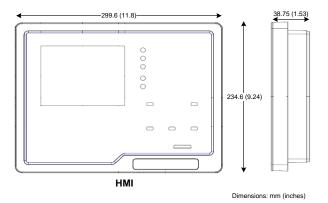
- · LED indicating lamps
 - genset running
 - remote start
 - not in auto
 - shutdown
 - warning
 - auto
 - manual and stop
 - Circuit breaker open (if equipped)
 - Circuit breaker closed (if equipped)
- 320 x 240 pixels graphic LED backlight LCD.
- Four tactile feel membrane switches for LCD defined operation. The functions of these switches are defined dynamically on the LCD.
- Seven tactile feel membrane switches dedicated screen navigation buttons for up, down, left, right, ok, home and cancel.

- Six tactile feel membrane switches dedicated to control for auto, stop, manual, manual start, fault reset and lamp test/panel lamps.
- Two tactile feel membrane switches dedicated to control of circuit breaker (where applicable).
- · Allows for complete genset control setup.
- Certifications: Suitable for use on gensets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std., UKCA and CE standards.
- Languages supported: English, Spanish, French, German, Italian, Greek, Portuguese, Finnish, Norwegian, Danish, Russian (Cyrillic), Chinese, Hungarian, Japanese, Polish, Korean, Romanian, Brazilian Portuguese, Turkish, Dutch, and Czech

Communications connections include:

- PC tool interface This RS-485 communication port allows the HMI to communicate with a personal computer running InPower.
- This RS-485 communication port allows the HMI to communicate with the main control board.

Mechanical Drawing



Software

InPower (beyond 6.5 version) is a PC-based software service tool that is designed to directly communicate to PowerCommand[®] gensets and transfer switches, to facilitate service and monitoring of these products.

Environment

The control is designed for proper operation without recalibration in ambient temperatures from -40 $^{\circ}$ C (-40 $^{\circ}$ F) to +70 $^{\circ}$ C (158 $^{\circ}$ F), and for storage from -55 $^{\circ}$ C (-67 $^{\circ}$ F) to +80 $^{\circ}$ C (176 $^{\circ}$ F). Control will operate with humidity up to 95%, non-condensing.

The HMI is designed for proper operation in ambient temperatures from -20 °C (-4 °F) to +70 °C (158 °F), and for storage from -30 °C (-22 °F) to +80 °C (176 °F).

The control board is fully encapsulated to provide superior resistance to dust and moisture. Display panel has a single membrane surface, which is impervious to effects of dust, moisture, oil and exhaust fumes. This panel uses a sealed membrane to provide long reliable service life in harsh environments.

The control system is specifically designed and tested for resistance to RFI/EMI and to resist effects of vibration to provide a long reliable life when mounted on a genset. The control includes transient voltage surge suppression to provide compliance to referenced standards.

Certifications

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

- NFPA 110 for level 1 and 2 systems.
- ISO 8528-4:2005 compliance, controls and switchgear (second edition)
- CE marking: The CE marking is only valid when equipment is used in a fixed installation application. Material compliance declaration is available upon request.
- UKCA marking- The UKCA marking is only valid when equipment is used in a fixed installation application. Material compliance declaration is available upon request.
- EN 61000-6-3,4 residential/light industrial emissions or industrial emissions.
- EN 50082-1,2 residential/light industrial or industrial susceptibility.
- ISO 7637-2, level 2; DC supply surge voltage test.
- Mil Std 202C, Method 101 and ASTM B117: Salt fog test.
- UL 6200 recognized, suitable for use on UL 2200 Listed generator sets.
- CSA C282-M1999 compliance
- CSA 22.2 No. 14 M91 industrial controls.
- PowerCommand[®] control systems and generator sets are designed and manufactured in ISO 9001 certified facilities.
- ROHS (Restriction of Hazardous substance) complaint both for HMI 320 & PCC3300v2.

Reference Documents

Please refer to the following reference documents available in the PowerSuite library:

- PowerCommand™ 3.3. Application Guide
- T-037: PowerCommand Control Application Manual (ANSI Protective Functions)
- T-040: PowerCommand 3.3 Paralleling Application Guide

Please refer to the following reference documents available on Cummins Quickserve:

- Service Manuals for PC3.3 (non-MLD) and PC3.3 (MLD)
- Modbus Register Mapping

Warranty

All components and subsystems are covered by an express limited one-year warranty. Other optional and extended factory warranties and local distributor maintenance agreements are available.





Alternator Data Sheet Frame Size: S7L1D-C4

Characteristics

No of Bearings: 1-bearing 2-bearing

 Weights:
 Stator assembly:
 2835 lb
 1286 kg
 2835 lb
 1286 kg

 Rotor assembly:
 2542 lb
 1153 kg
 2440 lb
 1107 kg

Complete assembly: 6415 lb 2910 kg 6358 lb 2884 kg

Maximum speed: 2250 rpm

Excitation current: Full load: Wdg 07: 2.6, Wdg 13: 2.5, Wdg 312: 2.8

No load: Wdg 07: 0.93, Wdg 13: 1.1, Wdg 312: 0.61-0.58

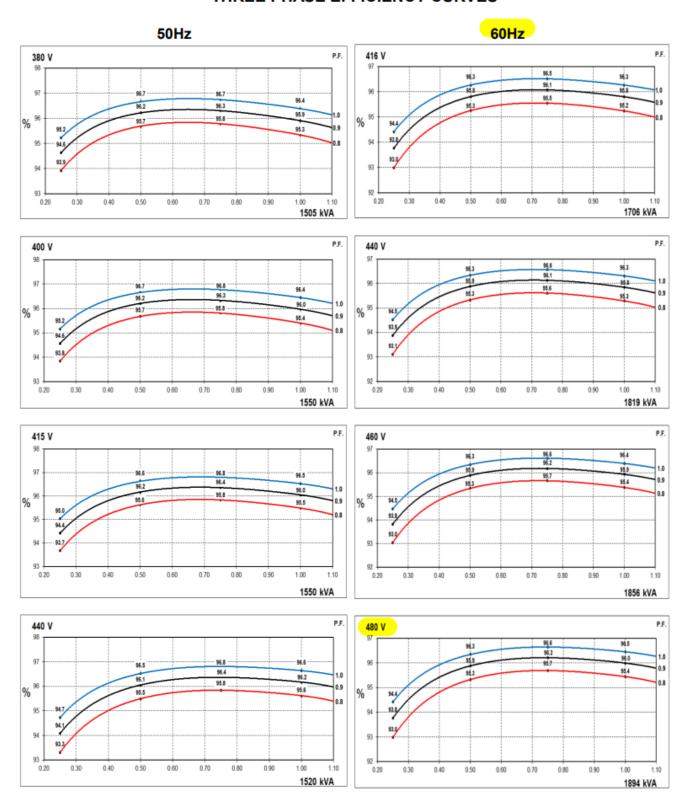
Insulation system: Class H throughout

miculanion cyclon	••									
3 Ø Ratings	(0.8 power f	actor)				60 Hz (winding no)			
			600	380	400	<u>416</u>	<u>416</u>	440	<u>480</u>	
			(07)	(13)	(13)	(13)	(312)	(312)	(312)	
163° C rise ratings	@ 27° C	kW	1620	1520	1520	1520	1456	1556	1620	
		kVA	2025	1900	1900	1900	1820	1945	2025	
150° C rise ratings	@ 40° C	kW	1580	1485	1485	1485	1420	1515	1580	
		kVA	1975	1856	1856	1856	1775	1894	1975	
125° C rise ratings	@ 40° C	kW	1515	1425	1425	1425	1365	1455	<mark>1515</mark>	
		kVA	1894	1781	1781	1781	1706	1819	<mark>1894</mark>	
105° C rise ratings	@ 40° C	kW	1410	1325	1325	1325	1275	1355	1410	
		kVA	1762	1656	1656	1656	1594	1694	1762	
80° C rise ratings	@ 40° C	kW	1300	1225	1225	1225	1175	1255	1300	
		kVA	1625	1531	1531	1531	1469	1569	1625	
3 Ø Reactance	S		<u>600</u>	<u>380</u>	<u>400</u>	<u>416</u>	<u>416</u>	<u>440</u>	<u>480</u>	
,			(07)	(13)	(13)	(13)	(312)	(312)	(312)	
(Based on full load at 1	25° C rise ratin	ıg)								
Synchronous			2.01	1.80	1.62	1.50	3.35	3.19	2.79	
Transient			0.19	0.20	0.18	0.16	0.26	0.24	0.21	
Subtransient			0.12	0.14	0.13	0.12	0.16	0.16	0.14	
Negative sequence			0.16	0.17	0.15	0.14	0.23	0.22	0.19	
Zero sequence			0.02	0.02	0.02	0.02	0.03	0.03	0.03	
3 Ø Motor star	ting		<u>600</u>	<u>380</u>	<u>400</u>	<u>416</u>	<u>416</u>	<u>440</u>	<u>480</u>	
			(07)	(13)	(13)	(13)	(312)	(312)	(312)	
Maximum kVA (90)% sustained vo	oltage)	6075	5700	4700	5100	6075	6075	6075	
Time constant	S	(sec)	<u>600</u>	<u>380</u>	<u>400</u>	<u>416</u>	<u>416</u>	<u>440</u>	<u>480</u>	
			(07)	(13)	(13)	(13)	(312)	(312)	(312)	
Transient			0.167	0.164	0.164	0.164	0.155	0.155	0.155	
Subtransient			0.018	0.019	0.019	0.019	0.0177	0.0177	0.0177	
Open circuit			4.17	3.93	3.93	3.93	4.05	4.05	4.05	
DC			0.031	0.026	0.026	0.026	0.036	0.036	0.036	
Windings	(@2	2° C)	<u>600</u>	<u>380</u>	<u>400</u>	<u>416</u>	<u>416</u>	<u>440</u>	<u>480</u>	
		•	(07)	(13)	(13)	(13)	(312)	(312)	(312)	
Stator resistance	(L-L	Ohms)	0.0032	0.0014	0.0014	0.0014	0.0024	0.0024	0.0024	
Rotor resistance		(Ohms)	1.710	1.710	1.710	1.710	1.710	1.710	1.710	
Number of leads			6	6	6	6	6	6	6	



S7L1D-C4 Wdg.312

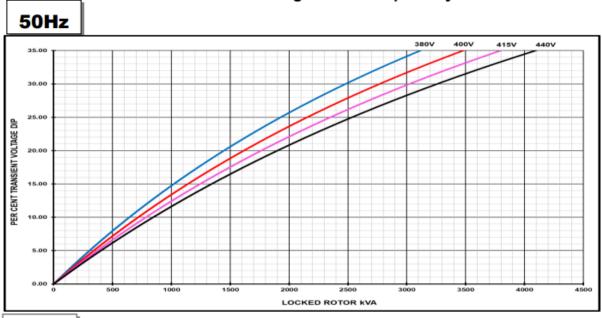
THREE PHASE EFFICIENCY CURVES



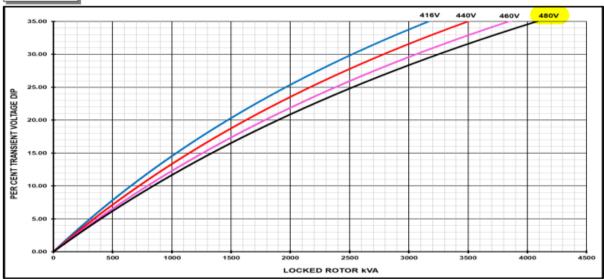


S7L1D-C4 Wdg.312

Locked Rotor Motor Starting Curves - Separately Excited





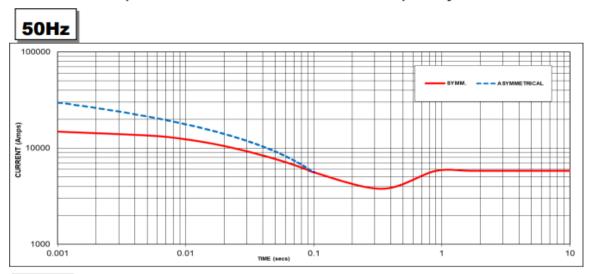


Transient Voltag	e Dip Scaling Factor	Transient Voltage Rise Scaling Factor
PF	Factor	
< 0.5	1	For voltage rise multiply voltage dip by 1.25
0.5	0.97	
0.6	0.93	
0.7	0.9	
0.8	0.85	
0.9	0.83	



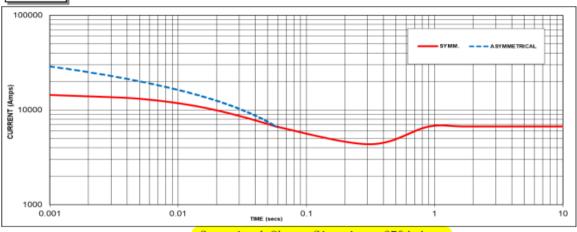
S7L1D-C4 Wdg.312

Three-phase Short Circuit Decrement Curve - Separately Excited





Sustained Short Circuit = 5820 Amps



Sustained Short Circuit = 6704 Amps

Note 1

The following multiplication factors should be used to adjust the values from curve between time 0.001 seconds and the minimum current point in respect of nominal operating voltage:

50	Hz	60	Hz
Voltage	Factor	Voltage	Factor
380V	X 1.00	416V	X 1.00
400V	X 1.05	440V	X 1.06
415V	X 1.09	460V	X 1.10
440V	X 1.16	480V	X 1.15

The sustained current value is constant irrespective of voltage level

Note 2

The sustained current values are for MX341 AVR. For MX322 and Digital AVR 1.2 factor to be applied to the sustained short circuit

Note 3

The following multiplication factor should be used to convert the values calculated in accordance with NOTE 1 to those applicable to the various types of short circuit:

	3-phase	2-phase L-L	1-phase L-N
Instantaneous	x 1.00	x 0.87	x 1.30
Minimum	x 1.00	x 1.80	x 3.20
Sustained	x 1.00	x 1.50	x 2.50
Max. sustained duration	10 sec.	5 sec.	2 sec.

lote 4 All other times are unchanged

Curves are drawn for Star connected machines under no-load excitation at rated speeds. For other connection (where applicable) the following multipliers should be applied to current values as shown:

Parallel Star = Curve current value X 2 Series Delta = Curve current value X 1.732

Sound Data C1500D6E QSK38-G18 60Hz Diesel

A-weighted Sound Pressure Level @ 7 meters, dB(A)

See notes 2, 5 and 7-11 listed below

Configuration	Exhaust	Applied	Position (Note 2)									
Configuration	Exnaust	Load	1	2	3	4	5	6	7	8	Position Average	
		0% Prime	88.8	93.6	92.7	94.5	94.5	97.0	95.0	92.7	94.1	
Standard – Unhoused	Infinite Exhaust	75% Prime	89.5	94.4	93.9	95.1	93.6	96.6	95.3	93.4	94.4	
with 50°C Cooling Package		100% Prime	89.8	95.2	95.3	96.1	93.5	96.7	95.4	93.7	94.9	
		100% Standby	90.2	95.5	95.2	96.3	93.8	96.8	95.8	94.0	<mark>95.1</mark>	

Average A-weighted Sound Pressure Level @ 1 meter, dB(A)

See notes 1, 5 and 7-14 listed below

			Octave Band Center Frequency (Hz)											Overall	
Configuration	Exhaust	Applied Load	16	31.5	63	125	250	500	1000	2000	4000	8000	16000	Sound Pressure Level	
	Infinite PExhaust 1.	0% Prime	N/A	55.5	65.2	91.8	91.5	96.6	96.3	94.3	91.6	84.0	73.3	102.1	
Standard – Unhoused		75% Prime	N/A	56.4	67.0	91.3	92.0	96.8	96.1	94.6	92.5	89.1	76.3	102.4	
with 50°C Cooling Package		100% Prime	N/A	55.8	67.1	91.2	92.6	96.9	96.2	94.8	93.1	90.7	77.4	102.7	
		100% Standby	N/A	55.9	67.2	91.3	93.0	97.0	96.4	95.0	93.5	91.2	77.9	102.9	

A-weighted Sound Pressure Level @ Operator Location, dB(A)

See notes 1, 5 and 7-14 listed below

				Octave Band Center Frequency (Hz)											
Configuration	Exhaust	Applied Load	16	31.5	63	125	250	500	1000	2000	4000	8000	16000	Sound Pressure Level	
Standard –	Infinite	100% Prime	N/A	61.5	71.0	87.5	89.9	92.3	92.3	88.9	86.4	81.5	67.4	98.0	
Unhoused with 50°C Cooling Package	Exhaust	100% Standby	N/A	<mark>61.6</mark>	70.6	<mark>87.7</mark>	90.7	<mark>92.6</mark>	<mark>92.8</mark>	<mark>89.4</mark>	<mark>87.1</mark>	82.4	<mark>68.3</mark>	98.5	

A-weighted Sound Power Level, dB(A)

See notes 1, 3 and 6-14 listed below

				Octave Band Center Frequency (Hz)										
Configuration	Exhaust	Applied Load	16	31.5	63	125	250	500	1000	2000	4000	8000	16000	Sound Power Level
Standard – Unhoused with 50°C Cooling Package	Infinite Exhaust	0% Prime	N/A	75.8	85.5	112.1	111.8	117.0	116.6	114.7	111.9	104.3	93.6	122.4
		75% Prime	N/A	76.7	87.3	111.6	112.4	117.1	116.4	114.9	112.8	109.5	96.6	122.7
		100% Prime	N/A	76.2	87.4	111.5	113.0	117.2	116.5	115.1	113.4	111.0	97.7	123.0
		100% Standby	N/A	<mark>76.2</mark>	<mark>87.5</mark>	111.7	113.3	117.3	116.7	<mark>115.3</mark>	113.8	111.5	98.2	123.2



Sound Data C1500D6E QSK38-G18 60Hz Diesel

Exhaust Sound Power Level, dB(A)

See notes 4 and 6-14 listed below

		Applied				Oct	ave Ban	d Center	Frequer	ncy (Hz)				Overall
Configuration	Exhaust	Applied Load	16	31.5	63	125	250	500	1000	2000	4000	8000	16000	Sound Power Level
		0% Prime	N/A	48.9	98.1	107.2	108.9	108.4	106.4	109.3	100.4	93.8	82.7	115.4
Open Exhaust (Unhoused with	With Tail	75% Prime	N/A	61.6	110.3	126.1	131.3	130.4	126.0	123.5	119.7	112.9	100.6	135.5
`	Pipe	100% Prime	N/A	60.4	112.6	127.7	132.7	131.6	128.6	125.8	122.6	116.6	103.7	137.2
		100% Standby	N/A	62.4	113.1	127.6	132.5	132.1	129.1	126.2	123.4	117.8	104.9	137.4

Global Notes:

- Sound pressure levels at 1 meter are measured per the requirements of ISO 3744, ISO 8528-10, and European Communities
 Directive 2000/14/EC as applicable. The microphone measurement locations are 1 meter from a reference parallelepiped just
 enclosing the generator set (enclosed or unenclosed).
- Seven-meter measurement location 1 is 7 meters (23 feet) from the generator (alternator) end of the generator set, and the
 locations proceed counter-clockwise around the generator set at 45° angles at a height of 1.2 meters (48 inches) above the
 ground surface.
- 3. Sound Power Levels are calculated according to ISO 3744, ISO 8528-10, and or CE (European Union) requirements...
- 4. Exhaust Sound Levels are measured and calculated per ISO 6798, Annex A.
- Reference Sound Pressure Level is 20 μPa.
- Reference Sound Power Level is 1 pW (10⁻¹² Watt).
- 7. Sound data for remote-cooled generator sets are based on rated loads without cooling fan noise.
- 8. Sound data for the generator set with infinite exhaust do not include the exhaust noise contribution.
- 9. Published sound levels are measured at CE certified test site and are subject to instrumentation, measurement, installation and manufacturing variability.
- 10. Unhoused/Open configuration generator sets refers to generator sets with no sound enclosures of any kind.
- 11. Housed/Enclosed/Closed/Canopy configuration generator sets refer to generator sets that have noise reduction sound enclosures installed over the generator set and usually integrally attached to the skid base/base frame/fuel container base of the generator set.
- 12. Published sound levels meet the requirements India's Central Pollution Control Board (Ministry of Environment & Forests),vide GSR 371 (E), which states the A-weighted sound level at1meter from any diesel generator set up to a power output rating of 1000kVA shall not exceed 75dB(A)
- 13. For updated noise pollution information for India see website: http://www.envfor.nic.in/legis/legis.html
- Sound levels must meet India's Ambient Air Noise Quality Standards detailed for Daytime/Night-time operation in Noise Pollution (Regulation and Control) Rules, 2000
- 15. Operator Location is near genset control panel and is at 1 meter distance from genset control panel and at 1.6 meter height.



Cooling System Data C1500D6E QSK38-G18

		High Am	ibient A	i <mark>r Tem</mark>	peratu	ıre Ra	diator C	ooling	Syste	<mark>em</mark>				
							static restri iter/mm wat	,		l in free ai arge restr	,			
				0.0/0.0	0.25/6.4	0.5/12.7	0.75/19.1	1.0/25.4	Weather	Sound level 1	Sound level 2			
	Fuel Type	Duty	Rating (kW)		Maxi	mum allo	wable ambi	ent tempe	rature, de	gree C				
		Standby	<mark>1500</mark>	42.5	40.4	39.5	39.2	38.5	N/A	N/A	N/A			
60 Hz	Diesel			Airflow (m³/s) – Actual @ Fan										
				17.97	17.27	16.58	16.29	16.09	N/A	N/A	N/A			

	Enha	nced Hiç	gh Ambi	ent Ai	r Tem _l	oeratu	re Radia	ator Co	ooling	Syster	n
					_		static restri iter/mm wat			l in free ai arge restr	•
				0.0/0.0	0.25/6.4	0.5/12.7	0.75/19.1	1.0/25.4	Weather	Sound level 1	Sound level 2
	Fuel Type	Duty	Rating (kW)		Maxi	mum allo	wable ambi	ent tempe	rature, de	gree C	
		Standby	1500	52.0	51.0	50.0	47.0	45.0	N/A	N/A	N/A
60 Hz	Diesel					Air	low (m³/s) -	- Actual @	Fan		
				24.12	23.52	23.00	22.45	22.00	N/A	N/A	N/A

Notes:

- 1. Data shown are anticipated cooling performance for typical generator set.
- 2. Cooling data is based on 1000 ft (305 m) site test location.
- 3. Generator set power output may need to be reduced at high ambient conditions. Consult generator set data sheet for derate schedules.
- 4. Cooling performance may be reduced due to several factors including but not limited to: Incorrect installation, improper operation, fouling of the cooling system, and other site installation variables.



2025 EPA Tier 2 Exhaust Emission Compliance Statement C1500D6E

Stationary Emergency

60 Hz Diesel generator set

Compliance Information:

The engine used in this generator set complies with the Tier 2 emissions limits of U.S EPA New source performance standards for stationary emergency engines under the provisions of 40 CFR 60 Subpart IIII.

Engine Manufacturer: Cummins Inc.

EPA Certificate Number: SCEXL050.AAD-039

Effective Date: 2/6/2025

Date Issued: 2/6/2025

EPA Diesel Engine Family: SCEXL050.AAD

Engine Information:

Model:QSK38-G18Bore:6.26 in. (159 mm)Engine Nameplate HP:1225Stroke:6.26 in. (159 mm)Type:4 Cycle, Vee, 12-cylinder dieselDisplacement:2307 cu. in. (38 liters)

Aspiration: Turbocharged and Charge Air-Cooled Compression ratio: 14.7:1

Emission Control Device: Turbocharged and Charge Air-Cooled

Diesel Fuel Emission Limits

D2 Cycle Exhaust Emissions	Gran	ns per BH	IP-hr	Grams per kWm-hr			
	NOx NMHC	<u>co</u>	<u>PM</u>	NOx NMHC	<u>co</u>	<u>PM</u>	
EPA Emissions Limit	4.8	2.6	0.15	6.4	3.5	0.20	

Test methods: EPA emissions recorded per 40 CFR Part 60, 89, 1039, 1065 and weighted at load points prescribed in the regulations for constant speed engines.

Diesel fuel specifications: 40-50 Cetane number, ASTM D975 No. 2-D, 300-500 ppm Sulfur

Reference conditions: Air inlet temperature: 25 °C (77 °F), Fuel inlet temperature: 40 °C (104 °F). Barometric pressure: 100 kPa (29.53 in Hg), Humidity: 10.7 g/kg (75 grains H₂O/lb) of dry air; required for NOx correction, Restrictions: Intake restriction set to a maximum allowable limit for clean filter; Exhaust back pressure set to a maximum allowable limit.

Tests conducted using alternate test methods, instrumentation, fuel or reference conditions can yield different results. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may result in elevated emission levels.



Exhaust Emission Data Sheet C1500D6E

60 Hz Diesel Generator Set EPA NSPS Stationary Emergency Tier 2

Engine Information:

Model:Cummins Inc. QSK38-G18Bore:6.26 in. (159 mm)Type:4 Cycle, VEE, 12-cylinder dieselStroke:6.26 in. (159 mm)Aspiration:Turbocharged and Charge Air-CooledDisplacement:2307 cu. in. (38 liters)

Compression Ratio: 14.7:1

Emission Control Device: Turbocharged and Charge Air-Cooled

Emission Level: Stationary Emergency

	<u>1/4</u>	<u>1/2</u>	<u>3/4</u>	<u>Full</u>
Performance Data	Standby	<u>Standby</u>	Standby	Standby
Engine BHP @ 1800 RPM (60 Hz)	556	1113	1669	2011
Fuel Consumption (US Gal/Hr)	32	56.3	82.9	95.1
Exhaust Gas Flow m³/min (CFM)	4548	6983	9573	10267
Exhaust Gas Temperature (°F)	754	829	877	909
Exhaust Emission Data				
HC (Total Unburned Hydrocarbons)	0.15	0.05	0.04	0.04
NOx (Oxides of Nitrogen as NO ₂)	3.04	3.76	4.10	5.52
CO (Carbon Monoxide)	1.07	0.73	0.49	0.32
PM (Particulate Matter)	0.08	0.10	0.05	0.02
SO ₂ (Sulfur Dioxide)	0.126	0.111	0.109	0.103
Smoke (Bosch)	0.49	0.78	0.43	0.20
All values (except smoke) are cited: g/BHP-hr				

Test Conditions

Steady-state emissions recorded per ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rates stabilized.

Fuel Specification: ASTM D975 No. 2-D S15 diesel fuel with 0.0015 Wt.% Sulfur content, 40-50 Cetane

Number

Air Inlet Temperature 25 °C (77 °F) Fuel Inlet Temperature: 40 °C (104 °F)

Barometric Pressure: 100 kPa (29.53 in Hg)

Humidity: NOx measurement corrected to 10.7 g/kg (75 grains H₂O/lb) of dry air

Intake Restriction: Set to 18 in of H₂O as measured from compressor inlet

Exhaust Back Pressure: Set to 1.5 in Hg

The NOx, HC, CO and PM emission data tabulated here are representative of test data taken from a single engine under the test conditions shown above. Data for the other components are estimated. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures and instrumentation. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.



Prototype Test Support (PTS) 60 Hz test summary

Generator set models Representative prototype

 C1500D6E
 Model:
 C1500D6E

 C1250D6E
 Engine:
 QSK38-G18

 Alternator:
 S7L1D-G4



The following summarizes prototype testing conducted on the designated representative prototype of the specified models. This testing is conducted to verify the complete generator set electrical and mechanical design integrity.

Prototype testing is conducted only on generator sets not sold as new equipment.

Maximum surge power: 1510 kW

The generator set was evaluated to determine the stated maximum surge power.

Maximum motor starting: N/A

The generator set was tested to simulate motor starting by applying the specified kVA load at low lagging power factor (0.4 or lower). With this load applied, the generator set recovered to a minimum of 90% rated voltage

Alternator temperature rise:

The highest rated temperature rise (125 °C) test result are reported as follows to verify that worst case temperature rises do not exceed allowable NEMA MG1 limits for class H insulation. Tests were conducted per IEEE 115, rise by resistance and embedded detector, with rated voltages. Only the highest temperatures are reported.

Location	Maximum Rise (°C)
Alternator Stator:	125
Alternator Rotor:	125
Exciter Stator:	125
Exciter Rotor:	125

Torsional analysis and testing:

The generator set on S7L1D-G4 was tested to verify that the design is not subjected to harmful torsional stresses. A spectrum analysis of the transducer output was conducted over the speed range of 1530 to 2070 RPM.

Cooling system: 50 °C ambient 0.5 in H2O restriction

The cooling system was tested to determine ambient temperature and static restriction capabilities. The test was performed at full rated load elevated ambient temperature under static restriction conditions.

Durability:

The generator set was subjected to a minimum 500 hour endurance test operating at variable load to verify structural soundness and durability of the design.

Electrical and mechanical strength:

The generator set was tested to several single phase and three phase faults to verify that the generator can safely withstand the forces associated with short circuit conditions. The generator set was capable of producing full rated output at the conclusion of the testing.

Steady state performance:

The generator set was tested to verify steady state operating performance. It was within the specified maximum limits.

 $\begin{array}{lll} \mbox{Voltage regulation:} & \pm 0.5\% \\ \mbox{Random voltage variation:} & \pm 1.0\% \\ \mbox{Frequency regulation:} & \mbox{Isochronous} \\ \mbox{Random frequency variation:} & \pm 0.25\% \\ \end{array}$

Transient performance:

The generator set was tested with the listed alternator to verify single step loading capability as required by NFPA 110. Voltage and frequency response on load addition or rejection were evaluated. The following results were recorded at 0.8 power factor:

Full load acceptance:

Voltage dip:	42.7%
Recovery time:	4.2 seconds
Frequency dip:	12.2%
Recovery time:	6.1 seconds

Full load rejection:

Voltage rise:	16.4%
Recovery time:	1.3 seconds
Frequency rise:	5.6%
Recovery time:	3.2 seconds

All data based on 0.8 power factor:

Harmonic analysis:

(per MIL-STD-705B, Method 601.4)

	Line to Line		Line to Neutral	
<u>Harmonic</u>	No load	Full load	No load	Full load
3	0.24	0.6	0.08	0.25
5	0.05	0.19	0.03	0.11
7	0.03	0.07	0.03	0.04
9	0.03	0.07	0.02	0.05
11	0.04	0.04	0.03	0.09
13	0.05	0.05	0.05	0.12
15	0.14	0.07	0.13	0.14

SECTION 3 GENERATOR ACCESSORIES

Product data sheet

Specifications



Circuit breaker, PowerPacT R, 1600A, 3 pole, 600VAC, 25kA, busbar, Micrologic 5.0,

RJF36160U33A

Main		
Range	PowerPact	
Product name	PowerPact R	
Product or Component Type	Circuit breaker	
Device Application	Distribution	
Complementary		
Line Rated Current	1600 A	
Number of Poles	3P	
Control Type	Operating handle	
Breaking capacity code	J	
Breaking capacity	AIR 100 kA 240 V AC 50/60 Hz UL 489 AIR 65 kA 480 V AC 50/60 Hz UL 489 AIR 25 kA 600 V AC 50/60 Hz UL 489 Icu 65 kA 240 V AC 50/60 Hz IEC 60947-2 Icu 50 kA 380/415 V AC 50/60 Hz IEC 60947-2	
[Ue] rated operational voltage	600 V AC 50/60 Hz UL 489	
Network Frequency	50/60 Hz	
[lcs] rated service breaking capacity	35 kA 240 V AC 50/60 Hz IEC 60947-2 25 kA 380/415 V AC 50/60 Hz IEC 60947-2	
[Uimp] rated impulse withstand voltage	8 kV IEC 60947-2	
Trip unit technology	Electronic, standard, Micrologic 5.0, LSI	
[Ui] rated insulation voltage	750 V IEC 60947-2	
Trip unit name	Micrologic 5.0	
Suitability for isolation	Yes IEC 60947-2	
Utilisation category	Category A	
	e see CB outline drawing grand termination details	
Local signalling	Alarm 1 LED yellow)long-time pick up)	
Mounting mode	Unit mount busbar)	
Mounting Support	Busbar	

Electrical connection	Busbar connection line Busbar connection load	
Terminal identifier	Please see CB outline drawing for lug and termination details	
Tightening torque	548.75 lbf.in (62 N.m) 0.080.62 in² (50400 mm²) (AWG 1/0750 kcmil) 548.75 lbf.in (62 N.m) 0.080.23 in² (50150 mm²) (2 x AWG 1/02 x 300 kcmil)	
Number of slots	2 auxiliary switch OF plug-in) 1 alarm switch SD plug-in) 1 voltage release MN or MX plug-in)	
Power wire stripping length	1.38 in (35 mm)	
Height	16.24 in (412.50 mm)	
Width	16.54 in (420.12 mm)	
Depth	14.49 in (368.05 mm)	
Net Weight	52 lb(US) (23.59 kg)	
Quantity per Set	1	
Circuit breaker application	HACR rated	

Environment

Quality labels	CE
Standards	UL CSA NEMA NMX J-266 IEC 60947-2
Product certifications	UL CSA NOM
IP degree of protection	IP40
Pollution degree	3 IEC 60947-1
Ambient Air Temperature for Operation	-13158 °F (-2570 °C)
Ambient Air Temperature for Storage	-58185 °F (-5085 °C)
Operating altitude	< 6561.68 ft (2000 m) without derating 13123.36 ft (4000 m) with derating

Ordering and shipping details

Category	01245-RG,H,J,K,L,N UNIT MT BREAKERS
Discount Schedule	DE2
GTIN	785901495598
Returnability	Yes
Country of origin	US

Packing Units

Unit Type of Package 1	PCE
Number of Units in Package 1	1
Package 1 Height	16.22 in (41.2 cm)
Package 1 Width	16.54 in (42.0 cm)
Package 1 Length	14.49 in (36.8 cm)
Package 1 Weight	52.00 lb(US) (23.587 kg)

Offer Sustainability

Sustainable offer status	Green Premium product	
California proposition 65	WARNING: This product can expose you to chemicals including: DINP, which is known to the State of California to cause cancer, and DIDP, which is known to the State of California to cause birth defects cother reproductive harm. For more information go to www.P65Warnings.ca.gov	
REACh Regulation	REACh Declaration	
EU RoHS Directive	Compliant EU RoHS Declaration	
Mercury free	Yes	
China RoHS Regulation	China RoHS declaration Product out of China RoHS scope. Substance declaration for your information.	
RoHS exemption information	Yes	
Environmental Disclosure	Product Environmental Profile	
Circularity Profile	End of Life Information	
PVC free	Yes	
Halogen content performance	Halogen free plastic parts product	

Product data sheet

Specifications





Trip unit, PowerPact P, R, with rating plug, Micrologic 5.0, LSI protection

S133A

ľ	VI	а	ı	n

Product name	Micrologic
Product or Component Type	Trip unit
Trip unit technology	Electronic
Circuit breaker type	P-frame R-Frame
Provided equipment	rating plug

Complementary

Trip unit name	Micrologic 5.0
Trip unit protection functions	LSI
Type of Installation	Field installable
Tightening torque	7.08 lbf.in (0.8 N.m)
Height	7.85 in (199.39 mm)
Width	2.11 in (53.59 mm)
Depth	2.88 in (73.15 mm)

Environment

Product certifications	UL Listed
	CSA

Ordering and shipping details

Category	01290-MASTERPACT ACCESSORIES
Discount Schedule	DE2F
GTIN	785901686002
Nbr. of units in pkg.	1
Package weight(Lbs)	16.48 oz (467.2 g)
Returnability	Yes
Country of origin	US

Packing Units

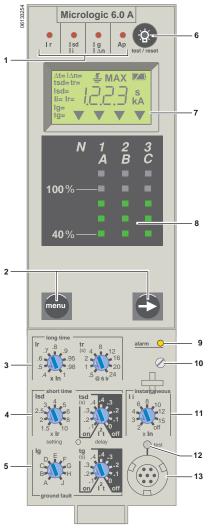
Unit Type of Package 1	PCE
Package 1 Height	3.80 in (9.652 cm)
Package 1 width	5.60 in (14.224 cm)
Package 1 Length	12.80 in (32.512 cm)

Offer Sustainability

California proposition 65	WARNING: Cancer and Reproductive Harm - www.P65Warnings.ca.gov
REACh Regulation	REACh Declaration
EU RoHS Directive	Compliant EU RoHS Declaration
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS declaration Product out of China RoHS scope. Substance declaration for your information.
PVC free	Yes

M-frame, P-frame, R-frame and NS630b–NS3200 Electronic Trip Circuit Breakers Electronic Trip Systems

Micrologic® 2.0A, 3.0A, 5.0A and 6.0A Trip Units with Ammeter



- 1—Indication of tripping cause
- 2—Navigation buttons
- 3-Long-time current setting and tripping delay
- 4—Short-time pickup and tripping delay
- 5—Ground-fault pickup and tripping delay
- 6—Test lamp and reset
- 7—Digital display
- 8—Three-phase bar graph and ammeter
- 9—Overload signal (LED)
- 10-Long-time rating plug screw
- 11—Instantaneous pickup
- 12—Electronic push-to-trip
- 13—Test connector

Micrologic A trip units protect power circuits and provide current measurements, overload protection, and short-circuit protection. In addition, the 6.0A trip units also provide ground-fault protection for equipment.

Protection Settings

Protection thresholds and delays are set using the rotary switches. The selected values are momentarily displayed in amperes and in seconds. A full-range of long-time settings are available via the field-installable rating plug.

- Overload protection (true RMS long-time protection).
- Thermal imaging (active thermal imaging before and after tripping).
- Short-circuit protection.
 - Short-time RMS.
- $I ^2t$ ON or OFF for short-time delay.
- Instantaneous protection.
- Ground-fault protection for equipment.
 - Residual ground-fault protection for equipment.
 - Source ground-return ground-fault protection for equipment.
 - Modified differential ground-fault protection (MDGF) for equipment.
- Neutral protection on four-pole circuit breakers.
- ZSI: Zone-selective interlocking (a ZSI terminal block may be used to interconnect a number of trip units to provide total discrimination for short-time and equipment ground-fault protection, without delay for tripping). Not available for 3.0A trip units or for 2.0A trip units installed as upstream device.

Ammeter Measurements

Micrologic A trip units measure the true RMS value of currents. They provide continuous current measurement from 0.2 to 20 x I_n with an accuracy of 1.5% (including sensors). No auxiliary source is needed where $I > 0.2 \times I_n$. The optional external power supply (24 Vdc) makes it possible to display currents where $I < 0.2 \times I_n$ and to store values of the interrupted current.

A digital LCD screen continuously displays the most heavily loaded phase (I_{max}) or displays the I_a , I_b , I_c , I_g , and (on 4P circuit breakers only) I_n stored current and setting values by successively pressing the navigation button.

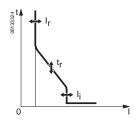
Communication Network

In conjunction with an optional communication network, the trip unit transmits the following parameters:

- Setting values
- All ammeter measurements
- Tripping causes.

M-frame, P-frame, R-frame and NS630b-NS3200 Electronic Trip Circuit Breakers **Electronic Trip Systems**

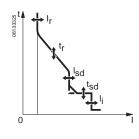
Micrologic 2.0A and 3.0A Trip Unit Settings Table 19:



	Current Setting (A)		2.0A:	0.40	0.50	0.60	0.70	0.80	0.90	0.95	0.98	1.00
	Tripping Between 1.05	$I_r = I_n x$	3.0A:	0.40	0.45	0.50	0.60	0.63	0.70	0.80	0.90	1.00
	and 1.20 x I _r		Other	Range	s are A	Aavailal	ole by (Changii	ng Rati	ng Plug	J	
Long-time Protection		t _r at 1.5 x I _r		12.5	25	50	100	200	300	400	500	600
Totoction	Maximum Time Delay (s) Accuracy: 0–20%	t _r at 6 x I _r		0.5	1	2	4	8	12	16	20	24
	Accuracy. 6 2076	t _r at 7.2 x I _r		0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	16.6
	Thermal Imaging			20 Mi	nutes E	Before (or After	Trippir	ng			
Short-time Protection	Current Setting (A) Accuracy: ±10% No delay	I _{sd} = I _r x	2.0A:	1.5	2	2.5	3	4	5	6	8	10
Instantaneous Protection	Current Setting (A) Accuracy: ±10%	I _i = I _n x	3.0A:	1.5	2	3	4	5	6	8	10	12

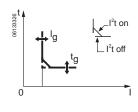
Table 20:

Micrologic 5.0A and 6.0A Trip Unit Settings



			•									
	Current Setting (A)		IEC:	0.40	0.50	0.60	0.70	0.80	0.90	0.95	0.98	1.00
	Tripping Between 1.05	$I_r = I_n \times$	UL:	0.40	0.45	0.50	0.60	0.63	0.70	0.80	0.90	1.00
	and 1.20 \times I_r		Other ranges are a	availab	le by c	hangin	g ratin	g plug				
Long-time Protection		t _r at 1.5 x I _r)	12.5	25	50	100	200	300	400	500	600
rotoction	Maximum Time Delay (s) Accuracy: 0–20%	t _r at 6 x I _r		0.5	1	2	4	8	12	16	20	24
	7 toodraby: 0 2070	t_r at 7.2 x I_r)	0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	16.6
	Thermal Imaging			20 m	nutes	before	or afte	r trippi	ing			
	Current Setting (A) Accuracy: ±10%	$I_{sd} = I_r x$		1.5	2	2.5	3	4	5	6	8	10
Short-time		Settings	I ² t OFF	0	0.1	0.2	0.3	0.4				
Protection	Maximum Time Delay (s)	Settings	I ² t ON		0.1	0.2	0.3	0.4				
	at 10 x I _r	4	Min. trip time (ms)	20	80	140	230	350				
		t _{sd}	Max. trip time (ms)	80	140	200	320	500				
Instantaneous Protection	Current Setting (A) Accuracy: ±10%	$I_i = I_n x$		2	3	4	6	8	10	12	15	off

Table 21: Micrologic 6.0A Trip Unit Ground-Fault Settings



		I _g = I _n x	Α	В	С	D	Е	F	G	Н	J
Ground-fault Pickup (A)		I _n ≤400 A	0.3	0.3	0.4	0.5	0.6	0.7	8.0	0.9	1.0
Accuracy: ±10%		400 A < I _n ≤1200 A	0.2	0.3	0.4	0.5	0.6	0.7	8.0	0.9	1.0
		I _n > 1200 A	500	640	720	800	880	960	1040	1120	1200
	Cottingo	I ² t OFF	0	0.1	0.2	0.3	0.4				
Maximum Time Delay (s) at	Settings	I ² t ON		0.1	0.2	0.3	0.4				
10 x I _r		Minimum Trip Tme (ms)	20	80	140	230	350				
	¹g	Maximum Trip Tme (ms)	80	140	200	320	500				

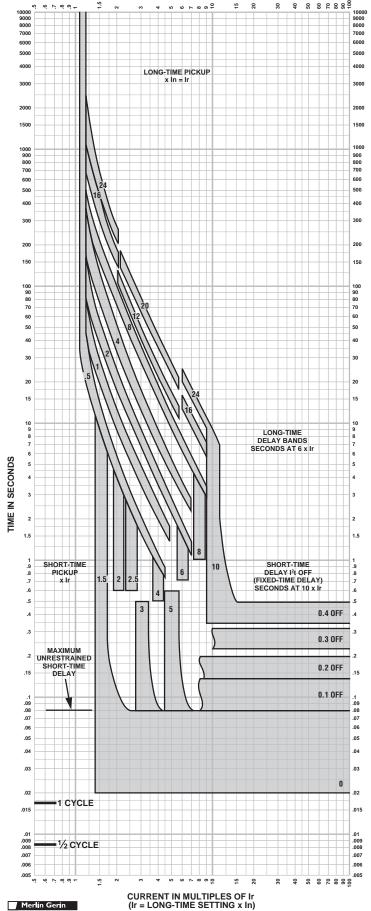
External Power Supplies for Micrologic Trip Units

Current-based protection functions require no auxiliary power source.

Table 22: Micrologic A Use of External 24 Vdc Power Supply

Function	Without 24 Vdc Power S	upply at F1 and F2	With 24 Vdc Power Supply at F1 and F2
Fault Protection for LSIG Functions	Yes		Yes
LED Trip Indication	Yes		Yes
Ammeter and bar graph displays	Yes		Yes
Trip setting and Max. Current Readings Can Be	Yes, If Current Flow on One	Phase is Equal To or Greater Than:	
Accessed on the Display by Using Navigation	Sensor Plug Value (In)	Minimum Ground-fault Pickup	
Buttons	100–250 A	30% of sensor rating	Yes
Ground-Fault Push-to-Trip Button Works for	400–1200 A	20% of sensor rating	
Testing Ground Fault ¹	1600–6300 A	500 A	
Modbus® Communications (Optional)	No		Yes, with separate 24 Vdc power supply for the circuit breaker communication module

Ground fault Push-to-trip button will also be functional if hand-held test kit or full-function test kit is powering the trip unit.



MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT CHARACTERISTIC TRIP CURVE NO. 613-4

Long-time Pickup and Delay Short-time Pickup and I²t OFF Delay

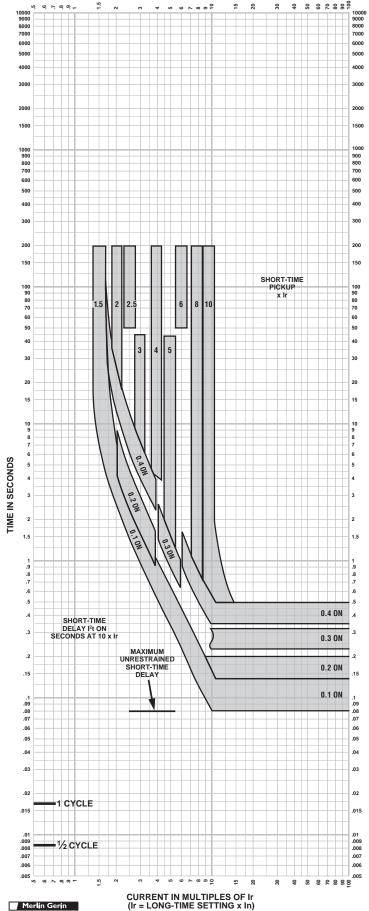
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C ambient temperature.

- 1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
- The end of the curve is determined by the interrupting rating of the circuit breaker.
- With zone-selective interlocking on, short-time delay utilized and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
- Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current
- For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
- 6. Overload indicator illuminates at 100%.







MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT **CHARACTERISTIC TRIP CURVE NO. 613-5**

Short-time Pickup and I2t ON Delay

The time-current curve information is to be used for application and coordination purposes only.

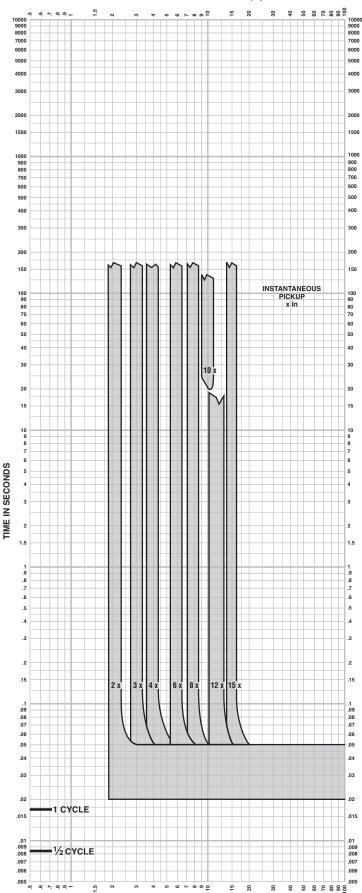
Curves apply from -30°C to +60°C ambient temperature.

- 1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermalimaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
- 2. The end of the curve is determined by the interrupting rating of the circuit breaker.
- 3. With zone-selective interlocking on, short-time delay utilized and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
- 4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the
- 5. For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
- 6. See 613-4 for long-time pickup and delay trip curve.





MULTIPLES OF SENSOR RATING (In)



MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT CHARACTERISTIC TRIP CURVE NO. 613-7

Instantaneous Pickup 2x–15x and OFF

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30° to +60°C ambient temperature.

- 1. The end of the curve is determined by the interrupting rating of the circuit breaker.
- Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
- 3. The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local Sales Office for additional information.
- For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
- See 613-4 and 613-5 for long-time pickup, long-time delay, short-time pickup, and shorttime delay trip curves.









INSTANTANEOUS OVERRIDE VALUES NO. 613-10

MASTERPA	ACT NW/NT	MASTERP	ACT NW/NT
ANSI CB Model No.	Inst. Override (kA RMS) +/- 10%	UL CB Model No.	Inst. Override (kA RMS) +/- 10%
NW08N1 ★	24	NW08N ★	24
NW08N1	None	NW08N	40
NW16N1	None	NW12N	40
NW08H1 ★	24	NW16N	40
NW08H1	None	NW20N	40
NW16H1	None	NW08H ★	24
NW20H1 NW32H1	None	NW08H NW12H	40 40
	None	NW12H NW16H	40
NW08H2 ★ NW08H2	24 None	NW20H	40
NW16H2	None None	NW25H	65
NW20H2	None	NW30H	65
NW32H2	None	NW40H	75
NW40H2	None	NW50H	75
NW50H2	None	NW60H	75
NW08H3 ★	24	NW08L ★	24
NW08H3	85	NW08L	35
NW16H3	85	NW08LF	24
NW20H3	85	NW12L	35
NW32H3	85	NW12LF NW16L	24 35
NW40H3	85	NW16LF	24
NW50H3	85	NW20L	65
NW08L1 ★	24	NW20LF	24
NW08L1 NW08L1F	35 24	NW25L	65
NW16L1	35	NW30L	65
NW16L1F	24	NW40L	75
NW20L1	35	NW50L	75
NW20L1F	24	NW60L	75
NW32L1	117	NW08HF	40
NW40L1	117	NW12HF	40 40
NW50L1	117	NW16HF NW20HF	40
NW08HA	None	NW25HF	65
NW16HA	None	NW30HF	65
NW20HA NW32HA	None None	NW40HF	75
NW40HA	None	NW50HF	75
NW50HA	None	NW60HF	75
NW08HF	85	NW08HB	35
NW16HF	85	NW12HB	35
NW20HF	85	NW16HB	35
NW32HF	85	NW20HB	65
NW40HF	85	NW25HB NW30HB	65 65
NW50HF	85	NW40HB	75
NW08HC	35	NW50HB	75
NW16HC	35	NW60HB	75
NW20HC	35	NT08N ★	24
NW32HC NW40HC	117 117	NT08N	40
NW50HC	117	NT12N	40
NT08N1 ★	24	NT16N	40
NT08N1 X	None	NT08H ★	24
NT08H1 ★	24	NT08H	40
NT08H1	None	NT12H	40
NT08L1F	10	NT16H	40
NT08NA	None	NT08L1	10
		NT12L1	10
		NT16L1	10
		NT08L NT08LF	10 10
		NT12L	10
		NT16L	10
		NT12LF	10
		NT08HF	40
		NT12HF	40
		Mavimum cons	or plug 250 A

★ Maximum sensor plug 250 A

Note:

MASTERPA	ACT NW/NT
IEC CB Model No.	Inst. Override (kA RMS) +/- 10%
NW08N1	None
NW10N1	None
NW12N1	None
NW16N1	None
NW08H1	None
NW10H1	None
NW12H1	None
NW16H1	None
NW20H1	None
NW25H1	None
NW32H1	None
NW40H1	None
NW50H1	None
NW63H1	None
NW08H2 ★	24
NW08H2	85
NW10H2	85
NW16H2	85
NW20H2	85
NW25H2	85
NW32H2	85
NW40H2	85
NW50H2	117
NW63H2	117
NW20H3	65 65
NW25H3 NW32H3 NW40H3	65 65
NW08L1 ★	24
NW08L1	35
NW10L1	35
NW12L1	35
NW16L1	35
NW20L1	35
NW08H10	None
NW10H10	None
NW12H10	None
NW16H10	None
NW20H10	None
NW25H10	None
NW32H10	None
NW40H10	None
NW08NA	None
NW10NA	None
NW16NA	None
NW08HA	None
NW10HA	None
NW12HA NW16HA	None
NW20HA	None None
NW25HA	None
NW32HA	None
NW40HA	None
NW50HA	None
NW63HA	None
NW08HF	85
NW10HF	85
NW12HF	85
NW16HF	85
NW20HF	85
NW25HF	85
NW32HF	85
NW40HF	85
NW08HA10	None
NW10HA10	None
NW12HA10	None
NW16HA10	None
NW20HA10	None
NW25HA10	None
NW32HA10	None
NW40HA10	None
NT08H1	None
NT10H1	None
NT12H1	None
NT16H1 NT08L1	None
NT08H10	10 None
NT10H10	None
NT12H10	None
NT16H10	None
NT08HA	None
NT10HA	None
NT12HA	None
NT16HA	None
NT08HA10	None
NT10HA10	None
NT12HA10	None
NT16HA10	None

POWERPACT / HORIZON / SELECT / COMPACT

SELECT /	COMPACT
UL/IEC CB Model No.	Inst. Override (kA RMS) +/- 10%
RG 600	57
RG 800	57
RG 1000	57
RG 1200	57
RG 1600	57
RG 2000	57
RG 2500	57
RJ 600	48▲
RJ 800	48 ▲
RJ 1000	48 ▲
RJ 1200	48 ▲
RJ 1600	48 ▲
RJ 2000	48 ▲
RJ 2500	48 ▲
RK 600	57
RK 800	57
RK 1000	57
RK 1200	57
RK 1600	57
RK 2000	57
RK 2500	57
RL 600	48▲
RL 800	48▲
RL 1000	48 ▲
RL 1200	48 ▲
RL 1600	48 ▲
RL 2000	48 ▲
RL 2500	48▲
PG 250	24
PG 400	24
PG 600	24
PG 800	24
PG 1000	24
PG 1200	24
PJ 250	7
PJ 400	10
PJ 600	10
PJ 800	10
PJ 1000	10
PJ 1200	10
PK 250	24
PK 400	24
PK 600	24
PK 800	24
PK 1000	24
PK 1200	24
PL 250	7
PL 400	10
PL 600	10
PL 800	10
PL 1000	10
PL 1200	10
MG 300	12▲
MG 350	12▲
MG 400	12▲
MG 450	12▲
MG 500	12▲
MG 600	12▲
MG 700	12▲
MG 800	12▲ 12▲
MJ 300 MJ 350	12▲
MJ 400	12▲
MJ 450	12▲
MJ 500	12▲
MJ 600	12▲
MJ 700	12▲
MJ 800	12▲
IVIJ OUU	12=

IEC CB Model No.	Inst. Override (kA RMS) +/- 10%
NS 800b N NS 1000b N	57 57
NS 1250b N	57
NS 1600b N	57
NS 2000 N	57
NS 2500 N NS 3200 N	57 57
NS 800b H	48▲
NS 1000b H	48▲
NS 1250b H	48▲
NS 1600b H NS 2000 H	48▲ 48▲
NS 2500 H	48▲
NS 3200 H	48▲
NS 630b N	24
NS 800 N NS 1000 N	24 24
NS 1250 N	24
NS 1600 N	24
NS 630b H	24
NS 800 H NS 1000 H	24 24
NS 1250 H	24
NS 1600 H	24
NS 630b L	24
NS 800 L	24
NS 1000 L NS 1250 L	24 24
NS 1600 L	24
4 Toloropoo . / 45	0/

▲ Tolerance +/- 15%



Faults at or above instantaneous override value will be cleared at 25 msec or less.





Product data sheet

Specifications







Circuit breaker, PowerPacT P, 1200A, 3 pole, 600VAC, 25kA, busbar, Micrologic 5.0

PJF36120U33A

Main

Range	PowerPact
Product Name	PowerPact P
Product Or Component Type	Circuit breaker
Device Application	Distribution

Complementary

Complementary	
Line Rated Current	1200 A
Number Of Poles	3P
Control Type	Toggle
Breaking Capacity Code	J
Breaking Capacity	AIR 100 kA 240 V AC 50/60 Hz UL 489 AIR 65 kA 480 V AC 50/60 Hz UL 489 AIR 25 kA 600 V AC 50/60 Hz UL 489 Icu 65 kA 240 V AC 50/60 Hz IEC 60947-2 Icu 50 kA 380/415 V AC 50/60 Hz IEC 60947-2
[Ue] Rated Operational Voltage	600 V AC 50/60 Hz UL 489
Network Frequency	50/60 Hz
[Ics] Rated Service Breaking Capacity	35 kA 240 V AC 50/60 Hz IEC 60947-2 25 kA 380/415 V AC 50/60 Hz IEC 60947-2
[Uimp] Rated Impulse Withstand Voltage	8 kV IEC 60947-2
Trip Unit Technology	Electronic, standard, MicroLogic 5.0, LSI
[Ui] Rated Insulation Voltage	750 V IEC 60947-2
Trip Unit Name	MicroLogic 5.0
Awg Gauge	Please see CB outline drawing for lug and termination details
Local Signalling	Overload 1 trip indicator green) 1 trip indicator green)
Mounting Mode	Unit mount busbar)
Mounting Support	Busbar
Electrical Connection	Busbar connection, line Busbar connection, load
Terminal Identifier	Please see CB outline drawing for lug and termination details
Long Time Pick-Up Adjustment Range	0.41 x lr

Tightening Torque	442.54 lbf.in (50 N.m) 0.150.37 in² (95240 mm²) (4 x AWG 3/0500 kcmil) 8.8511.51 lbf.in (1.01.3 N.m)
Number Of Slots	auxiliary switch OF plug-in) alarm switch SD plug-in) overcurrent trip switch SDE plug-in) voltage release MN or MX plug-in)
Power Wire Stripping Length	1.18 in (30 mm)
Height	16.16 in (410.46 mm)
Width	8.27 in (210.06 mm)
Depth	8.05 in (204.47 mm)
Net Weight	32 lb(US) (14.51 kg)
Quantity Per Set	1
Circuit Breaker Application	HACR rated

Environment

Quality Labels	CE	
Standards	UL CSA NEMA NOM-003-SCFI-2000 IEC 60947-2	
Product Certifications	UL CSA NOM	
Ip Degree Of Protection	Front cover IP40	
Pollution Degree	3 IEC 60947-1	
Ambient Air Temperature For Operation	28158 °F (-270 °C)	
Ambient Air Temperature For Storage	-58185 °F (-5085 °C)	
Operating Altitude	< 6561.68 ft (2000 m) without derating 13123.36 ft (4000 m) with derating	

Packing Units

Unit Type Of Package 1	PCE
Number Of Units In Backage 1	4



Green PremiumTM **label** is Schneider Electric's commitment to delivering products with best-inclass environmental performance. Green Premium promises compliance with the latest regulations, transparency on environmental impacts, as well as circular and low-CO₂ products.

Guide to assessing product sustainability is a white paper that clarifies global eco-label standards and how to interpret environmental declarations.

Learn more about Green Premium >

Guide to assess a product's sustainability >





Transparency RoHS/REACh

Certifications & Standards

Eu Rohs Directive	Pro-active compliance (Product out of EU RoHS legal scope)			
	EU RoHS Declaration			
Environmental Disclosure	Product Environmental Profile			
Circularity Profile	End of Life Information			
California Proposition 65	WARNING: This product can expose you to chemicals including: DINP, which is known to the State of California to cause cancer, and DIDP, which is known to the State of California to cause Birth Defects or other reproductive harm.For more information go to www.p65warnings.ca.gov			

Product data sheet

Specifications





Trip unit, PowerPact P, R, with rating plug, Micrologic 5.0, LSI protection

S133A

N	И	а	ır

Product name	Micrologic
Product or Component Type	Trip unit
Trip unit technology	Electronic
Circuit breaker type	P-frame R-Frame
Provided equipment	rating plug

Complementary

Trip unit name	Micrologic 5.0
Trip unit protection functions	LSI
Type of Installation	Field installable
Tightening torque	7.08 lbf.in (0.8 N.m)
Height	7.85 in (199.39 mm)
Width	2.11 in (53.59 mm)
Depth	2.88 in (73.15 mm)

Environment

Product certifications	UL Listed
	CSA

Ordering and shipping details

Category	01290-MASTERPACT ACCESSORIES
Discount Schedule	DE2F
GTIN	785901686002
Nbr. of units in pkg.	1
Package weight(Lbs)	16.48 oz (467.2 g)
Returnability	Yes
Country of origin	US

Packing Units

Unit Type of Package 1	PCE
Package 1 Height	3.80 in (9.652 cm)
Package 1 width	5.60 in (14.224 cm)
Package 1 Length	12.80 in (32.512 cm)

Offer Sustainability

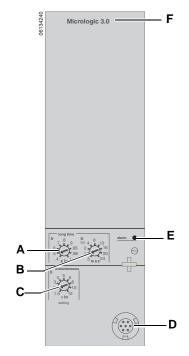
California proposition 65	WARNING: Cancer and Reproductive Harm - www.P65Warnings.ca.gov
REACh Regulation	REACh Declaration
EU RoHS Directive	Compliant EU RoHS Declaration
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS declaration Product out of China RoHS scope. Substance declaration for your information.
PVC free	Yes

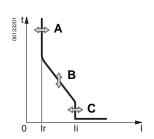
Micrologic 3.0 Trip Unit

The Micrologic 3.0 trip unit provides basic (LI) protection.

- A. Long-time pickup (Ir) switch
- B. Long-time delay (tr) switch
- C. Instantaneous pickup (li) switch
- D. Test plug receptacle
- E. Overload indicator light
- F. Trip unit name

Figure 3: Micrologic 3.0 Trip Unit



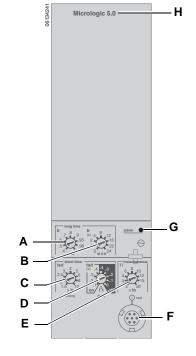


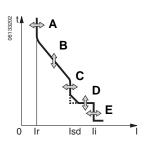
Micrologic 5.0 Trip Unit

The Micrologic 5.0 trip unit provides selective (LSI) protection.

- A. Long-time pickup (Ir) switch
- B. Long-time delay (tr) switch
- C. Short-time pickup (Isd) switch
- D. Short-time delay (tsd) switch
- E. Instantaneous pickup (Ii) switch
- F. Test plug receptacle
- G. Overload indicator light
- H. Trip unit name

Figure 4: Micrologic 5.0 Trip Unit





Trip Unit Switches

Long-Time Protection

Long-time protection protects equipment against overloads.

- Long-time protection is standard on all trip units.
- The long-time pickup (Ir) (A) sets maximum current level (based on sensor plug rating In) which circuit breaker will carry continuously. If current exceeds this value, circuit breaker will trip after the preset time delay. The longtime pickup (Ir) is adjustable from 0.4–1.0 times the sensor plug rating (In).
- The long-time delay (tr) (B) sets the length of time that the circuit breaker will carry an overcurrent below the short-time or instantaneous pickup current level before tripping. See Table 1 for long-time delay settings.
- The overload indicator light (C) indicates that the Ir long-time pickup threshold has been exceeded.
- Both long-time pickup and long-time delay are on the field-replaceable adjustable rating plug. To change settings to more precisely match the application, various rating plugs are available. For instructions on replacing the rating plug, see Section 4—Adjustable Rating Plug Replacement.
- The In value can be changed by replacing the sensor plug below the trip unit. For further information, see the instructions packed with the sensor plug replacement kit.
- Long-time protection uses true RMS measurement.

Thermal imaging provides continuous temperature rise status of the wiring, both before and after the device trips. This allows the circuit breaker to respond to a series of overload conditions which could cause conductor overheating, but would go undetected if the long-time circuit was cleared every time the load dropped below the pickup setting or after every tripping event.

NOTE: If checking trip times, wait a minimum of 15 minutes after circuit breaker trips before resetting to allow the thermal imaging to reset completely to zero.

Figure 5: Long-Time Protection Switches

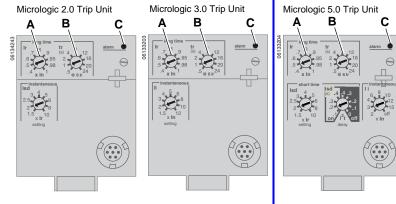


Table 1: Micrologic Trip Unit Long-Time Delay Values

Setting ¹	Long-Time Delay in Seconds ²								
tr at 1.5 x lr	12.5 25 50 100 200 300 400 500 600							600	
tr at 6 x Ir	0.5	1	2	4	8	12	16	20	24
tr at 7.2 x lr	0.343	0.69	1.38	2.7	5.5	8.3	11	13.8	16.6

¹In = sensor rating. Ir = In x long-time pickup. Trip threshold between 1.05 and 1.20 Ir. ²Time-delay accuracy +0/-20%

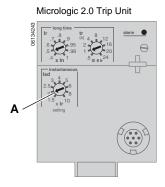
³For Micrologic 5.0 trip units, when tsd is set to 0.4 off or 0.4 on, then tr = 0.5 instead of 0.34.

Short-Time Protection

Short-time protection protects equipment against short circuits.

- Short-time protection is standard on 2.0 and 5.0 trip units. It is not available on 3.0 trip units.
- Short-time protection is based on the longtime pickup (Ir)
- The short-time pickup (Isd) (A) sets the current level (below instantaneous trip level) where the circuit breaker will trip after the preset time delay.
- The short-time delay (tsd) (B) sets the length of time that the circuit breaker will carry an overcurrent above the short-time pickup current level before tripping. It is adjustable on the 5.0 trip unit and factory set to zero on the 2.0 trip unit.
- The I²t on/I²t off option provides improved selectivity with downstream protective devices:
- With I²t off selected, fixed time delay is provided.
 - With I²t on selected, inverse time I²t protection is provided up to 10 x Ir.
 Above 10 x Ir, a fixed time delay is provided.
 - Intermittent currents in the short-time tripping range which do not last sufficiently long to trigger a trip are accumulated and shorten the trip delay appropriately.
- Setting tsd to the 0 setting turns off timedelay features.
- Short-time protection uses true RMS measurement.
- Short-time delay can be adjusted to provide selectivity with a downstream circuit breaker.

Figure 6: Short-Time Protection Switches



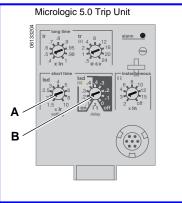


Table 2: Micrologic Trip Unit Short-Time Delay Values

Setting	Short-Time Delay				
I ² t off (Isd at 10 Ir) (seconds)	0	0.1	0.2	0.3	0.4
I ² t on (Isd at 10 Ir) (seconds)	-	0.1	0.2	0.3	0.4
tsd (min. trip) (milliseconds)	20	80	140	230	350
tsd (max. trip) (milliseconds)	80	140	200	320	500

Instantaneous Protection

Instantaneous protection protects equipment against short circuits with no intentional time delay.

- Instantaneous protection (li) (A) is standard on 3.0 and 5.0 trip units.*
- Instantaneous protection for 2.0 trip units is based on the circuit breaker sensor rating (Ir).
- Instantaneous protection for 3.0 and 5.0 trip units is based on the long-time delay pickup (In).
- Circuit breaker open command is issued as soon as threshold current is exceeded.
- Instantaneous protection for 3.0 and 5.0 trip units use peak current measurement.
 Instantaneous protection for 2.0 trip units use RMS current measurement.
- When instantaneous protection switch is set to off, the instantaneous protection is disabled.

*Instantaneous protection on 2.0 trip units is achieved by using short-time protection (Isd) with short-time delay factory set to 0 (zero).

Figure 7: Instantaneous Protection Switches

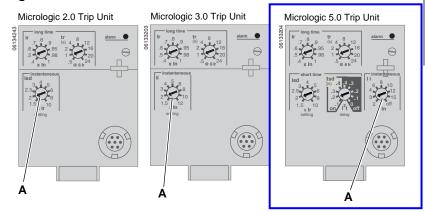


Table 3: Micrologic Instantaneous Values

Setting	Interruption Current								
2.0 lsd (= lr x)	1.5	2	2.5	3	4	5	6	8	10
3.0 li (= ln x)	1.5	2	3	4	5	6	8	10	12
5.0 li (= ln x)	2	3	4	6	8	10	12	15	off

Ii = UL and ANSI instantaneous

Isd = IEC instantaneous (short-time with zero delay)

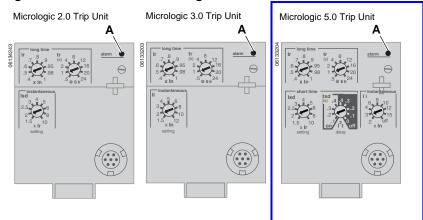
In = sensor rating

Ir = long-time pickup

Overload Indicator Light

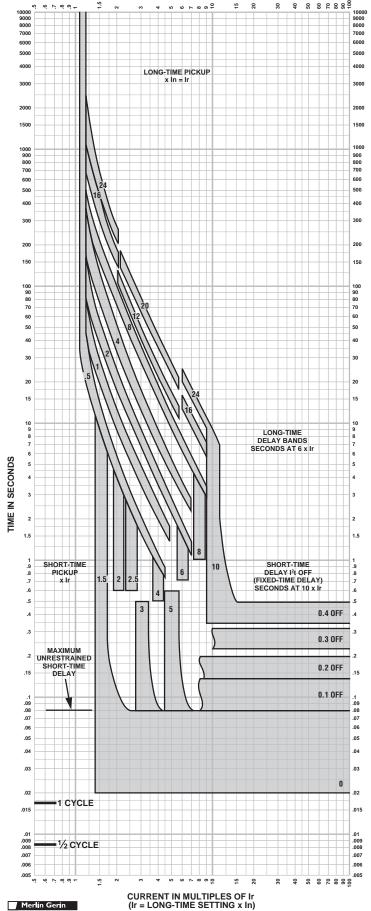
The overload indicator light (A) lights when the Ir long-time pickup level has been exceeded.

Figure 8: Overload Indicator Lights



Trip Unit Testing

Trip unit functions can be tested using primary injection testing or secondary injection testing.



MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT CHARACTERISTIC TRIP CURVE NO. 613-4

Long-time Pickup and Delay Short-time Pickup and I²t OFF Delay

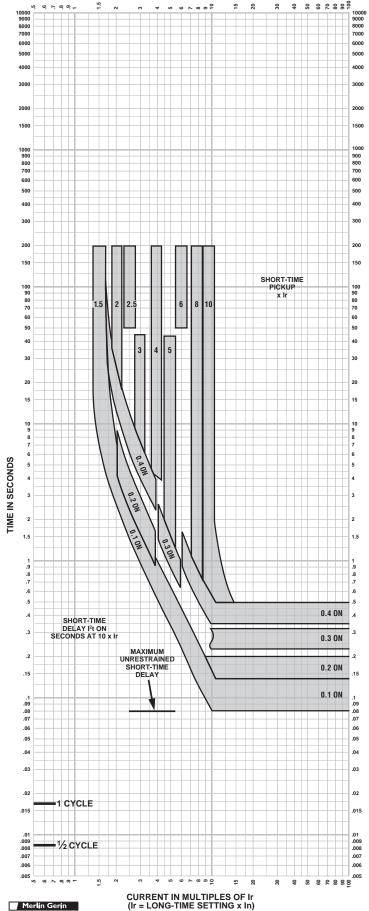
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C ambient temperature.

- 1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
- The end of the curve is determined by the interrupting rating of the circuit breaker.
- With zone-selective interlocking on, short-time delay utilized and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
- Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current
- For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
- 6. Overload indicator illuminates at 100%.







MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT **CHARACTERISTIC TRIP CURVE NO. 613-5**

Short-time Pickup and I2t ON Delay

The time-current curve information is to be used for application and coordination purposes only.

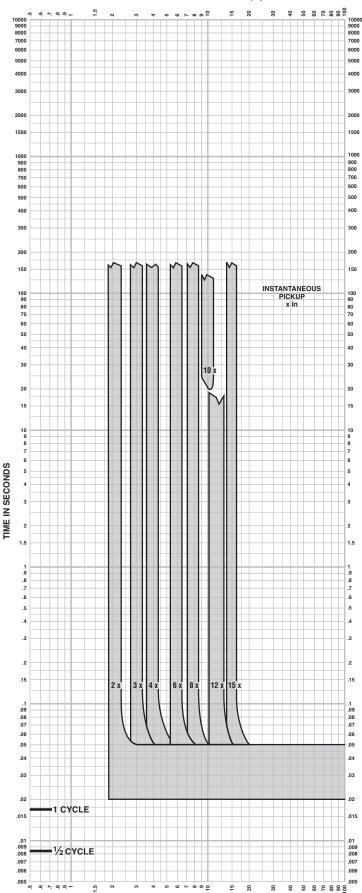
Curves apply from -30°C to +60°C ambient temperature.

- 1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermalimaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
- 2. The end of the curve is determined by the interrupting rating of the circuit breaker.
- 3. With zone-selective interlocking on, short-time delay utilized and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
- 4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the
- 5. For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
- 6. See 613-4 for long-time pickup and delay trip curve.





MULTIPLES OF SENSOR RATING (In)



MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT CHARACTERISTIC TRIP CURVE NO. 613-7

Instantaneous Pickup 2x–15x and OFF

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30° to +60°C ambient temperature.

- 1. The end of the curve is determined by the interrupting rating of the circuit breaker.
- Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
- 3. The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local Sales Office for additional information.
- For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
- See 613-4 and 613-5 for long-time pickup, long-time delay, short-time pickup, and shorttime delay trip curves.









INSTANTANEOUS OVERRIDE VALUES NO. 613-10

MASTERPA	ACT NW/NT	MASTERP	ACT NW/NT
ANSI CB Model No.	Inst. Override (kA RMS) +/- 10%	UL CB Model No.	Inst. Override (kA RMS) +/- 10%
NW08N1 ★	24	NW08N ★	24
NW08N1	None	NW08N	40
NW16N1	None	NW12N	40
NW08H1 ★	24	NW16N NW20N	40 40
NW08H1 NW16H1	None None	NW08H ★	24
NW20H1	None	NW08H	40
NW32H1	None	NW12H	40
NW08H2 ★	24	NW16H	40
NW08H2	None	NW20H	40
NW16H2	None	NW25H NW30H	65 65
NW20H2 NW32H2	None	NW40H	75
NW40H2	None None	NW50H	75
NW50H2	None	NW60H	75
NW08H3 ★	24	NW08L ★	24
NW08H3	85	NW08L	35
NW16H3	85	NW08LF	24
NW20H3	85	NW12L NW12LF	35 24
NW32H3 NW40H3	85 85	NW16L	35
NW50H3	85	NW16LF	24
NW08L1 ★	24	NW20L	65
NW08L1	35	NW20LF	24
NW08L1F	24	NW25L	65
NW16L1	35	NW30L NW40L	65 75
NW16L1F NW20L1	24	NW50L	75
NW20L1F	35 24	NW60L	75
NW32L1	117	NW08HF	40
NW40L1	117	NW12HF	40
NW50L1	117	NW16HF NW20HF	40 40
NW08HA	None	NW25HF	65
NW16HA	None	NW30HF	65
NW20HA NW32HA	None None	NW40HF	75
NW40HA	None	NW50HF	75
NW50HA	None	NW60HF	75
NW08HF	85	NW08HB	35
NW16HF	85	NW12HB NW16HB	35 35
NW20HF	85	NW20HB	65
NW32HF NW40HF	85 85	NW25HB	65
NW50HF	85	NW30HB	65
NW08HC	35	NW40HB	75
NW16HC	35	NW50HB NW60HB	75 75
NW20HC	35	NT08N ★	24
NW32HC	117	NT08N	40
NW40HC NW50HC	117 117	NT12N	40
NT08N1★	24	NT16N	40
NT08N1	None	NT08H ★	24
NT08H1 ★	24	NT08H NT12H	40 40
NT08H1	None	NT16H	40
NT08L1F	10	NT08L1	10
NT08NA	None	NT12L1	10
		NT16L1	10
		NT08L	10
		NT08LF	10
		NT12L NT16L	10 10
		NT16L NT12LF	10
		NT08HF	40
		NT12HF	40

NT12HF ★ Maximum sensor plug 250 A

Note:

Faults at or above instantaneous override value will be cleared at 25 msec or less.

MASTERPACT NW/NT				
IEC CB Model No.	Inst. Override (kA RMS) +/- 10%			
NW08N1	None			
NW10N1	None			
NW12N1	None			
NW16N1	None			
NW08H1	None			
NW10H1	None			
NW12H1	None			
NW16H1	None			
NW20H1	None			
NW25H1	None			
NW32H1	None			
NW40H1	None			
NW50H1	None			
NW63H1	None			
NW08H2 ★	24			
NW08H2	85			
NW10H2	85			
NW16H2	85			
NW20H2	85			
NW25H2	85			
NW32H2	85			
NW40H2	85			
NW50H2	117			
NW63H2	117			
NW20H3	65			
NW25H3	65			
NW32H3	65			
NW40H3	65			
NW08L1 ★	24			
NW08L1	35			
NW10L1	35			
NW12L1	35			
NW16L1	35			
NW20L1	35			
NW08H10	None			
NW10H10	None			
NW12H10	None			
NW16H10	None			
NW20H10	None			
NW25H10	None			
NW32H10	None			
NW40H10	None			
NW08NA	None			
NW10NA	None			
NW16NA	None			
NW08HA	None			
NW10HA	None			
NW12HA	None			
NW16HA	None			
NW20HA	None			
NW25HA	None			
NW32HA	None			
NW40HA	None			
NW50HA	None			
NW63HA	None			
NW08HF	85			
NW10HF	85			
NW12HF	85			
NW16HF	85			
NW20HF	85			
NW25HF	85			
NW32HF	85			
NW40HF	85			
NW08HA10	85 None			
NW10HA10	None			
NW12HA10	None			
NW16HA10	None			
NW20HA10	None			
NW25HA10	None			
NW32HA10	None			
NW40HA10	None			
NT08H1	None			
NT10H1	None			
NT12H1	None			
NT16H1	None			
NT08L1	10			
NT08H10	None			
NT10H10	None			
NT12H10	None			
NT16H10	None			
NT08HA	None			
NT10HA	None			
NT12HA	None			
NT16HA	None			
NT08HA10	None			

POWERPACT / HORIZON / SELECT / COMPACT

SELECT /	COMPACT
UL/IEC CB Model No.	Inst. Override (kA RMS) +/- 10%
RG 600 RG 800 RG 1000 RG 1200 RG 1600 RG 2000 RG 2500	57 57 57 57 57 57 57
RJ 600 RJ 800 RJ 1000 RJ 1200 RJ 1600 RJ 2000 RJ 2500	48 ▲ 48 ▲ 48 ▲ 48 ▲ 48 ▲ 48 ▲
RK 600 RK 800 RK 1000 RK 1200 RK 1600 RK 2000 RK 2500	57 57 57 57 57 57 57
RL 600 RL 800 RL 1000 RL 1200 RL 1600 RL 2000 RL 2500	48 ▲ 48 ▲ 48 ▲ 48 ▲ 48 ▲ 48 ▲
PG 250 PG 400 PG 600 PG 800 PG 1000 PG 1200	24 24 24 24 24 24
PJ 250 PJ 400 PJ 600 PJ 800 PJ 1000 PJ 1200	7 10 10 10 10 10
PK 250 PK 400 PK 600 PK 800 PK 1000 PK 1200	24 24 24 24 24 24 24
PL 250 PL 400 PL 600 PL 800 PL 1000 PL 1200	7 10 10 10 10 10
MG 300 MG 350 MG 400 MG 450 MG 500 MG 600 MG 700 MG 800	12
MJ 300 MJ 350 MJ 400 MJ 450 MJ 500 MJ 600 MJ 700 MJ 800	12 \(\) 12 \(\) 12 \(\) 12 \(\) 12 \(\) 12 \(\) 12 \(\) 12 \(\)

IEC CB Model No.	Inst. Override (kA RMS) +/- 10%
NS 800b N NS 1000b N	57 57
NS 1250b N	57
NS 1600b N	57
NS 2000 N	57
NS 2500 N NS 3200 N	57 57
	<u> </u>
NS 800b H NS 1000b H	48▲ 48▲
NS 1250b H	48▲
NS 1600b H	48▲
NS 2000 H	48▲
NS 2500 H	48▲
NS 3200 H	48▲
NS 630b N	24
NS 800 N	24
NS 1000 N NS 1250 N	24 24
NS 1250 N NS 1600 N	2 4 24
NS 630b H	24
NS 800 H	24
NS 1000 H	24
NS 1250 H	24
NS 1600 H	24
NS 630b L	24
NS 800 L	24
NS 1000 L NS 1250 L	24 24
NS 1250 L NS 1600 L	24 24
A Toloropoo I/ 1E	

▲ Tolerance +/- 15%







NT16HA NT08HA10 NT10HA10 NT12HA10 NT16HA10

None None None None



Battery Charger

A048G602 10 A 50/60 Hz **A051H785** 20 A 50/60 Hz



Description

Cummins® fully automatic battery chargers are constant voltage/constant current chargers incorporating a 4-stage charging algorithm. Designed for use in applications where battery life and reliability are important; these chargers, complete with built-in equalize charge capability, are ideal for stationary or portable starting battery charging service.

To achieve optimum battery life, a 4-stage charging cycle is implemented. The four charging stages are constant current, high-rate taper charge, finishing charge, and maintaining charge. During the constant current cycle, the charger operates at maximum possible output in the fast charge mode. During the high-rate taper charge cycle the charger stays at fast charge voltage level until battery current acceptance falls to a portion of the chargers rated output. During the finishing charge cycle the charger operates at the float voltage and completes the battery charge. During the maintaining charge cycle the charger supplies only a few milliamps required by the battery to stay at peak capability.

An optional temperature sensor (A043D534) may be used to adjust charging voltage based on temperature of the battery. Use of a battery temperature sensor helps to increase battery life by preventing over or under charging. The battery temperature sensor also protects the battery from overheating. Temperature compensation sensor is required for all applications when battery charger and battery are located in different temperature or battery heater is being used.

Battery chargers are field-configurable for charging either 12 or 24 VDC battery systems at 50/60 Hz operation. Simple jumper selectors enable selection of output voltage and battery type.

Features

Protection – Surge protected to IEEE and EN standards. All models include single pole cartridge type fuses mounted on the printed circuit board to protect against input or output overcurrent.

Easy Installation – Clearly marked terminal blocks and panel knockouts provide convenient connections of input and output leads.

User Display – Output voltage and current, fault information and status are indicated on the front panel. Includes precision ammeter and voltmeter.

Monitoring – Status LED indicators are provided to show the condition of the charger. LED's on the right side of the monitor indicate operational functions for Temperature Compensation active (Green), AC on (Green), Float (Green) or Boost (Amber) mode, as well as Battery Fault (Red). LED's on the left side of the monitor illuminate (in Red) when Charger fail, High or Low VDC or AC fail occur.

Adjustable Float Voltage – Float voltage can be set, using easy to understand jumpers, for optimum battery performance and life.

Construction – NEMA-1 (IP20) corrosion resistant aluminium enclosure designed for wall mounting.

Faults – The charger senses and annunciates the following fault conditions: AC power loss, battery overvoltage, battery under voltage, battery fault conditions and charger failure. Includes an individual 30 volt/2-amp isolated contact for each alarm.

Vibration Resistant Design – complies with UL991 class B vibration resistance requirements.

Listed – C-UL listed to UL 1236 CSA standard 22.2 No 107.2-M89. Suited for flooded and AGM lead acid and NiCd batteries in generator set installations.

Warranty - 5 year CPG warranty.







Field Selectable Jumper

Specifications

Performance and Physical Characteristics

Output:	Nominal voltage	12VDC* or 24VDC
	Float voltage – 12VDC batteries	12.87, 13.08, 13.31, 13.50*, 13.62, 14.30
	Float voltage – 24VDC batteries	25.74, 26.16, 26.62, 27.00*, 27.24, 28.60
	Equalize-voltage	6.5% above float voltage sensing
	Output voltage regulation	±0.5% (1/2%) line and load regulation
	Maximum output current	10 or 20 amps nominal
	Equalize charging	Battery interactive auto-boost
Input:	Voltage AC	120, 208, 240 ±10%
	Frequency	60/50 Hz +5%
Approximate net weight:		10A: 25 lbs. (11.36 Kg) 20A: 50 lbs. (22.68 Kg)
Approximate dimensions: height x width x depth-in		10A: 12.50" x 7.66" x 6.50"(318 x 195 x 165 mm) 20A: 13.06" x 13.95" x 6.83"(332 x 354 x1 73 mm)
Ambient temperature operation: At full rated output -		- 4 °F to 104 °F (-20 °C to 40 °C)

Note:

- Battery charger comes with default settings of 12VDC and 13.50/27.00VDC float voltage and can be changed to the battery manufacture recommendations. Replacement printed circuit board and f uses are identified in the Owner's Manual (10A: A050S537 and 20A: A051X126) which resides in Quick Serve On-Line. Service parts can be purchased through the Memphis Distribution Center. The PC board replacement instruction sheet (10A: A052N073, 20A: A053W929) and service manual (A050D829) is also available.
- 2. Installation and application must comply with "section 4.5.3 batteries and battery charger" of application guide T-030 (Liquid Cooled Generator Set Application Manual A040S369).

Caution:

- Higher input voltages (i.e. 480VAC or 600VAC) can be applied if a transformer with a 120VAC-240VAC output is installed. Higher input voltages (i.e. 480VAC or 600VAC) can be applied if a transformer with a 120VAC-240VAC output is installed. For voltages higher than 240 VAC, stepdown transformer must be used. Review the respective Owner/Installation manual A050S537 for 10Amp and A051X126 20A chargers for supplier recommended stepdown transformer requirements.
- 10Amp battery charger is recommended for genset applications with 1 or 2 factory provided batteries. 20Amp
 battery charger is recommended for Cummins Genset applications with 3 or 4 factory provided batteries. Please
 consider the auxiliary DC loads connected to the genset batteries and size this charger as per the T-030
 application guide to prevent misapplication issues.
- 3. Back feed to a utility system can cause electrocution and/or property damage. Do not connect generator sets to any building electrical system except through an approved device or after building main switch is open.
- 4. For professional use only. Must be installed by a qualified service technician. Improper installation presents hazards of electrical shock and improper operation, resulting in severe personal injury and/or property damage.
- 5. Use this charger for charging LEAD-ACID or LIQUID ELECTROLYTE NICKEL-CADMIUM batteries only. Do not use this battery charger for charging dry cells, alkaline, lithium, nickel-metal hydride, or sealed nickel-cadmium batteries that are commonly used with home appliances. These batteries may burst and cause injuries to persons and damage to property.
- 6. Do not parallel these battery chargers with any other charging system.

For more information contact your local Cummins distributor or visit power.cummins.com



Our energy working for you.™



PowerCommand® annunciator discrete input or PCCNet



Description

The Universal Annunciator Module provides visual and audible indication of up to 20 separate alarm or status conditions, based on discrete (relay) inputs or network inputs. Each LED can be controlled by either a discrete wire input or by a signal on the PCCNet network sent from an external device, such as a PCC1301 or PCC2100 (version 2.4 or later) control.

In addition to the LEDs, the annunciator can control four custom relays based on signals received over the PCCNet. When one of the annunciator's discrete inputs is activated, the annunciator will broadcast that information over the network. By taking advantage of the network, discrete inputs and custom relays, the annunciator can be used as expanded I/O for a genset controller.

Easily installed in a location to give immediate notification of an alarm or warning status. Designed to give operating/monitoring personnel quick-glance status information. The module directly senses battery voltage to provide green/yellow/red alarm and status information for that parameter.

Genset controller complies with NFPA level two requirements when used with the display but without the annunciator panel. When used with the annunciator it meets NFPA level one requirements (Emergency and Standby power systems). The annunciator module can also be used for monitoring of transfer switch or other equipment status.

Features

- Visual and audible warnings of up to 20 separate alarm or status conditions.
- LEDs can be controlled either via PCCNet or discrete input.
- Status of discrete inputs is broadcast on network.
- Four custom relays can be controlled over the PCCNet network.
- Configurable LED color (red, yellow or green) and selectable horn operation allows maximum flexibility.
- Standard NFPA 110 label, field configurable for other alarm status and conditions.
- Each audible alarm is annunciated, regardless of the number of existing alarm conditions displayed.
- Sealed membrane panel design provides environmental protection for internal components and is easy to clean.
- Configurable for negative (ground) input or positive input.
- Integral DC voltage sensing.
- Flush or surface mount provisions.
- UL Listed and labeled; CSA certified; CE and UKCA marked.

Specifications

Signal requirements

Positive - Input impedance is 1.82 kOhms to ground; maximum input voltage = 31 VDC.

Negative - Input impedance is 1.82 kOhms to Bat+: inputs are at Bat+ level when open.

Sink/source current threshold for detection - 150 Ua minimum, 3 mA maximum.

Typical conductor size: 16 ga for 304.8 m (1000 ft)

Max conductor size for terminal: 12 ga

Relay outputs

0.2 A at 125 VAC and 1 A at 30 VDC

Network connections

Use Belden 9729 two pair, stranded, shielded 24 AWG twisted pair cable for all PCCNet connections. Total network length cannot exceed 1219 m (4000 ft). Up to 20 nodes can be connected to the network.

Note: Any communications wire connected to the generator set should be stranded cable.

Power

Maximum consumption: 15 watts

Battery voltage

Functional range - Audible and visual conditions operational from 6.5 to 31 VDC.

Low voltage setting - 12.0 VDC for 12 Volt nominal systems; 24.0 for 24 Volt nominal systems.

High voltage setting - 16.0 Volt for 12 Volt nominal systems; 32.0 Volt for 24 Volt nominal systems.

Alarm horn

Sound level: 90 dB at 30 cm

Physical

Weight (with enclosure): 1.4 kg (3.0 lbs)

Temperature

-20 °C to +70 °C (-4 °F to +158 °F)

Humidity

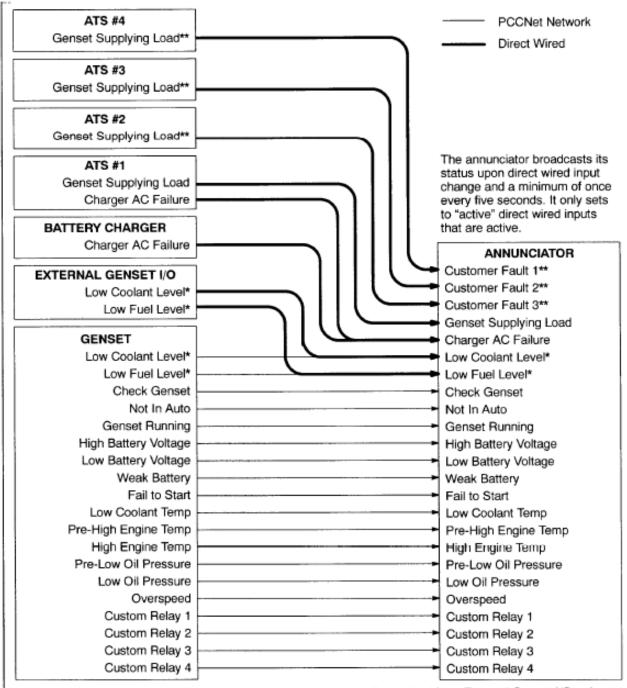
10% to 95% RH (non-condensing)

Default lamp configurations

Can be configured for current NFPA 110 standard or as a replacement for Legacy (pre-2001) NFPA 110 annunciator (300-4510 or 300 4511)

		NFPA 110		
Lamp	Description	Color	Horn	Flash
DS1	Customer fault 1	Green	No	No
DS2	Customer fault 2	Amber	No	No
DS3	Customer fault 3	Red	No	No
DS4	Genset supplying load	Amber	No	No
DS5	Charger AC failure	Amber	Yes	No
DS6	Low coolant level	Amber	Yes	No
DS7	Low fuel level	Red	Yes	No
DS8	Check generator set	Amber	No	No
DS9	Not in auto	Red	Yes	Yes
DS10	Generator set running	Amber	No	No
DS11	High battery voltage	Amber	Yes	No
DS12	Low battery voltage	Red	Yes	No
DS13	Weak battery	Red	Yes	No
DS14	Fail to start	Red	Yes	No
DS15	Low coolant temp	Red	Yes	No
DS16	Pre-high engine temp	Amber	Yes	No
DS17	High engine temp	Red	Yes	No
DS18	Pre-low oil pressure	Red	Yes	No
DS19	Low oil pressure	Red	Yes	No
DS20	Overspeed	Red	Yes	No

Typical installation

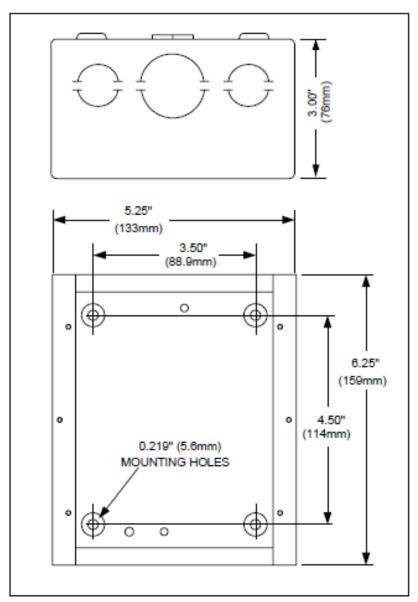


- Low Coolant Level and Low Fuel Level statuses can be either direct wired from External Genset I/O or be part of the PCCNet network status coming from the genset. If direct wired, then the annunciator sets the appropriate bit for the genset to reference.
- ** These can be Genset Supplying Load 2 thru 4 or Customer Faults.

When enabled, High Battery Voltage, Low Battery Voltage, and Normal Battery Voltage takes precedence over the hardwired input.

Normal Battery voltage can replace Weak Battery.

Dimensions



Dimensions: in (mm)

Ordering information

Part number	Description
0300-5929-01	Panel mount
0300-5929-02	Panel with enclosure

For more information contact your local Cummins distributor or visit power.cummins.com



Our energy working for you.™



PowerCommand® input/output expansion module AUX 101 and AUX 102



Description

The PowerCommand AUX 101 input/output module and the AUX 102 input/output expansion module provide up to sixteen (16) relay output and up to twelve (12) discrete/analog inputs for auxiliary control and monitoring of the power system.

Analog/discrete inputs can be used for system fault expansion and/or generator set metering.

Relay outputs can be used for controlling equipment such as motors, louvers, lamps, fans and pumps. The relays may be configured individually from the genset control operator interface or using $InPower^{TM}$ software.

The AUX 101 and AUX 102 modules are compatible with genset controls supporting a PCCNet network and require a twisted pair connection. This includes the PCC 1301 control.

AUX 101 - Contains eight (8) Form-C relay output sets and eight (8) discrete/analog inputs.

AUX 102 - Easily connects to the AUX 101 to provide an additional eight (8) Form-C relay outputs and (4) additional discrete inputs.



AUX 102 - Expansion

Features

- Up to sixteen (16) configurable Form-C relays provide easy control of system equipment such as lamps, louvers, motors and pumps. LED status of each relay.
- Up to twelve (12) configurable discrete inputs for monitoring equipment status and faults. Equipment status and faults will be annunciated.
- Up to eight (8) analog inputs. Analog inputs can be assigned one of seven preprogrammed functions:
 - -Oil temperature
 - Exhaust temperature
 - Fuel level
 - Ambient temperature
 - Alternator RTD
- Speed bias (for manual paralleling only)
- Voltage bias (for manual paralleling only)
- Two 5 VDC voltage sources for use with active senders.
- Four programmable current sources for use with resistive senders.
- Two status LEDs:
 - DS1 (green) indicates the AUX 101 is connected to the network and operating normally
 - DS2 (red) indicates the AUX 101 has lost its connection or is not connected to the network
- Device number indicator. Seven segment LED used to uniquely define more than one AUX 101 on the same network.
- May be connected at any point in the PCCNet network.
- Plug-and-play networking No binding required.
- Pluggable terminal blocks allow easy one-time wiring.
- Less wiring makes installation and system upgrades quick and easy
- PowerCommand controls are supported by a worldwide network of independent distributors who provide parts, service and warranty support.
- UL Listed and labeled; CSA certified; CE and UKCA compliant.

Specifications

Signal requirements

Network connections: RS485, twisted-pair 78 kbps

Control power: 5-40 VDC

Current

- 200 mA typical at 12 V, no active relay
- 100 mA typical at 24 V, no active relay
- 800 mA at 12 V, all relays active

Terminations for control power accept wire up to 16 ga.

Environment

The AUX 101 and AUX 102 are designed for proper operation in ambient temperatures from -40 °C to +60 °C (-40 °F to +140 °F) and for storage from -40 °C to +80 °C (-40 °F to +176 °F). Modules will operate with humidity up to 95%, non-condensing

Relay ratings (AUX 101)

- Normally closed: 3 A at 250 VAC or 30 VDC
- Normally open: 5 A at 250 VAC or 30 VDC

Relay ratings (AUX 102)

• 2 A at 125 VAC, 2 A at 30 VDC

Input ratings (AUX 101)

- Active low inputs
- Maximum voltage 24 VDC (inputs 1 6)
- Maximum voltage 40 VDC (inputs 7 8)

Network length

Maximum 1219 m (4000 ft)

Approved wiring

Cat 4 or Cat 5 (stranded)

Configurations

All configurations are stored in the main genset control and are modified from the generator set control HMI or using InPower PC software.

Discrete/analog inputs:

Each AUX 101 input can be configured as discrete or analog. AUX 102 inputs are discrete only. Discrete inputs have the following configuration options:

- · Active high or active low
- · Event, warning or shutdown
- Programmable text (displayed on genset HMI and InPower software)

Analog inputs have a set of predefined functions and can only be configured on certain module inputs. Below is a list of functions and possible module inputs:

- Input 1 Voltage bias (-3 to +3 VDC)*
- Input 2 Speed bias (0 to +5 VDC)*
- Inputs 3 6
 - Oil temperature
 - Exhaust temperature
 - Ambient air temperature
 - Fuel level
 - Alternator temperature

Inputs are defaulted to disabled

* Please note that speed and voltage bias interfaces are for manual paralleling only and must not be used with automatic paralleling controls.

Relay outputs

Outputs can be configured to energize on occurrence of any event or fault code supported by the genset control. The relay outputs default to the following:

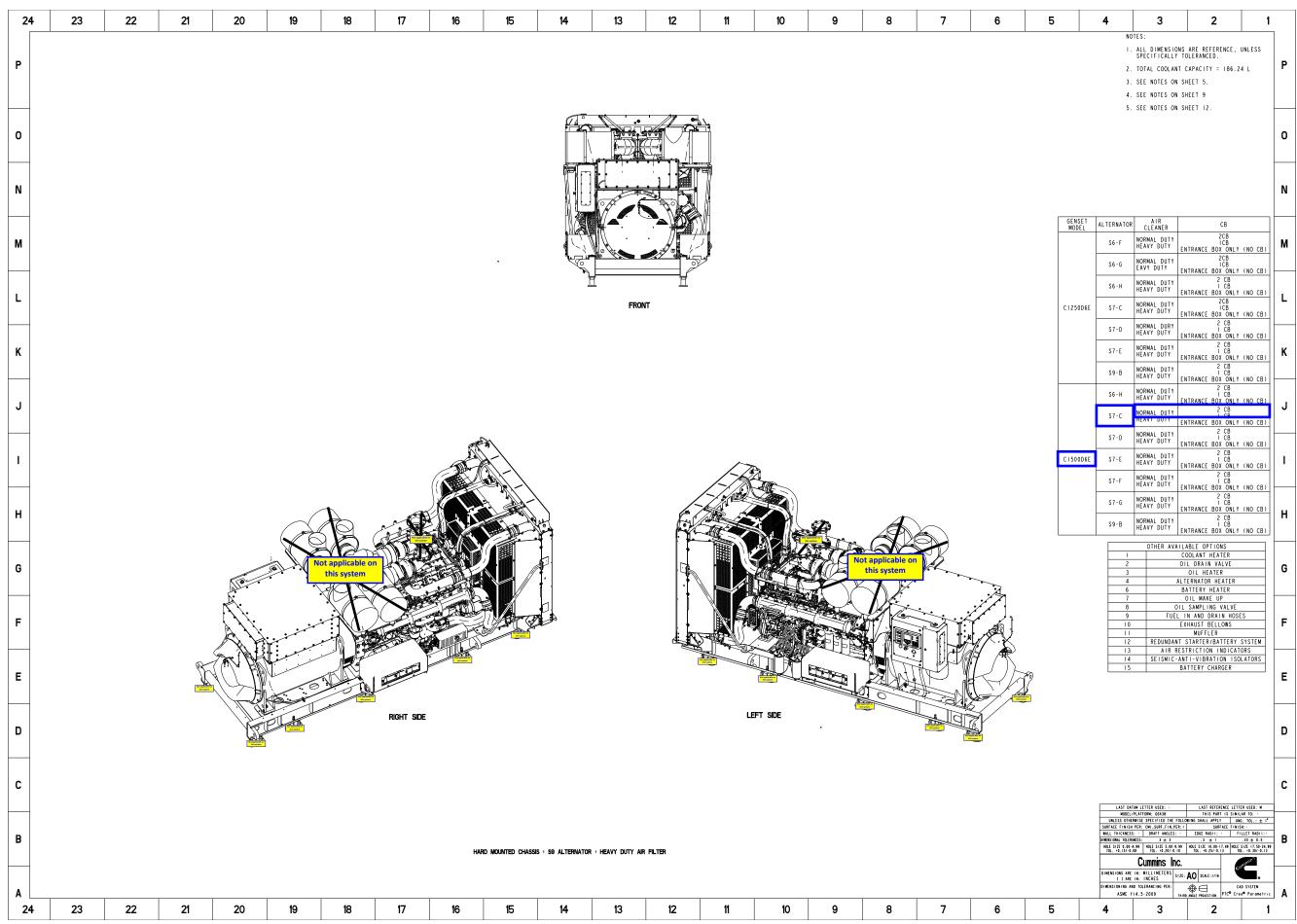
AUX 101

- 1 Low oil pressure
- 2 High engine temperature
- 3 Charger AC failure
- 4 Battery (low, weak, high)
- 5 Engine overspeed
- 6 Fail-to-start
- 7 Not-in-auto
- 8 Generator set running

AUX 102

- 9 Pre-low oil pressure
- 10 Pre-high engine temperature
- 11 Low coolant level*
- 12 Low fuel level*
- 13 Low coolant temperature
- 14 Common alarm
- 15 Not defined
- 16 Not defined

SECTION 4 GENERATOR DRAWINGS AND INTERCONNECTS

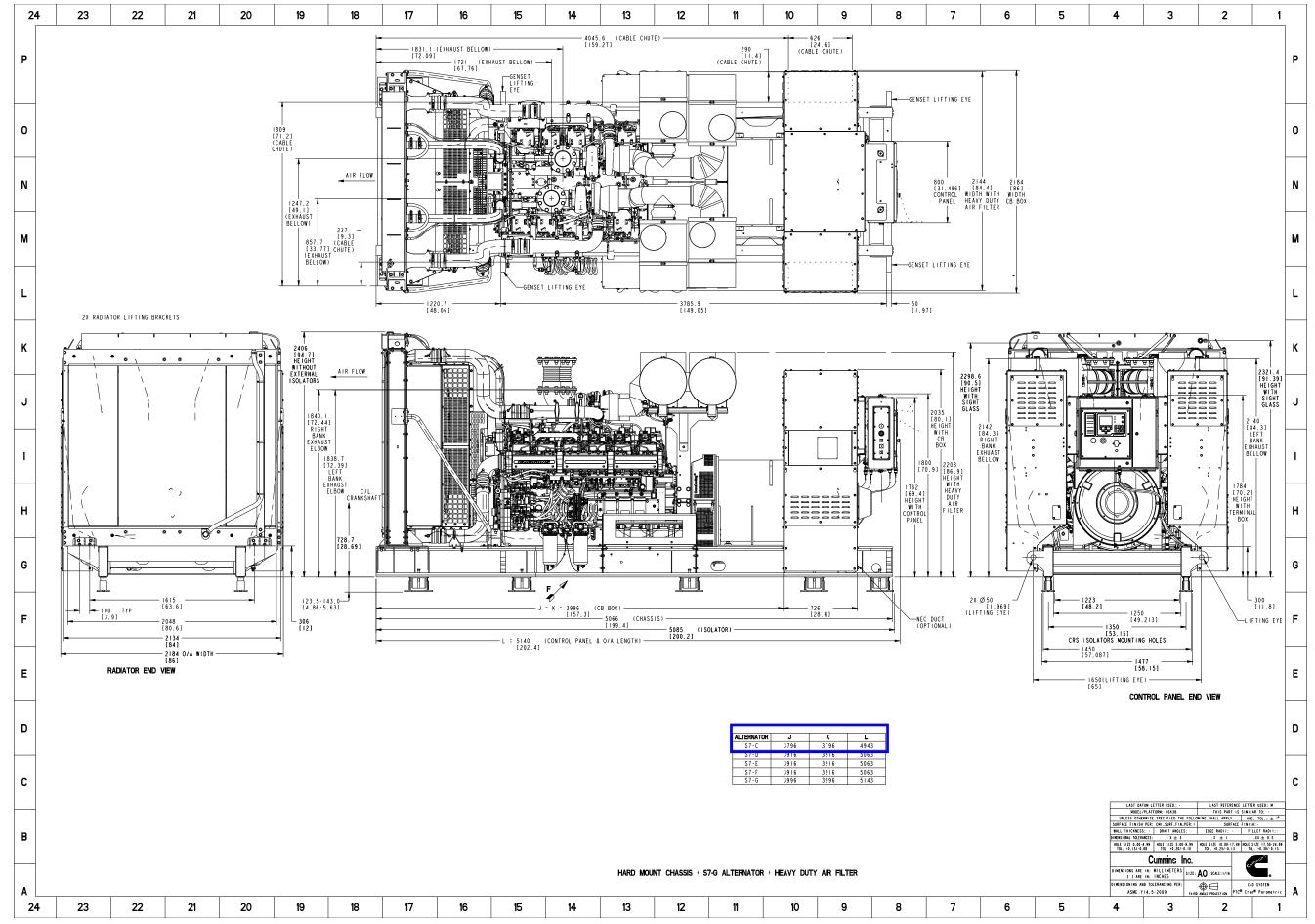


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Part Number: A062V279 Part Revision: D

Part Name: **OUTLINE,GENSET**Drawing Category: **Outline** State: **Released** Sheet **1** of **13**



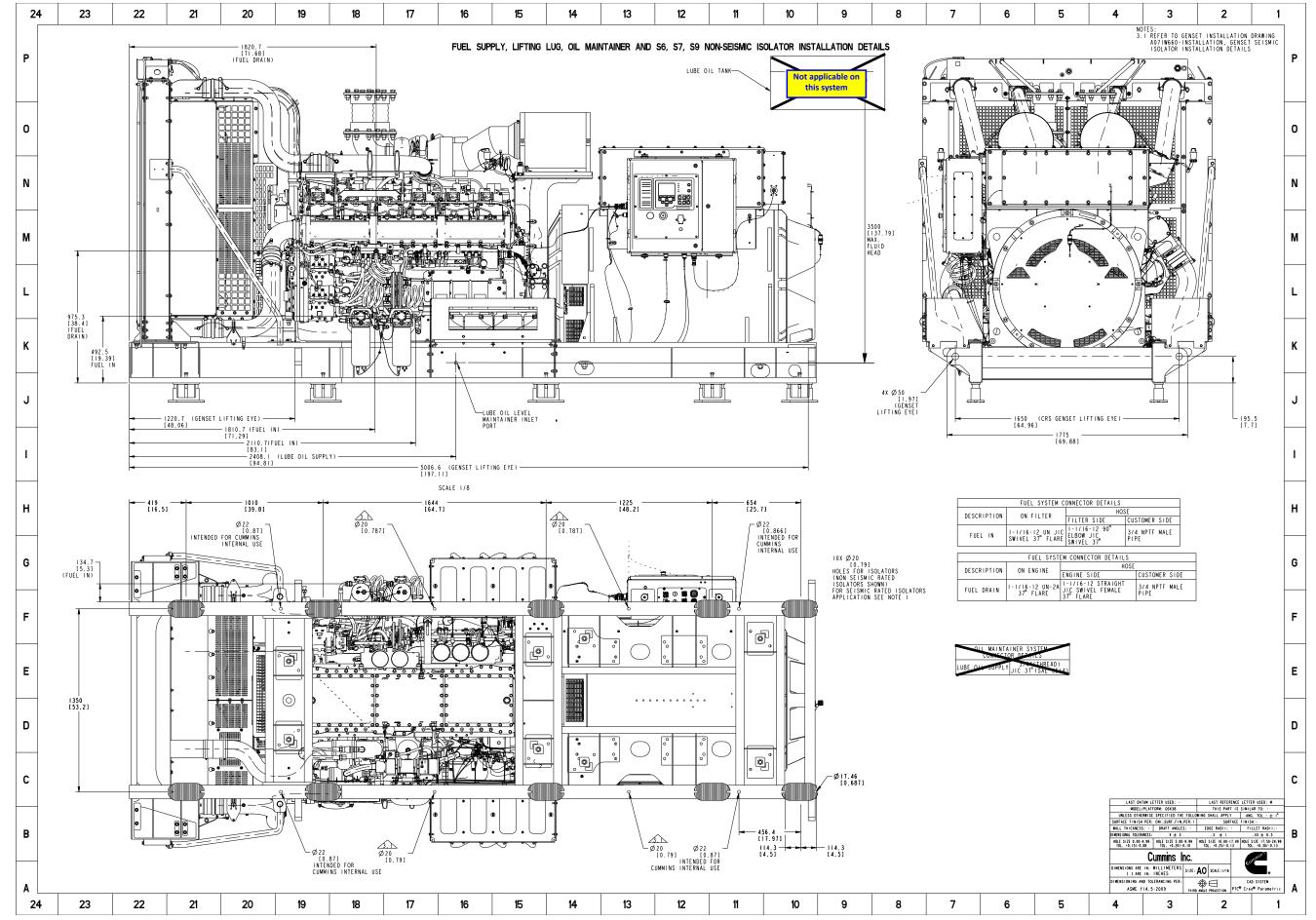
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Part Number: A062V279 Part Revision: D

Part Name: OUTLINE,GENSET

Drawing Category: Outline State: Released Sheet 4 of 13

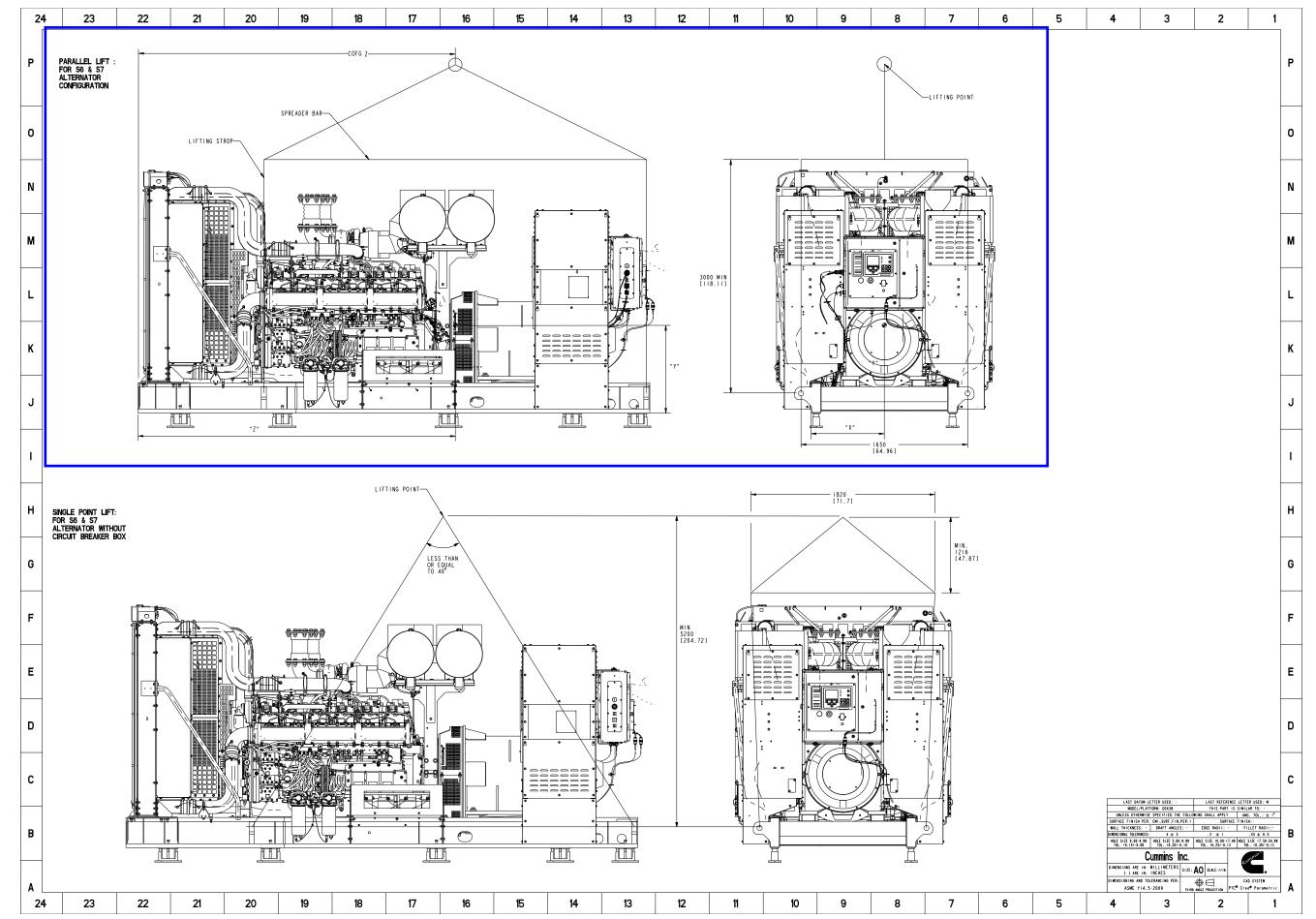


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Part Number: A062V279 Part Revision: D

Part Name: OUTLINE,GENSET

Drawing Category: **Outline** State: **Released** Sheet **5** of **13**

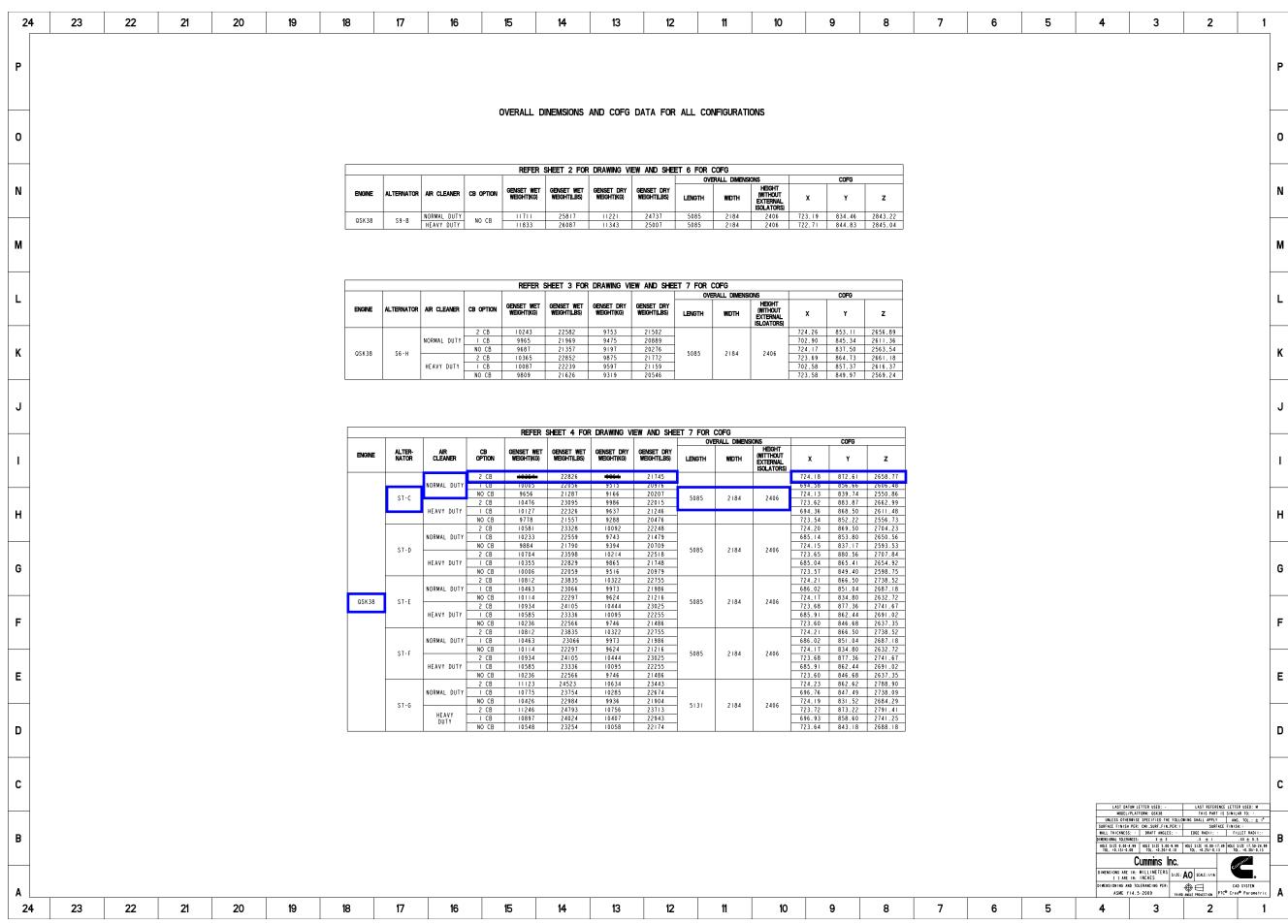


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Part Name: OUTLINE,GENSET

Drawing Category: **Outline** State: **Released** Sheet **7** of **13**

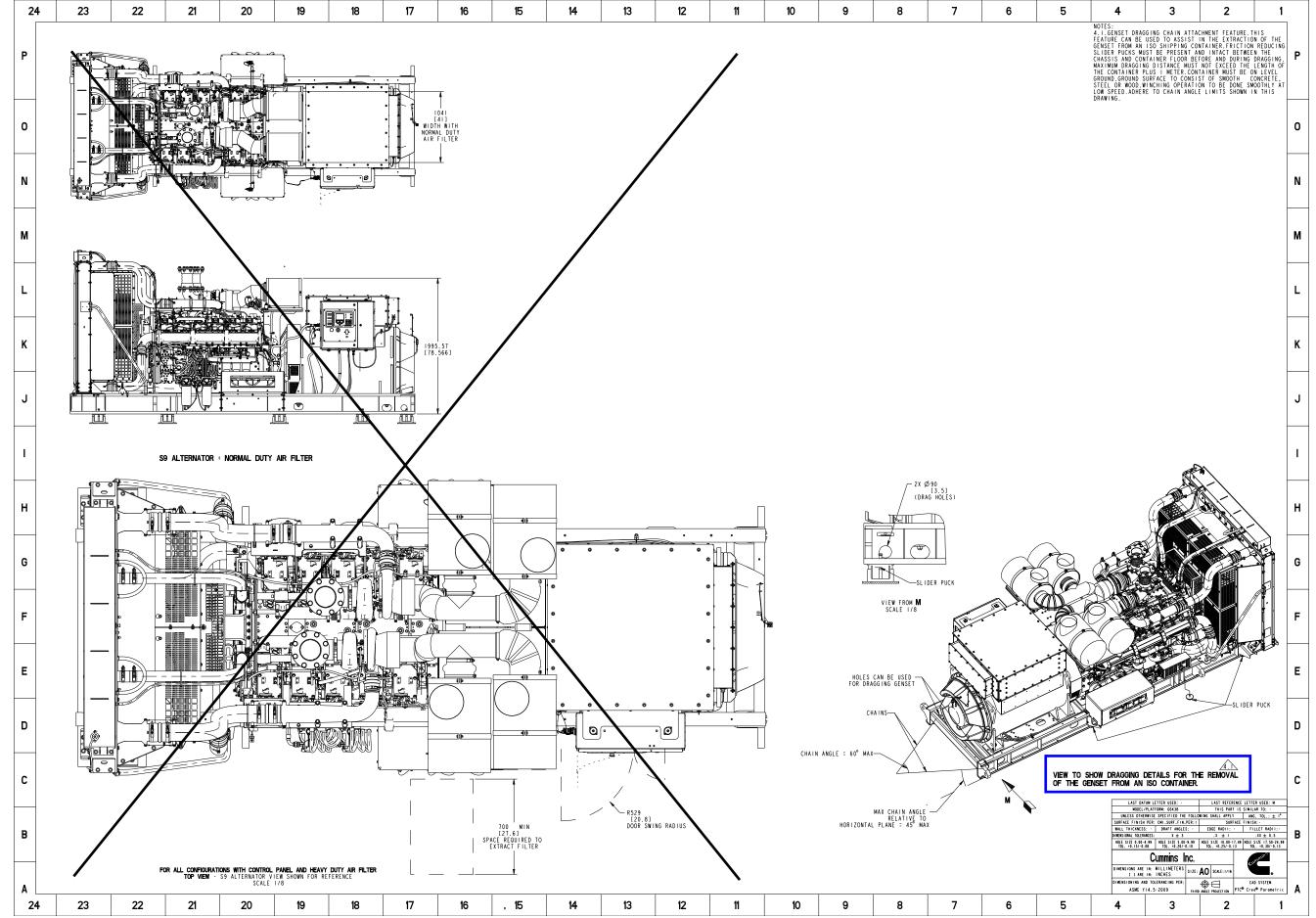


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Part Number: A062V279 Part Revision: D

Part Name: OUTLINE, GENSET

Drawing Category: Outline State: Released Sheet 8 of 13

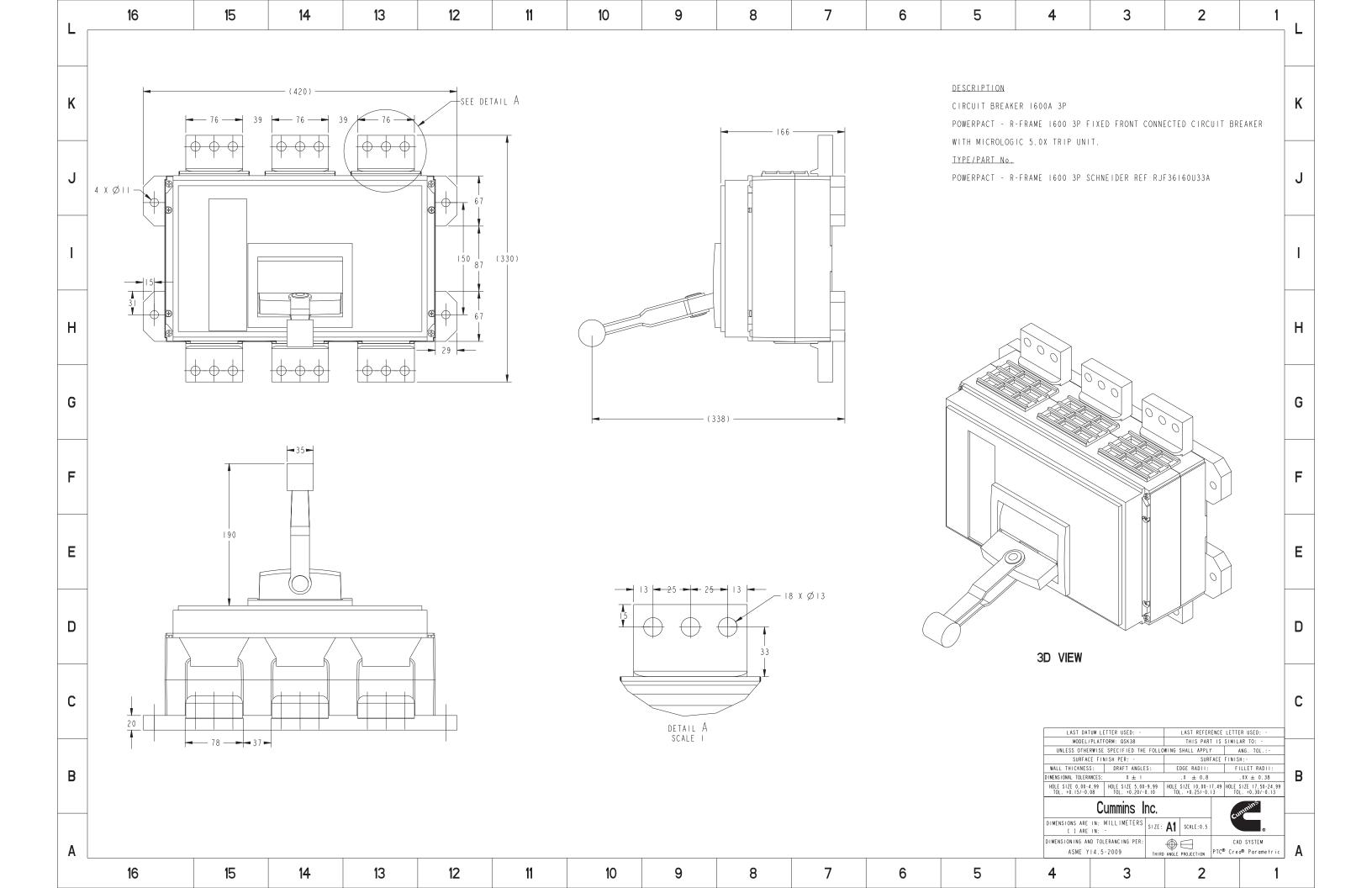


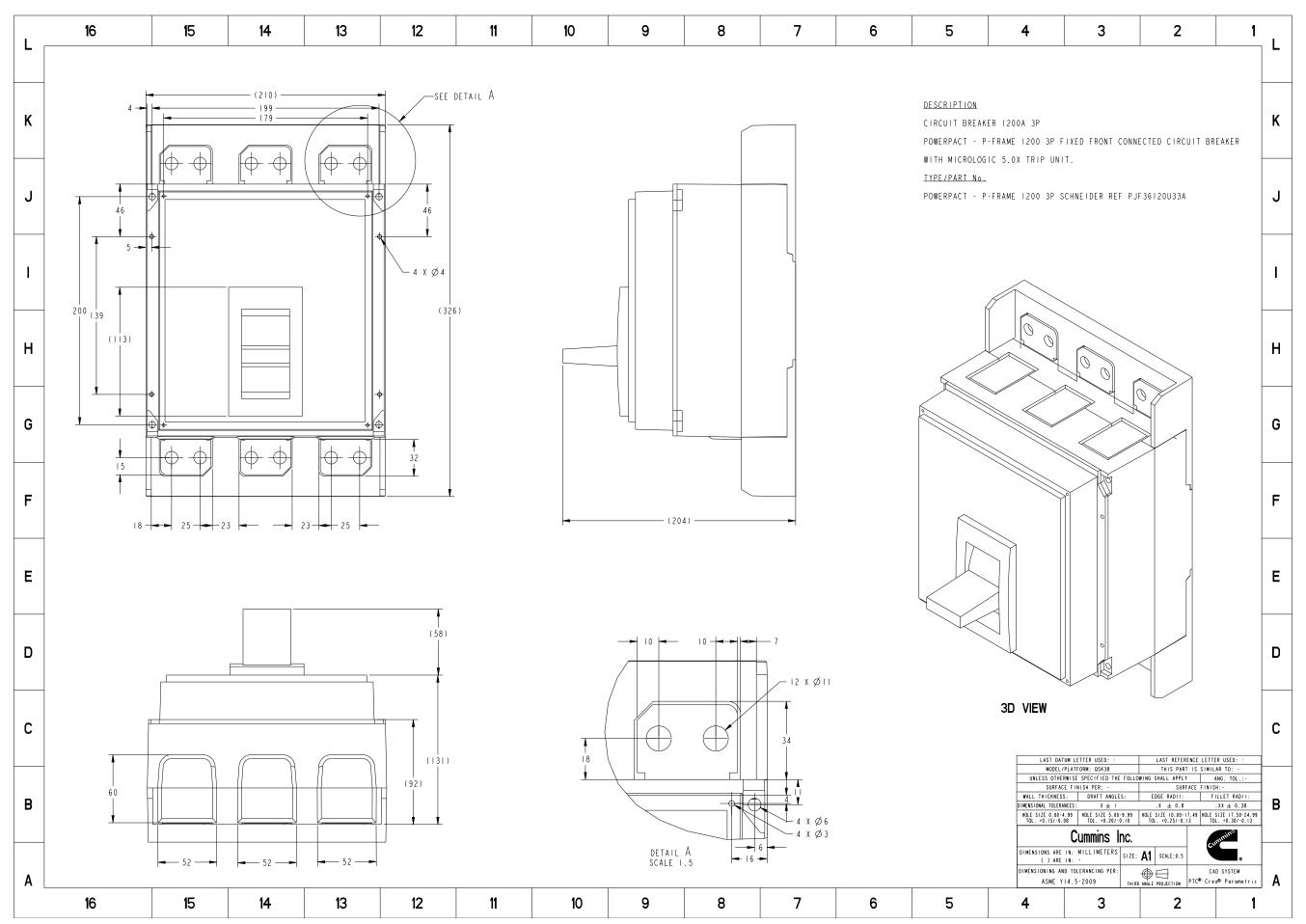
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Part Number: A062V279 Part Revision: D

Part Name: OUTLINE,GENSET

Drawing Category: **Outline** State: **Released** Sheet **9** of **13**

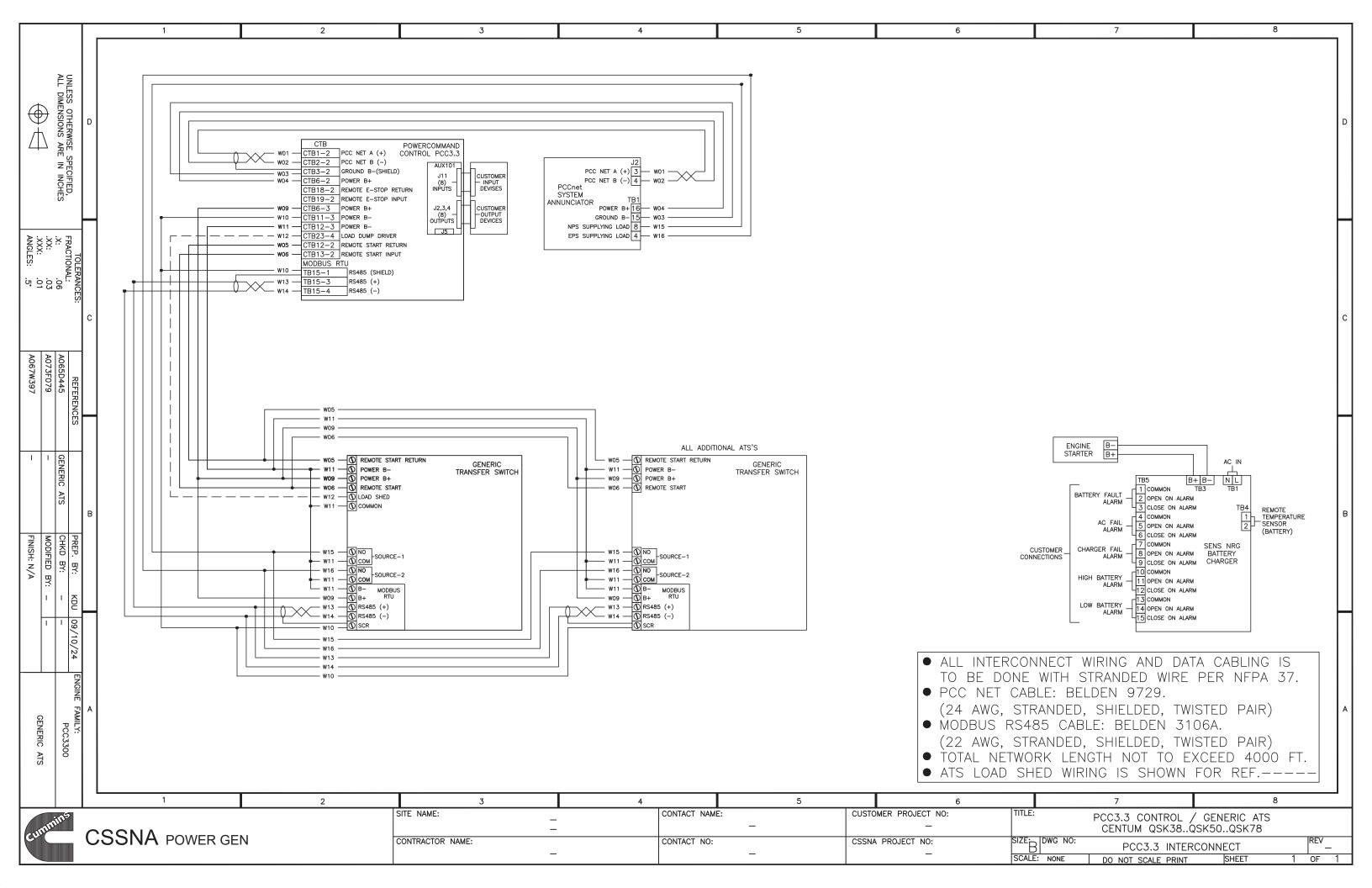


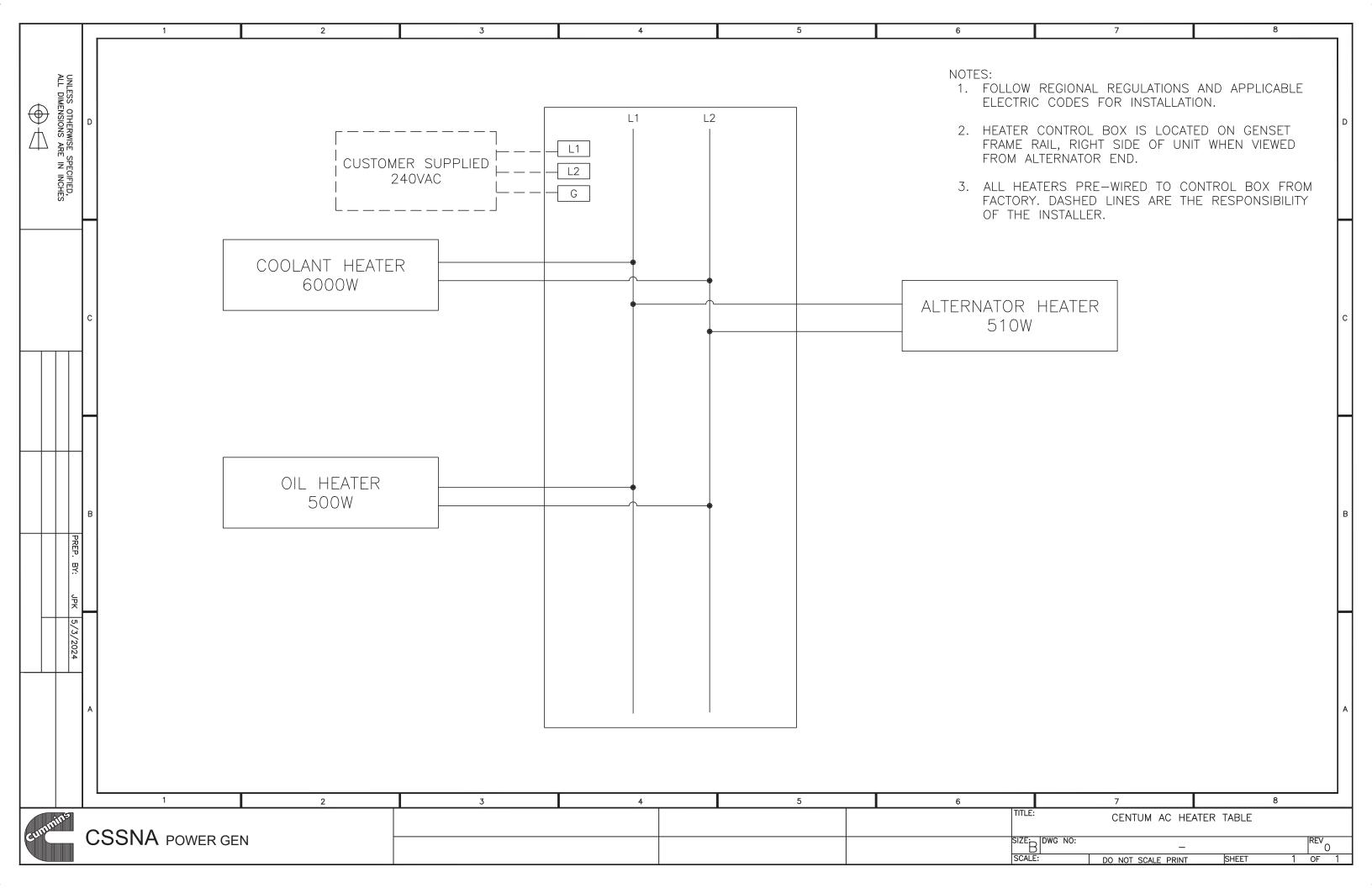


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Part Number: A065A772 Part Revision: C

Part Name: BREAKER,CIRCUIT
Drawing Category: Detail State: Released Sheet 1 of 2





SECTION 5 START-UP AND WARRANTY



Cummins Sales and Service

Customer / Contractor Pre Commissioning Inspection Form

The intent of this form is for the contractor to prepare for equipment to be commissioned by a certified Cummins Field Service Power Generation Technician. Filling out this form is required and will minimize delays due to equipment failing to meet requirements. Completing this checklist in its entirety should minimize the need for additional billing beyond the previously provided commissioning quote.

The items listed are the responsibility of the contractor and not Cummins Sales and Service.

Project Name/End User:			
Contractor:			
Address:	Contact:		
Business Phone:	_ Cell Phone:		
Email:			
ON SITE INFORMATION			
		 	
Time Requested Onsite:			
Out to action of Ourseaster (in Dec	(Language (language)		
Sub location of Generator (ie. Roo	f, basement, floor):		
Does the facility have the following:	Loading Dock Elevator		
Access (from truck and load bank p	arking to generator in feet):		
Parking: Is parking available on-site			
Permits: Have all necessary air quality and local permits been secured: Yes No N/A			
Fuel Tank Testing: Is fuel tank test	ing required: Yes No		
If yes when is the inspector	scheduled for:		



YES NA NO

ON SITE INFORMATION CONTINUED

Contractor "requestor" Signature

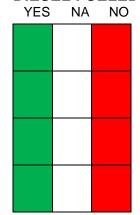
	generator is started?
	Will there be any site safety training needed for technician prior to beginning? On site contact for training:
	Will customer representative be on site for operator training?
	On site contact for operator training:
	·
MEGUANUGALA	
MECHANICAL L	OCATION AND PLACEMENT OF THE GENERATOR SET
YES NA NO	
	Generator is properly secured to pad or vibration isolators
	Generator Enclosure and/or Room is free of all debris
	No airflow obstructions to the engine or generator are present for cooling combustion
	(See Cummins T-030 or Installation manual of generator set)
	Room is designed for adequate inlet and outlet airflow
GASEOUS FUEL	. Natural Gas/LP Vapor/LP Liquid
GASEOUS FUEL YES NA NO	. Natural Gas/LP Vapor/LP Liquid
	Natural gas and/or LPG fuel supply is connected.
	Natural gas and/or LPG fuel supply is connected. Fuel piping is the appropriate size based on full-load CFH/BTU requirement. Pipe size after service regulator:
	Natural gas and/or LPG fuel supply is connected. Fuel piping is the appropriate size based on full-load CFH/BTU requirement. Pipe
	Natural gas and/or LPG fuel supply is connected. Fuel piping is the appropriate size based on full-load CFH/BTU requirement. Pipe size after service regulator: Service regulator(s), (if supplied), fuel strainer(s), flexible fuel line(s) and manual shut
	Natural gas and/or LPG fuel supply is connected. Fuel piping is the appropriate size based on full-load CFH/BTU requirement. Pipe size after service regulator: Service regulator(s), (if supplied), fuel strainer(s), flexible fuel line(s) and manual shut off are installed
YES NA NO	Natural gas and/or LPG fuel supply is connected. Fuel piping is the appropriate size based on full-load CFH/BTU requirement. Pipe size after service regulator: Service regulator(s), (if supplied), fuel strainer(s), flexible fuel line(s) and manual shut off are installed

Date

Is the facility occupied and is customer aware there will be power outages after



DIESEL FUELED GENERATORS



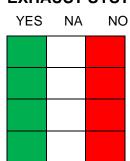
Flexible fuel connections, (supply and return) are connected to generator and piping.

Day tank installed, wired and plumbed (lines free of obstruction) to genset and main fuel tank if applicable. Only black iron pipe for fuel lines, never use copper or galvanized pipe.

All tanks filled with enough fuel to perform startup and testing.

A return line from engine to day tank and day tank to main tank should be in place

EXHAUST SYSTEM



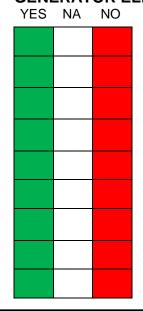
Exhaust wrapped or isolated to prevent accidental activation of fire protection devices and sprinklers.

Exhaust flex-pipe is installed at engine exhaust outlet (The silencer and flex-pipe are supplied with the generator set).

Silencer is installed with appropriate supports (no weight should be placed on the exhaust outlet of the genset).

Exhaust system has proper expansion joints and wall thimbles (Thimbles are required for wall or roof penetration).

GENERATOR ELECTRICAL CONNECTIONS



Load conductors connected to breakers

Flexible connections used on all conduit connections to the generator set output box

Remote start interconnection **<u>stranded</u>** wiring is installed between the generator set and the automatic transfer switch(s) and annunciator.

AC Power conductors in dedicated conduit separate from any DC control or network wiring

Ground fault connected/functioning on generator, if supplied

AC power wired to the coolant heaters (Do NOT energize)

Check for AC oil pan heater, control heater or generator winding heater (Needing AC wiring)

Generator is grounded in compliance with local codes

If applicable, louver motors are operational and connected to generator controls



05NED 470D EI				
GENERATOR ELECTRICAL CONNECTIONS CONTINUED				
YES NA NO				
	Annunciator mounted in a location where someone can observe a fault of the remote generator system Where is annunciator located?			
	Are there additional ancillary devices/equipment that need to be integrated into the system? If yes, please define			
	Battery charger mounted (free of vibration, weather, accessible for an operator to observe easily) and connected to the appropriate AC and DC wiring to operate the charger.			
	TCH ELECTRICAL CONNECTIONS			
YES NA NO				
	Conductors connected for Utility, Load and Emergency			
	Remote start interconnection <u>stranded</u> wiring is installed between the generator set and the automatic transfer switch(s).			
	Four Pole Transfer Switch: Is generator neutral grounded?			
DAY OF STARTU	JP			
YES NA NO				
Training of facility personnel will be done on the same day as start up. Additional trips for operational training will be an additional charge. Can transfer switch be tested at time of generator startup? (There will be a power interruption) <i>Note: After hours testing could result in additional charges.</i> If the associated switchgear and/or ATS(s) are not provided by Cummins, will the manufacturer's representative be on site?				
	If the associated switchgear and/or ATS(s) are not provided by Cummins, will			
Exercise with or witho	If the associated switchgear and/or ATS(s) are not provided by Cummins, will			
	If the associated switchgear and/or ATS(s) are not provided by Cummins, will the manufacturer's representative be on site?			
	If the associated switchgear and/or ATS(s) are not provided by Cummins, will the manufacturer's representative be on site? out load?			
	If the associated switchgear and/or ATS(s) are not provided by Cummins, will the manufacturer's representative be on site? out load?			
	If the associated switchgear and/or ATS(s) are not provided by Cummins, will the manufacturer's representative be on site? Out load? me delay set recommendations Generator Set to exercise Day: Time:			
If known, Transfer Tin	If the associated switchgear and/or ATS(s) are not provided by Cummins, will the manufacturer's representative be on site? Out load? me delay set recommendations Generator Set to exercise Day: Time: for" Signature Printed Name			

Please complete this form and return to schedule start up, if not returned within 5 business days prior to scheduled startup it may be delayed. I understand that the start-up date may have to be rescheduled at my expense if the above items have not been completed properly.



INSTRUCTION OF OPERATIONS AND MAINTENANCE

Generator

Training will be conducted by a factory-trained maintenance specialist in transfer switches. Training duration will be approximately 1 hour with a question-and-answer session to last as long as needed to satisfy the owner.

LESSON PLAN

- I. Safety
 - a. General safety precautions
 - b. Equipment safety code
 - c. Electrical shock and arc flash
- II. Equipment operation
 - a. Engine/generator operation process
 - b. Fundamental operating principals of the engine/generator
 - c. Identification of all equipment components mechanical, electrical, and electronic
 - d. Standard operating procedures start-up, monitoring, shutdown, and E-stop reset
- III. Component description
 - a. Identify each component's function engine/generator and automatic transfer switch and their relationship to one another, if applicable
- IV. Preventative maintenance
 - a. Inspection procedures
 - i. Inspection with equipment in operation
 - ii. Potential trouble symptoms
 - b. Procedures for testing equipment after maintenance has been performed
- V. Equipment troubleshooting
 - a. Alarms / display messages
 - b. Procedures
 - c. Symptom list
 - d. Probable cause and recommended correction
 - e. How to obtain service

"HANDS-ON" DEMONSTRATION

The instructor will demonstrate the engine/generator functionality in auto and manual modes.

Disclaimer

Training is for informational purposes only. If you have any specific safety or operational questions refer to the Operators Manual and/or Sequence of Operations documentation.



Warranty Statement

CENTUM™ Series Generator Set

C1250D6E, C1500D6E, C1750D6E, C2000D6E, C2750D6E, C3000D6EB

Limited Warranty

CENTUM™ Series Generator Set

This limited warranty applies to all Cummins Inc. branded CENTUM™ Series generator sets including C1250D6E, C1500D6E, C1750D6E, C2000D6E, C2750D6E, and C3000D6EB and associated accessories (hereinafter referred to as "Product").

This warranty covers any failures of the Product, under normal use and service, which result from a defect in material or factory workmanship.

Warranty Period:

The warranty start date[†] is the date of initial start up, first rental, demonstration or 18 months after factory ship date, whichever is sooner. See table for details.

Continuous Power (COP) is defined as being the maximum power which the generating set is capable of delivering continuously whilst supplying a constant electrical load when operated for an unlimited number of hours per year. No overload capability is available for this rating.

Prime Power (PRP) is defined as being the maximum power which a generating set is capable of delivering continuously whilst supplying a variable electrical load when operated for an unlimited number of hours per year. The permissible average power output over 24 hours of operation shall not exceed 70% of the PRP. For applications requiring permissible average output higher than stated, a COP rating should be used.

Limited-Time Running Power (LTP) is defined as the maximum power available, under the agreed operating conditions, for which the generating set is capable of delivering for up to 500 hours of operation per year.

Emergency Standby Power (ESP) is defined as the maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 3 years or 1,000 hours, whichever occurs first. The permissible average power output over 24 hours of operation shall not exceed 70% of the ESP.

Effective Date: 5-Apr-2024

Environmental Protection Agency – Stationary Emergency (EPA-SE) is defined as being the maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generator set is capable of delivering in the event of a utility power outage or under test conditions and used in strict accordance with the EPA NSPS for stationary engines, 40 CFR part 60, subparts IIII and JJJJ, where a reliable utility must be present. The permissible average power output over 24 hours of operation shall not exceed 70% of the EPA-SE.

Data Center Continuous (DCC) is defined as the maximum power which the generator is capable of delivering continuously to a constant or varying electrical load for unlimited hours in a data center application.

Base Warranty Coverage Duration (Whichever occurs first)

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Rating	Months	Max. Hours		
COP	12	Unlimited		
PRP	12	Unlimited		
LTP	12	500 hrs		
ESP	<mark>36</mark>	1000 hrs		
EPA-SE	24	Unlimited		
DCC	24	Unlimited		

[†] Warranty start date for designated rental and oil and gas model Products is determined to be date of receipt of Product by the end customer.

Cummins Inc. Responsibilities:

In the event of a failure of the Product during the warranty period due to defects in material or workmanship, Cummins Inc. will only be responsible for the following costs:

- All parts and labor required to repair the Product.
- Reasonable travel expenses to and from the Product site location.
- Maintenance items that are contaminated or damaged by a warrantable failure.

Owner Responsibilities:

The owner will be responsible for the following:

- Notifying Cummins Inc., its distributors or dealers within 30 days of the discovery of failure.
- Installing, operating, commissioning and maintaining the Product in accordance with Cummins Inc.'s published policies and guidelines.
- Providing evidence for date of commissioning.
- Providing sufficient access to and reasonable ability to remove the Product from the

- installation in the event of a warrantable failure.
- Incremental costs and expenses associated with Product removal and reinstallation resulting from non-standard installations.
- Costs associated with rental of generating sets used to replace the Product being repaired.
- Costs associated with labor overtime and premium shipping requested by the owner.
- All downtime expenses, fines, all applicable taxes, and other losses resulting from a warrantable failure.

Limitations:

This limited warranty does not cover Product failures resulting from:

- Inappropriate use relative to designated power rating.
- Inappropriate use relative to application guidelines.
- Inappropriate use of an EPA-SE application generator set relative to EPA's standards.
- Normal wear and tear.
- Improper and/or unauthorized installation.
- Negligence, accidents or misuse.
- Lack of maintenance or unauthorized repair.
- Noncompliance with any Cummins Inc. published guideline or policy.
- Use of improper or contaminated fuels, coolants or lubricants.
- Improper storage before and after commissioning.
- Owner's delay in making Product available after notification of potential Product problem.
- Replacement parts and accessories not authorized by Cummins Inc.
- Use of Battle Short Mode.
- Owner or operator abuse or neglect such as: operation without adequate coolant or lubricants; overfueling; overspeeding; lack of maintenance to lubricating, cooling or air intake systems; late servicing and maintenance; improper storage, starting, warm-up, run-in or shutdown practices, or for progressive damage resulting from a defective shutdown or warning device.
- Damage to parts, fixtures, housings, attachments and accessory items that are not part of the generating set.

This limited warranty does not cover costs resulting from:

- Difficulty in gaining access to the Product.
- Damage to customer property.

A "Data center" is defined as a dedicated facility that house computers and associated equipment for data storage and data handling.

Reliable utility is defined as utility power without routine or regularly scheduled black-outs.

Please contact your local Cummins Inc. Distributor for clarification concerning these limitations.

CUMMINS INC. RIGHT TO FAILED COMPONENTS:

Failed components claimed under warranty remain the property of Cummins Inc. Cummins Inc. has the right to reclaim any failed component that has been replaced under warranty.

Extended Warranty:

Cummins Inc. offers several levels of Extended Warranty Coverage. Please contact your local Cummins Inc. Distributor for details.

power.cummins.com

THE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS INC. IN REGARD TO THE PRODUCT. CUMMINS INC. MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

IN NO EVENT IS CUMMINS INC. LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

This limited warranty shall be enforced to the maximum extent permitted by applicable law. In the United States, some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may have other rights which vary from state to state or jurisdiction to jurisdiction.

Product Model Number:	
Product Serial Number:	
Date in Service:	