



Central States Diesel Generators

Cummins - DFEK 500kW Generator

1. Bill of Material
2. Generator Set Information
3. Generator Warranty
4. Generator Outline & Foundation Drawings

BILL OF MATERIALS

Project Name: Central States Diesel Generators

Item	Description	Qty
	Diesel Genset: 60Hz-500/455kW	
Install-US-Stat	U.S. EPA, Stationary Emergency Application	1
500DFEK	Genset-Diesel,60Hz,500kW-Standby Rating	1
A331-2	Duty Rating-Standby Power	1
L090-2	Listing-UL 2200	1
L170-2	Emissions Certification, EPA, Tier 2, NSPS CI Stationary Emergency	1
F200-2	Enclosure-Steel,Weather Prot,Base Mtd,w/ExhSys	1
C207-2	Fuel Tank-Subbase,850 Gallon,UL142 Compliant	1
R002-2	Voltage-277/480,3 Phase,Wye,4 Wire	1
B246-2	Alternator-60 Hz, 12 Lead, Limited Range, 125/105C	1
H703-2	Generator Set Control-PowerCommand 2.3	1
H536-2	Display Language-English	1
H678-2	Display-Control, LCD	1
H609-2	Control Mounting-Left Facing	1
KU94-2	CB or EB or TB-Right Only	1
KC62-2	Circuit Breaker-800A,Right CB on Right side,3-Pole,UL 600,IEC 690 100%	1
KB72-2	CB or EB or TB-Bottom Entry, Right	1
P175-2	Enclosure Color-Green,Steel Enclosure	1
L163-2	Listing, ULC-S601-07	1
C127-2	Separator-Fuel/Water	1
E074-2	Engine Cooling-Radiator, 50C Ambient	1
H389-2	Shutdown-Low Coolant Level	1
H556-2	Coolant Heater-208/240/480V, 40F Minimum Ambient Temp	1
D041-2	Engine Air Cleaner-Normal Duty	1
L028-2	Genset Warranty- Base 2 Years or 1000 Hours	1
A048G602	Battery Charger-10Amp,120/208/240VAC,12/24V,50/60Hz	1



Diesel generator set QSX15 series engine

450 kW – 500 kW Standby



Description

Cummins® commercial generator sets are fully integrated power generation systems providing optimum performance, reliability and versatility for stationary standby and prime power applications.

Features

Cummins heavy-duty engine - Rugged 4-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 and fault clearing short-circuit capability.

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

Control system - The PowerCommand® electronic 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™ protection, output metering, auto-shutdown at fault detection and NFPA 110 Level 1 compliance.

Cooling system - Standard integral set-mounted radiator system, designed and tested for rated ambient temperatures, simplifies facility design requirements for rejected heat.

Enclosures - Optional weather protective and sound attenuated enclosures are available.

Fuel tanks - Dual wall sub-base fuel tanks are also available.

NFPA - The genset accepts full rated load in a single step in accordance with NFPA 110 for Level 1 systems.

Warranty and service - Backed by a comprehensive warranty and worldwide distributor network.

	Standby rating	Prime rating	Continuous rating	Data sheets
	60 Hz kW (kVA)	60 Hz kW (kVA)	60 Hz kW (kVA)	60 Hz
DFEJ	450 (563)	410 (513)		D-3400
DFEK	500 (625)	455 (569)		D-3401

Generator set specifications

Governor regulation class	ISO 8528 part 1 Class G3
Voltage regulation, no load to full load	± 0.5%
Random voltage variation	± 0.5%
Frequency regulation	Isochronous
Random frequency variation	± 0.25%
EMS compatibility	IEC 61000-4-2: Level 4 Electrostatic discharge IEC 61000-4-3: Level 3 Radiated susceptibility

Engine specifications

Design	Turbocharged with air-to-air charge air-cooling
Bore	136.9 mm (5.39 in.)
Stroke	168.9 mm (6.65 in.)
Displacement	14.9 L (912.0 in ³)
Cylinder block	Cast iron with replaceable wet liners, in-line 6 cylinder
Battery capacity	1400 Amps minimum at ambient temperature 0 °C (32 °F)
Battery charging alternator	35 Amps
Starting voltage	24 volt, negative ground
Fuel system	Full authority electronic (FAE) Cummins HPI-TP
Fuel filter	
Air cleaner type	
Lube oil filter type(s)	Single spin-on combination full flow and bypass filters
Standard cooling system	40 °C (104 °F) ambient radiator

Alternator specifications

Design	Brushless, 4 pole, drip-proof revolving field
Stator	2/3 pitch
Rotor	Single bearing, flexible discs
Insulation system	Class H
Standard temperature rise	125 °C standby at 40 °C ambient
Exciter type	PMG (Permanent Magnet Generator)
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, < 3% for any single harmonic
Telephone influence factor (TIF)	< 50% per NEMA MG1-22.43
Telephone harmonic factor (THF)	< 3%

Available voltages

60 Hz Line – Neutral/Line - Line

- | | | | |
|-----------|-----------|-----------|-----------|
| • 110/190 | • 110/220 | • 115/200 | • 115/230 |
| • 120/208 | • 127/220 | • 139/240 | • 220/380 |
| • 230/400 | • 240/416 | • 255/440 | • 277/480 |
| • 347/600 | | | |

Note: Consult factory for other voltages.

Generator set options

Engine

- 208/240/480 V thermostatically controlled coolant heater for ambient above 4.5 °C (40°F)
- 208/240/480 V thermostatically controlled coolant heater for ambient below 4.5 °C (40°F)
- 120 V 300 W lube oil heater
- Heavy duty air cleaner with safety element

Alternator

- 80 °C rise
- 105 °C rise
- 150 °C rise
- 120/240 V 200 W anti-condensation heater

Exhaust system

- Critical grade exhaust silencer
- Exhaust packages
- Industrial grade exhaust silencer
- Residential grade exhaust silencer

Fuel system

- 1022 L (270 gal) sub-base tank
- 1136 L (300 gal) sub-base tank
- 1514 L (400 gal) sub-base tank
- 1893 L (500 gal) sub-base tank
- 2271 L (600 gal) sub-base tank
- 2498 L (660 gal) sub-base tank
- 3218 L (850 gal) sub-base tank
- 6435 L (1700 gal) sub-base tank
- 9558 L (2525 gal) sub-base tank

Cooling system

- High ambient 50 °C radiator

Control panel

- PC 3.3
- PC 3.3 with MLD
- 120/240 V 100 W control anti-condensation heater
- Ground fault indication
- Remote fault signal package
- Run relay package

Generator set

- AC entrance box
- Battery
- Battery charger
- Export box packaging
- UL 2200 Listed
- Main line circuit breaker
- Paralleling accessories
- Remote annunciator panel
- Spring isolators
- Enclosure: aluminium, steel, weather protective or sound attenuated
- 2 year standby power warranty
- 2 year prime power warranty
- 5 year basic power warranty
- 10 year major components warranty

*Note: Some options may not be available on all models - consult factory for availability.

Control system 2.3

The PowerCommand 2.3 control system - An integrated generator set control system providing voltage regulation, engine protection, generator protection, operator interface and isochronous governing (optional).

Control - Provides battery monitoring and testing features and smart-starting control system.

InPower™ - PC-based service tool available for detailed diagnostics.

PCCNet RS485 - Network interface (standard) to devices such as remote annunciator for NFPA 110 applications.

Control boards - Potted for environmental protection.

Ambient operation - Suitable for operation in ambient temperatures from -40 °C to +70 °C and altitudes to 13,000 feet (5000 meters). Prototype tested - UL, CSA and CE compliant.

AC protection

- AmpSentry protective relay
- Over current warning and shutdown
- Over and under voltage shutdown
- Over and under frequency shutdown
- Over excitation (loss of sensing) fault
- Field overload
- Overload warning
- Reverse kW shutdown
- Reverse Var shutdown
- Short circuit protection

Engine protection

- Overspeed shutdown
- Low oil pressure warning and shutdown
- High coolant temperature warning and shutdown
- Low coolant level warning or shutdown
- Low coolant temperature warning

- High, low and weak battery voltage warning
- Fail to start (overcrank) shutdown
- Fail to crank shutdown
- Redundant start disconnect
- Cranking lockout
- Sensor failure indication
- Low fuel level warning or shutdown
- Fuel-in-rupture-basin warning or shutdown

Operator/display panel

- Manual off switch
- 128 x 128 Alpha-numeric display with push button access for viewing engine and alternator data and providing setup, controls and adjustments (English or international symbols)
- LED lamps indicating genset running, not in auto, common warning, common shutdown, manual run mode and remote start
- Suitable for operation in ambient temperatures from -20 °C to +70 °C

Alternator data

- Line-to-Neutral AC volts
- Line-to-Line AC volts
- 3-phase AC current
- Frequency
- kVA, kW, power factor

Engine data

- DC voltage
- Lube oil pressure
- Coolant temperature

Control functions

- Time delay start and cool down
- Glow plug control (some models)
- Cycle cranking
- PCCNet interface
- (4) Configurable inputs
- (4) Configurable outputs
- Remote emergency stop
- Battle short mode
- Load shed
- Real time clock with exerciser
- Derate

Digital governing (optional)

- Integrated digital electronic isochronous governor
- Temperature dynamic governing

Digital voltage regulation

- Integrated digital electronic voltage regulator
- 3-phase Line-to-Line sensing
- Configurable torque matching
- Fault current regulation under single or three phase fault conditions

Other data

- Genset model data
- Start attempts, starts, running hours
- Fault history
- RS485 Modbus® interface
- Data logging and fault simulation (requires InPower service tool)
- Total kilowatt hours
- Load profile

Options

- Auxiliary output relays (2)
- 120/240 V, 100 W anti-condensation heater
- Remote annunciator with (3) configurable inputs and (4) configurable outputs
- PMG alternator excitation
- PowerCommand for Windows® remote monitoring software (direct connect)
- AC output analogue meters
- PowerCommand 2.3 and 3.3 control with AmpSentry protection

For further detail on PC 2.3 see document S-1569.

For further detail on PC 3.3 see document S-1570.

Emergency Standby Power (ESP):

Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Limited-Time running Power (LTP):

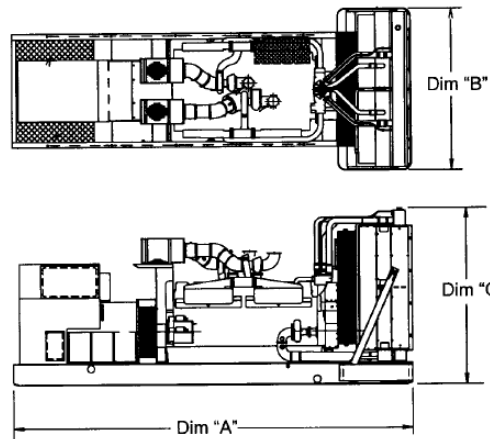
Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.

Prime Power (PRP):

Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Base Load (Continuous) Power (COP):

Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.



This outline drawing is for reference only. See respective model data sheet for specific model outline drawing number.





Do not use for installation design

Model	Dim 'A' mm (in.)	Dim 'B' mm (in.)	Dim 'C' mm (in.)	Set weight dry* kg (lbs)	Set weight wet* kg (lbs)
DFEJ	3864 (152.1)	1524 (60.0)	1812 (71.3)	4098 (9035)	4234 (9335)
DFEK	3864 (152.1)	1524 (60.0)	1812 (71.3)	4325 (9535)	4461 (9835)

*Weights represent a set with standard features. See outline drawings for weights of other configurations.

Codes and standards

Codes or standards compliance may not be available with all model configurations – consult factory for availability.

	<p>This generator set is designed in facilities certified to ISO 9001 and manufactured in facilities certified to ISO 9001 or ISO 9002.</p>		<p>The generator set is available listed to UL 2200, Stationary Engine Generator Assemblies for all 60 Hz low voltage models. The PowerCommand control is Listed to UL 508 - Category NITW7 for U.S. and Canadian usage. Circuit breaker assemblies are UL 489 Listed for 100% continuous operation and also UL 869A Listed Service Equipment.</p>
	<p>The Prototype Test Support (PTS) program verifies the performance integrity of the generator set design. Cummins products bearing the PTS symbol meet the prototype test requirements of NFPA 110 for Level 1 systems.</p>	<p>U.S EPA</p>	<p>Engine certified to Stationary Emergency U.S. EPA New Source Performance Standards, 40 CFR 60 subpart IIII Tier 2 exhaust emission levels. U.S. applications must be applied per this EPA regulation.</p>
	<p>All low voltage models are CSA certified to product class 4215-01.</p>	<p>International Building Code</p>	<p>The generator set package is available certified for seismic application in accordance with the following International Building Code: IBC2000, IBC2003, IBC2006, IBC2009 and IBC2012.</p>

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

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Generator set data sheet



Model: DFEK
Frequency: 60 Hz
Fuel type: Diesel
kW rating: 500 Standby
 455 Prime
Emissions level: EPA NSPS Stationary Emergency Tier 2

Exhaust emission data sheet:	EDS-173
Exhaust emission compliance sheet:	EPA-1005
Sound performance data sheet:	MSP-177
Cooling performance data sheet:	MCP-105
Prototype test summary data sheet:	PTS-145
Standard set-mounted radiator cooling outline:	0500-3326
Optional set-mounted radiator cooling outline:	
Optional heat exchanger cooling outline:	
Optional remote radiator cooling outline:	

Fuel consumption	Standby				Prime				Continuous
	kW (kVA)				kW (kVA)				kW (kVA)
Ratings	500 (625)				455 (569)				
Load	1/4	1/2	3/4	Full	1/4	1/2	3/4	Full	Full
US gph	11.6	18.8	25.7	34.4	10.9	17.6	23.7	30.4	
L/hr	44	71	97	130	41	67	90	115	

Engine	Standby rating	Prime rating	Continuous rating
Engine manufacturer	Cummins Inc.		
Engine model	QSX15-G9		
Configuration	Cast iron with replaceable wet cylinder liners, in-line 6 cylinder		
Aspiration	Turbocharged with air-to-air charge air-cooling		
Gross engine power output, kWm (bhp)	563.0 (755.0)	507.3 (680.0)	
BMEP at set rated load, kPa (psi)	2433.9 (353.0)	2213.2 (321.0)	
Bore, mm (in.)	136.9 (5.39)		
Stroke, mm (in.)	168.9 (6.65)		
Rated speed, rpm	1800		
Piston speed, m/s (ft/min)	10.1 (1995.0)		
Compression ratio	17.0:1		
Lube oil capacity, L (qt)	83.3 (88.0)		
Overspeed limit, rpm	2150 ± 50		
Regenerative power, kW	52.00		

Fuel flow

	Standby rating	Prime rating	Continuous rating
Maximum fuel flow, L/hr (US gph)	423.9 (112.0)		
Maximum inlet restriction, mm Hg (in Hg)	127.0 (5.0)		
Maximum return restriction, mm Hg (in Hg)	165.1 (6.5)		

Air

Combustion air, m ³ /min (scfm)	41.6 (1470.0)	38.8 (1370.0)	
Maximum air cleaner restriction, kPa (in H ₂ O)	6.2 (25.0)		
Alternator cooling air, m ³ /min (scfm)	62.0 (1290.0)		

Exhaust

Exhaust flow at set rated load, m ³ /min (cfm)	102.6 (3625.0)	88.7 (3135.0)	
Exhaust temperature, °C (°F)	482.8 (901.0)	466.7 (872.0)	
Maximum back pressure, kPa (in H ₂ O)	10.2 (41.0)		

Standard set-mounted radiator cooling

Ambient design, °C (°F)	40 (104)		
Fan load, kW _m (HP)	19 (25.5)		
Coolant capacity (with radiator), L (US gal)	57.9 (15.3)		
Cooling system air flow, m ³ /min (scfm)	707.5 (25000.0)		
Total heat rejection, MJ/min (Btu/min)	19.6 (18485.0)	17.7 (16680.0)	
Maximum cooling air flow static restriction, kPa (in H ₂ O)	0.12 (0.5)		

Optional set-mounted radiator cooling

Ambient design, °C (°F)	50 (122)		
Fan load, kW _m (HP)	19 (25.5)		
Coolant capacity (with radiator), L (US gal)	57.9 (15.3)		
Cooling system air flow, m ³ /min (scfm)	707.5 (25000.0)		
Total heat rejection, MJ/min (Btu/min)	19.6 (18485.0)	17.7 (16680.0)	
Maximum cooling air flow static restriction, kPa (in H ₂ O)	0.12 (0.5)		

Optional heat exchanger cooling

Set coolant capacity, L (US Gal.)			
Heat rejected, jacket water circuit, MJ/min (Btu/min)			
Heat rejected, after-cooler circuit, MJ/min (Btu/min)			
Heat rejected, fuel circuit, MJ/min (Btu/min)			
Total heat radiated room, MJ/min (Btu/min)			
Maximum raw water pressure, jacket water circuit, kPa (psi)			
Maximum raw water pressure, after-cooler circuit, kPa (psi)			
Maximum raw water pressure, fuel circuit, kPa (psi)			
Maximum raw water flow, jacket water circuit, L/min (US gal/min)			
Maximum raw water flow, after-cooler circuit, L/min (US gal/min)			
Maximum raw water flow, fuel circuit, L/min (US gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, jacket water circuit, L/min (US gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, after-cooler circuit, L/min (US gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, fuel circuit, L/min (US gal/min)			

Optional heat exchanger cooling (continued)

Raw water delta P at min flow, jacket water circuit, kPa (psi)			
Raw water delta P at min flow, after-cooler circuit, kPa (psi)			
Raw water delta P at min flow, fuel circuit, kPa (psi)			
Maximum jacket water outlet temp, °C (°F)			
Maximum after-cooler inlet temp, °C (°F)			
Maximum after-cooler inlet temp at 25 °C (77 °F) ambient, °C (°F)			

Optional remote radiator cooling¹

Set coolant capacity, L (US gal)	
Max flow rate at max friction head, jacket water circuit, L/min (US gal/min)	
Max flow rate at max friction head, after-cooler circuit, L/min (US gal/min)	
Heat rejected, jacket water circuit, MJ/min (Btu/min)	
Heat rejected, after-cooler circuit, MJ/min (Btu/min)	
Heat rejected, fuel circuit, MJ/min	
Total heat radiated to room, MJ/min (Btu/min)	
Maximum friction head, jacket water circuit, kPa (psi)	
Maximum friction head, after-cooler circuit, kPa (psi)	
Maximum static head, jacket water circuit, m (ft)	
Maximum static head, after-cooler circuit, m (ft)	
Maximum jacket water outlet temp, °C (°F)	
Maximum after-cooler inlet temp at 25 °C (77 °F) ambient, °C (°F)	
Maximum after-cooler inlet temp, °C (°F)	
Maximum fuel flow, L/hr (US gph)	
Maximum fuel return line restriction, kPa (in Hg)	

Weights²

Unit dry weight kgs (lbs)	4325 (9535)
Unit wet weight kgs (lbs)	4461 (9835)

Notes:

¹ For non-standard remote installations contact your local Cummins representative.

² Weights represent a set with standard features. See outline drawing for weights of other configurations.

Derating factors

Standby	<p>Genset may be operated at up to 1400 m (4593 ft) and 40°C (104°F) without power deration. For sustained operation above these conditions, derate by 3.1% per 305 m (1000 ft), and 9% per 10°C (9% per 18°F).</p> <p>Genset may be operated at up to 500 m (1640 ft) and 50°C (122°F) without power deration. For sustained operation above these conditions, derate by 3% per 305 m (1000 ft), and 9.5% per 10°C (9% per 18°F).</p>
Prime	<p>Genset may be operated at up to 2250 m (7382 ft) and 40°C (104°F) without power deration. For sustained operation above these conditions, derate by 3.2% per 305 m (1000 ft), and 16.6% per 10°C (16.6% per 18°F).</p> <p>Genset may be operated at up to 1600 m (5249 ft) and 50°C (122°F) without power deration. For sustained operation above these conditions, derate by 3.2% per 305 m (1000 ft), and 16.6% per 10°C (16.6% per 18°F).</p>
Continuous	

Ratings definitions

Emergency Standby Power (ESP):	Limited-Time Running Power (LTP):	Prime Power (PRP):	Base Load (Continuous) Power (COP):
Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power to a constant electrical load for limited hours. Limited-Time Running Power (LTP) is in accordance with ISO 8528.	Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) is in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.

Alternator data

Three phase table ¹	105 °C	105 °C	105 °C	125 °C	125 °C	125 °C	125 °C	125 °C	125 °C	150 °C	150 °C	150 °C	150 °C
Feature code	B262	B301	B252	B258	B252	B414	B246	B300	B426	B413	B424	B419	
Alternator data sheet number	308	307	307	308	307	308	306	306	307	307	305	306	
Voltage ranges	110/190 thru 139/240 220/380 thru 277/480	347/600	120/208 thru 139/240 240/416 thru 277/480	110/190 thru 139/240 220/380 thru 277/480	120/208 thru 139/240 240/416 thru 277/480	120/208 thru 139/240 240/416 thru 277/480	277/480	347/600	110/190 thru 139/240 220/380 thru 277/480	120/208 thru 139/240 240/416 thru 277/480	277/480	347/600	
Surge kW	514	517	514	514	514	516	515	515	512	514	512	515	
Motor starting kVA (at 90% sustained voltage)	Shunt												
	PMG	2429	2208	2208	2429	2208	2429	1896	1896	2208	2208	1749	1896
Full load current - amps at Standby rating	<u>110/190</u> 1901	<u>120/208</u> 1737	<u>110/220</u> 1642	<u>115/230</u> 1571	<u>139/240</u> 1505	<u>220/380</u> 951	<u>230/400</u> 903	<u>240/416</u> 868	<u>255/440</u> 821	<u>277/480</u> 753	<u>347/600</u> 602		

Note:

¹ Single phase power can be taken from a three phase generator set at up to 40% of the generator set nameplate kW rating at unity power factor.

Formulas for calculating full load currents:

Three phase output

Single phase output

$$\frac{\text{kW} \times 1000}{\text{Voltage} \times 1.73 \times 0.8} \qquad \frac{\text{kW} \times \text{SinglePhaseFactor} \times 1000}{\text{Voltage}}$$

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

Our energy working for you.™





PowerCommand®

2.3 Control System



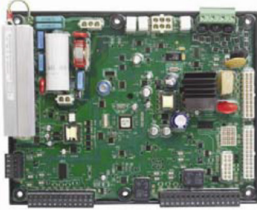
Control System Description

The PowerCommand control system is a microprocessor-based generator set monitoring, metering and control system designed to meet the demands of today's engine driven generator sets. The integration of all control functions into a single control system provides enhanced reliability and performance, compared to conventional generator set control systems. These control systems have been designed and tested to meet the harsh environment in which gensets are typically applied.

Features

- 320 x 240 pixels graphic LED backlight LCD.
- Multiple language support.
- AmpSentry™ protective relay - true alternator overcurrent protection.
- Real time clock for fault and event time stamping.
- Exerciser clock and time of day start/stop.
- Digital voltage regulation. Three phase full wave FET type regulator compatible with either shunt or PMG systems.
- Generator set monitoring and protection.
- 12 and 24 VDC battery operation.
- Modbus® interface for interconnecting to customer equipment.
- Warranty and service. Backed by a comprehensive warranty and worldwide distributor service network.
- Certifications - suitable for use on generator sets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std., CE and CSA standards.

PowerCommand Digital Genset Control PCC 2300



Description

The PowerCommand generator set control is suitable for use on a wide range of generator sets in non-paralleling applications. The PowerCommand control is compatible with shunt or PMG excitation style. It is suitable for use with reconnectable or non-reconnectable generators, and it can be configured for any frequency, voltage and power connection from 120-600 VAC Line-to-Line.

Power for this control system is derived from the generator set starting batteries. The control functions over a voltage range from 8 VDC to 30 VDC.

Features

- 12 and 24 VDC battery operation.
- Digital voltage regulation - Three phase full wave FET type regulator compatible with either shunt or PMG systems. Sensing is three phase.
- Full authority engine communications (where applicable) - Provides communication and control with the Engine
- due to thermal 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 overload or electrical faults by inverse time protection
- Common harnessing - with higher feature Cummins controls. Allows for easy field upgrades.
- Generator set monitoring - Monitors status of all critical engine and alternator functions.
- Digital genset metering (AC and DC).
- Genset battery monitoring system to sense and warn against a weak battery condition.
- Configurable for single or three phase AC metering.
- Engine starting - Includes relay drivers for starter, Fuel Shut Off (FSO), glow plug/spark ignition power and switch B+ applications.
- Generator set protection – Protects engine and alternator.
- Real time clock for fault and event time stamping.
- Exerciser clock and time of day start/stop.
- Advanced serviceability - using InPower™, a PC-based software service tool.

- Environmental protection - The control system is designed for reliable operation in harsh environments. The main control board is a fully encapsulated module that is protected from the elements.
- Modbus interface for interconnecting to customer equipment.
- Configurable inputs and outputs - Four discrete inputs and four dry contact relay outputs.
- Warranty and service - Backed by a comprehensive warranty and worldwide distributor service network.
- Certifications - Suitable for use on generator sets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std., CE and CSA standards.

Base Control Functions

HMI Capability

Operator adjustments - The HMI includes provisions for many set up and adjustment functions.

Generator set hardware data - Access to the control and software part number, generator set rating in kVA and generator set model number is provided from the HMI or InPower.

Data logs - Includes engine run time, controller on time, number of start attempts, total kWh, 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.)

Fault history - 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

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
- Comprehensive Full Authority Engine (FAE) data (where applicable)

Service adjustments - The HMI includes provisions for adjustment and calibration of generator set control functions. Adjustments are protected by a password. Functions include:

Service adjustments (continued)

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

Engine Control

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

12 VDC/24 VDC battery operations - PowerCommand will operate either on 12 VDC or 24 VDC batteries.

Temperature dependent governing dynamics (with electronic governing) - modifies the engine governing control parameters as a function of engine temperature. This allows the engine to be more responsive when warm and more stable when operating at lower temperature levels.

Isochronous governing - (where applicable) Capable of controlling engine speed within +/-0.25% for any steady state load from no load to full load. Frequency drift will not exceed +/-0.5% for a 33 °C (60 °F) change in ambient temperature over an 8 hour period.

Droop electronic speed governing - Control can be adjusted to droop from 0 to 10% from no load to full load.

Remote start mode - It accepts a ground signal from remote devices to automatically start the generator set and immediately accelerate to rated speed and voltage. The remote start signal will also wake up the control from sleep mode. The control can incorporate a time delay start and stop.

Remote and local emergency stop - The control accepts a ground signal from a local (genset mounted) or remote (facility mounted) emergency stop switch to cause the generator set to immediately shut down. The generator set is prevented from running or cranking with the switch engaged. If in sleep mode, activation of either emergency stop switch will wakeup the control.

Sleep mode - The control includes a configurable low current draw state to minimize starting battery current draw when the genset is not operating. The control can also be configured to go into a low current state while in auto for prime applications or applications without a battery charger.

Engine starting - The control system supports automatic engine starting. Primary and backup start disconnects are achieved by one of two methods: magnetic pickup or main alternator output frequency. The control also supports configurable glow plug control when applicable.

Cycle cranking - Is configurable for the number of starting cycles (1 to 7) and duration of crank and rest periods. Control includes starter protection algorithms to prevent the operator from specifying a starting sequence that might be damaging.

Time delay start and stop (cooldown) - Configurable for time delay of 0-300 seconds prior to starting after receiving a remote start signal and for time delay of 0-600 seconds prior to shut down after signal to stop in normal operation modes. Default for both time delay periods is 0 seconds.

Alternator Control

The control includes an integrated three phase Line-to-Line sensing voltage regulation system that is compatible with shunt or PMG excitation systems. The voltage regulation system is a three phase full wave rectified and has an FET output for good motor starting capability.

Major system features include:

Digital output voltage regulation - 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.

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

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

Fault current regulation - 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.

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 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.

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, shutdown or status indication and for labeling the input.

Emergency Stop

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

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.

General Engine Protection

Low and high battery voltage warning - 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 generator set is signaled to start and indicate a warning if the battery indicates impending failure.

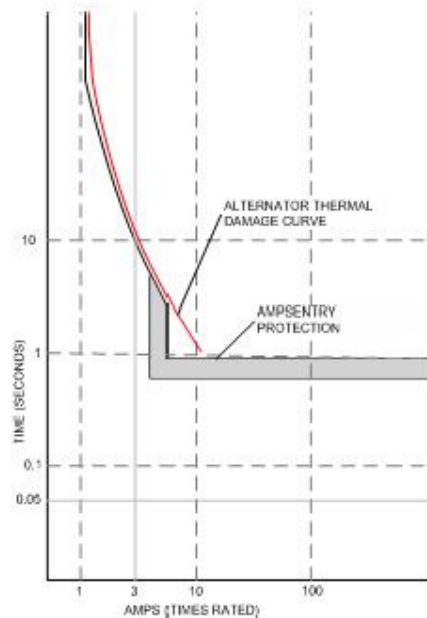
Fail to start (overcrank) shutdown - The control system will indicate a fault if the generator set fails to start by the completion of the engine crank sequence.

Fail to crank shutdown - Control has signaled starter to crank engine but engine does not rotate.

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

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 generator set or in the load. It also provides single and three phase fault current regulation 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 (2 sec for 1-Phase short, 5 sec for 2-Phase short). See document R1053 for a full-size time over current curve.



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 during synchronizing.

Under frequency shutdown (81 u) - Generator set 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 (81 o) - Generator set 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 - Thresholds and time delays are configurable. Implementation of the thermal damage curve with instantaneous trip level calculated based on current transformer ratio and application power rating.

Loss of sensing voltage shutdown - Shutdown of generator set will occur on loss of voltage sensing inputs to the control.

Field overload shutdown - Monitors field voltage to shutdown generator set 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 - 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.

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
- Battleshort
- Rupture basin
- Start type signal
- 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

Output signals from the PowerCommand control include:

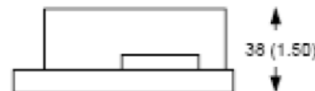
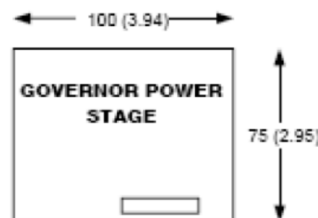
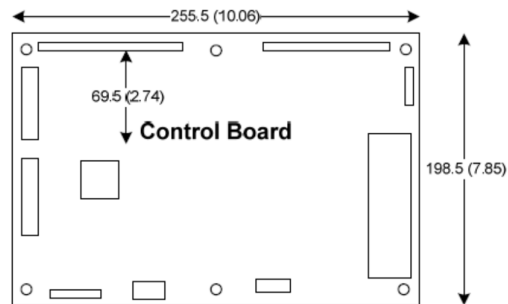
- Load dump signal: Operates when the generator set is in an overload condition.
- Delayed off signal: Time delay based output which will continue to remain active after the control has removed the run command. Adjustment range: 0 – 120 seconds. Default: 0 seconds.

- Configurable relay outputs: Control includes (4) relay output contacts (3 A, 30 VDC). 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 (generator set running) signal: Operates when the generator set has reached 90% of rated speed and voltage and latches until generator set is switched to off or idle mode.

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 products.

Mechanical Drawings



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

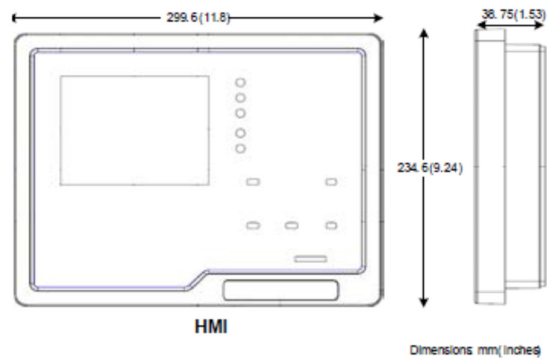
- LED indicating lamps:
 - Genset running
 - Remote start
 - Not in auto
 - Shutdown
 - Warning
 - Auto
 - Manual and stop
- 320 x 240 pixels graphic LED backlight LCD.
- Four tactile feel membrane switches for LCD defined operation. The functions of these switches are defined dynamically on the LCD.
- 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 generator sets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std., CE and CSA standards.
- LCD languages supported: English, Spanish, French, German, Italian, Greek, Dutch, Portuguese, Finnish, Norwegian, Danish, Russian and Chinese Characters.

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 generator sets 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 °C to +70 °C (-40 °F to 158 °F) and for storage from -55 °C to +80 °C (-67 °F to 176 °F). Control will operate with humidity up to 95%, non-condensing.

The HMI is designed for proper operation in ambient temperatures from -20 °C to +70 °C (-4 °F to 158 °F) and for storage from -30 °C to +80 °C (-22 °F to 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 generator set. 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: 1993 compliance, controls and switchgear.
- CE marking: The control system is suitable for use on generator sets to be CE-marked.
- EN50081-1,2 residential/light industrial emissions or industrial emissions.
- EN50082-1,2 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 and 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.

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.



Our energy working for you.™

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Alternator data sheet

Frame size: **HC5D**

Characteristics								
Weights:	Wound stator assembly:	1433 lb		650 kg				
	Rotor assembly:	1190 lb		536 kg				
	Complete assembly:	3090 lb		1392 kg				
Maximum speed:		2250 rpm						
Excitation current:	Full load:	1.72 Amps						
	No load:	0.40 Amps						
Insulation system:	Class H throughout							
3 ∅ Ratings (0.8 power factor)		60 Hz (winding no)				50 Hz (winding no)		
(Based on specific temperature rise at 40 °C ambient temperature)		110/190 <u>220/380</u> (311/312)	120/208 <u>240/416</u> (311/312)	139/240 <u>277/480</u> (311/312)	<u>347/600</u> (07/17)	110/190 <u>220/380</u> (311/312)	120/208 <u>240/415</u> (311/312)	127/220 <u>254/440</u> (311/312)
150 °C Rise ratings	kW	428	470	540	540	412	412	412
	kVA	535	588	675	515	515	515	515
125 °C Rise ratings	kW	420	460	515	515	400	400	400
	kVA	525	775	644	644	500	500	500
105 °C Rise ratings	kW	376	415	470	470	360	360	360
	kVA	470	519	588	588	450	450	450
80 °C Rise ratings	kW	328	360	412	412	312	312	312
	kVA	410	450	515	515	390	390	390
Reactances (per unit ±10%)		110/190 <u>220/380</u>	120/208 <u>240/416</u>	139/240 <u>277/480</u>	<u>347/600</u>	110/190 <u>220/380</u>	120/208 <u>240/415</u>	127/220 <u>254/440</u>
(Based on full load at 125 °C rise rating)								
Synchronous		3.85	3.52	2.96	2.96	3.02	2.53	2.25
Transient		0.18	0.17	0.14	0.14	0.16	0.14	0.12
Subtransient		0.13	0.12	0.10	0.10	0.11	0.10	0.08
Negative sequence		0.25	0.23	0.19	0.19	0.19	0.16	0.14
Zero sequence		0.11	0.10	0.09	0.09	0.09	0.08	0.07
Motor starting		<u>Broad range</u>			<u>600</u>	<u>Broad range</u>		
Maximum kVA	(90% sustained voltage)	1896			1896	1443		
Time constants (sec)		<u>Broad range</u>			<u>600</u>	<u>Broad range</u>		
Transient		0.080			0.080	0.080		
Subtransient		0.012			0.012	0.012		
Open circuit		2.200			2.200	2.200		
DC		0.018			0.018	0.018		
Windings (@ 20 °C)		<u>Broad range</u>			<u>600</u>	<u>Broad range</u>		
Stator resistance	(Ohms per phase)	0.0116			0.0158	0.0116		
Rotor resistance	(Ohms)	1.7700			1.7700	1.7700		
Number of leads		12			6	12		

Single phase power can be taken up to 40% of 3 phase-ratings



Data Sheet

Circuit Breakers

Description

This Data sheet provides circuit breaker manufacturer part numbers and specifications. The Circuit breaker box description is the rating of that breaker box installation on a Cummins Generator. Please refer to the website of the circuit breaker manufacturer for breaker specific ratings and technical information.

Applicable Models

Engine	Models					
Kubota	C10D6	C15D6	C20D6			
QJSJ2.4	C20N6	C25N6	C30N6	C30N6H	C36N6	C36N6H
	C40N6	C40N6H	C50N6H	C60N6H		
B3.3	C25D6	C30D6	C35D6	C40D6	C50D6	C60D6
QJSJ5.9G	C45N6	C50N6	C60N6	C70N6	C80N6	C100N6
QJSJ8.9G	C125N6	C150N6				
QSB5	DSFAC	DSFAD	DSFAE	C50D6C	C60D6C	C80D6C
	C100D6C	C125D6C				
QSB7	DSGAA	DSGAB	DSGAC	DSGAD	DSGAE	
		C125D6D	C150D6D	C175D6D	C200D6D	
QSL9	DSHAD	DQDAA	DQDAB	DQDAC		
QSM11	DQHAB					
QSX15	DFEJ	DFEK				

Instructions

1. Locate the circuit breaker feature code or part number and use the charts below to find the corresponding manufacturer circuit breaker catalog number.
2. Use the first letter of the circuit breaker catalog number to determine the "frame" of the breaker. If the first letter is an "N", use the second letter. Then follow the corresponding website link from the table below to find the breaker catalog number description.

Please refer to the catalog numbering systems page, which is given in the chart, to understand the nomenclature of the catalog number.

Frame	Catalog name*	Catalog number description page(s)
P	0612CT0101 http://www.schneider-electric.us/en/download/document/0612CT0101/	16-17
H, J, and L	0611CT1001 http://www.schneider-electric.us/en/download/document/0611CT1001/	8-9
Q	0734CT0201 http://www.schneider-electric.us/en/download/document/0734CT0201/	4

*The following link may also be used to search specifically by the breaker part number or for the catalog name listed above. <http://products.schneider-electric.us/technical-library/>

3. Search the catalog by using the first 3 letters of the breaker catalog number and the first 5 numbers to find information such as trip curves, accessories, and dimensional details regarding the circuit breaker.

*If the catalog number starts with "N", skip the N and begin your search with the second letter.

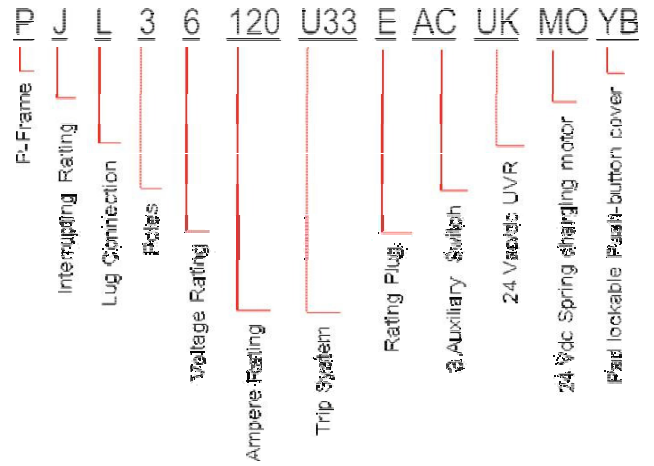
*If the first 3 letters are "PJP," the search will not work. You will need to start with just "PJ" and use the description pages to obtain the information you are looking for on the "PJP."

Example

After finding your circuit breaker catalog number to be "PJL36120U33EACUKMOYB," navigate to the P-frame catalog by using the link provided.

Look at pages 16-17 of the pdf catalog to find the nomenclature of the breaker.

Search the P-frame spec sheet using the search "PJL36120."



Mechanically Operated Breakers						
Feature Code	Breaker Box Description	Cummins Part #	Manufacturer	Breaker Catalog Number	Trip Unit	Plug Type
KC60-2	Circuit Breaker-1200A,Right CB on Right side,3-Pole, UL 600,IEC 690, 100%	0320-2183	Schneider Electric	PJP36120U31E	MicroLogic 3.0 LI	E
KC61-2	Circuit Breaker-1200A,Left CB on Right side,3-Pole, UL 600,IEC 690, 100%	0320-2183	Schneider Electric	PJP36120U31E	MicroLogic 3.0 LI	E
KC62-2	Circuit Breaker-800A,Right CB on Right side,3-Pole,UL 600,IEC 690 100%	0320-2182	Schneider Electric	PJP36080U31F	MicroLogic 3.0 LI	F
KC63-2	Circuit Breaker-800A,Left CB on Right side,3-Pole, UL 600,IEC 690 100%	0320-2182	Schneider Electric	PJP36080U31F	MicroLogic 3.0 LI	F
KC64-2	Circuit Breaker-600A,Right CB on Right side,3-Pole, UL 600,IEC 690, 100%	A044T468	Schneider Electric	NLGL36600U33X-600A	MicroLogic 3.3S	N/A
KC65-2	Circuit Breaker-600A,Left CB on Right side,3-Pole, UL 600,IEC 690, 100%	A044T468	Schneider Electric	NLGL36600U33X-600A	MicroLogic 3.3S	N/A
KC66-2	Circuit Breaker-400A,Right CB on Right side,3-Pole,UL 600,IEC 690 100%	A045U083	Schneider Electric	NLGL36400U33XLY-400A	MicroLogic 3.3S	N/A
KC67-2	Circuit Breaker-400A,Left CB on Right side,3-Pole, UL 600,IEC 690 100%	A045U083	Schneider Electric	NLGL36400U33XLY-400A	MicroLogic 3.3S	N/A
KS80-2	CircuitBreaker-15A,Right,3P,600VAC,80%,UL	0320-2346-72	Schneider Electric	HGL36015	Thermal Magnetic	N/A
KS81-2	CircuitBreaker-15A,Left,3P,600VAC,80%,UL	0320-2346-72A	Schneider Electric	HGL36015	Thermal Magnetic	N/A
KS84-2	CircuitBreaker-20A,Right,3P,600VAC,80%,UL	0320-2346-71	Schneider Electric	HGL36020	Thermal Magnetic	N/A
KS85-2	CircuitBreaker-20A,Left,3P,600VAC,80%,UL	0320-2346-71A	Schneider Electric	HGL36020	Thermal Magnetic	N/A
KS88-2	CircuitBreaker-30A,Right,3P,600VAC,80%,UL	0320-2346-70	Schneider Electric	HGL36030	Thermal Magnetic	N/A
KS89-2	CircuitBreaker-30A,Left,3P,600VAC,80%,UL	0320-2346-70A	Schneider Electric	HGL36030	Thermal Magnetic	N/A
KS94-2	CircuitBreaker-40A,Right,3P,600VAC,80%,UL	0320-2346-69	Schneider Electric	HGL36040	Thermal Magnetic	N/A
KS95-2	CircuitBreaker-40A,Left,3P,600VAC,80%,UL	0320-2346-69A	Schneider Electric	HGL36040	Thermal Magnetic	N/A



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.



Status and Fault LED



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 x 173 mm)
Ambient temperature operation: At full rated output -		- 4 °F to 104 °F (-20 °C to 45 °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.
- 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.
- 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.
- 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.
- 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.
- Do not parallel these battery chargers with any other charging system.

Our energy working for you.™





2020 EPA Tier 2 Exhaust Emission Compliance Statement 500DFEK Stationary Emergency 60 Hz Diesel Generator Set

Compliance Information:

The engine used in this generator set complies with Tier 2 emissions limit 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: LCEXL015.AAJ-052
 Effective Date: 10/28/2019
 Date Issued: 10/28/2019
 EPA Engine Family (Cummins Emissions Family): LCEXL015.AAJ

Engine Information:

Model: QSX/QSX15/QSX15-G/QSX15-G9 Bore: 5.39 in. (137 mm)
 Engine Nameplate HP: 755 Stroke: 6.65 in. (169 mm)
 Type: 4 Cycle, In-line, 6 Cylinder Diesel Displacement: 912 cu. in. (15 liters)
 Aspiration: Turbocharged and CAC Compression ratio: 17.0:1
 Emission Control Device: Electronic Control Exhaust stack diameter: 8 in. (203 mm)

Diesel Fuel Emission Limits

D2 Cycle Exhaust Emissions

	Grams per BHP-hr			Grams per kWm-hr		
	<u>NO_x + NMHC</u>	<u>CO</u>	<u>PM</u>	<u>NO_x + NMHC</u>	<u>CO</u>	<u>PM</u>
Test Results	4.3	0.4	0.10	5.7	0.6	0.13
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: Cetane number: 40-50, Reference: 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 NO_x 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.



Sound data

500DFEK

60Hz Diesel

Sound pressure level @ 7 meters, dB(A)

See notes 1-8 listed below

Configuration		Measurement location number								Average
		1	2	3	4	5	6	7	8	
Standard – unhoused	Infinite exhaust	89	92	92	91	88	91	91	93	91
F183 – residential muffler	Mounted muffler	88	90	90	89	88	88	88	90	89
F200 – weather	Mounted muffler	91	90	85	88	89	88	85	91	89
F201 – quiet site II first stage	Mounted muffler	90	89	84	83	79	81	83	90	87
F202 – quiet site II second stage	Mounted muffler	71	73	71	72	73	74	74	73	73

Sound power level, dB(A)

See notes 2-6, 9, 10 listed below

Configuration		Octave band center frequency (Hz)								Overall sound power level
		63	125	250	500	1000	2000	4000	8000	
Standard – unhoused (note 3)	Infinite exhaust	82	98	104	109	112	113	111	113	119
F183 – residential muffler	Mounted muffler	105	114	115	111	108	108	102	101	119
F200 – weather	Mounted muffler	101	108	106	110	112	111	107	102	118
F201 – quiet site II first stage	Mounted muffler	101	108	105	108	111	109	106	99	116
F202 – quiet site II second stage	Mounted muffler	84	93	93	96	98	99	96	89	104

Exhaust sound power level, dB(A)

Open exhaust (no muffler) @ rated load	Octave band center frequency (Hz)								Overall sound power level
	63	125	250	500	1000	2000	4000	8000	
		103	119	125	123	125	126	127	121

Note:

- Position 1 faces the engine front. The positions proceed around the generator set in a counter-clockwise direction in 45° increments. All positions are at 7 m (23 ft) from the surface of the generator set and 1.2 m (48 in.) from floor level.
- Sound levels are subject to instrumentation, measurement, installation and manufacturing variability.
- Sound data with remote-cooled generator sets are based on rated loads without cooling fan noise.
- Sound levels for aluminum enclosures are approximately 2 dB(A)s higher than listed sound levels for steel enclosures.
- Sound data for generator set with infinite exhaust do not include exhaust noise.
- Data is based on full rated load with standard radiator-cooling fan package.
- Sound pressure levels are measured per ANSI S1.13 and ANSI S12.18, as applicable.
- Reference sound pressure is 20 µPa.
- Sound power levels per ISO 3744 and ISO 8528-10, as applicable.
- Reference power = 1 pw (10⁻¹²W).
- Exhaust sound power levels are per ISO 6798, as applicable.



Prototype Test Support (PTS) 60 Hz test summary



<u>Generator set models</u>	<u>Representative prototype</u>
450DFEJ 500DFEK	Model: 500DFEK Alternator: HC5F Engine: QSX15-G9

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

Maximum motor starting: 2429 kVA
 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.

Torsional analysis and testing:
 The generator set was tested to verify that the design is not subjected to harmful torsional stresses in excess of 5000 psi. A spectrum analysis of the transducer output was conducted over the speed range of 1200 to 2000 RPM.

Cooling system: 50 °C ambient
 0.50 in. H₂O restriction

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

Durability:
 The generator set was subjected to a minimum 500 hour endurance test operating at variable load up to the Standby rating based upon MIL-STD-705 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 was within the specified maximum limits.

Voltage regulation: ± 0.5%
 Random voltage variation: ± 0.3%
 Frequency regulation: Isochronous
 Random frequency variation: ± 0.25%

Transient performance:
 The generator set was tested with the standard alternator to verify single step loading capability as required by NFPA 110. Verify acceptable Voltage and frequency response on load addition or rejection were evaluated. The following results were recorded:

Full load acceptance:

Voltage dip:	30.1%
Recovery time:	3.6 seconds
Frequency dip:	9.9%
Recovery time:	3.8 seconds

Full load rejection:

Voltage rise:	12.8%
Recovery time:	3.8 seconds
Frequency rise:	3.2%
Recovery time:	1.5 seconds

Harmonic analysis:
 (per MIL-STD-705B, method 601.4)

<u>Harmonic</u>	<u>Line to Line</u>		<u>Line to Neutral</u>	
	<u>No load</u>	<u>Full load</u>	<u>No load</u>	<u>Full load</u>
3	0.1	0.1	0.1	0.1
5	0.3	1.2	0.3	1.1
7	0.4	1.1	0.4	1.0
9	0.0	0.0	0.0	0.0
11	0.7	0.9	0.6	0.8
13	0.2	0.3	0.1	0.2
15	0.0	0.0	0.0	0.0



Warranty Statement

Global Commercial Warranty Statement

Generator Set

Limited Warranty

Commercial Generating Set

This limited warranty applies to all Cummins Power Generation® branded commercial generating sets 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 500 hours of operation per year. The permissible average power output over 24 hours of operation shall not exceed 70% of the ESP.

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)**

Rating	Months	Max. Hours
COP	12	Unlimited
PRP	12	Unlimited
LTP	12	500 hrs
ESP	24	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 Power Generation® Responsibilities:

In the event of a failure of the Product during the warranty period due to defects in material or workmanship, Cummins Power Generation® 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 Power Generation® distributor or dealer within 30 days of the discovery of failure.
- Installing, operating, commissioning and maintaining the Product in accordance with Cummins Power Generation®'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 Power Generation® 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 Power Generation®.
- 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 Power Generation® Distributor for clarification concerning these limitations.

CUMMINS POWER GENERATION® RIGHT TO FAILED COMPONENTS:

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

Extended Warranty:

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

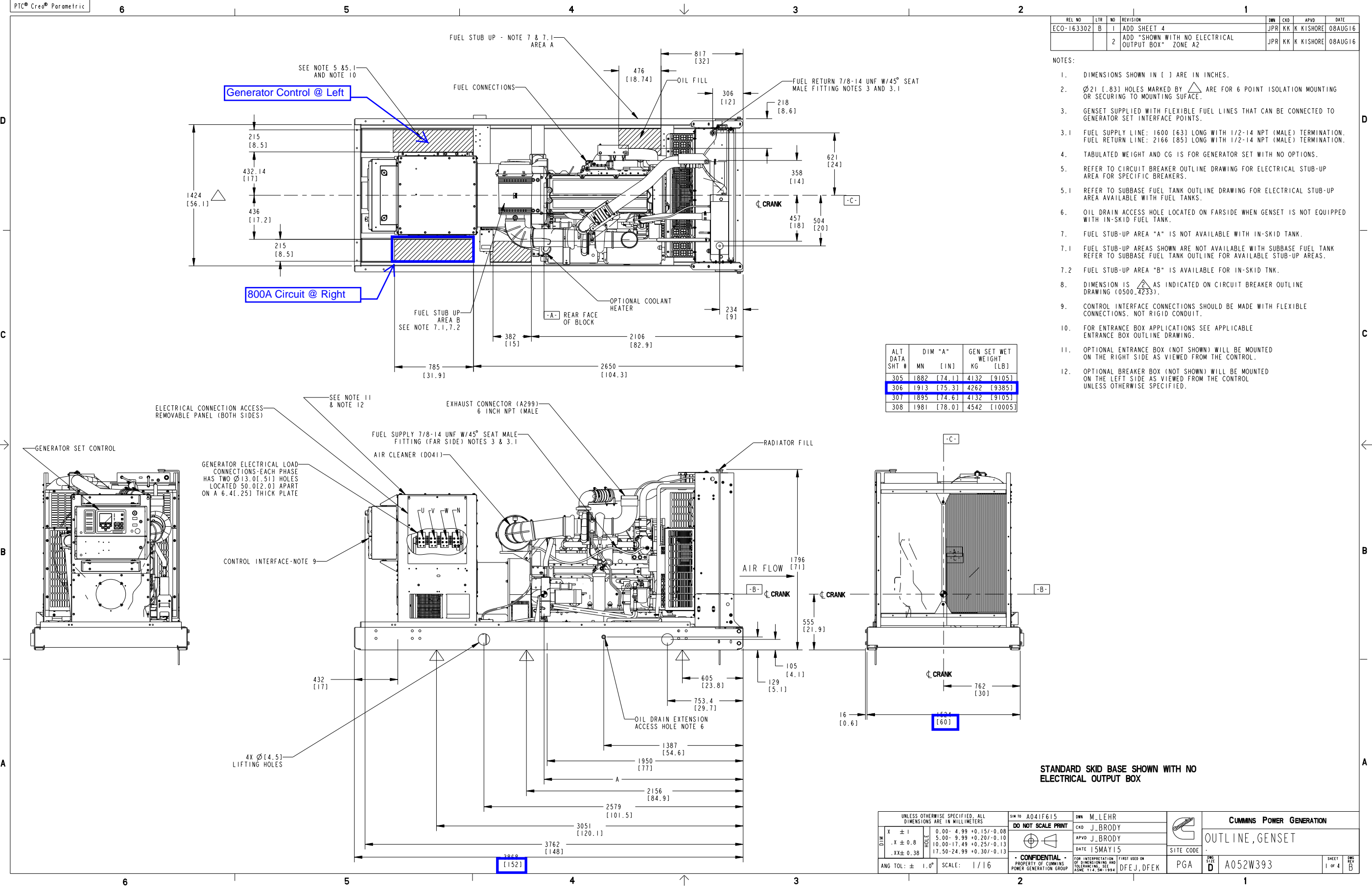
www.power.cummins.com

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

IN NO EVENT IS CUMMINS POWER GENERATION® LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

This limited warranty shall be enforced to the maximum extent permitted by applicable law. This limited warranty gives the owner specific rights that may vary from state to state or from jurisdiction to jurisdiction.

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



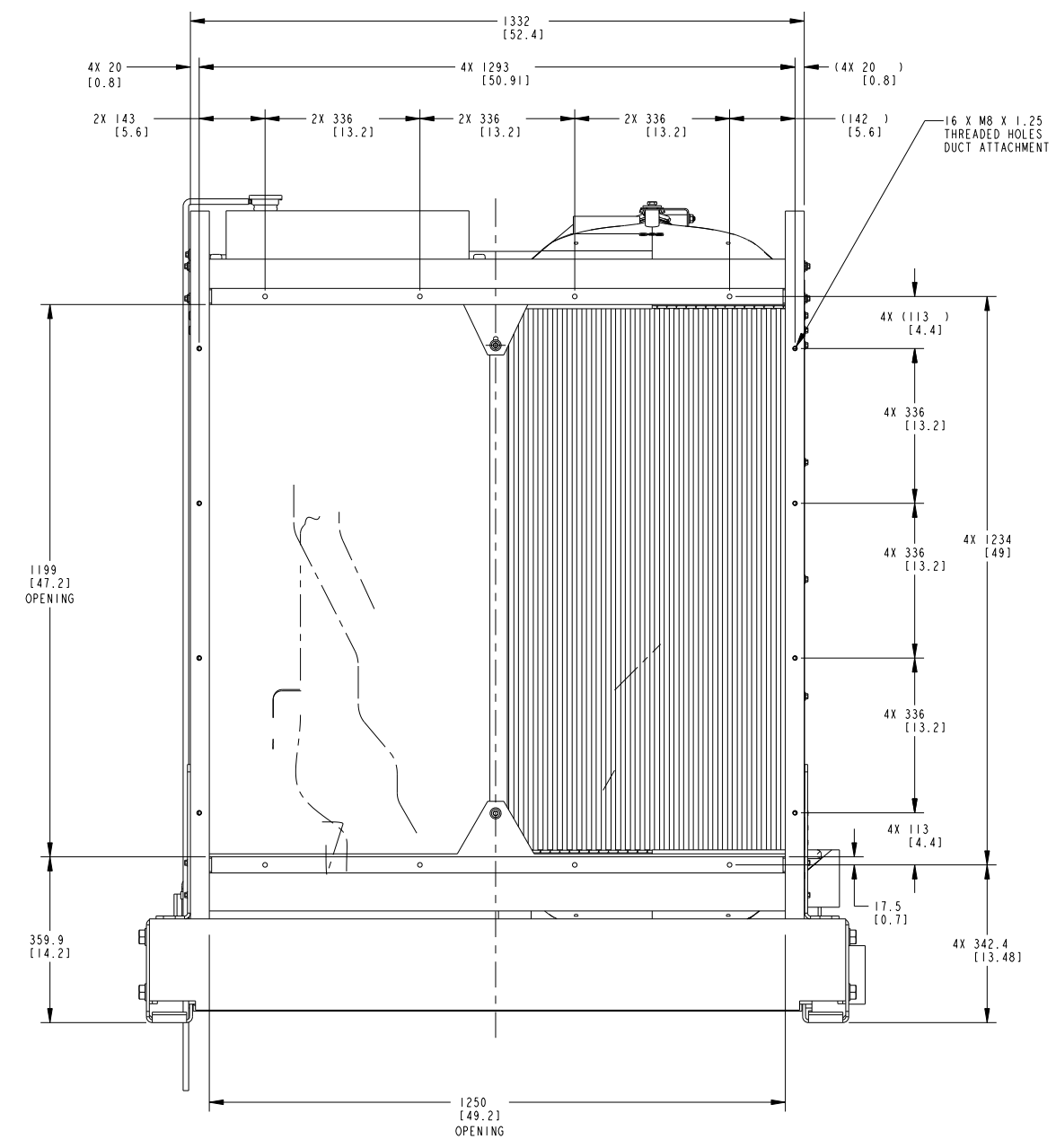
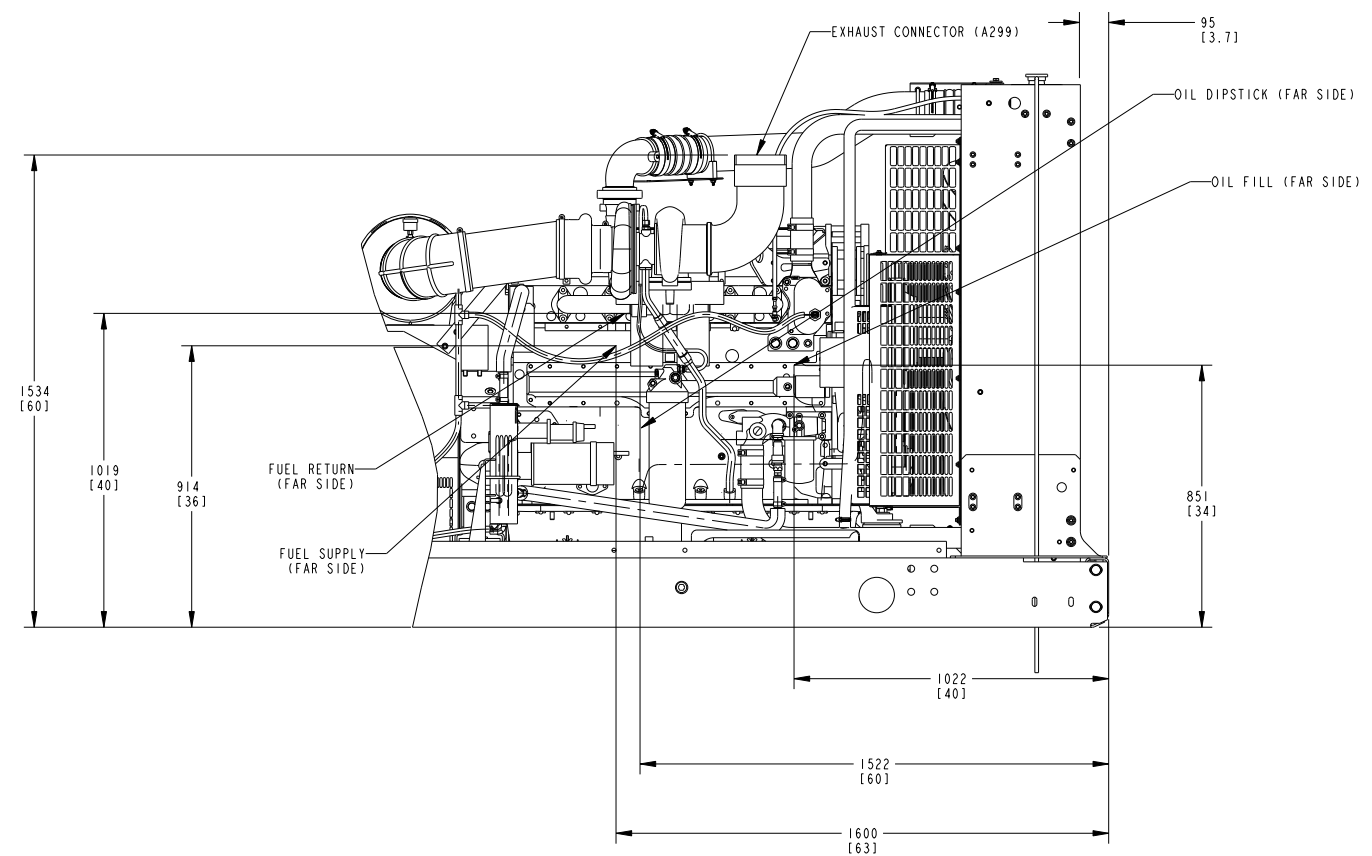
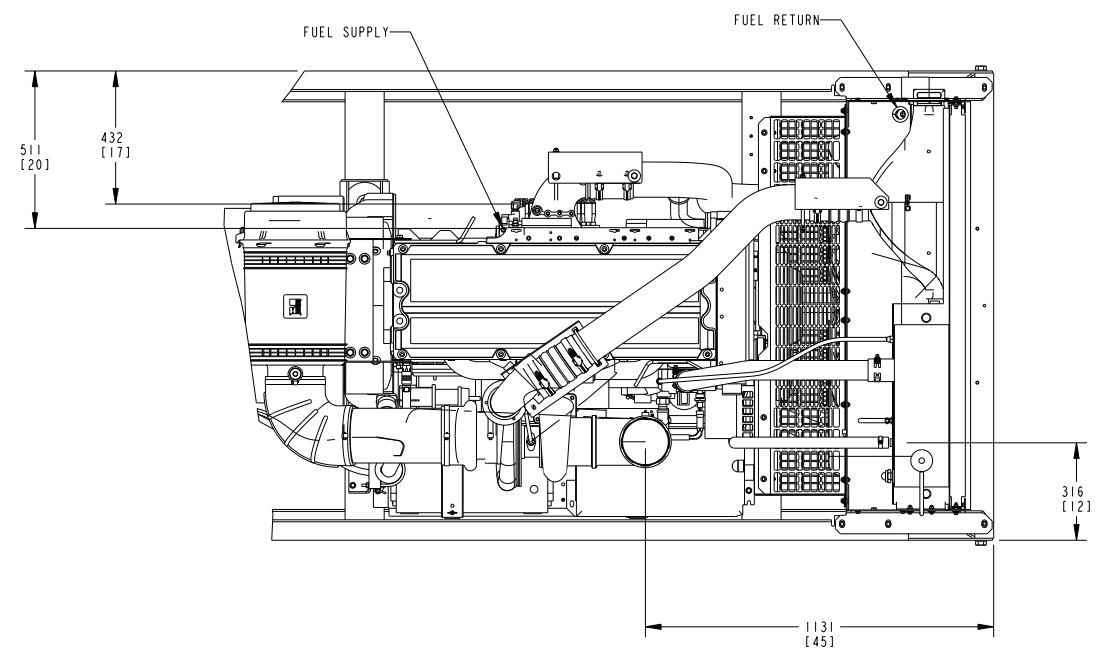
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		2	ADD "SHOWN WITH NO ELECTRICAL OUTPUT BOX" ZONE A2	JPR	KK	K KISHORE	08AUG16

- NOTES:
- DIMENSIONS SHOWN IN [] ARE IN INCHES.
 - Ø21 [0.83] HOLES MARKED BY \triangle ARE FOR 6 POINT ISOLATION MOUNTING OR SECURING TO MOUNTING SURFACE.
 - GENSET SUPPLIED WITH FLEXIBLE FUEL LINES THAT CAN BE CONNECTED TO GENERATOR SET INTERFACE POINTS.
 - FUEL SUPPLY LINE: 1600 [63] LONG WITH 1/2-14 NPT (MALE) TERMINATION. FUEL RETURN LINE: 2166 [85] LONG WITH 1/2-14 NPT (MALE) TERMINATION.
 - TABULATED WEIGHT AND CG IS FOR GENERATOR SET WITH NO OPTIONS.
 - REFER TO CIRCUIT BREAKER OUTLINE DRAWING FOR ELECTRICAL STUB-UP AREA FOR SPECIFIC BREAKERS.
 - REFER TO SUBBASE FUEL TANK OUTLINE DRAWING FOR ELECTRICAL STUB-UP AREA AVAILABLE WITH FUEL TANKS.
 - OIL DRAIN ACCESS HOLE LOCATED ON FAR SIDE WHEN GENSET IS NOT EQUIPPED WITH IN-SKID FUEL TANK.
 - FUEL STUB-UP AREA "A" IS NOT AVAILABLE WITH IN-SKID TANK.
 - FUEL STUB-UP AREAS SHOWN ARE NOT AVAILABLE WITH SUBBASE FUEL TANK REFER TO SUBBASE FUEL TANK OUTLINE FOR AVAILABLE STUB-UP AREAS.
 - FUEL STUB-UP AREA "B" IS AVAILABLE FOR IN-SKID TANK.
 - DIMENSION IS \triangle AS INDICATED ON CIRCUIT BREAKER OUTLINE DRAWING (0500_4233).
 - CONTROL INTERFACE CONNECTIONS SHOULD BE MADE WITH FLEXIBLE CONNECTIONS, NOT RIGID CONDUIT.
 - FOR ENTRANCE BOX APPLICATIONS SEE APPLICABLE ENTRANCE BOX OUTLINE DRAWING.
 - OPTIONAL ENTRANCE BOX (NOT SHOWN) WILL BE MOUNTED ON THE RIGHT SIDE AS VIEWED FROM THE CONTROL.
 - OPTIONAL BREAKER BOX (NOT SHOWN) WILL BE MOUNTED ON THE LEFT SIDE AS VIEWED FROM THE CONTROL UNLESS OTHERWISE SPECIFIED.

STANDARD SKID BASE SHOWN WITH NO ELECTRICAL OUTPUT BOX

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		SHEET NO: A041F615		DNW: M. LEHR		CUMMINS POWER GENERATION	
DO NOT SCALE PRINT		CAD: J. BRODY		APVD: J. BRODY		OUTLINE, GENSET	
DATE: 15MAY15		SITE CODE:		DATE: 15MAY15		PART NO: A052W393	
ANG TOL: ± 1.0°		SCALE: 1/16		PROPERTY OF CUMMINS POWER GENERATION GROUP		SHEET 1 OF 4	

REL NO	LTR	NO	REVISION	DNW	CAD	APVD	DATE
ECO-163302	B	--	----	JPR	KK	K KISHORE	08AUG16



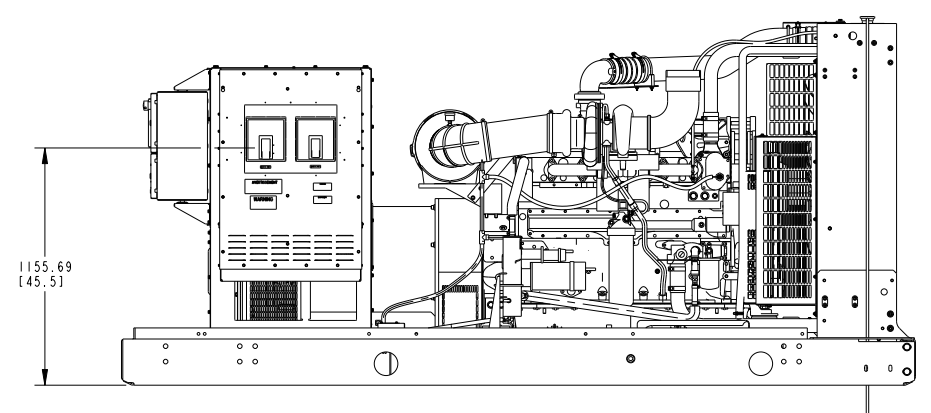
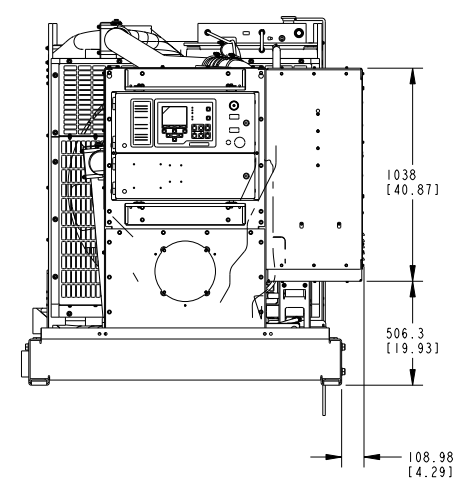
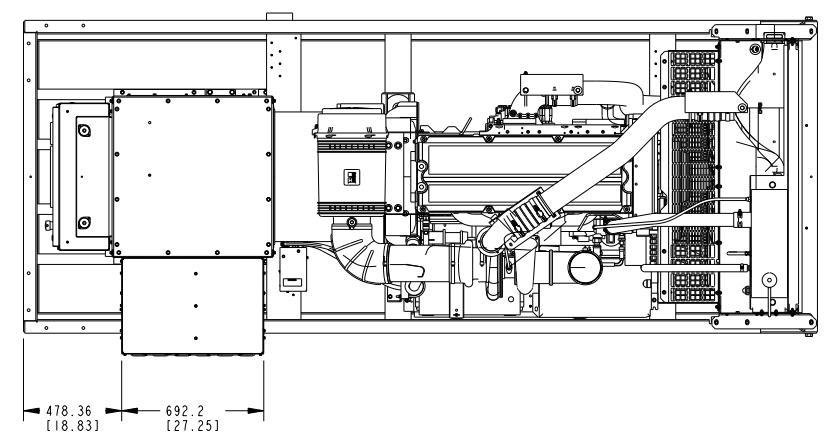
MOUNTING DIMENSIONS FOR DUCT ADAPTER

SCALE 5/32

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		SHW TO A041F615	DNW M. LEHR		CUMMINS POWER GENERATION		
DO NOT SCALE PRINT		DO NOT SCALE PRINT	CAD J. BRODY		OUTLINE, GENSET		
DIM	X ± 1	0.00-4.99 +0.15/-0.08	APVD J. BRODY		SITE CODE		
	.X ± 0.8	5.00-9.99 +0.20/-0.10	DATE 15MAY15				
	.XX ± 0.38	10.00-17.49 +0.25/-0.13					
ANG TOL: ± 1.0°		SCALE: 3/32	CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP FOR INTERPRETATION OF DIMENSIONS AND TOLERANCING, SEE ASME Y14.5M-1994		FIRST USED ON DFEJ, DFEK DFEJ, DFEK	SITE CODE PGA	SHEET 2 of 4 REV

PTC® Creo® Parametric

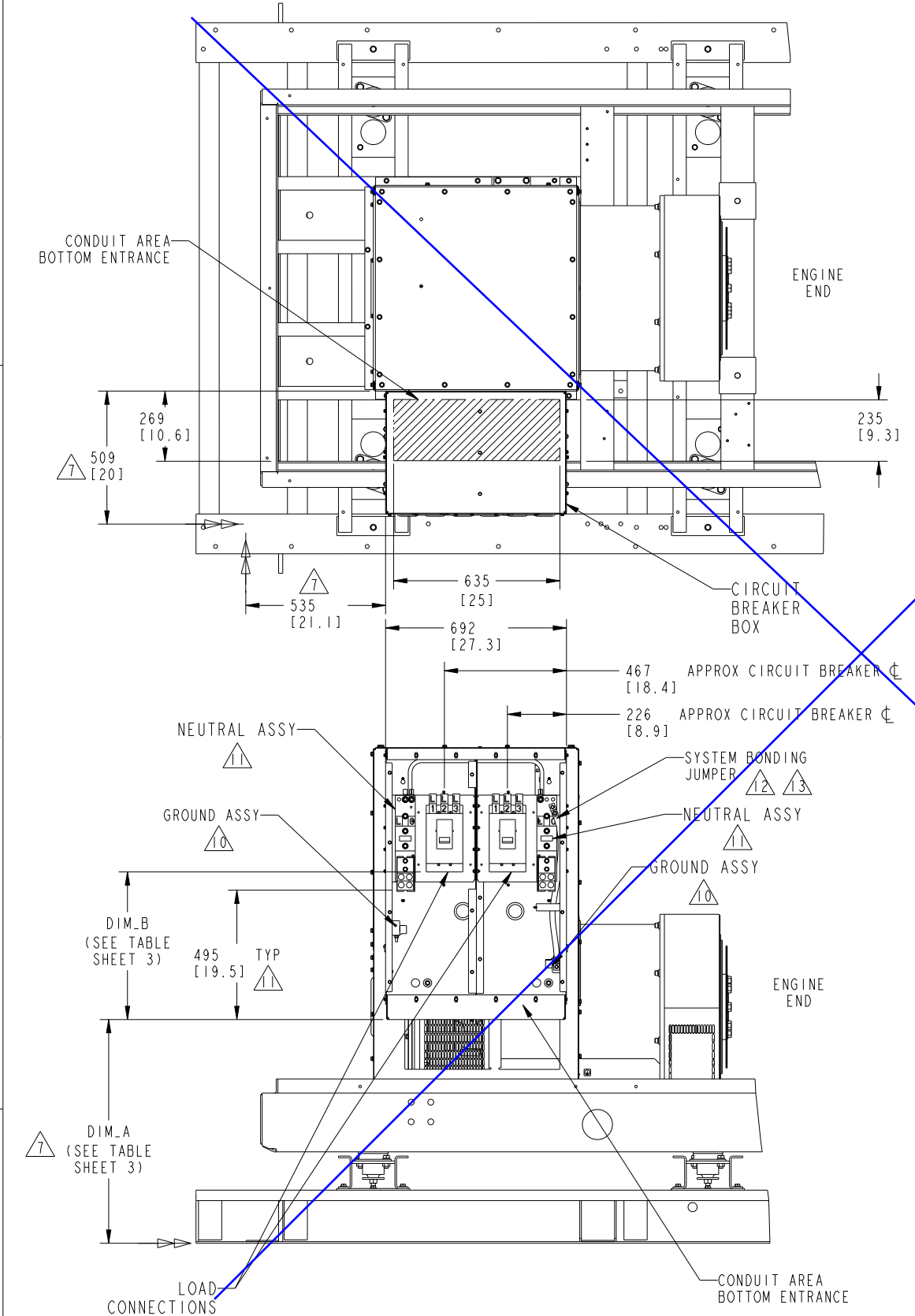
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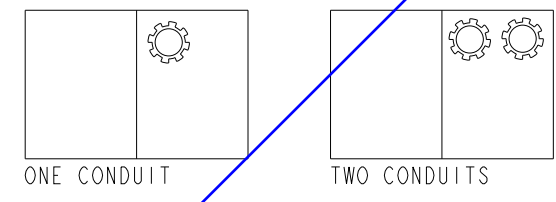
STANDARD SKID BASE SHOWN WITH
100% RATED CIRCUIT BREAKER BOX

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		SIN TO A041F615	DNW M_LEHR		CUMMINS POWER GENERATION																				
DO NOT SCALE PRINT			CAD J_BRODY		OUTLINE_GENSET																				
<table border="1"> <tr> <th>DIM</th> <th>TOL</th> <th>MIN</th> <th>MAX</th> </tr> <tr> <td>X ± 1</td> <td></td> <td>0.00-4.99</td> <td>+0.15/-0.08</td> </tr> <tr> <td>.X ± 0.8</td> <td></td> <td>5.00-9.99</td> <td>+0.20/-0.10</td> </tr> <tr> <td>.XX ± 0.38</td> <td></td> <td>10.00-17.49</td> <td>+0.25/-0.13</td> </tr> <tr> <td></td> <td></td> <td>17.50-24.99</td> <td>+0.30/-0.13</td> </tr> </table>		DIM	TOL	MIN	MAX	X ± 1		0.00-4.99	+0.15/-0.08	.X ± 0.8		5.00-9.99	+0.20/-0.10	.XX ± 0.38		10.00-17.49	+0.25/-0.13			17.50-24.99	+0.30/-0.13		APVD J_BRODY	SITE CODE	
DIM	TOL	MIN	MAX																						
X ± 1		0.00-4.99	+0.15/-0.08																						
.X ± 0.8		5.00-9.99	+0.20/-0.10																						
.XX ± 0.38		10.00-17.49	+0.25/-0.13																						
		17.50-24.99	+0.30/-0.13																						
ANG TOL: ± 1.0°		SCALE: 1/16	DATE 15MAY15		FOR INTERPRETATION OF DIMENSIONS AND TOLERANCING, SEE ASME Y14.5M-1994	FIRST USED ON DFEJ,DFEK																			
			PGA			A052W393																			
						SHEET 4 of 4																			

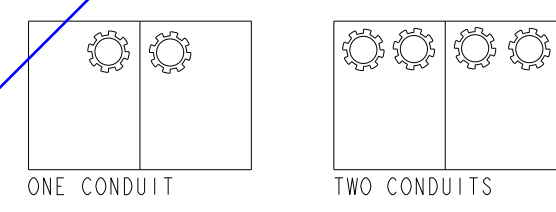
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		2	SEE SHEET 3	CJF	PA	L CASSENS	31AUG18



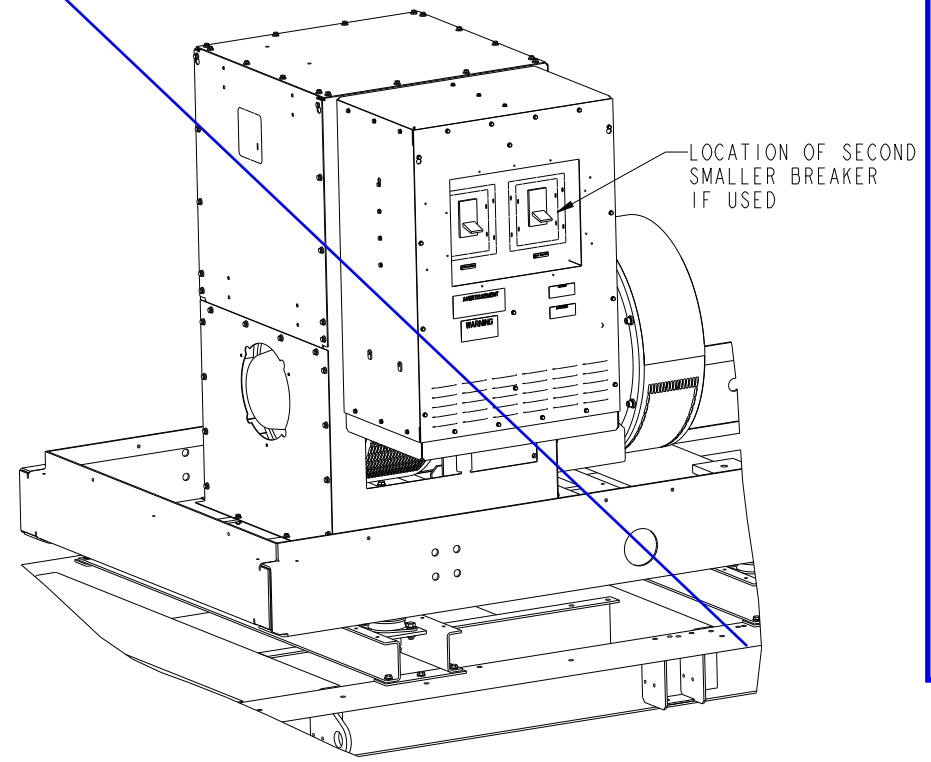
NSJ/NLG-FRAME 300-600A
RECOMMENDED CONDUIT LOCATIONS
SINGLE BREAKER



DUAL BREAKER



BOTTOM COVER
(LOOKING DOWN AT BOTTOM
OF BREAKER BOX)



DFEJ/DFEK
CIRCUIT BREAKER BOX
(RIGHT HAND BOTTOM ENTRY CONFIGURATION
NSJ/NLG-FRAME BREAKERS SHOWN)

NOTES:

- 1 ALL DIMENSIONS ARE FOR REFERENCE ONLY
- 2 DIMENSIONS SHOWN IN [] ARE IN INCHES
- 3 BOTTOM COVER IS ADJUSTABLE VERTICALLY PLUS OR MINUS 6 [0.25] TO EASE CONDUIT ATTACHMENT
- 4 THESE WIRE-CONDUIT COMBINATIONS MEET NEC AND CEC. TO USE OTHER COMBINATIONS, REFER TO APPLICABLE CODES TO ENSURE THAT WIRE AMPACITY, BEND SPACE AND GUTTER SPACE MEET THE REQUIREMENTS
- 5 "NS" SHUNT TRIP HAS NO INTERNAL CONTACTS, IT MUST BE USED IN CONJUNCTION WITH AUXILIARY CONTACTS TO ACCEPT CONTINUOUS APPLIED VOLTAGE. IT CAN OPERATE AT 75% OF NOMINAL VOLTAGE
- 6 CONDUITS AND WIRING SHOULD BE DESIGNED AND INSTALLED TO ALLOW FOR NORMAL GENERATOR SET MOVEMENT DURING CRANKING SHUT DOWN OR EXPECTED SEISMIC DISTURBANCES
- 7 SEE FOUNDATION LAYOUT DRAWING (GENSET OUTLINE (FOUNDATION)) FOR THE LOCATION OF THE ELECTRICAL STUB UP AREAS AND FOUNDATION REFERENCE POINT ()
- 8 ON FLORIDA UNITS WITH TANKS (FEATURE CODE LI16) ADD 106 [4.2] FOR RISER BEAMS THAT ARE REQUIRED ON THE UNDERSIDE OF THE TANK
- 9 BOX DIMENSIONS AND CONDUIT LOCATIONS ARE THE SAME FOR ENTRANCE BOX WITHOUT CONDUITS
- 10 EQUIPMENT GROUND AND GROUNDING ELECTRODE LUG IS MECHANICAL TYPE, COPPER 400 MCM-6 AWG SCREW 11/16"-16 UN-2B 5/16" HEX WRENCH
RECOMMENDED TORQUES:
250 MCM-1 AWG - 375 IN-LBS
2-6 AWG - 275 IN-LBS
- 11 NEUTRAL LUG IS MECHANICAL TYPE, COPPER #2-600 MCM SCREW 15/16"-16 UN-2B 3/8" HEX WRENCH
RECOMMENDED TORQUES:
600 MCM-4 AWG - 500 IN-LBS
- 12 TORQUE TO 9.8-11.9 Nm [7.2-8.8 FT-LBS] HARDWARE IS PROVIDED WITH BONDING JUMPER.
- 13 250 MCM SYSTEM BONDING JUMPER SIZED PER NEC TABLE 250.122 USING COPPER CABLE FOR A MAXIMUM AMPACITY RATING OF 2000 AMPS.
- 14 CIRCUIT BREAKER LUGS - REFER TO RECOMMENDED TORQUE ON LABEL.
- 15 MINIMUM WIRE BENDING SPACE AT BREAKER TERMINALS CALCULATED PER NEC TABLE 312.6(B) USING 500 MCM CABLES (2 WIRES PER TERMINAL), MECHANICAL LUGS USED AS TERMINALS.

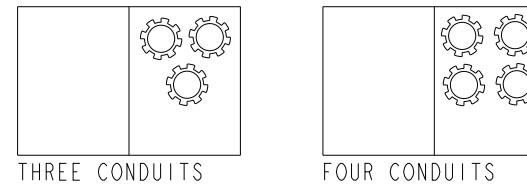
NUMBER OF CONDUCTORS PER PHASE CALCULATED PER TABLE 310.16 USING COPPER CABLES RATED AT 75° C ON A MAXIMUM AMBIENT TEMP OF 40° C.
- 16 MINIMUM WIRE BENDING SPACE AT GROUND TERMINALS CALCULATED PER NEC TABLE 312.6(A) USING [3/0-14] CABLES (1 WIRE PER TERMINAL), MECHANICAL LUGS USED AS TERMINALS.

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		SHW TO: A040J749	DWN: M_LEHR		CUMMINS POWER GENERATION	
DO NOT SCALE PRINT		CKD: J_BRODY	APVD: J_BRODY		OUTLINE, CIRCUIT BREAKER	
DATE 25MAY11		FIRST USED ON DFEJ,DFEK		SITE CODE	PGF	
ANG TOL: ± 1.0°		SCALE: 3/32	D		A052W389	

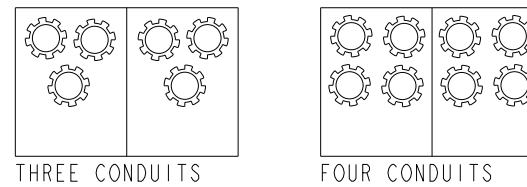
REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-180039	B	--	-----	CJF	PA	L CASSENS	31AUG18

**P-FRAME 800-1200A BREAKER
RECOMMENDED CONDUIT LOCATIONS**

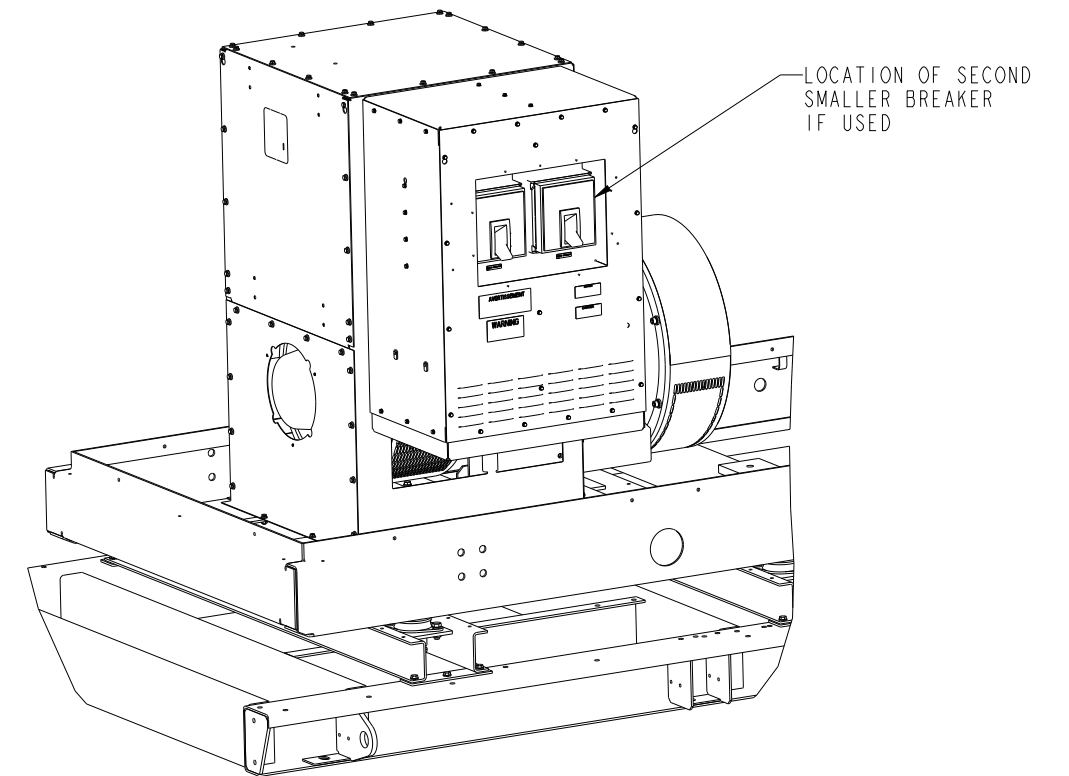
SINGLE BREAKER



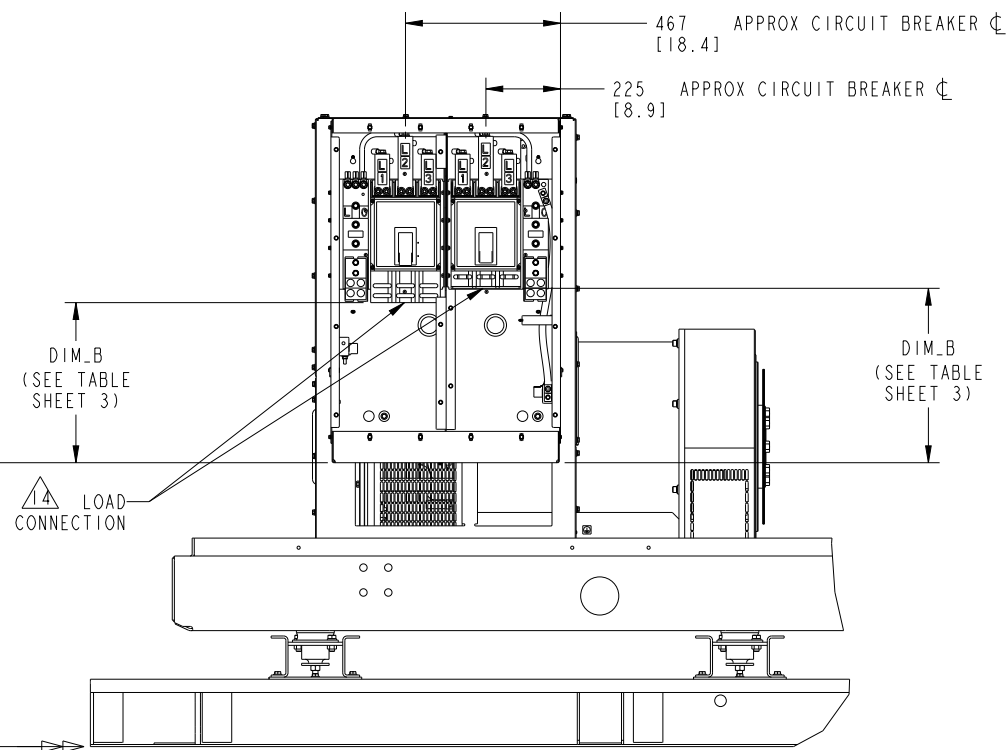
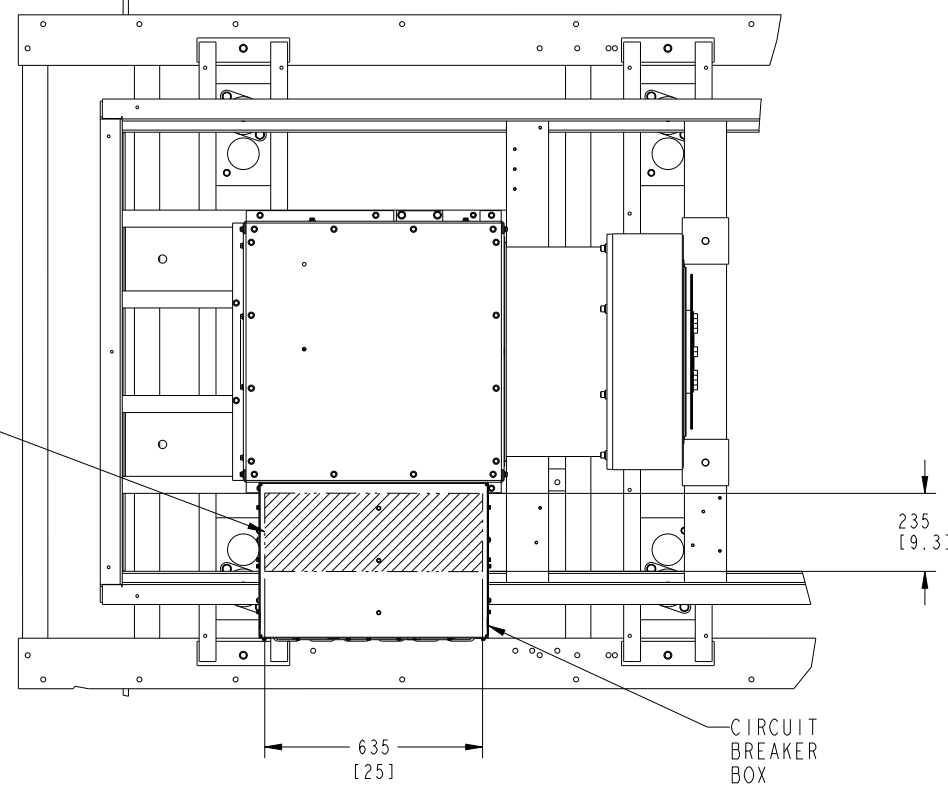
DUAL BREAKER



BOTTOM COVER
(LOOKING DOWN AT BOTTOM
OF BREAKER BOX)



CONDUIT AREA
BOTTOM ENTRANCE



DJEJ/DFEK
CIRCUIT BREAKER BOX
(RIGHT HAND BOTTOM ENTRY CONFIGURATION
P-FRAME BREAKERS SHOWN)

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		SHW TO: A040J749	DWN: M_LEHR		CUMMINS POWER GENERATION	
DIM	TOLERANCE	DO NOT SCALE PRINT	CKD: J_BRODY		OUTLINE, CIRCUIT BREAKER	
X ± 1	0.00 - 4.99 +0.15/-0.08		APVD: J_BRODY	SITE CODE	SHEET	DWG
.X ± 0.8	5.00 - 9.99 +0.20/-0.10		DATE 25MAY11			
.XX ± 0.38	10.00 - 17.49 +0.25/-0.13		DATE 25MAY11	1		
ANG TOL: ± 1.0°	17.50 - 24.99 +0.30/-0.13	SCALE: 3/32	DFEJ, DFEK	PGF	A052W389	B

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-180039	B	1	ZONE D-5: "#2---(400 AMPS)" WAS "#2---KCMIL"	CJF	PA	L CASSENS	31AUG18
		2	ZONE D-5: "270-500 KCMIL" WAS "270 350 KCMIL"	CJF	PA	L CASSENS	31AUG18

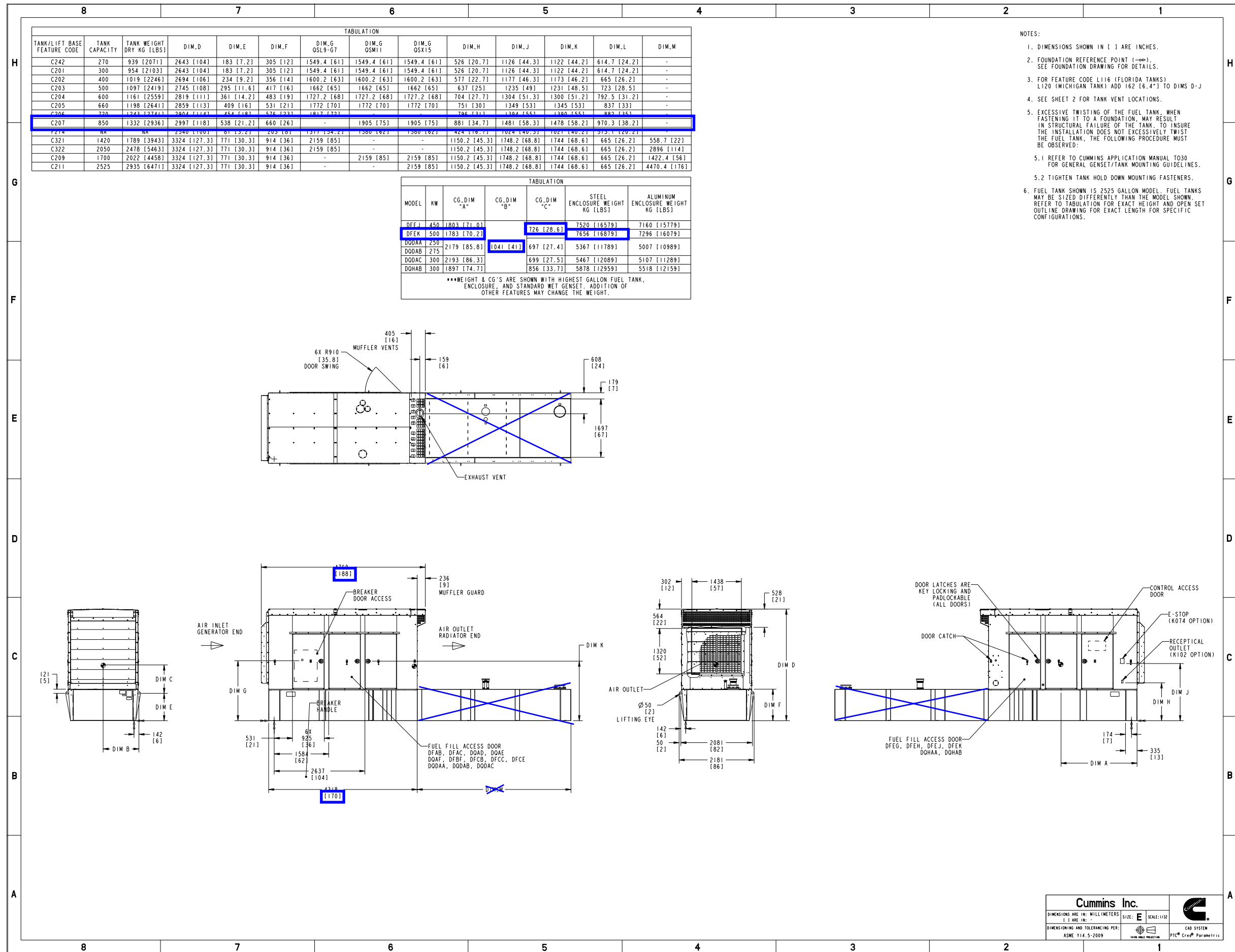
UL/IEC LUGS					ACCESSORY SPECIFICATIONS			
LUG	FRAME	MAX AMPS	WIRE RANGE COPPER	DIM_B	ACCESSORY DESCRIPTION	CONTACT RATING	INRUSH CURRENT	CONNECTION TYPE
	NSJ/NLG	400A 3 POLE	#2-600 KCMIL (250 AMPS) #2-500 KCMIL (400 AMPS)	565 [22.2]	24 VDC SHUNT TRIP	-	10A	COMPRESSION TERMINALS #20-16 AWG OR SMALLER TORQUE: 1.13 Nm [10 LB-IN]
		600A 3-POLE	270-500 KCMIL		1 EA. FORM C 1 AUX CONTACT + 1 TRIP ALARM	6A AT 690 VAC 2.5A AT 48 VDC, 0.3A AT 250 VDC	-	
	P	800A 3-POLE	370-500 KCMIL	18.9 [480]	24 VDC SHUNT TRIP	-	200VA	COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 1.13 Nm [10 LB-IN]
					1 EA. FORM C 4 AUX CONTACTS + 1 TRIP ALARM	6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125 VDC, 0.3A AT 250 VDC	-	
	P	1200A 3-POLE	370-500 KCMIL	17.2 [437]	24 VDC SHUNT TRIP	-	200VA	COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 1.13 Nm [10 LB-IN]
					1 EA. FORM C 4 AUX CONTACTS + 1 TRIP ALARM	6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125 VDC, 0.3A AT 250 VAC	-	

TYPICAL CONDUIT AND WIRE SIZE BASED ON NEC 2008, ARTICLE 310.15 AT 75C TEMPERATURE RATED CONDUCTOR AT 40C AMBIENT AND ANNEX C (LIQUID TIGHT FLEXIBLE METAL CONDUIT - LFCM)

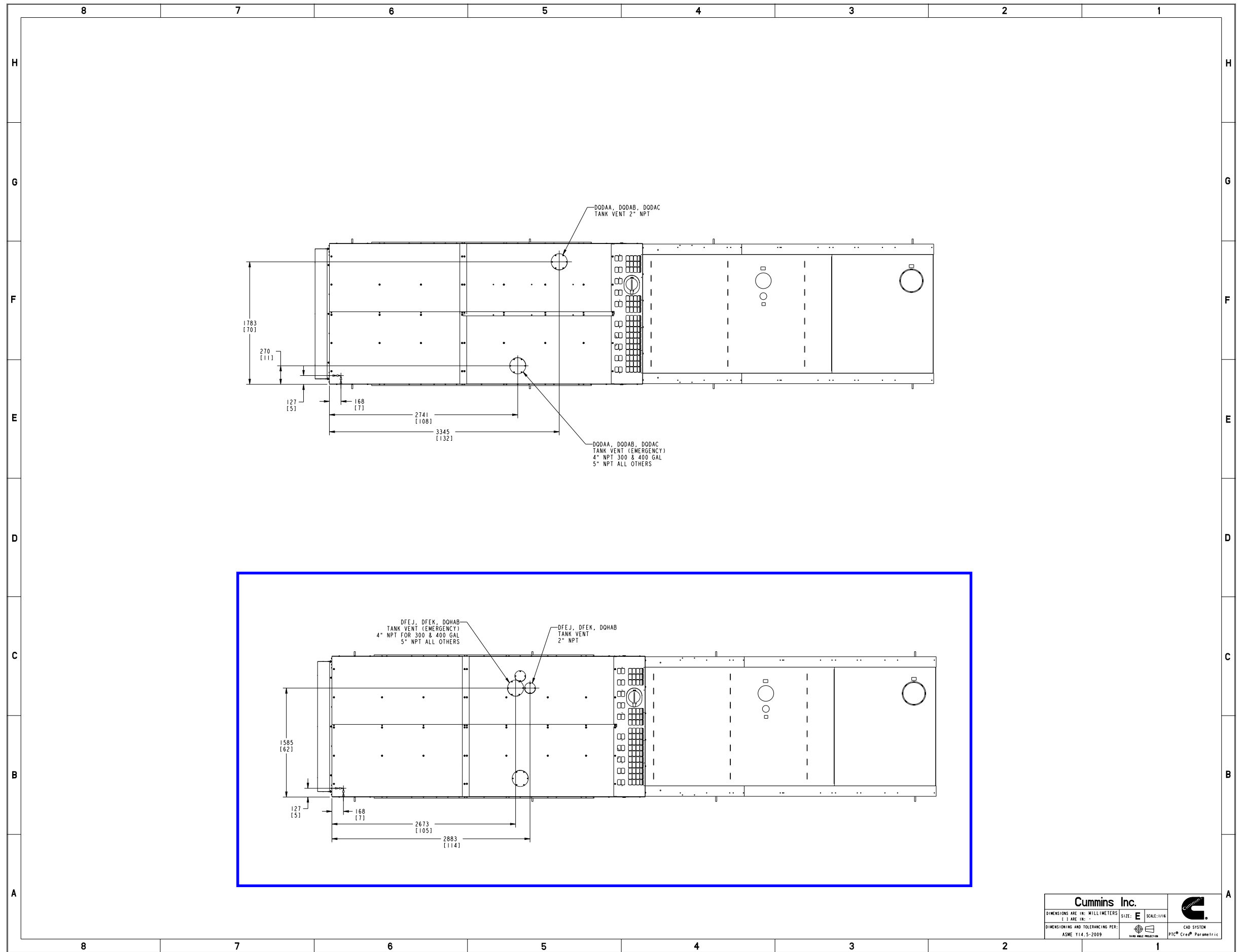
MAX BRKR AMPS	WIRE (COPPER)		CONDUIT	
	QTY	SIZE	QTY	SIZE
1200	4	500 KCMIL	4	4"
800	3	350 KCMIL	3	3 1/2"
600	2	350 KCMIL	2	3 1/2"
500	2	300 KCMIL	2	3 1/2"
450	2	300 KCMIL	2	3 1/2"
400	1	600 KCMIL	1	4"
350	1	600 KCMIL	1	4"
300	1	500 KCMIL	1	4"



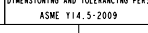
DIM_A TABULATION			
MODEL NAME	TANK/LIFT BASE FEATURE CODE	TANK CAPACITY (GAL)	HEIGHT DIM_A
DFEJ DFEK	C201	300	958[37.7]
	C202	400	1009[39.7]
	C203	500	1060[41.7]
	C204	600	1136[44.7]
	C205	660	1174[46.2]
	C207	850	1314[51.7]
	C209	1700	1568[61.7]
	C211	2525	1568[61.7]
	C242	270	1009[39.7]
	F214	NA	856[33.7]

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		SIN TO: A040J749	DWN: M_LEHR		CUMMINS POWER GENERATION	
DO NOT SCALE PRINT		CKD: J_BRODY	OUTLINE, CIRCUIT BREAKER			
DATE: 25MAY11		APVD: J_BRODY		SITE CODE: .		
ANG TOL: ± 1.0°		SCALE: 3/32		PGF: D		
FIRST USED ON: DFEJ, DFEK		SHEET: 3 of 3		PART: A052W389		

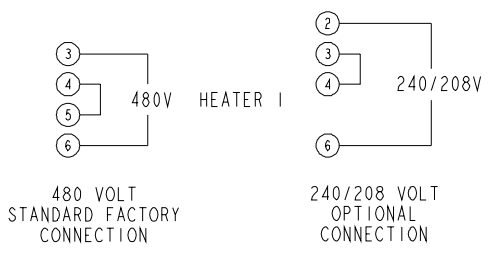


- NOTES:
1. DIMENSIONS SHOWN IN [] ARE INCHES.
 2. FOUNDATION REFERENCE POINT (—o—). SEE FOUNDATION DRAWING FOR DETAILS.
 3. FOR FEATURE CODE L116 (FLORIDA TANKS) L120 (MICHIGAN TANK) ADD 162 [6.4"] TO DIMS D-J
 4. SEE SHEET 2 FOR TANK VENT LOCATIONS.
 5. EXCESSIVE TWISTING OF THE FUEL TANK, WHEN FASTENING IT TO A FOUNDATION, MAY RESULT IN STRUCTURAL FAILURE OF THE TANK. TO INSURE THE INSTALLATION DOES NOT EXCESSIVELY TWIST THE FUEL TANK, THE FOLLOWING PROCEDURE MUST BE OBSERVED:
 - 5.1 REFER TO CUMMINS APPLICATION MANUAL T030 FOR GENERAL GENSET/TANK MOUNTING GUIDELINES.
 - 5.2 TIGHTEN TANK HOLD DOWN MOUNTING FASTENERS.
 6. FUEL TANK SHOWN IS 2525 GALLON MODEL. FUEL TANKS MAY BE SIZED DIFFERENTLY THAN THE MODEL SHOWN. REFER TO TABULATION FOR EXACT HEIGHT AND OPEN SET OUTLINE DRAWING FOR EXACT LENGTH FOR SPECIFIC CONFIGURATIONS.

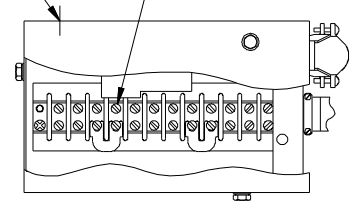


Cummins Inc.			
DIMENSIONS ARE IN: MILLIMETERS	SIZE: E	SCALE: 1/16"	
1/8 ARE IN: -			
DIMENSIONING AND TOLERANCING PER:		CAD SYSTEM	
ASME Y14.5-2009		PTC® Creo® Parametric	

REL NO	LTR	NO	REVISION	ZONE	DR	CHKD	APPROVED	DATE
FRD16606	A	1	PRODUCTION_RELEASE	-	WP	WP	EK	05-06-03

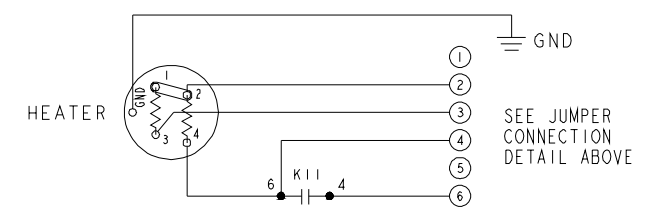


2X Ø28 [1.12] HOLES FOR CUSTOMER CONNECTIONS
 #8-32 TERMINAL FASTENING SCREWS Ø11.2 [0.44] LUG MAX

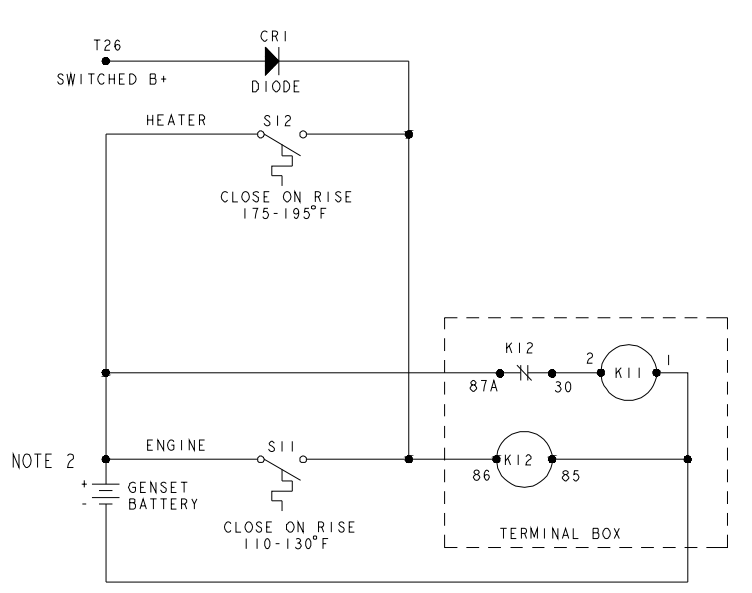
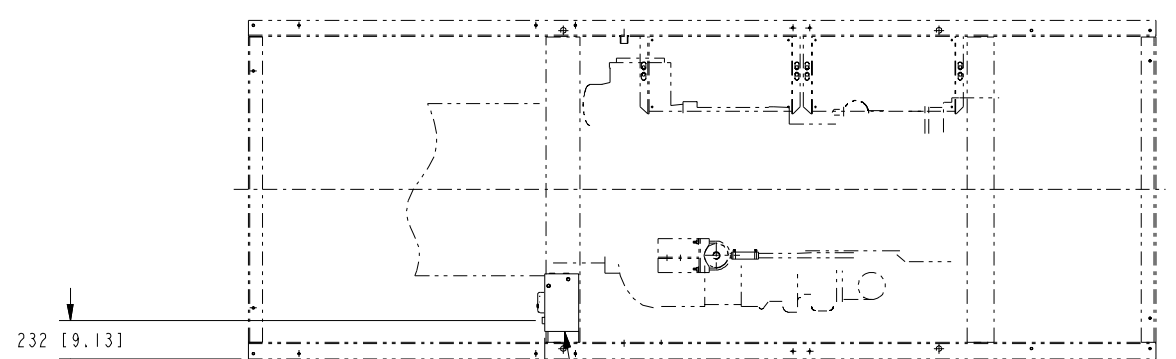


DETAIL OF HETER TERMINAL BOX

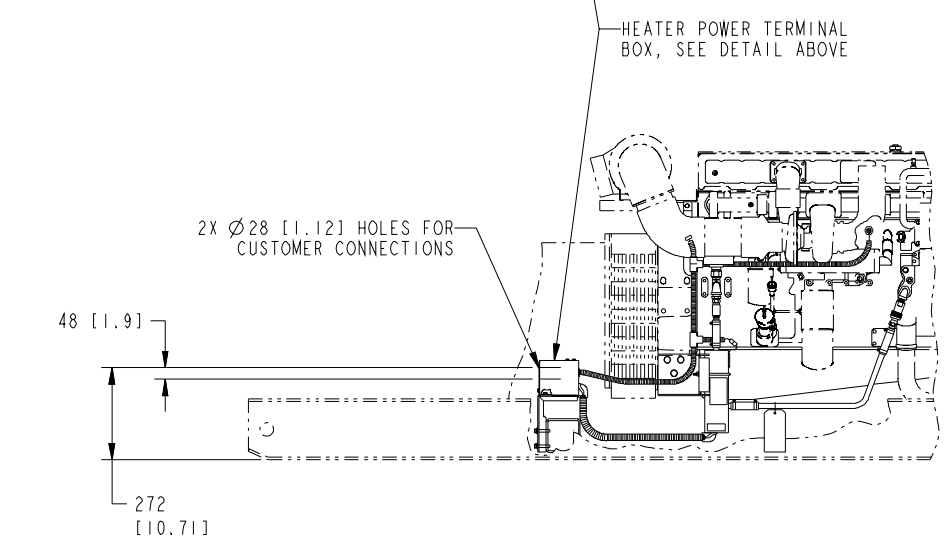
- NOTES:
1. DIMENSIONS IN [] ARE INCHES.
 2. THE HEATER CONTROL RELAY DRAWS 83mA OF CURRENT WHEN THE HEATERS ARE UNPOWERED. HEATERS ARE NOT POWERED WHEN:
 - 1) THE ENGINE HAS REACHED DESIGN TEMPERATURE OR
 - 2) THE ENGINE IS RUNNING.
- ⚠ A BATTERY CHARGER IS REQUIRED TO PREVENT BATTERY DISCHARGE.



AC POWER SCHEMATIC



DC CONTROL SCHEMATIC



HEATER POWER TERMINAL BOX, SEE DETAIL ABOVE

Coolant Heater Table

SINGLE PHASE HEATER VOLTAGE	HEATER AMPERAGE TABLE			
	FEATURE CODE H556 ONE HEATER		FEATURE CODE H557 ONE HEATER	
	HEATER AMPS	TOTAL WATTS	HEATER AMPS	TOTAL WATTS
208	18.0	3744	23.2	4825
240	20.8	4990	26.75	6420
480	10.4	4990	13.375	6420

DO NOT SCALE PRINT	TOLERANCE UNLESS OTHERWISE SPECIFIED	QTY	ITEM PART NO	DESCRIPTION OR MATERIAL	REF DIS
INCH	X ± .1	X ±	NAME	DATE	
FR. ANGLE PROJECTION	.XX ±		DR W. PELTIER	05-06-03	
ANG TOL ± 1.0°	.XX ±		CHKD W. PELTIER	05-06-03	
DRAWN TO 1/1	.XX ±		APPROVED E. KROHNFELDT	05-06-03	
SCALE OF	.XX ±		FOR INTERPRETATION MODEL FIRST USED ON		
	.XX ±		DFEH, E.J, EK	PGA	

CUMMINS POWER GENERATION
 1400 78th Ave NE
 MINNEAPOLIS, MINNESOTA 55432

TITLE: INTERFACE_OUTLINE (HEATER)
 SHEET: 1 of 1
 Dwg No: 0500_3820

Pro/ENGINEER

DFEG, DFEH, DFEJ, DFEK (C201, C207, C242, F214)

REL NO	LTR	NO	REVISION	OWN	CAD	APVD	DATE
ECO-118385	C	1	6X 1813.4 WAS 1803.4, ZONE C2	WGM	BJD	X. KISHORE	27 JUL 11
		2	6X 33.1 WAS 38.1, ZONE B2	WGM	BJD	X. KISHORE	27 JUL 11
		6	143 WAS 138, ZONE B4	WGM	BJD	X. KISHORE	27 JUL 11
		7	480 WAS 475, ZONE B6	WGM	BJD	X. KISHORE	27 JUL 11
		8	1535.7 WAS 1530.7, ZONE C6	WGM	BJD	X. KISHORE	27 JUL 11

