



RECORD ONLY SUBMITTAL PACKAGE

CSDG - 5104-5105

Prepared For:

Central States Diesel Generators
2001 S Prairie Ave.
Waukesha, WI 53189

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The information presented in this submittal package has been approved

and is provided for record purposes only.

Date: 6/8/2026

Opportunity # _____

BMS# _____

Customer PO# _____



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

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

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

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

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

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

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SECTION 1

PROJECT INFORMATION



05 June 2026

Bill of Material

Feature Code	Description	Qty
DQKAB 2000DQKAB Install-US-Stat A331-2 L170-2 L090-2 R002-2 B601-2 A416-2 C325-2 H609-2 H704-2 H606-2 H678-2 H720-2 KS53-2 H536-2 KP78-2 KS34-2 A334-2 D041-2 A333-2 E125-2 H389-2 H556-2 H607-2 L028-2 L050-2 A358-2	DQKAB, Diesel Genset, 60Hz, 2000kW-Standby Rating 2000DQKAB, Diesel Genset, 60Hz, 2000kW U.S. EPA, Stationary Emergency Application Duty Rating - Standby Power (ESP) Emission Certification, EPA, Tier 2, NSPS CI Stationary Emergency Listing - UL 2200 Voltage - 277/480, 3 Phase, Wye, 4 Wire Alternator - 60Hz, 3 Phase, 480 Volt, 80C - Standby Alternator Heater, 110/220 (120/240) Volt AC Fuel Filters - Engine, Single Control Mounting - Left Facing PowerCommand 3.3 Controller, Paralleling Capable Analog Meters - AC Output LCD Control Display AmpSentry™ UL Listed Protective Relay Signals - Auxiliary, 8 Inputs/8 Outputs Control Display Language - English Circuit Breaker or Entrance Box - None Terminal Housing - Bottom Entry Engine Starter - 24 Volt DC Motor Engine Air Cleaner - Normal Duty Battery Charging Alternator Engine Cooling - Radiator, High Ambient Air Temperature, Ship Fitted Shutdown - Low Coolant Level Coolant Heater - 208/240/480 Volts AC, 40F Minimum Ambient Temperature Engine Oil Filters, Full Flow with Bypass Genset Warranty - 2 Years Base Literature - English Packing - Standard. This is the standard packing for domestic over-the-road deliveries	2

Sales notes removed from BOM

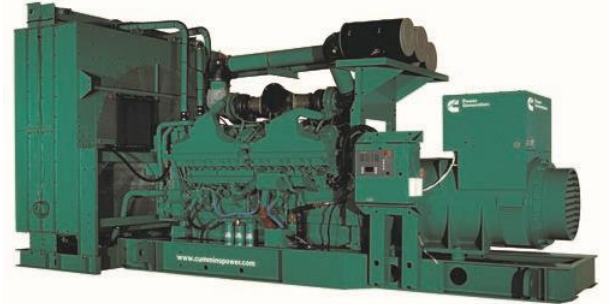
SECTION 2
GENERATOR
SPECIFICATIONS





Diesel Generator Set QSK60 Series Engine

1600 kW - 2000 kW 60 Hz



Description

Cummins® commercial generator sets are fully integrated power generation systems providing optimum performance, reliability and versatility for stationary Standby and Prime Power applications. Codes or standards compliance may not be available with all model configurations – consult factory for availability.

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® digital control is standard equipment and provides total genset system integration including automatic remote starting/stopping, precise frequency and voltage regulation, alarm and status message display, AmpSentry™ protective relay, output metering and 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.

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.

Model	Standby rating		Prime rating		Continuous rating		Data sheets	
	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz	50 Hz
DQKAA	1750 (2188)		1600 (2000)				D-3335	
DQKAB	2000 (2500)		1825 (2281)				D-3336	

Generator Set Specifications

Performance class	Genset models have been tested in accordance with ISO 8528-5. Consult factory for transient performance information.
Voltage regulation, no load to full load	± 0.5%
Random voltage variation	± 0.5%
Frequency regulation	Isochronous
Random frequency variation	± 0.25%
Radio frequency emissions compliance	IEC 801.2 through IEC 801.5; MIL STD 461C, Part 9

Engine Specifications

Bore	158.8 mm (6.25 in.)
Stroke	190.0 mm (7.48 in.)
Displacement	60.2 litres (3673 in ³)
Configuration	Cast iron, V 16 cylinder
Battery capacity	2200 amps minimum at ambient temperature of -18 °C to 0 °C (0 °F to 32 °F)
Battery charging alternator	40 amps
Starting voltage	24 volt, negative ground
Fuel system	Cummins' Modular Common Rail System
Fuel filter	Dual element, 10 micron filtration, spin-on fuel filters with 15 micron water separator
Air cleaner type	Dry replaceable element
Lube oil filter type(s)	Four spin-on, combination full flow filter and bypass filters
Standard cooling system	High 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 on low and medium voltage, Class F on high voltage
Standard temperature rise	150 °C Standby at 40 °C ambient
Exciter type	Permanent Magnet Generator (PMG)
Phase rotation	A (U), B (V), C (W)
Alternator cooling	Direct drive centrifugal blower fan
AC waveform Total Harmonic Distortion (THDV)	< 5% no load to full linear load, < 3% for any single harmonic

Available Voltages

60 Hz Line-Neutral/Line-Line				50 Hz Line-Neutral/Line-Line			
• 219/380	• 277/480	• 2400/4160	• 7620/13200	• 220/380	• 240/415	• 1905/3300	• 3810/6600
• 254/440	• 347/600	• 7200/12470	• 7970/13800	• 230/400	• 254/440	• 3640/6300	• 6350/11000

* Note: Consult factory for other voltages.

Generator Set options and Accessories

Engine

- 208/240/480 V coolant heater for ambient above 4.5 °C (40 °F)
- 208/240/480 V coolant heater for ambient below 4.5 °C (40 °F)

Control panel

- PowerCommand 3.3
- Multiple language support
- 120/240 V 100 W control anti-condensation heater
- Exhaust pyrometer
- Ground fault indication
- Remote annunciator panel
- Paralleling relay package
- Shutdown alarm relay package
- Audible engine shutdown alarm
- AC output analog meters (bargraph)

Alternator

- 80 °C rise
- 105 °C rise
- 125 °C rise
- 120/240 V 300 W anti-condensation heater
- Temperature sensor - RTDs, 2/phase
- Temperature sensor – alternator bearing RTD
- Differential current transformers

Exhaust system

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

Cooling system

- Remote radiator

Generator set

- AC entrance box
- Battery
- IBC and HCAI Certification

- Battery rack with hold-down - floor standing
- Circuit breaker - set mounted
- Disconnect switch – set mounted
- PowerCommand network
- Remote annunciator panel
- Spring isolators
- 2-year warranty
- 5-year warranty
- 10-year major components warranty

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

PowerCommand 3.3 – Control System



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

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

Power management – Control function provides battery monitoring and testing features and smart starting control system.

Advanced control methodology – Three phase sensing, full wave rectified voltage regulation, with a PWM output for stable operation with all load types.

Communications interface – Control comes standard with PCCNet and Modbus interface.

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

Easily upgradeable – PowerCommand controls are designed with common control interfaces.

Reliable design – The control system is designed for reliable operation in harsh environment.

Multi-language support

Operator Panel Features

Operator/display functions

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

Paralleling control functions

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

Alternator data

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

Engine data

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

Other data

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

Standard Control Functions

Digital governing

- Integrated digital electronic isochronous governor
- Temperature dynamic governing

Digital voltage regulation

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

AmpSentry AC protection

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

Engine protection

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

Standard Control Functions (continued)

Control functions




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

Options

- Auxiliary output relays (2)

Codes and Standards

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

<p>ISO 9001 ISO 14001 ISO 45001</p>	<p>This product was manufactured in a facility whose quality management system is certified to ISO 9001 and its Health Safety Environmental Management Systems certified to ISO 14001 and ISO 45001.</p>		<p>This product is listed to UL 2200, Stationary Engine Generator Assemblies.</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 genset models are available as CSA certified to CSA C22.2 No.100.</p>	<p>International Building Code</p>	<p>The generator set package is available certified for seismic application in accordance with International Building Code.</p>

Ratings Definitions

Emergency Standby Power (ESP):

Applicable for supplying power continuously to varying electrical loads for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528 and ISO 3046-1, obtained and corrected in accordance with ISO 15550.

Limited-Time Running Power (LTP):

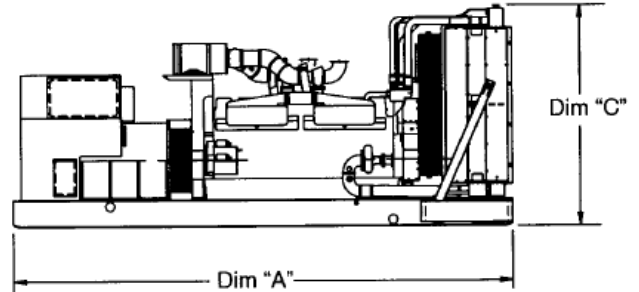
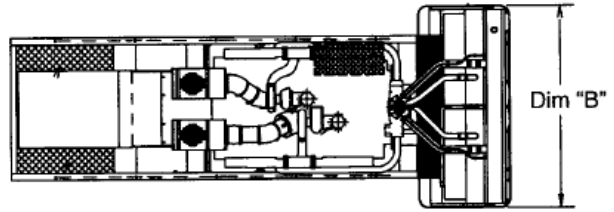
Applicable for supplying power to a constant electrical load for limited hours. Limited-Time Running Power (LTP) is in accordance with ISO 8528.

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 3046-1. Data shown above represents gross engine performance and capabilities as per ISO 3046-1, obtained and corrected in accordance with ISO 15550.

Base Load (Continuous) Power (COP):

Applicable for supplying power continuously to a constant load up to the full output rating for unlimited hours. No sustained overload capability is available for this rating. Consult authorized distributor for rating. (Equivalent to Continuous Power in accordance with ISO 8528 and ISO 3046-1, obtained and corrected in accordance with ISO 15550).



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)
DQKAA	6175 (243)	2534 (100)	3043 (120)	15231 (33569)	15396 (33932)
DQKAB	6175 (243)	2534 (100)	3043 (120)	17382 (38309)	17908 (39470)

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

**Refer to drawings for specific
weights and dimensions**

See your distributor for more information.

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S-1514 (07/22)

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Generator set data sheet

Model: DQKAB
Frequency: 60
Fuel type: Diesel
KW rating: 2000 standby
 1825 prime
Emissions level: EPA NSPS Stationary Emergency Tier 2

Exhaust emission data sheet:	EDS-1065
Exhaust emission compliance sheet:	EPA-1099
Sound performance data sheet:	MSP-1042
Cooling performance data sheet:	MCP-158
Prototype test summary data sheet:	PTS-267
Standard set-mounted radiator cooling outline:	A063L447
Optional set-mounted radiator cooling outline:	A030Y635
Optional remote radiator cooling outline:	A063H883

Fuel consumption	Standby				Prime			
	kW (kVA)				kW (kVA)			
Ratings	2000 (2500)				1825 (2281)			
Load	1/4	1/2	3/4	Full	1/4	1/2	3/4	Full
US gph	47.7	76.9	106.1	135.3	45.1	71.8	98.4	125.1
L/hr	180	291	402	512	171	272	373	474

Engine	Standby rating	Prime rating
Engine manufacturer	Cummins Inc.	
Engine model	QSK60-G6 NR2	
Configuration	Cast iron, V 16 cylinder	
Aspiration	Turbocharged and low temperature aftercooled	
Gross engine power output, kWm (bhp)	2163 (2899)	1969 (2639)
BMEP at set rated load, kPa (psi)	2413 (350)	2179 (316)
Bore, mm (in)	159 (6.25)	
Stroke, mm (in)	190 (7.48)	
Rated speed, rpm	1800	
Piston speed, m/s (ft/min)	11.4 (2244)	
Compression ratio	14.5:1	
Lube oil capacity, L (qt)	334 (304)	
Overspeed limit, rpm	2100 ±50	
Regenerative power, kW	207	

Fuel flow

Maximum fuel flow, L/hr (US gph)	1033 (273)
Maximum fuel inlet restriction, kPa (in Hg)	16.9 (5)
Maximum fuel inlet temperature, °C (°F)	71 (160)

Air	Standby rating	Prime rating
Combustion air, m ³ /min (scfm)	178 (6295)	159 (5615)
Maximum air cleaner restriction, kPa (in H ₂ O)	3.7 (15)	
Alternator cooling air, m ³ /min (cfm)	204 (7300)	

Exhaust

Exhaust flow at set rated load, m ³ /min (cfm)	436 (15385)	385 (13580)
Exhaust temperature, °C (°F)	482 (900)	466 (870)
Maximum back pressure, kPa (in H ₂ O)	6.8 (27)	

Standard set-mounted radiator cooling

Ambient design, °C (°F)	40 (104)	
Fan load, kW _m (HP)	57 (77)	
Coolant capacity (with radiator), L (US gal)	492 (130)	
Cooling system air flow, m ³ /min (scfm)	1610 (56845)	
Total heat rejection, MJ/min (Btu/min)	99.5 (94395)	91.0 (86382)
Maximum cooling air flow static restriction, kPa (in H ₂ O)	0.12 (0.5)	
Maximum fuel return line restriction kPa (in Hg)	34 (10)	

Optional set-mounted radiator cooling

Ambient design, °C (°F)	50 (122)	
Fan load, kW _m (HP)	57 (77)	
Coolant capacity (with radiator), L (US gal)	617 (163)	
Cooling system air flow, m ³ /min (scfm)	3142 (110945)	
Total heat rejection, MJ/min (Btu/min)	99.5 (94395)	91 (86382)
Maximum cooling air flow static restriction, kPa (in H ₂ O)	0.12 (0.5)	
Maximum fuel return line restriction, kPa (in Hg)	34 (10)	

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)	1902 (502)	
Max flow rate at max friction head, aftercooler circuit, L/min (US gal/min)	606 (160)	
Heat rejected, jacket water circuit, MJ/min (Btu/min)	46.9 (44526)	44.1 (41824)
Heat rejected, aftercooler circuit, MJ/min (Btu/min)	33.9 (32156)	30.4 (28887)
Heat rejected, fuel circuit, MJ/min (Btu/min)		
Total heat radiated to room, MJ/min (Btu/min)	17.5 (16597)	16.1 (15282)
Maximum friction head, jacket water circuit, kPa (psi)	69 (10)	
Maximum friction head, aftercooler circuit, kPa (psi)	48 (7)	
Maximum static head, jacket water circuit, m (ft)	18 (60)	
Maximum static head, aftercooler circuit, m (ft)	18 (60)	
Maximum jacket water outlet temp, °C (°F)	104 (220)	100 (212)
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)	49 (120)	
Maximum aftercooler inlet temp, °C (°F)	66 (150)	
Maximum fuel flow, L/hr (US gph)	1033 (273)	
Maximum fuel return line restriction, kPa (in Hg)	34 (10)	

Weights²

Unit dry weight kgs (lbs)
Unit wet weight kgs (lbs)

Refer to drawings for specific weights and dimensions

Notes:

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

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

Derating factors

Standby	Engine power available up to 447 m (1466 ft) at ambient temperatures up to 40°C (104°F). From 447m(1466 ft) up to 2001m(6562ft) engine derates at 5.1% per 305m(1000ft) for 40°C. Above these elevations, derate an additional at 5.8% per 305m (1000 ft). For temp above 40°C engine derates at 17.6% per 10°C (18°F).
Prime	Engine power available up to 447 m (1466 ft) at ambient temperatures up to 40°C (104°F). From 447m(1466 ft) up to 2001m(6562ft) engine derates at 5.1% per 305m(1000ft) for 40°C. Above these elevations, derate an additional at 5.8% per 305m (1000 ft). For temp above 40°C engine derates at 17.6% per 10°C (18°F).

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

Voltage	Connection ¹	Temp rise degrees C	Duty ²	Single phase factor ³	Max surge kVA ⁴	Winding No.	Alternator data sheet	Feature Code
380	Wye, 3-phase	150/125/105	S/P/C		7327	13	ADS-515	B595
380	Wye, 3-phase	125/105/80	S/P/C		7327	13	ADS-515	B598
380	Wye, 3-phase	105/80	S/P		7327	13	ADS-515	B599
380	Wye, 3-phase	80	S		7963	13	ADS-516	B660
380	Wye, 3-phase	125/105/80	S/P/C		7205	13	ADS-334	BA51
416	Wye, 3-phase	105/80	S/P		7695	12	ADS-517	B715
440	Wye, 3-phase	125/105/80	S/P/C		7361	312	ADS-334	B663
440	Wye, 3-phase	105	S		7284	12	ADS-515	B665
480	Wye, 3-phase	125/105/80	S/P/C		7361	312	ADS-334	B462
480	Wye, 3-phase	105/80	S/P		7695	312	ADS-335	B463
480	Wye, 3-phase	125/105	P/C		6716	312	ADS-332	B464
480	Wye, 3-phase	80	S		8412	12	ADS-516	B601
480	Wye, 3-phase	80	P		8412	12	ADS-516	B694
480	Wye, 3-phase	105	S		7695	12	ADS-517	B796
600	Wye, 3-phase	125/105/80	S/P/C		7361	07	ADS-334	B465
600	Wye, 3-phase	105/80	S/P		7695	07	ADS-335	B301
600	Wye, 3-phase	125/105	P/C		6716	07	ADS-333	B466
600	Wye, 3-phase	80	S		7265	07	ADS-516	B604
4160	Wye, 3-phase	105/80	S/P		6307	51	ADS-518	B937
4160	Wye, 3-phase	125/105/80	S/P/C		6307	51	ADS-518	B934
4160	Wye, 3-phase	80	S		6307	51	ADS-518	B935
4160	Wye, 3-phase	105	S		6307	51	ADS-520	B795
12470-13800	Wye, 3-phase	125/105/80	S/P/C		6062	91	ADS-521	B448
12470	Wye, 3-phase	105/80	S/P		6038	87	ADS-521	B567
13200-13800	Wye, 3-phase	105/80	S/P		6062	91	ADS-521	B612
12470	Wye, 3-phase	80	S		6685	7	ADS-522	B607
13200-13800	Wye, 3-phase	80	S		8012	91	ADS-523	B628
13800	Wye, 3-phase	80	S		6833	91	ADS-521	B610
13800	Wye, 3-phase	105	S		6062	91	ADS-523	B797

Notes:

¹ Limited single phase capability is available from some three phase rated configurations. To obtain single phase rating, multiply the three phase kW rating by the Single Phase Factor³. All single phase ratings are at unity power factor.

² Standby (S), Prime (P) and Continuous ratings (C).

³ Factor for the *Single Phase Output from Three Phase Alternator* formula listed below.

⁴ Maximum rated starting kVA that results in a minimum of 90% of rated sustained voltage during starting.

Our energy working for you.™

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Formulas for calculating full load currents:

Three phase output

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

Single phase output

$$\frac{\text{kW} \times \text{SinglePhaseFactor} \times 1000}{\text{Voltage}}$$

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.

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D-3336 (05/22)



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PowerCommand® 3.3 Generator Set Digital Integrated Control System



Bargraph Optional

Introduction

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

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

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

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

Benefits and Features

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

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

PowerCommand® Generator Set Digital Control System PCC 3300



Introduction

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

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

Features

- PCC3300 supports configurable control features via software download using InPower PC-compatible software
- 12 V (DC) and 24 V (DC) battery operation
- Digital automatic voltage regulation is provided using three phase sensing and full wave FET type regulator, which is compatible with either shunt or PMG excited systems with a standard AUX103 AVR or an option for a more powerful high-current field drive capability AUX106 AVR
- Digital engine speed governing on applicable platform is provided, which is capable of providing isochronous frequency regulation
- Full authority J1939 CANBus® prime mover communications and control is provided for platforms with an Engine Control Module (ECM)
- AmpSentry™ protection provides industry-leading alternator overcurrent protection:
 - Time-based generator protection applicable to both line-to-line and line-to-neutral, that can detect an unbalanced fault condition and swiftly react appropriately. Balanced faults can also be detected by AmpSentry and appropriate acted upon.
 - Reduces the risk of Arc Flash due to thermal overload or electrical faults by inverse time protection
- Generator set monitoring offers status information for all critical prime mover and generator functions
- AC and DC digital generator set metering is provided. AC measurements are configurable for single or three phase sensing with PCC3300 measuring voltage, current, kW and kVAr offering a measurement accuracy of 1%
- Battery monitoring system continually monitors the battery output and warns of the potential occurrence of a weak battery condition
- Relay drivers for prime mover starter, fuel shutoff (FSO), glow plug/spark ignition power and switched B+ applications are provided
- Integrated generator set protection is offered to protect the prime mover and generator
- Real time clock for fault and event time stamping
- Exerciser clock and time of day start/stop initiate a test with or without load, or a Base Load or Peak Shave session
- Digital Power Transfer Control (Automatic Mains Failure) provides load transfer operation in open transition, closed transition, or soft (ramping) transfer modes
- Extended Paralleling (Peak Shave/Base Load) regulates the genset real and reactive power output while paralleled to the utility. Power can be regulated at either the genset or utility bus monitoring point
- Digital frequency synchronization and voltage matching
- Isochronous Load Sharing
- Droop kW and kVAr Control
- The synchronization check function provides adjustments for phase angle window, voltage window, frequency window and time delay
- Utility / AC Bus metering and protection with PCC3300 voltage, current, kW and kVAr offering a measurement accuracy of 1%
- Advanced serviceability is offered via InPower™, a PC-based software service tool
- PCC3300 is designed for reliable operation in harsh environments with the unit itself being a fully encapsulated module
- RS-485 ModBus interface for interconnecting to customer equipment
- Native on PCC3300: Four discrete inputs, two dry contact relay outputs and two low-side driver outputs are provided and are all configurable.
 - Optional extra PCC3300 input and output capability available via AUX101
- Warranty and service – Cummins Power Generation offers a comprehensive warranty and worldwide distributor service network
- Global regulatory certification and compliance: PCC3300 is suitable for use on gensets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std., UKCA and CE standards

Base Control Functions

HMI capability

Options: Local and remote HMI320 options are available

Operator adjustments: The HMI320 includes provisions for many set up and adjustment functions.

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

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

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

For Lean Burn Natural Gas Engine applications:

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

Utility/AC bus data

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

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

Engine data

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

Lean Burn Natural Gas (LBNG) application parameters include:

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

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

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

Prime Mover Control

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

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

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

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

Drop electronic speed is governing capability is natively offered by PCC3300 to permit droop from 0% to 10% between no load to full load.

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

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

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

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

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

configurable glow plug control where applicable.

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

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

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

Lean Burn Natural Gas application specific parameters

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

Generator Control

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

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

Major features of generator control include:

Digital output voltage regulation - Capable of regulating output voltage to within $\pm 1.0\%$ for any loads between no load and full load. Voltage drift will not exceed $\pm 1.5\%$ 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.

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

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

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

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

Paralleling Functions

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

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

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

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

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

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

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

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

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

Under voltage sensor: 3-phase L-N or L-L under voltage sensing adjustable for pickup from 85-100% of nominal. Dropout adjustable from 75-98% of pickup. Dropout delay adjustable from 0.1-30 sec.

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

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

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

Phase rotation sensor: Checks for valid phase rotation of source. Field configurable to enable.

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

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

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

Breaker control – Utility and Genset breaker interfaces include separate relays for opening and closing breaker, as well as inputs for both 'a' and 'b' breaker position contacts and tripped status. Breaker diagnostics include Contact Failure, Fail to Close, Fail to Open, Fail to Disconnect, and Tripped. Upon breaker failure, appropriate control action is taken to maintain system integrity.

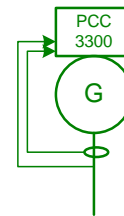
Exerciser clock –The exerciser clock (when enabled) allows the system to be operated at preset times in either test without load, test with load, or extended parallel mode. A Real Time Clock is built in. Up to 12 different programs can be set for day of week, time of day, duration, repeat interval, and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

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

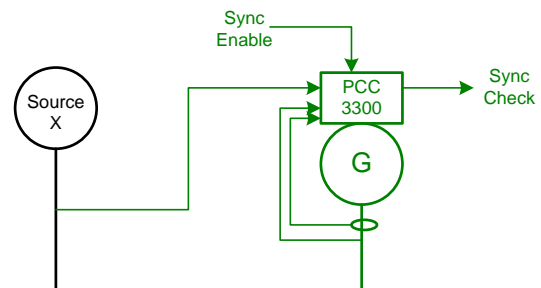
penalties due to low power factor. The System always operates within genset ratings. The control point can be changed while the system is in operation. Set points can be adjusted via hardwired analog input or adjusted through an operator panel display or service tool.

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

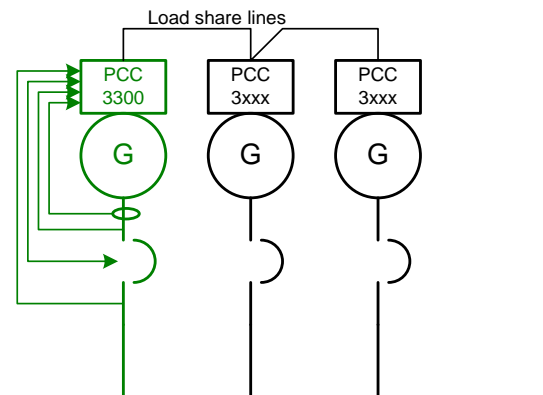
Standalone: Control provides monitoring, protection and control in a non-paralleling application.



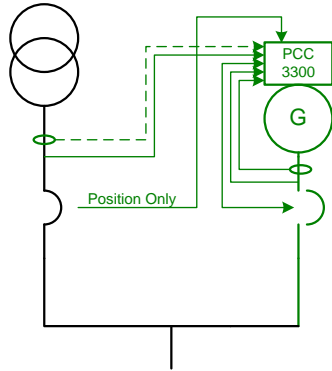
Synchronizer only: control will synchronize the genset to other source when commanded to either via a hardwired or Modbus driven input.



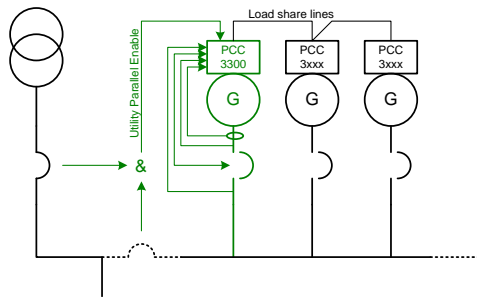
Isolated Bus: allows the genset to perform a dead bus closure or synchronize to the bus and isochronously share kW and kVAR loads with other gensets.



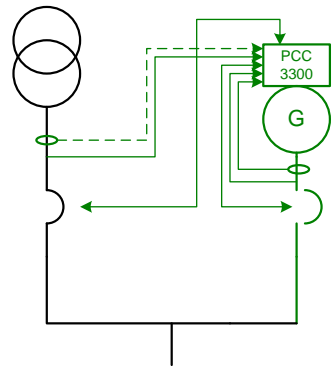
Utility Single: Control monitors one genset and utility. The control will automatically start and provide power to a load if the utility fails. The control will also resynchronize the genset back to the utility and provides extended paralleling capabilities.



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

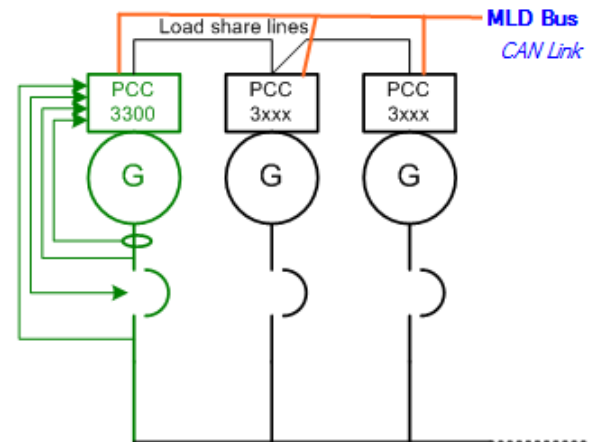
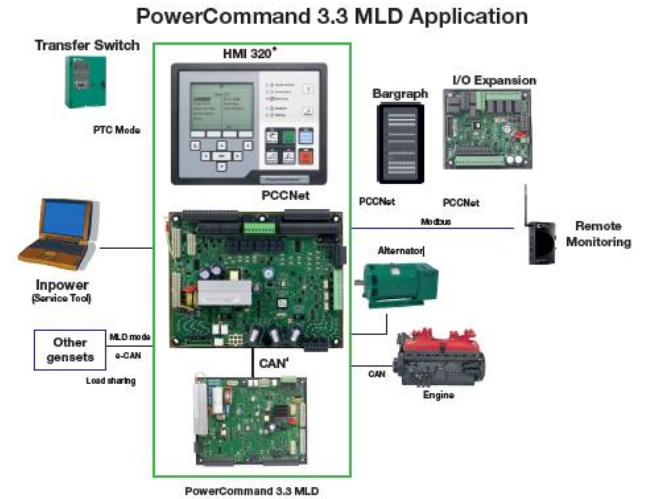


Power Transfer Control: Control operates a single genset/single utility transfer pair in open transition, fast closed transition, or soft closed transition. Extended paralleling functionality also provides base load and peak shave options.



Masterless Load Demand (Optional Feature):

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



PCC3300 External Voltage and Frequency Biasing Inputs

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

Protective Functions

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

Battle short mode

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

Derate

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

Configurable alarm and status inputs

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

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

Emergency stop

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

General prime mover protection

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 genset is signaled to start and indicate a warning if the battery indicates impending failure.

Low coolant level warning – Can be set up to be a warning or shutdown.

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

Fail to start (overcrank) shutdown - The control system will indicate a fault if the genset 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.

Fault simulation –The control in conjunction with InPower software, will accept commands to allow a technician to verify the proper operation of the control and its interface by simulating failure modes or by forcing the control to operate outside of its normal operating ranges. InPower also provides a complete list of faults and settings for the protective functions provided by the controller.

For Lean Burn Natural Gas Engine applications:

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

Hydro Mechanical fuel system engine protection:

Overspeed shutdown – Default setting is 115% of nominal

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

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

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

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

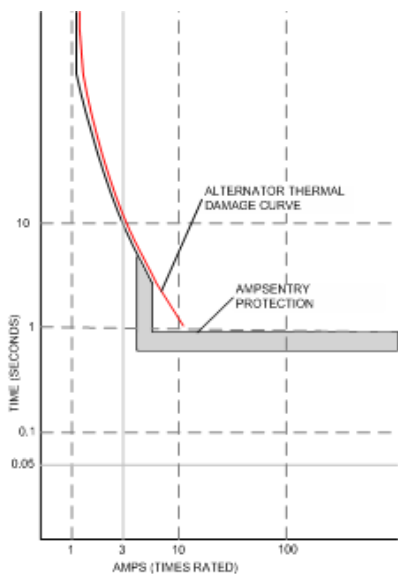
High intake manifold temperature shutdown – Level is preset (configurable with InPower or HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance alarms.

Full authority electronic engine protection:

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

Alternator Protection

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



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

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

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

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

Over frequency shutdown/warning (81o) - Genset is operating at a potentially damaging frequency level. Settings are adjustable from 2-10 Hz above nominal governor set point for a 1-20 second time delay. Default: 6 Hz, 20 seconds, disabled.

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

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

Field overload shutdown - Monitors field voltage to shutdown genset when a field overload condition occurs.

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

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

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

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

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

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

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

Paralleling Protection

Breaker fail to close Warning: When the control signals a circuit breaker to close, it will monitor the breaker auxiliary contacts and verify that the breaker has closed. If the control does not sense a breaker closure within an adjustable time period after the close signal, the fail to close warning will be initiated.

Breaker fail to open warning: The control system monitors the operation of breakers that have been signaled to open. If the breaker does not open within an adjustable time delay, a Breaker Fail to Open warning is initiated.

Breaker position contact warning: The controller will monitor both 'a' and 'b' position contacts from the breaker. If the contacts disagree as to the breaker position, the breaker position contact warning will be initiated.

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

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

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

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

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

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

Field Control Interface

Input signals to the PowerCommand® control include:

- Coolant level (where applicable)
 - Fuel level (where applicable)
 - Remote emergency stop
 - Remote fault reset
 - Remote start
 - Rupture basin
 - Start type signal
 - Battle short
 - Load demand stop
 - Synchronize enable
 - Genset circuit breaker inhibit
 - Utility circuit breaker inhibit
 - Single mode verify
 - Transfer inhibit – prevent transfer to utility (in power transfer control mode)
 - Retransfer inhibit – prevent retransfer to genset (in power transfer control mode)
 - kW and kVAR load setpoints
- Configurable inputs - Control includes (4) input signals from customer discrete devices that are configurable for warning, shutdown or status indication, as well as message displayed

Input signals for Lean Burn Natural Gas Engine applications:

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

Output signals from the PowerCommand® control include:

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

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

Output Signals for Lean Burn Natural Gas Engine applications:

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

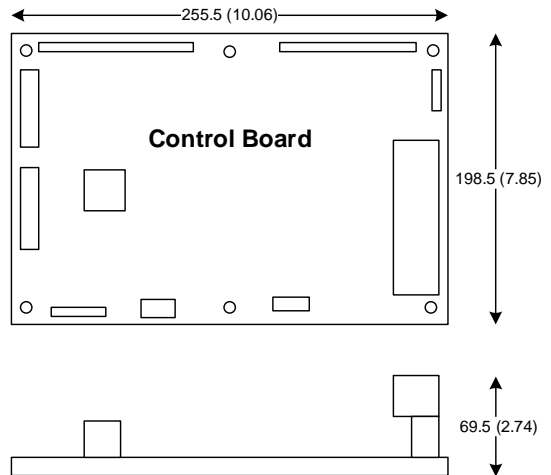
Communications connections include:

- PC tool interface: This RS-485 communication port allows the control to communicate with a personal computer running InPower software.
- Modbus RS-485 port: Allows the control to communicate with external devices such as PLCs using Modbus protocol.

Note - An RS-232 or USB to RS-485 converter is required for communication between PC and control.

- Networking: This RS-485 communication port allows connection from the control to the other Cummins Power Generation products.

Mechanical Drawing



PowerCommand® Human Machine Interface HMI320



Description

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

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

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

Features:

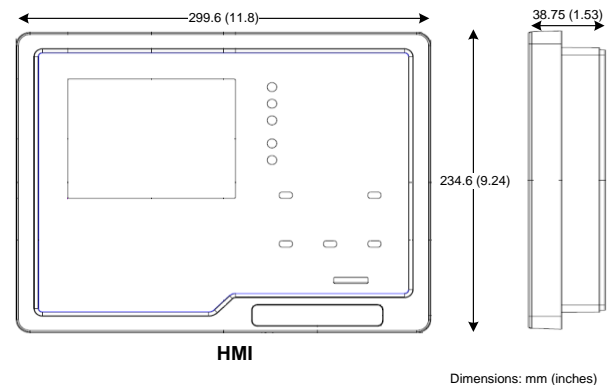
- LED indicating lamps
 - genset running
 - remote start
 - not in auto
 - shutdown
 - warning
 - auto
 - manual and stop
 - Circuit breaker open (if equipped)
 - Circuit breaker closed (if equipped)
- 320 x 240 pixels graphic LED backlight LCD.
- Four tactile feel membrane switches for LCD defined operation.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

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

Communications connections include:

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

Mechanical Drawing



Software

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

Environment

The control is designed for proper operation without recalibration in ambient temperatures from -40 °C (-40 °F) to +70 °C (158 °F), and for storage from -55 °C (-67 °F) to +80 °C (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 (-4 °F) to +70 °C (158 °F), and for storage from -30 °C (-22 °F) to +80 °C (176 °F).

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

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

Certifications

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

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

Reference Documents

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

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

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

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

Warranty

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





Power topic #6073 | Technical information from Cummins

AmpSentry Overcurrent Protection and Arc Energy Reduction

■ White Paper

By Rich Scroggins, Applications Engineering Technical Advisor, Cummins

In the interest of worker safety arc energy reduction has become a common requirement in emergency power systems. Manufacturers of circuit breakers and protective relays have responded by adding various arc energy reducing functions to their products. One of the most commonly used arc energy reduction methods is energy reducing maintenance switching or “maintenance mode”. When maintenance mode is enabled any time delays configured for selective coordination are bypassed in the event of a fault so the fault is cleared instantaneously. The logic behind this is that when a technician is working in the vicinity of live electrical equipment the high level of available arc flash energy allowed by the time delays in the overcurrent protective devices (OCPD) puts the worker at a significant risk if there is a fault in the system. Bypassing the time delay reduces the risk of injury due to arc flash to the worker. When the work is finished and the worker leaves the area the OCPD is taken out of maintenance mode which re-activates the time delays so that the system will be selectively coordinated.

Certain Cummins PowerCommand controls have an overcurrent protection and fault current regulating feature called AmpSentry, which is UL listed as a protective relay. In 2014 Cummins added a maintenance mode function to AmpSentry for PowerCommand 2.2, 2.3 and 3.3 controls. In this paper we will describe AmpSentry and its new maintenance mode, how to enable maintenance mode and how it meets NEC energy reduction requirements.

AmpSentry

When PowerCommand controls measure current in any phase as exceeding 110% of the generator set standby rating a current summing integral will be activated so that the generator will shut down based on the AmpSentry time current curve. The green line in Figure 1 is the AmpSentry trip curve. This allows AmpSentry to protect the alternator and also the feeder cables connected to the alternator provided they are rated for at least 100% of the full load current rating of the genset.

AmpSentry also has a fault current regulation feature. When the control measures current in any phase as exceeding 300% of the generator set standby rating the control recognizes that this is a fault condition and begins to regulate current in the phase with the highest level of current to 300% of rated current. The purpose of this is to allow a downstream OCPD to clear the fault, maintaining a coordinated system. AmpSentry's overcurrent protection function is in effect during a

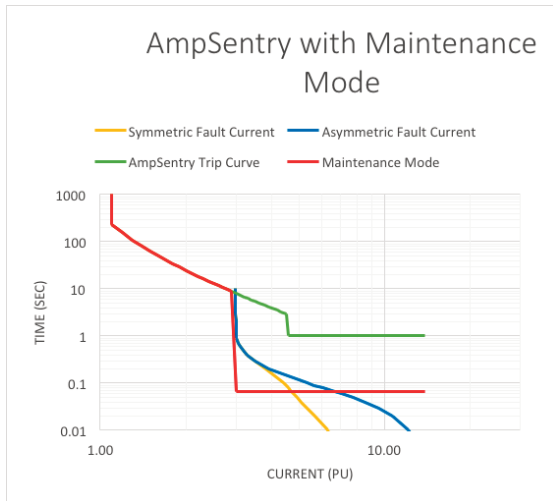


Figure 1. AmpSentry Time Over Current curve. Includes symmetric and asymmetric fault current decrement curves for a DQLD 2750 kW genset.

fault and will shut down the generator set based on the time current curve if the fault is still active. Note that in Figure 1 as fault current decays to 300% of rated current AmpSentry holds the current constant at that level until the line crosses the AmpSentry trip curve.

AmpSentry Maintenance Mode

PowerCommand AmpSentry's Maintenance Mode function acts in the same manner as maintenance mode on a circuit breaker. When maintenance mode is enabled AmpSentry shuts down the generator set (by shutting off fuel and excitation) as soon as it recognizes that current on any phase has exceeded 300% of the generator set rating. The short circuit shutdown event can also be mapped to one of the customer configurable outputs of the control to shunt trip a breaker providing immediate isolation. Tests have shown that excitation is shut off within 50 msec of the occurrence of the fault. In Figure 1, the red line is activated as the trip curve when maintenance mode is enabled. Note that for current less than 300% of rated current the maintenance mode trip curve is the same as the standard AmpSentry trip curve.

Figure 2 displays a current trace created during a test of AmpSentry Maintenance Mode. Note that in this test the control recognized the fault within 38 msec of the fault occurrence and shut off the genset fuel and excitation. The current decayed exponentially according to the transient time constant.

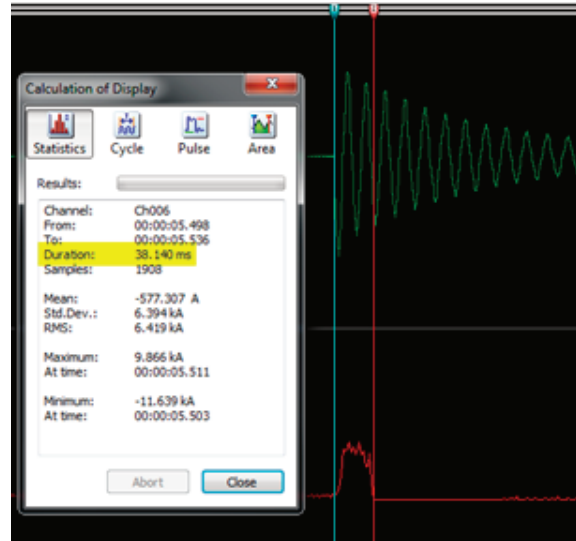


Figure 2. Control response and fault current decay resulting from a short circuit with AmpSentry Maintenance Mode active

Enabling AmpSentry Maintenance Mode

Maintenance Mode is enabled by either activating a configurable customer input while the control switch is in "Auto" or by plugging in the InPower Service tool.

There are several customer configurable inputs on the PowerCommand controls that can be configured as the Maintenance Mode enable switch by connecting a pair of dry contacts between two terminals on the control terminal block. InPower can be used to configure the input as the maintenance mode enable switch. The input can be configured to be either active closed or active open. Figure 3 displays an example of setting up a configurable input in InPower.

Fault code 5399 becomes active whenever Ampsentry maintenance mode is enabled. As a default this fault code is set up as an event only. By configuring this fault code to be a warning the control can log when maintenance mode is enabled and disabled. This log may be useful if the genset ever does sustain a short circuit. Figure 4 shows an example of how to use InPower to set up control to log the maintenance mode event.

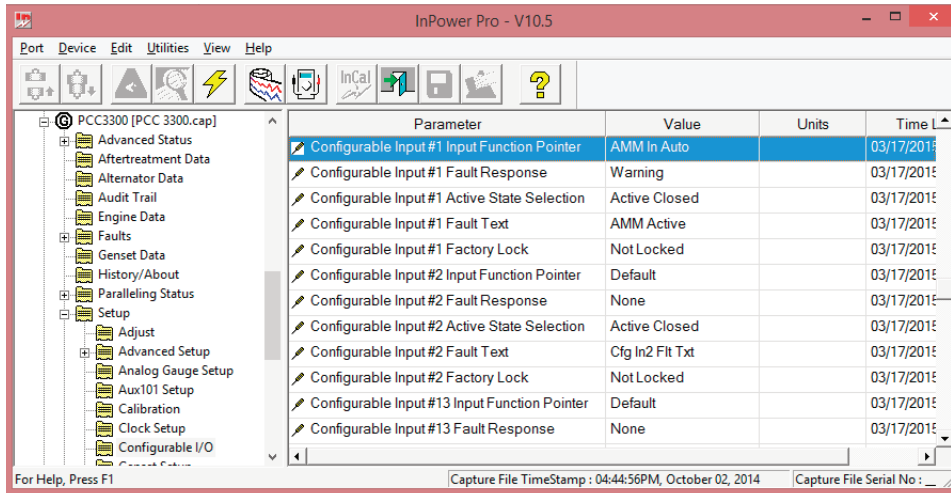


Figure 3. Setting up a configurable input to enable maintenance mode

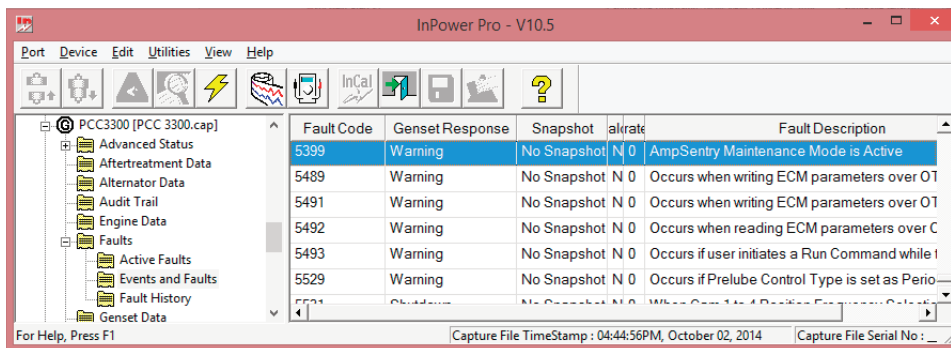


Figure 4. Ampsentry maintenance mode fault code

NEC Arc Energy Reduction requirements

The 2014 version of the NEC requires that OCPD's rated 1200 amps and higher have some type of arc energy reduction function. Relevant text from the 2014 NEC is printed below:

240.87 Arc Energy Reduction

Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted is 1200 A or higher, 240.87 (A) and (B) shall apply.

(A) Documentation. Documentation shall be available to those authorized to design, install, operate, or inspect the installation as to the location of the circuit breaker(s).

(B) Method to Reduce Clearing Time. One of the following or approved equivalent means shall be provided:

1. Zone-selective interlocking
2. Differential relaying
3. Energy-reducing maintenance switching with local status indicator
4. Energy-reducing active arc flash mitigation system
5. An approved equivalent means

Informational Note No. 1: An energy-reducing maintenance switch allows a worker to set a circuit breaker trip unit to "no intentional delay" to reduce the clearing time while the worker is working within an arc-flash boundary as defined in NFPA 70E-2012, Standard for Electrical Safety in the Workplace, and then to set the trip unit back to a normal setting after the potentially hazardous work is complete.

AmpSentry Maintenance Mode provides “energy reducing maintenance switching” as enumerated in 240.87(B)(3). The informational note describes the energy reducing maintenance switch as allowing a worker to set a breaker trip unit to “no intentional delay” while working within the arc flash boundary and then to set the trip unit back to a normal setting after the work is complete.

AmpSentry clearly meets the requirement for arc energy reduction as defined in NEC 240.87. The fact that the text in the informational note refers to a circuit breaker does not mean that only a circuit breaker can be used to meet this requirement. The fact that the code allows for “an approved equivalent means” underscores the point that a circuit breaker is not the only means for meeting this requirement.

Arc Energy Calculation

NFPA 70E references the IEEE 1584 method for estimating Arc Flash energy. This method is also used by SKM Power Tools software as well as other power system analysis programs. In addition to available fault current and arc interrupting time arc energy depends on a number of site specific factors such as system voltage, grounding method, conductor gap and working distance. Because of this arc energy available from a genset is site specific and within a site the arc flash incident energy will vary throughout the electrical distribution system based on cable resistance between the sources and the fault and on other sources such as motors that could feed the fault.

To illustrate the arc energy reduction capabilities of maintenance mode we have done calculations of arc energy for a specific generator set, a 2750 kW, 480 volt DQLD model. Note that these calculations are for comparison purposes only. In Table 1 we have calculated theoretical arc flash energy at the output of the generator using the IEEE 1584 method and parameters for a 480 volt, solidly grounded system for arcs in a box in low voltage panel board class of equipment. This calculation is intended for illustrative purposes only. Actual arc flash calculations should be performed by a licensed Professional Engineer taking into account all of the characteristics of the site.

Arc Flash Incident Energy – cal/cm²	
AmpSentry – current reduced to 300% of rated for 2 seconds	58.1
AmpSentry – maintenance mode – immediate shutdown	11.3
AmpSentry maintenance mode – breaker trip	3.57

Table 1. Arc Flash Energy Calculations – IEEE 1584 Method

Arc flash energy is calculated for three scenarios: One without maintenance mode enabled, one with maintenance mode enabled and one with maintenance mode enabled with a configurable output wired to shunt trip a breaker.

For a DQLD 2750 kW Genset without maintenance mode active we calculated an arc flash energy level of 58.1 cal/cm². In this scenario arcing current is not interrupted but the arc duration is 2 seconds. NFPA 70E (D.7.3) recognizes 2 seconds as a reasonable maximum time for calculations because a person will likely move away from the arc quickly if physically possible. In this scenario arc flash energy is calculated for both the transient period and the steady state period. This is how SKM calculates arc energy from a generator set in recognition that fault current from a synchronous generator decays rapidly. Three phase bolted fault current is used in the transient period calculation. 300% of rated current is used in the steady state calculation to correspond with AmpSentry’s fault current regulation function.

With AmpSentry Maintenance Mode enabled we calculated an arc flash energy level of 11.3 cal/cm². With Maintenance Mode enabled the control shuts off fuel and excitation immediately on recognizing the fault. The arc doesn’t necessarily immediately extinguish however due to energy stored in the windings. As can be seen in Figure 2 when excitation is shut off fault current decays exponentially based on the transient time constant. It takes 1 transient time constant (0.19 sec for this alternator) for the current to decay to a level that the arc extinguishes. (NFPA 70E D.5(1) states that the industry accepted minimum level for a sustaining arcing fault is 38 percent of available bolted fault current. 38 percent of initial current corresponds to 1 time constant.)



About the author

Rich Scroggins is a Technical Advisor in the Application Engineering group at Cummins. Rich has been with Cummins for 18 years in a variety of engineering and product management roles. Rich has led product development and application work with transfer switches, switchgear controls and networking and remote

monitoring products and has developed and conducted seminars and sales and service training internationally on several products. Rich received his bachelors degree in electrical engineering from the University of Minnesota and an MBA from the University of St. Thomas.

We calculated an arc flash energy level of 3.57 cal/cm^2 for the scenario in which a configurable output of the control is wired to shunt trip a breaker at the instant that the control recognizes the fault, isolating the working space from the energy stored in the alternator windings. Tests have shown that AmpSentry will recognize the fault within 50 msec. For this calculation we used 60 msec for the duration of the arc, allowing 10 msec for the breaker to clear.

Conclusion

Arc energy reduction requirements have been added to the National Electrical Code as a means for improving worker safety. Cummins AmpSentry protective relay with Maintenance Mode has the functionality to meet all of an onsite emergency generator's NEC requirements for overcurrent protection and arc energy reduction.



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Alternator Data Sheet Frame Size: LVSI804S

Characteristics						
	No of Bearings:		1-bearing		2-bearing	
Weights:	Stator assembly:	8049 lb	3651 kg	8049 lb	3651 kg	
	Rotor assembly:	4092 lb	1856 kg	3946 lb	1790 kg	
	Complete assembly:	12912 lb	5857 kg	13223 lb	5998 kg	
Maximum speed:		2250 rpm				
Excitation current:	Full load:	3.94 Amps				
	No load:	0.88 Amps				
Insulation system:	Class H throughout					
3 Ø Ratings (0.8 power factor)		60 Hz (winding no)				
		<u>380</u> (13)	<u>416</u> (12)	<u>440</u> (12)	<u>480</u> (12)	<u>600</u> (07)
163° C rise ratings	@ 27° C	kW	2856	2556	2704	2948
		kVA	3570	3195	3380	3685
150° C rise ratings	@ 40° C	kW	2776	2484	2628	2868
		kVA	3470	3105	3285	3585
125° C rise ratings	@ 40° C	kW	2600	2320	2456	2680
		kVA	3250	2900	3070	3350
105° C rise ratings	@ 40° C	kW	2380	2132	2256	2460
		kVA	2975	2665	2820	3075
80° C rise ratings	@ 40° C	kW	2104	1860	1964	2144
		kVA	2630	2325	2455	2680
3 Ø Reactances			<u>380</u> (13)	<u>416</u> (12)	<u>440</u> (12)	<u>480</u> (12)
			<u>600</u> (07)			
(Based on full load at 125° C rise rating)						
Synchronous			2.400	3.400	3.217	2.950
Transient			0.187	0.250	0.237	0.217
Subtransient			0.138	0.182	0.172	0.158
Negative sequence			0.200	0.263	0.249	0.228
Zero sequence			0.025	0.033	0.032	0.029
3 Ø Motor starting			<u>380</u> (13)	<u>416</u> (12)	<u>440</u> (12)	<u>480</u> (12)
			<u>600</u> (07)			
Maximum kVA	(90% sustained voltage)		7944	8412	8412	8412
Time constants		(sec)	<u>380</u> (13)	<u>416</u> (12)	<u>440</u> (12)	<u>480</u> (12)
			<u>600</u> (07)			
Transient			0.186	0.187	0.187	0.187
Subtransient			0.015	0.015	0.015	0.015
Open circuit			4.150	4.300	4.300	4.300
DC			0.071	0.070	0.070	0.075
Windings		(@20° C)	<u>380</u> (13)	<u>416</u> (12)	<u>440</u> (12)	<u>480</u> (12)
			<u>600</u> (07)			
Stator resistance	(L-L Ohms)		.00060	0.00109	0.00109	0.00109
Rotor resistance	(Ohms)		1.400	1.400	1.400	1.400
Number of leads			6	6	6	6



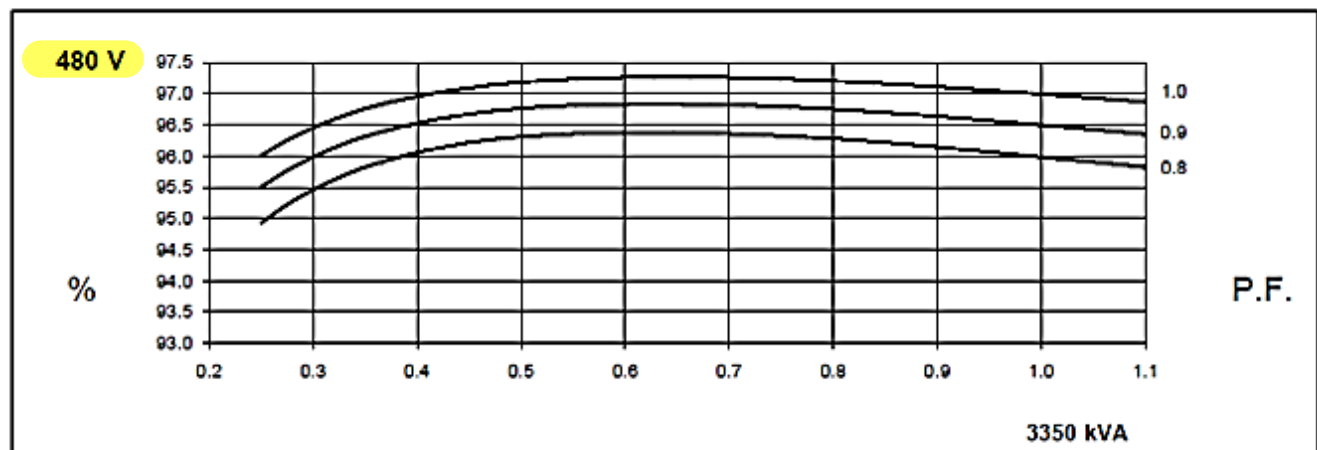
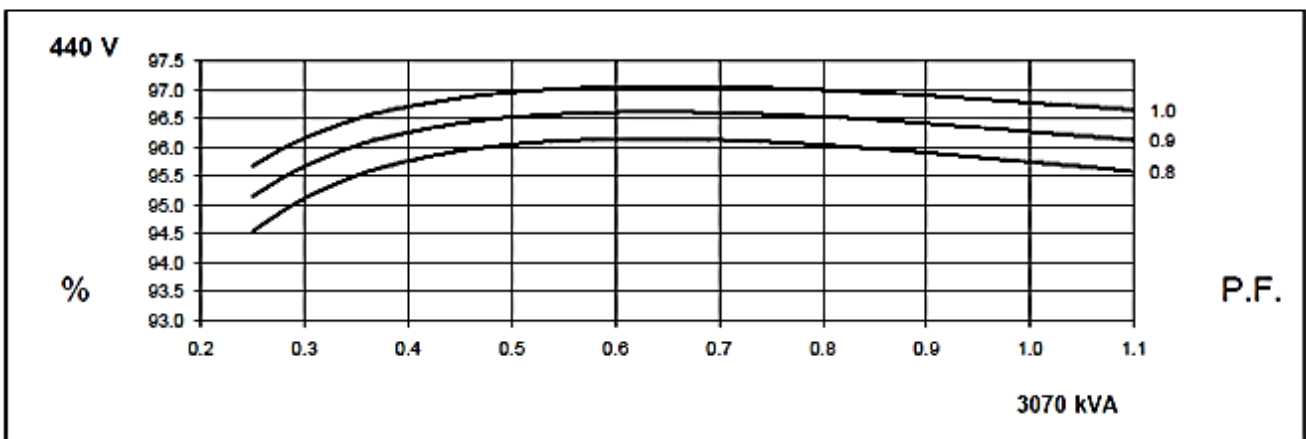
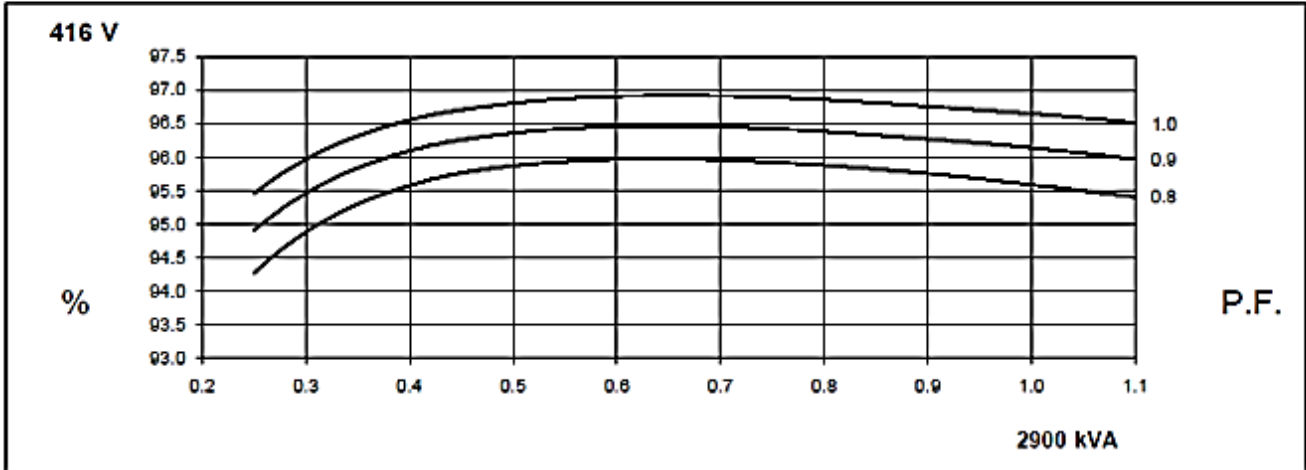
Alternator Data Sheet

Frame Size: LVSI804S

Three Phase Efficiency Curves

WDG 12

60 HZ





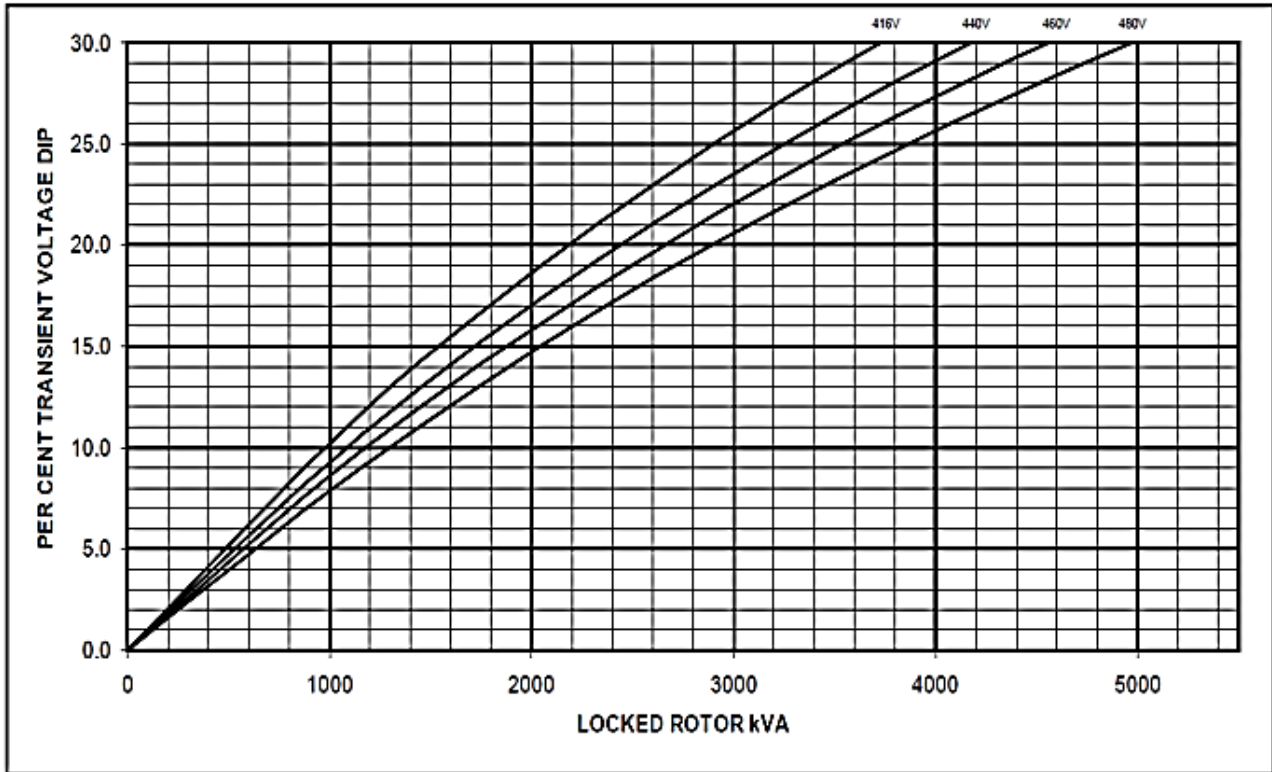
Alternator Data Sheet

Frame Size: LVSI804S

Locked Rotor Motor Starting Curve

WDG 12

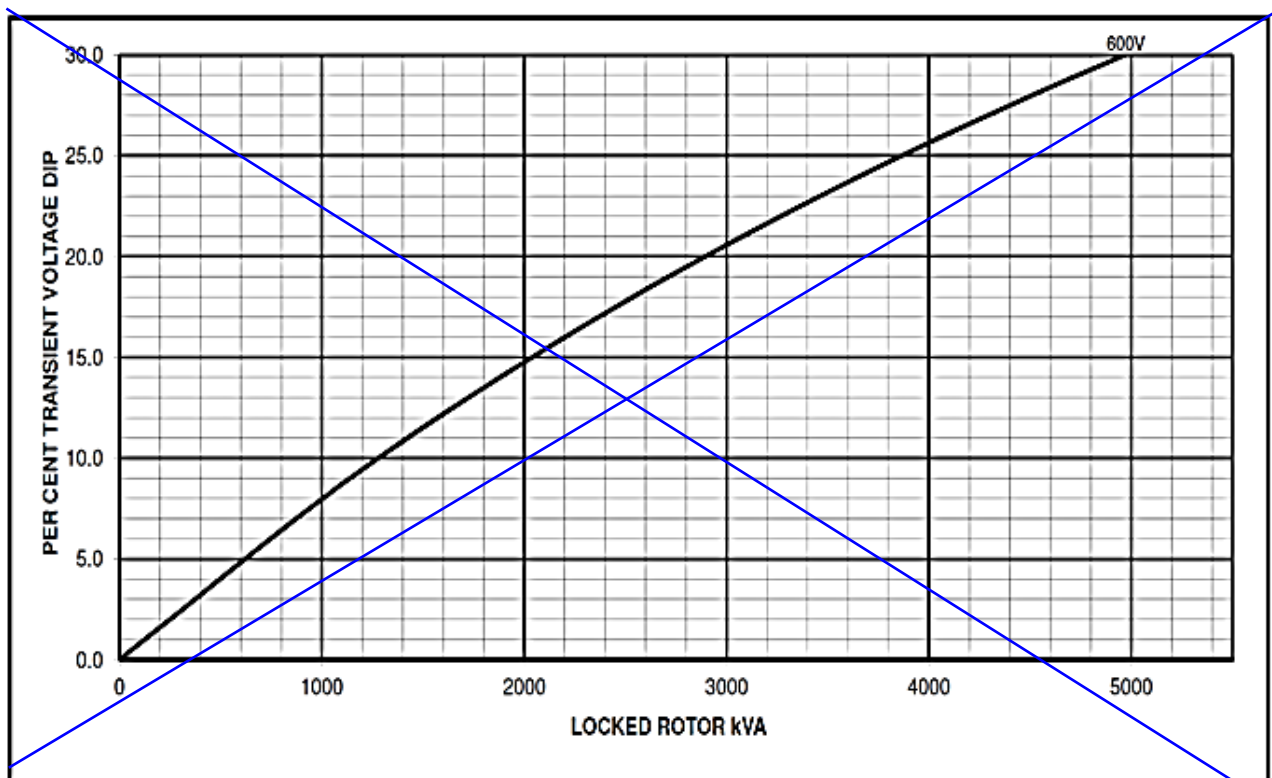
60 HZ



Locked Rotor Motor Starting Curve

WDG 7

60 HZ





Alternator Data Sheet

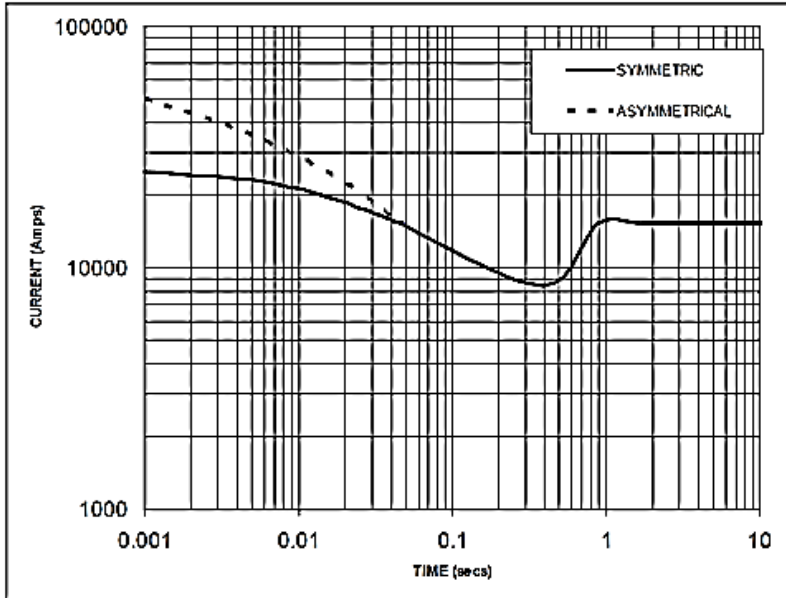
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Three Phase Short Circuit Decrement Curve No-Load Excitation at Rated Speed

WDG 12

60 HZ

Based on series star (wye) connection



NOTE 1
THE FOLLOWING MULTIPLICATION FACTORS SHOULD BE USED TO ADJUST THE VALUES FROM CURVES BETWEEN THE 0.001 SECONDS AND THE MINIMUM CURRENT POINT IN RESPECT OF NOMINAL OPERATING VOLTAGE

VOLTAGE	FACTOR
416V	X 0.87
440V	X 0.92
460V	X 0.96
480V	X 1.00

THE SUSTAINED CURRENT VALUE IS CONSTANT IRRESPECTIVE OF VOLTAGE LEVEL

NOTE 2
THE FOLLOWING MULTIPLICATION FACTORS SHOULD BE USED TO CONVERT THE VALUES CALCULATED IN ACCORDANCE WITH NOTE 1 TO THOSE APPLICABLE TO THE VARIOUS TYPES OF SHORT CIRCUIT

	3 PHASE	2 PHASE L-L	1 PHASE L-N
INSTANTANEOUS	X 1.0	X 0.87	X 1.30
MINIMUM	X 1.0	X 1.80	X 3.20
SUSTAINED	X 1.0	X 1.50	X 2.50
MAX SUSTAINED DURATION	10 SEC	5 SEC	2 SEC

ALL OTHER TIMES ARE UNCHANGED

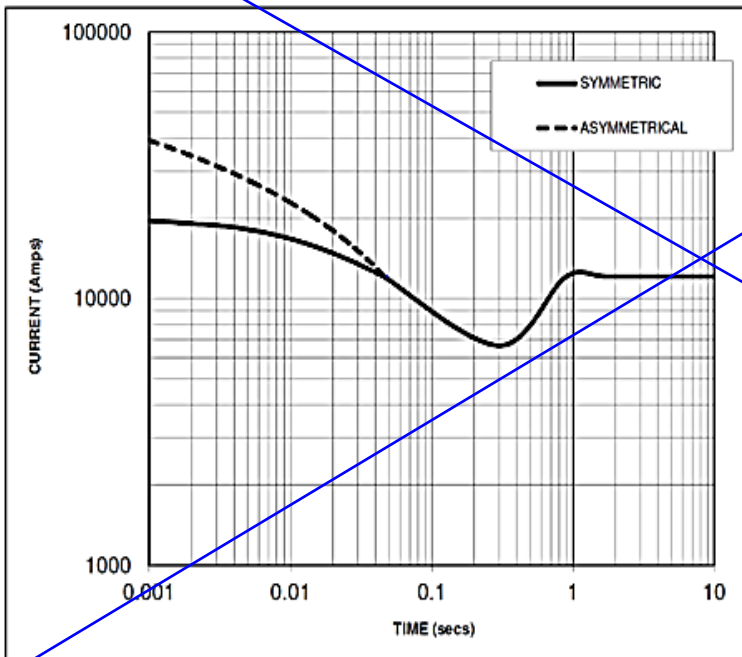
SUSTAINED SHORT CIRCUIT = 15312 Amps

Three Phase Short Circuit Decrement Curve No-Load Excitation at Rated Speed

WDG 7

60 HZ

Based on series star (wye) connection



NOTE 1
THE FOLLOWING MULTIPLICATION FACTORS SHOULD BE USED TO ADJUST THE VALUES FROM CURVES BETWEEN THE 0.001 SECONDS AND THE MINIMUM CURRENT POINT IN RESPECT OF NOMINAL OPERATING VOLTAGE

VOLTAGE	FACTOR
600V	X 1.00

THE SUSTAINED CURRENT VALUE IS CONSTANT IRRESPECTIVE OF VOLTAGE LEVEL

NOTE 2
THE FOLLOWING MULTIPLICATION FACTORS SHOULD BE USED TO CONVERT THE VALUES CALCULATED IN ACCORDANCE WITH NOTE 1 TO THOSE APPLICABLE TO THE VARIOUS TYPES OF SHORT CIRCUIT

	3 PHASE	2 PHASE L-L	1 PHASE L-N
INSTANTANEOUS	X 1.0	X 0.87	X 1.30
MINIMUM	X 1.0	X 1.80	X 3.20
SUSTAINED	X 1.0	X 1.50	X 2.50
MAX SUSTAINED DURATION	10 SEC	5 SEC	2 SEC

ALL OTHER TIMES ARE UNCHANGED

SUSTAINED SHORT CIRCUIT = 12120 Amps



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	99.2	99.6	100.1	99.9	96.8	100.8	99.6	100.4	99.7

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	Infinite Exhaust	90.6	106.7	118.9	123.4	121.3	117.8	118.7	120.4	128.3

Exhaust Sound Power Level, dB(A)

Open Exhaust (No Muffler Rated Load)	Octave Band Center Frequency (Hz)								Sound Power Level
	63	125	250	500	1000	2000	4000	8000	
		97.7	107.5	108.5	110.5	108.1	112.9	113.7	108.7

Note:

1. 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 7m (23 ft) from the surface of the generator set and 1.2m (48") from floor level.
2. Sound levels are subject to instrumentation, measurement, installation and manufacturing variability.
3. Sound data with remote-cooled generator sets are based on rated loads without cooling fan noise.
4. Sound levels for aluminum enclosures are approximately 2 dB(A)s higher than listed sound levels for steel enclosures.
5. Sound data for generator set with infinite exhaust do not include exhaust noise.
6. Data is based on full rated load with standard radiator-cooling fan package
7. Sound Pressure Levels are measured per ANSI S1.13 and ANSI S12.18, as applicable.
8. Reference sound pressure is 20 µPa.
9. Sound Power Levels per ISO 3744 and ISO 8528-10, as applicable.
10. Reference power = 1 pw (10⁻¹² W)
11. Exhaust Sound Pressure Levels are per ISO 6798, as applicable.



High Ambient Air Temperature Radiator Cooling System

	Fuel Type	Duty	Rating (kW)	Max cooling @ air flow static restriction, unhoused (inches water/mm water)					Housed in free air, no air discharge restriction		
				0.0/0.0	0.25/6.4	0.5/12.7	0.75/19.1	1.0/25.4	Weather	Sound level 1	Sound level 2
				Maximum allowable ambient temperature, degree C							
60 Hz	Diesel	Standby	2000	52.6	49.4	46.1	43.5	41.6	N/A	N/A	N/A
		Prime	1825	47.5	44.1	40.7	38.2	36.5	N/A	N/A	N/A
				Airflow (m ³ /s)							
				33.2	30.5	28.3	26.8	25.8	N/A	N/A	N/A

Enhanced High Ambient Air Temperature Radiator Cooling System

	Fuel Type	Duty	Rating (kW)	Max cooling @ air flow static restriction, unhoused (inches water/mm water)					Housed in free air, no air discharge restriction		
				0.0/0.0	0.25/6.4	0.5/12.7	0.75/19.1	1.0/25.4	Weather	Sound level 1	Sound level 2
				Maximum allowable ambient temperature, degree C							
60 Hz	Diesel	Standby	2000	56.5	56.5	56.5	54.6	54	N/A	N/A	N/A
		Prime	1825	50.6	50.1	49.6	49	48.4	N/A	N/A	N/A
				Airflow (m ³ /s)							
				60.6	58.8	57.4	55.7	53.7	N/A	N/A	N/A

Notes:

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



Exhaust Emission Data Sheet

2000DQKAB*

60 Hz Diesel Generator Set

Engine Information:

Model:	Cummins Inc QSK60-G6 NR2	Bore:	6.25 in. (158 mm)
Type:	4 Cycle, 60°V, 16 Cylinder Diesel	Stroke:	7.48 in. (189 mm)
Aspiration:	Turbocharged and Low Temperature Air Aftercooled	Displacement:	3673 cu. In. (60.1 liters)
Compression Ratio:	14.5:1		
Emission Control Device:	Turbocharged and Low Temperature Aftercooled		

	1/4	1/2	3/4	Full	Full
PERFORMANCE DATA	Standby	Standby	Standby	Standby	Prime
BHP @ 1800 RPM (60 Hz)	730	1460	2189	2919	2639
Fuel Consumption (gal/Hr)	46.5	82	107.3	141.3	124.1
Exhaust Gas Flow (CFM)	6510	10220	12000	14920	13780
Exhaust Gas Temperature (°F)	772	838	873	893	884
EXHAUST EMISSION DATA					
HC (Total Unburned Hydrocarbons)	0.22	0.13	0.10	0.11	0.09
NOx (Oxides of Nitrogen as NO2)	2.70	3.10	4.70	5.30	6.00
CO (carbon Monoxide)	0.57	0.36	0.13	0.18	0.16
PM (Particular Matter)	0.16	0.14	0.04	0.04	0.02
SO2 (Sulfur Dioxide)	0.14	0.13	0.11	0.11	0.11
Smoke (Bosch)	0.50	0.60	0.20	0.20	0.10

All values are Grams per HP-Hour, Smoke is Bosch#

TEST CONDITIONS

Data is representative of steady-state engine speed (± 25 RPM) at designated genset loads. Pressures, temperatures, and emission rates were stabilized.

Fuel Specification:	ASTM D975 No. 2-D diesel fuel with 0.03-0.05% sulfur content (by weight), and 40-48 cetane number.
Fuel Temperature:	99 \pm 9 °F (at fuel pump inlet)
Intake Air Temperature:	77 \pm 9 °F
Barometric Pressure:	29.6 \pm 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference Standard:	ISO 8178

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



Prototype Test Support (PTS) 60 Hz test summary



<u>Generator set models</u>	<u>Representative prototype</u>
1750DQKAA	Model: 2000DQKAB
2000DQKAB	Engine: QSK60-G6 NR2
	Alternator: P734G

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: 2125 kW
The generator set was evaluated to determine the stated maximum surge power.

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

Cooling system: 40 °C ambient
0.5 in. H₂O restriction

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

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: ± 0.50%
Random voltage variation: ± 0.50%
Frequency regulation: ± 0.25%
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. Voltage and frequency response on load addition or rejection were evaluated. The following results were recorded at 0.8 power factor:

Full load acceptance:

Voltage dip: 39.2%
Recovery time: 5.8 sec
Frequency dip: 8.8%
Recovery time: 4.6 sec

Full load rejection:

Voltage rise: 21.9%
Recovery time: 2.4 sec
Frequency rise: 2.8%
Recovery time: 1.4 sec

All data based on a 0.8 power factor.

Harmonic analysis:

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

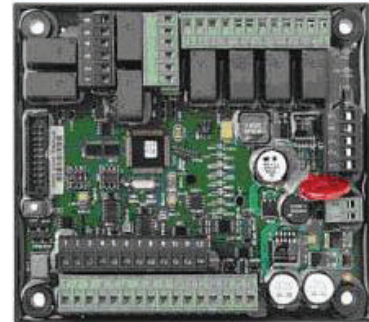
Harmonic	<u>Line to Line</u>		<u>Line to Neutral</u>	
	<u>No load</u>	<u>Full load</u>	<u>No load</u>	<u>Full load</u>
3	0.18	0.014	0.134	0.08
5	0.20	2.3	0.13	2.3
7	0.52	1.46	0.48	0.74
9	0.08	0.03	0.03	0.068
11	0.65	0.485	0.64	0.46
13	0.21	0.28	0.19	0.31
15	0.05	0.053	0.025	0.098

SECTION 3

GENERATOR ACCESSORIES



PowerCommand[®] input/output expansion module **AUX 101** and **AUX 102**



Description

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

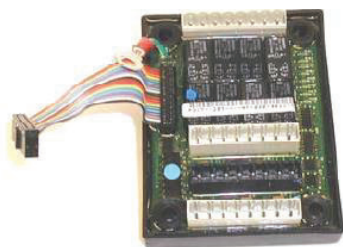
Analog/discrete inputs can be used for system fault expansion and/or generator set metering.

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

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

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

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



AUX 102 - Expansion

Features

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

Specifications

Signal requirements

Network connections: RS485, twisted-pair 78 kbps

Control power: 5-40 VDC

Current

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

Terminations for control power accept wire up to 16 ga.

Environment

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

Configurations

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

Discrete/analog inputs:

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

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

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

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

Inputs are defaulted to disabled

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

Relay ratings (AUX 101)

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

Relay ratings (AUX 102)

- 2 A at 125 VAC, 2 A at 30 VDC

Input ratings (AUX 101)

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

Network length

Maximum 1219 m (4000 ft)

Approved wiring

Cat 4 or Cat 5 (stranded)

Relay outputs

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

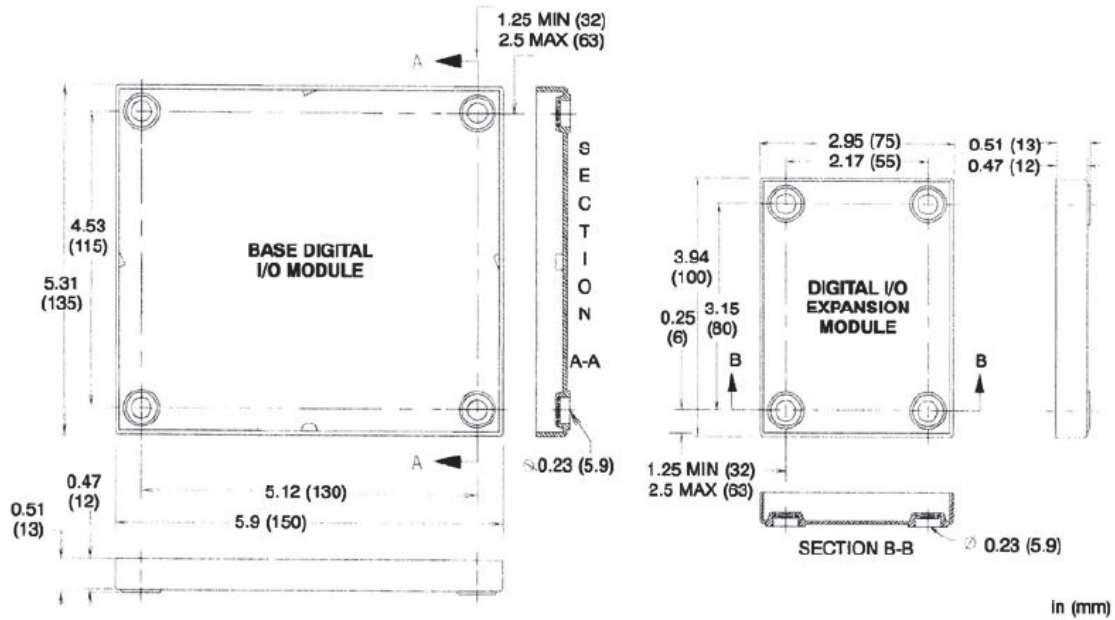
AUX 101

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

AUX 102

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

Dimensions



Ordering information

Part number	Description
A030K633	AUX101 Control Kit, 8 Discrete/Analog Input/ 8 Form-C Output-PCC 1.x/2.x/3.x
0184-0263	AUX 101 Digital Input/output Module - Base – PCC 1301 on DN and GN model generator sets
0630-3142	AUX 102 Digital Input/output Module wiring diagram - Instruction sheet C693
0541-0772	AUX 102 Digital Input/output Module - Expansion

PCCNet logo

Look for this logo on spec sheets of PCCNet compatible devices.



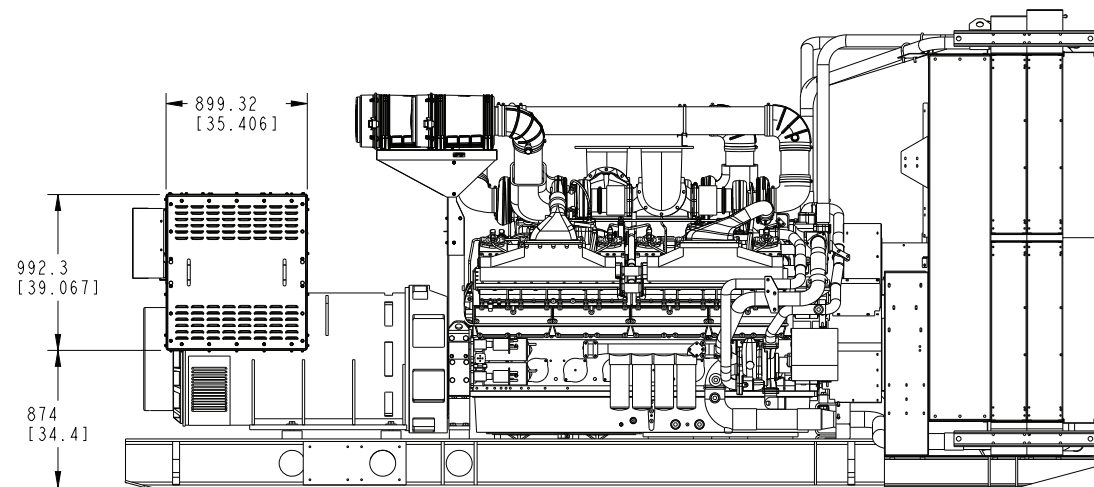
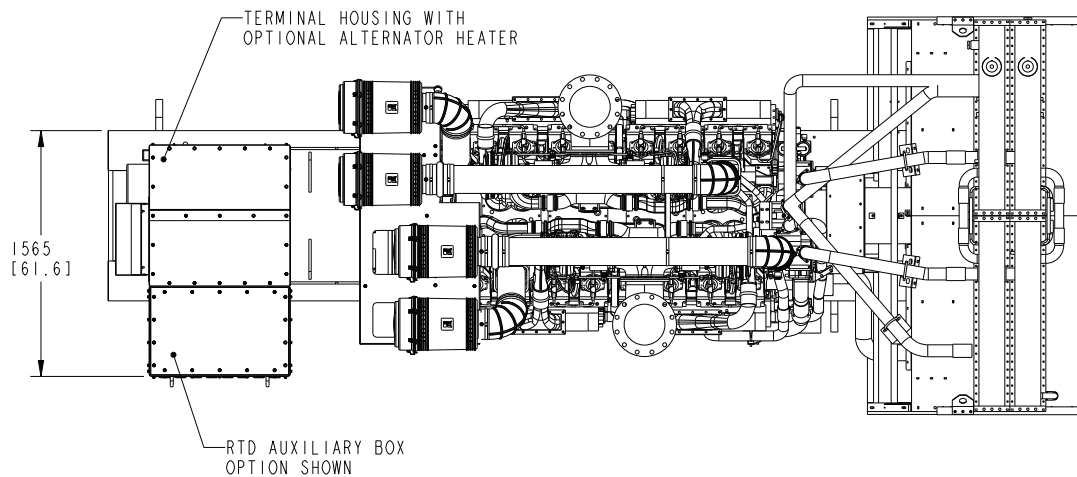
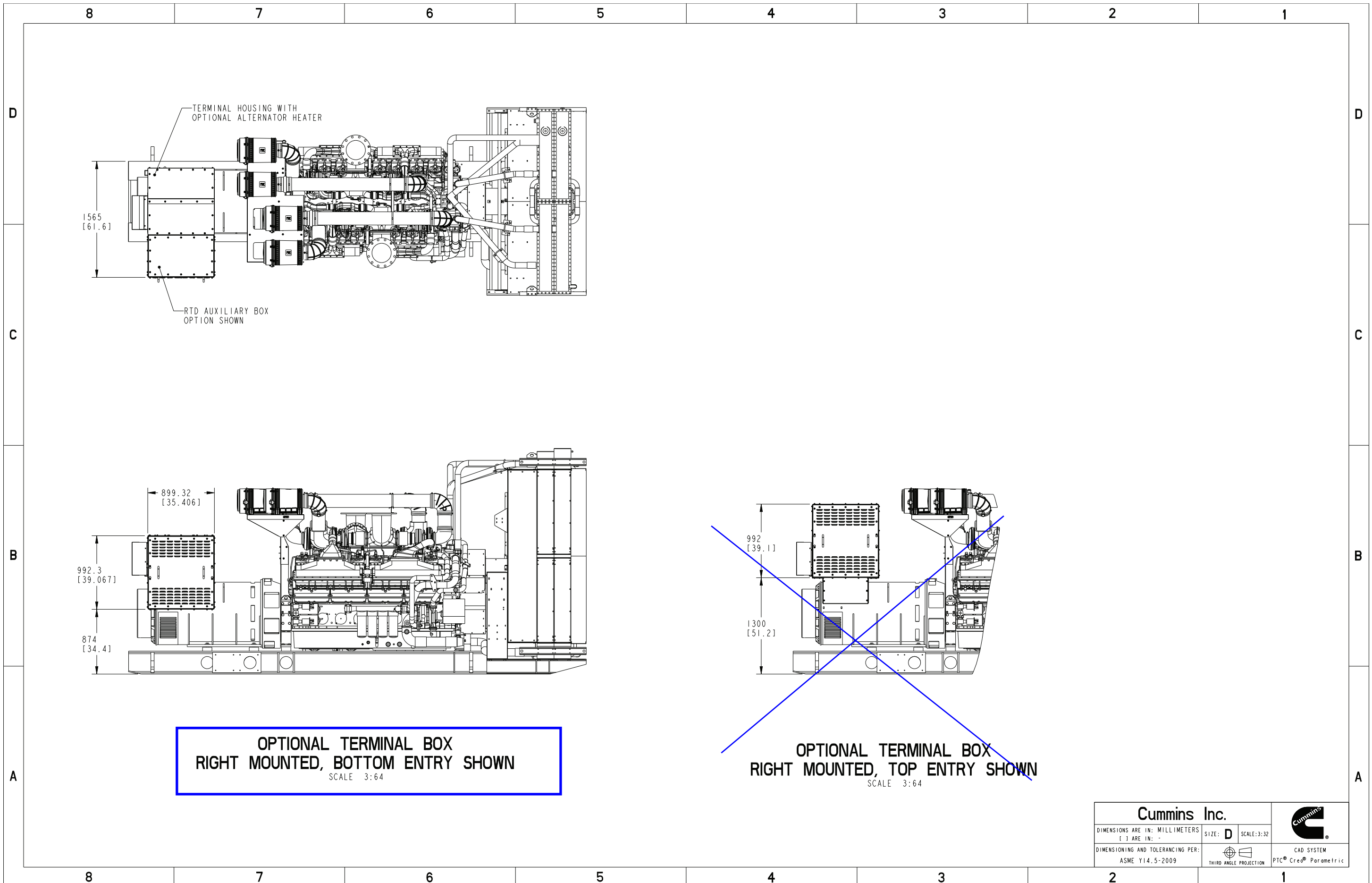
For more information contact your local Cummins distributor
or visit power.cummins.com

Our energy working for you.™

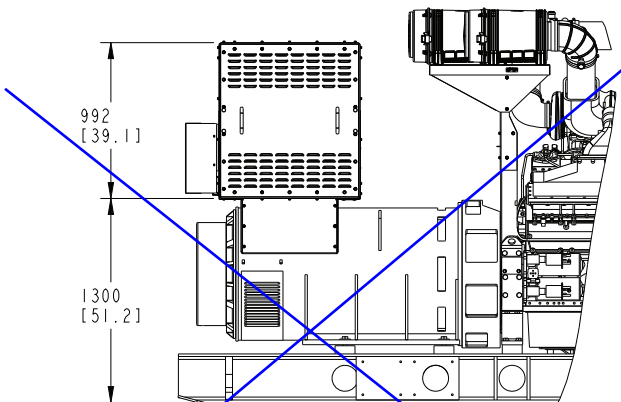


SECTION 4
GENERATOR DRAWINGS
AND INTERCONNECTS





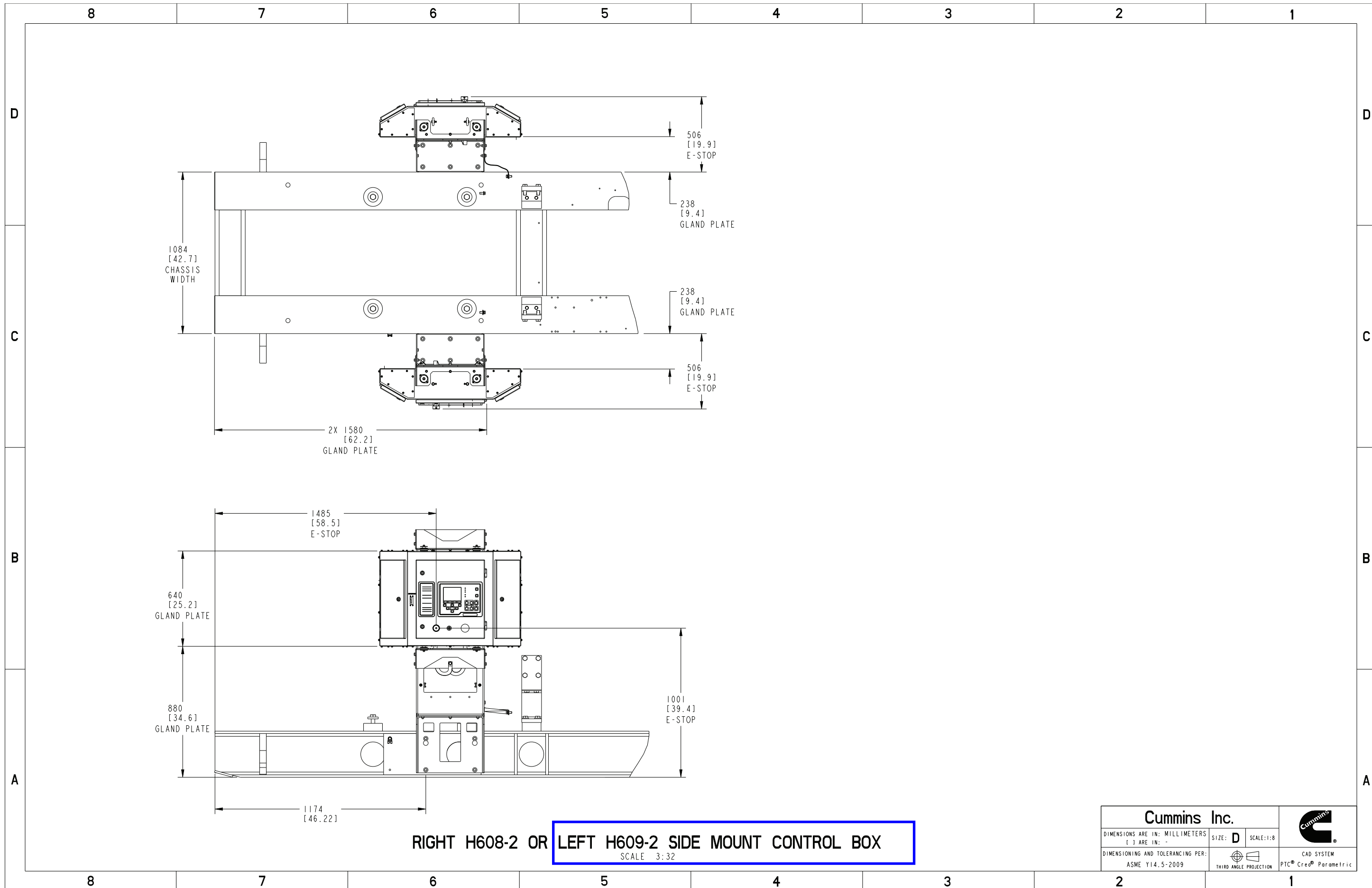
**OPTIONAL TERMINAL BOX
RIGHT MOUNTED, BOTTOM ENTRY SHOWN**
SCALE 3:64



**OPTIONAL TERMINAL BOX
RIGHT MOUNTED, TOP ENTRY SHOWN**
SCALE 3:64

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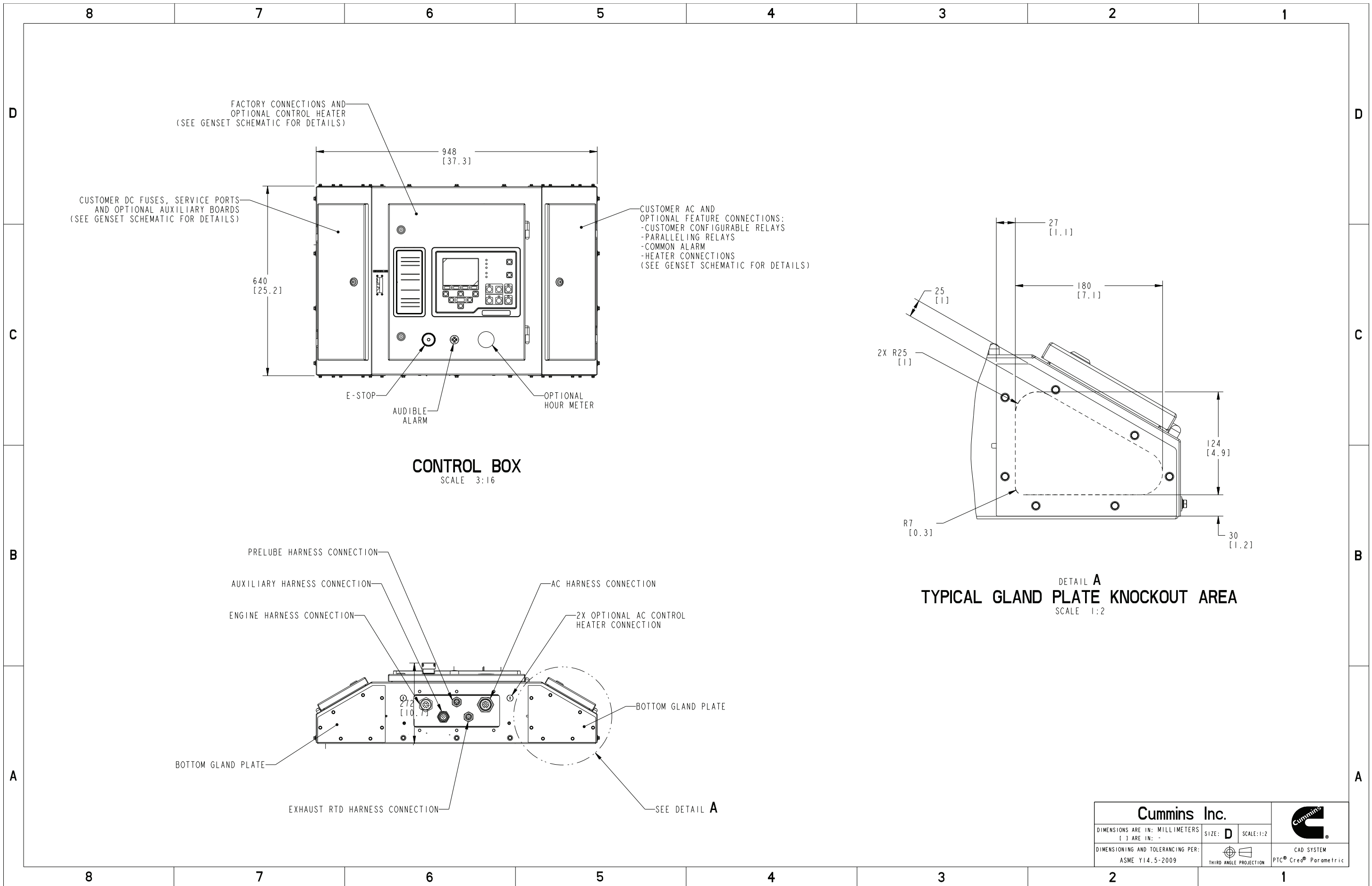
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 Part Name: **OUTLINE,GENSET**
 Drawing Category: **Outline** State: **Released** Sheet **7** of **20**



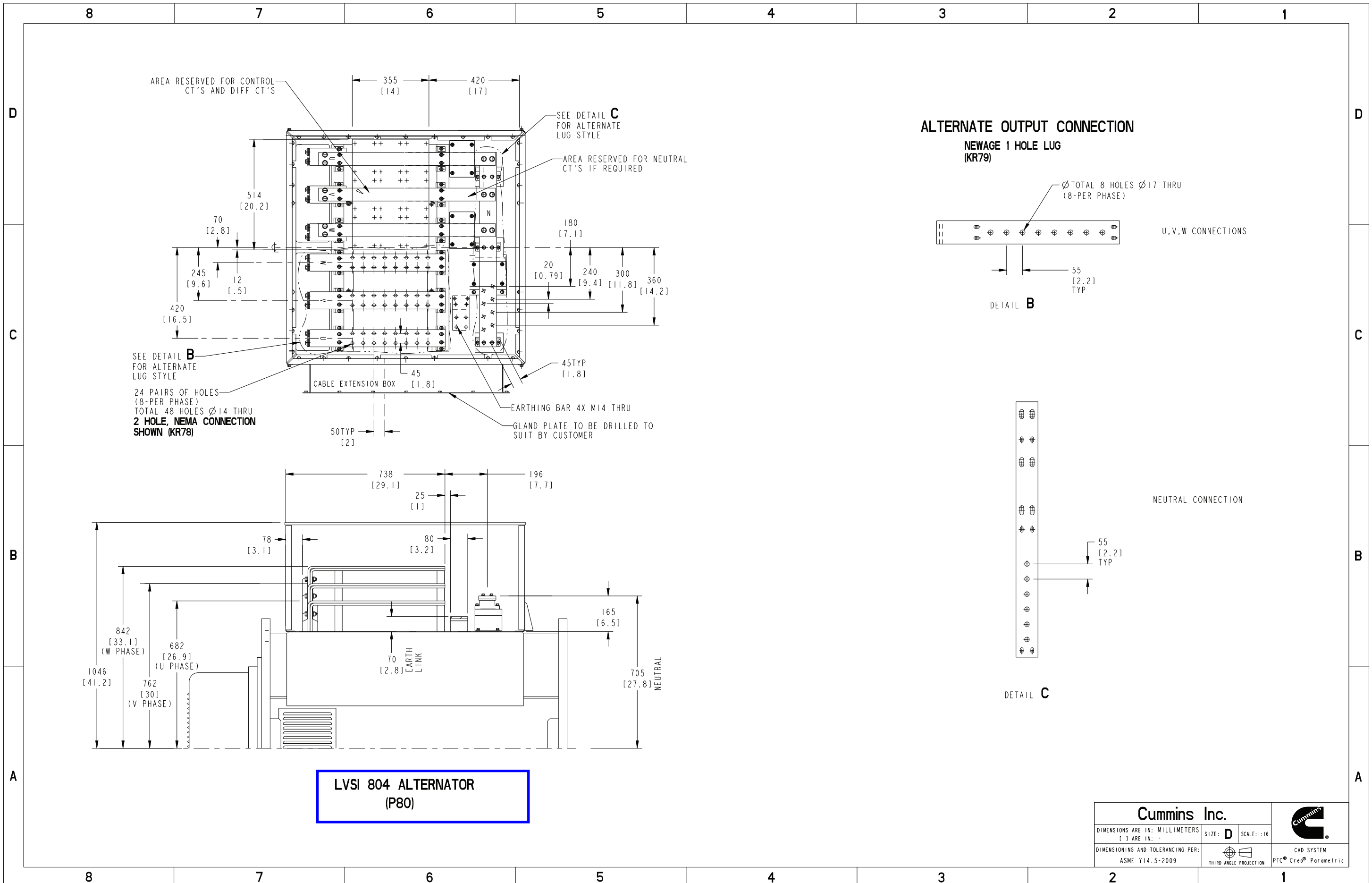
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Part Name: **OUTLINE,GENSET**
Drawing Category: **Outline** State: **Released** Sheet **8** of **20**



**LVSI 804 ALTERNATOR
(P80)**

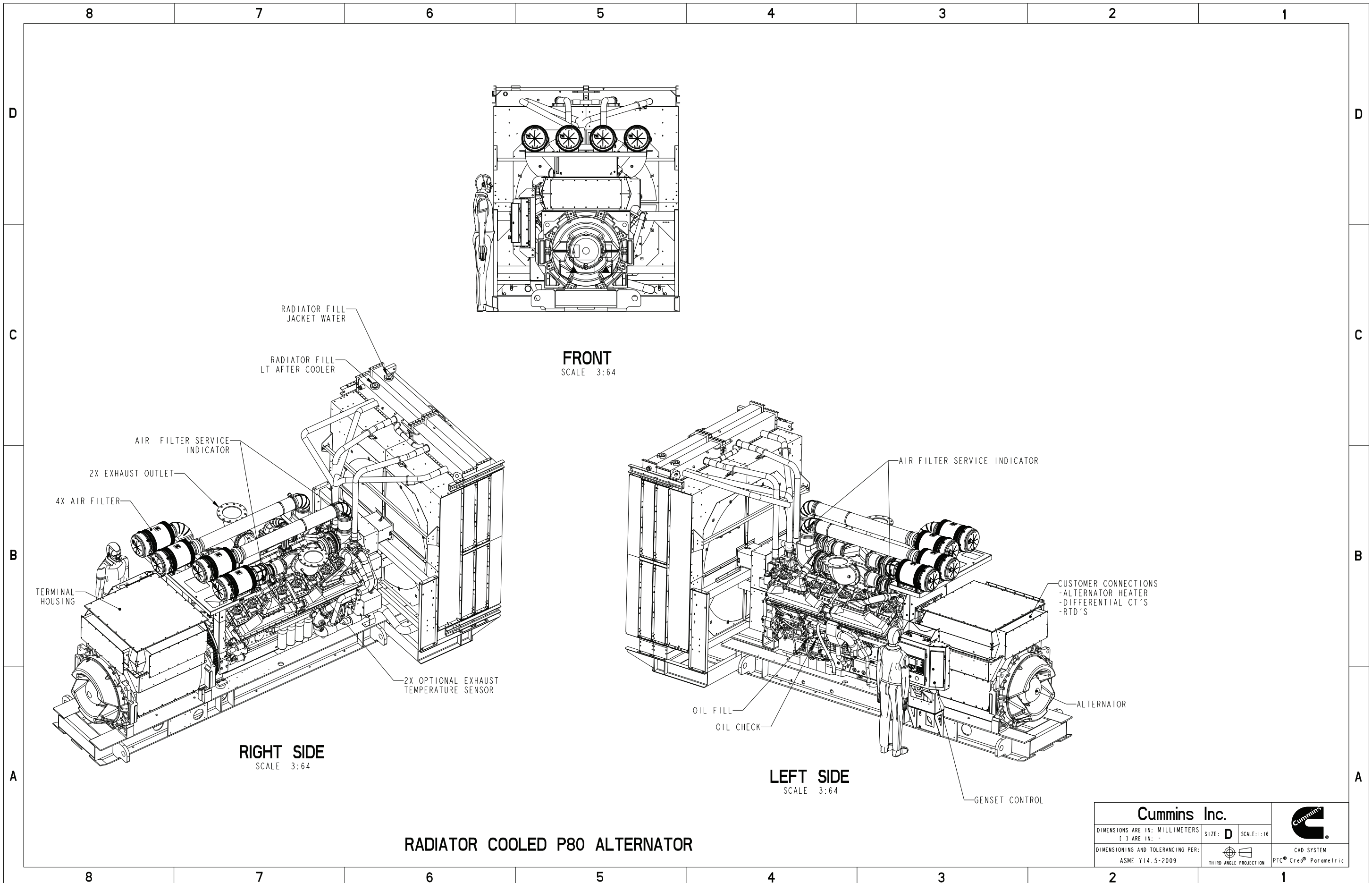
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RADIATOR COOLED P80 ALTERNATOR

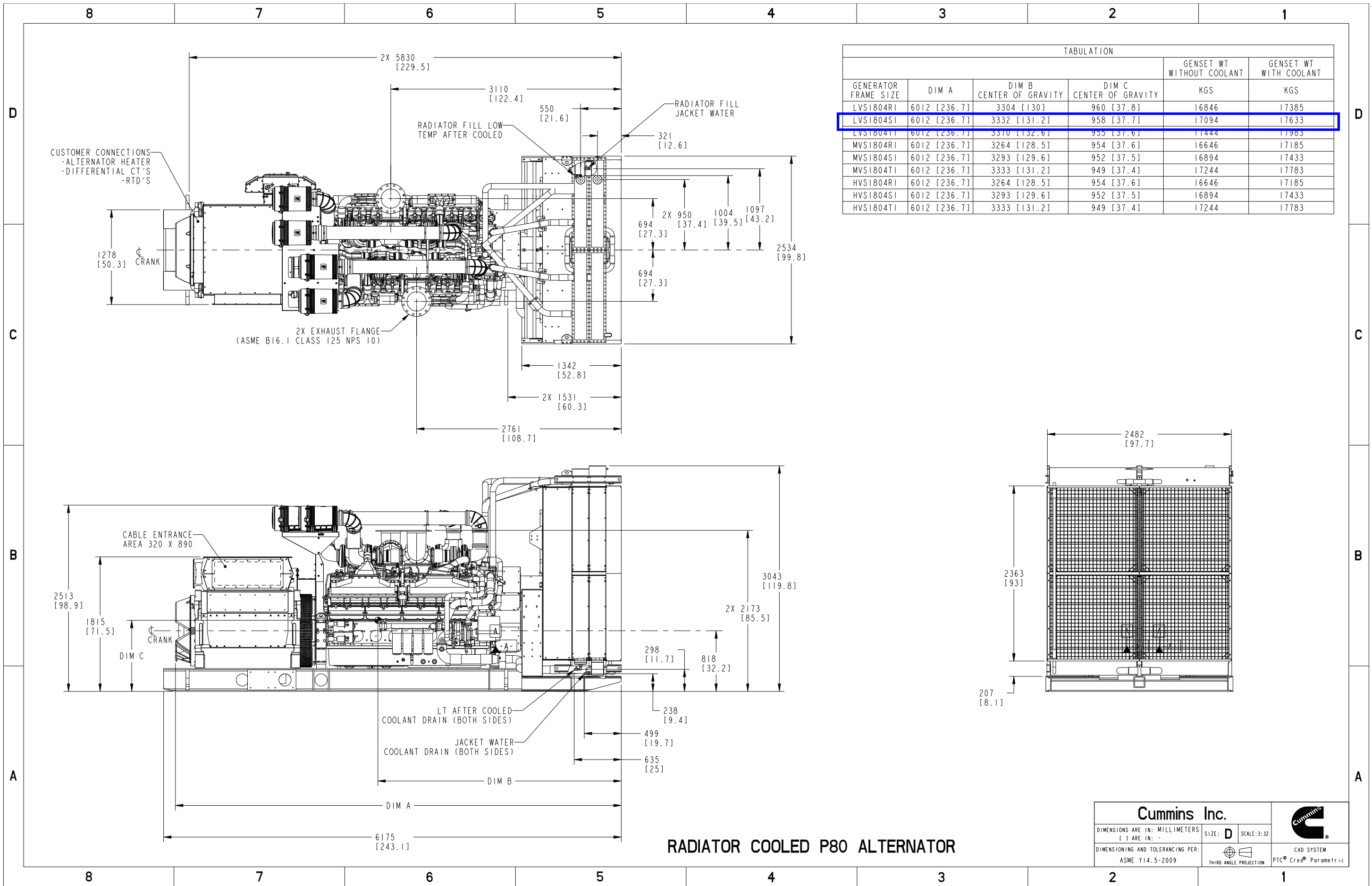
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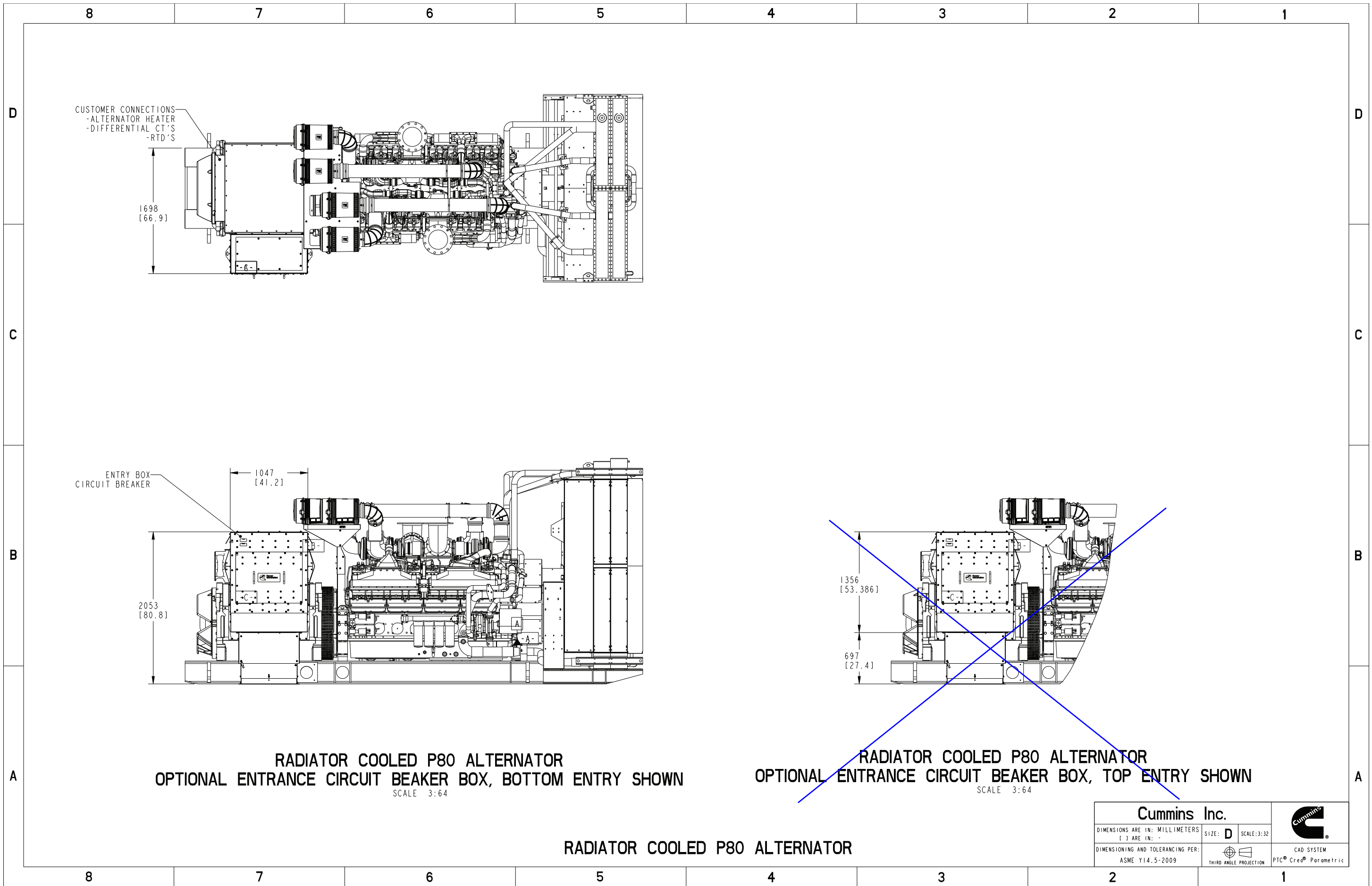


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Drawing Category: **Outline** State: **Released** Sheet **13** of **20**



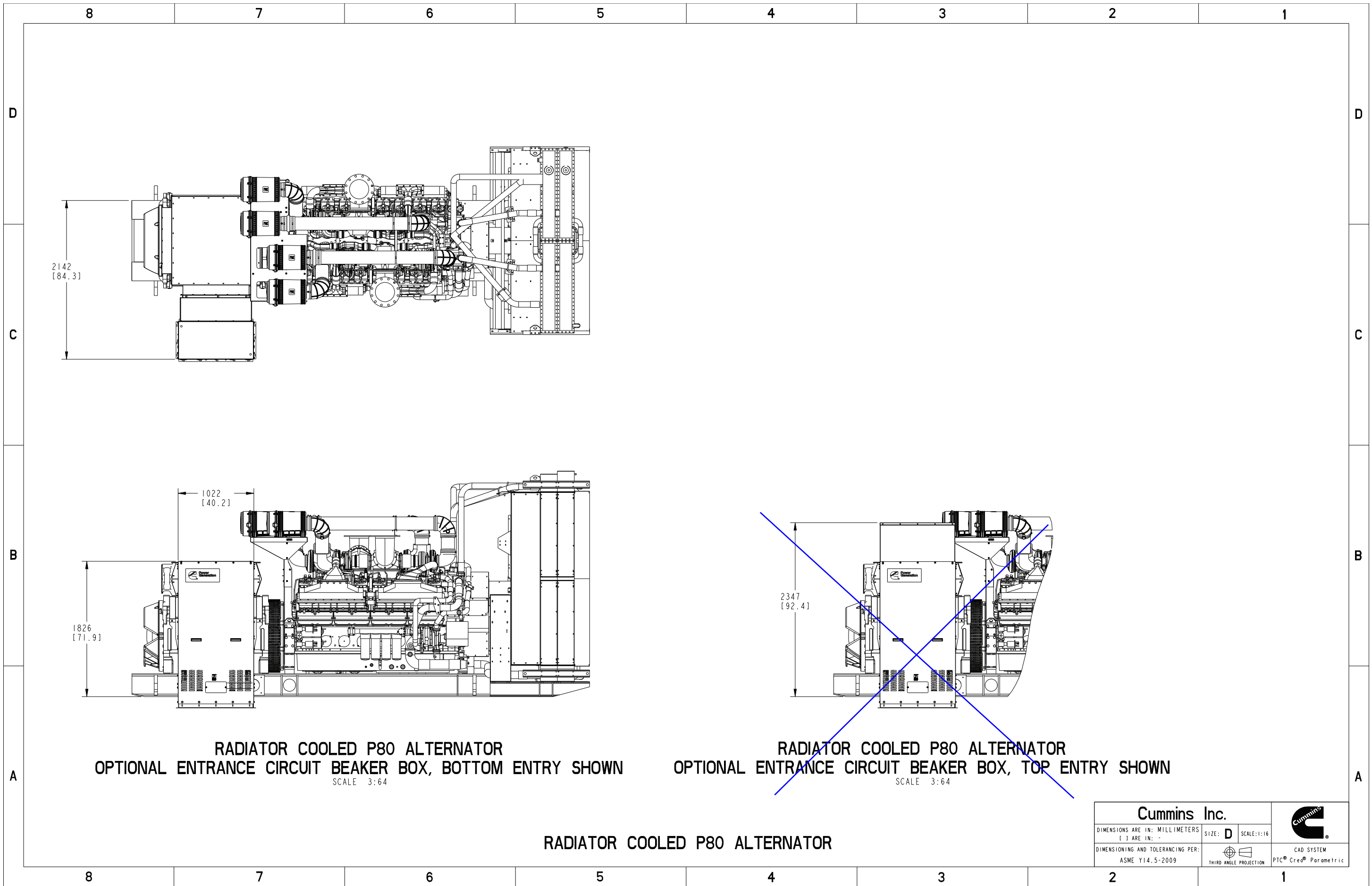
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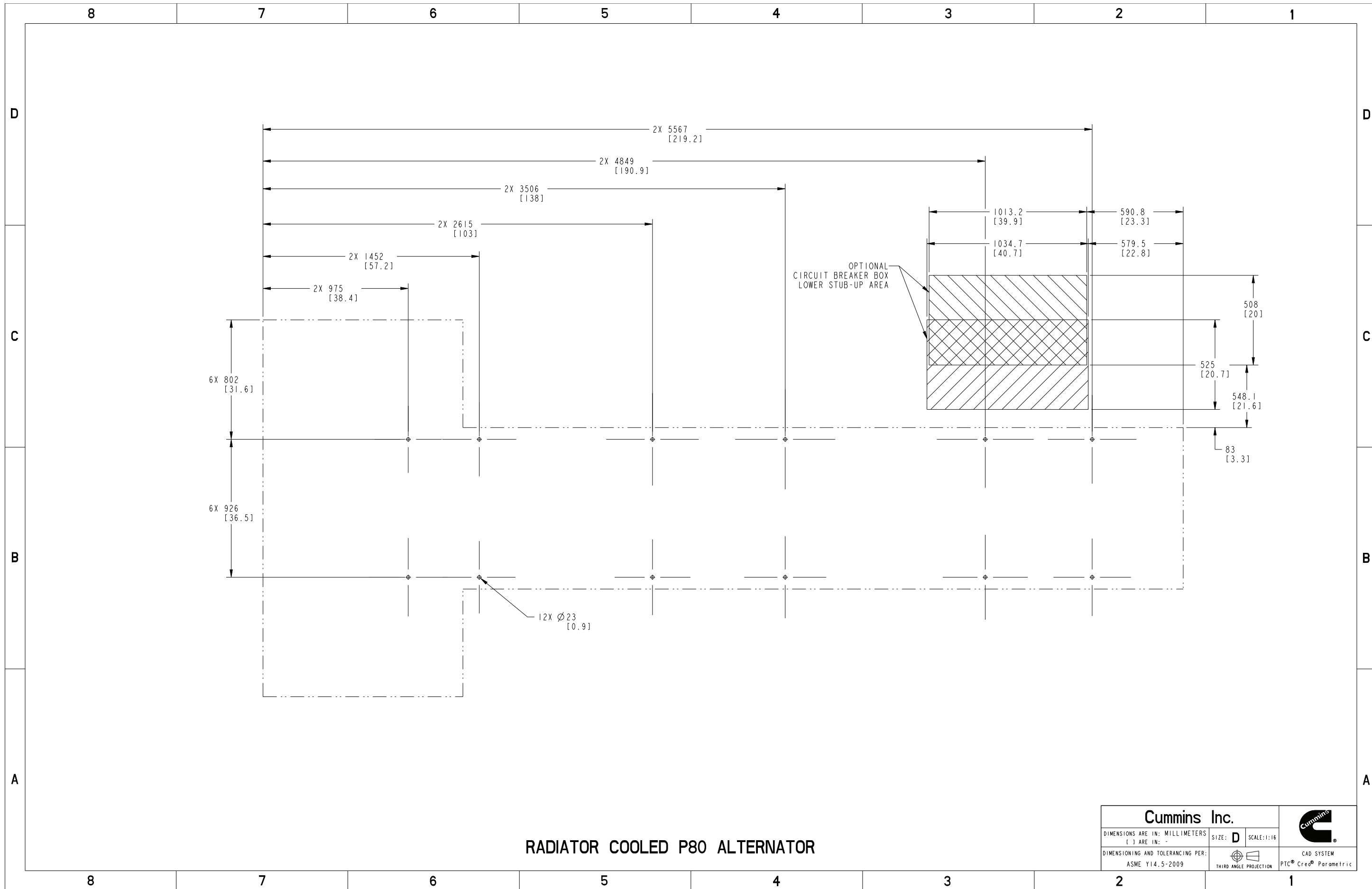
RADIATOR COOLED P80 ALTERNATOR
 OPTIONAL ENTRANCE CIRCUIT BEAKER BOX, BOTTOM ENTRY SHOWN
 SCALE 3:64

~~RADIATOR COOLED P80 ALTERNATOR
 OPTIONAL ENTRANCE CIRCUIT BEAKER BOX, TOP ENTRY SHOWN
 SCALE 3:64~~

RADIATOR COOLED P80 ALTERNATOR

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RADIATOR COOLED P80 ALTERNATOR

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Part Number: **A063L447** Part Revision: **B**

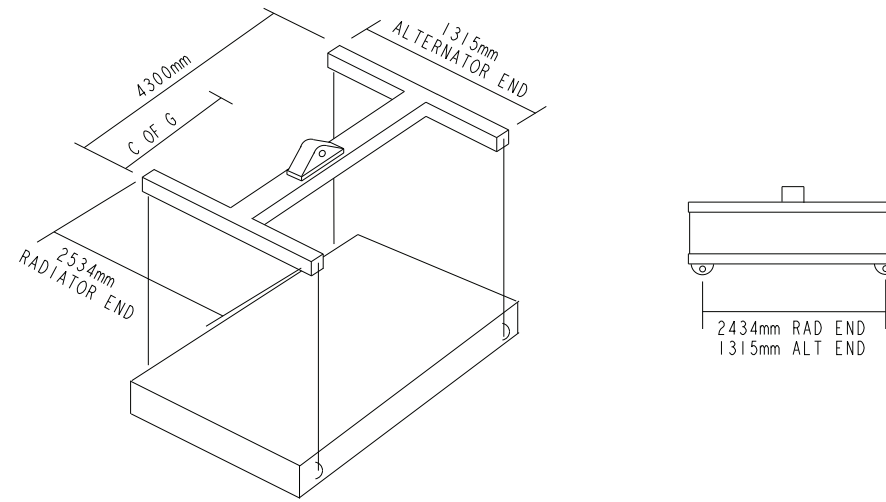
Part Name: **OUTLINE,GENSET**

Drawing Category: **Outline** State: **Released** Sheet 17 of 20

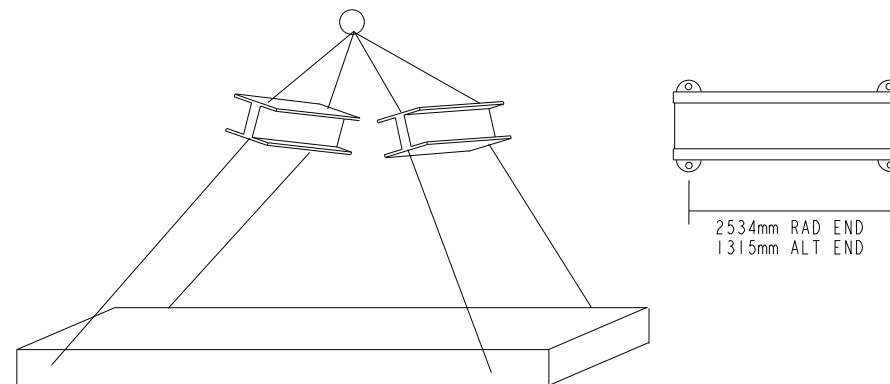
LIFTING ARRANGEMENT FOR GENSET

FOR C OF G VALUE OF
GENSET FRAME SIZE
REFER TO SHEET 3

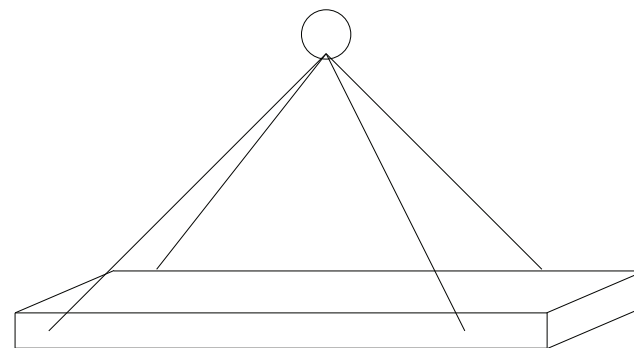
1. IDEAL
LIFTING FRAME AND STRAPS



2. NEXT BEST
SPREADERS, BARS AND STRAPS



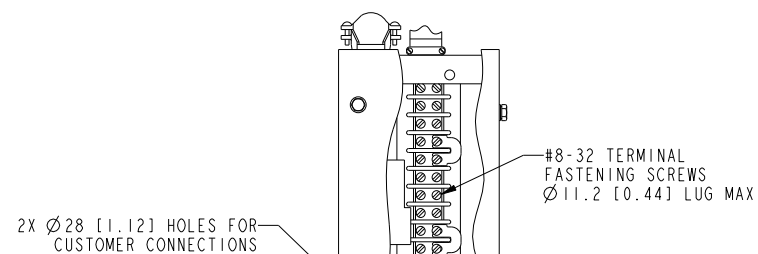
3. STRAPS
PROTECTION REQUIRED TO PREVENT DAMAGE TO
UNIT AND NYLON STRAPS WHERE THEY COME
INTO CONTACT



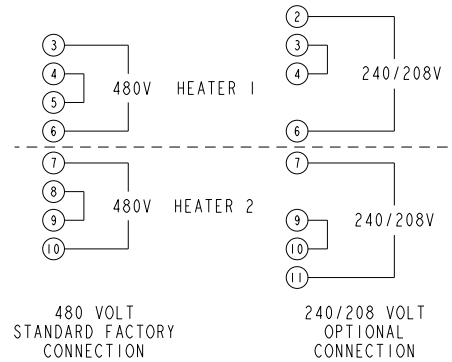
Cummins Inc.			
DIMENSIONS ARE IN: MILLIMETERS [] ARE IN: "	SIZE: D	SCALE: 1:16	
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION		CAD SYSTEM PTC® Creo® Parametric

Document Generated: 01AUG2022 19:44 GMT

REL NO	LTR	NO	REVISION	OWN	CAD	APVD	DATE
ECO-113665	C	1	REVISE DWG FORMAT TO CURRENT FORMAT	LDE	JWC	RKR	01DEC10
		2	REVISE DWG TITLE TO MATCH MATRIX	LDE	JWC	RKR	01DEC10
		3	RMV THE FOLLOWING GENSET MODELS FROM TABULATION: DQKAE, AF, C1500D6, C1400D5e, C1540D5e, C1700D5e, C1825D5e, C1540D5, C1700D5, DQKAE, AD, AF, C2000D5e, C2250D5e, C2500D5A.	LDE	JWC	RKR	01DEC10
		4	REPLACE () WITH [] ON INCH DIM IN TABULATION	LDE	JWC	RKR	01DEC10



DETAIL OF HEATER TERMINAL BOX

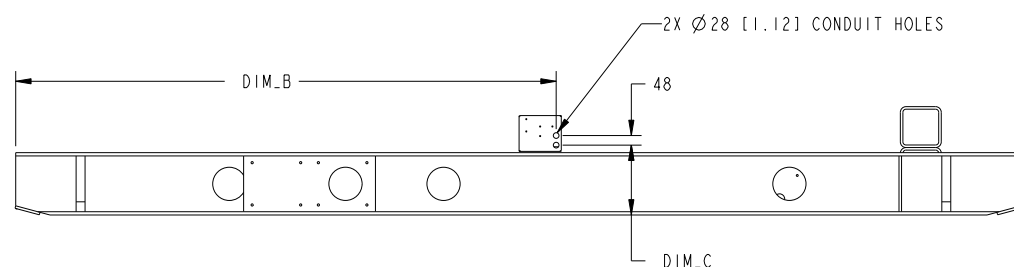
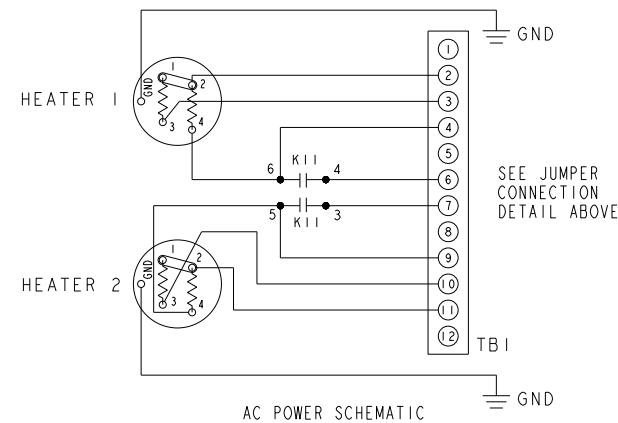
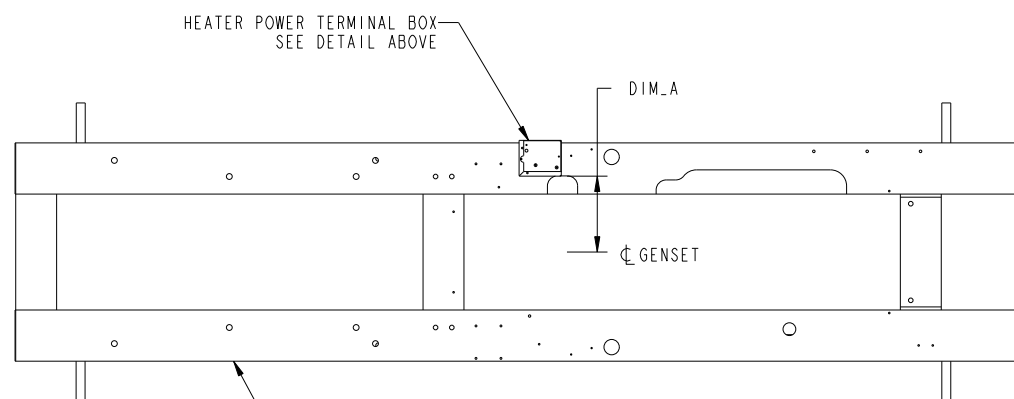


JUMPER CONNECTION DETAIL

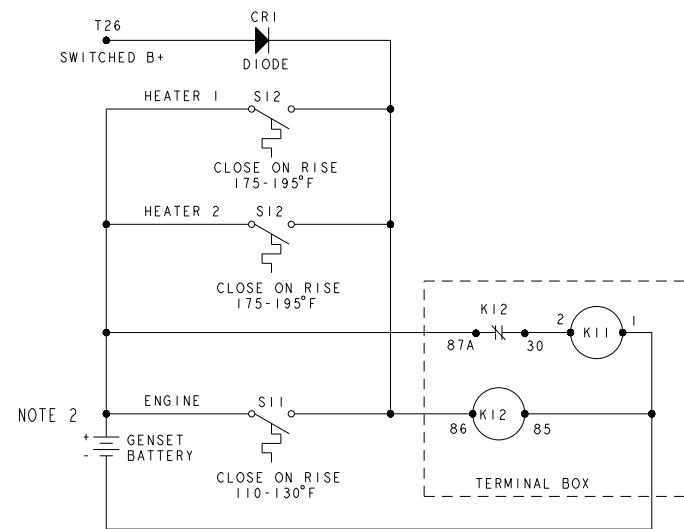
NOTES:

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.

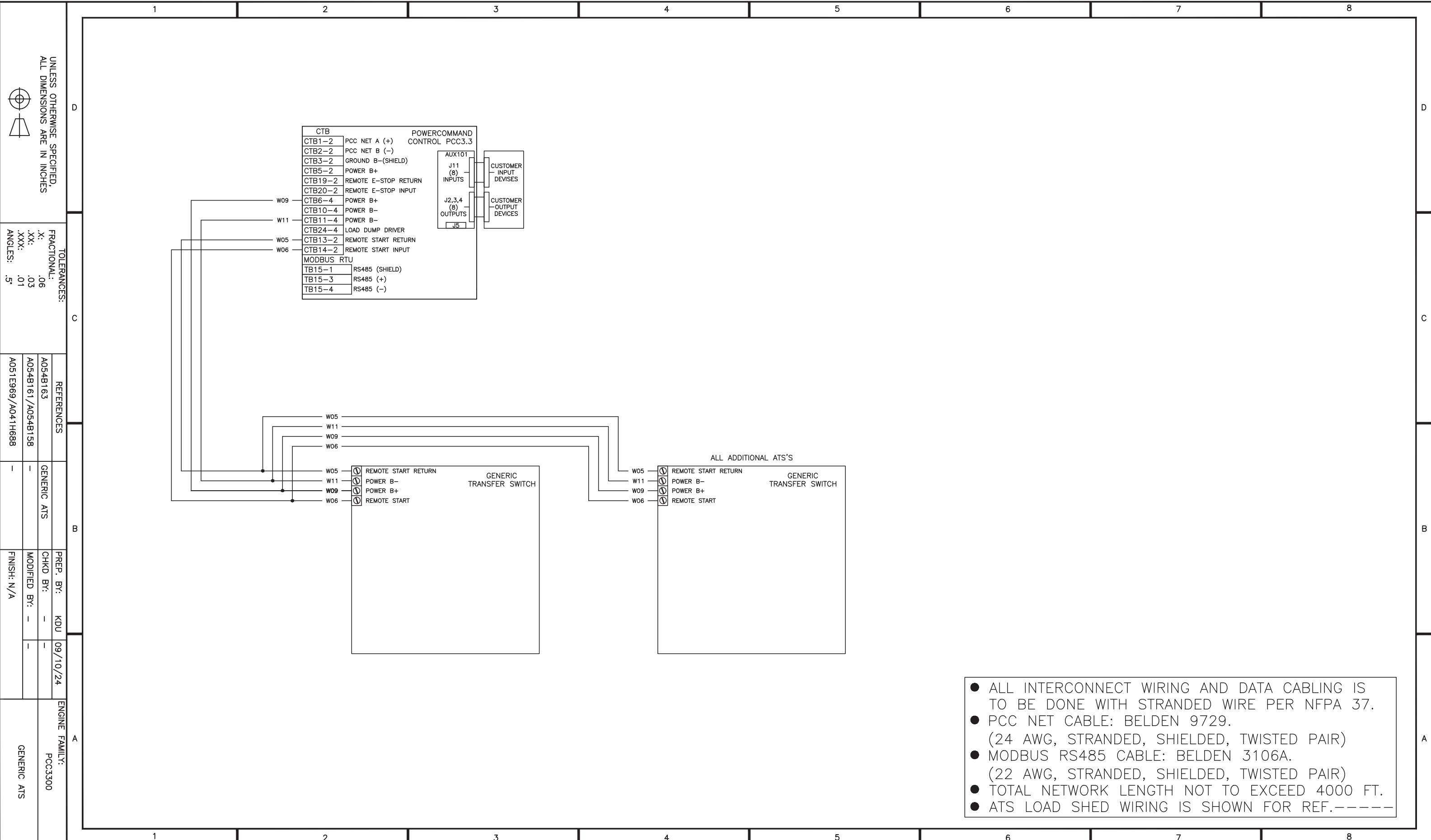


GENSET	DIM_A	DIM_B	DIM_C
DQKAA, AB	377 [14.8]	2684 [105.7]	347 [13.7]



SINGLE PHASE HEATER VOLTAGE	FEATURE CODE H556 TWO HEATERS			FEATURE CODE H557 TWO HEATERS		
	HEATER AMPS	TOTAL AMPS	TOTAL WATTS	HEATER AMPS	TOTAL AMPS	TOTAL WATTS
208	18.0	36.0	7488	23.2	46.4	8650
240	20.8	41.6	9980	26.75	53.5	12840
480	10.4	20.8	9980	13.375	26.75	12840

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		SIM 10 0500-3290	OWN L. HOKENSON	CUMMINS POWER GENERATION
DO NOT SCALE PRINT			CND L. HOKENSON	
DIM	X ± 1	0.00- 4.99 +0.15/-0.08	APVD B. HENNING	OUTLINE, INTERFACE (HEATER)
	.X ± 0.8	5.00- 9.99 +0.20/-0.10	DATE 02-21-05	
	.XX ± 0.38	10.00-17.49 +0.25/-0.13		
ANG TOL: ± 1.0°		SCALE: 1/16	CONFIDENTIAL	FOR INTERPRETATION OF DIMENSIONS AND TOLERANCING, SEE ASME Y14.5M-1994
			PROPERTY OF CUMMINS POWER GENERATION GROUP	FIRST USED ON DOK SERIES
				PGA
				D
				0500-4196
				SHEET 1 OF 1
				REV C



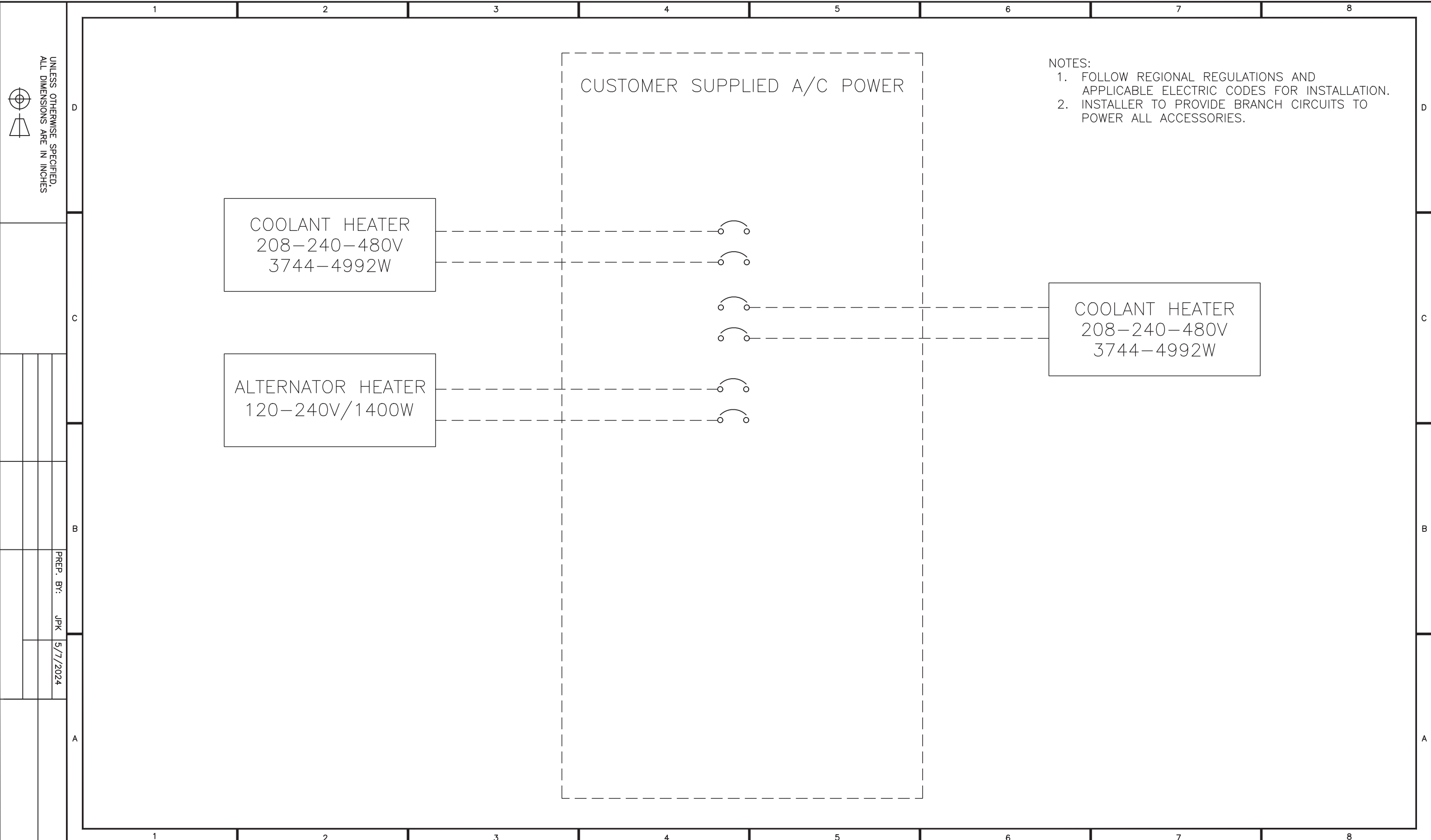
UNLESS OTHERWISE SPECIFIED,
ALL DIMENSIONS ARE IN INCHES

TOLERANCES:
FRACTIONAL: .06
X: .03
.XX: .01
.XXX: .01
ANGLES: .5°

REFERENCES
A054B163
A054B161/A054B158
A051E969/A041H688

GENERIC ATS
PREP. BY: KDU 09/10/24
CHKD BY: -
MODIFIED BY: -
FINISH: N/A

ENGINE FAMILY:
PCC3300
GENERIC ATS



- NOTES:
1. FOLLOW REGIONAL REGULATIONS AND APPLICABLE ELECTRIC CODES FOR INSTALLATION.
 2. INSTALLER TO PROVIDE BRANCH CIRCUITS TO POWER ALL ACCESSORIES.

UNLESS OTHERWISE SPECIFIED,
ALL DIMENSIONS ARE IN INCHES



PREP. BY:	JPK
DATE:	5/7/2024

SECTION 5

START-UP AND WARRANTY





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: _____