

**CSDG – 1500kW**

*Central States Diesel Generators*

**CUMMINS / DQGAB 1500**



**Sales and  
Service**

**Cummins Sales and Service**

# NOTICE

A COPY OF THIS GENERATOR SET SUBMITTAL MUST BE RETURNED TO OUR OFFICE, APPROVED IN ITS ENTIRETY AND BEARING THE DATE OF APPROVAL, STAMP OR SIGNATURE AND TITLE OF THE APPROVING AUTHORITY, BEFORE ANY ITEM WILL BE RELEASED FOR MANUFACTURE OR SHIPMENT. WE ASSUME NO RESPONSIBILITY FOR DELAYS IN OUR FORECASTED SHIPPING SCHEDULES ON ANY ITEM ON WHICH SUBMITTAL APPROVAL IS BEYOND THIRTY (30) DAYS FROM THE SUBMISSION DATE ON THE COVER PAGE.

THIS SUBMITTAL IS BASED UPON OUR INTERPRETATION OF THE PROJECT REQUIREMENTS AND/OR SPECIFICATIONS AND IS IN ACCORDANCE WITH YOUR ORDER AND PRODUCT AVAILABILITY OF FROM OUR VENDORS. PLEASE REVIEW THE ENCLOSED DATA COMPLETELY AND CAREFULLY. SHOULD ADDITIONAL INFORMATION OR CLARIFICATION BE REQUIRED PLEASE FORWARD A SUBMITTAL COPY, COMPLETE WITH YOUR NOTATIONS, TO OUR OFFICE WITHIN THIRTY (30) DAYS FOR A PROMPT RESPONSE AND/OR RESUBMITTAL.

CONSIDERABLE ATTENTION IS GIVEN TO THE PREPARATION OF THIS SUBMITTAL TO ENSURE IT IS COMPLETE, CONCISE AND CORRECT AS IS POSSIBLE. PLEASE REVIEW IT CAREFULLY AND THOROUGHLY.

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## Bill of Materials

	<b>DESCRIPTION</b>	<b>QTY</b>
DQGAB	Genset-Diesel, 60Hz, 1500kW-Standby Rating	1
	U.S. EPA, Stationary Emergency Application	1
1500DQGAB	Genset-Diesel,60Hz,1500kW	1
L170-2	Emission Certification, EPA, Tier 2, NSPS CI Stationary Emergency	1
L090-2	Listing - UL 2200	1
A331-2	Duty Rating - Standby Power (ESP)	1
R002-2	Voltage - 277 / 480, 3 Phase, Wye, 4 Wire	1
B276-2	Alternator - 60Hz, Wye, Limited Range, 125C	1
H608-2	Control Mounting - Right Facing	1
H704-2	PowerCommand 3.3 Generator Controller, Paralleling Capable	1
1300	Paralleling - Isolated Bus,None	1
H536-2	Control Display Language - English	1
H606-2	Analog Meters - AC Output	1
H678-2	Display-Control, LCD	1
H720-2	AmpSentry™ UL Listed Protective Relay	1
KA08-2	Alarm - Audible, Engine Shutdown	1
KX24-2	Relays-User Configured	1
KP79-2	Circuit Breaker or Entrance Box - Left Only	1
KP83-2	Circuit Breaker - 2500A, Left, 3P, 600, IEC 415, UL Serv Ent, 100%	1
H666-2	Indication - Ground Fault, 3 - Pole Transfer Switch	1
KR01-2	Circuit Breaker Lugs - Mechanical, Left Side	1
C325-2	Fuel Filters-Engine, Single	1
A334-2	Engine Starter - 24 Volt DC Motor	1
A333-2	Battery Charging Alternator	1
E125-2	Engine Cooling - Radiator, High Ambient Air Temperature, Ship Fitted	1
H389-2	Shutdown - Low Coolant Level	1
H557-2	Coolant Heater - 208 / 240 / 480 Volts AC, Below 40F Ambient Temperature	1
D041-2	Engine Air Cleaner - Normal Duty	1
H607-2	Engine Oil Filters, Full Flow with Bypass	1
L028-2	Genset Warranty - 2 Years Base	1
0416-0527-FRD	Battery Rack-Holddown Assembly Included	4





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	<b>DESCRIPTION</b>	<b>QTY</b>
A048G602	Battery Charger-10Amp, 120/208/240VAC, 12/24V, 50/60Hz	1
NSBOP01	Level II Sound Attenuated Enclosure <ul style="list-style-type: none"><li>• with AC distribution panel, enclosure lights, receptacles</li></ul>	1
NSBOP02	2750 Gallon Subbase Fuel tank <ul style="list-style-type: none"><li>• 5 gallon fill spill and 24V tank status alarm panel</li></ul>	1
0402-0691-04	Isolator Package-2720lbs, 0.77" Deflection, 3516lbs/in Constant (Qty 2)	6



# Diesel Generator Set QSK50 Series Engine

1100 kW – 1500 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, fault clearing short-circuits capability.

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

**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
DQGAA	1250 (1563)		1100 (1375)				D-3333	
DQGAB	1500 (1875)		1350 (1688)				D-3334	

## Generator Set Specifications

Governor regulation class	ISO8528 Part 1 Class G3
Voltage regulation, no load to full load	± 0.5%
Random voltage variation	± 0.5%
Frequency regulation	Isochronous
Random frequency variation	± 0.25%
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	158.8 mm (6.25 in.)
Displacement	50.3 Liters (3067 in <sup>3</sup> )
Configuration	Cast iron, V 16 cylinder
Battery capacity	1800 amps minimum at ambient temperature of 0 °C (32 °F)
Battery charging alternator	35 amps
Starting voltage	24 volt, negative ground
Fuel system	Cummins' Modular Common Rail System
Fuel filter	Dual Element 10 micron filtration spin-on fuel filter 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 disc
Insulation system	Class H
Standard temperature rise	150 °C standby at 40 °C ambient
Exciter type	PMG (Permanent Magnet Generator)
Phase rotation	A (U), B (V), C (W)
Alternator cooling	Direct drive centrifugal blower fan
AC waveform Total Harmonic Distortion (THDV)	< 5% no load to full linear load, < 3% for any single harmonic
Telephone Influence Factor (TIF)	< 50 per NEMA MG1-22.43
Telephone Harmonic Factor (THF)	< 3

## Available Voltages

60 Hz Line-Neutral/Line-Line		50 Hz Line-Neutral/Line-Line
220/380	277/480	2400/4160
255/440	347/600	

\*Note: Consult factory for other voltages.

## Generator Set Options

### Engine

208/240/480 V thermostatically controlled coolant heater for ambient above 4.5 °C (40 °F)  
 208/240/480 V thermostatically controlled coolant heater for ambient below 4.5 °C (40 °F)  
 Dual 120 V 300 W lube oil heaters  
 Dual 208/240 V 300 W lube oil heaters  
 Dual 480 V 300 W lube oil heaters

### Cooling System

Remote indicator

### 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)

### Exhaust System

Industrial grade exhaust silencer  
 Residential grade exhaust silencer  
 Critical grade exhaust silencer  
 Exhaust packages  
**Alternator**  
 80 °C rise  
 105 °C rise  
 125 °C rise  
 120/240 V 300 W anti-condensation heater

### Generator Set

AC entrance box  
 Battery  
 Battery charger  
 Circuit breaker -- set mounted  
 Disconnect switch - set mounted  
 PowerCommand Network  
 Remote annunciator panel  
 Spring isolations  
 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.

**Regulation compliant** – Prototype tested: UL, CSA and CE compliant.

**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, kVA, 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)

## Ratings Definitions

### Emergency Standby Power (ESP):

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

### Limited-Time Running Power (LTP):

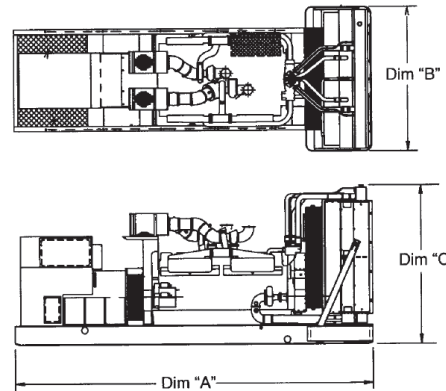
Applicable for supplying power to a constant electrical load for limited hours. Limited-Time Running Power (LTP) is in accordance with ISO 8528.

### Prime Power (PRP):

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

### Base Load (Continuous) Power (COP):

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



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





**Do not use for installation design**

Model	Dim 'A' (mm) (in.)	Dim 'B' (mm) (in.)	Dim 'C' (mm) (in.)	Set Weight dry* kg (lbs)	Set Weight* wet kg (lbs)
DQGAA	5969 (235)	2007 (79)	2840 (112)	10989 (24220)	11493 (25330)
DQGAB	5969 (235)	2007 (79)	2840 (112)	10989 (24220)	11493 (25330)

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

see below drawings for overall shipping weight and dimensions

## Codes and Standards

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

For more information contact your local Cummins distributor or visit [power.cummins.com](http://power.cummins.com)

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## Generator set data sheet

<b>Model:</b>	<b>DOGAB</b>
<b>Frequency:</b>	<b>60 Hz</b>
<b>Fuel type:</b>	<b>Diesel</b>
<b>KW rating:</b>	<b>1500 standby</b> <b>1350 prime</b>
<b>Emissions level:</b>	<b>EPA NSPS Stationary Emergency Tier 2</b>

Exhaust emission data sheet:	EDS-1059
Exhaust emission compliance sheet:	EPA-1093
Sound performance data sheet:	MSP-1034
Cooling performance data sheet:	MCP-152
Prototype test summary data sheet:	PTS-265
Standard set-mounted radiator cooling outline:	0500-4357
Optional remote radiator cooling outline:	0500-4309

Fuel consumption	Standby				Prime			
	kW (kVA)				kW (kVA)			
Ratings	1500 (1875)				1350 (1688)			
Load	1/4	1/2	3/4	Full	1/4	1/2	3/4	Full
US gph	35.4	58.2	81	103.8	33.1	53.6	74.2	94.7
L/hr	133.9	220.3	306.6	393	125.3	203	208.7	358.4

Engine	Standby rating	Prime rating
Engine manufacturer	Cummins Inc.	
Engine model	QSK50-G4 NR2	
Configuration	Cast iron, V 16 cylinder	
Aspiration	Turbocharged and low temperature aftercooled	
Gross engine power output, kWm (bhp)	1656 (2220)	1470 (1971)
BMEP at set rated load, kPa (psi)	2192 (318)	1957 (284)
Bore, mm (in)	159 (6.25)	
Stroke, mm (in)	159 (6.25)	
Rated speed, rpm	1800	
Piston speed, m/s (ft/min)	9.5 (1875)	
Compression ratio	15:1	
Lube oil capacity, L (qt)	235 (248)	
Overspeed limit, rpm	2100 ±50	
Regenerative power, kW	168	
Maximum fuel flow, L/hr (US gph)	912 (241)	
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 <sup>3</sup> /min (scfm)	139 (4895)	133 (4700)
Maximum air cleaner restriction, kPa (in H <sub>2</sub> O)	3.7 (15)	
Alternator cooling air, m <sup>3</sup> /min (cfm)	207 (7300)	

## Exhaust

Exhaust flow at set rated load, m <sup>3</sup> /min (cfm)	342 (12065)	312 (11000)
Exhaust temperature, °C (°F)	491 (915)	446 (835)
Maximum back pressure, kPa (in H <sub>2</sub> O)	6.78 (27)	

## Standard set-mounted radiator cooling

Ambient design, °C (°F)	40 (104)	
Fan load, kW <sub>m</sub> (HP)	45 (60)	
Coolant capacity (with radiator), L (US gal)	541 (143)	
Cooling system air flow, m <sup>3</sup> /min (scfm)	1705 (60150)	
Total heat rejection, MJ/min (Btu/min)	72.3 (68580)	64.8 (61510)
Maximum cooling air flow static restriction, kPa (in H <sub>2</sub> O)	0.12 (0.5)	
Maximum fuel return line restriction kPa (in Hg)	34 (10)	

## Optional remote radiator cooling<sup>1</sup>

Set coolant capacity, L (US gal)		
Max flow rate at max friction head, jacket water circuit, L/min (US gal/min)	1893 (500)	
Max flow rate at max friction head, aftercooler circuit, L/min (US gal/min)	537 (142)	
Heat rejected, jacket water circuit, MJ/min (Btu/min)	35.44 (33610)	32.11 (30455)
Heat rejected, aftercooler circuit, MJ/min (Btu/min)	26.93 (25545)	23.96 (22725)
Heat rejected, fuel circuit, MJ/min (Btu/min)		
Total heat radiated to room, MJ/min (Btu/min)	13.1 (12420)	11.9 (11275)
Maximum friction head, jacket water circuit, kPa (psi)	67 (10)	
Maximum friction head, aftercooler circuit, kPa (psi)	48 (7)	
Maximum static head, jacket water circuit, m (ft)	18.3 (60)	
Maximum static head, aftercooler circuit, m (ft)	18.3 (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)	71 (160)	66 (150)
Maximum fuel flow, L/hr (US gph)	469 (124)	
Maximum fuel return line restriction, kPa (in Hg)	34 (10)	

## Weights<sup>2</sup>

Unit dry weight kgs (lbs)	12700 (28000)
Unit wet weight kgs (lbs)	13270 (29260)

← see below drawings for overall shipping weight and dimensions

### Notes:

<sup>1</sup> For non-standard remote installations contact your local Cummins Power Generation representative.

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



## Derating factors

Standby	Full rated power available up to 1134.0m (3719.6 ft) elevation at ambient temperatures up to 40 °C (104 °F). Full rated power available up to 702.5m (2304.2 ft) elevation at ambient temperatures up to 50 °C (120 °F). Above these conditions derate by 6.6% per 305m (1000 ft) and derate by an additional 10.3% per 10 °C (18 °F).
Prime	Full rated power available up to 1334.9m (4378.6 ft) elevation at ambient temperatures up to 40 °C (104 °F). Above these conditions derate by 5.8% per 305m (1000 ft) and derate by an additional 14.0% per 10 °C (18 °F).

## Ratings definitions

<b>Emergency standby power (ESP):</b>	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 <sup>1</sup>	Temp rise degrees C	Duty <sup>2</sup>	Single phase factor <sup>3</sup>	Max surge kVA <sup>4</sup>	Winding No.	Alternator data sheet	Feature Code
380	Wye, 3-phase	125	P		5743		ADS-332	B596-2
380	Wye, 3-phase	150/105	S/P		6716		ADS-333	B595-2
380	Wye, 3-phase	80	P		6716		ADS-333	B687-2
380	Wye, 3-phase	105/80	S/P		7361		ADS-334	B599-2
380	Wye, 3-phase	80	S		7695		ADS-335	B660-2
440	Wye, 3-phase	125	P		4602		ADS-330	B692-2
440	Wye, 3-phase	150/125	S/P		5521		ADS-331	B691-2
440	Wye, 3-phase	125/105	S/P		5743		ADS-332	B663-2
440	Wye, 3-phase	80	S		6716		ADS-333	B688-2
440	Wye, 3-phase	80	P		7695		ADS-331	B689-2
480	Wye, 3-phase	105	P		4602		ADS-330	B693-2
480	Wye, 3-phase	125/105	S/P		5521		ADS-331	B276-2
480	Wye, 3-phase	80	P		5521		ADS-331	B694-2
480	Wye, 3-phase	105/80	S/P		5743		ADS-332	B600-2
480	Wye, 3-phase	80	S		6716		ADS-333	B601-2
600	Wye, 3-phase	105	P		4602		ADS-330	B581-2
600	Wye, 3-phase	125/105	S/P		5521		ADS-331	B602-2
600	Wye, 3-phase	80	P		5521		ADS-331	B695-2
600	Wye, 3-phase	105/80	S/P		5743		ADS-332	B603-2
600	Wye, 3-phase	80	S		6716		ADS-333	B604-2
4160	Wye, 3-phase	105	P		6204		ADS-322	B312-2
4160	Wye, 3-phase	105/80	S/P		7005		ADS-323	B313-2

### Notes:

<sup>1</sup> 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 Factor<sup>3</sup>. All single phase ratings are at unity power factor.

<sup>2</sup> Standby (S), Prime (P) and Continuous ratings (C).

<sup>3</sup> Factor for the *Single Phase Output from Three Phase Alternator* formula listed below.

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

## 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-3334k (6/15)



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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.

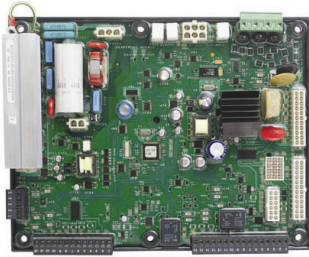
Offering enhanced reliability and performance over more conventional generator set controls via the integration of all generator control functions into a single system, PCC3300 is your Power of One generator set control solution.

## 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. 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. 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.

Droop 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 is a system should be the first to close to the bus. The system includes an independent backup function, so that if the primary system is disabled the required functions are still performed.

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

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

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

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

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

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

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

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

**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.

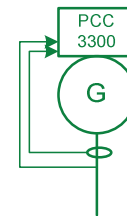
**Exerciser clock** –The exerciser clock (when enabled) allows the system to be operated at preset times in either test without load, test with load, or extended parallel mode. A Real Time Clock is built in. Up to 12 different programs can be set for day of week, time of day, duration, repeat interval, 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

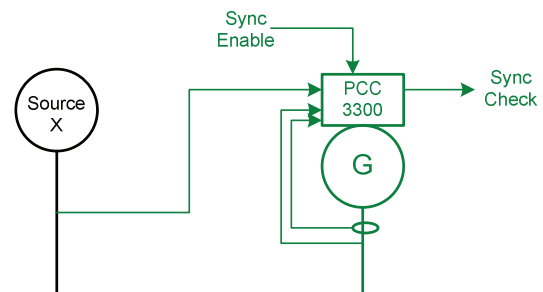
penalties due to low power factor. The System always operates within genset ratings. The control point can be changed while the system is in operation. Set points can be adjusted via hardwired analog input or adjusted through an operator panel display or service tool.

**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:

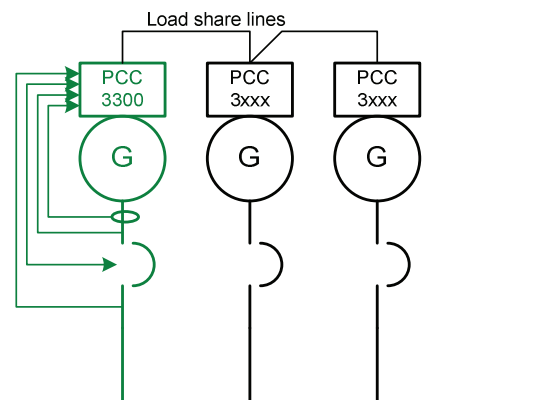
Standalone: Control provides monitoring, protection and control in a non-paralleling application.



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

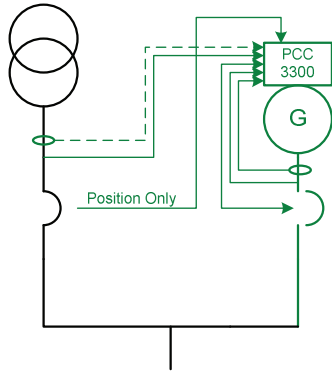


Isolated Bus: allows the genset to perform a dead bus closure or synchronize to the bus and isochronously share kW and kVAR loads with other gensets.

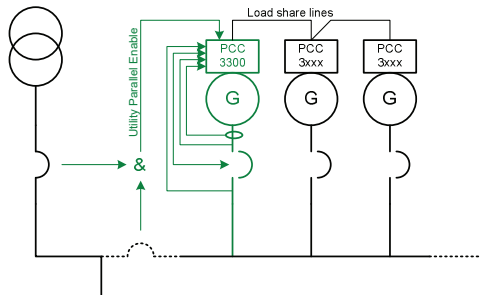




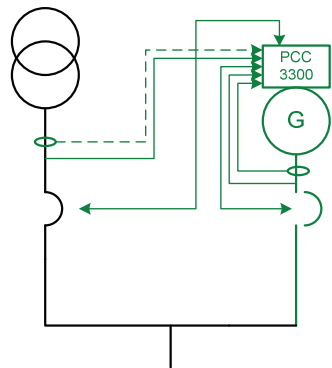
**Utility Single:** Control monitors one genset and utility. The control will automatically start and provide power to a load if the utility fails. The control will also resynchronize the genset back to the utility and provides extended paralleling capabilities.



**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.

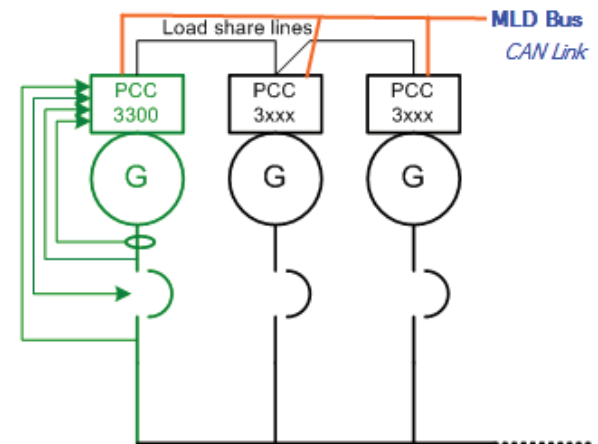
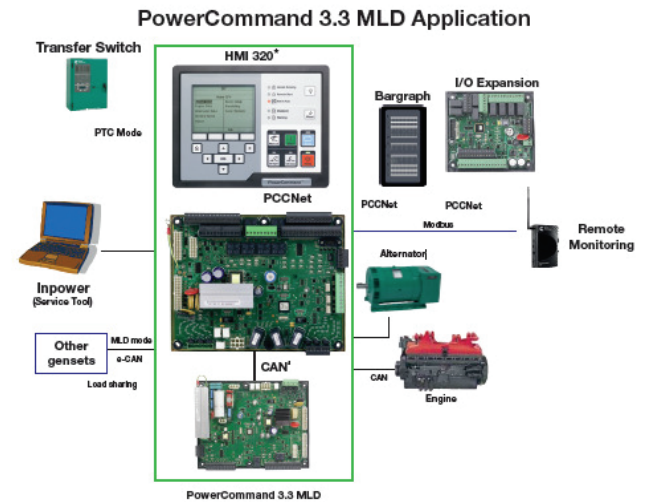


**Power Transfer Control:** Control operates a single genset/single utility transfer pair in open transition, fast closed transition, or soft closed transition. Extended paralleling functionality also provides base load and peak shave options.



**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.

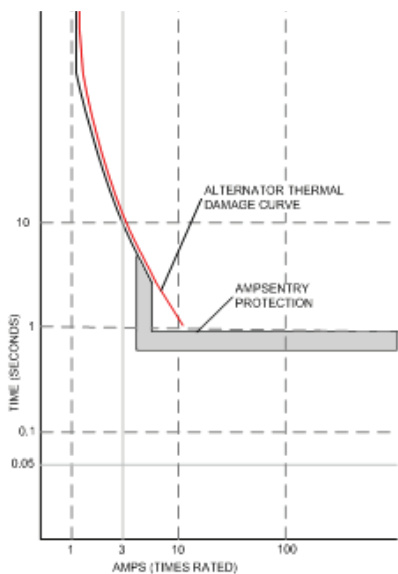
High intake manifold temperature shutdown – Level is preset (configurable with InPower or HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance alarms.

### 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

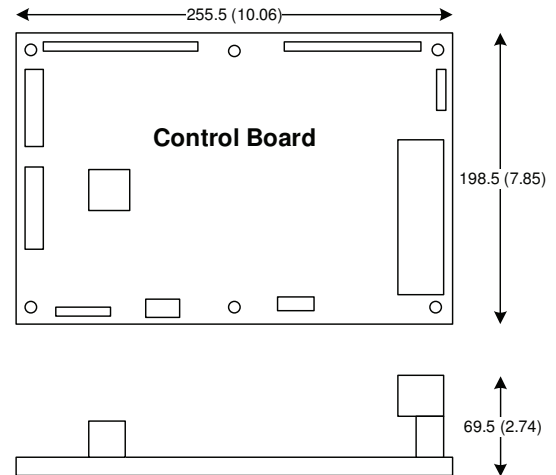
**Communications connections include:**

- 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:

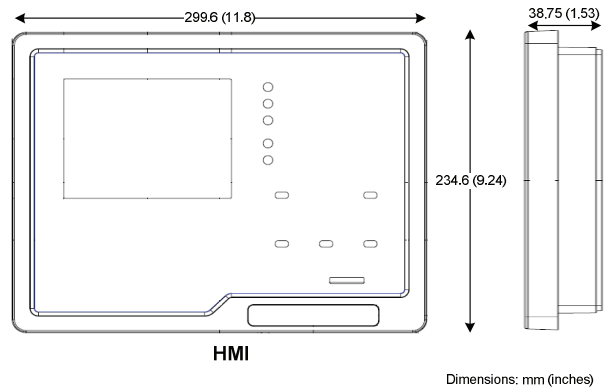
- LED indicating lamps
  - genset running
  - remote start
  - not in auto
  - shutdown
  - warning
  - auto
  - manual and stop
  - Circuit breaker open (if equipped)
  - Circuit breaker closed (if equipped)
- 320 x 240 pixels graphic LED backlight LCD.
- Four tactile feel membrane switches for LCD 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. 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: 1993 compliance, controls and switchgear.
- CE marking: The control system is suitable for use on generator sets to be CE-marked.
- EN 50081-1,2 residential/light industrial emissions or industrial emissions.
- EN 50082-1,2 residential/light industrial or industrial susceptibility.
- ISO 7637-2, level 2; DC supply surge voltage test.
- Mil Std 202C, Method 101 and ASTM B117: Salt fog test.
- UL 6200 recognized, suitable for use on UL 2200 Listed generator sets.
- CSA C282-M1999 compliance
- CSA 22.2 No. 14 M91 industrial controls.
- PowerCommand® control systems and generator sets are designed and manufactured in ISO 9001 certified facilities.
- ROHS (Restriction of Hazardous substance) complaint both for HMI 320 & PCC3300v2.

## Reference Documents

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

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

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

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

## Warranty

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





# Alternator data sheet

Frame size: P734C

<b>3 <math>\phi</math> Ratings</b> (0.8 power factor)		<b>60 Hz Voltage</b> (winding no)						
(Based on specific temperature rise at 40° C ambient temperature)		<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
163° C rise ratings	kW			1284	1456	1556	1620	1620
	kVA			1605	1820	1945	2025	2025
150° C rise ratings	kW			1248	1416	1512	1576	1576
	kVA			1560	1770	1890	1970	1970
<b>125° C rise ratings</b>	kW			1200	1364	1452	1512	1512
	kVA			1500	1705	1815	1890	1890
105° C rise ratings	kW			1116	1272	1352	1408	1408
	kVA			1395	1590	1690	1760	1760
80° C rise ratings	kW			1032	1172	1252	1300	1300
	kVA			1290	1465	1565	1625	1625
<b>Reactances</b> (per unit $\pm$ 10%)		<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
(Based on full load at 125° C rise rating)								
Synchronous				4.06	3.86	3.67	3.21	2.96
Transient				0.25	0.23	0.22	0.19	0.21
Subtransient				0.18	0.17	0.16	0.14	0.14
Negative sequence				0.26	0.25	0.23	0.20	0.16
Zero sequence				0.03	0.03	0.03	0.03	0.02
<b>Motor starting</b>		<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
Maximum kVA	(90% sustained voltage)			5521	5521	5521	5521	5521
<b>Time constants</b> (sec)		<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
Transient				0.135	0.135	0.135	0.135	0.135
Subtransient				0.010	0.010	0.010	0.010	0.010
Open circuit				2.230	2.230	2.230	2.230	2.230
DC				0.020	0.020	0.020	0.020	0.020
<b>Windings</b> (@ 20° C)		<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
Stator resistance	(Line to Line, Ohms)			0.00126	0.00126	0.00126	0.00126	0.00400
Rotor resistance	(Ohms)			1.85	1.85	1.85	1.85	1.85
Number of leads				6	6	6	6	6





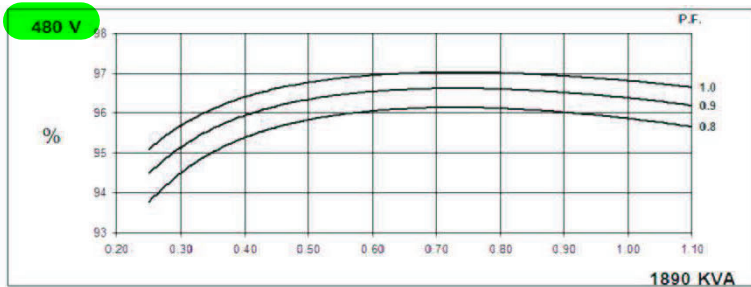
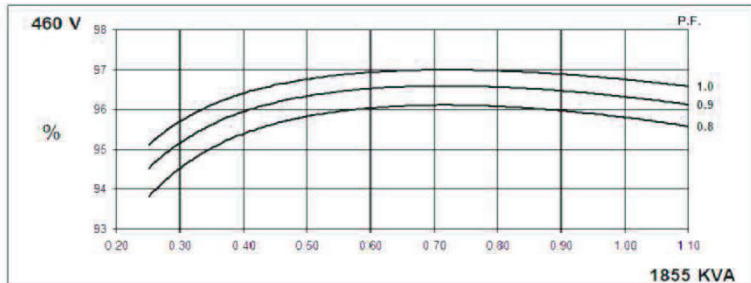
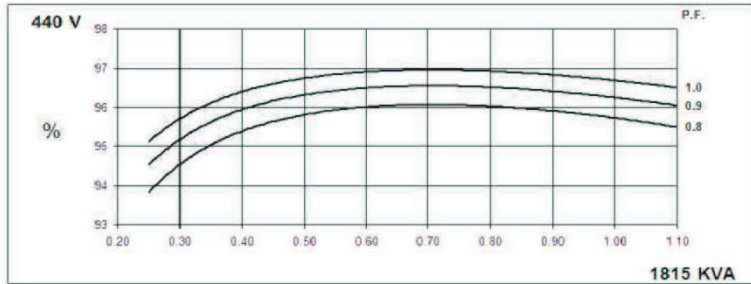
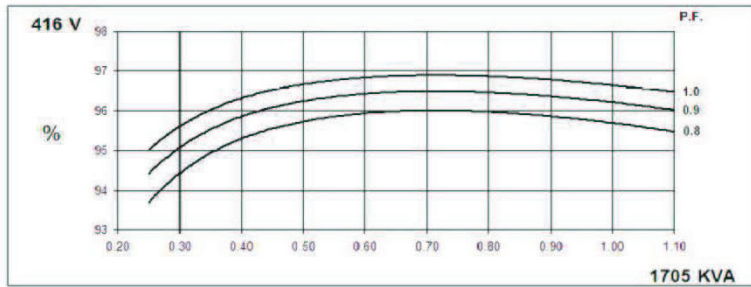
# Alternator data sheet

Frame size: P734C

**60  
Hz**

Winding 312

## THREE PHASE EFFICIENCY CURVES



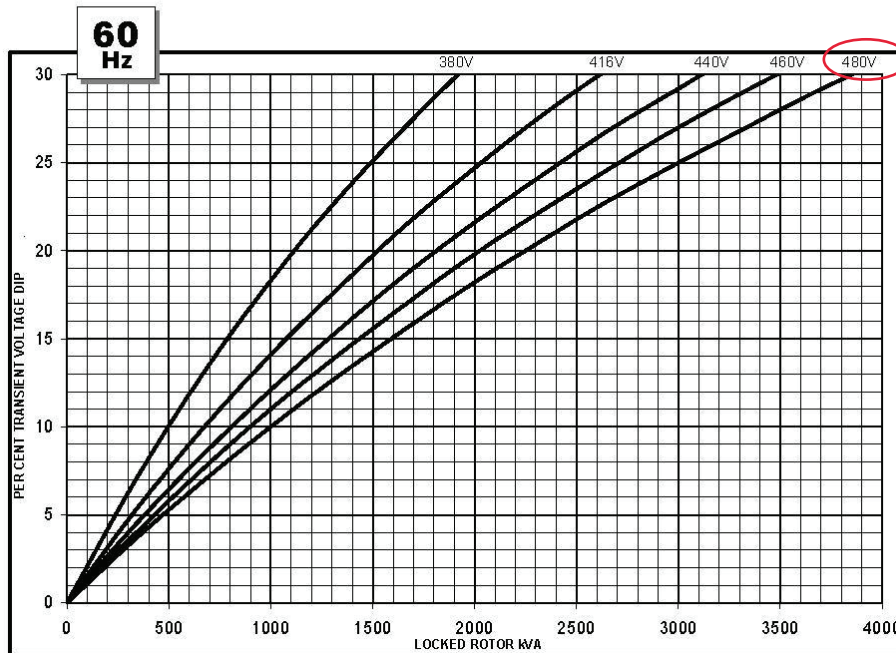
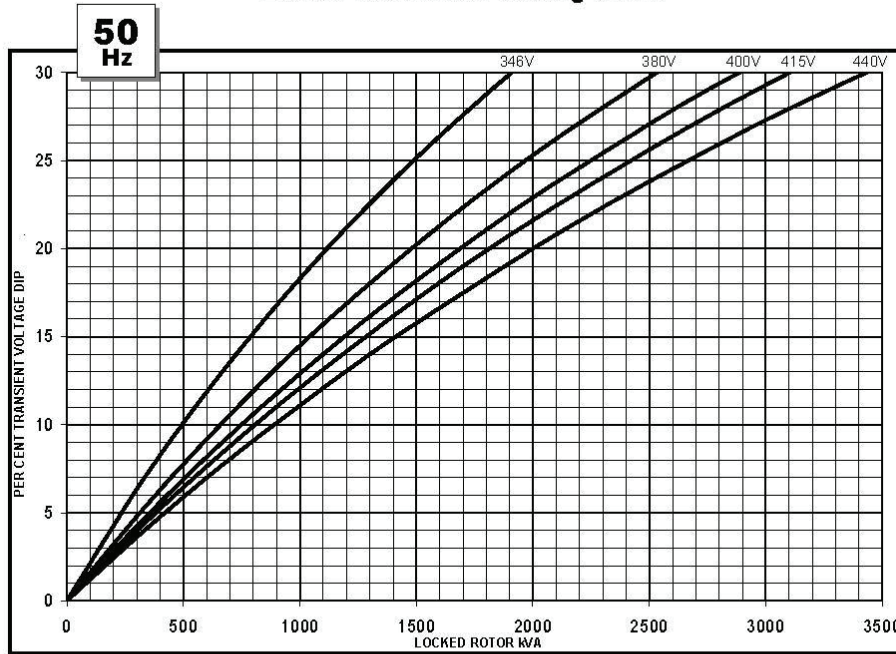


# Alternator data sheet

Frame size: P734C

Winding 312

Locked Rotor Motor Starting Curve



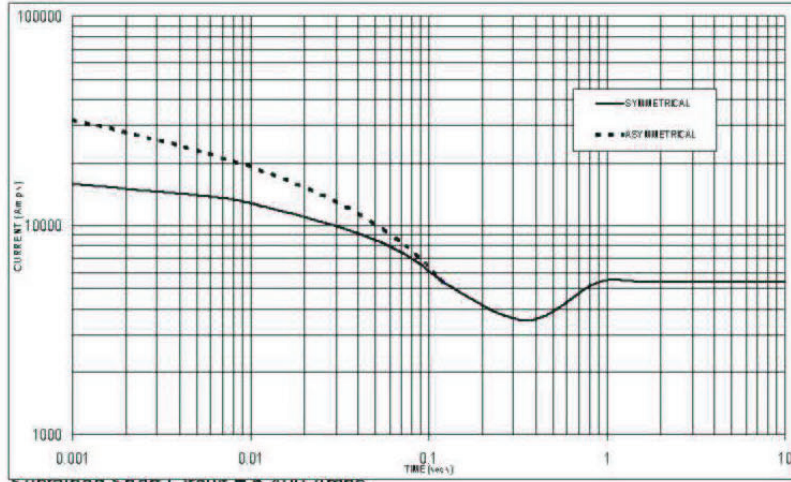


# Alternator data sheet

Frame size: P734C

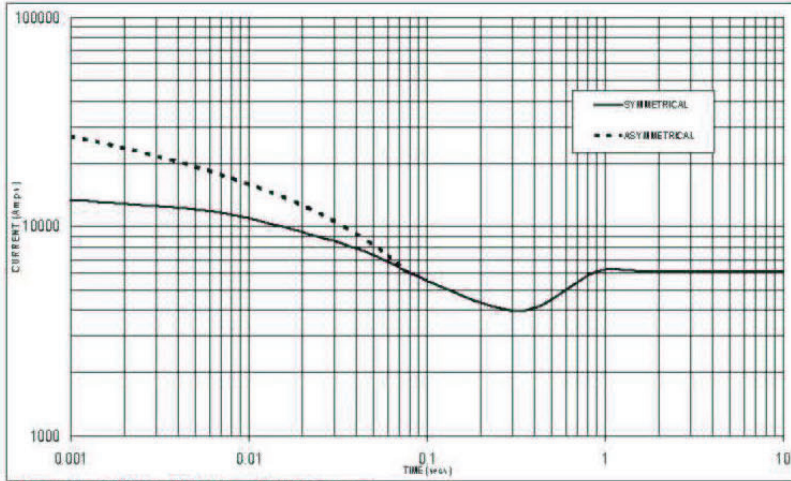
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed  
Based on star (wye) connection.

**50 Hz**



Sustained Short Circuit = 5,400 Amps

**60 Hz**



Sustained Short Circuit = 6,100 Amps

**Note 1**

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

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

The sustained current value is constant irrespective of voltage level

**Note 2**

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

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

All other times are unchanged

**Note 3**

Curves are drawn for Star (Wye) connected machines.



## Prototype Test Supported Emergency/Standby Generator Sets Certification

Cummins Power Generation certifies that its commercial generator sets bearing the Prototype Test Supported (PTS) seal have been subjected to a design and development process that includes extensive prototype testing and evaluation. A PTS production model is engineered and manufactured according to documentation developed through comprehensive research, design and design verification.

Design verification is based on tests of preproduction prototype models manufactured specifically for prototype test purposes and not sold as new equipment. To be certified as a PTS model, the generator set must satisfy these prerequisites:

**DESIGN** - The PTS certified generator set must be designed specifically for emergency/standby applications that require high reliability and rapid response.

**PROTOYPE TESTING** - Design suitability of the PTS certified generator set must be proven by tests on preproduction prototype models. The prototype test program is intended to:

1. Confirm the engine and generator have reserve capacity beyond rating to minimize the potential of damage or shutdown during steady state or transient loading conditions, including momentary overloads.
2. Demonstrate generator set, controls and accessories capability to perform reliably and compatibly in service during disturbances common in actual load circuits.
3. Verify the integrity of the generator and excitation system insulation systems and electrical components to withstand heating under rated load and transient overcurrent conditions.
4. Evaluate generator set mechanical and electrical strength to perform without damage during abnormal operating conditions, such as short circuits or out-of-phase paralleling. While operating at rated load, the generator set must be subjected to several 3-phase short circuits of 20 second duration. After the tests, the generator set is inspected to verify that no electrical or mechanical damage was incurred by any components.
5. Determine by endurance testing that no resonance conditions exist in the generator set or accessories that will cause premature failure of components on production units.
6. Investigate and identify failure modes to minimize the risk of any single component failure or human error that could lead to lack of essential electrical supply.
7. Provide a margin of safety, by actual trials, between the generator set component design and protection systems so that the components are not damaged before the protective devices activate a shutdown.

**DOCUMENTATION AND SOFTWARE** - The PTS certified generator set must be documented in a single drawing package with all components identified with Cummins Power Generation part numbers. A PTS test certificate must be created for each PTS generator set certifying the PTS testing performed.

**QUALITY ASSURANCE** - Engineering drawings, specifications and test requirements for a PTS certified generator set must be classified by components and assembly quality characteristics. A component and process inspection and test plan must be developed and maintained to measure product conformance to documentation requirements.

**PRODUCTION MODEL TESTING** - PTS certified generator sets must be subjected to complete production tests that demonstrate conformance to specifications at all rated conditions, including start-up, full load pickup and a performance run at full rated load and power factor.





## PROTOTYPE TEST SUPPORT (PTS) 60 HZ TEST SUMMARY

GENERATOR SET MODELS	REPRESENTATIVE PROTOTYPE
1250DQGAA	Model: 1500DQGAB
1500DQGAB	Alternator: P734C
	Engine: QSK50-G4 NR2



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: 1580 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:	Isochronous
Random Frequency Variation:	±0.25%

**Transient Performance:**

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

Full Load Acceptance:

Voltage Dip:	40.4	%
Recovery Time:	4.2	Second
Frequency Dip:	7.5	%
Recovery Time:	5.6	Second

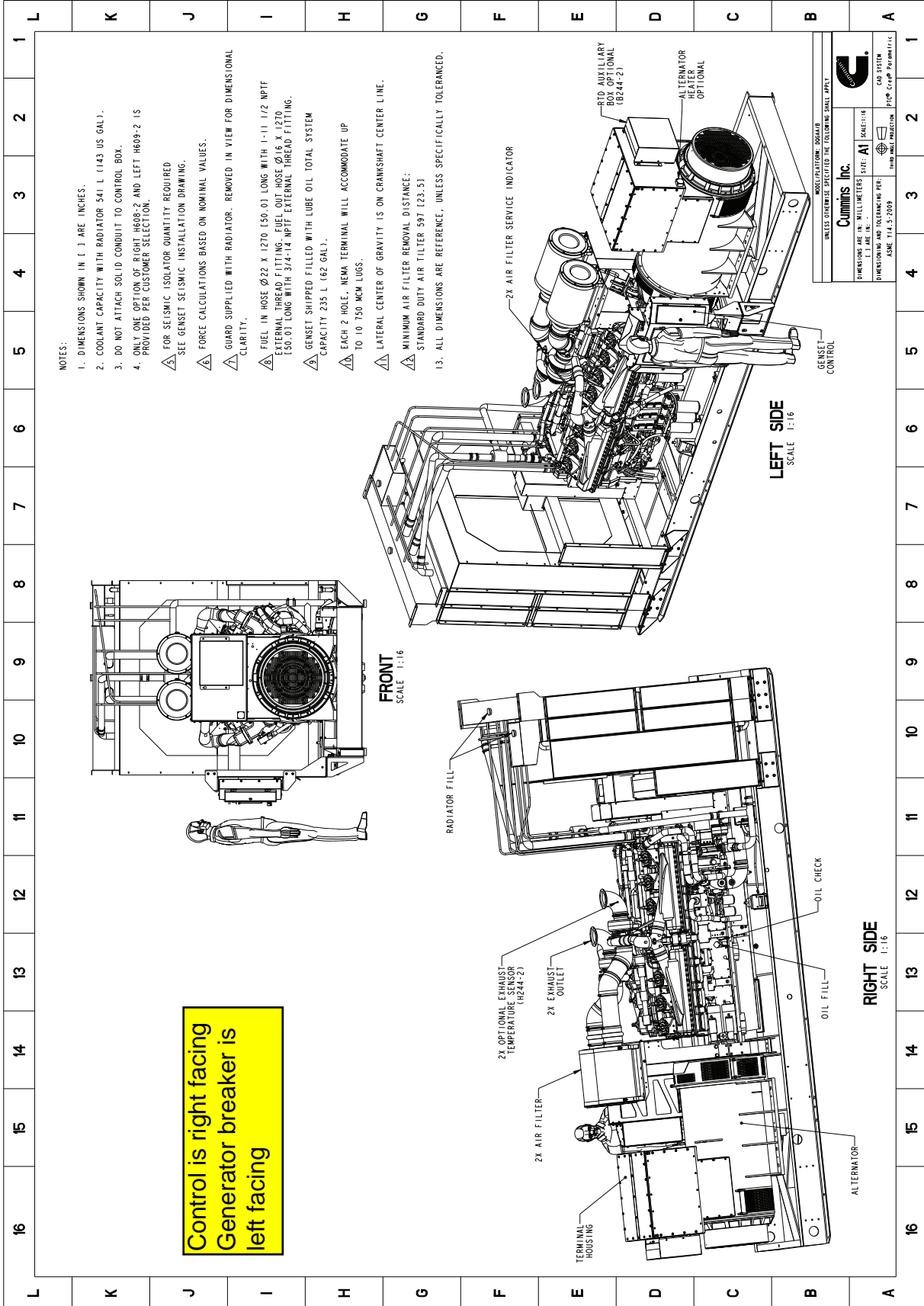
Full Load Rejection:

Voltage Rise:	26.4	%
Recovery Time:	2.8	Second
Frequency Rise:	3.5	%
Recovery Time:	1.3	Second

**Harmonic Analysis:**

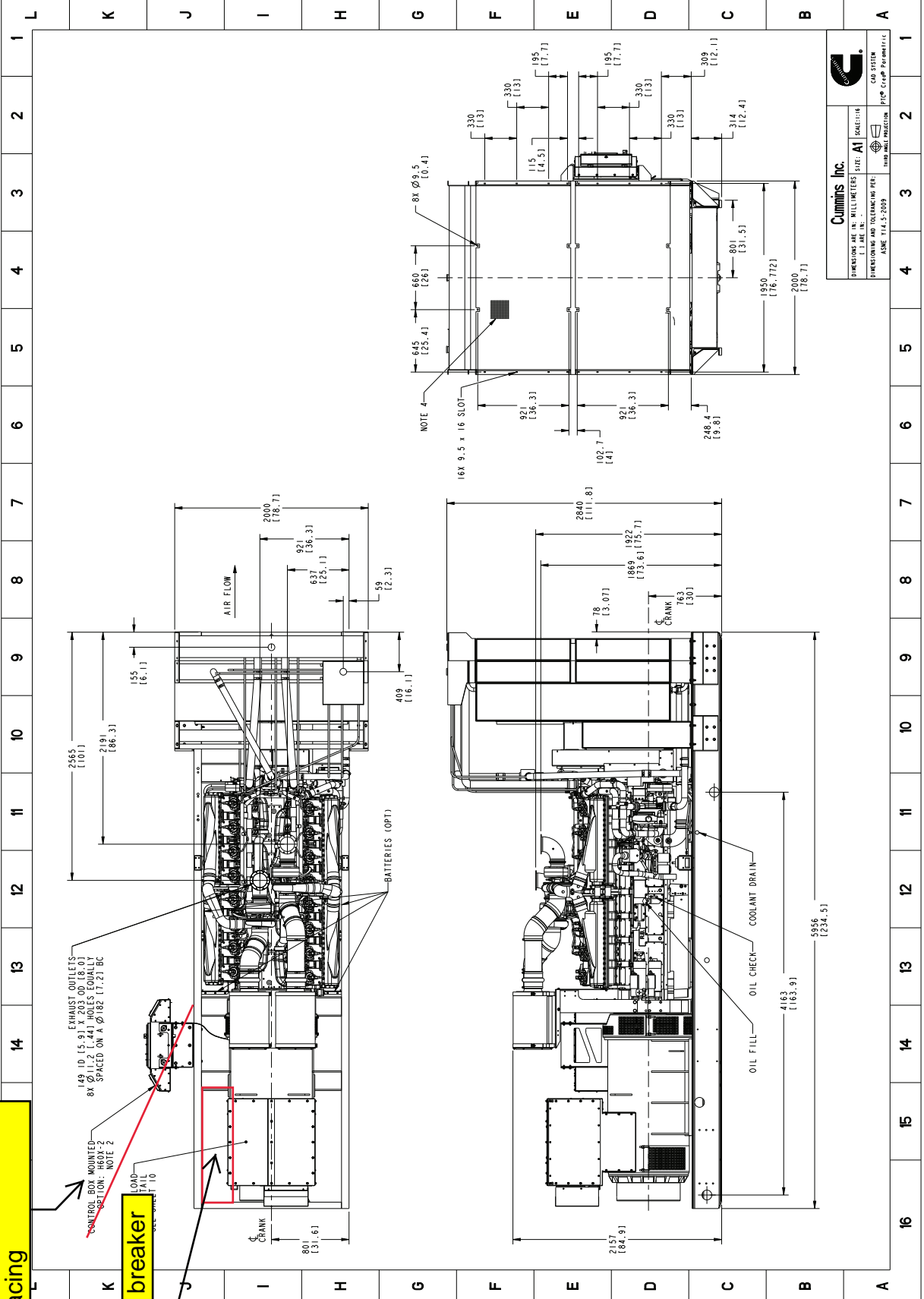
(per MIL-STD-705B, Method 601.4)

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	0.01	0.13	0.08
5	0.2	2.3	0.13	2.3
7	0.52	1.46	0.48	0.74
9	0.08	0.03	0.03	0.07
11	0.65	0.49	0.64	0.46
13	0.21	0.28	0.19	0.31
15	0.05	0.05	0.03	0.1



control is right facing

2500 amp breaker



**Cummins Inc.**

LOGO: Cummins Inc. logo

LOGO: ISO 9001

LOGO: ISO 14001

LOGO: ISO 45001

LOGO: ISO 13801

LOGO: ISO 26000

LOGO: ISO 27001

LOGO: ISO 28000

LOGO: ISO 31000

LOGO: ISO 34000

LOGO: ISO 38000

LOGO: ISO 40000

LOGO: ISO 43000

LOGO: ISO 45000

LOGO: ISO 49000

LOGO: ISO 50000

LOGO: ISO 54000

LOGO: ISO 56000

LOGO: ISO 60000

LOGO: ISO 63000

LOGO: ISO 65000

LOGO: ISO 69000

LOGO: ISO 70000

LOGO: ISO 73000

LOGO: ISO 75000

LOGO: ISO 78000

LOGO: ISO 80000

LOGO: ISO 83000

LOGO: ISO 85000

LOGO: ISO 88000

LOGO: ISO 90000

LOGO: ISO 93000

LOGO: ISO 95000

LOGO: ISO 99000

LOGO: ISO 100000

LOGO: ISO 102000

LOGO: ISO 104000

LOGO: ISO 106000

LOGO: ISO 108000

LOGO: ISO 110000

LOGO: ISO 112000

LOGO: ISO 114000

LOGO: ISO 116000

LOGO: ISO 118000

LOGO: ISO 120000

LOGO: ISO 122000

LOGO: ISO 124000

LOGO: ISO 126000

LOGO: ISO 128000

LOGO: ISO 130000

LOGO: ISO 132000

LOGO: ISO 134000

LOGO: ISO 136000

LOGO: ISO 138000

LOGO: ISO 140000

LOGO: ISO 142000

LOGO: ISO 144000

LOGO: ISO 146000

LOGO: ISO 148000

LOGO: ISO 150000

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LOGO: ISO 198000

LOGO: ISO 200000

LOGO: ISO 202000

LOGO: ISO 204000

LOGO: ISO 206000

LOGO: ISO 208000

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LOGO: ISO 252000

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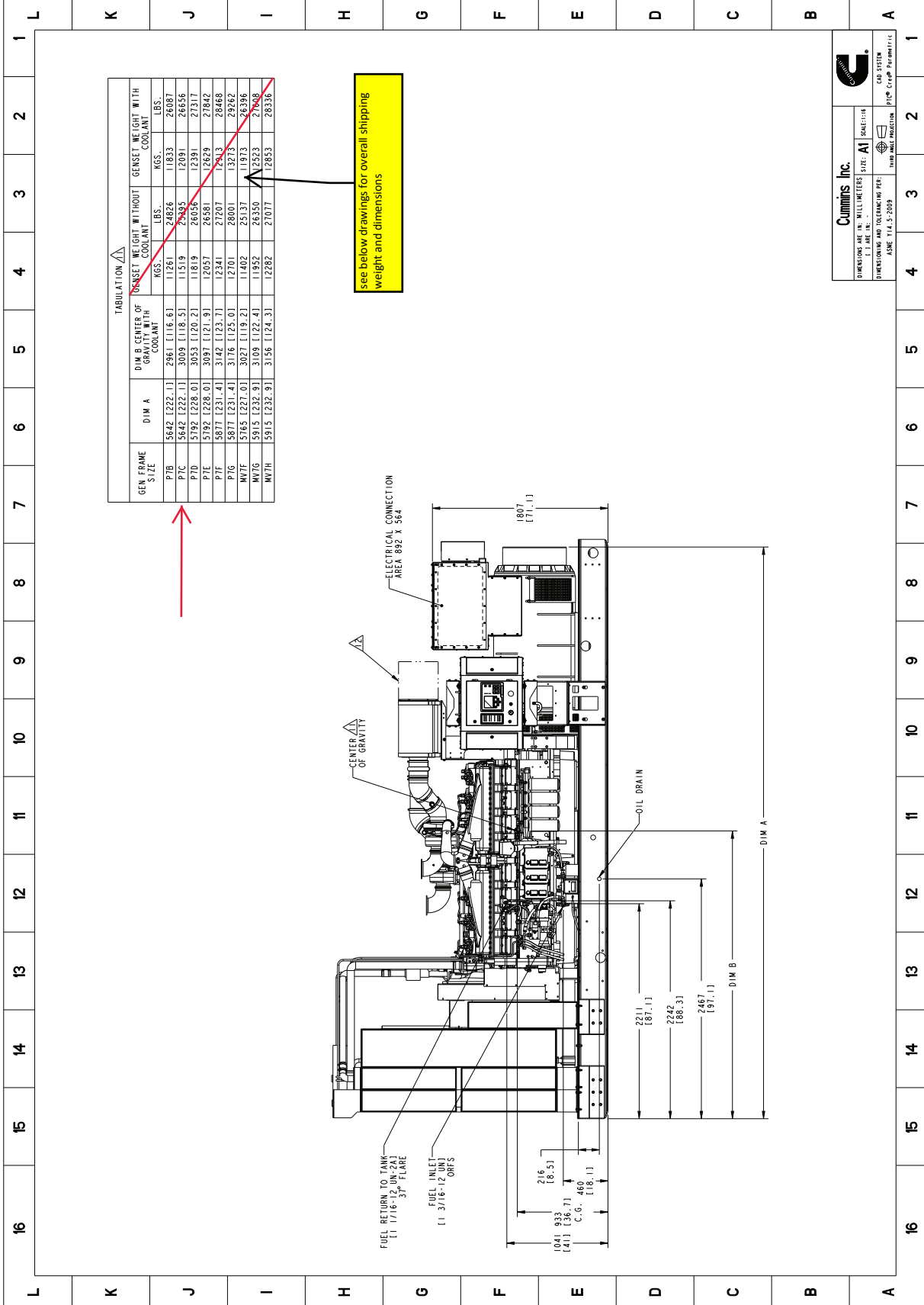
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LOGO: ISO 1000000

Part Number: **A062R947** Part Revision: **A**  
 Part Name: **OUTLINE,GENSET**  
 Drawing Category: **Detail State: Released** Sheet 2 of 14

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see below drawings for overall shipping weight and dimensions

**Cummins Inc.**

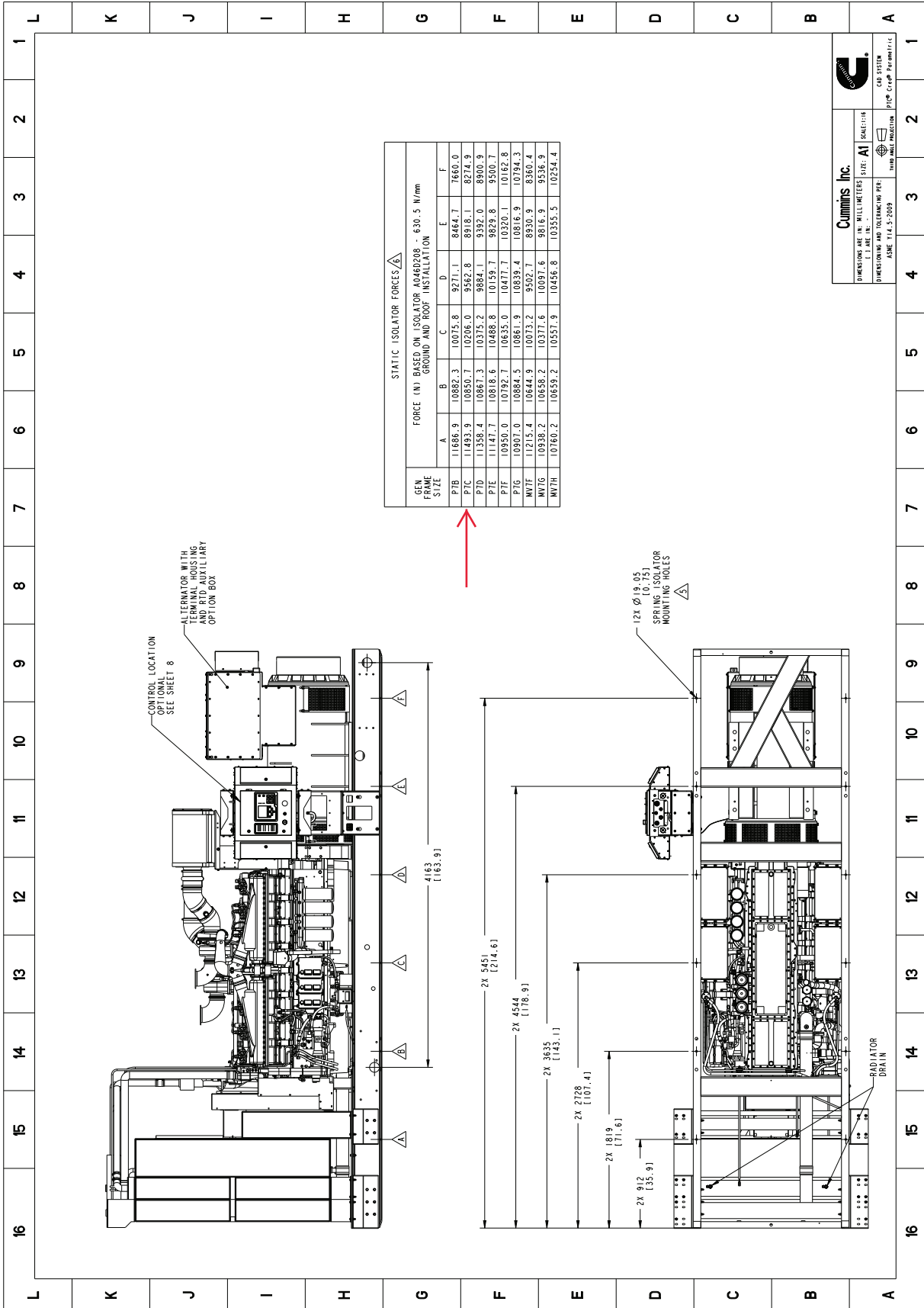
DIMENSIONS ARE IN MILLIMETERS SIZE: A1 SCALE: 1:10  
 DIMENSIONS ARE IN INCHES SIZE: A1 SCALE: 1:10  
 DIMENSIONS ARE IN MILLIMETERS PER: ASME Y14.5-2009  
 DIMENSIONS ARE IN INCHES PER: ASME Y14.5-2009

Cummins Inc. logo

Part Number: **A062R947** Part Revision: **A**  
 Part Name: **OUTLINE,GENSET**  
 Drawing Category: **Detail State: Released** Sheet **3** of **14**

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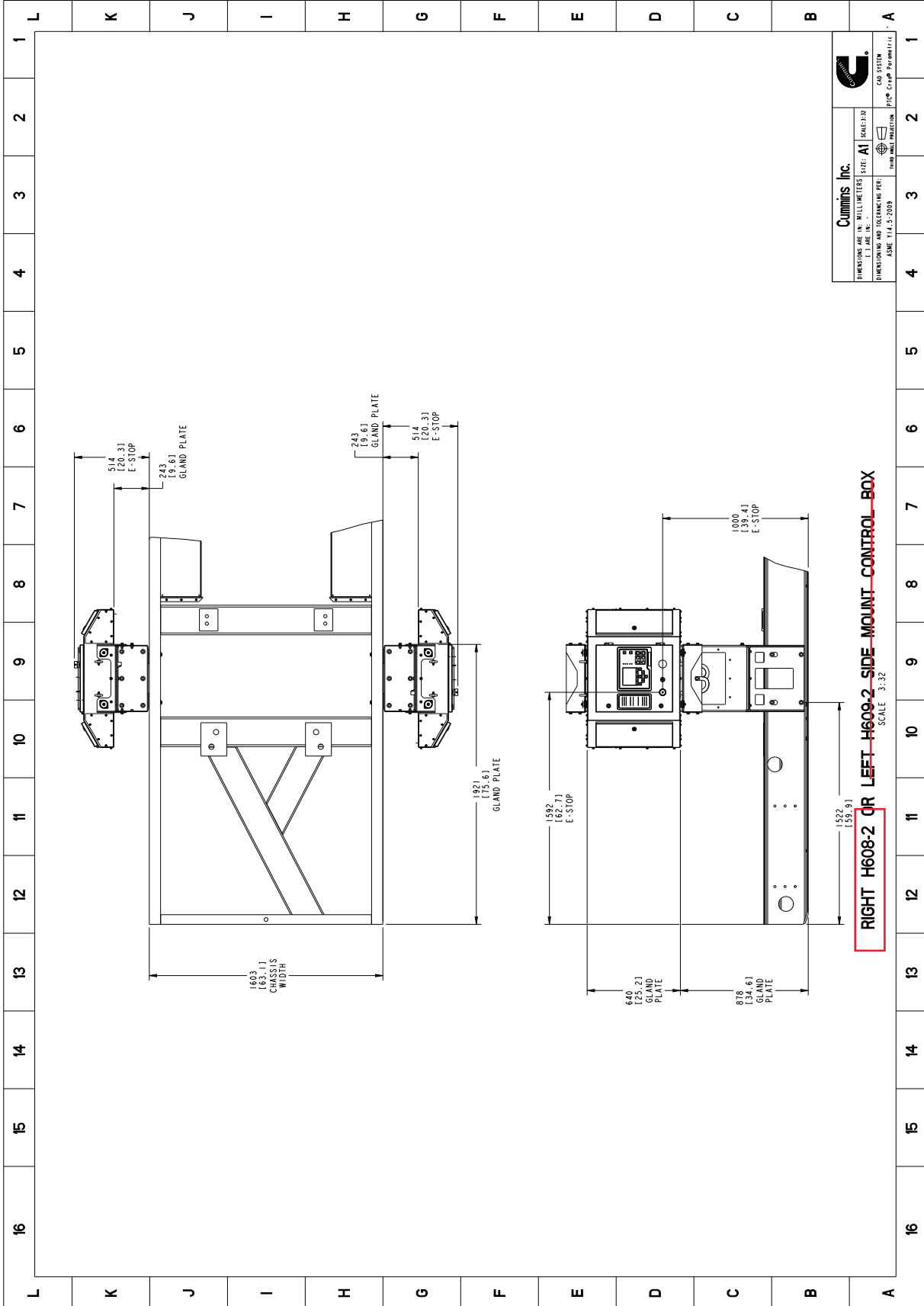
**Cummins Inc.**

DIMENSIONS ARE IN MILLIMETERS SIZE: A1 SCALE: 1:10  
 DIMENSIONS AND TOLERANCES PER:  
 ASME Y14.5-2009

ISO FIRST ANGLE PRACTICE  
 CUBIC SYSTEM  
 10° Crop Permissible

Part Number: **A062R947** Part Revision: **A**  
 Part Name: **OUTLINE, GENSET**  
 Drawing Category: **Detail State: Released** Sheet **4** of **14**

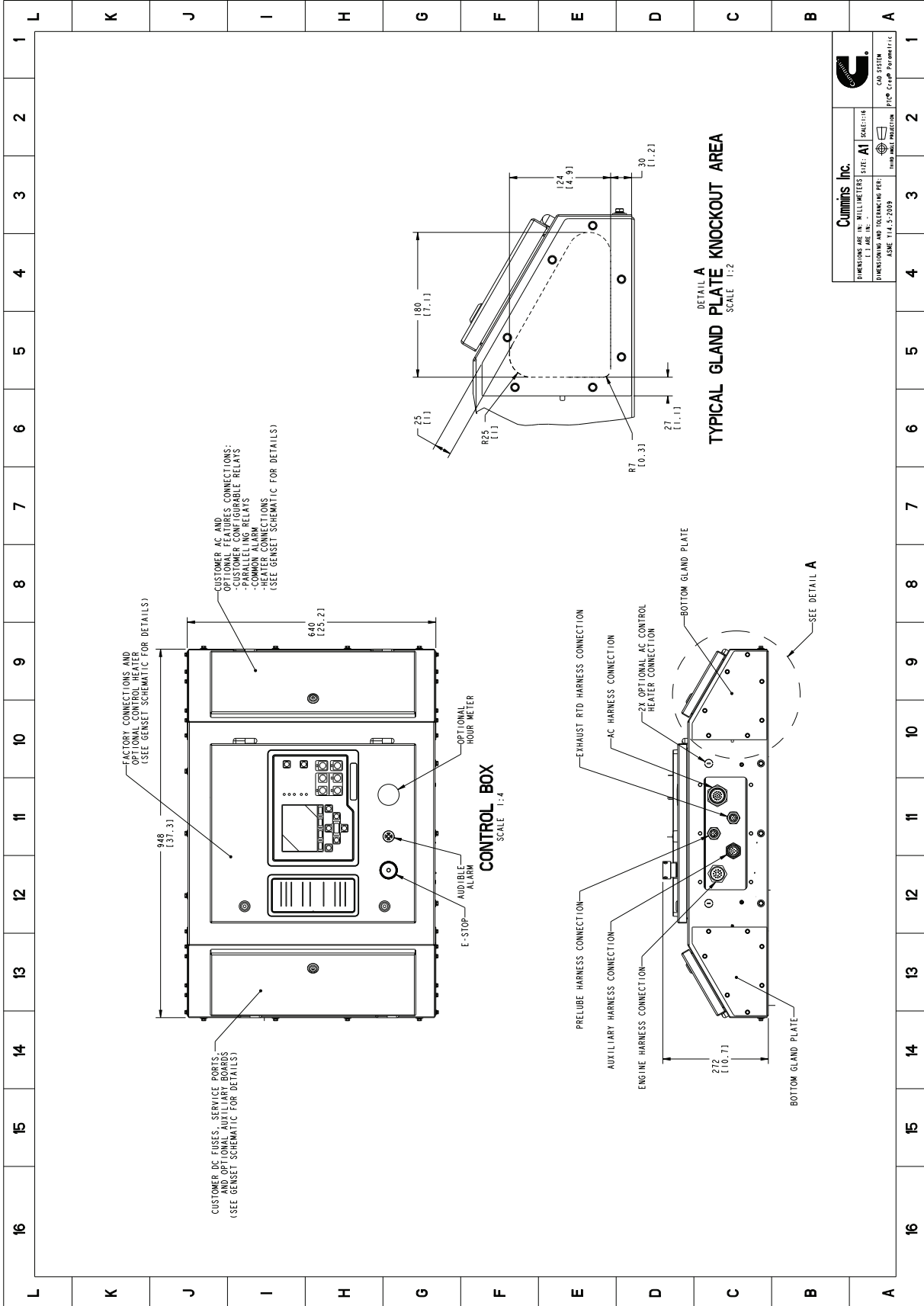
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DIMENSIONS ARE IN MILLIMETERS SIZE: A1 SCALE: 3:32	
DIMENSIONS AND TOLERANCES PER: ASME Y14.5-2009	ISO 2768-MS H10 Crop Permittance

Part Number: **A062R947** Part Revision: **A**  
 Part Name: **OUTLINE, GENSET**  
 Drawing Category: **Detail State: Released** Sheet 7 of 14

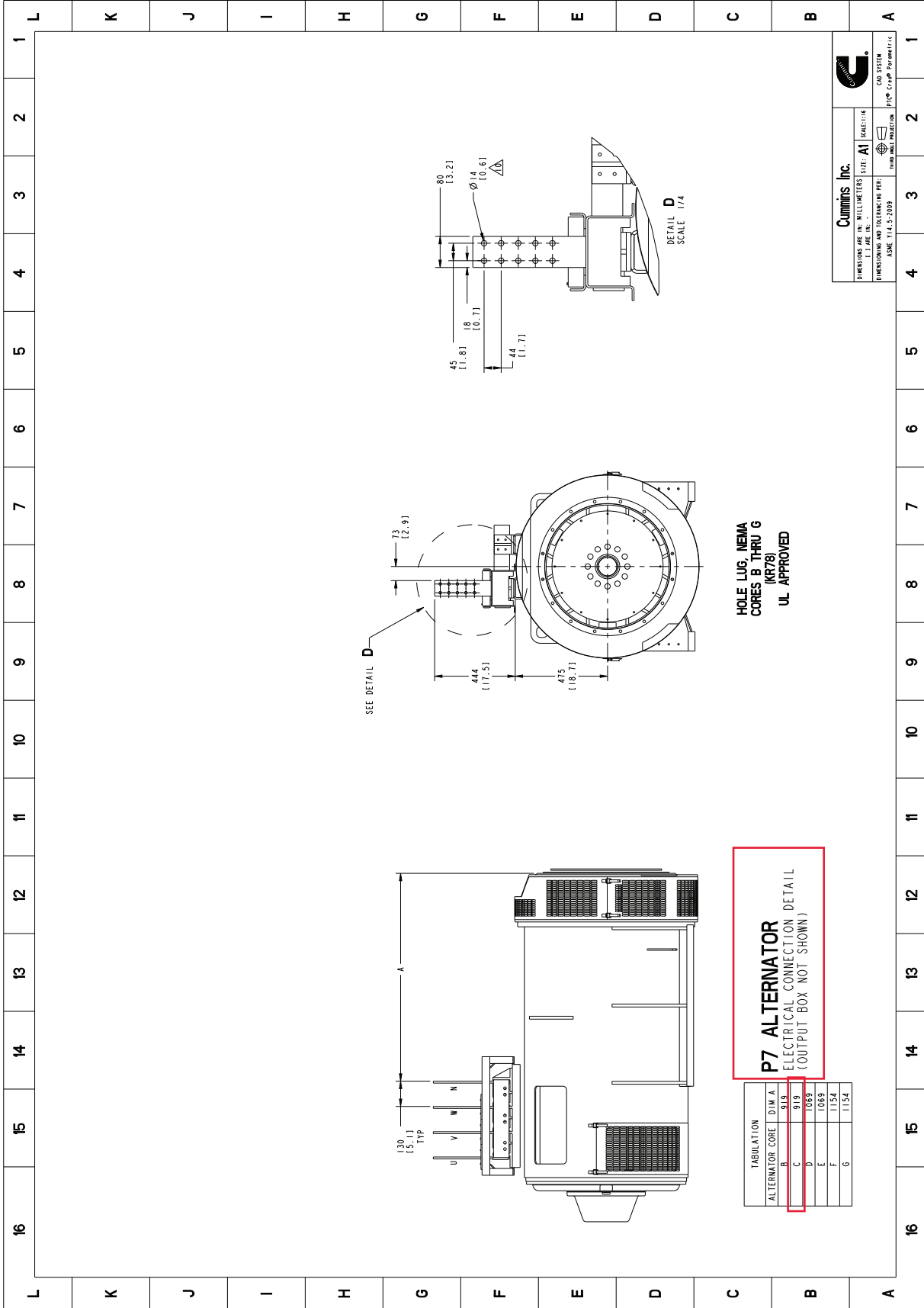
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Part Number: **A062R947** Part Revision: **A**  
 Part Name: **OUTLINE, GENSET**  
 Drawing Category: **Detail State: Released** Sheet **8** of **14**


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HOLE LUG, NEMA CORES B, THRU G  
UL APPROVED

**P7 ALTERNATOR**  
ELECTRICAL CONNECTION DETAIL  
(OUTPUT BOX NOT SHOWN)

	
DIMENSIONS ARE IN MILLIMETERS SIZE: A1 SCALE: 1:10 DIMENSIONS AND TOLERANCES PER: ASME Y14.5-2009	ISO 9001 REGISTERED ISO 14001 REGISTERED ISO 45001 REGISTERED

Part Number: **A062R947** Part Revision: **A**  
 Part Name: **OUTLINE, GENSET**  
 Drawing Category: **Detail State: Released** Sheet 10 of 14

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# Circuit Breakers



## Description

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

## Applicable Models

Engine	Models			
QSK23-G7	DQCA	DQCB	DQCC	
QST30-G5	DQFAA	DQFAB	DQFAC	DQFAD
QST30-G17	DQFAH			
QSK50-G5	DQGAE	DQGAF		
QSK50-G4	DQGAA	DQGAB		
QSK50-G8	DQGAS			
QSK60-G6	DQKAA	DQKAB	DQKAD	DQKAE
QSK60-G14	DQKAF			
QSK60-G17	DQKAM			

## Instructions

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

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

Frame	Catalog Name*	Catalog Number description pages
P and R	<a href="http://www.schneiderelectric.us/en/download/document/0612CT0101/">0612CT0101</a> <a href="http://www.schneiderelectric.us/en/download/document/0612CT0101/">http://www.schneiderelectric.us/en/download/document/0612CT0101/</a>	16-17
L	<a href="http://www.schneiderelectric.us/en/download/document/0611CT1001/">0611CT1001</a> <a href="http://www.schneiderelectric.us/en/download/document/0611CT1001/">http://www.schneiderelectric.us/en/download/document/0611CT1001/</a>	8-9
MasterPact NT/NW	<a href="http://www.schneider-electric.us/en/faqs/FA231180/">http://www.schneider-electric.us/en/faqs/FA231180/</a>	Please refer to PLS007 Rev 25

\*The following link may also be used to search specifically by the breaker part number or for the catalog name listed above.

<http://products.schneider-electric.us/technical-library/>

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

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

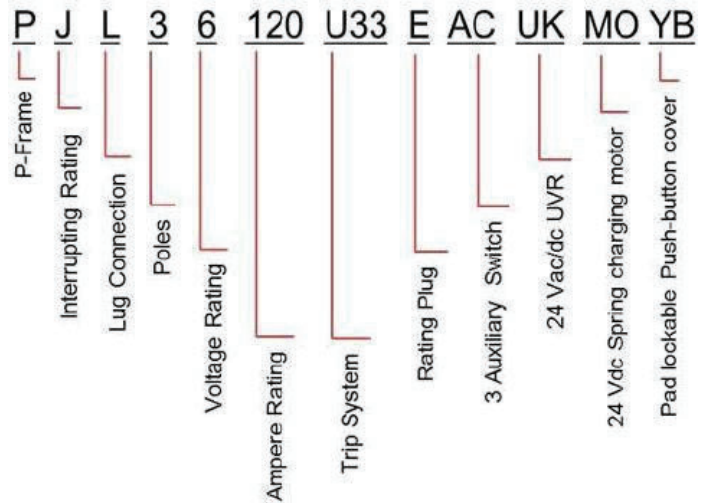
\*If the first 3 letters are "PJP," the search will not work. You will need to start with just "PJ" and use the description pages to obtain the information you are looking for on the "PJP."

### Example

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

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

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

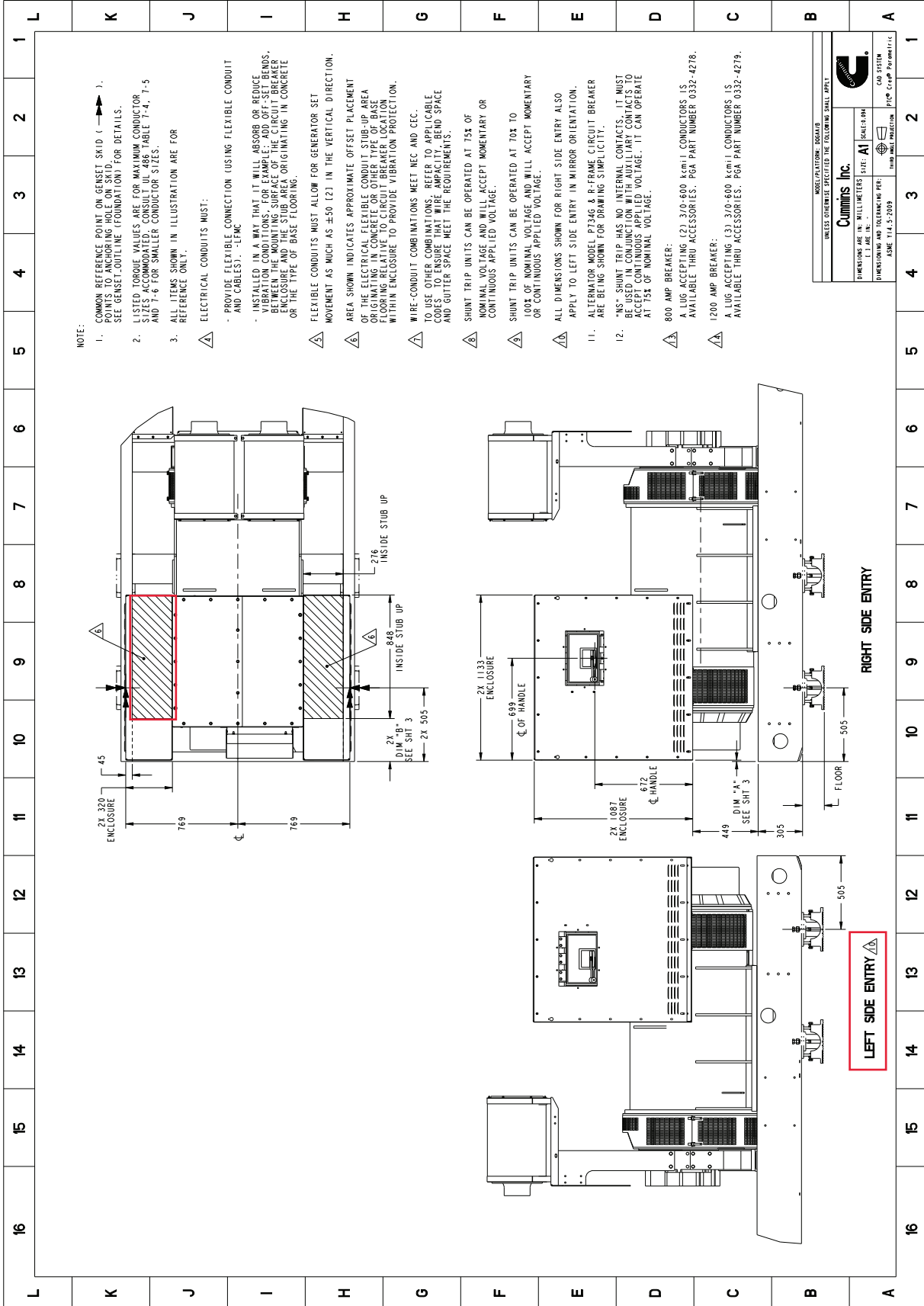


The following link is another way to decode the Schneider products

[https://www.productinfo.schneider-electric.com/portals/ui/digest/viewer/561d5d65e4b0c5c41a243bf2/561d5f9ae4b0c5c41a24480c/r/17707021\\_83351#\\_17707021\\_83351](https://www.productinfo.schneider-electric.com/portals/ui/digest/viewer/561d5d65e4b0c5c41a243bf2/561d5f9ae4b0c5c41a24480c/r/17707021_83351#_17707021_83351)

For decoding the ABB breakers, see the decoder sheet, titled "T8 Catalog number explanation"

Mechanically operated breakers							
Feature Code	Breaker box description	Cummins part #	Engine	Manufacturer	Breaker catalog number	Trip unit	Plug type
KP82-2	CB-2500, Right, 3P, UL600, IEC 415, UL Serv Ent, 100%	0320-2164-01	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	RLF36250U31F	MicroLogic 3.0 LI	F
		A054K364	QSK19-G8, QSK23-G7		RLF36250U33F	MicroLogic 5.0 LSI	
KP83-2	CB-2500A, Left, 3P, 600, IEC 415, UL Serv Ent, 100%	0320-2164-01	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	RLF36250U31F	MicroLogic 3.0 LI	F
		A054K364	QSK19-G8, QSK23-G7		RLF36250U33F	MicroLogic 5.0 LSI	
KP84-2	CB-2000, Right, 3P, UL 600, IEC 415, UL Serv Ent 100%	0320-2164-02	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	RLF36200U31F	MicroLogic 3.0 LI	F
		A054K366	QSK19-G8, QSK23-G7		RLF36200U33F	MicroLogic 5.0 LSI	
KP85-2	CB-2000, Left, 3P, UL 600, IEC 415, UL Serv Ent, 100%	0320-2164-02	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	RLF36200U31F	MicroLogic 3.0 LI	F
		A054K366	QSK19-G8, QSK23-G7		RLF36200U33F	MicroLogic 5.0 LSI	
KP86-2	CB-1600A, Right, 3P, UL 600, IEC 415, UL Serv Ent 100%	0320-2164-03	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, 50L, 60L, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	RLF36160U31F	MicroLogic 3.0 LI	F
		A054K368	QSK19-G8, QSK23-G7		RLF36160U33F	MicroLogic 5.0 LSI	
KP87-2	CB-1600, Left, 3P, UL 600, IEC 415, UL Serv Ent 100%	0320-2164-03	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	RLF36160U31F	MicroLogic 3.0 LI	F
		A054K368	QSK19-G8, QSK23-G7		RLF36160U33F	MicroLogic 5.0 LSI	
KP88-2	CB-1200, Right, 3P, UL 600, IEC 415, UL Serv Ent, 100%	0320-2183	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	PJP36120U31E	MicroLogic 3.0 LI	E
		A054K408	QSK19-G8, QSK23-G7		PJP36120U33F	MicroLogic 5.0 LSI	
KP89-2	CB-1200, Left, 3P, UL 600, IEC 415, UL Serv Ent, 100%	0320-2183	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	PJP36120U31E	MicroLogic 3.0 LI	E
		A054K408	QSK19-G8, QSK23-G7		PJP36120U33F	MicroLogic 5.0 LSI	
KP90-2	CB-800A, Right, 3P, UL 600, IEC 415, UL Serv Ent 100%	0320-2182	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	PJP36080U31F	MicroLogic 3.0 LI	F
		A054K405	QSK19-G8, QSK23-G7		PJP36080U33F	MicroLogic 5.0 LSI	
KP91-2	CB-800A, Left, 3P, UL 600, IEC 415, UL Serv Ent, 100%	0320-2182	QST30-G5, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	PJP36080U31F	MicroLogic 3.0 LI	F
		A054K405	QSK19-G8, QSK23-G7		PJP36080U33F	MicroLogic 5.0 LSI	
KP92-2	CB-600A, Right, 3P, UL 600, IEC 690, UL Serv Ent 100%	A044T468	QSK19-G8, QSK23-G7, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	NLGL36600U33X-600A	MicroLogic 3.3S LSI	N/A
KP93-2	CB-600A, Left, 3P, UL 600, IEC 690, UL Serv Ent, 100%	A044T468	QSK19-G8, QSK23-G7, 30L, QSK50-G4, QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	NLGL36600U33X-600A	MicroLogic 3.3S LSI	N/A
KU62-2	CB-3000A, 3P, 600/690V, UL/IEC, ServEnt, 100%UL, Right	A029B150	QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	RLF36300U31A	MicroLogic 3.0 LI	F
KU68-2	CB-3000A, 3P, 600/690V, UL/IEC, ServEnt, 100%UL, Left	A029B150	QSK50-G5, QSK50-G7, QSK60-G6, QSK60-G11 QSK60-G14, QSK60-G18	Schneider Electric	RLF36300U31A	MicroLogic 3.0 LI	F



- NOTE:
- COMMON REFERENCE POINT ON GENSET SKID ( → ). POINTS TO ANCHORING HOLE ON SKID. SEE GENSET OUTLINE (FOUNDATION) FOR DETAILS.
  - LISTED TORQUE VALUES ARE FOR MAXIMUM CONDUCTOR SIZES ACCORDING TO TABLE 7-4, 7-5 AND 7-6 FOR SMALLER CONDUCTOR SIZES.
  - ALL ITEMS SHOWN IN ILLUSTRATION ARE FOR REFERENCE ONLY.

- △ ELECTRICAL CONDUITS MUST:
- PROVIDE FLEXIBLE CONNECTION (USING FLEXIBLE CONDUIT AND CABLES). - LFMC
  - BE INSTALLED IN A WAY THAT IT WILL ABSORB OR REDUCE VIBRATION CONDITIONS, FOR EXAMPLE: ADD OFF-SET BENDS, BETWEEN THE MOUNTING SURFACE OF THE CIRCUIT BREAKER ENCLOSURE AND THE STUB AREA ORIGINATING IN CONCRETE OR THE TYPE OF BASE FLOORING.
- △ FLEXIBLE CONDUITS MUST ALLOW FOR GENERATOR SET MOVEMENT AS MUCH AS ±50 (2) IN THE VERTICAL DIRECTION.
- △ AREA SHOWN INDICATES APPROXIMATE OFFSET PLACEMENT OF THE ELECTRICAL FLEXIBLE CONDUIT STUB-UP AREA ORIGINATING IN CONCRETE OR OTHER TYPE OF BASE FLOORING RELATIVE TO CIRCUIT BREAKER LOCATION WITHIN ENCLOSURE TO PROVIDE VIBRATION PROTECTION.
- △ WIRE-CONDUIT COMBINATIONS MEET NEC AND CEC. TO USE OTHER COMBINATIONS, REFER TO APPLICABLE CODES TO ENSURE THAT WIRE AMPACITY, BEND SPACE AND GUTTER SPACE MEET THE REQUIREMENTS.
- △ SHUNT TRIP UNITS CAN BE OPERATED AT 75% OF NOMINAL VOLTAGE AND WILL ACCEPT MOMENTARY OR CONTINUOUS APPLIED VOLTAGE.
- △ SHUNT TRIP UNITS CAN BE OPERATED AT 10% TO 100% OF NOMINAL VOLTAGE AND WILL ACCEPT MOMENTARY OR CONTINUOUS APPLIED VOLTAGE.
- △ ALL DIMENSIONS SHOWN FOR RIGHT SIDE ENTRY ALSO APPLY TO LEFT SIDE ENTRY IN MIRROR ORIENTATION.
- ALTERNATOR MODEL P134G & R-FRAME CIRCUIT BREAKER ARE BEING SHOWN FOR DRAWING SIMPLICITY.
  - "NS" SHUNT TRIP HAS NO INTERNAL CONTACTS. IT MUST BE USED IN CONJUNCTION WITH AUXILIARY CONTACTS TO ACCEPT CONTINUOUS APPLIED VOLTAGE. IT CAN OPERATE AT 75% OF NOMINAL VOLTAGE.
- △ 800 AMP BREAKER:  
A. LUG ACCEPTING (2) 3/0-600 kcmil CONDUCTORS IS AVAILABLE THRU ACCESSORIES. PGM PART NUMBER 0332-4278.
- △ 1200 AMP BREAKER:  
A. LUG ACCEPTING (3) 3/0-600 kcmil CONDUCTORS IS AVAILABLE THRU ACCESSORIES. PGM PART NUMBER 0332-4279.

UNLESS OTHERWISE SPECIFIED THE FOLLOWING SHALL APPLY

**Cummins Inc.**

UNLESS OTHERWISE SPECIFIED THE FOLLOWING SHALL APPLY

DIMENSIONS ARE IN MILLIMETERS SIZE: A1 (SMALLER DIM)

DIMENSIONS ARE IN MILLIMETERS PER: IEC (SMALLER DIM)

ASME Y14.5-2009

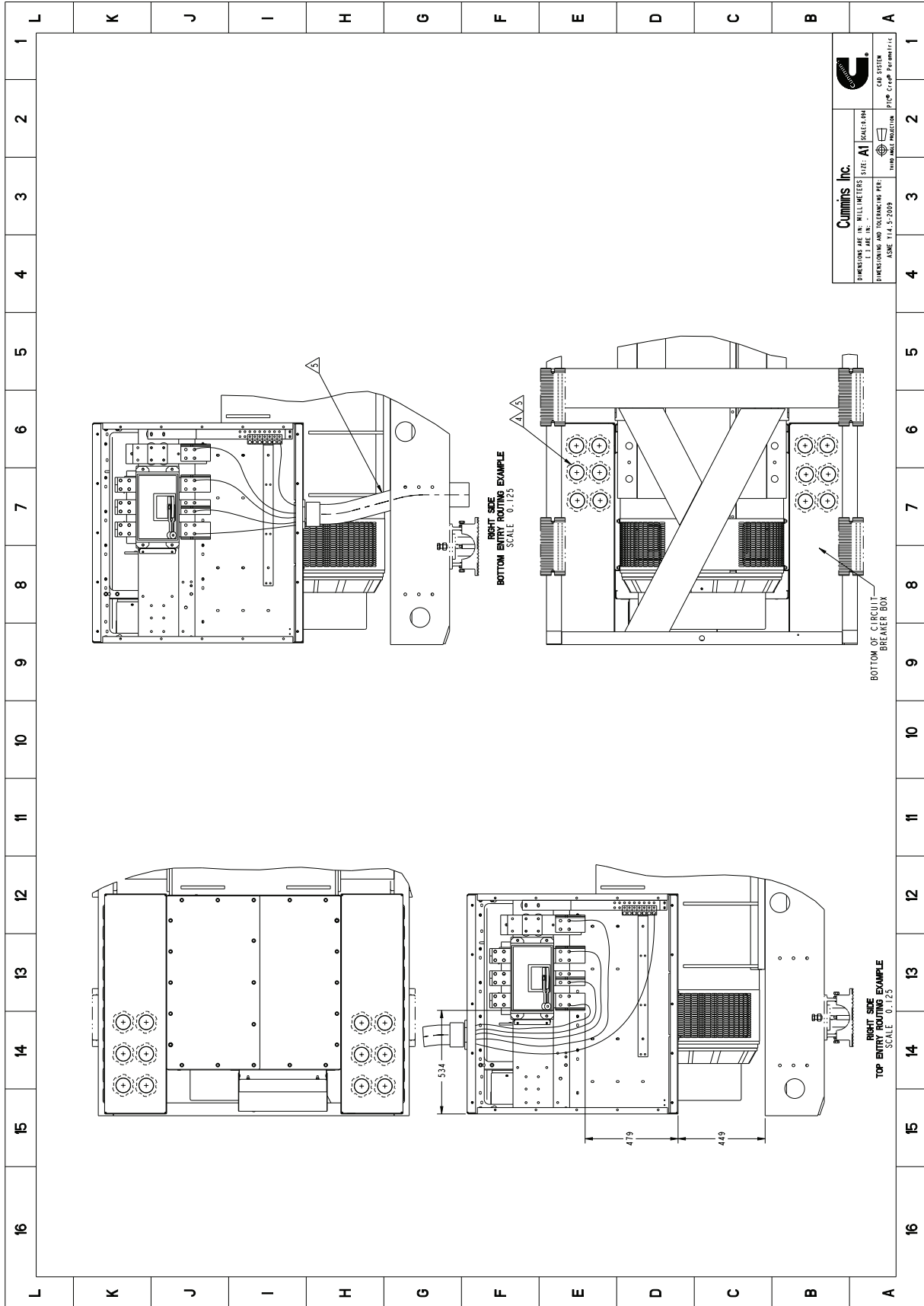
ISO 9001:2015 CERTIFIED

ISO 14001:2015 CERTIFIED

Part Number: A062R949 Part Revision: A  
 Part Name: INSTALLATION, CONTROL BOX  
 Drawing Category: Detail State: Released Sheet 1 of 4

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Part Number: **A062R949** Part Revision: **A**  
 Part Name: **INSTALLATION, CONTROL BOX**  
 Drawing Category: **Detail State: Released** Sheet 2 of 4

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16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1																																																															
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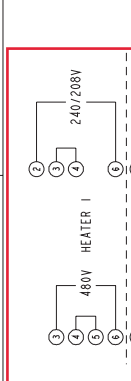
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 DIMENSIONS ARE IN INCHES PER: A4 (LARGER DIM)

ASME Y14.5-2009  
 THIRD ANGLE PROJECTION  
 FIRST ANGLE PROJECTION  
 FIRST ANGLE PROJECTION

Part Number: A062R949 Part Revision: A  
 Part Name: INSTALLATION, CONTROL BOX  
 Drawing Category: Detail State: Released  
 Sheet 3 of 4

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REV.	DATE	BY	DESCRIPTION	ISSUE NO.	DATE	BY	DESCRIPTION
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3	03/28/18	DFJ	INITIAL RELEASE	001	03/28/18	DFJ	INITIAL RELEASE
4	03/28/18	DFJ	INITIAL RELEASE	001	03/28/18	DFJ	INITIAL RELEASE
5	03/28/18	DFJ	INITIAL RELEASE	001	03/28/18	DFJ	INITIAL RELEASE
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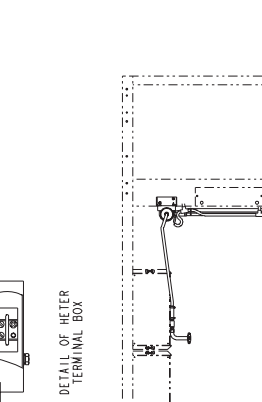
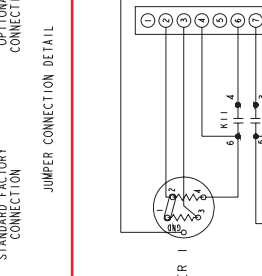


NOTES:

1. DIMENSIONS IN ( ) ARE INCHES.
2. THE HEATER CONTROL RELAY DRAINS 83mA OF CURRENT WHEN THE HEATERS ARE UNPOWERED. HEATERS ARE NOT OPERATED WHEN UNPOWERED.

1) TEMPERATURE OR 2) THE ENGINE IS RUNNING.

**⚠️ A BATTERY CHARGER IS REQUIRED TO PREVENT BATTERY DISCHARGE.**



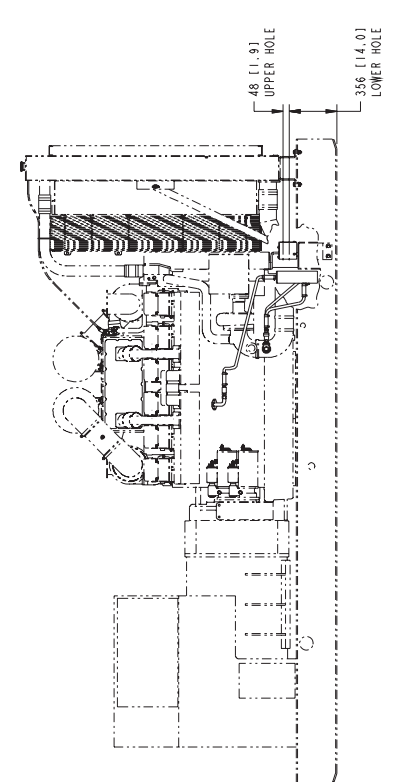
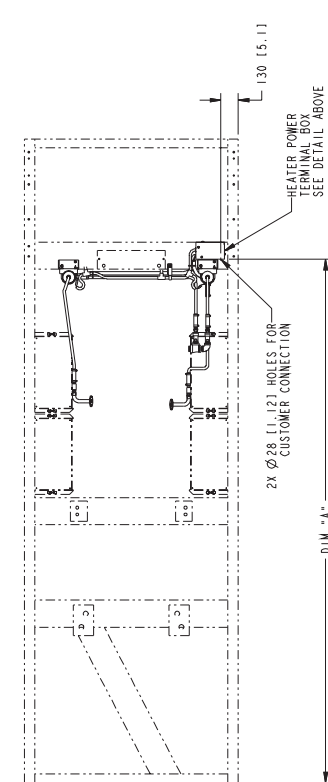
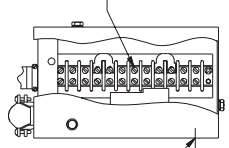
SINGLE PHASE HEATER VOLTAGE	FEATURE CODE		FEATURE CODE	
	HEATER AMPS	TOTAL WATTS	HEATER AMPS	TOTAL WATTS
208	18.0	36.0	23.1	46.3
240	20.8	41.6	26.8	53.5
480	10.4	20.8	13.4	26.8

GENSET ENGINE MODEL	DIM "A"
DFJA, LB, LC, LD	3927 (154.61)
DFLE, 50	4475 (176.2)
DFLM, LC, LD, MB	

0500\_3821

Pro/ENGINEER

METRIC DWG



REV.	DATE	BY	DESCRIPTION	ISSUE NO.	DATE	BY	DESCRIPTION
1	05/04/03	DFJ	INITIAL RELEASE	001	05/04/03	DFJ	INITIAL RELEASE
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3	05/04/03	DFJ	INITIAL RELEASE	001	05/04/03	DFJ	INITIAL RELEASE
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13	05/04/03	DFJ	INITIAL RELEASE	001	05/04/03	DFJ	INITIAL RELEASE
14	05/04/03	DFJ	INITIAL RELEASE	001	05/04/03	DFJ	INITIAL RELEASE
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20	05/04/03	DFJ	INITIAL RELEASE	001	05/04/03	DFJ	INITIAL RELEASE

DO NOT SCALE PRINT

SCALE: 1:1

DATE: 05/04/03

TIME: 10:00 AM

USER: DFJ

PROJECT: 0500\_3821

DESCRIPTION: HEATER

PG: 1

0500\_3821

Pro/ENGINEER

METRIC DWG

05/04/03

10:00 AM

DFJ

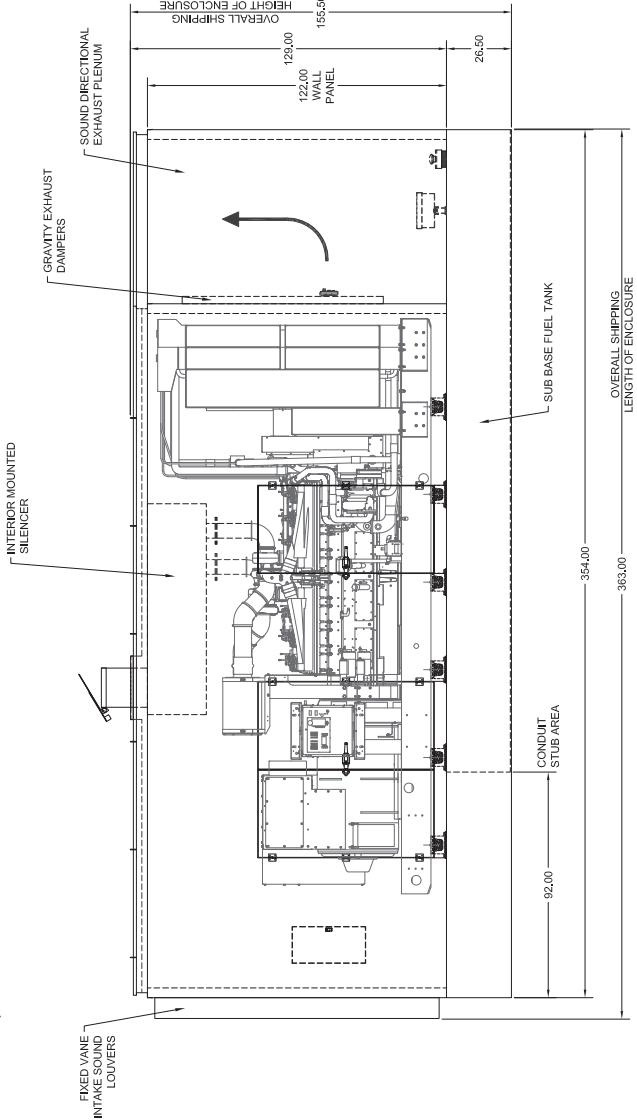
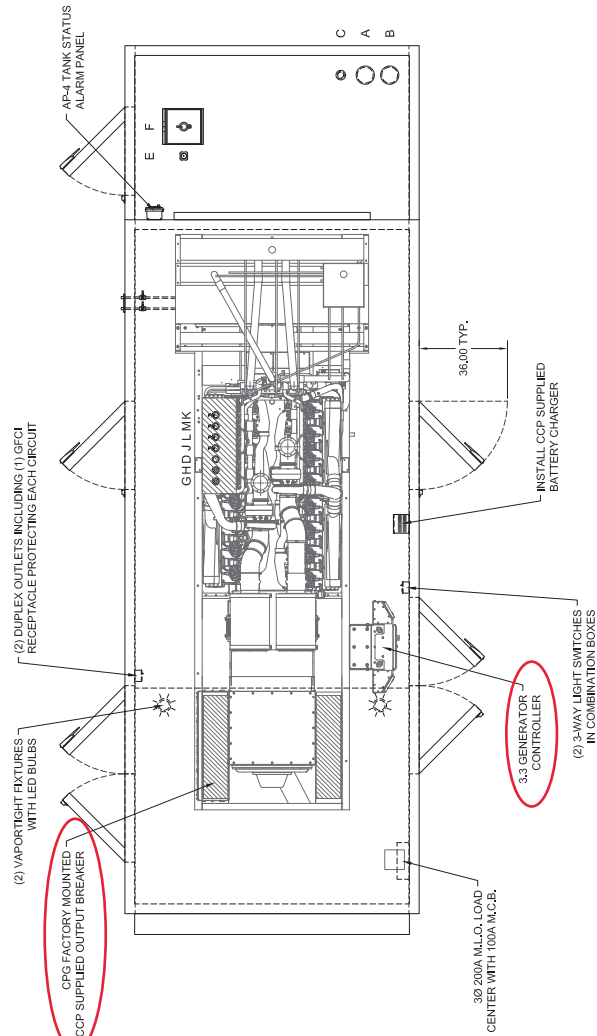
0500\_3821

HEATER

1

REV	DESCRIPTION	BY	DATE
0	ORIGINAL SUBMISSION RELEASE	AW	12/08/20
1	UPDATED PER REVISED BREAKER & CONTROL LOCATIONS	AW	12/10/20
2	CORRECTED CALL OUT FOR CCP SUPPLIED OUTPUT BREAKER	AW	12/10/20

use this drawing for overall shipping weight and dimensions



**GENERATOR DATA**  
 MODEL: 1500 D0C0AB  
 DIMS INCHES: 234.5L X 78.7W X 111.8H  
 FUEL CONSUMPTION: 28.262  
 GPH @ 100% LOAD: 109.4  
 COMBUSTION AND GEN DRAWING: 65.046  
 GEN DRAWING: A062-R847

**GENERAL DESCRIPTION:**  
 SUB BASE FUEL SUPPLY TANK MOUNTED ON WALL NORMAL & EMERGENCY VENTS LOW LEVEL, HIGH LEVEL, CRITICAL HIGH LEVEL & LEAK DETECTION FLOW SWITCHES LOCK DOWN FUEL TANK CONTAINER ROCHESTER 6540 FUEL LEVEL GAUGE  
 LEVEL 2 SOUND ATTENUATED ENCLOSURE FIXED VANE INTAKE SOUND LOUVERS GRAVITY EXHAUST DAMPERS IN A SOUND DIRECTIONAL ACCESS DOOR OPENING 72" X 36" TYP. SINGLE DOOR 72" X 72" TYP. DOUBLE DOOR  
**ELECTRICAL PACKAGE**  
 30 120/208 200A M.L.O. LOAD CENTER WITH 100A M.C.B. (2) GFCI DUPEX OUTLETS INCLUDING (1) GFCI PER RECEPTACLE PROTECTING EACH CIRCUIT (2) 3-WAY LIGHT SWITCHES IN COMBINATION BOXES BLOCK HEATERS WIRING IN STEEL W/IT WITH COMPRESSION FITTINGS & LIQUID TIGHT FLEXIBLE CONDUIT  
 AP-4 TANK STATUS ALARM PANEL  
**ACCESSORIES**  
 INTERIOR MOUNTED SILENCER, FLEX CONNECTION TRAPPE WITH RAIN LID & 5/8" CPV ASSEMBLY  
 \*\* INTERIOR & EXTERIOR EQUIPMENT MOUNTINGS MAY VARY IN LOCATION DUE TO MANUFACTURING DESIGN REQUIREMENTS

**PAIN T COLORS:**  
 ENCLOSURE COLOR: CUMMINS GREEN  
 FUEL TANK COLOR: BLACK

**ESTIMATED WEIGHTS (lbs)**  
 ENCLOSURE WEIGHT: 13,986  
 TOTAL SHIPPING WEIGHT: 54,387  
 TOTAL SYSTEM WET WEIGHT: 75,047

**TANK DATA & NOTES:**  
 CAPACITY GALLONS: 2,750  
 GALLONS PER IN OF DEPTH: 122.9  
 RUN TIME (60 MIN): 11,149  
 TANK WEIGHT DRY (lbs): 31,799  
 CONDUIT STUB AREA: TYPE A (STRAIGHT)  
 EMERGENCY VENT SIZING BASED ON UL 142 TABLE 8.1 PORTS PER UL 142 SECTION 10  
 NORMAL VENTING PER UL 142 SECTION 8.1, TABLE 8.2 WELDS & JOINTS PER UL SECTION 9 FIGURE 6.1, 6.2

**PORTS:**  
 A = EMERGENCY TANK VENT  
 B = EMERGENCY BASIN VENT  
 C = EMERGENCY TANK SPARE PORT (FNPT)  
 D = EMERGENCY TANK SPARE PORT (FNPT)  
 E = ROCHESTER 6540 FUEL LEVEL GAUGE  
 F = LOCKABLE FILL WITH 5 GALLON SPILL CONTAINER  
 H = ENGINE RETURN  
 J = LOW LEVEL FLOAT SWITCH  
 K = LEAK FLOAT SWITCH  
 M = CRITICAL HIGH LEVEL FLOAT SWITCH  
 \*\* TANK PORTS MAY VARY IN LOCATION DUE TO INHERENT CONSTRUCTION OF FUEL TANK & LOCATION(S) OF EQUIPMENT

Quota Reference	27115 R0	2
Edifion		
Drawing Number	S384905-2 GA	Sheet #
Date	12/08/20	N.T.S.
Scale	1/1	
Designed by	AW	

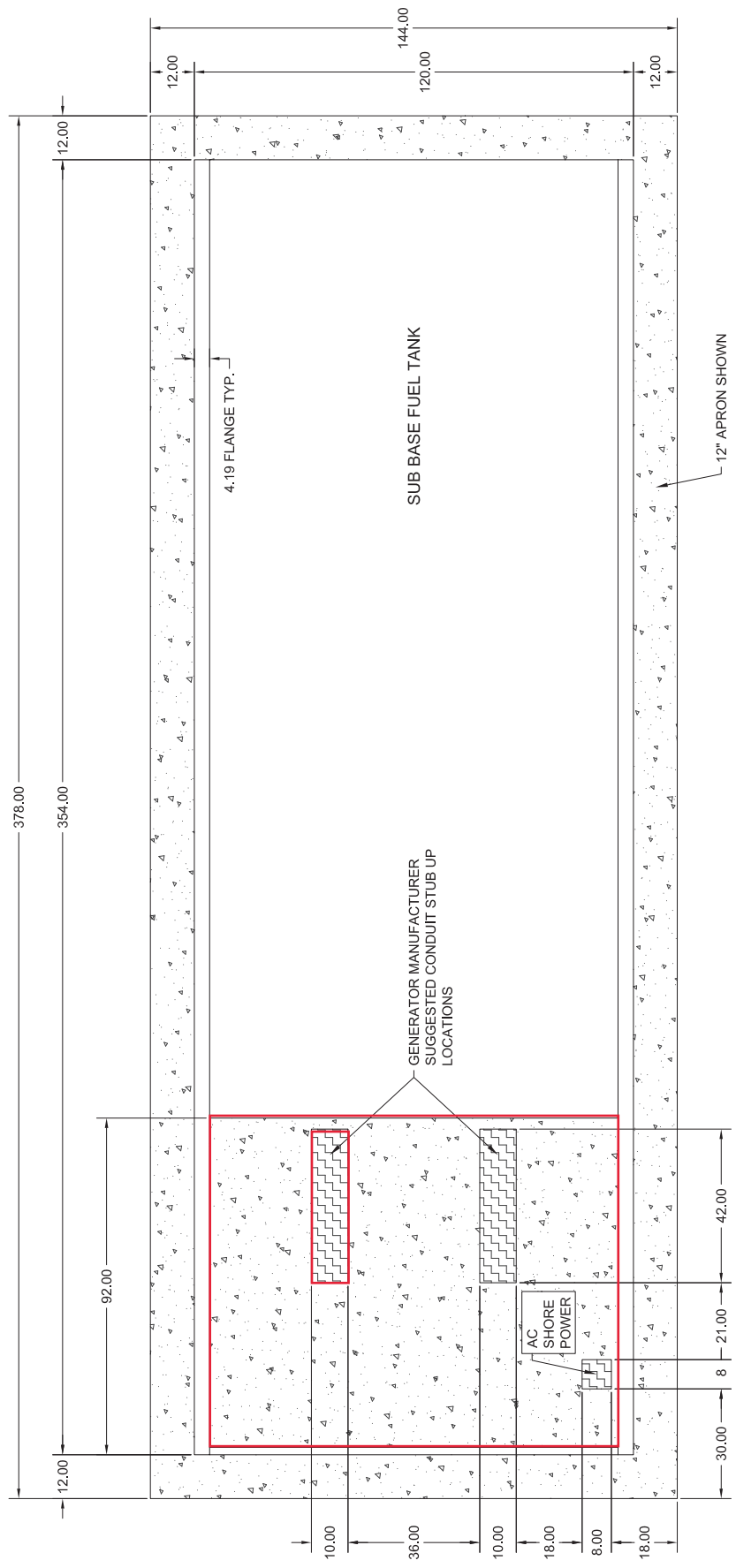
**CSDG**  
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 ALL DIMENSIONS ARE IN INCHES UNLESS SPECIFIED.



UL SPEC	DESCRIPTION	CLASS	FILE #
UL 142	SECONDARY CONTAINMENT DOUBLE WALL TANK	EVFT	MH47836
N/A			
N/A			



REV	DESCRIPTION	BY	DATE
1	UPDATED PER REVISED BREAKER & CONTROL LOCATIONS	AW	12/10/20
0	ORIGINAL SUBMISSION RELEASE	AW	12/08/20



Quota Reference	27115 R0	Edition	1
Drawing Number	S384905-1 PL	Scale	N.T.S.
Designated by	AW	Date	12/08/20
Substation	ST	Sheet #	1/1
<b>CSDG</b>			



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ALL DIMENSIONS ARE IN INCHES UNLESS SPECIFIED.

\*PAD DIMENSIONS ARE PROVIDED ONLY AS SUGGESTIONS. CONSULT AN ENGINEER FOR DESIGN ASSISTANCE.

TOTAL SYSTEM NET WEIGHT: ..... 75,047 (lbs)

- GENERAL NOTES:
1. A MINIMUM OF 4" IS REQUIRED FOR MOUNTING PURPOSES.
  2. ANCHOR BOLTS ARE NOT PROVIDED BY TANK MANUFACTURER.
  3. DRILL PAD FOR ANCHORS AFTER INSTALLATION OF TANK & ACCESSORIES.
  4. POUR PAD FLAT & LEVEL.

# PAD LAYOUT

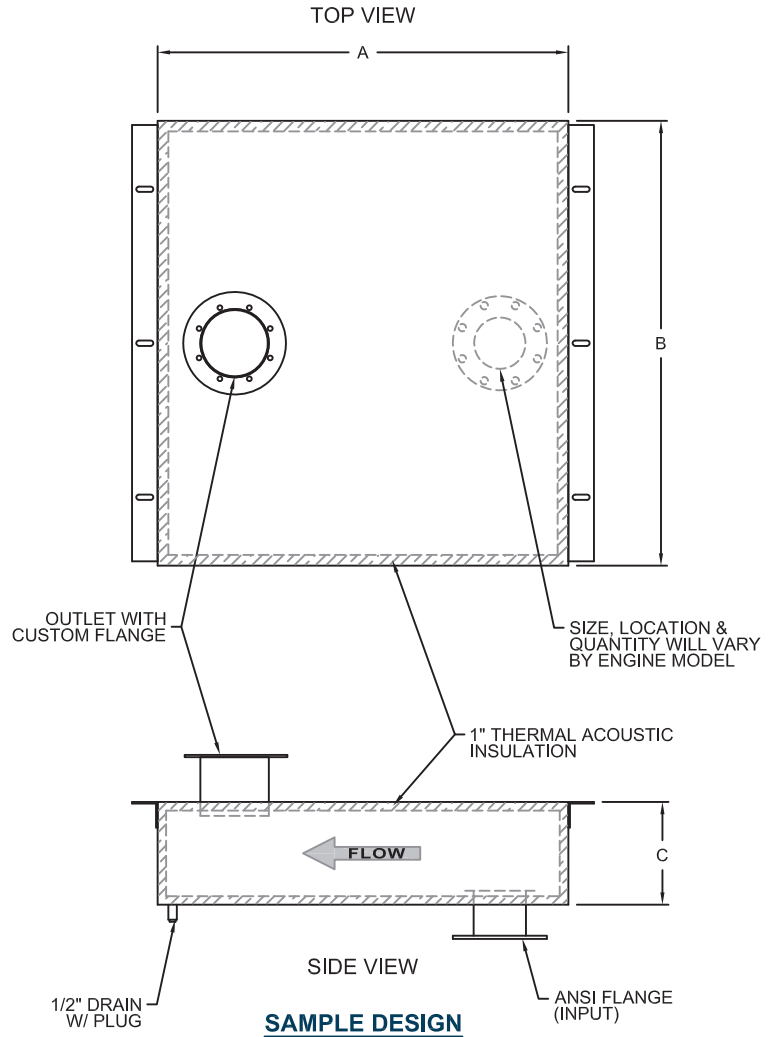
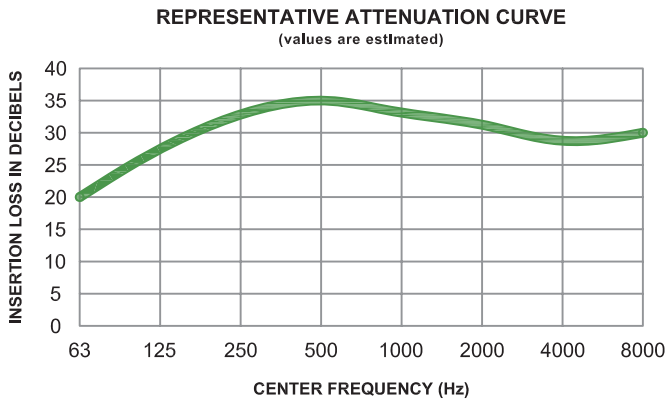
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### OVERVIEW

Freeman silencers are custom designed for each application and are optimized for use where ambient noise levels are relatively low and space is limited. Our features allow for excellent attenuation and surface temperature control while maintaining appropriate exhaust flow back pressure.

### CONSTRUCTION

Unique internal baffle layout and perforated chimney. 1" thick E-glass insulation packed shell with high temperature interior liner. Heavy duty carbon steel outer shell, mounting brackets, piping and flanges with high temperature painted black finish.



OUTLET SIZE	DIM "A"	DIM "B"	DIM "C"
4"	26.0	26.0	9.0
6"	36.0	31.0	11.0
8"	45.0	52.0	12.0
10"	54.0	54.0	14.0
12"	60.0	60.0	19.0
14"	68.0	60.0	21.0
16"	86.0	84.0	24.0
18"	88.0	88.0	28.0
20"	96.0	92.0	32.0
<b>THIS CHART IS FOR REFERENCE ONLY - ACTUAL SIZING &amp; DESIGN MAY VARY</b>			



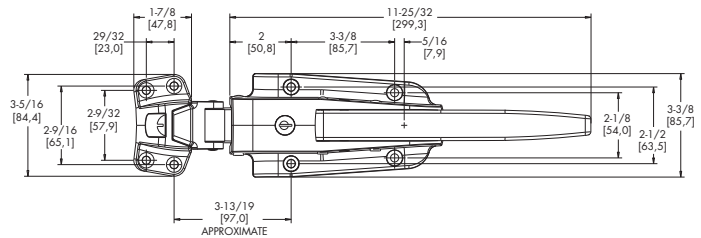
**ITEM # 778**



## 778 STAINLESS STEEL SAFEGUARD® LATCH

### CORROSION RESISTANT SAFETY LATCH

- New radial tongue makes for effortless door closure when combined with Kason door closers.
- The walk-in latch unsurpassed for reliability, is now available for the most challenging applications.
- No. 778 features unequalled strength and corrosion-resistance.
- Tamper-resistant locking mechanism and mounting are built in.
- Patented, adjustable roller strike assures precise adjustment.
- Padlocking provision standard on all models.
- Accepts Kason inside release lever to prevent accidental entrapment in locked walk-ins. Inside lever releases cylinder locked or padlocked door.



### SPECIFICATIONS

**MATERIAL:**  
Satin Finish, #316 stainless steel body and strike housing with #304 stainless steel roller.

**MOUNTING:**  
Holes drilled and countersunk for 1/4" (6mm) screws.

**INSIDE RELEASE:**  
Accepts No. 481SC, shown below. Order separately.

Model No.	Description
0778CL6020	Cylinder Latch Body, Light Spring
0778L06020	Padlocking Latch Body, Light Spring
0778006002	Strike, -1/8" to 3/4" (-3 - 19mm)
0778006003	Strike, 3/4" to 1-5/8" (19 - 41mm)
PACKAGING	6 per Carton

## 481SC STAINLESS STEEL INSIDE RELEASE

Opens padlocked or cylinder locked No. 778 latch from inside of walk-in. Clearly visible Safety-Glow™ knob for added safety.

### SPECIFICATIONS

**MATERIAL:**  
Stainless steel rod and flange, glow-in-the-dark plastic knob.

**MOUNTING:**  
Holes drilled for No. 10 (5mm) screws.



**ITEM # 481SC**



Model No.	Description
0481SC0400	Inside Release for 4" (102mm) Thick Door
0481SC0600	Inside Release for 6" (152mm) Thick Door*
PACKAGING	24 per Carton

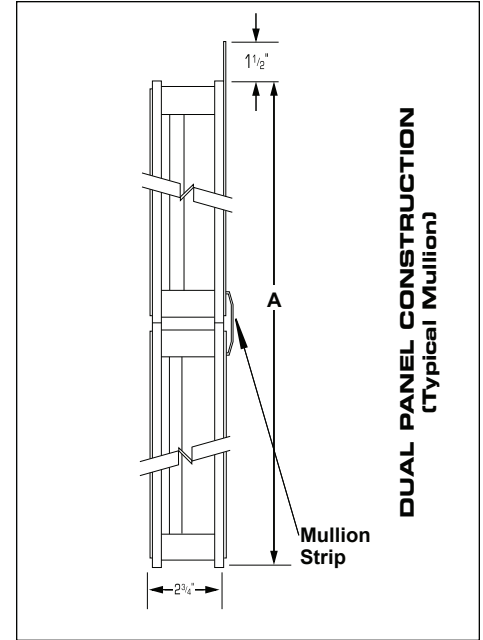
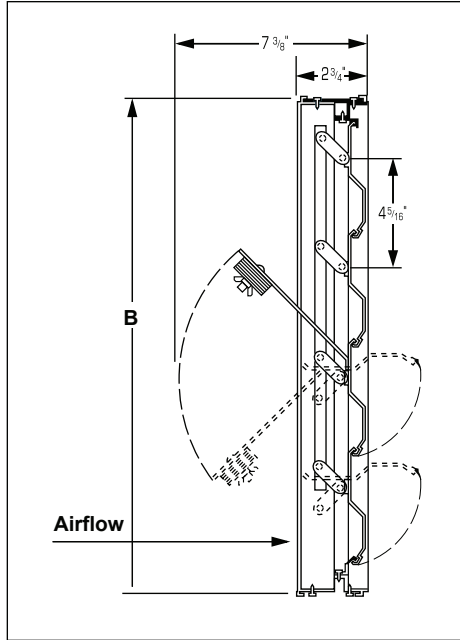
\*Available special order.







**CERTIFICATION & SUBMITTAL  
 MODEL 3400  
 Extruded Aluminum Backdraft Damper**



**STANDARD SPECIFICATIONS**

- **FRAME:** .090 6063T5 extruded aluminum.
- **BLADE:** .050 6063T5 extruded aluminum.
- **BLADE EDGE SEAL:** Vinyl gasketing extending full length of blades.
- **LINKAGE:** Synthetic pivot brackets and metallic tie rods concealed in damper frame.
- **FINISH:** Mill.
- **MAXIMUM SINGLE SECTION:** 40" x 48"
- **MINIMUM SIZE:** 6" x 6"
- **MAXIMUM FACE VELOCITY:** 2500 F.P.M.

**OPTIONS**

- 31 Flange (Specify air entering or air exiting).
- 40 3/4" expanded aluminum birdscreen (removable).
- 42 18 x 16 Mesh aluminum insect screen (removable).
- 43 18 x 16 Mesh bronze insect screen (removable).
- 44 1/2" x 1/2" x 16 ga. S.S. screen (removable).
- 45 1/2" x 1/2" x .063 aluminum screen (removable).
- 48 18 x 14 Mesh S.S. insect screen (removable).
- 89 Sleeve.

**NOTES**

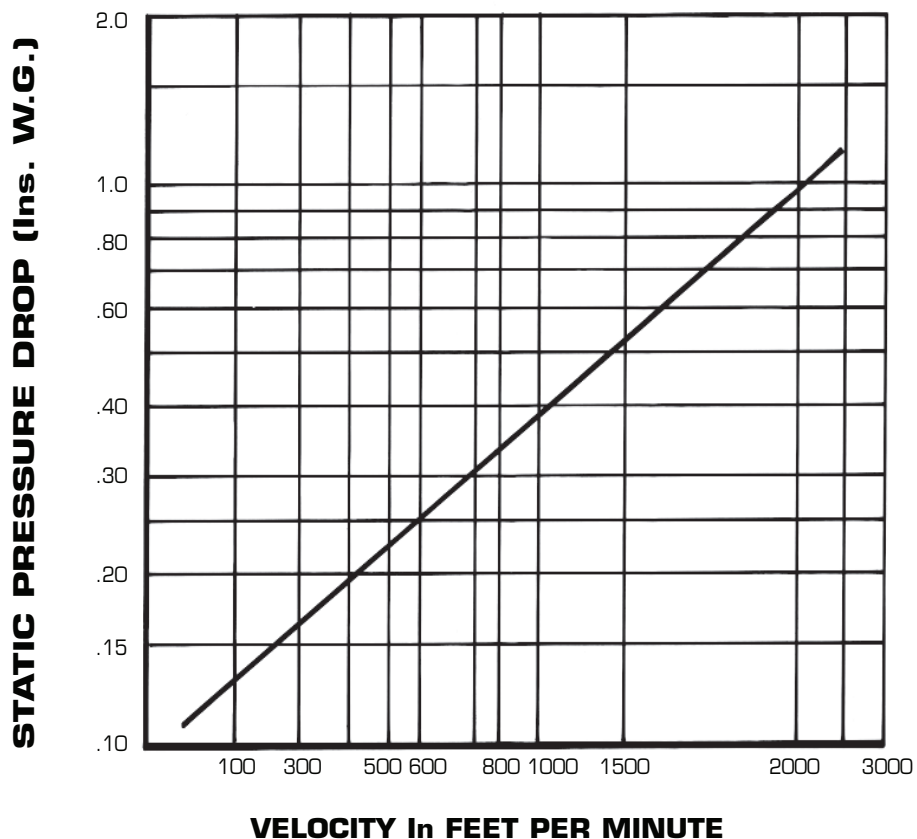
1. Recommended for horizontal airflow only.
2. A & B are opening dimensions. Unless otherwise specified, dampers are made 1/4" undersize.
3. Counterweights factory provided for dampers 9" in height and above.

Type text in this area.

**PERFORMANCE DATA**  
**MODEL 3400**  
**Extruded Aluminum Backdraft Damper**

This performance information is derived from testing in accordance with AMCA Standard 500; with test set up as per Figure 5.5.

**AIRFLOW CHART**



**NOTES**

- Maximum face velocity 2500 F.P.M.
- Leakage (Measured in CFM /SQ. FT.) shall not exceed 2% of maximum rated airflow at 1" W.G.
- Data does not reflect the use of adjustable counterweights.
- When used for fan discharge, dampers should be mounted 1/2 the fan diameter from the discharge.

PANEL SCHEDULE CSDS - #27115 R0

200 AMP, 120/208 VOLT, THREE PHASE, FOUR WIRE, M.L.D., 10000 AMPS MINIMUM A.I.C. BRACING, SURFACE MOUNTED, TYPE NEMA 3R ENCLOSURE

#	BKR.	WIRE AND CONDUIT			LOAD DESCRIPTION	NEUT.	LINE A	LINE B	LINE C	LOAD DESCRIPTION	WIRE AND CONDUIT			BKR.
		COND.	NEUTRAL	GND							KEYS	KEYS	C.	
1						0	0							
3	100/3			CTAL MAIN CIRCUIT BREAKER		0	2413							
5						0		2413		BLOCK HEATER		CTAL 1/2	#10	30/2
7	20/1	#12	#12	#12 1/2 CTAL (2) GFCI DUPLEX OUTLETS	720	720			2413			CTAL 1/2	#10	30/2
9	15/1	#14	#14	#14 1/2 CTAL (2) INTERIOR LIGHTS	72	72								
11	15/1	#14	#14	#14 1/2 CTAL BATTERY CHARGER	800				800					
13				SPACE	0									
15				SPACE	0									
17				SPACE	0									
19				SPACE	0									
21				SPACE	0									
23				SPACE	0									
25				SPACE	0									
27				SPACE	0									
29				SPACE	0									
1234				WIRE/CONDUIT KEY			5546	2485	3213					
				WIRING TYPE										
				INSULATION										
				CONDUIT TYPE										
				TEMP RATING										
				A-EMT										
				TEMP RATING										
				L-78-86 Deg. F.										
				CONDUIT TYPE										
				A-EMT										
				INSULATION										
				T-THHN										
				WIRING TYPE										
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				L-78-86 Deg. F.										
				CONDUIT TYPE										
				A-EMT										

Product availability : Stock - Normally stocked in distribution facility



### Main

Product or component type	Load Center
Range of product	QO
Load center type	Main lugs
Line Rated Current	200 A
Number of spaces	30
Short-circuit current	65 kA
Number of circuits	30
Number of tandem circuit breakers	0
Phase	3 phases
System Voltage	208Y/120 V AC 240/120 V delta AC 240 V delta AC

### Complementary

AWG gauge	AWG 6...300 kcmil (aluminium/copper)
NEMA degree of protection	NEMA 3R outdoor
Cover type	Surface cover
Electrical connection	Lugs
Device composition	Grounding bar included (not installed)
Electrical connection	Lugs
Wiring configuration	3-wire 4-wire
Material	Tin plated copper busbar
Enclosure material	Welded galvanized steel
Surface finish	Baked enamel grey
Box number	6R
Product certifications	UL listed
Height	29.84 in (758 mm)

Width	14.76 in (375 mm)
-------	-------------------

### Ordering and shipping details

Category	00017 - QO 3PH LOAD CENTER,OUTDOOR
Discount Schedule	DE3
GTIN	00785901295525
Nbr. of units in pkg.	1
Package weight(Lbs)	32.5
Returnability	Y
Country of origin	US

### Offer Sustainability

Sustainable offer status	Not Green Premium product
RoHS (date code: YYWW)	Compliant - since 1248 - Schneider Electric declaration of conformity <a href="#">Schneider Electric declaration of conformity</a>
REACH	Reference not containing SVHC above the threshold <a href="#">Reference not containing SVHC above the threshold</a>
Product end of life instructions	Need no specific recycling operations

### Contractual warranty

Warranty period	18 months
-----------------	-----------

Product availability : Stock - Normally stocked in distribution facility



### Main

Product or component type	Miniature circuit-breaker
Range of product	QO
Line Rated Current	100 A
System Voltage	240 V AC
Mounting mode	Plug-in
Poles description	3P
Circuit breaker type	Standard
Circuit breaker application	HACR rated
Electrical connection	Box lugs
Accessory / separate part type	None,

### Complementary

Breaking capacity	10 kA at: 120/240 V AC
Number of spaces required	3
AWG gauge	AWG 4...AWG 2/0 (copper or aluminium)
Height	3.5 in
Depth	2.91 in
Width	2.25 in

### Environment

Product certifications	CSA UL listed
Ambient air temperature for operation	104 °F (40 °C)

### Ordering and shipping details

Category	00012 - QO 3 POLE CIRCUIT BREAKER
Discount Schedule	DE2A

GTIN	00785901004417
Nbr. of units in pkg.	1
Package weight(Lbs)	1.0700000000000001
Returnability	Y
Country of origin	MX

### Offer Sustainability

Sustainable offer status	Green Premium product
RoHS (date code: YYWW)	Compliant - since 1323 - Schneider Electric declaration of conformity <a href="#">Schneider Electric declaration of conformity</a>
REACH	Reference not containing SVHC above the threshold <a href="#">Reference not containing SVHC above the threshold</a>
Product environmental profile	Available
Product end of life instructions	Need no specific recycling operations

### Contractual warranty

Warranty period	18 months
-----------------	-----------



# VX100DG

Box mount, die cast aluminum with built-in junction box and sturdy mounting lugs. Medium base socket, 1/2" or 3/4" NPS hub size and a variety of globes. incandescent lamp A21 for 100 Series, PS25 for 200 Series. Lamp not supplied. CFL: 13 & 22 watt lamp supplied.

Color: Natural

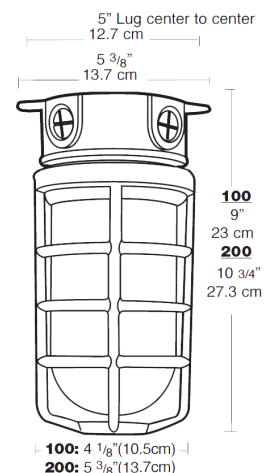
Weight: 2.8 lbs

## Lamp Info

Type: A19  
 Watts: 150W  
 Shape/Size: N/A  
 Base: N/A  
 ANSI: N/A  
 Hours: 0  
 Lamp Lumens: 0  
 Efficacy: N/A

## Ballast Info

Type: 0  
 120V: N/A  
 208V: 0  
 240V: N/A  
 277V: N/A  
 Input Watts: 0W  
 Efficiency: N/A



## Technical Specifications

### UL Listing:

Suitable for wet locations. Suitable for use in dwellings. Suitable for use with 90°C supply wiring. Complies with UL Standard 1598. For non-hazardous locations where the lamp, socket and wiring require protection from rain, corrosive fumes, non-combustible dusts, moisture, non-explosive vapors and gases. For lamp base up installation only when outdoors.

### Globes:

Supplied with clear thermal shock resistant soda lime glass unless otherwise stated. Colored and white glass globes available. Unbreakable Permaglobes available in clear and in color.

### Die Cast Guard:

Supplied with one piece die cast guard with set screw

### Maximum Watts:

150 watts

### Colored Globe Maximum Watts:

100 watts

### Patents:

RAB sensor and fixture designs are protected under U.S. and International Intellectual Property laws.

### Country of Origin:

Designed by RAB in New Jersey and assembled in Taiwan

### Trade Agreements Act Compliant:

This product is a product of Taiwan and a "designated country" end product that complies with the Trade Agreements Act.

### GSA Schedule:

Suitable in accordance with FAR Subpart 25.4

**RAB**  
LIGHTING

Tech Help Line: 888 RAB-1000

Email: [sales@rabweb.com](mailto:sales@rabweb.com)

On the web at: [www.rabweb.com](http://www.rabweb.com)

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Note: Specifications are subject to change without notice



# LED A-Lamps

**OMNI-DIRECTIONAL • ALL-PURPOSE • 3-WAY**

TCP's LED A-lamps provide the lighting you need at a cost you will love. Advanced factory techniques and rigorous testing ensure each lamp is perfect from day one. Install a LED A-lamp wherever you would a traditional lamp and see the improvement.



## LIMITLESS OPTIONS FOR THE FOLLOWING APPLICATIONS

- General lighting
- Floor lamps
- Ceiling fixtures
- Table lamps
- Sconces

### FEATURES

Up to 85% less energy than halogen alternatives

Long life

Very low heat generation

Excellent color consistency and CRI

UL approved for damp location

Durable plastic housing

ANSI construction compliant

### BENEFITS

Instant energy savings

Minimizes replacement and maintenance costs

Perfect for sensitive display lighting such as art galleries

Enhances colors of focal point while maintaining uniformity throughout lighting installation from lamp to lamp

Can be used outdoors when protected from elements—withstands humidity indoors/outdoors

Lower the risk of injury and breakage

Fits all A-lamp installations

Dims to ≤ 10% of full light level when applicable

## SPECIFICATIONS


Input Line Voltage ..... 120 VAC  
 Input Line Frequency ..... 50/60HZ  
 Lamp Life (Rated) ..... 10,000, 15,000, 20,000 or 25,000 hour options  
 Minimum Starting Temp ..... -30°C  
 Maximum Operating Temp ..... 40°C  
 CRI ..... 80

Suitable for use in totally enclosed fixtures.  
 (Vapor tight or jelly jar applications may reduce life)

\*Based on 12 hours use per day

Do not use more than 2 bulbs in an enclosed fixture.

If fixture is manufactured for incandescent bulbs, use no higher than the LED equivalent wattage, as shown on this spec sheet.



**1 YEAR WARRANTY\***  
10,000 HOUR LAMPS

**3 YEAR WARRANTY\***  
15,000 HOUR LAMPS

**5 YEAR WARRANTY\***  
25,000 HOUR LAMPS

we know light.™





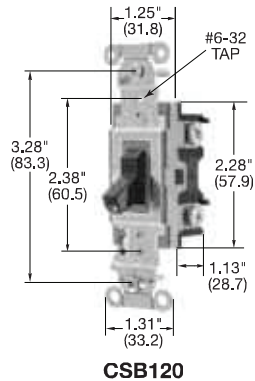
ITEM #	DESCRIPTION	ENERGY STAR	VOLTAGE	WATTS	INCANDESENT WATTS	LPW	LUMENS	CCT	HOURS	CRI	MOL (inches)	DIA (inches)	BASE	WARRANTY YEARS	CASE QUANTITY
<b>LED 75W Equivalent Options</b>															
<b>13.5W A19 A-Lamp • Non-Dimmable • 15,000 Hour</b>															
L11A19N1527K	LED 13.5W A19 ND 2700K	★	120	13.5	75	81.5	1100	2700K	15,000	80	4.4	2.4	E26	3	12
L11A19N1530K	LED 13.5W A19 ND 3000K	★	120	13.5	75	81.5	1100	3000K	15,000	80	4.4	2.4	E26	3	12
L11A19N1541K	LED 13.5W A19 ND 4100K	★	120	13.5	75	81.5	1100	4100K	15,000	80	4.4	2.4	E26	3	12
L11A19N1550K	LED 13.5W A19 ND 5000K	★	120	13.5	75	81.5	1100	5000K	15,000	80	4.4	2.4	E26	3	12
<b>13.5W A19 A-Lamp • Dimmable • 25,000 Hour</b>															
L11A19D2527K	LED 13.5W A19 DIM 2700K	★	120	13.5	75	81.5	1100	2700K	25,000	80	4.4	2.4	E26	5	12
L11A19D2530K	LED 13.5W A19 DIM 3000K	★	120	13.5	75	81.5	1100	3000K	25,000	80	4.4	2.4	E26	5	12
L11A19D2541K	LED 13.5W A19 DIM 4100K	★	120	13.5	75	81.5	1100	4100K	25,000	80	4.4	2.4	E26	5	12
L11A19D2550K	LED 13.5W A19 DIM 5000K	★	120	13.5	75	81.5	1100	5000K	25,000	80	4.4	2.4	E26	5	12
<b>LED 100W Equivalent Options</b>															
<b>14W A19 A-Lamp • Non-Dimmable • 10,000 Hour</b>															
L16A19N1027K4	LED 14W A19 ND 2700K 4PK		120	14	100	107.1	1500	2700K	10,000	80	4.7	2.6	E26	1	12
L16A19N1041K4	LED 14W A19 ND 4100K 4PK		120	14	100	107.1	1500	4100K	10,000	80	4.7	2.6	E26	1	12
<b>15.5W A19 A-Lamp • Non-Dimmable • 15,000 Hour</b>															
L16A19N1527K	LED 15.5W A19 ND 2700K	★	120	15.5	100	103.2	1600	2700K	15,000	80	4.7	2.6	E26	3	12
L16A19N1530K	LED 15.5W A19 ND 3000K	★	120	15.5	100	103.2	1600	3000K	15,000	80	4.7	2.6	E26	3	12
L16A19N1541K	LED 15.5W A19 ND 4100K	★	120	15.5	100	103.2	1600	4100K	15,000	80	4.7	2.6	E26	3	12
L16A19N1550K	LED 15.5W A19 ND 5000K	★	120	15.5	100	103.2	1600	5000K	15,000	80	4.7	2.6	E26	3	12
<b>15W A19 A-Lamp • Dimmable • 15,000 Hour</b>															
L15A21D1527K	LED 15W A19 DIM 2700K	★	120	15	100	106.7	1600	2700K	15,000	80	4.7	2.6	E26	3	12
L15A21D1530K	LED 15W A19 DIM 3000K	★	120	15	100	106.7	1600	3000K	15,000	80	4.7	2.6	E26	3	12
L15A21D1541K	LED 15W A19 DIM 4100K	★	120	15	100	106.7	1600	4100K	15,000	80	4.7	2.6	E26	3	12
L15A21D1550K	LED 15W A19 DIM 5000K	★	120	15	100	106.7	1600	5000K	15,000	80	4.7	2.6	E26	3	12
<b>15W A19 A-Lamp • Dimmable • 25,000 Hour</b>															
L15A19D2527K	LED 15W A19 DIM 2700K	★	120	15	100	106.7	1600	2700K	25,000	80	4.7	2.6	E26	5	12
L15A19D2530K	LED 15W A19 DIM 3000K	★	120	15	100	106.7	1600	3000K	25,000	80	4.7	2.6	E26	5	12
L15A19D2541K	LED 15W A19 DIM 4100K	★	120	15	100	106.7	1600	4100K	25,000	80	4.7	2.6	E26	5	12
L15A19D2550K	LED 15W A19 DIM 5000K	★	120	15	100	106.7	1600	5000K	25,000	80	4.7	2.6	E26	5	12
<b>LED 40/60/100 3-Way Equivalent Options</b>															
<b>4/8/16W A21 3-Way A-Lamp • Dimmable • 25,000 Hour</b>															
LED16A21D3WAY27K	LED 16W A21 DIM 2700K 3WAY	★	120	4/8/16	40/60/100	120/100/100	480/800/1600	2700K	25,000	80	4.9	2.6	E26	5	12
LED16A21D3WAY30K	LED 16W A21 DIM 3000K 3WAY	★	120	4/8/16	40/60/100	120/100/100	480/800/1600	3000K	25,000	80	4.9	2.6	E26	5	12
LED16A21D3WAY41K	LED 16W A21 DIM 4100K 3WAY	★	120	4/8/16	40/60/100	120/100/100	480/800/1600	4100K	25,000	80	4.9	2.6	E26	5	12
LED16A21D3WAY50K	LED 16W A21 DIM 5000K 3WAY	★	120	4/8/16	40/60/100	120/100/100	480/800/1600	5000K	25,000	80	4.9	2.6	E26	5	12
<b>LED 60W Wet Location Equivalent Options</b>															
<b>9.5W A19 Omni-Directional Wet Location A-Lamp • Dimmable • 25,000 Hour</b>															
LED10A19D0D27KW	LED 9.5W A19 DIM OMNI 27K WET	★	120	9.5	60	84.2	800	2700K	25,000	80	4.6	2.5	E26	5	12
LED10A19D0D30KW	LED 9.5W A19 DIM OMNI 30K WET	★	120	9.5	60	86.8	825	3000K	25,000	80	4.6	2.5	E26	5	12
LED10A19D0D41KW	LED 9.5W A19 DIM OMNI 41K WET	★	120	9.5	60	89.5	850	4100K	25,000	80	4.6	2.5	E26	5	12
LED10A19D0D50KW	LED 9.5W A19 DIM OMNI 50K WET	★	120	9.5	60	89.5	850	5000K	25,000	80	4.6	2.5	E26	5	12

For the most up-to-date specs, please visit [www.tcpi.com](http://www.tcpi.com)

## Switches

**15 and 20 Ampere, 120-277 Volts AC**

Specification Grade Commercial Series



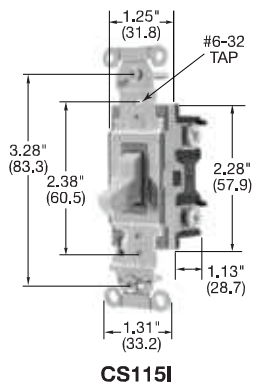
CSB120

**Specification Grade Commercial Series,  
15A, 120-277V AC**

Description	Toggle Color	Single Pole	Double Pole	Three Way	Four Way
Toggle, back and side wired.	Almond	CSB115AL	CSB215AL	CSB315AL	CSB415AL
	Black	CSB115BK	CSB215BK	CSB315BK	CSB415BK
	Brown	CSB115	CSB215	CSB315	CSB415
	Gray	CSB115GY	CSB215GY	CSB315GY	CSB415GY
	Ivory	CSB115I	CSB215I	CSB315I	CSB415I
	Light Almond	CSB115LA	CSB215LA	CSB315LA	CSB415LA
	White	CSB115W	CSB215W	CSB315W	CSB415W

**Specification Grade Commercial Series,  
20A, 120-277V AC**

Description	Toggle Color	Single Pole	Double Pole	Three Way	Four Way
Toggle, back and side wired.	Almond	CSB120AL	CSB220AL	CSB320AL	CSB420AL
	Black	CSB120BK	CSB220BK	CSB320BK	CSB420BK
	Brown	CSB120	CSB220	CSB320	CSB420
	Gray	CSB120GY	CSB220GY	CSB320GY	CSB420GY
	Ivory	CSB120I	CSB220I	CSB320I	CSB420I
	Light Almond	CSB120LA	CSB220LA	CSB320LA	CSB420LA
	Red	CSB120R	CSB220R	CSB320R	CSB420R
	White	CSB120W	CSB220W	CSB320W	CSB420W



CS115I

**Specification Grade Commercial Series,  
15A, 120-277V AC**

Description	Toggle Color	Single Pole	Double Pole	Three Way	Four Way
Toggle, side wired only.	Almond	CS115AL	—	CS315AL	—
	Black	CS115BK	—	CS315BK	—
	Brown	CS115	—	CS315	—
	Gray	CS115GY	—	CS315GY	—
	Ivory	CS115I	—	CS315I	—
	Light Almond	CS115LA	—	CS315LA	—
	White	CS115W	—	CS315W	—

**Specification Grade Commercial Series,  
20A, 120-277V AC**

Description	Toggle Color	Single Pole	Double Pole	Three Way	Four Way
Toggle, side wired only.	Almond	CS120AL	—	CS320AL	—
	Black	CS120BK	—	CS320BK	—
	Brown	CS120	—	CS320	—
	Gray	CS120GY	—	CS320GY	—
	Ivory	CS120I	—	CS320I	—
	Light Almond	CS120LA	—	CS320LA	—
	White	CS120W	—	CS320W	—

Note: See page C-11 for pre-wired/leaded devices.  
See page C-15 for accessories.  
See page C-16 for wallplates.  
See page C-18 for wiring diagrams.  
For pre-wired/leaded devices see page C-11.

**HP Conversion Chart**

	120V	208V	240V	277V AC
15A	.5HP	1.5HP	2HP	2HP
20A	1HP	2HP	2HP	2HP

## Features

- Patented AUTOGUARD® self test technology
- Internal back wiring clamp and guide for quick and secure termination
- Triple wipe construction

## Ordering Information

Description	Color	UPC	Catalog Number
20A, 125V, Style Line®, AUTOGUARD® self test GFCI receptacle, flush face, back and side wired, multiple drive screws	Ivory	883778122118	<b>GFRST20I</b>

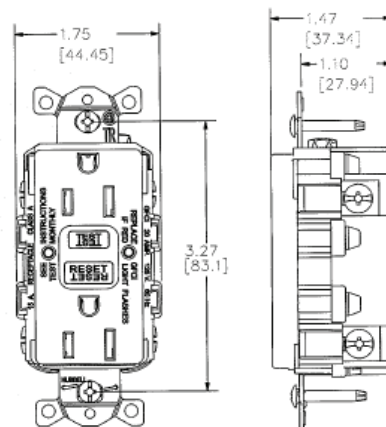


## Listings

UL Listed - Canadian and U.S.  
Meets ADA Standards  
Meets all NEC® requirements  
CSA Certified  
NEMA® WD-6 Compliant

## Specifications

Face	Nylon
Base	Nylon
Power Contacts	Brass
Ground Contacts	Brass
Mounting Strap	Zinc plated steel
Mounting Screws	Zinc plated steel



## Online Resources

Customer Use Drawing  
eCatalog  
Installation Instructions

Straight Blade Devices  
 20A, 125V, 2 Pole, 3 Wire Grounding  
 Commercial Specification Grade Duplex  
 Receptacles

# HUBBELL

## Features

- Easy access split circuit tab
- Nylon face and base
- Wrap-around galvanized steel strap
- Triple wipe contacts

## Ordering Information

Description	Device Color	UPC	Catalog Number
Smooth face, back and side wired.	Ivory	783585834887	BR20I

## Listings

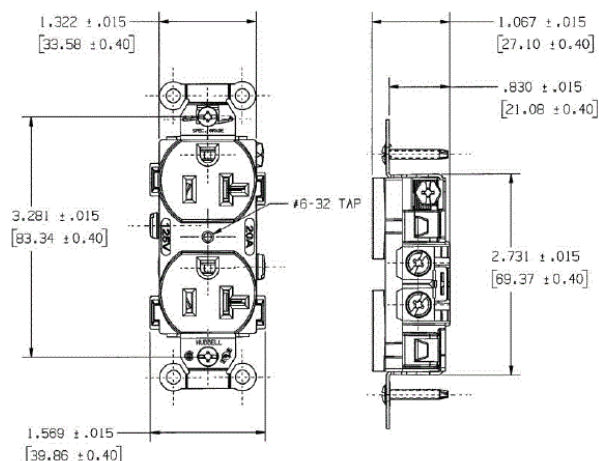
UL Listed to UL498 File No. E2186  
 Certified to CSA 22.2, No. 42  
 Fed. Spec. W-C-596  
 NEMA® WD-6 Compliant

## Specifications

Face	Nylon
Base	Nylon
Power Contacts	.030 in. (.8) Brass
Ground Contacts	Brass
Wire Clamp	.062 in. (1.6) Nickel plated steel
Terminal Screws	Plated steel
Mounting Strap	.040 in. (1) Galvanized steel
Automatic Self-grounding Staple	Stainless steel
Mounting Screws	Galvanized Steel

## Performance

<b>Electrical</b>	
Current Interrupting	Certified for current interrupting at full rated current
Dielectric Voltage	Withstands 2,000V minimum
<b>Mechanical</b>	
Product Identification	Ratings are a permanent part of the device
Terminal Accommodation	#12-#10 AWG copper stranded or solid conductor only
Terminal Identification	Terminals identified in accordance with UL 498 and CSA
<b>Environmental</b>	
Flammability	UL 94 V-2
Operating Temperatures	Maximum continuous 75°C; minimum -40°C (w/o impact)



## Accessories

Wallplate or Weatherproof Cover Duplex Opening

## Resources

Customer Use Drawing  
 eCatalog

Dimensions in Inches (mm)

Hubbell Wiring Device-Kellems • Hubbell Incorporated (Delaware) • 40 Waterview Drive • Shelton, CT 06484

Phone (800) 288-6000 • Fax (800) 255-1031 • Specifications subject to change without notice.



## Galvanized Mushroom Vent Caps

**Corrosion resistant vent caps are constructed of ultra durable rust resistant galvanized cast iron. Vent caps are designed with a 30 mesh screen, to prevent debris from entering the vent pipe.**

- Popular style is used in the majority of installations in the United States, Alaska, and Canada
- Rust-resistant zinc-plated cast iron design is available in female NPT sizes from  $\frac{3}{4}$  to 4
- Each cap is designed with a 30 mesh screen, to prevent debris from entering the vent pipe



SMP #	SIZE	OD
02-075M	$\frac{3}{4}$	2-3/16
02-100M	$\frac{1}{2}$	2-5/8
02-125M	1-1/4	2-3/4
02-150M	1-1/2	3-1/8
02-200M	2	3-15/16
02-300M	3	5-1/8
02-400M	4	6-1/2

## Emergency Vents

Model 100



PART #	SIZE	UL LISTED FLOW CAPACITY AT 2.5 PSIG (CFH)
1002	2"	24,058
1003	3"	63,633
1004	4"	125,343
1005	5"	195,347
1006	6"	284,968
1008	8"	541,014
10010*	10"	807,803

\*Non UL

- Improved design with increased airflow
- Spring loaded – pressure relief set at .5 PSI, full open by 2.5 PSI
- Buna-N-Gasket provides a vapor-tight seal
- Black painted steel construction – custom colors available
- Private labeling available
- NPT connections standard – all thread type connections available
- Male NPT: 2", 3", 4", 5", 6", 8"
- Female NPT: 3", 4", 5", 6", 8"

*Warning: Emergency Vents are designed for "Emergency Venting" and must be used in conjunction with other venting devices. Emergency vents must be sized per UL requirements.*

Global Tank Components Emergency Vents comply with UL Codes UL-2583, UL-142, UL-2085, UL-2244.

3765 Creamery Road, Bldg. 96 #5, DePere, WI 54115

Phone: 920.264.8457 • Fax: 847.239.7776

Email: [sales@globaltankcomponents.net](mailto:sales@globaltankcomponents.net)

[www.globaltankcomponents.net](http://www.globaltankcomponents.net)



### Suspendible/Submersible Leak Detection Switch



Madison Company offers a standard model M3782 liquid level switch that can be fully submerged with 20' of 22 AWG HALAR<sup>®</sup> jacketed 2-conductor wire. This model is weighted for suspension in non-magnetic tanks and can be used in conjunction with a still pipe. Its materials are suitable for water, hydrocarbons and certain chemicals. Contact Madison Company to check on material compatibility.

This low-cost switch is ideally suited for sumps, dispenser pans, monitoring wells and double-wall tanks where monitoring for leaks is required. The depth of the vertical mount can be easily adjusted by cutting the cable length as required.

This standard model can also be customized to meet your specific application needs. Simply complete the M Series Specification Worksheet and send it to Madison Company for a quotation.

## Features

- Affordable
- Easy installation; compact size
- Highly reliable; long service life
- No calibration required
- Suitable for water and hydrocarbons

*HALAR<sup>®</sup> is a registered trademark of Ausimont USA, Inc.*

# Specifications

## Materials

**Stem and Extension** – Brass

**Float** – Buna-N

**Slosh Shield** – PBT

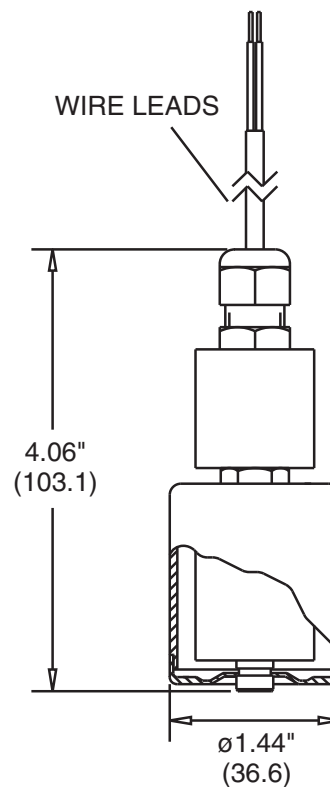
**Cable** – 20' 22 AWG, HALAR jacketed

## Operation

Normally Closed (NC), open on liquid rising

## Options

- Wire lengths
- Wetted materials



**M3782**

## Current and Voltage Ratings

Current Amps (Resistive)	Voltage
0.14	220 AC
0.28	110 AC
0.07	120 DC
0.28	24 DC

*All specifications are subject to change without notice.*



**Sensor solutions for today and the future™**



**Madison Company 800-466-5383 www.madisonco.com**

27 Business Park Drive, Branford, CT 06405 • 203-488-4477 • Fax: 203-481-5036 • E-mail: info@madisonco.com

**Madison Europe** – Phone: + 31 (0) 548 659 034 • Fax: + 31 (0) 548 659 010 • E-mail: madison@eurodev.com



**FUEL TANK LEVEL INDICATING SYSTEM  
STANDARD MODEL - 4LAP3\_24VDC**

**CONTROLLER DESCRIPTION:**

ENCLOSURE: FIBERGLASS 6" X 6" X 4"  
 POWER 24VDC  
 4 PILOT LIGHTS  
 3 RELAYS  
 ALARM HORN  
 ALARM SILENCE SWITCH  
 PUSH TO TEST FUNCTION  
 TERMINALS FOR ALL FIELD CONNECTIONS

**TANK LEVELS**

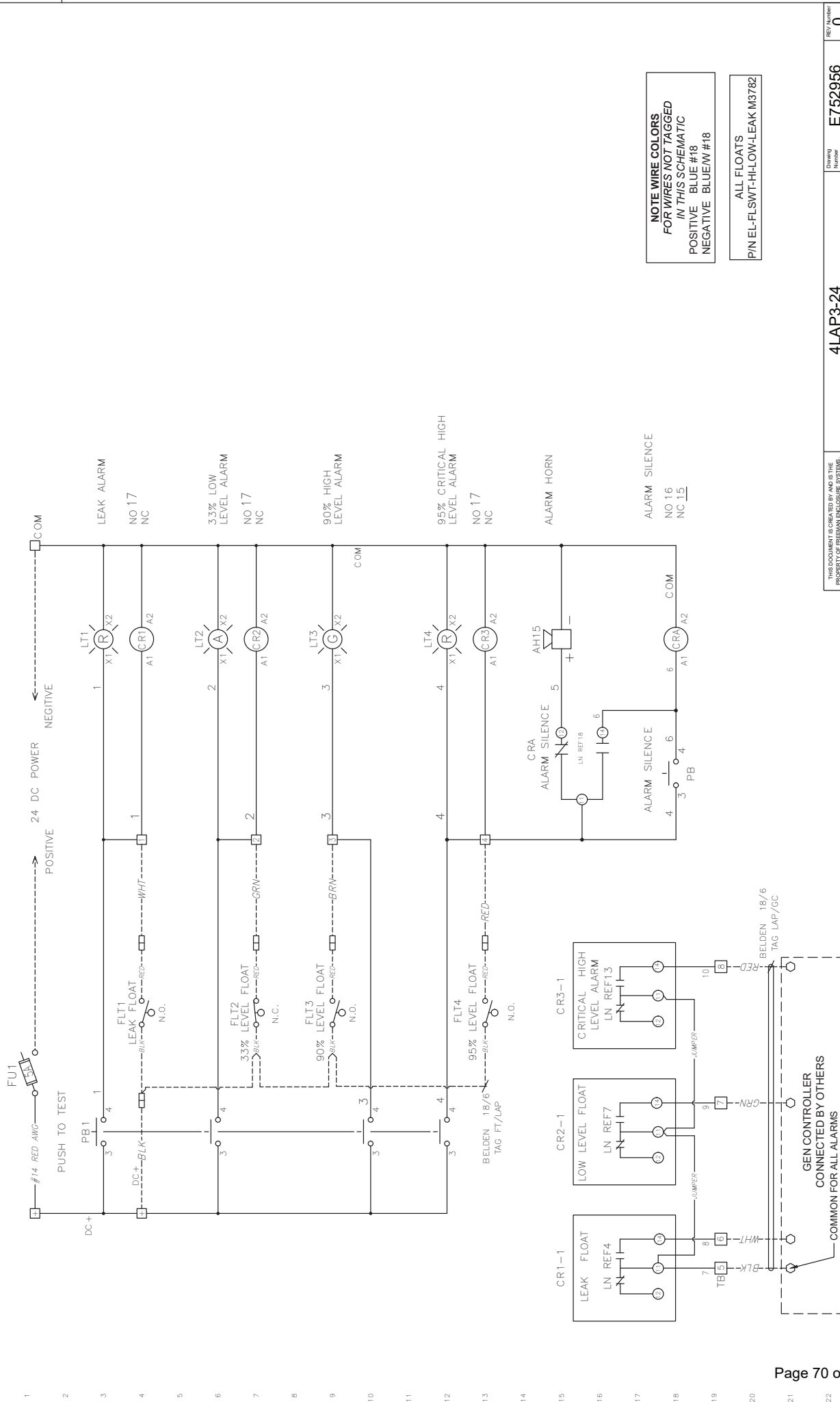
TANK LEAK  
 33% LOW LEVEL  
 90% HIGH LEVEL  
 95% CRITICAL HIGH LEVEL (WITH ALARM HORN)

RELAYS ARE DPDT FORM C  
 WITH DRY ISOLATED OUTPUTS FOR  
 GENERATOR CONTROL & CUSTOMER CONNECTION

DRAWING & REVISION HISTORY		DESCRIPTION	INITIALS	REV No.	DATE
		DRAWING CONSTRUCTION SET	SK	0	02/06/20

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Equipment: LAP ALARM PANEL	Designed by: SK	Approved by: MP	Date: 02/06/20
			Sheet: 1 of 3





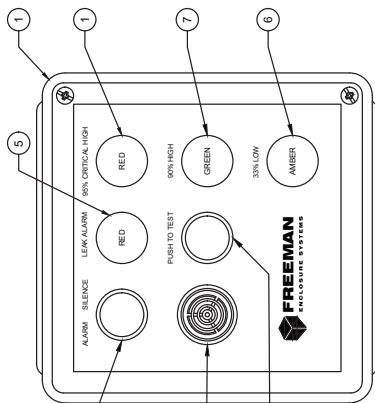
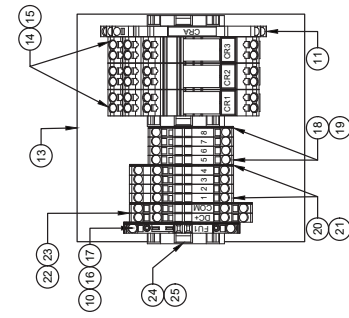
**NOTE WIRE COLORS  
FOR WIRES NOT TAGGED  
IN THIS SCHEMATIC**  
POSITIVE BLUE #18  
NEGATIVE BLUE/W #18

ALL FLOATS  
P/N EL-FLSWT-HI-LOW-LEAK M3782

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Drawing Number E752956		4LAP3-24		SCHEMATIC		LAP ALARM PANEL		2/6/2020 1:54:37 PM, PDF PRINT DATE		REV Number 0	
<b>FREEMAN</b> ENCLOSURE SYSTEMS											

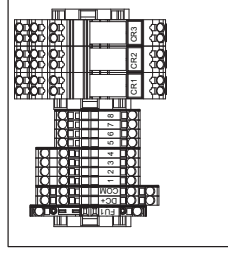
### 4LAP3 24 ENCLOSURE & BACK PLATE LAYOUT

ITEM #	QTY	DESCRIPTION	PART #	MFG	SUPPLIER
1	1	ENCLOSURE 6X8X4	EL-LAB-HOFF-6X8X4-FG-SCRCV-R	HOFFMANN	KENDALL
2	2	PUSH-BUTTON MOMENTARY RED	EL-LAB-SOD-ZB8A44	SCHNEIDER	KENDALL
3	2	MOUNTING COLLAR	EL-LAB-SOD-ZB8AZ009	SCHNEIDER	KENDALL
4	5	CONTACT BLOCK NO	EL-LAB-SOD-ZBE101	SCHNEIDER	KENDALL
5	2	PILOT LIGHT RED	EL-LAB-IDEC-HW1P-2FOD-R-24V	IDEC	KENDALL
6	1	PILOT LIGHT AMBER	EL-LAB-IDEC-HW1P-2FOD-A-24V	IDEC	KENDALL
7	1	PILOT LIGHT GREEN	EL-LAB-IDEC-HW1P-2FOD-G-24V	IDEC	KENDALL
8	1	HORN	EL-LAB-MALLORY-SC628NR	SOMALERT	KENDALL
9	1	HORN GASKET	EL-LAB-MALLORY-ACG033	SOMALERT	KENDALL
10	1	FUSE 5A	EL-LAB-WAGO-51220026	WAGO	KENDALL
11	1	RELAY SPST 24VDC	EL-LAB-WAGO-897-304	WAGO	KENDALL
12	1	BACK PLATE ASSEMBLY	EL-LAB-WAGO-51220029	WAGO	KENDALL



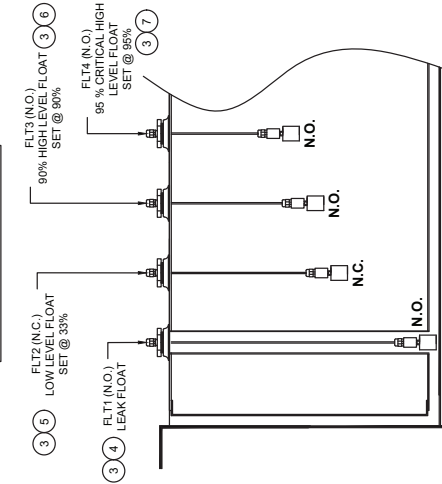
### BACK PLATE ASSEMBLY KIT P/N EL-LAB-WAGO 60251174

ITEM #	QTY	DESCRIPTION	PART #	MFG	SUPPLIER
13	1	ENCLOSURE BACK PLATE	EL-LAB-HOFFMAN 6X8 PANEL	HOFFMANN	KENDALL
14	3	RELAY DPDT 24VDC	EL-LAB-WAGO 788-312	WAGO	KENDALL
15	3	RELAY 788 JUMPER BAR	EL-LAB-WAGO 788-113	WAGO	KENDALL
16	1	FUSE TERMINAL BLOCK	EL-LAB-WAGO 2002-1681	WAGO	KENDALL
17	1	FUSE BLOCK END PLATE	EL-LAB-WAGO 2002-1692	WAGO	KENDALL
18	4	TERMINAL 2 POLE 22-12 AWG	EL-LAB-WAGO 2002-1201	WAGO	KENDALL
19	1	TERMINAL END PLATE 2 POLE 22-12 AWG	EL-LAB-WAGO 2002-1292	WAGO	KENDALL
20	4	TERMINAL 3 POLE 22-12 AWG	EL-LAB-WAGO 2002-1301	WAGO	KENDALL
21	1	TERMINAL END PLATE 3 POLE 22-12 AWG	EL-LAB-WAGO 2002-1392	WAGO	KENDALL
22	2	TERMINAL 4 POLE 22-12 AWG	EL-LAB-WAGO 2002-1401	WAGO	KENDALL
23	1	TERMINAL END PLATE 4 POLE 22-12 AWG	EL-LAB-WAGO 2002-1492	WAGO	KENDALL
24	2	DIN RAIL CLAMPS	EL-LAB-WAGO 248-116	WAGO	KENDALL
25	5*	DIN RAIL	EL-LAB-WAGO 210-112	WAGO	KENDALL

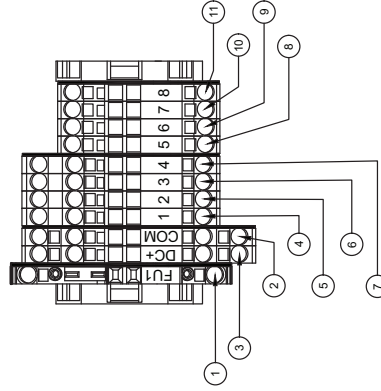
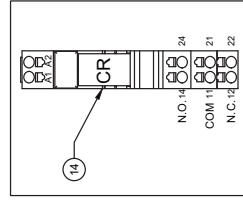


### FUEL TANK FLOATS

ITEM #	TERMINALS	DESCRIPTION	WIRE COLOR	CABLE TYPE
1	FU1	POWER INPUT 24 VDC POSITIVE	RED	16/2 RED/BLACK CABLE
2	TB COM DISTRIBUTION	POWER INPUT 24 VDC NEGATIVE & POWER DISTRIBUTION	BLACK	
3	TB DC+	24 VDC POSITIVE POWER DISTRIBUTION	BLACK	
4	TB 1	24 VDC POSITIVE SUPPLY TO FLOATS	WHITE	BELDEN 186 CABLE TAG: FTULAP
5	TB 2	FLOAT FLT1 TANK LEAK INPUT	GREEN	
6	TB 3	FLOAT FLT3 HIGH LEVEL INPUT 90%	BROWN	
7	TB 4	FLOAT FLT4 CRITICAL HIGH LEVEL INPUT 95%	RED	
		<b>TANK LEVEL ALARMS TO GEN ENCLOSURE</b>		
TB 5		ALARM COMMON INPUT TO GEN CONTROL	BLACK	BELDEN 186 CABLE TAG: LAF0C
TB 6		TANK LEAK ALARM INPUT TO GEN CONTROL	WHITE	
TB 7		LOW LEVEL ALARM INPUT TO GEN CONTROL	GREEN	
TB 8		CRITICAL HIGH LEVEL ALARM INPUT TO GEN CONTROL	RED	



### CONTROL RELAY DPDT @ 8 AMPS MAX



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4LAP3-24  
ENCLOSURE LAYOUT/BOM

LAP ALARM PANEL

Designed by: SK  
Reviewed by: MP  
Date: 02/06/20  
Sheet: 3 of 3

Drawing Number: E762956  
REV/Number: 0

**FREEMAN**  
ENCLOSURE SYSTEMS

2/16/2020 1:54:38 PM, PDF PRINT DATE

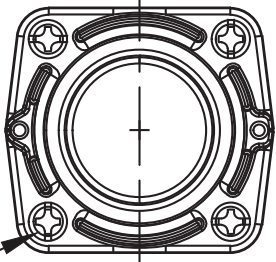


NOTE: P5648S02547 (240-30 Ω)  
P5816S02619 (0-90 Ω)  
5002S01379 DIRECT READ  
DIALS MAY BE USED WITH THIS GAUGE.

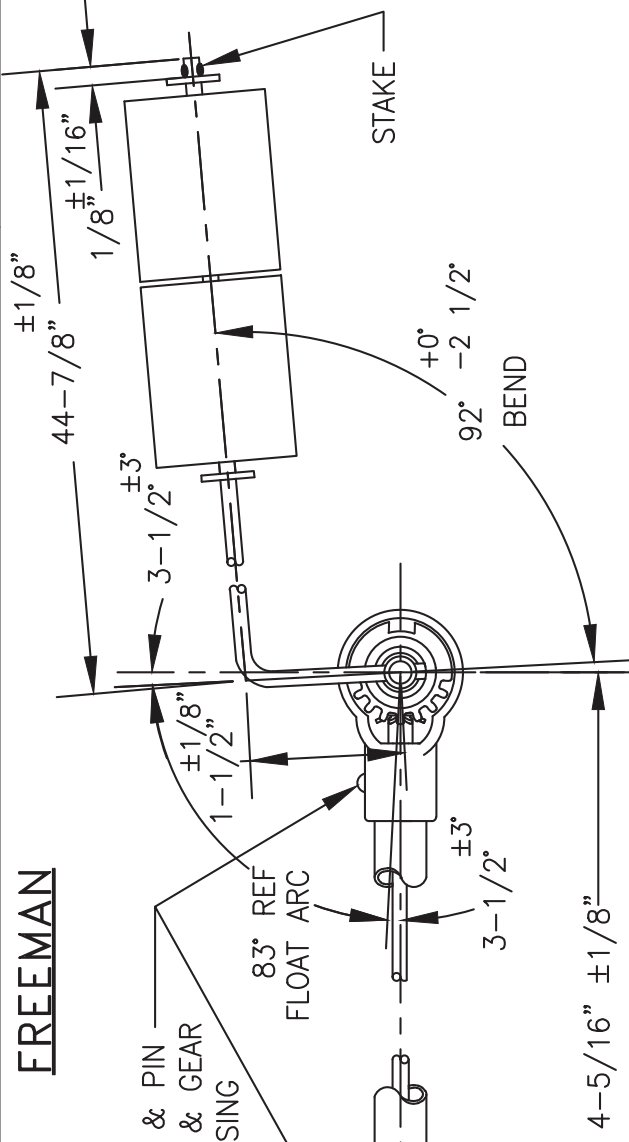
2.5" B.C. FOR ADAPTER MACHINING  
DETAILS SEE MS-502.

**FREEMAN**

DRILL & PIN  
HEAD & GEAR  
HOUSING



83° REF  
FLOAT ARC



REPLACEABLE PARTS

- DIAL S/A NO. : NONE PROVIDED
- DIAL SCREWS: NONE PROVIDED
- MOUNTING SCREWS: 40-419, 4 REQD (1/4-28 X 5/8"L)
- GASKET: 15-4, BUNA "N"

GAUGE MATERIALS

- HEAD: DIE CAST ALUMINUM
- DRIVE MAGNET: ALNICO "LARGE"
- CENTER SHAFT: TEMPERED ALUMINUM
- SUPPORT TUBE: TEMPERED ALUMINUM
- GEARS: STAINLESS STEEL
- CROSS STUD: STAINLESS STEEL
- GEAR HOUSING: DIE CAST ZINC
- BEARINGS: ALL STAINLESS STEEL
- FLOAT: NITRILE RUBBER
- FLOAT ROD: TEMPERED ALUMINUM

CUSTOMER NOTE:

SEE DS-1708 FOR FLOAT CUT LENGTH & ASSEMBLY DETAILS

PRODUCTION NOTES:

- USE 0085S00069 GEAR S/A (UNIVERSAL).
- USE DW6213S44879 FLOAT S/A WITH TWO 0006-0539 SHIPPED LOOSE. BEND FLOAT ROD AS SHOWN AND INSTALL BACKWARDS IN CROSS STUD.
- USE 5002S01379 FOR CALIBRATION.

A	44-7/8" WAS 48"	30059A	9/4 13	B	4-5/16 WAS 3; DS-1708 WAS DS-337	30059B	10/14 13				
LET	REVISIONS	E.R.#	DATE	LET	REVISIONS	E.R.#	DATE	LET	REVISIONS	E.R.#	DATE
TOLERANCES NOT SHOWN	DEC. ± .010	FAC. ± 1/64"	COMMERCIAL TOLERANCES ± 3"	DO NOT SCALE DRAWING	SUPERSEDES NEW	DRAWN JW	CHK. JW	USED ON			
ROCHESTER GAUGES, INC., OF TEXAS		SCALE NONE		DATE 8/28/13		PART NAME TM ADJUSTABLE GAUGE		DRAWING NUMBER 6540-00242			

**LEAK TEST PROCEDURES :**

1. INSURE BOX INTERIOR IS FREE OF FUEL RESIDUE AND DEBRIS
2. FILL WITH WATER TO WITHIN 1/4" FROM BOTTOM OF FILL CAP
3. LET STAND FOR 1 HOUR
4. VERIFY WATER LEVEL HAS NOT GONE DOWN
5. INSPECT EXTERIOR FOR VISIBLE LEAKS
6. IF LEAKS ARE FOUND, REMOVE, REPAIR AND REPEAT STEPS 2-4 UNTIL ALL LEAKS ARE COMPLETELY SEALED
7. DO NOT UNSCREW DRAIN COCK DURING TESTING. THIS WILL RELEASE WATER INTO TANK.
8. AFTER TEST IS COMPLETE, DRAIN WATER BY REMOVING EXTERNAL DRAIN PLUG. ADD SEALANT AND REPLACE PLUG

**DRAINAGE PROCEDURES :**

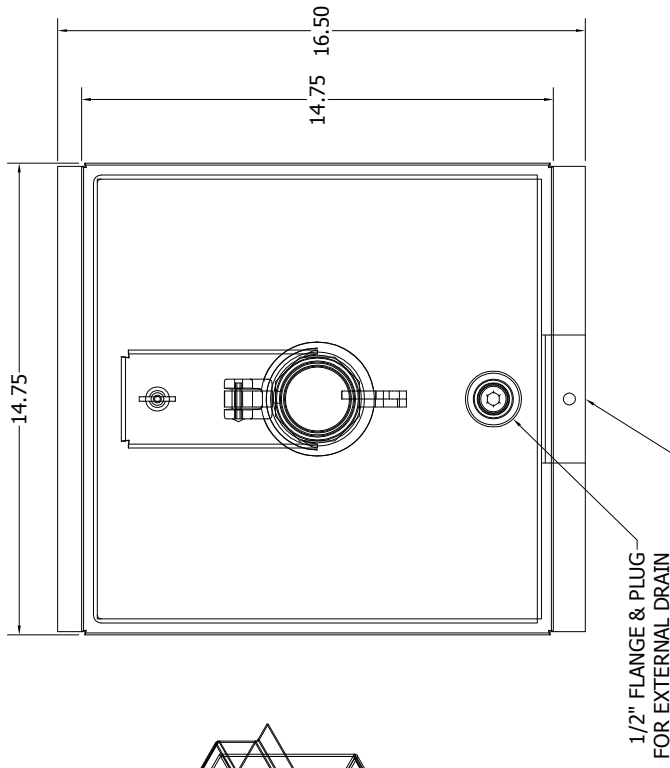
1. WHEN FUEL IS PRESENT IN CONTAINMENT BOX, UNSCREW FUEL DRAIN COCK TO RELEASE FUEL BACK INTO TANK.
2. THE EXTERNAL DRAIN MAY ALSO BE USED BY UNSCREWING STEEL PLUG.
3. USE APPROPRIATE CONTAINER FOR CATCHING DRAINED FLUIDS.
4. DO NOT OVER TIGHTEN FUEL DRAIN COCK AFTER DRAINING FLUID.

**BILL OF MATERIALS :**

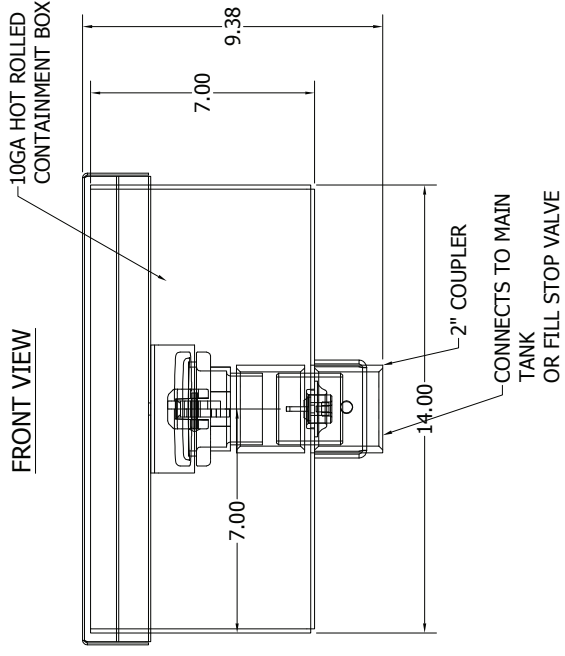
- (1) 2" CLOSED NIPPLE
- (2) 2" N.P.T. COUPLER
- (1) 2" HINGED LOCKABLE CAP
- (1) NAPA 6051279 FUEL DRAIN COCK

PAINT SCORPION BLACK

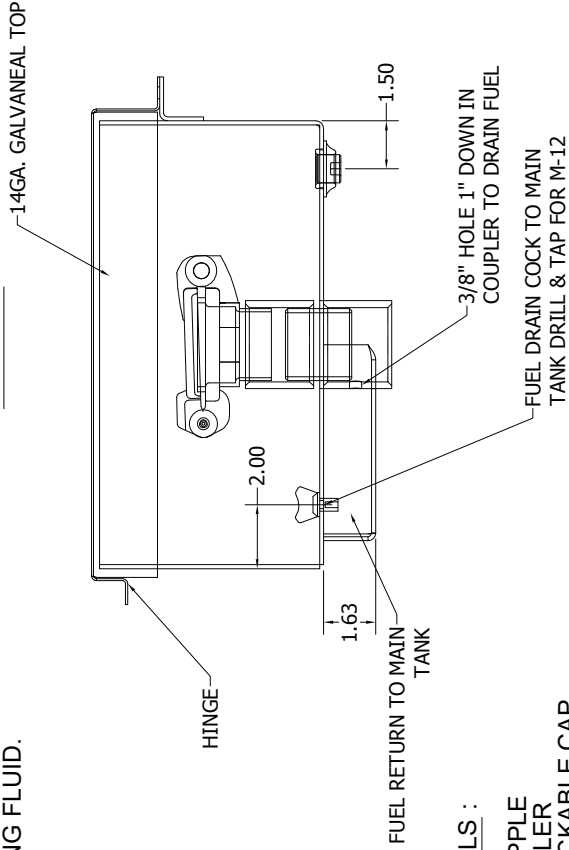
**TOP VIEW**



**FRONT VIEW**



**SIDE VIEW**



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GENERATOR:	N/A	Designed by:	Icilver	Checked by:	DF	Filename:	SHOP	Date:	7/13/2013	Reference:	0
Description:	5gal. Spill	Drawing Number:	D231V01	Scale:	1/1	Sheet:	1	of 1			



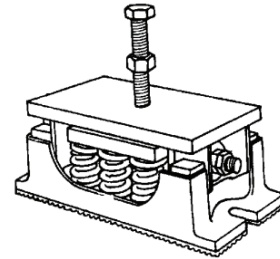
5gal. Spill Containment

D231V01

1/1 of 1

# Vibration Isolators

## Non-Seismic



### Description

Vibration isolators reduce generator set vibration and noise transmission to the surrounding structure.

The isolation mountings shall consist of malleable cast iron top and bottom housings incorporating one or more steel springs and shall be provided with built-in levelling bolts, elastomer pad, and built-in resilient chocks to control oscillation and withstand lateral forces in all directions.

Isolator/restraint with seismic capabilities that limits motion in all horizontal and vertical directions. The horizontal restraint is incorporated in the casting design with neoprene inserts to reduce the transmission of vibration noise. The vertical restraint is achieved by studs incorporated in the lower housing with nuts and washer above top housing.

### How to Specify

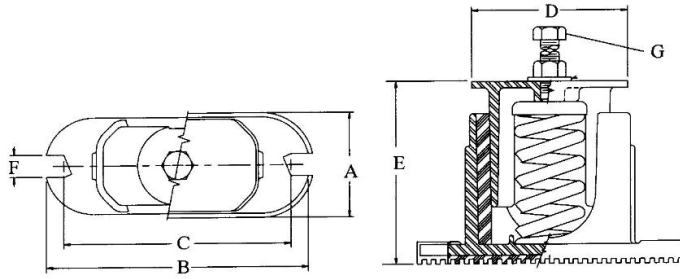
The isolation mountings shall consist of malleable cast iron top and bottom housings incorporating one or more steel springs and shall be provided with built-in levelling bolts, elastomer pad, and built-in resilient chocks to control oscillation and withstand lateral forces in all directions. They shall be pre-sized and installed in accordance with the recommendations of the generator set manufacturer. Not recommended in trailer-mounted applications.

## Non-Seismic Model to Isolator Reference

Model	Quantity of Isolators	Isolator Part Number	Max Rated Load (lbs)	Deflection at Max Rated Load (in)	Spring Constant (lbs/in)	Height (in)	Spring Color
DSHAD	4	0402-0690-15 (pkg 4) 0402-0222	1360 2200	0.77 1.93	1758 4260	5.25 4.38	White NA
DODAA	4	A049W372 0402-0691-02 (pkg 2)	2120 2400	1.00 0.90	2120 2654	5.75 5.63	NA Grey
DQDAB							
DQDAC							
DFEJ	6	0402-0222 0402-0691-02 (pkg 2)	2200 2400	1.93 0.90	4260 2654	4.38 5.63	NA Grey
DFEK							
DQCA	8	0402-0427	2400	1.37	3300	5.75	Purple
DQCB							
DQCC							
DQFAA	10	0402-0222 0402-0691-02 (pkg 2) 0402-0750-01	2200 2400 4800	1.93 0.90 1.37	4260 2654 6600	4.38 5.63 5.87	NA Grey Purple
DQFAB							
DQFAC							
DQFAD							
DQFAH							
DQGAA	12	0402-0427 <b>0402-0691-04 (pkg 2)</b> A049W384	2400 2720 3040	1.37 0.77 1.00	3300 3516 3366	5.75 5.63 5.75	Purple White NA
DQGAE	12*	0402-0427 0402-0691-04	2400 2720	1.37 0.77	3300 3516	5.75 5.63	Purple White
DQGAF	14						
DQGAS	12	0402-0750-01 A049W397	4800 6080	1.37 1.00	6600 6732	5.87 5.75	Purple NA
DQKAA							
DQKAB							
DQKAD	10*	0402-0750-01	4800	1.37	6600	5.87	Purple
DQKAE							
DQKAF							
DQKAM							
DQKAN	14*	0402-0750-01	4800	1.37	6600	5.87	Purple
DQLE	18						
DQLF	10*	0402-0750-01 A049W397	4800 6080	1.37 1.00	6600 6732	5.87 5.75	Purple NA
DQLH	14						
C3000 D6	Please refer to installation manual A043F056	A053M152	5440	0.77	7065	5.87	White
C3000 D6E							
C3250 D6							
C3250 D6E							
C3500 D6							
C3500 D6E							
C3500 D5							
C3500 D5E							
C3750 D5E							
C3750 D5							

\*Quantity of isolators required for a remotely cooled alternator option.

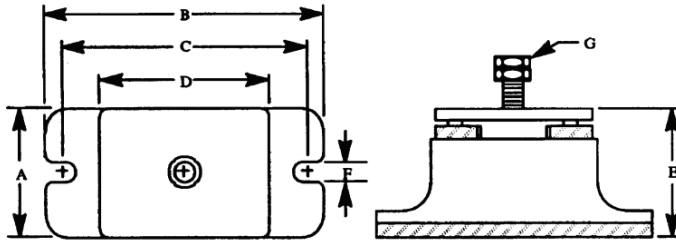
## Non-Seismic Isolator Drawings



Part Number	Quantity Included Per Part Number	Max Load Per Isolator (lbs)	Dimensions							Spring Constant (lbs/in)	Static Deflection (in)
			A	B	C	D	E	F	G		
0402-0690-15	4	1300	3.00	7.50	6.50	4.50	5.250	0.625	0.500	1757	0.74
0402-0691-02	2	2200	3.00	10.25	9.25	7.50	5.625	0.625	0.625	2651	0.83
0402-0691-04	2	2600	3.00	10.25	9.25	7.50	5.625	0.625	0.625	3514	0.74

NOTE: These isolators cannot be used with sub-base fuel tanks (0159-1486-xx, 0159-1512-xx, or 0179-4921-xx).

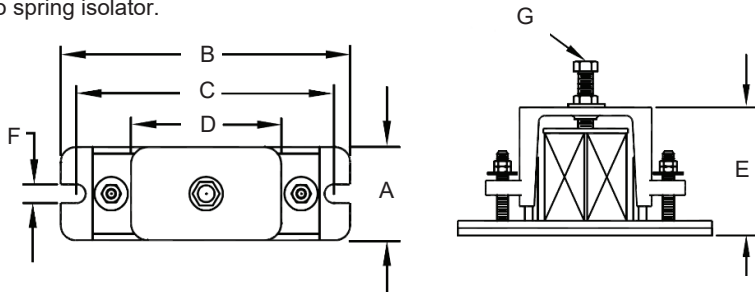
## Non-Seismic Isolator Drawings



Part Number	Quantity Included Per Part Number	Max Load Per Isolator (lbs)	Dimensions							Spring Constant (lbs/in)	Static Deflection (in)
			A	B	C	D	E	F	G		
0402-0222	1	2200	5.00	9.50	8.00	6.875	5.75	0.563	0.625	1392	1.58
0402-0427	1	2400	5.00	9.50	8.00	6.875	5.75	0.563	0.625	3288	0.73
0402-0750-01	1	4800	5.88	11.75	10.25	9.000	5.88	0.625	0.750	6575	0.73
A049W397	1	6080	4.63	13.00	12.00	7.000	5.75	0.687	0.625	6732	1.00

## Non-Seismic Isolator Drawings

Two spring isolator.



Part Number	Quantity Included Per Part Number	Max Load Per Isolator (lbs)	Dimensions							Spring Constant (lbs/in)	Static Deflection (in)
			A	B	C	D	E	F	G		
A049W372	1	2120	2.38	13.0	12.0	7.0	5.75	0.625	0.625	2120	1.00

# Battery Charger

**A048G602 10A 50/60 Hz**

**A051H785 20A 50/60 Hz**



## Description

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

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

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

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

## Features

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

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

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

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

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

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

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

**Vibration resistant design** – complies with UL991 class B vibration resistance requirements.

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

**Warranty** – 5 year CPG warranty.





Status and Fault LED



Field selectable jumper

## Specifications

### Performance and physical characteristics

Output:	Nominal voltage	12VDC* or 24VDC
	Float voltage– 12VDC batteries	12.87, 13.08, 13.31, 13.50*, 13.62, 14.30
	Float voltage– 24VDC batteries	25.74, 26.16, 26.62, 27.00*, 27.24, 28.60
	Equalize-voltage	6.5% above float voltage sensing
	Output voltage regulation	±0.5% (1/2%) line and load regulation
	Maximum output current	10 or 20 amps nominal
	Equalize charging	Battery interactive auto-boost
Input:	Voltage AC	120, 208, 240 ±10%
	Frequency	60/50 Hz ±5%
Approximate net weight:		10A: 25 lbs. (11.36 Kg) 20A: 50 lbs. (22.68 Kg)
Approximate dimensions: height x width x depth-in		10A: 12.50" x 7.66" x 6.50"(318x195x165 mm) 20A: 13.06" x 13.95" x 6.83"(332x354x173 mm)
Ambient temperature operation: At full rated output		- 4°F to 104 °F (-20 °C to 45 °C)

### Note:

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

### Caution:

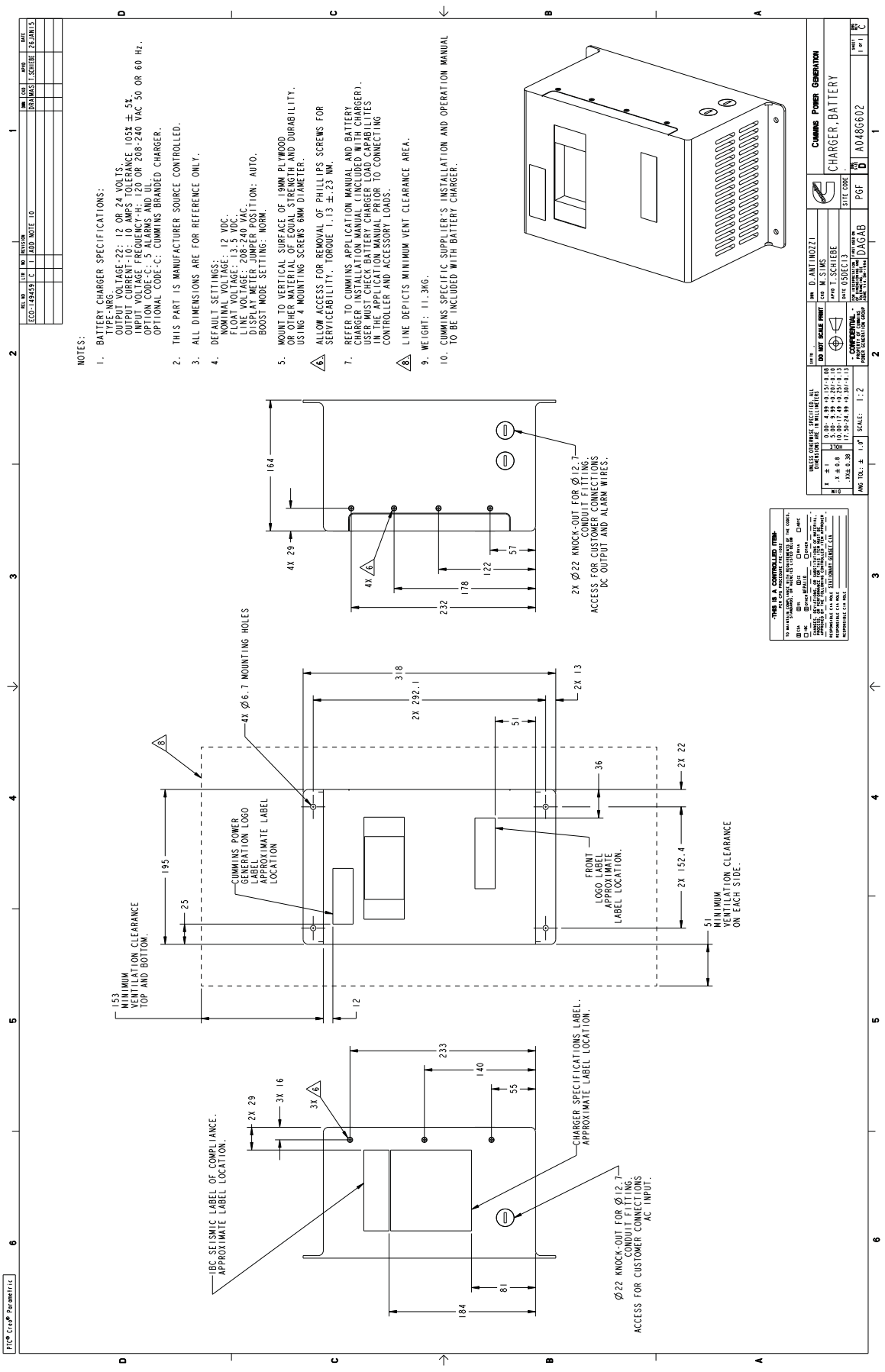
- Higher input voltages (i.e. 480VAC or 600VAC) can be applied if a transformer with a 120VAC-240VAC output is installed. Higher input voltages (i.e. 480VAC or 600VAC) can be applied if a transformer with a 120VAC-240VAC output is installed. For voltages higher than 240 VAC, step-down transformer must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

Americas  
1400 73rd Avenue N.E.  
Minneapolis, MN 55432 USA  
Phone: 763 574 5000  
Fax: 763 574 5298

Europe, CIS, Middle East and Africa  
Manston Park Columbus Ave.  
Manston Ramsgate  
Kent CT 12 5BF United Kingdom  
Phone 44 1843 255000  
Fax 44 1843 255902

Asia Pacific  
10 Toh Guan Road #07-01  
TT International Tradepark  
Singapore 608838  
Phone 65 6417 2388  
Fax 65 6417 2399





- NOTES:
1. BATTERY CHARGER SPECIFICATIONS:  
TYPE: IRS  
OUTPUT VOLTAGE: 22, 12 OR 24 VOLTS.  
OUTPUT CURRENT: 10, 10 AMPS TOLERANCE  $10\% \pm 5\%$ .  
OPERATING FREQUENCY: 50 OR 200-240 VAC 50 OR 60 HZ.  
OPTIONAL CODE: 5 ALARMS AND 10 ALARMS.  
OPTIONAL CODE-C: CUMMINS BRANDED CHARGER.
  2. THIS PART IS MANUFACTURER SOURCE CONTROLLED.
  3. ALL DIMENSIONS ARE FOR REFERENCE ONLY.
  4. DEFAULT SETTINGS:  
MANUAL MODE: 12 VDC.  
FLOAT VOLTAGE: 13.5 VDC.  
LINE VOLTAGE: 208-240 VAC.  
DISPLAY METER JUMPER POSITION: AUTO.  
BOOST MODE SETTING: NORM.
  5. MOUNT TO VERTICAL SURFACE OF 19MM PLYWOOD OR OTHER MATERIAL OF EQUAL STRENGTH AND DURABILITY. USING 4 MOUNTING SCREWS 6MM DIAMETER.
  6. ALLOW ACCESS FOR REMOVAL OF PHILLIPS SCREWS FOR SERVICEABILITY. TORQUE 1.13  $\pm$  0.23 NM.
  7. REFER TO CUMMINS APPLICATION MANUAL AND BATTERY USER MANUAL FOR BATTERY CHARGER (BATTERY CHARGER) IN THE APPLICATION MANUAL PRIOR TO CONNECTING CONTROLLER AND ACCESSORY LOADS.
  8. LINE DEFECTS MINIMUM VENT CLEARANCE AREA.
  9. WEIGHT: 11.3KG.
  10. CUMMINS SPECIFIC SUPPLIER'S INSTALLATION AND OPERATION MANUAL TO BE INCLUDED WITH BATTERY CHARGER.

TABLE 1. DIMENSIONS IN MILLIMETERS

REF. DIM.	MIN.	TYP.	MAX.
1	0.00	4.98	0.127
2	0.00	1.49	0.254
3	0.00	1.49	0.254
4	0.00	1.49	0.254
5	0.00	1.49	0.254
6	0.00	1.49	0.254
7	0.00	1.49	0.254
8	0.00	1.49	0.254
9	0.00	1.49	0.254
10	0.00	1.49	0.254
11	0.00	1.49	0.254
12	0.00	1.49	0.254
13	0.00	1.49	0.254
14	0.00	1.49	0.254
15	0.00	1.49	0.254
16	0.00	1.49	0.254
17	0.00	1.49	0.254
18	0.00	1.49	0.254
19	0.00	1.49	0.254
20	0.00	1.49	0.254
21	0.00	1.49	0.254
22	0.00	1.49	0.254
23	0.00	1.49	0.254
24	0.00	1.49	0.254
25	0.00	1.49	0.254
26	0.00	1.49	0.254
27	0.00	1.49	0.254
28	0.00	1.49	0.254
29	0.00	1.49	0.254
30	0.00	1.49	0.254
31	0.00	1.49	0.254
32	0.00	1.49	0.254
33	0.00	1.49	0.254
34	0.00	1.49	0.254
35	0.00	1.49	0.254
36	0.00	1.49	0.254
37	0.00	1.49	0.254
38	0.00	1.49	0.254
39	0.00	1.49	0.254
40	0.00	1.49	0.254
41	0.00	1.49	0.254
42	0.00	1.49	0.254
43	0.00	1.49	0.254
44	0.00	1.49	0.254
45	0.00	1.49	0.254
46	0.00	1.49	0.254
47	0.00	1.49	0.254
48	0.00	1.49	0.254
49	0.00	1.49	0.254
50	0.00	1.49	0.254
51	0.00	1.49	0.254
52	0.00	1.49	0.254
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55	0.00	1.49	0.254
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66	0.00	1.49	0.254
67	0.00	1.49	0.254
68	0.00	1.49	0.254
69	0.00	1.49	0.254
70	0.00	1.49	0.254
71	0.00	1.49	0.254
72	0.00	1.49	0.254
73	0.00	1.49	0.254
74	0.00	1.49	0.254
75	0.00	1.49	0.254
76	0.00	1.49	0.254
77	0.00	1.49	0.254
78	0.00	1.49	0.254
79	0.00	1.49	0.254
80	0.00	1.49	0.254
81	0.00	1.49	0.254
82	0.00	1.49	0.254
83	0.00	1.49	0.254
84	0.00	1.49	0.254
85	0.00	1.49	0.254
86	0.00	1.49	0.254
87	0.00	1.49	0.254
88	0.00	1.49	0.254
89	0.00	1.49	0.254
90	0.00	1.49	0.254
91	0.00	1.49	0.254
92	0.00	1.49	0.254
93	0.00	1.49	0.254
94	0.00	1.49	0.254
95	0.00	1.49	0.254
96	0.00	1.49	0.254
97	0.00	1.49	0.254
98	0.00	1.49	0.254
99	0.00	1.49	0.254
100	0.00	1.49	0.254

REV. NO.	DATE	DESCRIPTION
ECO-149459	C	1 ADD NOTE 10
REV. NO.	DATE	DESCRIPTION
REV. NO.	DATE	DESCRIPTION
REV. NO.	DATE	DESCRIPTION

REV. NO.	DATE	DESCRIPTION
ECO-149459	C	1 ADD NOTE 10
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ECO-149459	C	1 ADD NOTE 10
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REV. NO.	DATE	DESCRIPTION
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REV. NO.	DATE	DESCRIPTION

REV. NO.	DATE	DESCRIPTION
ECO-149459	C	1 ADD NOTE 10
REV. NO.	DATE	DESCRIPTION
REV. NO.	DATE	DESCRIPTION
REV. NO.	DATE	DESCRIPTION

REV. NO.	DATE	DESCRIPTION
ECO-149459	C	1 ADD NOTE 10
REV. NO.	DATE	DESCRIPTION
REV. NO.	DATE	DESCRIPTION
REV. NO.	DATE	DESCRIPTION

## Application – Gas Continued

Model	Current Spec	Battery Size*	Supported Part Number*	Battery CCA*	Genset Minimum CCA	Battery Voltage	Starting (Genset) Voltage	Required Battery Quantity*
<b>C125 N6</b>	A	34	A045P632	850	850	12	12	1
			A045P632	850				2
<b>C150 N6</b>	A	34	A045P632	850	850	12	12	1
			A045P632	850				2
<b>GGHG</b>	N	30H-31	0416-0796	725	600	12	12	1
			0416-0823	725				
			0416-0980	1000				
<b>GGHH</b>	N	30H-31	0416-0796	725	600	12	12	1
			0416-0823	725				
			0416-0980	1000				
<b>GGHJ</b>	A	30H-31	0416-0796	725	600	12	12	1
			0416-0823	725				
			0416-0980	1000				

\* First line refers to *standby* battery size and the second line refers to *cold starting* battery size for C20 N6 – C150 N6. Reference for battery size, supported part number, battery cold cranking amps, and required battery quantity.

## Battery Accessories

**Battery Racks** (not recommended for mounting on skids).

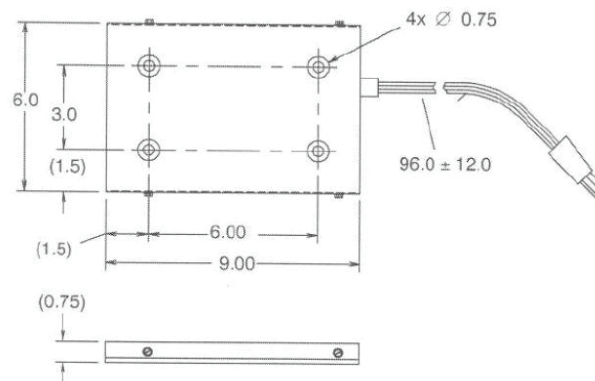
Part Number	Description
0416-0527	20.5" x 11.0" (includes how down brackets)
0416-0475	14.5" x 9.3" (loose rack, not intended for anchoring)
0541-0798	13.7" x 9.7" (includes hold down bracket)
A034F027	21.8" x 14.3" (includes hold down brackets)

## Battery Heater

Increases battery starting capability in lower ambient temperatures.

Heater Kit	Temperature Range	Voltage AC	Watts	Instruction Sheet	Critical Component
0333-0469	Pre-set to maintain 80° F	120	200	N/A	0333-0469-01
0333-0770	65° F on; 80° F off	120	50	G744	NA – as purchased
0541-0555	40° F / 70° F setting	120	120	C587	0333-0636

Image 1: 0333-0469



### 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<sup>†</sup> 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

<sup>†</sup> 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](http://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: \_\_\_\_\_