# Bill of Material (BOM)

Cummins Sales and Service

# 1000 kW Generator Set

| Line | Qty. | Description | Part Number |
|---|---|---|---|
| 1 | | | |
| 2 | 1 | **Diesel Genset: 60Hz-1000kW** | |
| 3 | | U.S. EPA, Stationary Emergency Application | Install-US-Stat |
| 4 | | Genset-Diesel,60Hz,1000kW | 1000DQFAH |
| 5 | | Duty Rating-Prime Power | A122-2 |
| 6 | | Listing-UL 2200 | L090-2 |
| 7 | | Emissions Certification, Tier 4 Final, Nonroad Compression Ignition | L229-2 |
| 8 | | Tier4 Final Certified | L178-2 |
| 9 | | DEF Fluid Heater (-30 deg F) Ambient Temperature | L179-2 |
| 10 | | DEF supply lines included | L181-2 |
| 11 | | Voltage-277/480,3 Phase,Wye,4 Wire | R002-2 |
| 12 | | Alternator-60 Hz, 12 Lead, Broad Range, 125/105C | B252-2 |
| 13 | | Generator Set Control-PowerCommand 3.3, Paralleling | H704-2 |
| 14 | | Display Language-English | H536-2 |
| 15 | | Relay - Alarm Shutdown | KU32-2 |
| 16 | | Relays-Paralleling Circuit Breaker Control | KU67-2 |
| 17 | | Relays-Genset Status, User Configured | K631-2 |
| 18 | | Display-Control, LCD | H678-2 |
| 19 | | Meters-AC Output,Analog | H606-2 |
| 20 | | Control Mounting-Front Facing | H679-2 |
| 21 | | Heater-Alternator, 120 Volt AC | A292-2 |
| 22 | | CB or EB or TB-Left Only | KU93-2 |
| 23 | | **CB-1600A,3P,600/690V,UL/IEC,ServEnt,100%UL,Left** | KP87-2 |
| 24 | | CB or EB or TB-Bottom Entry, Left | KB73-2 |
| 25 | | Circuit Breaker Lugs-Mechanical, Left Side | KR01-2 |
| 26 | | Separator-Fuel/Water | C127-2 |
| 27 | | EngineCooling-Enhanced HighAmbient Air Temperature | E126-2 |
| 28 | | Shutdown-Low Coolant Level | H389-2 |
| 29 | | Sight Glass-Coolant Level | E098-2 |
| 30 | | Coolant Heater-208/240/480V, Below 40F Ambient Temp | H557-2 |
| 31 | | Engine Air Cleaner-Heavy Duty | D036-2 |
| 32 | | Genset Warranty- Base | L028-2 |
| 33 | | Literature-English | L050-2 |
| 34 | | | |
| 35 | | | |

| Line | Qty. | Description | Part Number |
|---|---|---|---|
| 36 | | | |
| 37 | | Common Parts Listing | CP01-2 |
| 38 | | Product Revision - D | SPEC-D |
| 39 | 1 | **Battery Charger-10Amp,120/208/240VAC,12/24V,50/60Hz** | A048G602 |
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# Generator

Specification sheet

# Tier4 certified diesel generator set QST30 series engine

900 - 1000 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.

## Features

**Cummins heavy-duty engine** - Rugged 4-cycle, industrial diesel delivers reliable power, low emissions and fast response to load changes.

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

**Cummins aftertreatment system** - Fully integrated power generation systems that are certified to EPA Tier 4 standards. They provide optimum performance, reliability and versatility for stationary Standby, Prime Power and Continuous duty applications.

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

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

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

**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.

## 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 61000-4-2 : Level 4 Electrostatic discharge<br>IEC 61000-4-3 : Level 3 Radiated susceptibility |

## Engine specifications

| | |
|---|---|
| Bore | 140 mm (5.51 in) |
| Stroke | 165.0 mm (6.5 in) |
| Displacement | 30.5 litres (1860 $in^3$) |
| Configuration | Cast iron, V, 12 cylinder |
| Battery capacity | 1800 amps minimum at ambient temperature of -18 °C to 0 °C (0 °F to 32 °F) |
| Battery charging alternator | 35 amps |
| Starting voltage | 24 volt, negative ground |
| Fuel system | Direct injection: number 2 diesel fuel, fuel filter, automatic electric fuel shutoff |
| Fuel filter | Triple element, 10 micron filtration, spin-on fuel filters with 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 |

## Aftertreatment specifications

| | |
|---|---|
| Model | CA451 |
| Emissions certification | Tier4F certified |
| Duct diameter | 1143 mm (45 in) |
| Duct quantity | 1 |
| Components included | Insulated aftertreatment ducts, saddle supports for aftertreatment, control panel, DEF tank, heater with ILB, harness from control panel to engine and AFT, lifting tool. Assembly required at site. |

## Alternator specifications

| | |
|---|---|
| Design | Brushless, 4 pole, drip proof, revolving field |
| Stator | 2/3 pitch |
| Rotor | Single bearing, flexible disc |
| Insulation system | Class H on low and medium voltage, Class F on high voltage |
| Standard temperature rise | 150 ºC Standby at 40 °C ambient |
| Exciter type | Permanent Magnet Generator (PMG) |
| Phase rotation | A (U), B (V), C (W) |
| Alternator cooling | Direct drive centrifugal blower fan |
| AC waveform Total Harmonic Distortion (THDV) | < 5% no load to full linear load, < 3% for any single harmonic |
| Telephone Influence Factor (TIF) | < 50% per NEMA MG1-22.43 |
| Telephone Harmonic Factor (THF) | < 3% |

# 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 generator set 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 generator set 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 (baseload/peak shave) Mode
- Digital power transfer control, for use with a breaker pair to provide open transition, closed transition, ramping closed transition, peaking and base load functions,

**Alternator data**

- Line-to-neutral and line-to-line AC volts
- 3-phase AC current
- Frequency
- kW, kvar, power factor kVA (three phase and total)

**Engine data**

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

**Other data**

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

## Standard control functions

**Digital governing**

- Integrated digital electronic isochronous governor
- Temperature dynamic governing

**Digital voltage regulation**

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

**AmpSentry AC protection**

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

**Engine protection**

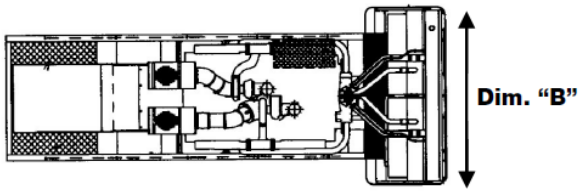
- Battery voltage monitoring, protection and testing
- Overspeed shutdown
- Low oil pressure warning and shutdown
- High coolant temperature warning and shutdown
- Low coolant level warning or shutdown
- Low coolant temperature warning
- Fail to start (overcrank) shutdown
- Fail to crank shutdown
- Cranking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

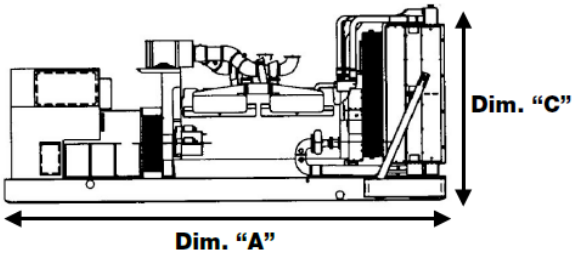
**Control functions**

- 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)

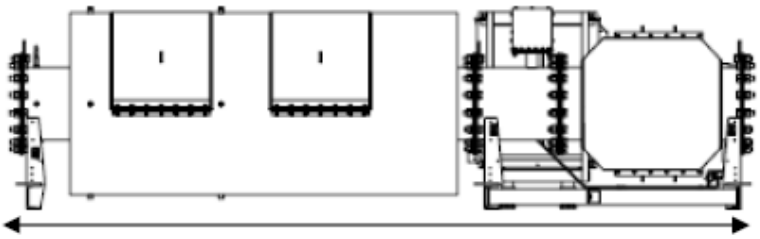


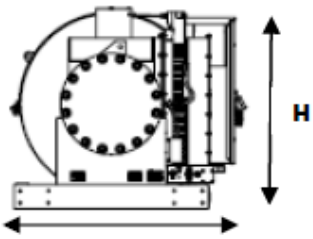




## Generator set weights and dimensions

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

| Model | Dim “A” mm (in.) | Dim “B” mm (in.) | Dim “C” mm (in.) | Set weight* dry kg (lbs) | Set weight* wet kg (lbs) |
|---|---|---|---|---|---|
| **DQFAH** | 4239 (167) | 2000 (79) | 2353 (93) | 7631 (16824) | 7929 (17480) |




## Aftertreatment weights and dimensions

* Due to multiple configurations of the CA451 model, maximum weight of the model is shown.
Note: Dimension and weights are subject to change. See submittal data for exact details.

| Aftertreatment model number* | Genset model | L (Length) mm (in.) | W (Width) mm (in.) | H (Height) mm (in.) | Weight of aftertreatment system (lbs) |
|---|---|---|---|---|---|
| **CA451** | DQFAH | 4651 (183) | 1480 (58) | 1260 (50) | 4367 |

## Codes and standards

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

| | | | |
|---|---|---|---|
| | All low and medium voltage models are CSA certified to product class 4215-01. | **ISO8528** | The generator set has been rated in accordance with ISO8528. |
| **U.S. EPA** | Engine certified to US EPA Nonroad 40CFR1039 and Stationary (Emergency and Non-Emergency) US EPA NSPS, 60CFR Subpart IIII Tier4 Emissions Standards. | | This generator set is designed in facilities certified to ISO 9001 and manufactured in facilities certified to ISO 9001 or ISO 9002. |
| **International Building Code** | The genset package is certified for seismic application in accordance with the following International Building Code: IBC2012. | | The Aftertreatment System bears the ETL ListedMark as proof of conformity to NFPA 79, UL 61010C-1, and CSA 22.2 No. 61010-1-12. |
| | 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. | | The generator set is available listed to UL 2200 for all 60 Hz low voltage models, Stationary Engine Generator Assemblies. 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. |

**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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S-1671.PDF (01/18)

# Generator Set Data Sheet

**Model:** DQFAH
**Frequency:** 60 Hz
**Fuel Type:** Ultra Low Sulphur Diesel (15 ppm sulphur)
**kW Rating:** 1000 Standby
900 Prime
**Emissions level:** EPA Stationary Non-Emergency Tier 4

| | |
|---|---|
| **Exhaust emission data sheet Tier 4F:** | **EDS-1156** |
| **Exhaust emission compliance sheet Tier4F** | **EPA-1195** |
| **Sound performance data sheet:** | **MSP-1119** |
| **Cooling performance data sheet:** | **MCP-217** |
| **Prototype test summary data sheet:** | **PTS-304** |
| **Standard set-mounted radiator cooling outline:** | **A034N275** |
| **Optional remote radiator cooling outline:** | **A034N273** |
| **After-treatment outline drawing Tier 4F** | **A041V017** |

## Fuel Consumption

| | Standby | | | | Prime | | | |
|---|---|---|---|---|---|---|---|---|
| | kW (kVA) | | | | kW (kVA) | | | |
| **Ratings** | 1000 (1250) | | | | 900 (1125) | | | |
| **Load** | **1/4** | **1/2** | **3/4** | **Full** | **1/4** | **1/2** | **3/4** | **Full** |
| **US gph** | 21.2 | 36.6 | 53.3 | 70.7 | 19.7 | 33.5 | 48.1 | 63.9 |
| **L/hr** | 80.4 | 138.6 | 201.9 | 267.6 | 74.5 | 127.0 | 182.1 | 241.9 |

## DEF Consumption

| | Standby | | | | Prime | | | |
|---|---|---|---|---|---|---|---|---|
| | kW (kVA) | | | | kW (kVA) | | | |
| **Ratings** | 1000 (1250) | | | | 900 (1125) | | | |
| **Load** | **1/4** | **1/2** | **3/4** | **Full** | **1/4** | **1/2** | **3/4** | **Full** |
| **US gph** | 0.94 | 1.41 | 2.17 | 3.03 | 0.86 | 1.32 | 1.94 | 2.68 |
| **L/hr** | 3.55 | 5.34 | 8.21 | 11.47 | 3.26 | 5.00 | 7.34 | 10.14 |

## Engine

| | **Standby rating** | **Prime rating** |
|---|---|---|
| Engine manufacturer | Cummins Inc. | |
| Engine model | QST30-G17 | |
| Configuration | Cast iron, V 12 cylinder | |
| Aspiration | Turbocharged and low temperature after-cooled | |
| Gross engine power output, kWm (bhp) | 1112 (1490) | 1007 (1350) |
| BMEP at set rated load, kPa (psi) | 2427 (351) | 2199 (319) |
| Bore, mm (in.) | 140 (5.51) | |
| Stroke, mm (in.) | 165 (6.5) | |
| Rated speed, rpm | 1800 | |
| Piston speed, m/s (ft/min) | 9.91 (1950) | |
| Compression ratio | 14.7:1 | |

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| | |
|---|---|
| Lube oil capacity, L (qt) | 132 (140) |
| Overspeed limit, rpm | 2070 |
| Regenerative power, kW | 82 |

## Fuel Flow

| | |
|---|---|
| Maximum supply fuel flow, L/hr (US gph) | 570 (150) |
| Maximum return fuel flow, L/hr (US gph) | 550 (145) |
| Maximum fuel inlet restriction with clean filter, kPa (in Hg) | 13.5 (4.0) |
| Maximum fuel inlet temperature, °C (°F) | 71 (160) |
| Maximum fuel inlet restriction, kPa (in Hg) | 68 (20) |

## Air

| | | |
|---|---|---|
| Combustion air, $m^3$/min (scfm) | 87 (3067) | 79 (2801) |
| Maximum air cleaner restriction with clean filter, kPa (in $H_2O$) | 3.7 (15) | |
| Alternator cooling air, $m^3$/min (cfm) | 204 (7300) | |

## Exhaust

| | | |
|---|---|---|
| Exhaust flow at rated load, $m^3$/min (cfm) | 212 (7469) | 193 (6829) |
| Exhaust temperature, °C (°F) | 465 (869) | 456 (852) |
| Maximum back pressure, kPa (in $H_2O$) | 6.8 (27) | |

## Standard Set-Mounted Radiator Cooling

| | |
|---|---|
| Ambient design at 0.5 in $H_2O$, °C (°F) | 50 (122) |
| Fan load, $kW_m$ (HP) | 33.1 (44.4) |
| Coolant capacity (with radiator), L (US gal) | 167 (44) |
| Cooling system air flow, $m^3$/min (scfm) | 1097.5 (38753) |
| Total heat rejection, MJ/min (Btu/min) | 48.9 (46455) |
| Maximum cooling air flow static restriction, kPa (in H2O) | 0.12 (0.5) |
| Maximum fuel return line restriction kPa (in Hg) | 67.5 (20) |

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| | |
|---|---|
| Maximum fuel return line restriction, kPa (in Hg) | 67.5 (20) |

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

## Aftertreatment System

| | T4F |
|---|---|
| Pressure drop across after-treatment, kPa (in $H_2O$) | 6.2 (25) |
| Available back pressure for exhaust system piping, kPa (in $H_2O$) | 0.5 (2) |
| Exhaust heater rating (kW) | 250 |
| Exhaust heater input requirements (Amps at 480 V) | 300 |
| DEF tank capacity (usable) L (gal) | 765 (202) |
| Heat radiated from aftertreatment, Btu/min (MJ/min) | 1820 (1.92) |

## DEF Flow

| | |
|---|---|
| Maximum supply flow, L/hr (US gph) | 98 (26) |
| Maximum return flow, L/hr (US gph) | 87 (23) |
| Maximum static head (from pump to injector), m (ft) | 6.4 (21) |

## Weights[1]

| | |
|---|---|
| Unit dry weight kgs (lbs) | 7633 (16824) |
| Unit wet weight kgs (lbs) | 7931 (17480) |
| Aftertreatment weight kgs (lbs) | 1981 (4367) |

## Derating Factors[2]

| | |
|---|---|
| **Standby** | Engine power available up to 701 m (2300 ft) at ambient temperatures up to 40 °C (104 °F). Above these elevations, derate at 3.5% per 305 m (1000 ft) and 7% per 10 °C (18 °F). |
| **Prime** | Engine power available up to 727 m (2385 ft) at ambient temperatures up to 40 °C (104 °F). Above these elevations, derate at 3.5% per 305 m (1000 ft) and 7% per 10 °C (18 °F). |

**Notes**:
[1] Weights represent a set with standard features. See outline drawing for weights of other configurations.
[2] Derating factors do not include after-treatment system.

## Ratings Definitions

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

## Alternator Data

| Voltage | Connection[1] | Temp rise degrees C | Duty[2] | Single phase factor[3] | Max surge kVA[4] | Surge kW | Alternator data sheet | Feature code |
|---|---|---|---|---|---|---|---|---|
| 120/208-139/240 | 12-lead | 125/105 | S/P | | 4234 | 1019 | ADS-312 | B252 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 240/416-277/480 | 12-lead | 125/105 | S/P | | 4234 | 1019 | ADS-312 | B252 |
| 277/480 | Wye, 3-phase | 125/105 | S/P | | 3866 | 1018 | ADS-311 | B276 |
| 220/380-277/480 | Wye, 3-phase | 125/105 | S/P | | 4602 | 1018 | ADS-330 | B282 |
| 220/380-277/480 | Wye, 3-phase | 105/80 | S/P | | 4602 | 1018 | ADS-330 | B283 |
| 210/380-277/480 | Wye, 3-phase | 80 | S | | 5521 | 1024 | ADS-331 | B284 |
| 240/416-277/480 | Wye | 125/105 | S/P | | 4234 | 1019 | ADS-312 | B288 |
| 347/600 | 3-phase | 125/105 | S/P | | 3866 | 1021 | ADS-311 | B300 |
| 347/600 | 3-phase | 105/80 | S/P | | 4234 | 1024 | ADS-312 | B301 |
| 347/600 | 3-phase | 80 | S | | 4602 | 1004 | ADS-330 | B604 |

**Notes**:

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

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

[3] Factor for the *Single phase output from Three phase alternator* formula listed below.

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

## 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-3535 PDA047J649 (06/19)

# Alternator data sheet

# Frame size: HC6K

## Characteristics

| | | | |
|---|---|---|---|
| **Weights:** | Wound stator assembly: | 2553 lb | 1150 kg |
| | Rotor assembly: | 2426 lb | 1093 kg |
| | Complete alternator: | 5162 lb | 2325 kg |
| **Maximum speed:** | | 2250 rpm | |
| **Excitation current:** | Full load: | 2.5 Amps | |
| | No load: | 0.5 Amps | |
| **Insulation system:** | Class H throughout | | |

| **3 Ø Ratings** (0.8 power factor) | | **60 Hz** | | | | **50 Hz** | | |
|---|---|---|---|---|---|---|---|---|
| (Based on specific temperature rise at 40° C ambient temperature) | | 110/190* 220/380 | 120/208* 240/416 | 139/240* (277/480) | 347/600 | 110/190* 220/380 | 120/208* 240/415 | 127/220* 254/440 |
| 150° C rise ratings | kW | 985 | 1080 | 1220 | 1220 | 944 | 944 | 944 |
| | kVA | 1231 | 1350 | 1525 | 1525 | 1180 | 1180 | 1180 |
| 125° C rise ratings | kW | 930 | 1020 | 1150 | 1150 | 888 | 888 | 888 |
| | kVA | 1163 | 1275 | 1438 | 1438 | 1110 | 1110 | 1110 |
| 105° C rise ratings | kW | 865 | 950 | 1050 | 1050 | 800 | 800 | 800 |
| | kVA | 1081 | 1188 | 1313 | 1313 | 1000 | 1000 | 1000 |
| 80° C rise ratings | kW | 750 | 824 | 900 | 900 | 708 | 708 | 708 |
| | kVA | 938 | 1030 | 1125 | 1125 | 885 | 885 | 885 |
| **Reactances** (per unit ± 10%) | | 110/190* 220/380 | 120/208* 240/416 | 139/240* 277/480 | 347/600 | 110/190* 220/380 | 120/208* 240/415 | 127/220* 254/440 |
| (Based on full load at 125° C rise rating) | | | | | | | | |
| Synchronous | | 3.45 | 3.15 | 2.67 | 2.67 | 2.77 | 2.32 | 2.07 |
| Transient | | 0.27 | 0.25 | 0.21 | 0.21 | 0.23 | 0.20 | 0.17 |
| Subtransient | | 0.19 | 0.18 | 0.15 | 0.15 | 0.17 | 0.14 | 0.13 |
| Negative sequence | | 0.26 | 0.24 | 0.20 | 0.20 | 0.22 | 0.18 | 0.16 |
| Zero sequence | | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 |
| **Motor starting** | | Broad range | | | 600 | Broad range | | |
| Maximum kVA | (90% sustained voltage) | 4234 | | | 4234 | 2875 | | |
| **Time constants** (sec) | | Broad range | | | 600 | Broad range | | |
| Transient | | 0.185 | | | 0.185 | 0.185 | | |
| Subtransient | | 0.025 | | | 0.025 | 0.025 | | |
| Open circuit | | 3.400 | | | 3.400 | 3.400 | | |
| DC | | 0.049 | | | 0.049 | 0.049 | | |
| **Windings** | (@ 20° C) | Broad range | | | 600 | Broad range | | |
| Stator resistance | (Ohms per phase) | 0.0038 | | | 0.0052 | 0.0038 | | |
| Rotor resistance | (Ohms) | 1.8900 | | | 1.8900 | 1.8900 | | |
| Number of leads | | 6 (12 Optional) | | | 6 | 6 (12 optional) | | |

* 12 lead reconnectible option is required to obtain low (parallel wye) voltages.

# Prototype Test Support (PTS)
# 60 Hz test summary

| Generator set models | | Representative prototype | |
|---|---|---|---|
| 750DQFAE | 1000DQFAH | Model: | 1000DQFAD |
| 800DQFAF | | Engine: | P734C |
| 900DQFAG | | Alternator: | QST30-G5 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: 1055 kW**

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

**Maximum motor starting: 5521 kVA**

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

**Torsional analysis and testing:**

The generator set on P7G 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:** 50 °C ambient
0.5 in H2O restriction

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

**Durability:**

The generator set was subjected to endurance test replicating field duty cycles operating at variable load up to the standby rating based upon MIL-STD-705 to verify structural soundness and durability of the design.

**Electrical and mechanical strength:**

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

**Steady state performance:**

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

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

**Transient performance:**

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

Full load acceptance:

| | |
|---|---|
| Voltage dip: | 35.5% |
| Recovery time: | 4.6 seconds |
| Frequency dip: | 7.3% |
| Recovery time: | 5.2 seconds |

Full load rejection:

| | |
|---|---|
| Voltage rise: | 16.7% |
| Recovery time: | 2.2 seconds |
| Frequency rise: | 3.0% |
| Recovery time: | 1.7 seconds |

All data based on 0.8 power factor.

**Harmonic analysis:**

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

| | Line to Line | | Line to Neutral | |
|---|---|---|---|---|
| Harmonic | No load | Full load | No load | Full load |
| 3 | 0.052 | 0.04 | 0.144 | 0.092 |
| 5 | 0.128 | 1.36 | 0.058 | 1.32 |
| 7 | 1.000 | 0.196 | 1.00 | 0.19 |
| 9 | 0.012 | 0.034 | 0.033 | 0.066 |
| 11 | 0.985 | 0.84 | 1.01 | 0.83 |
| 13 | 0.158 | 0.32 | 0.12 | 0.29 |
| 15 | 0.00 | 0.005 | 0.025 | 0.022 |

Note: THD will be slightly higher on configurations using ILB/exhaust heater specifically during low genset load/low heater load conditions.

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

See notes 2, 5 and 7-11 listed below

| Configuration | Exhaust | Applied Load | Position (Note 2) | | | | | | | | 8 Position Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| Standard – Unhoused | Infinite Exhaust | 0% Prime | 84.4 | 87.4 | 87.3 | 89.4 | 86.4 | 88.7 | 89.8 | 87.5 | 87.9 |
| | | 75% Prime | 87.8 | 91.1 | 90.7 | 91.7 | 88.7 | 91.2 | 92.0 | 90.9 | 90.7 |
| | | 100% Prime | 88.9 | 92.7 | 92.4 | 93.3 | 89.6 | 92.7 | 93.4 | 92.3 | 92.2 |
| | | ~~100% Standby~~ | ~~90.1~~ | ~~93.1~~ | ~~93.3~~ | ~~93.8~~ | ~~90.1~~ | ~~93.3~~ | ~~94.0~~ | ~~93.0~~ | ~~92.8~~ |

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

See notes 1, 5 and 7-14 listed below

| Configuration | Exhaust | Applied Load | Octave Band Center Frequency (Hz) | | | | | | | | | | Overall Sound Pressure Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 16 | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | 16000 | |
| Standard – Unhoused | Infinite Exhaust | 0% Prime | N/A | 42.1 | 62.4 | 80.7 | 85.4 | 89.7 | 93.1 | 91.0 | 85.8 | 79.3 | 70.9 | 97.1 |
| | | 75% Prime | N/A | 44.8 | 63.6 | 81.1 | 86.3 | 91.3 | 94.8 | 94.5 | 91.6 | 86.9 | 77.6 | 99.9 |
| | | 100% Prime | N/A | 46.5 | 65.9 | 81.8 | 87.1 | 92.2 | 95.7 | 95.9 | 92.9 | 92.7 | 79.6 | 101.4 |
| | | ~~100% Standby~~ | ~~N/A~~ | ~~47.1~~ | ~~66.6~~ | ~~82.4~~ | ~~87.3~~ | ~~92.4~~ | ~~96.0~~ | ~~96.5~~ | ~~93.4~~ | ~~94.6~~ | ~~81.7~~ | ~~102.1~~ |

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

See notes 1, 3, 5 and 7-14 listed below

| Configuration | Exhaust | Applied Load | Octave Band Center Frequency (Hz) | | | | | | | | | | Overall Sound Pressure Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 16 | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | 16000 | |
| Standard – Unhoused | Infinite Exhaust | 100% Prime | N/A | 53.2 | 67.7 | 79.0 | 83.7 | 86.7 | 89.6 | 91.0 | 85.6 | 88.1 | 70.4 | 96.0 |
| | | ~~100% Standby~~ | ~~N/A~~ | ~~54.0~~ | ~~69.3~~ | ~~79.5~~ | ~~83.5~~ | ~~86.7~~ | ~~90.2~~ | ~~91.7~~ | ~~86.0~~ | ~~93.8~~ | ~~75.3~~ | ~~97.9~~ |

## A-weighted Sound Power Level, dB(A)

See notes 1, 3 and 6-14 listed below

| Configuration | Exhaust | Applied Load | Octave Band Center Frequency (Hz) | | | | | | | | | | Overall Sound Power Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 16 | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | 16000 | |
| Standard – Unhoused | Infinite Exhaust | 0% Prime | N/A | 61.7 | 82.1 | 100.3 | 105.0 | 109.3 | 112.7 | 110.6 | 105.4 | 98.9 | 90.6 | 116.8 |
| | | 75% Prime | N/A | 64.4 | 83.2 | 100.7 | 106.0 | 111.0 | 114.4 | 114.2 | 111.2 | 106.6 | 97.2 | 119.5 |
| | | 100% Prime | N/A | 66.2 | 85.5 | 101.4 | 106.7 | 111.9 | 115.3 | 115.5 | 112.5 | 112.3 | 99.2 | 121.0 |
| | | ~~100%~~ Standby | N/A | ~~66.7~~ | ~~86.2~~ | ~~102.1~~ | ~~106.9~~ | ~~112.0~~ | ~~115.6~~ | ~~116.1~~ | ~~113.1~~ | ~~114.3~~ | ~~101.3~~ | ~~121.7~~ |

Global Notes:

1. Sound pressure levels at 1 meter are measured per the requirements of ISO 3744, ISO 8528-10, ANSI S1.13, ANSI S12.1 and European Communities Directive 2000/14/EC as applicable. The microphone measurement locations are 1 meter from a reference parallelepiped just enclosing the generator set (enclosed or unenclosed).
2. Seven-meter measurement location 1 is 7 meters (23 feet) from the generator (alternator) end of the generator set, and the locations proceed counter-clockwise around the generator set at 45° angles at a height of 1.2 meters (48 inches) above the ground surface.
3. Sound Power Levels are calculated according to ISO 3744, ISO 8528-10, and or CE (European Union) requirements.
4. Exhaust Sound Levels are measured and calculated per ISO 6798, Annex A.
5. Reference Sound Pressure Level is 20 µPa.
6. Reference Sound Power Level is 1 pW ($10^{-12}$ Watt).
7. Sound data for remote-cooled generator sets are based on rated loads without cooling fan noise.
8. Sound data for the generator set with infinite exhaust do not include the exhaust noise contribution.
9. Published sound levels are measured at CE certified test site and are subject to instrumentation, measurement, installation and manufacturing variability.
10. Unhoused/Open configuration generator sets refers to generator sets with no sound enclosures of any kind.
11. Housed/Enclosed/Closed/Canopy configuration generator sets refer to generator sets that have noise reduction sound enclosures installed over the generator set and usually integrally attached to the skid base/base frame/fuel container base of the generator set.
12. Published sound levels meet the requirements India's Central Pollution Control Board (Ministry of Environment & Forests),vide GSR 371 (E), which states the A-weighted sound level at1meter from any diesel generator set up to a power output rating of 1000kVA shall not exceed 75dB(A)
13. For updated noise pollution information for India see website: http://www.envfor.nic.in/legis/legis.html
14. Sound levels must meet India's Ambient Air Noise Quality Standards detailed for Daytime/Night-time operation in Noise Pollution (Regulation and Control) Rules, 2000
15. Open exhaust with T4fc, 1x45 Exhaust Sound Power Levels are calculated by using the Insertion Loss (IL) of T4fc, 1x45 system.

## Enhanced Ambient Air Temperature Radiator Cooling System

| | Fuel Type | Duty | Rating (kW) | Max cooling @ air flow static restriction, unhoused (inches water/mm water) | | | | | | Housed in free air, no air discharge restriction | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 0.0/0.0 | 0.25/6.4 | 0.5/12.7 | 0.75/19.1 | 1.0/25.4 | 1.5/38.1 | Weather | Sound level 1 | Sound level 2 |
| | | | | Maximum allowable ambient temperature, degree C | | | | | | | | |
| 60 Hz | Diesel | ~~Standby~~ | ~~1000~~ | ~~61.5~~ | ~~58.6~~ | ~~55.4~~ | ~~52.1~~ | ~~49.9~~ | ~~40.7~~ | ~~53.4~~ | ~~52.4~~ | ~~52.3~~ |
| | | Prime | 900 | 60.0 | 57.1 | 54.1 | 51.4 | 48.0 | 39.6 | 53.0 | 52.1 | 52.0 |

Notes:

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

# Exhaust emission data sheet
# DQFAH
## 60 Hz Diesel generator set
## EPA emission

**Engine information:**

| | | | |
|---|---|---|---|
| Model: | Cummins Inc. QST30-G17 | Bore: | 5.51 in. (140 mm) |
| Type: | 4 Cycle, 50° V 12 cylinder diesel | Stroke: | 6.50 in. (165 mm) |
| Aspiration: | Turbocharged and low temperature after-cooled | Displacement: | 1860 cu. in. (30.5 liters) |
| Compression ratio: | 14.7:1 | | |
| Emission control device: | SCR & DPF | | |
| Emission level: | Stationary non-emergency, Tier4 final (with DPF) | | |

| Performance data | 1/4 Standby | 1/2 Standby | 3/4 Standby | Full Standby | Full Prime |
|---|---|---|---|---|---|
| BHP @ 1800 RPM (60 Hz) | 371 | 741 | 1112 | 1482 | 1322 |
| Fuel consumption (Gal/Hr) | 19 | 36 | 54 | 72 | 64 |
| Exhaust gas flow (CFM) | 2780 | 4500 | 6370 | 7540 | 6950 |
| Exhaust gas temperature (°F) | 620 | 760 | 814 | 890 | 873 |
| **Exhaust emission data** | | | | | |
| HC (Total unburned hydrocarbons) | 0.02 | 0.01 | 0.03 | 0.04 | 0.03 |
| NOx (Oxides of nitrogen as NO2) | 0.72 | 0.40 | 0.35 | 0.42 | 0.39 |
| CO (Carbon monoxide) | 1.06 | 0.64 | 0.60 | 0.61 | 0.60 |
| PM (Particular matter) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SO2 (Sulfur dioxide) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Smoke (Bosch) | 0 | 0 | 0 | 0 | 0 |

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

**Test conditions**

Data is representative of steady-state engine speed (± 36 RPM) at designated genset loads. Pressures, temperatures, and emission rates were stabilized.

| | |
|---|---|
| Fuel specification: | ASTM D975 No. 2-D diesel fuel with ULSD, and 40-48 cetane number. |
| Fuel temperature | 99 ± 9 °F (at fuel pump inlet) |
| Intake air temperature: | 77 ± 9 °F |
| Barometric pressure: | 29.6 ± 1 in. Hg |
| Humidity: | NOx measurement corrected to 75 grains H2O/lb dry air |
| Reference standard: | ISO 8178 |

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

# 2019 EPA Tier4F Certified Exhaust Emission Compliance Statement 1000DQFAH Stationary Non-Emergency,

## 60 Hz Diesel generator set

**Compliance Information:**

**The engine used in this generator set complies with Tier 4 emissions limit of U.S. EPA New Source Performance Standards for stationary non-emergency engines under the provisions of 40 CFR 60 Subpart IIII when tested per ISO8178 D2.**

| | |
|---|---|
| Engine Manufacturer: | Cummins Inc. |
| EPA Certificate Number: | KCEXL78.0AAA-009 |
| Effective Date: | 09/17/2018 |
| Date Issued: | 09/17/2018 |
| EPA Engine Family (Cummins Emissions Family): | KCEXL78.0AAA |

**Engine Information:**

| | | | |
|---|---|---|---|
| Model: | QST30-G17 | Bore: | 5.51 in. (140 mm) |
| Engine Nameplate HP: | 1490 | Stroke: | 6.50 in. (165 mm) |
| Type: | 4 Cycle, 50°V, 12 Cylinder Diesel | Displacement: | 1860 cu. in. (30.5 liters) |
| Aspiration: | Turbocharged & Low Temperature Aftercooled | Compression Ratio: | 14.7:1 |
| Emission Control Device: | SCR & DPF | | |

**Diesel Fuel Emissions Limits**

| D2 cycle exhaust emissions | Grams per BHP-hr | | | | Grams per $kW_m$-hr | | | |
|---|---|---|---|---|---|---|---|---|
| | $NO_X$ | NMHC | CO | PM | $NO_X$ | NMHC | CO | PM |
| Test Results | 0.4 | 0.02 | 1.04 | 0.00 | 0.54 | 0.02 | 1.4 | 0.00 |
| EPA T4F Emissions Limit | 0.5 | 0.14 | 2.61 | 0.02 | 0.67 | 0.19 | 3.50 | 0.03 |

**Test methods:** EPA nonroad emissions recorded per 40 CFR 89 (ref. ISO8178-1) and weighted at load points prescribed in Subpart E, Appendix A for constant speed engines (ref. ISO8178-4, D2)

**Diesel fuel specifications:** Cetane number: 40-48. Reference: ASTM D975 No. 2-D, <15 ppm Sulfur.

**Reference conditions:** Air inlet temperature: 25°C (77°F), Fuel inlet temperature: 40°C (104°F). Barometric pressure: 100 kPa (29.53 in Hg), Humidity: 10.7 g/kg (75 grains $H_2O$/lb) of dry air; required for NOx correction, Restrictions: Intake restriction set to a maximum allowable limit for clean filter; Exhaust back pressure set to a maximum allowable limit.

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

Specification sheet

# PowerCommand® 3.3 control system

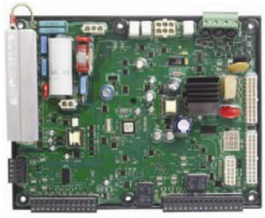
## Control system description

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

## Features

- 320 x 240 pixels graphic LED backlight LCD.
- Multiple language support.
- AmpSentry™ protection - for true alternator overcurrent protection.
- Digital power transfer control (AMF) 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 share
- 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 voltage regulation. Three phase full wave FET type regulator compatible with either shunt or PMG systems.
- Digital engine speed governing (where applicable)
- Generator set monitoring and protection.
- Utility/AC Bus metering and protection
- 12 and 24 V DC battery operation.
- ModBus® interface for interconnecting to customer equipment.
- Warranty and service. Backed by a comprehensive warranty and worldwide distributor service network.
- Certifications - Suitable for use on gensets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std. and CE standards.

# PowerCommand digital genset control PCC 3300



## Description

The PowerCommand genset control is suitable for use on a wide range of diesel and lean burn natural gas gensets in paralleling applications. The PowerCommand control is compatible with shunt or PMG excitation style. It is suitable for use with reconnectable or non-reconnectable generators, and it can be configured for any frequency, voltage and power connection from 120-600 VAC line-toline, 601-45,000 VAC with external PT.

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

## Features

- 12 and 24 VDC battery operation.
- Digital voltage regulation - Three phase full wave FET type regulator compatible with either shunt or PMG systems. Sensing is three phase.
- Digital engine speed governing (where applicable) - Provides isochronous frequency regulation.
- Full authority engine communications (where applicable) - Provides communication and control with the Engine Control Module (ECM).
- AmpSentry protection - for true alternator overcurrent protection.
- Genset monitoring - Monitors status of all critical engine and alternator functions.
- Digital genset metering (AC and DC).
- Genset battery monitoring system to sense and warn against a weak battery condition.
- Configurable for single or three phase AC metering.
- Engine starting - Includes relay drivers for starter, Fuel Shut Off (FSO), glow plug/spark ignition power and switch B+ applications.
- Genset protection – Protects engine and alternator.
- 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 (AMF) 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 share
- Droop kW and KVAr control
- Sync cCheck – The sync check function has adjustments for phase angle window, voltage window, frequency window and time delay.
- Utility/AC Bus metering and protection
- Advanced serviceability – using InPower™, a PC-based software service tool.
- Environmental protection – The control system is designed for reliable operation in harsh environments.
- The main control board is a fully encapsulated module that is protected from the elements.
- ModBus interface for interconnecting to customer equipment.
- Configurable inputs and outputs – Four discrete inputs and four dry contact relay outputs.
- Warranty and service – Backed by a comprehensive warranty and worldwide distributor service network.
- Certifications – Suitable for use on 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 HMI options.

Operator adjustments – The HMI 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 HMI or InPower.

Data logs – Includes 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)
- Alternator drive end bearing temperature
- Alternator non-drive end bearing temperature

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

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)

For lean burn natural gas engine applications:

- 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
- Manifold 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 (e.g., HT and LT)
- Coolant temperature 1 and 2 (e.g., HT and LT)
- Exhaust port temperature (up to 18 cylinders)
- Pre-filter oil pressure
- Exhaust back pressure
- CM700 internal temperature
- CM700 isolated battery voltage
- Speed bias
- CM558 internal temperature
- CM558 isolated battery voltage
- Knock level (up to 18 cylinders)
- Spark advance (up to 18 cylinders)
- Knock count (up to 18 cylinders)
- Auxiliary supply disconnector status
- Engine heater status
- Coolant circulating pump status
- Lube oil priming pump status
- Lube oil status
- Oil heater status
- Derate authorization status
- Start system status
- Ventilator fan status
- Ventilation louvre status
- Radiator fan status
- DC PSU status
- Start inhibit/enable status and setup

Service adjustments – The HMI 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

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

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

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

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

Remote start mode - It accepts a ground signal from remote devices to automatically start the genset and immediately accelerates to rated speed and voltage or run at idle until engine temperature is adequate. The remote start signal will also wake up the control from sleep mode. The control can incorporate a time delay start and stop.

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

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

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

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

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

For lean burn natural gas engine applications:

Engine start inhibit/enable – The function will allow application-specific processes to be started prior to the genset/engine start (e.g., pumps, boosters, etc.).

### Alternator control

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

Digital output voltage regulation - Capable of regulating output voltage to within +/-1.0% for any loads between no load and full load. Voltage drift will not exceed +/-1.5% for a 40 ºC
(104 ºF) 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.

## 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 Hz. 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- 300 sec, stop delay from 0-800 sec, transfer delay from
0- 120 sec, retransfer delay from 0-1800 sec, programmed transition delay from 0-60sec, and maximum parallel time from 0-1800 sec.

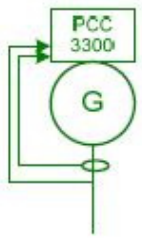
**Breaker control** – Utility and genset breaker interfaces include separate relays for opening and closing breaker, as well as inputs for both 'a' and 'b' breaker position contacts and tripped status. Breaker diagnostics include contact failure, fail to close, fail to open, fail to disconnect, and tripped. Upon breaker failure, appropriate control action is taken to maintain system integrity.

**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.

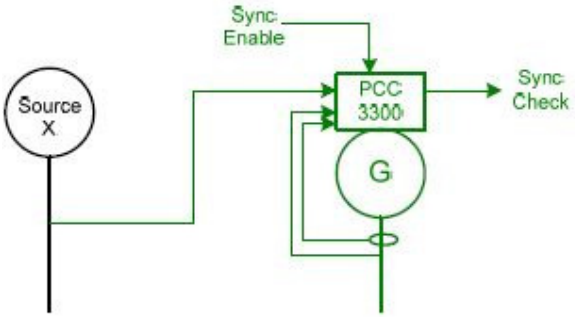
**Exerciser clock** –The exerciser clock (when enabled) allows the system to be operated at preset times in either test without load, test with load, or extended parallel mode. A real time clock is built in. Up to 12 different programs can be set for day of week, time of day, duration, repeat interval,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

**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:

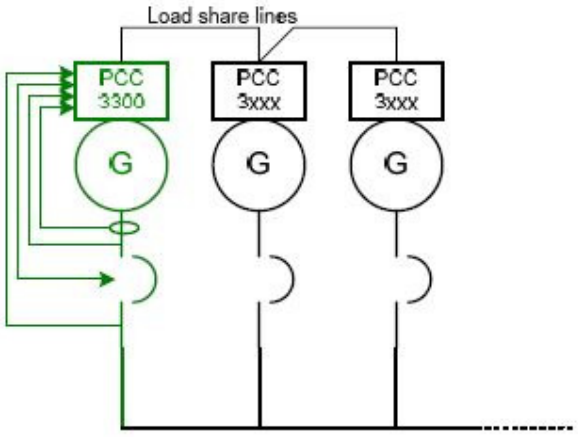
Standalone: Control provides monitoring, protection and control in a non-paralleling application.



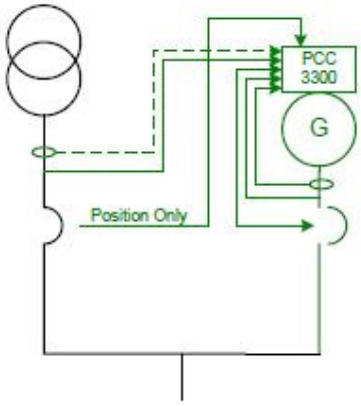

Synchronizer only: control will synchronize the genset to other source when commanded to either via a hardwired or Modbus driven input.



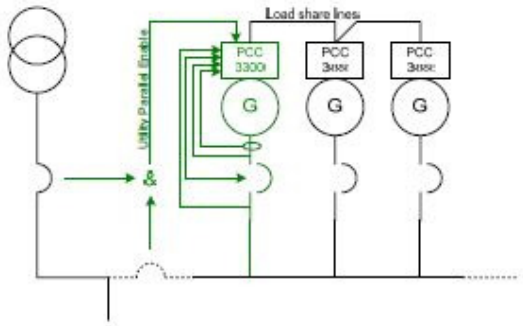
Isolated Bus: allows the genset to perform a dead bus closure or synchronize to the bus and isochronously share kW and kVAR loads with other gensets.



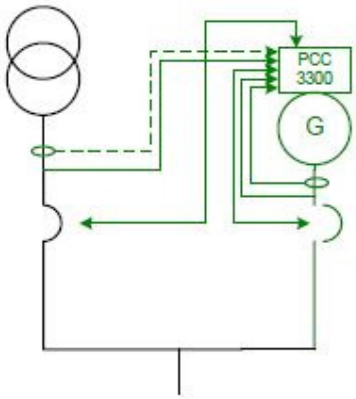

Utility single: Control monitors one genset and utility. The control will automatically start and provide power to a load if the utility fails. The control will also resynchronize the genset back to the utility and provides extended paralleling capabilities.




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.




## 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 engine protection

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

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

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

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

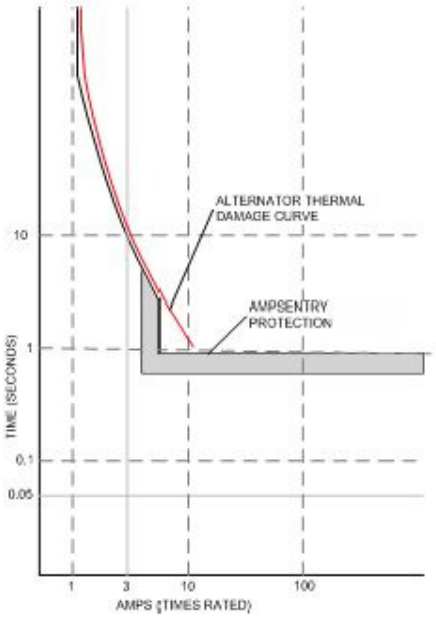
High intake manifold temperature shutdown – Level is preset (configurable with InPower or HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance alarms.

## 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 so that downstream protective devices have the maximum current available to quickly clear fault conditions without subjecting the alternator to potentially catastrophic failure conditions. See document R1053 for a full size time over current curve. The control does not included protection required for interconnection to a utility (mains) service.




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 - 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 signalled to open. If the breaker does not open within and adjustable time delay, a Breaker Fail to Open warning is initiated.

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

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

For lean burn natural gas engine applications:

- Gearbox oil pressure/temperature protection
- Fire fault
- Earth fault
- 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, 30 VDC). These outputs can be configured to activate on any control warning or shutdown fault as well as ready to load, not in auto, common alarm, common warning and common shutdown.
- Ready to load (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 (3.5 A, 30 VDC) for opening and closing of the genset and utility breakers.

For lean burn natural gas engine applications:

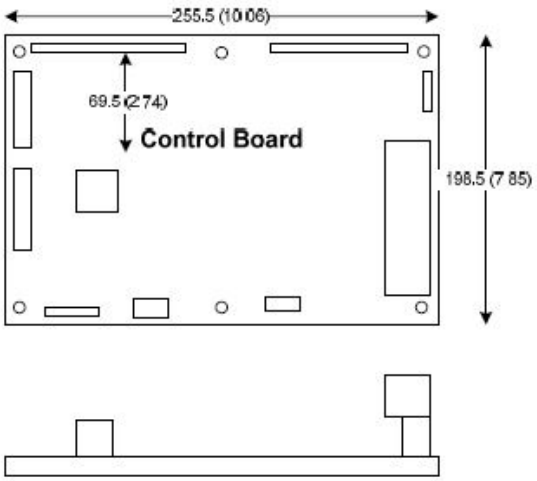
- Start inhibit/enable event
- Emergency stop event
- Ventilator fan run control
- Louvre control
- Radiator fan control
- Alternator heater control
- Engine at idle speed event

### 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 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.

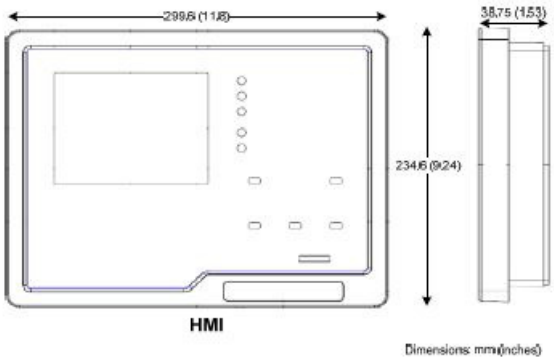
## Features

- 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.
- LCD languages supported: English, Spanish, French, German, Italian, Greek, Dutch, Portuguese, Finnish, Norwegian, Danish, Russian and Chinese characters.

### Communications connections include:

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

## Mechanical drawing



## Software

InPower (beyond 6.5 version) is a PC-based software service tool that is designed to directly communicate to PowerCommand 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 ºC (-40 ºF) to +70 ºC (158 ºF), and for storage from -55 ºC (-67 ºF) to +80 ºC (176 ºF). Control will operate with humidity up to 95%, non-condensing.

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

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 508 recognized or Listed and suitable for use on UL 2200 Listed generator sets.
- CSA C282-M1999 compliance
- CSA 22.2 No. 14 M91 industrial controls.
- PowerCommand control systems and generator sets are designed and manufactured in ISO 9001 certified facilities.

## Warranty

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

PCCNet COMPATIBLE

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

**Our energy working for you.™**


S-1570 (08/18)

# Accessories

**KP87 - RL1600 AMP MCCB**
**100% RATED**
**MICROLOGIC 3.0 LI TRIP UNIT**
**ADJ. RATING PLUG TYPE-F**
**1344 TO 1600 AMP TRIP**
**SET @ 1600 AMP**
**(LT - Ir = 1)**
**(MOUNTED ON LEFT SIDE)**

*R-Frame*

# POWERPACT® R-Frame Molded Case Circuit Breakers (Standard or 100% rated up to 2500 A)

***The most compact and innovative molded case circuit breakers***

POWERPACT Molded Case Circuit Breakers lead the industry with proven, reliable protection and innovative design. Providing unparalleled performance and control, this generation of R-frame circuit breakers features exclusive MICROLOGIC® Trip Units, which allow for a range of sophisticated applications for metering and monitoring. In addition, units can be interchanged to allow for maximum flexibility and are field-installable for easy upgrades as needed.

The circuit breakers are available in 100% rated construction up to 2500 A to meet a broad range of commercial and industrial application needs.

**Full-Featured Performance**

- R-frame – 2500 A available in both standard and 100% ratings with sensor sizes 600–2500 A. Interrupting ratings (AIR)
  L-100kAIR at 480 VAC
- MICROLOGIC 3.0 Trip Unit

Merlin Gerin
Modicon
Square D
Telemecanique
Schneider Electric Brands

SQUARE D
Schneider Electric

# POWERPACT® R-Frame Molded Case Circuit Breakers
## (Standard or 100% rated up to 2500 A)

### Onboard Intelligence

For “smarter breakers,” a range of MICROLOGIC® Trip Units provides advanced functionality, such as a communications interface, and power metering and monitoring capabilities. With the appropriate MICROLOGIC Trip Unit, you can communicate with breakers, gather power information, monitor events and remotely control breakers based on predetermined conditions, leading to substantial savings in electrical system operating costs.

These interchangeable, microprocessor-controlled, plug-in devices provide the next generation of protection, measurement and control functions, delivering not only greater electrical system safety but also improved system integration and coordination.

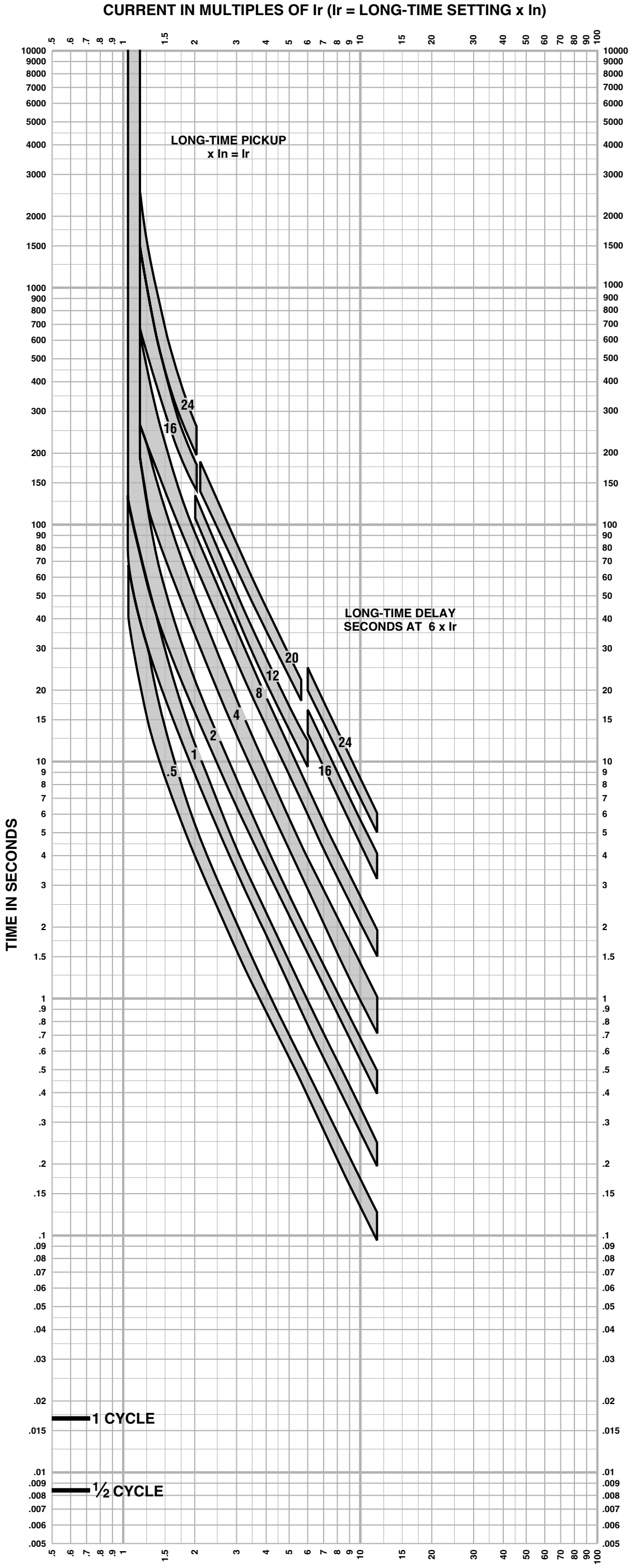
**MICROLOGIC 3.0**

- Basic circuit protection including long-time, instantaneous

**Contact your Square D sales representative for additional information. Or, visit www.SquareD.com.**


Order Number 0612HO0201

SQUARE D
Schneider Electric




## MICROLOGIC® 3.0 A TRIP UNIT CHARACTERISTIC TRIP CURVE NO. 613-6

Long-time Pickup and Delay

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

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

**Notes:**

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the instantaneous setting.
3. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
4. See 613-8 for instantaneous pickup trip curve.

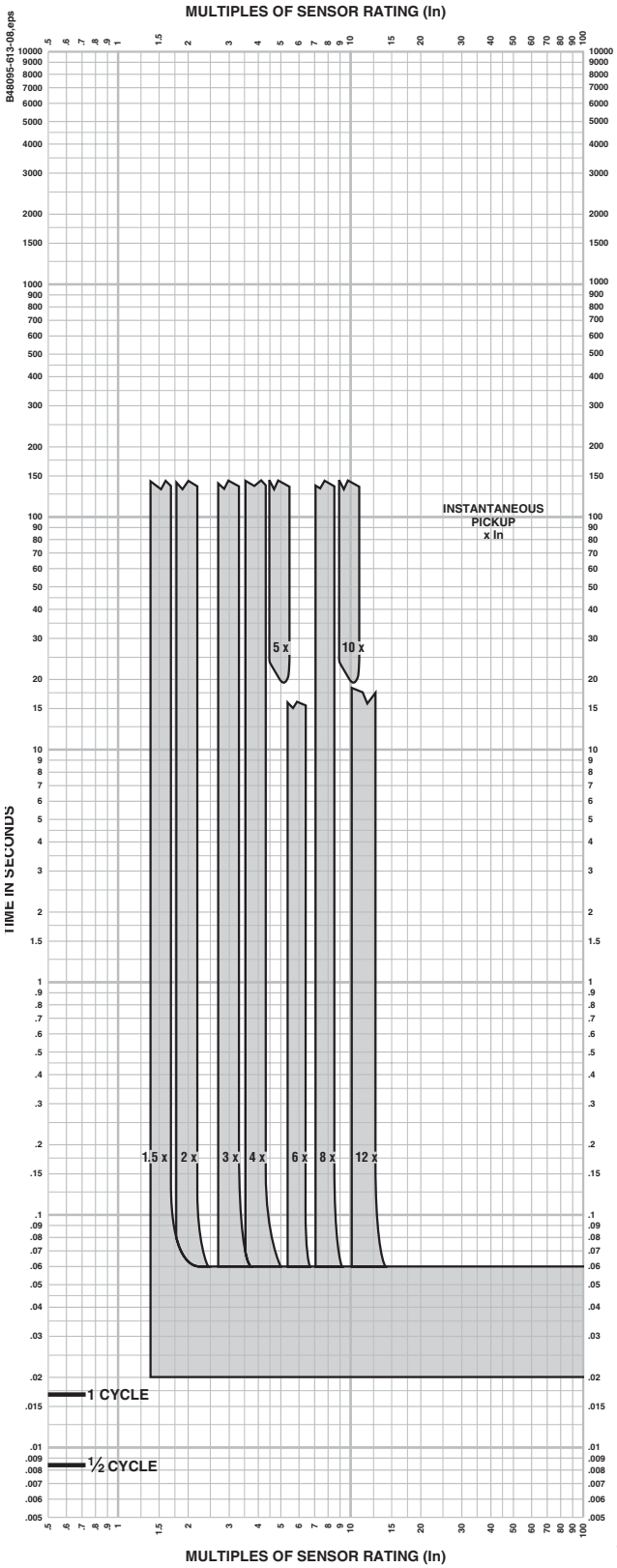
Merlin Gerin
Modicon
Square D
Telemecanique
Federal Pioneer
Federal Pacific
*Schneider Electric Brands*

Schneider Electric



Curve No. 0613TC0006
December 2000
Drawing No. B48095-613-06

## Micrologic 3.0A Trip Unit Characteristic Trip Curve




**Micrologic 3.0A Trip Unit**

**Instantaneous Pickup, 1.5X to 12X**

Characteristic Trip Curve No. 613-8

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

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

**Notes:**

The end of the curve is determined by the interrupting rating of the circuit breaker.

Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.

The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local sales office for additional information.

See trip curve 613-6 on page 112 for long-time pickup and delay trip curves.

Curve No. 0613TC0008
Drawing No. B48095-613-08

**Table 72: Instantaneous Override Values Characteristic Trip Curve**

| UL/IEC Circuit Breaker | Instantaneous Override[1] (kA RMS) | | |
|---|---|---|---|
| RL 1600 | 48 ± 15% | | |

[1] Note: Faults at or above instantaneous override value will be cleared at 25 msec or less.

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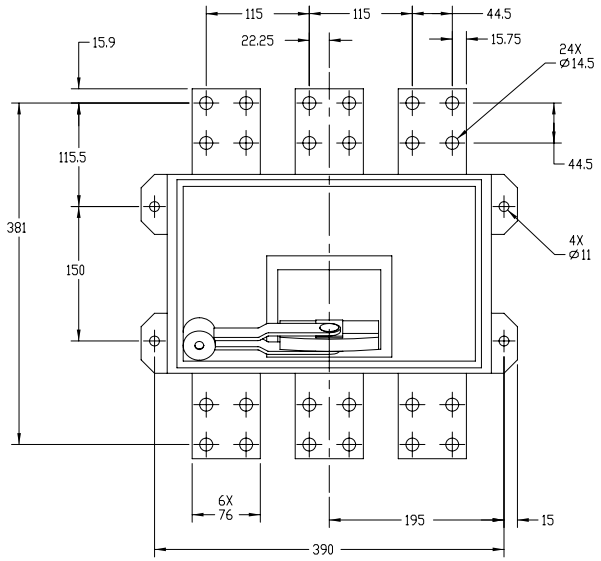
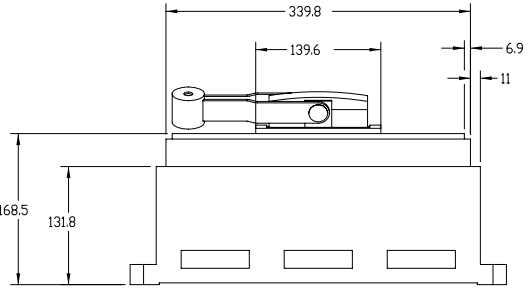
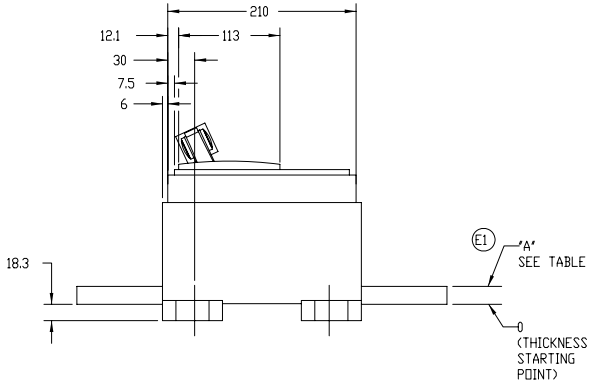
| 0320_2164 | D | Pro/ENGINEER | METRIC DWG |
|---|---|---|---|

| REL NO | LTR | NO | REVISION | ZONE | DR | CHKR | APPROVED | DATE |
|---|---|---|---|---|---|---|---|---|
| FRD16140 | A | 1 | PRODUCTION_RELEASE | - | DC | EC | EC | 03-21-03 |
| FRD16280 | B | 1 | 3.0 TRIP WAS 5.0 TRIP. ADD (LI). | 2D | DC | EC | EC | 04-08-03 |
| | | 2 | CHANGE TABLE | 2C | DC | EC | EC | 04-08-03 |
| | | 3 | RL WAS RG | 2B | DC | EC | EC | 04-08-03 |
| FRD19293 | C | 1 | ADD AND RELEASE DASH NOS. -04, -05, -06 | 3C | BMM | PL | LARSON | 04-06-04 |
| | | 2 | ADD NOTE 7 | 2B | BMM | PL | LARSON | 04-06-04 |
| FRD20299 | D | 1 | REMOVE -04, -05, -06 FROM AMP SETTINGS | 2-C | SJG | PPL | LARSON | 06-07-04 |
| | | 2 | REVISE INTERRUPTING RATINGS | 2-C | SJG | PPL | LARSON | 06-07-04 |
| | | 3 | ADD MATERIAL TO -04, -05, -06 | 1-A | SJG | PPL | LARSON | 06-07-04 |
| FRD21286 | E | 1 | RMV DIM 20, ADD NOTE REFERENCING TABLE | 3-A | SJG | PPL | LARSON | 08-31-04 |
| | | 2 | ADD TERMINAL THICKNESS TABLE | 4-C | SJG | PPL | LARSON | 08-31-04 |
| FRD26895 | F | 1 | NOTE 4, "NO LUGS" WAS "STABS ONLY" | - | WP | PPL | LARSON | 03-22-06 |




NOTES:

1. THIS PART IS VENDOR SOURCE CONTROLLED.
2. (B1) ELECTRONIC TRIP CIRCUIT BREAKER. STANDARD MICROLOGIC 3.0 TRIP UNIT. (LI)
3. (D1) BREAKERS TO BE SUPPLIED WITH TYPE F PLUG.

| TYPE F PLUG AMPERAGE SETTINGS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TYPE F | 84% | 86% | 88% | 90% | 92% | 94% | 96% | 98% | 100% |
| -01 | 2100 | 2150 | 2200 | 2250 | 2300 | 2350 | 2400 | 2450 | 2500 |
| -02 | 1680 | 1720 | 1760 | 1800 | 1840 | 1880 | 1920 | 1960 | 2000 |
| -03 | 1344 | 1376 | 1408 | 1440 | 1472 | 1504 | 1536 | 1568 | 1600 |

4. BREAKERS TO BE SUPPLIED WITH NO LUGS (AS SHOWN).
5. (D2) AGENCIES: 3 POLE UL LISTED
   IEC
6. INTERRUPTING RATING

| CIRCUIT BREAKER | UL/CSA RATING (60 Hz) | | | IEC 60947-2 RATING (50/60 Hz) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 240 Vac | | 380/415 Vac | |
| | 240 Vac | 480 Vac | 600 Vac | Icu | Ics | Icu | Ics |
| RL | 125 kA | 100 kA | 50 kA | 125 kA | 65 kA | 85 kA | 45 kA |

(C2)

7. LEVEL OF OPERATION ABOVE 80% CONTINUOUS LOAD REQUIRES SPECIAL TESTING, INSTALLATION AND APPLICATION REQUIREMENTS PER VENDOR LITERATURE.

(E2)

| BREAKER SIZE | TERMINAL THICKNESS 'A' | |
|---|---|---|
| | mm | [IN] |
| 1600 A | 12.8 | [0.50] |
| 2000 A | 16.0 | [0.63] |
| 2500 A | 20.0 | [0.79] |

(B3)

| PRODUCTION P/N | BREAKER | POLES | RATINGS | PLUG TYPE |
|---|---|---|---|---|
| 0320_2164_01 | RL2500 | 3 | SEE NOTE 6 | F |
| 0320_2164_02 | RL2000 | 3 | SEE NOTE 6 | F |
| 0320_2164_03 | RL1600 | 3 | SEE NOTE 6 | F |

-THIS IS A CONTROLLED PRODUCT-
PER CMMN PROCEDURE PRE-1002

TO MAINTAIN COMPLIANCE WITH REQUIRED EXITS OF THE CODES, STANDARDS, OR AGENCIES LISTED B BELOW

☐CSA ☐UL ☐IEC ☐KVDA ☐ABYC ☐OTHER ☐OTHER

AND/OR ASSIGN INTERNAL CMMN DESIGN C CONTROL FACILITIES ☐

CHANGES, DEVIATIONS, OR SUBSTITUTIO NS OF MATERIAL, PROCESS, OR PERFORMANCE FOR THIS PR ODUCT MUST BE APPROVED BY THE FOLLOWING DESIGN CONTROL FACILITIES

DESIGN CONTROL FACILITY

DESIGN CONTROL FACILITY

DO NOT SCALE PRINT

ANG TOL± 1.0 °

DRAWN TO SCALE OF 3/8

TOLERANCE UNLESS OTHERWISE SPECIFIED

| | mm | | Inch | |
|---|---|---|---|---|
| DIM | X ± 1 | | X ± | |
| | .X ± 0.8 | | .XX ± | |
| | .XX ± 0.38 | | .XXX ± | |

| | | | |
|---|---|---|---|
| 0.0 - 4.99 | ±0.5 / ±0.8 | 284 - 288 | ±0.6 / ±0.3 |
| 5.00 - 9.99 | ±0.29 / ±0.8 | 289 - 431 | ±0.8 / ±0.4 |
| 10.00 - 17.49 | ±0.25 / ±0.3 | 432 - 703 | ±0.8 / ±0.5 |
| 17.50 - 24.99 | ±0.30 / ±0.3 | 704 - 999 | ±0.12 / ±0.5 |

DIM TO .
COPIED FROM .

THIRD ANGLE PROJECTION

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| ITEM | PART NO | DWG SIZE | DESCRIPTION OR MATERIAL | REF DES |
|---|---|---|---|---|

| | NAME | DATE |
|---|---|---|
| DR | D CRANE | 03-21-03 |
| CHKR IF MFG ☐ | E_CZECHOWSKI | 03-21-03 |
| APPROVED | E_CZECHOWSKI | 03-21-03 |

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, REFER TO ANSI Y14.5M-1982

MODEL FIRST USED ON HC6/HC7

SITE CODE PGA

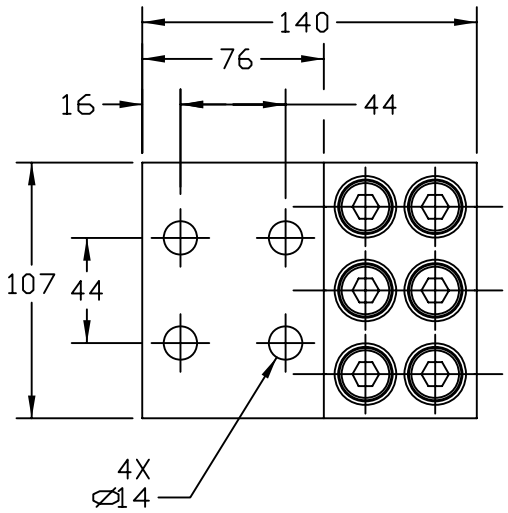
CUMMINS POWER GENERATION
1400 73RD AVE NE
MINNEAPOLIS, MINNESOTA 55432

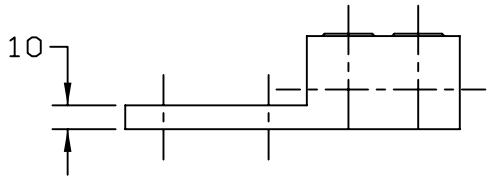
TITLE CIRCUIT_BREAKER .

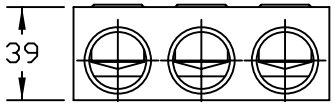
DWG NO 0320_2164 SHEET 1 #1 REV D

| 0332_3949 | B | Pro/ENGINEER | METRIC DWG |
|---|---|---|---|

| REL NO | LTR | NO | REVISION | ZONE | DR | CHKR | APPROVED | DATE |
|---|---|---|---|---|---|---|---|---|
| FRD16141 | A | 1 | PRODUCTION_RELEASE | – | DC | EC | EC | 03-24-03 |




NOTES:

1. THIS PART IS VENDOR SOURCE CONTROLLED. SEE APPROVED PRODUCT VENDOR LIST.
2. TYPE L3D4-600 ELECTRO TIN PLATED.
3. WIRE SIZE #2 TO 600 MCM.
4. MATERIAL 6061-T6 ALUMINUM.
5. CSA / UL 90°C RATING 486B LISTED.

QTY. (2) SUPPLIED PER PHASE.

USE FOR INTERNAL CONTROL ONLY

THIS DOCUMENT IS CONTROLLED TO MAINTAIN COMPLIANCE WITH CODES AND STANDARDS:

☒ UL ☒ CSA ☐ US TESTING ☐ OTHER _____

AND/OR TO RETAIN DESIGN RESPONSIBILITY. ☐

ANY CHANGES OR DEVIATIONS TO THIS DOCUMENT MUST BE APPROVED BY THE COORDINATOR LISTED.

FACILITY _____ DATE _____

SIGNATURE _____

FACILITY _____ DATE _____

SIGNATURE _____

DO NOT SCALE PRINT

ANG TOL ± 1.0°

DRAWN TO SCALE OF 1/2

| TOLERANCE UNLESS OTHERWISE SPECIFIED | mm | Inch |
|---|---|---|
| DIM | X ± 1<br>.X ± 0.8<br>.XX ± 0.38 | .X ±<br>.XX ±<br>.XXX ± |
| HOLE | 0.09- 4.99 +0.15/-0.08<br>5.00- 9.99 +0.20/-0.10<br>10.00-17.49 +0.25/-0.13<br>17.50-24.99 +0.30/-0.13 | .004-.200 +.006/-.003<br>.201-.421 +.008/-.004<br>.422-.703 +.010/-.005<br>.704-.999 +.012/-.005 |

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| ITEM | PART NO | DWG SIZE | DESCRIPTION OR MATERIAL | REF DES |
|---|---|---|---|---|

| | NAME | DATE |
|---|---|---|
| DR | D_CRANE | 03-24-03 |
| CHKR ☒ MFG ☐ | E_CZECHOWSKI | 03-24-03 |
| APPROVED | E_CZECHOWSKI | 03-24-03 |

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982

MODEL FIRST USED ON: HC6/HC7 CB

SITE CODE: PGA

CUMMINS POWER GENERATION
1400 73RD AVE NE
MINNEAPOLIS, MINNESOTA 55432

TITLE: LUG-CABLE (SOLDERLESS)

DWG NO: 0332_3949

SHEET: 1 OF 1

DWG SIZE: B

Pro/ENGINEER

| REL NO | LTR | NO | REVISION | DRN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-133490 | B | 1 | TITLE BLOCK; TITLE WAS "CIRCUIT BRKR OUTLINE" | BTW | JWC | R.CHANGELA | 27MAR13 |
| | | 2 | UPDATE TABLE 3; ADD GENSET MODELS DQFAE, DQFAF, DQFAG AND DQFAH | BTW | JWC | R.CHANGELA | 27MAR13 |

## TABLE 1

| UL/IEC LUGS | | | | | ACCESSORY SPECIFICATIONS | | | |
|---|---|---|---|---|---|---|---|---|
| LUG | FRAME | MAX AMPS | WIRE RANGE COPPER | DIM D ±25 [1.0] | ACCESSORY DESCRIPTION | CONTACT RATING | INRUSH | CONNECTION TYPE |
| | SQUARE D NSJ | 400A 3 OR 4 POLE | #2-600 KCMIL | 554 [21.8] | 24 VDC SHUNT TRIP | ---------- | 10A (10) | COMPRESSION TERMINALS #20-16 AWG OR SMALLER TORQUE: 10 LB-IN |
| | SQUARE D NSJ W/STR23SP TRIP UNIT | 600A 3-POLE | 2/0-350 KCMIL | 554 [21.8] | 24 VDC SHUNT TRIP | ---------- | 10A (10) | COMPRESSION TERMINALS #20-16 AWG OR SMALLER TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 1 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | |
| (14) | SQUARE D P 800 W/MICROLOGIC 3.0 TRIP UNIT | 800A 3-POLE | 3/0-500 KCMIL | 599 [23.5] | 24 VDC SHUNT TRIP | ---------- | 200VA (10) | COMPRESSION TERMINALS FOR 1 OR 2 #18-14 AWG. TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 1 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 10 LB-IN |
| (15) | SQUARE D P 1200 W/MICROLOGIC 3.0 TRIP UNIT | 1200A 3-POLE | 3/0-500 KCMIL | 556 [21.8] | 24 VDC SHUNT TRIP | ---------- | 200VA (10) | COMPRESSION TERMINALS FOR 1 OR 2 #18-14 AWG. TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 1 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 10 LB-IN |
| | SQUARE D R [redacted] 1600 3-POLE 1600 [redacted] AMP BUS BARS STANDARD W/MICROLOGIC 3.0 TRIP UNIT | NEMA HOLE PATTERN | | 490 [19] | 24 VDC SHUNT TRIP | ---------- | 200VA (10) | COMPRESSION TERMINALS FOR 1 OR 2 #18-14 AWG. TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 4 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 10 LB-IN |
| | R 2500/2000/1600 W/OPTIONAL LUG (3) 1600-2500 AMP BREAKERS TORQUE 375 IN LBS [42 Nm] | #2-600 KCMIL | | 490 [19] | 24 VDC SHUNT TRIP | ---------- | 200VA (10) | COMPRESSION TERMINALS FOR 1 OR 2 #18-14 AWG. TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 4 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 10 LB-IN |

## TABLE 2

TYPICAL CONDUIT AND WIRE SIZE BASED ON NEC 2008, ARTICLE 310.15 AT 75C TEMPERATURE RATED CONDUCTOR AT 30C AMBIENT AND ANNEX C (LIQUID TIGHT FLEXIBLE METAL CONDUIT - LFMC)

(8)

| MAX BRKR AMPS | WIRE (COPPER) | | CABLE AMPACITY | TOTAL NUMBER OF CONDUITS | |
|---|---|---|---|---|---|
| | QTY | SIZE | | QTY | SIZE (IN INCHES) |
| 2500 | 6 | 600 KCMIL | 420 | 6 | 4 |
| 2000 | 5 | 600 KCMIL | 420 | 5 | 4 |
| 1600 | 5 | 600 KCMIL | 420 | 5 | 4 |
| 1200 | 3 | 500 KCMIL | 385 | 3 | 3 |
| 1000 | 3 | 400 KCMIL | 335 | 3 | 3 |
| 800 | 2 | 300 KCMIL | 285 | 2 | 3 |
| 630 | 2 | 350 KCMIL | 310 | 2 | 3 |
| 600 | 2 | 350 KCMIL | 310 | 2 | 3 |
| 400 | 1 | 600 KCMIL | 420 | 1 | 4 |
| 250 | 1 | 250 KCMIL | 255 | 1 | 2 1/2 |
| 100 | 1 | 2 KCMIL | 115 | 1 | 2 |

TYPICAL CONDUIT AND WIRE SIZE BASED ON NEC 2008, ARTICLE 310.15 AND TABLE 310-16 AT 75C TEMPERATURE RATED CONDUCTOR AT 40C AMBIENT AND ANNEX C (LIQUID TIGHT FLEXIBLE METAL CONDUIT - LFMC)

(8)

| MAX BRKR AMPS | WIRE (COPPER) | | CABLE AMPACITY | TOTAL NUMBER OF CONDUITS | |
|---|---|---|---|---|---|
| | QTY | SIZE | | QTY | SIZE (IN INCHES) |
| 2500 | 6 | 750 KCMIL | 418 | 6 | 4 |
| 2000 | 5 | 700 KCMIL | 405 | 5 | 4 |
| 1600 | 4 | 700 KCMIL | 405 | 4 | 4 |
| 1000 | 3 | 500 KCMIL | 334 | 3 | 3 1/2 |
| 800 | 3 | 350 KCMIL | 273 | 3 | 3 |

## TABLE 3

| GENSET MODEL | ALTERNATOR MODEL | DIM "A" | DIM "B" |
|---|---|---|---|
| ☐ DFHA<br>☐ DFHB<br>☐ DFHC<br>☐ DFHD | ☐ HC634G | 659.2 [25.95] | 337.0 [13.27] |
| ☐ DQFAA<br>☐ DQFAB<br>☐ DQFAC<br>☐ DQFAD | ☐ HC634H | 659.2 [25.95] | 337.0 [13.27] |
| ☐ DQFAE | ☐ HC634J | 659.2 [25.95] | 337.0 [13.27] |
| ☐ DQFAF | ☐ HC634K | 760.3 [29.93] | 438.1 [17.25] |
| ☐ DQFAG | ☐ P734B | 742.6 [29.24] | 420.4 [16.55] |
| ☐ DQFAH | ☐ P734C | 742.6 [29.24] | 420.4 [16.55] |

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ±3, .X ±0.8, .XX± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0°

SCALE: 3/64

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DRN K_ZRUST

CKD Z_MOGES

APVD Z_MOGES

DATE 11AUG10

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DFHA,B,C,D

CUMMINS POWER GENERATION

OUTLINE, CIRCUIT BREAKER (30 LITER)

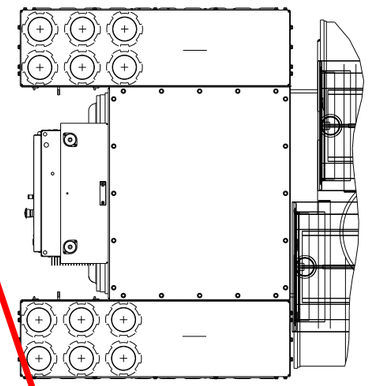
SITE CODE PGF

DWG SIZE D | A034N279 | SHEET 3 OF 3 | DWG REV B

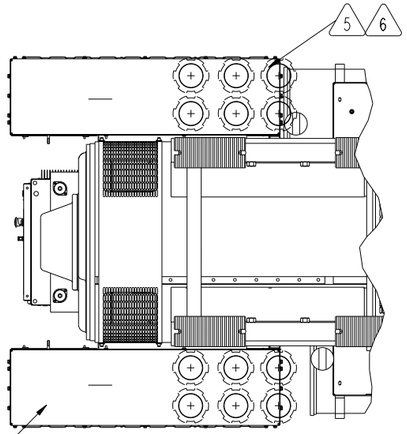
Drawing Name: A034N280 Revision: B
Part Name: A034N279 Revision: B
Sheet 3 of 4

Pro/ENGINEER

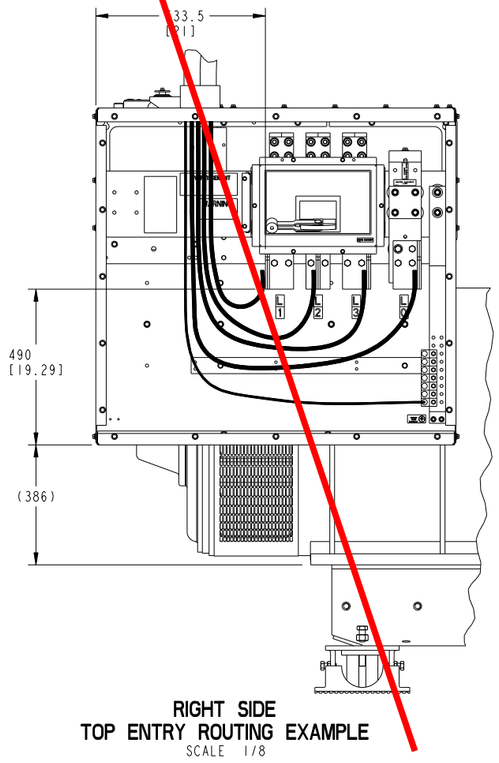
| REL NO | LTR | NO | REVISION | DRN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-133490 | B | 1 | TITLE BLOCK; TITLE WAS "CIRCUIT BRKR OUTLINE" | BTW | JWC | R.CHANGELA | 27MAR13 |



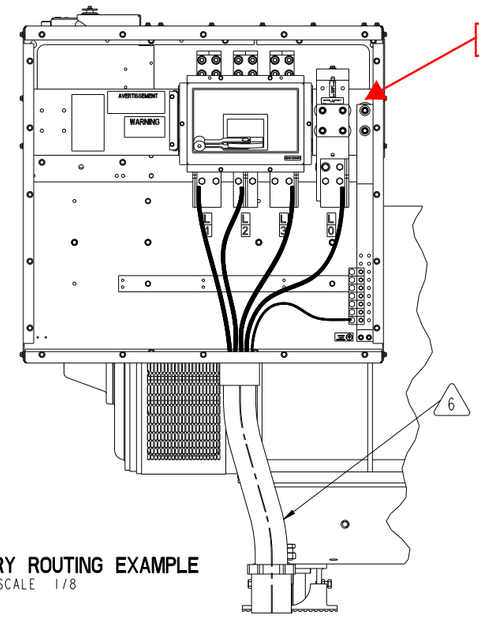
VIEW **B-B**
**TOP ENTRANCE**
SCALE 3/32




VIEW **C-C**
**BOTTOM ENTRANCE**
SCALE 3/32




**RIGHT SIDE**
**TOP ENTRY ROUTING EXAMPLE**
SCALE 1/8




**BOTTOM ENTRY ROUTING EXAMPLE**
SCALE 1/8

| | | | |
|---|---|---|---|
| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | SIM TO | DRN K_ZRUST | CUMMINS POWER GENERATION |
| DIM: X ±3, .X ±0.8, .XX± 0.38 — HOLE: 0.00-4.99 +0.15/-0.08, 5.00-9.99 +0.20/-0.10, 10.00-17.49 +0.25/-0.13, 17.50-24.99 +0.30/-0.13 | DO NOT SCALE PRINT | CHD Z_MOGES | OUTLINE, CIRCUIT BREAKER (30 LITER) |
| ANG TOL: ± 1.0° — SCALE: 3/64 | - CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP | APVD Z_MOGES | SITE CODE: PGF |
| | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING SEE ASME Y14.5M-1994 — FIRST USED ON: DFHA,B,C,D | DATE 11AUG10 | DWG SIZE D: A034N279 — SHEET 2 of 3 — DWG REV B |

Drawing Name: A034N280 Revision: B
Part Name: A034N279 Revision: B
Sheet 2 of 4

# NRG

## Intelligent Engine Start Battery Charger


CONSULTING - SPECIFYING engineer 2009 PRODUCT OF THE YEAR Gold

### The Smart Choice for Mission-Critical Engine Starting

- **Fast, accurate, mission-critical charging** – gives best starting reliability
- **4-rate, temperature-compensated output** – offers longest battery life
- **Replace nearly any charger** – without planning ahead
- **Industry-first battery-fault alarm** – helps dispatch service early
- **Lasting reliability** – field MTBF > 1 million hours with industry-best warranty
- **IBC seismic certification** – meets latest building codes, no installation delays

ISO 9000 c UL US LISTED CE IEC 61000-6-2 IBC 2006

SENS®
STORED ENERGY SYSTEMS

www.sens-usa.com • info@sens-usa.com • Toll-free 866.736.7872 • 303.678.7500

# NRG Battery Charger Benefits and Features


**Failure to start due to battery problems is the leading cause of inoperable engine generator sets.**

SENS NRG battery charger maximizes starting system reliability while slashing genset servicing costs:

**One NRG replaces almost any charger without extra site visits.** Installers can select or change at any time 120, 208 or 240 volts AC input, 12 or 24-volt battery and output settings optimized for nearly any lead-acid or nickel cadmium battery.

**Easy to understand user interface provides state-of-the-art system status** – including digital metering, NFPA 110 alarms and a battery fault alarm that can send service personnel to the site before failure to start.

**Batteries charged by NRG give higher performance and last longer.** In uncontrolled environments precision charging by SENS increases battery life and watering intervals 400% or more.

**NRG meets all relevant industry standards** – including UL, NFPA 110 and CE. Seismic Certification per International Building Code (IBC) 2000, 2003, 2006. All units are C-UL listed. 50/60 Hz units add CE marking to UL agency marks.

***EnerGenius* reliability technology built into every charger includes:**

- All-electronic operation with generous component de-rating
- Disconnected/reversed/incorrect voltage battery alarm and protection
- Protection of connected equipment against load dump transients
- Widest temperature rating, and overtemperature protection
- Superior lightning and voltage transient protection
- Demonstrated field MTBF > 1 million hours
- Standard 3-year warranty (10 years magnetics and power semiconductors) and available 10-year complete warranty with reimbursement of field service costs

## Earn the best return on your charger investment – choose SENS NRG

# NRG Specifications

VAC SHORE POWER PROVIDED BY OTHERS

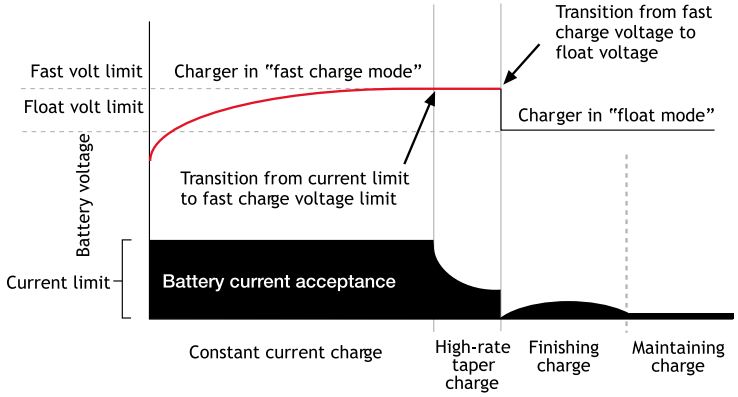
## AC Input

| | |
|---|---|
| Voltage | 110-120/208-240 VAC, ±10%, single phase, field selectable |
| Input current | 10A charger: 6.6/3.3 amps maximum |
| | ~~20A charger: 12.6/6.3 amps maximum~~ |
| Frequency | 60 Hz ±5% standard; 50/60 Hz ±5% optional |
| Input protection | 1-pole fuse, soft-start, transient suppression |

## Charger Output

| | |
|---|---|
| Nominal voltage ratings | 12 or 24 volt nominal |
| Optional voltage rating | 12/24 volt, field selectable |
| Battery settings | Six discrete battery voltage programs |
| | - Low or high S.G. flooded |
| | - Low or high S.G. VRLA |
| | - Nickel cadmium 9, 10, 18, 19 or 20 cells |
| Regulation | ±0.5% (1/2%) line and load regulation |
| Current | 10 or 20 amps nominal |
| Electronic current limit | 105% rated output typical – no crank disconnect required |
| Charge characteristic | Constant voltage, current limited, 4-rate automatic equalization |
| Temperature compensation | Enable or disable anytime, remote sensor optional |
| Output protection | Current limit, 1-pole fuse, transient suppression |

*Standard 4-rate charging*




## User Interface, Indication and Alarms

| | |
|---|---|
| Digital meter | Automatic meter alternately displays output volts, amps[4] |
| Accuracy | ±2% volts, ±5% amps |
| Alarms | LED and Form C contact(s) per table: |


*Front panel status display*

### Alarm System Functions

| | Alarm code "1"[1] | Alarm code "C" (meets requirements of NFPA 110) |
|---|---|---|
| AC good | LED | LED |
| Float mode | LED | LED |
| Fast charge | LED | LED |
| Temp comp active | LED | LED |
| AC fail | LED[2] | LED and Form C contact |
| Low battery volts | | LED and Form C contact |
| High battery volts | | LED and Form C contact |
| Charger fail | LED[2] | LED and Form C contact |
| Battery fault[3] | LED[2] | LED and Form C contact |

1. Alarms "1" available only on 10A charger
2. Form C contact provides summary alarm of these conditions. BBHH chargers include this alarm configuration. Contacts rated 2A @ 30 VDC or .5A @ 125 VAC resistive.
3. Battery fault alarm indicates these fault conditions:
   - Battery disconnected - Battery polarity reversed - Mismatched charger battery voltage - Open or high resistance charger to battery connection - Open battery cell or excessive internal resistance
4. Three-position jumper allows user to select from three display settings: alternating volts / amps (normal), constant volts, or constant amps

## Controls

| | |
|---|---|
| AC input voltage select | Field-selectable switch |
| Optional 12/24-volt output select | Field-selectable two-position jumper |
| Battery program select | Field-selectable six-position jumper |
| Meter display select | Field-selectable three-position jumper |
| Fast charger enable/disable | Field-selectable two-position jumper |
| Temp compensation enable | Standard. Can be disabled or re-enabled in the field |
| Remote temp comp enable | Connect optional remote sensor to temp comp port |


*Simple field adjustments*

## Environmental

| | |
|---|---|
| Operating temperature | -20C to +60C, meets full specification to +45C |
| Over temperature protection | Gradual current reduction to maintain safe power device temperature |
| Humidity | 5% to 95%, non-condensing |
| Vibration (10A unit) | UL 991 Class B (2G sinusoidal) |
| Transient immunity | ANSI/IEEE C62.41, Cat. B, EN50082-2 heavy industrial, EN 61000-6-2 |
| Seismic Certification | IBC 2000, 2003, 2006 Maximum $S_{ds}$ of 2.28 g |

## Agency Standards

| | |
|---|---|
| Safety | C-UL listed to UL 1236 (required for UL 2200 gensets), CSA standard 22.2 no. 107.2-M89<br>CE: 50/60 Hz units DOC to EN 60335 |
| Agency marking | 60 Hz: C-UL-US listed<br>50/60 Hz: C-UL-US listed plus CE marked |
| EMC | Emissions: FCC Part 15, Class B; EN 50081-2<br>Immunity: EN 61000-6-2 |
| NFPA standards | NFPA 70, NFPA 110. (NFPA 110 requires Alarms "C") |
| Optional agency compliance | Units with Alarms "1" configuration available with additional compliance to UL category BBHH and NFPA 20 |

## Construction

| | |
|---|---|
| Housing/configuration | Material: Non-corroding aluminum. Configuration options:<br>• Fully enclosed: C-UL listed enclosure<br>• Open frame: C-UL recognized |
| Packaging | Open-frame and Slimline configurations only available in bulk OEM quantities and packaging |
| Dimensions | See Drawings and Dimensions page for details |
| Printed circuit card | Surface mount technology, conformal coated |
| Cooling | Natural convection |
| Protection degree | Listed housing: NEMA-1 (IP20). Optional IP21 drip shield. Optional NEMA 3R enclosure |
| Damage prevention | Fully recessed display and controls |
| Electrical connections | Compression terminal blocks |

## Warranty

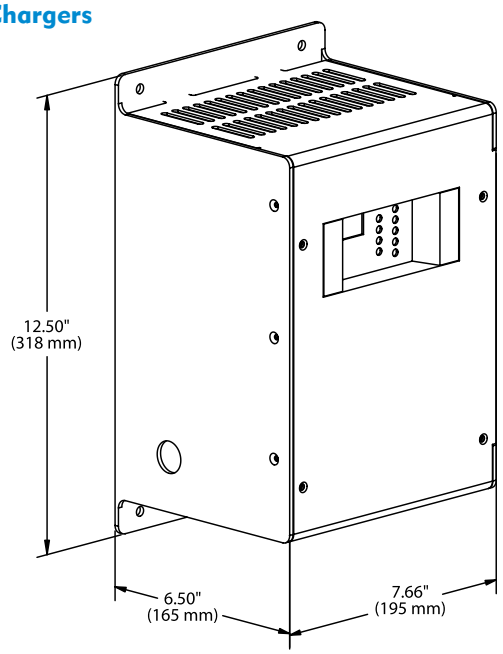
| | |
|---|---|
| Standard warranty | Three year parts and labor warranty (10 years magnetics and power semiconductors) from date of shipment |
| Optional warranty | If specified at time of order, warranty coverage can be increased to reimburse customer's documented field service costs up to the original charger price or increased to 5 or 10 years with field service cost reimbursement. Contact the factory for full details |

## Optional features

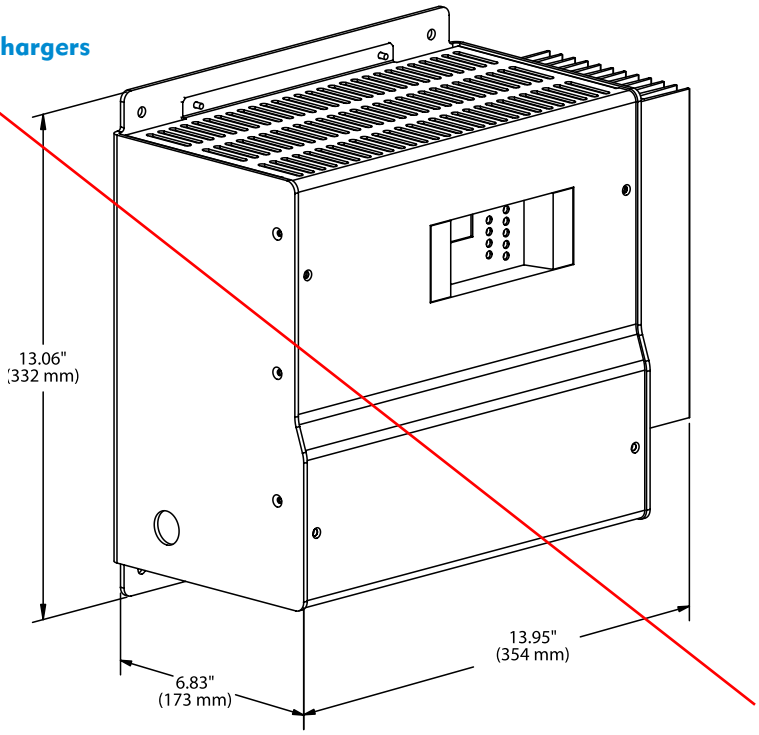
| | |
|---|---|
| Input | Input frequency, 50/60 Hz |
| Remote temp comp sensor | Recommended where battery and charger are in different locations |
| Drip shield meets s/b (IP21) | Protects from dripping water |
| NEMA 3R housing | Enables outdoor installation (remote temp sensor recommended) |
| UL BBHH listing | Available in 10A units with Alarms "1" |
| Field service warranty | Reimbursement of customer field service expenses up to charger price for 3, 5, or 10 years |

# Drawings and Dimensions

### 10A Chargers




### 20A Chargers




**Housing Dimensions Table**

| Amps | Width | Depth | Height |
|---|---|---|---|
| 10 | 7.66" (195 mm) | 6.50" (165 mm) | 12.50" (318 mm) |
| 20 | 13.95" (354 mm) | 6.83" (173 mm) | 13.06" (332 mm) |

## NRG Ordering Information

| Output volts | Output amps | Model | NFPA 110 Alarms | Lbs/Kg | Shipping Lbs/Kg |
|---|---|---|---|---|---|
| 12 | 10 | NRG12-10-RC | Yes | 19 / 8.7 | 21 / 9.5 |
| 24 | 10 | NRG24-10-RC | Yes | 23 / 10.4 | 25 / 11.4 |
| 12/24 | 10 | NRG22-10-R1 | No | 23 / 10.4 | 25 / 11.4 |
| 12/24 | 10 | NRG22-10-RC | Yes | 23 / 10.4 | 25 / 11.4 |
| 12 | 20 | NRG12-20-RC | Yes | 39 / 17.7 | 43 / 19.5 |
| 24 | 20 | NRG24-20-RC | Yes | 42 / 19.1 | 46 / 20.9 |
| 12/24 | 20 | NRG22-20-RC | Yes | 42 / 19.1 | 46 / 20.9 |

All models offer field-selectable input 120/208-240 volts. 60 Hz input is standard with C-UL listing. Optional 50/60 Hz input includes C-UL listing and adds CE mark.

### Model Number Breakout

NRG 2 2 – 1 0 – R C L S

**Model**

**Output voltage**
- 12: 12 volts
- 24: 24 volts
- 22: 12/24-volt field selectable

**Output current**
- 10: 10 amps
- 20: 20 amps

**AC input**
- R: 120/208-240 VAC, 60 Hz
- H: 120/208-240 VAC, 50/60 Hz

**Alarm system code**
- 1: LED and single Form C contact
- C: LEDs and Form C contacts to meet NFPA 110

**UL category code**
- S: UL category BBGQ (standard)
- H: UL category BBHH (Alarms "1" only)

**Housing/Agency**
- L: Enclosed: C-UL listed

## The Smart Choice for Mission-Critical Engine Starting

### Additional Information

Contact SENS or your local sales representative for additional specification, engineering and installation information. Check the SENS web site for latest available data. Specification is subject to change without notice.

### Contact Information

**For information and service on any SENS product, please contact us at:**
**Sales 1.866.736.7872 • 303.678.7500 • Fax 303.678.7504**
**www.sens-usa.com • info@sens-usa.com**
**1840 Industrial Circle, Longmont, CO 80501 USA**

SENS®
STORED ENERGY SYSTEMS

# STOP!

**Verify that all settings shown below are correct *before energizing charger*. CAUTION: Correct settings are essential to ensure proper battery performance and long battery life. *Before installation*, ensure adequate battery to charger wire gauge. Wire gauge that is too small may activate the open battery detector and the charger will shut down:**

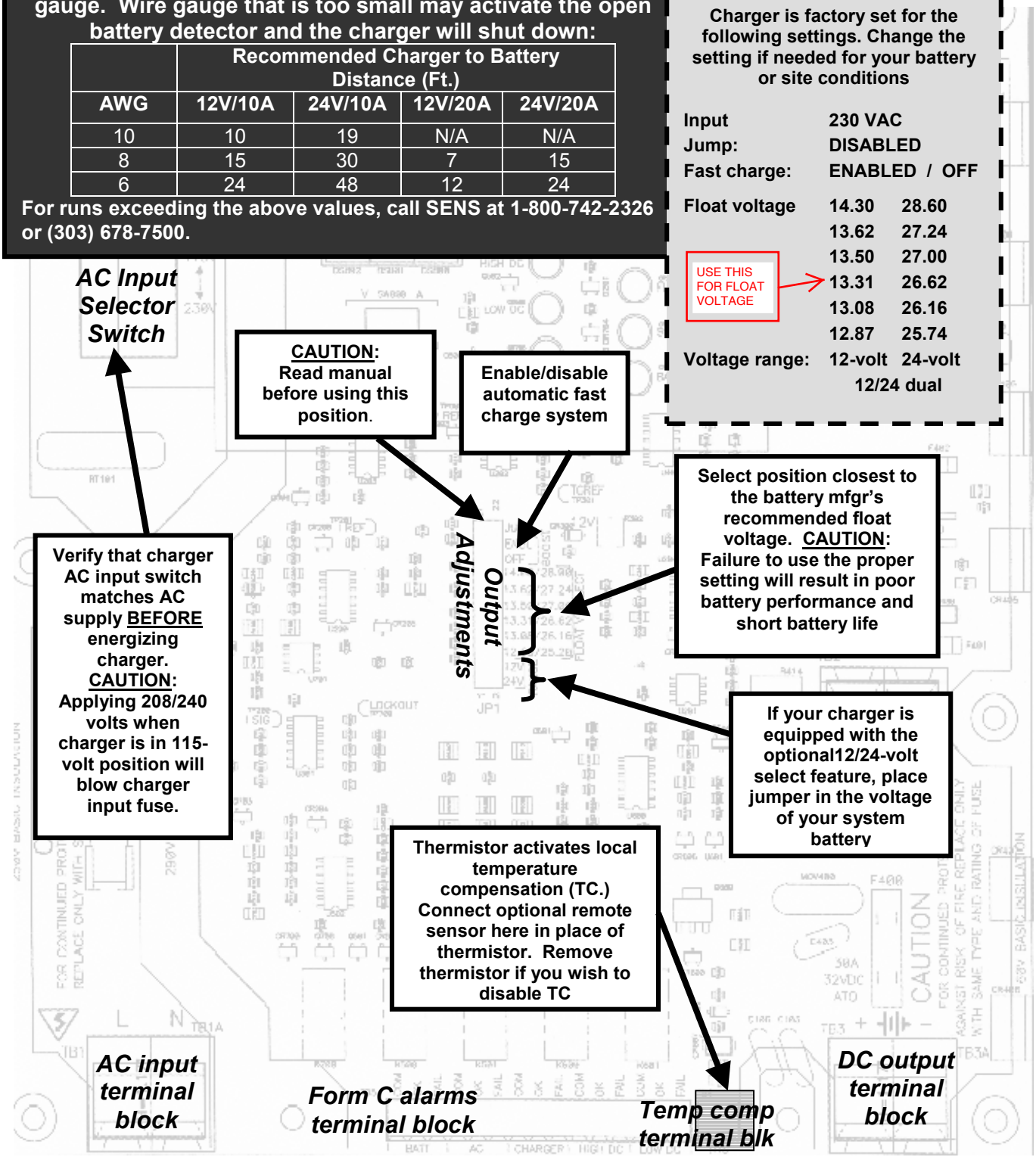
| | Recommended Charger to Battery Distance (Ft.) | | | |
|---|---|---|---|---|
| AWG | 12V/10A | 24V/10A | 12V/20A | 24V/20A |
| 10 | 10 | 19 | N/A | N/A |
| 8 | 15 | 30 | 7 | 15 |
| 6 | 24 | 48 | 12 | 24 |

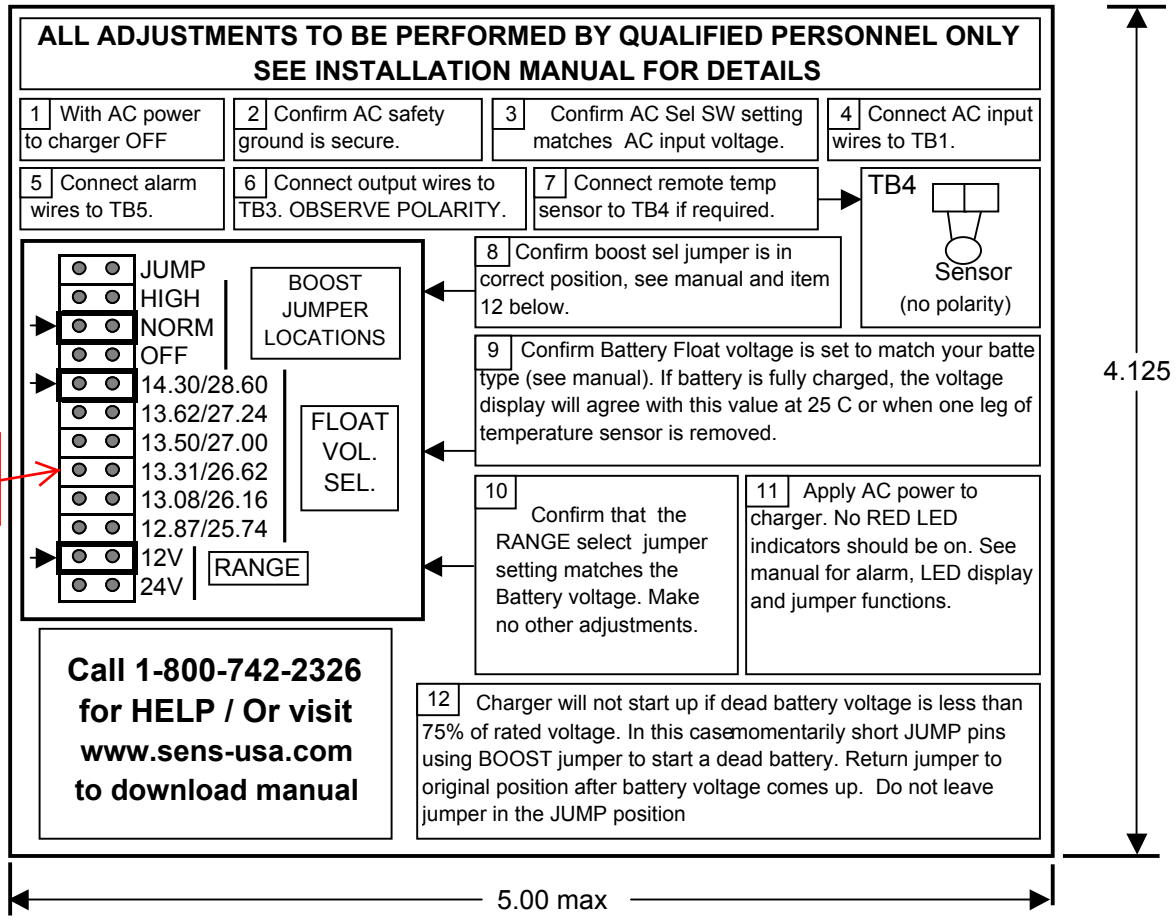
**For runs exceeding the above values, call SENS at 1-800-742-2326 or (303) 678-7500.**

## FACTORY SETTINGS

**Charger is factory set for the following settings. Change the setting if needed for your battery or site conditions**

| | | |
|---|---|---|
| Input | 230 VAC | |
| Jump: | DISABLED | |
| Fast charge: | ENABLED / OFF | |
| Float voltage | 14.30 | 28.60 |
| | 13.62 | 27.24 |
| | 13.50 | 27.00 |
| USE THIS FOR FLOAT VOLTAGE → | 13.31 | 26.62 |
| | 13.08 | 26.16 |
| | 12.87 | 25.74 |
| Voltage range: | 12-volt | 24-volt |
| | 12/24 dual | |






NOTES:

1. LETTERING TO BE BLACK INK ON SILVER FOIL LABEL, MATERIAL RATED PER R/C (PGDQ2). LABEL ADHESIVE PROVIDED MUST BE SUITABLE FOR USE ON ALUMINUM & RATED FOR 80 DEG C MINIMUM.
2. PSA MATERIAL IS TO BE PROVIDED WITH RELEASE LINER.
3. RADIUS CORNERS .125" MAXIMUM.

4. THIS DRAWING NOT TO SCALE.

SENS
*Our energy means business*

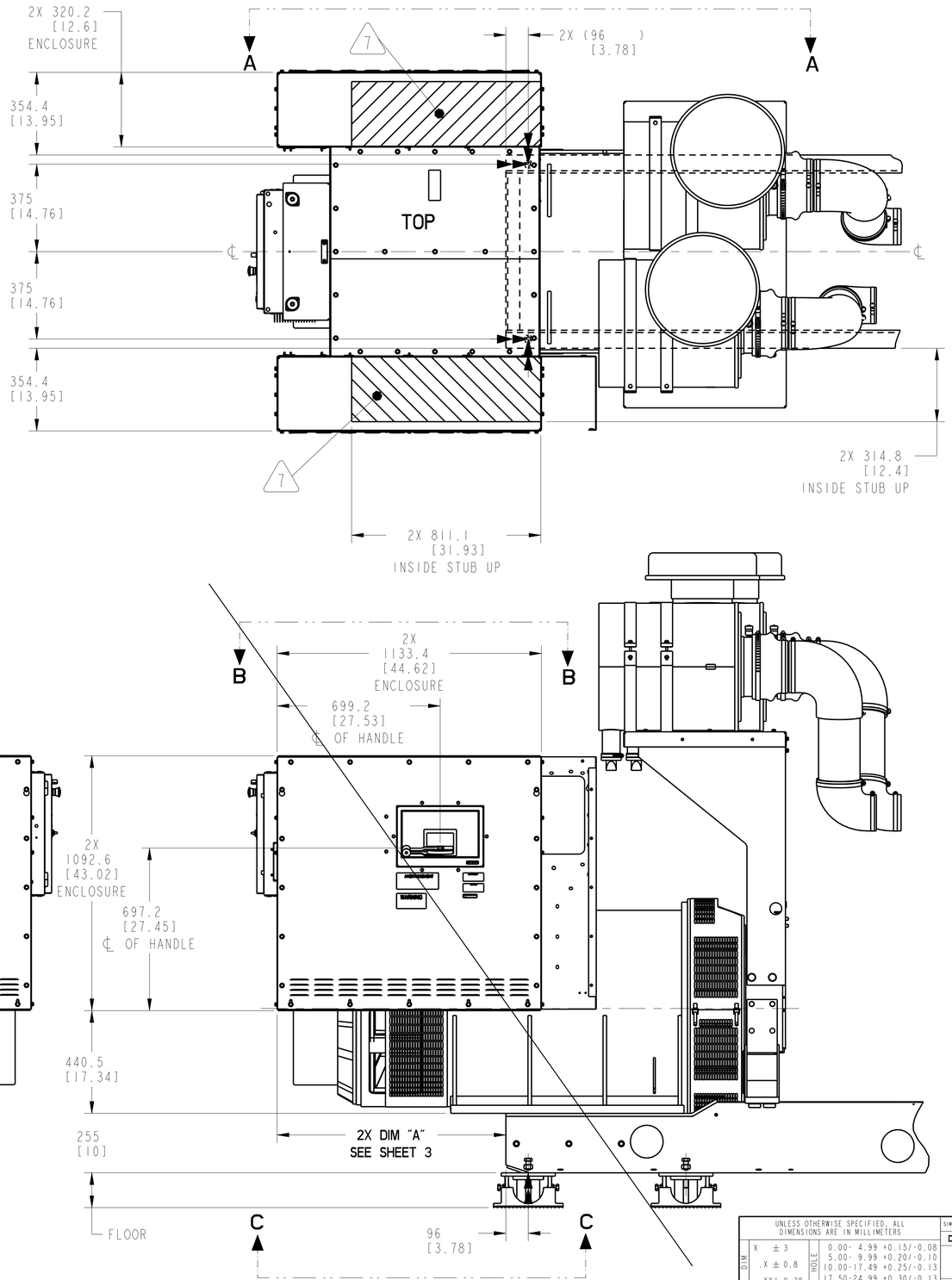
| | | | |
|---|---|---|---|
| DCN No. | 105073 | | |
| Drawn By: | KL | Date: | 1/13/2006 |
| Approved By: | | Date: | |
| DWG Name: | LABEL, INSIDE COVER, NRG10/20 | | |
| PN: 808526 | DWG REV. | C | |

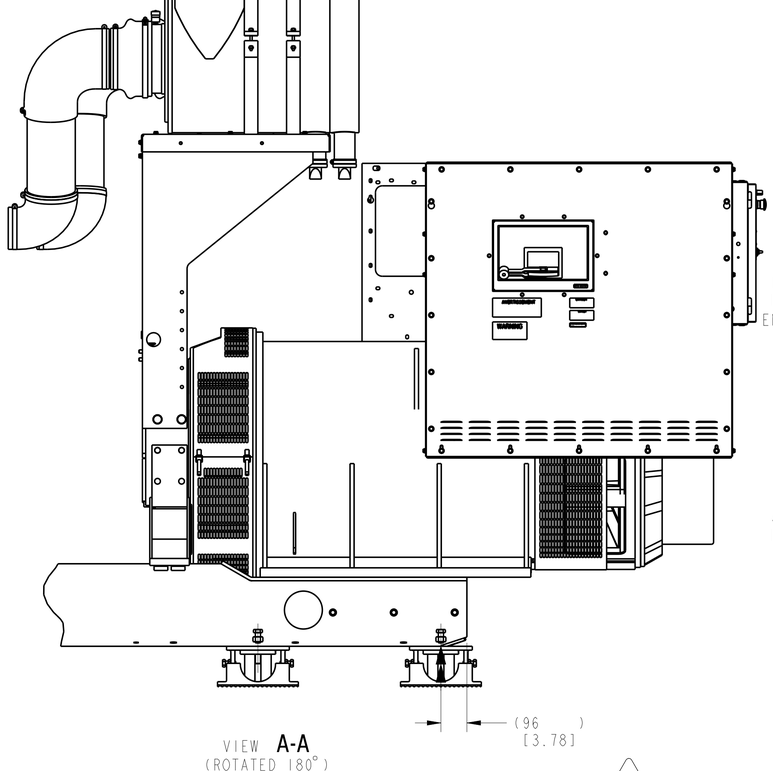
# Drawings

PTC® Creo® Parametric

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-183842 | E | 1 | ZONE D6; ADD NOTE "HC6/P7" | PPB | VSH | S.NAGARAJU | 25FEB19 |
| | | 2 | UPDATE NOTES- SEE ECO | PPB | VSH | S.NAGARAJU | 25FEB19 |
| | | 3 | SEE SHEET 2 | PPB | VSH | S.NAGARAJU | 25FEB19 |
| | | 4 | SEE SHEET 3 | PPB | VSH | S.NAGARAJU | 25FEB19 |
| | | 5 | ADD SHEET 4 | PPB | VSH | S.NAGARAJU | 25FEB19 |
| | | 6 | ADD SHEET 5 | PPB | VSH | S.NAGARAJU | 25FEB19 |

# HC6/P7




VIEW **A-A**
(ROTATED 180°)

LEFT SIDE ENTRY 11




RIGHT SIDE ENTRY

NOTES:

1. DIMENSIONS SHOWN IN [ ] ARE IN INCHES.
2. COMMON REFERENCE POINT ON GENSET SKID ( ⟶ ). POINTS TO ANCHORING HOLE ON SKID. SEE GENSET_OUTLINE (FOUNDATION) FOR DETAILS.
3. LISTED TORQUE VALUES ARE FOR MAXIMUM CONDUCTOR SIZES ACCOMMODATED. CONSULT UL 486 TABLE 7-4, 7-5 AND 7-6 FOR SMALLER CONDUCTOR SIZES.
4. ALL ITEMS SHOWN IN ILLUSTRATION ARE FOR REFERENCE ONLY.
5. ELECTRICAL CONDUITS MUST:
   - PROVIDE FLEXIBLE CONNECTION (USING FLEXIBLE CONDUIT AND CABLES).
   - 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.
6. CONDUIT AND CABLE INSTALLATION SHOULD PROVIDE VIBRATION BETWEEN GENSET AND GROUND.
7. 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.
8. 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.
9. SHUNT TRIP UNITS CAN BE OPERATED AT 75% OF NOMINAL VOLTAGE AND WILL ACCEPT MOMENTARY OR CONTINUOUS APPLIED VOLTAGE.
10. SHUNT TRIP UNITS CAN BE OPERATED AT 70% TO 100% OF NOMINAL VOLTAGE AND WILL ACCEPT MOMENTARY OR CONTINUOUS APPLIED VOLTAGE.
11. ALL DIMENSIONS SHOWN FOR RIGHT SIDE ENTRY ALSO APPLY TO LEFT SIDE ENTRY IN MIRROR ORIENTATION.
12. ALTERNATOR MODEL P734C & R-FRAME CIRCUIT BREAKER ARE SHOWN ON SHEET 1, 2 FOR DRAWING SIMPLICITY.
13. "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.
14. 800 AMP BREAKER:
    A LUG ACCEPTING (2) 3/0-600 kcmil CONDUCTORS IS AVAILABLE THRU ACCESSORIES. PGA PART NUMBER 0332-4278.
15. 1200 AMP BREAKER:
    A LUG ACCEPTING (3) 3/0-600 kcmil CONDUCTORS IS AVAILABLE THRU ACCESSORIES. PGA PART NUMBER 0332-4279.
16. ALTERNATOR MODEL S6E & R-FRAME CIRCUIT BREAKER ARE SHOWN ON SHEET 4, 5 FOR DRAWING SIMPLICITY

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

| DIM | | HOLE | |
|---|---|---|---|
| X | ± 3 | 0.00- 4.99 | +0.15/-0.08 |
| .X | ± 0.8 | 5.00- 9.99 | +0.20/-0.10 |
| .XX | ± 0.38 | 10.00-17.49 | +0.25/-0.13 |
| | | 17.50-24.99 | +0.30/-0.13 |

ANG TOL: ± 1.0° SCALE: 3/32

SIM TO NONE
DO NOT SCALE PRINT
- CONFIDENTIAL -
PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN B_WESTER
CKD M_SIMS
APVD V_KODIMALA
DATE 23SEP11
FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994
FIRST USED ON DFHA,B,C,D

CUMMINS POWER GENERATION

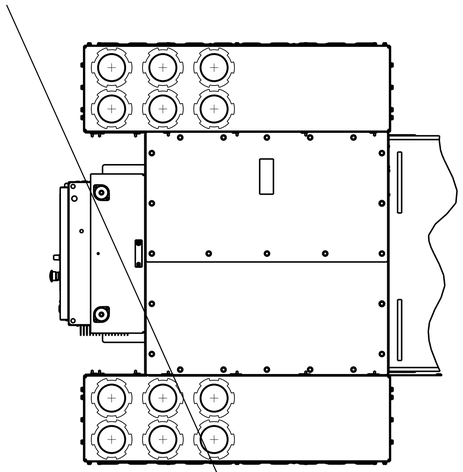
OUTLINE,CIRCUIT BREAKER

SITE CODE PGF
DWG SIZE D
A040V836
SHEET 1 of 5
DWG REV E

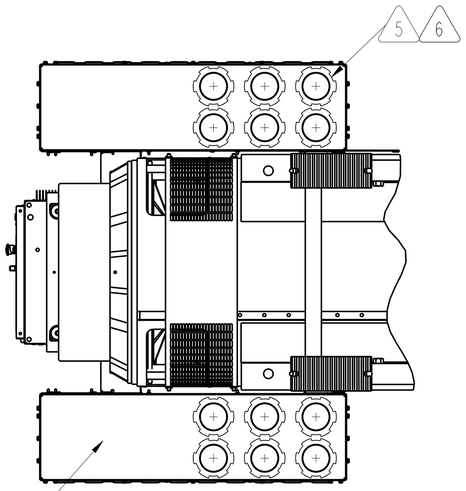
PTC® Creo® Parametric

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-183842 | E | 3 | ZONE D4; ADD NOTE "HC6/P7" | PPB | VSH | S.NAGARAJU | 25FEB19 |

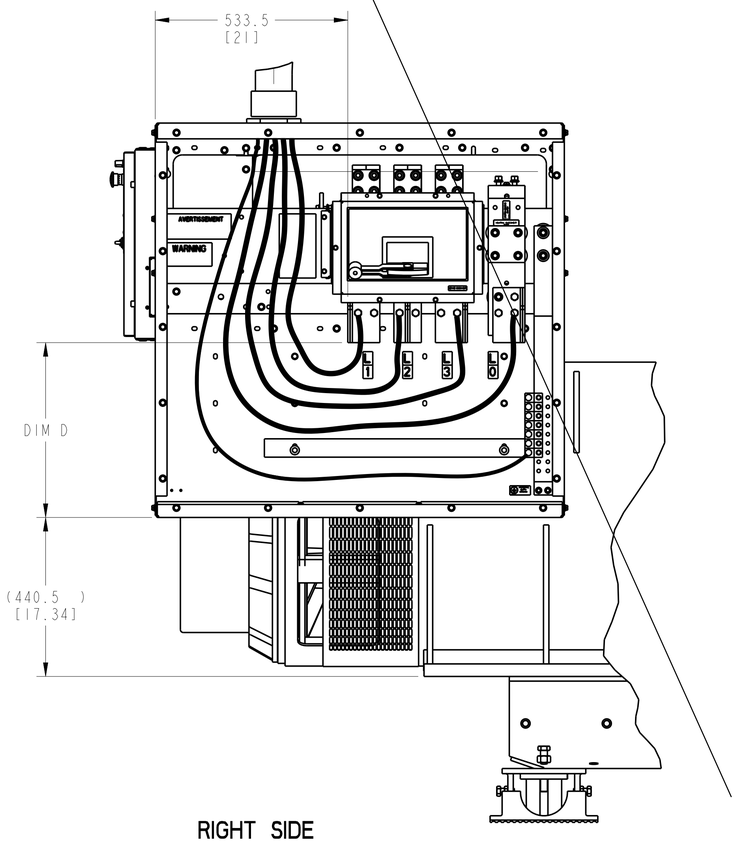
# HC6/P7



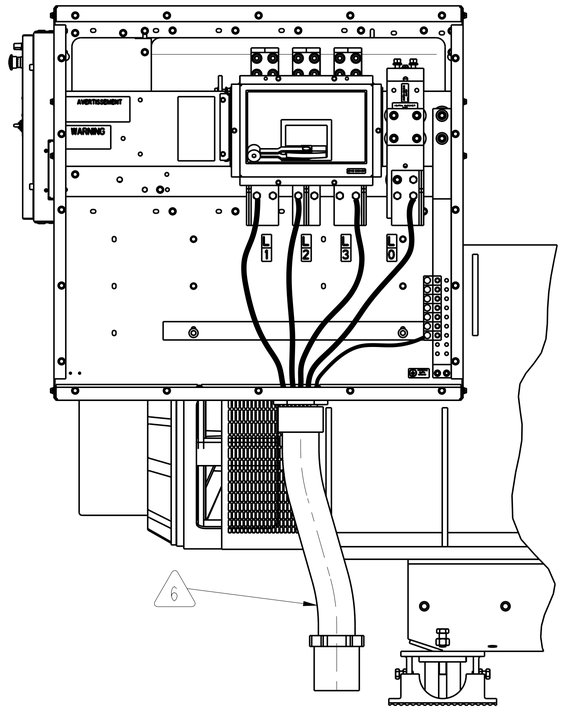
VIEW B-B
TOP ENTRANCE
SCALE 3/32




VIEW C-C
BOTTOM ENTRANCE
SCALE 3/32




RIGHT SIDE
TOP ENTRY ROUTING EXAMPLE
SCALE 1/8




RIGHT SIDE
BOTTOM ENTRY ROUTING EXAMPLE
SCALE 1/8

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

| DIM | | HOLE | |
|---|---|---|---|
| | X ±3 | | 0.00- 4.99 +0.15/-0.08 |
| | .X ±0.8 | | 5.00- 9.99 +0.20/-0.10 |
| | .XX±0.38 | | 10.00-17.49 +0.25/-0.13 |
| | | | 17.50-24.99 +0.30/-0.13 |

ANG TOL: ± 1.0° SCALE: 3/64

SIM TO NONE
DO NOT SCALE PRINT
- CONFIDENTIAL -
PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN B_WESTER
CKD M_SIMS
APVD V_KODIMALA
DATE 23SEP11
FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994
FIRST USED ON DFHA,B,C,D

CUMMINS POWER GENERATION
OUTLINE, CIRCUIT BREAKER
SITE CODE PGF
DWG SIZE D
A040V836
SHEET 2 of 5
DWG REV E

PTC® Creo® Parametric

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-183842 | E | 4 | TABLE 3; ADD DIM"A"<br>S6D - 528[20.77]<br>S6E - 648[24.49]<br>S6F - 648[24.49] | PPB | VSH | S.NAGARAJU | 25FEB19 |

## TABLE 1

| UL/IEC LUGS | | | | | ACCESSORY SPECIFICATIONS | | | |
|---|---|---|---|---|---|---|---|---|
| LUG | FRAME | MAX AMPS | WIRE RANGE COPPER | DIM D ±25 [1.0] | ACCESSORY DESCRIPTION | CONTACT RATING | INRUSH | CONNECTION TYPE |
| | SQUARE D NSJ | 400A 3 OR 4 POLE | #2-600 KCMIL | 554 [21.8] | 24 VDC SHUNT TRIP | ---------- | 10A (10) | COMPRESSION TERMINALS #20-16 AWG OR SMALLER TORQUE: 10 LB-IN |
| | SQUARE D NLGL W/ MICROLOGIC 3.0 TRIP UNIT | 600A 3-POLE | 2/0-350 KCMIL | 554 [21.8] | 24 VDC SHUNT TRIP | ---------- | 10A (10) | COMPRESSION TERMINALS #20-16 AWG OR SMALLER TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 1 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | |
| (14) | SQUARE D P 800 W/MICROLOGIC 3.0 TRIP UNIT | 800A 3-POLE | 3/0-500 KCMIL | 599 [23.5] | 24 VDC SHUNT TRIP | ---------- | 200VA (10) | COMPRESSION TERMINALS FOR 1 OR 2 #18-14 AWG. TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 1 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 10 LB-IN |
| (15) | SQUARE D P 1200 W/MICROLOGIC 3.0 TRIP UNIT | 1200A 3-POLE | 3/0-500 KCMIL | 556 [21.8] | 24 VDC SHUNT TRIP | ---------- | 200VA (10) | COMPRESSION TERMINALS FOR 1 OR 2 #18-14 AWG. TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 1 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 10 LB-IN |
| | SQUARE D R 2500/2000/1600 3-POLE 1600-2500 AMP BUS BARS STANDARD W/MICROLOGIC 3.0 TRIP UNIT | NEMA HOLE PATTERN | | 490 [19] | 24 VDC SHUNT TRIP | ---------- | 200VA (10) | COMPRESSION TERMINALS FOR 1 OR 2 #18-14 AWG. TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 4 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 10 LB-IN |
| | (3) R 2500/2000/1600 W/OPTIONAL LUG 1600-2500 AMP BREAKERS TORQUE 375 IN LBS [42 Nm] | #2-600 KCMIL | | 490 [19] | 24 VDC SHUNT TRIP | ---------- | 200VA (10) | COMPRESSION TERMINALS FOR 1 OR 2 #18-14 AWG. TORQUE: 10 LB-IN |
| | | | | | 1 EA. FORM C 4 AUX CONTACT + 1 TRIP ALARM | 6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125VDC, 0.3A AT 250 VDC | ---- | COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 10 LB-IN |

## TABLE 2

TYPICAL CONDUIT AND WIRE SIZE BASED ON NEC 2008, ARTICLE 310.15 AT 75C TEMPERATURE RATED CONDUCTOR AT 30C AMBIENT AND ANNEX C

(8)

| MAX BRKR AMPS | WIRE (COPPER) | | CABLE AMPACITY | TOTAL NUMBER OF CONDUITS | |
|---|---|---|---|---|---|
| | QTY | SIZE | | QTY | SIZE (IN INCHES) |
| 2500 | 6 | 600 KCMIL | 420 | 6 | 4 |
| 2000 | 5 | 600 KCMIL | 420 | 5 | 4 |
| 1600 | 5 | 600 KCMIL | 420 | 5 | 4 |
| 1200 | 3 | 500 KCMIL | 385 | 3 | 3 |
| 1000 | 3 | 400 KCMIL | 335 | 3 | 3 |
| 800 | 2 | 300 KCMIL | 285 | 2 | 3 |
| 630 | 2 | 350 KCMIL | 310 | 2 | 3 |
| 600 | 2 | 350 KCMIL | 310 | 2 | 3 |
| 400 | 1 | 600 KCMIL | 420 | 1 | 4 |
| 250 | 1 | 250 KCMIL | 255 | 1 | 2 1/2 |
| 100 | 1 | 2 KCMIL | 115 | 1 | 2 |

TYPICAL CONDUIT AND WIRE SIZE BASED ON NEC 2008, ARTICLE 310.15 AND TABLE 310-16 AT 75C TEMPERATURE RATED CONDUCTOR AT 40C AMBIENT AND ANNEX C

(8)

| MAX BRKR AMPS | WIRE (COPPER) | | CABLE AMPACITY | TOTAL NUMBER OF CONDUITS | |
|---|---|---|---|---|---|
| | QTY | SIZE | | QTY | SIZE (IN INCHES) |
| 2500 | 6 | 750 KCMIL | 418 | 6 | 4 |
| 2000 | 5 | 700 KCMIL | 405 | 5 | 4 |
| 1600 | 4 | 700 KCMIL | 405 | 4 | 4 |
| 1000 | 3 | 500 KCMIL | 334 | 3 | 3 1/2 |
| 800 | 3 | 350 KCMIL | 273 | 3 | 3 |

## TABLE 3

| GENSET MODEL | ALTERNATOR MODEL | DIM "A" |
|---|---|---|
| ☐ DQFAA<br>☐ DQFAB<br>☐ DQFAC<br>☐ DQFAD | ☐ HC634G | 654 [25.74] |
| | ☐ HC634H | 654 [25.74] |
| | ☐ HC634J | 654 [25.74] |
| | ☐ HC634K | 755 [29.72] |
| | ☐ P734B | 746 [29.37] |
| | ☐ P734C | 746 [29.37] |
| | ☐ S6D | 528 [20.77] |
| | ☐ S6E | 648 [24.49] |
| | ☐ S6F | |

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ±3; .X ±0.8; .XX± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 3/64

SIM TO NONE

DO NOT SCALE PRINT

- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN B_WESTER

CKD M_SIMS

APVD V_KODIMALA

DATE 23SEP11

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 | FIRST USED ON DFHA,B,C,D

SITE CODE PGF

CUMMINS POWER GENERATION

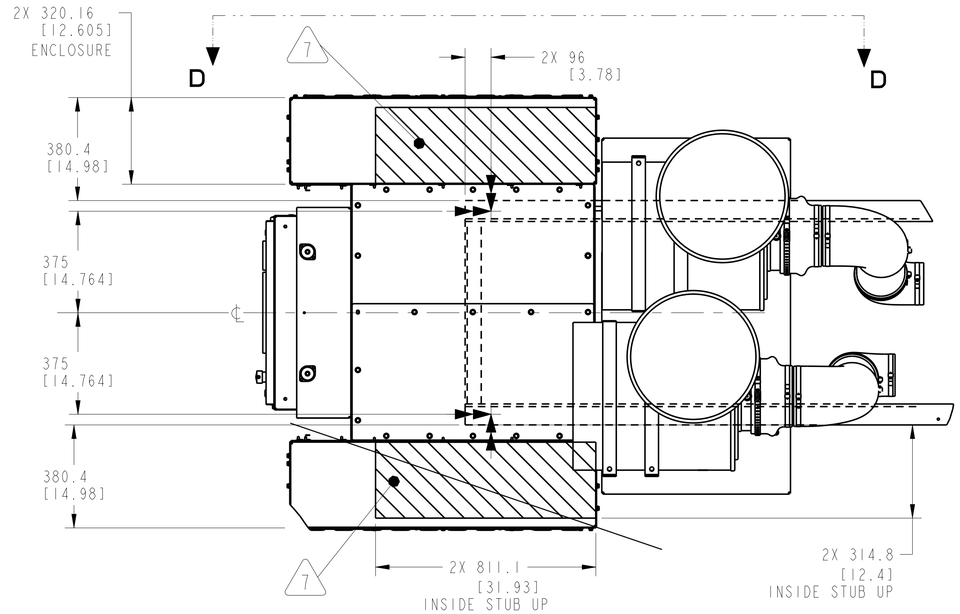
OUTLINE,CIRCUIT BREAKER

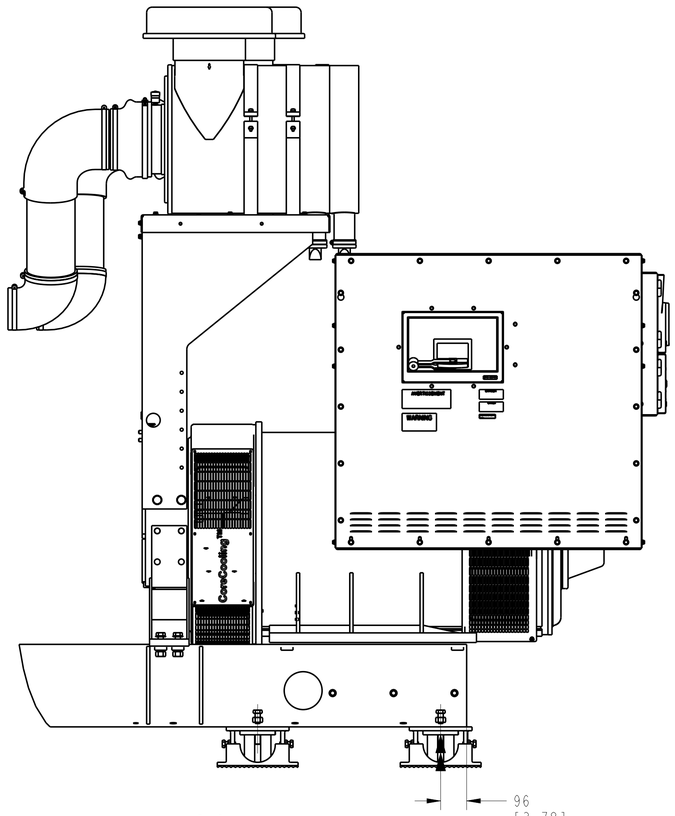
DWG SIZE D | A040V836 | SHEET 3 of 5 | DWG REV E

PTC® Creo® Parametric

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-183842 | E | 5 | ADD SHEET 4 | PPB | VSH | S.NAGARAJU | 25FEB19 |

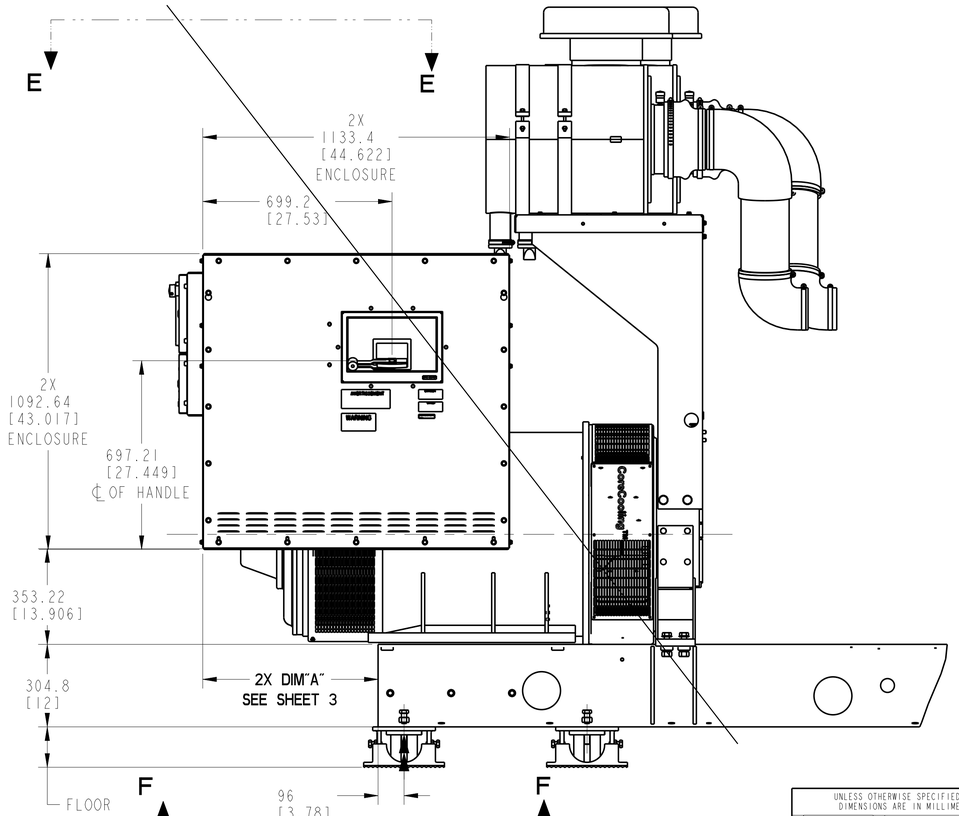
S6




VIEW A-A
(ROTATED 180°)

LEFT SIDE ENTRY 11



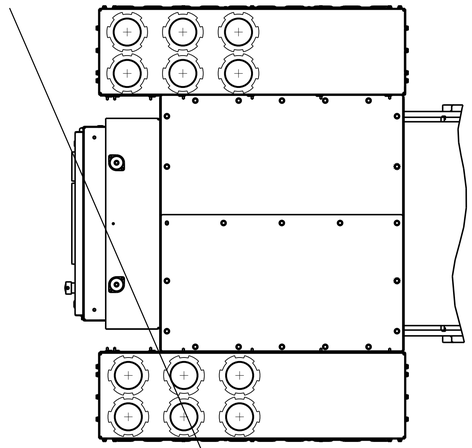

RIGHT SIDE ENTRY

| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | | | | SIM TO NONE | DWN B_WESTER | | CUMMINS POWER GENERATION |
|---|---|---|---|---|---|---|---|
| DIM: X ±3, .X ±0.8, .XX± 0.38 | HOLE: 0.00- 4.99 +0.15/-0.08, 5.00- 9.99 +0.20/-0.10, 10.00-17.49 +0.25/-0.13, 17.50-24.99 +0.30/-0.13 | | | DO NOT SCALE PRINT | CKD M_SIMS | | OUTLINE, CIRCUIT BREAKER |
| ANG TOL: ± 1.0° | SCALE: 3/32 | | | - CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP | APVD V_KODIMALA | SITE CODE | |
| | | | | | DATE 23SEP11 | PGF | |
| | | | | | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 | FIRST USED ON DFHA,B,C,D | DWG SIZE D: A040V836 — SHEET 4 of 5 — DWG REV E |

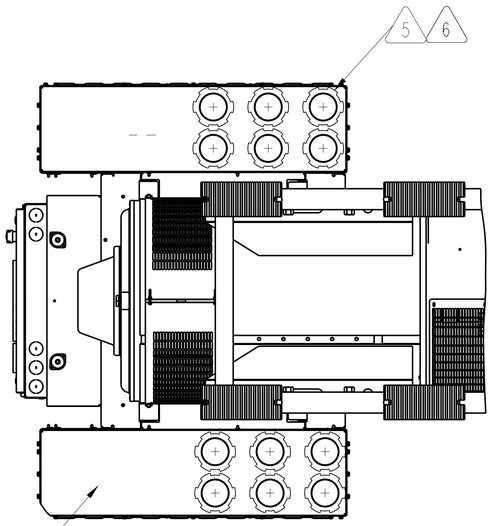
PTC® Creo® Parametric

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-183842 | E | 6 | ADD SHEET 5 | PPB | VSH | S.NAGARAJU | 25FEB19 |

S6

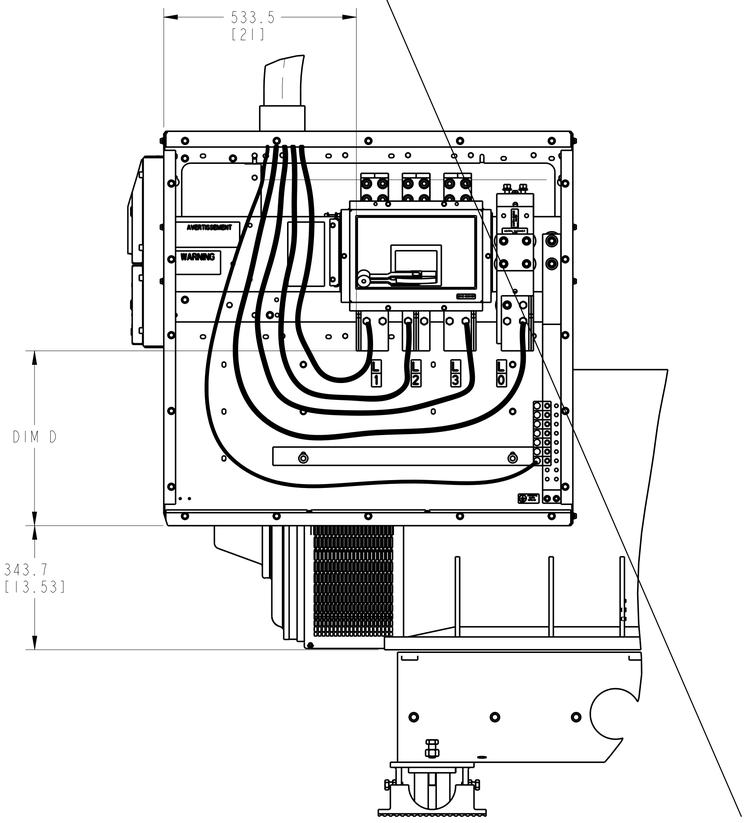


VIEW **E-E**
TOP ENTRANCE
SCALE 3/32

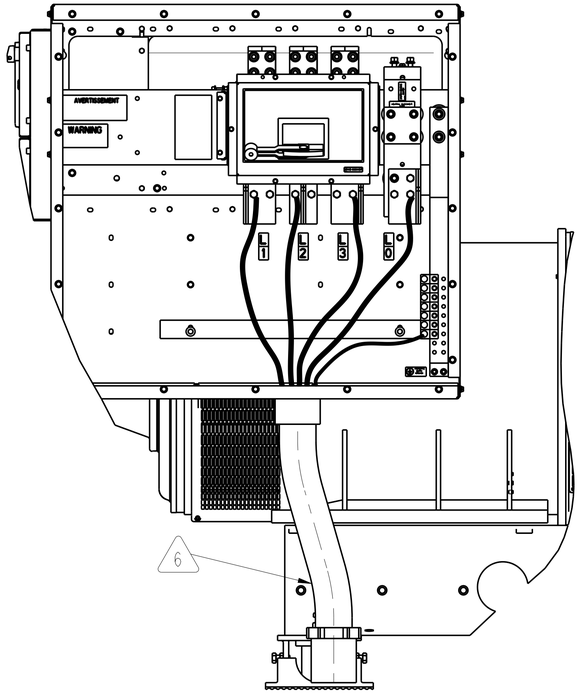



BOTTOM OF CIRCUIT BREAKER BOX

VIEW **E-E**
BOTTOM ENTRANCE
SCALE 3/32




RIGHT SIDE
TOP ENTRY ROUTING EXAMPLE
SCALE 1/8

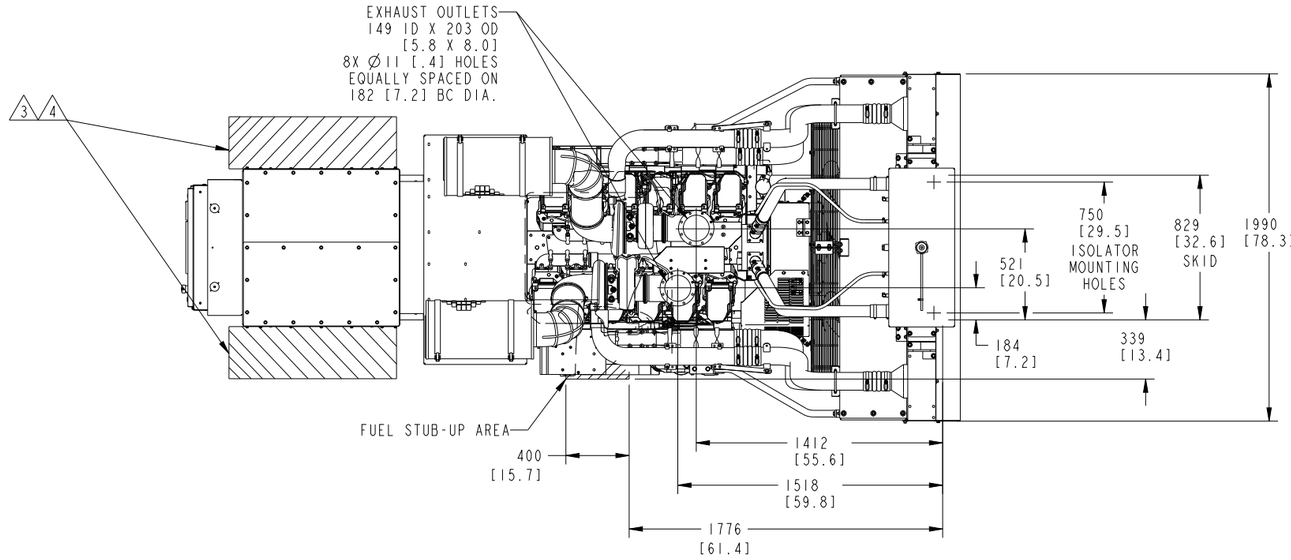



RIGHT SIDE
BOTTOM ENTRY ROUTING EXAMPLE
SCALE 1/8

| | | | | | | |
|---|---|---|---|---|---|---|
| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | | SIM TO: NONE | DWN: B_WESTER | | CUMMINS POWER GENERATION | |
| DIM: X ±3; .X ±0.8; .XX±0.38 — HOLE: 0.00-4.99 +0.15/-0.08; 5.00-9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13 | | DO NOT SCALE PRINT | CKD: M_SIMS | | | |
| | | | APVD: V_KODIMALA | | OUTLINE, CIRCUIT BREAKER | |
| | | - CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP | DATE: 23SEP11 | SITE CODE | | |
| ANG TOL: ± 1.0° | SCALE: 3/32 | | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 — FIRST USED ON: DFHA,B,C,D | PGF | DWG SIZE: D — A040V836 | SHEET: 5 OF 5 — DWG REV: E |

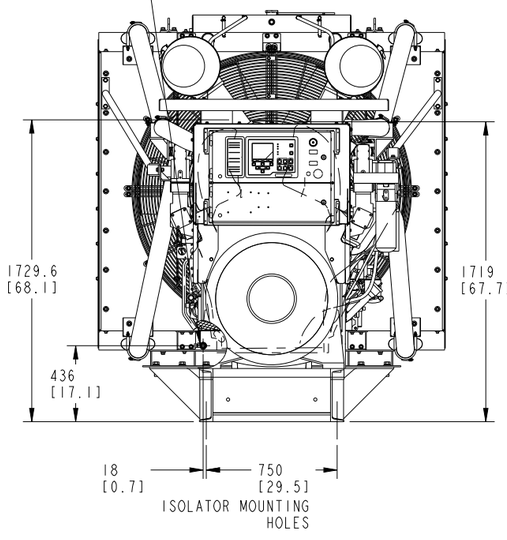
PTC® Creo® Parametric

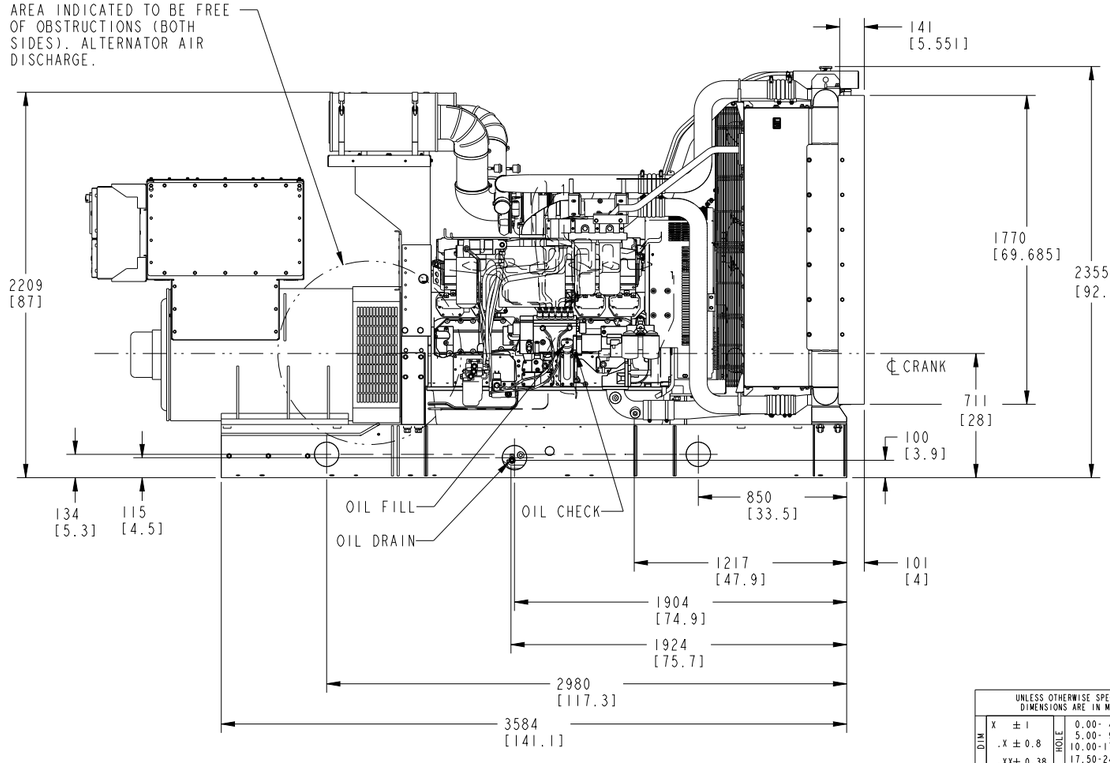
| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-179470 | D | 1 | DRAWING HAS BEEN PICTORIALLY UPDATED TO SHOW CORRECT ENGINE | CJF | LC | L CASSENS | 13SEP18 |




NOTES:

1. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED.
2. DIMENSIONS SHOWN IN [ ] ARE INCHES.
3. REFER TO CIRCUIT BREAKER OUTLINE DRAWING FOR ELECTRICAL STUB-UP AREA FOR SPECIFIC BREAKERS.
4. FOR ENTRANCE BOX APPLICATIONS, SEE APPLICABLE ENTRANCE BOX OUTLINE DRAWING.
5. 25 [1] DIA HOLES MARKED BY △ FOR 10 POINT ISOLATION MOUNTING.
6. FUEL IN HOSE [Ø.75] X 2009 [79.1] LONG WITH 3/4-14 NPTF EXTERNAL THREAD FITTING. FUEL OUT HOSE [Ø.50] X 1270 [50.0] LONG WITH 3/4-14 NPTF EXTERNAL THREAD FITTING.
7. TERMINALS WILL ACCOMMODATE STANDARD NEMA AND IEC 2-HOLE LUGS.
8. TERMINALS WILL ACCOMMODATE UP TO 10-750 MCM LUGS.
9. TERMINALS WILL ACCOMMODATE UP TO 6-350 CMC LUGS OR 4-500 MCM LUGS.
10. (NOTE REMOVED)




UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ±1, .X ±0.8, .XX± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 1/16

SIM TO A034N275

DO NOT SCALE PRINT

- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP

| | |
|---|---|
| DWN | A_MARBHAL |
| CKD | S_VENKATESAN |
| APVD | S_VENKATESAN |
| DATE | 06AUG15 |

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994. FIRST USED ON DQFAA/B/C/D

SITE CODE PGF

CUMMINS POWER GENERATION

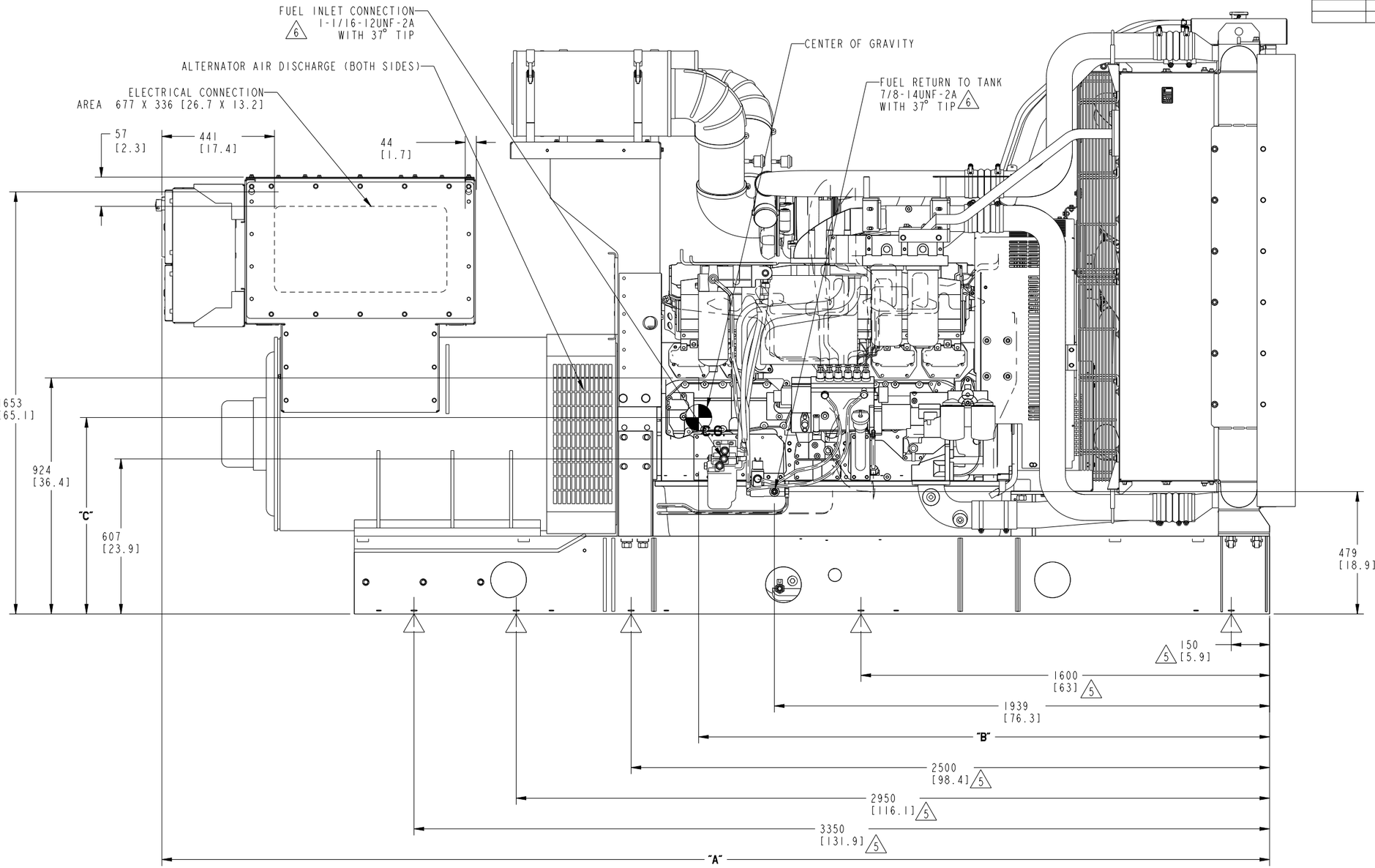
OUTLINE, GENSET

DWG SIZE D | A049K674 | SHEET 1 of 4 | DWG REV D

Drawing Name: A049K675 Revision: D
Part Name: A049K674 Revision: D
ECO-179470 Sheet 1 of 5

PTC® Creo® Parametric

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-179470 | D | -- | ----- | CJF | LC | L CASSENS | 13SEP18 |




TABULATION

| GEN. FRAME SIZE | DIM "A" | DIM."B" C.G. | DIM."C" C.G. | GEN SET DRY WT KGS | GEN SET DRY WT LBS | GEN SET WET WT KGS | GEN SET WET WT LBS |
|---|---|---|---|---|---|---|---|
| HC6G | 4326 [170.3] | 2022 [79.6] | 830 [32.7] | 6377 | 14060 | 6641 | 14640 |
| HC6H | 4326 [170.3] | 2060 [81.1] | 828 [32.6] | 6615 | 14585 | 6879 | 15165 |
| HC6J | 4326 [170.3] | 2096 [82.5] | 824 [32.4] | 6838 | 15076 | 7102 | 15656 |
| HC6K | 4427 [174.3] | 2108 [83.0] | 823 [32.4] | 6913 | 15242 | 7177 | 15822 |
| P7B | 4418 [174] | 2192 [86.3] | 817 [32.2] | 7317 | 16132 | 7581 | 16712 |
| P7C | 4418 [174] | 2210 [87.0] | 813 [32.0] | 7575 | 16701 | 7839 | 17281 |

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ±1; .X ±0.8; .XX± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 1/8

SIM TO A034N275

DO NOT SCALE PRINT

- CONFIDENTIAL -
PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN A_MARBHAL
CKD S_VENKATESAN
APVD S_VENKATESAN
DATE 06AUG15

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DQFAA/B/C/D

SITE CODE PGF

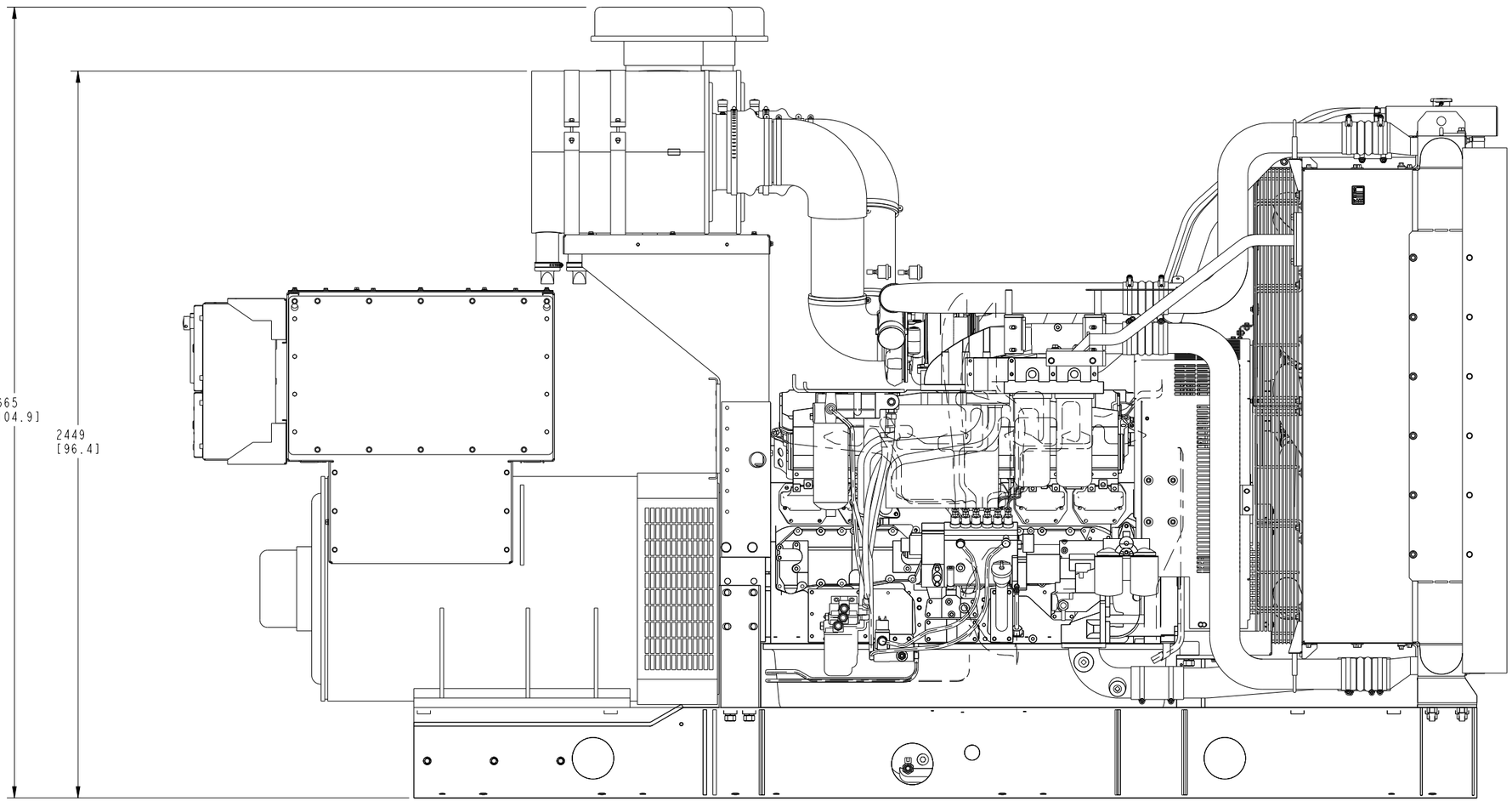
CUMMINS POWER GENERATION

OUTLINE, GENSET

DWG SIZE D | A049K674 | SHEET 2 of 4 | DWG REV D

PTC® Creo® Parametric

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-179470 | D | -- | ----- | CJF | LC | L CASSENS | 13SEP18 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |




HEAVY DUTY AIR CLEANERS

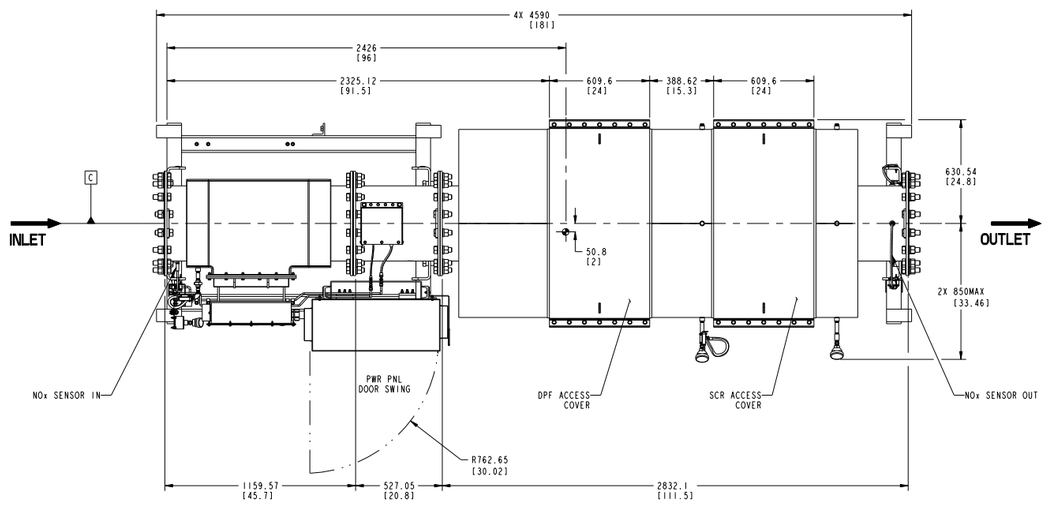
| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | | | SIM TO A034N275 | DWN A_MARBHAL | | CUMMINS POWER GENERATION | |
|---|---|---|---|---|---|---|---|
| DIM: X ±1; .X ±0.8; .XX± 0.38 | HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13 | | DO NOT SCALE PRINT | CKD S_VENKATESAN | | OUTLINE, GENSET | |
| | | | | APVD S_VENKATESAN | | | |
| | | | | DATE 06AUG15 | | SITE CODE | |
| ANG TOL: ± 1.0° | SCALE: 1/8 | | - CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 | FIRST USED ON DQFAA/B/C/D | PGF | DWG SIZE D \| A049K674 \| SHEET 3 OF 4 \| DWG REV D |

Drawing Name: A049K675 Revision: D
Part Name: A049K674 Revision: D
ECO-179470 Sheet 3 of 5

Creo Parametric

# AFTERTREATMENT T4fc
# MODEL - CA451
# FEATURE CODE - L178-2

| REV. NO. | LTR | NO. | REVISION | BY | CHD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-137023 | D | 1 | ZONE (D3):DIM 4590[181] WAS 4598[181] | SL | RC | R.CHANGELA | 12AUG13 |
| | | 2 | DRAWING HAS BEEN PICTORIALLY UPDATED | SL | RC | R.CHANGELA | 12AUG13 |
| | | 3 | SEE SHEET 2 | SL | RC | R.CHANGELA | 12AUG13 |
| | | 4 | SEE SHEET 2 | SL | RC | R.CHANGELA | 12AUG13 |
| | | 5 | ZONE(A3): DIM 4463.37[175.72] WAS 4455.61[175.4] | SL | RC | R.CHANGELA | 12AUG13 |
| | | 6 | ZONE(A3): RWV DIM 4638.12[182.5] | SL | RC | R.CHANGELA | 12AUG13 |
| | | 7 | ZONE(A3): ADD DIM 4666.04[183.7] | SL | RC | R.CHANGELA | 12AUG13 |




NOTES:-

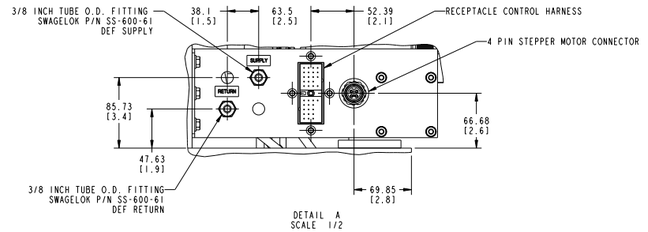
1. EXHAUST AFTERTREATMENT IS SUPPLIED WITH LISTED BELOW FLANGE MOUNTING HARDWARE.

| TOTAL QTY | DESCRIPTION |
|---|---|
| 2 | GASKET FLANGE |
| 32 | SCREW HEX HEAD 1.125-7X3.5 IN LG |
| 32 | SP.LOCK WASHER 1.125 DIA NOM |
| 64 | FLAT WASHER 1.125 DIA NOM |
| 32 | NUT 1.125-7 |

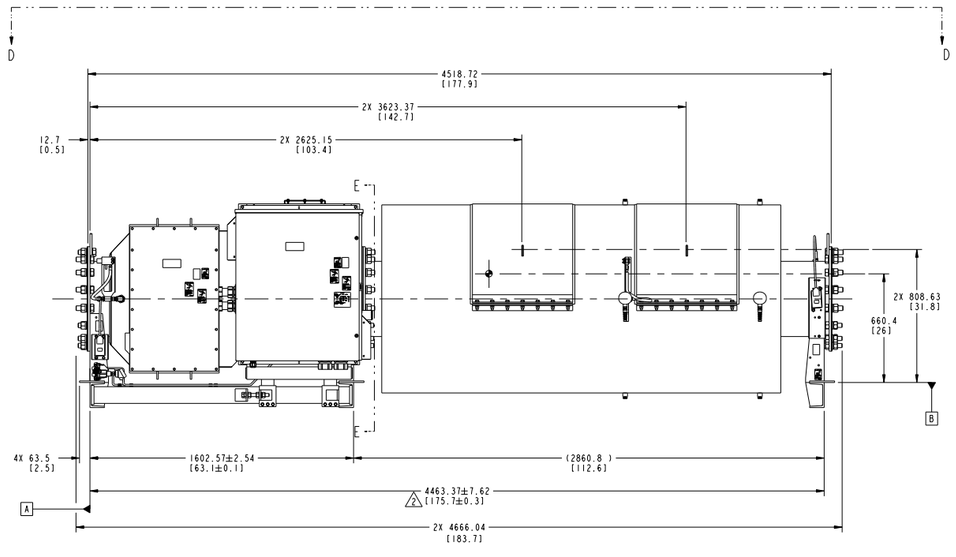
| DESCRIPTION | WEIGHT Kg (lbs) TOTAL |
|---|---|
| EXHAUST AFTERTREATMENT | 1981 [4367] |
| COMPONENT WEIGHT | |
| SCR/DPF COVER | 44 (97) |
| DPF | 19.5 (43) |
| SCR CARTRIDGE | 236.8 (522) |

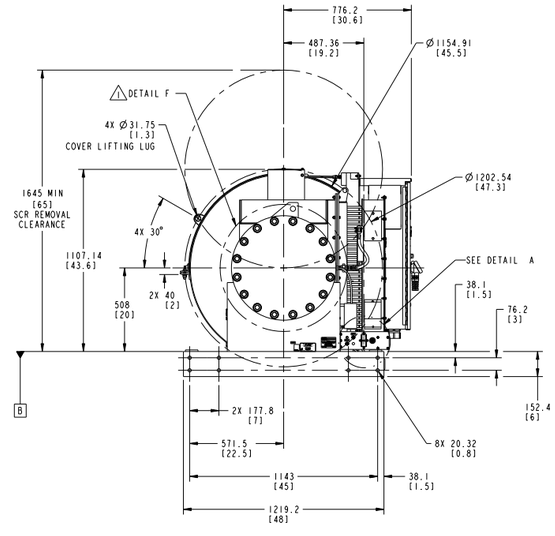
| DESCRIPTION | WEIGHT Kg (lbs) |
|---|---|
| UNIVERSAL LIFTING BEAM | 242 (533) |

2. FOR TRANSPORTATION DIMENSION WILL BE "4470.90 [176.02]"
3. VIEWS SHOWN WITHOUT INSULATION & UNIVERSAL LIFTING BEAM FOR CLARITY.
4. DIMENSION SHOWN IN [ ] ARE IN INCHES.




DETAIL A
SCALE 1/2



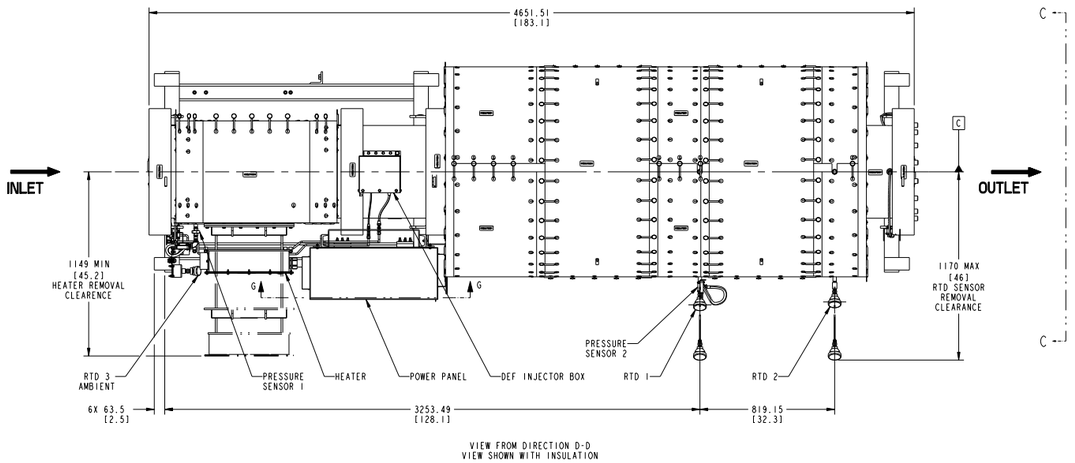

| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | | | DO NOT SCALE PRINT | DRN P.JOSHI<br>CHD R.CHANGELA<br>APVD R.CHANGELA<br>DATE 30MAR12 | CUMMINS POWER GENERATION |
|---|---|---|---|---|---|
| DIM: X ±1, .X ±0.8, XX±0.38 | DECIMAL: 0.00-4.99 ±0.15/-0.08; 5.00-9.99 ±0.20/-0.10; 10.00-17.49 ±0.25/-0.13; 17.50-24.99 ±0.30/-0.13 | | CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP | SIZE: ARCHITECTURAL D (ANSI B) 711.2MM X 1066.8MM | SITE CODE: PGF |
| ANG TOL: ± 1.0° | SCALE: 1/10 | | | DOKAK-M | OUTLINE,AFTERTREATMENT T4fc 1845" |
| | | | | | DWG NO: A041V017 REV: D SHEET 1 OF 3 |

Drawing Name: A041V018 Revision: D
Part Name: A041V017 Revision: D
Sheet 1 of 4

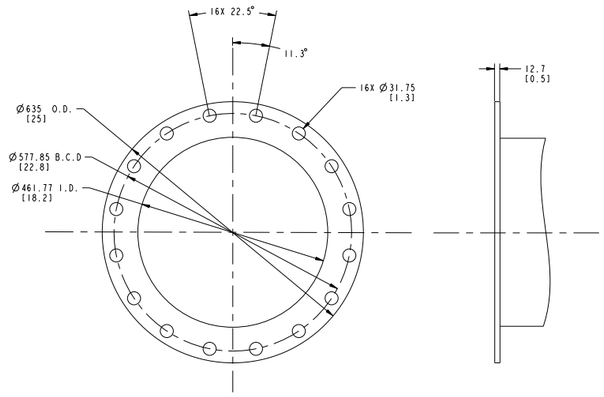
Creo Parametric

| REV. NO. | LTR | NO. | REVISION | DRN | CHD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-137023 | D | 2 | DRAWING HAS BEEN PICTORIALLY UPDATED | SL | RC | R.CHANGELA | 12AUG13 |
| | | 3 | ZONE(B1): NOTE WAS "TERMINAL...TWO AWG 500 Kcmil..." | SL | RC | R.CHANGELA | 12AUG13 |
| | | 4 | ZONE(A1): ADD DIM 95.25[3.8] | SL | RC | R.CHANGELA | 12AUG13 |

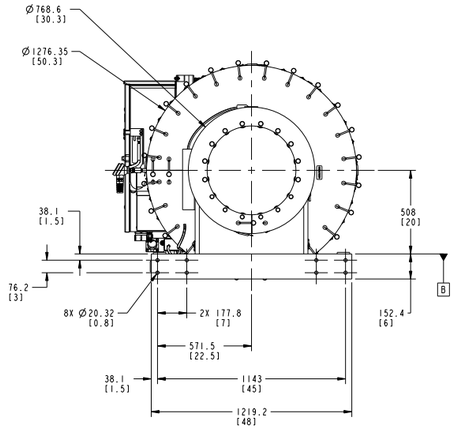
# AFTERTREATMENT T4fc
# MODEL - CA451
# FEATURE CODE - L178-2



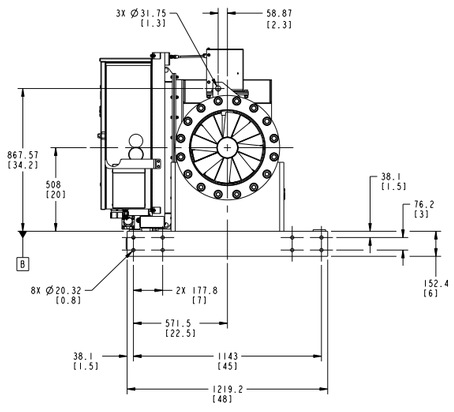

VIEW FROM DIRECTION D-D
VIEW SHOWN WITH INSULATION



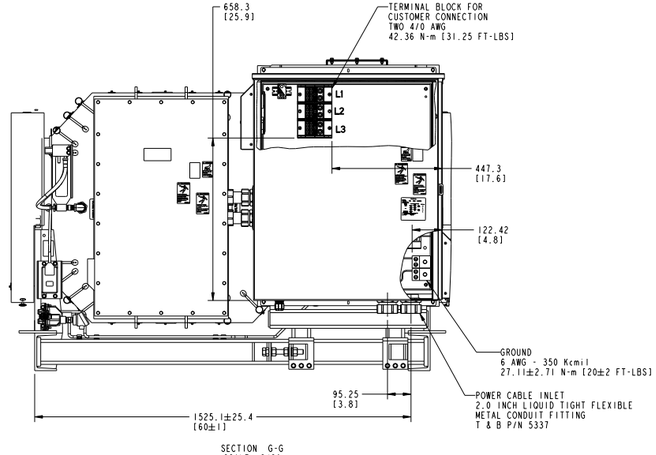

DETAIL F
125/150 ANSI 18" FLANGE, 2 PLACES
SCALE 1/4




VIEW FROM DIRECTION C-C
VIEW SHOWN WITH INSULATION




SECTION E-E




SECTION G-G
SCALE 3/20

UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN MILLIMETERS

| DECIMAL | | ANGULAR |
|---|---|---|
| X ±1 | 0.00- 4.99 ±0.15/-0.00 | ANG TOL: ± 1.0° |
| .X ±0.8 | 5.00- 9.99 ±0.20/-0.10 | |
| .XX± 0.38 | 10.00-17.49 ±0.25/-0.13 | |
| | 17.50-24.99 ±0.30/-0.13 | |

DO NOT SCALE PRINT

CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP

| | |
|---|---|
| DRN | P.JOSHI |
| CHD | R.CHANGELA |
| APVD | R.CHANGELA |
| DATE | 30MAR12 |

SCALE: 1/10

| | |
|---|---|
| SIZE | DWG NO |
| E | A041V017 |
| SITE CODE | PGF |
| SHEET | 2 of 3 |
| REV | D |

CUMMINS POWER GENERATION

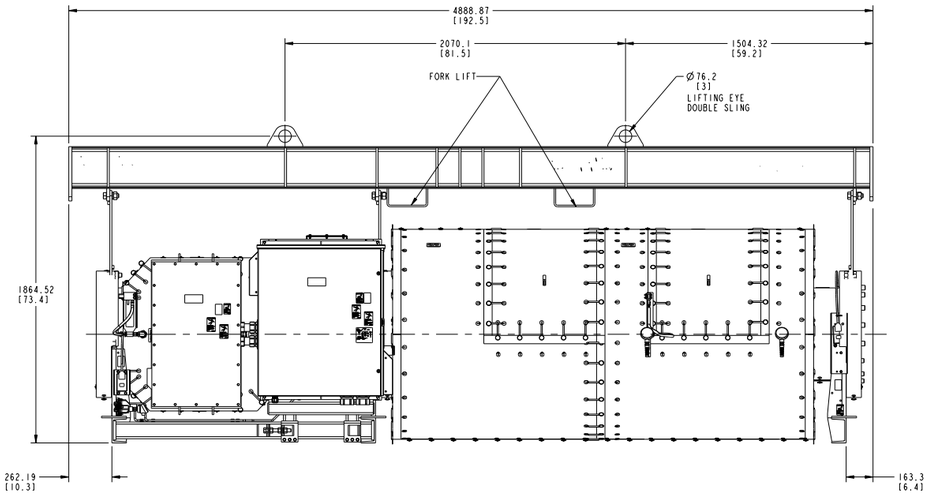
OUTLINE, AFTERTREATMENT T4fc 1845"

Drawing Name: A041V018 Revision: D
Part Name: A041V017 Revision: D
Sheet 2 of 4

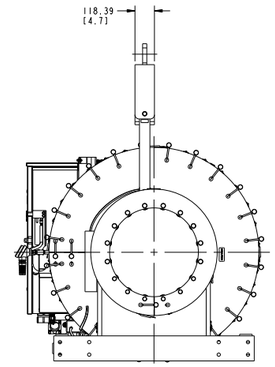
Creo Parametric

| REV. NO. | LTR | NO. | REVISION | DRN | CHD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-137023 | D | 2 | DRAWING HAS BEEN PICTORIALLY UPDATED | SL | RC | R.CHANGELA | 12AUG13 |

# AFTERTREATMENT T4fc
# MODEL - CA451
# FEATURE CODE - L178-2




VIEW SHOWN WITH INSULATION & UNIVERSAL LIFTING BEAM




VIEW SHOWN WITH INSULATION & UNIVERSAL LIFTING BEAM

| | | | |
|---|---|---|---|
| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | DO NOT SCALE PRINT | DRN P_JOSHI<br>CHD R_CHANGELA<br>APVD R_CHANGELA<br>DATE 30MAR12 | CUMMINS POWER GENERATION |
| X ±1 / .X ±0.4 / XXX ±0.38 | 0.00~4.99 +0.15/-0.00<br>5.00~9.99 +0.20/-0.10<br>10.00~17.49 +0.25/-0.13<br>17.50~24.99 +0.30/-0.13 | CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP | OUTLINE, AFTERTREATMENT T4fc 1X45° |
| ANG TOL: ± 1.0° | SCALE: 1/10 | DOKAK-M | SITE CODE PGF |
| | | | SIZE A041V017 SHEET 3 OF 3 REV D |

Drawing Name: A041V018 Revision: D
Part Name: A041V017 Revision: D
Sheet 3 of 4

PTC® Creo® Parametric

# DEF LINE INSTALLATION
# MODEL- CA451/CA452/CA542
# FEATURE CODE- L181-2

| REL NO | REV | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-171947 | B | 1 | PRODUCTION RELEASE | LDE | CJF | T.SCHIEBE | 28AUG17 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

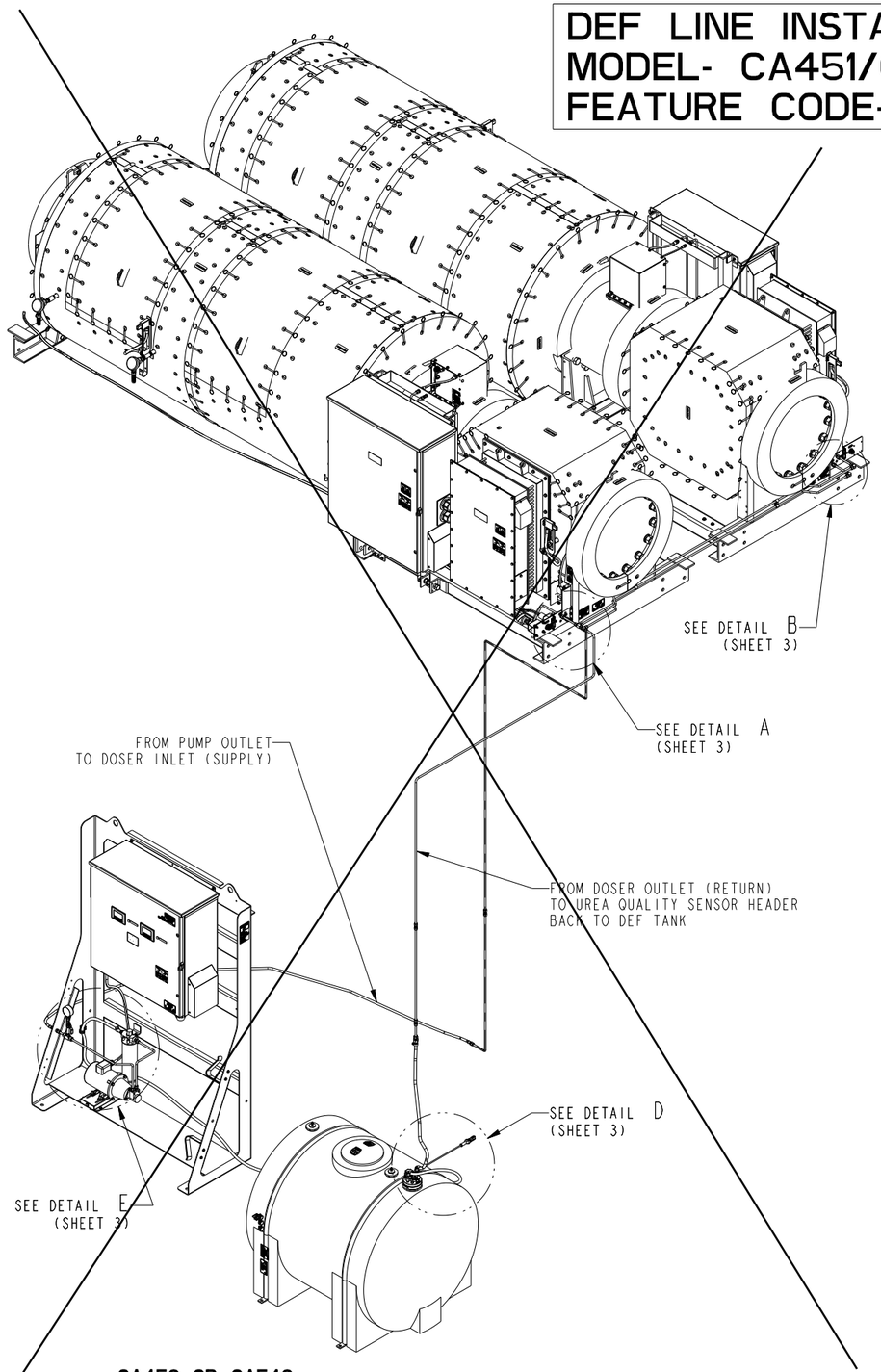
NOTE:

1. ALL DIMENSIONS ARE REFERENCE UNLESS SPECIFICALLY TOLERANCED.

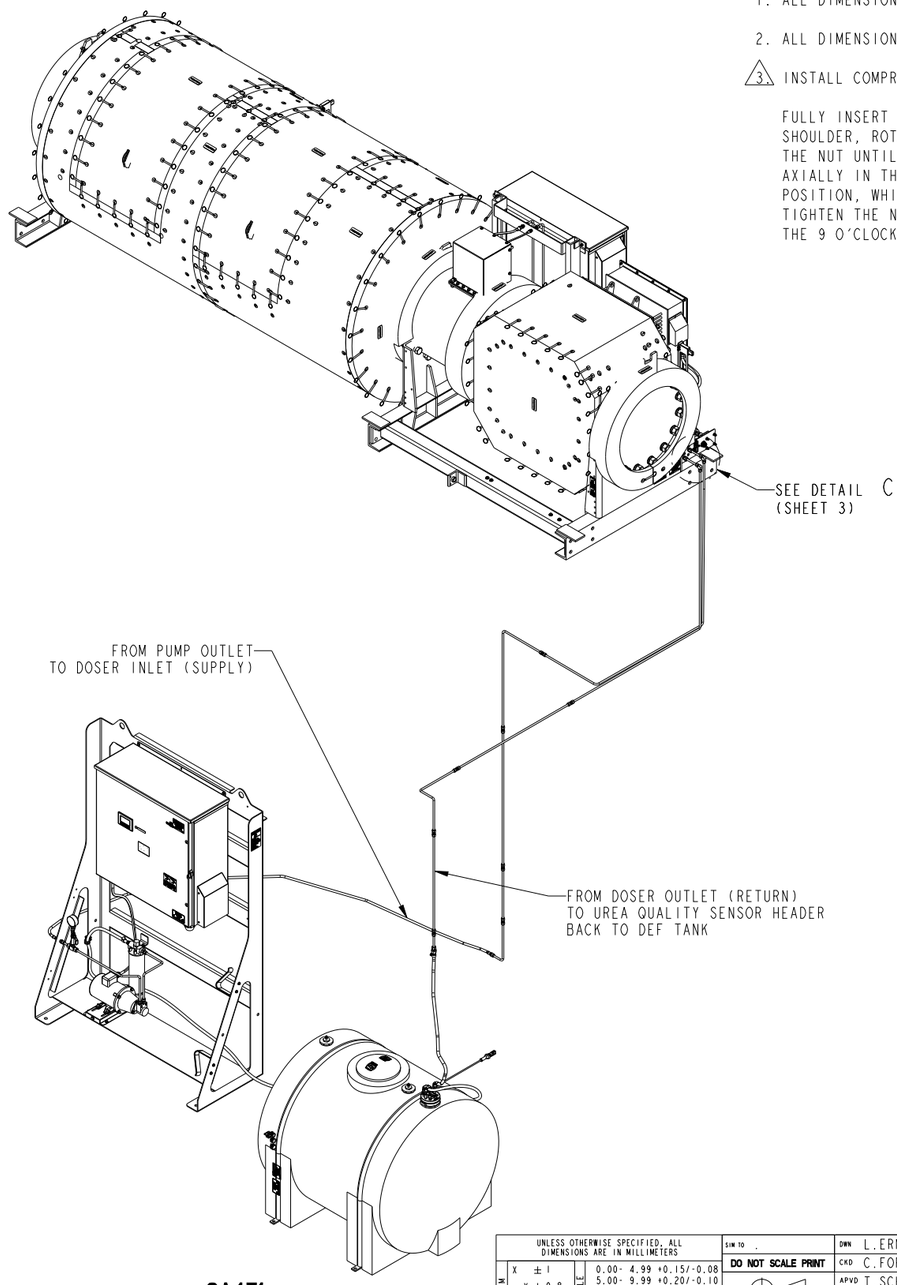
2. ALL DIMENSIONS IN [ ] ARE INCHES.

3. INSTALL COMPRESSION FITTING AS PER INSTRUCTION BELOW:

   FULLY INSERT THE TUBE INTO THE FITTING AND AGAINST THE SHOULDER, ROTATE THE NUT FINGER-TIGHT. FURTHER TIGHTEN THE NUT UNTIL THE TUBE WILL NOT TURN BY HAND OR MOVE AXIALLY IN THE FITTING. MARK THE NUT AT THE 6 O'CLOCK POSITION, WHILE HOLDING THE FITTING BODY STEADY, TIGHTEN THE NUT ONE AND ONE-QUARTER TURNS TO THE 9 O'CLOCK POSITION. (SEE SHEET 3)




CA452 OR CA542

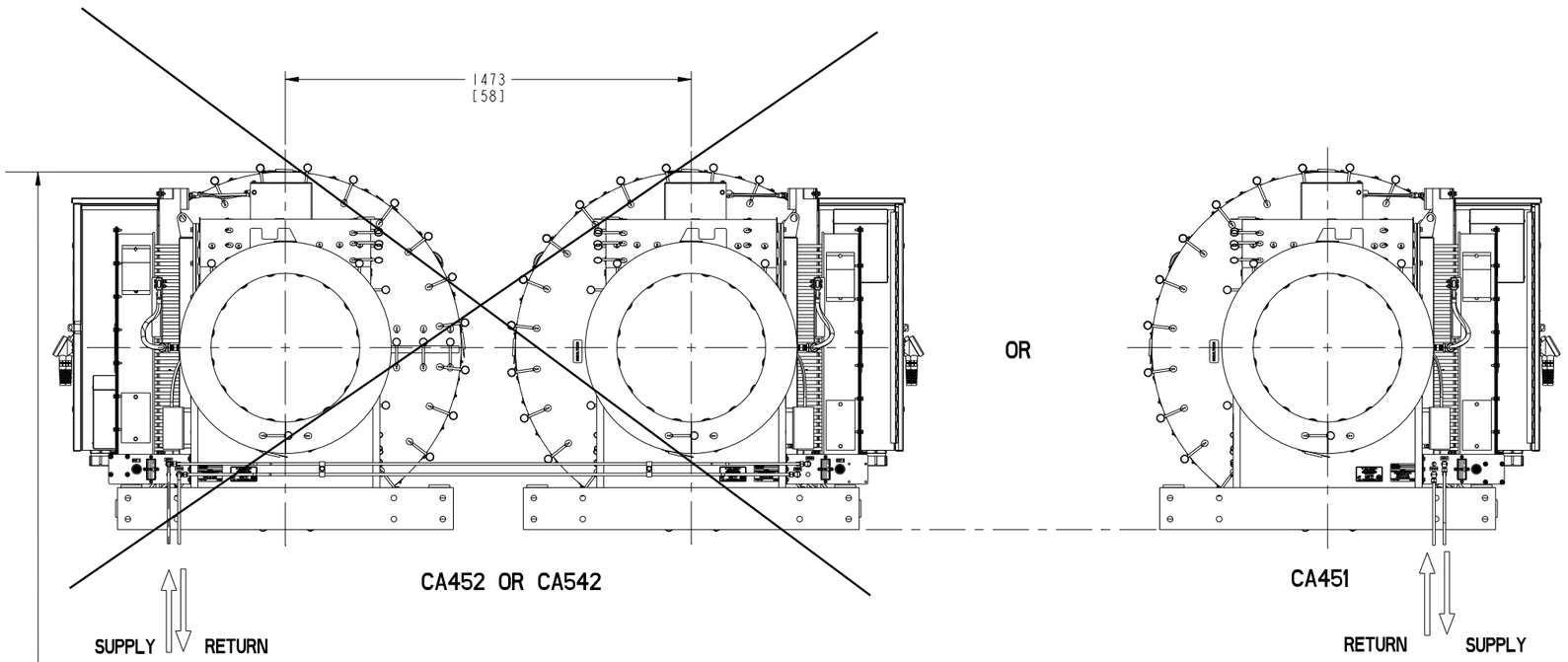


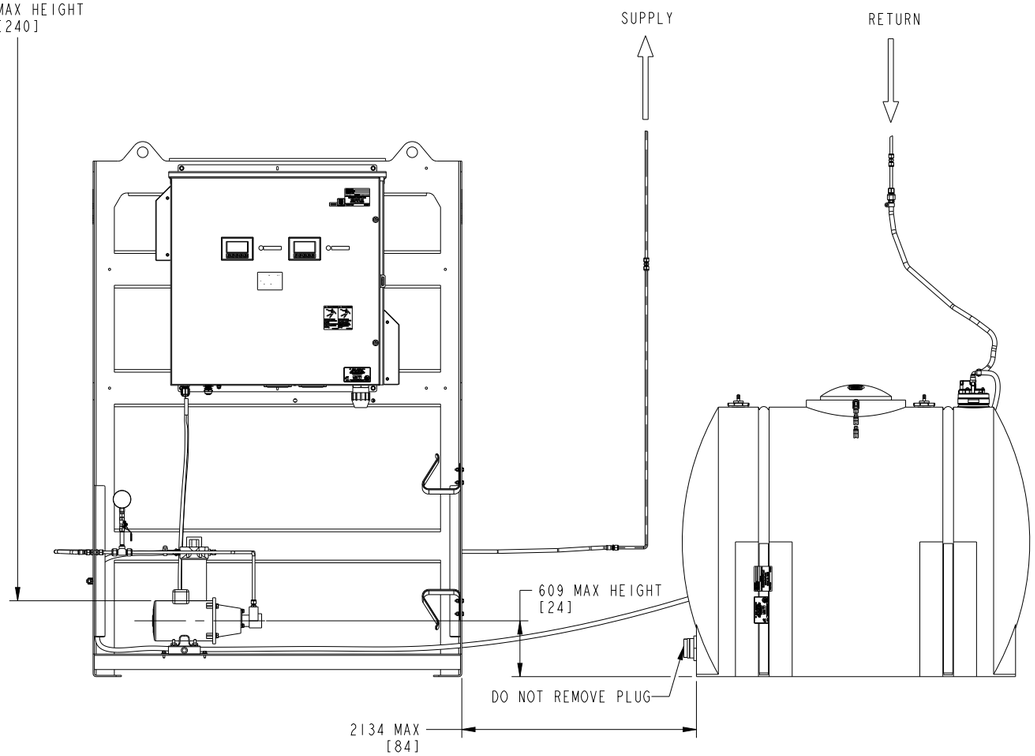

CA451

| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | | | SIM TO . | DWN L.ERNST | CUMMINS POWER GENERATION |
|---|---|---|---|---|---|
| DIM: X ±1; .X ±0.8; .XX± 0.38 | HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13 | | DO NOT SCALE PRINT | CKD C.FORNELL | |
| | | | | APVD T.SCHIEBE | OUTLINE, AFTERTREATMENT |
| | | | | DATE 29JUN17 | SITE CODE . |
| ANG TOL ± 1.0° | SCALE 1:16 | THIS DOCUMENT (AND THE INFORMATION SHOWN THEREON) IS CONFIDENTIAL AND PROPRIETARY AND SHALL NOT BE DISCLOSED TO OTHERS IN HARD COPY OR ELECTRONIC FORM, REPRODUCED BY ANY MEANS, OR USED FOR ANY PURPOSE WITHOUT WRITTEN CONSENT OF CUMMINS INC. | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5-2009 | FIRST USED ON DQKAM | PGF | DWG SIZE D A057U252 | CAD SHEET 1 OF 3 |

PTC® Creo® Parametric

| REL NO | REV | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-171947 | B | 1 | PRODUCTION RELEASE | LDE | CJF | T.SCHIEBE | 28AUG17 |

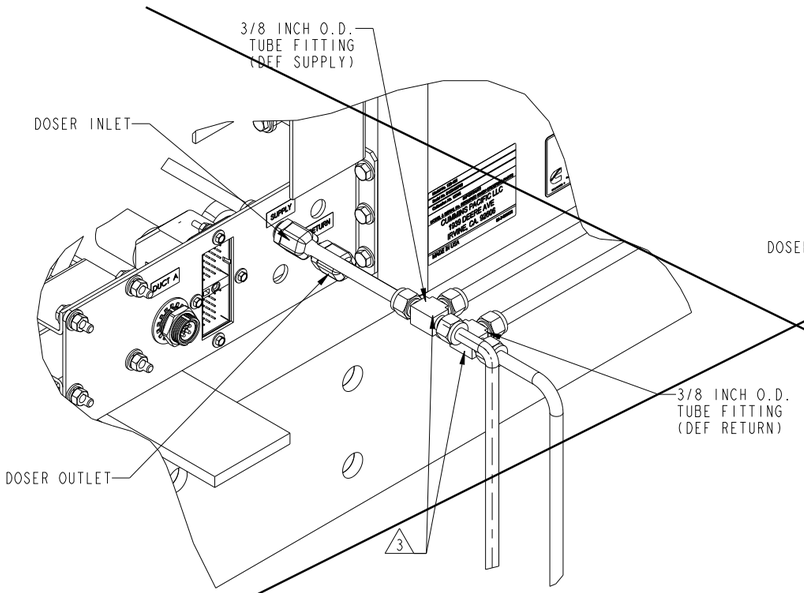


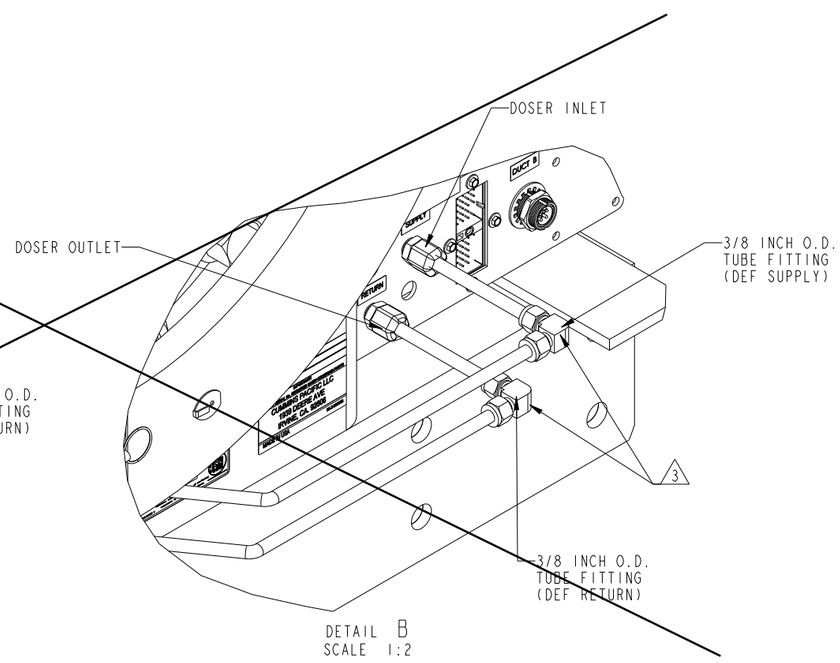

| | | | | | |
|---|---|---|---|---|---|
| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | | SIM TO . | DWN L.ERNST | CUMMINS POWER GENERATION | |
| DIM: X ±1, .X ±0.8, .XX± 0.38 — HOLE: 0.00- 4.99 +0.15/-0.08, 5.00- 9.99 +0.20/-0.10, 10.00-17.49 +0.25/-0.13, 17.50-24.99 +0.30/-0.13 | | DO NOT SCALE PRINT | CKD C.FORNELL | OUTLINE, AFTERTREATMENT | |
| | | | APVD T.SCHIEBE | SITE CODE . | |
| ANG TOL ± 1.0° | SCALE 1:10 | THIS DOCUMENT AND THE INFORMATION SHOWN THEREON IS CONFIDENTIAL AND PROPRIETARY AND SHALL NOT BE DISCLOSED TO OTHERS IN HARD COPY OR ELECTRONIC FORM, REPRODUCED BY ANY MEANS, OR USED FOR ANY PURPOSE WITHOUT WRITTEN CONSENT OF CUMMINS INC. | DATE 29JUN17 | PGF | DWG SIZE D — A057U252 — CAD SHEET 2 of 3 |
| | | | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5-2009 | FIRST USED ON DQKAM | |

PTC® Creo® Parametric

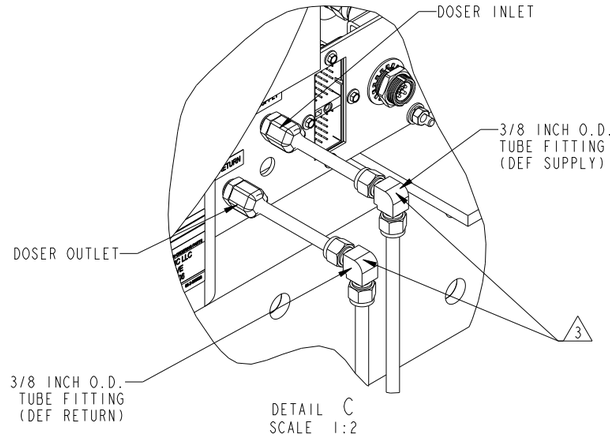
| REL NO | REV | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-171947 | B | 1 | PRODUCTION RELEASE | LDE | CJF | T.SCHIEBE | 28AUG17 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |



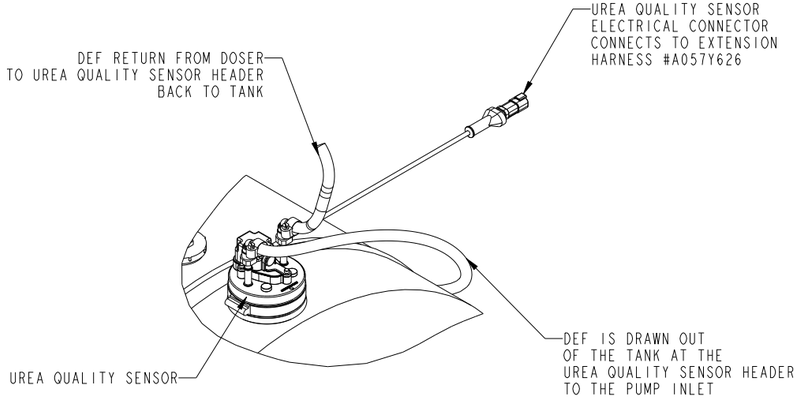

DETAIL A
SCALE 1:2



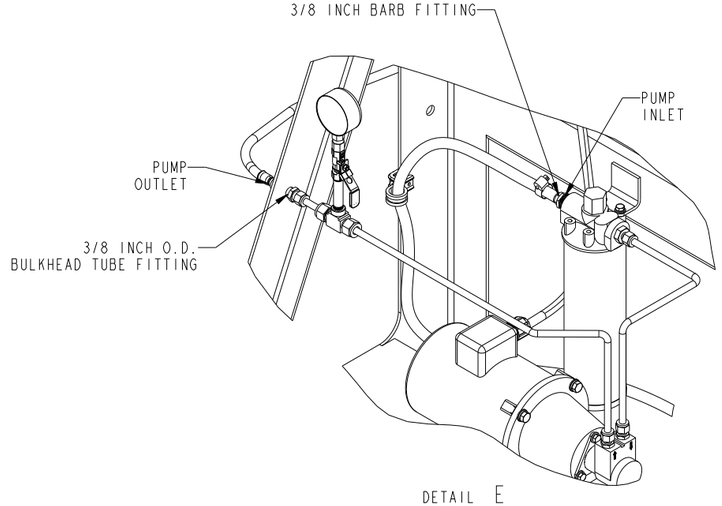

DETAIL B
SCALE 1:2




DETAIL C
SCALE 1:2




DETAIL D
SCALE 1:4




DETAIL E
SCALE 1:4

| | | | | |
|---|---|---|---|---|
| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | SIM TO . | DWN L.ERNST | Cummins® | CUMMINS POWER GENERATION |
| DIM: X ±1, .X ±0.8, .XX± 0.38 — HOLE: 0.00- 4.99 +0.15/-0.08, 5.00- 9.99 +0.20/-0.10, 10.00-17.49 +0.25/-0.13, 17.50-24.99 +0.30/-0.13 | DO NOT SCALE PRINT | CKD C.FORNELL | | OUTLINE, AFTERTREATMENT |
| | | APVD T.SCHIEBE | SITE CODE . | |
| | | DATE 29JUN17 | | |
| ANG TOL ± 1.0° | SCALE 1:16 | THIS DOCUMENT AND THE INFORMATION SHOWN THEREON IS CONFIDENTIAL AND PROPRIETARY AND SHALL NOT BE DISCLOSED TO OTHERS IN HARD COPY OR ELECTRONIC FORM, REPRODUCED BY ANY MEANS, OR USED FOR ANY PURPOSE WITHOUT WRITTEN CONSENT OF CUMMINS INC. | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5-2009 | FIRST USED ON DQKAM | PGF | DWG SIZE D | A057U252 | CAD SHEET 3 of 3 |

PTC® Creo® Parametric

| REL NO | REV | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-171893 | B | 1 | PRODUCTION RELEASE | LDE | CJF | T.SCHIEBE | 28AUG17 |
| | | 6 | ZONE A3/A4; DIM "F" WAS 693 [27.3] AND ADD DIM "F" CHART | LDE | CJF | T.SCHIEBE | 28AUG17 |

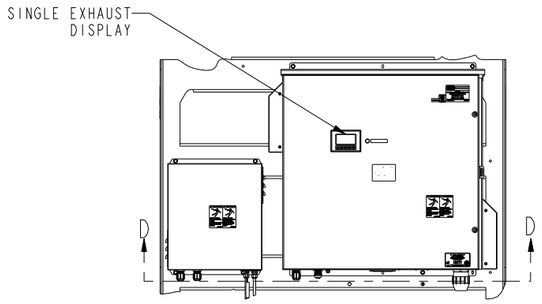
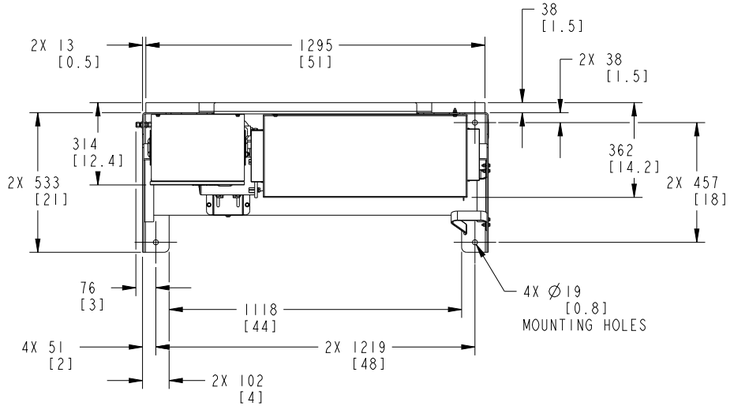
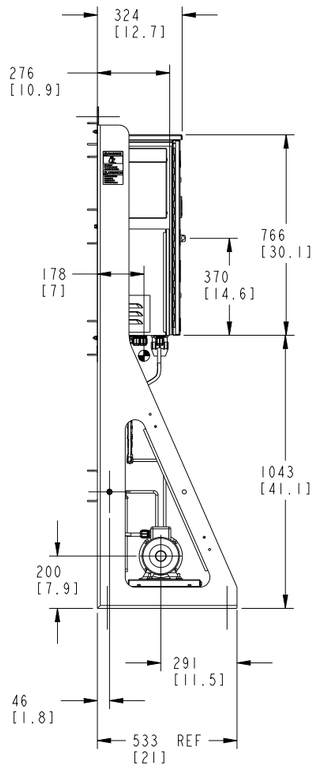
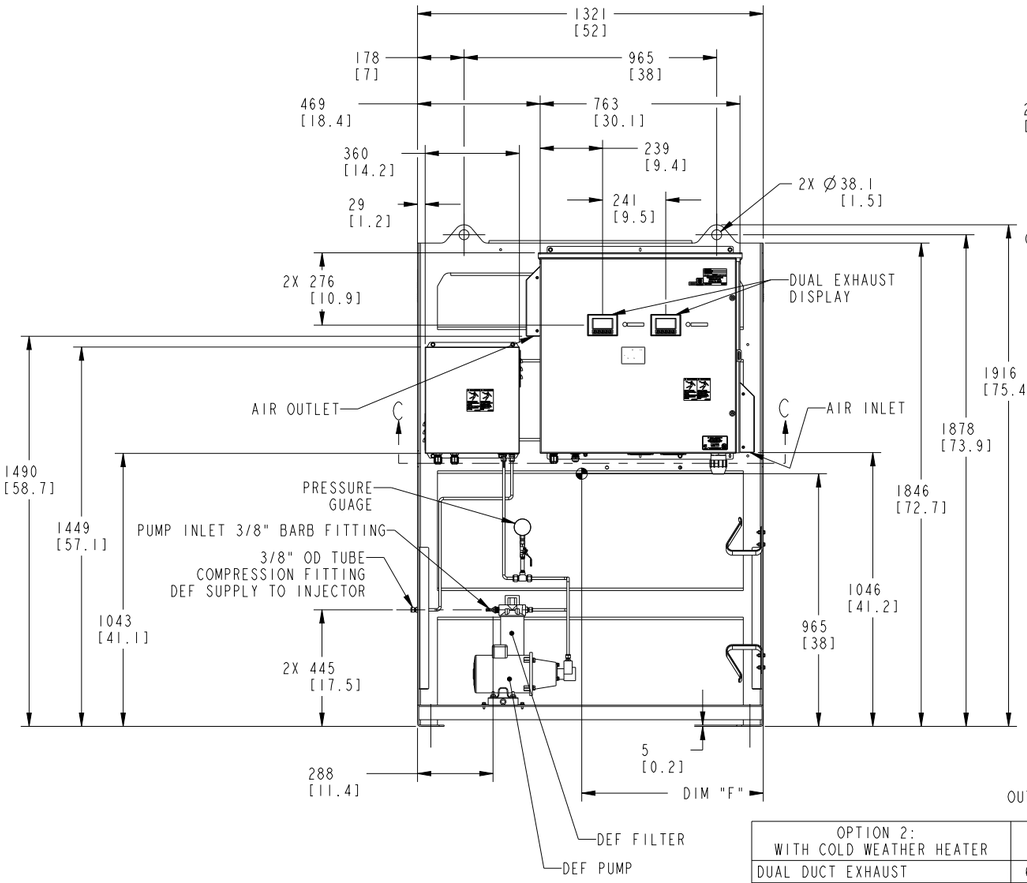



FIGURE 2
SINGLE DUCT EXHAUST CONTROL PANEL
WITH COLD WEATHER HEATER SHOWN
ALL DIMENSIONS SAME AS
DUAL DUCT EXHAUST CONTROL PANEL WITH COLD WEATHER HEATER
SCALE 3:32

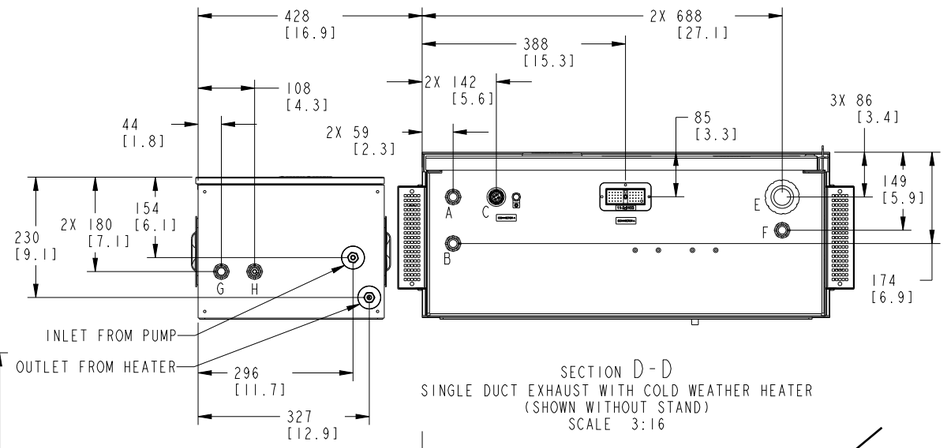



| CUSTOMER CABLE INLET | | | |
|---|---|---|---|
| DESIGNATION | SIZE | CORD RANGE | DESCRIPTION |
| A | 0.5 IN | 0.310-0.560 IN | 120 VAC INTO PANEL |
| B | 0.5 IN | 0.310-0.560 IN | 230 VAC OUT TO PUMP |
| C | 0.5 IN | 0.310-0.560 IN | STEPPER MOTOR A |
| D | 0.5 IN | 0.310-0.560 IN | STEPPER MOTOR B |
| E | 1.25 IN | 1.270-1.470 IN | INPUT FOR CUSTOMER CONNECTIONS |
| F | 0.5 IN | 0.310-0.560 IN | TESTING INPUT FOR COLD WEATHER OPTION |
| G | 0.5 IN | 0.310-0.560 IN | 120 VAC IN |
| H | 0.5 IN | 0.310-0.560 IN | SIGNAL WIRES FROM PORT C |

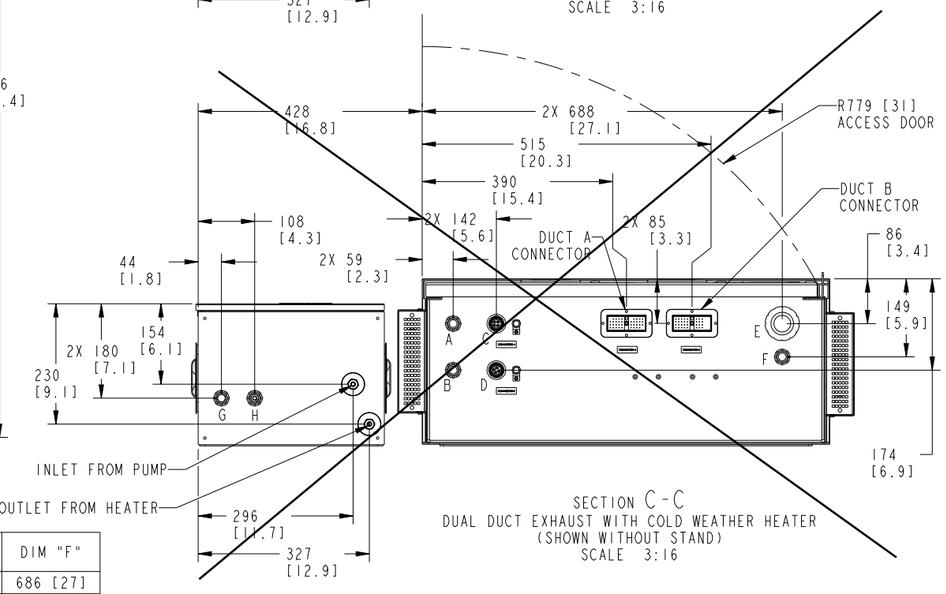



| OPTION 2: WITH COLD WEATHER HEATER | DIM "F" |
|---|---|
| DUAL DUCT EXHAUST | 686 [27] |
| SINGLE DUCT EXHAUST | 693 [27.3] |




SECTION D-D
SINGLE DUCT EXHAUST WITH COLD WEATHER HEATER
(SHOWN WITHOUT STAND)
SCALE 3:16




SECTION C-C
DUAL DUCT EXHAUST WITH COLD WEATHER HEATER
(SHOWN WITHOUT STAND)
SCALE 3:16

## OPTION II: CONTROL PANEL WITH COLD WEATHER HEATER

DUAL DUCT EXHAUST CONTROL PANEL WITH COLD WEATHER HEATER SHOWN
SEE FIGURE 2 FOR SINGLE DUCT EXHAUST CONTROL PANEL WITH COLD WEATHER HEATER

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

| DIM | | HOLE |
|---|---|---|
| X ±1 | | 0.00- 4.99 +0.15/-0.08 |
| .X ± 0.8 | | 5.00- 9.99 +0.20/-0.10 |
| .XX± 0.38 | | 10.00-17.49 +0.25/-0.13 |
| | | 17.50-24.99 +0.30/-0.13 |

ANG TOL ± 1.0° | SCALE 3:32



SIM TO: DO NOT SCALE PRINT

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5-2009

FIRST USED ON: DQKAM

| | |
|---|---|
| DWN | L.ERNST |
| CKD | C.FORNELL |
| APVD | T.SCHIEBE |
| DATE | 23JUN17 |

CUMMINS POWER GENERATION

OUTLINE, CONTROL PANEL (SPEC C)

SITE CODE: PGF | DWG SIZE: D | A057U250 | CAD SHEET 2 of 2

PTC® Creo® Parametric

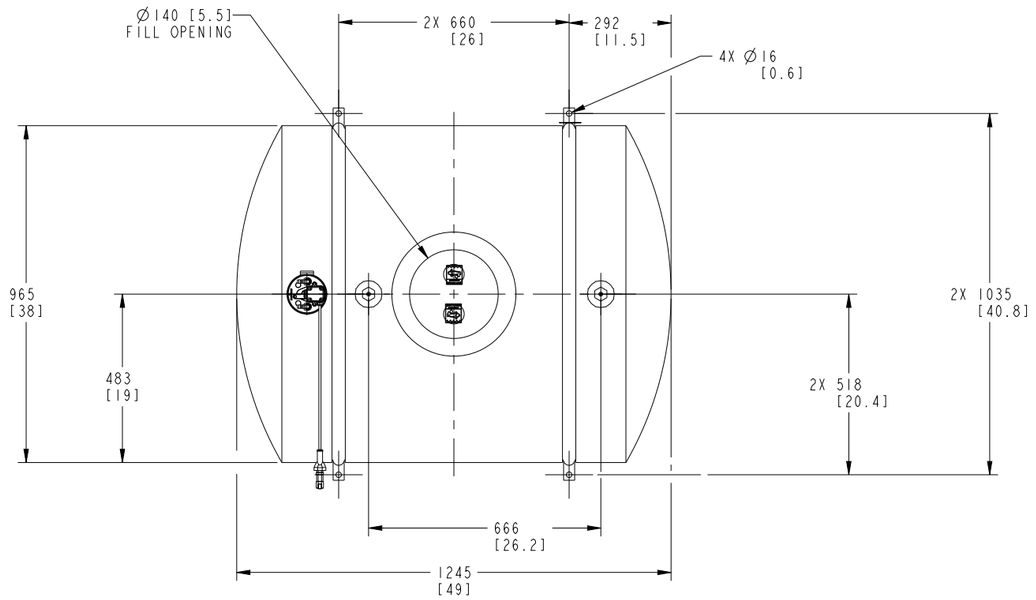
# DEF TANK

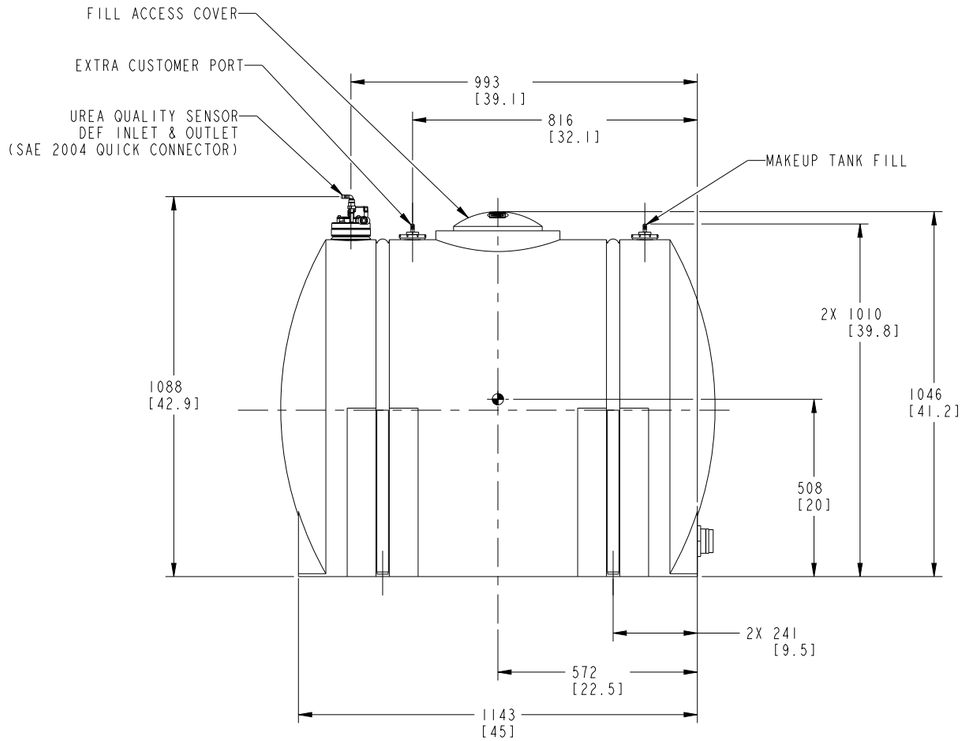
| REL NO | REV | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-171731 | B | 1 | PRODUCTION RELEASE | LDE | CJF | T.SCHIEBE | 23AUG17 |
| | | 2 | REVISE WEIGHT IN TABULATION:<br>DRY WAS 36.3 [80]<br>WET WAS 997.9 [2200] | LDE | CJF | T.SCHIEBE | 23AUG17 |
| | | 3 | MODEL FIRST USED ON; WAS DOKAK-M | LDE | CJF | T.SCHIEBE | 23AUG17 |
| | | | | | | | |

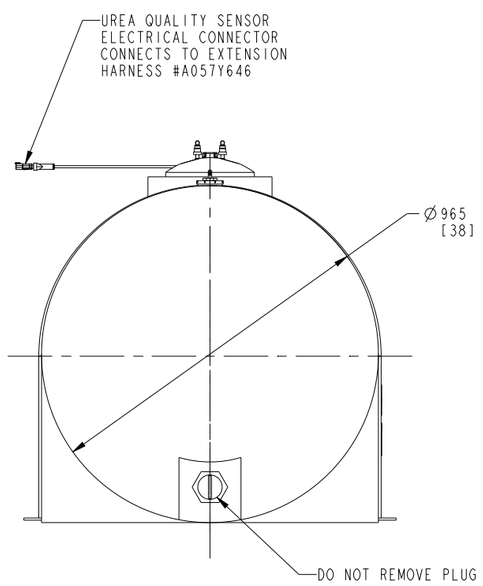
NOTES:

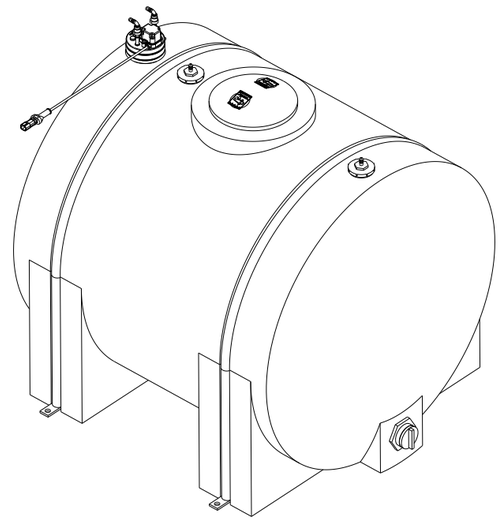
1. ALL DIMENSIONS ARE REFERENCE UNLESS SPECIFICALLY TOLERANCED.
2. ALL DIMENSIONS IN [ ] ARE INCHES.
3. TANK CAPACITY: 225 GALLONS.

| DESCRIPTION | WEIGHT KG [LBS] | |
|---|---|---|
| | DRY | WET |
| TANK WEIGHT | 37.6 [83] | 999.3 [2203] |



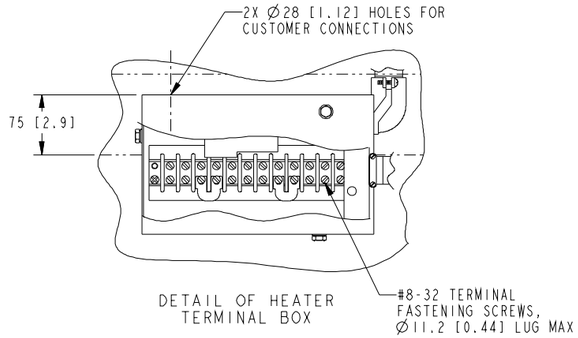



3D VIEW
SCALE 1:8

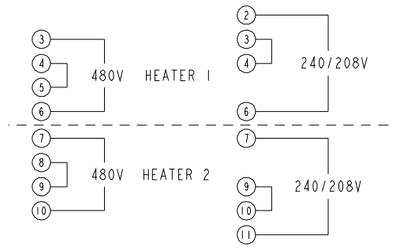
| | | | | | |
|---|---|---|---|---|---|
| UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS | SIM TO . | DWN L.ERNST | CUMMINS POWER GENERATION | | |
| DIM: X ±1, .X ±0.8, .XX± 0.38 — HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13 | DO NOT SCALE PRINT | CKD C.FORNELL | | | |
| | | APVD T.SCHIEBE | OUTLINE, TANK | | |
| | | DATE 19JUN17 | SITE CODE . | | |
| ANG TOL ± 1.0° | SCALE 1:8 | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5-2009 | DOKAM | PGF | ENG SIZE D | A057U248 | CAD SHEET 1 OF 1 |

| 0500_3846 | D | Pro/ENGINEER | METRIC DWG |
|---|---|---|---|

| REL NO | LTR | NO | REVISION | ZONE | DR | CHKR | APPROVED | DATE |
|---|---|---|---|---|---|---|---|---|
| FRD20709 | A | 1 | PRODUCTION_RELEASE | - | WP | HLS | HLS | 06-24-04 |
| FRD32924 | B | 1 | CHG TABLE 9984 WAS 9980 | 1B | GJT | BG | NAVARRETE | 08-23-07 |
| | | 2 | CHG TABLE 9650 WAS 8650 | 1B | GJT | BG | NAVARRETE | 08-23-07 |




DETAIL OF HEATER TERMINAL BOX




480 VOLT STANDARD FACTORY CONNECTION

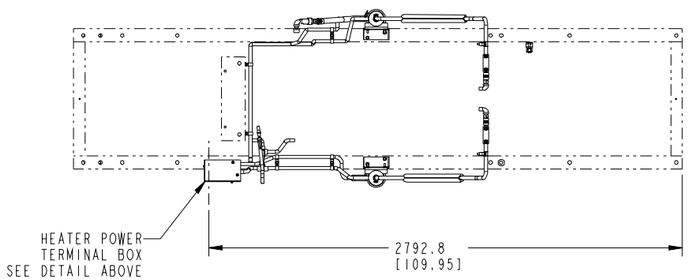
240/208 VOLT OPTIONAL CONNECTION

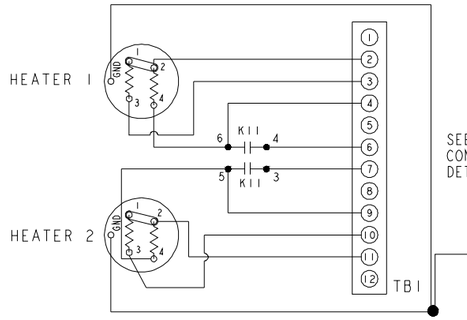
JUMPER CONNECTION DETAIL

NOTES:

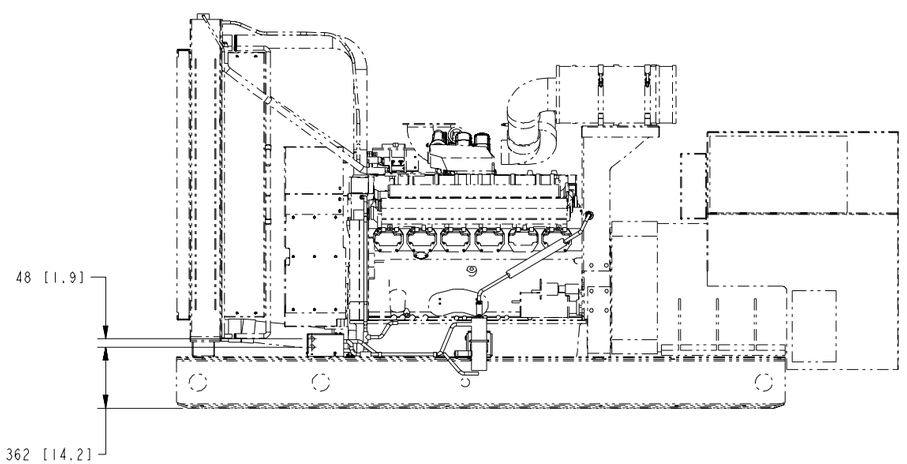
1. DIMENSIONS IN [ ] ARE INCHES.
2. THE HEATER CONTROL RELAY DRAWS 83mA OF CURRENT WHEN THE HEATERS ARE UNPOWERED. HEATERS ARE NOT POWERED WHEN:
   1) THE ENGINE HAS REACHED DESIGN TEMPERATURE OR
   2) THE ENGINE IS RUNNING.

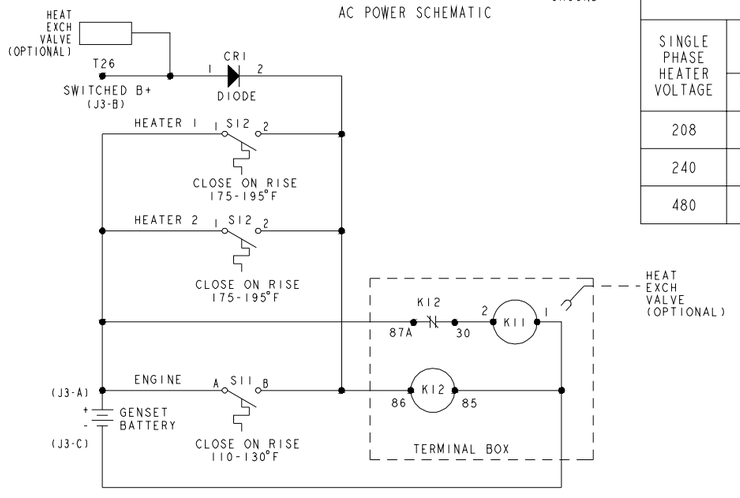
⚠ A BATTERY CHARGER IS REQUIRED TO PREVENT BATTERY DISCHARGE.




AC POWER SCHEMATIC




DC CONTROL SCHEMATIC

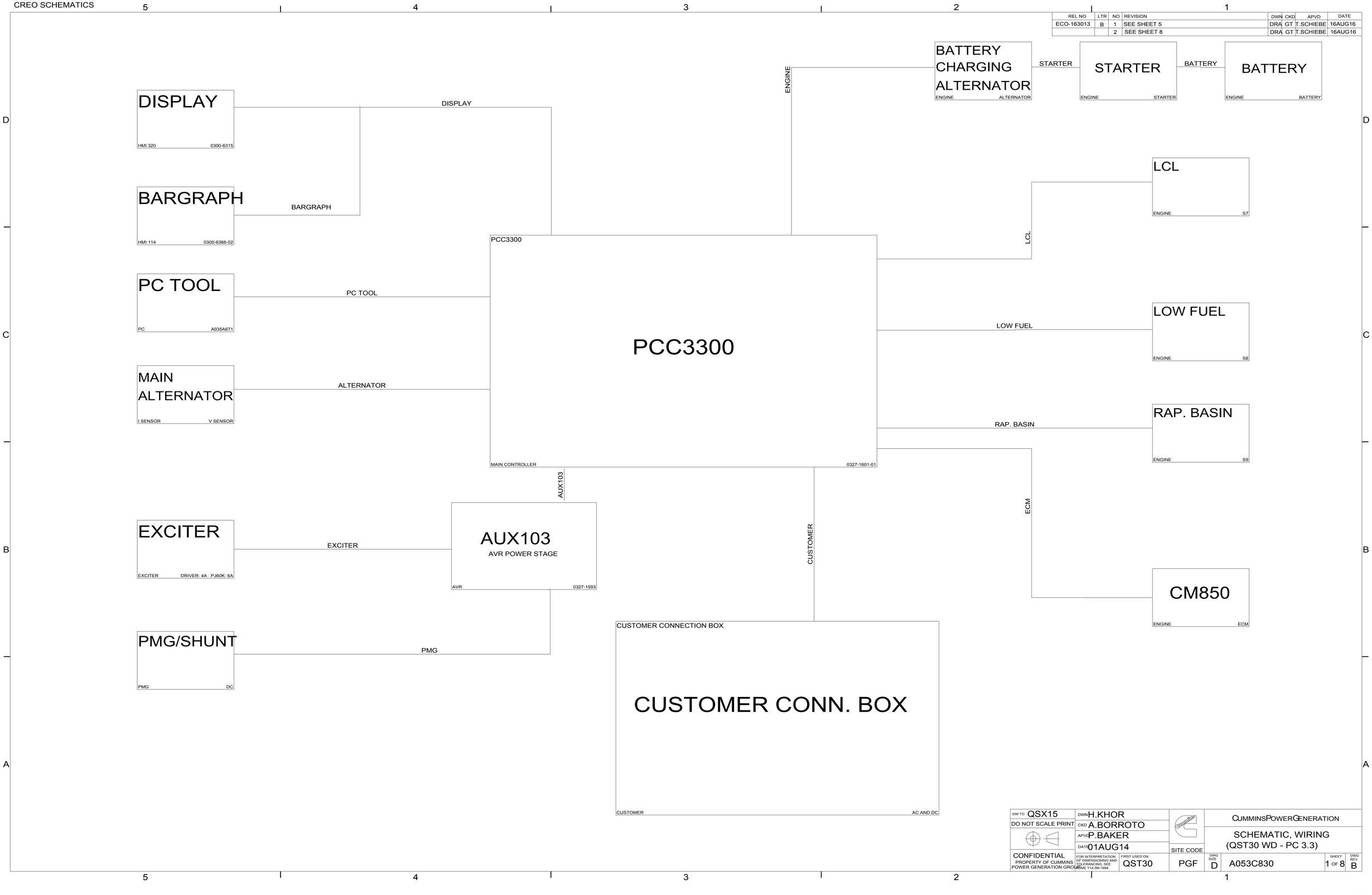
## HEATER AMPERAGE TABLE

| SINGLE PHASE HEATER VOLTAGE | FEATURE CODE H556 TWO HEATERS | | | FEATURE CODE H557 TWO HEATERS | | |
|---|---|---|---|---|---|---|
| | HEATER AMPS | TOTAL AMPS | TOTAL WATTS | HEATER AMPS | TOTAL AMPS | TOTAL WATTS |
| 208 | 18.0 | 36.0 | 7488 | 23.2 | 46.4 | 9650 |
| 240 | 20.8 | 41.6 | 9984 | 26.75 | 53.5 | 12840 |
| 480 | 10.4 | 20.8 | 9984 | 13.375 | 26.75 | 12840 |

| DO NOT SCALE PRINT | TOLERANCE UNLESS OTHERWISE SPECIFIED | | | | SIM TO 6660-3154 | - | ITEM | PART NO | DWG SIZE | DESCRIPTION OR MATERIAL | | REF DES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DIM | mm | | inch | COPIED FROM 0500-3823 | - | | NAME | | DATE | | CUMMINS POWER GENERATION 1400 73RD AVE NE MINNEAPOLIS, MINNESOTA 55432 |
| | | X ± 3 | | .X ± | | | DR | W PELTIER | | 04-23-04 | | |
| | | .X ± 0.8 | | .XX ± | | | CHKR □ MFG □ | H SEPPANEN | | 06-24-04 | | |
| ANG TOL± 1.0 ° | | .XX ± 0.38 | | .XXX ± | THIRD ANGLE PROJECTION | | APPROVED | H SEPPANEN | | 06-24-04 | | |
| | HOLE | 0.89-4.99 | +0.15/-0.08 | .004-.200 | | | | | | | SITE CODE | TITLE INTERFACE_OUTLINE (HEATER) |
| DRAWN TO 1/16 SCALE OF | | 5.00-9.99 | +0.20/-0.10 | .201-.421 | THIS DOCUMENT IS THE PROPERTY OF CUMMINS POWER GENERATION. IT CONTAINS PROPRIETARY AND CONFIDENTIAL INFORMATION WHICH MUST NOT BE DUPLICATED, USED OR DISCLOSED EITHER IN WHOLE OR IN PART EXPRESSLY AUTHORIZED BY CUMMINS POWER GENERATION OR ITS REPRESENTATIVE | | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982 | MODEL FIRST USED ON DFHA, HB, HC, HD | | PGA | DRG NO 0500_3846 | SHEET 1 of 1 | DRG SIZE D |
| | | 10.00-17.49 | +0.25/-0.13 | .422-.703 | | | | | | | | |
| | | 17.50-24.99 | +0.38/-0.13 | .704-.999 | | | | | | | | |

CREO SCHEMATICS

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-163013 | B | 1 | SEE SHEET 5 | DRA | GT | T.SCHIEBE | 16AUG16 |
| | | 2 | SEE SHEET 8 | DRA | GT | T.SCHIEBE | 16AUG16 |




| | | | |
|---|---|---|---|
| SIM TO QSX15 | DWN H.KHOR | | CUMMINS POWER GENERATION |
| DO NOT SCALE PRINT | CKD A.BORROTO | | |
| | APVD P.BAKER | | SCHEMATIC, WIRING (QST30 WD - PC 3.3) |
| | DATE 01AUG14 | SITE CODE | |
| CONFIDENTIAL PROPERTY OF CUMMINS POWER GENERATION GROUP | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 / FIRST USED ON QST30 | PGF | DWG SIZE D / A053C830 / SHEET 1 OF 8 / DWG REV B |

Drawing Name: A053C831 Revision: B
Part Name: A053C830 Revision: B
ECO-163013 Sheet 1 of 9

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-163013 | B | -- | ---- | DRA | GT | T.SCHIEBE | 16AUG16 |

# HMI 320 DISPLAY

PART # 0300-6315

J28-320 P28-320

HMI FUSED B+ 1
B+ RETURN 3

W-001 (1 – SP1 – 2)
W-004 (3 – SP2 – 3)

J6 P6: W-017 (1–1) → F03-1!1 W-097 >> [14,D]

J29-320 P29-320

PCCNet B (-) 2
PCCNet A (+) 1
SYSTEM WAKE UP 3
RUN (WAKE-UP) 6
AUTO 4

C-4/C-002 (2 – SP4 – 2)
C-4/C-003 (1 – SP5 – 1)
W-010 (3 – SP6 – 3)
SP3 (1 – 2)

P25 J25

| | | |
|---|---|---|
| W-005 | 8 | B+ RETURN |
| W-226 | 2 | LOCAL E-STOP |
| W-225 | 1 | DISCRETE INPUT RETURN |
| C-10/C-002 | 6 | PCCNet B |
| C-10/C-003 | 12 | PCCNet A |
| | 3 | PCCNet SHLD |
| W-011 | 7 | PCCNet SYSTEM WAKEUP |
| W-007 | 4 | MANUAL |
| W-008 | 9 | AUTO |
| | 5 | |
| | 10 | |
| | 11 | |

ESTOP-B-1 — ESTOP-B-2

W-205, W-245, C-3/C-003, C-3/C-002, W-006

# HMI 114 BARGRAPH

PART # 0300-6366-02

J1-114 P1-114: 5, 3, 4, 1, 2

J6-114 P6-114: 2 (W-205), 1 (W-245)

# PCC3300 BASEBOARD

PART # 0327-1601-01

TB15 P15

RETURN 1
RS485 A 3
RS485 B 4
PCCNet WAKE UP 5

C-6/C-003
C-6/C-002
W-244
[18,D] W-126 CTB1-3 1 >>

J65: 1, 2, 3, 4, 5

## PC TOOL

J12 P12

| | | |
|---|---|---|
| CT3 | 3 | W-361 |
| CT3 COMMON | 6 | W-020 |
| CT2 | 2 | W-362 |
| CT2 COMMON | 5 | W-021 |
| CT1 | 1 | W-364 |
| CT1 COMMON | 4 | W-022 |

J21 P21

| | | |
|---|---|---|
| W-046 | 1 | CT3-1 |
| W-047 | 2 | CT3-2/3 |
| W-063 | 3 | CT2-1 |
| W-093 | 4 | CT2-2/3 |
| W-171 | 5 | CT1-1 |
| W-262 | 6 | CT1-2/3 |

J22 P22

| | | |
|---|---|---|
| L1 | 1 | W-024 |
| L2 | 2 | W-027 |
| L3 | 3 | W-030 |
| LN | 4 | W-358 |

J21 P21

| | | |
|---|---|---|
| W-263 | 7 | F1U → W-025 (U) |
| W-264 | 8 | F1V → W-028 (V) |
| W-265 | 9 | F1W → W-031 (W) |
| | 10 | W-271 (N) |

GENERATOR

DRIVER RATINGS: 4A
PJ60K: 6A

L1 (U) — W-282 — CT3 — CT3-1, CT3-2/3
L2 (V) — W-287 — CT2 — CT2-1, CT2-2/3
L3 (W) — W-288 — CT1 — CT1-1, CT1-2/3
(N) — W-289

W-293, W-294

# AUX103

AVR POWER STAGE

PART # 0327-1593

J18 P18

PMG 1/SHUNT L1 1
PMG 2/SHUNT L2 2
PMG 3 3

W-033 (F10A-1 – F10A-2)
W-032 (F10B-1 – F10B-2)
W-034

J21 P21

| | | |
|---|---|---|
| W-041 | 11 | W-266 → P2 |
| W-054 | 12 | W-267 → P3 |
| | 13 | W-268 → P4 |

PMG

J17 P17

FIELD + 1
FIELD - 2

W-043
W-042

J21 P21

| | | |
|---|---|---|
| | 14 | W-269 → F1/F+ |
| | 15 | W-270 → F2/F- |

## ALTERNATOR EXT HARNESS A051B920

| | | | |
|---|---|---|---|
| SIM TO: QSX15 | DWN: H.KHOR | | CUMMINS POWER GENERATION |
| DO NOT SCALE PRINT | CKD: A.BORROTO | | SCHEMATIC, WIRING (QST30 WD - PC 3.3) |
| | APVD: P.BAKER | | |
| | DATE: 01AUG14 | SITE CODE | |
| CONFIDENTIAL PROPERTY OF CUMMINS POWER GENERATION GROUP | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 | FIRST USED ON: QST30 | PGF / DWG SIZE: D / A053C830 / SHEET 2 OF 8 / DWG REV: B |

# ENGINE EXT HARNESS A051D109

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-163013 | B | -- | ---- | DRA | GT | T.SCHIEBE | 16AUG16 |

## PCC3300 BASEBOARD PART # 0327-1601-01

J20 P20

| | | |
|---|---|---|
| GND-1 | | W-242 |
| B+ INPUT | 9 | W-059 |
| B+ INPUT | 10 | W-060 |
| B+ INPUT | 20 | W-061 |
| B+ INPUT | 21 | W-062 |
| RELAY COIL B+ | 13 | W-065 |
| RUPTURE BASIN RETURN | 8 | W-131P20 8 [18,C] |
| STARTER RELAY DRIVER | 15 | W-072 |
| SWITCHED B+ LOW SIDE DRIVER | 3 | W-073 |
| B+ RETURN | 2 | W-366 |
| B+ RETURN | 4 | W-075 |
| B+ RETURN | 7 | W-076 |
| B+ RETURN | 12 | W-077 |
| CHASSIS GND | 1 | W-078 |
| FSO RELAY DRIVER | 14 | |
| LOW FUEL RETURN | 6 | [18,C] W-164 CTB17-3 1 |
| ALT FLASH INPUT | 22 | |
| STARTER DISCONNECT INPUT | 11 | |
| OIL PRIMING PUMP RELAY | 16 | |
| COOLANT LEVEL RETURN | 5 | [18,C] W-166 P20 5 |
| #5 LOW COOLANT LEVEL | 17 | [18,C] W-183 P20 17 |
| #6 LOW FUEL SWITCH | 18 | [18,C] W-165 P20 18 |
| #12 RAPTURE BASIN | 19 | [18,C] W-163 P20 19 |

ESTOP-LOCAL-A1 — ESTOP-LOCAL-A2

[18,A] W-190 CTB50-3 1 [18,A] W-203 CTB51-3 1

SP15 SP14 SP34 SP18 SP17 SP16 SP11 SP12 SP13

[9,D] W-097 P6 1

W-019 W-094 W-127 CTB2-3!1 [18,D] W-092

F03-1 F03-2 F03 (15A) W-055
F04-1 F04-2 F04 (15A) W-056
F05-1 F05-2 F05 (5A) W-058
F02-1 F02-2 F02 (20A) W-221
F07-1 F07-2 F07 (15A) W-064

B+ SP17 → W-098, W-099, W-100, W-230

NOC-1 K5-1 K5-4 K5-5 K5-6 COIL-1 K5

W-410 SP16 [18,C] W-129 CTB13-3!1 W-334 J14-P!1 [25,C]

W-246

SP34 W-224 W-228 W-227

K4 K4-5 K4-1 K4-6 K4-4 COIL-1 NOC-1

W-231

W-082 W-085 W-096 W-368

B+ RTN SP18 [23,B] W-182 J16 1 [19,D] W-053 SP18 2 [18,D] W-128 CTB7-3 1

5A FUSED B+ NOC-1 K15,11 K15,14 K15,A2 K15,A1 COIL-1 K15

W-080

P50 120%%185 C B A

C-25!C-003 C-25!C-002

C-21/C-003 C-002 C-21/C-002

J60 P60

| | | |
|---|---|---|
| B+ | 8 | W-247 |
| B+ | 10 | W-343 |
| B+ | 18 | W-344 |
| CRANK | 19 | W-050 |
| B+ RTN | 12 | W-217 |
| B+ RTN | 14 | W-074 |
| B+ RTN | 16 | W-071 |
| | 13 | W-406 |
| | | W-256 |
| FUSED B+ | 15 | |
| FUSED B+ | 4 | |
| KEYSWITCH | 17 | |
| SHIELD | 9 | |
| CAN HI | 6 | C-11/C-003 |
| CAN LO | 1 | C-11/C-002 |
| | 3 | |

COOLANT HEATER

P13 A C B

F06 (10A) 1 (LOAD) W-257 W-321

SP10 B+ W-070

SP27 B+ RTN

F08 (30A) W-057 W-069 W-373

K-CRANK

K-CRANK(BATT) NOC-1 K-CRANK(SW) K-CRANK(S1) K-CRANK(S2) COIL-1

W-218 W-229

B1_GND2 B1_GND1 B1 SW B1_BATT2 B1_BATT3 B1_BATT1 B1_BATT4 STARTER MOTOR

W-352 G1_GND 24V 12V 12V

W-323 F12 (80A) F12-1 F12-2 G1_B+(1) W-324

W-322 W-102 C-003 C-002

LCL LCL(S7) COOLANT LEVEL SENSOR

| | |
|---|---|
| A | +5V SUPPLY |
| C | RETURN |
| B | CL SIGNAL |

W-308 W-309 W-310

CO4 CO4

J1939

| | |
|---|---|
| C | 37 J1939 SHIELD |
| B | 47 J1939 LOW |
| A | 46 J1939 HIGH |

50 PIN CONNECTOR

J26 P26

| | | |
|---|---|---|
| J1939 SHIELD | 1 | W-295 |
| J1939 HIGH | 11 | W-181 |
| J1939 LOW | 10 | W-178 |
| PCCNet SHIELD | 4 | |
| N/A | 6 | |
| B+ RETURN | 8 | |
| PCCNET A | 12 | |
| PCCNET B | 13 | |
| N/A | 17 | |
| KEY SWITCH B+ | 18 | W-081 |
| KEY SWITCH LOW SIDE | 15 | W-084 |
| AVR B+ | 9 | W-370 |
| AVR B+ RETURN | 5 | W-372 |
| AVR PWM+ | 16 | W-086 |
| AVR PWM- | 3 | W-087 |
| FIELD CURRENT + | 14 | W-088 |
| FIELD CURRENT - | 7 | W-089 |
| BACKUP START DISC + | 2 | W-090 |

J11 P11

| | | |
|---|---|---|
| | 17 | C-20/C-003 |
| | 20 | C-20/C-002 |
| | 19 | |
| | 22 | (NOT USED) |
| | 21 | W-104 |

C-20/C-003 C-20/C-002

P19 J19

GND W-371

| | | |
|---|---|---|
| | 5 | |
| | 6 | |
| | 7 | |
| | 11 | |
| | 12 | |
| | 13 | |
| | 14 | CHASSIS GND |
| | 1 | AVR B+ |
| | 8 | AVR B+ RETURN |
| | 2 | AVR PWM+ |
| | 9 | AVR PWM- |
| | 4 | FIELD CURRENT + |
| | 10 | FIELD CURRENT - |
| | 3 | BACKUP START DISC + |

## AUX103
AVR POWER STAGE
PART # 0327-1593

CO1 CO1

| | | |
|---|---|---|
| | H | W-296 |
| B+ RTN | L | W-292 |
| | K | W-290 |
| | J | W-291 |
| B+ | F | W-285 |
| | D | W-284 |
| | C | W-283 |
| | A | W-286 |

SP28 SP29

16 PIN OEM CONNECTOR

## CM850
ECM

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SIM TO QSX15 | | DWN H.KHOR | | CUMMINS POWER GENERATION | | | |
| DO NOT SCALE PRINT | | CKD A.BORROTO | | SCHEMATIC, WIRING (QST30 WD - PC 3.3) | | | |
| | | APVD P.BAKER | | | | | |
| | | DATE 01AUG14 | SITE CODE | | | | |
| CONFIDENTIAL PROPERTY OF CUMMINS POWER GENERATION GROUP | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 | FIRST USED ON QST30 | PGF | DWG SIZE D | A053C830 | SHEET 3 OF 8 | DWG REV B |

CREO SCHEMATICS

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-163013 | B | -- | ---- | DRA | GT | T.SCHIEBE | 16AUG16 |

## P1/TB1

| | | |
|---|---|---|
| 1 | PCCNet A (+) | C-5/C-003 |
| 2 | PCCNet B (-) | C-5/C-002 |
| 3 | B+ RETURN/SHIELD | |
| 4 | READY TO LOAD DRIVER | W-376 |
| 5 | CUSTOMER FUSED B+ | W-377 |
| 6 | CUSTOMER OUTPUT #1 NO | W-147 |
| 7 | CUSTOMER OUTPUT #1 COM | W-146 |
| 8 | CUSTOMER OUTPUT #2 NO | W-144 |
| 9 | CUSTOMER OUTPUT #2 COM | W-142 |
| 10 | REMOTE START RTN | W-140 |
| 11 | REMOTE START INPUT | W-138 |
| 12 | CUSTOMER INPUT #1 | W-136 |
| 13 | CUSTOMER INPUT #1 RTN | W-134 |
| 14 | CUSTOMER INPUT #2 | W-133 |
| 15 | REMOTE E-STOP RTN | W-132 |
| 16 | REMOTE E-STOP INPUT | |

## P8/TB8

| | | |
|---|---|---|
| 1 | FAULT RESET INPUT RTN | W-148 |
| 2 | START TYPE INPUT RTN | W-149 |
| 3 | DELAYED OFF DRIVER | W-150 |
| 4 | SWITCHED B+ DRIVER | W-151 |
| 5 | FAULT RESET INPUT | W-152 |
| 6 | START TYPE INPUT | W-153 |

## P 3/TB3

| | | |
|---|---|---|
| 1 | TRANSFER INHIBIT/C1 #20 RTN | W-118 |
| 2 | MASTER CAN SHIELD | |
| 3 | MASTER CAN L | C-2/C-003 |
| 4 | MASTER CAN H | C-2/C-002 |
| 5 | LOW-SIDE OUTPUT | W-113 |
| 6 | LOW-SIDE OUTPUT | W-112 |
| 8 | LOW-SIDE OUTPUT | W-108 |
| 9 | TRANSFER INHIBIT/C1 #20 | W-119 |
| 10 | RETRANSFER INHIBIT/C1 #21 | W-117 |
| 11 | MASTER FIRST START ARBITRATION | W-107 |
| 12 | MASTER FIRST START RETURN | W-106 |

## P5/TB5

| | | |
|---|---|---|
| 1 | GENSET CB CLOSE - NO | W-009 |
| 2 | GENSET CB CLOSE - COM | W-014 |
| 4 | GENSET CB OPEN - COM | W-016 |
| 5 | GENSET CB OPEN - NC | W-018 |
| 6 | UTILITY CB CLOSE - NO | W-023 |
| 7 | UTILITY CB CLOSE - COM | W-026 |
| 8 | UTILITY CB OPEN - NC | W-029 |
| 9 | UTILITY CB OPEN -COM | W-035 |

## P9/TB9

| | | |
|---|---|---|
| 1 | KW LOAD SET POINT SENSE | W-036 |
| 2 | KW & KVAR SET POINTS RTN | W-037 |
| 3 | KVAR SET POINTS RTN | W-038 |
| 4 | VOLTAGE BIAS ANALOG OUT | W-039 |
| 5 | SPEED BIAS ANALOG OUT | W-048 |
| 6 | VOLTAGE & SPEED ANALOG RTN | W-049 |
| | | W-281 |

C-1/C-003 CTB2-1 1 [23,C]
C-1/C-002 CTB1-1 1 [23,C]

CTB1 2 … CTB51 2

W-002 CTB5-2!1 [35,C]
W-051 CTB9-2!1 [33,C]
W-052 CTB10-2!1 [33,B]
W-053 CTB11-2!1 [14,C]
W-306 [39,A]
W-307 [39,A]
[23,D] W-219 ESTOP_REM_B2 1
[23,D] W-220 ESTOP REM-B1 1
[24,B] W-079 CTB37-2 1
[25,A] W-255
[25,A] W-258
[23,B] W-103 K17-A2 1
[25,A] W-259
[25,A] W-260
W-223 CTB51-2!1 [32,D]

[7,D] W-126 P15 5
[14,D] W-127 F02-1!1
[14,C] W-128 SP18 2
[24,A] W-261
[13,D] W-129 SP16 2
[14,D] W-131 CTB15-3 1
[15,C] W-163 CTB16-3 1
[15,C] W-164 P20 6
[15,C] W-165 CTB18-3 1
[15,C] W-166 CTB19-3 1
[15,C] W-183 P20 17

CTB1 4 … CTB51 4

B+ GFR W-317 [39,D]
W-222 CTB3-4!1 [32,D]
W-238 SP7 2 [21,D]
PYROMETER
B- W-305 [39,D]
GFR RTN
W-239 SP8 2 [21,C]
PYROMETER RTN
SW+ SWITCH B+
RUPTURE BASIN RTN W-320 [32,B]
RUPTURE BASIN IN W-319 [32,B]
LOW FUEL SWITCH RTN
LOW FUEL SWITCH IN
LOW COOLANT LVL RTN
LOW COOLANT LVL IN
W-298 05 1 [32,B]
30L XFER PUMP

## P8/TB8

| | | |
|---|---|---|
| 13 | CUSTOMER INPUT #4 RTN | W-158 |
| 12 | CUSTOMER INPUT #3 RTN | W-159 |
| 11 | LOAD DUMP DRIVER | W-160 |
| 10 | CUSTOMER OUTPUT #3 DRIVER | W-161 |
| 9 | CUSTOMER OUTPUT #4 DRIVER | W-162 |
| 8 | CUSTOMER INPUT #4 | W-168 |
| 7 | CUSTOMER INPUT #3 | W-154 |

W-122 CTB24-4 1 [33,C]
W-123 CTB25-4 1 [33,B]
W-297 04 1 [32,B]
30L XFER PUMP

## P10/TB10

| | | |
|---|---|---|
| 17 | RTN | W-196 |
| 16 | RTN | W-193 |
| 15 | EXTENDED PARALLEL | W-195 |
| 14 | LOAD DEMAND STOP | W-198 |
| 13 | SYNCHRONIZER ENABLE | W-197 |
| 12 | SINGLE MODE VERIFY | W-194 |
| 11 | GENSET CB INHIBIT | W-192 |
| 10 | GENSET CB TRIPPED STATUS | W-186 |
| 9 | RTN | W-187 |
| 8 | GEN CB B STATUS | W-185 |
| 7 | GEN CB A STATUS | W-184 |
| 6 | GENSET CB INHIBIT | W-188 |
| 5 | UTIL CB TRIP STATUS | W-179 |
| 4 | UTILITY CB B STATUS | W-177 |
| 3 | UTILITY CB A STATUS | W-176 |
| 2 | RTN | W-180 |
| 1 | RTN | W-169 |

W-116 J24 9 [23,B]
W-121 J24 7 [23,B]
W-240 J24 8 [23,B]
W-241 CTB43-4 1 [23,B]

## P9/TB9

| | | |
|---|---|---|
| 11 | KVAR LOAD SHARE - | C-7!C-002 |
| 10 | KVAR LOAD SHARE + | C-7!C-003 |
| 9 | SHIELD | |
| 8 | KW LOAD SHARE + | C-9!C-002 |
| 7 | KW LOAD SHARE - | C-9!C-003 |

[14,D] W-190 ESTOP-LOCAL-A2 1
[14,D] W-203 SP34 1
W-124 ESTOP REMOTE-A1 1 [23,D]
REMOVABLE JUMPER
W-125 ESTOP REMOTE-A2 1 [23,D]

C-8/C-002
C-8/C-003
W-111
W-115
W-120

P1-101 J1-101 AUX101 J5 J6 AUX102
PART # 0327-1265
J14-101 P14-101
PART # 0327-1536

## UTILITY SIDE

U V W N

CTU CTV CTW
W-232 W-233 W-234
CTTB: CTTB1-1 … CTTB6-1 / CTTB1-2 … CTTB6-2
W-378 W-235 W-379 W-236 W-380 W-237
SB1: SB1-2 … SB6-2

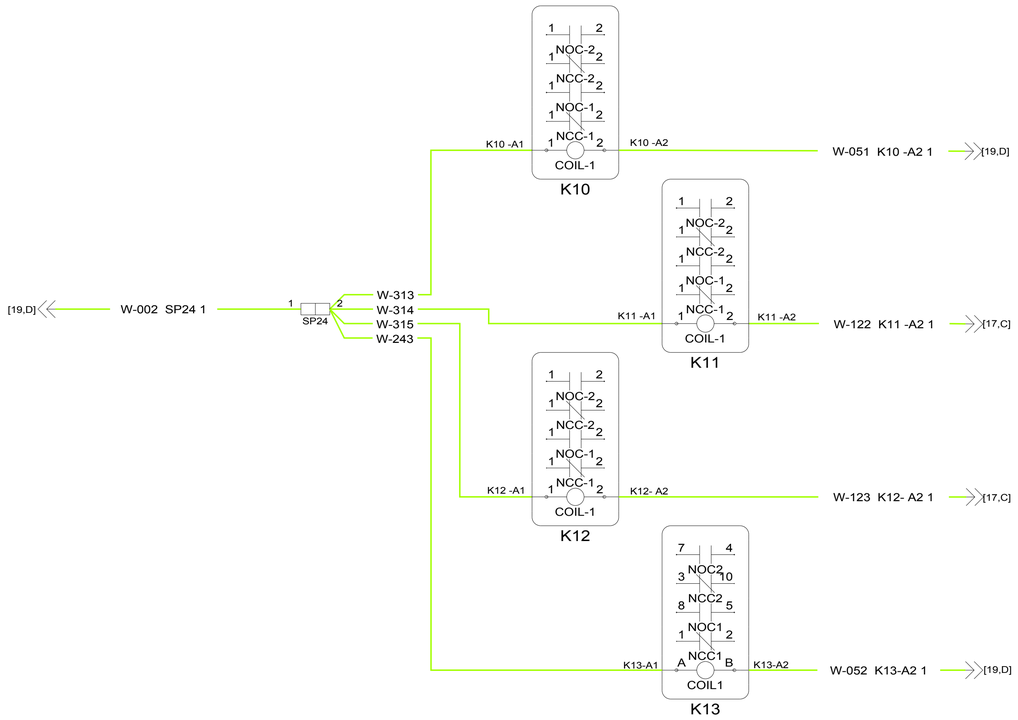
TB7 P7
L1 L2 L3 LN
W-012 W-003 W-013 W-381
FUSE HOLDER FX1-2, FX1-1 … FX3-2, FX3-1
TB7-2

| | | | |
|---|---|---|---|
| SIM TO QSX15 | DWN H.KHOR | Cummins | CUMMINS POWER GENERATION |
| DO NOT SCALE PRINT | CKD A.BORROTO | | SCHEMATIC, WIRING (QST30 WD - PC 3.3) |
| | APVD P.BAKER | | |
| | DATE 01AUG14 | SITE CODE | |
| CONFIDENTIAL PROPERTY OF CUMMINS POWER GENERATION GROUP | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 | FIRST USED ON QST30 | PGF / DWG SIZE D / A053C830 / SHEET 4 OF 8 / DWG REV B |

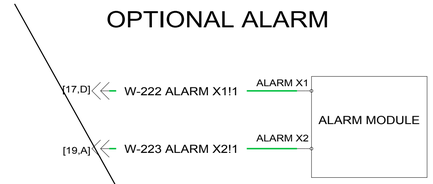
Drawing Name: A053C831 Revision: B
Part Name: A053C830 Revision: B
ECO-163013 Sheet 4 of 8

| REL NO | LTR | NO | REVISION | DWN | CKD | APVD | DATE |
|---|---|---|---|---|---|---|---|
| ECO-163013 | B | -- | ---- | DRA | GT | T.SCHIEBE | 16AUG16 |
| | | | | | | | |
| | | | | | | | |

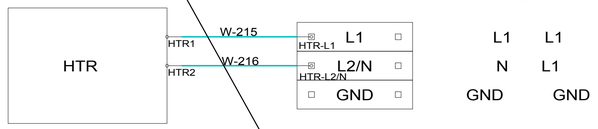
## OPTIONAL CUSTOMER CONFIGURABLE RELAYS



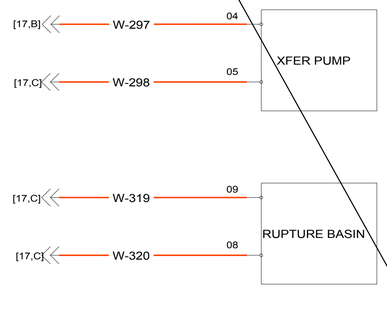

## OPTIONAL ALARM




## CONTROL HEATER




## 30L XFER PUMP




IF REQUIRED FOR THOR OPTIONS, B+, B- AND SWITCH B+ ARE AVAILABLE ON CUSTOMER CONNECTIONS

SEE SHEET 4

| | | | |
|---|---|---|---|
| SIM TO: QSX15 | DWN H.KHOR | | CUMMINS POWER GENERATION |
| DO NOT SCALE PRINT | CKD A.BORROTO | | SCHEMATIC, WIRING (QST30 WD - PC 3.3) |
| | APVD P.BAKER | | |
| | DATE 01AUG14 | SITE CODE | |
| CONFIDENTIAL PROPERTY OF CUMMINS POWER GENERATION GROUP | FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 / FIRST USED ON QST30 | PGF | DWG SIZE D / A053C830 / SHEET 7 OF 8 / DWG REV B |

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