



18 August 2015

Colorado Department of Public Health & Environment
APCD-SS-B1
4300 Cherry Creek Drive South
Denver, CO 80246-1530



RE: APEN Permit Application Requesting Coverage Under General Permit GP06
Denver Data Center, OneNeck IT Solutions LLC

Dear Sir or Madam:

Please find enclosed an Air Pollutant Emission Notice (APEN) & Application for Construction Permit – Diesel Reciprocating Internal Combustion Engine, (Form APCD – 213) Permit Application for the above referenced facility located at 8675 Concord Center Dr. Englewood, CO 80112

Two 1500 kW emergency generator sets are currently installed (DEN-GEN-1A-1 and DEN-GEN-1B-1) and two more will be installed in the very near future (DEN-GEN-1A-2 and DEN-GEN-1B-2). These generators supply electrical power for the building on an emergency basis in the event of a disruption of electrical power supplied by the commercial grid. This application includes the appropriate department forms, emission calculations, and generator engine specifications for all four generators. A Form APCD – 213 was submitted in May of 2015 for two separate operating scenarios (500 hours per year and 2,000 hours per year) for generator DEN-GEN-1B-1 along with a check for \$2,105.80. OneNeck wishes to withdraw that submittal because it was an incomplete submittal and replace it with the attached application. We would like to apply the previously submitted fee to the existing generators (DEN-GEN-1A-1 and DEN-GEN-1B-1) and have enclosed a check for \$2105.80 for permit fees for the two future emergency generators (DEN-GEN-1A-2 and DEN-GEN-1B-2).

If you have any questions or comments please contact either myself at (303) 784-4401; or by email at: Michael.Brunson@OneNeck.com. You may also contact our consultant Melanie Rish at (251) 209-5609 or by email at melanie.rish@cardno.com.

Warmest Regards,

Michael Brunson
Manager, Data Center Facilities - Denver
Attachments

AIR PERMIT APPLICATION

**ONENECK IT SOLUTIONS LLC
DENVER DATA CENTER**

**FACILITY PERMIT NO. NOT ASSIGNED
8675 CONCORD CENTER DR.
ENGLEWOOD, CO 80112**

AUGUST 2015

ATTACHMENT 1
PROCESS DESCRIPTION AND FLOW DIAGRAM

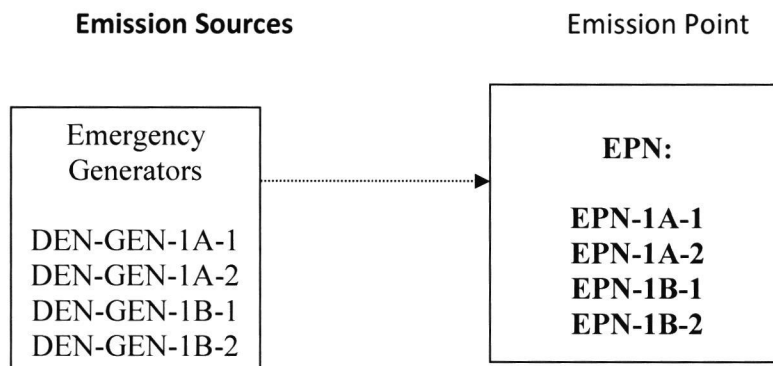
**PROCESS DESCRIPTION
ONENECK IT SOLUTIONS LLC.
DENVER DATA CENTER
8675 CONCORD CENTER DR.
ENGLEWOOD, CO 80112**

Two 1500 kW emergency generator sets are currently installed (DEN-GEN-1A-1 and DEN-GEN-1B-1) and two more will be installed in the very near future (DEN-GEN-1A-2 and DEN-GEN-1B-2). OneNeck will operate these generators at the Denver Data Center located at 8675 Concord Center Dr. Englewood, CO 80112. These generators supply electrical power for the building on an emergency basis in the event of a disruption of electrical power supplied by the commercial grid. The generators are located north of the building in the generator yard of the facility.

All generators are tested weekly for maintenance purposes and no individual unit will be operated more than 500 hours per year. In accordance with the regulations codified in 40 CFR 60 subpart IIII - 60.4211(e), maintenance checks and readiness testing of each generator will be limited to less than 100 hours per year.

Diesel fuel day tanks are associated with each of the generators for supplying fuel. There are no other combustion sources owned or operated by OneNeck at this facility.

**PROCESS FLOW DIAGRAM
ONENECK IT SOLUTIONS LLC.
DENVER DATA CENTER
8675 CONCORD CENTER DR.
ENGLEWOOD, CO 80112**



ATTACHMENT 2
SITE LOCATION DRAWINGS

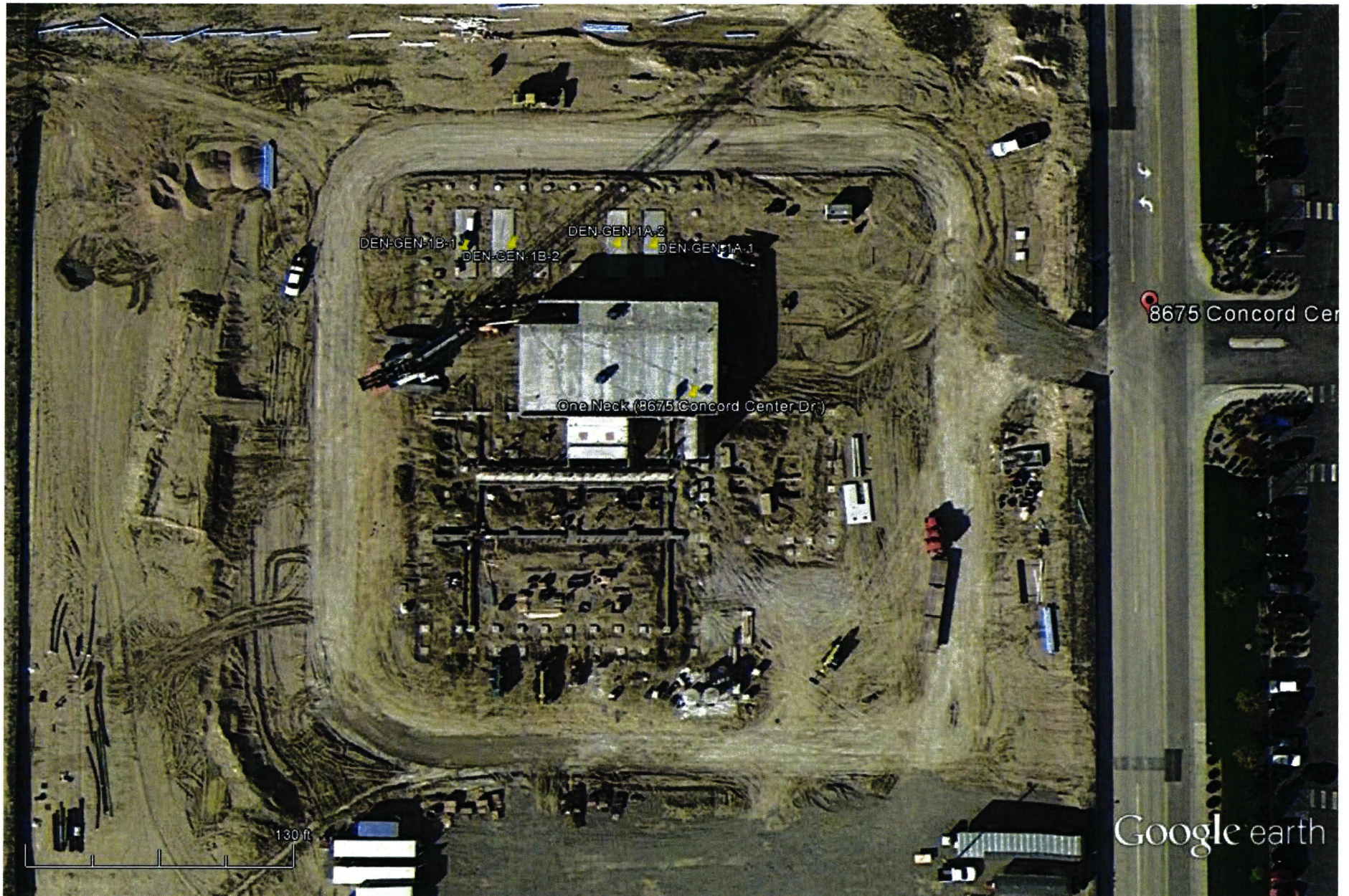


FIGURE 1
SITE LAYOUT DRAWING
ONENECK IT SOLUTIONS LLC, DENVER DATA CENTER

ATTACHMENT 3
EMISSION CALCULATIONS

ONENECK IT SOLUTIONS, L.L.C.
8675 CONCORD CENTER DRIVE, ENGLEWOOD, CO 80112
POTENTIAL EMISSIONS SUMMARY

REPORTING YEAR: **PTE - 500 Hours/year**

Unit	Capacity		Operating Hours *	POLLUTANTS									
				NO _x		CO		PM ₁₀		Total HC		SO _x	
	KW	BHp		lbs/hr	Tons / Yr	lbs/hr	Tons / Yr	lbs/hr	Tons / Yr	lbs/hr	Tons / Yr	lbs/hr	Tons / Yr
EG1A-1	1,500	2,205	500.0	27.71	6.93	2.77	0.69	0.15	0.04	0.39	0.10	0.535	0.1337
EG1A-2	1,500	2,205	500.0	27.71	6.93	2.77	0.69	0.15	0.04	0.39	0.10	0.535	0.1337
EG1B-1	1,500	2,205	500.0	27.71	6.93	2.77	0.69	0.15	0.04	0.39	0.10	0.535	0.1337
EG1B-2	1,500	2,205	500.0	27.71	6.93	2.77	0.69	0.15	0.04	0.39	0.10	0.535	0.1337
TOTALS	6,000				27.71		2.77		0.15		0.39		0.5348

* Enter the hours here only

ONENECK IT SOLUTIONS, L.L.C.
8675 CONCORD CENTER DRIVE, ENGLEWC
POTENTIAL EMISSIONS SUMMARY

REPORTING YEAR: **PTE - 500 Hours/y**

Unit	Capacity		Operating Hours *	GREENHOUSE GASSES						
				CO ₂		CH ₄		N ₂ O		CO ₂ e
	KW	BHp		lbs/hr	Tons / Yr	lbs/hr	Tons / Yr	lbs/hr	Tons / Yr	Tons / Yr
EG1A-1	1,500	2,205	500.0	2,474.14	618.54	0.10	2.51E-02	0.020	5.0179E-03	620.62
EG1A-2	1,500	2,205	500.0	2,474.14	618.54	0.10	2.51E-02	0.020	5.0179E-03	620.62
EG1B-1	1,500	2,205	500.0	2,474.14	618.54	0.10	2.51E-02	0.020	5.0179E-03	620.62
EG1B-2	1,500	2,205	500.0	2,474.14	618.54	0.10	2.51E-02	0.020	5.0179E-03	620.62
TOTALS	6,000				2,474.14		0.10		0.02	2,482.47

* Enter the hc

TABLE 1-1
ANNUAL EMISSIONS POTENTIAL TO EMITT
ONENECK IT SOLUTIONS
DOUGLAS COUNTY
8675 CONCORD CENTER DRIVE, ENGLEWOOD, CO 80112
Facility I.D. No.: Not Assigned by Agency
REPORTING YEAR: PTE

Emergency Generator Calculations:

Make: Cummins Inc. QSK50-G4 NR2

Gen Num.	Size (kW)	BHP	Max Fuel Use (gal/hr)	Heat Input (MM BTU/hr)
EG1A-1	1,500	2,205	109.4	15.17

Heat value of diesel fuel = 138,700 BTU/gal

Monthly Fuel Consumption = 4,558

Annual Fuel Consumption = 54,700

Total number of Generators = 1

Annual Hours of Operation = 500.00

Emission Rates

Pollutant	Emission Rate (gms/Hp-hr)	Emission Rate * (gm/hr)	Maximum Emission Rates			Regulatory Limits	
			Emission Rate*** (lb/hr)	Permit Operating [Hours/yr]	Permit Emission Rate [TPY]	[lbs/hr]	[TPY]
NO _x	5.7	12,568.50	27.71	500	6.93		
CO	0.57	1256.85	2.77	500	0.69		
PM ₁₀	0.03	66.15	0.15	500	0.04	1.52	0.379
Total HC	0.08	176.4	0.39	500	0.10		
SO _x	0.11	242.55	0.53	500	0.13	4.55	1.138
GHG Emissions	lbs/mmBtu						
CO ₂	163.05		2,474.14		618.54		
CH ₄	6.61E-03		0.1004		2.51E-02		
N ₂ O	1.32E-03		0.0201		5.02E-03		
Total CO ₂ E					620.62		

* Emission rates obtained from manufacturer's standby engine specification data at 100% load

Where Fuel %S = 0.035 wt %

*** Conversion Factor: 0.002205 lb/gm

PM Regulatory Limit 0.1 lbs / mmBtu

SO_x Regulatory Limit 0.3 lbs / mmBtu

Stack Parameters

Exit Diameter (ft) 1
Exit Gas Vol (afcm) 12,065
Exit Gas Vel (fpm) 15,362
Exit Gas Vel (fps) 256

TABLE 1-2
ANNUAL EMISSIONS POTENTIAL TO EMITT
ONENECK IT SOLUTIONS
DOUGLAS COUNTY
8675 CONCORD CENTER DRIVE, ENGLEWOOD, CO 80112
Facility I.D. No.: Not Assigned by Agency
REPORTING YEAR: PTE

Emergency Generator Calculations:

Make: Cummins QSK60-G6 NR2

Gen Num.	Size (kW)	BHP	Max Fuel Use (gal/hr)	Heat Input (MM BTU/hr)
EG1A-2	1,500	2,205	109.4	15.2

Heat value of diesel fuel = 138,700 BTU/gal

Monthly Fuel Consumption = 4,558

Annual Fuel Consumption = 54,700

Total number of Generators = 1

Annual Hours of Operation = 500.00

Emission Rates

Pollutant	Emission Rate (gms/Hp-hr)	Emission Rate * (gm/hr)	Maximum Emission Rates			Regulatory Limits	
			Emission Rate*** (lb/hr)	Permit Operating [Hours/yr]	Permit Emission Rate [TPY]	[lbs/hr]	[TPY]
NO _x	5.7	12,568.50	27.71	500	6.93		
CO	0.57	1256.85	2.77	500	0.69		
PM ₁₀	0.03	66.15	0.15	500	0.04	1.52	0.379
Total HC	0.08	176.4	0.39	500	0.10		
SOx	0.11	242.55	0.53	500	0.13	4.55	1.138
GHG Emissions	lbs/mmBtu						
CO ₂	163.05		2,474.14		618.54		
CH ₄	6.61E-03		0.1004		2.51E-02		
N ₂ O	1.32E-03		0.0201		5.02E-03		
Total CO₂E					620.62		

* Emission rates obtained from manufacturer's standby engine specification data at 100% load

Where Fuel %S = 0.035 wt %

*** Conversion Factor: 0.002205 lb/gm

PM Regulatory Limit 0.1 lbs / mmBtu

SOx Regulatory Limit 0.3 lbs / mmBtu

Stack Parameters

Exit Diameter (ft) 1
Exit Gas Vol (afcm) 12,065
Exit Gas Vel (fpm) 15,362
256

TABLE 1-3
ANNUAL EMISSIONS POTENTIAL TO EMITT
ONENECK IT SOLUTIONS
DOUGLAS COUNTY
8675 CONCORD CENTER DRIVE, ENGLEWOOD, CO 80112
Facility I.D. No.: Not Assigned by Agency
REPORTING YEAR: PTE

Emergency Generator Calculations:

Make: Cummins QSK60-G6 NR2

Gen Num.	Size (kW)	BHP	Max Fuel Use (gal/hr)	Heat Input (MM BTU/hr)
EG1B-1	1,500	2,205	109.4	15.2

Heat value of diesel fuel = 138,700 BTU/gal

Monthly Fuel Consumption = 4,558

Annual Fuel Consumption = 54,700

Total number of Generators = 1

Annual Hours of Operation = 500.00

Emission Rates

Pollutant	Emission Rate (gms/Hp-hr)	Emission Rate * (gm/hr)	Maximum Emission Rates			Regulatory Limits	
			Emission Rate*** (lb/hr)	Permit Operating [Hours/yr]	Permit Emission Rate [TPY]	[lbs/hr]	[TPY]
NO _x	5.7	12,568.50	27.71	500	6.93		
CO	0.57	1256.85	2.77	500	0.69		
PM ₁₀	0.03	66.15	0.15	500	0.04	1.52	0.379
Total HC	0.08	176.4	0.39	500	0.10		
SOx	0.11	242.55	0.53	500	0.13	4.55	1.138
GHG Emissions lbs/mmBtu							
CO ₂	163.05		2,474.14		618.54		
CH ₄	6.61E-03		0.1004		2.51E-02		
N ₂ O	1.32E-03		0.0201		5.02E-03		
Total CO₂E					620.62		

* Emission rates obtained from manufacturer's standby engine specification data at 100% load

Where Fuel %S = 0.035 wt %

*** Conversion Factor: 0.002205 lb/gm

PM Regulatory Limit 0.1 lbs / mmBtu

SOx Regulatory Limit 0.3 lbs / mmBtu

Stack Parameters

Exit Diameter (ft) 1
Exit Gas Vol (afcm) 12,065
Exit Gas Vel (fpm) 15,362
256

TABLE 1-4
ANNUAL EMISSIONS POTENTIAL TO EMIT
ONENECK IT SOLUTIONS
DOUGLAS COUNTY
8675 CONCORD CENTER DRIVE, ENGLEWOOD, CO 80112
Facility I.D. No.: Not Assigned by Agency
REPORTING YEAR: PTE

Emergency Generator Calculations:

Make: Cummins QSK60-G6 NR2

Gen Num.	Size (kW)	BHP	Max Fuel Use (gal/hr)	Heat Input (MM BTU/hr)
EG1B-2	1,500	2,205	109.4	15.2

Heat value of diesel fuel = 138,700 BTU/gal
Monthly Fuel Consumption = 4,558
Annual Fuel Consumption = 54,700
Total number of Generators = 1
Annual Hours of Operation = 500.00

Emission Rates

Pollutant	Emission Rate (gms/Hp-hr)	Emission Rate * (gm/hr)	Maximum Emission Rates			Regulatory Limits	
			Emission Rate*** (lb/hr)	Permit Operating [Hours/yr]	Permit Emission Rate [TPY]	[lbs/hr]	[TPY]
NO _x	5.7	12,568.50	27.71	500	6.93		
CO	0.57	1256.85	2.77	500	0.69		
PM ₁₀	0.03	66.15	0.15	500	0.04	1.52	0.379
Total HC	0.08	176.4	0.39	500	0.10		
SO _x	0.11	242.55	0.53	500	0.13	4.55	1.138
GHG Emissions lbs/mmBtu							
CO ₂	163.05		2,474.14		618.54		
CH ₄	6.61E-03		0.1004		2.51E-02		
N ₂ O	1.32E-03		0.0201		5.02E-03		
Total CO ₂ E					620.62		

* Emission rates obtained from manufacturer's standby engine specification data at 100% load

Where Fuel %S = 0.035 wt %

*** Conversion Factor: 0.002205 lb/gm

PM Regulatory Limit 0.1 lbs / mmBtu

SO_x Regulatory Limit 0.3 lbs / mmBtu

Stack Parameters

Exit Diameter (ft) 1
Exit Gas Vol (afcm) 12,065
Exit Gas Vel (fpm) 15,362
256

Engine Information:

Model: Cummins Inc. QSK50-G4 NR2
Displacement: 3067 cu. in. = 50.3 Liters
3.14375 Liters/Cyl
Cylinders 16
Name Plate: 1500 KW
Name Plate: 2220 BHp
Aspiration: Turbocharged and Low Temperature aftercooled
Emission Control Device: Aftercooled

PERFORMANCE DATA

	1/4	1/2	3/4	Full	
	Standby	Standby	Standby	Standby	Prime
BHP @ 1800 RPM (60 Hz)	555	1111	1666	2205	1971
Fuel Consumption (gal/Hr)	32.5	60.2	83.4	109.4	97.8
Exhaust Gas Flow (CFM)	4815	8320	10180	12065	11000
Exhaust Gas Temperature (°F)	665	745	785	915	835

EXHAUST EMISSION DATA [gm / BHp-hr]

	9.35%	5.15%	2.39%	1.38%	1.53%
HC (Total Unburned Hydrocarbons)	0.33	0.19	0.12	0.08	0.09
NOx (Oxides of Nitrogen as NO2)	3.2	3.5	4.9	5.7	5.8
CO (carbon Monoxide)	0.96	0.55	0.4	0.57	0.48
PM (Particular Matter)	0.15	0.05	0.05	0.03	0.03
SO2 (Sulfur Dioxide)	0.13	0.12	0.12	0.11	0.11
Smoke (Bosch)	0.5	0.2	0.2	0.2	0.2

Fuel Specification:

Cetane Number: 40-48
Wt.% Sulfur: 0.03-0.05%

Table 3.4-1.
GASEOUS EMISSION FACTORS FOR LARGE STATIONARY DIESEL AND ALL STATIONARY DUAL-
FUEL ENGINES

Source: AP 42, Fifth Edition
Compilation of Air Pollutant Emission Factors,
 Volume 1: Stationary Point and Area Sources
 Chapter 3.4: Large Stationary Diesel And All Stationary Dual-fuel Engines

Pollutant	DIESEL FUEL / EMISSION FACTOR		
	(lb/hp-hr) (power output)	(lb/MMBtu) (fuel input)	RATING
NOx			
Uncontrolled	0.024	3.2	B
Controlled	0.013	1.9	B
CO	5.50E-03	0.85	C
SOx	8.09 E-03S	1.01S	B
Calculated SOx	4.05E-06	5.05E-04	B
PM	0.0007	0.1	B
TOC (as CH ₄)	7.05E-04	0.09	C
Methane	6.35E-05	8.10E-03	E
NonMethane	6.42E-04	8.19E-02	E
Greenhouse Gases			
CO ₂	1.16E+00	1.65E+02	B
CH ₄	6.35E-05	8.10E-03	E
N ₂ O	not available	not available	

Based on data from 1 engine, TOC is by weight 9% methane and 91% nonmethane.
 Assume Sulfur Content in Fuel = 0.05%

Greenhouse Gas Emission Factors

Source: 40 CFR 98, Subpart C
[Subpart C--GENERAL STATIONARY FUEL COMBUSTION SOURCES](#)
[Table C-1 and Table C-2](#)

Pollutant	DIESEL FUEL / EMISSION FACTOR		
	(Kg / mmBtu) (Fuel Input)	(lb/MMBtu) (fuel input)	RATING
Greenhouse Gases			
CO ₂	7.40E+01	1.63E+02	
CH ₄	3.00E-03	6.61E-03	
N ₂ O	6.00E-04	1.32E-03	

Based on a HHV of the fuel = 0.138 mmBtu / gallon
 138,000 Btu / gallon

GHGs	GWP
Carbon dioxide CO ₂	1
Methane CH ₄	21
Nitrous oxide N ₂ O	310
Sulphur hexafluoride SF ₆	23900



**Power
Generation**

Exhaust Emission Data Sheet

1500DQGAB

60 Hz Diesel Generator Set

Engine Information:

Model:	Cummins Inc, QSK50-G4 NR2	Bore:	6.25 in. (159 mm)
Type:	4 Cycle, 60°V, 16 Cylinder Diesel	Stroke:	6.25 in. (159 mm)
Aspiration:	Turbocharged and Low Temperature Aftercooled	Displacement:	3067 cu. In. (50.2 liters)
Compression Ratio:	15.0:1		
Emission Control Device:	Turbocharged and Low Temperature Aftercooled		

	<u>1/4</u>	<u>1/2</u>	<u>3/4</u>	<u>Full</u>	<u>Full</u>
PERFORMANCE DATA	Standby	Standby	Standby	Standby	Prime
BHP @ 1800 RPM (60 Hz)	555	1111	1666	2205	1971
Fuel Consumption (gal/Hr)	32.5	60.2	83.4	109.4	97.8
Exhaust Gas Flow (CFM)	4815	8320	10180	12065	11000
Exhaust Gas Temperature (°F)	665	745	785	915	835
EXHAUST EMISSION DATA					
HC (Total Unburned Hydrocarbons)	0.33	0.19	0.12	0.08	0.09
NOx (Oxides of Nitrogen as NO2)	3.20	3.50	4.90	5.70	5.80
CO (carbon Monoxide)	0.96	0.55	0.40	0.57	0.48
PM (Particular Matter)	0.15	0.05	0.05	0.03	0.03
SO2 (Sulfur Dioxide)	0.13	0.12	0.12	0.11	0.11
Smoke (Bosch)	0.50	0.20	0.20	0.20	0.20

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

TEST CONDITIONS

Data is representative of steady-state engine speed (± 25 RPM) with full load ($\pm 2\%$). Pressures, temperatures, and emission rates were stabilized.

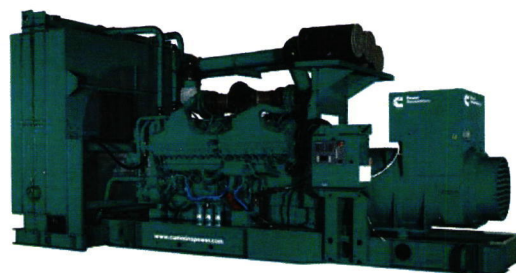
Fuel Specification:	ASTM D975 No. 2-D diesel fuel with 0.03-0.05% sulfur content (by weight), and 40-48 cetane number.
Fuel Temperature:	99 $\pm$ 9 °F (at fuel pump inlet)
Intake Air Temperature:	77 $\pm$ 9 °F
Barometric Pressure:	29.6 $\pm$ 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H2O/lb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

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

Bill of Materials
Re: TDS Denver

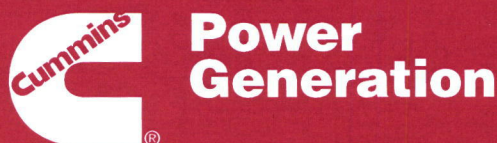
Item	Description	Qty
	Diesel Genset: 60Hz-1500kW	
Install-US-Stat	U.S. EPA, Stationary Emergency Application	2
1500DQGAB	Genset-Diesel,60Hz,1500kW	
A331-2	Duty Rating-Standby Power	
L090-2	Listing-UL 2200	
L170-2	Emission Cert, EPA, Tier 2,NSPS CI Stationary Emergency	
R002-2	Voltage-277/480,3 Phase,Wye,4 Wire	
B276-2	Alternator-60Hz,3 Phase, Wye, Limited Range125/105C	
H611-2	Set Control-PCC	
H613-2	Paralleling-Isolated Bus, Automatic	
H605-2	Display-Control, Graphical	
H606-2	Meters-AC Output, Analog	
KP60-2	Interface-CommunicationsNtwk,FTT-10	
H679-2	Control Mounting-Front Facing	
KP79-2	Circuit Breaker Or Entrance Box-Left Side Only	
CB-2	CB-2500A,3P,600V,	
H667-2	Indication-Ground Fault, 4-Pole XfrSw&Ckt Brkr, LS	
KR01-2	Circuit Breaker Lugs-Mechanical, Left Side	
C127-2	Separator-Fuel/Water	
A334-2	Engine Starter-24 VDC Motor	
A333-2	Battery Charging Alternator-Normal Output	
E125-2	Engine Cooling-High Ambient Air Temperature	
H389-2	Shutdown-Low Coolant Level	
H557-2	Coolant Heater-208/240/480V, Below 40F Ambient Temp	
D041-2	Engine Air Cleaner-Normal Duty	
H607-2	Filters-Engine Oil, Full Flow and Bypass	
L028-2	Genset Warranty- Base, Standby 2 years / 400 hours	
0300-5878-01	Battery Charger	
BA	Batteries	
EN	Sound Attenuated Enclosure Level 2	
EN	Critical Muffler	
FT	24 Hour Subbase Fuel Tank - UL142	
VI	Vibration Isolators	
SU	Start Up	

Diesel generator set QSK50 series engine



> Specification sheet 1100 kW - 1500 kW 60 Hz

Our energy working for you.™



Description

Cummins Power Generation commercial generator sets are fully integrated power generation systems providing optimum performance, reliability and versatility for stationary standby and prime power applications. Codes may not be available with all model configurations – consult factory for availability.



This generator set is designed in facilities certified to ISO 9001 and manufactured in facilities certified to ISO 9001 or ISO 9002.



The Prototype Test Support (PTS) program verifies the performance integrity of the generator set design. Cummins Power Generation products bearing the PTS symbol meet the prototype test requirements of NFPA 110 for Level 1 systems.



All low voltage models are CSA certified to product class 4215-01.



The generator set is available listed to UL 2200, Stationary Engine Generator Assemblies for all 60 Hz low voltage models. The PowerCommand control is Listed to UL 508 - Category NITW7 for U.S. and Canadian usage. Circuit breaker assemblies are UL 489 Listed for 100% continuous operation and also UL 869A Listed Service Equipment.

U.S. EPA

Engine certified to Stationary Emergency U.S. EPA New Source Performance Standards, 40 CFR 60 subpart IIII Tier 2 exhaust emission levels. U.S. applications must be applied per this EPA regulation.

International Building Code

The generator set package is available certified for seismic application in accordance with the following International Building Code: IBC2000, IBC2003, IBC2006 and IBC2009.

Features

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

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

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

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

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

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

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

Model	Standby rating		Prime rating		Continuous rating		Data sheets	
	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz	50 Hz
DQGAA	1250 (1563)		1100 (1375)				D-3333	
DQGAB	1500 (1875)		1350 (1688)				D-3334	

Generator set specifications

Governor regulation class	ISO8528 Part 1 Class G3
Voltage regulation, no load to full load	± 0.5%
Random voltage variation	± 0.5%
Frequency regulation	Isochronous
Random frequency variation	± 0.25%
Radio frequency emissions compliance	IEC 801.2 through IEC 801.5; MIL STD 461C, Part 9

Engine specifications

Bore	158.8 mm (6.25 in)
Stroke	158.8 mm (6.25 in)
Displacement	50.3 litres (3067 in ³)
Configuration	Cast iron, V 16 cylinder
Battery capacity	1800 amps minimum at ambient temperature of 0 °C (32 °F)
Battery charging alternator	35 amps
Starting voltage	24 volt, negative ground
Fuel system	Cummins' Modular Common Rail System
Fuel filter	Dual element 10 micron filtration spin-on fuel filter with 15 micron water separator
Air cleaner type	Dry replaceable element
Lube oil filter type(s)	Four spin-on, combination full flow filter and bypass filters
Standard cooling system	High ambient radiator

Alternator specifications

Design	Brushless, 4 pole, drip proof revolving field
Stator	2/3 pitch
Rotor	Single bearing, flexible disc
Insulation system	Class H
Standard temperature rise	150 °C standby at 40 °C ambient
Exciter type	PMG (permanent magnet generator)
Phase rotation	A (U), B (V), C (W)
Alternator cooling	Direct drive centrifugal blower fan
AC waveform total harmonic distortion	< 5% no load to full linear load, < 3% for any single harmonic
Telephone influence factor (TIF)	< 50 per NEMA MG1-22.43
Telephone harmonic factor (THF)	< 3

Available voltages

60 Hz line-neutral/line-line	50 Hz line-neutral/line-line
• 220/380 • 277/480 • 2400/4160 • 255/440 • 347/600	

* Note: Consult factory for other voltages.

Generator set options and accessories

Engine

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

Control panel

- ☐ 120/240 V 100 W control anti-condensation heater
- ☒ Paralleling configuration
- ☐ Remote fault signal package
- ☐ Run relay package
- ☐ Exhaust pyrometer
- ☐ Fuel pressure indication
- ☒ Ground fault indication

Alternator

- ☐ 80 °C rise
- ☐ 105 °C rise
- ☒ 125 °C rise
- ☐ 120/240 V 300 W anti-condensation heater

Exhaust system

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

Cooling system

- ☐ Remote radiator

Generator set

- ☐ AC entrance box
- ☒ Battery
- ☒ Battery charger
- ☒ Circuit breaker - set mounted
- ☐ Disconnect switch - set mounted
- ☐ PowerCommand Network
- ☐ Remote annunciator panel
- ☒ Spring isolators
- ☒ 2 year warranty
- ☐ 5 year warranty
- ☐ 10 year major components warranty

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

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**Power
Generation**

Control system PCC 3201



PowerCommand control is an integrated generator set control system providing governing, voltage regulation, engine protection and operator interface functions. Major features include:

- Integral AmpSentry™ Protective Relay providing a full range of alternator protection functions that are matched to the alternator provided.
- Battery monitoring and testing features and smart starting control system.
- Three phase sensing, full wave rectified voltage regulation system, with a PWM output for stable operation with all load types.
- Control suitable for operation in ambient temperatures from -40 °C to +70 °C (-40 °F to +158 °F) and altitudes to 5000 meters (13,000 feet).
- Prototype tested; UL, CSA, and CE compliant.
- InPower™ PC-based service tool available for detailed diagnostics.
- Optional Echelon® LONWORKS® network interface.

Operator/display panel

- Off/manual/auto mode switch
- Manual run/stop switch
- Panel lamp test switch
- Emergency stop switch
- Exercise switch
- Alpha-numeric display with pushbutton access for viewing engine and alternator data and providing setup, controls and adjustments
- LED lamps indicating not in auto, common warning, common shutdown, remote start
- Configurable for local language

Engine protection

- Overspeed shut down
- Low oil pressure warning and shut down
- High coolant temperature warning and shut down
- High oil temperature warning
- Low coolant level warning or shut down
- Low coolant temperature warning
- High and low battery voltage warning
- Weak battery warning
- Dead battery shut down
- Fail to start (overcrank) shut down
- Fail to crank shut down
- Redundant start disconnect
- Cranking lockout
- Sensor failure indication

Engine data

- DC voltage
- Lube oil pressure
- Coolant temperature
- Lube oil temperature
- Engine speed
- Engine ECM data

AmpSentry AC protection

- Over current and short-circuit shut down
- Over current warning
- Single and three phase fault regulation
- Over and under voltage shut down
- Over and under frequency shut down
- Overload warning with alarm contact
- Reverse power and reverse Var shut down

Alternator data

- Line-to-line and line-to-neutral AC volts
- Three phase AC current
- Frequency
- Total and individual phase power factor, kW and kVA
- Bus voltage and frequency (with paralleling options)

Other data

- Genset model data
- Start attempts, starts, running hours
- kW hours (total and since reset)
- Fault history
- Load profile (accessible with InPower)

Governing

- Digital electronic isochronous governor
- Temperature dynamic governing
- Smart idle speed mode

Voltage regulation

- Digital PWM electronic voltage regulation
- Three phase line-to-neutral sensing
- Single and three phase fault regulation
- Configurable torque matching

Control functions

- Data logging on faults
- Fault simulation (requires InPower)
- Time delay start and cooldown
- Cycle cranking
- Configurable customer outputs (4)
- Configurable network inputs (8) and outputs (16) (with optional network)
- Remote emergency stop

Paralleling (Option)

- Active digital phase lock loop synchronizer
- Isochronous kW and kVar load sharing controls
- kW import/export and kVar/PF control for utility (mains) paralleling

Options

- ☐ Thermostatically controlled space heater
- ☐ Key-type mode switch
- ☒ **Ground fault module**
- ☐ Auxiliary relays (3)
- ☐ Echelon LONWORKS interface
- ☐ Modion Gateway to convert to Modbus (loose)
- ☐ PowerCommand iWatch web server for remote monitoring and alarm notification (loose)
- ☐ Digital input and output module(s) (loose)
- ☐ Remote annunciator (loose)
- ☒ **Paralleling**
- ☐ Power transfer control

For further detail see document S-1444.

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**Power
Generation**

Ratings definitions

Emergency standby power (ESP):

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

Limited-time running power (LTP):

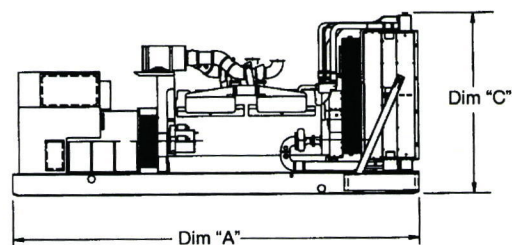
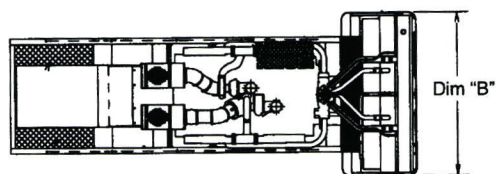
Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.

Prime power (PRP):

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

Base load (continuous) power (COP):

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



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

Do not use for installation design

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

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

Cummins Power Generation

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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-1512f (7/10)



Model: DQGAB
Frequency: 60
Fuel type: Diesel
KW rating: 1500 standby
1350 prime

Emissions level: EPA NSPS Stationary Emergency Tier 2

➤ **Generator set data sheet**



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

Fuel consumption	Standby				Prime				Continuous
	kW (kVA)				kW (kVA)				kW (kVA)
Ratings	1500 (1875)				1350 (1688)				
Load	1/4	1/2	3/4	Full	1/4	1/2	3/4	Full	Full
US gph	32.5	60.2	83.4	109.4	30.1	55.2	78.1	97.8	
L/hr	123	227.9	315.7	414.1	113.9	209	295.6	370.2	

Engine	Standby rating	Prime rating	Continuous rating
Engine manufacturer	Cummins Inc.		
Engine model	QSK50-G4 NR2		
Configuration	Cast iron, V 16 cylinder		
Aspiration	Turbocharged and low temperature aftercooled		
Gross engine power output, kWm (bhp)	1656 (2220)		1470 (1971)
BMEP at set rated load, kPa (psi)	2192 (318)		1957 (284)
Bore, mm (in)	159 (6.25)		
Stroke, mm (in)	159 (6.25)		
Rated speed, rpm	1800		
Piston speed, m/s (ft/min)	9.5 (1875)		
Compression ratio	15:1		
Lube oil capacity, L (qt)	235 (248)		
Overspeed limit, rpm	2100 ±50		
Regenerative power, kW	168		

Fuel flow		
Maximum fuel flow, L/hr (US gph)	757 (200)	
Maximum fuel inlet restriction, kPa (in Hg)	30 (9.0)	
Maximum fuel inlet temperature, °C (°F)	70 (160)	

Air

	Standby rating	Prime rating	Continuous rating
Combustion air, m ³ /min (scfm)	139 (4895)	133 (4700)	
Maximum air cleaner restriction, kPa (in H ₂ O)	6.2 (25)		
Alternator cooling air, m ³ /min (cfm)	207 (7300)		

Exhaust

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

Standard set-mounted radiator cooling

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

Optional set-mounted radiator cooling

Ambient design, °C (°F)			
Fan load, kW _m (HP)			
Coolant capacity (with radiator), L (US gal)			
Cooling system air flow, m ³ /min (scfm)			
Total heat rejection, MJ/min (Btu/min)			
Maximum cooling air flow static restriction, kPa (in H ₂ O)			
Maximum fuel return line restriction, kPa (in Hg)			

Optional heat exchanger cooling

Set coolant capacity, L (US gal)			
Heat rejected, jacket water circuit, MJ/min (Btu/min)			
Heat rejected, aftercooler circuit, MJ/min (Btu/min)			
Heat rejected, fuel circuit, MJ/min (Btu/min)			
Total heat radiated to room, MJ/min (Btu/min)			
Maximum raw water pressure, jacket water circuit, kPa (psi)			
Maximum raw water pressure, aftercooler circuit, kPa (psi)			
Maximum raw water pressure, fuel circuit, kPa (psi)			
Maximum raw water flow, jacket water circuit, L/min (US gal/min)			
Maximum raw water flow, aftercooler circuit, L/min (US gal/min)			
Maximum raw water flow, fuel circuit, L/min (US gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, jacket water circuit, L/min (US gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, aftercooler circuit, L/min (US gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, fuel circuit, L/min (US gal/min)			
Raw water delta P at min flow, jacket water circuit, kPa (psi)			
Raw water delta P at min flow, aftercooler circuit, kPa (psi)			
Raw water delta P at min flow, fuel circuit, kPa (psi)			
Maximum jacket water outlet temp, °C (°F)			
Maximum aftercooler inlet temp, °C (°F)			
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)			
Maximum fuel return line restriction, kPa (in Hg)			

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Optional remote radiator cooling¹

	Standby rating	Prime rating	Continuous rating
Set coolant capacity, L (US gal)			
Max flow rate at max friction head, jacket water circuit, L/min (US gal/min)	1779 (470)		
Max flow rate at max friction head, aftercooler circuit, L/min (US gal/min)	492 (130)		
Heat rejected, jacket water circuit, MJ/min (Btu/min)	35.44 (33610)	32.11 (30455)	
Heat rejected, aftercooler circuit, MJ/min (Btu/min)	26.93 (25545)	23.96 (22725)	
Heat rejected, fuel circuit, MJ/min (Btu/min)			
Total heat radiated to room, MJ/min (Btu/min)	9.94 (9425)	8.78 (8330)	
Maximum friction head, jacket water circuit, kPa (psi)	67 (10)		
Maximum friction head, aftercooler circuit, kPa (psi)	48 (7)		
Maximum static head, jacket water circuit, m (ft)	18.3 (60)		
Maximum static head, aftercooler circuit, m (ft)	18.3 (60)		
Maximum jacket water outlet temp, °C (°F)	104 (220)	100 (212)	
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)	49 (120)		
Maximum aftercooler inlet temp, °C (°F)	71 (160)	66 (150)	
Maximum fuel flow, L/hr (US gph)			
Maximum fuel return line restriction, kPa (in Hg)			

Weights²

Unit dry weight kgs (lbs)	10989 (24220)
Unit wet weight kgs (lbs)	11493 (25330)

Notes:

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

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

Derating factors

Standby	Engine power available up to 890 m (2920 ft) at ambient temperatures up to 40 °C (104 °F). Above these elevations, derate at 6.6% per 305 m (1000 ft) and 14.0% per 10 °C (18 °F).
Prime	Engine power available up to 562 m (1844 ft) at ambient temperatures up to 40 °C (104 °F). Above these elevations, derate at 6.6% per 305 m (1000 ft) and 14.0% per 10 °C (18 °F).
Continuous	

Ratings definitions

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

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Alternator data

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

Notes:

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

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

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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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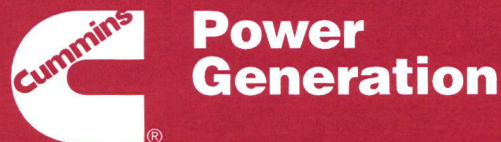
PowerCommand® 3201

Digital generator set control



> Specification sheet

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Description

The PowerCommand® 3201 Control is a microprocessor-based generator set monitoring, metering and control system. The control provides an operator interface to the genset, digital voltage regulation, digital governing and generator set protective functions. It may incorporate optional automatic digital paralleling controls and/or power transfer controls. The integration of all the functions into a single control system provides enhanced reliability and performance compared to conventional control systems.

The PowerCommand control is designed for mounting on the generator set and is suitable for use on generator sets ranging in size from 20 kW to 4000 kW. It will directly read AC voltages up to 600 VAC and can be configured for any frequency, voltage and power connection configuration from 120 to 13,800 VAC. The operator panel may be remote-mounted from the generator set and connected via an RS485 network connection.

The control offers a wide range of standard control and digital display features so custom control configurations are not needed to meet application requirements and system reliability is not compromised by use of untested special components.

Power for PowerCommand Control is usually derived from the generator set starting batteries. It functions over a voltage range from 8 VDC to 35 VDC.

Features

Digital full authority electronic engine controls -

Provide engine monitoring, protection and governing. These functions are integrated with voltage regulation and paralleling functions for optimum system performance.

Digital voltage regulation - Provides fast, controlled response to load changes and high levels of immunity to the effects of non-linear loads.

AmpSentry™ protective relay - UL Listed, true alternator overcurrent protection.

AC output metering - Includes analog and digital display.

Battery monitoring system - Senses and warns against weak battery condition that is not detected by conventional DC over and undervoltage monitoring.

Message display - Digital alarm and status.

Generator set monitoring - Displays status of all critical engine and alternator generator set functions.

Smart starting control system - Integrated fuel ramping to limit black smoke and frequency overshoot, in addition to optimized cold weather starting.

Advanced serviceability - Utilizes InPower™, a PC-based software service tool.

Digital power transfer control - Optional control functions that allow operation in open transition, closed transition or soft (ramping) transfer modes.

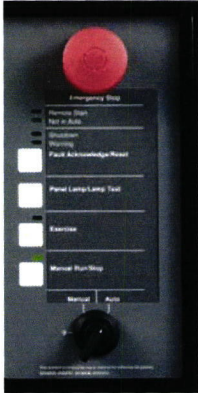
PowerCommand LonWorks® network - Optional network interface providing expanded input/output capability, remote monitoring and control by annunciators and other equipment, and easier installation.

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

Operator panel

The operator panel provides the user with a complete range of easy to view and use information. It includes an enhanced graphical operator panel that allows the user to view up to 9 lines of information, as well as graphical displays of system data. Connections to the operator panel are sealed, locking plug interfaces for reliable, vibration-resistant interconnection to the generator set wiring harness.

Control switches and functions



Off/manual/auto mode control switch - The *not in auto* lamp will flash when the control is in the *manual* or *off* mode. In the *auto* mode, the generator set can be started using the exercise push-button or with a start signal from a remote device, such as automatic transfer switches.

Manual run/stop control switch and indicating LED - When the mode control switch is in the *manual* position and the *manual run/stop* switch is pressed, the generator set will start, bypassing all time delay starts. (Time delay idle can also be bypassed with another control action.) If the generator set is running in the *manual* mode, pressing the *run/stop* switch will cause the generator set to shut down. An LED (light emitting diode) lamp adjacent to the switch will light to indicate the generator set is in manual mode.

Exercise control switch and indicating LED - When the mode control switch is in the *auto* position the *exercise* control switch is used to complete a pre-programmed exercise sequence. All exercise functions are disabled when an emergency start command is received by the control. An LED lamp adjacent to the switch will light to indicate the generator set is in exercise mode.

Panel lamp/lamp test control switch.

Fault acknowledge/reset switch - The control includes a fault acknowledge function to allow the operator to reset the fault condition. If the fault condition is not corrected, the fault will reappear, but will not be logged as a separate event. Multiple faults can be logged and displayed at one time.

Emergency stop control switch.

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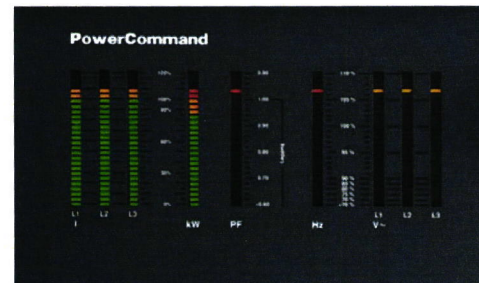
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Operator adjustments - The control includes provisions for many set up and adjustment functions via raise/lower switches on the operator panel. Functions that can be adjusted by the operator include:

- Time delay start (0-300 seconds)
- Time delay stop (0-600 seconds)
- Alternator voltage ($\pm 5\%$)
- Alternator frequency (± 3 Hz)

The operator panel can be configured to require an access code prior to adjusting these values. A second access code is used to protect the control from unauthorized service level adjustments. Voltage and frequency adjustments are disabled during operation in parallel with a system bus to prevent inadvertent misadjustment of the paralleling load sharing functions.

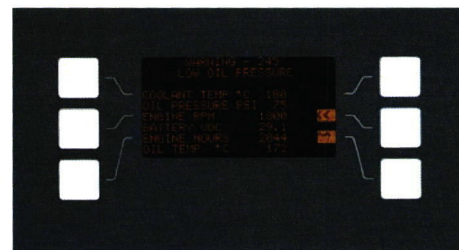
Analog AC metering panel



The PowerCommand control is equipped with an analog AC metering panel that simultaneously displays 3-phase line-to-line AC volts and current, kW, power factor and frequency.

The meter panel is composed of a series of LEDs configured in bar graphs for each function. The LEDs are color coded with green indicating normal range values, amber for warning levels and red for shutdown conditions. Scales for each function are in % of nominal rated values.

Graphical display panel



The PowerCommand control is provided with a graphical display capable of displaying up to 9 lines of data with approximately 27 characters per line. The graphical display is accompanied by a set of six tactile-feel membrane switches that are used by the operator to navigate through control menus and to make control adjustments. Display is configurable for multiple languages. It is configurable for units of measurement. The display incorporates three levels of operation and adjustability. All data on the control can be viewed by

scrolling through screens with the navigation keys. The top three lines of the display are allocated to mode and status messages that continuously display the operating mode of the control system, as well as any faults or warning conditions that may be present on the controller. If more than one fault or warning message is present, the messages will scroll to allow the operator to view all active messages in the system.

Screen-saver mode - The operator panel can be programmed to automatically switch off to reduce battery voltage drain when the control is not being used and the generator set is not running. Depressing any button on the operator panel, new fault conditions or receipt of a remote signal at the control will "wake up" the control.

Generator set data

Generator set hardware data - Generator set rating in kVA, complete generator set model number and serial number, engine model and serial number and alternator model and serial number. The control also displays the part number of the control and the software version present in the control.

Data logs - Number of start attempts and number of start attempts since reset. Number of times generator set has run and number of times since reset. Duration of generator set running time and duration of running time since last reset. Generator set kWh produced and kWh produced since last reset.

Adjustment history - Record of adjustment and setting changes made on the control, identifies whether adjustment was made via the operator panel or with a service tool. If a service tool is used, the control provides a record of the serial number of the tool used. This information is read with InPower.

Fault history - Record of the most recent fault conditions with time stamp, along with the number of times each fault has occurred. At least 20 events are stored in the control memory.

Load profile data - Data indicating the total operating hours at percent of load in 10% increments and since reset.

Generator set AC data

Generator set output frequency, voltage and current - All phases (line-to-line and line-to-neutral for voltage. Accuracy 1%.

Generator set power output - PowerCommand displays generator set kW and kVA output (average phase, individual phase and direction of flow) and power factor with leading/lagging indication. Accuracy 5%.

Generator set kWh energy output - Total kWh produced and total produced since last reset with time stamp of time of last reset.

Digital synchroscope - Bus voltage and frequency, generator set bus voltage and frequency, the phase angle displacement and a signal indicating "ready to close". A breaker control switch is included on this panel for convenient operation of the equipment without switching between viewing screens.

Engine data

Basic engine data - Engine starting battery voltage, engine lube oil pressure and engine coolant temperature.

Engine service data - Varies with engine used, but typically includes: Engine coolant pressure, engine fuel rail temperature and pressure, engine fuel input and output temperature, intake manifold temperature and pressure, ambient air pressure, crankcase blowby flow and aftercooler inlet coolant temperature.

Engine fuel consumption - The fuel consumed by the engine is calculated by the control based on fuel flow into the engine and returned by the engine, and the temperature of the two flow streams. Accuracy is $\pm 5\%$ over 500 hours of operation. Data provided includes overall average fuel consumed and consumption since reset. This information is read with InPower.

Engine exhaust temperature (optional).

Power transfer control data (optional)

Utility (mains) source data - Displays line-to-line and line-to-neutral voltage of utility (mains) source, frequency and estimated amps, and kW and kVA supplied by utility (mains) source (optional when power transfer control is used).

System status information - Provides graphical system status display showing availability of sources and positions of each contactor.

System control - Allows operator to view status of system and manually control operation of the system. Provides manual adjustment capability for time delay start, stop, transfer and retransfer, as well as time delays for program transition (when used) and power transfer overlap time.

Internal control functions

General functions

System control voltage - The control operates on 24 VDC from the generator set starting batteries. Control functions are fully operational over a voltage range of 8 VDC to 36 VDC.

Emergency start mode - PowerCommand accepts a ground signal from remote devices or a network signal to automatically start the generator set and immediately accelerate to rated speed and voltage.

PowerCommand includes a smart starting system that is designed to quickly start the engine, minimize black smoke, minimize voltage and frequency overshoot, and

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oscillations on starting. The control system does this by careful simultaneous control of the engine fuel system and alternator excitation system.

Non-emergency start mode - The control is provided with a separate remote start input or a network signal to start the generator set via the programmable idle control. Using the non-emergency mode, the generator set takes longer to start, but there is less wear on the engine. In this start mode, the generator set will start, operate at idle speed for a predefined time period or until the engine reaches operating temperature (whichever time is shorter), and then ramp to rated speed and voltage. Time delay is adjustable from 0-300 seconds and default is 10 seconds. The control also monitors and records the source of start signals, when that information is available. The control automatically exits idle mode if an emergency remote start signal is received at the control.

Data logging - The control maintains a record of manual control operations, warning and shutdown conditions and other events. It uses the control "on" time as the time-stamp means when a real time clock is not included with the control. The control also stores critical engine and alternator data before and after a fault occurs, for use by InPower and the technician in evaluating the root causes for the fault condition.

Fault simulation mode - PowerCommand, in conjunction with InPower software, will accept commands to allow a technician to verify the proper operation of critical protective functions of the control 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 of the specific generator set it is communicating with.

Built in test - The control system automatically tests itself, and all the sensors, actuators and harnesses in the control system, on a startup signal. The test can also be initiated from InPower and can be accomplished either locally to the generator set or remotely.

Engine control

Engine starting - The control operates a factory-supplied fuel valve that enables engine starting.

Cycle cranking - Configurable for 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. Default setting is for (3) start cycles composed of 15 seconds of cranking and 15 seconds of rest.

Programmable idle speed control - In this mode the generator set would start and run to idle speed. It would operate at that speed for a programmed time period, then ramp to rated speed. When the control gets a signal to stop, it will ramp to idle, operate for the programmed period at idle and then shut down. During idle mode,

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engine protective functions are adjusted for the lower engine speed and alternator function is disabled.

Time delay start and stop (cool down) - Configurable for time delay of 0-300 seconds prior to starting after receiving a remote start signal in normal operation modes and for time delay of 0-600 seconds prior to ramp-to-idle or shutdown after signal to stop in normal operation modes. The generator set control will monitor the load during operation of the generator set, and if the total load on the set is less than 10% of rated it will reduce the operation time for the time delay stop in order to prevent extended operation of the engine at very light load levels. Default for both time delay periods is 0 seconds.

Engine governing

Isochronous governing - Controls engine speed within $\pm 0.25\%$ for any steady state load from no load to full load. Frequency drift will not exceed $\pm 0.5\%$ for a 33 °C (60 °F) change in ambient temperature over an 8 hour period.

Droop governing - Control can be adjusted to droop from 0 to 10% from no load to full load, using InPower.

Temperature dynamics - Modifies the engine fuel system control parameters as a function of engine temperature. Allows engine to be more responsive when warm and more stable when operating at lower temperature levels.

Isochronous load sharing control - See *Paralleling Functions/Load sharing controls*.

Droop load sharing control - See *Paralleling Functions/Load sharing controls*.

Idle mode - Engine governing can be regulated at an idle speed for a programmed period on start or stop of the engine. When the engine is operating at idle speed, the alternator excitation is automatically switched off.

Alternator control

Digital output voltage regulation - PowerCommand will regulate output voltage to within 0.5% for any loads between no load and full load. Voltage drift will not exceed $\pm 0.5\%$ for a 33 °C (60 °F) change in temperature in an 8 hour period. On engine starting, or sudden load acceptance, voltage is controlled to a maximum of 5% overshoot over nominal level.

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. This function is automatically disabled when the control is in a synchronizing mode.

Fault current regulation - PowerCommand will regulate the output current on any phase to a maximum of 3 times rated current under fault conditions for both single phase and three phase faults. In conjunction with a permanent magnet generator, it will provide 3 times rated current on all phases for motor starting and short circuit coordination purposes.



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Isochronous (kVar) load sharing control - See *Paralleling Functions/Load sharing controls*.

Droop (kVar) load sharing control - See *Paralleling Functions/Load sharing controls*.

Protective functions

On a warning condition, the control will indicate a fault by lighting the warning LED on the control panel and displaying the fault name and code on the operator display panel. 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.

On a shutdown condition, the control will light the shutdown LED on the control panel, display the fault name and code, initiate shutdown and lock out the generator set. The shutdown sequence of the generator set includes programmable cooldown at idle for fault conditions that do not endanger the engine. The control maintains a data log of all fault conditions as they occur and time stamps them with the controller run time and engine operating hours data. Adjustments to most set points are made using the InPower service tool.

The control system includes a "fault bypass" mode that forces the system to function regardless of the status of protective functions. In this mode, the only protective functions that are operational are over speed, loss of both speed sensors, moving the control switch to the off position or pressing the *emergency stop* switch. The control maintains a record of the time that the mode is enabled and of all warning or shutdown conditions that have occurred while in the "fault bypass" mode.

Many protective functions within the control system are configurable for warning, shutdown or both (2 levels). Exceptions to this include functions such as over speed conditions, and loss of speed sensing. In addition, some warning functions can incorporate control functions as a consequence of a fault.

System protective functions:

Ground fault warning (option - 600 VAC class generator sets) - Ground (earth) fault sensing is adjustable over a range of 100-1200 amps with time delays of 0-1 second. May be configured for shutdown rather than alarm.

Configurable alarm and status inputs - PowerCommand will accept up to four alarm or status inputs (contact closed to ground) to indicate customer-specified conditions. The control is programmable for warning, shutdown or status indication and for labeling the input (up to 24 characters). Sixteen additional faults can be input to the control via the network.

Breaker fail to close and breaker auxiliary contact warning or shutdown - When the paralleling control signals a circuit breaker to close, it will monitor the breaker

auxiliary contacts and verify that the breaker has connected the generator set to the system bus. If the control does not sense a breaker closure within 0.5 second of the close signal, the control will monitor the phase relationship between the generator set and the bus. If this indicates that the generator set is not closed to the bus, the "breaker fail to close" alarm will be indicated, the breaker will be opened and the generator set shut down. If the phase relationship monitor indicates that the generator set is in parallel with the bus, "circuit breaker auxiliary contact failure" will be indicated and the generator set will continue to run in normal operation mode.

Breaker fail to open warning - The control system monitors the operation of breakers that have been signaled to open. If the breaker does not open within 1 second of initiation of signal, a "breaker fail to open" warning is initiated. The control will logically allow the generator set to continue to run if shutdown of the generator set with the breaker closed will cause potential damage or operating problems.

Bus or generator set PT input calibration error - The control system monitors the sensed voltage from the bus and generator set output voltage-potential transformers. When the paralleling breaker is closed, it will indicate a warning condition when they read different values.

Emergency stop - Annunciated whenever the local or remote emergency stop signal is received. Alarm panel distinguishes between local or remote operation.

AmpSentry protective relay

AmpSentry protective relay is a UL Listed comprehensive monitoring and control system integral to the PowerCommand Control System that guards the electrical integrity of the alternator and power system by providing protection against a wide array of fault conditions in the generator set or in the load. It also provides single and three phase fault current regulation so that downstream protective devices have the maximum current available to quickly clear fault conditions without subjecting the alternator to potentially catastrophic failure conditions. See document R1053 below for a full size time over current curve. The control does not include protection required for interconnection to a utility (mains) service.

Over current warning - Output current on any phase at more than 110% of rating for more than 60 seconds.

Over current shutdown (51V) - Output current on any phase is more than 110%, less than 175% of rating and approaching thermal damage point of alternator. Control includes algorithms to protect alternator from repeated over current conditions over a short period of time. The control does not include instantaneous trip functions, as they are not necessary for alternator protection and complicate short circuit coordination (discrimination).

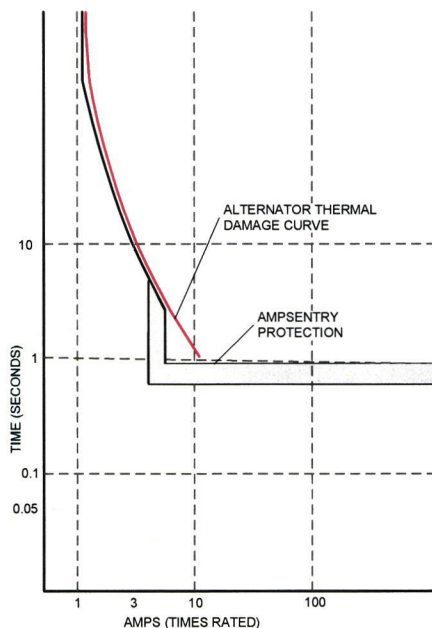
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Short circuit shutdown (51) - Output current on any phase is more than 175% of rating at time of shutdown. The control replicates the function of a 51V relay by discriminating between short circuit conditions and shutdown conditions, and shutting down the genset as fast as is necessary on a short circuit condition while operating as long as is possible on an overload condition. Control includes algorithms to protect alternator from repeated over current conditions over a short time.

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 0.25-10 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 2-10 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 voltage roll-off during synchronizing.

Under frequency shutdown (81u) - Generator set output frequency cannot be maintained. Settings are adjustable from 0-10 Hz below nominal governor set point, for a 0-20 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 or the synchronizer is enabled).

Over frequency shutdown/warning (81o) - Generator set is operating at a potentially damaging frequency level. Defaults: Disabled.

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 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. Defaults: 10%, 3 seconds.

Sync check (25) - Verifies that the generator set is operating in synchronism with the system bus prior to allowing the paralleling breaker to close. Includes dead bus sensing capability.

Fail to synchronize warning or shutdown - Indicates that the generator set could not be brought to synchronization with the system bus. Configurable for warning or shutdown and adjustable for time delay of 10-120 seconds. Default is 120 seconds.

Phase sequence sensing shutdown - Verifies that the generator set phase sequence matches the bus prior to allowing the paralleling breaker to close. The generator set will shutdown if the generator set and bus phase sequence do not match.

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

High alternator temperature (option).

Engine protection

Over speed shutdown - Default setting is 115% of nominal.

Low lube oil pressure shutdown - Level is preset to match the capabilities of each engine. Control includes time delays to prevent nuisance shutdown signals.

Low lube oil pressure warning - Level is preset to match the capabilities of each engine. Control includes time delays to prevent nuisance shutdown signals.

High coolant temperature shutdown.

High coolant temperature warning.

Low coolant pressure warning/shutdown.

Low coolant level warning/shutdown.

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

Low and high battery voltage warning - Indicates battery charging system failure by continuously monitoring battery voltage and indicating a problem when voltage is outside a preset acceptance band.

Discharged battery protection - When DC voltage is below a preset threshold, the control will shut down to avoid completely discharging the battery.

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

Fail to start (overcrank) shutdown.

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

Redundant starter disconnect.

Redundant speed sensors - Loss of one sensor results in a mag pickup sensor warning. Loss of both sensors results in mag pickup failure.

Low fuel day tank and low fuel main tank warning.

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

Sensor failure indication - All analog sensors are provided with sensor failure logic to indicate if the sensor or interconnecting wiring has failed. Separate indication is provided for fail high or low.

High crankcase blowby level warning.

High fuel temperature warning.

High intake manifold temperature/pressure.

Aftercooler cooler inlet over temperature.

Paralleling functions (optional)

First Start Sensor™ System - PowerCommand provides a unique control function that positively prevents multiple generator sets from simultaneously closing to an isolated bus under black start conditions. The First Start Sensor system is a communication system between generator sets that allows the generator sets to work together to determine which generator set in 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.

Synchronizer - PowerCommand incorporates a digital synchronizing function to force the generator set to match the phase relationship and voltage of the generator set output with the system bus or utility grid. The synchronizer includes provisions to provide proper operation even with highly distorted bus voltage waveforms. The synchronizer includes adjustments for phase angle window (5°-20°) and time delay (0.5-5 seconds). The synchronizer is 3-phase sensing, and includes controls to directly operate a paralleling breaker. The breaker controls include fail to open and fail to close protection.

Load sharing controls - The generator set control includes an integrated load sharing control system for both real (kW) and reactive (kVar) loads when the generator set(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 generator set 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 controls - When PowerCommand receives a signal indicating that the generator set is paralleled with an infinite source such as a utility (mains) service, the generator set will operate in load govern mode. In this mode the generator set 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 (leading). Default setting is 80% of standby and 1.0 power factor. The control includes inputs to allow independent control of kW and kVar load sharing level by a remote device while in the load govern mode. The rate of load increase and decrease is also adjustable in the control.

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

Power transfer control (optional)

The Power transfer control feature allows PowerCommand to provide integrated automatic power transfer functions including source availability sensing and transfer device (circuit breaker) monitoring and control. The control is configurable for open transition, fast transfer (100 ms), or soft (ramping) sequences of operation. Standard functions include:

- 3-phase (line-to-neutral) close differential under voltage sensing for utility (mains) service. Sensing for pickup in an adjustable range from 85-100% of nominal, with default at 95% of dropout setting. Dropout is configurable 75-98% of pickup, with default at 85%.
- 3-phase over voltage sensing for normal utility service adjustable for pickup at 95-105% of dropout and dropout configurable for 105-135% of nominal. Time delay is adjustable in a range of 0.5-120 seconds. Default is disabled and is enabled using InPower.
- Under frequency sensing for normal utility service. Adjustment range is 80-95% of nominal. Default is disabled and is enabled using InPower.
- Configurable sequence of operation with or without adjustable program-transition capability. Adjustment range is 0-60 seconds.
- Remote exercise feature accepts a remote signal to initiate with or without load testing, or testing can be

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initiated by the operator. Test sequence may include a programmed idle period prior to acceleration to rated voltage and frequency, and after cool down. Test may be configured to be performed with load or without load.

- Time delay start and stop as described in this document; time delay transfer adjustable in a range of 0-120 seconds and retransfer in a range of 0-1800 seconds; all in 1-second increments.
- Fail to disconnect timer is adjustable in a range of 0.1 to 120 seconds.

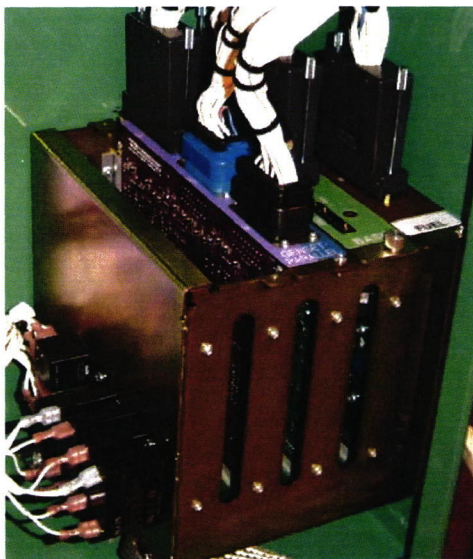
Environment

The control is designed for proper operation without recalibration in ambient temperatures from -40 °C to +70 °C (-40 °F to +158 °F) and for storage from -40 °C to +80 °C (-40 °F to +176 °F). Control will operate with humidity up to 95%, non-condensing and at altitudes up to 5000 m (13,000 ft).

The operator control panel has a single membrane surface which is impervious to the effects of dust, moisture, oil and exhaust fumes. The panel uses sealed membrane or oil-tight switches to provide long reliable service life in harsh environments.

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

The control is mounted on a vibration-isolated structure attached to the generator set skid and includes all generator set wiring factory-installed.



Control interface

Input signals to the PowerCommand control include:

Remote start signal - May be connected via either discrete signal or Lon® Network or both for premium reliability. Discrete signal is normally open contact to ground or normally closed contact that opens to indicate start signal. Separate signal inputs available for emergency start and non-emergency start.

Remote emergency stop.

Low main or day tank fuel level warning.

Remote alarm reset.

Load demand stop.

Utility parallel (load govern) mode command.

Configurable customer inputs - Control includes provisions for (4) input signals from customer discrete devices. (16) additional input signals can be implemented with the use of external network modules.

Output signals from the control include:

Generator set running signal - Fused normally open contact rated 5 A at 30 VDC/180 VAC, closes to indicate generator set is running.

Generator set common shutdown signal - Self-protected relay driver.

Load shed signal - Self-protected relay driver. Operation is configurable for under frequency or over kW load or both. Adjustment range is 80-140% of standby rating with time delay of 0-120 seconds. Default settings are overload 105%, 60 sec, and under frequency 3 Hz below governor reference for 3 seconds.

Ready to load signal - Self-protected relay driver. Operates when the generator set has reached 90% of rated speed and voltage and latches until generator set is switched to off or idle mode.

Modem control signal - Self-protected relay driver.

Paralleling breaker interface - Fused normally open relay contact (5 A, 30 VDC/180 VAC) for parallel breaker close signal and normally open contact for parallel breaker open signal.

Control power for auxiliary devices is available from the controller.

Network connections include:

Serial interface - This communication port is to allow the control to communicate with a personal computer running InPower service and maintenance software.

Echelon® LonWorks interface (option) - System allows for fast, effective incorporation of auxiliary I/O, remote annunciation, redundant start commands from Cummins transfer switches, and other control functions.

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Software

InPower - An optional PC-based software service tool that is designed to directly communicate to PowerCommand generator sets and transfer switches to facilitate service and monitoring of these products.

PowerCommand for Windows® - An optional software tool that is used to remotely monitor and control generator sets, transfer switches and other on-site power system devices.

Certifications

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

NFPA110: For Level 1 systems

UL508: Recognized or Listed and suitable for use on UL 2200 Listed generator sets

CSA C282-M: 1999 compliance

CSA 22.2 No. 14 M91: Industrial Controls

ISO 8528-4: 1993 compliance, Controls and Switchgear

NFPA99: Standard for Health Care Facilities

CE Mark

EN 50081-1: Residential, Commercial, Light Industrial

EN 50081-2: Industrial

EN 50082-1: Residential, Commercial, Light Industrial

EN 50082-2: Industrial

ISO 7637, pulses #2b, 4: DC Supply Surge Voltage Test

Mil Std 202C, Method 101: Salt Fog Test

ANSI C62.41: Surge Withstand

IEC 801.2, 3, 4, 5

ISO9001: PowerCommand control systems and generator sets are designed and manufactured in ISO9001 certified facilities.

Warranty

PowerCommand control systems are a part of complete power systems provided by Cummins Power Generation and are covered by a one year limited warranty as a standard feature.

Extended warranty options are available for coverage up to 10 years.

Options and accessories

- ☒ **Isolated bus paralleling.** Provides all automatic and manual paralleling functions for systems that operate isolated from the utility service.
- ☐ Full function paralleling. Provides all paralleling functions, including automatic and manual operation, protection, and other features described in this document.
- ☐ Open transition power transfer control. Control will operate two circuit breakers to provide power transfer between a normal source and a generator in a "break before make" sequence.
- ☐ Fast closed transition power transfer control. Control will operate two circuit breakers to provide power transfer between a normal source and generator in a "make before break" sequence between live sources, and "break before make" from a failed source. Overlap between sources is 100 mS or less.
- ☐ Closed transition (ramping) power transfer control. Control will operate two circuit breakers to provide power transfer between a normal source and generator in a "make before break" sequence between live sources, and "break before make" from a failed source. Overlap time between sources is configurable, and control ramps load from source to source to minimize disturbances on transfer.
- ☐ Key-type mode select switch.
- ☒ **Ground fault alarm module.**
- ☐ Exhaust temperature monitoring.
- ☐ Alternator temperature monitoring.
- ☐ Network Interface Module
- ☐ Digital remote annunciator. (See S-1343)
- ☐ Digital output relay module (See S-1431)
- ☐ Modbus® interface. (See S-1471)
- ☐ Cummins Power Generation iWatch™ remote monitoring system (S-1518)
- ☐ Cummins Power Generation iWatch Wireless™ remote monitoring system (S-1572)
- ☐ ILSI (isochronous load sharing interface). Allows PowerCommand to share real load with other load sharing systems that incorporate analog load sharing lines. See document C604 for more information.
- ☐ Utility protective relaying. Gensets can be provided with power switching mechanisms and utility grade protective relaying to meet local grid protection requirements.

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**Power
Generation**

See your distributor for more information

Cummins Power Generation

Americas

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

Europe, CIS, Middle East and Africa

Manston Park Columbus Ave.
Manston Ramsgate
Kent CT 12 5BF United Kingdom
Phone 44 1843 255000
Fax 44 1843 255902

Asia Pacific

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

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

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**Power
Generation**

ALTERNATOR DATA SHEET

Frame Size P734C

CHARACTERISTICS

WEIGHTS:

Stator Assembly:	3186 lb	1445 kg
Rotor Assembly:	2756 lb	1250 kg
Complete Assembly:	6654 lb	3018 kg

MAXIMUM SPEED:

2250 rpm

EXCITATION CURRENT:

Full Load	3.6 Amps
No Load	0.5 Amps

INSULATION SYSTEM: Class H Throughout

3 Ø RATINGS

(0.8 power factor)

(Based on specific temperature rise at 40°C ambient temperature)

60 Hz Voltage

(winding no)

		<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
163°C Rise Ratings	kW			1284	1456	1556	1620	1620
	kVA			1605	1820	1945	2025	2025
150°C Rise Ratings	kW			1248	1416	1512	1576	1576
	kVA			1560	1770	1890	1970	1970
125°C Rise Ratings	kW			1200	1364	1452	1512	1512
	kVA			1500	1705	1815	1890	1890
105°C Rise Ratings	kW			1116	1272	1352	1408	1408
	kVA			1395	1590	1690	1760	1760
80°C Rise Ratings	kW			1032	1172	1252	1300	1300
	kVA			1290	1465	1565	1625	1625

REACTANCES

(per unit ± 10%)

(Based on full load at 125°C Rise Rating)

	<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
Synchronous			4.06	3.86	3.67	3.21	2.96
Transient			0.25	0.23	0.22	0.19	0.21
Subtransient			0.18	0.17	0.16	0.14	0.14
Negative Sequence			0.26	0.25	0.23	0.20	0.16
Zero Sequence			0.03	0.03	0.03	0.03	0.02

MOTOR STARTING

Maximum kVA (90% Sustained Voltage)

<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
5521	5521	5521	5521	5521	5521	5521

TIME CONSTANTS

(Sec)

<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
0.135	0.135	0.135	0.135	0.135	0.135	0.135
0.010	0.010	0.010	0.010	0.010	0.010	0.010
2.230	2.230	2.230	2.230	2.230	2.230	2.230
0.020	0.020	0.020	0.020	0.020	0.020	0.020

WINDINGS

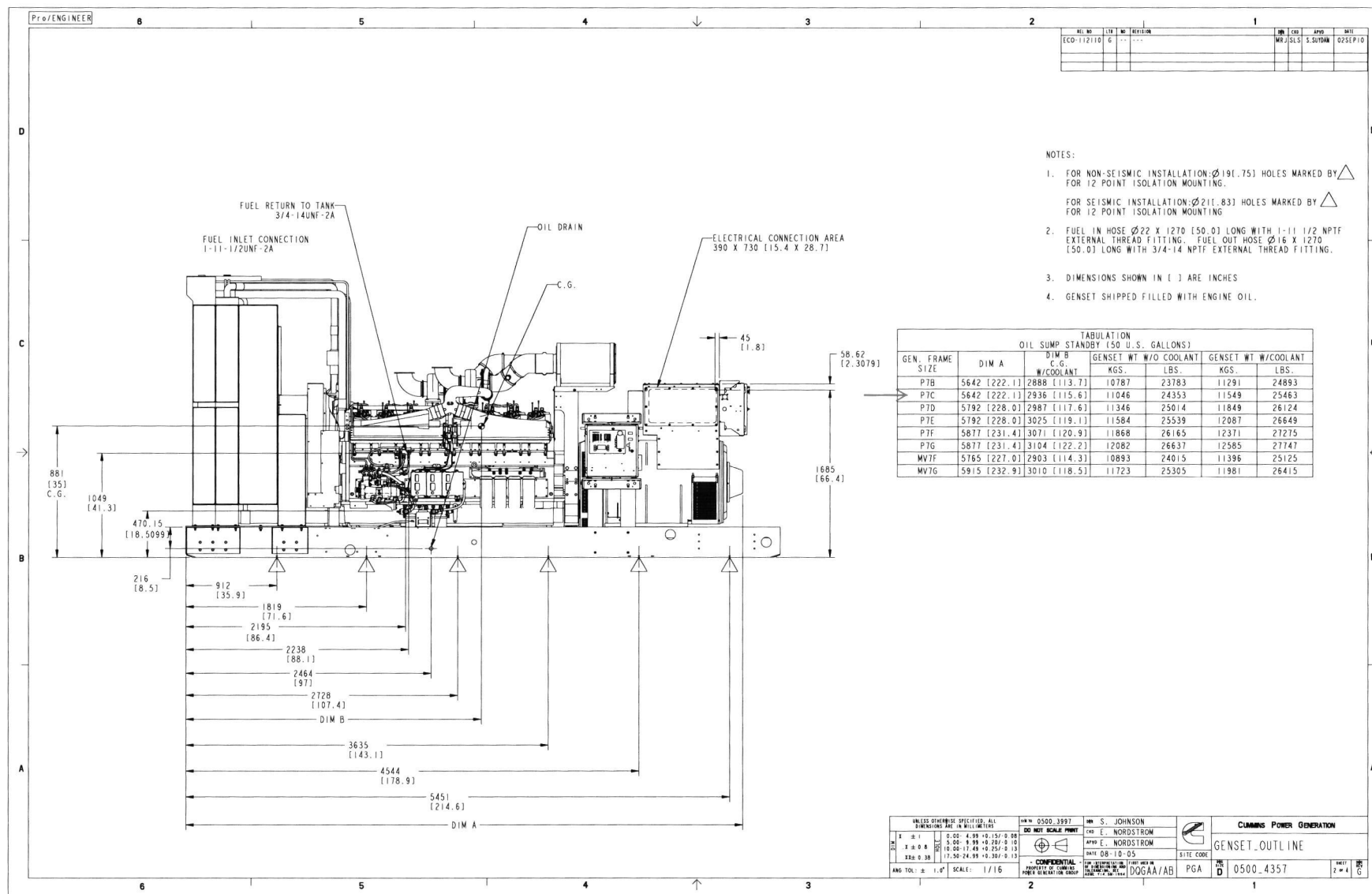
(@20°C)

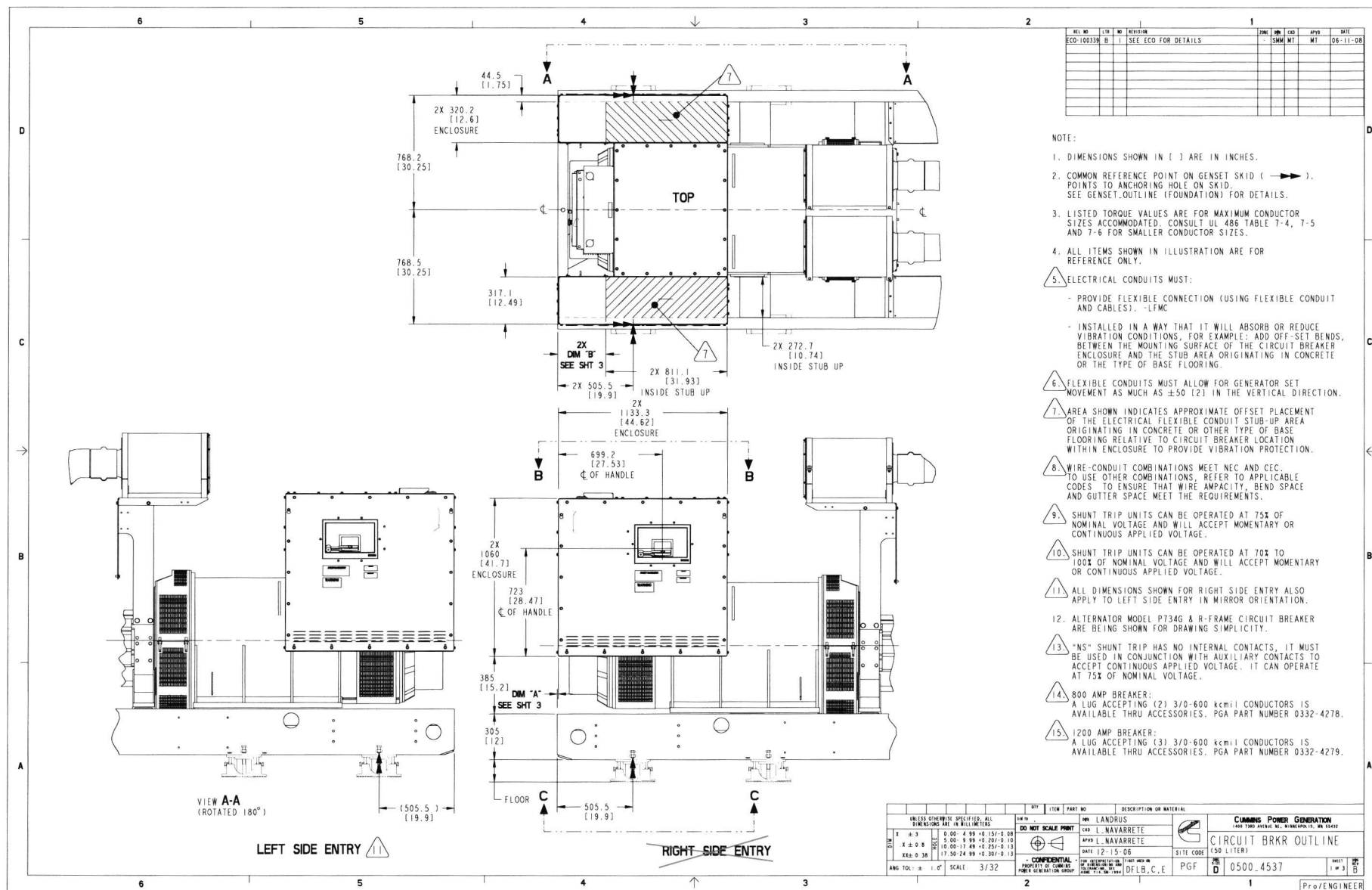
Stator Resistance (Line to Line, Ohms)

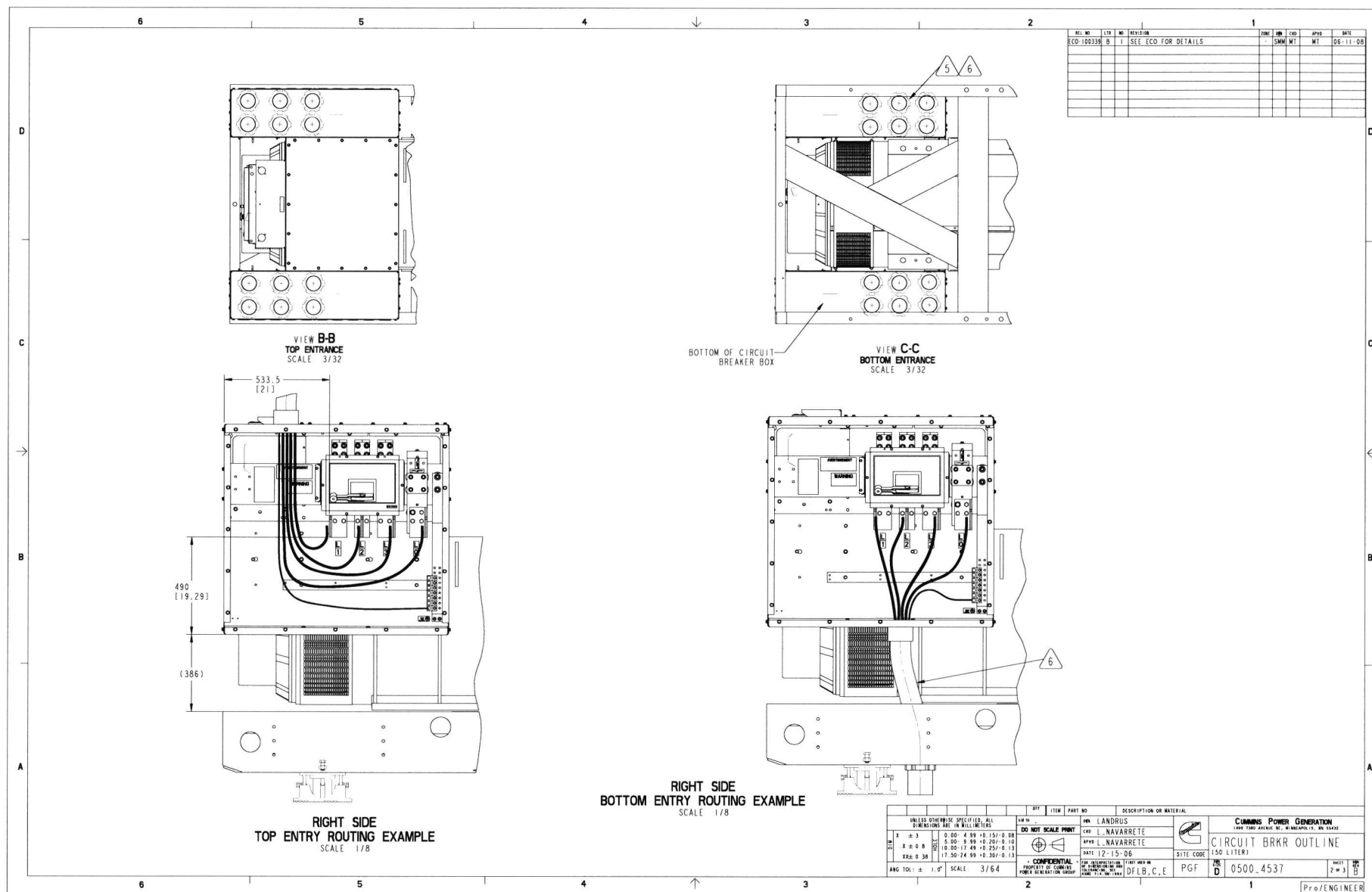
Rotor Resistance (Ohms)

Number of Leads

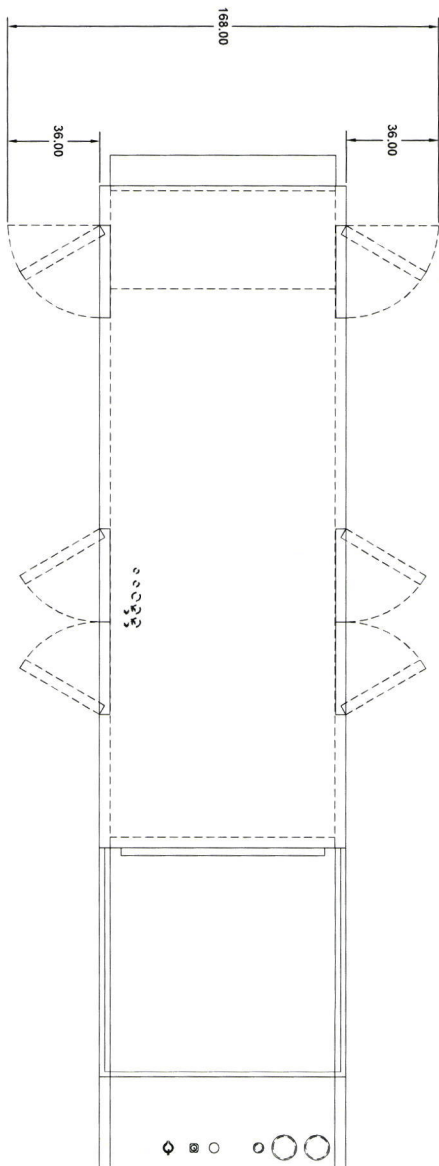
<u>220/380</u> (13)	<u>240/416</u> (13)	<u>220/380</u> (312)	<u>240/416</u> (312)	<u>254/440</u> (312)	<u>277/480</u> (312)	<u>347/600</u> (07)
0.00126	0.00126	0.00126	0.00126	0.00126	0.00126	0.00400
1.85	1.85	1.85	1.85	1.85	1.85	1.85
6	6	6	6	6	6	6







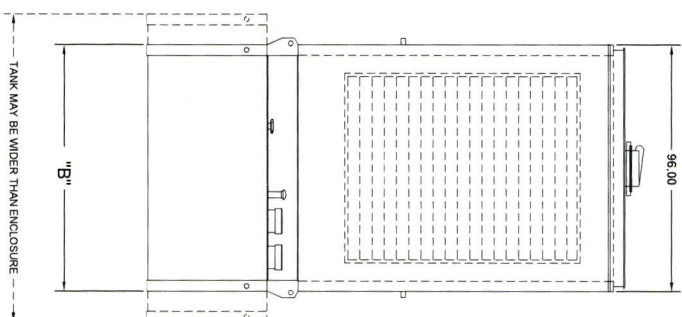
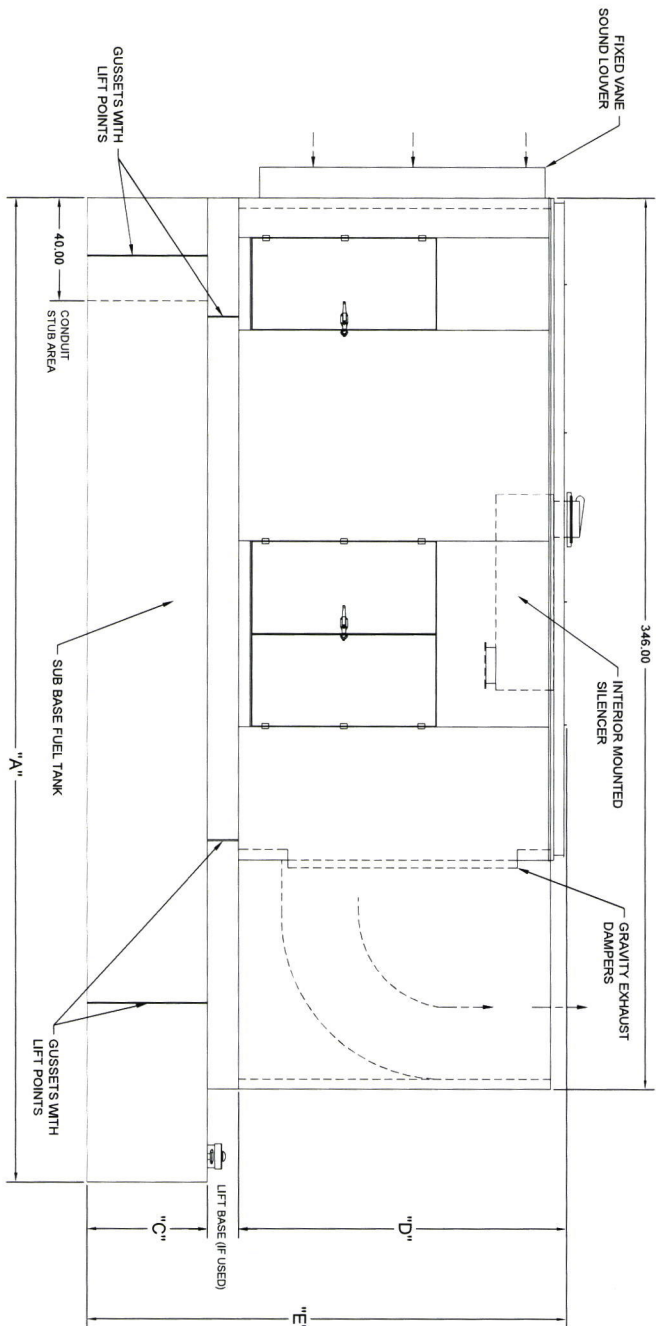
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CUMMINS GENERATOR MODEL: 1250DQGA / 1500DQAB
LEVEL 2 SOUND ATTENUATED ENCLOSURE
SUB BASE FUEL TANK

GALLONS	TANK STYLE	DIM "A"	DIM "B"	DIM "C"	DIM "D"	DIM "E"	LIFT BASE
350	UL 142	370.00"	96.00"	8.00"	125.00"	133.00"	8.00"
350	UL 2095	370.00"	96.00"	19.75"	125.00"	146.00"	
660	UL 142	370.00"	96.00"	10.25"	125.00"	136.00"	
660	UL 2095	370.00"	96.00"	22.75"	125.00"	146.00"	
1200	UL 142	370.00"	96.00"	13.00"	125.00"	136.00"	
1200	UL 2095	370.00"	96.00"	15.75"	125.00"	144.00"	
1500	UL 142	370.00"	96.00"	18.75"	125.00"	147.00"	
1500	UL 2095	370.00"	96.00"	21.25"	125.00"	147.00"	
2000	UL 142	370.00"	96.00"	25.75"	125.00"	151.00"	
2000	UL 2095	370.00"	96.00"	28.25"	125.00"	154.00"	
2500	UL 142	370.00"	96.00"	30.25"	125.00"	154.00"	
3000	UL 2095	370.00"	96.00"	34.75"	125.00"	164.00"	8.00"
4000	UL 142	370.00"	96.00"	36.75"	125.00"	166.00"	8.00"
4000	UL 2095	370.00"	96.00"	43.75"	125.00"	173.00"	8.00"
5000	UL 142	370.00"	120.00"	36.00"	129.00"	165.00"	8.00"
5000	UL 2095	370.00"	120.00"	42.50"	129.00"	172.00"	8.00"

** ENCLOSURE LIFT BASE IS REQUIRED, SHIPS LOOSE FROM TANK



REVISIONS

EDITION	DESCRIPTION	DATE
0	ORIGINAL SUBMISSION RELEASE	07/19/12

GENERAL NOTES

1. EMERGENCY VENT SIZING BASED ON UL 142 TABLE 8.1.
2. PORTS PER UL 142 SECTION 9 TO SECTION 8.11 TABLE 8.2
3. WELDS AND JOINTS PER UL 142 SECTION 6 FIGURE 6.1, 6.2
4. WELDS AND JOINTS PER UL 142 SECTION 6 FIGURE 6.1, 6.2



THIS ENCLOSURE IS DESIGNED TO BE USED IN CONJUNCTION WITH A FREEMAN GENERATOR. IT IS NOT TO BE USED FOR ANY OTHER PURPOSE. THE ENCLOSURE IS NOT TO BE USED FOR ANY OTHER PURPOSE. THE ENCLOSURE IS NOT TO BE USED FOR ANY OTHER PURPOSE. THE ENCLOSURE IS NOT TO BE USED FOR ANY OTHER PURPOSE.

Designed by	Checked by	Submitted	Date
CFS	NP	07/19/12	NA
L2	1250/1500kW		
53810263	N.T.S.	171	



Batteries and accessories

> Specification sheet

Our energy working for you.™



Part number	Battery	Cold cranking amps	Voltage	Reserve capacity	Length	Width	Height	Group size	Ship weight lbs	Qts electrolyte
0416-0439	Dry	1400	12	430	20.75	11.00	9.63	8D	110	16.0
0416-0579	Dry	525	12	90	10.25	6.63	8.75	24C-675	20	6.0
0416-0579-01	Wet	525	12	90	10.25	6.63	8.75	24C-675	36	5.9
0416-0796	Wet	725	12	150	13.00	6.88	9.63	31-4	62	4.2
0416-0823	Dry	725	12	150	13.00	6.88	9.63	31-4	42	4.2
0416-0848	Dry	1080	12	270	20.75	8.63	9.63	4D	85	13.0
0416-0980	Wet	1000	12	200	13.00	6.88	9.63	31-5	65	4.2
0416-1040	Dry	800	12	160	13.00	6.88	9.44	31	65	4.2
0416-1051	Wet	530	12	80	8.13	6.63	7.50	26-775	31	3.7
0416-1105	Wet	1400	12	430	20.75	11.00	9.63	8D	125	16.0
0416-1138	Sealed	NA	12	NA	5.88	3.88	3.75	NP12-12	9	4.0
0416-1264	Dry	730	12	420	20.67	10.83	9.45	8D	110	16.0
0416-1291	Sealed	800	12	110	10.00	6.88	7.81	34	38	4.0
0416-1330	Wet	810	12	146	10.25	6.63	8.88	24XL	43	5.9
0416-1332	Dry	420	12	60	9.13	5.25	8.88	22NF	19	4.0

Battery racks (Not recommended for mounting on skids.)

Part number	Description
0416-0527	20.5" x 11" (includes hold down brackets)
0416-0475	14.5" x 9.25" (loose rack, not intended for anchoring)
0541-0798	13.725" x 9.725" (includes hold down brackets)

Battery heater Increases battery starting capability in lower than optimum ambient temperatures.

Part number	Description
0333-0469	Heater is a 6" x 9" pad installed in the battery rack directly under the battery case. Comes complete with an 8' cord and standard duplex plug. 200 Watts at 120 VAC.
0541-0555	Heater is a 6.5" x 8" pad with 3' cord, 120 Watts at 120 VAC, 40 °F/70 °F preset thermostat.

Battery box

Part number	Description
0416-1263	Battery box has approximate inside dimensions of 21.125" long X 11.75" wide X 10.5" high. Box is constructed of black plastic with 4 mounting feet and a cover held on by 2 thumb screws. The box also has 2 slots on each side to accommodate battery cables. (see drawing on page 3). Note: Box material will become soft and pliable around 240 °F.

Four-stage battery charger

15 amp @ 12 volt

12 amp @ 24 volt



> Specification sheet

Our energy working for you.™



**Power
Generation**

Description

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

To achieve optimum battery life, a 4-stage charging cycle is implemented. The four charging stages are trickle, bulk, absorption and float. The trickle stage safely charges overly discharged batteries. It protects a damaged or shorted battery from excessive current. During bulk charge a constant current is applied to quickly restore the maximum battery charge level in the shortest amount of time. The absorption stage applies a constant voltage to the battery to bring the battery to 100% capacity. The float stage tailors the constant voltage output to maintain the battery at full capacity while serving DC operated loads.

An optional temperature sensor may be used to adjust charging rate based on internal battery temperature in the absorption and float stages. Use of a battery temperature sensor helps to increase battery life by preventing over or under charging of the battery. The battery temperature sensor also protects the battery from overheating. Temperature compensation is recommended in all applications, but is particularly valuable for generator sets in outdoor applications.

Battery chargers are field-configurable for charging either 12 or 24 VDC battery systems and for operation at 50 or 60 Hz. Output voltage and battery type selection is done through the alphanumeric display.

Features

Protection - All models include a 20 amp DC output breaker. Re-settable breakers are used for input voltages 240 VAC and lower. For over 240 VAC branch circuit rated fuses are used.

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

User display - Output voltage and current, fault information and configuration options are indicated on the alphanumeric display.

Monitoring - An LED indicates the condition of the charger. Green indicates normal charging operation, amber indicates equalizing and red indicates a fault condition.

Adjustable float voltage - Float voltage can be set through the alpha-numeric display for optimum battery performance and life.

Temperature compensation - An optional external sensor is available for temperature compensated battery charging.

Faults - The charger senses and annunciates the following fault conditions: Input overvoltage, input undervoltage, AC power loss, battery overvoltage, battery undervoltage, charger circuitry over temperature, battery over temperature, unrecoverable battery and overload/overcurrent. Includes 30 volt/2 amp isolated contact for common alarm.

Parallel redundant operation - Chargers can be operated in parallel for redundant reliability or additional charging capacity.

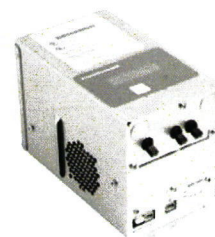
Vibration resistant design - complies with UL 991 vibration resistance requirements.

UL 1236 (BBHH) Listing - for use with lead acid batteries in generator set installations. Also suitable for use with NiCad, gel and AGM batteries.

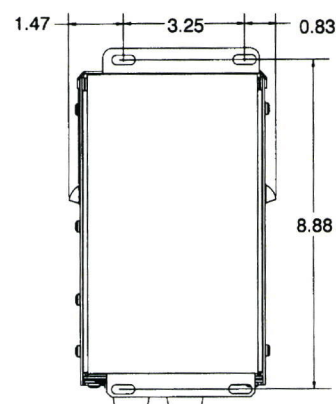
Specifications

Performance and physical characteristics

Output:	Nominal voltage	12 or 24 VDC
	Float voltage – 12 V batteries	12.8, 13.0, 13.3, 13.5, 13.6, 14.3
	Float voltage – 24 V batteries	25.7, 26.1, 26.6, 27.0, 27.2, 28.6
	Equalize-voltage	15.5 or 31.0 VDC
	Output voltage regulation	±1%
	Maximum output current	15 A @ 12 VDC or 12 A @ 24 VDC
	Equalize charger time	0-12 hrs
Input:	Voltage AC	120, 208, 240, 277, 380, 416, 480, 600
	Frequency	50 or 60 Hz
Approximate net weights:		11.6 lbs (5.3 Kg)
Approximate dimensions: height x width x depth - in (mm)		9.75 x 5.56 x 6.14 (248 x 141 x 156)
Ambient temperature operation:		-22 °F to 122 °F (-30 °C to 50 °C)



Input volts	Genset kit part number	ATS kit part number
120/208/240	0300-5878-01	0300-5878-13
277	0300-5878-02	0300-5878-14
380	0300-5878-03	0300-5878-15
416	0300-5878-04	0300-5878-16
480	0300-5878-05	0300-5878-17
600	0300-5878-06	0300-5878-18
Temperature sensor kit	0541-0918	0541-0918



Enclosure

The NEMA 1, corrosion resistant, aluminum enclosure is designed for wall mounting. When wall mounted, louvers protect cooling holes in the sides of the enclosure. Use 1/4 in (6.35 mm) diameter bolts for mounting.

Mounting dimensions – inches
Bottom view

RFI/EMI and voltage surge compliance

Charger complies with the requirements of EN61000-4-5 for voltage surge resistance, EN50082-2 (heavy industrial) for immunity, EN61000-4-2 for ESD, EN61000-4-3 for radiated immunity, ANSI/IEEE C62.41 Category B & EN 61000-4-4 for electrically fast transient, EN61000-4-6 for conducted, and FCC Part 15 Class A for emissions.

Americas

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

Europe, CIS, Middle East and Africa

Manston Park Columbus Ave.
Manston Ramsgate
Kent CT 12 5BF United Kingdom
Phone 44 1843 255000
Fax 44 1843 255902

Asia Pacific

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

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

Warning: For professional use only. Must be installed by a qualified service technician. Improper installation presents hazards of electrical shock and improper operation, resulting in severe personal injury and/or property damage.

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S-1470d (5/08) Page 2 of 2

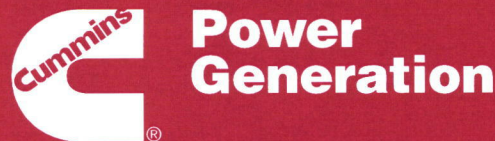


100% rated breaker assemblies application guide and option kits

Alternator Frame Sizes 6 and 7

> Specification sheet

Our energy working for you.™



Description

100% rated breaker assemblies may also be used with engines QSK23, VTA28, QST30, KTA50, QSK50, QSK60 or frame breakers NSJ/R/P. They are UL Listed, CSA certified, IEC rated, 3-pole, molded case generator output circuit breakers with an adjustable electronic solid state trip unit mounted in a NEMA 1 enclosure on the right or left side of the generator (right and left sides are determined when viewing the generator set from the generator/control end). The circuit breaker assembly is UL Listed at 100% of the frame rating for continuous duty up to 600 VAC and is suitable for use as service equipment. IEC rating is to 415 VAC.

Specs/vendor manuals

R-Solid State. LI Sensor Micrologic 3.0 Type F (84%-100%) Adjusting Plug. 0612CT0101R0709 Trip Unit-Section 2, R-Frame-Section 5, Trip Curves-Section 11. (Optional Type A (40%-100%) Adjusting Plug Square D Part Number is S48818).

P-Solid State. LI Sensor Micrologic 3.0 Type F (84%-100%) (800Amp)/Type E (60%-100%) (1200Amp) Adjusting Plug 0612CT0101R0709 Trip Unit-Section 2, P-Frame-Section 4, Trip Curves-Section 11. (Optional Type A (40%-100%) Adjusting Plug Square D Part Number is S48818).

N-Solid State. LI Sensor STR23SP (40%-100%) 0615CT9901R4-03 Trip Unit-Section 4, Ratings-Section 3.

Circuit Breaker Kits

1600/2000/2500 ampere frame. Long time pickup, long time delay and instantaneous pickup are adjustable. UL/CSA interrupting ratings are 125 kA at 240 VAC, 100 kA at 480 VAC and 50 kA at 600 VAC. Load cables are connected to the circuit breaker with NEMA 1-3/4" compression or optional mechanical lugs (lugs supplied separately). A ground bar with lugs is provided.

Feature	Description	DFGB/E(HC6) DFHA/B/C/D(HC6)	DQFAA/B/C/D (HC6/P7) DQCA/B/C (HC6)	DFHA/B/C/D(P7) DFLB/C/E (P7) DQGAA/B(P7) DQKAA/B(P7) DQKB/C/D/H(P7)
KP82	Circuit breaker kit-100% rated-R frame 2500 A - right mounted	0179-3489-12	0179-3534-12	0179-3534-12
KP83	Circuit breaker kit-100% rated-R frame 2500 A – left mounted	0179-3489-11	0179-3534-18	0179-3534-11
KP84	Circuit breaker kit-100% rated-R frame 2000 A – right mounted	0179-3489-10	0179-3534-10	0179-3534-10
KP85	Circuit breaker kit-100% rated-R frame 2000 A – left mounted	0179-3489-09	0179-3534-17	0179-3534-09
KP86	Circuit breaker kit-100% rated-R frame 1600 A - right mounted	0179-3489-08	0179-3534-08	0179-3534-08
KP87	Circuit breaker kit-100% rated-R frame 1600 A – left mounted	0179-3489-07	0179-3534-16	0179-3534-07



SERIES C Vibro Isolators

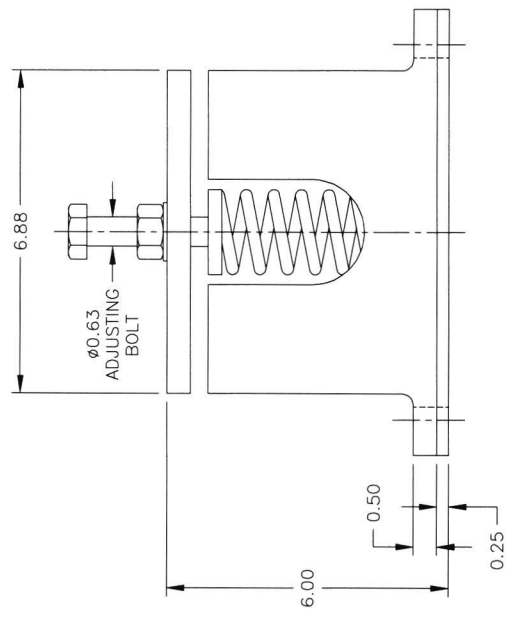
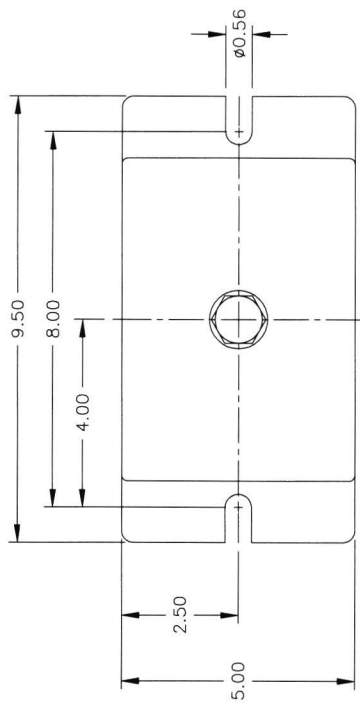
Series C Vibro Isolators are rugged cast iron housed isolators with oil tempered steel springs for **all purpose** applications.

Isolators are available with *external* (CK) or *internal* (CI) adjustment and also feature adjustable or non-adjustable resilient snubbers for varying degrees of damping and to limit oscillation.

All isolators are provided with a bottom sound pad for maximum noise reduction. These isolators are also available with chrome vanadium springs for shock applications.

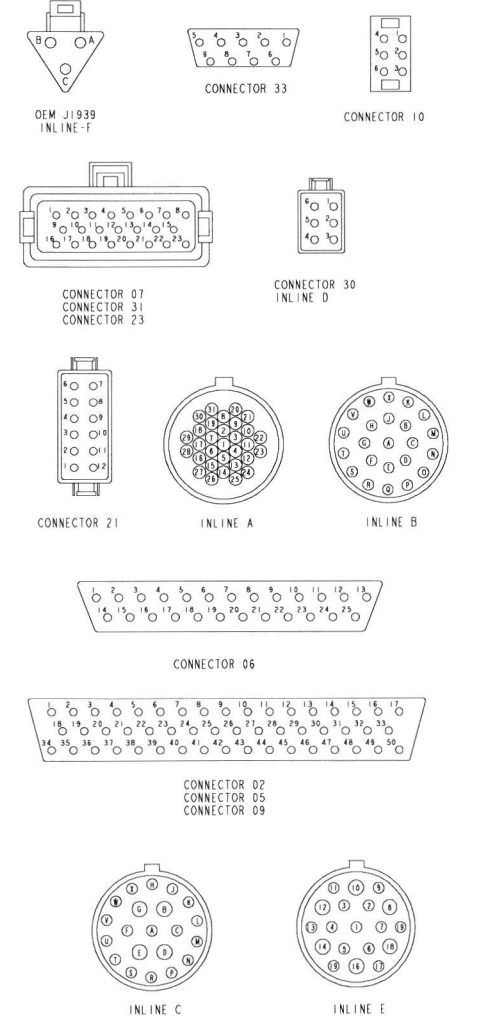
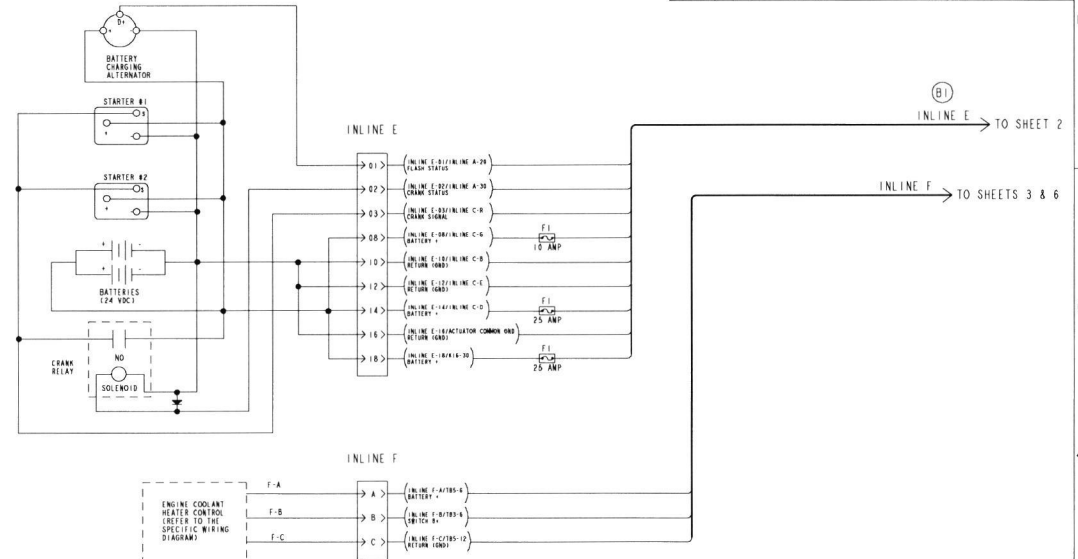
ISOL. NO.	RATED LOAD-lb.		ISOL. NO.	RATED LOAD-lb.	
	STEADY	IMPACT		STEADY	IMPACT
C*2-1	250	-	C*4-1	500	-
C*2-2	400	-	C*4-2	800	-
C*2-3	600	-	C*4-3	1200	-
C*2-4	1000	-	C*4-4	2000	-
C*2-5	1400	-	C*4-5	2800	-
C*2-6	2400	-	C*4-6	4800	-
C*2-S5	650	520	C*4-S5	1300	1040
C*2-S6	900	720	C*4-S6	1800	1440
C*2-S7	1200	960	C*4-S7	2400	1920
C*2-S8	2200	1650	C*4-S8	4400	3300
C*2-S9	2600	2450	C*4-S9	5200	4900

ISOL. NO.	RATED LOAD-lb.	
	STEADY	IMPACT
C*9-1	1125	-
C*9-2	1800	-
C*9-3	2700	-
C*9-4	4500	-
C*9-5	6300	-
C*9-6	10800	-
C*9-S5	2925	2340
C*9-S6	4000	3200
C*9-S7	5400	4320
C*9-S8	9900	7425
C*9-S9	11700	11025



ENGINE STARTER/POWER HARNESS

REV NO	DATE	BY	CHK	APPV	DATE
FRD25434	A	T	PRODUCTION RELEASE	JM	10-26-05
FRD27825	B	I	INLINE E WAS INLINE C	LD	05-18-06



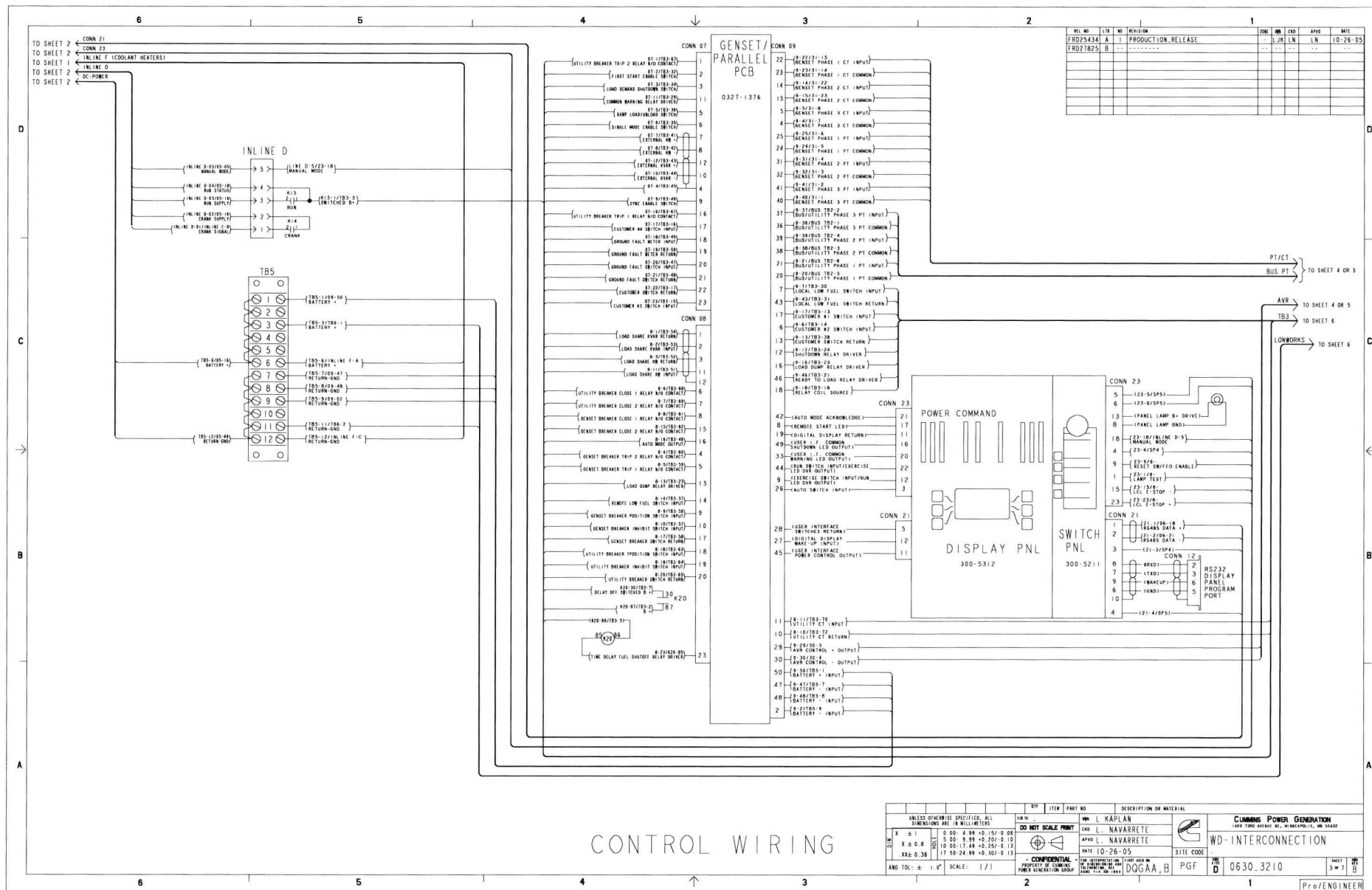
CONNECTOR CAVITIES
(VIEW LOOKING INTO BACK OF CONNECTOR WHERE CONTACTS ARE INSERTED)

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS	DATE	ITEM	PART NO	DESCRIPTION OR MATERIAL
1 X 0.1	0.05	0.05	0.05	0.05
2 X 0.2	0.10	0.10	0.10	0.10
3 X 0.3	0.15	0.15	0.15	0.15
4 X 0.4	0.20	0.20	0.20	0.20
5 X 0.5	0.25	0.25	0.25	0.25
6 X 0.6	0.30	0.30	0.30	0.30
7 X 0.7	0.35	0.35	0.35	0.35
8 X 0.8	0.40	0.40	0.40	0.40
9 X 0.9	0.45	0.45	0.45	0.45
10 X 1.0	0.50	0.50	0.50	0.50
11 X 1.1	0.55	0.55	0.55	0.55
12 X 1.2	0.60	0.60	0.60	0.60
13 X 1.3	0.65	0.65	0.65	0.65
14 X 1.4	0.70	0.70	0.70	0.70
15 X 1.5	0.75	0.75	0.75	0.75
16 X 1.6	0.80	0.80	0.80	0.80
17 X 1.7	0.85	0.85	0.85	0.85
18 X 1.8	0.90	0.90	0.90	0.90
19 X 1.9	0.95	0.95	0.95	0.95
20 X 2.0	1.00	1.00	1.00	1.00
21 X 2.1	1.05	1.05	1.05	1.05
22 X 2.2	1.10	1.10	1.10	1.10
23 X 2.3	1.15	1.15	1.15	1.15
24 X 2.4	1.20	1.20	1.20	1.20
25 X 2.5	1.25	1.25	1.25	1.25
26 X 2.6	1.30	1.30	1.30	1.30
27 X 2.7	1.35	1.35	1.35	1.35
28 X 2.8	1.40	1.40	1.40	1.40
29 X 2.9	1.45	1.45	1.45	1.45
30 X 3.0	1.50	1.50	1.50	1.50
31 X 3.1	1.55	1.55	1.55	1.55
32 X 3.2	1.60	1.60	1.60	1.60
33 X 3.3	1.65	1.65	1.65	1.65
34 X 3.4	1.70	1.70	1.70	1.70
35 X 3.5	1.75	1.75	1.75	1.75
36 X 3.6	1.80	1.80	1.80	1.80
37 X 3.7	1.85	1.85	1.85	1.85
38 X 3.8	1.90	1.90	1.90	1.90
39 X 3.9	1.95	1.95	1.95	1.95
40 X 4.0	2.00	2.00	2.00	2.00
41 X 4.1	2.05	2.05	2.05	2.05
42 X 4.2	2.10	2.10	2.10	2.10
43 X 4.3	2.15	2.15	2.15	2.15
44 X 4.4	2.20	2.20	2.20	2.20
45 X 4.5	2.25	2.25	2.25	2.25
46 X 4.6	2.30	2.30	2.30	2.30
47 X 4.7	2.35	2.35	2.35	2.35
48 X 4.8	2.40	2.40	2.40	2.40
49 X 4.9	2.45	2.45	2.45	2.45
50 X 5.0	2.50	2.50	2.50	2.50

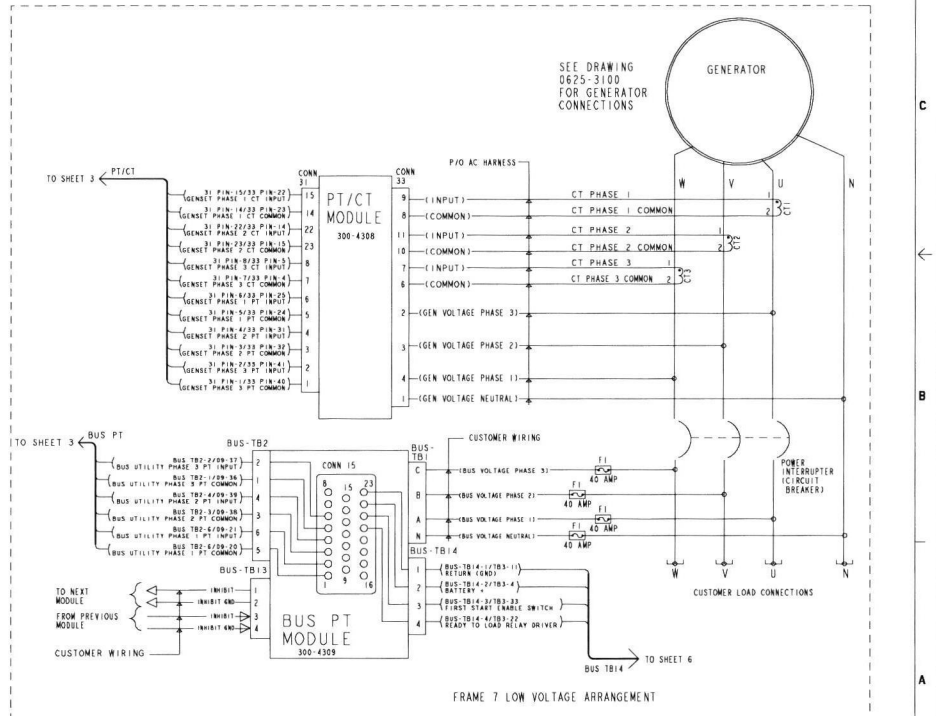
ProENGINEER



Pro/ENGINEER

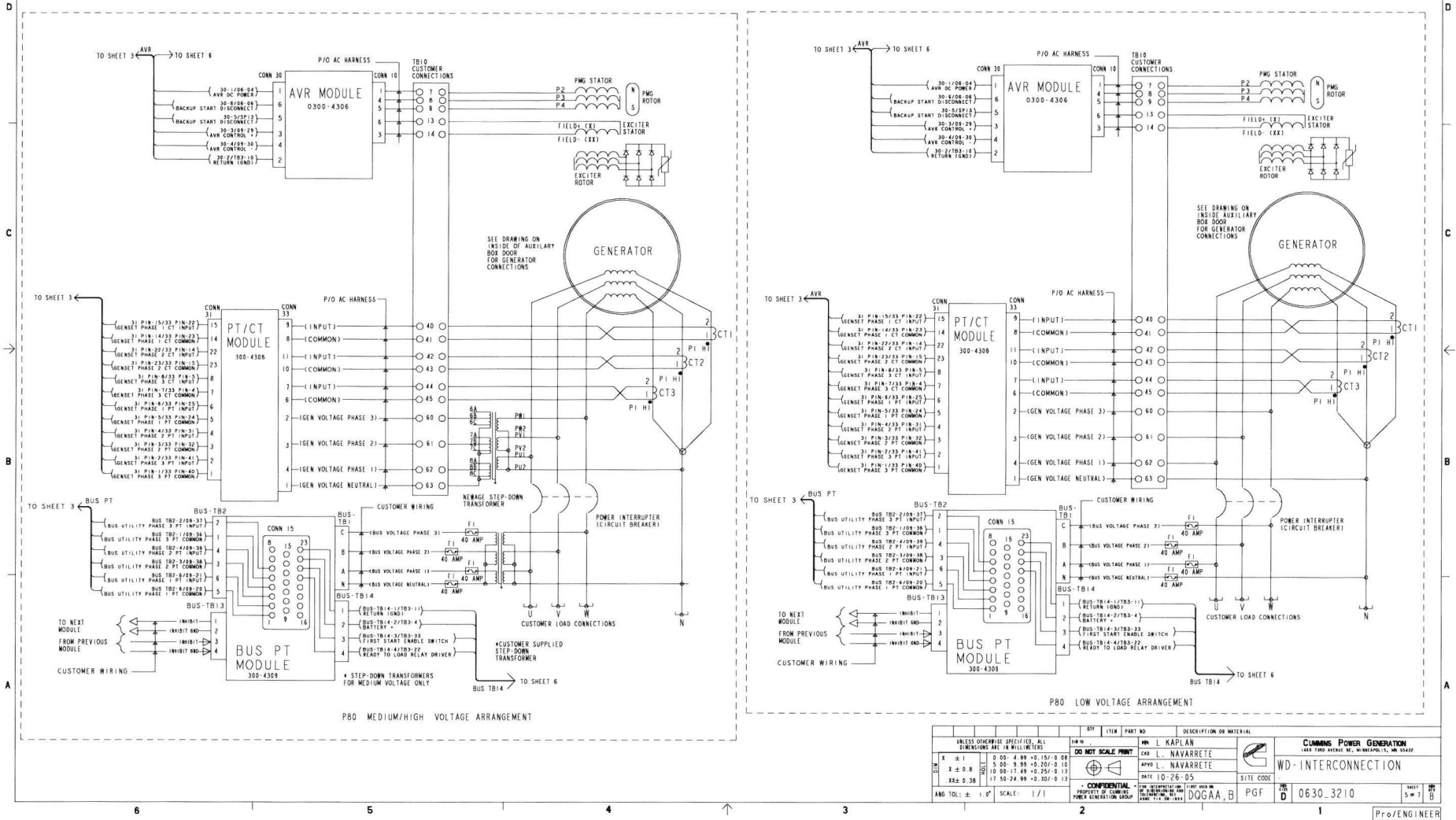


AVR ARRANGEMENT FOR FRAME 7 GENERATORS

[illegible]

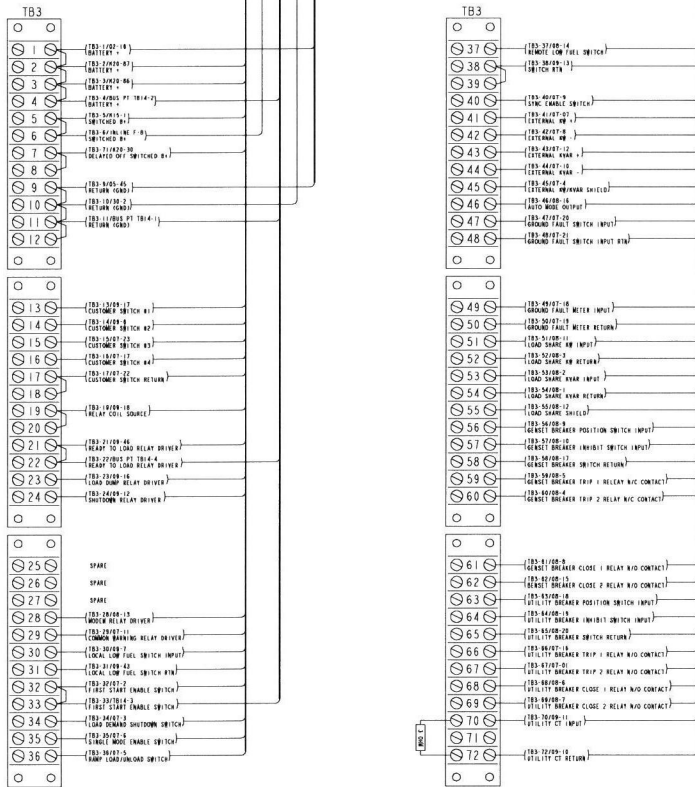
GENERATOR/BUS CONNECTIONS

REV NO	DATE	BY	CHK	APPV	DATE
1	10-26-05	LJK	LN		
2					
3					
4					
5					
6					
7					
8					
9					
10					

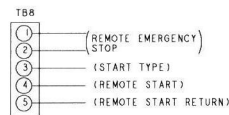


CUSTOMER CONNECTIONS

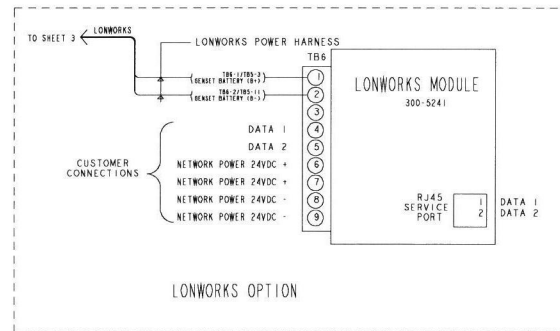
TO SHEET 2 DC-POWER
TO SHEETS 4 OR 5 AVR
TO SHEET 3 BUS TBI4
TO SHEET 3 TB3
TO SHEET 1 IN-LINE-F



CUSTOMER CONNECTIONS ON BASE PCB



TABULATION		
TBB-	FUNCTION	DESCRIPTION
1	REMOTE EMERGENCY STOP	OPEN THE CONNECTION BETWEEN THESE TERMINAL POSITIONS TO INITIATE AN EMERGENCY STOP. TERMINAL POSITIONS MUST BE SHORTED TOGETHER IF REMOTE EMERGENCY STOP IS NOT USED.
2	REMOTE START TYPE	DETERMINES START TYPE: OPEN = EMERGENCY START SEQUENCE. CLOSED = NORMAL START SEQUENCE. APPLY REMOTE START RETURN (TBB-5) TO CLOSE.
3	REMOTE START	APPLY REMOTE START RETURN (TBB-5) TO REMOTE START THE GENSET.
4	REMOTE START RETURN	RETURN LINE FOR REMOTE START TYPE AND REMOTE START.



UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		DWG. NO. 10-26-05		DESCRIPTION OF MATERIAL	
1. A 1		2. 0.00-4.00 +0.15/-0.08		L. KAPLAN	
3. 0.00-9.00 +0.25/-0.10		4. 0.00-17.00 +0.25/-0.13		L. NAVARRETE	
5. 0.00-25.00 +0.35/-0.13		6. 0.00-35.00 +0.35/-0.13		L. NAVARRETE	
7. 0.00-45.00 +0.35/-0.13		8. 0.00-55.00 +0.35/-0.13		L. NAVARRETE	
9. 0.00-65.00 +0.35/-0.13		10. 0.00-75.00 +0.35/-0.13		L. NAVARRETE	
11. 0.00-85.00 +0.35/-0.13		12. 0.00-95.00 +0.35/-0.13		L. NAVARRETE	
13. 0.00-105.00 +0.35/-0.13		14. 0.00-115.00 +0.35/-0.13		L. NAVARRETE	
15. 0.00-125.00 +0.35/-0.13		16. 0.00-135.00 +0.35/-0.13		L. NAVARRETE	
17. 0.00-145.00 +0.35/-0.13		18. 0.00-155.00 +0.35/-0.13		L. NAVARRETE	
19. 0.00-165.00 +0.35/-0.13		20. 0.00-175.00 +0.35/-0.13		L. NAVARRETE	
21. 0.00-185.00 +0.35/-0.13		22. 0.00-195.00 +0.35/-0.13		L. NAVARRETE	
23. 0.00-205.00 +0.35/-0.13		24. 0.00-215.00 +0.35/-0.13		L. NAVARRETE	
25. 0.00-225.00 +0.35/-0.13		26. 0.00-235.00 +0.35/-0.13		L. NAVARRETE	
27. 0.00-245.00 +0.35/-0.13		28. 0.00-255.00 +0.35/-0.13		L. NAVARRETE	
29. 0.00-265.00 +0.35/-0.13		30. 0.00-275.00 +0.35/-0.13		L. NAVARRETE	
31. 0.00-285.00 +0.35/-0.13		32. 0.00-295.00 +0.35/-0.13		L. NAVARRETE	
33. 0.00-305.00 +0.35/-0.13		34. 0.00-315.00 +0.35/-0.13		L. NAVARRETE	
35. 0.00-325.00 +0.35/-0.13		36. 0.00-335.00 +0.35/-0.13		L. NAVARRETE	
37. 0.00-345.00 +0.35/-0.13		38. 0.00-355.00 +0.35/-0.13		L. NAVARRETE	
39. 0.00-365.00 +0.35/-0.13		40. 0.00-375.00 +0.35/-0.13		L. NAVARRETE	
41. 0.00-385.00 +0.35/-0.13		42. 0.00-395.00 +0.35/-0.13		L. NAVARRETE	
43. 0.00-405.00 +0.35/-0.13		44. 0.00-415.00 +0.35/-0.13		L. NAVARRETE	
45. 0.00-425.00 +0.35/-0.13		46. 0.00-435.00 +0.35/-0.13		L. NAVARRETE	
47. 0.00-445.00 +0.35/-0.13		48. 0.00-455.00 +0.35/-0.13		L. NAVARRETE	
49. 0.00-465.00 +0.35/-0.13		50. 0.00-475.00 +0.35/-0.13		L. NAVARRETE	
51. 0.00-485.00 +0.35/-0.13		52. 0.00-495.00 +0.35/-0.13		L. NAVARRETE	
53. 0.00-505.00 +0.35/-0.13		54. 0.00-515.00 +0.35/-0.13		L. NAVARRETE	
55. 0.00-525.00 +0.35/-0.13		56. 0.00-535.00 +0.35/-0.13		L. NAVARRETE	
57. 0.00-545.00 +0.35/-0.13		58. 0.00-555.00 +0.35/-0.13		L. NAVARRETE	
59. 0.00-565.00 +0.35/-0.13		60. 0.00-575.00 +0.35/-0.13		L. NAVARRETE	
61. 0.00-585.00 +0.35/-0.13		62. 0.00-595.00 +0.35/-0.13		L. NAVARRETE	
63. 0.00-605.00 +0.35/-0.13		64. 0.00-615.00 +0.35/-0.13		L. NAVARRETE	
65. 0.00-625.00 +0.35/-0.13		66. 0.00-635.00 +0.35/-0.13		L. NAVARRETE	
67. 0.00-645.00 +0.35/-0.13		68. 0.00-655.00 +0.35/-0.13		L. NAVARRETE	
69. 0.00-665.00 +0.35/-0.13		70. 0.00-675.00 +0.35/-0.13		L. NAVARRETE	
71. 0.00-685.00 +0.35/-0.13		72. 0.00-695.00 +0.35/-0.13		L. NAVARRETE	
73. 0.00-705.00 +0.35/-0.13		74. 0.00-715.00 +0.35/-0.13		L. NAVARRETE	
75. 0.00-725.00 +0.35/-0.13		76. 0.00-735.00 +0.35/-0.13		L. NAVARRETE	
77. 0.00-745.00 +0.35/-0.13		78. 0.00-755.00 +0.35/-0.13		L. NAVARRETE	
79. 0.00-765.00 +0.35/-0.13		80. 0.00-775.00 +0.35/-0.13		L. NAVARRETE	
81. 0.00-785.00 +0.35/-0.13		82. 0.00-795.00 +0.35/-0.13		L. NAVARRETE	
83. 0.00-805.00 +0.35/-0.13		84. 0.00-815.00 +0.35/-0.13		L. NAVARRETE	
85. 0.00-825.00 +0.35/-0.13		86. 0.00-835.00 +0.35/-0.13		L. NAVARRETE	
87. 0.00-845.00 +0.35/-0.13		88. 0.00-855.00 +0.35/-0.13		L. NAVARRETE	
89. 0.00-865.00 +0.35/-0.13		90. 0.00-875.00 +0.35/-0.13		L. NAVARRETE	
91. 0.00-885.00 +0.35/-0.13		92. 0.00-895.00 +0.35/-0.13		L. NAVARRETE	
93. 0.00-905.00 +0.35/-0.13		94. 0.00-915.00 +0.35/-0.13		L. NAVARRETE	
95. 0.00-925.00 +0.35/-0.13		96. 0.00-935.00 +0.35/-0.13		L. NAVARRETE	
97. 0.00-945.00 +0.35/-0.13		98. 0.00-955.00 +0.35/-0.13		L. NAVARRETE	
99. 0.00-965.00 +0.35/-0.13		100. 0.00-975.00 +0.35/-0.13		L. NAVARRETE	
101. 0.00-985.00 +0.35/-0.13		102. 0.00-995.00 +0.35/-0.13		L. NAVARRETE	
103. 0.00-1005.00 +0.35/-0.13		104. 0.00-1015.00 +0.35/-0.13		L. NAVARRETE	
105. 0.00-1025.00 +0.35/-0.13		106. 0.00-1035.00 +0.35/-0.13		L. NAVARRETE	
107. 0.00-1045.00 +0.35/-0.13		108. 0.00-1055.00 +0.35/-0.13		L. NAVARRETE	
109. 0.00-1065.00 +0.35/-0.13		110. 0.00-1075.00 +0.35/-0.13		L. NAVARRETE	
111. 0.00-1085.00 +0.35/-0.13		112. 0.00-1095.00 +0.35/-0.13		L. NAVARRETE	
113. 0.00-1105.00 +0.35/-0.13		114. 0.00-1115.00 +0.35/-0.13		L. NAVARRETE	
115. 0.00-1125.00 +0.35/-0.13		116. 0.00-1135.00 +0.35/-0.13		L. NAVARRETE	
117. 0.00-1145.00 +0.35/-0.13		118. 0.00-1155.00 +0.35/-0.13		L. NAVARRETE	
119. 0.00-1165.00 +0.35/-0.13		120. 0.00-1175.00 +0.35/-0.13		L. NAVARRETE	
121. 0.00-1185.00 +0.35/-0.13		122. 0.00-1195.00 +0.35/-0.13		L. NAVARRETE	
123. 0.00-1205.00 +0.35/-0.13		124. 0.00-1215.00 +0.35/-0.13		L. NAVARRETE	
125. 0.00-1225.00 +0.35/-0.13		126. 0.00-1235.00 +0.35/-0.13		L. NAVARRETE	
127. 0.00-1245.00 +0.35/-0.13		128. 0.00-1255.00 +0.35/-0.13		L. NAVARRETE	
129. 0.00-1265.00 +0.35/-0.13		130. 0.00-1275.00 +0.35/-0.13		L. NAVARRETE	
131. 0.00-1285.00 +0.35/-0.13		132. 0.00-1295.00 +0.35/-0.13		L. NAVARRETE	
133. 0.00-1305.00 +0.35/-0.13		134. 0.00-1315.00 +0.35/-0.13		L. NAVARRETE	
135. 0.00-1325.00 +0.35/-0.13		136. 0.00-1335.00 +0.35/-0.13		L. NAVARRETE	
137. 0.00-1345.00 +0.35/-0.13		138. 0.00-1355.00 +0.35/-0.13		L. NAVARRETE	
139. 0.00-1365.00 +0.35/-0.13		140. 0.00-1375.00 +0.35/-0.13		L. NAVARRETE	
141. 0.00-1385.00 +0.35/-0.13		142. 0.00-1395.00 +0.35/-0.13		L. NAVARRETE	
143. 0.00-1405.00 +0.35/-0.13		144. 0.00-1415.00 +0.35/-0.13		L. NAVARRETE	
145. 0.00-1425.00 +0.35/-0.13		146. 0.00-1435.00 +0.35/-0.13		L. NAVARRETE	
147. 0.00-1445.00 +0.35/-0.13		148. 0.00-1455.00 +0.35/-0.13		L. NAVARRETE	
149. 0.00-1465.00 +0.35/-0.13		150. 0.00-1475.00 +0.35/-0.13		L. NAVARRETE	
151. 0.00-1485.00 +0.35/-0.13		152. 0.00-1495.00 +0.35/-0.13		L. NAVARRETE	
153. 0.00-1505.00 +0.35/-0.13		154. 0.00-1515.00 +0.35/-0.13		L. NAVARRETE	
155. 0.00-1525.00 +0.35/-0.13		156. 0.00-1535.00 +0.35/-0.13		L. NAVARRETE	
157. 0.00-1545.00 +0.35/-0.13		158. 0.00-1555.00 +0.35/-0.13		L. NAVARRETE	
159. 0.00-1565.00 +0.35/-0.13		160. 0.00-1575.00 +0.35/-0.13		L. NAVARRETE	
161. 0.00-1585.00 +0.35/-0.13		162. 0.00-1595.00 +0.35/-0.13		L. NAVARRETE	
163. 0.00-1605.00 +0.35/-0.13		164. 0.00-1615.00 +0.35/-0.13		L. NAVARRETE	
165. 0.00-1625.00 +0.35/-0.13		166. 0.00-1635.00 +0.35/-0.13		L. NAVARRETE	
167. 0.00-1645.00 +0.35/-0.13		168. 0.00-1655.00 +0.35/-0.13		L. NAVARRETE	
169. 0.00-1665.00 +0.35/-0.13		170. 0.00-1675.00 +0.35/-0.13		L. NAVARRETE	
171. 0.00-1685.00 +0.35/-0.13		172. 0.00-1695.00 +0.35/-0.13		L. NAVARRETE	
173. 0.00-1705.00 +0.35/-0.13		174. 0.00-1715.00 +0.35/-0.13		L. NAVARRETE	
175. 0.00-1725.00 +0.35/-0.13		176. 0.00-1735.00 +0.35/-0.13		L. NAVARRETE	
177. 0.00-1745.00 +0.35/-0.13		178. 0.00-1755.00 +0.35/-0.13		L. NAVARRETE	
179. 0.00-1765.00 +0.35/-0.13		180. 0.00-1775.00 +0.35/-0.13		L. NAVARRETE	
181. 0.00-1785.00 +0.35/-0.13		182. 0.00-1795.00 +0.35/-0.13		L. NAVARRETE	
183. 0.00-1805.00 +0.35/-0.13		184. 0.00-1815.00 +0.35/-0.13		L. NAVARRETE	
185. 0.00-1825.00 +0.35/-0.13		186. 0.00-1835.00 +0.35/-0.13		L. NAVARRETE	
187. 0.00-1845.00 +0.35/-0.13		188. 0.00-1855.00 +0.35/-0.13		L. NAVARRETE	
189. 0.00-1865.00 +0.35/-0.13		190. 0.00-1875.00 +0.35/-0.13		L. NAVARRETE	
191. 0.00-1885.00 +0.35/-0.13		192. 0.00-1895.00 +0.35/-0.13		L. NAVARRETE	
193. 0.00-1905.00 +0.35/-0.13		194. 0.00-1915.00 +0.35/-0.13		L. NAVARRETE	
195. 0.00-1925.00 +0.35/-0.13		196. 0.00-1935.00 +0.35/-0.13		L. NAVARRETE	
197. 0.00-1945.00 +0.35/-0.13		198. 0.00-1955.00 +0.35/-0.13		L. NAVARRETE	
199. 0.00-1965.00 +0.35/-0.13		200. 0.00-1975.00 +0.35/-0.13		L. NAVARRETE	
201. 0.00-1985.00 +0.35/-0.13		202. 0.00-1995.00 +0.35/-0.13		L. NAVARRETE	
203. 0.00-2005.00 +0.35/-0.13		204. 0.00-2015.00 +0.35/-0.13		L. NAVARRETE	
205. 0.00-2025.00 +0.35/-0.13		206. 0.00-2035.00 +0.35/-0.13		L. NAVARRETE	
207. 0.00-2045.00 +0.35/-0.13		208. 0.00-2055.00 +0.35/-0.13		L. NAVARRETE	
209. 0.00-2065.00 +0.35/-0.13		210. 0.00-2075.00 +0.35/-0.13		L. NAVARRETE	
211. 0.00-2085.00 +0.35/-0.13		212. 0.00-2095.00 +0.35/-0.13		L. NAVARRETE	
213. 0.00-2105.00 +0.35/-0.13		214. 0.00-2115.00 +0.35/-0.13		L. NAVARRETE	
215. 0.00-2125.00 +0.35/-0.13		216. 0.00-2135.00 +0.35/-0.13		L. NAVARRETE	

TABULATION TB3		
TB3-	FUNCTION	DESCRIPTION
1-4 B+		24VDC/10 AMPS BATTERY VOLTAGE SUPPLY
5-6 SWITCHED B+		24VDC/10 AMPS BATTERY VOLTAGE SUPPLY, AVAILABLE WHEN GENSET IS RUNNING
7-8 DELAYED OFF SWITCHED B+		24VDC/10 AMPS BATTERY VOLTAGE SUPPLY, AVAILABLE WHEN GENSET IS RUNNING. CONFIGURABLE DELAYED OFF IS TYPICALLY USED FOR FUEL SHUTOFF
9-12 GND		BATTERY NEGATIVE
13 CONFIGURABLE INPUT #1		CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
14 CONFIGURABLE INPUT #2		CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
15 CONFIGURABLE INPUT #3		CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
16 CONFIGURABLE INPUT #4		CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
17 CONFIGURABLE INPUT RETURN		RETURN PATH FOR CONFIGURABLE INPUTS. (TB3-13,14,15,16)
19 RELAY COIL SOURCE		SWITCHED 24VDC POWER SUPPLY. USE ON THE HIGH SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY DRIVER. PROVIDES A MINIMUM 800ma OF CURRENT
21-22 READY TO LOAD RELAY DRIVER		ACTIVATES WHEN GENSET HAS REACHED 90% OF FREQUENCY. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
23 LOAD DUMP RELAY DRIVER		ACTIVATES AT A CONFIGURABLE LOAD LEVEL OR UNDER FREQUENCY CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
24 COMMON SHUTDOWN RELAY DRIVER		ACTIVATES ON ANY GENSET SHUTDOWN CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
25 SPARE		
26 SPARE		
27 SPARE		
28 MODEM RELAY DRIVER		PROVIDES A CONFIGURABLE METHOD OF CONTROLLING AND CYCLING POWER TO AN EXTERNAL MODEM. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH RELAY COIL SOURCE (TB3-19/20)
29 COMMON WARNING RELAY DRIVER		ACTIVATES ON ANY WARNING CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
30 LOCAL LOW FUEL INPUT		PROVIDES A LOW FUEL INDICATION FOR GENSETS SUPPLIED WITH A DAY TANK OR AN INTEGRATED FUEL TANK. SWITCH RETURN WITH TB3-31
31 LOCAL LOW FUEL RETURN		SWITCH RETURN FOR LOCAL LOW FUEL INPUT (TB3-30)
32-33 FIRST START INPUT		FOR PARALLELING APPLICATIONS, CONNECTS TO REMOTE MASTER START SENSOR OR BUS PT MODULE WITH FIRST START SENSOR
34 LOAD DEMAND INPUT		FOR MULTIPLE GENSET PARALLEL APPLICATIONS, INPUT ALLOWS GENSET TO RAMP TO NO LOAD, OPEN BREAKER AND SHUT DOWN. REMOVING INPUT CAUSES GENSET TO START, SYNCHRONIZE, CLOSE BREAKER, AND RAMP TO LOAD. APPLY WITH SWITCH RETURN (TB3-38/39)
35 SINGLE MODE ENABLE INPUT		FOR SINGLE GENSET PARALLEL POWER TRANSFER (PLT) APPLICATIONS ONLY. APPLY WITH SWITCH RETURN (TB3-38/39) TO ENABLE MODE
36 RAMP LOAD/UNLOAD SWITCH		USED WITH MULTIPLE GENSETS IN PARALLEL IN CONJUNCTION WITH A MASTER CONTROL OR OTHER PLC DEVICE. APPLY SWITCH RETURN (TB3-38/39) TO LOAD/UNLOAD GENSET AS LOAD PROFILE DICTATES
37 REMOTE LOW FUEL INPUT		PROVIDES A LOW FUEL INDICATION FOR GENSETS THAT ARE NOT FITTED WITH AN INTEGRATED FUEL TANK. APPLY SWITCH RETURN TB3-38/39 TO ACTIVATE
38-39 SWITCH RETURN		SWITCH RETURN FOR TB3-34, 35, 36, AND 37
40 SYNC ENABLE INPUT		FOR USE IN SINGLE MODE PLT APPLICATIONS ONLY. INPUT SIGNALS GENSET TO SYNCHRONIZE WITH UTILITY
41 LOAD GOVERN KW+ INPUT		ALLOWS A REMOTE DEVICE TO CONTROL KW LOAD ON GENSET WHILE UTILITY PARALLELED. ANALOG INPUT 0-5VDC
42 LOAD GOVERN KW- INPUT		RETURN LINE LOAD GOVERN KW
43 LOAD GOVERN KVAR+ INPUT		ALLOWS A REMOTE DEVICE TO CONTROL KVAR LOAD ON GENSET WHILE UTILITY PARALLELED. ANALOG INPUT 0-5VDC. THIS INPUT IS DEFAULTED TO "DISABLED" AND IS ENABLED WITH INPOWER
44 LOAD GOVERN KVAR- INPUT		RETURN LINE LOAD GOVERN KVAR

TABULATION TB3		
TB3-	FUNCTION	DESCRIPTION
45 EXTERNAL KW/KVAR SHIELD		SHIELD TERMINATION POINT FOR LOAD GOVERN INPUTS
46 AUTO MODE OUTPUT		SWITCH BATTERY 24VDC, FUSED AT 5A. AVAILABLE WHEN GENSET IS IN AUTO MODE
47 GROUND FAULT INPUT		ACTIVATES A GROUND FAULT WARNING WHEN SWITCHED TO THE GROUND FAULT RETURN (TB3-48). USE IN CONJUNCTION WITH AN EXTERNAL GROUND FAULT RELAY
48 GROUND FAULT RETURN		RETURN LINE FOR GROUND FAULT INPUT
49 GROUND FAULT ANALOG INPUT		FUTURE FEATURE
50 GROUND FAULT METER RETURN		RETURN LINE FOR GROUND FAULT ANALOG INPUT
51 LOAD SHARE KW+		FOR ISOLATED BUS PARALLELING ONLY. KW LOAD SHARING LINES FOR POWER COMMAND GENSETS
52 LOAD SHARE KW-		RETURN FOR LOAD SHARE KW
53 LOAD SHARE KVAR+		FOR ISOLATED BUS PARALLELING ONLY. KVAR LOAD SHARING LINES FOR POWER COMMAND GENSETS
54 LOAD SHARE KVAR-		RETURN FOR LOAD SHARE KVAR
55 LOAD SHARE SHIELD		SHIELD TERMINATION POINT FOR LOAD SHARE KW AND LOAD SHARE KVAR LINES
56 GENSET BREAKER POSITION SWITCH INPUT		FOR PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED INDICATES TO CONTROL THAT GENSET BREAKER IS CLOSED. USE WITH GENSET BREAKER SWITCH RETURN (TB3-58)
57 GENSET BREAKER INHIBIT SWITCH INPUT		FOR PARALLELING APPLICATIONS. WHEN CLOSED TO GENSET BREAKER SWITCH RETURN (TB3-50), GENSET BREAKER WILL OPEN, OR BE PREVENTED FROM CLOSING
58 GENSET BREAKER SWITCH RETURN		RETURN LINE FOR TB3-56/57
59 GENSET BREAKER OPEN COMMAND		FOR USE IN PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. NORMALLY CLOSED CONTACT THAT OPENS TO OPEN GENSET BREAKER. USE WITH TB3-60
60 GENSET BREAKER OPEN COMMAND RETURN		USE WITH TB3-59
61 GENSET BREAKER CLOSE COMMAND		FOR USE IN PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. NORMALLY OPEN CONTACT THAT CLOSSES TO CLOSE GENSET BREAKER. USE WITH TB3-62
62 GENSET BREAKER CLOSE COMMAND RETURN		USE WITH TB3-61
63 UTILITY BREAKER POSITION INPUT		FOR POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED INDICATES TO CONTROL THAT UTILITY BREAKER IS CLOSED. USE WITH UTILITY BREAKER RETURN (TB3-65)
64 UTILITY BREAKER INHIBIT INPUT		FOR POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED TO UTILITY BREAKER RETURN (TB3-65), UTILITY BREAKER WILL OPEN, OR BE PREVENTED FROM CLOSING
65 UTILITY BREAKER RETURN		USE WITH TB3-63/64
66 UTILITY BREAKER OPEN COMMAND		FOR POWER TRANSFER CONTROL APPLICATIONS. NORMALLY CLOSED CONTACT THAT OPENS TO OPEN UTILITY BREAKER. USE WITH TB3-67
67 UTILITY BREAKER OPEN COMMAND RETURN		USE WITH TB3-66
68 UTILITY BREAKER CLOSE COMMAND		FOR POWER TRANSFER CONTROL APPLICATIONS. NORMALLY OPEN CONTACT THAT CLOSSES TO CLOSE UTILITY BREAKER. USE WITH TB3-69
69 UTILITY BREAKER CLOSE COMMAND RETURN		USE WITH TB3-68
70 SYSTEM LOAD INPUT		FOR POWER TRANSFER CONTROL APPLICATIONS. ACCEPTS CT INPUT FOR MONITORING B PHASE CURRENT ON THE UTILITY BUS. USE UTILITY CT RETURN (TB3-72). A 3 OHM BURDEN RESISTOR IS CONNECTED ACROSS TB3-70 AND TB3-72
71 SPARE		
72 SYSTEM LOAD RETURN		USE WITH TB3-70

CUSTOMER CONNECTIONS (DESCRIPTIONS)

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		DATE: 10-26-05		SHEET: 1 OF 1	
DO NOT SCALE PRINT		CUMMINS POWER GENERATION		WD-INTERCONNECTION	
BY: L. KAPLAN		CNO: L. NAVARRETE		DATE: 10-26-05	
APPROVED: L. NAVARRETE		DATE: 10-26-05		SITE CODE: 0630-3210	
CONFIDENTIAL		FOR INTERCONNECTION WITH UTILITY		DGGAA, B PGF	
AND TOL: ± 1.0°		SCALE: 1/1		PRO/ENGINEER	