Air Permit to Construct - New

version 1.2

(Submission #: HQA-FF0E-J1XM1, version 1)

Details

Submission ID HQA-FF0E-J1XM1

Form Input

Form Instructions

General Process for all Pre-Construction Permitting

NOTE: At the very minimum, an application should include the following items:

1. A written description of the proposed project and the facility including site diagrams (if a physical change is proposed) and applicable process descriptions and technical specifications.

2. A summary of Hazardous Air Pollutant emissions and compliance with the Air Toxics Policy.

3. A written section addressing Title V and PSD applicability.

4. A summary of state and federal rule applicability including a listing of any New Source Performance Standards (NSPS, see 40 CFR 60) and National Emission Standards for Hazardous Air Pollutants (NESHAP, see 40 CFR 63) subparts that apply.

5. A statement addressing any dispersion modeling requirements for Criteria Pollutants or Air Toxics and the inclusion of any required modeling analysis with a complete method description in accordance with the State Air Quality Analysis Guide or Department guidance.

6. All Applicable Air Quality Permit Application forms.

7. The $325 Permit to Construct filing fee payment per NDAC 33.1-15-23-02.
Additional Pre-Construction Permitting Information

Section A - Applicant Information

Applicant

First Name	Last Name
Kristi	Biewer

Title
Environmental Representative

Phone Type	Number	Extension
Mobile	7012058587	

Email
biewerkristia@johndeere.com

Section B - Source Information

Permit Application for Air Contaminant Sources

Follow link to complete form SFN 8516 and upload below. If this form is already included in your application package, please upload complete application in Section D instead of this Section.
Link to SFN 8516 - Permit Application for Air Contaminant Sources

Upload form SFN 8516

SFN38516 Generator 2025.pdf - 03/06/2025 09:00 AM

Comment

Replacing Unit 4 with new Tier IV generator

Section C - Source Location

Facility Name

1750 Research Park Drive, Fargo North Dakota

Facility Location:

46.9020296004211,-96.80829785940567

Section D - File Upload

File Upload

Select and upload applicable SFN permit forms, from the list below, to detail information provided in Section D of SFN 8516.

DO NOT ADD CONFIDENTIAL INFORMATION to this form. If you have Confidential Information see NDAC 33.1-15-14-01-16.
NDAC 33.1-15-14-01-16

Please also remember to upload all additional documents necessary to meet Steps 1-5 of the Form Instructions Section.

Additional Forms

NONE PROVIDED

Attachments

npi generator map final.docx - 03/06/2025 09:03 AM
T4D-6000-SUBMITTAL-SPECS-20190720.pdf - 03/06/2025 09:06 AM
T4D-6000-Cert Generator.pdf - 03/06/2025 09:06 AM
PTE Calculations NPI Unit 4 Generator (002).xlsx - 03/06/2025 09:09 AM

Comment

NONE PROVIDED


North
Prevailing winds N/NW
100FT
GENERATOR
86FT
John Deere NPI
18th St N
18th St N
NDSU Research Park Dr N
NDSU Research Park Dr N
17th Ave N
17th Ave N
17t

GILLETTE GENERATORS

LIQUID COOLED DIESEL ENGINE GENERATOR SET

60 HZ MODEL

T4D-6000

Model	HZ	STANDBY 130ºC RISE	PRIME 105ºC RISE
T4D-6000-60 HERTZ	60	600	570

All generator sets are USA prototype built and thoroughly tested. Production models are USA factory built and 100% load tested.

UL2200, UL1446, UL508, UL142, UL498

NFPA 110, 99, 70, 37
All generator sets meet NFPA-110 Level 1, when equipped with the necessary accessories and installed per NFPA standards.

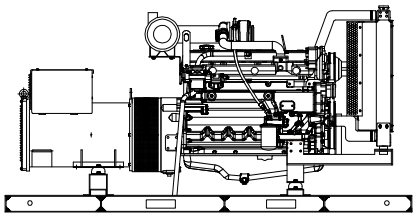
NEC 700, 701, 702, 708

NEMA ICS10, MG1, ICS6, AB1

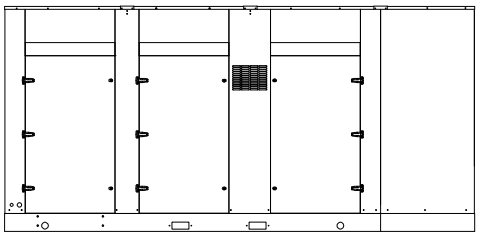
ANSI C62.41, 27, 59, 32, 480, 40Q, 81U, 360-05

ASCE 7-05 & 7-10
All generator sets meet 180 MPH rating.

EPA 40CFR Part 60, 89, 1039, 1048, 1054, 1065, 1068



"OPEN" GEN-SET
There is no enclosure, so gen-set must be placed within a weather protected area, un-inhabited by humans or animals, with proper ventilation. Silencer not supplied, as installation requirements are not known. However, this item is available as optional equipment.



"LEVEL 2" HOUSED GEN-SET
Full aluminum weather protection and superior sound attenuation for specific low noise applications. Critical grade muffler is standard.

GENERATOR RATINGS

GENERATOR MODEL	VOLTAGE		PH	HZ	130ºC RISE STANDBY RATING		105ºC RISE PRIME RATING	
	L-N	L-L			KW/KVA	AMP	KW/KVA	AMP
T4D-6000-3-2	120	208	3	60	600/750	2084	570/712	1980
T4D-6000-3-3	120	240	3	60	600/750	1806	570/712	1716
T4D-6000-3-4	277	480	3	60	600/750	903	570/712	858
T4D-6000-3-5	127	220	3	60	600/750	1970	570/712	1872
T4D-6000-3-16	346	600	3	60	600/750	722	570/712	686

RATINGS: All three phase gen-sets are 12 lead windings, rated at .8 power factor. 130° C "STANDBY RATINGS" are strictly for gen-sets that are used for back-up emergency power to a failed normal utility power source. This standby rating allows varying loads, with no overload capability, for the entire duration of utility power outage. 105° C "PRIME RATINGS" are strictly for gen-sets that provide the prime source of electric power, where normal utility power is unavailable or unreliable. A 10% overload is allowed for a total of 1 hour, within every 12 hours of operation, on every PRIME RATED systems. All gen-set power ratings are based on temperature rise measured by resistance method as defined by MIL-STD 705C and IEEE STD 115, METHOD 6.4.4. All generators have class H (180°C) insulation system on both rotor and stator windings. All factory tests and KW/KVA charts shown above are based 130°C (standby), and 105°C (prime) R/R winding temperature, within a maximum 40°C ambient condition. Generators operated at standby power ratings must not exceed the temperature rise limitation for class H insulation system, as specified in NEMA MG1-22.40. Specifications & ratings are subject to change without prior notice.

APPLICATION & ENGINEERING DATA FOR MODEL T4D-6000-60 HZ

GENERATOR SPECIFICATIONS

Manufacturer ..... Stamford Generators
Model & Type ..... HCI634G-311, 4 Pole, 12 Lead, Three Phase
..... HCI534F-311, 4 Pole, 12 Lead, 480V, Three Phase
..... HCI534F-17, 4 Pole, 12 Lead, 600V, Three Phase
Exciter ..... Brushless, shunt excited
Voltage Regulator ..... Solid State, HZ/Volts
Voltage Regulation ..... ½%, No load to full load
Frequency ..... 60 HZ
Frequency Regulation ..... ± ½% (1/2 cycle, no load to full load)
Unbalanced Load Capability ..... 100% of standby amps
One Step Load Acceptance ..... 100% of nameplate rating
Total Stator and Load Insulation ..... Class H, 180°C
Temperature Rise ..... 105°C R/R, prime rating @ 40°C amb.
3 Ø Motor Starting @ 30% Voltage Dip (208-240V) ... 1500 kVA
3 Ø Motor Starting @ 30% Voltage Dip (480V-600V) 2300 kVA
Bearing ..... 1, Pre-lubed and sealed
Coupling ..... Direct flexible disc.
Total Harmonic Distortion ..... Max 3½% (MIL-STD705B)
Telephone Interference Factor ..... Max 50 (NEMA MG1-22)
Deviation Factor ..... Max 5% (MIL-STD 405B)
Alternator ..... Self ventilating and drip-proof
Ltd. Warranty Period ..... 24 Months from start-up date or
..... 1000 hours use, first to occur.

GENERATOR FEATURES

- World Renown Stamford Electric Generator having UL-1446 certification.
- Full generator protection with **Basler DGC-2020** controller, having UL-508 certification.
- Automatic voltage regulator with over-excitation, under-frequency compensation, under-speed protection, and EMI filtering. Entire solid-state board is encapsulated for moisture protection.
- Generator power ratings are based on temperature rise, measured by resistance method, as defined in MIL-STD 705C and IEEE STD 115, Method 6.4.4.
- Power ratings will not exceed temperature rise limitation for class H insulation as per NEMA MG1-22.40.
- Insulation resistance to ground, exceeds 1.5 meg-ohm.
- Stator receives 2000 V. hi-potential test on main windings, and rotor windings receive a 1500 V. hi-potential test, as per MIL-STD 705B.
- Full amortisseur windings with UL-1446 certification.
- Complete engine-generator torsional acceptance, confirmed during initial prototype testing.
- Full load testing on all engine-generator sets, before shipping.

ENGINE SPECIFICATIONS AND APPLICATIONS DATA

ENGINE

Manufacturer ..... VOLVO-PENTA
Model and Type ..... TWD1673GE, 4 cycle, liquid Cooled
Aspiration ..... Turbo After Cooler, H2O to Air
Charged Air Cooled System ..... H2O to Air
Cylinder Arrangement ..... 6 Cylinders, In-Line
Displacement Cu. In. (Liters) 984 (16.1)
Bore & Stroke in (Cm) ..... 5.67 x 6.50 (14.4 x 16.5)
Compression Ratio 16.8:1
Main Bearings ..... Tin Overlay with Babbit Backing
Cylinder Head ..... Cast Iron with overhead Cam
Pistons ..... Aluminum Alloy with Graphite Coating
Crankshaft ..... Induction Hardened, Heat Treated Forged
Valves ..... Heat Treated and Hardened Exhaust Valve
Governor ..... Electronic, EMS 2.2
Frequency Regulation ..... ± 1/4%
Air Cleaner ..... Dry, Replaceable Cartridge
Engine Speed ..... 1800 rpm
Max Power, bhp (kwm) Standby 932 (695)
Max Power, bhp (kwm) Prime 850 (625)
BMEP: psi (MPa) Standby 411 (2.8)
Ltd. Warranty Period ..... 2 Year or 1000 hrs, first to occur

FUEL SYSTEM

Type ..... Diesel Fuel Oil (ASTM No. 2-D)
Combustion System ..... Direct Injection
Fuel Injection Pump ..... Electronic, Delphi E3
24 VDC Coolant heaters ..... Optional Equipment
Fuel Filter .... Yes with Water Separator

FUEL CONSUMPTION

GAL/HR (LITER/HR)	STANDBY	PRIME
100% LOAD	42.8 (162)	40.1 (152)
75% LOAD	29.7 (112)	26.9 (101)
50% LOAD	20.0 (75.7)	18.3 (69.3)

OIL SYSTEM

Type ..... Full Pressure
Oil Pan Capacity qt. (L) 50.7 (48)
Oil Pan Cap. W/ filter qt. (L) 44.3 (42)
Oil Filter ..... 3, Replaceable Cartridge type

ELECTRICAL SYSTEM

Ignition System ..... Electronic
Eng. Alternator/Starter: 24 VDC, negative ground, 110 amp/hr.

Recommended battery to -18°C (0° F): ....(2) 12 VDC, BCI# 31, Max. Dimensions: 14"lg x 6 3/4" wi x 10" hi, with standard round posts. Min output 1000 CCA. Battery tray (max. dim. at 15"lg x 7"wi). This model has (2) battery trays, (2) hold down straps, (2) sets of battery cables, and (1) battery charger. Installation of (2) 12VDC starting batteries connected in series for 24VDC output is required, with possible higher AMP/HR rating, as described above, if the normal environment temperature averages -13° F (-25°C) or cooler.

CERTIFICATIONS

All engines are EPA emissions certified. All non-emergency stationary diesel engines are Tier IV Final compliant.

APPLICATION & ENGINEERING DATA FOR MODEL T4D-6000-60 HZ

COOLING SYSTEM

Type of System ..... Air to Air, Charged Air Cooler
Coolant Pump .....Pre-lubricated, self-sealing
Cooling Fan Type .....Pusher
Fan Diameter inches (cm).....35.1 (89)
Fan drive ratio..... 1.04:1
Ambient Capacity of Radiator °F (°C).....131 (55)
Engine Jacket Coolant Capacity gal. (L).....8.70 (33)
Radiator Coolant Capacity gal. (L) 16.0 (60)
Water Pump Capacity gpm (L/min)..... .....122 (462)
Heat Reject Coolant: Btu/min ....….12,682
Air to Air Heat Reject, BTU/min. ....….11,715
Heat Radiated to Ambient, BTU/min .... ….4,253
Low Radiator Coolant Level Shutdown……..Standard
Note: Coolant temp. shut-down switch setting at 228°F (109°C) with 50/50 (water/antifreeze) mix.

COOLING AIR REQUIREMENTS

Combustion Air cfm (m^3/min) 1,646 (46.6)
Max Air Intake Restrictions:
Clean Air Cleaner, KPA (psi) 5 (1.5)
Radiator Cooling Air, SCFM (m^3/min)……....29,894 (846)

EXHAUST SYSTEM

Exhaust Outlet Size.....10"
Max. Back Pressure in KPA (in. H2O).....10 (40)
Exhaust Flow, at rated KW, CFM (m3/min)..... 4,347 (123)
Exhaust Temp, (Stack) °F (ºC) 932 (500)

SOUND LEVELS MEASURED IN dB(A)

	Open Set	Level 2 Encl.
Level 2, SCR/Residential Silencer	98	83

Note: Open sets (no enclosure) have installed selective catalytic reduction/residential silencer system. Level 2 enclosure has installed selective catalytic reduction/residential silencer. Sound tests are averaged from several test points and taken at 23 ft. (7 m) from source of noise at normal operation.

DERATE GENERATOR FOR ALTITUDE

3% per 1000 ft. (305m) above 3000 ft. (914m) from sea level

DERATE GENERATOR FOR TEMPERATURE

2% per 10°F (5.6°C) above 104°F (40°C)

DIMENSIONS AND WEIGHTS

	Open Set	Level 2 Enclosure
Length in (cm)	152 (368)	200 (508)
Width in (cm)	72 (183)	72 (183)
Height in (cm)	116 (295)	94 (239)
3 Ø Net Weight lbs (kg)	9625 (4366)	14975 (6793)
3 Ø Ship Weight lbs (kg)	10025 (4547)	15375 (6974)

BASLER DGC-2020 DIGITAL MICROPROCESSOR CONTROLLER

Basler DGC-2020

The "**2020**" controller is a highly advanced integrated gen-set control system for single gen-set applications. This controller includes a backlit LCD display which continuously displays the status of the engine and generator at all times.

Basler "**DGC-2020"** includes: Generator metering (including three phase) • Engine – Generator protections including IEEE-[27] under voltage, [32] power, [40] loss of excitation, [59] over voltage, [81] over and under frequency, Exercise timer • SAE J1939 engine ECU communications • Expansion capabilities for both inputs and outputs with expansion • Remote communications through RS-485 to Basler's RDP110 remote Display panel • (16) programmable contact inputs • (15) programmable contact outputs- (3) for up to 30AmpDC and (12) for up to 2 Amp DC • Illuminated Text Display • Front panel menu scroll buttons • Front panel operation mode buttons for STOP, RUN and AUTO • Alarm Silence and Lamp Test buttons

This controller includes expansion features including, RS485 (using MODBUS), direct USB connection with PC, expansion optioned using BESTCOMSPlus for remote annunciation and remote relay interfacing for a distance of up to 3300FT. The controller software is freely downloadable from the internet and allows monitoring with direct USB cable, LAN, or by internet via the built in web interface.

Further expansion is available by adding the optional RDP-110 remote display panel module. This featured device will allow Four programmable LEDs (2) alarms and (2) pre-alarms • (17) alarms and pre-alarms displayed from Basler controller • audible alarm horn • lamp test and alarm silence buttons • RD100 local power supply inputs of either 12vdc or 24vdc • connects through Basler controller through RS-485 communications protocol • conduit box included for (2) mounting configurations- either surface mount or semi-flush mounting.

STANDARD FEATURES FOR MODEL T4D-6000-60 HZ

STANDARD FEATURES

CONTROL PANEL:

Basler DGC-2020 digital microprocessor with logic allows programming in the field. Controller has:

- STOP-MANUAL-AUTO modes and automatic engine shutdowns, signaled by full text LCD indicators:
- Low oil pressure
- High engine temp
- Low Radiator Level
- Three auxiliary alarms
- Battery fail alarm
- Engine fail to start
- Engine over speed
- Engine under speed
- Over & under voltage

Also included is tamper-proof engine hour meter

ENGINE:

Fuel filter • Full flow Oil filter • Air filter • Fuel pump • Oil pump • Solenoid type starter motor • Hi-temp radiator • Jacket water pump • Thermostat • Pusher fan and guard • Exhaust manifold • Electronic Governor • 24 VDC battery charging alternator • Flexible fuel and exhaust connectors • Vibration isolators • Open coolant recovery system with 50/50 water to anti-freeze mixture • flexible oil & radiator hose • Shut-down sensors for low oil pressure, high coolant temp., low coolant level, high ambient temp.

Design & specifications subject to change without prior notice. Dimensions shown are approximate. Contact Gillette for certified drawings. DO NOT USE DIMENSIONS FOR INSTALLATION PURPOSES.

AC GENERATOR SYSTEM:

AC generator • Shunt excited • Brushless design • Circuit Breaker installed and wired to gen-set • Direct connection to engine with flex disc • Class H, 180°C insulation • Self ventilated • Drip proof construction • UL Certified

VOLTAGE REGULATOR:

1% Voltage regulation • EMI filter • Under-speed protection • Over-excitation protection • total encapsulation

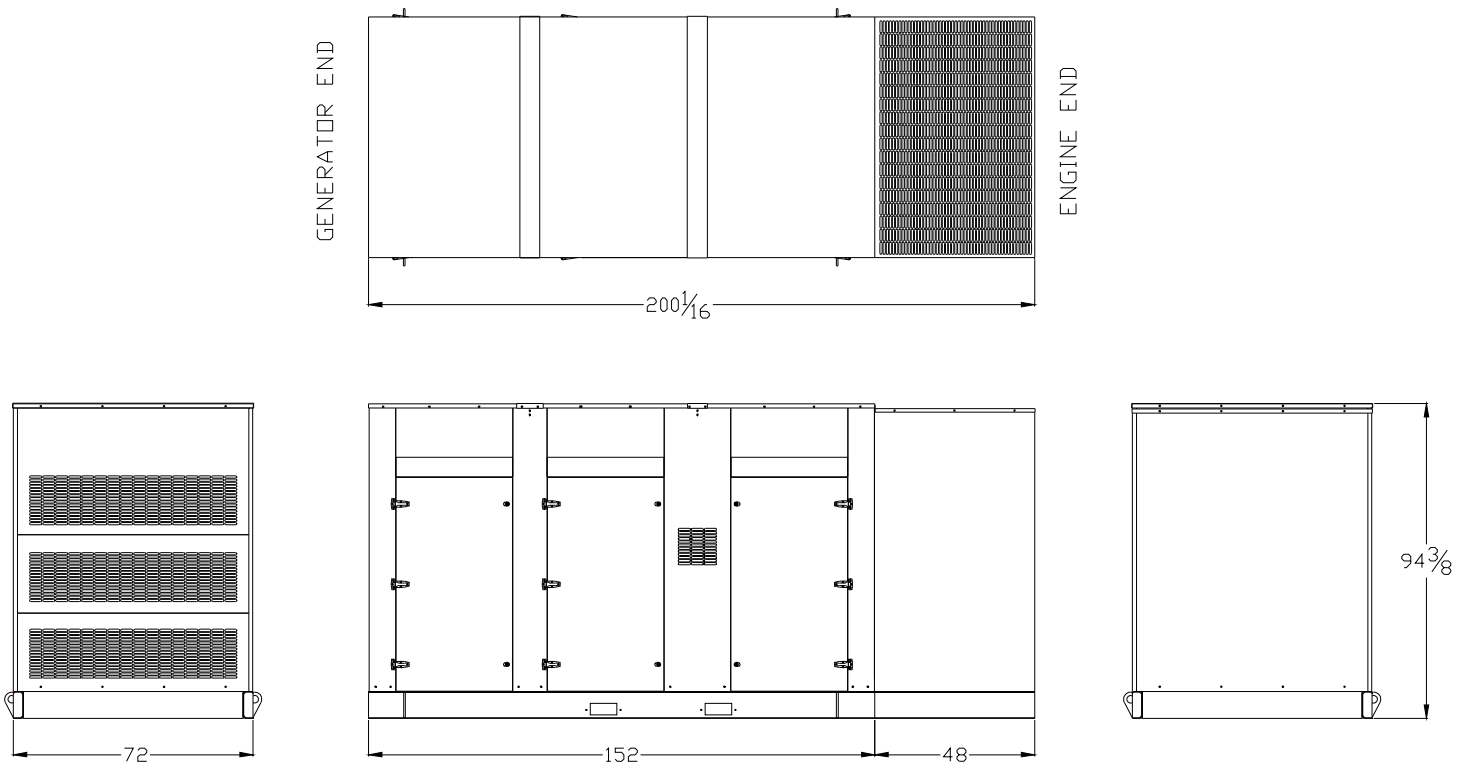
DC ELECTRICAL SYSTEM:

Battery trays • Battery cables • Battery hold down straps • 3-stage battery charger with float, absorption, & bulk automatic charge stages

WEATHER / SOUNDPROOF ALUMINUM HOUSING:

Corrosion Resistant Protection consisting of:

- (9) Heated and Agitated Wash Stages
- Zinc Phosphate Etching-Coating Stage
- Final Baked on Enamel Powder Coat
- 18/8 Stainless Steel Hardware



 Gillette Generators, Inc. • 2921 Thorne Dr. •Elkhart, IN • 46514 • Ph: 574-264-9639 • Fax: 574-262-1840 • Web: www.gillettegenerators.com • spc4-190720

TWD1672-1673GE

615 kW (836 hp) & 685 (932) at 1800 rpm, acc. to ISO 3046

US EPA & CARB Tier 4 Final

A powerful, reliable and economical generating set diesel engine range built on the proven Volvo Group in-line six concept.

Powerful package

High power density in a compact package with dual stage turbo charging. Excellent load step performance according to ISO 8528-5.

Low cost of ownership & operation

World class fuel efficiency in combination with a proven and reliable engine and exhaust aftertreatment system design. The exhaust aftertreatment system consists of only SCR, without EGR, DOC or DPF. Minimal of components are used and no downtime for regeneration or decreased service intervals. No EGR also results in less heat rejection, leading to excellent power density and improved fuel economy.

Compact & simple installation

SCR technology selected by Volvo Group does not increase the amount of cooling capacity needed. In combination with the compact engine design, installation is easy with minor impact on existing installation layout. Installation guidelines as well as drawings and CAD models are easy to access.

Durability & low noise

Volvo Group´s long experience with SCR systems in combination with base engine development reduces risk of downtime. Well-balanced to produce smooth and vibration free operation with low noise.

Low exhaust emission

Efficient injection as well as robust engine design in combination with SCR technology contributes to excellent combustion and low fuel consumption.

Easy service & maintenance

Easily accessible service and maintenance points contribute to the ease of service.

- **Proven and straight-forward design - built on Volvo Group technology**
- **Low cost of ownership and operation**
- **SCR only - no EGR, DOC, DPF or regeneration**
- **High efficient cooling system**
- **Excellent step load performance acc. to ISO 8528-5**
- **Compact, simple installation and easy to service**
- **Available as Genpac or Base engine configuration**

60 Hz/1800 rpm

	Prime power			Standby power			Generator eff.
Engine	**kWm**	**kWe**	**kVa**	**kWm**	**kWe**	**kVa**	**(%)**
TWD1672GE	532	508	635	585	559	698	95,5
TWD1673GE	595	570	713	655	625	781	95,5

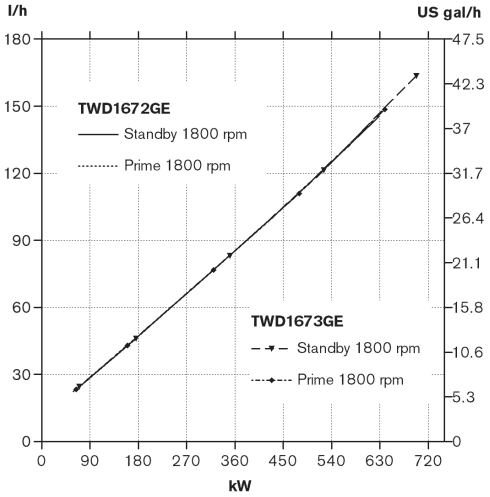
VOLVO PENTA

TWD1672-1673GE

Technical Data

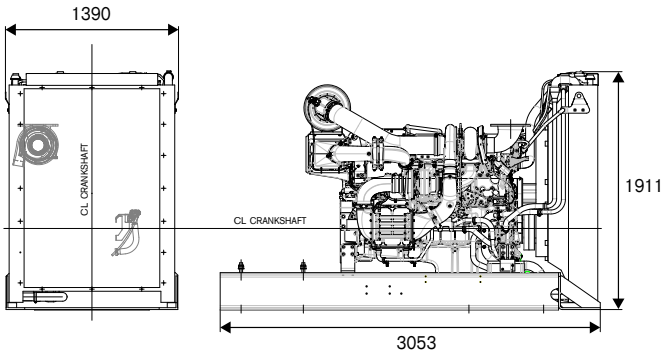
Engine designation	TWD1672-1673GE
Configuration and no. of cylinders	in-line 6
Displacement, l (in³)	16.12 (983.9)
Method of operation	4-stroke
Bore, mm (in.)	144 (5.67)
Stroke, mm (in.)	165 (6.50)
Compression ratio	16.8:1
Wet weight, engine only, kg (lb)	1810 (3390)
Wet weight, Genpac (engine, cooling system, air filtration system and frame kg (lb)	2767(6100)

Performance (with fan, kW (hp))	**1800 rpm**
TWD1672GE	
Prime Power	532 (724)
Standby Power	585 (796)
Fan power consumption	30 (41)
TWD1673GE	
Prime Power	595 (809)
Standby Power	655 (891)
Fan power consumption	30 (41)



Dimensions

Not for installation. Dimensions in mm.



Technical description

Engine and block
- Cast iron cylinder block with optimum distribution of forces without the block being unnessarily heavy.
- Wet, replaceable cylinder liners
- Tapered connecting rods for increased piston lifetime
- Crankshaft induction hardened bearing surfaces and fillets with seven bearings for moderate load on main and high-end bearings
- Case hardened and Nitrocarburized transmission gears for heavy duty operation
- Viscous type crankshaft vibration dampers to withstand single bearing alternator torsional vibrations
- Replaceable valve guides and valve seats
- Over head camshaft and 4 valves per cylinder

Lubrication system
- Full flow oil cooler
- Full flow disposable spin-on oil filter, for extra high filtration
- The lubricating oil level can be measured at start-up

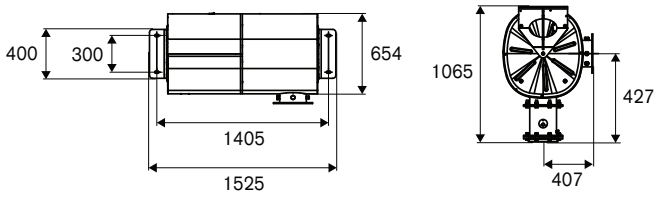
Fuel system
- Electronic high pressure unit injectors
- Fuel prefilter with water separator and water-in-fuel indicator / alarm
- Fine fuel filter with manual feed pump and fuel pressure switch

Cooling system
- Efficient cooling with accurate coolant control through a water distribution duct in the cylinder block.
- Belt driven coolant pumps with high degree of efficiency
- Water-cooled charge air coolers

Turbo charger
- Efficient and reliable dual stage turbo chargers
- Intermediate charge air coolers for both turbo chargers
- Waste gate system for the high pressure turbo charger

Electrical system
- Engine Management System 2.3 (EMS 2.3), an electronically controlled processing system which optimizes engine performance. It also includes advanced facilities for diagnostics and fault tracing
- The instruments and controls connect to the engine via the CAN SAE J1939 interface. The DCU is a control panel with display, engine control, monitoring, alarm, parameter setting and diagnostic functions. It also presents error codes in clear text. The DCU makes it possible to install and combine several sets of analogue and digital instruments.
- Sensors for oil pressure, oil temp, boost pressure, boost temp, coolant temp, fuel temp, water in fuel, fuel pressure and two speed sensors.

Exhaust aftertreatment system
- SCR only. No EGR, DOC, DPF or regeneration. Wide range of installation options available.
- AdBlue/DEF tank including AdBlue/DEF Quality Level Temperature Sensor



Rating guidelines

PRIME POWER rating corresponds to ISO Standard Power for continuous operation. It is applicable for supplying electrical power at variable load for an unlimited number of hours instead of commercially purchased power. A10 % overload capability for govering purpose is available for this rating.
STANDBY POWER rating corresponds to ISO Standard Fuel Stop Power. It is applicable for supplying standby electrical power at variable load in areas with well established electrical networks in the event of normal utility power failure. No overload capability is available for this rating.
1 kW = 1 hp x 1.36
1 hp = 1 kW x 0.7355

Power standards

The engine performance corresponds to ISO 3046, BS 5514 and DIN 6271. The technical data applies to an engine without cooling fan and operating on a fuel with calorific value of 42.7 MJ /kg (18360 BTU/lb) and a density of 0.84 kg/liter (7.01 lb/US gal), also where this involves a deviation from the standards. Power output guaranteed within 0 to +2% att rated ambient conditions at delivery. Ratings are based on ISO 8528. Engine speed governing in accordance with ISO 3046/IV, class A1 and ISO 8528-5 class G3

Additional information

For additional information, please contact your Volvo Penta representative or visit www.volvopenta.com

VOLVO PENTA

AB Volvo Penta
SE-405 08 Göteborg, Sweden
www.volvopenta.com

Important

This Technical Data Sheet and the corresponding Installation Instructions provide important information to ensure the installed engine will operate according to the design specification in the Volvo Penta application for certification.

Requirements marked with ⚠ are considered as critical for exhaust emissions compliance according to the design specification in the Volvo Penta application for certification.

Failing to follow and meet these instructions and requirements when installing a certified engine in a piece of nonroad equipment for use in the United States violates U.S. federal law (40 CFR 1068.105(b)), subject to fines or other penalities as described in the Clean Air Act.

General

In-line four stroke diesel engine with direct injection. Rotation direction, anti-clockwise viewed towards flywheel. Turbocharged

Number of cylinders			6
Displacement, total		litre in^3	16,12 983,9
Firing order			1-5-3-6-2-4
Bore		mm in	144 5,67
Stroke		mm in	165 6,50
Compression ratio			16,8:1
Wet weight (Not including after treatment system)	Engine only	kg lb	1810 3990
	Engine incl. cooling system and air filtration system	kg lb	2217 4888
	Frame	kg lb	550 1213
	Compensator and Mixer pipe	kg lb	25 55
	EATS Muffler	kg lb	188 414

Performance			**rpm**	**1500**	**1800**
Prime Power		without fan	kW	NA	625
			hp	NA	850
		with fan	kW	NA	595
			hp	NA	809
Standby Power		without fan	kW	NA	685
			hp	NA	932
		with fan	kW	NA	655
			hp	NA	891
Torque at:	Prime Power		Nm	NA	3316
			lbft	NA	2445
	Standby Power		Nm	NA	3634
			lbft	NA	2680
Mean piston speed			m/s	NA	9,9
			ft/sec	NA	32,6
Effective mean pressure at:	Prime Power		MPa	NA	2,6
			psi	NA	375
Effective mean pressure at:	Standby Power		MPa	NA	2,8
			psi	NA	411
Max combustion pressure at:	Prime Power		MPa	NA	22
			psi	NA	3191
Max combustion pressure at:	Standby Power		MPa	NA	22,5
			psi	NA	3263
Total mass moment of inertia, J (mR^2) with flywheel			kgm^2	2,50	
			$lbft^2$	59,3	
Total mass moment of inertia, J (mR^2) without flywheel			kgm^2	1,92	
			$lbft^2$	45,6	
Friction Power			kW	NA	51
			hp	NA	69,4

Derating due to altitude - see Technical Diagrams

Engine noise emission
Test Standards: ISO 3744-1981 (E) sound power
Tolerance ± 0.75 dB(A)

		rpm	**1500**	**1800**
Measured sound power Lw	No load	dB(A)	NA	118,1
	Prime Power	dB(A)	NA	119,1
	Standby Power	dB(A)	NA	118,9
Calculated sound pressure Lp at 1 m	No load	dB(A)	NA	101,1
	Prime Power	dB(A)	NA	102,1
	Standby Power	dB(A)	NA	101,9

Test conditions for load acceptance data

Warm engine.	**Generator**			**Model**		**Type of AVR**	
	Stamford			HCM534F1		MX341	
AVR Settings	UFRO (Hz):		57	DIP (%)*:	50	DWELL (%)*:	N/A
	Stability (%)*:	According to Stamford instructions		Voltage (V):	400	Load factor:	1.0

Applies to Stamford nomenclature,
(%)* : % of max potentiometer setting range
Load acceptance performance can vary due to actual alternator inertia, voltage regulator, type of load and local ambient conditions.

Abbreviation:	**Full name:**	**Descriptions**
AVR	Automatic Voltage Regulator	Generator performance and safty control unit
UFRO	Under Frequency Roll Off	Overheating protection at under frequency
DIP		Controls the slope of voltage drop when the UFRO is active
DWELL		Controls the slope of voltage recovery when the UFRO is active.

Single step load performance at 1800 rpm - PRIME (Resistiv load)

Load (%)	Speed diff (%)	Speed Recovery time (s)	Voltage diff (%)	Voltage Recovery time (s)	Remaining load (%)	Speed diff (%)	Speed Recovery time (s)	Voltage diff (%)	Voltage Recovery time (s)
0-20	2,6	1,5	0,5	0,0	20-100	8,8	2,9	17,6	1,6
0-40	4,8	2,1	5,3	1,2	40-100	5,9	2,5	9,8	1,5
0-52	7 (G3)	2,3	10,6	1,2	58-100	4,5	2,2	4,0	1,1
0-60	7,4	2,3	11,6	1,2	60-100	4,5	2,1	3,5	1,1
0-68	10 (G2)	2,7	17,1	1,2	71-100	3,5	1,8	2,0	0,8
0-80	12,3	3,1	22,4	1,4	80-100	2,6	1,4	1,5	0,4
0-100	17,4	3,4	31,7	2,1					
100-0	5,6	1,9	8,3	1,7					

Single step load performance at 1800 rpm - STAND BY (Resistiv load)

Load (%)	Speed diff (%)	Speed Recovery time (s)	Voltage diff (%)	Voltage Recovery time (s)	Remaining load (%)	Speed diff (%)	Speed Recovery time (s)	Voltage diff (%)	Voltage Recovery time (s)
0-20	2,9	1,5	0,8	0,6	20-100	10,8	3,2	21,6	1,7
0-40	5,1	2,1	5,8	1,1	40-100	6,9	2,8	12,3	1,6
0-54	7 (G3)	2,3	10,8	1,2	54-100	5,3	2,4	6,0	1,4
0-60	8,4	2,7	14,6	1,2	60-100	4,7	2,2	4,0	1,4
0-67	10 (G2)	2,9	16,8	1,2	67-100	4,3	2,1	3,3	1,2
0-80	13,3	3,2	24,1	1,7	80-100	3,1	1,6	2,3	0,8
0-100	19,8	3,8	35,4	1,8					
100-0	4,3	1,0	9,8	2,4					

Cold start performance			rpm	1500	1800
Time from start to stay within 0.5% of no load speed at ambient temperature:	°C	20	s	NA	4,3
		5	s	NA	5,3
		-15 *	s	NA	5,3
		-30 **	s	NA	5,7
		Min start temp*	°C	-31,0	

* With manifold heater 4 kW engaged, lubrication oil 15W/40 and block heater.
** With manifold heater 4 kW engaged, lubrication oil 5W/30 and block heater, Fuel MK-1.

Block heater type	Make	Power kW	Engaged hours	Cooling water temp engine block
Volvo part No: 22454340 P01	Calix	1.5 kW	10h ambient temp-30 C	-2°C 28°F

Lubrication system			rpm	1500	1800
Lubricating oil consumption	Prime Power		litre/h	NA	0,10
			US gal/h		0,026
	Standby Power		litre/h	NA	0,11
			US gal/h		0,029
Oil system capacity including filters			litre	48	
			US gal	12,7	
Oil sump capacity:		max	litre	42	
			US gal	11,1	
		min	litre	32	
			US gal	8,5	
Oil change intervals/specifications:	VDS-3*		h	500	
Engine angularity limits:		front up	°	30	
		front down	°	30	
		side tilt	°	30	
Oil pressure at rated speed			kPa	NA	399
			psi	NA	58
Lubrication oil temperature in oil sump:		max	°C	130	
			°F	266	
Oil filter micron size			µ	40	

* See also general section in the sales guide

Fuel system			rpm	1500	1800
Prime Power	25%	g/kWh		NA	227
Specific **fuel** consumption at:		lb/hph		NA	0,368
	50%	g/kWh		NA	202
		lb/hph		NA	0,327
	75%	g/kWh		NA	195
		lb/hph		NA	0,316
	100%	g/kWh		NA	195
		lb/hph		NA	0,316
% adBlue consumption at:	25%	%		NA	6,4
(Compare to Fuel consumption by Volyme)	50%	%		NA	6,7
	75%	%		NA	7,2
	100%	%		NA	6,4

Standby Power	25%	g/kWh		NA	223
Specific **fuel** consumption at:		lb/hph		NA	0,361
	50%	g/kWh		NA	201
		lb/hph		NA	0,326
	75%	g/kWh		NA	195
		lb/hph		NA	0,316
	100%	g/kWh		NA	197
		lb/hph		NA	0,319
% adBlue consumption at:	25%	%		NA	6,6
(Compare to Fuel consumption by Volyme)	50%	%		NA	6,7
	75%	%		NA	7,2
	100%	%		NA	6,1

Fuel system		rpm	1500	1800
See front page for important information ⚠ Fuel to conform to	ASTM D975 (2D)			
System supply flow at:		litre/h	NA	210,0
		US gal/h	NA	55,5
Fuel supply line max restriction		kPa	NA	30,0
(Measured at fuel inlet connection)		psi	NA	4,4
Fuel supply line max pressure, engine stopped		kPa	NA	0,0
		psi	NA	0,0
System return flow		litre/h	NA	25,0
		US gal/h	NA	6,6
Fuel return line max restriction		kPa	NA	20,0
(Measured at fuel return connection)		psi	NA	2,9
Maximum allowable inlet fuel temp		°C	NA	60
(Measured at fuel inlet connection)		°F	NA	140
Prefilter / Water separator micron size		µ	10	
Fuel filter micron size		µ	5	
Governor type/make, standard		Volvo/EMS 2.3		
Injection pump type/make		Unit injector hybrid		

Intake and exhaust system			rpm	1500	1800
Air consumption at: (+25°C and 100kPa)	Prime Power	m^3/min		NA	48,1
		cfm		NA	1699
	Standby Power	m^3/min		NA	51,1
		cfm		NA	1805
See front page for important information ⚠ Max allowed air intake restriction including piping		kPa		NA	5
		psi		NA	0,7
Air filter restriction clean Volvo Penta filter		kPa		NA	1,4
		psi		NA	0,2
Heat rejection to exhaust at:	Prime Power	kW		NA	458
		BTU/min		NA	26072
	Standby Power	kW		NA	521
		BTU/min		NA	29623
Exhaust gas temperature after turbine at:	Prime Power	°C		NA	455
		°F		NA	851
	Standby Power	°C		NA	484
		°F		NA	903
See front page for important information ⚠ Max allowable back pressure in exhaust line (after turbine) Pipe dimension Ø: mm	Prime Power	kPa		NA	19
		psi		NA	2,7
	Standby Power	kPa		NA	20
		psi		NA	2,9
See front page for important information ⚠ Max allowable temperature drop between turbine and SCR muffler inlet.	Prime Power	Δ°C		NA	10
		Δ°F		NA	18
	Standby Power	Δ°C		NA	10
		Δ°F		NA	18
SCR muffler pressure drop (at exhaust gas flow and exhaust temp given)	Prime Power	kPa		NA	9
		psi		NA	1,3
	Standby Power	kPa		NA	10
		psi		NA	1,5
Exhaust gas flow at: (temp and pressure after turbine at the corresponding power setting)	Prime Power	m^3/min		NA	126,6
		cfm		NA	4471
	Standby Power	m^3/min		NA	137,8
		cfm		NA	4866

Cooling system			**rpm**	**1500**	**1800**
Heat rejection radiation from engine at:		Prime Power	kW	NA	26
			BTU/min	NA	1479
		Standby Power	kW	NA	29
			BTU/min	NA	1649
Coolant		Volvo Penta coolant "ready mix or Volvo Penta coolant mixed with fresh water 40/60			
Radiator cooling system type			Closed circuit		
Standard radiator core area			m²	NA	1,68
			foot²	NA	18,08
Fan diameter			mm	NA	965
			in	NA	37,99
Fan power consumption			kW	NA	30
			hp	NA	41
Fan drive ratio					1.04:1
Coolant capacity,	Engine only		litre	NA	33
			US gal	NA	8,72
	CACs (Charge Air Coolers)		litre	NA	10
			US gal	NA	2,64
	Coolant radiators incl piping, Engine circuit		litre	NA	48
			US gal	NA	12,68
	Coolant radiators incl piping, CAC- circuit		litre	NA	48
			US gal	NA	12,68
	Expansion tank, Engine circuit		litre	NA	20
			US gal	NA	5,28
	Expansion tank, CAC circuit		litre	NA	7
			US gal	NA	1,85
Coolant pump			drive/ratio	Belt / 1,85:1	
Coolant pump , CAC circuit			drive/ratio	Belt / 2,29:1	
Thermostat, Engine circuit	Start to open		°C	NA	82
			°F	NA	180
	Fully open		°C	NA	92
			°F	NA	198
Thermostat, CAC circuit	Start to open		°C	NA	40
			°F	NA	104
	Fully open		°C	NA	52
			°F	NA	126
Maximum static pressure head (expansion tank height + pressure cap setting)			kPa	NA	100
			psi	NA	14,5
Minimum static pressure head (expansion tank height + pressure cap setting)			kPa	NA	70
			psi	NA	10,2
Standard pressure cap setting			kPa	NA	75
			psi	NA	10,9
Maximum top tank temperature			°C	NA	107
			°F	NA	225
Charge air pressure (after charge air coolers)			kPa	NA	360
			psi	NA	52,2
See front page for important information Max allowed Charge air outlet temp. At air inlet temp. 25°C ⚠	Prime Power		°C	NA	50
			°F	NA	122
	Standby Power		°C	NA	50
			°F	NA	122

OEM cooling system design:

- move of standard radiatorts		**rpm**	**1500**	**1800**
Maximum additional coolant, Engine circuit with standard expansion tank		litre	NA	15
		US gal	NA	3,96
Maximum additional coolant, CAC circuit with standard expansion tank		litre	NA	5
		US gal	NA	1,32
Maximum distans in vertikal direction with standard pressure cap (75 kPa)		m	NA	2,5
		ft	NA	8,20
Maximum additional pressure drop due to move		KPa	NA	10
		psi	NA	1,5
- replacement of standard radiators				
Heat rejection to coolant **engine radiator** at:	Prime Power	kW	NA	223
		BTU/min	NA	12682
	Standby Power	kW	NA	245
		BTU/min	NA	13933
Heat rejection to coolant **CAC radiator** at:	Prime Power	kW	NA	208
		BTU/min	NA	11829
	Standby Power	kW	NA	216
		BTU/min	NA	12284
Minimum coolant flow **engine radiator** (at fully open thermostat)		litre/s	NA	6
		US gal/s	NA	1,59
Minimum coolant flow **CAC radiator** (at fully open thermostat)		litre/s	NA	2,5
		US gal/s	NA	0,66
Maximum coolant pressure drop over **engine radiator** incl. Piping (at coolant flow above)		kPa	NA	70
		psi	NA	10,2
Coolant pressure drop over complete engine circuit cooling system (at coolant flow above)		kPa	NA	160
		psi	NA	23,2
Coolant pressure drop over complete CAC circuit cooling system (at coolant flow above)		kPa	NA	135
		psi	NA	19,6
Nominal coolant pressure before engine circuit coolant pump		kPa	NA	30
		psi	NA	4,4
Nominal coolant pressure before CAC circuit coolant pump		kPa	NA	30
		psi	NA	4,4

Cooling performance

Standard fan: Fan ratio: 1 : 1.04 Fan type: FIX

Cooling air flow and external restriction at different radiator air temperatures based on 107°C TTT and 40% antifreeze.
Valid at 1 atm. (radiator and cooling fan, see optional equipment)

Engine speed rpm	Air on temp °C	PRIME POWER		STANDBY POWER	
		Air flow m^3/s	External restriction Pa	Air flow m^3/s	External restriction Pa
1800	63	15,2	0		
	62	14,5	100	15,2	0
	61	14,1	200		
	60	13,6	300		
	59			14,5	100
	58			13,9	200
	57			13,6	300

Note! External restrictions are calculated for values >0 Pa

Engine management system

Functionality	Alternatives	Default setting
Governor mode	Isochronous	Isochronous
Governor droop	N/A	N/A
Governor response	Adjustable PID-constants (VODIA)	
Dual speed	Single speed 1800rpm, 60Hz	1800,0
Idle speed	600-1200rpm	900,0
Fine speed adjustment	+- 90 rpm	0,0
Preheating function	On / Off	Off

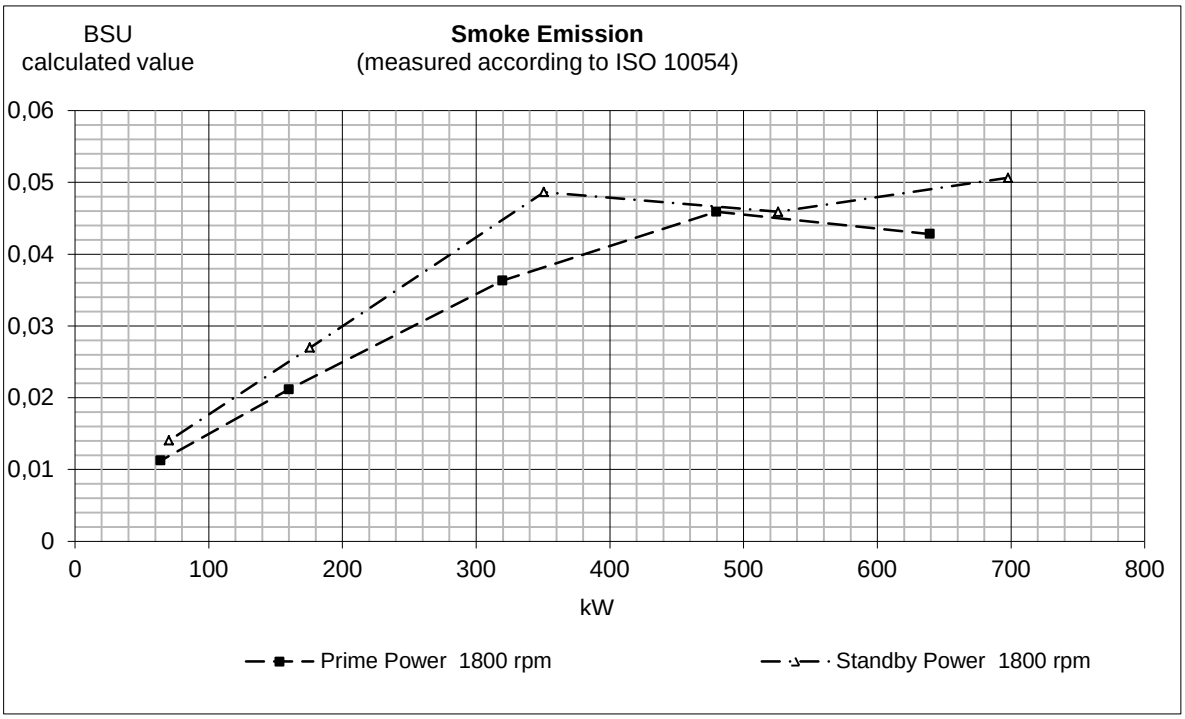
Engine sensor and switch settings

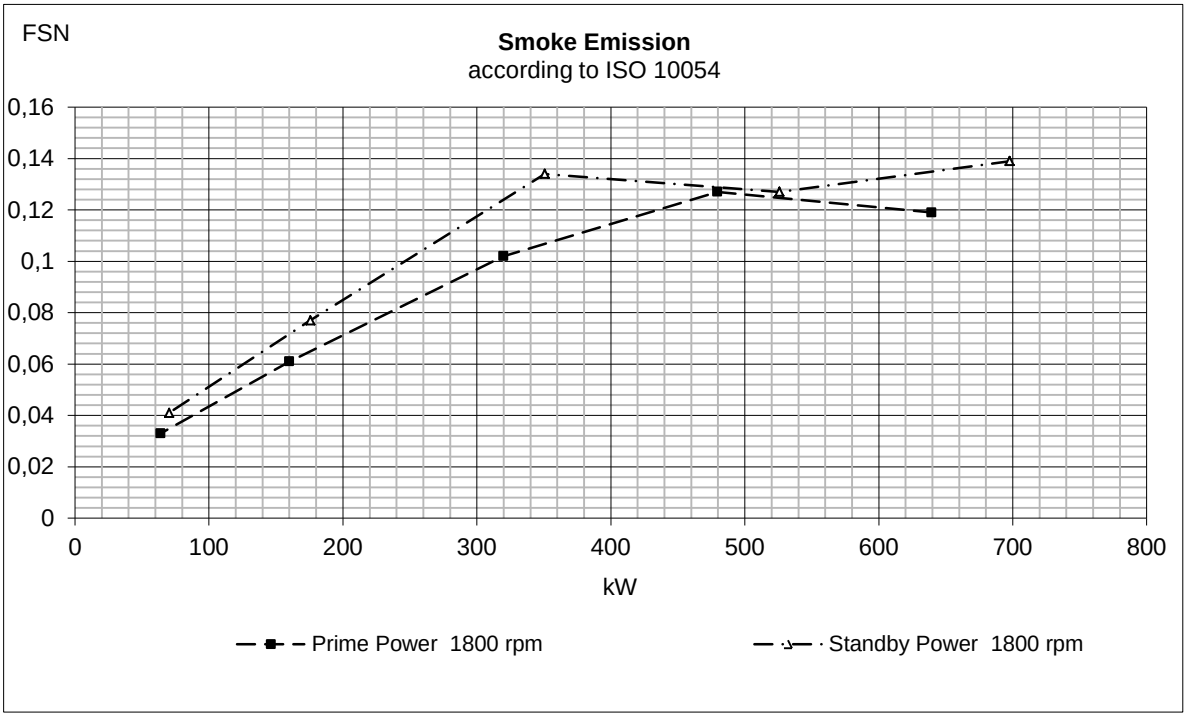
			Alarm level		Engine protection	
Parameter		Unit	Setting range	Default setting	Level	Action. Default/Alternative
Oil temp		°C	120 - 130	125	Setting +2.5	Shutdown after 10s
Oil pressure	Low idle 900rpm	kPa	NA	170	145	Shutdown
	1800 rpm	kPa	NA	300	275	Shutdown
Oil level			NA	Min level		
DEF dosing injector failure			NA	On	Low level	Shutdown after 10s
Coolant temp		°C	95 - 101	103	Setting +4	Shutdown after 10s
Coolant level			See cooling system	On	Low level	Shutdown after 10s
Fuel feed pressure	Low idle	kPa	NA	Min level		
	>1400 rpm	kPa	NA	Min level		
Water in fuel			NA	Max level		
Crank case pressure		kPa	NA	Rapid increase	Rapid increase	Shutdown
Air filter pressure drop		kPa	NA	5		
Altitude, above sea		m				Automatic derating, see section Smoke, Fuel & Derating
Charge air temp		°C	NA	80	82,5	Shutdown after 10s
Charge air pressure		kPa	NA	25 above demand	35 above demand	Shutdown after 1s
Engine speed		rpm	100 - 120% of rated speed	115% of rated speed	Alarm level	Shutdown
Exhaust Temperature (before SCR volume)		°C	NA	530	550,0	Shutdown after 10s
Engine protection can be disabled. For consequences please see VP International Limited Warranty Policy						

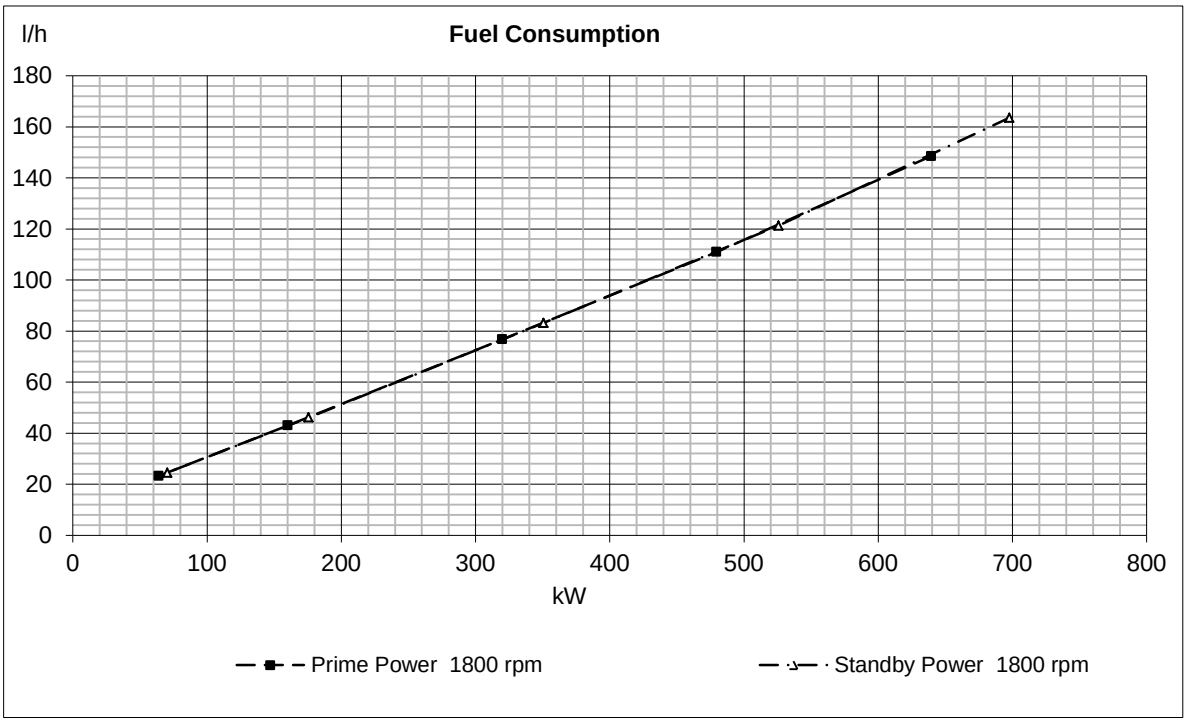
Electrical system

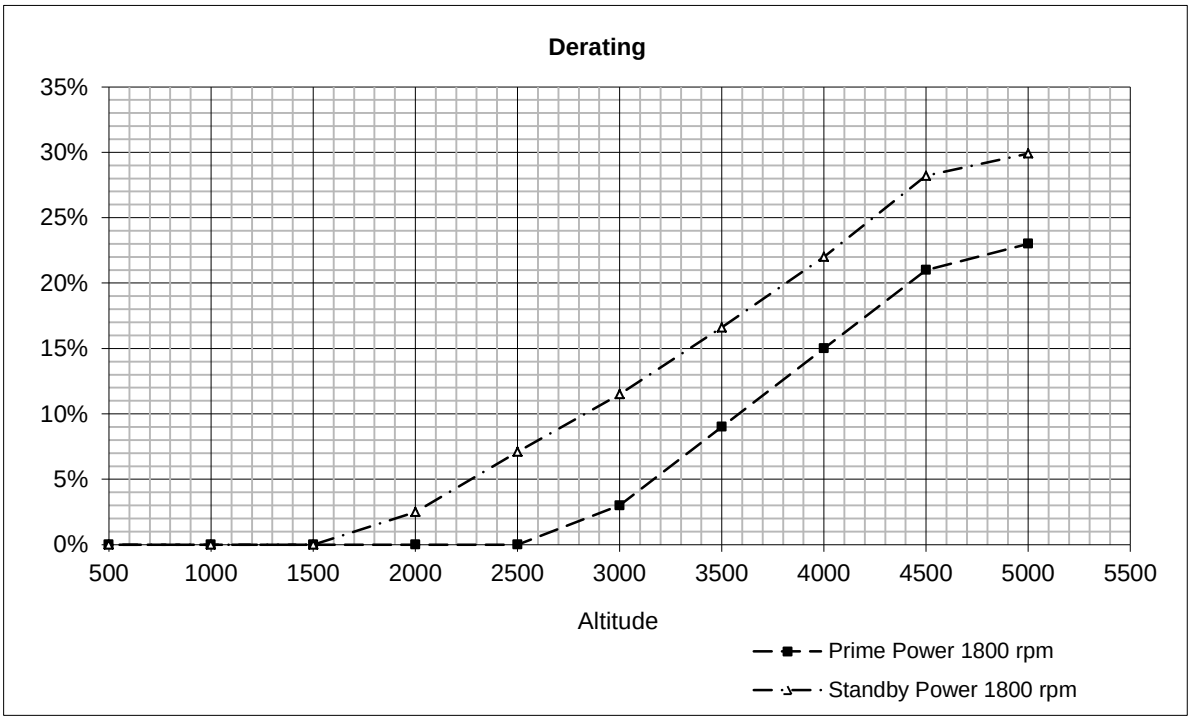
Voltage and type		24V / insulated from earth	
Alternator:	make/output	A	Bosch / 80
	tacho output	Hz/alt. Rev	6
	drive ratio		3,94 : 1
Starter motor		make	Mitsubishi Electric
		type	24V7.0KW12/3.175F
		kW	7,0
Number of teeth on:	flywheel		153
	starter motor		12
Max wiring resistance main circuit		mΩ	
Cranking current at +20°C		A	300
Crank engine speed at 20°C		rpm	155
Starter motor battery capacity:	max	Ah/A	2x225
	min at +5°C	Ah/A	
Inlet manifold heater (at 20 V)		kW	4,0
Power relay for the manifold heater		A	1

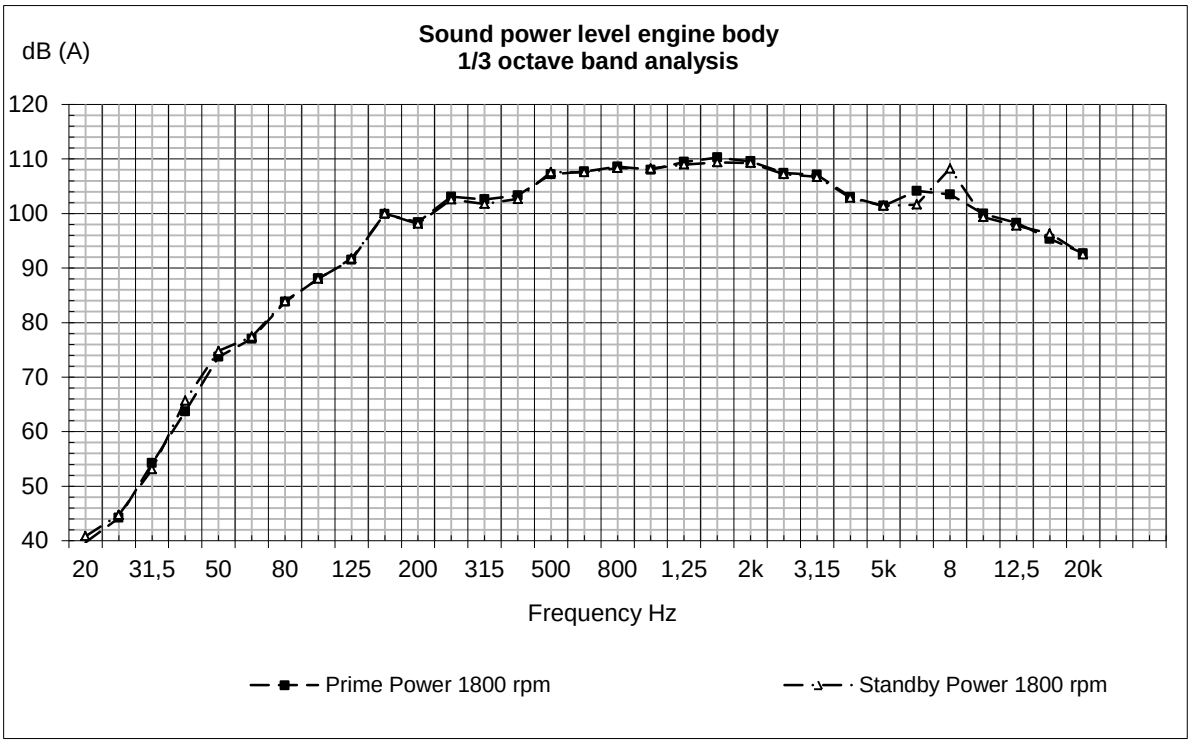
Power take off		**rpm**	**1500**	**1800**
Front end in line with crank shaft max:		Nm	NA	NA
		lbft	NA	NA
Front end belt pulley load. Direction of load viewed from flywheel side:	max left	kW	NA	NA
		hp	NA	NA
	max down	kW	NA	NA
		hp	NA	NA
	max right	kW	NA	NA
		hp	NA	NA
Timing gear at compressor PTO max:		Nm	NA	NA
		lbft	NA	NA
Speed ratio direction of rotation viewed from flywheel side		0,91:1/clockwise		
Timing gear at servo pump PTO max:		Nm	NA	NA
		lbft	NA	NA
Speed ratio direction of rotation viewed from flywheel side		1,58:1/clockwise		
Timing gear at hydraulic pump PTO max:		Nm	NA	NA
		lbft	NA	NA
Speed ratio direction of rotation viewed from flywheel side				
Max allowed bending moment in flywheel housing		Nm	15000	
		lbft	11063	
Max. rear main bearing load		N	NA	NA
		lbf	NA	NA

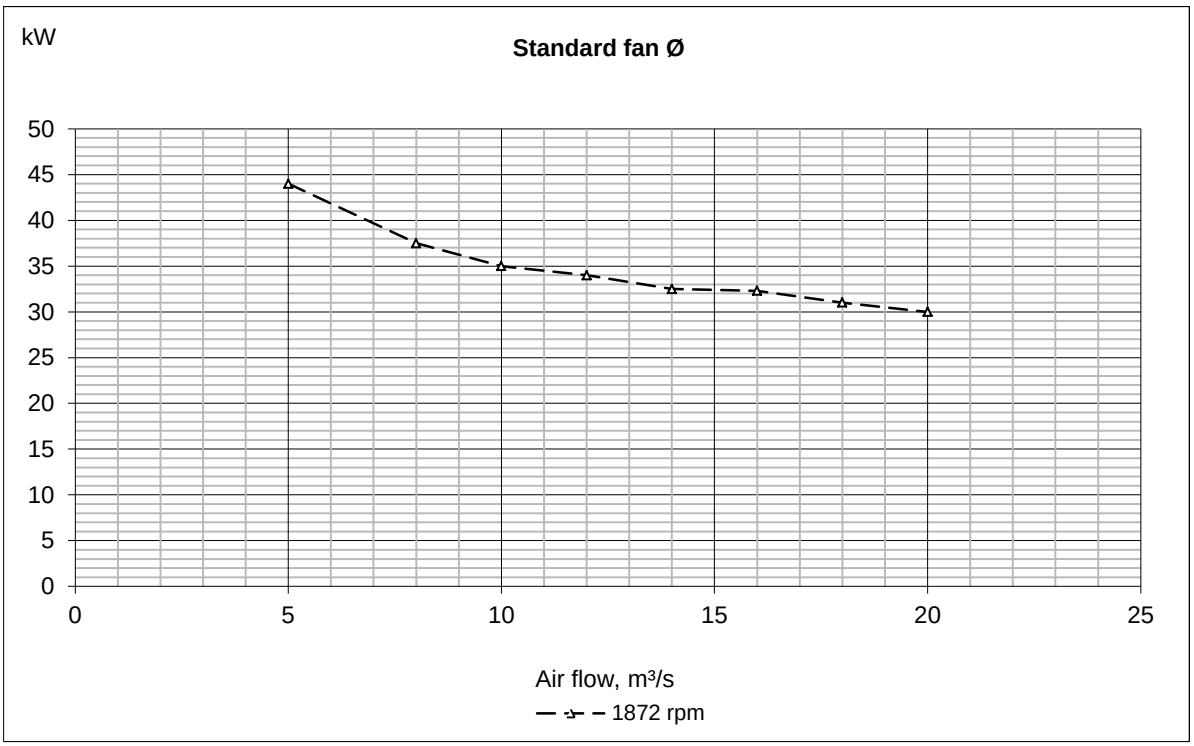

BSU
calculated value
Smoke Emission
(measured according to ISO 10054)
0,06
0,05
0,04
0,03
0,02
0,01
0
0
100
200
300
400
500
600
700
800
kW
Prime Power 1800 rpm
Standby Power 1800 rpm

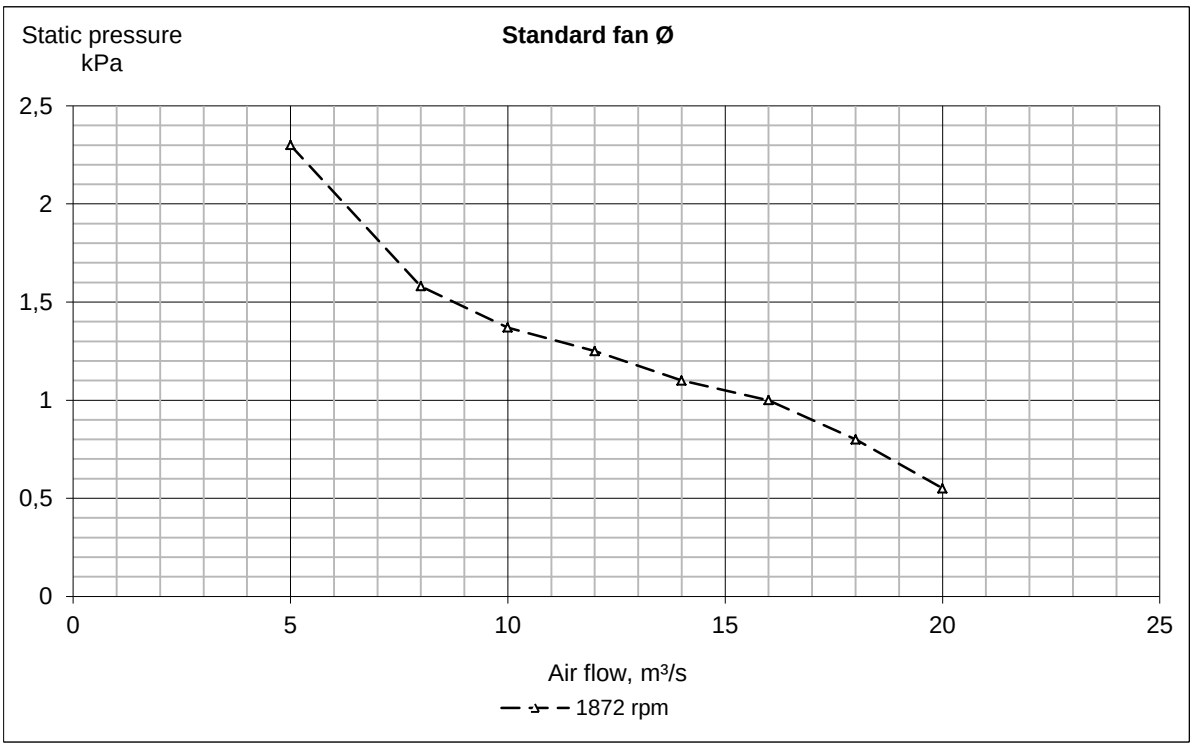

FSN
Smoke Emission
according to ISO 10054
0,16
0,14
0,12
0,1
0,08
0,06
0,04
0,02
0
0
100
200
300
400
500
600
700
800
kW
Prime Power 1800 rpm
Standby Power 1800 rpm


Fuel Consumption
l/h
180
160
140
120
100
80
60
40
20
0
0
100
200
300
400
500
600
700
800
kW
Prime Power 1800 rpm
Standby Power 1800 rpm


Derating
35%
30%
25%
20%
15%
10%
5%
0%
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
Altitude
Prime Power 1800 rpm
Standby Power 1800 rpm


Sound power level engine body
1/3 octave band analysis
dB (A)
120
110
100
90
80
70
60
50
40
20
31,5
50
80
125
200
315
500
800
1,25
2k
3,15
5k
8
12,5
20k
Frequency Hz
Prime Power 1800 rpm
Standby Power 1800 rpm

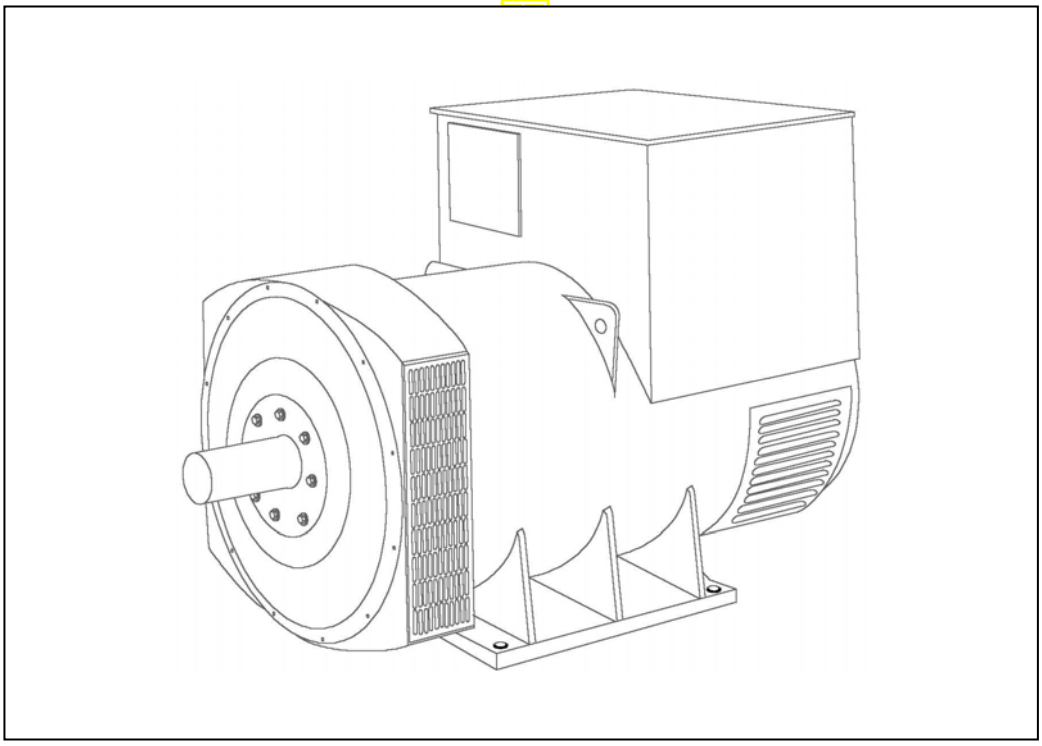

kW
Standard fan Ø
50
45
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
Air flow, m³/s
1872 rpm


Static pressure
kPa
Standard fan Ø
2,5
2
1,5
1
0,5
0
0
5
10
15
20
25
Air flow, m³/s
1872 rpm

STAMFORD®

HCI634G - Winding 311 and 312

Technical Data Sheet



SPECIFICATIONS & OPTIONS
WINDING 311 and 312

STANDARDS

Stamford industrial generators meet the requirements of BS EN 60034 and the relevant section of other international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC34, CSA C22.2-100, AS1359.
Other standards and certifications can be considered on request.

VOLTAGE REGULATORS

MX321 AVR - STANDARD

This sophisticated Automatic Voltage Regulator (AVR) is incorporated into the Stamford Permanent Magnet Generator (PMG) system and is fitted as standard to generators of this type.
The PMG provides power via the AVR to the main exciter, giving a source of constant excitation power independent of generator output. The main exciter output is then fed to the main rotor, through a full wave bridge, protected by a surge suppressor. The AVR has in-built protection against sustained over-excitation, caused by internal or external faults. This de-excites the machine after a minimum of 5 seconds.
Over voltage protection is built-in and short circuit current level adjustments is an optional facility.

WINDINGS & ELECTRICAL PERFORMANCE

All generator stators are wound to 2/3 pitch. This eliminates triplen (3rd, 9th, 15th …) harmonics on the voltage waveform and is found to be the optimum design for trouble-free supply of non-linear loads. The 2/3 pitch design avoids excessive neutral currents sometimes seen with higher winding pitches, when in parallel with the mains. A fully connected damper winding reduces oscillations during paralleling. This winding, with the 2/3 pitch and carefully selected pole and tooth designs, ensures very low waveform distortion.

TERMINALS & TERMINAL BOX

Standard generators feature a main stator with either 6 ends (Winding 312) or 12 ends (Winding 311) brought out to the terminals, which are mounted on the frame at the non-drive end of the generator. A sheet steel terminal box contains the AVR and provides ample space for the customers' wiring and gland arrangements. It has removable panels for easy access.

SHAFT & KEYS

All generator rotors are dynamically balanced to better than BS6861:Part 1 Grade 2.5 for minimum vibration in operation. Two bearing generators are balanced with a half key.

INSULATION/IMPREGNATION

The insulation system is class 'H'.
All wound components are impregnated with materials and processes designed specifically to provide the high build required for static windings and the high mechanical strength required for rotating components.

QUALITY ASSURANCE

Generators are manufactured using production procedures having a quality assurance level to BS EN ISO 9001.

The stated voltage regulation may not be maintained in the presence of certain radio transmitted signals. Any change in performance will fall within the limits of Criteria 'B' of EN 61000-6-2:2001. At no time will the steady-state voltage regulation exceed 2%.

DE RATES

All values tabulated on page 8 are subject to the following reductions

5% when air inlet filters are fitted.
10% when IP44 Filters are fitted.
3% for every 500 metres by which the operating altitude exceeds 1000 metres above mean sea level.
3% for every 5°C by which the operational ambient temperature exceeds 40°C.
Note: Requirement for operating in an ambient exceeding 60°C must be referred to the factory.

NB Continuous development of our products entitles us to change specification details without notice, therefore they must not be regarded as binding.

Front cover drawing typical of product range.

HCI634G

STAMFORD

WINDING 311 and 312

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.	
A.V.R.	MX321	
VOLTAGE REGULATION	± 0.5 %	With 4% ENGINE GOVERNING
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVES (page 7)	

INSULATION SYSTEM	CLASS H							
PROTECTION	IP23							
RATED POWER FACTOR	0.8							
STATOR WINDING	DOUBLE LAYER LAP							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	6 (Wdg 312) or 12 (Wdg 311)							
STATOR WDG. RESISTANCE	0.003 Ohms PER PHASE AT 22°C STAR CONNECTED							
ROTOR WDG. RESISTANCE	1.75 Ohms at 22°C							
EXCITER STATOR RESISTANCE	17 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.079 Ohms PER PHASE AT 22°C							
R.F.I. SUPPRESSION	BS EN 61000-6-2 & BS EN 61000-6-4,VDE 0875G, VDE 0875N. refer to factory for others							
WAVEFORM DISTORTION	NO LOAD < 1.5% NON-DISTORTING BALANCED LINEAR LOAD < 5.0%							
MAXIMUM OVERSPEED	2250 Rev/Min							
BEARING DRIVE END	BALL. 6224 (ISO)							
BEARING NON-DRIVE END	BALL. 6317 (ISO)							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	1965 kg				1989 kg			
WEIGHT WOUND STATOR	934 kg				934 kg			
WEIGHT WOUND ROTOR	814 kg				766 kg			
WR² INERTIA	18.3482 kgm^2				17.8009 kgm^2			
SHIPPING WEIGHTS in a crate	2023kg				2029kg			
PACKING CRATE SIZE	183 x 92 x 140(cm)				183 x 92 x 140(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	1.614 m³/sec 3420 cfm				1.961 m³/sec 4156 cfm			
VOLTAGE STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
VOLTAGE PARALLEL STAR (*)	190/110	200/115	208/120	220/127	208/120	220/127	230/133	240/138
VOLTAGE DELTA	220	230	240	254	240	254	266	277
kVA BASE RATING FOR REACTANCE VALUES	800	800	800	800	875	925	963	1000
Xd DIR. AXIS SYNCHRONOUS	3.14	2.83	2.63	2.34	3.53	3.34	3.18	3.03
X'd DIR. AXIS TRANSIENT	0.25	0.23	0.21	0.19	0.28	0.26	0.25	0.24
X"d DIR. AXIS SUBTRANSIENT	0.18	0.16	0.15	0.13	0.21	0.20	0.19	0.18
Xq QUAD. AXIS REACTANCE	1.88	1.70	1.58	1.40	2.10	1.98	1.89	1.80
X"q QUAD. AXIS SUBTRANSIENT	0.21	0.19	0.18	0.16	0.24	0.23	0.22	0.21
X_L LEAKAGE REACTANCE	0.10	0.09	0.08	0.07	0.12	0.11	0.10	0.10
X_2 NEGATIVE SEQUENCE	0.22	0.20	0.19	0.17	0.24	0.23	0.22	0.21
X_0 ZERO SEQUENCE	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							

T'd TRANSIENT TIME CONST.	0.185
T"d SUB-TRANSTIME CONST.	0.025
T'do O.C. FIELD TIME CONST.	2.35
Ta ARMATURE TIME CONST.	0.04
SHORT CIRCUIT RATIO	1/Xd

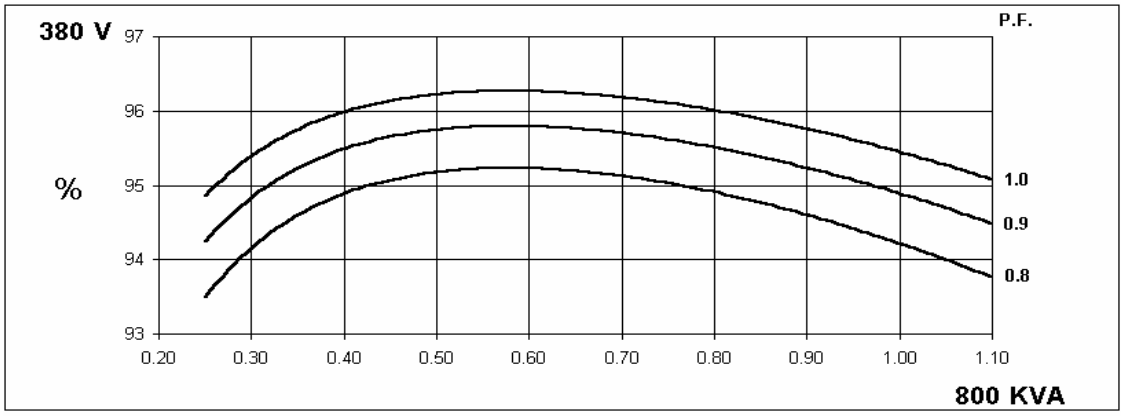
(*) Parallel Star connection only available with Wdg 311

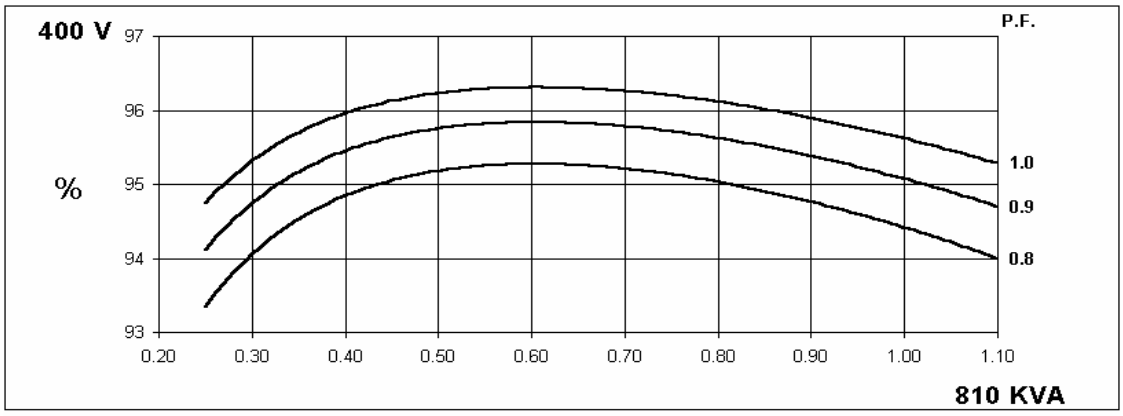
50 Hz

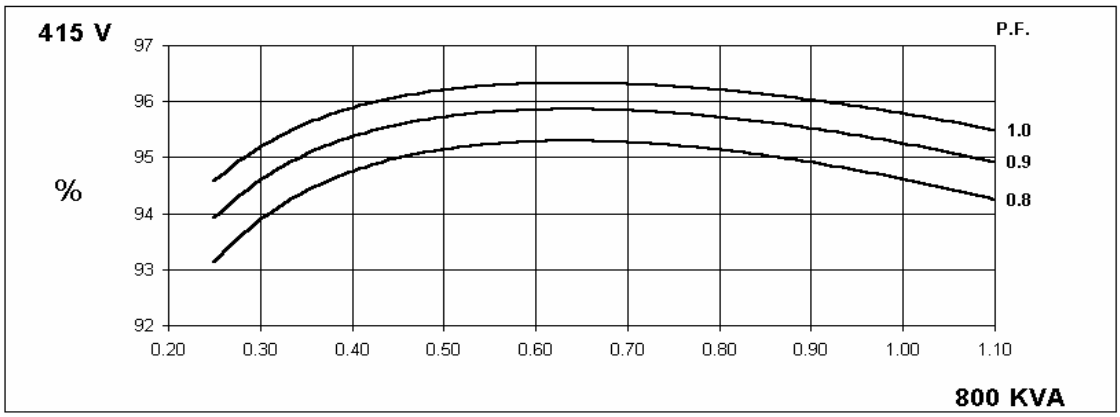
HCI634G

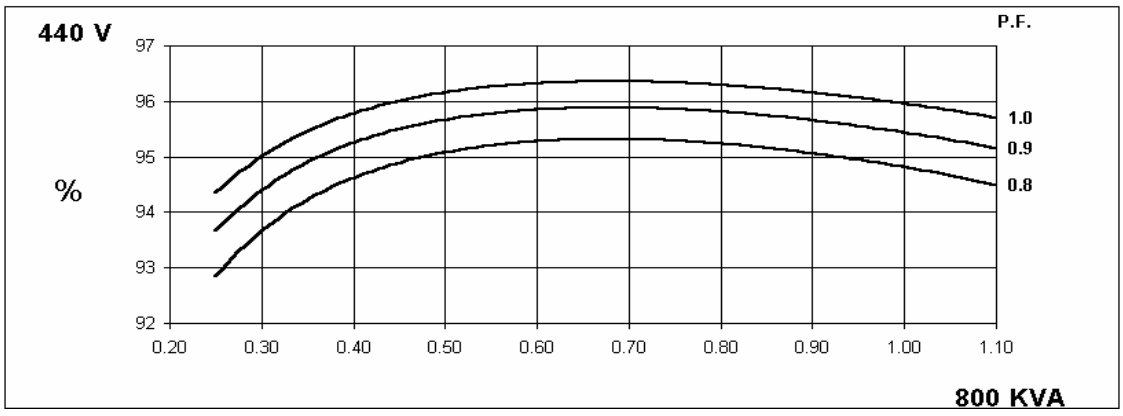
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES







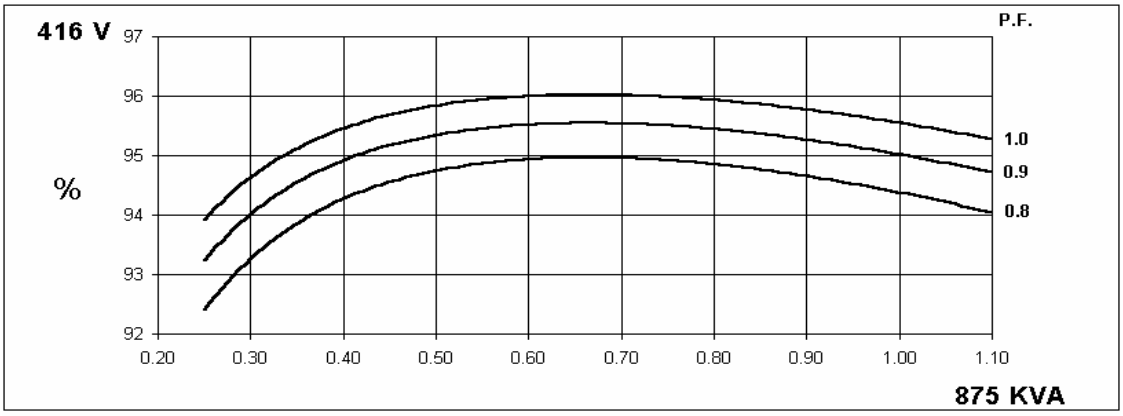


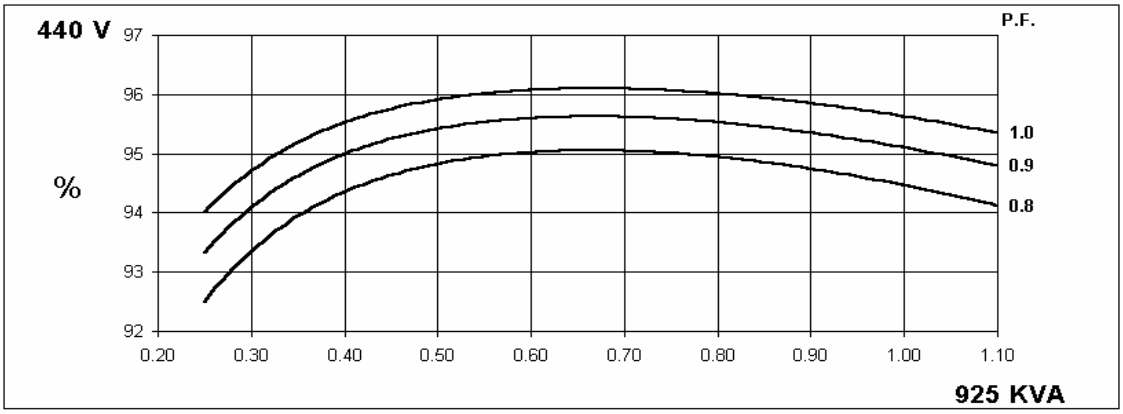
60 Hz

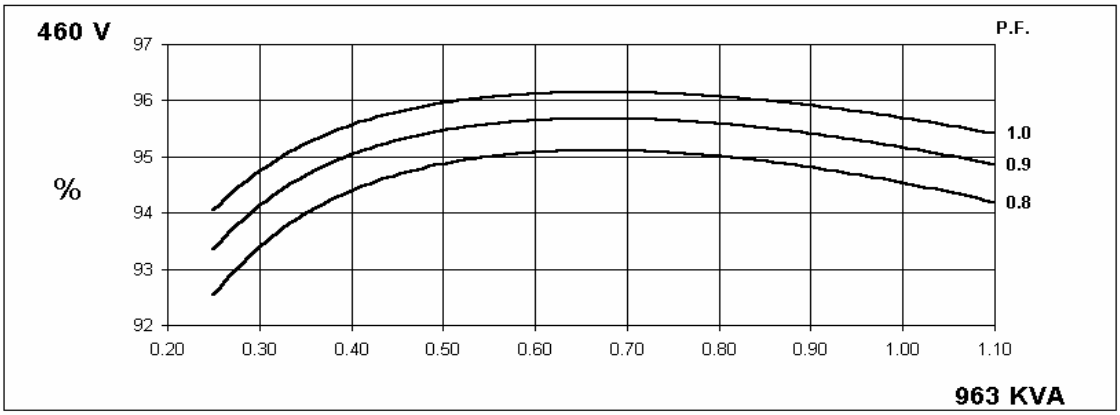
HCI634G

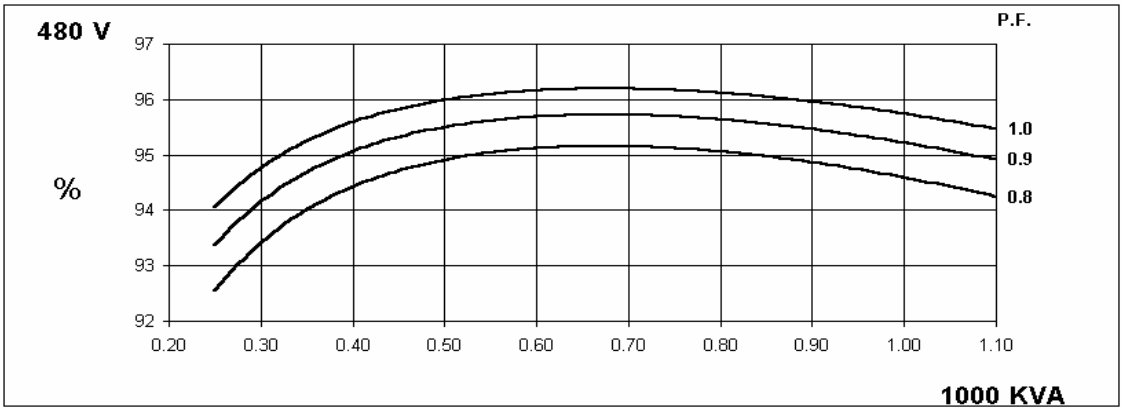
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES

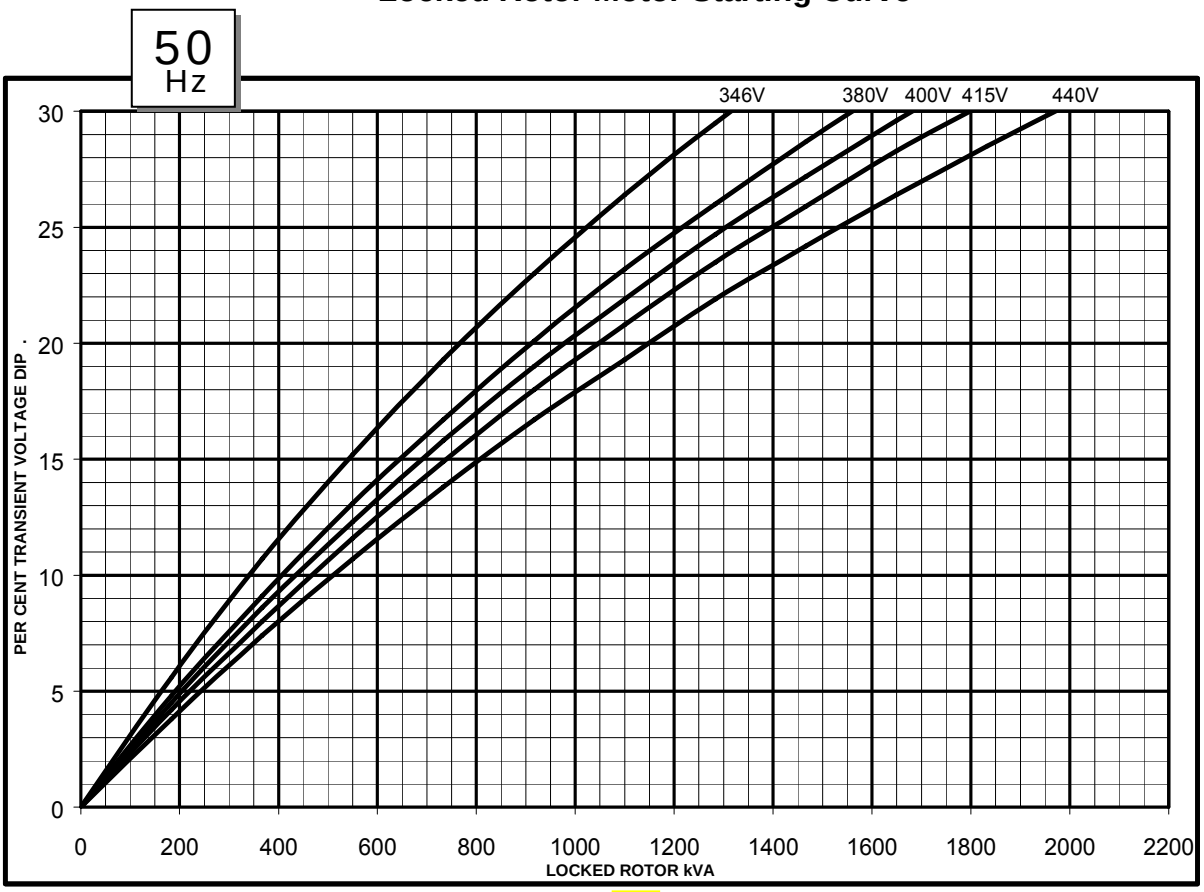


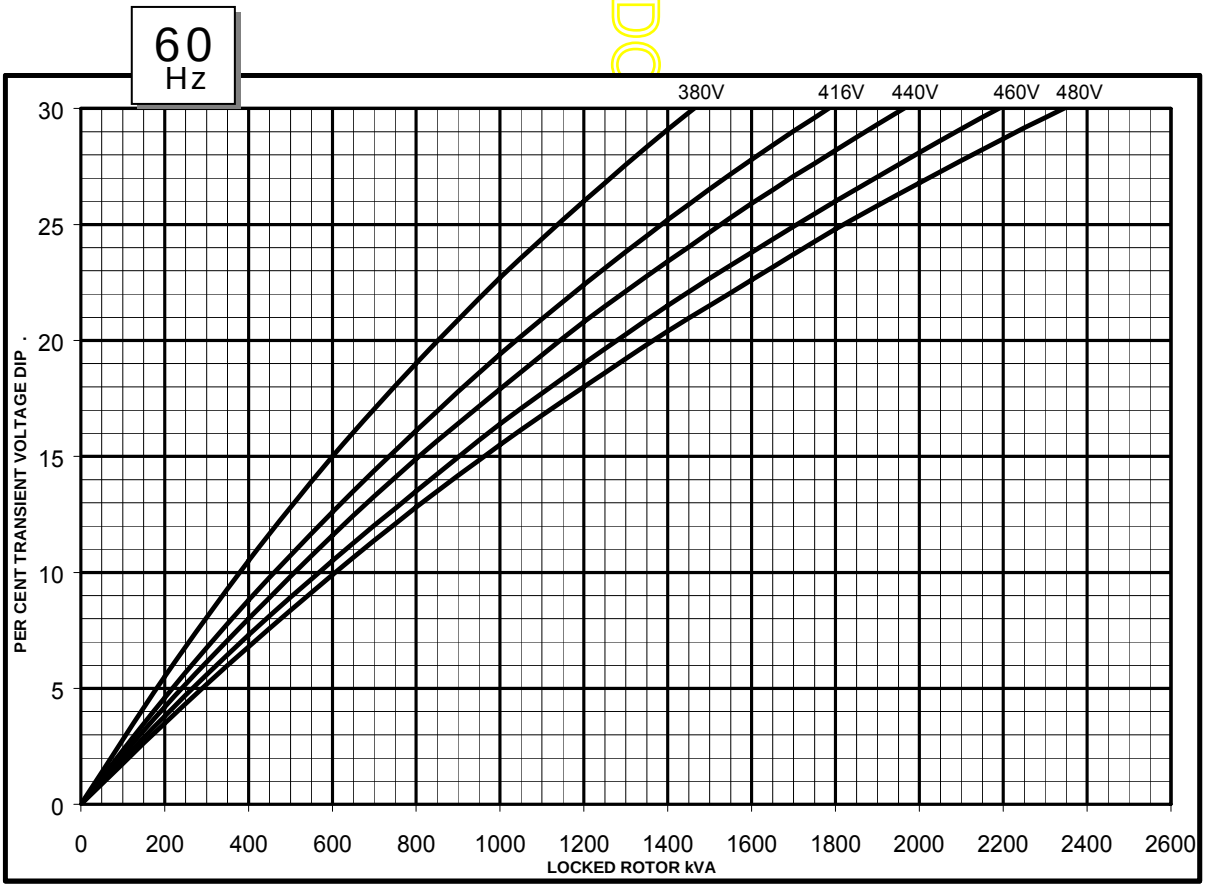






Locked Rotor Motor Starting Curve





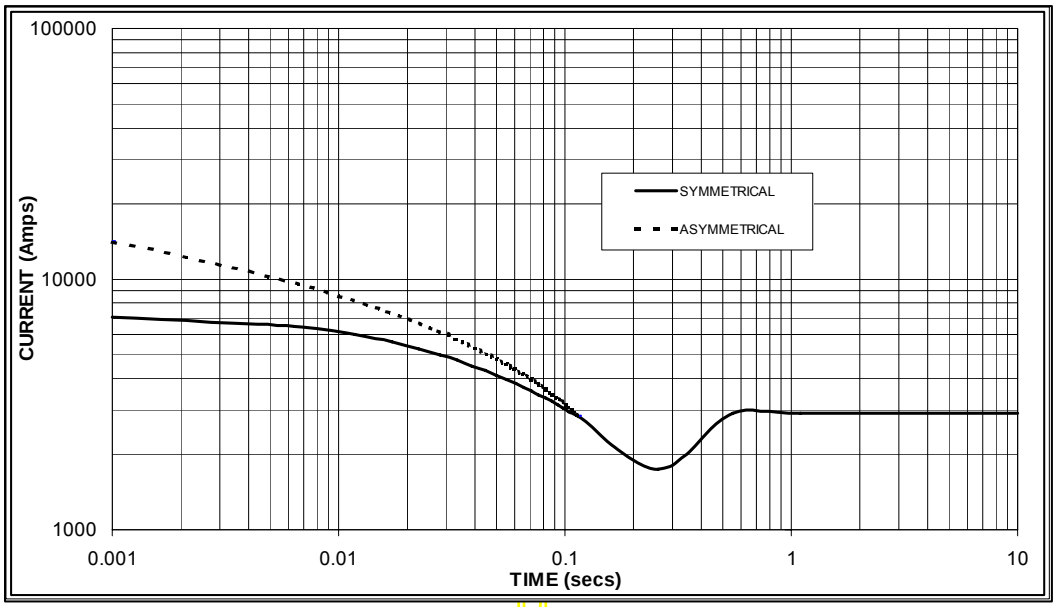
STAMFORD

WINDING 311 and 312

Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed

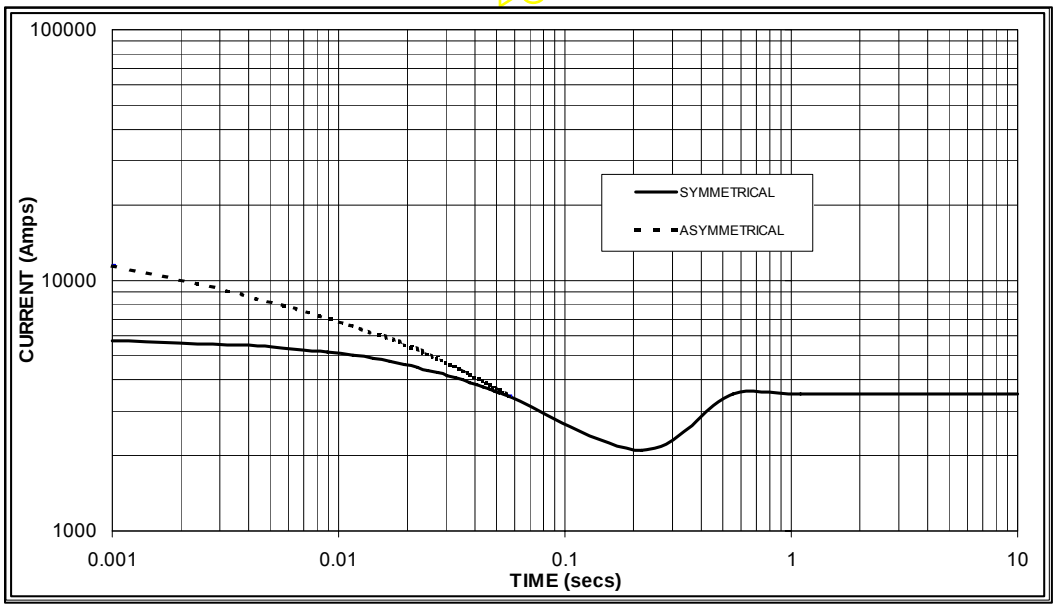
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 2,900 Amps

60 Hz



Sustained Short Circuit = 3,500 Amps

Note 1

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

50Hz		60Hz	
Voltage	Factor	Voltage	Factor
380v	X 1.00	416v	x 1.00
400v	X 1.07	440v	x 1.06
415v	X 1.12	460v	x 1.12
440v	X 1.18	480v	x 1.17

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For Delta connection multiply the Curve current value by 1.732

HCI634G

STAMFORD

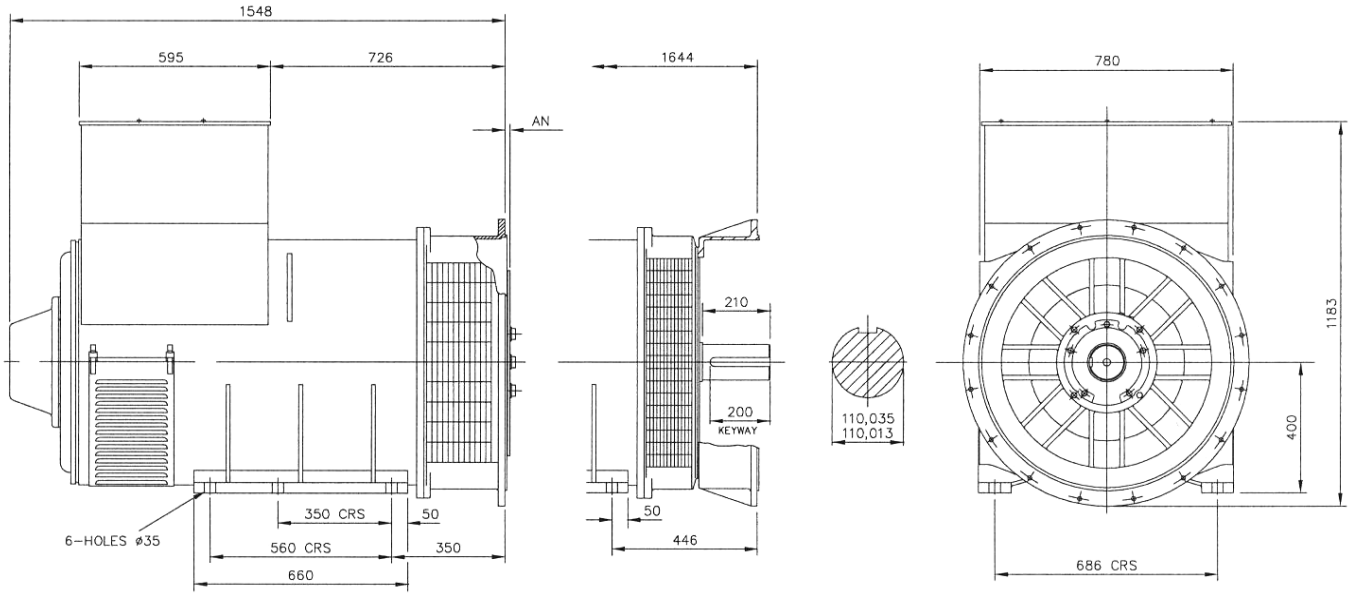
Winding 311 and 312 0.8 Power Factor

RATINGS

Class - Temp Rise		Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
50Hz	Star (V)	380	400	415	440	380	400	415	440	380	400	415	440	380	400	415	440
	Parallel Star (V) *	180	200	208	220	180	200	208	220	180	200	208	220	180	200	208	220
	Delta (V)	220	230	240	254	220	230	240	254	220	230	240	254	220	230	240	254
	kVA	750	760	750	750	800	810	800	800	825	830	825	820	850	860	850	850
	kW	600	608	600	600	640	648	640	640	660	664	660	656	680	688	680	680
	Efficiency (%)	94.5	94.6	94.8	95.0	94.2	94.4	94.6	94.8	94.1	94.3	94.5	94.7	93.9	94.2	94.4	94.6
	kW Input	635	643	633	632	679	686	677	675	702	704	698	693	724	730	720	719
60Hz	Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	Parallel Star (V) *	208	220	230	240	208	220	230	240	208	220	230	240	208	220	230	240
	Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	813	844	888	913	875	925	963	1000	913	969	1008	1046	950	1000	1044	1088
	kW	650	675	710	730	700	740	770	800	730	775	806	837	760	800	835	870
	Efficiency (%)	94.6	94.7	94.8	94.8	94.4	94.5	94.5	94.6	94.2	94.3	94.4	94.4	94.1	94.2	94.3	94.3
	kW Input	688	713	749	770	742	783	815	846	775	822	854	886	808	849	886	923

* Parallel Star only available with Wdg 311

DIMENSIONS



SAE	14	18	21	24
AN	25.4	15.87	0	0

APPROVED DOCUMENT

STAMFORD

Head Office Address:
Barnack Road, Stamford
Lincolnshire, PE9 2NB
United Kingdom
Tel: +44 (0) 1780 484000
Fax: +44 (0) 1780 484100

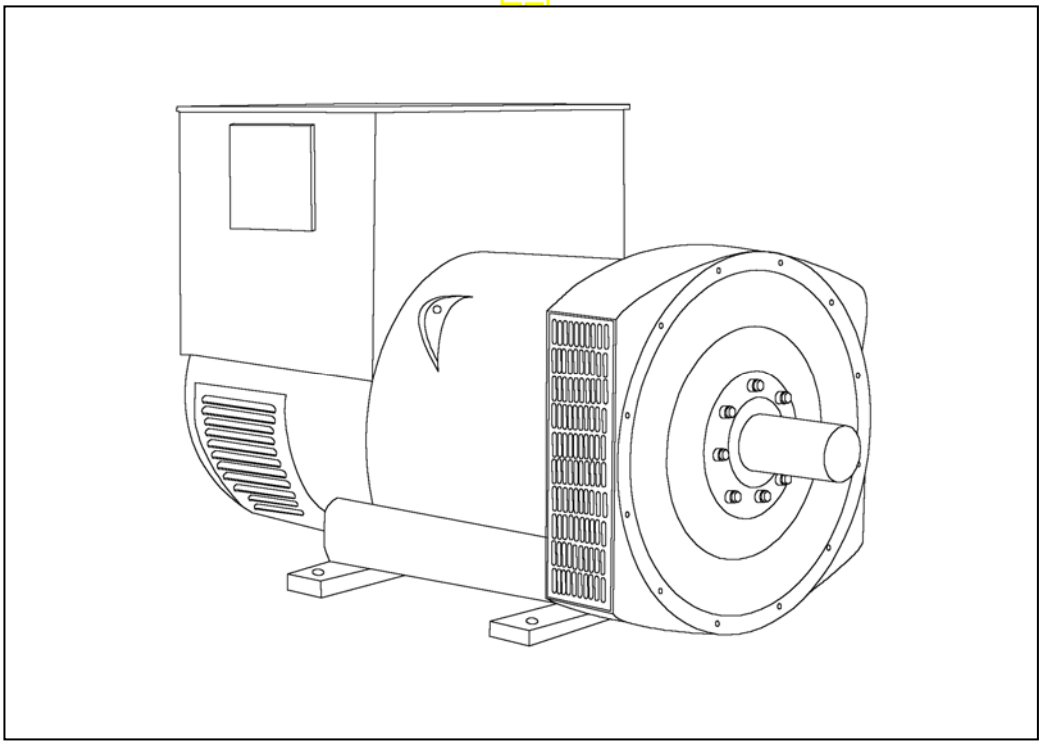
www.cumminsgeneratortechnologies.com

HCI6G-311-312-TD-EN-SG-A

STAMFORD®

HCI 534F/544F - Winding 311

Technical Data Sheet



SPECIFICATIONS & OPTIONS

STANDARDS

Stamford industrial generators meet the requirements of BS EN 60034 and the relevant section of other international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC34, CSA C22.2 100, AS1359.
Other standards and certifications can be considered on request.

VOLTAGE REGULATORS

AS440 AVR - STANDARD

With this self-excited system the main stator provides power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semi-conductors of the AVR ensure positive build-up from initial low levels of residual voltage.
The exciter rotor output is fed to the main rotor through a three-phase full-wave bridge rectifier. The rectifier is protected by a surge suppressor against surges caused, for example, by short circuit or out-of-phase paralleling.
The AS440 will support a range of electronic accessories, including a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.

MX341 AVR

This sophisticated AVR is incorporated into the Stamford Permanent Magnet Generator (PMG) control system.
The PMG provides power via the AVR to the main exciter, giving a source of constant excitation power independent of generator output. The main exciter output is then fed to the main rotor, through a full wave bridge, protected by a surge suppressor.
The AVR has in-built protection against sustained over-excitation, caused by internal or external faults. This de-excites the machine after a minimum of 5 seconds.
An engine relief load acceptance feature can enable full load to be applied to the generator in a single step.
If three-phase sensing is required with the PMG system the MX321 AVR must be used.
We recommend three-phase sensing for applications with greatly unbalanced or highly non-linear loads.

MX321 AVR

The most sophisticated of all our AVRs combines all the features of the MX341 with, additionally, three-phase rms sensing, for improved regulation and performance.
Over voltage protection is built-in and short circuit current level adjustments is an optional facility.

WINDINGS & ELECTRICAL PERFORMANCE

All generator stators are wound to 2/3 pitch. This eliminates triplen (3rd, 9th, 15th …) harmonics on the voltage waveform and is found to be the optimum design for trouble-free supply of non-linear loads. The 2/3 pitch design avoids excessive neutral currents sometimes seen with higher winding pitches, when in parallel with the mains. A fully connected damper winding reduces oscillations during paralleling. This winding, with the 2/3 pitch and carefully selected pole and tooth designs, ensures very low waveform distortion.

TERMINALS & TERMINAL BOX

Standard generators are 3-phase reconnectable with 12 ends brought out to the terminals, which are mounted on a cover at the non-drive end of the generator. A sheet steel terminal box contains the AVR and provides ample space for the customers' wiring and gland arrangements. It has removable panels for easy access.

SHAFT & KEYS

All generator rotors are dynamically balanced to better than BS6861:Part 1 Grade 2.5 for minimum vibration in operation. Two bearing generators are balanced with a half key.

INSULATION/IMPREGNATION

The insulation system is class 'H'.
All wound components are impregnated with materials and processes designed specifically to provide the high build required for static windings and the high mechanical strength required for rotating components.

QUALITY ASSURANCE

Generators are manufactured using production procedures having a quality assurance level to BS EN ISO 9001.

The stated voltage regulation may not be maintained in the presence of certain radio transmitted signals. Any change in performance will fall within the limits of Criteria 'B' of EN 61000-6-2:2001. At no time will the steady-state voltage regulation exceed 2%.

DE RATES

All values tabulated on page 8 are subject to the following reductions

5% when air inlet filters are fitted.
3% for every 500 metres by which the operating altitude exceeds 1000 metres above mean sea level.
3% for every 5°C by which the operational ambient temperature exceeds 40°C.
Note: Requirement for operating in an ambient exceeding 60°C must be referred to the factory.

NB Continuous development of our products entitles us to change specification details without notice, therefore they must not be regarded as binding.

Front cover drawing typical of product range.

WINDING 311

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX321	MX341	
VOLTAGE REGULATION	± 0.5 %	± 1.0 %	With 4% ENGINE GOVERNING
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVES (page 7)		

CONTROL SYSTEM	SELF EXCITED	
A.V.R.	AS440	
VOLTAGE REGULATION	± 1.0 %	With 4% ENGINE GOVERNING
SUSTAINED SHORT CIRCUIT	SERIES 4 CONTROL DOES NOT SUSTAIN A SHORT CIRCUIT CURRENT	

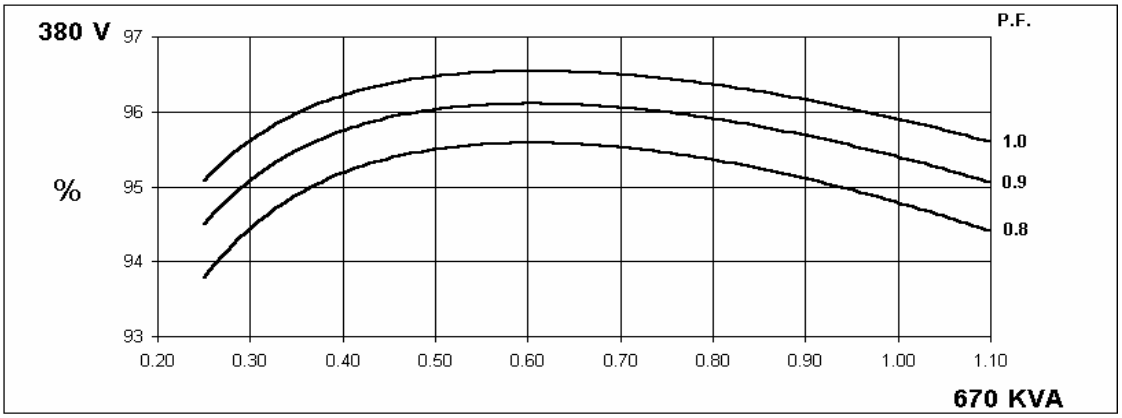
INSULATION SYSTEM	CLASS H						
PROTECTION	IP23						
RATED POWER FACTOR	0.8						
STATOR WINDING	DOUBLE LAYER LAP						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.0037 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	2.16 Ohms at 22°C						
EXCITER STATOR RESISTANCE	17 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.092 Ohms PER PHASE AT 22°C						
R.F.I. SUPPRESSION	BS EN 61000-6-2 & BS EN 61000-6-4,VDE 0875G, VDE 0875N. refer to factory for others						
WAVEFORM DISTORTION	NO LOAD < 1.5% NON-DISTORTING BALANCED LINEAR LOAD < 5.0%						
MAXIMUM OVERSPEED	2250 Rev/Min						
BEARING DRIVE END	BALL. 6220 (ISO)						
BEARING NON-DRIVE END	BALL. 6314 (ISO)						
	1 BEARING				2 BEARING		
WEIGHT COMP. GENERATOR	1685 kg				1694 kg		
WEIGHT WOUND STATOR	805 kg				805 kg		
WEIGHT WOUND ROTOR	684 kg				655 kg		
WR² INERTIA	10.033 kgm²				9.7551 kgm²		
SHIPPING WEIGHTS in a crate	1775 kg				1780kg		
PACKING CRATE SIZE	166 x 87 x 124(cm)				166 x 87 x 124(cm)		
	50 Hz				60 Hz		
TELEPHONE INTERFERENCE	THF<2%				TIF<50		
COOLING AIR	1.035 m³/sec 2202 cfm				1.312 m³/sec 2780 cfm		
VOLTAGE SERIES STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
VOLTAGE PARALLEL STAR	190/110	200/115	208/120	220/127	208/120	220/127	230/133	240/138
VOLTAGE SERIES DELTA	220/110	230/115	240/120	254/127	240/120	254/127	266/133	277/138
kVA BASE RATING FOR REACTANCE VALUES	670	670	670	650	738	775	800	825
Xd DIR. AXIS SYNCHRONOUS	2.90	2.62	2.43	2.10	3.33	3.13	2.95	2.80
X'd DIR. AXIS TRANSIENT	0.16	0.14	0.13	0.11	0.16	0.15	0.14	0.13
X"d DIR. AXIS SUBTRANSIENT	0.11	0.10	0.09	0.08	0.11	0.10	0.10	0.09
Xq QUAD. AXIS REACTANCE	2.42	2.19	2.03	1.75	2.66	2.50	2.36	2.23
X"q QUAD. AXIS SUBTRANSIENT	0.25	0.23	0.21	0.18	0.31	0.29	0.27	0.26
X_L LEAKAGE REACTANCE	0.05	0.04	0.04	0.03	0.05	0.05	0.04	0.04
X_2 NEGATIVE SEQUENCE	0.18	0.16	0.15	0.13	0.21	0.20	0.19	0.18
X_0 ZERO SEQUENCE	0.08	0.08	0.07	0.06	0.09	0.08	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED						
T'd TRANSIENT TIME CONST.	0.08s						
T"d SUB-TRANSTIME CONST.	0.012s						
T'do O.C. FIELD TIME CONST.	2.5s						
Ta ARMATURE TIME CONST.	0.019s						
SHORT CIRCUIT RATIO	1/Xd						

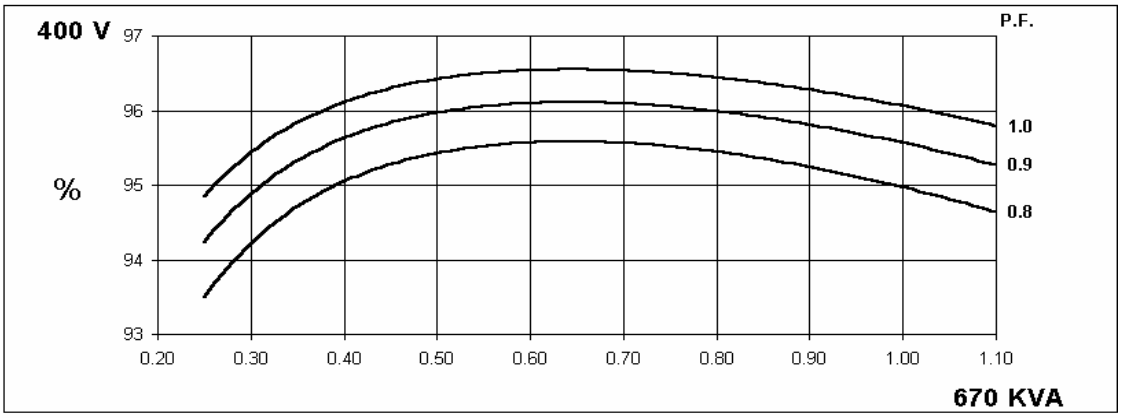
50 Hz

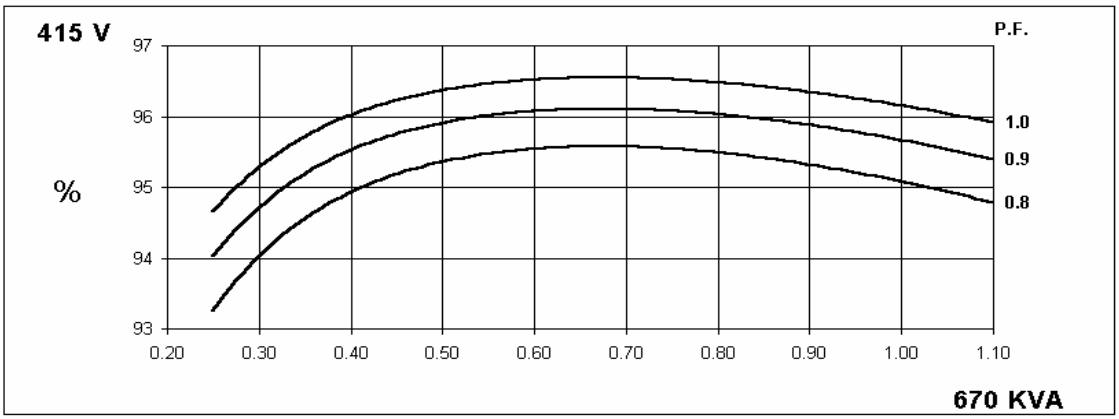
HCI534F/544F

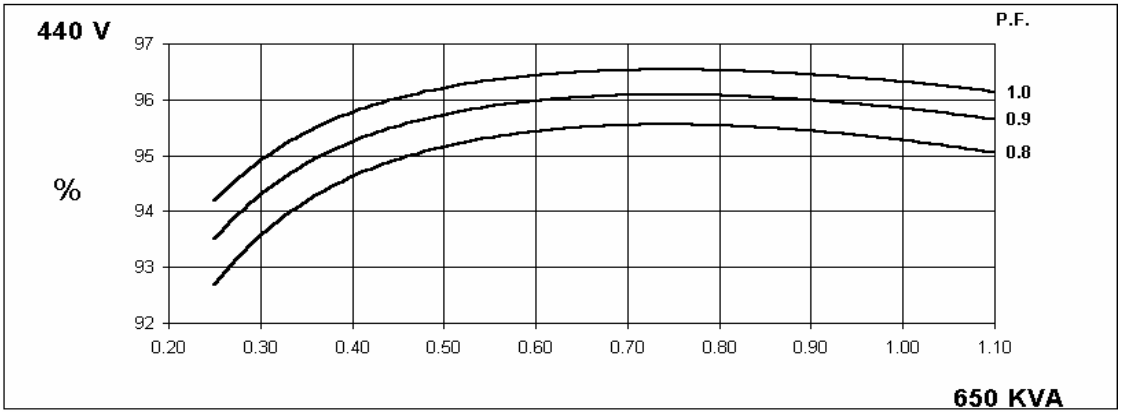
Winding 311

THREE PHASE EFFICIENCY CURVES







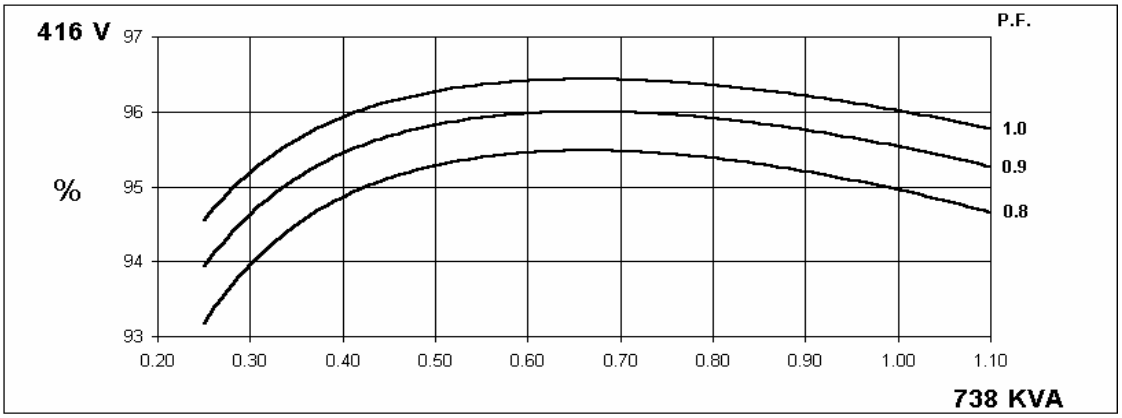


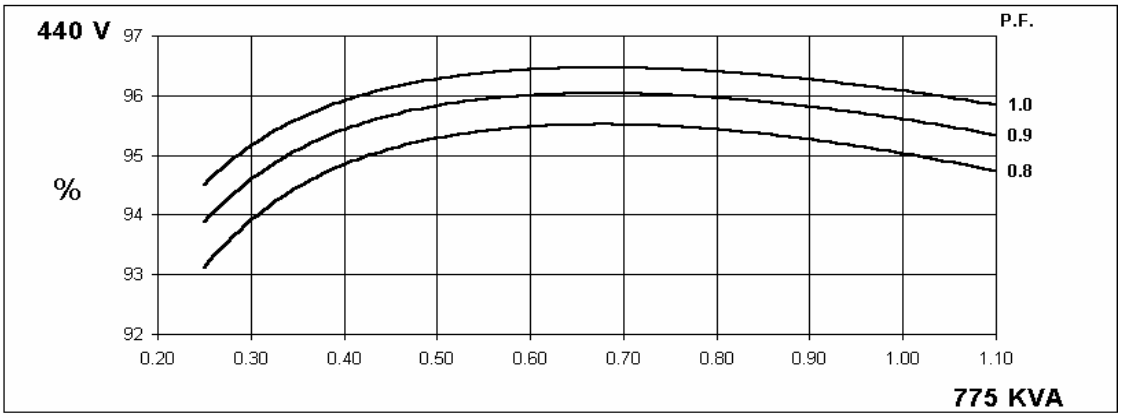
60 Hz

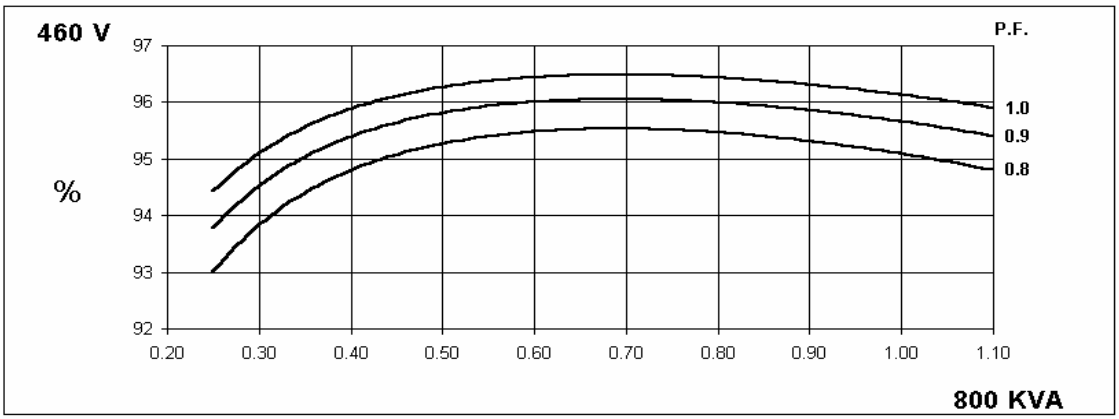
HCI534F/544F

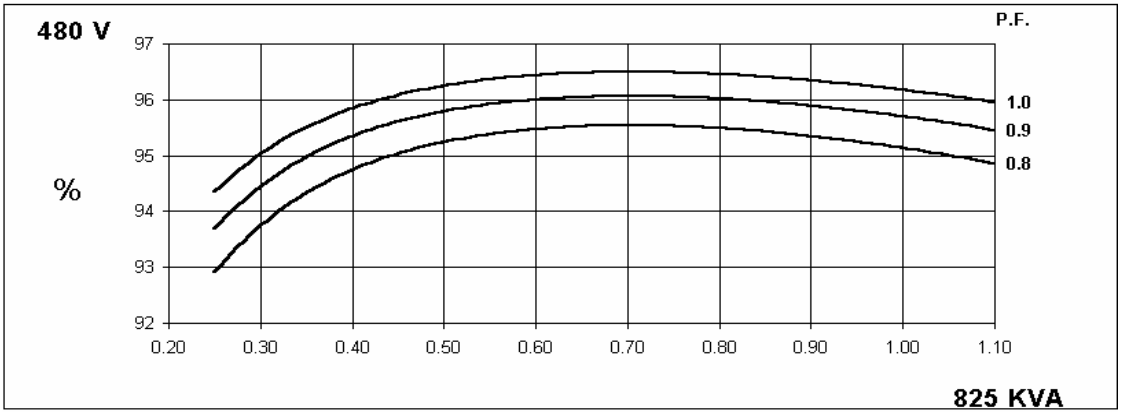
Winding 311

THREE PHASE EFFICIENCY CURVES









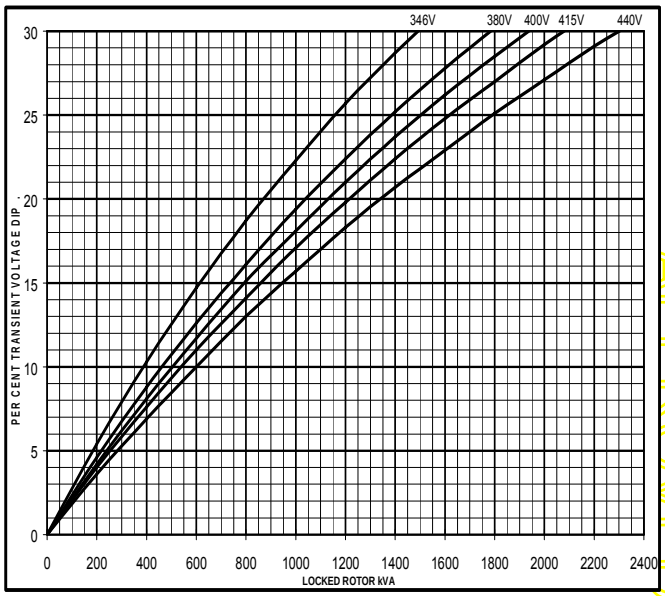
HCI534F/544F

Winding 311

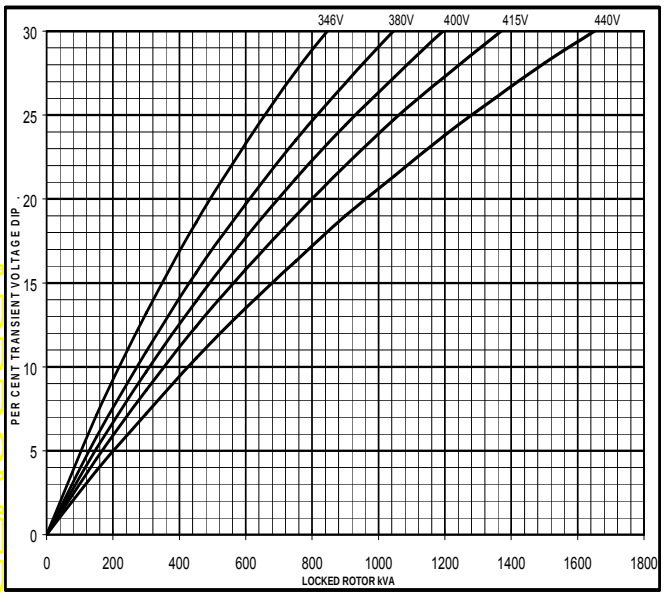
Locked Rotor Motor Starting Curve

50 Hz

MX

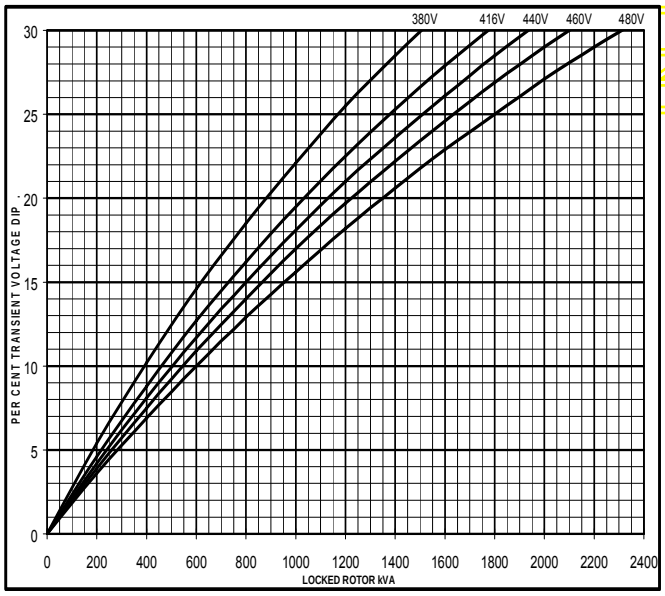


SX

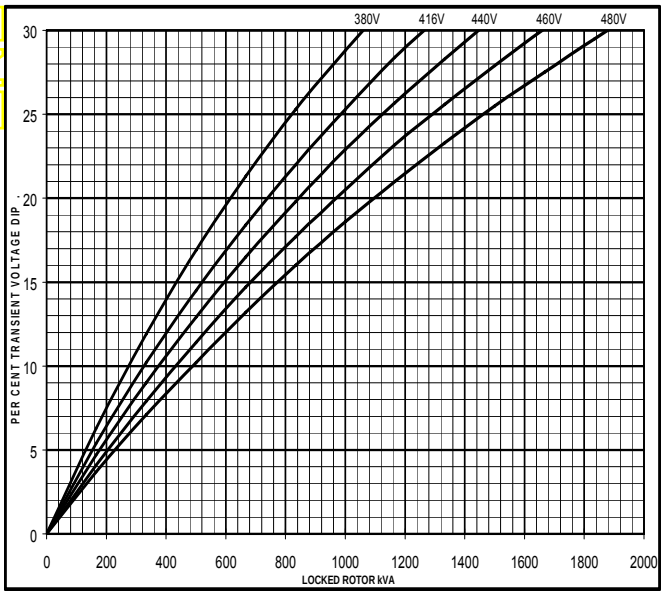


60 Hz

MX

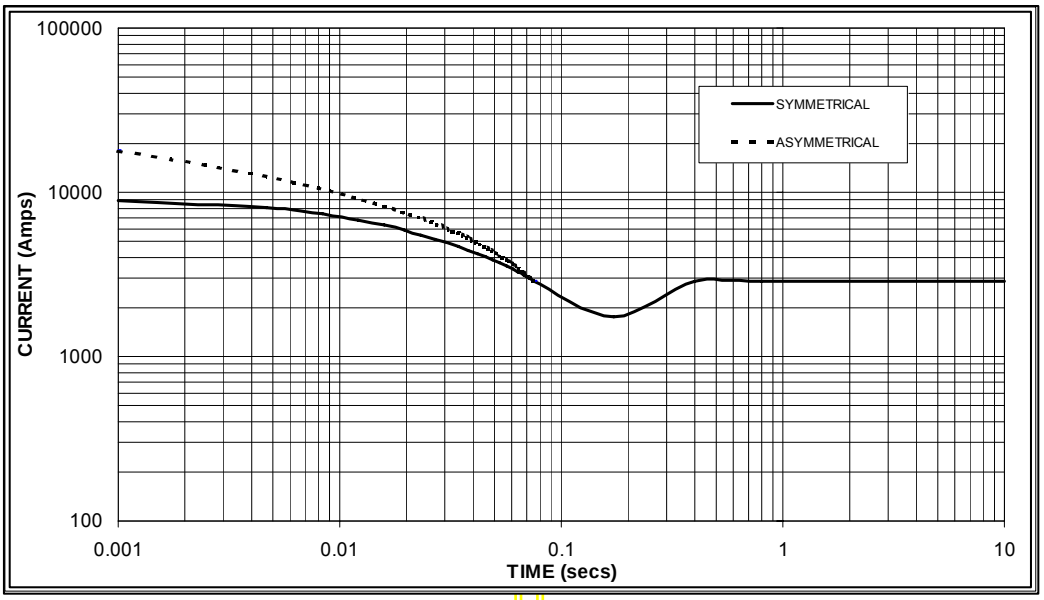


SX



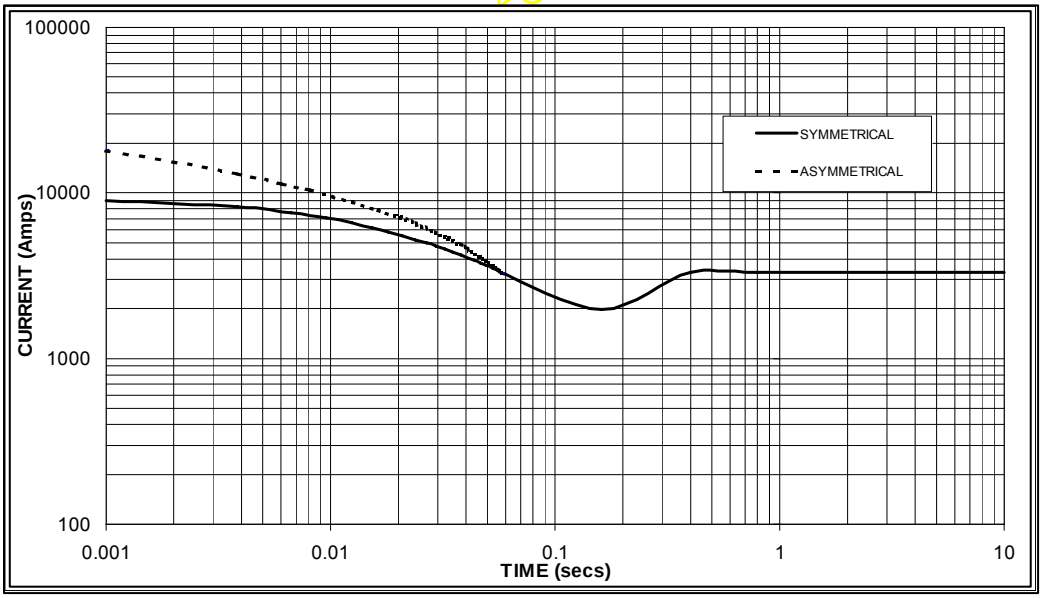
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 2,900 Amps

60 Hz



Sustained Short Circuit = 3,300 Amps

Note 1

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

50Hz		60Hz	
Voltage	Factor	Voltage	Factor
380v	X 1.00	416v	X 1.00
400v	X 1.06	440v	X 1.06
415v	X 1.09	460v	X 1.12
440v	X 1.12	480v	X 1.20

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connections the following multipliers should be applied to current values as shown :

Parallel Star = Curve current value X 2

Series Delta = Curve current value X 1.732

HCI534F/544F

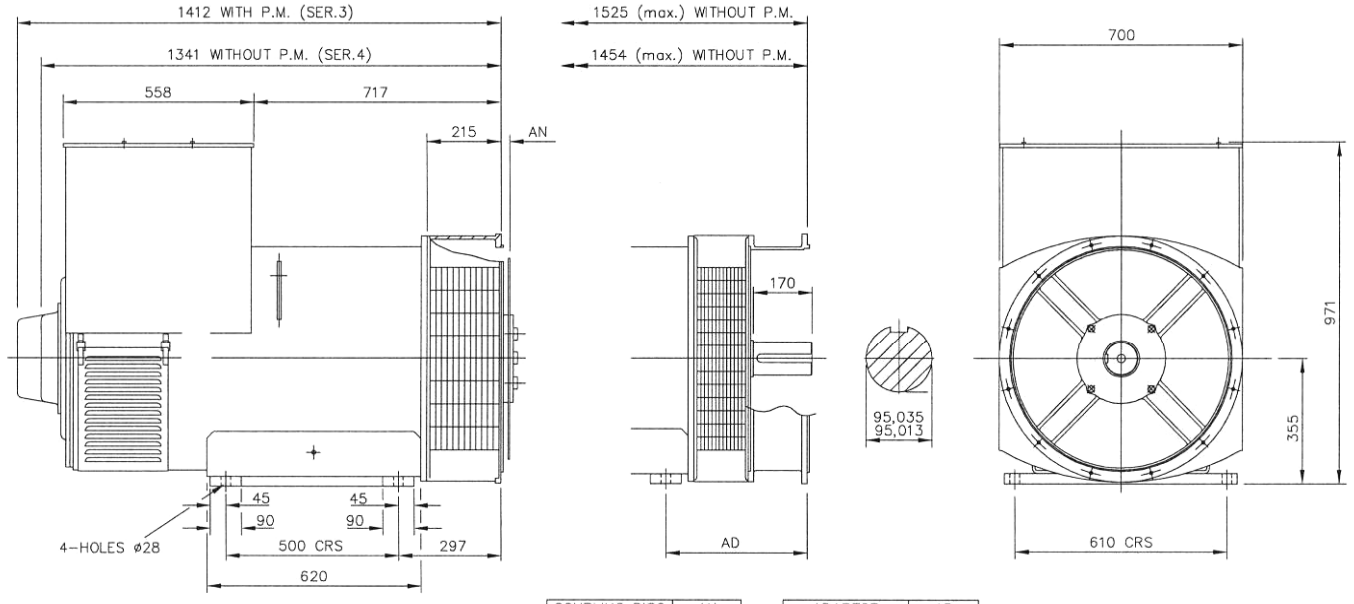
Winding 311 0.8 Power Factor

STAMFORD

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
50 Hz	Series Star (V)	380	400	415	440	380	400	415	440	380	400	415	440	380	400	415	440
	Parallel Star (V)	190	200	208	220	190	200	208	220	190	200	208	220	190	200	208	220
	Series Delta (V)	220	230	240	254	220	230	240	254	220	230	240	254	220	230	240	254
	kVA	620	620	620	600	670	670	670	650	710	710	710	690	738	738	738	715
	kW	496	496	496	480	536	536	536	520	568	568	568	552	590	590	590	572
	Efficiency (%)	95.0	95.2	95.3	95.4	94.8	95.0	95.1	95.3	94.6	94.8	94.9	95.1	94.4	94.6	94.8	95.1
	kW Input	522	521	520	503	565	564	564	546	600	599	599	580	625	624	623	601
60 Hz	Series Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	Parallel Star (V)	208	220	230	240	208	220	230	240	208	220	230	240	208	220	230	240
	Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	688	719	731	750	738	775	800	825	781	819	848	875	806	844	878	906
	kW	550	575	585	600	590	620	640	660	625	655	678	700	645	675	702	725
	Efficiency (%)	95.1	95.2	95.3	95.3	95.0	95.0	95.1	95.1	94.8	94.9	94.9	95.0	94.7	94.8	94.8	94.9
	kW Input	579	604	614	630	621	653	673	694	659	690	715	737	681	712	741	764

DIMENSIONS



COUPLING DISC	AN
SAE 14	25,4
SAE 18	15,87
SAE 21	0

ADAPTOR	AD
SAE 00	410
SAE 0	410
SAE 1/2	390
SAE 1	390

APPROVED DOCUMENT

STAMFORD

Head Office Address:
Barnack Road, Stamford
Lincolnshire, PE9 2NB
United Kingdom
Tel: +44 (0) 1780 484000
Fax: +44 (0) 1780 484100

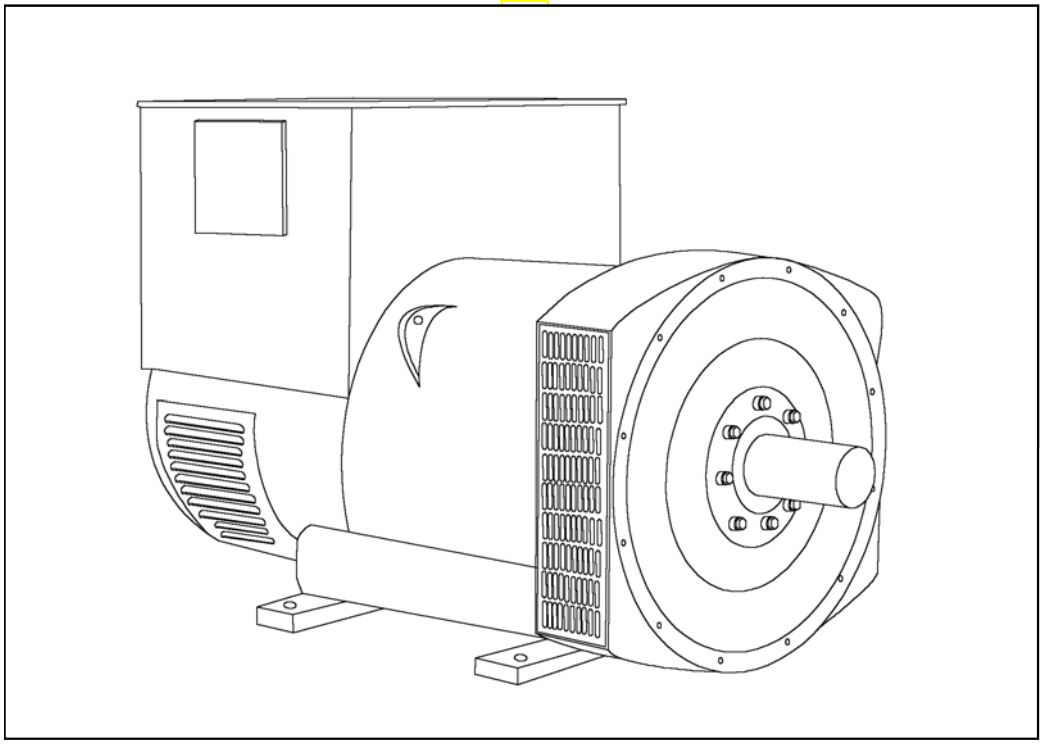
www.cumminsgeneratortechnologies.com

HC5F-311-TD-EN-SG-A

STAMFORD®

HCI534F/544F - Winding 17

Technical Data Sheet



SPECIFICATIONS & OPTIONS

STANDARDS

Stamford industrial generators meet the requirements of BS EN 60034 and the relevant section of other international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC34, CSA C22.2-100, AS1359.
Other standards and certifications can be considered on request.

VOLTAGE REGULATORS

AS440 AVR - STANDARD

With this self-excited system the main stator provides power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semi-conductors of the AVR ensure positive build-up from initial low levels of residual voltage.
The exciter rotor output is fed to the main rotor through a three-phase full-wave bridge rectifier. The rectifier is protected by a surge suppressor against surges caused, for example, by short circuit or out-of-phase paralleling.
The AS440 will support a range of electronic accessories, including a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.

MX341 AVR

This sophisticated AVR is incorporated into the Stamford Permanent Magnet Generator (PMG) control system.
The PMG provides power via the AVR to the main exciter, giving a source of constant excitation power independent of generator output. The main exciter output is then fed to the main rotor, through a full wave bridge, protected by a surge suppressor. The AVR has in-built protection against sustained over-excitation, caused by internal or external faults. This de-excites the machine after a minimum of 5 seconds.
An engine relief load acceptance feature can enable full load to be applied to the generator in a single step.
If three-phase sensing is required with the PMG system the MX321 AVR must be used.
We recommend three-phase sensing for applications with greatly unbalanced or highly non-linear loads.

MX321 AVR

The most sophisticated of all our AVRs combines all the features of the MX341 with, additionally, three-phase rms sensing, for improved regulation and performance.
Over voltage protection is built-in and short circuit current level adjustments is an optional facility.

WINDINGS & ELECTRICAL PERFORMANCE

All generator stators are wound to 2/3 pitch. This eliminates triplen (3rd, 9th, 15th …) harmonics on the voltage waveform and is found to be the optimum design for trouble-free supply of non-linear loads. The 2/3 pitch design avoids excessive neutral currents sometimes seen with higher winding pitches, when in parallel with the mains. A fully connected damper winding reduces oscillations during paralleling. This winding, with the 2/3 pitch and carefully selected pole and tooth designs, ensures very low waveform distortion.

TERMINALS & TERMINAL BOX

Standard generators are 3-phase reconnectable with 12 ends brought out to the terminals, which are mounted on a cover at the non-drive end of the generator. A sheet steel terminal box contains the AVR and provides ample space for the customers' wiring and gland arrangements. It has removable panels for easy access.

SHAFT & KEYS

All generator rotors are dynamically balanced to better than BS6861:Part 1 Grade 2.5 for minimum vibration in operation. Two bearing generators are balanced with a half key.

INSULATION/IMPREGNATION

The insulation system is class 'H'.
All wound components are impregnated with materials and processes designed specifically to provide the high build required for static windings and the high mechanical strength required for rotating components.

QUALITY ASSURANCE

Generators are manufactured using production procedures having a quality assurance level to BS EN ISO 9001.

The stated voltage regulation may not be maintained in the presence of certain radio transmitted signals. Any change in performance will fall within the limits of Criteria 'B' of EN 61000-6-2:2001. At no time will the steady-state voltage regulation exceed 2%.

DE RATES

All values tabulated on page 6 are subject to the following reductions

5% when air inlet filters are fitted.
3% for every 500 metres by which the operating altitude exceeds 1000 metres above mean sea level.
3% for every 5 C by which the operational ambient temperature exceeds 40 C.
Note: Requirement for operating in an ambient exceeding 60 C must be referred to the factory.

NB Continuous development of our products entitles us to change specification details without notice, therefore they must not be regarded as binding.

Front cover drawing typical of product range.

STAMFORD

WINDING 17

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX321	MX341	
VOLTAGE REGULATION	± 0.5 %	± 1.0 %	With 4% ENGINE GOVERNING
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVES (page 5)		

CONTROL SYSTEM	SELF EXCITED	
A.V.R.	AS440	
VOLTAGE REGULATION	± 1.0 %	With 4% ENGINE GOVERNING
SUSTAINED SHORT CIRCUIT	WILL NOT SUSTAIN A SHORT CIRCUIT	

INSULATION SYSTEM	CLASS H	
PROTECTION	IP23	
RATED POWER FACTOR	0.8	
STATOR WINDING	DOUBLE LAYER LAP	
WINDING PITCH	TWO THIRDS	
WINDING LEADS	12	
STATOR WDG. RESISTANCE	0.0049 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED	
ROTOR WDG. RESISTANCE	2.16 Ohms at 22°C	
EXCITER STATOR RESISTANCE	17 Ohms at 22°C	
EXCITER ROTOR RESISTANCE	0.092 Ohms PER PHASE AT 22°C	
R.F.I. SUPPRESSION	BS EN 61000-6-2 & BS EN 61000-6-4,VDE 0875G, VDE 0875N. refer to factory for others	
WAVEFORM DISTORTION	NO LOAD < 1.5% NON-DISTORTING BALANCED LINEAR LOAD < 5.0%	
MAXIMUM OVERSPEED	2250 Rev/Min	
BEARING DRIVE END	BALL. 6220 (ISO)	
BEARING NON-DRIVE END	BALL. 6314 (ISO)	
	1 BEARING	2 BEARING
WEIGHT COMP. GENERATOR	1685 kg	1694 kg
WEIGHT WOUND STATOR	805 kg	805 kg
WEIGHT WOUND ROTOR	684 kg	655 kg
WR² INERTIA	10.033 kgm^2	9.7551 kgm^2
SHIPPING WEIGHTS in a crate	1775 kg	1780 kg
PACKING CRATE SIZE	166 x 87 x 124 (cm)	166 x 87 x 124 (cm)
TELEPHONE INTERFERENCE	THF<2%	TIF<50
COOLING AIR	1.035 m^3/sec 2202 cfm	
VOLTAGE SERIES STAR	600V	
VOLTAGE PARALLEL STAR	300V	
VOLTAGE SERIES DELTA	346V	
kVA BASE RATING FOR REACTANCE VALUES	825	
Xd DIR. AXIS SYNCHRONOUS	2.44	
X'd DIR. AXIS TRANSIENT	0.11	
X"d DIR. AXIS SUBTRANSIENT	0.09	
Xq QUAD. AXIS REACTANCE	1.95	
X"q QUAD. AXIS SUBTRANSIENT	0.23	
X_L LEAKAGE REACTANCE	0.04	
X_2 NEGATIVE SEQUENCE	0.16	
X_0 ZERO SEQUENCE	0.07	
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED	
T'd TRANSIENT TIME CONST.	0.08 s	
T"d SUB-TRANSTIME CONST.	0.012 s	
T'do O.C. FIELD TIME CONST.	2.5 s	
Ta ARMATURE TIME CONST.	0.019 s	
SHORT CIRCUIT RATIO	1/Xd	

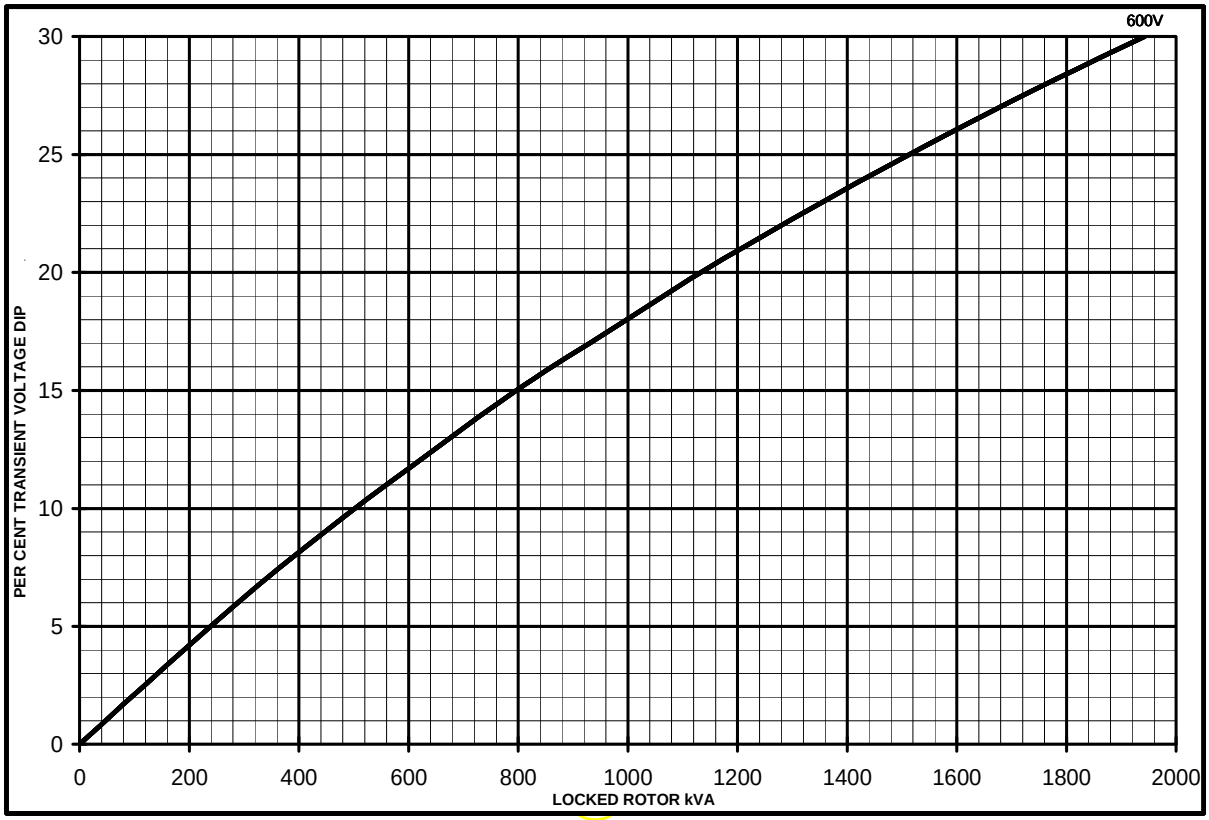
HCI534F/544F

STAMFORD

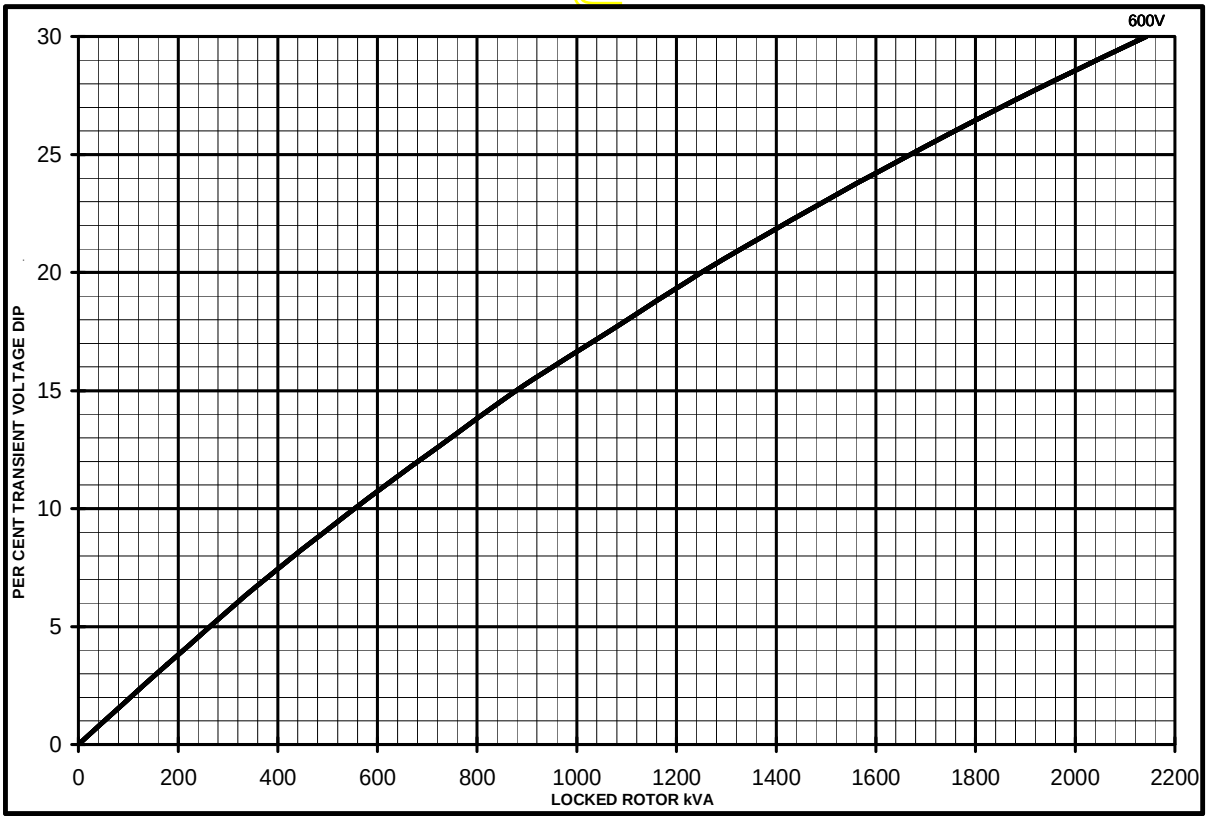
Winding 17

SX

Locked Rotor Motor Starting Curves

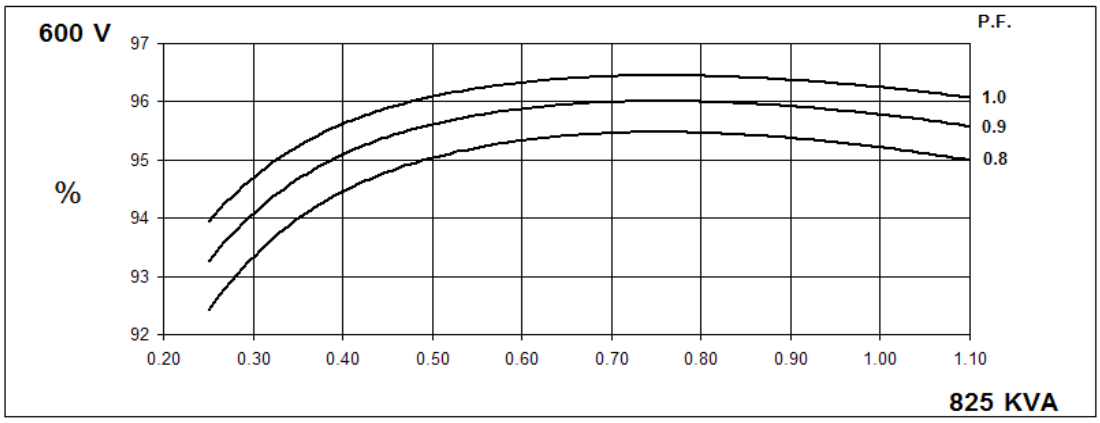


MX

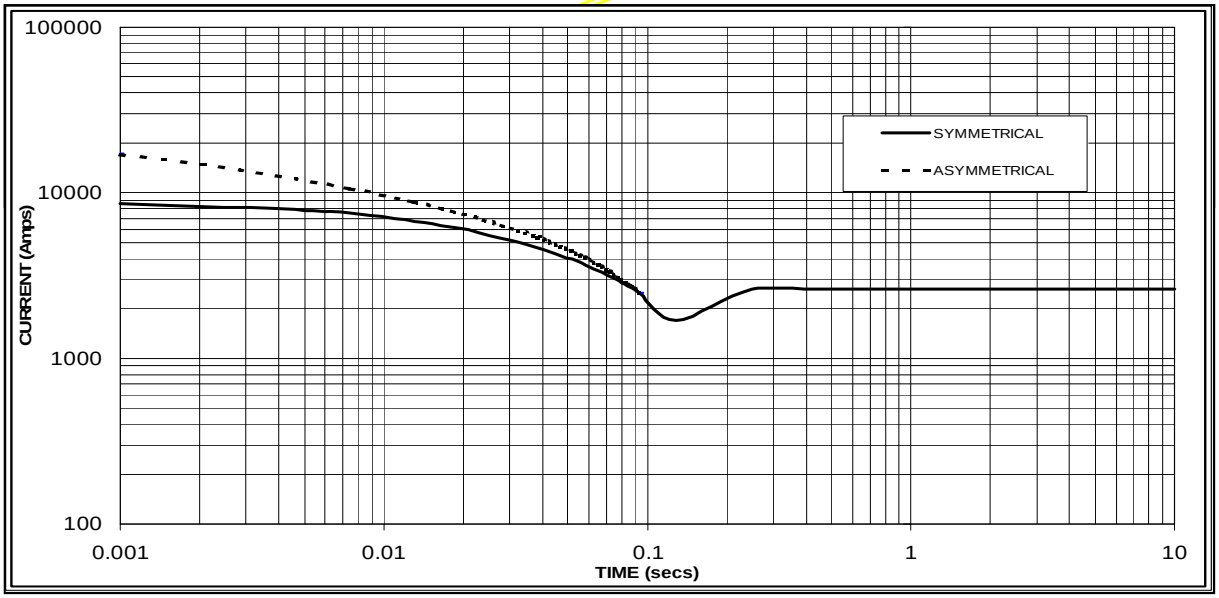


STAMFORD

THREE PHASE EFFICIENCY CURVES



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



Sustained Short Circuit = 2600 Amps

Note
The following multiplication factor should be used to convert the values from curve for the various types of short circuit :

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

All other times are unchanged

HCI534F/544F

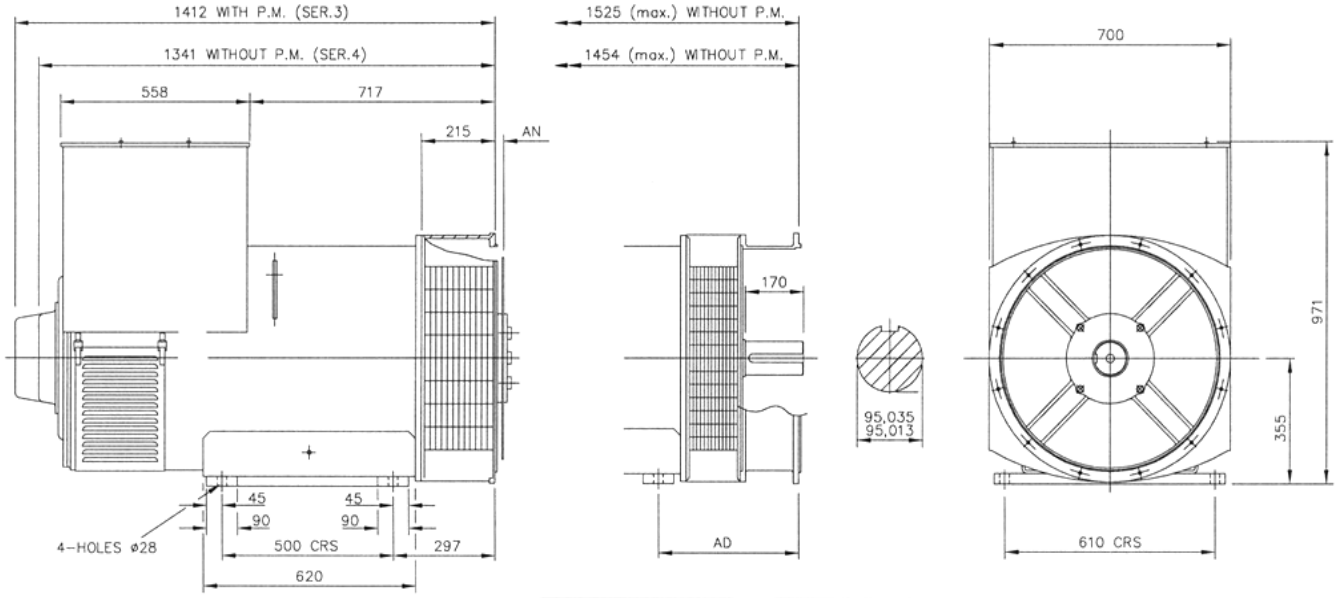
Winding 17 / 0.8 Power Factor

60Hz

RATINGS

Class - Temp Rise	Cont. F - 105/40°C	Cont. H - 125/40°C	Standby - 150/40°C	Standby - 163/27°C
Series Star (V)	600	600	600	600
Parallel Star (V)	300	300	300	300
Series Delta (V)	346	346	346	346
kVA	750	825	875	906
kW	600	660	700	725
Efficiency (%)	95.4	95.2	95.1	95.0
kW Input	629	692	734	760

DIMENSIONS



COUPLING DISC	AN
SAE 14	25,4
SAE 18	15,87
SAE 21	0

ADAPTOR	AD
SAE 00	410
SAE 0	410
SAE 1/2	390
SAE 1	390

APPROVED DOCUMENT

STAMFORD

Head Office Address:
Barnack Road, Stamford
Lincolnshire, PE9 2NB
United Kingdom
Tel: +44 (0) 1780 484000
Fax: +44 (0) 1780 484100

www.cumminsgeneratortechnologies.com

DGC-2020 Digital Genset Controller

A highly advanced integrated genset control system, this device provides genset control, transfer switch control, metering, protection, and programmable logic in a simple, easy-to-use, reliable, rugged, and cost effective package.

Features

- Generator metering (includes three-phase mains)
- Engine and generator protection: 27, 32R, 40Q, 59, 81O/U
- Optional enhanced generator protection: 47, 51, 78, and 81ROCOF
- Load sharing and generator sequencing (via LSM-2020 Load Share Module)
- Var sharing over Ethernet (via LSM-2020)
- BESTCOMS*Plus*® Software
  - Programming and setup
  - Intuitive and powerful
  - Remote control and monitoring
  - Programmable logic
  - USB communications
- Automatic transfer switch control
- Automatic synchronizer (optional)
- Exercise timer
- SAE J1939 engine ECU communications
- Automatic generator configuration detection
- Expandable functionality via add-on modules
  - LSM-2020 Load Share Module
  - CEM-2020 Contact Expansion Module
  - AEM-2020 Analog Expansion Module
- Multilingual capability
- Remote communications to Basler's RDP-110 (remote display panel)
- Sixteen programmable contact inputs
- Up to 15 contact outputs: 3 contacts rated for 30 Adc and up to 12 programmable contacts rated for 2 Adc

Visit www.basler.com for additional information.

Benefits

- Provides integrated engine-genset control, protection, and metering in a single package.
- The Offline Simulator, provided in BESTlogic™*Plus*, helps test and troubleshoot logic without the need for expensive hardware.
- Flexible programmable logic and programmable I/O make it easy to expand the DGC-2020's inputs and outputs with the CEM-2020 (Contact Expansion Module) and the AEM-2020 (Analog Expansion Module). This saves time and money by eliminating unnecessary external PLCs and control relaying.

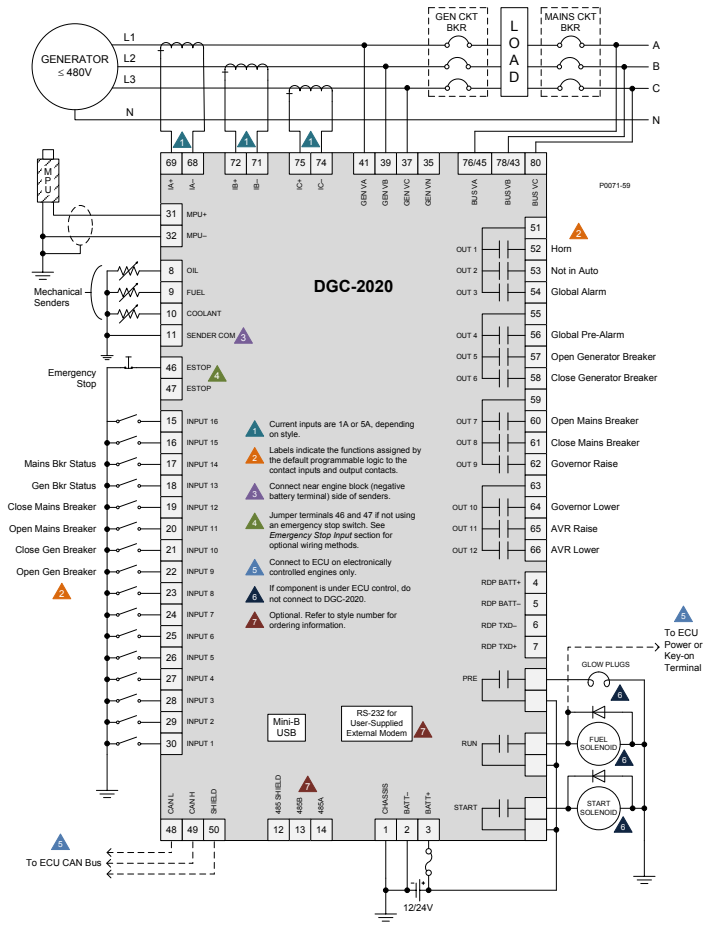


Figure 1 - DGC-2020 Connection Diagram for a Typical Application

DGC-2020 Digital Genset Controller

Specifications

Power Supply

Nominal:	12 or 24 Vdc
Range:	6 to 32 Vdc
Battery Ride Through:	Starting at 10 Vdc, withstands cranking ride-through down to 0 V for 50 ms

Power Consumption

Sleep Mode:	5 W
Normal Operational Mode:	7.9 W
Maximum:	14.2 W

Current Sensing

1 A Sensing:	0.02 to 1.0 Aac, continuous 2 Aac for 1 second
5 A Sensing:	0.1 to 5.0 Aac, continuous 10 Aac for 1 second
Burden:	1 VA

Voltage Sensing

Range:	12 to 576 Vrms L-L
Frequency Range:	10 to 72 Hz for 50/60 Hz style, 10 to 480 Hz for 400 Hz style
Burden:	1 VA
One-second Rating:	720 Vrms

Contact Sensing

Contact Inputs (16):	Accepts normally open (N.O.), Dry Contacts, programmable
Emergency Stop:	Normally closed (N.C.), Dry Contact

Engine Speed Sensing

Magnetic Pickup:	
Voltage Range:	6 to 70 Vpp
Frequency Range:	32 to 10,000 Hz
Generator Frequency:	
Generator Voltage Range:	12 to 576 Vrms
Via ECU over J1939	

Resistive Senders

Fuel Level Sender:	0 to 250 Ω nominal
Coolant Temp Sender:	10 to 2,750 Ω nominal
Oil Pressure Sender:	0 to 250 Ω nominal

Output Contacts

Fuel Solenoid, Engine Crank, Pre-Start Relays Rating:	30 Adc at 28 Vdc-make, break, and carry
Programmable Relays:	Up to 12
Rating:	2 Adc at 28 Vdc-make, break, and carry

Protection

Generator:	27, 32R, 40Q, 59, 81O/U (standard) 47, 51, 78, 81 ROCOF (optional)
Engine:	Oil pressure, coolant temperature, overcrank, ECU-specific elements, and diagnostic reporting.

Agency Approvals

CSA certified, NFPA compliant, CE compliant, UL recognized (Hazardous Location certification available upon request), EAC certified

Communication

USB Port:	USB 2.0, Mini-B jack
RS-485 (optional):	9600 baud, 8 data bits, no parity
RDP-110 (optional):	4,000 ft (1,219 m) max wire length, 20 AWG (0.52 mm²) min wire size
Modem (optional):	DB-9 connector (male)
CAN bus:	250 kb/s communication rate, 1.5 to 3 Vdc differential bus

Environmental

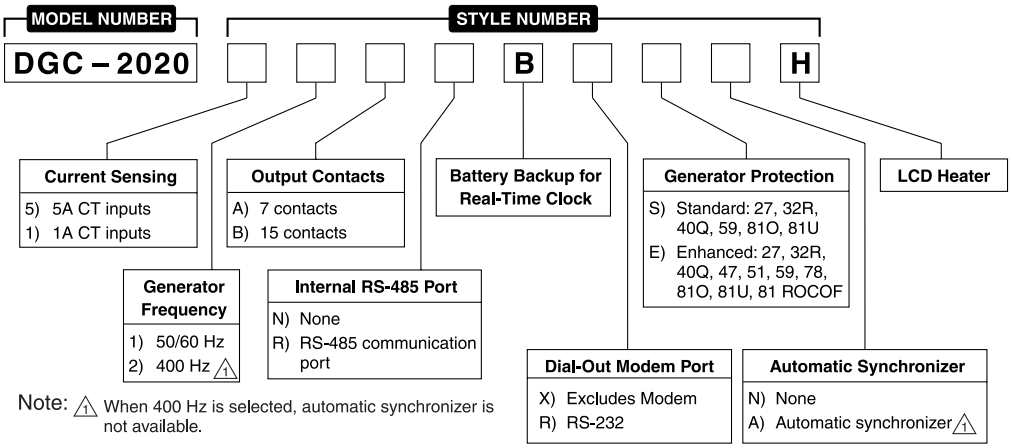
Operating Temp:	-40°C to 70°C (-40°F to 158°F)
Storage Temp:	-40°C to 85°C (-40°F to 185°F)
Humidity:	IEC 68-2-38
Salt Fog:	ASTM B 17-73, IEC 68-2-11
Ingress Protection:	IEC IP54 for front panel
Shock:	15 G in three perpendicular planes
Vibration:	
5 to 29 Hz:	1.5 G peak
29 to 52 Hz:	0.036″ (0.914 mm) double amplitude
52 to 500 Hz:	5 G peak

Physical

Weight:	4.4 lb (2 kg)
Dimensions (WxHxD):	11.77 x 8.27 x 2.69 inches (299 x 210 x 69 mm)

For complete specifications, download the instruction manual at www.basler.com.

Style Chart



Note: 1 When 400 Hz is selected, automatic synchronizer is not available.

Related Products

- BE1-11*g* Generator Protection System
  - A complete generator protection system.
- DECS-250 Digital Excitation Control System
  - Total control in a compact package provides precise voltage, var and power factor regulation, exceptional system response, and generator protection.

Accessories

- AEM-2020 Analog Expansion Module
  - Easily increases the functionality by seamlessly adding analog inputs and outputs.
- CEM-2020, CEM-2020H Contact Expansion Module
  - Each module adds 10 inputs and up to 24 outputs that are easily programmed through BESTCOMS*Plus*® for easy integration into the system.
- LSM-2020 Load Share Module
  - The simple-to-use LSM-2020 easily adds paralleling capabilities with little effort and expense.
- RDP-110 Remote Display Panel
  - Provides remote alarm and pre-alarm indication and annunciation of system status, easily meeting the annunciation requirements of NFPA-110 applications.

ISO 9001-2008
Highland, IL USA Wasselonne, France
Taylor, TX USA Suzhou, China
Basler Plastics, LLC

Basler Electric®
12570 State Route 143, Highland, Illinois 62249-1074 USA
Tel +1 618.654.2341 Fax +1 618.654.2351
email:info@basler.com www.basler.com

P.A.E. Les Pins, 67319 Wasselonne Cedex, FRANCE
Tel +33 3.88.87.1010 Fax +33 3.88.87.0808
e-mail: franceinfo@basler.com

No. 59 Heshun Road Loufeng District (N),
Suzhou Industrial Park, 215122, Suzhou, P.R.China
Tel +86(0)512.8227.2888 Fax +86(0)512.8227.2887
e-mail: chinainfo@basler.com

111 North Bridge Road #15-06 Peninsula Plaza
Singapore 179098
Tel +65 68.44.6445 Fax +65 68.44.8902
e-mail: singaporeinfo@basler.com

Annex to the
technical catalog

Tmax T8

Low voltage molded case
circuit breaker up to 3000 A

UL 489 and CSA C22.2 Standard

1SDC210026D0201 – 2008 Edition

Main characteristics

The Tmax family, conforming to the UL 489 and CSA C22.2 No. 5.1 Standards, is enriched with the Tmax T8 size, which allows 3000 A to be reached. Also available in the 1600 A, 2000 A and 2500 A frames, Tmax T8 is equipped with the same electronic trip units as Tmax T7, thereby guaranteeing extremely high performances able to satisfy all installation requirements. Adequately sized for the performances offered (W=16.8 / D=11.2 / H=15.0 in). Tmax T8 is able to interrupt the following short-circuit currents: 125 kA@480 V and 100 kA@600 V.

Main characteristics

General characteristics

The Tmax T8 size has both circuit breakers and molded case switches (MCS). The following tables show the main characteristics of these ranges.

Circuit breakers for power distribution

				Tmax T8
Frame size			[A]	1600/2000/2500/3000
Number of poles			[No]	3/4
Rated voltage		(AC) 50-60 Hz	[V]	600
		(DC)	[V]	–
Test voltage (1 min) 50-60 Hz			[V]	3000
Interrupting ratings			[kA rms]	V
	240 V AC		[kA rms]	125
	480 V AC		[kA rms]	125
	600 V AC		[kA rms]	100
Trip units	Electronic	PR232/P-T8		■
		PR331/P		■
		PR332/P		■
Dimensions fixed version (3p)		H	[in-mm]	15.0 - 382
		W	[in-mm]	16.8 - 427
		D	[in-mm]	11.2 - 282
Mechanical life			[operations]	15000
Weight (fixed 3p)		1600/2000/2500 A	[lbs]	161
		3000 A	[lbs]	236

Molded case switches (MCS)

The Tmax T8 MCS are derived from the corresponding circuit breakers, of which they keep the overall dimensions, the versions, the fixing systems and the possibility of mounting accessories unchanged. This version only differs from the circuit breakers in the absence of the protection trip units. All molded case switches comply with the UL 489 and CSA C22.2 Standards and are self-protected.

			Tmax T8V-D
Rating		[A]	2000/2500/3000
Poles		[No]	3/4
Magnetic override		[A]	40000
Rated voltage	AC (50-60 Hz)	[V]	600
	DC	[V]	–

Tmax-Molded Case Circuit Breakers

T7 1200A Frame

AC Circuit Breakers and Switches

3 and 4 Pole

Motor Circuit Protectors

Higher Performances in Less Space

Field Installable Accessories and Trip Units

Dimensions	3P Fixed Version	10.55H x 8.26W x 6.06D
Weight	21.4 (lbs)	

Compliance with Standards

UL 489
CSA C22.2 No.5.1
IEC 60947-2
Standards
EC directive:
– “Low Voltage Directives” (LVD) no. 73/23 EEC
– “Electromagnetic Compatibility Directive” (EMC) no.89/336 EEC

The ABB Quality System complies with the international ISO 9001 - 2000 Standard (model for quality assurance in design, development, construction, and installation and service) and with the equivalent European EN ISO 9001 and Italian UNI EN ISO 9001 Standards

Interrupting ratings (RMS sym. kAmps)	T7		
Continuous Current Rating	1200		
Number of Poles	3-4		
	S	**H**	**L**
AC			
240V	65	100	150
480V	50	65	100
600V	25	50	65

Company Quality Systems and Environmental Systems

The new Tmax series has a hologram on the front, obtained using special anti-imitation techniques, which guarantees the quality and that the circuit breaker is an original ABB product.

Attention to protection of the environment and to health and safety in the work place is another priority commitment for ABB and, as confirmation of this, the company environmental management system has been certified by RINA in 1997, in conformity with the international ISO 14001 Standard. This certification has been integrated in 1999 with the Management System for Health and Safety in the workplace, according to OHSAS 18001 (British Standards), obtaining one of the first certification of integrated management System, QES (Quality, Environment, Safety) issued by RINA. ABB - the first industry in the electromechanical section in Italy to obtain this recognition - thanks to a revision of the production process with an eye to ecology has been able to reduce the consumption of raw materials and waste from processing by 20%. ABB's commitment to safeguarding the environment is also shown in a concrete way by the Life Cycle Assessments of its products carried out directly by the ABB Research and Development in collaboration with the ABB Research Center. Selection of materials, processes and packing materials is made optimizing the true environmental impact of the product, also foreseeing the possibility of its being recycled.

Mounting

Fixed
Drawout

Connections

Busbar connection or compression lugs
Pressure-type terminals for bare cables
Rear connections

Trip Unit

PR231/P, PR232/P, PR331DS, and PR332DS/P electronic trip unit

Auxiliary Devices for Indication and Control

- Auxiliary contacts - AUX
- Undervoltage release - UVR
- Shunt trip - SOR
- Terminal covers
- Padlock provision - PLL
- Direct rotary handle - RHD
- Key lock - KLF
- Early auxiliary contact - AUE
- Transmitted rotary handle - RHE
- Front extended terminal - EF
- Front terminal for copper-aluminum - FC CuAl
- Front extended spread terminal – ES
- Rear orientated terminal - R
- Phase separators
- Residual current relay (IEC Only)

Publication LV114
No. 1SXU210114D0201
Printed in USA, April, 2008

ABB Inc.

1206 Hatton Road
Wichita Falls, TX 76302
For more information and
the location of your local
field office please go to
www.abb-control.com

Tmax-Molded Case Circuit Breakers

T6 800A Frame

AC Circuit Breakers and Switches

DC Circuit Breakers and Switches

3 and 4 Pole

Motor Circuit Protectors

Higher Performances in Less Space

Field Installable Accessories and Trip Units

Dimensions	3P Fixed Version	10.55H x 8.26W x 4.07D
Weight	20.9 (lbs)	

Compliance with Standards

UL 489
CSA C22.2 No.5.1
IEC 60947-2
Standards
EC directive:
– "Low Voltage Directives" (LVD) no. 73/23 EEC
– "Electromagnetic Compatibility Directive" (EMC) no.89/336 EEC

The ABB Quality System complies with the international ISO 9001 - 2000 Standard (model for quality assurance in design, development, construction, and installation and service) and with the equivalent European EN ISO 9001 and Italian UNI EN ISO 9001 Standards

Interrupting ratings (RMS sym. kAmps)		T6			
Continuous Current Rating		800			
Number of Poles		3-4			
		N	**S**	**H**	**L**
AC					
	240V	65	100	200	200
	480V	35	50	65	100
	600V	20	25	35	42
DC*					
	500V 2 poles in series	35	35	50	65
	600V 3 poles in series	20	20	35	50

*Thermal Magnetic Trip Only

Company Quality Systems and Environmental Systems

The new Tmax series has a hologram on the front, obtained using special anti-imitation techniques, which guarantees the quality and that the circuit breaker is an original ABB product.

Attention to protection of the environment and to health and safety in the work place is another priority commitment for ABB and, as confirmation of this, the company environmental management system has been certified by RINA in 1997, in conformity with the international ISO 14001 Standard. This certification has been integrated in 1999 with the Management System for Health and Safety in the workplace, according to OHSAS 18001 (British Standards), obtaining one of the first certification of integrated management System, QES (Quality, Environment, Safety) issued by RINA. ABB - the first industry in the electromechanical section in Italy to obtain this recognition - thanks to a revision of the production process with an eye to ecology has been able to reduce the consumption of raw materials and waste from processing by 20%. ABB's commitment to safeguarding the environment is also shown in a concrete way by the Life Cycle Assessments of its products carried out directly by the ABB Research and Development in collaboration with the ABB Research Center. Selection of materials, processes and packing materials is made optimizing the true environmental impact of the product, also foreseeing the possibility of its being recycled.

Mounting

Fixed
Drawout

Connections

Busbar connection or compression lugs
Pressure-type terminals for bare cables
Rear connections

Trip Unit

TMA thermal magnetic trip units, with adjustable thermal threshold (I1 = 0.7…1 x In) and adjustable magnetic threshold (I3 = 5…10 x In).

PR221DS, PR222DS/P, and PR222DS/PD-A electronic trip unit

Auxiliary Devices for Indication and Control

- Auxiliary contacts - AUX
- Undervoltage release - UVR
- Shunt trip - SOR
- Terminal covers
- Front for lever operating mechanism - FLD
- Direct rotary handle - RHD
- Stored energy motor operator - MOE
- Key lock - KLF
- Early auxiliary contact - AUE
- Transmitted rotary handle - RHE
- Front extended terminal - EF
- Front terminal for copper-aluminum - FC CuAl
- Front extended spread terminal – ES
- Rear orientated terminal - R
- Phase separators
- Residual current relay (IEC Only)

Publication LV113
No. 1SXU210113D0201
Printed in USA, April, 2008

ABB Inc.

1206 Hatton Road
Wichita Falls, TX 76302
For more information and
the location of your local
field office please go to
www.abb-control.com

Digital Linear Chargers

On-Board Chargers Today

- Current Supplier provides quality product and design services. However, services are at their pacing with limited resources; and a history of issues meeting launch dates. PC charger delays prompted a re-evaluation of our controls and processes
- Resulted in a renewed commitment to the charger category
    - Allow supplier to focus on what they do well… build product
    - All charger development controlled by Minn Kota engineering
- Minn Kota designs, tests, and qualifies
- Supplier manufactures – period
- Revised product plan
    - 2011 Digital Linear On-board chargers
    - 2012 Precision Charge On-board chargers

New Digital Linear On-Board Chargers

- Taking existing Linear On-board family of chargers and raising the bar
    - Analog to Digital designs; New “D” designation in model name

Digital± CONTROL

Digital Linear Chargers

New Digital Linear On-Board Chargers (cont.)

- New microprocessor controlled linear design provides software enriched features and functionality
    - More repeatable set points (voltage limit and current) = improved charge curves
    - Maintenance mode time-out feature (auto-off)
    - Arc protection
    - Enhanced status codes
        - System okay
        - Charge stage indication (Bulk, Absorption, or Maintenance)
        - Full charge
        - Maintenance mode status
        - Multiple specific error indications – low battery voltage, damaged temp sensor, no output lead attached, etc.
- Up to 2X Faster Charge Times in high heat conditions

LED Status Code Detail

1. A GREEN power light is lit to indicate AC power is applied
2. A YELLOW light is lit for each bank to indicate the battery is charging in the Bulk Mode
3. A flashing YELLOW light is lit for each bank to indicate the battery is charging in the Absorption Mode
4. A flashing GREEN light is lit for each bank to indicate the battery is in maintenance mode and ready to use
5. A GREEN light is lit for each bank to indicate the battery is in long term maintenance mode and ready to use
6. A RED light for each bank is lit if any of the following apply:
    a) No battery is connected to an output cord - this may also indicate a blown fuse in the fuse holder
    b) The battery is connected reverse polarity
    c) A short circuit
    d) The battery voltage is below 4 volts - the bank will not charge a battery in this condition

Digital Linear Chargers

LED Status Code Detail (cont.)

e) The battery voltage is above 18 volts - the bank will not charge a battery in this condition

7. A flashing RED light is lit for each bank if there is a damaged temperature sensor on the output cord - the bank will not operate if this occurs.
8. Flashing RED and GREEN lights are lit for each bank if any of the following apply:

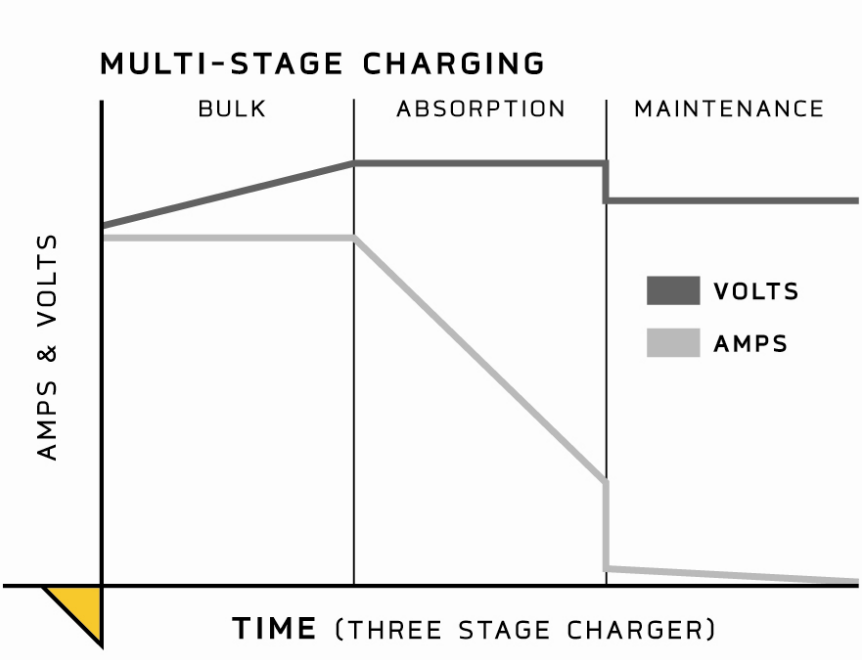
   a) The battery voltage does not rise above 10.5V after 3 hours - the battery may be damaged and will not be charged

   b) Charging in Bulk Mode exceeds 20 hours - the battery may be damaged and will not be charged

Digital Linear Charging Technologies

Automatic 3-Stage Charging

- Bulk – high amps at low voltage until battery reaches ~75% charge
- Absorption – at ~75% charge, current tapers down until the battery voltage reaches 14.4V* (full charge)
- Maintenance (or Float) – when the battery voltage reaches full charge, charger output is dropped to 13.4V* (.1A-.3A). After 24 hours, the charger automatically turns off and automatically turns on when the battery voltage drops below 12.6 volts



*** At 77 degrees Fahrenheit**

Digital Linear Charging Technologies (cont.)

Automatic Temperature Compensation

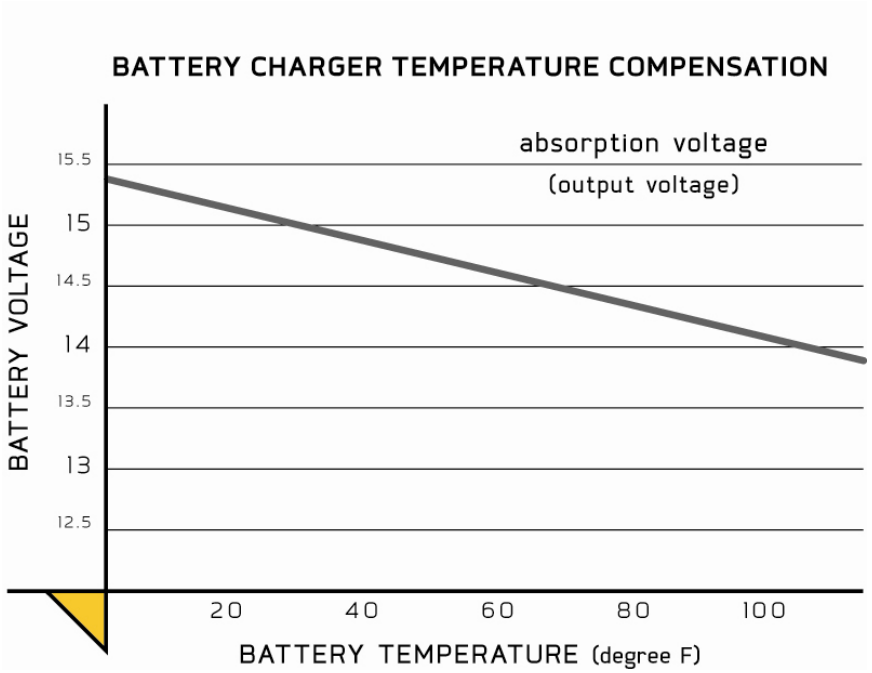
- Senses temperature and adjusts output voltage
- Protects batteries from overcharging at high temperatures
- Maintains gassing threshold for a full charge

Gassing Threshold

- Voltage level at which electrolyte begins moving within the battery
- This threshold must be reached in order to fully charge a battery

Effect of Temperature

- Gassing threshold is higher at lower temps, lower at higher temps
- Too much voltage at high temperatures can “boil” and destroy a battery



Digital Linear Chargers

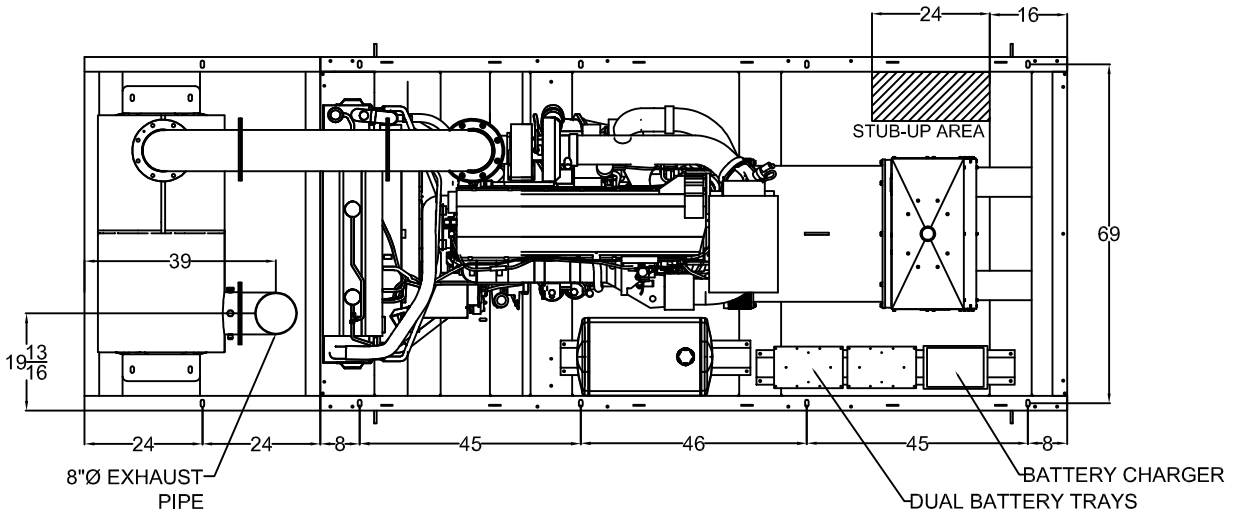
Specifications

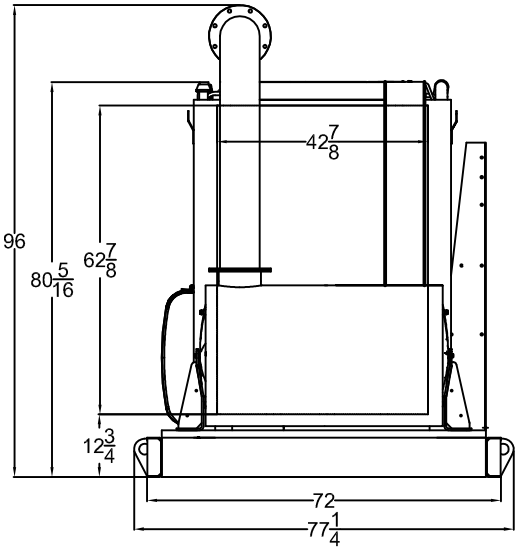
- Waterproof, shock-and vibration-resistant aluminum construction
- Saltwater tested and fully corrosion-resistant
- Short circuit, reverse polarity, and ignition protected
- For use with 12V/6 cell batteries that are flooded/wet cell, maintenance free or starved electrolyte (AGM) only
- FCC compliant
- UL listed to marine standard 1236
- 3 year warranty
- Replaces all existing current on-board chargers (excluding portables)
- No Price Increase
- Availability: November 2010

DIGITAL LINEAR ON-BOARD CHARGERS	
PRODUCT CODE	PRODUCT DESCRIPTION
1821065	MK 106D (1 bank x 6 amps)
1821105	MK-110D (1 bank x 10 amps)
1822105	MK-210D (2 bank x 5 amps)
1823155	MK-315D (3 bank x 5 amps)
1822205	MK-220D (2 bank x 10 amps)
1823305	MK-330D (3 bank x 10 amps)
1824405	MK-440D (4 bank x 10 amps)
1822305	MK-230D (2 bank x 15 amps)
1823455	MK-345D (3 bank x 15 amps)
1824605	MK-460D (4 bank x 15 amps)

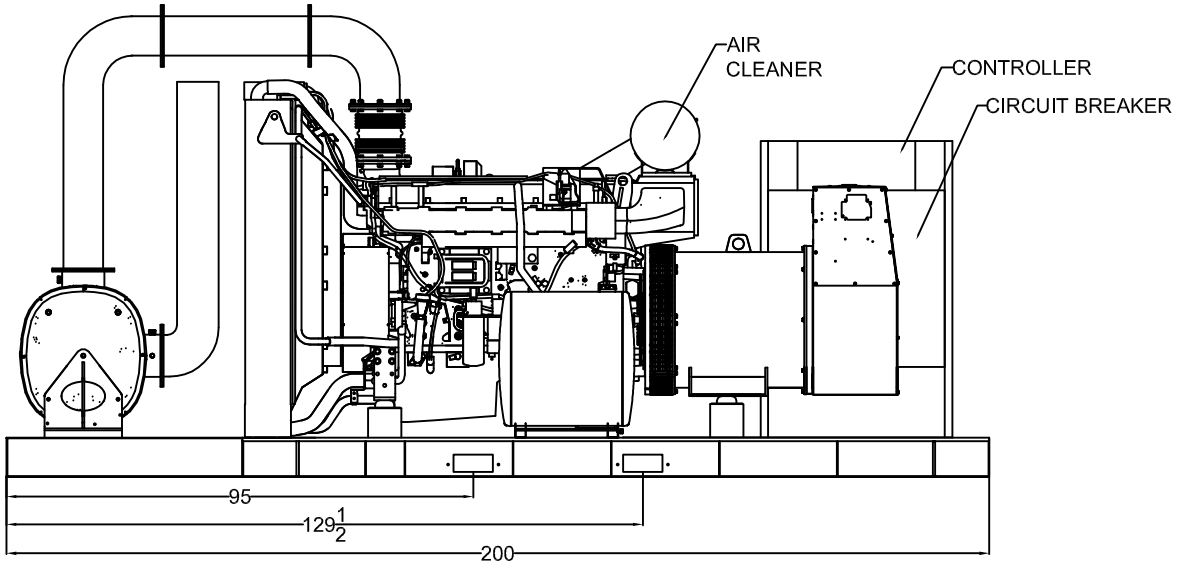
T4D-6000 OPEN DIMENSIONAL OVERVIEW

TOP VIEW





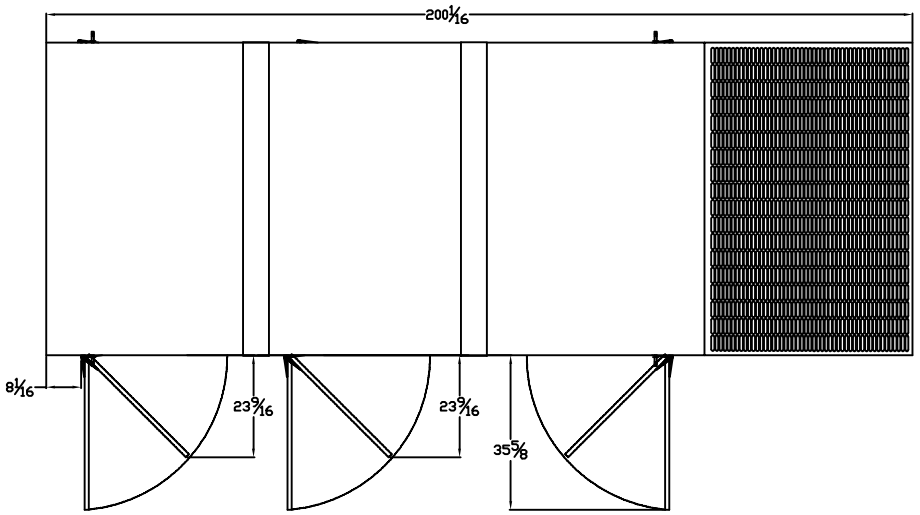
RADIATOR VIEW



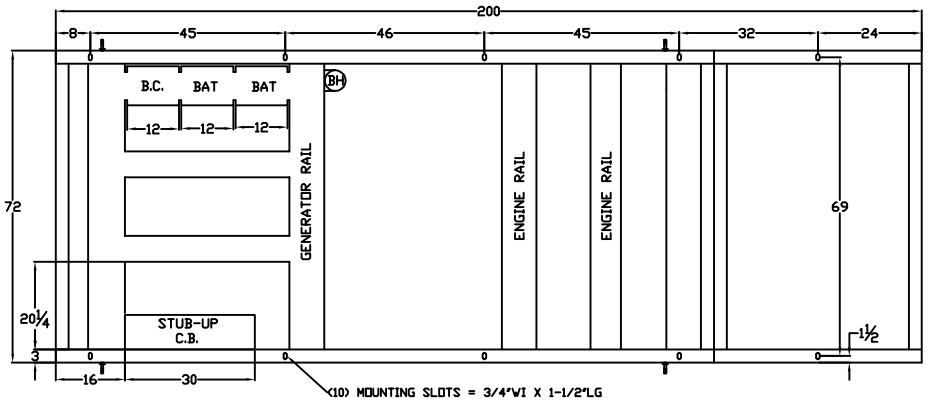
SIDE VIEW

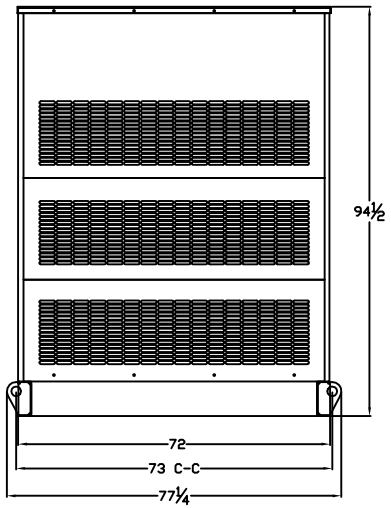
T4D-5500 THRU T4D-6000 LEVEL 2 ENCLOSURE OUTLINE DIMENSIONS
WITH RESIDENTIAL GRADE SILENCER

TOP VIEW
(GEN-SET HAS (6) DOORS, (3) SHOWN OPEN ARE TYPICAL FOR BOTH SIDES)

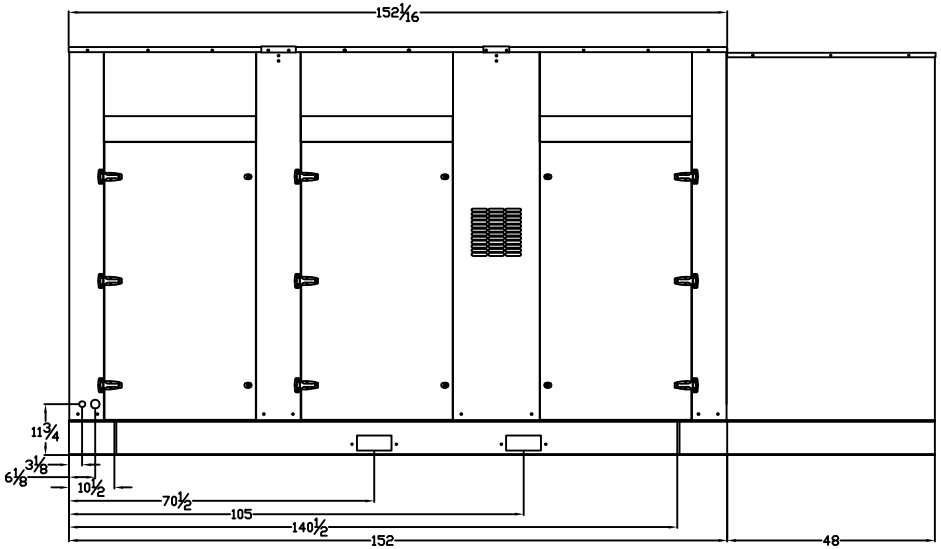


FRAME VIEW

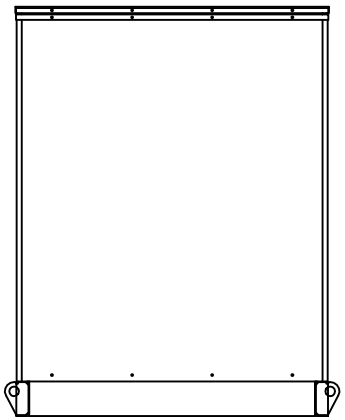




GENERATOR END VIEW



SIDE VIEW



RADIATOR END VIEW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2024 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **AB Volvo Penta**
(U.S. Manufacturer or Importer)

Certificate Number: RVPXL16.1CDC-007

Effective Date: 10/13/2023

Expiration Date: 12/31/2024

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 10/13/2023

Revision Date: N/A

Model Year: 2024
Manufacturer Type: Original Engine Manufacturer
Engine Family: RVPXL16.1CDC

Mobile/Stationary Indicator: Both
Emissions Power Category: kW>560
Fuel Type: Diesel
After Treatment Devices: Ammonia Slip Catalyst, Selective Catalytic Reduction
Non-after Treatment Devices: Electronic Control, Smoke Puff Limiter

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Parts 60 and 1039, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Parts 60 and 1039 and produced in the stated model year.

This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Parts 60 and 1039 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Parts 60 and 1039.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Parts 60 and 1039. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Parts 60 and 1039.

This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

PTE Calculations
Emission Unit: Non-Emergency
Description: Non-Emergency

Conversions Engine:

Engine hp:	932	hp
Engine kW:	696	kW
Engine displacement:	16.1	Liters, Total for 6 Cylinders
Engine Model Year:	2024	Non-EMRG
hp to kW	1.34	hp/kW
Grams to Pounds:	454	g/lb
Fuel Use (Standby 100% Load	42.8	gal/hr (vendor data)
PTE hours	500	hr/yr

Air Pollutant	Emission Factor	Emission Factor Units	Emission Factor Source
PM2.5	0.04	g/kWhr	
PM10	0.04	g/kWhr	
Total PM	0.04	g/kWhr	
SO_2	0.000213	lb/gal	15 ppm S fuel
NO_x	0.63	g/kWhr	
CO	2.60	g/kWhr	
VOC	0.09	lb/MMBtu	AP-42 Table 3.4-1
Greenhouse Gases			
CO2	165.00	lb/MMBtu	AP-42 Table 3.4-1
Hazardous Air Pollutants			
Benzene	7.76E-04	lb/MMBtu	AP-42 Table 3.4-3
Toluene	2.81E-04	lb/MMBtu	AP-42 Table 3.4-3
Xylenes	1.93E-04	lb/MMBtu	AP-42 Table 3.4-3
Formaldehyde	7.89E-05	lb/MMBtu	AP-42 Table 3.4-3
Acetaldehyde	2.52E-05	lb/MMBtu	AP-42 Table 3.4-3
Acrolein	7.88E-06	lb/MMBtu	AP-42 Table 3.4-3
Naphthalene	0.00E+00	lb/MMBtu	AP-42 Table 3.4-3

Notes:

1. For pollutants other than CO, PM, and NOx use AP 42, Fifth Edition (1996), Volur
   Table 3.4-1, and Table 3.4-3 (automatically applied in this tab)
2. ~~For pre 2007 model year engines use AP 42, Fifth Edition (1996), Volume I: Chap~~
   ~~where RICE MACT requires CO stack testing. Use stack test 95% confidence inte~~
3. For 2007 and later model year engine review 40 CFR Part 60 Subpart IIII for the a
4. VOC factor is a AP42 factor for TOC (total organic compounds) this is worst case
5. SO2 factor assumes 15 ppm (wt%) S fuel is combusted
6. PM emission factor based on NSPS standard should include a 1.25 NTE multiplie
7. NOx emission factor has 1.25 NTE multilplier to account for actual emissions at va

Conversions Fuel:

Fuel Density:	7.1	lb/gal
Fuel Btu content	137000	Btu/gal diesel
FLRS* fuel consumption	220	g fuel/kW/hr produced
FLRS converted	0.36	lb fuel/hp/hr produced
fuel conversion factor	6.98E-03	MMBtu/hphr

*full load rated speed

Ash or Sulfur %	Potential Hourly Uncontrolled Emissions (Lbs/Hr)	Combined Control Efficiency	Potential Hourly Controlled Emissions (Lbs/Hr)	Potential Annual Controlled Emissions (Tons/Yr)
	0.06	0%	0.06	0.016
	0.06	0%	0.06	0.016
	0.06	0%	0.06	0.016
	9.12E-03	0%	9.12E-03	0.002
	0.96	0%	0.96	0.239
	3.98	0%	3.98	0.996
	5.28E-01	0%	0.53	0.132
	9.67E+02	0%	967.49	219.621
	4.55E-03	0%	4.55E-03	0.001
	1.65E-03	0%	1.65E-03	0.000
	1.13E-03	0%	1.13E-03	0.000
	4.63E-04	0%	4.63E-04	0.000
	1.48E-04	0%	1.48E-04	0.000
	4.62E-05	0%	4.62E-05	0.000
	0.00E+00	0%	0.00E+00	0.000

E
W

ne I: Chapter 3: Stationary Internal Combustion Sources. Table 3.3-1, Table 3.3-2,

ter 3: Stationary Internal Combustion Sources. Table 3.3-1 or Table 3.4-1 for CO, NOx, and PM. E
rval for CO where applicable.

appropriate emission factor for PM, NOx, and CO (standards) based on hp, model year and displace
assumption

r and a 1.5 multiplier included to account for condensable emissions.
arious operating conditions vs emission standard.

ngines Above 560 kW. Tier 4 emission standards for engines above 560 kW are listed in Table 4. The 2011 standards are sometimes referred to as 't
hile the 2015 limits represent final Tier 4 standards.

Table 4
Tier 4 emission standards—Engines above 560 kW, g/kWh (g/bhp-hr)

Year	Category	CO	NMHC	NO_x	PM
2011	Generator sets > 900 kW	3.5 (2.6)	0.40 (0.30)	0.67 (0.50)	0.10 (0.075)
	All engines except gensets > 900 kW	3.5 (2.6)	0.40 (0.30)	3.5 (2.6)	0.10 (0.075)
2015	Generator sets	3.5 (2.6)	0.19 (0.14)	0.67 (0.50)	0.03 (0.022)
	All engines except gensets	3.5 (2.6)	0.19 (0.14)	3.5 (2.6)	0.04 (0.03)

~~kcept~~

ement.

:ransitional Tier 4',

EP	EU	EU Description	Pollutant
		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA
		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA
		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA
		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA
		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA
		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA
		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA

		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA
		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA
		CI Non-Emergency Engines at an Area Source manufactured after 4/1/2006 and are not fire pumps and are < 30 L per cylinder and are certified	NA

Permit Limit, Term, Condition or Applicable Requirement
Owners and operators of 2007 model year and later non-emergency stationary CI ICE with a displacement of less th cylinder must comply with the emission standards for new CI engines in §60.4201 for their 2007 model year and late ICE, as applicable
(b) Beginning October 1, 2010, owners and operators of stationary CI ICE subject to this subpart with a displacemer liters per cylinder that use diesel fuel must purchase diesel fuel that meets the requirements of 40 CFR 80.510(b) fo fuel.
(b) If you are an owner or operator of a stationary CI internal combustion engine equipped with a diesel particulate fi the emission standards in § 60.4204, the diesel particulate filter must be installed with a backpressure monitor that r or operator when the high backpressure limit of the engine is approached.
60.4206 Owners and operators of stationary CI ICE must operate and maintain stationary CI ICE that achieve the er as required in §§60.4204 and 60.4205 over the entire life of the engine
(a) If you are an owner or operator and must comply with the emission standards specified in this subpart, you must following, except as permitted under paragraph (g) of this section: (1) Operate and maintain the stationary CI internal combustion engine and control device according to the manufact related written instructions; (2) Change only those emission-related settings that are permitted by the manufacturer; and (3) Meet the requirements of 40 CFR part 1068, as they apply to you
(a) Overview. Except as specified in § 1090.300(a), diesel fuel must meet the ULSD per-gallon standards of this sec (b) Sulfur standard. Maximum sulfur content of 15 ppm. (c) Cetane index or aromatic content. Diesel fuel must meet one of the following standards: (1) Minimum cetane index of 40. (2) Maximum aromatic content of 35 volume percent.
(c) If you are an owner or operator of a 2007 model year and later stationary CI internal combustion engine and mus emission standards specified in §60.4204(b) or §60.4205(b), or if you are an owner or operator of a CI fire pump eng manufactured during or after the model year that applies to your fire pump engine power rating in table 3 to this subp comply with the emission standards specified in §60.4205(c), you must comply by purchasing an engine certified to standards in §60.4204(b), or §60.4205(b) or (c), as applicable, for the same model year and maximum (or in the cas NFPA nameplate) engine power. The engine must be installed and configured according to the manufacturer's emis specifications, except as permitted in paragraph (g) of this section.

(a) Owners and operators of non-emergency stationary CI ICE that are greater than 2,237 KW (3,000 HP), or have a
greater than or equal to 10 liters per cylinder, or are pre-2007 model year engines that are greater than 130 KW (17
certified, must meet the requirements of paragraphs (a)(1) and (2) of this section. (1) Submit an initial notification as
§60.7(a)(1). The notification must include the information in paragraphs (a)(1)(i) through (v) of this section. (i) Name
the owner or operator; (ii) The address of the affected source; (iii) Engine information including make, model, engine
number, model year, maximum engine power, and engine displacement; (iv) Emission control equipment; and (v) Fu
records of the information in paragraphs (a)(2)(i) through (iv) of this section. (i) All notifications submitted to comply
and all documentation supporting any notification. (ii) Maintenance conducted on the engine. (iii) If the stationary CI
combustion is a certified engine, documentation from the manufacturer that the engine is certified to meet the emiss
If the stationary CI internal combustion is not a certified engine, documentation that the engine meets the emission s

(c) If the stationary CI internal combustion engine is equipped with a diesel particulate filter, the owner or operator m
of any corrective action taken after the backpressure monitor has notified the owner or operator that the high backpr
engine is approached

(c) Stationary RICE subject to Regulations under 40 CFR Part 60. An affected source that meets any of the criteria i
(1) through (7) of this section must meet the requirements of this part by meeting the requirements of 40 CFR part 6
compression ignition engines or 40 CFR part 60 subpart JJJJ, for spark ignition engines. No further requirements ap
engines under this part.
(1) A new or reconstructed stationary RICE located at an area source;
(2) A new or reconstructed 2SLB stationary RICE with a site rating of less than or equal to 500 brake HP located at
HAP emissions;
(3) A new or reconstructed 4SLB stationary RICE with a site rating of less than 250 brake HP located at a major sou
emissions;
(4) A new or reconstructed spark ignition 4 stroke rich burn (4SRB) stationary RICE with a site rating of less than or
brake HP located at a major source of HAP emissions;
(5) A new or reconstructed stationary RICE with a site rating of less than or equal to 500 brake HP located at a majo
emissions which combusts landfill or digester gas equivalent to 10 percent or more of the gross heat input on an ann
(6) A new or reconstructed emergency or limited use stationary RICE with a site rating of less than or equal to 500 b
at a major source of HAP emissions;
(7) A new or reconstructed compression ignition (CI) stationary RICE with a site rating of less than or equal to 500 b
at a major source of HAP emissions.

Const. Permit/ Exempt	Basis of Requirement
	40 CFR Part 60, Section 4204, Paragraph (b)
	40 CFR Part 60, Section 4207 Paragraph (b)
	41 CFR Part 60, Section 4209, Paragraph (b)
	42 CFR Part 60, Section 4206
	40 CFR Part 60, Section 4211, Paragraph (a)
	40 CFR Part 1090, Section 305 - ULSD standards
	40 CFR Part 60, Section 4211, Paragraph (c)

	40 CFR Part 60, Section 4214, Paragraph (a)
	40 CFR Part 60, Section 4214, Paragraph (c)
	40 CFR Part 63, Section 6590, Paragraph (c)

Explanation of how you are in compliance
[Reference Cerificate]
[Maintain records of ULSD purchase]
[Engine specs state that the engine has an SCR only for add-on controls and that a diesel particulate filter (DPF) is not used.]
[Document and reference maintenace procedures]
[Document and reference maintenace procedures]
[Maintain records of ULSD purchase]
[Reference engine certification. Document and reference maintenace procedures]

[Not applicable due to model year and size of the engine]
[Engine specs state that the engine has an SCR only for add-on controls and that a diesel particulate filter (DPF) is not used.]
[Negative Documentation that the 4Z does not apply.]

Location / link to specific files to supplement explanation column	Calculated and actual values reviewed for compliance	Annual Follow-up (Yes/No)

Reviewed By	Date of Review	
