# STAMFORD®

S9H1D-A4 Wdg.91 - Technical Data Sheet

Standards

STAMFORD industrial alternators meet the requirements of the relevant parts of the IEC 60034 and the relevant sections of other international standards such as BS5000-3, ISO 8528-3, VDE 0530, NEMA MG1-32, CSA C22.2-100 and AS 60034. Other standards and certifications can be considered on request.

Quality Assurance

Alternators are manufactured using production procedures having a quality assurance level to BS EN ISO 9001.
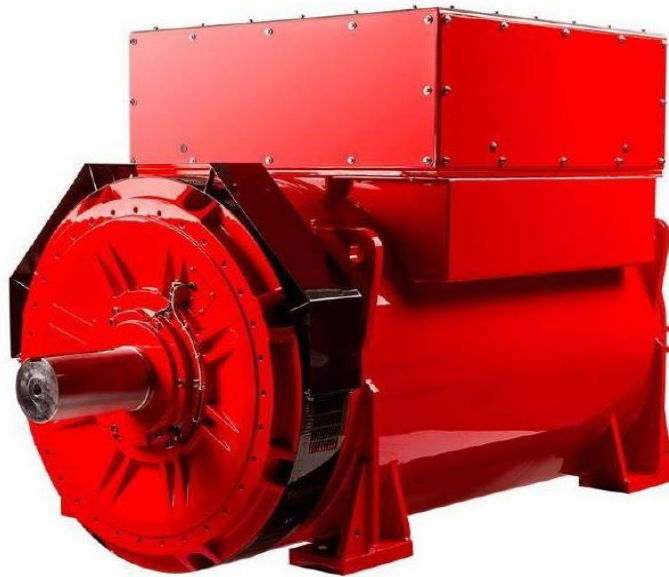
Excitation and Voltage Regulators

Excitation System				
AVR Type	DM110	DECS100	DECS150	
Voltage Regulation	± 0.25%	± 0.25%	± 0.25%	with 4% Engine Governing
AVR Power	PMG	PMG	PMG	

No Load Excitation Voltage (V)	11.3
No Load Excitation Current (A)	1
Full Load Excitation Voltage (V)	36
Full Load Excitation Current (A)	3.3
Exciter Time Constant (seconds)	0.24

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Electrical Data	
Insulation System	H
Stator Winding	Double Layer Lap
Winding Pitch	5/6
Winding Leads	6
Winding Number	91
Number of Poles	4
IP Rating	IP23
RFI 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%
Short Circuit Ratio	1/Xd
Steady State X/R Ratio	18.69

60 Hz				
Telephone Interference	TIF<50			
Cooling Air Flow	3.33 m³/sec			
Voltage Star (V)	11000	12470	13200	13800
Voltage Parallel Star (V)	-	-	-	-
Voltage Delta (V)	-	-	-	-
kVA Base Rating (Class H) for Reactance Values (kVA)	1753	1988	2104	2200

Saturated Values in Per Unit at Base Ratings and Voltages				
Xd Dir. Axis Synchronous	2.571	2.269	2.143	2.050
X'd Dir. Axis Transient	0.310	0.273	0.258	0.247
X"d Dir. Axis Subtransient	0.203	0.179	0.169	0.162
Xq Quad. Axis Reactance	1.214	1.071	1.012	0.968
X"q Quad. Axis Subtransient	0.329	0.290	0.274	0.262
XL Stator Leakage Reactance	0.166	0.146	0.138	0.132
X2 Negative Sequence Reactance	0.250	0.220	0.208	0.199
X0 Zero Sequence Reactance	0.177	0.156	0.147	0.141

Unsaturated Values in Per Unit at Base Ratings and Voltages				
Xd Dir. Axis Synchronous	3.085	2.722	2.571	2.460
X'd Dir. Axis Transient	0.356	0.314	0.297	0.284
X"d Dir. Axis Subtransient	0.238	0.210	0.198	0.190
Xq Quad. Axis Reactance	1.250	1.103	1.042	0.997
X"q Quad. Axis Subtransient	0.394	0.348	0.329	0.314
XL Stator Leakage Reactance	0.187	0.165	0.156	0.149
Xlr Rotor Leakage Reactance	0.258	0.228	0.215	0.206
X2 Negative Sequence Reactance	0.299	0.264	0.250	0.239
X0 Zero Sequence Reactance	0.207	0.183	0.172	0.165

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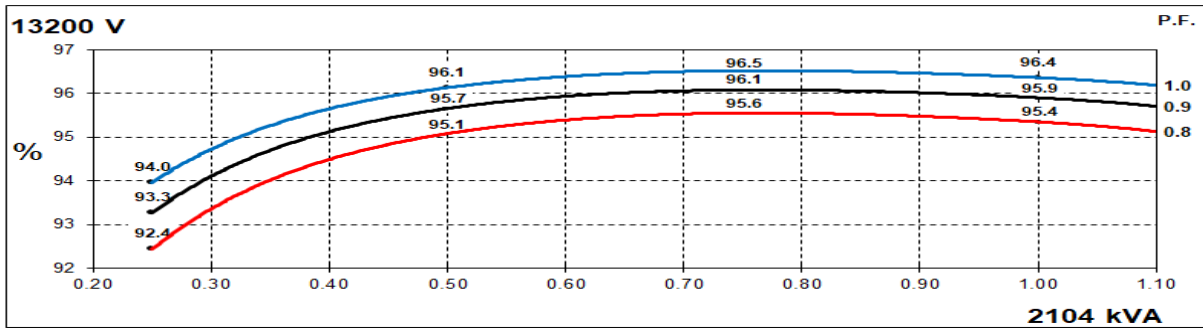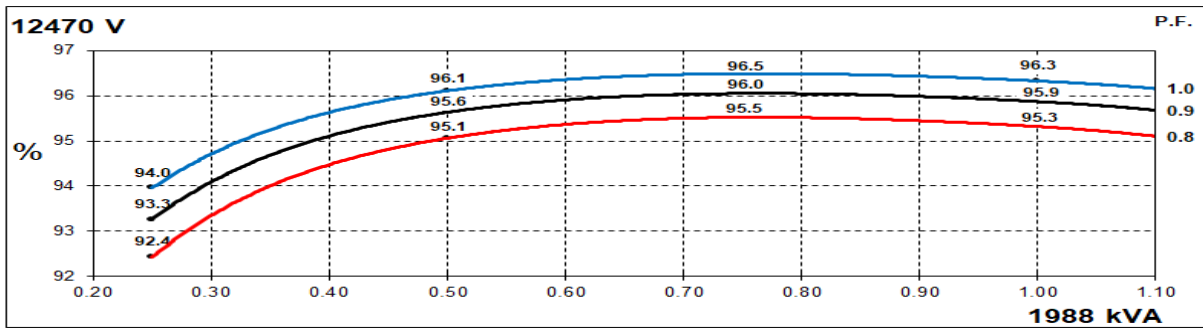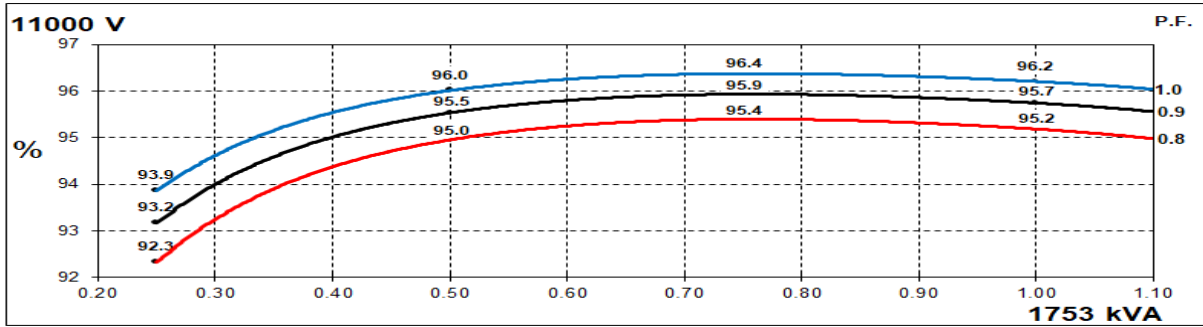
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Time Constants (Seconds)	
T'd Transient Time Const.	0.269
T''d Sub-Transient Time Const.	0.022
T'do O.C. Field Time Const.	3.042
Ta Armature Time Const.	0.050
T''q Sub-Transient Time Const.	0.026

Resistances in Ohms (Ω) at 22^{0}C	
Stator Winding Resistance (Ra), per phase for series connected	0.8940
Rotor Winding Resistance (Rf)	0.48
Exciter Stator Winding Resistance	9.8
Exciter Rotor Winding Resistance per phase	0.014
PMG Phase Resistance (Rpmg) per phase	1.91
Positive Sequence Resistance (R1)	1.1175
Negative Sequence Resistance (R2)	1.2874
Zero Sequence Resistance (R0)	1.1175

Saturation Factors	13800V
SG1.0	0.21
SG1.2	0.926

Mechanical Data		
Shaft and Keys	All alternator rotors are dynamically balanced to better than ISO 21940-11 Grade 2.5 for minimum vibration in operation. Two bearing generators are balanced with a half key.	
	1 Bearing	2 Bearing
SAE Adaptor	0, 00	0, 00, None
Moment of Inertia	65.8 kgm²	63.7 kgm²
Weight Wound Stator	1500kg	1500kg
Weight Wound Rotor	1685kg	1614kg
Weight Complete Alternator	4850kg	4800kg
Shipping weight in a Crate	5100kg	5050kg
Packing Crate Size	260 x 200 x 220(cm)	260 x 200 x 220(cm)
Maximum Over Speed	2250 RPM for two minutes	
Bearing Drive End	-	6232
Bearing Non-Drive End	6324	6324

THREE PHASE EFFICIENCY CURVES

60Hz

11000 V

P.F.

96.4
96.2
96.0
95.9 — 1.0
95.5 95.7 — 0.9
95.0 95.4 95.2 — 0.8
93.9
93.2
92.3

% (y-axis: 92, 93, 94, 95, 96, 97)
x-axis: 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 1.00, 1.10

1753 kVA

12470 V

P.F.

96.5
96.3
96.1
96.0 — 1.0
95.6 95.9 — 0.9
95.1 95.5 95.3 — 0.8
94.0
93.3
92.4

% (y-axis: 92, 93, 94, 95, 96, 97)
x-axis: 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 1.00, 1.10

1988 kVA

13200 V

P.F.

96.5
96.4
96.1
96.1 — 1.0
95.7 95.9 — 0.9
95.1 95.6 95.4 — 0.8
94.0
93.3
92.4

% (y-axis: 92, 93, 94, 95, 96, 97)
x-axis: 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 1.00, 1.10

2104 kVA

13800 V

P.F.

96.5
96.4
96.1
96.1 — 1.0
95.7 95.9 — 0.9
95.1 95.6 95.4 — 0.8
94.0
93.3
92.4

% (y-axis: 92, 93, 94, 95, 96, 97)
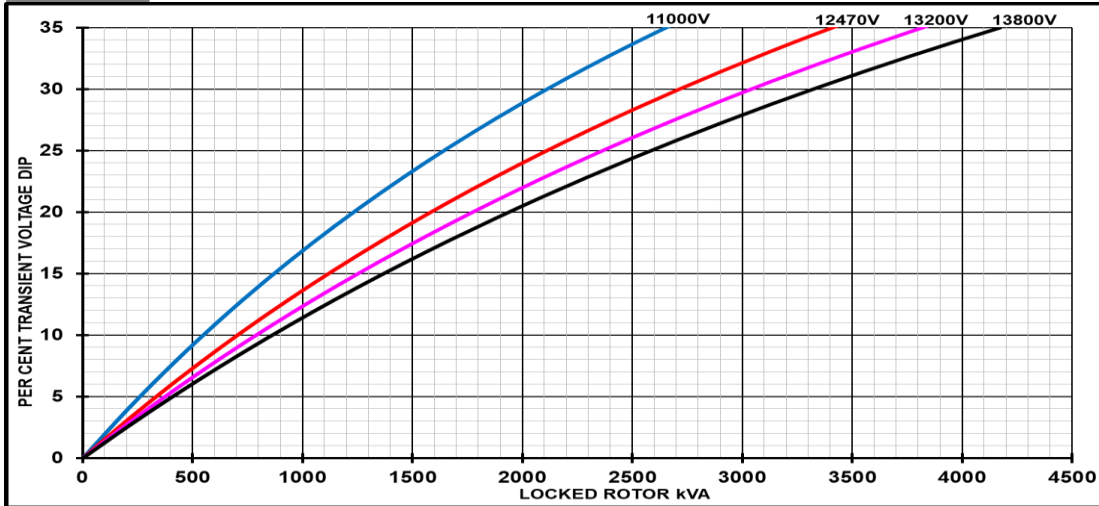x-axis: 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 1.00, 1.10

2200 kVA

Locked Rotor Motor Starting Curves - Separately Excited

60Hz

| Transient Voltage Dip Scaling Factor		Transient Voltage Rise Scaling Factor	
Lagging PF	Scaling Factor	Lagging PF	Scaling Factor
<= 0.4	1.00	<= 0.4	1.25
0.5	0.95	0.5	1.20
0.6	0.90	0.6	1.15
0.7	0.86	0.7	1.10
0.8	0.83	> 0.7	1.00
0.9	0.75		
0.95	0.70		
1	0.65		

Note: To determine % Transient Voltage Dip or Voltage Rise at various PF, multiply the % Voltage Dip from the curve directly by the Scaling Factor.

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Three-phase Short Circuit Decrement Curve - Separately Excited
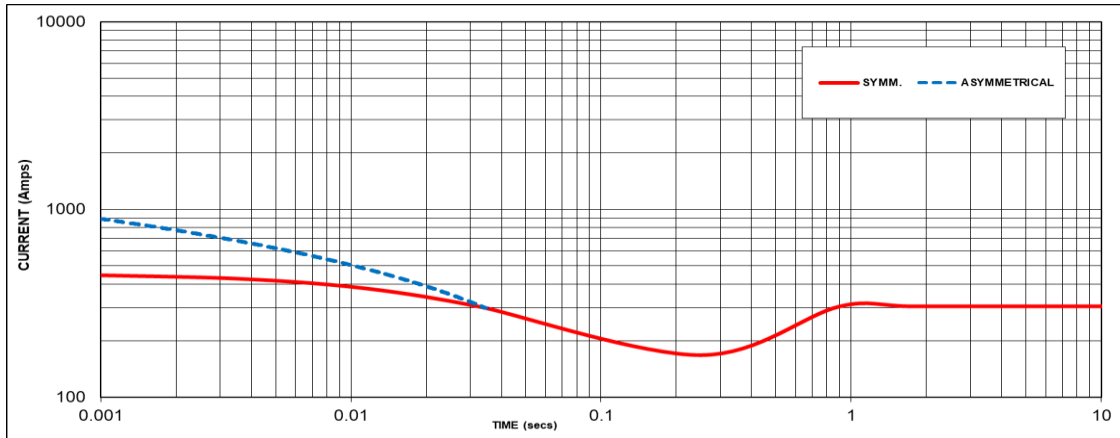
60Hz

Sustained Short Circuit = 304 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
-	-	11000V	X 1.00
-	-	12470V	X 1.13
-	-	13200V	X 1.20
-	-	13800V	X 1.25

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.

Note 3   All other times are unchanged

Curves are drawn for Star connections under no-load excitation at rated speeds. For other connection (where applicable) the following multipliers should be applied to current values as shown :
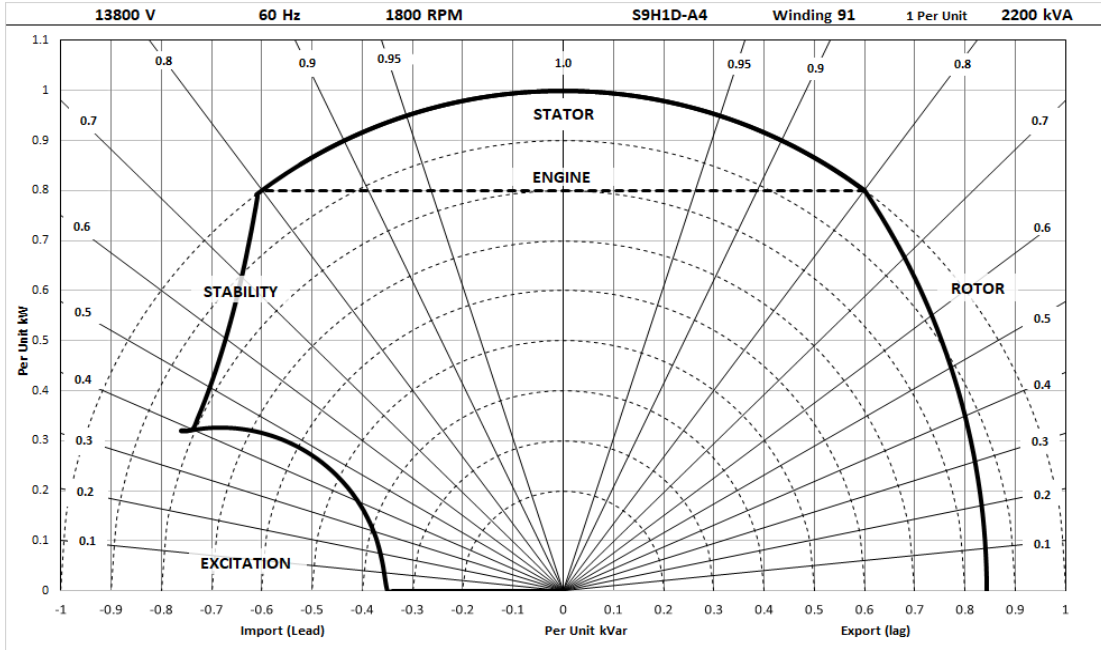Parallel Star = Curve current value X 2
Series Delta = Curve current value X 1.732

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Typical Alternator Operating Charts

13800V/60Hz

| 13800 V | 60 Hz | 1800 RPM | S9H1D-A4 | Winding 91 | 1 Per Unit | 2200 kVA |

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RATINGS AT 0.8 POWER FACTOR

Class - Temp Rise	Standby - 150/40°C				Cont. H - 125/40°C				Cont. F - 105/40°C				Cont. B - 80/40°C			
50 Hz Star (V)	N/A				N/A				N/A				N/A			
Parallel Star (V)	N/A				N/A				N/A				N/A			
Delta (V)	N/A				N/A				N/A				N/A			
kVA	N/A				N/A				N/A				N/A			
kW	N/A				N/A				N/A				N/A			
Efficiency (%)	N/A				N/A				N/A				N/A			
kW Input	N/A				N/A				N/A				N/A			

Class - Temp Rise	Standby - 150/40°C				Cont. H - 125/40°C				Cont. F - 105/40°C				Cont. B - 80/40°C			
60 Hz Star (V)	11000	12470	13200	13800	11000	12470	13200	13800	11000	12470	13200	13800	11000	12470	13200	13800
Parallel Star (V)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Delta (V)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
kVA	1876	2127	2251	2354	1753	1988	2104	2200	1613	1829	1936	2024	1402	1590	1683	1760
kW	1501	1702	1801	1883	1402	1590	1683	1760	1290	1463	1549	1619	1122	1272	1346	1408
Efficiency (%)	95.1	95.2	95.2	95.2	95.2	95.3	95.4	95.4	95.3	95.4	95.5	95.5	95.4	95.5	95.6	95.6
kW Input	1579	1788	1891	1978	1473	1669	1765	1846	1354	1533	1622	1696	1176	1332	1409	1473

De-rates

All values tabulated above are subject to the following reductions:
- 5% when air inlet filters are fitted
- 3% for every 500 meters by which the operating altitude exceeds 1000 meters above mean sea level
- 3% for every 5°C by which the operational ambient temperature exceeds 40°C @ Class H temperature rise
  (please refer to applications for ambient temperature de-rates at other temperature rise classes)
- For marine alternators, 3% for every 5°C by which the operational ambient temperature exceeds 50°C
- For any other operating conditions impacting the cooling circuit please refer to applications

Note: Requirement for operating in an ambient exceeding 60°C and altitude exceeding 4000 meters (for <690V) or 1500 meters (for >690V) must be referred to applications.

Dimensional and Torsional Drawing

For dimensional and torsional information please refer to the alternator General Arrangement and rotor drawings available on our website (http://stamford-avk.com/)

Note: Continuous development of our products means that the information contained in our data sheets can change without notice, and specifications should always be confirmed with Cummins Generator Technologies prior to purchase.

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