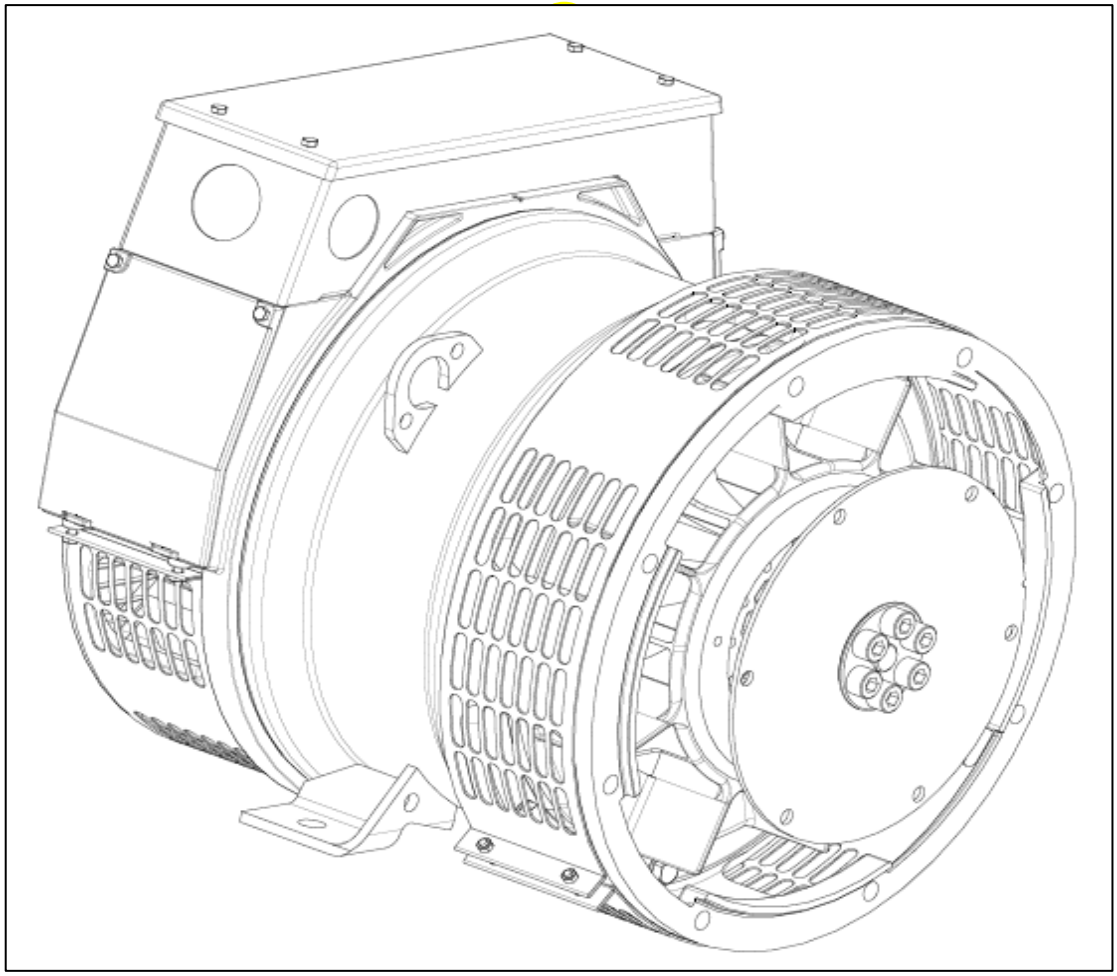
STAMFORD®

PI044D - 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 REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the 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 AS480 will support limited accessories, RFI suppression remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

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 at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

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 9 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.

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

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WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

INSULATION SYSTEM	CLASS H							
PROTECTION	IP23							
RATED POWER FACTOR	0.8							
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	2.1 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.437 Ohms at 22°C							
EXCITER STATOR RESISTANCE	17.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.211 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	75 kg		73.3 kg		78 kg		76.3 kg	
WEIGHT WOUND STATOR	24 kg		24 kg		24 kg		24 kg	
WEIGHT WOUND ROTOR	26.32 kg		24.61 kg		27.32 kg		25.62 kg	
WR² INERTIA	0.0893 kgm^2		0.0876 kgm^2		0.0895 kgm^2		0.0878 kgm^2	
SHIPPING WEIGHTS in a crate	92 kg		90.3 kg		101 kg		99.3 kg	
PACKING CRATE SIZE	71 x 51 x 67 (cm)				71 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.110 m³/sec 233cfm				0.135 m³/sec 286 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	7.5	7.5	7.5	7.1	8.3	8.8	9.1	9.4
Xd DIR. AXIS SYNCHRONOUS	1.62	1.46	1.36	1.14	1.94	1.84	1.74	1.65
X'd DIR. AXIS TRANSIENT	0.17	0.15	0.14	0.12	0.19	0.18	0.17	0.16
X''d DIR. AXIS SUBTRANSIENT	0.11	0.10	0.09	0.08	0.13	0.12	0.12	0.11
Xq QUAD. AXIS REACTANCE	0.78	0.70	0.65	0.55	0.93	0.88	0.83	0.79
X''q QUAD. AXIS SUBTRANSIENT	0.17	0.15	0.14	0.12	0.20	0.19	0.18	0.17
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.07	0.07	0.06	0.06
X_2 NEGATIVE SEQUENCE	0.14	0.13	0.12	0.10	0.17	0.16	0.15	0.14
X_0 ZERO SEQUENCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.006 s							
T''d SUB-TRANSTIME CONST.	0.002 s							
T'do O.C. FIELD TIME CONST.	0.15 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

50 Hz

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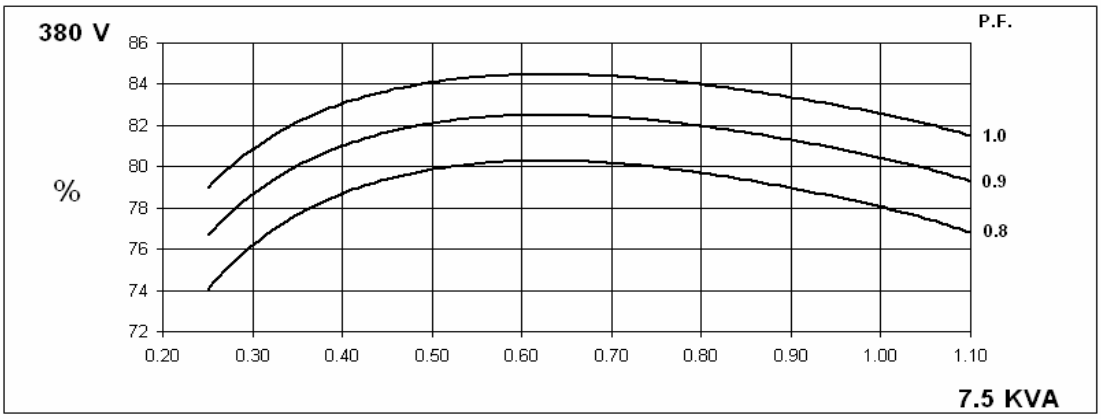
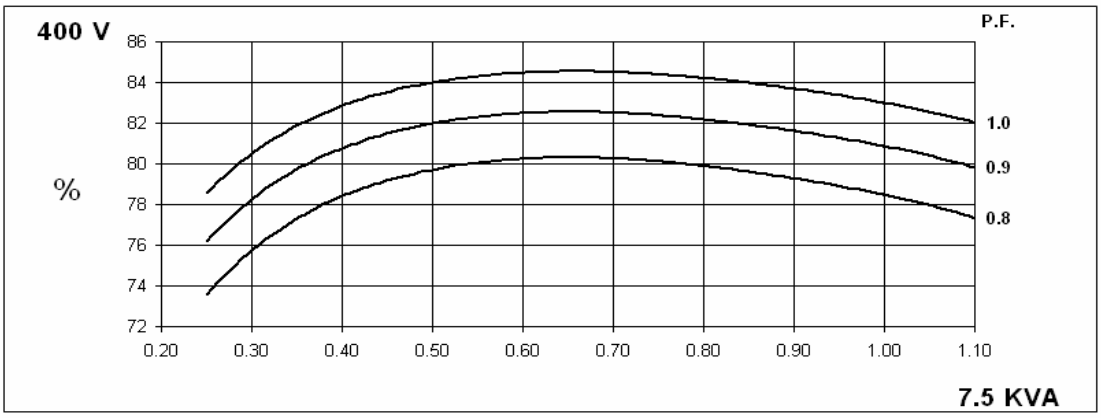
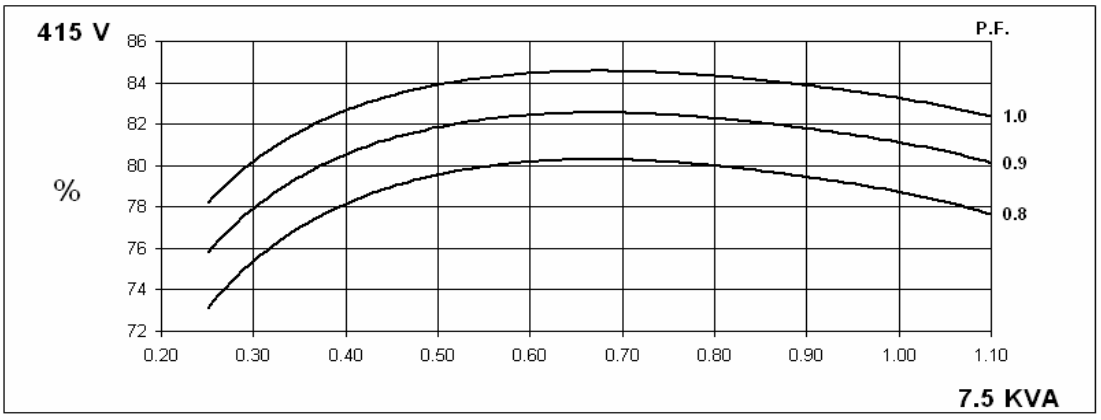
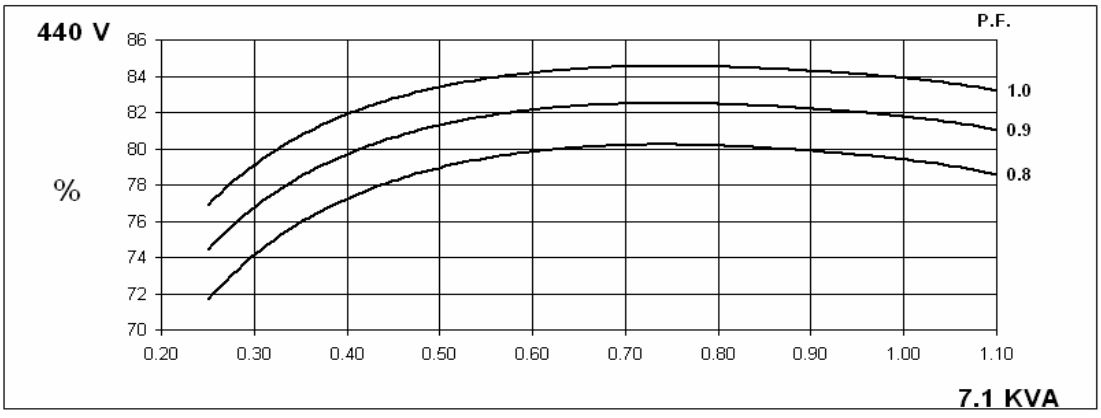
Winding 311

THREE PHASE EFFICIENCY CURVES







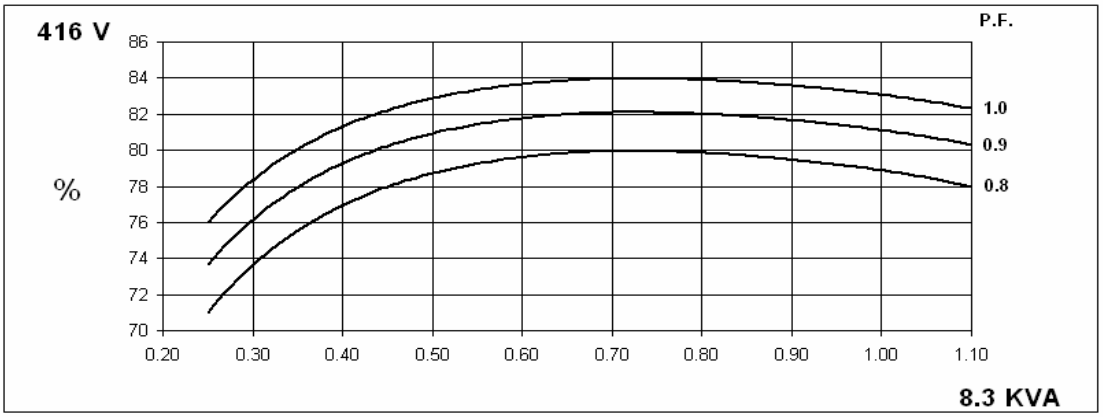


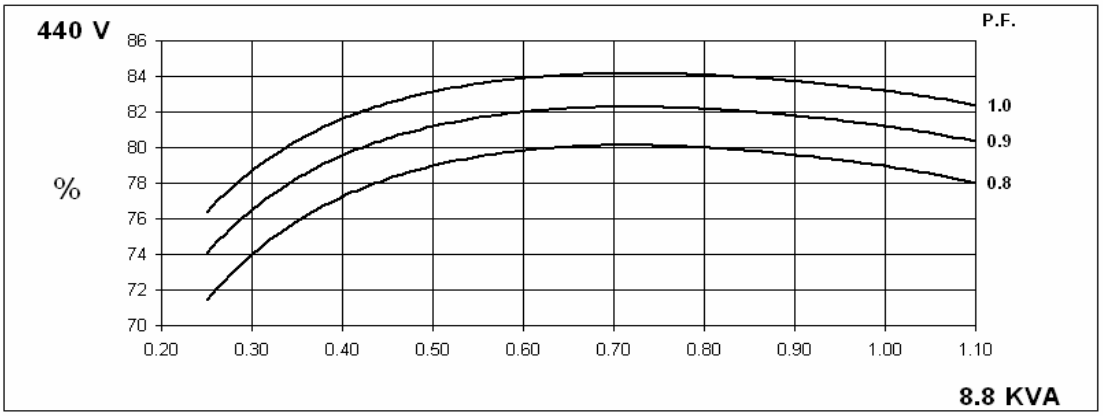
60 Hz

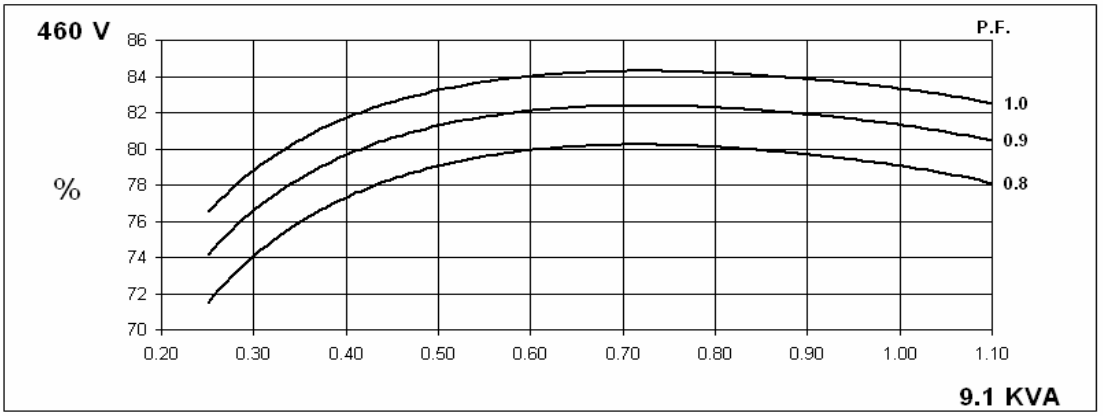
PI044D

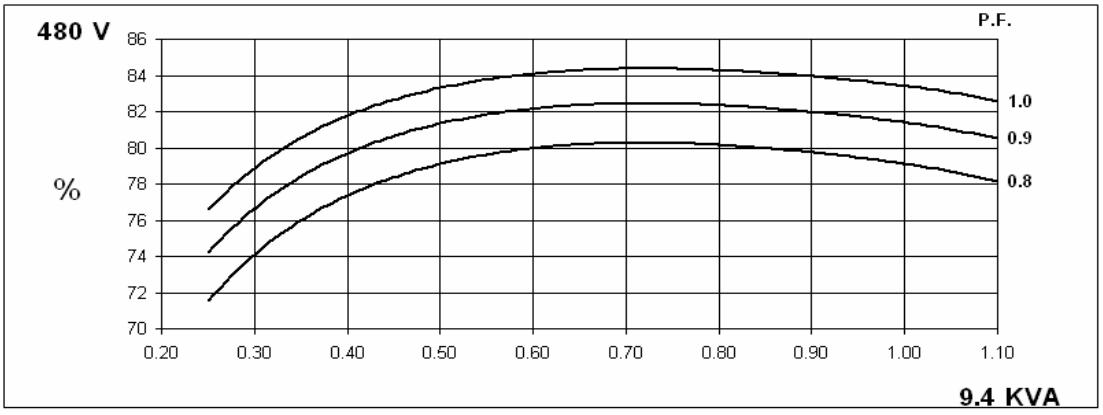
Winding 311

THREE PHASE EFFICIENCY CURVES



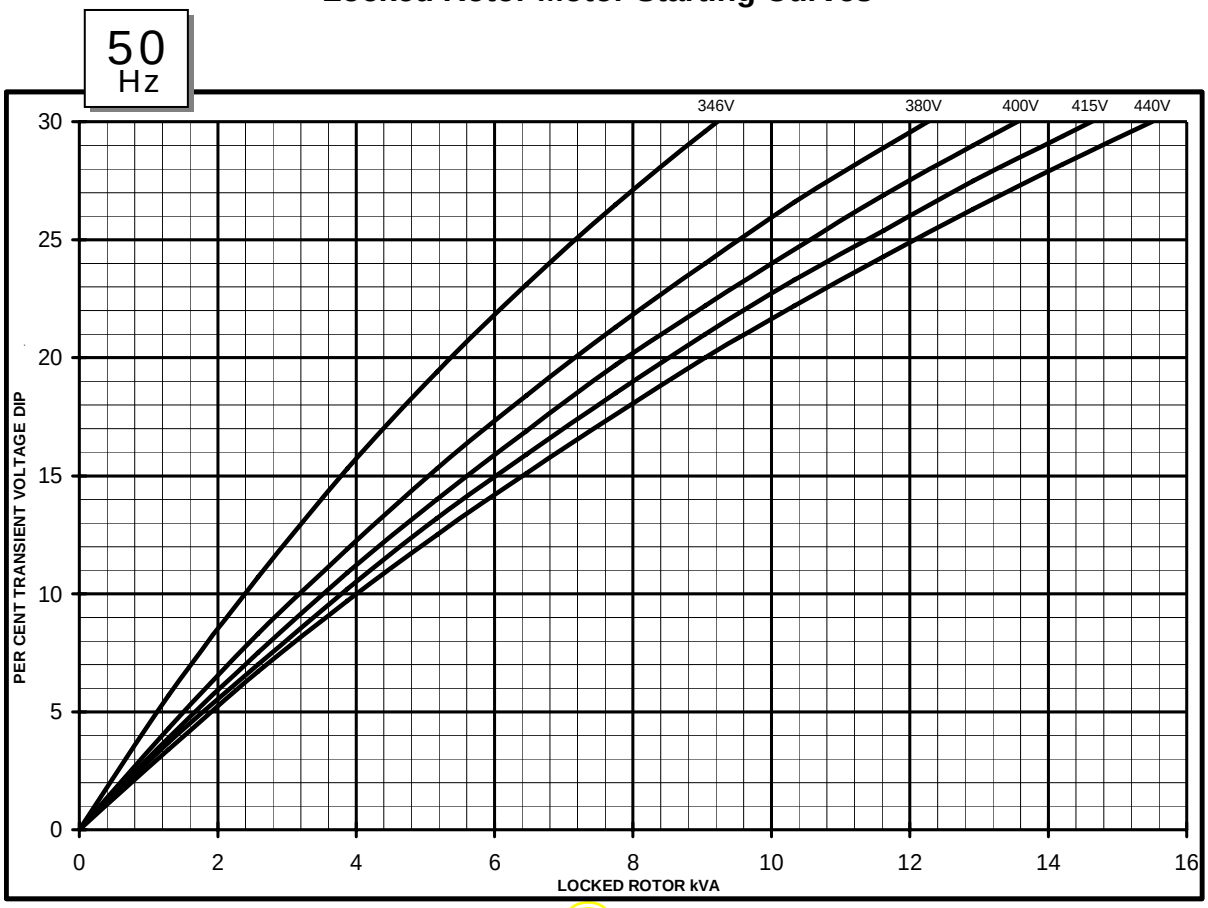


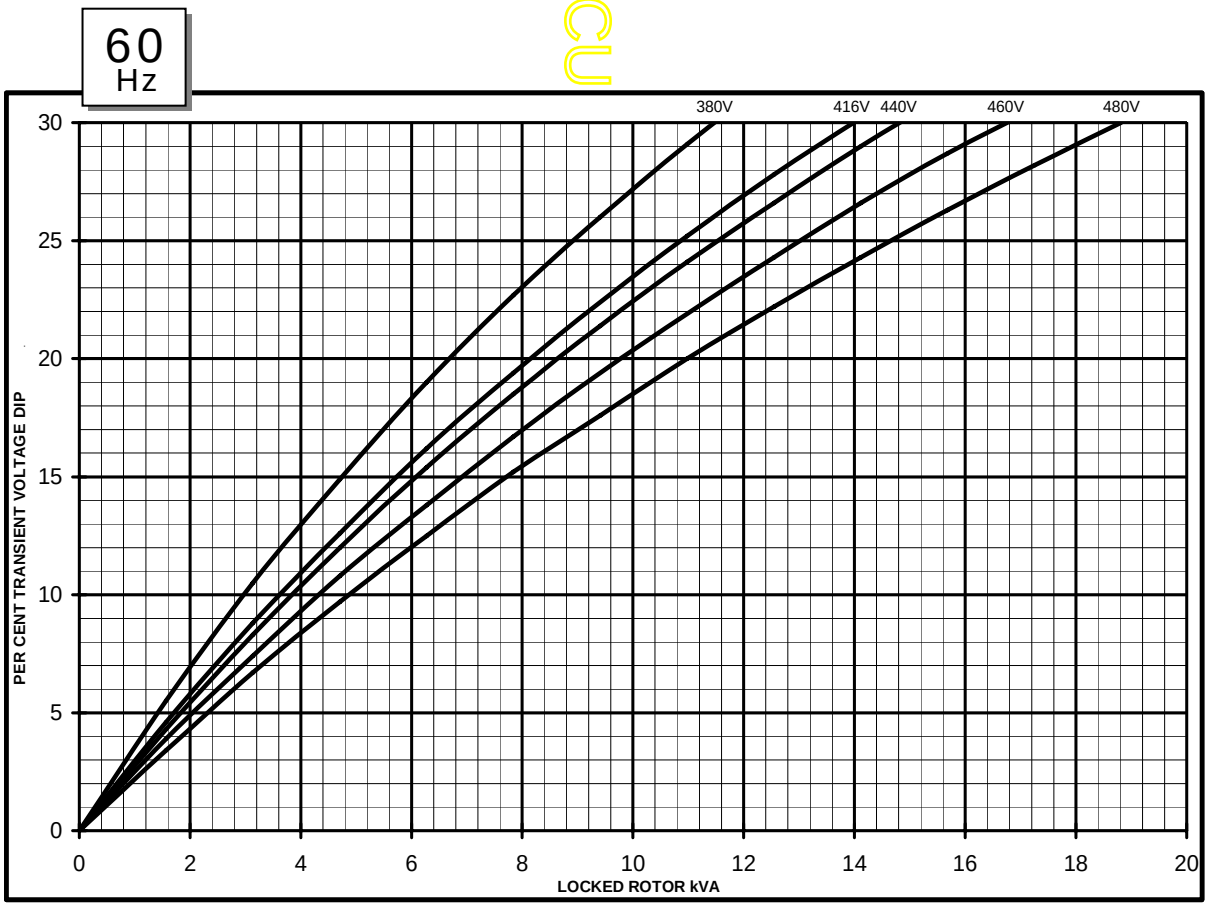




PI044D

Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves





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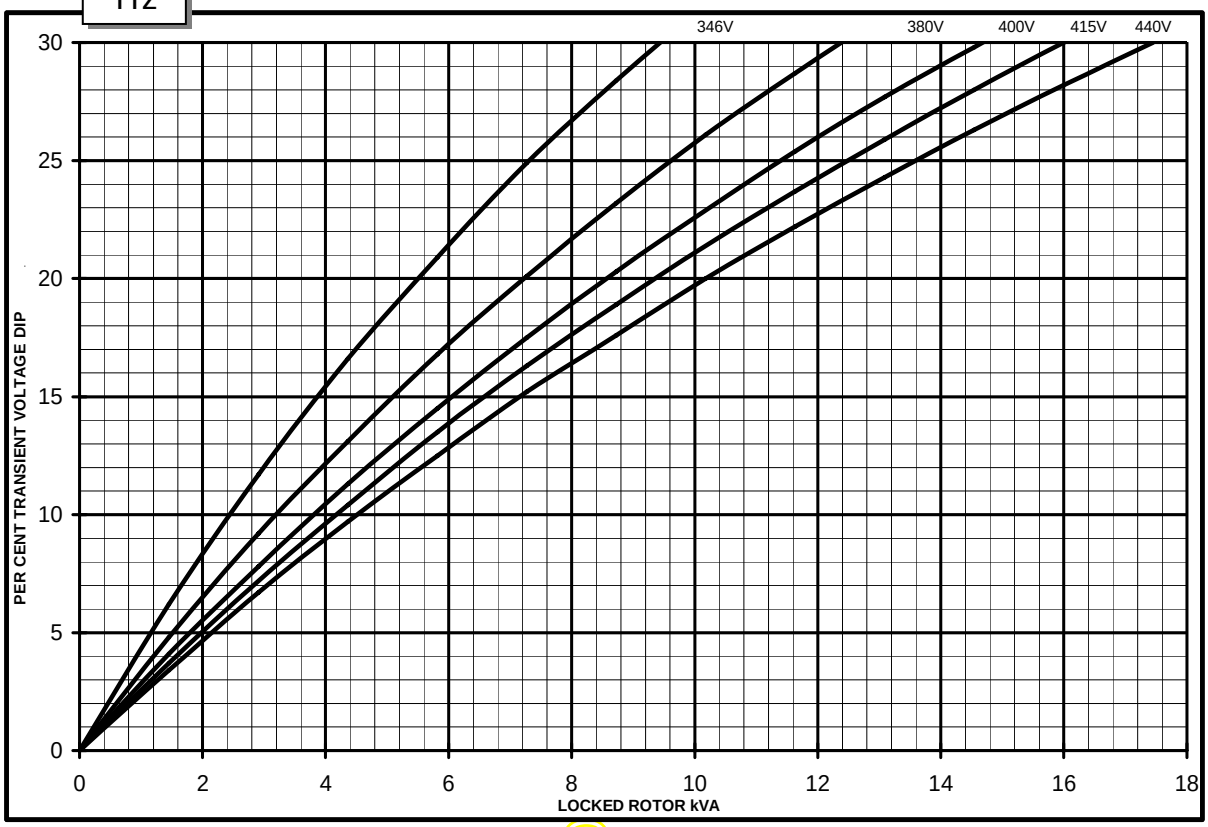
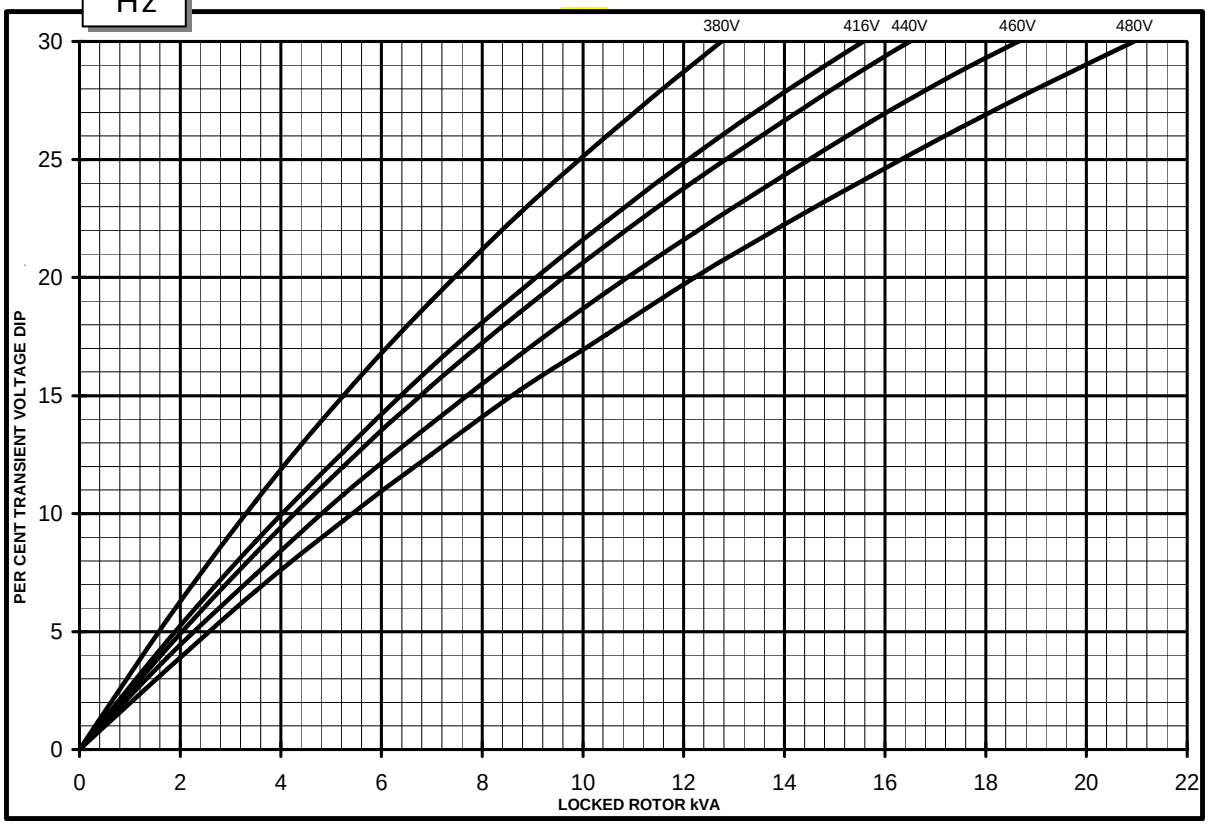
Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves

50 Hz



60 Hz



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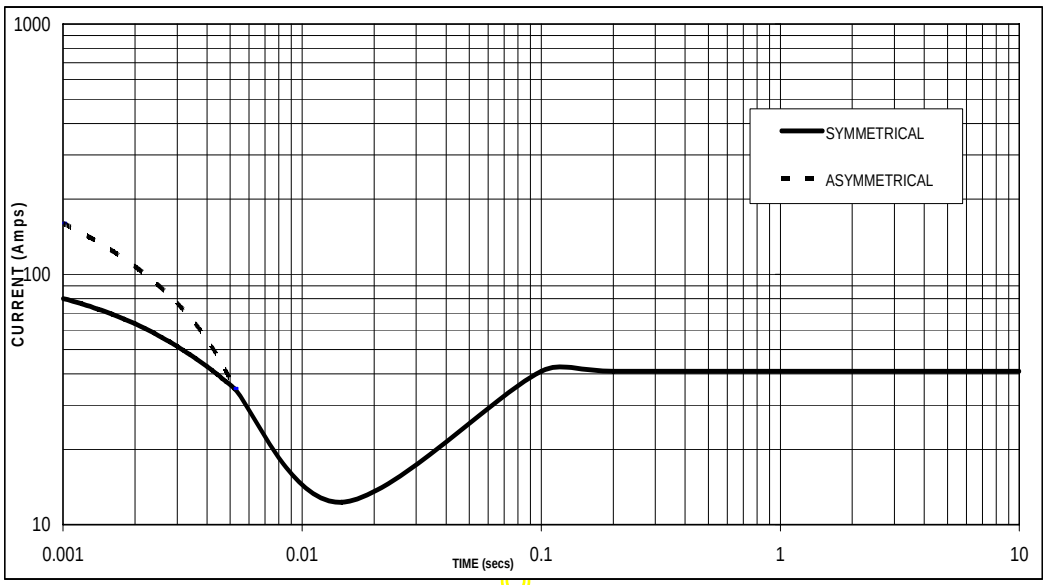
WITH EBS FITTED

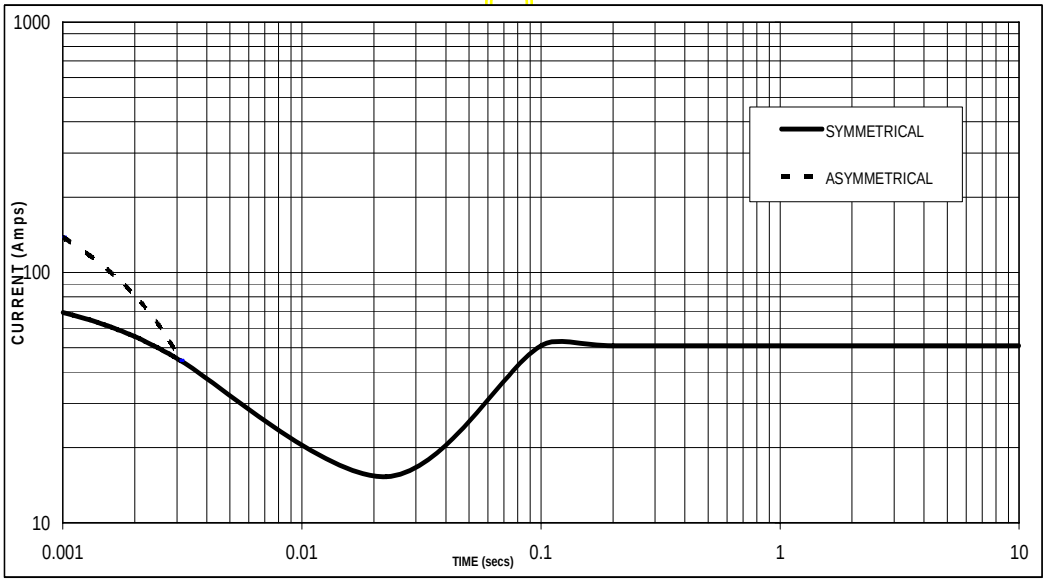
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 41 Amps

60 Hz



Sustained Short Circuit = 51 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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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Winding 311 / 0.8 Power Factor

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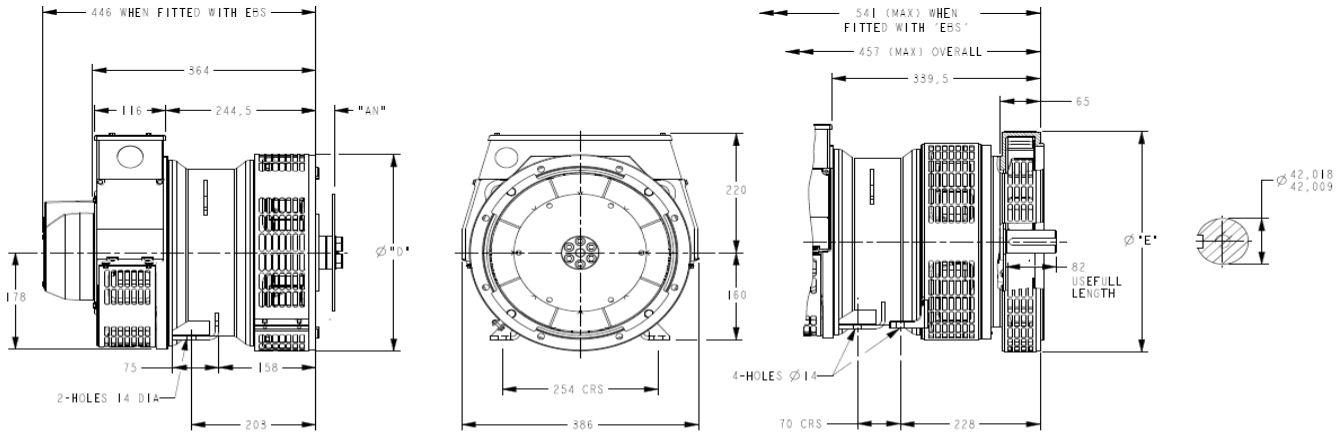
RATINGS

	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	6.8	6.8	6.8	6.5	7.5	7.5	7.5	7.1	8.1	8.1	8.1	7.7	8.3	8.3	8.3	7.8
	kW	5.4	5.4	5.4	5.2	6.0	6.0	6.0	5.7	6.5	6.5	6.5	6.2	6.6	6.6	6.6	6.2
	Efficiency (%)	79.0	79.3	79.5	79.9	78.0	78.5	78.7	79.4	77.1	77.7	78.0	78.8	76.8	77.4	77.7	78.7
	kW Input	6.9	6.9	6.8	6.5	7.7	7.6	7.6	7.2	8.4	8.3	8.3	7.8	8.6	8.6	8.5	7.9
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	7.5	8.0	8.2	8.5	8.3	8.8	9.1	9.4	8.9	9.5	9.8	10.1	9.1	9.7	10.0	10.3
	kW	6.0	6.4	6.6	6.8	6.6	7.0	7.3	7.5	7.1	7.6	7.8	8.1	7.3	7.8	8.0	8.2
	Efficiency (%)	79.5	79.6	79.7	79.8	78.9	79.0	79.1	79.1	78.3	78.3	78.4	78.5	78.1	78.1	78.2	78.3
	kW Input	7.5	8.0	8.2	8.5	8.4	8.9	9.2	9.5	9.1	9.7	10.0	10.3	9.3	9.9	10.2	10.5

DIMENSIONS



COUPLING DISC	
SAE	"AN"
6.5	30.2
7.5	30.2
8	62
10	53.8
11.5	39.6

1-BRG APAPTOR	
SAE	Ø"D"
5	361
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG APAPTOR	
SAE	Ø"E"
5	359
4	406
3	455
2	493

APPROVED DOCUMENT

STAMFORD

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www.cumminsgeneratortechnologies.com

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PI044E - Winding 311

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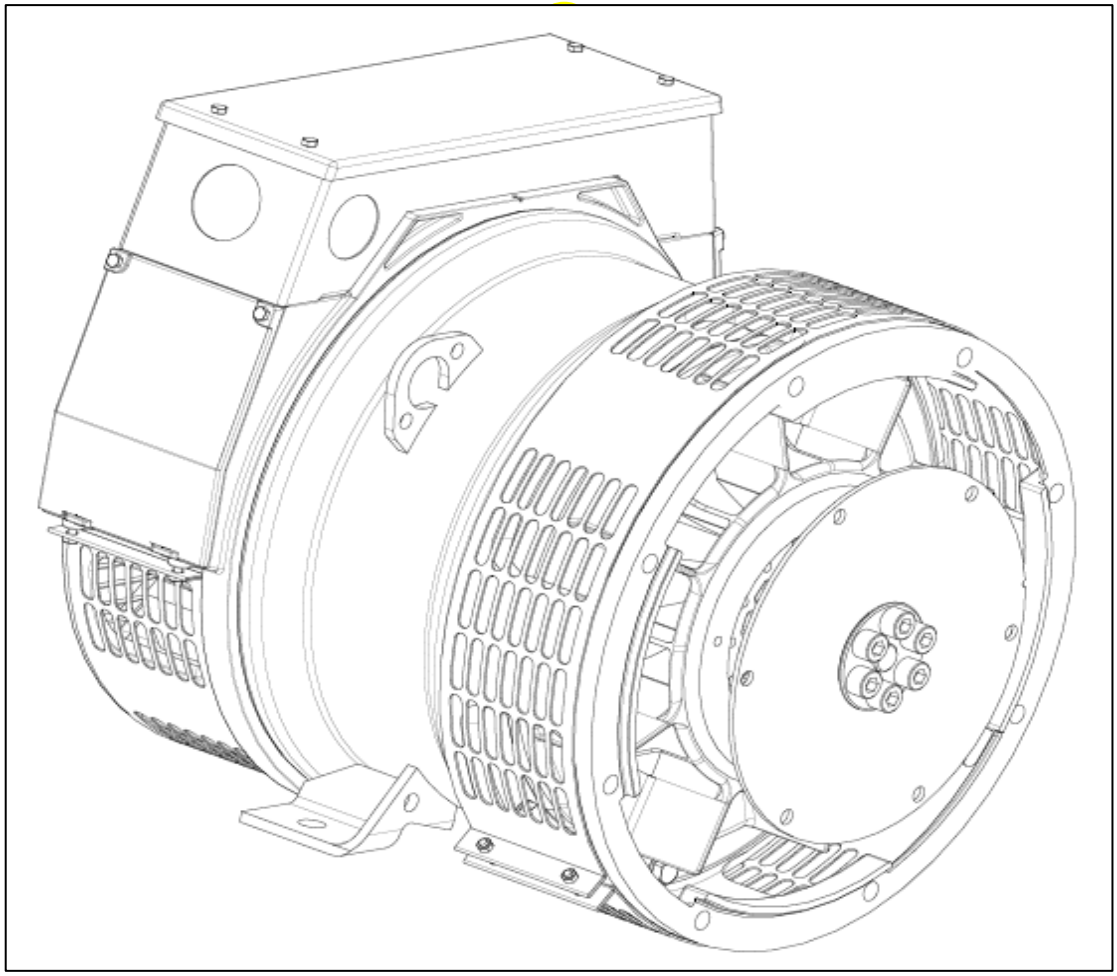

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(Standard rotation CW when viewed from DE)

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Front cover drawing typical of product range.

PI044E

STAMFORD

WINDING 311

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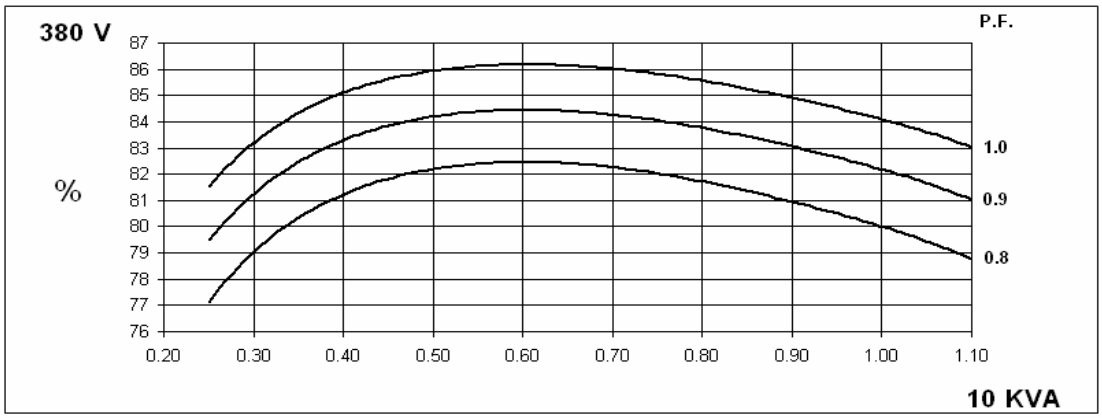
INSULATION SYSTEM	CLASS H							
PROTECTION	IP23							
RATED POWER FACTOR	0.8							
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	1.327 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.415 Ohms at 22°C							
EXCITER STATOR RESISTANCE	17.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.211 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	80 kg		78.3 kg		83 kg		81.3 kg	
WEIGHT WOUND STATOR	27 kg		27 kg		27 kg		27 kg	
WEIGHT WOUND ROTOR	27.87 kg		26.17 kg		28.87 kg		27.17 kg	
WR² INERTIA	0.0953 kgm^2		0.0952 kgm^2		0.097 kgm^2		0.0953 kgm^2	
SHIPPING WEIGHTS in a crate	100 kg		98.3 kg		109 kg		107.3 kg	
PACKING CRATE SIZE	71 x 51 x 67 (cm)				71 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.110 m³/sec 233cfm				0.135 m³/sec 286 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	10	10	10	9.5	11	11.8	12.1	12.5
Xd DIR. AXIS SYNCHRONOUS	1.86	1.68	1.56	1.32	2.20	2.11	1.98	1.88
X'd DIR. AXIS TRANSIENT	0.19	0.17	0.16	0.13	0.22	0.21	0.20	0.19
X''d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.09	0.15	0.14	0.13	0.13
Xq QUAD. AXIS REACTANCE	0.89	0.80	0.74	0.63	1.06	1.02	0.95	0.90
X''q QUAD. AXIS SUBTRANSIENT	0.19	0.17	0.16	0.13	0.23	0.22	0.21	0.20
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	0.11	0.19	0.18	0.17	0.16
X_0 ZERO SEQUENCE	0.08	0.07	0.07	0.05	0.09	0.09	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.007 s							
T''d SUB-TRANSTIME CONST.	0.002 s							
T'do O.C. FIELD TIME CONST.	0.17 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

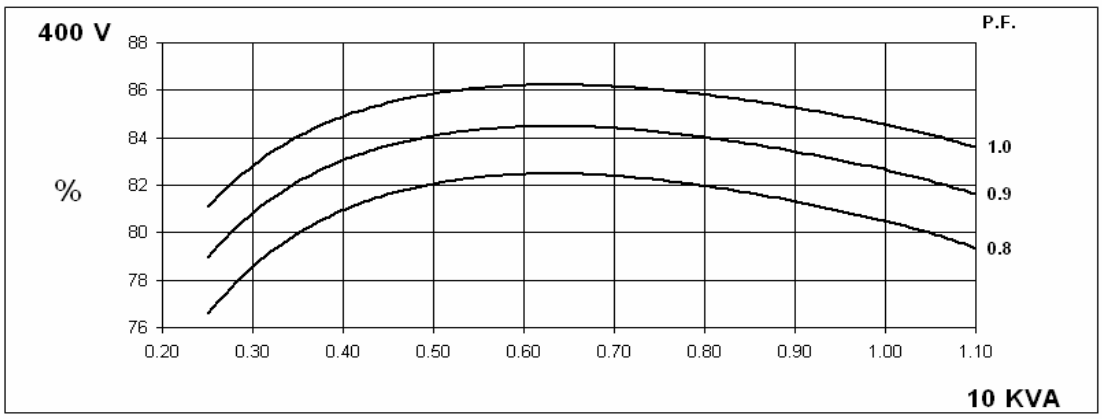
50 Hz

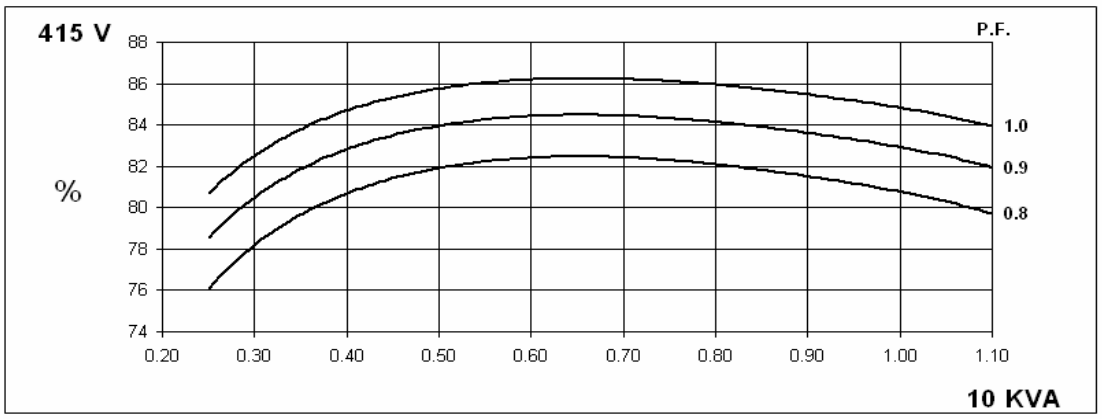
PI044E

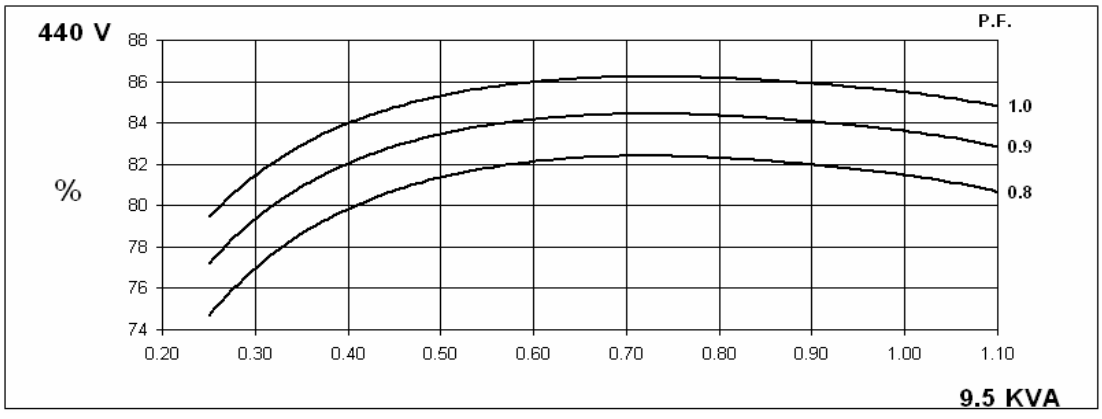
Winding 311

THREE PHASE EFFICIENCY CURVES







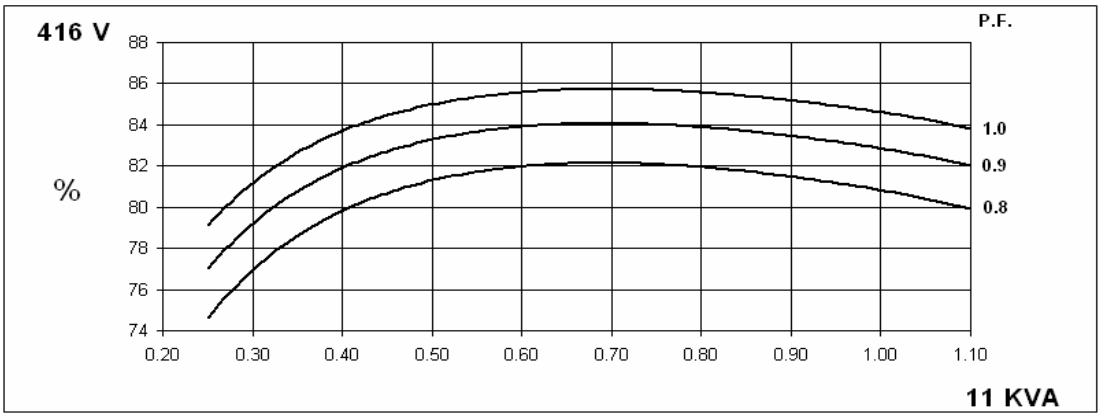


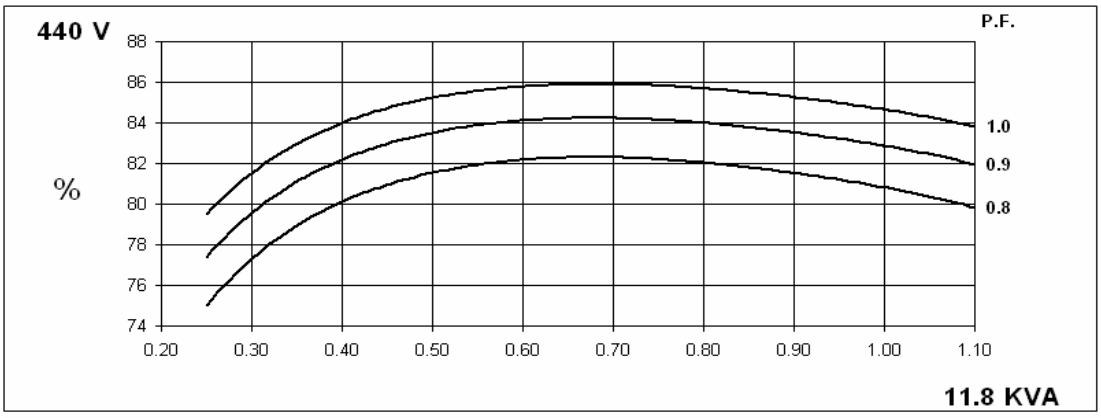
60 Hz

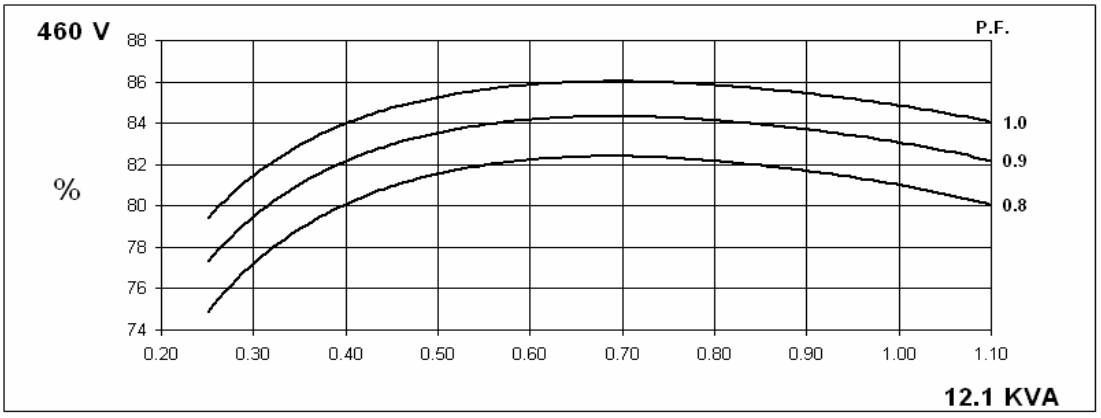
PI044E

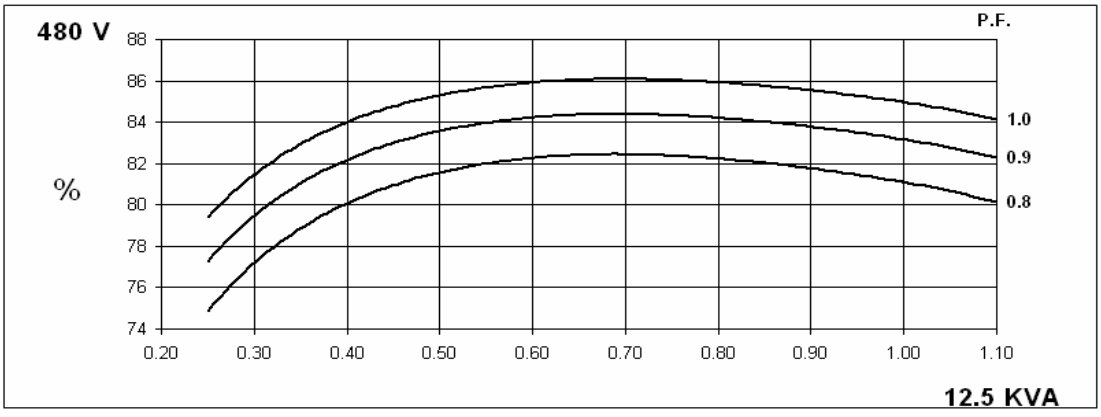
Winding 311

THREE PHASE EFFICIENCY CURVES



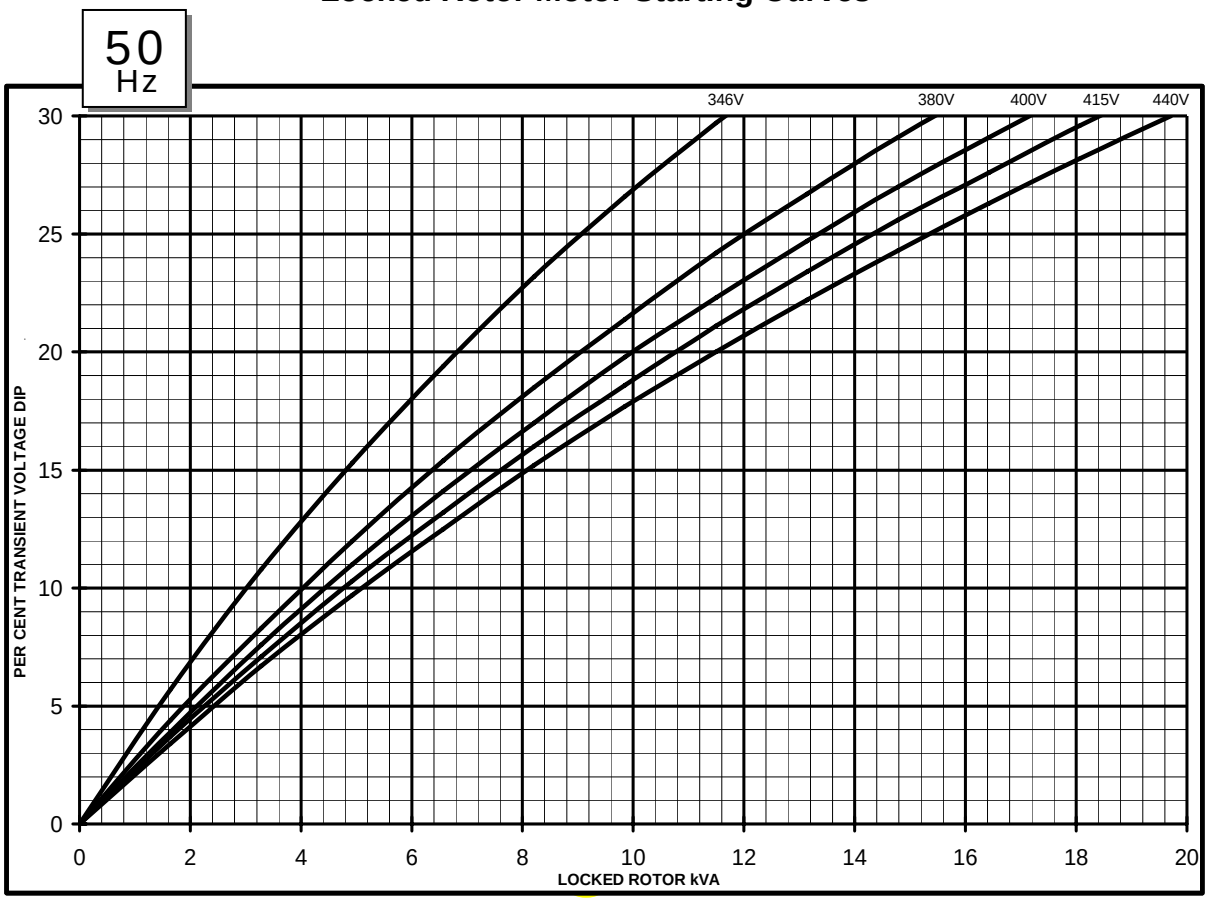


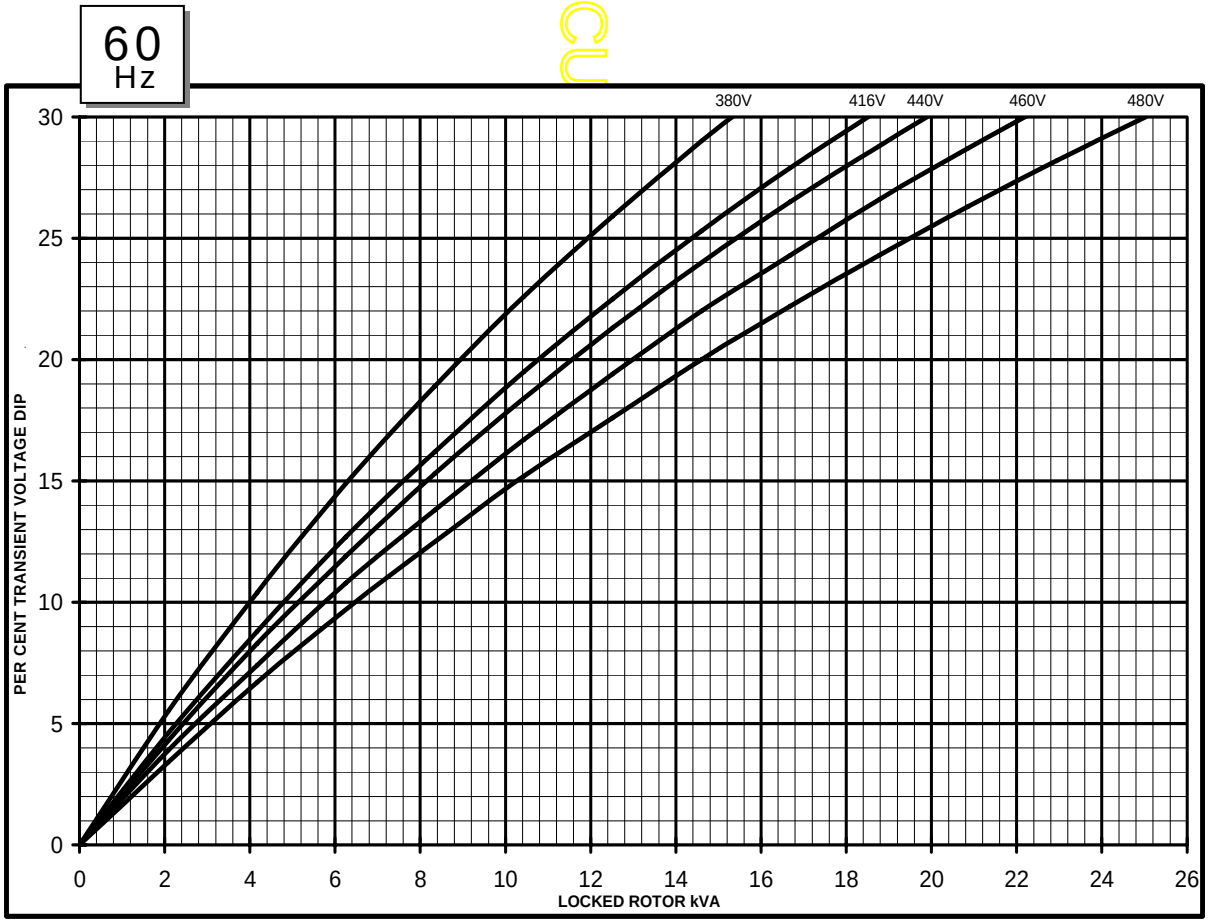




PI044E

Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

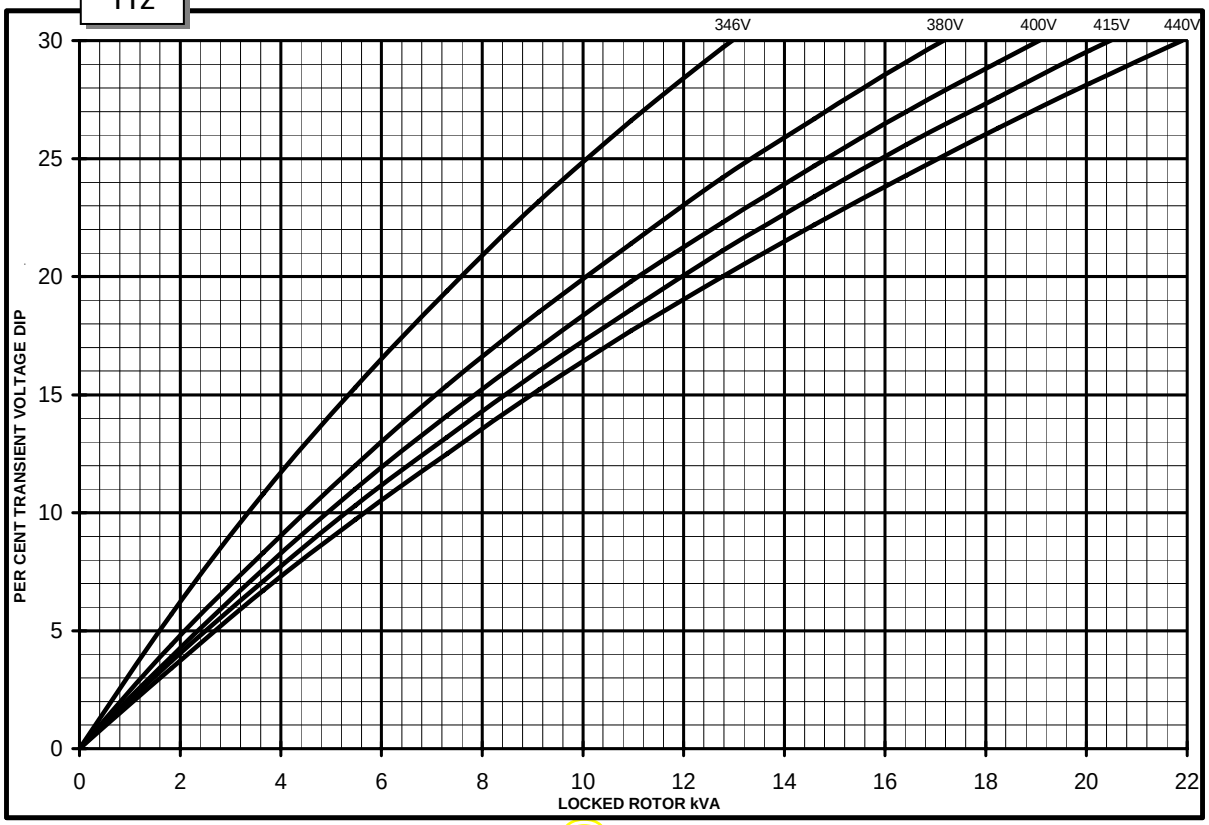




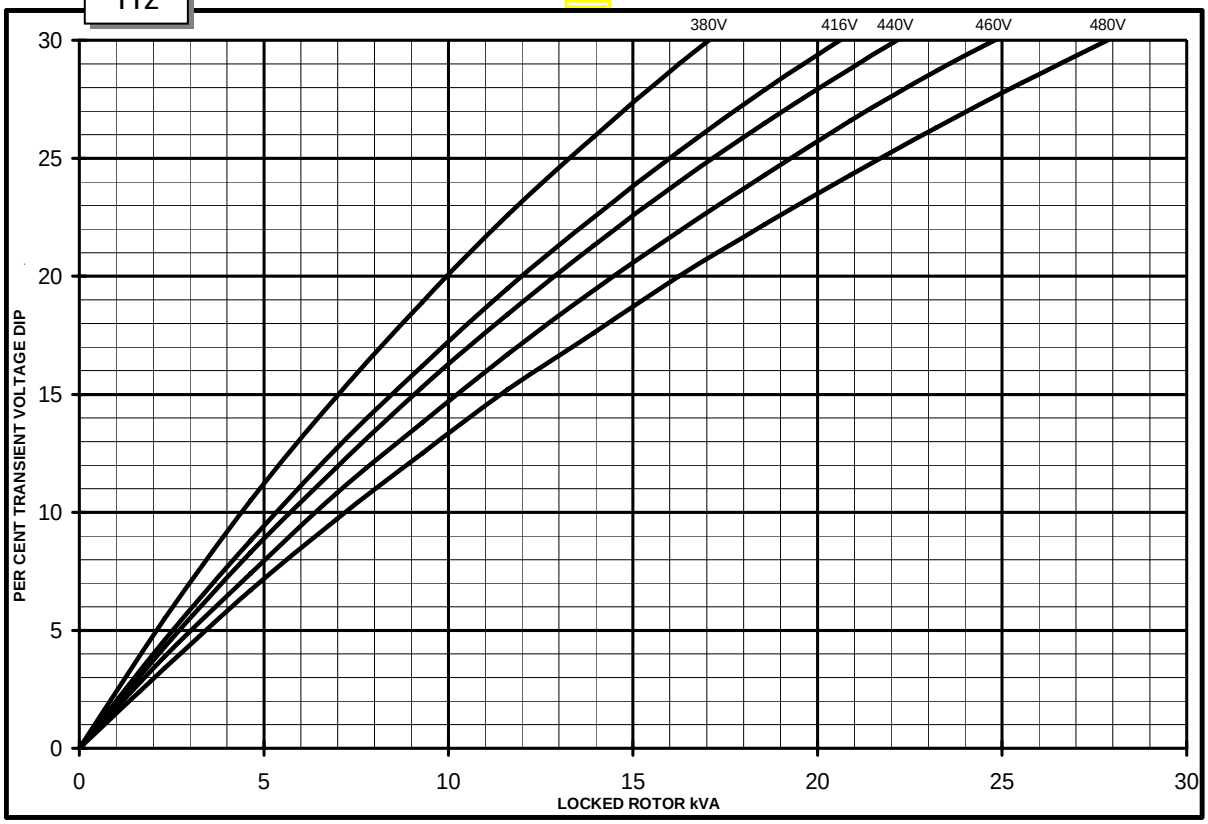
PI044E

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves

50 Hz



60 Hz

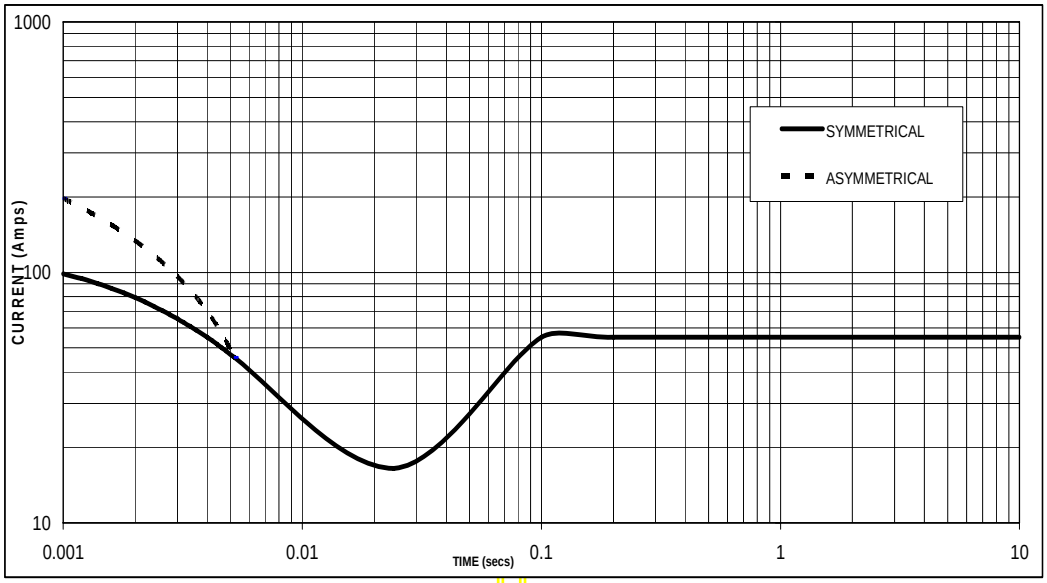


PI044E

WITH EBS FITTED

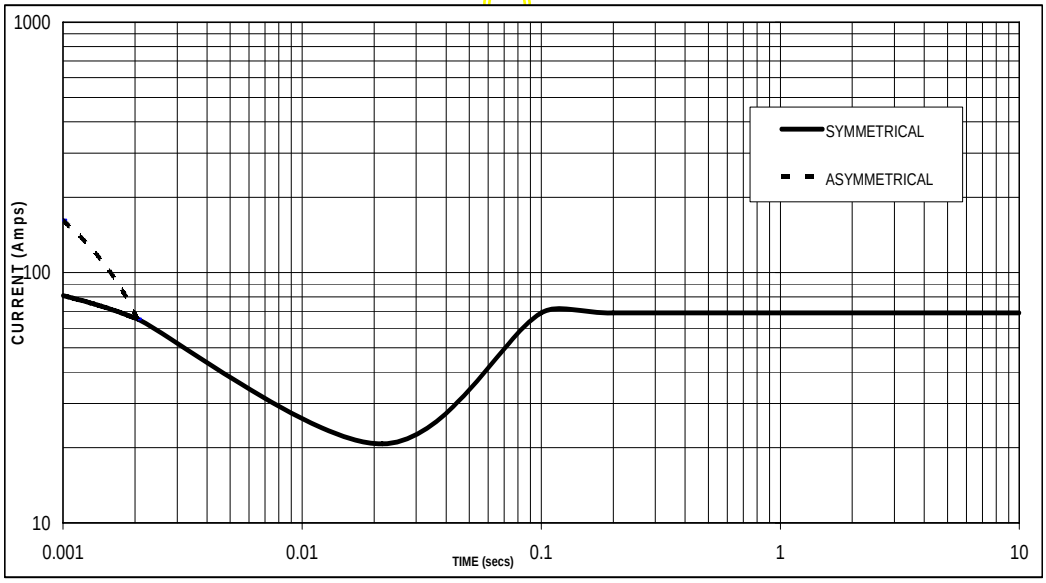
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 55 Amps

60 Hz



Sustained Short Circuit = 69 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI044E

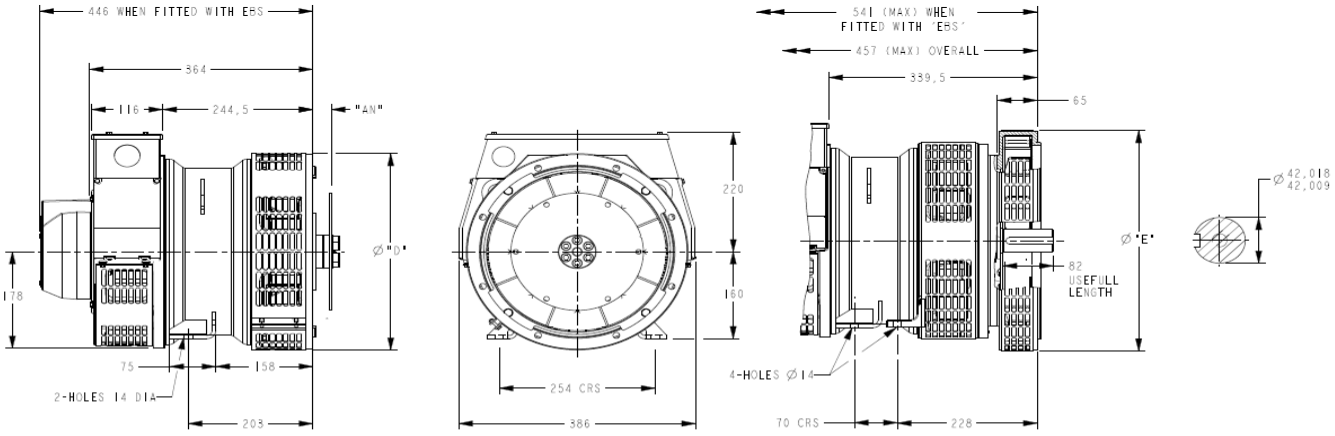
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	9.1	9.1	9.1	8.6	10.0	10.0	10.0	9.5	10.8	10.8	10.8	10.3	11.0	11.0	11.0	10.5
	kW	7.3	7.3	7.3	6.9	8.0	8.0	8.0	7.6	8.6	8.6	8.6	8.2	8.8	8.8	8.8	8.4
	Efficiency (%)	80.9	81.3	81.5	82.0	80.0	80.5	80.8	81.5	79.1	79.7	80.0	80.9	78.8	79.4	79.8	80.7
	kW Input	9.0	9.0	8.9	8.4	10.0	9.9	9.9	9.3	10.9	10.8	10.8	10.2	11.2	11.1	11.0	10.4

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	10.0	10.7	11.0	11.4	11.0	11.8	12.1	12.5	11.9	12.7	13.1	13.5	12.1	12.9	13.3	13.8
	kW	8.0	8.6	8.8	9.1	8.8	9.4	9.7	10.0	9.5	10.2	10.5	10.8	9.7	10.3	10.6	11.0
	Efficiency (%)	81.4	81.5	81.7	81.7	80.8	80.8	81.0	81.1	80.1	80.1	80.3	80.4	80.0	80.0	80.1	80.1
	kW Input	9.8	10.5	10.8	11.2	10.9	11.7	11.9	12.3	11.9	12.7	13.1	13.4	12.1	12.9	13.3	13.8

DIMENSIONS



COUPLING DISC	
SAE	"AN"
6.5	30.2
7.5	30.2
8	62
10	53.8
11.5	39.6

1-BRG APAPTOR	
SAE	Ø"D"
5	361
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG APAPTOR	
SAE	Ø"E"
5	359
4	406
3	455
2	493

APPROVED DOCUMENT

STAMFORD

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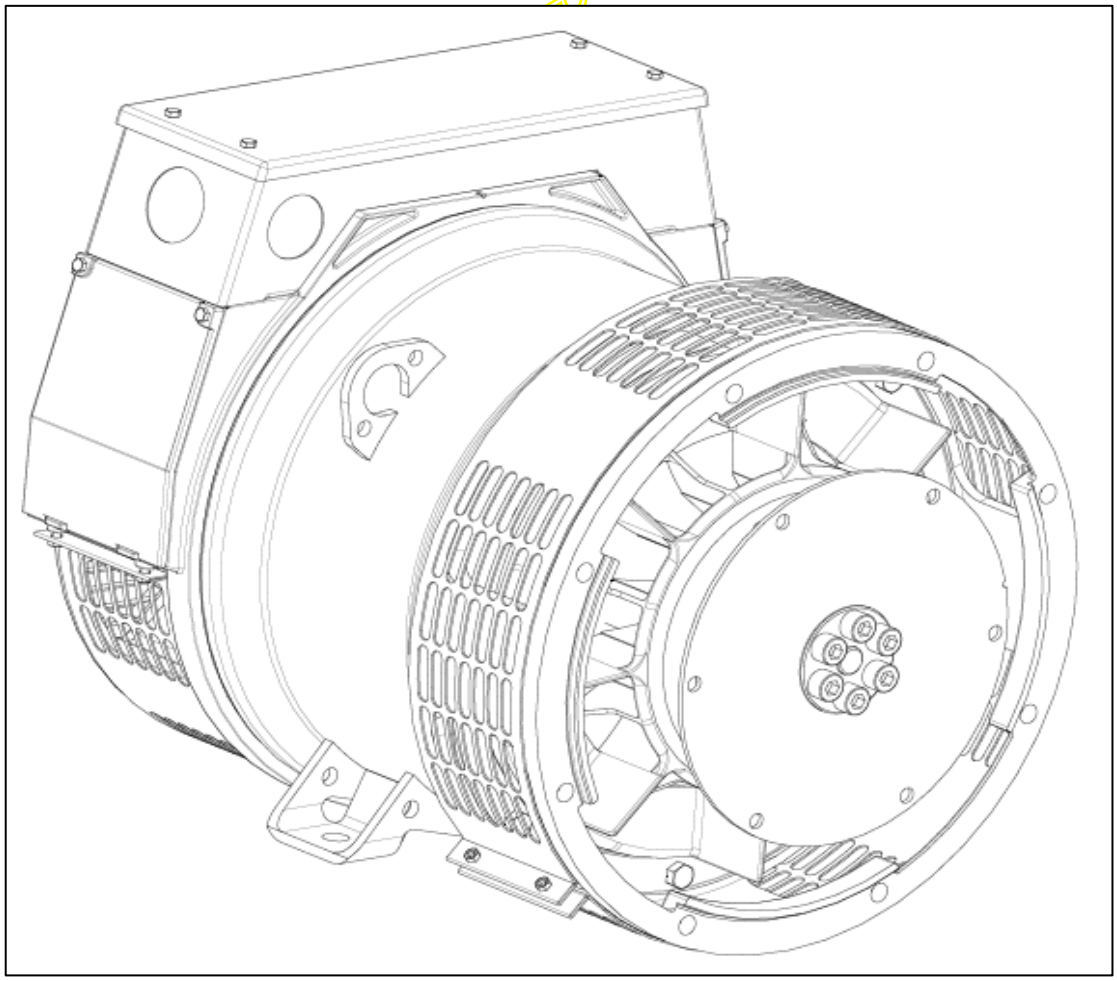
Technical Data Sheet



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 REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the 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 AS480 will support limited accessories, RFI suppression remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

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 at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

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 9 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.

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

PI044F

STAMFORD

WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

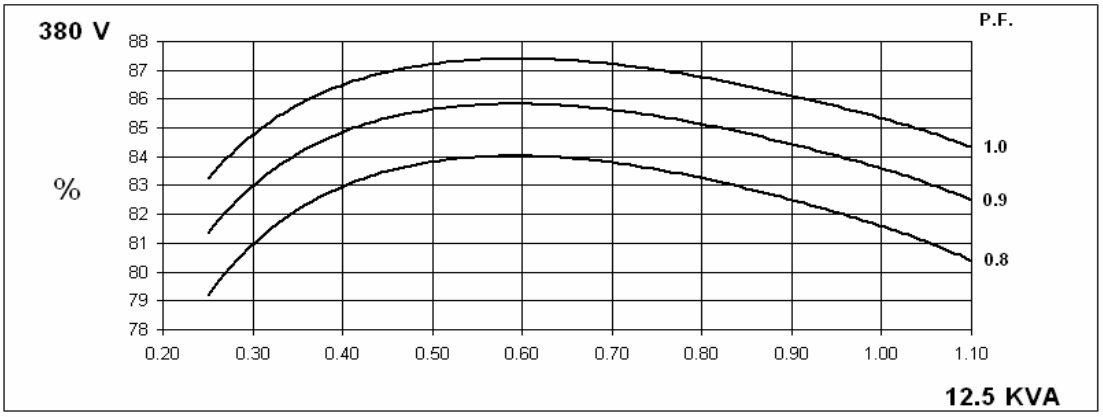
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.951 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.465 Ohms at 22°C							
EXCITER STATOR RESISTANCE	18.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.228 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	89 kg		87.3 kg		92 kg		90.3 kg	
WEIGHT WOUND STATOR	33 kg		33 kg		33 kg		33 kg	
WEIGHT WOUND ROTOR	31.62 kg		29.92 kg		32.62 kg		30.92 kg	
WR² INERTIA	0.1113 kgm^2		0.1096 kgm^2		0.1114 kgm^2		0.1097 kgm^2	
SHIPPING WEIGHTS in a crate	106 kg		104.3 kg		115 kg		113.3 kg	
PACKING CRATE SIZE	71 x 51 x 67 (cm)				71 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.110 m³/sec 233cfm				0.135 m³/sec 286 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	12.5	12.5	12.5	11.9	13.8	14.7	15.2	15.6
Xd DIR. AXIS SYNCHRONOUS	2.03	1.83	1.70	1.44	2.42	2.30	2.18	2.05
X'd DIR. AXIS TRANSIENT	0.20	0.18	0.17	0.14	0.24	0.23	0.22	0.20
X''d DIR. AXIS SUBTRANSIENT	0.13	0.12	0.11	0.09	0.16	0.15	0.14	0.14
Xq QUAD. AXIS REACTANCE	0.98	0.88	0.82	0.69	1.16	1.10	1.04	0.98
X''q QUAD. AXIS SUBTRANSIENT	0.21	0.19	0.18	0.15	0.25	0.24	0.23	0.21
X_L LEAKAGE REACTANCE	0.08	0.07	0.07	0.06	0.09	0.09	0.08	0.08
X_2 NEGATIVE SEQUENCE	0.18	0.16	0.15	0.13	0.21	0.20	0.19	0.18
X_0 ZERO SEQUENCE	0.09	0.08	0.07	0.06	0.10	0.10	0.09	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.009 s							
T''d SUB-TRANSTIME CONST.	0.002 s							
T'do O.C. FIELD TIME CONST.	0.2 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

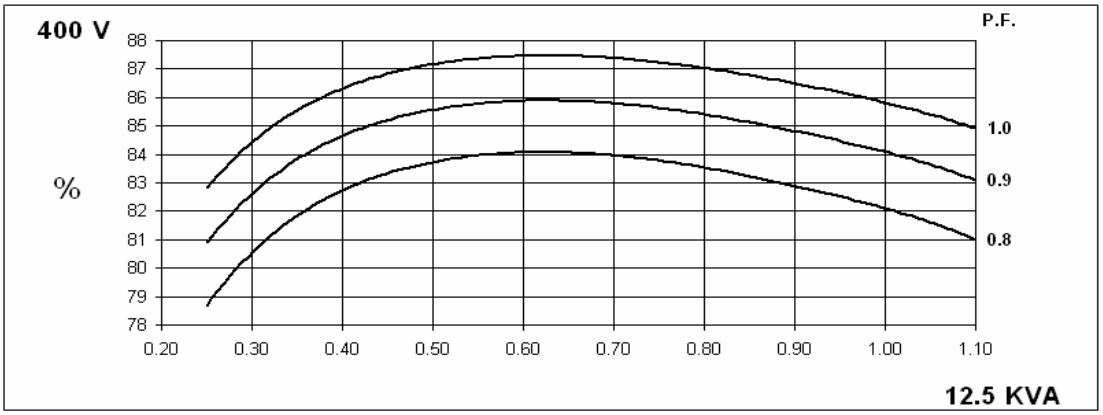
50 Hz

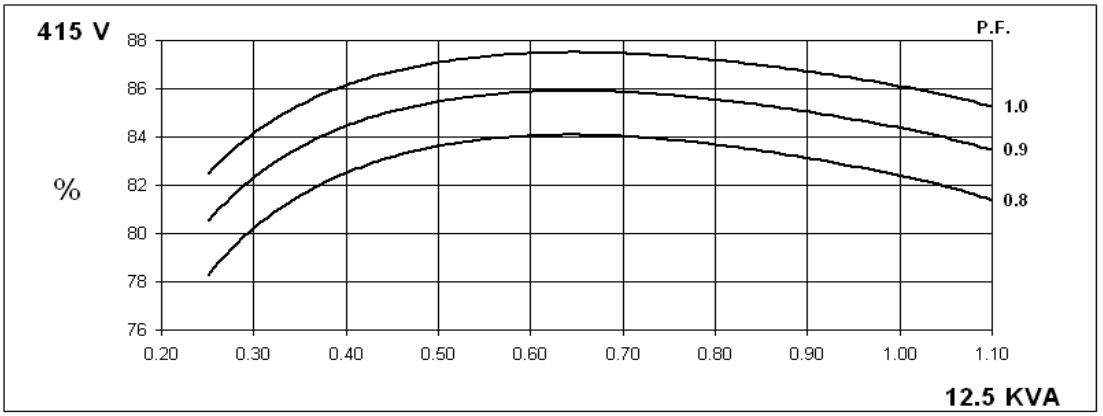
PI044F

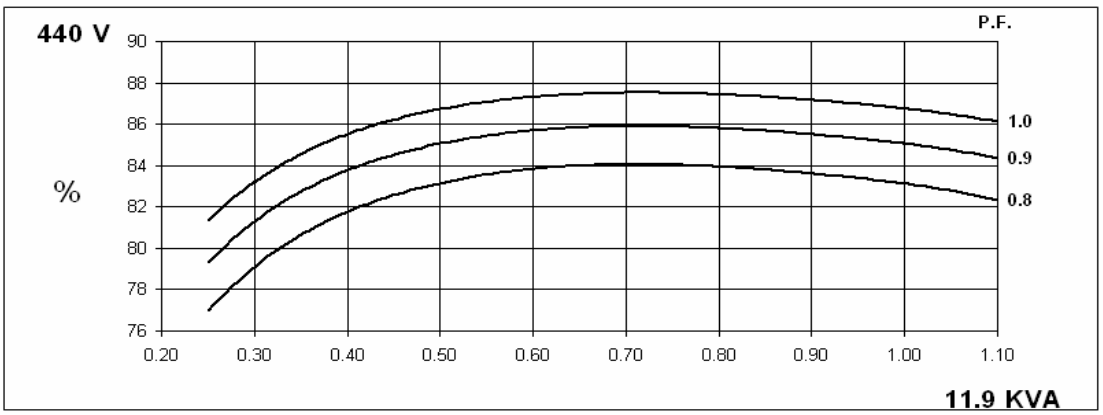
Winding 311

THREE PHASE EFFICIENCY CURVES







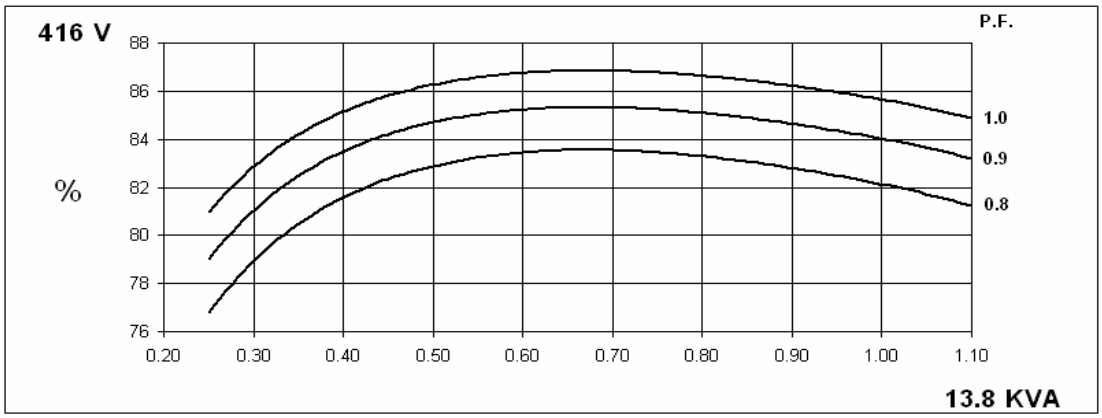


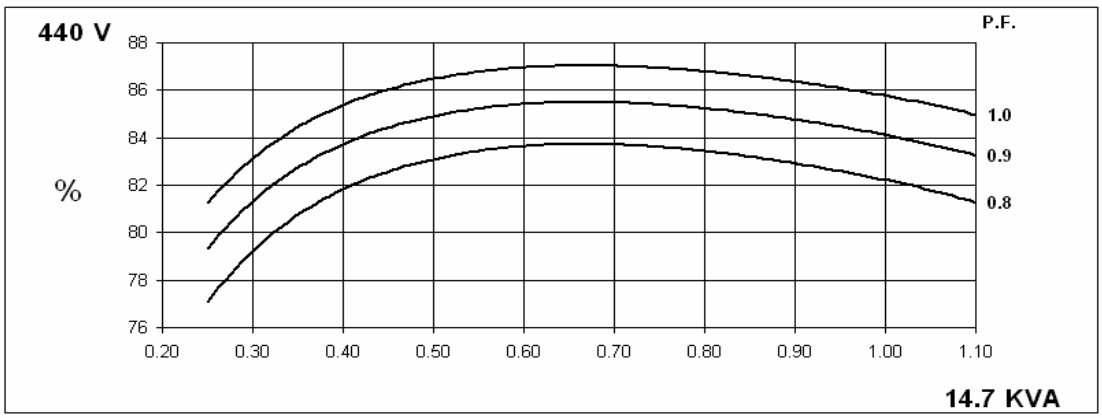
60 Hz

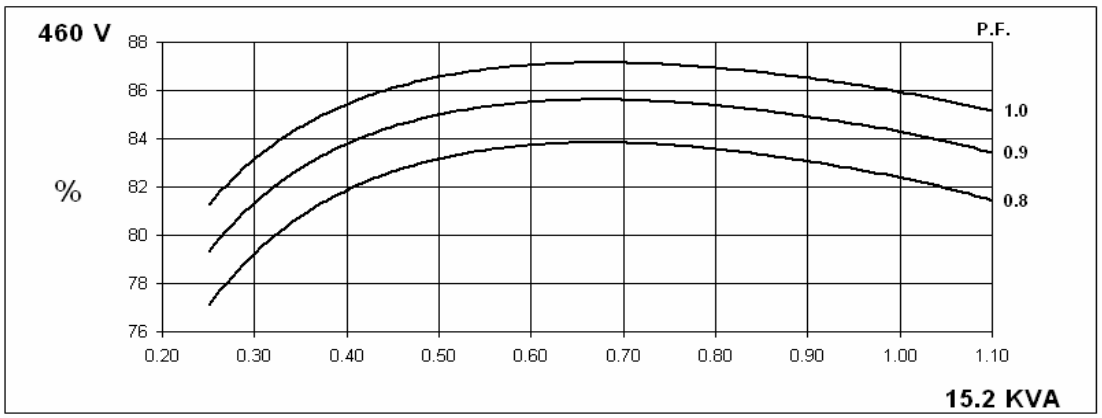
PI044F

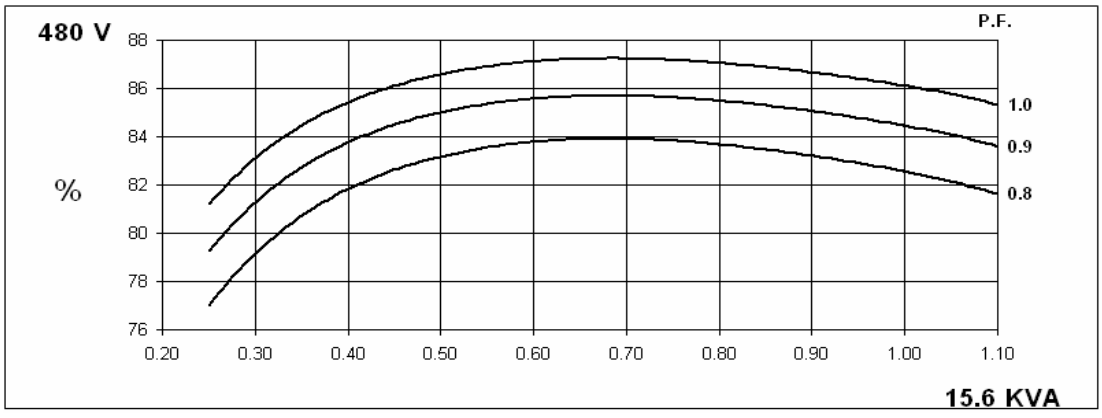
Winding 311

THREE PHASE EFFICIENCY CURVES





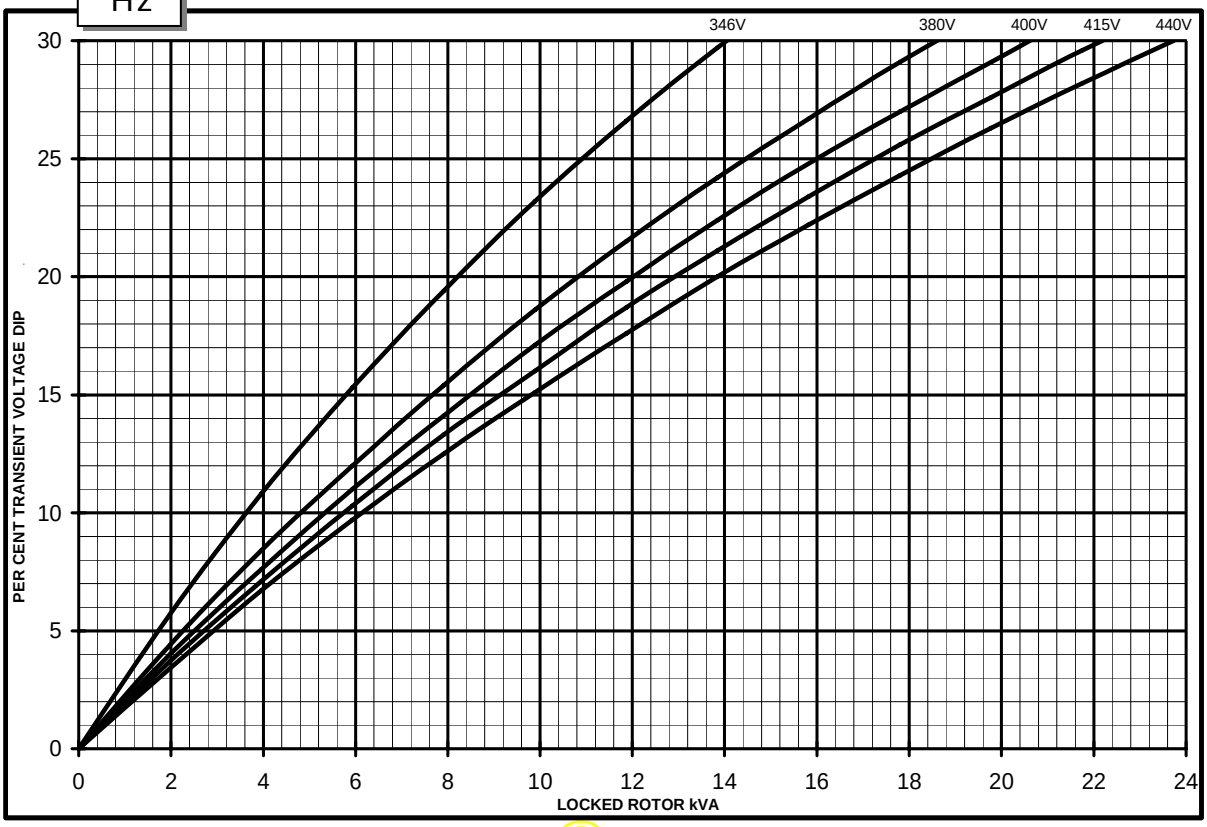




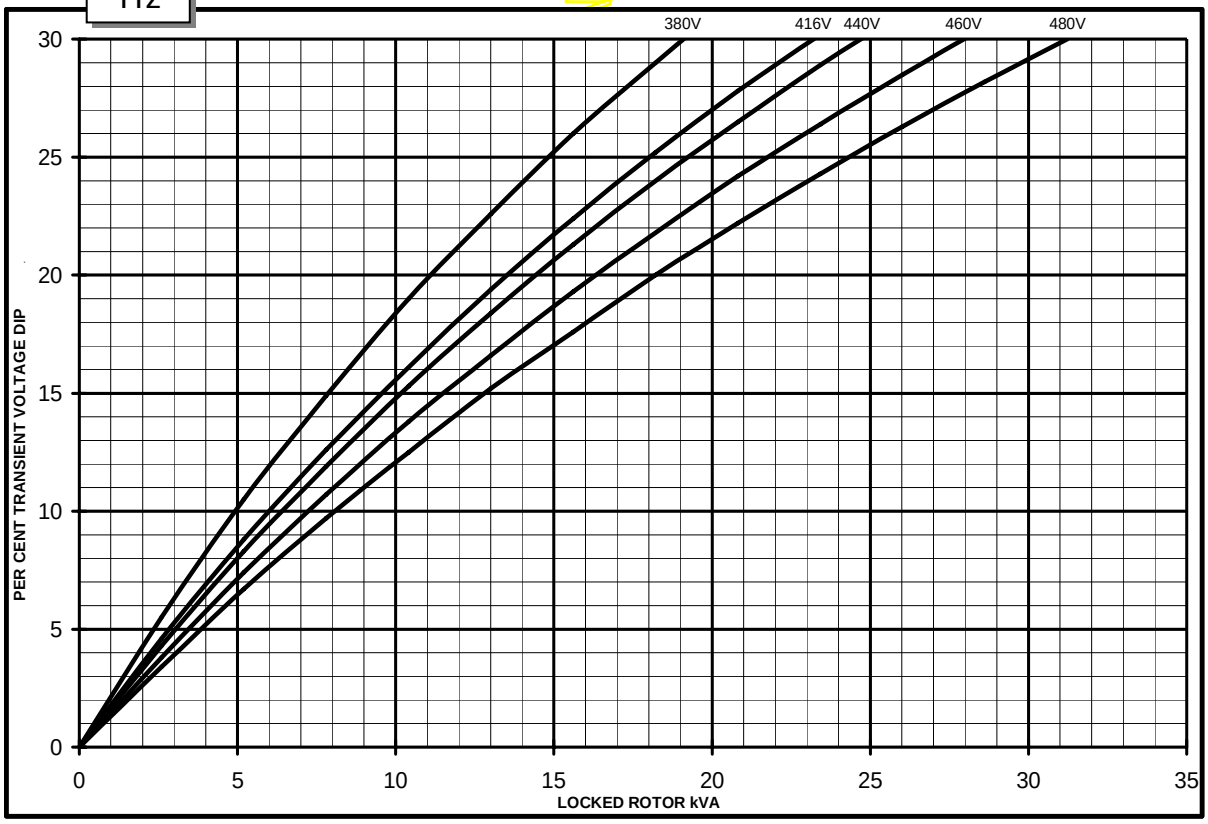
PI044F

Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

50 Hz

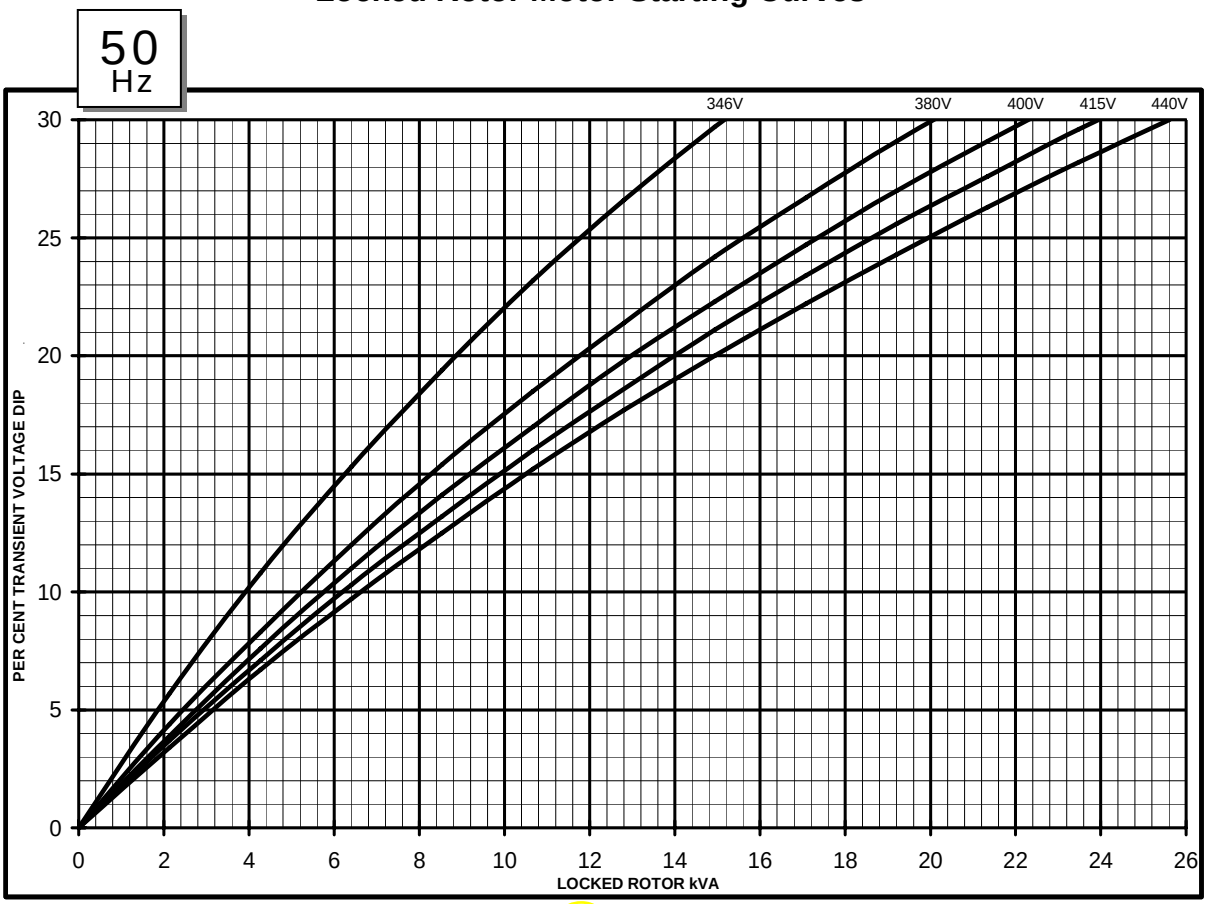


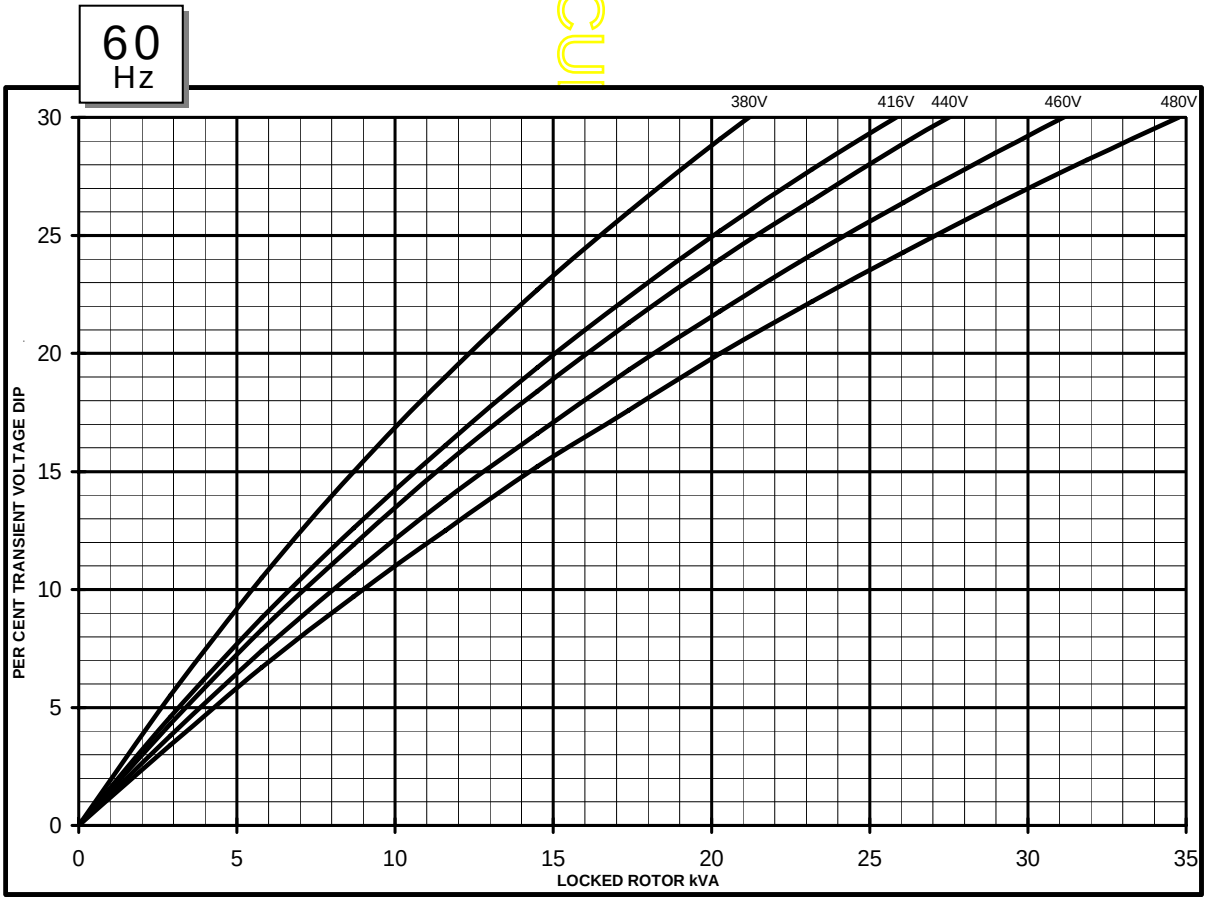
60 Hz



PI044F

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves





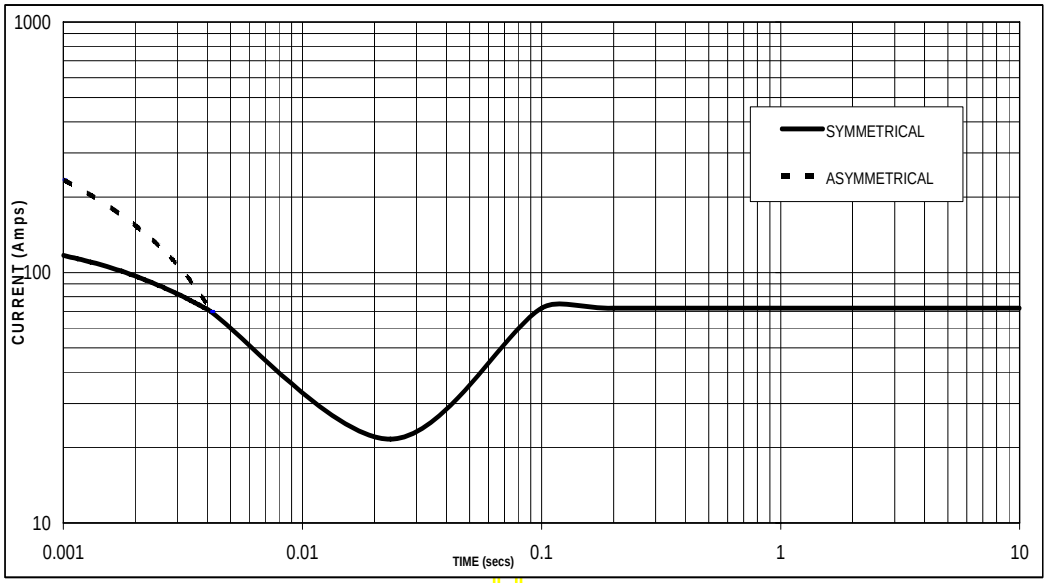
PI044F

WITH EBS FITTED

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

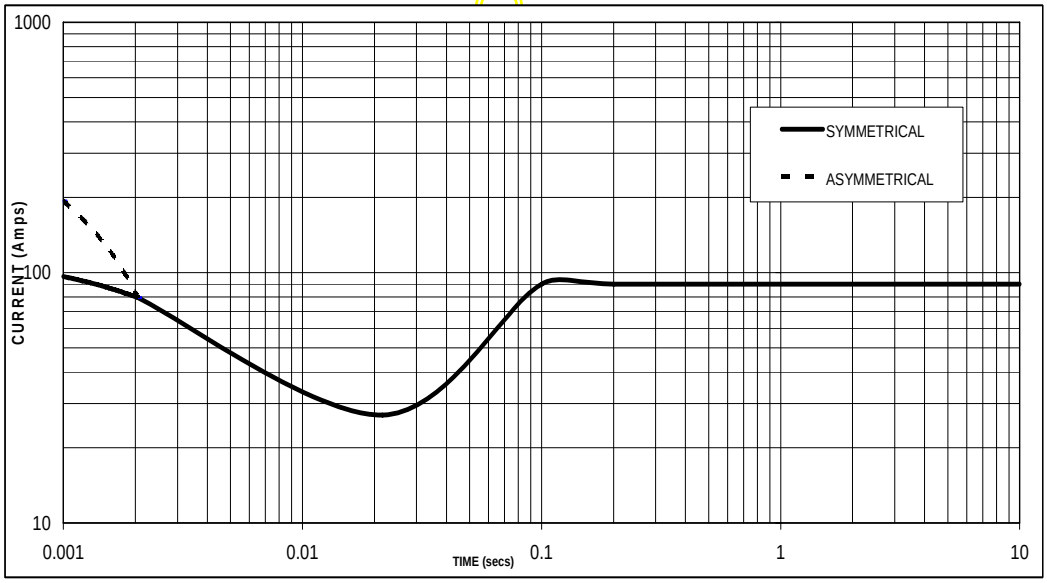
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 72 Amps

60 Hz



Sustained Short Circuit = 90 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI044F

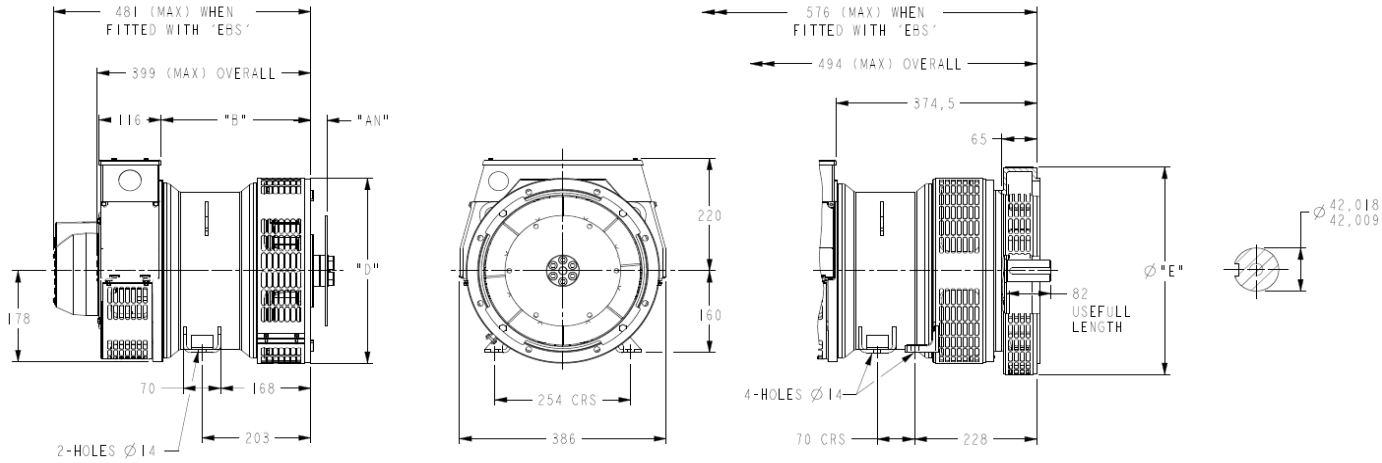
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	11.4	11.4	11.4	10.8	12.5	12.5	12.5	11.9	13.5	13.5	13.5	12.8	13.8	13.8	13.8	13.1
	kW	9.1	9.1	9.1	8.6	10.0	10.0	10.0	9.5	10.8	10.8	10.8	10.2	11.0	11.0	11.0	10.5
	Efficiency (%)	82.5	82.8	82.9	83.3	81.7	82.1	82.3	82.9	80.9	81.3	81.6	82.4	80.6	81.1	81.4	82.2
	kW Input	11.0	11.0	11.0	10.3	12.2	12.2	12.2	11.5	13.3	13.3	13.2	12.4	13.6	13.6	13.5	12.8

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	12.5	13.4	13.8	14.3	13.8	14.7	15.2	15.6	14.9	15.9	16.4	16.9	15.1	16.2	16.7	17.2
	kW	10.0	10.7	11.0	11.4	11.0	11.8	12.2	12.5	11.9	12.7	13.1	13.5	12.1	13.0	13.4	13.8
	Efficiency (%)	83.3	83.3	83.4	83.4	82.7	82.7	82.8	82.8	82.1	82.0	82.1	82.2	82.0	81.9	82.0	82.0
	kW Input	12.0	12.8	13.2	13.7	13.3	14.3	14.7	15.1	14.5	15.5	16.0	16.4	14.8	15.9	16.3	16.8

DIMENSIONS



COUPLING DISC	
SAE	"AN"
6.5	30.2
7.5	30.2
8	62
10	53.8
11.5	39.6

1-BRG ADAPTORS	
SAE	"D"
5	361
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTORS	
SAE	Ø"E"
5	359
4	406
3	455
2	493

APPROVED DOCUMENT

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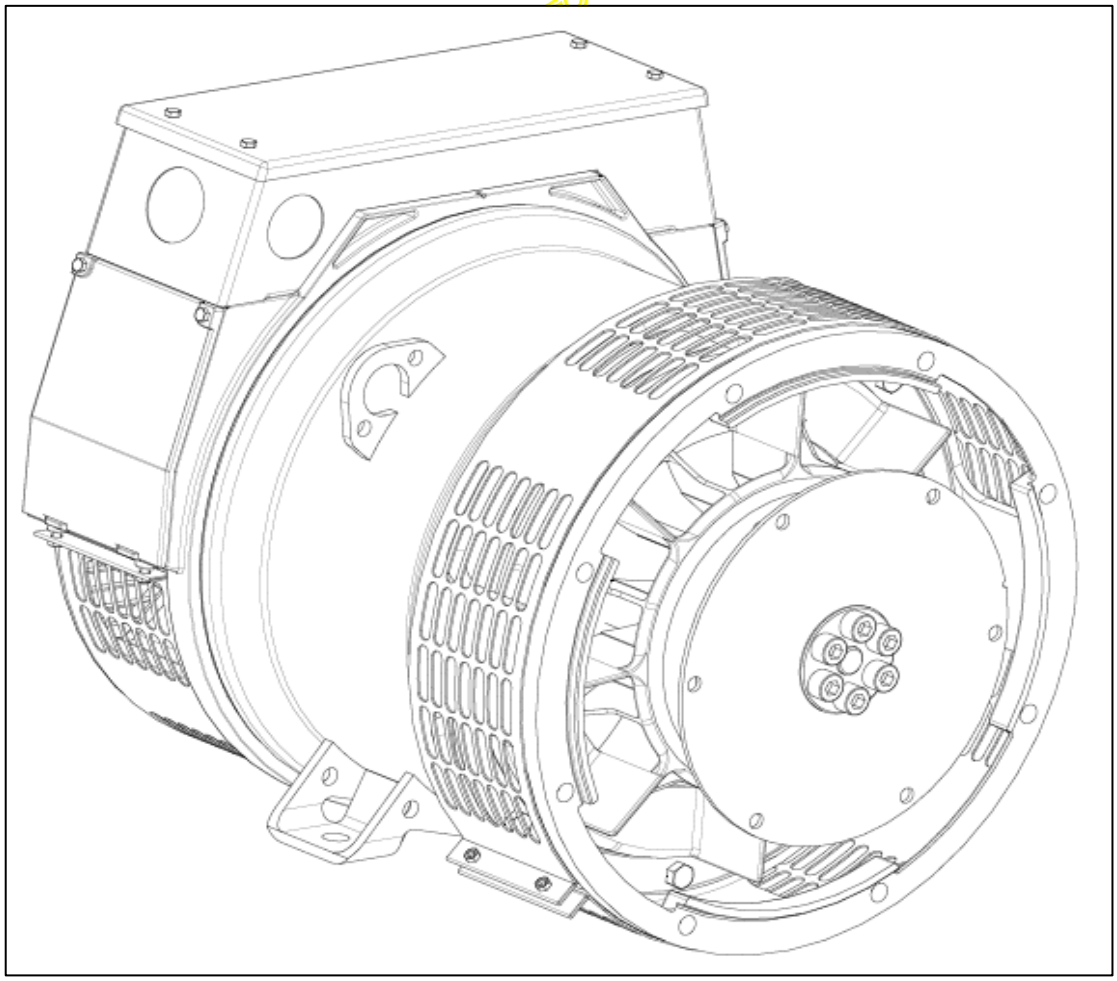
PI044G - Winding 311

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 REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the 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 AS480 will support limited accessories, RFI suppression remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

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 at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

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 9 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.

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

PI044G

STAMFORD

WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

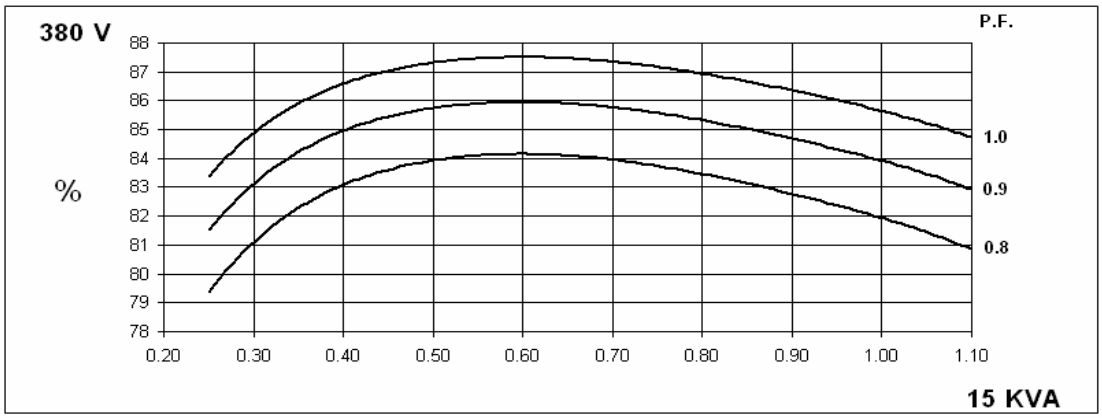
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.702 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.551 Ohms at 22°C							
EXCITER STATOR RESISTANCE	18.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.228 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	96 kg		94.3 kg		99 kg		97.3 kg	
WEIGHT WOUND STATOR	36 kg		36 kg		36 kg		36 kg	
WEIGHT WOUND ROTOR	34.94 kg		33.24 kg		35.94 kg		34.24 kg	
WR² INERTIA	0.1266 kgm^2		0.1249 kgm^2		0.1267 kgm^2		0.125 kgm^2	
SHIPPING WEIGHTS in a crate	112 kg		110.3 kg		121 kg		119.3 kg	
PACKING CRATE SIZE	71 x 51 x 67 (cm)				71 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.110 m³/sec 233cfm				0.135 m³/sec 286 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	15	15	15	14.3	16.5	17.6	18.2	18.8
Xd DIR. AXIS SYNCHRONOUS	1.82	1.64	1.52	1.29	2.15	2.05	1.94	1.84
X'd DIR. AXIS TRANSIENT	0.19	0.17	0.16	0.13	0.22	0.21	0.20	0.19
X''d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.09	0.15	0.14	0.14	0.13
Xq QUAD. AXIS REACTANCE	0.86	0.78	0.72	0.61	1.03	0.98	0.93	0.88
X''q QUAD. AXIS SUBTRANSIENT	0.19	0.17	0.16	0.13	0.22	0.21	0.20	0.19
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	0.11	0.19	0.18	0.17	0.16
X_0 ZERO SEQUENCE	0.08	0.07	0.07	0.06	0.09	0.09	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.011 s							
T''d SUB-TRANSTIME CONST.	0.003 s							
T'do O.C. FIELD TIME CONST.	0.26 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

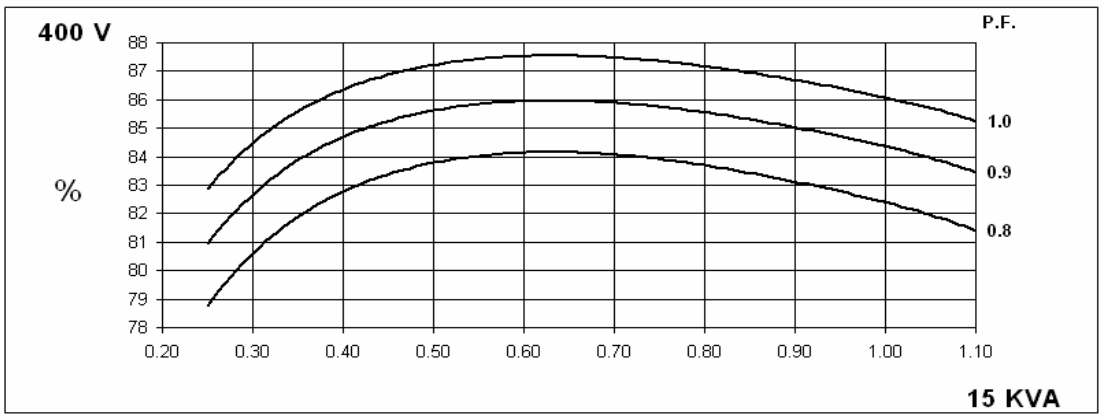
50 Hz

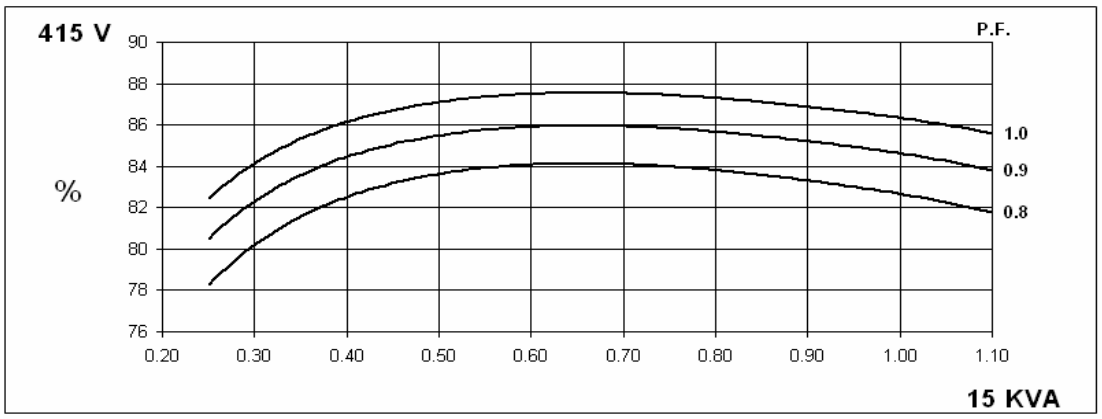
PI044G

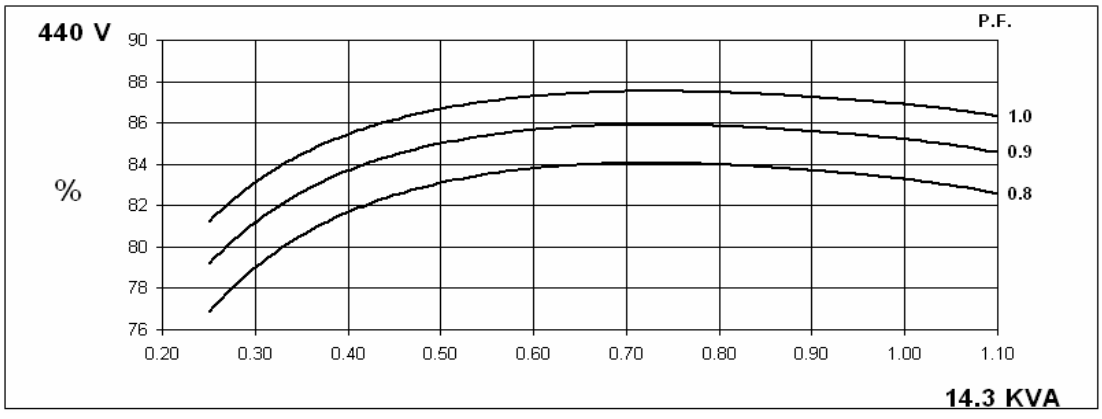
Winding 311

THREE PHASE EFFICIENCY CURVES







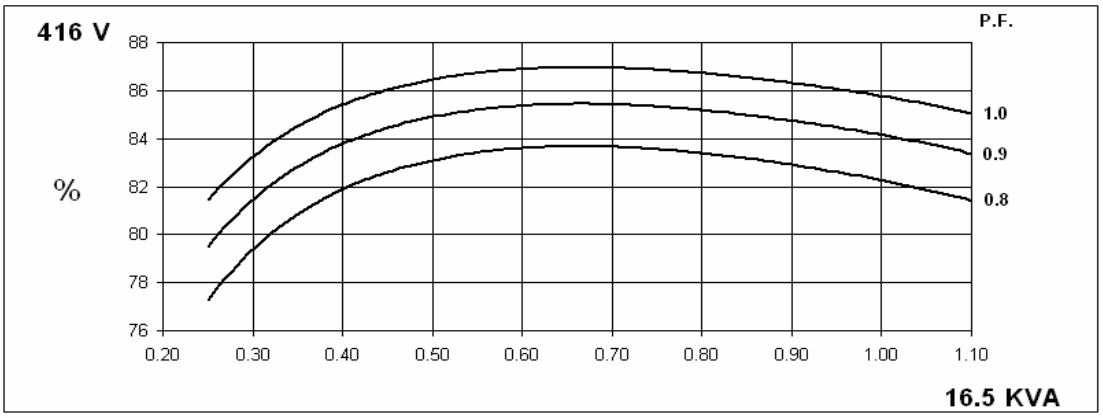


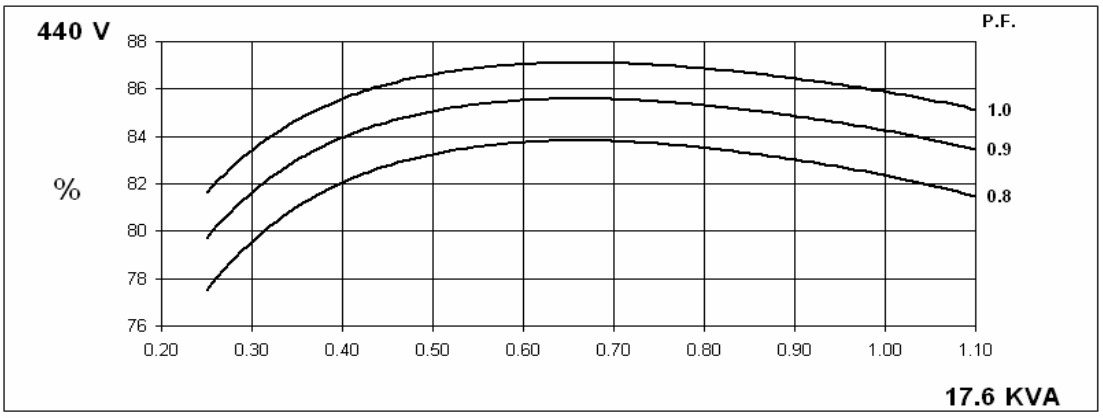
60 Hz

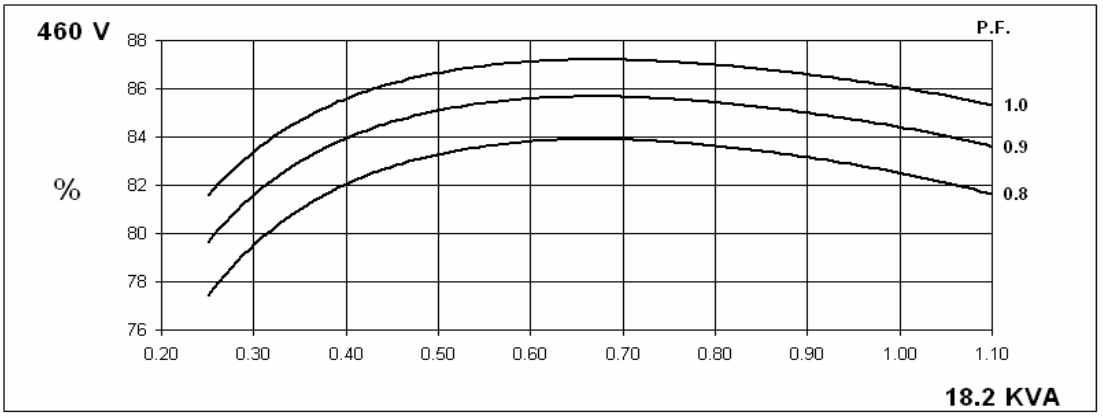
PI044G

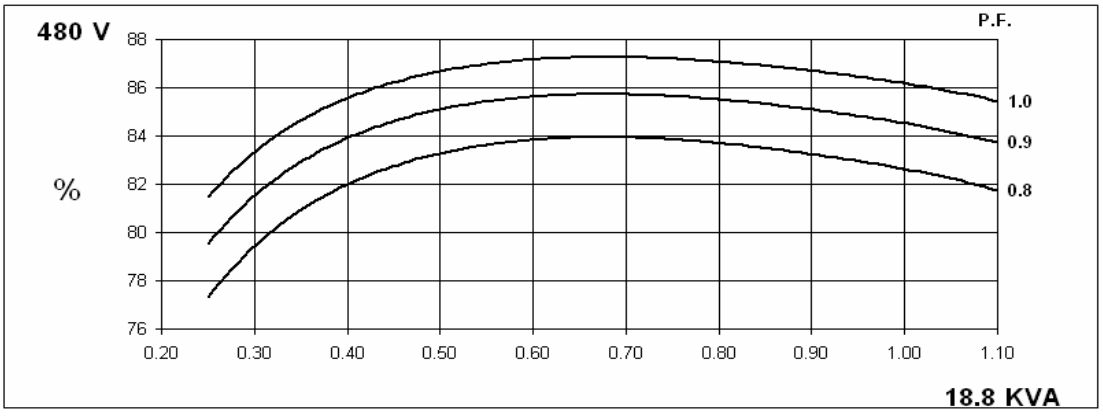
Winding 311

THREE PHASE EFFICIENCY CURVES



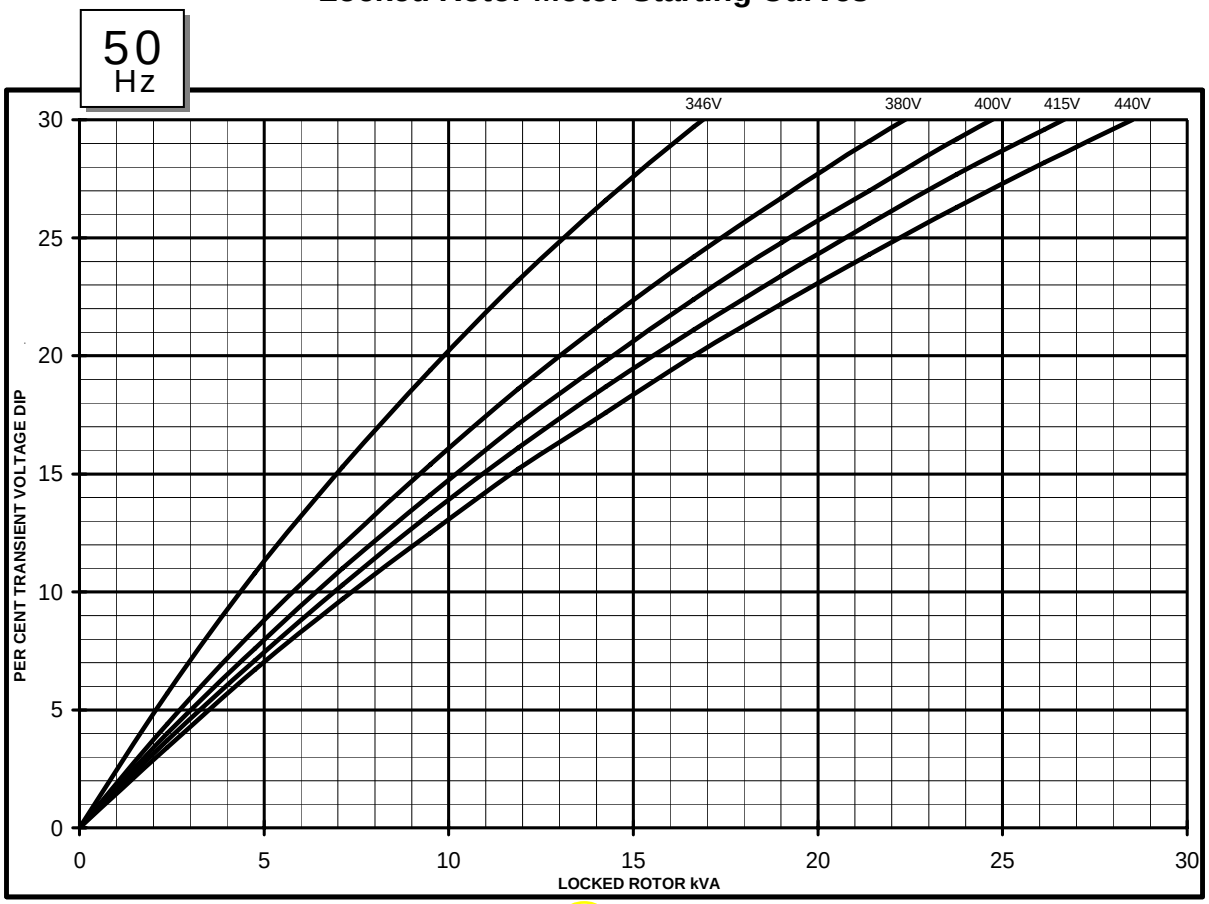


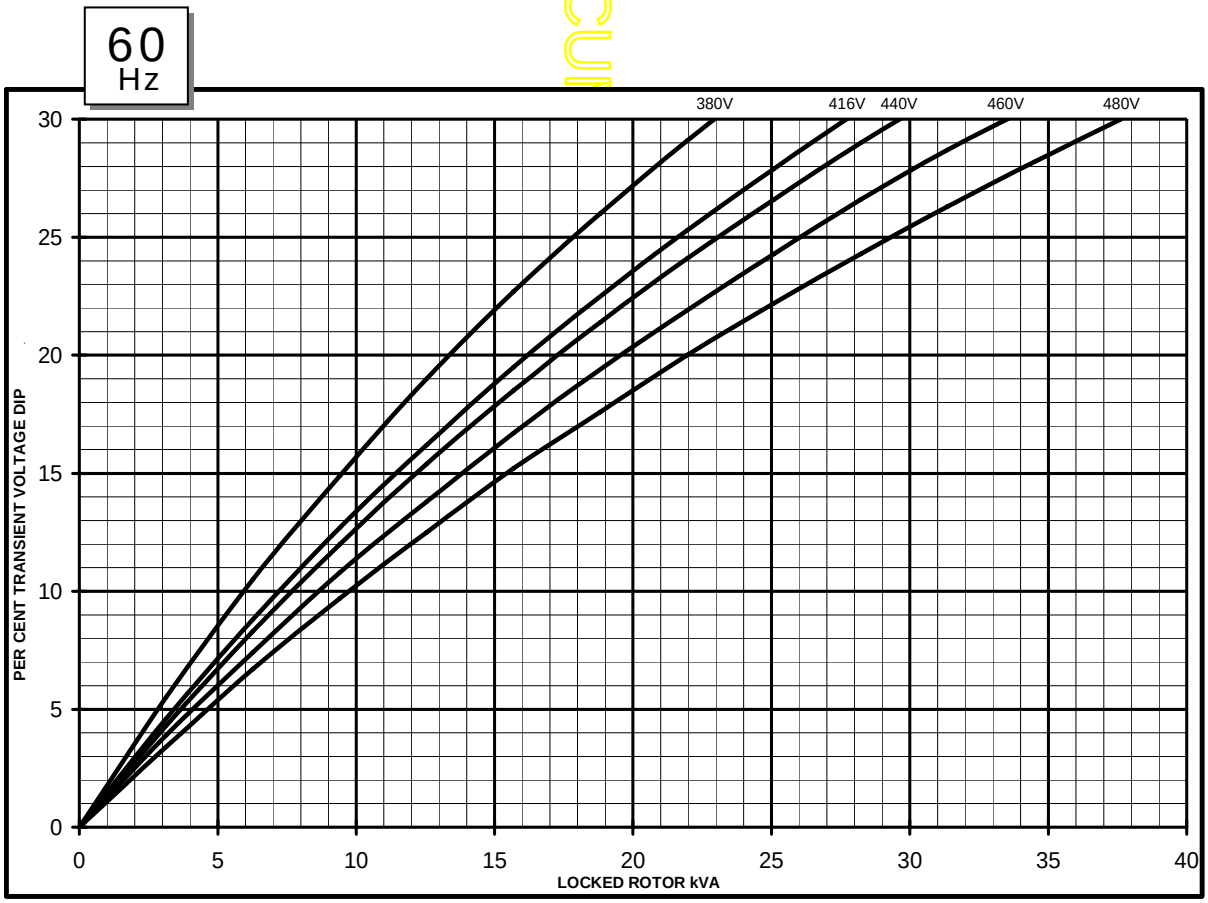




PI044G

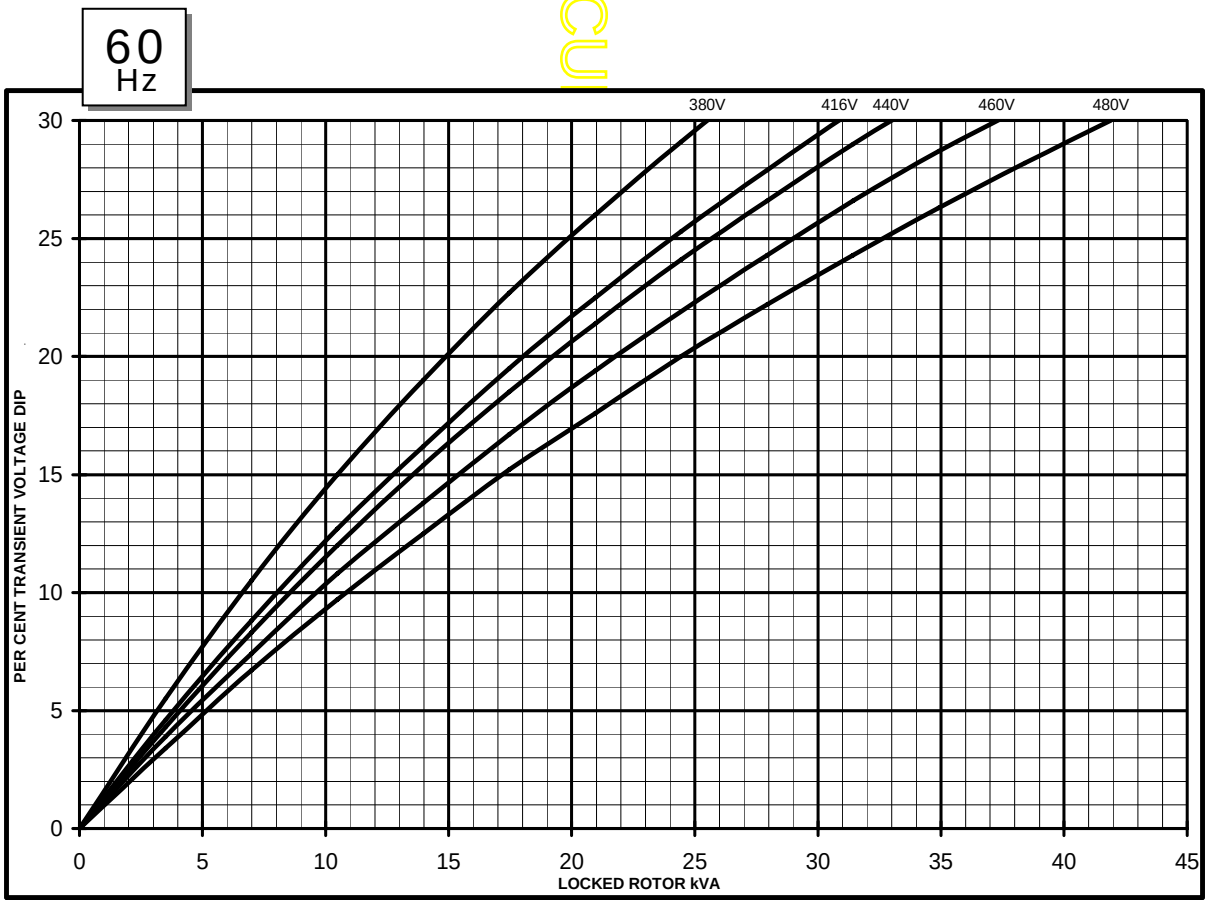
Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves





PI044G

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves

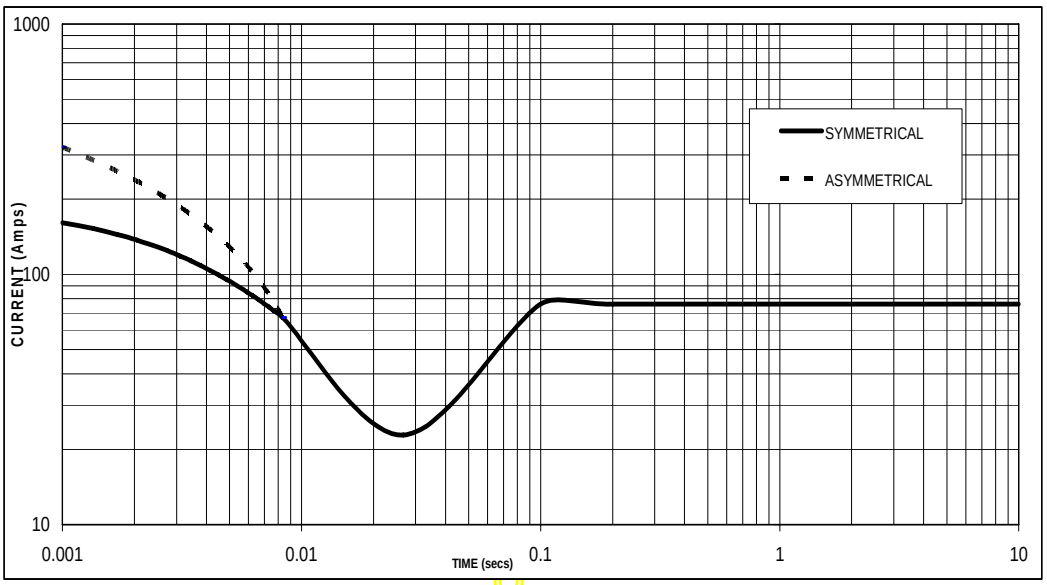


PI044G

WITH EBS FITTED

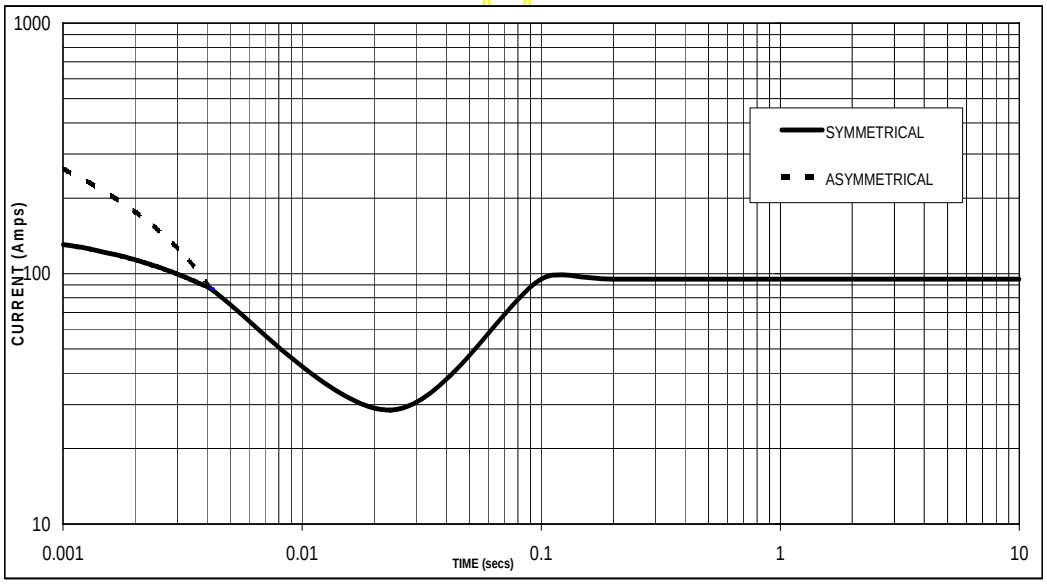
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 76 Amps

60 Hz



Sustained Short Circuit = 95 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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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Winding 311 / 0.8 Power Factor

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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	13.7	13.7	13.7	13.0	15.0	15.0	15.0	14.3	16.2	16.2	16.2	15.4	16.5	16.5	16.5	15.7
	kW	11.0	11.0	11.0	10.4	12.0	12.0	12.0	11.4	13.0	13.0	13.0	12.3	13.2	13.2	13.2	12.6
	Efficiency (%)	82.3	82.6	82.7	83.0	81.6	81.9	82.1	82.6	80.8	81.2	81.5	82.1	80.6	81.1	81.3	82.0
	kW Input	13.4	13.3	13.3	12.5	14.7	14.7	14.6	13.8	16.1	16.0	16.0	15.0	16.4	16.3	16.2	15.4

60 Hz	Series Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
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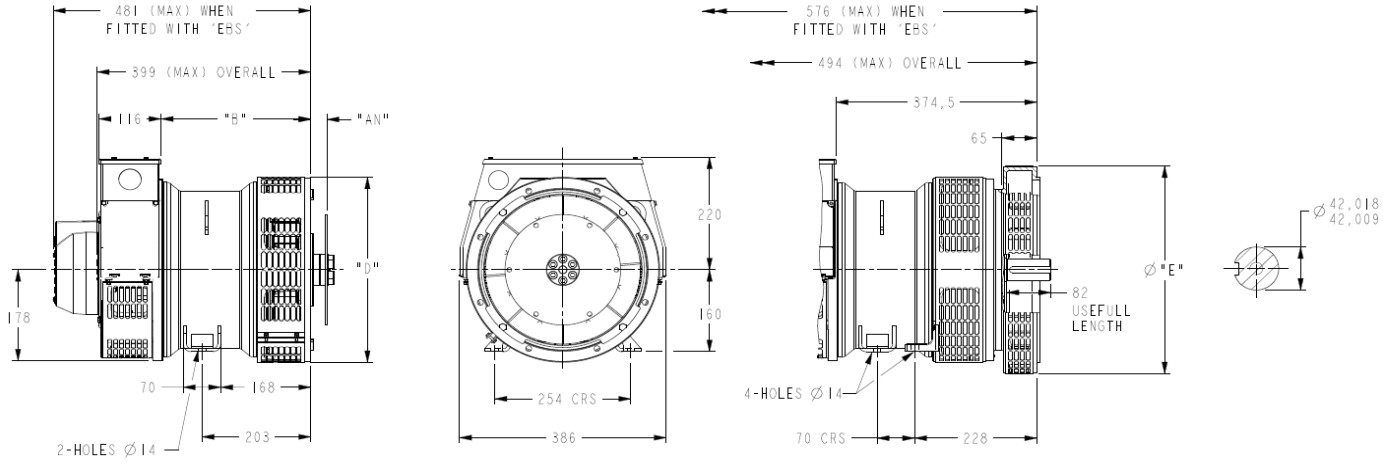
	Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	15.1	16.1	16.6	17.1	16.5	17.6	18.2	18.8	17.8	19.0	19.6	20.3	18.2	19.4	20.0	20.6
	kW	12.1	12.9	13.3	13.7	13.2	14.1	14.6	15.0	14.2	15.2	15.7	16.2	14.6	15.5	16.0	16.5
	Efficiency (%)	82.9	82.9	83.0	83.0	82.4	82.3	82.4	82.4	81.8	81.7	81.8	81.8	81.6	81.5	81.6	81.7
	kW Input	14.6	15.6	16.0	16.5	16.0	17.1	17.7	18.2	17.4	18.6	19.2	19.8	17.9	19.0	19.6	20.2

DIMENSIONS



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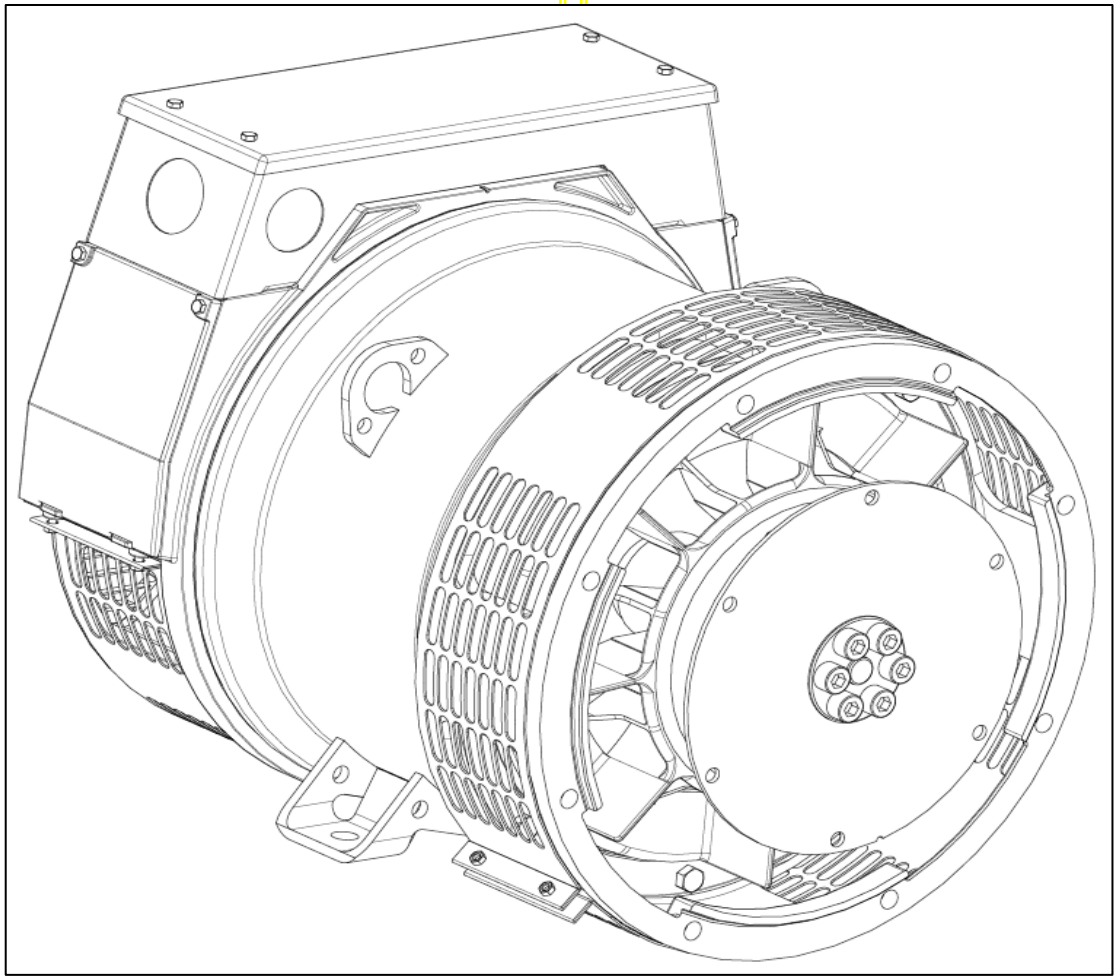
PI044H - Winding 311

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 REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the 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 AS480 will support limited accessories, RFI suppression remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

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 at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

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 9 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.

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

PI044H

STAMFORD

WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

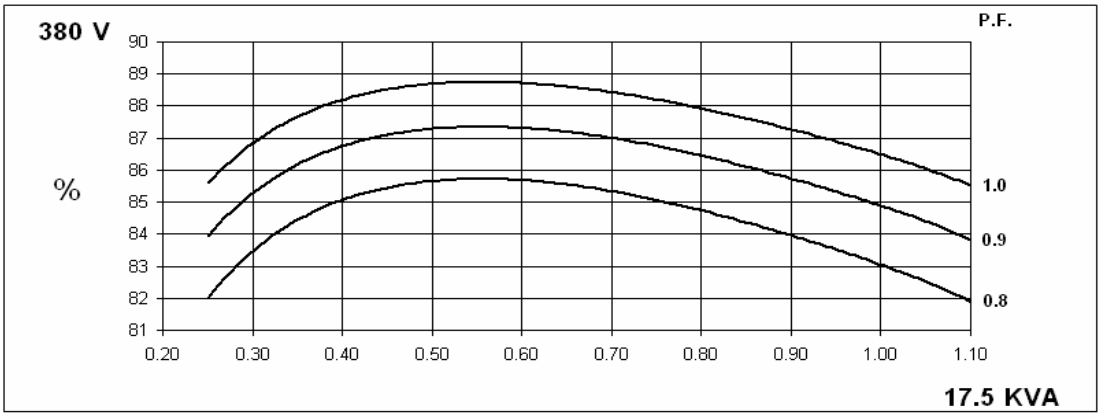
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.506 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.545 Ohms at 22°C							
EXCITER STATOR RESISTANCE	18.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.228 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	107 kg		105.3 kg		110 kg		108.3 kg	
WEIGHT WOUND STATOR	38 kg		38 kg		38 kg		38 kg	
WEIGHT WOUND ROTOR	37.51 kg		35.81 kg		38.51 kg		36.81 kg	
WR² INERTIA	0.1374 kgm^2		0.1357 kgm^2		0.1375 kgm^2		0.1358 kgm^2	
SHIPPING WEIGHTS in a crate	124 kg		122.3 kg		133 kg		131.3 kg	
PACKING CRATE SIZE	71 x 51 x 67 (cm)				71 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.110 m³/sec 233cfm				0.135 m³/sec 286 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	17.5	17.5	17.5	16.6	19.3	20.6	21.2	21.9
Xd DIR. AXIS SYNCHRONOUS	1.82	1.64	1.52	1.29	2.16	2.06	1.94	1.84
X'd DIR. AXIS TRANSIENT	0.19	0.17	0.16	0.13	0.22	0.21	0.20	0.19
X''d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.09	0.15	0.14	0.13	0.13
Xq QUAD. AXIS REACTANCE	0.88	0.79	0.73	0.62	1.03	0.98	0.93	0.88
X''q QUAD. AXIS SUBTRANSIENT	0.19	0.17	0.16	0.13	0.23	0.22	0.21	0.20
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	0.11	0.19	0.18	0.17	0.16
X_0 ZERO SEQUENCE	0.08	0.07	0.07	0.05	0.09	0.09	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.013 s							
T''d SUB-TRANSTIME CONST.	0.003 s							
T'do O.C. FIELD TIME CONST.	0.31 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

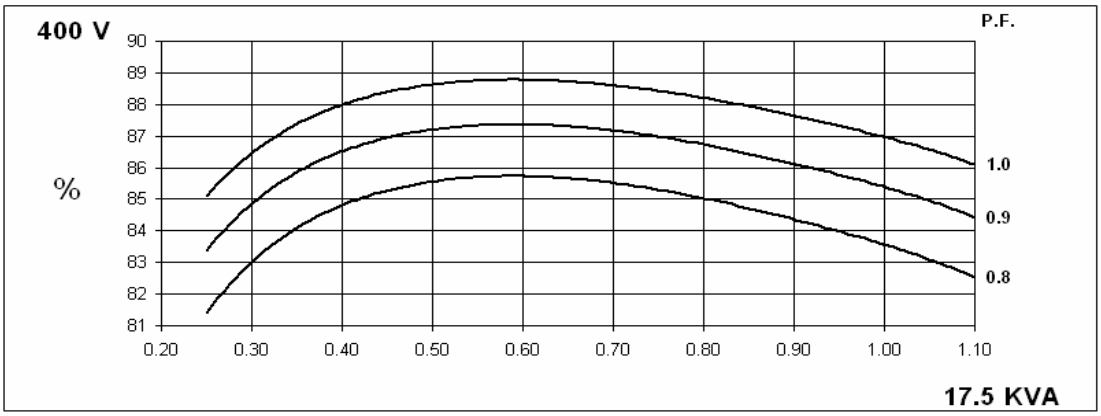
50 Hz

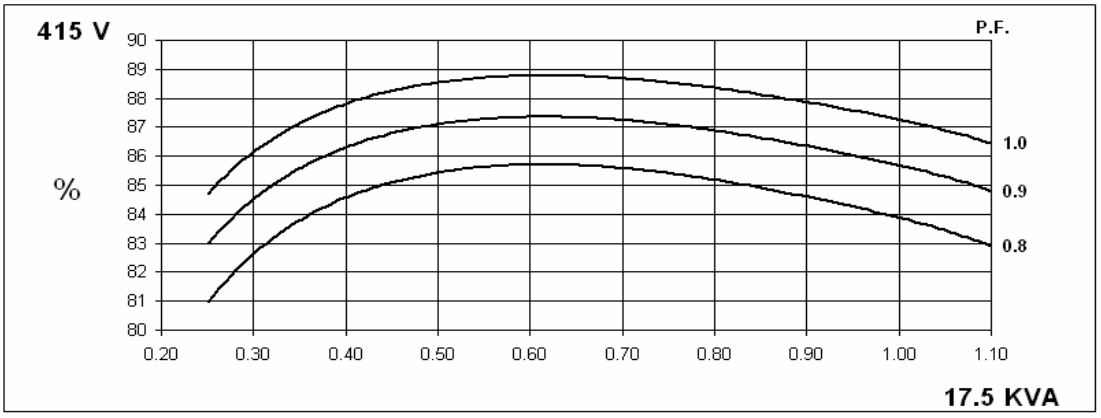
PI044H

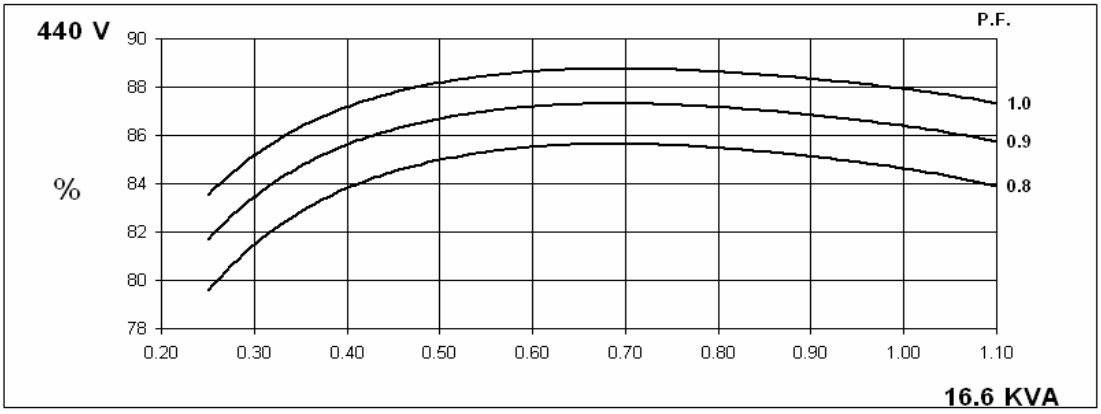
Winding 311

THREE PHASE EFFICIENCY CURVES









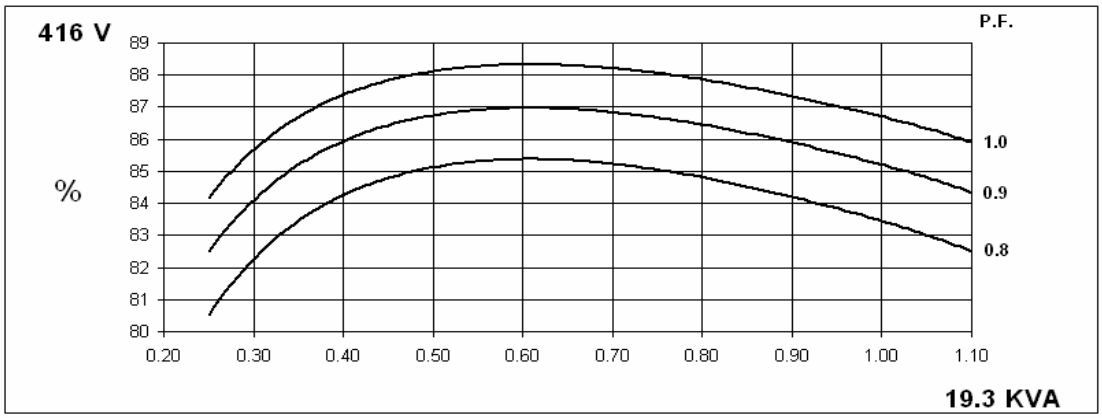
60 Hz

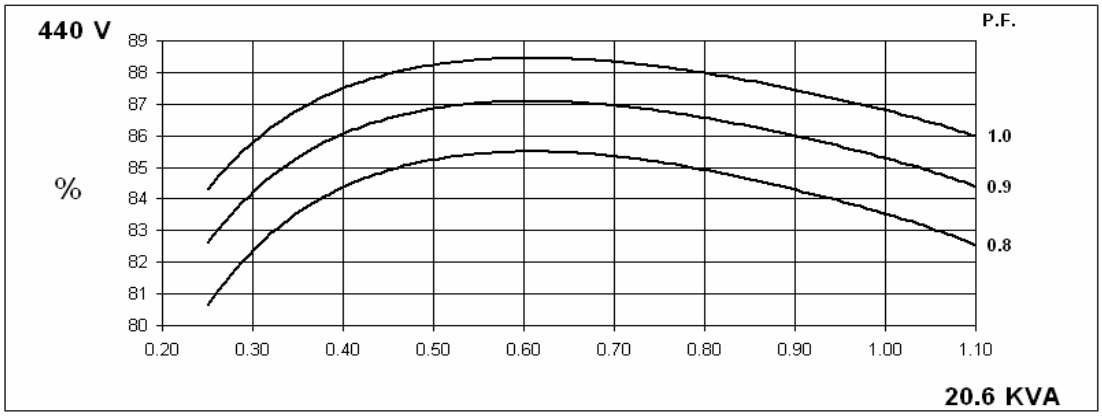
PI044H

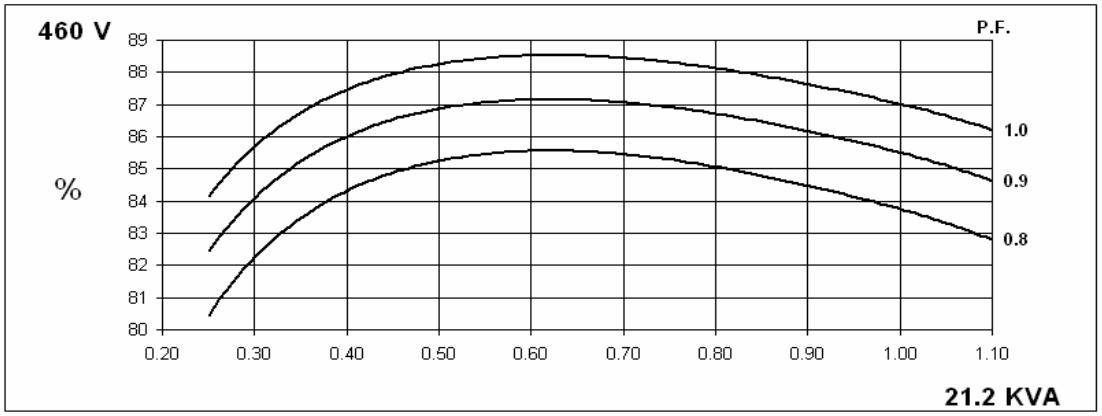
Winding 311

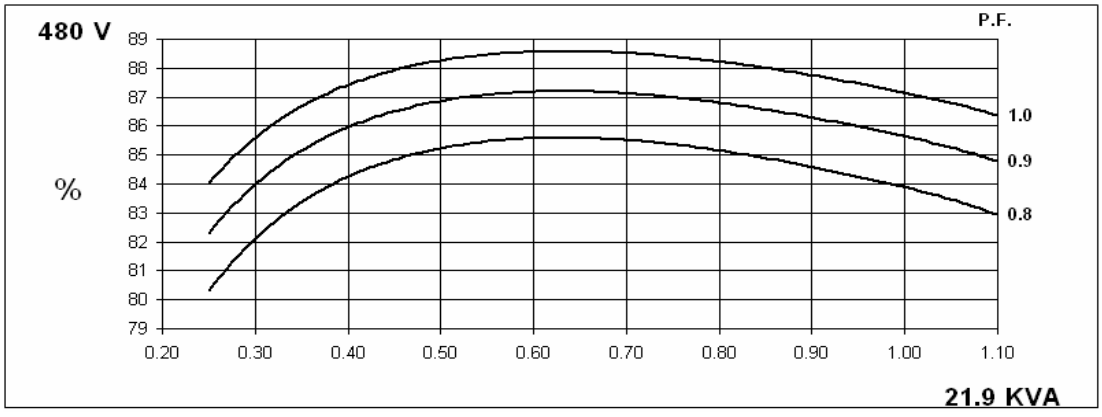
STAMFORD

THREE PHASE EFFICIENCY CURVES



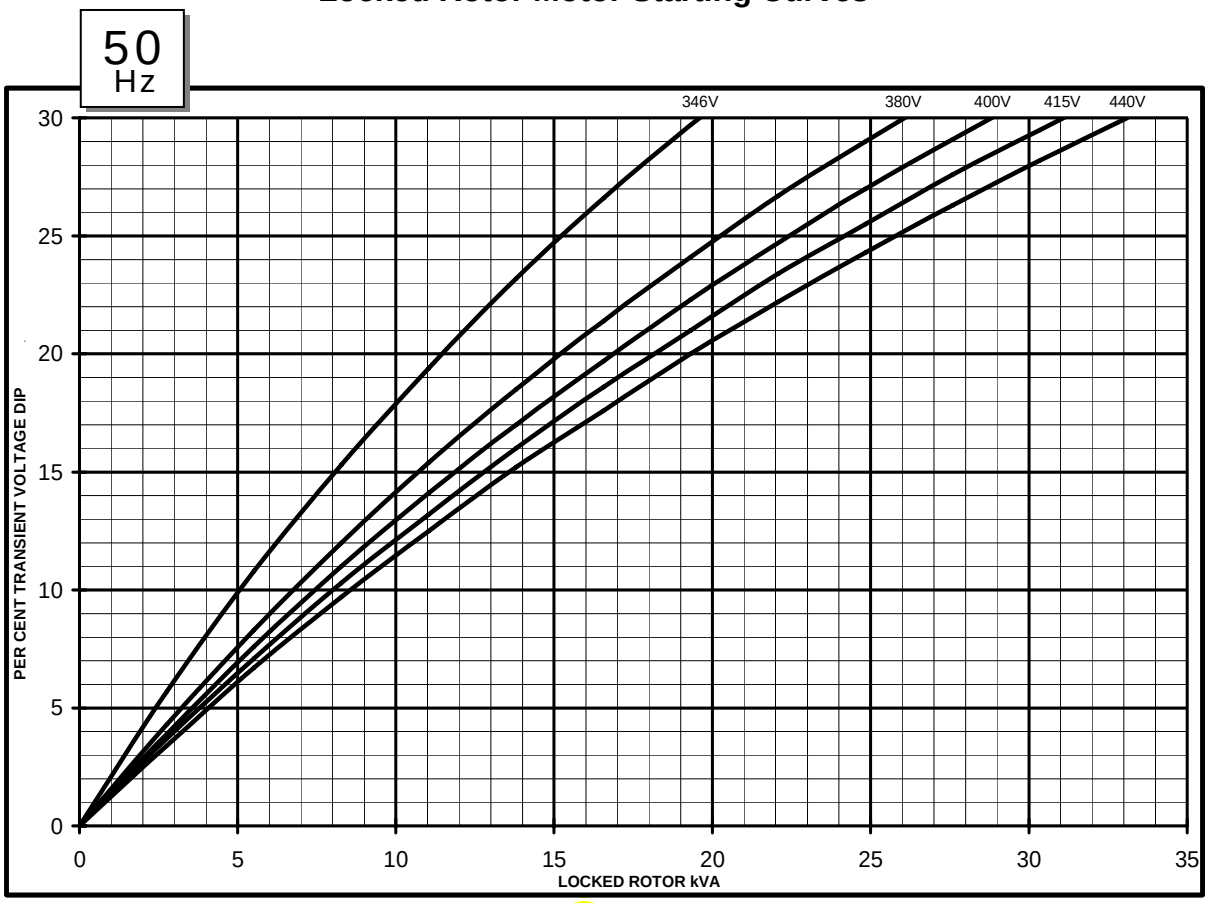


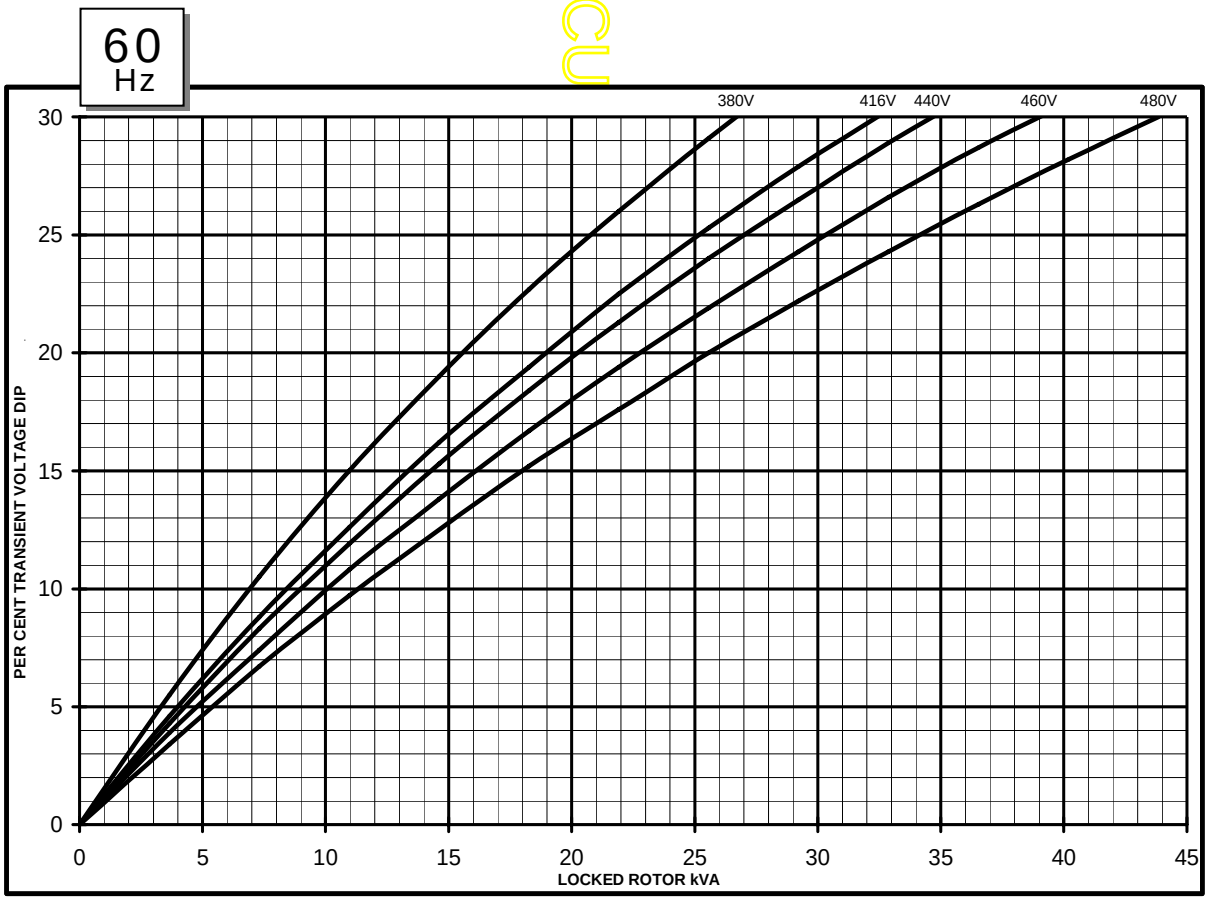




PI044H

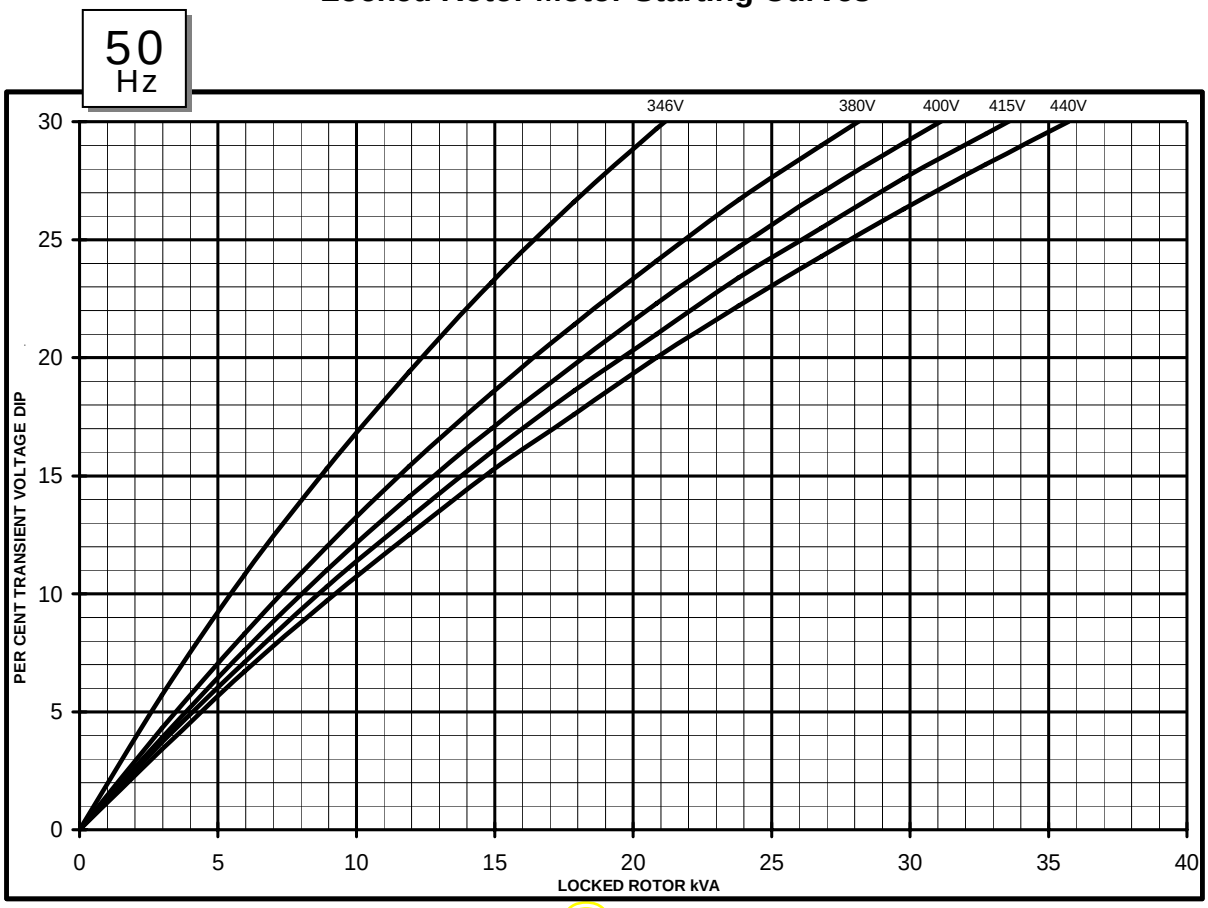
Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

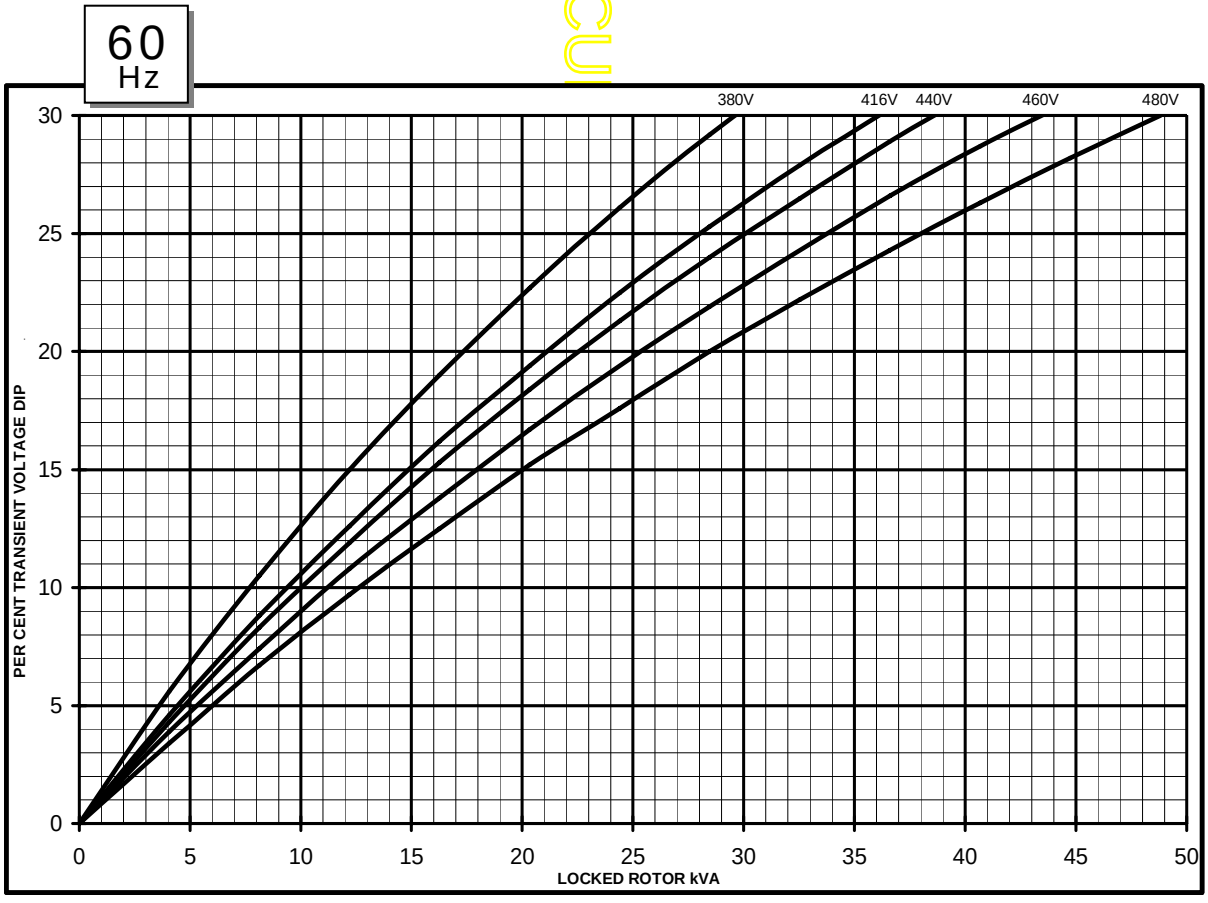




PI044H

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves





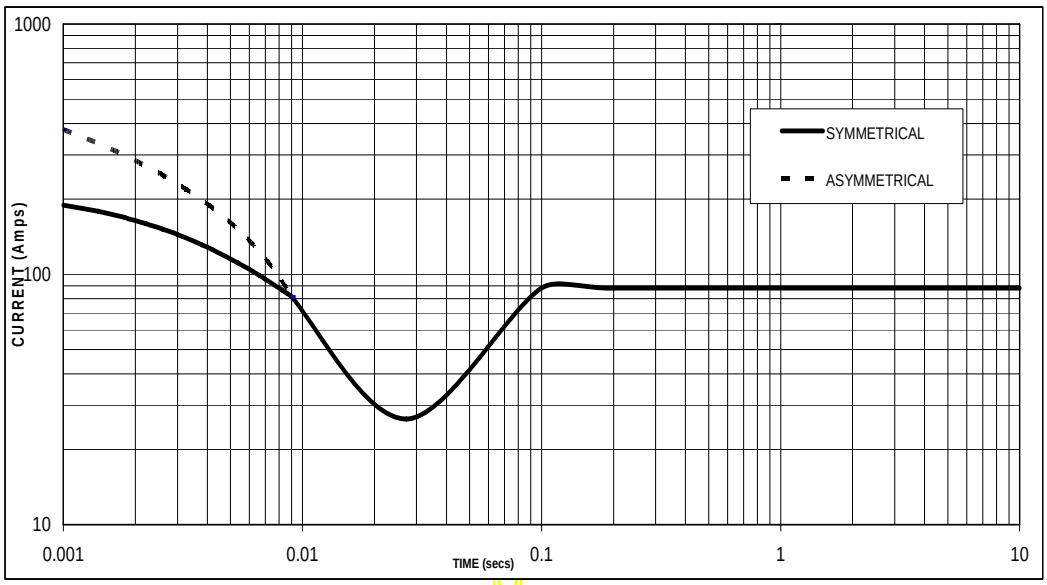
PI044H

WITH EBS FITTED

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

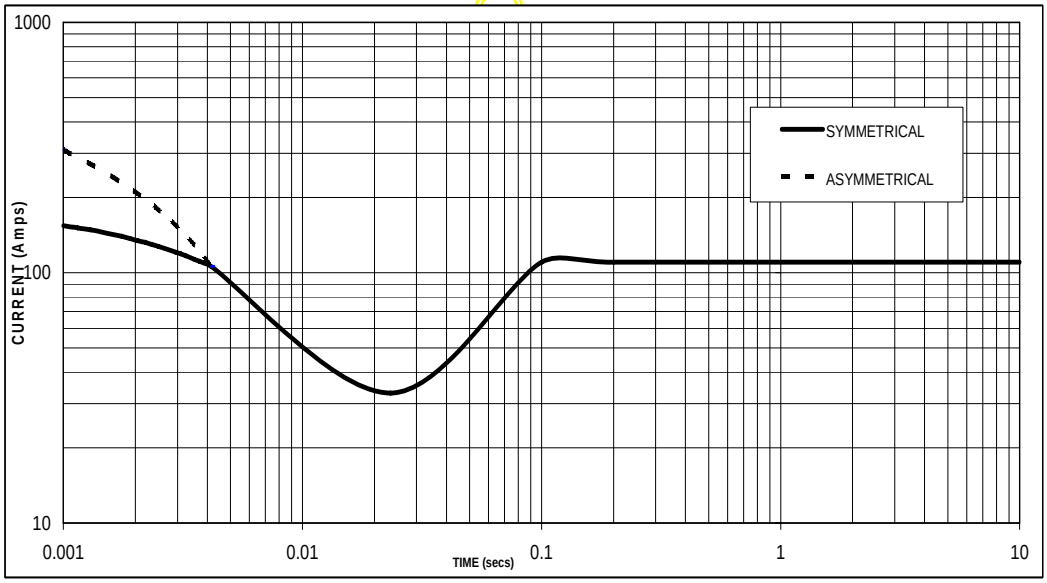
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 88 Amps

60 Hz



Sustained Short Circuit = 110 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI044H

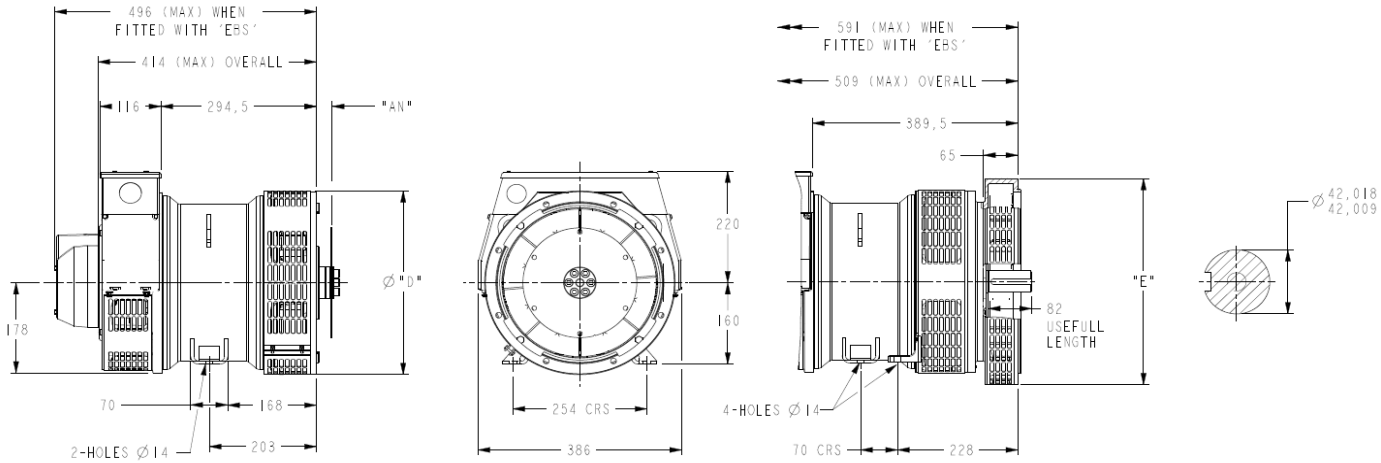
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	16.0	16.0	16.0	15.2	17.5	17.5	17.5	16.6	18.9	18.9	18.9	18.0	19.3	19.3	19.3	18.3
	kW	12.8	12.8	12.8	12.2	14.0	14.0	14.0	13.3	15.1	15.1	15.1	14.4	15.4	15.4	15.4	14.6
	Efficiency (%)	83.9	84.3	84.4	84.8	83.2	83.6	83.8	84.4	82.3	82.8	83.1	83.9	82.1	82.6	82.9	83.8
	kW Input	15.3	15.2	15.2	14.4	16.8	16.7	16.7	15.8	18.3	18.2	18.2	17.2	18.8	18.6	18.6	17.4

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	17.6	18.8	19.4	20.0	19.3	20.6	21.2	21.9	20.8	22.2	22.9	23.6	21.2	22.6	23.3	24.1
	kW	14.1	15.0	15.5	16.0	15.4	16.5	17.0	17.5	16.6	17.8	18.3	18.9	17.0	18.1	18.6	19.3
	Efficiency (%)	84.5	84.6	84.7	84.7	83.9	83.9	84.1	84.1	83.3	83.2	83.4	83.5	83.1	83.1	83.2	83.3
	kW Input	16.7	17.7	18.3	18.9	18.4	19.7	20.2	20.8	19.9	21.4	21.9	22.6	20.5	21.8	22.4	23.2

DIMENSIONS



COUPLING DISC	
SAE	"AN"
6.5	30.2
7.5	30.2
8	62
10	53.8
11.5	39.68

1-BRG ADAPTOR	
SAE	"D"
5	361
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTOR	
SAE	"E"
5	359
4	406
3	455
2	493

APPROVED DOCUMENT

STAMFORD

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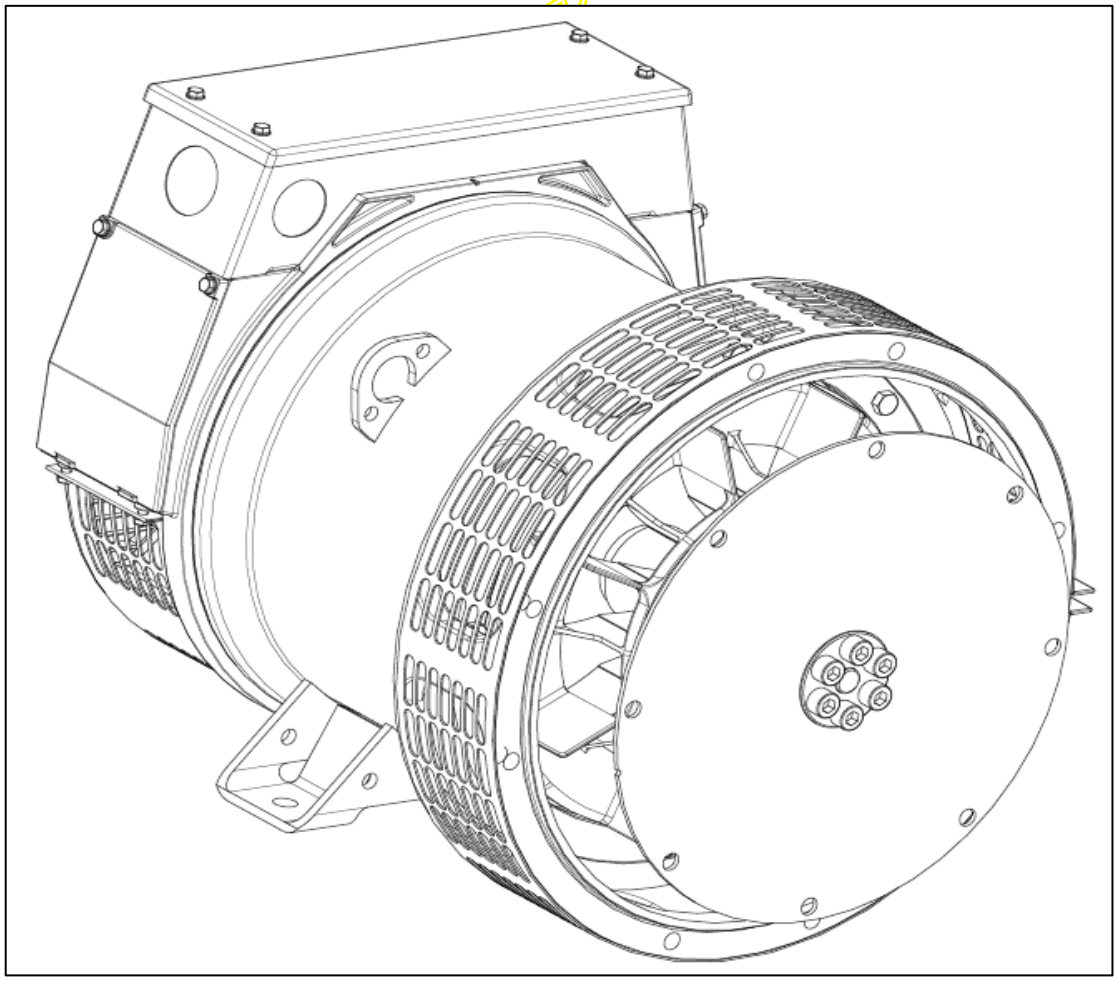
www.cumminsgeneratortechnologies.com

STAMFORD®

PI144D - Winding 311

Technical Data Sheet



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(Standard rotation CW when viewed from DE)

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Front cover drawing typical of product range.

PI144D

STAMFORD

WINDING 311

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SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

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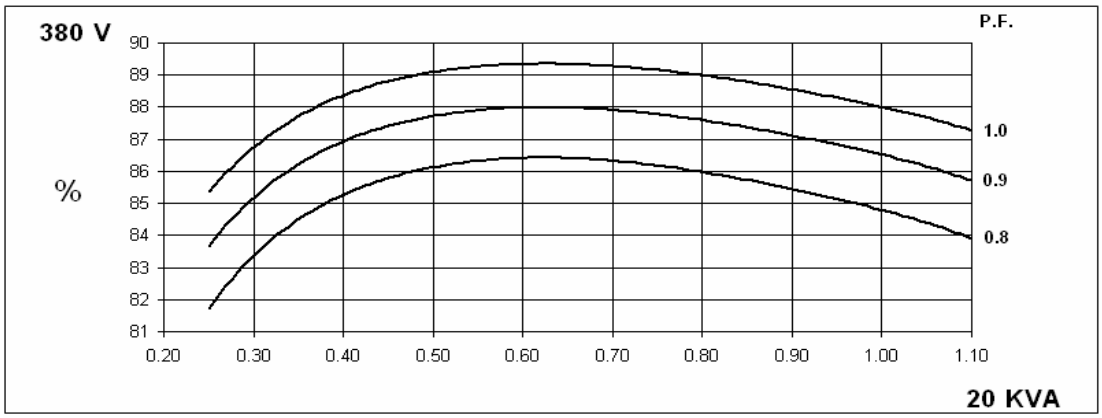
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.377 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.657 Ohms at 22°C							
EXCITER STATOR RESISTANCE	18.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.228 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	120.5 kg		118.8 kg		123.5 kg		121.8 kg	
WEIGHT WOUND STATOR	44 kg		44 kg		44 kg		44 kg	
WEIGHT WOUND ROTOR	41.87 kg		40.17 kg		42.87 kg		41.17 kg	
WR² INERTIA	0.156 kgm^2		0.1544 kgm^2		0.1562 kgm^2		0.1545 kgm^2	
SHIPPING WEIGHTS in a crate	138 kg		136.3 kg		147 kg		145.3 kg	
PACKING CRATE SIZE	71 x 51 x 67 (cm)				71 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.100 m³/sec 212cfm				0.122 m³/sec 251 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	20	20	20	19	22	23.5	24.3	25
Xd DIR. AXIS SYNCHRONOUS	1.66	1.50	1.39	1.18	1.97	1.88	1.78	1.68
X'd DIR. AXIS TRANSIENT	0.17	0.15	0.14	0.12	0.20	0.19	0.18	0.17
X''d DIR. AXIS SUBTRANSIENT	0.11	0.10	0.09	0.08	0.13	0.12	0.12	0.11
Xq QUAD. AXIS REACTANCE	0.80	0.72	0.67	0.57	0.95	0.91	0.86	0.81
X''q QUAD. AXIS SUBTRANSIENT	0.18	0.16	0.15	0.13	0.21	0.20	0.19	0.18
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.14	0.13	0.12	0.10	0.17	0.16	0.15	0.15
X_0 ZERO SEQUENCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.017 s							
T''d SUB-TRANSTIME CONST.	0.004 s							
T'do O.C. FIELD TIME CONST.	0.38 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

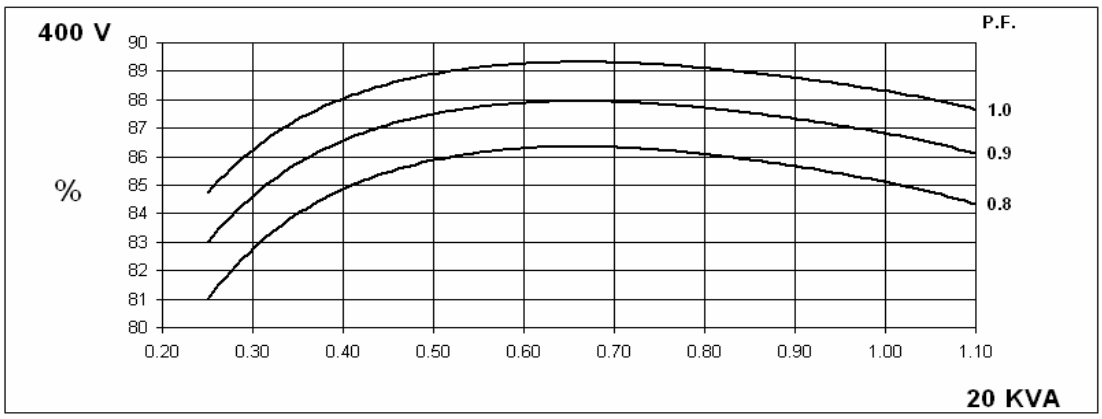
50 Hz

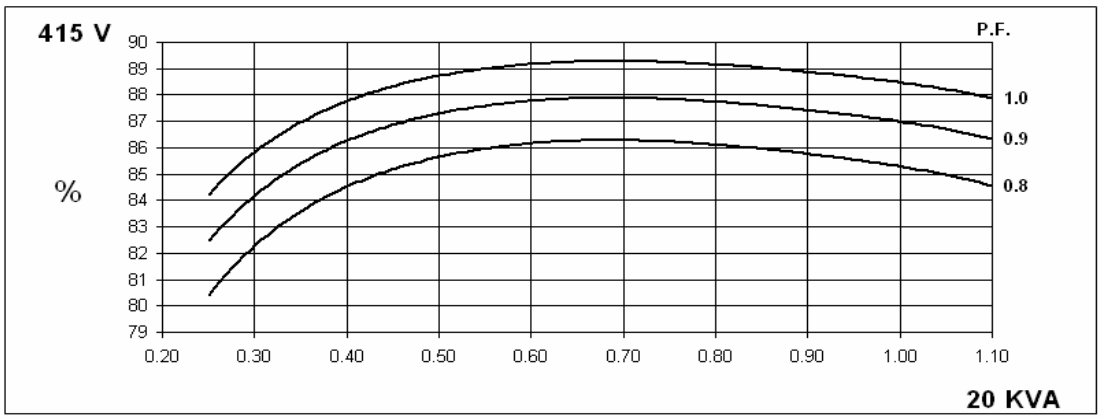
PI144D

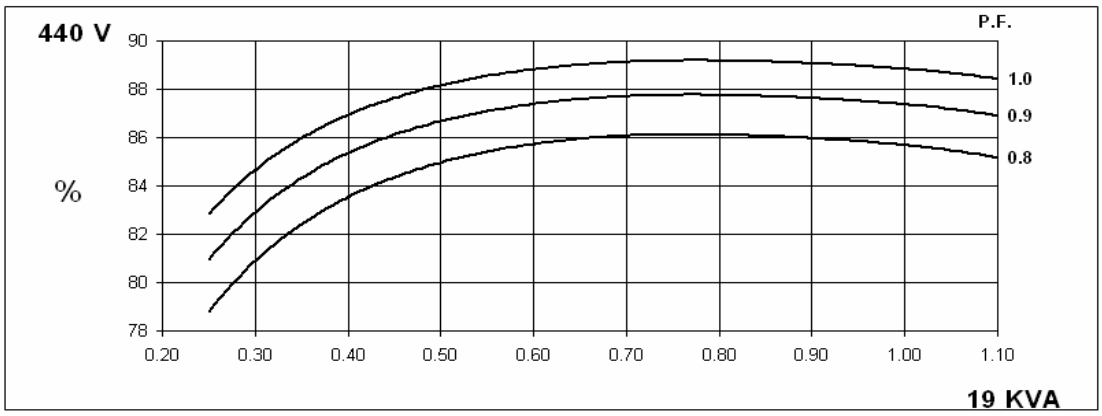
Winding 311

THREE PHASE EFFICIENCY CURVES







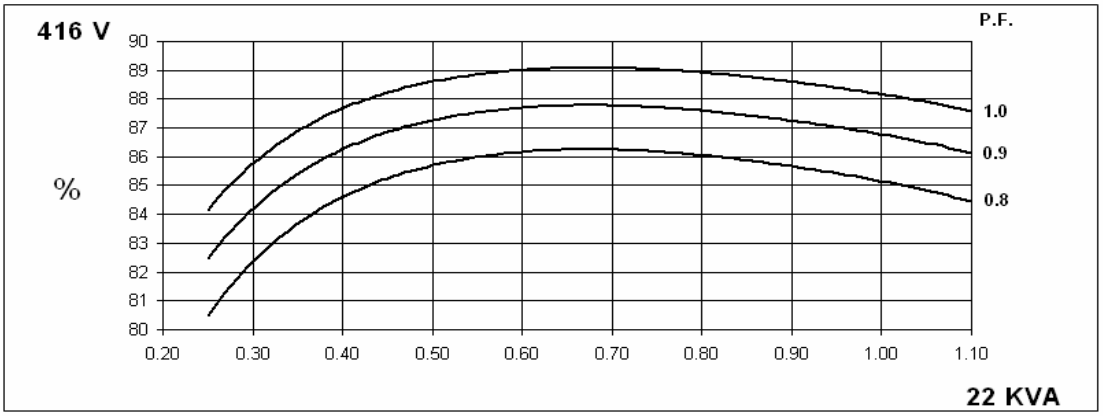


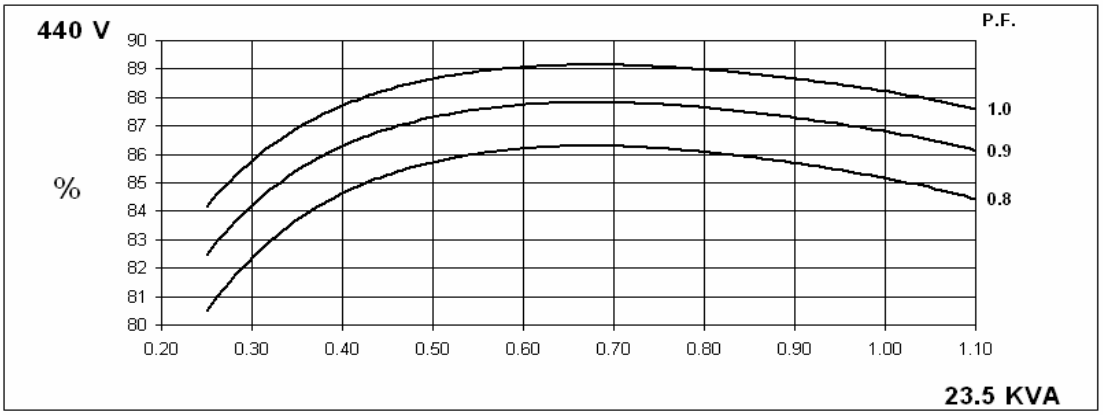
60 Hz

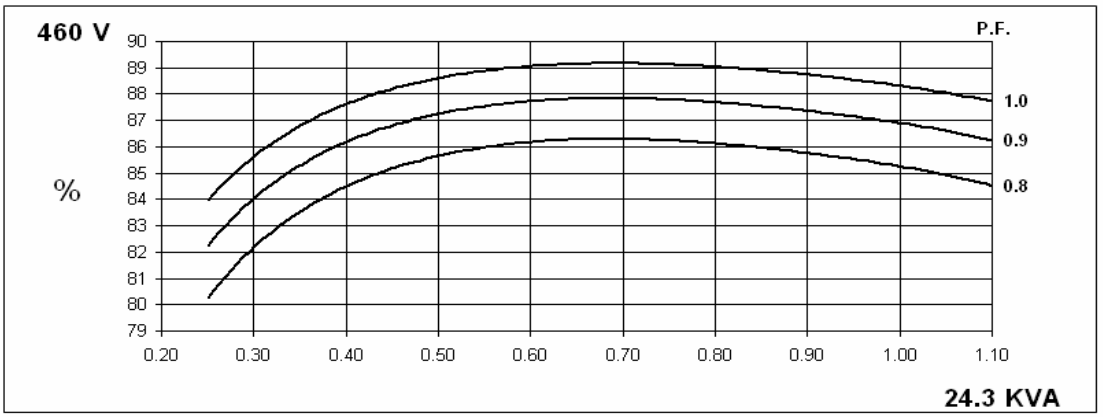
PI144D

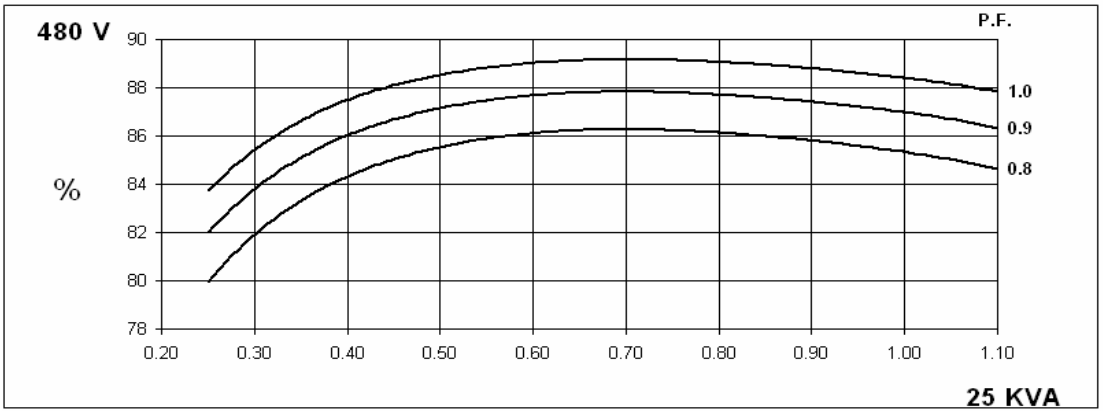
Winding 311

THREE PHASE EFFICIENCY CURVES



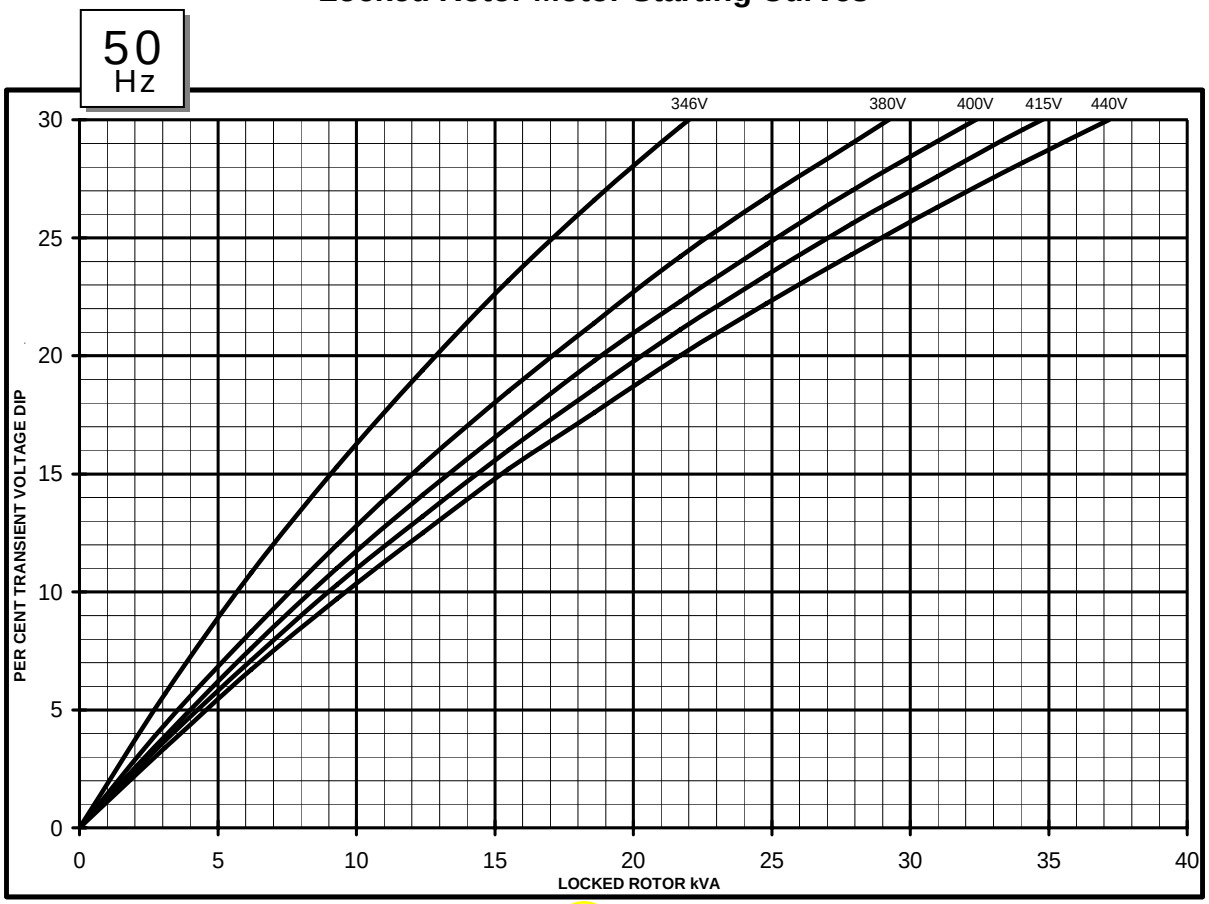


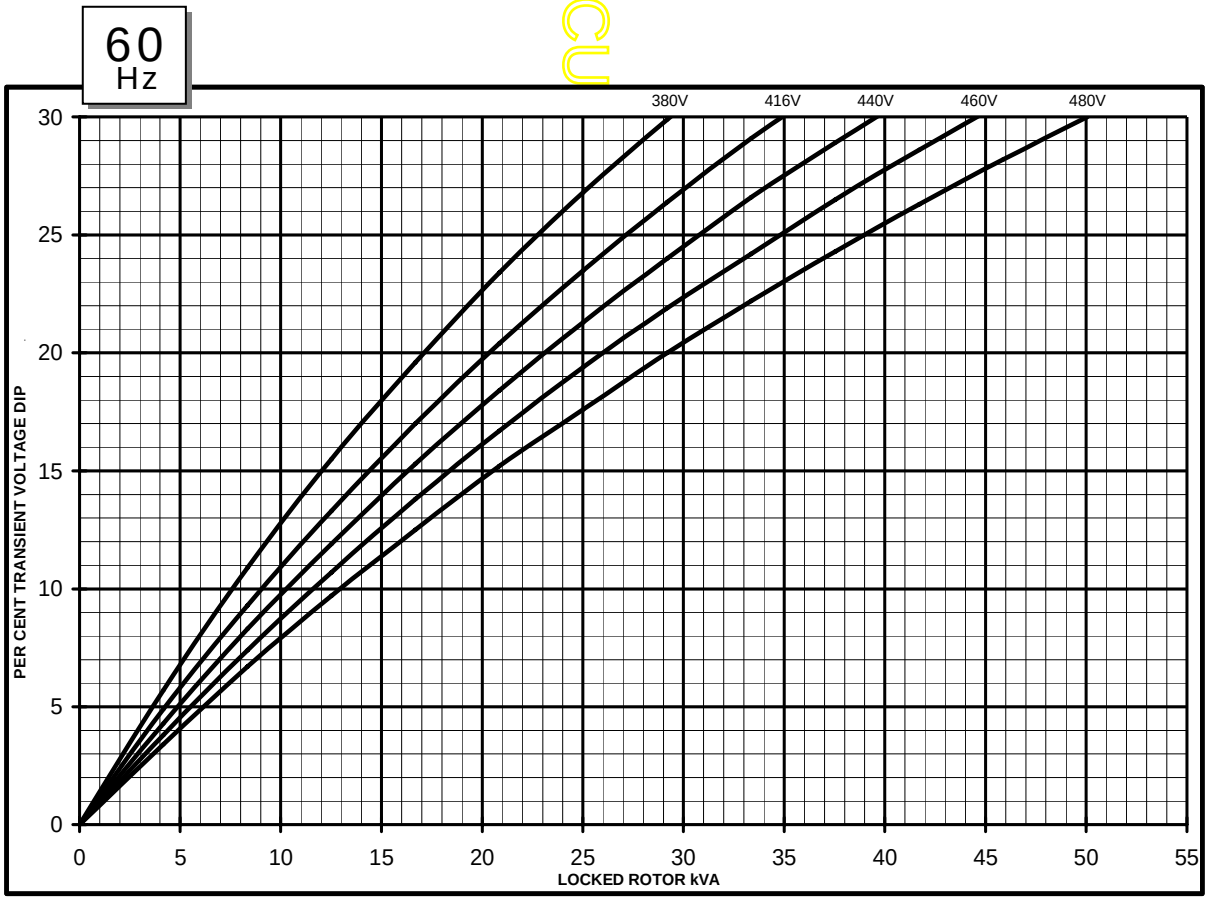




PI144D

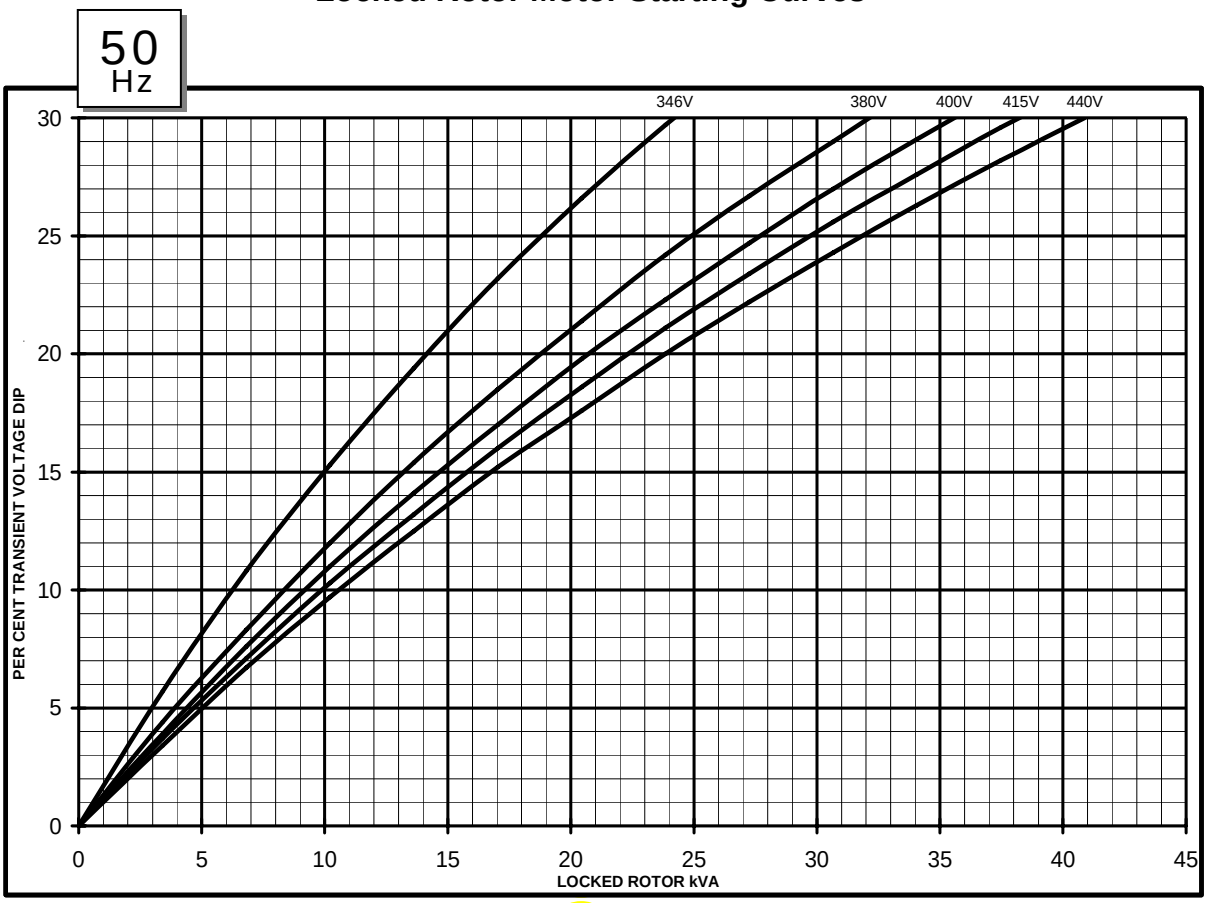
Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

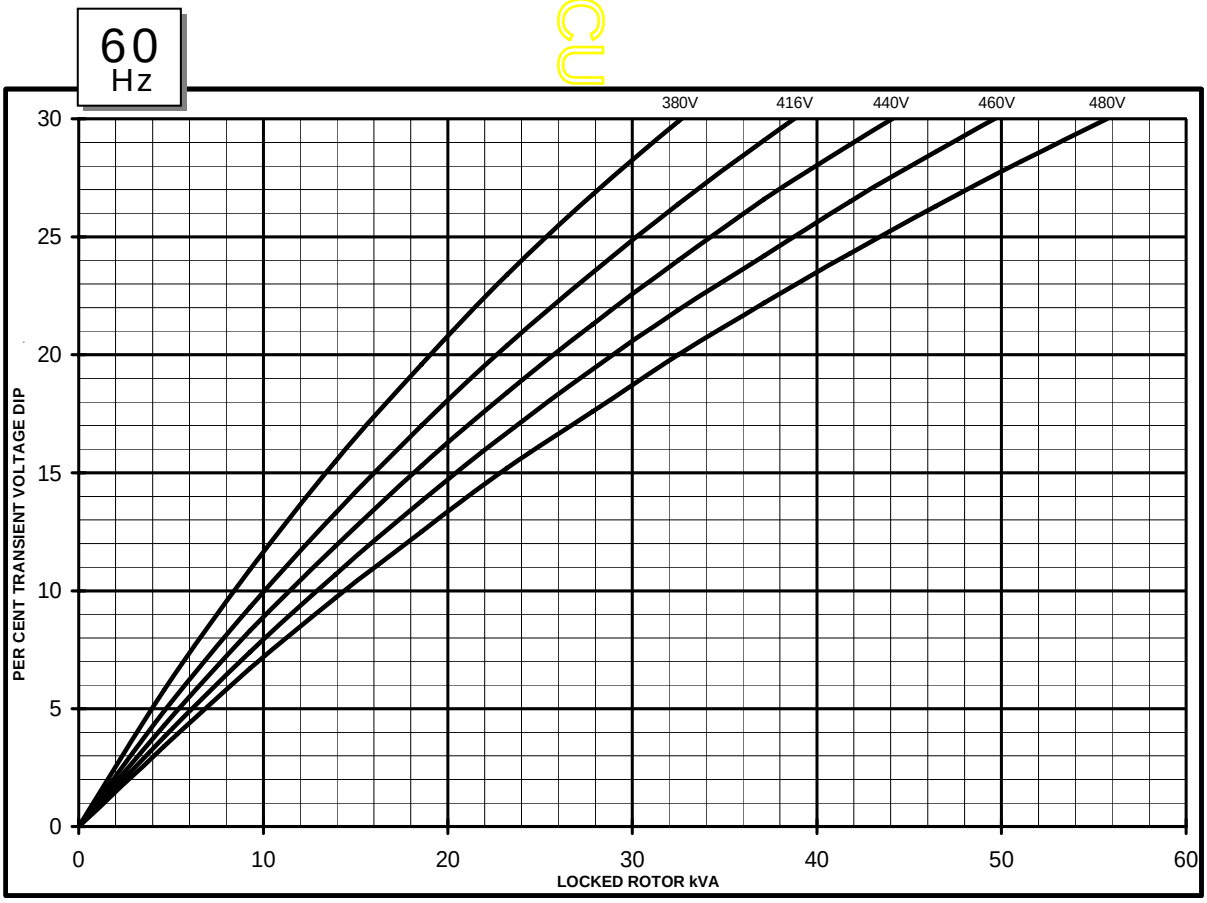




PI144D

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves



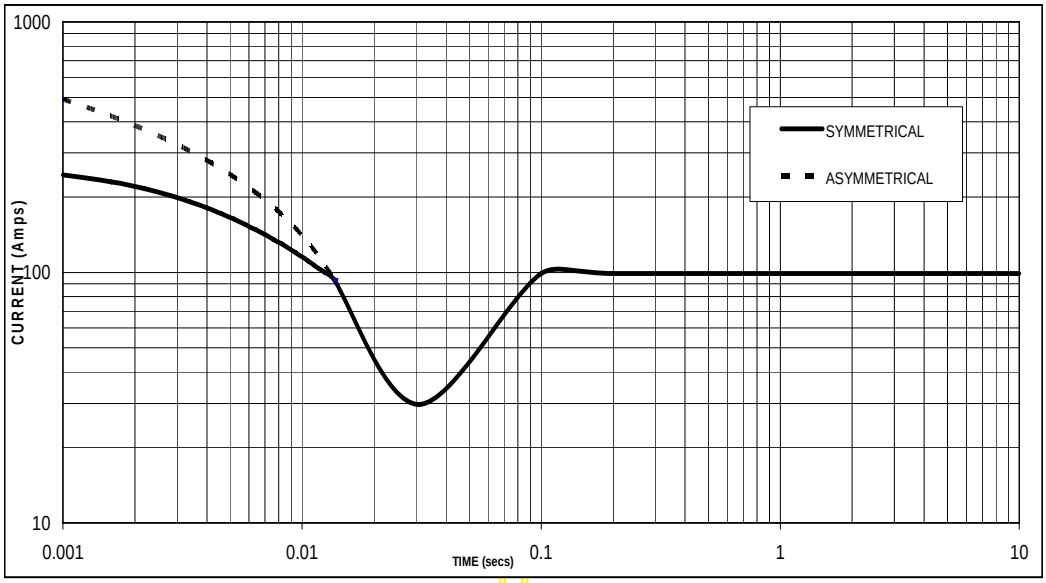


PI144D

WITH EBS FITTED

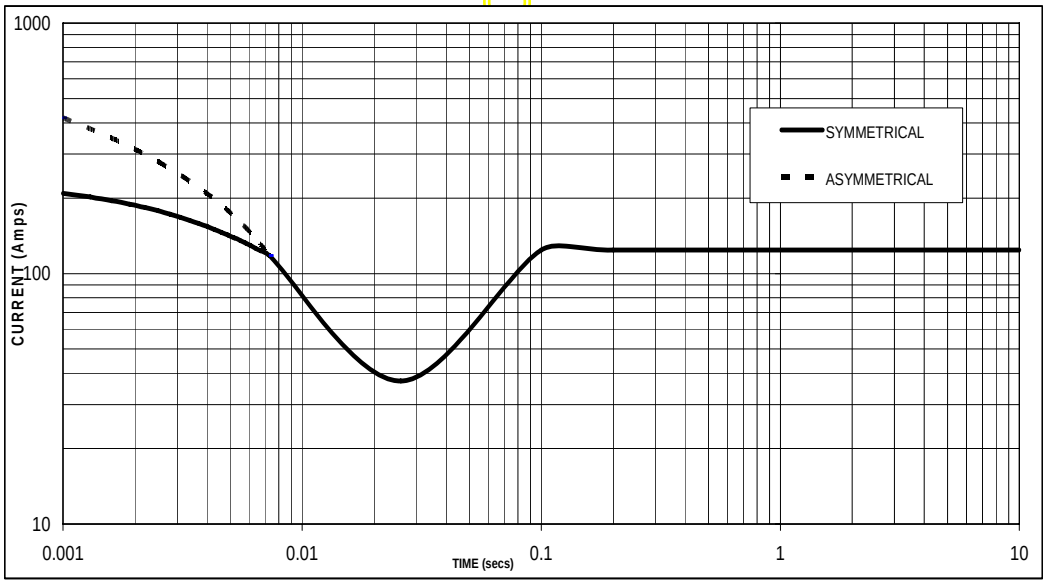
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 99 Amps

60 Hz



Sustained Short Circuit = 124 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI144D

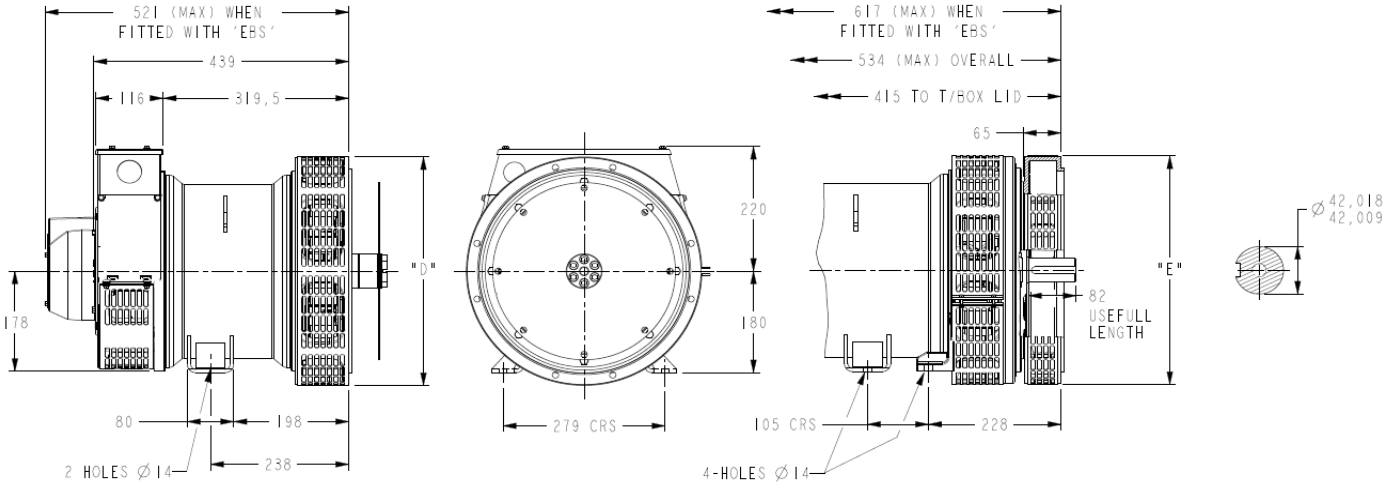
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	18.2	18.2	18.2	17.3	20.0	20.0	20.0	19.0	21.5	21.5	21.5	20.4	22.0	22.0	22.0	20.9
	kW	14.6	14.6	14.6	13.8	16.0	16.0	16.0	15.2	17.2	17.2	17.2	16.3	17.6	17.6	17.6	16.7
	Efficiency (%)	85.4	85.7	85.8	86.0	84.8	85.1	85.3	85.7	84.2	84.6	84.8	85.4	84.0	84.4	84.6	85.2
	kW Input	17.0	17.0	17.0	16.1	18.9	18.8	18.8	17.7	20.4	20.3	20.3	19.1	21.0	20.9	20.8	19.6

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	20.0	21.4	22.1	22.8	22.0	23.5	24.3	25.0	23.7	25.3	26.1	26.9	24.2	25.9	26.7	27.5
	kW	16.0	17.1	17.7	18.2	17.6	18.8	19.4	20.0	19.0	20.2	20.9	21.5	19.4	20.7	21.4	22.0
	Efficiency (%)	85.6	85.7	85.7	85.8	85.1	85.2	85.3	85.3	84.6	84.6	84.8	84.8	84.5	84.5	84.6	84.7
	kW Input	18.7	20.0	20.6	21.3	20.7	22.1	22.8	23.4	22.4	23.9	24.6	25.4	22.9	24.5	25.3	26.0

DIMENSIONS



COUPLING DISC	
SAE	"AN"
6.5	30.2
7.5	30.2
8	62
10	53.8
11.5	39.6

1-BRG ADAPTOR	
SAE	"D"
5	361
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTOR	
SAE	"E"
5	359
4	406
3	455
2	493

APPROVED DOCUMENT

STAMFORD

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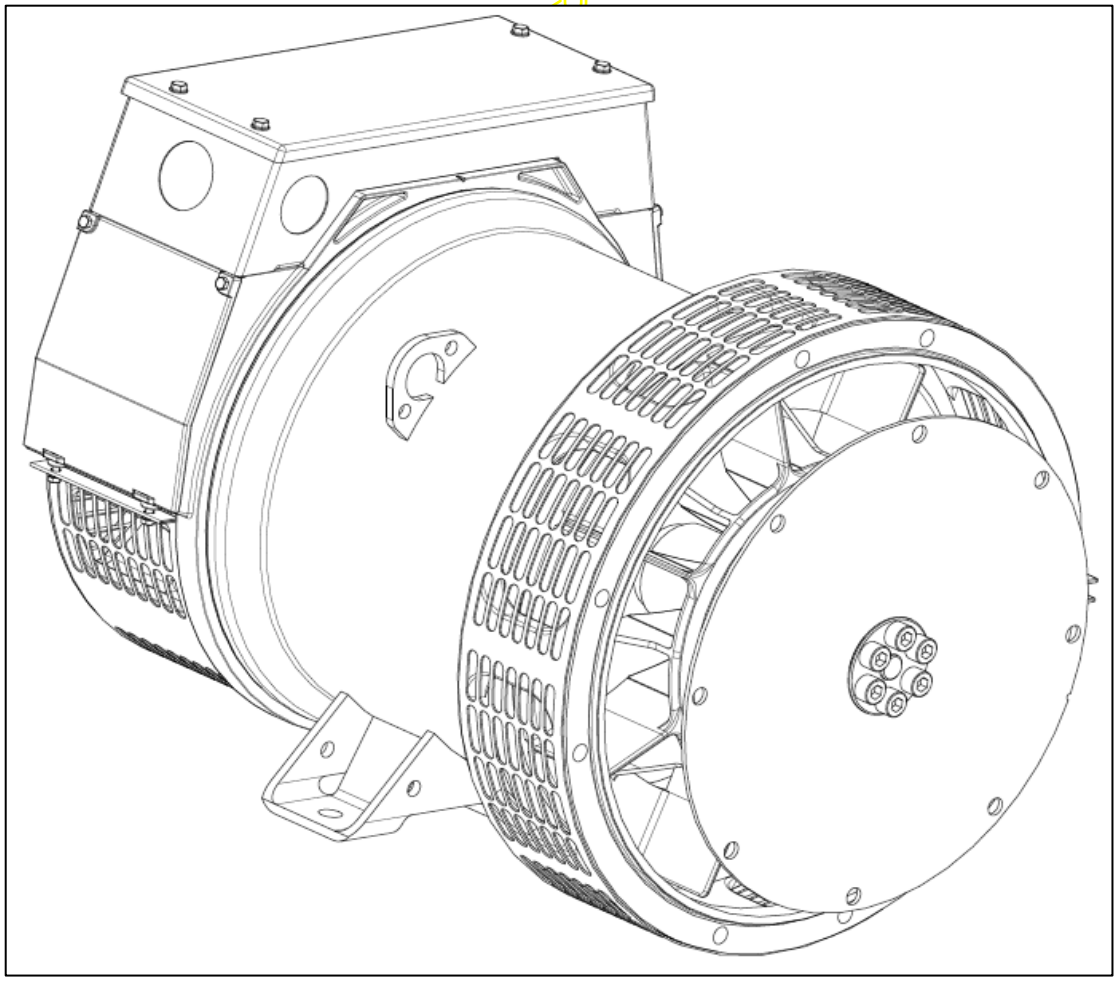
PI144E - Winding 311

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 REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the 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 AS480 will support limited accessories, RFI suppression remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

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 at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

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 9 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.

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

PI144E

STAMFORD

WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.296 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.67 Ohms at 22°C							
EXCITER STATOR RESISTANCE	19.4 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.215 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	135 kg		133.3 kg		138 kg		136.3 kg	
WEIGHT WOUND STATOR	55 kg		55 kg		55 kg		55 kg	
WEIGHT WOUND ROTOR	47.24 kg		45.54 kg		48.24 kg		46.54 kg	
WR² INERTIA	0.1771 kgm^2		0.1754 kgm^2		0.1772 kgm^2		0.1755 kgm^2	
SHIPPING WEIGHTS in a crate	152 kg		150.3 kg		161 kg		159.3 kg	
PACKING CRATE SIZE	71 x 51 x 67 (cm)				71 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.100 m³/sec 212cfm				0.122 m³/sec 251 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	25	25	25	23.8	27.5	29.4	30.3	31.3
Xd DIR. AXIS SYNCHRONOUS	1.78	1.61	1.50	1.27	2.11	2.02	1.90	1.80
X'd DIR. AXIS TRANSIENT	0.17	0.15	0.14	0.12	0.19	0.18	0.17	0.16
X''d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.09	0.14	0.13	0.13	0.12
Xq QUAD. AXIS REACTANCE	0.85	0.77	0.72	0.61	1.01	0.97	0.91	0.86
X''q QUAD. AXIS SUBTRANSIENT	0.19	0.17	0.16	0.13	0.22	0.21	0.20	0.19
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	0.11	0.18	0.17	0.16	0.15
X_0 ZERO SEQUENCE	0.08	0.07	0.07	0.06	0.09	0.09	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.019 s							
T''d SUB-TRANSTIME CONST.	0.005 s							
T'do O.C. FIELD TIME CONST.	0.45 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

50 Hz

PI144E

Winding 311

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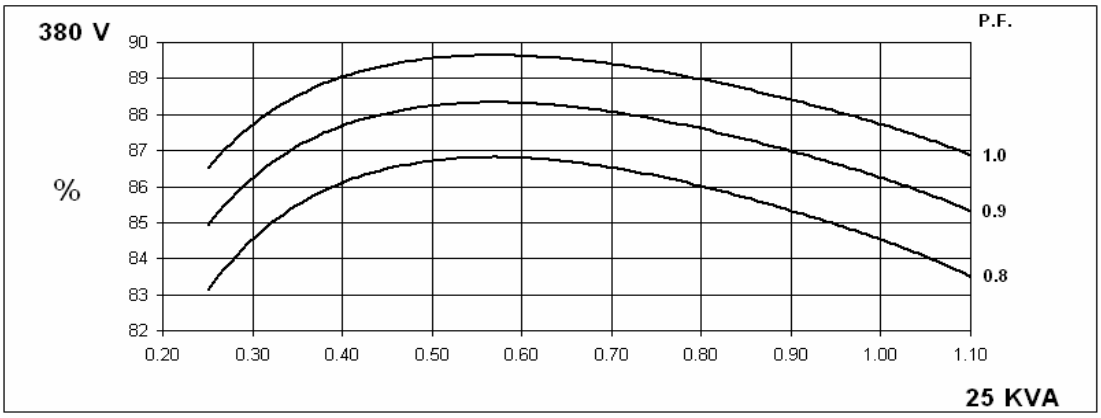
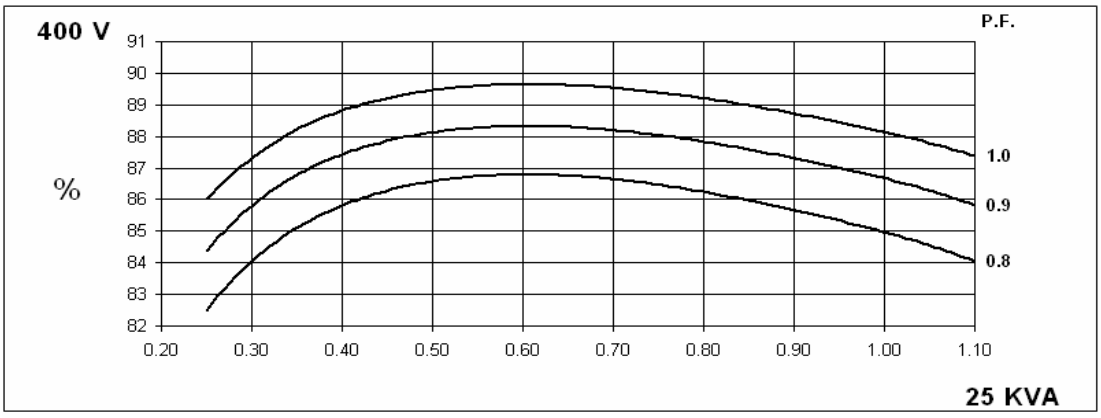
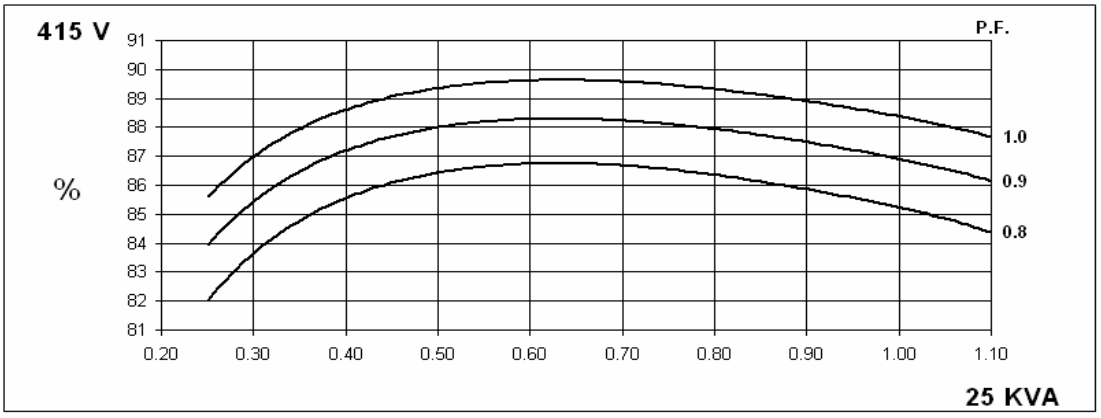
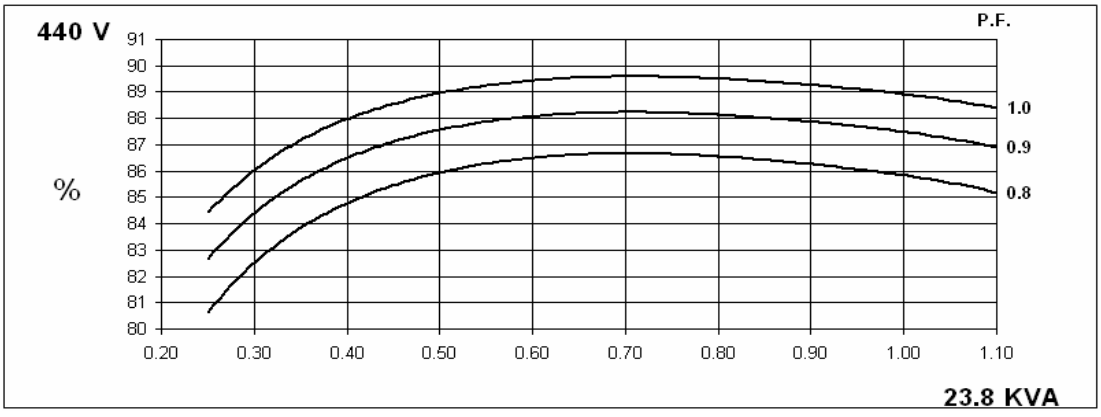
THREE PHASE EFFICIENCY CURVES







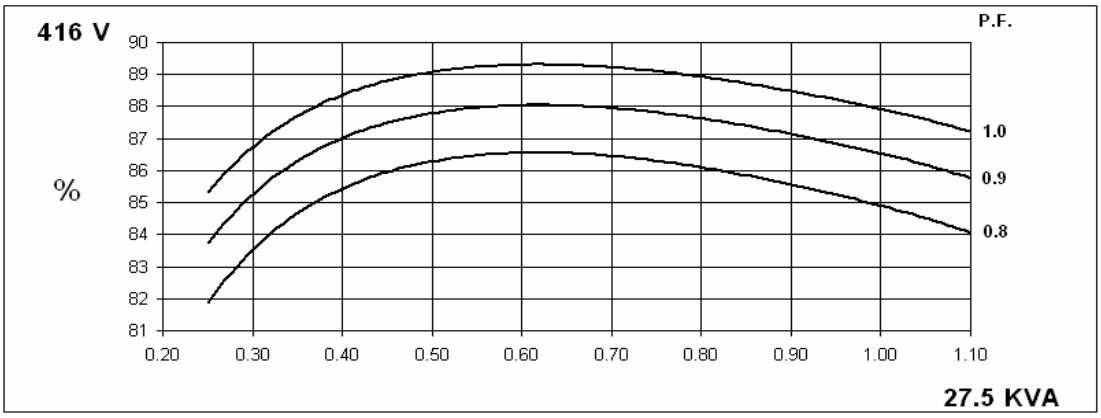


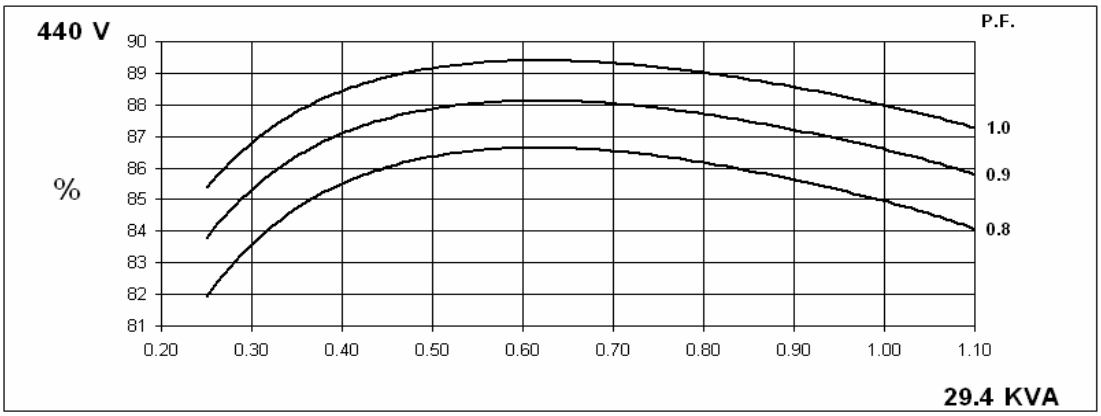
60 Hz

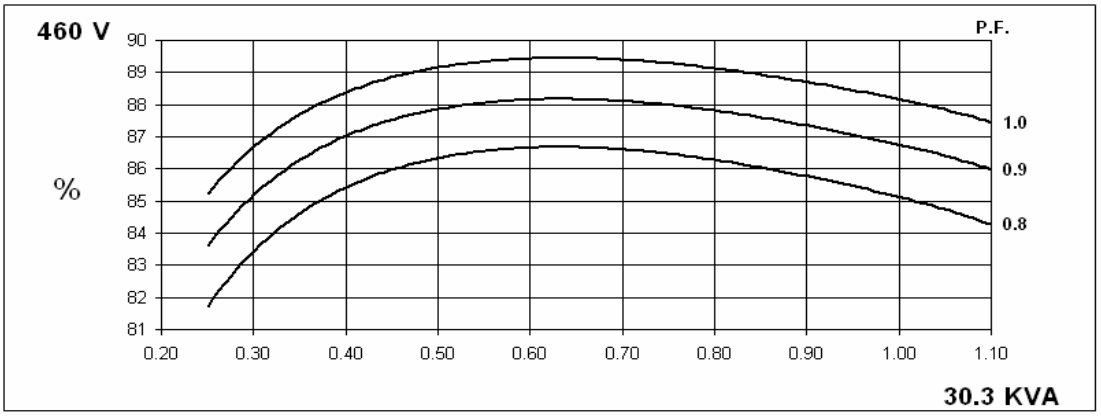
PI144E

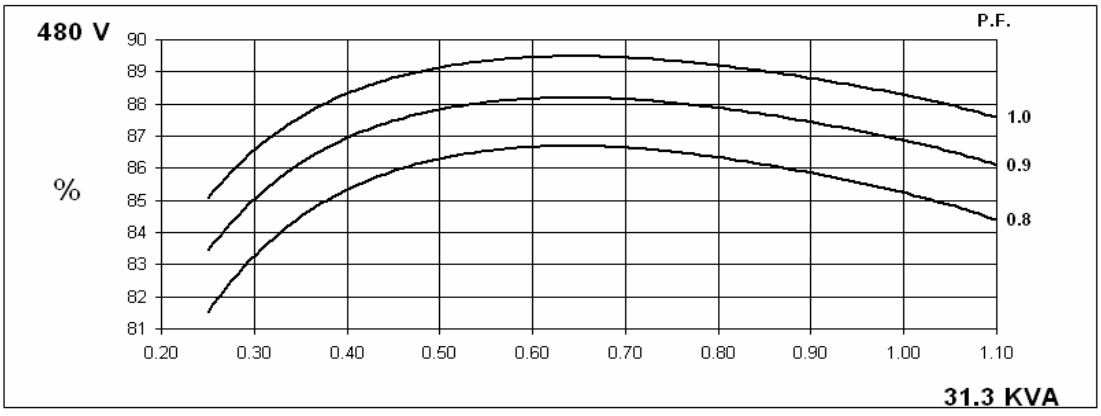
Winding 311

THREE PHASE EFFICIENCY CURVES



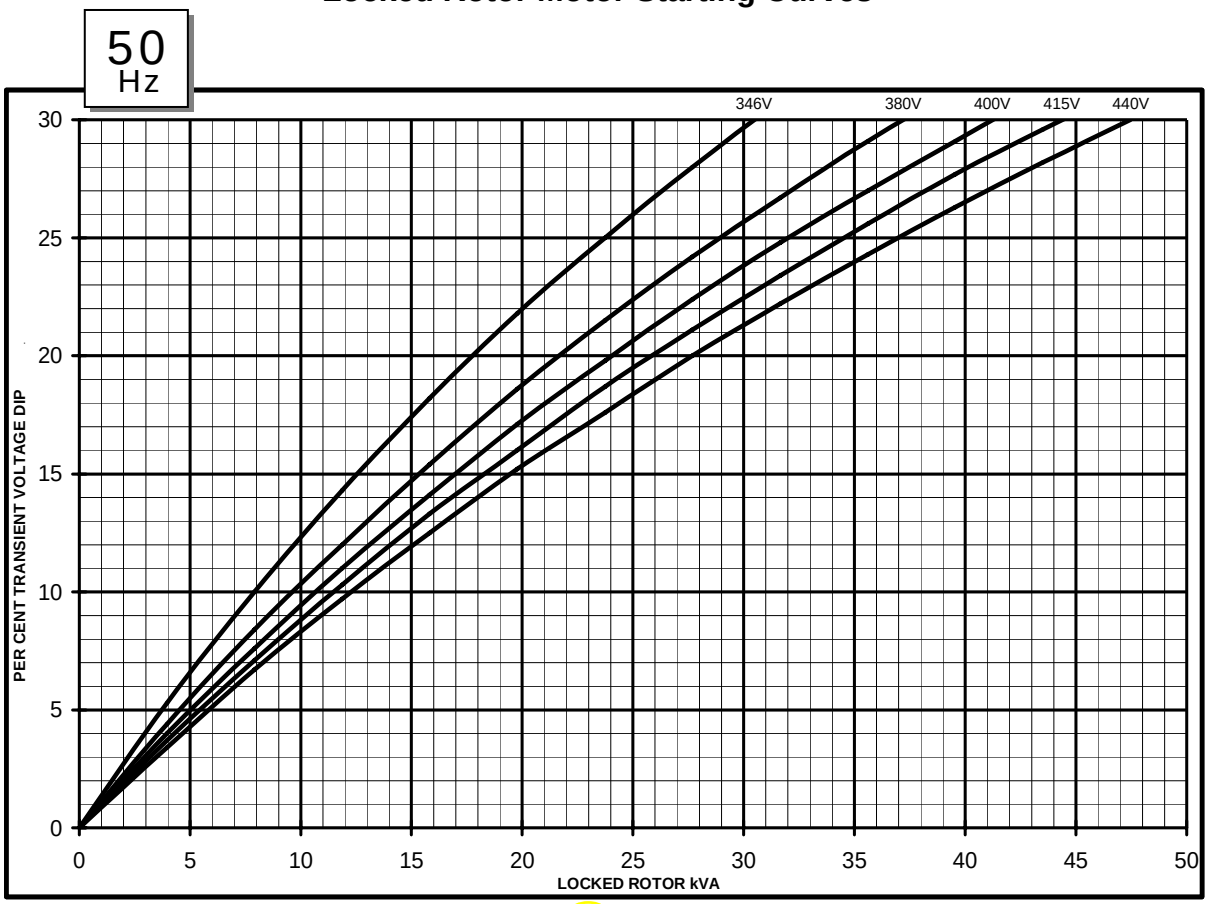


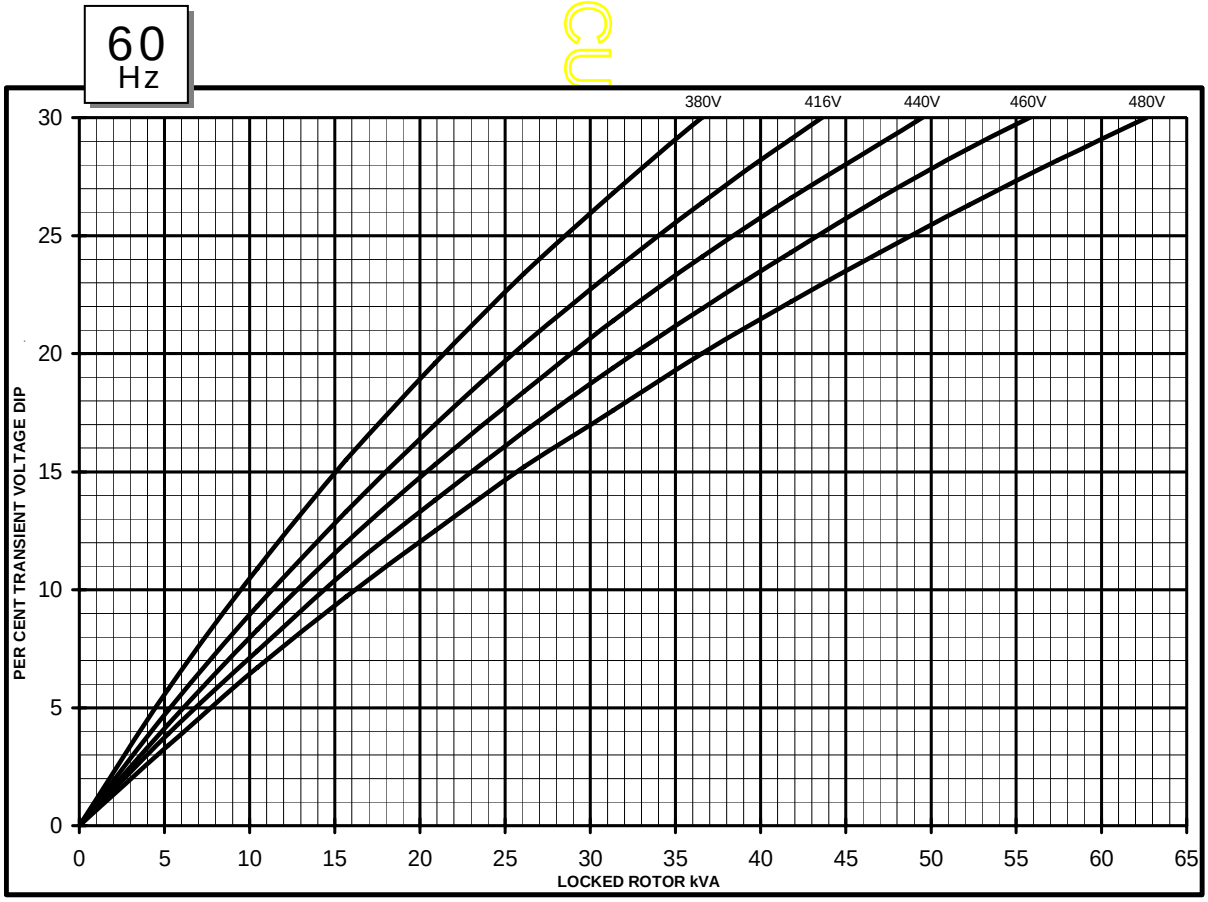




PI144E

Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

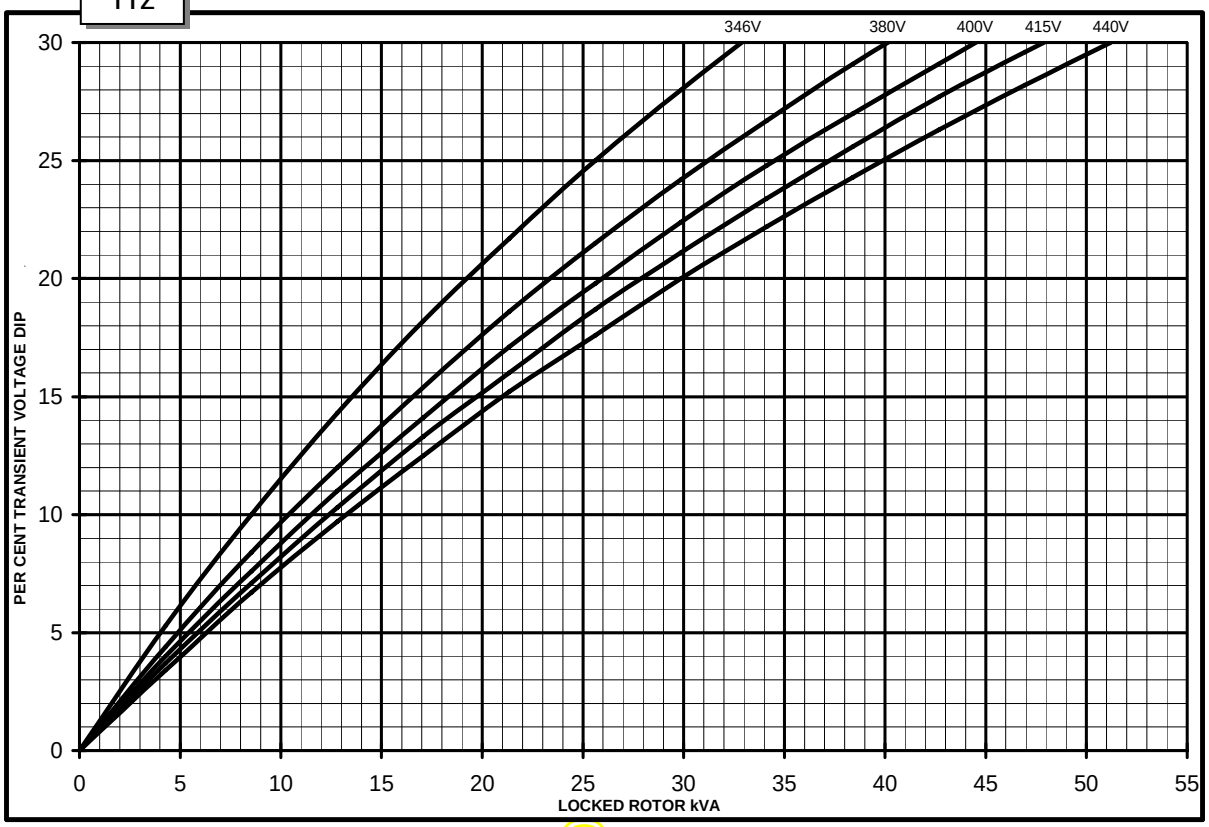




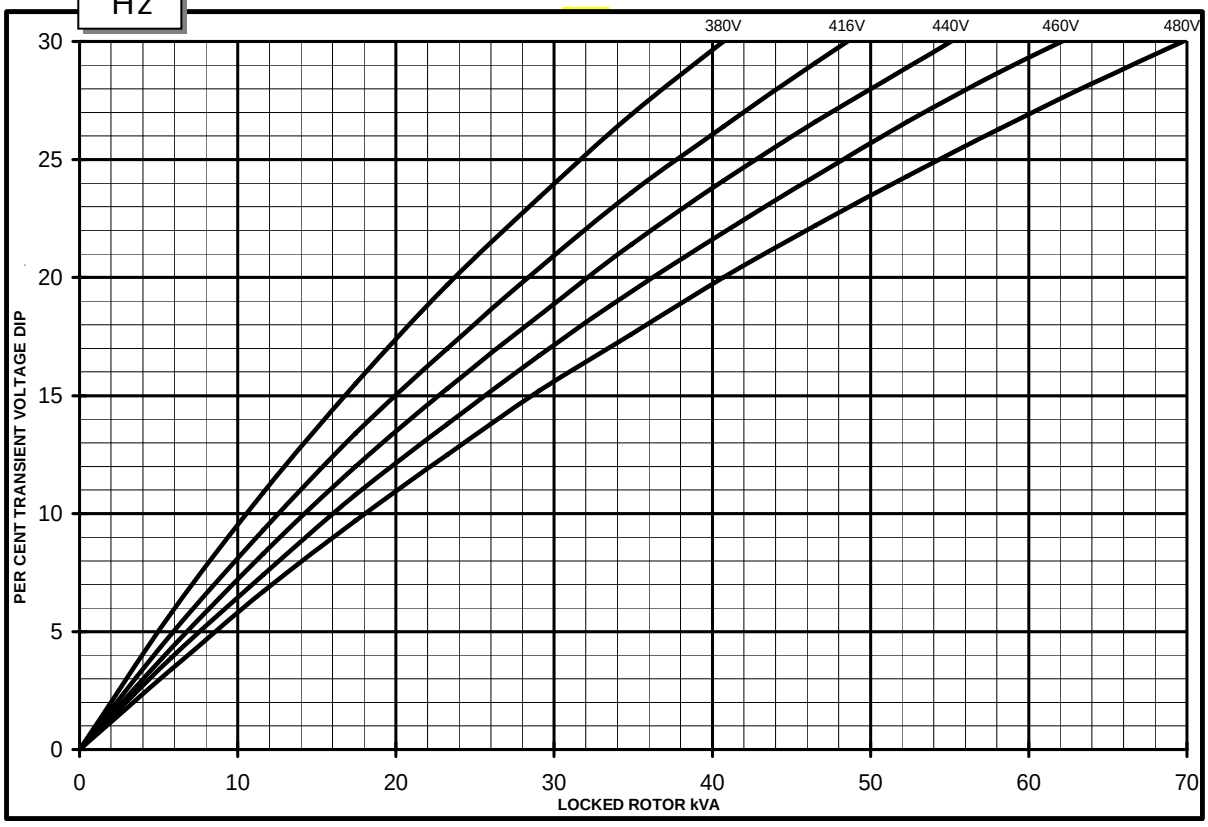
PI144E

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves

50 Hz



60 Hz

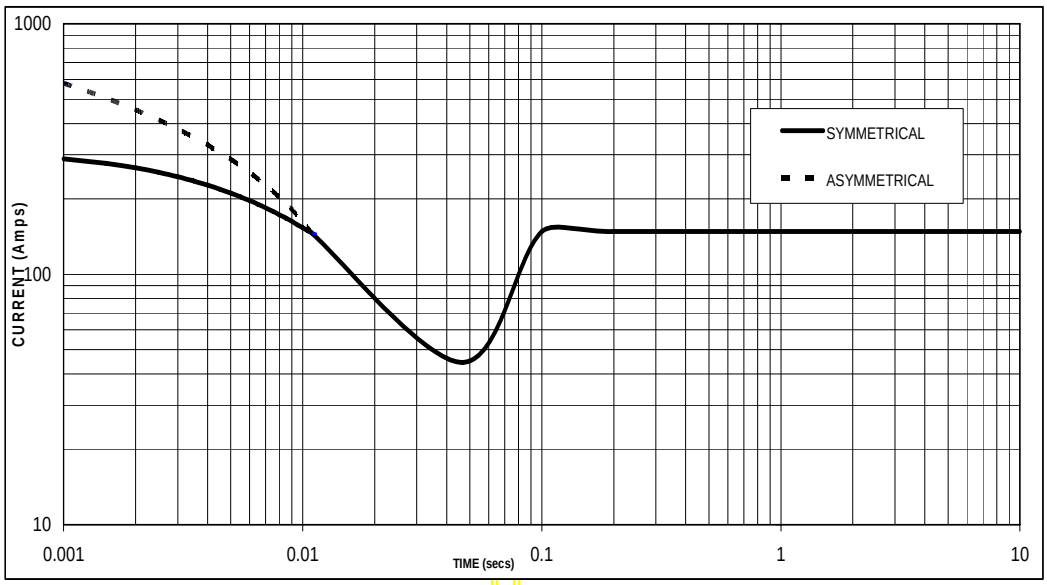


PI144E

WITH EBS FITTED

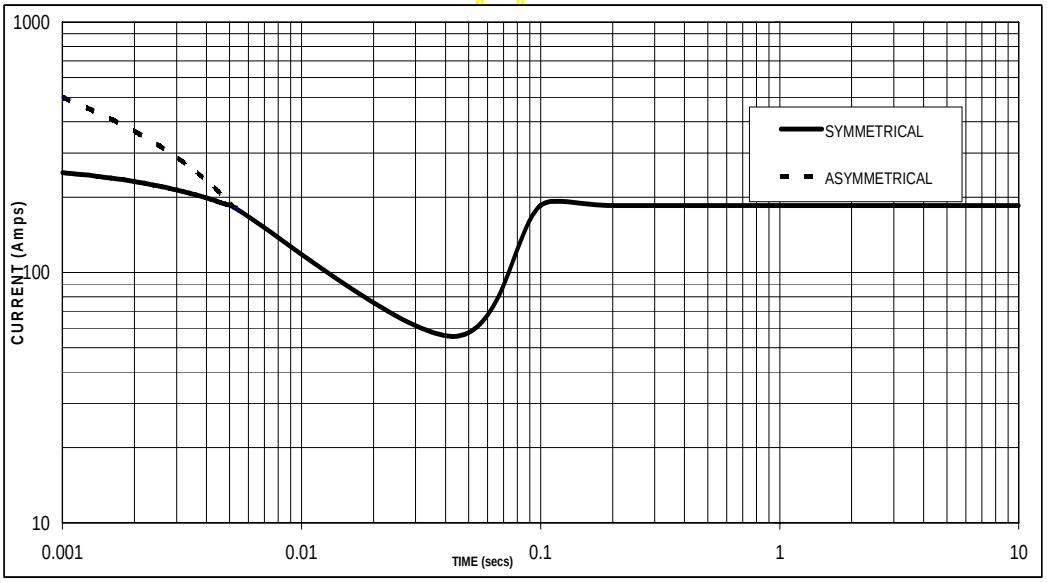
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 148 Amps

60 Hz



Sustained Short Circuit = 185 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI144E

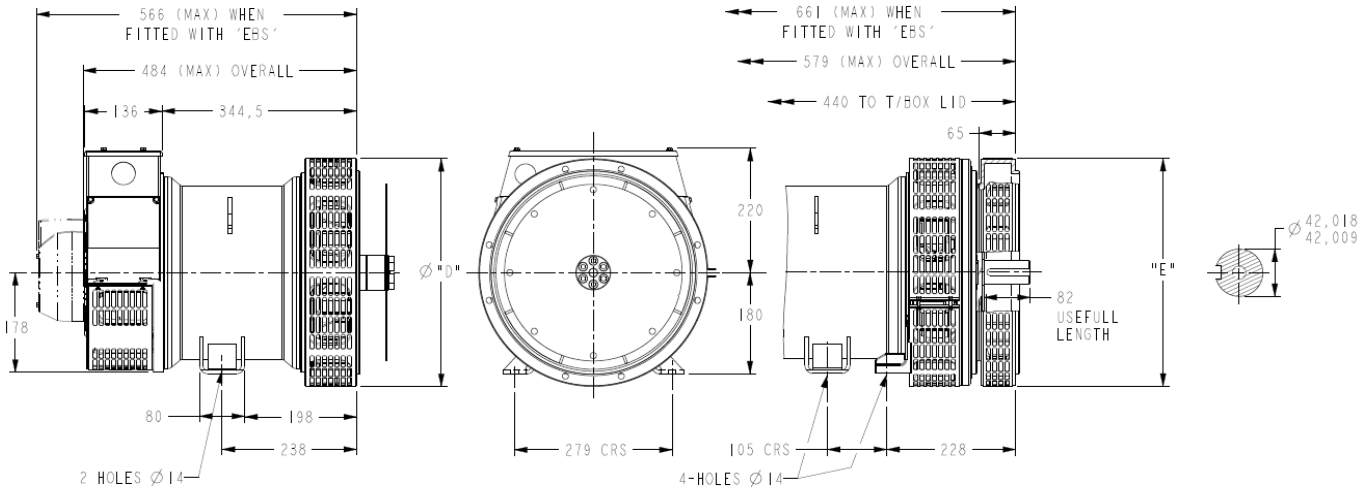
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	22.8	22.8	22.8	21.6	25.0	25.0	25.0	23.8	26.9	26.9	26.9	25.6	27.5	27.5	27.5	26.1
	kW	18.2	18.2	18.2	17.3	20.0	20.0	20.0	19.0	21.5	21.5	21.5	20.5	22.0	22.0	22.0	20.9
	Efficiency (%)	85.3	85.6	85.7	86.0	84.6	85.0	85.2	85.6	83.9	84.4	84.6	85.2	83.7	84.1	84.4	85.1
	kW Input	21.3	21.3	21.2	20.1	23.6	23.5	23.5	22.2	25.6	25.5	25.4	24.1	26.3	26.2	26.1	24.6

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	25.0	26.7	27.6	28.4	27.5	29.4	30.3	31.3	29.6	31.6	32.6	33.6	30.3	32.3	33.3	34.4
	kW	20.0	21.4	22.1	22.7	22.0	23.5	24.2	25.0	23.7	25.3	26.1	26.9	24.2	25.8	26.6	27.5
	Efficiency (%)	85.9	85.9	85.9	86.0	85.3	85.3	85.4	85.4	84.8	84.7	84.8	84.9	84.6	84.5	84.6	84.7
	kW Input	23.3	24.9	25.7	26.4	25.8	27.5	28.3	29.3	27.9	29.9	30.8	31.7	28.6	30.5	31.4	32.5

DIMENSIONS



COUPLING DISC	
SAE	"AN"
6.5	30.2
7.5	30.2
8	62
10	53.8
11.5	39.6

1-BRG ADAPTOR	
SAE	"D"
5	361
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTOR	
SAE	"E"
5	359
4	406
3	455
2	493

APPROVED DOCUMENT

STAMFORD

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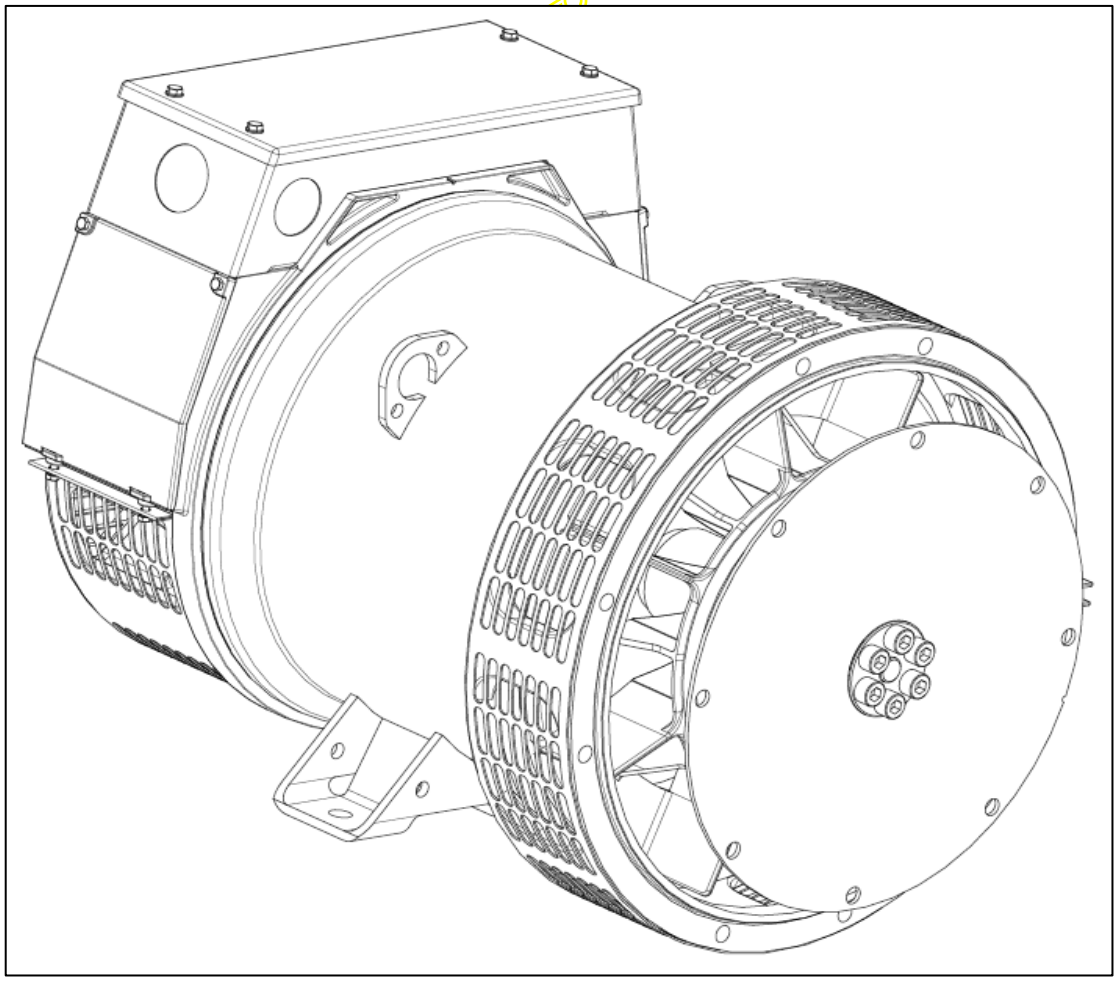
STAMFORD®

PI144F - 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 REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the 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 AS480 will support limited accessories, RFI suppression remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

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 at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

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 9 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.

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

PI144F

STAMFORD

WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

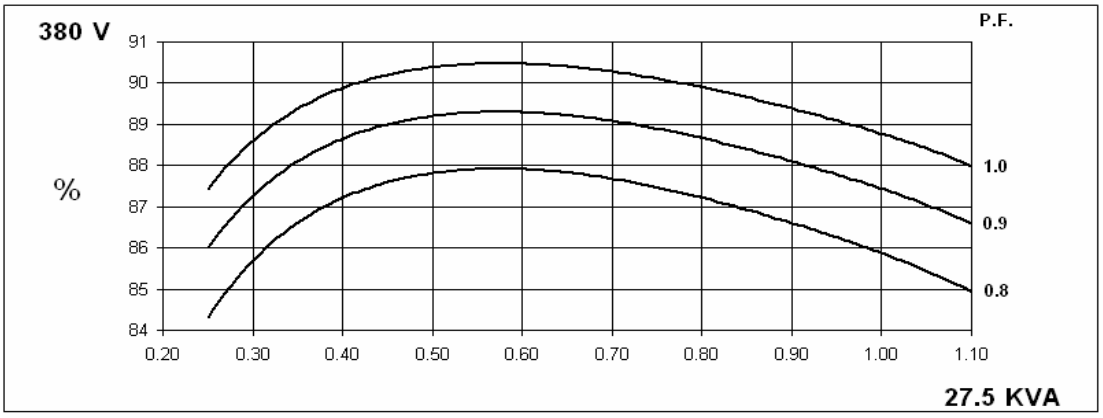
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.265 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.708 Ohms at 22°C							
EXCITER STATOR RESISTANCE	20.3 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.201 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	143.5 kg		141.8 kg		146.5 kg		144.8 kg	
WEIGHT WOUND STATOR	58 kg		58 kg		58 kg		58 kg	
WEIGHT WOUND ROTOR	50.45 kg		48.75 kg		51.45 kg		49.75 kg	
WR² INERTIA	0.1903 kgm^2		0.1886 kgm^2		0.1904 kgm^2		0.1887 kgm^2	
SHIPPING WEIGHTS in a crate	161 kg		159.3 kg		170 kg		168.3 kg	
PACKING CRATE SIZE	85 x 51 x 67 (cm)				85 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.100 m³/sec 212cfm				0.122 m³/sec 251 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	27.5	27.5	27.5	26.1	30.3	32.3	33.3	34.4
Xd DIR. AXIS SYNCHRONOUS	1.83	1.65	1.53	1.29	2.18	2.08	1.96	1.86
X'd DIR. AXIS TRANSIENT	0.17	0.15	0.14	0.12	0.20	0.19	0.18	0.17
X''d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.09	0.15	0.14	0.13	0.13
Xq QUAD. AXIS REACTANCE	0.88	0.79	0.73	0.62	1.04	0.99	0.93	0.89
X''q QUAD. AXIS SUBTRANSIENT	0.19	0.17	0.16	0.13	0.23	0.22	0.21	0.20
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	0.11	0.19	0.18	0.17	0.16
X_0 ZERO SEQUENCE	0.08	0.07	0.07	0.05	0.09	0.09	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.021 s							
T''d SUB-TRANSTIME CONST.	0.005 s							
T'do O.C. FIELD TIME CONST.	0.48 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

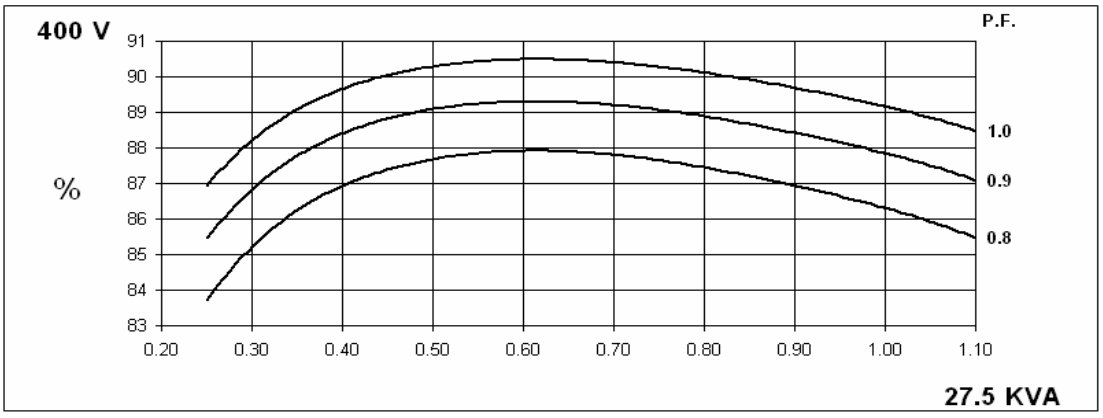
50 Hz

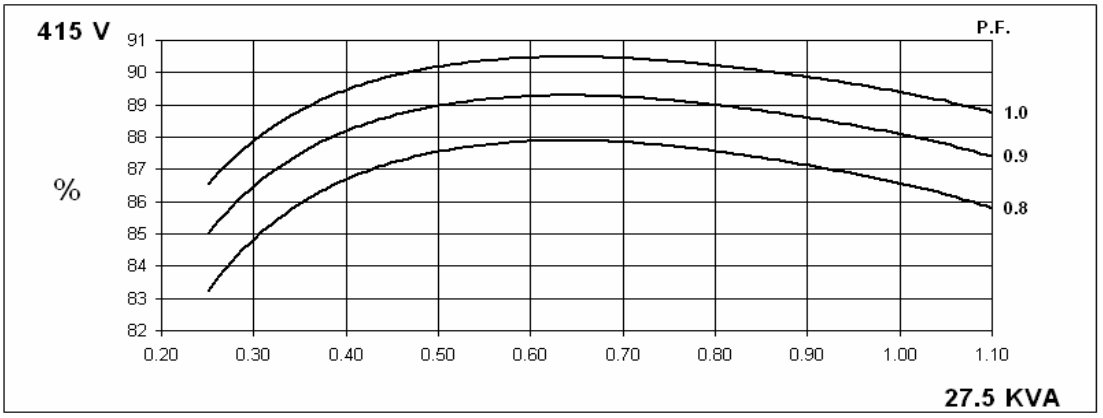
PI144F

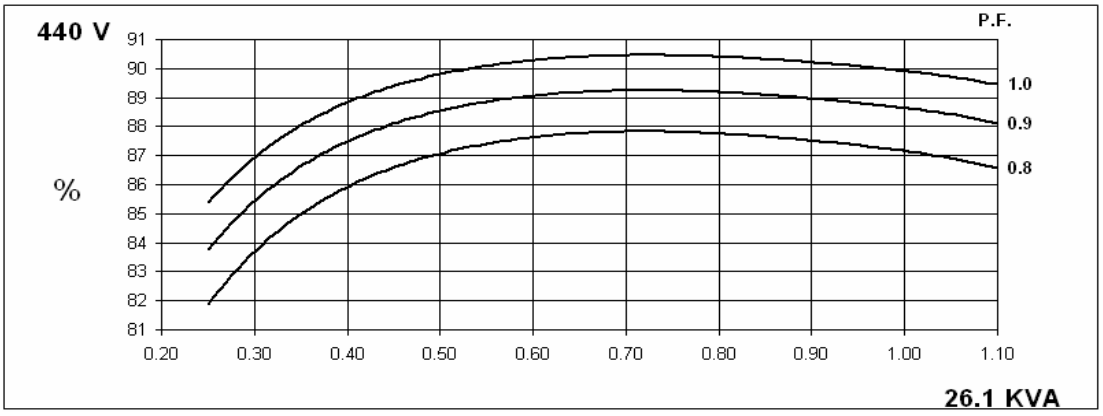
Winding 311

THREE PHASE EFFICIENCY CURVES









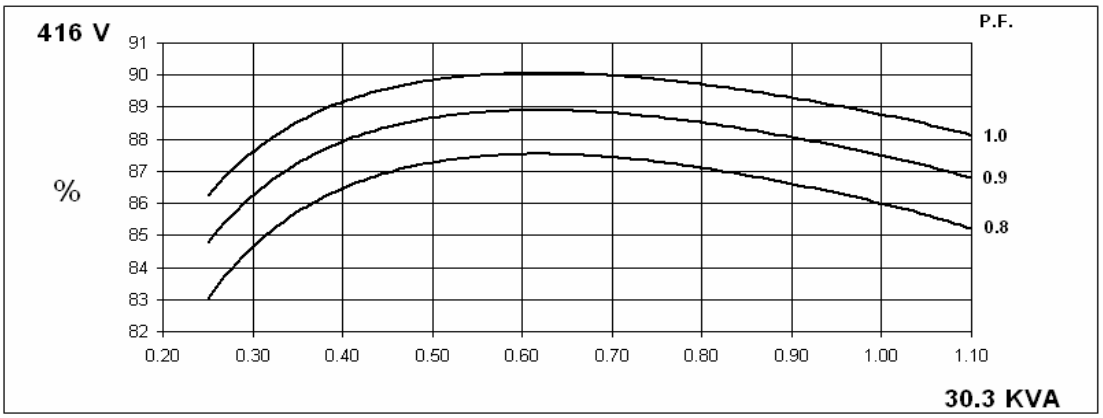
60 Hz

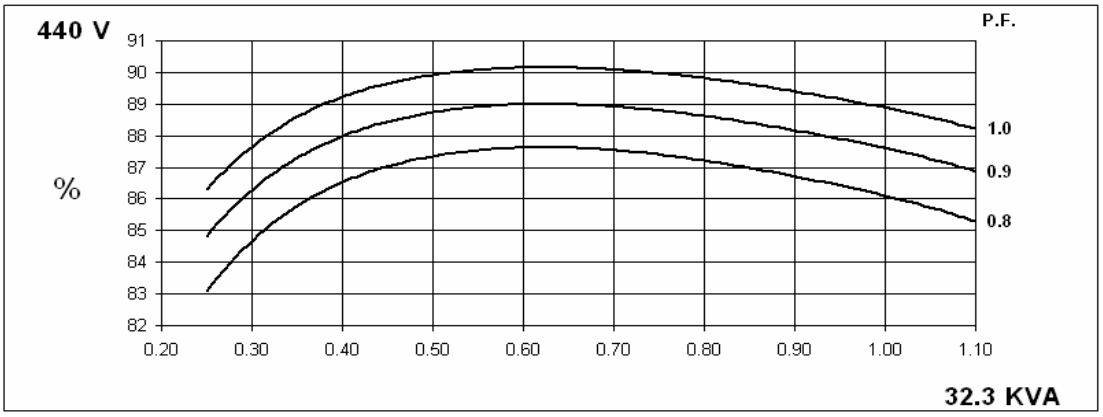
PI144F

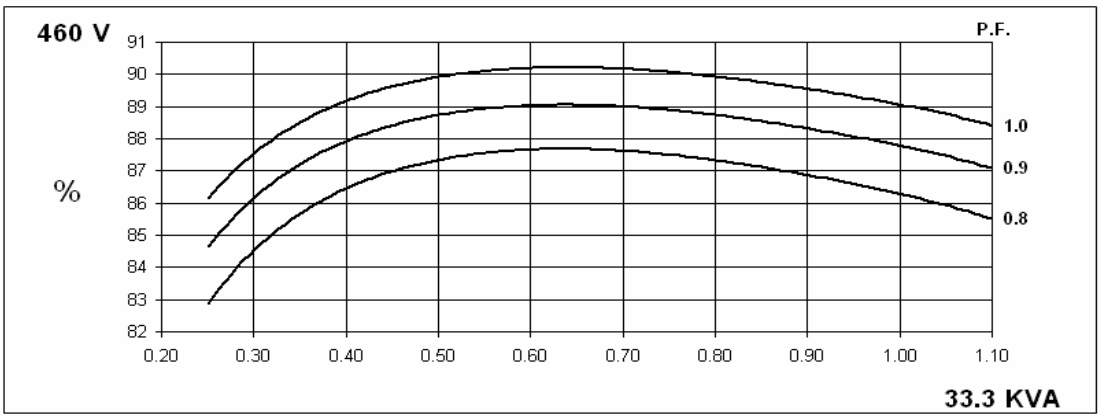
Winding 311

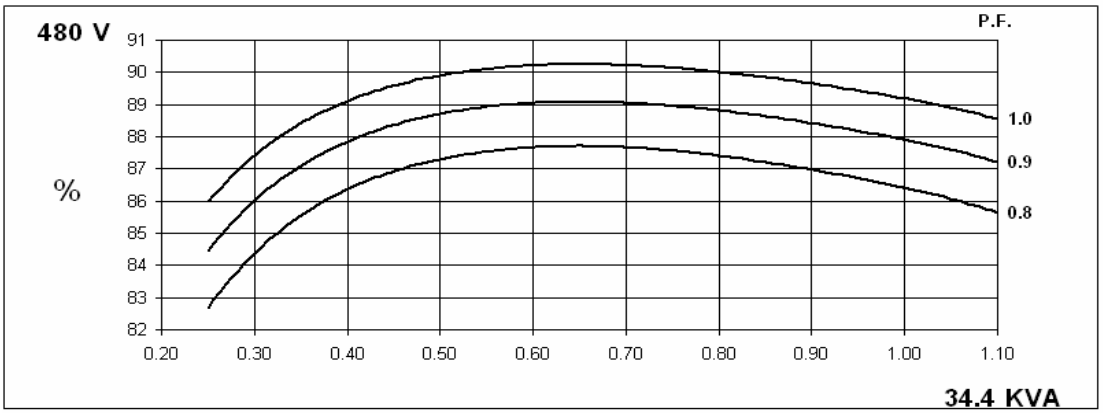
STAMFORD

THREE PHASE EFFICIENCY CURVES



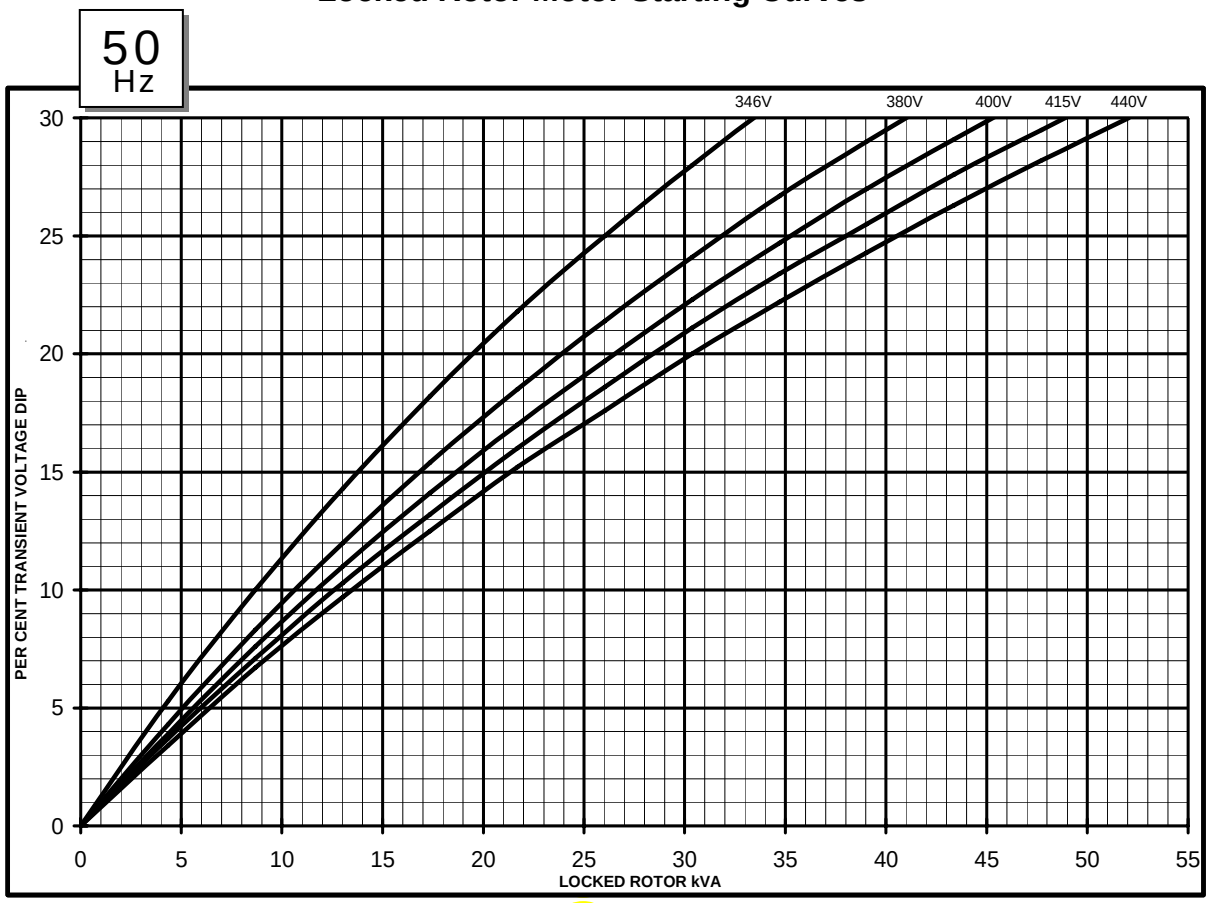


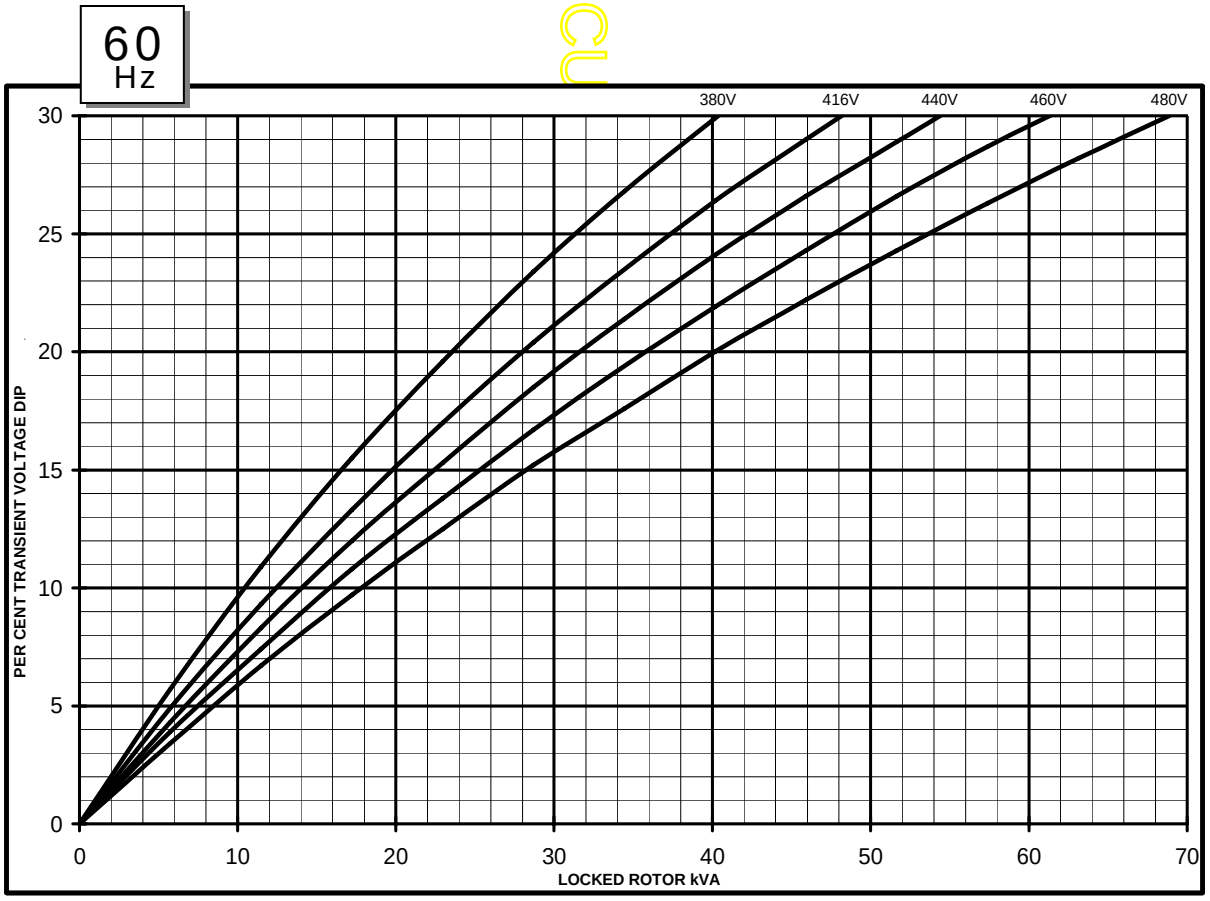




PI144F

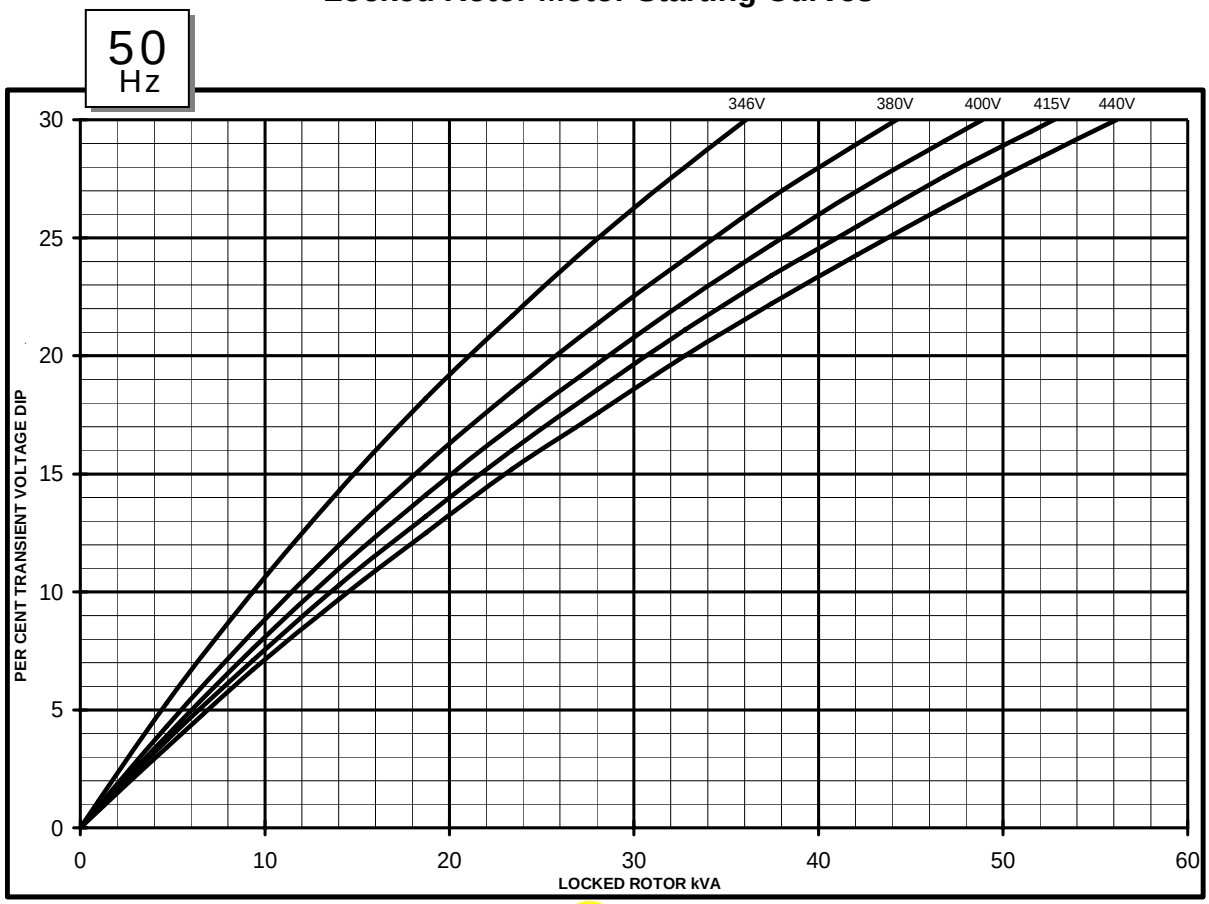
Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

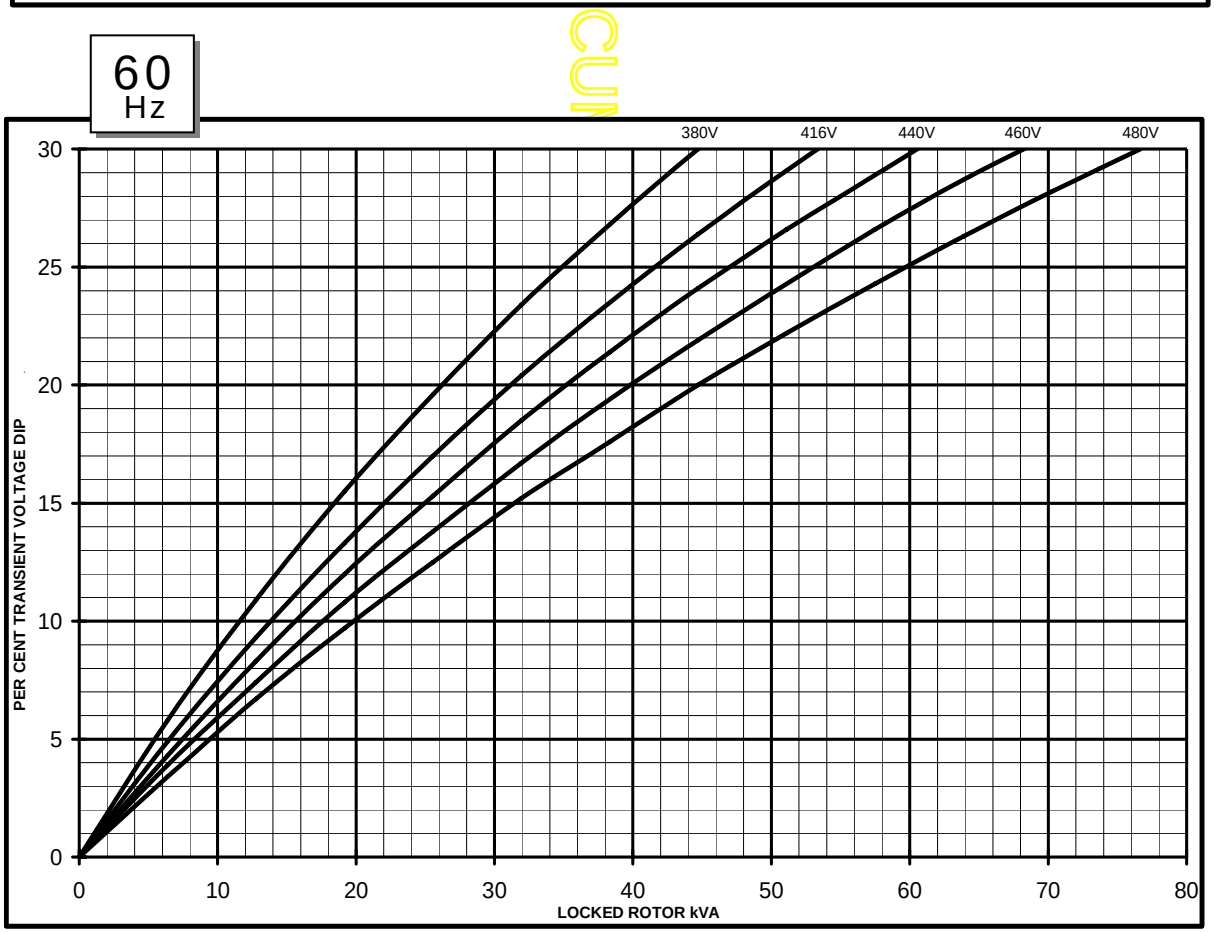




PI144F

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves



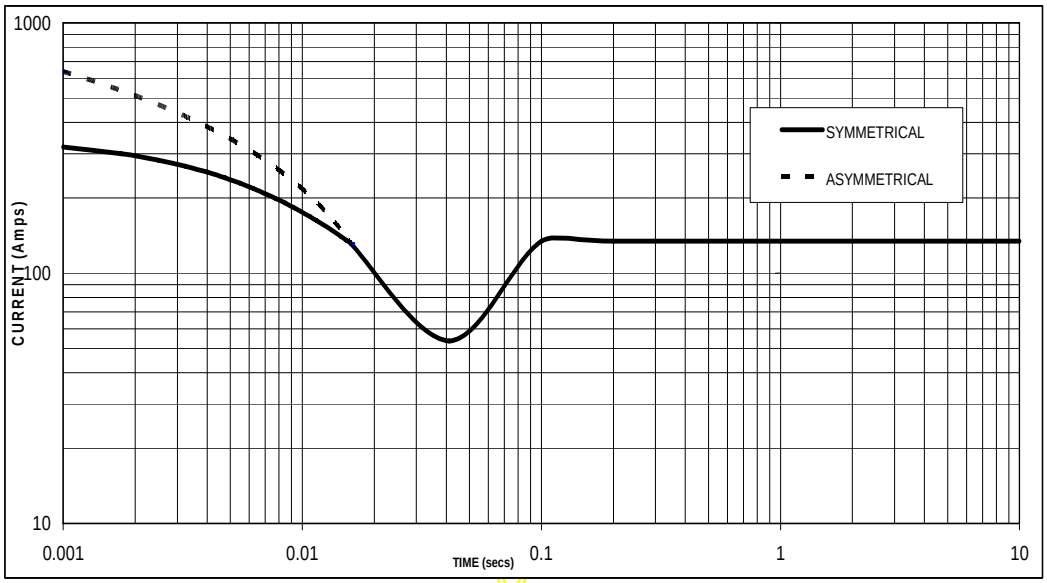


PI144F

WITH EBS FITTED

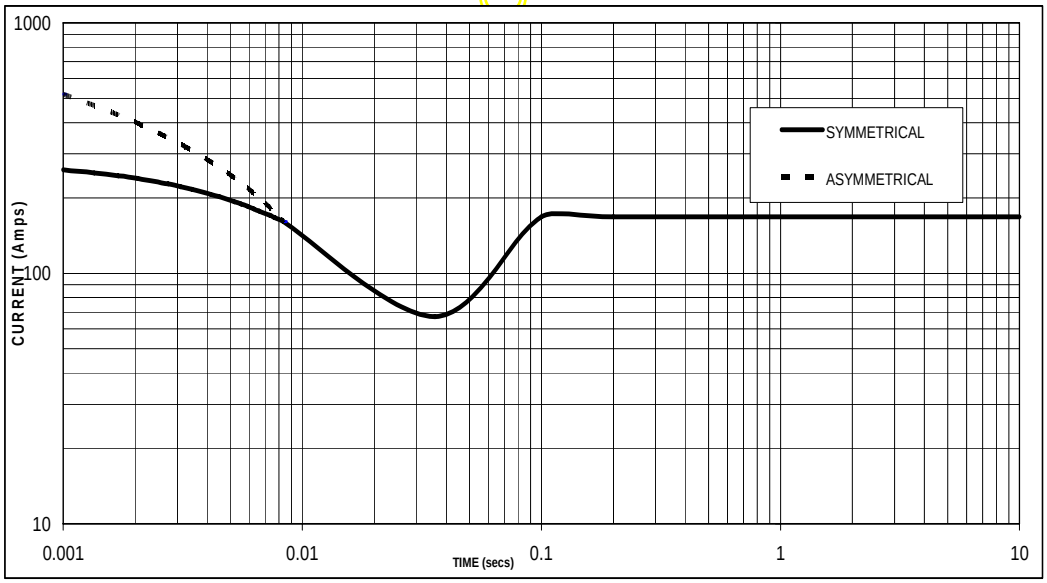
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 134 Amps

60 Hz



Sustained Short Circuit = 168 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI144F

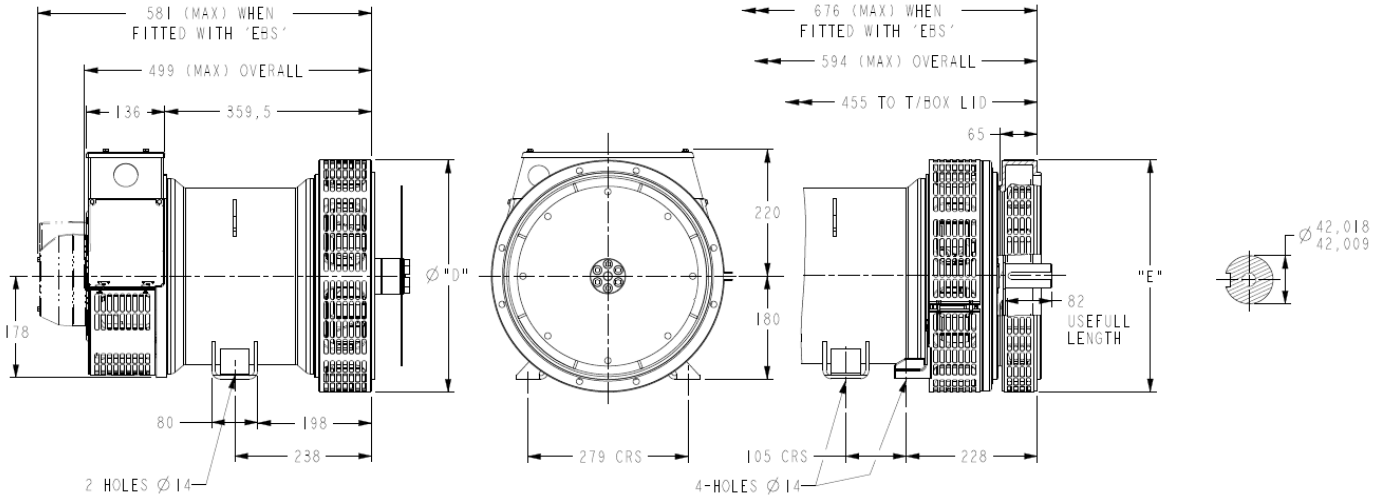
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	25.0	25.0	25.0	23.8	27.5	27.5	27.5	26.1	29.6	29.6	29.6	28.1	30.3	30.3	30.3	28.7
	kW	20.0	20.0	20.0	19.0	22.0	22.0	22.0	20.9	23.7	23.7	23.7	22.5	24.2	24.2	24.2	23.0
	Efficiency (%)	86.6	86.9	87.0	87.3	86.0	86.3	86.5	87.0	85.3	85.8	86.0	86.6	85.1	85.6	85.8	86.5
	kW Input	23.1	23.0	23.0	21.8	25.6	25.5	25.4	24.0	27.8	27.6	27.6	26.0	28.4	28.3	28.2	26.6

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	27.5	29.4	30.3	31.3	30.3	32.3	33.3	34.4	32.6	34.8	35.9	37.0	33.3	35.5	36.7	37.8
	kW	22.0	23.5	24.2	25.0	24.2	25.8	26.6	27.5	26.1	27.8	28.7	29.6	26.6	28.4	29.4	30.2
	Efficiency (%)	86.9	87.0	87.1	87.1	86.4	86.4	86.6	86.6	85.9	85.9	86.0	86.1	85.7	85.7	85.9	85.9
	kW Input	25.3	27.0	27.8	28.7	28.0	29.9	30.7	31.8	30.4	32.4	33.4	34.4	31.0	33.1	34.2	35.2

DIMENSIONS



COUPLING DISC	
SAE	"AN"
6.5	30.2
7.5	30.2
8	62
10	53.8
11.5	39.6

1-BRG ADAPTOR	
SAE	"D"
5	361
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTOR	
SAE	"E"
5	359
4	406
3	455
2	493

APPROVED DOCUMENT

STAMFORD

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Fax: +44 (0) 1780 484100

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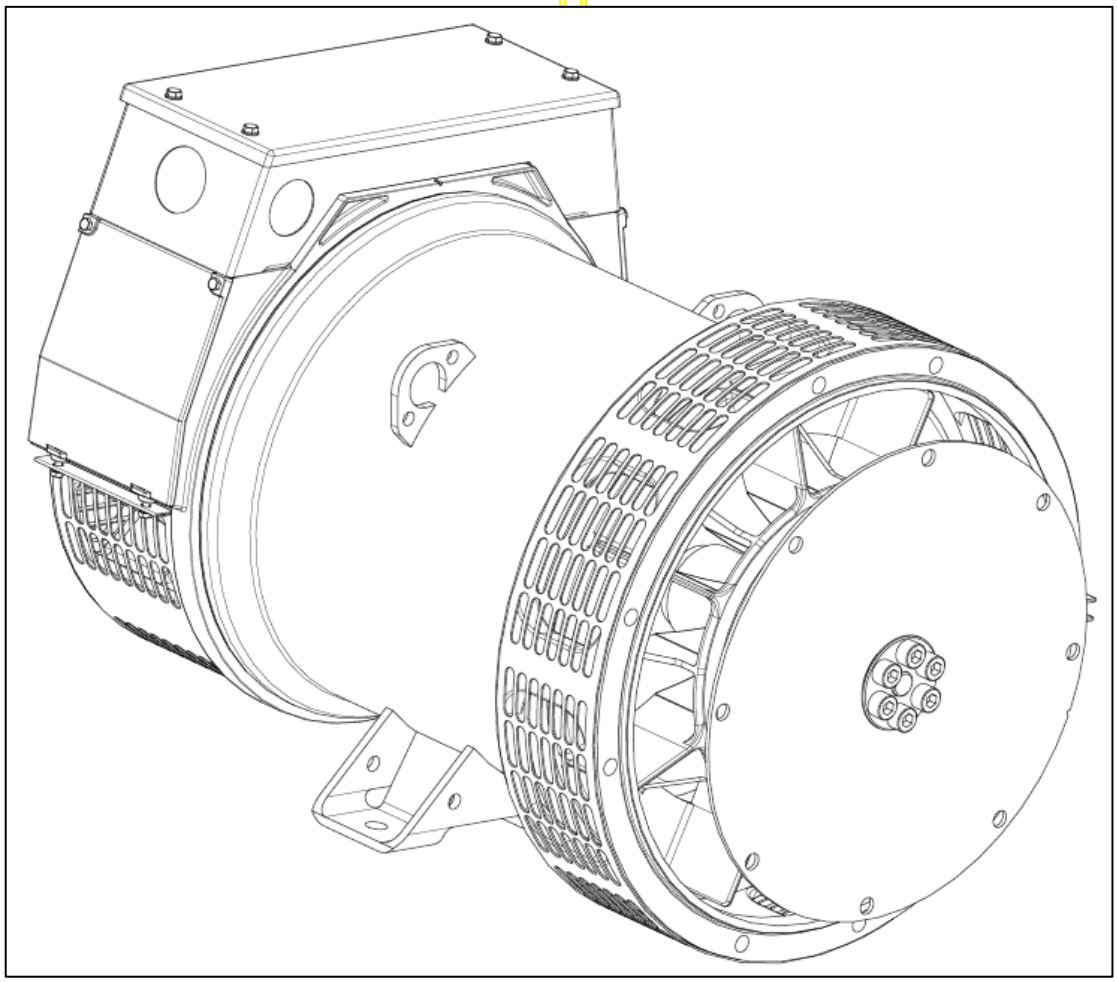
STAMFORD®

PI144G - 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 REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the 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 AS480 will support limited accessories, RFI suppression remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

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.

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Standard generators are 3-phase reconnectable with 12 ends brought out to the terminals, which are mounted at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

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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.

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All values tabulated on page 9 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.

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

PI144G

STAMFORD

WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

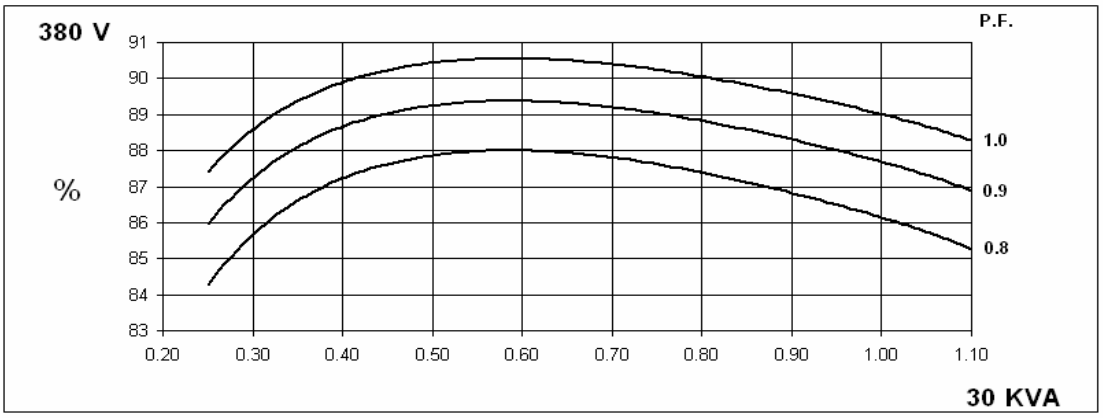
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.222 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.857 Ohms at 22°C							
EXCITER STATOR RESISTANCE	20.3 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.201 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	160 kg		158.3 kg		163 kg		161.3 kg	
WEIGHT WOUND STATOR	68 kg		68 kg		68 kg		68 kg	
WEIGHT WOUND ROTOR	57.39 kg		55.68 kg		58.39 kg		56.69 kg	
WR² INERTIA	0.2196 kgm^2		0.2179 kgm^2		0.2198 kgm^2		0.2181 kgm^2	
SHIPPING WEIGHTS in a crate	178 kg		176.3 kg		187 kg		185.3 kg	
PACKING CRATE SIZE	85 x 51 x 67 (cm)				85 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.100 m³/sec 212cfm				0.122 m³/sec 251 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	30	30	30	28.5	33	35.3	36.4	37.5
Xd DIR. AXIS SYNCHRONOUS	1.74	1.57	1.46	1.23	2.06	1.97	1.86	1.76
X'd DIR. AXIS TRANSIENT	0.16	0.14	0.13	0.11	0.19	0.18	0.17	0.16
X''d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.09	0.14	0.13	0.13	0.12
Xq QUAD. AXIS REACTANCE	0.83	0.75	0.70	0.59	0.99	0.95	0.89	0.85
X''q QUAD. AXIS SUBTRANSIENT	0.18	0.16	0.15	0.13	0.21	0.20	0.19	0.18
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	0.11	0.18	0.17	0.16	0.15
X_0 ZERO SEQUENCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.024 s							
T''d SUB-TRANSTIME CONST.	0.006 s							
T'do O.C. FIELD TIME CONST.	0.55 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

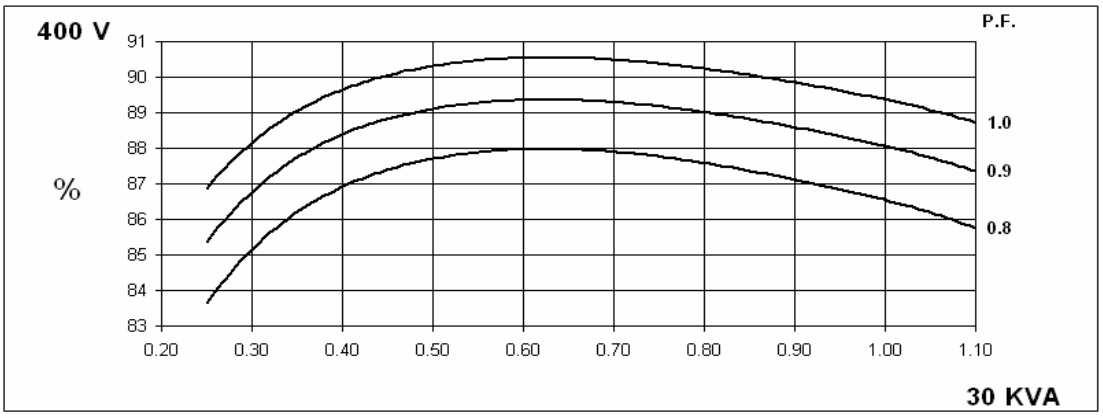
50 Hz

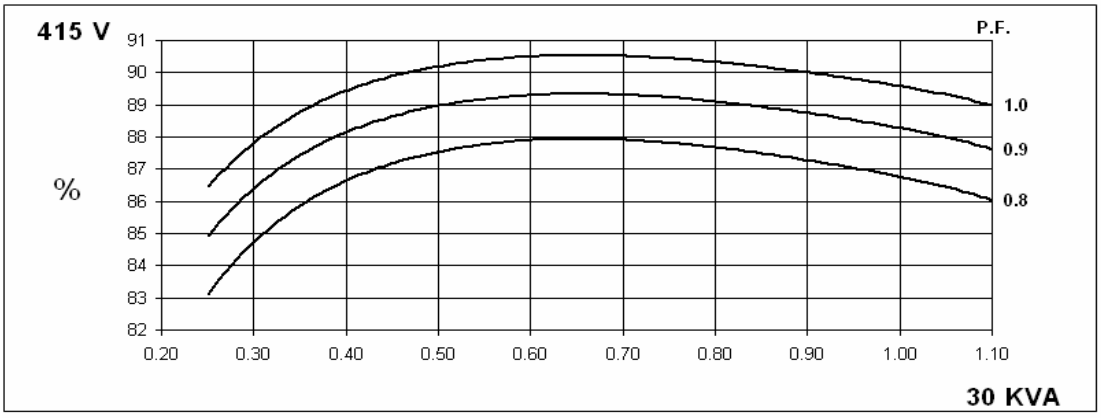
PI144G

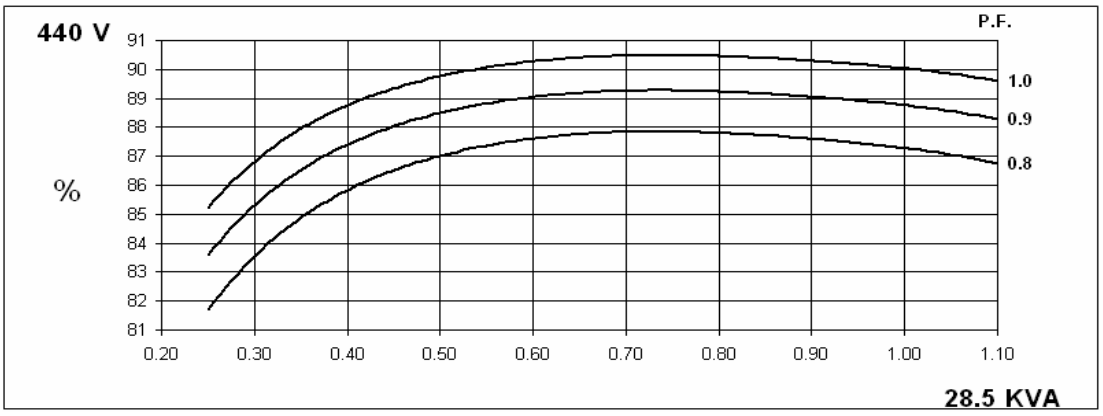
Winding 311

THREE PHASE EFFICIENCY CURVES







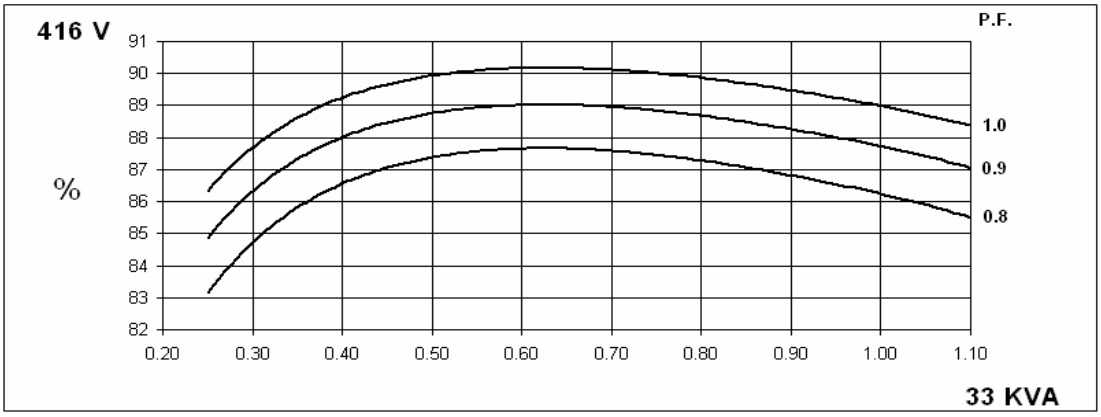


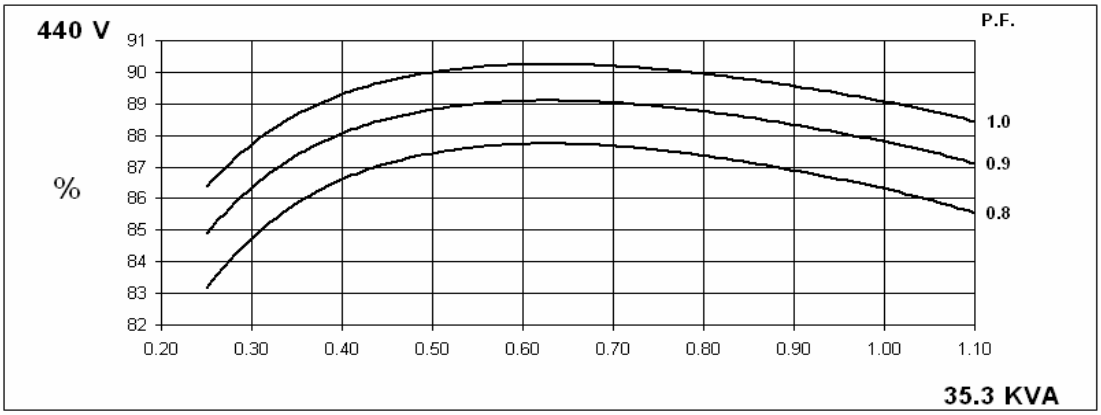
60 Hz

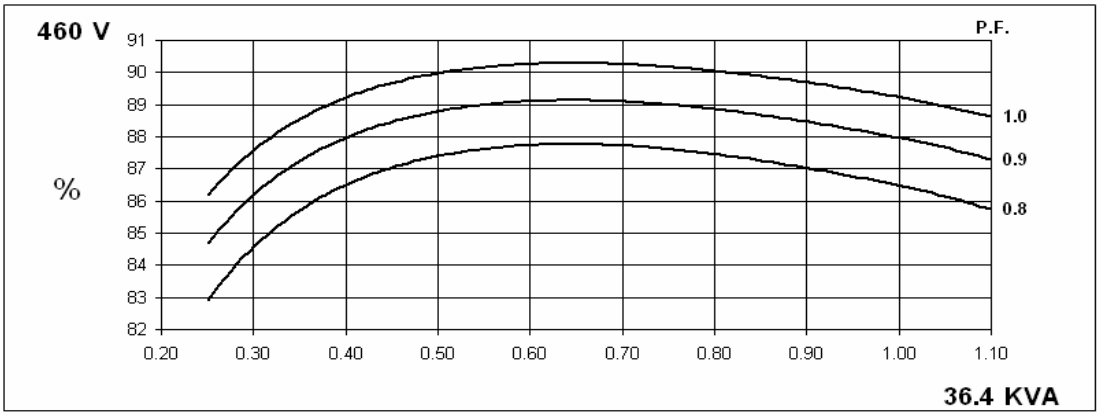
PI144G

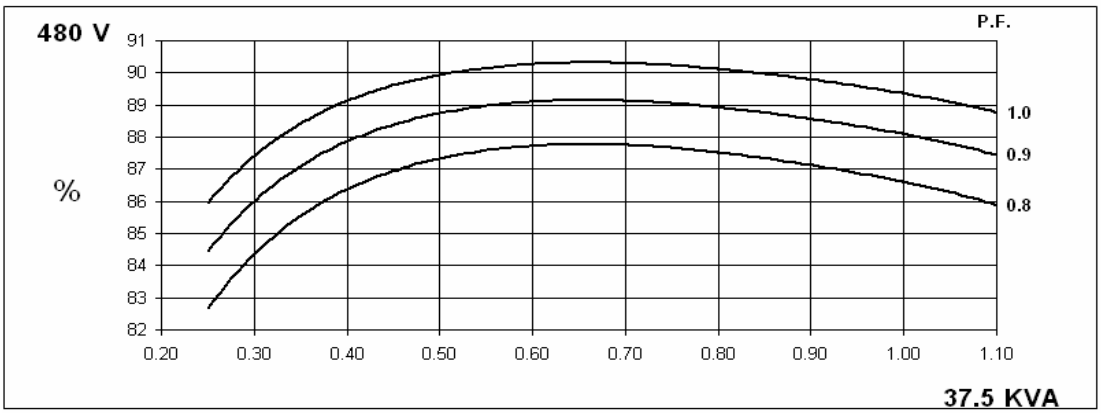
Winding 311

THREE PHASE EFFICIENCY CURVES



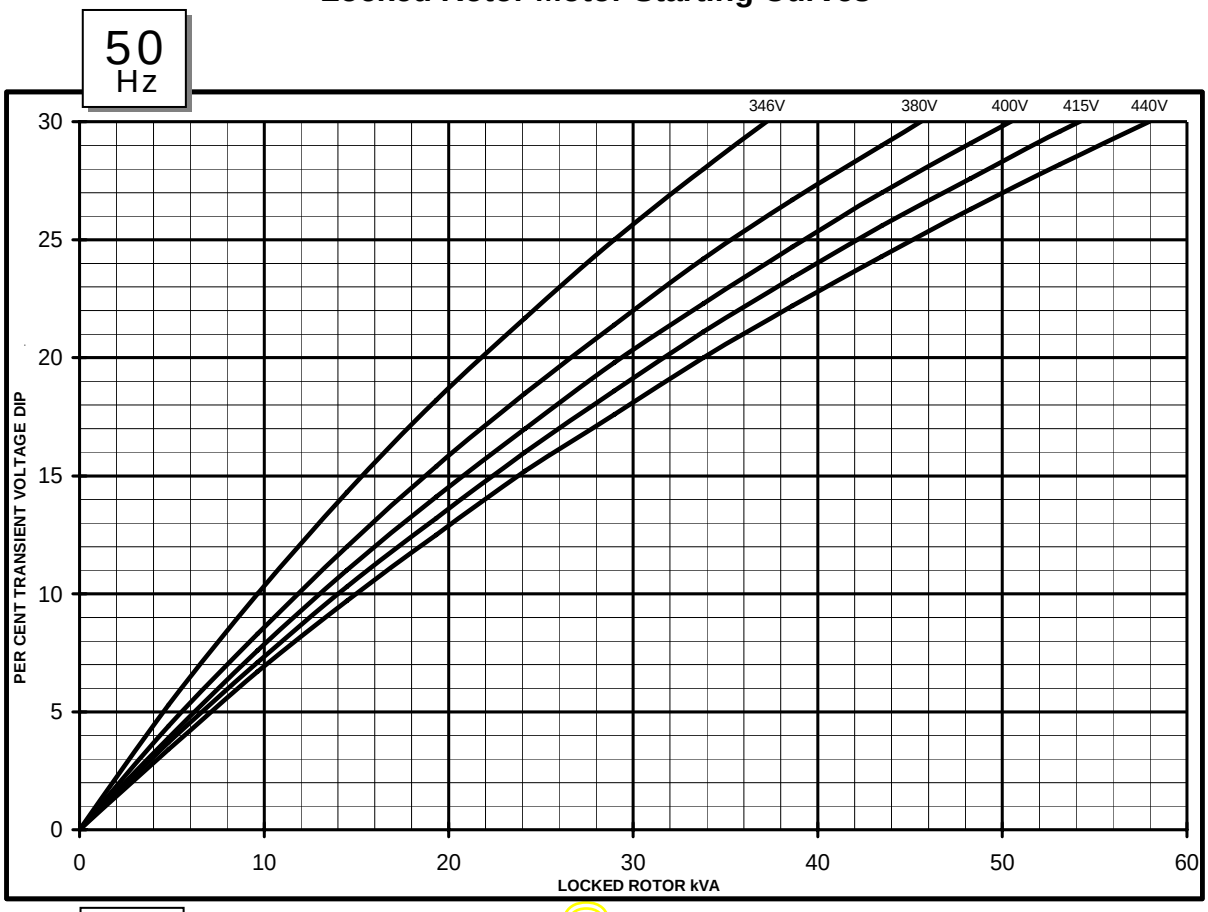


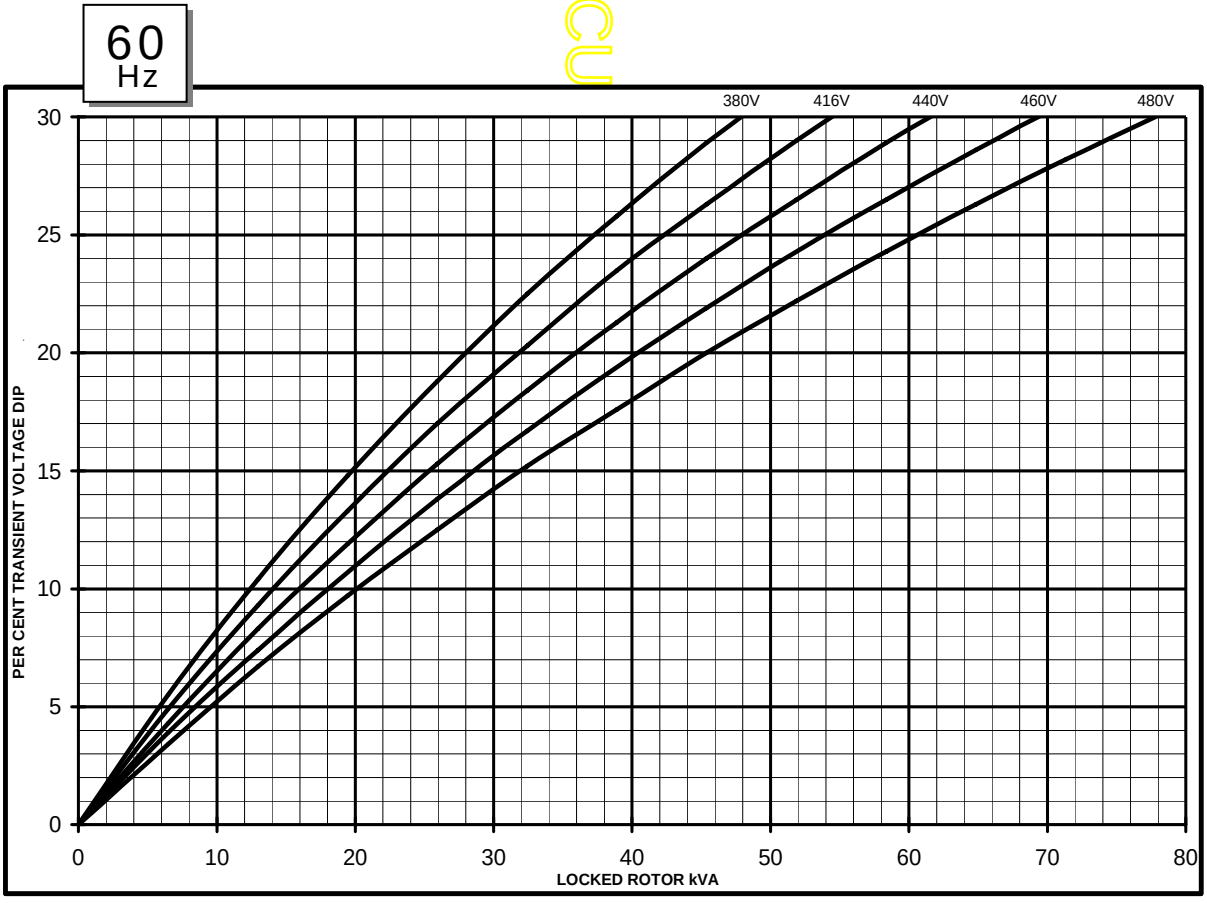




PI144G

Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

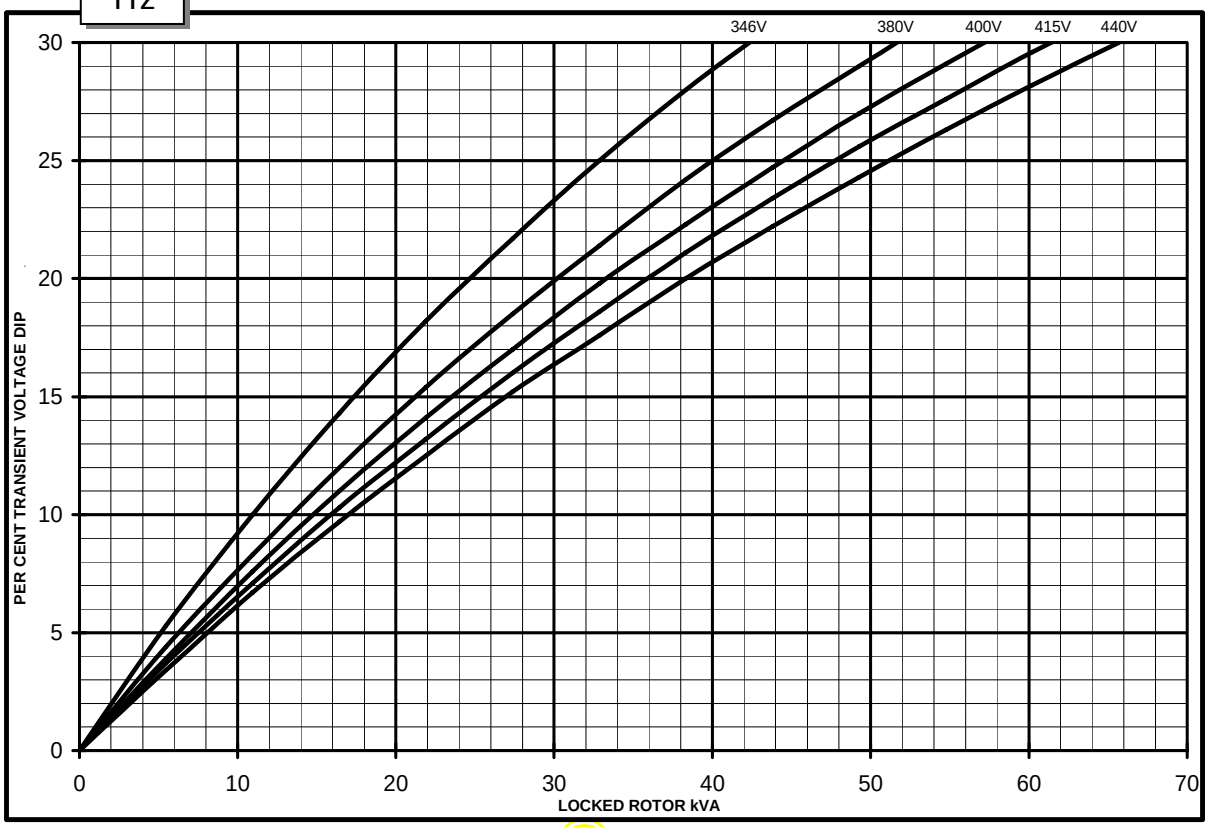




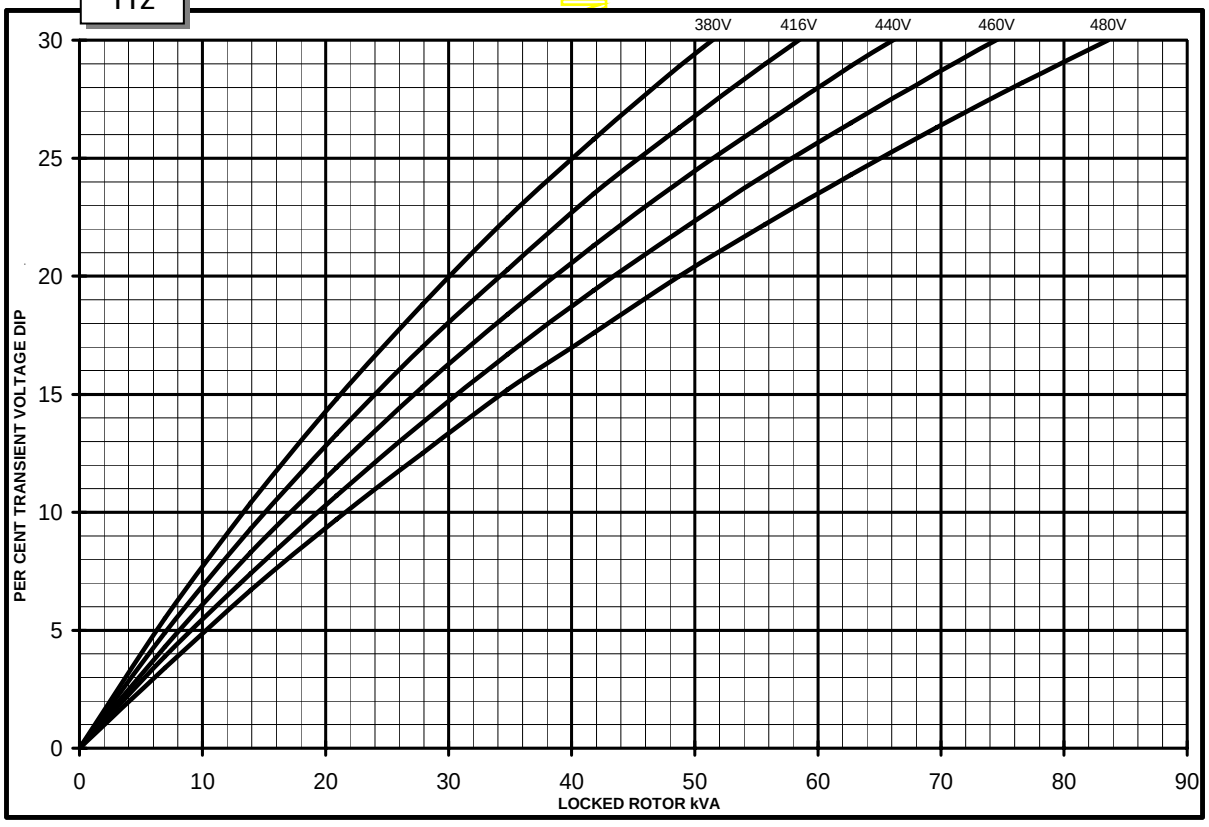
PI144G

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves

50 Hz



60 Hz

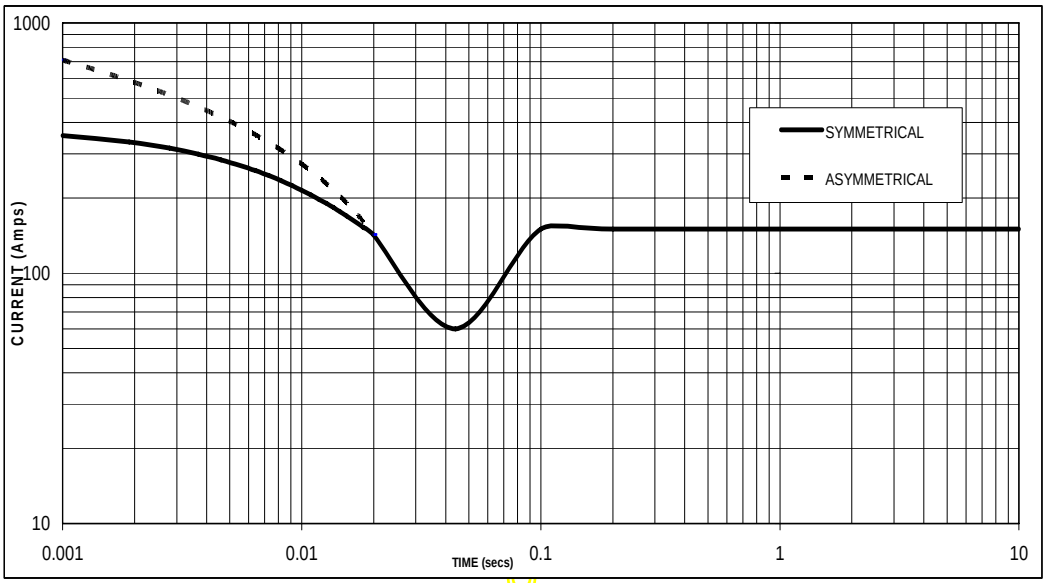


PI144G

WITH EBS FITTED

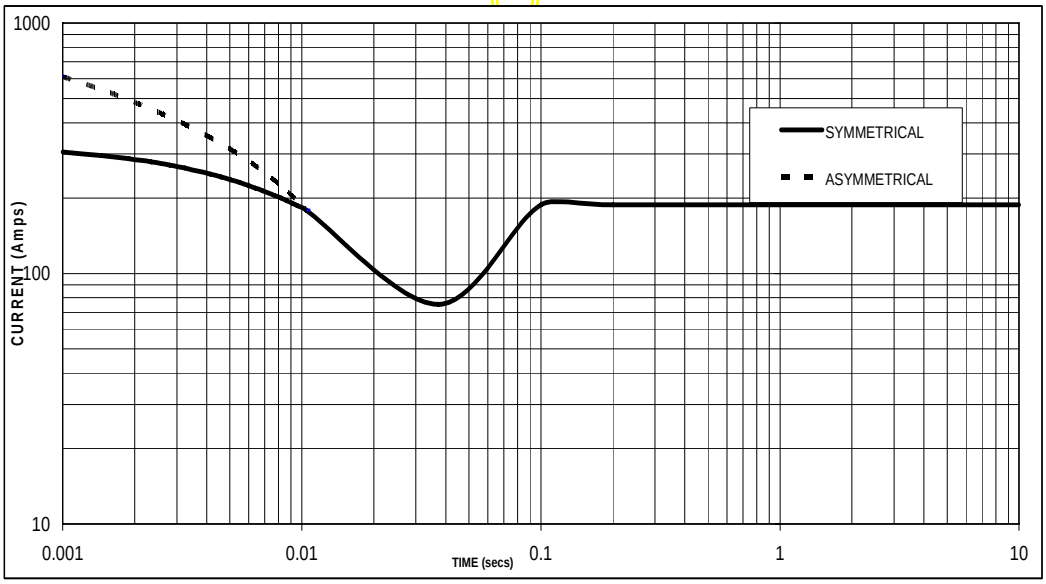
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 150 Amps

60 Hz



Sustained Short Circuit = 188 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI144G

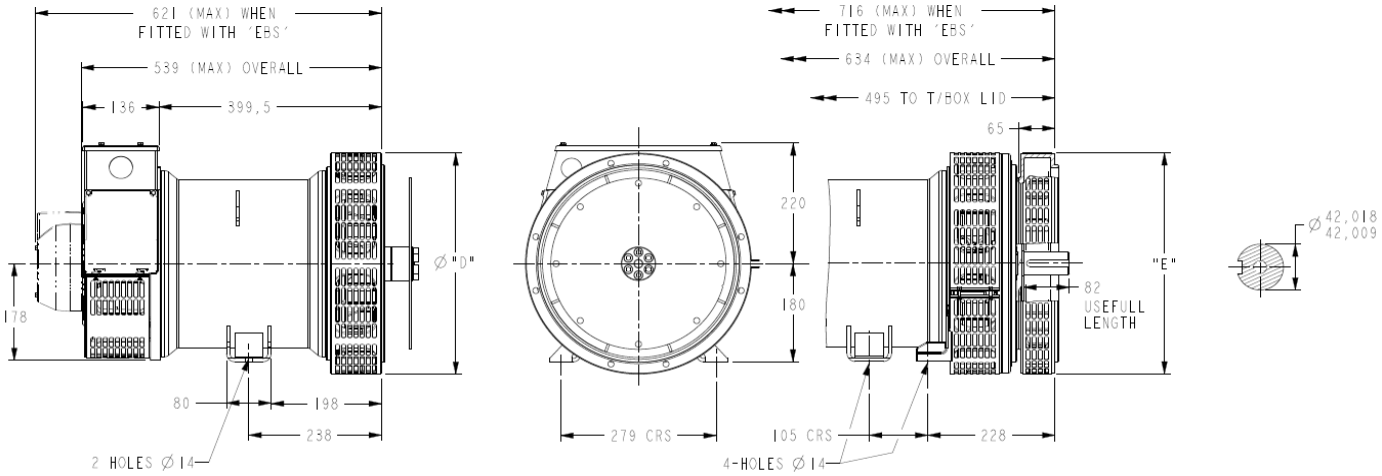
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	27.5	27.5	27.5	26.1	30.0	30.0	30.0	28.5	32.3	32.3	32.3	30.6	33.0	33.0	33.0	31.4
	kW	22.0	22.0	22.0	20.9	24.0	24.0	24.0	22.8	25.8	25.8	25.8	24.5	26.4	26.4	26.4	25.1
	Efficiency (%)	86.8	87.0	87.1	87.4	86.2	86.5	86.7	87.1	85.7	86.0	86.2	86.8	85.5	85.8	86.1	86.6
	kW Input	25.3	25.3	25.3	23.9	27.8	27.7	27.7	26.2	30.1	30.0	29.9	28.2	30.9	30.8	30.7	29.0

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	30.3	32.3	33.3	34.4	33.0	35.3	36.4	37.5	35.5	37.9	39.1	40.3	36.3	38.8	40.0	41.3
	kW	24.2	25.8	26.6	27.5	26.4	28.2	29.1	30.0	28.4	30.3	31.3	32.2	29.0	31.0	32.0	33.0
	Efficiency (%)	87.1	87.1	87.2	87.2	86.7	86.6	86.7	86.8	86.2	86.2	86.3	86.3	86.0	86.0	86.1	86.2
	kW Input	27.8	29.6	30.5	31.5	30.4	32.6	33.6	34.6	32.9	35.2	36.3	37.3	33.7	36.0	37.2	38.3

DIMENSIONS



COUPLING DISC	
SAE	"AN"
6.5	30.2
7.5	30.2
8	62
10	53.8
11.5	39.6

1-BRG ADAPTOR	
SAE	"D"
5	361
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTOR	
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STAMFORD

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www.cumminsgeneratortechnologies.com

STAMFORD®

PI144H - Winding 311

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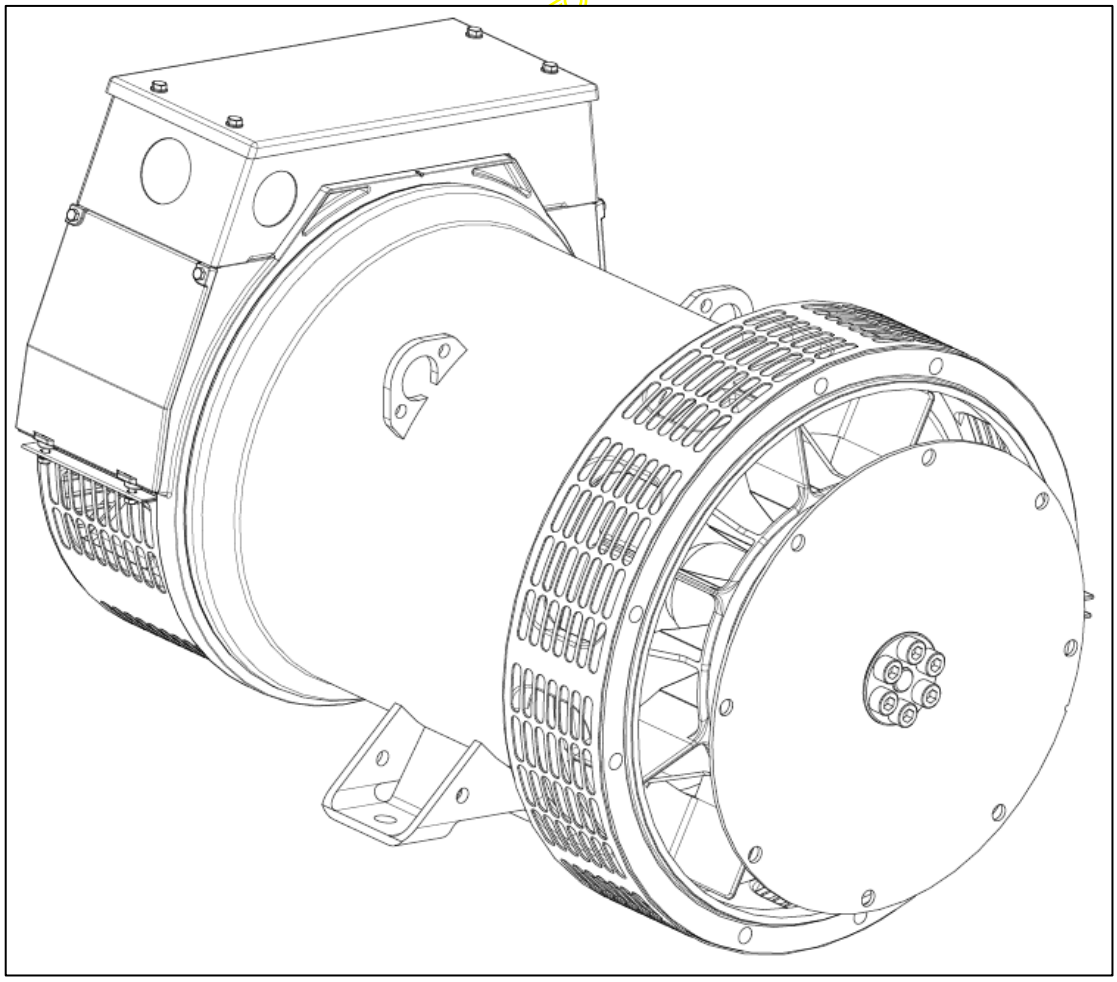

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3% for every 500 metres by which the operating altitude exceeds 1000 metres above mean sea level.
3% for every 5°C by which the operational ambient temperature exceeds 40°C.
Note: Requirement for operating in an ambient exceeding 60°C must be referred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

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

PI144H

STAMFORD

WINDING 311

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VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

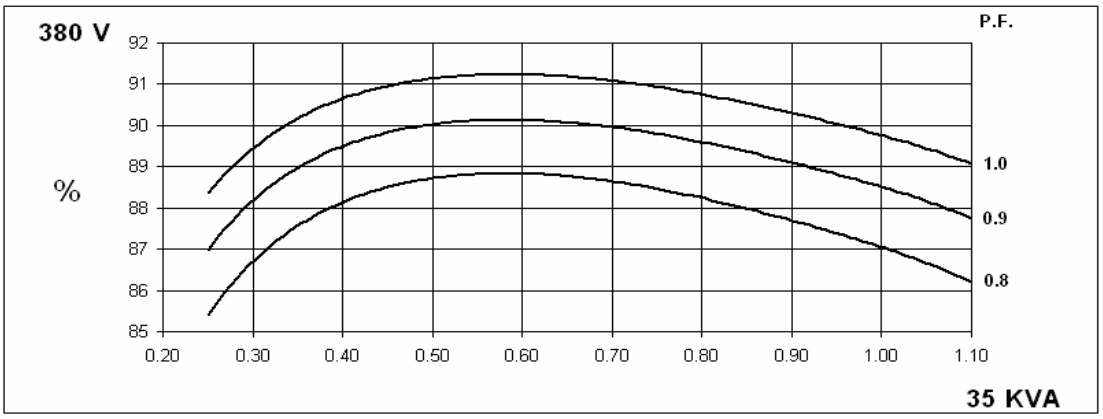
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.179 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.89 Ohms at 22°C							
EXCITER STATOR RESISTANCE	22.9 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.21 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6310 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	172.5 kg		170.8 kg		175.5 kg		173.8 kg	
WEIGHT WOUND STATOR	75 kg		75 kg		75 kg		75 kg	
WEIGHT WOUND ROTOR	65.63 kg		63.93 kg		67.34 kg		65.64 kg	
WR² INERTIA	0.2541 kgm^2		0.2524 kgm^2		0.2545 kgm^2		0.2528 kgm^2	
SHIPPING WEIGHTS in a crate	191 kg		189.3 kg		200 kg		198.3 kg	
PACKING CRATE SIZE	85 x 51 x 67 (cm)				85 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.135 m³/sec 286cfm				0.165 m³/sec 340 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	35	35	35	33.3	38.5	41.1	42.4	43.8
Xd DIR. AXIS SYNCHRONOUS	1.85	1.67	1.55	1.31	2.20	2.10	1.98	1.88
X'd DIR. AXIS TRANSIENT	0.17	0.15	0.14	0.12	0.20	0.19	0.18	0.17
X''d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.09	0.15	0.14	0.14	0.13
Xq QUAD. AXIS REACTANCE	0.89	0.80	0.74	0.63	1.05	1.00	0.95	0.90
X''q QUAD. AXIS SUBTRANSIENT	0.19	0.17	0.16	0.13	0.23	0.22	0.21	0.20
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	0.11	0.19	0.18	0.17	0.16
X_0 ZERO SEQUENCE	0.08	0.07	0.07	0.06	0.09	0.09	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.026 s							
T''d SUB-TRANSTIME CONST.	0.007 s							
T'do O.C. FIELD TIME CONST.	0.6 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

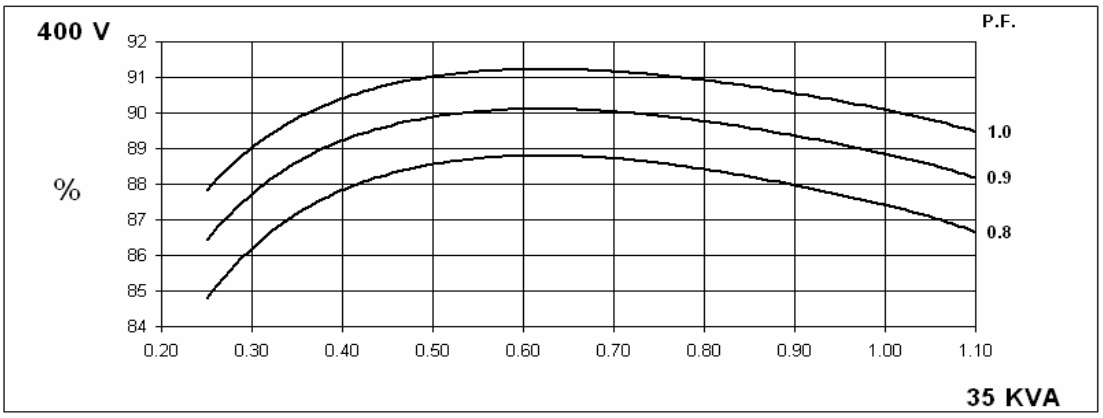
50 Hz

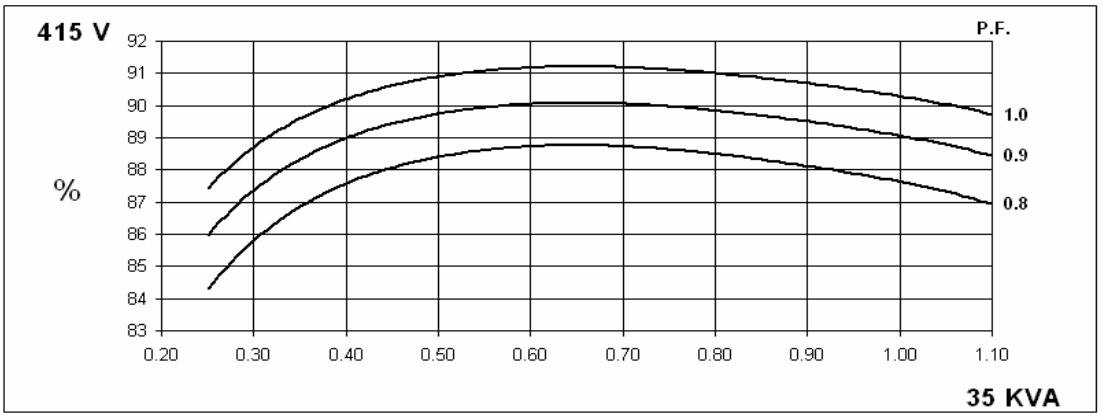
PI144H

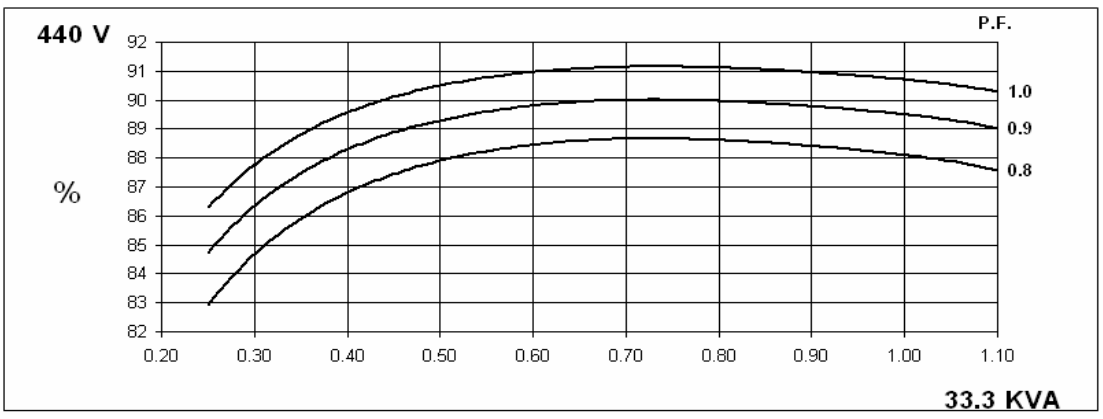
Winding 311

THREE PHASE EFFICIENCY CURVES







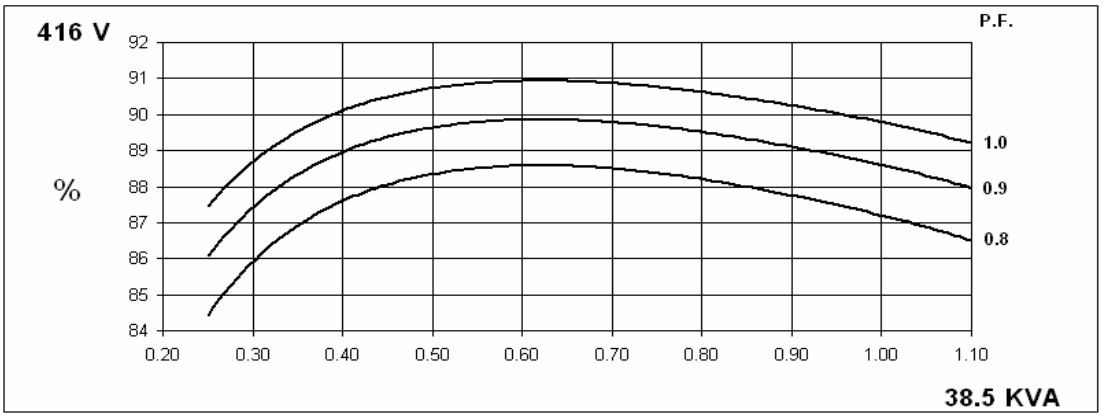


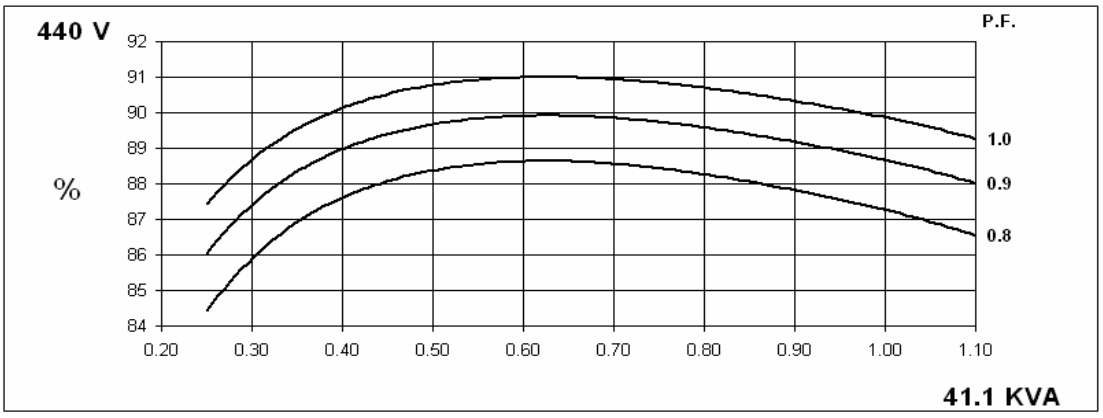
60 Hz

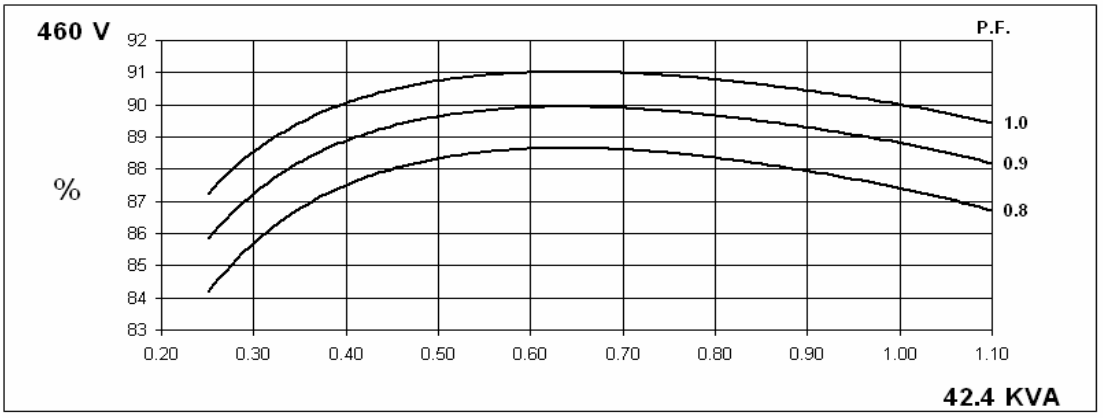
PI144H

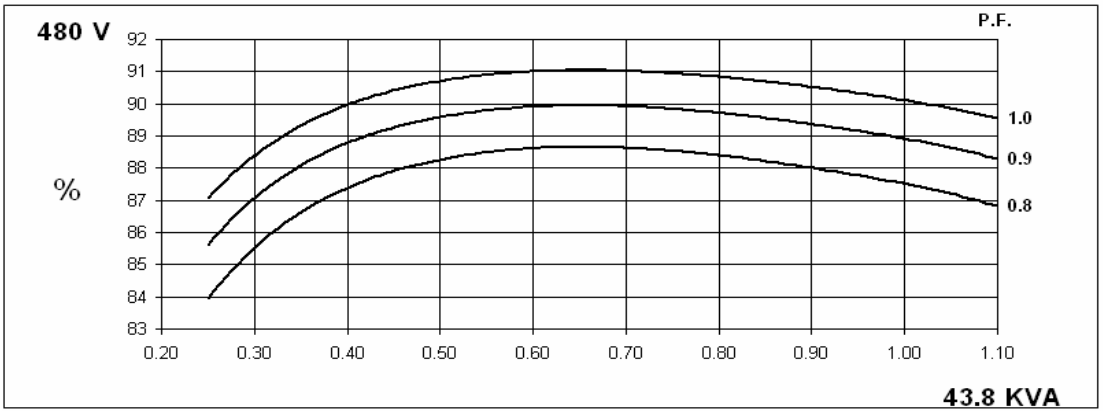
Winding 311

THREE PHASE EFFICIENCY CURVES



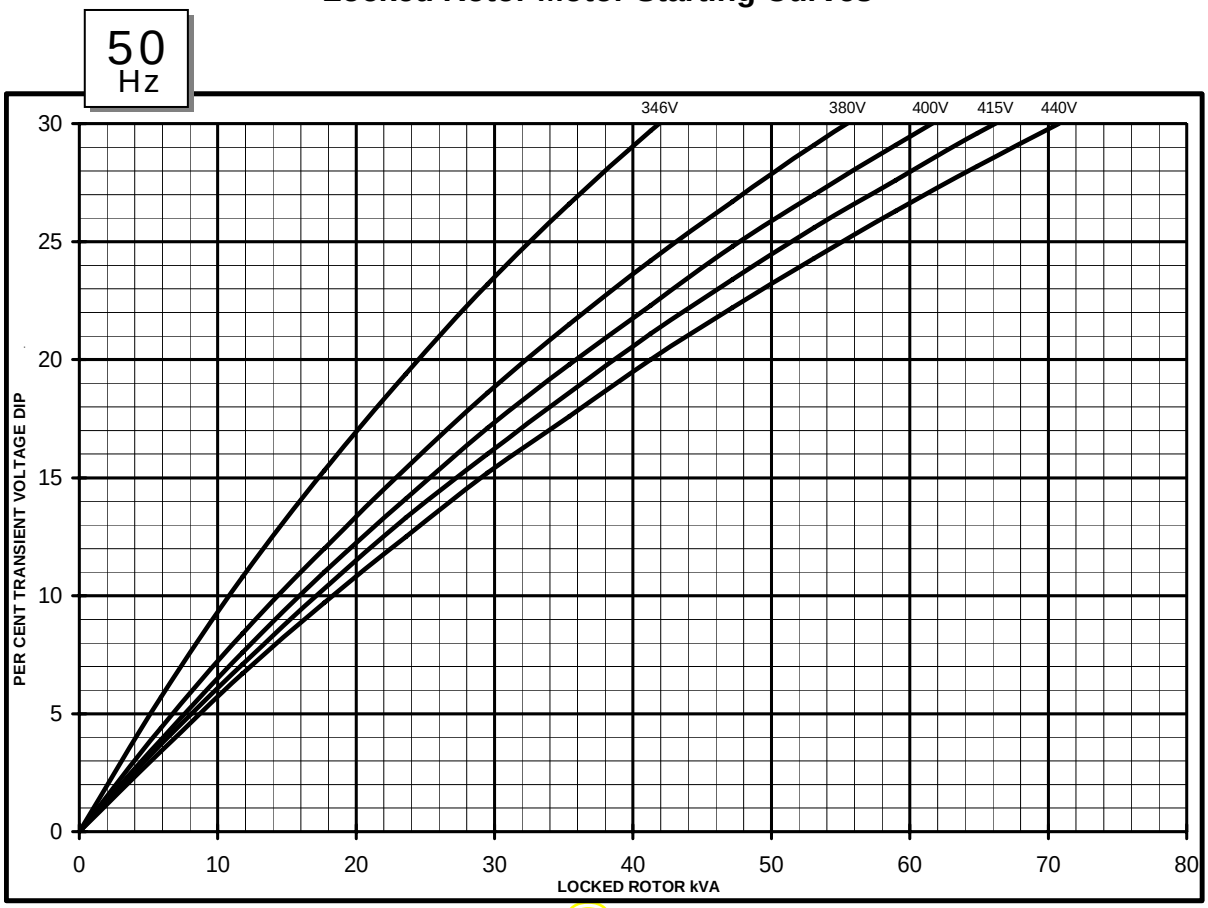


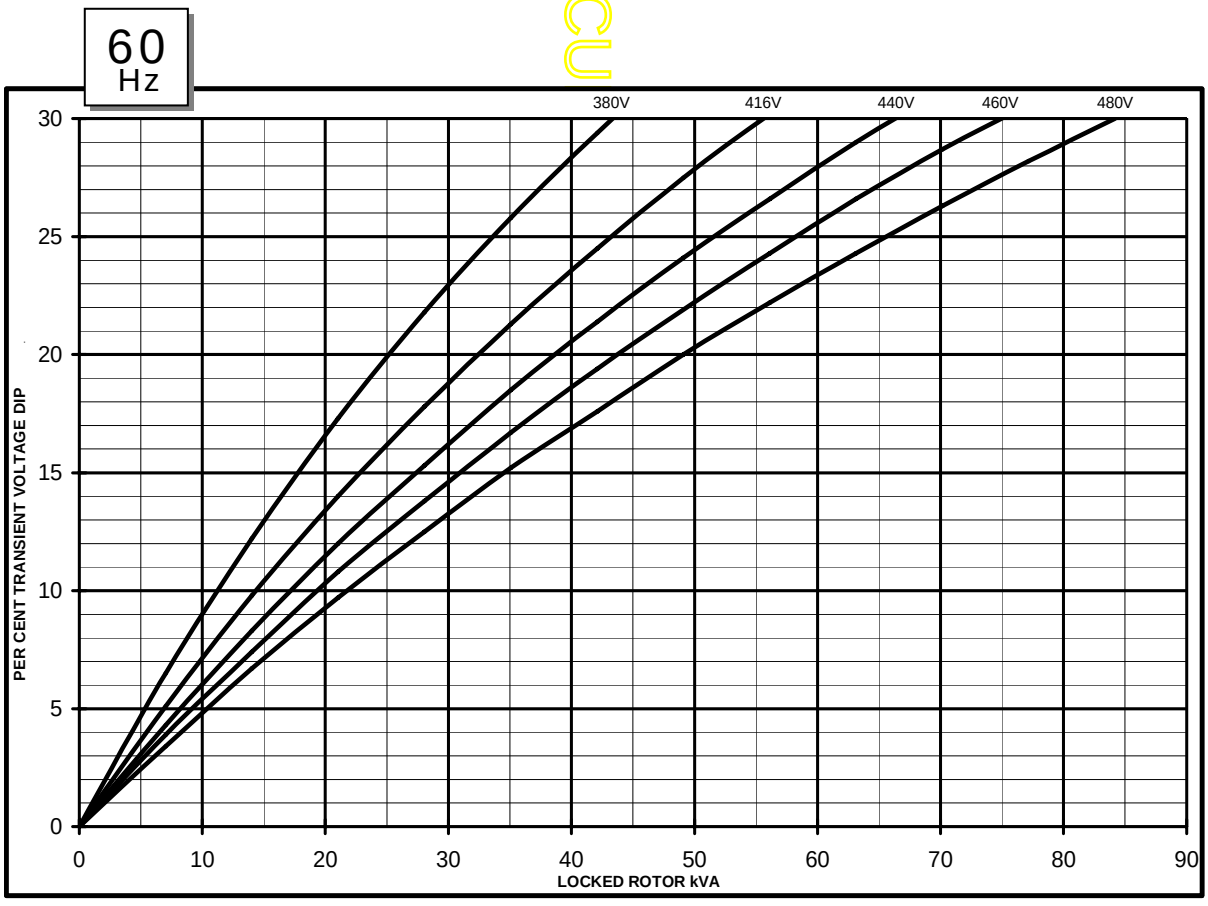




PI144H

Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

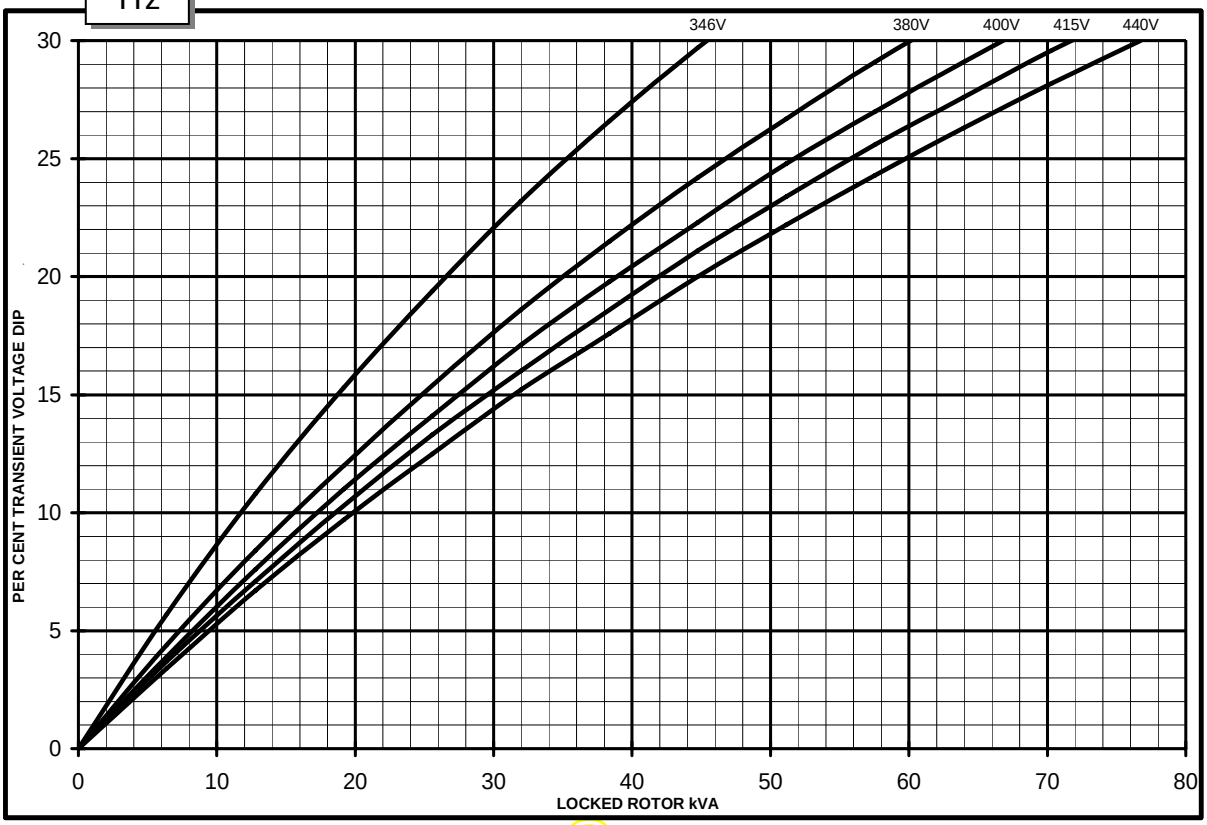




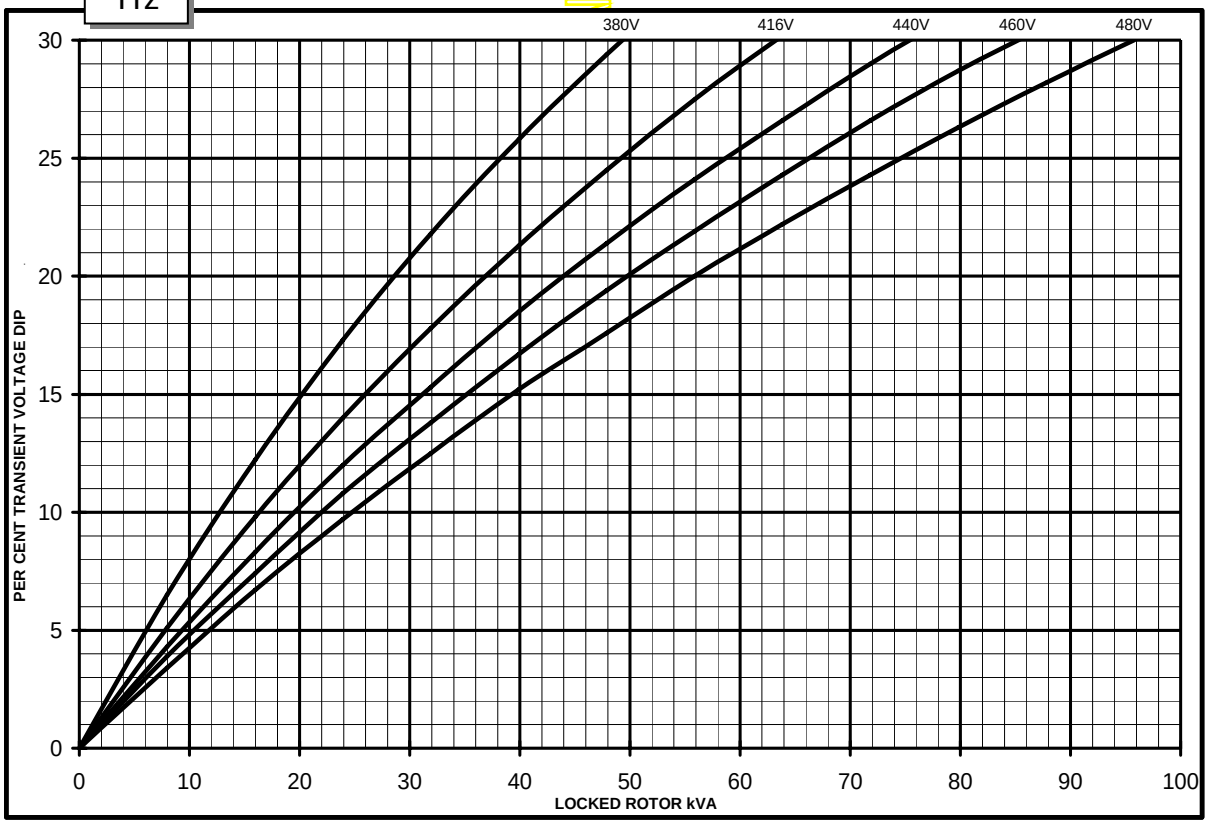
PI144H

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves

50 Hz



60 Hz

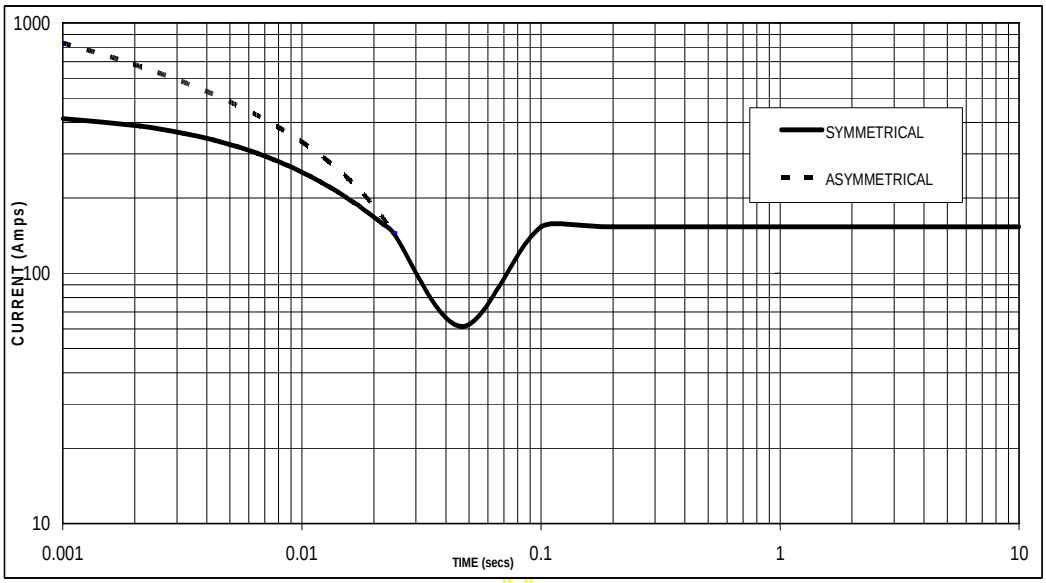


PI144H

WITH EBS FITTED

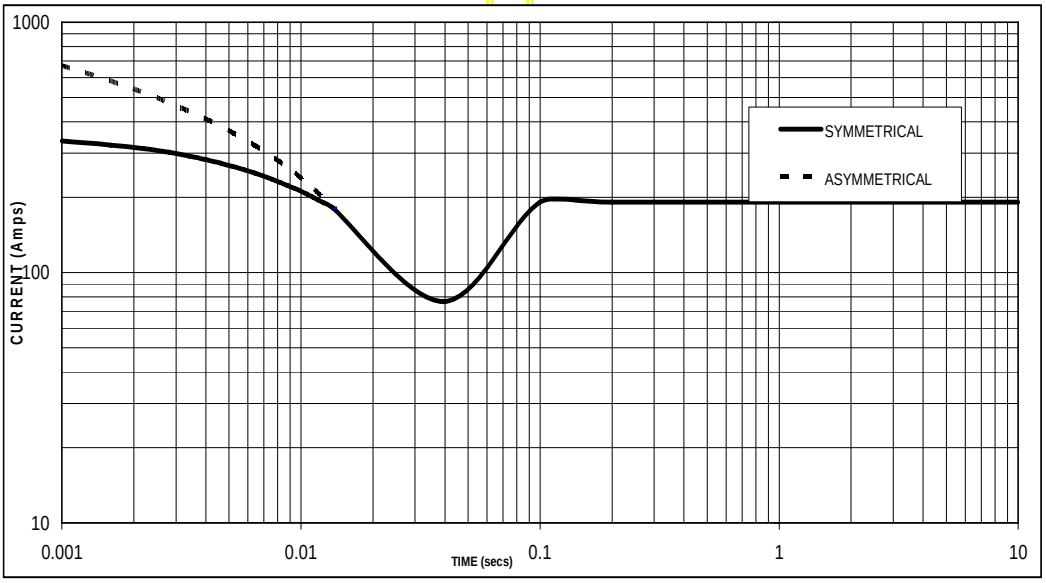
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 153 Amps

60 Hz



Sustained Short Circuit = 191 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI144H

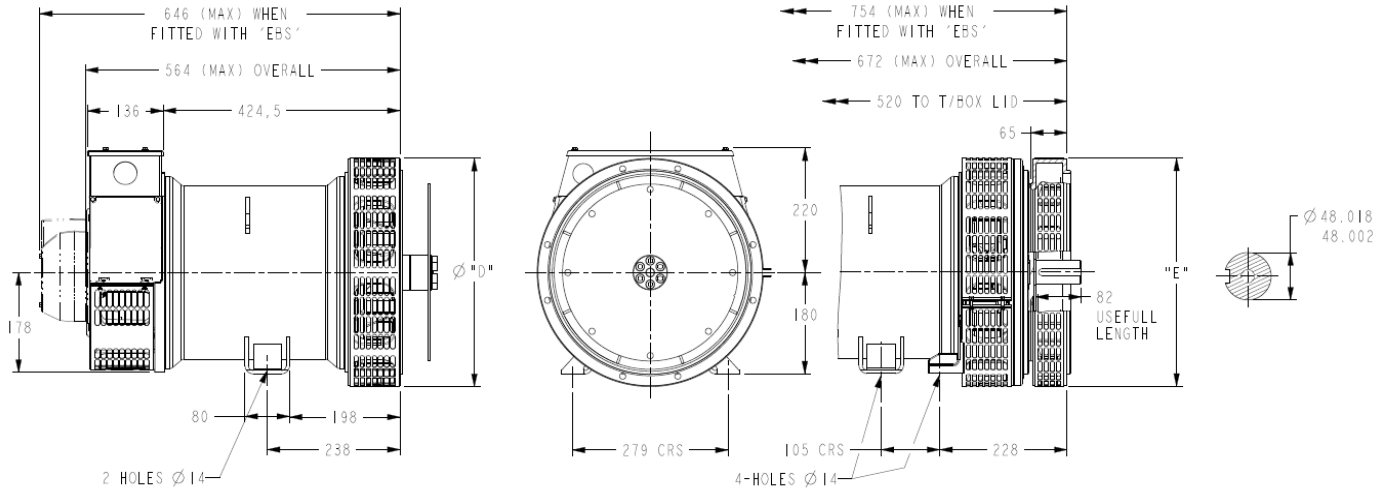
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	32.0	32.0	32.0	30.4	35.0	35.0	35.0	33.3	37.5	37.5	37.5	35.6	38.5	38.5	38.5	36.6
	kW	25.6	25.6	25.6	24.3	28.0	28.0	28.0	26.6	30.0	30.0	30.0	28.5	30.8	30.8	30.8	29.3
	Efficiency (%)	87.7	87.9	88.0	88.2	87.1	87.4	87.6	87.9	86.6	87.0	87.2	87.7	86.4	86.8	87.0	87.5
	kW Input	29.2	29.1	29.1	27.6	32.1	32.0	32.0	30.3	34.6	34.5	34.4	32.5	35.6	35.5	35.4	33.5

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	35.2	37.6	38.8	40.0	38.5	41.1	42.4	43.8	41.3	44.1	45.5	46.9	42.4	45.2	46.7	48.1
	kW	28.2	30.1	31.0	32.0	30.8	32.9	33.9	35.0	33.0	35.3	36.4	37.5	33.9	36.2	37.4	38.5
	Efficiency (%)	88.0	88.0	88.1	88.1	87.5	87.5	87.6	87.7	87.1	87.1	87.2	87.3	86.9	86.9	87.0	87.1
	kW Input	32.0	34.2	35.2	36.3	35.2	37.6	38.7	39.9	37.9	40.5	41.7	43.0	39.0	41.7	43.0	44.2

DIMENSIONS



COUPLING DISC	
SAE	"AN"
8	62
10	53.8
11.5	39.6

1-BRG ADAPTOR	
SAE	"D"
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTOR	
SAE	"E"
5	359
4	406
3	455
2	493

APPROVED DOCUMENT

STAMFORD

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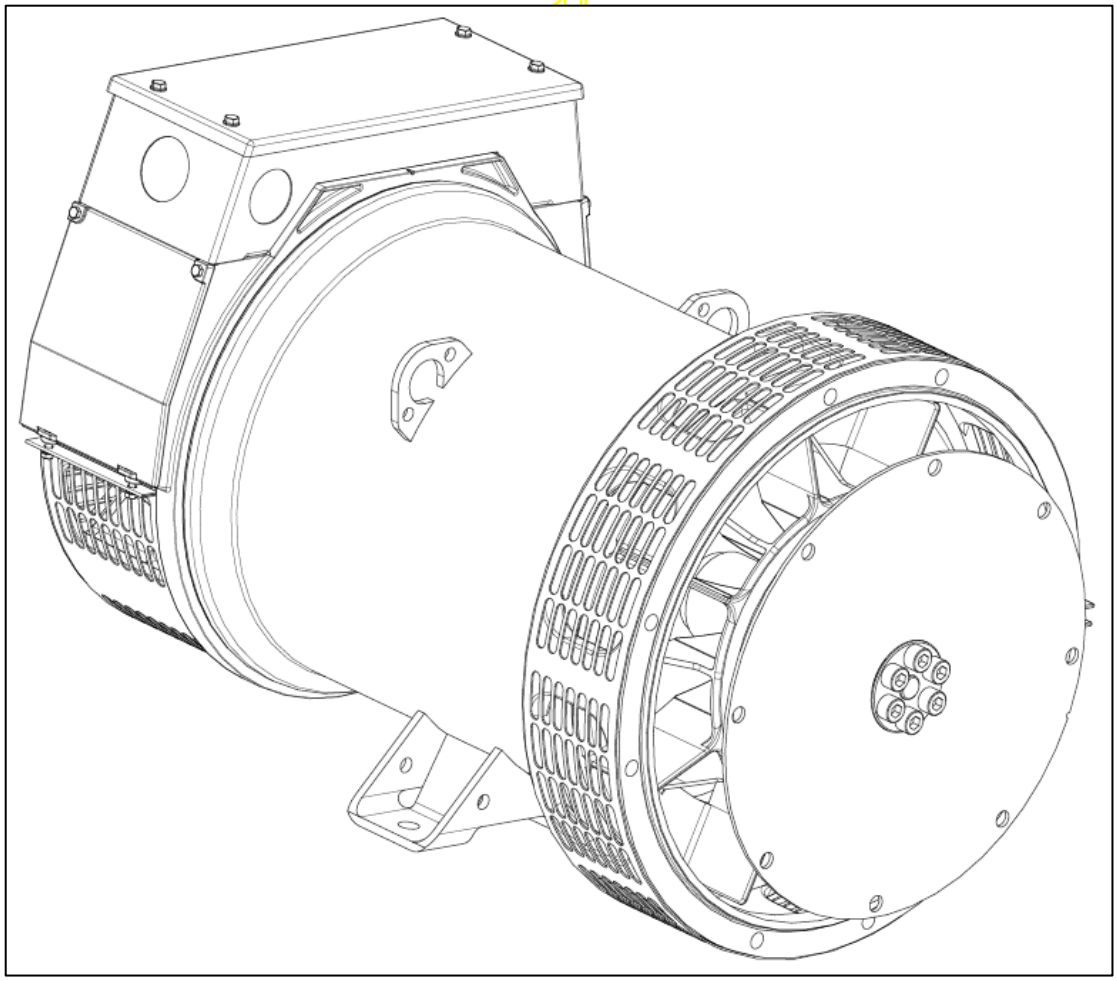
Technical Data Sheet



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 REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the 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 AS480 will support limited accessories, RFI suppression remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

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 at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

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 9 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.

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

PI144J

STAMFORD

WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

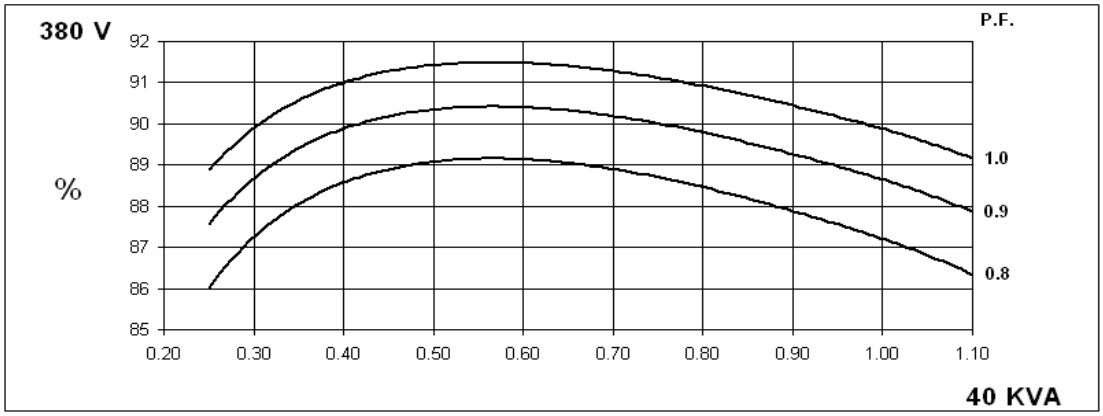
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.154 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.99 Ohms at 22°C							
EXCITER STATOR RESISTANCE	22.9 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.21 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6310 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	184 kg		182.3 kg		187 kg		185.3 kg	
WEIGHT WOUND STATOR	84 kg		84 kg		84 kg		84 kg	
WEIGHT WOUND ROTOR	70.97 kg		69.27 kg		72.68 kg		70.98 kg	
WR² INERTIA	0.2758 kgm^2		0.2741 kgm^2		0.2763 kgm^2		0.2746 kgm^2	
SHIPPING WEIGHTS in a crate	202 kg		200.3 kg		211 kg		209.3 kg	
PACKING CRATE SIZE	85 x 51 x 67 (cm)				85 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.135 m³/sec 286cfm				0.165 m³/sec 340 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	40	40	40	38	44	47	48.5	50
Xd DIR. AXIS SYNCHRONOUS	1.92	1.73	1.61	1.36	2.27	2.17	2.05	1.94
X'd DIR. AXIS TRANSIENT	0.18	0.16	0.15	0.13	0.21	0.20	0.19	0.18
X''d DIR. AXIS SUBTRANSIENT	0.13	0.12	0.11	0.09	0.15	0.14	0.14	0.13
Xq QUAD. AXIS REACTANCE	0.92	0.83	0.77	0.65	1.09	1.04	0.98	0.93
X''q QUAD. AXIS SUBTRANSIENT	0.20	0.18	0.17	0.14	0.24	0.23	0.22	0.20
X_L LEAKAGE REACTANCE	0.08	0.07	0.07	0.05	0.09	0.09	0.08	0.08
X_2 NEGATIVE SEQUENCE	0.17	0.15	0.14	0.12	0.20	0.19	0.18	0.17
X_0 ZERO SEQUENCE	0.08	0.07	0.07	0.05	0.09	0.09	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.029 s							
T''d SUB-TRANSTIME CONST.	0.007 s							
T'do O.C. FIELD TIME CONST.	0.66 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

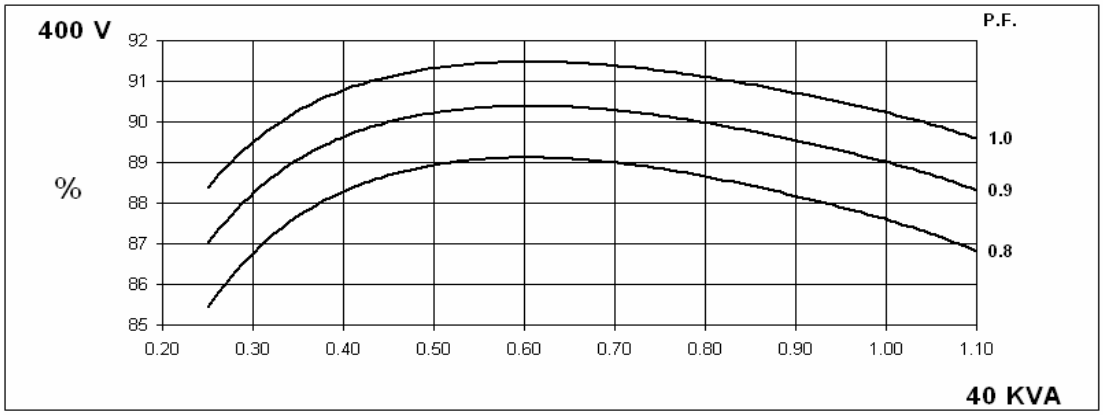
50 Hz

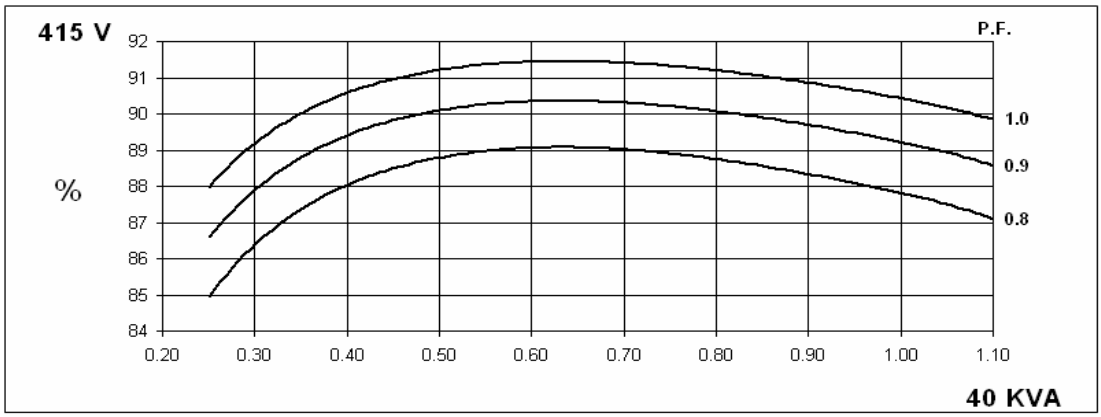
PI144J

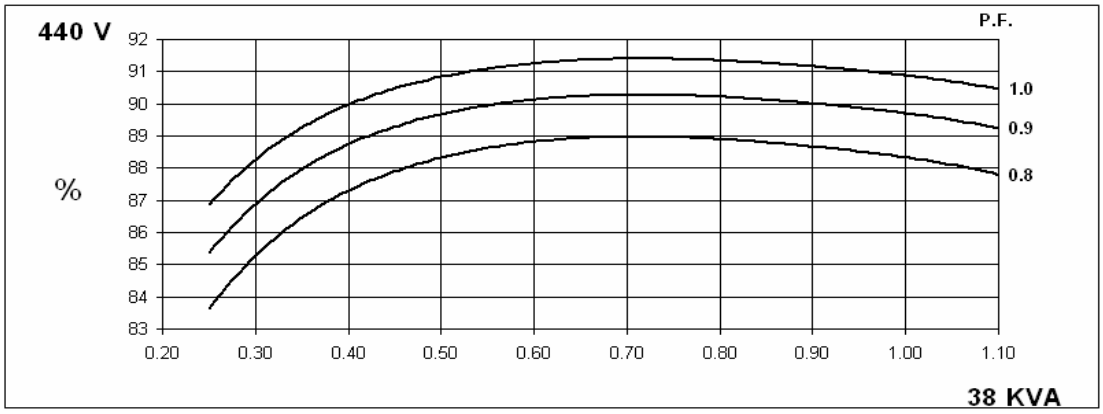
Winding 311

THREE PHASE EFFICIENCY CURVES







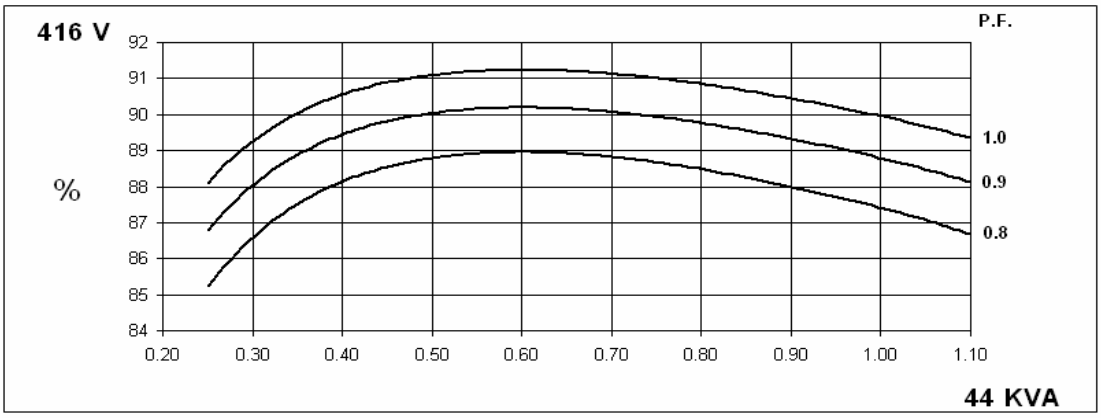


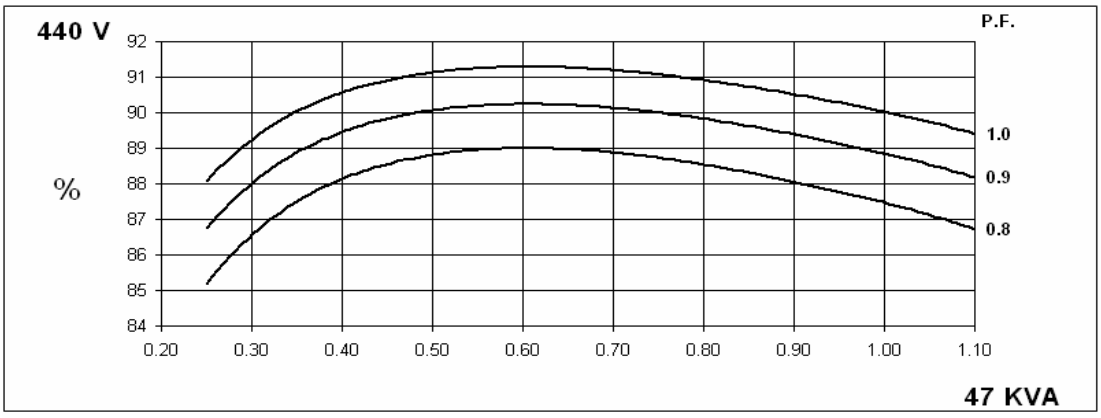
60 Hz

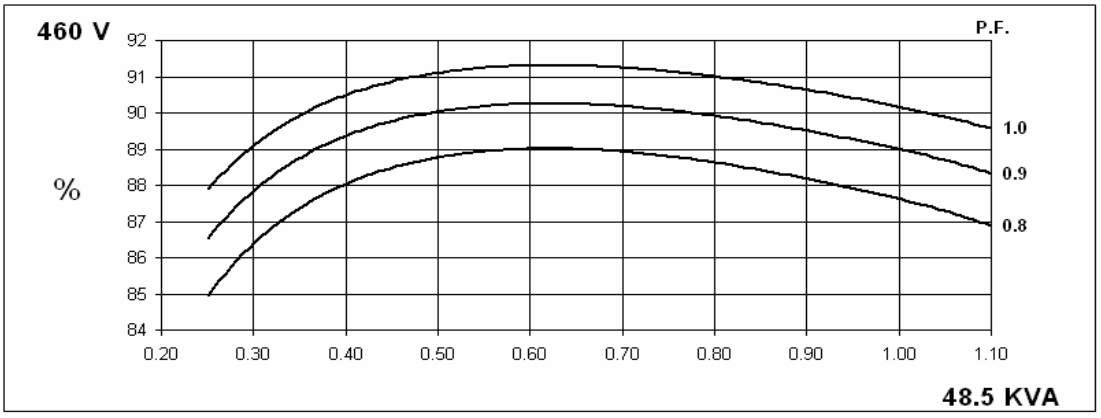
PI144J

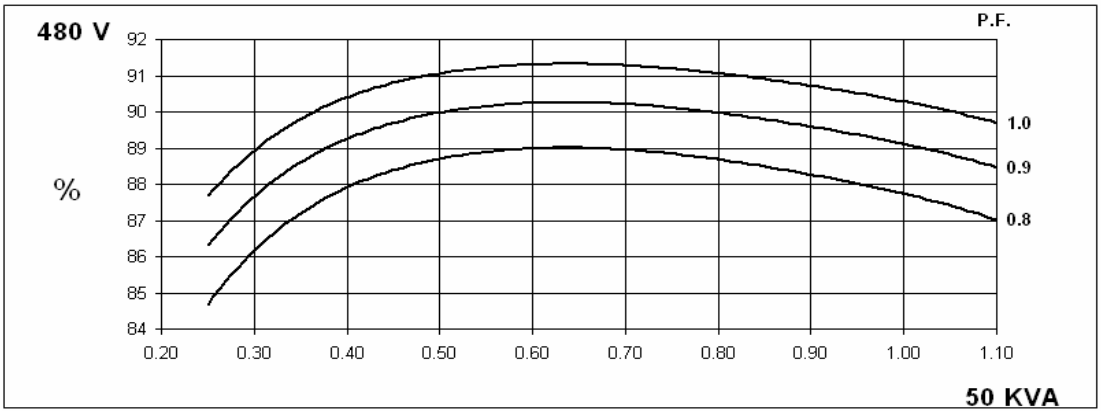
Winding 311

THREE PHASE EFFICIENCY CURVES



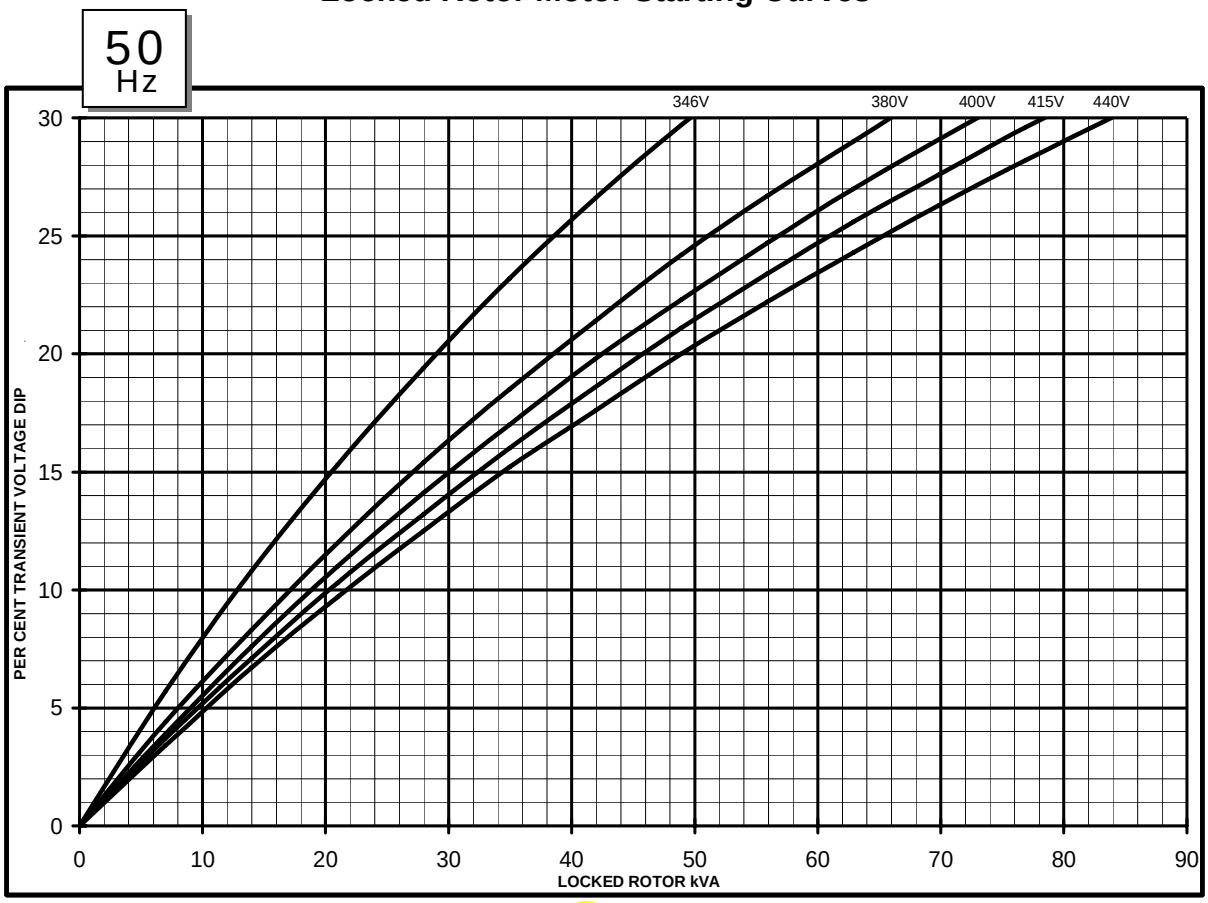


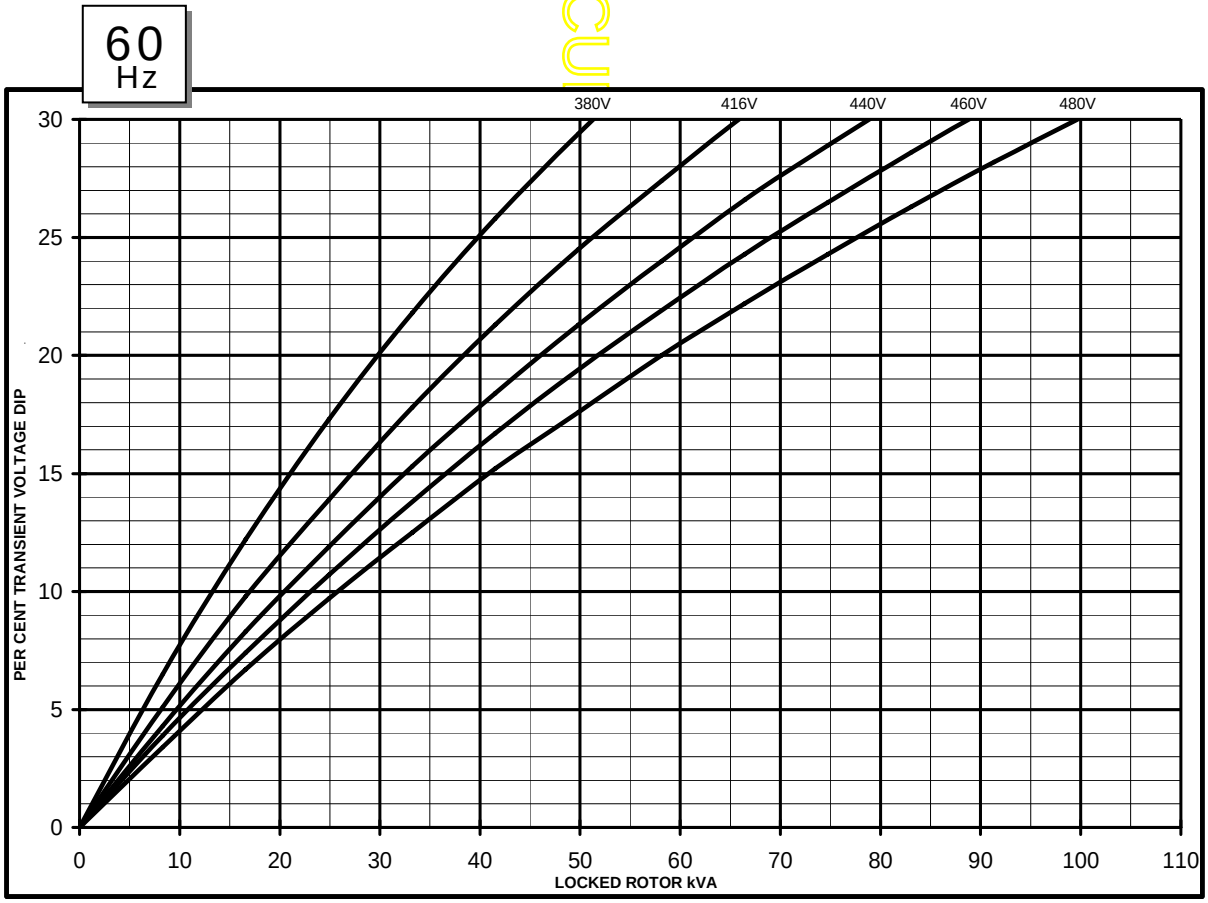




PI144J

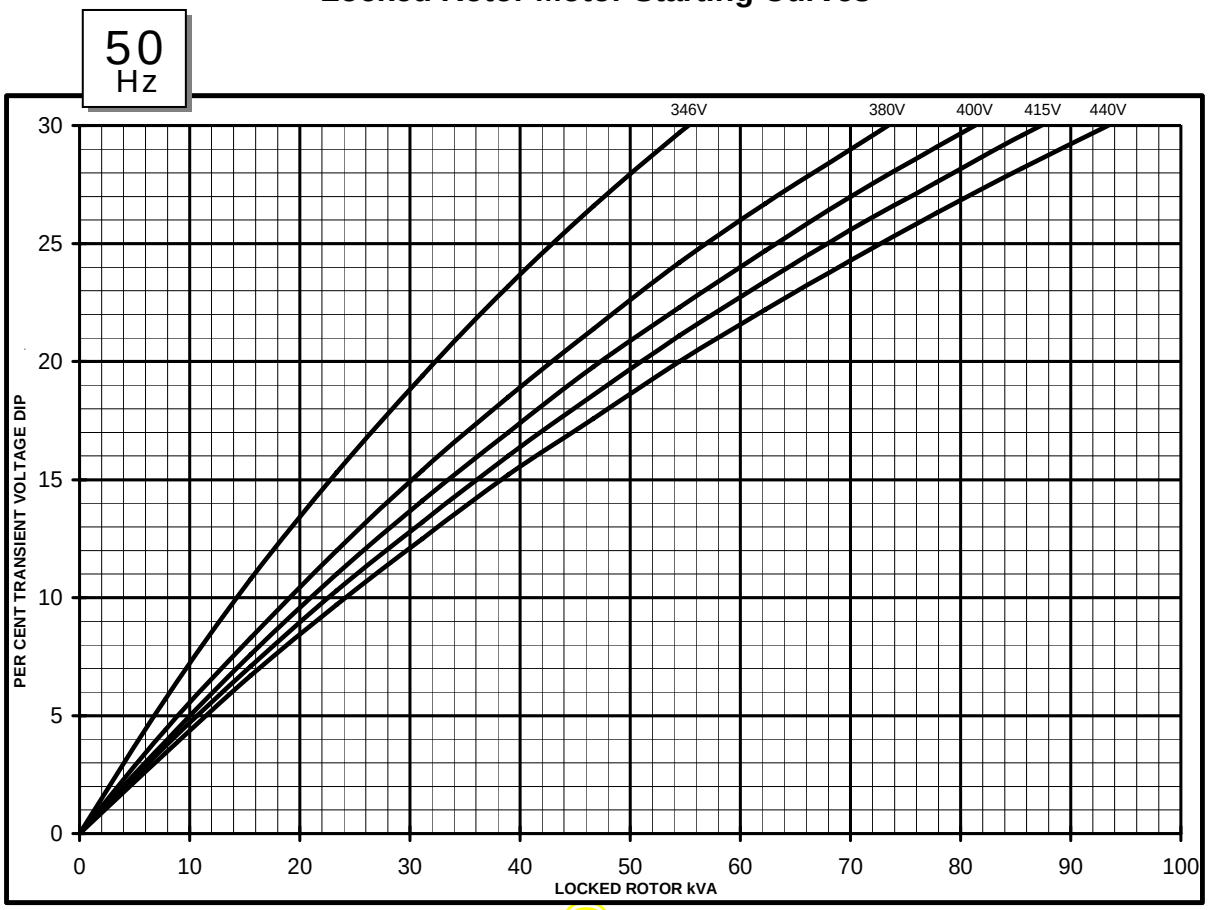
Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

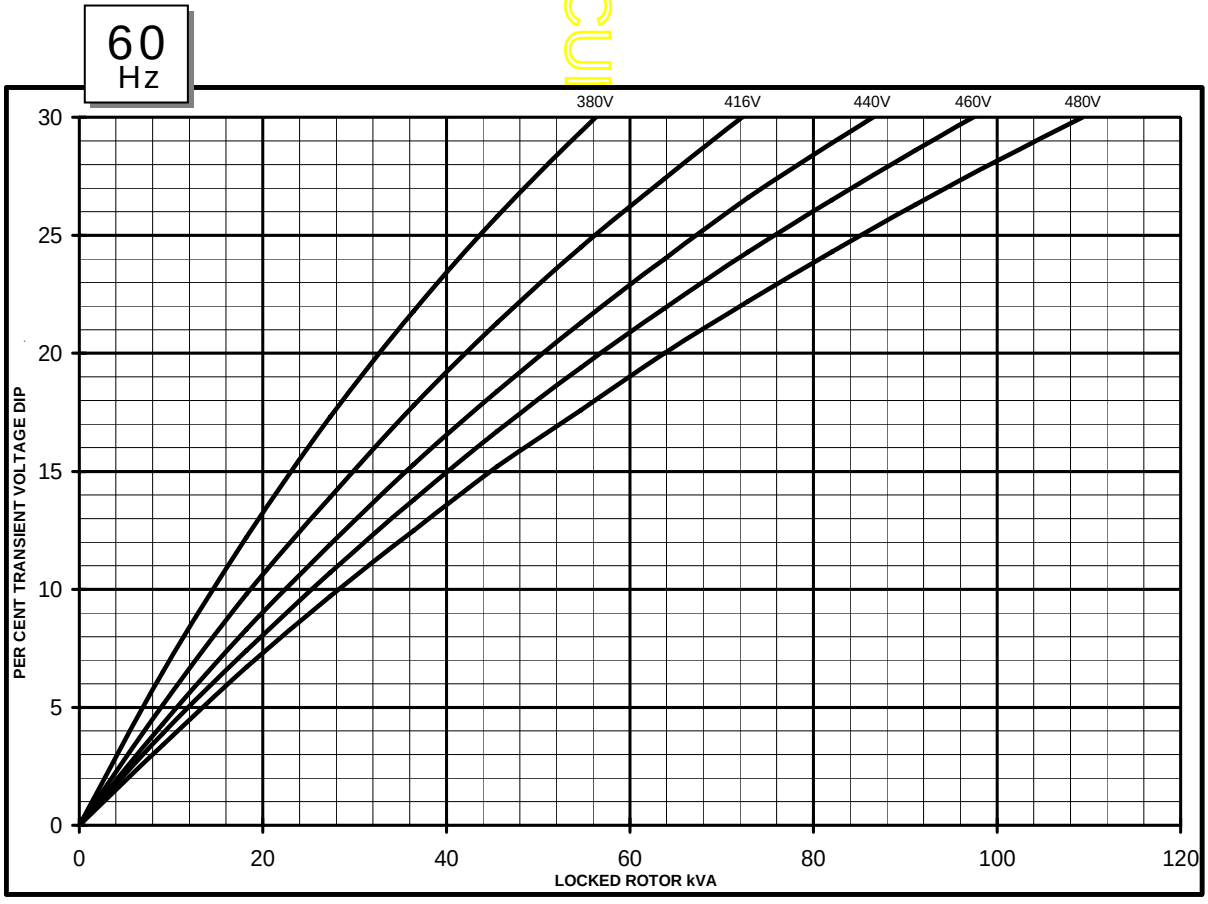




PI144J

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves



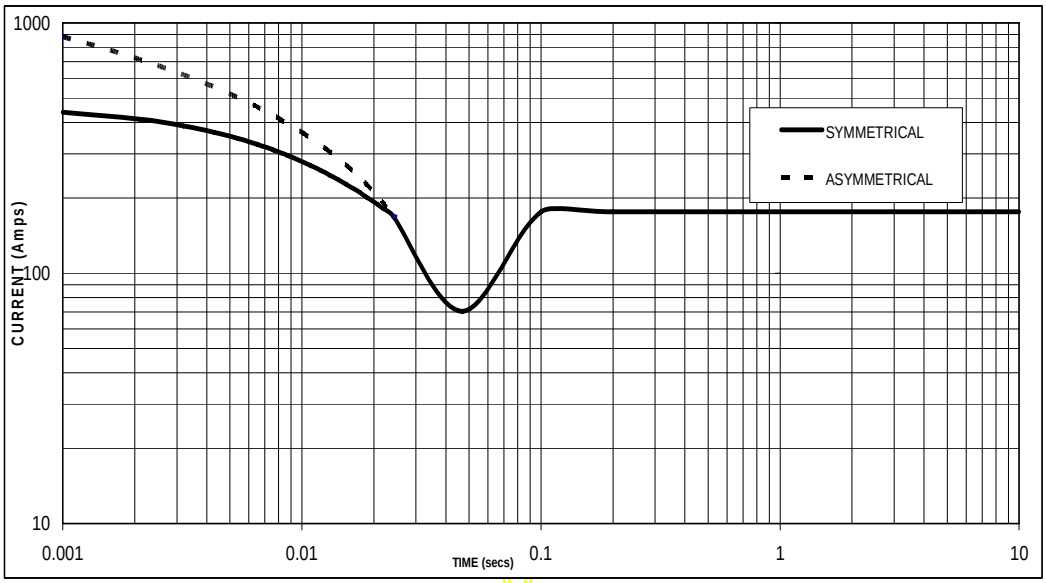


PI144J

WITH EBS FITTED

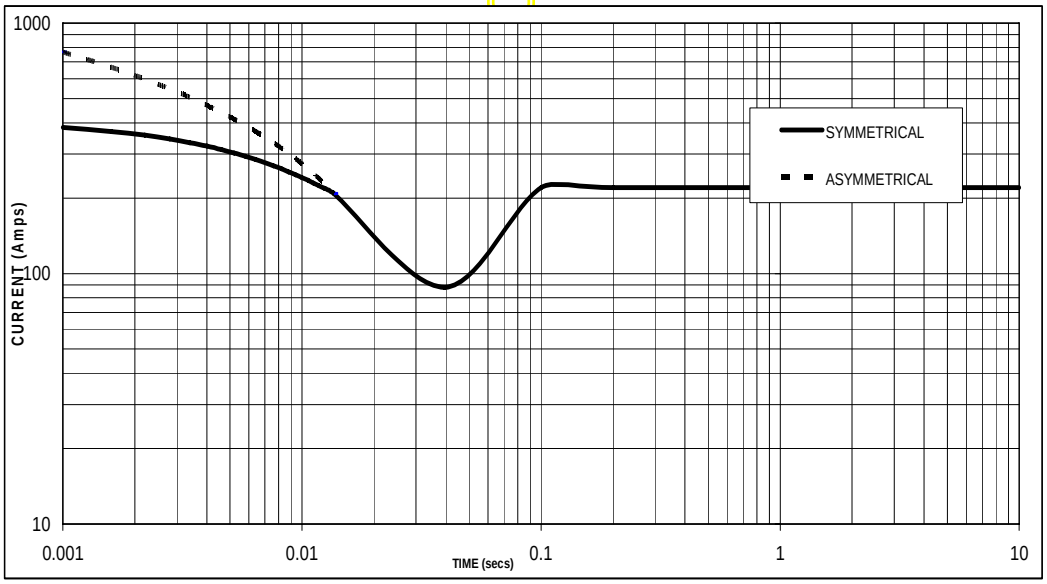
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 176 Amps

60 Hz



Sustained Short Circuit = 220 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI144J

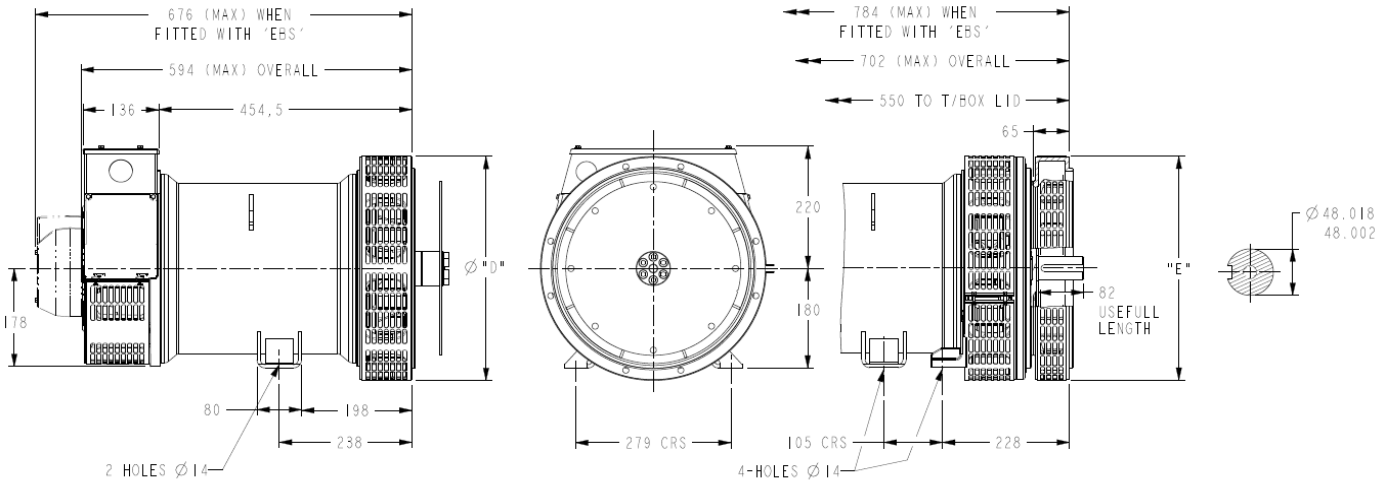
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	36.5	36.5	36.5	34.7	40.0	40.0	40.0	38.0	44.0	44.0	44.0	41.8	45.0	45.0	45.0	42.8
	kW	29.2	29.2	29.2	27.8	32.0	32.0	32.0	30.4	35.2	35.2	35.2	33.4	36.0	36.0	36.0	34.2
	Efficiency (%)	87.9	88.1	88.2	88.5	87.3	87.6	87.8	88.2	86.5	86.9	87.1	87.7	86.3	86.7	87.0	87.6
	kW Input	33.2	33.1	33.1	31.4	36.7	36.5	36.4	34.5	40.7	40.5	40.4	38.1	41.7	41.5	41.4	39.0

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	40.2	42.9	44.3	45.6	44.0	47.0	48.5	50.0	48.4	51.7	53.4	55.0	49.5	52.9	54.6	56.3
	kW	32.2	34.3	35.4	36.5	35.2	37.6	38.8	40.0	38.7	41.4	42.7	44.0	39.6	42.3	43.7	45.0
	Efficiency (%)	88.2	88.2	88.3	88.4	87.7	87.7	87.8	87.9	87.1	87.1	87.2	87.3	86.9	86.9	87.0	87.1
	kW Input	36.5	38.9	40.1	41.3	40.1	42.9	44.2	45.5	44.4	47.5	49.0	50.4	45.6	48.7	50.2	51.7

DIMENSIONS



COUPLING DISC	
SAE	"AN"
8	62
10	53.8
11.5	39.6

1-BRG ADAPTOR	
SAE	"D"
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTOR	
SAE	"E"
5	359
4	406
3	455
2	493

APPROVED DOCUMENT

STAMFORD

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Fax: +44 (0) 1780 484100

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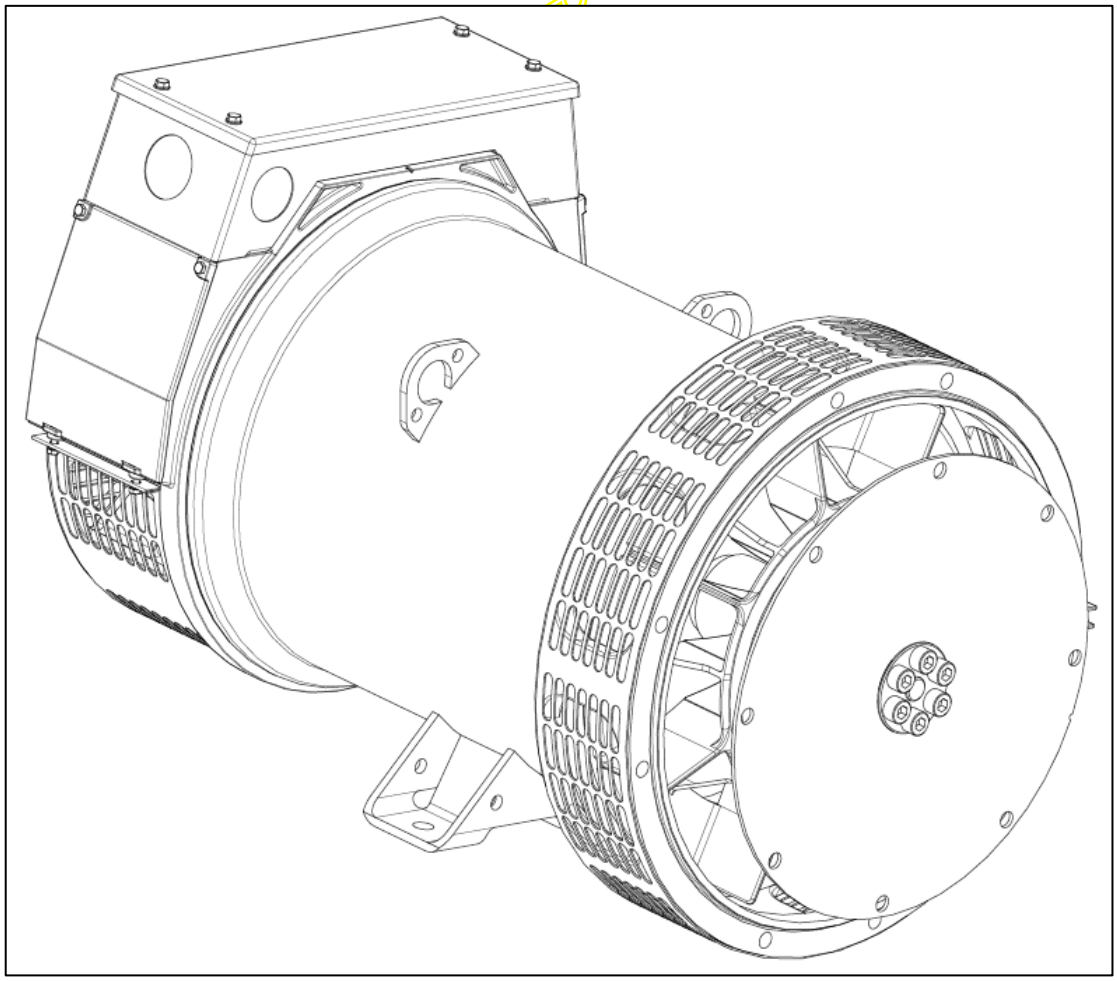
STAMFORD®

PI144K - 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 REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the 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 AS480 will support limited accessories, RFI suppression remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

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 at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

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 9 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.

5% For reverse rotation
(Standard rotation CW when viewed from DE)

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.

PI144K

STAMFORD

WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 8)

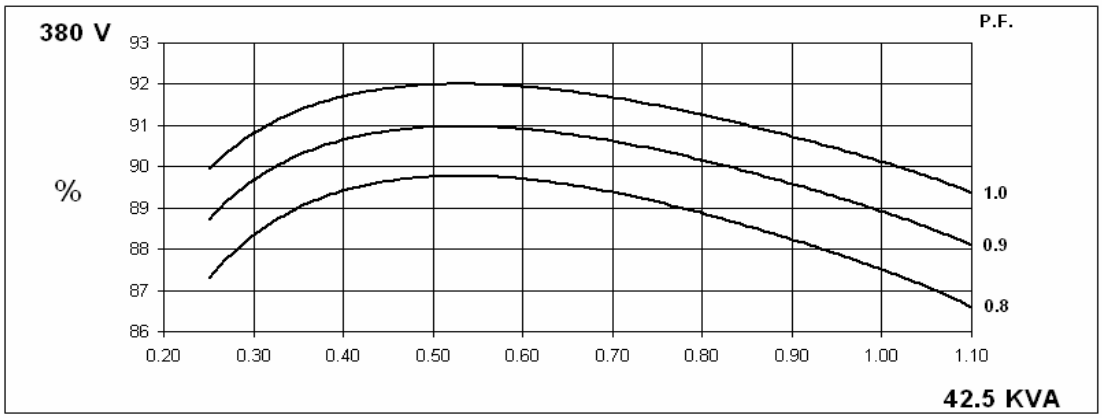
STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.153 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.983 Ohms at 22°C							
EXCITER STATOR RESISTANCE	22.9 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.21 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms 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. 6310 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
	WITH EBS		WITHOUT EBS		WITH EBS		WITHOUT EBS	
WEIGHT COMP. GENERATOR	193 kg		191.3 kg		196 kg		194.3 kg	
WEIGHT WOUND STATOR	94 kg		94 kg		94 kg		94 kg	
WEIGHT WOUND ROTOR	73.55 kg		71.85 kg		75.26 kg		73.56 kg	
WR² INERTIA	0.2866 kgm^2		0.2849 kgm^2		0.2871 kgm^2		0.2854 kgm^2	
SHIPPING WEIGHTS in a crate	211 kg		209.3 kg		220 kg		218.3 kg	
PACKING CRATE SIZE	85 x 51 x 67 (cm)				85 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.135 m³/sec 286cfm				0.165 m³/sec 340 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	42.5	42.5	42.5	40.4	50	52.5	52.5	55
Xd DIR. AXIS SYNCHRONOUS	1.98	1.79	1.66	1.41	2.51	2.36	2.16	2.07
X'd DIR. AXIS TRANSIENT	0.19	0.17	0.16	0.13	0.24	0.23	0.21	0.20
X''d DIR. AXIS SUBTRANSIENT	0.13	0.12	0.11	0.09	0.17	0.16	0.15	0.14
Xq QUAD. AXIS REACTANCE	0.95	0.86	0.80	0.68	1.21	1.14	1.04	1.00
X''q QUAD. AXIS SUBTRANSIENT	0.21	0.19	0.18	0.15	0.27	0.25	0.23	0.22
X_L LEAKAGE REACTANCE	0.08	0.07	0.07	0.05	0.10	0.09	0.09	0.08
X_2 NEGATIVE SEQUENCE	0.18	0.16	0.15	0.13	0.22	0.21	0.19	0.18
X_0 ZERO SEQUENCE	0.08	0.07	0.07	0.05	0.10	0.09	0.09	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.03 s							
T''d SUB-TRANSTIME CONST.	0.007 s							
T'do O.C. FIELD TIME CONST.	0.68 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

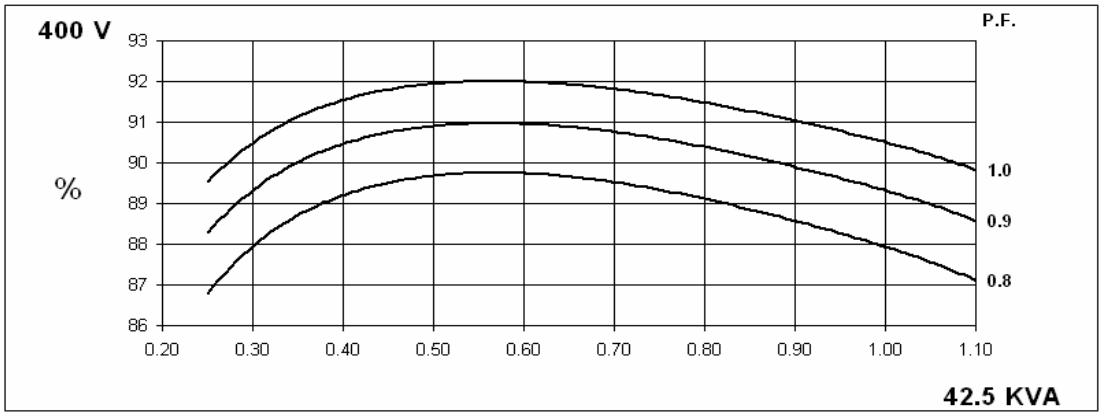
50 Hz

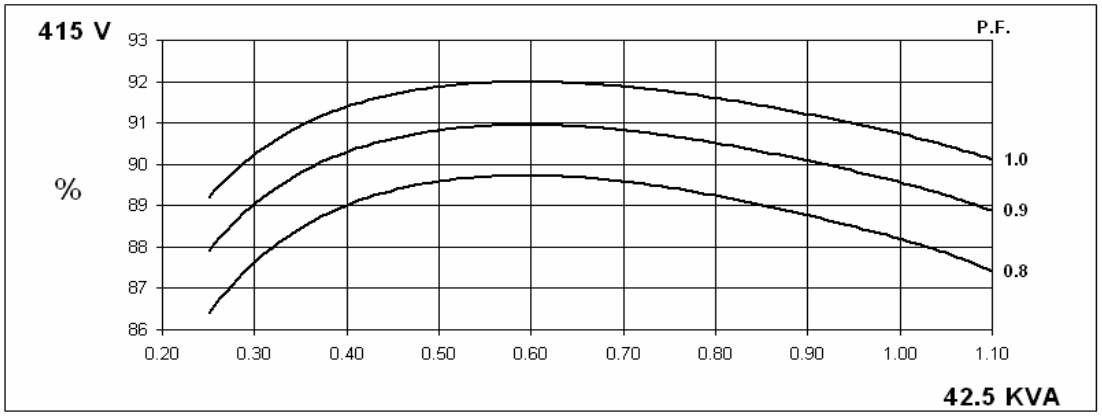
PI144K

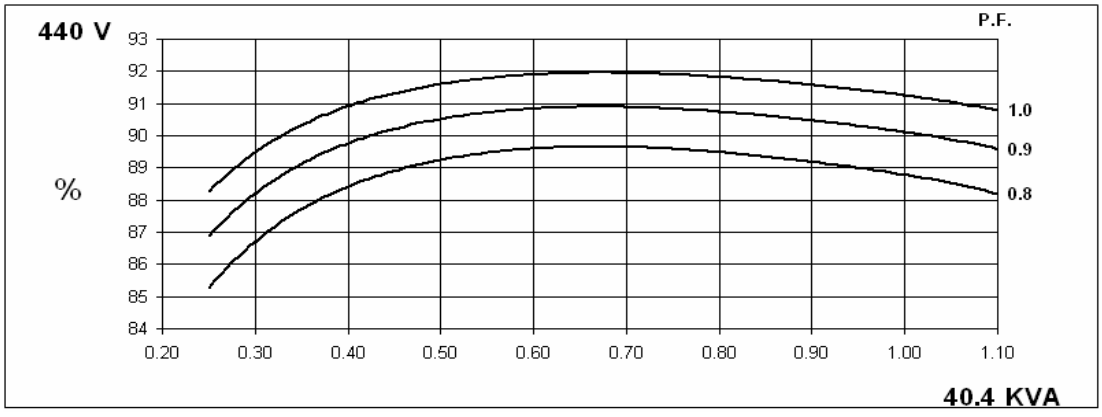
Winding 311

THREE PHASE EFFICIENCY CURVES







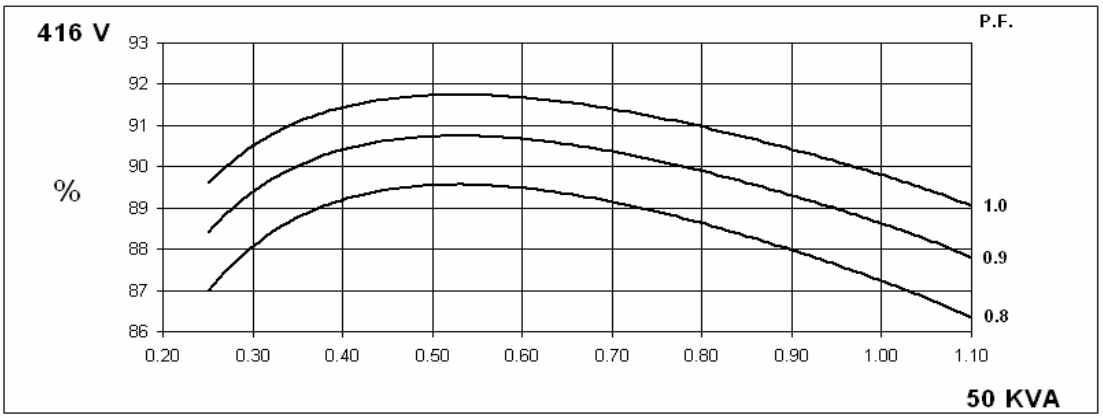


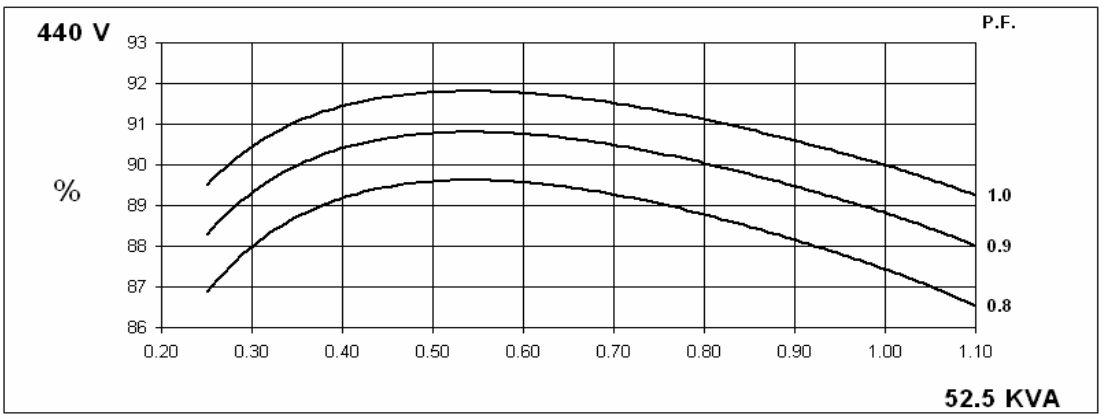
60 Hz

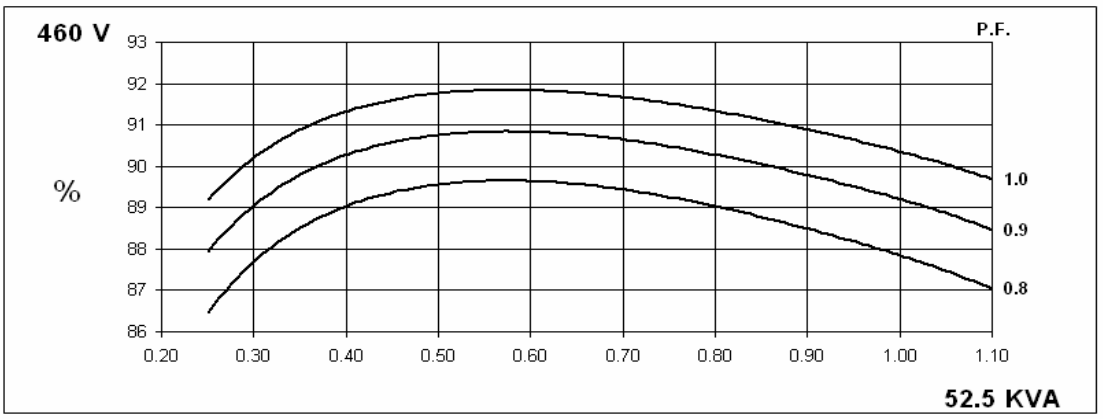
PI144K

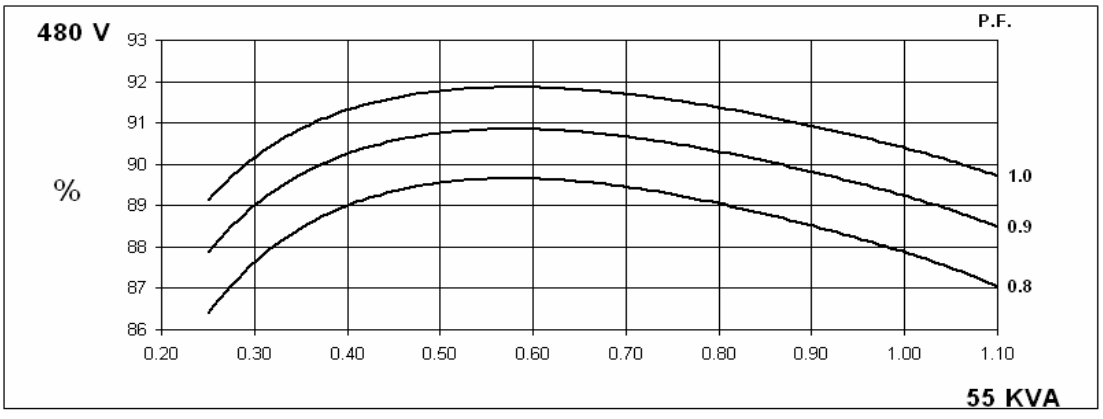
Winding 311

THREE PHASE EFFICIENCY CURVES





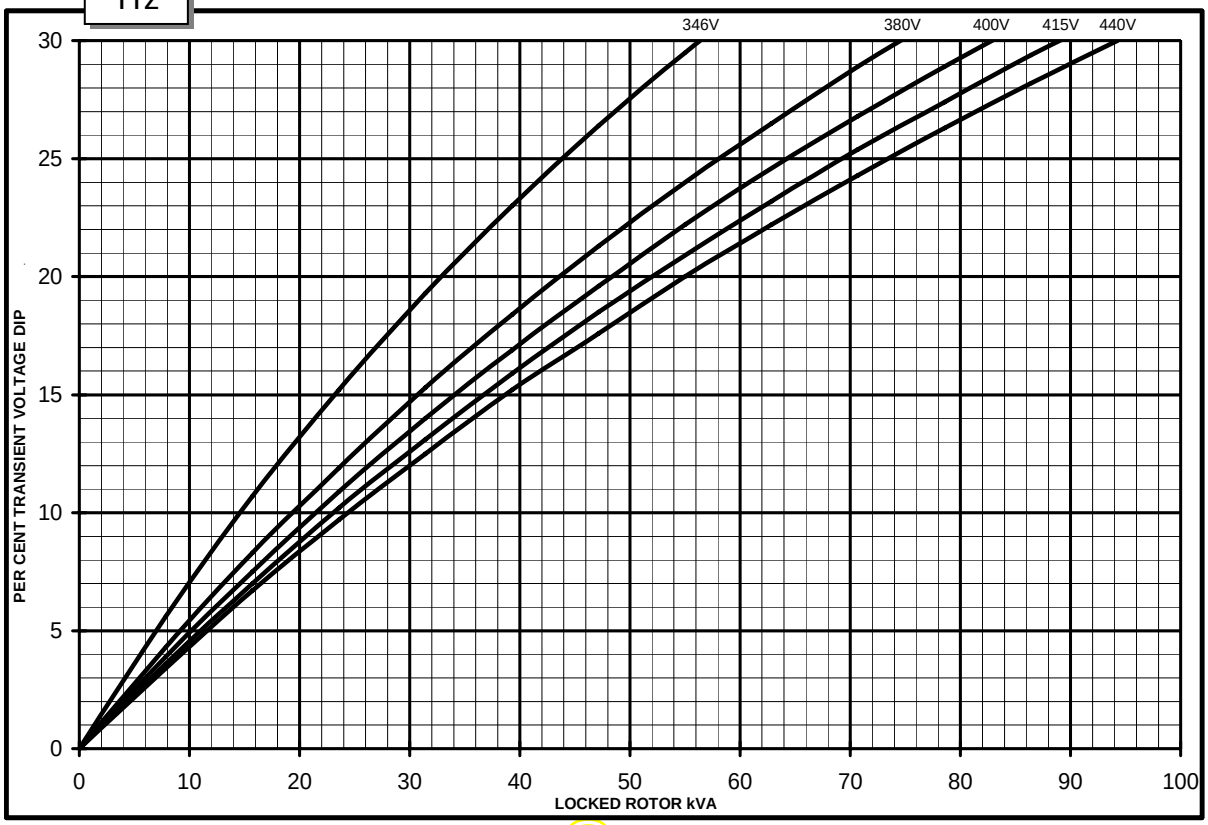




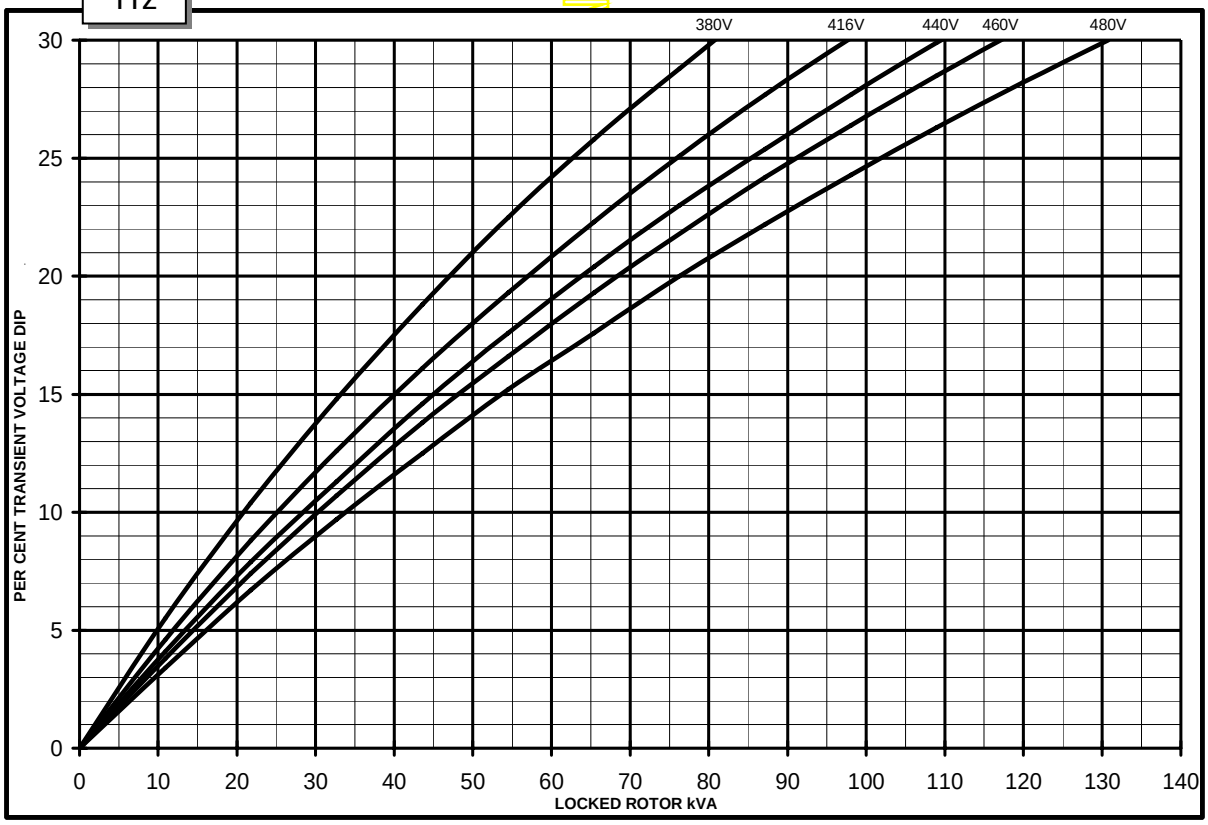
PI144K

Winding 311
AS480 AVR Without EBS
Locked Rotor Motor Starting Curves

50 Hz

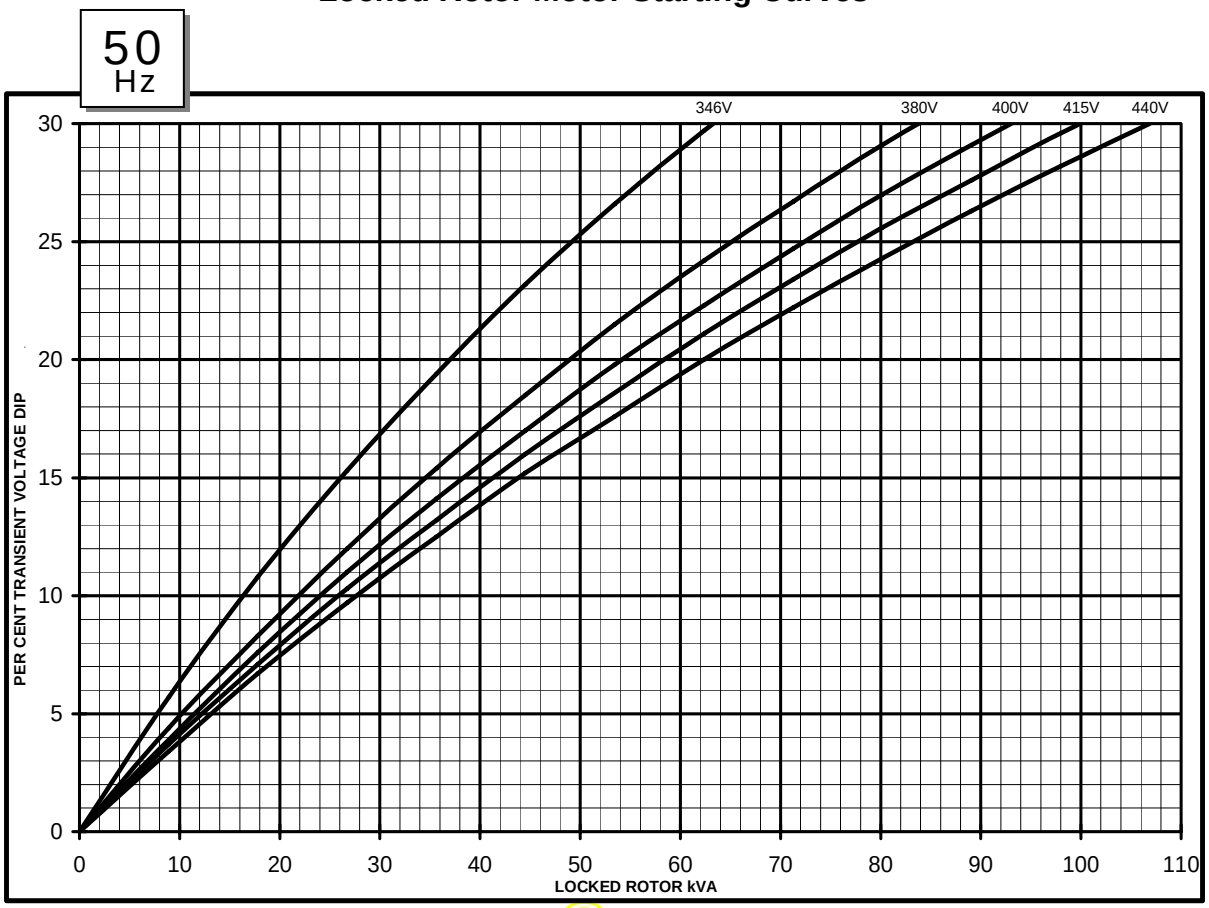


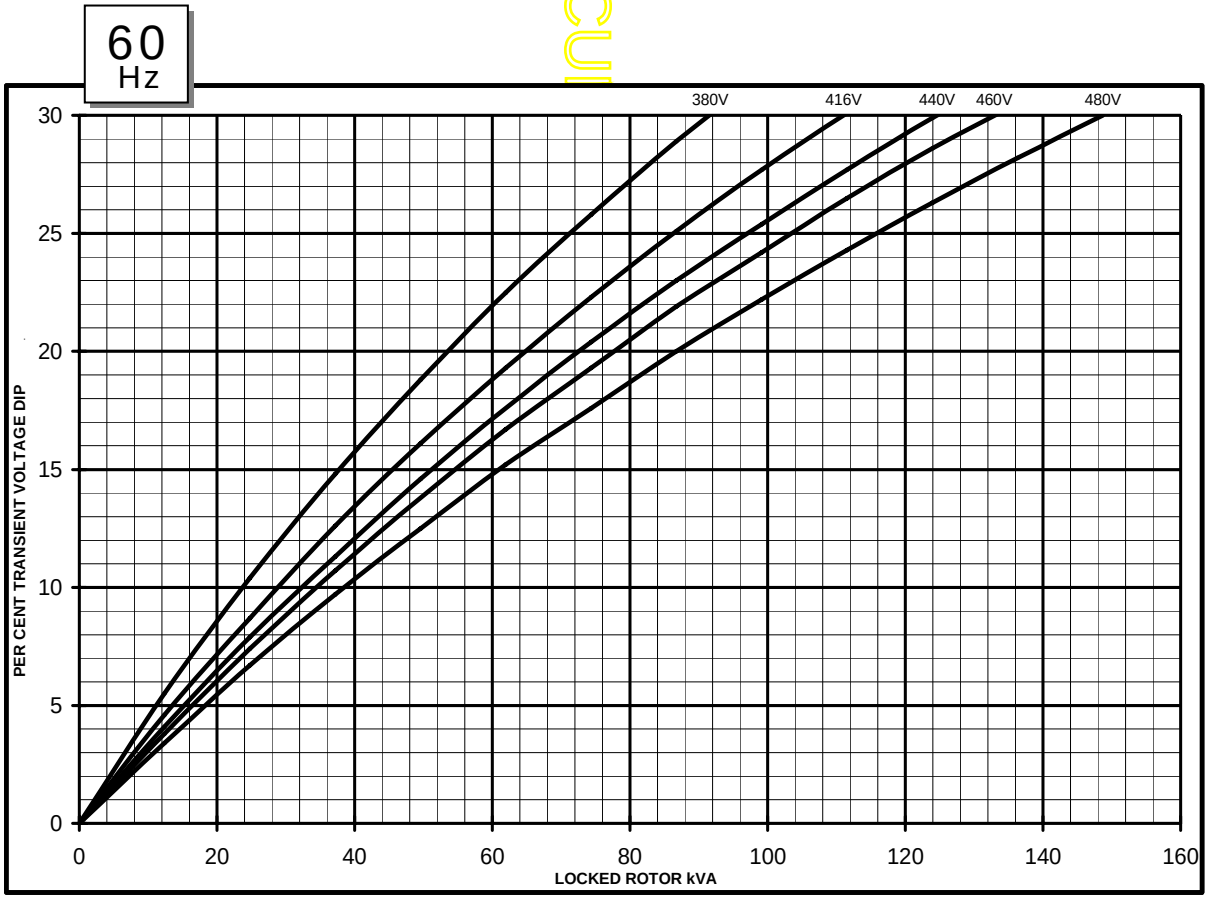
60 Hz



PI144K

Winding 311
AS480 AVR With EBS fitted
Locked Rotor Motor Starting Curves



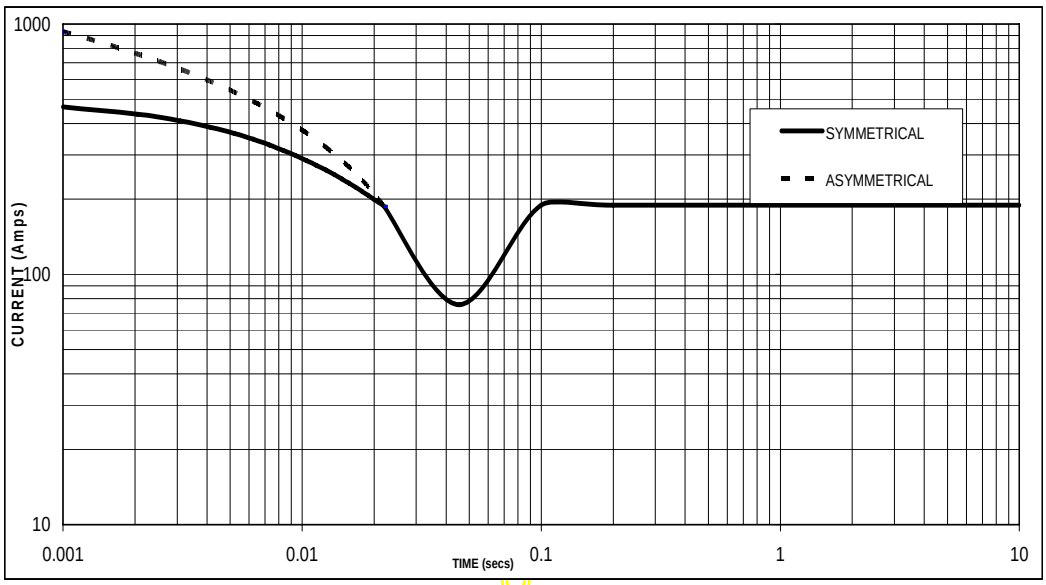


PI144K

WITH EBS FITTED

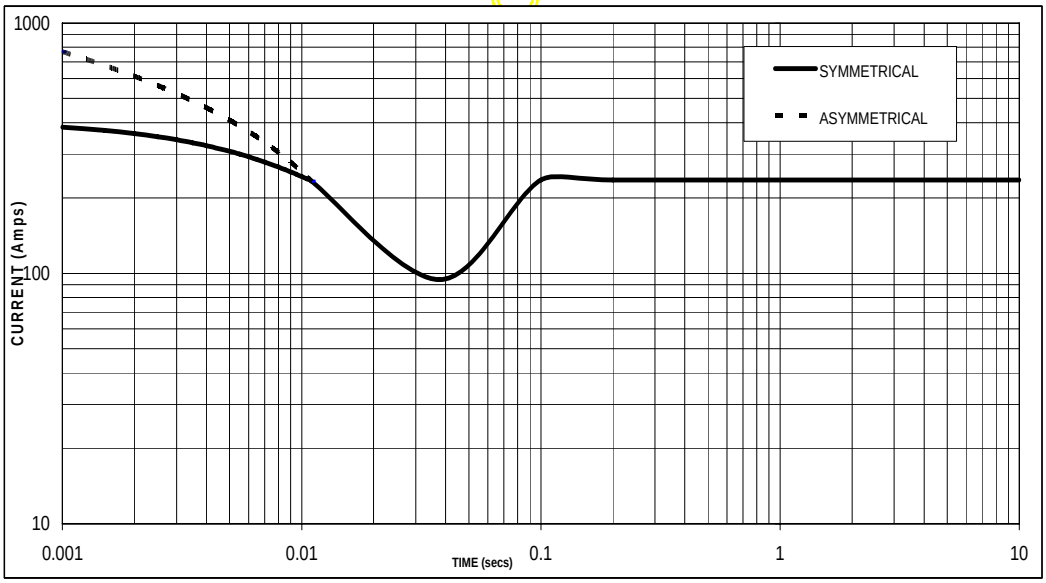
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 189 Amps

60 Hz



Sustained Short Circuit = 236 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection 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

PI144K

Winding 311 / 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			
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	37.5	37.5	37.5	35.6	42.5	42.5	42.5	40.4	45.0	45.0	45.0	42.8	46.8	46.8	46.8	44.5
	kW	30.0	30.0	30.0	28.5	34.0	34.0	34.0	32.3	36.0	36.0	36.0	34.2	37.4	37.4	37.4	35.6
	Efficiency (%)	88.4	88.7	88.8	89.3	87.6	87.9	88.1	88.8	87.1	87.5	87.7	88.5	86.8	87.2	87.4	88.2
	kW Input	33.9	33.8	33.8	31.9	38.8	38.7	38.6	36.4	41.3	41.1	41.0	38.7	43.1	42.9	42.8	40.3

60 Hz	Series Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
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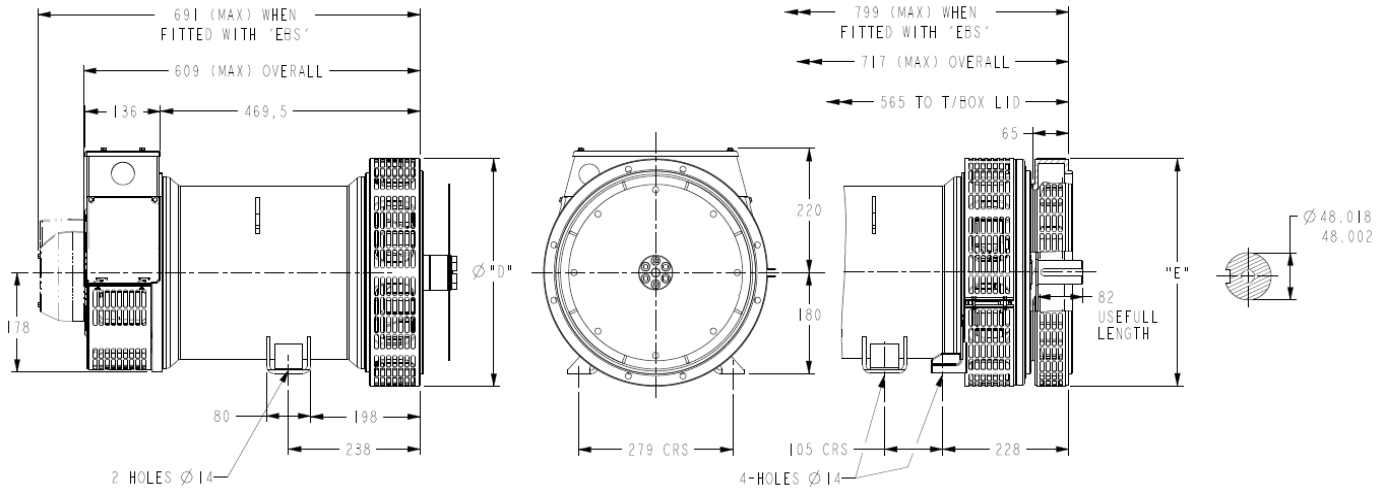
	Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	45.0	46.3	46.3	48.0	50.0	52.5	52.5	55.0	53.1	55.0	55.0	58.1	55.0	56.3	56.3	60.0
	kW	36.0	37.0	37.0	38.4	40.0	42.0	42.0	44.0	42.5	44.0	44.0	46.5	44.0	45.0	45.0	48.0
	Efficiency (%)	88.3	88.5	88.8	88.8	87.6	87.7	88.1	88.0	87.1	87.4	87.7	87.6	86.8	87.2	87.6	87.4
	kW Input	40.8	41.8	41.7	43.2	45.7	47.9	47.7	50.0	48.8	50.3	50.2	53.1	50.7	51.6	51.4	54.9

DIMENSIONS



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2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTOR	
SAE	"E"
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4	406
3	455
2	493

APPROVED DOCUMENT

STAMFORD

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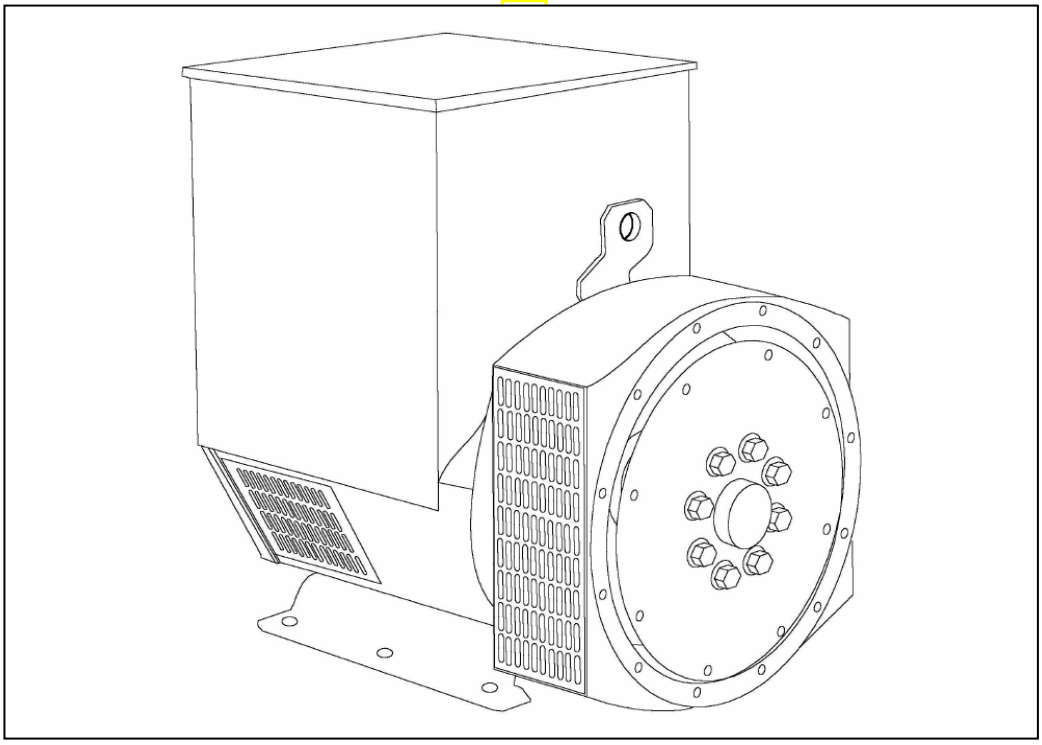
STAMFORD®

UCI224C - 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

SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

AS440 AVR

With this self-excited system the main stator provides power via the AVR to the exciter stator. The high efficiency semi-conductors of the AVR ensure positive build-up from initial low levels of residual voltage.
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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%.

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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.

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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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.181 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	0.59 Ohms at 22°C						
EXCITER STATOR RESISTANCE	21 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.071 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. 6312-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6309-2RS (ISO)						
	1 BEARING				2 BEARING		
WEIGHT COMP. GENERATOR	271 kg				280 kg		
WEIGHT WOUND STATOR	75 kg				75 kg		
WEIGHT WOUND ROTOR	78.95 kg				70.58 kg		
WR² INERTIA	0.3987 kgm²				0.3667 kgm²		
SHIPPING WEIGHTS in a crate	294 kg				301 kg		
PACKING CRATE SIZE	97 x 57 x 96(cm)				97 x 57 x 96(cm)		
	50 Hz				60 Hz		
TELEPHONE INTERFERENCE	THF<2%				TIF<50		
COOLING AIR	0.216 m³/sec 458 cfm				0.281 m³/sec 595 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	42.5	42.5	42.5	30	50	52.5	52.5	55
Xd DIR. AXIS SYNCHRONOUS	2.42	2.19	2.03	1.27	3.03	2.84	2.60	2.50
X'd DIR. AXIS TRANSIENT	0.19	0.17	0.16	0.10	0.22	0.21	0.19	0.18
X"d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.06	0.15	0.14	0.13	0.12
Xq QUAD. AXIS REACTANCE	1.12	1.01	0.94	0.59	1.40	1.31	1.20	1.16
X"q QUAD. AXIS SUBTRANSIENT	0.16	0.14	0.13	0.08	0.14	0.13	0.12	0.12
X_L LEAKAGE REACTANCE	0.08	0.08	0.07	0.04	0.10	0.09	0.09	0.08
X_2 NEGATIVE SEQUENCE	0.14	0.13	0.12	0.08	0.14	0.13	0.12	0.12
X_0 ZERO SEQUENCE	0.10	0.09	0.08	0.05	0.10	0.09	0.09	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED						
T'd TRANSIENT TIME CONST.	0.025 s						
T"d SUB-TRANSTIME CONST.	0.006 s						
T'do O.C. FIELD TIME CONST.	0.65 s						
Ta ARMATURE TIME CONST.	0.005 s						
SHORT CIRCUIT RATIO	1/Xd						

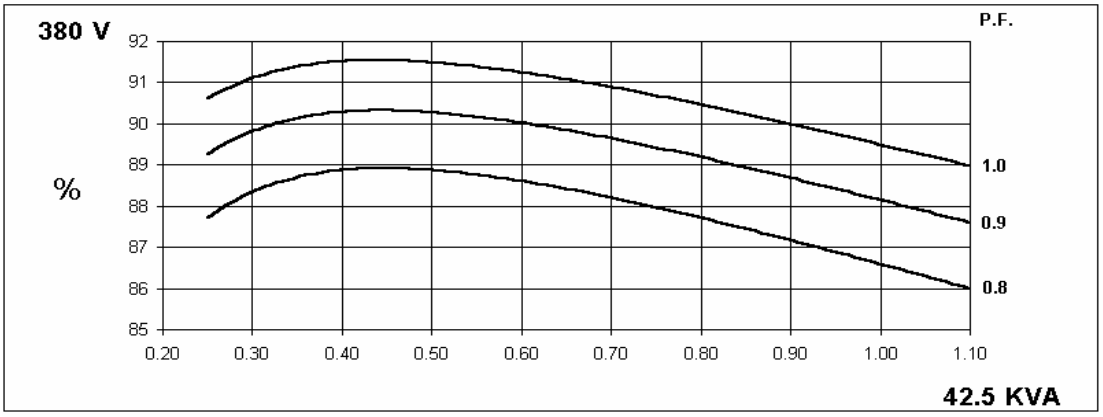
50 Hz

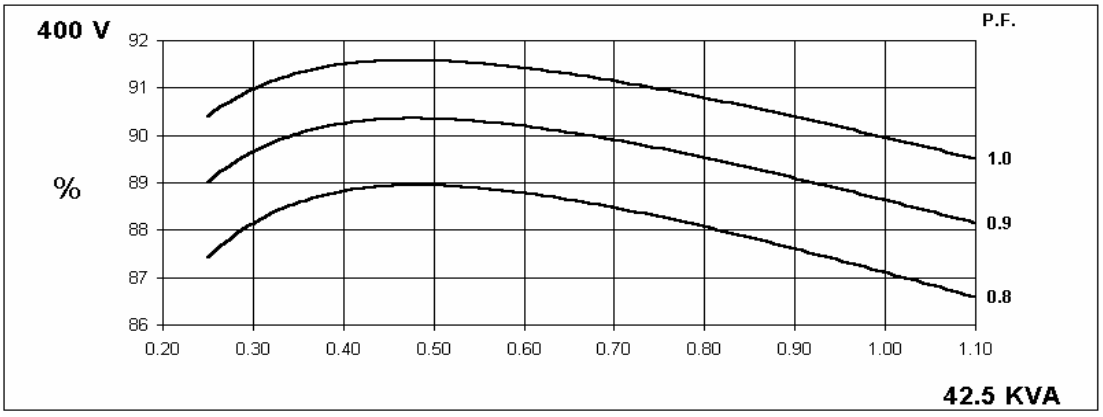
UCI224C

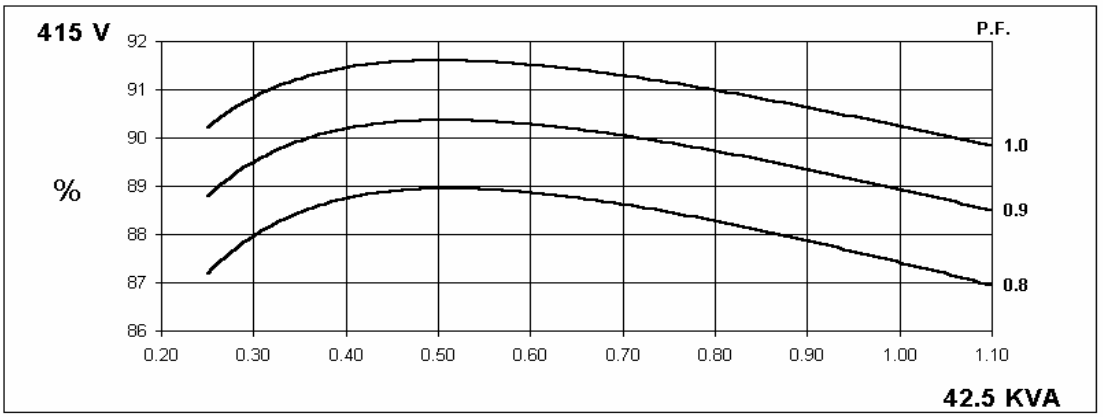
Winding 311

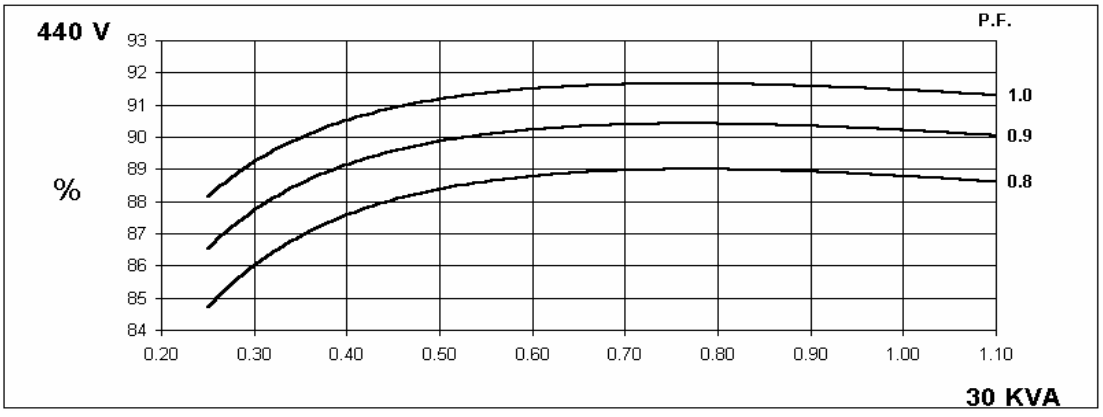
STAMFORD

THREE PHASE EFFICIENCY CURVES









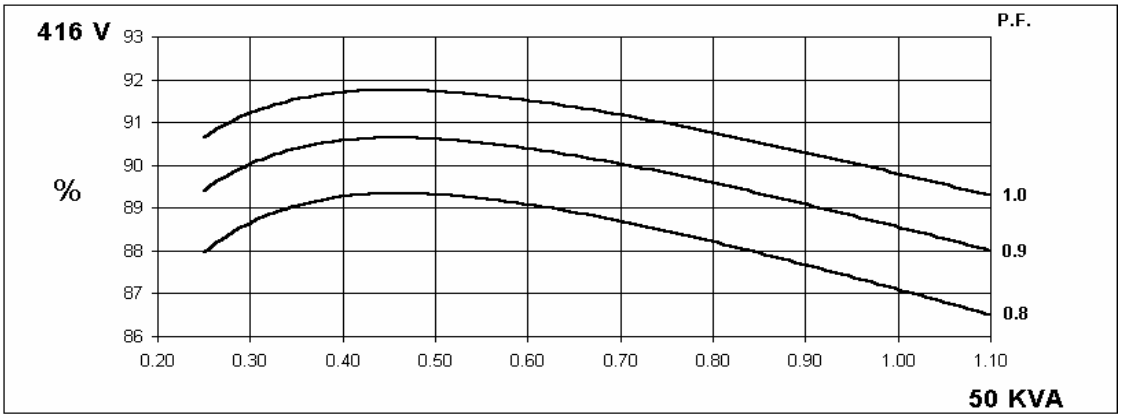
60 Hz

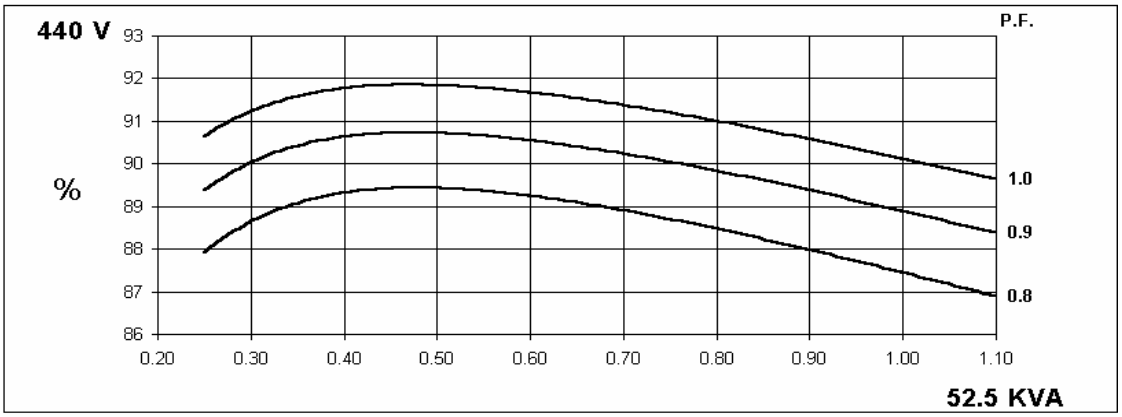
UCI224C

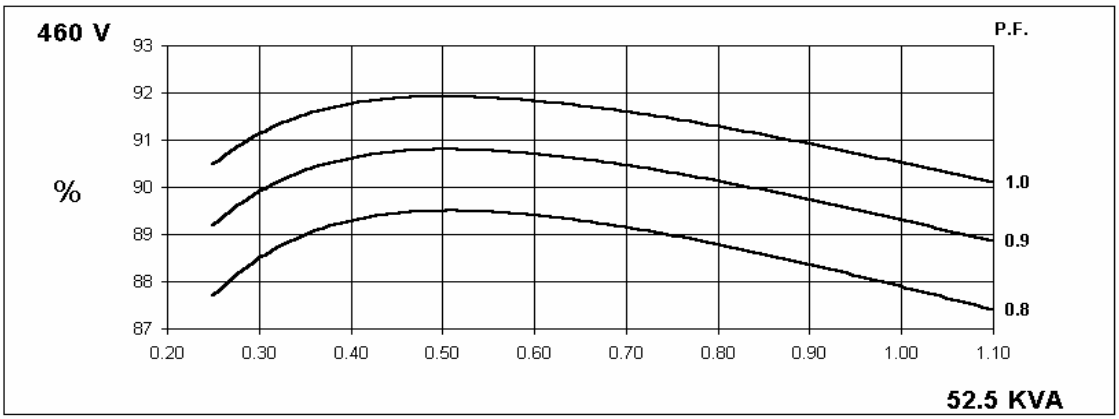
Winding 311

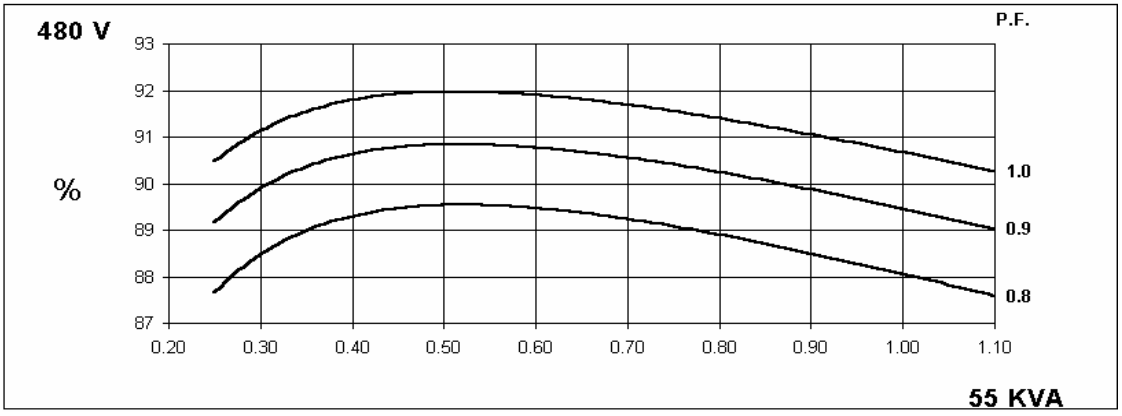
STAMFORD

THREE PHASE EFFICIENCY CURVES









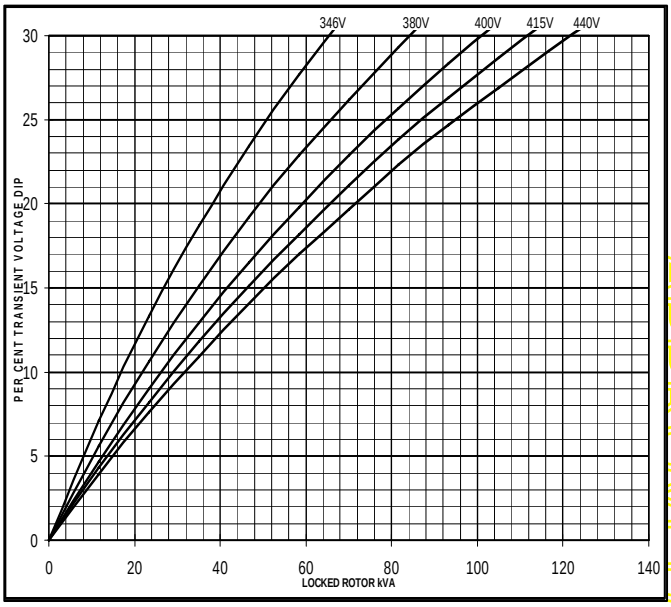
UCI224C

Winding 311

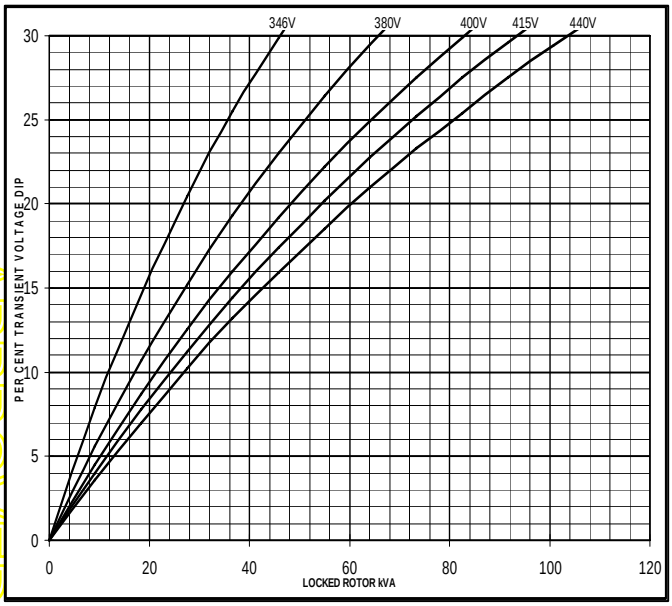
Locked Rotor Motor Starting Curve

50 Hz

MX

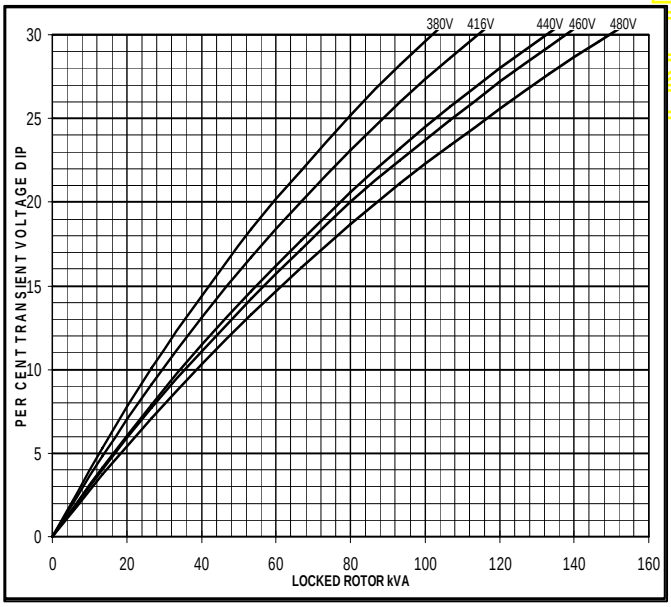


SX

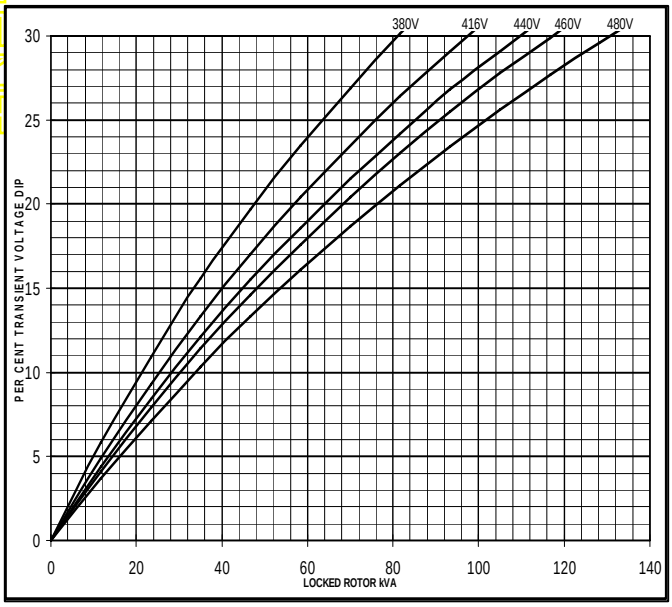


60 Hz

MX

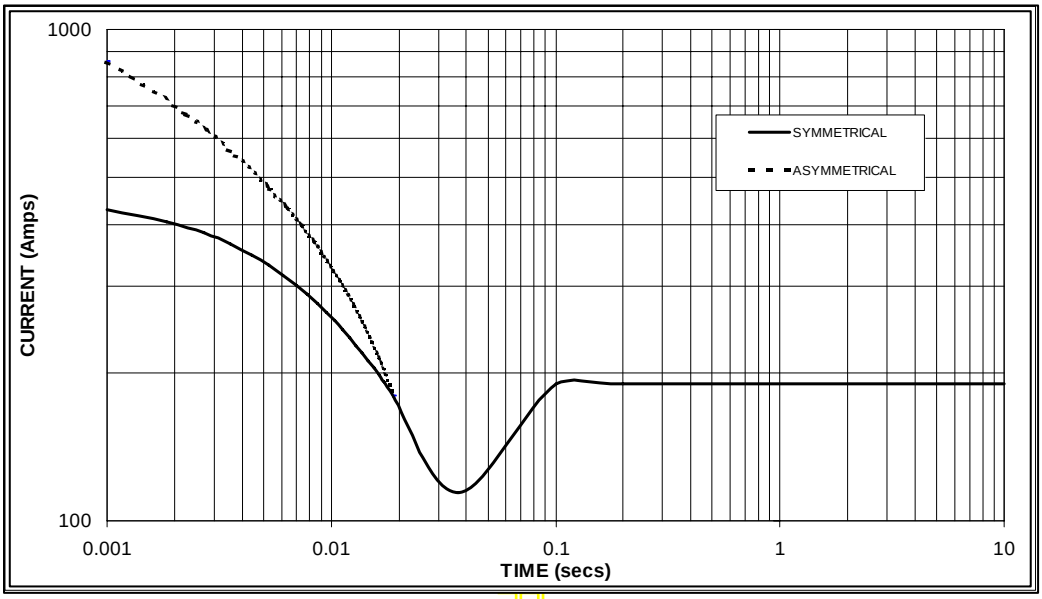


SX



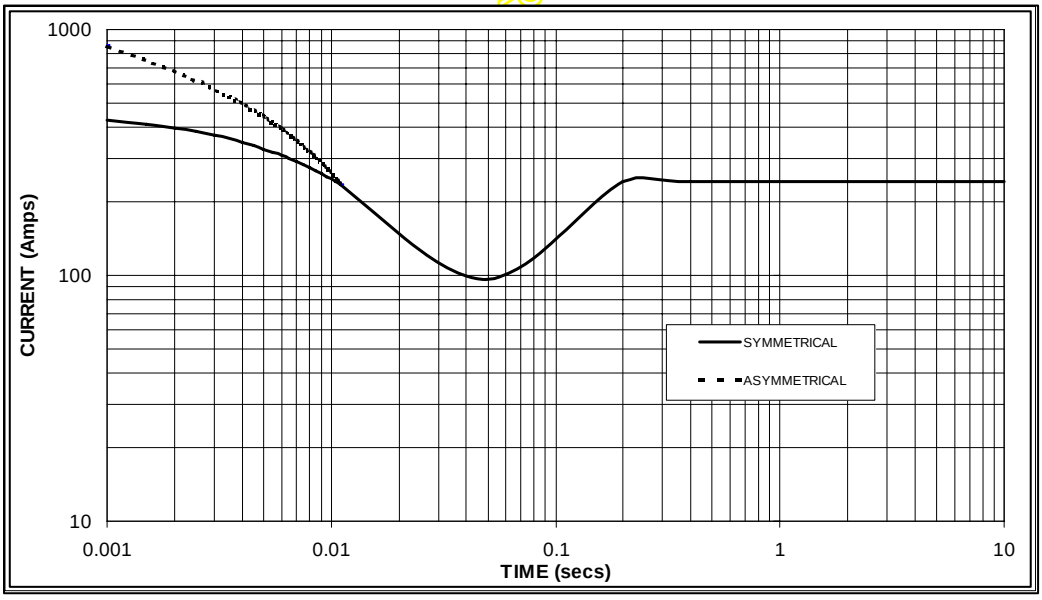
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 190 Amps

60 Hz



Sustained Short Circuit = 240 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 other connection 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

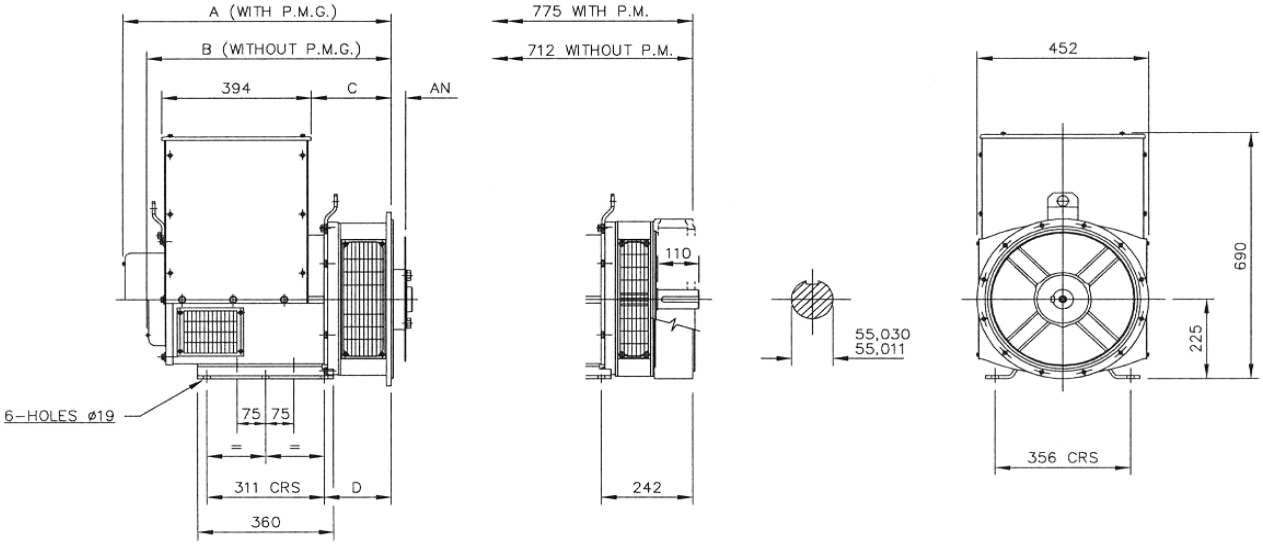
UCI224C

Winding 311 / 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			
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	37.5	37.5	37.5	27.0	42.5	42.5	42.5	30.0	45.0	45.0	45.0	31.7	46.8	46.8	46.8	33.0
	kW	30.0	30.0	30.0	21.6	34.0	34.0	34.0	24.0	36.0	36.0	36.0	25.4	37.4	37.4	37.4	26.4
	Efficiency (%)	87.3	87.7	88.0	88.9	86.6	87.1	87.4	88.8	86.2	86.8	87.1	88.7	86.0	86.6	86.9	88.6
	kW Input	34.4	34.2	34.1	24.3	39.3	39.0	38.9	27.0	41.8	41.5	41.3	28.6	43.5	43.2	43.1	29.8
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	45.0	46.3	46.3	48.0	50.0	52.5	52.5	55.0	53.1	55.0	55.0	58.1	55.0	56.3	56.3	60.0
	kW	36.0	37.0	37.0	38.4	40.0	42.0	42.0	44.0	42.5	44.0	44.0	46.5	44.0	45.0	45.0	48.0
	Efficiency (%)	87.7	88.1	88.4	88.6	87.1	87.5	87.9	88.1	86.7	87.2	87.7	87.8	86.5	87.1	87.5	87.6
	kW Input	41.0	42.0	41.9	43.3	45.9	48.0	47.8	49.9	49.0	50.5	50.2	52.9	50.9	51.7	51.5	54.8

DIMENSIONS



SINGLE BEARING MACHINES ONLY						
ADAPTOR	A	B	C	D	COUPLING DISCS	AN
SAE 1	724,3	661,3	224,3	191,3	SAE 8	61,90
SAE 2	710	647	210	177	SAE 10	53,98
SAE 3	710	647	210	177	SAE 11,5	39,68
SAE 4	710	647	210	177	SAE 14	25,40

APPROVED DOCUMENT

STAMFORD

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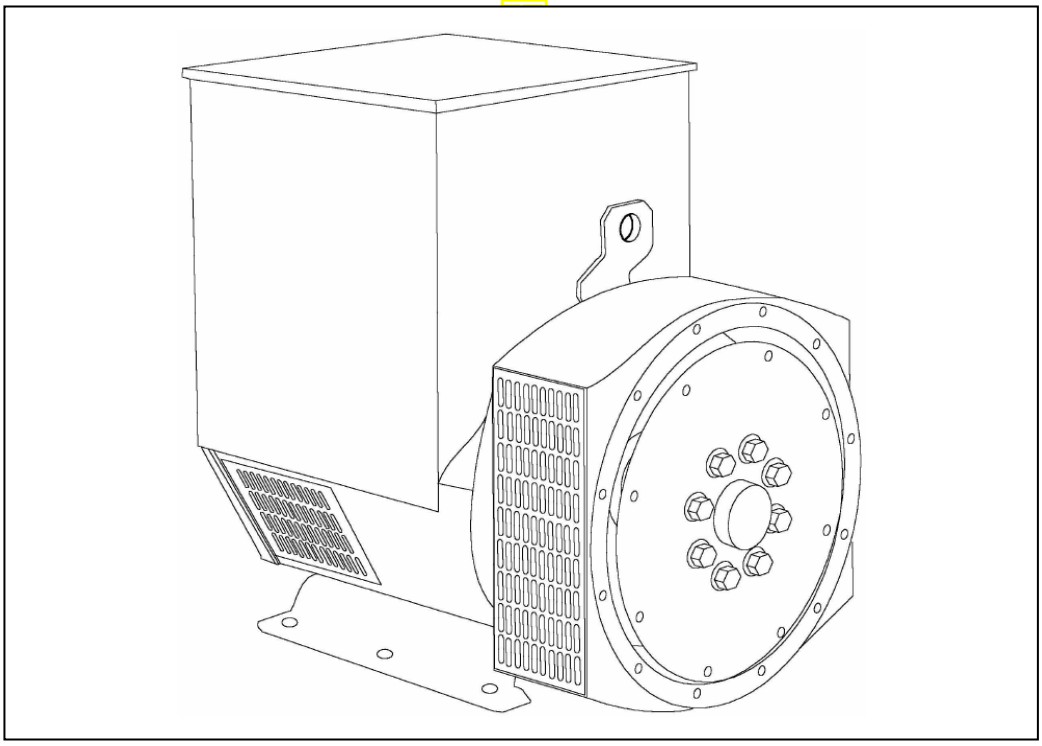
STAMFORD®

UCI224D - Winding 311

Technical Data Sheet



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3% for every 5°C by which the operational ambient temperature exceeds 40°C.
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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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.129 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	0.64 Ohms at 22°C						
EXCITER STATOR RESISTANCE	21 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.071 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. 6312-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6309-2RS (ISO)						
	1 BEARING				2 BEARING		
WEIGHT COMP. GENERATOR	285 kg				290 kg		
WEIGHT WOUND STATOR	86 kg				86 kg		
WEIGHT WOUND ROTOR	86.28 kg				77.9 kg		
WR² INERTIA	0.4216 kgm²				0.4198 kgm²		
SHIPPING WEIGHTS in a crate	307 kg				311 kg		
PACKING CRATE SIZE	97 x 57 x 96(cm)				97 x 57 x 96(cm)		
	50 Hz				60 Hz		
TELEPHONE INTERFERENCE	THF<2%				TIF<50		
COOLING AIR	0.216 m³/sec 458 cfm				0.281 m³/sec 595 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	50	50	50	37.5	60	62.5	62.5	65
Xd DIR. AXIS SYNCHRONOUS	2.33	2.10	1.95	1.30	3.04	2.83	2.59	2.47
X'd DIR. AXIS TRANSIENT	0.18	0.16	0.15	0.10	0.22	0.20	0.19	0.18
X"d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.07	0.15	0.14	0.13	0.12
Xq QUAD. AXIS REACTANCE	1.07	0.97	0.90	0.60	1.40	1.30	1.19	1.14
X"q QUAD. AXIS SUBTRANSIENT	0.14	0.13	0.12	0.08	0.14	0.13	0.12	0.11
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.04	0.09	0.08	0.08	0.07
X_2 NEGATIVE SEQUENCE	0.13	0.12	0.11	0.07	0.14	0.13	0.12	0.11
X_0 ZERO SEQUENCE	0.08	0.08	0.07	0.05	0.09	0.08	0.08	0.07
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED						
T'd TRANSIENT TIME CONST.	0.027 s						
T"d SUB-TRANSTIME CONST.	0.006 s						
T'do O.C. FIELD TIME CONST.	0.7 s						
Ta ARMATURE TIME CONST.	0.0055 s						
SHORT CIRCUIT RATIO	1/Xd						

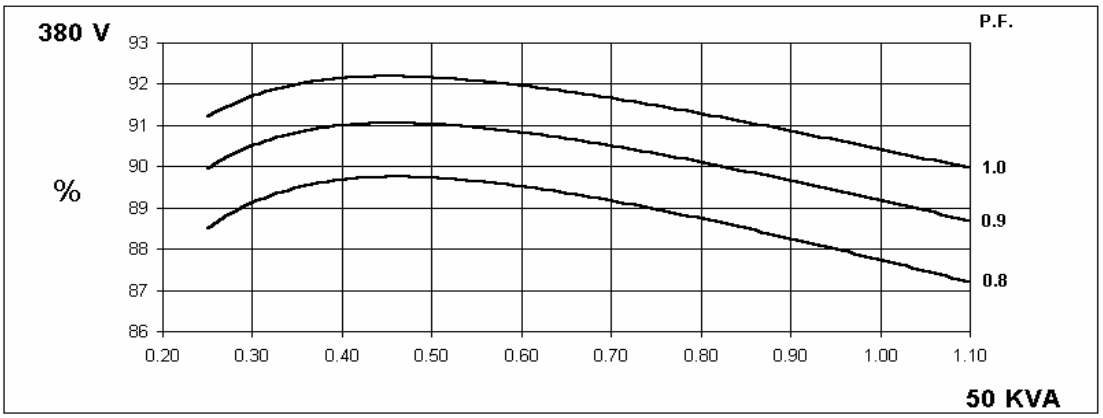
50 Hz

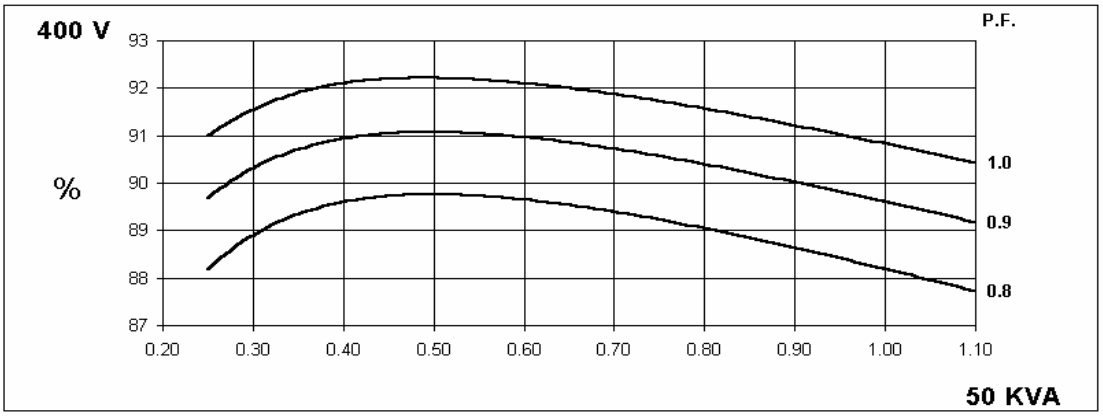
UCI224D

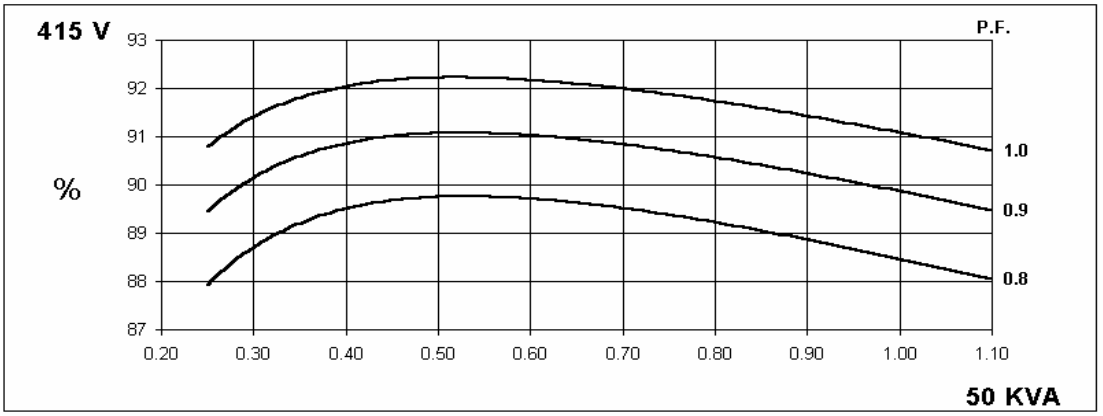
Winding 311

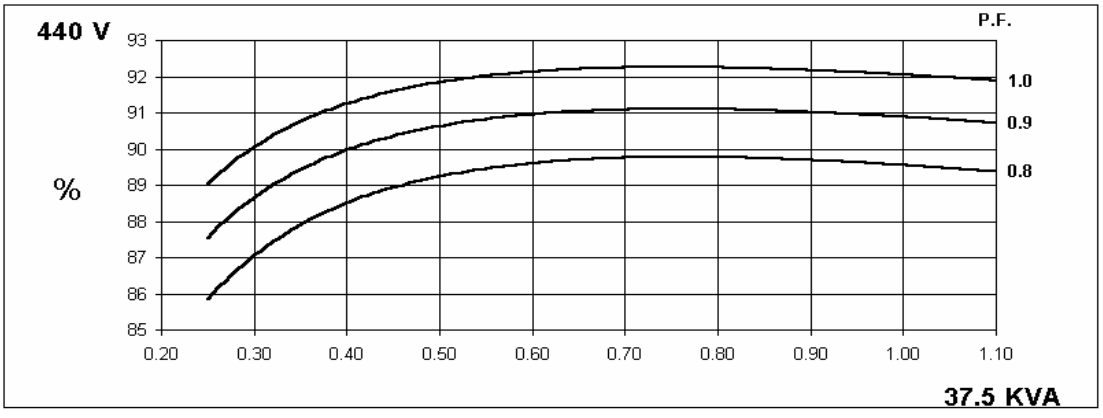
STAMFORD

THREE PHASE EFFICIENCY CURVES







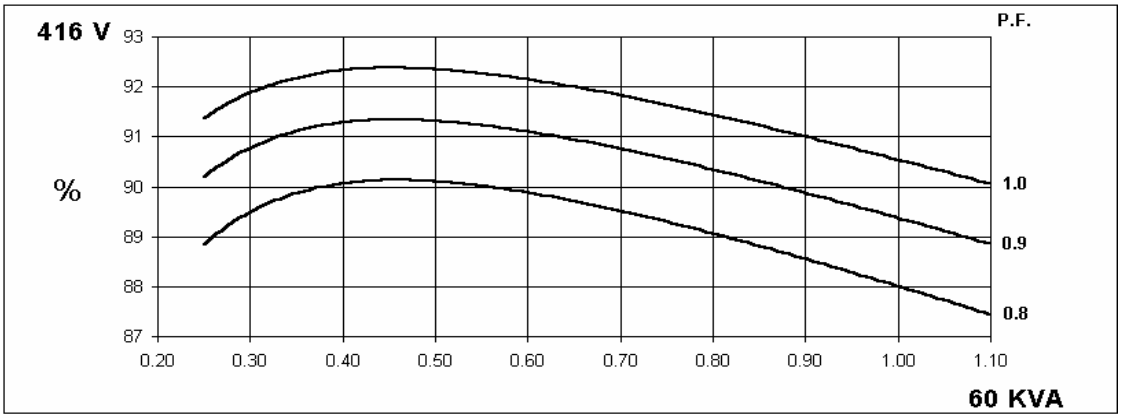


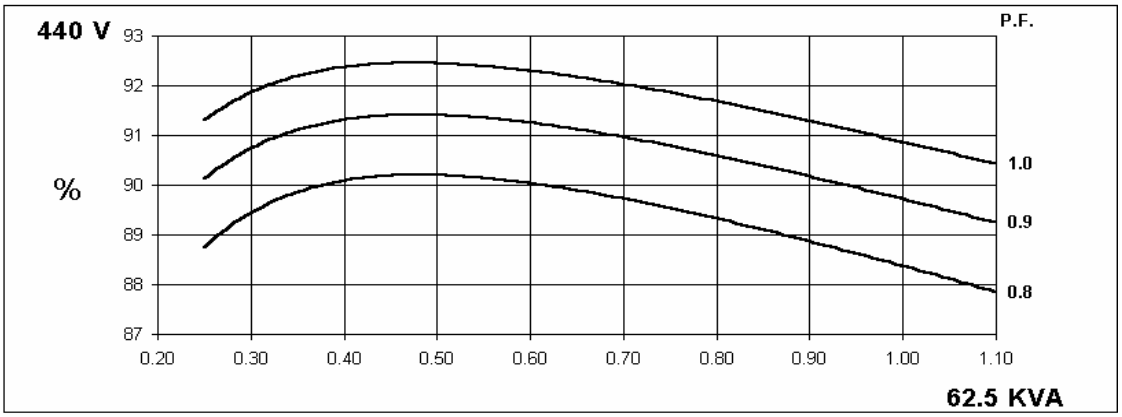
60 Hz

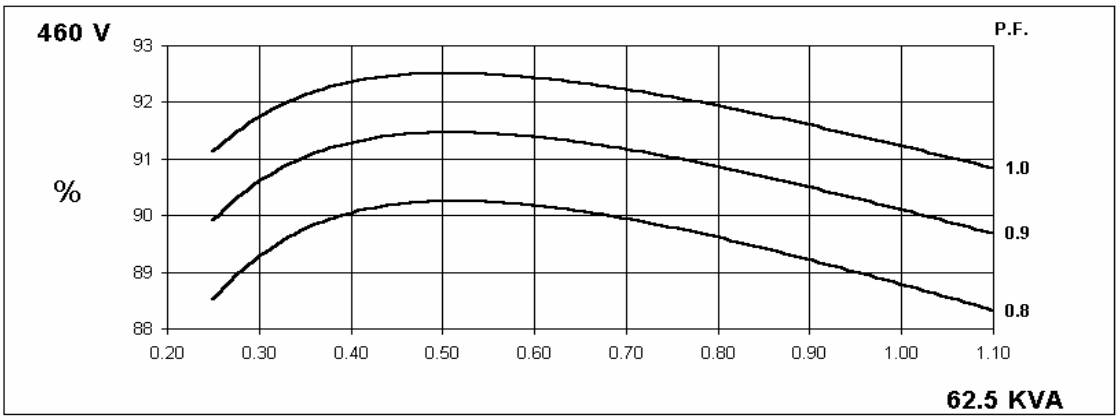
UCI224D

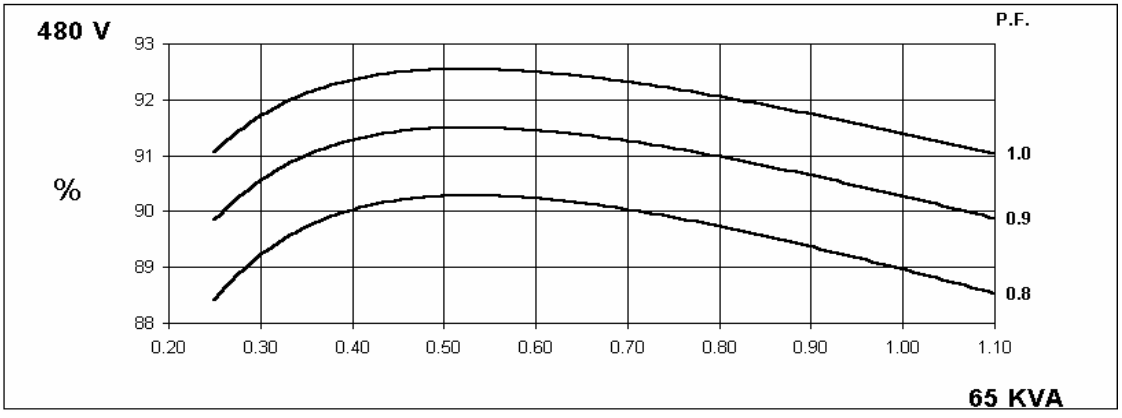
Winding 311

THREE PHASE EFFICIENCY CURVES









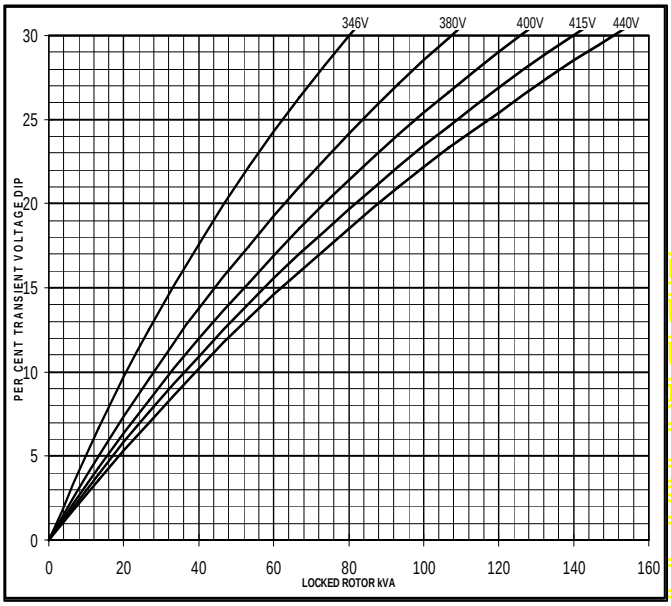
UCI224D

Winding 311

Locked Rotor Motor Starting Curve

50 Hz

MX



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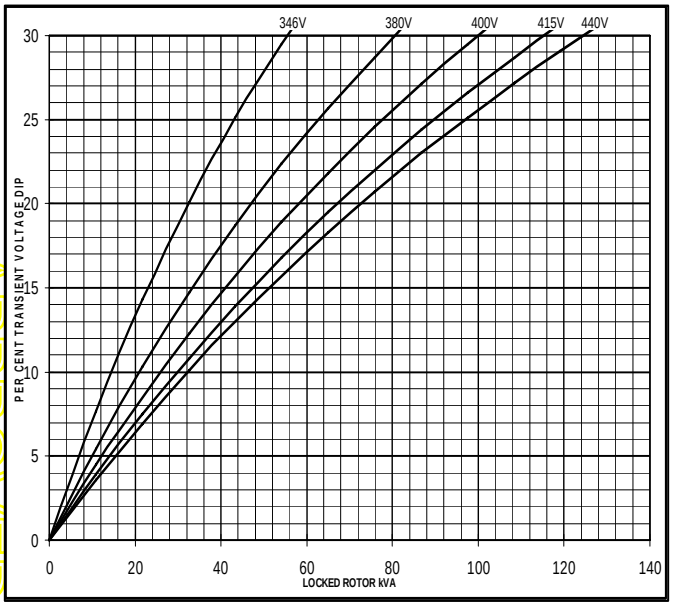
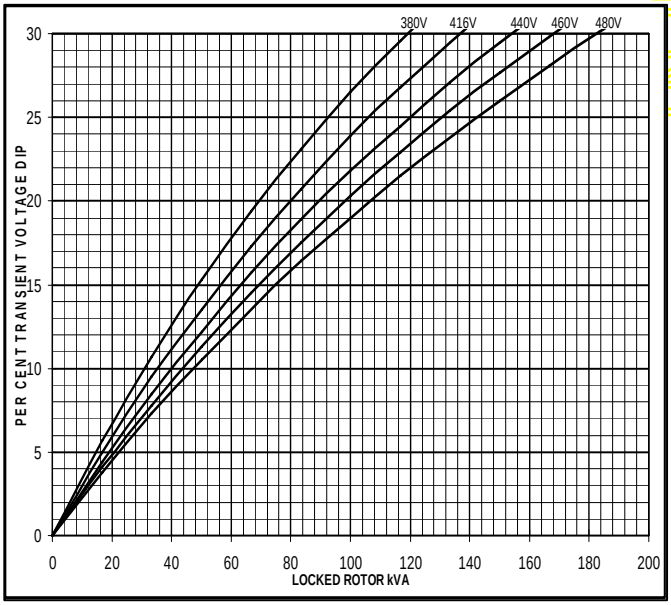


60 Hz

MX



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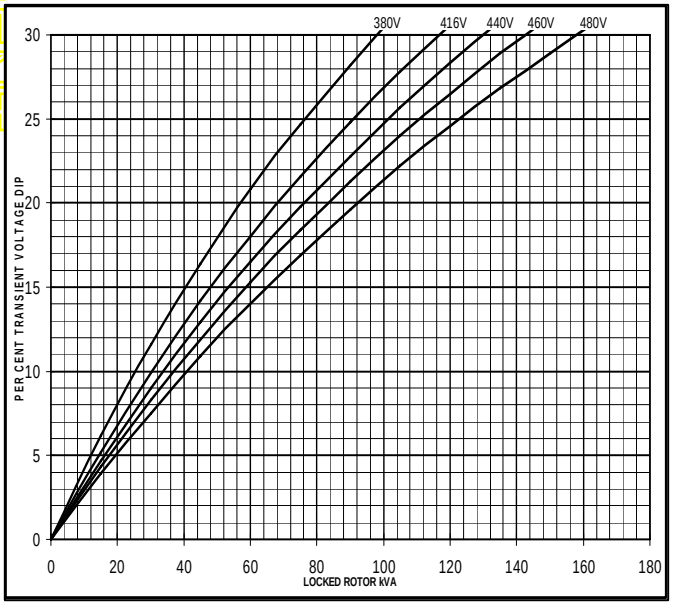
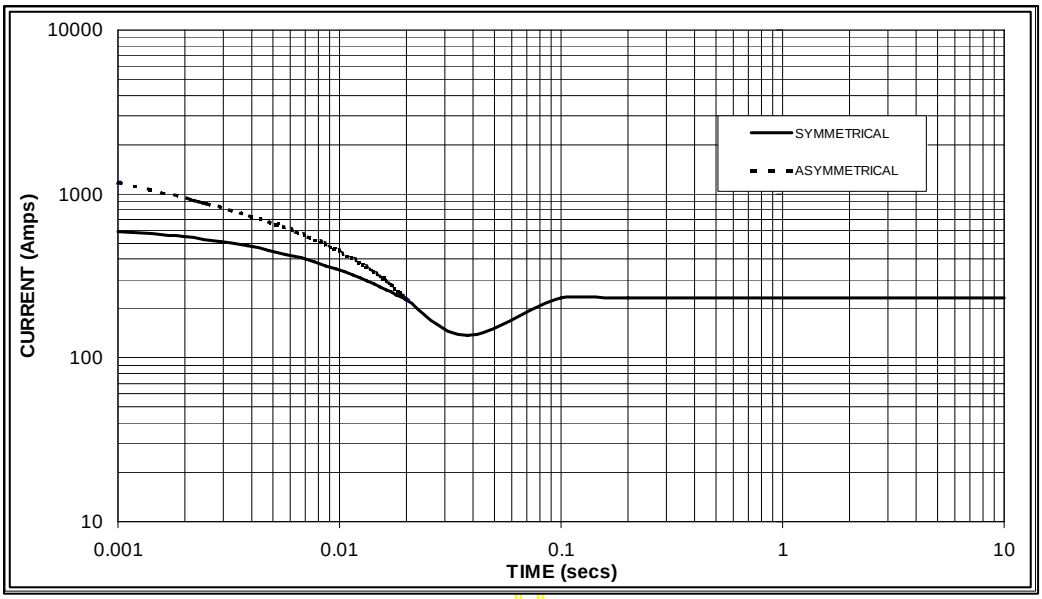


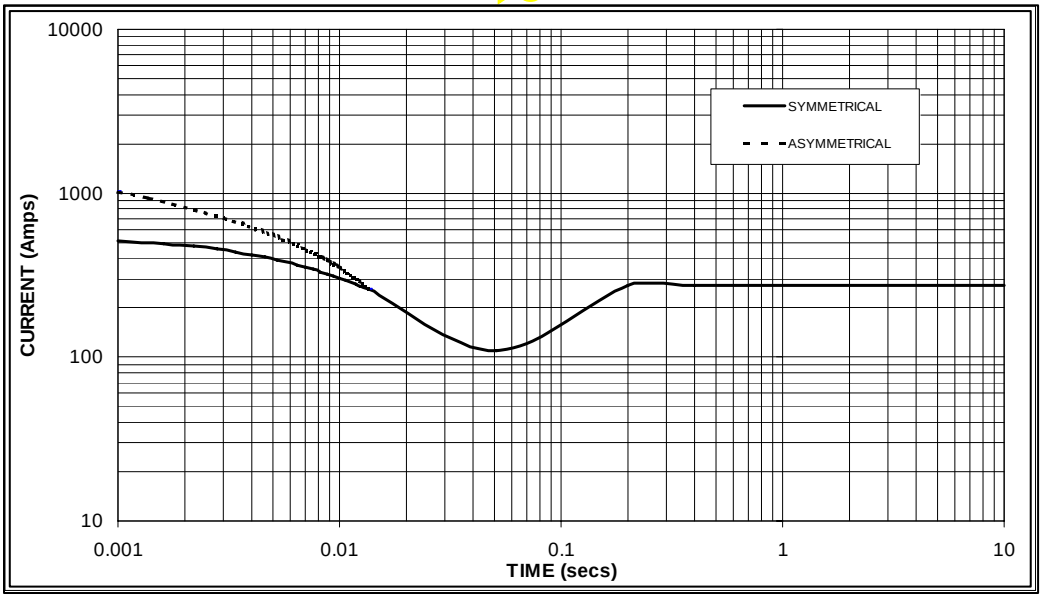
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 230 Amps

60 Hz



Sustained Short Circuit = 275 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 other connection 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

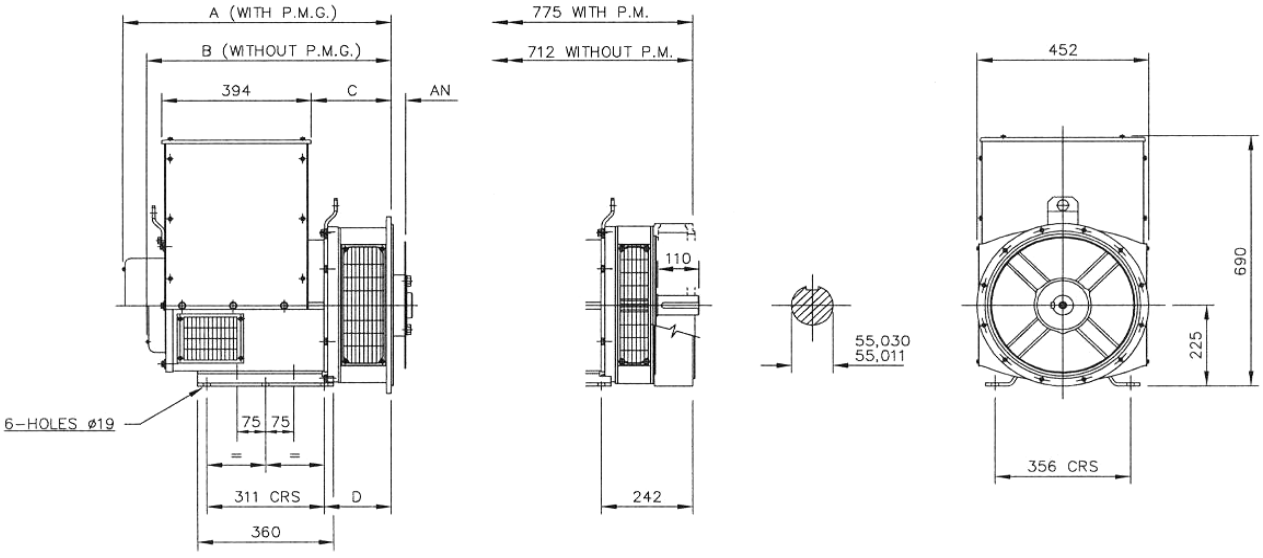
UCI224D

Winding 311 / 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			
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	45.0	45.0	45.0	33.6	50.0	50.0	50.0	37.5	53.0	53.0	53.0	39.1	55.0	55.0	55.0	41.2
	kW	36.0	36.0	36.0	26.9	40.0	40.0	40.0	30.0	42.4	42.4	42.4	31.3	44.0	44.0	44.0	33.0
	Efficiency (%)	88.3	88.6	88.9	89.7	87.7	88.2	88.5	89.6	87.4	87.9	88.2	89.5	87.2	87.7	88.0	89.4
	kW Input	40.8	40.6	40.5	30.0	45.6	45.4	45.2	33.5	48.5	48.2	48.1	35.0	50.5	50.2	50.0	36.9
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	52.5	55.0	56.0	58.0	60.0	62.5	62.5	65.0	62.5	65.0	65.0	68.8	65.0	66.3	66.3	71.3
	kW	42.0	44.0	44.8	46.4	48.0	50.0	50.0	52.0	50.0	52.0	52.0	55.0	52.0	53.0	53.0	57.0
	Efficiency (%)	88.7	89.0	89.2	89.4	88.0	88.4	88.8	89.0	87.8	88.2	88.6	88.7	87.5	88.1	88.5	88.5
	kW Input	47.4	49.4	50.2	51.9	54.5	56.6	56.3	58.4	56.9	59.0	58.7	62.1	59.4	60.2	59.9	64.5

DIMENSIONS



SINGLE BEARING MACHINES ONLY						
ADAPTOR	A	B	C	D	COUPLING DISCS	AN
SAE 1	724,3	661,3	224,3	191,3	SAE 8	61,90
SAE 2	710	647	210	177	SAE 10	53,98
SAE 3	710	647	210	177	SAE 11,5	39,68
SAE 4	710	647	210	177	SAE 14	25,40

APPROVED DOCUMENT

STAMFORD

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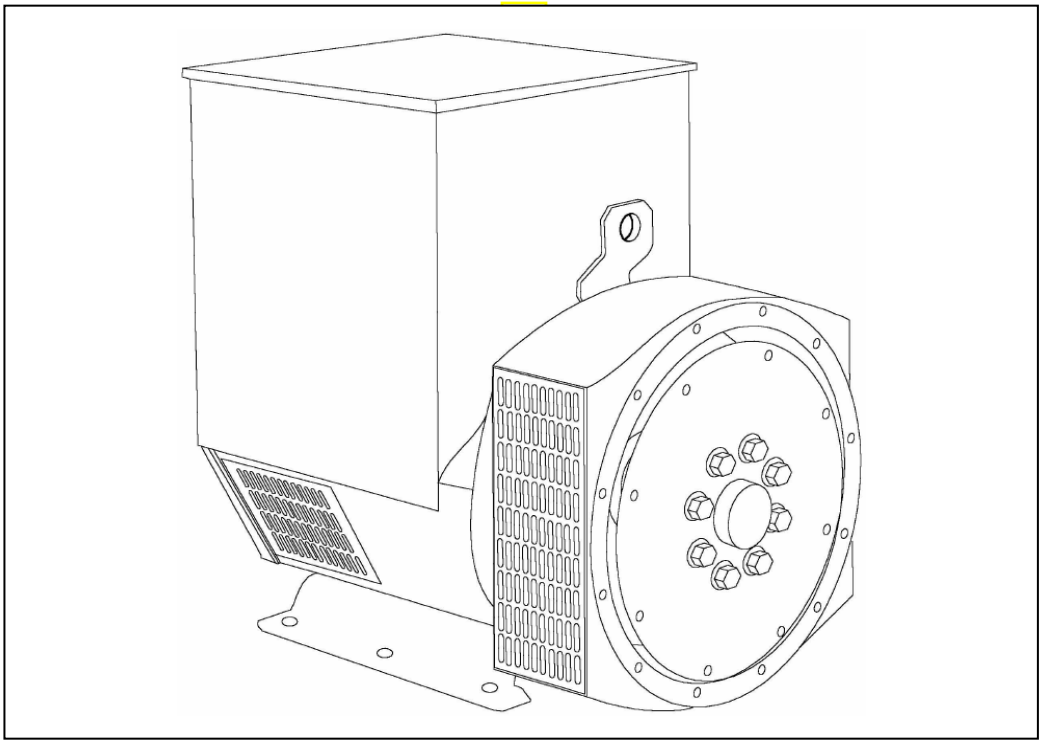
STAMFORD®

UCI224E - 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

SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

AS440 AVR

With this self-excited system the main stator provides power via the 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.

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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.101 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	0.69 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.078 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. 6312-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6309-2RS (ISO)						
	1 BEARING				2 BEARING		
WEIGHT COMP. GENERATOR	311 kg				330 kg		
WEIGHT WOUND STATOR	103 kg				103 kg		
WEIGHT WOUND ROTOR	95.89 kg				87.52 kg		
WR² INERTIA	0.4999 kgm²				0.4682 kgm²		
SHIPPING WEIGHTS in a crate	334 kg				351 kg		
PACKING CRATE SIZE	105 x 57 x 96(cm)				105 x 57 x 96(cm)		
	50 Hz				60 Hz		
TELEPHONE INTERFERENCE	THF<2%				TIF<50		
COOLING AIR	0.216 m³/sec 458 cfm				0.281 m³/sec 595 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	60	60	60	45	67.5	70	72.5	75
Xd DIR. AXIS SYNCHRONOUS	2.48	2.24	2.08	1.39	3.00	2.78	2.64	2.50
X'd DIR. AXIS TRANSIENT	0.19	0.17	0.16	0.11	0.22	0.20	0.19	0.18
X"d DIR. AXIS SUBTRANSIENT	0.13	0.12	0.11	0.07	0.15	0.14	0.13	0.13
Xq QUAD. AXIS REACTANCE	1.13	1.02	0.95	0.63	1.38	1.28	1.21	1.15
X"q QUAD. AXIS SUBTRANSIENT	0.14	0.13	0.12	0.08	0.14	0.13	0.12	0.12
X_L LEAKAGE REACTANCE	0.08	0.08	0.07	0.05	0.09	0.08	0.08	0.08
X_2 NEGATIVE SEQUENCE	0.13	0.12	0.11	0.07	0.14	0.13	0.12	0.12
X_0 ZERO SEQUENCE	0.11	0.10	0.09	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.	0.028 s						
T"d SUB-TRANSTIME CONST.	0.007 s						
T'do O.C. FIELD TIME CONST.	0.7 s						
Ta ARMATURE TIME CONST.	0.006 s						
SHORT CIRCUIT RATIO	1/Xd						

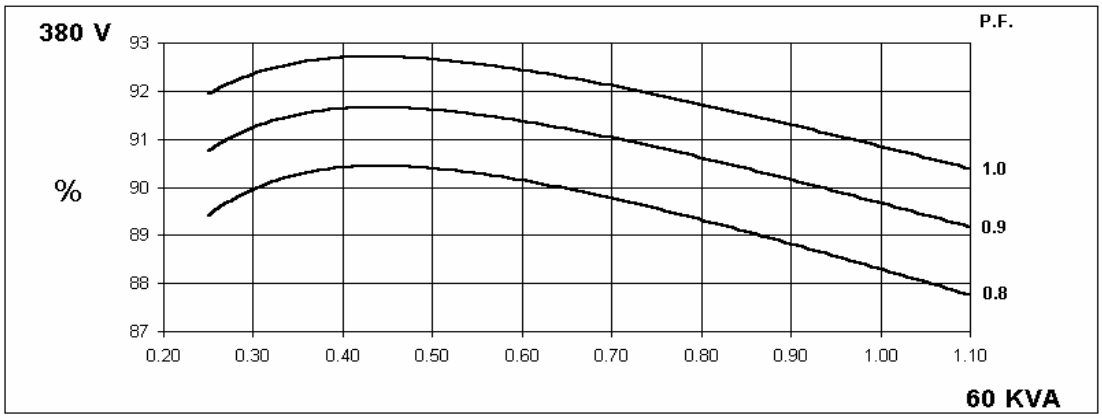
50 Hz

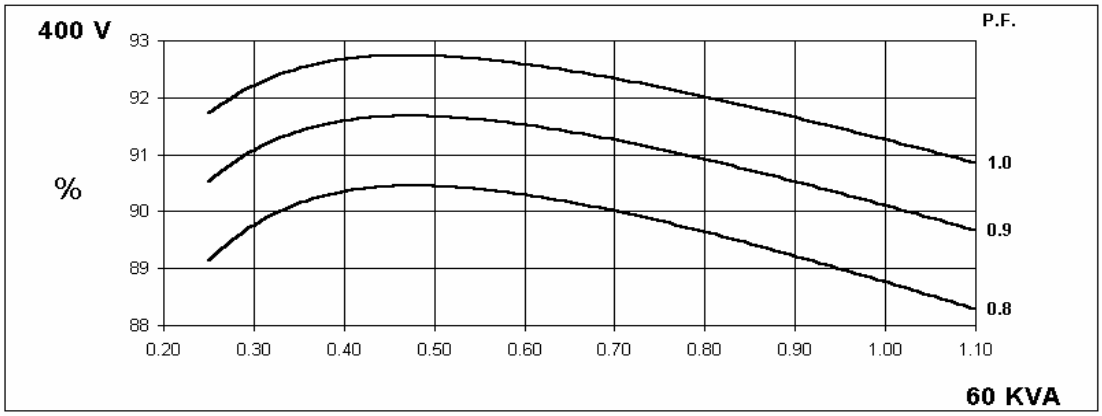
UCI224E

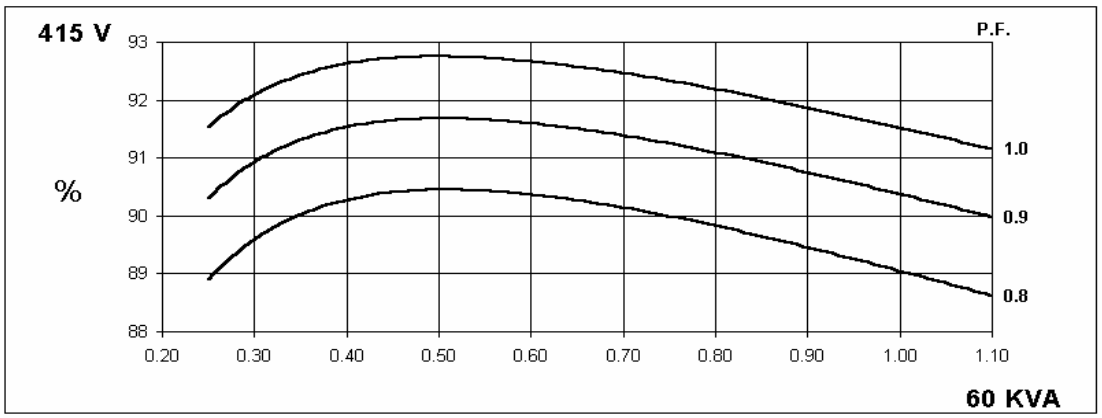
Winding 311

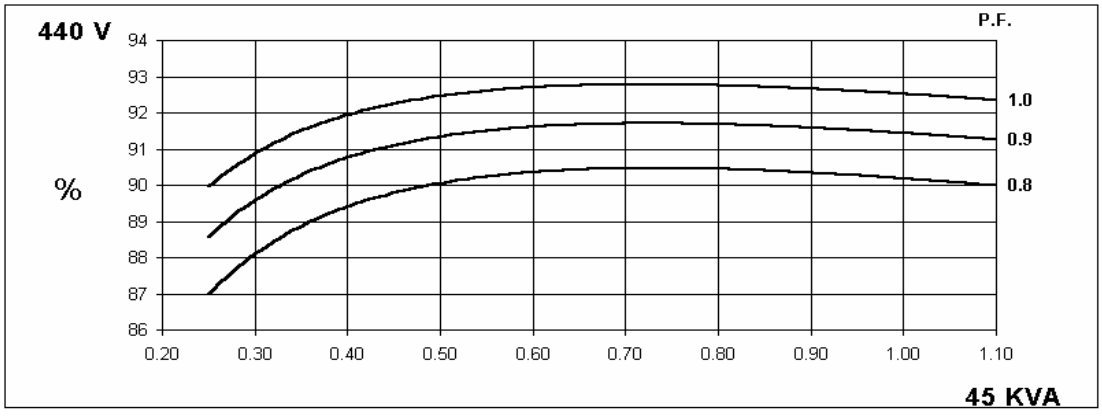
STAMFORD

THREE PHASE EFFICIENCY CURVES









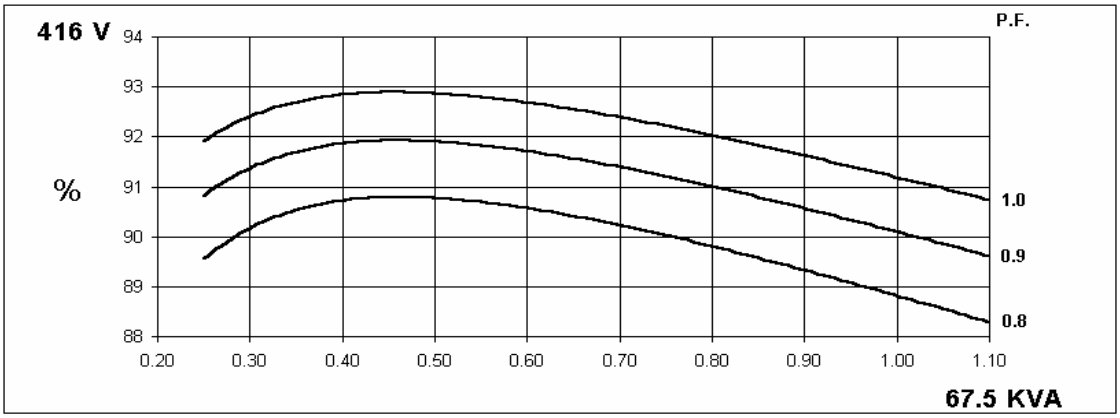
60 Hz

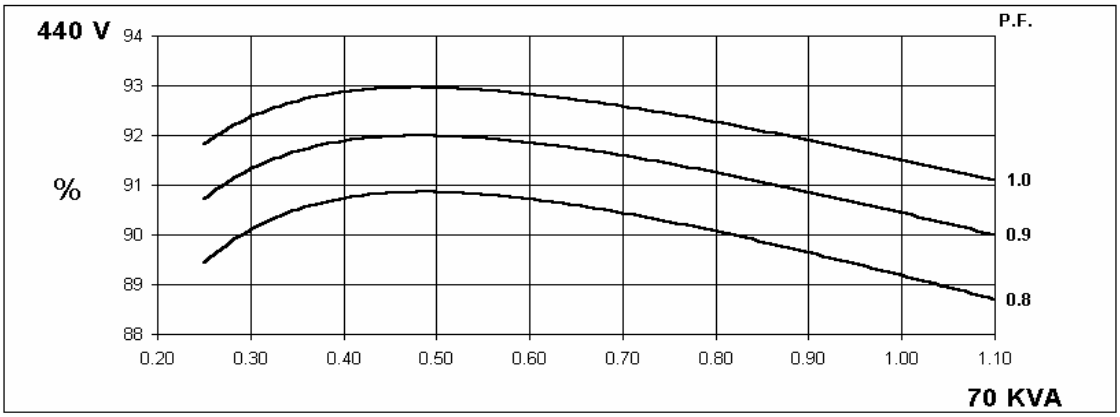
UCI224E

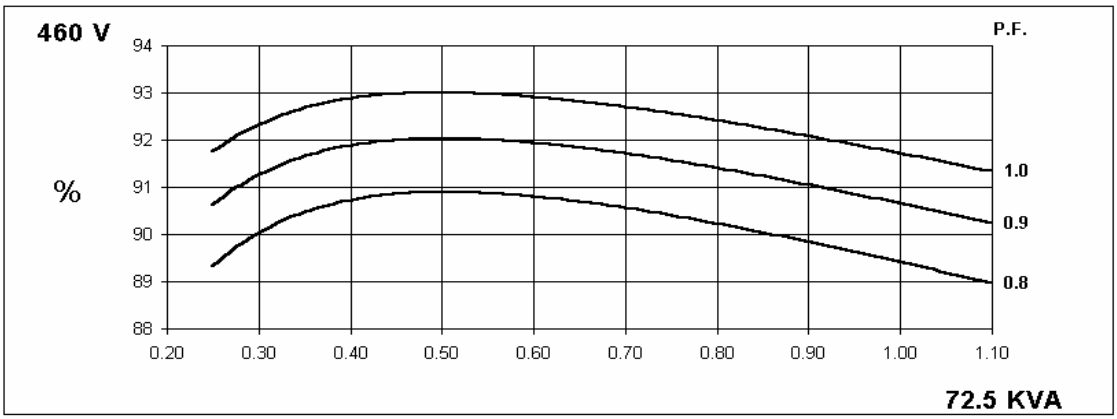
Winding 311

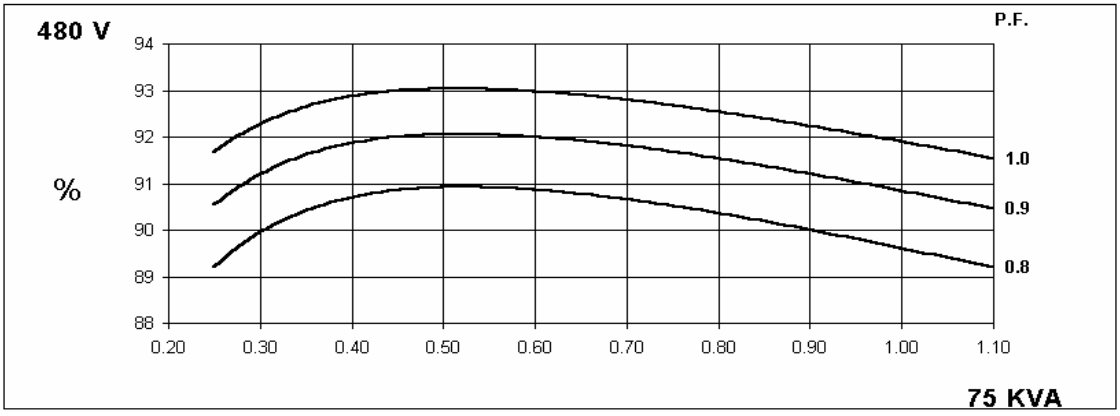
STAMFORD

THREE PHASE EFFICIENCY CURVES









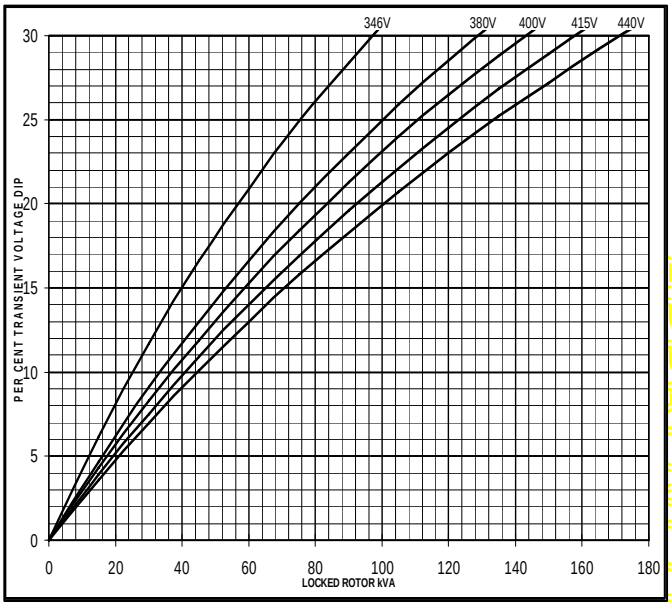
UCI224E

Winding 311

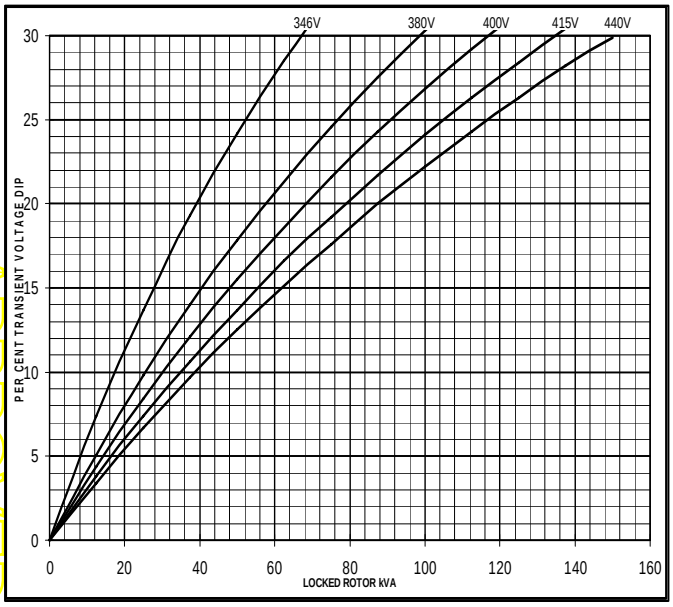
Locked Rotor Motor Starting Curve

50 Hz

MX

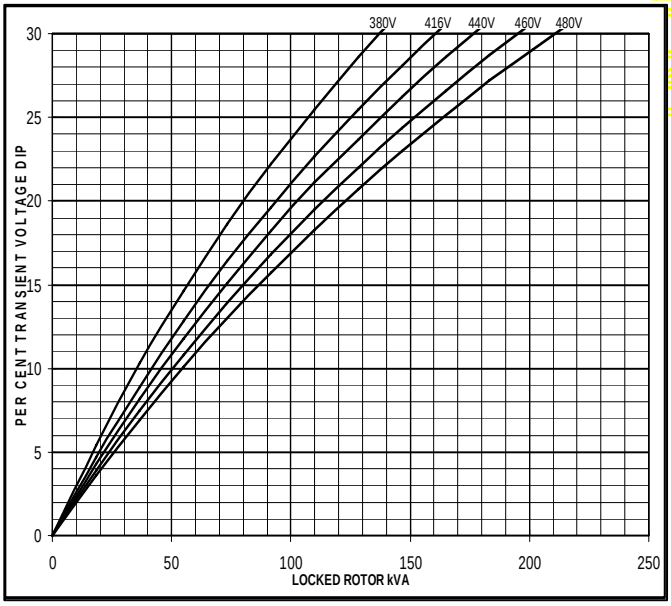


SX



60 Hz

MX



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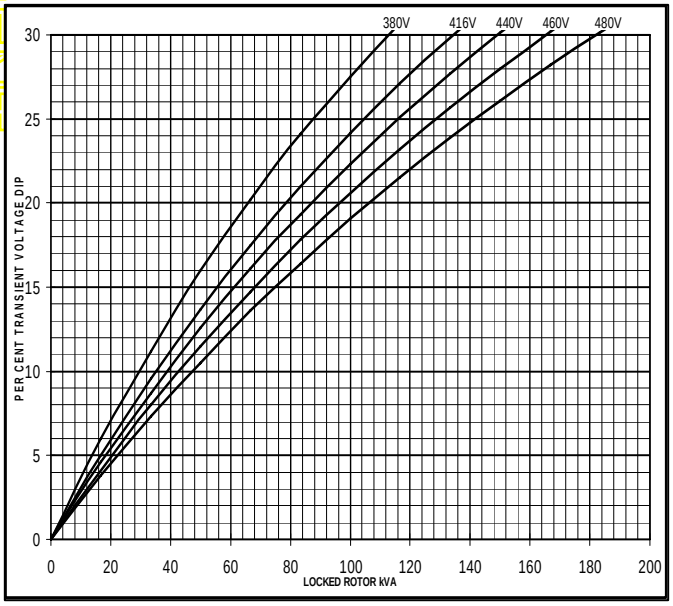
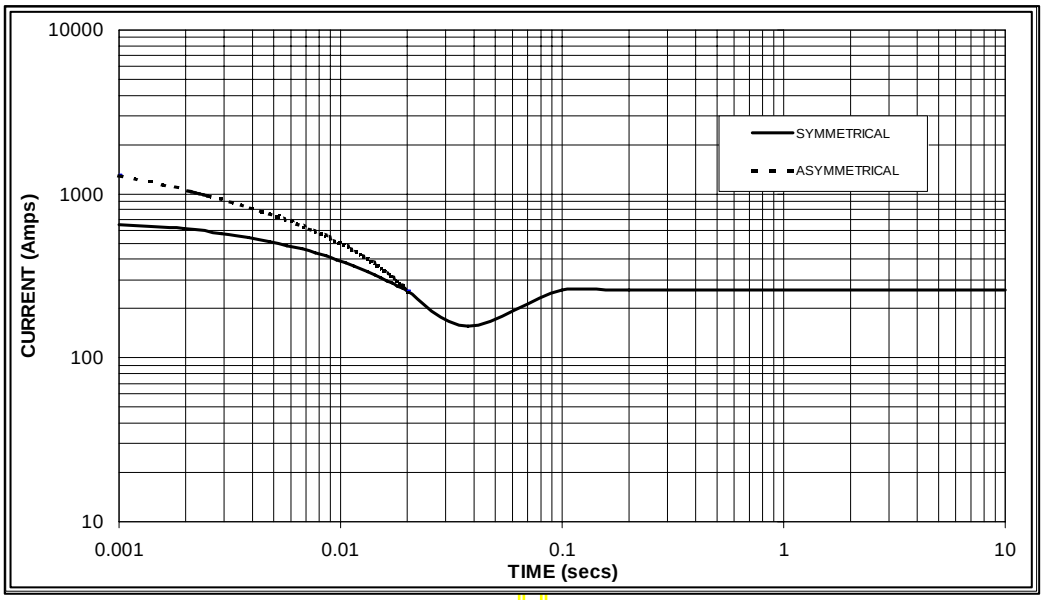


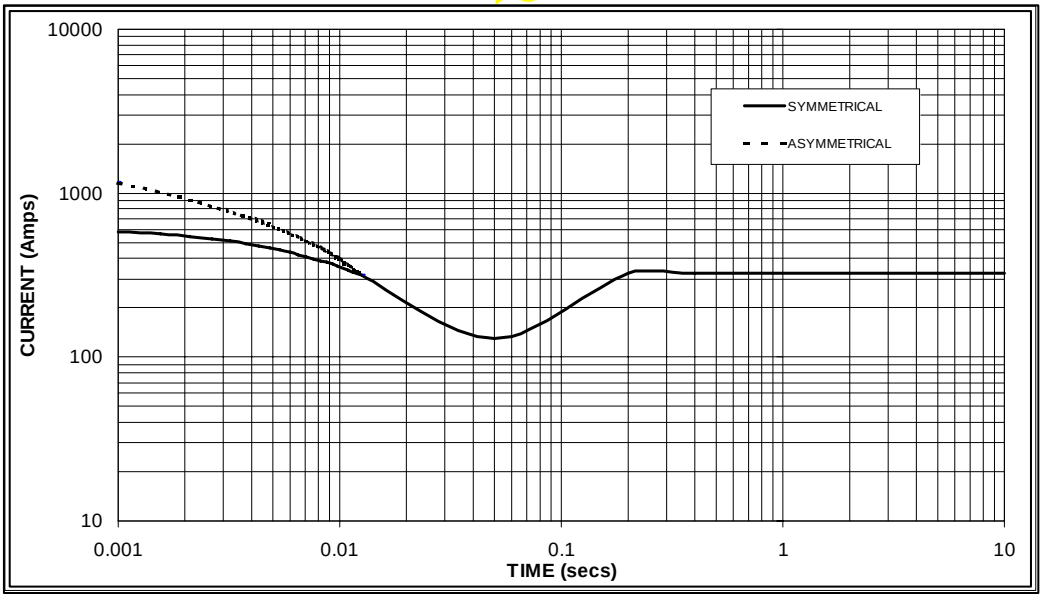
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 260 Amps

60 Hz



Sustained Short Circuit = 325 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 other connection 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

UCI224E

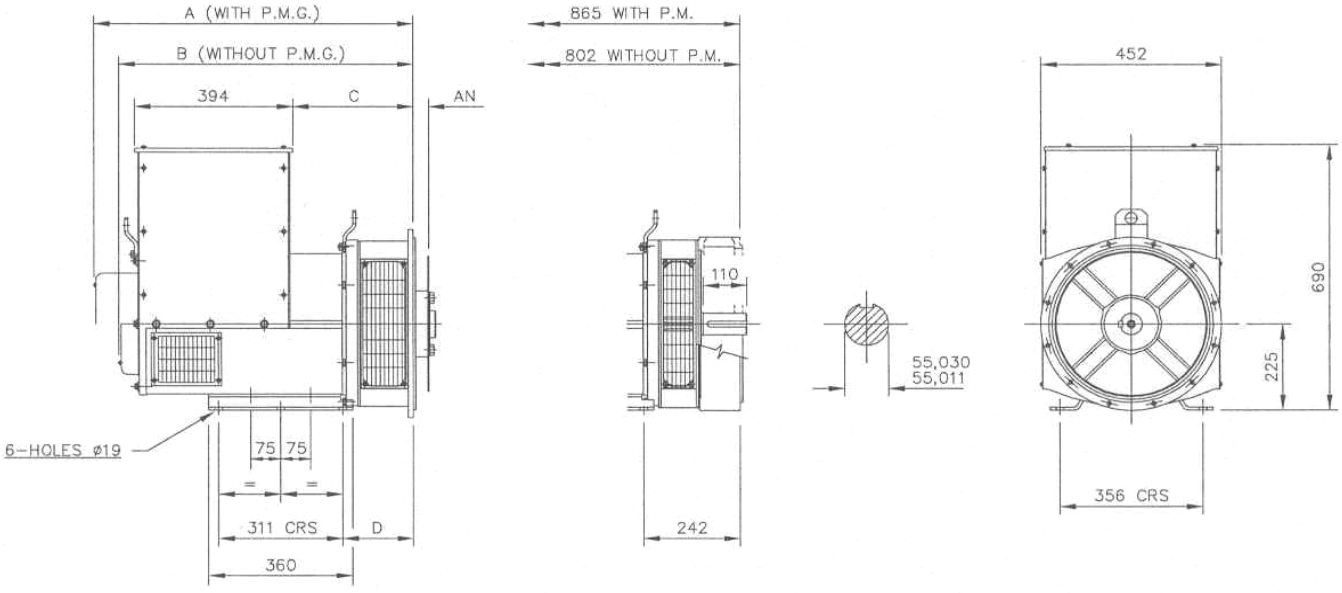
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	53.0	53.0	53.0	40.3	60.0	60.0	60.0	45.0	61.0	61.0	61.0	45.8	63.0	63.0	63.0	47.3
	kW	42.4	42.4	42.4	32.2	48.0	48.0	48.0	36.0	48.8	48.8	48.8	36.6	50.4	50.4	50.4	37.8
	Efficiency (%)	88.9	89.3	89.5	90.3	88.3	88.8	89.1	90.2	88.2	88.7	89.0	90.2	88.0	88.5	88.8	90.1
	kW Input	47.7	47.5	47.4	35.7	54.4	54.1	53.9	39.9	55.3	55.0	54.8	40.6	57.3	56.9	56.8	42.0

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	62.5	65.0	65.0	68.0	67.5	70.0	72.5	75.0	70.0	73.8	73.8	78.8	72.5	75.0	75.0	80.0
	kW	50.0	52.0	52.0	54.4	54.0	56.0	58.0	60.0	56.0	59.0	59.0	63.0	58.0	60.0	60.0	64.0
	Efficiency (%)	89.2	89.5	89.9	90.0	88.8	89.2	89.4	89.6	88.6	88.9	89.3	89.4	88.4	88.8	89.3	89.3
	kW Input	56.1	58.1	57.8	60.4	60.8	62.8	64.9	67.0	63.2	66.4	66.1	70.5	65.6	67.6	67.2	71.7

DIMENSIONS



SINGLE BEARING MACHINES ONLY						
ADAPTOR	A	B	C	D	COUPLING DISCS	AN
SAE 1	814,3	751,3	314,3	191,3	SAE 8	61,90
SAE 2	800	737	300	177	SAE 10	53,98
SAE 3	800	737	300	177	SAE 11,5	39,68
SAE 4	800	737	300	177	SAE 14	25,40

APPROVED DOCUMENT

STAMFORD

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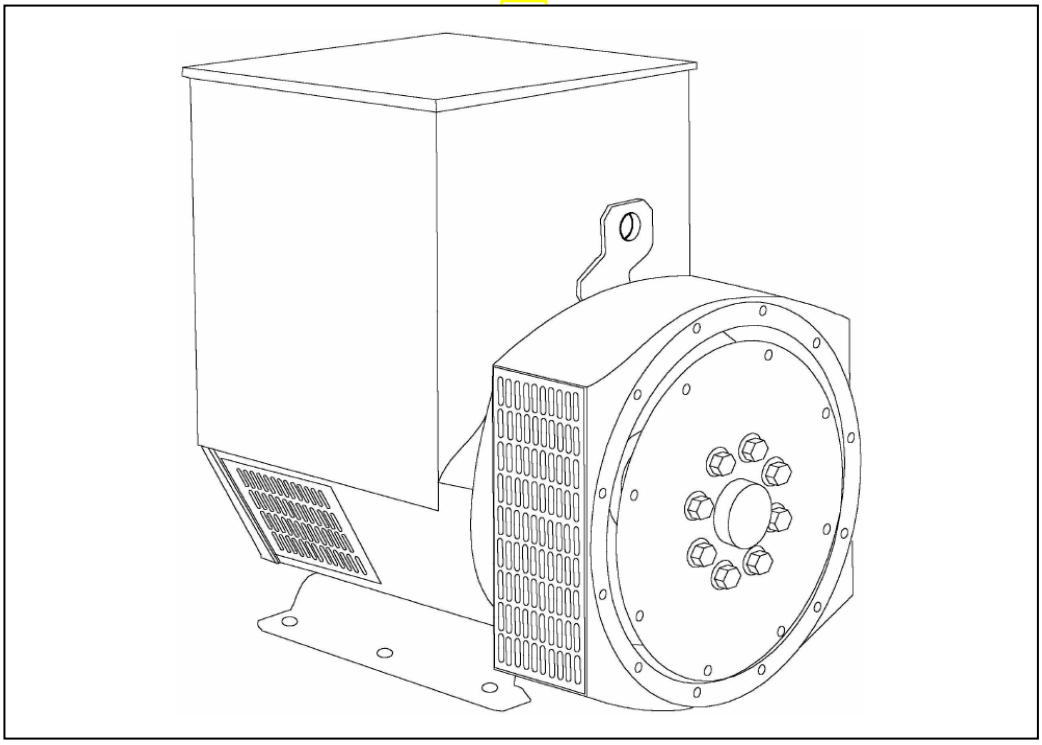
STAMFORD®

UCI224F - 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

SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

AS440 AVR

With this self-excited system the main stator provides power via the 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.

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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.065 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	0.83 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.078 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. 6312-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6309-2RS (ISO)						
	1 BEARING				2 BEARING		
WEIGHT COMP. GENERATOR	337 kg				350 kg		
WEIGHT WOUND STATOR	120 kg				120 kg		
WEIGHT WOUND ROTOR	110.69 kg				102.32 kg		
WR² INERTIA	0.6071 kgm²				0.5754 kgm²		
SHIPPING WEIGHTS in a crate	360 kg				371 kg		
PACKING CRATE SIZE	105 x 57 x 96(cm)				105 x 57 x 96(cm)		
	50 Hz				60 Hz		
TELEPHONE INTERFERENCE	THF<2%				TIF<50		
COOLING AIR	0.216 m³/sec 458 cfm				0.281 m³/sec 595 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	72.5	72.5	72.5	55	83.8	87.5	87.5	93.8
Xd DIR. AXIS SYNCHRONOUS	2.29	2.07	1.92	1.30	2.52	2.35	2.15	2.12
X'd DIR. AXIS TRANSIENT	0.18	0.16	0.15	0.10	0.21	0.20	0.18	0.18
X"d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.07	0.14	0.13	0.12	0.12
Xq QUAD. AXIS REACTANCE	1.05	0.95	0.88	0.59	1.16	1.08	0.99	0.98
X"q QUAD. AXIS SUBTRANSIENT	0.16	0.14	0.13	0.09	0.13	0.12	0.11	0.11
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.04	0.08	0.07	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.14	0.13	0.12	0.08	0.13	0.12	0.11	0.11
X_0 ZERO SEQUENCE	0.11	0.10	0.09	0.06	0.10	0.09	0.09	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED						
T'd TRANSIENT TIME CONST.	0.03 s						
T"d SUB-TRANSTIME CONST.	0.008 s						
T'do O.C. FIELD TIME CONST.	0.75 s						
Ta ARMATURE TIME CONST.	0.0065 s						
SHORT CIRCUIT RATIO	1/Xd						

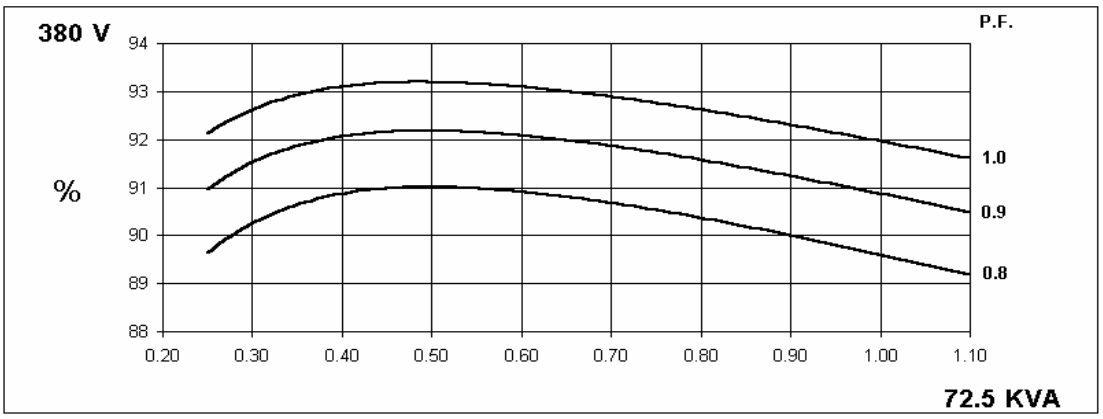
50 Hz

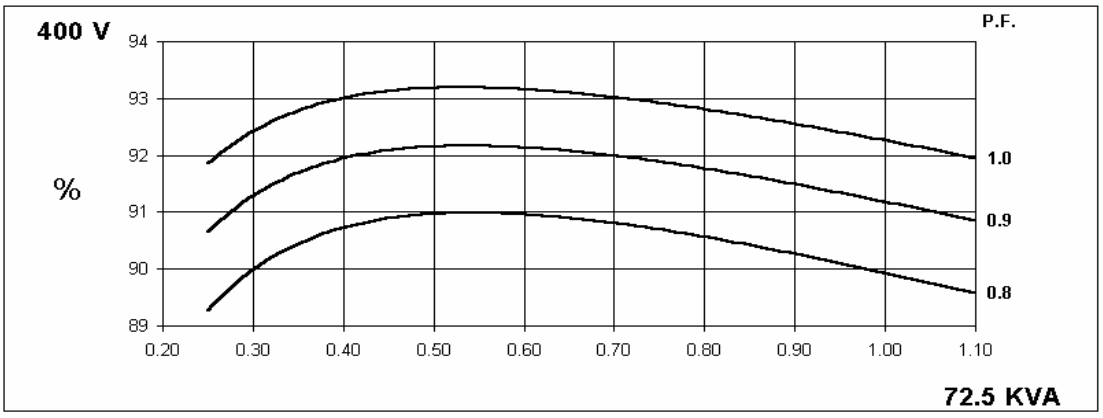
UCI224F

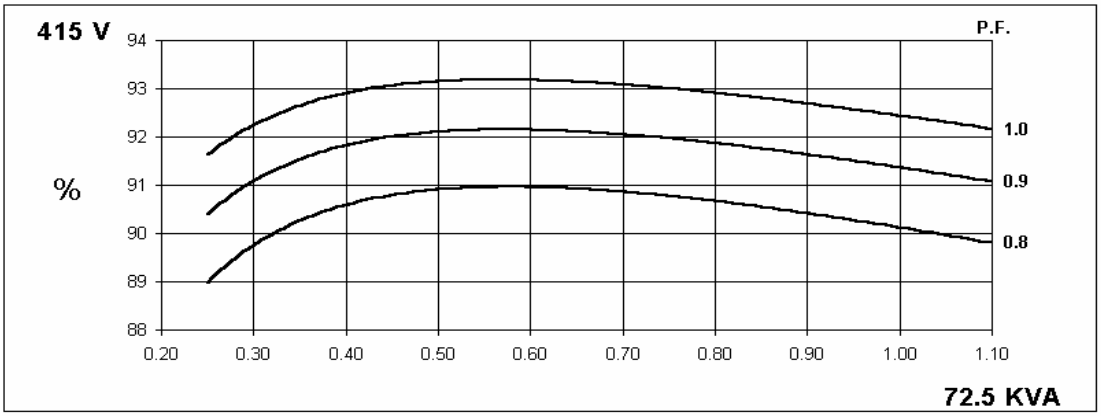
Winding 311

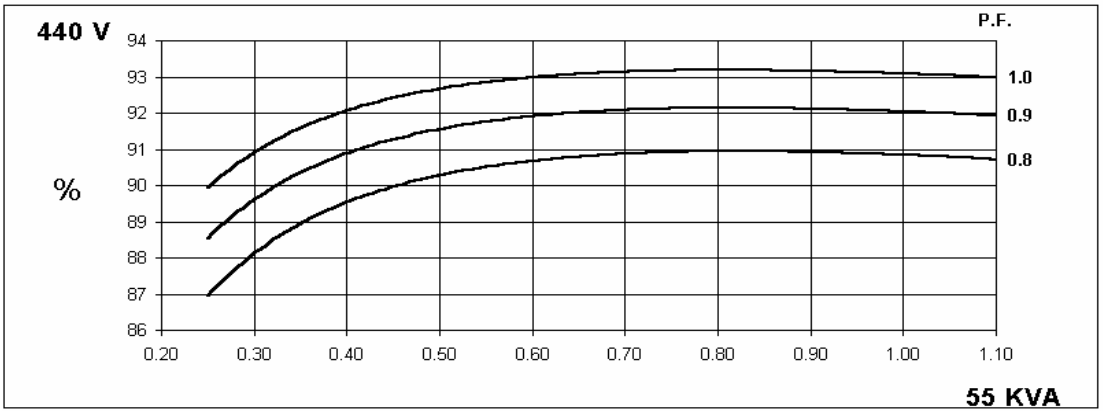
STAMFORD

THREE PHASE EFFICIENCY CURVES







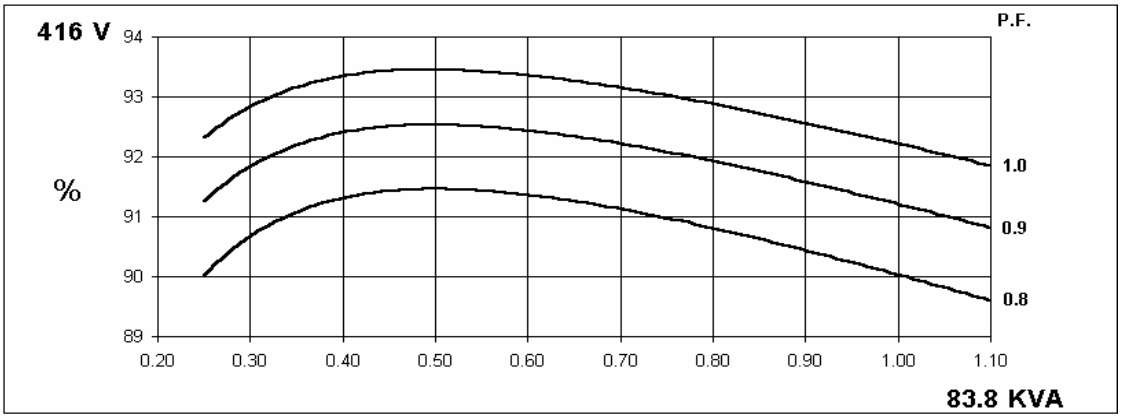


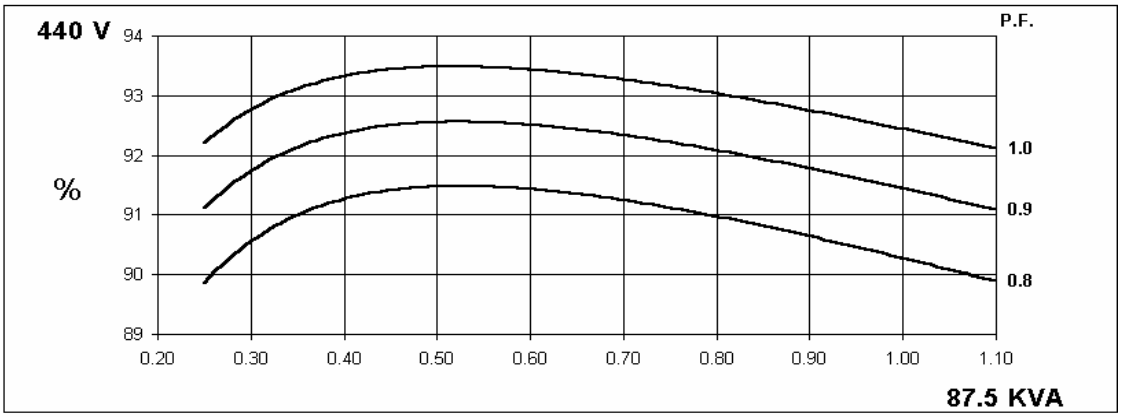
60 Hz

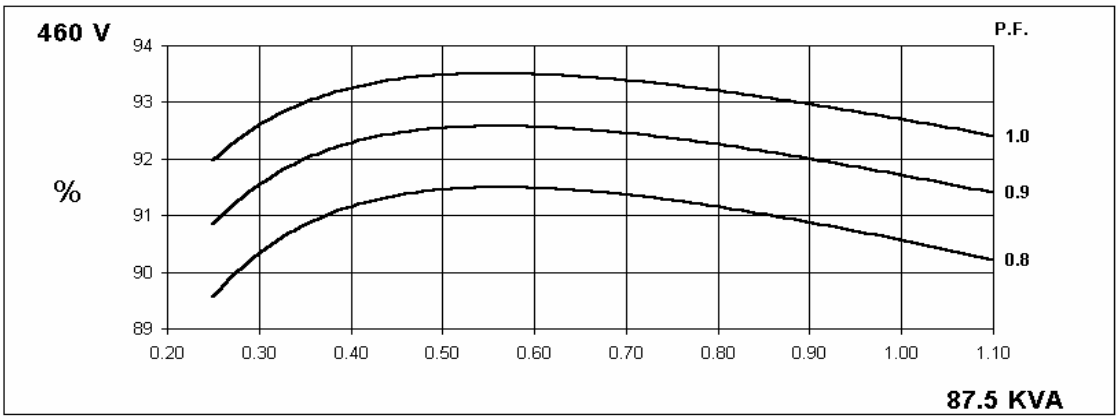
UCI224F

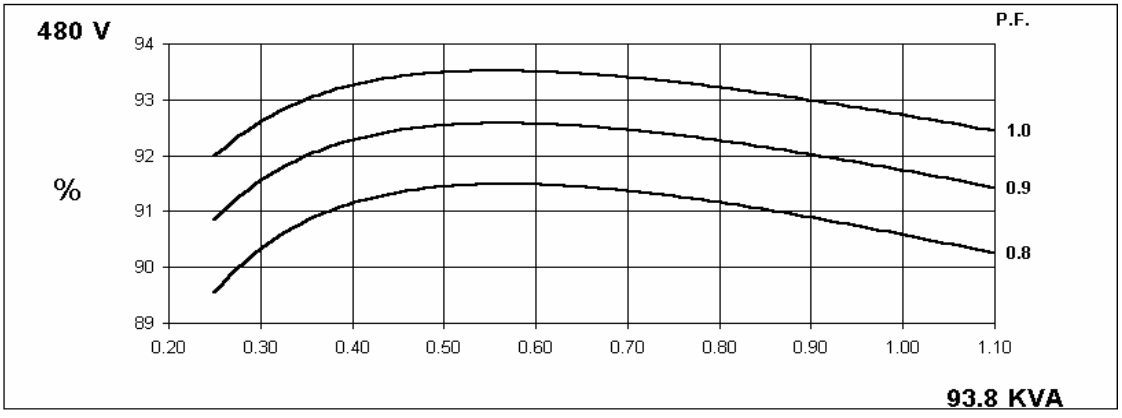
Winding 311

THREE PHASE EFFICIENCY CURVES









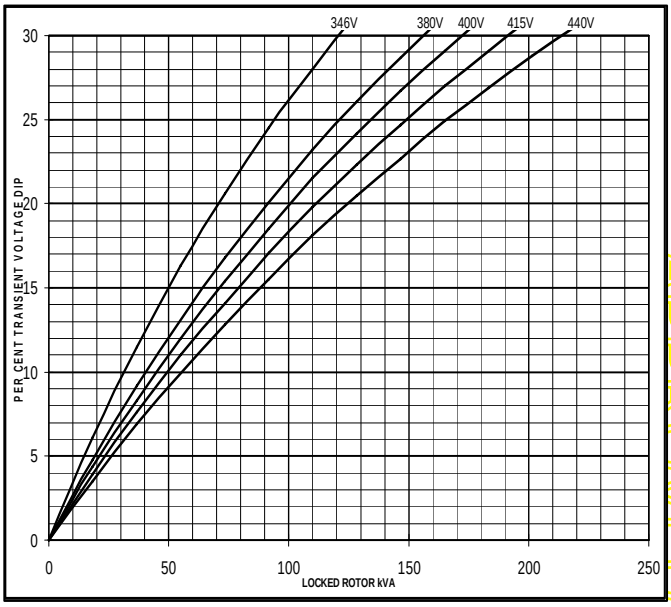
UCI224F

Winding 311

Locked Rotor Motor Starting Curve

50 Hz

MX



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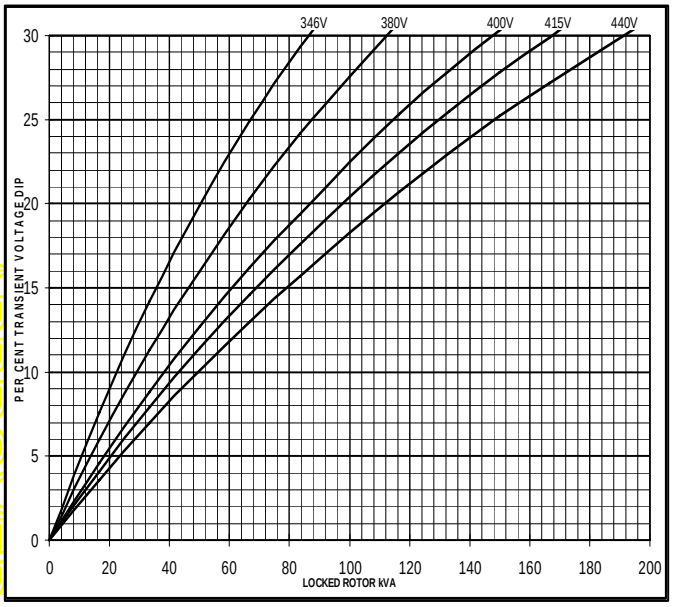
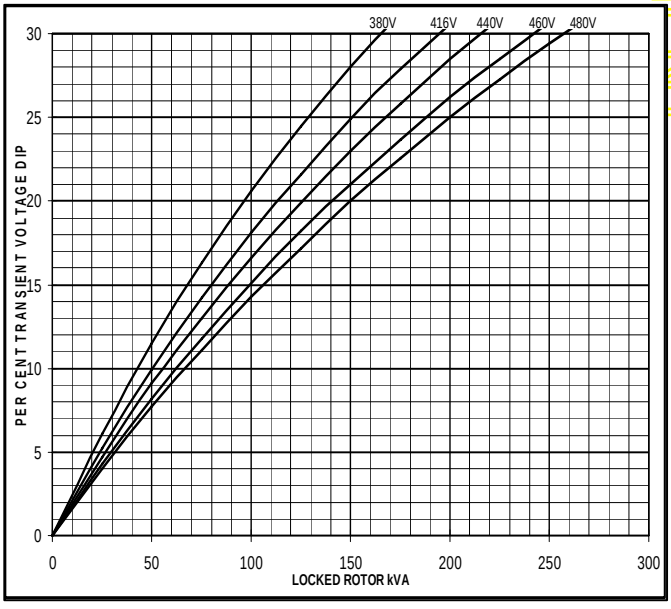


60 Hz

MX



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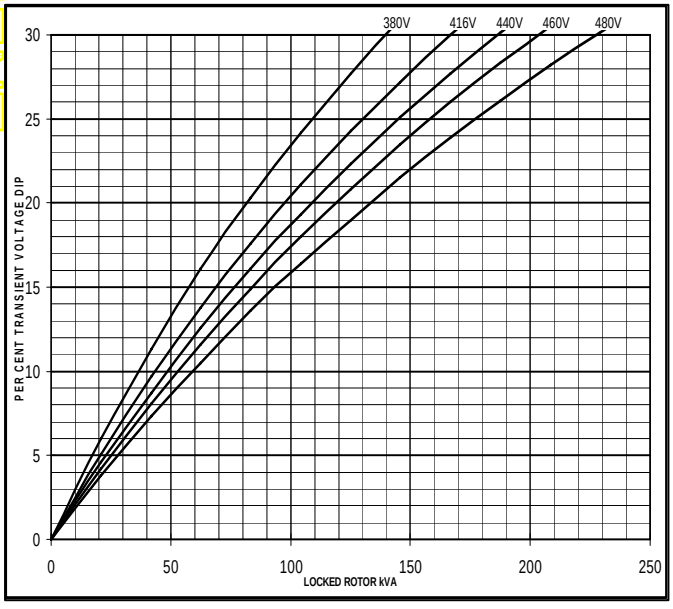
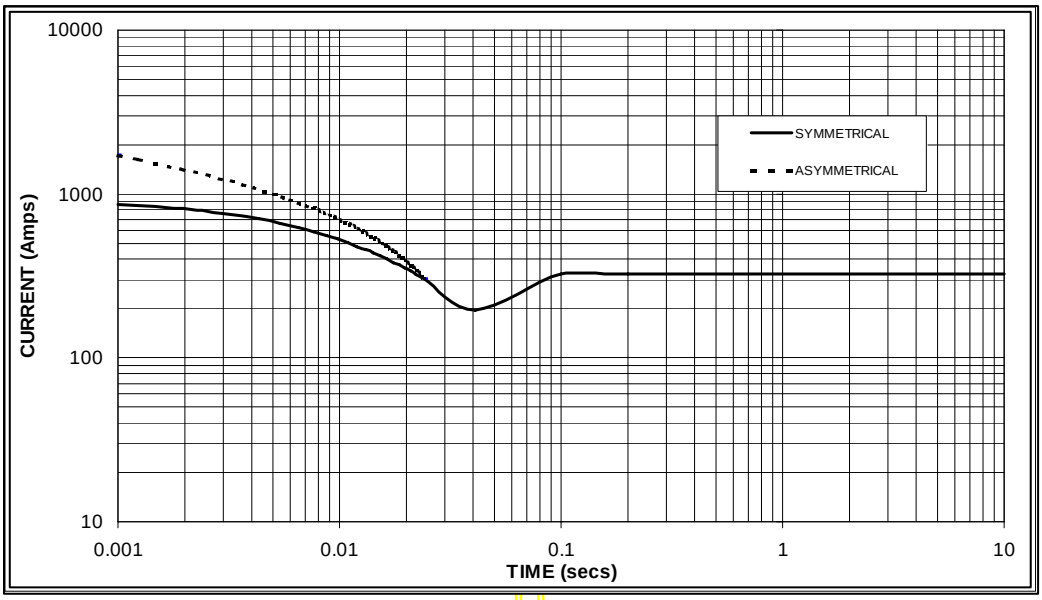


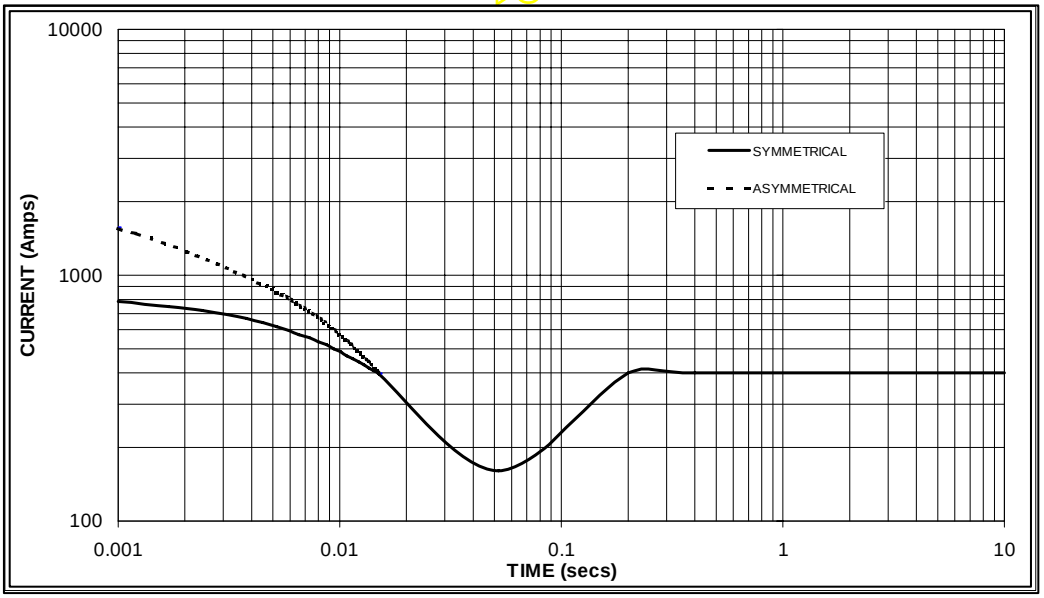
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 325 Amps

60 Hz



Sustained Short Circuit = 400 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 other connection 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

UCI224F

Winding 311 / 0.8 Power Factor

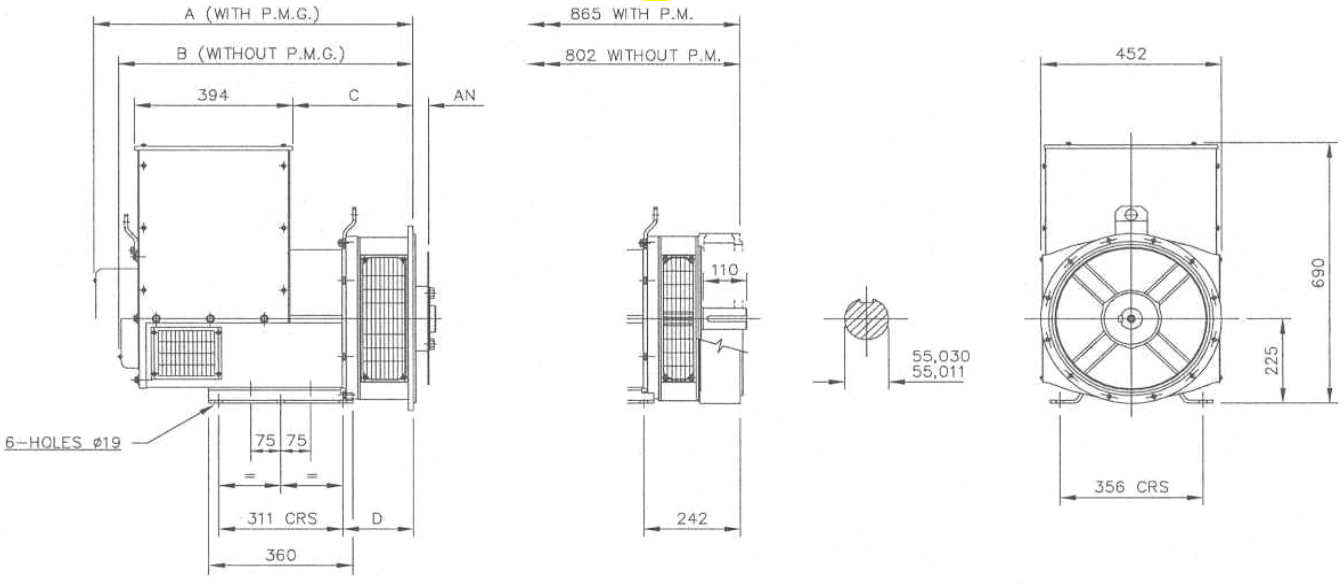
STAMFORD

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	65.0	65.0	65.0	48.7	72.5	72.5	72.5	55.0	77.0	77.0	77.0	58.0	80.0	80.0	80.0	60.5
	kW	52.0	52.0	52.0	39.0	58.0	58.0	58.0	44.0	61.6	61.6	61.6	46.4	64.0	64.0	64.0	48.4
	Efficiency (%)	90.0	90.3	90.4	90.9	89.6	89.9	90.1	90.8	89.4	89.7	89.9	90.8	89.2	89.6	89.8	90.7
	kW Input	57.8	57.6	57.5	42.9	64.7	64.5	64.4	48.5	68.9	68.7	68.5	51.1	71.7	71.4	71.3	53.4

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	75.0	78.1	78.1	82.5	83.8	87.5	87.5	93.8	88.8	92.5	92.5	100.0	91.9	95.0	95.0	102.5
	kW	60.0	62.5	62.5	66.0	67.0	70.0	70.0	75.0	71.0	74.0	74.0	80.0	73.5	76.0	76.0	82.0
	Efficiency (%)	90.5	90.7	90.9	91.0	90.0	90.3	90.6	90.6	89.8	90.1	90.4	90.4	89.6	89.9	90.3	90.3
	kW Input	66.3	68.9	68.7	72.5	74.5	77.5	77.3	82.8	79.1	82.1	81.9	88.5	82.1	84.5	84.2	90.8

DIMENSIONS



SINGLE BEARING MACHINES ONLY						
ADAPTOR	A	B	C	D	COUPLING DISCS	AN
SAE 1	814,3	751,3	314,3	191,3	SAE 8	61,90
SAE 2	800	737	300	177	SAE 10	53,98
SAE 3	800	737	300	177	SAE 11,5	39,68
SAE 4	800	737	300	177	SAE 14	25,40

APPROVED DOCUMENT

STAMFORD

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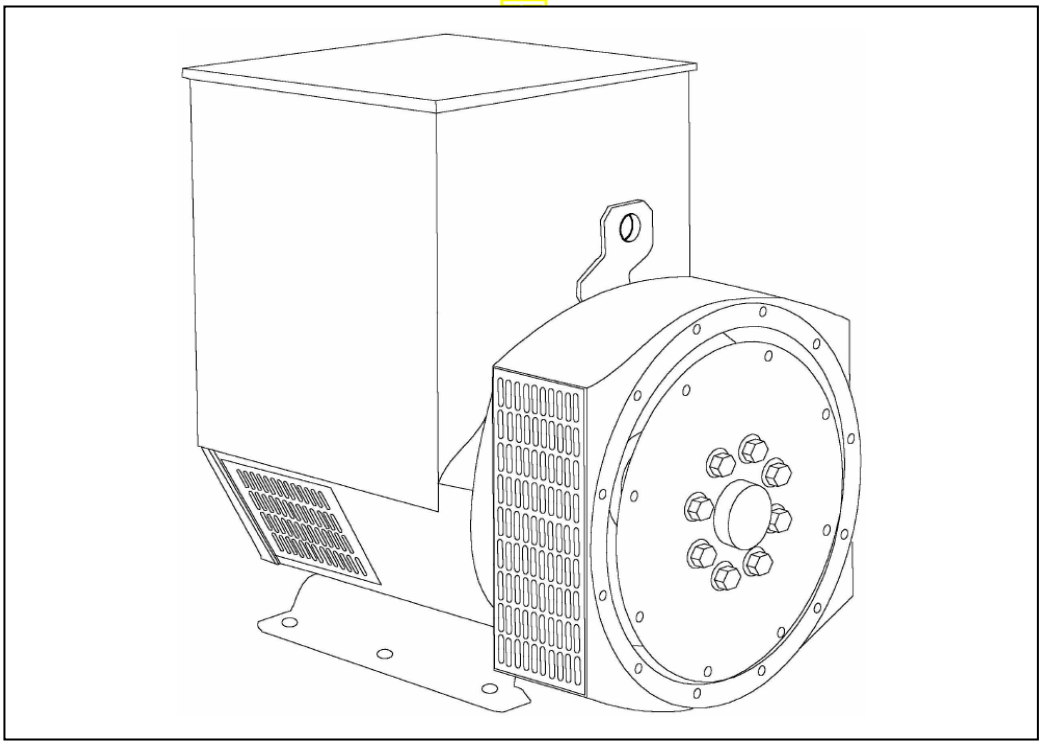
Lincolnshire, PE9 2NB
United Kingdom
Tel: +44 (0) 1780 484000
Fax: +44 (0) 1780 484100

www.cumminsgeneratortechnologies.com

STAMFORD®

UCI224G - Winding 311

Technical Data Sheet



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SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

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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.

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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.

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All generator rotors are dynamically balanced to better than BS6861:Part 1 Grade 2.5 for minimum vibration in operation.

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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.

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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.

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Front cover drawing typical of product range.

UCI224G

STAMFORD

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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.055 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	0.94 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.078 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. 6312-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6309-2RS (ISO)						
	1 BEARING				2 BEARING		
WEIGHT COMP. GENERATOR	383 kg				400 kg		
WEIGHT WOUND STATOR	139 kg				139 kg		
WEIGHT WOUND ROTOR	126.75 kg				118.38 kg		
WR² INERTIA	0.7136 kgm²				0.6818 kgm²		
SHIPPING WEIGHTS in a crate	404 kg				420 kg		
PACKING CRATE SIZE	105 x 57 x 96(cm)				105 x 57 x 96(cm)		
	50 Hz				60 Hz		
TELEPHONE INTERFERENCE	THF<2%				TIF<50		
COOLING AIR	0.216 m³/sec 458 cfm				0.281 m³/sec 595 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	85	85	85	75	93.8	97.5	100	103.8
Xd DIR. AXIS SYNCHRONOUS	2.43	2.20	2.04	1.60	2.66	2.47	2.32	2.21
X'd DIR. AXIS TRANSIENT	0.19	0.17	0.16	0.13	0.20	0.19	0.17	0.17
X"d DIR. AXIS SUBTRANSIENT	0.13	0.12	0.11	0.09	0.14	0.13	0.12	0.12
Xq QUAD. AXIS REACTANCE	1.12	1.01	0.94	0.74	1.22	1.13	1.06	1.01
X"q QUAD. AXIS SUBTRANSIENT	0.17	0.15	0.14	0.11	0.15	0.14	0.13	0.12
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.07	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	0.10	0.15	0.14	0.13	0.12
X_0 ZERO SEQUENCE	0.11	0.10	0.09	0.07	0.11	0.10	0.10	0.09
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED						
T'd TRANSIENT TIME CONST.	0.03 s						
T"d SUB-TRANSTIME CONST.	0.008 s						
T'do O.C. FIELD TIME CONST.	0.75 s						
Ta ARMATURE TIME CONST.	0.007 s						
SHORT CIRCUIT RATIO	1/Xd						

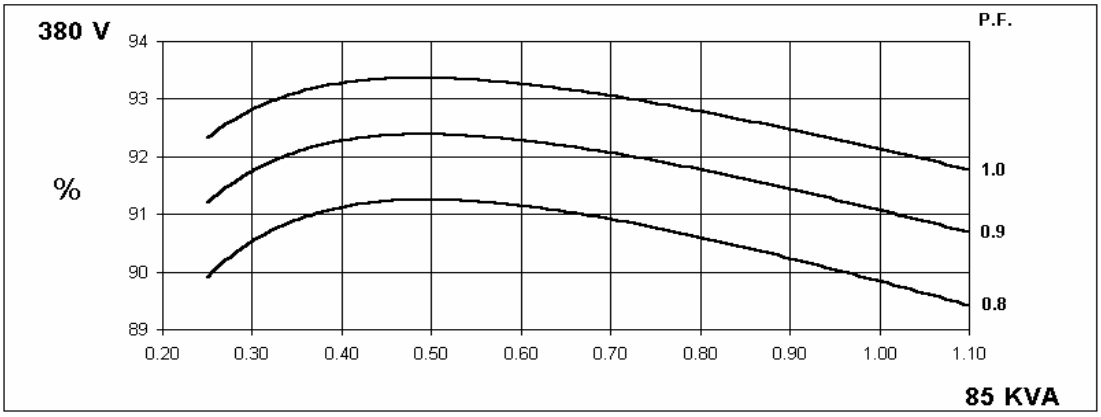
50 Hz

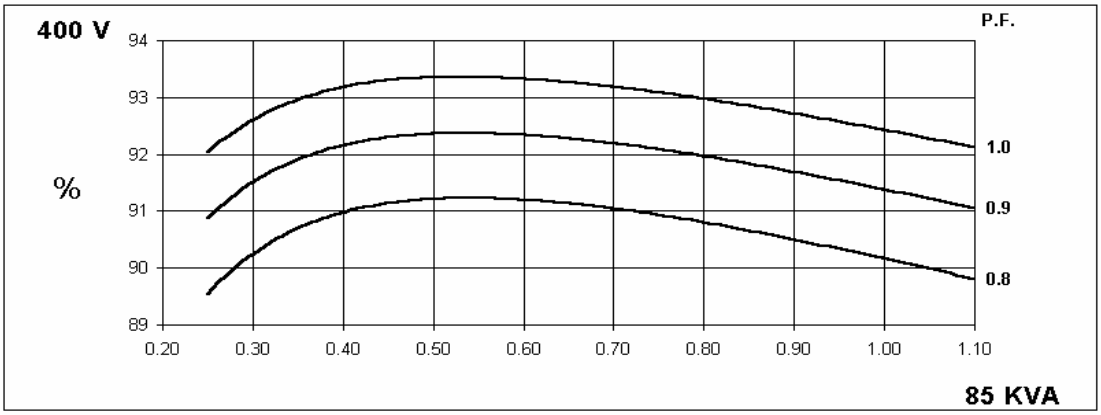
UCI224G

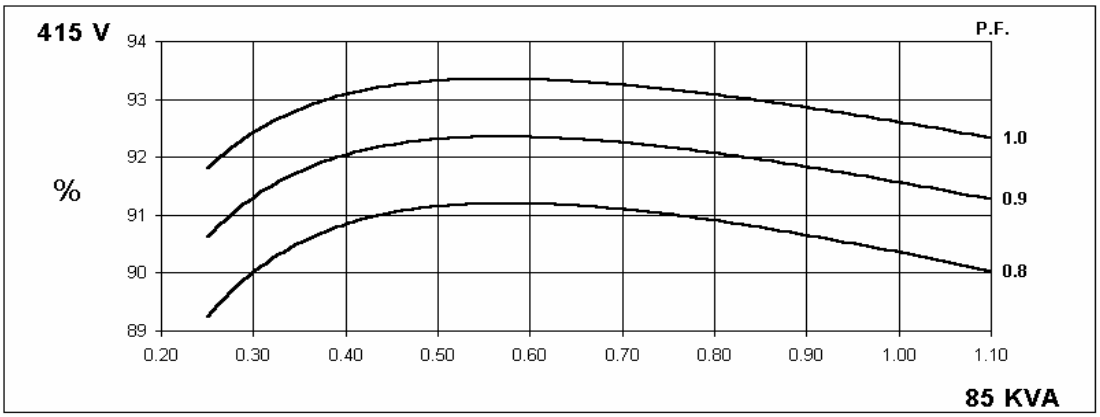
Winding 311

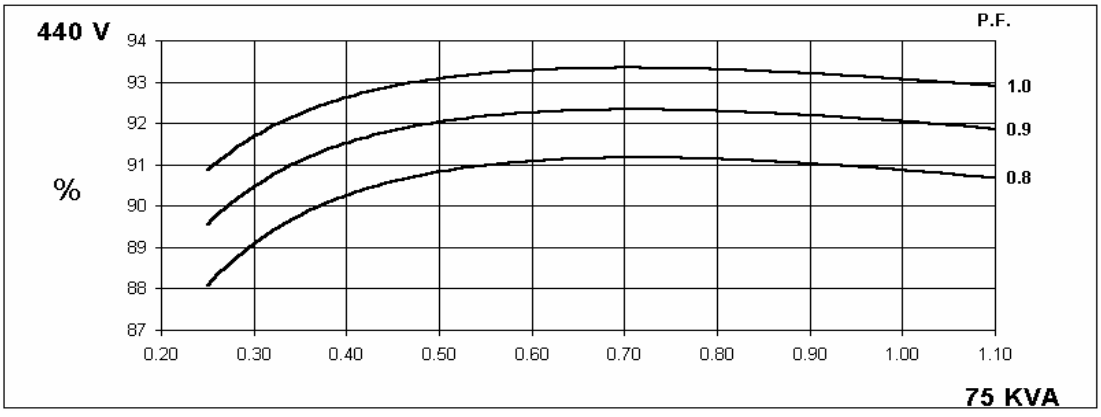
STAMFORD

THREE PHASE EFFICIENCY CURVES









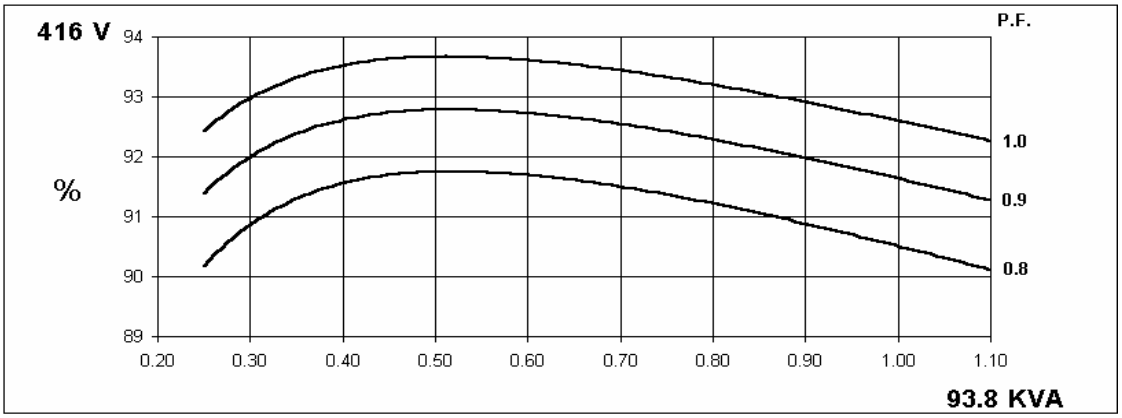
60 Hz

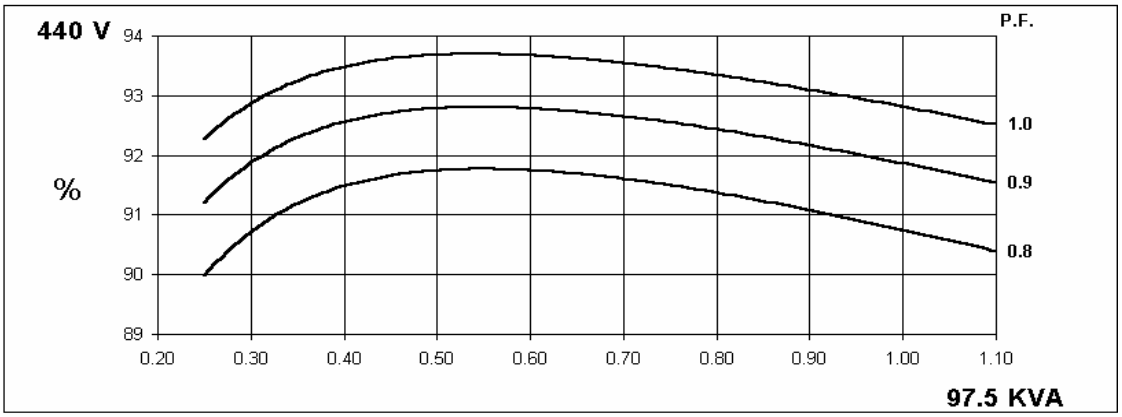
UCI224G

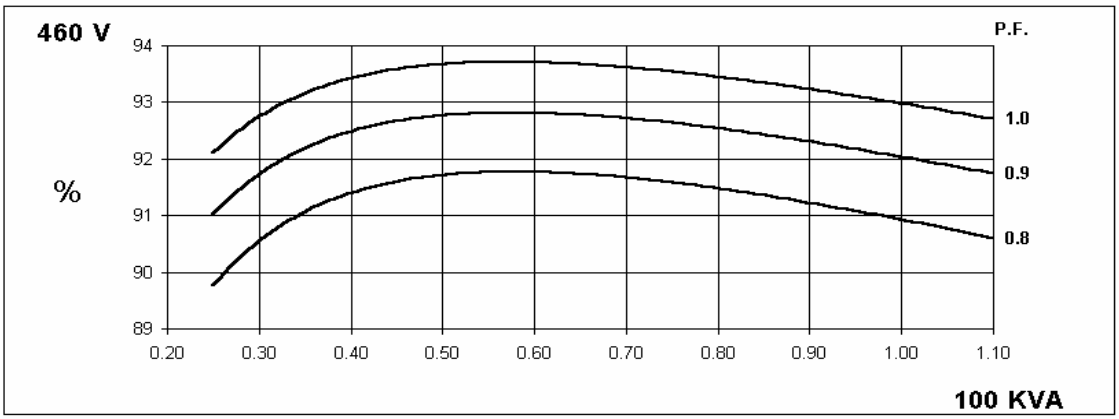
Winding 311

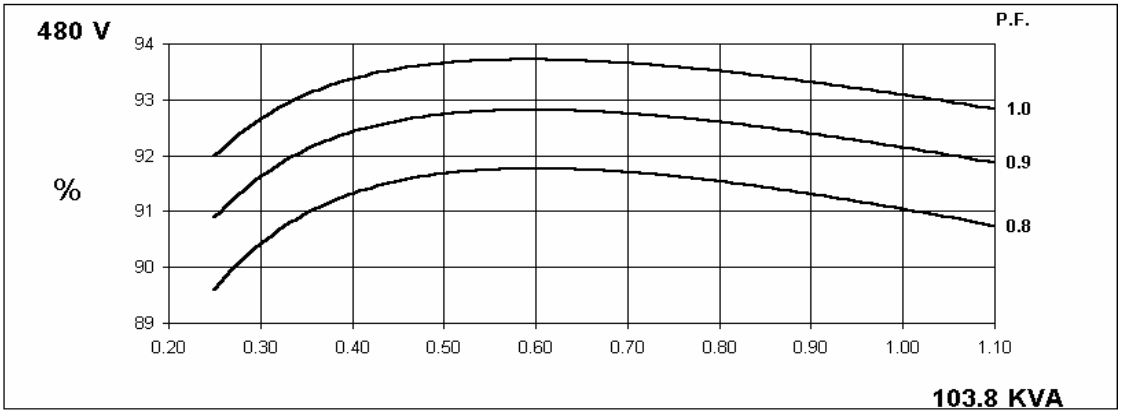
STAMFORD

THREE PHASE EFFICIENCY CURVES









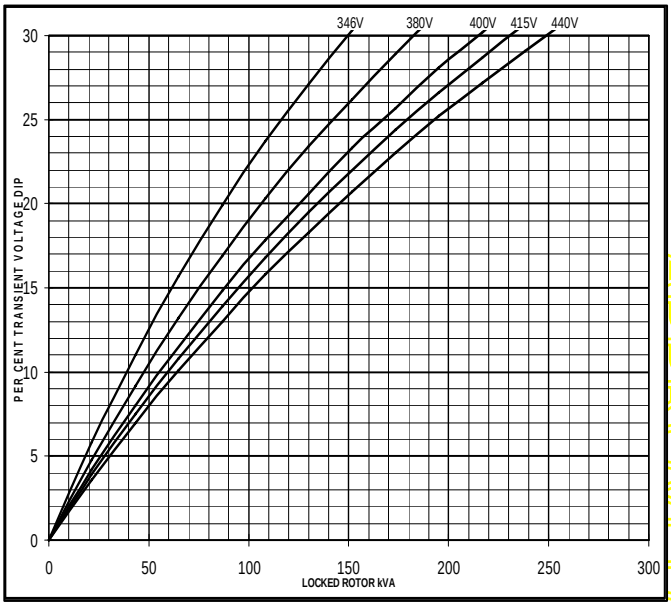
UCI224G

Winding 311

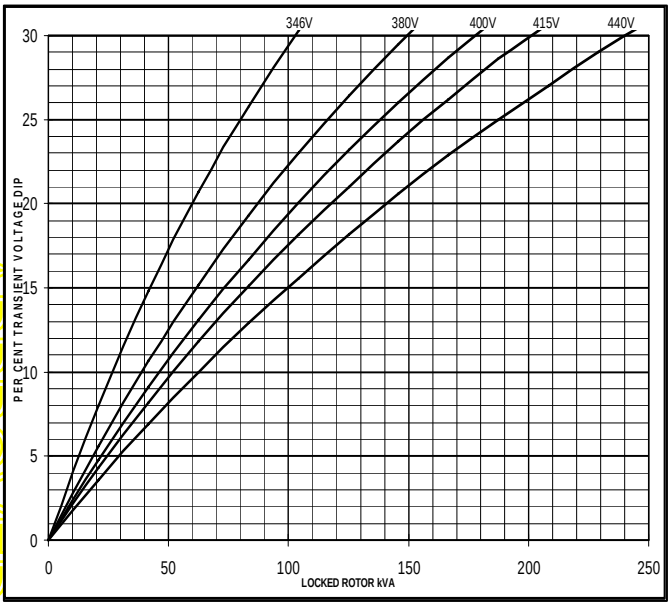
Locked Rotor Motor Starting Curve

50 Hz

MX

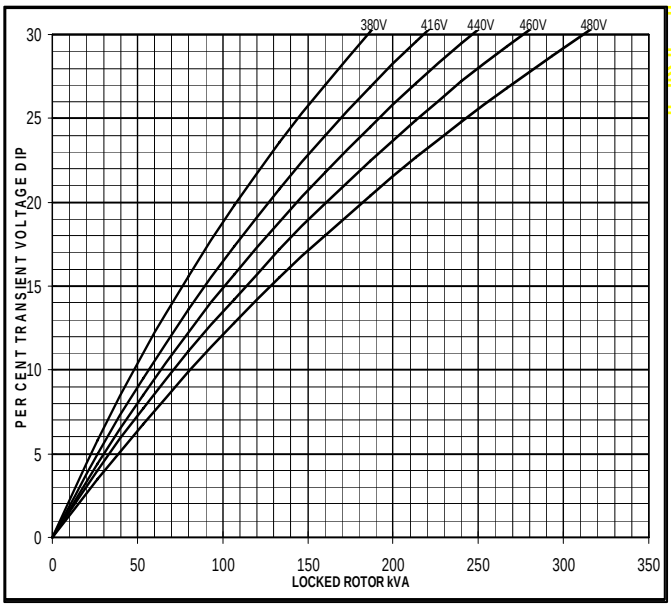


SX

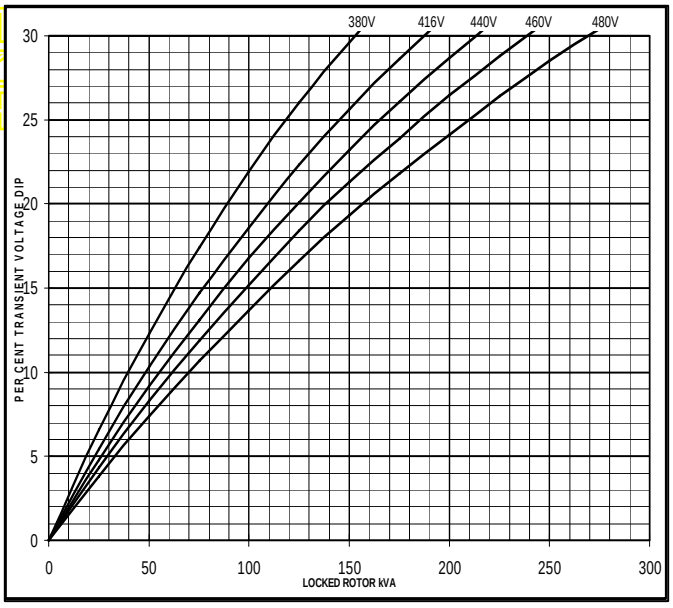


60 Hz

MX

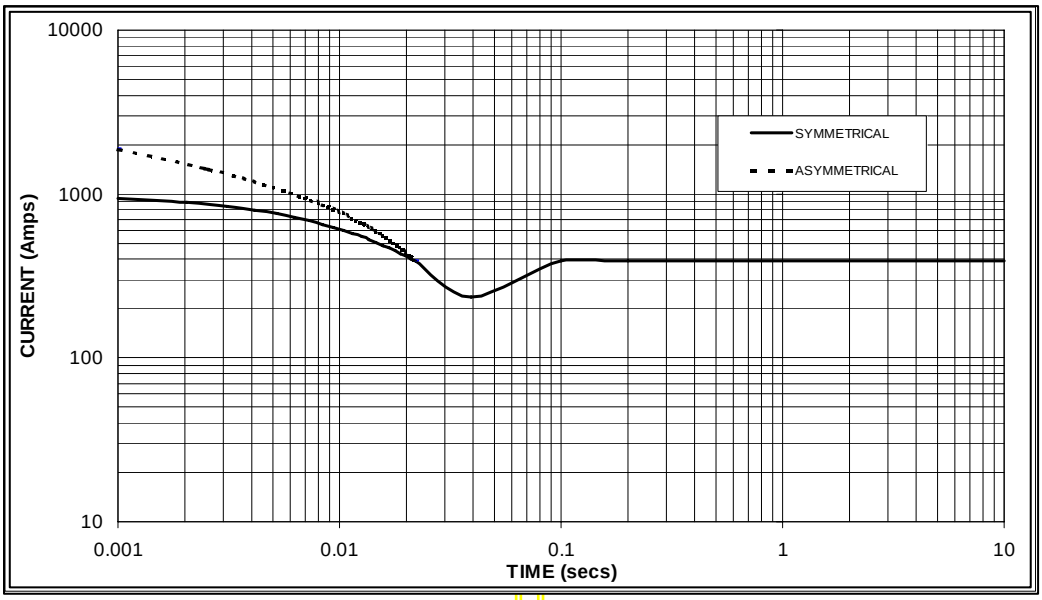


SX



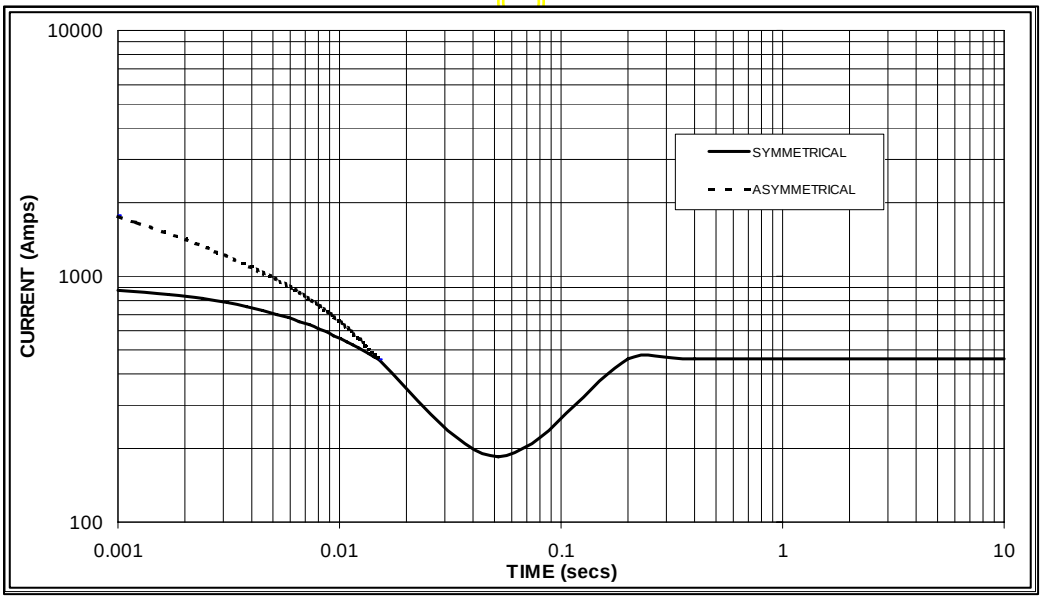
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 390 Amps

60 Hz



Sustained Short Circuit = 460 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 other connection 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

UCI224G

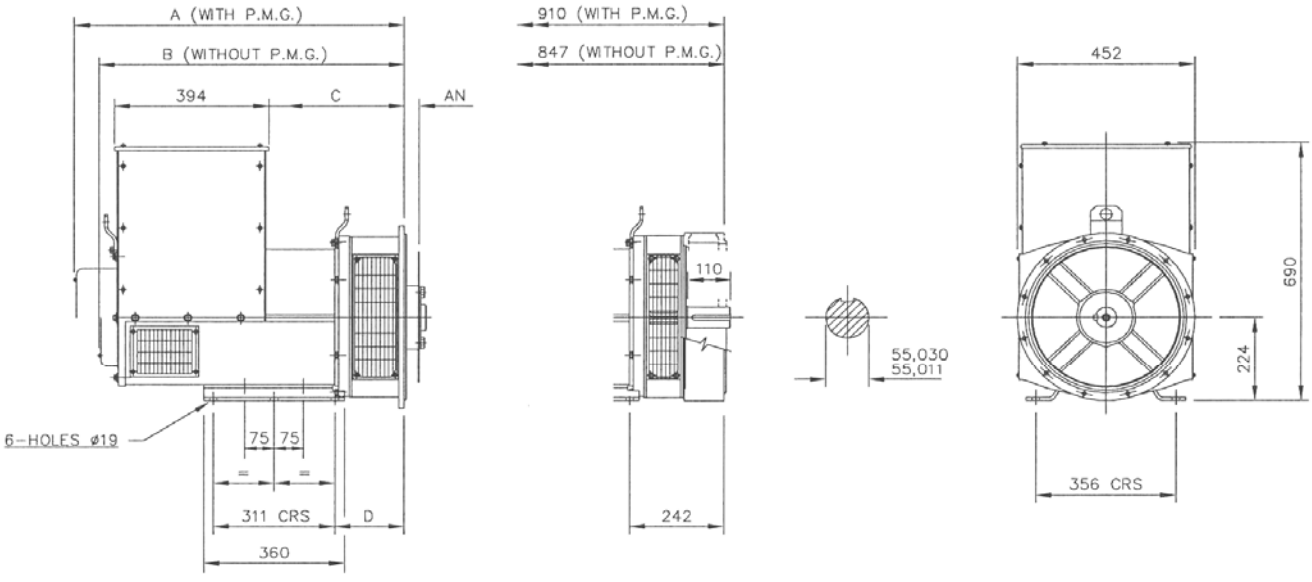
STAMFORD

Winding 311 / 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			
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	75.0	75.0	75.0	67.4	85.0	85.0	85.0	75.0	87.5	87.5	87.5	76.9	90.8	90.8	90.8	80.1
	kW	60.0	60.0	60.0	53.9	68.0	68.0	68.0	60.0	70.0	70.0	70.0	61.5	72.6	72.6	72.6	64.1
	Efficiency (%)	90.3	90.6	90.7	91.0	89.8	90.2	90.4	90.9	89.7	90.1	90.3	90.8	89.6	89.9	90.1	90.7
	kW Input	66.4	66.2	66.2	59.2	75.7	75.4	75.2	66.0	78.0	77.7	77.5	67.7	81.1	80.8	80.6	70.7
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	87.5	90.0	93.8	95.0	93.8	97.5	100.0	103.8	98.1	102.5	102.5	110.0	101.3	106.3	106.3	113.8
	kW	70.0	72.0	75.0	76.0	75.0	78.0	80.0	83.0	78.5	82.0	82.0	88.0	81.0	85.0	85.0	91.0
	Efficiency (%)	90.8	91.0	91.1	91.3	90.5	90.8	90.9	91.0	90.3	90.6	90.9	90.9	90.2	90.4	90.7	90.8
	kW Input	77.1	79.1	82.4	83.2	82.9	85.9	88.0	91.3	86.9	90.5	90.2	96.8	89.8	94.1	93.8	100.3

DIMENSIONS



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SAE 1	859,3	796,3	359,3	191,3
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SAE 3	845	782	345	177
SAE 4	845	782	345	177

COUPLING DISCS	
DISC	AN
SAE 8	61,90
SAE 10	53,98
SAE 11,5	39,68
SAE 14	25,40

APPROVED DOCUMENT

STAMFORD

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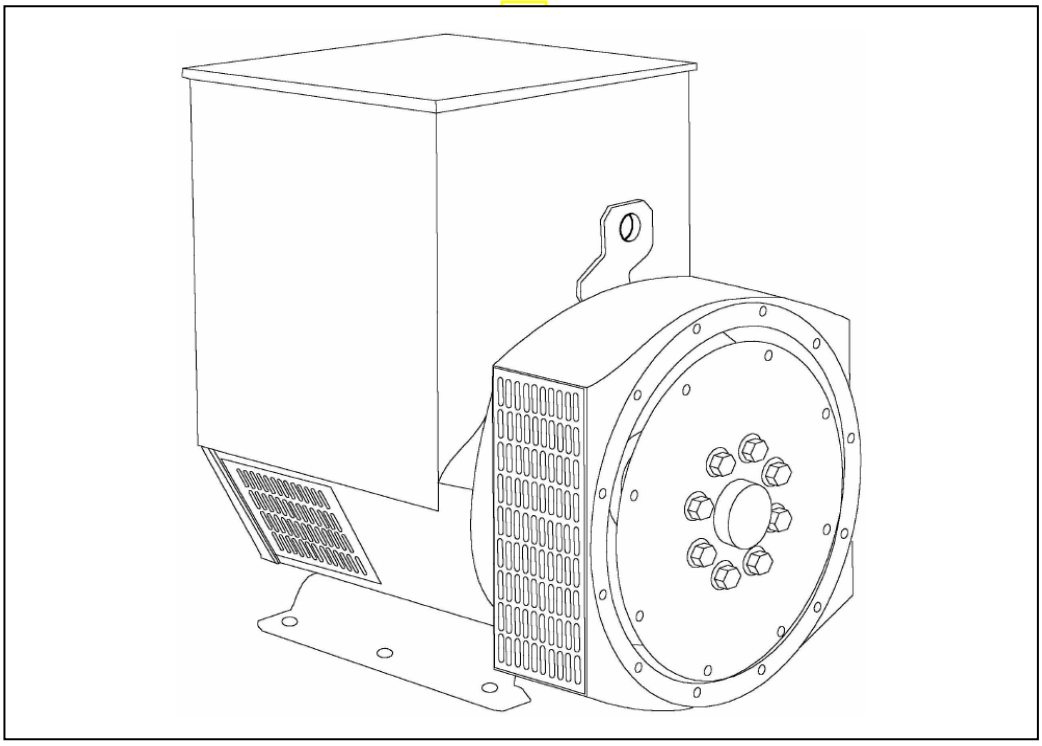
www.cumminsgeneratortechnologies.com

STAMFORD®

UCI274C - Winding 311

Technical Data Sheet



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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.

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The insulation system is class 'H'.
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Front cover drawing typical of product range.

WINDING 311

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX321	MX341	
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SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVES (page 7)		

CONTROL SYSTEM	SELF EXCITED		
A.V.R.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.059 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.12 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.078 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. 6315-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6310-2RS (ISO)						
	1 BEARING				2 BEARING		
WEIGHT COMP. GENERATOR	406 kg				420 kg		
WEIGHT WOUND STATOR	131 kg				131 kg		
WEIGHT WOUND ROTOR	133.78 kg				122.82 kg		
WR² INERTIA	1.0288 kgm²				0.9781 kgm²		
SHIPPING WEIGHTS in a crate	439 kg				452 kg		
PACKING CRATE SIZE	105 x 67 x 103(cm)				105 x 67 x 103(cm)		
	50 Hz				60 Hz		
TELEPHONE INTERFERENCE	THF<2%				TIF<50		
COOLING AIR	0.514 m³/sec 1090 cfm				0.617 m³/sec 1308 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	100	100	100	N/A	112.5	117.5	117.5	125
Xd DIR. AXIS SYNCHRONOUS	2.45	2.21	2.05	-	2.76	2.58	2.36	2.30
X'd DIR. AXIS TRANSIENT	0.20	0.18	0.17	-	0.24	0.22	0.21	0.20
X"d DIR. AXIS SUBTRANSIENT	0.14	0.13	0.12	-	0.16	0.15	0.14	0.13
Xq QUAD. AXIS REACTANCE	1.59	1.43	1.33	-	1.58	1.48	1.35	1.32
X"q QUAD. AXIS SUBTRANSIENT	0.18	0.16	0.15	-	0.23	0.21	0.20	0.19
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	-	0.08	0.07	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	-	0.19	0.18	0.16	0.16
X_0 ZERO SEQUENCE	0.10	0.09	0.08	-	0.12	0.11	0.10	0.10
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED						
T'd TRANSIENT TIME CONST.	0.028 s						
T"d SUB-TRANSTIME CONST.	0.001 s						
T'do O.C. FIELD TIME CONST.	0.8 s						
Ta ARMATURE TIME CONST.	0.007 s						
SHORT CIRCUIT RATIO	1/Xd						

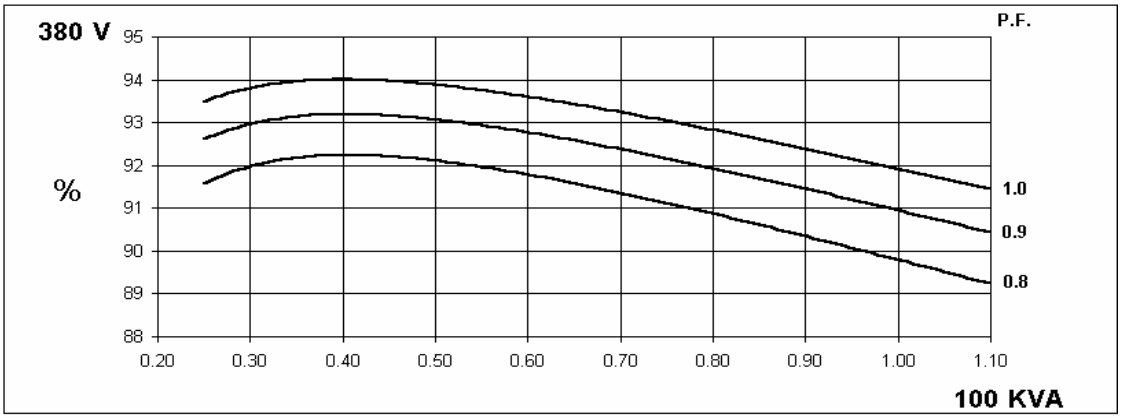
50 Hz

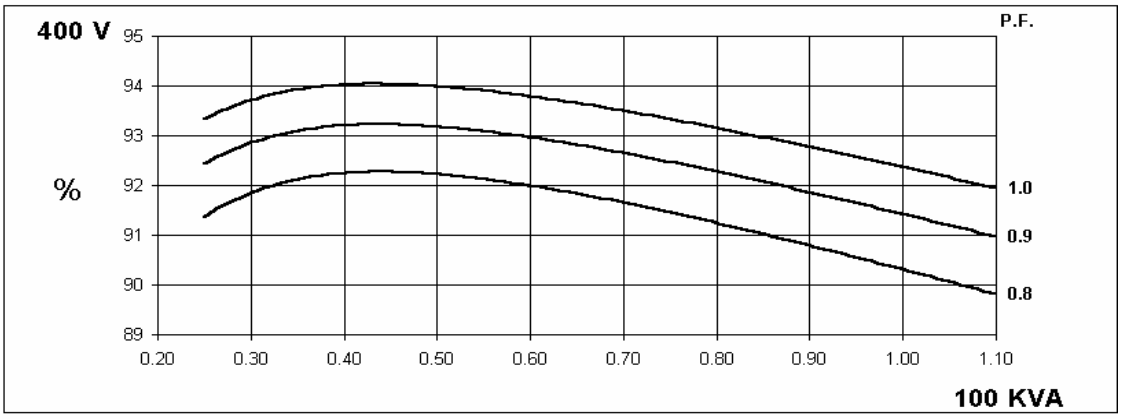
UCI274C

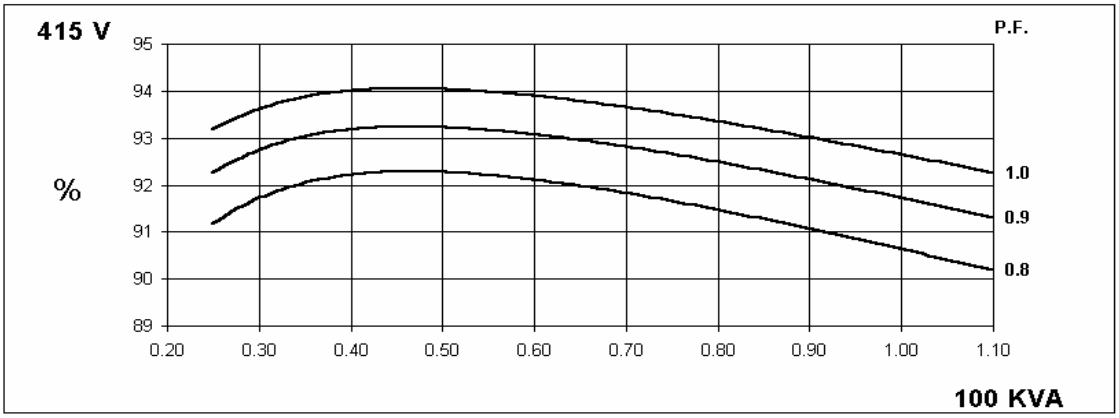
Winding 311

STAMFORD

THREE PHASE EFFICIENCY CURVES







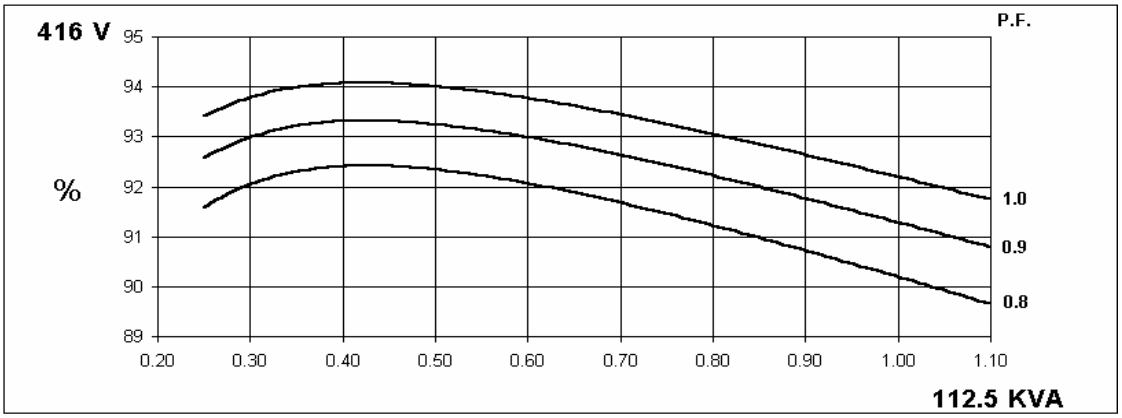
60 Hz

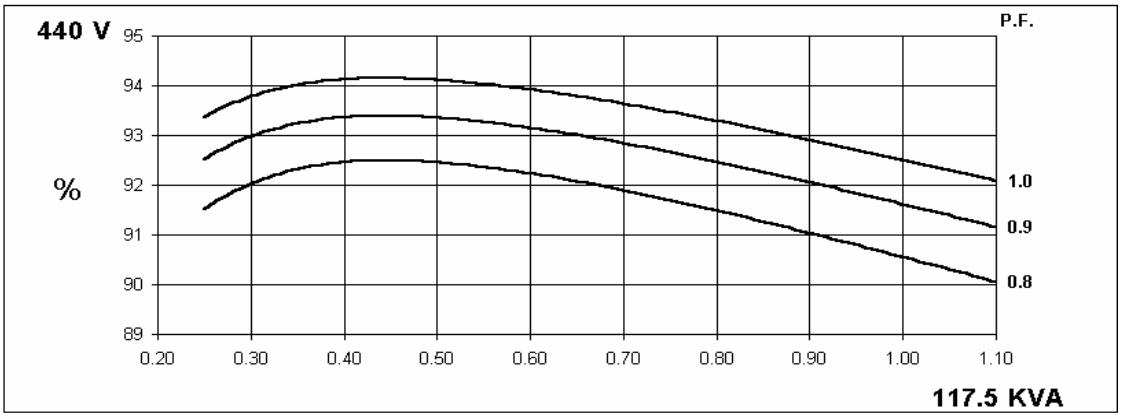
UCI274C

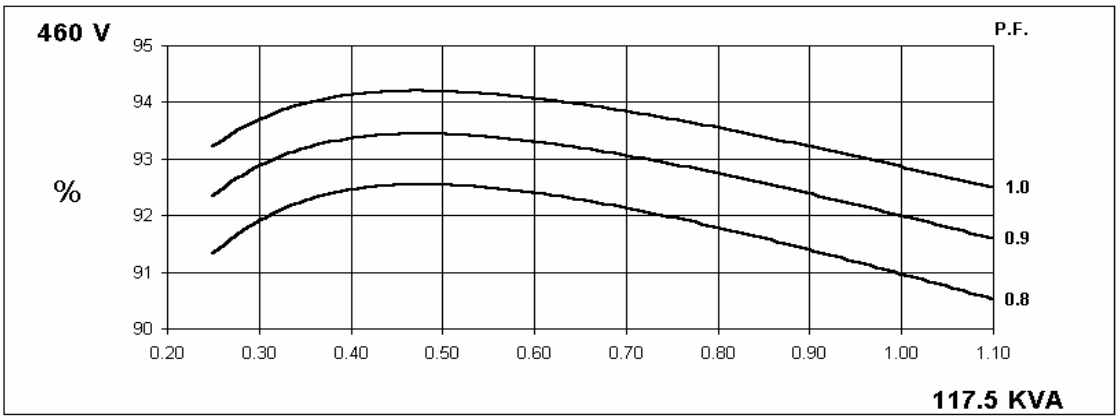
Winding 311

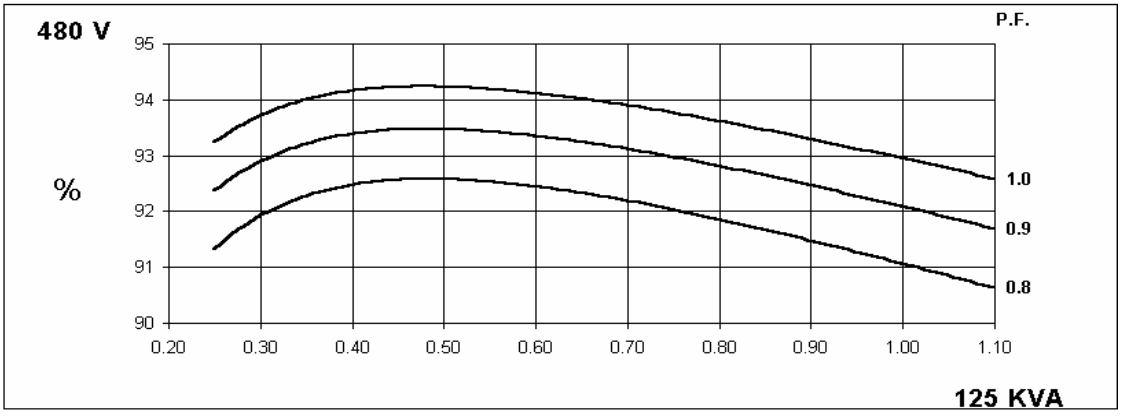
STAMFORD

THREE PHASE EFFICIENCY CURVES







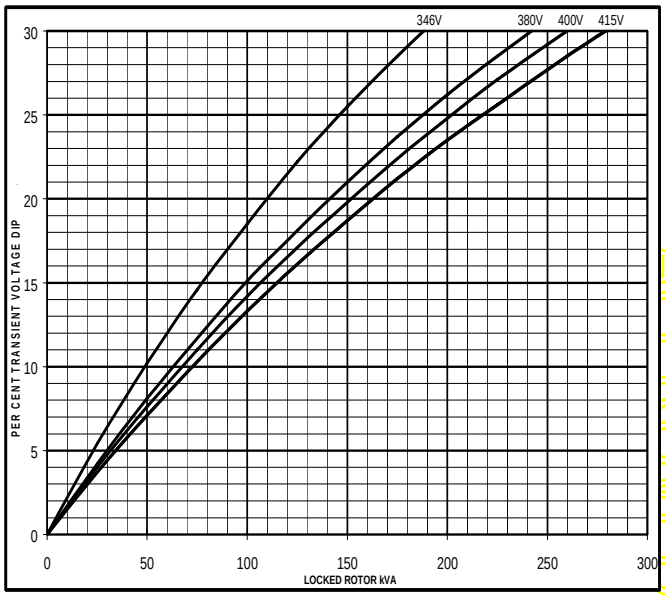


STAMFORD

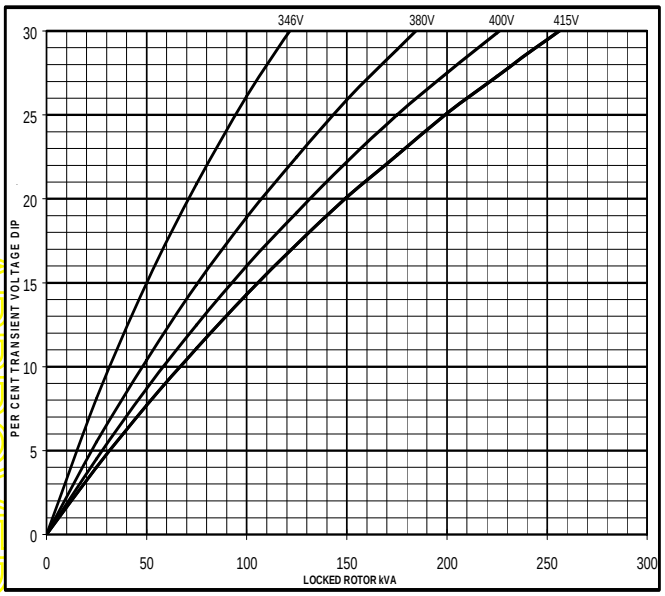
Locked Rotor Motor Starting Curve

50 Hz

MX

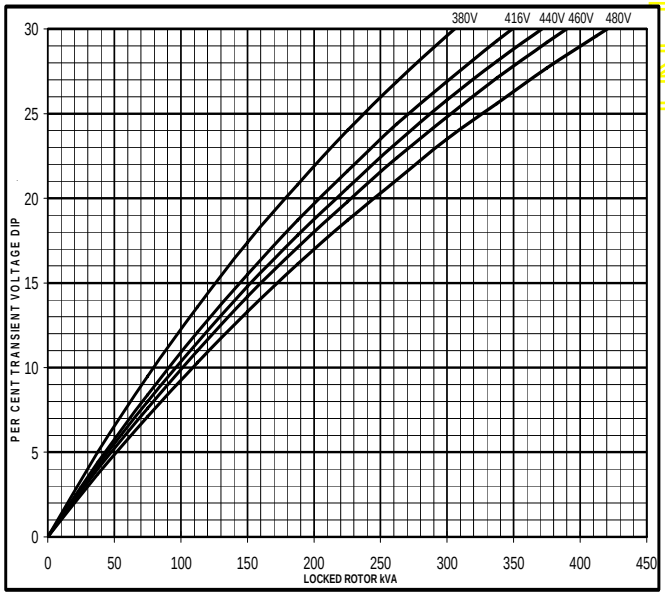


SX

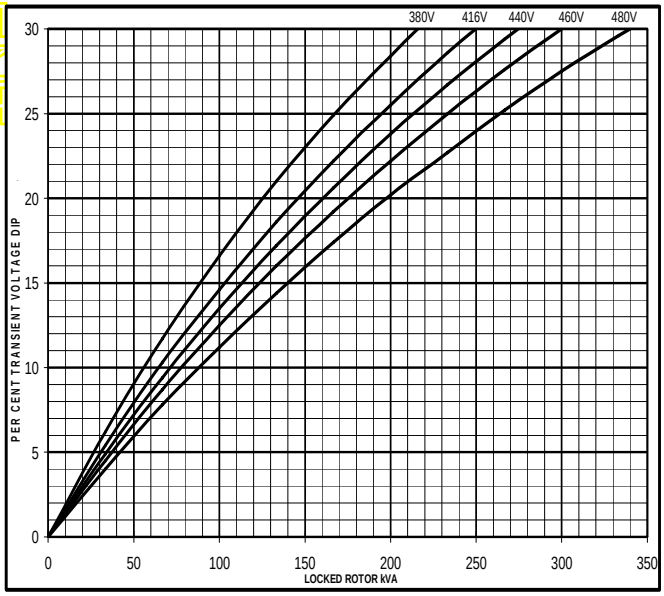


60 Hz

MX

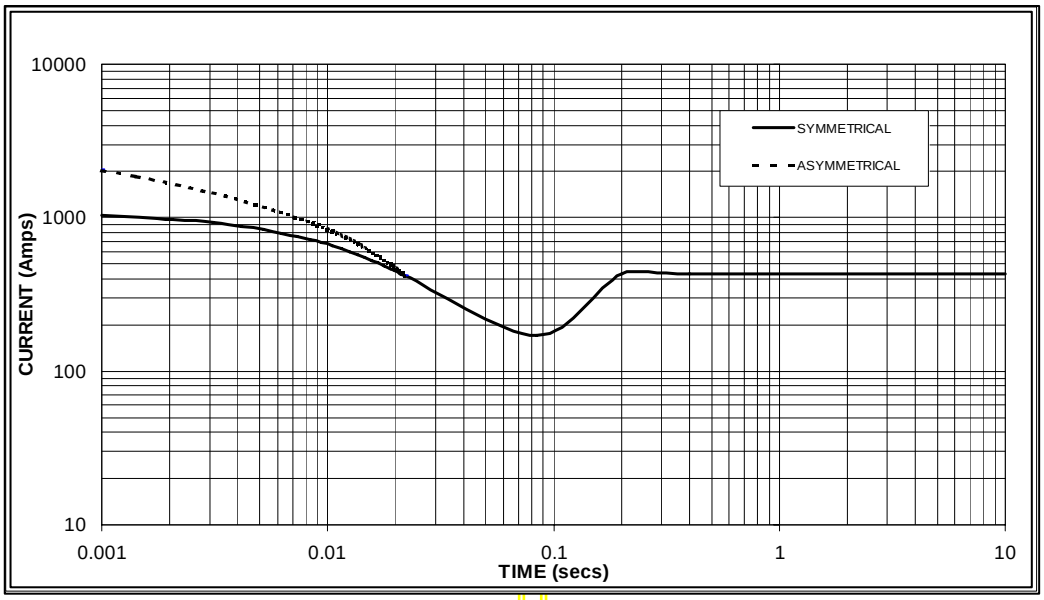


SX



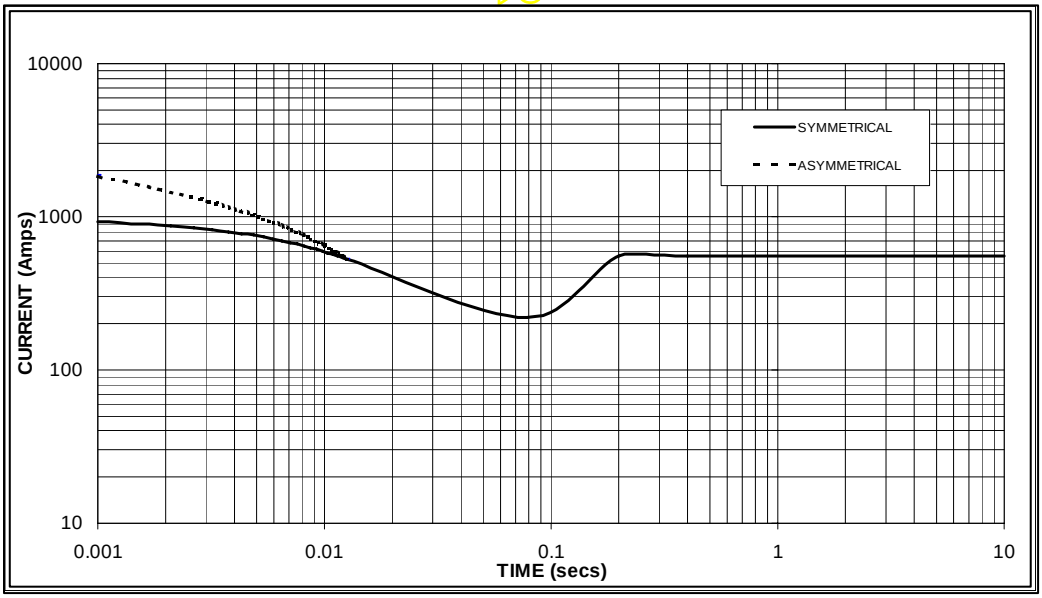
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 430 Amps

60 Hz



Sustained Short Circuit = 550 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
		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 other connection 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

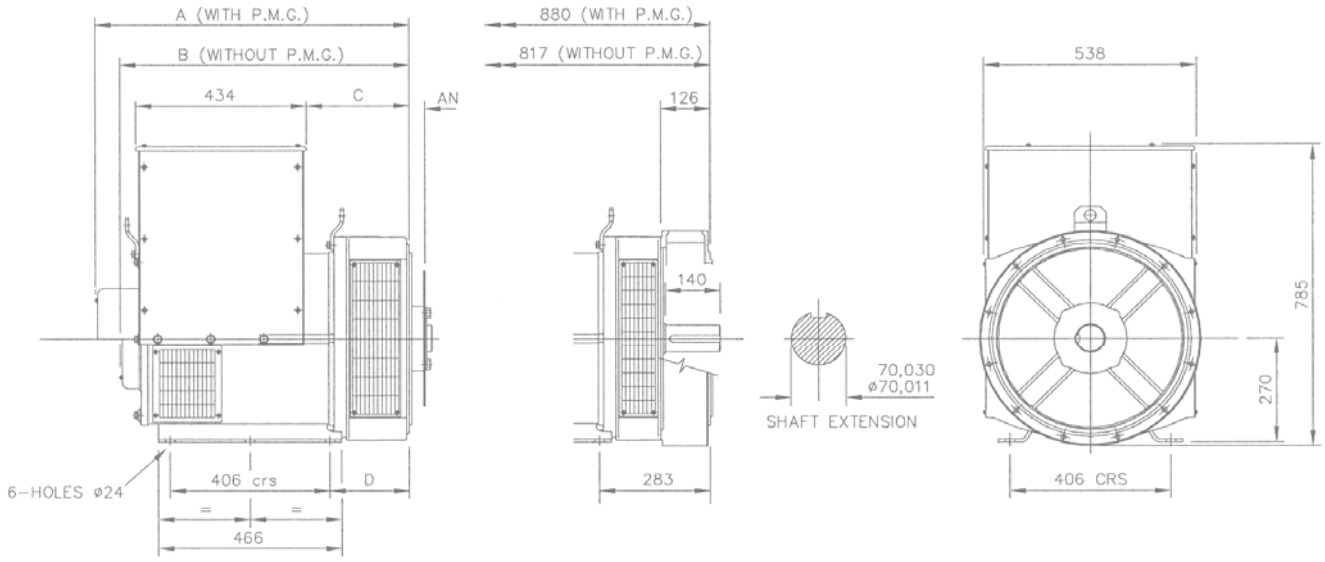
UCI274C

Winding 311 / 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			
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	84.0	84.0	84.0	N/A	100.0	100.0	100.0	N/A	106.0	106.0	106.0	N/A	110.0	110.0	110.0	N/A
	kW	67.2	67.2	67.2	N/A	80.0	80.0	80.0	N/A	84.8	84.8	84.8	N/A	88.0	88.0	88.0	N/A
	Efficiency (%)	90.7	91.1	91.3	N/A	89.8	90.3	90.6	N/A	89.5	90.0	90.4	N/A	89.2	89.8	90.2	N/A
	kW Input	74.1	73.8	73.6	N/A	89.1	88.6	88.3	N/A	94.7	94.2	93.8	N/A	98.7	98.0	97.6	N/A
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	97.5	106.3	106.3	112.5	112.5	117.5	117.5	125.0	116.3	125.0	125.0	132.5	120.0	127.5	127.5	137.5
	kW	78.0	85.0	85.0	90.0	90.0	94.0	94.0	100.0	93.0	100.0	100.0	106.0	96.0	102.0	102.0	110.0
	Efficiency (%)	90.9	91.0	91.4	91.5	90.2	90.6	91.0	91.1	90.0	90.2	90.7	90.8	89.8	90.1	90.6	90.6
	kW Input	85.8	93.5	93.0	98.4	99.8	103.8	103.3	109.8	103.4	110.9	110.3	116.7	106.9	113.2	112.6	121.4

DIMENSIONS



SINGLE BEARING ADAPTORS				
ADAPTOR	A	B	C	D
SAE 1	813,3	750,3	274,3	216,3
SAE 2	799	736	260	202
SAE 3	799	736	260	202

COUPLING DISCS	
DISC	AN
SAE 10	53,98
SAE 11,5	39,68
SAE 14	25,40

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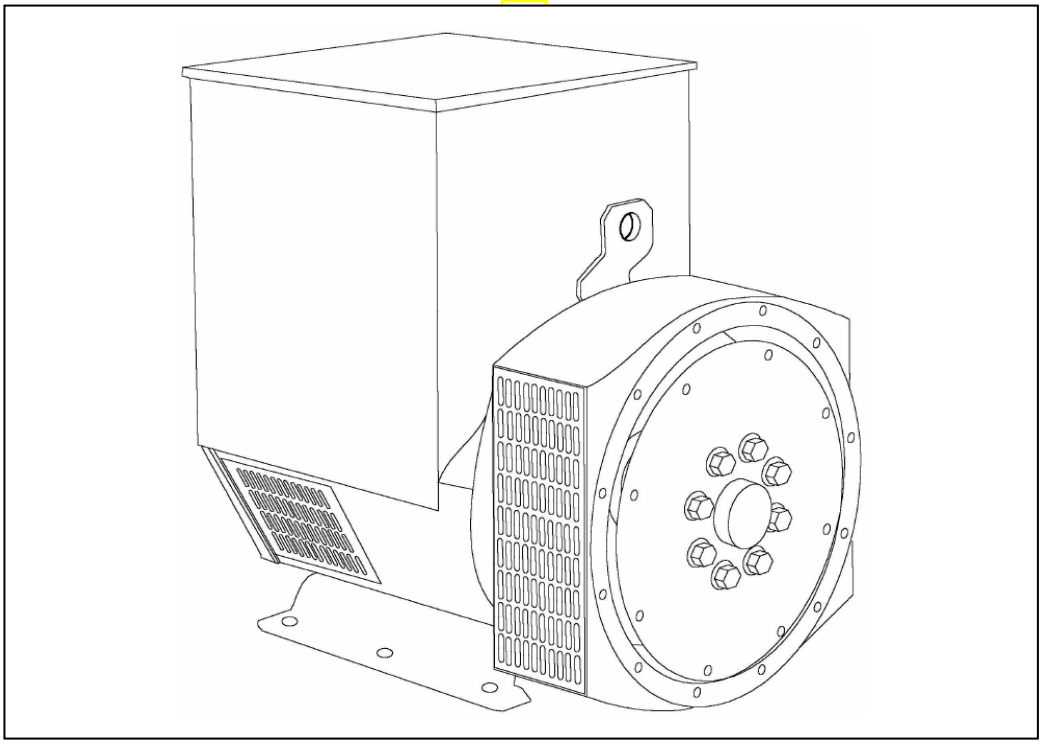
UCI274D - Winding 311

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

SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

AS440 AVR

With this self-excited system the main stator provides power via the 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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.044 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.26 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.078 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. 6315-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6310-2RS (ISO)						
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	431 kg				450 kg			
WEIGHT WOUND STATOR	141 kg				141 kg			
WEIGHT WOUND ROTOR	149.37 kg				138.41 kg			
WR² INERTIA	1.1962 kgm²				1.1455 kgm²			
SHIPPING WEIGHTS in a crate	458 kg				476 kg			
PACKING CRATE SIZE	105 x 67 x 103(cm)				105 x 67 x 103(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.514 m³/sec 1090 cfm				0.617 m³/sec 1308 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	114	120	114	N/A	131.3	137.5	137.5	146.3
Xd DIR. AXIS SYNCHRONOUS	2.17	2.06	1.82	-	2.52	2.36	2.16	2.11
X'd DIR. AXIS TRANSIENT	0.18	0.18	0.16	-	0.21	0.20	0.18	0.17
X"d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	-	0.15	0.14	0.13	0.12
Xq QUAD. AXIS REACTANCE	1.39	1.32	1.17	-	1.49	1.39	1.28	1.25
X"q QUAD. AXIS SUBTRANSIENT	0.16	0.16	0.14	-	0.21	0.20	0.18	0.17
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	-	0.07	0.07	0.06	0.06
X_2 NEGATIVE SEQUENCE	0.14	0.13	0.12	-	0.17	0.16	0.15	0.14
X_0 ZERO SEQUENCE	0.09	0.08	0.07	-	0.10	0.09	0.09	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.031 s							
T"d SUB-TRANSTIME CONST.	0.01 s							
T'do O.C. FIELD TIME CONST.	0.85 s							
Ta ARMATURE TIME CONST.	0.0073 s							
SHORT CIRCUIT RATIO	1/Xd							

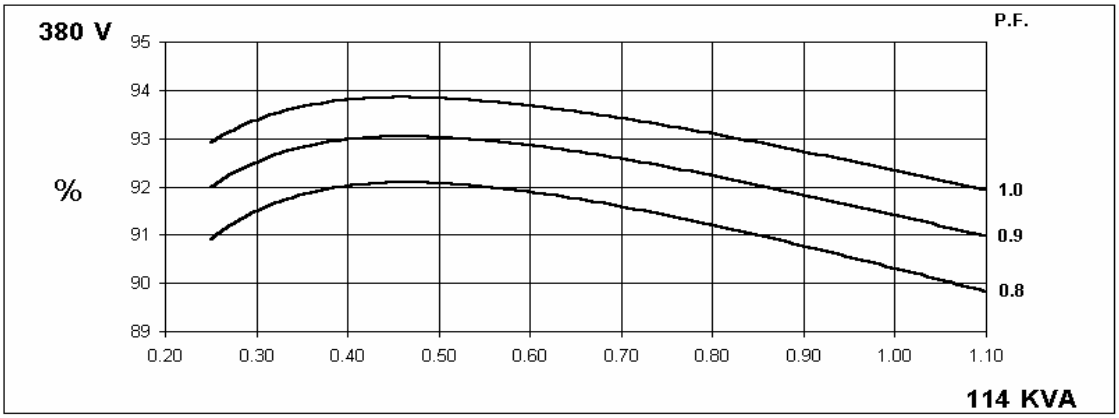
50 Hz

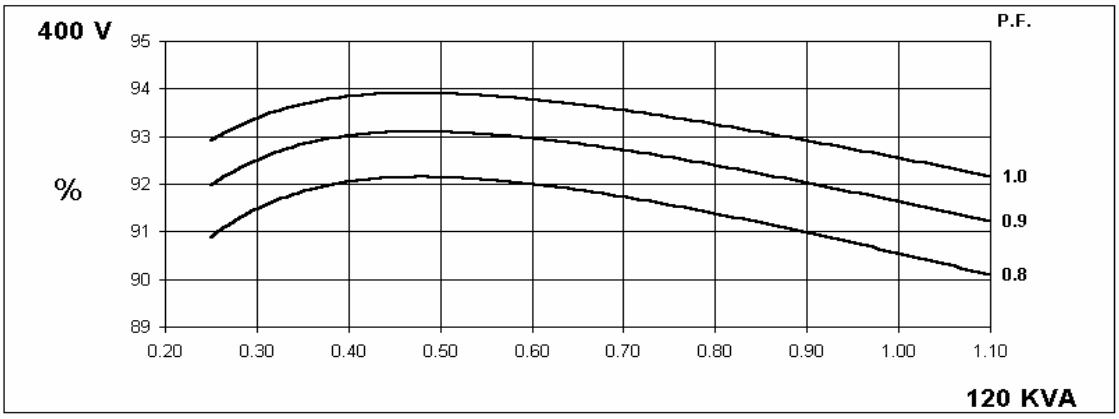
UCI274D

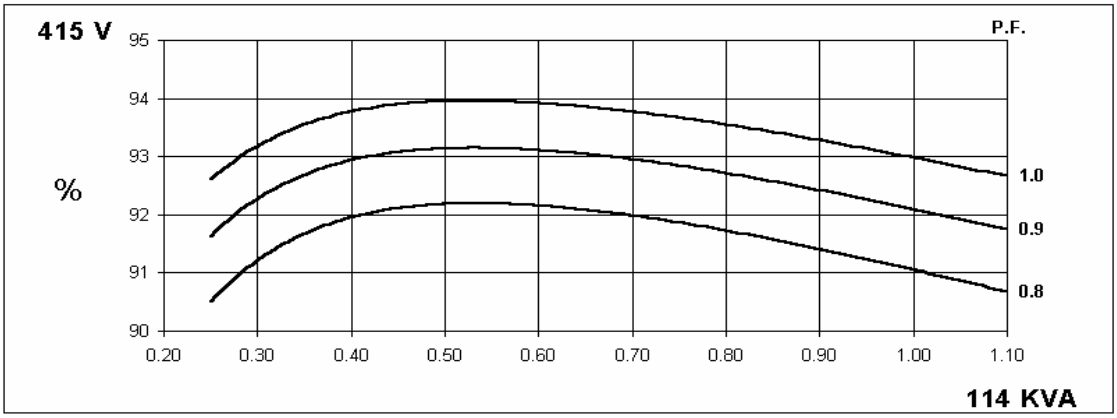
Winding 311

STAMFORD

THREE PHASE EFFICIENCY CURVES







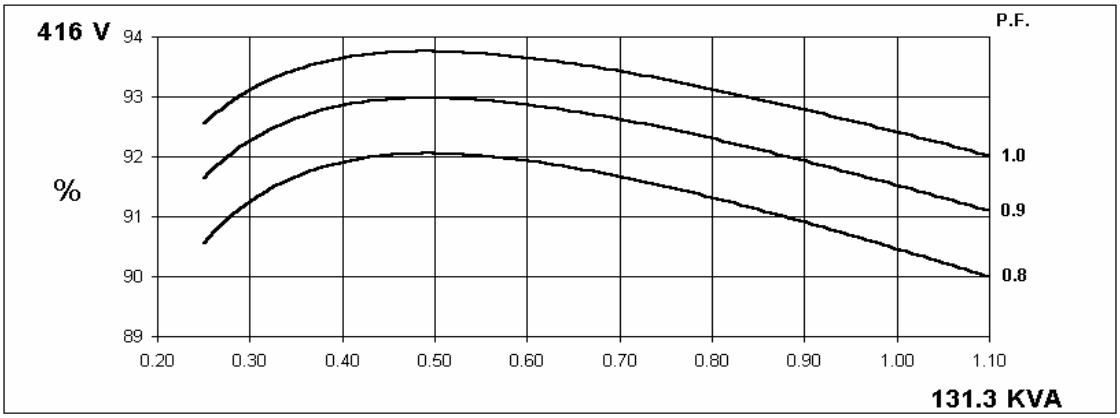
60 Hz

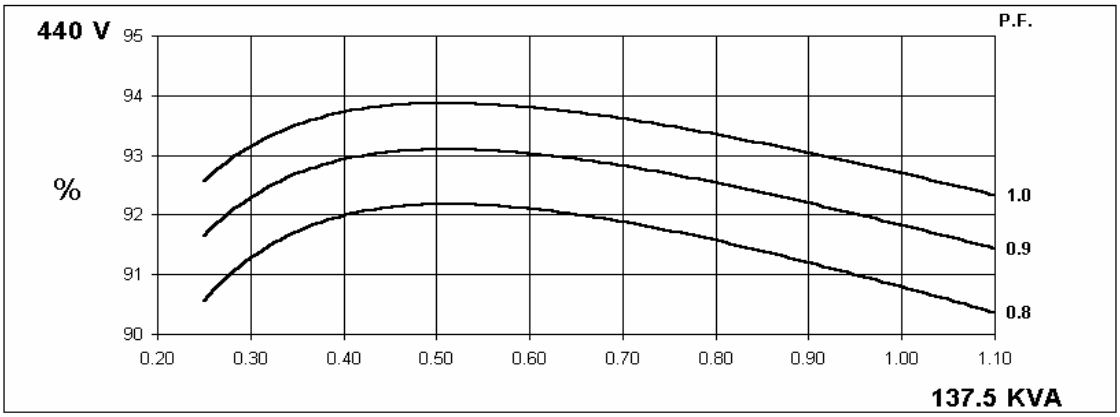
UCI274D

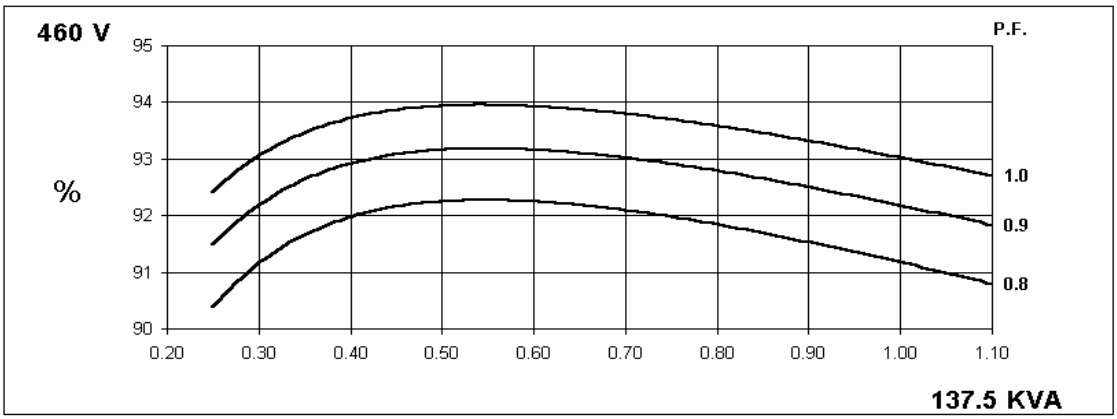
Winding 311

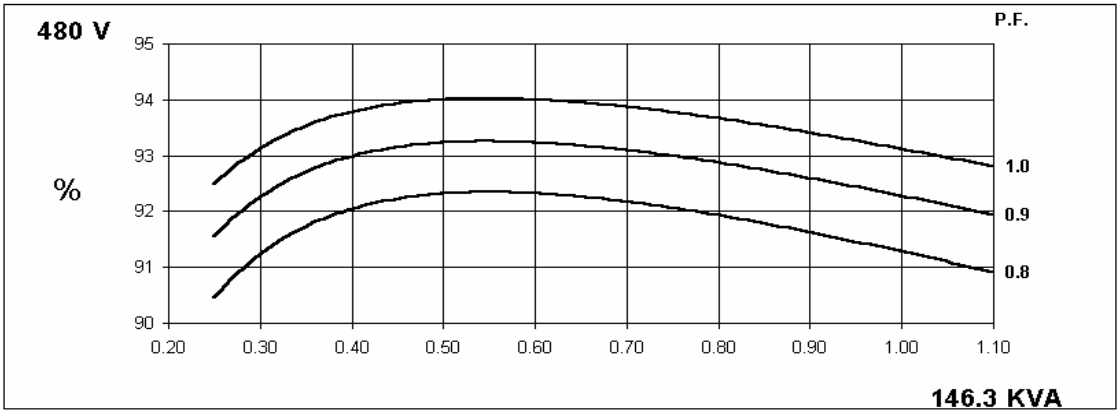
STAMFORD

THREE PHASE EFFICIENCY CURVES





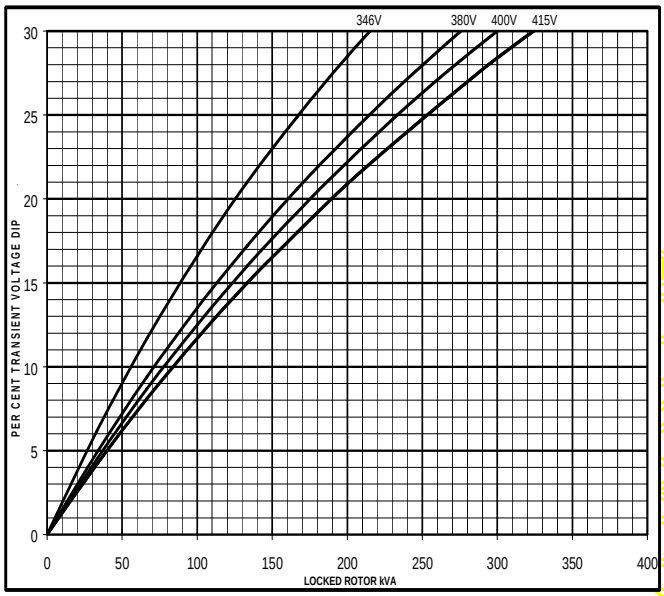




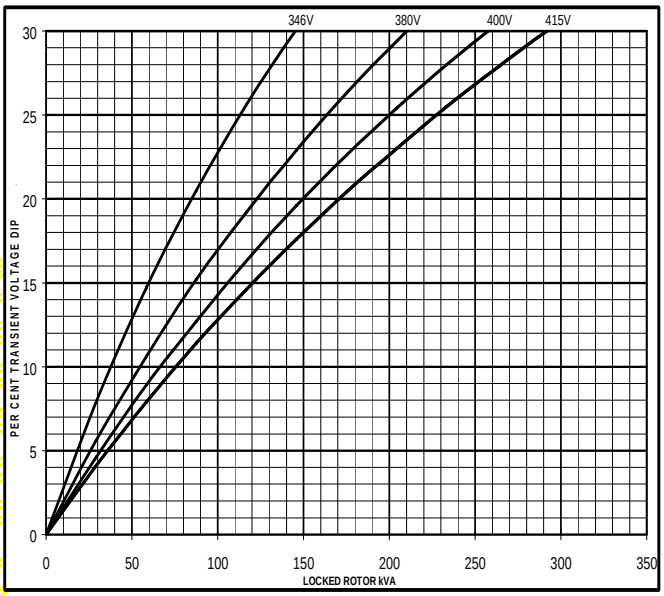
Locked Rotor Motor Starting Curve

50 Hz

MX

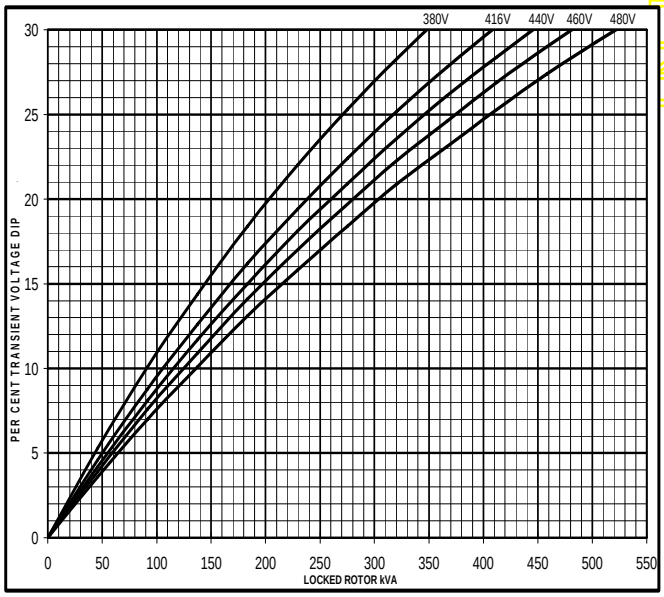


SX



60 Hz

MX



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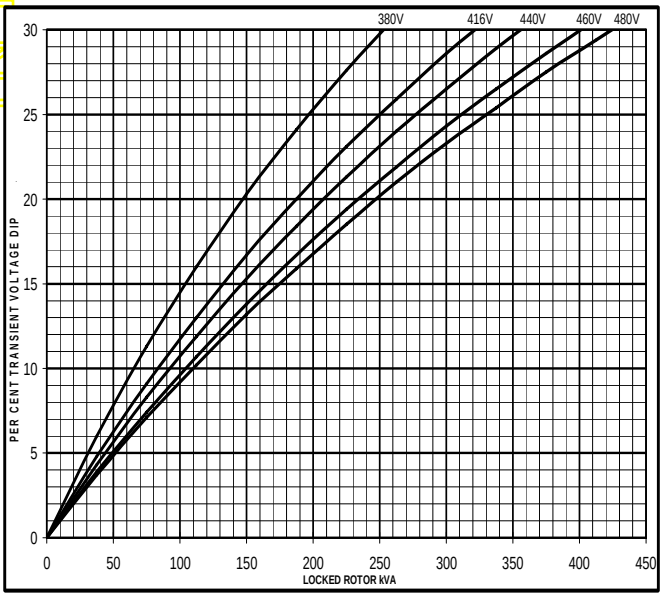
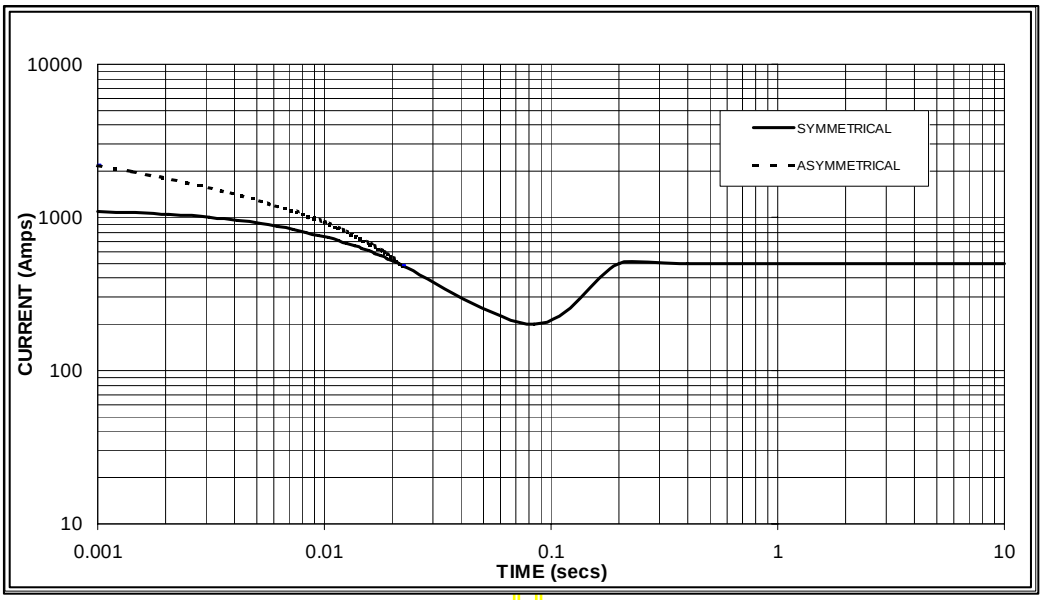


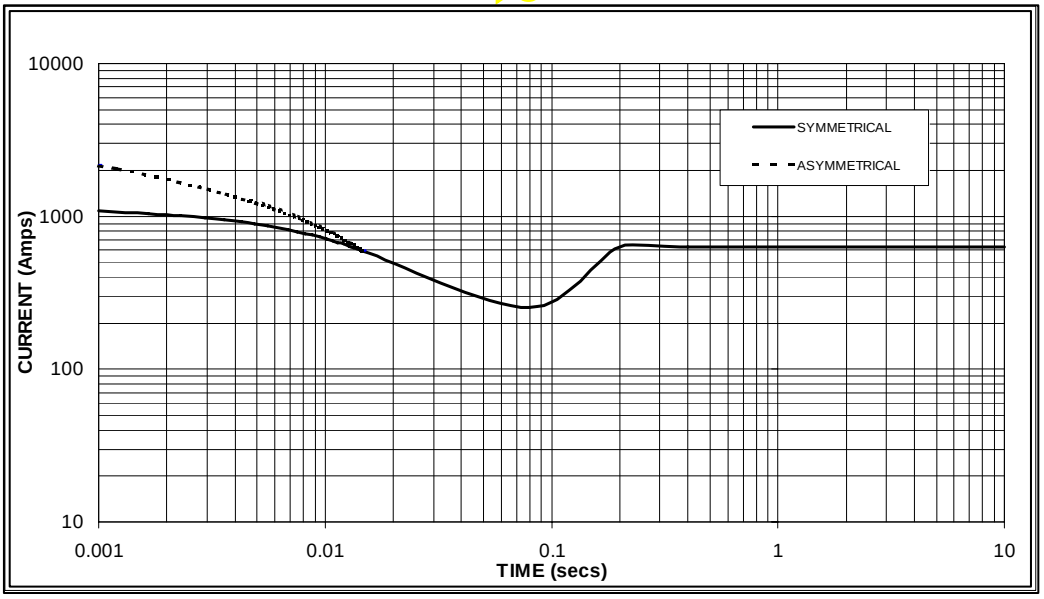
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 500 Amps

60 Hz



Sustained Short Circuit = 630 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
		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 other connection 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

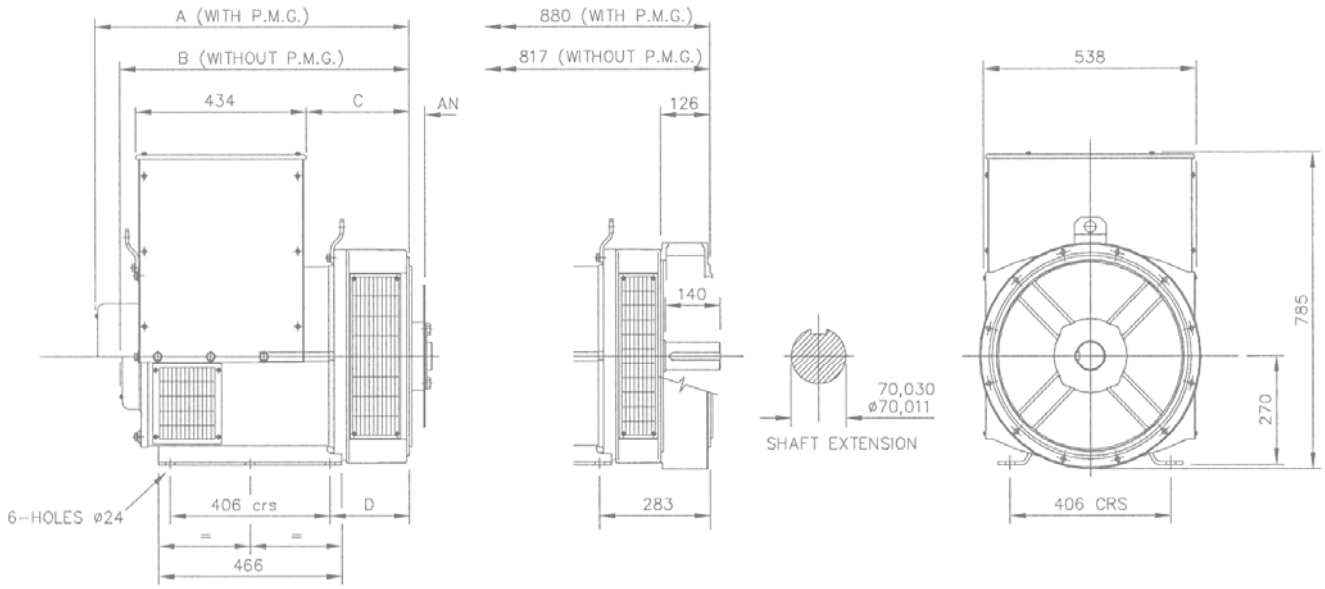
UCI274D

Winding 311 / 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			
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	100.0	100.0	100.0	N/A	114.0	120.0	114.0	N/A	121.0	127.0	121.0	N/A	125.0	130.0	125.0	N/A
	kW	80.0	80.0	80.0	N/A	91.2	96.0	91.2	N/A	96.8	101.6	96.8	N/A	100.0	104.0	100.0	N/A
	Efficiency (%)	90.9	91.3	91.5	N/A	90.3	90.6	91.1	N/A	90.0	90.3	90.8	N/A	89.8	90.2	90.7	N/A
	kW Input	88.0	87.6	87.4	N/A	101.0	106.0	100.1	N/A	107.6	112.5	106.6	N/A	111.4	115.3	110.3	N/A
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	120.0	125.0	125.0	131.3	131.3	137.5	137.5	146.3	137.5	145.0	145.0	156.3	142.5	150.0	150.0	158.8
	kW	96.0	100.0	100.0	105.0	105.0	110.0	110.0	117.0	110.0	116.0	116.0	125.0	114.0	120.0	120.0	127.0
	Efficiency (%)	90.9	91.2	91.5	91.6	90.5	90.8	91.2	91.3	90.2	90.6	91.0	91.0	90.1	90.4	90.8	91.0
	kW Input	105.6	109.6	109.3	114.7	116.1	121.1	120.6	128.2	122.0	128.0	127.5	137.4	126.5	132.7	132.2	139.6

DIMENSIONS



SINGLE BEARING ADAPTORS				
ADAPTOR	A	B	C	D
SAE 1	813,3	750,3	274,3	216,3
SAE 2	799	736	260	202
SAE 3	799	736	260	202

COUPLING DISCS	
DISC	AN
SAE 10	53,98
SAE 11,5	39,68
SAE 14	25,40

APPROVED DOCUMENT

STAMFORD

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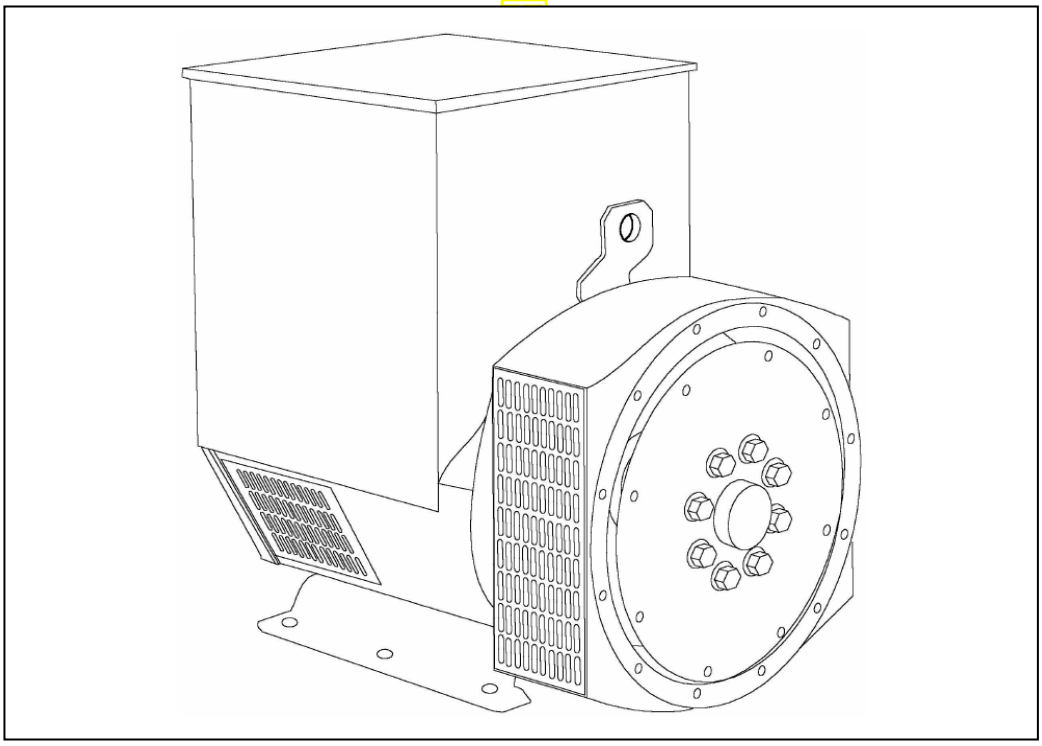
UCI274E - Winding 311

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

SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

AS440 AVR

With this self-excited system the main stator provides power via the 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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.0317 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.34 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.091 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. 6315-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6310-2RS (ISO)						
	1 BEARING				2 BEARING		
WEIGHT COMP. GENERATOR	492 kg				511 kg		
WEIGHT WOUND STATOR	180 kg				180 kg		
WEIGHT WOUND ROTOR	167.51 kg				156.55 kg		
WR² INERTIA	1.3271 kgm²				1.2765 kgm²		
SHIPPING WEIGHTS in a crate	525 kg				539 kg		
PACKING CRATE SIZE	123 x 67 x 103(cm)				123 x 67 x 103(cm)		
	50 Hz				60 Hz		
TELEPHONE INTERFERENCE	THF<2%				TIF<50		
COOLING AIR	0.514 m³/sec 1090 cfm				0.617 m³/sec 1308 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	140	140	140	N/A	160	167.5	167.5	178.8
Xd DIR. AXIS SYNCHRONOUS	2.34	2.11	1.96	-	2.68	2.51	2.29	2.25
X'd DIR. AXIS TRANSIENT	0.21	0.19	0.18	-	0.25	0.23	0.21	0.21
X"d DIR. AXIS SUBTRANSIENT	0.14	0.13	0.12	-	0.17	0.16	0.15	0.14
Xq QUAD. AXIS REACTANCE	1.53	1.38	1.28	-	1.74	1.63	1.49	1.46
X"q QUAD. AXIS SUBTRANSIENT	0.18	0.16	0.15	-	0.22	0.21	0.19	0.18
X_L LEAKAGE REACTANCE	0.08	0.08	0.07	-	0.09	0.08	0.08	0.08
X_2 NEGATIVE SEQUENCE	0.16	0.14	0.13	-	0.19	0.18	0.16	0.16
X_0 ZERO SEQUENCE	0.10	0.09	0.08	-	0.11	0.10	0.09	0.09
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED						
T'd TRANSIENT TIME CONST.	0.032 s						
T"d SUB-TRANSTIME CONST.	0.01 s						
T'do O.C. FIELD TIME CONST.	0.85 s						
Ta ARMATURE TIME CONST.	0.007 s						
SHORT CIRCUIT RATIO	1/Xd						

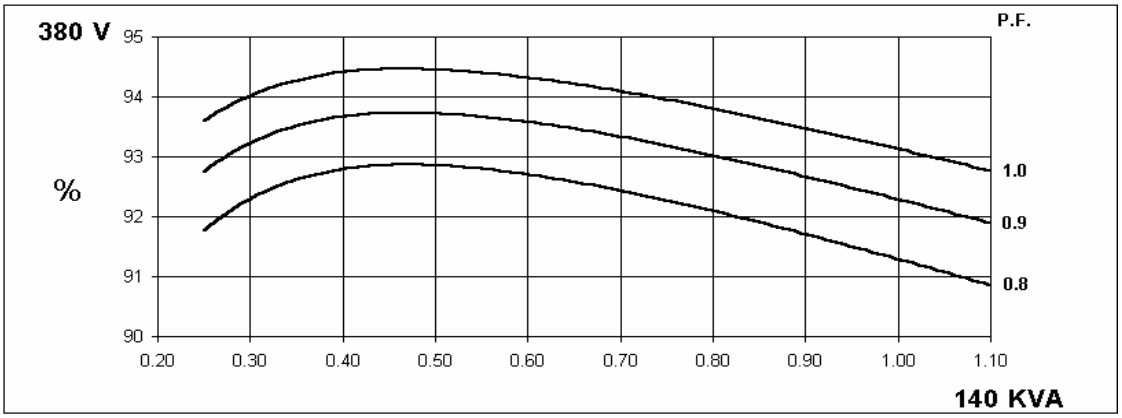
50 Hz

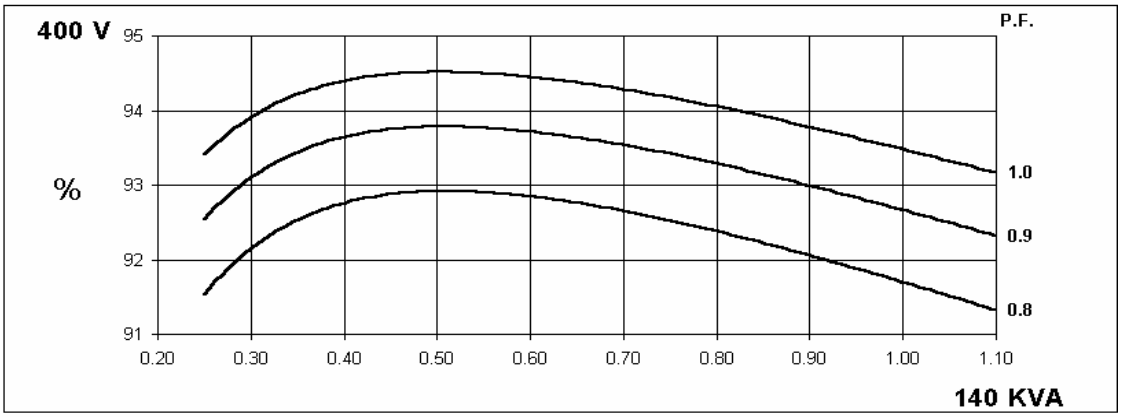
UCI274E

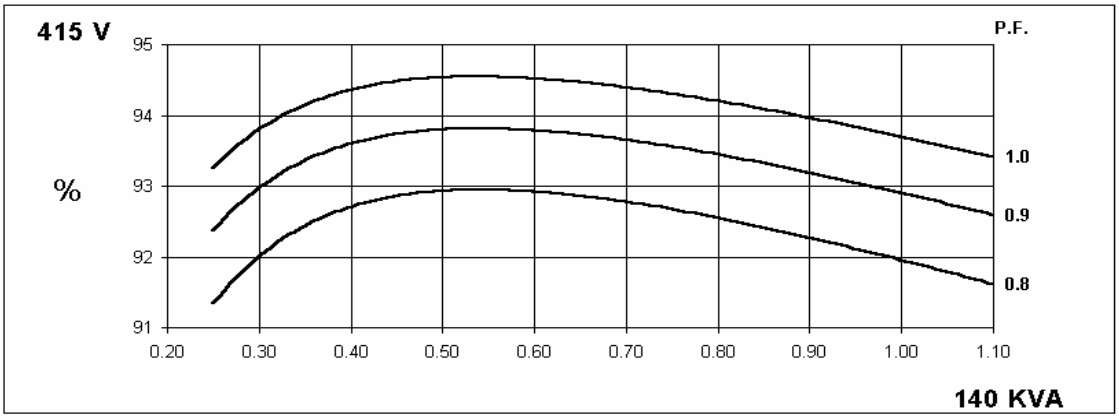
Winding 311

STAMFORD

THREE PHASE EFFICIENCY CURVES







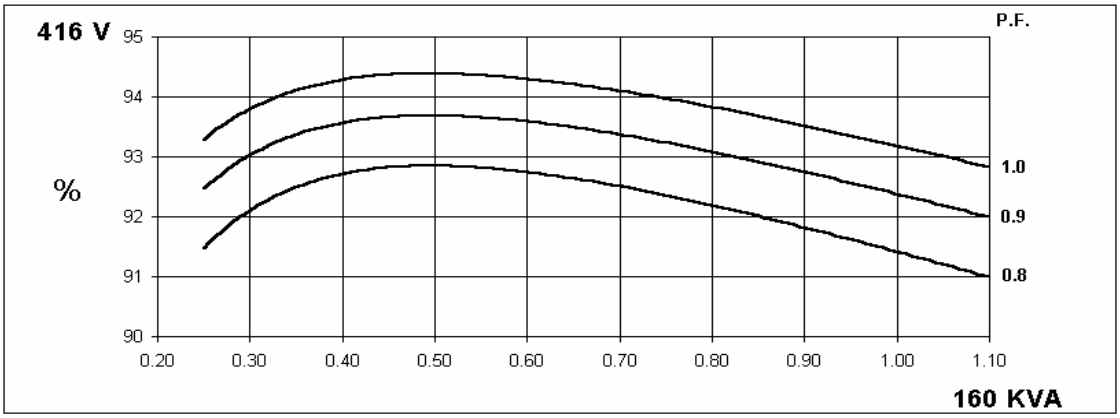
60 Hz

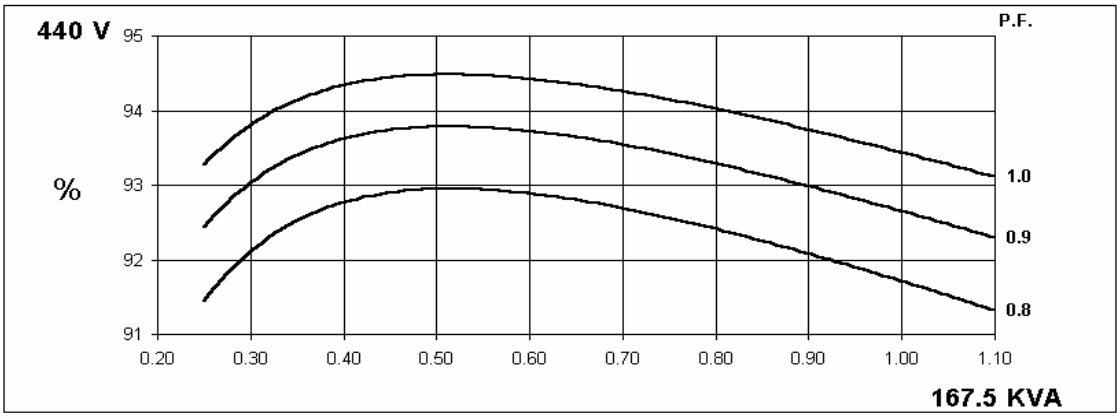
UCI274E

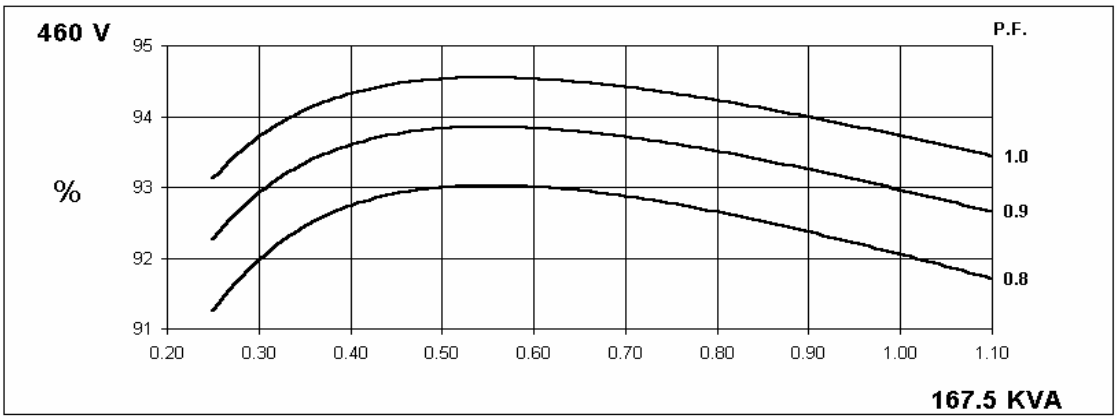
Winding 311

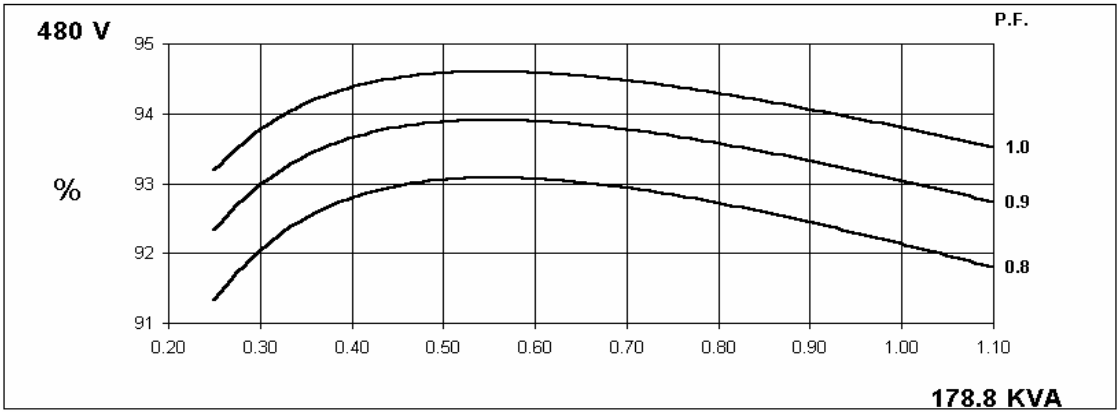
STAMFORD

THREE PHASE EFFICIENCY CURVES









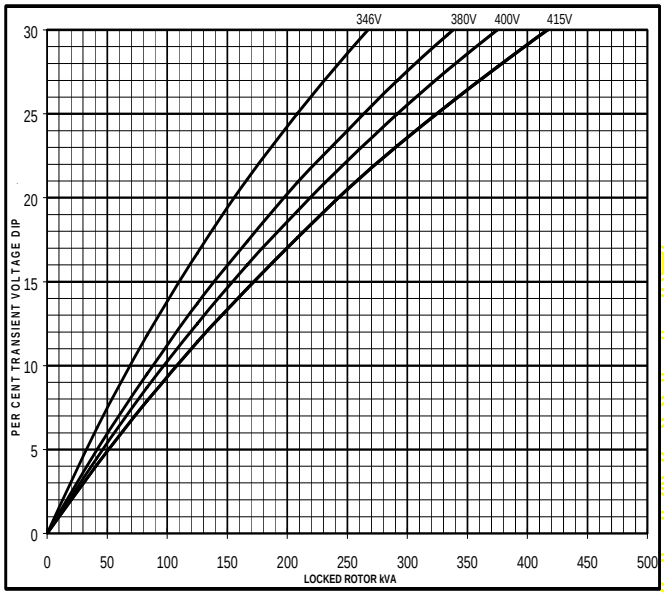
UCI274E

Winding 311

Locked Rotor Motor Starting Curve

50 Hz

MX



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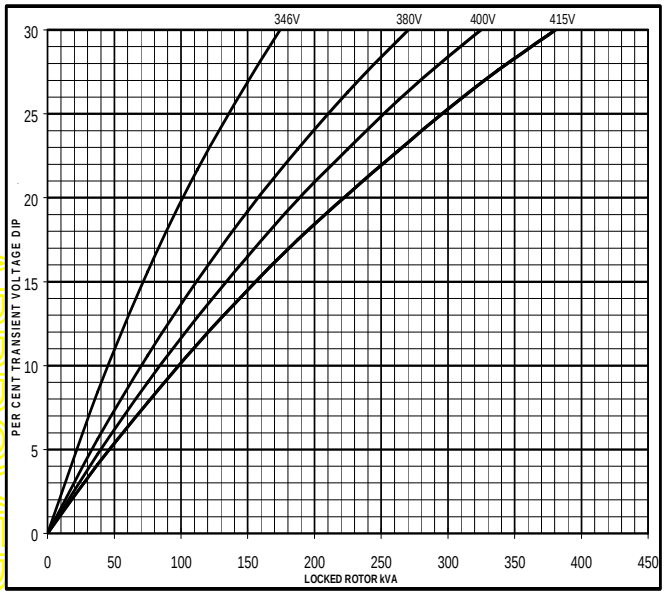
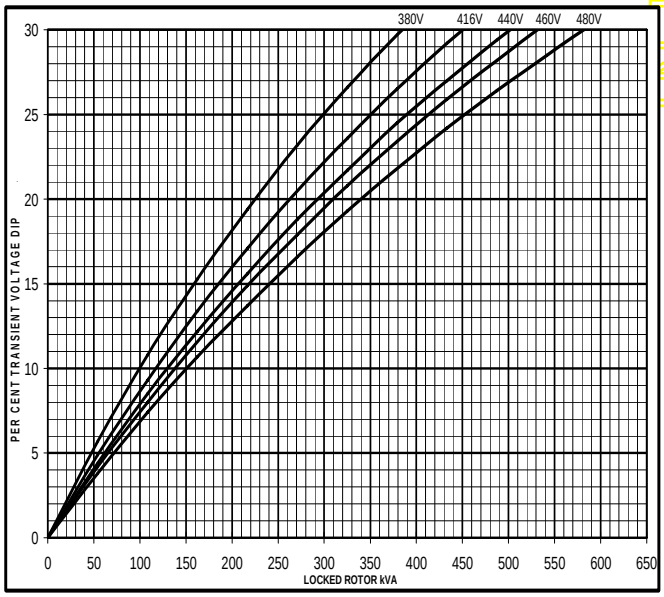
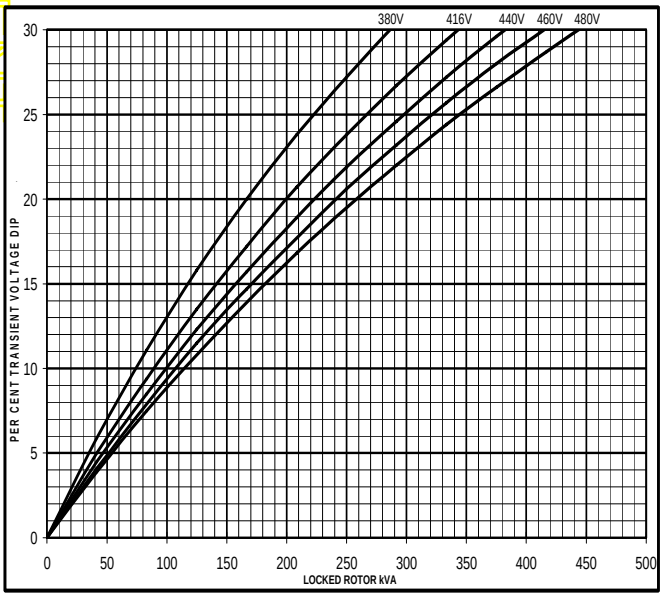


60 Hz

MX

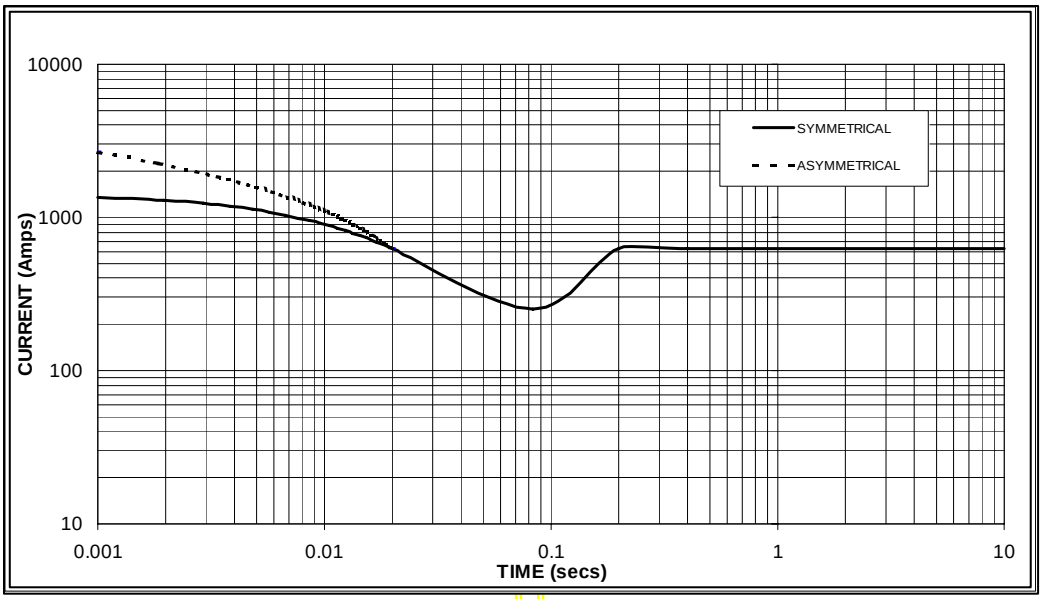


SX



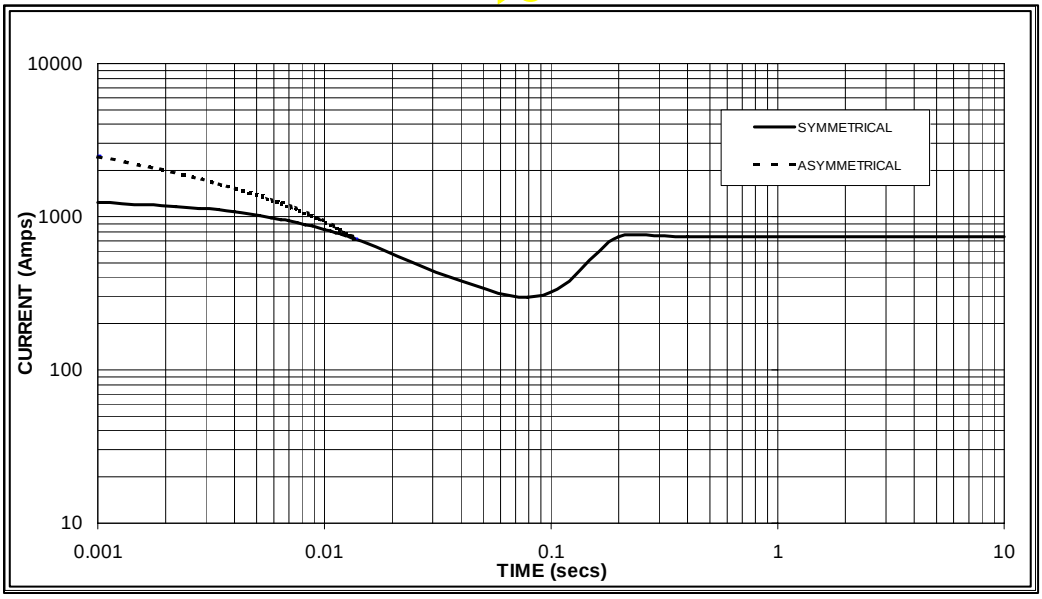
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 630 Amps

60 Hz



Sustained Short Circuit = 740 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
		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 other connection 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

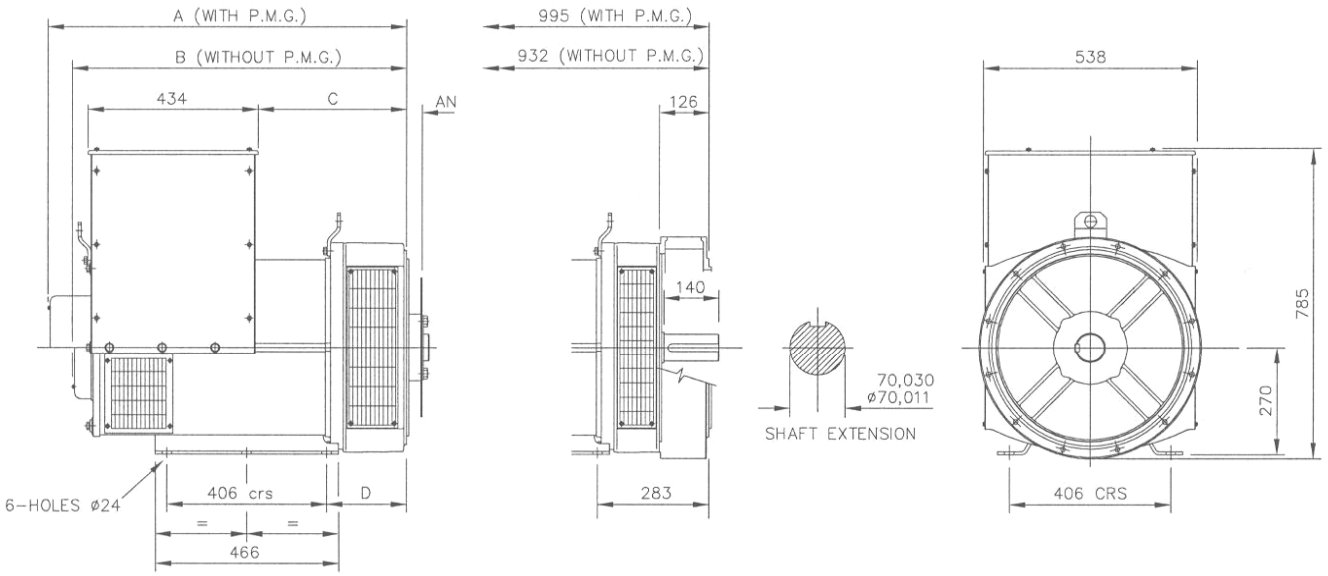
UCI274E

Winding 311 / 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			
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	125.0	125.0	125.0	N/A	140.0	140.0	140.0	N/A	145.0	145.0	145.0	N/A	150.0	150.0	150.0	N/A
	kW	100.0	100.0	100.0	N/A	112.0	112.0	112.0	N/A	116.0	116.0	116.0	N/A	120.0	120.0	120.0	N/A
	Efficiency (%)	91.7	92.1	92.3	N/A	91.3	91.7	92.0	N/A	91.1	91.6	91.8	N/A	91.0	91.4	91.7	N/A
	kW Input	109.1	108.6	108.3	N/A	122.7	122.1	121.7	N/A	127.3	126.6	126.4	N/A	131.9	131.3	130.9	N/A
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	140.0	143.8	143.8	160.0	160.0	167.5	167.5	178.8	170.0	175.0	175.0	187.5	175.0	181.3	181.3	193.8
	kW	112.0	115.0	115.0	128.0	128.0	134.0	134.0	143.0	136.0	140.0	140.0	150.0	140.0	145.0	145.0	155.0
	Efficiency (%)	91.9	92.2	92.5	92.5	91.4	91.7	92.1	92.1	91.2	91.5	91.9	92.0	91.0	91.4	91.8	91.9
	kW Input	121.9	124.8	124.4	138.4	140.0	146.1	145.5	155.3	149.1	153.0	152.3	163.0	153.8	158.7	158.0	168.7

DIMENSIONS



SINGLE BEARING ADAPTORS				
ADAPTOR	A	B	C	D
SAE 1	928,3	865,3	389,3	216,3
SAE 2	914	851	375	202
SAE 3	914	851	375	202

COUPLING DISCS	
DISC	AN
SAE 10	53,98
SAE 11,5	39,68
SAE 14	25,40

APPROVED DOCUMENT

STAMFORD

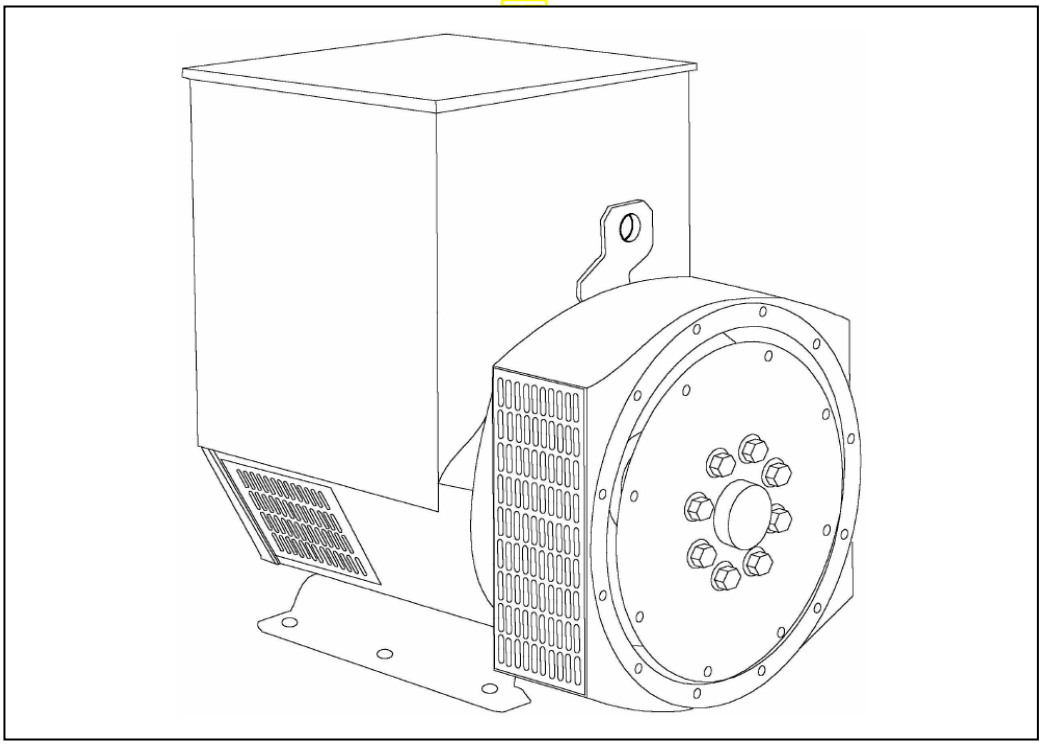
Head Office Address:
Barnack Road, Stamford
Lincolnshire, PE9 2NB
United Kingdom
Tel: +44 (0) 1780 484000
Fax: +44 (0) 1780 484100

www.cumminsgeneratortechnologies.com

STAMFORD®

UCI274F - Winding 311

Technical Data Sheet



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VOLTAGE REGULATORS

SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

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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.

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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.

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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.

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

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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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.024 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.52 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.091 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. 6315-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6310-2RS (ISO)						
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	530 kg				545 kg			
WEIGHT WOUND STATOR	200 kg				200 kg			
WEIGHT WOUND ROTOR	188.67 kg				177.71 kg			
WR² INERTIA	1.555 kgm²				1.5044 kgm²			
SHIPPING WEIGHTS in a crate	563 kg				577 kg			
PACKING CRATE SIZE	123 x 67 x 103(cm)				123 x 67 x 103(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.514 m³/sec 1090 cfm				0.617 m³/sec 1308 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	160	160	160	N/A	181.3	190	190	206.3
Xd DIR. AXIS SYNCHRONOUS	2.24	2.02	1.88	-	2.53	2.37	2.17	2.16
X'd DIR. AXIS TRANSIENT	0.19	0.17	0.16	-	0.21	0.20	0.18	0.18
X"d DIR. AXIS SUBTRANSIENT	0.13	0.12	0.11	-	0.14	0.13	0.12	0.12
Xq QUAD. AXIS REACTANCE	1.38	1.25	1.16	-	1.53	1.43	1.31	1.31
X"q QUAD. AXIS SUBTRANSIENT	0.17	0.15	0.14	-	0.20	0.19	0.17	0.17
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	-	0.09	0.08	0.08	0.08
X_2 NEGATIVE SEQUENCE	0.14	0.13	0.12	-	0.16	0.15	0.14	0.14
X_0 ZERO SEQUENCE	0.08	0.08	0.07	-	0.10	0.09	0.09	0.09
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.035 s							
T"d SUB-TRANSTIME CONST.	0.011 s							
T'do O.C. FIELD TIME CONST.	0.9 s							
Ta ARMATURE TIME CONST.	0.009 s							
SHORT CIRCUIT RATIO	1/Xd							

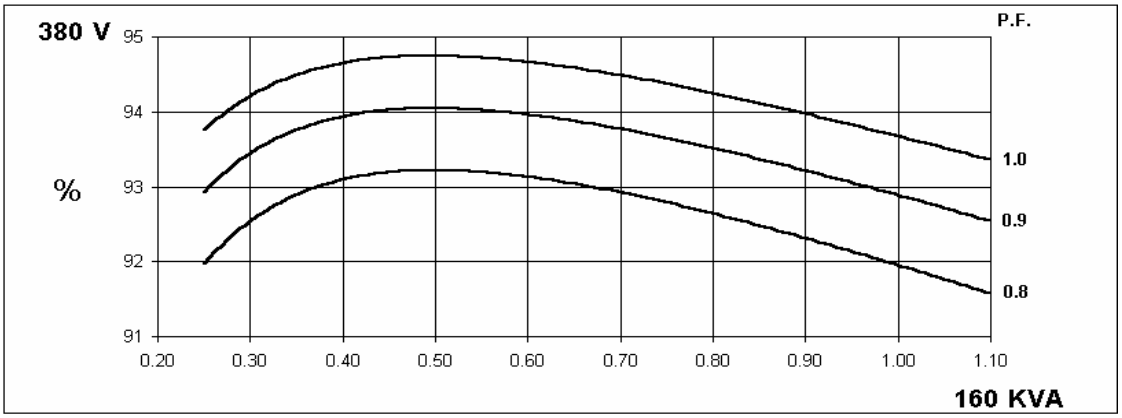
50 Hz

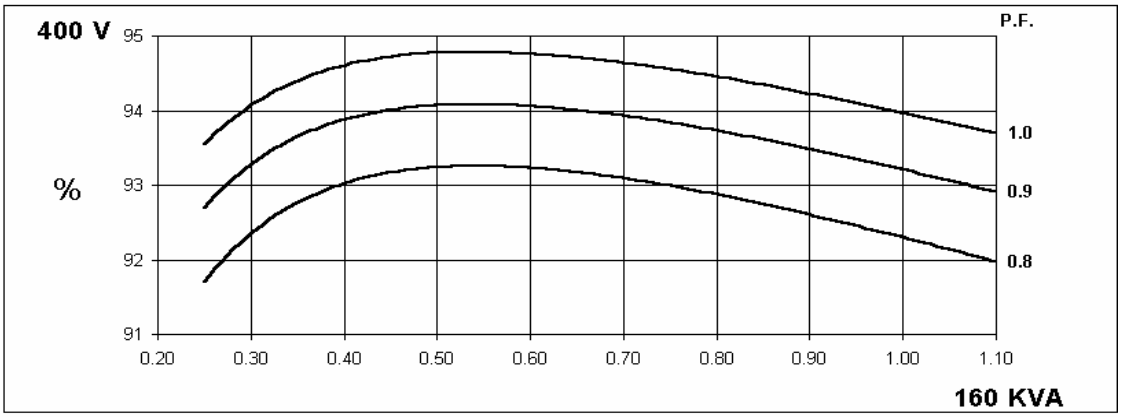
UCI274F

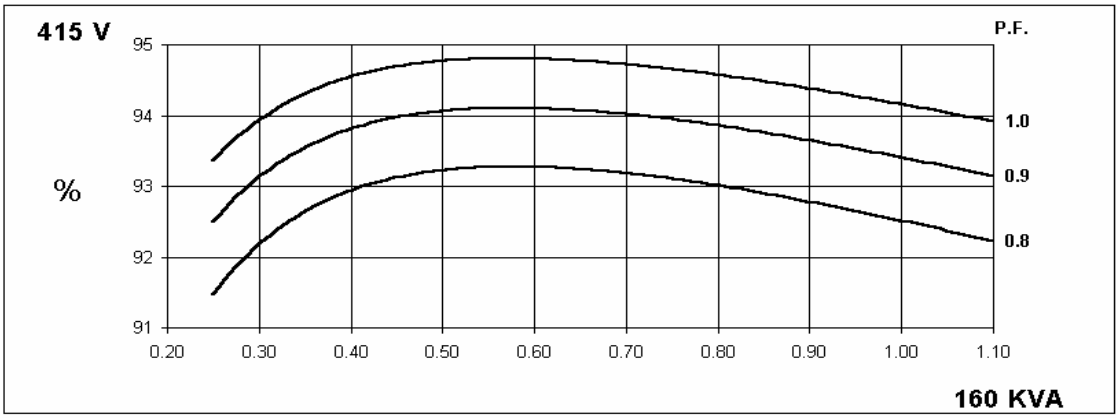
Winding 311

STAMFORD

THREE PHASE EFFICIENCY CURVES







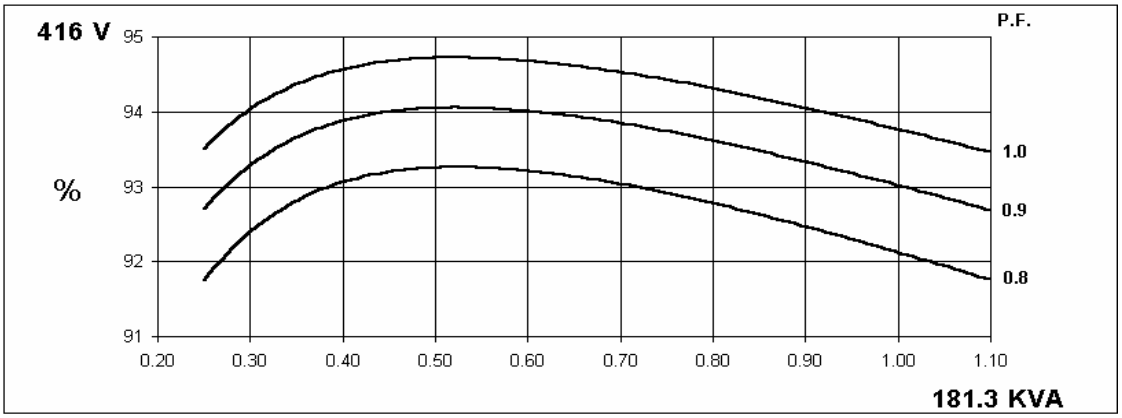
60 Hz

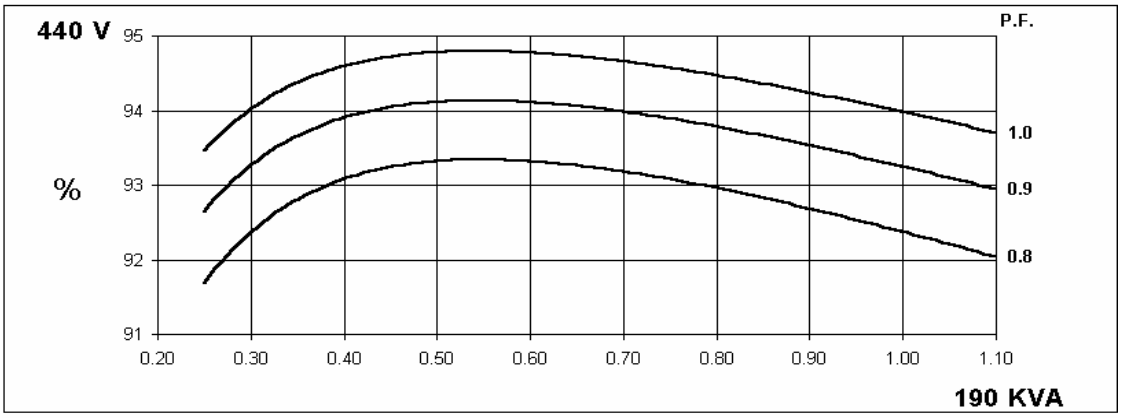
UCI274F

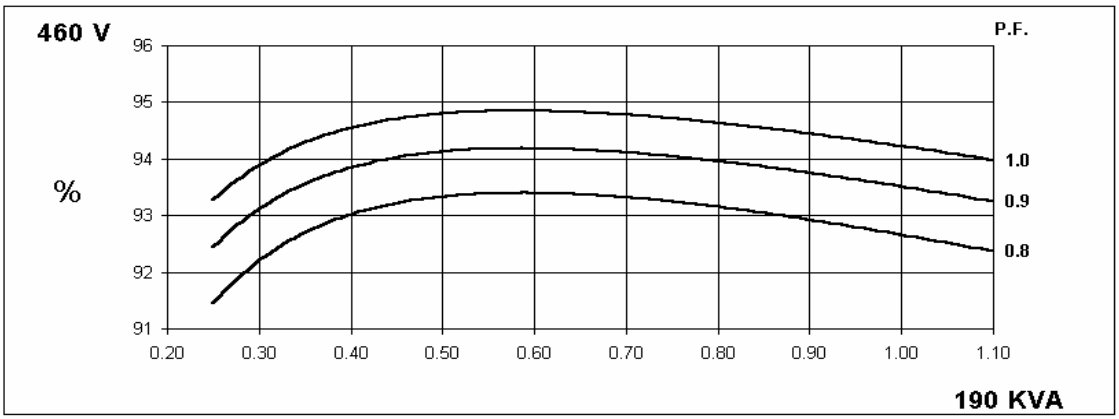
Winding 311

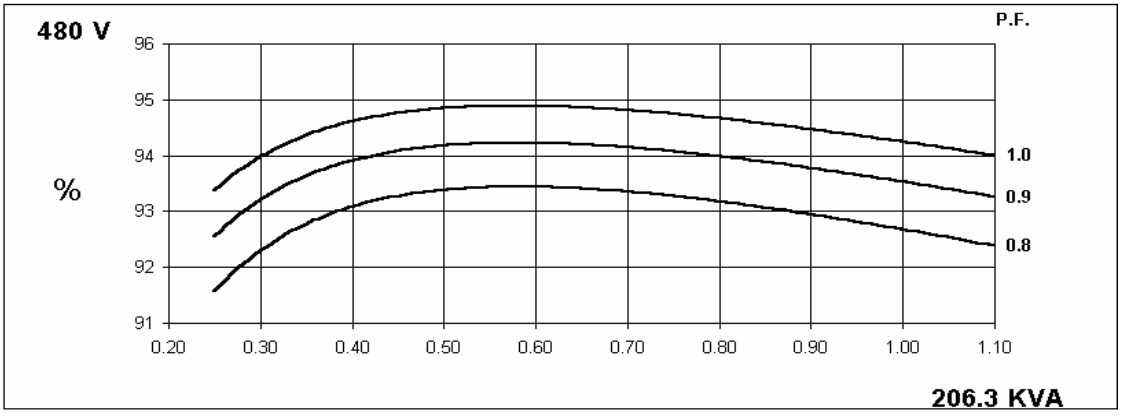
STAMFORD

THREE PHASE EFFICIENCY CURVES









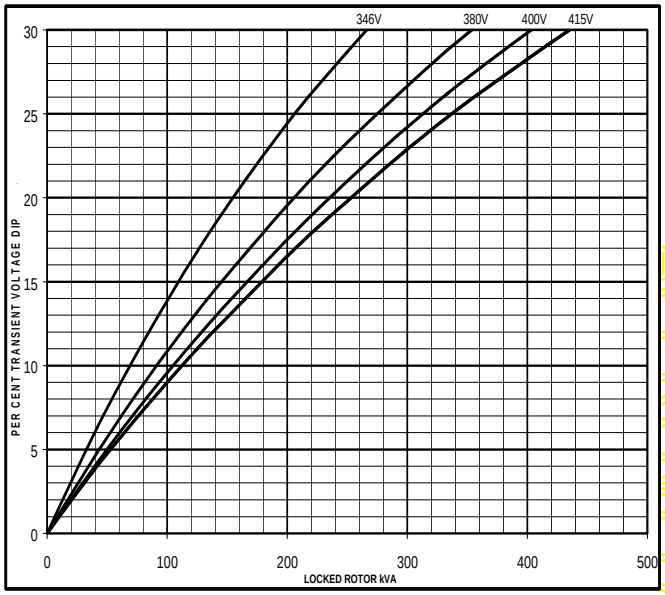
UCI274F

Winding 311

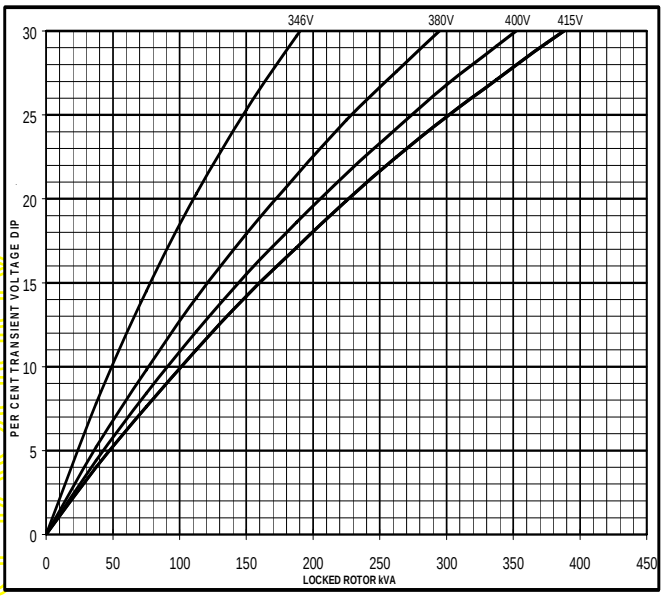
Locked Rotor Motor Starting Curve

50 Hz

MX

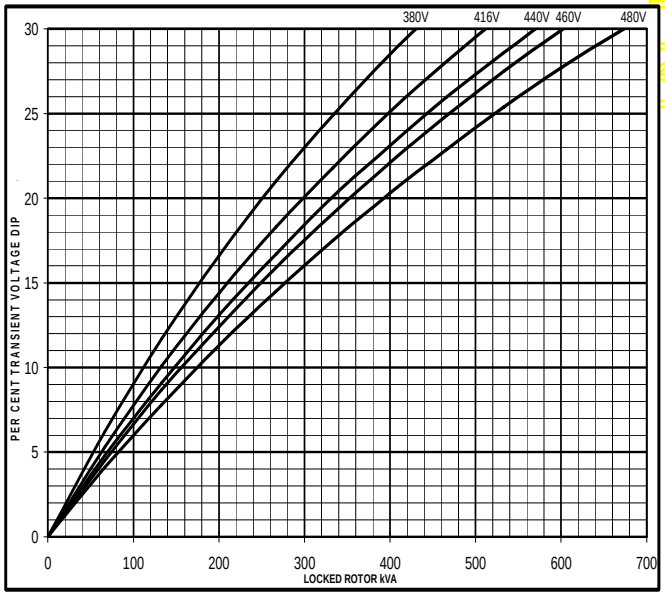


SX

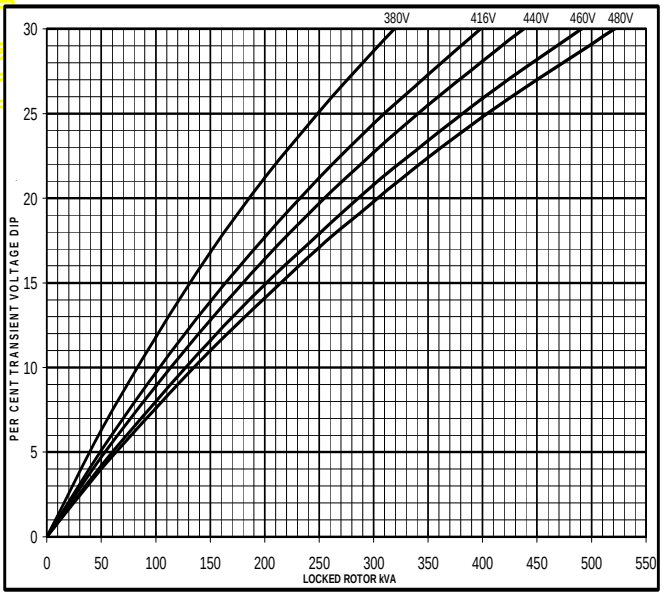


60 Hz

MX

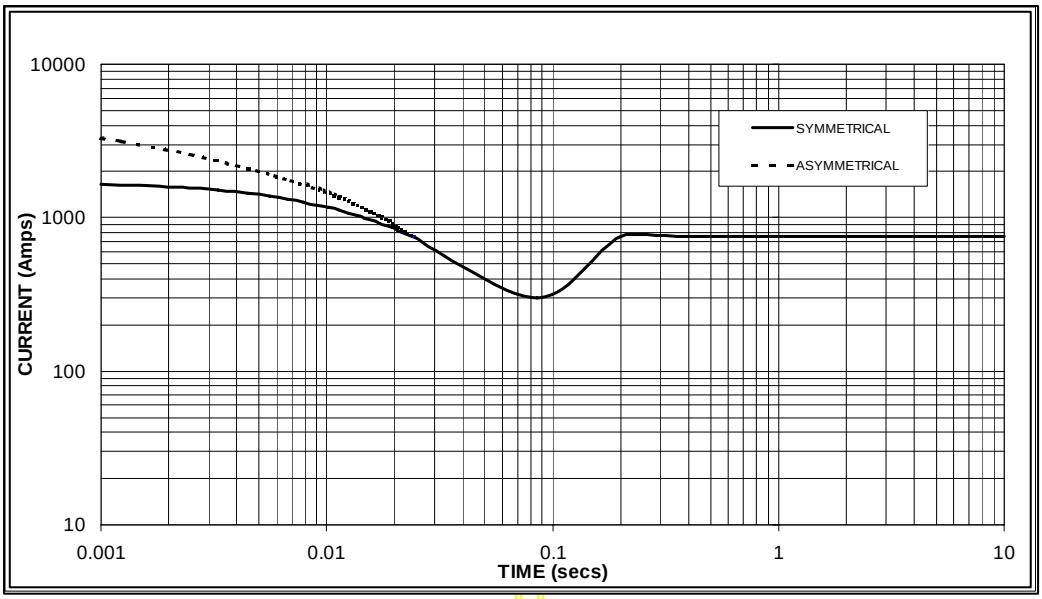


SX



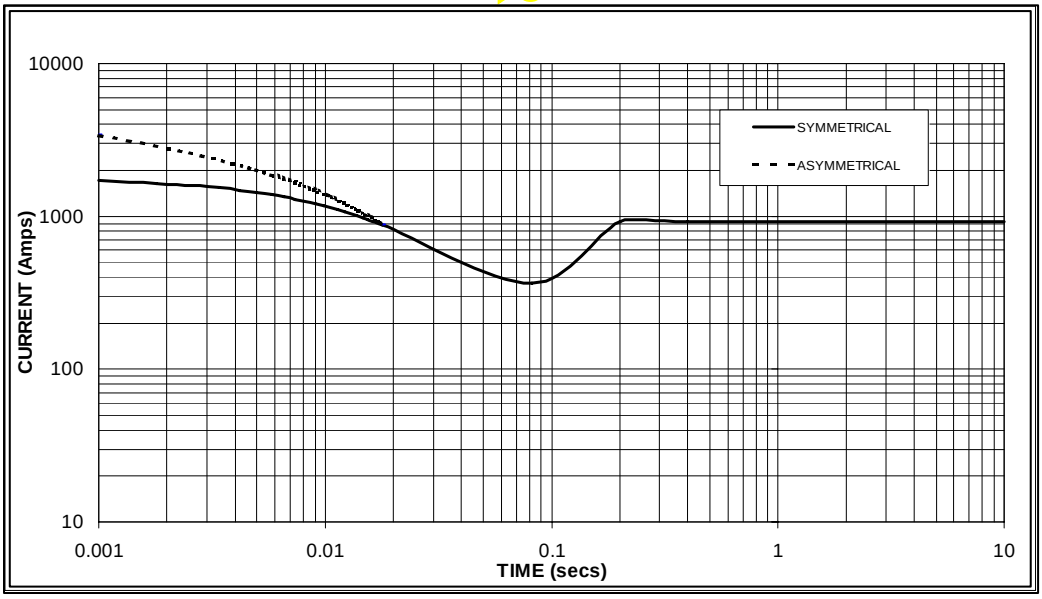
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 750 Amps

60 Hz



Sustained Short Circuit = 920 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
		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 other connection 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

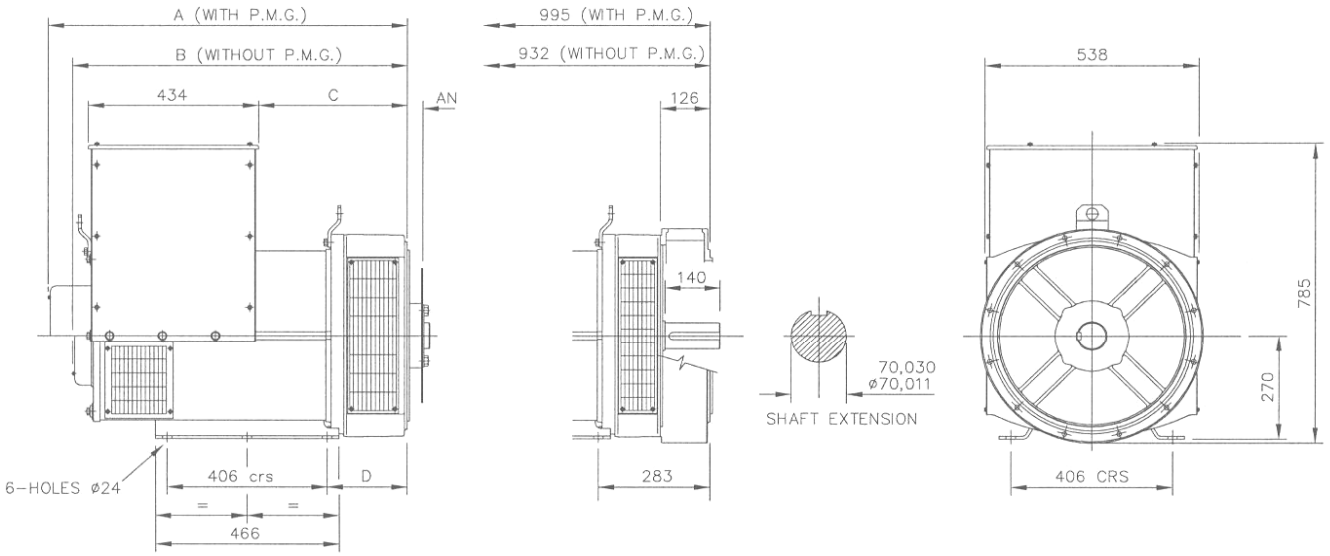
UCI274F

Winding 311 / 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			
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	145.0	145.0	145.0	N/A	160.0	160.0	160.0	N/A	170.0	170.0	170.0	N/A	175.0	175.0	175.0	N/A
	kW	116.0	116.0	116.0	N/A	128.0	128.0	128.0	N/A	136.0	136.0	136.0	N/A	140.0	140.0	140.0	N/A
	Efficiency (%)	92.3	92.6	92.8	N/A	92.0	92.3	92.5	N/A	91.7	92.1	92.3	N/A	91.6	92.0	92.2	N/A
	kW Input	125.7	125.3	125.0	N/A	139.1	138.7	138.4	N/A	148.3	147.7	147.3	N/A	152.8	152.2	151.8	N/A
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	162.5	172.5	172.5	187.5	181.3	190.0	190.0	206.3	187.5	200.0	200.0	212.5	192.5	206.3	206.3	218.8
	kW	130.0	138.0	138.0	150.0	145.0	152.0	152.0	165.0	150.0	160.0	160.0	170.0	154.0	165.0	165.0	175.0
	Efficiency (%)	92.5	92.7	92.9	92.9	92.1	92.4	92.7	92.7	92.0	92.2	92.5	92.6	91.9	92.1	92.4	92.5
	kW Input	140.5	148.9	148.5	161.5	157.5	164.5	164.0	178.0	163.0	173.5	173.0	183.6	167.6	179.2	178.6	189.2

DIMENSIONS



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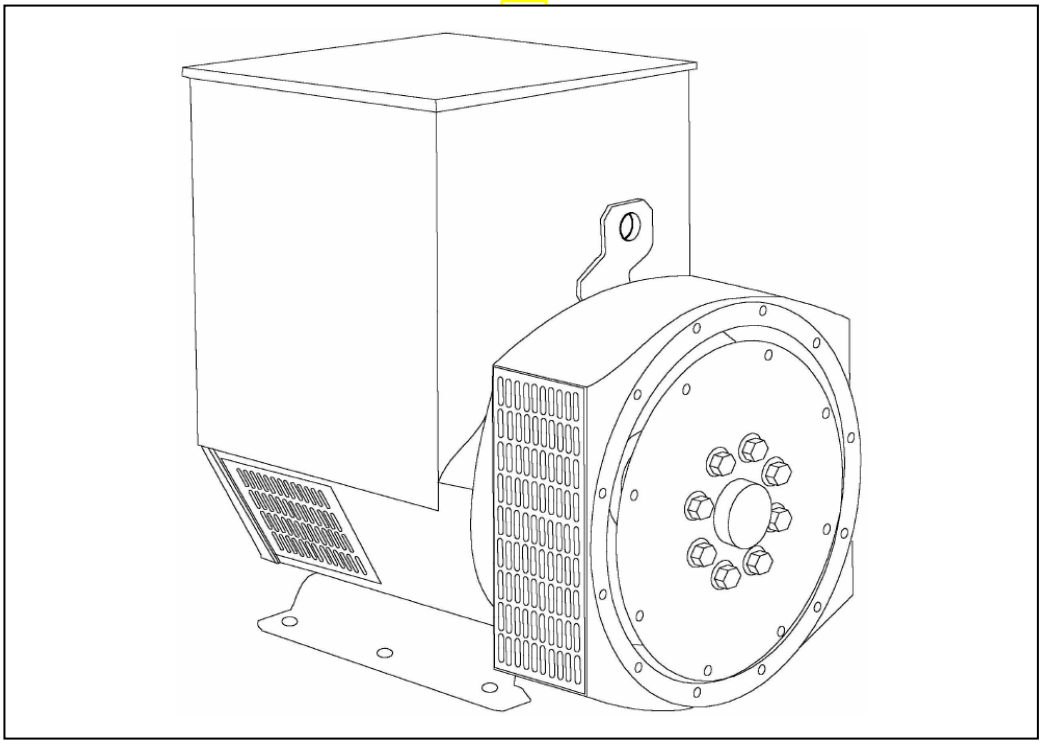
STAMFORD®

UCI274G - Winding 311

Technical Data Sheet



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Front cover drawing typical of product range.

STAMFORD

WINDING 311

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A.V.R.	MX321	MX341	
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SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVES (page 7)		

CONTROL SYSTEM	SELF EXCITED		
A.V.R.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.0199 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.69 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.091 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. 6315-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6310-2RS (ISO)						
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	580 kg				598 kg			
WEIGHT WOUND STATOR	225 kg				225 kg			
WEIGHT WOUND ROTOR	210.35 kg				199.39 kg			
WR² INERTIA	1.7674 kgm²				1.7169 kgm²			
SHIPPING WEIGHTS in a crate	613 kg				630 kg			
PACKING CRATE SIZE	123 x 67 x 103 (cm)				123 x 67 x 103 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.514 m³/sec 1090 cfm				0.617 m³/sec 1308 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	182	182	182	N/A	205	218	218	231
Xd DIR. AXIS SYNCHRONOUS	2.15	1.94	1.80	-	2.43	2.31	2.11	2.06
X'd DIR. AXIS TRANSIENT	0.19	0.17	0.16	-	0.21	0.20	0.18	0.18
X"d DIR. AXIS SUBTRANSIENT	0.13	0.12	0.11	-	0.15	0.14	0.13	0.12
Xq QUAD. AXIS REACTANCE	1.29	1.16	1.08	-	1.47	1.40	1.28	1.24
X"q QUAD. AXIS SUBTRANSIENT	0.18	0.16	0.15	-	0.18	0.17	0.16	0.15
X_L LEAKAGE REACTANCE	0.08	0.07	0.07	-	0.09	0.08	0.08	0.07
X_2 NEGATIVE SEQUENCE	0.13	0.12	0.11	-	0.16	0.15	0.13	0.13
X_0 ZERO SEQUENCE	0.08	0.07	0.07	-	0.10	0.09	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.038 s							
T"d SUB-TRANSTIME CONST.	0.012 s							
T'do O.C. FIELD TIME CONST.	1 s							
Ta ARMATURE TIME CONST.	0.01 s							
SHORT CIRCUIT RATIO	1/Xd							

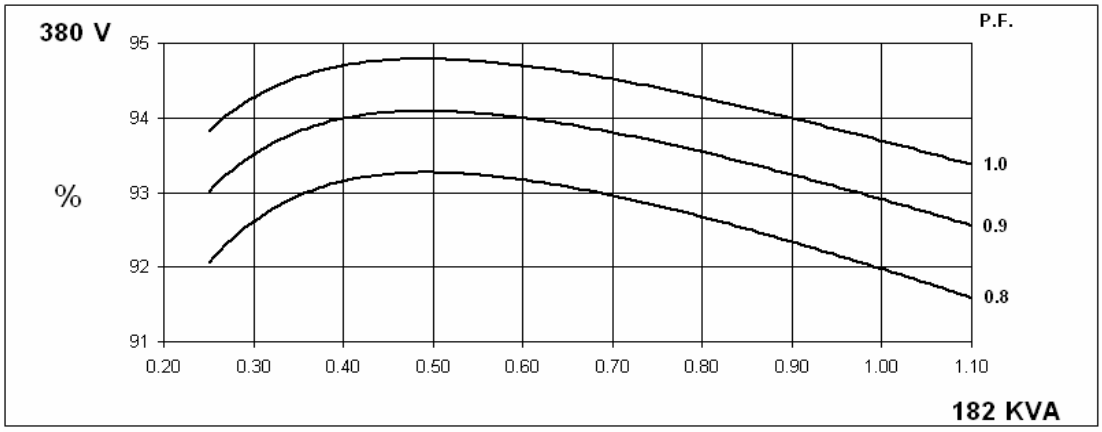
50 Hz

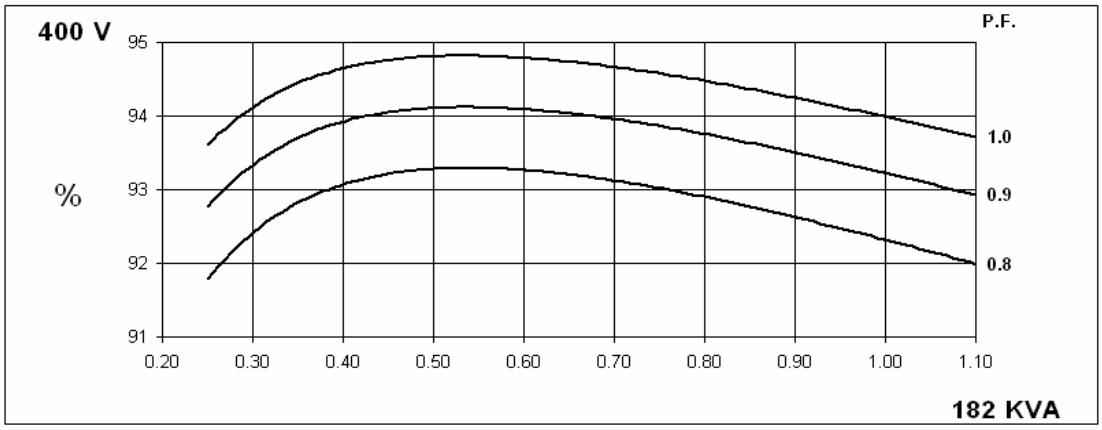
UCI274G

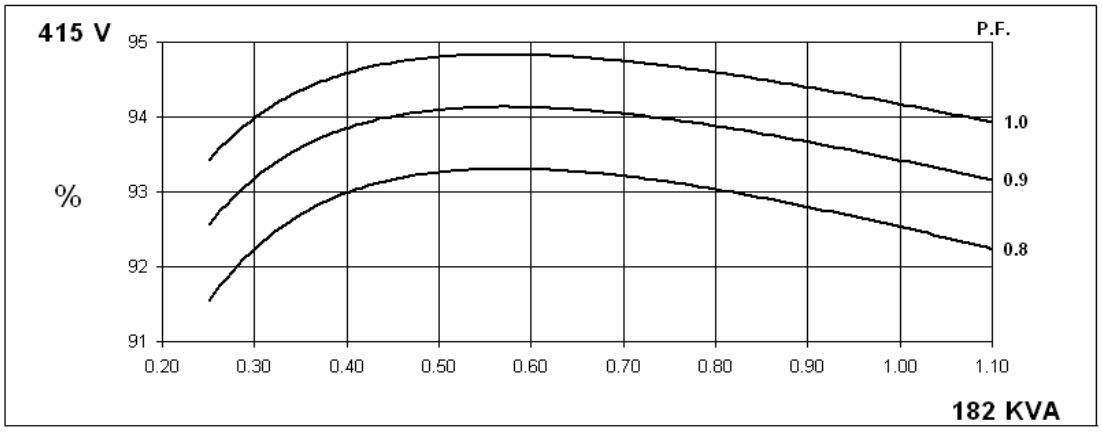
Winding 311

STAMFORD

THREE PHASE EFFICIENCY CURVES







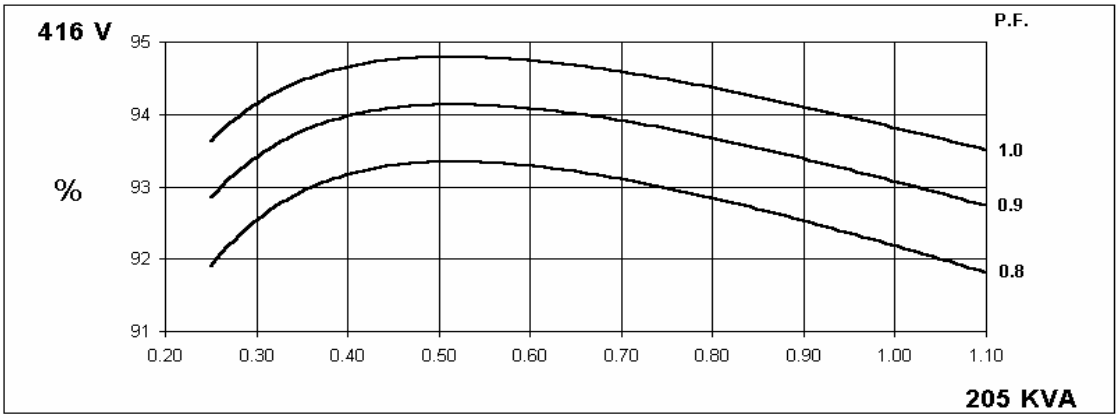
60 Hz

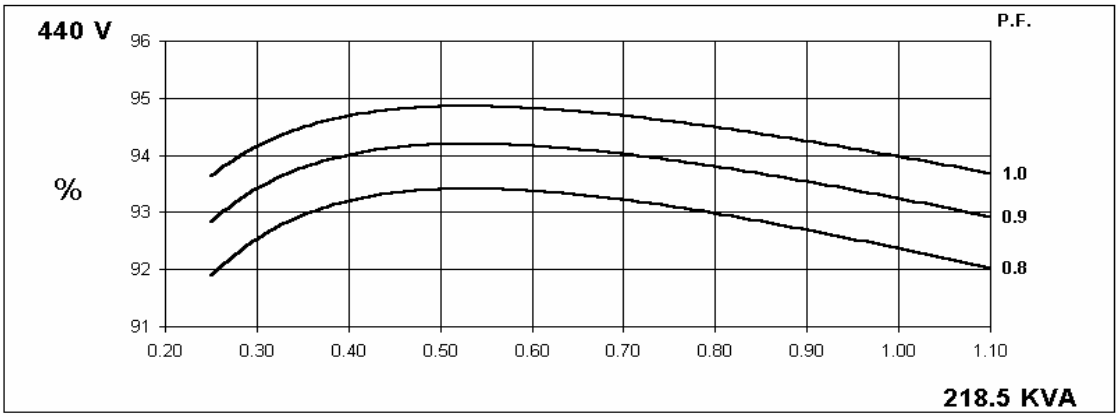
UCI274G

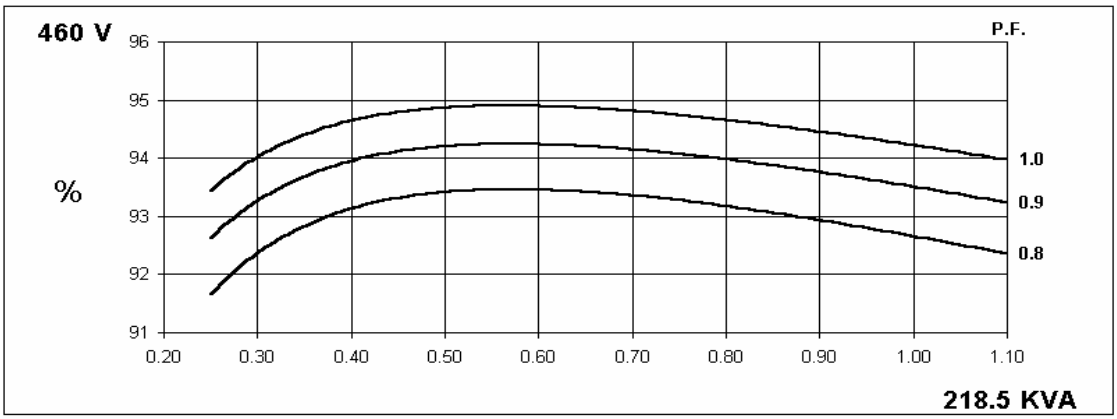
Winding 311

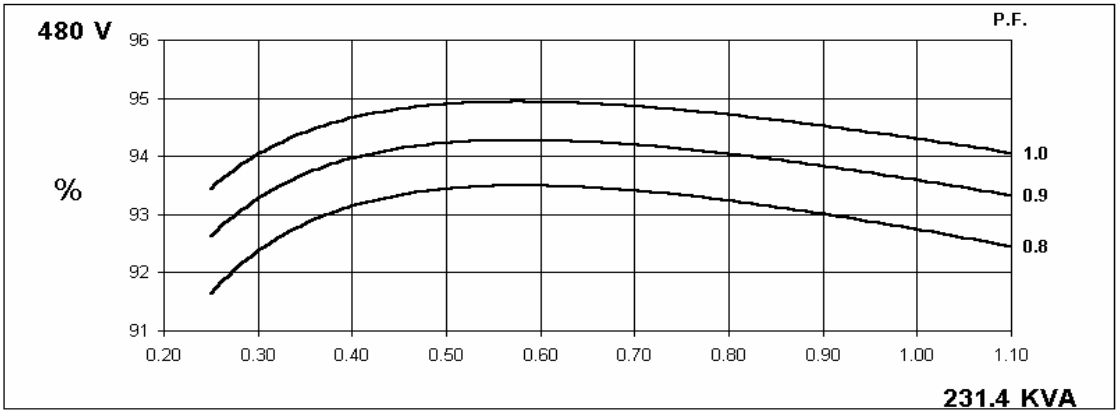
STAMFORD

THREE PHASE EFFICIENCY CURVES









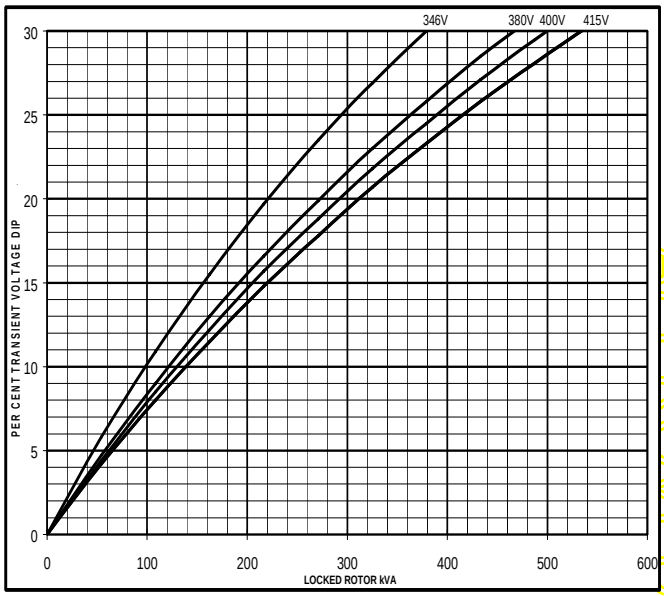
UCI274G

Winding 311

Locked Rotor Motor Starting Curve

50 Hz

MX



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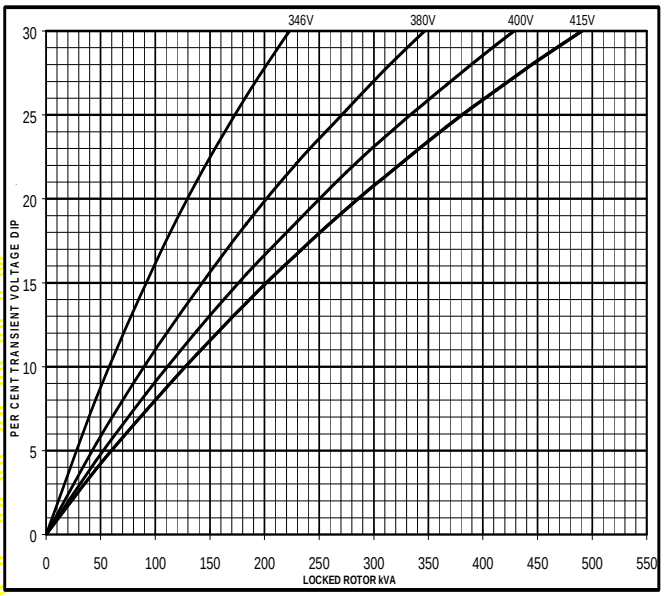
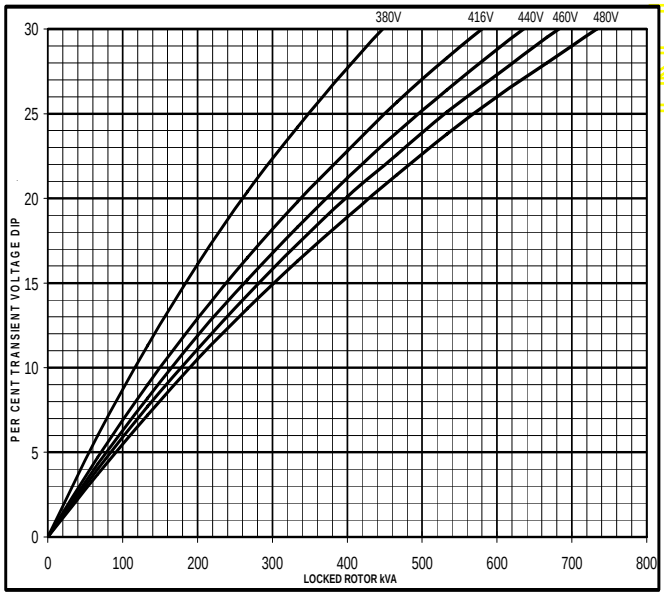


60 Hz

MX



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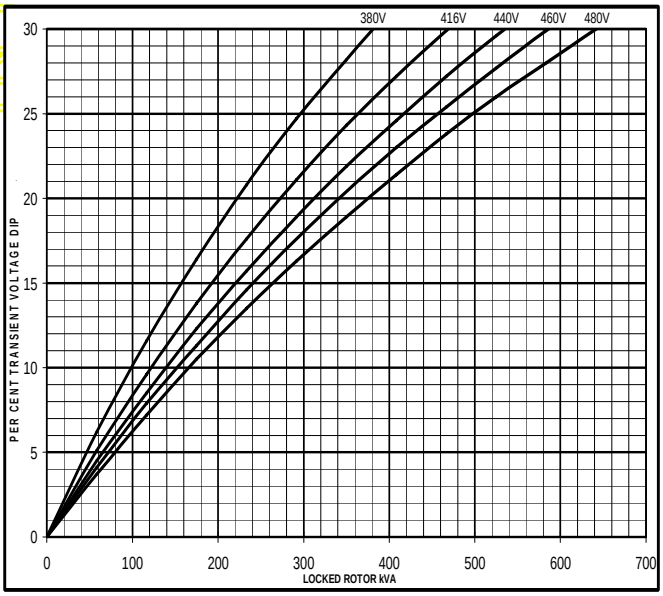
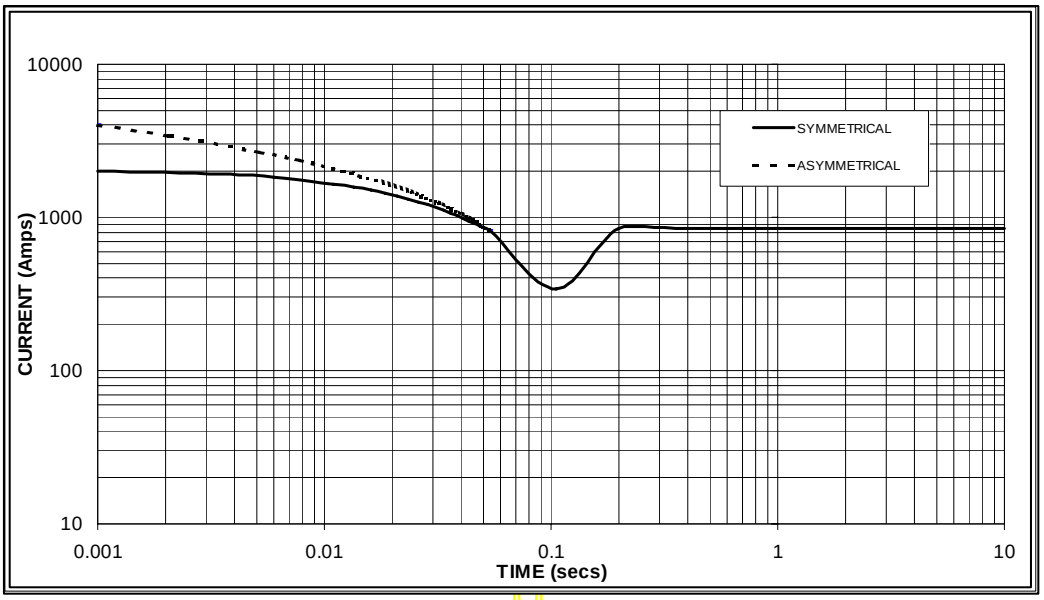


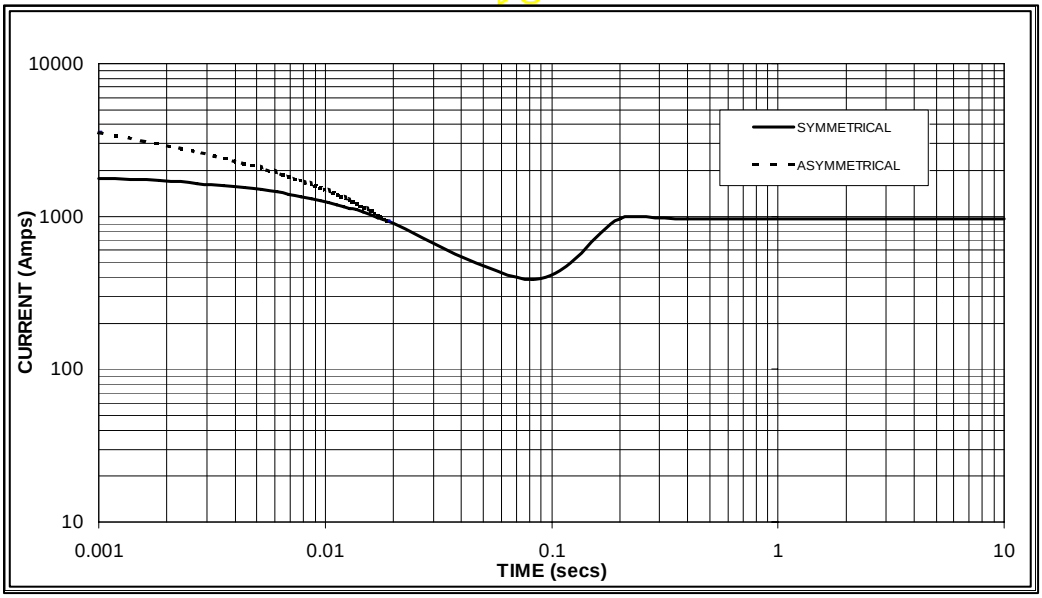
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 850 Amps

60 Hz



Sustained Short Circuit = 970 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
		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 other connection 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

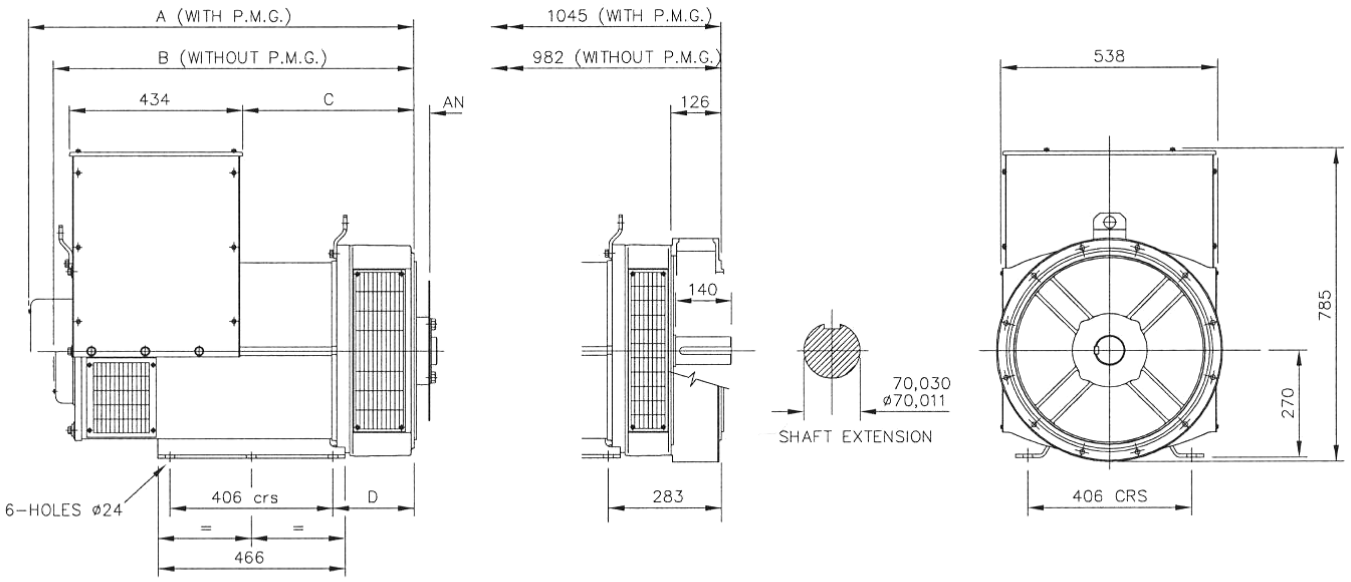
UCI274G

Winding 311 / 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			
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	164.6	164.6	164.6	N/A	182.0	182.0	182.0	N/A	187.0	187.0	187.0	N/A	200.0	200.0	200.0	N/A
	kW	131.7	131.7	131.7	N/A	145.6	145.6	145.6	N/A	149.6	149.6	149.6	N/A	160.0	160.0	160.0	N/A
	Efficiency (%)	92.3	92.6	92.8	N/A	92.0	92.3	92.5	N/A	91.9	92.2	92.5	N/A	91.6	92.0	92.2	N/A
	kW Input	142.7	142.2	141.9	N/A	158.3	157.7	157.4	N/A	162.8	162.2	161.8	N/A	174.7	173.9	173.5	N/A
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	192.8	199.0	199.0	212.2	205.0	218.5	218.5	231.4	213.0	228.8	228.8	250.0	218.5	234.0	234.0	253.3
	kW	154.2	159.2	159.2	169.8	164.0	174.8	174.8	185.1	170.4	183.0	183.0	200.0	174.8	187.2	187.2	202.6
	Efficiency (%)	92.4	92.7	92.9	93.0	92.2	92.4	92.7	92.7	92.0	92.2	92.5	92.5	91.9	92.1	92.4	92.5
	kW Input	166.9	171.7	171.4	182.5	177.9	189.2	188.6	199.7	185.2	198.5	197.9	216.2	190.2	203.3	202.6	219.1

DIMENSIONS



SINGLE BEARING ADAPTORS				
ADAPTOR	A	B	C	D
SAE 1	978,3	915,3	439,3	216,3
SAE 2	964	901	425	202
SAE 3	964	901	425	202

COUPLING DISCS	
DISC	AN
SAE 10	53,98
SAE 11,5	39,68
SAE 14	25,40

APPROVED DOCUMENT

STAMFORD

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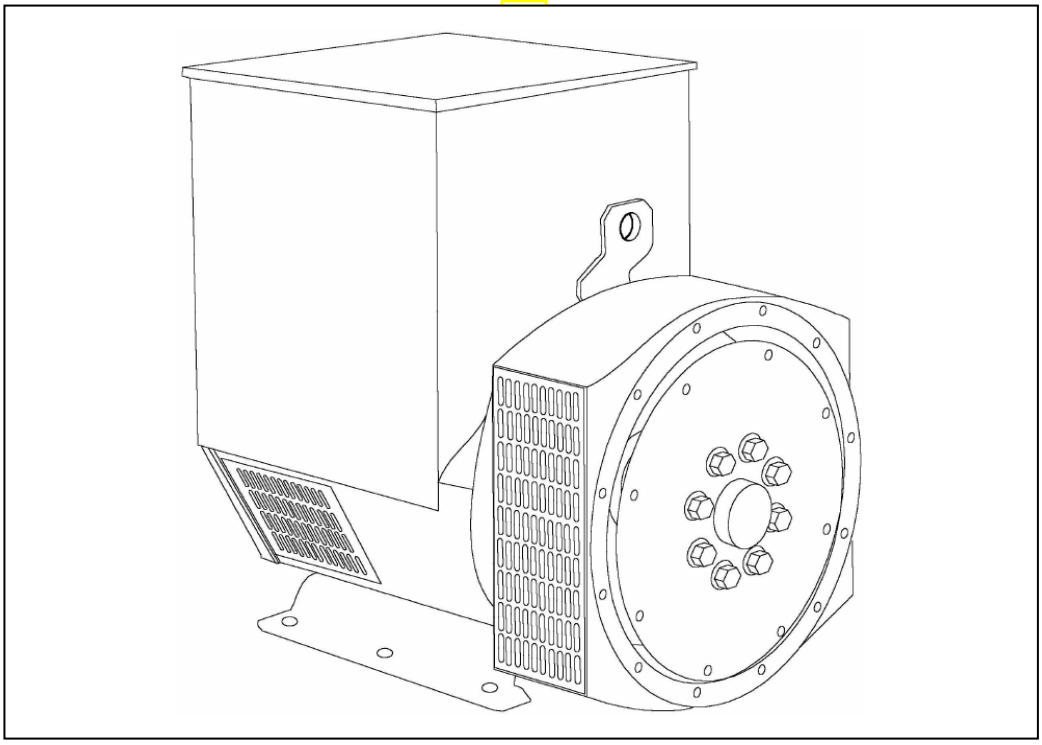
STAMFORD®

UCI274H - 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

SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

AS440 AVR

With this self-excited system the main stator provides power via the 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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.0155 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.82 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.091 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. 6315-2RS (ISO)						
BEARING NON-DRIVE END	BALL. 6310-2RS (ISO)						
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	626 kg				641 kg			
WEIGHT WOUND STATOR	253 kg				253 kg			
WEIGHT WOUND ROTOR	227.53 kg				216.57 kg			
WR² INERTIA	1.9349 kgm²				1.8843 kgm²			
SHIPPING WEIGHTS in a crate	659 kg				673 kg			
PACKING CRATE SIZE	123 x 67 x 103 (cm)				123 x 67 x 103 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.514 m³/sec 1090 cfm				0.617 m³/sec 1308 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	200	200	200	N/A	237.5	245	245	255
Xd DIR. AXIS SYNCHRONOUS	2.11	1.91	1.77	-	2.50	2.31	2.11	2.02
X'd DIR. AXIS TRANSIENT	0.18	0.16	0.15	-	0.21	0.19	0.18	0.17
X"d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	-	0.14	0.13	0.12	0.11
Xq QUAD. AXIS REACTANCE	1.28	1.15	1.07	-	1.53	1.41	1.29	1.23
X"q QUAD. AXIS SUBTRANSIENT	0.17	0.15	0.14	-	0.20	0.18	0.17	0.16
X_L LEAKAGE REACTANCE	0.08	0.08	0.07	-	0.10	0.09	0.08	0.08
X_2 NEGATIVE SEQUENCE	0.13	0.12	0.11	-	0.16	0.15	0.13	0.13
X_0 ZERO SEQUENCE	0.08	0.08	0.07	-	0.10	0.09	0.08	0.08
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.042 s							
T"d SUB-TRANSTIME CONST.	0.012 s							
T'do O.C. FIELD TIME CONST.	1.1 s							
Ta ARMATURE TIME CONST.	0.012 s							
SHORT CIRCUIT RATIO	1/Xd							

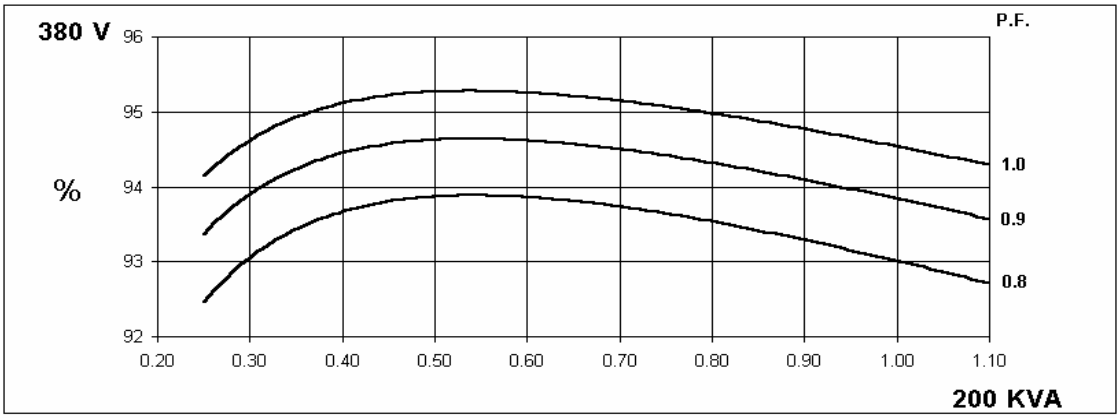
50 Hz

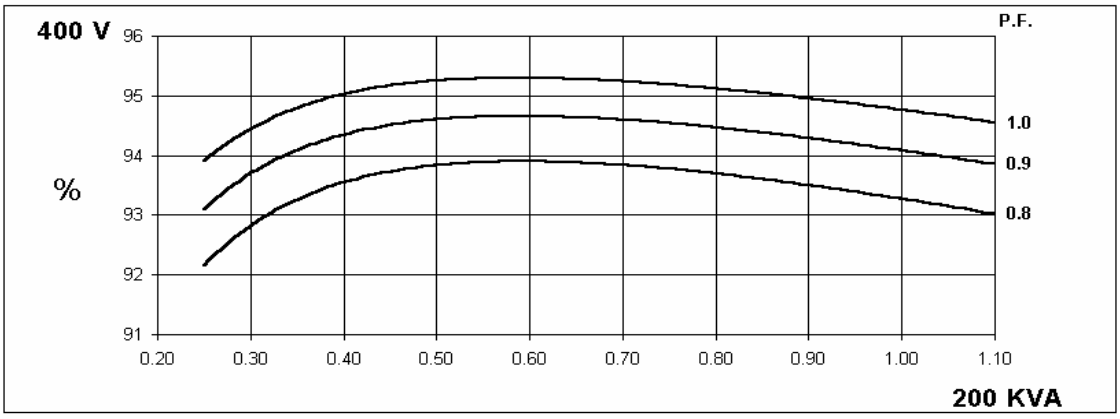
UCI274H

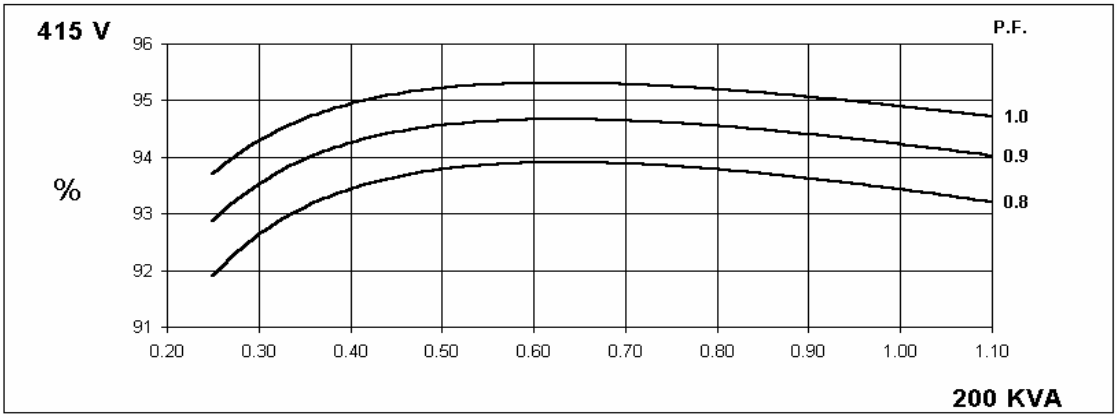
Winding 311

STAMFORD

THREE PHASE EFFICIENCY CURVES







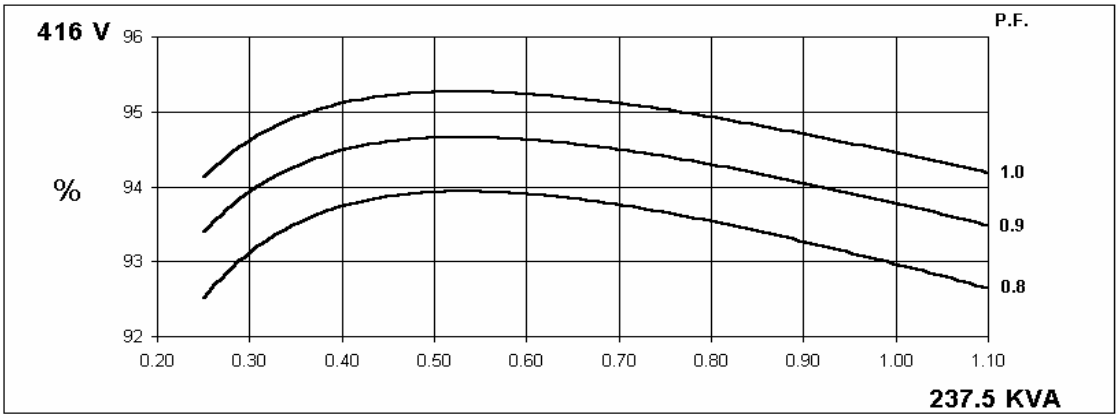
60 Hz

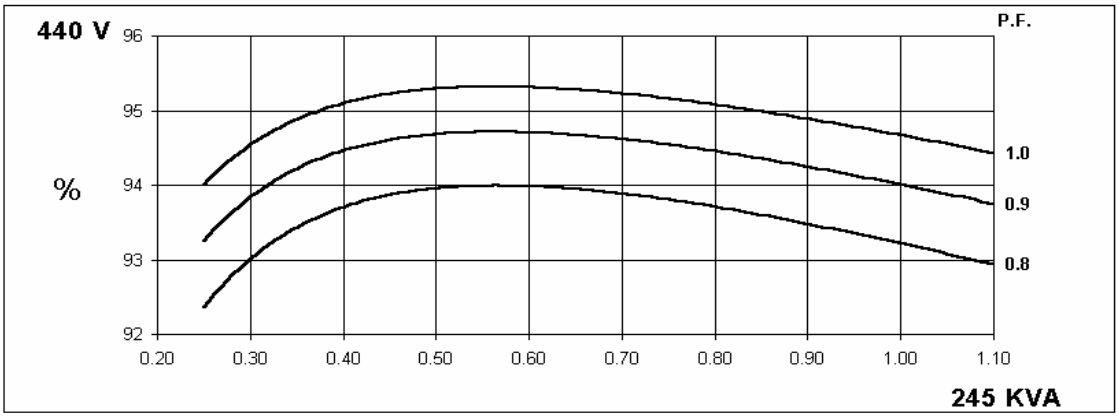
UCI274H

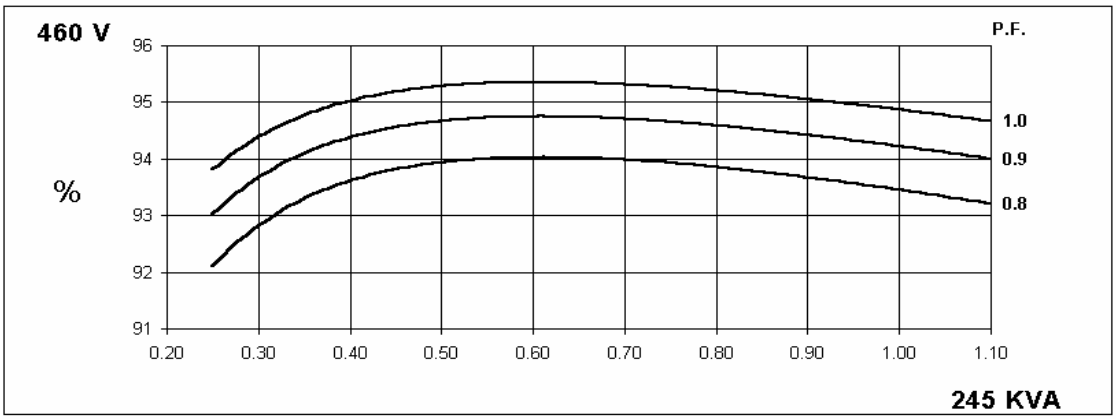
Winding 311

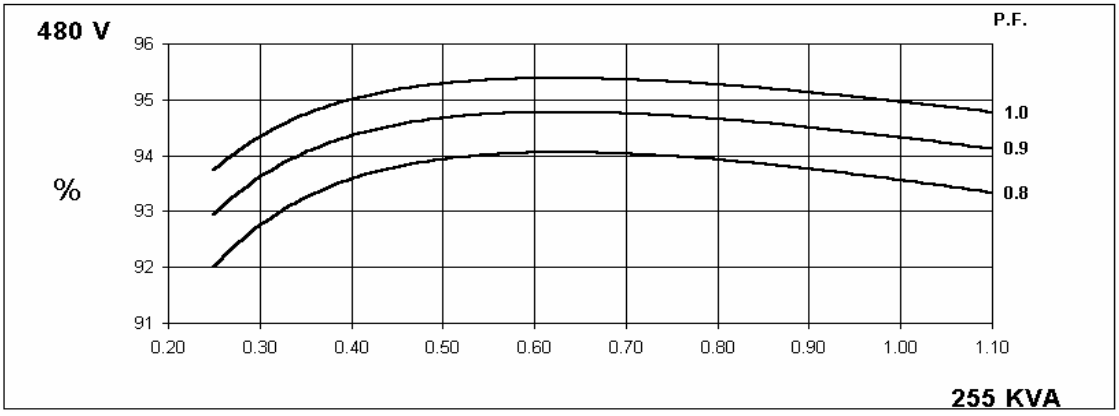
STAMFORD

THREE PHASE EFFICIENCY CURVES









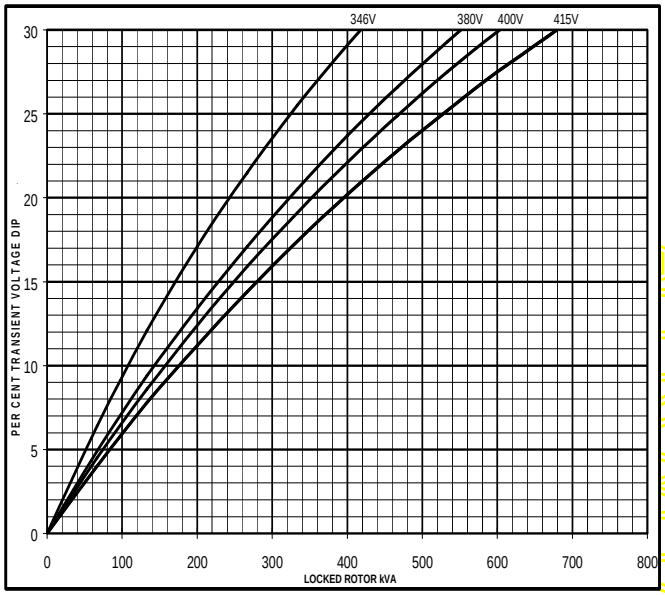
UCI274H

Winding 311

Locked Rotor Motor Starting Curve

50 Hz

MX



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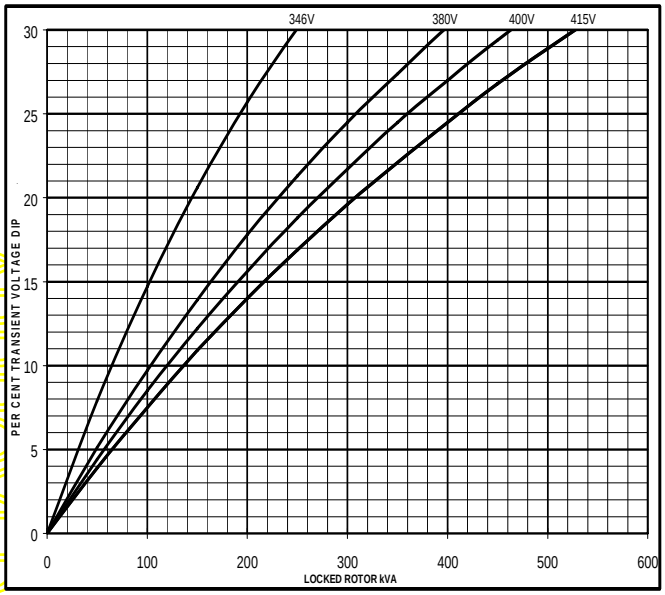
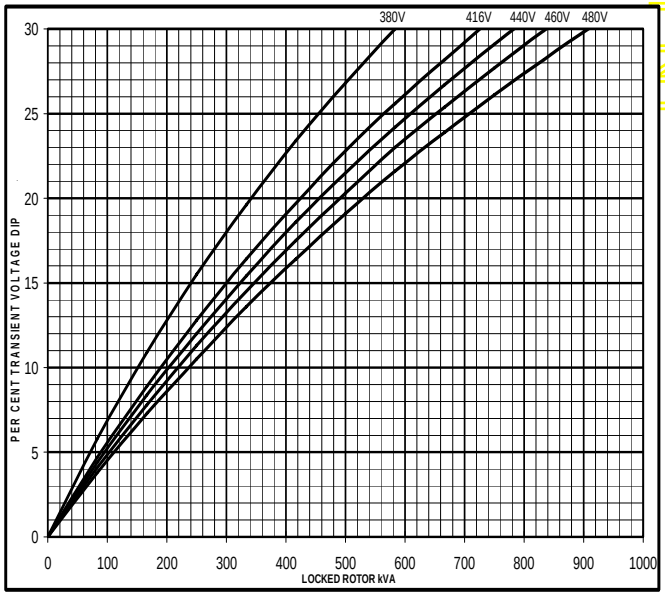
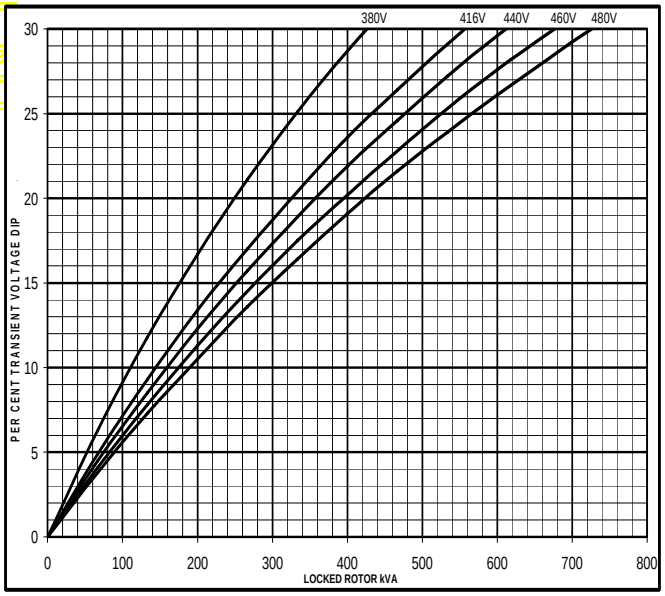


60 Hz

MX

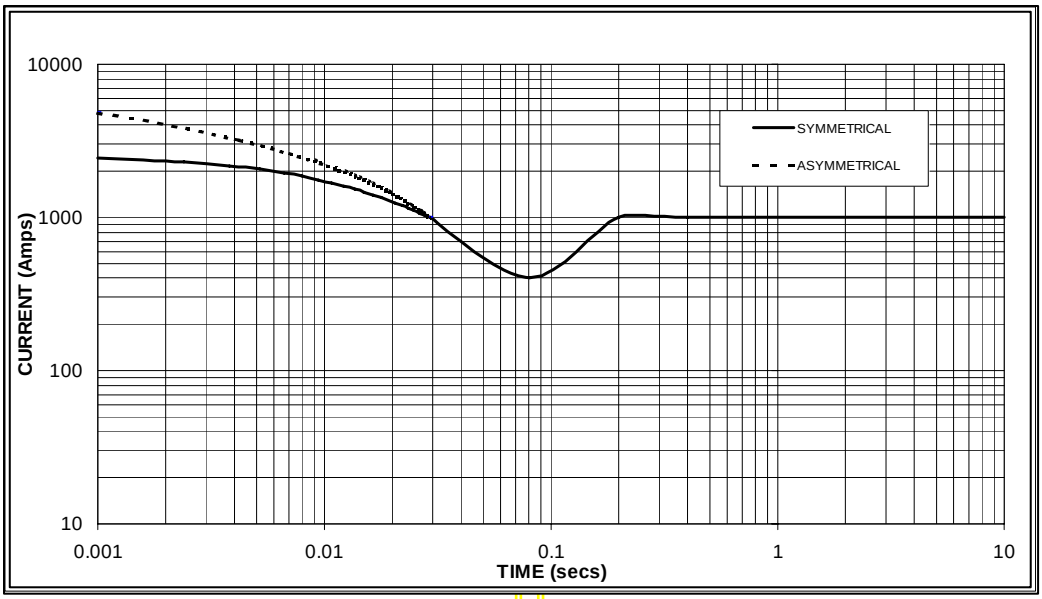


SX



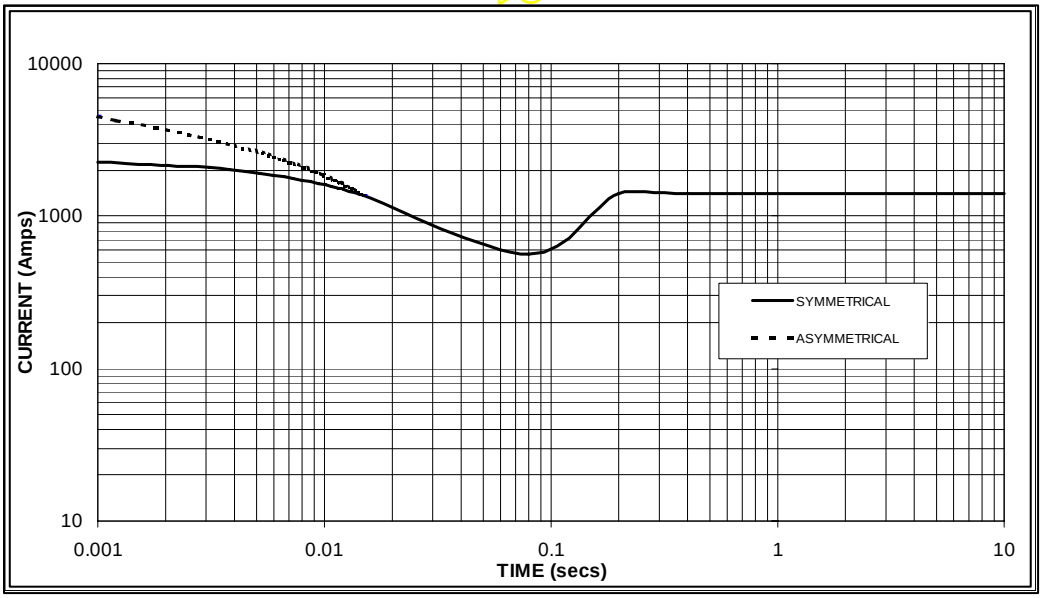
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 1,000 Amps

60 Hz



Sustained Short Circuit = 1,400 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
		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 other connection 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

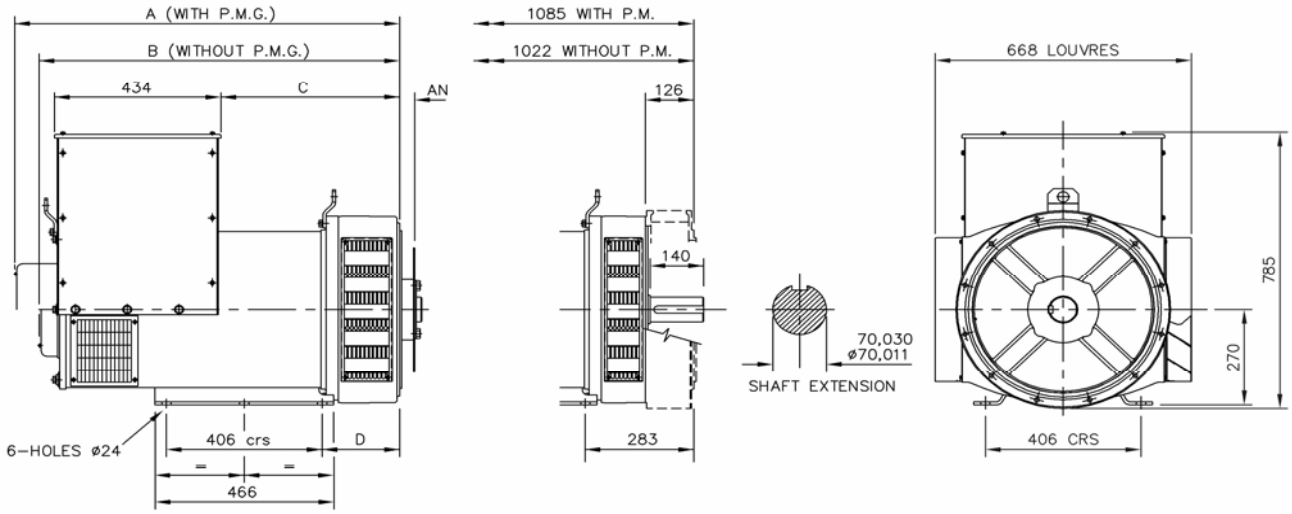
UCI274H

Winding 311 / 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			
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	182.0	182.0	182.0	N/A	200.0	200.0	200.0	N/A	212.0	212.0	212.0	N/A	220.0	220.0	220.0	N/A
	kW	145.6	145.6	145.6	N/A	160.0	160.0	160.0	N/A	169.6	169.6	169.6	N/A	176.0	176.0	176.0	N/A
	Efficiency (%)	93.3	93.5	93.6	N/A	93.0	93.3	93.4	N/A	92.8	93.1	93.3	N/A	92.7	93.0	93.2	N/A
	kW Input	156.1	155.7	155.6	N/A	172.0	171.5	171.3	N/A	182.8	182.2	181.8	N/A	189.9	189.2	188.8	N/A
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	218.8	225.0	225.0	235.0	237.5	245.0	245.0	255.0	250.0	258.8	258.8	275.0	256.3	265.0	265.0	280.0
	kW	175.0	180.0	180.0	188.0	190.0	196.0	196.0	204.0	200.0	207.0	207.0	220.0	205.0	212.0	212.0	224.0
	Efficiency (%)	93.2	93.4	93.6	93.7	93.0	93.2	93.5	93.6	92.8	93.1	93.3	93.4	92.7	93.0	93.3	93.3
	kW Input	187.8	192.7	192.3	200.6	204.3	210.3	209.6	217.9	215.5	222.4	221.9	235.5	221.2	228.0	227.2	240.1

DIMENSIONS



SINGLE BEARING MACHINES ONLY						
ADAPTOR	A	B	C	D	COUPLING DISCS	AN
SAE 1	1018,3	955,3	479,3	216,3	SAE 10	53,98
SAE 2	1004	941	465	202	SAE 11,5	39,68
SAE 3	1004	941	465	202	SAE 14	25,40

APPROVED DOCUMENT

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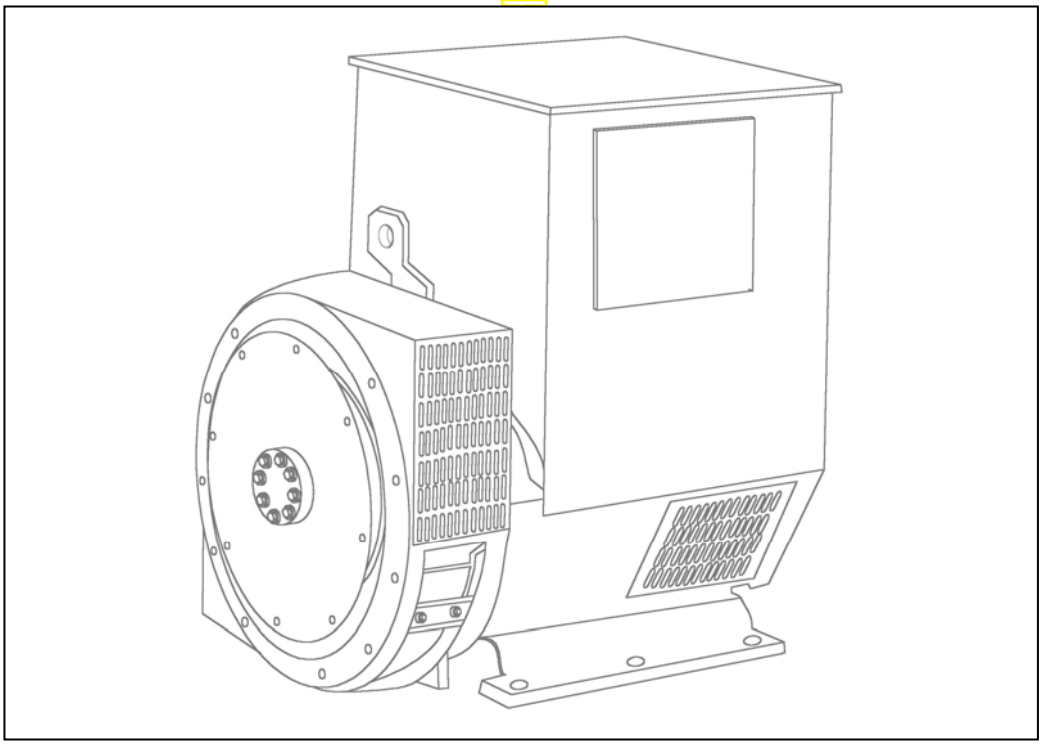
UCDI274J - Winding 311

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

SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

AS440 AVR

With this self-excited system the main stator provides power via the 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.

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.

UCDI274J

STAMFORD

WINDING 311

CONTROL SYSTEM SER.3	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 SER.4	SELF EXCITED		
A.V.R.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.0126 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	2.08 Ohms at 22°C						
EXCITER STATOR RESISTANCE	20 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.091 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 NON-DRIVE END	BALL. 6310-2RS (ISO)						
WEIGHT COMP. GENERATOR	727 kg						
WEIGHT WOUND STATOR	304 kg						
WEIGHT WOUND ROTOR	271.9 kg						
WR² INERTIA	2.3744 kgm^2						
SHIPPING WEIGHTS in a crate	740 kg						
PACKING CRATE SIZE	123 x 67 x 103 (cm)						
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.58 m³/sec 1230 cfm				0.69 m³/sec 1463 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	230	230	230	N/A	269	281	294	300
Xd DIR. AXIS SYNCHRONOUS	1.939	1.750	1.626	-	2.651	2.475	2.370	2.221
X'd DIR. AXIS TRANSIENT	0.103	0.093	0.086	-	0.164	0.153	0.147	0.137
X"d DIR. AXIS SUBTRANSIENT	0.070	0.064	0.059	-	0.096	0.090	0.086	0.080
Xq QUAD. AXIS REACTANCE	0.886	0.800	0.743	-	1.206	1.126	1.078	1.010
X"q QUAD. AXIS SUBTRANSIENT	0.163	0.147	0.137	-	0.138	0.129	0.123	0.116
X_L LEAKAGE REACTANCE	0.062	0.056	0.052	-	0.081	0.076	0.072	0.068
X_2 NEGATIVE SEQUENCE	0.117	0.105	0.098	-	0.117	0.109	0.105	0.098
X_0 ZERO SEQUENCE	0.044	0.040	0.037	-	0.048	0.045	0.043	0.040
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.045 s							
T"d SUB-TRANSTIME CONST.	0.015 s							
T'do O.C. FIELD TIME CONST.	1.27 s							
Ta ARMATURE TIME CONST.	0.03 s							
SHORT CIRCUIT RATIO	1/Xd							

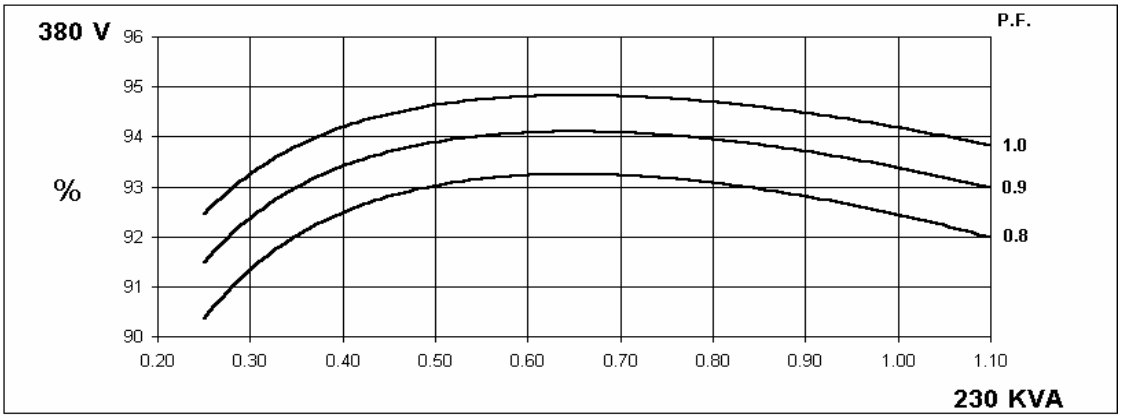
50 Hz

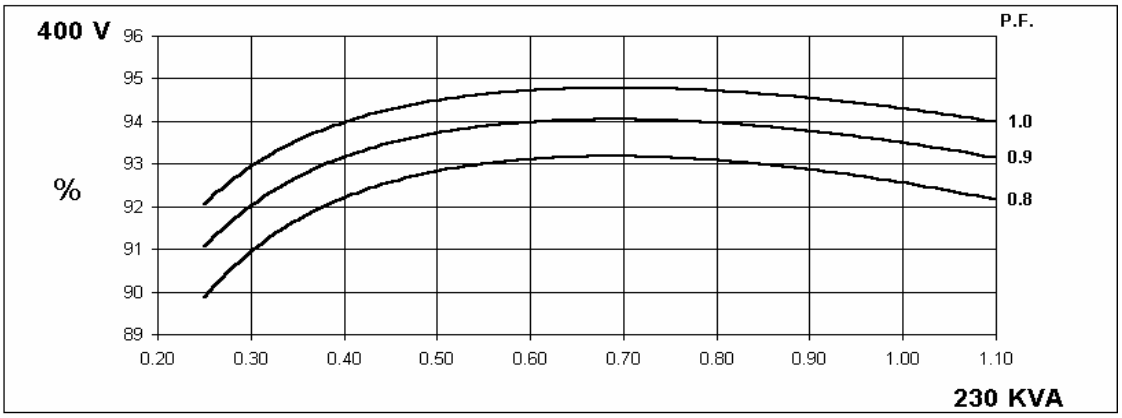
UCDI274J

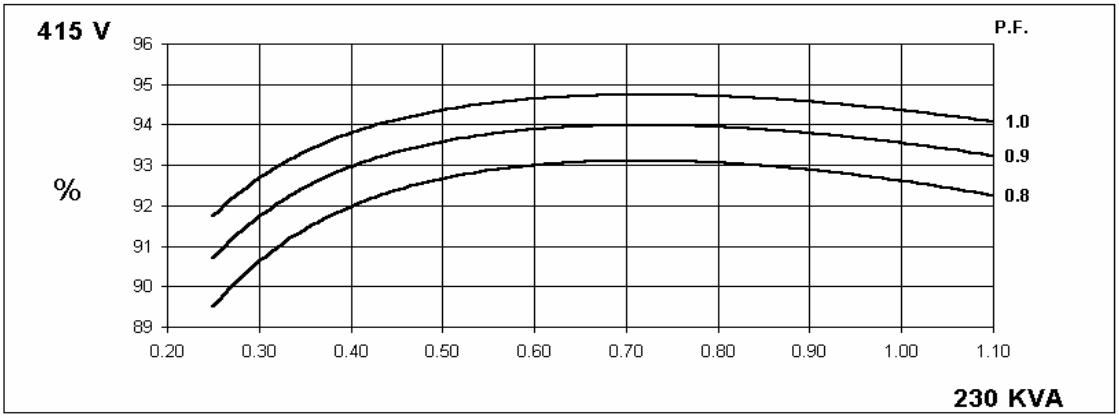
Winding 311

STAMFORD

THREE PHASE EFFICIENCY CURVES







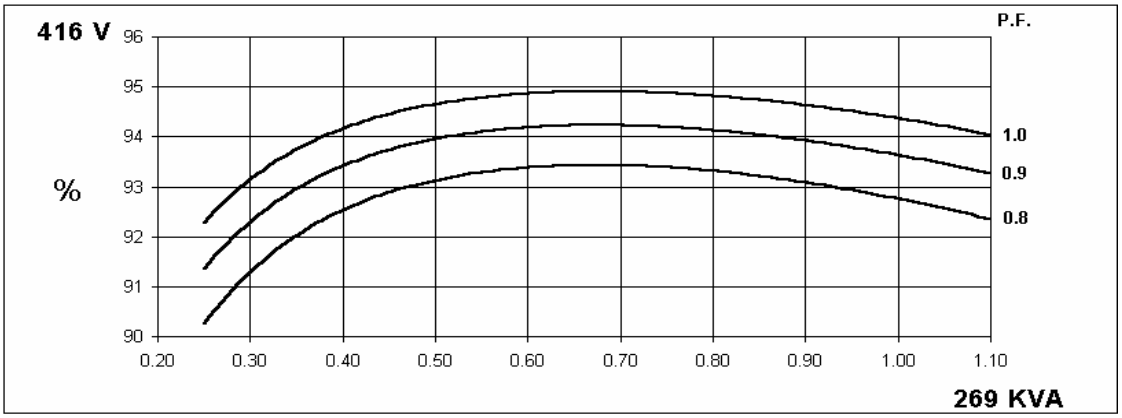
60 Hz

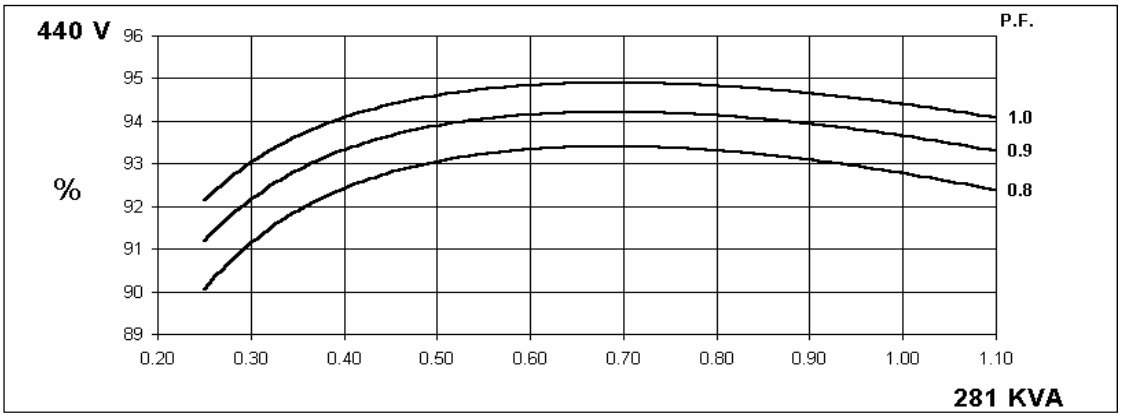
UCDI274J

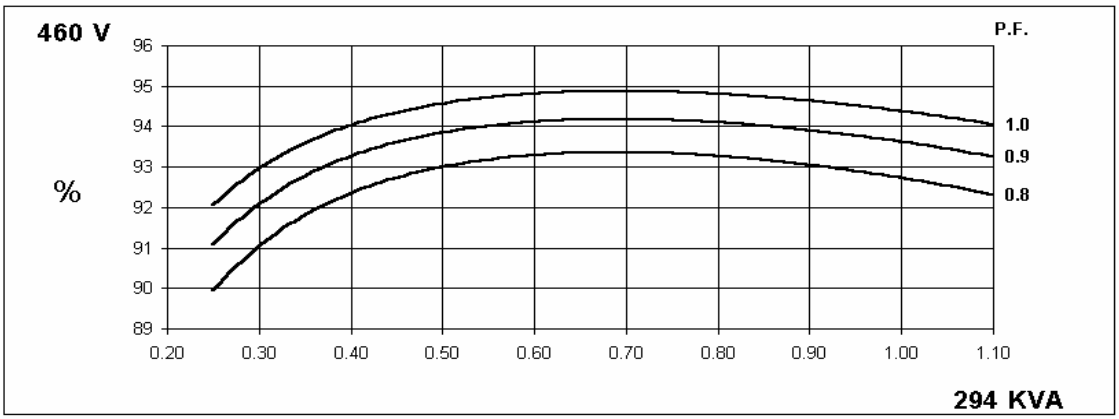
Winding 311

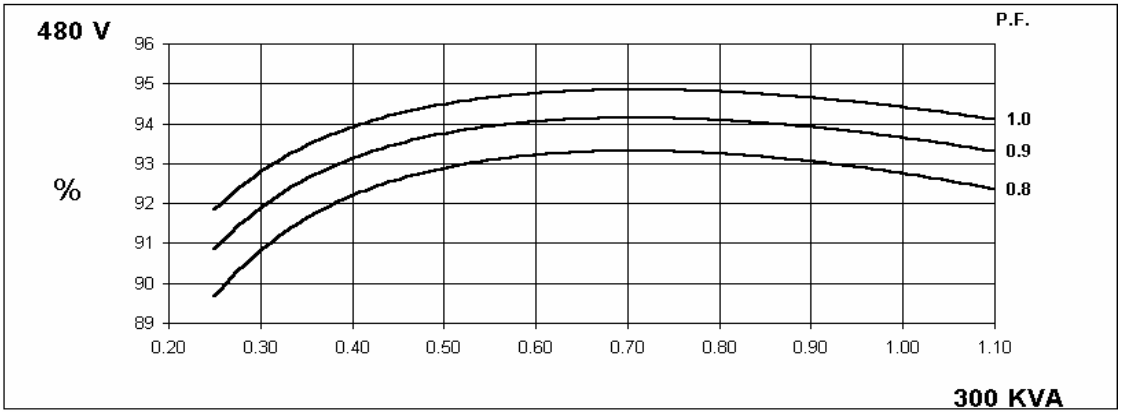
STAMFORD

THREE PHASE EFFICIENCY CURVES









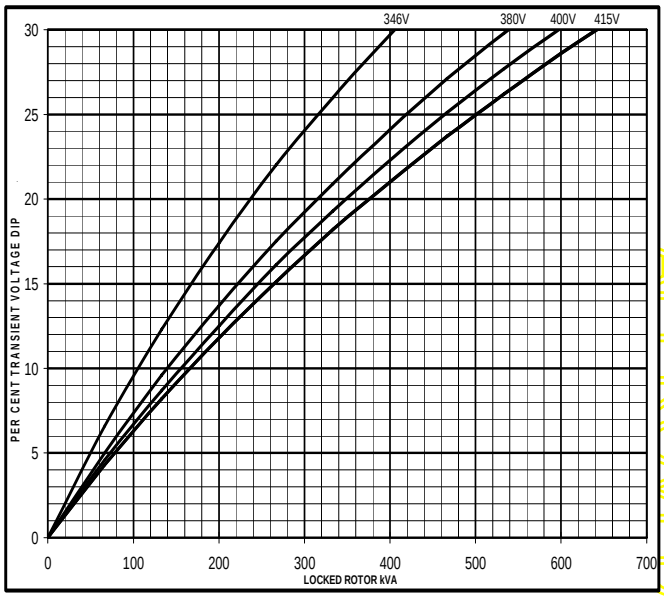
UCDI274J

Winding 311

Locked Rotor Motor Starting Curve

50 Hz

MX



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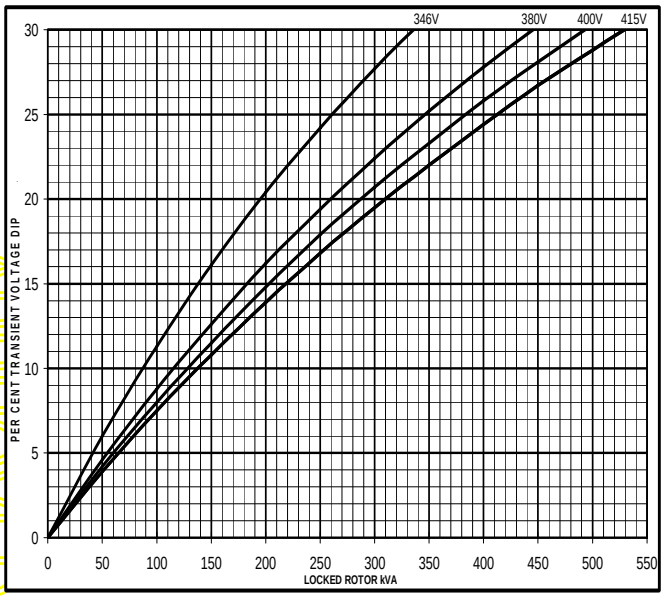
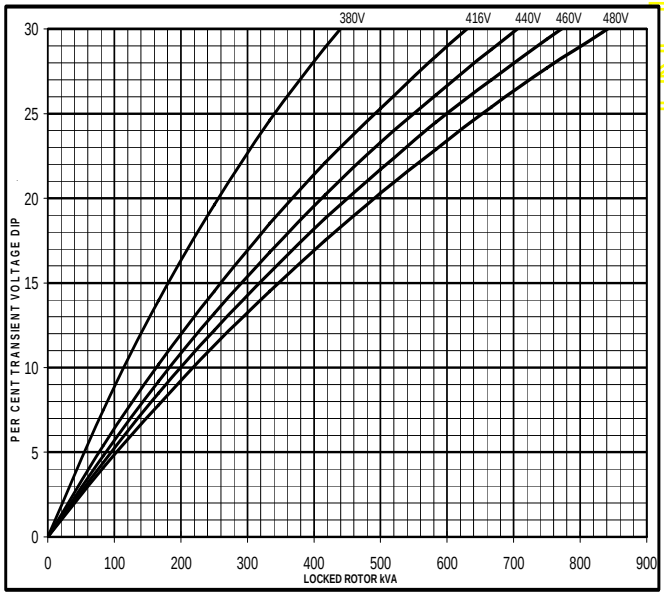


60 Hz

MX



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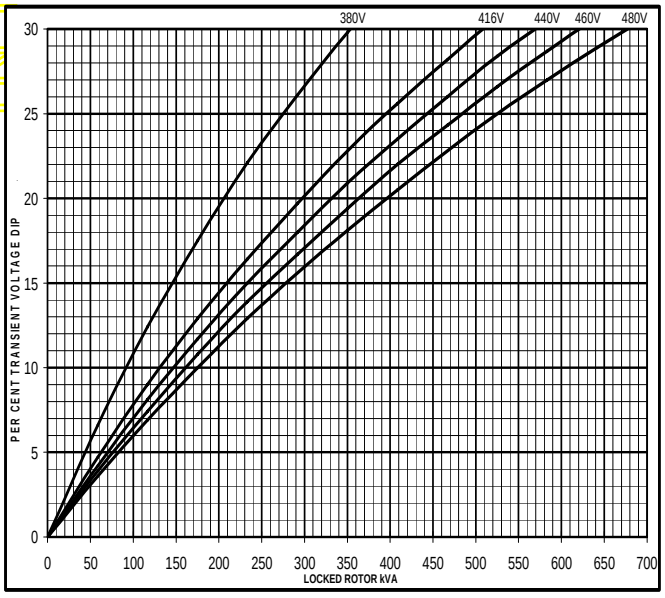
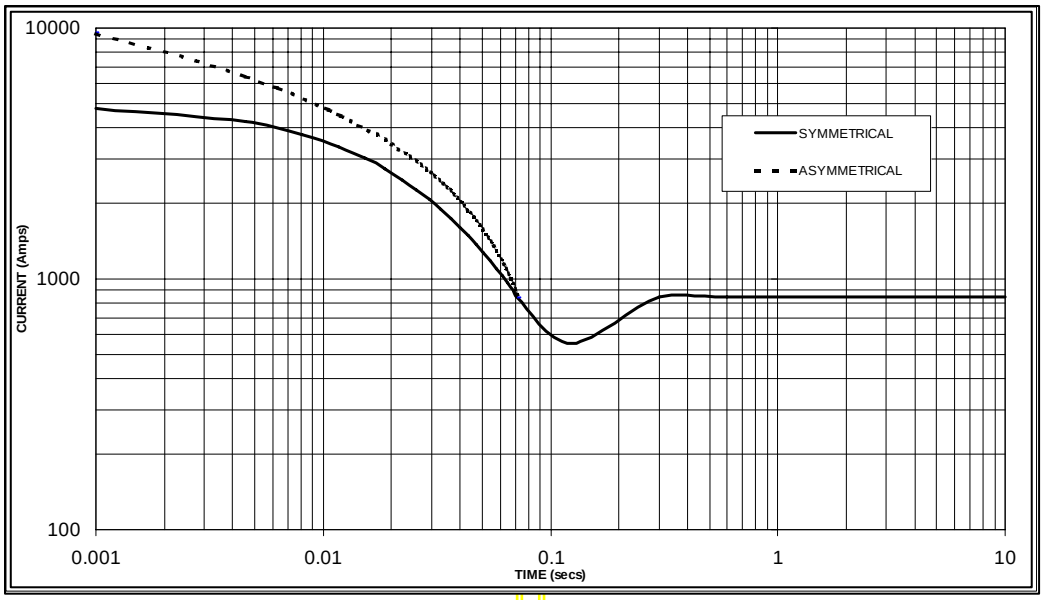


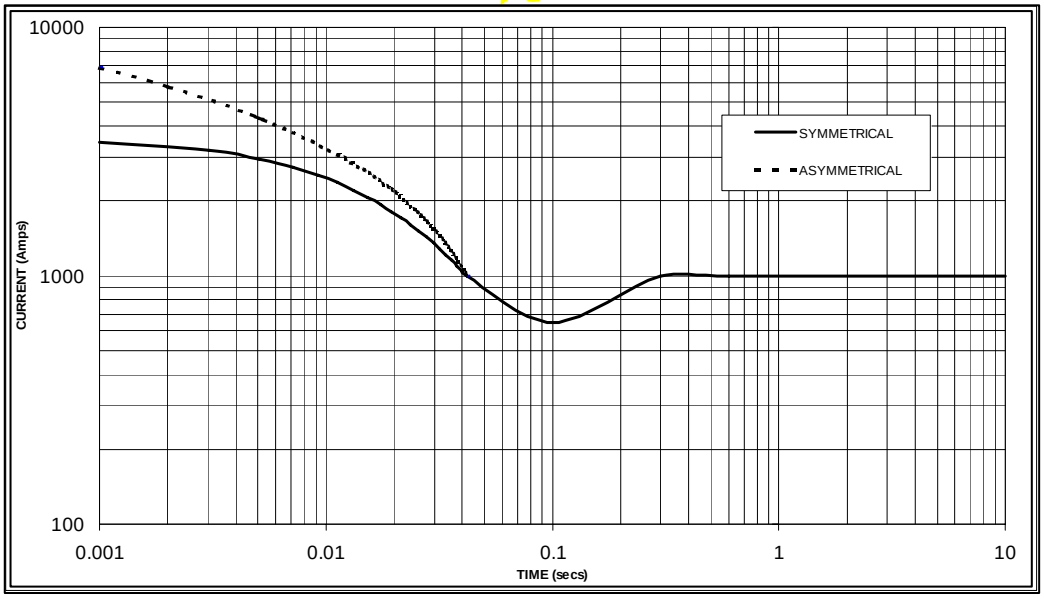
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 850 Amps

60 Hz



Sustained Short Circuit = 1,000 Amps

Note 1

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

50Hz		60Hz	
Voltage	Factor	Voltage	Factor
380v	X 1.00	416v	X 1.00
400v	X 1.05	440v	X 1.07
415v	X 1.10	460v	X 1.12
		480v	X 1.16

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 connection 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

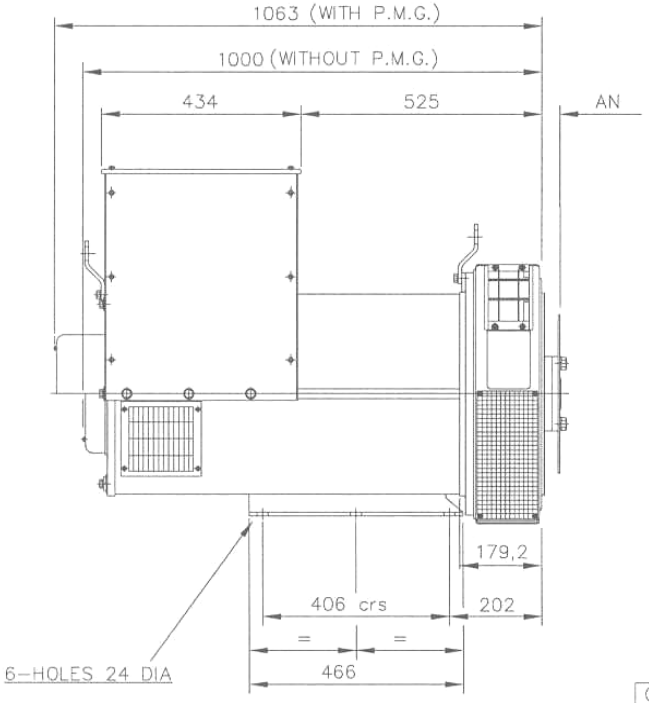
UCDI274J

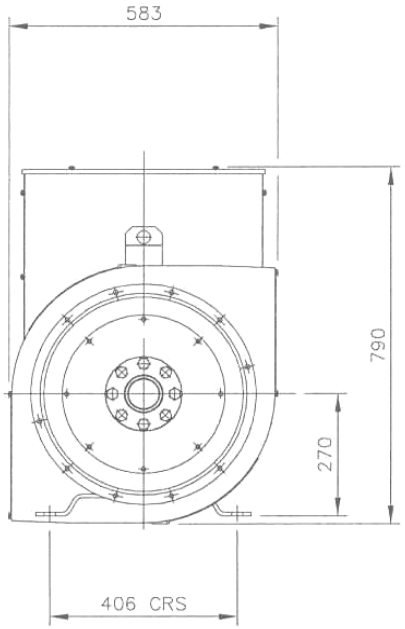
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	210	210	210	N/A	230	230	230	N/A	250	250	250	N/A	260	260	260	N/A
	kW	168	168	168	N/A	184	184	184	N/A	200	200	200	N/A	208	208	208	N/A
	Efficiency (%)	92.8	92.8	92.9	N/A	92.4	92.6	92.6	N/A	92.1	92.2	92.3	N/A	91.8	92.0	92.1	N/A
	kW Input	181.0	181.0	180.8	N/A	199.1	198.7	198.7	N/A	217.2	216.9	216.7	N/A	226.6	226.1	225.8	N/A
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	250	264	275	275	269	281	294	300	288	300	313	319	294	306	319	325
	kW	200.0	211.2	220.0	220.0	215.2	224.8	235.2	240.0	230.4	240.0	250.4	255.2	235.2	244.8	255.2	260.0
	Efficiency (%)	93.0	93.0	93.0	93.0	92.8	92.8	92.7	92.8	92.5	92.5	92.5	92.5	92.4	92.4	92.4	92.4
	kW Input	215.1	227.1	236.6	236.6	231.9	242.2	253.7	258.6	249.1	259.5	270.7	275.9	254.5	264.9	276.2	281.4

DIMENSIONS





COUPLING DISC	AN
SAE 11,5	39,68
SAE14	25,4

APPROVED DOCUMENT

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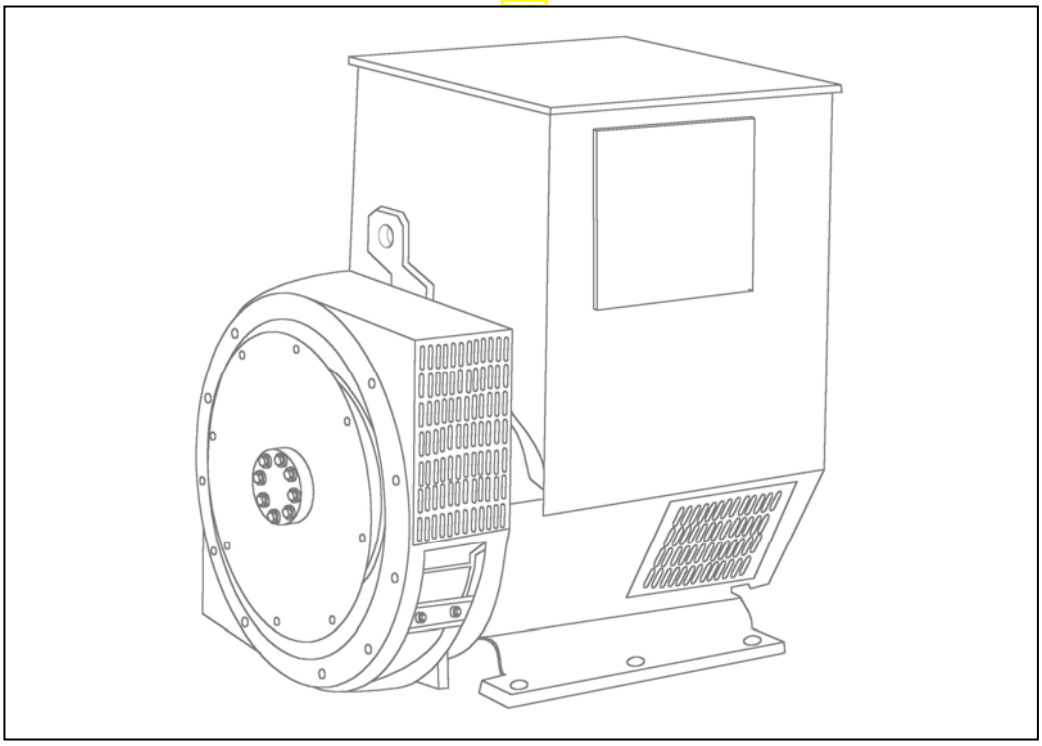
UCDI274K - Winding 311

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

SX460 AVR - STANDARD

With this self excited control system the main stator supplies power via the Automatic Voltage Regulator (AVR) to the exciter stator. The high efficiency semiconductors 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. This rectifier is protected by a surge suppressor against surges caused, for example, by short circuit.

AS440 AVR

With this self-excited system the main stator provides power via the 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.

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.	SX460	AS440	
VOLTAGE REGULATION	± 1.0 %	± 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 CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.0126 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	2.08 Ohms at 22°C							
EXCITER STATOR RESISTANCE	20 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.091 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 NON-DRIVE END	BALL. 6310-2RS (ISO)							
WEIGHT COMP. GENERATOR	727 kg							
WEIGHT WOUND STATOR	304 kg							
WEIGHT WOUND ROTOR	272.6 kg							
WR² INERTIA	2.3934 kgm^2							
SHIPPING WEIGHTS in a crate	740 kg							
PACKING CRATE SIZE	123 x 67 x 103 (cm)							
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.58 m³/sec 1230 cfm				0.69 m³/sec 1463 cfm			
VOLTAGE SERIES STAR (Y)	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
VOLTAGE PARALLEL STAR (Y)	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	250	250	250	N/A	291	299	312.5	312.5
Xd DIR. AXIS SYNCHRONOUS	2.825	2.550	2.369	-	3.161	2.903	2.776	2.550
X'd DIR. AXIS TRANSIENT	0.132	0.119	0.111	-	0.148	0.136	0.130	0.119
X"d DIR. AXIS SUBTRANSIENT	0.086	0.078	0.072	-	0.097	0.089	0.085	0.078
Xq QUAD. AXIS REACTANCE	1.263	1.140	1.059	-	1.413	1.298	1.241	1.140
X"q QUAD. AXIS SUBTRANSIENT	0.152	0.137	0.127	-	0.170	0.156	0.149	0.137
X_L LEAKAGE REACTANCE	0.066	0.060	0.056	-	0.074	0.068	0.065	0.060
X_2 NEGATIVE SEQUENCE	0.120	0.108	0.100	-	0.134	0.123	0.118	0.108
X_0 ZERO SEQUENCE	0.022	0.020	0.019	-	0.025	0.023	0.022	0.020
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.049 s							
T"d SUB-TRANSTIME CONST.	0.02 s							
T'do O.C. FIELD TIME CONST.	1.27 s							
Ta ARMATURE TIME CONST.	0.018 s							
SHORT CIRCUIT RATIO	1/Xd							

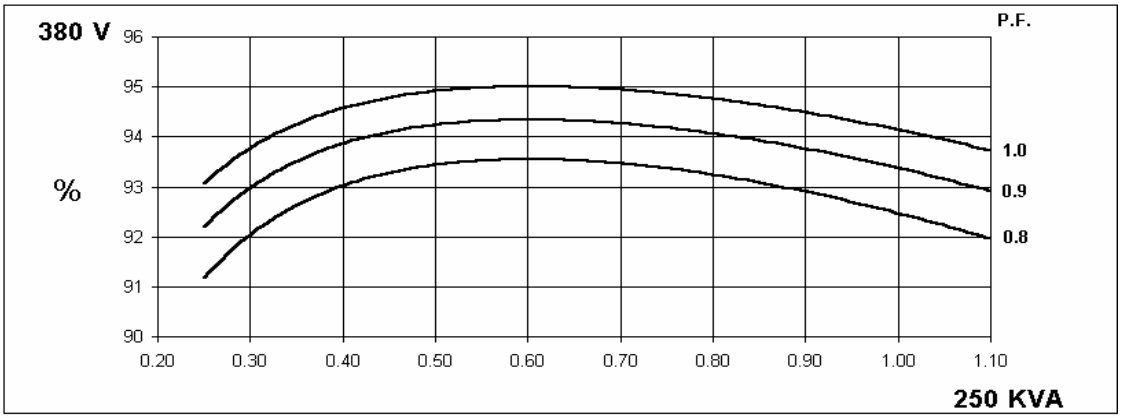
50 Hz

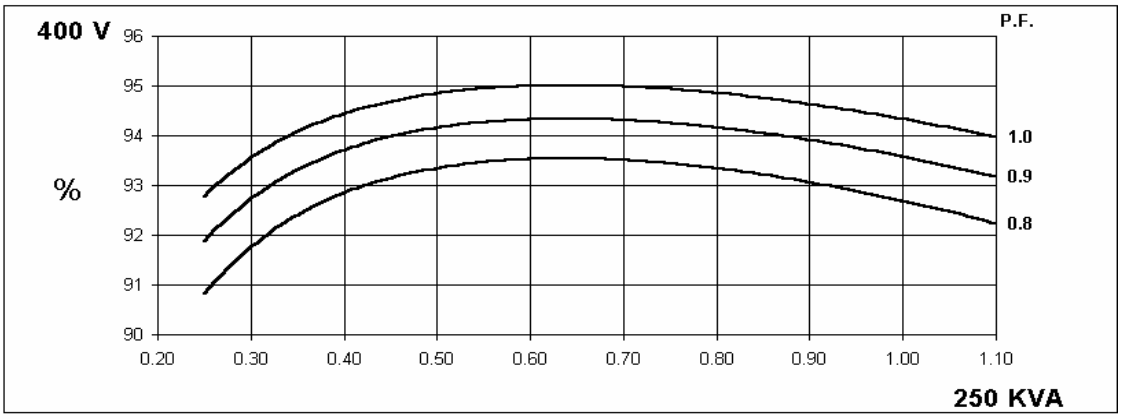
UCDI274K

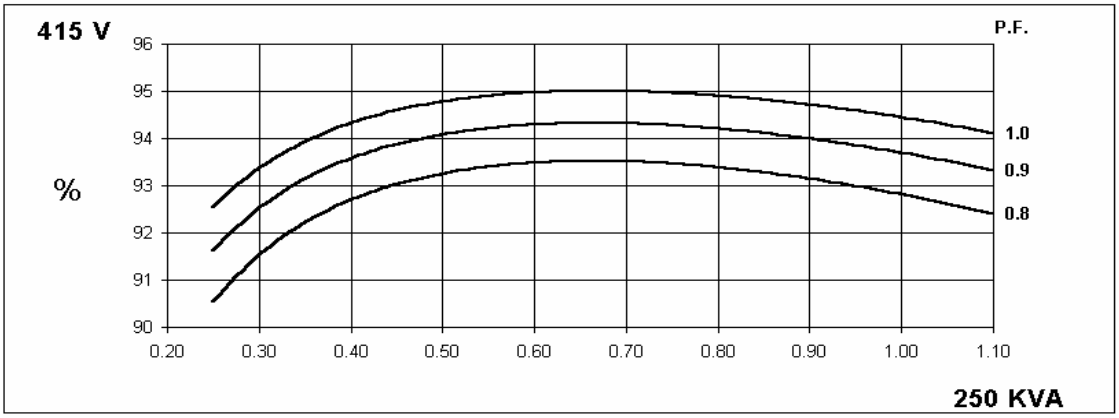
Winding 311

STAMFORD

THREE PHASE EFFICIENCY CURVES







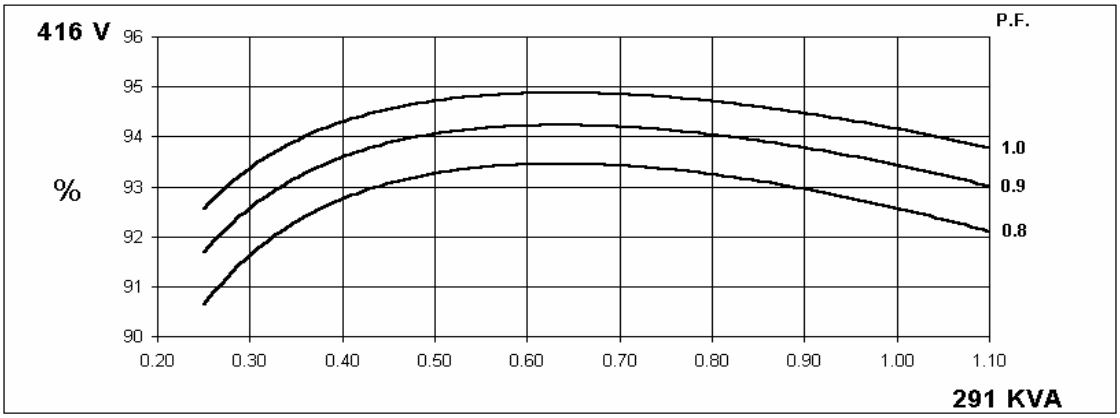
60 Hz

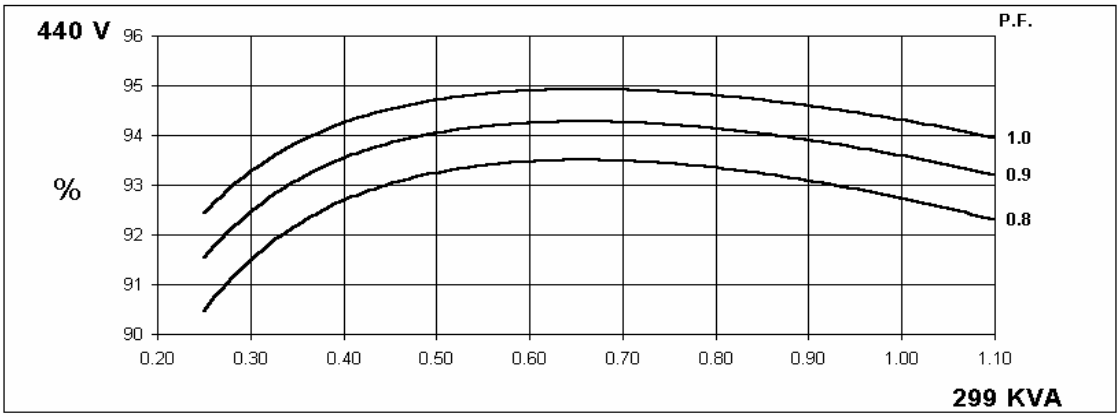
UCDI274K

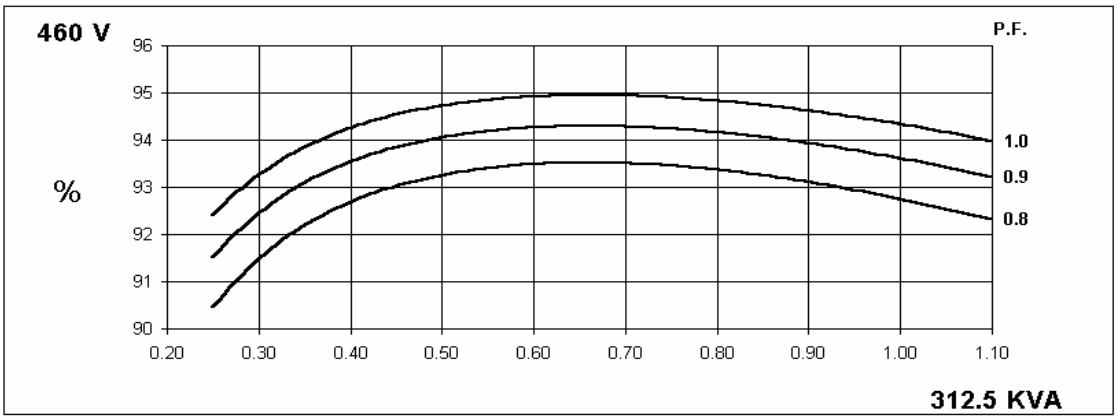
Winding 311

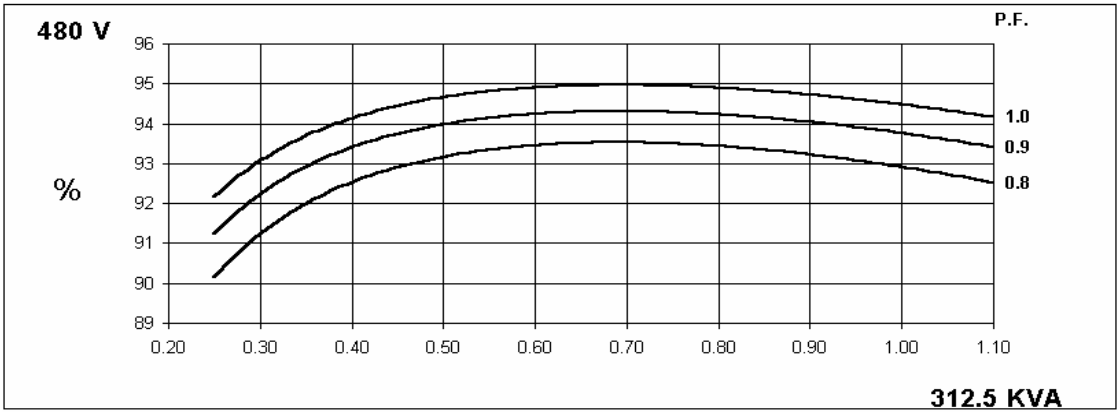
STAMFORD

THREE PHASE EFFICIENCY CURVES









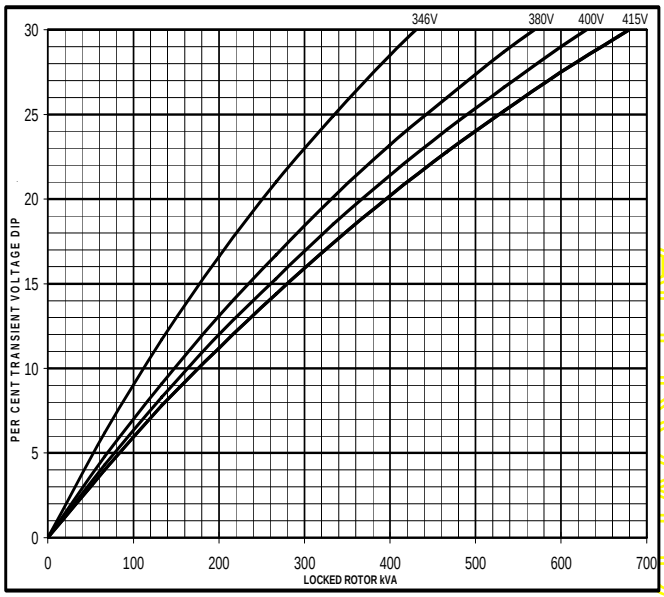
UCDI274K

Winding 311

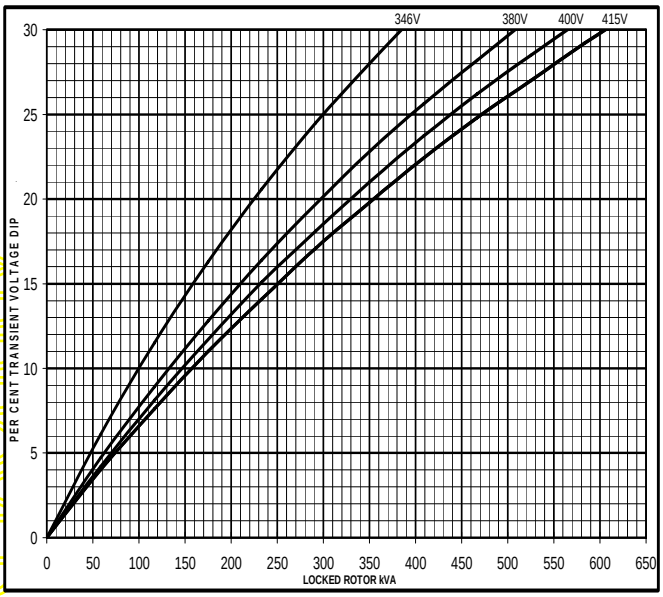
Locked Rotor Motor Starting Curve

50 Hz

MX

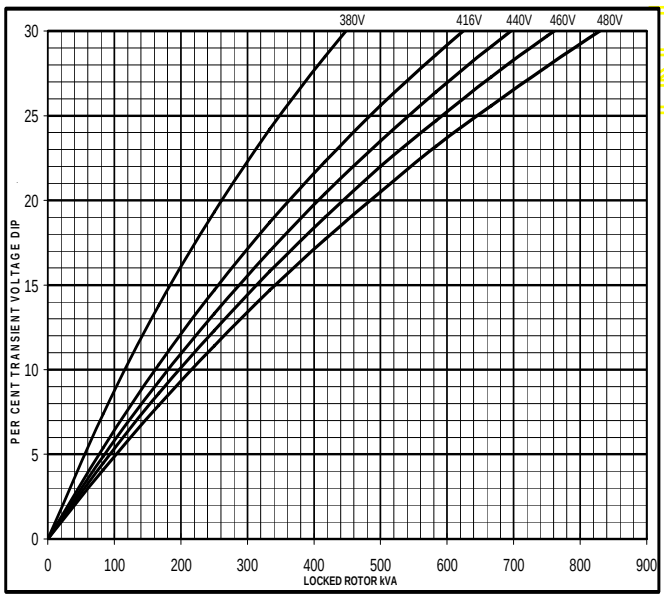


SX

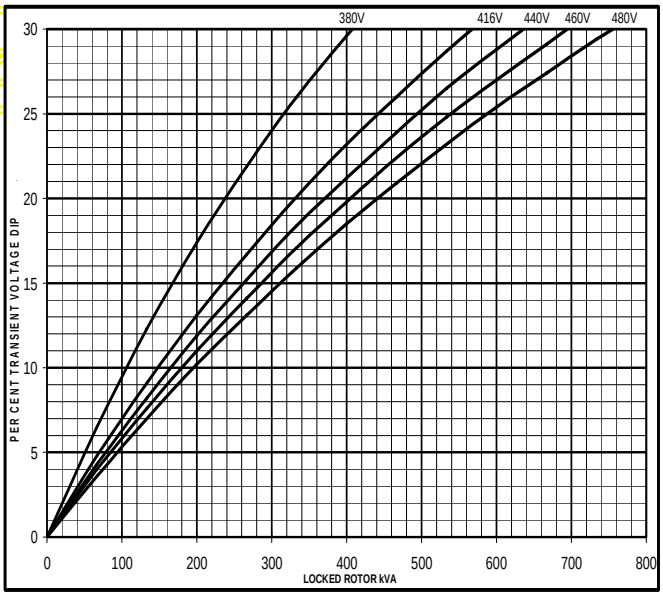


60 Hz

MX

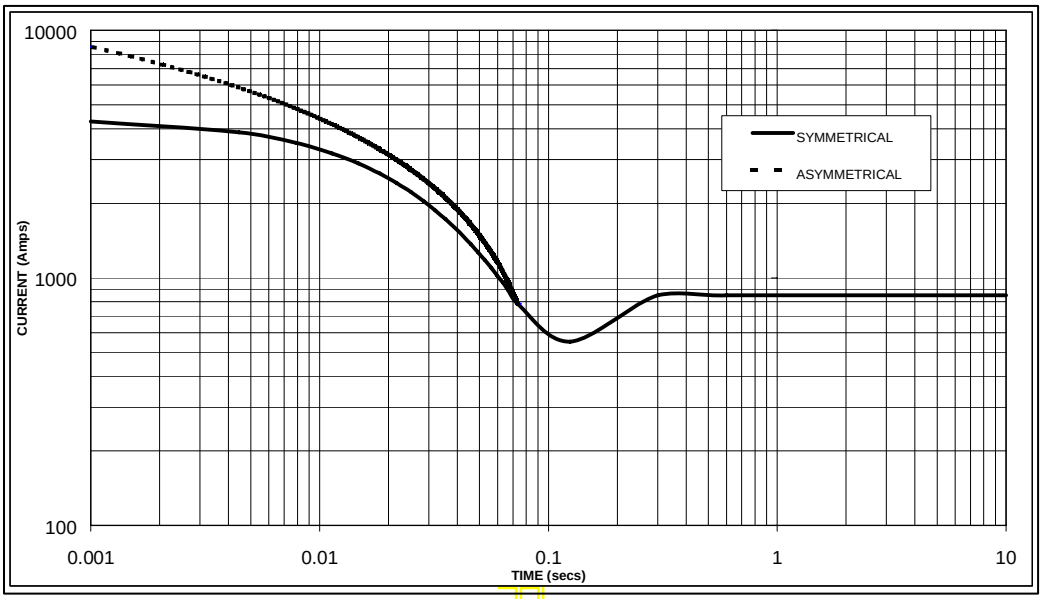


SX



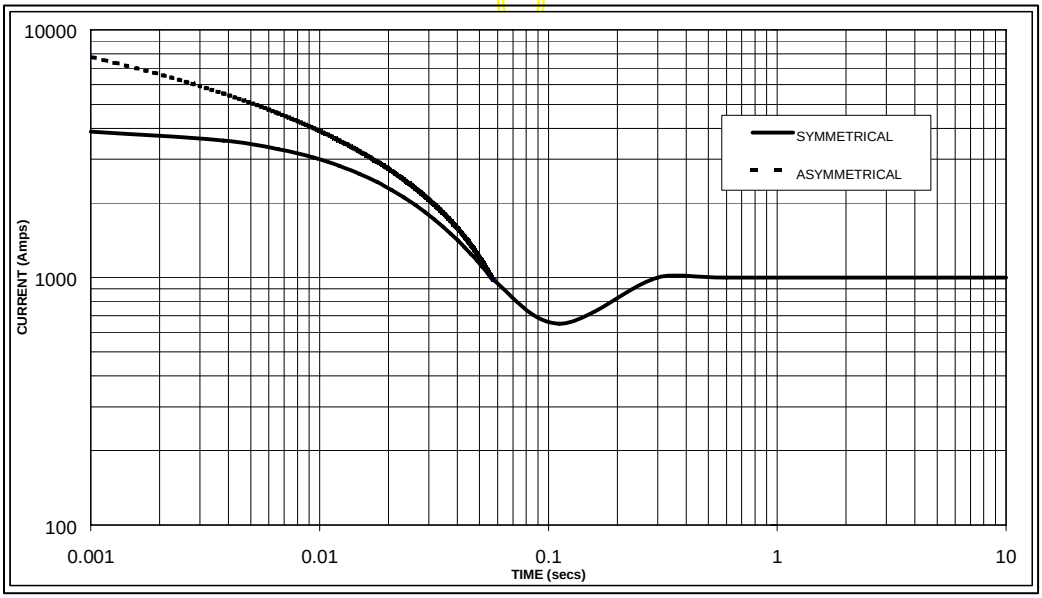
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 850 Amps

60 Hz



Sustained Short Circuit = 1,000 Amps

Note 1

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

50Hz		60Hz	
Voltage	Factor	Voltage	Factor
380v	X 1.00	416v	X 1.00
400v	X 1.05	440v	X 1.07
415v	X 1.10	460v	X 1.12
		480v	X 1.16

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 connection 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

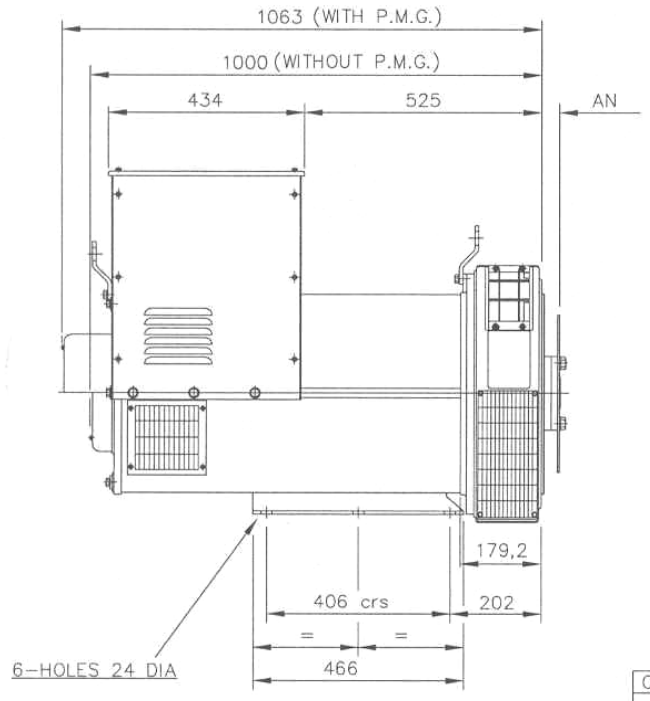
UCDI274K

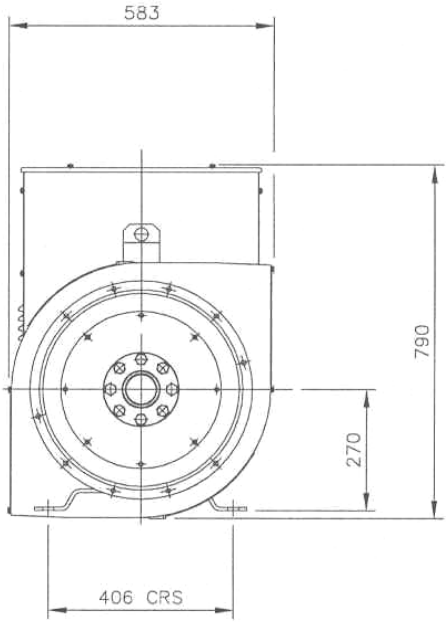
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
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	229.0	229.0	229.0	N/A	250.0	250.0	250.0	N/A	265.0	265.0	265.0	N/A	275.0	275.0	275.0	N/A
	kW	183.2	183.2	183.2	N/A	200.0	200.0	200.0	N/A	212.0	212.0	212.0	N/A	220.0	220.0	220.0	N/A
	Efficiency (%)	92.8	93.0	93.1	N/A	92.5	92.7	92.8	N/A	92.2	92.4	92.6	N/A	92.0	92.2	92.4	N/A
	kW Input	197.4	197.0	196.8	N/A	216.2	215.7	215.5	N/A	229.9	229.4	228.9	N/A	239.1	238.6	238.1	N/A
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	267.0	275.0	286.5	288.0	291.0	299.0	312.5	312.5	304.0	312.5	331.3	331.3	312.0	320.0	343.8	343.8
	kW	213.6	220.0	229.2	230.4	232.8	239.2	250.0	250.0	243.2	250.0	265.0	265.0	249.6	256.0	275.0	275.0
	Efficiency (%)	92.9	93.0	93.1	93.2	92.6	92.7	92.8	92.9	92.4	92.6	92.5	92.7	92.2	92.4	92.3	92.5
	kW Input	229.9	236.6	246.2	247.3	251.4	258.0	269.4	269.1	263.2	270.0	286.5	285.9	270.7	277.1	298.0	297.3

DIMENSIONS





COUPLING DISC	AN
SAE 11,5	39,68
SAE 14	25,4

APPROVED DOCUMENT

STAMFORD

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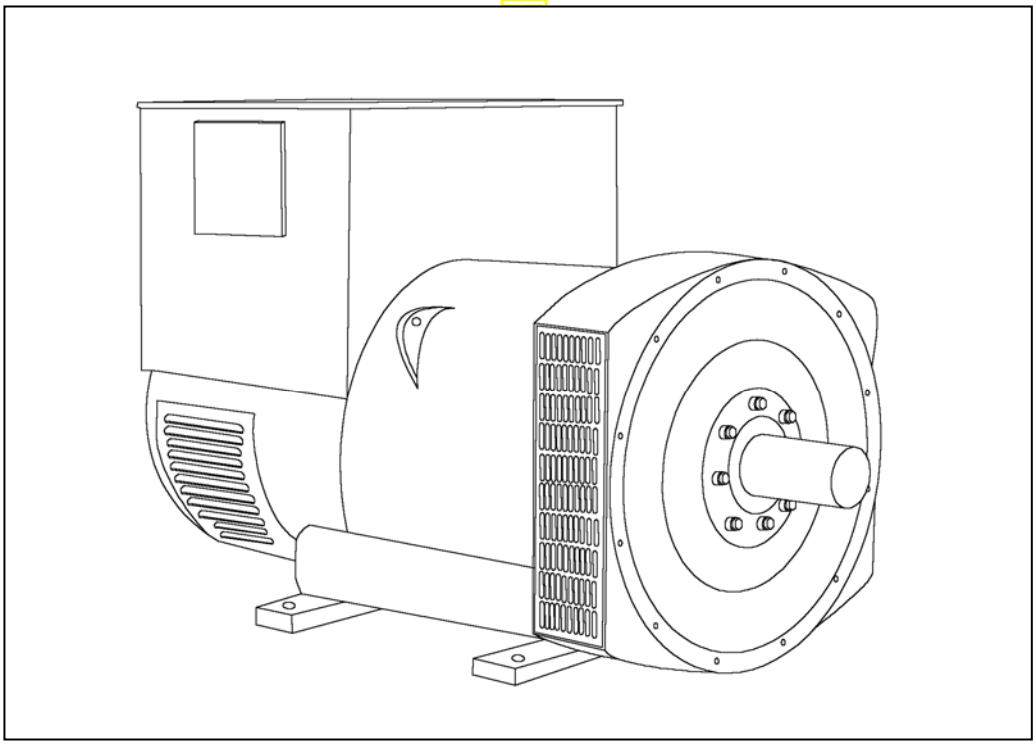
STAMFORD®

HCI 434C/444C - Winding 311

Technical Data Sheet



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QUALITY ASSURANCE

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3% for every 5°C by which the operational ambient temperature exceeds 40°C.
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Front cover drawing typical of product range.

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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	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	0.0166 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.92 Ohms at 22°C							
EXCITER STATOR RESISTANCE	18 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.068 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. 6317 (ISO)							
BEARING NON-DRIVE END	BALL. 6314 (ISO)							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	850 kg				885 kg			
WEIGHT WOUND STATOR	370 kg				370 kg			
WEIGHT WOUND ROTOR	324 kg				301 kg			
WR² INERTIA	3.5531 kgm²				3.3543 kgm²			
SHIPPING WEIGHTS in a crate	920 kg				945 kg			
PACKING CRATE SIZE	155 x 87 x 107(cm)				155 x 87 x 107(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.8 m³/sec 1700 cfm				0.99 m³/sec 2100 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	250	250	250	250	288	300	315	315
Xd DIR. AXIS SYNCHRONOUS	3.15	2.84	2.64	2.35	3.77	3.51	3.37	3.10
X'd DIR. AXIS TRANSIENT	0.20	0.18	0.17	0.15	0.24	0.23	0.22	0.20
X"d DIR. AXIS SUBTRANSIENT	0.14	0.13	0.12	0.11	0.16	0.15	0.14	0.13
Xq QUAD. AXIS REACTANCE	2.71	2.44	2.27	2.02	3.25	3.03	2.91	2.67
X"q QUAD. AXIS SUBTRANSIENT	0.39	0.36	0.33	0.29	0.43	0.40	0.39	0.36
X_L LEAKAGE REACTANCE	0.10	0.09	0.08	0.07	0.10	0.09	0.09	0.08
X_2 NEGATIVE SEQUENCE	0.27	0.25	0.23	0.20	0.30	0.28	0.27	0.25
X_0 ZERO SEQUENCE	0.10	0.09	0.08	0.07	0.10	0.09	0.09	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.	0.019s							
T'do O.C. FIELD TIME CONST.	1.7s							
Ta ARMATURE TIME CONST.	0.018s							
SHORT CIRCUIT RATIO	1/Xd							

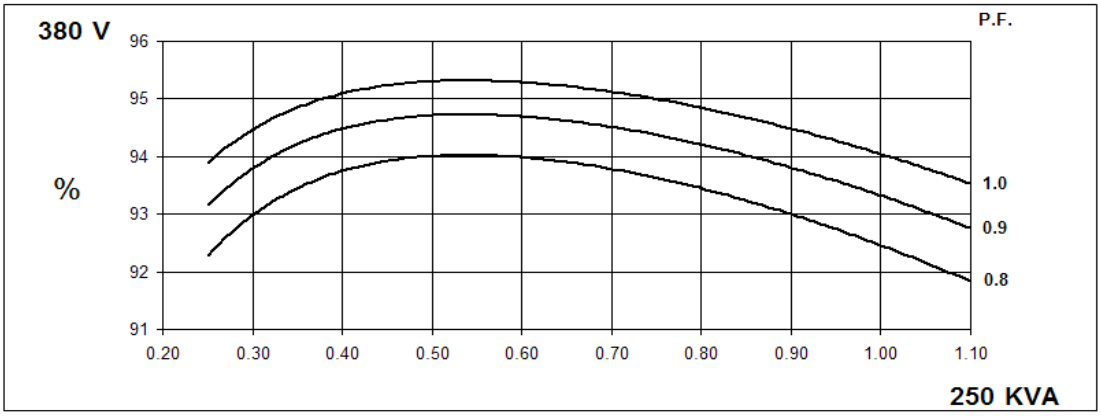
50 Hz

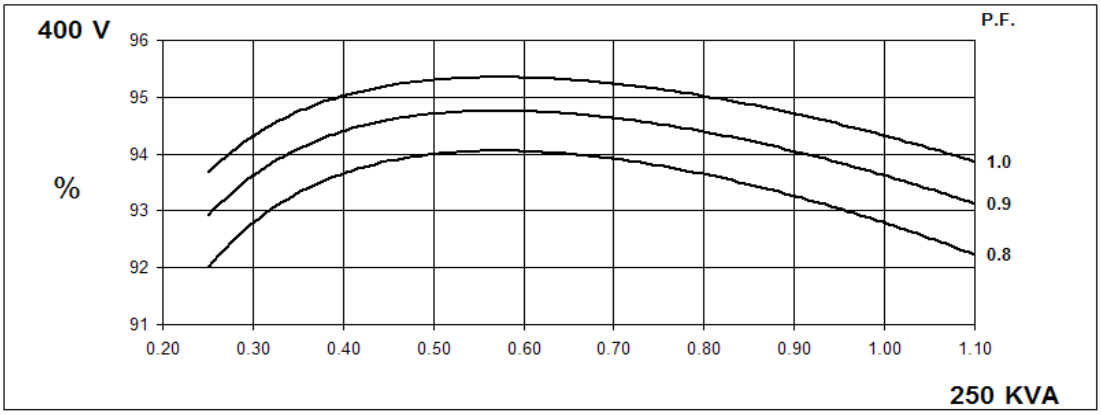
HCI434C/444C

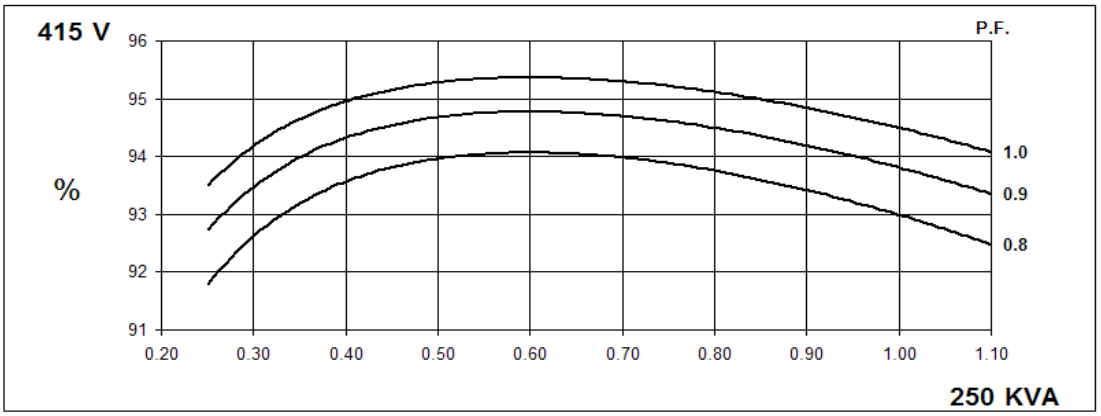
Winding 311

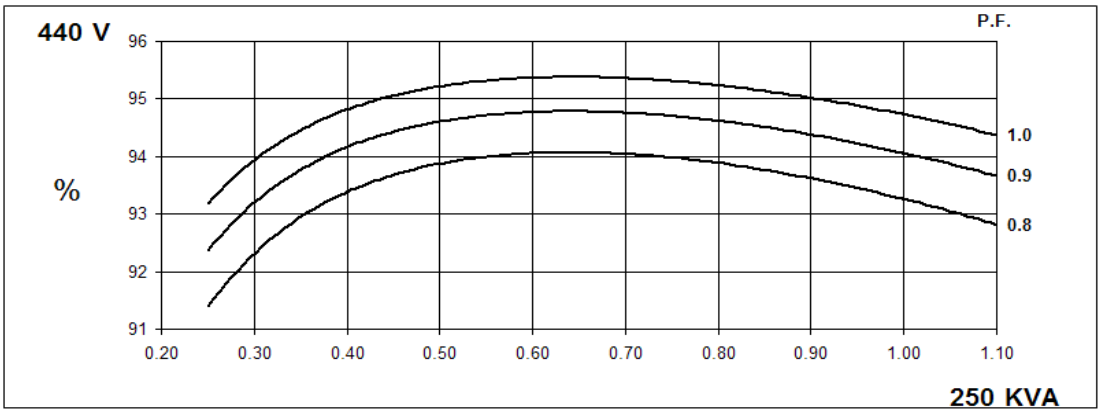
STAMFORD

THREE PHASE EFFICIENCY CURVES









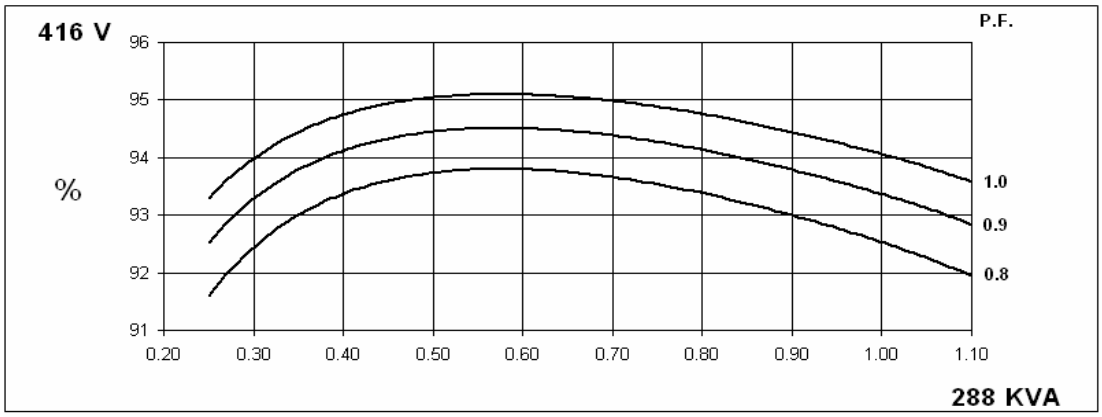
60 Hz

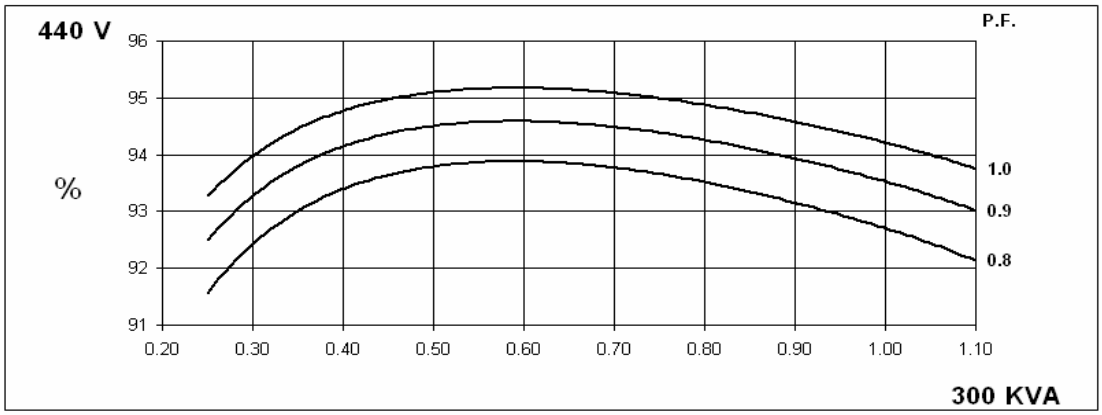
HCI434C/444C

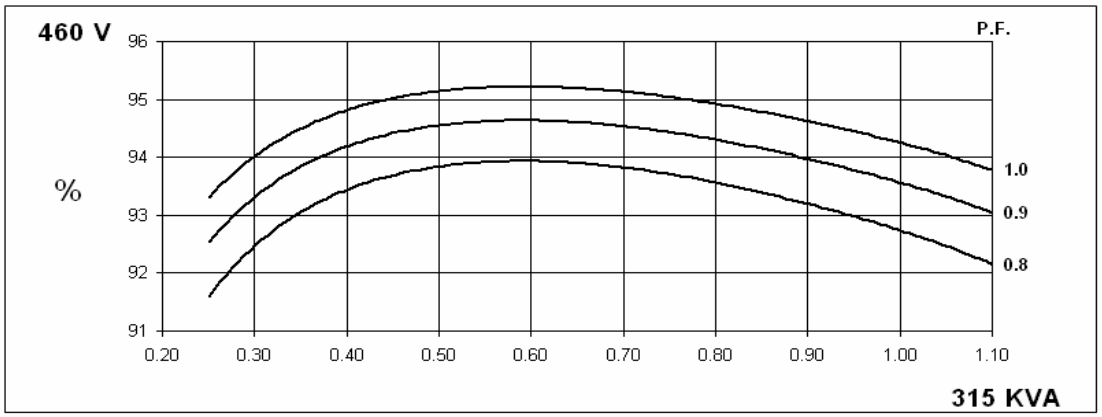
Winding 311

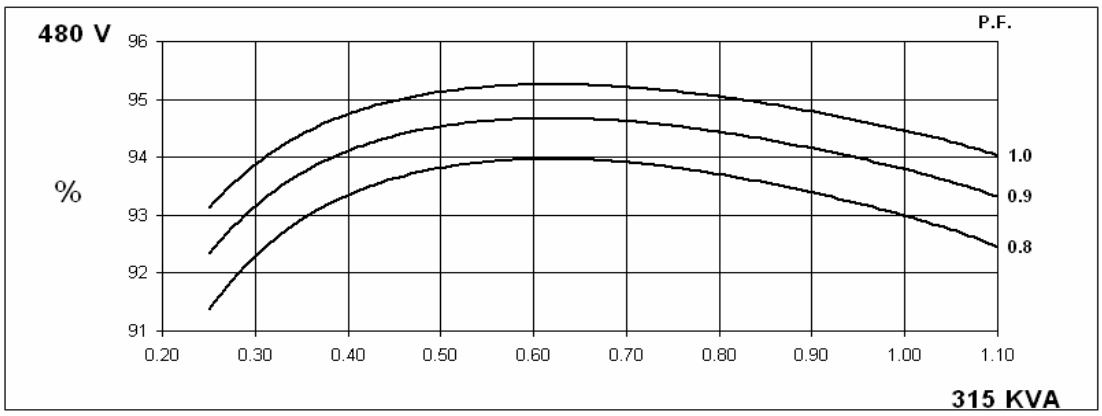
STAMFORD

THREE PHASE EFFICIENCY CURVES









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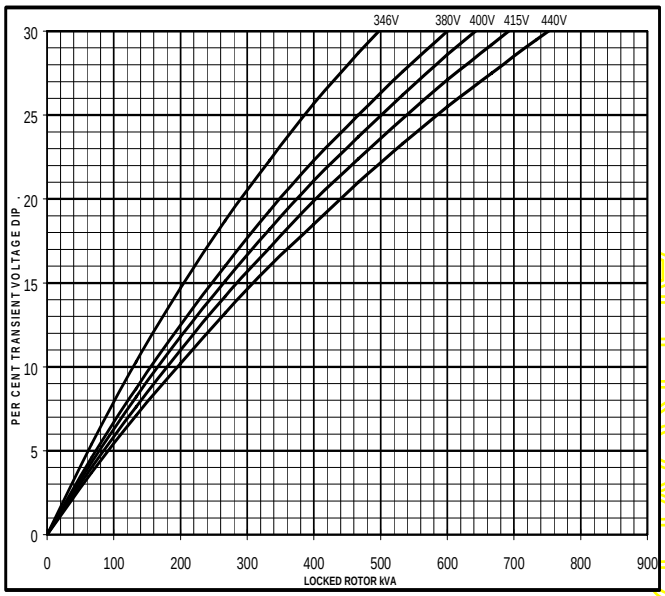
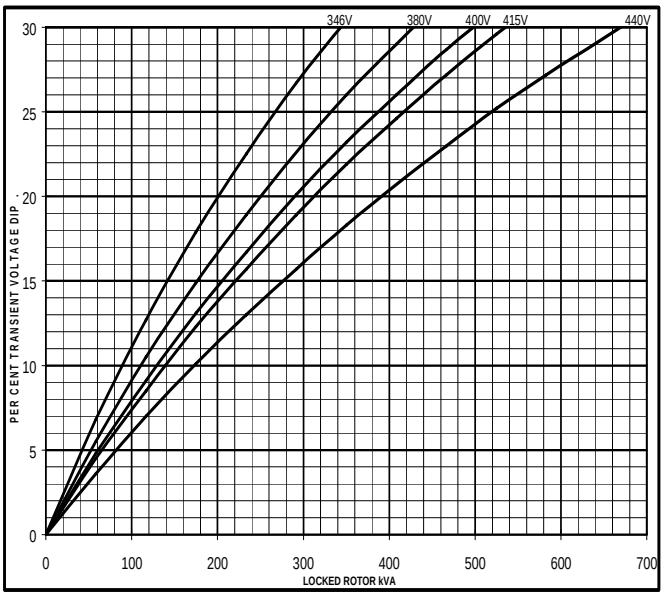
Locked Rotor Motor Starting Curve

50 Hz

MX

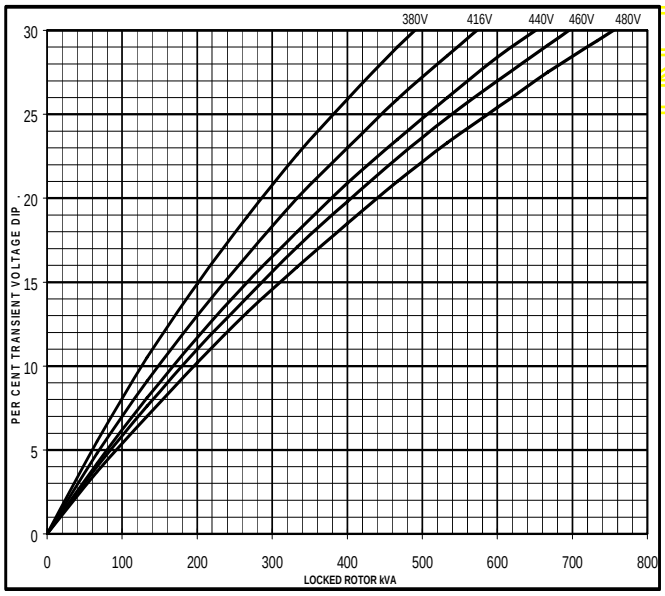


SX



60 Hz

MX



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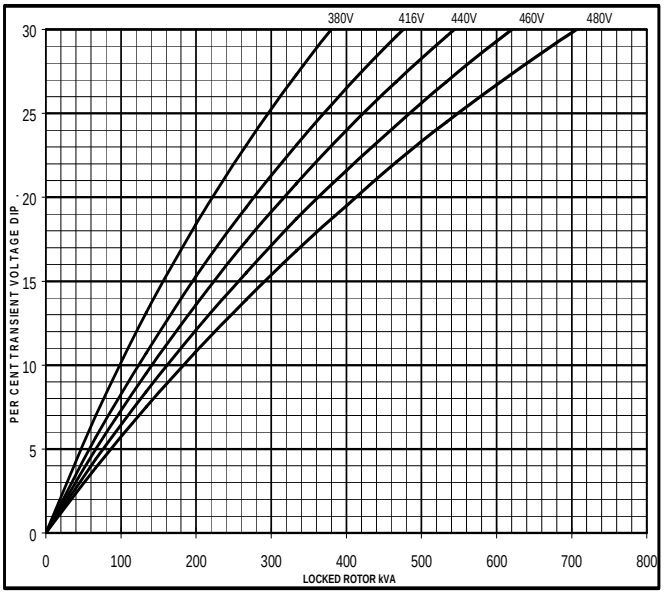
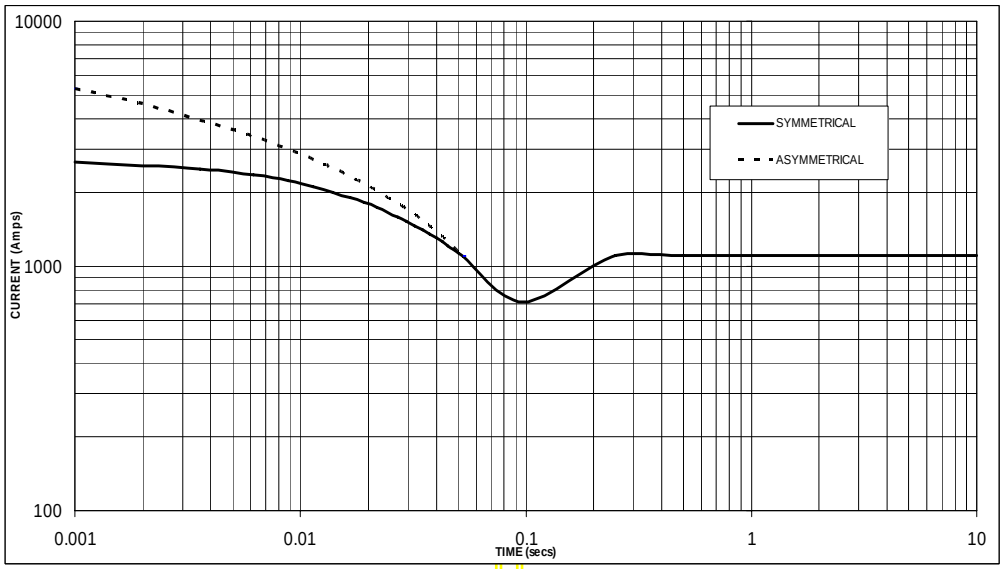


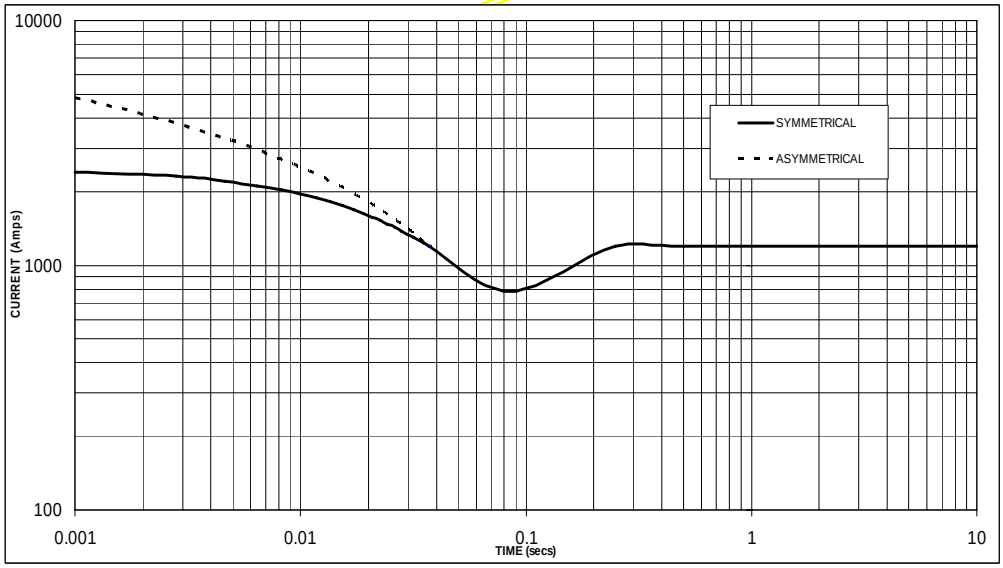
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 1,100 Amps

60 Hz



Sustained Short Circuit = 1,200 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

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

Parallel Star = Curve current value X 2

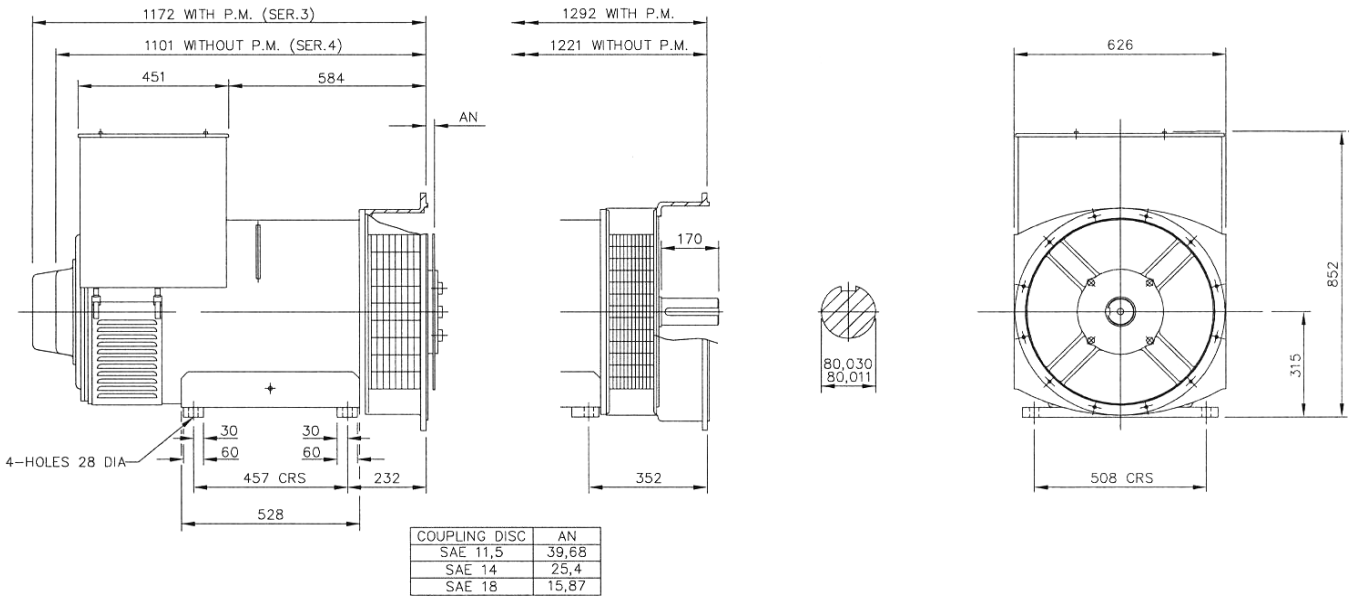
HCI434C/444C

Winding 311 / 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			
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	230	230	230	230	250	250	250	250	270	270	270	270	275	275	275	275
	kW	184	184	184	184	200	200	200	200	216	216	216	216	220	220	220	220
	Efficiency (%)	92.9	93.2	93.3	93.6	92.5	92.8	93.0	93.3	92.0	92.3	92.6	92.9	91.8	92.2	92.5	92.8
	kW Input	198	197	197	197	216	216	215	214	235	234	233	233	240	239	238	237
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	260	275	290	290	288	300	315	315	300	320	335	335	310	330	345	345
	kW	208	220	232	232	230	240	252	252	240	256	268	268	248	264	276	276
	Efficiency (%)	93.0	93.1	93.1	93.3	92.5	92.7	92.7	93.0	92.3	92.3	92.4	92.7	92.1	92.2	92.2	92.5
	kW Input	224	236	249	249	249	259	272	271	260	277	290	289	269	286	299	298

DIMENSIONS



COUPLING DISC	AN
SAE 11,5	39,68
SAE 14	25,4
SAE 18	15,87

APPROVED DOCUMENT

STAMFORD

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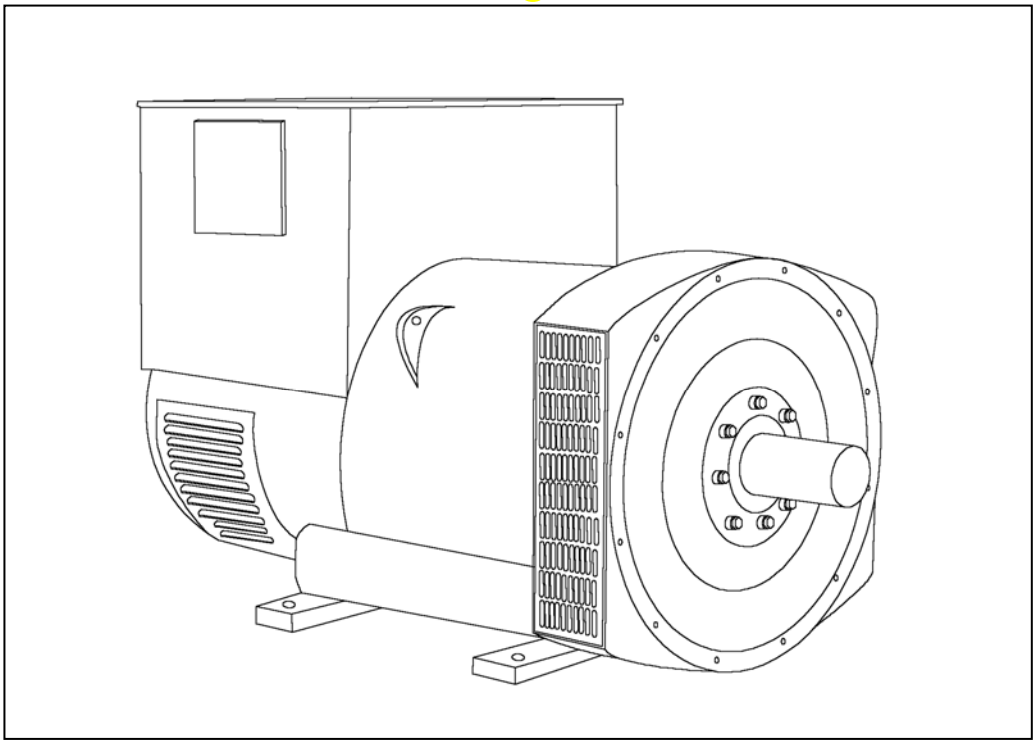
HCI 434D/444D - Winding 311

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.

STAMFORD

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	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	0.0124 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	1.05 Ohms at 22°C							
EXCITER STATOR RESISTANCE	18 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.068 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. 6317 (ISO)							
BEARING NON-DRIVE END	BALL. 6314 (ISO)							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	940 kg				950 kg			
WEIGHT WOUND STATOR	415 kg				415 kg			
WEIGHT WOUND ROTOR	361 kg				338 kg			
WR² INERTIA	4.0771 kgm²				3.8783 kgm²			
SHIPPING WEIGHTS in a crate	1010 kg				1010 kg			
PACKING CRATE SIZE	155 x 87 x 107(cm)				155 x 87 x 107(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.8 m³/sec 1700 cfm				0.99 m³/sec 2100 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	300	300	300	290	344	360	375	375
Xd DIR. AXIS SYNCHRONOUS	3.16	2.85	2.65	2.28	3.60	3.37	3.21	2.95
X'd DIR. AXIS TRANSIENT	0.20	0.18	0.17	0.15	0.22	0.21	0.20	0.18
X"d DIR. AXIS SUBTRANSIENT	0.14	0.13	0.12	0.10	0.15	0.14	0.14	0.12
Xq QUAD. AXIS REACTANCE	2.66	2.40	2.23	1.92	3.09	2.89	2.75	2.53
X"q QUAD. AXIS SUBTRANSIENT	0.39	0.36	0.33	0.28	0.40	0.38	0.36	0.33
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.09	0.09	0.08	0.07
X_2 NEGATIVE SEQUENCE	0.26	0.24	0.22	0.19	0.28	0.27	0.25	0.23
X_0 ZERO SEQUENCE	0.10	0.09	0.08	0.07	0.10	0.09	0.09	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.	0.019s							
T'do O.C. FIELD TIME CONST.	1.7s							
Ta ARMATURE TIME CONST.	0.018s							
SHORT CIRCUIT RATIO	1/Xd							

50 Hz

HCI434D/444D

Winding 311

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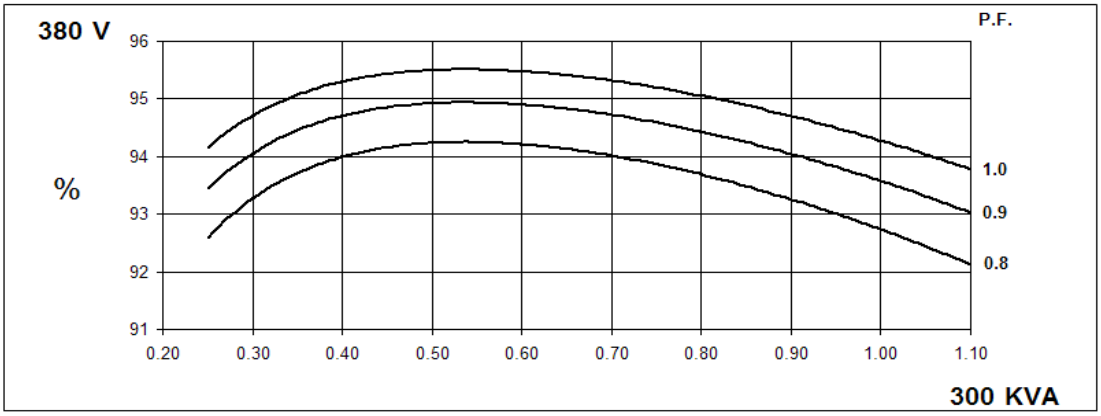
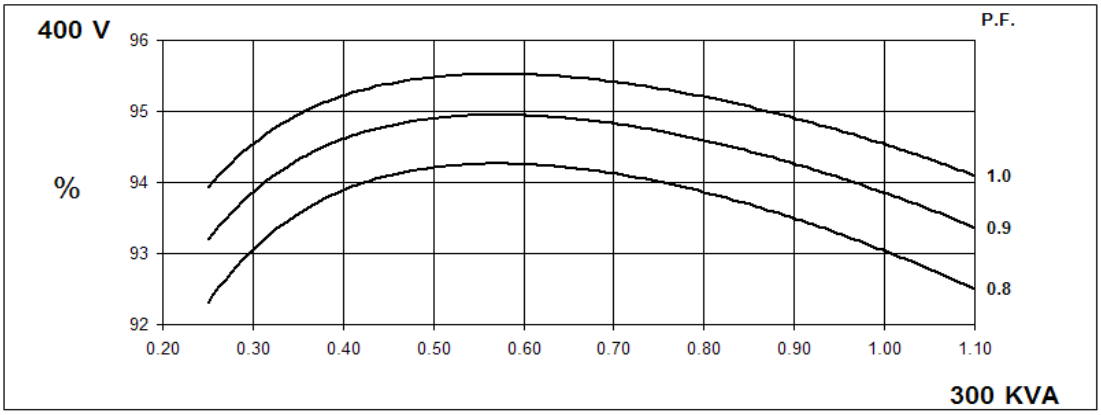
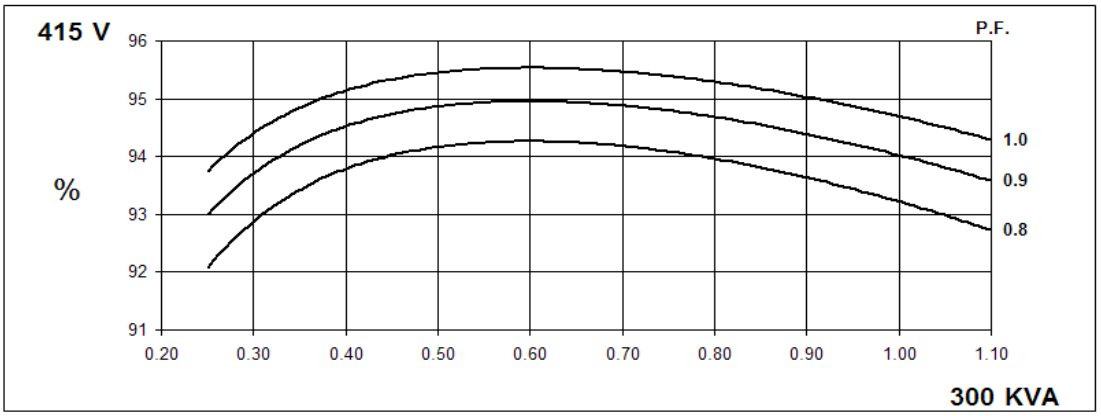
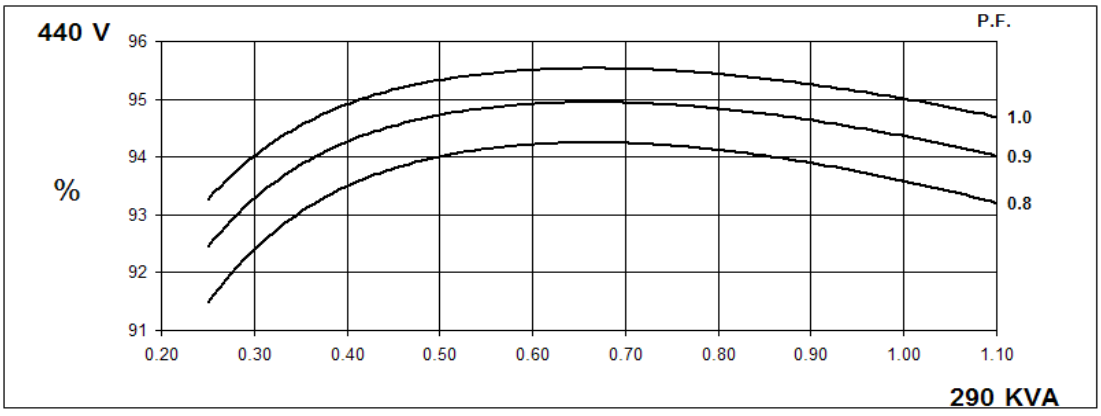
THREE PHASE EFFICIENCY CURVES









60 Hz

HCI434D/444D

Winding 311

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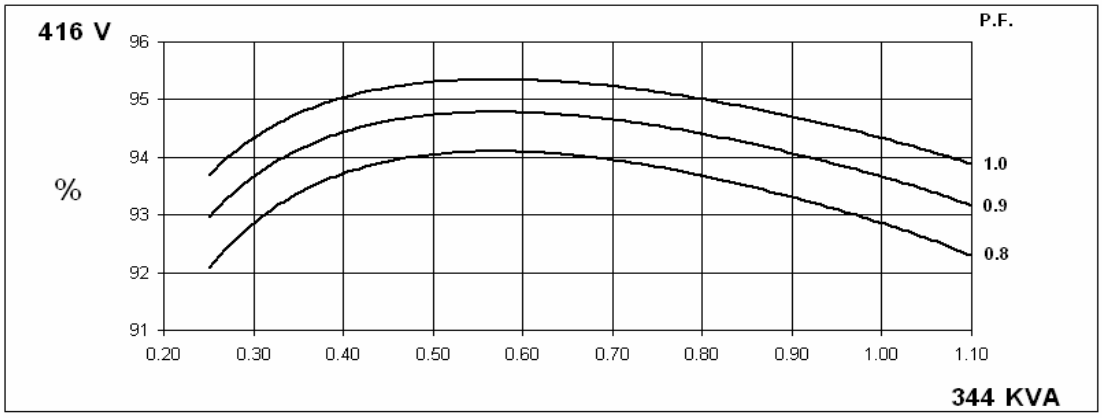
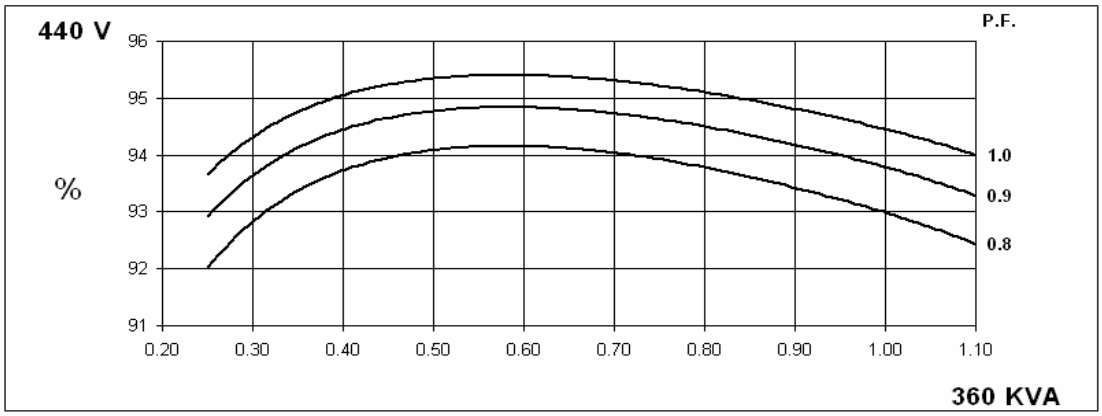
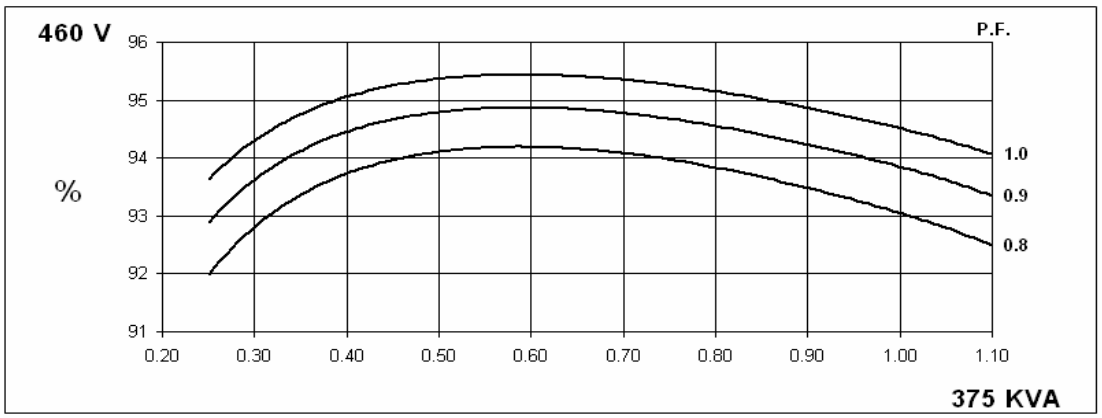
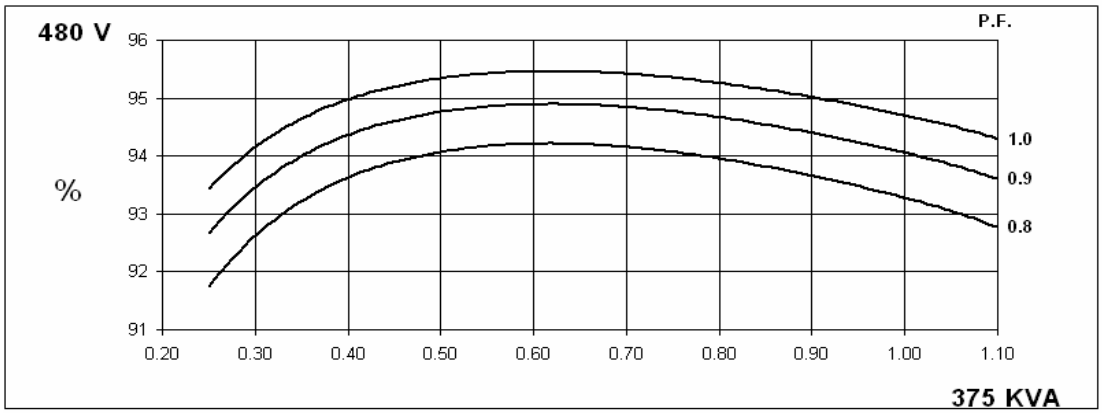
THREE PHASE EFFICIENCY CURVES









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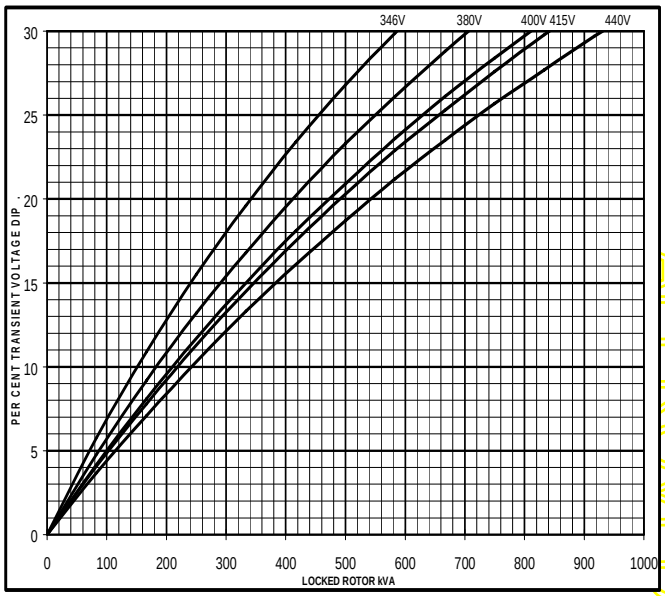
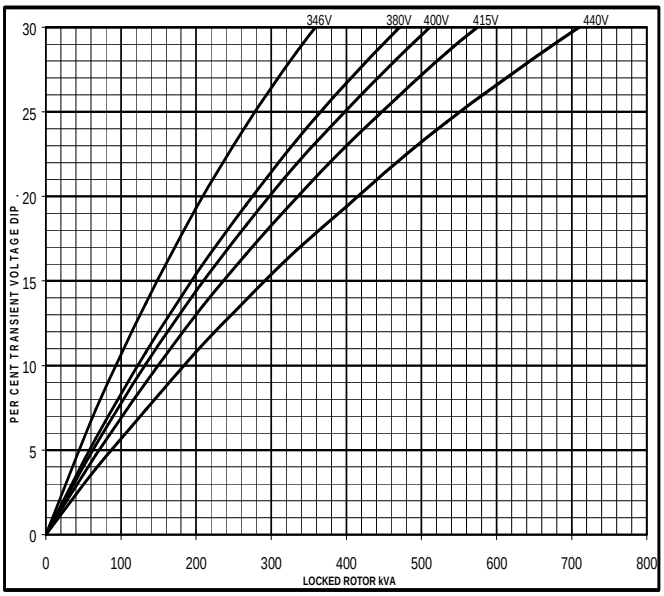
Locked Rotor Motor Starting Curve

50 Hz

MX

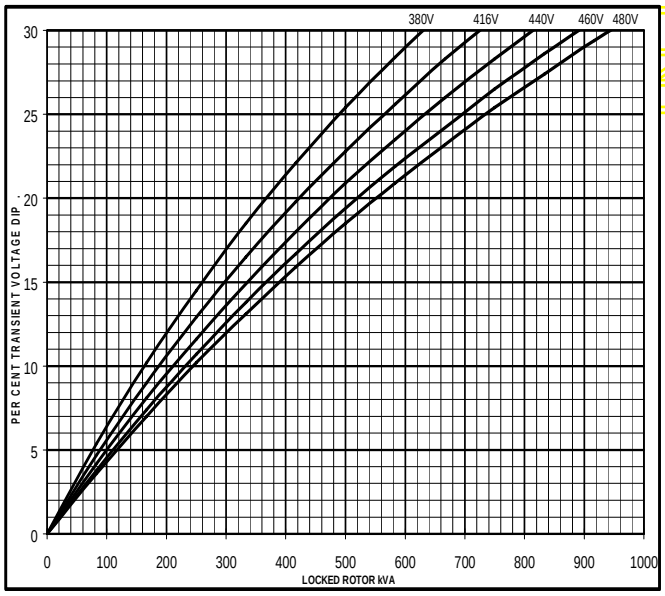


SX

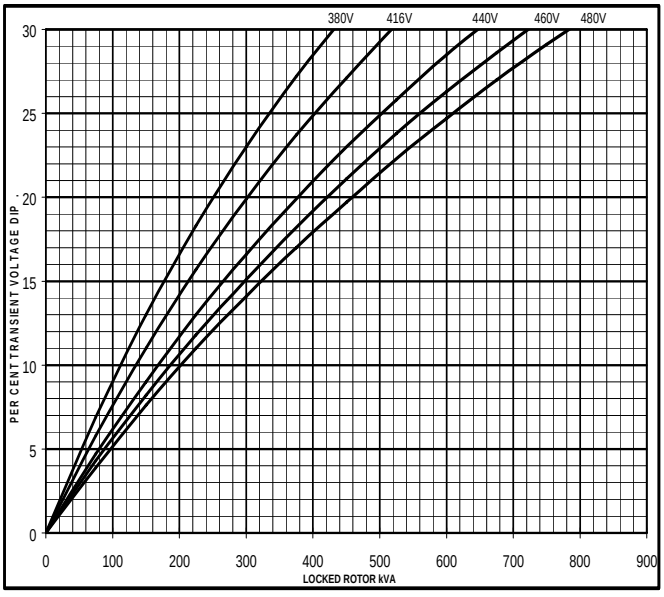


60 Hz

MX

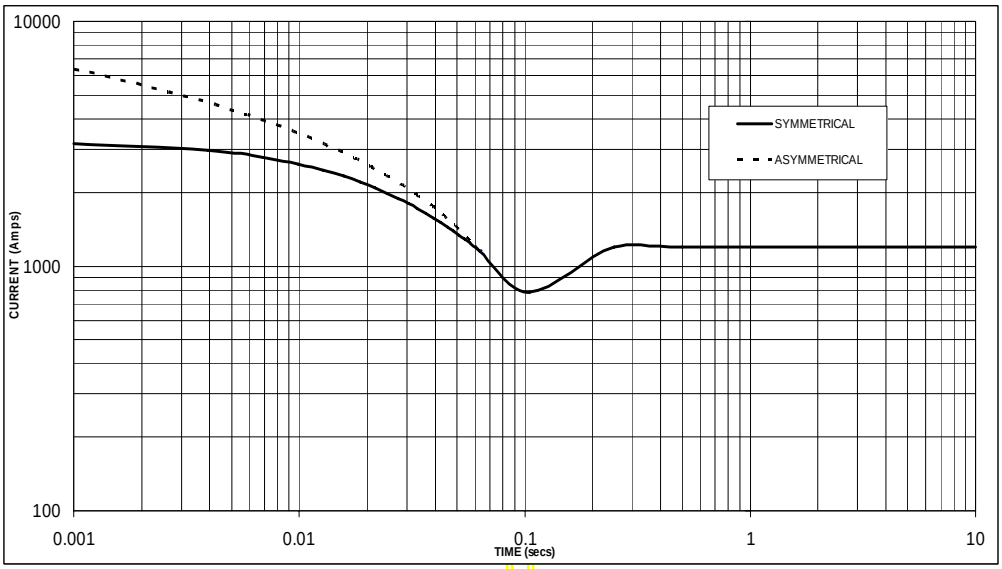


SX



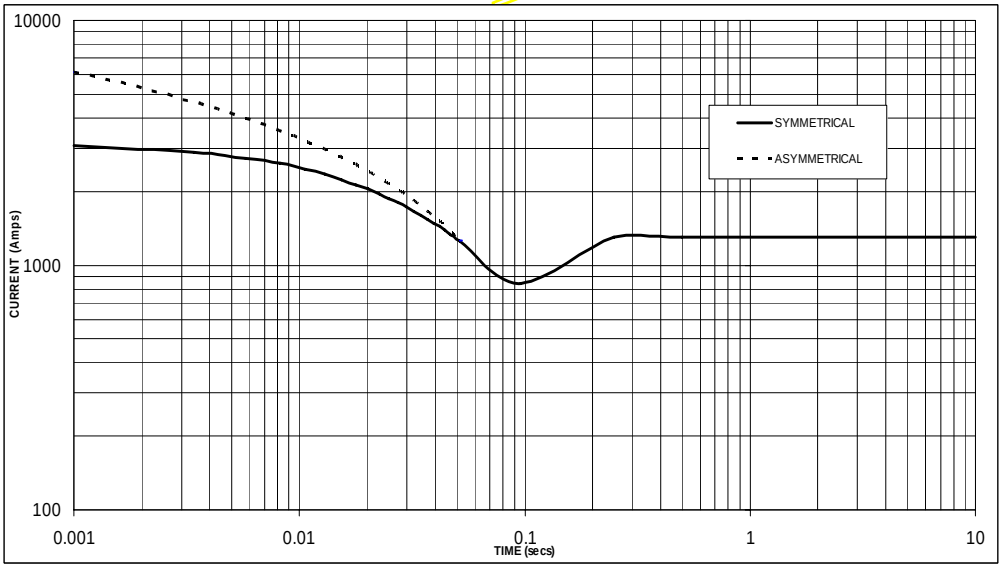
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 1,200 Amps

60 Hz



Sustained Short Circuit = 1,300 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 1.05	440v	X 1.06
415v	X 1.09	460v	X 1.10
440v	X 1.16	480v	X 1.15

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

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

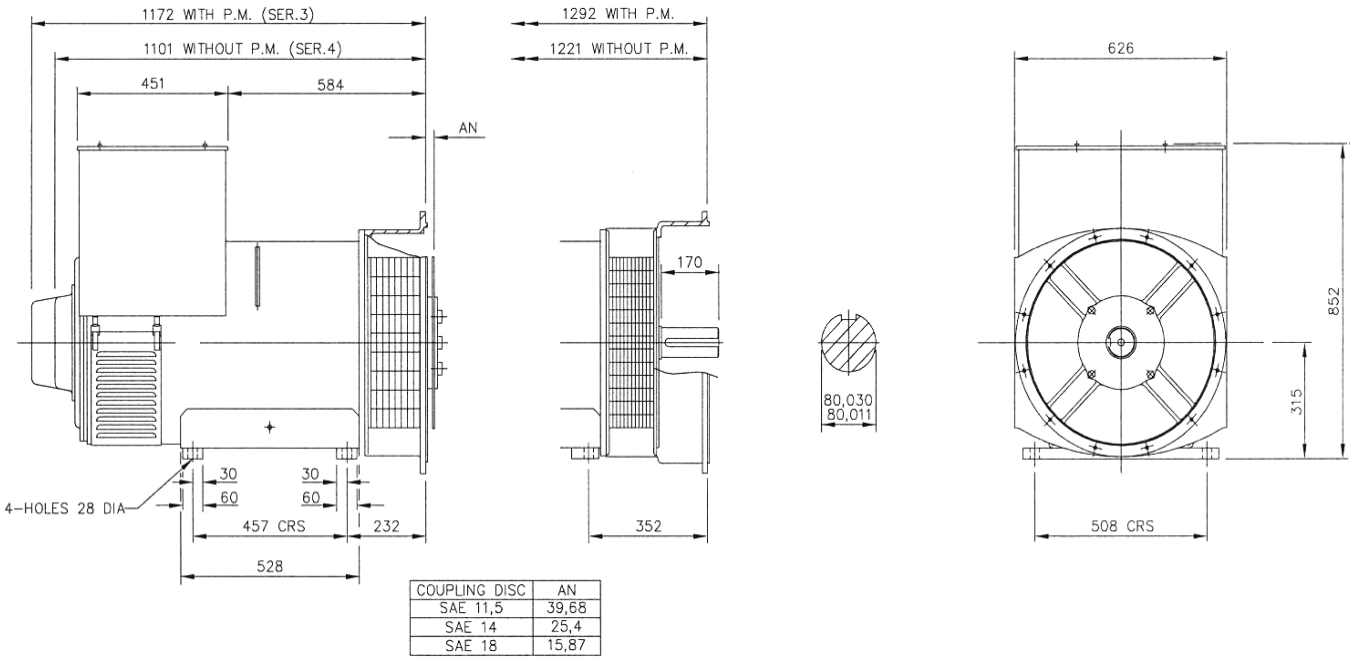
HCI434D/444D

Winding 311 / 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			
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	280	280	280	270	300	300	300	290	320	320	320	310	330	330	330	320
	kW	224	224	224	216	240	240	240	232	256	256	256	248	264	264	264	256
	Efficiency (%)	93.1	93.4	93.5	93.8	92.7	93.0	93.2	93.6	92.3	92.7	92.9	93.3	92.1	92.5	92.7	93.2
	kW Input	241	240	240	230	259	258	258	248	277	276	276	266	287	285	285	275
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	315	335	345	345	344	360	375	375	365	385	400	400	375	395	415	415
	kW	252	268	276	276	275	288	300	300	292	308	320	320	300	316	332	332
	Efficiency (%)	93.3	93.3	93.4	93.6	92.9	93.0	93.1	93.3	92.5	92.6	92.7	93.0	92.4	92.5	92.5	92.8
	kW Input	270	287	296	295	296	310	322	322	316	333	345	344	325	342	359	358

DIMENSIONS



COUPLING DISC	AN
SAE 11,5	39,68
SAE 14	25,4
SAE 18	15,87

APPROVED DOCUMENT

STAMFORD

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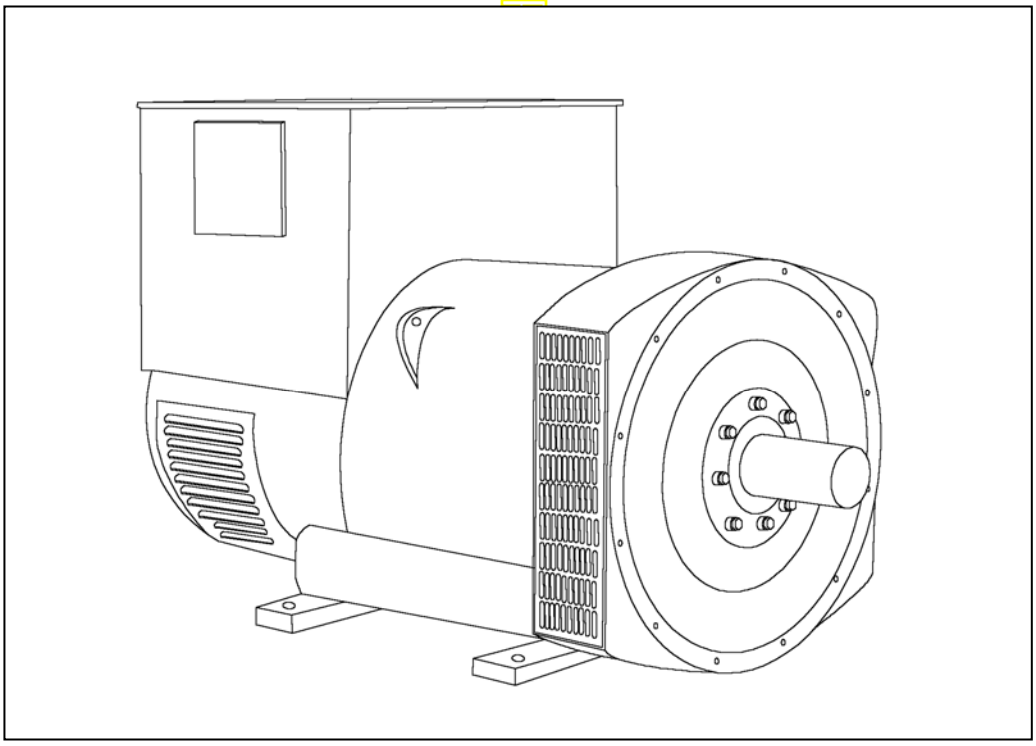
HCI 434E/444E - Winding 311

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.
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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.

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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.

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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	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	0.009 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	1.19 Ohms at 22°C							
EXCITER STATOR RESISTANCE	18 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.068 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. 6317 (ISO)							
BEARING NON-DRIVE END	BALL. 6314 (ISO)							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	1024 kg				1030 kg			
WEIGHT WOUND STATOR	470 kg				470 kg			
WEIGHT WOUND ROTOR	400 kg				377 kg			
WR² INERTIA	4.6331 kgm²				4.4343 kgm²			
SHIPPING WEIGHTS in a crate	1095 kg				1100 kg			
PACKING CRATE SIZE	155 x 87 x 107(cm)				155 x 87 x 107(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.8 m³/sec 1700 cfm				0.99 m³/sec 2100 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	350	350	350	350	400	420	440	440
Xd DIR. AXIS SYNCHRONOUS	3.01	2.71	2.52	2.24	3.47	3.26	3.12	2.87
X'd DIR. AXIS TRANSIENT	0.20	0.18	0.17	0.15	0.21	0.20	0.19	0.17
X"d DIR. AXIS SUBTRANSIENT	0.14	0.13	0.12	0.11	0.15	0.14	0.13	0.12
Xq QUAD. AXIS REACTANCE	2.58	2.33	2.16	1.92	2.92	2.74	2.63	2.41
X"q QUAD. AXIS SUBTRANSIENT	0.36	0.32	0.30	0.27	0.41	0.38	0.37	0.34
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.24	0.22	0.20	0.18	0.28	0.26	0.25	0.23
X_0 ZERO SEQUENCE	0.10	0.09	0.08	0.07	0.10	0.09	0.09	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.	0.019s							
T'do O.C. FIELD TIME CONST.	1.7s							
Ta ARMATURE TIME CONST.	0.018s							
SHORT CIRCUIT RATIO	1/Xd							

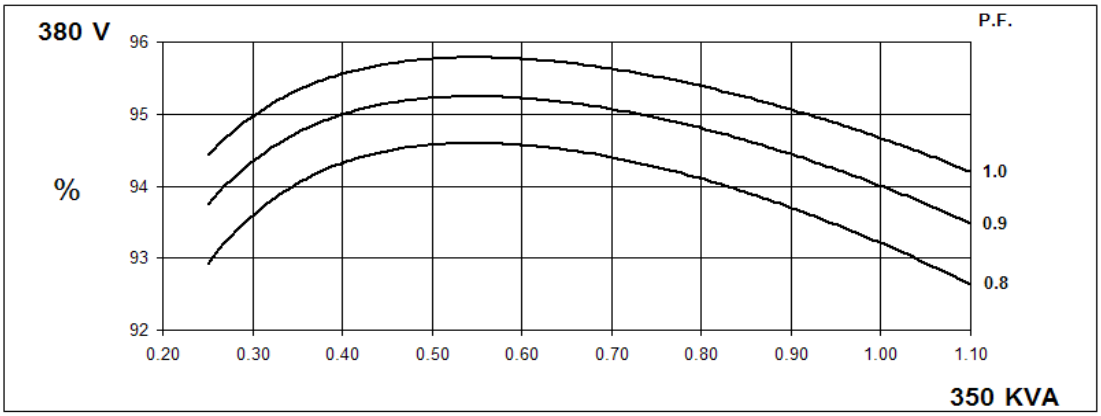
50 Hz

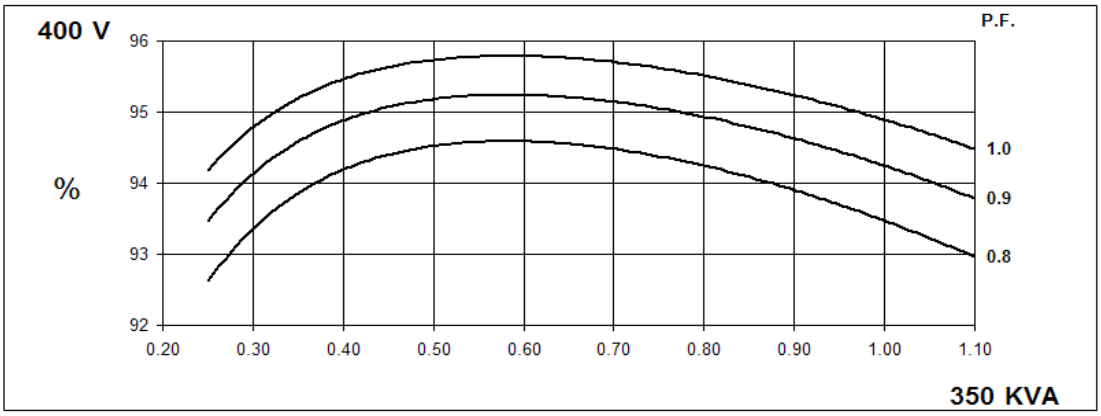
HCI434E/444E

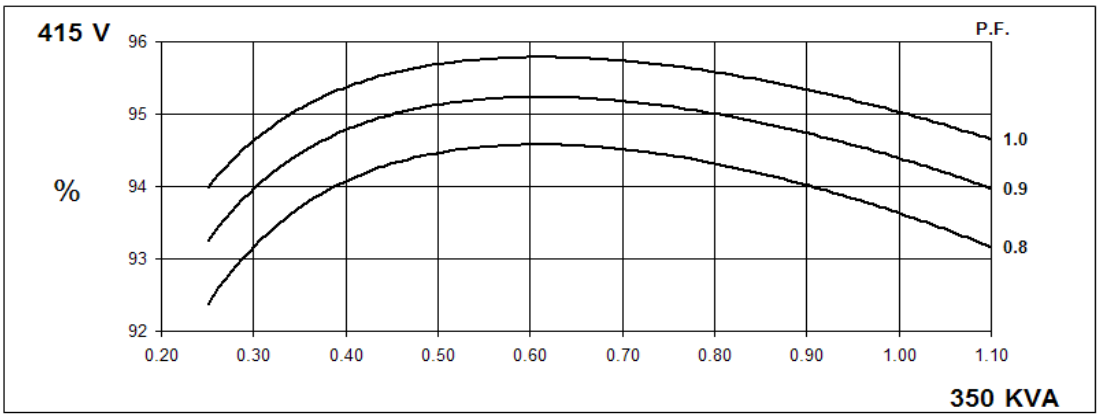
Winding 311

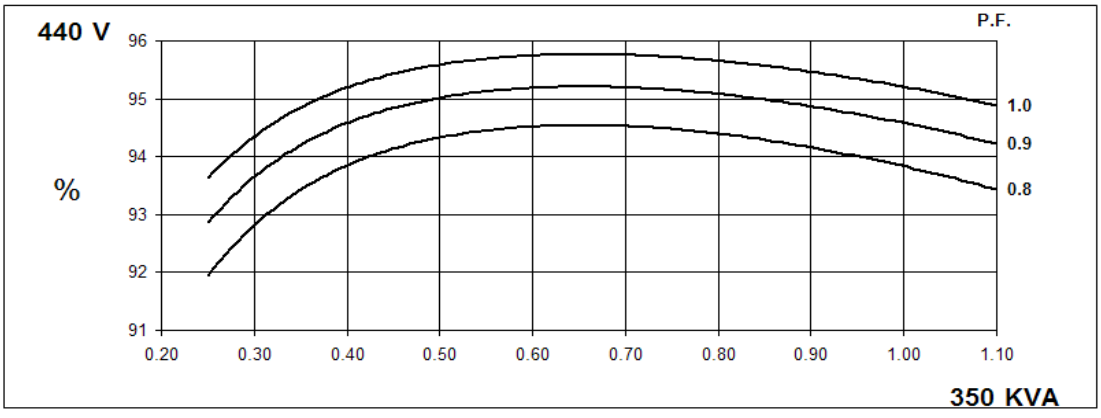
STAMFORD

THREE PHASE EFFICIENCY CURVES









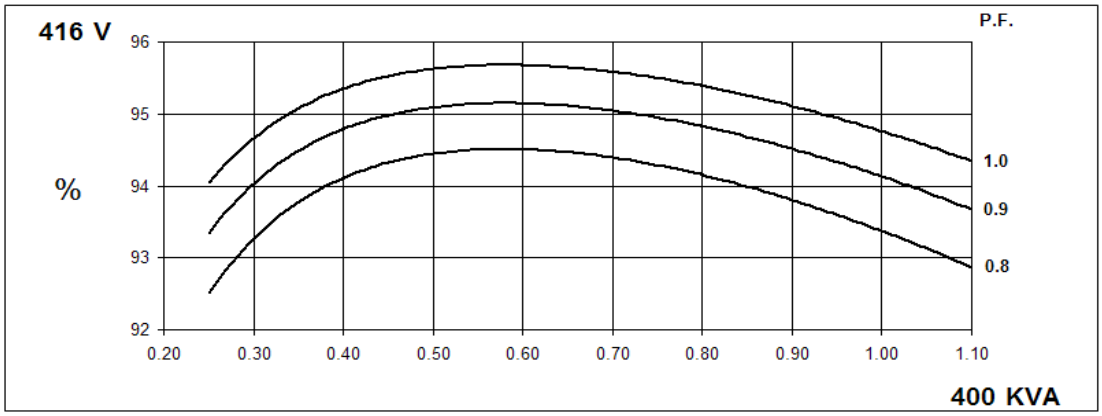
60 Hz

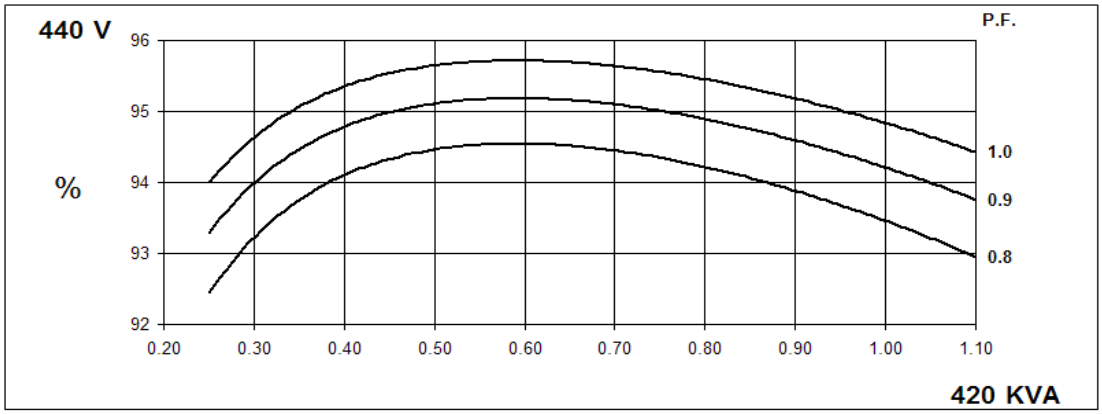
HCI434E/444E

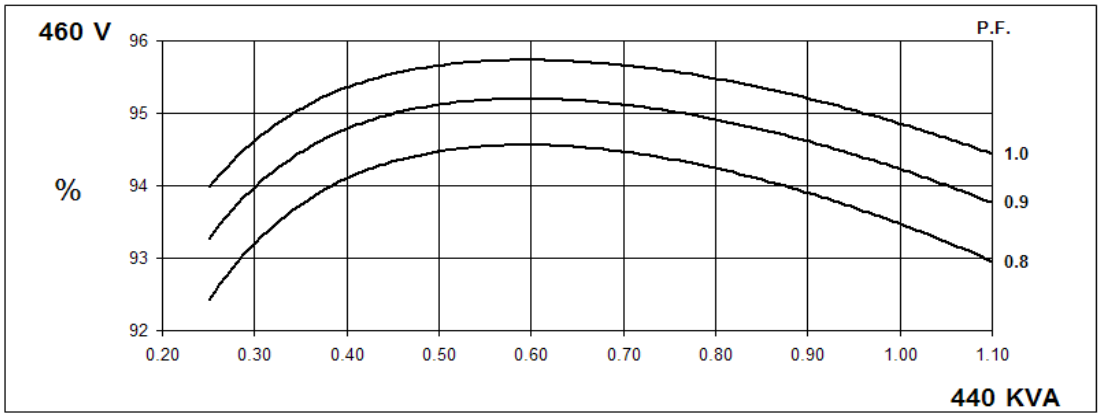
Winding 311

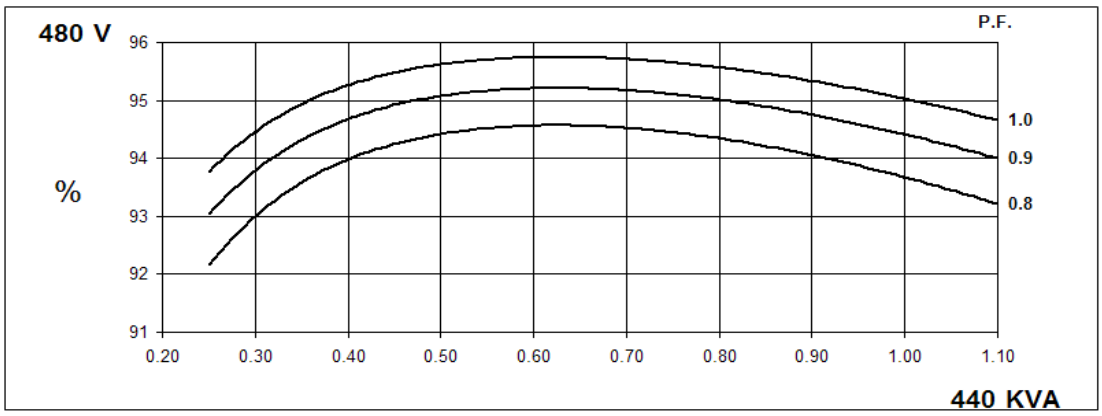
STAMFORD

THREE PHASE EFFICIENCY CURVES









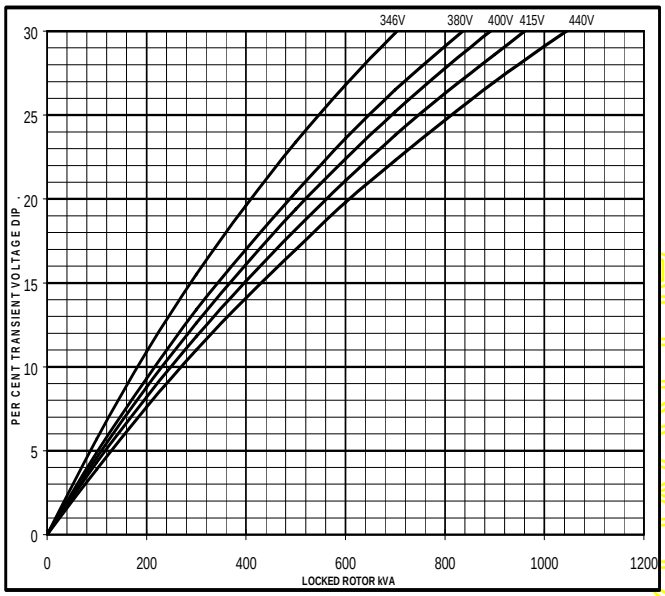
HCI434E/444E

Winding 311

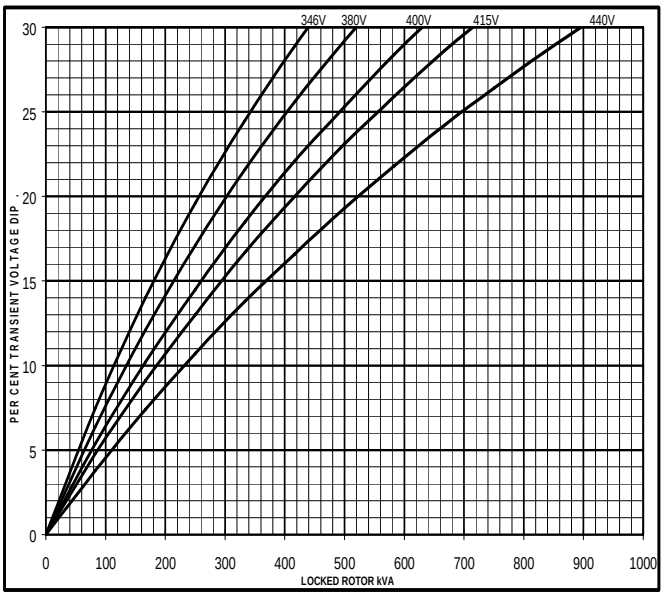
Locked Rotor Motor Starting Curve

50 Hz

MX

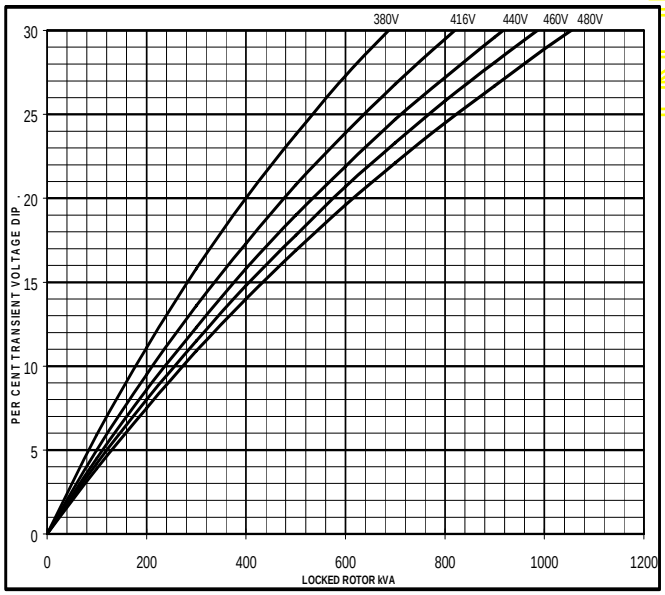


SX



60 Hz

MX



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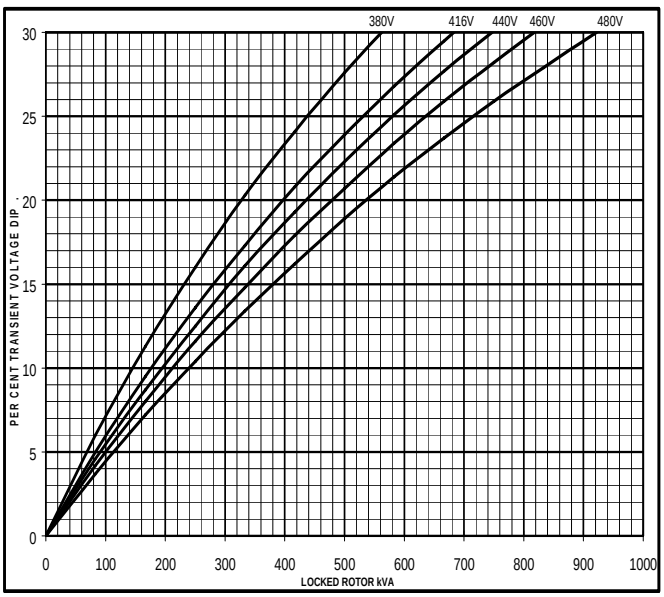
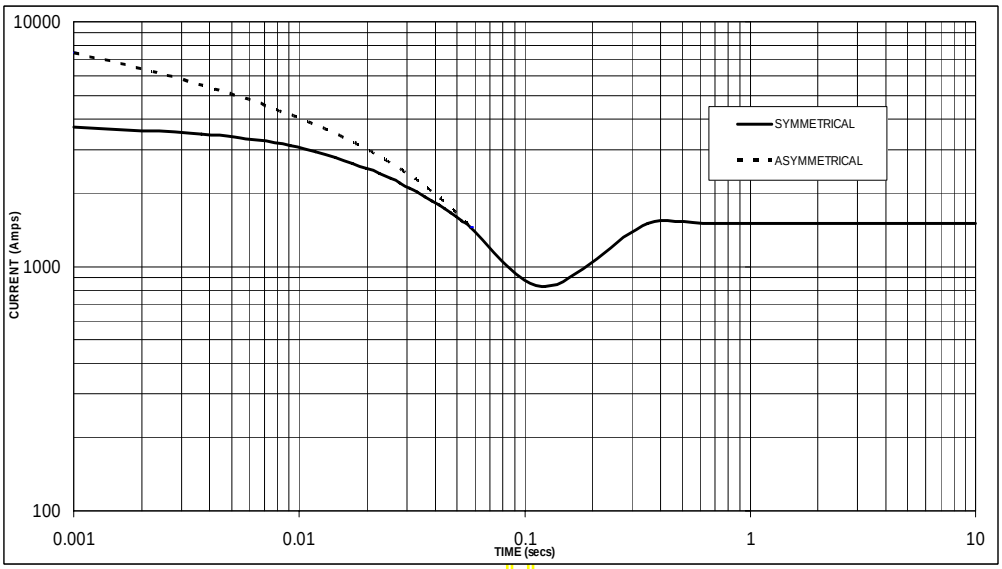


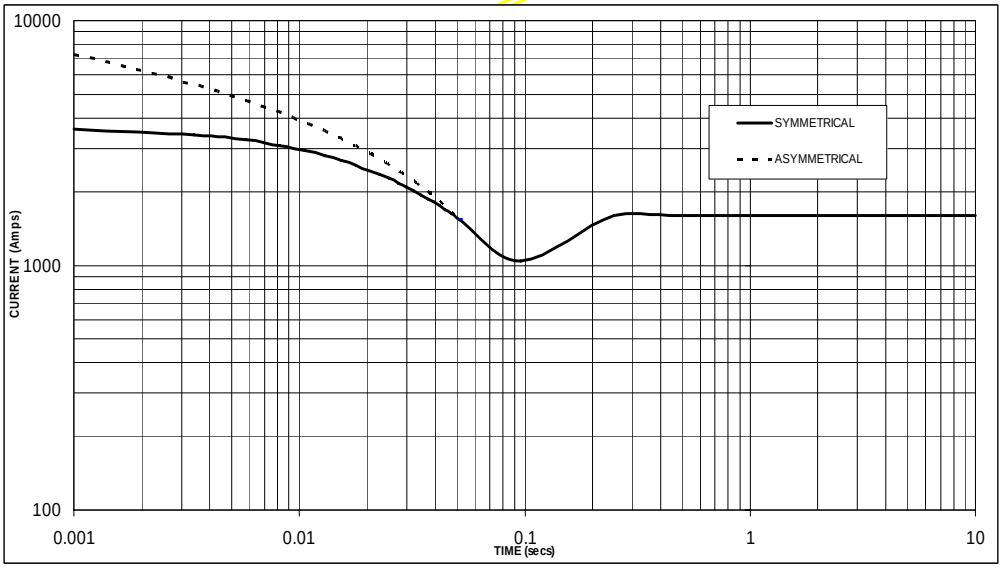
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 1,500 Amps

60 Hz



Sustained Short Circuit = 1,600 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

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

HCI434E/444E

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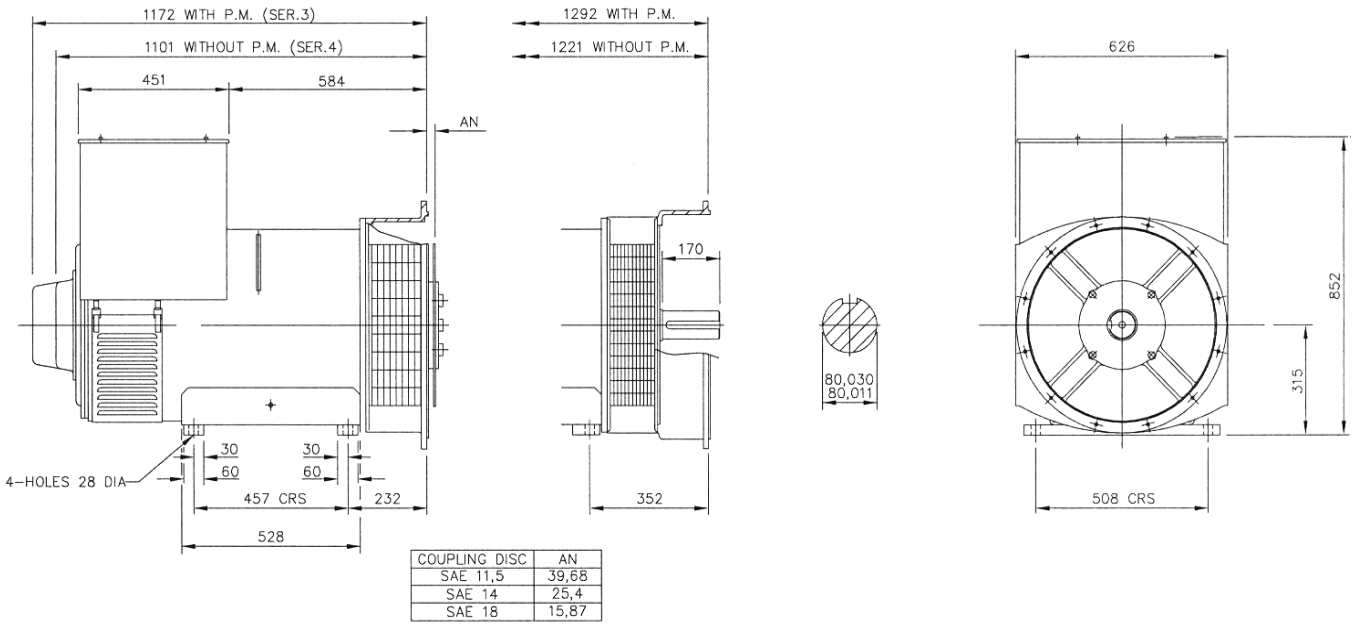
	Series Delta (V)	220	230	240	254	220	230	240	254	220	230	240	254	220	230	240	254
	kVA	320	320	320	320	350	350	350	350	370	370	370	370	380	400	380	380
	kW	256	256	256	256	280	280	280	280	296	296	296	296	304	320	304	304
	Efficiency (%)	93.6	93.8	94.0	94.1	93.2	93.5	93.6	93.8	92.9	93.2	93.4	93.6	92.7	92.7	93.2	93.5
	kW Input	274	273	272	272	300	299	299	299	319	318	317	316	328	345	326	325
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	365	385	400	400	400	420	440	440	420	445	460	460	435	455	475	475
	kW	292	308	320	320	320	336	352	352	336	356	368	368	348	364	380	380
	Efficiency (%)	93.8	93.8	93.9	94.0	93.4	93.5	93.5	93.7	93.1	93.2	93.2	93.5	92.9	93.0	93.1	93.3
	kW Input	311	328	341	340	343	359	376	376	361	382	395	394	375	391	408	407

DIMENSIONS



COUPLING DISC	AN
SAE 11,5	39,68
SAE 14	25,4
SAE 18	15,87

APPROVED DOCUMENT

STAMFORD

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STAMFORD®

HCI 434F/444F - Winding 311

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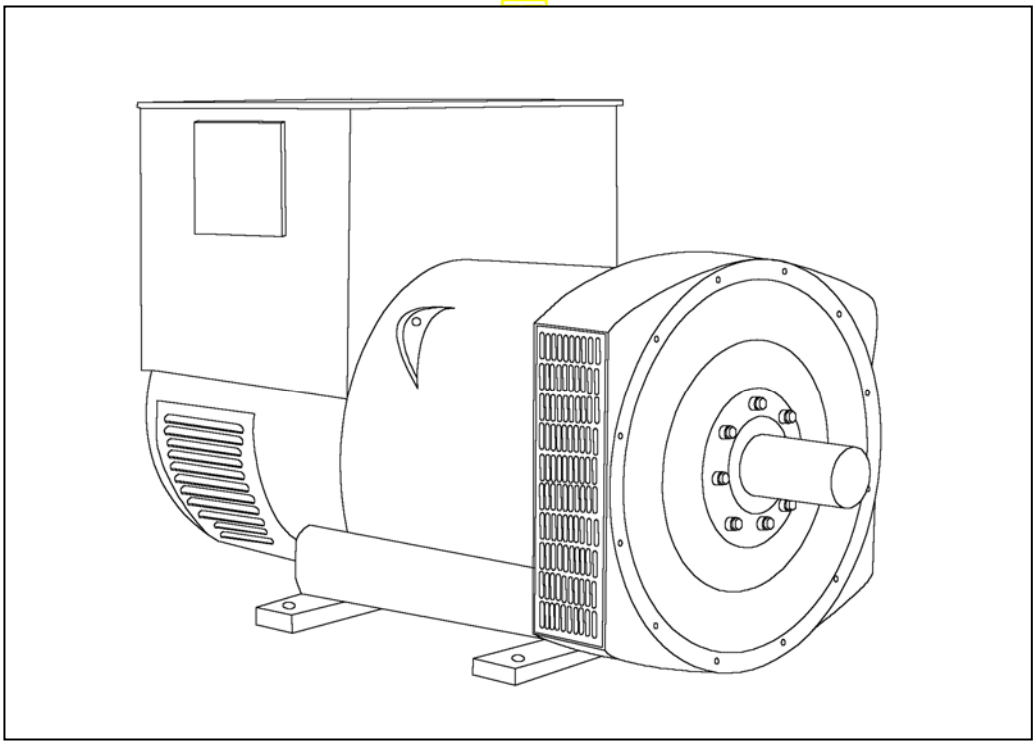

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3% for every 5°C by which the operational ambient temperature exceeds 40°C.
Note: Requirement for operating in an ambient exceeding 60°C must be referred to the factory.

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.

HCI434F/444F

STAMFORD

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	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	0.0073 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.37 Ohms at 22°C						
EXCITER STATOR RESISTANCE	18 Ohms at 22°C						
EXCITER ROTOR RESISTANCE	0.068 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. 6317 (ISO)						
BEARING NON-DRIVE END	BALL. 6314 (ISO)						
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	1160 kg				1160 kg			
WEIGHT WOUND STATOR	535 kg				535 kg			
WEIGHT WOUND ROTOR	463 kg				440 kg			
WR² INERTIA	5.4292 kgm²				5.2304 kgm²			
SHIPPING WEIGHTS in a crate	1230 kg				1230 kg			
PACKING CRATE SIZE	155 x 87 x 107(cm)				155 x 87 x 107(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.8 m³/sec 1700 cfm				0.99 m³/sec 2100 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	400	400	400	400	455	480	500	500
Xd DIR. AXIS SYNCHRONOUS	2.72	2.45	2.28	2.03	3.28	3.09	2.95	2.71
X'd DIR. AXIS TRANSIENT	0.18	0.16	0.15	0.13	0.18	0.17	0.16	0.15
X"d DIR. AXIS SUBTRANSIENT	0.13	0.12	0.11	0.10	0.13	0.12	0.12	0.11
Xq QUAD. AXIS REACTANCE	2.35	2.12	1.97	1.75	2.90	2.73	2.61	2.39
X"q QUAD. AXIS SUBTRANSIENT	0.31	0.28	0.26	0.23	0.43	0.41	0.39	0.35
X_L LEAKAGE REACTANCE	0.06	0.05	0.05	0.04	0.07	0.07	0.06	0.06
X_2 NEGATIVE SEQUENCE	0.23	0.20	0.19	0.17	0.29	0.27	0.26	0.24
X_0 ZERO SEQUENCE	0.08	0.08	0.07	0.06	0.10	0.09	0.09	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.	0.019s							
T'do O.C. FIELD TIME CONST.	1.7s							
Ta ARMATURE TIME CONST.	0.018s							
SHORT CIRCUIT RATIO	1/Xd							

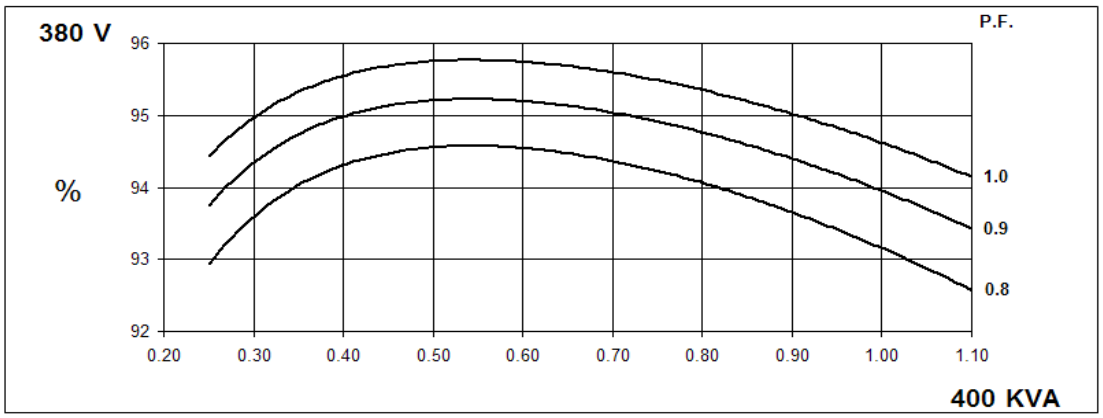
50 Hz

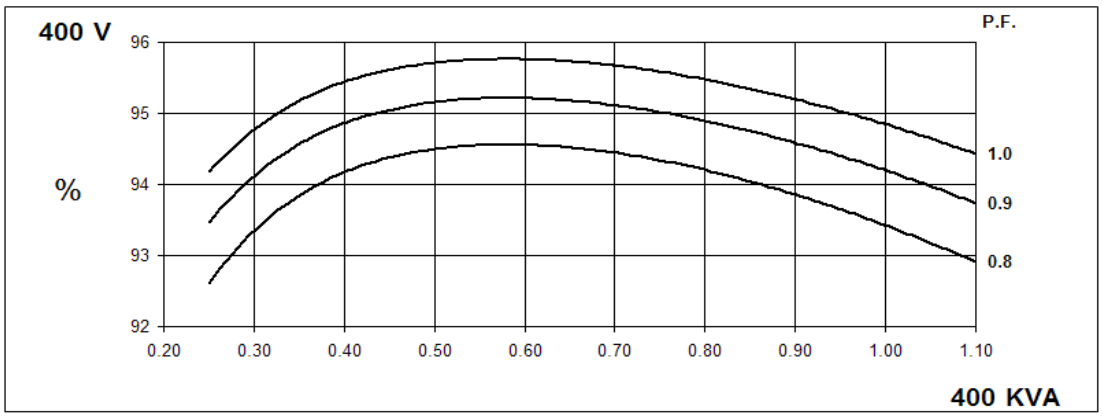
HCI434F/444F

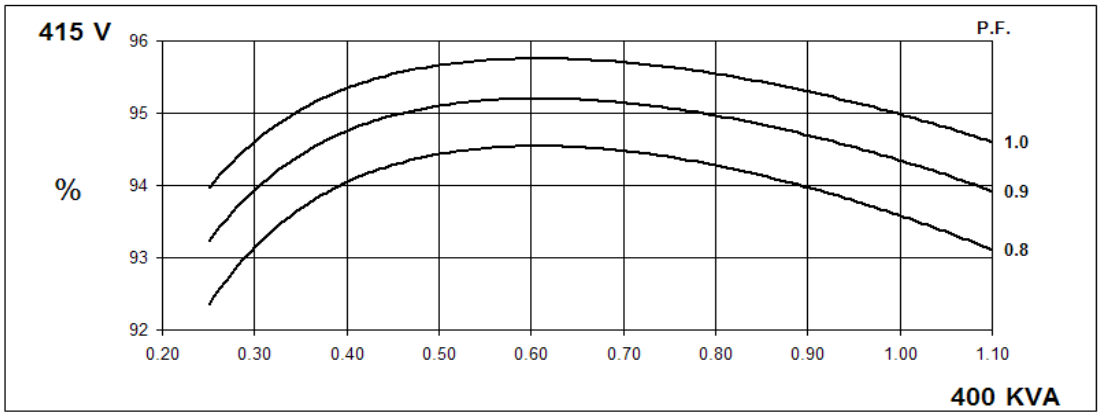
Winding 311

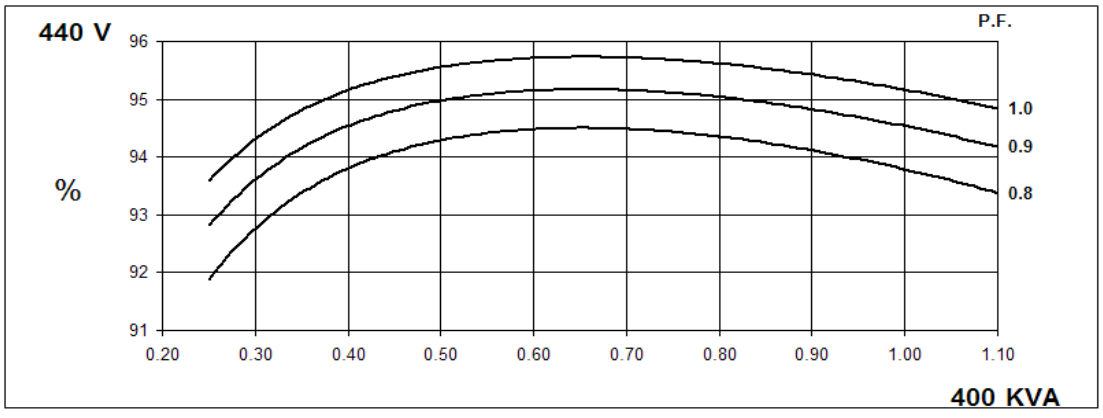
STAMFORD

THREE PHASE EFFICIENCY CURVES









60 Hz

HCI434F/444F

Winding 311

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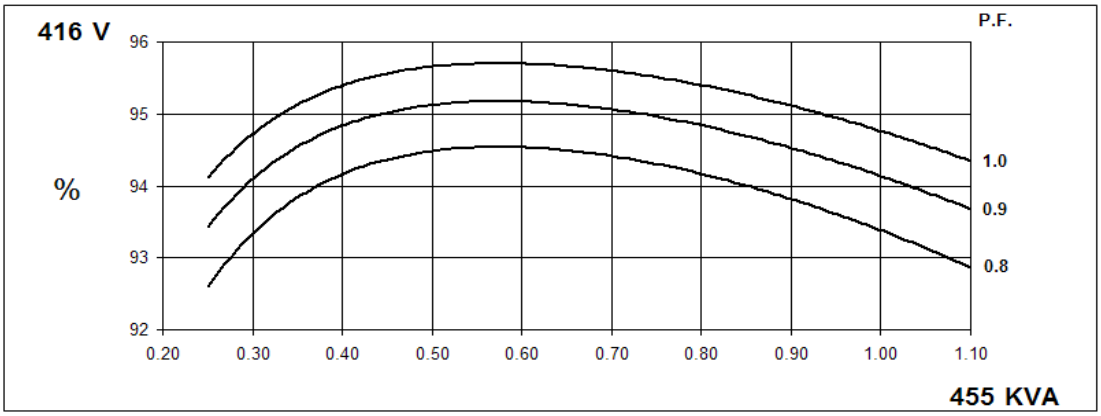
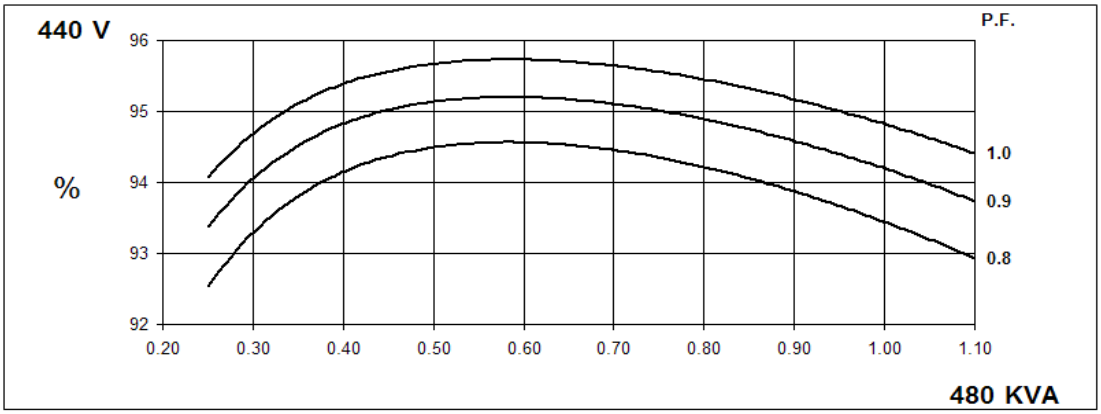
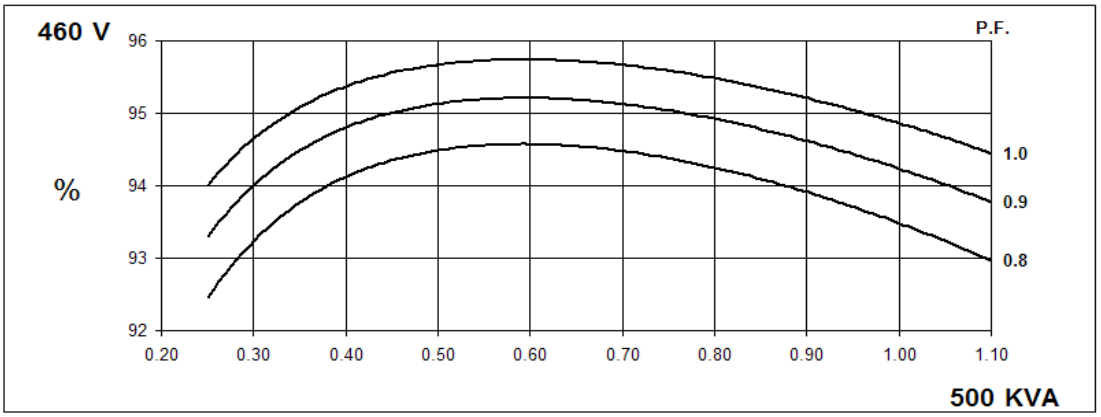
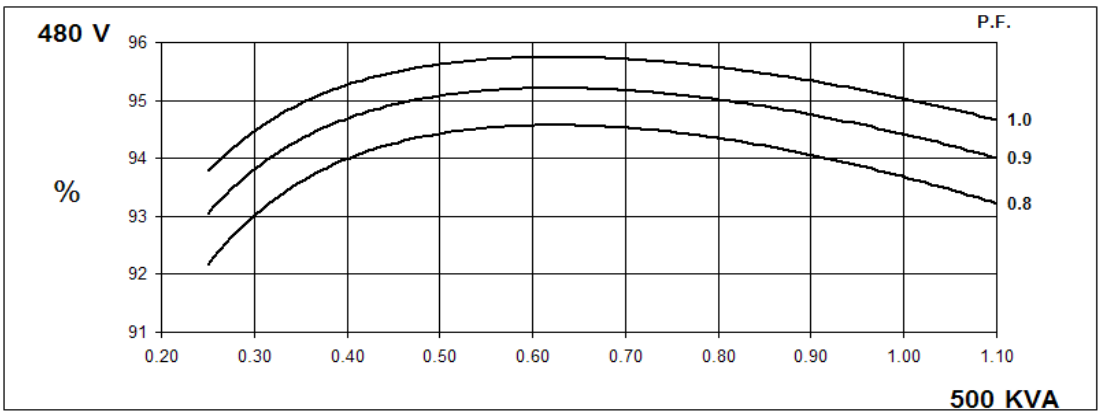
THREE PHASE EFFICIENCY CURVES









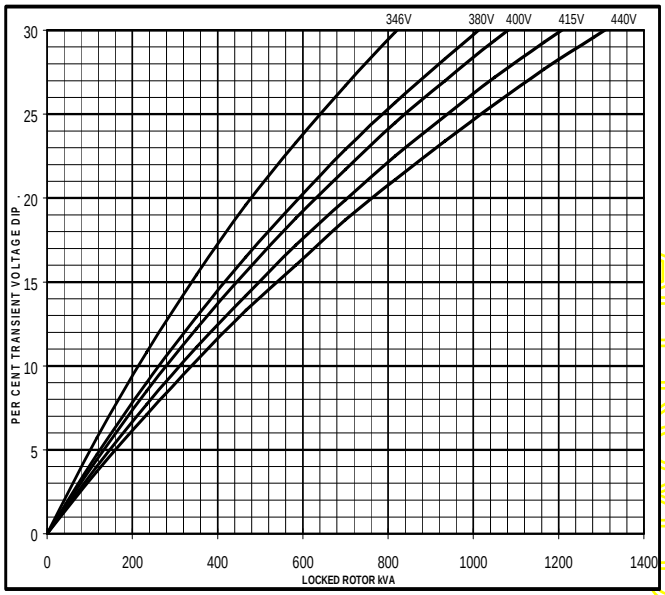
HCI434F/444F

Winding 311

Locked Rotor Motor Starting Curve

50 Hz

MX



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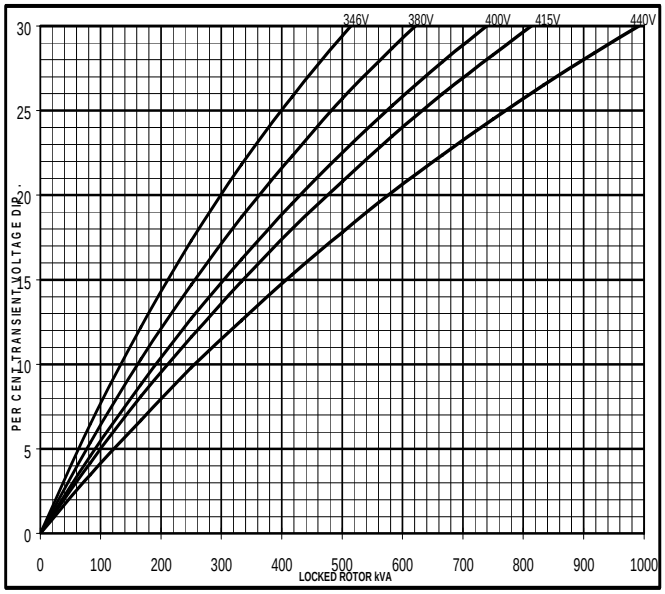
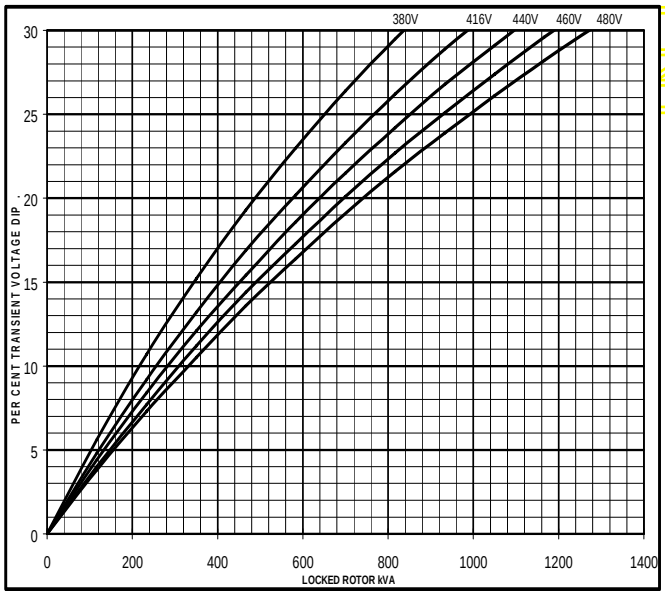


60 Hz

MX



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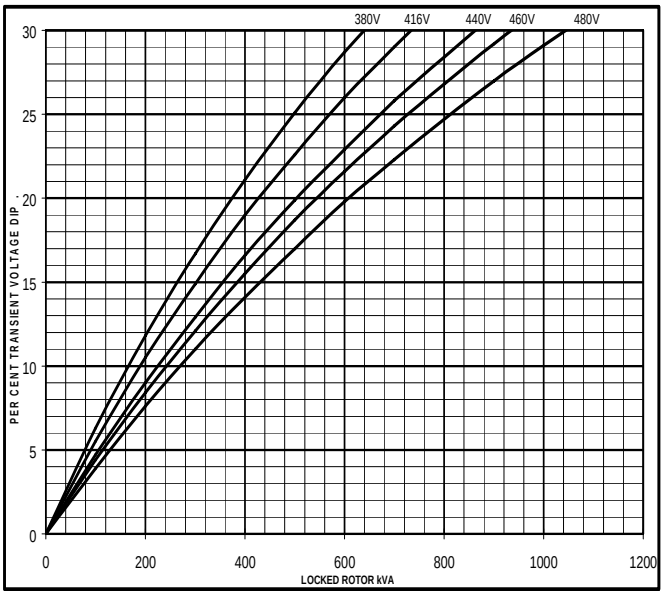
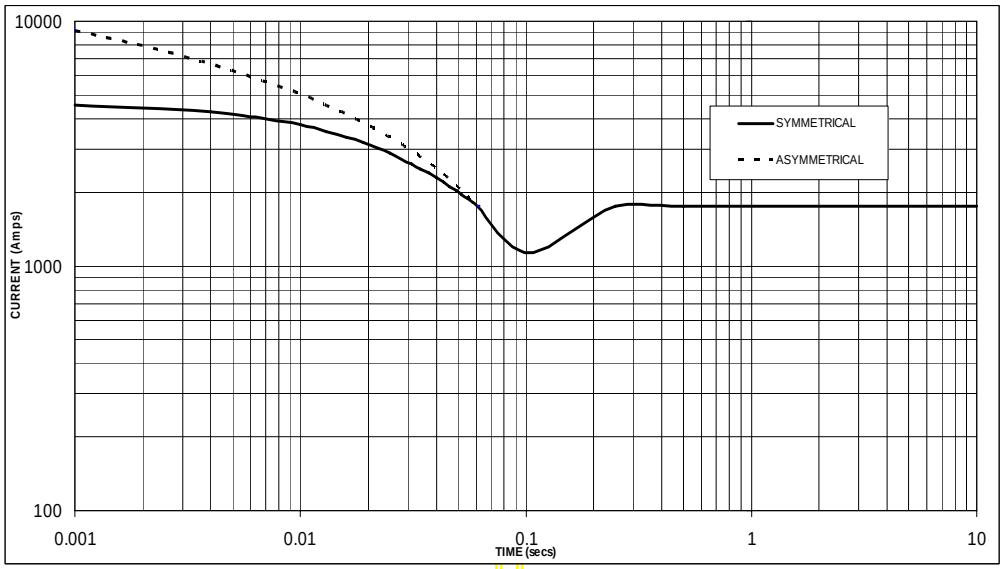


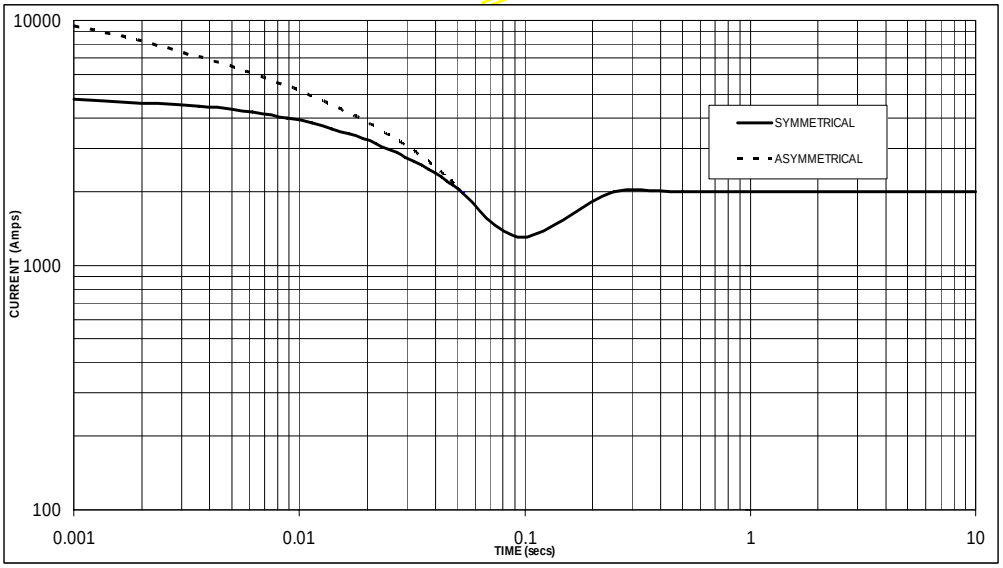
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 1,750 Amps

60 Hz



Sustained Short Circuit = 2,000 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

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

Parallel Star = Curve current value X 2

HCI434F/444F

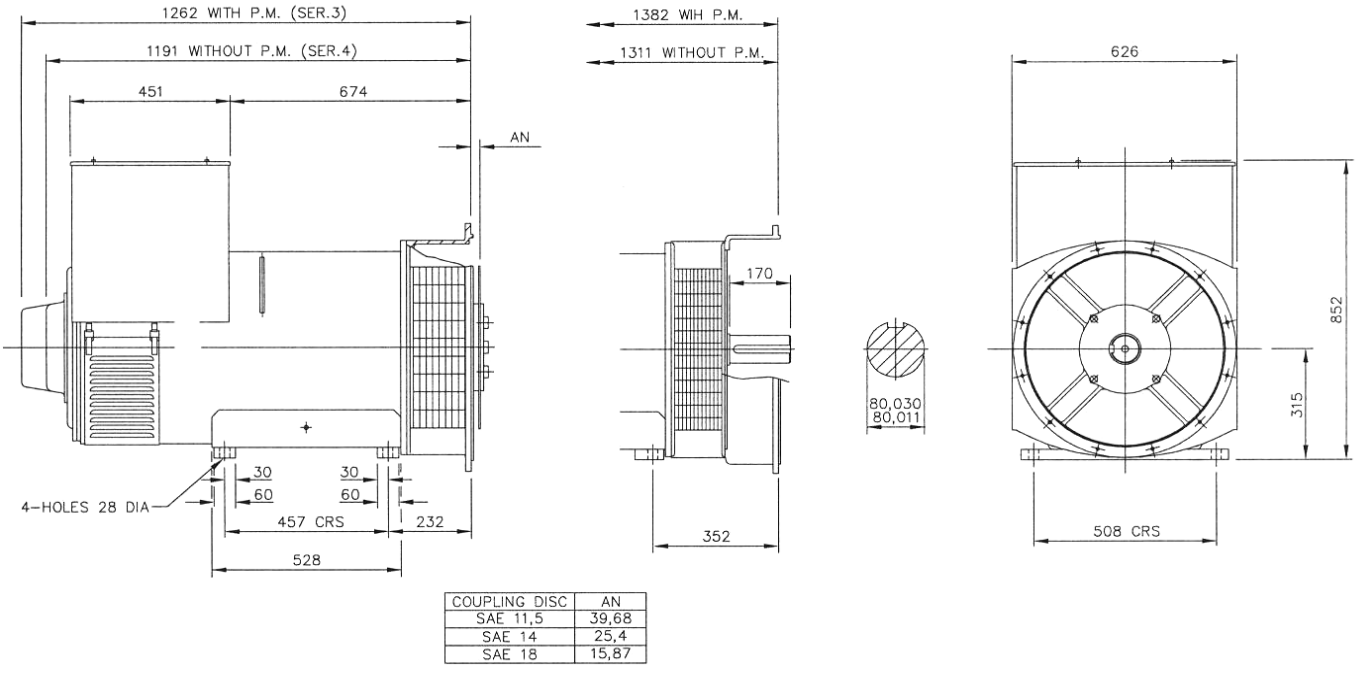
Winding 311 / 0.8 Power Factor

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	370	370	370	370	400	400	400	400	415	430	430	430	425	450	440	440
	kW	296	296	296	296	320	320	320	320	332	344	344	344	340	360	352	352
	Efficiency (%)	93.5	93.8	93.9	94.0	93.2	93.4	93.6	93.8	92.9	93.0	93.2	93.5	92.8	92.8	93.1	93.4
	kW Input	317	316	315	315	343	343	342	341	357	370	369	368	366	388	378	377
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
	Series Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	420	445	465	465	455	480	500	500	485	515	535	535	500	530	550	550
	kW	336	356	372	372	364	384	400	400	388	412	428	428	400	424	440	440
	Efficiency (%)	93.7	93.8	93.8	94.0	93.4	93.4	93.5	93.7	93.1	93.1	93.1	93.4	92.9	92.9	93.0	93.2
	kW Input	359	380	397	396	390	411	428	427	417	443	460	458	431	456	473	472

DIMENSIONS



COUPLING DISC	AN
SAE 11,5	39,68
SAE 14	25,4
SAE 18	15,87

APPROVED DOCUMENT

STAMFORD

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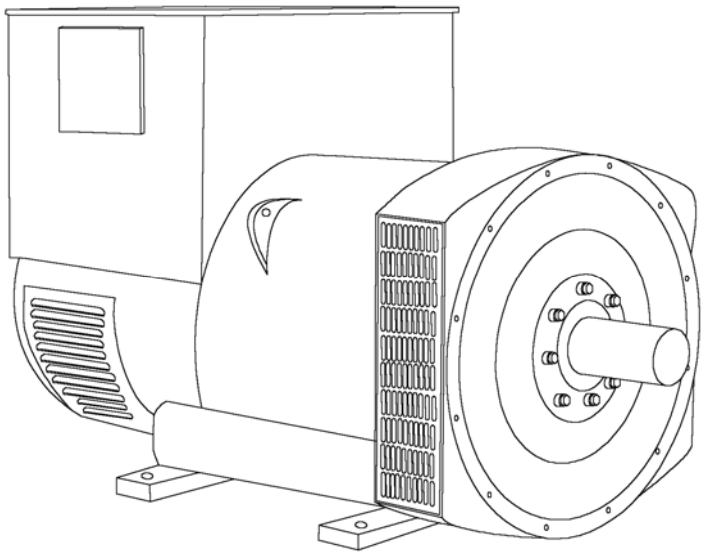
STAMFORD®

HCI 534C/544C - 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	0.0065 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.55 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	1263 kg				1275 kg		
WEIGHT WOUND STATOR	584 kg				584 kg		
WEIGHT WOUND ROTOR	502 kg				473 kg		
WR² INERTIA	6.8928 kgm^2				6.6149 kgm^2		
SHIPPING WEIGHTS in a crate	1355 kg				1395 kg		
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	455	500	455	450	525	550	581	594
Xd DIR. AXIS SYNCHRONOUS	3.30	3.28	2.77	2.44	3.94	3.69	3.57	3.35
X'd DIR. AXIS TRANSIENT	0.18	0.18	0.15	0.13	0.18	0.17	0.16	0.15
X"d DIR. AXIS SUBTRANSIENT	0.13	0.13	0.11	0.10	0.13	0.12	0.12	0.11
Xq QUAD. AXIS REACTANCE	2.69	2.67	2.25	1.98	3.12	2.92	2.82	2.65
X"q QUAD. AXIS SUBTRANSIENT	0.27	0.26	0.22	0.20	0.34	0.32	0.31	0.29
X_L LEAKAGE REACTANCE	0.07	0.07	0.06	0.05	0.08	0.07	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.19	0.19	0.16	0.14	0.23	0.22	0.21	0.20
X_0 ZERO SEQUENCE	0.11	0.11	0.09	0.08	0.11	0.10	0.10	0.09
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.	2s						
Ta ARMATURE TIME CONST.	0.017s						
SHORT CIRCUIT RATIO	1/Xd						

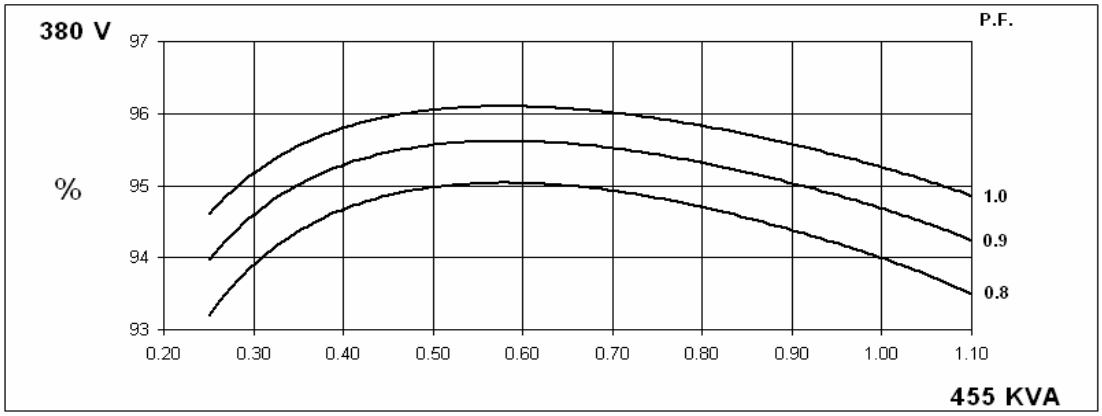
50 Hz

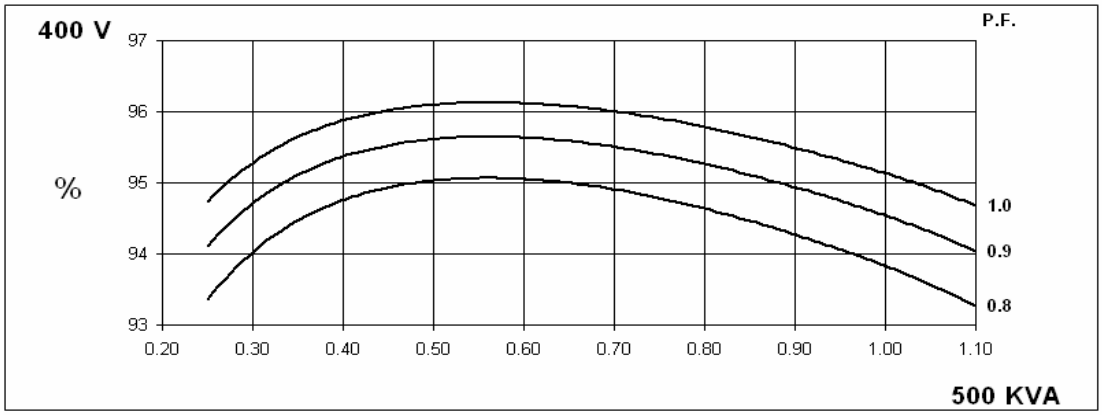
HCI534C/544C

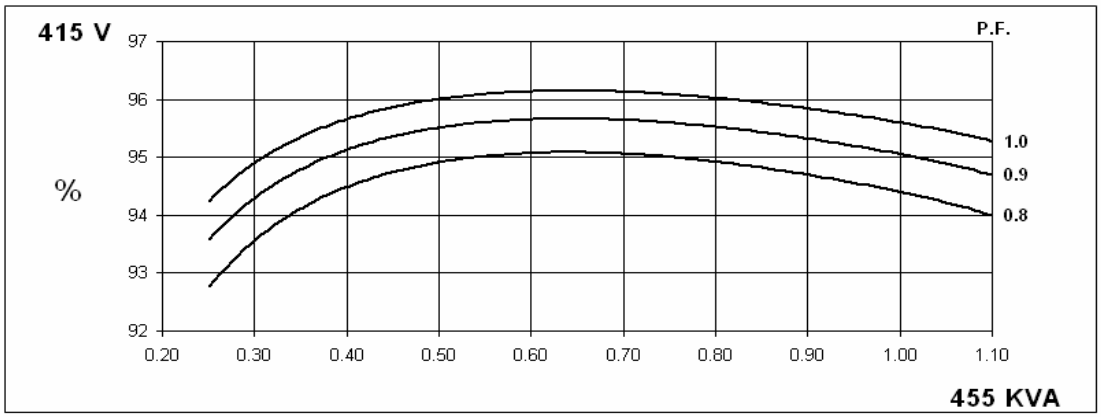
Winding 311

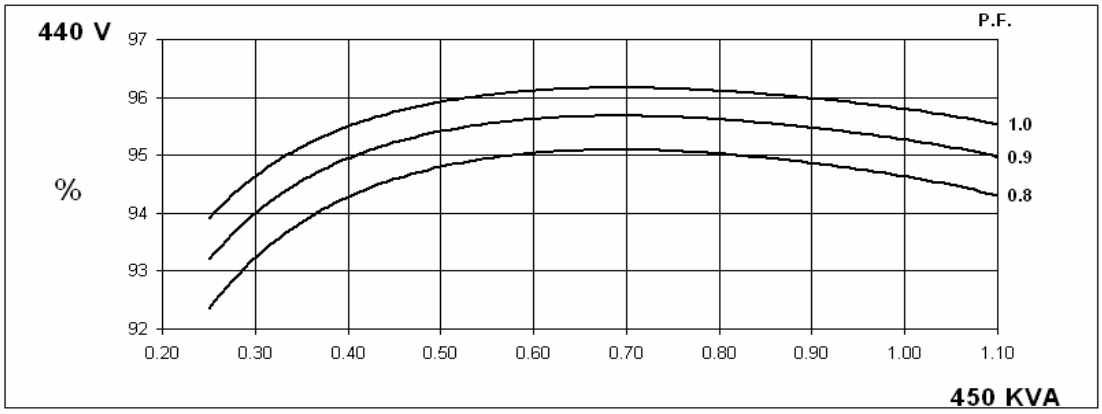
STAMFORD

THREE PHASE EFFICIENCY CURVES









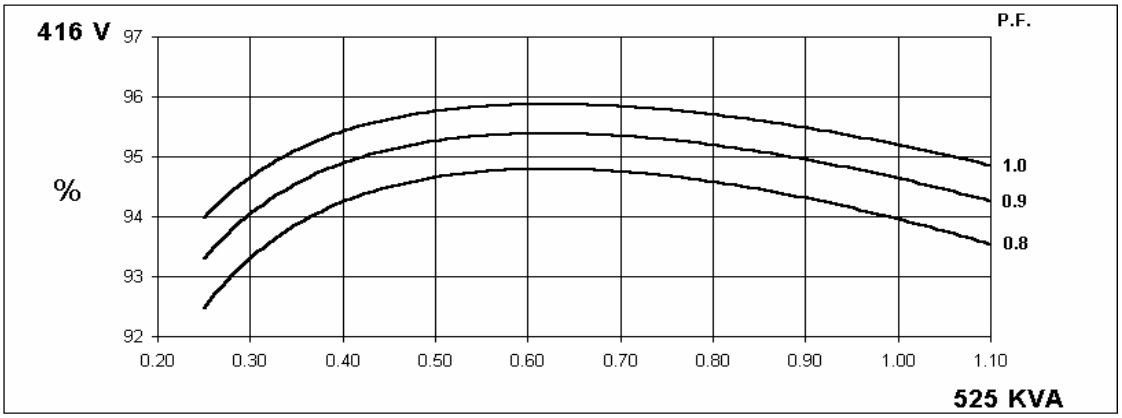
60 Hz

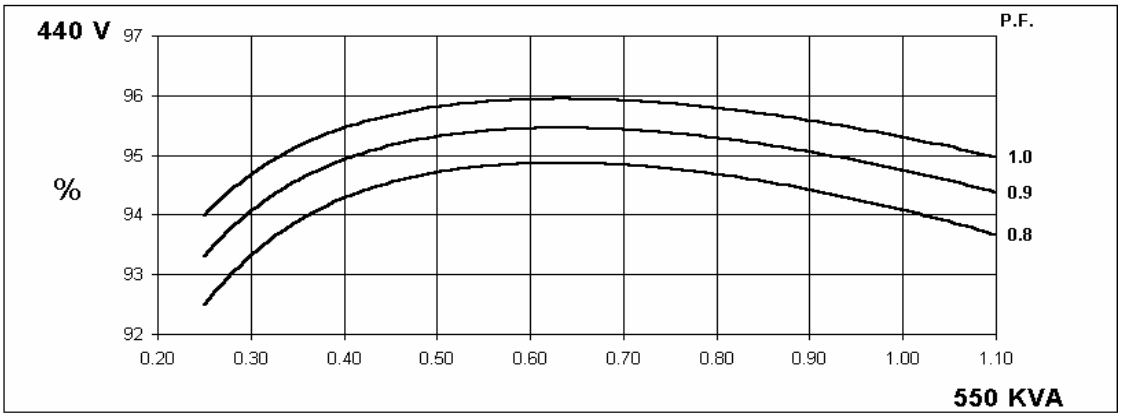
HCI534C/544C

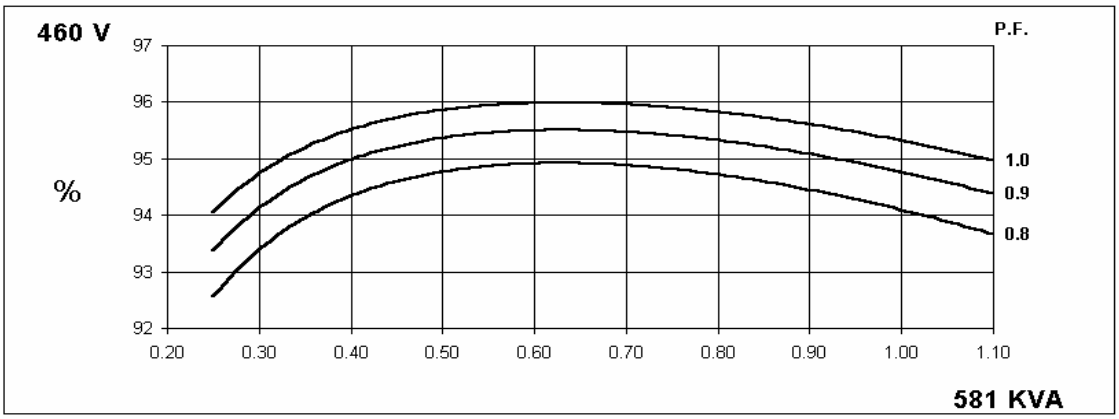
Winding 311

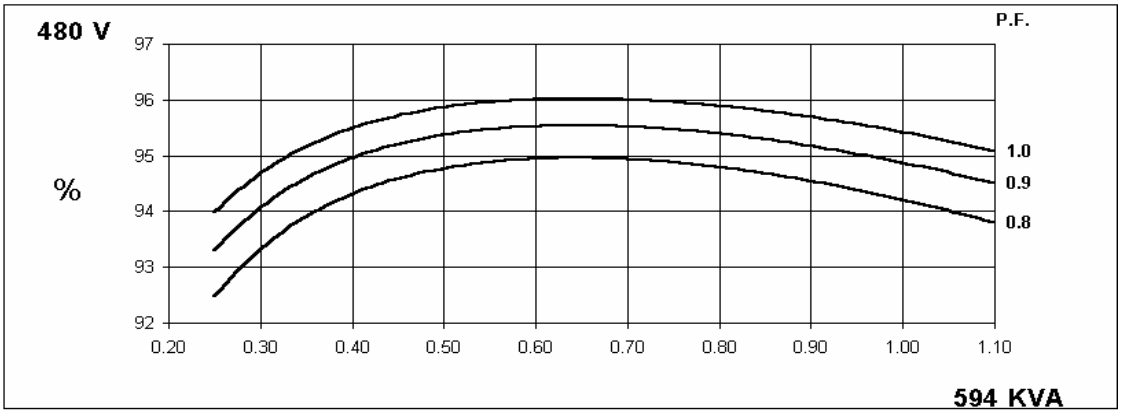
STAMFORD

THREE PHASE EFFICIENCY CURVES







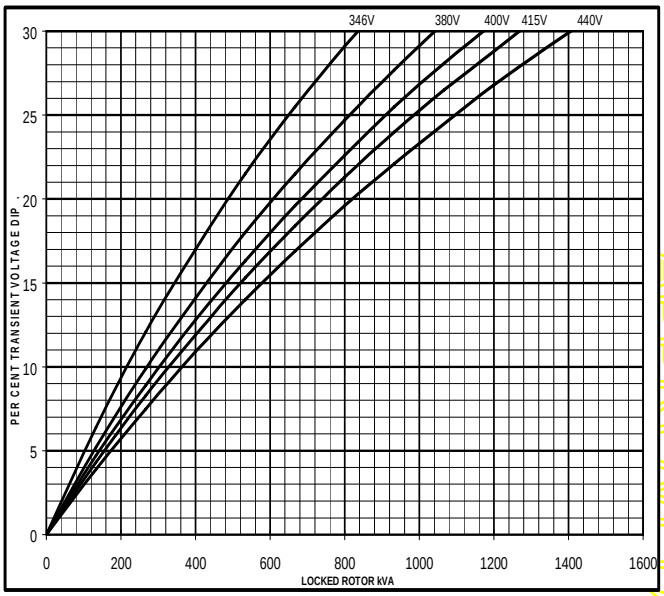


STAMFORD

Locked Rotor Motor Starting Curve

50 Hz

MX



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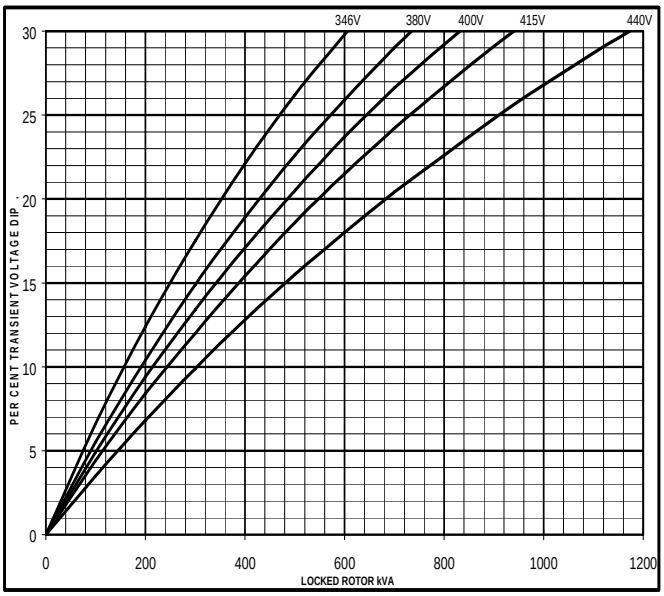
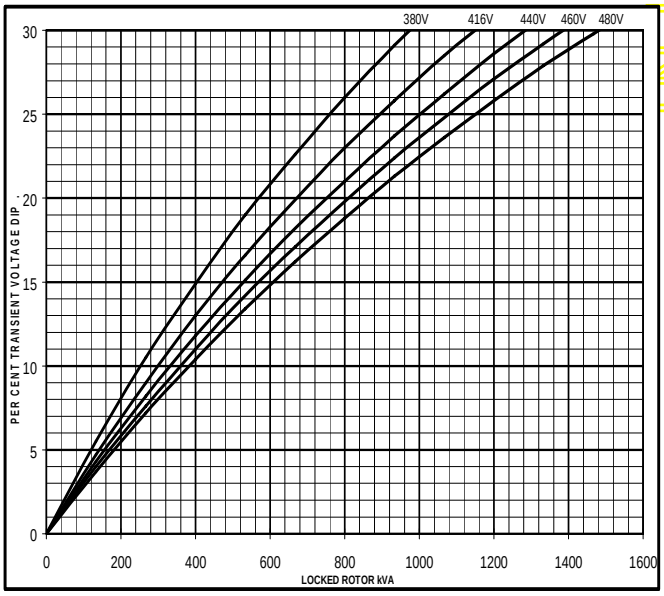


60 Hz

MX



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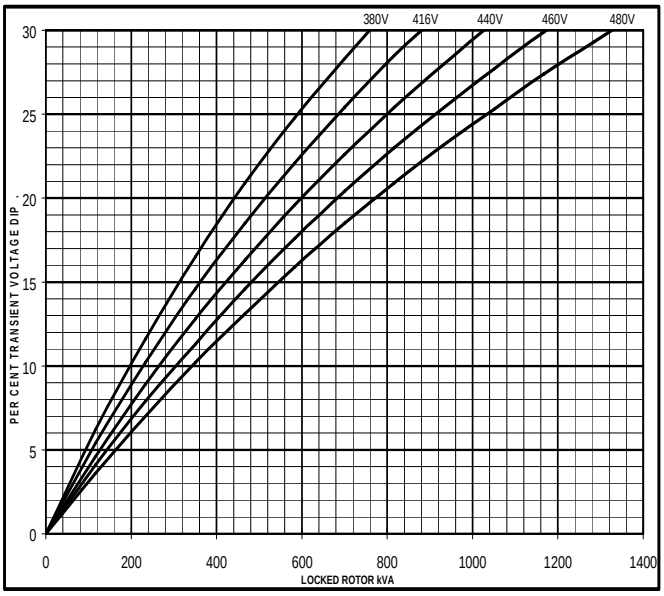
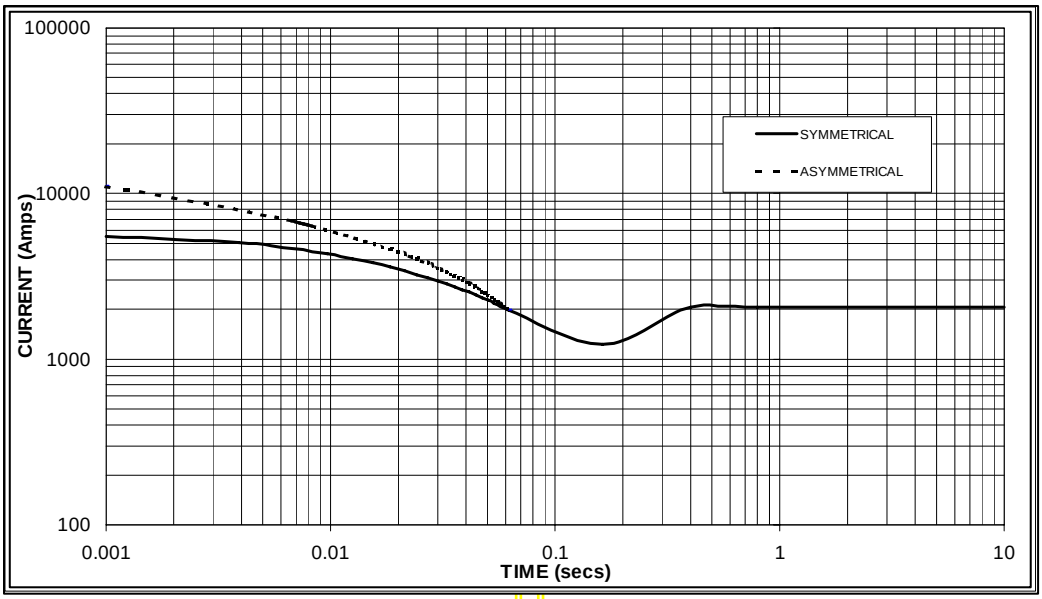


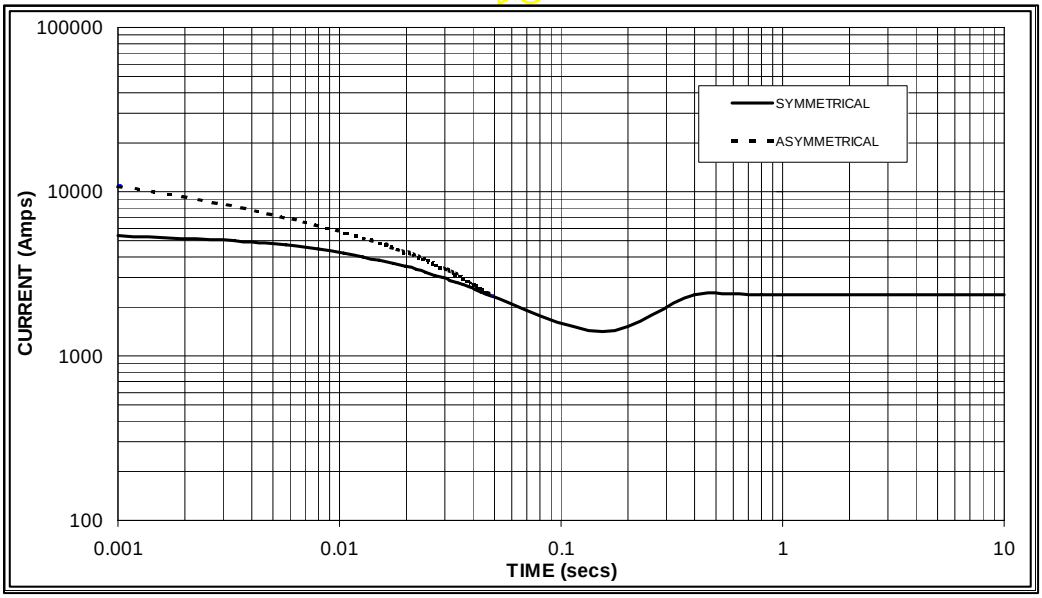
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 2,050 Amps

60 Hz



Sustained Short Circuit = 2,350 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 1.03	440v	X 1.06
415v	X 1.05	460v	X 1.12
440v	X 1.07	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

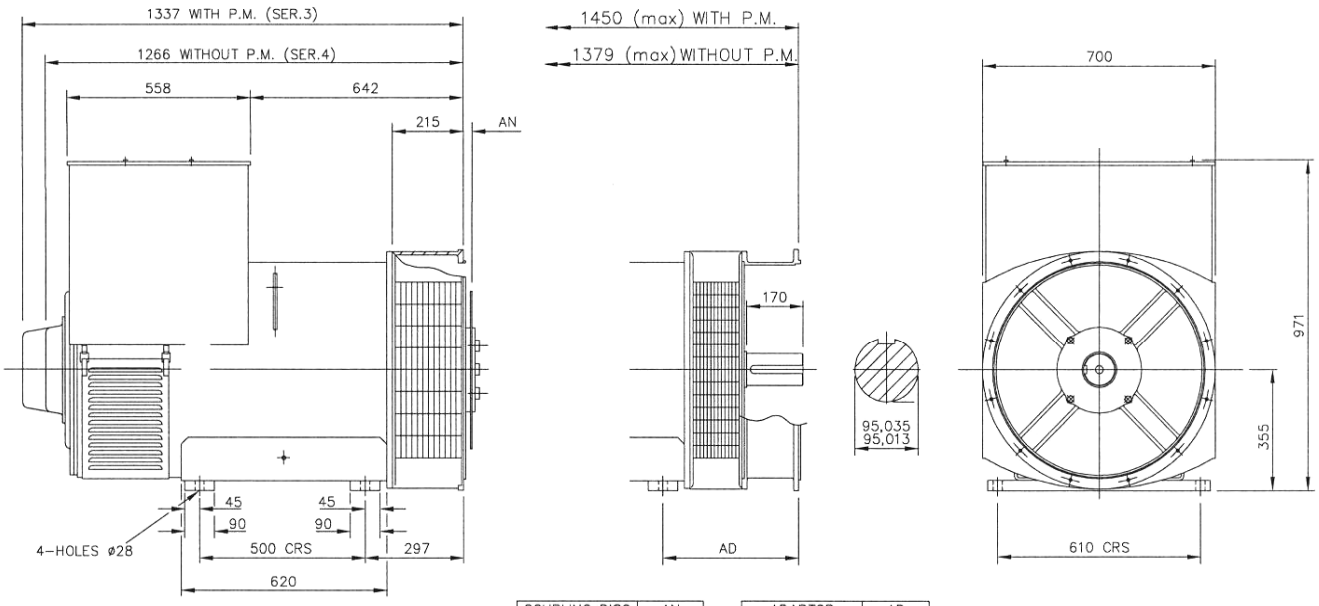
HCI534C/544C

Winding 311 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			
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	400	445	400	400	455	500	455	450	478	512	478	478	500	520	500	495
	kW	320	356	320	320	364	400	364	360	382	410	382	382	400	416	400	396
	Efficiency (%)	94.5	94.3	94.8	94.9	94.0	93.8	94.4	94.6	93.8	93.7	94.2	94.4	93.5	93.6	94.0	94.3
	kW Input	339	378	338	337	387	426	386	381	408	437	406	405	428	444	425	420
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	481	500	531	538	525	550	581	594	550	581	613	625	569	600	631	644
	kW	385	400	425	430	420	440	465	475	440	465	490	500	455	480	505	515
	Efficiency (%)	94.3	94.4	94.4	94.5	94.0	94.1	94.1	94.2	93.8	93.9	93.9	94.0	93.6	93.7	93.7	93.9
	kW Input	408	424	450	455	447	468	494	504	469	495	522	532	486	512	539	549

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

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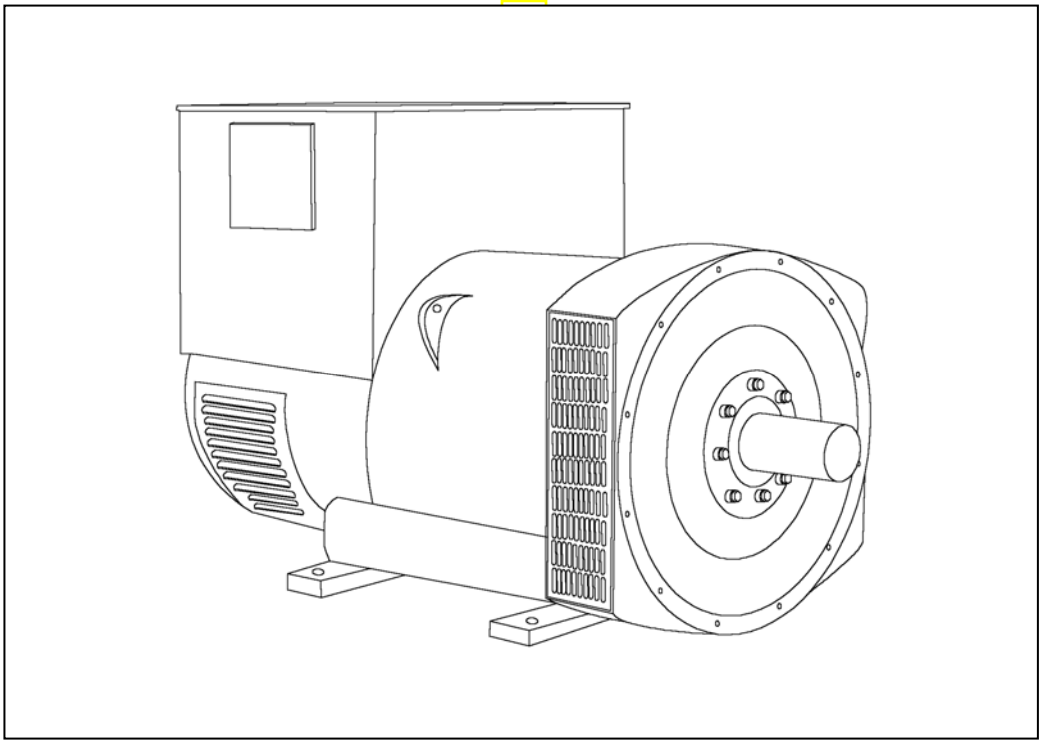
STAMFORD®

HCI 534D/544D - 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	0.0049 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.77 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	1393 kg				1395 kg		
WEIGHT WOUND STATOR	657 kg				657 kg		
WEIGHT WOUND ROTOR	563 kg				535 kg		
WR² INERTIA	8.0068 kgm²				7.7289 kgm²		
SHIPPING WEIGHTS in a crate	1485 kg				1485 kg		
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	500	550	500	500	575	594	625	644
Xd DIR. AXIS SYNCHRONOUS	3.02	2.99	2.53	2.25	3.52	3.25	3.13	2.96
X'd DIR. AXIS TRANSIENT	0.16	0.15	0.13	0.12	0.17	0.16	0.15	0.14
X"d DIR. AXIS SUBTRANSIENT	0.11	0.11	0.09	0.08	0.12	0.11	0.11	0.10
Xq QUAD. AXIS REACTANCE	2.48	2.46	2.08	1.85	2.87	2.65	2.55	2.41
X"q QUAD. AXIS SUBTRANSIENT	0.27	0.28	0.23	0.20	0.31	0.29	0.28	0.26
X_L LEAKAGE REACTANCE	0.05	0.04	0.04	0.04	0.06	0.06	0.05	0.05
X_2 NEGATIVE SEQUENCE	0.19	0.19	0.16	0.14	0.22	0.20	0.20	0.19
X_0 ZERO SEQUENCE	0.10	0.10	0.08	0.07	0.10	0.09	0.09	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.	2.2s						
Ta ARMATURE TIME CONST.	0.018s						
SHORT CIRCUIT RATIO	1/Xd						

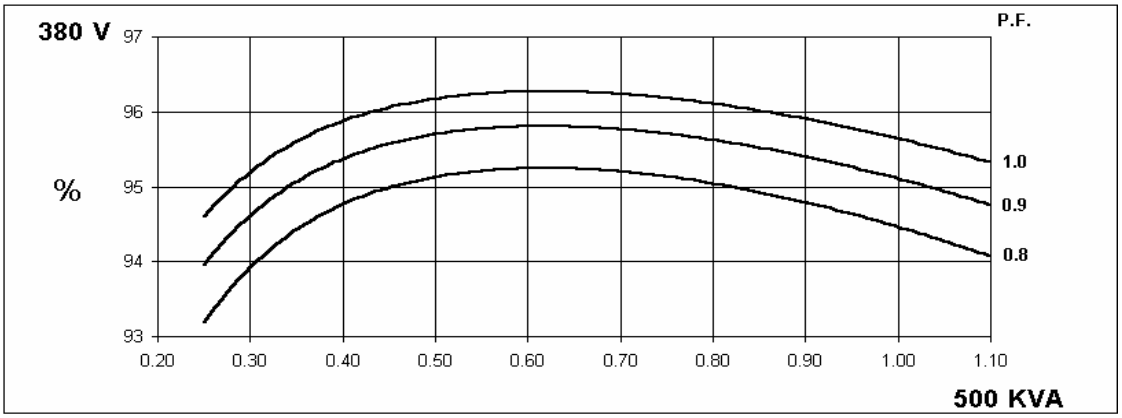
50 Hz

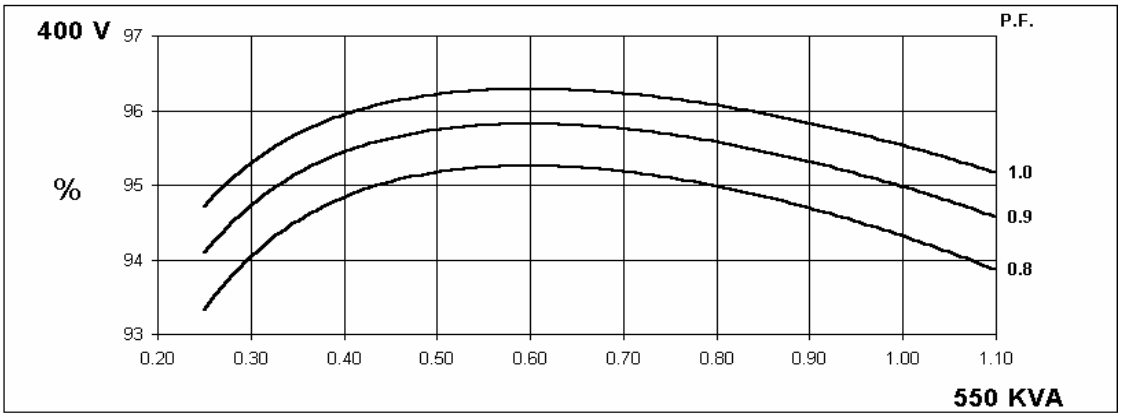
HCI534D/544D

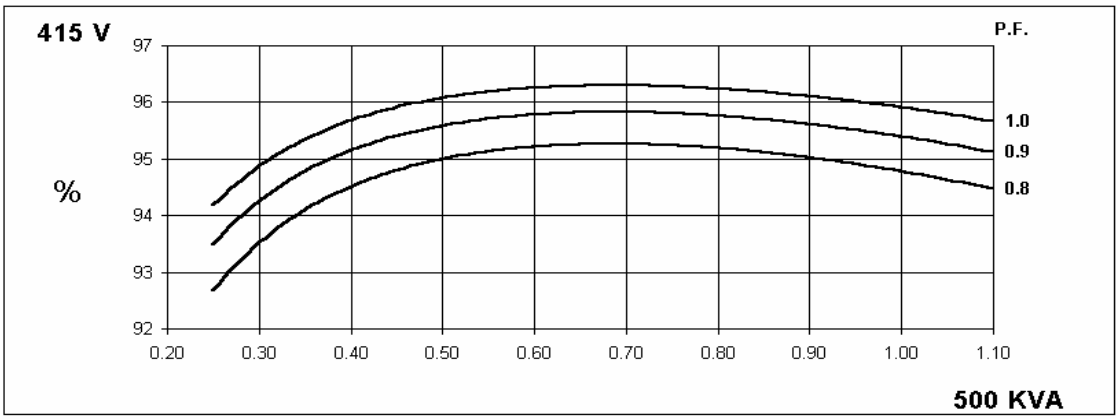
Winding 311

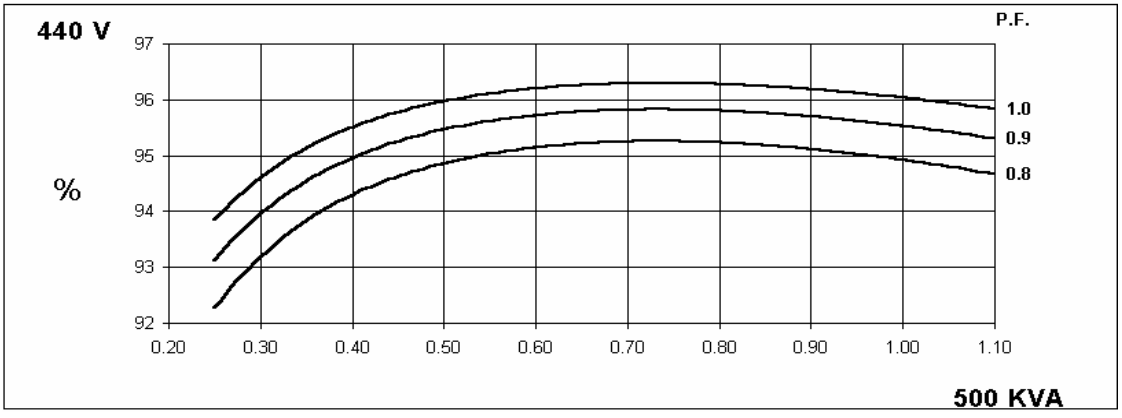
STAMFORD

THREE PHASE EFFICIENCY CURVES









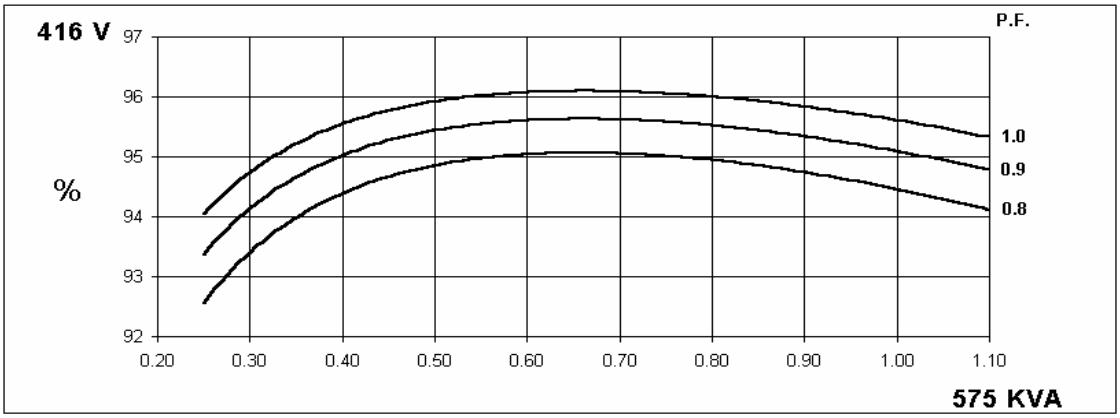
60 Hz

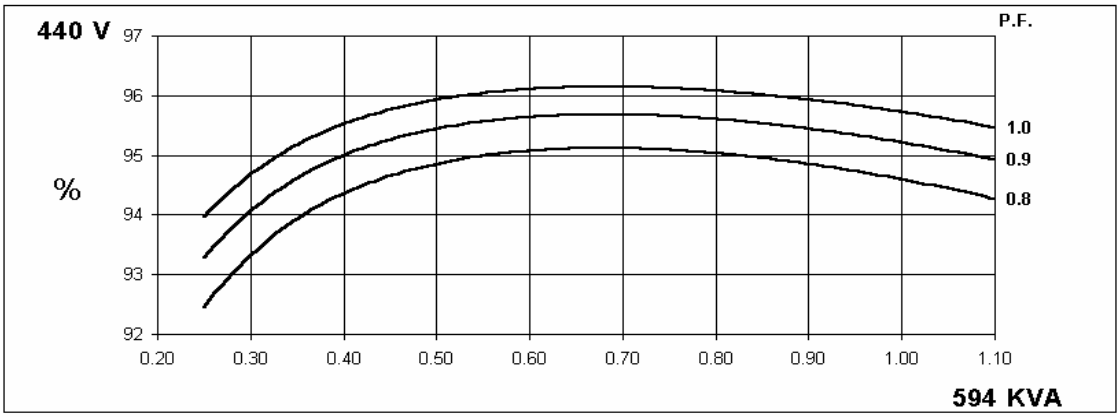
HCI534D/544D

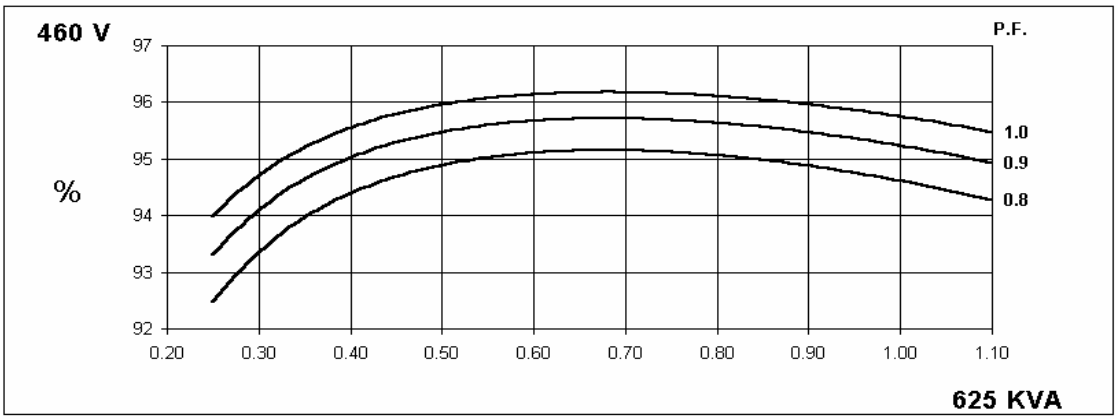
Winding 311

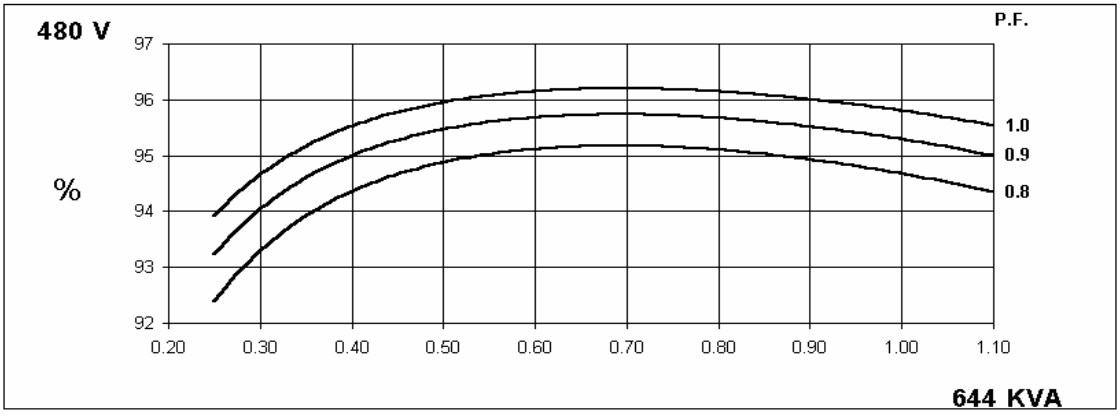
STAMFORD

THREE PHASE EFFICIENCY CURVES









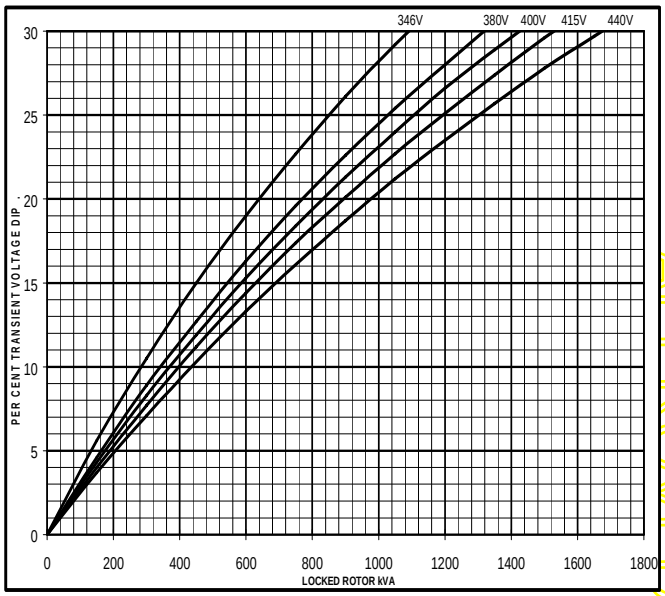
HCI534D/544D

Winding 311

Locked Rotor Motor Starting Curve

50 Hz

MX



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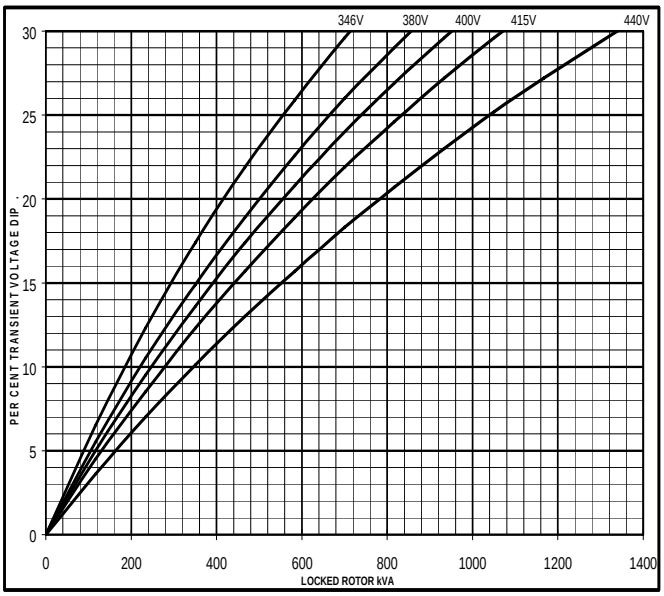
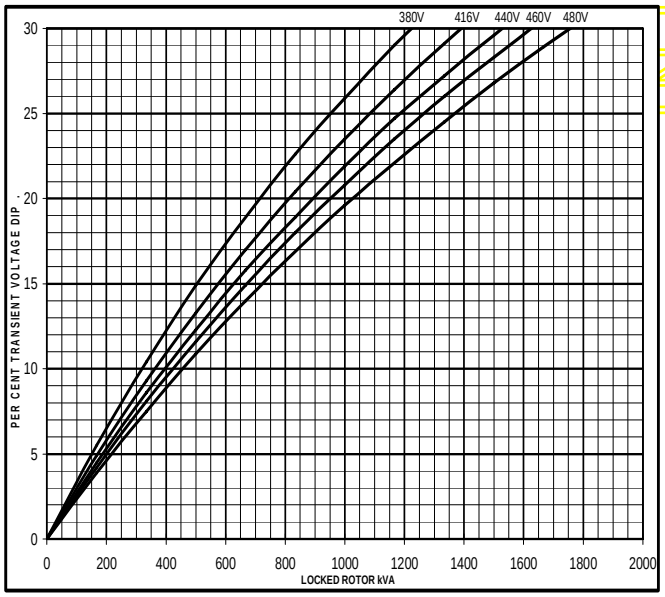


60 Hz

MX



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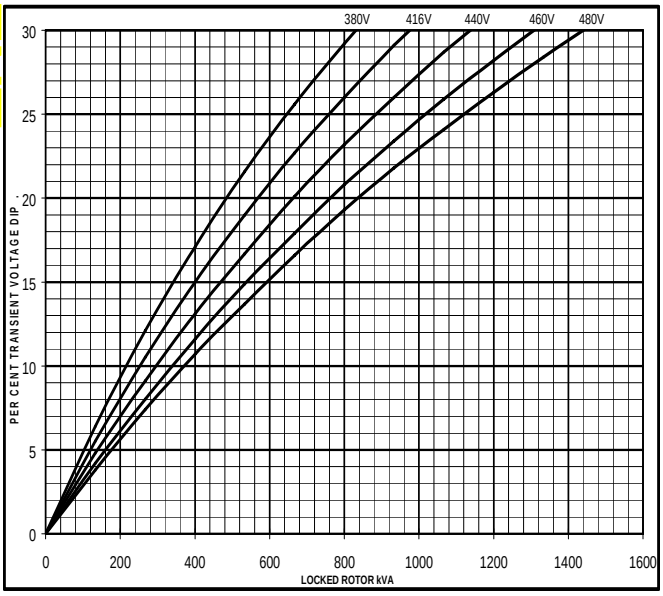
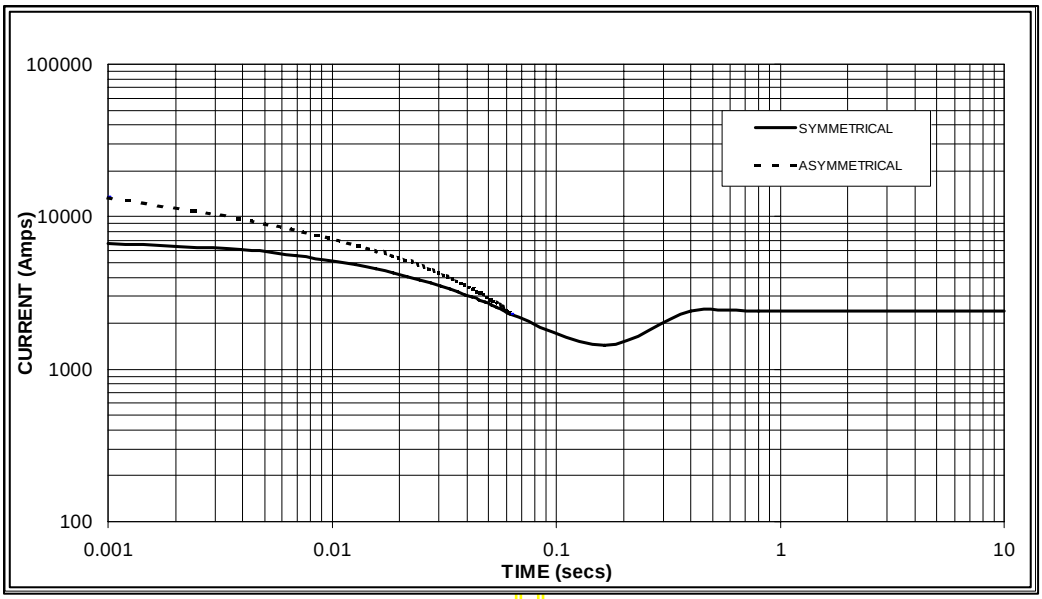


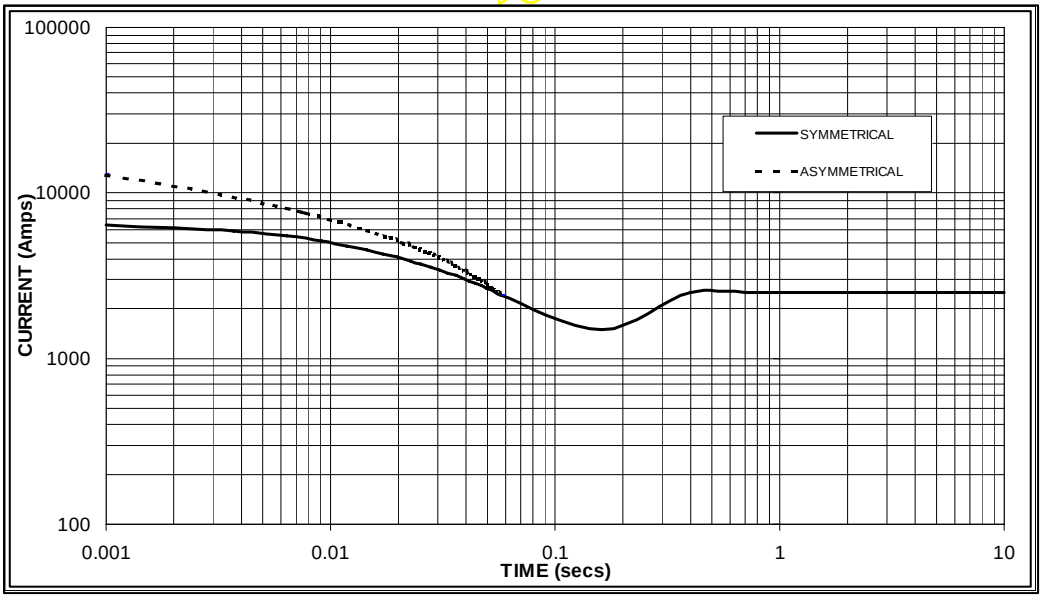
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 2,400 Amps

60 Hz



Sustained Short Circuit = 2,500 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 1.06	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

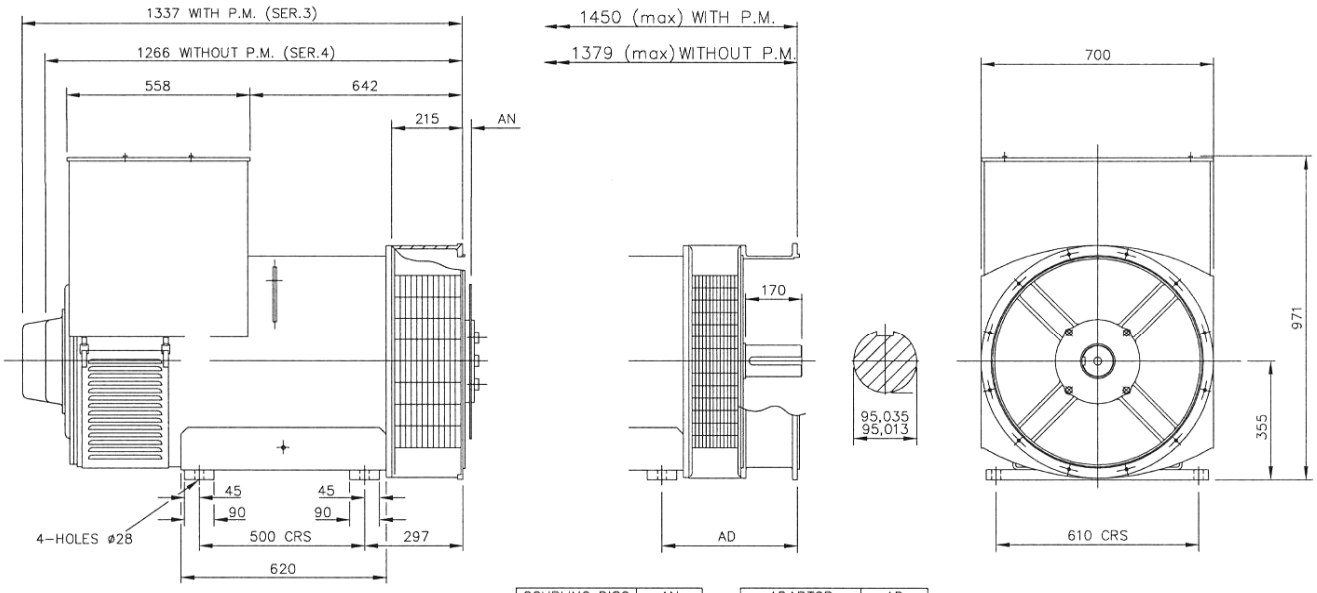
HCI534D/544D

Winding 311 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			
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	450	495	450	450	500	550	500	500	515	575	515	515	550	590	550	530
	kW	360	396	360	360	400	440	400	400	412	460	412	412	440	472	440	424
	Efficiency (%)	94.8	94.7	95.0	95.1	94.5	94.3	94.8	94.9	94.4	94.1	94.7	94.9	94.1	94.0	94.5	94.8
	kW Input	380	418	379	379	423	467	422	421	436	489	435	434	468	502	466	447
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	519	538	563	588	575	594	625	644	588	625	655	675	606	644	673	694
	kW	415	430	450	470	460	475	500	515	470	500	524	540	485	515	538	555
	Efficiency (%)	94.7	94.8	94.9	94.9	94.5	94.6	94.6	94.7	94.4	94.4	94.5	94.5	94.3	94.3	94.4	94.4
	kW Input	438	454	475	496	487	502	529	544	498	530	554	571	514	546	570	588

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

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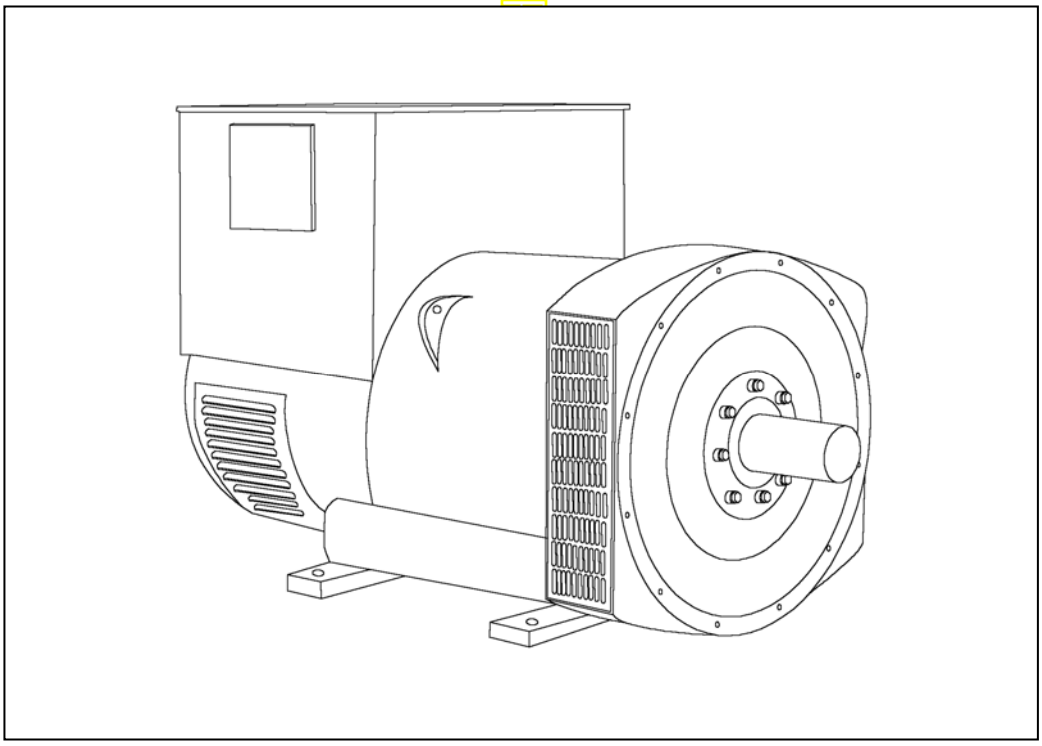
STAMFORD®

HCI 534E/544E - Winding 311

Technical Data Sheet



SPECIFICATIONS & OPTIONS

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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.

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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.

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The insulation system is class 'H'.
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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.
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Front cover drawing typical of product range.

STAMFORD

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	0.0043 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	1.96 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	1543 kg				1535 kg		
WEIGHT WOUND STATOR	722 kg				722 kg		
WEIGHT WOUND ROTOR	617 kg				588 kg		
WR² INERTIA	8.9828 kgm²				8.7049 kgm²		
SHIPPING WEIGHTS in a crate	1635 kg				1625 kg		
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	600	610	600	600	681	713	731	750
Xd DIR. AXIS SYNCHRONOUS	3.14	2.88	2.63	2.34	3.53	3.30	3.10	2.92
X'd DIR. AXIS TRANSIENT	0.17	0.15	0.14	0.12	0.17	0.16	0.15	0.14
X"d DIR. AXIS SUBTRANSIENT	0.12	0.11	0.10	0.09	0.12	0.11	0.11	0.10
Xq QUAD. AXIS REACTANCE	2.45	2.25	2.05	1.82	2.82	2.64	2.48	2.33
X"q QUAD. AXIS SUBTRANSIENT	0.26	0.24	0.22	0.20	0.34	0.32	0.30	0.28
X_L LEAKAGE REACTANCE	0.06	0.05	0.05	0.04	0.06	0.06	0.05	0.05
X_2 NEGATIVE SEQUENCE	0.18	0.16	0.15	0.13	0.23	0.22	0.20	0.19
X_0 ZERO SEQUENCE	0.08	0.08	0.07	0.06	0.10	0.09	0.09	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						

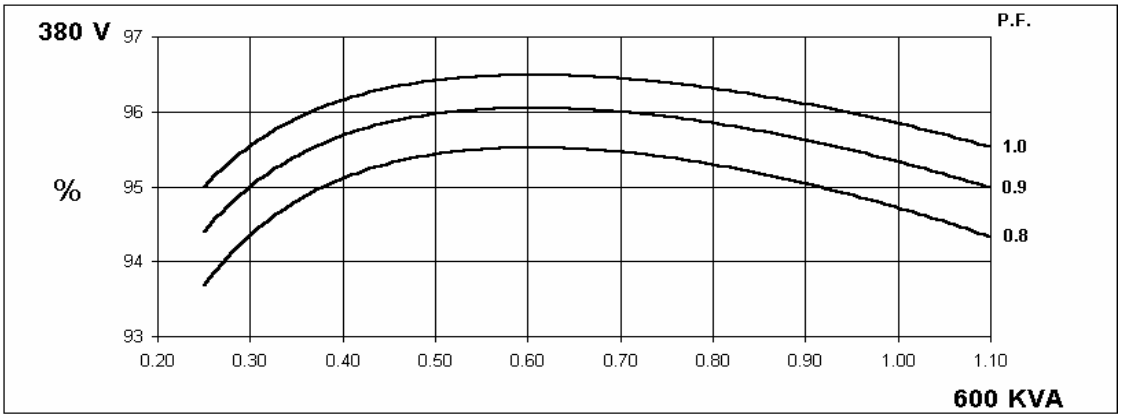
50 Hz

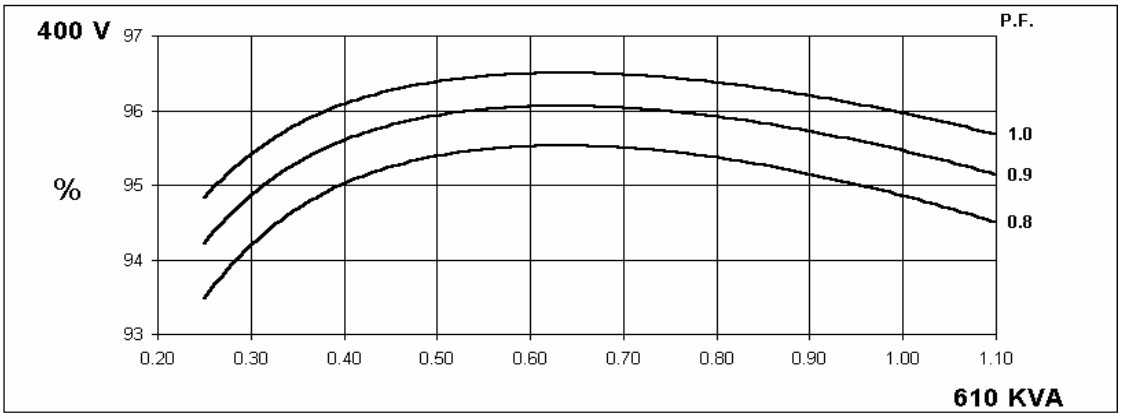
HCI534E/544E

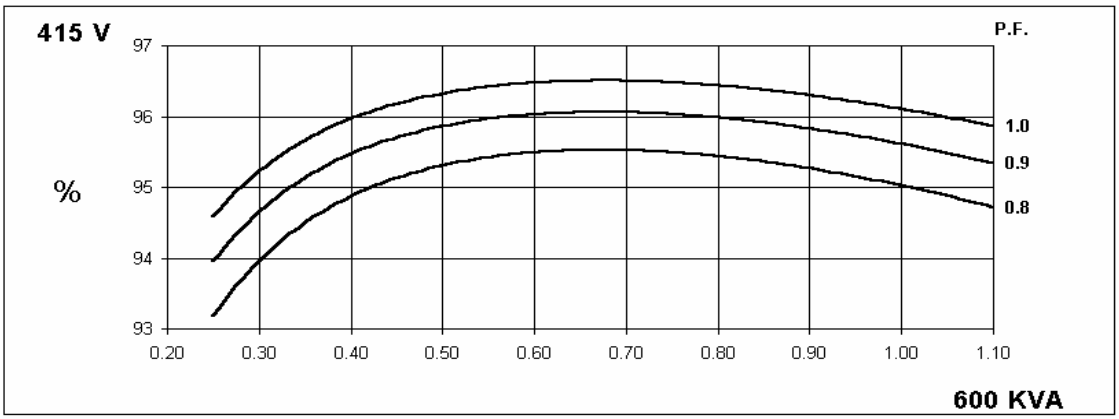
Winding 311

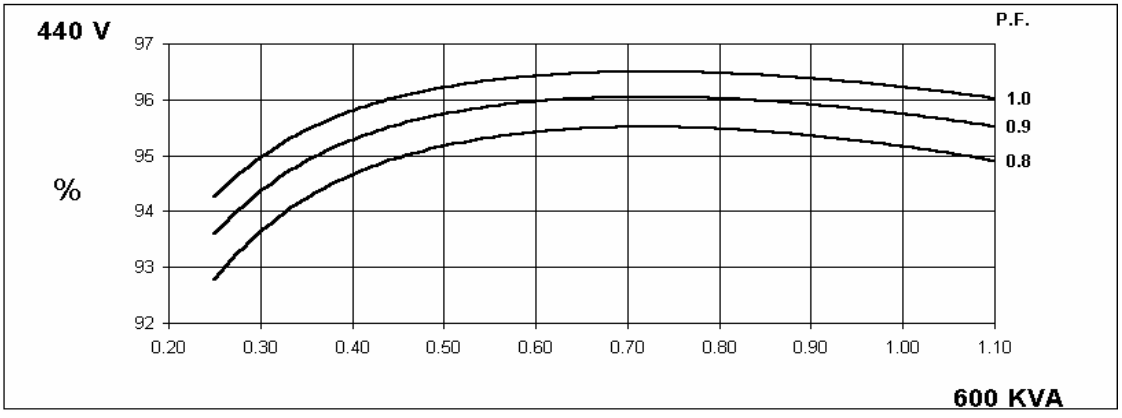
STAMFORD

THREE PHASE EFFICIENCY CURVES









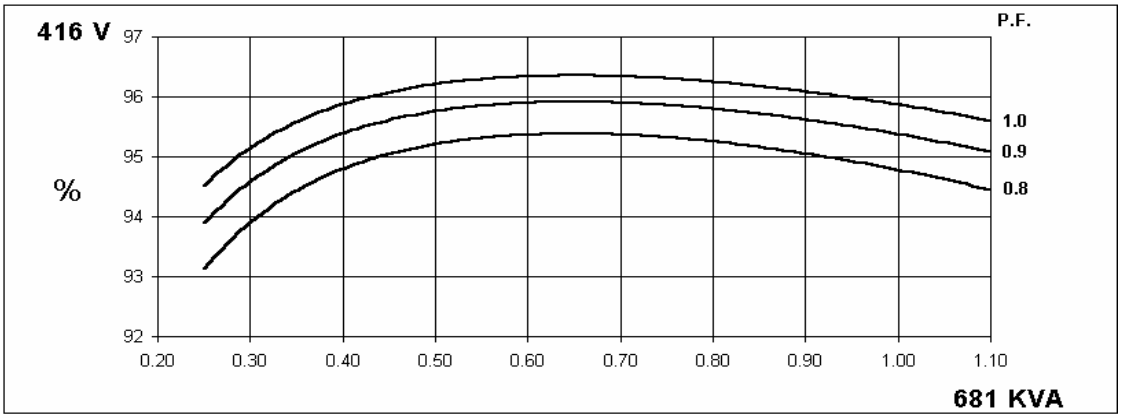
60 Hz

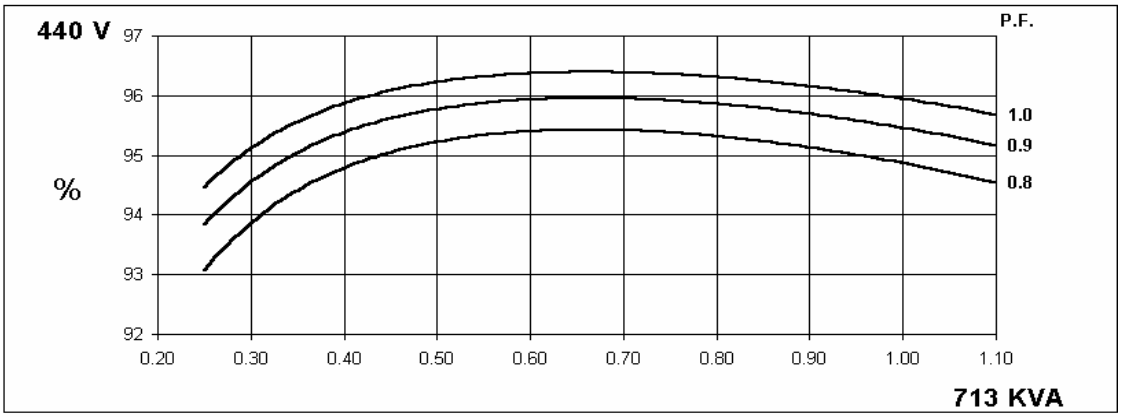
HCI534E/544E

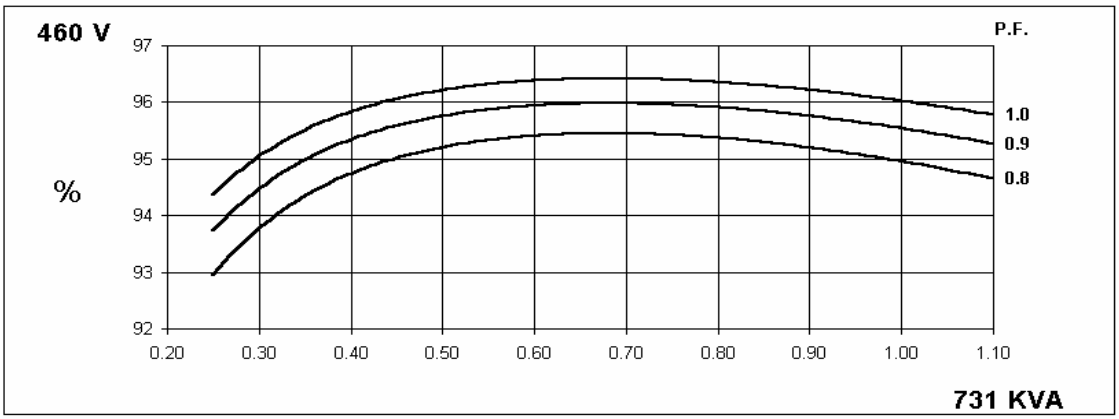
Winding 311

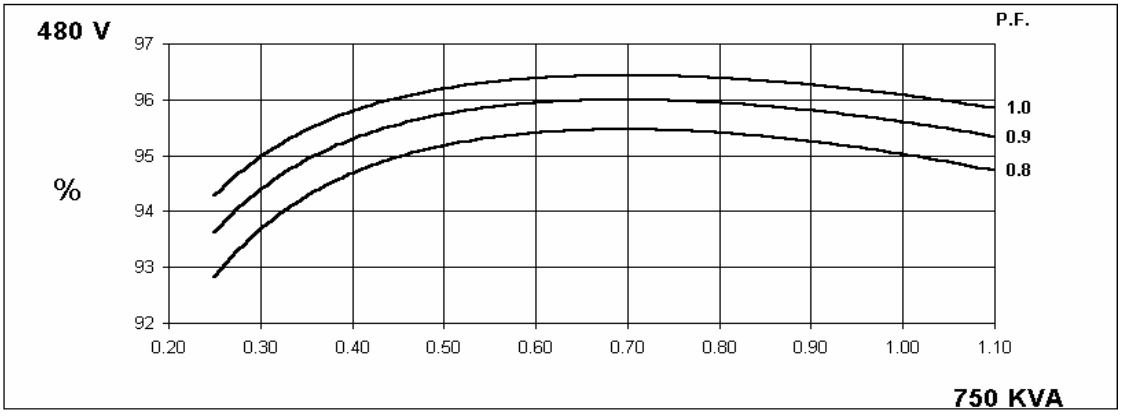
STAMFORD

THREE PHASE EFFICIENCY CURVES









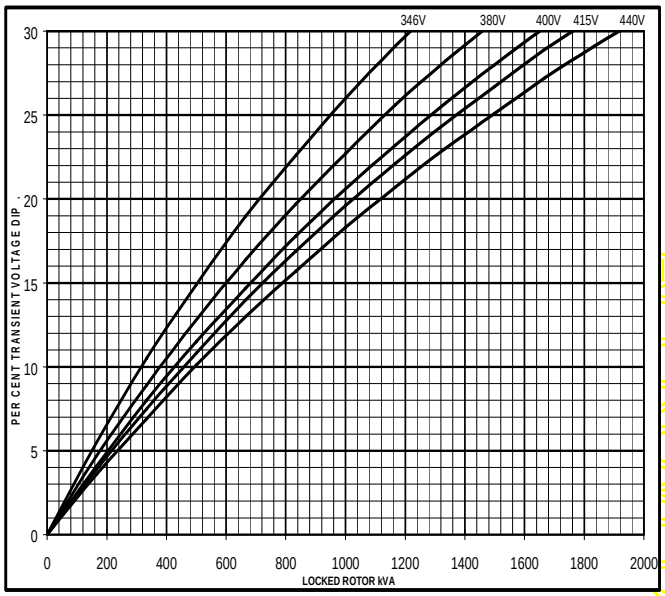
HCI534E/544E

Winding 311

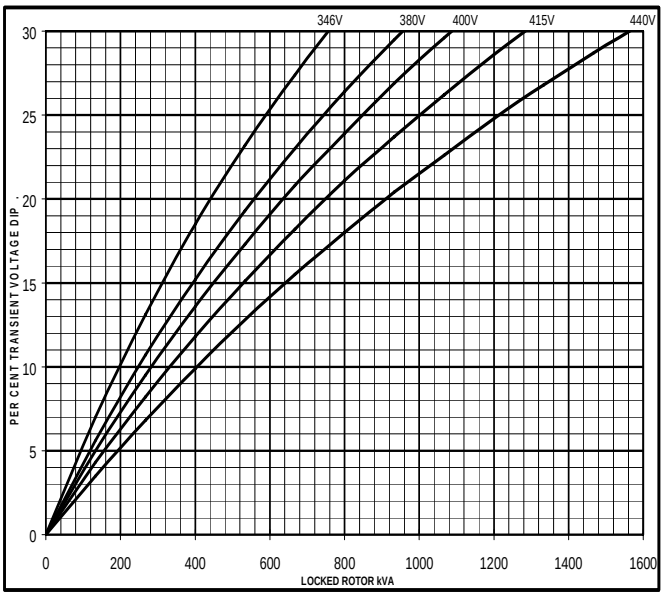
Locked Rotor Motor Starting Curve

50 Hz

MX

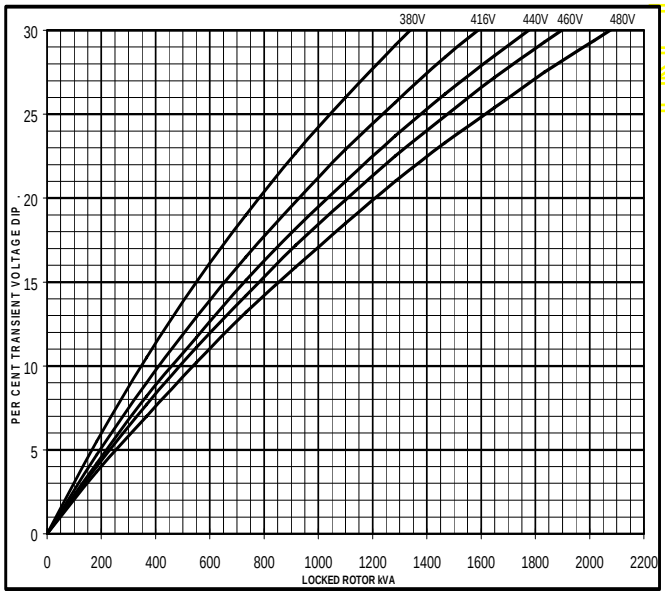


SX



60 Hz

MX



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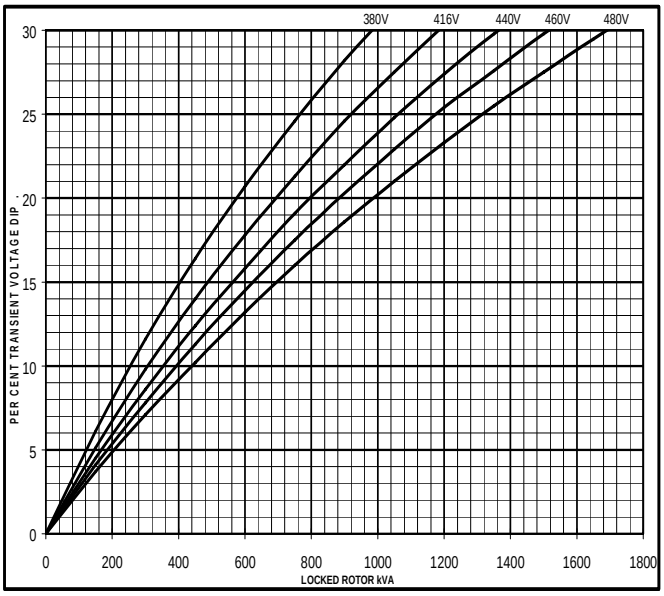
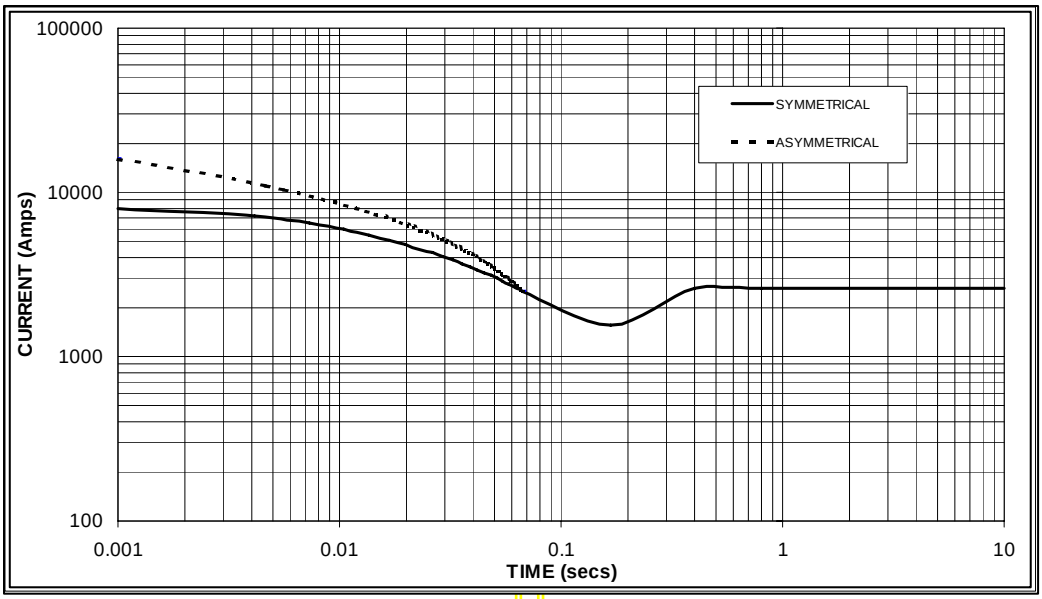


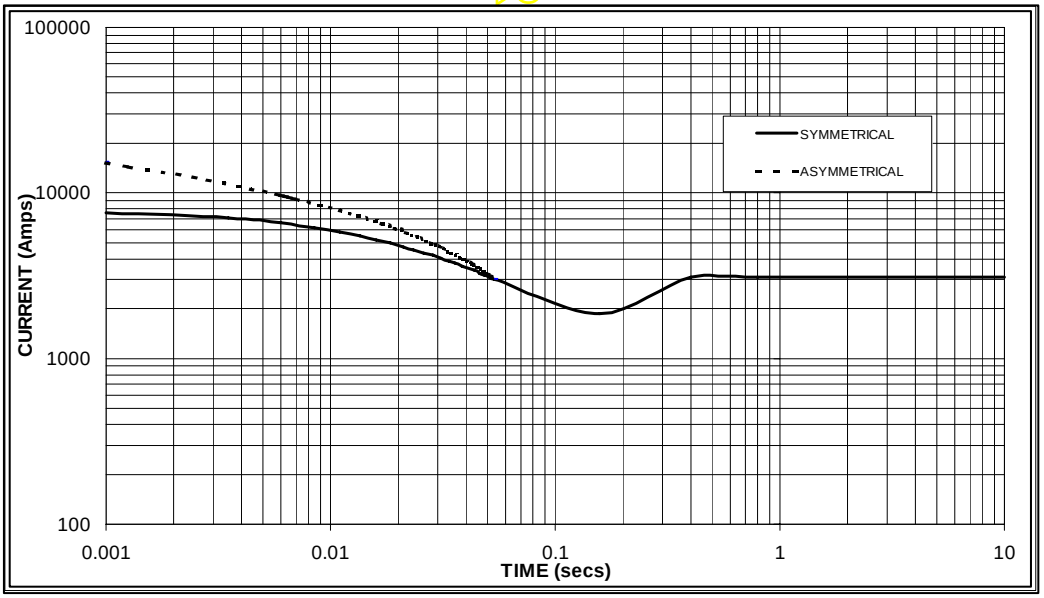
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 2,600 Amps

60 Hz



Sustained Short Circuit = 3,100 Amps

Note 1

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

50Hz		60Hz	
Voltage	Factor	Voltage	Factor
380v	X 1.00	416v	X 1.00
400v	X 1.06	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 connection 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

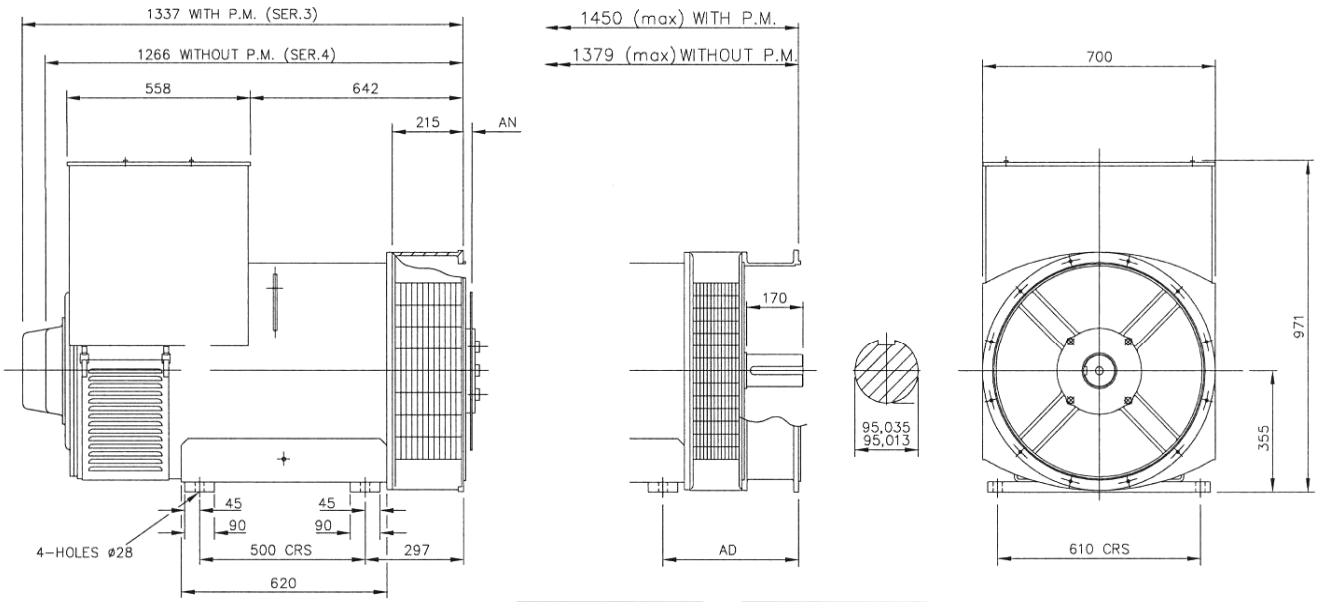
HCI534E/544E

Winding 311 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			
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	550	560	550	550	600	610	600	600	636	640	636	636	660	665	660	660
	kW	440	448	440	440	480	488	480	480	509	512	509	509	528	532	528	528
	Efficiency (%)	95.0	95.1	95.2	95.3	94.7	94.9	95.0	95.2	94.5	94.7	94.8	95.0	94.3	94.5	94.7	94.9
	kW Input	463	471	462	462	507	514	505	504	538	541	537	536	560	563	558	556
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	625	650	663	675	681	713	731	750	719	750	780	800	738	769	798	819
	kW	500	520	530	540	545	570	585	600	575	600	624	640	590	615	638	655
	Efficiency (%)	95.0	95.1	95.2	95.3	94.8	94.9	95.0	95.0	94.6	94.7	94.8	94.8	94.5	94.6	94.7	94.8
	kW Input	526	547	557	567	575	601	616	632	608	634	658	675	625	650	674	691

DIMENSIONS



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STAMFORD®

HCI 534F/544F - Winding 311

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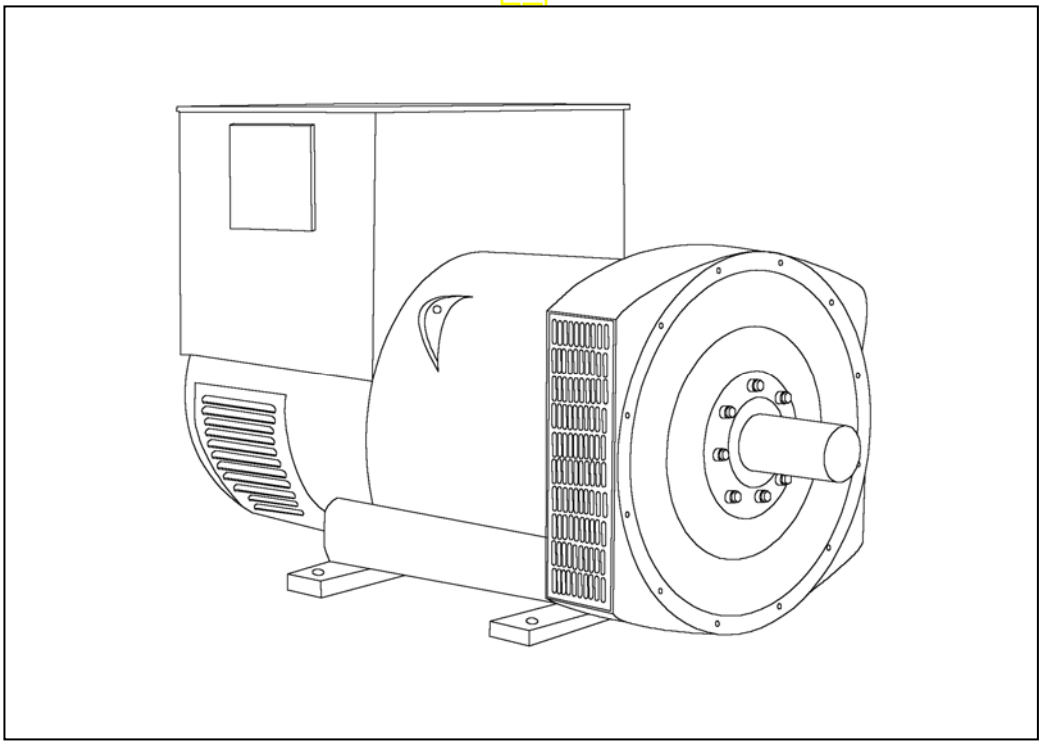

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3% for every 500 metres by which the operating altitude exceeds 1000 metres above mean sea level.
3% for every 5°C by which the operational ambient temperature exceeds 40°C.
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Front cover drawing typical of product range.

STAMFORD

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	

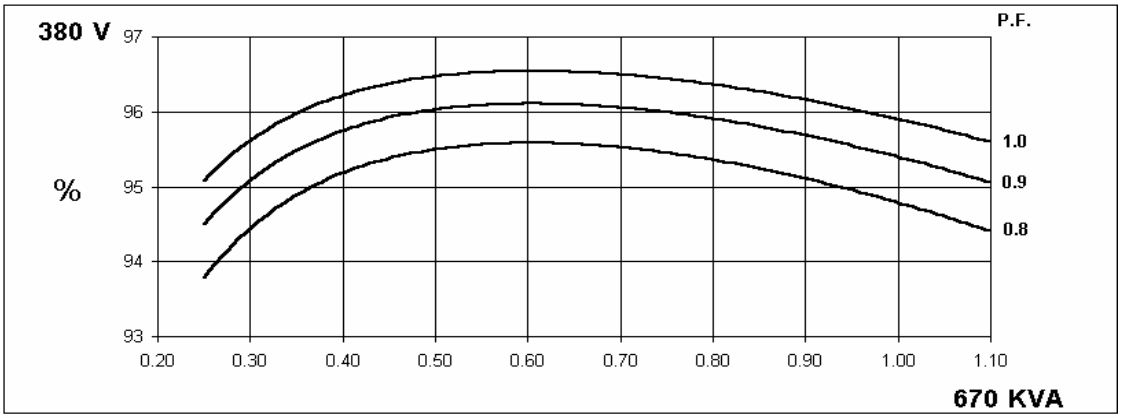
INSULATION SYSTEM	CLASS H						
PROTECTION	IP23						
RATED POWER FACTOR	0.8						
STATOR WINDING	DOUBLE LAYER LAP						
WINDING PITCH	TWO THIRDS						
WINDING LEADS	12						
STATOR WDG. RESISTANCE	0.0037 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED						
ROTOR WDG. RESISTANCE	2.16 Ohms at 22°C						
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						

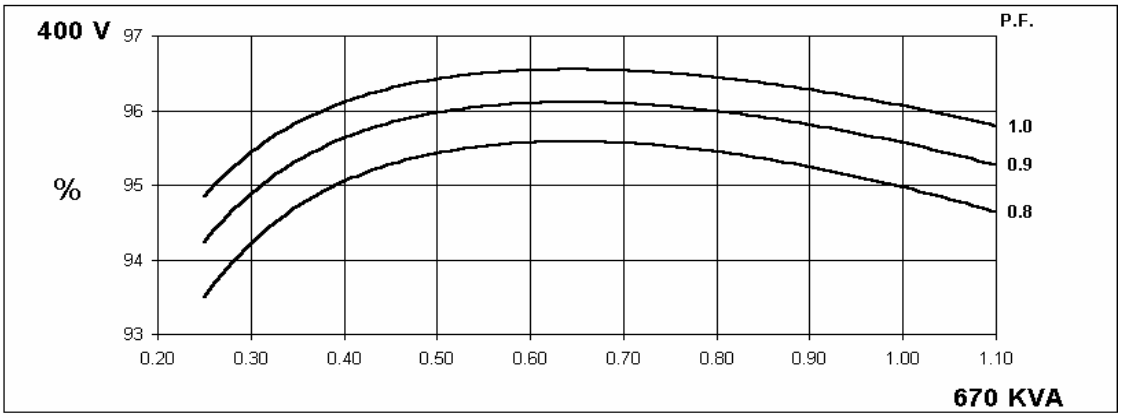
50 Hz

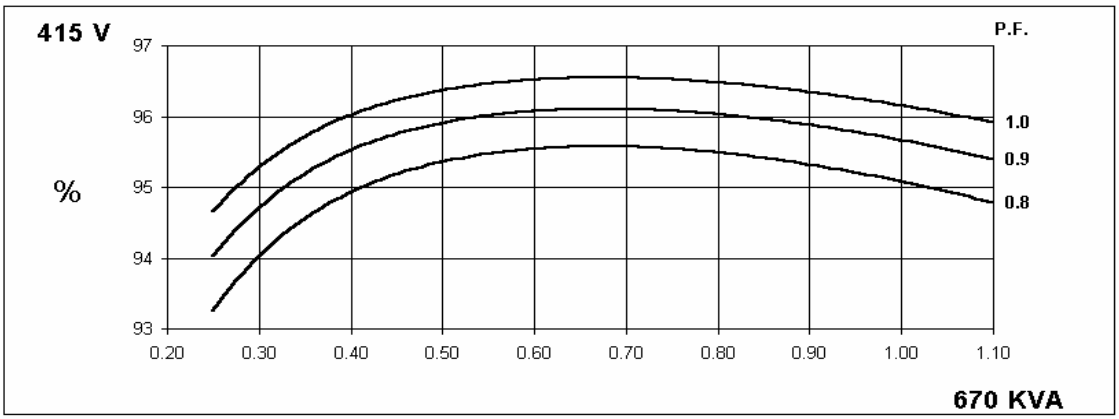
HCI534F/544F

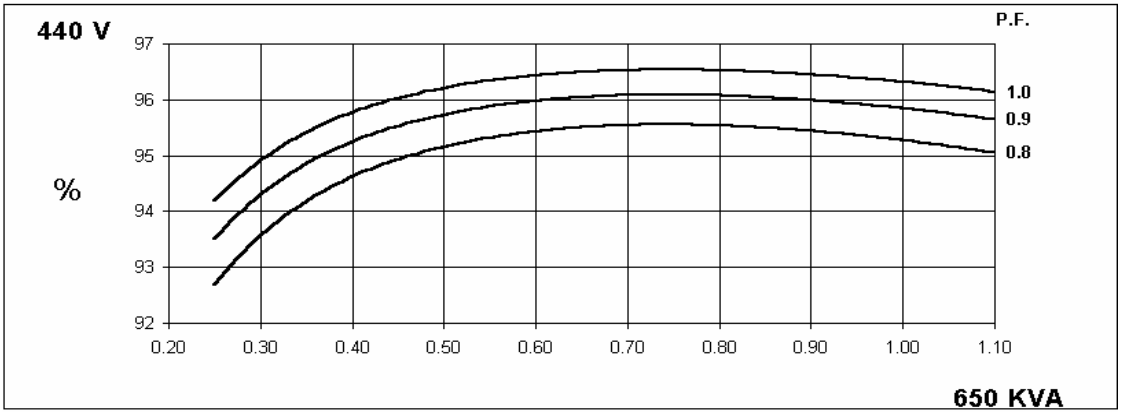
Winding 311

THREE PHASE EFFICIENCY CURVES







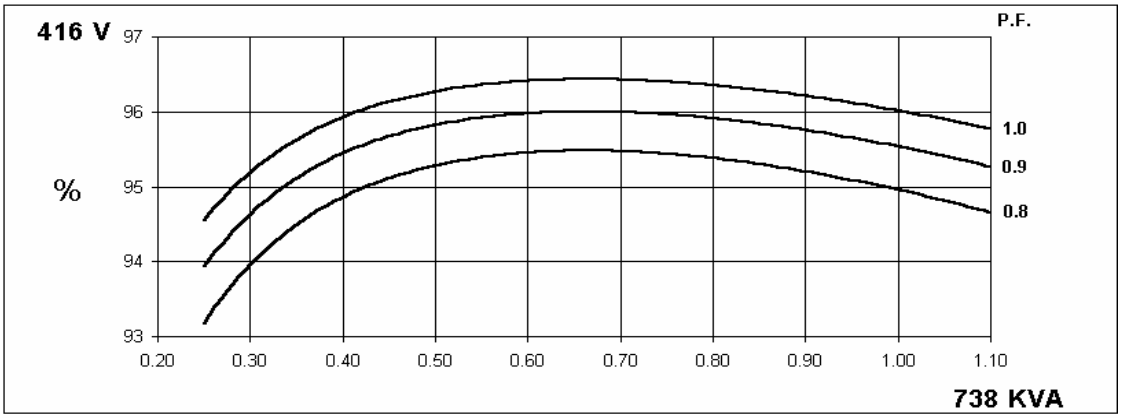


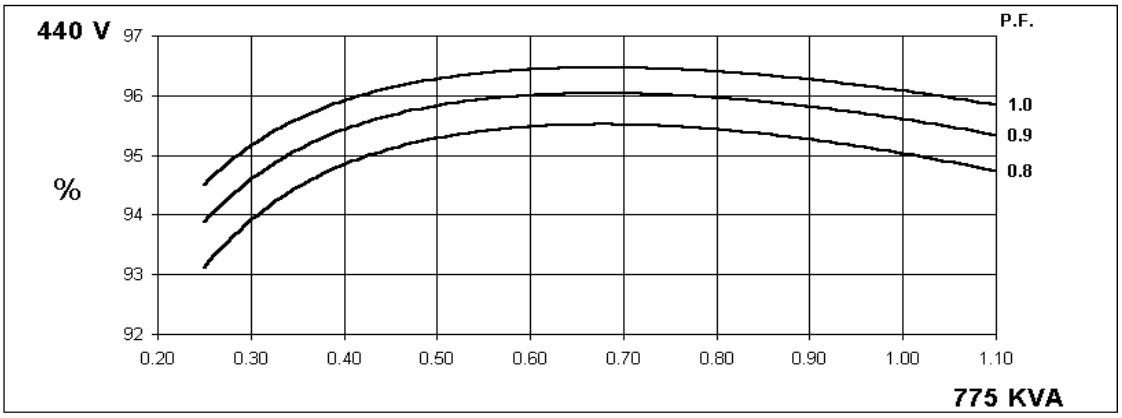
60 Hz

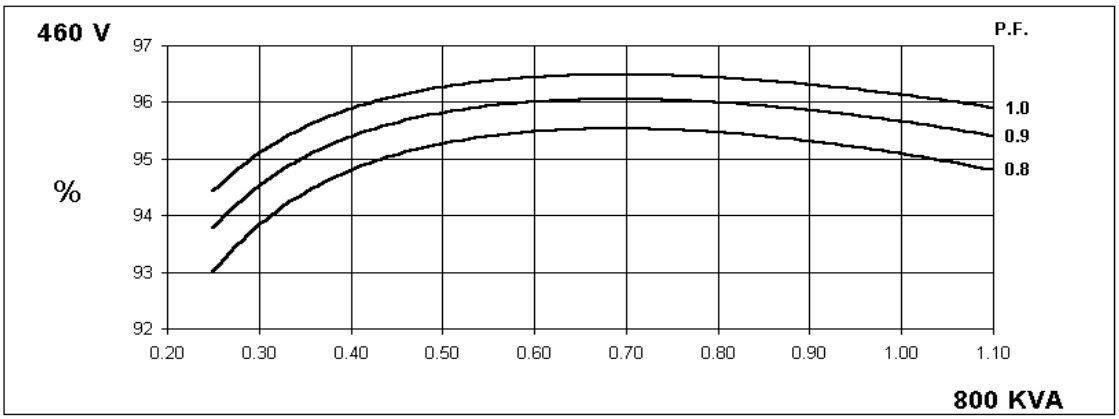
HCI534F/544F

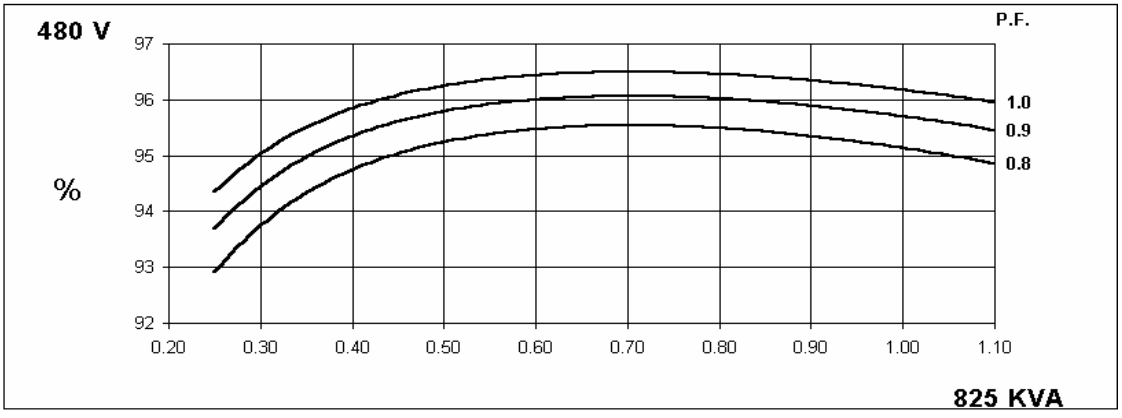
Winding 311

THREE PHASE EFFICIENCY CURVES









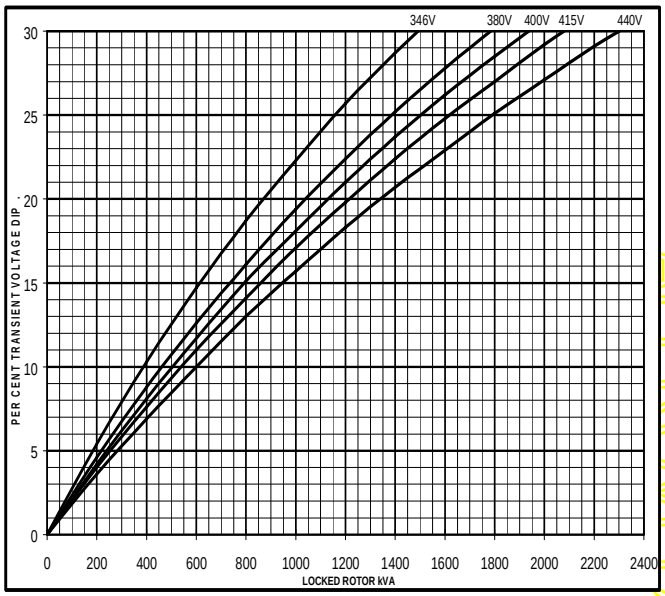
HCI534F/544F

Winding 311

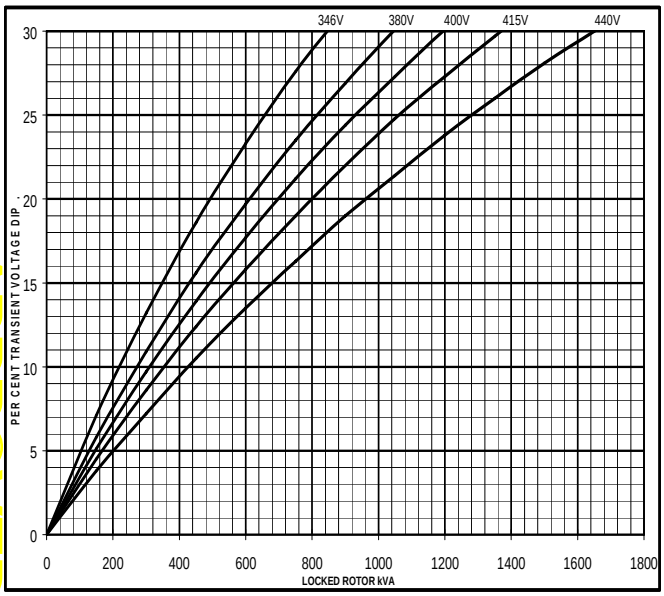
Locked Rotor Motor Starting Curve

50 Hz

MX

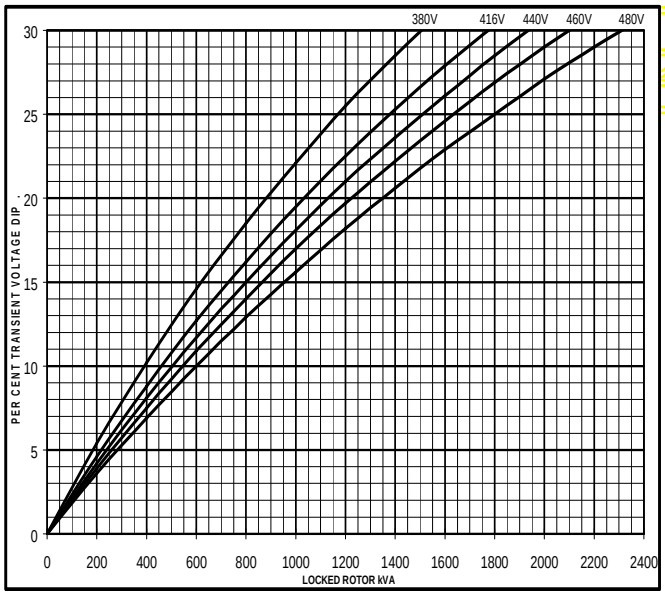


SX

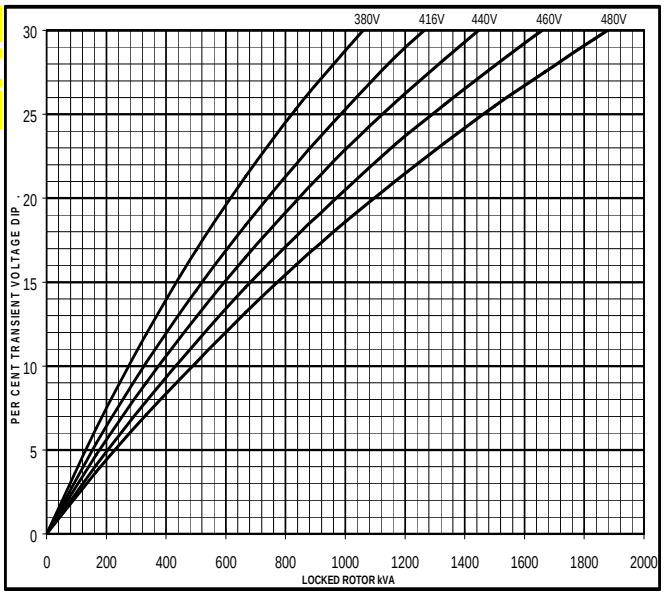


60 Hz

MX

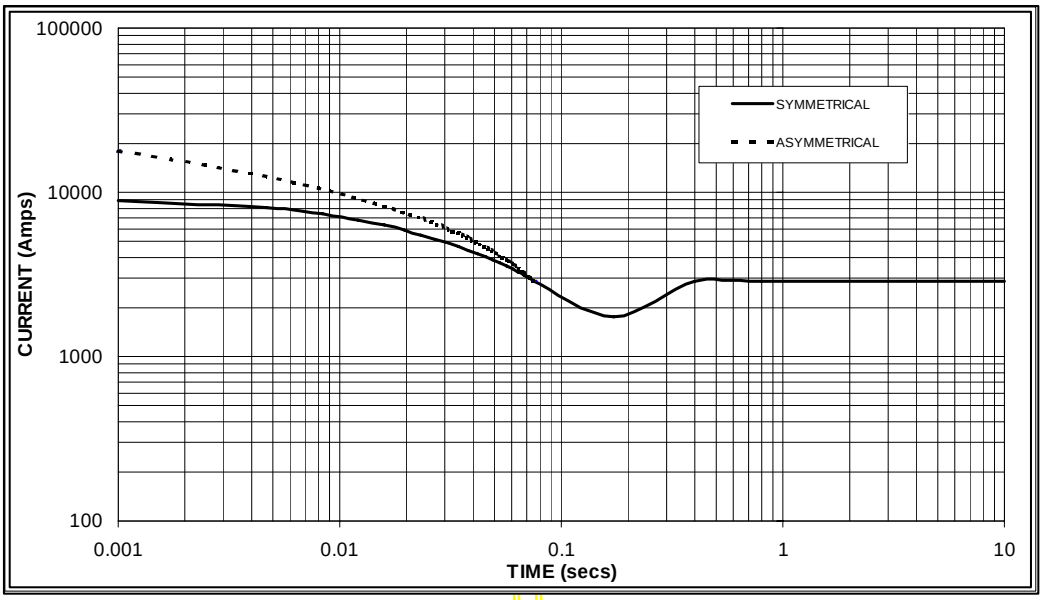


SX



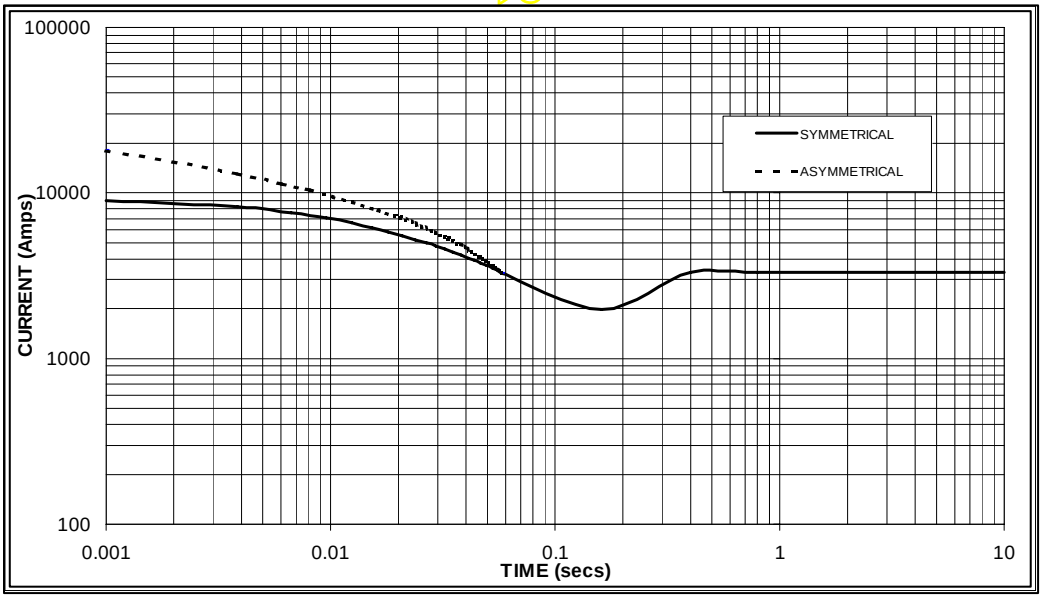
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed Based on star (wye) connection.

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

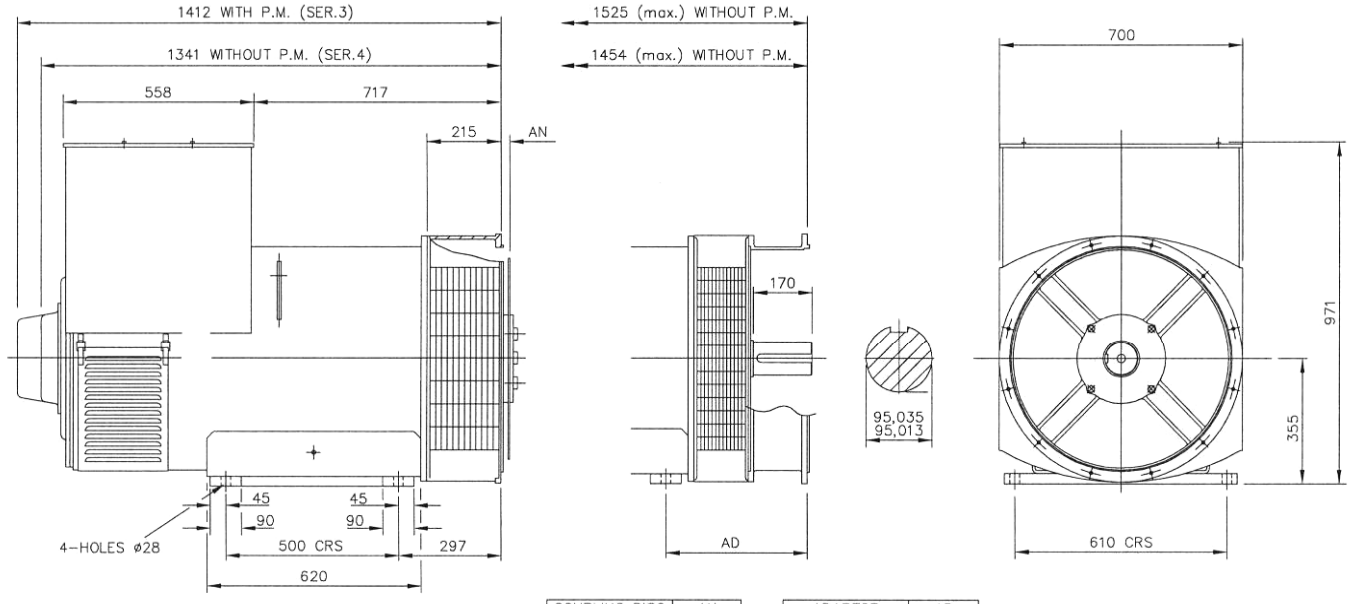
Winding 311 0.8 Power Factor

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

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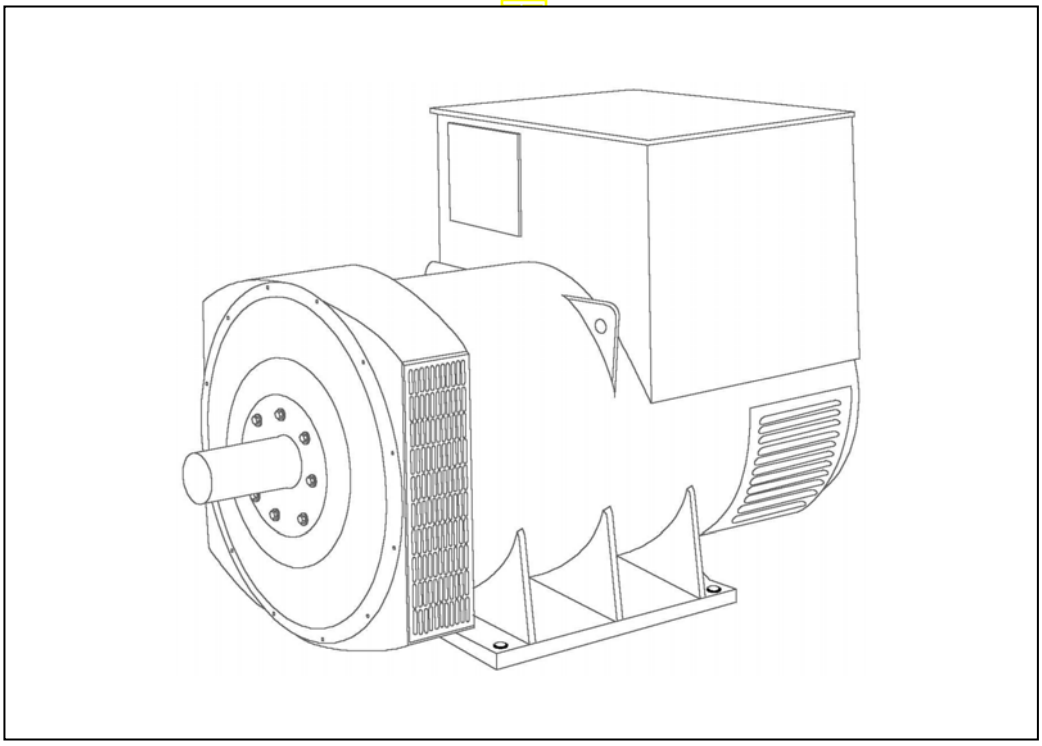
STAMFORD®

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

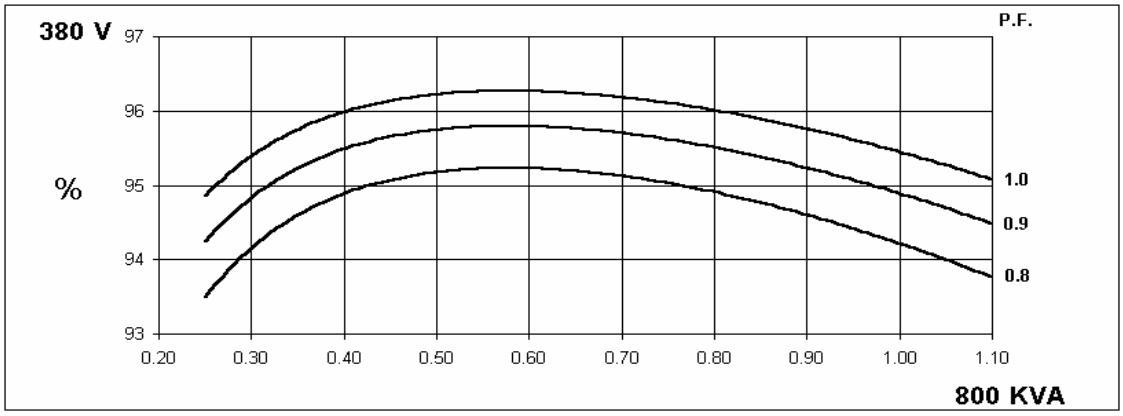
(*) Parallel Star connection only available with Wdg 311

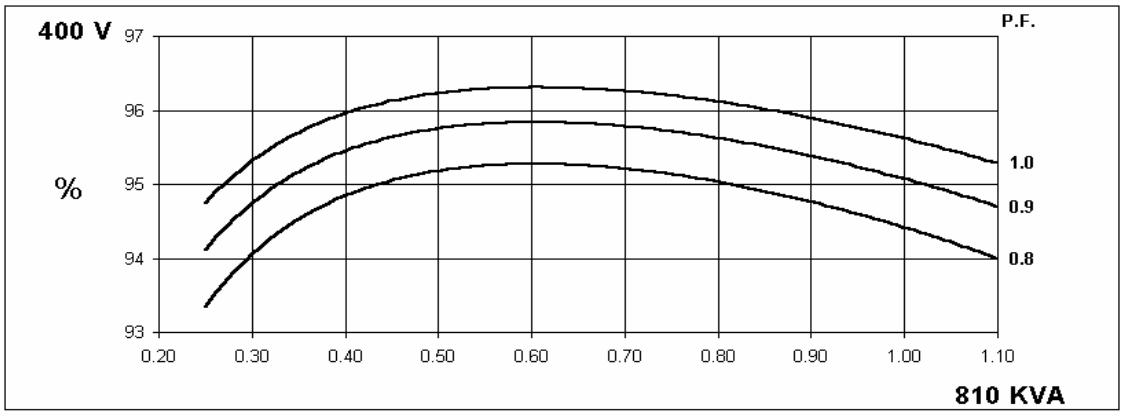
50 Hz

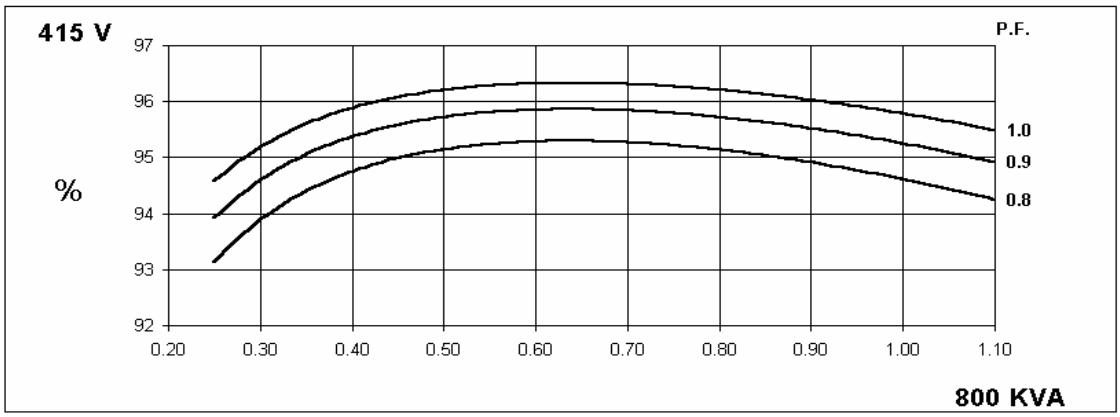
HCI634G

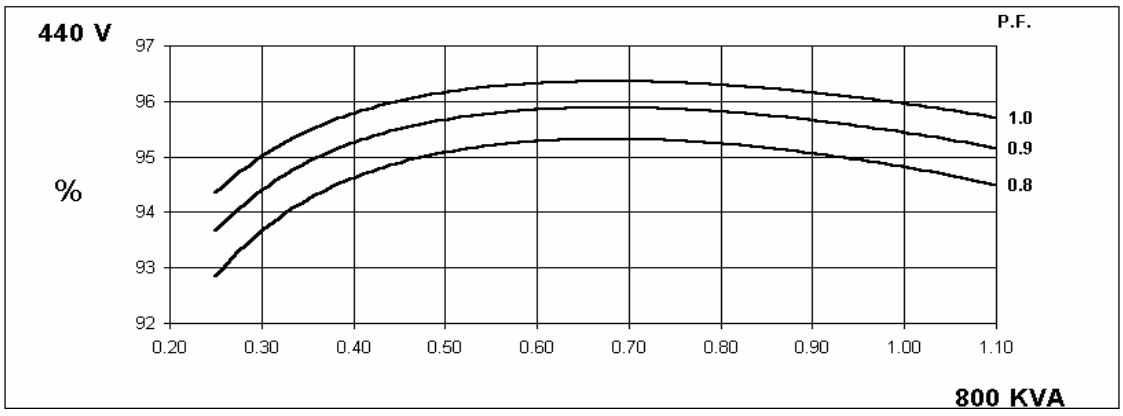
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES







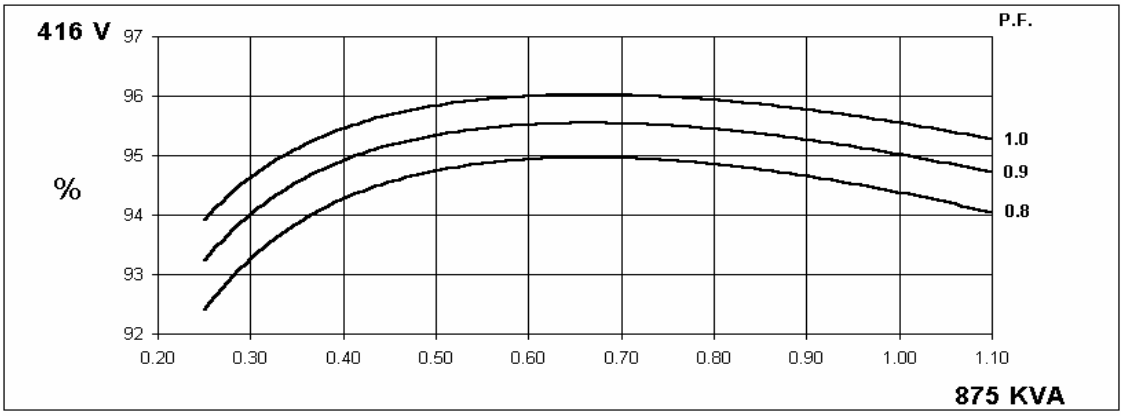


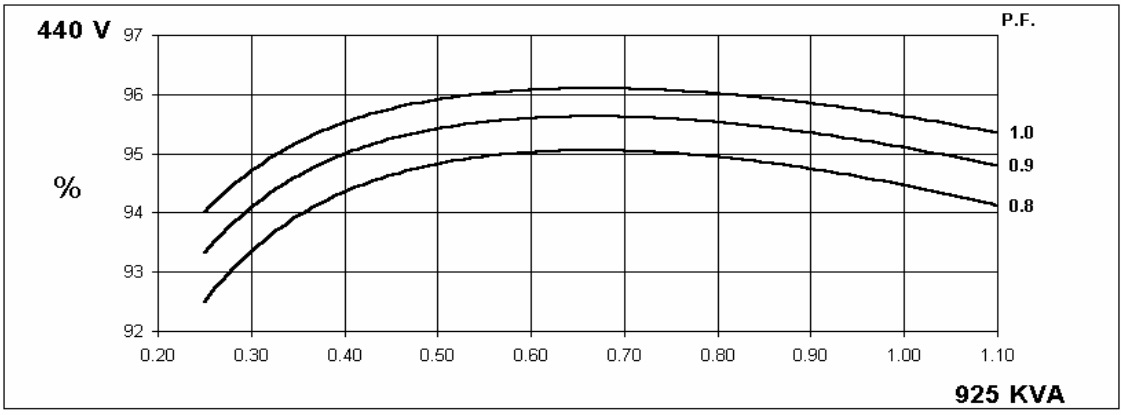
60 Hz

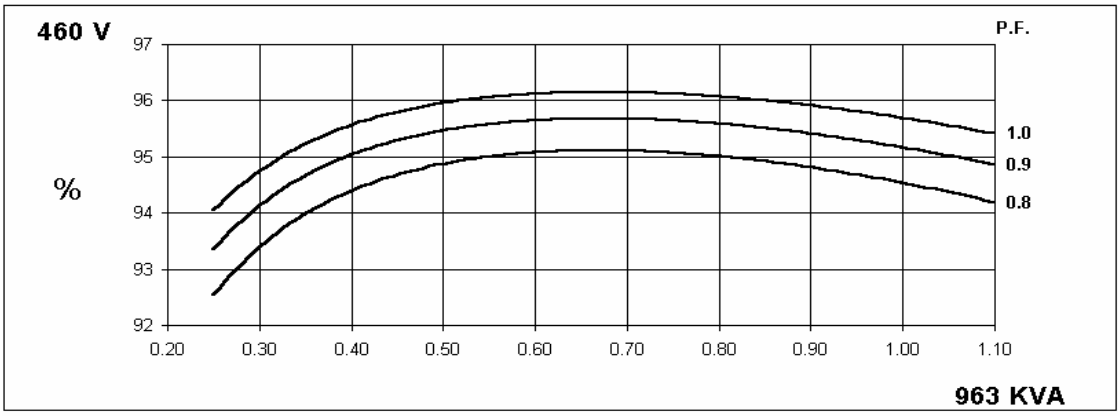
HCI634G

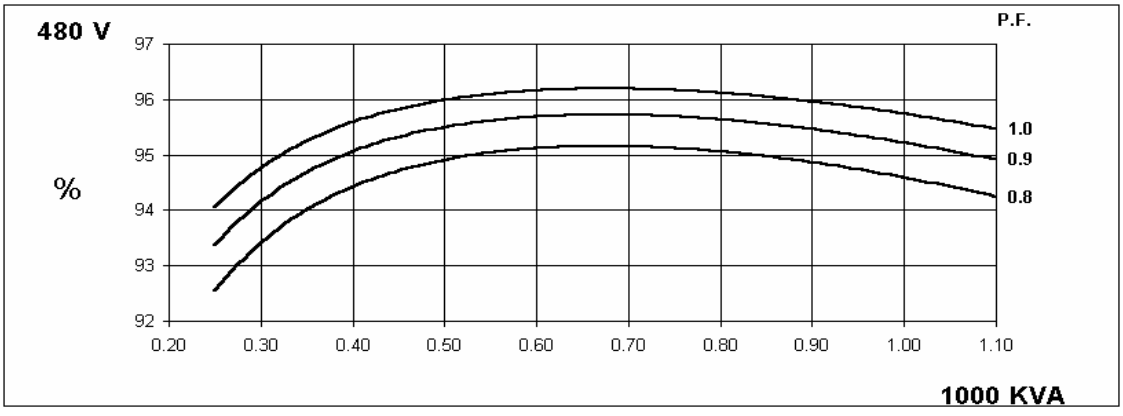
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES

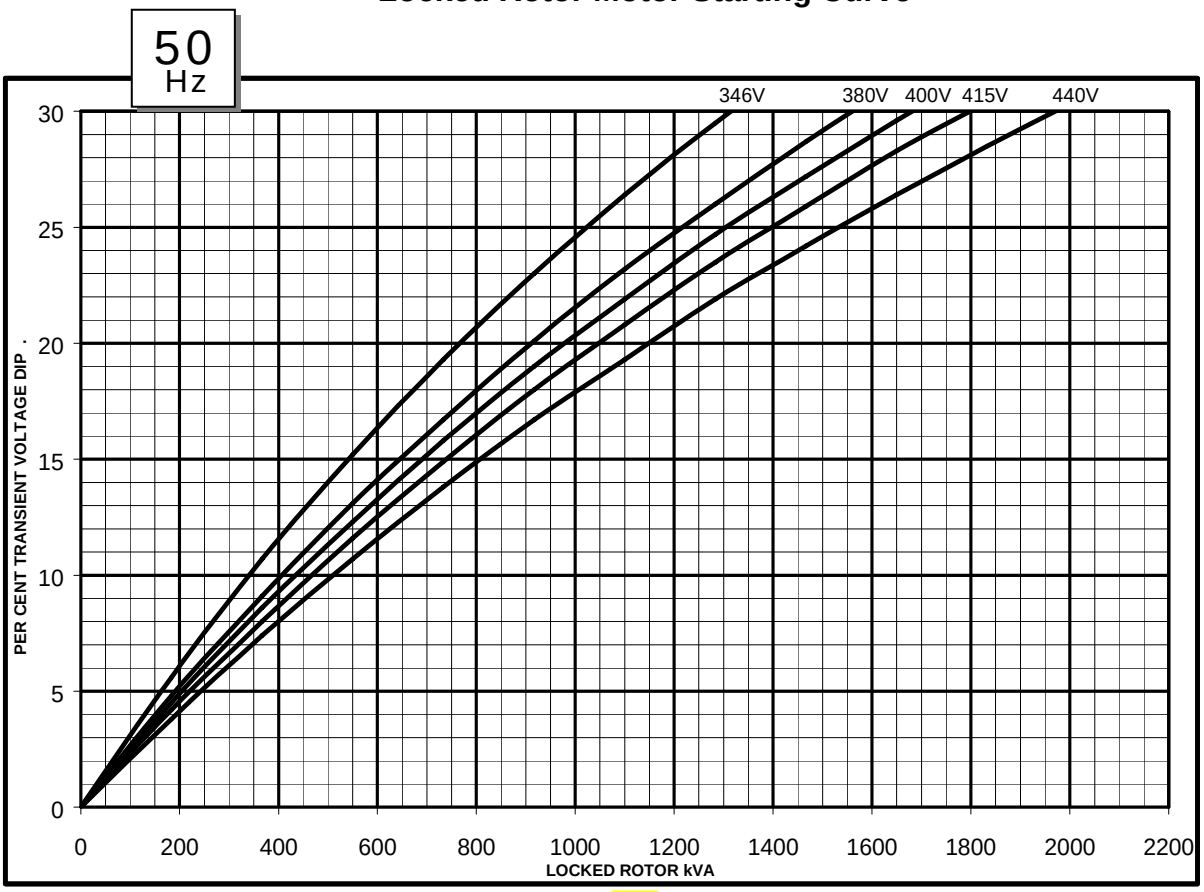


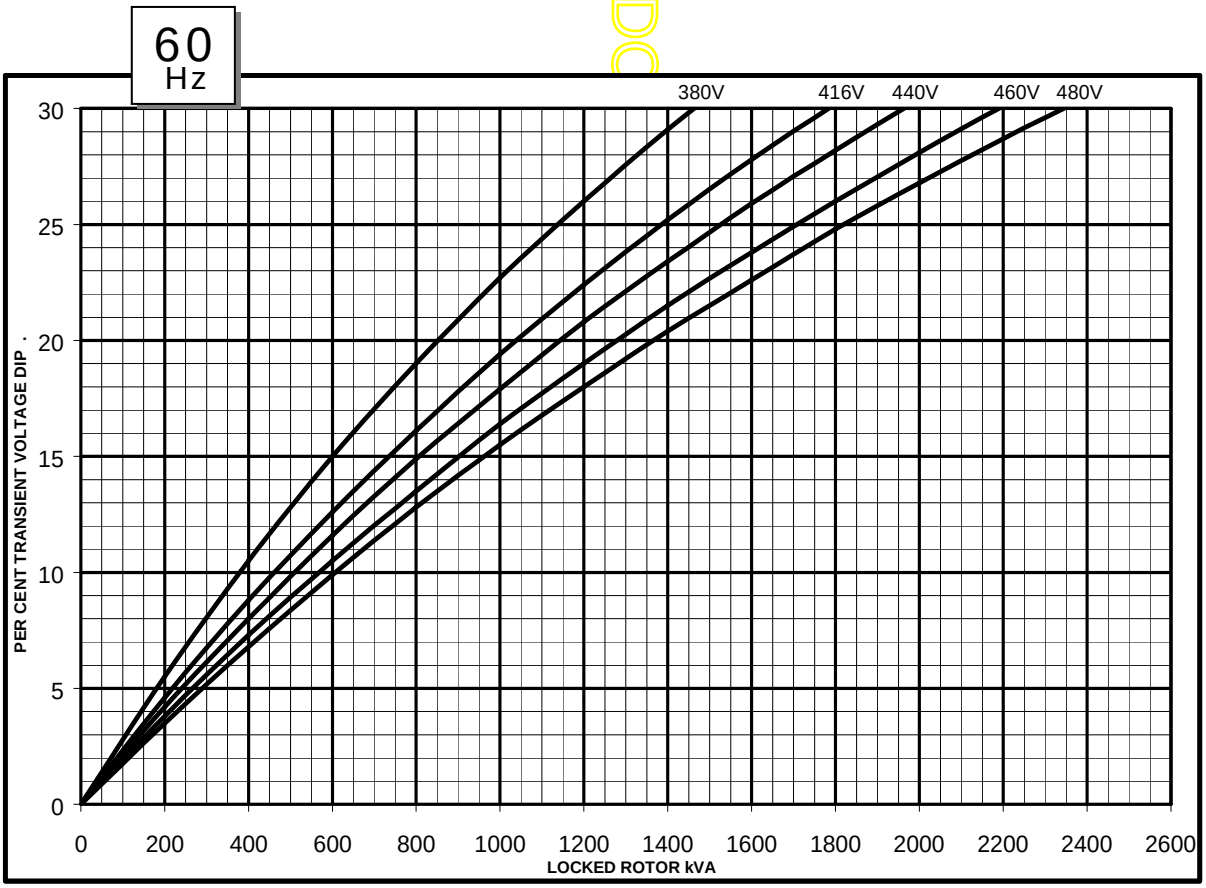






Locked Rotor Motor Starting Curve





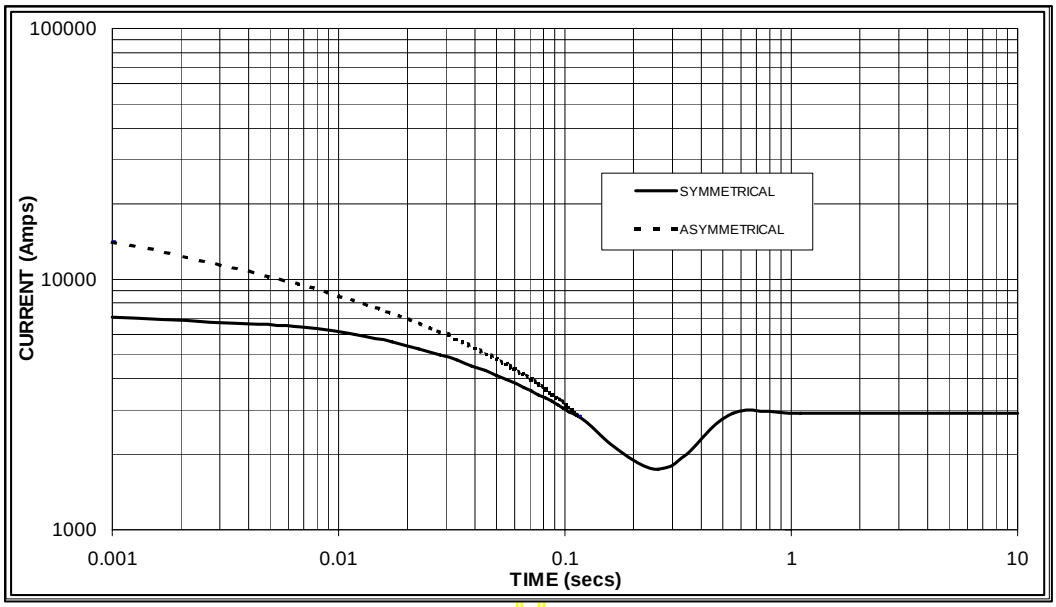
STAMFORD

WINDING 311 and 312

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

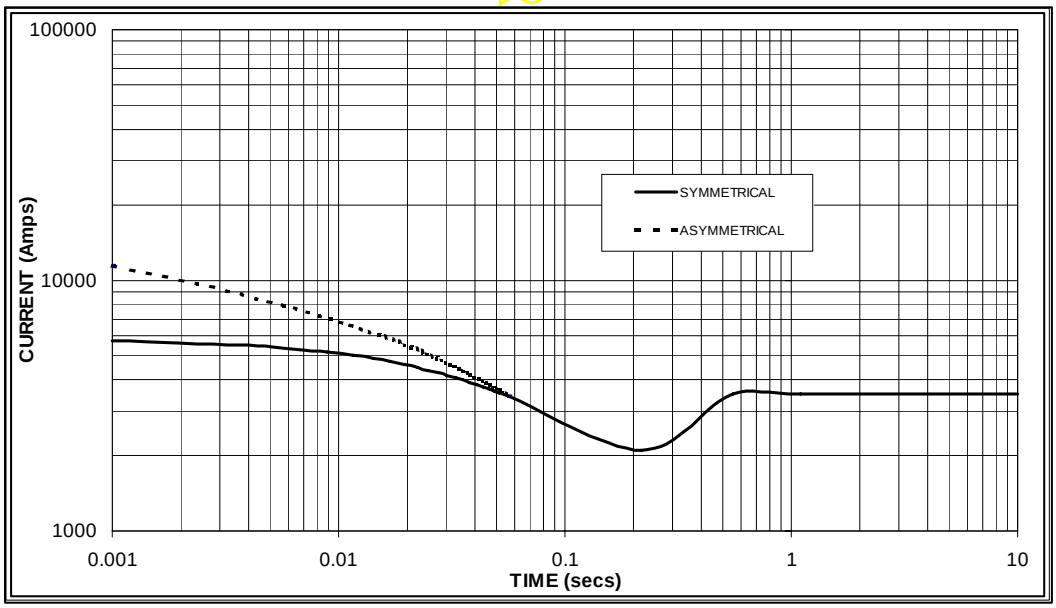
Based on star (wye) connection.

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

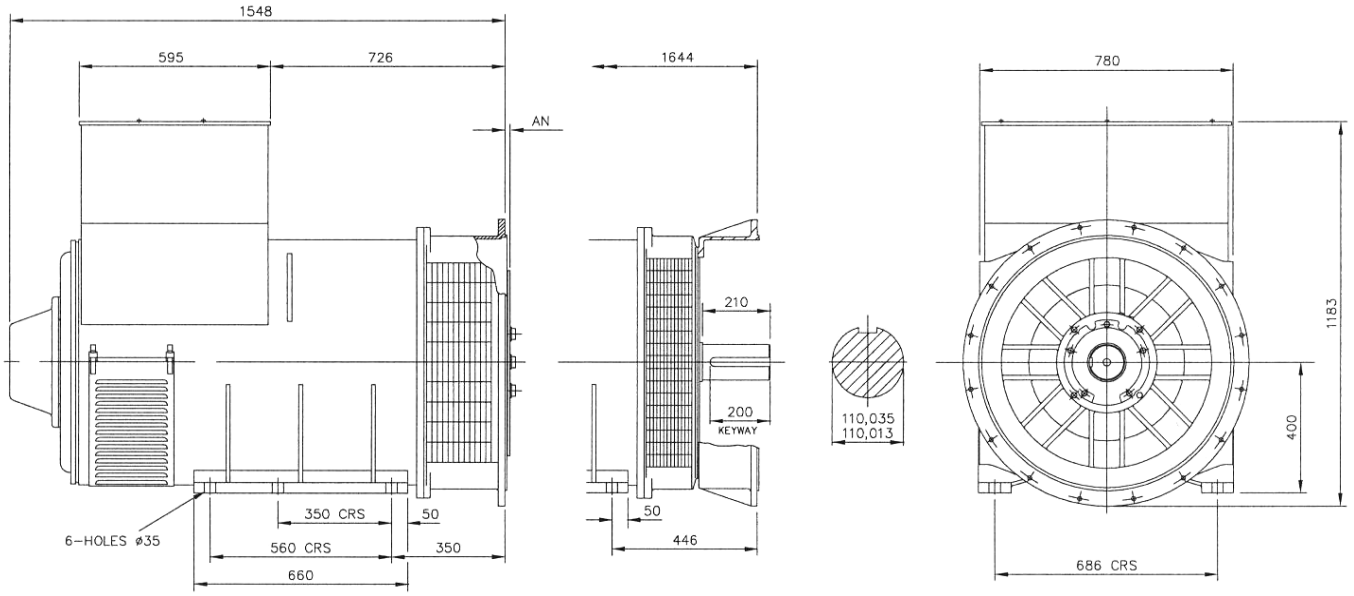
RATINGS

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

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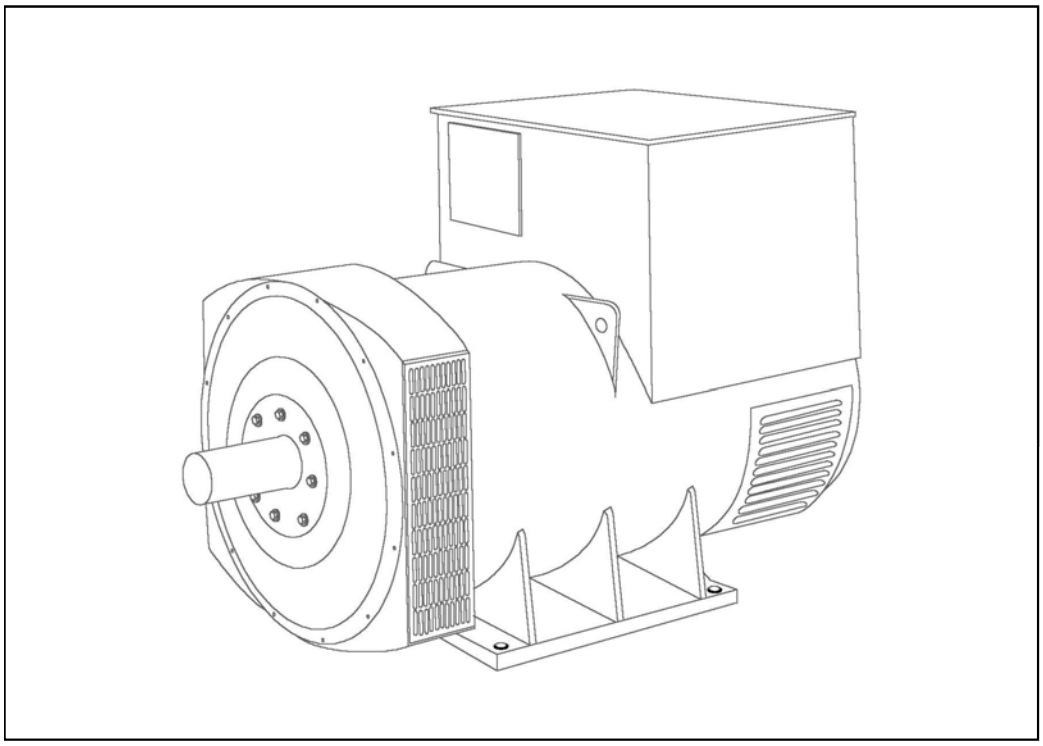
STAMFORD®

HCI634H - 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.

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	1.88 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	2117 kg				2145 kg			
WEIGHT WOUND STATOR	1010 kg				1010 kg			
WEIGHT WOUND ROTOR	866 kg				821 kg			
WR² INERTIA	20.0438 kgm^2				19.4965 kgm^2			
SHIPPING WEIGHTS in a crate	2173kg				2180kg			
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	910	940	910	875	1025	1063	1075	1125
Xd DIR. AXIS SYNCHRONOUS	2.99	2.80	2.51	2.15	3.37	3.13	2.89	2.78
X'd DIR. AXIS TRANSIENT	0.25	0.24	0.21	0.18	0.29	0.27	0.25	0.24
X''d DIR. AXIS SUBTRANSIENT	0.18	0.17	0.15	0.13	0.19	0.18	0.17	0.16
Xq QUAD. AXIS REACTANCE	1.77	1.65	1.49	1.27	2.00	1.86	1.72	1.65
X''q QUAD. AXIS SUBTRANSIENT	0.19	0.18	0.16	0.14	0.22	0.20	0.19	0.18
X_L LEAKAGE REACTANCE	0.09	0.09	0.07	0.06	0.10	0.09	0.08	0.08
X_2 NEGATIVE SEQUENCE	0.20	0.19	0.17	0.14	0.23	0.21	0.20	0.19
X_0 ZERO SEQUENCE	0.03	0.02	0.02	0.02	0.03	0.03	0.02	0.02
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.	2.44							
Ta ARMATURE TIME CONST.	0.04							
SHORT CIRCUIT RATIO	1/Xd							

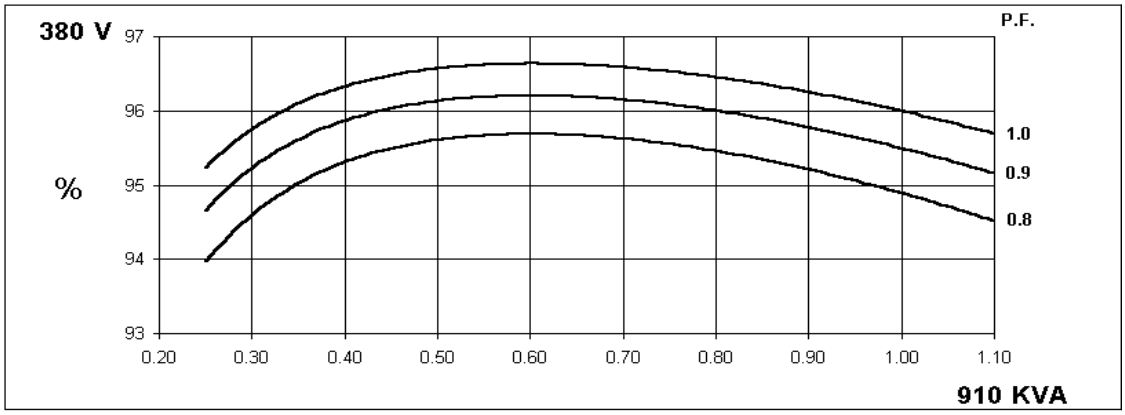
(*) Parallel Star connection only available with Wdg 311

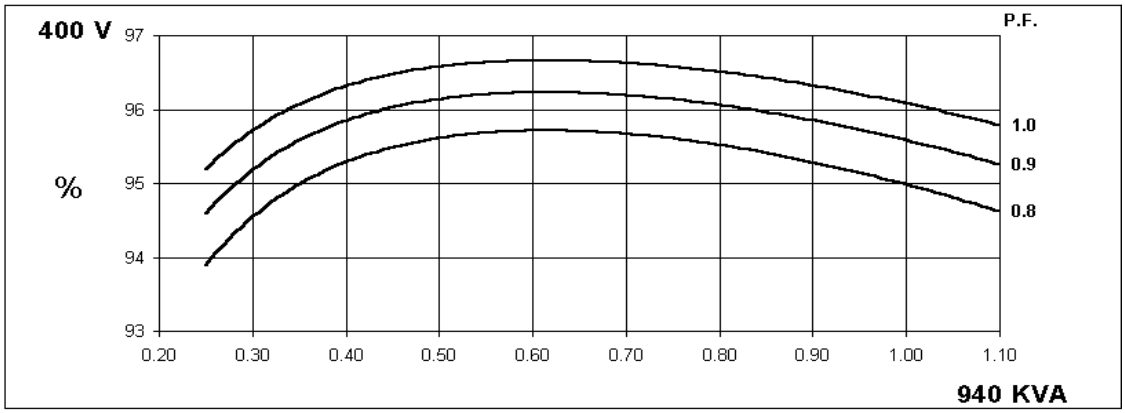
50 Hz

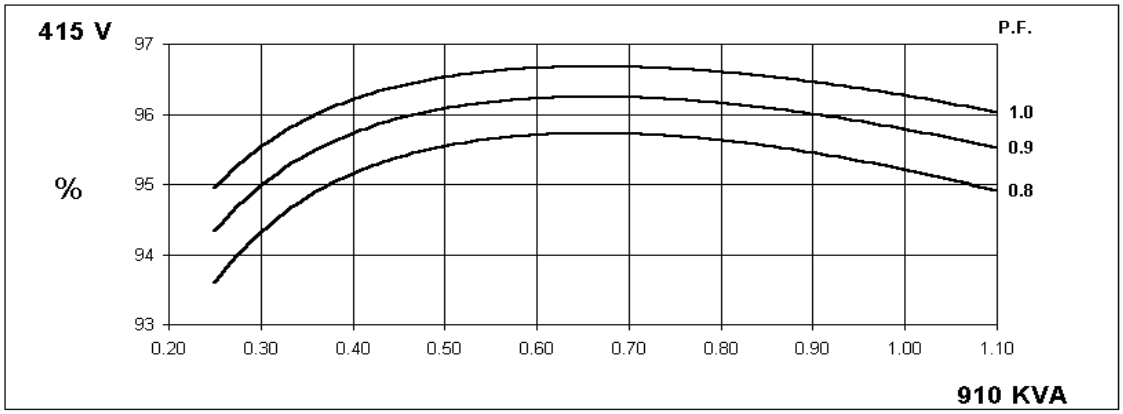
HCI634H

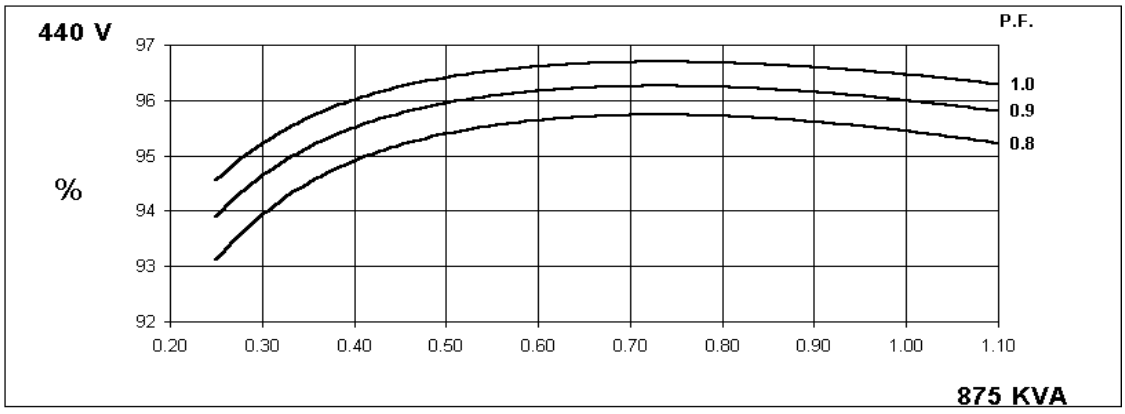
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES







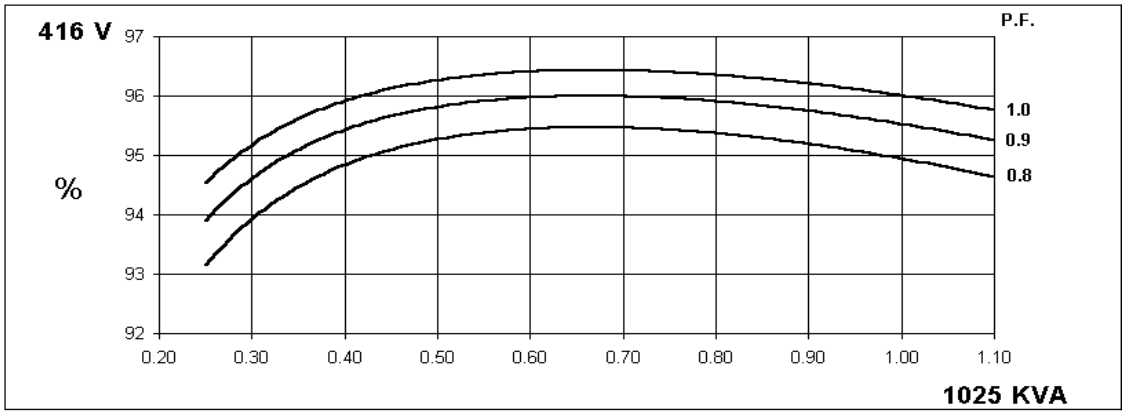


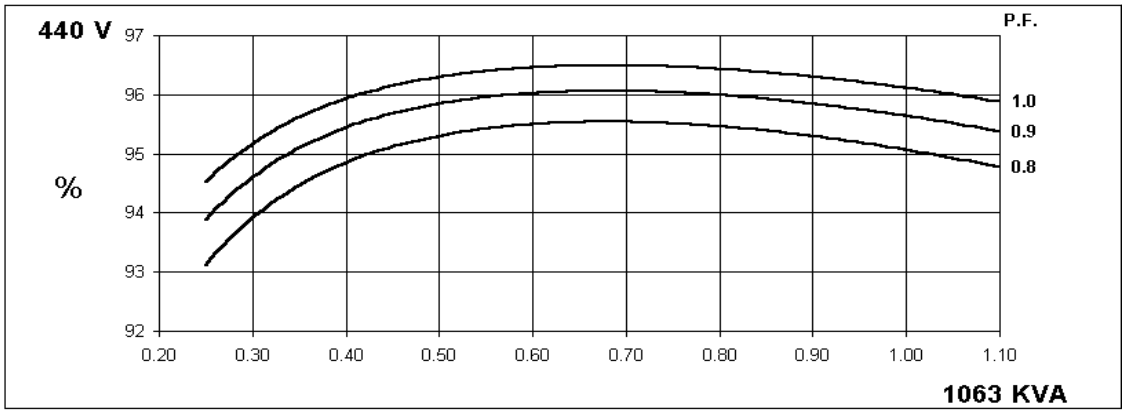
60 Hz

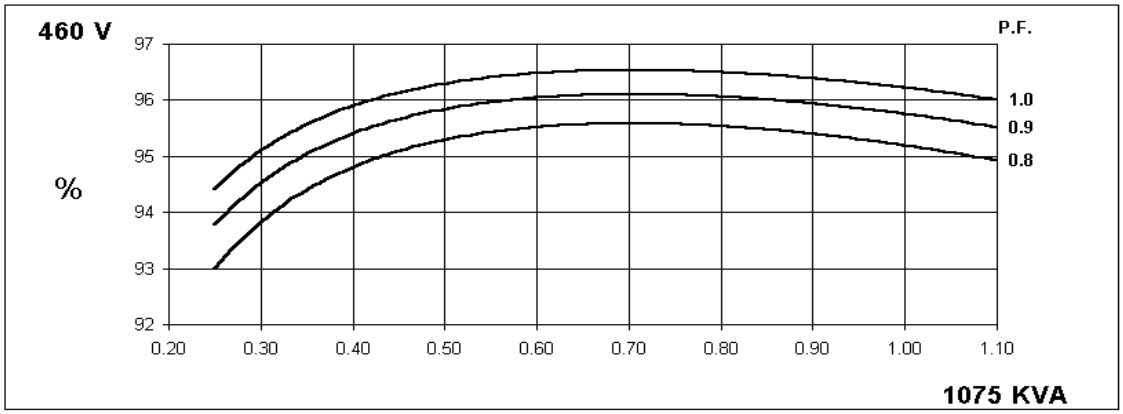
HCI634H

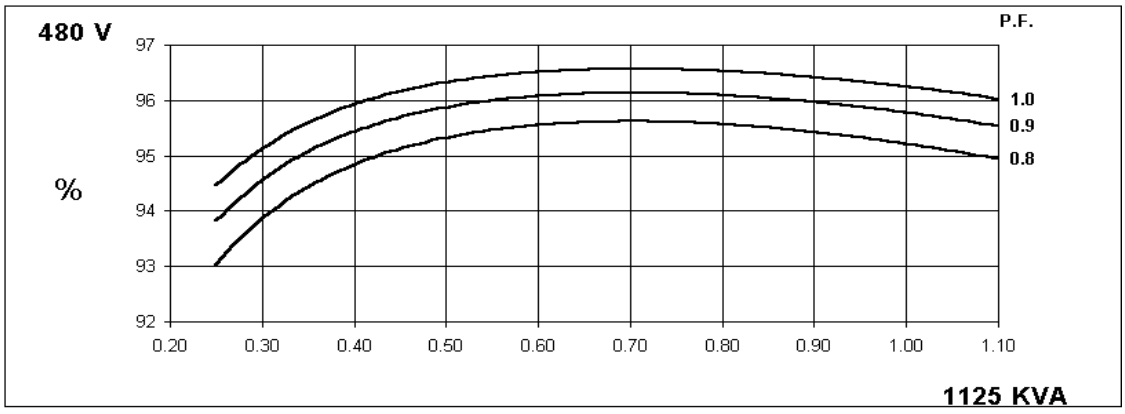
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES

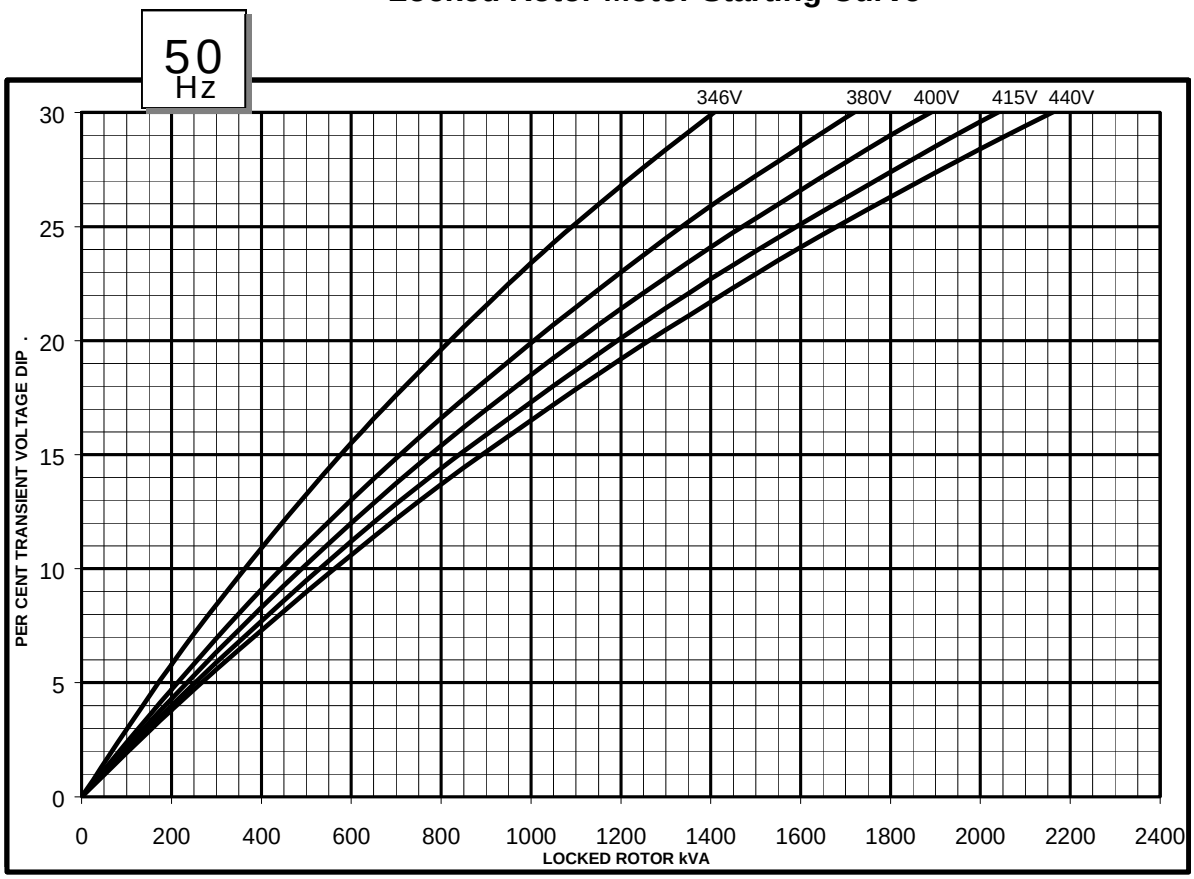


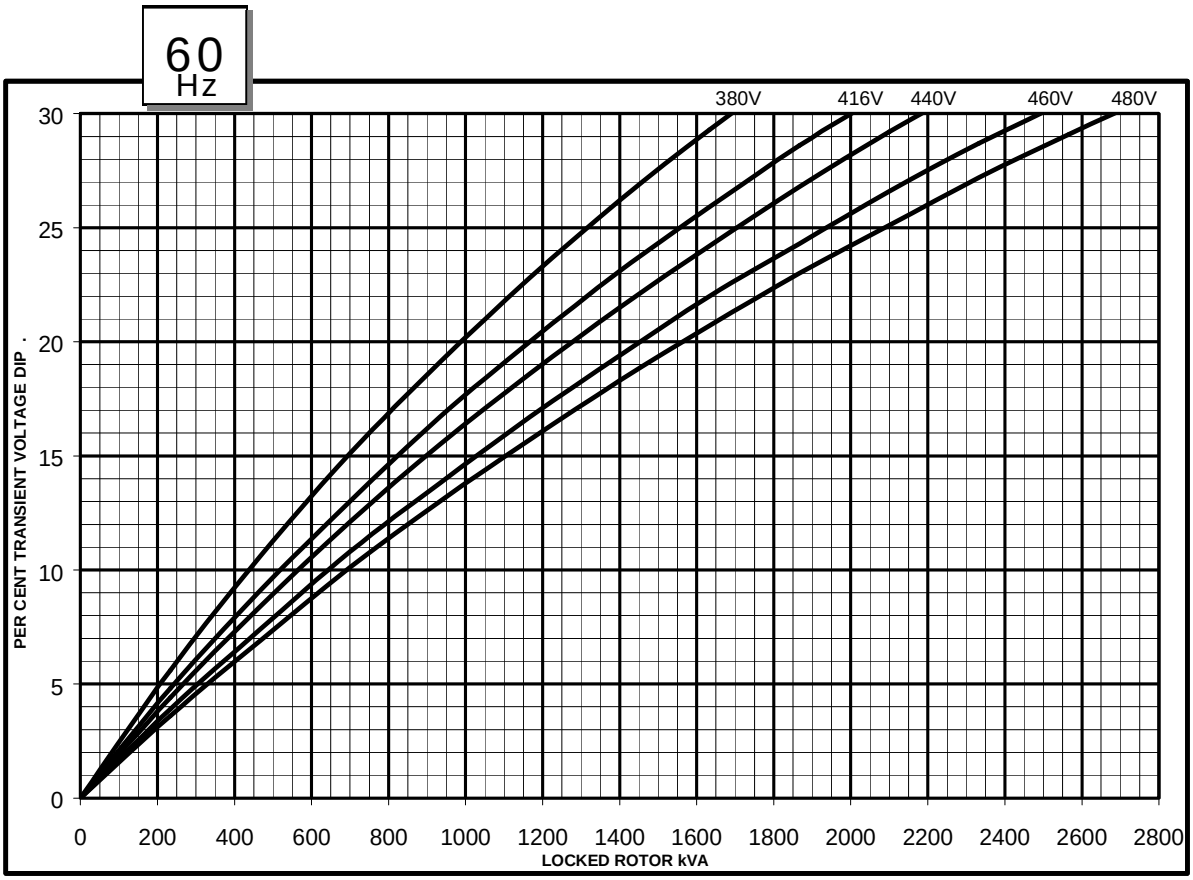






Locked Rotor Motor Starting Curve



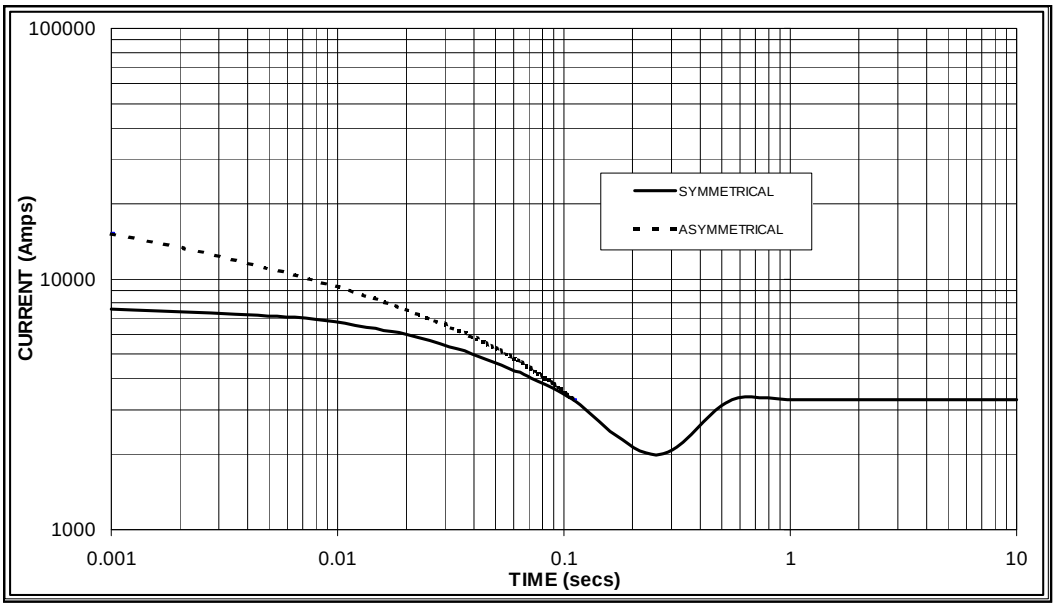


WINDING 311 and 312

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

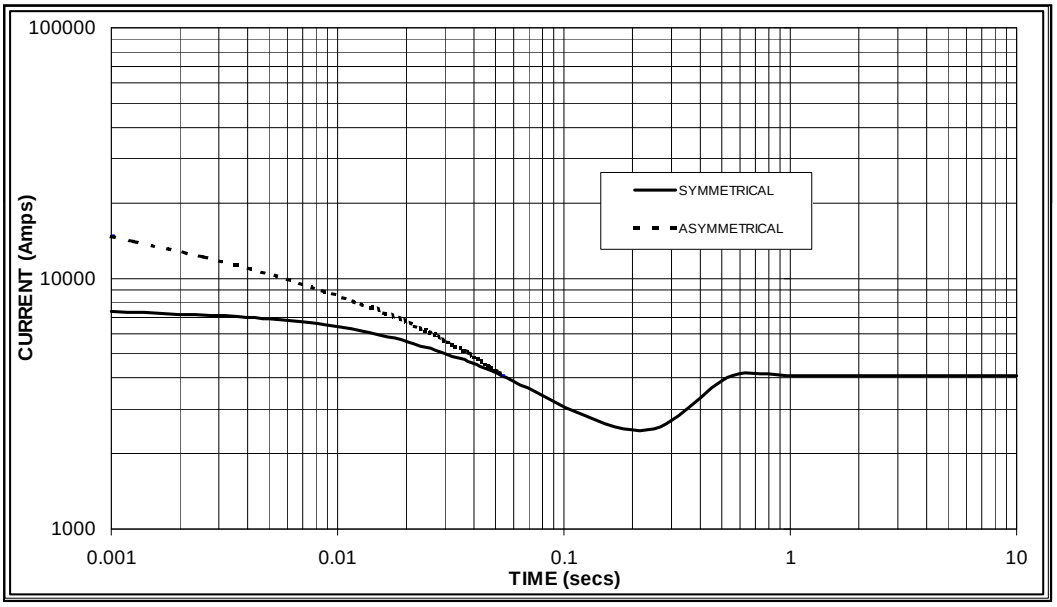
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 3,300 Amps

60 Hz



Sustained Short Circuit = 4,000 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

HCI634H

Winding 311 and 312 0.8 Power Factor

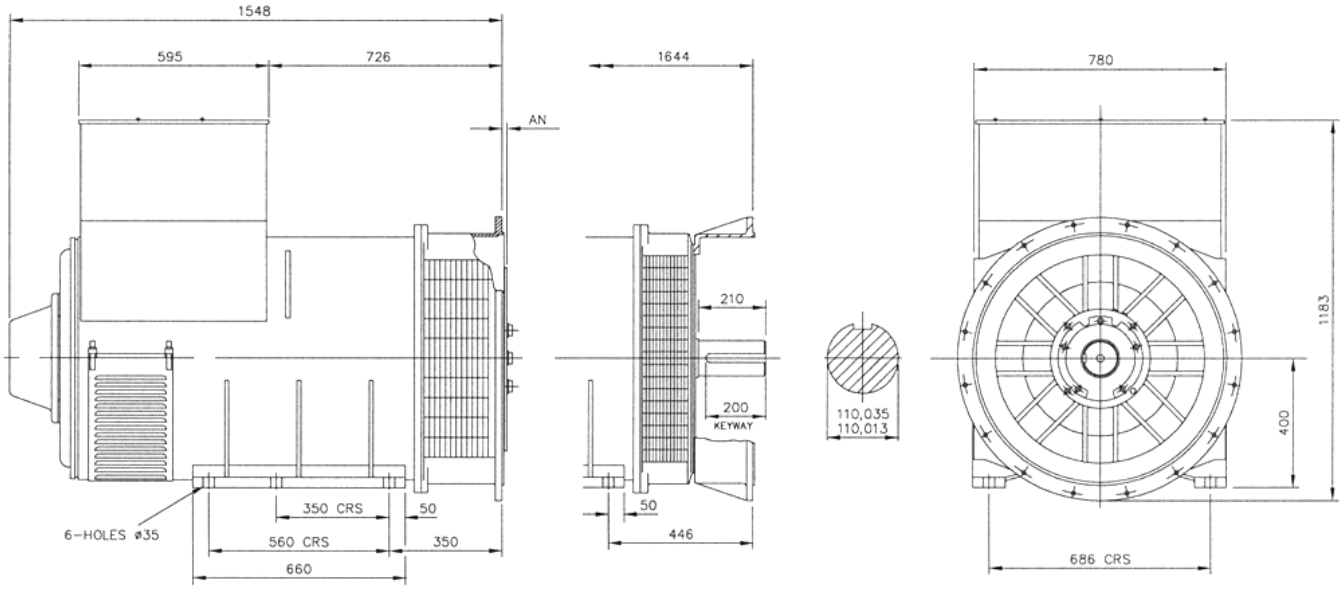
RATINGS

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	830	860	830	800	910	940	910	875	960	980	960	920	1000	1010	1000	960
kW	664	688	664	640	728	752	728	700	768	784	768	736	800	808	800	768
Efficiency (%)	95.2	95.3	95.4	95.6	94.9	95.0	95.2	95.4	94.7	94.8	95.1	95.3	94.5	94.7	94.9	95.2
kW Input	697	722	696	669	767	792	765	734	811	827	808	772	847	853	843	807

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	913	963	1000	1025	1025	1063	1075	1125	1088	1125	1138	1188	1125	1163	1175	1219
kW	730	770	800	820	820	850	860	900	870	900	910	950	900	930	940	975
Efficiency (%)	95.2	95.3	95.3	95.4	94.9	95.1	95.2	95.2	94.8	94.9	95.0	95.1	94.6	94.8	94.9	95.0
kW Input	767	808	839	860	864	894	903	945	918	948	958	999	951	981	991	1027

* Parallel Star only available with Wdg 311

DIMENSIONS



SAE	14	18	21	24
AN	25.4	15.87	0	0

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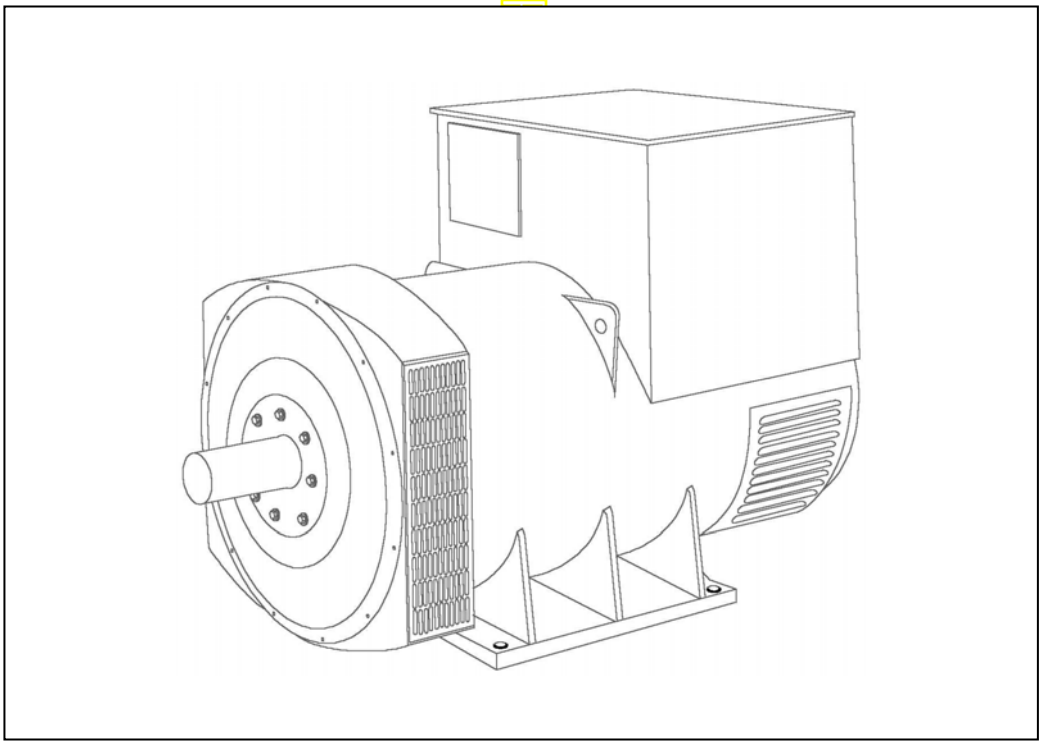
HCI634J - Winding 311 and 312

Technical Data Sheet



SPECIFICATIONS & OPTIONS
WINDING 311 and 312

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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.

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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

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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.

HCI634J

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)	

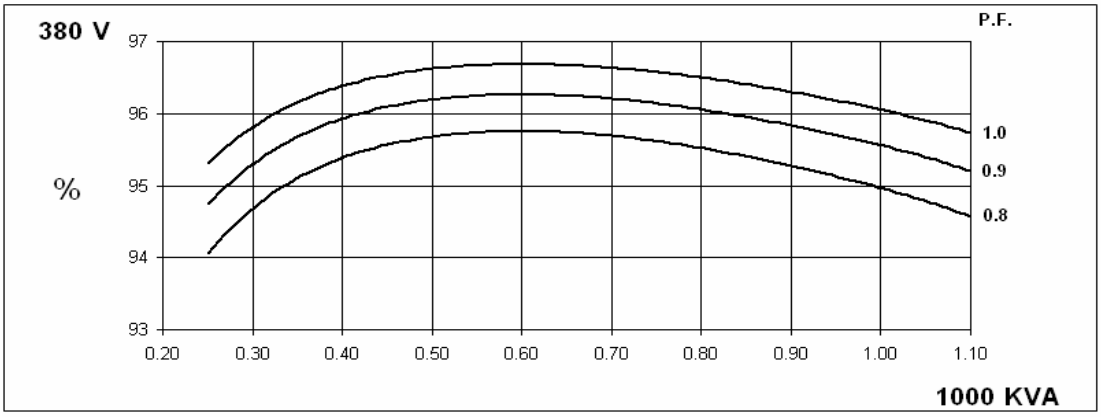
INSULATION SYSTEM	CLASS H							
PROTECTION	IP23							
RATED POWER FACTOR	0.8							
STATOR WINDING	DOUBLE LAYER LAP							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	6 (Wdg 312) or 12 (Wdg 311)							
STATOR WDG. RESISTANCE	0.002 Ohms PER PHASE AT 22°C STAR CONNECTED							
ROTOR WDG. RESISTANCE	2.09 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	2279 kg				2300 kg			
WEIGHT WOUND STATOR	1120 kg				1120 kg			
WEIGHT WOUND ROTOR	962 kg				916 kg			
WR² INERTIA	22.9287 kgm^2				22.3814 kgm^2			
SHIPPING WEIGHTS in a crate	2328kg				2329kg			
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	1000	1030	1030	1000	1150	1200	1250	1300
Xd DIR. AXIS SYNCHRONOUS	3.02	2.81	2.61	2.25	3.49	3.25	3.10	2.96
X'd DIR. AXIS TRANSIENT	0.24	0.23	0.21	0.18	0.28	0.26	0.25	0.24
X"d DIR. AXIS SUBTRANSIENT	0.17	0.15	0.14	0.12	0.19	0.18	0.17	0.16
Xq QUAD. AXIS REACTANCE	1.78	1.66	1.54	1.33	2.05	1.91	1.82	1.74
X"q QUAD. AXIS SUBTRANSIENT	0.21	0.20	0.19	0.16	0.25	0.23	0.22	0.21
X_L LEAKAGE REACTANCE	0.09	0.08	0.07	0.07	0.10	0.10	0.09	0.09
X_2 NEGATIVE SEQUENCE	0.21	0.20	0.19	0.16	0.25	0.23	0.22	0.21
X_0 ZERO SEQUENCE	0.03	0.02	0.02	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.	3.03							
Ta ARMATURE TIME CONST.	0.046							
SHORT CIRCUIT RATIO	1/Xd							

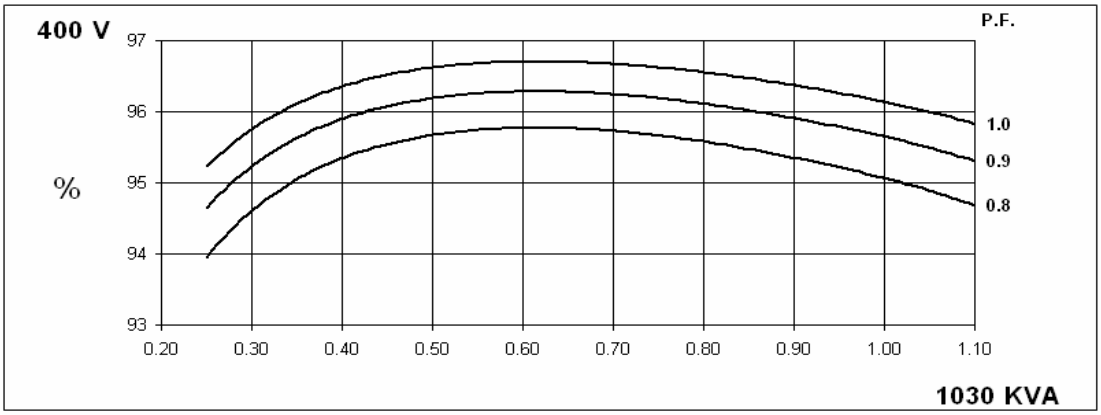
50 Hz

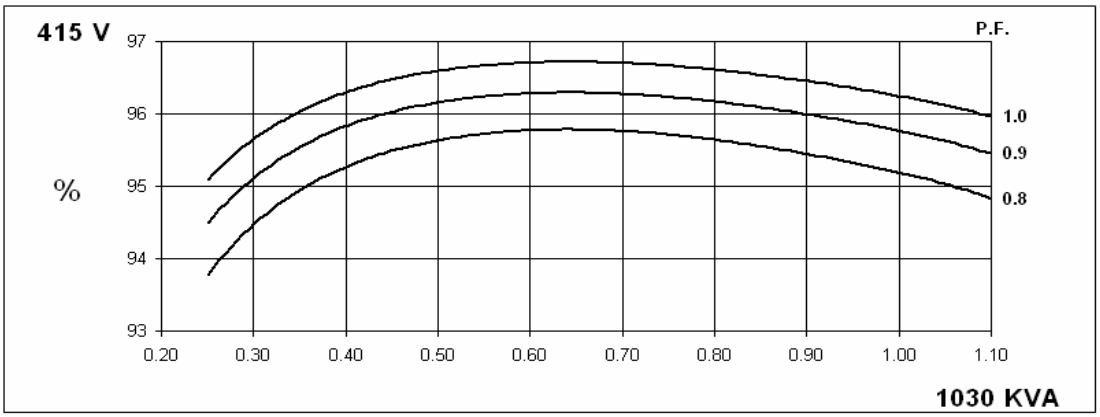
HCI634J

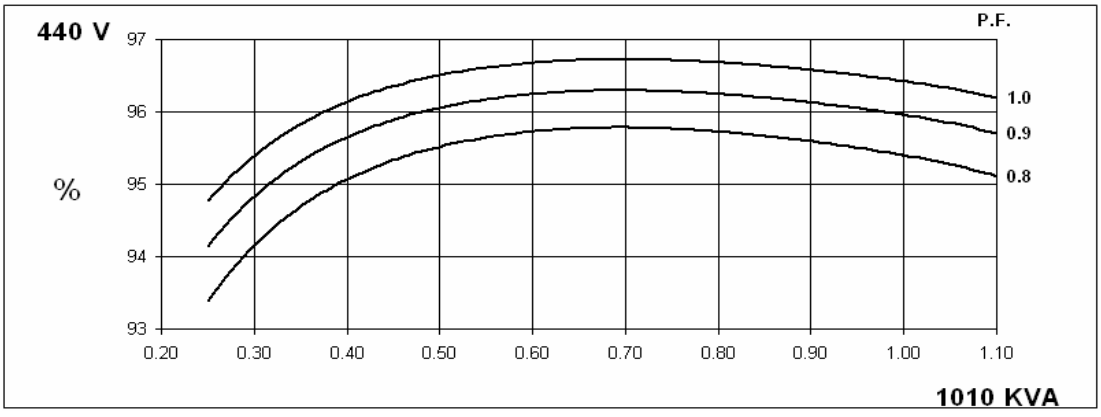
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES







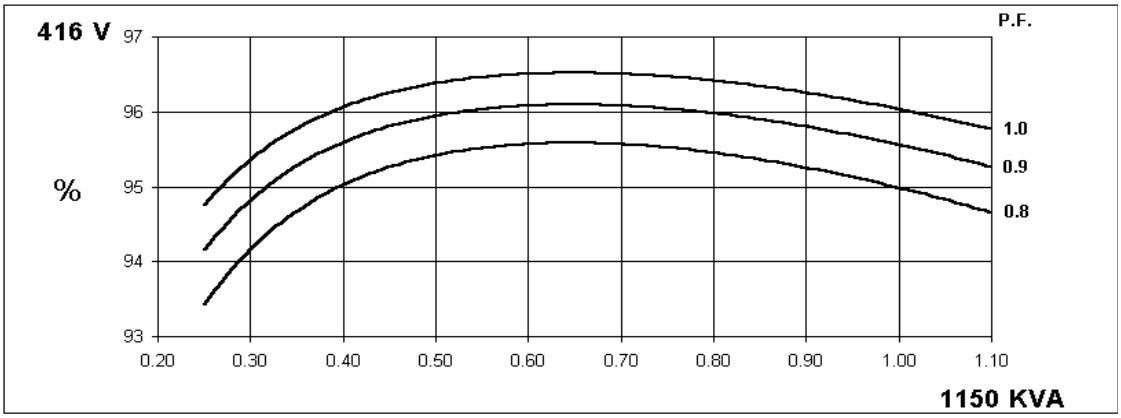


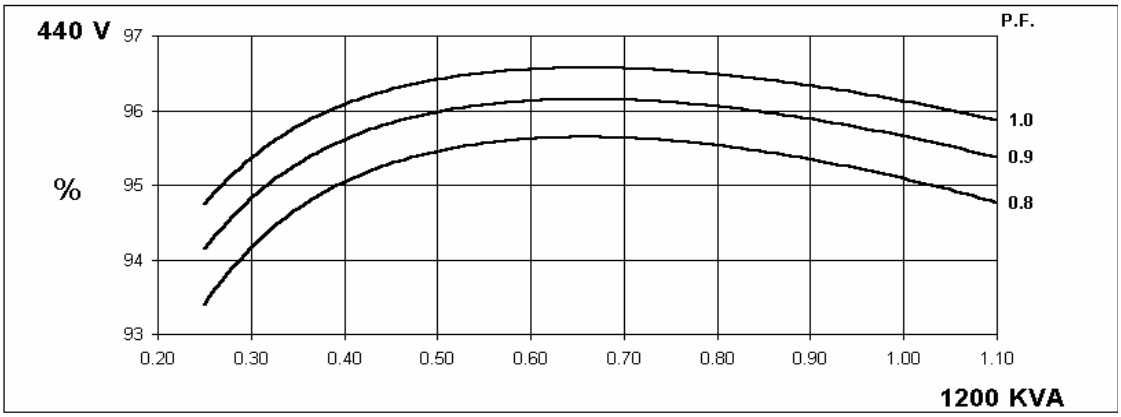
60 Hz

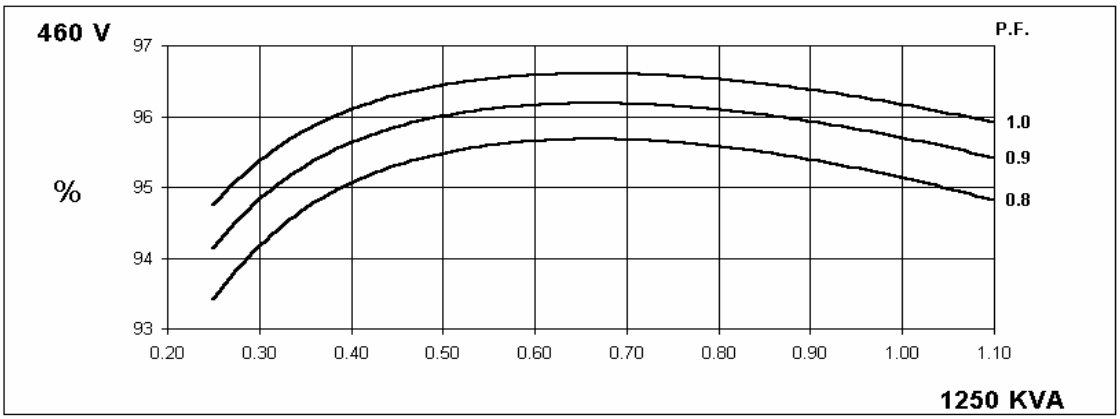
HCI634J

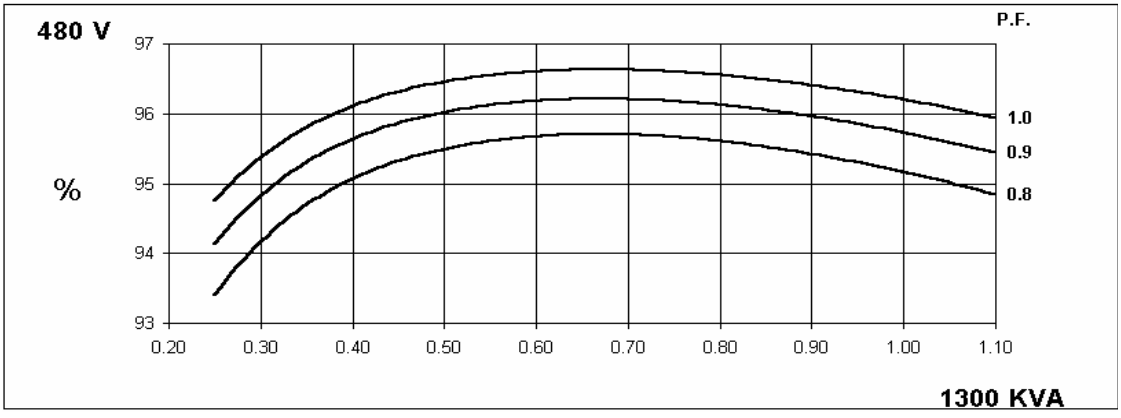
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES

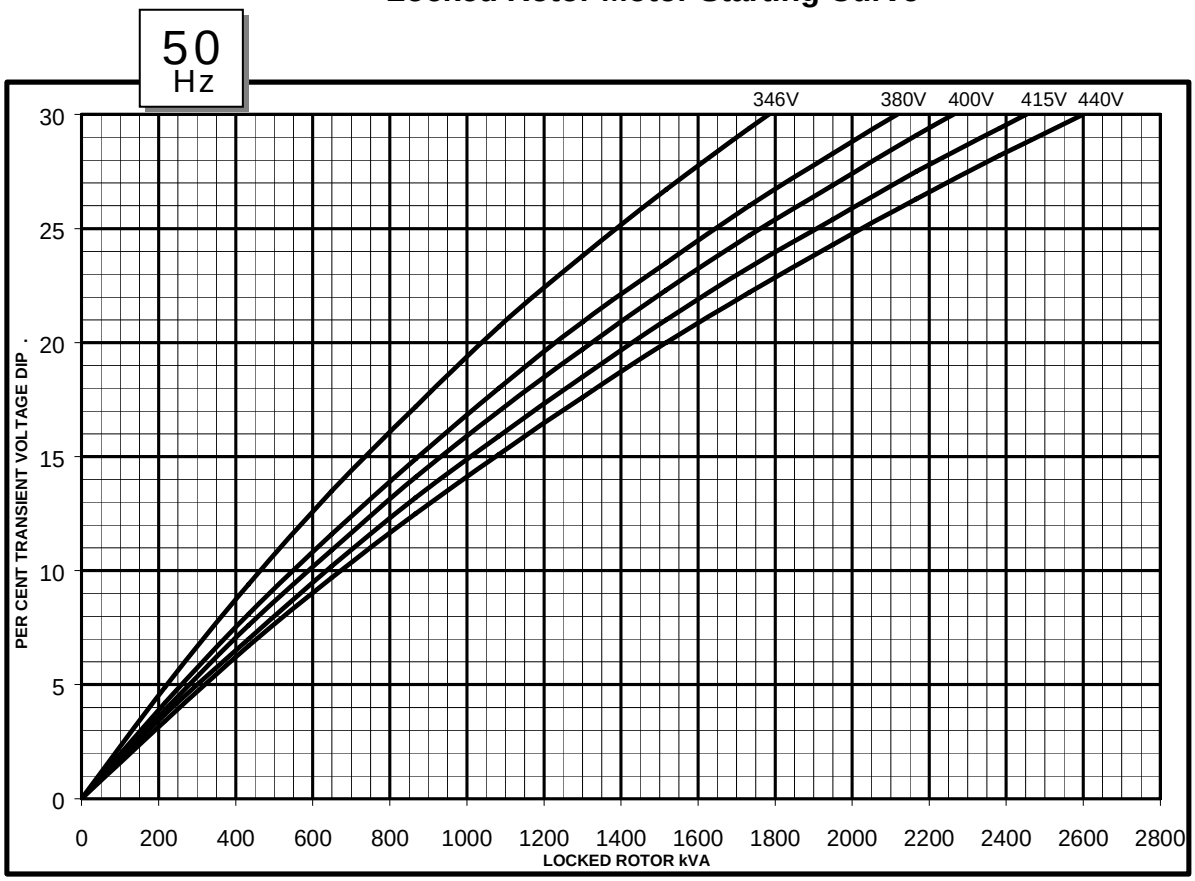


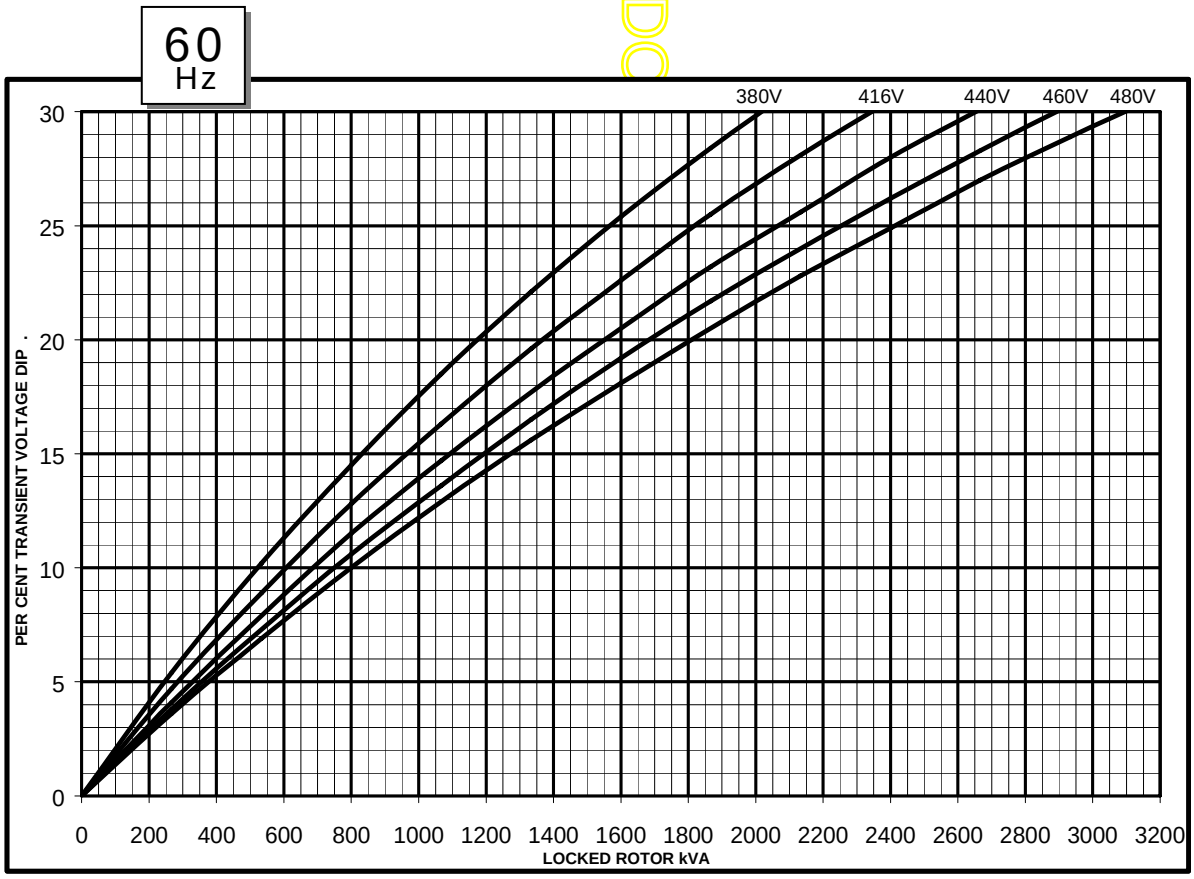






Locked Rotor Motor Starting Curve





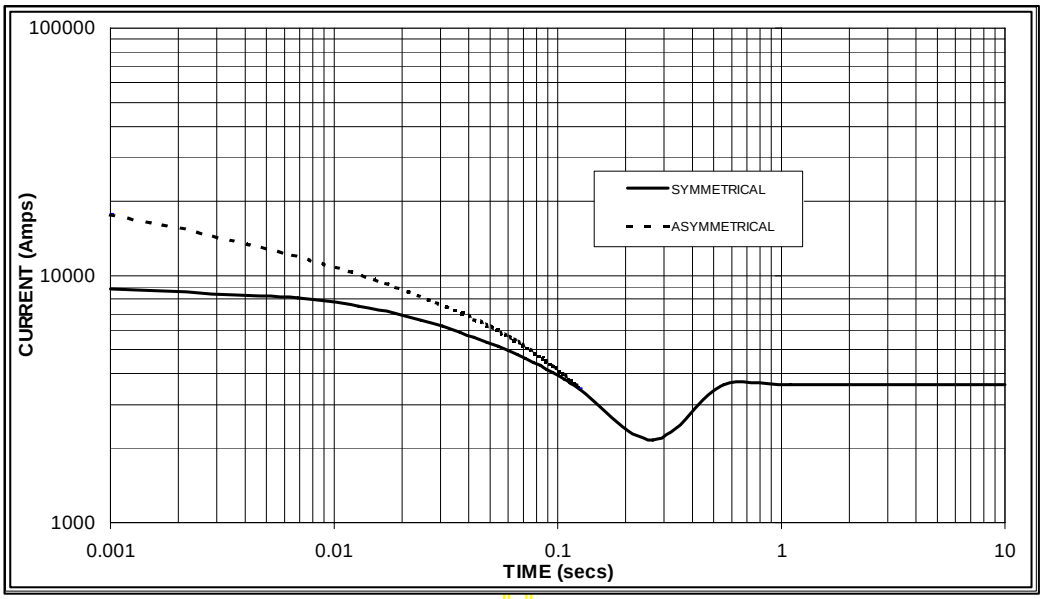
HCI634J

WINDING 311 and 312

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

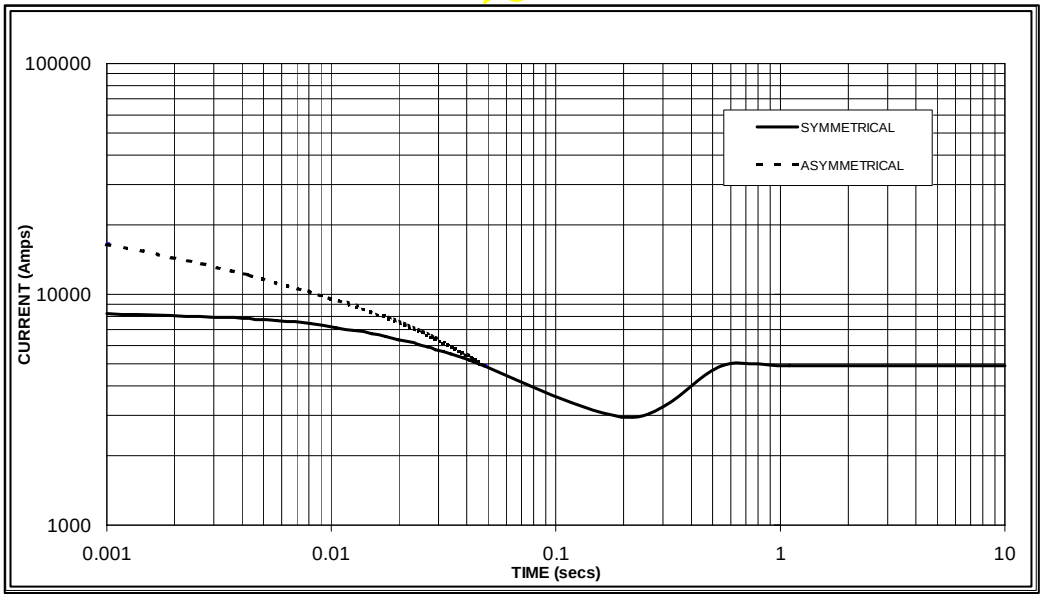
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 3,600 Amps

60 Hz



Sustained Short Circuit = 4,900 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

HCI634J

Winding 311 and 312 0.8 Power Factor

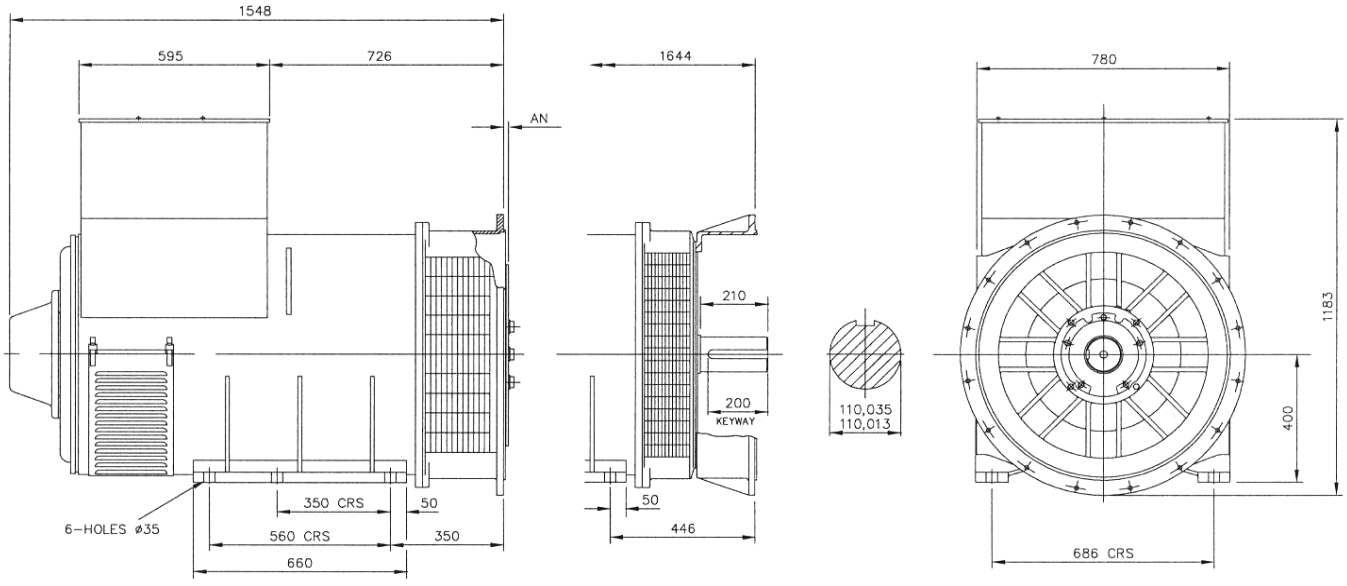
RATINGS

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	900	927	927	900	1000	1030	1030	1010	1060	1070	1070	1060	1100	1110	1110	1100
kW	720	742	742	720	800	824	824	808	848	856	856	848	880	888	888	880
Efficiency (%)	95.3	95.4	95.5	95.6	95.0	95.1	95.2	95.4	94.7	94.9	95.1	95.3	94.6	94.8	94.9	95.2
kW Input	756	777	777	753	842	866	866	847	895	902	900	890	930	937	936	924

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	1063	1100	1150	1188	1150	1200	1250	1300	1206	1250	1300	1350	1250	1300	1350	1400
kW	850	880	920	950	920	960	1000	1040	965	1000	1040	1080	1000	1040	1080	1120
Efficiency (%)	95.2	95.3	95.3	95.4	95.0	95.1	95.1	95.2	94.8	95.0	95.0	95.1	94.7	94.8	94.9	94.9
kW Input	893	923	965	996	968	1009	1052	1092	1018	1053	1095	1136	1056	1097	1138	1180

* Parallel Star only available with Wdg 311

DIMENSIONS



SAE	14	18	21	24
AN	25.4	15.87	0	0

APPROVED DOCUMENT

STAMFORD

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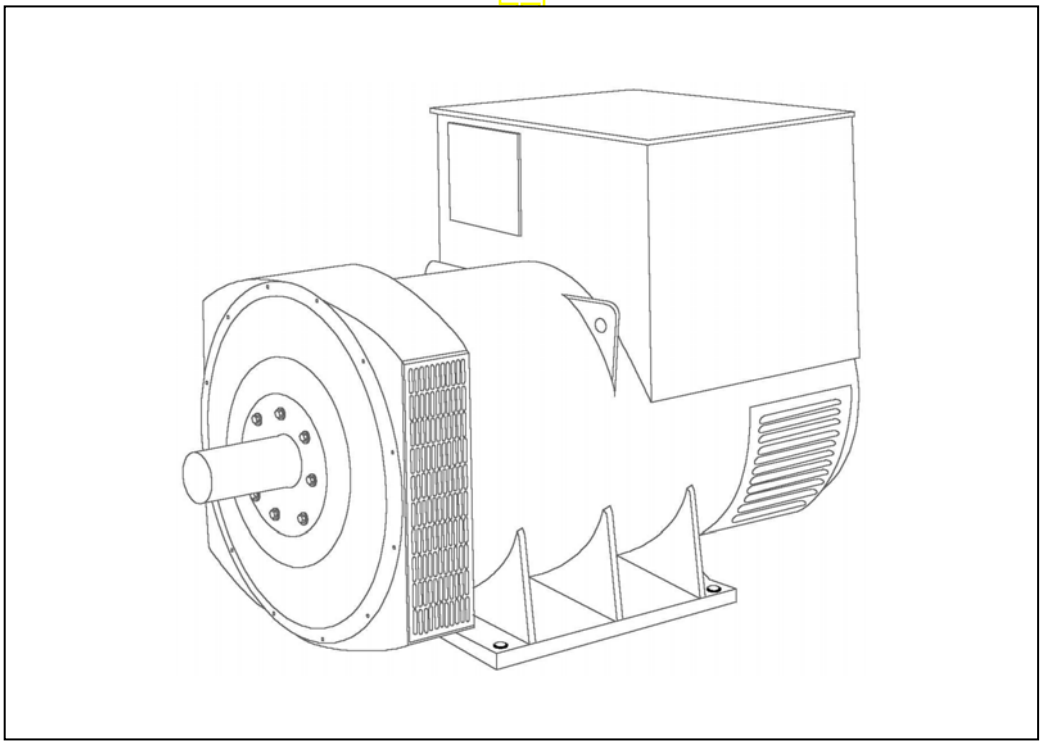
STAMFORD®

HCI634K - 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.

HCI634K

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	0.002 Ohms PER PHASE AT 22°C STAR CONNECTED							
ROTOR WDG. RESISTANCE	2.36 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	2541 kg				2581 kg			
WEIGHT WOUND STATOR	1294 kg				1294 kg			
WEIGHT WOUND ROTOR	1093 kg				1048 kg			
WR² INERTIA	26.5295 kgm^2				25.9823 kgm^2			
SHIPPING WEIGHTS in a crate	2601kg				2622kg			
PACKING CRATE SIZE	194 x 92 x 147(cm)				194 x 92 x 147(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	1110	1135	1110	1110	1275	1338	1388	1438
Xd DIR. AXIS SYNCHRONOUS	2.78	2.57	2.33	2.08	3.20	3.00	2.85	2.71
X'd DIR. AXIS TRANSIENT	0.22	0.20	0.18	0.16	0.26	0.24	0.23	0.22
X"d DIR. AXIS SUBTRANSIENT	0.15	0.14	0.13	0.11	0.18	0.17	0.16	0.15
Xq QUAD. AXIS REACTANCE	1.63	1.50	1.36	1.21	1.88	1.76	1.67	1.59
X"q QUAD. AXIS SUBTRANSIENT	0.23	0.21	0.19	0.17	0.27	0.25	0.24	0.23
X_L LEAKAGE REACTANCE	0.08	0.07	0.06	0.06	0.09	0.08	0.08	0.07
X_2 NEGATIVE SEQUENCE	0.22	0.20	0.18	0.16	0.26	0.24	0.23	0.22
X_0 ZERO SEQUENCE	0.02	0.02	0.02	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.	3.4							
Ta ARMATURE TIME CONST.	0.049							
SHORT CIRCUIT RATIO	1/Xd							

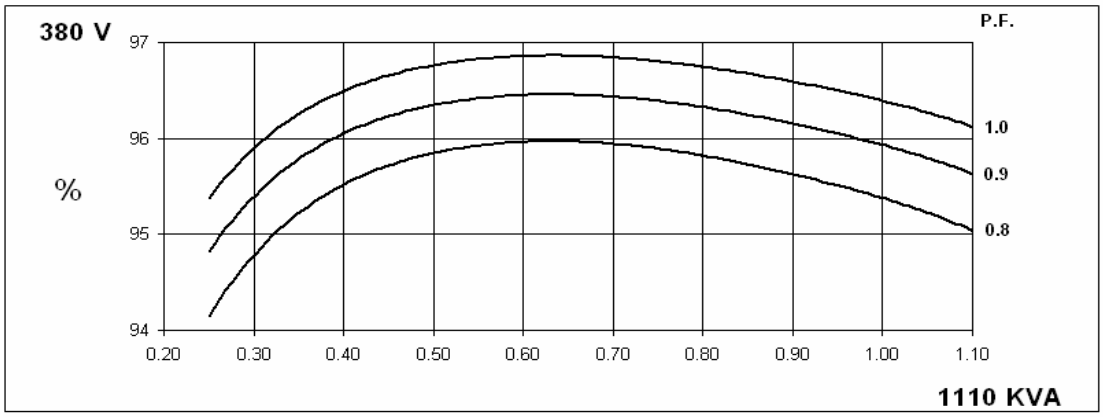
(*) Parallel Star connection only available with Wdg 311

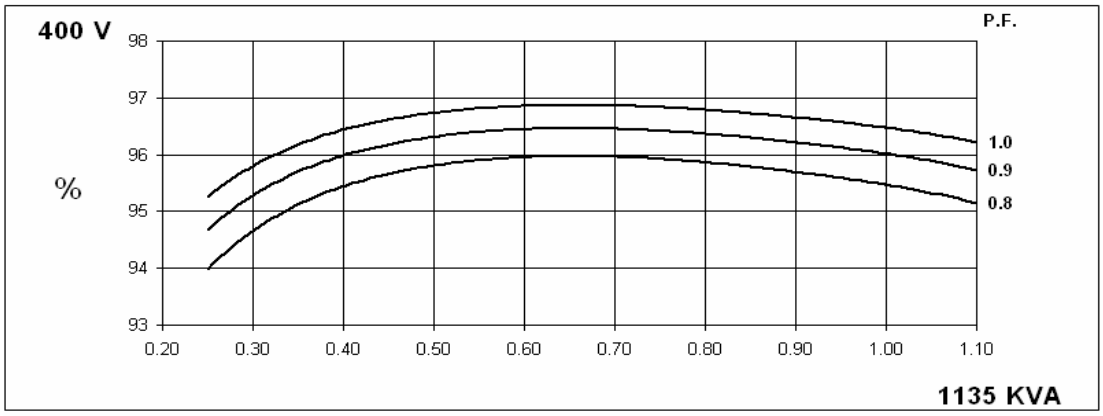
50 Hz

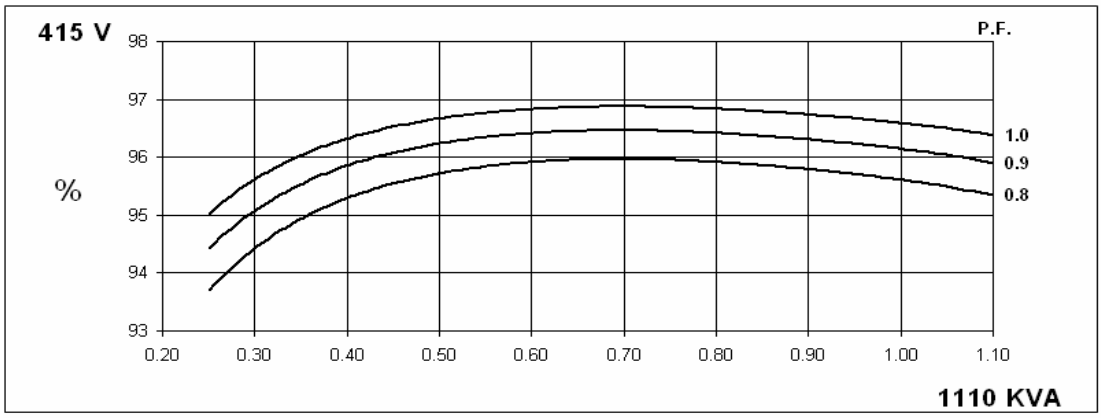
HCI634K

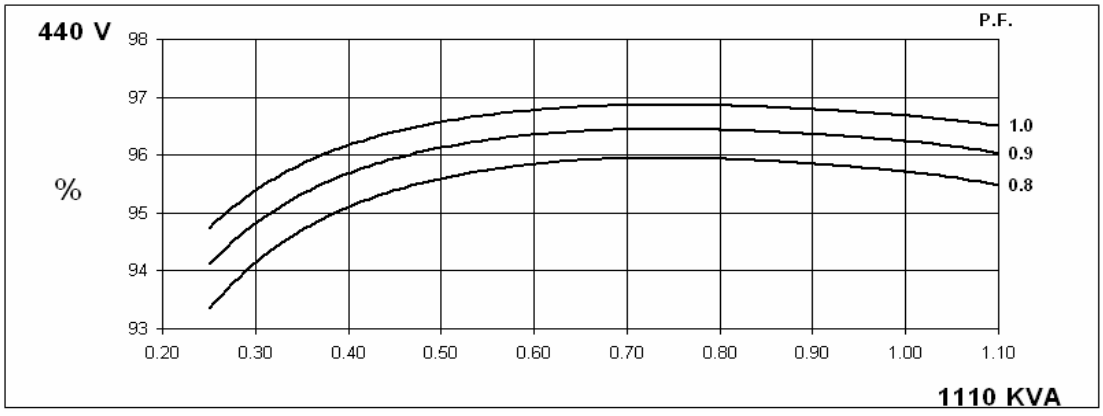
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES







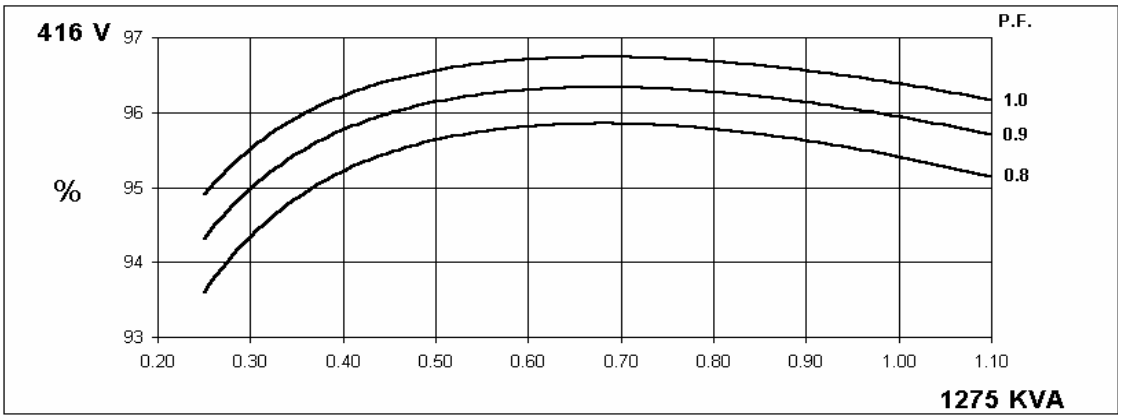


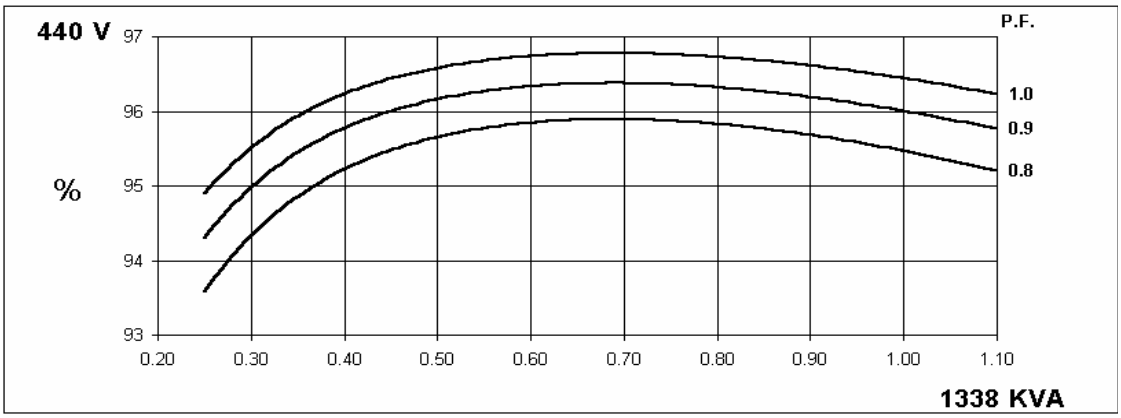
60 Hz

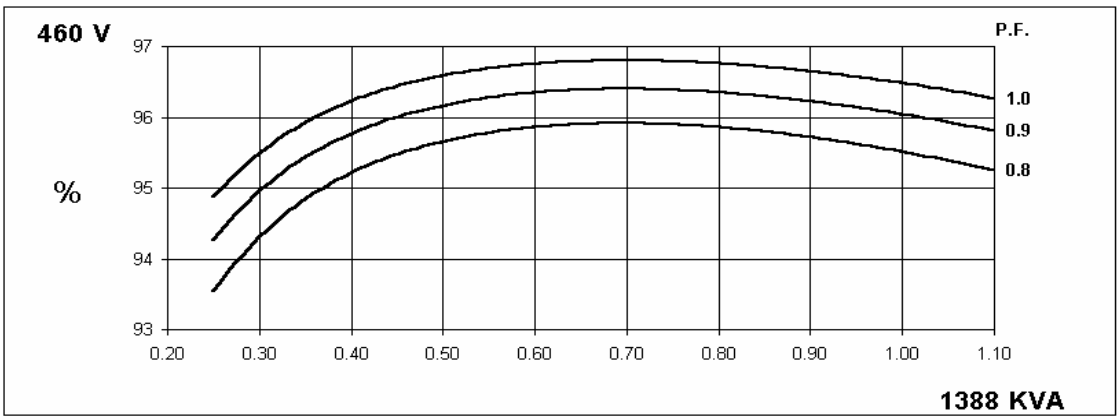
HCI634K

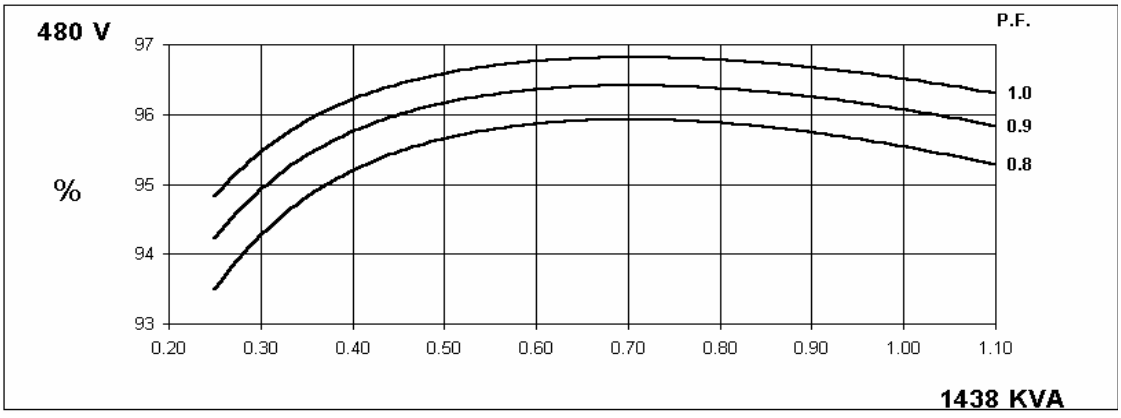
WINDING 311 and 312

THREE PHASE EFFICIENCY CURVES

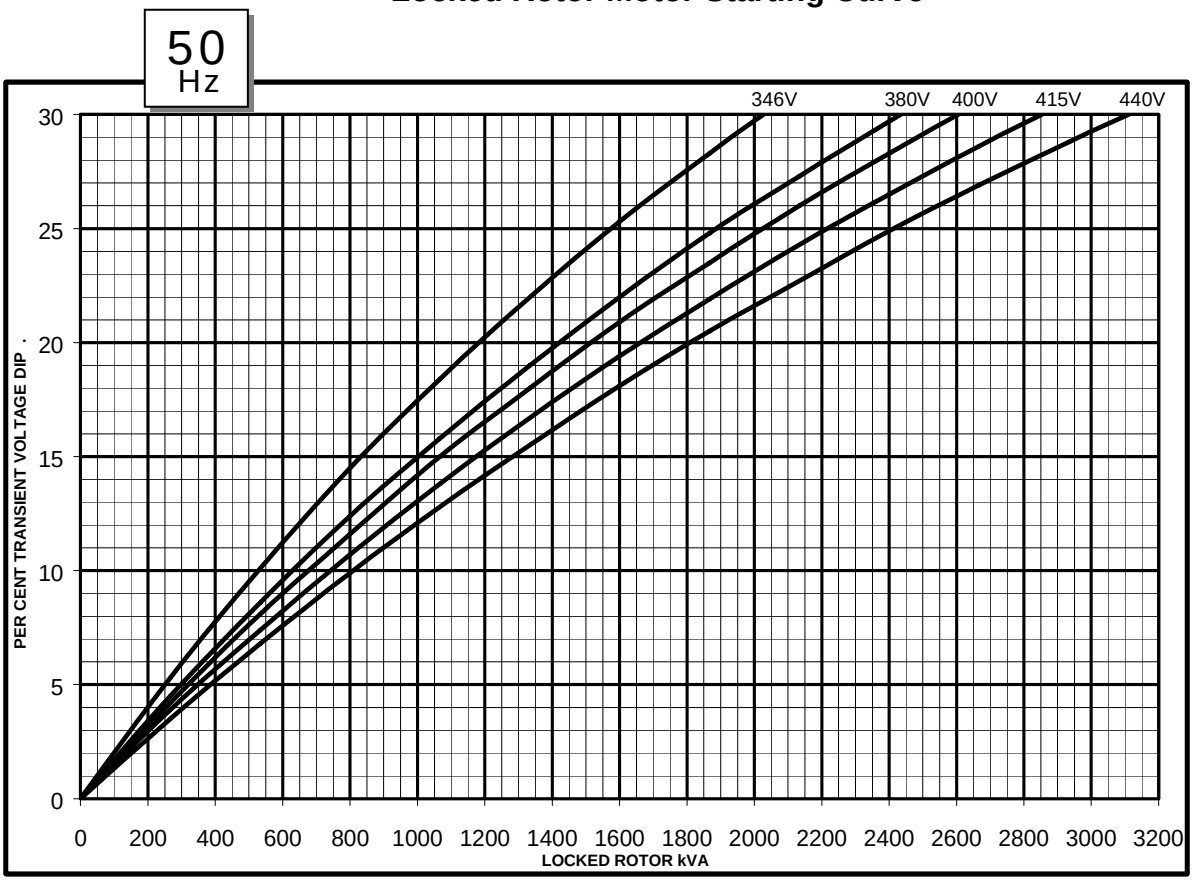


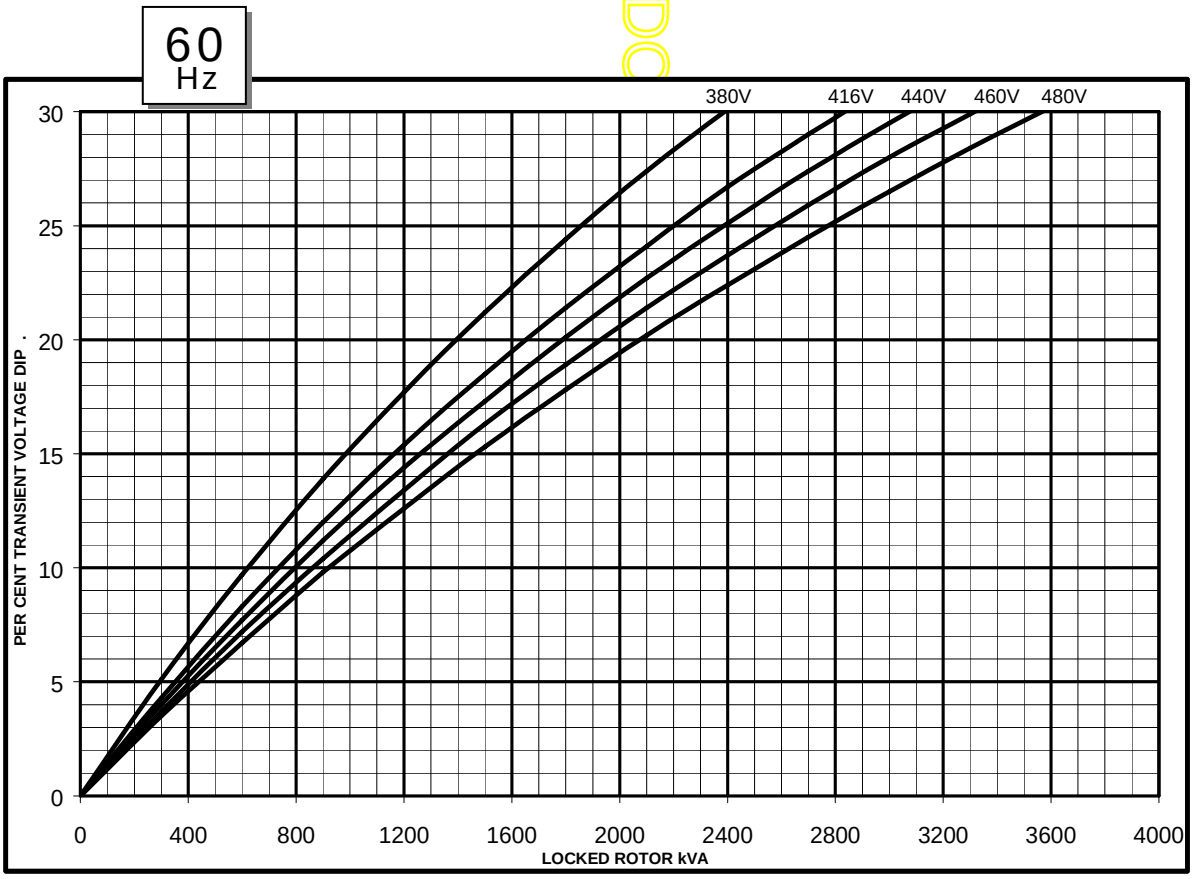






Locked Rotor Motor Starting Curve



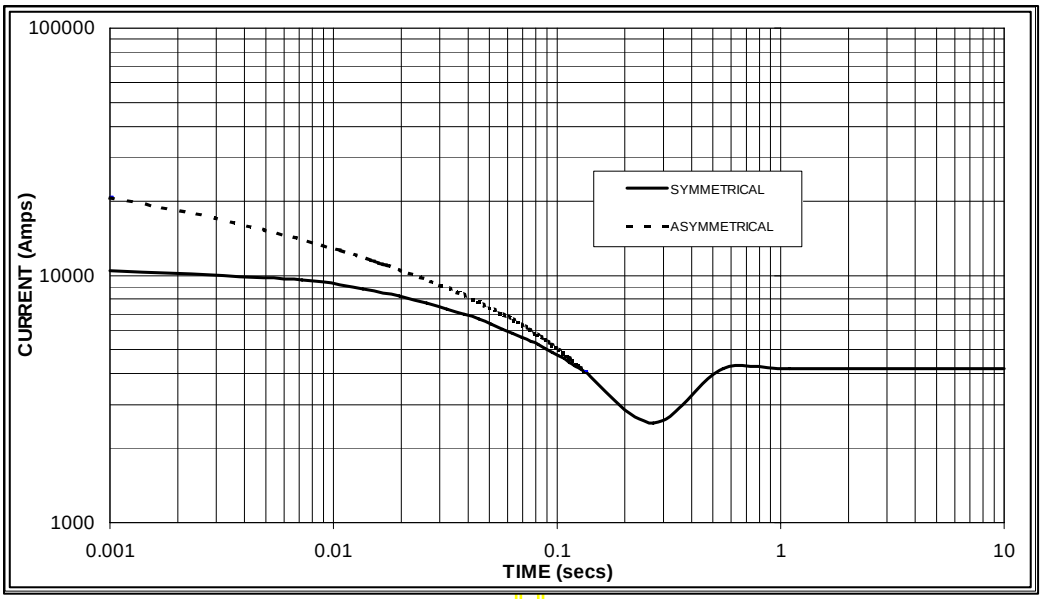


WINDING 311 and 312

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

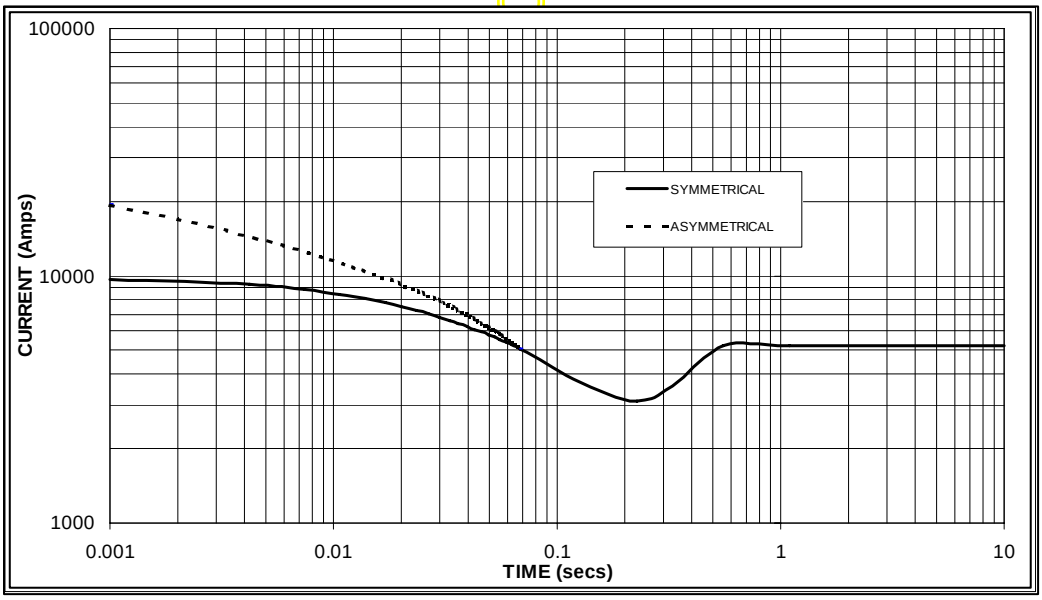
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 4,200 Amps

60 Hz



Sustained Short Circuit = 5,200 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

HCI634K

STAMFORD

Winding 311 and 312 0.8 Power Factor

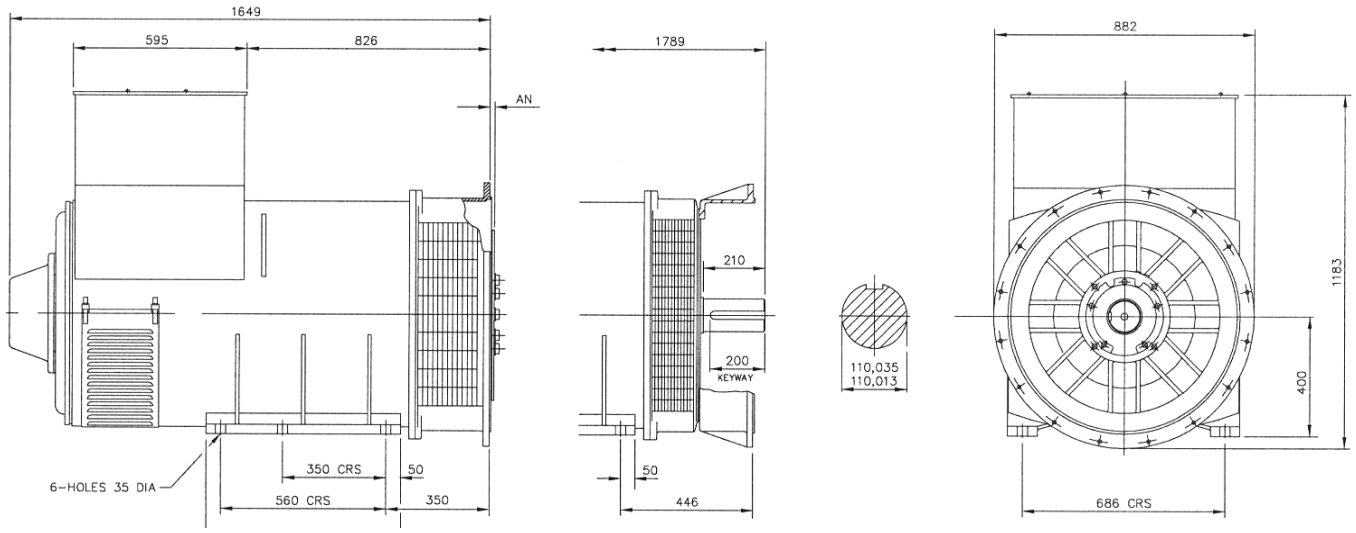
RATINGS

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	1000	1018	1000	1000	1110	1135	1110	1110	1180	1190	1180	1180	1220	1230	1220	1220
	kW	800	814	800	800	888	904	888	888	944	952	944	944	976	984	976	976
	Efficiency (%)	95.6	95.7	95.8	95.9	95.4	95.5	95.6	95.7	95.2	95.3	95.5	95.6	95.1	95.2	95.4	95.5
	kW Input	837	851	835	834	931	951	929	928	992	999	988	987	1026	1034	1023	1022

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	1188	1238	1275	1313	1275	1338	1388	1438	1350	1413	1469	1525	1400	1463	1519	1575
	kW	950	990	1020	1050	1020	1070	1110	1150	1080	1130	1175	1220	1120	1170	1215	1260
	Efficiency (%)	95.6	95.6	95.7	95.7	95.4	95.5	95.5	95.5	95.3	95.3	95.4	95.4	95.1	95.2	95.3	95.3
	kW Input	994	1036	1066	1098	1069	1121	1163	1205	1133	1186	1232	1279	1178	1229	1275	1322

* Parallel Star only available with Wdg 311

DIMENSIONS



SAE	14	18	21	24
AN	25.4	15.87	0	0

APPROVED DOCUMENT

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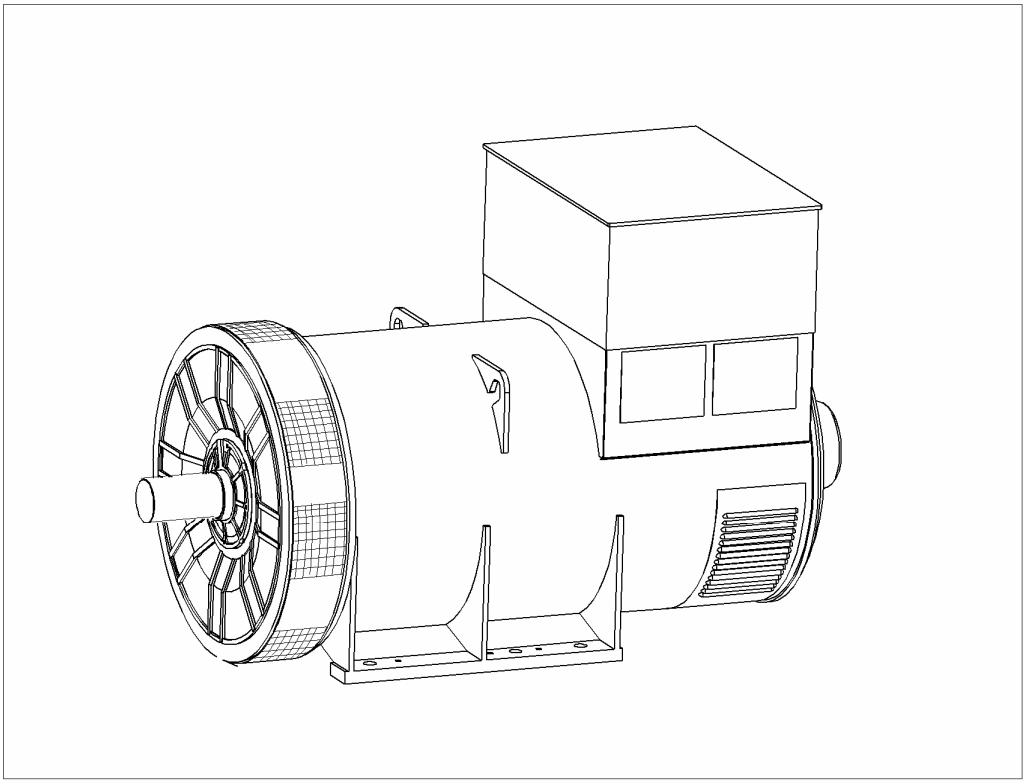
STAMFORD®

PI734A - Winding 312

Technical Data Sheet



SPECIFICATIONS & OPTIONS

STANDARDS
Stamford industrial generators meet the requirements of BS EN 60034 and the relevant sections of other national and international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC60034, CSA C22.2-100, AS1359.
Other standards and certifications can be considered on request.

DESCRIPTION
The STAMFORD PI range of synchronous ac generators are brushless with a rotating field. They are separately excited by the STAMFORD Permanent Magnet Generator (PMG). This is a shaft mounted, high frequency, pilot exciter which provides a constant supply of clean power via the Automatic Voltage Regulator (AVR) to the main exciter. The main exciter output is fed to the main rotor, through a full wave bridge rectifier, protected by surge suppression.

VOLTAGE REGULATORS
The PI range generators, complete with a PMG, are available with one of two AVRs. Each AVR has soft start voltage build up and built in protection against sustained over-excitation, which will de-excite the generator after a minimum of 8 seconds.
Underspeed protection (UFRO) is also provided on both AVRs. The UFRO will reduce the generator output voltage proportional to the speed of the generator below a pre-settable level.

The **MX341 AVR** is two phase sensed with a voltage regulation of ± 1 %. (see the note on regulation).

The **MX321 AVR** is 3 phase rms sensed with a voltage regulation of 0.5% rms (see the note on regulation). The UFRO circuit has adjustable slope and dwell for controlled recovery from step loads. An over voltage protection circuit will shutdown the output device of the AVR, it can also trip an optional excitation circuit breaker if required. As an option, short circuit current limiting is available with the addition of current transformers.

Both the MX341 and the MX321 need a generator mounted current transformer to provide quadrature droop characteristics for load sharing during parallel operation. Provision is also made for the connection of the STAMFORD power factor controller, for embedded applications, and a remote voltage trimmer.

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. 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 levels of voltage waveform distortion.

TERMINALS & TERMINAL BOX
Standard generators feature a main stator with 6 ends 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', and meets the requirements of UL1446.
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.

NOTE ON REGULATION
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 temperature exceeding 60°C must be referred to the factory.

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

Front cover drawing is typical of the product range.

PI734A

STAMFORD

WINDING 312

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX341	MX321	
VOLTAGE REGULATION	± 1%	± 0.5 %	With 4% ENGINE GOVERNING
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVES (page 7)		

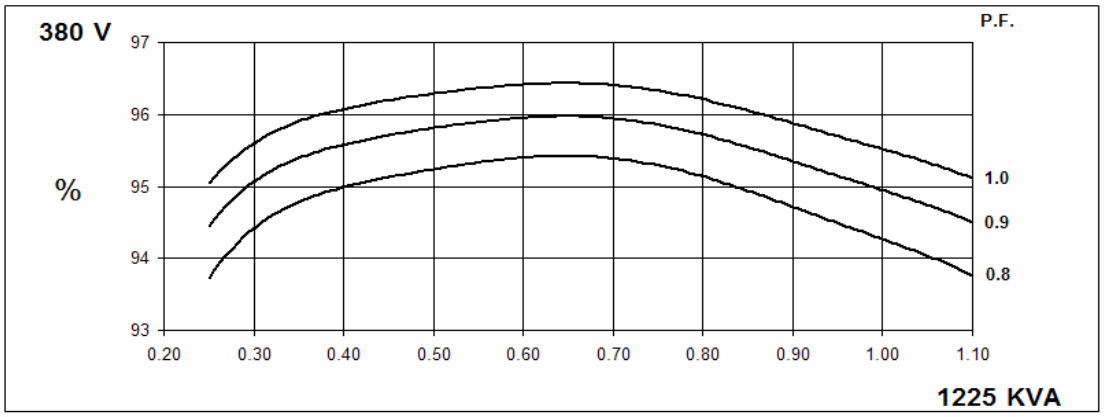
INSULATION SYSTEM	CLASS H							
PROTECTION	IP23							
RATED POWER FACTOR	0.8							
STATOR WINDING	DOUBLE LAYER LAP							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	6							
MAIN STATOR RESISTANCE	0.0016 Ohms PER PHASE AT 22°C STAR CONNECTED							
MAIN ROTOR RESISTANCE	1.67 Ohms at 22°C							
EXCITER STATOR RESISTANCE	17.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.063 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. 6228 C3							
BEARING NON-DRIVE END	BALL. 6319 C3							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	2760 kg				2710 kg			
WEIGHT WOUND STATOR	1306 kg				1306 kg			
WEIGHT WOUND ROTOR	1139 kg				1077 kg			
WR² INERTIA	32.7498 kgm^2				31.7489 kgm^2			
SHIPPING WEIGHTS in a crate	2833kg				2779kg			
PACKING CRATE SIZE	194 x 105 x 154(cm)				194 x 105 x 154(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	2.69 m³/sec 5700 cfm				3.45 m³/sec 7300 cfm			
VOLTAGE STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
kVA BASE RATING FOR REACTANCE VALUES	1225	1260	1260	1235	1375	1500	1510	1525
Xd DIR. AXIS SYNCHRONOUS	3.51	3.26	3.02	2.64	4.24	4.14	3.81	3.53
X'd DIR. AXIS TRANSIENT	0.21	0.20	0.18	0.16	0.26	0.25	0.23	0.22
X"d DIR. AXIS SUBTRANSIENT	0.16	0.15	0.14	0.12	0.19	0.19	0.17	0.16
Xq QUAD. AXIS REACTANCE	2.26	2.10	1.95	1.70	2.74	2.67	2.46	2.28
X"q QUAD. AXIS SUBTRANSIENT	0.32	0.29	0.27	0.24	0.38	0.37	0.34	0.32
X_L LEAKAGE REACTANCE	0.04	0.04	0.03	0.03	0.05	0.05	0.04	0.04
X_2 NEGATIVE SEQUENCE	0.22	0.21	0.19	0.17	0.27	0.26	0.24	0.23
X_0 ZERO SEQUENCE	0.03	0.03	0.02	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.	0.13s							
T"d SUB-TRANSTIME CONST.	0.01s							
T'do O.C. FIELD TIME CONST.	2.14s							
Ta ARMATURE TIME CONST.	0.02s							
SHORT CIRCUIT RATIO	1/Xd							

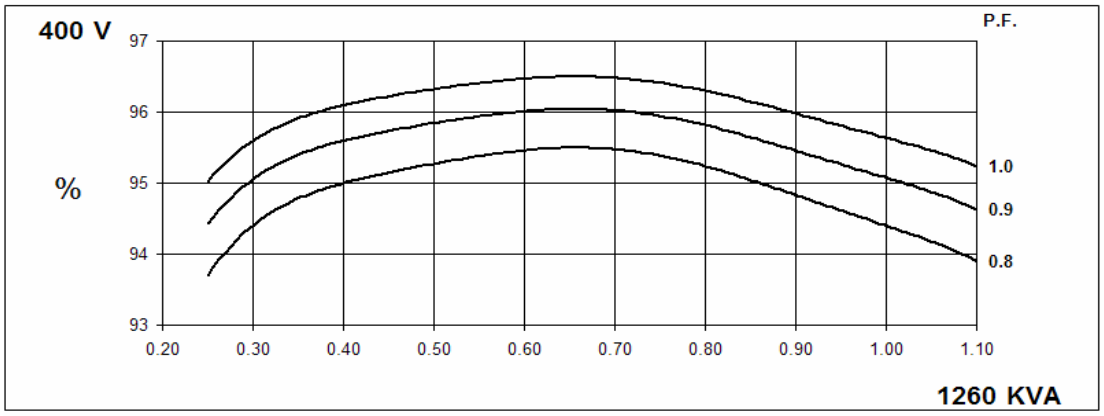
50 Hz

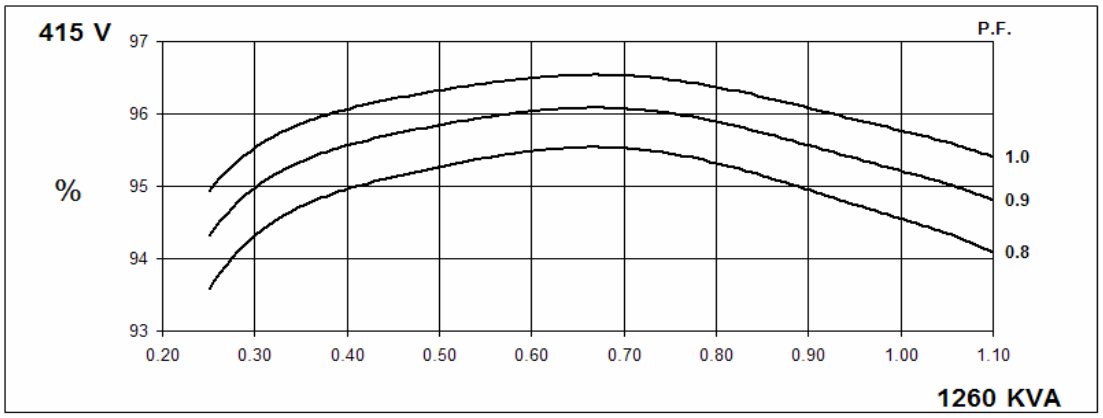
PI734A

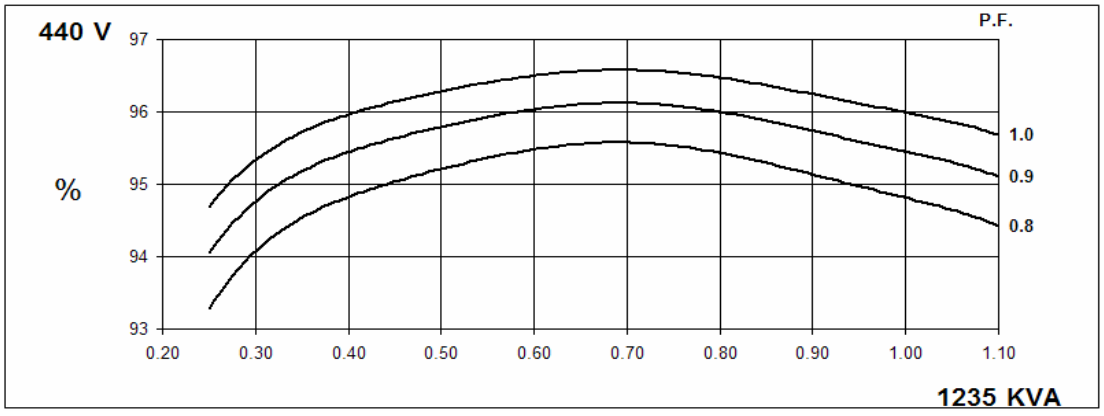
Winding 312

THREE PHASE EFFICIENCY CURVES









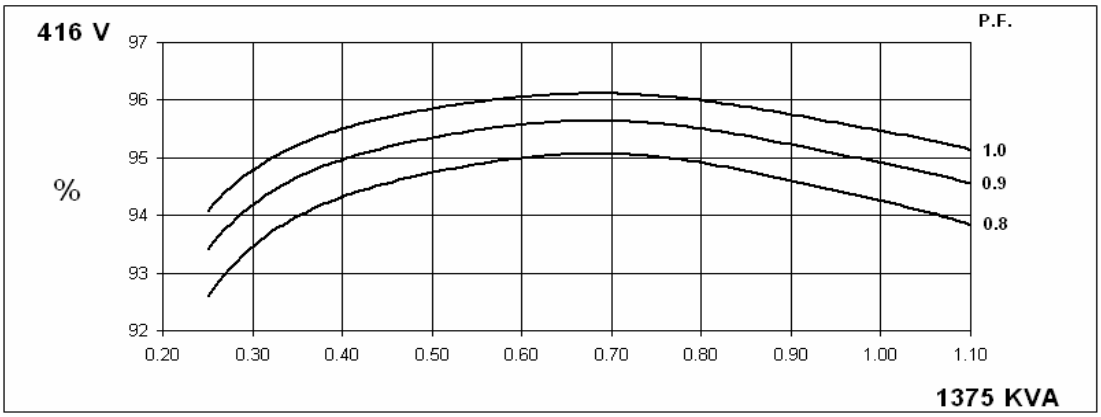
60 Hz

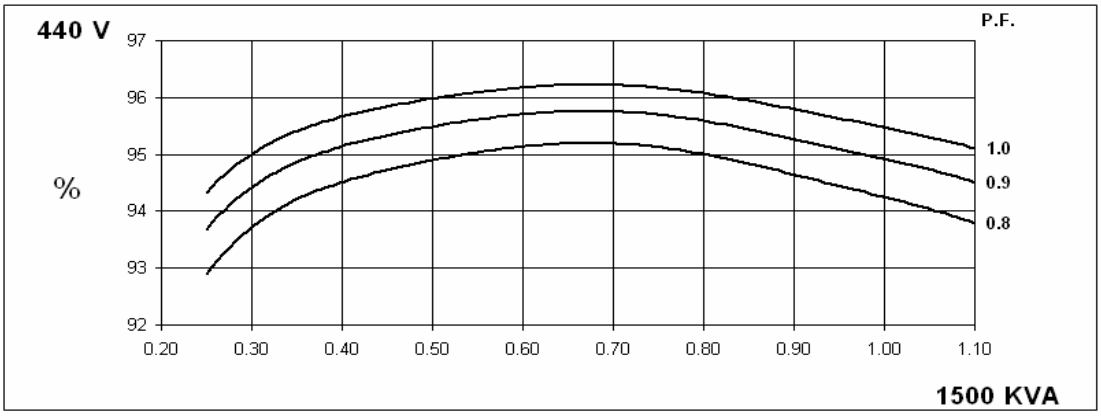
PI734A

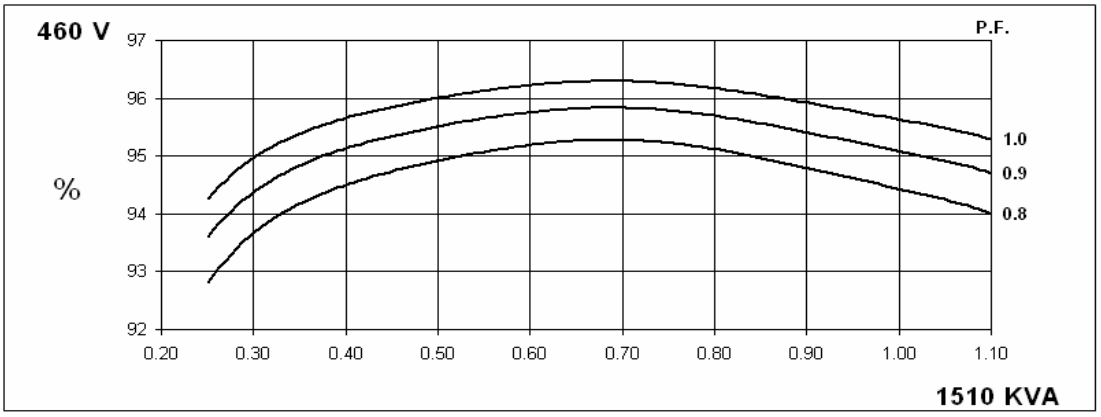
Winding 312

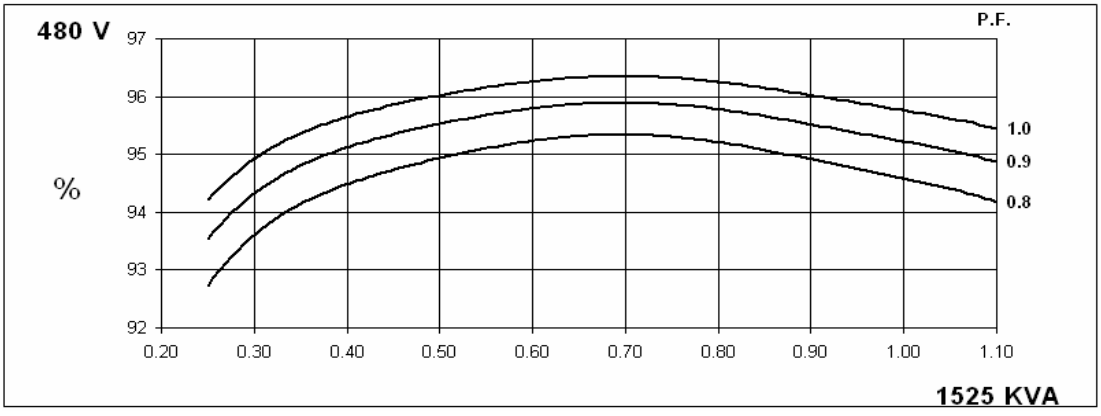
STAMFORD

THREE PHASE EFFICIENCY CURVES





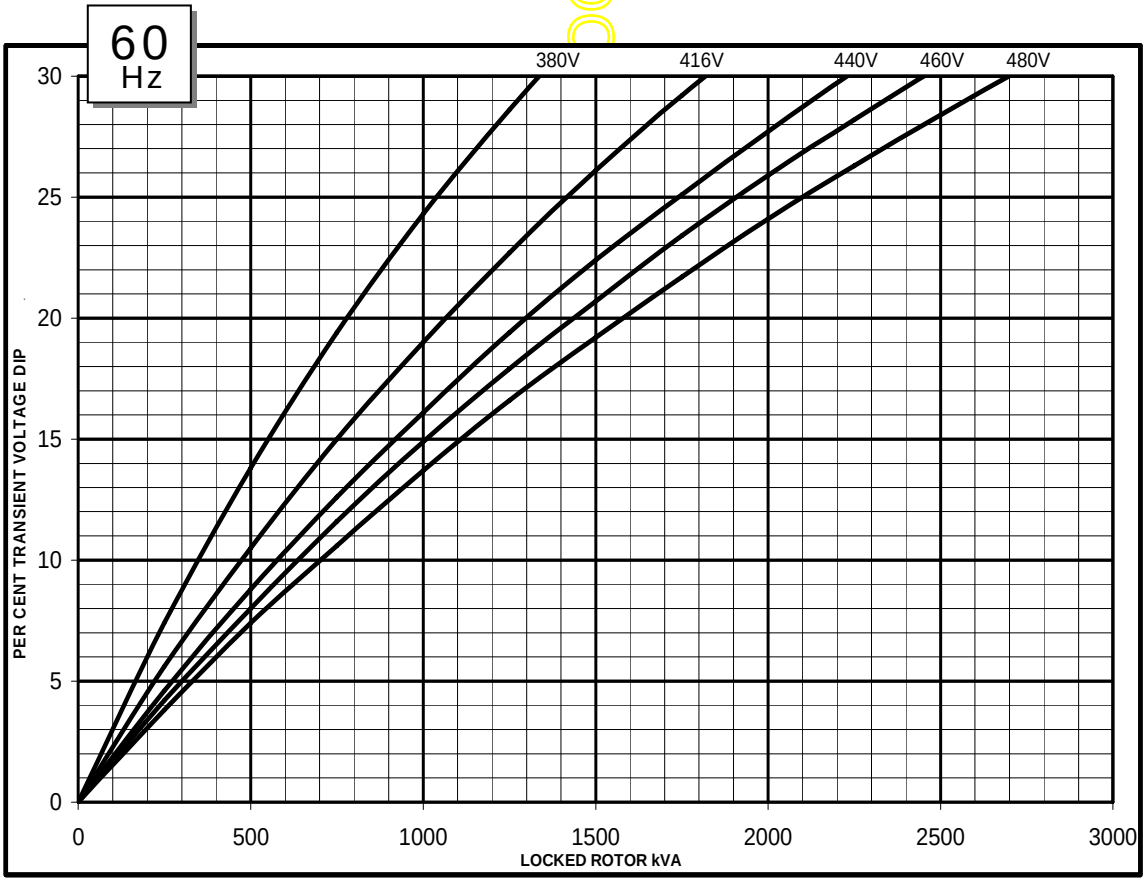




PI734A

Winding 312

Locked Rotor Motor Starting Curve



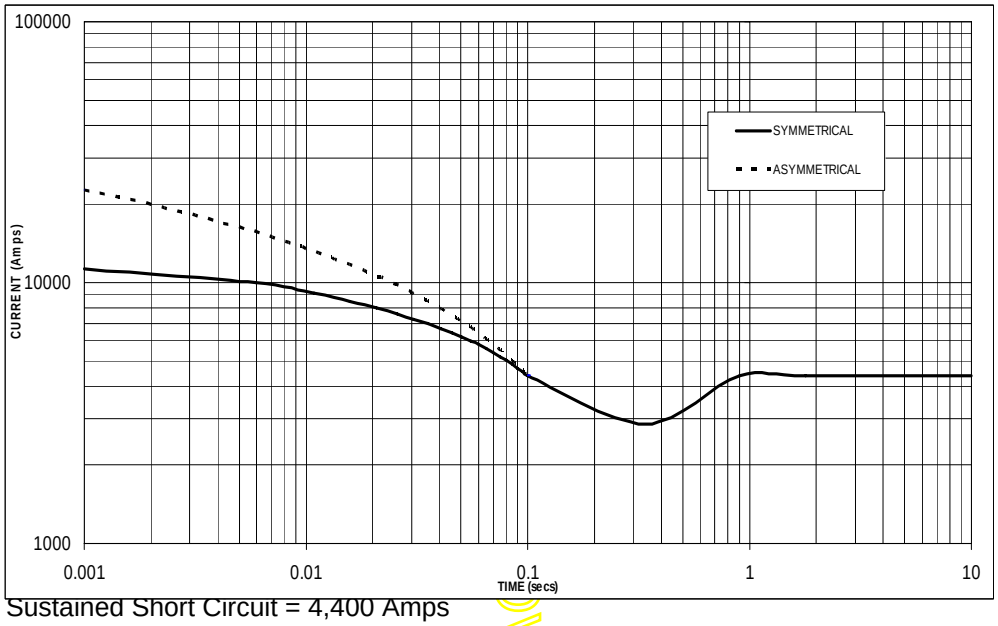
PI734A

Winding 312

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

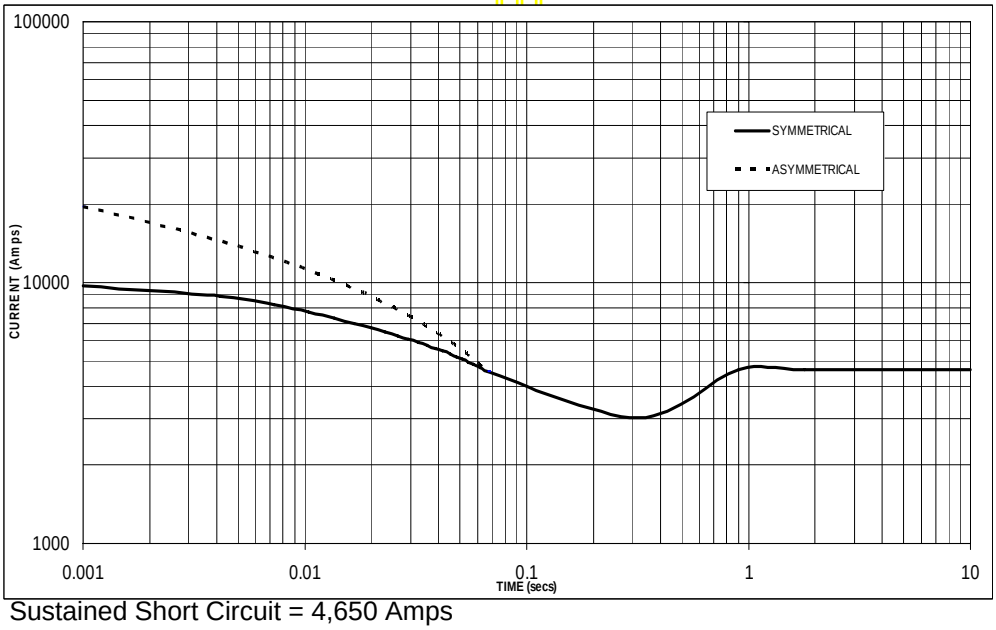
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 4,400 Amps

60 Hz



Sustained Short Circuit = 4,650 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines.

PI734A

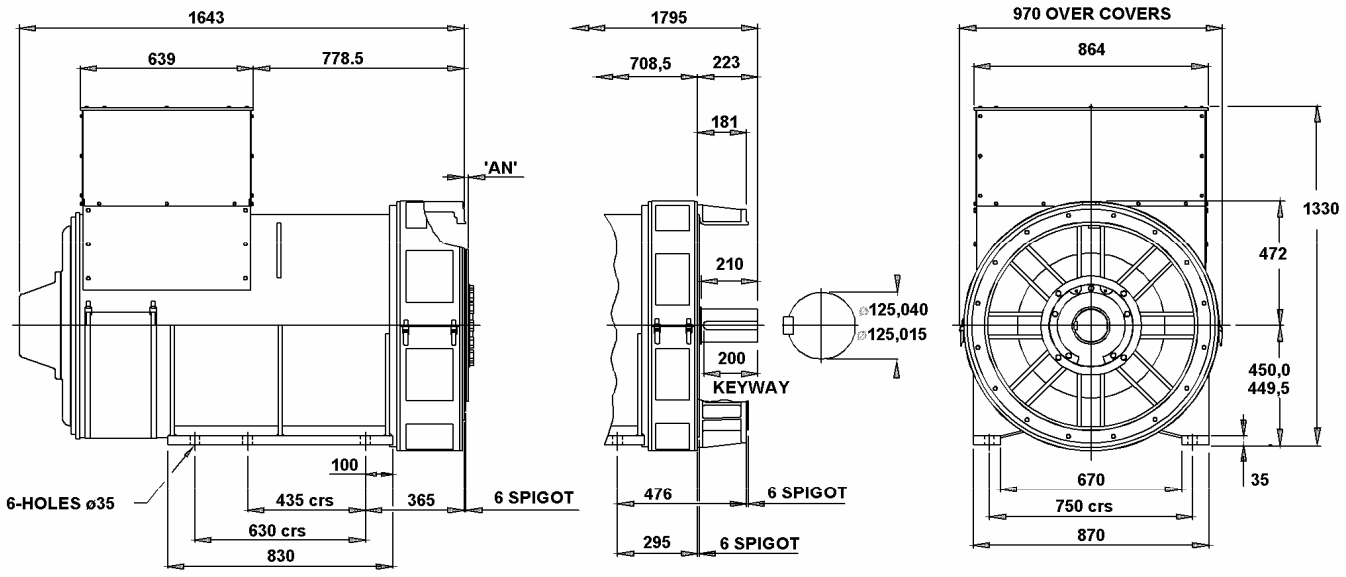
Winding 312 / 0.8 Power Factor

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
	kVA	1140	1175	1175	1150	1225	1260	1260	1235	1275	1315	1315	1290	1310	1350	1350	1325
	kW	912	940	940	920	980	1008	1008	988	1020	1052	1052	1032	1048	1080	1080	1060
	Efficiency (%)	94.5	94.6	94.8	95.0	94.3	94.4	94.6	94.8	94.1	94.2	94.4	94.7	94.0	94.1	94.3	94.6
	kW Input	965	994	992	968	1039	1068	1066	1042	1084	1117	1114	1090	1115	1148	1145	1121

60Hz	Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	kVA	1275	1395	1405	1415	1375	1500	1510	1525	1425	1560	1570	1585	1465	1605	1615	1630
	kW	1020	1116	1124	1132	1100	1200	1208	1220	1140	1248	1256	1268	1172	1284	1292	1304
	Efficiency (%)	94.5	94.5	94.6	94.8	94.3	94.2	94.4	94.6	94.1	94.1	94.3	94.5	94.0	94.0	94.2	94.4
	kW Input	1079	1181	1188	1194	1167	1274	1280	1290	1211	1326	1332	1342	1247	1366	1372	1381

DIMENSIONS



COUPLING DISC	'AN'
S.A.E No 18	15,7
S.A.E No 21	0
S.A.E No 24	0

1-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

2-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

APPROVED DOCUMENT

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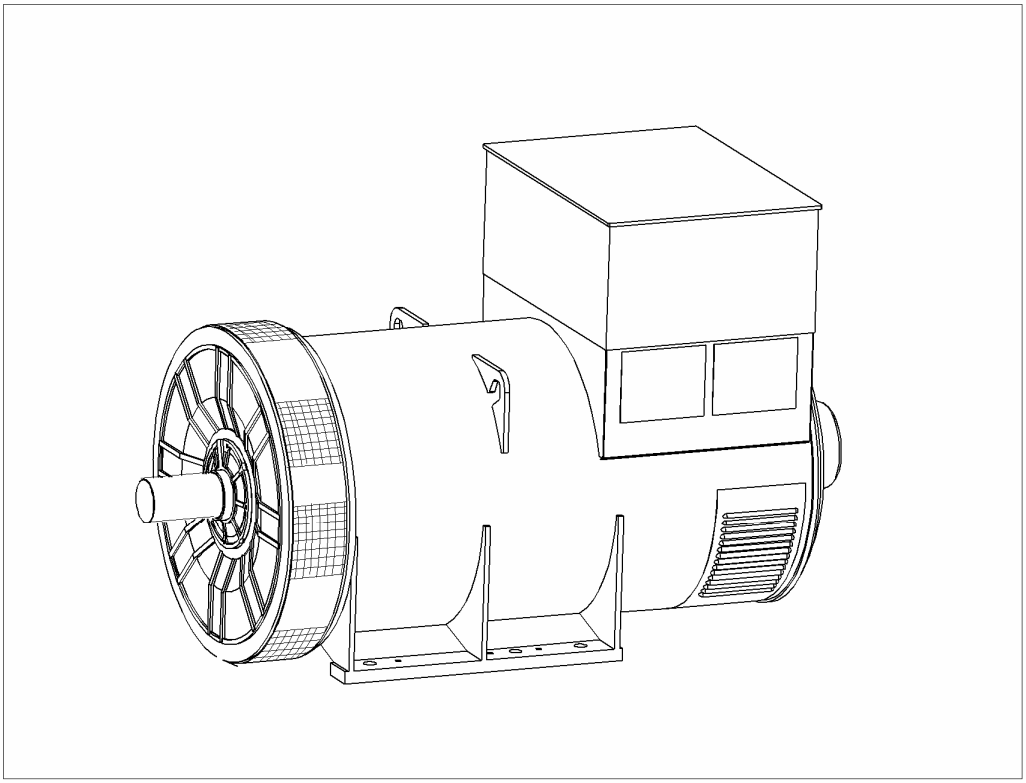
STAMFORD®

PI734B - Winding 312

Technical Data Sheet



SPECIFICATIONS & OPTIONS

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Underspeed protection (UFRO) is also provided on both AVRs. The UFRO will reduce the generator output voltage proportional to the speed of the generator below a pre-settable level.

The **MX341 AVR** is two phase sensed with a voltage regulation of ± 1 %. (see the note on regulation).

The **MX321 AVR** is 3 phase rms sensed with a voltage regulation of 0.5% rms (see the note on regulation). The UFRO circuit has adjustable slope and dwell for controlled recovery from step loads. An over voltage protection circuit will shutdown the output device of the AVR, it can also trip an optional excitation circuit breaker if required. As an option, short circuit current limiting is available with the addition of current transformers.

Both the MX341 and the MX321 need a generator mounted current transformer to provide quadrature droop characteristics for load sharing during parallel operation. Provision is also made for the connection of the STAMFORD power factor controller, for embedded applications, and a remote voltage trimmer.

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. 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 levels of voltage waveform distortion.

TERMINALS & TERMINAL BOX
Standard generators feature a main stator with 6 ends 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.

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The insulation system is class 'H', and meets the requirements of UL1446.
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Generators are manufactured using production procedures having a quality assurance level to BS EN ISO 9001.

NOTE ON REGULATION
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 temperature exceeding 60°C must be referred to the factory.

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

Front cover drawing is typical of the product range.

PI734B

STAMFORD

WINDING 312

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX341	MX321	
VOLTAGE REGULATION	± 1%	± 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							
MAIN STATOR RESISTANCE	0.0016 Ohms PER PHASE AT 22°C STAR CONNECTED							
MAIN ROTOR RESISTANCE	1.67 Ohms at 22°C							
EXCITER STATOR RESISTANCE	17.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.063 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. 6228 C3							
BEARING NON-DRIVE END	BALL. 6319 C3							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	2760 kg				2710 kg			
WEIGHT WOUND STATOR	1306 kg				1306 kg			
WEIGHT WOUND ROTOR	1139 kg				1077 kg			
WR² INERTIA	32.7498 kgm^2				31.7489 kgm^2			
SHIPPING WEIGHTS in a crate	2833kg				2779kg			
PACKING CRATE SIZE	194 x 105 x 154(cm)				194 x 105 x 154(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	2.69 m³/sec 5700 cfm				3.45 m³/sec 7300 cfm			
VOLTAGE STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
kVA BASE RATING FOR REACTANCE VALUES	1360	1400	1400	1375	1525	1625	1655	1690
Xd DIR. AXIS SYNCHRONOUS	3.50	3.26	3.02	2.64	4.25	4.04	3.77	3.53
X'd DIR. AXIS TRANSIENT	0.21	0.20	0.18	0.16	0.26	0.25	0.23	0.22
X"d DIR. AXIS SUBTRANSIENT	0.16	0.15	0.14	0.12	0.19	0.18	0.17	0.16
Xq QUAD. AXIS REACTANCE	2.26	2.10	1.95	1.70	2.74	2.61	2.43	2.28
X"q QUAD. AXIS SUBTRANSIENT	0.32	0.29	0.27	0.24	0.38	0.37	0.34	0.32
X_L LEAKAGE REACTANCE	0.04	0.04	0.03	0.03	0.05	0.05	0.04	0.04
X_2 NEGATIVE SEQUENCE	0.22	0.21	0.19	0.17	0.27	0.26	0.24	0.23
X_0 ZERO SEQUENCE	0.03	0.03	0.02	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.	0.13s							
T"d SUB-TRANSTIME CONST.	0.01s							
T'do O.C. FIELD TIME CONST.	2.14s							
Ta ARMATURE TIME CONST.	0.02s							
SHORT CIRCUIT RATIO	1/Xd							

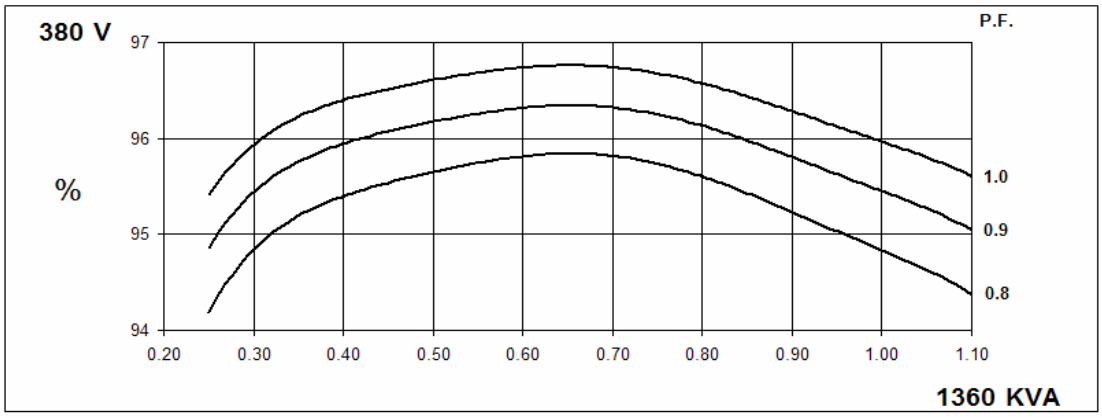
50 Hz

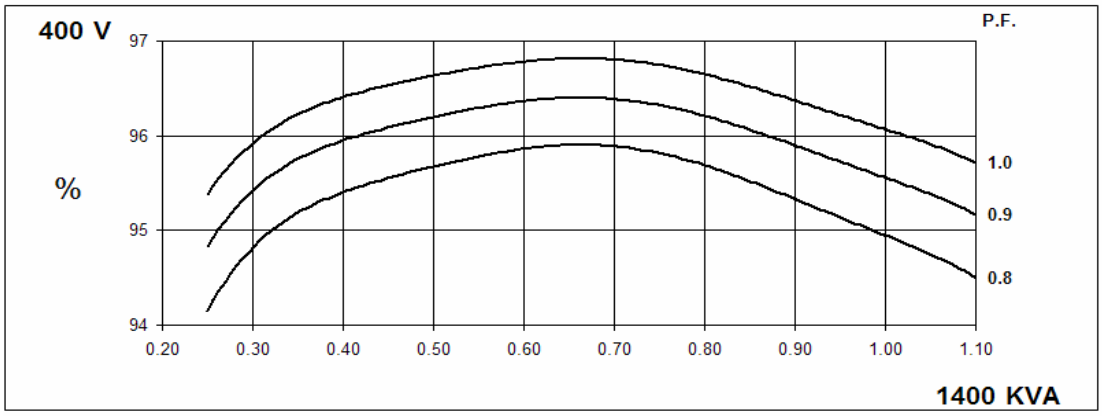
PI734B

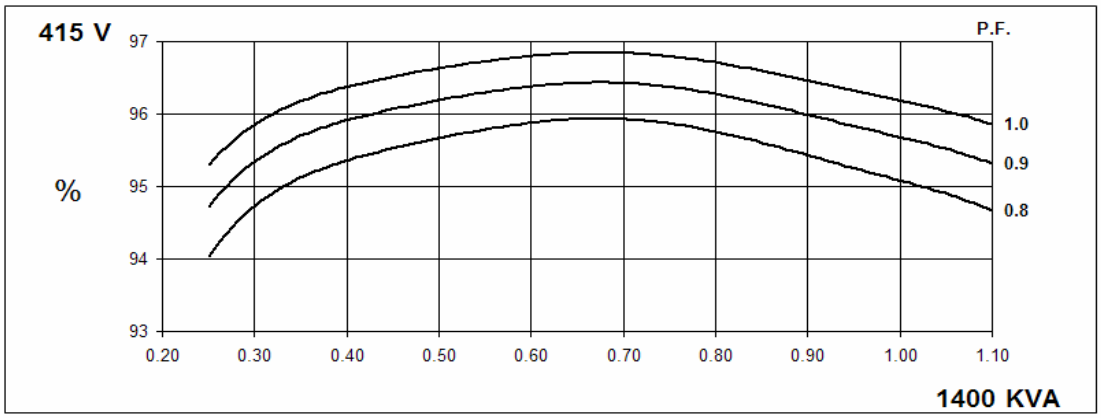
Winding 312

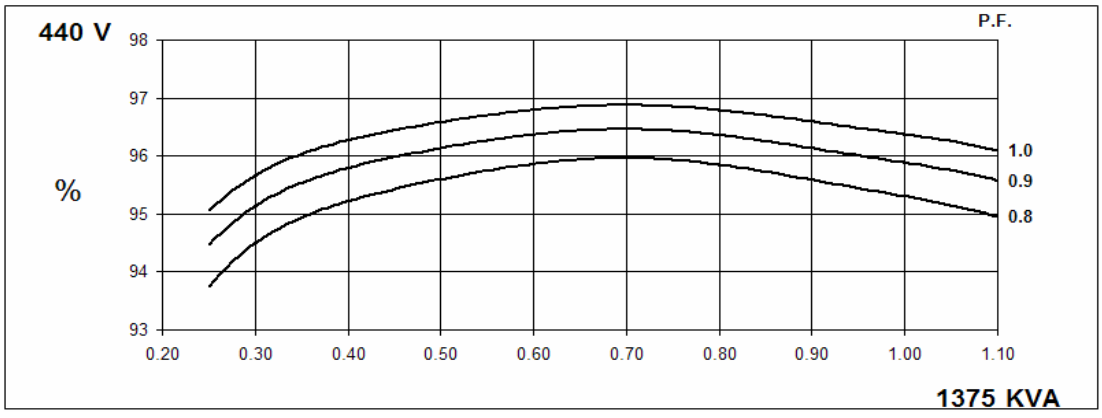
STAMFORD

THREE PHASE EFFICIENCY CURVES









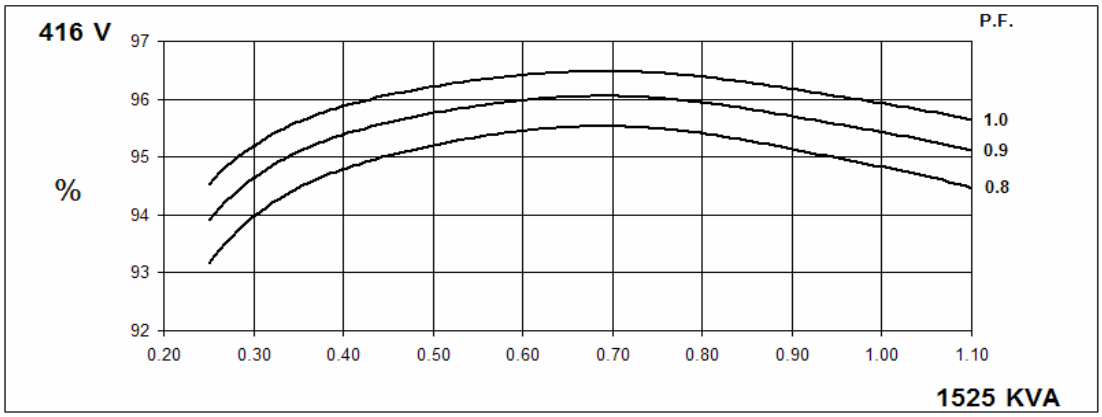
60 Hz

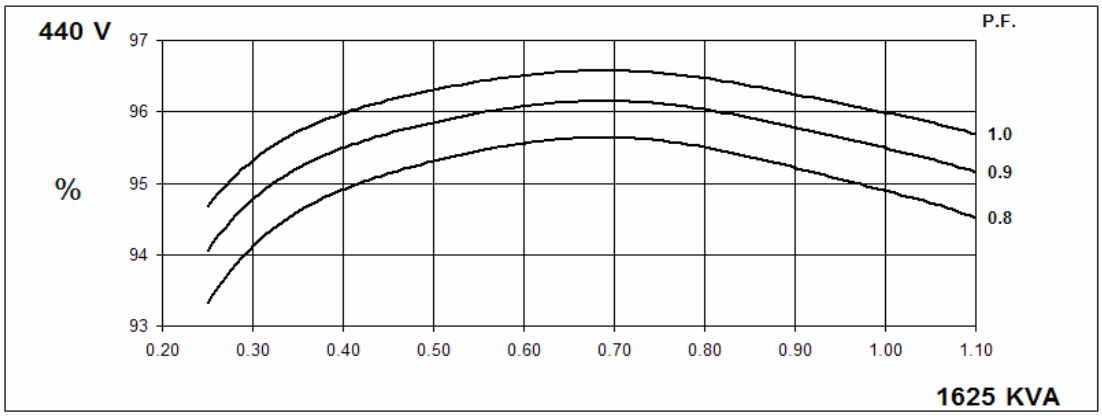
PI734B

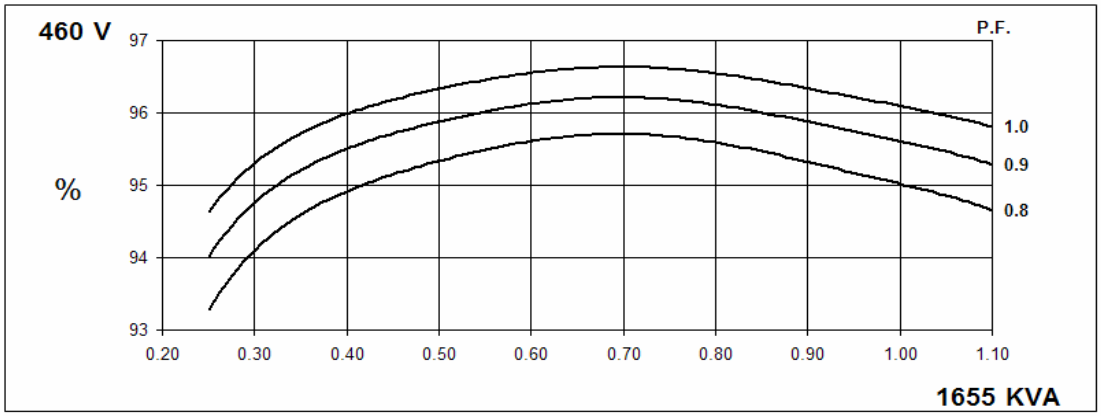
Winding 312

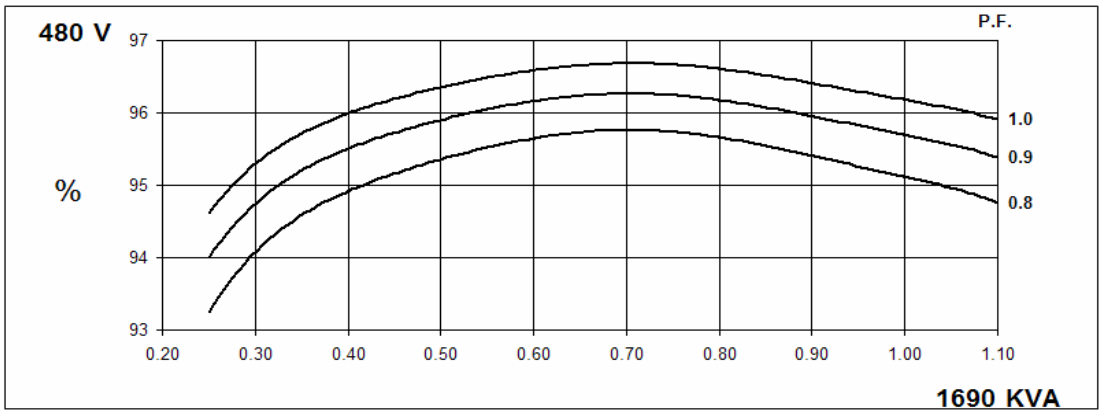
STAMFORD

THREE PHASE EFFICIENCY CURVES





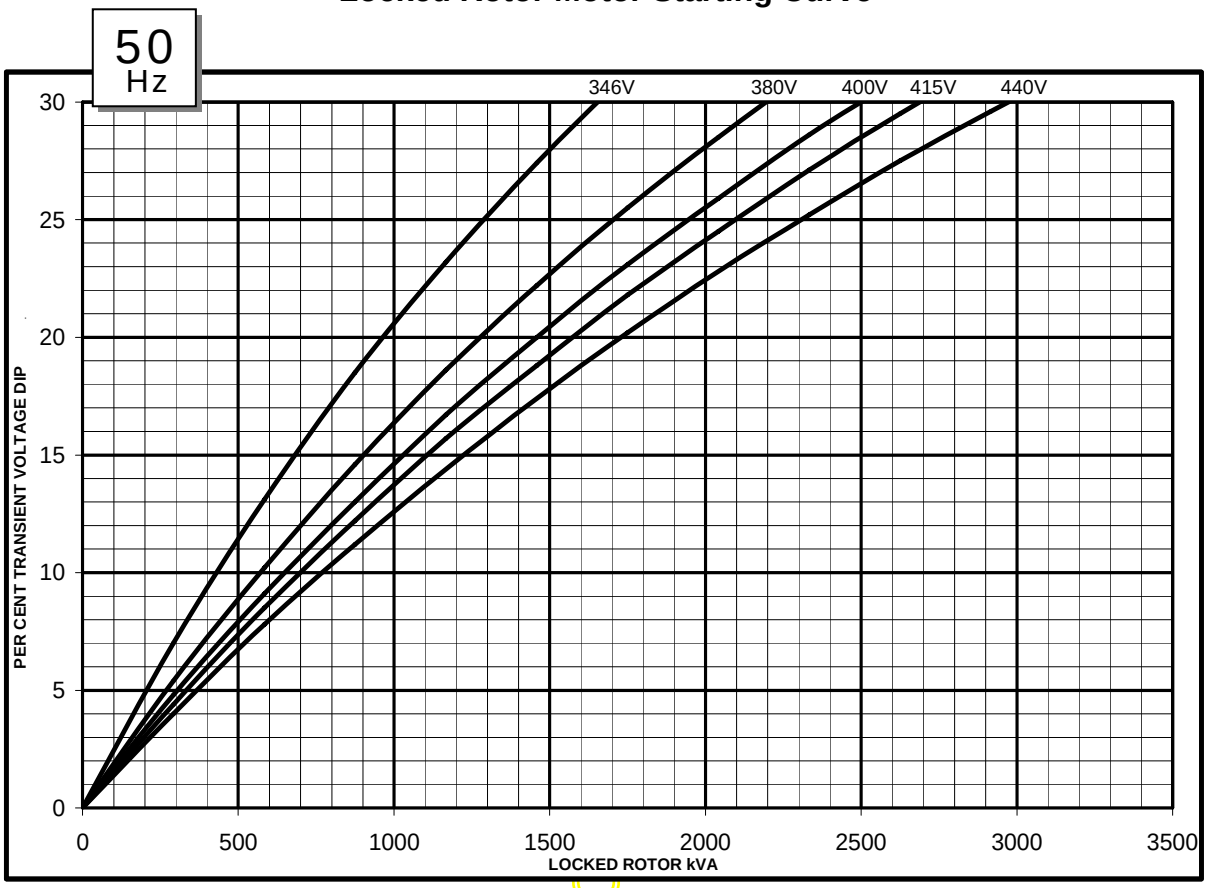


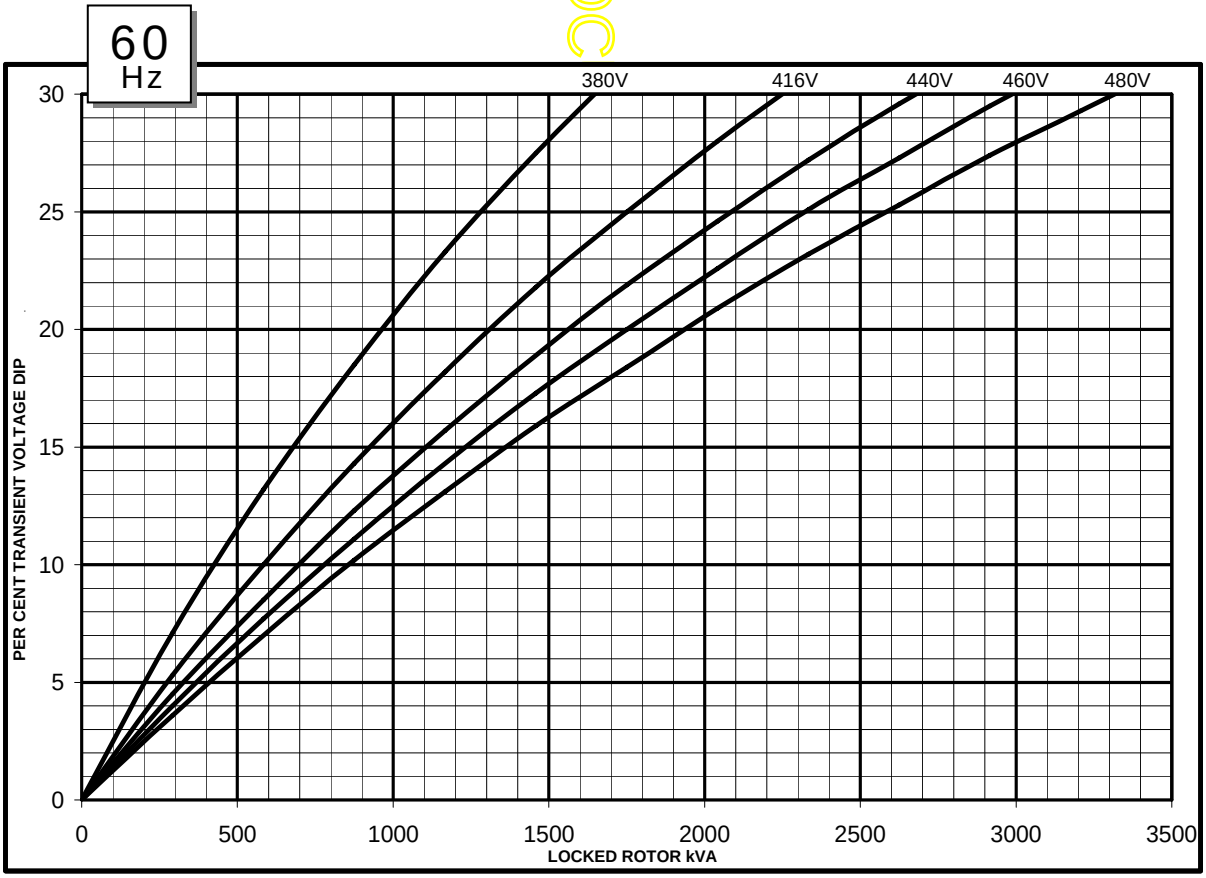


PI734B

Winding 312

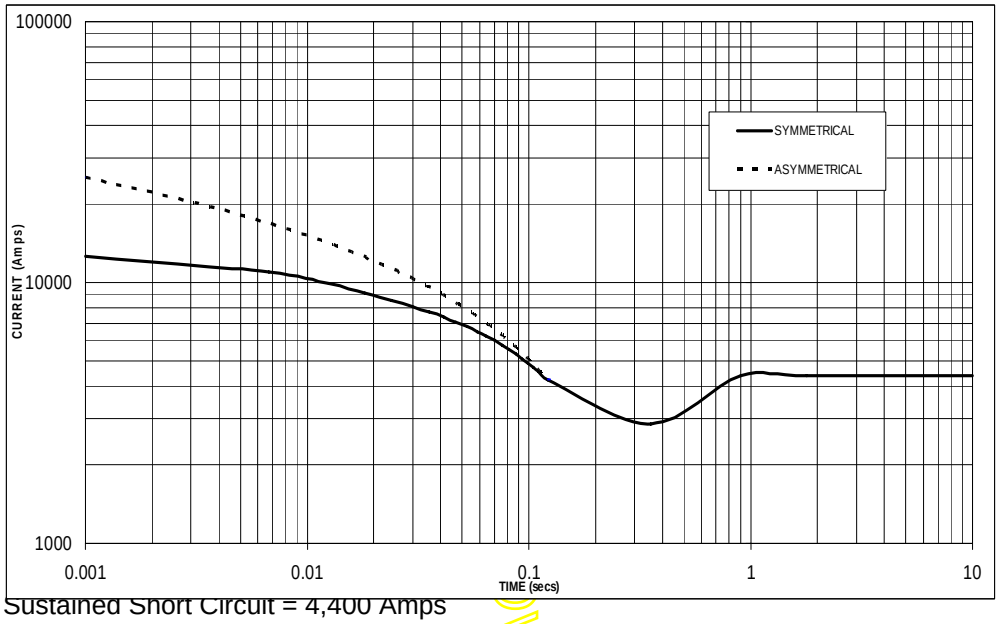
Locked Rotor Motor Starting Curve





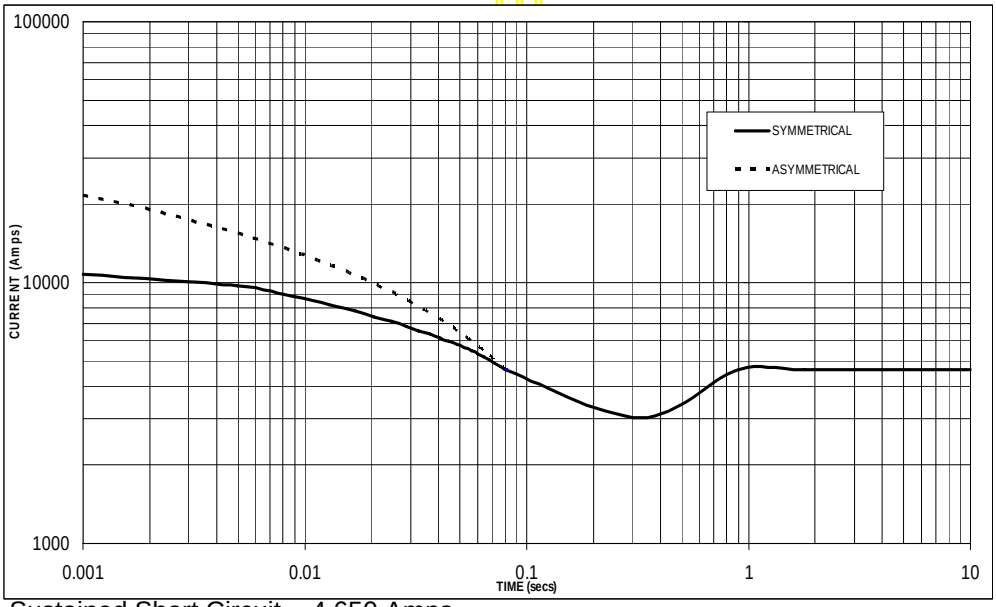
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 4,400 Amps

60 Hz



Sustained Short Circuit = 4,650 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines.

PI734B

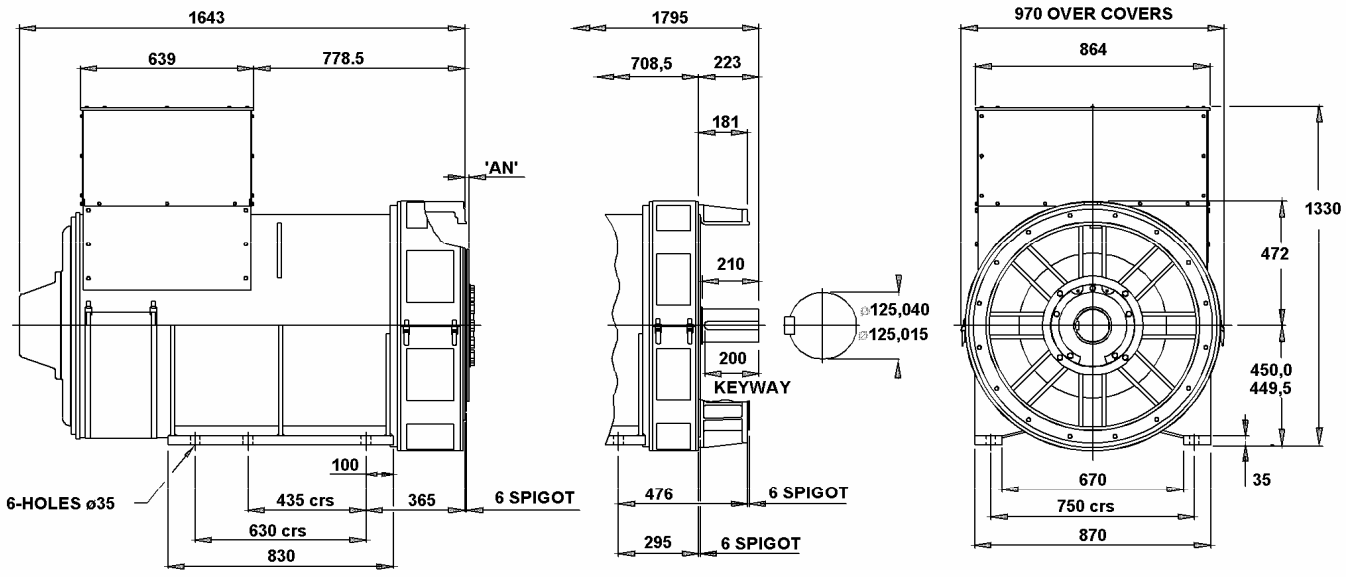
Winding 312 / 0.8 Power Factor

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
	kVA	1265	1305	1305	1280	1360	1400	1400	1375	1415	1460	1460	1430	1455	1500	1500	1470
	kW	1012	1044	1044	1024	1088	1120	1120	1100	1132	1168	1168	1144	1164	1200	1200	1176
	Efficiency (%)	95.1	95.2	95.3	95.5	94.8	94.9	95.1	95.3	94.7	94.8	94.9	95.2	94.6	94.7	94.9	95.1
	kW Input	1064	1097	1095	1072	1148	1180	1178	1154	1195	1232	1231	1202	1230	1267	1264	1237

60Hz	Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	kVA	1415	1510	1540	1575	1525	1625	1655	1690	1590	1690	1725	1760	1630	1740	1775	1810
	kW	1132	1208	1232	1260	1220	1300	1324	1352	1272	1352	1380	1408	1304	1392	1420	1448
	Efficiency (%)	95.0	95.1	95.2	95.3	94.8	94.9	95.0	95.1	94.7	94.8	94.9	95.0	94.6	94.7	94.8	94.9
	kW Input	1192	1270	1294	1322	1287	1370	1394	1422	1343	1426	1454	1482	1378	1470	1498	1526

DIMENSIONS



COUPLING DISC	'AN'
S.A.E No 18	15,7
S.A.E No 21	0
S.A.E No 24	0

1-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

2-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

APPROVED DOCUMENT

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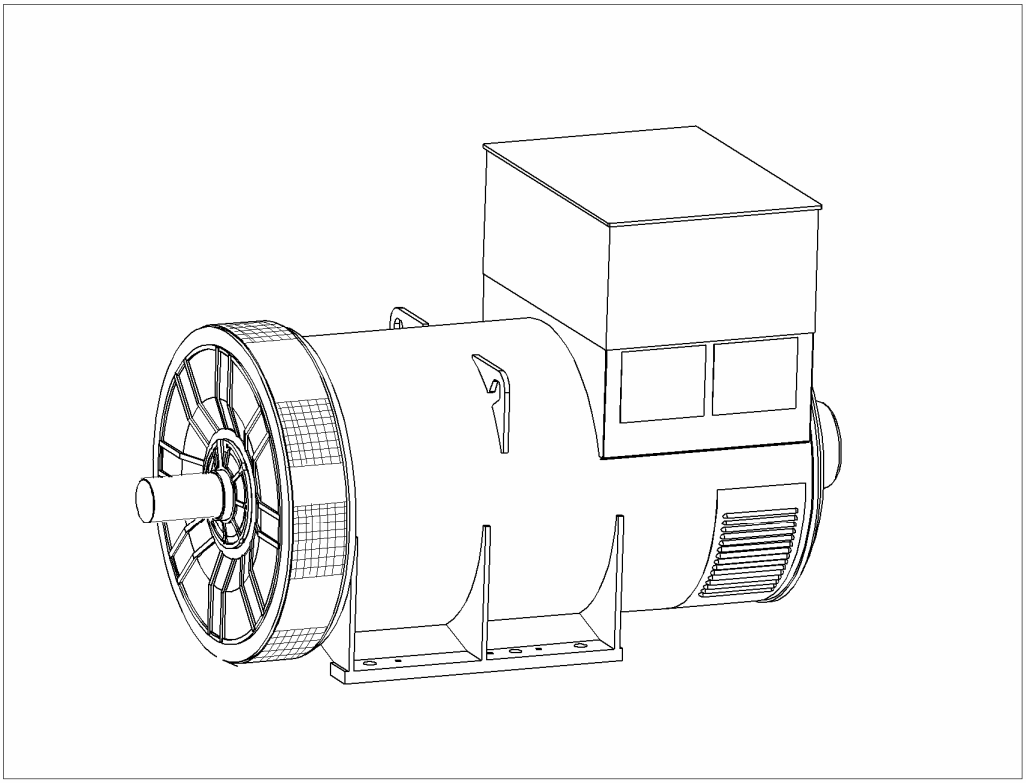
STAMFORD®

PI734C - Winding 312

Technical Data Sheet



SPECIFICATIONS & OPTIONS

STANDARDS
Stamford industrial generators meet the requirements of BS EN 60034 and the relevant sections of other national and international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC60034, CSA C22.2-100, AS1359.
Other standards and certifications can be considered on request.

DESCRIPTION
The STAMFORD PI range of synchronous ac generators are brushless with a rotating field. They are separately excited by the STAMFORD Permanent Magnet Generator (PMG). This is a shaft mounted, high frequency, pilot exciter which provides a constant supply of clean power via the Automatic Voltage Regulator (AVR) to the main exciter. The main exciter output is fed to the main rotor, through a full wave bridge rectifier, protected by surge suppression.

VOLTAGE REGULATORS
The PI range generators, complete with a PMG, are available with one of two AVRs. Each AVR has soft start voltage build up and built in protection against sustained over-excitation, which will de-excite the generator after a minimum of 8 seconds.
Underspeed protection (UFRO) is also provided on both AVRs. The UFRO will reduce the generator output voltage proportional to the speed of the generator below a pre-settable level.

The **MX341 AVR** is two phase sensed with a voltage regulation of ± 1 %. (see the note on regulation).

The **MX321 AVR** is 3 phase rms sensed with a voltage regulation of 0.5% rms (see the note on regulation). The UFRO circuit has adjustable slope and dwell for controlled recovery from step loads. An over voltage protection circuit will shutdown the output device of the AVR, it can also trip an optional excitation circuit breaker if required. As an option, short circuit current limiting is available with the addition of current transformers.

Both the MX341 and the MX321 need a generator mounted current transformer to provide quadrature droop characteristics for load sharing during parallel operation. Provision is also made for the connection of the STAMFORD power factor controller, for embedded applications, and a remote voltage trimmer.

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. 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 levels of voltage waveform distortion.

TERMINALS & TERMINAL BOX
Standard generators feature a main stator with 6 ends 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', and meets the requirements of UL1446.
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.

NOTE ON REGULATION
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 temperature exceeding 60°C must be referred to the factory.

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

Front cover drawing is typical of the product range.

PI734C

STAMFORD

WINDING 312

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX341	MX321	
VOLTAGE REGULATION	± 1 %	± 0.5 %	With 4% ENGINE GOVERNING
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVES (page 7)		

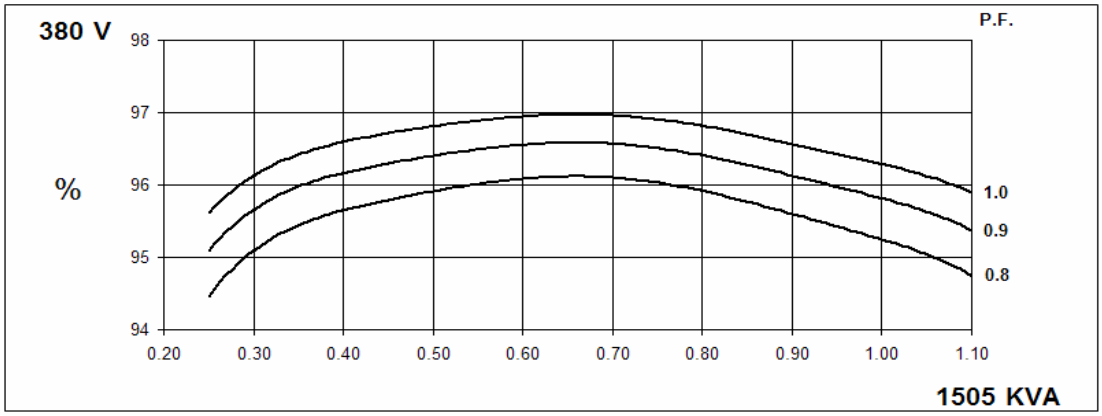
INSULATION SYSTEM	CLASS H							
PROTECTION	IP23							
RATED POWER FACTOR	0.8							
STATOR WINDING	DOUBLE LAYER LAP							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	6							
MAIN STATOR RESISTANCE	0.00126 Ohms PER PHASE AT 22°C STAR CONNECTED							
MAIN ROTOR RESISTANCE	1.85 Ohms at 22°C							
EXCITER STATOR RESISTANCE	17.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.063 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. 6228 C3							
BEARING NON-DRIVE END	BALL. 6319 C3							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	3018 kg				2967 kg			
WEIGHT WOUND STATOR	1445 kg				1445 kg			
WEIGHT WOUND ROTOR	1257 kg				1195 kg			
WR² INERTIA	37.3309 kgm^2				36.33 kgm^2			
SHIPPING WEIGHTS in a crate	3091kg				3036kg			
PACKING CRATE SIZE	194 x 105 x 154(cm)				194 x 105 x 154(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	2.69 m³/sec 5700 cfm				3.45 m³/sec 7300 cfm			
VOLTAGE STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
kVA BASE RATING FOR REACTANCE VALUES	1505	1550	1550	1520	1705	1815	1855	1890
Xd DIR. AXIS SYNCHRONOUS	3.18	2.96	2.75	2.40	3.86	3.67	3.43	3.21
X'd DIR. AXIS TRANSIENT	0.19	0.18	0.17	0.15	0.23	0.22	0.21	0.20
X"d DIR. AXIS SUBTRANSIENT	0.14	0.13	0.12	0.11	0.17	0.16	0.15	0.14
Xq QUAD. AXIS REACTANCE	2.05	1.91	1.77	1.55	2.49	2.37	2.22	2.07
X"q QUAD. AXIS SUBTRANSIENT	0.29	0.27	0.25	0.22	0.35	0.33	0.31	0.29
X_L LEAKAGE REACTANCE	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04
X_2 NEGATIVE SEQUENCE	0.20	0.19	0.18	0.15	0.25	0.23	0.22	0.21
X_0 ZERO SEQUENCE	0.02	0.02	0.02	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.	0.135s							
T"d SUB-TRANSTIME CONST.	0.01s							
T'do O.C. FIELD TIME CONST.	2.23s							
Ta ARMATURE TIME CONST.	0.02s							
SHORT CIRCUIT RATIO	1/Xd							

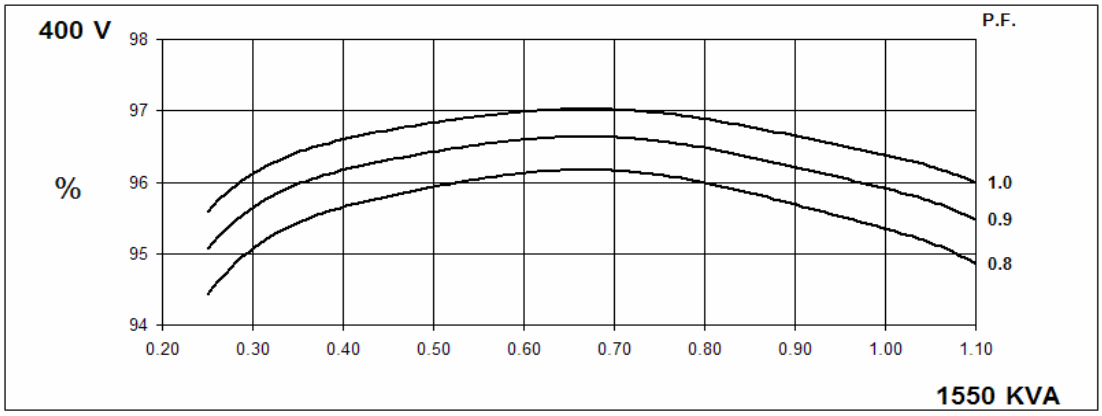
50 Hz

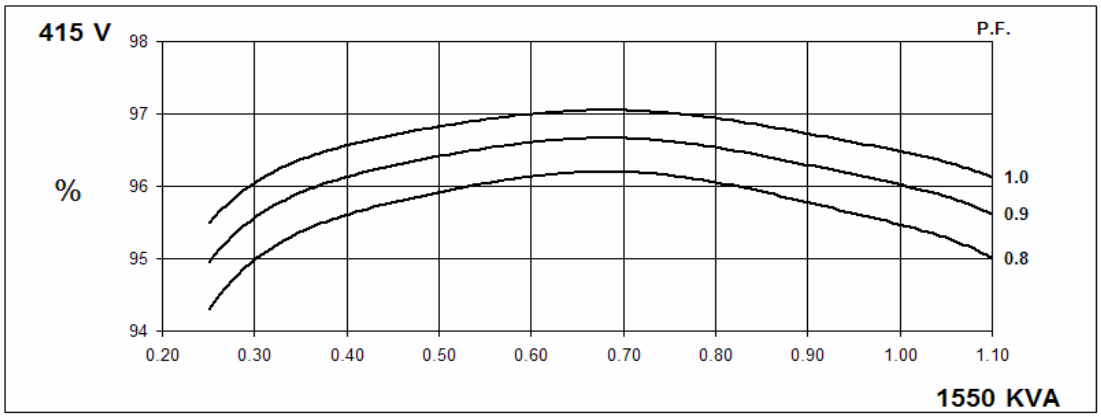
PI734C

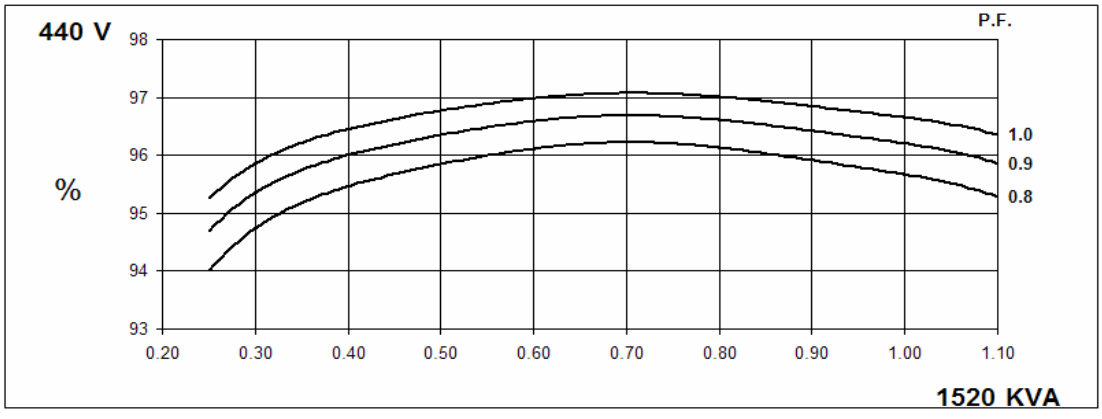
Winding 312

THREE PHASE EFFICIENCY CURVES







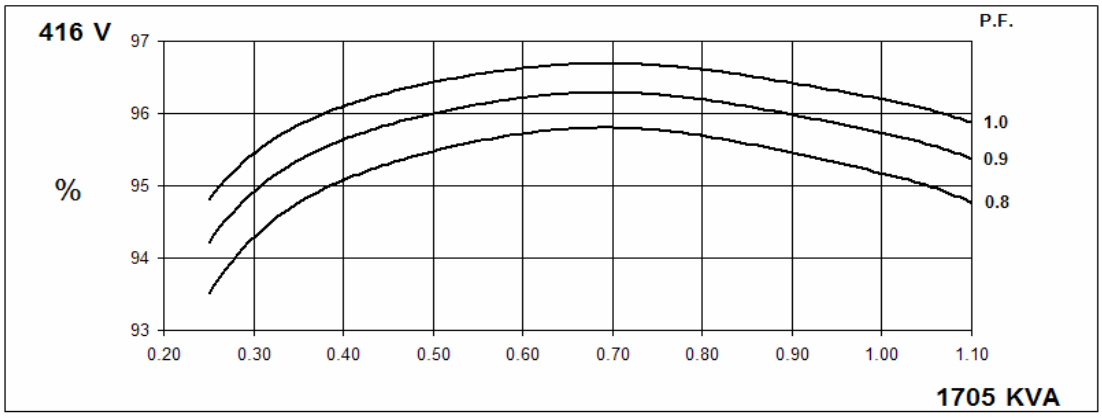


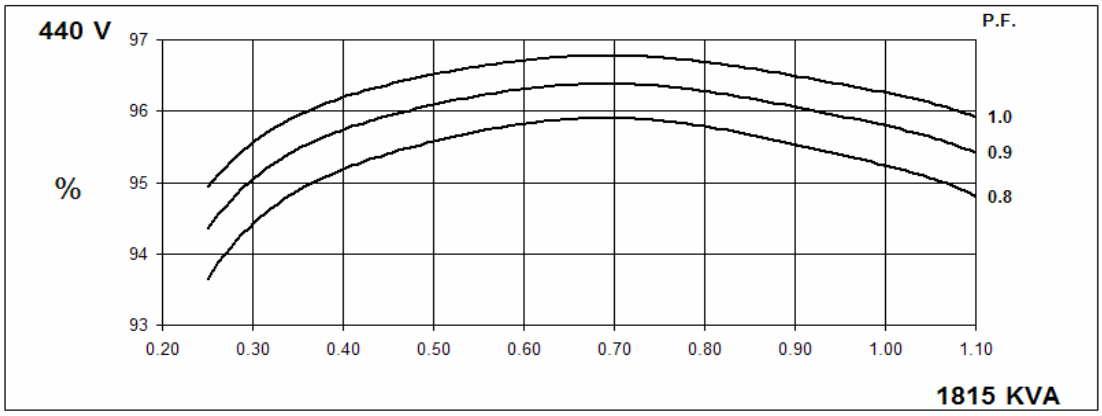
60 Hz

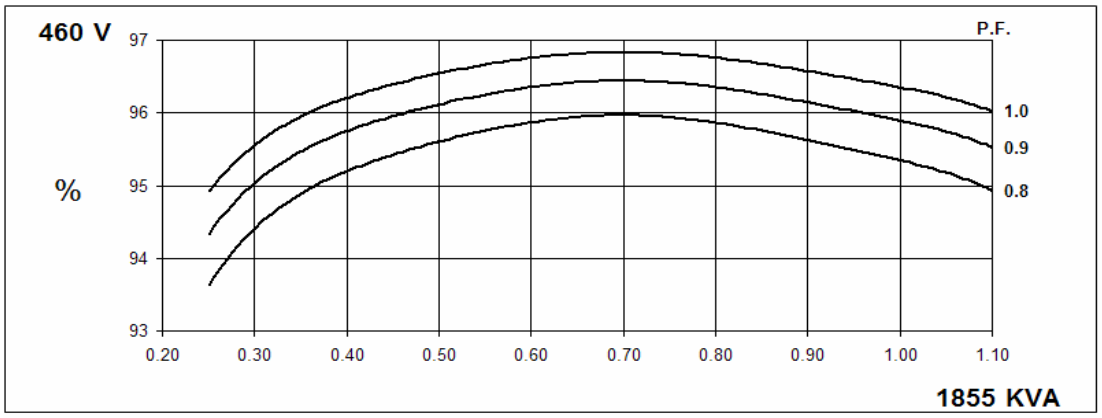
PI734C

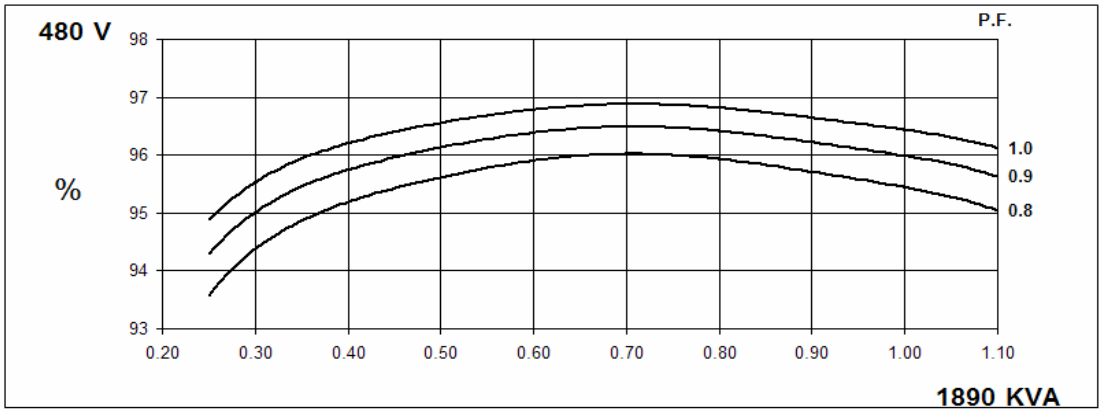
Winding 312

THREE PHASE EFFICIENCY CURVES





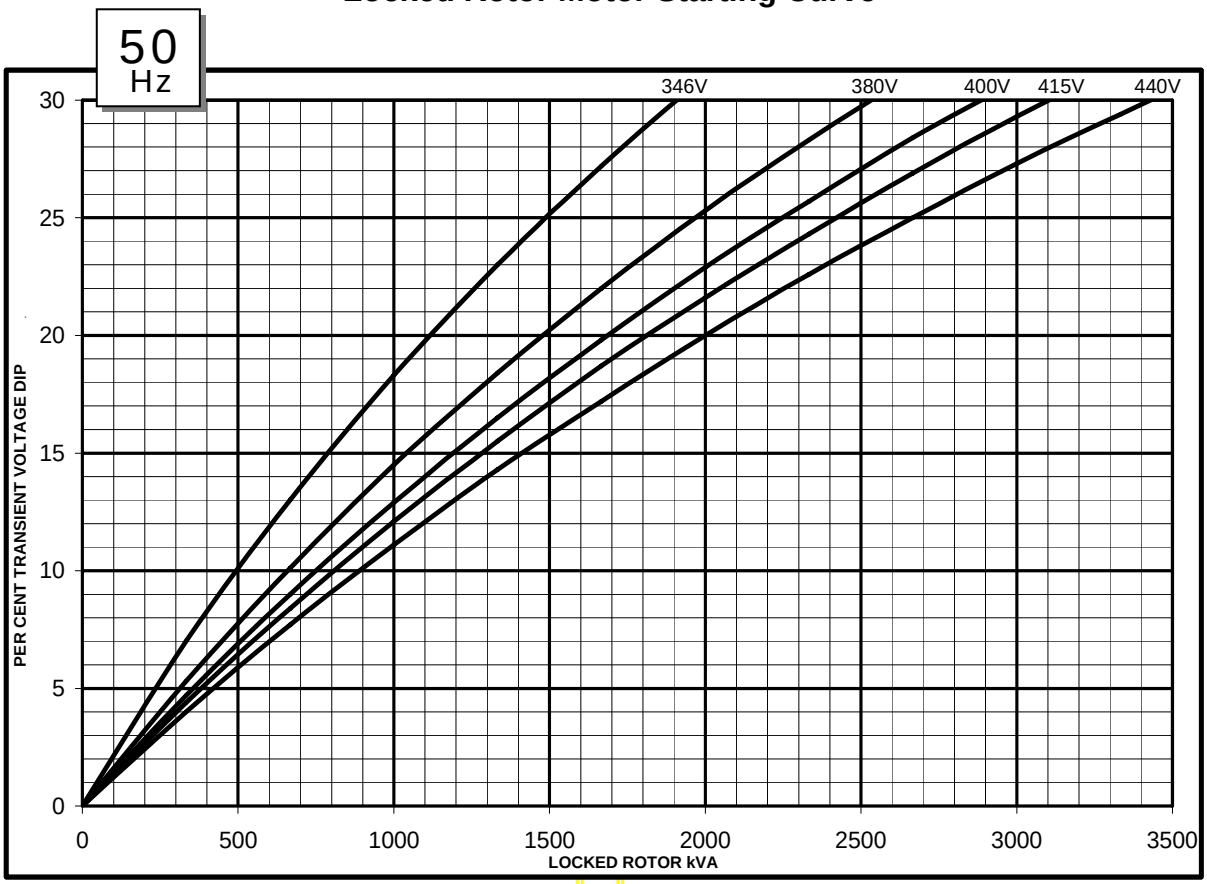


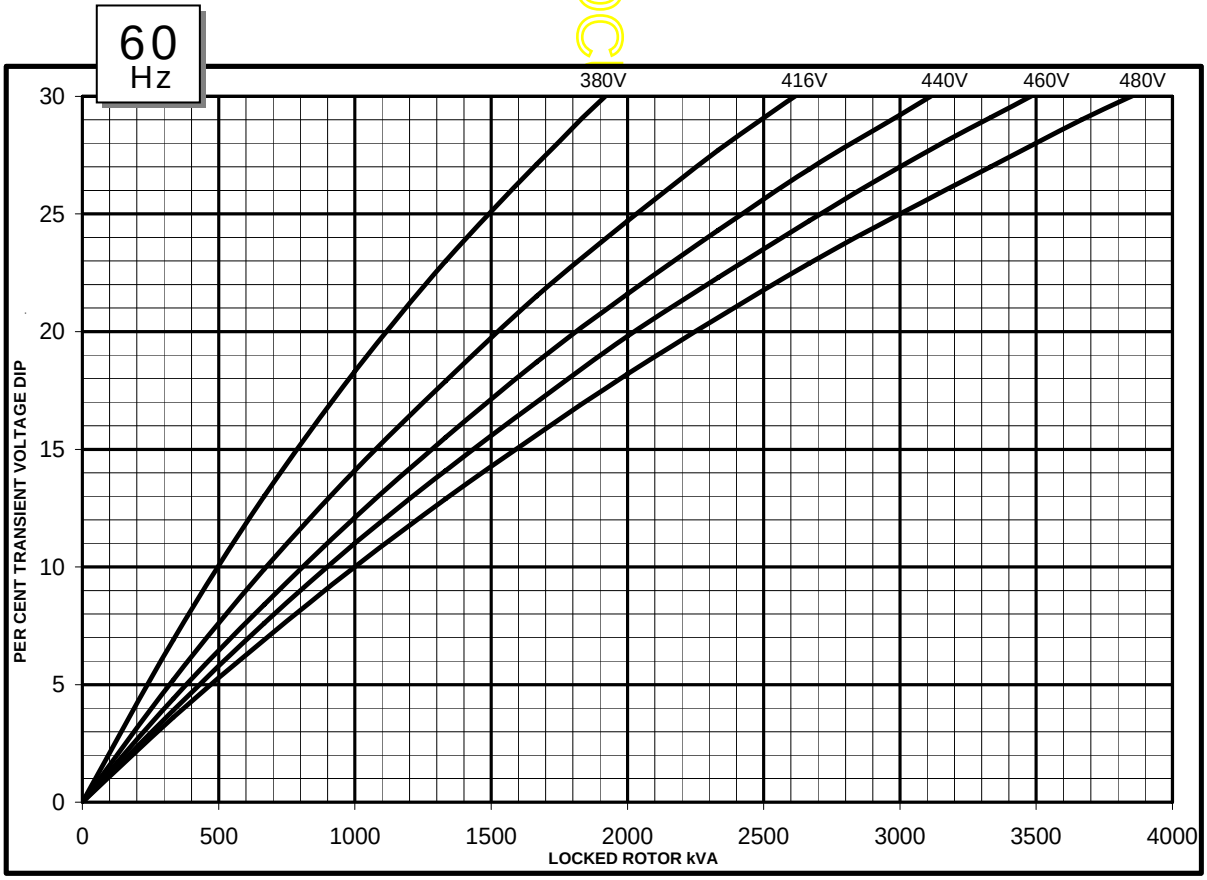


PI734C

Winding 312

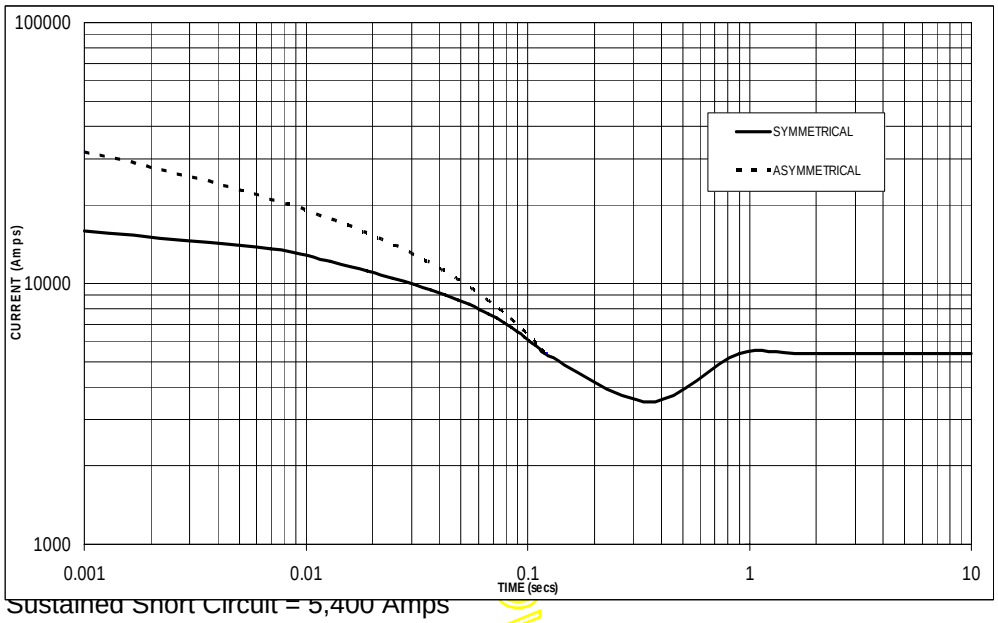
Locked Rotor Motor Starting Curve





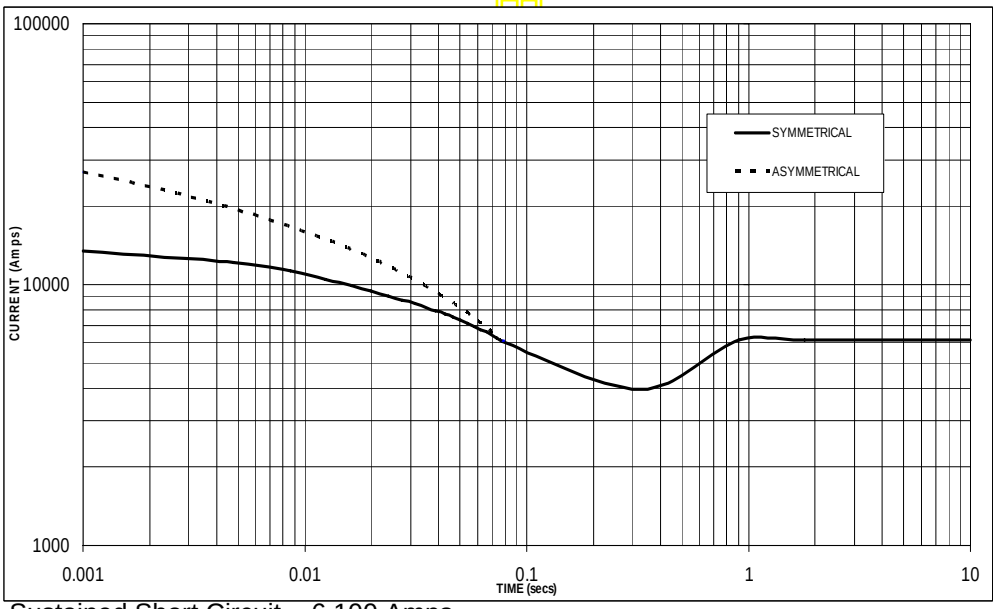
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 5,400 Amps

60 Hz



Sustained Short Circuit = 6,100 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines.

PI734C

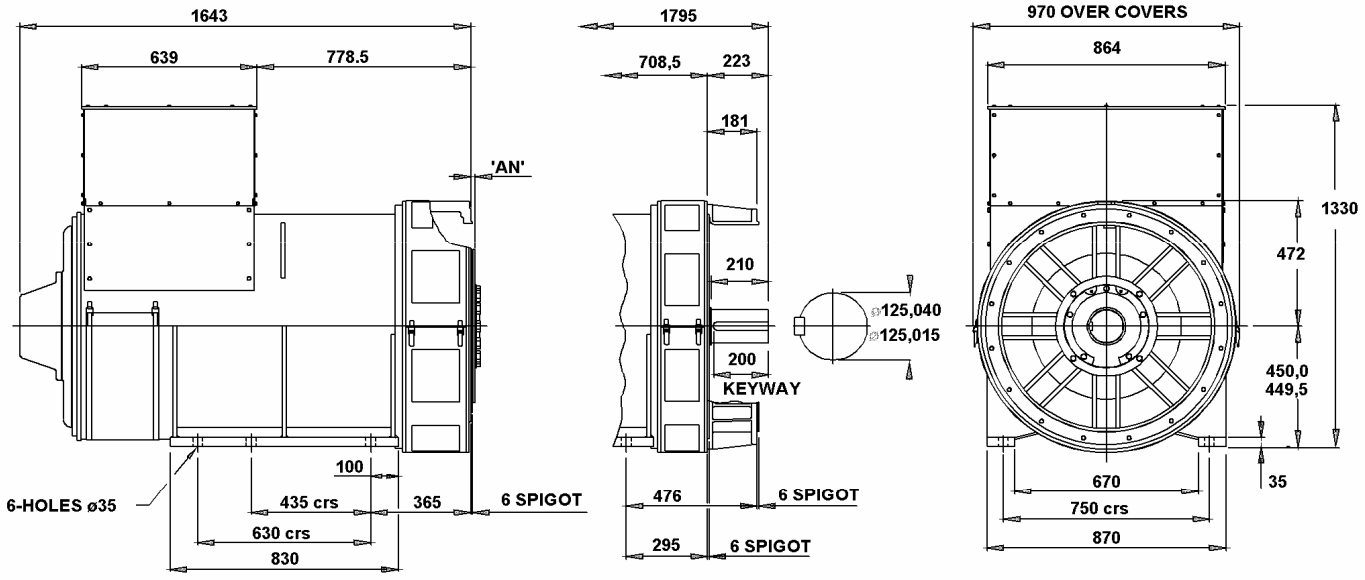
Winding 312 / 0.8 Power Factor

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
	kVA	1400	1445	1445	1415	1505	1550	1550	1520	1570	1615	1615	1590	1615	1660	1660	1630
	kW	1120	1156	1156	1132	1204	1240	1240	1216	1256	1292	1292	1272	1292	1328	1328	1304
	Efficiency (%)	95.4	95.5	95.6	95.8	95.2	95.4	95.5	95.7	95.1	95.2	95.4	95.6	95.0	95.1	95.3	95.5
	kW Input	1174	1210	1209	1182	1265	1300	1298	1271	1321	1357	1354	1331	1360	1396	1393	1365

60Hz	Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	kVA	1590	1690	1725	1760	1705	1815	1855	1890	1770	1890	1930	1970	1820	1945	1985	2025
	kW	1272	1352	1380	1408	1364	1452	1484	1512	1416	1512	1544	1576	1456	1556	1588	1620
	Efficiency (%)	95.3	95.4	95.5	95.6	95.2	95.2	95.3	95.4	95.1	95.1	95.2	95.3	95.0	95.0	95.2	95.3
	kW Input	1335	1417	1445	1473	1433	1525	1557	1585	1489	1590	1622	1654	1533	1638	1668	1700

DIMENSIONS



COUPLING DISC	'AN'
S.A.E No 18	15,7
S.A.E No 21	0
S.A.E No 24	0

1-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

2-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

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STAMFORD

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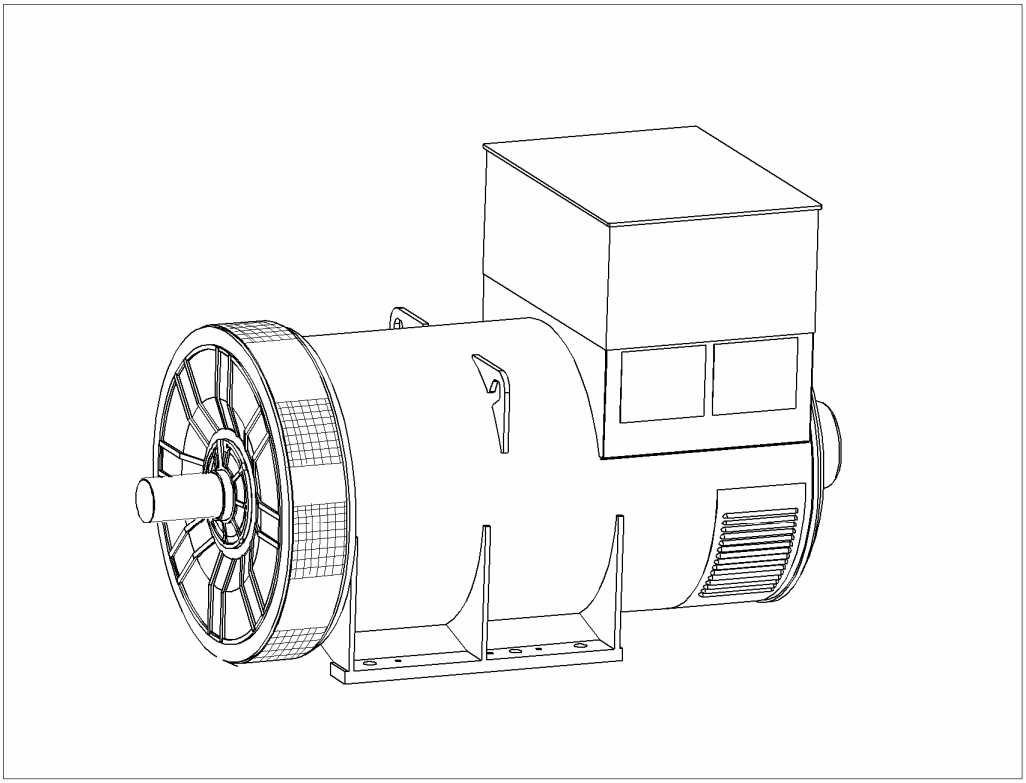
STAMFORD®

PI734D - Winding 312

Technical Data Sheet



SPECIFICATIONS & OPTIONS

STANDARDS
Stamford industrial generators meet the requirements of BS EN 60034 and the relevant sections of other national and international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC60034, CSA C22.2-100, AS1359.
Other standards and certifications can be considered on request.

DESCRIPTION
The STAMFORD PI range of synchronous ac generators are brushless with a rotating field. They are separately excited by the STAMFORD Permanent Magnet Generator (PMG). This is a shaft mounted, high frequency, pilot exciter which provides a constant supply of clean power via the Automatic Voltage Regulator (AVR) to the main exciter. The main exciter output is fed to the main rotor, through a full wave bridge rectifier, protected by surge suppression.

VOLTAGE REGULATORS
The PI range generators, complete with a PMG, are available with one of two AVRs. Each AVR has soft start voltage build up and built in protection against sustained over-excitation, which will de-excite the generator after a minimum of 8 seconds.
Underspeed protection (UFRO) is also provided on both AVRs. The UFRO will reduce the generator output voltage proportional to the speed of the generator below a pre-settable level.

The **MX341 AVR** is two phase sensed with a voltage regulation of ± 1 %. (see the note on regulation).

The **MX321 AVR** is 3 phase rms sensed with a voltage regulation of 0.5% rms (see the note on regulation). The UFRO circuit has adjustable slope and dwell for controlled recovery from step loads. An over voltage protection circuit will shutdown the output device of the AVR, it can also trip an optional excitation circuit breaker if required. As an option, short circuit current limiting is available with the addition of current transformers.

Both the MX341 and the MX321 need a generator mounted current transformer to provide quadrature droop characteristics for load sharing during parallel operation. Provision is also made for the connection of the STAMFORD power factor controller, for embedded applications, and a remote voltage trimmer.

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. 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 levels of voltage waveform distortion.

TERMINALS & TERMINAL BOX
Standard generators feature a main stator with 6 ends 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', and meets the requirements of UL1446.
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.

NOTE ON REGULATION
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 temperature exceeding 60°C must be referred to the factory.

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

Front cover drawing is typical of the product range.

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STAMFORD

WINDING 312

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX341	MX321	
VOLTAGE REGULATION	± 1 %	± 0.5 %	With 4% ENGINE GOVERNING
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVES (page 7)		

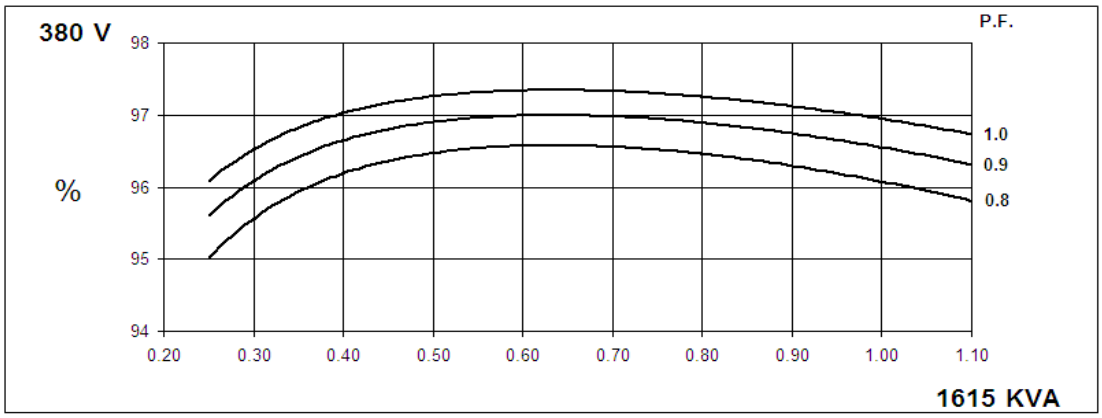
INSULATION SYSTEM	CLASS H							
PROTECTION	IP23							
RATED POWER FACTOR	0.8							
STATOR WINDING	DOUBLE LAYER LAP							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	6							
MAIN STATOR RESISTANCE	0.00114 Ohms PER PHASE AT 22°C STAR CONNECTED							
MAIN ROTOR RESISTANCE	1.98 Ohms at 22°C							
EXCITER STATOR RESISTANCE	17.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.063 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. 6228 C3							
BEARING NON-DRIVE END	BALL. 6319 C3							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	3318 kg				3267 kg			
WEIGHT WOUND STATOR	1619 kg				1619 kg			
WEIGHT WOUND ROTOR	1383 kg				1321 kg			
WR² INERTIA	41.2206 kgm^2				40.2197 kgm^2			
SHIPPING WEIGHTS in a crate	3391kg				3336kg			
PACKING CRATE SIZE	216 x 105 x 154(cm)				216 x 105 x 154(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	2.69 m³/sec 5700 cfm				3.45 m³/sec 7300 cfm			
VOLTAGE STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
kVA BASE RATING FOR REACTANCE VALUES	1615	1650	1650	1620	1815	1935	1975	2015
Xd DIR. AXIS SYNCHRONOUS	3.12	2.88	2.67	2.33	3.75	3.57	3.33	3.12
X'd DIR. AXIS TRANSIENT	0.19	0.18	0.16	0.14	0.23	0.22	0.20	0.19
X"d DIR. AXIS SUBTRANSIENT	0.14	0.13	0.12	0.11	0.17	0.16	0.15	0.14
Xq QUAD. AXIS REACTANCE	2.01	1.85	1.72	1.50	2.41	2.30	2.15	2.01
X"q QUAD. AXIS SUBTRANSIENT	0.28	0.26	0.24	0.21	0.34	0.32	0.30	0.28
X_L LEAKAGE REACTANCE	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04
X_2 NEGATIVE SEQUENCE	0.20	0.18	0.17	0.15	0.24	0.23	0.21	0.20
X_0 ZERO SEQUENCE	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.02
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.137s							
T"d SUB-TRANSTIME CONST.	0.01s							
T'do O.C. FIELD TIME CONST.	2.25s							
Ta ARMATURE TIME CONST.	0.02s							
SHORT CIRCUIT RATIO	1/Xd							

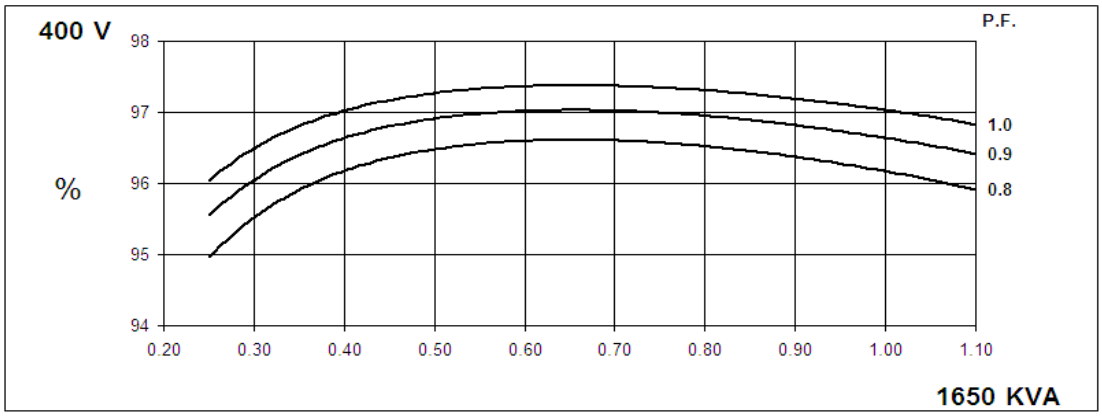
50 Hz

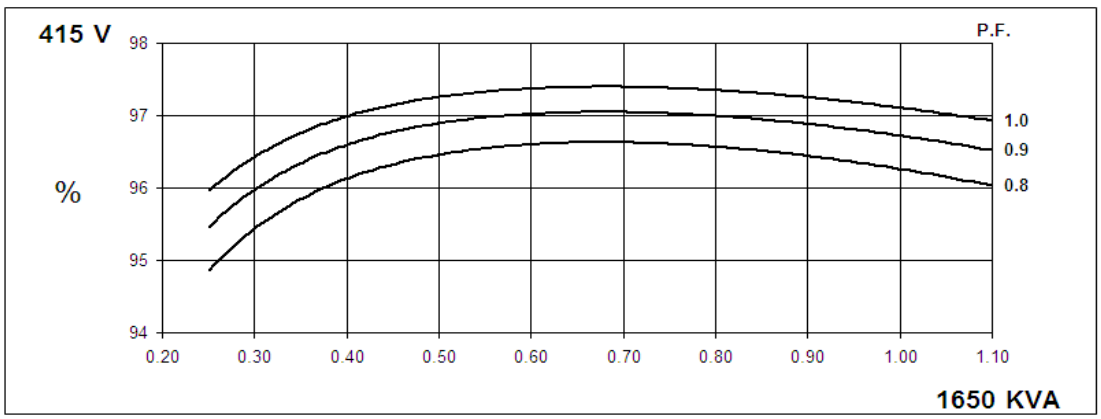
PI734D

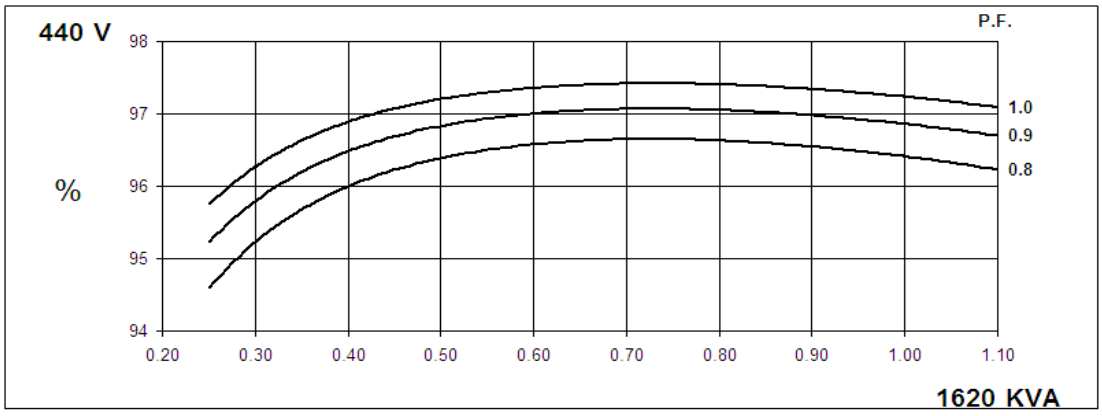
Winding 312

THREE PHASE EFFICIENCY CURVES









60 Hz

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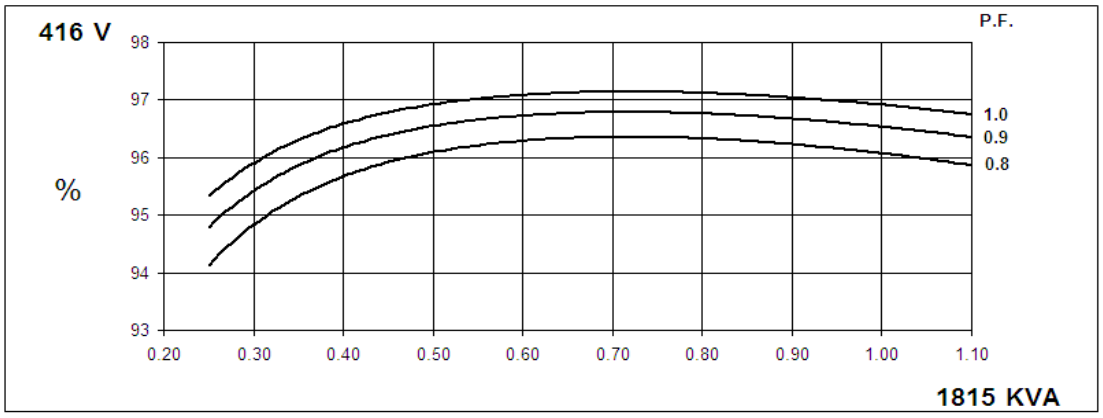
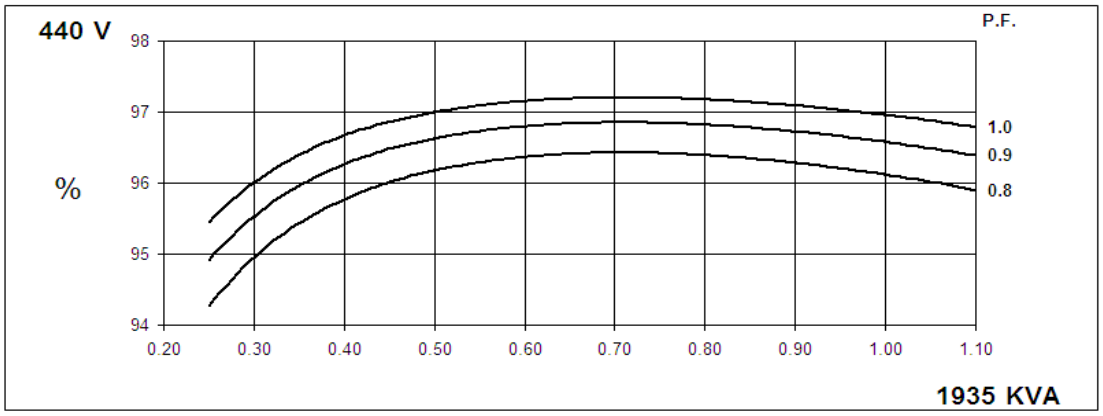
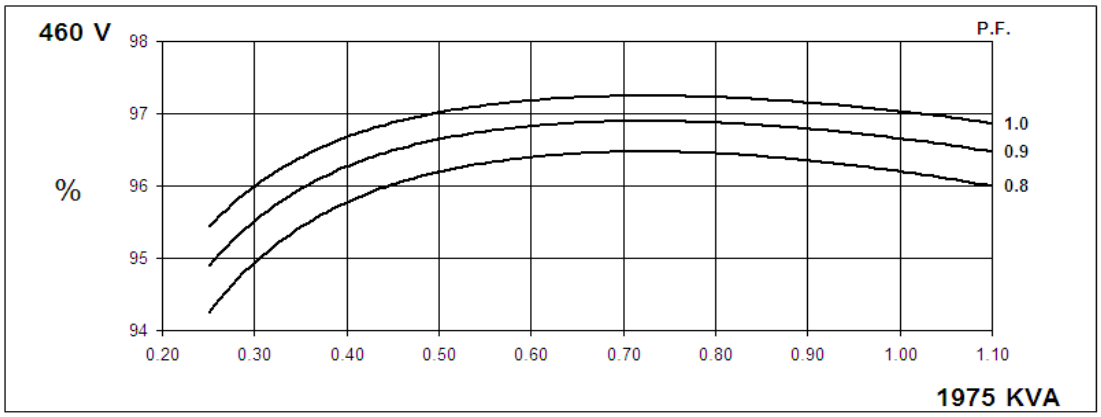
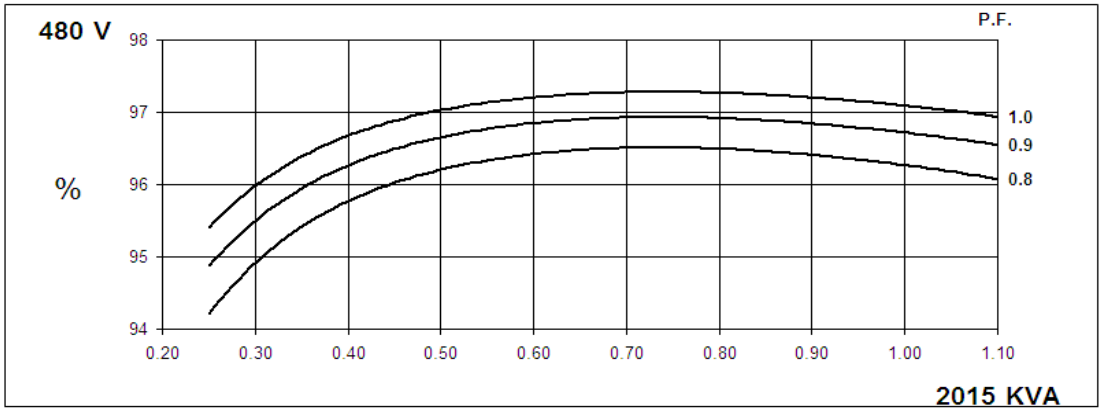
Winding 312

THREE PHASE EFFICIENCY CURVES





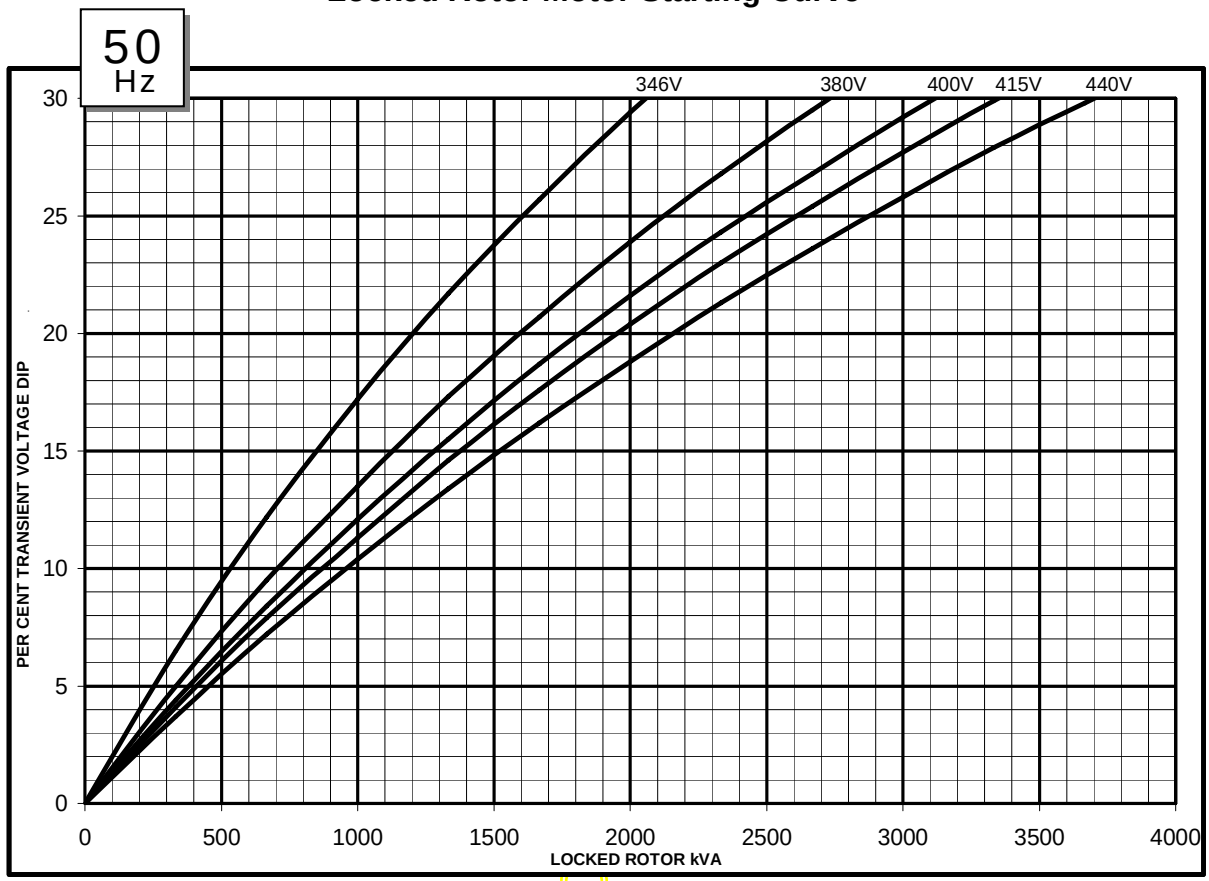


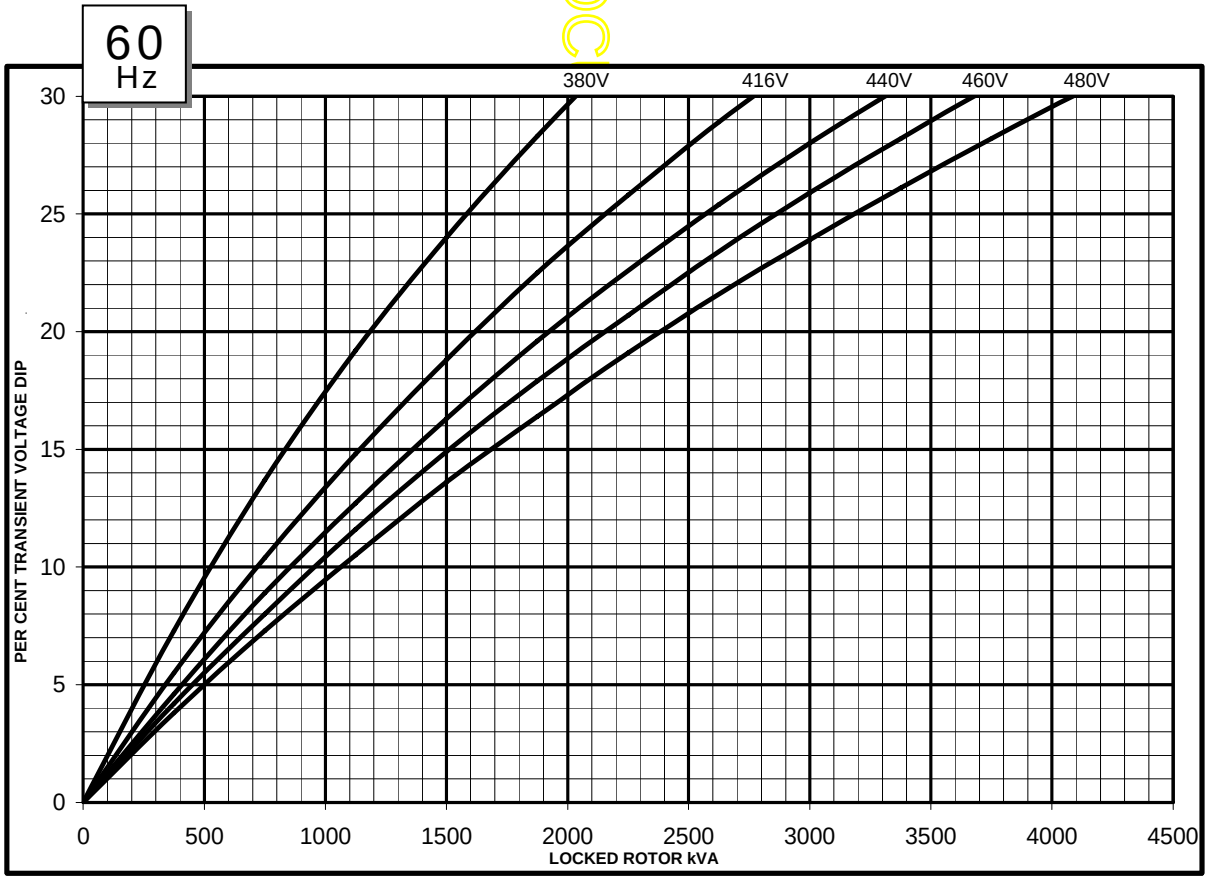


PI734D

Winding 312

Locked Rotor Motor Starting Curve





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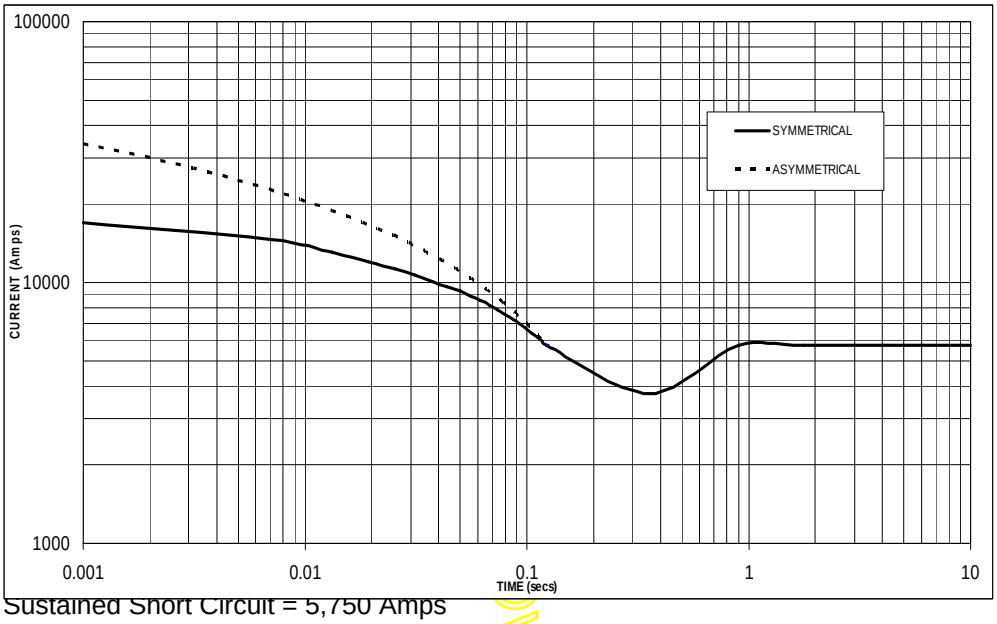
Winding 312

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

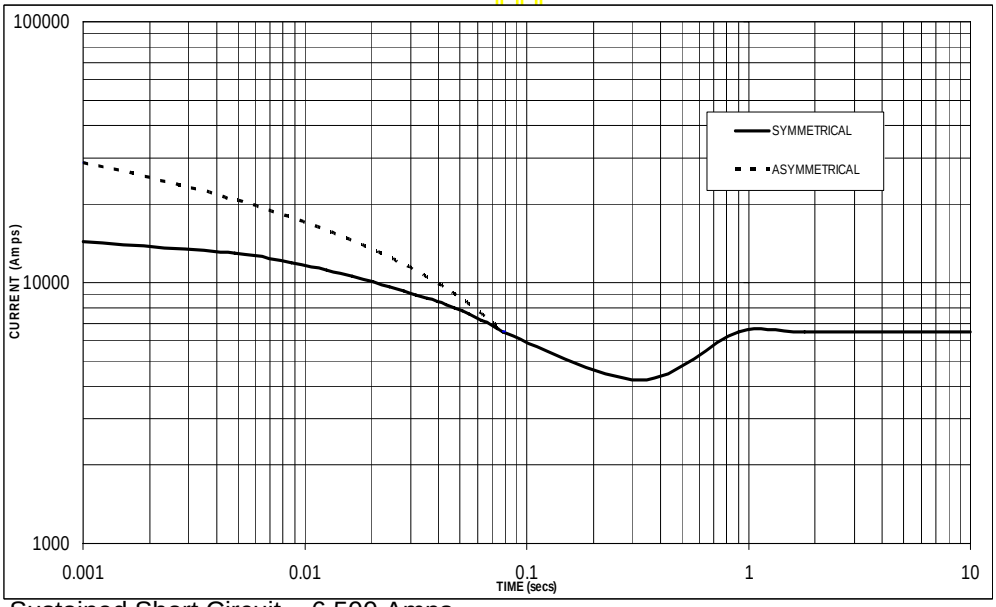
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 5,750 Amps

60 Hz



Sustained Short Circuit = 6,500 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 1.05	440v	x 1.06
415v	x 1.09	460v	x 1.10
440v	x 1.16	480v	x 1.15

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines.

PI734D

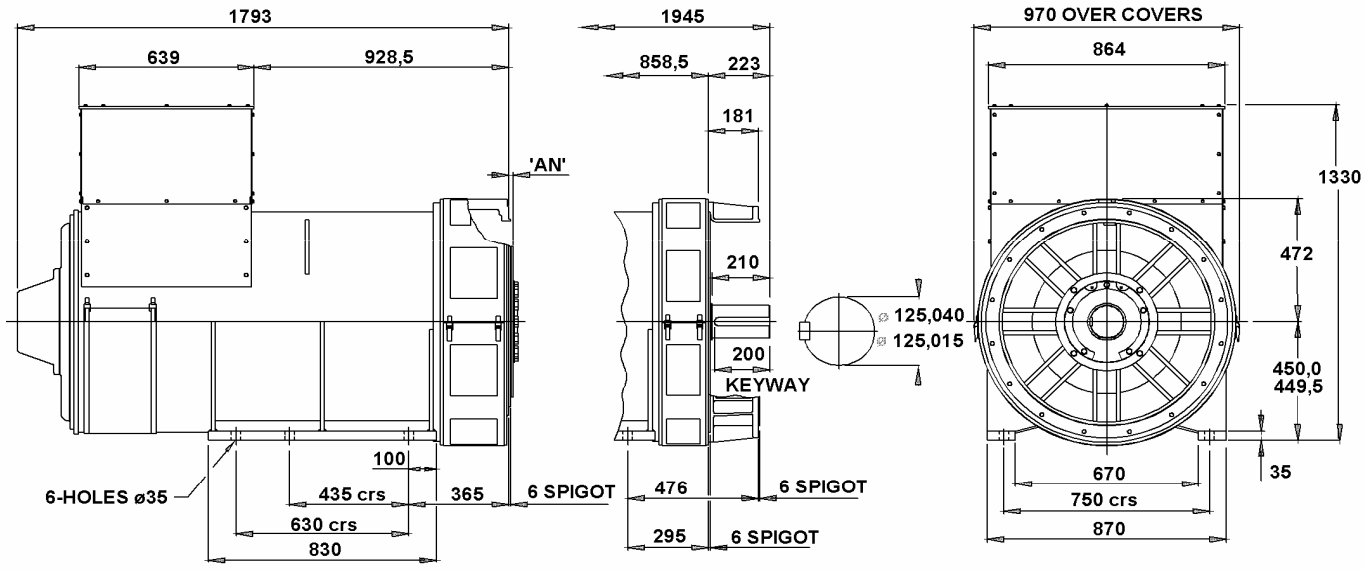
Winding 312 / 0.8 Power Factor

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
	kVA	1500	1540	1540	1505	1615	1650	1650	1620	1675	1720	1720	1685	1715	1770	1770	1735
	kW	1200	1232	1232	1204	1292	1320	1320	1296	1340	1376	1376	1348	1372	1416	1416	1388
	Efficiency (%)	96.2	96.3	96.4	96.5	96.1	96.2	96.3	96.4	96.0	96.1	96.2	96.3	95.9	96.0	96.1	96.3
	kW Input	1247	1279	1278	1248	1344	1372	1371	1344	1396	1432	1430	1400	1431	1475	1473	1441

60Hz	Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	kVA	1690	1800	1840	1875	1815	1935	1975	2015	1890	2015	2055	2100	1940	2070	2115	2160
	kW	1352	1440	1472	1500	1452	1548	1580	1612	1512	1612	1644	1680	1552	1656	1692	1728
	Efficiency (%)	96.2	96.2	96.3	96.4	96.1	96.1	96.2	96.3	96.0	96.0	96.1	96.2	95.9	96.0	96.1	96.1
	kW Input	1405	1497	1529	1556	1511	1611	1642	1674	1575	1679	1711	1746	1618	1725	1761	1798

DIMENSIONS



COUPLING DISC	'AN'
S.A.E No 18	15,7
S.A.E No 21	0
S.A.E No 24	0

1-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

2-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

APPROVED DOCUMENT

STAMFORD

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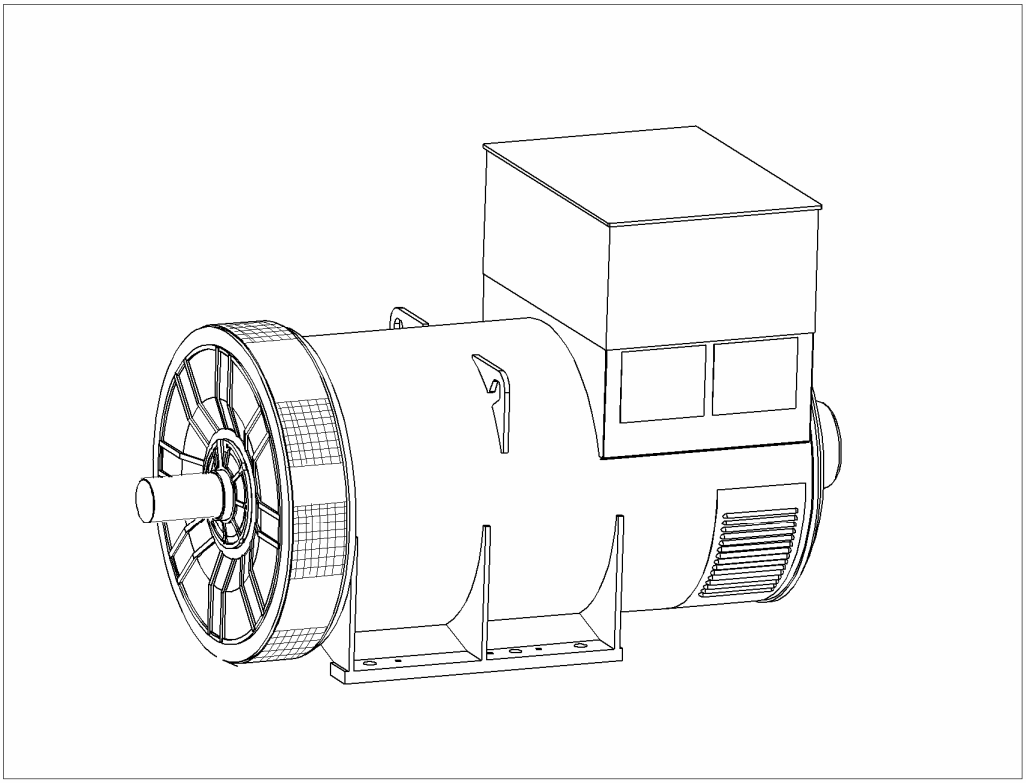
PI734E - Winding 312

Technical Data Sheet



SPECIFICATIONS & OPTIONS

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The **MX341 AVR** is two phase sensed with a voltage regulation of ± 1 %. (see the note on regulation).

The **MX321 AVR** is 3 phase rms sensed with a voltage regulation of 0.5% rms (see the note on regulation). The UFRO circuit has adjustable slope and dwell for controlled recovery from step loads. An over voltage protection circuit will shutdown the output device of the AVR, it can also trip an optional excitation circuit breaker if required. As an option, short circuit current limiting is available with the addition of current transformers.

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Standard generators feature a main stator with 6 ends 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.

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The insulation system is class 'H', and meets the requirements of UL1446.
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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 temperature exceeding 60°C must be referred to the factory.

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

Front cover drawing is typical of the product range.

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WINDING 312

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX341	MX321	
VOLTAGE REGULATION	± 1 %	± 0.5 %	With 4% ENGINE GOVERNING
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVES (page 7)		

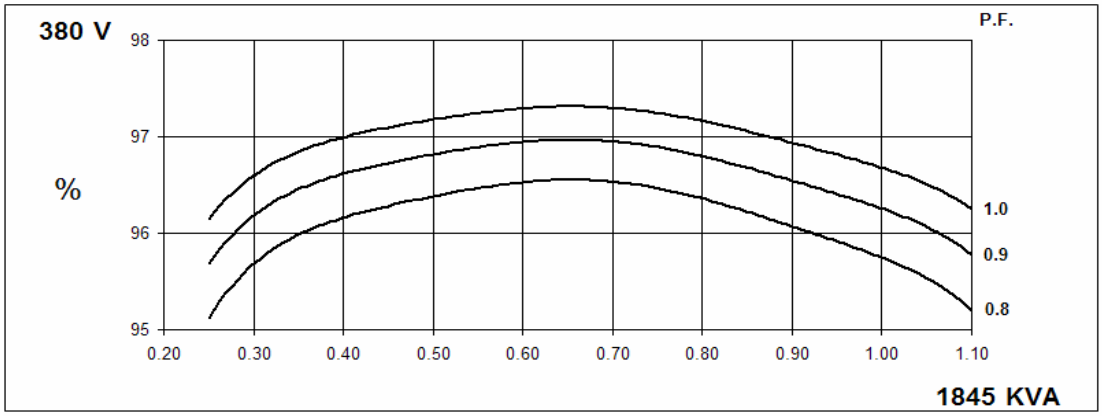
INSULATION SYSTEM	CLASS H							
PROTECTION	IP23							
RATED POWER FACTOR	0.8							
STATOR WINDING	DOUBLE LAYER LAP							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	6							
MAIN STATOR RESISTANCE	0.00093 Ohms PER PHASE AT 22°C STAR CONNECTED							
MAIN ROTOR RESISTANCE	2.17 Ohms at 22°C							
EXCITER STATOR RESISTANCE	17.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.063 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. 6228 C3							
BEARING NON-DRIVE END	BALL. 6319 C3							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	3556 kg				3506 kg			
WEIGHT WOUND STATOR	1747 kg				1747 kg			
WEIGHT WOUND ROTOR	1494 kg				1432 kg			
WR² INERTIA	45.49 kgm^2				44.4891 kgm^2			
SHIPPING WEIGHTS in a crate	3629kg				3575kg			
PACKING CRATE SIZE	216 x 105 x 154(cm)				216 x 105 x 154(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	2.69 m³/sec 5700 cfm				3.45 m³/sec 7300 cfm			
VOLTAGE STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
kVA BASE RATING FOR REACTANCE VALUES	1845	1900	1900	1865	2070	2210	2255	2300
Xd DIR. AXIS SYNCHRONOUS	3.18	2.96	2.75	2.40	3.84	3.67	3.42	3.21
X'd DIR. AXIS TRANSIENT	0.19	0.18	0.17	0.15	0.23	0.22	0.21	0.19
X"d DIR. AXIS SUBTRANSIENT	0.14	0.13	0.12	0.11	0.17	0.16	0.15	0.14
Xq QUAD. AXIS REACTANCE	2.04	1.90	1.76	1.54	2.47	2.36	2.20	2.06
X"q QUAD. AXIS SUBTRANSIENT	0.29	0.27	0.25	0.22	0.35	0.33	0.31	0.29
X_L LEAKAGE REACTANCE	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04
X_2 NEGATIVE SEQUENCE	0.20	0.19	0.17	0.15	0.24	0.23	0.22	0.20
X_0 ZERO SEQUENCE	0.02	0.02	0.02	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.	0.149s							
T"d SUB-TRANSTIME CONST.	0.02s							
T'do O.C. FIELD TIME CONST.	2.46s							
Ta ARMATURE TIME CONST.	0.02s							
SHORT CIRCUIT RATIO	1/Xd							

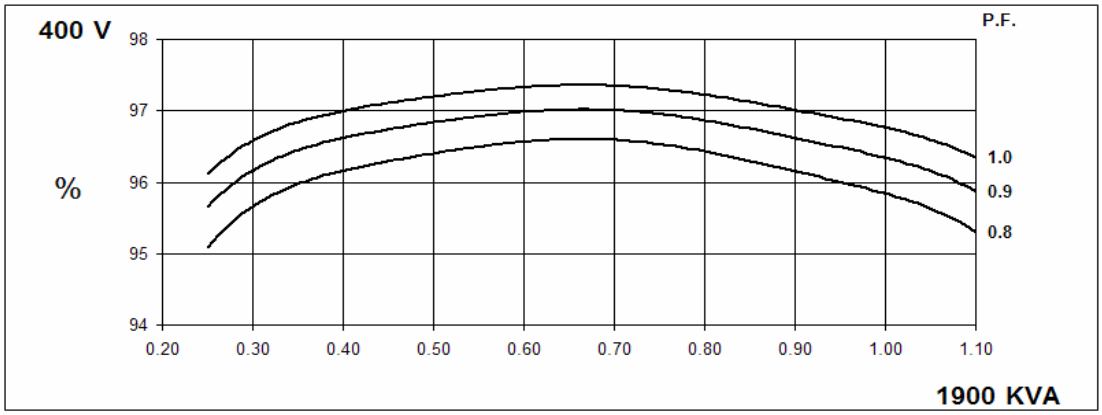
50 Hz

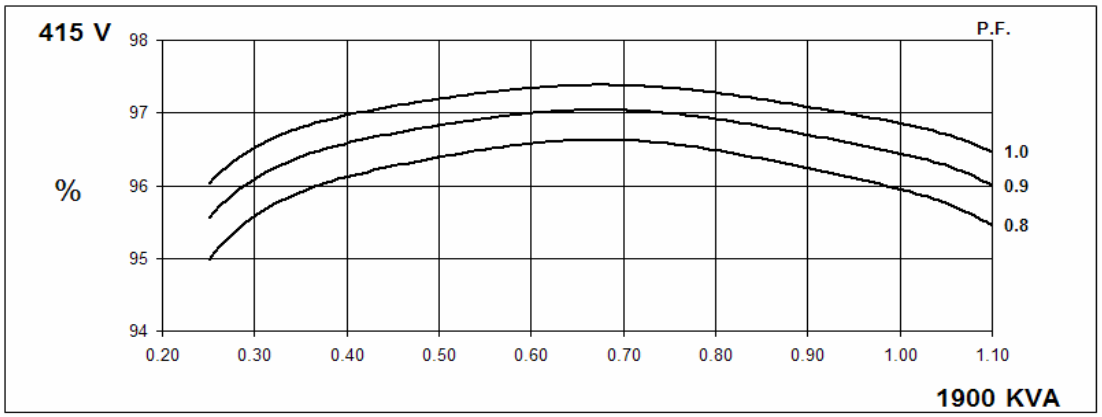
PI734E

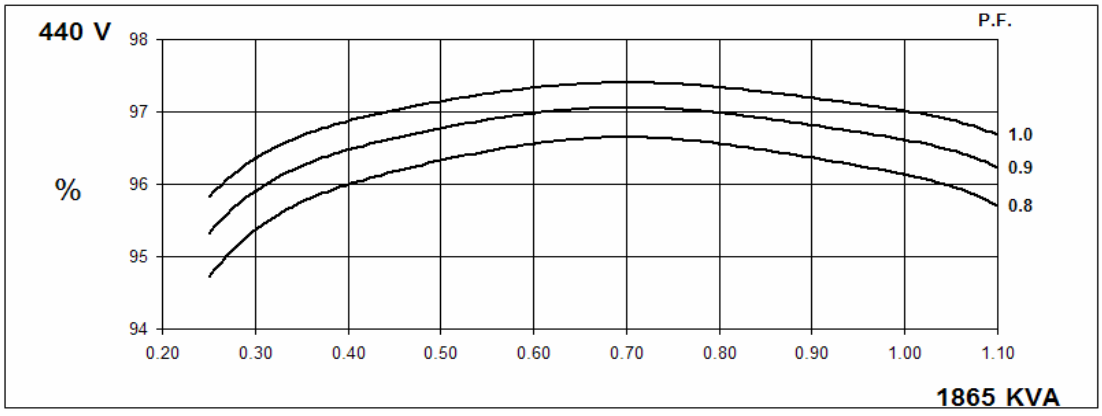
Winding 312

THREE PHASE EFFICIENCY CURVES







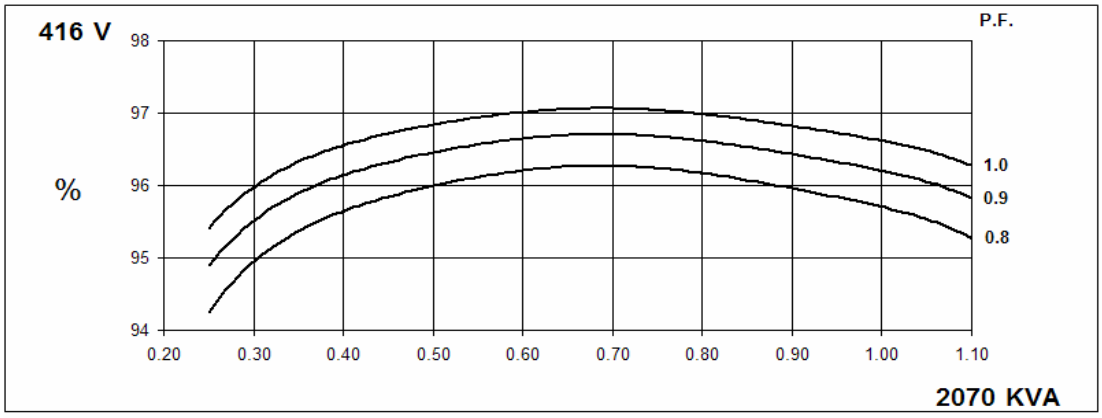


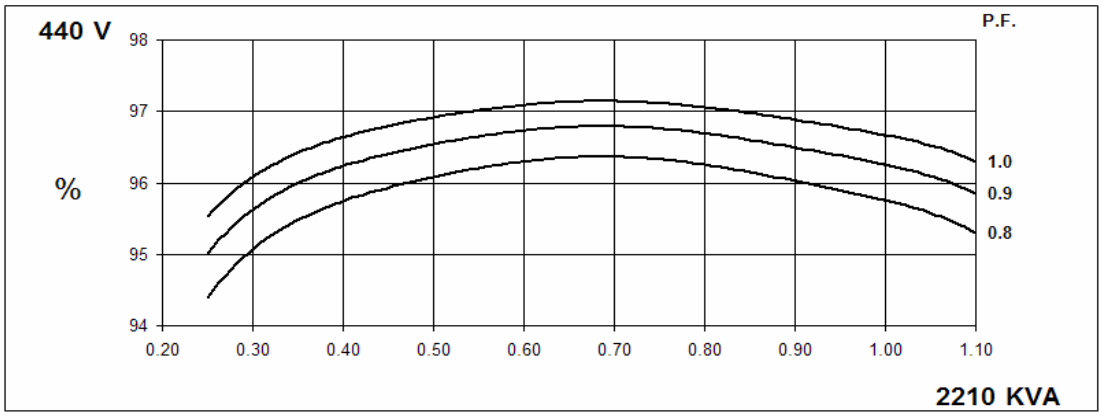
60 Hz

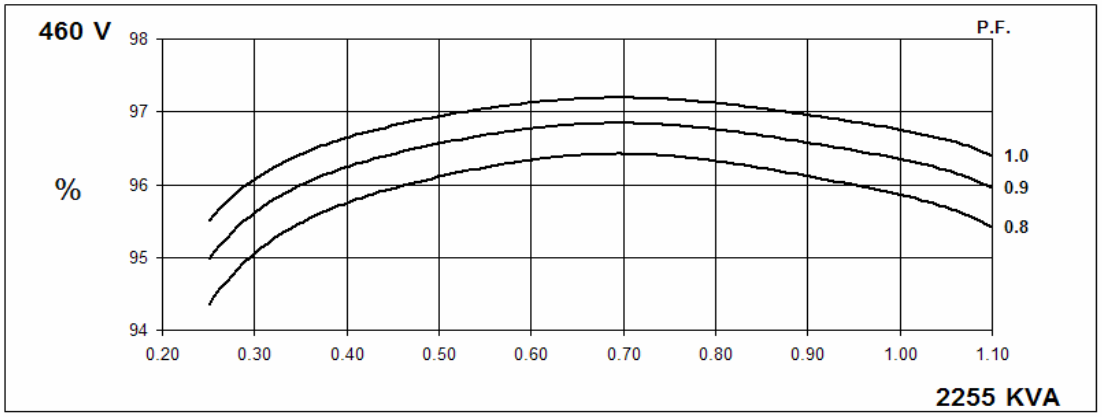
PI734E

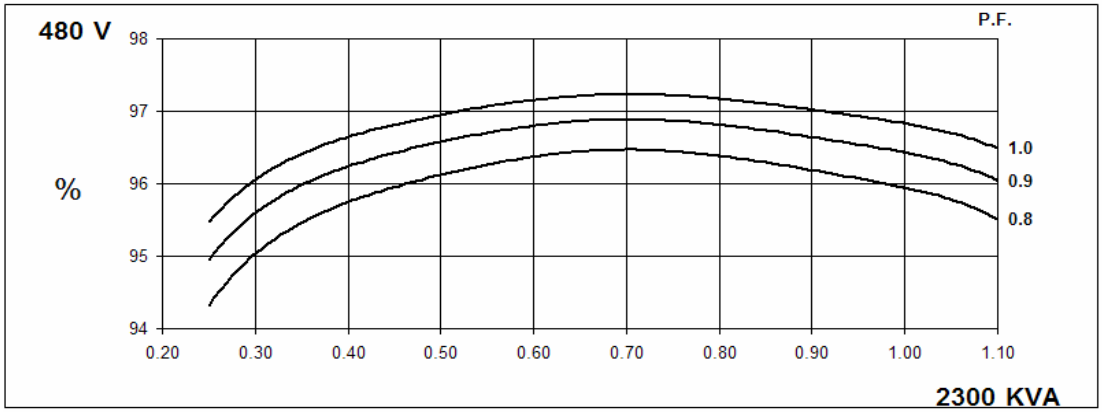
Winding 312

THREE PHASE EFFICIENCY CURVES





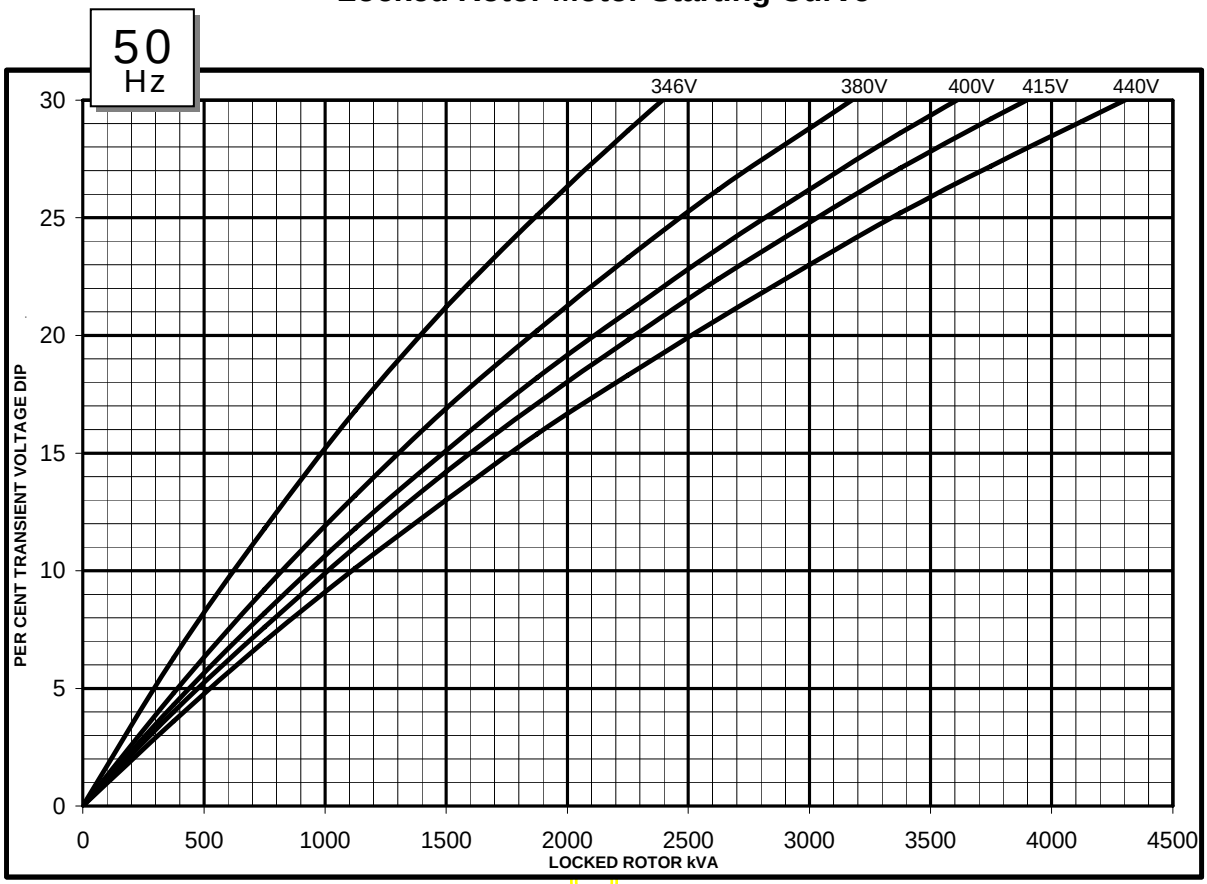


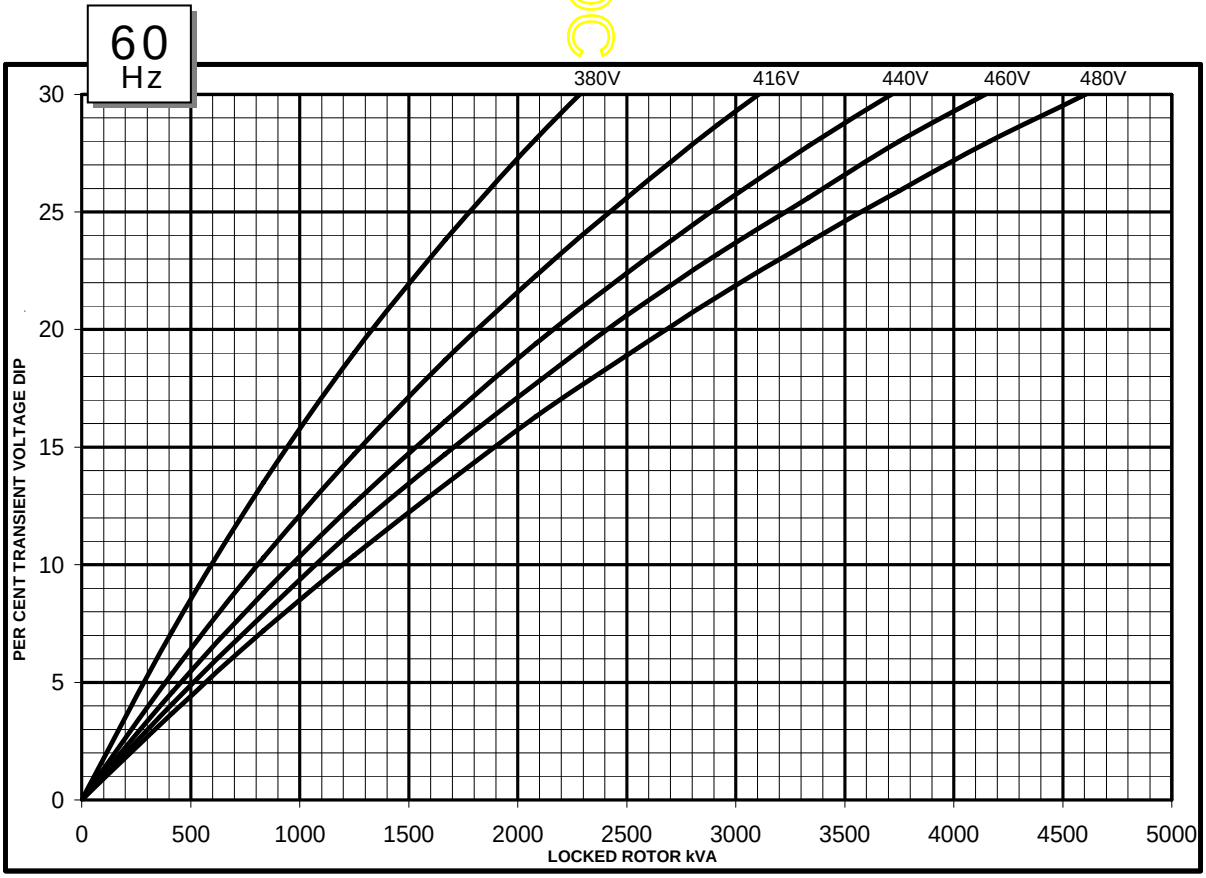


PI734E

Winding 312

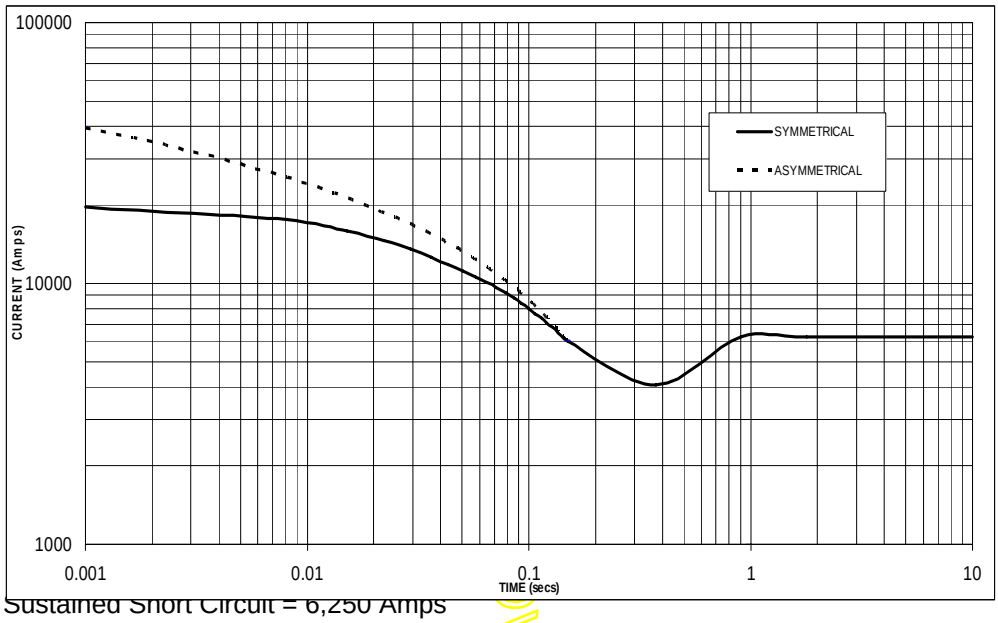
Locked Rotor Motor Starting Curve





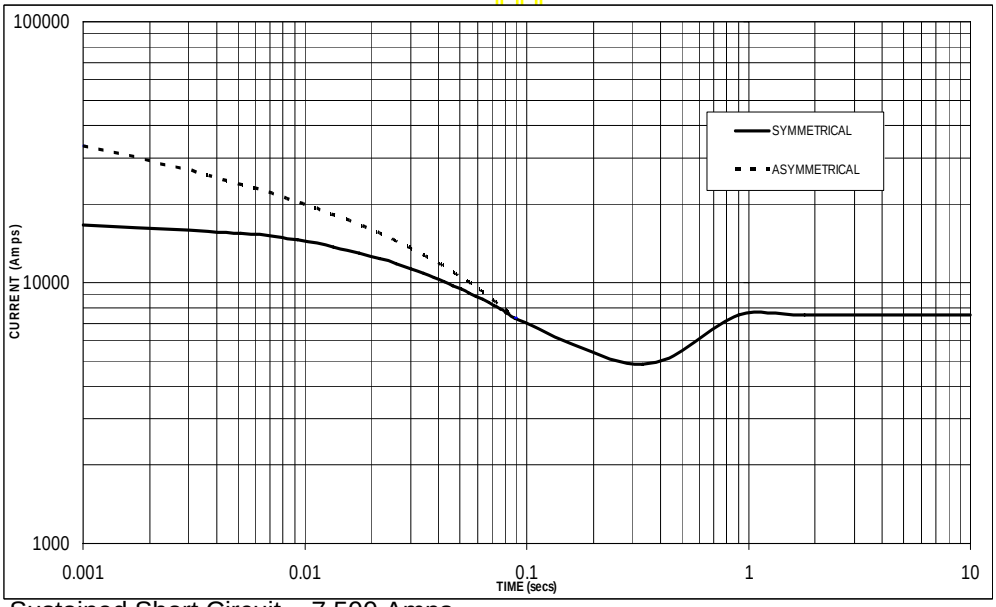
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 6,250 Amps

60 Hz



Sustained Short Circuit = 7,500 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 1.05	440v	x 1.06
415v	x 1.09	460v	x 1.10
440v	x 1.16	480v	x 1.15

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines.

PI734E

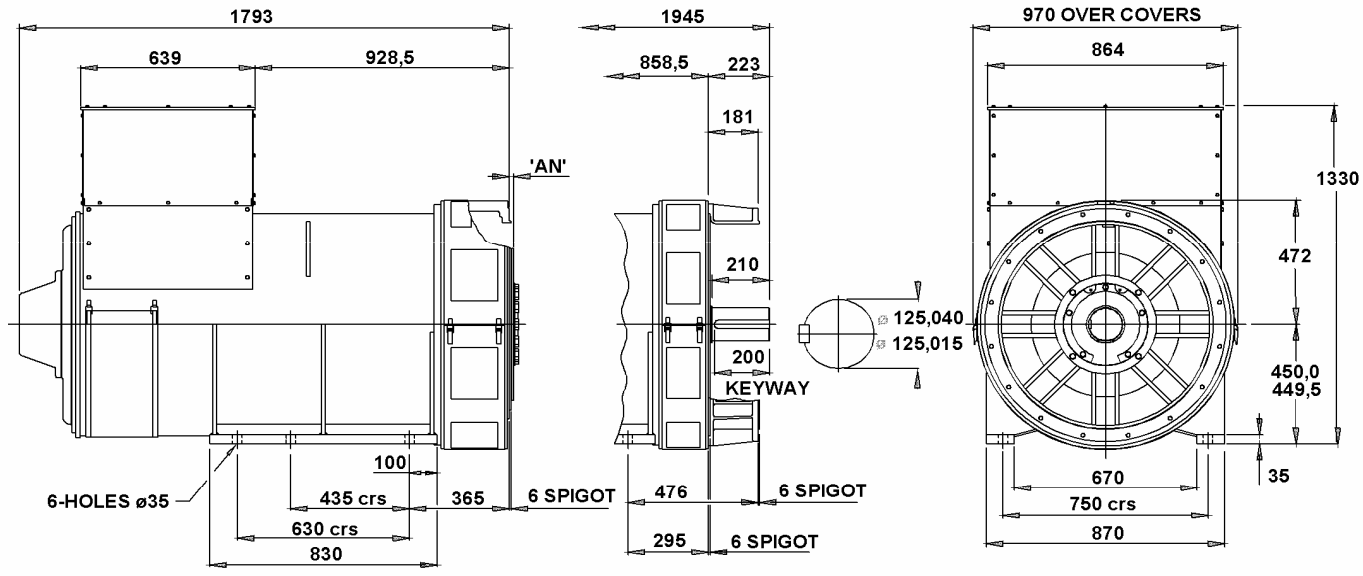
Winding 312 / 0.8 Power Factor

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
	kVA	1715	1770	1770	1735	1845	1900	1900	1865	1920	1980	1980	1940	1975	2035	2035	1995
	kW	1372	1416	1416	1388	1476	1520	1520	1492	1536	1584	1584	1552	1580	1628	1628	1596
	Efficiency (%)	95.9	96.0	96.1	96.3	95.7	95.8	96.0	96.1	95.6	95.7	95.8	96.1	95.5	95.6	95.8	96.0
	kW Input	1431	1475	1473	1441	1542	1587	1583	1553	1607	1655	1653	1615	1654	1703	1699	1663

60Hz	Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	kVA	1935	2055	2100	2140	2070	2210	2255	2300	2155	2300	2345	2395	2215	2365	2415	2465
	kW	1548	1644	1680	1712	1656	1768	1804	1840	1724	1840	1876	1916	1772	1892	1932	1972
	Efficiency (%)	95.8	95.9	96.0	96.1	95.7	95.8	95.9	95.9	95.6	95.7	95.8	95.9	95.5	95.6	95.7	95.8
	kW Input	1616	1714	1750	1781	1730	1846	1881	1919	1803	1923	1958	1998	1855	1979	2019	2058

DIMENSIONS



COUPLING DISC	'AN'
S.A.E No 18	15,7
S.A.E No 21	0
S.A.E No 24	0

1-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

2-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

APPROVED DOCUMENT

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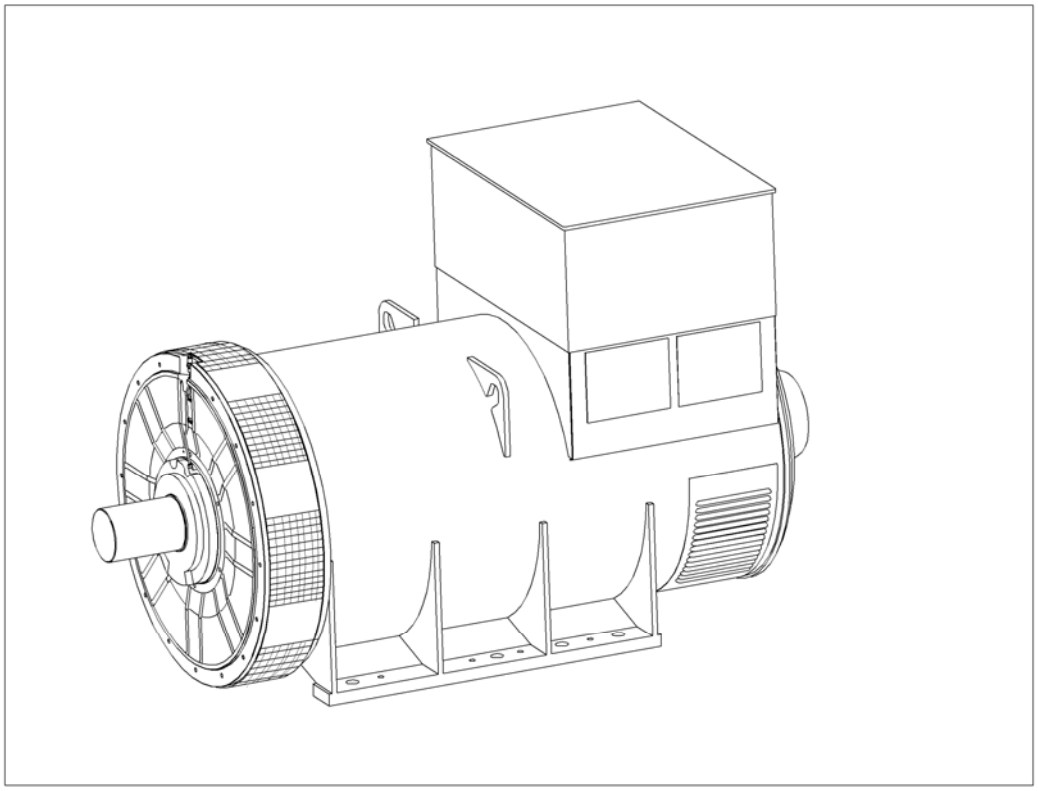
STAMFORD®

PI734F - Winding 312

Technical Data Sheet



SPECIFICATIONS & OPTIONS

STANDARDS
Stamford industrial generators meet the requirements of BS EN 60034 and the relevant sections of other national and international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC60034, CSA C22.2-100, AS1359.
Other standards and certifications can be considered on request.

DESCRIPTION
The STAMFORD PI range of synchronous ac generators are brushless with a rotating field. They are separately excited by the STAMFORD Permanent Magnet Generator (PMG). This is a shaft mounted, high frequency, pilot exciter which provides a constant supply of clean power via the Automatic Voltage Regulator (AVR) to the main exciter. The main exciter output is fed to the main rotor, through a full wave bridge rectifier, protected by surge suppression.

VOLTAGE REGULATORS
The PI range generators, complete with a PMG, are available with one of two AVRs. Each AVR has soft start voltage build up and built in protection against sustained over-excitation, which will de-excite the generator after a minimum of 8 seconds.
Underspeed protection (UFRO) is also provided on both AVRs. The UFRO will reduce the generator output voltage proportional to the speed of the generator below a pre-settable level.

The **MX341 AVR** is two phase sensed with a voltage regulation of ± 1 %. (see the note on regulation).

The **MX321 AVR** is 3 phase rms sensed with a voltage regulation of 0.5% rms (see the note on regulation). The UFRO circuit has adjustable slope and dwell for controlled recovery from step loads. An over voltage protection circuit will shutdown the output device of the AVR, it can also trip an optional excitation circuit breaker if required. As an option, short circuit current limiting is available with the addition of current transformers.

Both the MX341 and the MX321 need a generator mounted current transformer to provide quadrature droop characteristics for load sharing during parallel operation. Provision is also made for the connection of the STAMFORD power factor controller, for embedded applications, and a remote voltage trimmer.

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. 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 levels of voltage waveform distortion.

TERMINALS & TERMINAL BOX
Standard generators feature a main stator with 6 ends 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', and meets the requirements of UL1446.
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.

NOTE ON REGULATION
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 temperature exceeding 60°C must be referred to the factory.

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

Front cover drawing is typical of the product range.

PI734F

STAMFORD

WINDING 312

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX341	MX321	
VOLTAGE REGULATION	± 1%	± 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							
MAIN STATOR RESISTANCE	0.00076 Ohms PER PHASE AT 22°C STAR CONNECTED							
MAIN ROTOR RESISTANCE	2.31 Ohms at 22°C							
EXCITER STATOR RESISTANCE	17.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.063 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. 6232 C3							
BEARING NON-DRIVE END	BALL. 6319 C3							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	3840 kg				3807 kg			
WEIGHT WOUND STATOR	1908 kg				1908 kg			
WEIGHT WOUND ROTOR	1609 kg				1565 kg			
WR² INERTIA	49.3409 kgm^2				48.424 kgm^2			
SHIPPING WEIGHTS in a crate	3913kg				3876kg			
PACKING CRATE SIZE	216 x 105 x 154(cm)				216 x 105 x 154(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	2.69 m³/sec 5700 cfm				3.45 m³/sec 7300 cfm			
VOLTAGE STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
kVA BASE RATING FOR REACTANCE VALUES	2020	2080	2080	2040	2345	2500	2550	2600
Xd DIR. AXIS SYNCHRONOUS	2.93	2.73	2.53	2.21	3.55	3.38	3.16	2.96
X'd DIR. AXIS TRANSIENT	0.18	0.17	0.15	0.13	0.21	0.20	0.19	0.18
X"d DIR. AXIS SUBTRANSIENT	0.13	0.12	0.11	0.10	0.16	0.15	0.14	0.13
Xq QUAD. AXIS REACTANCE	1.89	1.75	1.63	1.42	2.28	2.18	2.03	1.90
X"q QUAD. AXIS SUBTRANSIENT	0.26	0.25	0.23	0.20	0.32	0.31	0.29	0.27
X_L LEAKAGE REACTANCE	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.03
X_2 NEGATIVE SEQUENCE	0.19	0.17	0.16	0.14	0.23	0.22	0.20	0.19
X_0 ZERO SEQUENCE	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.154s							
T"d SUB-TRANSTIME CONST.	0.02s							
T'do O.C. FIELD TIME CONST.	2.54s							
Ta ARMATURE TIME CONST.	0.02s							
SHORT CIRCUIT RATIO	1/Xd							

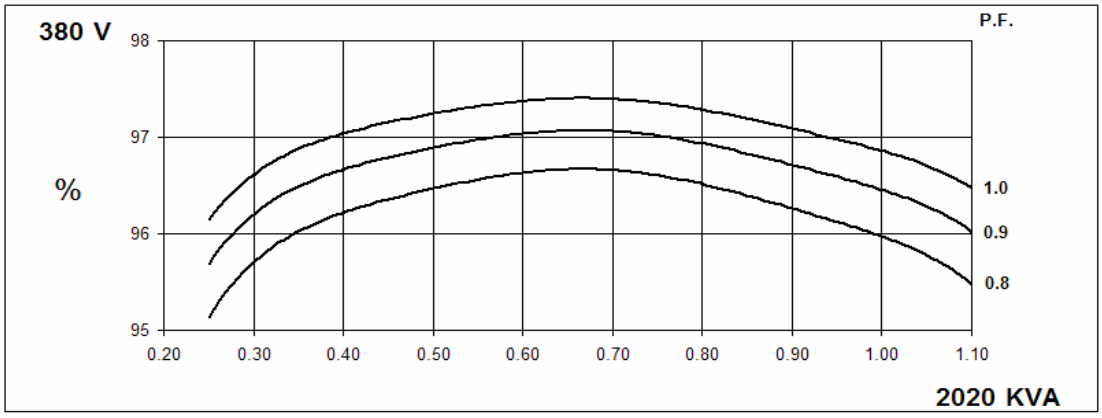
50 Hz

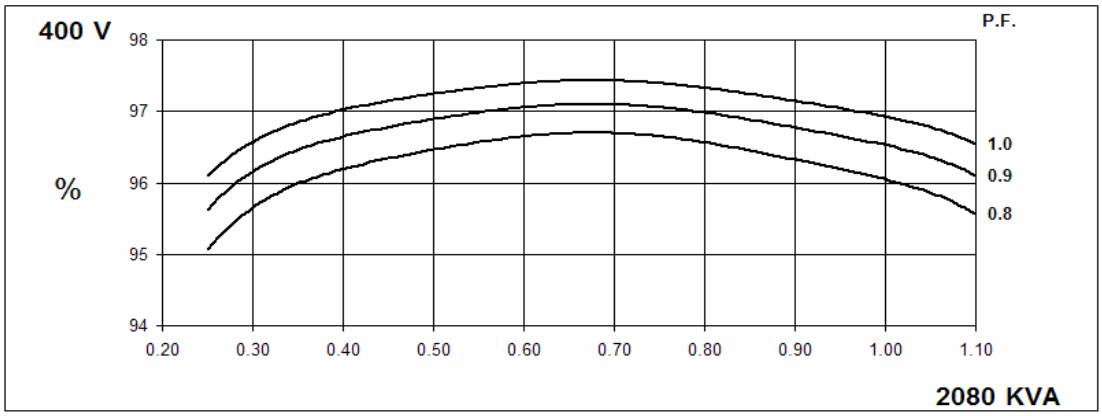
PI734F

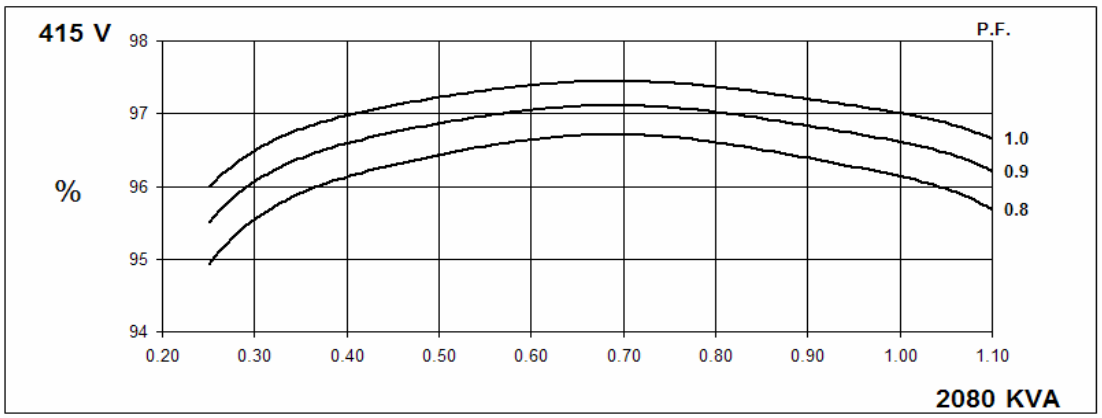
Winding 312

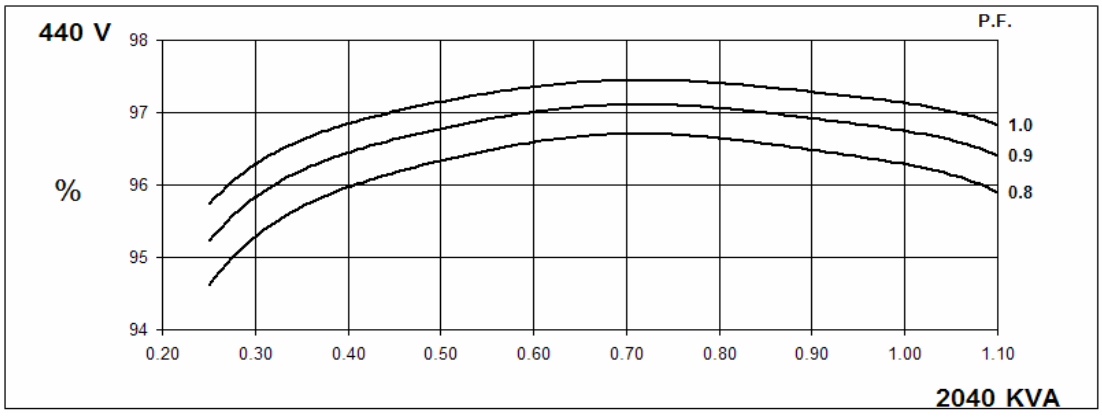
STAMFORD

THREE PHASE EFFICIENCY CURVES







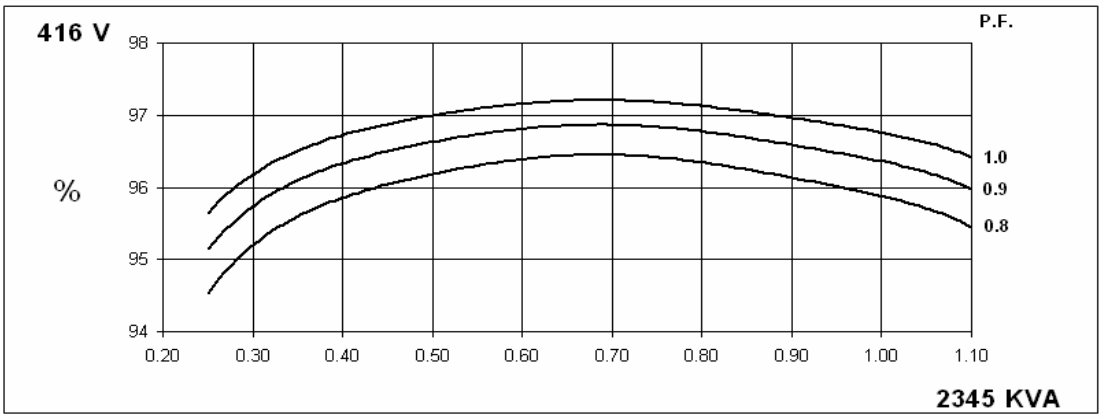


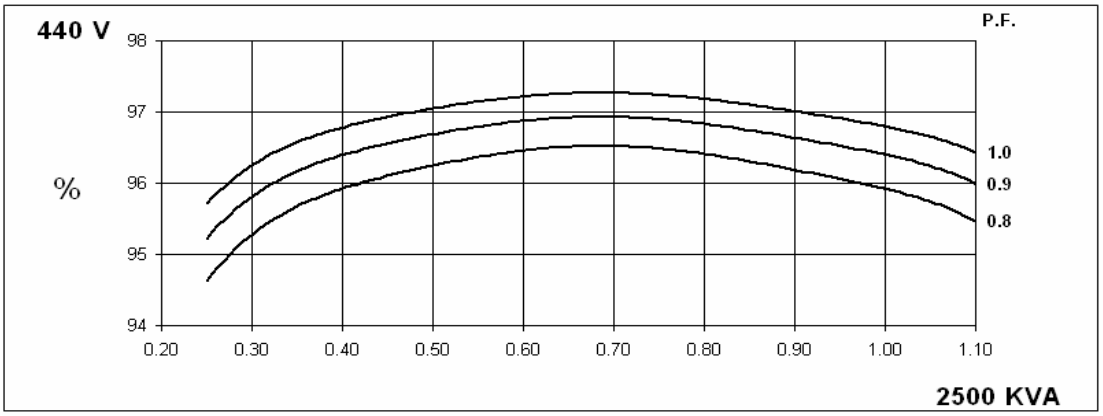
60 Hz

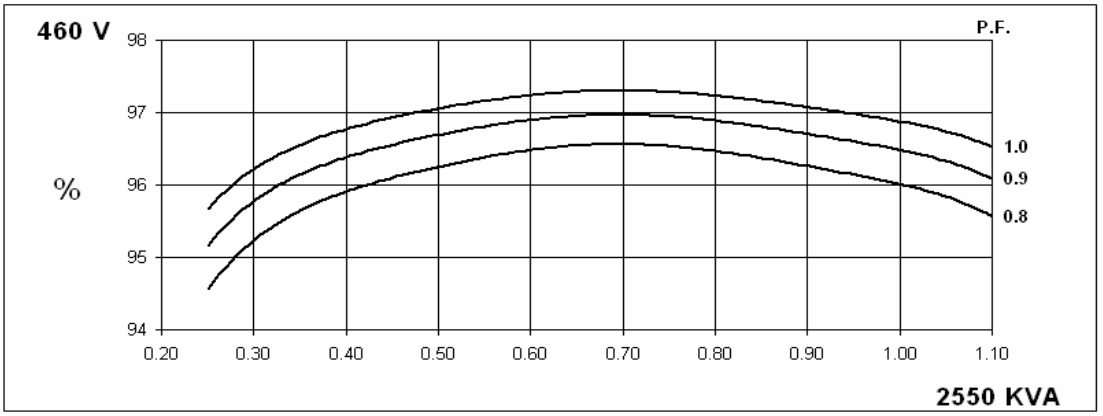
PI734F

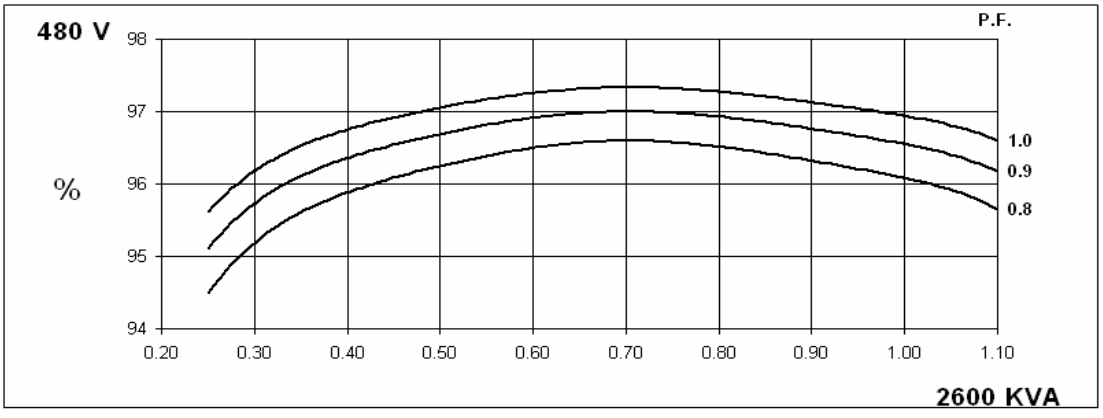
Winding 312

THREE PHASE EFFICIENCY CURVES





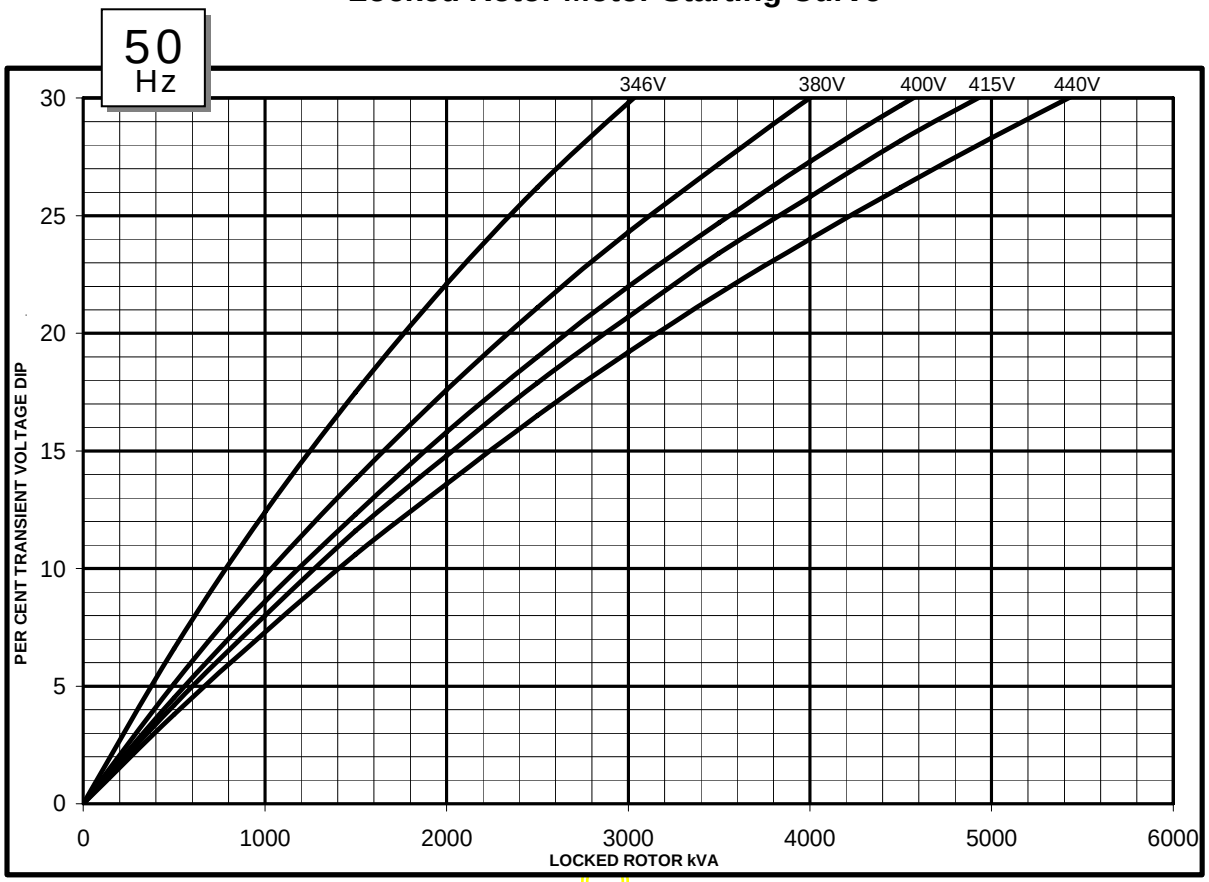


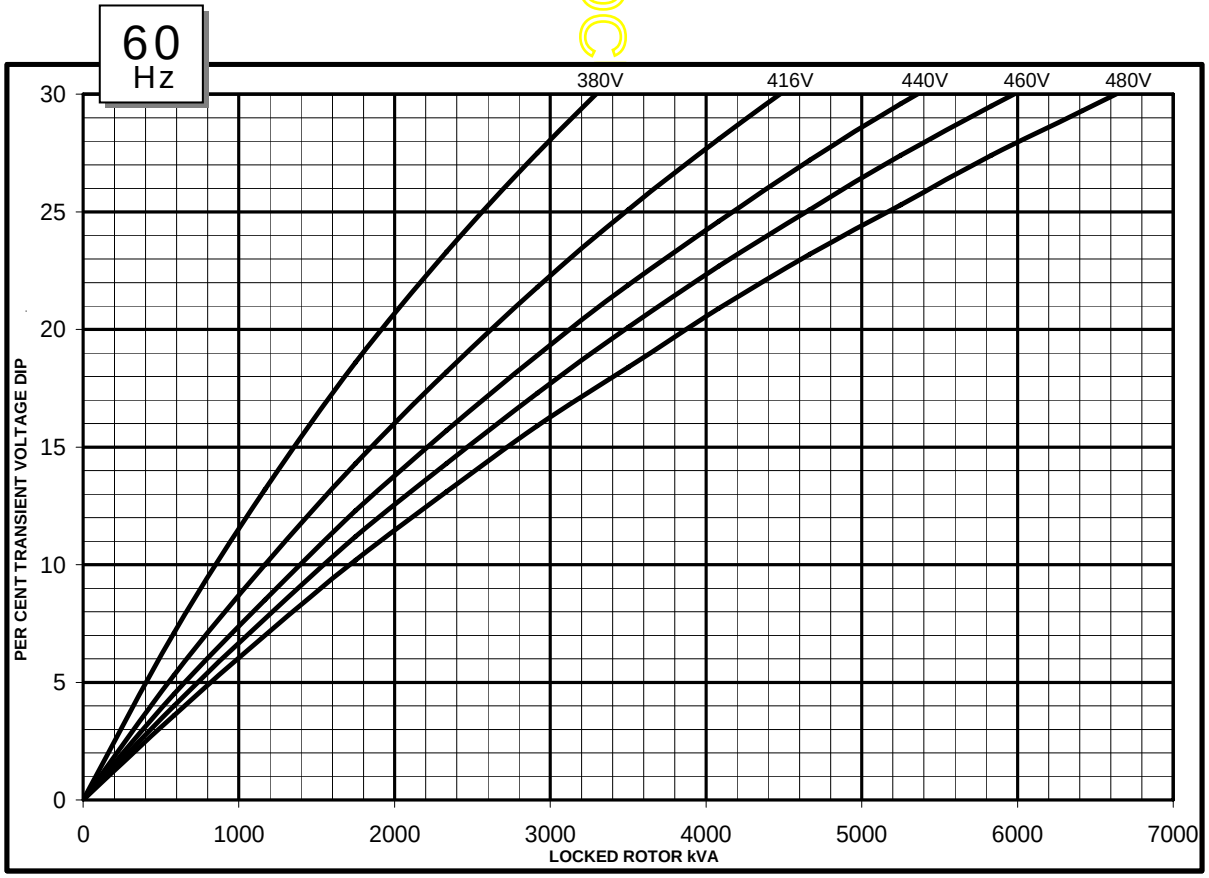


PI734F

Winding 312

Locked Rotor Motor Starting Curve





PI734F

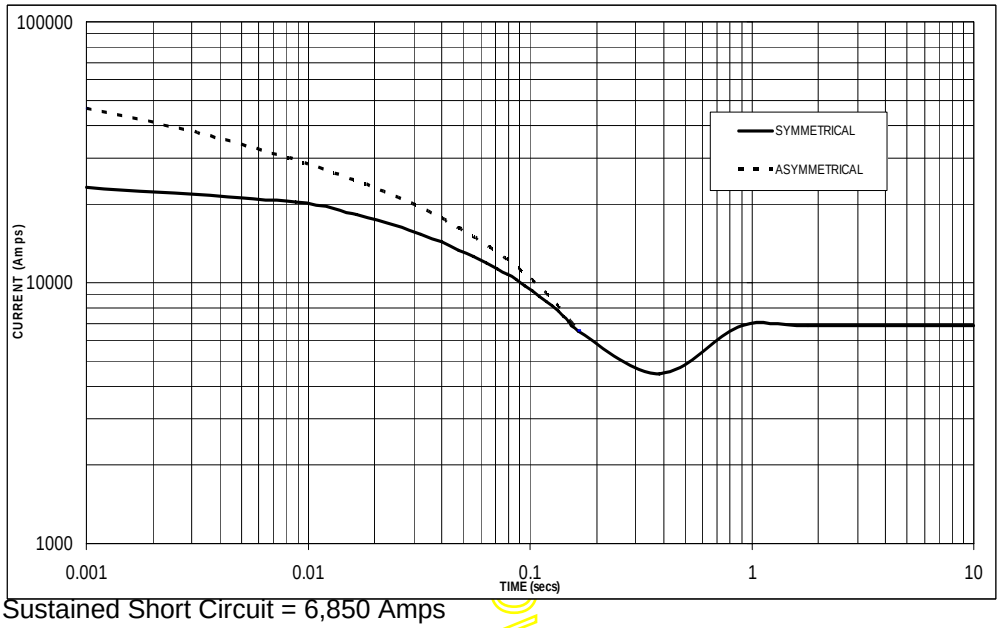
STAMFORD

Winding 312

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

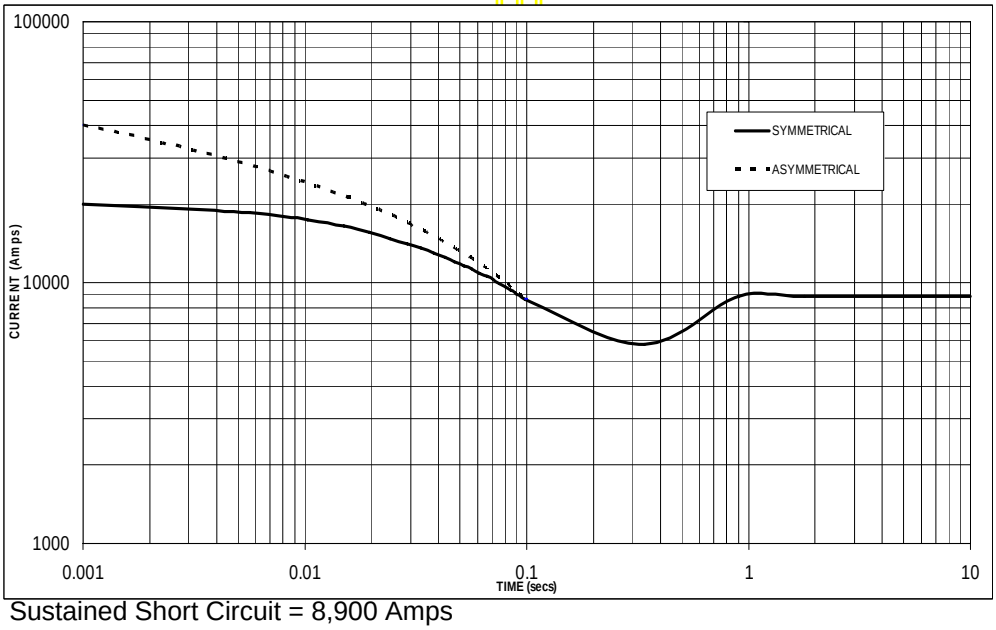
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 6,850 Amps

60 Hz



Sustained Short Circuit = 8,900 Amps

Note 1

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

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

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines.

PI734F

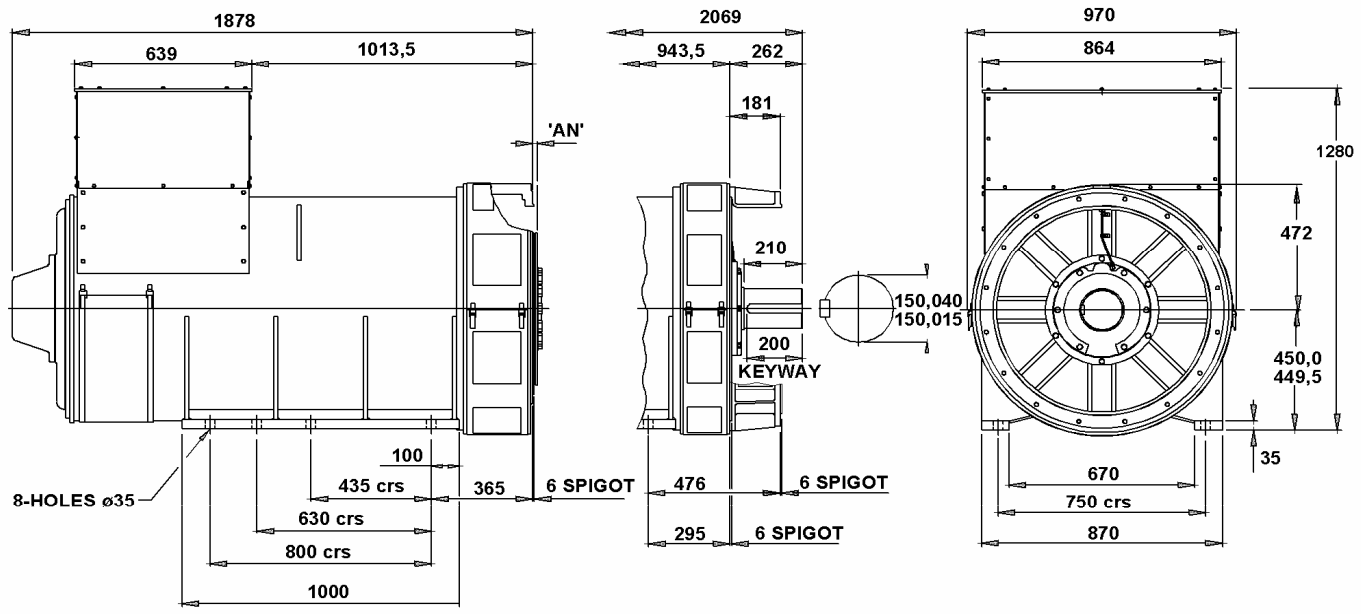
Winding 312 / 0.8 Power Factor

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
	kVA	1880	1935	1935	1900	2020	2080	2080	2040	2105	2170	2170	2125	2165	2250	2250	2185
	kW	1504	1548	1548	1520	1616	1664	1664	1632	1684	1736	1736	1700	1732	1800	1800	1748
	Efficiency (%)	96.1	96.2	96.3	96.4	96.0	96.0	96.1	96.3	95.9	95.9	96.0	96.2	95.8	95.8	96.0	96.2
	kW Input	1565	1609	1607	1577	1683	1733	1732	1695	1756	1810	1808	1767	1808	1878	1876	1817

60Hz	Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	kVA	2190	2325	2370	2420	2345	2500	2550	2600	2435	2600	2650	2705	2505	2675	2730	2785
	kW	1752	1860	1896	1936	1876	2000	2040	2080	1948	2080	2120	2164	2004	2140	2184	2228
	Efficiency (%)	96.0	96.1	96.1	96.2	95.9	95.9	96.0	96.1	95.8	95.8	95.9	96.0	95.7	95.8	95.9	95.9
	kW Input	1825	1935	1973	2012	1957	2086	2125	2164	2033	2171	2211	2254	2094	2234	2277	2323

DIMENSIONS



COUPLING DISC	'AN'
S.A.E No 18	15,7
S.A.E No 21	0
S.A.E No 24	0

1-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

2-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

APPROVED DOCUMENT

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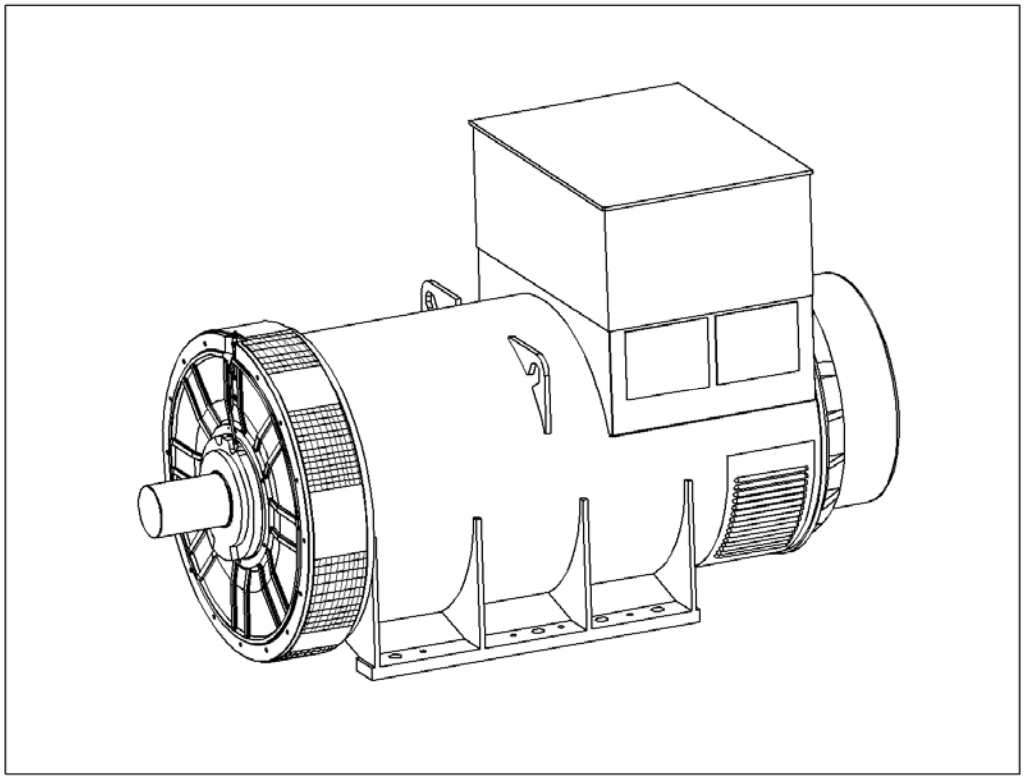
PI734G - Winding 312

Technical Data Sheet



SPECIFICATIONS & OPTIONS

STANDARDS
Stamford industrial generators meet the requirements of BS EN 60034 and the relevant sections of other national and international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC60034, CSA C22.2-100, AS1359.
Other standards and certifications can be considered on request.

DESCRIPTION
The STAMFORD PI range of synchronous ac generators are brushless with a rotating field. They are separately excited by the STAMFORD Permanent Magnet Generator (PMG). This is a shaft mounted, high frequency, pilot exciter which provides a constant supply of clean power via the Automatic Voltage Regulator (AVR) to the main exciter. The main exciter output is fed to the main rotor, through a full wave bridge rectifier, protected by surge suppression.

VOLTAGE REGULATORS
The PI range generators, complete with a PMG, are available with one of two AVRs. Each AVR has soft start voltage build up and built in protection against sustained over-excitation, which will de-excite the generator after a minimum of 8 seconds.
Underspeed protection (UFRO) is also provided on both AVRs. The UFRO will reduce the generator output voltage proportional to the speed of the generator below a pre-settable level.

The **MX341 AVR** is two phase sensed with a voltage regulation of ± 1 %. (see the note on regulation).

The **MX321 AVR** is 3 phase rms sensed with a voltage regulation of 0.5% rms (see the note on regulation). The UFRO circuit has adjustable slope and dwell for controlled recovery from step loads. An over voltage protection circuit will shutdown the output device of the AVR, it can also trip an optional excitation circuit breaker if required. As an option, short circuit current limiting is available with the addition of current transformers.

Both the MX341 and the MX321 need a generator mounted current transformer to provide quadrature droop characteristics for load sharing during parallel operation. Provision is also made for the connection of the STAMFORD power factor controller, for embedded applications, and a remote voltage trimmer.

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. 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 levels of voltage waveform distortion.

TERMINALS & TERMINAL BOX
Standard generators feature a main stator with 6 ends 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', and meets the requirements of UL1446.
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.

NOTE ON REGULATION
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 temperature exceeding 60°C must be referred to the factory.

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

Front cover drawing is typical of the product range.

PI734G

STAMFORD

WINDING 312

CONTROL SYSTEM	SEPARATELY EXCITED BY P.M.G.		
A.V.R.	MX341	MX321	
VOLTAGE REGULATION	± 1%	± 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							
MAIN STATOR RESISTANCE	0.0008 Ohms PER PHASE AT 22°C STAR CONNECTED							
MAIN ROTOR RESISTANCE	2.42 Ohms at 22°C							
EXCITER STATOR RESISTANCE	16 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.056 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. 6232 C3							
BEARING NON-DRIVE END	BALL. 6319 C3							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	4054 kg				4022 kg			
WEIGHT WOUND STATOR	2015 kg				2015 kg			
WEIGHT WOUND ROTOR	1697 kg				1654 kg			
WR² INERTIA	52.2511 kgm^2				51.3341 kgm^2			
SHIPPING WEIGHTS in a crate	4127kg				4091kg			
PACKING CRATE SIZE	216 x 105 x 154(cm)				216 x 105 x 154(cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	2.69 m³/sec 5700 cfm				3.45 m³/sec 7300 cfm			
VOLTAGE STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
kVA BASE RATING FOR REACTANCE VALUES	2135	2200	2200	2160	2420	2535	2625	2750
Xd DIR. AXIS SYNCHRONOUS	3.71	3.45	3.20	2.80	4.38	4.10	3.89	3.74
X'd DIR. AXIS TRANSIENT	0.21	0.19	0.18	0.15	0.24	0.23	0.22	0.21
X"d DIR. AXIS SUBTRANSIENT	0.15	0.14	0.13	0.11	0.17	0.16	0.15	0.15
Xq QUAD. AXIS REACTANCE	2.38	2.22	2.06	1.80	2.82	2.64	2.50	2.41
X"q QUAD. AXIS SUBTRANSIENT	0.28	0.26	0.24	0.21	0.33	0.31	0.30	0.28
X_L LEAKAGE REACTANCE	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
X_2 NEGATIVE SEQUENCE	0.20	0.19	0.18	0.15	0.24	0.22	0.21	0.21
X_0 ZERO SEQUENCE	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.04
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.16s							
T"d SUB-TRANSTIME CONST.	0.01s							
T'do O.C. FIELD TIME CONST.	2.89s							
Ta ARMATURE TIME CONST.	0.02s							
SHORT CIRCUIT RATIO	1/Xd							

50 Hz

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Winding 312

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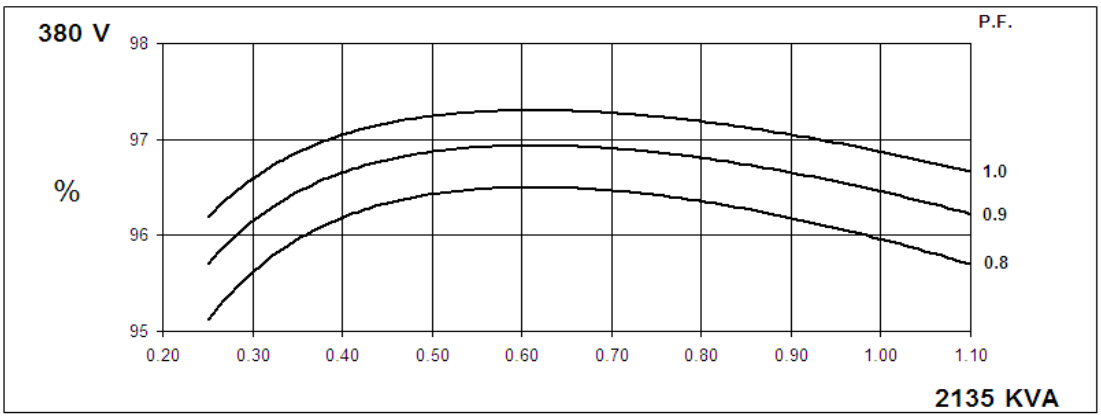
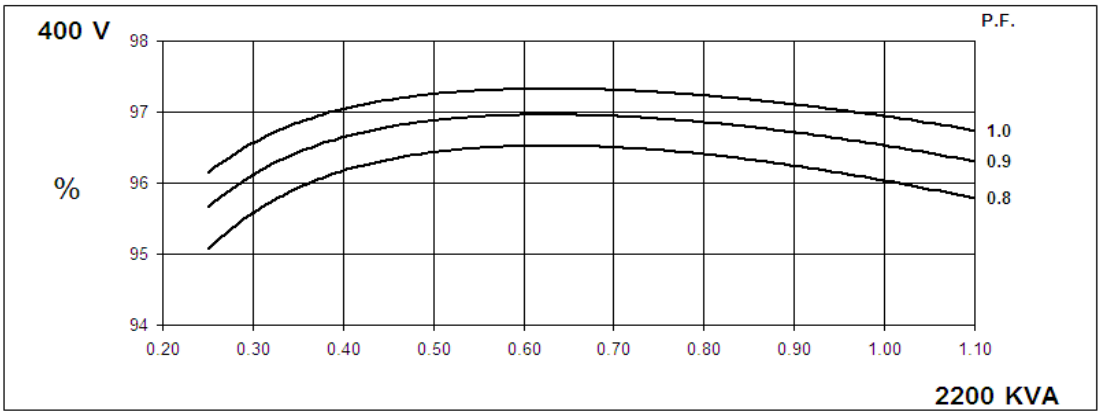
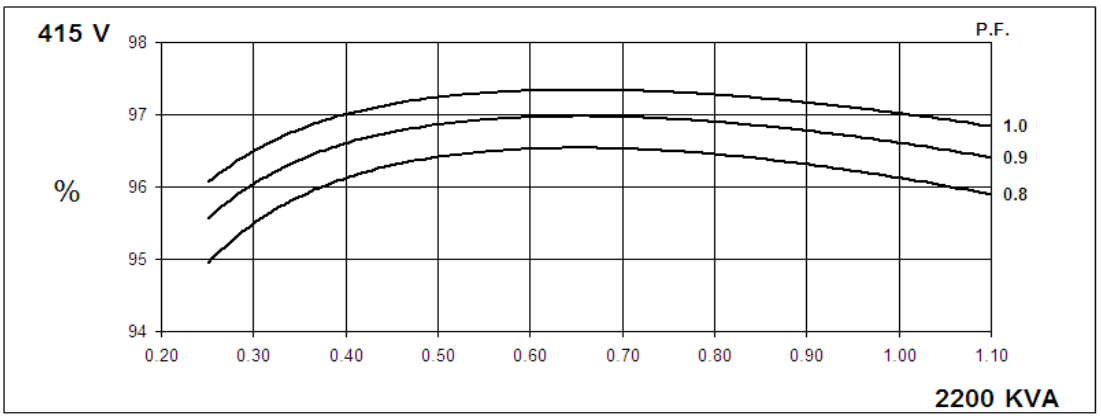
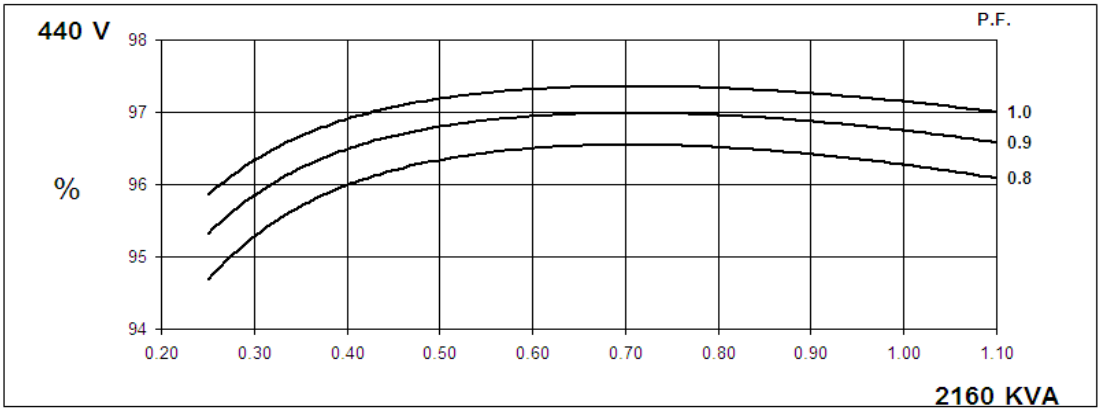
THREE PHASE EFFICIENCY CURVES









60 Hz

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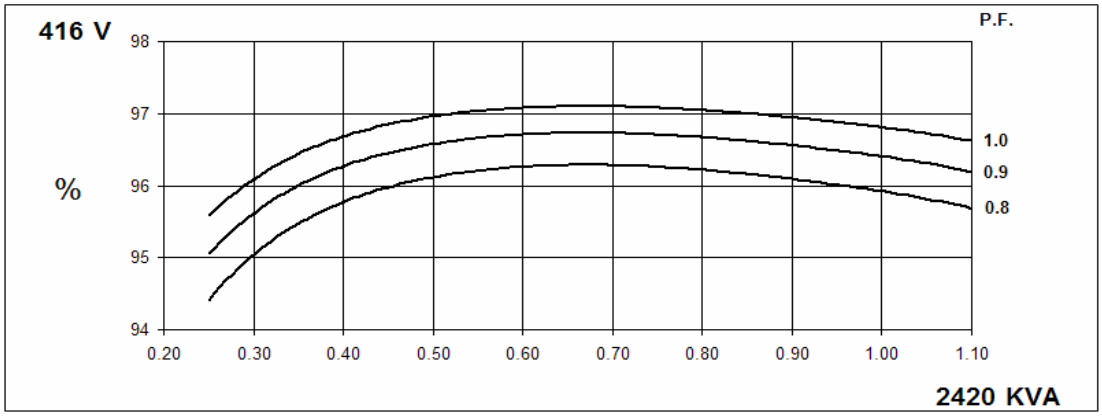
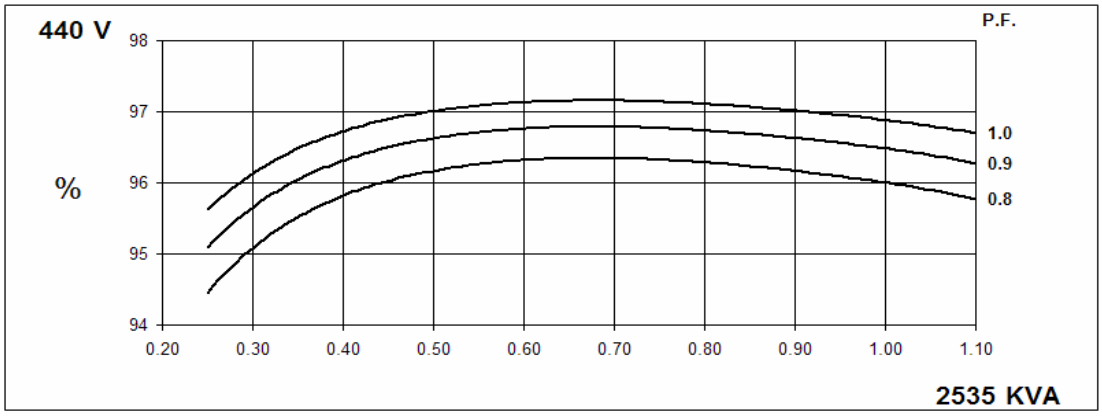
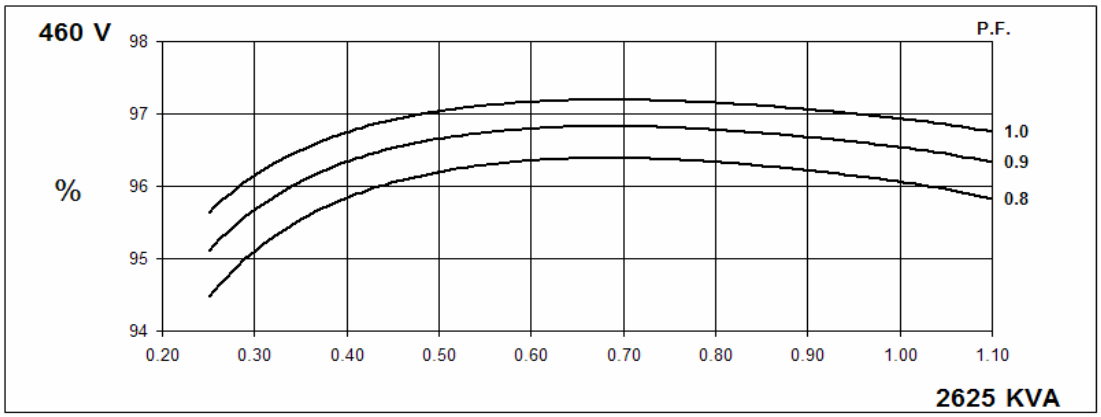
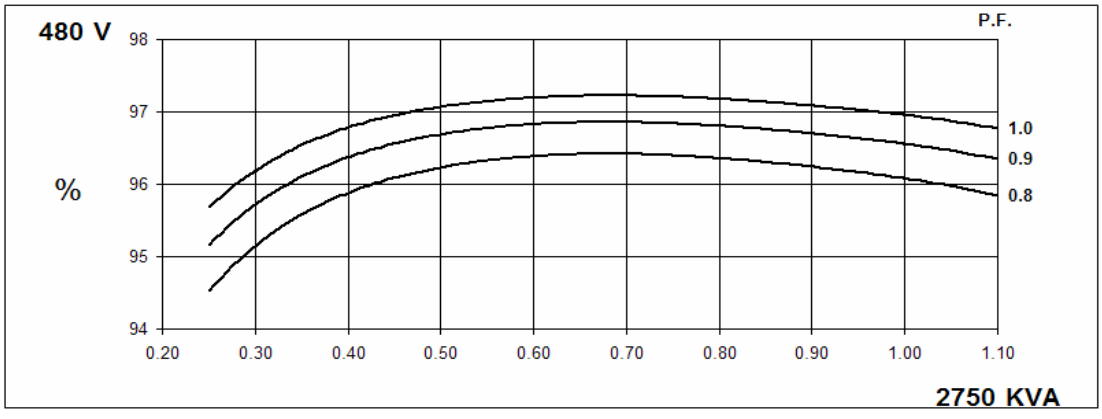
THREE PHASE EFFICIENCY CURVES









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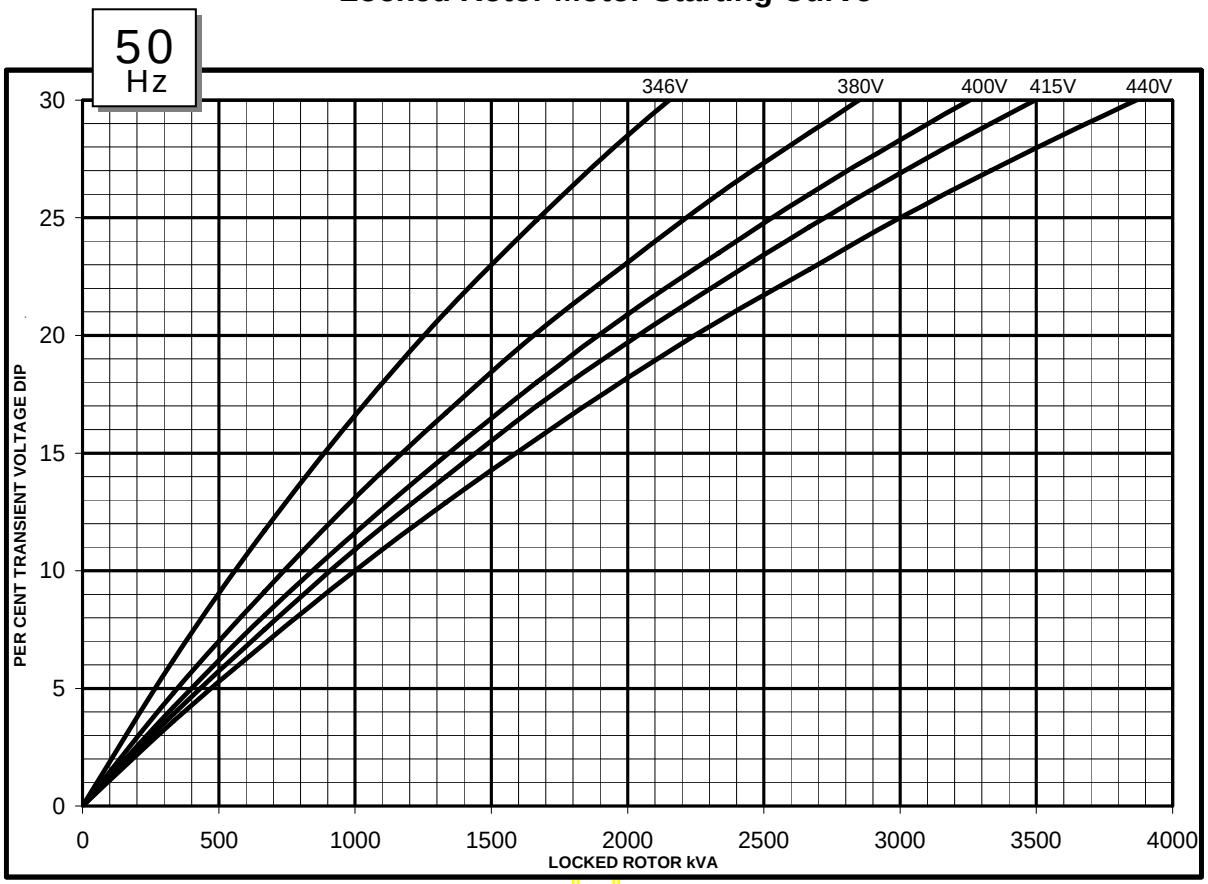
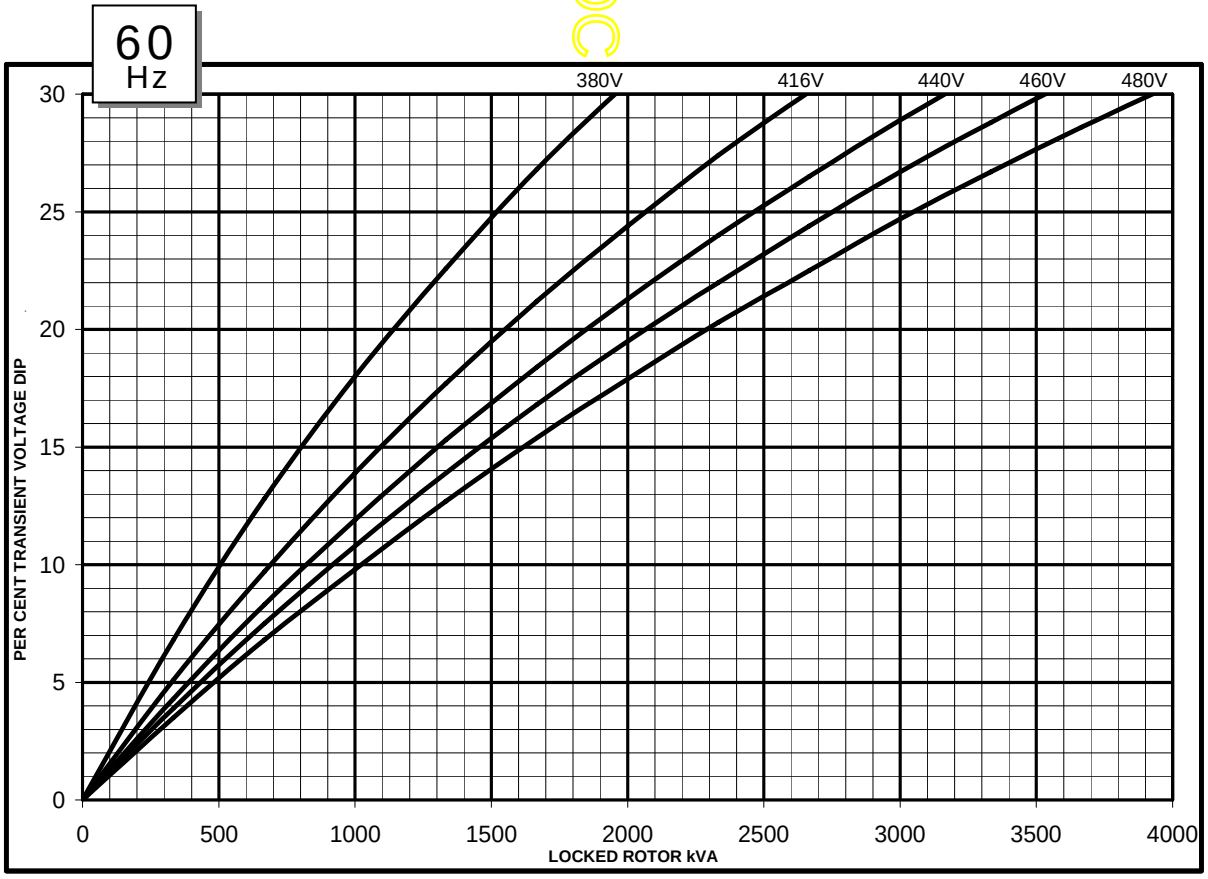
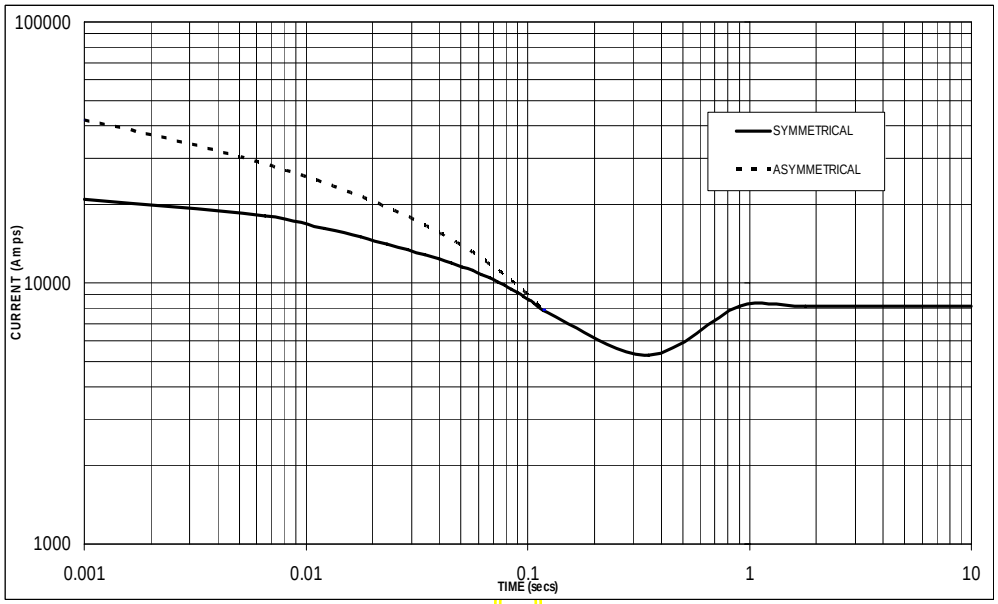
Locked Rotor Motor Starting Curve





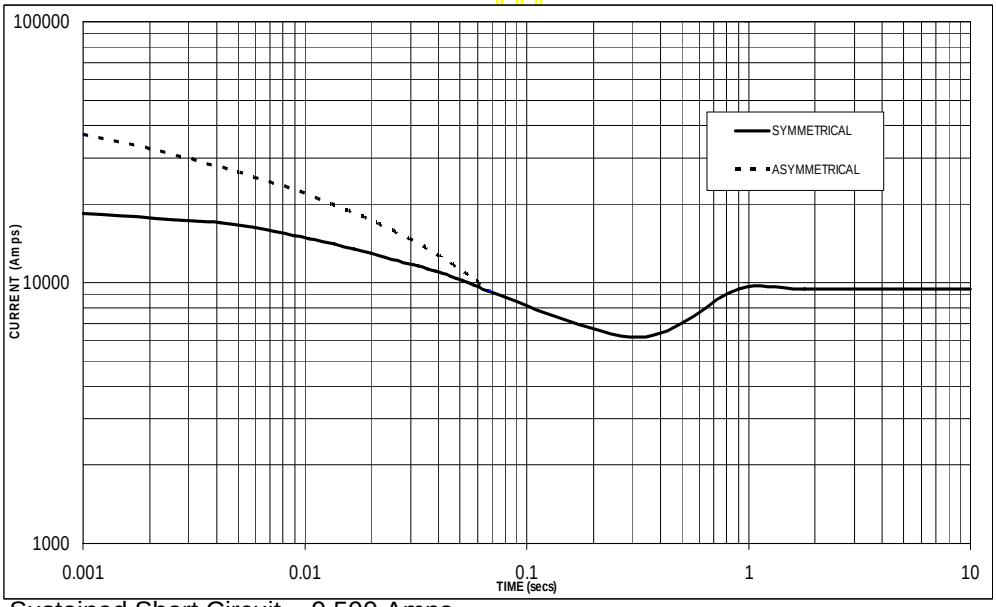
Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 8,150 Amps

60 Hz



Sustained Short Circuit = 9,500 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 1.05	440v	x 1.06
415v	x 1.09	460v	x 1.10
440v	x 1.16	480v	x 1.15

The sustained current value is constant irrespective of voltage level

Note 2

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

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

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines.

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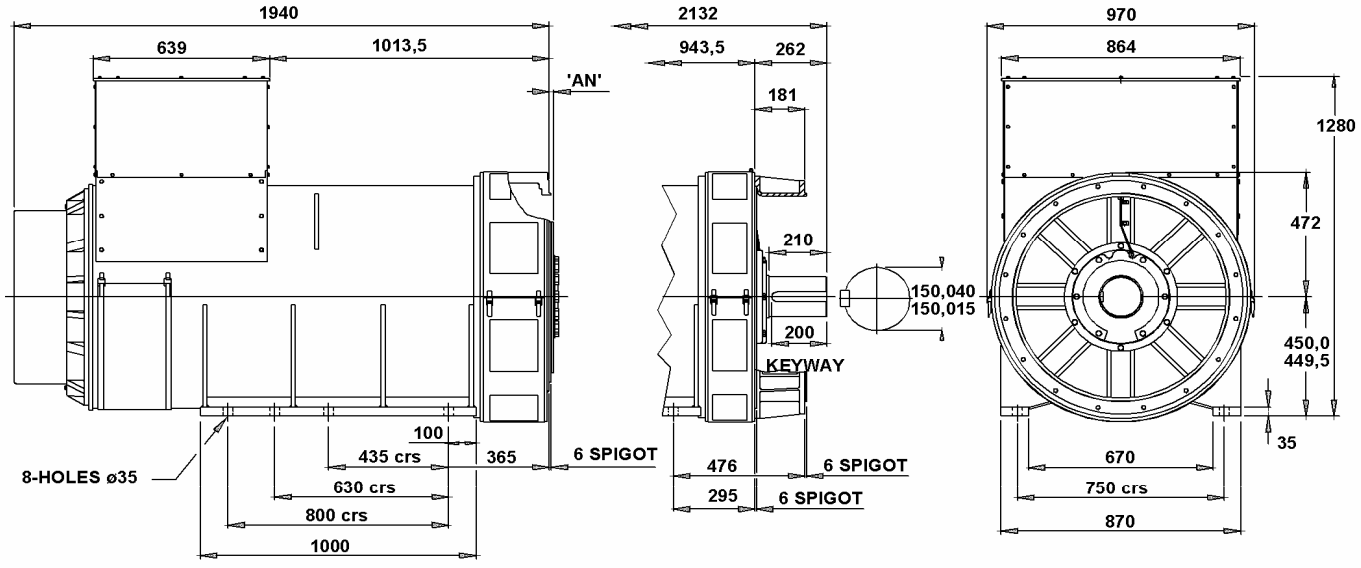
Winding 312 / 0.8 Power Factor

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
	kVA	1985	2050	2050	2005	2135	2200	2200	2160	2225	2295	2295	2250	2290	2360	2360	2310
	kW	1588	1640	1640	1604	1708	1760	1760	1728	1780	1836	1836	1800	1832	1888	1888	1848
	Efficiency (%)	96.1	96.2	96.3	96.4	96.0	96.0	96.1	96.3	95.9	95.9	96.0	96.2	95.8	95.9	96.0	96.1
	kW Input	1652	1705	1703	1664	1779	1833	1831	1794	1856	1914	1913	1871	1912	1969	1967	1923

60Hz	Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	kVA	2255	2360	2445	2560	2420	2535	2625	2750	2515	2635	2725	2860	2590	2715	2810	2945
	kW	1804	1888	1956	2048	1936	2028	2100	2200	2012	2108	2180	2288	2072	2172	2248	2356
	Efficiency (%)	96.0	96.1	96.2	96.2	95.9	96.0	96.1	96.1	95.8	95.9	96.0	96.0	95.8	95.9	95.9	95.9
	kW Input	1879	1965	2033	2129	2019	2113	2185	2289	2100	2198	2271	2383	2163	2265	2344	2457

DIMENSIONS



COUPLING DISC	'AN'
S.A.E No 21	0
S.A.E No 24	0

1-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

2-BRG ADAPTORS
S.A.E No 0
S.A.E No 00

APPROVED DOCUMENT

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