PI734F - Winding 312
Technical Data Sheet
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
#### 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

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEIGHT COMP. GENERATOR</td>
<td>3840 kg</td>
</tr>
<tr>
<td>WEIGHT WOUND STATOR</td>
<td>1908 kg</td>
</tr>
<tr>
<td>WEIGHT WOUND ROTOR</td>
<td>1609 kg</td>
</tr>
<tr>
<td>WR² INERTIA</td>
<td>49.3409 kgm²</td>
</tr>
<tr>
<td>SHIPPING WEIGHTS in a crate</td>
<td>3913kg</td>
</tr>
<tr>
<td>PACKING CRATE SIZE</td>
<td>216 x 105 x 154(cm)</td>
</tr>
<tr>
<td>TELEPHONE INTERFERENCE</td>
<td>THF&lt;2%, TIF&lt;50</td>
</tr>
<tr>
<td>COOLING AIR</td>
<td>2.69 m³/sec 5700 cfm</td>
</tr>
<tr>
<td>VOLTAGE STAR</td>
<td>380/220 400/231 415/240 440/254 416/240 440/254 460/266 480/277</td>
</tr>
<tr>
<td>kVA BASE RATING FOR REACTANCE VALUES</td>
<td>2020 2080 2080 2040 2345 2500 2550 2600</td>
</tr>
<tr>
<td>Xd DIR. AXIS SYNCHRONOUS</td>
<td>2.93 2.73 2.53 2.21 3.55 3.38 3.16 2.96</td>
</tr>
<tr>
<td>X’d DIR. AXIS TRANSIENT</td>
<td>0.18 0.17 0.15 0.13 0.21 0.20 0.19 0.18</td>
</tr>
<tr>
<td>X”d DIR. AXIS SUBTRANSIENT</td>
<td>0.13 0.12 0.11 0.10 0.16 0.15 0.14 0.13</td>
</tr>
<tr>
<td>Xq QUAD. AXIS REACTANCE</td>
<td>1.89 1.75 1.63 1.42 2.28 2.18 2.03 1.90</td>
</tr>
<tr>
<td>X”q QUAD. AXIS SUBTRANSIENT</td>
<td>0.26 0.25 0.23 0.20 0.32 0.31 0.29 0.27</td>
</tr>
<tr>
<td>XL LEAKAGE REACTANCE</td>
<td>0.03 0.03 0.03 0.03 0.04 0.04 0.04 0.03</td>
</tr>
<tr>
<td>Xe NEGATIVE SEQUENCE</td>
<td>0.19 0.17 0.16 0.14 0.23 0.22 0.20 0.19</td>
</tr>
<tr>
<td>Xe ZERO SEQUENCE</td>
<td>0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02</td>
</tr>
</tbody>
</table>

**REACTANCES ARE SATURATED**

**VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>T’d TRANSIENT TIME CONST.</td>
<td>0.154s</td>
</tr>
<tr>
<td>T”d SUB-TRANS TIME CONST.</td>
<td>0.02s</td>
</tr>
<tr>
<td>Tdq O.C. FIELD TIME CONST.</td>
<td>2.54s</td>
</tr>
<tr>
<td>Ta ARMATURE TIME CONST.</td>
<td>0.02s</td>
</tr>
<tr>
<td>SHORT CIRCUIT RATIO</td>
<td>1/Xd</td>
</tr>
</tbody>
</table>
THREE PHASE EFFICIENCY CURVES

60 Hz

PI734F
Winding 312

2345 KVA

416 V

440 V

460 V

480 V

2500 KVA

2550 KVA

2600 KVA
Locked Rotor Motor Starting Curve

50 Hz

60 Hz

0 1000 2000 3000 4000 5000 6000

0 1000 2000 3000 4000 5000 6000

346V 380V 400V 415V 440V

380V 416V 440V 460V 480V

Per Cent Transient Voltage Dip

Locked Rotor kW

Locked Rotor kVA

0 5 10 15 20 25 30

0 5 10 15 20 25 30

380V 416V 440V 460V 480V

346V 380V 400V 415V 440V

50 Hz

60 Hz

Hz
PI734F
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:

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>50Hz Factor</th>
<th>60Hz Voltage</th>
<th>60Hz Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>380v</td>
<td>x 1.00</td>
<td>416v</td>
<td>x 1.00</td>
</tr>
<tr>
<td>400v</td>
<td>x 1.05</td>
<td>440v</td>
<td>x 1.06</td>
</tr>
<tr>
<td>415v</td>
<td>x 1.09</td>
<td>460v</td>
<td>x 1.10</td>
</tr>
<tr>
<td>440v</td>
<td>x 1.16</td>
<td>480v</td>
<td>x 1.15</td>
</tr>
</tbody>
</table>

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:

- Instantaneous: x 1.00
- Minimum: x 1.00
- Sustained: x 1.00
- Max. sustained duration: 10 sec.

All other times are unchanged.

Note 3
Curves are drawn for Star (Wye) connected machines.
### RATINGS

<table>
<thead>
<tr>
<th>Class - Temp Rise</th>
<th>Cont. F - 105/40°C</th>
<th>Cont. H - 125/40°C</th>
<th>Standby - 150/40°C</th>
<th>Standby - 163/27°C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>50Hz</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Star (V)</td>
<td>380 400 415 440</td>
<td>380 400 415 440</td>
<td>380 400 415 440</td>
<td>380 400 415 440</td>
</tr>
<tr>
<td>kVA</td>
<td>1880 1935 1935 1900</td>
<td>2020 2080 2080 2040</td>
<td>2105 2170 2170 2125</td>
<td>2165 2250 2250 2185</td>
</tr>
<tr>
<td>kW</td>
<td>1504 1548 1548 1520</td>
<td>1616 1664 1664 1632</td>
<td>1684 1736 1736 1700</td>
<td>1732 1800 1800 1748</td>
</tr>
<tr>
<td>Efficiency (%)</td>
<td>96.1 96.2 96.3 96.4</td>
<td>96.0 96.0 96.1 96.3</td>
<td>95.9 95.9 96.0 96.2</td>
<td>95.8 95.8 96.0 96.2</td>
</tr>
<tr>
<td>kW Input</td>
<td>1565 1609 1607 1577</td>
<td>1683 1733 1732 1695</td>
<td>1756 1810 1808 1767</td>
<td>1808 1878 1876 1817</td>
</tr>
<tr>
<td><strong>60Hz</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Star (V)</td>
<td>416 440 460 480</td>
<td>416 440 460 480</td>
<td>416 440 460 480</td>
<td>416 440 460 480</td>
</tr>
<tr>
<td>kVA</td>
<td>2190 2325 2370 2420</td>
<td>2345 2500 2550 2600</td>
<td>2435 2600 2650 2705</td>
<td>2505 2675 2730 2785</td>
</tr>
<tr>
<td>kW</td>
<td>1752 1860 1896 1936</td>
<td>1876 2000 2040 2080</td>
<td>1948 2080 2120 2164</td>
<td>2004 2140 2184 2228</td>
</tr>
<tr>
<td>Efficiency (%)</td>
<td>96.0 96.1 96.1 96.2</td>
<td>95.9 95.9 96.0 96.1</td>
<td>95.8 95.8 95.9 96.0</td>
<td>95.7 95.8 95.9 95.9</td>
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<tr>
<td>kW Input</td>
<td>1825 1935 1973 2012</td>
<td>1957 2086 2125 2164</td>
<td>2033 2171 2211 2254</td>
<td>2094 2234 2277 2323</td>
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</table>

### DIMENSIONS

<table>
<thead>
<tr>
<th>COUPLING DISC 'AN'</th>
<th>1-BRG ADAPTORS</th>
<th>2-BRG ADAPTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.A.E No 18 15,7</td>
<td>S.A.E No 0</td>
<td>S.A.E No 0</td>
</tr>
<tr>
<td>S.A.E No 21 0</td>
<td>S.A.E No 00</td>
<td>S.A.E No 00</td>
</tr>
<tr>
<td>S.A.E No 24 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>