SSW7000
Medium Voltage Soft-Starter
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The SSW7000 uses **latest technology** to provide start/stop control and protection for three-phase induction and synchronous medium voltage motors. Developed to ensure **excellent performance**, it prevents mechanical shocks from the load, protects the motor against related burnouts or current surges in the power supply and thus, offers prepackaged and engineered solutions for various applications including Marine & Mining.

**The SSW7000 reduces the voltage applied to the motor at start.** As a consequence, motor current and torque are reduced for a smooth start. The motor voltage control is performed with the firing angle control of the thyristors in antiparallel connection.

**Main Features**
- Integrated bypass
- Circuit breakers are not required because there is a line contactor
- Motor protection built-in in the standard cabinet
- Heavy duty design at 50 °C ambient temperature (above 40 °C with current derating)
- User friendly configuration and operation
- Fibre-optic firing
- Complete isolation between MV and LV compartments
Certifications

CE  UL  US
Features

- Motor Voltage: 2.3 kV to 6.9 kV
- Torque control - FTC - Flexible Torque Control, technology developed by WEG which uses the vector control and control of direct torque concepts, based on technologies developed for the vector frequency inverters CFW. The FTC is flexible to select the desired torque control according to the type of load applied to the motor (constant loads, quadratic loads, or loads with lower or higher starting torque), providing a smooth start with a linear speed ramp along the entire starting process.
- Accessories can be easily and quickly installed by using the Plug & Play concept.
- Protection degree: IP41 or NEMA 12
- Operating interface (HMI) with graphic LCD
- Real-time clock
- Medium voltage fuses
- Power and control insulated by fiber optics
- Main and Bypass Vacuum Contactors able to perform DOL start
- Flash memory module (accessory)
- SoftPLC function
- Licence-free software SuperDrive and WLP
- USB connection to PC
- Motor thermal protection - Pt-100 - 8 channels (optional accessory)
- 5 start modes
- Network communication boards (accessories): DeviceNet, Profibus-DP, Ethernet and Modbus, RS232 or RS485
- Oriented Startup function presents minimum programming sequence to commence the operation
- Active Protection offers complete motor protection in DOL mode and eliminated the need of extra protection relays
- Ground Fault Protection – Standard
- Easy installation and suitable for Retrofits
- 40 years MTBF
- No need of back access

Plug & Play Philosophy

The installation of the accessories is based on the Plug & Play philosophy, that is, they are automatically configured when connected to the SSW7000, ensuring a faster and easier process.

Human Machine Interface - HMI (standard)

Slot 5 - Flash memory module (optional)

Slot 1 and 2 - Temperature sensor module Pt-100 (optional)

Slot 3 - Communication (optional)

Slot 4 - Communication (optional)

Superdrive G2

License-free software (available at WEG website) for total control and monitoring of WEG SSW7000.
- Parameter upload and download
- Soft-Starter operation
- Soft-Starter monitoring
- On-line and off-line programming

Trace function
Heavy Duty Design

- The heatsinks are sized for real heavy duty overload cycle
- The power stacks are developed in independent modules with wheels, making installation and maintenance easy

Human Machine Interface - HMI

Navigation is similar to the logic used in cell phones, with the option of sequential access to the parameters or through the groups (Menu) by means of the function access keys on the display (soft keys).

Easy to Read Display

SSW7000 has an easy to read display, offering extensive feedback and real-time information.

You can configure your own display to show the most relevant data for your application.

Remote Mount Display

SSW7000 display can be mounted on panel door reducing the need of separate meters and status indicators or mounted remotely on customer’s console.

Languages

English, Portuguese, Spanish, others under request.

Event Log

SSW7000 HMI interface provides a fault history saving last 10 faults with date and time, motor current, power supply voltage in the fault and operating status.
Applications

Cement & Mining
Pumps, Fans, Exhausters, Conveyors and Mills

Sugar & Ethanol
Pumps, Fans and Exhausters

Metals
Pumps, Fans and Exhausters

Water & Waste
Pumps, Fans and Exhausters

Pulp & Paper
Pumps, Fans and Exhausters
Chemical, Petrochemical, Oil & Gas

Pumps, Fans, Exhausters, Compressors and Mixers

Customized Solutions

WEG can provide engineered solutions under request.

- Reversing motor starter (clockwise and counter-clockwise)
- Redundant protection via relay
- Medium voltage capacitors - PFC
- IP54 protection degree
- Output grounding switch
- Soft-Starter for brush/brushless synchronous motors
- Over 600 A under request

Note: for engineered solutions, please get in contact with the factory or WEG sales representative.
Advantages in Using WEG Soft-Starter

Mechanical Benefits
- Reduced mechanical stress on drive-train (gear, bearing wear and failures, belt wear, pump impeller wear, minimizes valve and pipe repair costs)
- Prolong motor life
- Provides smooth (step-less) ramping of motor speed

Electrical Benefits
- Better power quality
- Reduced stress on transformers, power line and motor rotor/stator
- Reduced voltage drop
- No need of oversized generators
- Prolong motor life
- Complete isolation between MV and LV compartments
- Optical fiber firing
- Fewer distribution problems

Cost Benefits
- Normally MV solid state Soft-Starters cost less than other reduced voltage starting methods and less than a DOL + Protection Relay
- Lower operating costs as SSW7000 helps to reduce energy consumption, for example with the reduction of inrush currents
- Providing smoother and step-less acceleration reduces load shocking to the drive train and machinery which means less investment in maintenance
- Faster pay-back when compared to other starting methods
- Extends the life time of the complete drive system, reduces maintenance time and costs
- Better price/performance ratio

Process Benefits
- Productivity and uptime can be greatly increased by reducing costs associated with maintenance, downtime and parts replacement.
- Prolong system life
- Provides smooth (step-less) ramping of motor speed
- Gradually stop a load (e.g. avoid water hammer in pipe lines)
- Prevents pressure surges from pumps and piping systems
- Prevents jerk and surge-free motion of conveyor belts
Starting and Stopping Modes

WEG SSW7000 is Supplied With the Possibility to Adjust Starting Curve to the Load Curve With Several Options

**Torque Control**

It allows choosing which torque profile the SSW will follow during the motor starting. WEG SSW7000 has three torque profiles available, which makes possible to start any type of load, constant or 1 point linear or 2 points and quadratic or 3 points:

1: Constant torque
2: Linear torque
3: Quadratic torque

**Pump Control**

It limits the starting torque and the stopping speed for a smooth management in water pumps. Reduce the Water Hammer, pressure overshoots inside the hydraulic pipelines which could damage them. Set voltage is applied using voltage and current feedback measurement. Special algorithm aims to minimize pressure overshoots within piping to prevent material wear.

**Current Ramp**

Useful for application with Variable Torque. It can be used in weak power supplies to limit the current.

**Voltage Ramp**

Used for starting loads with low starting torque and quadratic torque.
## Models

### Size A and B

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Product</th>
<th>Rated current (A)</th>
<th>Frame</th>
<th>Motor maximum power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2,300 V ac</strong></td>
<td>SSW7000A 070 T2 XX 41</td>
<td>70</td>
<td>A</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 180 T2 XX 41</td>
<td>180</td>
<td>A</td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 300 T2 XX 41</td>
<td>300</td>
<td>A</td>
<td>1,350</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 360 T2 XX 41</td>
<td>360</td>
<td>A</td>
<td>1,500</td>
</tr>
<tr>
<td></td>
<td>SSW7000B 500 T2 XX 41</td>
<td>500</td>
<td>B</td>
<td>2,375</td>
</tr>
<tr>
<td></td>
<td>SSW7000B 600 T2 XX 41</td>
<td>600</td>
<td>B</td>
<td>2,750</td>
</tr>
<tr>
<td><strong>3,300 V ac</strong></td>
<td>SSW7000A 070 T4 XX 41</td>
<td>70</td>
<td>A</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 180 T4 XX 41</td>
<td>180</td>
<td>A</td>
<td>1,300</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 300 T4 XX 41</td>
<td>300</td>
<td>A</td>
<td>2,200</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 360 T4 XX 41</td>
<td>360</td>
<td>A</td>
<td>2,700</td>
</tr>
<tr>
<td></td>
<td>SSW7000B 500 T4 XX 41</td>
<td>500</td>
<td>B</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>SSW7000B 600 T4 XX 41</td>
<td>600</td>
<td>B</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>4,160 V ac</strong></td>
<td>SSW7000A 070 T4 XX 41</td>
<td>70</td>
<td>A</td>
<td>650</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 180 T4 XX 41</td>
<td>180</td>
<td>A</td>
<td>1,500</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 300 T4 XX 41</td>
<td>300</td>
<td>A</td>
<td>2,500</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 360 T4 XX 41</td>
<td>360</td>
<td>A</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td>SSW7000B 500 T4 XX 41</td>
<td>500</td>
<td>B</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>SSW7000B 600 T4 XX 41</td>
<td>600</td>
<td>B</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>6,900 V ac</strong></td>
<td>SSW7000A 070 T6 XX 41</td>
<td>70</td>
<td>A</td>
<td>1,100</td>
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<td></td>
<td>SSW7000A 180 T6 XX 41</td>
<td>180</td>
<td>A</td>
<td>2,500</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 300 T6 XX 41</td>
<td>300</td>
<td>A</td>
<td>3,700</td>
</tr>
<tr>
<td></td>
<td>SSW7000A 360 T6 XX 41</td>
<td>360</td>
<td>A</td>
<td>4,500</td>
</tr>
<tr>
<td></td>
<td>SSW7000B 500 T6 XX 41</td>
<td>500</td>
<td>B</td>
<td>6,250</td>
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<tr>
<td></td>
<td>SSW7000B 600 T6 XX 41</td>
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<td>7,500</td>
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### Size N (Manufactured in USA)

<table>
<thead>
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<th>Power supply</th>
<th>Product</th>
<th>Rated current (A)</th>
<th>Frame</th>
<th>Motor maximum power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2,300 V ac</strong></td>
<td>SSW7000N 070 T2 XX N2</td>
<td>70</td>
<td>N</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>SSW7000N 180 T2 XX N2</td>
<td>180</td>
<td>N</td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>SSW7000N 300 T2 XX N2</td>
<td>300</td>
<td>N</td>
<td>1,350</td>
</tr>
<tr>
<td></td>
<td>SSW7000N 360 T2 XX N2</td>
<td>360</td>
<td>N</td>
<td>1,500</td>
</tr>
<tr>
<td><strong>3,300 V ac</strong></td>
<td>SSW7000N 070 T4 XX N2</td>
<td>70</td>
<td>N</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>SSW7000N 180 T4 XX N2</td>
<td>180</td>
<td>N</td>
<td>1,300</td>
</tr>
<tr>
<td></td>
<td>SSW7000N 300 T4 XX N2</td>
<td>300</td>
<td>N</td>
<td>2,200</td>
</tr>
<tr>
<td></td>
<td>SSW7000N 360 T4 XX N2</td>
<td>360</td>
<td>N</td>
<td>2,700</td>
</tr>
<tr>
<td><strong>4,160 V ac</strong></td>
<td>SSW7000N 070 T4 XX N2</td>
<td>70</td>
<td>N</td>
<td>650</td>
</tr>
<tr>
<td></td>
<td>SSW7000N 180 T4 XX N2</td>
<td>180</td>
<td>N</td>
<td>1,500</td>
</tr>
<tr>
<td></td>
<td>SSW7000N 300 T4 XX N2</td>
<td>300</td>
<td>N</td>
<td>2,500</td>
</tr>
<tr>
<td></td>
<td>SSW7000N 360 T4 XX N2</td>
<td>360</td>
<td>N</td>
<td>3,000</td>
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</tbody>
</table>

### Size C

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Product</th>
<th>Rated current (A)</th>
<th>Frame</th>
<th>Motor maximum power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2,300 V ac</strong></td>
<td>SSW7000C 125 T4 XX XX</td>
<td>125</td>
<td>C</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>SSW7000C 250 T4 XX XX</td>
<td>250</td>
<td>C</td>
<td>1,300</td>
</tr>
<tr>
<td></td>
<td>SSW7000C 360 T4 XX XX</td>
<td>360</td>
<td>C</td>
<td>1,900</td>
</tr>
<tr>
<td><strong>4,160 V ac</strong></td>
<td>SSW7000C 125 T4 XX XX</td>
<td>125</td>
<td>C</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>SSW7000C 250 T4 XX XX</td>
<td>250</td>
<td>C</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>SSW7000C 360 T4 XX XX</td>
<td>360</td>
<td>C</td>
<td>3,000</td>
</tr>
</tbody>
</table>
Sizing the Appropriate Soft-Starter

- Type of application (pump, compressor, conveyor, etc.)
- Motor rated power (HP or kW)
- Motor nominal current (A)
- Motor nominal voltage (V)
- Motor synchronous speed (rpm)
- Curve current x speed
- Curve motor torque x speed
- Curve load torque x speed
- Rotor and load inertia J=GD²/4 (Kgm²)
- Number of starts per hour and time between them
- Ambient temperature
- Altitude above sea level

**Product Code**

**Output current**
- 070 = 70 A
- 180 = 180 A
- 300 = 300 A
- 360 = 360 A
- 500 = 500 A
- 600 = 600 A

**Single phase auxiliary power supply**
- 11 = 110 V ac
- 22 = 220 V ac

**Frame size**
- A - Size A
- B - Size B
- C - Size C
- N - Size N

**Protection degree**
- 00 - IP00 (kits)
- 41 - IP41
- N2 - NEMA12

**Product line**

- SSW7000
- T2 - 2.3 kV
- T4 - 3.3/4.16 kV
- T6 - 6.9 kV

- A
- 500
- T4
- XX
- 41
## Accessories

<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
<th>Slot</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOE-04</td>
<td>Module for 8 temperature sensors Pt-100</td>
<td>1 and 2</td>
</tr>
<tr>
<td>RS485-01</td>
<td>RS485 serial communication module (Modbus)</td>
<td>3</td>
</tr>
<tr>
<td>RS232-01</td>
<td>RS232 serial communication module (Modbus)</td>
<td></td>
</tr>
<tr>
<td>RS232-02</td>
<td>RS232C serial communication module with switch to program the microcontroller Flash memory</td>
<td></td>
</tr>
<tr>
<td>RS232-03</td>
<td>RS232 interface module (passive) (Modbus)</td>
<td></td>
</tr>
<tr>
<td>PROFDP-05</td>
<td>Profibus-DP interface module</td>
<td>4</td>
</tr>
<tr>
<td>DEVCENET-05</td>
<td>DeviceNet interface module</td>
<td></td>
</tr>
<tr>
<td>ETHERNET/IP-05</td>
<td>Ethernet/IP interface module</td>
<td></td>
</tr>
<tr>
<td>RS485-05</td>
<td>RS485 interface module (passive) (Modbus)</td>
<td></td>
</tr>
<tr>
<td>MMF-01</td>
<td>Flash memory module</td>
<td>5</td>
</tr>
<tr>
<td>HMI-01</td>
<td>Man Machine Interface – MMI (sold separately)</td>
<td></td>
</tr>
<tr>
<td>RHIMF-01</td>
<td>Frame kit for MMI (protection rate IP56)</td>
<td></td>
</tr>
<tr>
<td>TC FT</td>
<td>Ground fault CT</td>
<td></td>
</tr>
</tbody>
</table>

## Block Diagram - Standard

Medium voltage power supply

- Disconnecting switch and fuses
- Main contactor
- CTs
- Bypass contactor

Power stack

- Soft-Starter panel
- Medium voltage motor

- M 3~
Dimensions

SSW7000 Complete Panel Dimensions

<table>
<thead>
<tr>
<th>Frame</th>
<th>Width (mm/in)</th>
<th>Height (mm/in)</th>
<th>Depth (mm/in)</th>
<th>Weight (without the arms) (kg/lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,200 (47)</td>
<td>2,365 (93)</td>
<td>1,007 (40)</td>
<td>720 (1,588)</td>
</tr>
<tr>
<td>B</td>
<td>1,800 (71)</td>
<td>2,365 (93)</td>
<td>1,007 (40)</td>
<td>1,200 (600)</td>
</tr>
<tr>
<td>C</td>
<td>915 (36)</td>
<td>2,413 (95)</td>
<td>762 (30)</td>
<td>546 (1,205)</td>
</tr>
<tr>
<td>N</td>
<td>1,072 (42)</td>
<td>2,365 (93)</td>
<td>845 (33)</td>
<td>560 (1,235)</td>
</tr>
</tbody>
</table>

Kits - Power Arms

<table>
<thead>
<tr>
<th>Rated voltage (kV)</th>
<th>Width (mm/in)</th>
<th>Height (mm/in)</th>
<th>Depth (mm/in)</th>
<th>Weight (kg/lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3</td>
<td>262 (10.31)</td>
<td>722 (28.42)</td>
<td>430 (16.93)</td>
<td>53.0 (116.84)</td>
</tr>
<tr>
<td>4.16</td>
<td>262 (10.31)</td>
<td>722 (28.42)</td>
<td>546 (21.5)</td>
<td>68.8 (151.24)</td>
</tr>
<tr>
<td>6.9 kV</td>
<td>262 (10.31)</td>
<td>722 (28.42)</td>
<td>664 (26.14)</td>
<td>83.3 (183.64)</td>
</tr>
<tr>
<td>4.16 - Compact</td>
<td>226 (9.90)</td>
<td>585 (23.03)</td>
<td>482 (19.0)</td>
<td>30.1 (66.35)</td>
</tr>
</tbody>
</table>
## General Technical Characteristics

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Standard (Frame: A, B)</th>
<th>Compact (Frame: C, N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>Power voltage (R/1 L1, S/3L2, T/5L3)</td>
<td>Models: 2,300 V ac: (-60% to +10%) or (920 to 2,530 V ac) 4,160 V ac: (-60% to +10%) or (1,664 to 4,576 V ac) 6,900 V ac: (-60% to +10%) or (2,760 to 7,590 V ac)</td>
</tr>
<tr>
<td>Frequency</td>
<td>(50 to 60 Hz): (±10%) or (45 to 66 Hz)</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>Number of starts</td>
<td>5 starts in 2 hours (one start every 30 minutes), others under request</td>
</tr>
<tr>
<td></td>
<td>Starting current</td>
<td>450% for 30s 400% for 20s (Frame C) 450% for 30s (Frame N)</td>
</tr>
<tr>
<td>Thyristors</td>
<td>Medium voltage SCRs per power stack</td>
<td>2,300 V ac: 2 thyristors per power stack 4,160 V ac: 2 matched pairs of thyristors 6,900 V ac: 2 matched triplets of thyristors</td>
</tr>
<tr>
<td></td>
<td>Peak reverse voltage on the power stack</td>
<td>2,300 V ac: 6.5 kV 4,160 V ac: 13 kV 6,900 V ac: 19.5 kV</td>
</tr>
<tr>
<td>Protections</td>
<td>Protection by hardware</td>
<td>dv/dt filter Active overvoltage protection on the thyristors</td>
</tr>
<tr>
<td>Control supply</td>
<td>Control voltage</td>
<td>As per code of the SSW7000: 110 V ac: (-15% to 10%) or (93.5 to 121 V ac) 230 V ac: (-15% to 10%) or (195.6 to 253 V ac)</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
<td>(50 to 60 Hz): (±10%) or (45 to 66 Hz)</td>
</tr>
<tr>
<td></td>
<td>Consumption</td>
<td>Continuous: 900 mA (200 W) Peak: 9.5 A (during the closing of the vacuum contactors)</td>
</tr>
<tr>
<td>Control</td>
<td>Method</td>
<td>Voltage ramp Current limitation Pump control Torque control Current ramp</td>
</tr>
<tr>
<td>Inputs</td>
<td>Digital</td>
<td>6 insulated digital inputs, 24 V dc, programmable functions</td>
</tr>
<tr>
<td></td>
<td>Analog</td>
<td>2 differential inputs insulated by differential amplifier; A1 resolution: 12 bits, A2 resolution: 11 bits + signal, (0 to 10) V, (0 to 20) mA or (4 to 20) mA, impedance: 400 kΩ for (0 to 10 V), 500 Ω for (0 to 20 mA) or (4 to 20 mA), programmable functions</td>
</tr>
<tr>
<td>Outputs</td>
<td>Digital</td>
<td>3 NO/NC contact relays, 240 V ac, 1 A, programmable functions</td>
</tr>
<tr>
<td></td>
<td>Analog</td>
<td>2 insulated outputs, (0 to 10 V) RL = 10 kΩ (maximum load), 0 to 20 mA or 4 to 20 mA RL&lt;500 Ω, 11 bit resolution, programmable functions</td>
</tr>
<tr>
<td>Man machine interface</td>
<td>Standard</td>
<td>9 keys: Turn/Stop, Increase, Decrease, Rotation Direction, Jog, Local/Remote, right soft key and left soft key. Graphic LCD. It enables access/charge of all parameters</td>
</tr>
<tr>
<td>Safety</td>
<td>Main protections</td>
<td>Under and overcurrent and current unbalance Under and overvoltage and voltage unbalance Under and overtorque and active overpower phase loss Reverse phase sequence overtemperature in the power racks Motor overload Motor overtemperature (optional) External defect Ground fault by voltage or current Fault in the power racks Fault in the power control boards Faults in the control boards Communication faults of MMI and between controls Faults in the communication networks Programming errors</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP41 or NEMA 12</td>
<td>As per code</td>
</tr>
<tr>
<td>PC connection for programming</td>
<td>USB connector</td>
<td>USB standard rev. 2.0 (basic speed) USB plug type B “device” Interconnecting cable: standard host/device shielded USB cable</td>
</tr>
<tr>
<td>Environmental conditions</td>
<td>Temperature</td>
<td>-10 to 40 °C, up to 50 °C with derating 2%/1 °C</td>
</tr>
<tr>
<td></td>
<td>Altitude</td>
<td>Up to 1,000 m above sea level. For higher altitudes, contact our sales force</td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>Air relative humidity of 5% to 90% non-condensing</td>
</tr>
<tr>
<td>Standards</td>
<td>NBR IEC 62271-200 High voltage controlgear and switchgear - Part 200: High voltage controlgear and switchgear in metal enclosure for voltages over 1 kV up to and including 52 kV</td>
<td></td>
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<tr>
<td></td>
<td>IEC 62271-1 High-voltage switchgear and controlgear - Part 1: Common specifications</td>
<td></td>
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<td></td>
<td>IEC 60900-1 High-voltage test techniques, Part 1: General definitions and test requirements</td>
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<td></td>
<td>CISPR 11 Industrial, scientific and medical (ISM) radio-frequency equipment - electromagnetic disturbance characteristics - limits and methods of measurement</td>
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<td></td>
<td>IEC 61000-4-4 Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: electrical fast transient/burst immunity test, Basic EMB publication</td>
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<td></td>
<td>IEC 61000-4-18 Electromagnetic compatibility (EMC) - Part 4-18: Testing and measurement techniques - damped oscillatory wave immunity test</td>
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<td>NBR IEC 60529 Protection rates for electric equipment enclosures (ip code)</td>
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<tr>
<td></td>
<td>UL 347</td>
<td>- Medium voltage ac contactors, controllers and control centers</td>
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<tr>
<td></td>
<td>UL 347B</td>
<td>- Medium voltage motor controllers</td>
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</tbody>
</table>
## Standard Protections

<table>
<thead>
<tr>
<th>ANSI/IEEE C37.2</th>
<th>Function/protection feature</th>
<th>Standard</th>
<th>Option</th>
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<td>Reduced voltage starting and bypass</td>
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<td>Undercurrent protection</td>
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<td>Phase-balance current protection</td>
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<td></td>
</tr>
<tr>
<td>47</td>
<td>Phase sequence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Incomplete sequence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Instantaneous overcurrent trip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Overcurrent trip</td>
<td></td>
<td></td>
</tr>
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<td>Power factor check</td>
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<td>Lockout relay - electronic</td>
<td></td>
<td></td>
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<tr>
<td>50N/51G</td>
<td>Ground fault detection instantaneous and fault-current</td>
<td></td>
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</tr>
<tr>
<td>49 &amp; 38</td>
<td>Winding temperature and bearing temperature</td>
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<td></td>
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</tbody>
</table>
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