

EMX4i CONSULTANT SPECIFICATION:

Soft Starter 3 Phase Induction Motor Control & Protection

LOW VOLTAGE

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Introduction

1.1 Scope

This document contains reference information that may be utilised by an engineering consultant when drafting project based tender documents for the selection and supply of soft starters for the control and protection of 3 phase induction motors in low voltage applications.

1.2 Guide

When drafting specifications, it is important to include the following basic application details as well as the control and protections features required to ensure the soft starter of the correct rating is selected for the specific application needs.

Motor details:

- Name plate full load amperage
- Operating voltage (mains voltage)
- Wiring configuration (inline - 3wire or inside delta - 6 wire)

Application details:

- Load type (Compressor, Conveyer, Crusher, Fan, Mill, Pump, Saw)
- Duty (expected number of starts per hour)
- Ambient temperature
- Altitude
- Control voltage (24 VAC/VDC, or 110/120 or 220/240 VAC)

Network Communication details:

- Network protocol required (ModbusRTU, Profibus, DeviceNet, ModbusTCP, Profinet, Ethernet/IP)

Sample text

The solid state reduced voltage starter shall control 3-phase induction motors at **<V>**nominal mains voltage, **<Hz>** and shall be rated to suit the **<FLC Amperage>** motor and **<Specific>** application characteristics. Where possible motor and load curves will be provided and the supplier will use this data to justify selection. The starter shall provide soft starting and soft stopping of the motor as required.

Soft Starter Specifications

2.1 Supplier Qualifications

The soft starter shall have been manufactured by a single vendor.

The manufacturer shall be certified under ISO9000.

The manufacturer shall have produced solid state reduced voltage starters for a minimum of 20 years.

The manufacturer shall have authorised service facilities able to provide 24 hour support within <insert country name>.

2.2 Environmental Specifications

The soft starter shall be suitable for storage at temperatures from -25 °C to +60 °C.

The soft starter shall be suitable for use at temperatures from -10 °C to 40 °C without derating, and up to 60 °C with derating.

The soft starter shall be suitable for operation at altitudes up to 1000 m above sea level without derating.

The soft starter shall be suitable for use in environments with relative humidity between 5% and 95% (non-condensing).

The soft starter shall use printed circuit boards conformally coated with silicone or similar approved compound.

The soft starter shall be designed to meet Pollution Degree 3.

2.3 Physical Specifications

The soft starter enclosure shall have <IPxx> degree of protection.
IP20 up to 135 amp units as standard
IP00 above 184 amp units as standard Or
IP20 above 184 amp with optional covers for power terminals.

The soft starter control terminals shall be removable plug type for ease of field wiring.

The soft starter should be capable of being mounted without any additional clearances at the side of the product.

All accessory options such as network communication cards shall be hot-swappable and able to be easily fitted in the field.

All accessory options such as network communication cards shall not increase the overall physical dimensions of the soft starter.

2.4 General Electrical Specifications

The soft starter shall be a three-phase controlling type using reverse parallel SCR pairs in each phase of the power section. The SCRs shall have a minimum PIV rating of 1600 V.

The soft starter shall include at least two current transformers for deriving motor current to ensure accurate motor protection.

The nominal ratings information shall be shown on the nameplate label of the soft starter and shall be shown either in the AC53a or AC53b format.

The soft starter shall be correctly selected for the application and rated for a minimum of <x> starts per hour. The soft starter supplier shall provide written confirmation of the soft starter ratings in AC53a or AC53b format.

The soft starter shall be suitable for controlling motors on a wide range of <x> Mains network voltages.

select: 200 VAC to 525 VAC or 380 VAC to 690 VAC

Important when selecting soft starters for global use.

The soft starter control power supply input shall accept a wide range of <x> supply voltages:

select: 110 to 120 VAC and 220 to 240 VAC +10% -15% or
24 VAC/VDC +10% -15%

Wide control voltage range: Important when selecting soft starters for global use.

24VAC/DC: Important when selecting soft starters for either low voltage battery back-up applications and/or increased general safety due to extra low voltage.

2.5 Safety

The control input signals shall be current limited, 24 VDC (supplied by the soft starter internal power supply)

The soft starter shall provide means to safely test its correct installation:

- The soft starter shall provide a means to test the installation using a low power (kW) motor.
- The soft starter shall provide a means to test operation of all control circuitry and protection mechanisms, without connection to mains voltage. Functions to be tested include, at minimum:
 - motor starting
 - motor stopping

2.6 User Interface

The soft starter shall be supplied as standard with a built-in graphical user interface specifically designed for operation in conjunction with the soft starter.

The soft starter shall have the option to add a remote graphical user interface. The remote user interface must have a minimum environmental rating of IP65 when panel mounted and must be capable of being mounted flush on the panel door.

The onboard and optional remote display shall display all information in the following user selected languages (English, Spanish, Chinese, French, German, Brazilian Portuguese, Russian, Italian).

The built-in and remote user interface shall comprise as minimum:

- A four line, 16 character, backlit LCD screen for information feedback in <insert language> language and have the ability to display data captured by the soft starter in a graphical format.
- status LEDs indicating
 - motor state
 - starter control state
 - trip status
- local pushbuttons to control:
 - menu access
 - parameter configuration

The remote user interface shall include the additional functions as minimum:

- local pushbuttons to control:
 - motor start

- motor stop
- starter reset
- menu access
- parameter configuration
- parallel operation with built-in user interface
- hot-pluggable operation

The user interface shall provide a means for the operator to quickly access and configure parameters.

The user interface shall display the serial number and software version(s) used within the soft starter.

The user interface shall provide the operator with access to a short list of critical parameters for common applications, including:

- pump (centrifugal or submersible)
- fan (damped or undamped)
- compressor (screw or reciprocating)
- crusher (rotary or jaw)
- conveyor

The soft starter shall permit the operator through the means of standard USB memory stick to:

- save the current configuration to an external file
- reload a previously saved configuration or default set from an external file
- save log contents and diagnostic data to an external file for further analysis
- update firmware
- add additional languages (maximum 11)

The soft starter shall support remote management via a control network with a choice of either:

- ModbusRTU
- Profibus
- DeviceNet
- Modbus TCP
- Profinet
- Ethernet/IP

The control network settings shall be configurable via the soft starter user interface.

The soft starter shall provide an on-board real-time clock. Failure of the real-time clock shall not prevent operation of the starter.

2.7 Operating Configurations

The soft starter shall provide the following starting methods:

- Current ramp starting
- Constant current starting
- Adaptive Acceleration Control – to allow the selection of acceleration profiles according to application type and able to self-tune to the motor characteristics.

The soft starter shall provide the following stopping methods

- Timed Voltage Ramp (TVR) soft stop
- Adaptive Acceleration Control – to allow the selection of deceleration profiles according to the application type and able to self tune to motor characteristics.
- DC braking function. The method of DC braking shall ensure the DC pulses are evenly distributed across all three phases of the power circuit. Methods using only two phase DC braking or that require an external DC braking contactor are not acceptable.
- Soft Brake function. Utilising built-in changeover relay to control forward run and braking contactors with the ability to automatically stop when motor speed approaches zero through interfacing with the zero speed sensor directly with the soft starter.

The soft starter shall provide a kickstart option for starting the motor. The kickstart option will allow a maximum current level and time to be set, uncontrolled voltage boost methods are not acceptable.

The soft starter shall include a slow speed or jog function that is able to operate both in forward and reverse direction.

The soft starter shall provide a calendar function means of automatically starting and stopping the motor at predetermined days of the week and time of day.

The soft starter shall include shorted SCR functionality, enabling the soft starter to re-start and control the motor even if the soft starter is damaged on one phase (shorted SCR).

The soft starter shall provide an emergency run feature to allow the soft starter to override any warning or trip conditions thus allowing the motor to run as long as possible in emergency situations.

The soft starter shall provide a programmable pump clean control cycle to assist with the removal of debris from pump impellor blades.

The soft starter shall provide the control logic to enable the direction of the motor (forward or reverse) to be selected as part of each start cycle.

2.8 Motor and System Protection Features

The soft starter shall provide the following protections as standard:

- Motor electronic thermal model
- Excess start time
- Motor overtemperature
- Motor thermistor circuit
- Current imbalance
- Frequency out of range
- Phase sequence
- Undercurrent
- Overcurrent
- Undervoltage
- Overvoltage
- Underpower
- Overpower
- Power loss
- Input A trip
- Input B trip
- Starter communications
- Network communications

- Bypass contactor failure (where internal bypass is used)
- L1, L2, L3 phase loss
- L1, L2, L3 shorted SCR
- Motor connection
- Heatsink overtemperature
- Battery / clock failure
- Remote Keypad Fault
- Current when stopped detection

The soft starter's sensitivity to protection situations shall be programmable.

The soft starter's response to a protection activation shall be selectable.

The soft starter's possible responses to a protection activation shall include, at minimum:

- Trip: cease operation immediately and disable the motor
- Shunt Trip + Trip: Activate the shunt trip relay and perform a Trip operation
- Soft trip: cease operation with controlled stop if possible and disable the motor
- Warning and log: notify the condition to the operator and continue operating
- Log: write the event to memory without tripping

The soft starters fault diagnostics shall be displayed in clear language on the LCD display. The exclusive use of fault codes is not acceptable.

2.9 Programmable Outputs

The soft starter shall provide one dedicated output relay (for main contactor or shunt trip relay control) and two programmable output relays with user-selectable functionality, enabling indication of, at minimum:

- Ready (Soft starter is in ready state)
- Run (Start starter is in run state, motor is running at full speed)
- Warning
- Trip*
- Trip* + Shunt Relay Trip
- Trip Fail Safe
- Low current warning
- High current warning
- Motor temperature state
- Soft Brake Relay

* Trip states to include at least the following: Motor overload, Current imbalance, Undercurrent, Instantaneous overcurrent, Mains frequency, Programmable Input A trip, Programmable Input B trip, Heatsink overtemperature, Phase loss, Motor thermistor

The soft starter shall provide programmable on and off delay times for each of the two programmable relay outputs.

The soft starter shall provide a programmable analog output (selectable as either 0-20mA or 4-20mA) with the following selectable functionality:

- Current
- Motor temperature
- Motor power factor (pf)
- Motor power (kW)
- Heatsink temperature

2.10 Programmable Control Inputs

The soft starter shall provide at least two programmable inputs with the following functionality:

- Motor parameter set selection
- Auxiliary trip (configurable for either N/O or N/C). The input name shall be customisable by the user.
- Jog Forward
- Jog Reverse
- Zero Speed Sensor
- Emergency Mode
- Motor Reverse Direct
- Pump Clean
- Command Override (Network, Digital Inputs, Keypad)

The soft starter shall provide for programmable trip delays for each auxiliary input and allow for assignable text to be displayed on the LCD display following an auxiliary trip.

The settings for each programmable input shall be fully independent of the other.

2.11 Metering and Performance Monitoring

The soft starter shall include comprehensive metering and monitoring functions.

The soft starter shall provide real-time feedback of operating conditions, including:

- starter status
- average current
- L1 current
- L2 current
- L3 current
- mains frequency
- motor voltage (Average rms across all three phases)
- motor voltage (phase voltages A-B, B-C, C-A)
- motor power factor
- motor temperature (as a % of total thermal capacity)
- analog output value
- heatsink temperature
- bypass model
- SCR temperature
- rating capacity
- number of starts
- hours run
- current graph
- last start information including starting current and start duration

The soft starter's user interface shall be able to be programmed to display four operating conditions simultaneously on one viewing screen.

The soft starter shall provide feedback of historical operating information, including:

- lifetime hours run
- lifetime start count
- lifetime thermal resets

- resettable hours run
- resettable start count
- resettable thermal resets

The user interface shall allow the user to select which parameters to display on the LCD.

The soft starter shall record full details of its state at the time of every protection activation. The recorded details shall include, at minimum:

- time & date stamp
- protection type
- motor operating status
- mains frequency
- line current
- last start time (if successful)
- motor thermistor
- ambient temperature
- heatsink temperature
- motor thermal model
- SCR temperature
- Bypass model
- Rating capacity

The soft starter shall record all changes to its configuration for storage in an event log.

The soft starter's event log shall store no fewer than 384 events.

Support and Services

3.1 Commissioning

The soft starter supplier shall undertake to assist the customer in commissioning the soft starter.

The soft starter supplier shall provide suitably qualified staff to ensure successful commissioning.

3.2 Documentation

The soft starter shall be provided with complete with:

- User manual

Additional information from the supplier shall be made available upon request:

- Service manual
- Recommended list of spare parts
- 2D & 3D CAD drawings

3.3 Training

The soft starter supplier shall be capable of providing a complete training schedule with the soft starter.

The soft starter supplier shall undertake to deliver the complete training programme if required by the customer.

The training programme shall be delivered at the customer's premises or at the supplier's premises, as required by the customer.

The training programme shall deliver to the customer the skills to:

- appropriately programme the soft starter to meet customer requirements
- safely commission the soft starter
- safely operate the soft starter
- identify and rectify operating problems caused by incorrect programming
- identify and diagnose operating problems caused by faulty soft starter

3.4 Warranty and Repair

The supplier shall guarantee the soft starter against faults of materials or manufacture workmanship for a period of not less than 18 months.

The supplier shall guarantee to provide servicing support for the soft starter for a period of not less than 5 years from time of last manufacture.

3.5 Standards and Approvals

The soft starter must, as a minimum comply with and be certified to:

UL /cUL UL508

CE IEC60947-4-2

Lloyds 2002 Lloyds Marine No1 Specification

ABS 2010 Steel Vessels Rules

CCC China Compulsory Certificate mark

EAC EurAsEC Customs Union (Russia, Belarus and Kazakhstan)