



CSX & CSXi

Compact Starter Series



Product Guide / Manual

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CAUTION STATEMENTS

Section 1

Caution Statements



This symbol is used throughout this manual to draw attention to topics of special importance to the installation and operation of the CSX Series soft starter.

Caution Statements cannot cover every potential cause of equipment damage but can highlight common causes of damage. It is therefore the installer's responsibility to adhere to all instructions in this manual, to follow good electrical practice and to seek advice before operating this equipment in a manner other than as detailed in this manual.

- Ensure that the CSX Series is completely isolated from the power supply before attempting any work on the unit.
- Do not apply incorrect voltages to the control input terminals.
- Ensure cables to the control inputs are segregated from AC power and control wiring.
- Some electronic contactor coils are not suitable for direct switching with PCB mount relays. Consult the contactor manufacturer/supplier to see if this is advisable.
- Do not connect Power Factor Correction capacitors to the output of CSX Series soft starters. If static power factor correction is employed, it must be connected to the supply side of the soft starter.

The examples and diagrams in this manual are included solely for illustrative purposes. Users are cautioned that the information contained in this manual is subject to change at any time and without prior notice. In no event will responsibility or liability be accepted for direct or indirect or consequential damages resulting from the use or application of this equipment.



WARNING – ELECTRICAL SHOCK HAZARD

The CSX Series soft starter contains dangerous voltages when connected to line voltage. Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the CSX Series may cause equipment failure, serious injury or death. Follow this manual, the National Electrical Code (NEC[®]) and local safety codes.



GROUNDING AND BRANCH CIRCUIT PROTECTION

It is the responsibility of the user or person installing the CSX Series to provide proper grounding and branch circuit protection according to the National Electrical Code (NEC[®]) and local safety codes.



SHORT CIRCUIT

The CSX Series is not short circuit proof. Therefore, after severe overload or short circuit, the operation of the starter should be fully tested.

Section 2 Series Overview

2.1 Overview

The CSX Series comprises two separate ranges, CSX and CSXi. These ranges share common power and mechanical designs but offer different feature sets.

These ranges include an internal bypass function that bypasses the soft starter SCRs during run. This allows the CSX Series to be installed in a non-ventilated enclosure without the need for an external bypass contactor.

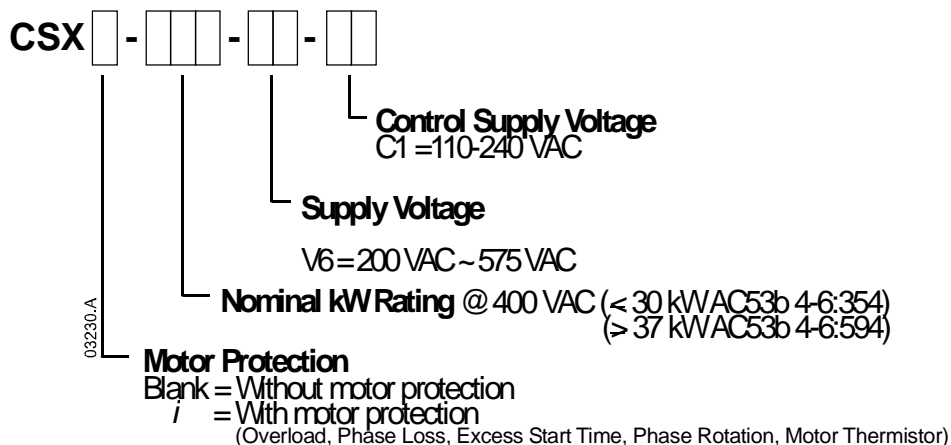
2.2 Feature List

Feature	CSX	CSXi
Starting		
Timed Voltage Ramp	●	
Current Limit		●
Current Ramp		●
Stopping		
Coast To Stop	●	●
Soft Stop	●	●
Protection		
Motor Overload		●
Phase Loss		●
Excess Start Time		●
Phase Sequence		●
Phase Imbalance		●
Motor Thermistor		●
Power Circuit Fault	●	●
Supply Frequency	●	●
Communications Failure	●	●
Interface		
Fixed Relay Output (Main Contactor Relay)	●	●
Programmable Relay (Trip or Run)		●
Accessories		
Remote Operator	○	○
Modbus Interface	○	○
Profibus Interface	○	○
DeviceNet Interface	○	○
AS-i Interface	○	○
PC Software	○	○

● = Standard

○ = Optional

2.3 Model Number Format



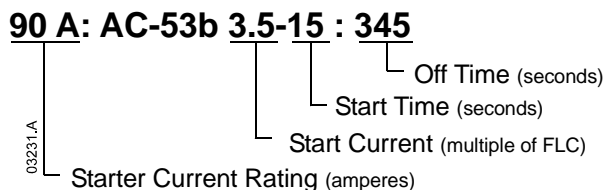
CSX RANGE

Section 3 Specifications

3.1 Current Ratings

	AC53b 4-6:354 <1000 metres		AC53b 4-20:340 <1000 metres	
	40 °C	50 °C	40 °C	50 °C
CSX-007	18 A	17 A	17 A	15 A
CSX-015	34 A	32 A	30 A	28 A
CSX-018	42 A	40 A	36 A	33 A
CSX-022	48 A	44 A	40 A	36 A
CSX-030	60 A	55 A	49 A	45 A
	AC53b 4-6:594 <1000 metres		AC53b 4-20:580 <1000 metres	
	40 °C	50 °C	40 °C	50 °C
CSX-037	75 A	68 A	65 A	59 A
CSX-045	85 A	78 A	73 A	67 A
CSX-055	100 A	100 A	96 A	87 A
CSX-075	140 A	133 A	120 A	110 A
CSX-090	170 A	157 A	142 A	130 A
CSX-110	200 A	186 A	165 A	152 A

AC53b Utilisation Category Format



Starter Current Rating: The Full Load Current rating of the soft starter given the parameters detailed in the remaining sections of the utilisation code.

Start Current: The maximum available start current given the parameters detailed in the remaining sections of the utilisation code.

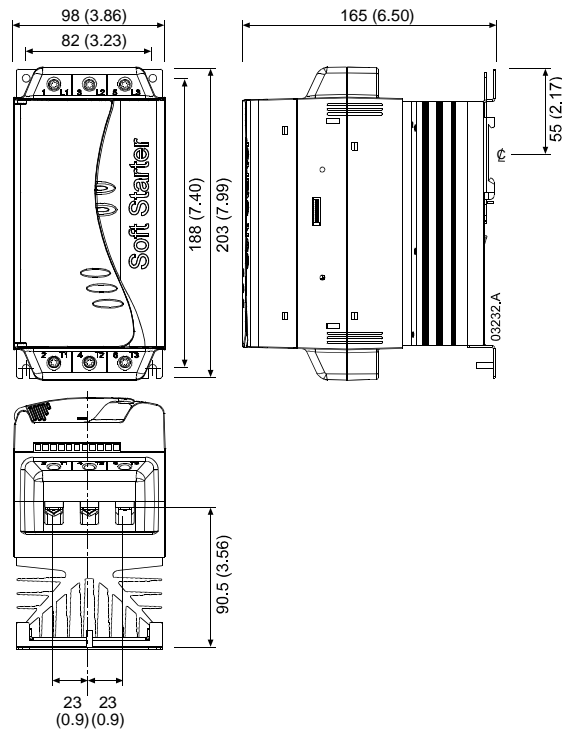
Start Time: The maximum available start time given the parameters detailed in the remaining sections of the utilisation code.

Off Time: The minimum allowable time between the end of one start and the beginning of the next start given the parameters detailed in the remaining sections of the utilisation code.

Contact your local supplier for ratings under operating conditions not covered by the above ratings charts.

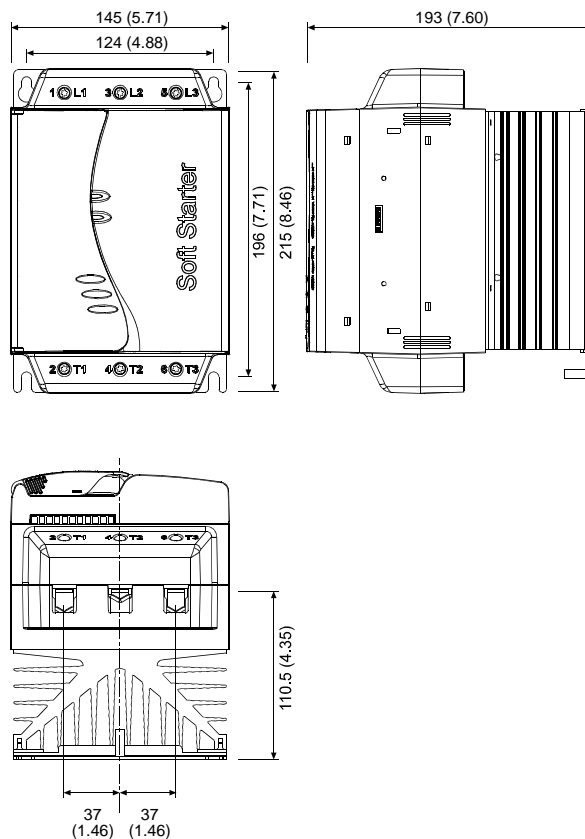
3.2 Dimensions and Weights

CSX-007 ~ CSX-030 (2.2 kg / 4.85 lb)
 CSXi-007 ~ CSXi-030 (2.4 kg / 5.29 lb)



mm (inch)

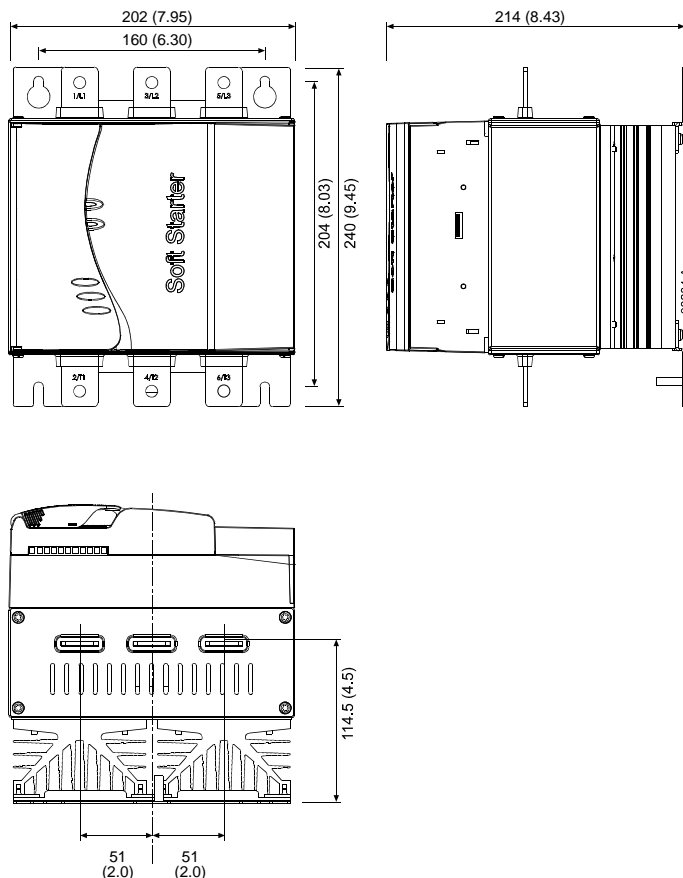
CSX-037 ~ CSX-055 (4.0 kg / 8.82 lb)
 CSXi-037 ~ CSXi-055 (4.3 kg / 9.48 lb)



mm (inch)

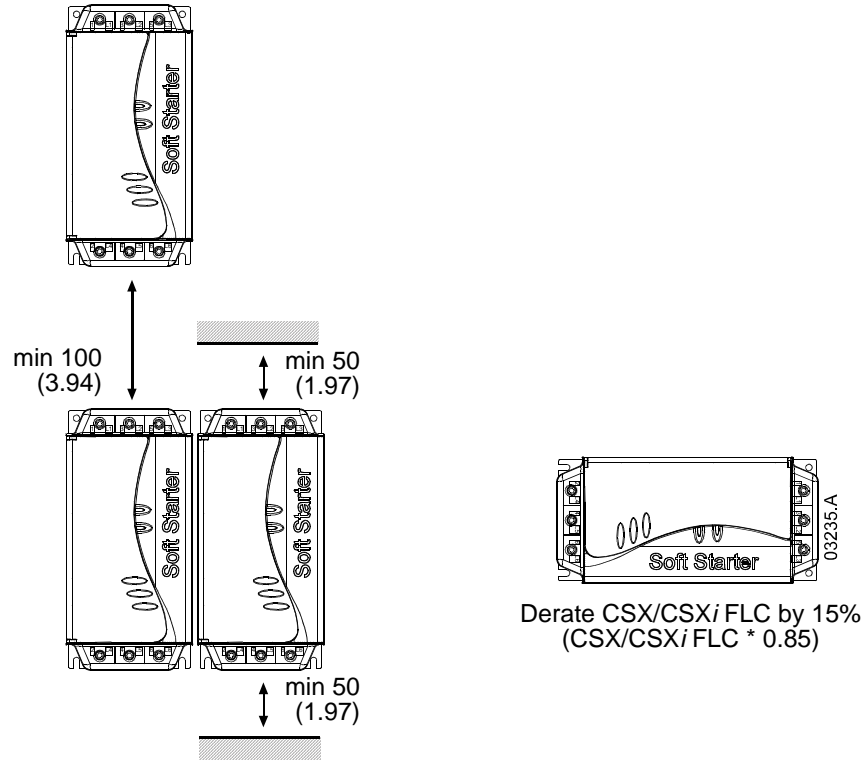
CSX RANGE

CSX-075 ~ CSX-110 (6.1 kg / 13.45 lb)
CSXi-075 ~ CSXi-110 (6.8 kg / 14.99 lb)



mm (inch)

3.3 Mounting



mm (inch)

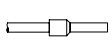


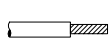
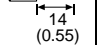
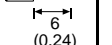
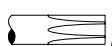

3.4 Semiconductor Fuses

Semiconductor fuses can be used with the CSX Series soft starter to reduce the potential for damage to SCRs from transient overload currents and for Type 2 coordination. CSX Series soft starters have been tested to achieve Type 2 coordination with semiconductor fuses. Suitable Bussman & Ferraz semiconductor fuses are detailed below.

CSX Model	SCR $I_t^2 s$ (A ² s)	Ferraz Fuse	Bussman Fuse Square Body (170M)	
007	1150	A070URD30xxx0063	170M-1314	
015	8000	A070URD30xxx0125	170M-1317	
018	10500	A070URD30xxx0160	170M-1318	
022	15000	A070URD30xxx0160	170M-1318	
030	18000	A070URD30xxx0160	170M-1319	
037	51200	A070URD30xxx0250	170M-1321	
045	80000	A070URD30xxx0315	170M-1321	
055	97000	A070URD30xxx0315	170M-1321	
075	168000	A070URD31xxx0450	170M-1322	
090	245000	A070URD31xxx0450	170M-3022	
110	320000	A070URD31xxx0450	170M-3022	

xxx = Blade Type.
Refer Ferraz for options.

3.5 Power Terminations

	L1/1, L2/3, L3/5, T1/2, T2/4, T3/6 mm ² (AWG)			A1, A2, A3, 01, 02, B4, B5, 13, 14, 23, 24 mm ² (AWG)
	007 ~ 030	037 ~ 055	075 ~ 110	007 ~ 110
	10 - 35 (8 - 2)	 25 - 50 (4 - 1/0)	N.A.	 0.14 - 1.5 (26 - 16)
	10 - 35 (8 - 2)	 25 - 50 (4 - 1/0)	N.A.	 0.14 - 1.5 (26 - 16)
	Torx (T20) 3 Nm 2.2 ft-lb	Torx (T20) 4 Nm 2.9 ft-lb	N.A.	N.A.
	7 mm 3 Nm 2.2 ft-lb	7 mm 4 Nm 2.9 ft-lb	N.A.	3.5 mm 0.5 Nm max 4.4 in-lb max

75 °C Wire - Use copper conductors only

CSX RANGE

3.6 General Technical Data

Mains Supply (L1, L2, L3)	
CSX-xxx-V6-xxx	3 x 200 VAC ~ 575 VAC (+ 10% / - 15%)
Supply frequency (at start)	45 Hz to 66 Hz
Rated insulation voltage	600 VAC
Form designation	Bypassed semiconductor motor starter form 1

Control Supply (A1, A2, A3)	
CSX-xxx-xx-C1	110-240 VAC (+ 10% / - 15%)

Control Inputs	
Start Terminal 01	Normally Open, 300 VAC max
Stop Terminal 02	Normally Closed, 300 VAC max

Relay Outputs	
Main Contactor (Terminals 13 & 14)	Normally Open 6 A, 30 VDC resistive / 2 A, 400 VAC, AC11
Programmable Relay (Terminals 23 & 24)	Normally Open 6 A, 30 VDC resistive / 2 A, 400 VAC, AC11

Environmental	
Degree of Protection CSX-007 to CSX-055	IP20
Degree of Protection CSX-075 to CSX-110	IP00
Operating Temperatures	- 10 °C to + 60 °C
Humidity	5% to 95% Relative Humidity
Pollution Degree	Pollution Degree 3
Vibration	IEC 60068 Test Fc Sinusoidal 4 Hz to 13.2 Hz: ± 1 mm displacement 13.2 Hz to 200 Hz: ± 0.7 g

EMC Emission	
Equipment class (EMC)	Class A
Conducted radio frequency emission	0.15 MHz to 0.5 MHz: < 90 dB (µV) 0.5 MHz to 5 MHz: < 76 dB (µV) 5 MHz to 30 MHz: 80-60 dB (µV)
Radiated radio frequency emission	30 MHz to 230 MHz: < 30 dB (µV/m) 230 MHz to 1000 MHz: < 37 dB (µV/m)
This product has been designed for Class A equipment. Use of the product in domestic environments may cause radio interference, in which case the user may be required to employ additional mitigation methods.	

EMC Immunity	
Electrostatic discharge	4 kV contact discharge, 8 kV air discharge
Radio frequency electromagnetic field	0.15 MHz to 1000 MHz: 140 dB (µV)
Fast transients 5/50 ns (main and control circuits)	2 kV / 5.0 kHz
Surges 1.2/50 µs – 8/20 ms (main and control circuits)	2 kV line to earth, 1 kV line to line
Voltage dip and short time interruption	5000 ms (at 0% nominal voltage)

Short Circuit	
Rated short-circuit current CSX-007 to CSX-037	5 kA
Rated short-circuit current CSX-045 to CSX-110	10 kA

Heat Dissipation	
During Start	3 watts / ampere
During Run	< 4 watts

Standards Approvals	
C✓	IEC 60947-4-2
UL / C-UL	UL 508
CE	IEC 60947-4-2
CCC	GB 14048.6

CSX RANGE

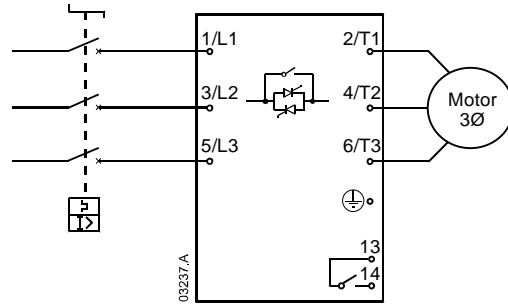
Section 4 CSX Range

4.1 Overview

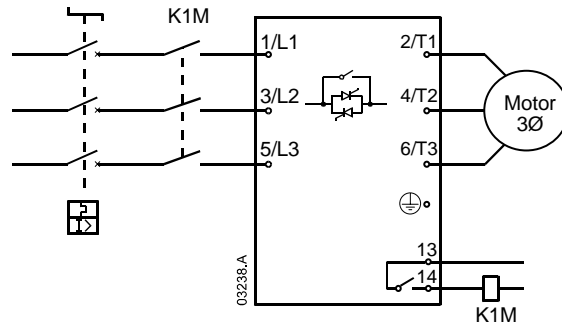
CSX soft starters provide soft start and soft stop control. They are designed to be used with an external motor protection device.

4.2 Electrical Schematics

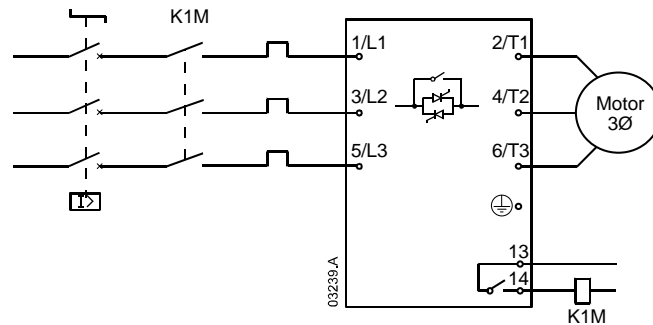
Example 1. CSX soft starter installed with a motor protection circuit breaker.



Example 2. CSX soft starter installed with a motor protection circuit breaker and line contactor.



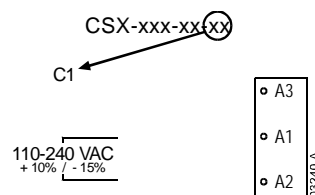
Example 3. CSX soft starter installed with a system protection circuit breaker, separate overload and line contactor.



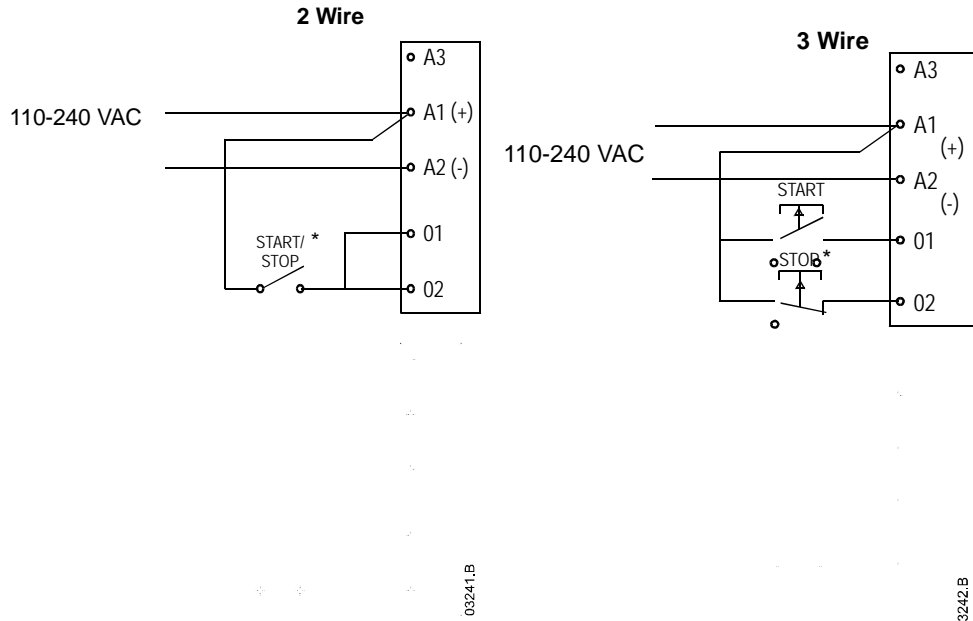
4.3 Control Voltages

CSX soft starters can be supplied in either of two control voltage configurations:

CSX-xxx-xx-C1 110-240 VAC (+ 10% / - 15%)



4.4 Control Circuits



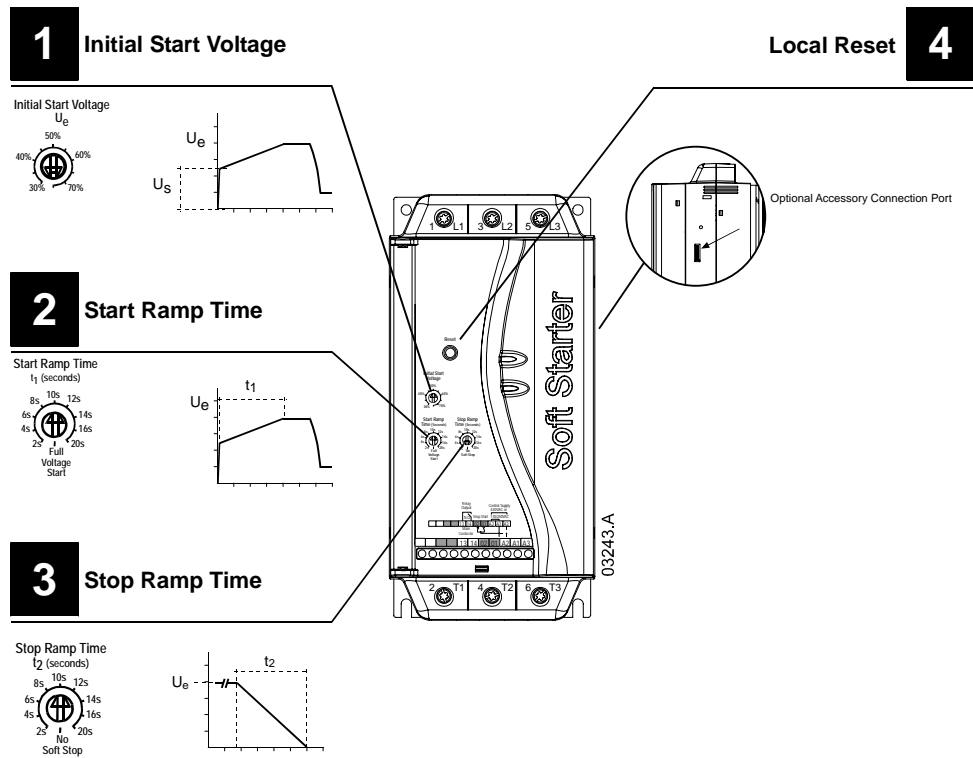
* Also resets trip states.



WARNING

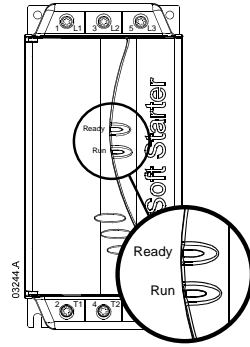
Always apply control voltage before (or with) mains power.

4.5 Adjustments







CSX RANGE

4.6 Indication



LED Status	Ready	Run
Off	No control power	Motor not running
On	Ready	Motor running at full speed
Flash	Starter tripped	Motor starting or stopping

4.7 Diagnostic Trip Codes

Ready LED	Description
 x 1	Power Circuit: Check mains supply L1, L2 & L3, motor circuit T1, T2 & T3 and soft starter SCRs.
 x 6	Supply Frequency: Check supply frequency is in range.
 x 8	Network Communication Failure (between interface and network): Check network connections and settings.
 x 9	Starter Communication Failure (between starter and interface): Remove and refit interface.

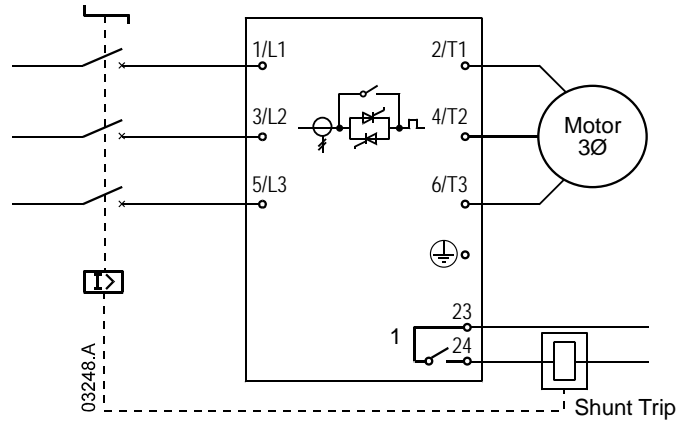
Section 5 CSXi Range

5.1 Overview

CSXi soft starters provide current limit soft start, soft stop and a range of motor protection functions.

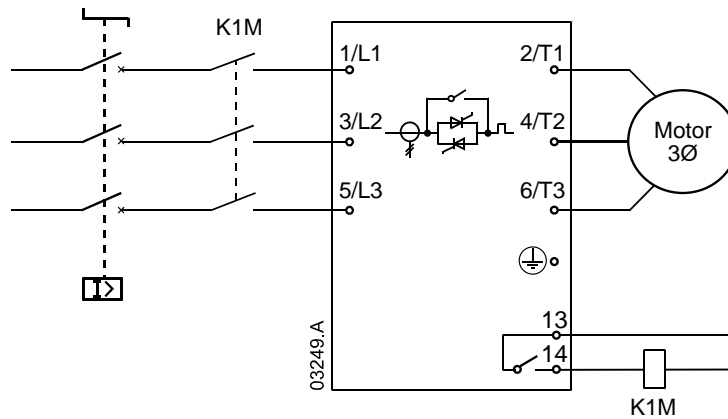
5.2 Electrical Schematics

Example 1. CSXi soft starter installed with a system protection circuit breaker complete with a shunt trip device.



¹ Auxiliary Relay Function = Trip

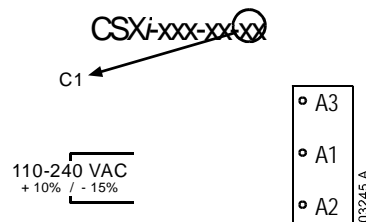
Example 2. CSXi soft starter installed with a system protection circuit breaker and line contactor.



5.3 Control Voltages

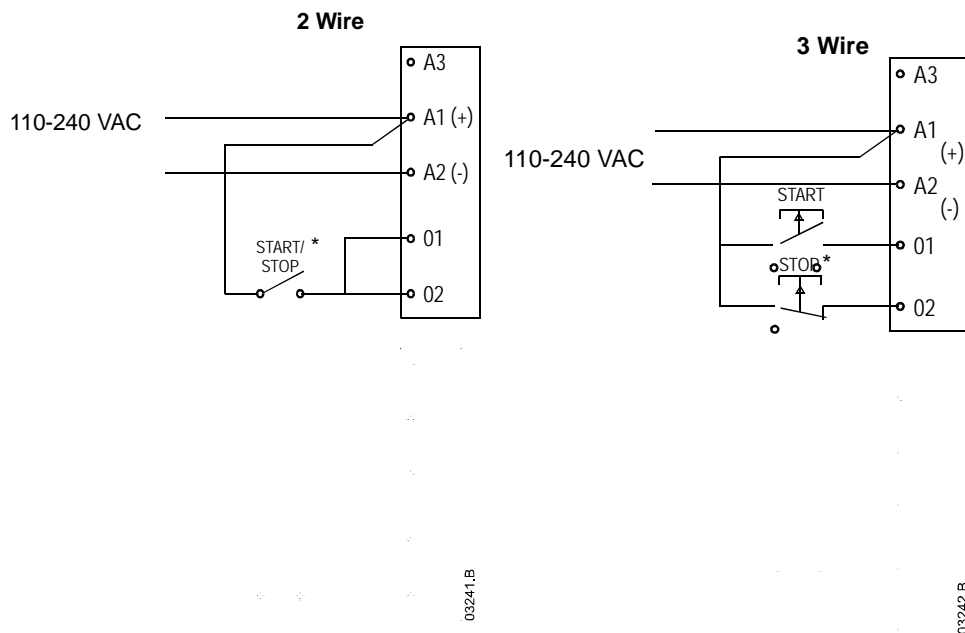
CSXi soft starters can be supplied in either of two control voltage configurations:

CSXi-xxx-xx-C1 110-240 VAC (+ 10% / - 15%)



CSXi RANGE

5.4 Control Circuits



* Also resets trip states.

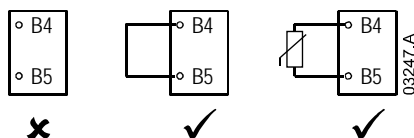


WARNING

Always apply control voltage before (or with) mains power.

5.5 Motor Thermistor

Motor thermistors (if any) can be connected directly to the CSXi terminals B4 and B5. If no motor thermistors are connected there must be a link between B4 and B5.



5.6 Adjustments

1 Motor FLC

2 Current Ramp

3 Current Limit

4 Motor Trip Class

5 Local Reset

6 Soft Stop Time

7 Excess Start Time

8 Phase Sequence Protection

Phase Sequence	FWD	ANY
L1 L2 L3	✓	✓
L1 L3 L2	✗	✓

9 Auxiliary Relay Function

Phase Sequence	Aux Relay
ANY	Trip
FWD	Run

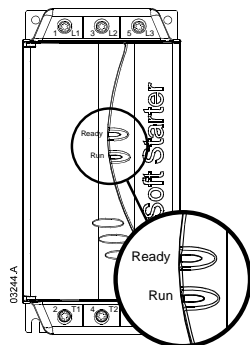
Optional Accessory Connection Port

8 9 Example

Phase Sequence = ANY	Phase Sequence = FWD
Aux Relay = Trip	Aux Relay = Run










CSXi RANGE

5.7 Indication



LED Status	Ready	Run
Off	No control power	Motor not running
On	Ready	Motor running at full speed
Flash	Starter tripped	Motor starting or stopping

5.8 Diagnostic Trip Codes

Ready LED	Description
 x 1	Power Circuit: Check mains supply L1, L2 & L3, motor circuit T1, T2 & T3 and soft starter SCRs.
 x 2	Excess Start Time: Check load, increase Current Limit or adjust Excess Start Time setting.
 x 3	Motor Overload: Allow motor to cool, reset soft starter and restart. Soft starter cannot be reset until motor has cooled adequately.
 x 4	Motor Thermistor: Check motor ventilation and thermistor connection B4 and B5. Allow motor to cool.
 x 5	Phase Imbalance: Check line current L1, L2 & L3.
 x 6	Supply Frequency: Check supply frequency is in range.
 x 7	Phase Sequence: Check for correct phase sequence.
 x 8	Network Communication Failure (between interface and network): Check network connections and settings.
 x 9	Starter Communication Failure (between starter and interface): Remove and refit interface.

Section 6

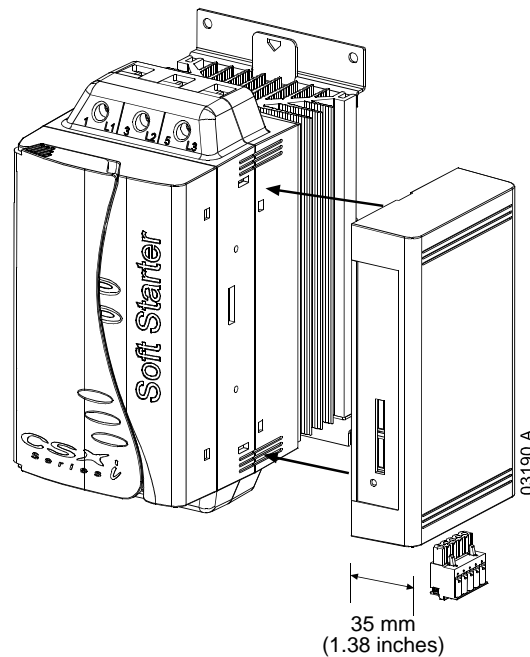
Accessories

6.1 Overview

The CSX Series includes a range of optional accessories including:

- CSX Series Remote Operator
- Modbus Interface
- Profibus Interface
- DeviceNet Interface
- PC Software

The interfaces plug into the side of CSX Series soft starters as shown in the diagram below:



WARNING

Control power and mains supply must be removed from the CSX Series soft starters before attachment or removal of accessory items. Failure to do so may result in equipment damage.

6.2 Remote Operator

Model Number: PIM-RO-01

The CSX Remote Operator can control and monitor CSX Series soft starter performance. Functionality includes:

- Operational Control (Start, Stop, Quick Stop and Reset)
 - Starter Status Monitoring (Start, Run and Trip)
 - Performance Monitoring (Motor Current and Motor Temperature) ¹
 - Trip Code Display
 - 4-20 mA Analogue Output (Motor Current) ¹
- ¹ = CSXi models only.

Please refer to the Remote Operator User Manual for further details.

ACCESSORIES

6.3 Modbus Interface

Model Number: PIM-MB-01

The Modbus Interface can be used with both CSX and CSX*i* models to enable control and monitoring via a Modbus RTU network.

Please refer to the Modbus Interface Instructions for further details.

6.4 Profibus Interface

Model Number: PIM-PB-01

The Profibus Interface can be used with both CSX and CSX*i* models to enable control and monitoring via a Profibus network.

Please refer to the Profibus Interface Instructions for further details.

6.5 DeviceNet Interface

Model Number: PIM-DN-01

The DeviceNet Interface can be used with both CSX and CSX*i* models to enable control and monitoring via a DeviceNet network.

Please refer to the DeviceNet Interface Instructions for further details.

6.6 PC Software

WinMaster PC Software can be used with CSX and CSX*i* soft starters to provide the following functionality for networks of up to 99 soft starters:

Feature	CSX	CSX <i>i</i>	
Operational Control (Start, Stop, Reset, Quick Stop)	●	●	
Starter Status Monitoring (Ready, Starting, Running, Stopping, Tripped)	●	●	
Performance Monitoring (Motor Current, Motor Temperature)		●	
Upload Parameter Settings			
Download Parameter Settings			

Additionally, each CSX Series soft starter connected to the network must be fitted with a Modbus Interface (PIM-MB-01) or a Remote Operator (PIM-RO-01).

Please refer to the WinMaster User Manual for further details.

Section 7 General

7.1 Frequently Asked Questions (and their answers)

- *What is the minimum allowable motor current when using a CSX open loop soft starter?*
There is no minimum current when using a CSX open loop soft starter.
- *What is the minimum allowable motor current when using a CSXi closed loop soft starter?*
The minimum "Motor FLC" setting is 50% of the CSXi nameplate rating. All the motor protections are based on this setting.

It is possible to operate a CSXi with a small kW motor, for testing purposes. In this case, the motor will effectively start DOL, and the CSXi will not protect the motor. The starter will not trip, because there is no undercurrent protection on CSXi.
- *What type of motor protection does the CSXi have?*
The CSXi has built-in motor overload protection of the electronic "thermal model" type. The motor current is continuously monitored and the expected temperature is calculated based on this monitored current.

The rate of rise of the calculated motor temperature is determined by the Motor Trip Class setting. The lower this setting, the faster the rate of rise of calculated motor temperature. A Motor Overload trip (x 2 Ready LED flashes) will occur when the calculated temperature reaches 105%. The setting of the Motor Trip Class pot is similar to a motor trip class setting on a standard thermal overload relay.

An external motor protection device is not required when using a CSXi soft starter. CSXi is certified to conform to the IEC 60947-4-2 standard for electronic soft starters. The reliability of the motor protection feature is part of this standard.
- *How do I select a CSX Series soft starter for duty cycles different from those listed in the standard ratings table?*
The WinStart software package is available for selecting soft starters for different duty cycles.
- *Which CSX Series models carry the UL mark?*
All V6 models carry the UL mark.
- *What are the CSX Series operational ratings before maintenance may be required?*
The operational ratings for CSX are size-dependent, and are due to the capability of the internal bypass relays:
Size 1 & 2 (7.5 ~ 55 kW): 1,000,000 operations
Size 3 (75 ~ 110 kW): 100,000 operations
- *When would I use a line contactor?*
A line contactor may be compulsory for a specific installation. This requirement will be the same whether using a two-phase controlled soft starter or a three-phase controlled soft starter (refer Product Note for more detail).
- *How do I size the fuses of the motor branch circuit when using a CSX Series soft starter?*
For "Current Limit" settings $\leq 350\%$ and start times ≤ 15 seconds, the nominal rating of standard line supply fuses should be $1.75 \times$ Motor FLC. If motor rated fuses are being used, their nominal rating should be $1.5 \times$ Motor FLC.

NOTES

For "Current Limit" settings > 350% and start times > 15 seconds, the nominal rating of standard line supply fuses should be 2 x Motor FLC. If motor rated fuses are being used, their nominal rating should be 1.75 x Motor FLC.

- *When would I use semiconductor fuses?*

Either when specified for an installation, or when Type 2 coordination is required.

The CSX Series is internally bypassed, so the SCRs are in use only during starting and soft stopping.

- *What is the current consumption of the CSX Series control supply?*

The steady state consumption the control supply is 100 mA maximum, for both C1 and C2 models.

However, the short time inrush current at control supply "switch-on" can be as high as 10 A for C1 models, and 2 A for C2 models (due to the SMPS power supply).

- *How can the CSXi programmable output relay be used?*

The programmable output relay provides an N/O contact, which can be used for a "Trip" or "Run" output.

Trip output:

The relay operates when the CSXi trips on any fault. This can be used to operate a shunt-trip mechanism of an upstream circuit breaker to isolate the motor branch circuit. It could also be used to signal CSXi "Trip" status to an automation system.

Run output:

The relay operates on completion of start ramp. This can be used to operate a contactor for power-factor correction capacitors. It could also be used to signal CSXi "Run" status to an automation system.

- *Is the CSXi suitable for flying start application?*

Yes. There is a built-in two second delay between the end of one stop and the beginning of the next start. This delay allows the motor flux to decay, eliminating any chance of the CSXi tripping on Power Circuit fault (x 1 Ready LED flash) due to detection of motor back EMF when the start signal is applied. The major effect of a flying start is on the actual time the CSXi "current limits". The ramp-up time will be reduced and is determined by the motor speed on re-application of the start signal.

- *What is the remote start and stop input impedance? Are any special precautions necessary during installation?*

The 01/02 input impedance is approximately 400 k Ω @ 300 VAC and 5.6 k Ω @ 24 VAC/VDC.

All control wiring, for long runs, should be either twisted pair or shielded cable with the screen earthed at one end. Control wiring should be separated from power cables by a minimum distance of 300 mm.

If long cable runs cannot be avoided, the best assurance against noise interference is to install an interposing relay in close proximity to the CSX Series soft starter.

- *Why is it necessary to apply control voltage before (or with) mains voltage?*

There is a possibility the soft starter could arrive at site with the internal bypass relays in "closed" state. On first application of control voltage, the bypass relays are commanded to open. If mains voltage is applied without control voltage, this step is missed, and the motor may start DOL without warning (refer Product Note for more detail).

- *Why is the middle phase starting current higher than the other two phases?*
The middle phase (L2/T2) of the CSX Series is uncontrolled. During soft starting, SCRs in the two outside phases (L1/T1 and L3/T3) provide control. The current in the uncontrolled phase will always be higher than the current in the two controlled phases, typically by 20-25%.
Note: the current in the uncontrolled phase will still be lower than the locked rotor current of the motor (refer Product Note for more detail).
- *What are the under- and over-frequency trip points for CSX Series soft starters?*
The trip points are 40 Hz and 72 Hz. If the frequency falls below 40 Hz or rises above 72 Hz, the soft starter will trip (x 6 Ready LED flashes). These trip points are not adjustable.
A supply frequency trip will also occur if all three phases from the mains supply are lost, or fall below approximately 120 VAC while the soft starter is running.
A supply frequency trip will occur if the line contactor drops out during running.
- *Will the motor start DOL if the start ramp of CSX open loop soft starter is set to "full voltage"?*
No, the CSX will still provide a limited soft start. The voltage is ramped up from 0 to 100% in approximately 0.25 seconds.