Contents

English

1 Quick Start-Up Guide

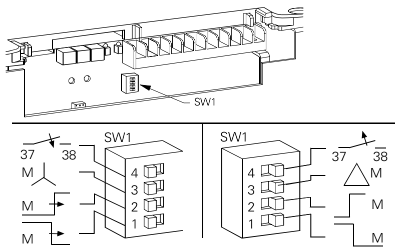
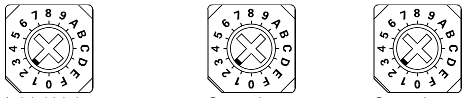


Fig. 1 : Setup Controls

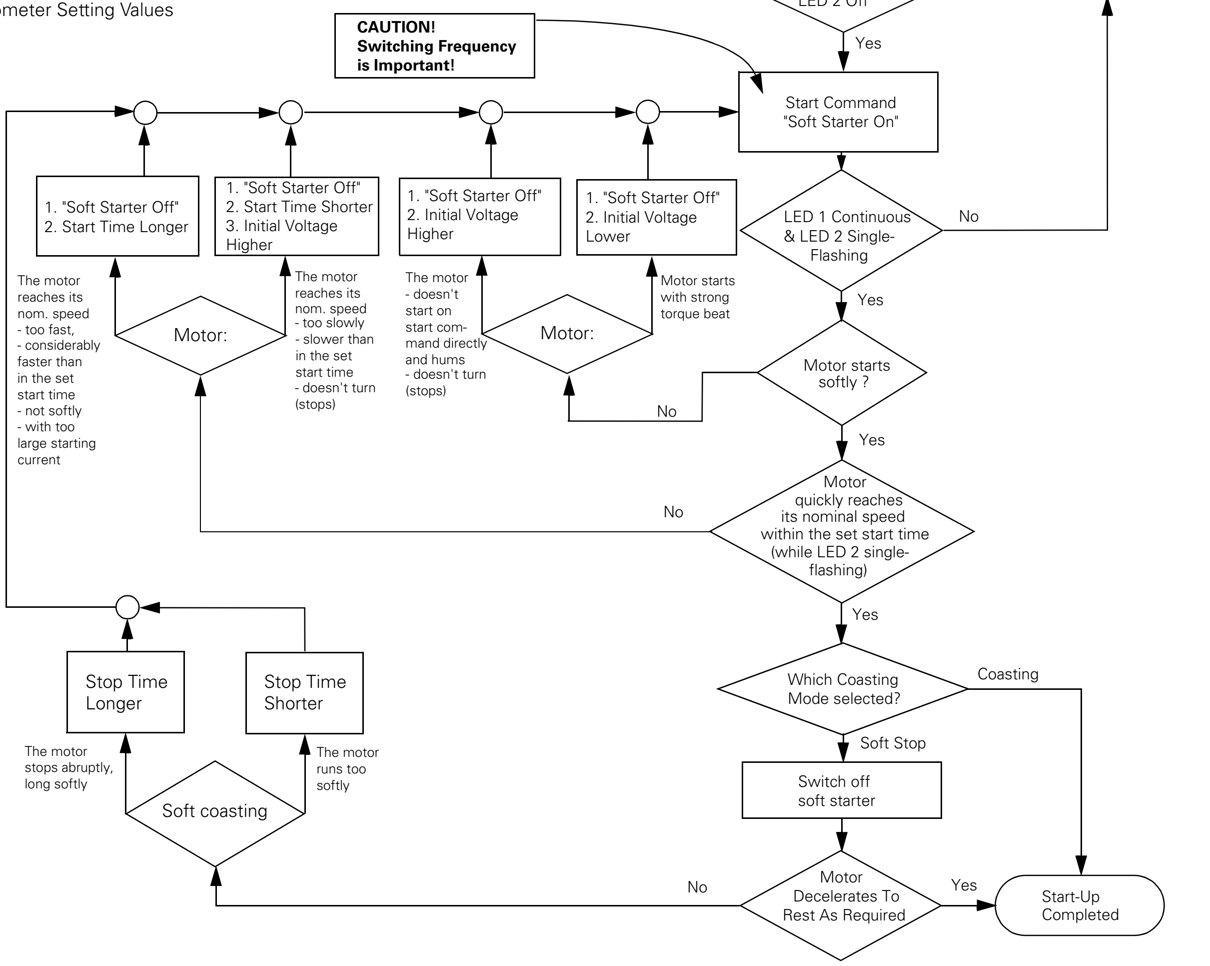
		Alarm Contact		Circuit Version		Isol. Contct.		Bypass Cont.	
		NO Con't	NC C.	Default	$\sqrt{3}$	Yes	No	Yes	No
Switch Position	SW1.4	Left	Right						
	SW1.3			Left	Right				
	SW1.2					Left	Right		
	SW1.1							Left	Right

Table 1: Switch Position SW1



Dial Setting	Initial Voltage U (% of Full Voltage)	Ramp Time T1, T2 (seconds)
0	30 (lowest starting torque)	0.5 (shortest start/stop time)
1	33	1,0
2	36	2,0
3	40	4,0
4	43	6,0
5	46	8,0
6	50	10
7	53	12
8	56	15
9	60	20
A	63	25
B	66	30
C	70	35
D	73	40
E	76	50
F	80 (highest starting torque)	60 (longest start/stop time)

Table 2: Potentiometer Setting Values



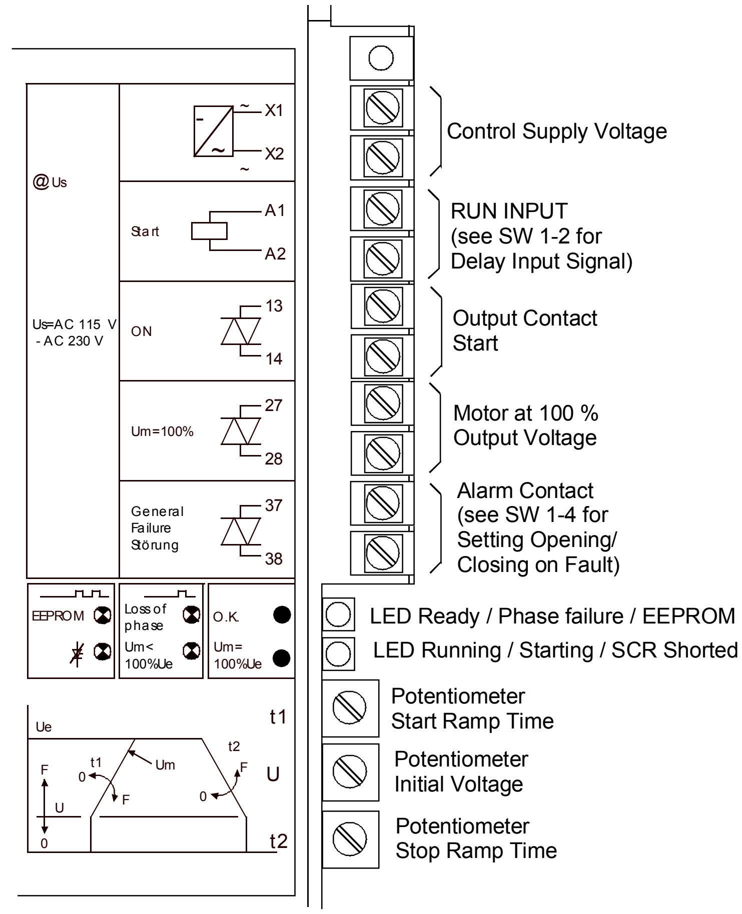


Fig. 2 : SIKOSTART Control Terminals with Us AC 115 V and AC 230 V

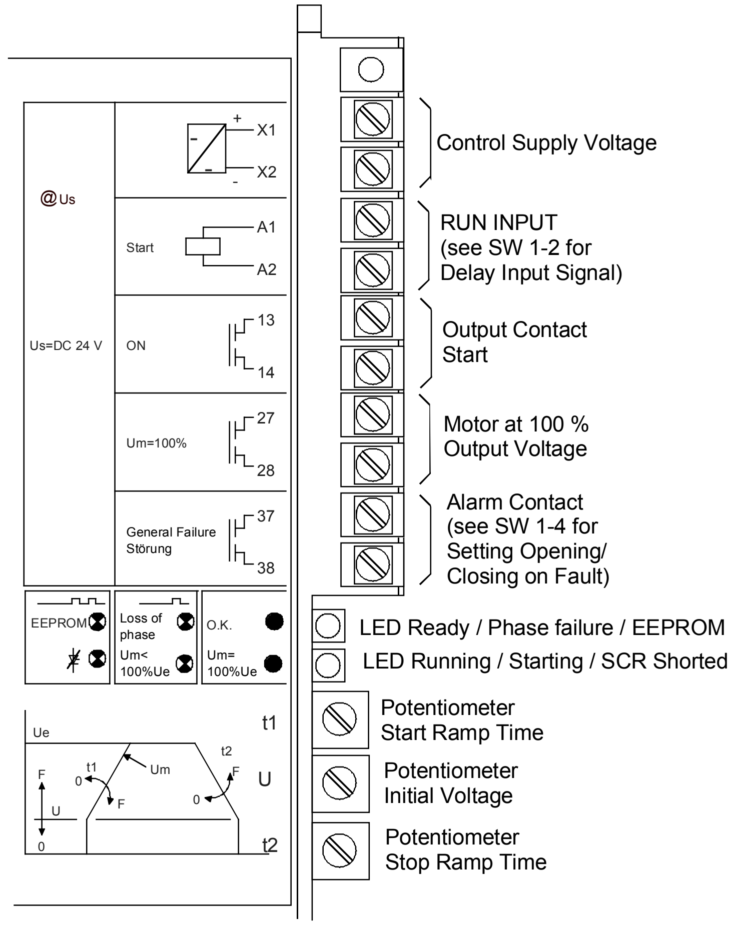
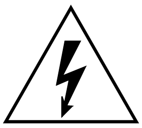


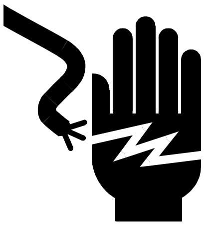
Fig. 3 : SIKOSTART Control Terminals with Us DC 24 V



⚠ WARNING

HAZARDOUS VOLTAGE.
Can cause electrical shock and burns.
Disconnect power before proceeding with any work on this equipment.

Reliable functioning of the equipment is only ensured with certified components.



⚠ DANGER

Hazardous voltage.
Will cause death, serious injury, or property damage.

Always de-energize and ground the equipment before maintenance. Read and understand this manual before installing, operating, or maintaining equipment. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel may result in dangerous conditions which may cause death or serious injury, or equipment or property damage. Comply with all pertinent standards and obey all safety instructions contained in this document.

SIGNAL WORDS

The signal words **DANGER, WARNING**, and **CAUTION** used in this manual indicate the degree of hazard that may be encountered by the user. These words are defined as:

⚠ **DANGER** - Indicates death, serious injury, or property damage will result if proper **precautions** are not taken.

⚠ **WARNING** - Indicates death, serious injury, or property damage can result if proper precautions are not taken.

⚠ **CAUTION** - Indicates death, serious injury, or property damage can result if proper precautions are not taken.

QUALIFIED PERSON

For the purposes of this manual and product labels, a qualified person is one who is familiar with the installation, construction, operation, or maintenance of the equipment and the hazards involved. In addition, this person has the following qualifications:

(a) is 'trained' and 'authorized' to energize, de-energize, isolate, ground, and tag circuits and equipment in accordance with established safety practices.

(b) is 'trained' in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, or face shields, flash clothing, etc. in accordance with established safety practices.

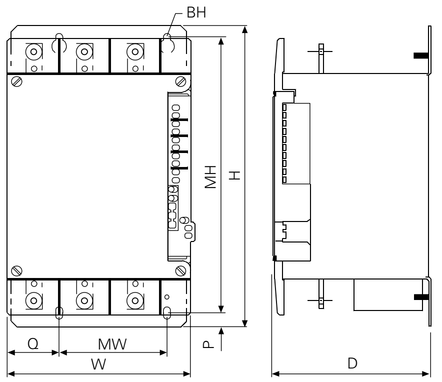
(c) is trained in rendering first aid.

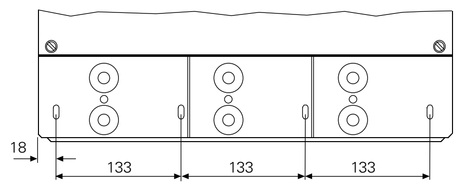
2 Dimensions

Order Number	I_e (amps)	Width (W)	Height (H)	Depth (D)	Mount Width (MW)	Width Offset (Q)	Mount Height (MH)	Height Offset (P)	Mount Hole (BH)
3RW34 5*...	35-105	216	356	187	127 / 94	61	327	16	6 (4)
3RW34 6*...	131-248	292	381	189	248	22	332	27	6 (4)
3RW34 72...	361	344	417	224	286	29	336	45	6 (4)
3RW34 83... / 84...	480, 720	442	517	231	133 (3)	18	450	32	6 (8)
3RW34 86...	960	448	719	235	101 / 138 / 138	23	653	29	6 (8)

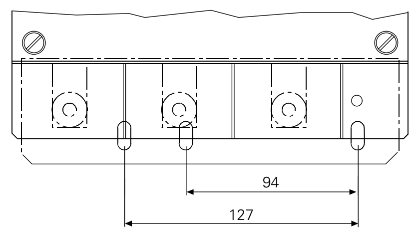
Table 3 : Dimensions (mm)

Dimensions in mm

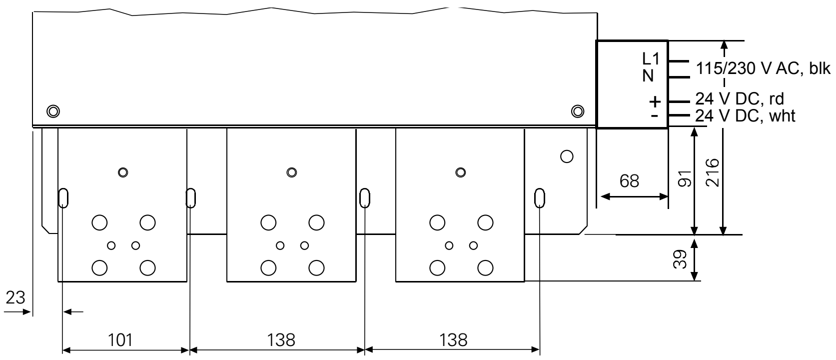




3RW34 83/84-..-.. Upper & Lower Mounting Hole Locations



3RW34 5* - Lower Mounting Hole Locations



3RW34 86-.. Upper & Lower Mounting Hole Locations and Power Pack

Fig. 4 : Dimension Drawings

3 Introduction

3.1 Scope of Manual

This manual provides an overview for the installation, setup, and operation of the Siemens SIKOSTART 3RW34 soft starter. Maintenance data consists of troubleshooting and spare parts information. Note that the instructions in this manual do not cover all details or variations in equipment, nor provide for every possible contingency to be met in connection with installation, operation, or maintenance.

3.2 3RW34 SIKOSTART Features

The SIKOSTART 3RW34 product line combines DSP microprocessor and SCR technologies to provide AC induction motor starting and operation.
The SIKOSTART 3RW34 soft starter is a single ramp style soft starter using phase control for the operation of three-phase induction motors. Each unit includes soft start and stop parameters plus fault detection. The SIKOSTART 3RW34 soft starter is available as an open type. The unit can be installed together with an overload relays, or as a combination of a starter with a disconnecting switch and circuit overload protection device.

4 Operating Principle

4.1 Function Overview

The SIKOSTART 3RW34 soft starter utilizes a voltage ramp design to produce an output voltage to the motor that increases from a customer selected initial voltage to full line supply voltage over an adjustable starting time.
The accelerating and coasting ramp times can be set independently.

4.1.1 Soft Start with Coast to Rest

Fig. 5 shows the relationship of voltage and speed with respect to time when a soft start is used with coast to rest. The controller potentiometers have been set as follows:
U_m The initial voltage is set at approximately 30 %.
t1 The start time setting is greater than 0.
t2 The stop time is set at 0 which allows the motor to coast to a stop.

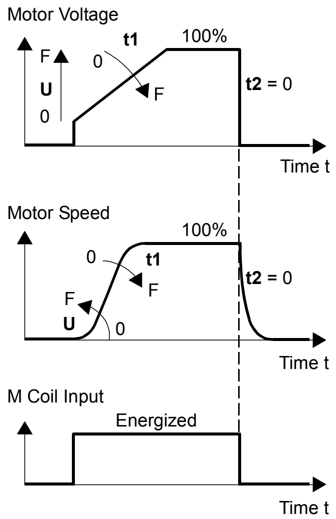


Fig. 5 : Voltage and time curves for soft start with coast to stop

4.1.2 Soft Start with Soft Stop

Fig. 6, like Fig. 5, shows the voltage and speed curves for a soft start but with controlled deceleration. The potentiometers have been set as follows:
U_m The initial voltage is set at approximately 30 %.
t1 The start time setting is greater than 0.
t2 The stop time setting is greater than 0 which allows the motor to soft stop.

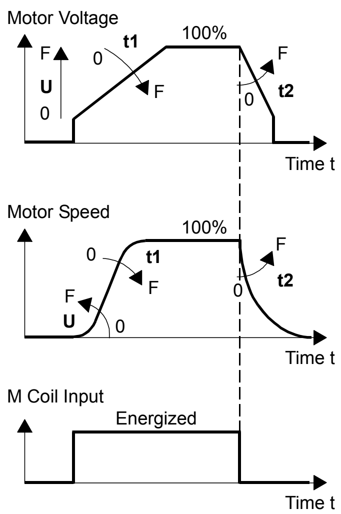


Fig. 6 : Voltage and Speed Curves for Soft Start with Soft Stop

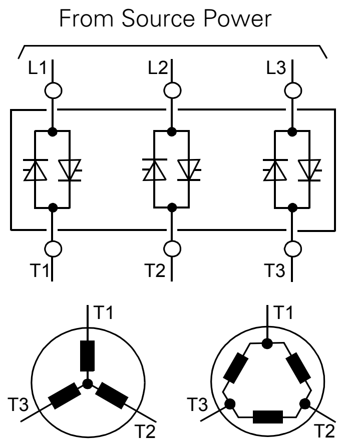
English

4.1.3 Connecting the Motor to the Soft Starter

Wye Motor. The soft starter can be used for either a three-lead or six-lead wye motor. Connecting the soft starter to a wye motor inserts the SCR's directly in the line wiring, referred to as "In Line" wiring.

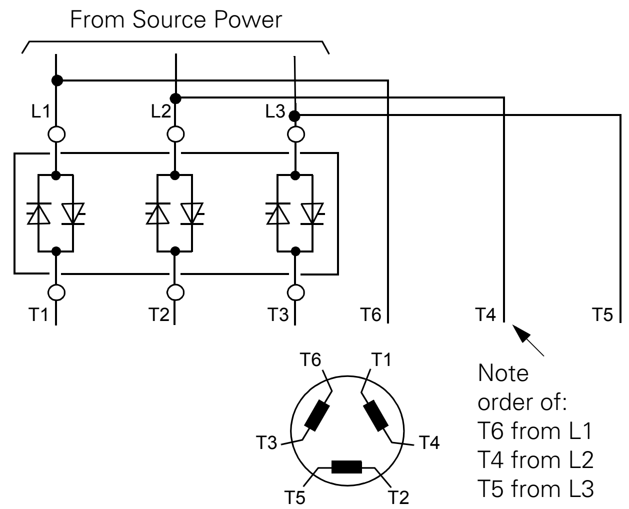
Delta Motor. The soft starter can be used for either 6 or 12 lead delta motors. If the motor is hard wired as delta, the starter must be connected and sized with "In Line" wiring as shown in Fig. 7a.

Fig. 7b shows the soft starter connected with the SCRs inside the delta, referred to as "Inside Delta" wiring. For Inside Delta wiring, the soft starter power rating may be increased (line current = 1.73 phase current) relative to the In Line power rating.
The type of connection, "In Line" or "Inside Delta" must be set using the DIP switch SW1.3 (see Section 7.1) on the control board.



3 or 6 Lead Wye Motors and 3 Lead Delta Motors

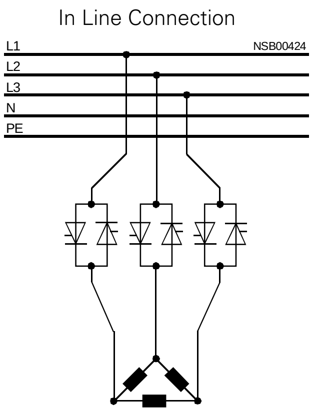
Fig. 7a



6 or 12 Lead Delta Motors

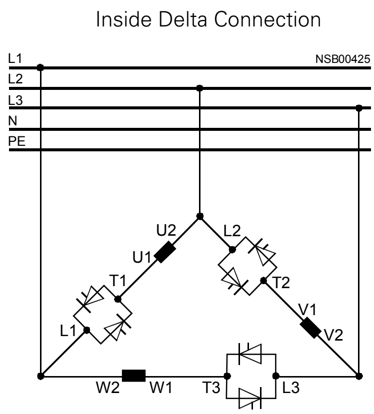
Fig. 7b

Fig. 7 : Motor Connections



Rated Current I_e Equals Motor Rated Current I_n
3 Leads to the Motor

Fig. 8a



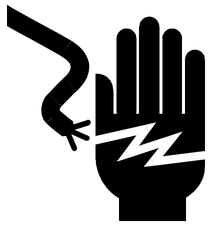
Rated Current I_e Equals Approx. 58 % of Motor Rated Current I_n
6 Leads to the Motor
(Like for Wye-Delta Starters)

Fig. 8b

Fig. 8 : In Line Connection; Inside Delta Connection

5 Installation

5.1 Incoming Inspection



⚠ CAUTION

Heavy equipment
May cause injury or property damage.
To avoid personal injury or soft starter damage, do not use the unit's cover as a handle when moving and/or positioning the unit.

1. If the soft starter is not installed immediately, it should be stored in a clean, dry area where the ambient temperature is between 0 °C and 70 °C. Avoid storage environments with corrosive atmospheres or high humidity.
   Note: Installation must be performed by qualified personnel as indicated on page 3 of this manual.

⚠ WARNING

Voltage or fire hazard.
Can cause death, serious injury,
or property damage.
To prevent electrical shock or burns, do not leave foreign objects (wire clippings, metal chips, etc.) either inside or on top of the soft starter during installation procedures.

2. The carton and packing materials should be retained in case there is a future need to return the soft starter to the factory for service or repair. The carton and packing material are especially fitted to protect the soft starter from shipping damage.

If these materials are not used for shipping, claims for shipping damage may be rejected by the freight carrier.

5.2 Mounting

1. Section 2 of the manual contains soft starter mounting dimensions and data. Air flow through the unit is vertical, from bottom to top.

⚠ WARNING

Fire hazard
Can cause death, serious injury, or property damage.
To prevent a fire, the soft starter, especially a non-fan-cooled unit, must be mounted with its fins in a vertical direction only. Sideways mounting and improper ventilating can result in fire.

2. Adequate cooling is essential for proper operation. Leave at least 6 inches (150 mm) of clearance above and below the unit to allow unimpeded convection or fan air flow. Wire bending allowance may require more than this recommended minimum clearance.

3. When mounting the soft starter in an enclosure, the enclosure must be properly sized or ventilated to provide cooling for the continuous power dissipation in the SCRs, approximately 3 watts per amp of continuous rating. The following vent areas are required for each inlet and each outlet on customer furnished enclosures, motor control centers, etc.

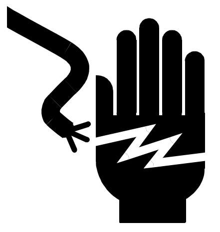
Order No.	sq. in.	cm^2	A
3RW34 54	not required	not required	up to 57 A
3RW34 55 - 65	20	129	up to 131 A
3RW34 66 - 67	40	258	up to 248 A
3RW34 72 - 83	80	516	up to 480 A
3RW34 84 - 86	120	774	up to 960 A

Table 4 : Ventilation Cross-Sections

Locate front ventilation air inlet vent at least 3 inches (75 mm) below the bottom edge of the soft starter. Locate the outlet air vent area at least 6 inches (150 mm) above the unit's top edge. Air filters impede air circulation and require a fan at inlet and/or outlet.

5.3 Installation Precautions

The following precautions are intended for use as guidelines for proper installation of the soft starter. Because of the variety of applications, all of these precautions may not pertain to your system and they are not all-inclusive. In addition to the following, refer to codes and standards applicable to your particular system.



⚠ WARNING

Hazardous voltage.
Can cause death, serious injury,
or property damage.
To avoid electrical shock, this soft starter MUST be wired with motor disconnecting means and branch circuit protection because the soft starter does not provide electrical isolation to the motor when the soft starter is OFF.

5.3.1 Soft Starter Protection

⚠ DANGER

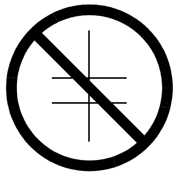
Hazardous voltage.
Will cause death or serious injury.
To avoid electrical shock or burn, do not touch soft starter terminals when voltage is applied to the soft starter. Output terminals will have voltage present even when soft starter is OFF.

When planning your installation, be aware of potential hazards to personnel and to the unit that can be caused by control devices used in the system or by unique system features.

Motor Disconnect. When any motor disconnect device connected to the soft starter output (motor) terminals is opened during operation, the soft starter continues to source full voltage if running. If the disconnect device is reclosed, the motor will be restarted at full voltage. When the disconnect device is opened, a hazardous voltage is present at the soft starter output terminals due to SCR and snubber leakage.

Motor Start/Stop. For normal operation, the soft starter is designed to start and stop the motor with signals that are input to the soft starter's circuitry. Do not use the device that disconnects and reapplies line power to the soft starter for ordinary starting and stopping of the motor.

Asymmetric Motor Windings. Some delta motors are wound (or re-wound) asymmetrically. The soft starter is unsuitable for these motors.



⚠ CAUTION

Hazardous voltage.
May cause property damage.
To avoid damaging solid-state power devices, do not connect power-factor-correcting capacitors to the load side of the soft starter.

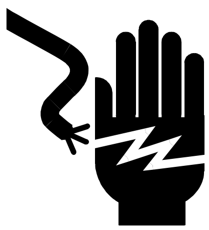
Power-factor-correcting (PFC) Capacitors. Do not use PFC capacitors at the soft starter output terminals. Connection to the output terminals will damage the soft starter. If PFC capacitors are used, they must be connected on the line side of the unit.
When an isolation contactor is used with the soft starter, the PFC capacitors must be disconnected from the soft starter when the isolation contactor is open.

Hazardous Environment. Depending on the system environment, consideration must be given to unexpected hazards such as an accidental spray of gas, liquid or solid particles or inadvertent contact with moving machinery. Since the soft starter's start/stop control circuitry includes solid-state components, a potentially hazardous environment may require the installation of an additional hard wired emergency stop circuit that will either disconnect AC input power to the SIKOSTART soft starter or disconnect the motor from the soft starter.

Multiple Motors. When the soft starter is used for more than one motor, be sure the combined full load current (sum of individual motor FLAs) does not exceed the soft starter's rated output current. Each motor requires separate overload relay protection.

Bypassing the Soft Starter. When the soft starter is mounted in a sealed enclosure, a bypass contactor is generally used to prevent heat from being generated by the SCRs during running. If not bypassed during operation, supplemental cooling may be required depending on the operating current and enclosure size and type.

5.4 Power and Motor Wiring



⚠ DANGER

Hazardous voltage.
Will cause death or serious injury.
To avoid electrical shock or burn, turn off main and control voltages before performing installation or maintenance.

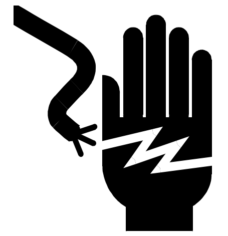
⚠ WARNING

Fire hazard.
Can cause death, serious injury, or property damage.

Welding cable requires crimp type solderless terminals to prevent arcing and possible fire.

5.4.1 Power Connection

Connect the proper capacity 3-phase 50/60 Hz voltage source to the soft starter input terminals L1, L2, and L3. These terminals are not phase sensitive.



WARNING

Hazardous voltage.
Can cause death, serious injury, and property damage.

The soft starter case must be grounded to earth for operator's safety.

CAUTION

Only use flexible connectors to connect power wires to soft starter busbar.

5.4.2 Motor Connection

CAUTION

Wrong motor connection can cause property damage.
Confirm that the motor connections are according to the wiring diagrams in Section 6.

1. The IEC (International Electrotechnical Commission) motor overload protection requirement can be met with an overload relay.
2. The soft starter can be used for wye or delta motors with connections to the motor as either In Line wiring or Inside Delta wiring Section 4.1.3). Be sure the power ratings are correct for the type of connection required for the application; refer to Section 9.
   The SIKOSTART is for both wye and delta motors. Where the winding ends are not accessible, the SIKOSTART is connected directly to the power-in lead (In Line connection). Set In Line connected motors to SW1-3 "star" and use the HP/kW ratings for In Line connected motors. With (6) or (12) lead Inside Delta connected motors operate the SIKOSTART inside the delta. Set selector switch SW1-3 to "delta" and use the HP/kW rating for Inside Delta connected motors.
3. 3RW34 soft starters should not be operated without a connected load. Even if the ON command is not present, the self-diagnosis function of the soft starter may output error messages if the load is disconnected when the main and supply voltages are still connected. This will not, however, destroy the device.

5.4.3 Grounding

The soft starter case and motor frame must be properly grounded in accordance with pertinent installation instructions. The SIKOSTART Soft Starter features a ground stud at the power and ground terminals for connection to system ground in the unit enclosure.

5.5 Control Connection

1. The control supply voltage U_S and the supply voltage for the control inputs and outputs must be connected in accordance with the specifications on the rating plate of the soft starter (see Fig. 2 and Fig. 3).
2. Connect control circuit pilot devices in accordance with the application. Section 6 provides examples of several typical arrangements; Section 7 describes the DIP switch (SW-1) settings.
3. The specified rated values and starting load capacities of the 3RW34 can only be achieved by cooling with the built-in fans. After the soft starter has been switched off by canceling the ON command at terminals A1 and A2, the built-in fans must run on for approx. 60 minutes to ensure that the power electronics are sufficiently cooled. For this reason, it is extremely important that the supply voltage at terminals X1 and X2 is not switched off until approx. 60 minutes (at the earliest) after the ON command has been canceled.
   If the supply voltage at terminals X1 and X2 is switched off (which also results in the fans being switched off) at the same time the ON command is canceled at terminals A1 and A2, the soft starter can only be switched on again, at the earliest, approx. 3 hours later in order to achieve the specified rated values and starting load capacities of the 3RW34.

5.6 Overtemperature Switch Connection for 3RW3486

The SIKOSTART 3RW34 86 soft starter for 960 A rated operating current requires an overtemperature switch. A description of mounting and wiring the switch:

Mounting The Overtemperature Switch

The Overtemperature Switch and Bracket are mounted at the top end of the SIKOSTART Control without any cooling fans. This is the main line and utility power end of the control (L1 to L3). The bracket is mounted under one of the center housing mounting bolts.

Wiring The Overtemperature Switch

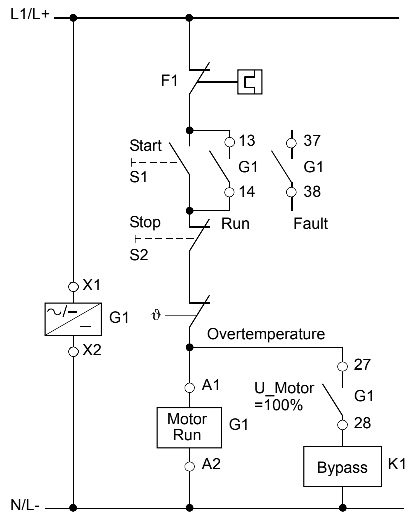


Fig. 9 : Typical Overtemperature Switch Wiring

⚠ DANGER

Hazardous voltage.
Will cause death or serious injury.
To avoid electrical shock or burn, do not touch soft starter output terminals when voltage is applied to the soft starter.
Output terminals will have voltage present even when the soft starter is OFF.

The overtemperature switch has a normally closed contact that opens when an overtemperature condition exists. The contact has two 2¼" (6,3 mm) quick-connect terminals for connection to the control circuit. The contact is wired in series with the start/stop control circuit. The switch contact is rated for 230 V AC at 8 A resistive maximum.

WARNING

Hazardous voltage.
Can cause death, serious injury,
or property damage.
To prevent electrical shock or burns, do not leave foreign objects (wire clippings, metal chips, etc.) either inside or on top of the controller during mounting procedures.

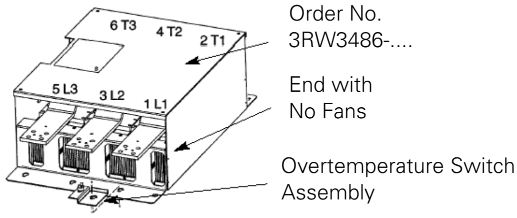


Fig. 10 : Overtemperature Switch Mounting for 3RW3486

5.7 Coil Suppression

Relay, electromechanical brake, or solenoid coils produce electrical noise transients (especially when being de-energized) which can be coupled into the controller circuitry and cause erratic operation. For all such devices connected to or near the soft starter or its wiring, see Fig. 11 and observe the following.

24 V DC Coils. Connect a diode directly across each DC coil. A standard diode (e.g. 1N4004) is acceptable for most 24 V DC applications up to 1.0 A.

CAUTION

The control outputs are semiconductor (solid-state) outputs. Applying improper control voltage and/or frequency can damage the control circuits.

Use control circuits only at the rated voltage and frequency. 24 V DC models have solid-state FET outputs and should not be used on AC circuits. Alternately, 115 V AC & 230 V AC models have triac outputs and should not be used on DC circuits.

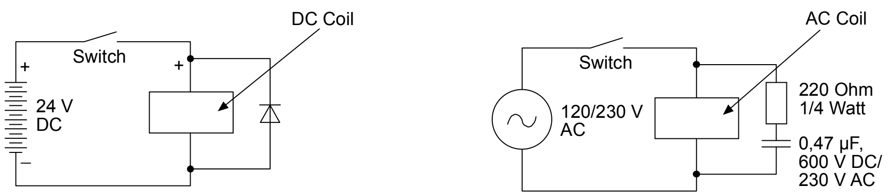
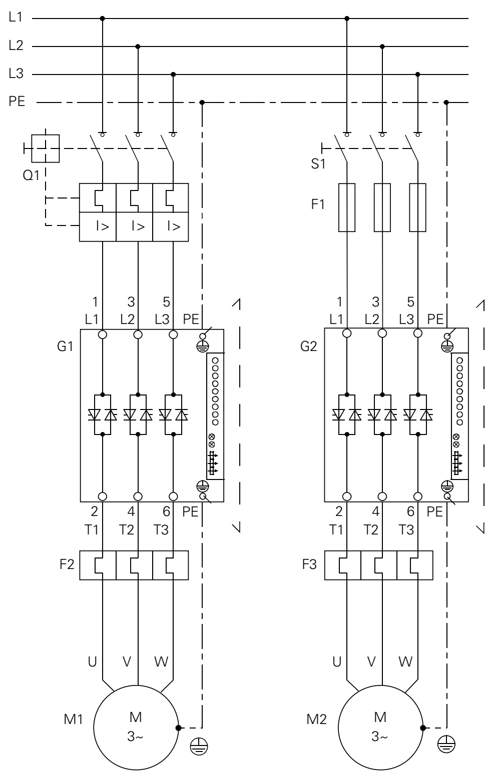


Fig. 11 : Inductive Load Suppression

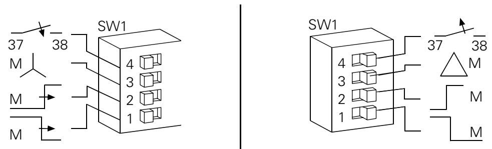
6 Connection Diagrams

"In Line Connection"



Switch Settings for M1			Switch Settings for M2
Close On Fault (SW 1-4)	←	←	(SW 1-4) Close On Fault
Wye Motor (SW 1-3)	←	←	(SW 1-3) Wye Motor
No Start Delay (SW 1-2)	→	→	(SW1-2) No Start Delay
No Stop Delay (SW 1-1)	→	→	(SW 1-1) No Stop Delay

Switch Functions



View of Terminal Block Edge of SIKOSTART

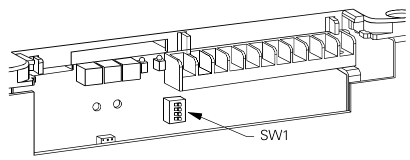


Fig. 12 : Power wiring for motors, wired "In Line", in a vented enclosure (circuit breaker or fusible disconnect)

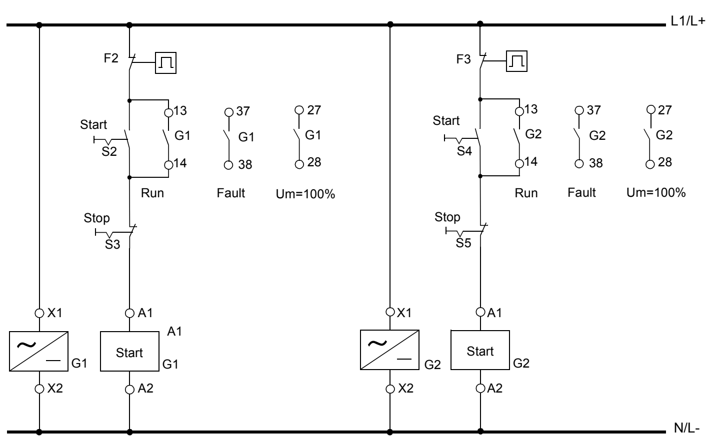
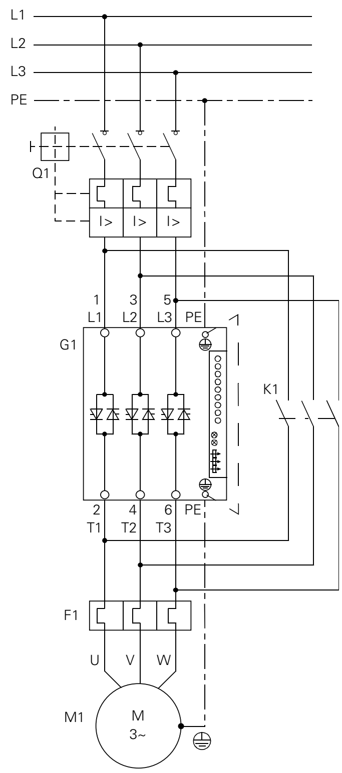


Fig. 13 : Control wiring motors, wired "In Line", in a vented enclosure (circuit breaker or fusible disconnect)

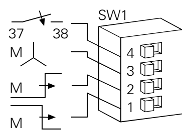
English

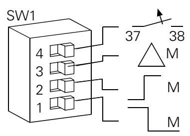
wired "In Line" with bypass contactor



Switch Settings for M1	
Open On Fault (SW 1-4)	→
Wye Motor (SW 1-3)	←
No Start Delay (SW 1-2)	→
With Stop Delay (SW 1-1)	←

Switch Functions





View of Terminal Block Edge of SIKOSTART

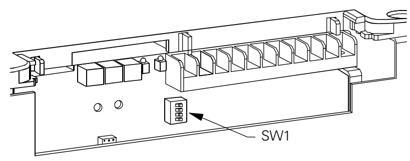


Fig. 14 : Power wiring for motor, wired "In Line" with bypass contactor

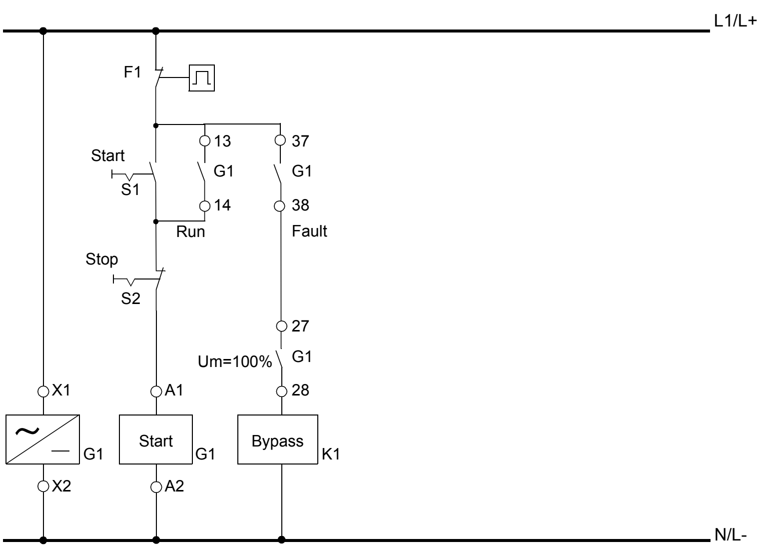
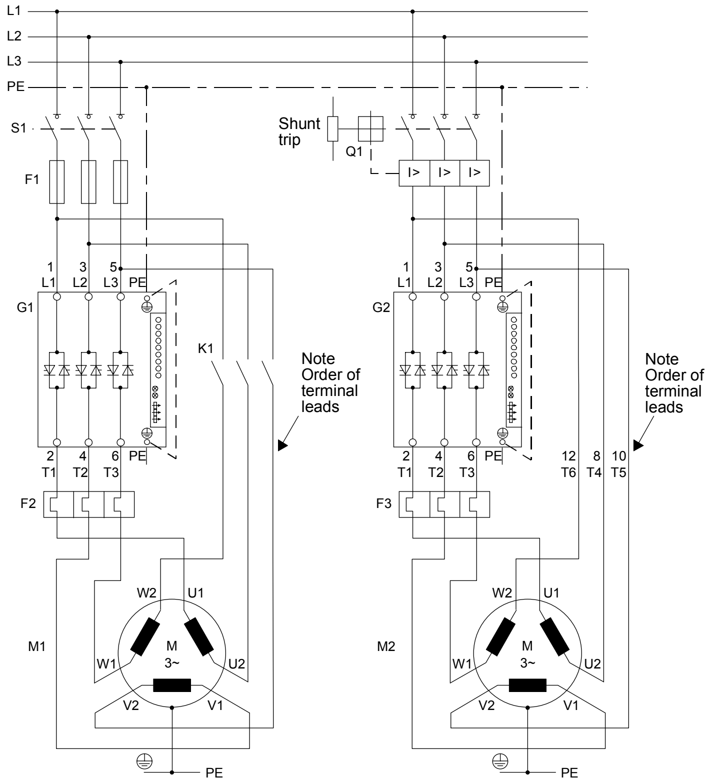


Fig. 15 : Control wiring for a motor, wired "In Line" with vented enclosure

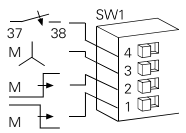
English

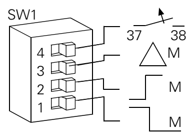
"Inside Delta Connection"



Switch Settings for M1			Switch Settings for M2
Open On Fault (SW 1-4)	→	←	(SW 1-4) Close On Fault
Delta Motor (SW 1-3)	→	→	(SW 1-3) Delta Motor
With Start Delay (SW 1-2)	←	→	(SW 1-2) No Start Delay
No Stop Delay (SW 1-1)	→	→	(SW 1-1) No Stop Delay

Switch Functions





View of Terminal Block Edge of SIKOSTART

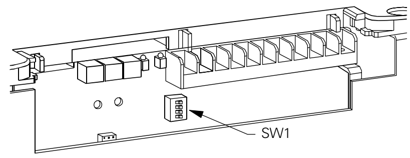


Fig. 16 : Power wiring for motors, wired "Inside Delta" in a vented enclosure, with fusible disconnect and isolation contactor, and shunt release.

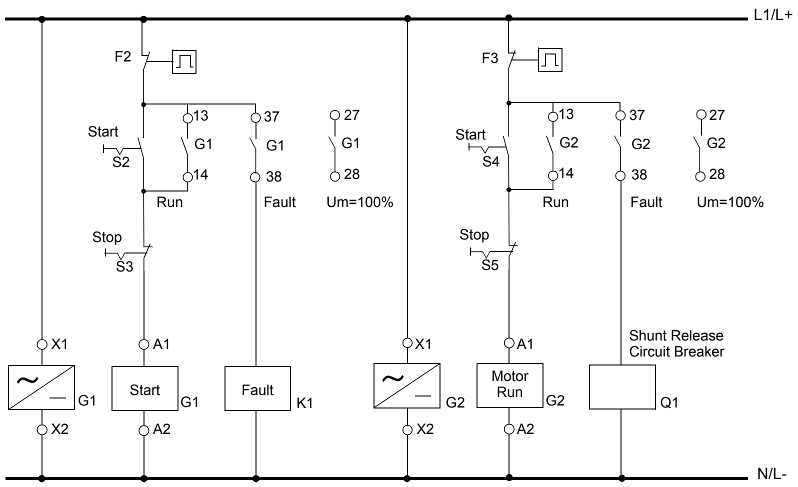
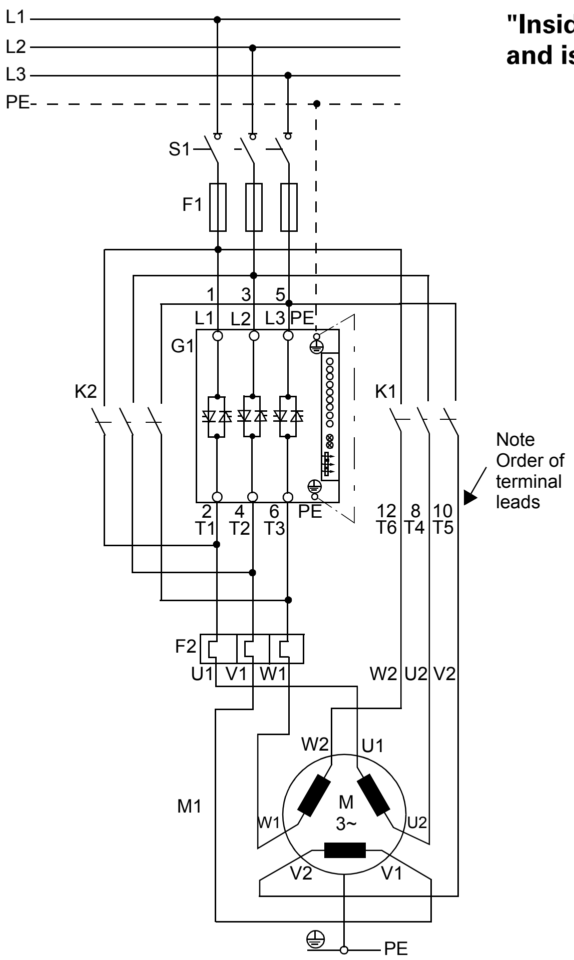


Fig. 17 : Control wiring for motors, wired "Inside Delta" in a vented enclosure, with fusible disconnect and isolation contactor, and shunt release.

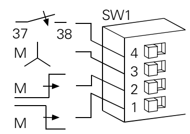
English

"Inside Delta Connection" with bypass and isolation contactors



Switch Settings for M1	
Open On Fault (SW 1-4)	→
Delta Motor (SW 1-3)	→
With Start Delay (SW 1-2)	←
With Stop Delay (SW 1-1)	←

Switch Function



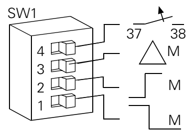


Fig. 18 : Power wiring for a motor, wired "Inside Delta", with bypass and isolation contactors

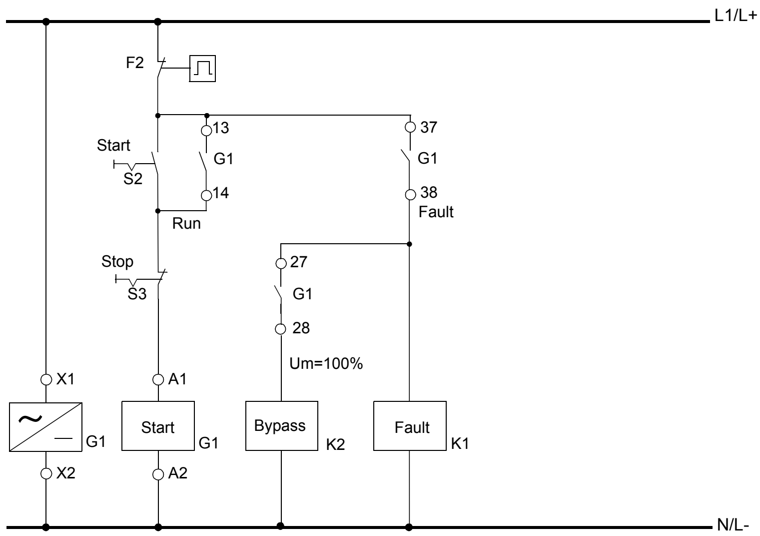


Fig. 19 : Control wiring for a motor, wired "Inside Delta", with bypass and isolation contactors

6.1 Circuit Devices

Common Circuit Devices. Some circuit devices common to each application shown include:

- an overload relay (e. g. F1, F2) for motor protection;
- either a circuit breaker (Q1) or a fused disconnect switch (S1/F1) to connect and disconnect main power to the application;
- a Start/Stop control that is connected so when the start switch is pushed, the RUN coil in the soft starter is energized, and the soft starter RUN interlock contact closes and latches in the RUN coil. When the stop switch is pushed or power is lost, the circuit is broken and the soft starter drops out which shuts off power to the motor. If a three wire Start/Stop control connection is used, the motor may automatically restart when power is restored to the soft starter.

Bypass Contactor. The applications shown in Fig. 14 and Fig. 18 include a bypass contactor (K1). The bypass contactor is rated to handle the running current of the motor (AC1) but not the starting current (AC3).
The bypass contactor remains open until the soft starter has soft-started the motor. Once the motor is operating at line voltage, the Up-to-Voltage contact closes and the bypass contactor is energized causing motor current to flow through the bypass contactor rather than the soft starter.

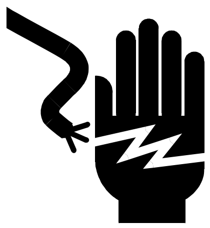
A bypass contactor is useful when the soft starter is mounted in a IP 4x, or other airtight enclosure. When the motor current is routed through the bypass contactor, no current is flowing through the soft starter SCRs, and the soft starter generates no heat. For both applications, the switch SW1-1 is set to the turn off delay position so that the bypass contactor de-energizes before the soft starter (refer to Section 7.1).

Isolation Contactor. The applications shown in Fig. 16 and Fig. 18 include an isolation contactor. The contactor disconnector is energized when the soft starter is connected to control supply voltage and provides power to half of the windings of the six-lead delta motor. If a soft starter fault occurs, the fault contact opens which de-energizes the isolation contactor and the motor stops.
For both applications, switch SW1-4 is set to open the fault contact on fault detection and switch SW1-2 is set so that the isolation contactor energizes before the soft starter (refer to Section 7.1).
The isolation contactor is rated to disconnect the start current (AC3).

Shunt Release. A circuit breaker with shunt release is used on the second motor in Fig. 16. The switch SW1-4 is set to close the fault contact on fault detection. With the circuit breaker (Q1) closed and the soft starter operating (RUN coil is On), the shunt release coil is de-energized. If a soft starter fault occurs, the fault contact closes to energize the shunt release coil which trips open the circuit breaker and disconnects power to the soft starter and motor.
The Fig. 16 application shows two methods of using the soft starter fault contact to stop the motor when a fault occurs: 1) the fault contact opens to de-energize the isolation contactor for the first motor (M1) and 2) the fault contact closes to operate the shunt release on the circuit breaker for the second motor (M2).

7 Setup and Operation

7.1 Setup Controls



DANGER

Hazardous voltage.
Will cause death or serious injury.

To avoid electrical shock or burn, turn off main and control voltages before performing installation or maintenance.

The setup controls are at the right side of the soft starter and are accessible without removing the cover. Fig. 20 shows the controls: three potentiometers, T1, U, and T2; and DIP switch SW1. Values for the potentiometer settings are listed in Table 2. Use a small screwdriver to change the potentiometer setting, rotating clockwise to increase and counterclockwise to decrease.
Note: The controls are set at the factory for a typical starter. Please verify the application for proper settings. (For detailed picture of the potentiometers see Fig. 22).

T1 - Start Time. This 16-position potentiometer sets the acceleration ramp time from 0.5 to 60 seconds maximum. This setting determines the time interval for the voltage to increase from the initial setting (U) to line voltage.

U - Initial Voltage. This 16-position potentiometer sets the initial voltage at a percentage of line voltage: 30 % to 80 %. The initial setting should be the level that causes the motor shaft to turn as soon as the RUN signal is given.

T2 - Stop Time. This 16-position potentiometer sets the coasting ramp time from 0.5 to 60 seconds maximum. This setting determines the time interval for the voltage to decrease from line voltage to the initial setting (U). Note: The voltage for the final torque is 80 % of the setting for "U".

SW1 - DIP Switch. This switch has four sections for setting the soft starter software to correspond to the application. Each switch is positioned by sliding it to the right or left as illustrated in Fig. 20 (or up or down when the soft starter is mounted vertically). On the wiring diagrams in Section 6, the position of each switch is indicated by an arrow pointing to either the right or left.

1. SW1-1: This switch provides a turn off delay signal setting (left position). The off delay allows a bypass contactor to de-energize 1.0 seconds before the soft starter RUN coil de-energizes. This delay eliminates damage to the SCRs caused by voltage transients produced when the bypass contactor interrupts motor current.
The right position of switch SW1-1 provides no delay. When the stop device is actuated, the RUN coil de-energizes immediately.

2. SW1-2: This switch provides a turn on delay signal setting (left position). The on delay allows an isolation contactor to energize first, at zero current, followed by the soft starter RUN coil 1.0 seconds later.
The delay maximizes the contact life of the isolation contactor. If no delay is set this can cause a failure (missing phase).
Also use this switch for isolation contactors behind the soft starter (e.g. Dahlander circuits).

The right position of switch SW1-2 provides no delay. Operating the RUN device energizes the starter immediately.

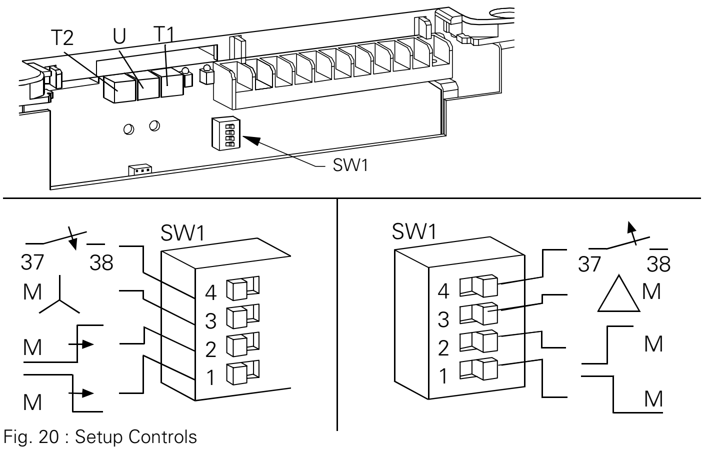


Fig. 20 : Setup Controls

Dial Setting	Initial Voltage U (% of Full Voltage)	Ramp Time T1, T2 (Seconds)
0	30	0.5
1	33	1.0
2	36	2.0
3	40	4.0
4	43	6.0
5	46	8.0
6	50	10
7	53	12
8	56	15
9	60	20
A	63	25
B	66	30
C	70	35
D	73	40
E	76	50
F	80	60

Table 5 : Potentiometer Setting Values

Factory Settings: **T1 = 8 (15 sec)**
T2 = 0 (0.5 sec)
U = 8 (56 %)

3. SW1-3: This switch directs the soft starter software to operate the SCRs for either a Wye motor - In Line wiring (left position) or a Star/Delta motor - Inside Delta wiring (right position).

⚠ WARNING

When the switch set to "In Line", the motor must be operated in In Line connection and when the switch is set to "Inside Delta", the motor must be operated in Inside Delta connection!

Setting the switch to the wrong type of connection can cause very high currents during operation. These currents can destroy or damage the SCRs and other components. Be sure to set the soft starter only to the type of connection actually used.

4. SW1-4: This switch sets the fault contact, which is a normally open contact,to respond to a fault by either closing (arrow down position, switch to the left) or opening (arrow up position, switch to the right).

With the "open on fault" position selected, contact status is as follows:

Power off - contact is open
Power on - contact closes
Fault occurs or loss of power - contact opens

With the "close on fault" position selected, contact status is as follows:

Power off - contact is open
Power on - contact is open
Fault occurs - contact closes

The contact remains open on loss of power.

The factory settings for switch SW1 sections are:
SW1-4: close on fault (switch left)
SW1-3: In Line wiring (switch left)
SW1-2: no on delay (switch right)
SW1-1: no off delay (switch right)

7.2 LED Indicators

Two LED indicators are located above the potentiometers. These LEDs indicate soft starter status and fault conditions as follows.
LEDs: The LEDs indicate both the function and the fault status of the unit. Both LEDs display three states as follows:

LED 1 (Top)

Constant Display	Soft starter is ready for operation
Single Flashing	FAULT: Main voltage phase loss*)
Double Flashing	FAULT: EEPROM parity error

LED 2 (Bottom)

Constant Display	Output voltage equals line voltage, i.e., motor is up to speed.
Single Flashing	Output voltage is less than line voltage, i.e., motor is starting or stopping
Double Flashing	FAULT: Shorted SCR.

*) no action to fault output

7.3 Soft Starter Setup

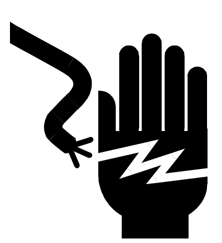
Before the initial startup, set the controls as follows:
1. Set switch SW1 sections in accordance with the application.

2. Set Start Time T1. This setting is application dependent, affected by load torque, motor voltage, and total inertia. The as-supplied setting is 8; this corresponds to 15 seconds.

3. Set Initial Voltage U. The as-supplied setting is potentiometer setting 8; this corresponds to 56 % of U.

4. Set Stop Time T2. The 0 setting allows the load to coast to rest. If the soft stop feature is required for the application, set T2 to a position other than "0". The factory setting is 0.

7.4 Preliminary Checks



⚠ DANGER

Hazardous voltage.
Will cause death or serious injury.

To avoid electrical shock or burn, turn off main and control voltages prior to performing preliminary checks.

With main power disconnect device open and control power off, check the following:

1. Power and Motor Connections: Check that the soft starter has been properly connected to the power source and motor.

2. Control Connections: Check that control power, the start/stop control, and applicable devices have been properly connected to the control terminal board (Fig. 2 and Fig. 3).

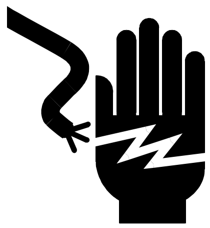
3. AC Line Power Verification: Verify that each phase of the AC line power at the disconnect device is within the rated value of the soft starter as indicated on the unit's nameplate.

4. Ground Check: Use an ohmmeter set to its highest scale and observe the following:

   a) Check for a ground between each soft starter output terminal (T1, T2, T3) and chassis ground. Each terminal to ground reading should be over 500 kilohms.

   b) The measurement between each input terminal (L1, L2, L3) and ground should be over 500 kilohms.

7.5 Initial Energization



⚠ WARNING

Hazardous voltage.
Can cause death, serious injury, or property damage.

To avoid electrical shock or burn, do not operate soft starter with either the cover or the control terminal finger guard removed.

1. Temporarily remove RUN signal connections by opening the circuit at control terminals A1 and A2.

2. Turn on main AC power and control power to the soft starter; LED 1 comes on.

3. Measure input AC voltages L1 to L2, L2 to L3, and L3 to L1. Voltages should be within the soft starter's rated range and balanced for proper motor operation.
   If the line voltages are not equal, unbalanced currents in the stator windings occur. A small percentage voltage unbalance results in a much larger percentage current unbalance. Consequently, the temperature rise of the motor operating at a particular load and percentage voltage unbalance is greater than for the motor operating under the same conditions with balanced voltages.

4. Measure individual input AC voltages L1, L2 and L3 to ground. On most systems, voltage will be about 58 % of line voltage and nearly equal. Any unbalanced voltage may indicate a ground in the motor or the SIKOSTART soft starter.

5. Measure the control voltage. It should be within -15 % to +10 % of the nominal controller rating.

6. Measure voltage across each pole of the SIKOSTART soft starter, i.e., L1 to T1, L2 to T2, and L3 to T3. property damage.
   These voltages should be nearly equal and have values as follows:
   a) For a wye motor, the voltage across each pole should be approximately 58 % of the input line to line voltage.
   b) For a delta motor, the voltage across each pole should be approximately 100 % of the input line to line voltage.

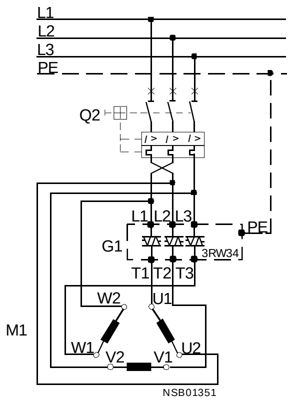
Low voltage, zero voltage, or unequal voltages indicate 1) the load circuit to the motor is open or improperly grounded, or 2) an SCR is shorted or bad (usually indicated by a double flashing LED 2; refer to Section 10 "Troubleshooting").

To check the load circuit, disconnect power to the soft starter, check and correct connections and close any load circuit switching device(s). Energize the soft starter and recheck voltage across each pole.

English

7. De-energize main AC power and control power. Reconnect actuating signal wires to terminals A1 and A2. Unit is now ready.

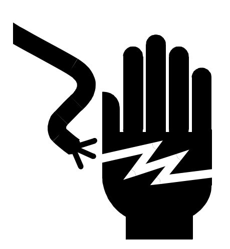
8. Energize main AC power and control power. Initiate start by actuating pilot device(s). Check for proper operation and desired starting performance. Verify proper motor rotation; if required, reverse rotation by interchanging motor leads. Adjust potentiometers per Section 7.6.



Note:
The phase sequence should be changed on the line side.
Changing the phase sequence on the motor side can cause faults.

Fig. 21 : Phase exchange for Inside Delta circuit

7.6 Motor Starting Adjustments



WARNING

Hazardous voltage.
Can cause death, serious injury, or property damage.

To avoid electrical shock or burn, turn off main and control voltages between starts when making adjustments.

Observe the motor during the first trial starts. With the setup controls adjusted as described in Section 7.3 and soft starter LED 1 on, start the motor.

Initial Voltage U. Ideally, the motor begins to rotate almost immediately after the starting voltage is applied to it and the load begins to move. If the motor fails to start rotating when the starting voltage is applied, increase the U potentiometer setting. If the motor accelerates too quickly, decrease the U setting. Repeat trial starts until the load just begins to move when power is first applied.

DANGER

Frequency of starting:
Keep cooling time in mind!

Start the motor. If more or less torque is required to start the driven machine, switch off the line voltage and turn the potentiometer for the initial voltage in the right direction until the driven machine starts to rotate when power is first applied. Two or three attempts may be necessary to set the correct initial voltage.

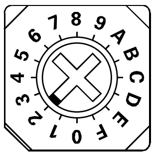
Additional initial voltage may be needed if motor is subject to starting load variance such as stiff belts or cold grease.

All changes to potentiometers do not take effect until the device is switched off.

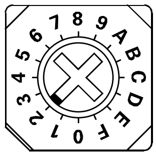
Start Time T1. During setup procedures, T1 was set to a mid range acceleration ramp time. If the soft starter ramp ends before the motor reaches full speed, turn RUN signal off and increase the T1 setting. Repeat trial starts to achieve a smooth acceleration to full speed (LED 2 changes from single blinking mode to continuously on) before the T1 time elapses.

Stop Time T2. For most applications, the motor load will coast to rest; T2 setting equals 0.

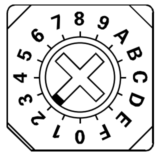
A soft stop is required for some applications, e.g. to reduce water hammer in a pumping system. For a soft stop, most applications require the stop time T2 to be equal to or longer than the start time T1. Turn RUN signal off before changing the T2 setting.



Initial Voltage
(0 is minimum, F is maximum)



Start Time
(0 is minimum, F is maximum)



Stop Time
(0 is minimum, F is maximum)

Fig. 22 : Potentiometer Settings

Record the final potentiometer settings in the blank spaces above.

8 Electrical Specifications

Main Voltage Required	In Line Application: 200 to 460 V AC or 400 to 600 V AC ± 15 % (specified by order number) Inside Delta Application: 200 to 460 V AC or 400 to 600 V AC ± 15 % (specified by order number)
Control Voltage Required	24 V DC, 115 V AC or 230 V AC +10 %, -15 % (specified by order number) Control power requirements are listed below (Table 6).
AC Frequency & Phase Temperature Range	50/60 Hz, working 45 to 65 Hz; 3 phase 0° to 60 °C inside enclosure in which unit is mounted. Derating for 60 °C see table 12.
Permissible Altitude	1000 m at rated output 2000 m at 0.87 $*I_e$ 3000 m at 0.77 $*I_e$
Overcurrent Protection	The standard SIKOSTART Soft Starter is not equipped with overload protection. **The user must provide overload protection.**
Adjustment Ranges - 16 settings each: **Start Time (Accel. Ramp)**	0.5 to 60 seconds*
Stop Time (Decel. Ramp)	0.5 to 60 seconds
Initial Voltage	30 % to 80 % of nominal voltage (approximately 10 % to 64 % of the normal starting torque)

* The motor acceleration time should be shorter than the set starting time and is dependent on the friction and inertia characteristics of the load or system.

Number of starts per hour and starting time in standard connection at Ta = 40 °C, duty cycle = 30 % and Ie = 300 %

Order Number	Ie in A	Starting time in s	Starts per hour
3RW34 54	57	30	7
3RW34 55	70	30	11
3RW34 57	110	30	11
3RW34 58	135	20	8
3RW34 65	162	30	11
3RW34 66	195	30	11
3RW34 67	235	30	11
3RW34 72	352	30	11
3RW34 83	500	30	11
3RW34 84	700	30	5
3RW34 86	1050	20	6

To determine the unit best suited to your application, we recommend using Win-Sikostart (Order No. E20001-D1020-P302-X-7400)

English

Input (RUN) Coil

Order No.	**3RW34..0DC2.**	**..0DC3.**	**..0DC4.**
Coil Voltage	24 V DC	115 V AC	230 V AC
Isolation Voltage, V AC	1500	1500	1500
Input Current, mA	10	10	10
On Voltage, volts min.	17 V DC	85 V AC	170 V AC
On Current, mA min.	6	6	6
Off Voltage, volts max.	8 V DC	40 V AC	80 V AC
Off Current, mA max.	3	3	3
Input Impedance, ohms (typical)	5 k	12 k	27 k

Table 6 : Input (RUN) Coil

User Outputs	Rating	Outputs are rated 0.5 A maximum at 24 V DC, and 1.0 A at 115 V AC and 230 V AC.
User Output for 115 V AC and 230 V AC version	ISOL Logic to Power	1500 V AC
	Rating	10 A Make 1 A Break 1 A Continuous at 115 V AC / 230 V AC
	On Voltage Drop	1.2 V AC (typical)
	On Current	25 mA (minimum)
	Off Leakage Current	2 mA (typical)
User Output for 24 V DC version	ISOL Logic to Power	1500 V AC
	Rating	1.5 A Make 0.5 A Break 0.5 A Continuous at 24 V
	On Voltage Drop	1.6 V DC (typical)
	Off Leakage Current	2 mA (typical)
Solid-State Outputs	M (RUN)	When soft starter is operating, the RUN contact is closed.
	Um = 100 %	When motor is running at 100 % of line voltage (after starting is complete), the Um contact is closed.
	FAULT	The FAULT contact responds either to an EEPROM error or to a short-circuited thyristor, depending on the setting of switch SW1-4. (Refer to Section 7.1 re SW1-4 settings. Reset fault simply by giving a new start signal.)

Recommended Fuse Type*

Two levels of short circuit protection can be provided by the user:

1. Type 1 protection is available where the short circuit protective device protects the wiring and the integrity enclosure. The soft starter will probably damage and require replacement or repair before being re-energized. Circuit breakers and motor circuit protectors provide this type of protection.
2. Type 2 protection is available where the short circuit protective device protects both the wiring and the soft starter. The soft starter should not require repair before re-energizing after the short circuit has been cleared. Fuses of an KR-1 type or HRC-1 type sized in accordance with the NEC/CEC code or SITOR semiconductor type fuses provide this kind of protection.

* For a complete listing of Siemens SITOR fuses, see Appendix A.

English

Wire Cross-Section		Torque	
AWG or MCM*	mm^2	lb-in	Nm
6 to 4	16 to 25	100	11
3 to 2	35	125	14
1	50	135	15
1/0 to 2/0	50 to 70	150	17
3/0 to 4/0	95 to 120	225	25
250 to 400	120 to 185	290	33
500 to 600	240 to 300	335	38

Table 7 : Torques for Terminal Screws and Ground Stud Nuts
* For 75 °C, aluminum or copper conductor

Nut on ground nut
Operating current of soft starter

<= 240 A	35 lb-in	4 Nm
>= 360 A	110 lb-in	12 Nm

Tighten the control circuit screws acc. to wire cross-section as follows:

Wire Cross-Section		Tightening Torque	
AWG	mm^2	lb-in	Nm
24 ... 12	0.25 ... 4	8	0.9

Electrical Specifications

Order Number	Operational Current Rating (amps)	Power Dissipation at Rated Current (watts)	Surge Capacity (1 cycle) (amps)	I^2t (1/2 cycle) of Starter (A^2s)
3RW34 54...	57	158	1 800	16 200
3RW34 55...	70	190	3 200	51 200
3RW34 57...	110	306	4 400	97 000
3RW34 58...	135	358	5 000	125 000
3RW34 65...	162	493	5 800	168 000
3RW34 66...	195	515	8 000	320 000
3RW34 67...	235	629	14 500	1 051 000
3RW34 72...	352	1 023	12 500	781 000
3RW34 83...	500	1 425	22 360	2 500 000
3RW34 84...	700	2 020	30 000	4 500 000
3RW34 86...	1 050	2 949	36 000	6 480 000

Table 8 : Electrical Specifications

Order Number	Nominal Controller Current Required (Terminals X1, X2)								
	24 V DC Control Voltage		Number of Fans	115 V AC Control Voltage		Number of fans	230 V AC Control Voltage		Number of Fans
	Control	Fans		Control	Fans		Control	Fans	
3RW34 54	45 mA	—	0	14 mA	—	0	13 mA	—	0
3RW34 55 -58	45 mA	400 mA	2	14 mA	300 mA	2	13 mA	170 mA	2
3RW34 65 - 67	45 mA	200 mA	1	14 mA	200 mA	1	13 mA	140 mA	1
3RW34 72	45 mA	450 mA	2	14 mA	400 mA	2	13 mA	280 mA	2
3RW34 83 - 86	45 mA	700 mA	3	14 mA	600 mA	3	13 mA	420 mA	3

Table 9 : Control Power Requirements

English

9 Soft Starter Selection

Each soft starter has two ratings: "In Line" and "Inside Delta."
Inside Delta ratings are higher than In Line ratings.
Be sure to select equipment with the proper ratings for the type of connections used.

For 24 V DC replace the "?" in the order number with "2".
For 115 V AC replace the "?" in the order number with "3".
For 230 V AC replace the "?" in the order number with "4".
Decisive for the dimensioning of the motor controller is the rated operational current. The kW values are for standard motors and can be used as guide values.

U_e: Rated operating voltage
I_e: Rated operational current

Order Number	U_e in V	In Line				Inside Delta			
		I_e in A	230 V kW	400 V kW	500 V kW	I_e in A	230 V kW	400 V kW	500 V kW
3RW34 54-0DC?4	200 to 460	57	15	30	—	99	22	45	—
3RW34 55-0DC?4		70	18,5	37	—	135	37	75	—
3RW34 57-0DC?4		110	30	55	—	195	55	110	—
3RW34 58-0DC?4		135	37	75	—	235	75	132	—
3RW34 65-0DC?4		162	45	90	—	285	90	160	—
3RW34 66-0DC?4		195	55	110	—	352	110	200	—
3RW34 67-0DC?4		235	75	132	—	450	132	250	—
3RW34 72-0DC?4		352	110	200	—	608	200	355	—
3RW34 83-0DC?4		500	160	250	—	865	250	500	—
3RW34 84-0DC?4		700	200	400	—	1216	400	710	—
3RW34 86-0DC?4		1050	355	630	—	1720	530	1000	—
3RW34 54-0DC?5	400 to 600	57	—	30	37	99	—	45	55
3RW34 55-0DC?5		70	—	37	45	135	—	75	90
3RW34 57-0DC?5		110	—	55	75	195	—	110	132
3RW34 58-0DC?5		135	—	75	90	235	—	132	160
3RW34 65-0DC?5		162	—	90	110	285	—	160	200
3RW34 66-0DC?5		195	—	110	132	352	—	200	200
3RW34 67-0DC?5		235	—	132	160	450	—	250	335
3RW34 72-0DC?5		352	—	200	200	608	—	355	400
3RW34 83-0DC?5		500	—	250	355	865	—	500	630
3RW34 84-0DC?5		700	—	400	500	1216	—	710	850
3RW34 86-0DC?5		1050	—	630	710	1720	—	1000	1200

Table 10 : Motor Power Ratings (kW) TA = 40°C

Order Number	U_e in V	In Line				Inside Delta			
		I_e in A	230 V kW	400 V kW	500 V kW	I_e in A	230 V kW	400 V kW	500 V kW
3RW34 54-0DC?4	200 to 460	42	11	22	—	81	22	45	—
3RW34 55-0DC?4		57	15	30	—	110	30	55	—
3RW34 57-0DC?4		81	22	45	—	162	45	90	—
3RW34 58-0DC?4		110	30	55	—	195	55	110	—
3RW34 65-0DC?4		135	37	75	—	235	75	132	—
3RW34 66-0DC?4		162	45	90	—	285	90	160	—
3RW34 67-0DC?4		195	55	110	—	352	110	200	—
3RW34 72-0DC?4		285	90	160	—	500	160	250	—
3RW34 83-0DC?4		450	132	250	—	700	200	400	—
3RW34 84-0DC?4		608	200	355	—	1050	375	630	—
3RW34 86-0DC?4		865	250	500	—	1416	450	800	—
3RW34 54-0DC?5	400 to 600	42	—	—	22	81	—	—	55
3RW34 55-0DC?5		57	—	—	37	110	—	—	75
3RW34 57-0DC?5		81	—	—	55	162	—	—	110
3RW34 58-0DC?5		110	—	—	75	195	—	—	132
3RW34 65-0DC?5		135	—	—	90	235	—	—	160
3RW34 66-0DC?5		162	—	—	110	285	—	—	200
3RW34 67-0DC?5		195	—	—	132	352	—	—	250
3RW34 72-0DC?5		285	—	—	200	500	—	—	355
3RW34 83-0DC?5		450	—	—	315	700	—	—	500
3RW34 84-0DC?5		608	—	—	400	1050	—	—	710
3RW34 86-0DC?5		865	—	—	630	1416	—	—	1000

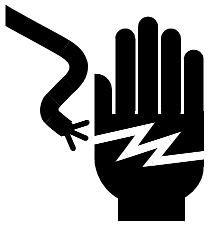
Table 11 : Motor Power Ratings (Kilowatts) TA = 50°C

Order Number	U_e in V	In Line				Inside Delta			
		I_e in A	230 V kW	400 V kW	500 V kW	I_e in A	230 V kW	400 V kW	500 V kW
3RW34 54-0DC?4	200 to 460	35	11	18,5	—	57	15	30	—
3RW34 55-0DC?4		42	11	22	—	81	22	45	—
3RW34 57-0DC?4		57	15	30	—	135	37	75	—
3RW34 58-0DC?4		81	22	45	—	162	45	90	—
3RW34 65-0DC?4		110	30	55	—	195	55	110	—
3RW34 66-0DC?4		135	37	75	—	235	75	132	—
3RW34 67-0DC?4		162	45	90	—	285	90	160	—
3RW34 72-0DC?4		235	75	132	—	448	132	250	—
3RW34 83-0DC?4		352	110	200	—	637	200	355	—
3RW34 84-0DC?4		500	160	250	—	865	250	500	—
3RW34 86-0DC?4		726	200	400	—	1257	400	710	—
3RW34 54-0DC?5	400 to 600	35	—	—	22	57	—	—	37
3RW34 55-0DC?5		42	—	—	22	81	—	—	55
3RW34 57-0DC?5		57	—	—	37	135	—	—	90
3RW34 58-0DC?5		81	—	—	55	162	—	—	110
3RW34 65-0DC?5		110	—	—	75	205	—	—	132
3RW34 66-0DC?5		135	—	—	90	235	—	—	160
3RW34 67-0DC?5		162	—	—	110	285	—	—	200
3RW34 72-0DC?5		235	—	—	160	448	—	—	315
3RW34 83-0DC?5		352	—	—	250	637	—	—	450
3RW34 84-0DC?5		500	—	—	355	865	—	—	630
3RW34 86-0DC?5		726	—	—	500	1257	—	—	900

Table 12 : Motor Power Ratings (Kilowatts) TA = 60°C

10 Troubleshooting

10.1 Maintenance and Troubleshooting



DANGER

Hazardous voltage/fire hazard.
Failure to properly maintain this equipment can result in death, serious injury, property damage or product failure. The instructions referred to below should be carefully reviewed, understood and followed regularly.

Regularly check (the frequency depends upon the amount of airborne particulate matter) the fans and heatsink fins for unimpeded air flow and check that the fans are moving freely.

This checklist does not provide an exhaustive survey of maintenance steps necessary to ensure safe operation of the equipment. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Siemens sales office.

Dangerous voltages are present in the equipment which can cause death, serious injury, or property damage. Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel.

The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which can cause death, serious injury, or equipment damage. Follow all safety instructions contained herein.

10.2 Troubleshooting Tables

Two LED indicators on the SIKOSTART Soft Starter provide fault indications as listed in Table 13 which includes recommended checks and remedies. Table 14 is a general troubleshooting table listing faults, their possible causes, and recommended checks and remedies.
Inside Delta wiring problems are described in Table 15.

Indication	Cause	Check/Remedy
LED 1 single flashing	Phase loss	Verify that proper three-phase incoming power is present per Section 7.5, steps 3 and 4. Inside Delta wiring problem. See problem 5.08 cm Table 15.
LED 1 double flashing	EEPROM error	Replace the logic board. Replacement instructions are included with the new logic board.
LED 2 double flashing	Shorted SCR	Check SCRs as described in Section 10.4.

Table 13 : LED Fault Indications

Fault	Cause	Check/Remedy
Motor does not start and LED 1 is not on	No main power	Check input side of terminals L1, L2 and L3 for open disconnect switch, breaker trip, or insecure terminal connections. Verify that proper three-phase incoming power is present per Section 7.5, steps 3, 4, and 6.
	No control power	Check input side of control terminals X1 and X2 for blown fuse, any open circuit condition or insecure terminal connections. Verify that proper control voltage is present (within +10%,-15% of nominal soft starter rating). If the control circuit includes a control power transformer (CPT), verify that the CPT primary voltage is present and proper for the CPT primary tap.
Motor does not start and LED 1 is glowing steadily	Motor not connected to soft starter	Check that any series disconnect switch or isolating contact is closed. Check for tripped overload relay. Determine and remedy cause of trip per "Motor overload relay trips..." trouble below. Verify that the motor is connected to the soft starter. With proper incoming power and the motor connected but stopped, voltmeter readings across terminals T1 and T2, T2 and T3, and T3 and T1 should be zero. A reading of line voltage indicates that the motor is not connected properly.
	Discontinuity in the control input circuit to the RUN coil	Check that control power is present at terminals A1 and A2. If power is not present, check for insecure wiring connections at terminals A1 and A2, at applicable control terminals (13, 14, etc.), and at the control devices (e.g., start-stop device, isolation contact) used in the input circuit to the RUN coil.
	Bad cable connection or defective printed circuit board (PCB)	Remove control power and check that Logic PCB-to-Snubber PCB cable is secure. If secure, remove main power and replace Logic PCB and/or snubber PCB.
	Faulty motor	Troubleshoot motor according to the manufacturer's instructions.
Motor does not start and both LEDs come on at RUN command	Inside Delta wiring problem	See problem 3 in Table 15.
Motor starts but does not come up to speed	Soft starter not finished ramping to line voltage	Check that LED 2 is on, which indicates output voltage equals line voltage. If motor is coming up to speed too slowly, decrease Start Time T1 and/or increase Initial Voltage U; refer to Section 7.6.
Motor growls or hums at start but comes up to speed	Initial Voltage U is set too low	Raise setting of Initial Voltage U until motor just starts to rotate when power is first applied; refer to Section 7.6.
Motor growls at start and does not come up to speed	Motor unable to start load	Check load for mechanical blockage (rocks, logs, seized bearings, etc.) Increase motor size; for proper soft starter selection, refer to Section 4.
	Soft starter not finished ramping to line voltage	Check that LED 2 is on, which indicates output voltage equals line voltage. If motor is coming up to speed too slowly, decrease Start Time T1 and/or increase Initial Voltage U; refer to Section 7.6.
	Shorted SCR (LED 2 double flashing)	Check SCRs as described in Section 10.4.
Motor comes up to speed too quickly	Improper settings	Adjust Start Time T1 and Initial Voltage U settings per Section 7.6.
	Load is too light or too heavy	Adjust load or consider decreasing or increasing motor size; for proper soft starter selection, refer to Section 4.
Motor runs noisily with very high current	Inside Delta wiring problem	See problem 1 in Table 15.
Motor starts hard, not softly	Improper setup	Refer to Section 7.6 for motor starting adjustments.
	Shorted SCR (LED 2 double flashing)	Check SCRs as described in Section 10.4.
	Inside Delta wiring problem	See problem 4 in Table 15.

Table 14 : Troubleshooting

English

Fault	Cause	Check/Remedy
	Unsuitable delta motor	A certain delta motor design (wired Inside Delta) will not start softly with a high friction load (e.g., conveyor), only with a low friction load (e.g., water pump). The soft start produces balanced three-phase power to the motor, but it becomes stuck at a low rpm until the end of the start ramp at high current. It then jumps quickly to full speed due to the high voltage and current.
Soft starter is off but motor is running	Shorted SCRs (LED 2 double flashing)	Check voltage from terminal A1 to A2 to verify that RUN coil is not energized. Check SCRs as described in Section 10.4.
Motor overload relay trips during starting	Motor is overloaded while running	Check for a mechanical cause of overload and clear.
Motor not able to accelerate load		Check that motor comes up to speed when started by applying across-the-line full voltage directly to the motor. An alternative is to use the soft starter with T1 set at 0 (0.5 seconds) and U at F (80% full voltage). a) If motor cannot accelerate the load, increase motor size; for correct soft starter selection, refer to Section 4. b) If motor accelerates the load, continue checking the following causes.
	Improper overload relay	Check overload relay to determine correct settings.
	Overload relay current transformers incorrectly wired	Verify current transformer wiring per applicable diagram(s).
Motor branch circuit protection trips during starting or running	Branch circuit protective device incorrectly sized	Size the device in accordance with all applicable standards (DIN/IEC).
		Check circuit breaker trip settings.
	Incorrect power wiring causing a short on input or load side of soft starter	Check all power wiring connections to determine if a phase-to-phase or phase-to-ground short is present.

Table 14 : (cont.) Troubleshooting

10.3 Inside Delta Wiring Problems

⚠ WARNING

When the switch is set to "In Line", the motor must be operated in In Line connection and when the switch is set to "Inside Delta", the motor must be operated in Inside Delta connection!
Setting the switch to the wrong type of connection can cause very high currents during operation. These currents can destroy or damage the SCRs and other components. Be sure to set the soft starter only to the type of connection actually used.

Fig. 23 shows a correct inside delta connection. With the correct connection, the motor runs properly with current limit during starting and the line and leg currents are balanced.
Table 15 lists four improper connection problems and the unsuccessful response for each. The "Example" column illustrates only one of many combinations that may be responsible for the problem.

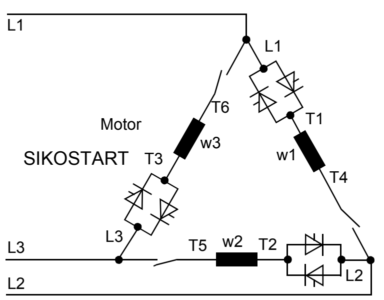
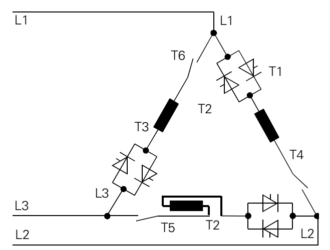
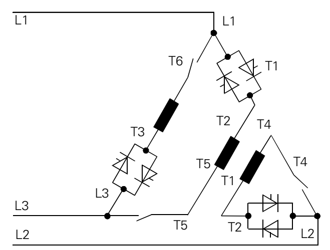


Fig. 23 : Proper Inside Delta Wiring Connection

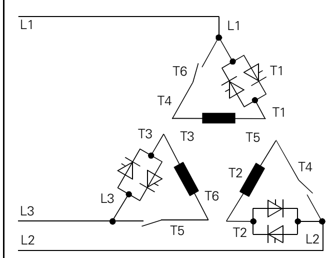
Problem	Response/Example
1. Reversed Winding	The motor runs but makes abnormal sounds and the running current is very high.
2. Dead Ended Winding	The soft starter trips out on a single phase fault. The line with the Dead End Winding will have no current flow. The other two lines will have very large currents flowing. **Note:** Repeated attempts at starting with this connection can damage the soft starter.
3. Dead Ended on All Windings	The motor does not start. There is no current flow on any of the lines. The soft starter indicators LED 1 and LED 2 come on at the same time when a RUN command is given.
4. Soft Starter to Fault Contactor Leads Swapped	The motor runs but there is no current limiting during starting. The line and leg currents are balanced. Due to the phase shift in the leg currents compared with the controller's internal timing for starting control, there is no current limiting during starting.
5. Switch position SW1-3 does not match actual circuit type.	Incorrect firing pulses cause very high currents in the motor which can destroy the soft starter.



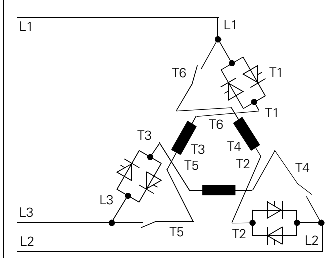
Problem 1



Problem 2



Problem 3



Problem 4

Table 15 : Inside Delta Wiring Problems

10.4 Shorted SCR Checks

Perform one of the following checks to identify any shorted SRCs:
These checks require no disassembly of the unit. Extensive SCR tests are detailed in later paragraphs.

⚠ DANGER

Hazardous voltage. Will cause death or serious injury.

Switch off the power before taking the measurements. High voltage is present on all soft starter components except heat sinks. All bus bars, terminals, snubber boards, and SCRs are energized at rated voltage.

10.4.1 Resistance Check

Use an ohmmeter to check for shorted SCR(s) as follows.

1. Disconnect and lock out all power to unit.
2. Measure the resistance from the line to load terminals (L1 to T1, etc.), across each phase of the soft starter.
3. Any reading of less than 3 kΩ indicates a shorted SCR that must be replaced. Note that the reading can be as high as 3 MΩ.

English

11 Spare and Optional Parts

11.1 Spare Parts

Table 16 lists the order numbers for the logic board and cooling fan(s) plus the quantity required for each soft starter.

11.1.1 Soft Starter Amps, U_c and U_e

Three ratings identify each soft starter: current in amps (In Line or Inside Delta), control supply voltage U_c (24 V DC, 115 V AC, 230 V AC) and main supply voltage U_e (200 - 460 V AC, 400 - 600 V AC). Each spare part relates to one or more of the ratings, e.g., each cooling fan corresponds to the Amps and U_c ratings regardless of the U_e ratings (U_e = All, where All means either main voltage selection).

11.1.2 Fan Orientation

Between one and three cooling fans are used per soft starter depending on the ratings. When one fan is used, it is mounted centrally along the width of the unit. When two fans are used, one is mounted to the left (L) and the other to the right (R). Left and right are defined by facing the cover of the unit, consequently, the fan on the left is the furthest from the control terminals. Similarly, when three fans are used, mounting locations are left (L), center (Ctr), and right (R).

Catalog No.	Number of Fans	U_c = 24 V DC U_e = All	Number of Fans	U_c = 115 V AC U_e = All	Number of Fans	U_c = 230 V AC U_e = All
Logic Board						
3RW34...		3RW39 50-6DC28		3RW39 50-6DC38		3RW39 50-6DC48
Cooling Fan						
3RW34 55 -58	2	3RW39 50-8DC28	2	3RW39 50-8DC38	2	3RW39 50-8DC48
3RW34 6.	1	3RW39 60-8DC28	1	3RW39 60-8DC38	1	3RW39 60-8DC48
3RW34 7.	2	3RW39 70-8DC28	2	3RW39 60-8DC38	2	3RW39 60-8DC48
3RW34 83/84	3	3RW39 72-8DC28	3	3RW39 60-8DC38	3	3RW39 60-8DC48
3RW34 86	3	3RW39 73-8DC28	3	3RW39 60-8DC38	3	3RW39 60-8DC48

Table 16 : Spare Parts, Logic Board and Cooling Fan Order Numbers

11.2 Optional Parts

11.2.1 Overload Relays

The standard SIKOSTART Soft Starter does not include overload protection. Please refer to Catalog NSK for overload selection.

Appendix A

English

Fuse Assignment

Fuse design with SITOR fuses 3NE1 for full utilization[1]) of the soft starter. (solid-state component and wire protection)

Soft Starter	Full Range Fuse				Soft Starter	Full Range Fuse			
Type	Type	Nominal Current A	Fuse Size	Necessary Connection Cross-Section per Fuse mm^2	Type	Type	Nominal Current A	Fuse Size	Necessary Connection Cross-Section per Fuse mm^2
Assignment Type 2: I_q = 50 kA at 400 V					**Assignment Type 2: I_q = 50 kA at 575 V**				
3RW34 54-0DC.4	3NE1 021-0	100	00	35	3RW34 54-0DC.5	3NE1 022-2	125	00	50
3RW34 55-0DC.4	3NE1 0220	125	00	50	3RW34 55-0DC.5	3NE1 0220	125	00	50
3RW34 57-0DC.4	3NE1 225-0	200	1	95	3RW34 57-0DC.5	3NE1 225-0	200	1	95
3RW34 58-0DC.4[2])	3NE1 227-0	250	1	120	3RW34 58-0DC.5[2])	3NE1 225-0	200	1	95
3RW34 65-0DC.4	3NE1 230-0	315	1	2 x 70	3RW34 65-0DC.5	3NE1 227-0	250	1	120
3RW34 66-0DC.4	3NE1 230-0	315	1	2 x 70	3RW34 66-0DC.5	3NE1 230-0	315	1	2 x 70
3RW34 67-0DC.4	3NE1 332-0	400	2	2 x 95	3RW34 67-0DC.5	3NE1 332-0	400	2	2 x 95
3RW34 72-0DC.4	3NE1 435-0	560	3	2 x 150	3RW34 72-0DC.5	3NE1 435-2	560	3	2 x 150
3RW34 83-0DC.4	3NE1 438-0	800	3	2 x (50 x 5)	3RW34 83-0DC.5	3NE1 437-0	710	3	2 x (40 x 5)
3RW34 84-0DC.4	2 x 3NE1 435-0	2 x 560	3	2 x 150	3RW34 84-0DC.5	2 x 3NE1 435-0	2 x 560	3	2 x 150
3RW34 86-0DC.4[2])	2 x 3NE1 437-1	2 x 710	3	2 x (40 x 5)	3RW34 86-0DC.5[2])	2 x 3NE1 437-2	2 x 710	3	2 x (40 x 5)

Table 17 : Fuse design with SITOR fuses 3NE1 for full utilization of the soft starter.

Fuse design with SITOR fuses 3NE3 for full utilization[1]) of the soft starter, least possible protection, non-aging (solid-state protection)

Soft starter	Semiconductor Fuse			Soft starter	Semiconductor Fuse		
Type	Type	Nominal Current A	Fuse Size	Type	Type	Nominal Current A	Fuse Size
Assignment Type 2: I_q = 50 kA at 400 V				**Assignment Type 2: I_q = 50 kA at 575 V**			
3RW34 54-0DC.4	3NE3 222	125	1	3RW34 54-0DC.5	3NE3 222	125	1
3RW34 55-0DC.4	3NE3 224	160	1	3RW34 55-0DC.5	3NE3 224	160	1
3RW34 57-0DC.4	3NE3 225	200	1	3RW34 57-0DC.5	3NE3 225	200	1
3RW34 58-0DC.4[2])	3NE3 227	250	1	3RW34 58-0DC.5[2])	3NE3 227	250	1
3RW34 65-0DC.4	3NE3 230-0B	315	1	3RW34 65-0DC.5	3NE3 230-0B	315	1
3RW34 66-0DC.4	3NE3 231	350	1	3RW34 66-0DC.5	3NE3 231	350	1
3RW34 67-0DC.4	3NE3 233	450	1	3RW34 67-0DC.5	3NE3 233	450	1
3RW34 72-0DC.4	3NE3 336	630	2	3RW34 72-0DC.5	3NE3 336	630	2
3RW34 83-0DC.4	3NE3 340-8	900	2	3RW34 83-0DC.5	3NE3 340-8	900	2
3RW34 84-0DC.4	2 x 3NE3 336	2 x 630	2	3RW34 84-0DC.5	2 x 3NE3 336	2 x 630	2
3RW34 86-0DC.4[2])	2 x 3NE3 340-8	2 x 900	2	3RW34 86-0DC.5[2])	2 x 3NE3 340-8	2 x 900	2

Table 18 : Fuse design with SITOR fuses 3NE3 for full utilization of the soft starter, least possible protection.

[1]) e.g. 3 x I_e for 60 s.
[2]) e.g. 3 x I_e for 30 s.

English

Fuse design with SITOR fuses 3NE3 for full utilization[1]) of the soft starter, greatest possible protection. (solid-state protection)							
Soft starter	**Semiconductor Fuse**			**Soft starter**	**Semiconductor Fuse**		
Type	**Type**	**Nominal Current A**	**Fuse Size**	**Type**	**Type**	**Nominal Current A**	**Fuse Size**
Assignment Type 2: I_q = 50 kA at 400 V				**Assignment Type 2: I_q = 50 kA at 575 V**			
3RW34 54-0DC.4	3NE3 225	200	1	3RW34 54-0DC.5	3NE3 225	200	1
3RW34 55-0DC.4	3NE3 231	350	1	3RW34 55-0DC.5	3NE3 230-0B	315	1
3RW34 57-0DC.4	3NE3 233	450	1	3RW34 57-0DC.5	3NE3 233	415	1
3RW34 58-0DC.4[2])	3NE3 333	450	2	3RW34 58-0DC.5[2])	3NE3 333	450	2
3RW34 65-0DC.4	3NE3 334-0B	500	2	3RW34 65-0DC.5	3NE3 334-0B	500	2
3RW34 66-0DC.4	3NE3 336	630	2	3RW34 66-0DC.5	3NE3 336	630	2
3RW34 67-0DC.4	3NE3 340-8	900	2	3RW34 67-0DC.5	3NE3 340-8	900	2
3RW34 72-0DC.4	3NE3 340-8	900	2	3RW34 72-0DC.5	3NE3 340-8	900	2
3RW34 83-0DC.4	3NE3 340-8	900	2	3RW34 83-0DC.5	3NE3 340-8	900	2
3RW34 84-0DC.4	2 x 3NE3 340-8	2 x 900	2	3RW34 84-0DC.5	2 x 3NE3 340-8	2 x 900	2
3RW34 86-0DC.4[2])	2 x 3NE3 340-8	2 x 900	2	3RW34 86-0DC.5[2])	2 x 3NE3 340-8	2 x 900	2

Table 19 : Fuse design with SITOR fuses 3NE3 for full utilization of the soft starter, greatest possible protection

[1]) e.g. 3 x I_e for 60 s.
[2]) e.g. 3 x I_e for 30 s.