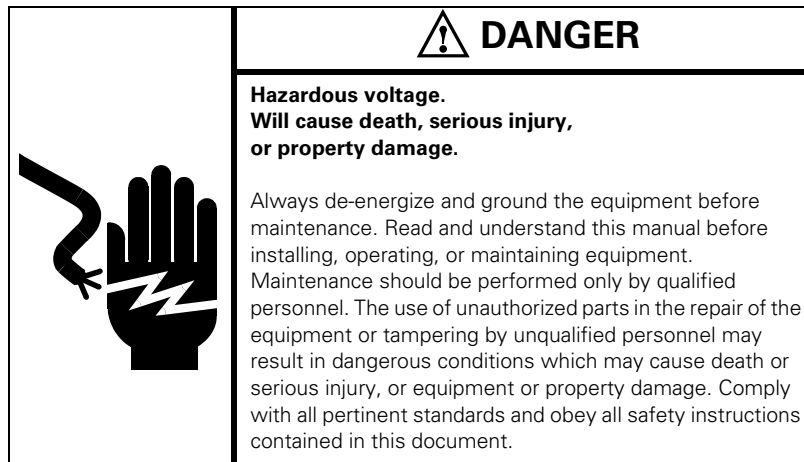


Reliable functioning of the equipment is only ensured with certified components.



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.

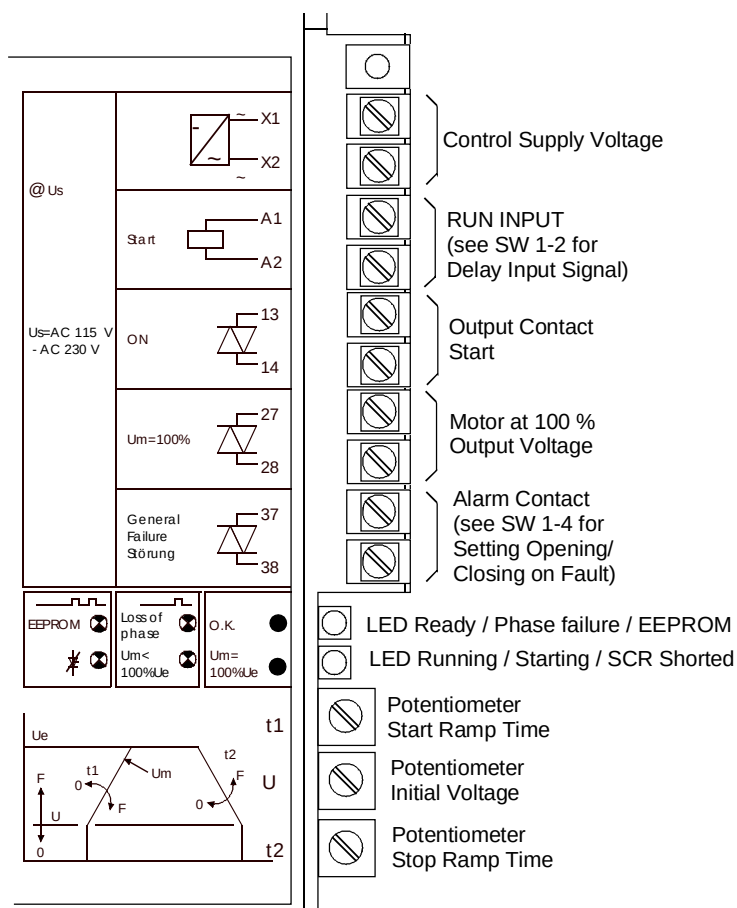


Fig. 2 : SIKOSTART Control Terminals with Us AC 115 V and AC 230 V

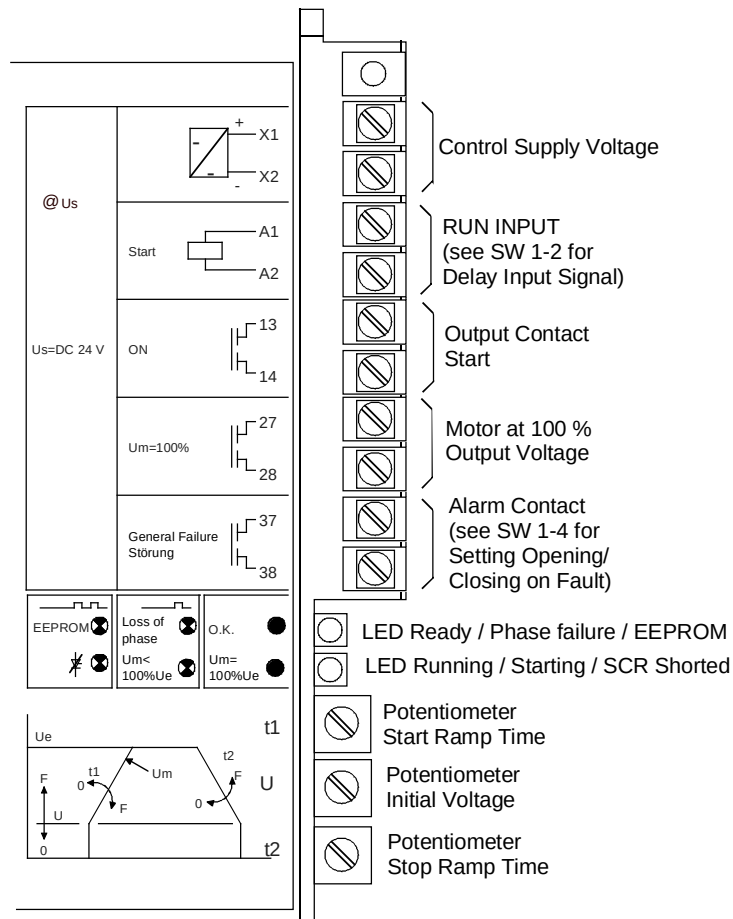


Fig. 3 : SIKOSTART Control Terminals with Us DC 24 V

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 (8.50)	356 (14.00)	187 (7.36)	127 (5.00) 94 (3.71)	61 (2.42)	327 (12.88)	16 (0.62)	4 x 6 (0.25)
3RW34 65/66/67...	131-248	292 (11.49)	381 (15.00)	190 (7.46)	248 (9.75)	22 (0.87)	332 (13.07)	27 (1.08)	4 x 6 (0.25)
3RW34 68...	352	292 (11.49)	412 (16.4)	190 (7.46)	248 (9.75)	22 (0.87)	363 (14.29)	27 (1.08)	4 x 6 (0.25)
3RW34 83/84...	480, 720	442 (17.42)	517 (20.35)	231 (9.10)	133 (5.23)	18 (0.71)	450 (17.71)	32 (1.24)	8 x 6 (0.25)
3RW34 86...	960	448 (17.62)	719 (28.32)	235 (9.25)	101 (3.99) / 138 (5.44) / 138 (5.44)	23 (0.91)	653 (25.71)	29 (1.13)	8 x 6 (0.25)

Table 3 : Dimensions in mm (inch)

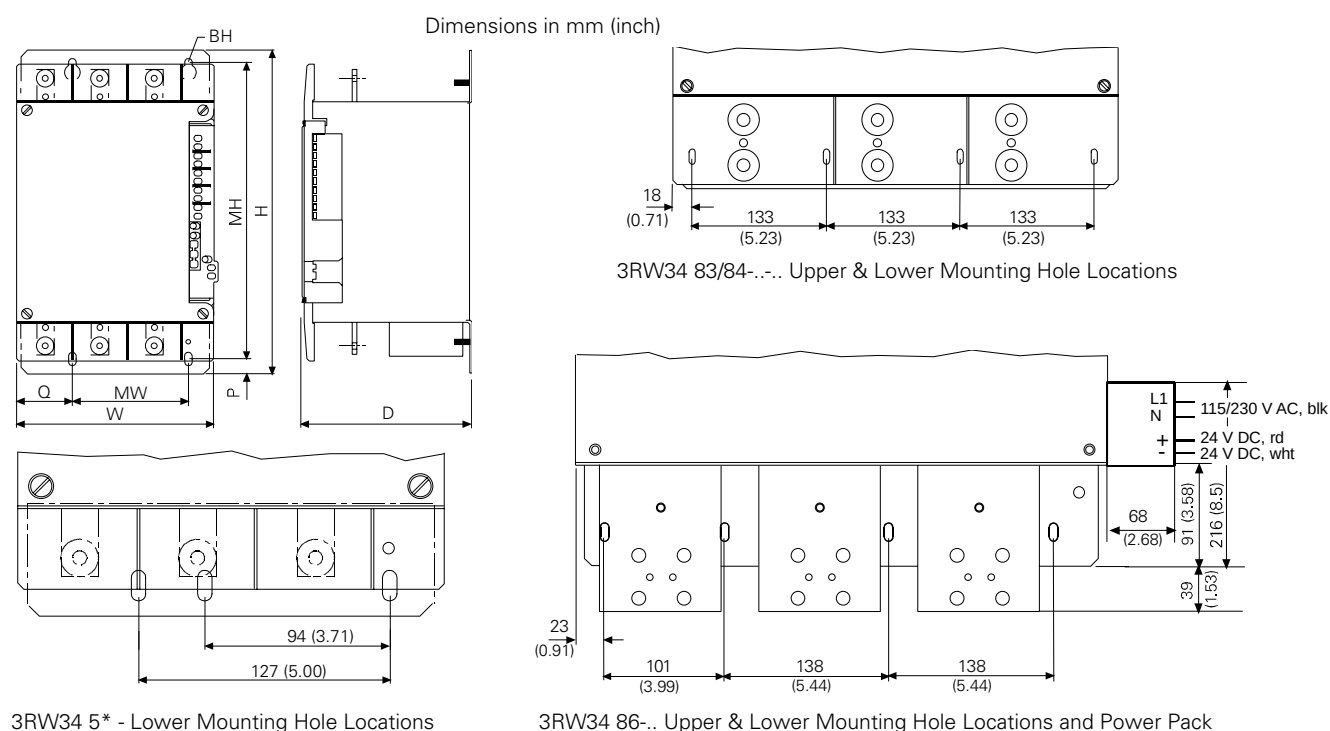


Fig. 4 : Dimension Drawings

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 relay, 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.

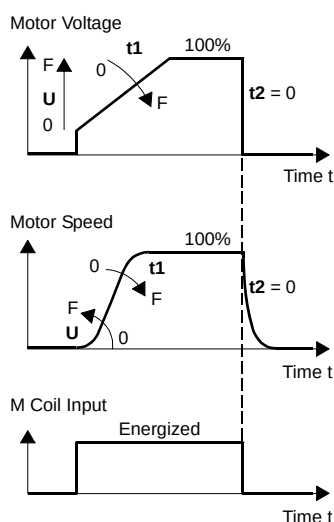


Fig. 5 : Voltage and time curves for soft start with coast to stop

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.

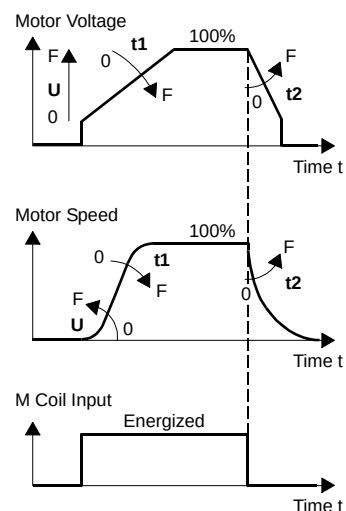
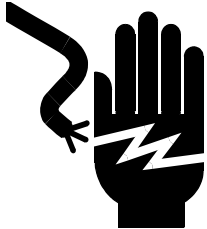


Fig. 6 : Voltage and Speed Curves for Soft Start with Soft Stop

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.

5.4.4 Series-connected switching unit

Improper usage (e.g. overload) may cause one or several thyristors of the unit to change to low-resistance values. Depending on the wiring, the motor cannot be switched off any more by the motor control unit. As a preventive measure, a series-connected switching unit (e.g. contactor, circuit-breaker) may be inserted on the line side. Triggering can be executed via the fault contact of the unit or via EMERGENCY STOP.

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 3RW34 86

The SIKOSTART 3RW34 86 soft starter 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

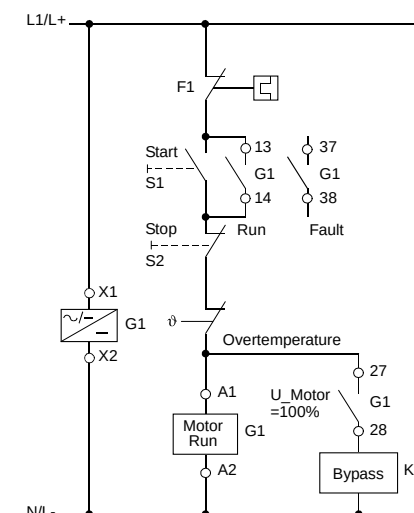


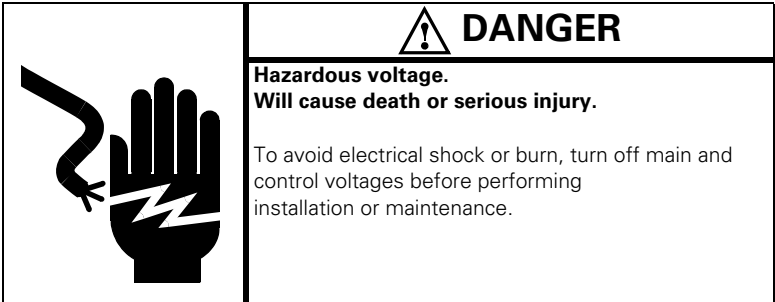
Fig. 9 : Typical Overtemperature Switch Wiring

	! 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.

7 Setup and Operation

7.1 Setup Controls



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 5. 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.

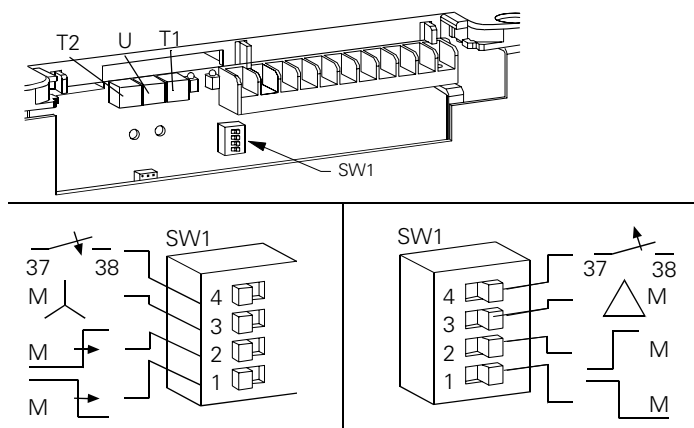


Fig. 20 : Setup Controls

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.

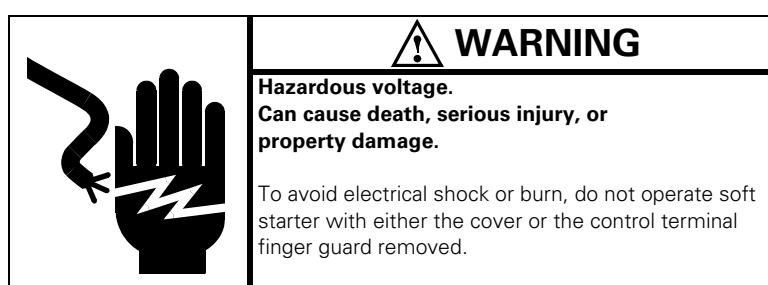
7.4 Preliminary Checks

	 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



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.

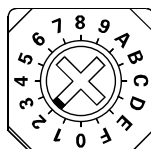
Low voltage, zero voltage, or unequal voltages indicate 1) the load circuit to the motor is open or improperly grounded, or 2) an SCR is shorted or bad (usually indicated by a double flashing LED 2; refer to Section 10 "Troubleshooting").

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.

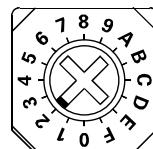
Start Time T1. During setup procedures, T1 was set to a mid range acceleration ramp time. If the soft starter ramp ends before the motor reaches full speed, turn RUN signal off and increase the T1 setting. Repeat trial starts to achieve a smooth acceleration to full speed (LED 2 changes from single blinking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

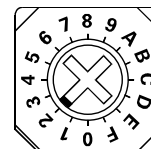
A soft stop is required for some applications, e.g. to reduce water hammer in a pumping system. For a soft stop, most applications require the stop time T2 to be equal to or longer than the start time T1. Turn RUN signal off before changing the T2 setting.



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 +10 %, -15 % (specified by order number) Inside Delta Application: 200 to 400 V AC or 400 to 600 V AC +10 %, -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, $\pm 10\%$ 0° to 60 °C inside enclosure in which unit is mounted. Derating from 40 °C see Table 10 to 13 (page 26 to 28).
Permissible Altitude	1000 m at rated output 2000 m at $0.87 \cdot I_e$ 3000 m at $0.77 \cdot I_e$
Overcurrent Protection	The standard SIKOSTART Soft Starter is not equipped with overload protection. The user must provide overload protection.
Adjustment Ranges - 16 settings each:	0.5 to 60 seconds*
Start Time (Accel. Ramp)	
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 52	35	30	7
	3RW34 54	57	30	7
	3RW34 55	70	30	11
	3RW34 56	80	30	9
	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 68	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)

Input (RUN) Coil

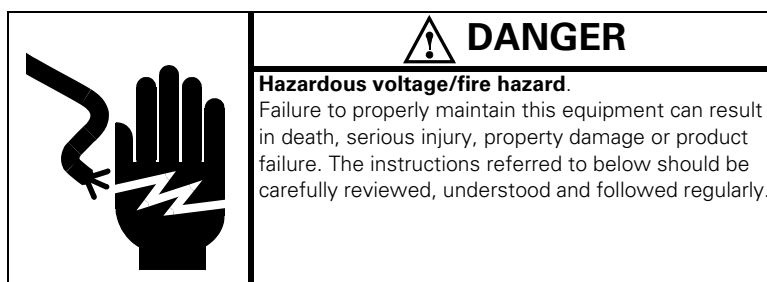
Order No.	3RW34..0DC2.	..0DC3.	..0DC4.
Coil Voltage	24 V DC	115 V AC	230 V AC
Isolation Voltage, V AC	1500	1500	1500
Input Current, mA	10	10	10
On Voltage, volts min.	17 V DC	85 V AC	170 V AC
On Current, mA min.	6	6	6
Off Voltage, volts max.	8 V DC	40 V AC	80 V AC
Off Current, mA max.	3	3	3
Input Impedance,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

10 Troubleshooting

10.1 Maintenance and Troubleshooting



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 14 which includes recommended checks and remedies. Table 15 is a general troubleshooting table listing faults, their possible causes, and recommended checks and remedies.

Inside Delta wiring problems are described in Table 16.

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 2, Table 16.
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 14 : 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 16.
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 16.
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 16.

Table 15 : Troubleshooting

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 15 : (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 16 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.

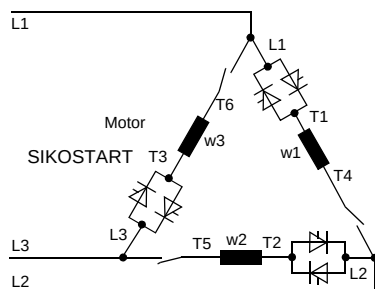


Fig. 23 : Proper Inside Delta Wiring Connection

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.

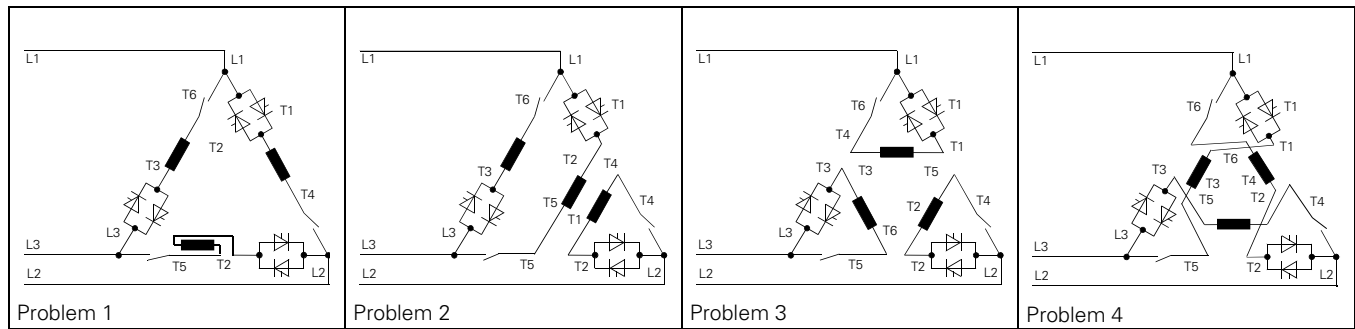


Table 16 : Inside Delta Wiring Problems

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.

11 Spare and Optional Parts

11.1 Spare Parts

Table 17 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	$U_c = 24 \text{ V DC}$ $U_e = \text{All}$	Number of Fans	$U_c = 115 \text{ V AC}$ $U_e = \text{All}$	Number of Fans	$U_c = 230 \text{ V AC}$ $U_e = \text{All}$
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 65/66/67	1	3RW39 60-8DC28	1	3RW39 60-8DC38	1	3RW39 60-8DC48
3RW34 68	2	3RW39 60-8DC28	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 17 : 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 the Catalog for overload selection.