8

Semiconductor soft starter 3RW3 (Sanftstarter)

8.1 Regulations/specifications/approvals

The semiconductor soft starters 3RW3 are approved in conformity with UL and CSA.

UL / CSA	UL 508
Types of protection, of housings	DIN EN
Standard profile rail	DIN EN 50 022
Electronic soft starters	IEC 60947 - 4-2
Shock hazard protection	IEC 60947 - 1 and DIN 40050
EMV	IEC 60801 - 4 -2 (draft)
General definitions	DIN EN 602 69 - 1A1
Controllers and switching elements	DIN EN 602 69 - 1A1
Gost	Approved to Gost
CTic	EMC conformity mark for Australia (cf. CE mark)

Tabelle 8-1: Standards and approvals, 3RW3

"In-service switching"

The soft starters 3RW3 may be used for "in-service switching" in accordance with DIN VDE 0100 Part 460:
A switch for in-service switching must be provided for every circuit that is to be switched independently of the other parts. Switches for in-service switching need **not necessarily switch all active conductors** of a circuit.

"Isolating"

The soft starters do not meet the requirements for "isolating" as detailed in DIN VDE 0100 Part 460 and EN 60 947-1".
Each circuit must be capable of being isolated from the active conductors of the power supply.
Circuit groups may be isolated by one common device if permitted by the conditions of operation. In the open position, devices with an isolating function must have a corresponding isolating gap and an indicating facility that indicates the positions of the moving contacts.

Warning notes

⚠ Warning!

The units have been conscientiously tested at the works before delivery and have been found to be in proper working order. During the course of transportation, stresses may occur upon which we have no influence.

As the result of this, the bypass relays in the main circuit may be in an undefined switching state.

In the interests of complete safety, the following procedure is necessary during commissioning or after a replacement of the SIRIUS soft starter:

Apply the supply voltage **first** in order to set the bypass relays to a defined switching state

Then activate the main circuit.

If you do not keep to this procedure, the motor may be inadvertently activated and may cause injuries or damage to parts of the system.

⚠ Caution

The soft starter 3RW3...-1.B1. was produced as a Class A device. Use of this product in dwellings may cause radio frequency interference.

8.2 Description of the unit

The SIRIUS 3RW3 soft starters are part of the SIRIUS 3R modular system. They are compatible with the other SIRIUS 3R switching devices. Possible combinations consist of:
Soft starter 3RW3 + circuit-breaker 3RV
Soft starter 3RW3 + overload relay 3RU/3RB + contactor 3RT.
The connecting modules that are used for contactor/circuit-breaker combinations are used for this purpose (see Chapter 8.3.2 "Assembly guidelines").

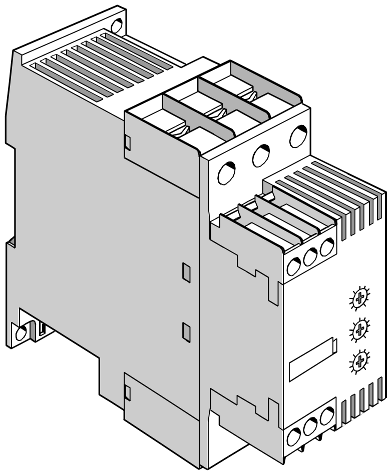


Fig. 8-1: Overload relay 3RU11, sizes S00 to S3

Sizes 3RW30/31

The soft starter 3RW30 is available in the four sizes S00, S0, S2 and S3.
The soft starter 3RW31 is available in the S0 size
The following table contains the power ranges of the individual sizes (all data applies to UN = 400 V and 40° C ambient temperature):

Size S00	Size S0	Size S2	Size S3
1.1 - 4 kW	5.5 - 11 kW	15 - 22 kW	30 - 55 kW
6 - 9 A	12.5 - 25 A	32 - 45 A	63 - 100 A
(W x H x D) (mm) 45 x 97.5 x 93	(W x H x D) (mm) 45 x 125 x 119	(W x H x D) (mm) 55 x 160 x 143	(W x H x D) (mm) 70 x 170 x 178

Tabelle 8-2: 3RW3, sizes

8.2.1 Physical principles

Starting current

Three-phase asynchronous motors have a high on current $I_{(start)}$. Depending on the version of motor, this vary between 3 and 15 times the rated operating current. 7-8 times the rated motor current can be assumed as a typical value..

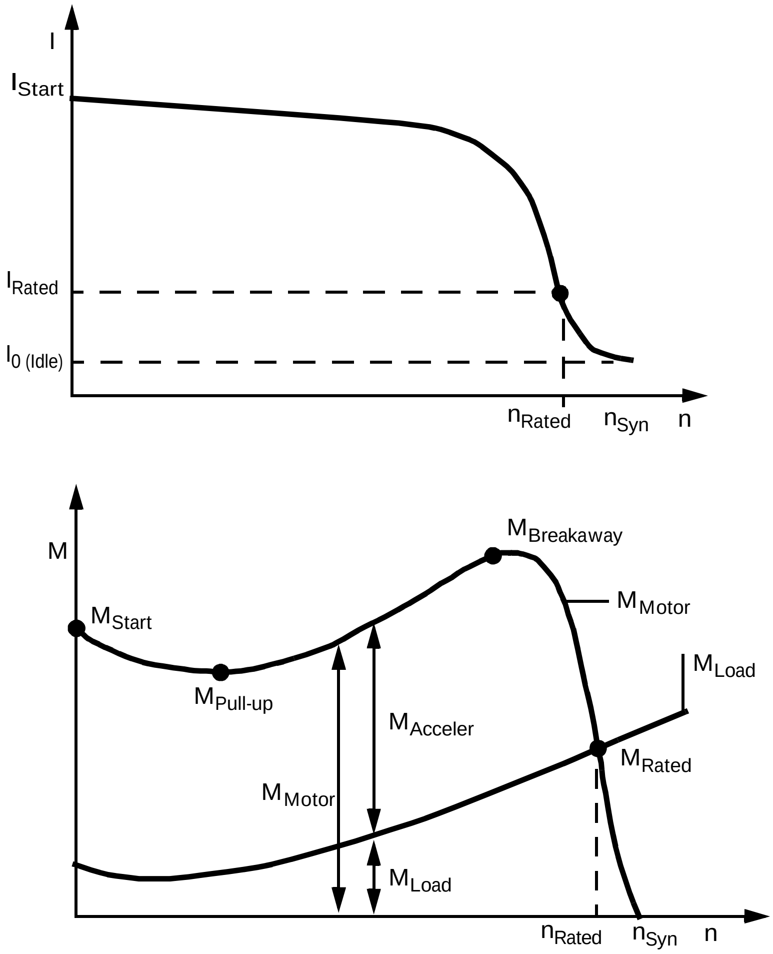


Fig. 8-2: Typical current and torque profiles of a 3-phase asynchronous motor

Note

This starting current must be taken into consideration appropriately when designing the feeding network, e.g. among other things by adapting the supply (high heat development) and also the fusing (inadvertent tripping of the fuses).

Reducing the starting current

There are various possibilities of reducing the starting current:

- by star-delta starter
- by frequency converter
- by soft starter

Star-delta-starter

After a certain changeover time, the motor windings are switched over from a wye (star) motor connection to a delta motor connection. In the case of wye starting, the motor current only amounts to around 1/3 of the delta-starting current (in the wye (star) motor connection, the motor torque is also reduced to about 1/3 of the delta torque).

Disadvantages:

- 6 motor leads are needed
- Changeover jerking occurs (in the current and in the torque profile)
- Adaption of starting to the situation of the motor is not possible
- Relatively complex and time-consuming installation
- Large space requirement in the control cabinet

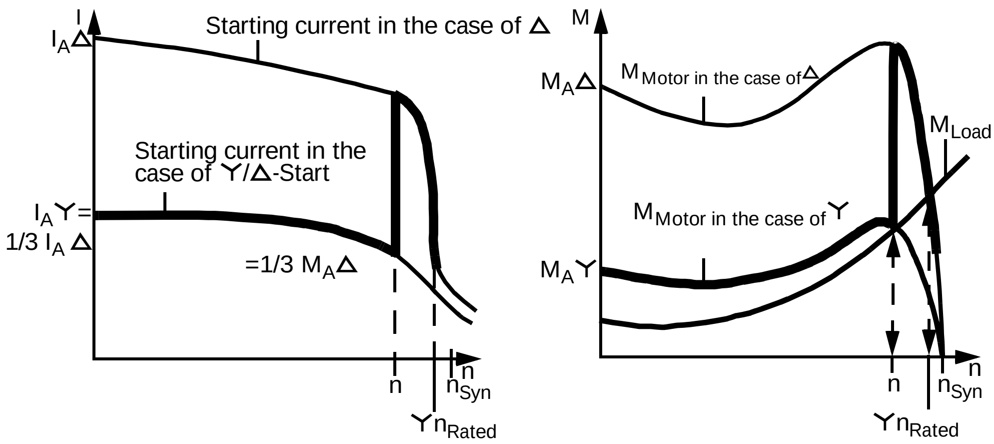


Fig. 8-3: Current and torque profile in the case of star-delta starting

Frequency converter

When a frequency converter is used, the AC voltage of the line is converted to a DC voltage which, in turn, can be converted to a voltage of any frequency.
The following graphic shows the operating principle of a frequency converter:

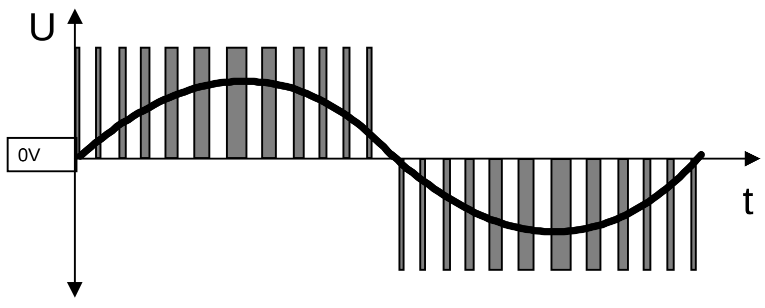


Fig. 8-4: Operating principle of a frequency converter

Disadvantages:

- Relatively complex when it comes to keeping to the RFI suppression regulations; filters are often indispensable.
- Only limited motor line length owing to line capacitance; it may be necessary to use chokes, sinusoidal filters or even du/dt filters.
- High price
- Owing to the large number of operator control parameters, commission-

ing is often awkward and time-consuming.
- Screen motor connection lines may be necessary.

Advantages:
- Modification and precise adjustment of the motor speed are possible.

The voltage/frequency ratio stays almost constant, thus permitting high torques with relatively low currents.

Soft starter

In the case of a soft starter, the motor voltage is boosted by an adjustable starting voltage to the rated motor voltage by phase control within a starting time. As the motor current is proportional to the motor voltage, the starting current is reduced by the factor of the set starting voltage.
The following graphic shows the operating principle of the soft starter 3RW3:

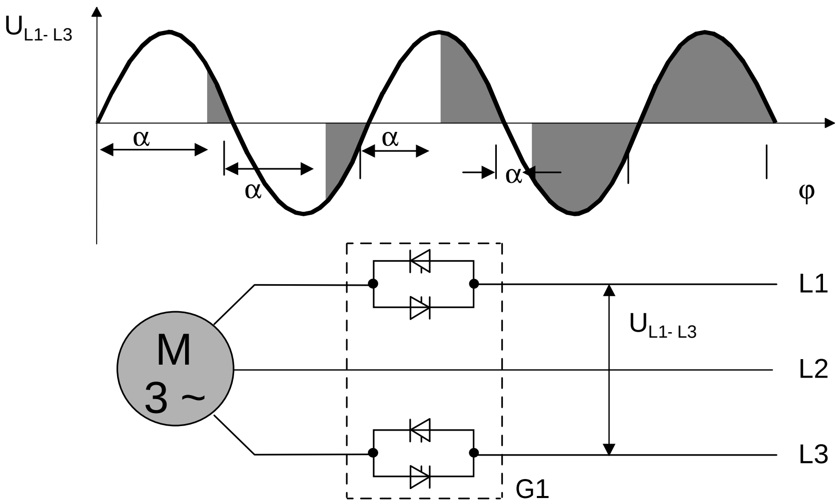


Fig. 8-5: Phase control of the line voltage by semiconductor elements in the case of the soft starter 3RW3

Example:
Starting voltage 50% of the input voltage Ue => starting current equal to 50% of the motor starting current in the case of direct starting.

Soft starting also reduces the motor torque. This is why a soft-started motor no longer jerks when activated.
The following applies to the relationship: motor torque proportional to the square of the motor voltage
.

Example:
Starting voltage 50% of the input voltage Ue => starting torque 25% of the starting torque in the case of direct starting.

Advantages:
- Low space requirement in the control cabinet
- No wiring (e.g. filters) necessary to keep to the RFI suppression regulations (Class A; in UC 24 V control voltage version also Class B)
- Low assembly effort
- No-problem commissioning

- Only three motor connection leads in comparison with the star-delta starter
- Adjustment options permit adaption to the system.

Disadvantages:
- No prolonged speed setting possible.
- Lower torque with reduced voltage

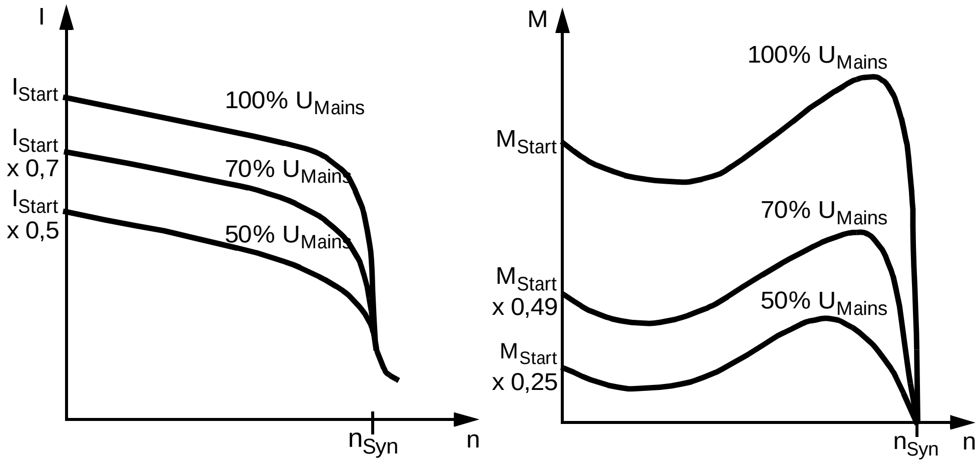


Fig. 8-6: Current and torque profile when using a soft starter

8.2.2 General device description

The modular SIRIUS 3R system offers diverse possibilities for load feeder. Besides star-delta switching (see Ch. 5, "Fuseless load feeders 3RA") the SIRIUS soft starters 3RW3 are also available.
The soft starter 3RW3 can be combined with the following SIRIUS 3R units:
- Contactors 3RT
- Circuit-breakers 3RV
- Thermal overload relays 3RU
- Electronic overload relays 3RB10

Assembly and connection are standardized.
Pay attention to the assembly guidelines given in Section 8.3.2.

Functions of the load feeder

In-service switching

According to the definition ("Isolating" and "In-service switching", DIN VDE 0100; see Section 8.1), in-service switching of a circuit can be realized with a contactor or with a soft starter on its own.

Isolating

As detailed in DIN VDE 0100, isolation from the feeding line cannot be realized with a semiconductor element, i.e. a soft starter, a frequency converter or a contactor etc.
For isolation from the feeding line, a circuit-breaker 3RV (or a different isolating device that meets the requirements of the aforementioned DIN VDE 0100) must be used in addition to the contactor or the soft starter. A contactor alone in conjunction with the soft starter is not enough!
Both functions, i.e. "isolating" and "in-service switching" can be realized swiftly and easily with the soft starter 3RW3 in combination with the modules from the modular SIRIUS system.

Versions

Two versions of the electronic soft starter are available:

Standard version 3RW30
The standard version 3RW30 is available for single-speed motors. This version is available in all four sizes. The starting voltage U_S, the starting time t_{Ron} and the coasting time t_{Roff} can be set independently of one another on the unit. It is activated by means of a cycling contact IN.

Special variant 3RW31
The special version 3RW31 serves to cycle pole-changing motors (Dahlander winding). The following can be set independently:
- Starting voltageU_S
- Starting time, first speed t_{R1}
- Starting time, second speed t_{R2}.

The unit does not have a coasting function. The set starting voltage applies to both ramp times t_{R1} and t_{R2}.
The respective ramp time is chosen via two inputs IN1 and IN2, which also activate the soft starter.
The units in the 3RW31 series are only available in the S0 size.

Settings

The units offer the following setting possibilities:
3RW30
The following can be set by means of 3 potentiometers:
- Starting time within the range from 0 to 20 sec.

- Starting voltage within the range from approx. 30 to 100% of the rated motor voltage
- Coasting time within the range from 0 to 20 sec.

3RW31
The following can be set by means of 3 potentiometers:
- Starting time 1 within the range from 0 to 20 sec.
- Starting voltage within the range from approx. 30 to 100% of the rated motor voltage
- Starting time 2 within the range from 0 to 20 sec.

A special software ensures setting of progressive ramp times. Short times of up to 5 sec. can therefore be et very exactly.

Auxiliary contacts

3RW30
The following auxiliary contacts are integrated in sizes S0 to S3:
- "ON": when triggered, the latching signal is used for locking by way of a simple "On" and "Off" pushbutton (contact designation 13/14)
- "BYPASSED": with the starting end signal, control valves can be addressed after soft starting of a pump, for example, in order to enable conveying (contact designation 23/24)

The size S00 units do not have any auxiliary switches.

3RW31
The 3RW31 does not have any auxiliary contacts.

Soft starting function

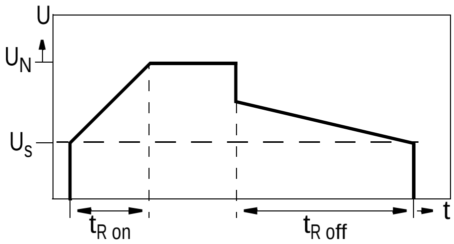
Torque-reduced starting for three-phase asynchronous motors:
By two-phase cycling, the current is kept at low values during the complete starting time. Current spikes, as are encountered during star-delta switching, are prevented by continuous voltage influencing.
Transient current spike (inrush currents) are avoided automatically by the special cycling function of the power semiconductors during each power-on cycle.

Soft coasting function

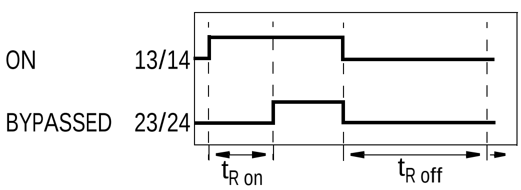
Abrupt stopping of the drive on deactivation of the motor is avoided by the integrated soft coasting function.

Time ramps 3RW30

The following graphics show the time ramp of the 3RW30 and the timing diagram of the auxiliary contacts :



3RW30: Time ramp



Time diagram of the auxiliary contacts

Fig. 8-7: Ramp/timing diagram, 3RW30

The following graphic shows the time ramp in the case of the 3RW3:

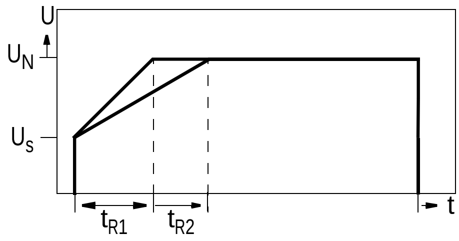


Fig. 8-8: Time ramp, 3RW31

Accessories

A fan can be snapped in from below in sizes S0 to S3 of the soft starter case, thus ensuring the following characteristics:

- Extended possibilities in relation to the installation position
- Increased switching frequency (see Chapter 8.3.2 "Assembly specifications")

In the case of sizes S0 and S2, terminal covers can be fitted onto the frame covers to cover up the cable ends for safety against finger touch. These are identical with the terminal covers of the SIRIUS 3R contactors 3RT in the same sizes
Connection covers for cable lug or rail connection are available for size S3. These are also identical with the accessories of the corresponding SIRIUS 3R contactor size.
See Chapter 8.4 for details of further accessories.

Assembly

The units are fitted to the circuit-breaker 3RV by means of a connection module, and are thus linked mechanically and electrically. The connection module is identical with the one that is also used for the corresponding contactor and circuit-breaker combinations. This assembly variant offers all the advantages of a fuseless load feeder.

Connection modules

The following connection modules are used for assembly of the soft starter 3RW3 and the circuit-breaker 3RV1:

Size	Connection module
S00	3RA1911-1A
S0	3RA1921-1A
S2	3RA1931-1A
S3	3RA1941-1A

Tabelle 8-3: Connection modules, soft starter 3RW3 + circuit-breaker 3RV1

Connection

The electronic soft starter 3RW3 are available from screw connection. Plus-minus POZIDRIV 2 screws are used.
The SIGUT connection technique (captive screws, contacts open on delivery etc.) is applied.

8.2.3 Comparison: soft starter 3RW3 with the soft starters SIKOSTART 3RW22 and SIKOSTART 3RW34

Soft starters are available for diverse applications.
The following graphic provides an overview of the various soft starters:

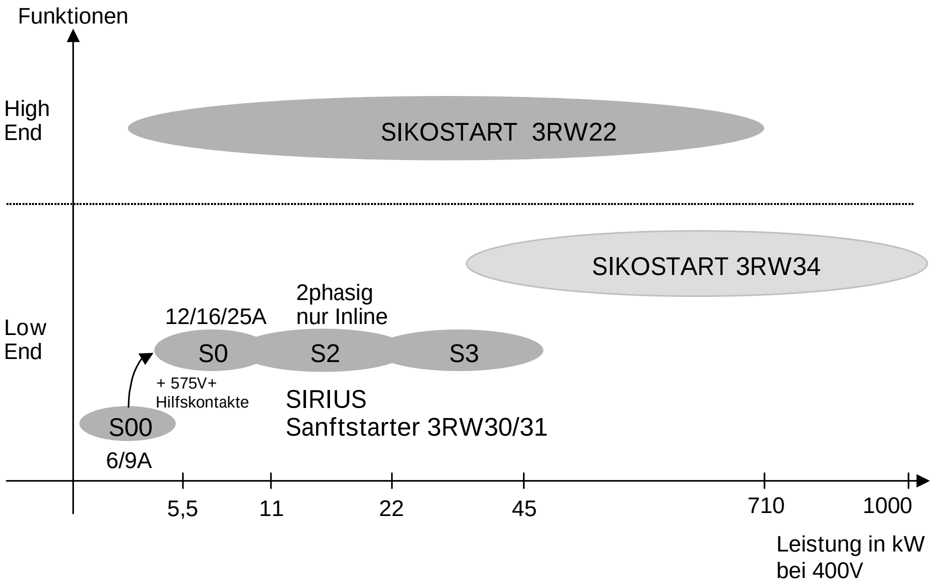


Fig. 8-9: Overview of soft starters

SIKOSTART 3RW22

The SIKOSTART 3RW22 is suitable for drives that place a high demand on the functionality of the starter. It covers a power range between 3 and 710 kW (at 400 V).

SIKOSTART 3RW22 offers the following possibilities:

- Soft starting and coasting
- Breakaway torque
- DC braking
- Energy saving mode
- Temperature monitoring
- Possibilities of operation with a PC via an RS232 interface
- Selection and configuration program
- Current and voltage limiting
- Pump functionality (e.g. pump coasting)
- Starting detection
- Three parameter sets
- Diverse coasting modes
- Electronic device overload protection

The " SIKOSTART 3RW22 application manual" presents the various application areas and circuit variants
(Order No. E20001-P285-A484-V4).

SIKOSTART 3RW34

Drives with low demands on the functionality of the soft starter can be realized with a SIKOSTART 3RW34. SIKOSTART 3RW34 is very similar to the SIRIUS soft starter in terms of operation and features. It covers a power range up to 1000 kW (400 V).
The functions of the 3RW34 can be summarized as follows:

- Soft starting and coasting
- 2 circuit variants: standard and delta
- 3-phase cycling
- Optional AS-i bus control

The technical data and an exact description of the 3RW34 can be found in the document entitled SIKOSTART 3RW22/3RW34 - Electronic Soft Starters (Order No.: E20001-P285-A682-V2).

SIRIUS 3RW3 soft starter

The SIRIUS 3RW3 soft starter covers the power range from 1.5 to 45 kW. Power semiconductors always have a dissipated power, which manifests itself in generation of heat. To minimize this power dissipation, the semiconductors are bypassed by relay contacts after the motor has started. Thus, it has been possible to keep the dimensions of the unit's heatsinks and thus also its overall dimensions small. Moreover, there is no need to use a bypass contactor, as is usually encountered in conventional designs to bypass the power semiconductors.
The unit offers two relay outputs for further processing in the system control:

- "ON" - The unit offers two relay outputs for further processing in the system control).
- "BYPASSED" - contact (terminals 23/24) which signals the end of starting, e.g. to switch a solenoid valve after a soft started pump has started.

For drives in this power range, good motor starting can be achieved with a 2-phase control.
With a 2-phase control, semiconductor elements are only used in two phases, thus reducing the motor current and voltage in all three phases. The third phase is bypassed internally in the soft starter

8.2.4 Comparison: soft starter 3RW3 with star-delta combination 3RA

The comparison between soft starters and star-delta combinations shows the following advantages in the case of the 3RW3 (example here: 22 kW)::

Soft starter 3RW3	Star-delta starter 3RA
Overall width: 55 mm	Overall width: 165 mm
Wiring: 3 motor connection leads	Wiring: 6 motor connection leads
Optional starting parameters	None
Minimum current values during starting	Fixed current conditions ($I_{Y} = 1/3 I_{\Delta}$)
No dangerous changeover current spikes	Current spikes when changing over from star to delta
Special variant for Dahlander motors	-----
Soft coasting function	-----

Tabelle 8-4: Comparison: 3RW3/3RA

8.2.5 Configuration notes

For a motor to be able to reach its rated speed at all, the motor's torque must be greater at any moment of starting that the torque demanded of the load as otherwise a stable operating point will set in even before the motor's rated speed is reached. The difference between the motor torque and the load torque is the acceleration torque, which is responsible for the speed increase of the drive. The lower this acceleration torque is, the greater is the motor's starting time.

Starting torque

By reducing the terminal voltage of a three-phase asynchronous motor, a reduction in the starting current and torque is achieved.
The current depends directly on the voltage, while a square relationship prevails between the voltage and the motor torque.

Example:
Motor = 55 kW, rated current = 100 A, starting current = 7 x rated current, motor torque = 355 Nm, starting torque = 2,4 x rated torque
Settings on the soft starter: starting voltage 50% of the motor's rated voltage
This results in the following reductions:

- The starting current is reduced to half the starting current for direct starting: 50% of (7 x 100 A) = 350 A
- The starting torque is reduced to 0.5 x 0.5 = 25 % of the starting torque in the case of direct starting: 25% of 2.4 x 355 Nm = 213 Nm

Note

Owing to the square relationship between the starting voltage and the torque, the starting voltage must therefore not be set too low. This must above all be observed in the event of a distinct pull-up torque, the lowest motor torque that occurs during starting to the rated speed.

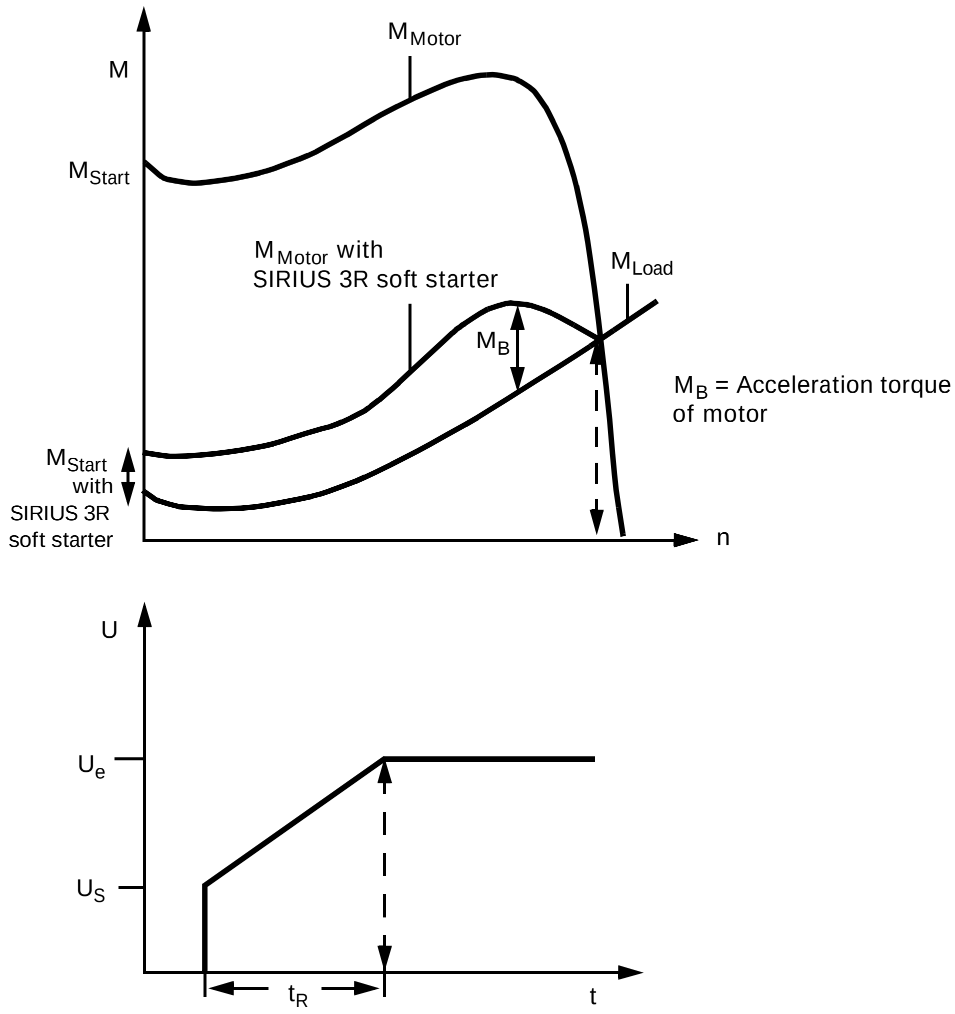


Fig. 8-10: Load and motor torque as well as motor terminal voltage when operating with soft starter

Selection criteria

Note:
In the case of the SIRIUS soft starters 3RW30/31, the corresponding soft starter must be chosen in accordance with the motor's rated current (rated current of soft starter must be $\geq$ motor's rated current).

The starting voltage, the starting time and the coasting time can be set by means of the three setting parameters.
The soft starter is optimally set when the connected motor starts smoothly, but swiftly.
Ramp times of up to 20 sec. can be set.

8.3 Application and use

8.3.1 Application areas and selection criteria

The SIRIUS soft starters 3RW3 offer an alternative to star-delta starters (see Chapter 8.2.4 for a comparison and advantages
The most important advantages are soft starting and coasting, interruption-free changeover without current spikes placing a burden on the line and compact dimensions.
Many drives that previously could only be operated with frequency converters can be converted to soft starter operation with the 3RW3, provided no speed adjustment is necessary

Applications

Applications can be, for example:

Conveyor belts, transport systems:
- Jolt-free starting
- Jolt-free deceleration,
- Use of lower-cost belt material

Centrifugal pumps, piston pumps
- Avoidance of pressure surges
- Prolonged useful life of the piping system

Agitators, mixers:
- Reduced starting current

Fans:
- Gentle operation of gears and V-belts

Cooling time

Note:
The cooling time must be taken into account when considering the duty cycle!

8.3.2 Assembly specifications

Owing to heat development, certain assembly specifications have to be observed when combining soft starters 3RW30/31 with other SIRIUS 3R switching devices.

Stand-alone setup

In a standalone setup, the vertical **and** lateral clearance between the installed units is not less than a certain minimum value. This applies regardless of whether individual units or complete load feeders are involved.
For a stand-alone setup, the following minimum clearances must be observed (the minimum clearances depend on the size):

Size	Lateral minimum clear-ance
S00	15
S0	20
S2	30
S3	40

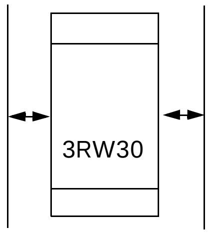


Tabelle 8-5: Stand-alone setup, lateral minimum clearances, 3RW3

Size	Vertical clearance a	Vertical clearance b
S00	50	40
S0	60	40
S2	50	30
S3	60	30

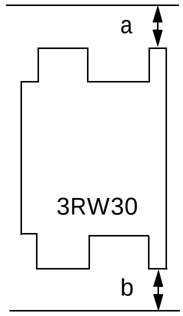


Tabelle 8-6: Stand-alone setup, vertical minimum clearances, 3RW3

Cable lengths for cycling

The control inputs for activation and deactivation are not designed for long distances. This means:
- Coupling relays must be used for control that exceeds the scope of the control cabinet
- The control lines inside the control cabinet should not be laid together with power cables.

When electronic output modules are used for control (e.g. triac outputs in the case of 230 V AC), in certain circumstances RC networks (e.g. 3TX7462-3T or similar with C > 100 nF) are needed at the control inputs

Compensation factors

If clearances are less than the minimum, fixed compensation factors must be used when combining the soft starter wit a circuit-breaker to determine the unit's rated current and the switching frequency.
The following quantities can be modified by compensation factors:
- Unit's rated current
- Switching frequency
- Circuit-breaker's current setting
- Overload relay's current setting

Overload relay's current setting

A factor is specified by which the rated current of the soft starter has to be reduced.

Example:
Compensation factor for the unit's rated current = 0.9
Chosen unit = 3RW3014-1CB14 (in normal circumstances, this unit has a rated current of 6 A at 40° C)
Accordingly, the actual rated current of the unit is:
0.9 x 6A = 5.4 A

Compensation factor forswitching frequency

The switching frequency is the maximum permitted number of starts per hour. This value must be modified by the specified compensation factor. The specified compensation factors refer to the following operating conditions: S4 operation, 40° C ambient temperature, 30% duty cycle

Example:
Compensation factor for the switching frequency = 1.5
Chosen unit = 3RW3014-1CB14 (under the conditions specified above, this unit has a maximum switching frequency of 30 starts/hours)
This results in a corrected switching frequency of::
1.5 x 30 = 45 starts/hour

A larger unit can also be used to increase the switching frequency.

Compensation factor for the circuit-breaker's current setting

When the soft starter 3RW30 and the circuit-breaker 3RV1 are combined, there may be a need to correct the circuit-breaker's setting. The compensation factor specifies the amount of the change.

Example:
Compensation factor for the circuit-breaker's current setting: 1.1
Chosen unit = 3RW3014-1CB14
The connected motor has a rated current of 5 A..
The circuit-breaker's setting must be changed to:
1.1 x 5 A = 5.5 A

Compensation factor for the overload relay's current setting

When the soft starter 3RW30 and a thermal overload relay 3RU1 or a soft starter 3RW30 and an electronic overload relay 3RB10 are combined, the overload relay's setting must be corrected accordingly. The compensation factor specifies the amount of the change.

Example:
Compensation factor for the overload relay's current setting: 0.9
Chosen unit = 3RW3014-1CB14
The connected motor has a rated current of 5 A
The overload relay's setting must not be changed to
0.9 x 5 A = 4.5 A

8.3.3 Overview tables: compensation factors

The following tables list the compensation factors for the circuit-breaker current setting, the unit rated current and the switching frequency.
The values indicate the difference between use with a fan (accessory) and use without a fan.
All compensation values apply throughout the complete temperature range, i.e. for 40°, 50° and 60° C.
The individual tables successively specify the values forr:
Soft starter 3RW30/31 stand-alone
Soft starter 3RW30/31+ circuit-breaker 3RV1
Soft starter 3RW30/31+ contactor 3RT1+ thermal overload relay 3RU1
Soft starter 3RW30/31+ contactor 3RT1+ electronic overload relay 3RB10

8.3.3.1 Soft starter 3RW30/31, stand-alone

Minimum clearance

For the size S00 (3RW301..), the following applies to stand-alone installation without directly fitted switching devices and vertical installation:
To ensure the required arc blow-out space, a distance of at least 50 mm from earthed parts must be observed at top and bottom.

Compensation factors: 3RW30/31

Soft starter 3RW30/31 in no combination with other switching devices:

Order No.	Size(BG)	Rated unit current in A at Tamb. = 40°C	Compensation factor Rated unit current	Compensation factor Switching frequecy	Compensation factor Rated unit current	Compensation factor Switching frequency	Compensation factor Rated unit current	Compensation factor Switching frequency
3RW3014-1CB..	S00	6	1	1	1	0,75	- 1)	- 1)
3RW3016-1CB..	S00	9	1	1	1	0,75	- 1)	- 1)
3RW3.24-1AB..	S0	12,5	1	1	1	0,65	1	1,8
3RW3.25-1AB..	S0	16	1	1	1	0,65	1	1,8
3RW3.26-1AB..	S0	25	1	1	1	0,65	1	1,8
3RW3034-1AB..	S2	32	1	1	1	0,65	1	1,8
3RW3035-1AB..	S2	38	1	1	1	0,65	1	1,8
3RW3036-1AB..	S2	45	1	1	1	0,65	1	1,8
3RW3044-1AB..	S3	63	1	1	1	0,8	1	1,6
3RW3045-1AB..	S3	75	1	1	1	0,75	1	1,6
3RW3046-1AB..	S3	100	1	1	1	0,7	1	1,6

Fig. 8-11: Compensation factors, 3RW30/31

1) The SIRIUS 3R soft starters 3RW301.. cannot be operated with a fan.

8.3.3.2 Soft starters 3RW30/31 in combination with circuit-breakers 3RV1

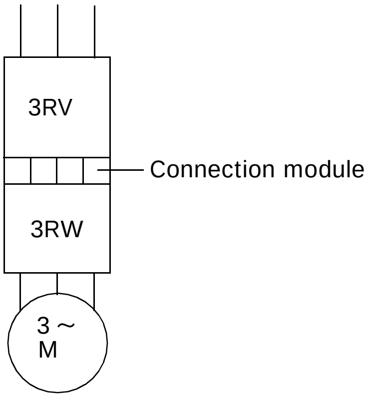


Fig. 8-12: 3RW, stand-alone

Circuit-breaker dimensioning

The chosen size of the circuit-breaker should be so large that the calculated current value can still just be set.
The next smallest circuit-breaker must be used if current values are lower than can be set with the specified circuit-breaker.

Compensation factors: 3RV1 + 3RW30/31

Combination of circuit-breaker 3RV1 + soft starter 3RW30/31:

Order number	Size	Rated unit current in A at Tamb=40°C	Circuit-breaker order number	Circuit-breaker adjustment range	Without fan Stand-alone: Compensation factor Rated unit current	Without fan Stand-alone: Compensation factor Switching frequency	Without fan Stand-alone: Compensation factor Circuit-breaker setting	Without fan Butt-mounted: Compensation factor Rated unit current	Without fan Butt-mounted: Compensation factor Switching frequency	Without fan Butt-mounted: Compensation factor Circuit-breaker setting	With fan Stand-alone: Compensation factor Rated unit currrent	With fan Stand-alone: Compensation factor Switching frequency	With fan Stand-alone: Compensation factor Circuit-breaker setting	With fan Butt-mounted: Compensation factor Rated unit current	With fan Butt-mounted: Compensation factor Switching frequency	With fan Butt-mounted: Compensation factor Circuit-breaker setting
3RW3014-1CB..	S00	6	3RV1011-1GA10	(4,5 - 6,3) A	1	0,9	1	1	0,65	1,1	- 1)	- 1)	- 1)	- 1)	- 1)	- 1)
3RW3016-1CB..	S00	9	3RV1011-1JA10	(7 - 10) A	1	0,9	1	1	0,65	1,1	- 1)	- 1)	- 1)	- 1)	- 1)	- 1)
3RW3.24-1AB..	S0	12,5	3RV1021-1KA10	(9 - 12,5) A	1	0,85	1	1	0,5	1,1	1	1,8	1	1	1,7	1,1
3RW3.25-1AB..	S0	16	3RV1021-4AA10	(11 - 16) A	1	0,85	1	1	0,5	1,1	1	1,8	1	1	1,7	1,1
3RW3.26-1AB..	S0	25	3RV1021-4DA10	(20 - 25) A	1	0,75	1	0,9	0,5	1,1	1	1,8	1	1	1,7	1,1
3RW3034-1AB..	S2	32	3RV1031-4EA10	(22 - 32) A	1	0,65	1	0,9	0,45	1,1	1	2,2	1	1	1,9	1,1
3RW3035-1AB..	S2	38	3RV1031-4FA10	(28 - 40) A	1	0,85	1	0,95	0,35	1,1	1	1,8	1	1	1,7	1,1
3RW3036-1AB..	S2	45	3RV1031-4GA10	(36 - 45) A	1	0,85	1	0,9	0,4	1,1	1	1,8	1	1	1,7	1,1
3RW3044-1AB..	S3	63	3RV1041-4JA10	(45 - 63) A	1	0,85	1	0,95	0,6	1,1	1	1,6	1	1	1,3	1,1
3RW3045-1AB..	S3	75	3RV1041-4KA10	(57 - 75) A	1	0,8	1	0,9	0,5	1,1	1	1,6	1	1	1,3	1,1
3RW3046-1AB..	S3	100	3RV1041-4MA10	(80 - 100) A	1	0,75	1	0,85	0,55	1,1	1	1,6	1	1	1,2	1,1

= SIRIUS soft starter 3RW301 .. cannot be combined with fans

Tabelle 8-7: Compensation factors: circuit-breaker 3RV1 + soft starter 3RW3

8.3.3.3 Combining the contactor 3RT with the thermal overload relay 3RU1 and the soft starter 3RW3

Size of the overload relay

The chosen size of the overload relay should be so large that the calculated current value can still just be adjusted.
The next smallest overload relay must be used if the resulting current values are less than in the case of the specified overload relay.

Important

It is not permitted to install the thermal overload relay under the "contactor - connecting lead - soft starter" combination.
The overload relay must be installed in the branch before the contactor - connecting lead - soft starter combination. The specified compensation factors apply only to this permissible assembly sequence

DIN rail1:
Combination of contactor 3RT1 and thermal overload relay 3RU1

DIN rail 2:
Soft starter 3RW3

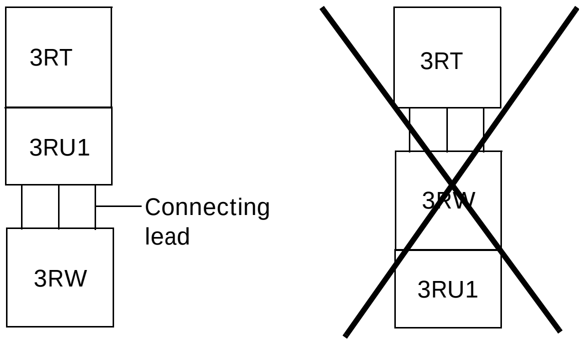


Fig. 8-13: Combination 3RT+3RU1+3RW3

Minimum clearances

A minimum clearance between the contactor/overload relay combination and the soft starter and a minimum length of the connecting leads are necessary for thermal reasons.
The following table lists the minimum clearances and minimum length of the connecting cable for the individual sizes:

Size	Minimum clearance between DIN rail 1 and DIN rail 2 (center - center) in mm	Minimum length of the connecting lead in mm
S00	160	100
S0	200	150
S2	240	200
S3	300	250

Tabelle 8-8: Assembly specifications 3RW3, minimum clearances/lengths

Compensation factors: 3RT + 3RU1 + 3RW30/ 31

Combination of contactor 3RT1 with fitted thermal relay - connecting lead - soft starter 3RW30/31:

Order number	Size	Rated unit current in A at Tamb=40°C	Contactor order number	Thermal overload relay order number	Overload relay adjustment range	Without fan Stand-alone: Compensation factor Rated unit current	Without fan Stand-alone: Compensation factor Switching frequency	Without fan Stand-alone: Compensation factor Thermal overload relay setting	Without fan Butt-mounted: Compensation factor Rated unit current	Without fan Butt-mounted: Compensation factor Switching frequency	Without fan Butt-mounted: Compensation factor Thermal overload relay setting	With fan Stand-alone: Compensation factor Rated unit current	With fan Stand-alone: Compensation factor Switching frequency	With fan Stand-alone: Compensation factor Circuit-breaker setting	With fan Butt-mounted: Compensation factor Rated unit current	With fan Butt-mounted: Compensation factor Switching frequency	With fan Butt-mounted: Compensation factor Thermal overload relay seeting
3RW3014-1CB..	S00	6	3RT1015-1A..	3RU1116-1GBO	(4,5-6,3)A	0,95	1	1	0,9	0,75	1	- 1)	- 1)	- 1)	- 1)	- 1)	- 1)
3RW3016-1CB..	S00	9	3RT1016-1A..	3RU1116-1JBO	(7-10)A	0,9	0,95	1	0,8	0,8	1	- 1)	- 1)	- 1)	- 1)	- 1)	- 1)
3RW3.24-1AB..	S0	12,5	3RT1024-1A..	3RU1126-1KBO	(9-12,5)A	0,95	0,9	1	0,9	0,55	1	1	1,8	0,95	1	1,7	0,95
3RW3.25-1AB..	S0	16	3RT1025-1A..	3RU1126-4ABO	(11-16)A	0,95	0,9	1	0,9	0,55	1	1	1,8	0,95	1	1,7	0,95
3RW3.26-1AB..	S0	25	3RT1026-1A..	3RU1126-4DBO	(22-25)A	0,9	0,8	1	0,8	0,55	1	1	1,8	0,95	1	1,7	0,95
3RW3034-1AB..	S2	32	3RT1034-1A..	3RU1136-4EBO	(22-32)A	0,95	0,7	1	0,9	0,45	1	1	2,2	0,92	1	1,9	0,92
3RW3035-1AB..	S2	38	3RT1035-1A..	3RU1136-4FBO	(28-40)A	0,95	0,9	1	0,9	0,35	1	1	1,8	0,92	1	1,7	0,92
3RW3036-1AB..	S2	45	3RT1036-1A..	3RU1136-4HBO	(36-45)A	0,9	0,95	1	0,8	0,45	1	1	1,8	0,92	1	1,7	0,92
3RW3044-1AB..	S3	63	3RT1044-1A..	3RU1146-4JBO	(45-63)A	0,95	0,9	1	0,9	0,65	1	1	1,6	0,92	1	1,5	0,92
3RW3045-1AB..	S3	75	3RT1045-1A..	3RU1146-4KBO	(57-75)A	0,95	0,85	1	0,9	0,5	1	1	1,6	0,92	1	1,5	0,92
3RW3046-1AB..	S3	100	3RT1046-1A..	3RU1146-1MBO	(80-100)A	0,9	0,8	1	0,8	0,55	1	1	1,6	0,92	1	1,5	0,92

1) = SIRIUS soft starter 3RW301 .. cannot be combined with fans.

Tabelle 8-9: Compensation factors, contactor 3RT + thermal overload relay 3RU - soft starter 3RW

8.3.3.4 Combining the contactor 3RT with the electronic overload relay 3RB10 and the soft starter 3RW3

A contactor, electronic load relay and soft starter can be combined in two ways:

- Combination of the contactor 3RT1 with a fitted electronic overload relay 3 RB10 - connecting lead - soft starter 3RW30/31
- Combination of the contactor 3RT1 - connecting lead - combination of soft starter 3RW30/31 with a fitted electronic overload relay 3RB10

3RT + 3RB10 + connecting lead + 3RW3

DIN rail1:
3RT + 3RB10 + connecting lead + 3RW3 electronic overload relay 3RB10

DIN rail 2:
Soft starter 3RW30/31

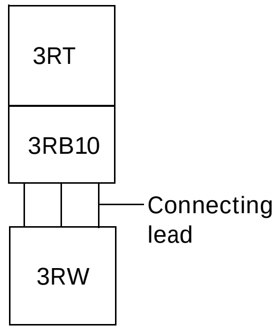


Fig. 8-14: Combination 3RT+3RB10+3RW3

Minimum clearances

A minimum clearance between the contactor/overload relay combination and the soft starter and a minimum length of the connecting leads is necessary for thermal reasons.
The following table lists the minimum clearances and minimum connecting lead lengths for the individual sizes:

Size	Minimum clearance between DIN rails 1 and 2 (center - center) in mm	Minimum length of the connecting lead in mm
S00	160	100
S0	200	150
S2	240	200
S3	300	250

Tabelle 8-10: Assembly specifications for 3RT + 3RB10 + 3RW3, minimum clearances/minimum lengths

3RT + connecting lead + 3RB10 + 3RW3

DIN rail 1:
Contactor 3RT1

DIN rail 2:
Combination of soft starter 3RW30/31 and electronic overload relay 3RB10

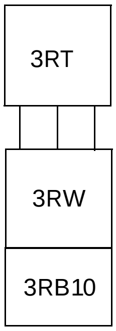


Fig. 8-15: Combination 3RT+3RW3+3RB10

Minimum clearances

Size	Minimum clearance between DIN rail1 and 2 (center - center) in mm	Minimum length of the connecting lead in mm
S00	100	100
S0	140	150
S2	180	200
S3	240	250

Tabelle 8-11: Assembly specifications for 3RT1 + 3RW30/31 + 3RB10, minimum clearances/ minimum lengths

Compensation factors: 3RT+ 3RB10 + 3RW3

Combination of contactor 3RT1 with fitted electronic overload relay 3RB10 - connecting lead - soft starter 3RW30/31:

Order number	Size	Rated unit current in A at Tamb=40° C	Contactor order number	Electronic overload relay order number	Overload relay adjustment range	Without fan Stand-alone: Compensation factor Rated unit current	Without fan Stand-alone: Compensation factor Switching frequency	Without fan Stand-alone: Compensation factor Electronic overload relay setting	Without fan Butt-mounted: Compensation factor Rated unit current	Without fan Butt-mounted: Compensation factor Switching frequency	Without fan Butt-mounted: Compensation factor Electronic overload relay setting	With fan Stand-alone: Compensation factor Rated unit current	With fan Stand-alone: Compensation factor Switching frequency	With fan Stand-alone: Compensation factor Circuit-breaker setting	With fan Butt-mounted: Compensation factor Rated unit current	With fan Butt-mounted: Compensation factor Switching frequency	With fan Butt-mounted: Compensation factor Electronic overload relay setting
3RW3014-1CB..	S00	6	3RT1015-1A..	3RB1016-1SBO	(3-12)A	1	0,95	1	1	?	1	- [1]	- [1]	- [1]	- [1]	- [1]	- [1]
3RW3016-1CB..	S00	9	3RT1016-1A..	3RB1016-1SBO	(3-12)A	1	0,95	1	1	?	1	- [1]	- [1]	- [1]	- [1]	- [1]	- [1]
3RW3.24-1AB..	S0	12,5	3RT1024-1A..	3RB1026-1QBO	(6-25)A	1	0,85	1	1	0,5	1	1	1,8	1	1	1,7	1
3RW3.25-1AB..	S0	16	3RT1025-1A..	3RB1026-1QBO	(6-25)A	1	0,85	1	1	0,5	1	1	1,8	1	1	1,7	1
3RW3.26-1AB..	S0	25	3RT1026-1A..	3RB1026-1QBO	(6-25)A	1	0,75	1	1	0,45	1	1	1,8	1	1	1,7	1
3RW3034-1AB..	S2	32	3RT1034-1A..	3RB1036-1UBO	(15-50)A	1	0,65	1	1	0,4	1	1	2,2	1	1	1,9	1
3RW3035-1AB..	S2	38	3RT1035-1A..	3RB1036-1UBO	(15-50)A	1	0,85	1	1	0,35	1	1	1,8	1	1	1,7	1
3RW3036-1AB..	S2	45	3RT1036-1A..	3RB1036-1UBO	(15-50)A	1	0,85	1	1	0,35	1	1	1,8	1	1	1,7	1
3RW3044-1AB..	S3	63	3RT1044-1A..	3RB1046-1EBO	(25-100)A	1	0,85	1	1	0,6	1	1	1,6	1	1	1,5	1
3RW3045-1AB..	S3	75	3RT1045-1A..	3RB1046-1EBO	(25-100)A	1	0,8	1	1	0,5	1	1	1,6	1	1	1,5	1
3RW3046-1AB..	S3	100	3RT1046-1A..	3RB1046-1EBO	(25-100)A	1	0,75	1	1	0,55	1	1	1,6	1	1	1,5	1

1) = SIRIUS soft starter 3RW301 .. cannot be combined with a fan.

Tabelle 8-12: Compensation factors, contactor 3RT + electronic overload relay 3RB10 + soft starter 3RW

8.3.4 Example circuit

Example circuit (version with UC110-230 V):

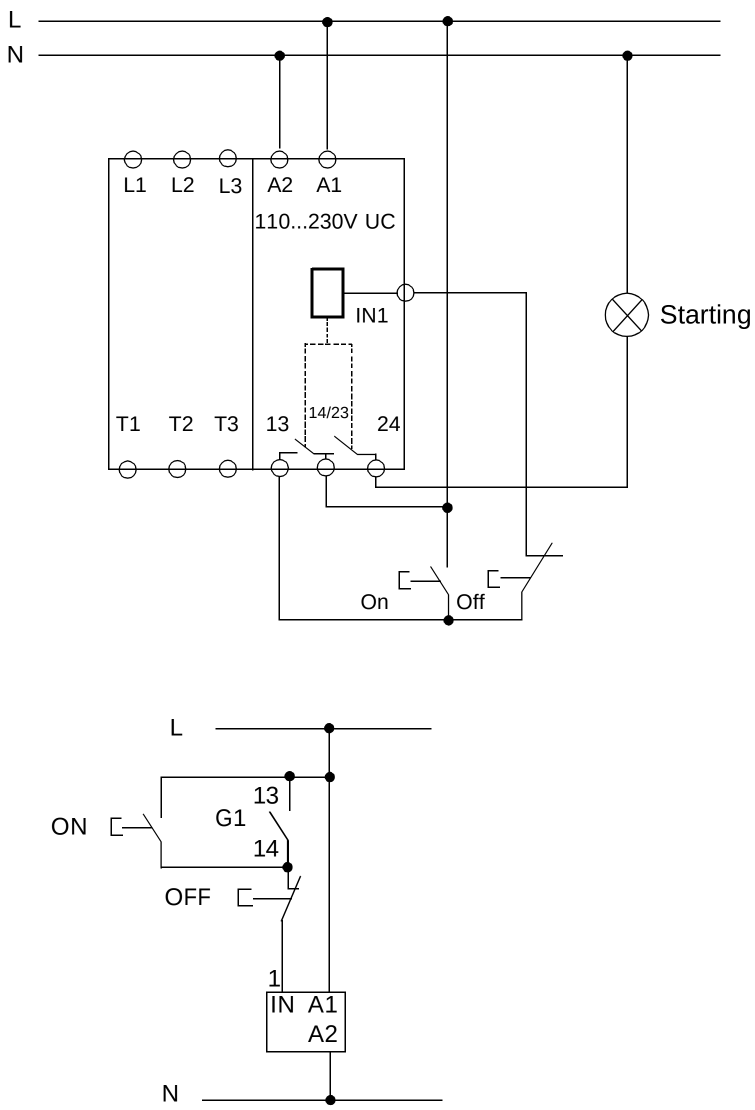


Fig. 8-16: Example circuit, 3RW3

8.3.5 Commissioning

Every SIRIUS 3RW soft starter comes with the following warning information, which it is imperative to observe:

Warning

This unit has been conscientiously tested at the works before delivery and found to be in proper working order. During the course of transportation, stresses may occur upon which we have no influence. As the result of this, the bypass relays in the main circuit may be in an undefined state
In the interests of complete safety, the following procedure is necessary during commissioning or after a replacement of the SIRIUS soft starter:

Apply the supply voltage **first** to A1/A2 in order to set the bypass relays to a defined switching state.

Then activate the main circuit (L1/L2/L3)..

Otherwise, the motor may be inadvertently activated and may cause injuries or damage to parts of the system.

Settings

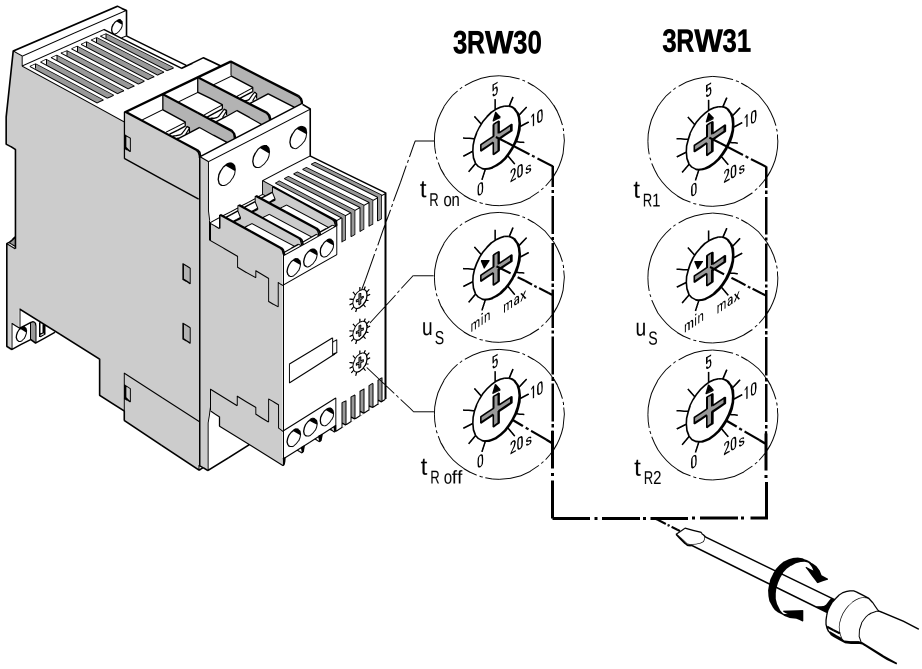


Fig. 8-17: Settings, 3RW3

Note

During initial commissioning, the settings of the "ramp time" and "starting voltage" potentiometers should not be changed. These settings must be determined by trial and error.

Modifying settings

The potentiometer settings are queried before every switching cycle ("ON"

or "OFF")..
For example, if the setting for the starting time potentiometer is modified during starting of a motor, it takes effect the next time it is started.

Starting voltage

The starting voltage should be set so that the motor starts up swiftly.

Ramp time

The ramp time should be set so that the motor can start within this time. If the star time of a star-delta start is known, the ramp time can be set to this value.

Coasting time

The duration of the voltage ramp during coasting is set with the "coasting time" potentiometer. This can be used to achieve an extension of coasting in comparison with free coasting
If the value is set to 0, coasting is free.

Switching frequency

To avoid thermal overloading of the units, it is imperative to keep to the maximum permitted switching frequency and compensation factor tables (see assembly guidelines in Ch. 8.3.2).

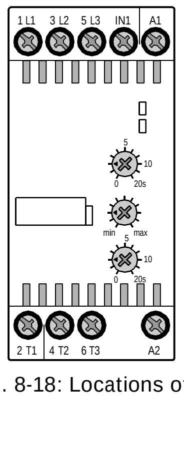
Starting time

To arrive at optimum operating conditions for the soft starter 3RW3, the set starting time should be approximately 1 s longer than the resulting motor starting time to ensure that the internal bypass contacts will not be loaded with the starting current. This protects the internal bypass contacts and increases their useful life. Longer starting times increase the thermal load on the units and the motor, leading to a reduction in the permissible switching frequency.

Locations of the connecting terminals

3RW30
The following depiction shows the positions of the connection terminals and of the adjustment potentiometers.

Size S00
3RW301.



Size S0 to S3
3RW302./303./304.

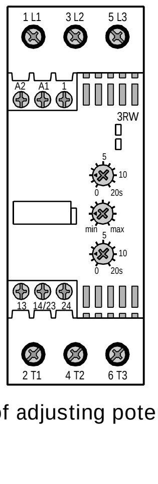


Fig. 8-18: Locations of connecting terminals and of adjusting potentiometers

3RW31
The soft starter 3RW31 is available in size S0. Externally, the difference with respect to the 3RW30 consists of the marking of the contacts and of the terminals:

- The "BYPASSED" - auxiliary contact does not exist. The free contact is used to enable the necessary cycling contact IN2 to switch between the two ramp times t_{R1} and t_{R2}.
- The 3 RW31 does not have a coasting ramp. The adjustment potentiometer with which the coasting time is set on the 3RW30 serves here to set the second ramp time t_{R2}.
- The "ON" auxiliary contact does not exist

Length of the control cable

To rule out line coupling capacitance problems, the control line should be shorter than 15 m (basis: units with rated control supply voltage UC 24 V up to 50 m).
UmCoupling elements must be used to rule out interference in the case of control lines that leave the control cabinet.

8.3.6 Operating messages and fault diagnostics

Operating messages

LED READY	Lit continuously Flashing	Ready during starting or coasting
LED BYPASSED	Lit continuously	Bypassed

Tabelle 8-13: Operating messages of the 3RW30/31

Fault diagnostics

Malfunction	Possible cause	Remedy
LED READY off	• Supply voltage too low	• Check and adapt supply voltage at A1, A2
No reaction to control input IN (LED READY on)	• No line voltage	• Check fuses or line contactor
	• Phase failure	• Check fuses or line contactor • Check voltages L1 to L3
	• Wrong line switched to IN	• Connect IN as depicted for connection terminals
	• No load	• Connect motor
Motor starts directly (LED BYPASSED on)	• Switch the line voltage off and on again during continuous operation without actuating the control input IN	• Always switch the line contactor on and off in conjunction with the control input IN

Tabelle 8-14: Fault diagnostics 3RW30/31

8.3.7 Timing diagram

Starting and coasting response

The following diagram shows the changeover times during switching on and off:

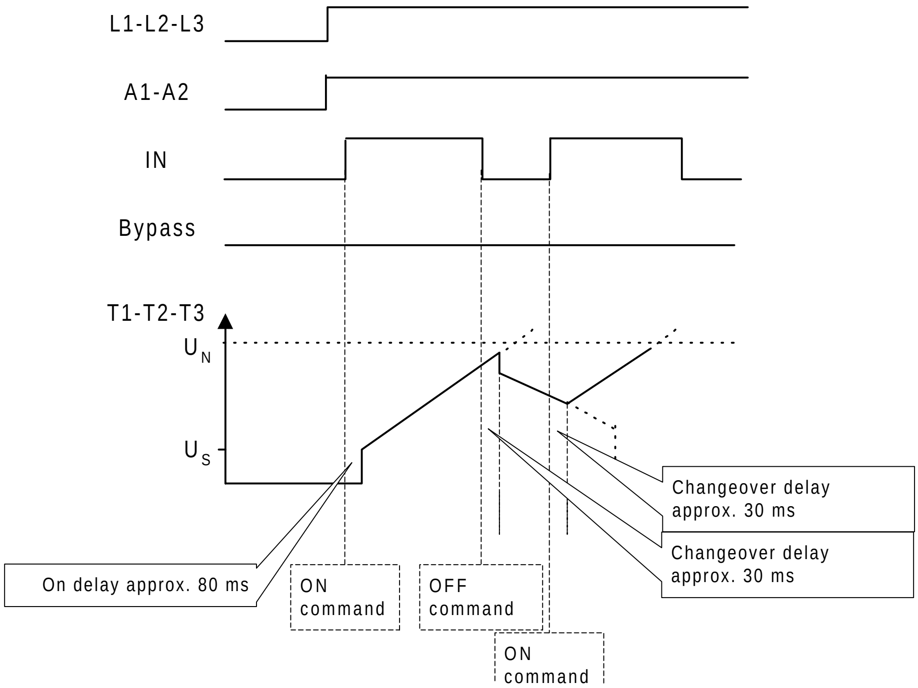


Fig. 8-19: Starting and coasting response

Line discontinuity in the bypassed state

If the load voltage is switched off in the bypassed state while the auxiliary voltage is still applied to the terminals A1/A2, the soft starter starts the motor directly after reactivation of the load voltage. To avoid this, the On command must be withdrawn when the main voltage disappears.
The following graphic elucidates the response to a line discontinuity in the bypassed state:

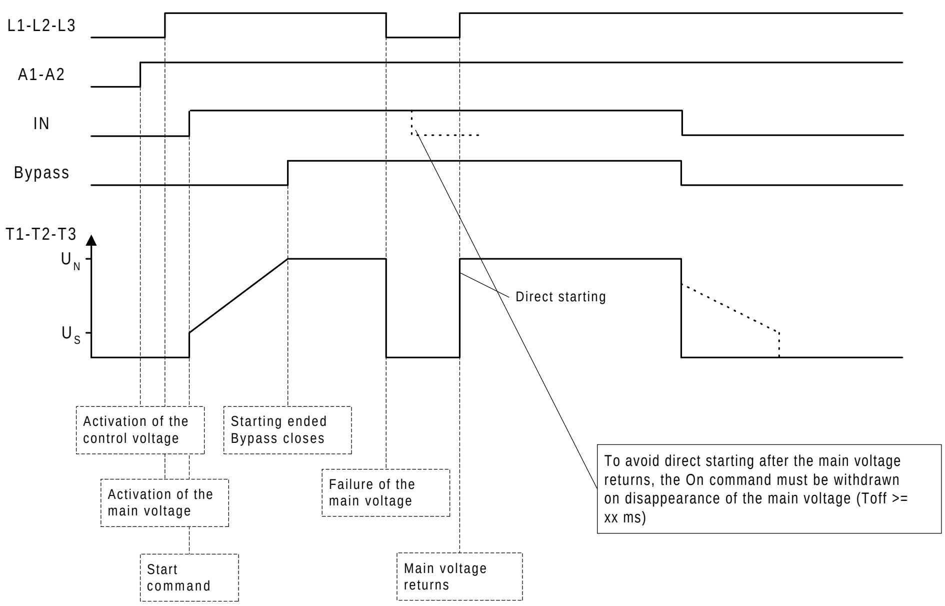


Fig. 8-20: Line discontinuity in the bypassed state

8.4 Accessories

The following accessories are available for the soft starter 3RW3:

Description	Order No.
Fan for 3RW3.2..	3RW3926-8A
Fan for 3RW303.. and 3RW304..	3RW3936-8A
Terminal covers for frame covers 3RW303..	3RT1936-4EA2
Terminal covers for frame covers 3RW304..	3RT1946-4EA2
Conne tion cover for rail connection 3RW304..	3RT1946-4EA1
Connection modules for combination with circuit-breakers 3RV1	3RA19.1-1A (sizes S00 to S3)
RE element for cycling from PLC	3TX7462-3T

Tabelle 8-15: Accessories, 3RW30/31

Fan cycling

The fan is cycled by the control electronics of the soft starter. It only runs during motor starting and coasting.

Fan installation

The fan is snapped into the recess provided on the underside of the soft starter and the plug-in cable is plugged into the appropriate plug. The installation direction is marked by an arrow on the fan.
No additional parameterization is necessary.
Thanks to these fan modules, the starter can be installed in any position.
Exception: the fan cannot blow from top to bottom opposite the convection direction.

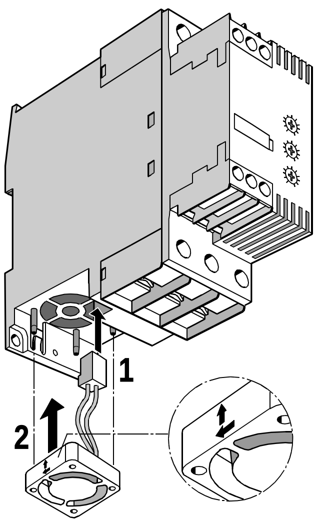


Fig. 8-21: Accessories: fan installation

Terminal covers

For sizes S2 and S3, the terminal covers of the contactors 3RT1 belonging to the same size can be used for additional finger protection. Installation of the soft starters corresponds to installation on the contactors.

Connection modules

For the creation of fuseless feeders (soft starter + circuit-breaker 3RV), the same connection modules are available as are also used for the combinations 3RT + circuit-breaker 3RV.
Also observe the notes and allocation tables in Chapter 8.3.2 entitled "Assembly specifications".

RC element

If the soft starter 3RW30/31 is to be cycled from a PLC by triac or thyristor output, incorrect response can be avoided with an RC element. If there is s leakage current of more than 1 mA, and if no RC element is used, the soft starter may interpret the voltage drop at the input as an "ON" command.

RC element connection example

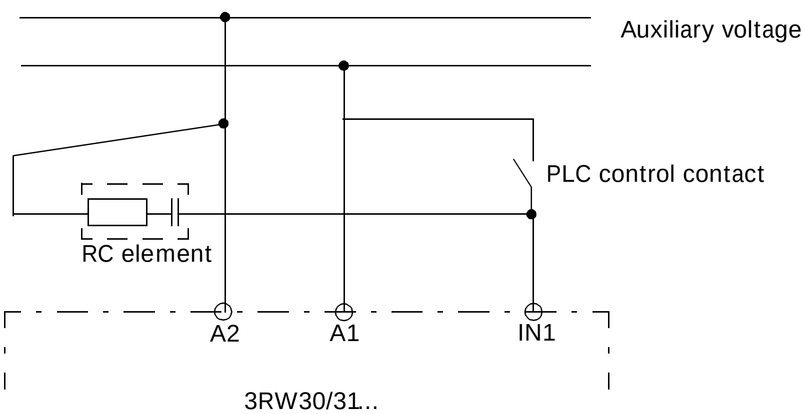


Fig. 8-22: Connection example with RC element

8.5 Assembly and connection

8.5.1 Assembly

Snap-on mounting

The soft starters 3RW30 are snapped onto 35 mm rails conforming to DIN EN 50 022 without the need for tools
The starter is positioned against the top edge of the DIN rail and is pressed down until it snaps onto the bottom edge of the rail. Sizes S00 and S0 can be removed just as easily: the starters are pressed down so as to loosen the pull of the securing spring and the starter can be removed.
In the case of sizes S2 and S3, this securing spring is relieved by a bracket that can be pulled on the underside of the starter using a screwdriver.

8.5.2 Connection

Screw connection

The electronic soft starters 3RW3 are available with SIGUT connection in conjunction with plus-minus POZIDRIV 2 screws

Connection cross-sections

The following table lists the permitted cross-sections for the electronic soft starter 3RW30:

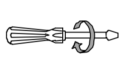
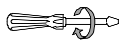
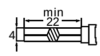
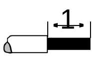
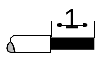
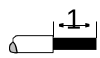
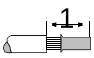
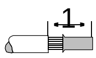
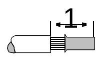
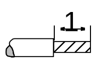
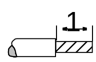
	3RW301. L1 L2 L3 A1/A2; NO/NC	3RW302. 3RW312. L1 L2 L3		3RW303. L1 L2 L3		3RW304.. L1 L2 L3
 ∅ 5 ... 6 mm / PZ2	0.8 ... 1.2 Nm 7 to 10.3 LB.IN	2 ... 2.5 Nm 18 to 22 LB.IN	 ∅ 5 ... 6 mm / PZ2	3 ... 4.5 Nm 27 to 40 LB.IN		4 ... 6 Nm 35 to 53 LB.IN
	2 x 0.5 ... .1.5 mm² 2 x 0.75 ... 2.5 mm²	2 x 1 ... 2.5 mm² 2 x 2.5 ... 6 mm²		2 x 0.75 ... 16 mm²		2 x 2.5 ... 16 mm²
	2 x 0.5 ... .2.5 mm²	2 x 1 ... 2.5 mm² 2 x 2.5 ... 6 mm²		2 x 0.75 ... 16 mm² 1 x 0.75 ... 25 mm²		2 x 2.5 ... 35 mm² 1 x 2.5 ... 50 mm²
----	----	----		2 x 0.75 ... 25 mm² 1 x 0.75 ... 35 mm²		2 x 10 ... 50 mm² 1 x 10 ... 70 mm²
AWG	2 x 18 to 14	2 x 14 to 10	**AWG**	2 x 18 to 3 1 x 18 to 2	**AWG**	2 x 10 to 1/0 1 x 10 to 2/0

Tabelle 8-16: Connection cross-sections, 3RW30/31

8.5.3 Wiring diagrams

There are two possible variants for wiring the soft starter 3RW3:

- Cycling by pushbutton and latching of the ON pushbutton via the auxiliary "ON" contact of the 3RW3
- Cycling via a switch

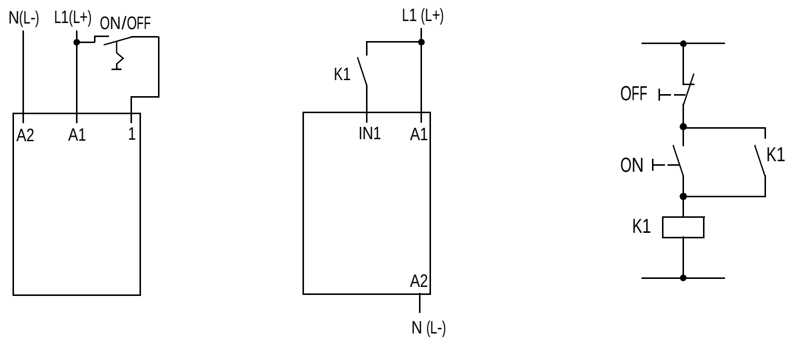


Fig. 8-23: Wiring diagrams, 3RW3

3RW30

3RW302.
3RW303./3RW304

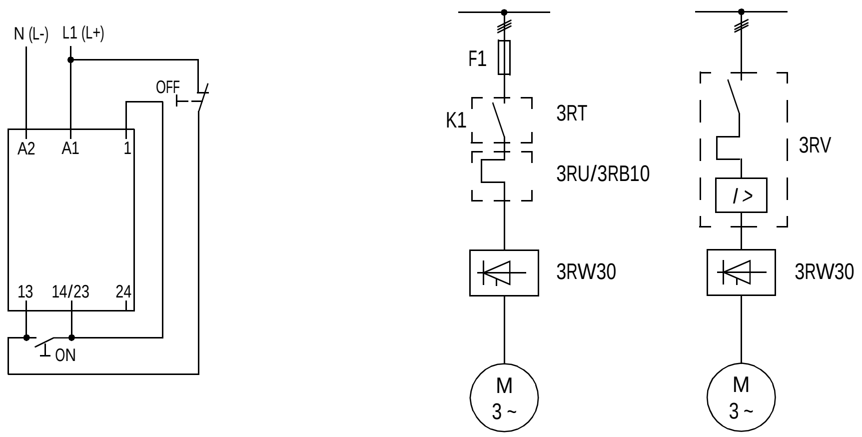


Fig. 8-24: Wiring diagrams, 3RW30

3RW31

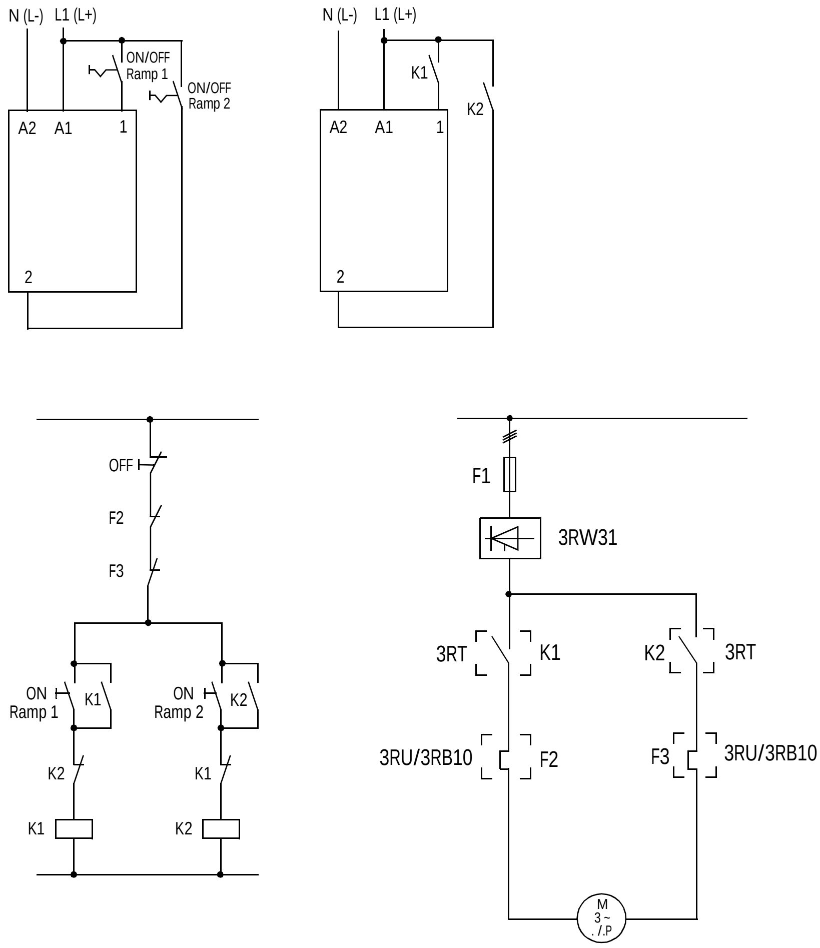


Fig. 8-25: Wiring diagrams, 3RW31

Automatic operation

Direct starting of the soft starter is possible as soon as the auxiliary voltage is applied to the terminals A1 and A2. To this end, a jumper is needed between the auxiliary voltage contact A1 and the cycling contact IN.

Attention must be paid to the fact that:

- an on delay of up to 4 s can occur depending on the size
- soft coasting is no longer possible after deactivation of the auxiliary voltage

Cycling via PLC

The soft starter 3RW3 can be cycled via a programmable logic controller. The wiring is the same as for cycling via a switch.

Important

Always pay attention to the correct connection of A1 and A2! Although reverse voltages cannot destroy the unit, they may lead to malfunctions.

Control of a motor with an electromechanical brake

An electromechanical brake that is fed from the main voltage (L1/L2/L3) should not be wired directly into the soft starter's output. An electromechanical brake should be controlled via a separate contactor (K1 in the following wiring diagram):

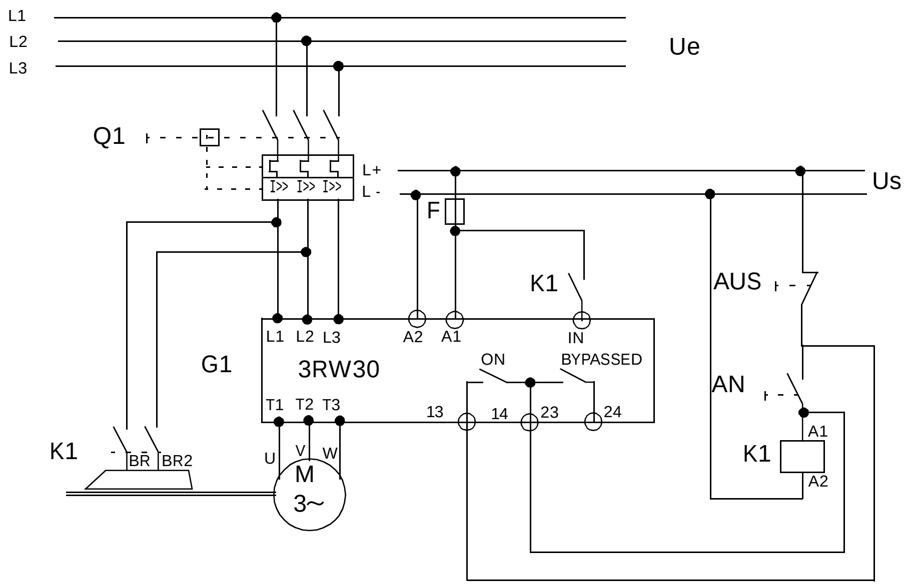
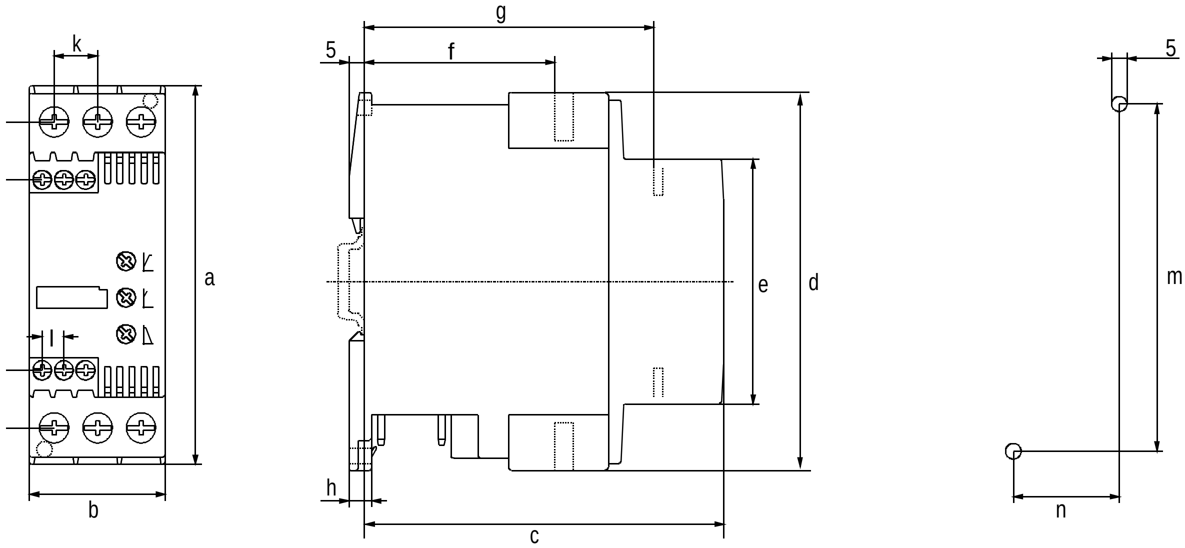


Fig. 8-26: Motor control with electromechanical brake

8.6 Dimension drawings



mm	a	b	c	d	e	f	g	h	i	j	k	l	m	n
3RW301.	97,5	45	93	95	66	51	--	7,5	76	--	86	--	90	35
3RW302./3RW312.	125	45	119	125	81	63	96	7	101	63	14	7	115	35
3RW303.	160	55	143	141	95	63	115	8	119	77	18	7	150	30
3RW304.	170	70	183	162	108	87	156	8	132	87	22,5	7	160	60

8.7 Technical data

8.7.1 Control electronics

Type		3RW3. ..-1.B0.	3RW3. ..-1.B1.
Rated control supply voltage	V	UC 24	UC 110 to 230
Rated control supply current	mA	approx. 50	approx. 25 to 20
Rated frequency for AC	Hz	50/60 ± 10 %	50/60 ± 10 %

Power electronics

Type		3RW3. ..-1.B.4	3RW3. ..-1.B.5
Voltage operating range	V	200 to 460 (± 10 %)	460 to 575 (± 10 %)
Rated frequency	Hz	50/60 ± 10 %	
Permissible installation altitude		up to 3000 m MSL; above 2000 m MSL, linear reduction of I_e, with the result that 3000 m MSL 0,87 x I_e	

Type Size		3RW30 1. S00	3RW3. 2. S0	3RW30 3. S2	3RW30 4. S3
Continuous operation (% of I_e)	%	100	100	100	100
Starting current (% of I_e)/ maximum starting time	% $I_{e/s}$	250/2	300/2	300/3	300/4
Minimum load[1]) (% of I_e); at 40 °C	%	4	4	4	4
Permissible ambient temperature	°C	–25 to +60 (derating from 40 °C; see below)			

Type			3RW30 14	3RW30 16	3RW30 24	3RW30 25	3RW30 26
Load carrying capacity Rated operating current I_e	at 40/50/60 °C, AC-53b	A	6/5/4	9/8/7	12.5/11/9	16/14/12	25/21/18
Dissipated power at rated operating current (40 °C) approx.		W	5	8	7	9	13
Permissible starts per hour Intermittent operation S4, T_{amb}= 40 °C		1/h	30	20	30	30	12
Duty cycle = 30 %		%	250 x I_e, 2 s	250 x I_e, 2 s	300 x I_e, 2 s	300 x I_e, 2 s	300 x I_e, 2 s
Pause time after continuous operation with I_e before starting again		s	0	0	0	0	900
Connection cross-sections							
Screw connection (1 or 2 conductors can be connected) for standard screwdriver size 2 aund Pozidriv 2	**Auxiliary conductors:** Single-wire	mm^2	2 x (0.5 to 1.5); 2 x (0.75 to 2.5) acc. to IEC 60 947; max. 2 x (0.75 to 4)				
	Fine-wire with wire end ferrule	mm^2	2 x (0.5 to 1.5); 2 x (0.75 to 2.5)				
	AWG wires, single or multiple-wired	AWG	2 x (18 to 14)				
	– Connection screws		M 3				
	– Tightening torque	Nm	0.8 to 1.2 (7 to 10.3 lb.in)		2 to 2.5 (18 to 22 lb.in)		
	Main conductors: Single-wire	mm^2	2 x (0.5 to 1.5) 2 x (0.75 to 2.5)		2 x (1 to 2.5) 2 x (2.5 to 6)		
	Fire-wire with wire end ferrule	mm^2	2 x (0.5 to 2.5)		2 x (1 to 2.5) 2 x (2.5 to 6)		
	Multiple-wire	mm^2	–		–		
	AWG wires, single or multiple-wired	AWG	2 x (18 to 14)		2 x (14 to 10)		

8.7.2 Power electronics

Type			3RW30 34	3RW30 35	3RW30 36	3RW30 44	3RW30 45	3RW30 46
Load carrying capacity Rated operating current I_e	at 40/50/60 °C, AC-53b	A	32/27/23	38/32/27	45/38/32	63/54/46	75/64/54	100/85/72
Dissipated power at operating current (40 °C) approx.		W	10	13	17	22	29	48
Permissible stars per hour Intermittent operation S4, T_{amb} = 40 °C		1/h	20	15	4	20	10	3
Duty cycle = 30 %		%	300 x I_e, 3 s	300 x I_e, 3 s	300 x I_e, 3 s	300 x I_e, 4 s	300 x I_e, 4 s	300 x I_e, 4 s
Pause time after continuous operation with I_e before starting again		s	0	0	900	0	0	900
Connection cross-sections								
Screw connection (1 or 2 conductors can be connected) for standard screwdriver size 2 and Pozidriv 2	**Auxiliary conductors:** Single-wire	mm^2	2 x (0.5 to 1.5); 2 x (0.75 to 2.5) acc. to IEC 60 947; max. 2 x (0.75 to 4)					
	Fine-wire with wire end ferrule	mm^2	2 x (0.5 to 1.5); 2 x (0.75 to 2.5)					
	AWG wires, single or multiple-wired	AWG	2 x (18 to 14)					
	– Connection screws		M 3					
	– Tightening torque	Nm	3 to 4.5 (27 to 40 lb.in)			4 to 6 (35 to 53 lb.in)		
	Main conductors: Single-wire	mm^2	2 x (0.75 to 16)			2 x (0.75 to 16)		
	Fine-wire with wire end ferrule	mm^2	2 x (0.75 to 16) 1 x (0.75 to 25)			2 x (0.75 to 16) 1 x (0.75 to 25)		
	Multiple-wire	mm^2	2 x (0.75 to 25) 1 x (0.75 to 35)			2 x (10 to 50) 1 x (10 to 70)		
	AWG wires, single or multiple-wired	AWG	2 x (18 to 3) 1 x (18 to 2)			2 x (10 to 1/0) 1 x (10 to 2/0)		

8.7.3 Installation altitude

If the installation altitude exceeds 1000 m, this calls for:

- a reduction in the rated current for thermal reasons
- a reduction in the rated voltage owing to the limited insulation strength

The following graphic shows the reduction in the unit's rated current depending on the installation altitude:

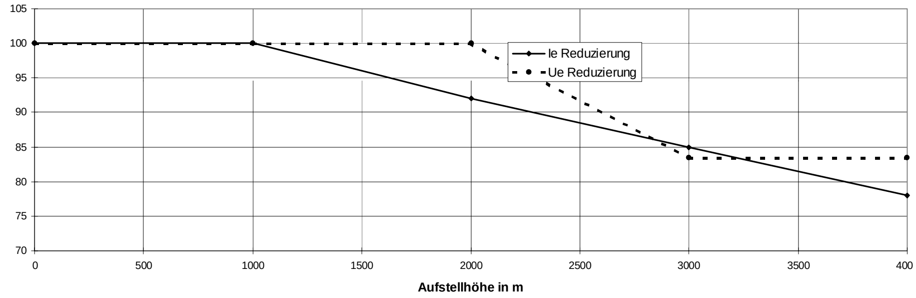


Fig. 8-27: Reduction depending on the installation altitude

8.7.4 IEC data

The specified motor power values consist of reference data.
The soft starter must be chosen according to the rated current I_e.
The motor power values are based on the values of DIN 42 973 (kW) and NEC 96 / UL 508 (hp).

Tamb=40°C

230 V	400 V	I_e	Order No.	500 V	I_e	Order No.
Pe in kW	Pe in kW	in A	MLFB	Pe in kW	in A	MLFB
1.5	3	6	3RW3014-1CB.4	-	-	-
2.2	4	9	3RW3016-1CB.4	-	-	-
3	5.5	12.5	3RW3024-1AB.4	7.5	12.5	3RW3024-1AB.5
4	7.5	16	3RW3025-1AB.4	7.5	16	3RW3025-1AB.5
5.5	11	25	3RW3026-1AB.4	15	25	3RW3026-1AB.5
7,5	15	32	3RW3034-1AB.4	18.5	32	3RW3034-1AB.5
11	18.5	38	3RW3035-1AB.4	22	38	3RW3035-1AB.5
11	22	45	3RW3036-1AB.4	30	45	3RW3036-1AB.5
19	30	63	3RW3044-1AB.4	37	63	3RW3044-1AB.5
22	37	75	3RW3045-1AB.4	45	75	3RW3045-1AB.5
30	55	100	3RW3046-1AB.4	70	100	3RW3046-1AB.5

Tabelle 8-17: 3RW3 motor power data in accordance with IEC at 40° C

Tamb=50°C

230 V	400 V	I_e	Order No.	500 V	I_e	Order No.
Pe in kW	Pe in kW	in A	MLFB	Pe in kW	in A	MLFB
1.1	2.2	5	3RW3014-1CB.4	-	-	-
1.5	4	8	3RW3016-1CB.4	-	-	-
3	5.5	11	3RW3024-1AB.4	5.5	11	3RW3024-1AB.5
4	5-5	14	3RW3025-1AB.4	7.5	14	3RW3025-1AB.5
5.5	11	21	3RW3026-1AB.4	11	21	3RW3026-1AB.5
7.5	11	27	3RW3034-1AB.4	15	27	3RW3034-1AB.5
7.5	15	32	3RW3035-1AB.4	18.5	32	3RW3035-1AB.5
11	18.5	38	3RW3036-1AB.4	22	38	3RW3036-1AB.5
15	22	54	3RW3044-1AB.4	30	54	3RW3044-1AB.5
18.5	30	64	3RW3045-1AB.4	37	64	3RW3045-1AB.5
22	45	85	3RW3046-1AB-4	55	85	3RW3046-1AB.5

Tabelle 8-18: 3RW3 motor power data in accordance with IEC at 50° C

Tamb=60°C

230 V	400 V	I_e	Order No.	500 V	I_e	Order No.
Pe in kW	Pe in kW	in A	MLFB	Pe in kW	in A	MLFB
0.75	1.5	4	3RW3014-1CB.4	-	-	-
1.5	3	7	3RW3016-1CB.4	-	-	-
2.2	4	9	3RW3024-1AB.4	5.5	9	3RW3024-1AB.5
3	5.5	12	3RW3025-1AB.4	7.5	12	3RW3025-1AB.5
4	7.5	18	3RW3026-1AB.4	11	18	3RW3026-1AB.5
5.5	11	23	3RW3034-1AB.4	15	23	3RW3034-1AB.5
7.5	11	27	3RW3035-1AB.4	15	27	3RW3035-1AB.5
7.5	15	32	3RW3036-1AB.4	18.45	32	3RW3036-1AB.5
11	22	46	3RW3044-1AB.4	30	46	3RW3044-1AB.5
15	22	54	3RW3045-1AB.4	30	54	3RW3045-1AB.5
18.5	37	72	3RW3046-1AB.4	45	72	3RW3046-1AB.5

Tabelle 8-19: 3RW3 motor power data accordinng to IEC at 60° C

8.7.5 NEMA data

The specified motor power values consist of reference data.
The soft starter must be chosen according to the rated current I_e.
The motor power values are based on the values of DIN 42 973 (kW) and NEC 96 / UL 508 (hp).

Tamb=40°C

200 V	230 V	460 V	I_e	Order No.	460 V	575 V	I_e	Order No.
Pe in hp	Pe in hp	Pe in hp	in A	MLFB	Pe in hp	Pe in hp	in A	MLFB
1	1	3	4.8	3RW3014-1CB.4	-	-	-	-
2	2	5	7.8	3RW3016-1CB.4	-	-	-	-
3	3	7.5	11	3RW3024-1AB.4	7.5	10	11	3RW3024-1AB.5
5	5	10	17.5	3RW3025-1AB.4	10	15	17.5	3RW3025-1AB.5
7.5	7.5	15	25.3	3RW3026-1AB.4	15	20	25.3	3RW3026-1AB.5
7.5	7.5	20	27	3RW3034-1AB.4	20	25	27	3RW3034-1AB.5
10	10	25	34	3RW3035-1AB.4	25	30	34	3RW3035-1AB.5
10	15	30	42	3RW3036-1AB.4	30	40	42	3RW3036-1AB.5
20	20	40	62.1	3RW3044-1AB.4	40	60	62.1	3RW3044-1AB.5
20	25	50	68	3RW3045-1AB.4	50	60	68	3RW3045-1AB.5
30	30	75	99	3RW3046-1AB.4	75	100	99	3RW3046-1AB.5

Tabelle 8-20: 3RW3 motor power data in accordance with NEMA at 40° C

Tamb=50°C

200 V	230 V	460 V	I_e	Order No.	460 V	575 V	I_e	Order No.
Pe in hp	Pe in hp	Pe in hp	in A	MLFB	Pe in hp	Pe in hp	in A	MLFB
1	1	3	4.8	3RW3014-1CB.4	-	-	-	-
2	2	5	7.8	3RW3016-1CB.4	-	-	-	-
3	3	7.5	11	3RW3024-1AB.4	7.5	10	11	3RW3024-1AB.5
3	3	10	14	3RW3025-1AB.4	10	10	14	3RW3025-1AB.5
5	5	15	21	3RW3026-1AB.4	15	15	21	3RW3026-1AB.5
7.5	7.5	20	27	3RW3034-1AB.4	20	25	27	3RW3034-1AB.5
7.5	10	20	32	3RW3035-1AB.4	20	30	32	3RW3035-1AB.5
10	10	25	38	3RW3036-1AB.4	25	30	38	3RW3036-1AB.5
15	20	40	54	3RW3044-1AB.4	40	50	54	3RW3044-1AB.5
20	20	40	64	3RW3045-1AB.4	40	60	64	3RW3045-1AB.5
25	30	60	85	3RW3046-1AB.4	60	75	85	3RW3046-1AB.5

Tabelle 8-21: 3RW3 motor power data in accordance with NEMA at 50° C

Tamb=60°C

200 V	230 V	460 V	I_e	Order No.	460 V	575 V	I_e	Order No.
Pe in hp	Pe in hp	Pe in hp	in A	MLFB	Pe in hp	Pe in hp	in A	MLFB
0.75	0.75	2	4	3RW3014-1CB.4	-	-	-	-
1.5	1.5	3	7	3RW3016-1CB.4	-	-	-	-
2	2	5	9	3RW3024-1AB.4	5	7.5	9	3RW3024-1AB.5
3	3	7.5	12	3RW3025-1AB-4	7.5	10	12	3RW3025-1AB.5
5	5	10	18	3RW3026-1AB.4	10	15	18	3RW3026-1AB.5
5	7.5	15	23	3RW3034-1AB.4	15	20	23	3RW3034-1AB.5
7.5	7.5	20	27	3RW3035-1AB.4	20	25	27	3RW3035-1AB.5
7.5	10	20	32	3RW3036-1AB.4	20	30	32	3RW3036-1AB.5
10	15	30	46	3RW3044-1AB.4	30	40	46	3RW3044-1AB.5
15	20	40	54	3RW3045-1AB.4	40	50	54	3RW3045-1AB.5
20	25	50	72	3RW3046-1AB.4	50	60	72	3RW3046-1AB.5

Tabelle 8-22: 3RW3 motor power data in accordance with NEMA at 60° C

8.7.6 Short-circuit protection and fuse coordinations

The DIN VDE 0660 Part 102/IEC 60947-4-1 specification distinguishes between two types of coordination, which are referred to as type of coordination 1 and type of coordination 2. With both types of coordination, the short-circuit to be mastered is reliably deactivated. Differences merely lie in the degree of damage caused to the unit after a short-circuit.

Type of coordination 1

The motor feeder may be operable after every short-circuit deactivation. Damage to he soft starter is possible. The circuit-breaker itself always reaches type of coordination 1.

Type of coordination 2

Damage to the soft starter or to any other switching device must not have occurred after a short-circuit; only the short-circuit fusing is destroyed. After renewal of the short-circuit fusing, the actual motor feeder can immediately commence operation again.

Maximum short-circuit current

All specified fuse designs take a maximum short-circuit current of 50 kA into account, thus ensuring that short-circuits amounting to 50 kA can be deactivated without jeopardizing persons and systems

Motor feeder: Type of coordination 1

Planning note:
The fuseless structure is recommended for motor feeders, i.e. the combination of the circuit-breaker 3RV and the soft starter 3RW30, thus achieving type of coordination 1.

Motor feeder: Type of coordination 1

If a motor feeder is to be set up as "type of coordination 2", the feeder must be fused, i.e. overload protection must be provided for the motor.
The following can be used for this purpose:

- All-range fuse 3NE1, uniting line and semiconductor protection
- Semiconductor protection fuse 3NE8, for which additional fusing of the line must be provided.

Comparison of types of coordination 1 and 2

The variant based on type of coordination 2 calls for higher costs than the one based on type of coordination 1. This is why the fuseless arrangement (type of coordination 1) is recommended. Advantages are

- Less components in the control cabinet
- Less wiring complexity
- Less control cabinet space
- Lower price

Fuse design with SITOR fuses 3NE1..-0

The following table shows the fuse design (degree of protection 2) for 3RW30/31 with SITOR fuses 3NE1..-0 (short-circuit and line protection); max. short-circuit current 50 kA:

Soft starter order number	Fuse order number	Rated current of fuse	Size of fuse
MLFB	MLFB	A	
3RW3014	3NE1814-0[1)]	20	000
3RW3016	3NE1815-0[1)]	25	000
3RW3024/3RW3124	3NE1815-0[2)]	25	000
3RW3025/3RW3125	3NE1815-0[2)]	25	000
3RW3026/3RW3126	3NE1802-0[2)]	40	000
3RW3034	3NE1818-0[2)]	63	000
3RW3035	3NE1820-0[2)]	80	000
3RW3036	3NE1820-0[2)]	80	000
3RW3044	3NE1820-0[2)]	80	000
3RW3045	3NE1021-0[2)]	100	00
3RW3046	--[3)]	--	--

Tabelle 8-23: Fuse design (SITOR)

1 fuse coordination for up to 400 V
2 fuse coordination for up to 500 V
3 fuse coordination for all-range fuses not possible; it may be necessary) to take recourse to pure semiconductor fuses plus circuit-breakers)

Fuse design with SITOR fuses 3NE8

The following table shows the fuse design (type of coordination 2) for 3RW30/31 with SITOR fuses 3NE8 (semiconductor protection by the fuse; line and overload protection by the circuit-breaker); Max. short-circuit current 50 kA:

Soft starter order number	Fuse order number	Rated current of fuse	Size of fuse	Circuit-breaker order number[2)]	Connection module 3RW - 3RV
MLFB	MLFB	A	Gr.	MLFB	MLFB[3)]
3RW3014	3NE8003	35	00	3RV1011	3RA1911-1A
3RW3016	3NE8003	35	00	3RV1011	3RA1911-1A
3RW3024/3RW3124	3NE8003	35	00	3RV1021	3RA1921-1A
3RW3025/3RW3125	3NE8003	35	00	3RV1021	3RA1921-1A
3RW3026/3RW3126	--[1)]	--	--	--	--
3RW3034	3NE8022	125	00	3RV1031	3RA1931-1A
3RW3035	3NE8024	160	00	3RV1031	3RA1931-1A
3RW3036	3NE8024	160	00	3RV1031	3RA1931-1A
3RW3044	3NE8024	160	00	3RV1041	3RA1941-1A
3RW3045	3NE8024	160	00	3RV1041	3RA1941-1A
3RW3046	3NE8024	160	00	3RV1041	3RA1941-1A

Tabelle 8-24: Fuse design (SITOR)

1 coordination with pure semiconductor fuses not possible; it may be necessary to take recourse to all-range 3NE1..-0 (see table above)
2 selection and adjustment of the circuit-breaker are based on the motor current
3 pay attention to the qantity unit

If the motor is to be arranged in compliance with UL regulations the order number of the fuse is: 8NE80..-1.

Fuseless version

The following table shows the fuseless version (type of coordination 1) for 3RW30/31; short-circuit current 50 kA:

Soft starter order number	Circuit-breaker order number[1)]	Connection module
MLFB	MLFB	MLFB[3)]
3RW3014	3RV1011[2)]	3RA1911-1A
3RW3016	3RV1011[2)]	3RA1911-1A
3RW3024/3RW3124	3RV1021	3RA1921-1A
3RW3025/3RW3125	3RV1021	3RA1921-1A
3RW3026/3RW3126	3RV1021	3RA1921-1A
3RW3034	3RV1031	3RA1931-1A
3RW3035	3RV1031	3RA1931-1A
3RW3036	3RV1031	3RA1931-1A
3RW3044	3RV1041	3RA1941-1A
3RW3045	3RV1041	3RA1941-1A
3RW3046	3RV1041	3RA1941-1A

Tabelle 8-25: Motor feeder: Fuseless version

1 selection and adjustment of the circuit-breaker are based on the motor current
2 50 mm distance in the upward and downward direction between the 3RV/3RW combination and earthed components is necessary
3 pay attention to the quantity unit

Fused version

The following table shows the fused version (type of coordination 1) for 3RW30/31; short-circuit current 50 kA:

Soft starter order number	Fuse order number	Rated fuse current / size	Thermal overload relay order number[1)]	Electronic overload relay order number[1)]	Contactor order number
MLFB	MLFB	A / Gr.	MLFB	MLFB	MLFB
3RW3014	3NE3810	25 / 00	3RU1116[2)4)]	3RB1016[2)4)]	3RT1015
3RW3016	3NE3810	25 / 00	3RU1116[2)4)]	3RB1016[2)4)]	3RT1016
3RW3024/ 3RW3124	3NE3822	63 / 00	3RU1126[3)]	3RB1026[3)]	3RT1024
3RW3025/ 3RW3125	3NE3822	63 / 00	3RU1126[3)]	3RB1026[3)]	3RT1025
3RW3026/ 3RW3126	3NE3824	80 / 00	3RU1126[3)]	3RB1026[3)]	3RT1026
3RW3034	3NE3830	100 / 00	3RU1136[3)]		3RT1034
3RW3035	3NE3830	100 / 00	3RU1136[3)]		3RT1035
3RW3036	3NE3830	100 / 00	3RU1136[3)]		3RT1036
3RW3044	3NE3144	250 / 1	3RU1146[3)]		3RT1044
3RW3045	3NE3144	250 / 1	3RU1146[3)]		3RT1045
3RW3046	3NE3144	250 / 1	3RU1146[3)]		3RT1046

Tabelle 8-26: Motor feeder: Fused version

1 selection and adjustment of the overload relay are based on the motor current
2 short-circuit current 50 kA to max. 400 V
3 short-circuit current 50 kA to max. 500 V
4 50 mm distance at the top and bottom between the 3R./3RT combination and earthed parts is necessary