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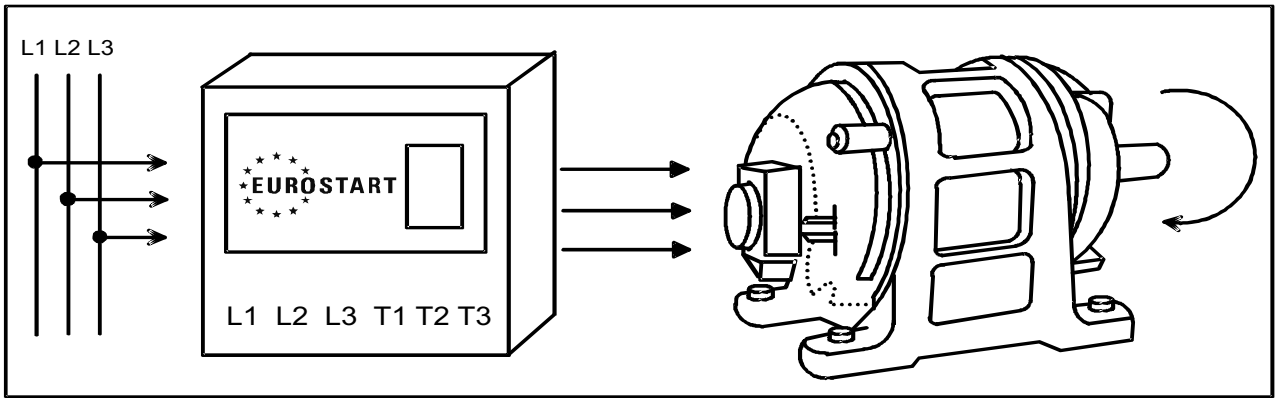
Start-up instructions

Electronic soft-starter
Type:

EUROSTART



Content

1. Important safety instructions

This manual contains instructions, which have to be observed for your personal safety and for the prevention of material damage. The instructions about your personal safety are highlighted with a warning triangle labelled with three exclamation marks, hints about material damages are listed with a warning triangle and one exclamation mark.

Danger-symbol
Personal injury **may** occur, if appropriate safety precautions are not taken into account.

Caution-symbol
Material damages may occur, if appropriate safety precautions are not taken into account.

Disposal regulations
The devices contain electrical components and must not be disposed together with household garbage. The devices for disposal have to be recycled according to local and currently valid regulations for electronic waste.

Qualified personnel
The corresponding device/system may only be set up and operated in conjuntion with this documentation. Commissioning and operation of the device/system may only be performed by **qualified personnel**. Qualified personnel within the meaning of the safety instructions in this documentation are persons with the authority to put electric circuits into operation, provide ground connections and label them according to current safety regulations.

The device should only be used in applications described in this document. The reliable and proper use of the product depends on appropriate transport, storage, installation and careful commissioning.

2. General instructions

Use of the document
This instruction should demonstrate the technical application possibilities of the soft-starter to the engineer in charge. The soft-starter of the type EUROSTART… is an electronic engine control unit, which allows an optimal three-phase start of three-phase asynchronous motors.

Target group
The document should assist the user during commissioning. It also helps in case of service and maintenance work. It supports the planner and project engineer with the conception of new plants.

Necessary competence
Generic skills in the field of electrical engineering are necessary.

Validity
The present document is valid for the soft-starter of the type EUROSTART... . It contains the currently valid description of the unit. We reserve the right to attach new descriptions of the devices. This involves types and options with modified version status of the technical documents.

Standards and approvals
The soft-starter of the type EUROSTART… are based on the IEC/EN 60947-4-2 standard.

Disclaimer
It lies within the responsibility of the plant manufacturer of the technical equipment or machine to ensure the proper overall function. The producer can not guarantee all properties of the overall system or the machine.

3. Technical explanations on soft-starter

The widely used three-phase asynchronous motors are used in great numbers in trade, industry and handcraft because of their robust, simple construction and their operation with low maintenance requirements.
Serious technical problems may arise in case of a direct activation as the typical current characteristic and torque performance of the three-phase asynchronous motors in the start-up phase have a disturbing impact on the providing supply network and the load machine.
Three-phase asynchronous motors have a high direct start-up current I_{anl}. Depending on the motor design, the start-up current may have 3 to 15 times the value of the rated operational current.
The 7-fold up to the 8-fold of the rated motor current may be assumed as the typcial value.
Consequently, a higher loading of the electrical supply network is observed and the supply mains have to be dimensioned for this higher performance during the motor start-up.
The tightening torque and the tilting torque can usually be assumed between the 2-fold and the 4-fold of the rated torque. For the load machine this means that the occuring start-up and acceleration forces in relation to the rated operation cause a higher mechanical stress on the machine and the transported material. Consequently, the machine´s mechanical components are under higher strain and therefore the costs caused by wear and maintenance increase significantly.

The solution is to influence the starting current and torque performance during the run-up phase accordingly by using the soft-starter EUROSTART… .

The EUROSTART... type of electronic soft-starters have been designed for starting and stopping electric motors without the risk of uneven or jerky starts/stops. This greatly reduces the wear on mechanical parts and elliminates the displacement or dropping of goods on conveyor belts.

The EUROSTART... controls the motor by switching three thyristor pairs to vary the voltage supply to the motor.

The EUROSTART... soft-starters are assembled modularly. They consist of two basic elements:

- power element with cooling system and thyristor switching facility
- control unit with electronic starting and control system

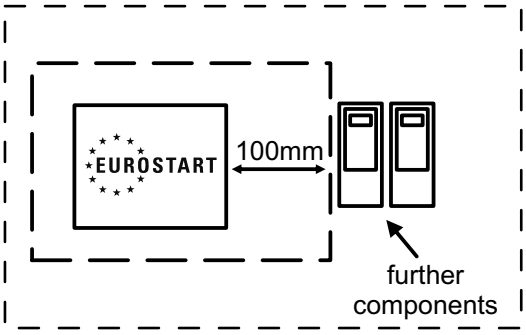
4. Installation of the soft-starter EUROSTART

The built-in device, according to IP 40 has to be mounted in a housing or a switchboard panel. Take care of adequate cooling (separate ventilation, for instance). The environment temperature must not exceed the value of 50°C. The device is to be mounted on a vertical plane, avoiding that the ventilating pipes of the cooling element are not placed vertical. The device has to be mounted in a dry room.

Further conditions to the operating area:

- protection from dust and moisture
- protection from aggressive atmosphere
- free from vibrations

No other devices should be placed closer than 100mm to the device, in order to provide adequate cooling.



Devices with options /EUK and /IP 54 argree with IP 54 and can therefore be placed in locations which are not protected from dust and moisture.

5. EMC-equitable assembly

According to EMC standards electronic soft-starter are regarded as components, which do not fulfil any intended use by themselves. The devices constitute a functional unit of the entire plant. The control electronics of the soft-starter are implemented according to valid EMC standards.
The plant has to be supplied with appropriate mains chokes and mains filters. These components can also be obtained from us. It should be noted that the standards of the resource category A are not sufficient in a special industrial sector, for example if sensitive measuring channels are affected. In this case, the user has to apply equipment of class B. The class A is the usual class of equipments, which is normally intended for the use in the industrial sector. The devices are connected to the industrial network via an assigned transformer. Soft-starter of class B are required if they should be used in the area of industry and small-scale industry and if they should be connected to the public low-voltage system.

Use of mains chokes (only necessary with increased EMC requirements):

On the input side of the soft-starter, mains chokes reduce the current-dependent line reactions and effect an improvement of the performance factor. This reduces the current harmonics and improves the mains quality. The use of mains chokes is particularly recommended when connecting soft-starters whose power section (Thyristor set, W3C) is constantly in the network and works with different phase angles (e.g. option: energy optimisation). In case of interconnected or bridged power section, this circumstance is cancelled (see also EN 60947-4-2, article 8.3.2.1).

Use of mains filters (only necessary with increased EMC requirements):

Radio interference filters and mains filters (combination of radio interference filter and one mains choke) protect from high-frequency disturbances, which are emitted via the power cable. The high-frequency disturbances should be limited to a mandatory or legal degree. Mains filters should possibly be mounted close to the soft-starter and moreover it is necessary to ensure that the connecting cable between the soft-starter and the mains filter is as short as possible.

CAUTION: The mounting surfaces of the soft-starter and the radio interference filters have to be free from paint and well conducting in the high-frequency range.

Furthermore, mains filters have leakage currents, which may become significantly larger than the nominal values in case of failure (phase failure, unbalanced load). To avoid dangerous voltages, the mains filters have to be grounded. As the leakage currents are high-frequent disturbances, the grounding measures have to be low-resistance and extensive.

With leakage currents, which exceed the value of 3,5mA, VDE 0160 or EN 60335 specify that either:

- the cross section of the protective conductor has to be > 10mm² sein
- the protective conductor has to be monitored on interruption or
- a second protective conductor has to be laid.

Shielding measures:

Shielding measures help to reduce the radiated interference energy. Electrical lines between soft-starter and load can be laid shielded. Thereby the shield must not replace the PE line. Four-wire cables (three phases + PE), whose shield is double-sided and extensive laid on earth potential (PES), are recommended. The shield must not be applied over the connecting wires. Interruptions of the shielding e.g. in the case of clamps, contactors, mains chokes etc. have to be bridged with low-resistance and appropriate space considerations.
In practice this can be done for example by interrupting the shield close to the assembly and then connecting it extensively with the earth potential (PES, shield clamp). The free cables, which are not shielded, should not be longer than 100mm.

Grounding measures: 

Grounding measures are absolutely necessary to fulfil legal provisions. They constitute a prerequisite for an efficient use of further measures such as filters and shielding. All conductive, metallic housing com-ponents have to be electroconductive connected with the earth potential. For the EMC-measure, the important factor is not the cable´s crosssection, but its surface, since this is where high frequency current flows to earth. Once again, all grounding points have to be led directly, extensively and with low-resistance to the central grounding point (equipotential bonding bar, star-shaped grounding system). The contact points have to be free from paint and corrosion (use galvanized mounting plate and materials).

6. Operation

To begin with, all electrical connections are to be made according to the accompanying wiring diagrams: L1, L2, L3, T1 (U), T2 (V), T3 (W). Simply connect the device to the motor supply lines; it doesn't matter whether the motor is star or delta wired.

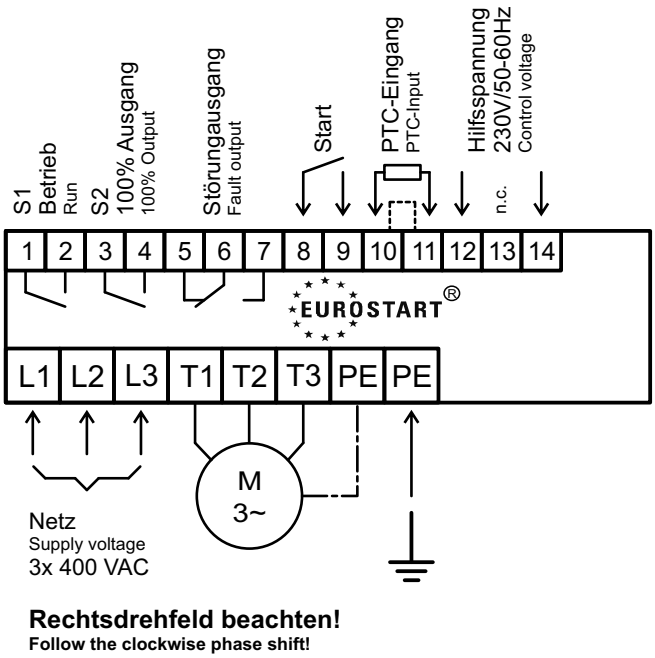
The power supply, the user supply, as well as the control wiring have to be placed in separate ducts or conduits.

To avoid malfunction, it is advisable, to install the electronic signal wiring separated from the power supply and/or from the protective control wiring as well as to twist the feed and return signal lines or use shielded control lines.

The soft-starters have to be connected to the power supply according to the VDE rules, in a way that they can be disconnected again by appropriate switching means (i.e. master switch, contactor, protective power switch) (VDE 0100, VDE 0113, VDE 160).

Fuses:

The mains fuse protection depends on the recommended or employed power-transmission cross-section and has to be carried out, according to DIN 57100, part 430/VDE 0100 and part 430/6.81.



Rechtsdrehfeld beachten!
Follow the clockwise phase shift!

Activation:

The start-up is activated by linking the terminals 8-9. Immediately after the activation, the “Start - LED” is illuminated. Simultaneously the potential-free contact 1-2 is closed.
As soon as the end of the acceleration ramp is reached, the potential-free contact 3-4 is closed.
The auxiliary voltage 230V/50Hz (standard version) has to be connected with the terminals 12 and 14.

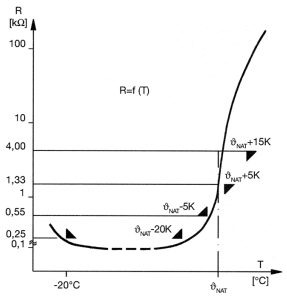
Overtemperature protection:

The devices are equipped with an overtemperature protection, which constantly measures the temperature of the heat sink. When the overtemperature reaches 75°C, the device will be switched off. At this point the “Start - LED” goes out and the potential-free error-output switches over from 5-6 to 6-7.
Simultaneously the “Fault-LED” is illuminated.

Monitoring of the motor overtemperature:

The input 10-11 can be connected with the PTC-sensor of the motor (suitable also for thermistor or Klixon). At overtemperature, the device will be switched off. At this point the “Start - LED” goes out and the potential-free error-output switches over from 5-6 to 6-7. Simultaneously the “Fault - LED” is illuminated. If the input is not required, this has to be linked.

General information on the PTC-thermistor:

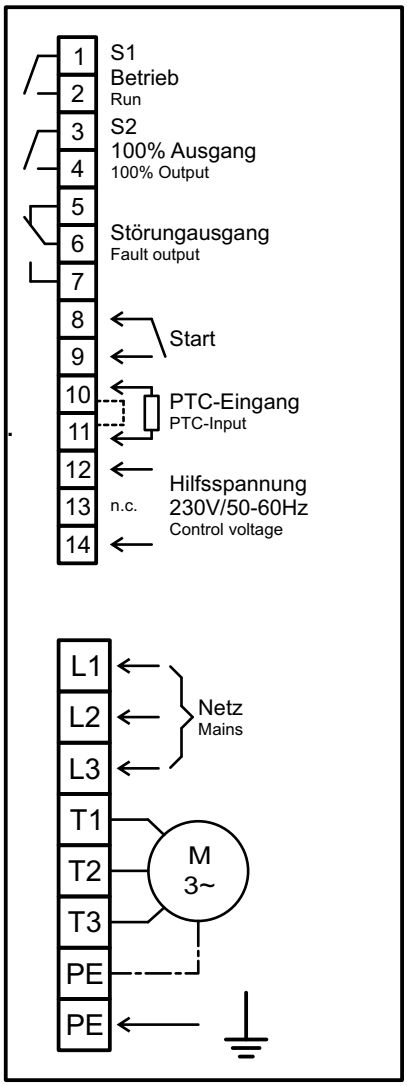


PTC-temperature sensors according to DIN 44081 (triplet design DIN 44082) are used to protect electrical machines against thermal overload. According to the present DIN standard they are arbitrarily exchangeable among themselves. It is a range of types from 60 to 190°C available.
PTC-temperature sensors with different rated shut-off temperatures can also be connected in series. Thereby it is possible to get optimum use out of machine Components and winding parts with different limit temperatures and to protect them cost-effectively.

Technical data PTC

	Single	Triplet	
Tolerance of ϑ_{NAT}	± 5	± 5	K
Reproducibility of ϑ_{NAT}	± 0,5	± 0,5	K
Cold resistance R_{25}	≤ 100	≤ 300	Ω
Cold resistance at a cold-conductor temperature of ϑ_{NAT} -5K	≤ 550	≤ 1650	Ω
Cold resistance at a cold-conductor temperature of ϑ_{NAT} +5K	≥ 1330	≥ 3990	Ω
Cold resistance at a cold-conductor temperature of ϑ_{NAT} +15K	≥ 4	≥ 12	kΩ
Thermal response time t_a	≤ 5	≤ 5	s

7. Connection



Connecting the control signals:

The activation is made by bridging the terminals 8 and 9.

After the activation, the terminals 1-2 are closed.

When achieving 100% of the output voltage, the contacts 3-4 are closing. This contact usually can be used for the bypass contactor.

The terminals 10-11 can be used as a PTC-input.
Otherwise the terminals have to be bridged

In case of failure (overtemperature of the heat sink, PTC-input, Option: phase failure, undervoltage) the contact 5-6 switches over to 6-7.

Terminals 12 and 14: Supply voltage of the electronics
(standard: 230V/50-60Hz)

Connecting of power supply:

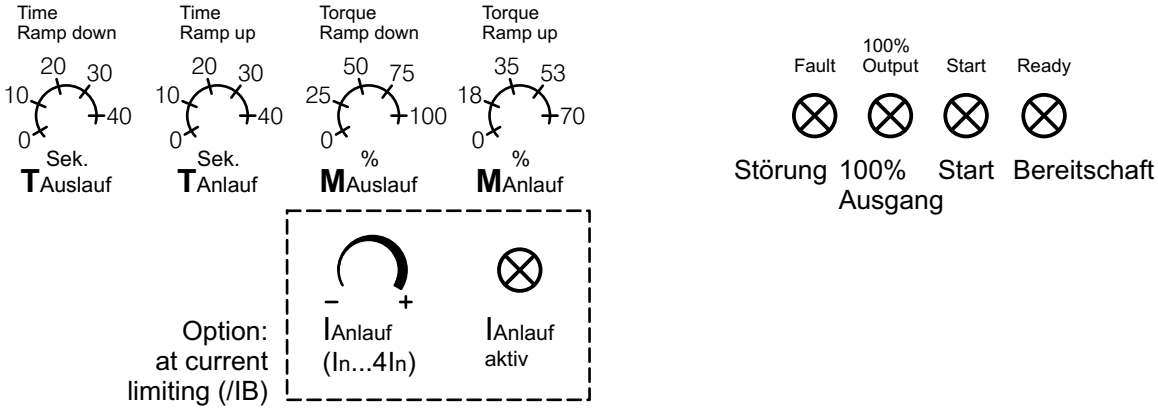
Inputs of the mains: L1, L2, L3 (observe clockwise phase shift)

Motor output: T1, T2, T3

Protective conductor: PE
Attention: The case has to be connected to PE!

8. Summary of the adjustments and indication possibilities

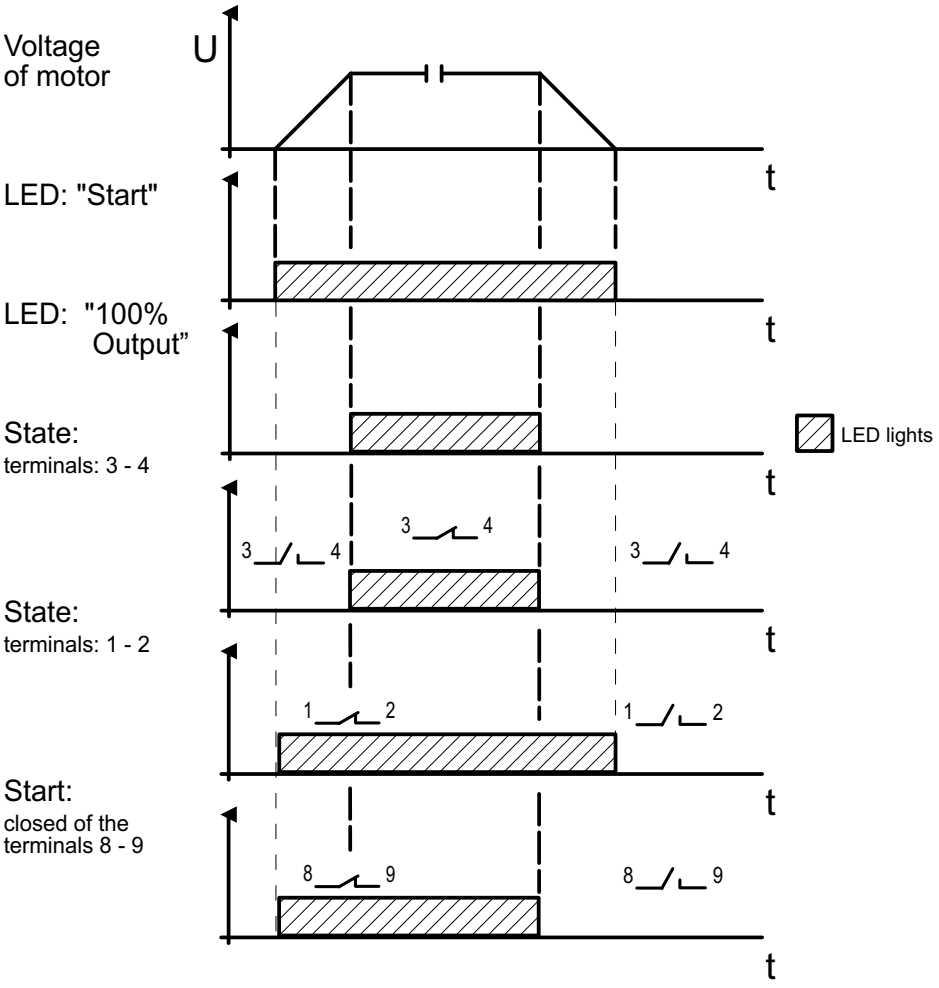
Potentiometers and LEDs:



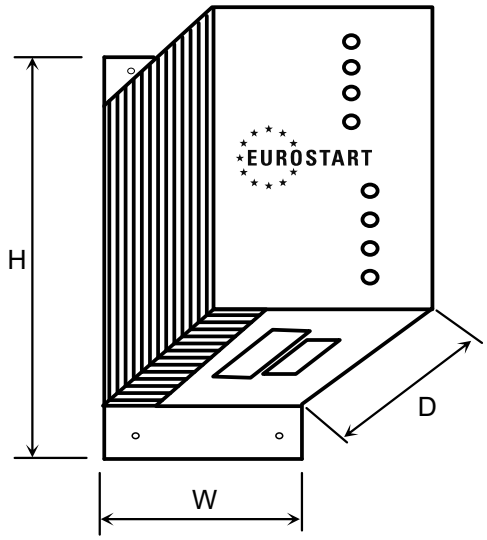
LEDs of the monitoring panel:

Run	Stand-by
Start	ter. 8 and 9 are bridged, activation is performed
100% Output	100% of mains voltage is put on the motor (nominal operation)
Fault	Device has fault
Option: I_{Anlauf} aktiv	Current limiting active

Timeline of a ramp-up and ramp-down process:

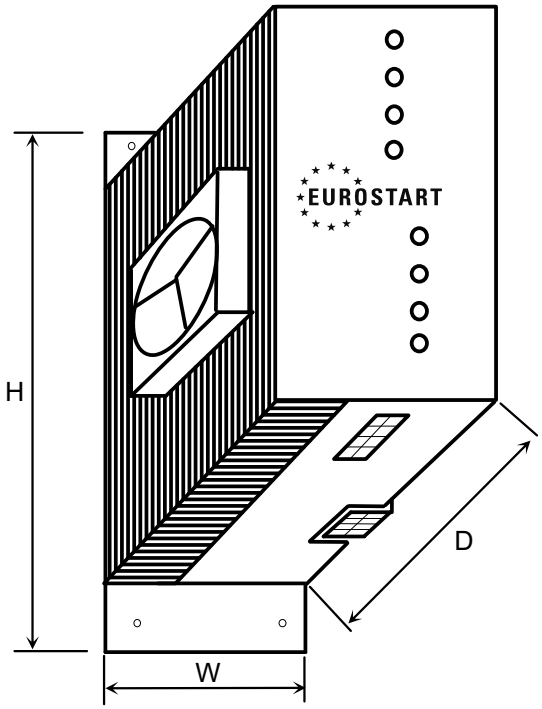


9. Frame sizes



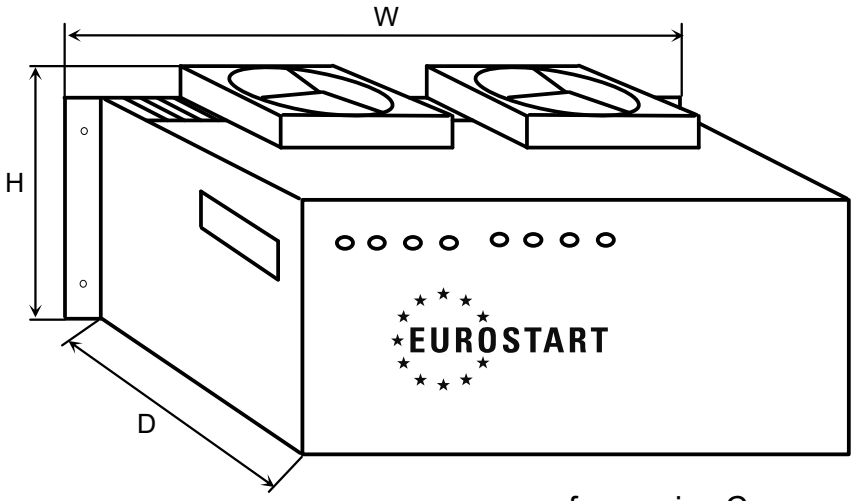
frame size A

W x H x D = 83x200x106mm



frame size B

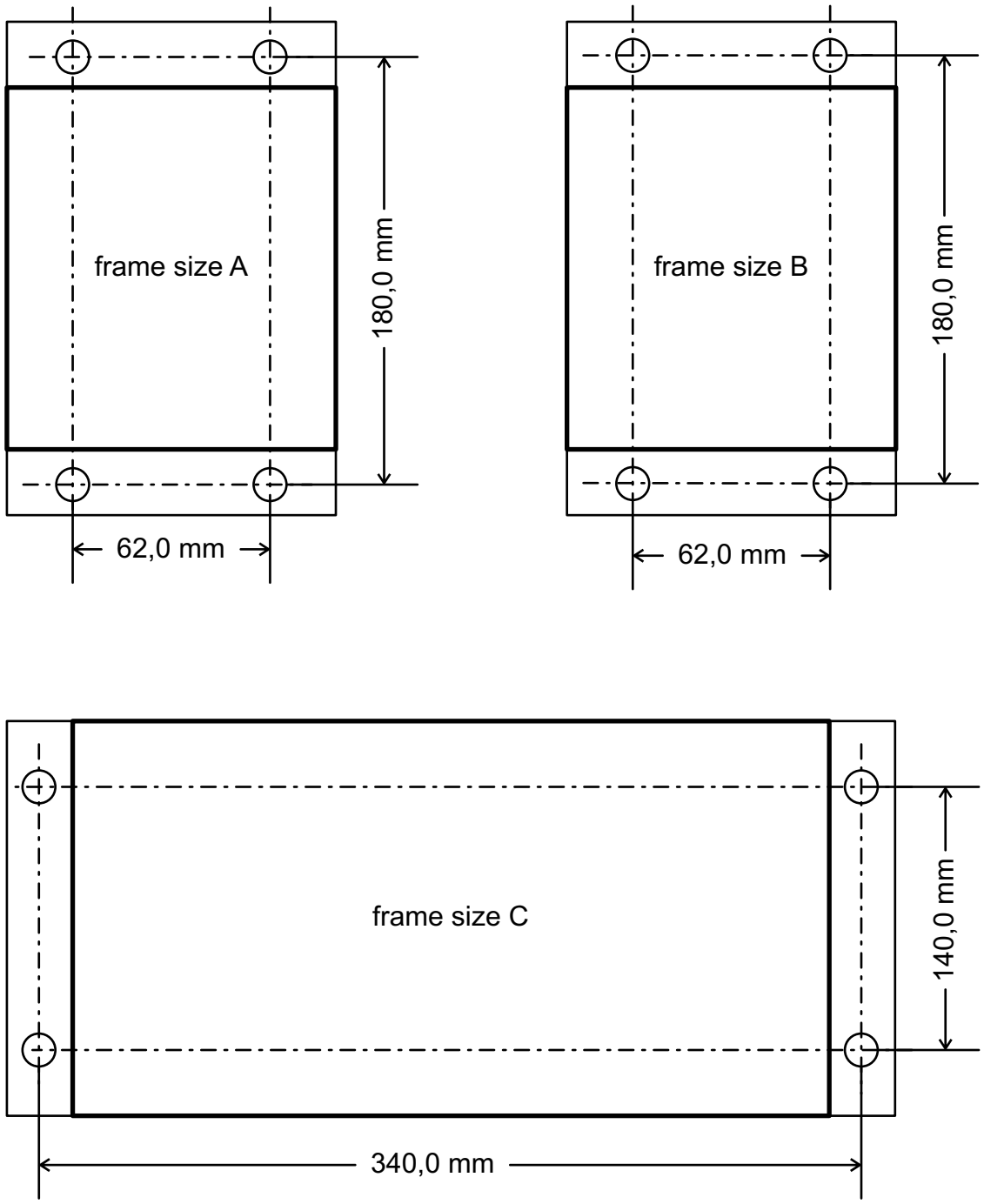
W x H x D = 116 (with fan) x200x205mm



frame size C

W x H x D = 360x245 (with fan) x140mm

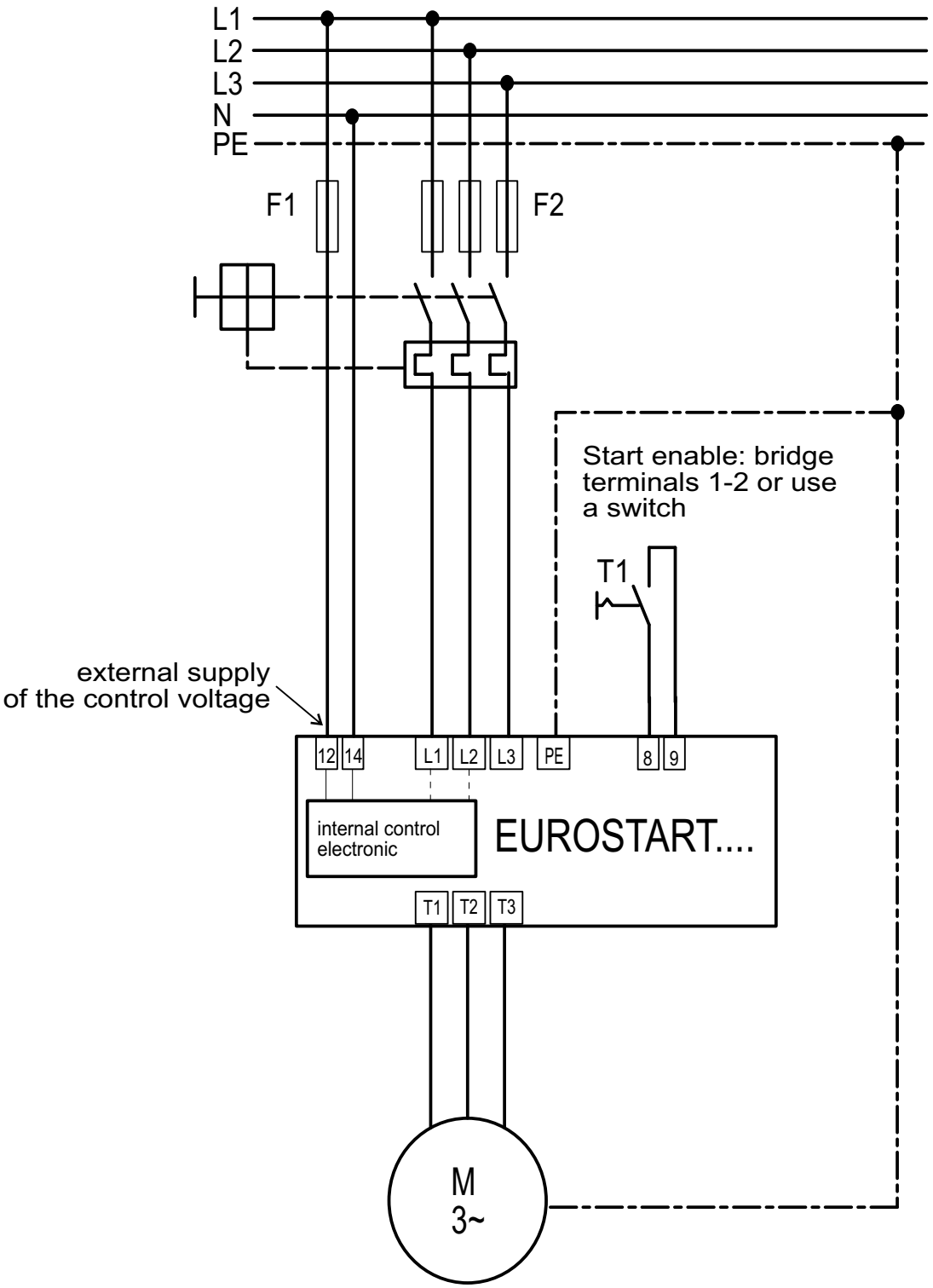
10. Drill dimensions



Ø of drills: 6mm

11. Basic circuit

The following example can be modified in order to adapt it to different use cases:

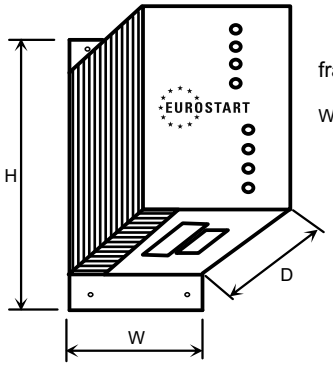


12. Survey of the individual types

Type	Motor power [kW]	max. startimg current [A]	rec. semi-conductor fuse [A]	Mains fuse [A]	rec. cross-section [mm²]	Weight [kg]	Frame size	Dimensions WxHxD [mm]
EUROSTART 1.5	1,5	12	12	8	1,5	1,20	A	83x200x106
EUROSTART 2.2	2,2	15	12	10	1,5	1,20	A	83x200x106
EUROSTART 3.0	3,0	24	16	10	1,5	1,20	A	83x200x106
EUROSTART 4.0	4,0	32	30	16	2,5	1,20	A	83x200x106
EUROSTART 5.5	5,5	48	35	16	2,5	1,20	A	83x200x106
EUROSTART 7.5	7,5	65	50	20	4,0	2,40	B	116x200x205
EUROSTART 11.0	11,0	85	63	25	6,0	2,40	B	116x200x205
EUROSTART 15.0	15,0	110	80	35	10,0	2,40	B	116x200x205
EUROSTART 18.5	18,5	135	100	35	16,0	2,40	B	116x200x205
EUROSTART 22.0	22,0	175	160	63	16,0	2,40	B	116x200x205
EUROSTART 30.0	30,0	210	160	63	25,0	6,50	C	360x245x140
EUROSTART 37.0	37,0	265	200	80	35,0	6,50	C	360x245x140
EUROSTART 45.0	45,0	325	300	100	35,0	6,50	C	360x245x140
EUROSTART 55.0	55,0	400	350	125	50,0	6,50	C	360x245x140
EUROSTART 75.0	75,0	575	400	160	70,0	6,50	C	360x245x140
EUROSTART 90.0	90,0	700	450	160	95,0	6,50	C	360x245x140

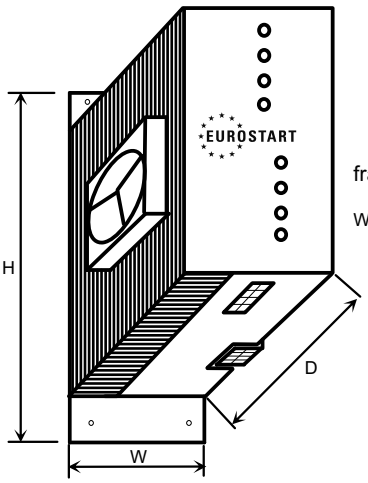
Errors and technical modifications excepted (Date: 2016/06)

The given values refer to the operation voltage of 3x400V AC.



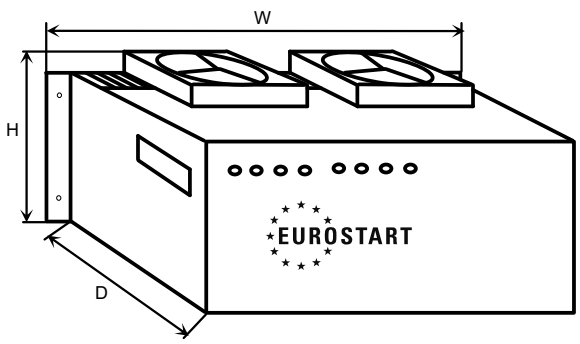
frame size A

W x H x D = 83x200x106mm



frame size B

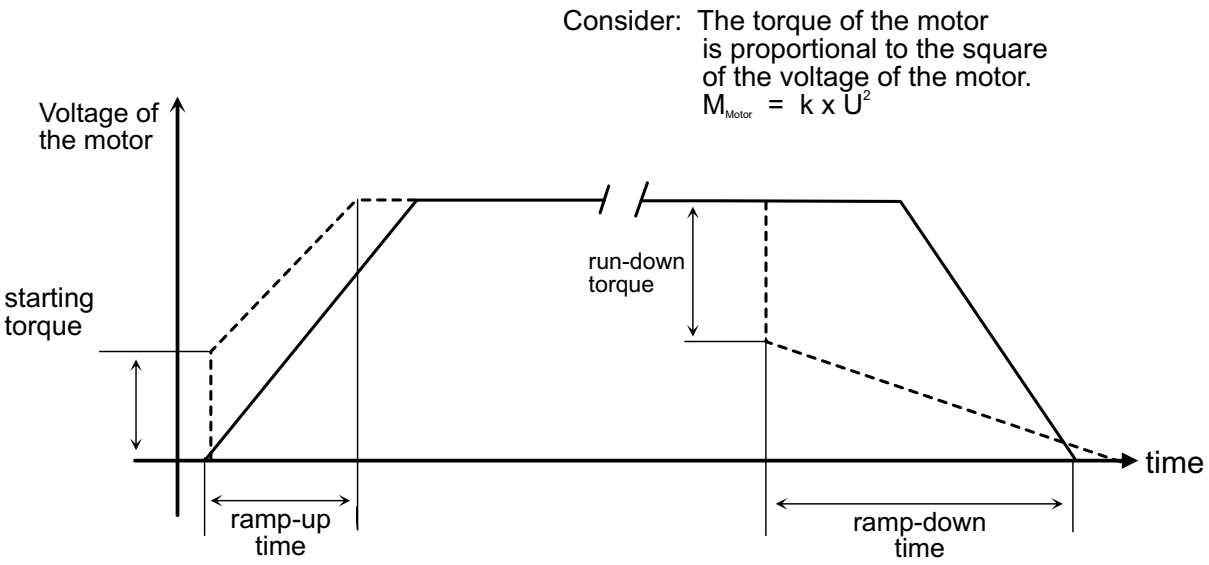
W x H x D = 116 (with fan) x200x205mm



frame size C

W x H x D = 360x245 (with fan) x140mm

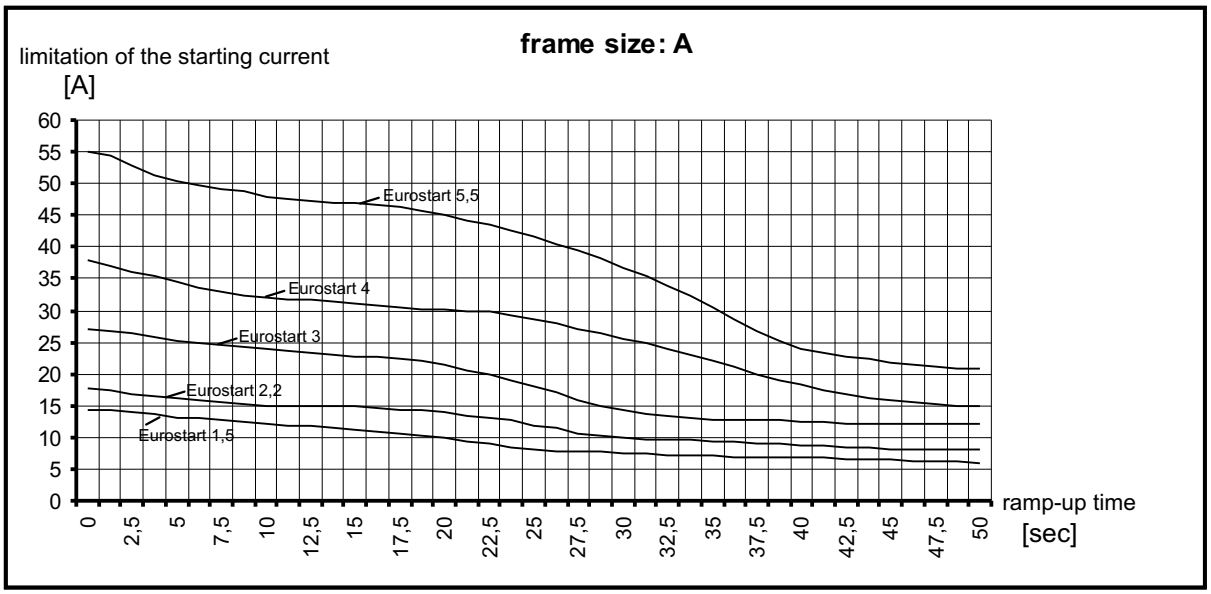
13. Chronological description of a ramp-up and ramp-down process

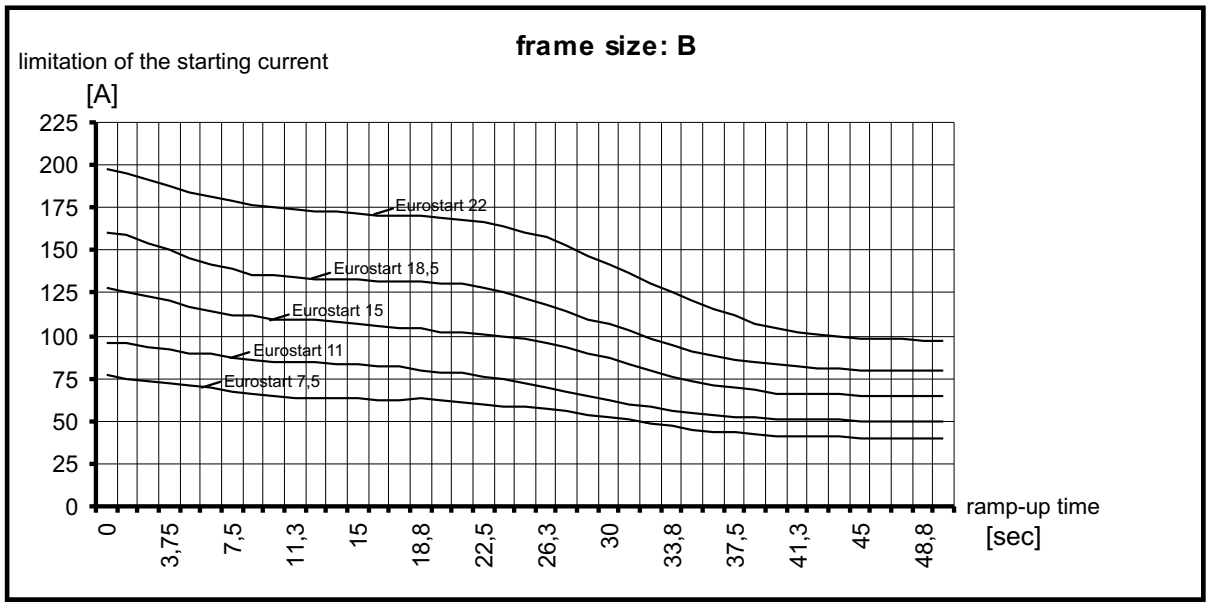


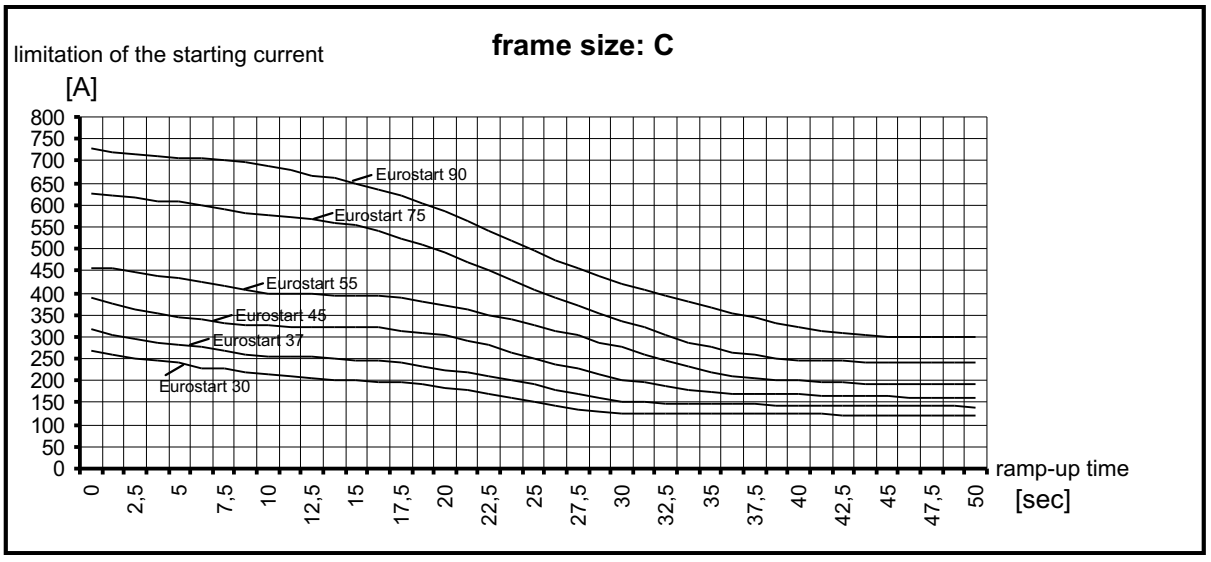
The diagram illustrates two different approaches.

The start-up process is initiated by bridging the terminals 8-9. Depending on the adjustment of the potentiometers $Time_{Ramp\ up}$ and $Torque_{Ramp\ up}$ different start-up characteristics arise. For the run-down process the potentiometers $Time_{Ramp\ down}$ and $Torque_{Ramp\ down}$ are decisive. The actuation of the heat sink or motor overtemperature control leads to the switch-off of the power section and to an obstruction of the electronics. This is indicated when the “Start - LED” goes out and the “Fault - LED” is illuminated.
To reset the fault state, the activation contact at the terminals 8-9 has to be opened and afterwards to be connected again. At the same time, a new start-up process is initiated.

14. Load characteristics







15. Technical Data

Auxiliary voltage	230V AC (Option: 24V DC or internal of three-phase voltage)
Mains power	3-phase 400V AC (Option: 3x110V AC, 3x230V AC, 3x500V AC)
Mains frequency	50Hz...60Hz ±10%
Rotary field	clockwise phase shift
Number of controlled phases	3x control of three-phase power circuit (W3C circuit)
Starts per hour	60 starts medium load
Operating temperature	-20° C to +45° C
Relative humidity	95% (not condensing)
Installation altitude	up to 1000m above sea level at rated load, 1% current reduction per 100m
Degree of protection of enclosure	IP 40
Adjustments	• ramp-up torque: 0...70% • ramp-down torque: 0...100% • ramp-up time: 0...40 sec. • ramp-down time: 0...40 sec.
LED-display	Ready, Start, 100% Output, Fault, Option: I_{Anlauf} aktiv
Unit sizes	1,5kW to 90kW (according to standard series motors)
Fault monitoring	temperature rise of the heat sink or of the motor (PTC input), option: phase failure, undervoltage
Weight	• frame size A: 1,20kg • frame size B: 2,40kg • frame size C: 6,50kg
Built-in features	vertical, electrical connections below
Control inputs	galvanically isolated
CE-regulations	EMC Directive 2014/30/EU LVD 2014/35/EU

Options:
- Mains power: 3x110V AC, 3x230V AC, 3x500V AC
- Internal auxiliary voltage (/IV) (e. g. 3x400V AC)
- Auxiliary voltage with 24V DC (/24VDC)
- Activation with SPS 24V signal (/AS)
- Current ramp with current limitation (/IB)
- Independent of the load ramp-up and ramp-down (/TA)
- EUROSTART „compakt" (IP54 with fuses and operation display and fault indication) (/EUK)
- Version IP54 (Installing the unit in IP54 enclosure) (/IP54)
- Snap-on mounting for frame size A (/SB)

Ordering example: EUROSTART 22/24VDC/IB
(=EUROSTART 22kW / auxiliary voltage with 24V DC / Current ramp with current limitation)

Attention:
In option /EUK and /IP54 change dimensions due to higher enclosure!