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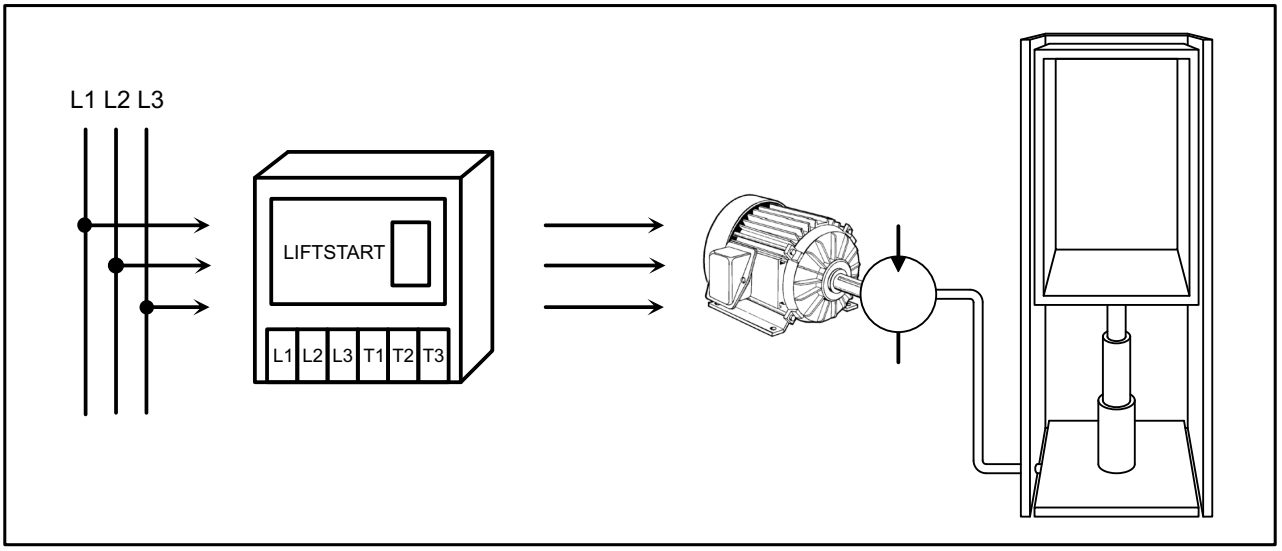
Start-up instructions

Electronic soft-starter
Type: LIFTSTART



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.

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 LIFTSTART 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 LIFTSTART. 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 LIFTSTART… 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 LIFTSTART.

The electronic soft-starters LIFTSTART have been designed for starting and stopping three phase electric motors without risking of uneven or jerky starts and stops. This greatly reduces the wear on mechanical parts and prevents big current peak loads.
Starting and stopping the three phase motor without steps or transitions lengthens the life of power-driven machine mechanical elements, greatly reducing stress on transmission and coupling parts.

The LIFTSTART range of solid state soft starters are electronic controlled 6 thyristors devices designed to provide progressive acceleration for 3 phase induction motors.

The electronic soft-starters type LIFTSTART consist of two parts:

- power unit (thyristor moduls)
- control unit

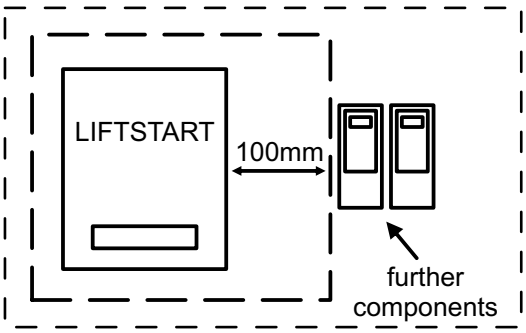
4. Installation of the soft-starter LIFTSTART

The LIFTSTART device (IP 22) should be mounted vertically in a housing. The upper and lower side of the heatsink must be kept free to allow cooling air to circulate freely. Controllers with cooling fans must be mounted on a flat surface to ensure that cooling air is channelled to the heat sink.

Further conditions to the operating area:

- vibration free environment
- protection against hazardous environments
- protection against dust and humidity

Please avoid to mount other components in distance of 100mm around the controller because the cooling system can be affected.



The LIFTSTART versions "LUK" (with fuses, operation and fault indications) and "AIP 54" are built according to IP 54. Therefore these versions can be mounted in areas where they are not protected by dust and humidity.

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. Wiring

When wiring consider the following points to ensure correct and reliable operation:

- dangerous voltage are present to the LIFTSTART during operation
- the operation of the soft-starter with a capacitive load at the output (e.g. for power factor compensation) is not allowed
- using an installation tester can damage the LIFTSTART
- connect the controller as shown in the following recommended connection.

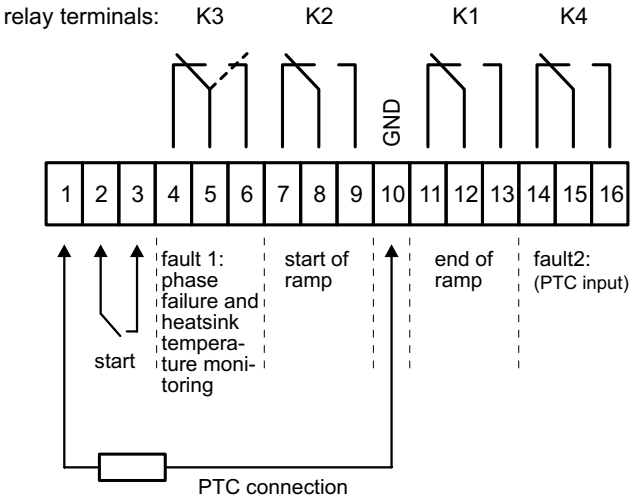
Confirm the power side L1, L2 and L3 and motor side T1, T2 und T3. Take care of the following parts in regard to the control signals: Install a surge suppressor on the relay exciting coil. Use a shielded wirde for twisted wire for the control circuit wiring. Distance this from the main circuit wiring. High voltage wiring (L1, L2, L3, T1, T2, T3) should be physically and electrically separated from low voltage signal wires or control wires. Only qualified persons should work on or near these controllers. The successful and safe operation of these controllers depends on proper transport, storage, planning and installing as well as commissioning. Please regard established safety practices like VDE 0100, VDE 0113, VDE 160.

The LIFTSTART device can cause the movement of dangerous machinery or moving constructions. The general safety precautions must be taken before putting into operation.

Fuses:

Conventional short circuit protection of the connections to the controller and to the motor in accordance with the wiring regulations must be provided. Circuit breakers, motor starters or additional fuses can be used. The control voltage should be protected with 2A.

Connection of the control terminals:



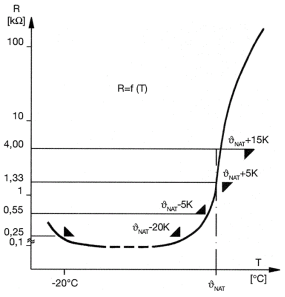
Start (Enable):
Command: "START" connect terminal 2 to terminal 3.

Monitoring signal "End of ramp":
Terminals 12-11 switch to 12-13 (K1) (S2-function) when the end of ramp is reached.

External control voltage:
230V 50/60Hz, terminals: look examples of standard wiring.

Temperature exceedance:
The controller is equipped with a temperature control circuit. This module continuously monitors the temperature of the heat sink and as soon as the values exceeds 75°C the LIFTSTART will be shut down.
The LED St1 flashes and the terminals 4-5 switch to 5-6 (In cace of internal supply (/IV) the relay K3 switches from 5-6 to 4-5 and the LED St1 goes out).

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. Operation

Confirm that no parts have been damaged during shipping. If the LIFTSTART is not used immediately after purchase, store it in a place with no dust and with good ventilation.The adjusting and connection work are to be accomplished according to established safety practices.

For damages or accidents, caused by unsatisfactory installation or inexpert interferences in the LIFT-START, the manufacturer can not be made liable.

The indicated mains voltage must agree with engine performance and the same applies to the existing frequency.

Connection:

The devices can be connected on either with the six-pole circuit of the three-phase motor (W3 - circuit) or between main and motor (see example wirings).

The start instruction can be released via bridging terminal 2 and 3.

As of LIFTSTART xx-6/TS, i.e. with two separate contactors, activation is caused with creation of 230V AC-starting voltage. The two separation contactors pull up and activate by auxiliary contacts switched into row the electronic system of the LIFTSTART.

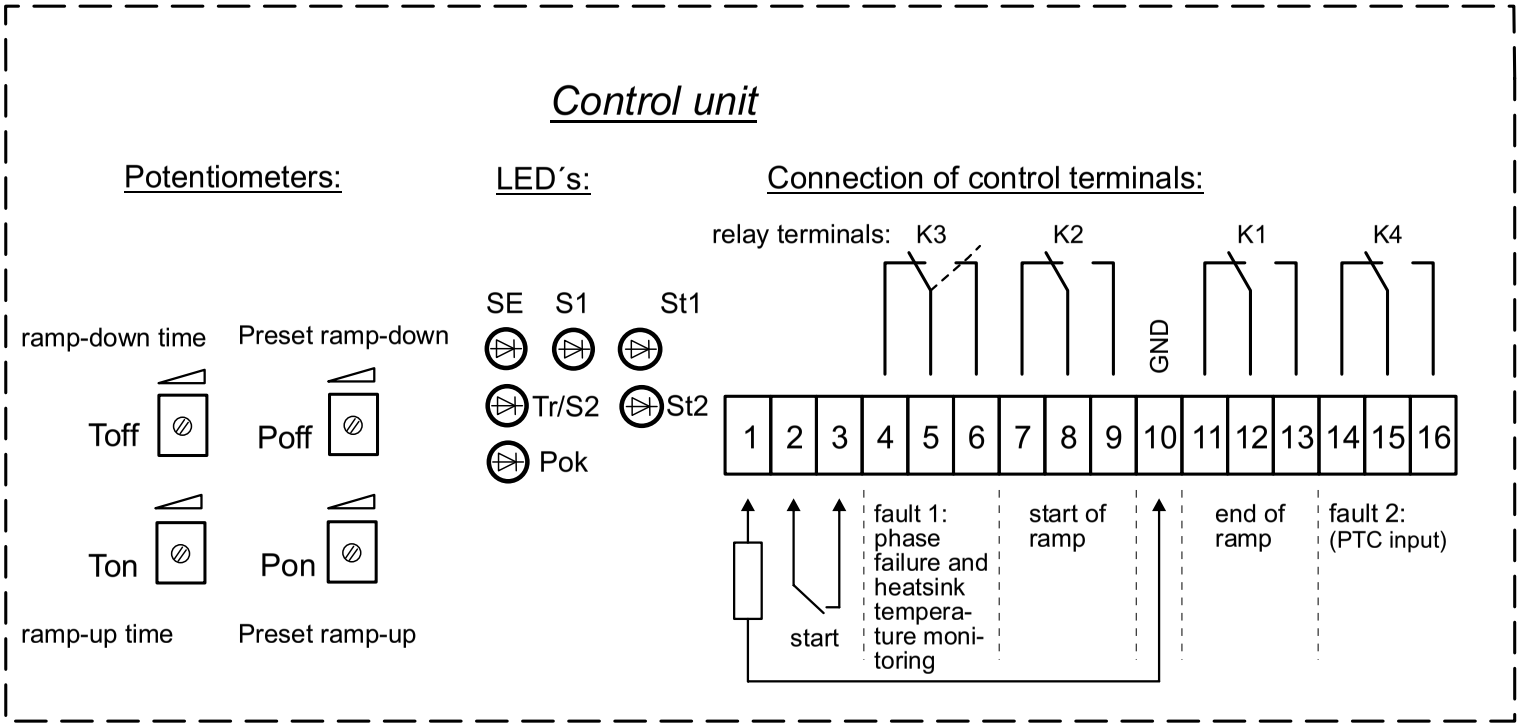
Diagnostic LEDs:

In order to indicated the different function states the LIFTSTART provides six LEDs which light depending on its current state:

LED	Meaning	
Pok	power ok	mains voltage available
Tr/S2	top of ramp	100% of mains voltage is put on the motor (nominal operation)
SE	activated	ramp-up process initiated
S1	ramp-up active	on-going ramp-up process, continuous operation, on-going ramp-down process
St2	Fault 2	lights if PTC-input is activated
St1	Fault 1	lights (with option: IV (internal supply) goes out) in case if phase failure, phase follow-up failure, undervoltage and temperature exceedance of heatsink

If fault 1 occurs, the LEDs Tr and S1 (with internal supply also St1) will expire, whereas LED St1 will light (with standard version (auxiliary voltage: 230V AC, mains voltage: 3x400V AC). Any type of error message can be reseted by connecting the control or mains voltage or activating the ramp-up process. Alternatively, automatic auto-reset is also available upon request.

8. Connection diagram



alternative start: 24V DC and GND, terminal 10 (SPS etc.)

PTC connection: terminal 1 and 10 (for thermistor and klixon, too)

ATTENTION:
If fault St1 occurs (terminals 4, 5, 6) the power unit will be switched off.
If fault St2 occurs, however, only an error message is indicated (terminals 14, 15, 16). The power unit will not be switched off.

Adjustment of potentiometers:

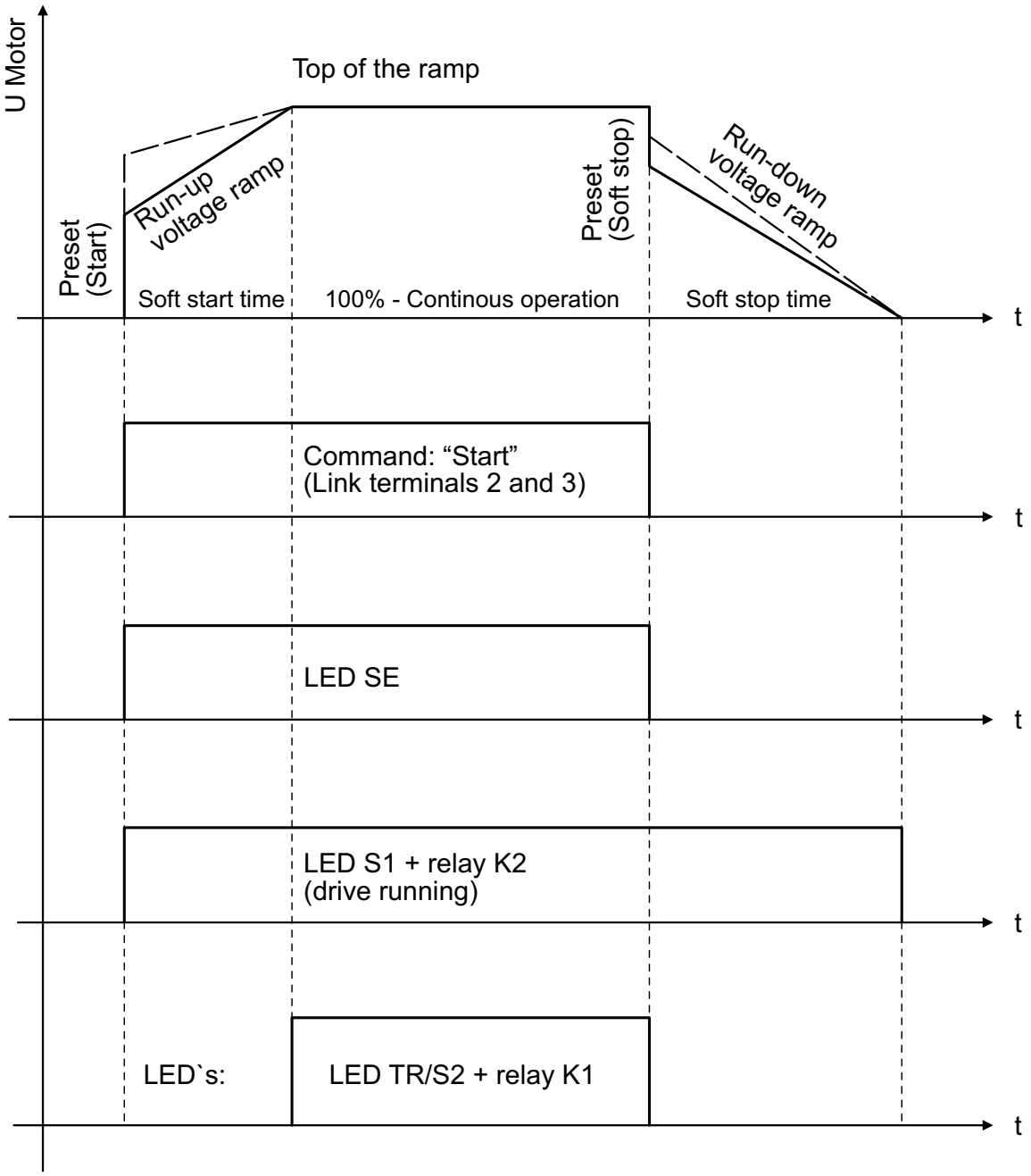
T_{on}	ramp-up time	2-8s
T_{off}	ramp-down time	2-8s
P_{on}	ramp-up torque	0-90%
P_{off}	ramp-down torque	0-100%

(other values are possible upon request)

LEDs:

Pok (gn)	supply voltage available (ready for operation)
SE (gn)	start terminals activatded
Tr/S2 (gn)	ramp-up process has finished (100%), at the same time K1 switches
S1 (gn)	at operation (LIFTSTART active), at the same time K2 switches
St1 (rd) (yellow with option: IV)	indicates faults involving phase failure, phase follow-up failure, undervoltage, temperature exceedance of heat-sink; relay contacts K3 switch from 4-5 to 5-6 With option: /IV (internal supply) the LED glows at ready for operation and goes out in case of failure (in the case of failure the contacts switches form 5-6 to 4-5).
St2 (rd)	indicates faults concerning the temerpature exceedance of the motor (PTC), terminals 15-14 switch to 15-16

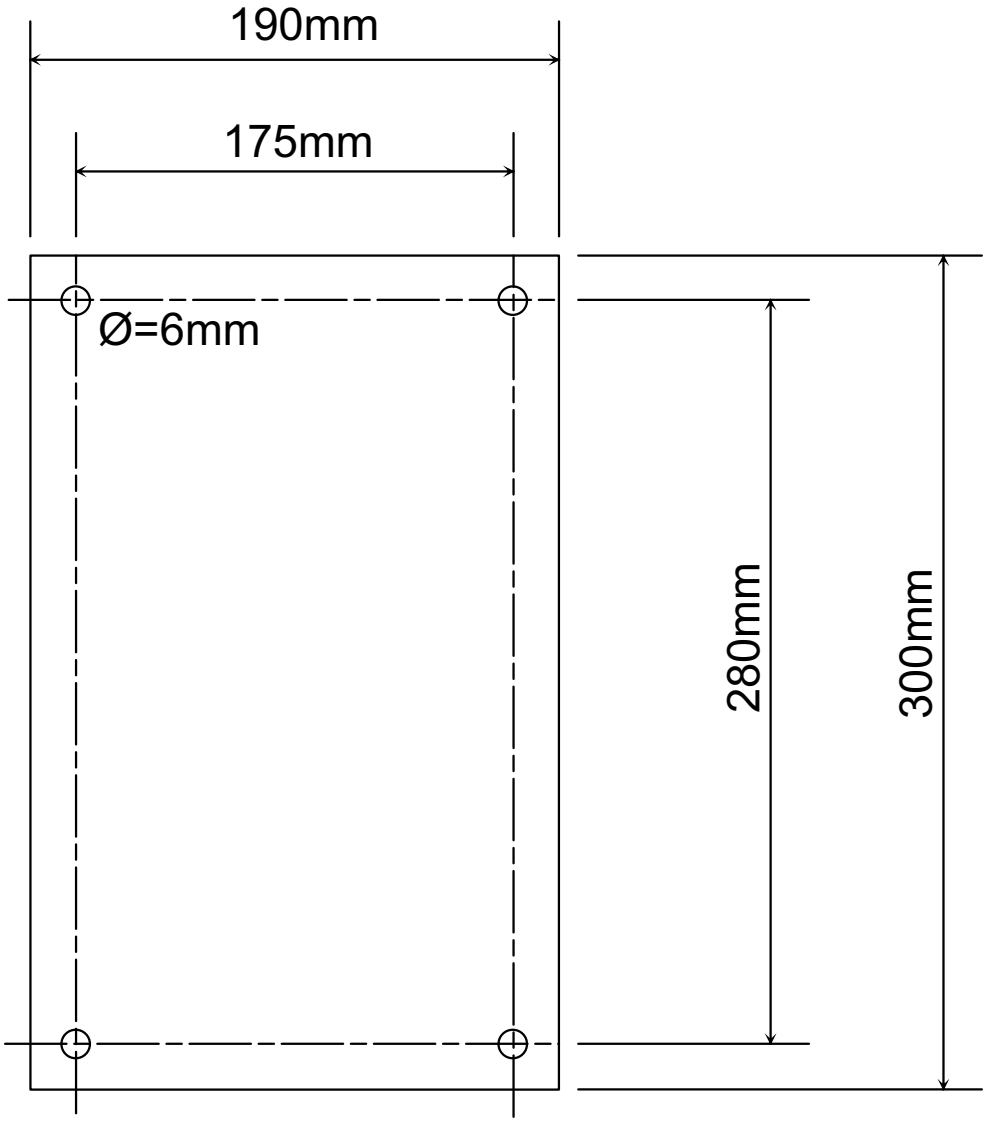
9. Operation diagram

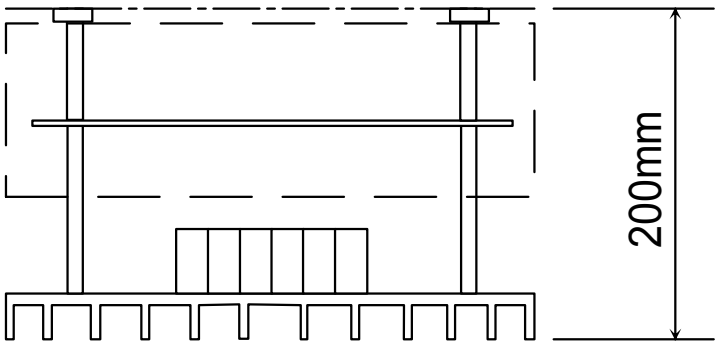


10. Frame sizes

Frame size A:

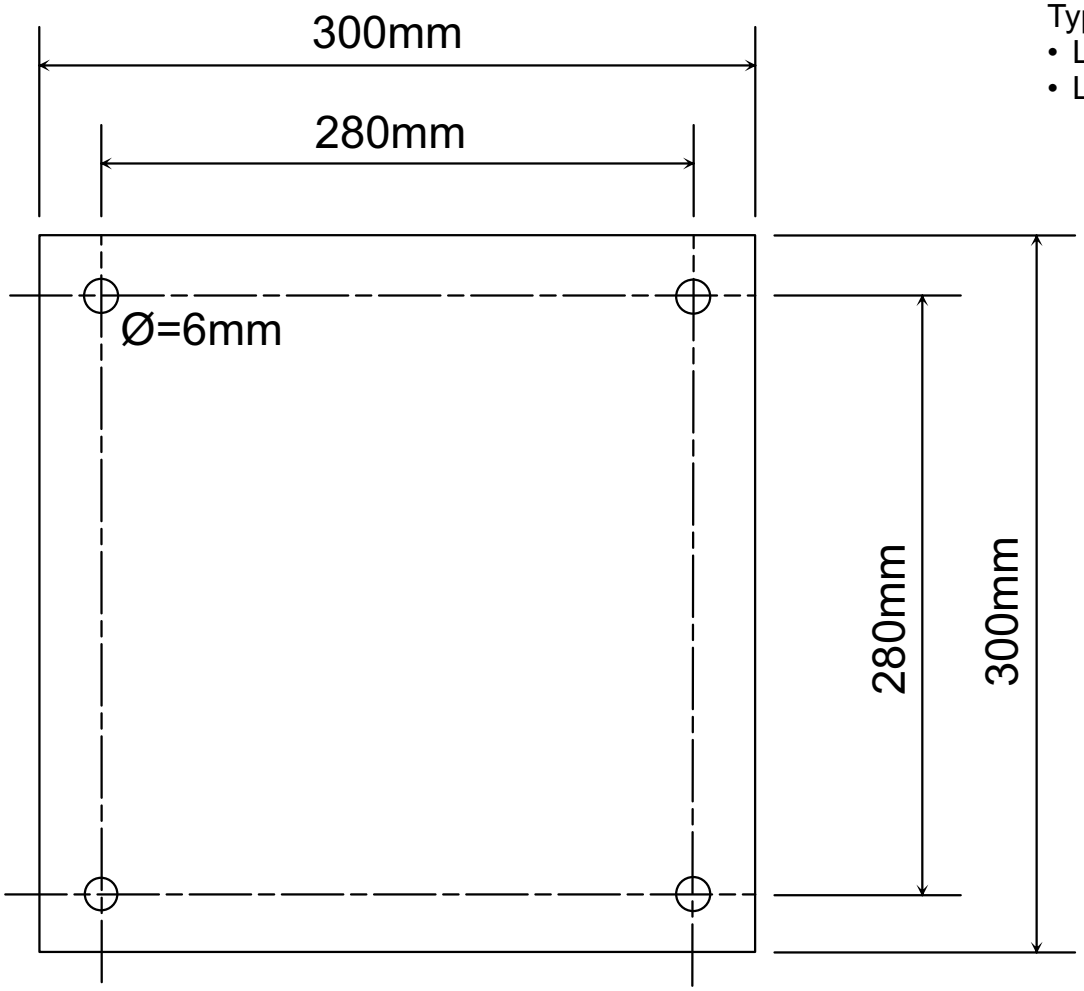
Types:
- LIFTSTART 9
- LIFTSTART 12
- LIFTSTART 16
- LIFTSTART 24
- LIFTSTART 33

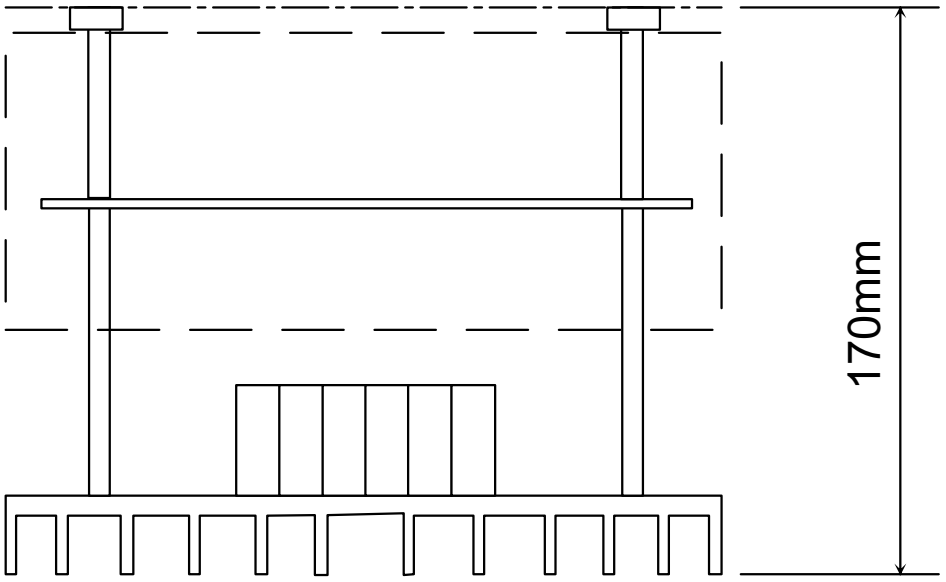




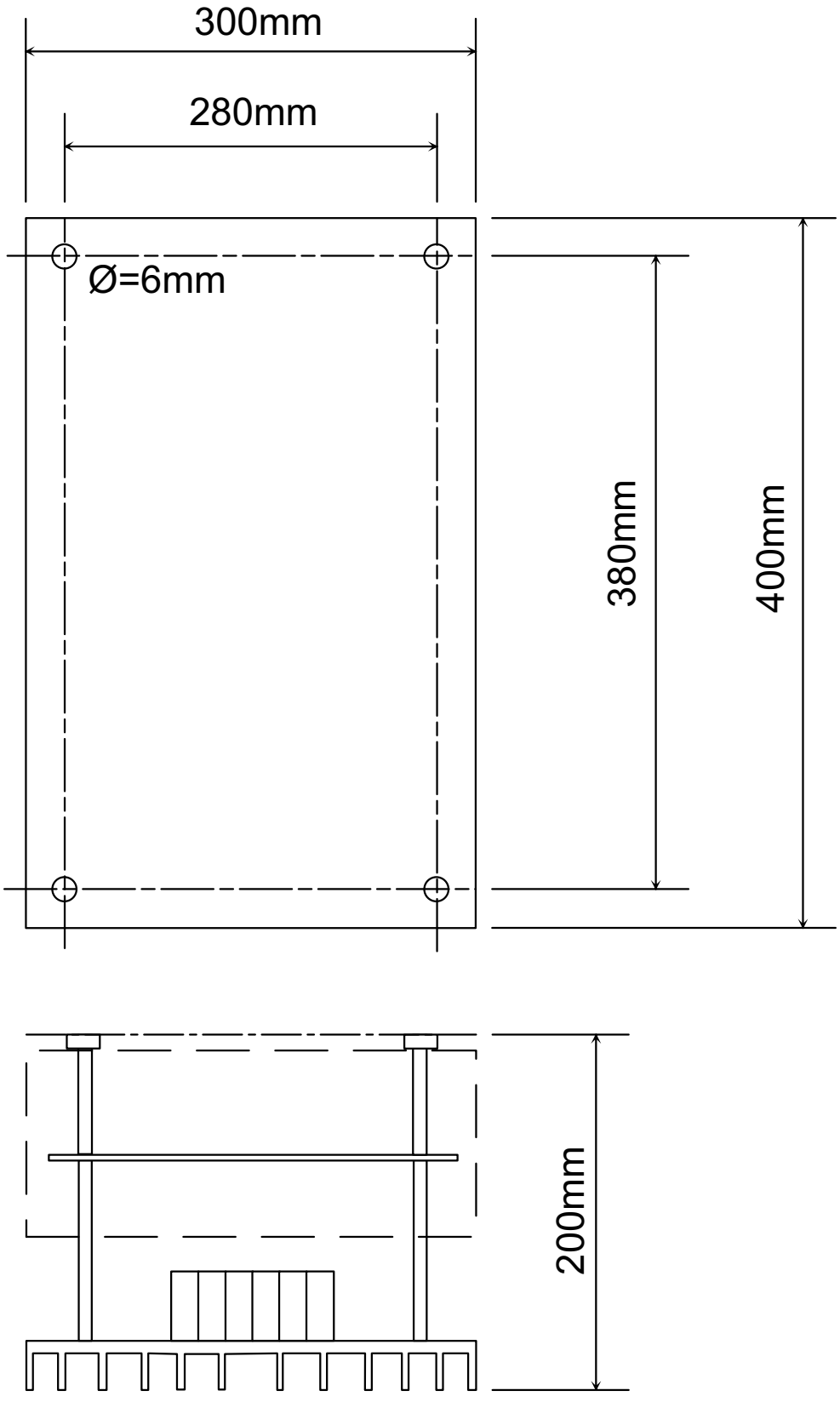
Frame size B:

Types:
- LIFTSTART 40
- LIFTSTART 60





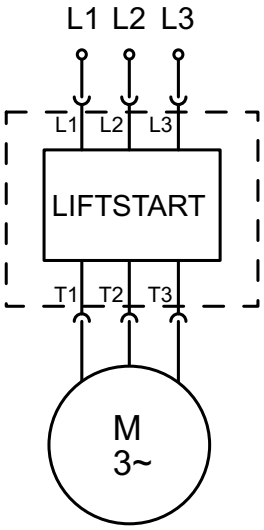
Frame size C:



Types:
- LIFTSTART 77
- LIFTSTART 90

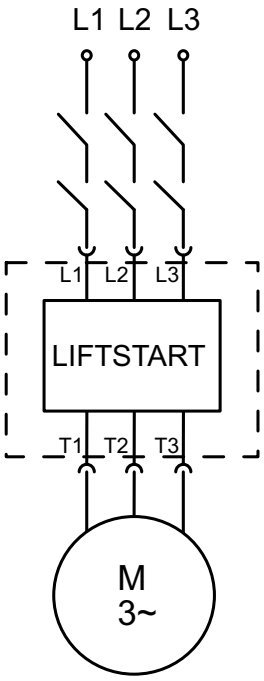
11. Summary of available LIFTSTART models

Type	Motor power [kW]	Motor current [A]	Dimensions WxHxD [mm]
LIFTSTART 9-3	9	30	190x300x200
LIFTSTART 12-3	12	42	190x300x200
LIFTSTART 16-3	16	53	190x300x200
LIFTSTART 24-3	24	68	190x300x200
LIFTSTART 33-3	33	76	190x300x200
LIFTSTART 40-3	40	110	300x300x170
LIFTSTART 60-3	60	138	300x300x170
LIFTSTART 77-3	77	180	300x400x200
LIFTSTART 90-3	90	220	300x400x200



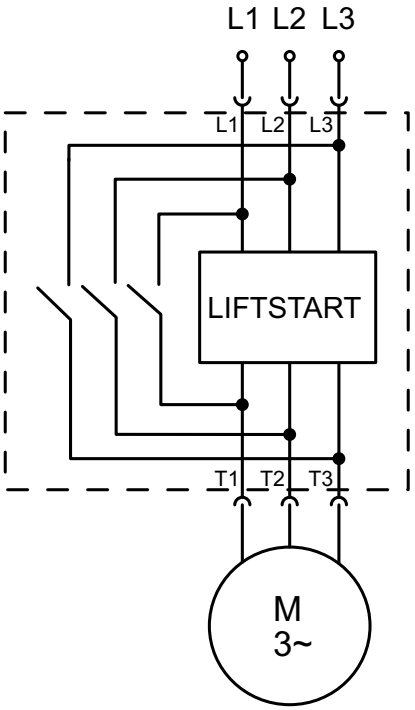
The LIFTSTART is placed between line and three-phase motor.

Type	Motor power [kW]	Motor current [A]	Dimensions WxHxD [mm]
LIFTSTART 9-3/TS	9	30	190x300x200
LIFTSTART 12-3/TS	12	42	190x300x200
LIFTSTART 16-3/TS	16	53	190x300x200
LIFTSTART 24-3/TS	24	68	190x300x200
LIFTSTART 33-3/TS	33	76	190x300x200
LIFTSTART 40-3/TS	40	110	300x300x170
LIFTSTART 60-3/TS	60	138	300x300x170
LIFTSTART 77-3/TS	77	180	300x400x200
LIFTSTART 90-3/TS	90	220	300x400x200



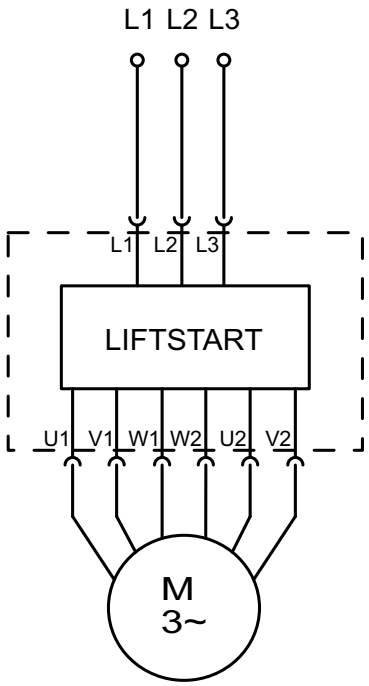
The LIFTSTART is placed between line and three-phase motor by two seperation contactors.

Type	Motor power [kW]	Motor current [A]	Dimensions WxHxD [mm]
LIFTSTART 9-3/BY	9	30	190x300x200
LIFTSTART 12-3/BY	12	42	190x300x200
LIFTSTART 16-3/BY	16	53	190x300x200
LIFTSTART 24-3/BY	24	68	190x300x200
LIFTSTART 33-3/BY	33	76	190x300x200
LIFTSTART 40-3/BY	40	110	300x300x170
LIFTSTART 60-3/BY	60	138	300x300x170
LIFTSTART 77-3/BY	77	180	300x400x200
LIFTSTART 90-3/BY	90	220	300x400x200



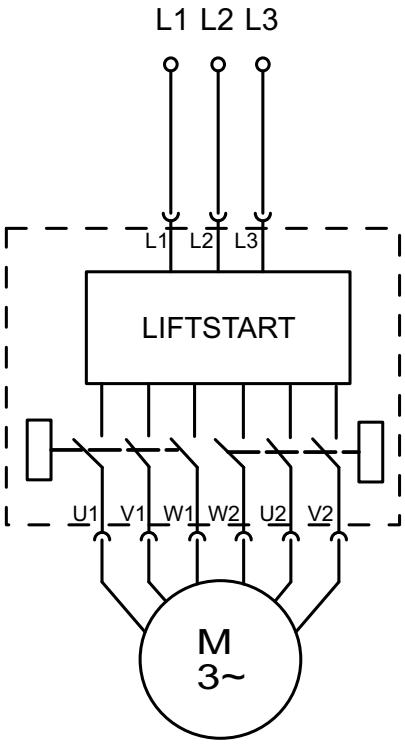
Version with integrated bypass-contactors.

Type	Motor power [kW]		Motor current		Dimensions WxHxD [mm]
	3-pole version [kW]	W3-connection [kW]	3-pole version [kW]	W3-connection [kW]	
LIFTSTART 9-6	9	12	30	50	190x300x200
LIFTSTART 12-6	12	16	42	70	190x300x200
LIFTSTART 16-6	16	24	53	100	190x300x200
LIFTSTART 24-6	24	33	68	120	190x300x200
LIFTSTART 33-6	33	40	76	130	190x300x200
LIFTSTART 40-6	40	60	110	190	300x300x170
LIFTSTART 60-6	60	77	138	235	300x300x170
LIFTSTART 77-6	77	90	180	310	300x400x200
LIFTSTART 90-6	90	125	220	380	300x400x200



Six-clamps version without seperation contactors.

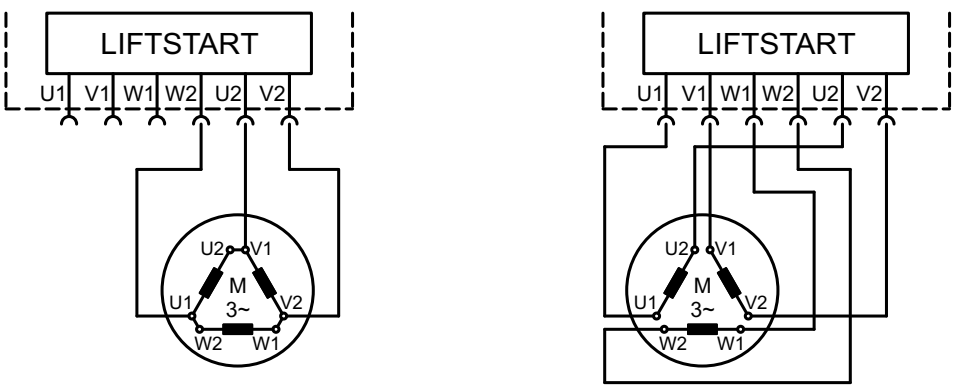
Type	Motor power [kW]		Motor current		Dimensions WxHxD [mm]
	3-pole version [kW]	W3-connection [kW]	3-pole version [kW]	W3-connection [kW]	
LIFTSTART 9-6/TS	9	12	30	50	190x300x200
LIFTSTART 12-6/TS	12	16	42	70	190x300x200
LIFTSTART 16-6/TS	16	24	53	100	190x300x200
LIFTSTART 24-6/TS	24	33	68	120	190x300x200
LIFTSTART 33-6/TS	33	40	76	130	190x300x200
LIFTSTART 40-6/TS	40	60	110	190	300x300x170
LIFTSTART 60-6/TS	60	77	138	235	300x300x170
LIFTSTART 77-6/TS	77	90	180	310	300x400x200
LIFTSTART 90-6/TS	90	125	220	380	300x400x200



Six-clamps version with two seperation contactors.

<u>Connection of motor:</u>

3-pole version and W3-connection (6-pole version)



12. Survey of the individual types

Type	Motor power [kW]	Motor current [A]	max. starting current [A]	Number of starts /h	rec. semiconductor fuses [A]	weight [kg]	rec. cross section [mm²]	frame size	rec. reactance coil
LIFTSTART 9-3	9	30	80	75	60	2,8	4,0	A	NDR-3Ph 36
LIFTSTART 12-3	12	42	110	75	60	3,5	4,0	A	NDR-3Ph 50
LIFTSTART 16-3	16	53	145	75	80	4,0	6,0	A	NDR-3Ph 50
LIFTSTART 24-3	24	68	220	75	100	4,2	10,0	A	NDR-3Ph 75
LIFTSTART 33-3	33	76	300	75	125	5,5	16,0	A	NDR-3Ph 75
LIFTSTART 40-3	40	110	360	75	200	5,9	25,0	B	NDR-3Ph 120
LIFTSTART 60-3	60	138	480	75	250	6,4	35,0	B	NDR-3Ph 160
LIFTSTART 77-3	77	180	600	40	400	8,5	50,0	C	NDR-3Ph 220
LIFTSTART 90-3	90	220	750	30	500	10,2	70,0	C	NDR-3Ph 220

Type	Motor power		Motor current		max. starting current (W3-connection) [A]	Number of starts /h	rec. semiconductor fuses [A]	weight [kg]	rec. cross section [mm²]		frame size	rec. reactance coil
	3-pole version [kW]	W3-connection [kW]	3-pole version [A]	W3-connection [A]					input 3-pole	output 6-pole		
LIFTSTART 9-6	9	12	30	50	110	75	60	3,0	4,0	4,0	A	NDR-3Ph 50
LIFTSTART 12-6	12	16	42	70	145	75	60	3,6	6,0	4,0	A	NDR-3Ph 75
LIFTSTART 16-6	16	24	53	100	220	75	80	4,2	10,0	6,0	A	NDR-3Ph 100
LIFTSTART 24-6	24	33	68	120	290	75	100	4,5	16,0	10,0	A	NDR-3Ph 120
LIFTSTART 33-6	33	40	76	130	360	75	125	6,0	25,0	16,0	A	NDR-3Ph 160
LIFTSTART 40-6	40	60	110	190	480	75	200	6,3	35,0	25,0	B	NDR-3Ph 220
LIFTSTART 60-6	60	77	138	235	600	40	250	7,0	50,0	35,0	B	NDR-3Ph 280
LIFTSTART 77-6	77	90	180	310	750	30	400	9,0	70,0	50,0	C	NDR-3Ph 350
LIFTSTART 90-6	90	125	220	380	900	30	500	10,5	95,0	70,0	C	NDR-3Ph 420

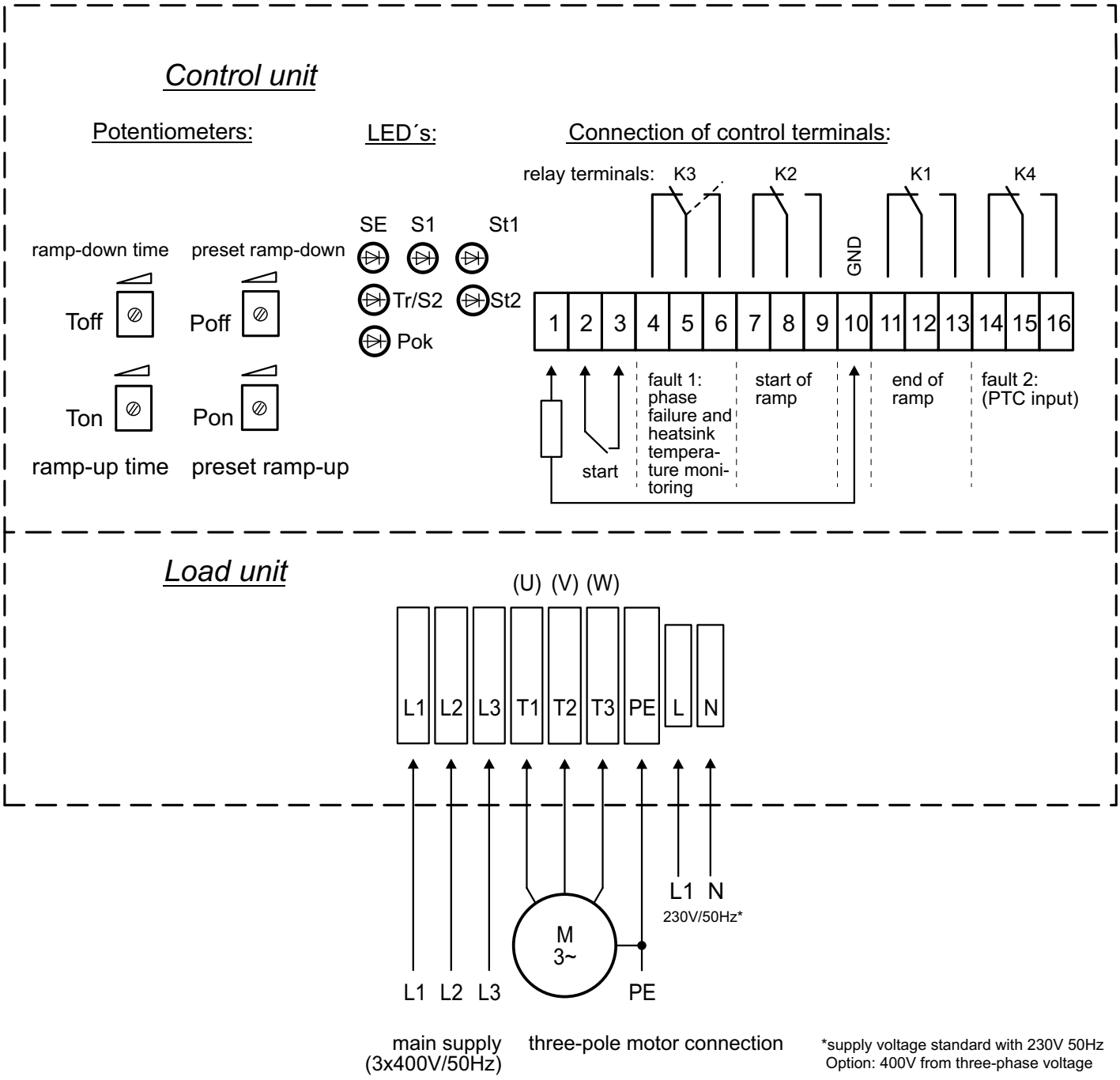
13. Technical data

Mains voltage	Standard: 3x 400V AC (-15...+10%) (Option: 3x 110V AC, 3x 230V AC, 3x 500V AC, 3x 690V AC)
Auxiliary voltage	Standard: 230V AC ±15% (Option: 24V DC, generated internally)
Frequency	45 - 65Hz (self-synchronizing)
Power loss of control electronic	4W
Number of controlled phases	3, (L1, L2, L3), W3C-connection
Operation temperature	-10...55° (at rated operation)
Relative Humidity	95% (non-condensing)
Pollution degree	3
Vibration	13,2Hz – 100Hz: +/- 0,7g (IEC 60068 Test, sinusoidal)
Installation altitude	1500m
Potential-free outputs	250V AC / 8A or 24V DC / 3A
Failure monitoring	• temperature exeedance of heat sink • PTC monitoring • phase follow-up failure • undervoltage • phase failure
Mounting	vertically, electrical connections below
Cooling system	natural convection
Control inputs	seperated galvanically
CE-regulations	EMC Directive 2014/30/EU LVD 2014/35/EU
Protection	Open version IP 22 (Option: IP 54)
Other norms	EN 60947-4-2

(Equipment for other voltages and power ratings available)

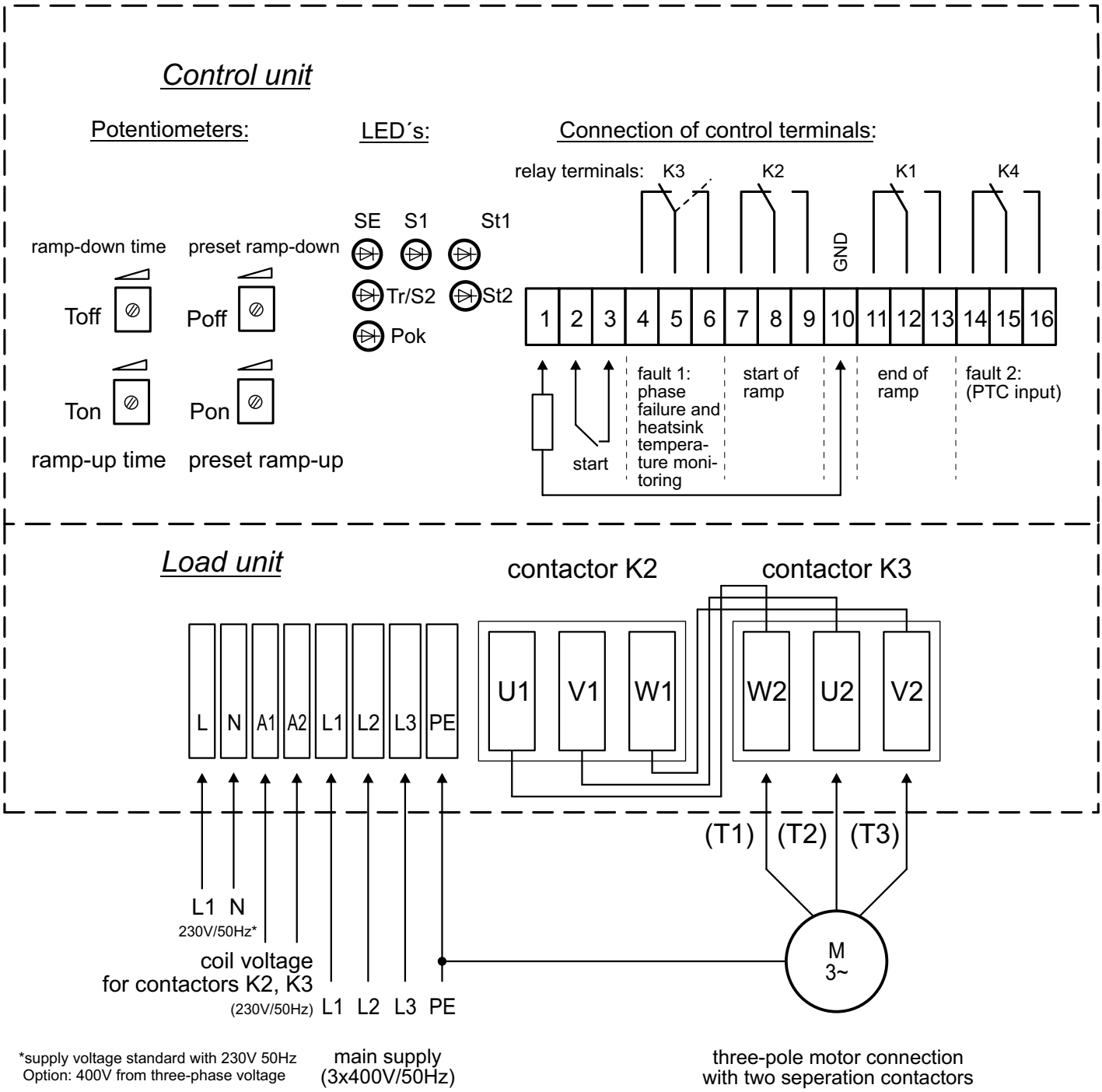
14. Circuit diagrams (standard version)

LIFTSTART 9-3 to LIFTSTART 90-3



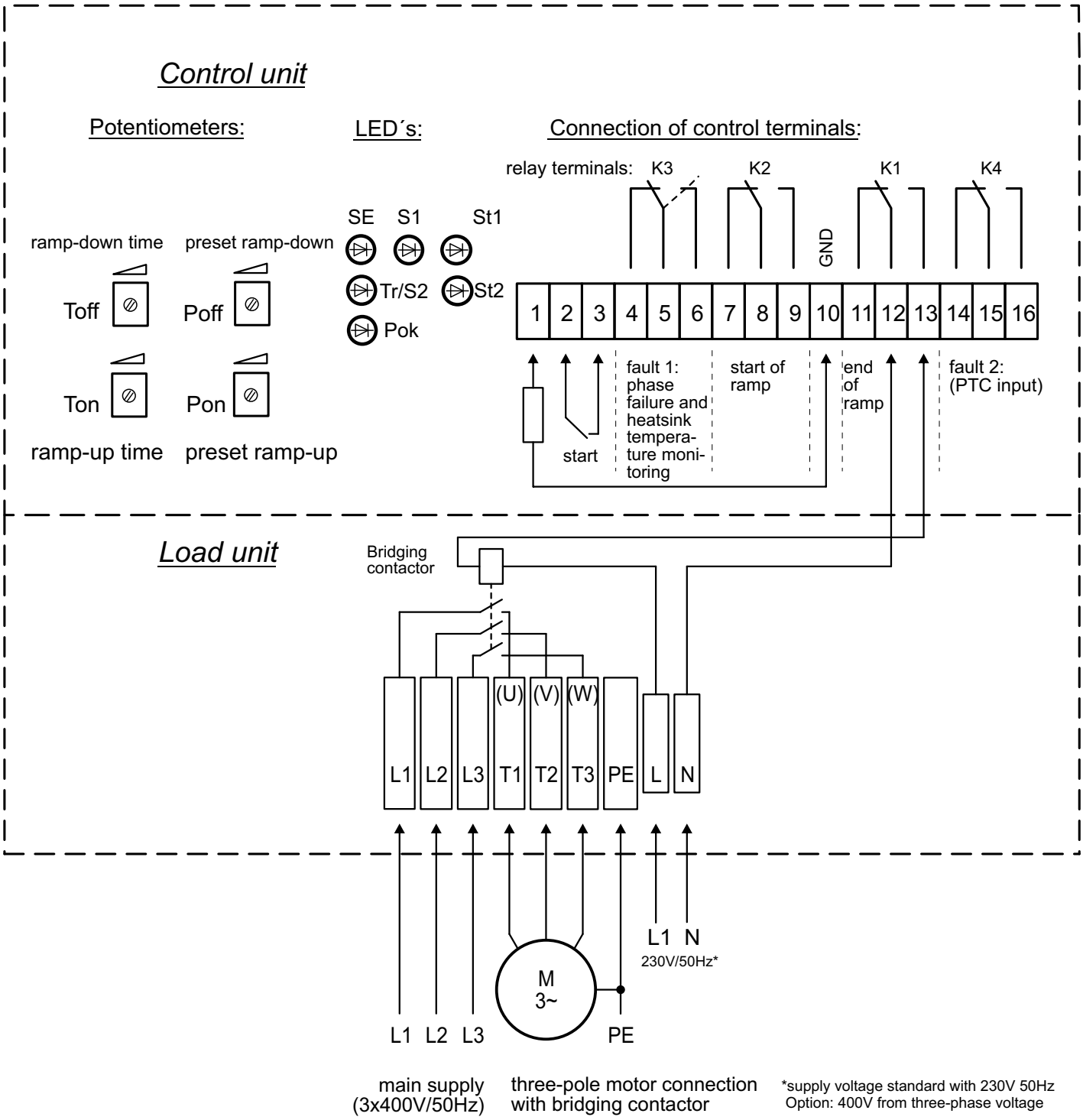
The main circuits are connected to the clamps L1, L2 and L3.The output of the LIFTSTART has to be connected to U, V, W (T1, T2, T3).

LIFTSTART 9-3/TS to LIFTSTART 90-3/TS



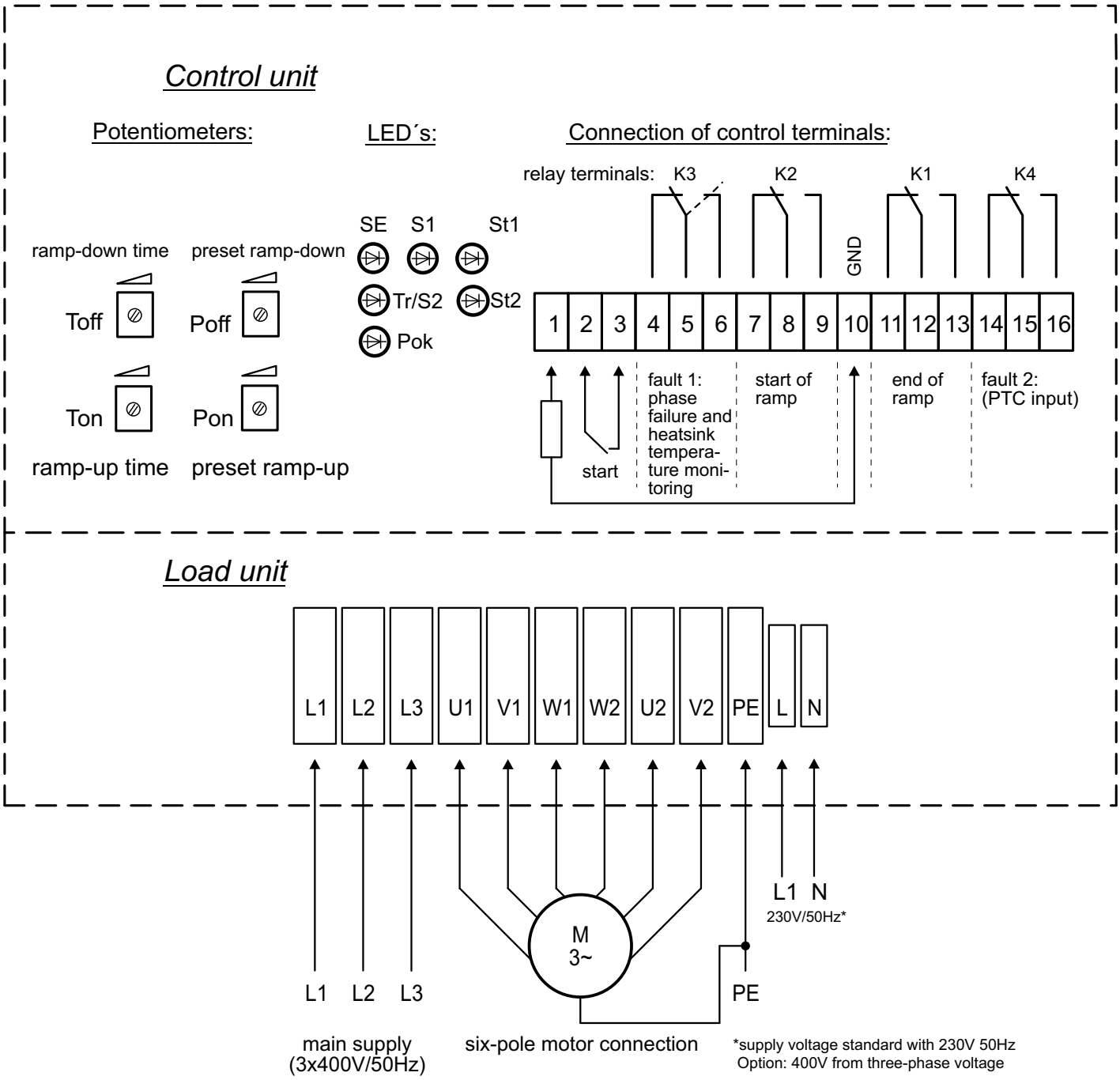
The main circuits are connected to the clamps L1, L2 and L3. The output of the LIFTSTART has to be connected to W2, U2, V2 (T1, T2, T3).

LIFTSTART 9-3/BY to LIFTSTART 90-3/BY



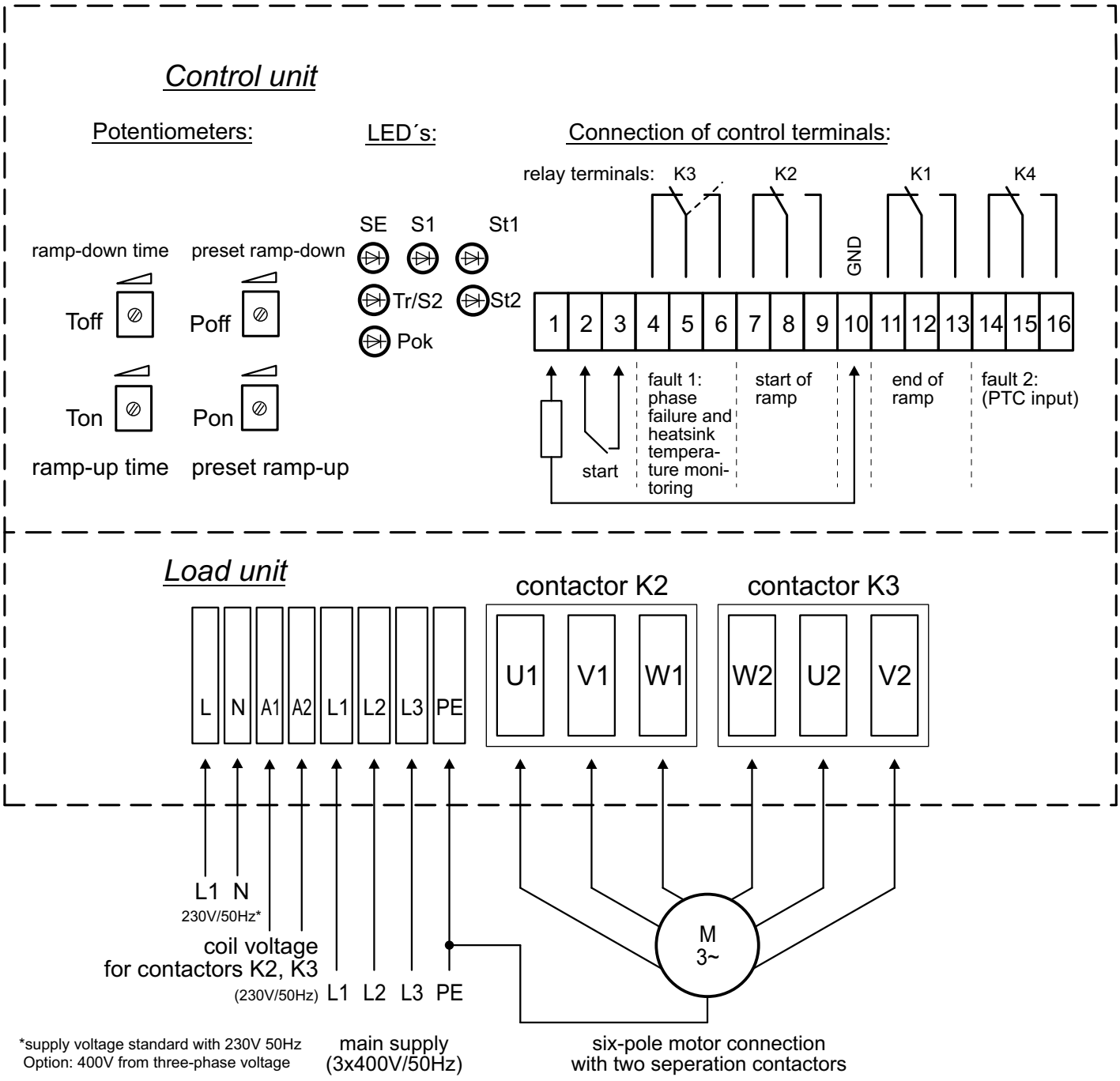
The main circuits are connected to the clamps L1, L2 and L3.The output of the LIFTSTART has to be connected to U, V, W (T1, T2, T3).

LIFTSTART 9-6 to LIFTSTART 90-6



The main circuits are connected to the clamps L1, L2 and L3.The output of the LIFTSTART has to be connected to U1, V1, W1, W2, U2 and V2.

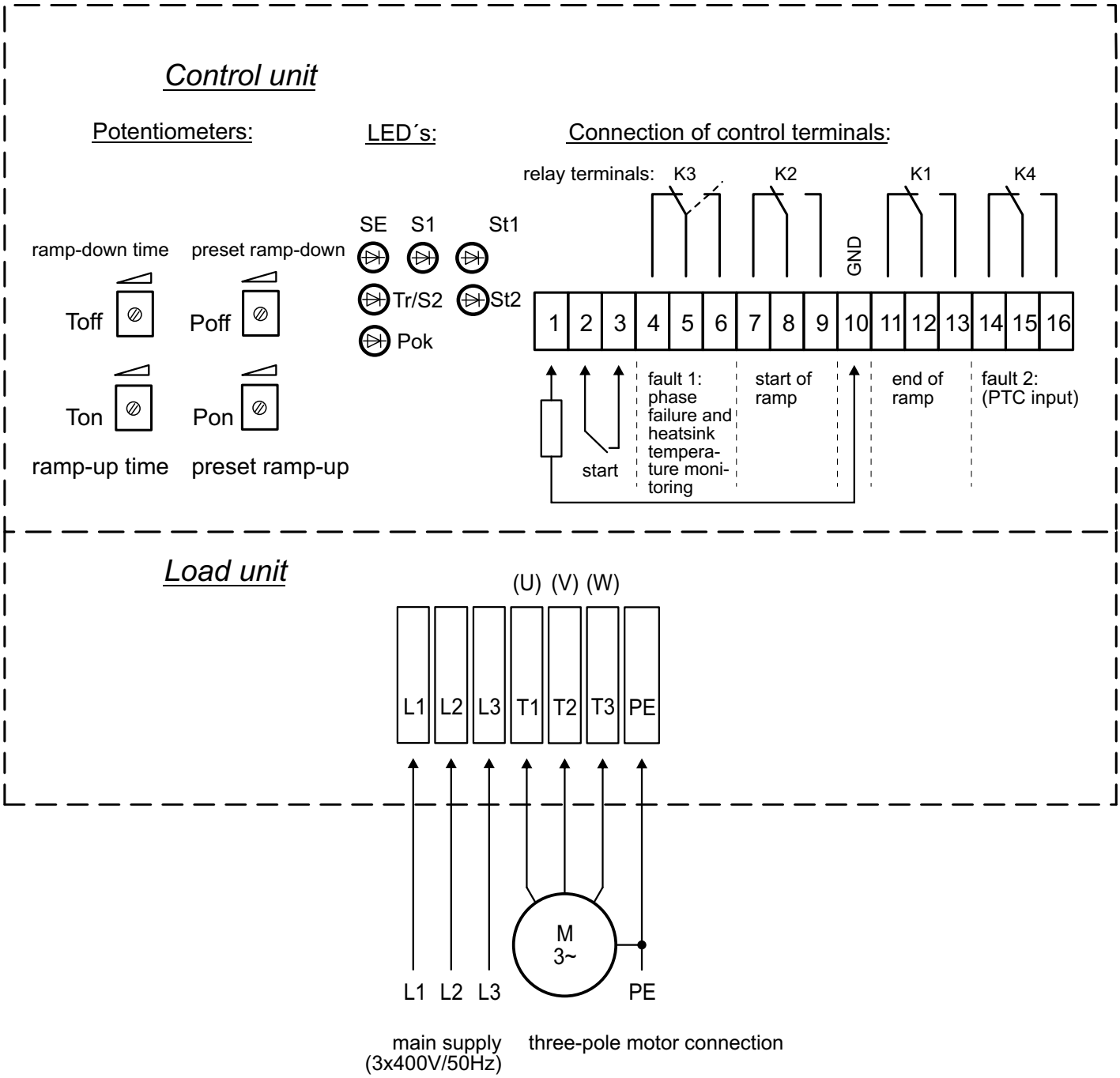
LIFTSTART 9-6/TS to LIFTSTART 90-6/TS



The main circuits are connected to the clamps L1, L2 and L3.The output of the LIFTSTART has to be connected to U1, V1, W1, W2, U2 and V2.

14.1 Circuit diagrams (option: IV (internal supply))

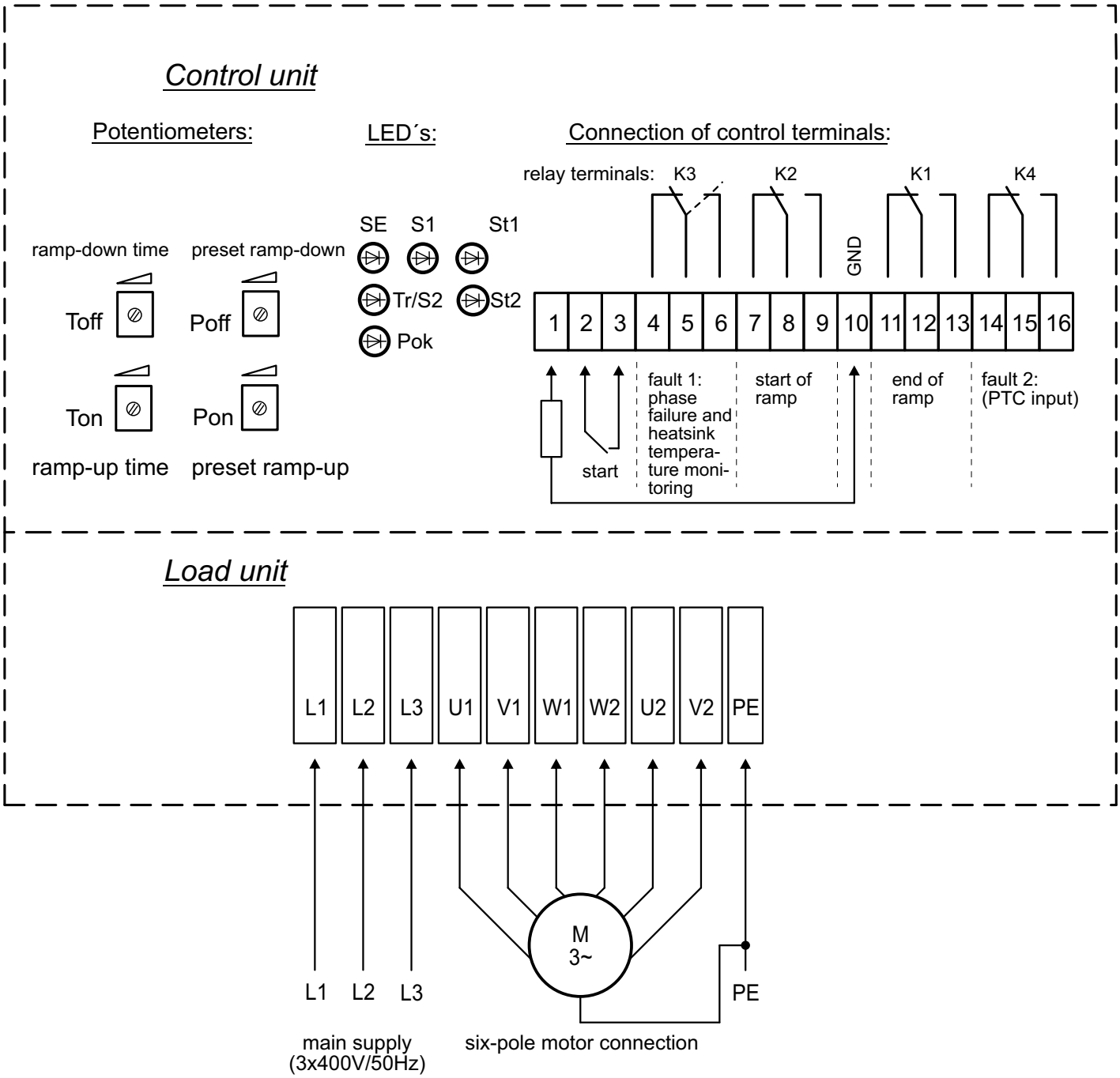
LIFTSTART 9-3/IV to LIFTSTART 90-3/IV
(with internal power supply for electronic option: /IV)



The main circuits are connected to the clamps L1, L2 and L3.The output of the LIFTSTART has to be connected to U, V, W (T1, T2, T3).

Please note the function of LED St1 and relay contact K3 (see points 4, 5, 6).

LIFTSTART 9-6/IV to LIFTSTART 90-6/IV
(with internal power supply for electronic option: /IV)



The main circuits are connected to the clamps L1, L2 and L3.The output of the LIFTSTART has to be connected to U1, V1, W1, W2, U2 and V2.

Please note the function of LED St1 and relay contact K3 (see points 4, 5, 6).