



THERMAL RELAYS,
MOTORSTARTERS



TYPES OF THERMAL RELAYS



MH mini thermal relay
plugged version



H0-2K thermal relay
with adapter



H0-2K thermal relay
plugged version



T63I thermal relay
plugged version



H6 thermal relay with
current transformer

MOTORSTARTER COMBINATIONS



MK + MH
motorstarter



DL-K4...DL-K18 + H0-2K
motorstarter



DL-K22...DL-K37 + T63I
motorstarter

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INTRODUCTION

Using contactors, overload (thermal) relays and other control elements several motorstarter, reversing, star-delta and other combinations can be designed to protect the electrical motors against overloads. Combinations can be assembled by their user in the place of application.

Note: We are using the term "combination" in slightly different understand from item 3.2.7 of standard EN 60947-4-1. For reasons of usage we are designating as

motorstarter-combination that assembles too, which are composed of contactors, (in enclosures too) overload protection devices but they do not consist short-circuit protection.

The purpose of this catalogue is to make easier choosing of devices. It is recommended to use the following catalogue: „CONTACTORS from 2,2 kW to 132 kW”.

Switching and protective devices are in this catalogue:

Elements of motorstarters:

Contactors:

- MK2, MK4 mini contactors
- DL-K4, DL-K5, DL-K7, DL-K11, DL-K15, DL-K18, DL-K22, DL-K30, DL-K37, DL-K45, DL-K55, DL-K75, DL-K90, DL-K110, DL-K132,

Overload (thermal) relays:

- MH mini thermal relay
- H0-2K thermal relay
- T63I thermal relay
- H6 thermal relay with current transformer

Control and protective elements:

- Y/Δ timer
- MV-e mechanical interlock
- BB mechanical interlock
- KS... auxiliary contacts
- Hi..., and Li...auxiliary contacts
- S... auxiliary contacts
- PK22E auxiliary contacts
- PKB11 auxiliary contacts

Compact motorstarters:

- DTMn-K5 and DTMn-K11 enclosed motorstarter
- GMV 25f manual motorstarter

The overload relays, motorstarters and combinations refer to requirement of standard EN 60947-4-1.

At the end of this catalogue the following tables and diagram can be found to choose of motorstarters:

- Table 1. Switchable powers of contactors
- Table 2. Fit of contactors and thermal relays
- Table 3. Switching current-ranges of motorstarter combinations
- Table 4. Switching current-ranges of star-delta combinations
- Diagram 1. Electrical durability related to break current

1. OVERLOAD (THERMAL) RELAYS

The three phase thermobimetal relays are suitable for the protecting of the electric consumers especially electric motors against overcurrent and overheating.

Type-variants

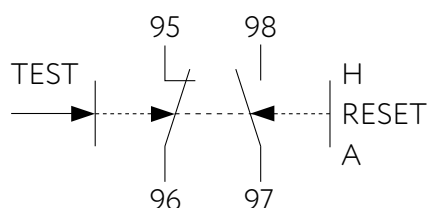


Common characteristics of type-variants

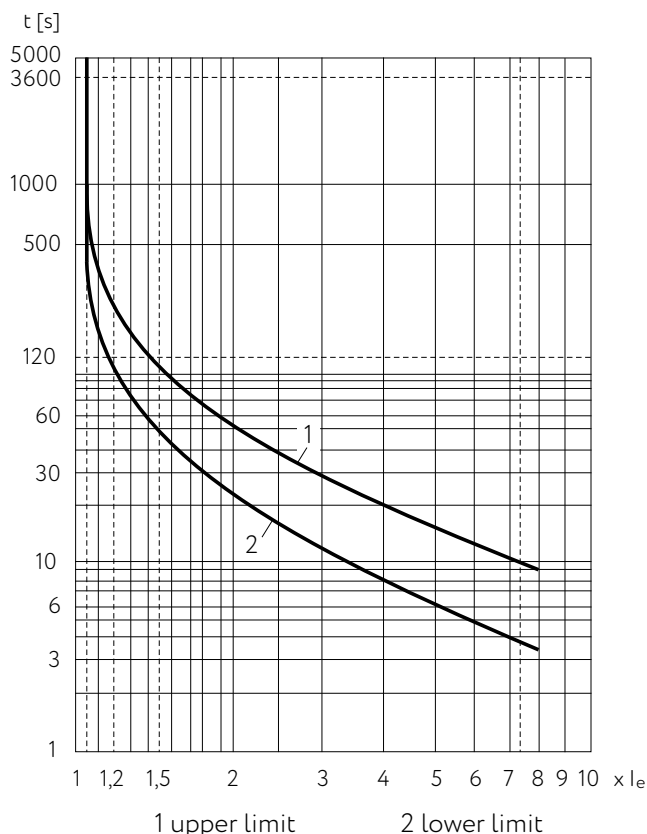
The compensating bimetallic unit ensures the operation irrespectively the actual ambient temperature (within the given wide temperature-range).

The resetting mode (manual or automatic) can be chosen. The thermal relays have a double slide-system which operates the switch - off mechanism, in case of phase failure. It releases faster: (by standard within 2 hours at 15 % overload, but in practice after some minutes). TEST button is suitable for verification of the functional capability. The contacting mechanism contains two electrically independent NO and NC contacts.

Contacts



Time-current characteristics



Time-values of release

Multiplies of current setting		Time of release [T_p]	Working condition
$1,05 \times I_e$		after 2 hours	cold
$1,2 \times I_e$		within 2 hours	warm
$1,5 \times I_e$		within 2 min	warm
Trip class: 10 A	$7,2 \times I_e$	$2 < T_p < 10$ s	cold
10		$4 < T_p < 10$ s	
20		$6 < T_p < 20$ s	

1.1 MH mini thermal relay

The mini thermal relays are produced in the current-range of 0,11 A...14 A covered by 13 differently range devices. They can be plugged directly to the lower terminals of the MK 2- and MK 4- type minicontactors, they cannot mounted independently to a plate or rail.

Before starting of the motor, the rated current should be adjusted by the arrow on the knob.

The resetting mode („H” for manual and „A” for automatic) can be chosen by the blue (RESET) knob, change-over carry out by push and turn of the knob with a screw-driver.

Before putting into operation push the RESET knob.

1.2 H0-2K thermal relay

The current-ranges are available from 0,2 A to 32 A covered by 13 differently set devices. Mounting is possible to 35 mm rail (snap on) or fixed with three M4 screws to

a mounting plate. In the final technical execution (with adapters) the thermal relay can be connected by wiring to any contactor. The device can be plugged directly to lower terminals (2T1, 4T2, 6T3) of DL-K4-..., DL-K5-..., DL-K7-..., DL-K11-..., DL-K15 and DL-K18 contactors after removing the fixing and connecting elements. The right-side terminal (L3) of the H0-2K relay should be put to the correct position before connecting to the contactor.

Marks of the lower, middle and the upper values of current are printed on the adjusting knob (lower and upper limits on the front plate too). The value of the motor's rated current should be adjusted by the knob to the arrow.

The corresponding lower and upper limits of the line-currents (in star-delta combination) can be found under the adjusting knob. The resetting mode („H” for manual, „A” for automatic) can be chosen by the right side (blue) button.

By pushing the „TEST” button (red), which can be found in the middle, the (circuit) connection breaks between opening contacts (95, 96) and (circuit) connection is made between closing contacts (97, 98).

1.3 T63I thermal relay

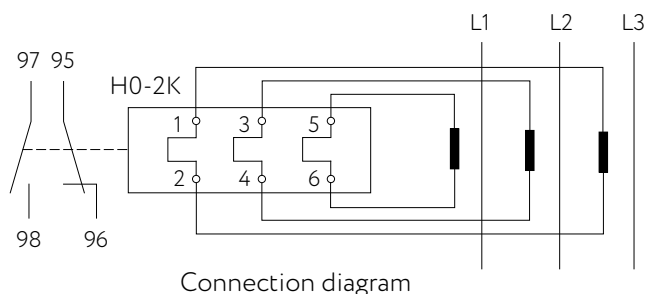
The current-ranges are available from 21 A to 75 A covered by 4 differently devices. The thermal relay can be plugged to lower terminals of DL-K22-11, DL-K30-11 and DL-K37-11 contactors. It cannot be mounted independently.

1.4 H6 thermal relay with reeveable current-transformer

The reeveable current-transformer is available between 25 and 250 A, covered by 6 ranges.

It can be used for motorstarter, reversing, star-delta and other combinations with DL-K15, DL-K18, DL-K22-11, DL-K30-11, DLK37-11, DL-K45-22, DL-K55-22, DL-K75-22, DL-K90-22, DLK110-22, DL-K132-22 contactors.

The H0-2K type thermal relay and the three-phase current-transformer make one constructive unit. The wound iron cores of the current-transformer are in a thermoplastic body. The insulated connecting wires of the main current paths should be reeved through the holes of the body. The lead-in conductors of the secondary winding are connected to the proper terminals of the thermal relay by our factory.



Technical data of thermal relays

Technical data	MH	H0-2K	T63I	H6 (with current transformer)
Application	plugged to contactors MK 2 and MK 4	plugged to DL-K4-...DL-K18 contactors or mounted independently	plugged to DL-K22-... DL-K37 contactors	wiring with any contactor
Rated insulation voltage [V]	690	500	690	1000
Ambient and compensating temperature [°C]	-25... + 50	-25... + 50	-25... + 50	-25...+50
Loss of main current paths	~ 2 W/pole	2,5... 6 V A	2,3... 6 W	
Trip class	10 A	10	10 A	10
Switching frequency [c/h]	15	15	15	15
Mass [kg]	0,1	0,17	0,28	1,05
Degree of protection	IP 20	IP 20	IP 10 / IP 20	IP 20
Mechanical durability [c]	5 x 10 ³	10 ⁴	3 x 10 ³	10 ⁴
Connection [mm ²]	rigid, stranded, flexible: 1x 0,75 - 2 x 2,5 with end sleeve: 1 x 0,5 - 2 x 1,5	upper: rigid: 1 x 1...6 flexible: 1 x 1...4 lower: rigid: 1 x 1...6 1 v. 2 x 1...4 flexible: 1 v. 2 x 1...4	rigid: 2,5...25 flexible: 2,5...16	21-51 A: 25 mm ² 51-250 A: 120 mm ²
Built-in auxiliary contact: I _{th} [A] (1NO + 1 NC) I _e AC-15, 230 V I _e AC-15, 400 V connection [mm ²]	6 1,5 0,5 2 x 1...2,5	6 1,5 1,2 1 x or 2 x 0,75...1,5	6 2 1 x 0,75...1,5	6 1,5 1,2 1 x 0,75...1,5
Current range / Fuse [A]	0,11 - 0,16/0,5 0,16 - 0,25/1 0,25 - 0,4/2 0,4 - 0,6/2 0,6 - 0,9/4 0,9 - 1,3/6 1,3 - 1,9/6 1,9 - 2,8/10 2,8 - 4/10 4 - 6/16 6 - 9/20 8 - 11/20 11 - 14/25	0,2-0,3/2-2 0,3-0,45/2-2 0,45-0,67/2-2 0,67-1,0/2-2 1,0-1,5/2-4 1,5-2,2/4-10 2,2-3,3/4-10 3,3-4,9/6-16 4,9-7,3/10-20 7,3-11/16-25 11-16,5/20-35 16,5-25,0/35-50 21,5-32,0/35-50	21-30/50-63 30-40/50-60 43-63/63-100 52-75/80-125	25-36/50-80 34-51/63-100 51-76/100-160 76-113/160-200 113-168/200-250 168-250/250-315

2. COMBINATIONS

2.1 Enclosed direct motorstarters



2.1.1 Enclosed direct motorstarter

Inside enclosure are available 1 pc DL-K5 or DL-K11 contactor, 1 pc H0-2K thermal relay, 2 pcs push-buttons and 1 pc earth terminal wiring.

Type-variants: DTMn-K5, DTMn-K11.

Mounting position: vertical mounting plate (deviation is $\pm 22,5^\circ$) with vertical main wires.

Mounting: 2 pcs M5×20 screws (attached).

Ambient temperature: $-25...+50\text{ }^\circ\text{C}$.

Degree of protection: IP 54

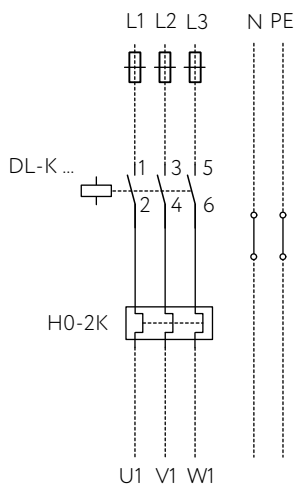
Switching (motor) power [kW]:

		DTMn-K5	DTMn-K11
AC-2	230 V	3	5,5
and	400 V	5,5	11
AC-3	500 V	7,5	15
AC-4	400 V	4	5,5

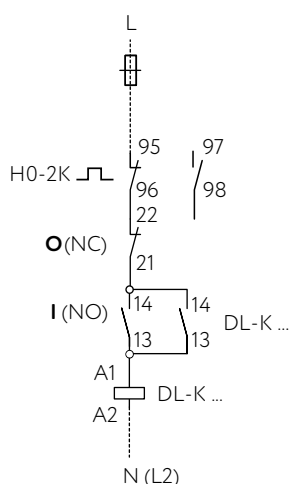
Connection:

Connecting wires [mm ²]	DL-K...		H0-2K		Push-button type N
	main circuit	auxiliary circuit	main circuit	auxiliary circuit	
Rigid	1...6	1...2,5	1...6	0,75...1,5	1...2,5
Flexible	1...6	1...2,5	1...4	0,75...1,5	1...2,5
With ferrule	0,5...4	0,5...4	1...4	0,75...1,5	1...2,5
Terminal screws Size/tightening torque [Nm]	DL-K5: M3,5/1,2 DL-K11: M3,5/1,8	M3,5/1,2	M4/1,8	M3,5/1,2	-

Main circuit:



Auxiliary circuit:



Operation:

The motorstarter-combination can be controlled by pushing of built-in pushbuttons, it can be switched-on by an outside NO contact connected to terminals of contactor № 13-14.

The switch-off can be carried out by an NC contact connected in series with coil of contactor and by a connected to terminal № 95 of H0-2K overload relay. After an eventual trip of relay its reset can be made by pushing the red knob of enclosure.

Maximum values of short-circuit protecting fuses (type gG) in main contact system

DL-K5: 25 A

DL-K11: 35 A

The DTMn-K11 can be loaded to 20 A max.

Selection diagram and tables consist further parameters need to choose the convenient device.

2.1.2 GMV 25f manual motorstarter

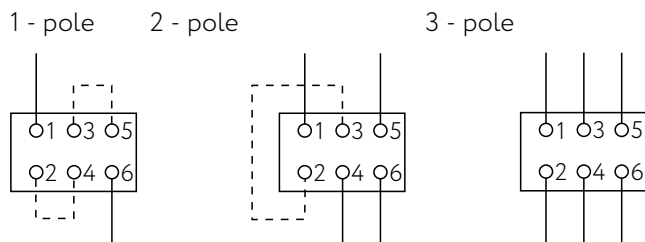


Application, functions:

The motorstarter is suitable for switching and protection of individual a.c. motors against overload and short-circuit currents. It is sensitive to phase-failure. Mounting is possible by snap on a 35 mm rail and fit to 45 mm mounting slot. The operation is compensated to ambient temperature.

The convenient value (from current which are legible on the turn-knob) of the rated operational current of motor should be set to arrow which can be found under the knob. In favour of correct function of motorstarter it should be loaded all three poles at single- and two-pole application as well.

Connection:



Technical data

General data:

Mechanical endurance	0,1×10 ⁶ c
Ambient temperature	in enclosure -25 ... +50 °C
temperature compensation	-25 ... +40 °C
Temperature compensation	-5 ... +40 °C
Shock resistance (shock duration 20 ms)	20 g
Climatic conditions	IEC 68
Degree of protection	IP 20
Operating frequency	max. 40 c/h
Mass	max. 0,25 kg
Relevant standards	EN 60947-4

Main circuit:

Rated insulation voltage	690 V	
Rated impuls withstand voltage	6 kV	
Free air thermal current $I_{th} > I_e$	max. 25 A	
Electrical endurance (AC-3, up to 690 V)	$0,1 \times 10^6$ c	
Cross section of connecting wires	0,75 ... 4 mm ²	
Rated short-circuit breaking capacity	to 4 A	100 kA
	to 16 A	4 kA
	to 25 A	3 kA

Auxiliary circuit:

Rated insulation voltage		500 V
Free air thermal current		6 A
Rated operational current AC-15	230 V	3,5 A
	400 V	2 A
	500 V	1,5 A
Fuse		max. 6 A (gL, gG)
Cross section of connecting wires		0,75 ... 2,5 mm ²

Fit of fuse:

Setting range of overload release [A]	Short-circuit release [A]	Fuse [A]		Rated short-circuit breaking capacity [kA]	
		230 V	400 V	230 V	400 V
0,1-0,16	1,9	Fuse are not necessary, switches any value		100	100
0,16-0,25	2,6				
0,25-0,40	4,4				
0,40-0,63	8				
0,63-1,0	11				
1,0-1,6	19				
1,6-2,5	30				
2,5-4,0	42				
4,0-6,3	69				
6,3-10	110	50	50	6	4
10-16	210	63	63		3
16-20	220				
20-25	220				

Accessories (for specific order)

Enclosure
IP 41 or IP55Front
plate IP
41 or IP
552NO - PS20
1NO - PS10
1NC - PS01
1NO+1NC - PS11Auxiliary
contact block
mountable to
booth sideShunt trip
24...400 V 50 HzUndervoltage trip
24...400 V 50 HzEmergency
stop buttonPadlockable
element

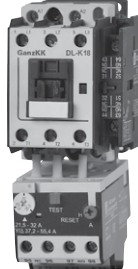
- Pushbutton diaphragm
- Neutral link
- Signal lamp

Selection of motorstarter:

Single phase motor starter [kW]	Three-phase motor power [kW]					Setting range of overload release [A]	Rated short-circuit breaking capacity [A]
	230 V	230 V	400 V	440 V	500 V	690 V	
			0,02			0,06	1,9
			0,06	0,06	0,06	0,09	2,6
		0,06	0,09	0,12	0,12	0,18	4,4
		0,09	0,12	0,18	0,25	0,25	8
0,06 ... 0,09	0,06 ... 0,12	0,18 ... 0,25	0,25	0,37	0,37 ... 0,55	0,63 ... 1	11
0,12	0,18 ... 0,25	0,37 ... 0,55	0,37 ... 0,55	0,55 ... 0,8	0,75 ... 1,1	1 ... 1,6	19
0,18 ... 0,25	0,37	0,75 ... 1,1	0,75 ... 1,1	1,1	1,5	1,6 ... 2,5	30
0,37	0,55 ... 0,8	1,1 ... 1,5	1,5	1,5 ... 2,2	2,2 ... 3	2,5 ... 4	42
0,55 ... 0,75	1,1 ... 1,5	2,2 ... 2,5	2,2 ... 3	3	4	4 ... 6,3	69
1,1 ... 1,5	1,5 ... 2,5	3 ... 4	4 ... 5	4 ... 5,5	5,5 ... 7,5	6,3 ... 10	110
2,2	3 ... 4	5 ... 7,5	5,5 ... 9	7,5 ... 9	11	10 ... 16	210
3	5,5	9	11	11 ... 12,5	15	16 ... 20	220
	5,5 ... 7,5	11 ... 12,5	12,5	15	18,5	20 ... 25	220

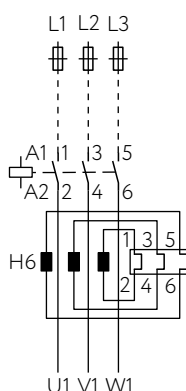
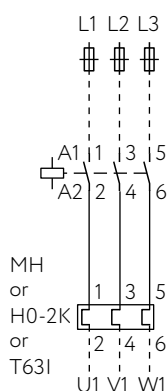
2.2 Motorstarter combinations

2.2.1 Opened direct motorstarter

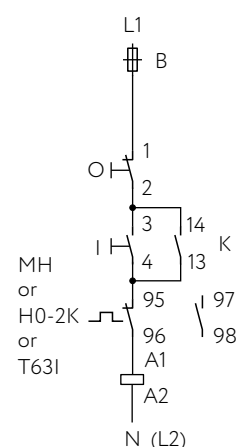
Technical data					
	MK kontaktor + MH thermal relay	DL-K kontaktor (4-18,5 kW) + H0-2K thermal relay	DL-K kontaktor (22-37 kW) + T63I thermal relay	DL-K kontaktor (45-132 kW) + H6 thermal relay	
Insulation voltage [V]	690 V AC	contactor: 690 V AC thermal relay: 500 V AC	690 V AC	contactor: 690 V AC thermal relay: 1000 V AC	
Mounting	2 pcs M4 screws or on a mounting rail			contactor: 3 x M5 v. M6 thermal relay: 4 x M5	
Mounting position	vertical plate ± 22,5°			vertical plate ± 10°	
Ambient temperaturet [°C]	- 25...+50 °C	- 25...+50 °C			
Connection of main circuit	[mm ²]	0,75...2,5	1...6 ill. 2,5...25	2,5...25	16...50; 35...150; 70...150
	screw/Nm	M3,5/1,2	M3,5/1,2...2,5...25	M6/2,5	
Connection of aux. circuit	wire	0,75...2,5	1...2,5	rigid: 1...2,5	
	ferrule	0,5...4	0,5...4	flexible: 0,75...1,5	
Marking of NO auxiliary contacts	13; 14	DL-K4...-11: 13; 14 DL-K15...-18: 53; 54	03;04	13; 14 or 43; 44	

The extreme and middle values of setting range are legible on the turn-knob and on the front plate of relay. The convenient value of the rated operational current of motor should be set to arrow which can be found under the knob.

Main circuit



Auxiliary circuit:



Selection diagrams and tables consist further parameters need to choose the convenient device. (Examples see in item 3).

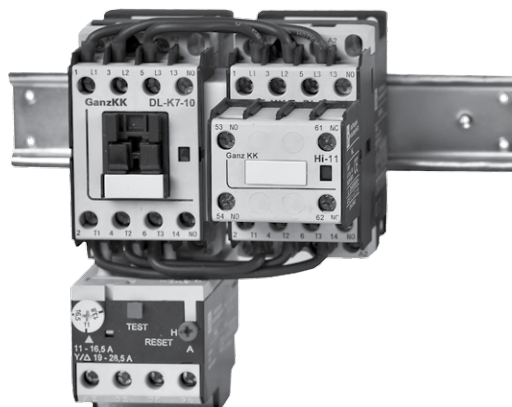
2.2.2 Opened reversing, two rotating direction motorstarter, respectively

Technical data can be found in item 2.2.1. (The photo shows one auxiliary contact block on the front plate of contactor only).

Marking of NO auxiliary contacts (need for self-holding connection) see in item 2.2.1.

Besides electric lock on behalf on increase the safety you can place a mechanical interlock between two contactors.

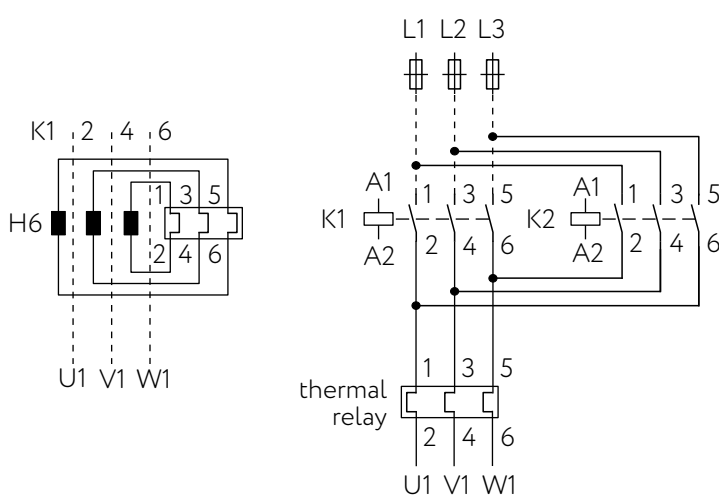
Types: to MK 2 and MK 4: MB7
to DL-K4-...DL-K18: MV-e
to DL-K22-...DL-K37: BB



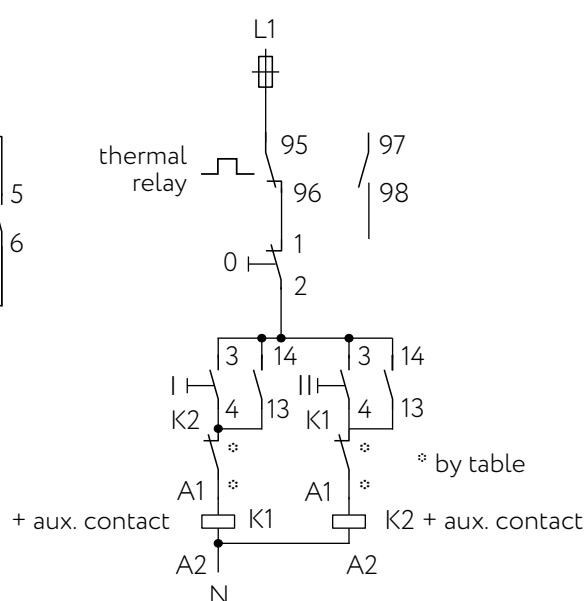
Needs of device:

K1 and K2 contactor	Auxiliary contacts on the K1 and K2 contactors	Marking of NC auxiliary contacts
MK 2, MK 4	KS-11	21, 22
DL-K4-...DL-K11-	Hi-11	61, 62
DL-K15-...DL-K18	Li-11	21, 22
DL-K4-...DL-K18	S 11	31, 32 or 51, 52
DL-K22-...DL-K37-	built-in	91, 92
DL-K45-...DL-K132-	built-in	21, 22 or 31, 32

Main circuit:



Auxiliary circuit:



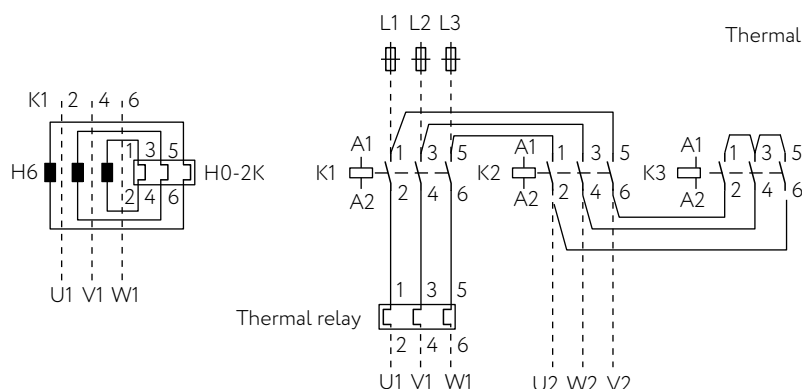
2.2.3 Opened star-delta motorstarter

Technical data can be found in item 2.2.1. (The photo shows one auxiliary contact block on the front plate of contactor only). Marking of NO auxiliary contacts (need for self-holding connection) see in item 2.2.1.

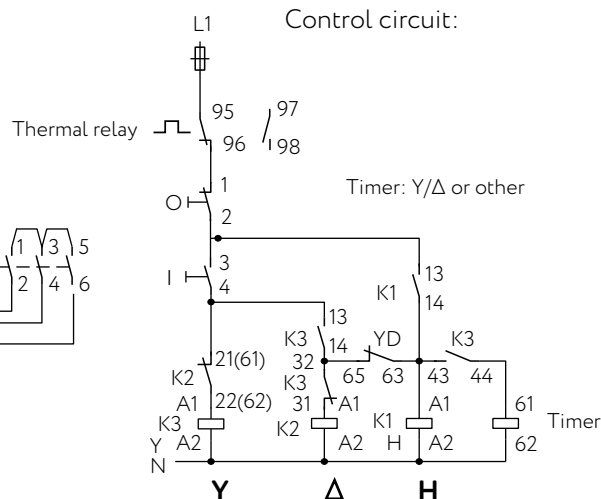
In star scheme the $\sqrt{3}$ -part of the line voltage becomes to phase winding of motor, the starting current is 1/3 part of the direct starting current. (The proportion of starting moments is 1/3 too). According to the low arrangement the phase current of motor flows across the overload relay, but - seeing that the motor works permanently in delta scheme - the scale of relay should be adjusted to convenient value of line current, that is to rated operational current of motor ($\sqrt{3} I_f$). (The values of phase currents and line currents are legible too on the scale of H0-2K thermal relay).



Main circuit:



Control circuit:



Needs of device::

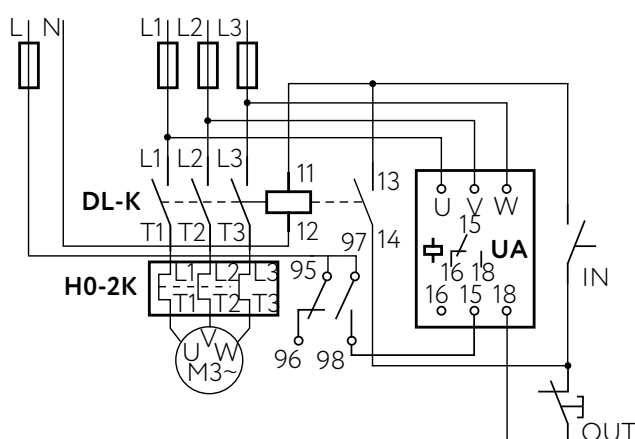
Contactor (K)	3 pcs DL-K4-10 or 3 pcs DL-K5-10	3 pcs DL-K7-10 or 3 pcs DL-K11-10 *	3 pcs DL-K15 or 3 pcs DL-K18 *	3 pcs DL-K22-11 or 3 pcs DL-K30-11 or 3 pcs DL-K37-11 *	3 pcs DL-K45 or 3 pcs DL-K55 or 3 pcs DL-K75 or 3 pcs DL-K90 or 3 pcs DL-K110 or 3 pcs DL-K132 *
Auxiliary contact block	Hi-11 (to K2) (NC: 61,62) S 11 (to K3) (NO: 43,44, NC: 31,32)	Hi-11 (to K2) (NC: 61,62) S 11 (to K3) (NO: 43,44, NC: 31,32)	1 pc Li-11 (to K1) 1 pc S-11 (to K2) 1 pc Li-22 (to K3)	1 pc PKB-11 (to K3) NO: 53,54 or 73,74 NC: 61,62 or 81,82 Built-in: NO: 03,04 NC: 91,92	Built-in: 2 pcs NO: 13,14 and 43,44 2 pcs NC: 21,22 and 31,32
Thermal relay	H0-2K (to K1)	H0-2K (to K1)	H0-2K (to K1) or H6	T63I (to K1) or H6	H6
Timer	YD (to K3)	YD (to K3)	YD (to K2)	other, optional	other, optional
Mechanical interlock	MV-e between K2 and K3	MV-e between K2 and K3	MV-e between K2 and K3	BB between K2 and K3	

* The K3 contactor (Y-contactor) may be smaller with one degree **O** - OUT push-button **I** - ON push-button

Note: At star-delta combinations made from DL-K4-10...DL-K11-10 contactors the Hi-11 auxiliary contact block is negligible, if use variant DL-K...-01 (with built-in NC auxiliary contact) contactor (K2) as a star-contactor, but in this case does not remain auxiliary contact for signal.

Technical data of Y/Δ timer:

Rated insulation voltage [V]		400 V AC
Rated control circuit voltage [V]		24, 42, 110, 230, 400V 50 / 60 Hz
Power consumption [VA]		2
Choosable delay time [s]		1...12 ± 40 % 2...24 ± 40 %
Time needed to restart of timer [ms]		min. 300
Mechanical / electrical endurance [10 ⁶ c]		0,5 / 0,1
Degree of protection		IP 20
Contacts		change-over
thermal current [A]		8
operational current (AC-15) [A]	400 V	0,6
	230 V	1,0
	24...110 V	1,6
Switching frequency [c/h]		120
Mounting		to DL-K4...DL-K18 contactors
Connecting wires [mm ²]		2 x (1...6)
Dimensions [mm]		45 x 39 x 45 (Box of Hi aux. cont.)

2.3 Motorstarter scheme with asymmetry protection**2.4 Other possible combinations**

- GMV 25f / DL-K... motorstarter
- DL-K + miniature circuit breaker (3×1 pole or 2 + 1 pole or 3 pole)
- DL-K...+ residual current circuit breaker
- DL-K...+ UA asymmetry relay
- DL-K...+ VH overheat protection relay
- DL-K...+ GLE 5 lighting switch

3. SELECTION OF MOTORSTARTERS

To select the suitable motorstarter - according to working conditions - you have to know the technical parameters of protected equipment. You should also take into consideration the durability (selection) characteristics of contactors and the fitting conditions of overload (thermal) relays.

Table 1. shows the switchable powers with motorstarters.

Table 2. shows arrangement of contactors and thermal relays, by its nominal data.

Table 3. makes relation between power, rated operational current of three-phase a.c. motors (inner and surface cooling, 1500 r.p.m.) and offered overload relay, the cross section of connecting wires, the offered fuses.

At direct starting ($6 \times I_e$) the running up time is < 5 s, Y/Δ starting ($2 \times I_e$) $t_r < 15$ s.

In this table the values of operational currents are reckoned from next relation (by rounding up of results):

$$I_e = \frac{P_e \times 10^3}{\sqrt{3} \times U_e \times \eta \times \cos \varphi}$$

Table 4. gives the current-ranges of star-delta combinations. Electrical durability (life) of the contactor primarily depend on the break (switch-off) current of the appliance. Diagram 1. shows the accessible number of switching cycles with several types of contactors in most frequent utilization category (AC-3, 400 V) plotted against of break current.

In case of AC-2 and AC-3 utilization categories the break current is equal with the rated operational current of the rated motor power. In case of AC-4 category the break current is six times higher than the rated operational current.

Examples for selection of devices

Example 1.

It is given a three phase asynchron motor with rated power $P_e = 11 \text{ kW}$. $U_e = 400 \text{ V}$ 50 Hz. From Table 3. the rated operational current: $I_e = 22 \text{ A}$. In AC-3 utilization category the breaking current is the same. In case of requirement to reach 10^6 durability (see diagram 1.) DL-K11-... type contactor should be selected. As direct motorstarter the setting range of the plugging overload relay (type: H0-2K) should be chosen 16,5...25 A. The scale of relay should be set to 22 A. Fuse in main circuit path should be 50 A. For protect control circuit the offered fuse: 16 A gG.

Example 2.

The motor with $P_e = 11 \text{ kW}$ (see: previous example) works in utilization category AC-4 (reversing, stepping, plugging, breaking). $I_e = 22 \text{ A}$. According to Table 1. DL-K15 contactor is the right selection ($P_e = 12,5 \text{ kW}$), but in this case the durability is only $4 \times 10^4 \text{ c}$. To reach $4 \times 10^5 \text{ c}$ the right selection is DL-K45-22 contactor.

The H0-2K thermal relay current range is 16,5...25 A in case of selection DL-K15 contactor, and H6 thermal relay with 25...36 A in case of DL-K45-22. Fuses: in main circuit 50 A, in control circuit: 16 A.

Example 3.

Three phase load, in utilization category AC-3 is given a squarrel cage motor with rated power $P_e = 15 \text{ kW}$. $U_e = 400 \text{ V}$ 50 Hz. Starting from zero revs, stopping at rated revolution number (full running speed). Expected durability of machine is 2,5 years. Switching frequency: 250 c/h. The required durability of contactor:

$T = 2,5 \text{ years} \times 50 \text{ weeks} \times 40 \text{ hours} \times 250 \text{ c/h} = 1,25 \times 10^6 \text{ cycles}$. Switching frequency is at least one third of the allowed frequency, so the contactor - according to experience - can be used up to maximum (100 %) motor power.

According to the Diagram 1. of electrical durability DL-K18 contactor should be chosen for 1,25 million cycles with 15 kW motor power. ($I_e = 30 \text{ A}$).

In case of direct starting the rated operational current of motor can be read from the label of motor, or it can be determined from Table 2. From this 15 kW $\rightarrow I_e = 30 \text{ A}$.

According to Table 2. the suitable protecting device is or thermal relay H0-2K range: 21,5...32 A, or H6 overload relay with current transformer, range 25...36 A. Short-circuit protection: 80 A.

Example 4.

It is given a squarrel cage induction motor with rated power $P_e = 30 \text{ kW}$, works in star-delta starting. Switching frequency: 20 c/h. $U_e = 400 \text{ V}$ 50 Hz, utilization category AC-3, three phase load. The overload (thermal) relay is connected between contactor and motor. The expected life-time of the machine is 4 years. The required durability of the contactor: $T = 4 \text{ years} \times 50 \text{ weeks} \times 40 \text{ hours} \times 20 \text{ c/h} = 160 \times 10^3 \text{ c}$.

3 pcs DL-K30-11 (or 2 pcs DL-K30-11 and 1 pc DL-K22-11) contactors are suitable for this duty. $I_e = 63 \text{ A}$. The suggested thermal relay type is T63I with current-range 52...75 A. The value of the motor's rated operational current (63 A) have to be adjusted by the turn knob. The running up time of the motor is about 15 s, therefore the delay of star-delta timer should be more than 15 s. The short circuit protection is 80 A.

(Note: At reversing combination the above mentioned about direct motorstarters are suggested. Pay attention to the utilization category too).

Example 5.

An unique agricultural machine is working under permanent supervision at switching frequency 40 c/h. The required durability of switching element: $> 10^5 \text{ c}$.

$40 \text{ c/h} \times 40 \text{ hours} \times 50 \text{ weeks} = 80000 \text{ cycles/year}$. In the place of application the danger of phase-failure involves from time to time. Power of single phase motor: 0,75 kW, $U_e = 230 \text{ V}$ 50 Hz. Utilization category: AC-3. For these data the offered switching and protecting device: GMV 25f motorstarter with current-range: 4...6,3 A. (see item 2.1.3). The turn knob should be adjusted to upper current limit. Short-circuit protection is not necessary, but an undervoltage relay with rated voltage 230 V is suggested, to avoid breakdowns and accidents after returning of failed network voltage.

Table 1. Switchable powers of contactors

Type	$I_n [\text{A}]$ AC-1	AC-2; AC-3						AC-4	
		230 V		400 V		500 V		400 V	
		P_e [kW]	I_e [A]	P_e [kW]	I_e [A]	P_e [kW]	I_e [A]	P_e [kW]	I_e [A]
MK 2	20	1,5	6,5	2,2	6,5	3	4		
MK 4	20	2,2	8,5	4	8,5	5	6,5		
DL-K4	22	2,2	8,5	4	9	5,5	8,9	3	6,6
DL-K5	25	3	11,5	5,5	12	7,5	12	4	8,5
DL-K7	32	4	15,3	7,5	16	11	16,7	5,5	11,5
DL-K11	32	5,5	20,5	11	22	15	22,5	7,5	15,5
DL-K15	54	7,5	27,4	15	30	18,5	28,5	12,5	22
DL-K18	54	11	39,2	18,5	37	20	30,5	15	30
DL-K22	85	15	52,6	22	44	30	33	7,5	15,5
DL-K30	85	18,5	65	30	63	37	44	9	18
DL-K37	85 (95)	22	75,2	37	72	45	54	10	21
DL-K45	140	30	101	45	85	45	64,5	15	30
DL-K55	140	37	124	55	105	55	79	18,5	36
DL-K75	225	45	150	75	140	75	106	25	43
DL-K90	225	55	181	90	170	90	128	30	57
DL-K110	350	75	245	110	205	110	156	37	70
DL-K132	350	90	292	132	250	132	186	45	85

* Estimated value

Limitation of current-setting (I_{emax}) (AC-3, 230-500 V)	AC-4 (400V)
DL-K4:	max. 9 A
DL-K11:	max. 22 A
DL-K15:	max. 30 A
DTM _n -K11:	max. 20 A
	max. 5,5 kW

[illegible]

Table 3. Setting current-ranges of motorstarter combinations

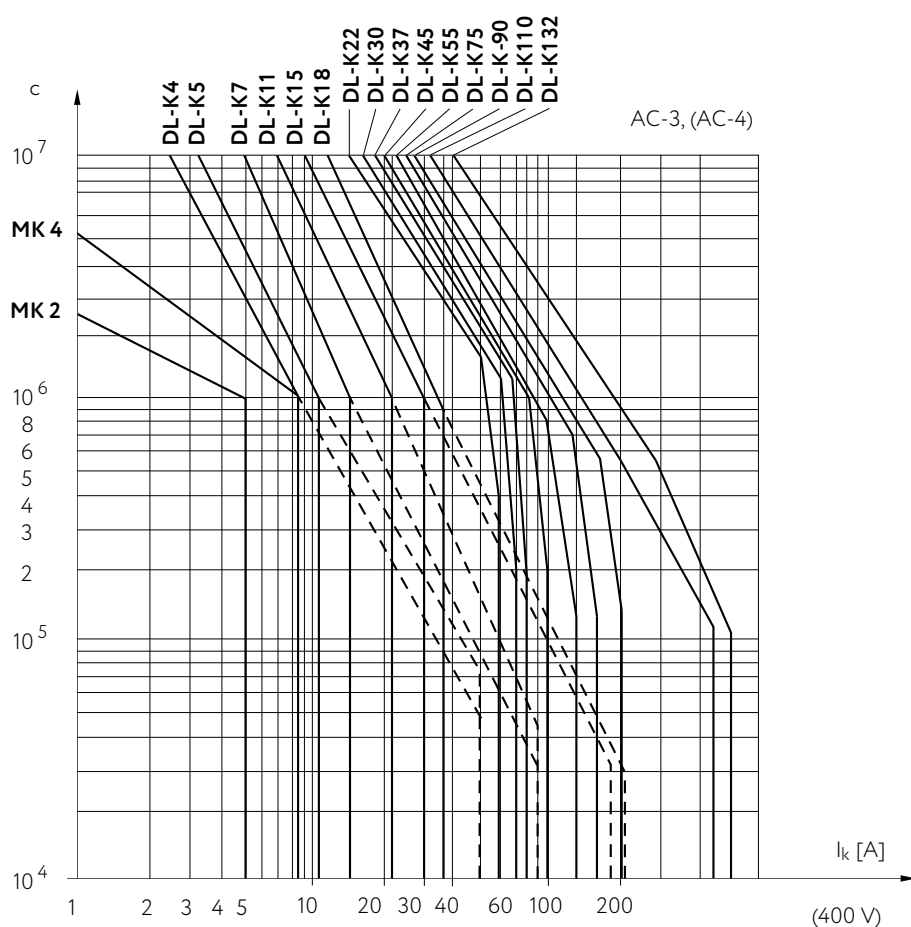
Motor-power AC-1 P _e [kW]	cos φ	η [%]	I _e [A] (AC-3)			Contactor		
			230 V	400 V	500 V	230 V	400 V	500 V
0,06	0,7	59	0,38	0,22	-	DL-K4	DL-K4	-
0,06	0,7	59	0,38	-	-	MK 2	-	-
0,12	0,7	61	0,76	0,42	0,33	DL-K4	DL-K4	DL-K4
0,12	0,7	61	0,76	0,42	0,33	MK 2	MK 2	MK 2
0,18	0,7	61	1,10	0,64	0,46	DL-K4	DL-K4	DL-K4
0,18	0,7	61	1,10	0,64	0,46	MK 2	MK 2	MK 2
0,25	0,7	62	1,40	0,88	0,59	DL-K4	DL-K4	DL-K4
0,25	0,7	62	1,40	0,88	0,59	MK 2	MK 2	MK 2
0,55	0,75	69	2,70	1,50	1,20	DL-K4	DL-K4	DL-K4
0,55	0,75	59	2,70	1,50	1,20	MK 2	MK 2	MK 2
0,75	0,8	74	3,30	2,0	1,48	DL-K4	DL-K4	DL-K4
0,75	0,8	74	3,30	2,0	1,48	MK 2	MK 2	MK 2
1,1	0,83	77	4,9	2,6	2,1	DL-K4	DL-K4	DL-K4
1,1	0,83	77	4,9	2,6	2,1	MK 2	MK 2	MK 2
1,5	0,83	78	6,2	3,5	2,6	DL-K4	DL-K4	DL-K4
1,5	0,83	78	6,2	3,5	2,6	MK 2	MK 2	MK 2
2,2	0,83	81	8,7	5,0	3,8	DL-K4	DL-K4	DL-K4
2,2	0,83	81	8,5	6,5	3,8	MK 4	MK 2	MK 2
3,0	0,84	81	11,6	6,6	5,1	DL-K7	DL-K4	DL-K4
3,0	0,84	81	11,6	6,6	4,0	MK 4	MK 4	MK 2
4,0	0,84	82	15,3	8,5	6,5	DL-K7	DL-K4	DL-K4
4,0	0,84	82	8,5	8,5	6,5	MK 4	MK 4	MK 4
5,5	0,85	83	20,6	11,5	8,9	DL-K11	DL-K5	DL-K4
7,5	0,86	85	27,4	15,5	11,9	DL-K15	DL-K7	DL-K7
7,5	0,86	85	27,4	15,5	11,9	DL-K18	-	-
11,0	0,86	87	39,2	22,0	16,7	-	DL-K11	DL-K11
11,0	0,86	87	39,2	22,0	16,7	DL-K22	-	-
15,0	0,86	87	52,6	30,0	22,5	-	DL-K15	DL-K11
15,0	0,86	87	52,6	30,0	22,5	DL-K22	DL-K22	-
15,0	0,86	87	52,6	30,0	22,5	DL-K22	DL-K22	-
18,5	0,86	88	64,9	37,0	28,5	-	DL-K18	DL-K15
18,5	0,86	88	64,9	37,0	28,5	DL-K30	DL-K22	-
18,5	0,86	88	64,9	37,0	28,5	DL-K30	DL-K22	-
22,0	0,87	89	75,2	44,0	33,0	DL-K37	DL-K22	DL-K22
22,0	0,87	89	75,2	44,0	33,0	DL-K37	DL-K22	DL-K22
30,0	0,87	90	101	63	44	-	DL-K30	DL-K30
30,0	0,87	90	101	63	44	DL-K45	-	-
37,0	0,87	90	124	72	54	-	DL-K37	DL-K37
37,0	0,87	90	124	72	54	DL-K55	-	-
45	0,88	91	150	85	65	DL-K75	DL-K45	DL-K45
55	0,88	91	181	105	79	DL-K90	DL-K55	DL-K55
75	0,88	91	245	140	106	DL-K110	DL-K75	DL-K75
90	0,88	92	292	170	128	-	DL-K90	DL-K90
110	0,88	92	358	205	156	-	DL-K110	DL-K110
132	0,88	92	425	245	186	-	DL-K132	DL-K132

Fuse [A]			Thermal relay [A]				Cu wire. [mm ²]
230 V	400 V	500 V	Type	230 V	400 V	500 V	
2-2	2-2	-	H0-2K	0,30-0,45	0,20-0,30	-	1,5
2-2	-	-	MH	0,25-0,4	-	-	1,5
2-2	2-2	2-2	H0-2K	0,67-1,0	0,3-0,45	0,3-0,45	1,5
2-2	2-2	2-2	MH	0,25-0,4	0,25-0,4	0,25-0,4	1,5
2-4	2-2	2-2	H0-2K	1,0-1,5	0,45-0,67	0,45-0,67	1,5
2-4	2-2	2-2	MH	0,9-1,3	0,4-0,6	0,4-0,6	1,5
2-4	2-2	2-2	H0-2K	1,0-1,5	0,67-1,0	0,45-0,67	1,5
2-4	2-2	2-2	MH	0,9-1,3	0,6-0,9	0,4-0,6	1,5
4-10	2-4	2-2	H0-2K	2,2-3,3	1,0-1,5	1,0-1,5	1,5
4-10	2-4	2-2	MH	2,8-4	0,9-1,3	0,9-1,3	1,5
4-10	4-10	2-2	H0-2K	2,2-3,3	1,5-2,2	1,0-1,5	1,5
4-10	4-10	2-2	MH	2,8-4	1,9-2,8	0,9-1,3	1,5
6-10	4-10	4-10	H0-2K	3,3-4,9	2,2-3,3	1,5-2,2	1,5
4-10	4-10	4-10	MH	4-6	1,9-2,8	1,3-1,9	1,5
10-20	6-16	4-10	H0-2K	4,9-7,3	3,3-4,9	2,2-3,3	1,5
10-20	4-10	4-10	MH	6-9	2,8-4	2,8-4	1,5
16-25	10-20	6-10	H0-2K	7,3-11,0	4,9-7,3	3,3-4,9	1,5
16-25	10-16	6-16	MH	8-11	4-6	4-6	1,5
20-35	10-20	10-16	H0-2K	11-16,5	4,9-7,3	4,9-7,3	1,5
16-25	10-20	10-16	MH	11-14	8-11	4-6	1,5
20-35	16-25	10-16	H0-2K	11-16,5	7,3-11	4,9-7,3	1,5
20-35	16-25	10-16	MH	6-9	6-9	6-9	1,5
35-50	20-35	16-20	H0-2K	16,6-25	11-16,5	7,3-11	2,5
35-50	20-35	20-25	H0-2K	21,5-32	11-16,5	11-16,5	4,0
50-60	-	-	H6	25-36	-	-	4,0
-	35-50	35-50	H0-2K	-	16,5-25	16,5-25	6,0
50-80	-	-	T63I	30-40	-	-	6,0
-	35-50	35-50	H0-2K	-	21,5-32	16,5-25	10,0
63-100	50-63	-	T63I	43-63	21-30	-	10,0
100-60	50-80	-	H6	51-80	25-36	-	10,0
-	35-50	35-50	H0-2K	-	21,5-32	21,5-32	10,0
80-125	50-80	-	T63I	52-80	30-40	-	10,0
100-160	63-100	-	H6	51-76	34-51	-	10,0
80-125	63-100	50-80	T63I	52-80	43-63	30-40	16,0
100-160	63-100	50-80	H6	51-76	34-51	25-36	16,0
-	80-125	63-100	T63I	-	52-75	43-63	25,0
160-200	-	-	H6	76-113	-	-	25,0
-	80-125	63-100	T63I	-	52-75	43-63	35,0
100-160	-	-	H6	51-76	-	-	35,0
200-315	200-315	160-250	H6	113-168	76-113	34-51	50
315-500	160-250	80-125	H6	168-250	76-113	51-76	70
315-500	160-200	100-160	H6	168-250	113-168	76-113	95
-	315-500	160-250	H6	-	168-250	113-168	120
-	315-500	160-250	H6	-	168-250	113-168	150 or rail
-	315-500	160-250	H6	-	168-250	168-250	150 or rail

Table 4. Setting current-ranges of star-delta combinations

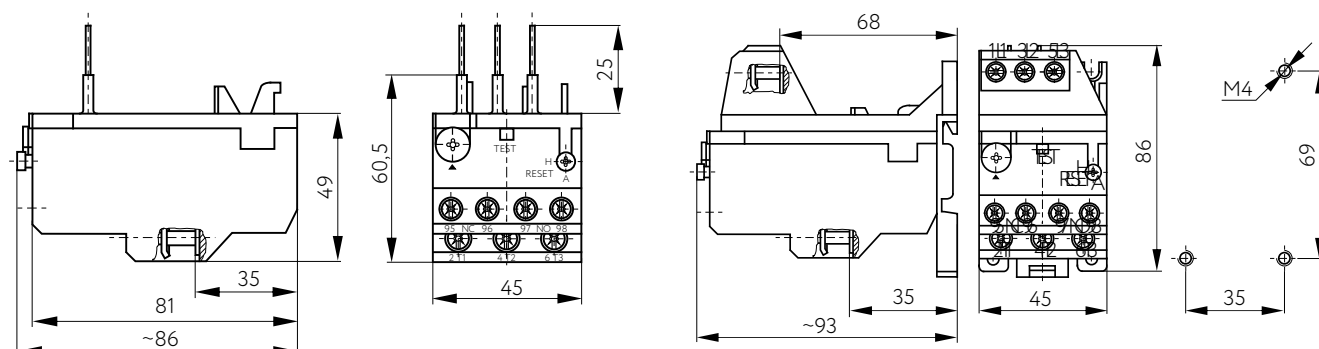
Motor-power AC-1 P _e [kW]	cos φ	η [%]	I _e [A] (AC-3)			Contactor	Fuse [A]			Thermal relay [A]				Cu wire. [mm ²]
			230 V	400 V	500 V		3 pcs	230 V	400 V	500 V	Típus	230 V	400 V	
4,0	0,84	82	15,3	8,5	6,5	DL-K4	20	10	10	H0-2K		7,3 - 11		1,5
5,5	0,85	83	20,6	11,5	8,9	DL-K5	25	16	10	H0-2K		7,3 - 11		2,5
7,5	0,86	85	27,4	15,5	11,9	DL-K7	35	20	16	H0-2K		11 - 16,5		4,0
11	0,86	87	32,2	22,0	16,7	DL-K11	50	25	20	H0-2K		11 - 16,5		6,0
15	0,86	87	52,5	30,5	22,5	DL-K15	63	35	25	H0-2K		16,5 - 25		10,0
18,5	0,86	88	64,9	37,0	28,5	DL-K18	80	50	35	H0-2K		16,5 - 25		10,0
22	0,87	89	75,2	44,0	33,0	DL-K22-11	80	50	50	T63I		21 - 30		16,0
30	0,87	90	101	63	44	DL-K30-11	125	63	50	T63I		30 - 40		25,0
37	0,87	90	124	72	54	DL-K37-11	160	80	63	T63I		43 - 62		35,0
45	0,88	91	150	85	64,5	DL-K45-22	160	100	80	H6		51 -76		50,0
55	0,88	91	181	105	79	DL-K55-22	200	125	100	H6		76 -113		70,0
75	0,88	91	245	140	106	DL-K75-22	250	160	125	H6		76 - 113		95,0
90	0,88	92	292	170	128	DL-K90-22	315	200	160	H6		113 - 168		150 or rail
110	0,88	92	358	205	156	DL-K110-22	400	250	200	H6		113 - 168		150 or rail
132	0,88	92	425	245	186	DL-K132-22	500	250	200	H6		168 - 250		

Diagram 1. Electrical durability related to the break current



Curves indicated as "-----" refer to the expected number of switching cycles in AC-4 utilization category at DL-K4... DL-K18 contactors

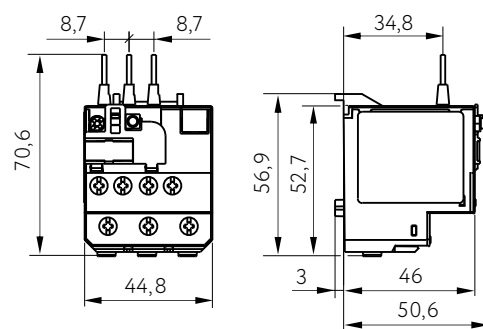
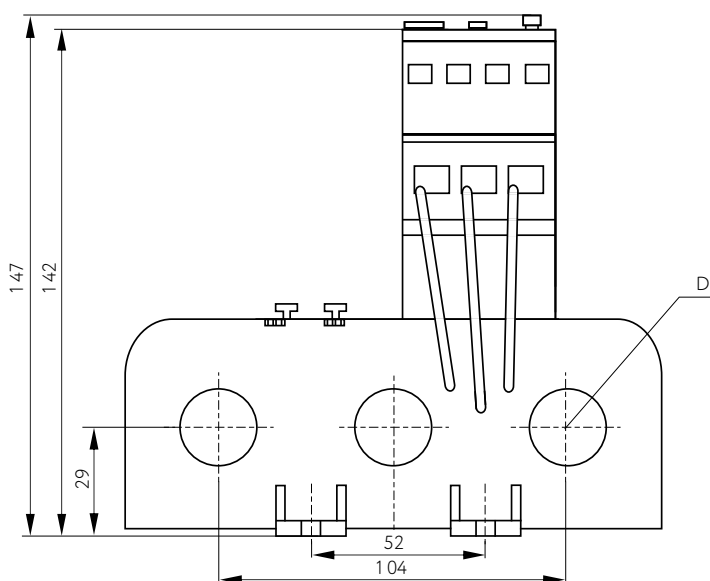
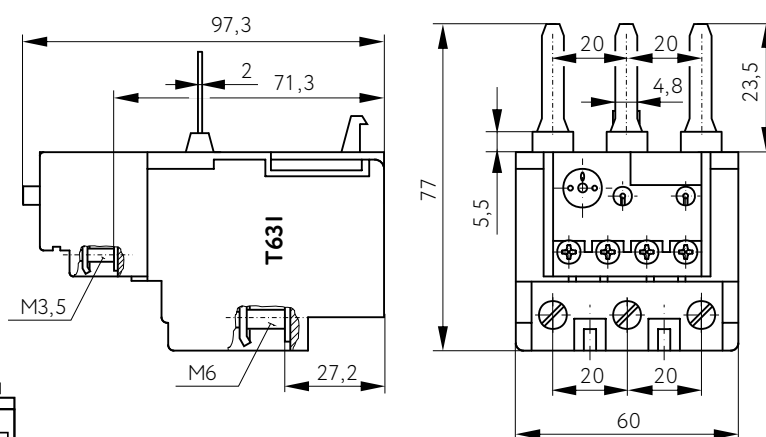
4. DIMENSIONS



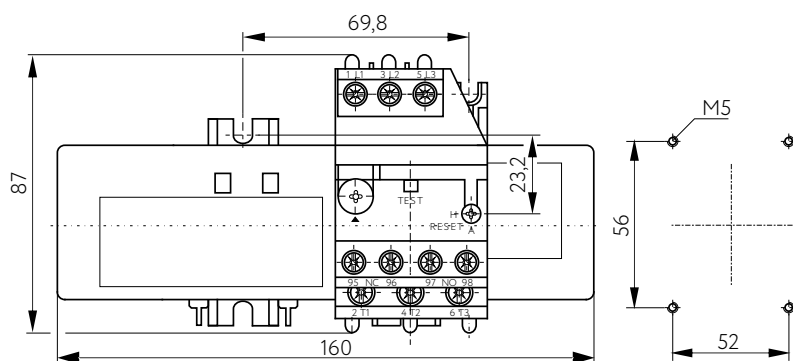
H0-2K thermal relay snapped on a rali

H0-2K thermal relay after removing the fixing and connecting elements (it can be plugged to a DL-K4...DL-K18 contactor)

T63I thermal relay (it can be plugged to a DL-K22...DL-K37 contactor)

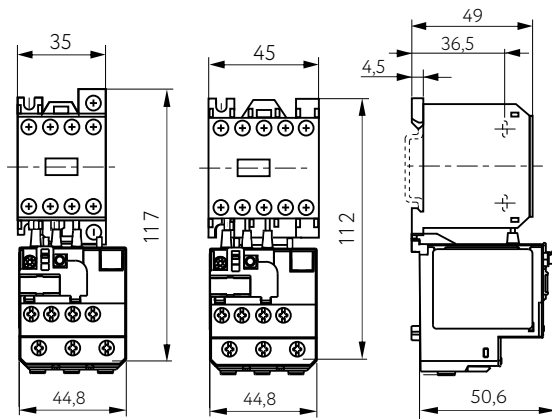


MH mini thermal relay (it can be plugged to a MK2 or MK4 contactor)

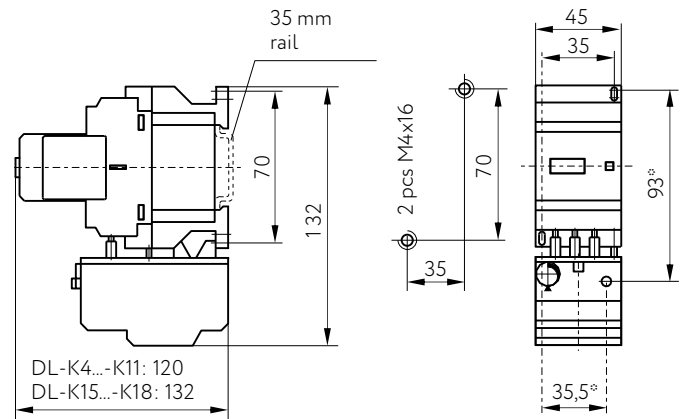


H6 thermal relay with current transformer

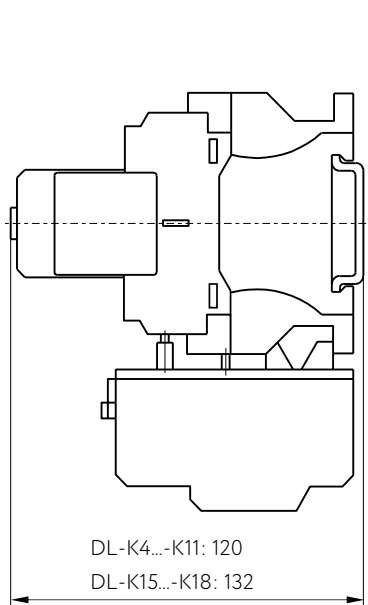
Range (A)		D [mm]
25...36	Y / Δ 43...62	Ø 12
34...51	Y / Δ 59...88	
51...76	Y / Δ 88...131	Ø 22
76...113	Y / Δ 131...195	
113...168	Y / Δ 195...290	
168...250	Y / Δ 290...432	



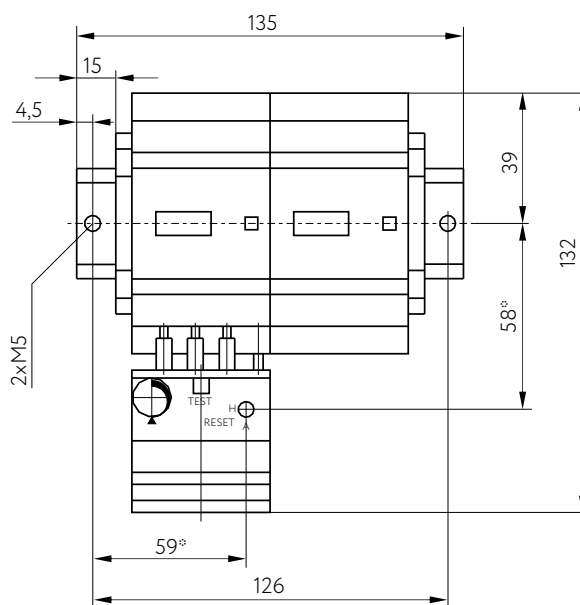
MK + MH plugged motorstarter combination



DL-K4...DL-K18 + H0-2K plugged motorstarter combination

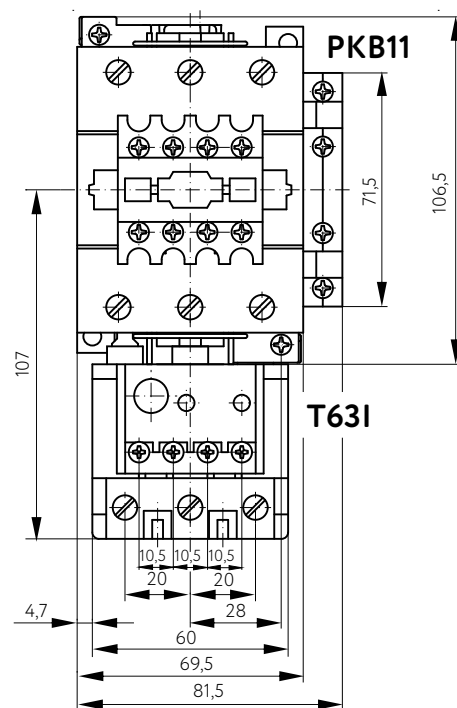
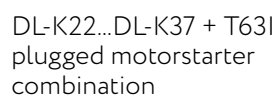


DL-K4...DL-K18 + H0-2K reversing motorstarter combination



DL-K4...DL-K18 + H0-2K star-delta motorstarter combination

Dimensions marked by * show position of resetting knob of thermal relay



Technical drawing of the 1000x1000x1000 mm cabinet showing front, side, and top views with dimensions:

- Front View:** Shows a square cabinet with a width of 85 and a height of 129. It features two doors with a central handle and a lock mechanism.
- Side View:** Shows the cabinet's depth of 80 and a height of 105. It includes a side panel and a handle.
- Top View:** Shows the cabinet's width of 69,6 and a depth of 80. It features a central handle and a lock mechanism.

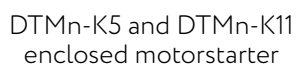
Technical drawing of a mechanical part showing front and side views with dimensions.

Front View (Left):

- Overall width: 45
- Overall height: 80
- Four circular holes arranged in a 2x2 grid.
- Four small rectangular features, one centered on each horizontal centerline.

Side View (Right):

- Overall width: 83
- Overall height: 45
- Top flange thickness: 3,5
- Distance from left face to first vertical step: 4
- Distance between first and second vertical steps: 38
- Distance from second vertical step to right face: 73,5



Technical drawing of a mechanical part. The main view shows a cross-section with a total width of 77 and a total height of 80. The top edge has a width of 41,5, and a smaller section has a width of 26,5. A central hole has a diameter of 8. A vertical dimension of 45 is shown on the right side. A side view below the main view shows a length of 9.

GMV 25f
manual
motorstarter

APPENDIX

Extract from EN 60947-4-1: standard

Table 1. Utilization categories

AC-1: Non-inductive or slightly inductive loads, resistance furnaces	AC-4: Squirrel-cage motors: starting, plugging, inching
AC-2: Slip-ring motors: starting, switching off	DC-3: Shunt-motors: starting, plugging, inching, dynamic breaking of d.c. motors
AC-3: Squirrel-cage motors: starting, switching off motors during running	DC-5: Series-motors: starting, plugging, inching, dynamic breaking of d.c. motors

3.2. Definitions concerning starters (IEV: International Electrotechnical Vocabulary)

3.2.1. Starter (IEV 441-14-38)

The combination of all the switching means necessary to start and stop a motor in combination with suitable overload protection.

3.2.2. Direct-on-line starter (IEV 441-14-40)

A starter which connects the line voltage across the motor terminals in one step.

3.2.3. Reversing starter

Starter intended to cause the motor to reverse the direction of rotation by reversing the motor primary connections while the motor may be running.

3.2.4. Two-direction starter

Starter intended to cause the motor to reverse the direction of rotation by reversing the motor primary connections only when the motor is not running.

3.2.5.1. Star-delta starter (IEV 441-14-44)

A starter for a three-phase induction motor such that in the starting position the stator windings are connected in star and in the final running position they are connected in delta.

3.2.7. Combination starter

Equipment consisting of a starter, a manual externally operated switching device and a short-circuit protective device, mounted and wired in a dedicated enclosure. The switching and short-circuit protective devices may be a fuse combination unit, a switch with fuses or a circuit-breaker with or without an insulating function.

Notes:

1. A dedicated enclosure is an enclosure specifically designed and dimensioned for its application in which all tests are conducted.
2. The manually operated switching device and the short-circuit protective device may be just one device and may incorporate the overload protection as well.

3.2.8. Protected starter

Equipment consisting of a starter, a manually operated switching device and a short-circuit protective device, mounted and wired, enclosed or unenclosed according to the instructions of the starter manufacturer.

Note:

The manually operated switching device and the short-circuit protective device may be one single device and may incorporate the overload protection as well.

3.2.9. Manual starter (IEV 441-14-39)

A starter in which the force for closing the main contacts is provided exclusively by manual energy.

3.2.10 Electromagnetic starter

A starter in which the force for closing the main contacts is provided by an electromagnet.

MOTORSTARTER COMBINATIONS



Star-delta motorstarter combination



Reversing motorstarter combination



DTMn-K... enclosed motorstarter



Enclosed version
IP41 or IP 55



GMV 25f manual motorstater



Version with front plate
IP41 or IP 55



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