LARSEN & TOUBRO

SUPERNOVA™

MO Contactors & RTO Thermal Overload Relays

L&T SWITCHGEAR
SAFE & SURE

About us

Larsen & Toubro infuses engineering with imagination. The Company offers a wide range of advanced solutions in the field of Engineering, Construction, Electrical & Automation, Machinery and Information Technology.

L&T Switchgear, a part of the Electrical & Automation business, is India's largest manufacturer of low voltage switchgear, with the scale, sophistication and range to meet global benchmarks. With over five decades of experience in this field, the Company today enjoys a leadership position in the Indian market with a growing international presence.

It offers a complete range of products including powergear, controlgear, industrial automation, building electricals & automation, reactive power management, energy meters, and protective relays. These products conform to Indian and International Standards.

Switchgear Factory, Mumbai

Switchgear Factory, Ahmednagar

CONTENTS

SUPERNOVA™ Product Range

L&T launches Supernova range of Products covering Contactors, Thermal Overload Relays, Motor Protection Circuit Breakers, Soft Starters and Motors.

MO Contactors and RTO Thermal Overload Relays

The latest range of contactors and thermal overload relays, rated from 9A to 110A.

Motor Protection Circuit Breakers

The new range of MPCBs from 0.1A to 63A in two frame sizes.

Soft Starters

The range of Soft Starters extends from simple soft start control devices to advanced systems that match complex requirements.

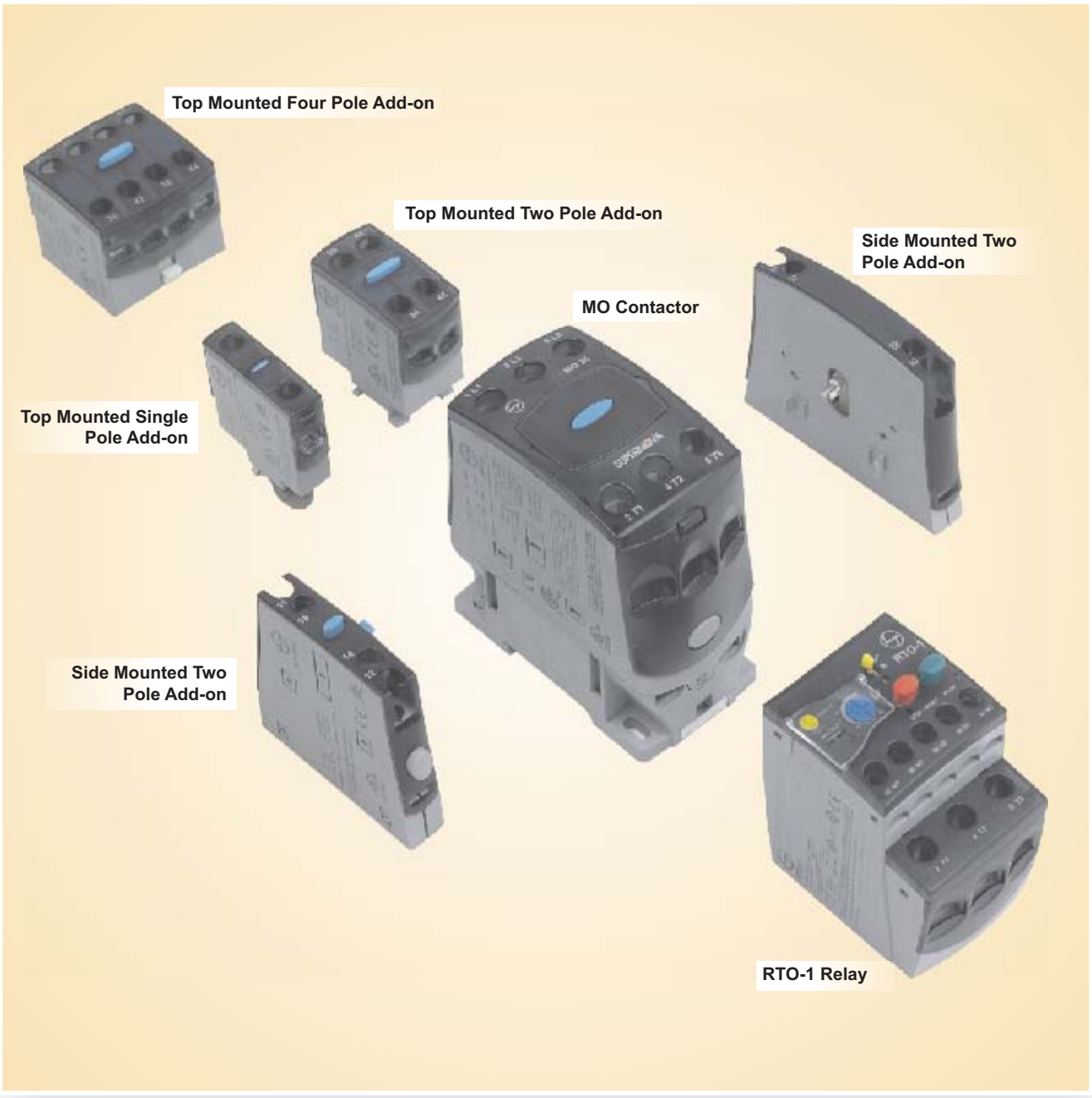
Range of Soft Starters:

- CSX Series
- CSXi Series
- EMX3 Series

Motors

The unique range of 3 Phase Inverter Duty Motors (LTI Series) operate at desirable base speed, reducing the cost of switchgear, cable & inverter. These motors can operate from rated speed to 10% of rated speed without any reduction in torque. They can be offered for constant power application in field weakening mode.

MO CONTACTORS | RTO THERMAL OVERLOAD RELAYS



Overview

Patented cassette type bridge

Compact mechanical interlock

Safety shrouds for power terminals

Box clamp terminations

Tamper proof settings

Modular load feeder

MO
CONTACTORS

Key Features

Completely shrouded

•

Compact

•

Unique styling and visual appeal

•

Standardized accessories throughout the range

•

Lug less termination

•

Low VA consumption

•

Wide range of accessories

RoHS

In keeping with the mission to deliver the best, Larsen & Toubro understands the requirements of the RoHS directive. The directive restricts the use of hazardous substances in electrical and electronic equipment and bans electrical equipment containing more than permitted levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBS) and polybrominated diphenyl ether (PBDE) flame retardants.

Technical Details

Catalogue No.		MO 9 CS94564	MO 12 CS94565	MO 18 CS94566	MO 25 CS94567	MO 32 CS94568
Conformance to standards						
Power Contacts						
No. of poles		3	3	3	3	3
Rated insulation voltage, U_i		690V	690V	690V	690V	690V
Rated impulse withstand voltage, U_{imp}		8 kV	8 kV	8 kV	8 kV	8 kV
Rated operational current, Ie Motor duty : 3ϕ, 415V, 50Hz	Utilization category AC-1	30A	35A	40A	45A	50A
	Utilization category AC-2	9A	12A	18A	25A	32A
	Utilization category AC-3	9A / 4 kW	12A / 5.5 kW	18A / 9.3 kW	25A / 11 kW	32A / 17.3 kW
	Utilization category AC-4	9A / 4 kW	12A / 5.5 kW	18A / 9.3 kW	25A / 11 kW	32A / 17.3 kW
Making capacity		400	450	450	550	550
Breaking capacity, 415V		350	350	350	550	550
Mechanical life, No. of operating cycles		10 million	10 million	10 million	10 million	10 million
Max. Frequency of operations Operating cycles / hr	Mechanical	7200	7200	7200	7200	7200
	Utilization category AC-2	750	750	750	750	750
	Utilization category AC-3	750	750	750	750	750
	Utilization category AC-4	300	300	300	300	300
Service temperature						
Main terminal capacity	Solid conductor (mm^2)	2 x 10	2 x 10	2 x 10	2 x 10	2 x 10
	Stranded conductor (mm^2)	2 x 10	2 x 10	2 x 10	2 x 10	2 x 10
	Finely standard conductor (mm^2)	2 x 6	2 x 6	2 x 6	2 x 6	2 x 6
Auxiliary Contacts						
No. of snap on aux. contact poles (Side or Front Mounting)		4	4	4	4	4
Conventional thermal current, I_{th}		10A	10A	10A	10A	10A
AC-15 rating at 415V, 50Hz		4A	4A	4A	4A	4A
Terminal capacity (solid or multi stranded conductors) (mm^2)		2 x 2.5	2 x 2.5	2 x 2.5	2 x 2.5	2 x 2.5
Coil						
Voltages available for AC-50Hz operative, U_c (V)		24, 42, 110, 220 240, 360, 415, 525	24, 42, 110, 220 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525
Pick up (VA)		77	77	77	77	77
Hold-On	VA	9	9	9	9	9
	Watts	2.8	2.8	2.8	2.8	2.8
Limits of operations	Pick up (% U_c)	75 - 110	75 - 110	75 - 110	75 - 110	75 - 110
	Drop off (% U_c)	35 - 65	35 - 65	35-65	35 - 65	35 - 65
Overall Dimensions (mm)	H	83.5	83.5	83.5	83.5	83.5
	W	45	45	45	45	45
	D	93.5	93.5	93.5	93.5	93.5
Weight		0.41 kg	0.41 kg	0.41 kg	0.44 kg	0.44 kg

MO 40 CS94569	MO 45 CS94570	MO 50 CS94572	MO 60 CS94573	MO 70 CS94574	MO 80 CS94576	MO 95 CS94577	MO 110 CS94578
IS 13947-4-1, IEC 60947-4-1, EN 60947-4-1							
3	3	3	3	3	3	3	3
690V	690V	1000V	1000V	1000V	1000V	1000V	1000V
8 kV	8 kV	8 kV	8 kV	8 kV	8 kV	8 kV	8 kV
50A	50A	65A	80A	100A	125A	125A	140A
40A	45A	50A	60A	70A	80A	95A	110A
40A / 22.5 kW	45A / 25 kW	50A / 30 kW	60A / 33.5 kW	70A / 37 kW	80A / 40 kW	95A / 45 kW	110A / 55 kW
40A / 22.5 kW	45A / 25 kW	50A / 30 kW	60A / 33.5 kW	70A / 37 kW	80A / 40 kW	95A / 45 kW	110A / 55 kW
550	550	1000	1000	1000	1500	1500	1500
550	550	900	900	900	1200	1200	1200
10 million	10 million	10 million	10 million	10 million	10 million	10 million	10 million
7200	7200	3600	3600	3600	3600	3600	3600
750	750	750	750	750	750	750	750
750	750	750	750	750	750	750	750
300	150	300	300	150	150	150	150
-50°C to 55°C							
2 x 10	2 x 10	-	-	-	-	-	-
2 x 10	2 x 10	2 x 35	2 x 35	2 x 35	2 x 70	2 x 70	2 x 70
2 x 6	2 x 6	2 x 25	2 x 25	2 x 25	2 x 50	2 x 50	2 x 50
4	4	6	6	6	8	8	8
10A	10A	10A	10A	10A	10A	10A	10A
4A	4A	4A	4A	4A	4A	4A	4A
2 x 2.5	2 x 2.5	2 x 2.5	2 x 2.5	2 x 2.5	2 x 2.5	2 x 2.5	2 x 2.5
24, 42, 110, 220, 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525	24, 42, 110, 220, 240, 360, 415, 525
77	77	144	144	144	240	240	240
9	9	15	15	15	25	25	25
2.8	2.8	5	5	5	6.5	6.5	6.5
75 - 110	75 - 110	75 - 110	75 - 110	75 - 110	75 - 110	75 - 110	75 - 110
35 - 65	35 - 65	35 - 65	35 - 65	35 - 65	35 - 65	35 - 65	35 - 65
83.5	83.5	124	124	124	135	135	135
45	45	55	55	55	70	70	70
93.5	93.5	122	122	122	135	135	135
0.44 kg	0.44 kg	1.1 kg	1.1 kg	1.1 kg	1.6 kg	1.6 kg	1.6 kg

Selection Chart for Fuse protected DOL Starter Feeder

Type '2' Co-ordination, Iq=50kA at 415V, 3Ø, 50Hz
as per Standards : IEC 60947-4-1, IS 13947 (Part 4/Sec 1), EN 60947-4-1

Sr. No.	Motor Rating 1ϕ, 240V, 50Hz			Motor Rating 3ϕ, 415V, 50Hz			Contactor	Overload Relay		Nominal Backup		Switch Disconnector Fuse
	hp	kW	I_n(A)	hp	kW	I_n(A)	Type	Type	Range (A)	Type	Range (A)	Range (A)
1				0.125	0.09	0.4	MO 9	RTO 1	0.31 - 0.55	HF	2	FN32 / FNX32
2				0.16	0.12	0.45	MO 9	RTO 1	0.31 - 0.55	HF	2	FN32 / FNX32
3				0.2	0.15	0.57	MO 9	RTO 1	0.55 - 0.85	HF	2	FN32 / FNX32
4				0.25	0.19	0.75	MO 9	RTO 1	0.55 - 0.85	HF	4	FN32 / FNX32
5				0.33	0.25	0.9	MO 9	RTO 1	0.78 - 1.2	HF	4	FN32 / FNX32
6				0.5	0.37	1.2	MO 9	RTO 1	1.2 - 2.0	HF	6	FN32 / FNX32
7	0.25	0.18	2	0.75	0.55	1.6	MO 9	RTO 1	1.2 - 2.0	HF	6	FN32 / FNX32
8	0.5	0.4	3.6	1	0.75	2.1	MO 9	RTO 1	1.9 - 2.8	HF	8	FN32 / FNX32
9				1.5	1.1	2.7	MO 9	RTO 1	2.4 - 3.6	HF	10	FN32 / FNX32
10				1.75	1.3	3	MO 9	RTO 1	2.4 - 3.6	HF	10	FN32 / FNX32
11				2	1.5	3.5	MO 9	RTO 1	3.5 - 5.2	HF	16	FN32 / FNX32
12				2.5	1.8	4.8	MO 9	RTO 1	3.5 - 5.2	HF	16	FN32 / FNX32
13				3	2.25	5	MO 9	RTO 1	4.6 - 6.7	HF	16	FN32 / FNX32
14	1	0.75	7.5	4	3	6.4	MO 9	RTO 1	4.6 - 6.7	HF	20	FN32 / FNX32
15				5	3.7	7.9	MO 9	RTO 1	6.7 - 9.7	HF	20	FN32 / FNX32
16	1.25	0.9	8	5.5	4	8.5	MO 9	RTO 1	6.7 - 9.7	HF	20	FN32 / FNX32
17	2	1.5	9.5	6	4.5	9	MO 12	RTO 1	8.5 - 12.5	HF	25	FN32 / FNX32
18	3	2.25	14	7.5	5.5	11.2	MO 12	RTO 1	8.5 - 12.5	HF	32	FN32 / FNX32
19				10	7.5	14.8	MO 18	RTO 1	12.5 - 18.5	HF	32	FN32 / FNX32
20				12.5	9.3	19	MO 25	RTO 1	17 - 25.5	HF	50	FN63 / FNX63
21				15	11	22	MO 25	RTO 1	17 - 25.5	HF	63	FN63 / FNX63
22				17.5	13	24	MO 32	RTO 1	17 - 25.5	HF	63	FN63 / FNX63
23				20	15	29	MO 32	RTO 1	25 - 37	HF	63	FN63 / FNX63
24				25	18.6	35	MO 40	RTO 1	25 - 37	HN, 000*	80*	FN100 / FNX100*
25				30	22.5	40	MO 40	RTO 1	35 - 45	HN, 000*	80*	FN100 / FNX100*
26				35	26	47	MO 50	MN 5	30 - 50	HN, 000*	100*	FN100 / FNX100*
27				40	30	55	MO 60	MN 5	45 - 75	HN, 000*	100*	FN100 / FNX100*
28				45	33.5	60	MO 60	MN 5	45 - 75	HN, 000*	100*	FN100 / FNX100*
29				50	37	66	MO 70	MN 5	45 - 75	HN, 00	125	FN125 / FNX125
30				60	45	80	MO 95	MN 5	66 - 110	HN, 00	125	FN125 / FNX125
31				75	55	100	MO 110	MN 5	66 - 110	HN, 00#	160#	FN160 / FNX160#

Notes :

- The selection is valid only for complete L&T combinations i.e. SDF+DIN Fuse+Contactor
- In any case if this combination is changed to accommodate another brand/rating of SDF/DIN Fuse etc. it shall be the responsibility of the person making such a change to assure Type 2 performance
- Normal Motor Starting time (5 sec.) is assumed. For higher Starting time, refer back to L&T
- * : Only size “000” fuses to be used with FNX100 SDF
- # : Only size “00” fuses should be used FNX160 SDF

Selection Chart for Fuseless protected DOL Starter Feeders with MCCBs, Type 'DM'

Type '2' Co-ordination, Iq=50kA at 415V, 3Ø, 50Hz
as per Standards : IEC 60947-4-1, IS 13947 (Part 4/Sec 1), EN 60947-4-1

Sr. No.	Motor Rating: 3ϕ, 415V, 50Hz			Overload Relay		Contactor	MCCB	
	hp	kW	FLC, In (A)	Type	Range(A)	Type	Type	Rating
1	0.125	0.09	0.4	RTO 1	0.31 - 0.55	MO 9	DM 16	0.63
2	0.16	0.12	0.45	RTO 1	0.31 - 0.55	MO 9	DM 16	0.63
3	0.2	0.15	0.57	RTO 1	0.55 - 0.85	MO 9	DM 16	1
4	0.25	0.19	0.75	RTO 1	0.55 - 0.85	MO 9	DM 16	1
5	0.33	0.25	0.9	RTO 1	0.78 - 1.2	MO 9	DM 16	1
6	0.5	0.37	1.2	RTO 1	1.2 - 2.0	MO 9	DM 16	1.6
7	0.75	0.55	1.6	RTO 1	1.2 - 2.0	MO 9	DM 16	1.6
8	1	0.75	2.1	RTO 1	1.9 - 2.8	MO 9	DM 16	2.5
9	1.5	1.1	2.7	RTO 1	2.4 - 3.6	MO 9	DM 16	2.5
10	1.75	1.3	3	RTO 1	2.4 - 3.6	MO 9	DM 16	4
11	2	1.5	3.5	RTO 1	3.5 - 5.2	MO 9	DM 16	4
12	2.5	1.8	4.8	RTO 1	3.5 - 5.2	MO 9	DM 16	5
13	3	2.25	5	RTO 1	4.6 - 6.7	MO 9	DM 16	5
14	4	3	6.4	RTO 1	4.6 - 6.7	MO 9	DM 16	7.5
15	5	3.7	7.9	RTO 1	6.7 - 9.7	MO 9	DM 16	7.5
16	6	4.5	9	RTO 1	6.7 - 9.7	MO 12	DM 16	10
17	7.5	5.5	11.2	RTO 1	8.5 - 12.5	MO 12	DM 16	12
18	10	7.5	14.8	RTO 1	12.5 - 18.5	MO 18	DM 16	16
19	12.5	9.3	19	RTO 1	17 - 25.5	MO 25	DM100	25
20	15	11	22	RTO 1	17 - 25.5	MO 25	DM 100	25
21	17.5	13	24	RTO 1	17 - 25.5	MO 32	DM 100	30
22	20	15	29	RTO 1	25 - 37	MO 32	DM 100	35
23	25	18.6	35	RTO 1	25 - 37	MO 40	DM 100	50
24	30	22.5	40	RTO 1	35 - 45	MO 40	DM 100	50
25	35	26	47	MN 5	30 - 50	MO 50	DM 100	60
26	40	30	55	MN 5	45 - 75	MO 60	DM 100	70
27	45	33.5	60	MN 5	45 - 75	MO 60	DM 100	70
28	50	37	66	MN 5	45 - 75	MO 70	DM 100	80
29	60	45	80	MN 5	66 - 110	MO 95	DM 160	100
30	75	55	100	MN 5	66 - 110	MO 110	DM 160	120

Notes :

- Selection Chart is for Standard 3-phase, Squirrel cage Motor with Average Power Factor and Efficiency
- Motor ratings at 415V, 50Hz
- Normal Motor Starting time (5 sec.) is assumed. For higher Starting time, refer back to L&T
- All the MCCBs are Instantaneous type only
- Selection is valid only for complete L&T combinations ie. "Contactor, Relay & MCCB". Compliance to Type '2' co-ordination is not assured in case these combinations are changed to accommodate another brand / rating of products

Selection Chart for Fuseless protected DOL Starter Feeders with MPCBs, Type 'MOG-S1/H1/H2'

Type '2' Co-ordination, Iq=50kA at 415V, 3Ø, 50Hz
as per Standards : IEC 60947-4-1, IS 13947 (Part 4/Sec 1), EN 60947-4-1

Sr. No.	Motor Rating: 3ϕ, 415V, 50Hz			Contactor	MPCB	
	hp	kW	FLC, In (A)	Type	Type	Rating (A)
1	0.125	0.09	0.40	MO 9	MOG-S1/MOG-H1	0.4 - 0.63
2	0.16	0.12	0.45	MO 9	MOG-S1/MOG-H1	0.4 - 0.63
3	0.2	0.15	0.57	MO 9	MOG-S1/MOG-H1	0.63 - 1
4	0.25	0.19	0.75	MO 9	MOG-S1/MOG-H1	0.63 - 1
5	0.33	0.25	0.90	MO 9	MOG-S1/MOG-H1	1 - 1.6
6	0.5	0.37	1.20	MO 9	MOG-S1/MOG-H1	1 - 1.6
7	0.75	0.55	1.60	MO 9	MOG-S1/MOG-H1	1.6 - 2.5
8	1	0.75	2.10	MO 9	MOG-S1/MOG-H1	1.6 - 2.5
9	1.5	1.10	2.70	MO 9	MOG-S1/MOG-H1	2.5 - 4
10	1.75	1.30	3.00	MO 9	MOG-S1/MOG-H1	2.5 - 4
11	2	1.50	3.50	MO 9	MOG-S1/MOG-H1	4 - 6.3
12	2.5	1.80	4.80	MO 9	MOG-S1/MOG-H1	4 - 6.3
13	3	2.25	5.00	MO 9	MOG-S1/MOG-H1	4 - 6.3
14	4	3.00	6.40	MO 9	MOG-S1/MOG-H1	6.3 - 10
15	5	3.70	7.90	MO 9	MOG-S1/MOG-H1	6.3 - 10
16	5.5	4.00	8.50	MO 9	MOG-S1/MOG-H1	6.3 - 10
17	6	4.50	9.00	MO 12	MOG-S1/MOG-H1	9 - 13
18	7.5	5.50	11.20	MO 12	MOG-H1	11 - 16
19	10	7.50	14.80	MO 18	MOG-H1	14 - 20
20	12.5	9.30	19.00	MO 25	MOG-H1	19 - 25
21	15	11.00	22.00	MO 25	MOG-H1	24 - 32
22	17.5	13.00	24.00	MO 32	MOG-H1	24 - 32
23	20	15.00	29.00	MO 32	MOG-H2	28 - 40
24	25	18.60	35.00	MO 40	MOG-H2	35 - 50
25	30	22.50	40.00	MO 40	MOG-H2	35 - 50
26	35	26.00	47.00	MO 50	MOG-H2	45 - 63

Notes :

- Selection Chart is for Standard 3-phase, Squirrel cage Motor with Average Power Factor, and Efficiency
- Motor ratings at 415V, 50Hz
- Normal Motor Starting time (5 sec.) is assumed. For higher Starting time, refer back to L&T
- Selection is valid only for complete L&T combinations ie. "Contactor & MPCB". Compliance to Type '2' co-ordination is not assured in case these combinations are changed to accommodate another brand / rating of products

Selection Chart for Fuseless protected DOL Starter Feeders with MPCBs, Type 'MOG-H1M/H2M'

Type '2' Co-ordination, Iq=50kA at 415V, 3Ø, 50Hz
as per Standards : IEC 60947-4-1, IS 13947 (Part 4/Sec 1), EN 60947-4-1

Sr. No.	Motor Rating: 3ϕ, 415V, 50Hz			Contactor	Overload Relay		MPCB	
	hp	kW	FLC, In (A)	Type	Type	Range (A)	Type	Rating (A)
1	0.125	0.09	0.4	MO 9	RTO 1	0.31 - 0.55	MOG - H1M	0.63
2	0.16	0.12	0.45	MO 9	RTO 1	0.31 - 0.55	MOG - H1M	0.63
3	0.2	0.15	0.57	MO 9	RTO 1	0.55 - 0.85	MOG - H1M	1
4	0.25	0.19	0.75	MO 9	RTO 1	0.55 - 0.85	MOG - H1M	1
5	0.33	0.25	0.9	MO 9	RTO 1	0.78 - 1.2	MOG - H1M	1.6
6	0.5	0.37	1.2	MO 9	RTO 1	1.2 - 2.0	MOG - H1M	1.6
7	0.75	0.55	1.6	MO 9	RTO 1	1.2 - 2.0	MOG - H1M	2.5
8	1	0.75	2.1	MO 9	RTO 1	1.9 - 2.8	MOG - H1M	2.5
9	1.5	1.1	2.7	MO 9	RTO 1	2.4 - 3.6	MOG - H1M	4
10	1.75	1.3	3	MO 9	RTO 1	2.4 - 3.6	MOG - H1M	4
11	2	1.5	3.5	MO 9	RTO 1	3.5 - 5.2	MOG - H1M	6.3
12	2.5	1.8	4.8	MO 9	RTO 1	3.5 - 5.2	MOG - H1M	6.3
13	3	2.25	5	MO 9	RTO 1	4.6 - 6.7	MOG - H1M	6.3
14	4	3	6.4	MO 9	RTO 1	4.6 - 6.7	MOG - H1M	10
15	5	3.7	7.9	MO 9	RTO 1	6.7 - 9.7	MOG - H1M	10
16	5.5	4	8.5	MO 9	RTO 1	6.7 - 9.7	MOG - H1M	10
17	6	4.5	9	MO 12	RTO 1	8.5 - 12.5	MOG - H1M	13
18	7.5	5.5	11.2	MO 12	RTO 1	8.5 - 12.5	MOG - H1M	16
19	10	7.5	14.8	MO 18	RTO 1	12.5 - 18.5	MOG - H1M	20
20	12.5	9.3	19	MO 25	RTO 1	17 - 25.5	MOG - H1M	25
21	15	11	22	MO 25	RTO 1	17 - 25.5	MOG - H1M	32
22	17.5	13	24	MO 32	RTO 1	17 - 25.5	MOG - H1M	32
23	20	15	29	MO 32	RTO 1	25 - 37	MOG - H2M	40
24	25	18.6	35	MO 40	RTO 1	25 - 37	MOG - H2M	50
25	30	22.5	40	MO 40	RTO 1	35 - 45	MOG - H2M	50
26	35	26	47	MO 50	MN 5	30 - 50	MOG - H2M	63

Notes :

- Selection Chart is for Standard 3-phase, Squirrel cage Motor with Average Power Factor and Efficiency
- Motor ratings at 415V, 50Hz
- Normal Motor Starting time (5 sec.) is assumed; for higher Starting time, refer back to L&T
- Selection is valid only for complete L&T combinations ie. "Contactor, Relay & MPCB"; compliance to Type '2' co-ordination is not assured in case these combinations are changed to accommodate another brand / rating of products

Selection Chart for Capacitor switching

According to IEC 60947-4-1: AC-6b Utilization category

When capacitors are switched into a circuit, they are charged for a transient period. During this period, high current peaks at frequencies of the order of a few thousand hertz, may be produced. These naturally impose particular demands on the switchgear. The amplitude and frequency of these switch-on currents are determined by characteristics and configuration of the electrical network.

Consequences for the contactors

For fixed capacitor banks, a conventional three pole contactor can be employed provided the inrush current is lower than the peak current capacity of the contactor. For APFC arrangements, it is advisable to use our capacitor switching contactor type MPX.

Application

The peak switching current and capacitors power ratings that MO contactor can switch are given below. The capacitors must be discharged (maximum residual voltage at terminals < 50V) before being re-energized.

Selection Table

Type	Power in kVAr 50/60Hz (AC-6b)						
	220/240V			415/440V			Max peak current
	40°C	55°C	70°C	40°C	55°C	70°C	I (kA)
MO 9	4	4	3	7	7	6	0.4
MO 12	5	5	4	9	9	8	0.5
MO 18	7	7	6	14	14	11	0.7
MO 25	10	10	9	19	19	16	1.0
MO 32	13	13	11	24	24	20	1.3
MO 40	16	16	14	30	30	26	1.6
MO 45	19	19	16	34	34	29	1.8
MO 50	21	21	17	38	38	32	2.0
MO 60	25	25	21	45	45	38	2.4
MO 70	29	29	24	53	53	45	2.8
MO 80	33	33	28	60	60	51	3.2
MO 95	39	39	33	71	71	61	3.7
MO 110	45	45	38	83	83	70	4.3

If in an application, the current peak is greater than the maximum peak current specified in the table above, select a higher rating contactor or add inductances.

Notes :

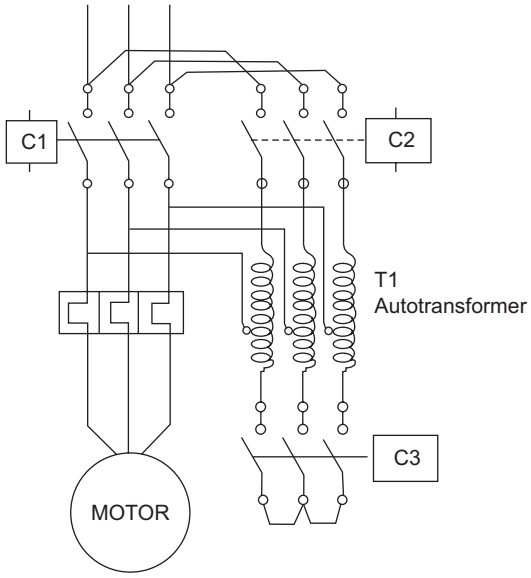
- The ratings given below are for single stage capacitors connected in star
- The rating of fuse to be 1.5 to 1.8 times the rated capacitors current
- The rating of fuse to be 1.5 to 1.8 times the rated capacitors current
- Use gG type of fuse for SC protection of capacitor bank
- For higher values of peak in-rush current other than specified above, use of current limiting reactor is must, alternatively higher ratings / contactors may be used

Selection Chart for Auto Transformer starters

An autotransformer starter reduces inrush current by using a transformer in the line just ahead of the motor to step down the voltage applied to the motor terminals. By reducing the voltage, the current drawn from the line is reduced during start-up. Starting with reduced voltage decreases the full load current at the motor terminals in proportion to the voltage reduction while the full load torque is reduced by the square of the voltage reduction.

As shown in the wiring diagram

- Star connection of the autotransformer is made by C3, then contactor C2 closes and the motor starts under reduced voltage
- The neutral point is opened by C3; part of the autotransformer winding is switched into each phase for a short moment, constituting a stator starting inductance
- C1 switches the motor to full mains voltage and causes the autotransformer to be shunted out of circuit by C2



Contactor Switching Sequence

Contactors	Start	Transition (initial)	Transition (final)	ON
C3 (Star)	Close	Open	Open	Open
C2 (Step)	Close	Close	Close	Open
C1 (Main)	Open	Open	Close	Close

Selection Table

Sr. No.	Motor Rating : 3ϕ, 415V, 50Hz			Contactors					Overload Relay		Nominal Backup fuse		Switch Disconnector Fuse
	hp	kW	In (A)	Main (C1)	Step (C2)			Star (C3)	Type	Range (A)	Type	Rating (A)	
					50%	65%	80%						
1	7.5	5.5	11.2	MO 12	MO 9	MO 9	MO 9	MO 9	RTO 1	8.5 - 12.5	HF	32	FN 32 / FNX 32
2	10	7.5	14.8	MO 18	MO 9	MO 9	MO 12	MO 9	RTO 1	12.5 - 18.5	HF	32	FN 32 / FNX 32
3	12.5	9.3	19	MO 25	MO 9	MO 9	MO 18	MO 9	RTO 1	17 - 25.5	HF	50	FN 63 / FNX 63
4	15	11	22	MO 25	MO 9	MO 12	MO 18	MO 12	RTO 1	17 - 25.5	HF	63	FN 63 / FNX 63
5	17.5	13	24	MO 32	MO 9	MO 12	MO 18	MO 12	RTO 1	17 - 25.5	HF	63	FN 63 / FNX 63
6	20	15	29	MO 32	MO 9	MO 18	MO 25	MO 18	RTO 1	25 - 37	HF	63	FN 63 / FNX 63
7	25	18.6	35	MO 40	MO 9	MO 18	MO 25	MO 18	RTO 1	35 - 45	HN, 000*	80	FN 100 / FNX 100*
8	30	22.5	40	MO 45	MO 12	MO 18	MO 32	MO 18	RTO 1	35 - 45	HN, 000*	80	FN 100 / FNX 100*
9	35	26	47	MO 50	MO 12	MO 25	MO 32	MO 25	MN 5	30 - 50	HN, 000*	100	FN 100 / FNX 100*
10	40	30	55	MO 70	MO 18	MO 25	MO 40	MO 25	MN 5	45 - 75	HN, 000*	100	FN 100 / FNX 100*
11	45	33.5	60	MO 70	MO 18	MO 32	MO 40	MO 32	MN 5	45 - 75	HN, 000*	100	FN 100 / FNX 100*
12	50	37	66	MO 80	MO 18	MO 32	MO 45	MO 32	MN 5	45 - 75	HN, 00	125	FN 125 / FNX 125
13	60	45	80	MO 95	MO 25	MO 40	MO 70	MO 40	MN 5	66 - 110	HN, 00	125	FN 125 / FNX 125
14	75	55	100	MO 110	MO 32	MO 45	MO 70	MO 45	MN 5	66 - 110	HN, 00#	160	FN 160 / FNX 160#

Selection Chart for Three Phase Slip Ring Motor

According to IEC 60947-4-1: AC-2 Utilization category

Three kinds of contactors are used to control three-phase slip-ring motors:

- The Stator Contactors
- The Acceleration Contactors
- The Rotor Short Circuit Contactors

Stator Contactors

The starting current is determined by the value of rotor resistance. It may reach 1.5 to 4 times rated motor operational current. The table below gives permissible values of Ie/AC-2 rated operational stator current, as a function of the load factor. The table is valid for a maximum switching frequency of 600 cycles an hour and a temperature of 55^{0}C max near the contactor.

Contactors			MO 9	MO 12	MO 18	MO 25	MO 32	MO 40	MO 45	MO 50	MO 60	MO 70	MO 80	MO 95	MO 110
Load Factor	15%	Ie/AC-2 (A)	13.5	19	26	35	50	55	55	70	95	125	125	200	220
	25%	Ie/AC-2 (A)	12	17	23	32	45	50	50	63	85	110	110	165	185
	40%	Ie/AC-2 (A)	10.5	15	19.5	27	39	42	42	54	73	95	95	135	150
	60%	Ie/AC-2 (A)	9.5	13	17.5	2	34	37	37	48	65	85	85	120	135

Acceleration Contactors

The sizing of these contactors is based on the AC-1 rated operational current. Delta connection of these contactors is considered (reduce currents by 35% if star connection is used). The table below lists the permissible limit value of the motor rated operational rotor current. This table takes into account the number of cycles per hour (without inching) and the current flow time per cycle, in the contactor.

Contactors	MO 9	MO 12	MO 18	MO 25	MO 32	MO 40	MO 45	MO 50	MO 60	MO 70	MO 80	MO 95	MO 110
Rated operational current Ie/AC-1 for air temperature near the contactor $\leq$ =55^{0}C	22	25	27	40	55	60	60	85	95	105	105	135	145

Rotor Short-Circuit Contactors

The duty of this contactor is characterised by small closing stresses. The decisive factor while selecting a contactor is the thermal stress. Delta connection of the contactor is considered (reduce currents by 35% if star connection is used). The following table gives the permissible values of the rated operational rotor current, as a function of load factor. Temperature: 55^{0}C maximum near the contactor.

Contactors			MO 9	MO 12	MO 18	MO 25	MO 32	MO 40	MO 45	MO 50	MO 60	MO 70	MO 80	MO 95	MO 110
Load Factor	15%	Ie/AC-2 (A)	45	58	70	105	112	125	125	160	210	245	245	290	330
	25%	Ie/AC-2 (A)	40	51	63	93	102	115	115	140	180	215	215	260	300
	40%	Ie/AC-2 (A)	35	42	54	80	87	95	95	120	155	185	185	230	260
	60%	Ie/AC-2 (A)	30	39	47	70	76	86	86	110	140	163	163	200	230
Rated operational rotor voltage: Maximum value for starting and breaking (V)			1100 (1320 if star connection)											2200 (2600)	
Maximum value for starting and electrical breaking (V)			550 (600 if star connection)											690 (730)	

Selection Chart for Lighting Circuit Switching

According to IEC 60947-4-1: AC-5a, 5b Utilization category

The operating conditions of lighting circuits have the following characteristics:

- Continuous duty: the switching device can remain closed for several days or even months
- A dispersion factor of 1: all luminaries in the same group are switched ON or OFF simultaneously
- A relatively high temperature around the device due to the enclosure, the presence of fuses, or an unventilated control panel location

Contactor Selection

Based on:	Considerations:
• A 220/240V single-phase circuit • An ambient temperature of 55^{0}C, taking into account the operating conditions • An electrical life of more than 10 years (200 day's operation per year)	• The total current • Transient phenomena which occur at switch-on • The starting current and their duration • The circulation of any harmonics which may be present

Incandescent and halogen lamps

Voltage: 220/240V AC

Lamp characteristics		Maximum permissible number of lamps per phase												
W	A	MO 9	MO 12	MO 18	MO 25	MO 32	MO 40	MO 45	MO 50	MO 60	MO 70	MO 80	MO 95	MO 110
60	0.27	57	65	70	103	142	155	155	220	246	272	272	355	390
100	0.45	34	38	42	62	85	93	93	132	147	163	163	210	240
200	0.91	17	19	20	30	42	46	46	65	73	80	80	105	120
300	1.37	11	12	13	20	28	30	30	43	48	53	53	70	80
500	2.28	6	7	8	12	16	26	26	26	29	32	32	42	48
1000	4.55	3	4	4	6	8	13	13	13	14	16	16	21	24

Fluorescent lamps with starter single fitting

Voltage: 220/240V AC

Lamp characteristics		Maximum permissible number of lamps per phase												
W	A	MO 9	MO 12	MO 18	MO 25	MO 32	MO 40	MO 45	MO 50	MO 60	MO 70	MO 80	MO 95	MO 110
Non Corrected														
20	0.39	41	41	53	66	89	112	112	143	143	143	205	205	410
40	0.45	35	35	46	57	77	97	97	124	124	124	177	177	354
65	0.70	22	22	30	37	50	62	62	80	80	80	114	114	228
80	0.80	20	20	26	32	43	55	55	70	70	70	100	100	200
110	1.2	13	13	17	21	29	36	36	46	46	46	66	66	132
With parallel Correction														
20	0.17	94	94	123	152	205	258	258	329	329	329	470	470	940
40	0.26	61	61	80	100	134	169	169	215	215	215	367	367	614
65	0.42	38	38	50	61	83	104	104	133	133	133	190	190	380
80	0.52	30	30	40	50	67	84	84	107	107	107	153	153	306
110	0.72	22	22	29	36	48	61	61	77	111	111	222	222	266

Three phase Transformer Switching

According to IEC 60947-4-1 Utilization Category: AC-6a

A very high current peak of extremely short duration is produced when a low-voltage transformer is switched on. These inrush currents, which are caused by the initial build-up of the magnetic field, may be as high as 30 times the rated current of the transformer. The inrush currents are, however, different for each transformer type. They are dependent on the following:

- The position of transformer winding
- The characteristic values of the magnetic circuit
- The phase angle of the voltage at the instant of switch-on

Contactor selection is based on the making and continuous current carrying capacity.

Selection Table

AC operated contactors		MO 9	MO 12	MO 18	MO 25	MO 32	MO 40	MO 45	MO 50	MO 60	MO 70	MO 80	MO 95	MO 110
Operational Power at Ue : 50/60 Hz														
220/440 V	kVA	4	4	5	9.5	13	15	15	19	20	22	22	23	26
415/440 V	kVA	8	8	9	18	24	28.5	28.5	36	38	41	41	43	50
Maximum Permissible I_{peak}	A	330	330	360	750	1000	1200	1200	1500	1600	1700	1700	1800	2100

Maximum permissible control cable lengths

The permissible length of control cable for 50 Hz networks is given by the formula below:-

$$L_{perm} \cong 3.184 \left(\frac{m}{1+m}\right)\left(\frac{P_H \times 10^6}{U_c^2 \times C_c}\right) \text{ meters}$$

where,

m is the per unit drop-off voltage of contactor in V
U_d is the minimum drop-off voltage in V
U_c is the rated control supply voltage in V
P_H is the rated hold-on power of the contactor in VA
C_c is the cable capacitance in microfarad/km

Family	Contactors	Hold-on Power (P_H)	Per Unit Drop-off (m)	Max. Length, L(in meters)		
		(VA)	Ud/Uc	for 110 VAC	for 240 VAC	for 415 VAC
MO	MO 9/12/18/25/32/40/45	8	0.40	3010	630	210
	MO 50/60/70	14	0.40	5260	1105	370
	MO 80/95/110	22	0.40	8270	1740	580

Notes:
- All values for 50 Hz Coil Voltage
- Cable Capacitance (C_c) assumed 0.2 microfarad/km
- The values need to be corrected for decrease in permanent air gap if the contactor is required to perform more than 1 million operating cycles the correction factor is approximately 0.5

RTO

THERMAL OVERLOAD RELAYS

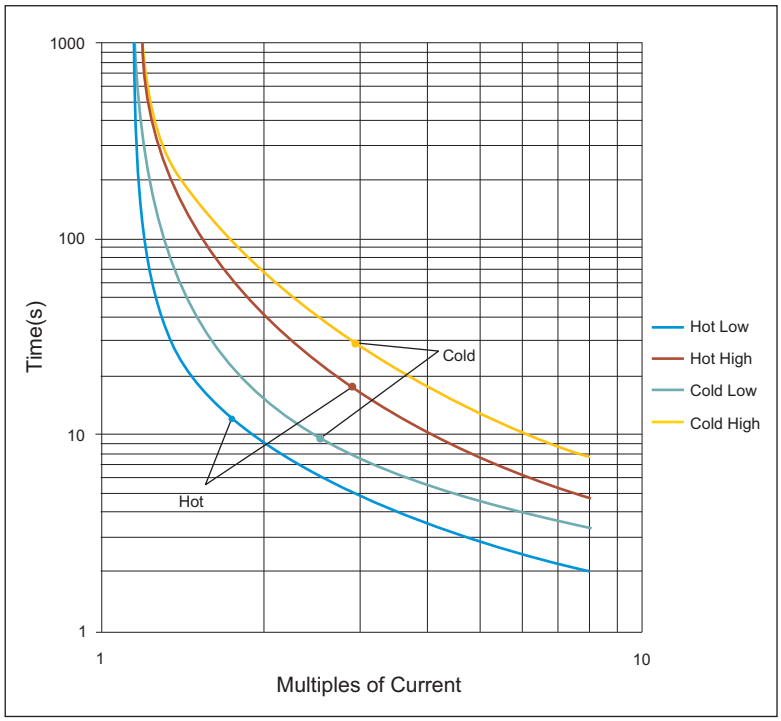
L&T introduces RTO range of Thermal Overload Relays to complement the MO range of contactors. RTO-1 thermal overload relay is available in 16 ranges from 0.2A to 40A in 45mm width. It protects the load against overload and phase failure and is modular in design.

Features	• Visual status indication-tripped / non-tripped from front • Phase failure sensitive • Ambient temperature compensated • Auto manual / Reset function • Trip free feature • Test function-simulates the tripping of the Relay from the front • Front access to START and STOP/RESET buttons • Three contacts: Alarm, Trip and Start • Isolated alarm circuit (N.O.) contact • Sealable in OFF condition • Hingeable shroud • Sealable transparent top cover
Accessories	• Mounting Adapter for separate mounting • Mechanical Reset Cord

Technical Details

Type	RTO-1	MN5
	Main Circuit	
Rated insulation voltage (U_i)	690V	
Rated impulse withstand voltage (U_{imp})	6kV	
Rated operational voltage	415V, 50Hz	
Type of operation	Direct acting, Trip free mechanism	
Trip class	10A	
	Wires	Lugs
Main terminal capacity	Solid-2x2.5 to 1x10 sq. mm Finely stranded-2x2.5 to 6 sq. mm Tightening Torque - 2.5 Nm Type of screw - M4, Class 6.8 for power conductors.	50 sq. mm
Temp. compensation	-20°C to +55°C	-5°C to +55°C
No. of contacts	**Auxiliary Circuit**	
	1 NO - Alarm	
	1 NO - Start	
	1 NC - Trip	
Rated insulation voltage	690V	
Rated impulse withstand voltage	6kV	
AC-15 Rating	2A at 415V, 50Hz	
Thermal current	6 Amp.	
Terminal capacity	2x2.5 mm², solid or finely stranded Type of screw - M3, Class 6.8 Tightening Torque-1.5 Nm	2x2.5 mm², solid or finely stranded

I-T Characteristics



Tripping characteristics of RTO-1 Thermal Overload Relays

Ordering Details

MO Contactors

Type	AC1 Rating (A)	AC3 Rating (A)	Cat. Nos.
MO 9	30	9	CS94564
MO 12	35	12	CS94565
MO 18	40	18	CS94566
MO 25	45	25	CS94567
MO 32	50	32	CS94568
MO 40	50	40	CS94569
MO 45	50	45	CS94570
MO 50	65	50	CS94572
MO 60	80	60	CS94573
MO 70	110	70	CS94574
MO 80	125	80	CS94576
MO 95	145	95	CS94577
MO 110	160	110	CS94578

RTO Thermal Overload Relays

Type	Range (A)	Cat. Nos.
RTO-1	0.23 - 0.41	CS96355OOFO
	0.31 - 0.55	CS96355OOGO
	0.55 - 0.85	CS96355OOJO
	0.78 - 1.2	CS96355OOLO
	1.2 - 2.0	CS96355OONO
	1.9 - 2.8	CS96355OOPO
	2.4 - 3.6	CS96355OOQO
	3.5 - 5.2	CS96355OOSO
	4.6 - 6.7	CS96355OOTO
	6.7 - 9.7	CS96355OOVO
	8.5 - 12.5	CS96355OOAO
	12.5 - 18.5	CS96356OOCO
	17 - 25.5	CS96356OODO
	25 - 37	CS96356OOEO
	35 - 45	CS96356OOGO

Accessories

Add-on auxiliary contact block, suitable for all MO contactors

Mounting Position	Contacts	Terminal Marking	Cat. Nos.
Side Mounted First Left	1 NO + 1 NC	13 - 14, 21 - 22	CS94580
Side Mounted First Right	1 NO + 1 NC	33 - 34, 41 - 42	CS94581
Side Mounted Second Left	1 NO + 1 NC	53 - 54, 61 - 62	CS94582
Side Mounted Second Right	1 NO + 1 NC	73 - 74, 81 - 82	CS94583
Top Mounted Single Pole	1 NO	13 - 14	CS94585
Top Mounted Single Pole	1 NC	11 - 12	CS94586
Top Mounted Two Pole	2 NO	13 - 14, 23 - 24	CS94591
Top Mounted Two Pole	1 NO + 1 NC	13 - 14, 21 - 22	CS94592
Top Mounted Two Pole	2 NC	11 - 12, 21 - 22	CS94593
Top Mounted Four Pole	4 NO	13 - 14, 23 - 24, 33 - 34, 43 - 44	CS94594
Top Mounted Four Pole	3 NO + 1 NC	13 - 14, 23 - 24, 33 - 34, 41 - 42	CS94595
Top Mounted Four Pole	2 NO + NC	13 - 14, 23 - 24, 31 - 32, 41 - 42	CS94596
Top Mounted Four Pole	1 NC + 3 NO	13 - 14, 21 - 22, 31 - 32, 41 - 42	CS94597
Top Mounted Four Pole	4 NC	11 - 12, 21 - 22, 31 - 32, 41 - 42	CS94598

Ordering suffix for coil voltage

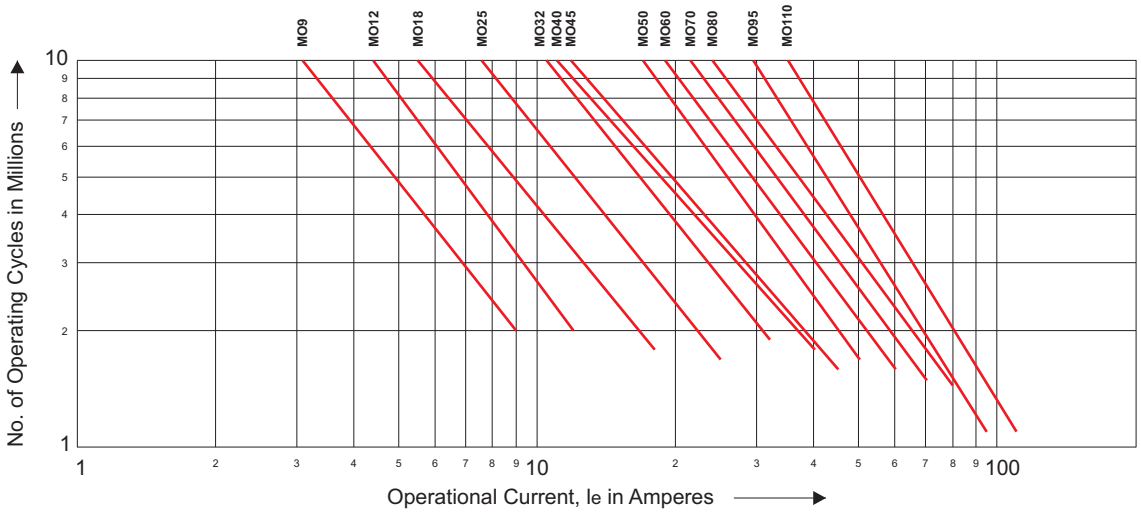
AC	24V	42V	48V	110V	120V	230V	220/240V	240V	320V	360V	380V	415V	440V	525V
Coils	GOOO	HOOO	JOOO	AOOO	KOOO	NOOO	QOOO	BOOO	ROOO	COOO	LOOO	DOOO	POOO	MOOO

Adapter link for mounting MN5 Relays on MO Contactors

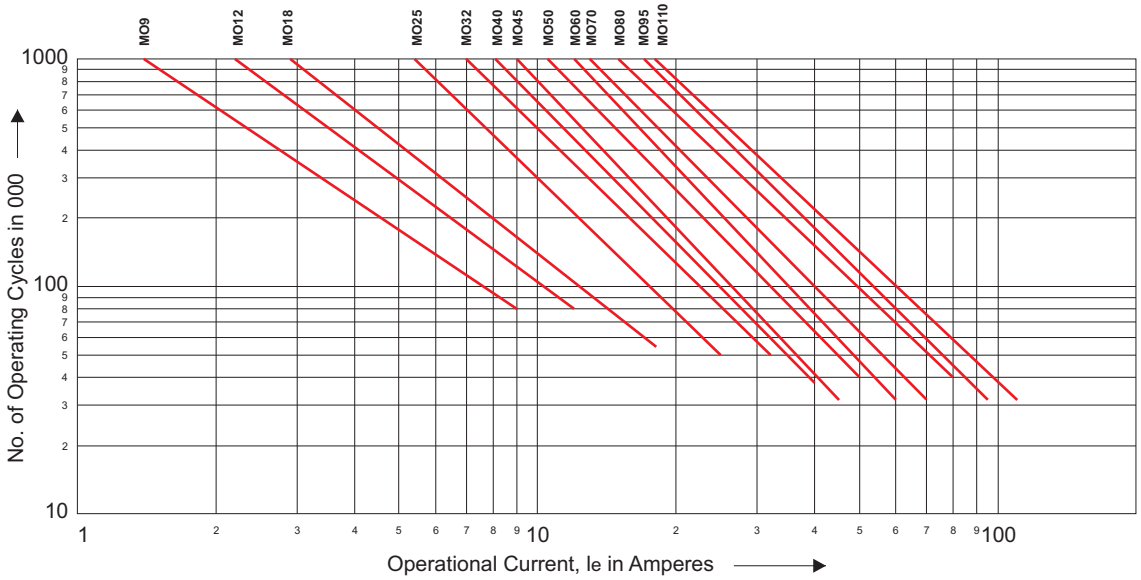
Description	Cat. No.
Link for Mounting MN5 Relay on MO 50/60/70	CS96433OOOO
Link for Mounting MN5 Relay on MO 80/95/110	CS96432OOOO

Electrical Life Curves

Utilisation Category AC-3



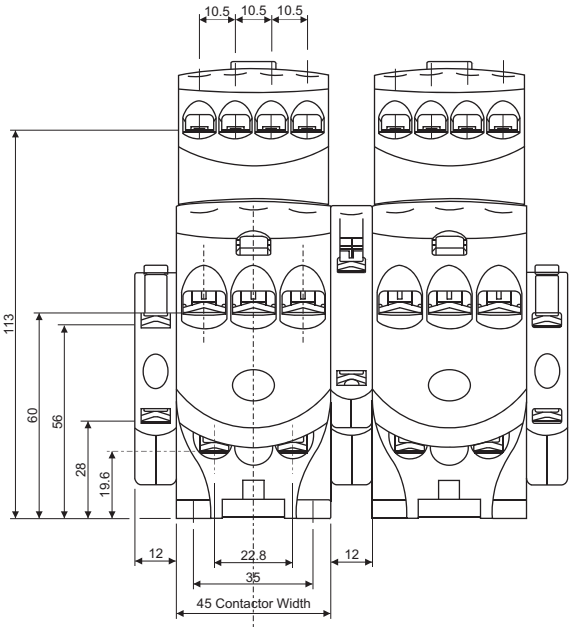
Utilisation Category AC-4

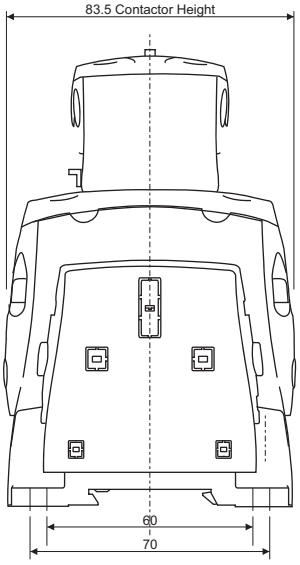


Dimensional Drawings

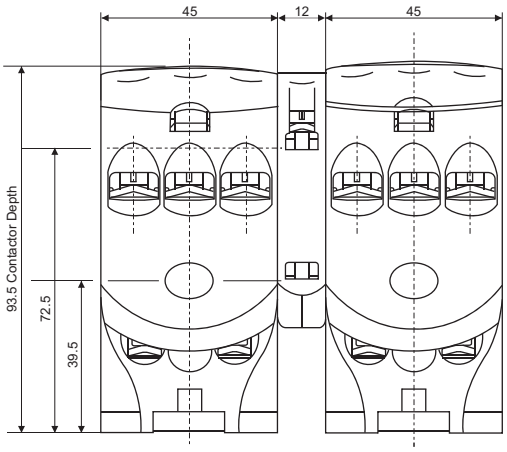
MO Frame I: 9, 12, 18, 25, 32, 40, 45

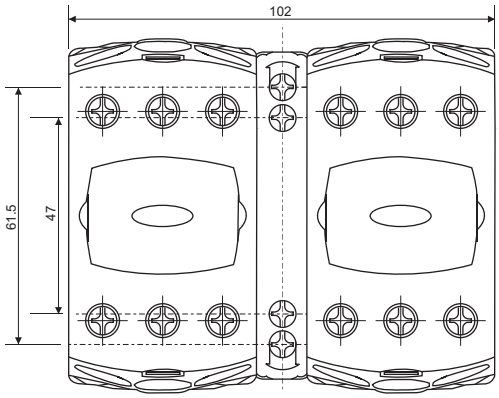
Overall Dimensions With Auxiliary Contact Block

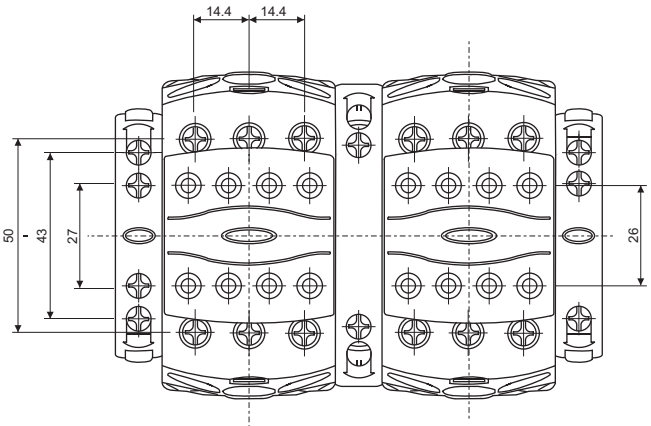




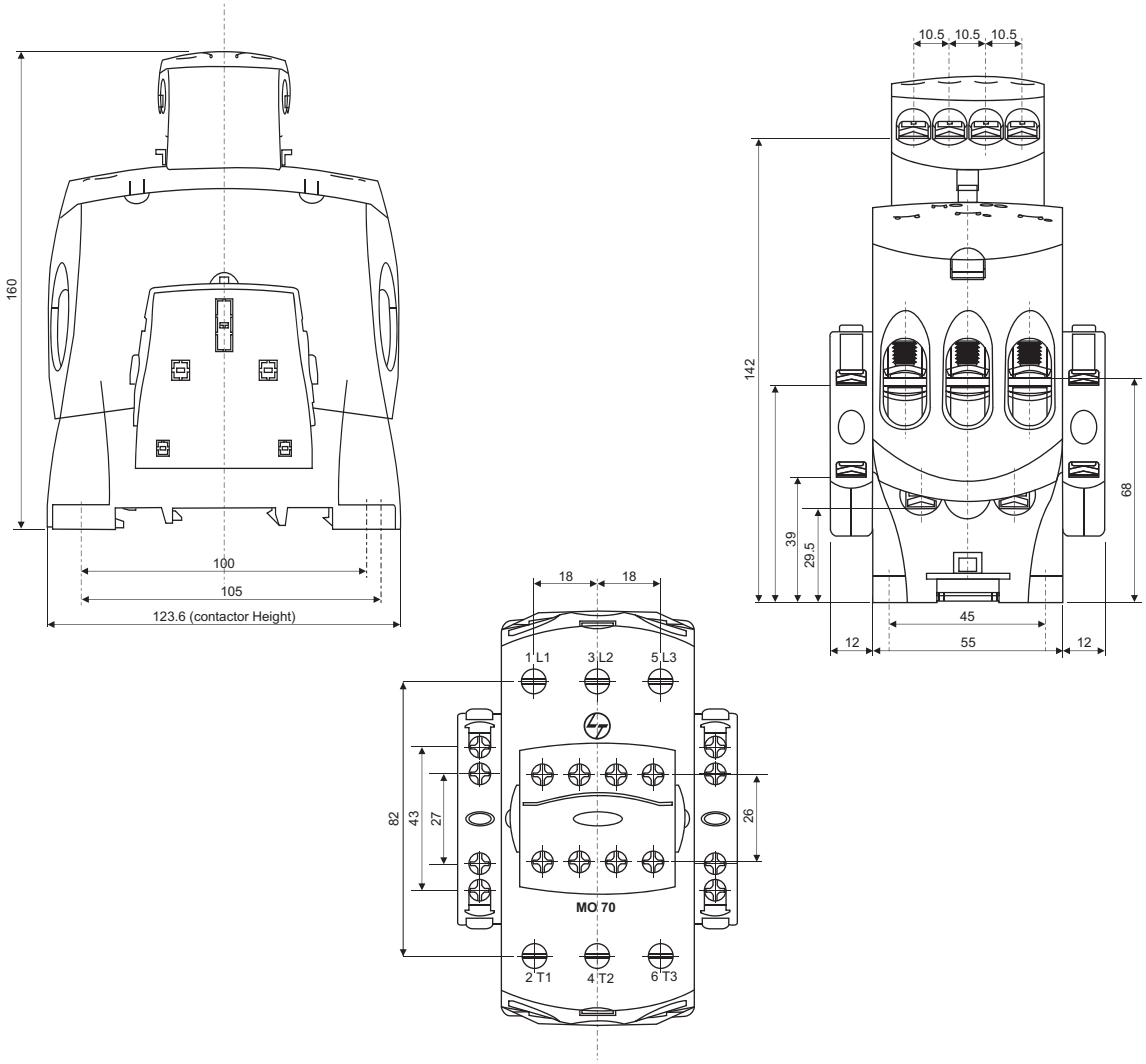
Overall Dimensions with Mechanical Interlock



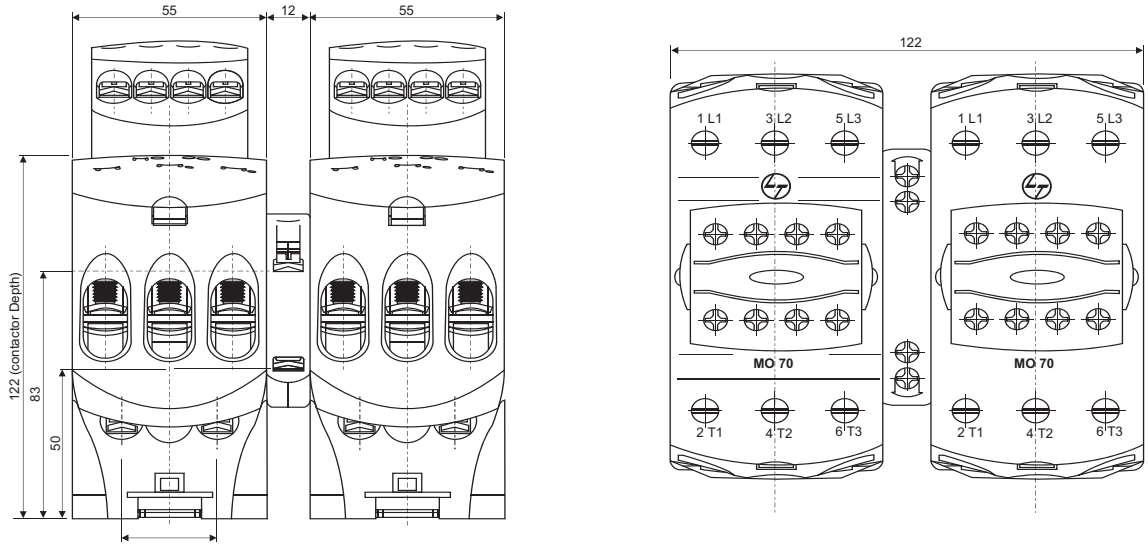




Overall Dimensions With Auxiliary Contact Block



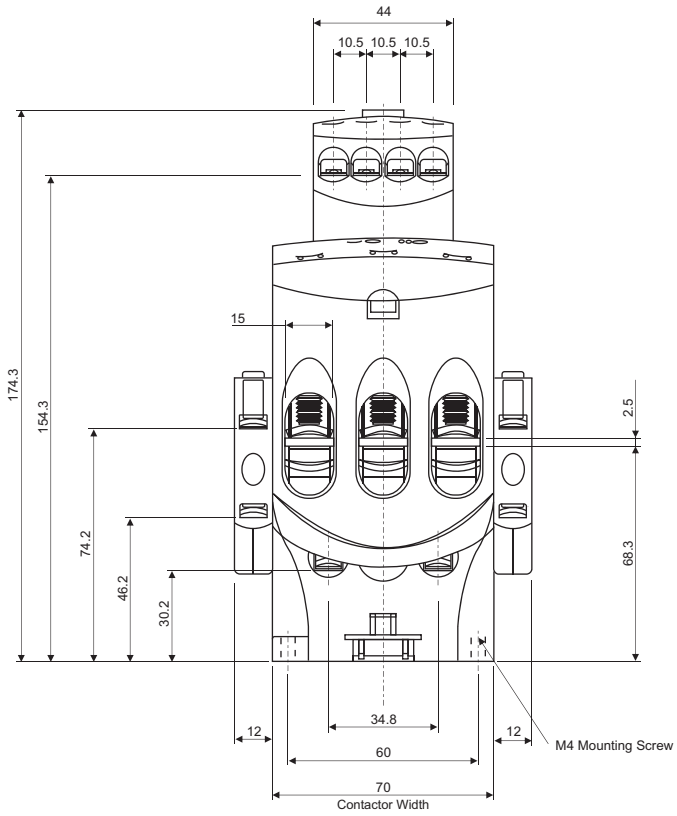
Overall Dimensions with Mechanical Interlock

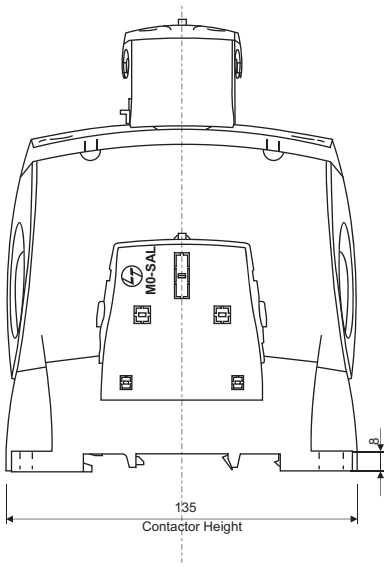


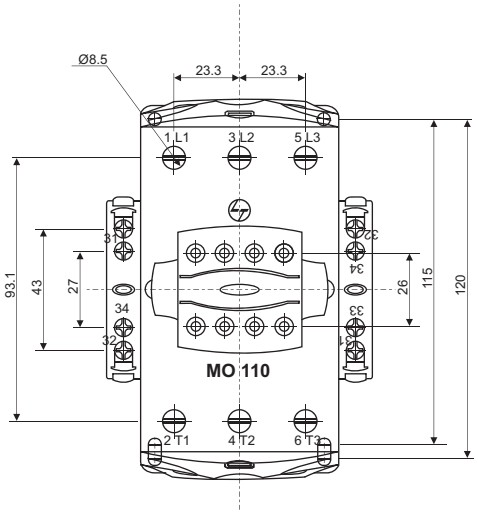
Dimensional Drawings

MO Frame III: 80, 95, 110

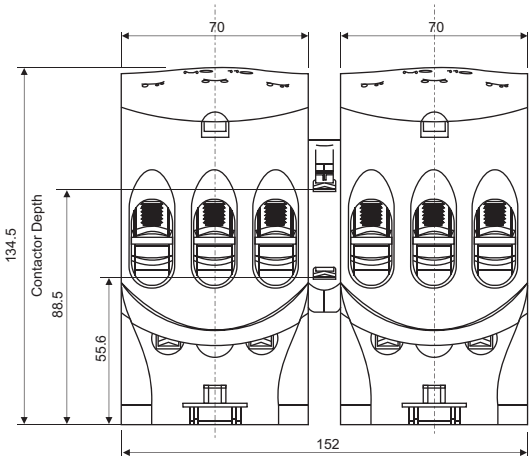
Overall Dimensions With Auxiliary Contact Block

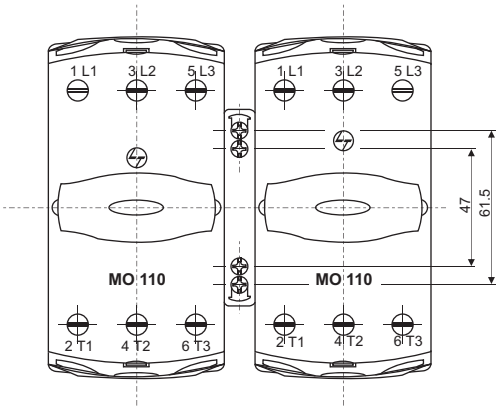






Overall Dimensions with Mechanical Interlock





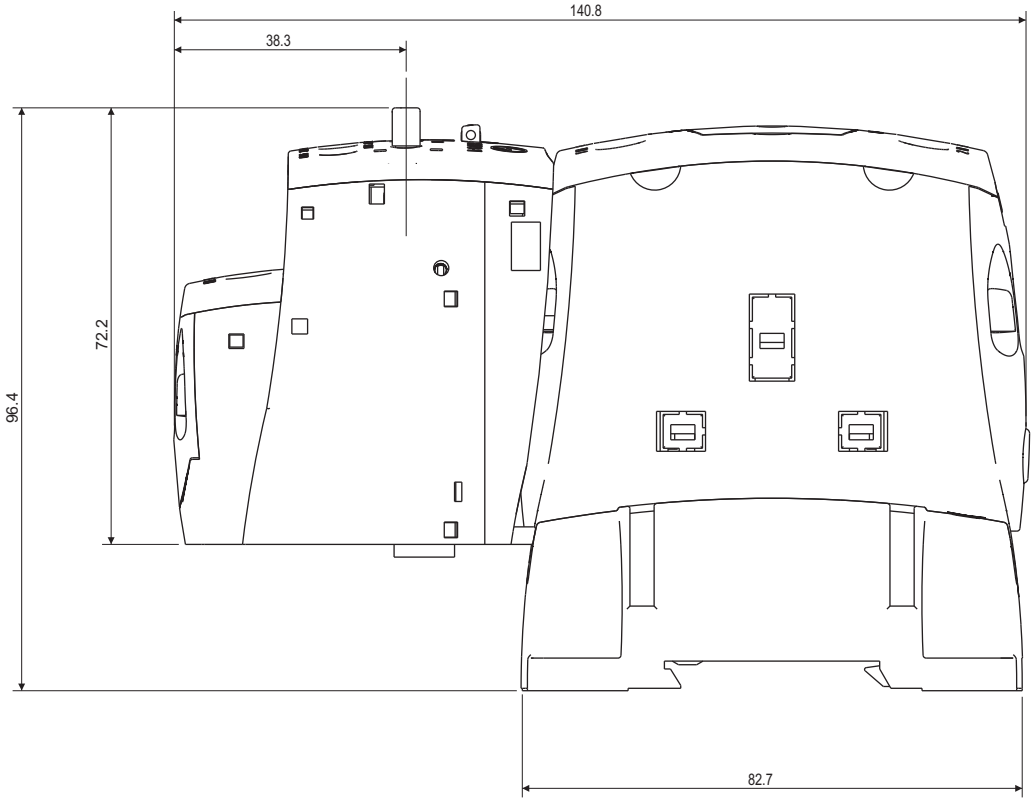
All dimensions in mm.

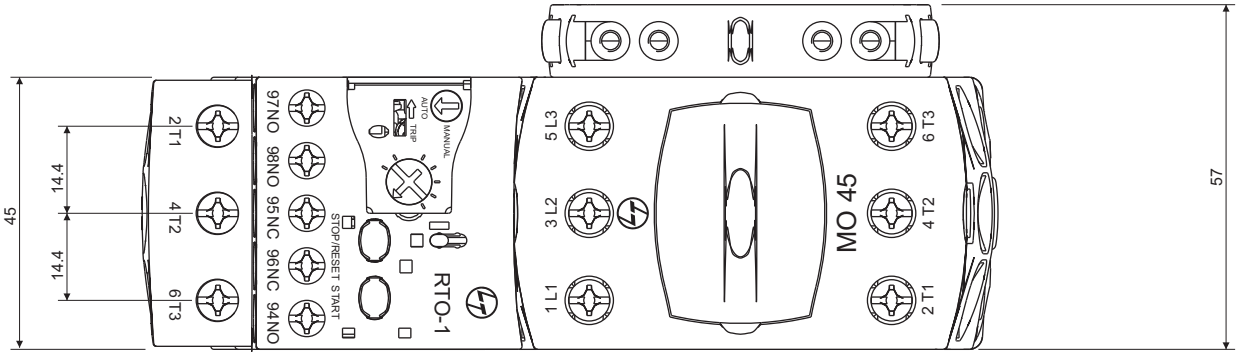
Note: Mechanical interlock kit can be fitted even with side auxiliary contacts in that case width will increase by 12 mm per auxiliary contact block.

Dimensional Drawings

MO-RTO-1

Overall Dimensions of RTO-1 relay mounted on MO contactor





All dimensions in mm.

Note: RTO-1 can be directly mounted to MO frame 1.

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Product improvement is a continuous process. For the latest information and special applications, please contact any of our offices listed here.

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