

**L&T SWITCHGEAR**

SAFE & SURE

**OVERLOAD RELAYS, STARTERS  
TESTING, INSTALLATION &  
TROUBLE SHOOTING.**



**LARSEN & TOUBRO LIMITED**

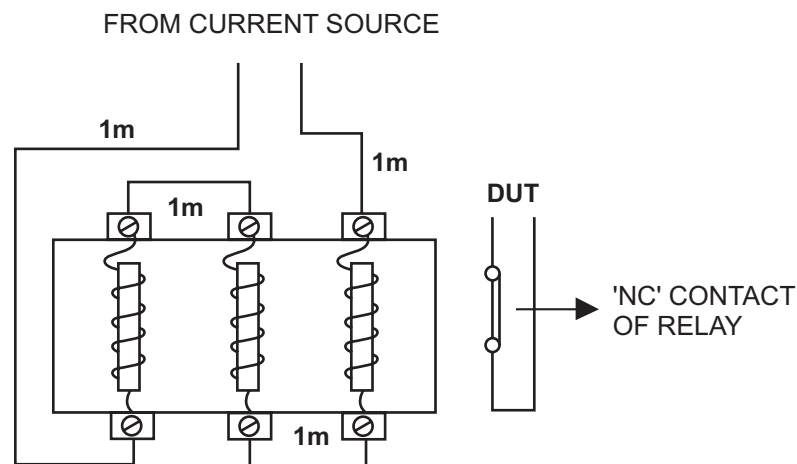
## ▶ TESTING OF THERMAL OVERLOAD RELAY

1. Fill up the following data of relay under test.
  - a) Relay Type \_\_\_\_\_
  - b) Relay Range \_\_\_\_\_
  - c) Max. Back up fuse rating \_\_\_\_\_
2. Check continuity of auxiliary contacts and main poles.
  - a) Normally open \_\_\_\_\_
  - b) Normally closed \_\_\_\_\_
  - c) R Pole \_\_\_\_\_
  - d) Y Pole \_\_\_\_\_

**NOTE : If the answer is O.K. to all above points then only take the relay for overload testing.**

3. Select the proper size of cable for connection. In case of smaller size of cable or improper termination, relay may trip early.
4. Connect all three poles of relay in series as shown in the following diagram. Use proper size of cables. Length of cable should be one metre.
5. Connect normally closed (NC) contact of relay in series with test panel's auxiliary contact. (This will give relay trip to test panel.)

## ▶ OVERLOAD TEST



6. Set the relay and calculate the test current as follows:

Relay Setting	X	Multiples of Set Current (% of overload)	=	Test Current Amps
Eg.: 10 Amps.	X	2(200%)	=	20 Amps
1.	X	2(200%)	=	
2.	X	3(300%)	=	

7. Find out the minimum and maximum trip time with respect to multiples of set current you have selected and note down the values in the following table.

Sr. No.	Relay Setting	Test Current (Amp)	Trip Time in Seconds i-t characteristics.		Actual	Remark OK / Not OK
			As per Curve			
			Min.	Max.		
1.						
2.						

8. Switch on the supply and adjust the test current. Immediately switch off the current. Keep variac at adjusted position. Reset the time counter. Cool the relay for about 10 minutes.

9. Switch on the test current and check trip time of the relay.

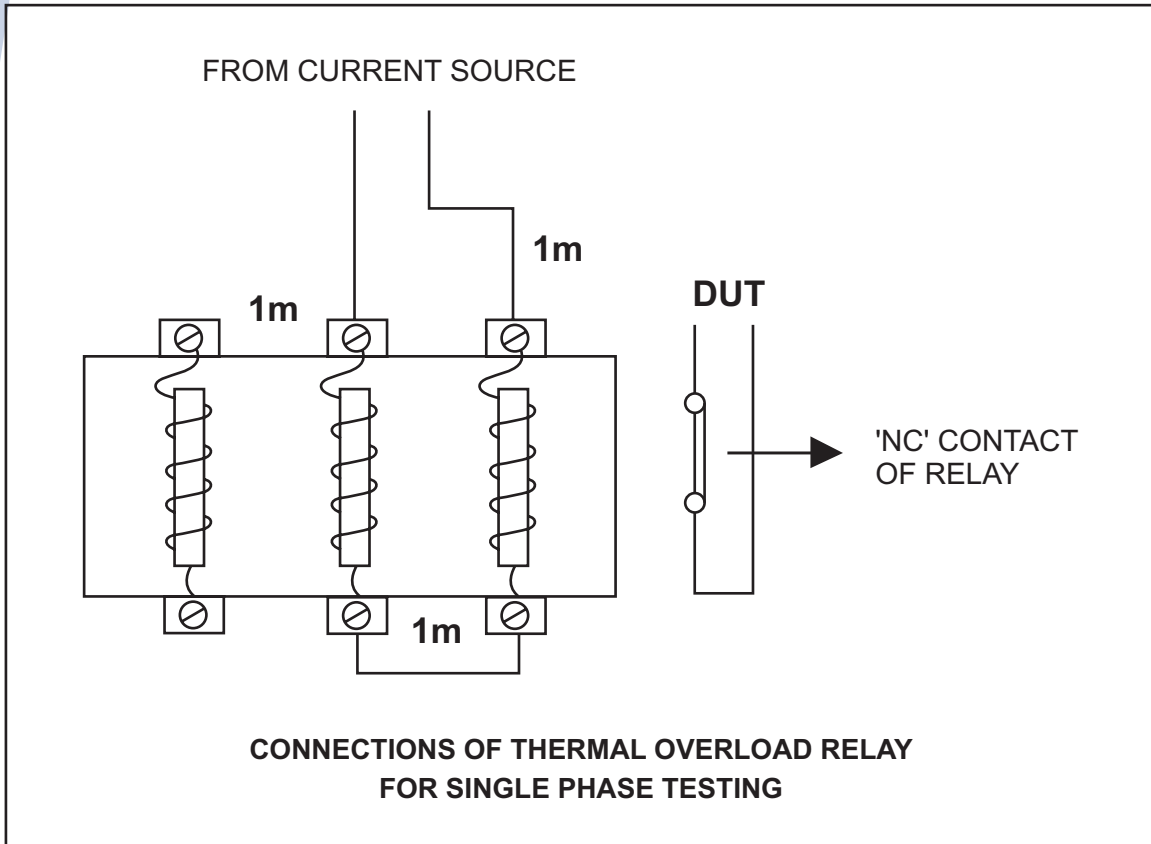
**Caution**

After each test, cool the relay for minimum 10 minutes. Otherwise, relay will trip early and you will not get correct results.

**Cable size with respect to test current.**

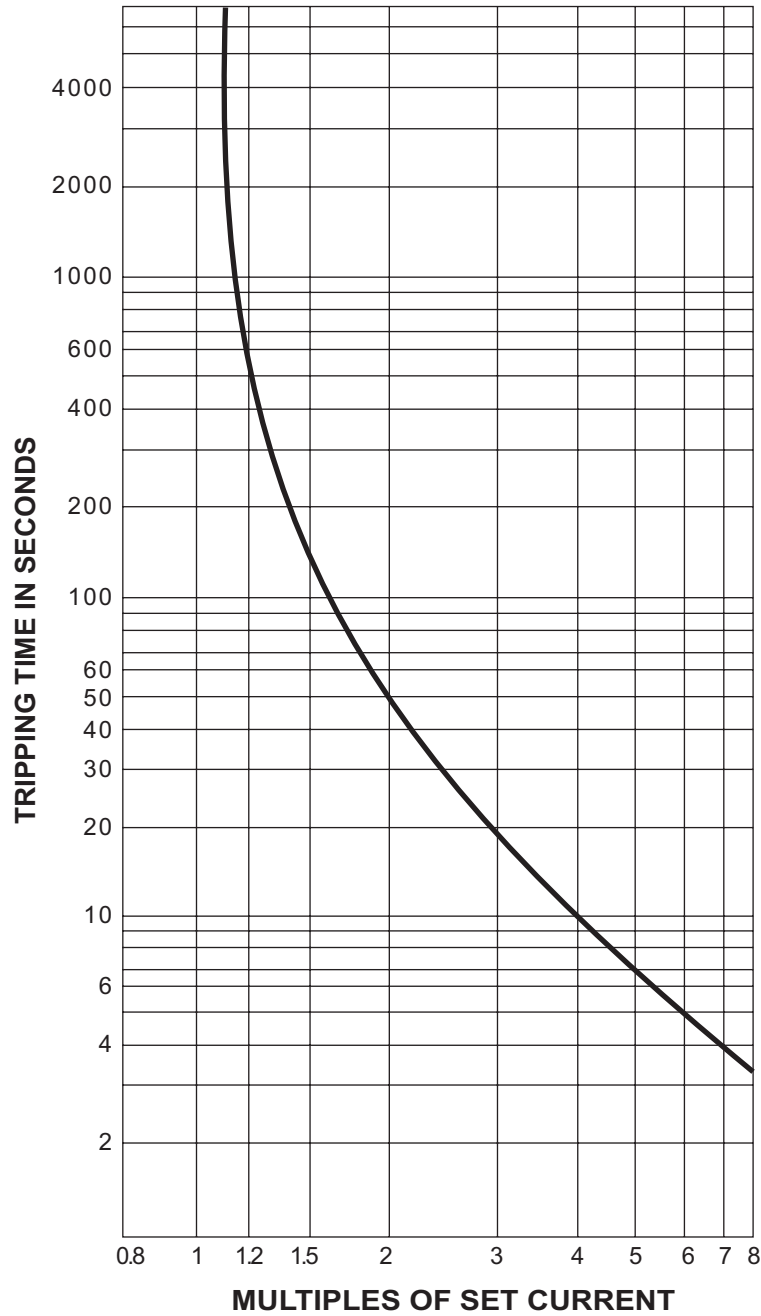
Test Current Amp	0 to 15	15 to 30	30 to 46	46 to 66	66 to 110	100 to 150	150 to 220
For Copper Cables sq. mm	1	1.5	4	6	10	25	35

## ▶ SINGLE PHASING TEST



Sr. No.	Relay Setting	Test Current (Amp)	Trip Time in Sec. from i-t characteristics.		Actual	Remark OK / Not OK
			Min.	Max.		
1.						
2.						

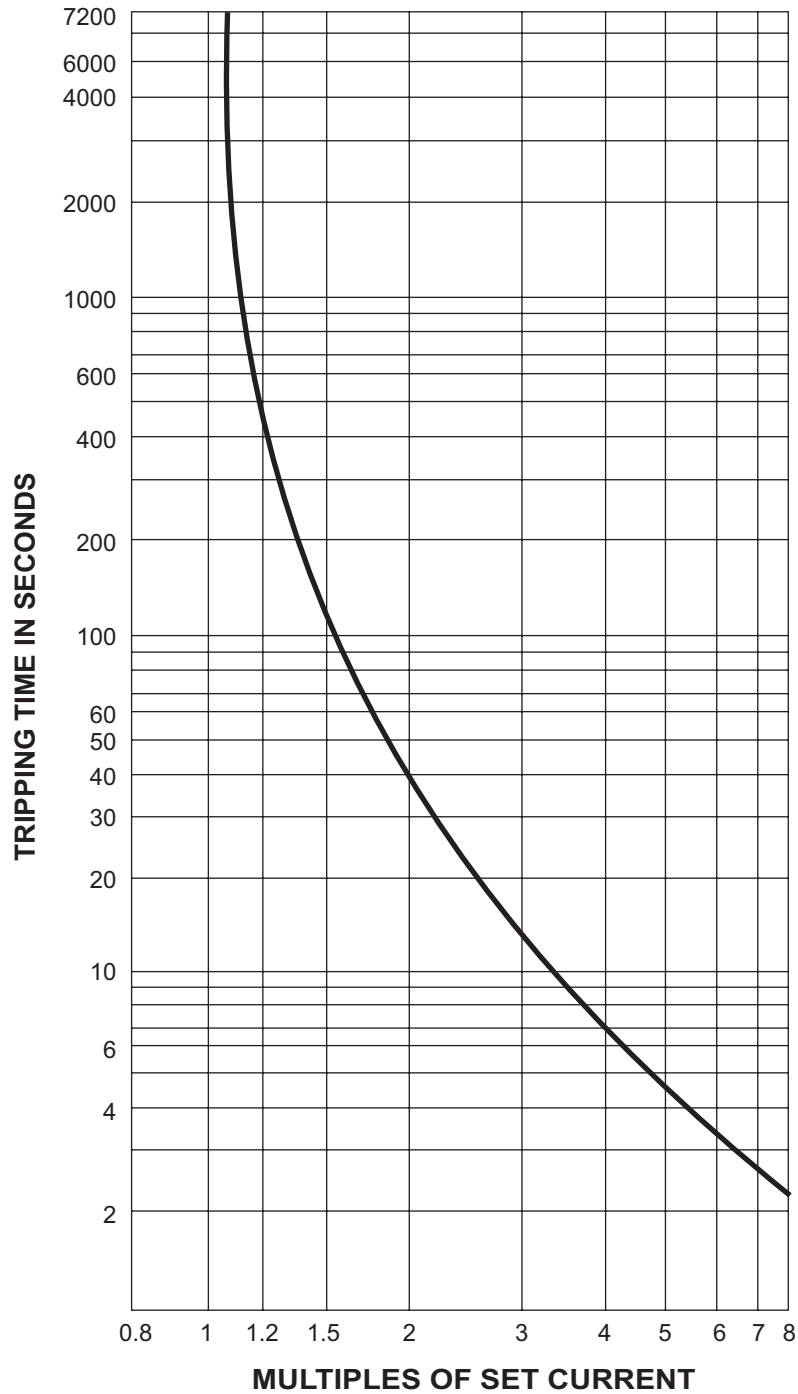
▶ **TRIPPING CURVE FOR MK1 / ML1 RELAYS  
FOR RANGES UPTO 6-10 AMPS.**



**NOTE :**

1. THE TRIPPING TIME FOR ANY CURRENT SHALL LIE BETWEEN THE VALUES CORRESPONDING TO 90% AND 110% OF THAT CURRENT.
2. CURVE REPRESENTS COLD STATE CHARACTERISTICS.

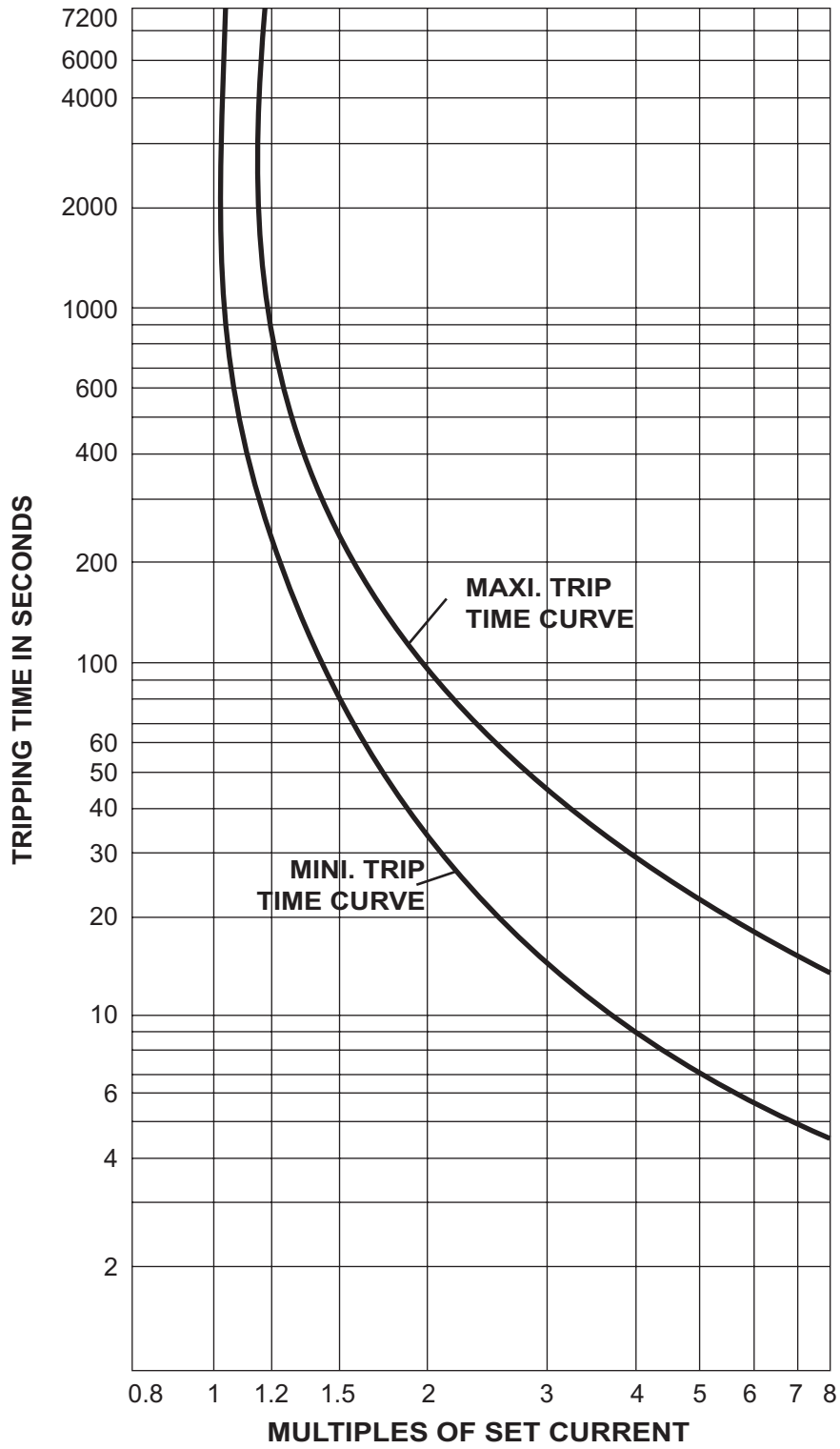
▶ **TRIPPING CURVE FOR MK1 / ML1 RELAYS  
FOR RANGES UPTO 9-14 & 10-16 AMPS.**



**NOTE :**

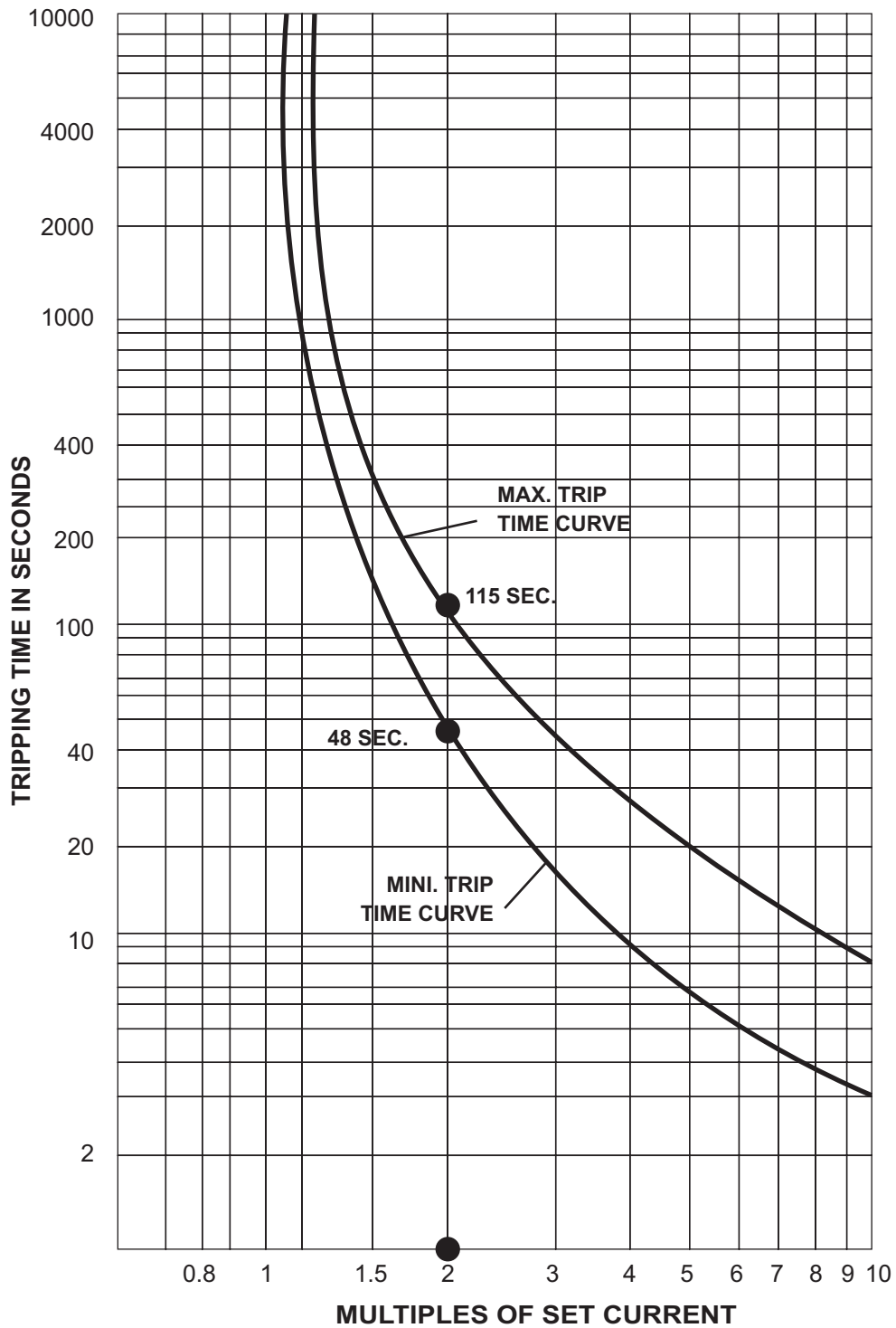
1. THE TRIPPING TIME FOR ANY CURRENT SHALL LIE BETWEEN THE VALUES CORRESPONDING TO 90% AND 110% OF THAT CURRENT.
2. CURVE REPRESENTS COLD STATE CHARACTERISTICS.

## ▶ TRIPPING CURVE FOR ML2 / ML3 RELAYS



**NOTE :** CURVE REPRESENTS COLD STATE CHARACTERISTICS.

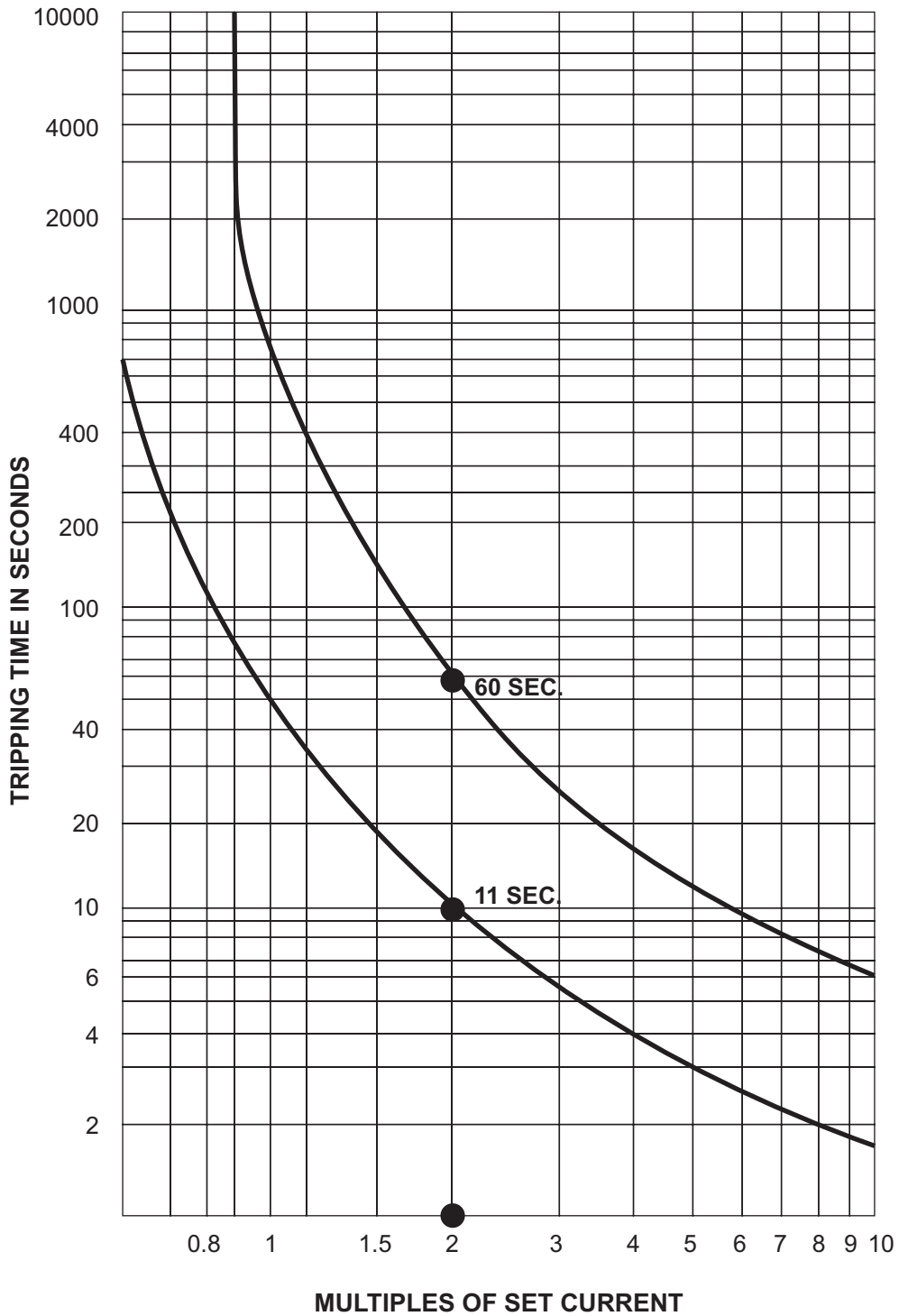
▶ **TRIPPING CURVE FOR MN RELAYS  
ON 3 POLE LOADING (BALANCED) CONDITION**



**NOTE :** CURVE REPRESENTS COLD STATE CHARACTERISTICS.

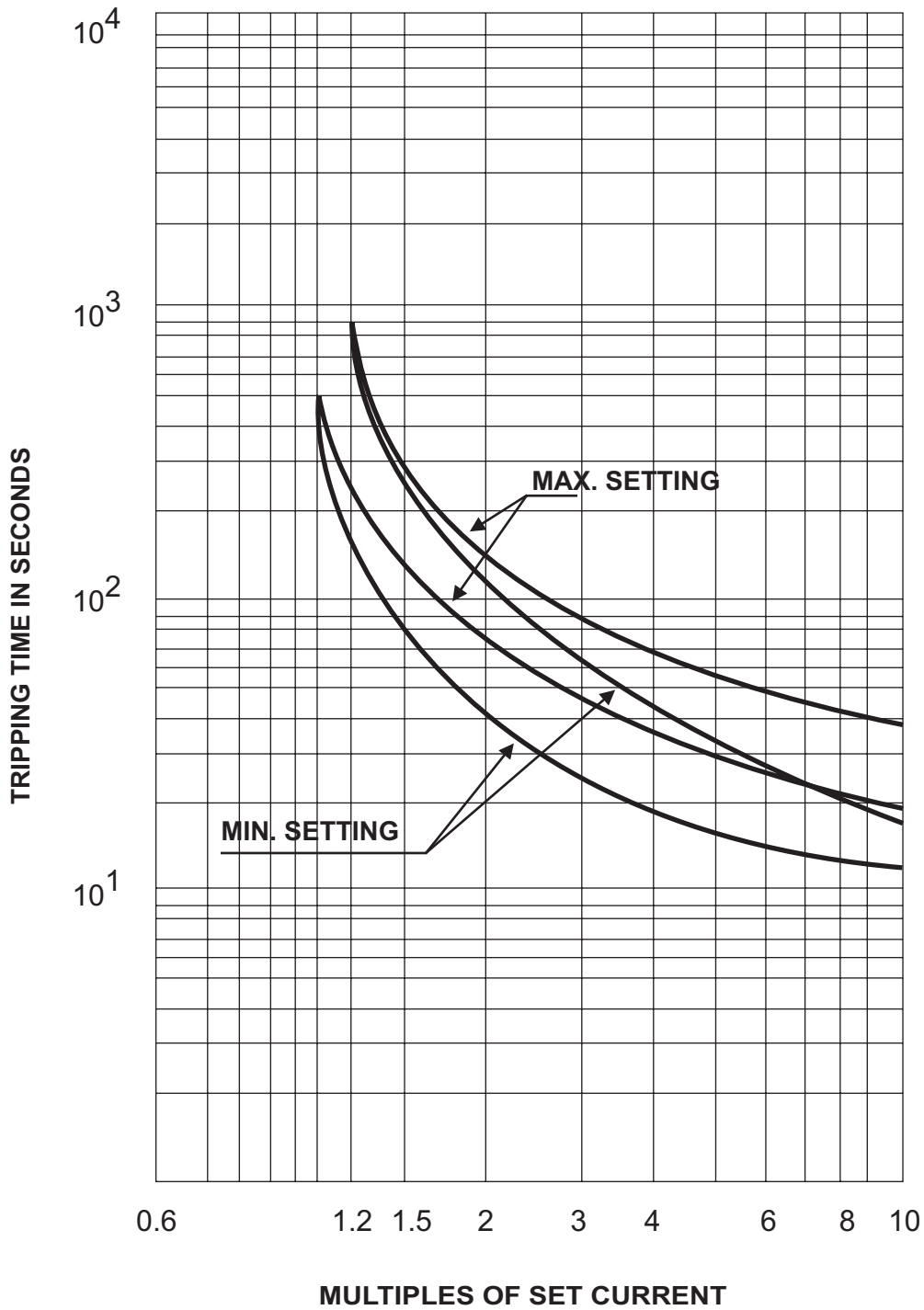


▶ **TRIPPING CURVE FOR MN RELAYS  
ON 2 POLE LOADING (SINGLE PHASING) CONDITION**

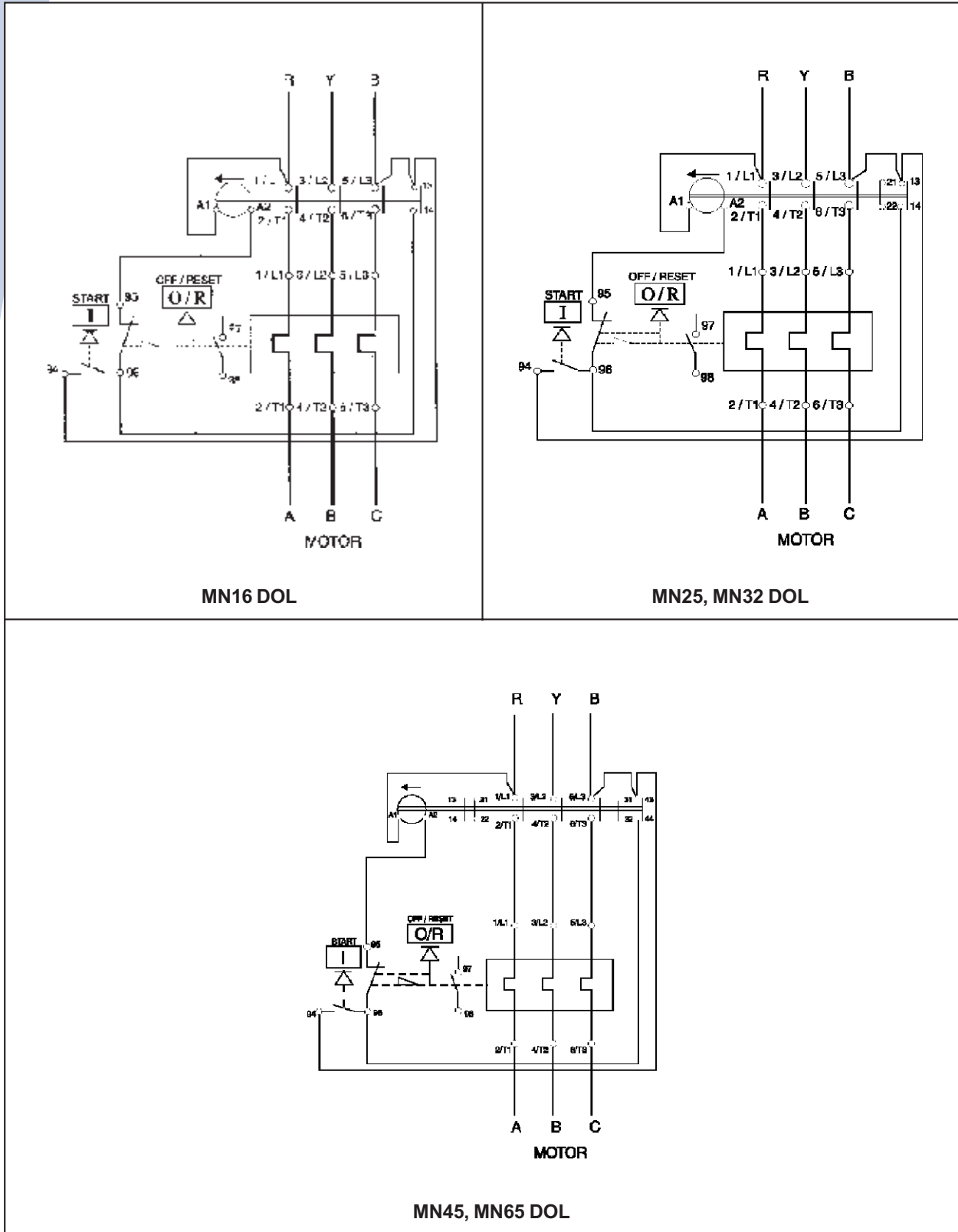


**NOTE :** CURVE REPRESENTS COLD STATE CHARACTERISTICS.

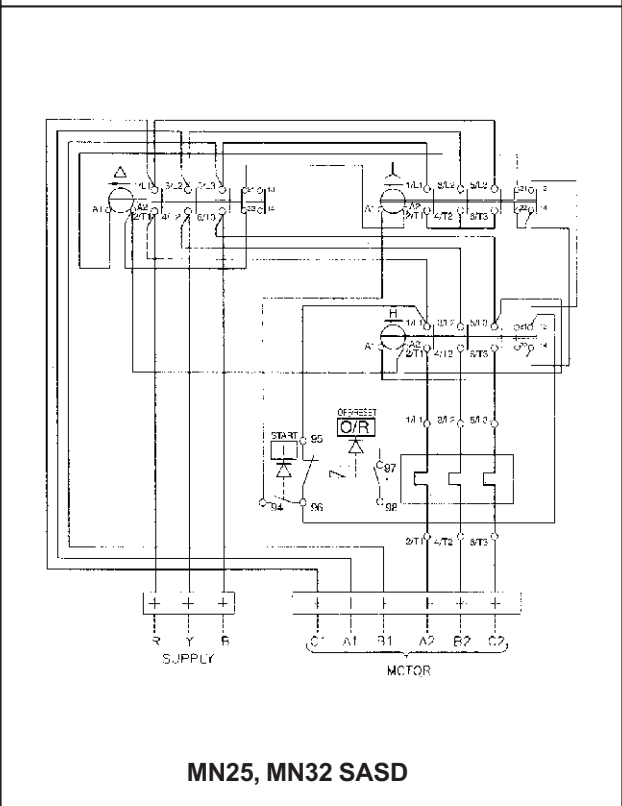
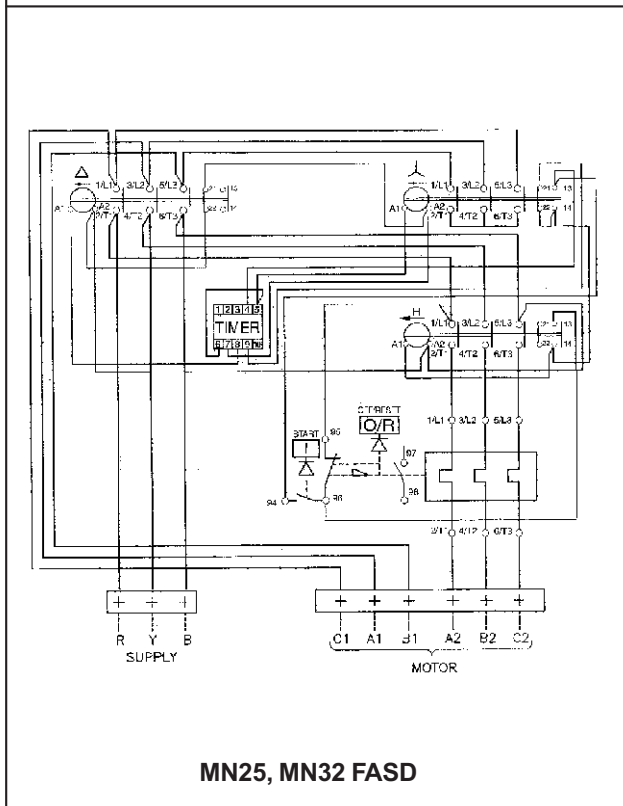
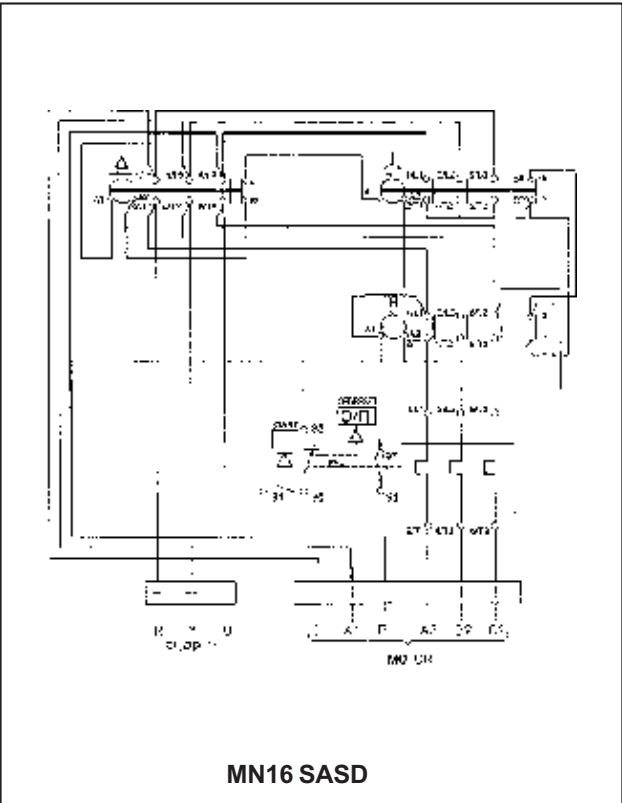
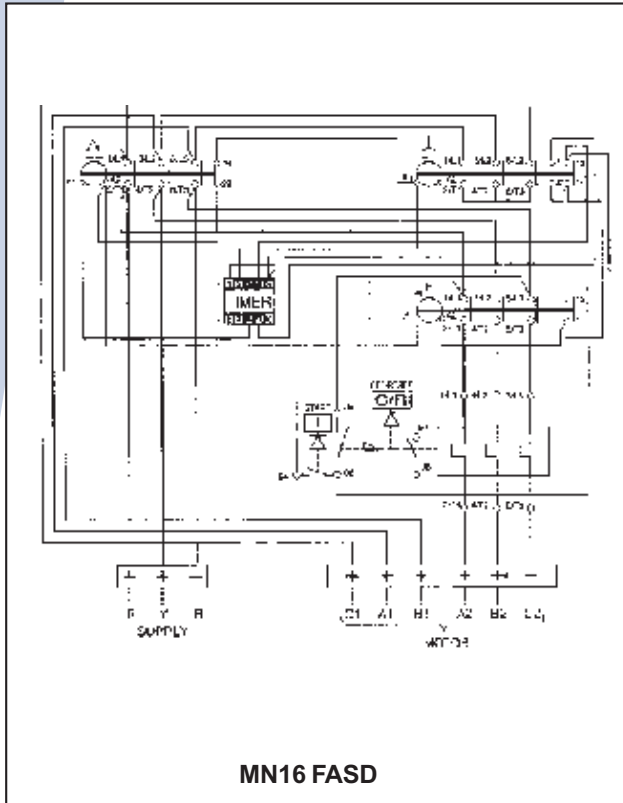
▶ **TRIPPING CURVE FOR MN12 L RELAYS  
ON 3 POLE BALANCED LOADING CONDITION**



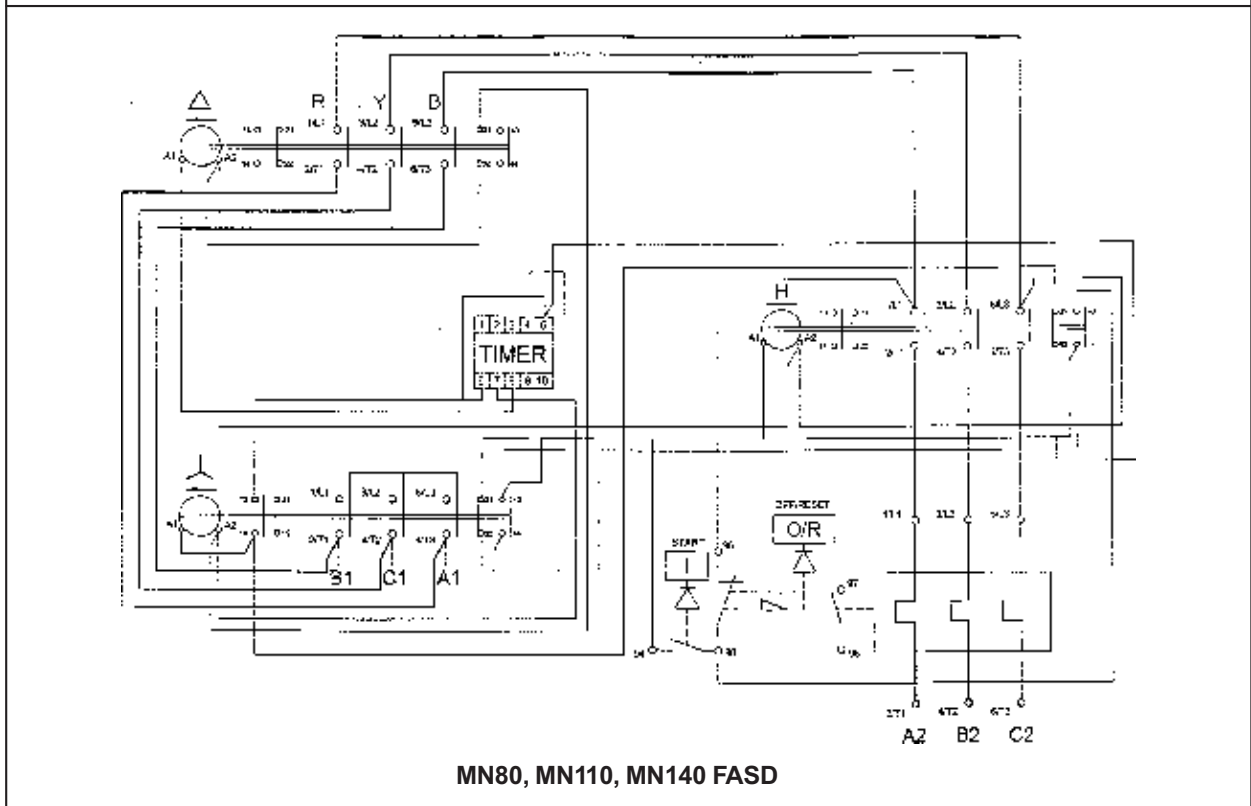
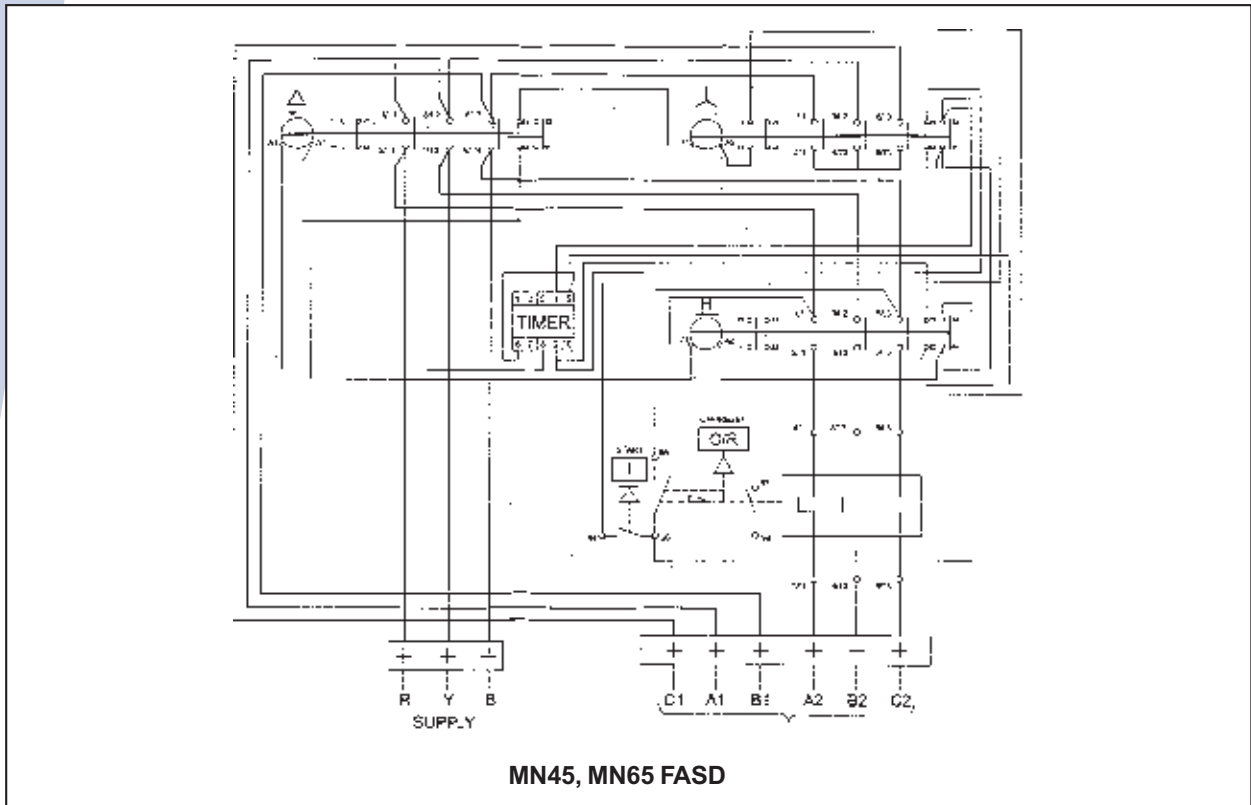
► WIRING DETAILS



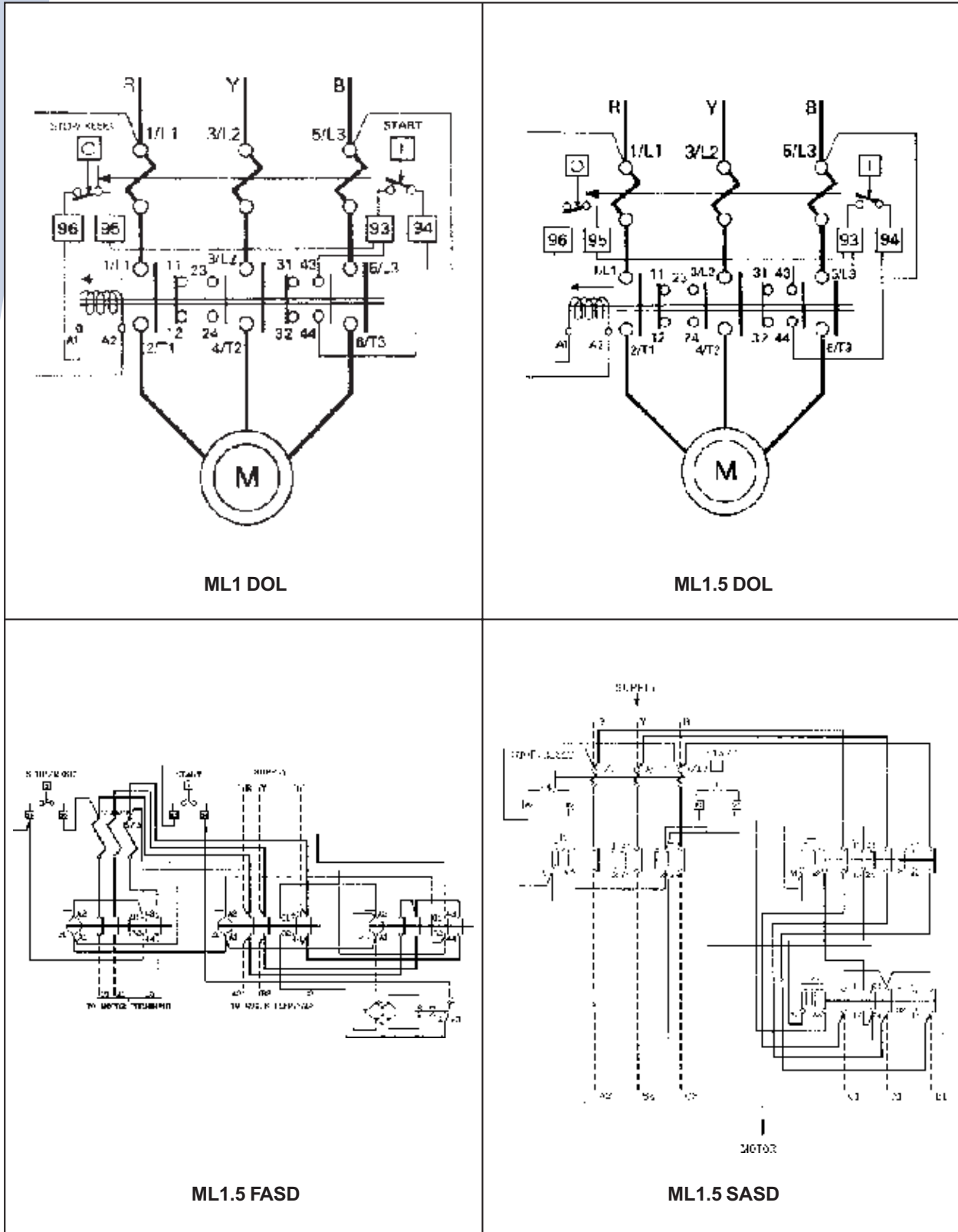
► WIRING DETAILS



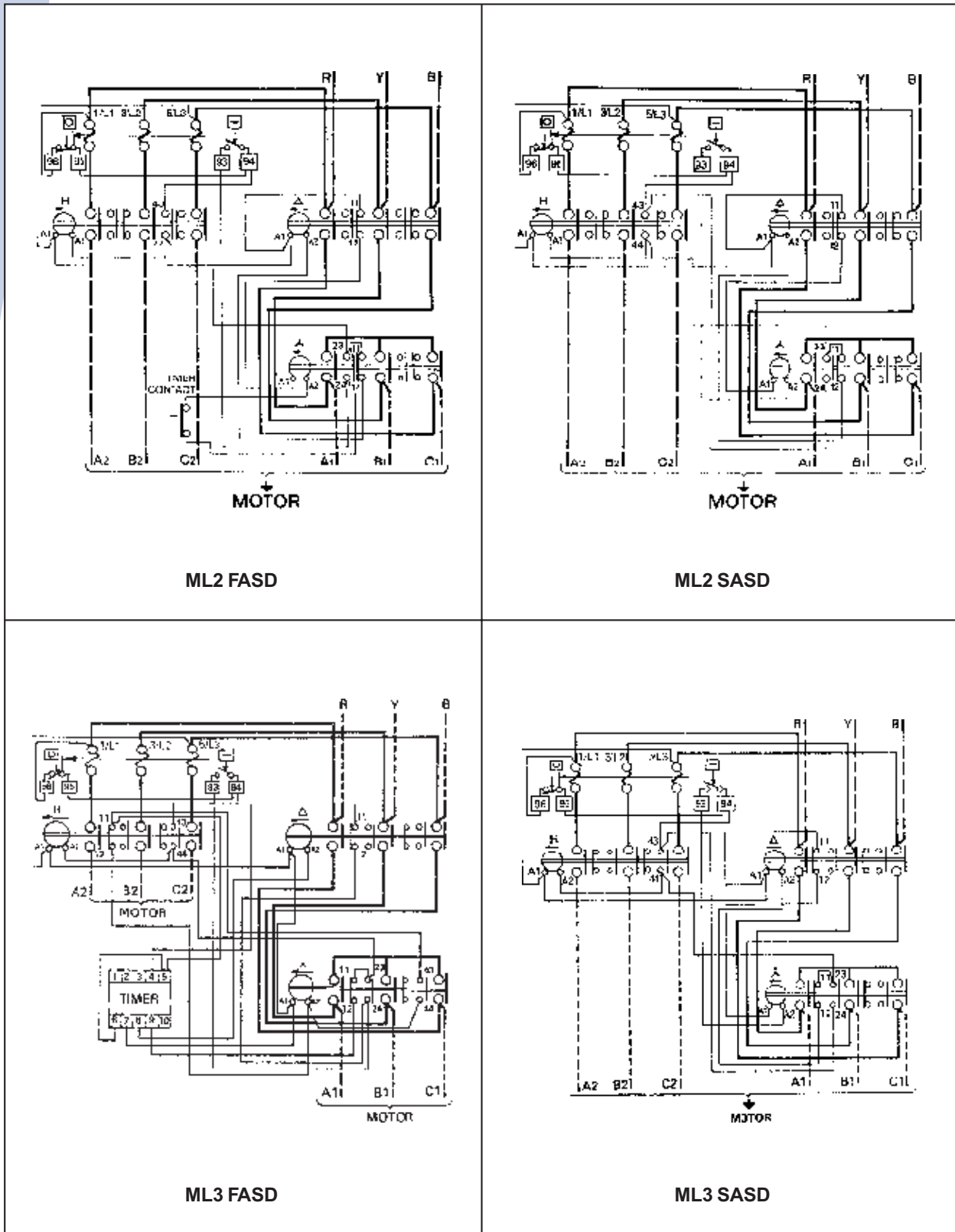
► WIRING DETAILS



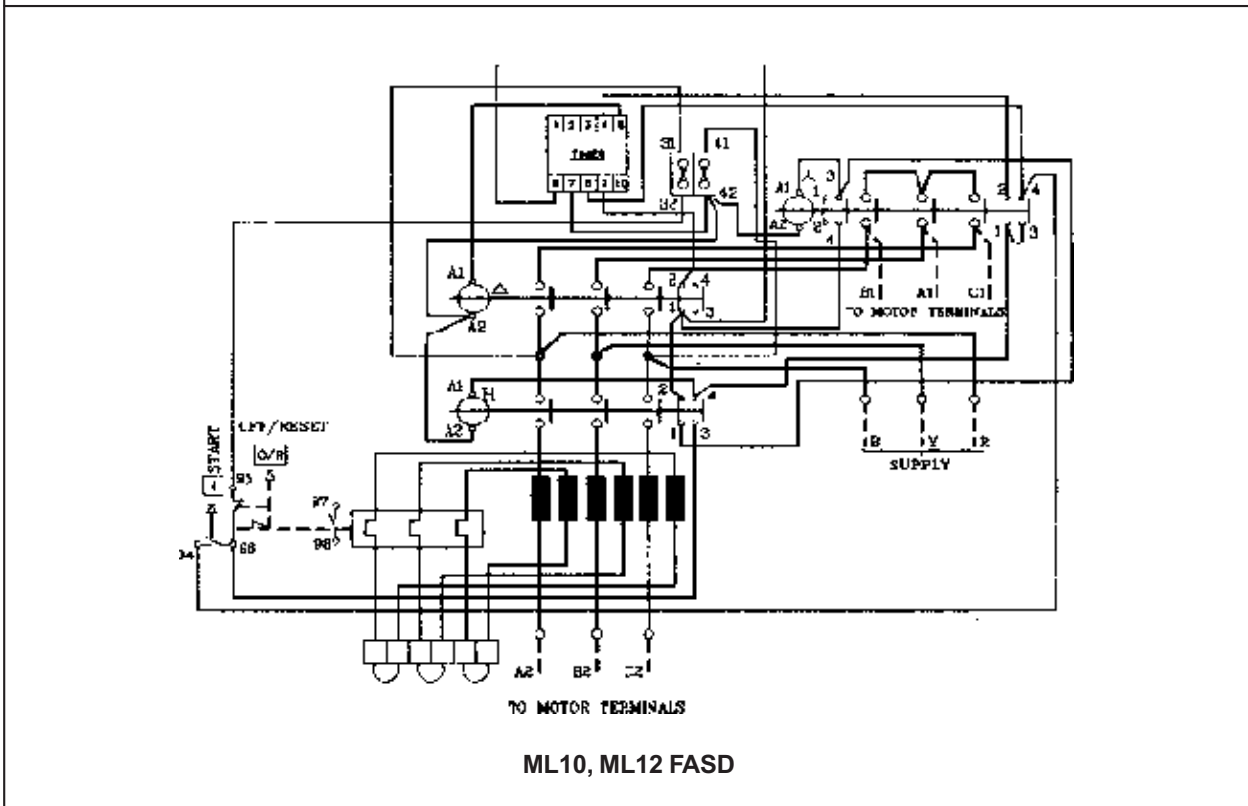
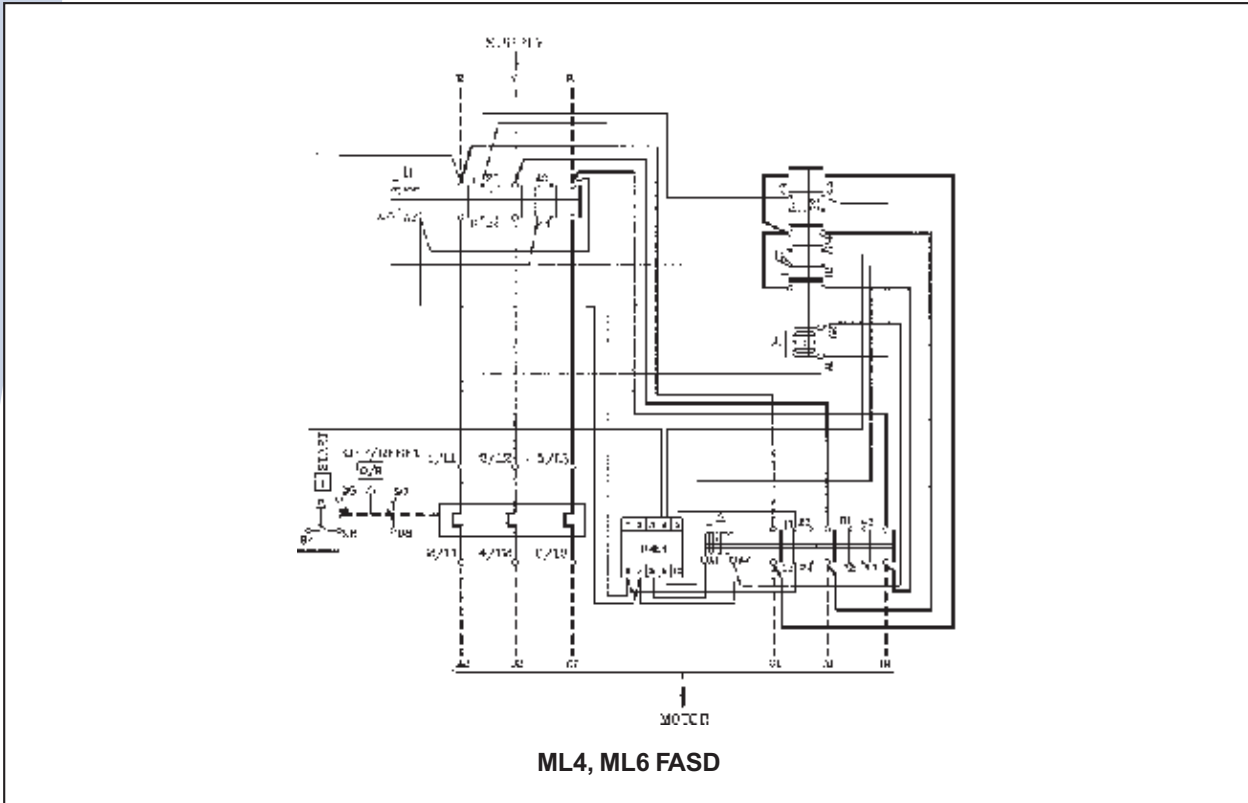
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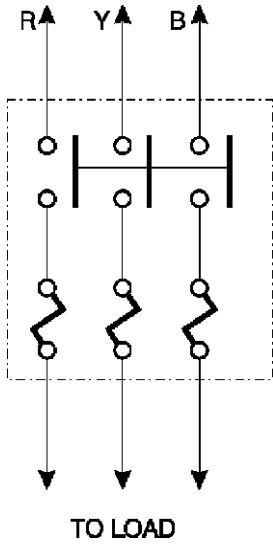


► WIRING DETAILS

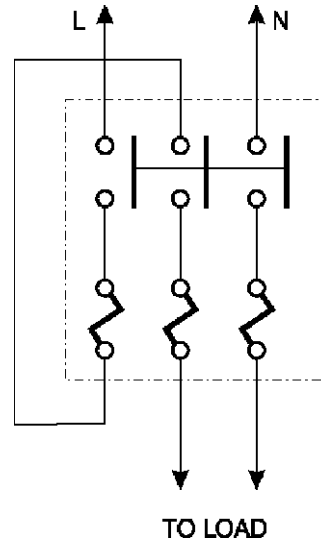




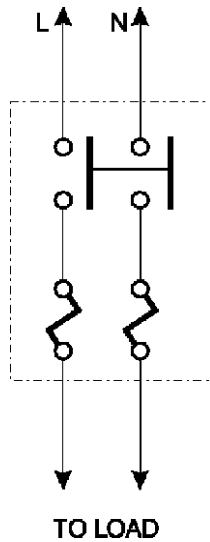
## ► WIRING DETAILS



MF1 DOL (3 PHASE) STARTERS

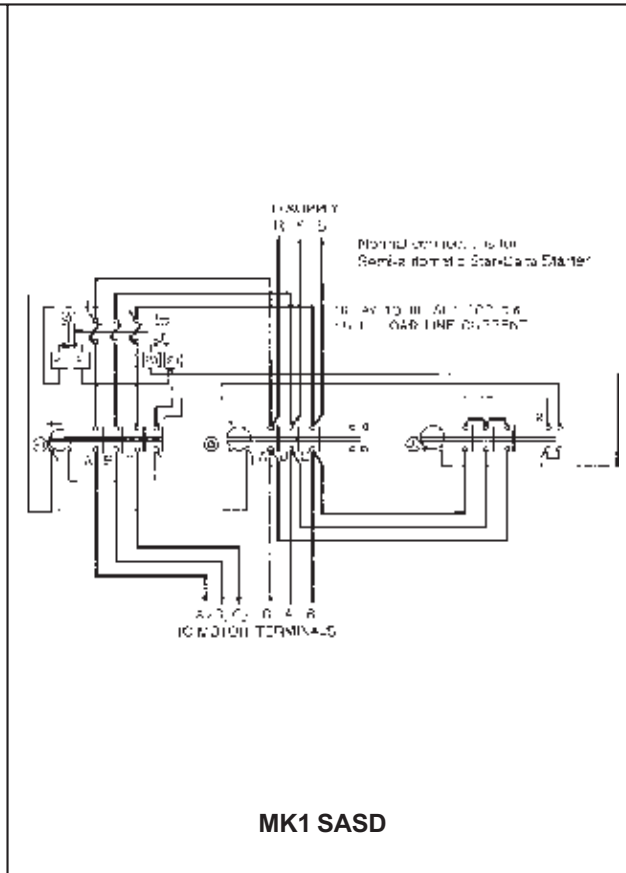
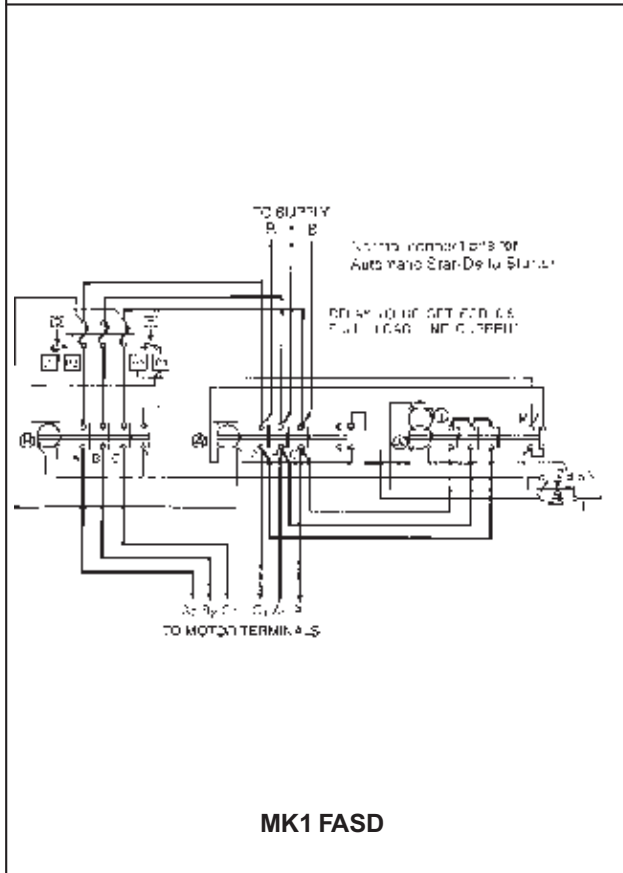
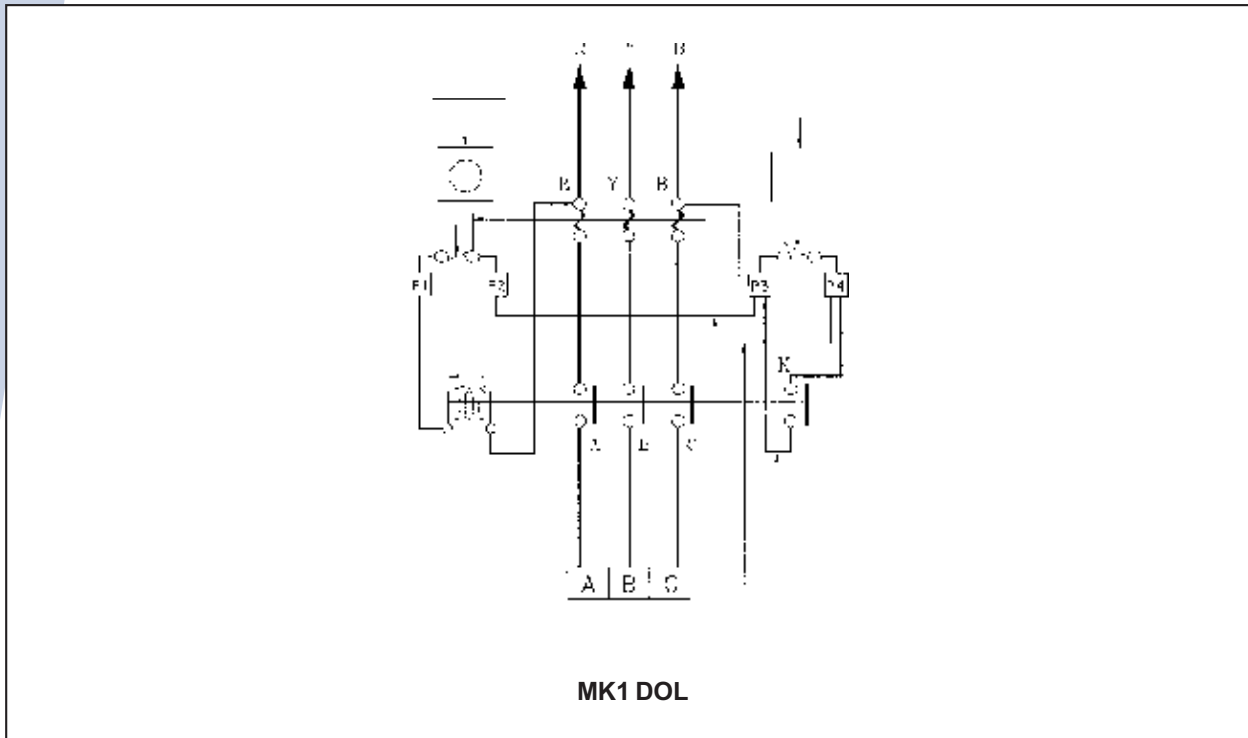


MF1 DOL (3 PHASE) STARTERS  
FOR SINGLE PHASE LOADS



MF1 DOL (SINGLE PHASE) STARTERS

► WIRING DETAILS



## ▶ STAR DELTA STARTERS (ML SERIES)

### Details of Contactors and timers used in ML series star delta starters

Starters		Contactors			Timers
		STAR	DELTA	HOLD ON	
ML 1.5	SASD	ML 1	ML 1.5	ML 1.5	—
ML 1.5	FASD	ML 1	ML 1.5	ML 1.5	GT-200
ML 2	SASD	ML 2	ML 2	ML 2	—
ML 2	FASD	ML 2	ML 2	ML 2	GT-200
ML 3	SASD	ML 2	ML 3	ML 3	—
ML 3	FASD	ML 2	ML 3	ML 3	ET-100
ML 4	FASD	ML 3	ML 4	ML 4	ET-100
ML 6	FASD	ML 4	ML 6	ML 6	ET-100
ML 10	FASD	ML 10	ML 10	ML 10	ET-100
ML 12	FASD	ML 12	ML 12	ML 12	ET-200

## ▶ CHART FOR DOL MOTOR STARTERS WITH ML RELAYS

Sr. No	Motor Rating 240V-1 Phase			Motor Rating 215V-3 Phase			Relay Range (A)	Contactor	Back up fuse		SDF
	hp	kW	In	hp	kW	In			Rating	Type	
1				0.125	0.09	0.45	0.4-0.65	MLO	2	HF	FN32
2				0.15	0.11	0.45	0.4-0.65	MLO	2	HF	FN32
3				0.2	0.15	0.57	0.4-0.65	MLO	2	HF	FN32
4				0.25	0.19	0.7	0.6-1.0	MLO	4	HF	FN32
5				0.33	0.25	0.88	0.6-1.0	MLO	4	HF	FN32
6	0.125	0.11		0.5	0.37	1.2	1.0-1.6	MLO	6	HF	FN32
7				0.75	0.55	1.6	1.5-2.5	MLO	6	HF	FN32
8	0.25	0.18	2.0	1.0	0.75	1.8	1.5-2.5	MLO	6	HF	FN32
9				1.25	0.92	2.1	1.5-2.5	MLO	8	HF	FN32
10	0.5	0.4	3.6	1.5	1.1	2.6	2.5-4.0	MLO	10	HF	FN32
11				1.75	1.3	3.0	2.5-4.0	MLO	10	HF	FN32
12				2.0	1.5	3.5	2.5-4.0	MLO	10	HF	FN32
13	0.75	0.55		2.5	1.8	4.8	4-6.5	MLO	16	HF	FN32
14				3.0	2.2	5.0	4-6.5	MLO	16	HF	FN32
15				4.0	3.0	6.2	4-6.5	MLO	16	HF	FN32

## ▶ CHART FOR DOL MOTOR STARTERS WITH ML RELAYS

Sr. No	Motor Rating 240V-1 Phase			Motor Rating 215V-3 Phase			Relay Range (A)	Contactor	Back up fuse		SDF
	hp	kW	In	hp	kW	In			Rating	Type	
16	1.0	0.75	7.5	5.0	3.7	7.5	6-10	MLO	20	HF	FN32
17	1.25	0.9	8.0	6.0	4.5	9.0	6-10	MLO	25	HF	FN32
18	2.0	1.5	9.5	7.5	5.5	11.0	10-16	MLO	25	HF	FN32
19	3.0	2.25	14.0	10.0	7.5	14.0	10-16	ML1	32	HF	FN32
20				12.5	9.3	18.0	13-21	ML1.5	50	HF	FN63
21				15.0	11.0	21.0	20-32	ML1.5	63	HF	FN63
22				17.5	13.0	24.0	20-32	ML2	63	HF	FN63
23				20.0	15.0	28.0	20-32	ML2	63	HN/00	FN100
24				25.0	18.6	35.0	28-42	ML3	80	HN/00	FN100
25				30.0	22.5	40.0	28-42	ML3	80	HN/00	Fn100

### NOTES:

- (1) The full load currents given apply in the case of single phase motors, to capacitor-start type motors and in the case of 3 phase motors, to squirrel cage type induction motors at full load having average power factor and efficiency. The motors should have speeds not less than the following:  
Upto 10 hp - 750 R.P.M., 10 to 30 HP - 600 R.P.M., 30 - 125 HP - 500 R.P.M., 125 - 300 HP - 375 R.P.M.
- (2) Contactors/Switches indicated are the minimum ratings suitable for the application. Higher sizes/Ratings can be used.
- (3) Normal motor starting times are assumed in all cases.

## ▶ CHART FOR STAR-DELTA MOTOR STARTERS WITH ML RELAYS

Sr. No	Motor Rating		Current at 415 V (A)		Relay Range (A)	Contactor			Nominal Back up fuse link		SDF
	hp	kW	LINE	PHASE		STAR	LINE	DELTA	Rating A	Type/Size	
1	1	0.75	1.8	1.04	1-1.6	MLO	MLO	MLO	4	HF	FN32
2	1.5	1.1	2.6	1.5	1-1.6	MLO	MLO	MLO	6	HF	FN32
3	2	1.5	3.5	2.02	1.5-2.5	MLO	MLO	MLO	6	HF	FN32
4	3	2.25	5	2.88	2.5-4.0	MLO	MLO	MLO	8	HF	FN32
5	4	3	6.2	3.58	2.5-4	MLO	MLO	MLO	10	HF	FN32
6	5	3.75	7.5	4.32	4-6.5	MLO	MLO	MLO	16	HF	FN32
7	6	4.5	9	5.2	4-6.5	MLO	MLO	MLO	16	HF	FN32
8	7.5	5.5	11	6.34	6-10	MLO	MLO	MLO	20	HF	FN32
9	10	7.5	14	8.08	6-10	MLO	MLO	MLO	20	HF	FN32
10	12.5	9.3	18	10.04	10-16	MLO	MLO	MLO	32	HF	FN32
11	15	11	21	12.1	10-16	MLO	MI1	MI1	32	HF	FN32
12	20	15	28	16.2	13-21	ML1	ML1.5	ML1.5	40	HF	FN63
13	25	18.5	35	20.2	13-21	ML1	ML1.5	ML1.5	50	HF	FN63
14	30	22.5	40	23	20-32	ML2	ML2	ML2	63	HF	FN63
15	35	26	47	27	20-32	ML2	ML2	MI2	63	HN/00	FN100
16	40	30	55	31.8	28-42	ML2	ML3	ML3	63	HN/00	FN100
17	45	33.5	60	34.6	28-42	ML2	ML3	ML3	80	HN/00	FN100
18	50	37.5	66	38.2	28-42	ML2	ML3	ML3	80	HN/00	FN100

**NOTES:**

- (1) Contactors/Switches indicated are the minimum ratings suitable for the application. Higher sizes/Ratings can be used.
- (2) For applications above 35 hp suitable scheme to be employed to ensure change over delay of 40-75ms between star and delta contactors.
- (3) Normal motor starting times are assumed in all cases.

## ▶ CHART FOR MF1 THREE PHASE / SINGLE PHASE

Motor rating in hp		Relay scale	Maximum safe rating of back-up fuses*	
240V Single phase	415V 3 phase	Amps (A)	Cartridge fuses	Rewritable fuses SWG
0.125	0.125	0.4-0.65	4A	35
	0.25	0.6-1.0	6A	32
	0.5	1.0-1.6	6A	32
	0.75	1.5-2.5	16A	25
0.25	1.0	1.5-2.5	16A	25
	1.25	1.5-2.5	16A	25
0.5	1.5	2.5-4.0	25A	23
	1.75	2.5-4.0	25A	23
0.75	2.0	2.5-4.0	25A	23
	2.5	4.0-6.5	25A	23
	3.0	4.0-6.5	25A	23
	4.0	4.0-6.5	25A	23
	4.5-7	25A	23	
1.00/1.25	5.0	6.5-11	32A	21
		6.0-10	32A	21
2.00	6.0	6.0-10	32A	21
		10.5-17.5A	32A	21
3.00	7.5	9.0-15	32A	21
		11-18	32A	21
		12-20A	32A	21

\* Cartridge type fuses are recommended

## ▶ CHART FOR Mk1 DOL STARTER

Cat No.	Motor rating H.P.			Relay Amps. Range	Back-up Fuse Rating				
	220 1-Phase	400V 3-phase	440V 4-phase		Maximum		Minimum		
					Diazed	SWG	Diazed	SWG	
		0.005	0.05	0.15-0.25	1A				
		0.1	0.1	0.25-0.4	2A				
		0.125	0.125	0.25-0.4	2A				
		0.15	0.15	0.4-0.65	4A	35			
			0.2	0.2	0.4-0.65	4A	35		
				0.25	0.4-0.65	4A	35		
			0.25		0.6-1.0	6A	32	6A	32
		0.125	0.5	0.5	1.0-1.6	6A	32	6A	32
				0.75	1.0-1.6	6A	32	6A	32
		0.25	0.75	1.0	1.5-2.5	15A	25	6A	32
			1.0	1.25	1.5-2.5	15A	25	6A	32
	SS96210	0.5	1.25	1.5	2.5-4.0	25A	23	10A	28
		1.5	1.75	2.5-4.0	25A	23	10A	28	
		1.75	2.0	2.5-4.0	25A	23	10A	28	
		2.0		2.5-4.0	25A	23	10A	28	
	0.75	2.5	2.5	4.0-6.5	25A	23	10A	28	
		3.0	3.0	4.0-6.5	25A	23	10A	28	
			4.0	4.0-6.5	25A	23	10A	28	
	1.0	4.0		6-10	35A	21	15A	25	
		1.25	5.0	5.0	6-10	35A	21	15A	25
		1.5	6.0	6.0	6-10	35A	21	15A	25
		1.75			9-14	35A	21	15A	25
		2.0	7.5	7.5	11-18	35A	21	15A	25
SS96211	2.0	7.5	7.5	11-18	35A	21	15A	25	
SS96228	2.0	7.5	7.5	13-22	40A	21	15A	25	

**Note :**

Amp. Rating of back-up fuse refers to the recommended diazed type HRC cartridge fuse. Where rewirable semi-enclosed, tinned copper wire fuses are used, SWG number in table is approximate guide to size of wire required.



## ▶ CHART FOR MK1 STAR-DELTA STARTER

Cat No.	Motor Rating 400/440v 3-phase hp	Full load line current in Amps. In	In V3	Relay Amps. Range	Back-up Fuse Rating			
					Maximum		Minimum	
					Diazed	SWG	Diazed	SWG
SS96254 & SS96255	1	1.7	1	1-1.6A	6	32	4	35
	1.5	2.4	1.4	1-1.6A	15	25	6	32
	2	3.1	1.8	1.5-2.5A	15	25	6	32
	3	4.4	2.5	2.5-4A	25	23	6	32
	4	5.7	3.3	2.5-4A	25	23	10	28
	5	7.1	4.1	4-6.5A	25	23	10	28
	6	8.4	4.9	4-6.5A	25	23	10	28
	7.5	10.4	6	6-10A	35	21	15	25
	10	13.6	7.9	6-10A	35	21	15	25
	12.5	17	9.7	9-14A	35	21	20	24
15	19.9	11.5	9-14A	35	21	25	23	
SS96257 & SS96258	15	19.9	11.5	11-18A	35	21	25	23

**Note:** Amp. Rating of back-up fuse refers to the recommended diazed type HRC cartridge fuse. Where rewirable semi-enclosed, tinned copper wire fuses and used, SWG number in table is approximate guide to size of wire required.

Cat. No SS 96254 & SS 96257 - FASD Starters

Cat. No SS 96255 & SS 96258 - SASD Starters

## ► SELECTION CHART FOR MU/MBDOL STARTERS

Type	Maximum Motor rating at 145V.3 ph 50 HZ		Approx. Full load Current in	Relay Range (A)	Relay	Contactor	Back-up HRC Fuse		Switch Disconnector Fuse Unit
	HP	KW					Type	Rating (A)	
MB1 DOL	7.5	5.5	11	9-15	MN2	MU1	HF	32	FN 32
	10	7.5	14	14-23			HF	50	FN 63
MB2 DOL	12.5	9.3	18	14-23	MN2	MU2	HF	50	FN 63
	15	11	21	14-23			HF	63	FN 63
	15	11	21	20-33			HF	63	FN 63
MU1 DOL	7.5	5.5	11	9-14	MU2	MU1	HF	32	FN 32
	10	7.5	14	13-21			HF	50	FN 63
MU2 DOL	12.5	9.3	18	13-21	MU2	MU2	HF	50	FN 63
	15	11	21	13.21			HF	63	FN 63
	15	11	21	20-32			HF	63	FN 63

## ► SELECTION CHART FOR MU/MB STAR DELTA STARTERS

Type	Maximum Motor rating at 145V.3 ph 50 HZ		Approx. Full load Current in	Phase Current	Relay Range (A)	Relay	Contactor	Back-up HRC Fuse		Switch Disconnector Fuse Unit
	HP	KW						Type	Rating (A)	
MB1 SASD	15	11	21	12.1	9-15	MN2	MU1	HF	32	FN 32
	15	11	21	12.1	14-23			HF	40	FN 63
MB2 SASD	20	15	28	16.2	14-23	MN2	MU1	HF	40	FN 63
	25	18.5	35	20.2	14-23			HF	50	FN 63
	30	22.5	40	23	20-33			HF	63	FN 63
MU1 SASD	15	11	21	12.1	9-14	MU2	MU1	HF	32	FN 32
	15	11	21	12.1	13-21			HF	40	FN 63
MU2 SASD	20	15	28	16.2	9-14	MU2	MU2	HF	40	FN 63
	25	18.5	35	20.2	13-21			HF	50	FN 63
	30	22.5	40	23	20-32			HF	63	FN 63

## ▶ SELECTION CHART FOR MUG-10 DOL SUBMERSIBLE PUMP STARTERS

Type	Maximum submersible pump rating at 415 V, 3ph., 50hz		Relay Range (A)	Relay Type	Contactor Type	Back-up HRC Fuse		Switch Disconnector Fuse Unit
	HP	KW				Type	Rating (A)	
MUG-10 DOL	3	2.2	4-6.5	MU 1	MU 1	HF	16	FN 32
	5	3.7	6-10	MU 1	MU 1	HF	16	FN 32
	7.5	5.5	9-14	MU 2	MU 1	HF	32	FN 32
	10	7.5	13-21	MU 2	MU 1	HF	40	FN 63
MUG-10N DOL	5	3.7	6-10	MN 2	MU 1	HF	16	FN 32
	7.5	5.5	9-15	MN 2	MU 1	HF	32	FN 32
MUG-10H DOL*	10	7.5	20-32	MU 2	MU 2	HF	63	FN 63
	10	7.5	28-42	MU 2	MU 2	HN/00	63	FN 100

\* - Controllers for low voltage application

**Note :** MU 1/2 contactors are available in 415 V coil operating voltage also.

**Note :** MUG-10 DOL are available with dry run facility as a optional feature.

## ▶ SELECTION CHART FOR MUG-20 STAR - DELTA SUBMERSIBLE PUMP STARTERS

Type	Maximum submersible pump rating at 415 V, 3ph., 50hz		Relay Range (A)	Relay Type	Contactor Type	Back-up HRC Fuse		Switch Disconnector Fuse Unit
	HP	KW				Type	Rating (A)	
MUG-20 Star-Delta	15	11	9-14	MU 2	MU 1	HF	32	FN 32
	20	15	13-21	MU 2	MU 1	HF	40	FN 63
MUG-20H* Star-Delta	20	15	20-32	MU 2	MU 2	HF	63	FN 63
	20	15	28-42	MU 2	MU 2	HN/00	63	FN 100

\* - Controllers for low voltage application

**Note :** MU 1/2 contactors are available in 415 V coil operating voltage also.

**Note :** MUG-10 DOL are available with dry run facility as a optional feature.

## INFORMATION FOR INSTALLATION AND PREVENTIVE MAINTENANCE

### Cable connections to the terminals

When aluminium wires are used, the following method should be adopted:

If the wire is small up to 1 mm<sup>2</sup>

– Single strand

1. Clean the wire surface by rubbing with a small hard wire brush.
2. Tin the wire immediately (within 2 or 3 minutes).
3. Put wire under terminal clamp and tighten screws. Do not tighten to such an extent that the wire becomes flat.

Every two or three months, it may be necessary to ensure that the screws are tight and the wire has not become loose. This may happen because aluminium is soft and is likely to “flow”. Always apply inhibiting grease around the terminal and wire to prevent moisture from reaching the area of contact. Apply inhibiting grease, only on the terminals and wire and not on the contacts.

If the wire is large – larger than 10 mm<sup>2</sup>

– Multi-strand

Wires should be connected with the help of cable lugs or thimbles. The cable lugs may be of "soldering" or "crimping" type.

For "soldering" type cable lugs:

- Check that cable lug socket is clean and dry inside.
- Clean every strand of aluminium wire with a small hard wire brush by opening out the cable strands.
- Immediately dip all the strands in tin solder.
- Insert the stranded cable in the proper size cable lug and pour solder through the cable lug. Ensure that solder fills the entire space inside the cable lug socket.
- Wipe off excess solder on cable insulation.
- Connect the cable lug to the terminal and tighten terminal screws using spring washers on the cable lug.
- There should not be excess load on the cable lug, or else the solder will become loose. Care must, therefore, be taken to cut the cable core and strip the insulation to the correct length. The cable lug should sit flat on the terminal and the cable should not have sharp bends.

Every two or three months it is necessary to check whether the connection is firm and to tighten the screws, if necessary. Also check and ensure that the cable is not loose in the cable lug.

For "crimping" type cable-lugs :

- Check that cable lug socket is clean and dry inside.
- Clean every strand of aluminium wire with a small hard wire brush after opening strands.
- Close the strand again immediately, insert to the proper length inside the cable lug socket and crimp, using the correct crimping tool.
- Connect the cable lugs to the terminal and tighten terminal screws using spring washers on the cable lug.

### Contact maintenance

Contact tips are made of silver compositions like silver nickel and silver cadmium oxide. In normal use, these tips may show slight brown or black tarnish. If the atmosphere around the starter contains high moisture and sulphur, the contact tips will show excessive tarnishing. To clean the contact tips, use this maintenance procedure:

1. Rub the contact tips lightly with fine emery paper.  
DO NOT FILE THE CONTACT.
2. Remove small particles by rubbing with wet cotton wool or with a wet, clean cloth.
3. Remove the water on the contact tip surface with a dry, clean cloth. If possible, apply acetone or carbon tetrachloride. Do not use petrol.

The maintenance procedure is necessary only if contact tips are covered with thick, black tarnish film. If the contact tip is uneven, but not heavily tarnished, do not disturb the contact.

### Contact replacement

Contact replacement becomes necessary if less than one-third of the original contact tip remains on the contact. This can be ascertained by comparing the contact with a new one of the same starter. When replacing contacts, change contact springs and leaf springs, if any.

#### Note :

Proper soldering of aluminium cables requires special grade of solders and fluxes meant for that purpose. Normal solders and fluxes will produce a joint deceptively acceptable but it will in practice lead to over-heating and eventually to burnouts.

## ▶ SECTION VIII

### Trouble shooting chart for starters

Given below are some of the common complaints in starters. The probable cause and suggested remedy are also given. But before attending to any complaint, ensure that the wiring is as per the wiring diagram given in this booklet. Most of the complaints can be traced to the wiring carried out at the site.

#### FOR DOL STARTERS :

Complaint	Reasons/Solutions
1. Motor does not start even though 'Start' button is pressed. However on lifting the moving magnet manually, motor starts.	1) a) Coil does not get energised (see control wiring diagram) b) Check nylon strip on relay, Check nylon button below start button.
2. Relay/coil has been charged. However motor does not start when green button is pressed.	2. Check if red wire on the relay and black wire on the coil are properly connected.
3. Motor starts when green button is pressed. It however stops immediately when it is released.	3. a) Blue wire is not connected properly or completely absent, b) Hold-on contact moving strip is missing or improperly placed.
4. Humming and/or chattering noise.	4. a) Low supply voltage b) Magnet faces unclean. Moving system functioning is obstructed by dirt.
5. Use of starters on 230V 10 supply. Incoming / outgoing lines wired. However motor does not start.	5. Coil obtains supply from across R & B supply. However if in/out wires are connected on R & Y phases coil will not energise. You may connect all three phases in series.
6. Remote start/stop button not working properly; motor starts on remote start; however does not stop on remote stop.	6. Red wire not wired as per wiring diagram.

7. Thermostat/float switch/pressure switch are wired to the starter. Motor cannot be stopped properly. Motor stops on pressing stop button. However it restarts on releasing the same.
8. Motor does not restart immediately after tripping on O/L even though resetting has been resorted to.
- 7) No mistake in wiring here  
However it is necessary that the stop button is of the stay-put type or locked in. Off position  
Alternatively, you could shut the main switch.
- 8) It takes a little time for the thermal bimetals to coil and reset. Hence wait for 2-4 minutes before restarting.

#### **FOR STAR-DELTA STARTERS :**

1. Motor works in Star. However it does not work properly In Delta and refuses to take load.
2. a) Motor starts with difficulty in Star or trips when additional load is present,  
b) Motor works in Star. However stops when Delta connection comes on.
3. a) Even though all six wires have been connected, motor stops when in Delta,  
b) Motor stops when in Delta, starter trips and fuse blows.
4. Relay has been changed in semi-automatic starter, however when the main switch is on, the motor starts immediately without the necessity of pressing the start button. Motor stops in Star itself.
1. Check if only three wires are being terminated in terminal box of motor. Six wires should be connected to starter. If shorting links are present they should be removed.
2. Reduce time delay from Star to Delta in case it is kept very long.  
a) Or if a semi-automatic starter is being used, switch over from Star to Delta earlier than done previously.  
b) Possibly due to low system voltage.
3. a) Delta connection from motor is improper.  
b) Low system voltage. Star/Delta connection in starter wrongly connected.
4. This is a usual complaint. You may have changed the original relay yourself. All factory made relays have loop-wires 2-3 wired, in semi-automatic starters. 2-4 terminals on relays must be connected. Check relay before connecting it on starter.



## INSTALLATION & COMMISSIONING OF THE MOTOR CONTROLLER MU-G10 AND MU-G20

This controller is provided with several protection features and indicating instruments for the convenience of operation and safety. The motor can be set to start (automatically) within 30-60 secs. after supply is restored. For this, the rocker switch on SPPR has to be set to "AUTO", otherwise set to "BY-PASS" mode. This feature is by-passed as supplied from the factory.

### The motor controller is armed with the following protection features:

1. Overload protection
2. Phase failure\*
3. Phase unbalance \*
4. Phase reversal \*
5. Dry run protection (Not Standard)\*

\* - Protection features enabled only in AUTO mode and not in BY-PASS mode.

### Visual indication is provided :

1. Supply Voltage (Line)
2. Current drawn by motor (Phase)
3. Lamp-indicating supply ON
4. Lamp - indicating motor ON

For normal operation (manual mode) motor can be switched ON-OFF with GREEN & RED push buttons. Toggle switch should be in ON position.

However, please note that the standard RED push button will not function in "AUTO" mode & toggle switch has to be used for switching OFF.

By taking these few precautions and care the starter will be able to perform satisfactorily year after year.

### Installation & Commissioning of the motor controller MU-G10 and MIU-G20

#### A) Installation instruction:

- Ensure that the enclosure is mounted in the vertical position.
- Set the rocker switch on the SPPR to "BY-PASS" mode, the switch can be set to "Auto" mode only after ensuring the proper operation of the motor for a few minutes.
- Use right size of the cables with cable lugs. Use cable glands for fixing cables to the enclosure to avoid excess stress on terminals.
- Connect the supply (Line) cables on the terminal block provided, Marked "Supply terminals" in star-delta controller and in DOL controller on the MU contactor.
- Connect the motor terminals on the terminal block provided, marked "Motor terminals".

- Ensure that the termination joints are properly tightened.
- Set the relay pointer corresponding to the actual current drawn by the motor, as indicated by the ammeter. In star-delta controller, the relay setting (phase current) should be reduced to 1 /1.732 times of the ammeter reading (line current)

**B) Commissioning**

- Keep the toggle switch in OFF position & SPPR in "By-Pass" mode:
- Switch ON the power supply. The RED lamp will be switched ON indicating the presence of the power supply, the actual voltage can be read in the voltmeter (select the phase using the selectorswitch provided.)
- Now put the Toggle switch in ON position.
- Press the START button. The Green LED lamp should glow and the motor should start.
- Ammeter will show the line current drawn by the motor.
- For starting the motor automatically after the supply is restored set the switch on the SPPR in "AUTO" mode. The motor will start after a delay of 30-60 secs. In this mode the motor can be switched OFF by the toggle switch - Not by the red button.

**Star Delta Motor Controller Troubleshooting**

	<b>PROBLEM</b>	<b>CAUSE</b>	<b>SOLUTION</b>
1.	Motor runs in reverse direction	Phase sequence not correct	Interchange the supply sequence
2.	Motor runs in correct direction but stops immediately	Motor overloaded Relay tripping	Check the current & increase the relay setting appropriately
3.	Motor not starting	SPPR trips sensing wrong sequence (lamp doesn't glow) Low supply voltage  Single phasing SPPR trips Phase is unbalanced SPPR trips	Interchange Y&B on the SPPR  Wait till proper supply is restored Wait till proper supply is restored Wait till proper supply is restored