

Description	Page No.
Circuit Breakers	
Motor Circuit Protectors	
Application	460
Catalog Listings	460
Pressure Connectors (Solderless)	452
Thermal/Magnetic Trip	
Application/Selection	450, 451
Catalog Listings	
100A Frame	453
100/150A Frame	454, 455
225/250A Frame	456, 457
400/600A Frame	458
800/1000A Frame	459
Disconnect Switches	
	461
Motor Line Starters	
General Information	446
Magnetic	
Reversing and Two-Speed	
Catalog Listings	448
Control Circuit Diagrams	464, 465
Single-Speed, Non-Reversing	
Catalog Listings	447
Control Circuit Diagrams	462, 463
Manual	449

Table No.	Page No.	Table No.	Page No.
1	447	9	455
2	448	10	456
3	449	11	457
4	451	12	458
5	451	12A	458
6	452	13	459
7	453	14	460
8	454	15	461

Selection of Size (Horsepower Ratings)

Horsepower Ratings: Listings of EBM, EPC, and similar enclosures complete with motor starters indicate the maximum horsepower rating of the starter. In the case of EBM, EPC combination motor starter and circuit breaker enclosures, the maximum horsepower shown is also dependent on the ampere rating of the circuit breaker.

Selection of Heaters: All magnetic motor starter enclosures ordered complete with starter are furnished with heaters.

All manual motor starter enclosures ordered complete with starter are furnished with heaters. One heater is furnished with two-pole starters and three heaters with three-pole starters.

Based on motor nameplate data, (required with each order), Cooper Crouse-Hinds will select heaters or relay coils satisfactory for average conditions of 55°C motors with ambient temperature at 75°F. If complete motor data is not available at the time the starter is ordered, heaters will be supplied for any ampere rating specified, or, upon request, complete heater tables will be supplied for any manufacturers' starter listed for use in a Cooper Crouse-Hinds enclosure.

Unusual Conditions: For frequent starting, for high inertia (slow starting loads), for extremely high or low ambient temperature, or for prevailing ambient temperature at the motor differing greatly from that at the starter, the heater size required will differ from the standard. Consult Cooper Crouse-Hinds or the starter manufacturer for recommendations, giving full particulars.

Special Features Available – Magnetic Starters Only

All magnetic starters can be provided with separate ac control circuit and additional electrical interlocks, N.O. or N.C. The number of interlocks is limited by the design of the starter and information will be furnished on request. Most starters can be supplied with automatic reset overload relays.

Standard magnetic starters are equipped with three overload relays. Starters can be provided with control circuit transformers and time delay low voltage release. Availability of these features depends on the enclosure design, and details will be found in the listing pages.

Wiring Diagrams: Typical control circuit wiring diagrams for single-speed, reversing and two-speed magnetic starters are shown on pages 462 to 465.

Thermal Overload Relays For Motor Running Overload Protection

Application:

Excessive motor running currents, caused by overloading of the motor, will damage the motor if allowed to continue beyond the point where the maximum permissible motor operating temperature is reached. Thermal overload relays (supplied as part of the magnetic motor starter) will detect such excessive current, and act automatically to disconnect the motor from its supply lines when the danger point is reached. When properly chosen, the sensing device of the relay (heater element) will closely match the thermal characteristics of the motor, and will allow the maximum motor starting current to flow during the normal starting period and still afford protection against motor overheating. A series of heater elements, rated in Full Load Motor Current, are interchangeable on the overload relays, and selection is based on motor operating data as given on the motor nameplate.

Selection of Heater Elements

Overload relay heater elements are selected on the basis of (A) motor type, and (B) difference in ambient (surrounding air) temperature, if any, between motor and starter locations.

A. Motor Type

Motors may be divided into two basic types according to the allowable internal (winding) temperature rise under full load; 40°C rise motors, which are usually of open frame construction, and 50°C or 55°C motors of enclosed frame construction such as splash-proof, drip-proof, and totally enclosed (including explosion-proof). The temperature rise classification will be found on the motor nameplate, and is specified in the motor manufacturer's catalog data.

40°C rise motors are designed to permit their use continuously at an overload of 15 percent more than rated load. 50°C rise or 55°C rise motors do not have this extra capacity. Therefore, a heater selected for a 40°C rise motor should not be applied to 50°C or 55°C motors. Heaters should be selected from heater tables for 50°C or 55°C motors as supplied by Cooper Crouse-Hinds or as recommended by starter manufacturer.

B. Ambient Temperature Effect

The overload relay is basically a temperature-operated device, and a properly selected heater will provide the relay with a temperature rise curve the same as that of the motor so that the relay closely approaches its tripping point as the motor reaches its maximum allowable operating temperature. Any overload current which will overheat the motor will also cause the relay to reach its tripping point and disconnect the motor from the line. The temperature rise curves of both the overload relay and the motor are based on a standard ambient temperature of 40°C (104°F).

An increase or decrease in ambient temperature will affect both the overload relay and the motor equally, if both are in the same location, since the final temperature of each is the sum of the operating temperature rise and the ambient temperature. Under this condition, no compensation for ambient is necessary, since the tripping point of the relay will fall or rise as the thermal capacity of the motor falls or rises.

Any difference in ambient between the overload relay location and the motor location will cause a difference between the tripping point of the overload relay and the maximum permissible motor operating temperature. This can result in premature tripping of the relay if the relay ambient is higher than that of the motor, or overheating of the motor under overload if the relay ambient is lower than that of the motor so that the relay does not trip when required.

To compensate for any such difference, and when specific recommendations of the starter manufacturers cannot be obtained, the following rule may be used when making heater selections:

Ambient Temperature at Overload Relay Higher –

For each 14°C difference, use one size larger heater.

Ambient Temperature at Overload Relay Lower –

For each 14°C difference, use one size smaller heater.

Single-Speed, Non-Reversing 3-Phase 60 hertz

Table 1

Starters require three heaters, which should be selected in accordance with the manufacturer's recommendations. Most explosion-proof motors are rated at 55°C rise, and heaters should be selected accordingly. See page 446 for starter and heater selection data.

Allen-Bradley

Bulletin 509

Size	120V Cat. #	240V Cat. #	480V Cat. #	600V Cat. #
0	509-AOD	509-AOA	509-AOB	509-AOC
1	509-BOD	509-BOA	509-BOB	509-BOC
2	509-COD	509-COA	509-COB	509-COC
3	509-DOD	509-DOA	509-DOB	509-DOC
4	509-EOD	509-EOA	509-EOB	509-EOC
5	509-FOD	509-FOA	509-FOB	509-FOC

Cutler-Hammer

Series A10

Size	120V Cat. #	240V Cat. #	480V Cat. #	600V Cat. #
0	A10BNOA	A10BNOB	A10BNOC	A10BNOD
1	A10CNOA	A10CNOB	A10CNOC	A10CNOD
2	A10DNOAB	A10DNOBB	A10DNOCB	A10DNODB
3	A10ENOA	A10ENOB	A10ENOC	A10ENOD
4	A10FNOAB	A10FNOBB	A10FNOCB	A10FNODB
5	A10GNOA	A10GNOB	A10GNOC	A10GNOD

Specify voltage in addition to horsepower, phase, frequency and full load current of motor.

General Electric

CR306

Size	120V Cat. #	240V Cat. #	480V Cat. #	600V Cat. #
0	CR306B002AAA	CR306B003AAA	CR306B004AAA	CR306B005AAA
1	CR306C002AAA	CR306C003AAA	CR306C004AAA	CR306C005AAA
2	CR306D002AAA	CR306D003AAA	CR306D004AAA	CR306D005AAA
3	CR306E002AAA	CR306E003AAA	CR306E004AAA	CR306E005AAA
4	CR306F002AAA	CR306F003AAA	CR306F004AAA	CR306F005AAA
5	CR306G002AAA	CR306G003AAA	CR306G004AAA	CR306G005AAA

Square D

Specify class and type of starter. Give horsepower, voltage, phase, frequency and full load current of motor.

(EPC, Enclosures)

Class 8536

Size	With Melting Alloy	Type Overload Relays With Bi-Metallic Type
	Cat. #	Overload Relays † Cat. #
0	8536-SBO-2	8536-SBO-2 Form †
1	8536-SCO-3	8536-SCO-3 Form †
2	8536-SDO-1	8536-SDO-1 Form †
3	8536-SEO-1	8536-SEO-1 Form B5
4	8536-SFO-1	8536-SFO-1 Form B5
5	8536-SGO-1	8536-SGO-1 Form B5

Cutler-Hammer

Class A200 – Sizes 0-5

Size	120V‡ Cat. #	240V Cat. #	480V Cat. #	600V Cat. #
0	A200M0CAC	A200M0CW	A200M0CX	A200M0CE
1	A200M1CAC	A200M1CW	A200M1CX	A200M1CE
2	A200M2CAC	A200M2CW	A200M2CX	A200M2CE
3	A200M3CAC	A200M3CW	A200M3CX	A200M3CE
4	A200M4CAC	A200M4CW	A200M4CX	A200M4CE
5	A200M5CAC	A200M5CW	A200M5CX	A200M5CE

Cutler-Hammer Products – Advantage® Series

Class W200 – Sizes 1-5

Size	120V, 240V, 480V, 600V Cat. #
1	W200M1CFC
2	W200M2CFC
3	W200M3CFC
4	W200M4CFC
5	W200M5CFC

(coil voltage 120V)

6C Technical Data

† A Class 9065 Type TUP overload relay will be supplied as standard on all Type S starters (sizes 0-2) specifying bimetallic overload protection. The Type TUP contains three built-in bimetals. **No additional thermal units are required.** To order, select appropriate Form letter (Forms B20-B42) based on motor full load current.

‡ Sizes 0-5 inclusive 120V Cutler-Hammer starters are wired with a separate control circuit. Starters with control circuit wired to line terminals available.

Reversing and Two-Speed
3-Phase 60 hertz

Table 2

Reversing starters require three heaters; two-speed starters require six heaters. These should be selected in accordance with the manufacturer's recommendations. Most explosion-proof motors are rated at 55°C rise and heaters should be selected accordingly. See page 446 for starter and heater selection data.

Reversing Starters

Specify class and type or bulletin number, and size of starter. Give horsepower, voltage, phase, frequency and full load current of motor.

Allen-Bradley

Bulletin 505V

With Melting Alloy Type
Overload Relays

Size	120V Cat. #	240V Cat. #	480V Cat. #	600V Cat. #
0	505V-AOD	505V-AOA	505V-AOB	505V-AOC
1	505V-BOD	505V-BOA	505V-BOB	505V-BOC
2	505V-COD	505V-COA	505V-COB	505V-COC
3	505V-DOD	505V-DOA	505V-DOB	505V-DOC

Square D

Class 8736

With Melting Alloy Type
Overload Relays

Size	Cat. #
0	8736-SBO-10
1	8736-SCO-7
2	8736-SDO-1
3	8736-SEO-1

With Bi-Metallic Type
Overload Relays†

Size	Cat. #
0	8736-SBO-10 Form†
1	8736-SCO-7 Form†
2	8736-SDO-1 Form†
3	8736-SEO-1 Form B5

Cutler-Hammer

A250 Series

Size	120V Cat. # ♦	240V Cat. #	480V Cat. #	600V Cat. #
0	A250M0CAC	A250M0CW	A250M0CX	A250M0CE
1	A250M1CAC	A250M1CW	A250M1CX	A250M1CE
2	A250M2CAC	A250M2CW	A250M2CX	A250M2CE
3	A250M3CAC	A250M3CW	A250M3CX	A250M3CE
4	A250M4CAC	A250M4CW	A250M4CX	A250M4CE

♦ 120 volt starters are wired with separate control circuit.

♦ ♦ Starters for constant horsepower applications or open delta connections can be supplied. Information will be furnished on request accompanied by complete details.

† A Class 9065 Type TUP overload relay will be supplied as standard on all Type S starters (sizes 0-2) specifying bimetallic overload protection. The Type TUP contains three built-in bimetals. **No additional thermal units are required.** To order, select appropriate Form letter (Forms B20-B42) based on motor full-load current.

Two-Speed Starters

Specify class and type or bulletin number, and size of starter. Give horsepower, voltage, phase, frequency and full load current of motor at each motor speed.

The following are only for Two-Winding, Constant or Variable Torque, Star Connected Motors ♦ ♦

Allen-Bradley

Bulletin 520V

With Melting Alloy Type
Overload Relays

Size	120V Cat. #	240V Cat. #	480V Cat. #	600V Cat. #
0	520VE-AOD	520VE-AOA	520VE-AOB	520VE-AOC
1	520VE-BOD	520VE-BOA	520VE-BOB	520VE-BOC
2	520VE-COD	520VE-COA	520VE-COB	520VE-COC
3	520VE-DOD	520VE-DOA	520VE-DOB	520VE-DOC

Square D

Class 8810

With Melting Alloy Type
Overload Relays

Size	Cat. #
1	8810-SCO-14
2	8810-SDO-14
3	8810-SEO-14

With Bi-Metallic Type
Overload Relays†

Size	Cat. #
1	8810-SCO-14 Form†
2	8810-SDO-14 Form†
3	8810-SEO-14 Form B5

The following are only for Single Winding, Consequent Pole, Constant or Variable Torque Motors ♦ ♦

Allen-Bradley

Bulletin 520V

With Melting Alloy Type
Overload Relays

Size	120V Cat. #	240V Cat. #	480V Cat. #	600V Cat. #
0	520VF-AOD	520VF-AOA	520VF-AOB	520VF-AOC
1	520VF-BOD	520VF-BOA	520VF-BOB	520VF-BOC
2	520VF-COD	520VF-COA	520VF-COB	520VF-COC
3	520VF-DOD	520VF-DOA	520VF-DOB	520VF-DOC

Square D

Class 8810

With Melting Alloy Type
Overload Relays

Size	Cat. #
1	8810-SCO-12
2	8810-SDO-12
3	8810-SEO-12

With Bi-Metallic Type
Overload Relays†

Size	Cat. #
1	8810-SCO-12 Form†
2	8810-SDO-12 Form†
3	8810-SEO-12 Form B5

2-Pole, 1-Phase 3-Pole, 3-Phase

Table 3

Two-pole starters require one heater; three-pole starters require three heaters. These should be selected in accordance with the manufacturer's recommendations. Most explosion-proof motors are rated at 55°C, and heaters should be selected accordingly. See page 446 for starter and heater selection data.

Allen-Bradley

Bulletin 609 (Toggle Lever)

Size	Poles	Cat. #
M-0	2 (1 Ph)	609T-AOX
	3 (3 Ph)	609T-AOW
M-1	2 (1 Ph)	609T-BOX
	3 (3 Ph)	609T-BOW
M-1P	2 (1 Ph)	609T-XOX

Allen-Bradley

Bulletin 609U (Toggle Lever)

With Undervoltage Protection

Size	Poles	Coil Volts @ 60 Hertz†	Cat. #
M-0	2 (1 Ph)	120	609TU-AOXD
	2 (1 Ph)	240	609TU-AOXA
	3 (3 Ph)	240	609TU-AOA
	3 (3 Ph)	480	609TU-AOB
	3 (3 Ph)	600	609TU-AOC
M-1	2 (1 Ph)	120	609TU-BOXD
	2 (1 Ph)	240	609TU-BOXA
	3 (3 Ph)	240	609TU-BOA
	3 (3 Ph)	480	609TU-BOB
	3 (3 Ph)	600	609TU-BOC
M-1P	2 (1 Ph)	120	609TU-XOXD
	2 (1 Ph)	240	609TU-XOXA

Cutler-Hammer

A300 (3 Ph) (Pushbutton) B300 (1 Ph)

Size	Poles	Cat. #
M-0	2 (1 Ph)	9115-H166
	3 (3 Ph)	9115-H167
M-1	2 (1 Ph)	9115-H173
	3 (3 Ph)	9115-H174
M-1P	2 (1 Ph)	9115-H180

General Electric

CR1062 (Toggle Lever)

Size	Poles	Cat. #	With Undervoltage Protection	
			Coil Volts @ 60 Hertz†	Cat. #
M-0	2 (1 Ph)	CR1062-R13A	115	CR1062-RL13A02
	2 (1 Ph)		230	CR1062-RL13A03
	3 (3 Ph)	CR1062-R9B	200/208	CR1062-RL9B23
	3 (3 Ph)		230	CR1062-RL9B03
	3 (3 Ph)		460	CR1062-RL9B04
M-1	3 (3 Ph)		575	CR1062-RL9B05
	2 (1 Ph)	CR1062-S13A	115	CR1062-SL13A02
	2 (1 Ph)		230	CR1062-SL13A03
	3 (3 Ph)	CR1062-S9B	200/208	CR1062-SL9B23
	3 (3 Ph)		230	CR1062-SL9B03
M-1P	3 (3 Ph)		460	CR1062-SL9B04
	3 (3 Ph)		575	CR1062-SL9B05
	2 (1 Ph)	CR1062-S22A	115	CR1062-SL22A02
	2 (1 Ph)		230	CR1062-SL22A03

Square D

Class 2510 (Toggle Lever)

Size	Poles	Cat. #*	With Undervoltage Protection
			Cat. #*
M-0	2 (1 Ph)	TBO-1	TBO-21
	3 (3 Ph)	TBO-2	TBO-22
M-1	2 (1 Ph)	TCO-1	TCO-21
	3 (3 Ph)	TCO-3	TCO-23
M-1P	2 (1 Ph)	TCO-2	TCO-22

Cutler-Hammer

B100 Series (Toggle Lever)

Size	Poles	Cat. #
M-0	2 (1 Ph)	B100M0BX
	3 (3 Ph)	B100M0CX
M-1	2 (1 Ph)	B100M1BX
	3 (3 Ph)	B100M1CX
M-1P	2 (1 Ph)	B100MDBX

* Specify class and type, motor line voltage, coil voltage, and frequency.

† Coil is not dual rated for 50 Hertz. For 50 Hertz, consult Cooper Crouse-Hinds.

Selection of Circuit Breakers

Lighting, Heating, Appliance and Similar

Circuits: Circuit breakers should have ampere ratings not exceeding ampere capacities of conductors protected. See National Electrical Code®, Section 240-3.

Individual Motor: An individual motor branch circuit having a starter including overcurrent features is considered protected if the circuit breaker does not exceed the values shown in table 430-152 of the NEC. If these values are insufficient to permit starting, the ampere ratings of the circuit breakers may be increased up to a maximum of 400 percent of the full load amperes of the motors. See NEC Section 430-52.

Motor Feeder: A motor feeder is a circuit supplying a group of motors. Its conductors should be protected by a circuit breaker of ampere setting not greater than the setting of the largest breaker for any motor in the group, plus the sum of the full load currents of the other motors in the group. See NEC, Section 430-62.

Application Data: Page 451 contains information which will be helpful in selecting proper circuit breakers for usual applications.

Ambient Temperature: High or low ambient temperatures affect ratings of circuit breakers. For further information see note for Breaker Selection Table 4 on page 451.

Load Conditions: Ampere ratings of circuit breakers for motors shown in Table 4, page 451 are for average conditions. High inertia (slow starting) loads of frequent starting may require larger ampere rated breakers. For further information see note for Breaker Selection Table 4 on page 451.

Special Features Available:

Many circuit breakers can be provided with special features such as shunt trip, undervoltage release, auxiliary switches, bell-alarm switches, fungus-proofing, or ambient compensation. These features are not available on all sizes and makes of breakers, however. Complete information will be furnished on request.

Application of Molded Case Thermal Magnetic Circuit Breakers as Motor Branch Circuit Protection

Use:

When used in conjunction with motor starters (Cooper Crouse-Hinds EBMC and EPC combination motor controllers) as motor branch circuit protection, the circuit breaker is primarily intended for the protection of conductors, motor control components, and motors against short circuits and ground fault conditions.

On motor overloads, the motor starter overload relays will open the circuit before the circuit breaker will trip, provided that the breaker has been properly selected. Currents higher than motor locked rotor value will be interrupted by the breaker before the overload relays can act, and protect the circuit from these heavy fault currents. The breaker must not trip on normal starting.

Circuit breakers provided in combination motor controllers listed complete with starter and circuit breaker have been selected to meet these requirements for the maximum horsepower ratings shown.

Application

Circuit breakers are supplied in a variety of frame sizes (types), each of which has specific voltage and short circuit interrupting capacity limitations. Each frame size is available in a number of current carrying capacity ratings, generally known as "trip ratings".

Proper selection of the circuit breaker for any combination motor controller requires the following factors to be considered:

1. Circuit Voltage and Frequency: Rated breaker voltage must not be lower than the circuit voltage. Higher voltage rated breakers may be satisfactorily used.

For frequency ratings from dc up to 120 Hertz ac standard breaker ratings are applied. Above 120 Hertz ac derating factors must be applied. Consult Cooper Crouse-Hinds for recommendations.

2. Interrupting Capacity: Rated breaker interrupting capacity must not be less than the available short circuit current (including motor contributions) at the breaker location. Standard procedures for determining the available short circuit current should be used.

If calculated short circuit current exceeds the interrupting capacity of the breakers listed in cataloged motor control combinations, consult Cooper Crouse-Hinds, giving full data.

3. Trip Rating: The trip rating of the breaker must be at least 115 percent of the motor full load current, but not more than the maximum rating permitted (as a percentage

of full load current) by National Electrical Code Table 430-152. Within these limits, the lowest rating should be selected which will permit motor acceleration through the normal starting period. Unusual ambient temperature at the circuit breaker location may require that the breaker trip rating be derated.

Breaker trip rating selection Tables 4 and 5, page 451, have been established on the basis of the above rating requirements under assumed conditions of:

- (a) Full load motor currents (FLMC) for given horsepower
- (b) 600 percent motor inrush (locked rotor current as a percentage of FLMC)
- (c) Accelerating time not more than ten seconds
- (d) Frequency of starts not more than three per hour

These tables will cover the selection requirements of the majority of installations using Cooper Crouse-Hinds motor control equipment. For conditions varying widely from the above, consult Cooper Crouse-Hinds for recommendations.

Use of Breaker Selector Tables (Page 6C-5)

A. Determine frame size breaker required by referring necessary voltage rating and interrupting capacity to breaker listings (pages 453 through 459)

B. Determine breaker trip rating required as follows:

1. If FLMC is not known:

(a) Refer to Table 5, Terminal Amperes of Motors at Full Load, (page 451), and opposite known horsepower rating find average FLMC under appropriate voltage and motor type columns

(b) Refer this FLMC to Table 4, Selection of Circuit Breakers for Motor Circuits (page 451), and find breaker rating under appropriate motor type column

2. If FLMC is known:

(a) Refer known FLMC to Table 4, Selection of Circuit Breakers for Motor Circuits (page 451), and find breaker rating under appropriate motor type column.

C. Refer breaker rating to breaker listings determined in "A" above, and obtain breaker Cat. No.

It should be noted that EBMC and EPC combination motor controllers are listed for use with particular frame size breakers as shown in columns headed "Circuit Breakers." Reference should be made to combination listings to insure the breaker selected can be accommodated in conjunction with the desired motor starter size. The combinations shown will cover all normal motor control branch circuit requirements.

Table 4/Selection of Circuit Breakers for Motor Circuits

Values Given Based on One Motor per Circuit and Wire Size in Accordance with Code ‡

Important – Consult footnotes before making breaker selection.

Full Load Rating of Motor in Amperes (See Table 5)	Squirrel Cage† or Synchronous (Full Voltage, Reactor or Resistor Starting), Single-Phase of All Types	Squirrel Cage† or Synchronous (Auto Transformer Starting), High Reactance	AC Wound Rotor & DC
1 – 7	15	15	15
7.1 – 9	20	20	15
9.1 – 10	30	20	20
10.1 – 12	30	30	20
12.1 – 15	30	30	30
15.1 – 16	40	40	30
16.1 – 20	40	40	30
20.1 – 24	50	50	40
24.1 – 30	50	50	40
30.1 – 32	70	50	50
32.1 – 46	70	70	70
46.1 – 60	90	90	90
60.1 – 66	100	100	100
66.1 – 82	125	125	125
82.1 – 100	150	150	150
100.1 – 115	175	175	175
115.1 – 135	200	200	200
140 – 158	300	300	300
160 – 175	350	350	350
180 – 200	400	400	400
210 – 250	500	500	500

† High reactance squirrel cage motors are those designed to limit the starting current by means of deep-slotted secondaries or double-wound secondaries, and are generally started on full voltage.

‡ These values are for motors running at usual speeds with normal torques. Motors built for slow speeds, or where high inertia (slow starting) loads exist, may require more current; therefore, use larger ampere-rated circuit breakers. If the rating of the circuit breaker shown is insufficient to permit starting, it can be increased up to a maximum of 400 percent of full load current. See Section 430-52, NEC.

◆ High Ambient Temperatures: High ambients (surrounding temperatures) affect ratings of circuit breakers. For ambients above 75°F, derate breaker 1 percent for each 5°F. If rating obtained by this method is below requirement as shown, select next higher rated breaker. This rule applies over a range of 40°F.

It should be borne in mind that temperatures within metal housings, if exposed to direct rays from the sun, may rise considerably above the ambient temperature. Enclosures with thermal circuit breakers and/or starters, if so exposed, should not be painted with a dark colored heat-absorbing paint.

◆◆ For running protection of motors of 1 hp or less, see Sec. 430-32, NEC.

☆ For full load currents of 208 and 200 volt motors:

Three-phase – increase corresponding 220 volt FLC by 10 and 15 percent respectively.

Single-phase – increase corresponding 230 volt FLC by 10 and 15 percent respectively.

☆☆ For 90 and 80 percent power factor, the above figures should be multiplied by 1.1 and 1.25 respectively.

Table 5/Terminal Amperes of Motors at Full Load

(From National Electrical Code, Article 430)

To Obtain Breaker Select Current Ratings Below and see Table 4

Single-Phase AC Motors				Direct Current Motors		
Amperes HP	115V	230V☆	Amperes HP	120V	240V	
1/6◆◆	4.4	2.2	1/4◆◆	3.1	1.6	
1/4◆◆	5.8	2.9	1/2◆◆	5.4	2.7	
1/2◆◆	9.8	4.9	3/4◆◆	7.6	3.8	
3/4◆◆	13.8	6.9	1◆◆	9.5	4.7	
1◆◆	16	8	1 1/2	13.2	6.6	
1 1/2	20	10	2	17	8.5	
2	24	12	3	25	12.2	
3	34	17	5	40	20	
5	56	28	7 1/2	58	29	
7 1/2	80	40	10	76	38	
10	100	50	15		55	
			20		72	
			25		89	

Three-Phase AC Motors					Synchronous Type		
Amperes HP	Induction Type Squirrel Cage and Wound Rotor		Squirrel Cage		Unity Power Factor Amperes☆☆		
	115V	230V☆	460V	575V	230V☆	460V	575V
1/2◆◆	4	2	1	.8			
3/4◆◆	5.6	2.8	1.4	1.1			
1◆◆	7.2	3.6	1.8	1.4			
1 1/2	10.4	5.2	2.6	2.1			
2	13.6	6.8	3.4	2.7			
3		9.6	4.8	3.9			
5		15.2	7.6	6.1			
7 1/2		22	11	9			
10		28	14	11			
15		42	21	17			
20		54	27	22			
25		68	34	27	53	26	21
30		80	40	32	63	32	26
40		104	52	41	83	41	33
50		130	65	52	104	52	42
60		154	77	62	123	61	49
75		192	96	77	155	78	62
100		248	124	99	202	101	81
125		312	156	125	253	126	101
150		360	180	144	302	151	121
200		480	240	192	400	201	161

Pressure Connectors (Solderless)

For Front Connected Circuit Breakers

All front connected circuit breakers are furnished with suitable pressure connectors. The table below lists the wire sizes accommodated by each make and frame size of circuit breaker. EPC enclosures for, or assembled with, 800 ampere frame size

circuit breakers are furnished with special double pressure connectors and bolts for attaching them to the breakers. Each half of the special connector takes conductors from 4/0 to 500 MCM, allowing the use of single or parallel conductors in these sizes.

**Table 6/Wire Sizes Accommodated by Pressure Connectors
Front Connected Circuit Breakers**

Cutler-Hammer			Square D			General Electric		
Frame	Max. Amps	Wire ‡ Sizes	Frame	Max. Amps	Wire ‡ Sizes	Frame	Max. Amps	Wire ‡ Sizes
100 Amp EB 240VAC	20 100	#14 – #10 #14 – #1/0	100 Amp FAL 240VAC	30 100	#14 – #4* #14 – #1/0**	100 Amp TEB 240VAC	60 100	#14 – #3 #6 – #2/0
100 Amp EHD 480VAC	20 100	#14 – #10 #14 – #1/0	100 Amp FAL 480VAC	30 100	#14 – #4* #14 – #1/0**	150 Amp TED 480VAC	60 110 150	#14 – #3 #6 – #2/0 #2 – #3/0
150 Amp FDB/FD 600VAC	100 150	#14 – #1/0 #4 – #4/0	100 Amp FAL 600VAC	30 100	#14 – #4 #14 – #1/0	150 Amp TED 600VAC	60 110 150	#14 – #3 #6 – #2/0 #2 – #3/0
250 Amp JDB	250	#4 – 350 MCM	250 Amp KAL	250	#4 – 350 MCM	225 Amp TFJ	225	#4 – 300 MCM
250 Amp JD	250	#4 – 350 MCM				225 Amp TFK	225	#4 – 300 MCM
400 Amp KDB	225 350 400	#6 – 350 MCM § 250 – 500 MCM #3/0 – 250 MCM †	400 Amp LAL	400	One #1 – 600 MCM or Two #1 – 250 MCM	400 Amp TJK/TJJ	400	One #6 – 600 MCM or Two #2/0 – 250 MCM
600 Amp KD	600	250 – 500 MCM †				600 Amp TJK	400 600	One #6 – 600 MCM or Two #6 – 250 MCM Two 250 – 350 MCM
800 Amp ND	600 800	Two #1 – 500 MCM Three #3/0 – 400 MCM	1000 Amp MAL	400 800	One #1 – 600 MCM or Two #1 – 250 MCM Three #3/0 – 500 MCM	800 Amp TKMA	400 600 800	Two #1/0 – 250 MCM or One #4 – 600 MCM #2/0 – 500 MCM † Three #3/0 – 500 MCM

† Double connectors for parallel conductors.

‡ All wire sizes shown are for copper wire type. For aluminum wire type information, consult Cooper Crouse-Hinds.

§ KDB range is #3 – 350 MCM.

* 2 and 3-pole #14 – #10.

** 2 and 3-pole #14 – #3.

Table 7 – Front connection terminals for all enclosures; 10,000 ampere interrupting rating, * ♦ 120/240 VAC-NEMA; non-interchangeable trip units

General Electric Type TEB

Amps	1-Pole Cat. #	2-Pole Cat. #	3-Pole Cat. #
15	TEB111015WL	TEB122015WL	TEB132015WL
20	TEB111020WL	TEB122020WL	TEB132020WL
25	TEB111025WL	TEB122025WL	TEB132025WL
30	TEB111030WL	TEB122030WL	TEB132030WL
35	TEB111035WL	TEB122035WL	TEB132035WL
40	TEB111040WL	TEB122040WL	TEB132040WL
45	TEB111045WL	TEB122045WL	TEB132045WL
50	TEB111050WL	TEB122050WL	TEB132050WL
60	TEB111060WL	TEB122060WL	TEB132060WL
70	TEB111070WL	TEB122070WL	TEB132070WL
80	TEB111080WL	TEB122080WL	TEB132080WL
90	TEB111090WL	TEB122090WL	TEB132090WL
100	TEB111100WL	TEB122100WL	TEB132100WL
100 MCS	TEB111Y100	TEB122Y100	TEB132Y100

Square D FAL Frame

Amps	1-Pole Cat. #	2-Pole Cat. #	3-Pole Cat. #
15	FAL12015	FAL22015	FAL32015
20	FAL12020	FAL22020	FAL32020
25	FAL12025	FAL22025	FAL32025
30	FAL12030	FAL22030	FAL32030
35	FAL12035	FAL22035	FAL32035
40	FAL12040	FAL22040	FAL32040
45	FAL12045	FAL22045	FAL32045
50	FAL12050	FAL22050	FAL32050
60	FAL12060	FAL22060	FAL32060
70	FAL12070	FAL22070	FAL32070
80	FAL12080	FAL22080	FAL32080
90	FAL12090	FAL22090	FAL32090
100	FAL12100	FAL22100	FAL32100

See pages 450 and 451 for explanation of breakers and their use.

* Ratings do not apply to molded case switches.

♦ For additional information on interrupting ratings, refer to specific circuit breaker manufacturers' data.

** GE has AC & DC rating; Square D is AC only.

Table 8 – Front connection terminals for all enclosures; non-interchangeable trip units; see chart at right.

Circuit Breaker Frame Type	Interrupting Ratings – * ♦ RMS Symmetrical Amperes	
	240 VAC	480 VAC
TED	18,000	14,000
FAL	25,000	18,000
EHD	18,000	14,000

General Electric TED Frame

Amps	2-Pole Cat. #	3-Pole Cat. #
15	TED124015WL	TED134015WL
20	TED124020WL	TED134020WL
25	TED124025WL	TED134025WL
30	TED124030WL	TED134030WL
35	TED124035WL	TED134035WL
40	TED124040WL	TED134040WL
45	TED124045WL	TED134045WL
50	TED124050WL	TED134050WL
60	TED124060WL	TED134060WL
70	TED124070WL	TED134070WL
80	TED124080WL	TED134080WL
90	TED124090WL	TED134090WL
100	TED124100WL	TED134100WL
110		TED134110WL
125		TED134125WL
150		TED134150WL
100 MCS	TED124Y100WL	TED134YT100
150 MCS	TED124Y150WL	TED134YT150

Cutler-Hammer EHD Frame

Amps	2-Pole Cat. #	3-Pole Cat. #
15	EHD2015L	EHD3015L
20	EHD2020L	EHD3020L
25	EHD2025L	EHD3025L
30	EHD2030L	EHD3030L
35	EHD2035L	EHD3035L
40	EHD2040L	EHD3040L
45	EHD2045L	EHD3045L
50	EHD2050L	EHD3050L
60	EHD2060L	EHD3060L
70	EHD2070L	EHD3070L
80	EHD2080L	EHD3080L
90	EHD2090L	EHD3090L
100	EHD2100L	EHD3100L
100 MCS	EHD2100KL	EHD3100KL

Square D FAL Frame

Amps	2-Pole Cat. #	3-Pole Cat. #
15	FAL24015	FAL34015
20	FAL24020	FAL34020
25	FAL24025	FAL34025
30	FAL24030	FAL34030
35	FAL24035	FAL34035
40	FAL24040	FAL34040
45	FAL24045	FAL34045
50	FAL24050	FAL34050
60	FAL24060	FAL34060
70	FAL24070	FAL34070
80	FAL24080	FAL34080
90	FAL24090	FAL34090
100	FAL24100	FAL34100

See pages 450 and 451 for explanation of breakers and their use.

‡ Square D: 480 VAC/250 VDC.

♦ Ratings do not apply to molded case switches.

* For additional information on interrupting ratings, refer to specific circuit breaker manufacturers' data.

Table 9 – Front connection terminals for all enclosures; non-interchangeable trip units; see chart at right.

Circuit Breaker Frame Type	Interrupting Rating RMS Symmetrical Amperes* ♦		
	240 VAC	480 VAC	600 VAC
TED	18,000	14,000	14,000
FAL	25,000	18,000	14,000
FDB	18,000	14,000	14,000
FD	65,000	25,000	18,000

General Electric TED Frame

Amps	3-Pole Cat. #
15	TED136015WL
20	TED136020WL
25	TED136025WL
30	TED136030WL
35	TED136035WL
40	TED136040WL
45	TED136045WL
50	TED136050WL
60	TED136060WL
70	TED136070WL
80	TED136080WL
90	TED136090WL
100	TED136100WL
100 MCS	TED136YT100
110	TED136110WL
125	TED136125WL
150	TED136150WL
150 MCS	TED136YT150

Cutler-Hammer FD Frame

Amps	2-Pole Cat. #	3-Pole Cat. #
15	FD2015L	FD3015L
20	FD2020L	FD3020L
25	FD2025L	FD3025L
30	FD2030L	FD3030L
35	FD2035L	FD3035L
40	FD2040L	FD3040L
45	FD2045L	FD3045L
50	FD2050L	FD3050L
60	FD2060L	FD3060L
70	FD2070L	FD3070L
80	FD2080L	FD3080L
90	FD2090L	FD3090L
100	FD2100L	FD3100L
100 MCS	FD2100KL	FD3100KL
110	FD2110L	FD3110L
125	FD2125L	FD3125L
150	FD2150L	FD3150L
150 MCS	FD2150KL	FD3150KL

Square D Type FAL

Amps	2-Pole Cat. #	3-Pole Cat. #
15	FAL26015	FAL36015
20	FAL26020	FAL36020
25	FAL26025	FAL36025
30	FAL26030	FAL36030
35	FAL26035	FAL36035
40	FAL26040	FAL36040
45	FAL26045	FAL36045
50	FAL26050	FAL36050
60	FAL26060	FAL36060
70	FAL26070	FAL36070
80	FAL26080	FAL36080
90	FAL26090	FAL36090
100	FAL26100	FAL36100
100 MCS	FHL26000M	FHL36000M

Cutler-Hammer FDB Frame

Amps	2-Pole Cat. #	3-Pole Cat. #
15	FDB2015L	FDB3015L
20	FDB2020L	FDB3020L
25	FDB2025L	FDB3025L
30	FDB2030L	FDB3030L
35	FDB2035L	FDB3035L
40	FDB2040L	FDB3040L
45	FDB2045L	FDB3045L
50	FDB2050L	FDB3050L
60	FDB2060L	FDB3060L
70	FDB2070L	FDB3070L
80	FDB2080L	FDB3080L
90	FDB2090L	FDB3090L
100	FDB2100L	FDB3100L
110	FDB2110L	FDB3110L
125	FDB2125L	FDB3125L
150	FDB2150L	FDB3150L

See pages 450 and 451 for explanation of breakers and their use.

† Square D: 600 VAC/250 VDC

♦ Ratings do not apply to molded case switches.

* For additional information on interrupting ratings, refer to specific circuit breaker manufacturers' data.

Table 10 – Front connection terminals for all enclosures; non-interchangeable trip units. See chart at right.

Circuit Breaker Frame Type	Interrupting Rating RMS Symmetrical Amperes* ◆		
	240 VAC	480 VAC	600 VAC
TFJ	25,000	22,000	18,000
KAL	42,000	25,000	22,000
JB	25,000	22,000	18,000
JDB	65,000	25,000	18,000

General Electric Type TFJ

Amps	2-Pole Cat. #	3-Pole Cat. #
70	TFJ224070WL	TFJ236070WL
80	TFJ224080WL	TFJ236080WL
90	TFJ224090WL	TFJ236090WL
100	TFJ224100WL	TFJ236100WL
110	TFJ224110WL	TFJ236110WL
125	TFJ224125WL	TFJ236125WL
150	TFJ224150WL	TFJ236150WL
175	TFJ224175WL	TFJ236175WL
200	TFJ224200WL	TFJ236200WL
225	TFJ224225WL	TFJ236225WL
225 MCS	TFJ226Y225	TFJ236Y225
250		TFJ236250WL

Cutler-Hammer JDB Frame

Amps	2-Pole Cat. #	3-Pole Cat. #
70	JDB2070	JDB3070
90	JDB2090	JDB3090
100	JDB2100	JDB3100
125	JDB2125	JDB3125
150	JDB2150	JDB3150
175	JDB2175	JDB3175
200	JDB2200	JDB3200
225	JDB2225	JDB3225
250	JDB2250	JDB3250

Square D Type KAL

Amps	2-Pole Cat. #	3-Pole Cat. #
70	KAL26070	KAL36070
80	KAL26080	KAL36080
90	KAL26090	KAL36090
100	KAL26100	KAL36100
110	KAL26110	KAL36110
125	KAL26125	KAL36125
150	KAL26150	KAL36150
175	KAL26175	KAL36175
200	KAL26200	KAL36200
225	KAL26225	KAL36225
250	KAL26250	KAL36250
250 MCS	KHL26000M	KHL36000M

See pages 450 and 451 for explanation of breakers and their use.

‡ Square D: 600 VAC/250 VDC

Cutler-Hammer: 600 VAC/250 VDC

* Ratings do not apply to molded case switches.

◆ For additional information on interrupting ratings, refer to specific circuit breaker manufacturers data.

** GE: 480 VAC 2 Pole TFJ

Table 11 – Front connection terminals for all enclosures; interchangeable trip units. See chart at right.

Circuit Breaker Frame Type	Interrupting Ratings RMS Symmetrical Amperes**		
	240 VAC	480 VAC	600 VAC
TFK	25,000	22,000	18,000
KB	25,000	22,000	14,000
JD	65,000	25,000	18,000

General Electric Type TFK

Amps	2-Pole Cat. #	3-Pole Cat. #
70	TFK224070WL	TFK236070WL
80	TFK224080WL	TFK236080WL
90	TFK224090WL	TFK236090WL
100	TFK224100WL	TFK236100WL
110	TFK224110WL	TFK236110WL
125	TFK224125WL	TFK236125WL
150	TFK224150WL	TFK236150WL
175	TFK224175WL	TFK236175WL
200	TFK224200WL	TFK236200WL
225	TFK224225WL	TFK236225WL
225 MCS	TAC226Y225	TFK236Y225

Cutler-Hammer JD Frame

Amps	2-Pole Cat. #	3-Pole Cat. #
70	JD2070	JD3070
90	JD2090	JD3090
100	JD2100	JD3100
125	JD2125	JD3125
150	JD2150	JD3150
175	JD2175	JD3175
200	JD2200	JD3200
225	JD2225	JD3225
250	JD2250	JD3250
250 MCS	JD2250K	JD3250K

See pages 450 and 451 for explanation of breakers and their use.

* GE: 480 VAC/250 VDC

** Ratings do not apply to molded case switches.

400 and 600 A Frame, Thermal Magnetic

400 A

Table 12 – Front connection terminals for all enclosures; interchangeable trip units. See chart at right.

Circuit Breaker Frame Type	Interrupting Ratings RMS Symmetrical Amperes † ◆		
	240 VAC	480 VAC	600 VAC
TJJ/TJK	42,000	30,000	22,000
LAL	42,000	30,000	22,000
LB	42,000	30,000	22,000
KD/KDB	65,000	35,000	25,000

General Electric Type TJK

Amps*	2-Pole Cat. #	3-Pole Cat. #
225	TJK426225WL	TJK436225WL
250	TJK426250WL	TJK436250WL
300	TJK426300WL	TJK436300WL
350	TJK426350WL	TJK436350WL
400	TJK426400WL	TJK436400WL
400 MCS	TJK426Y400	TJK436Y400

Cutler-Hammer KD Frame

Amps*	2-Pole Cat. #	3-Pole Cat. #
225	KD2225	KD3225
250	KD2250	KD3250
300	KD2300	KD3300
350	KD2350	KD3350
400	KD2400	KD3400
400 MCS	KD2400K	KD3400K

Non-Interchangeable Trip Units

Cutler-Hammer KDB Frame

Amps*	2-Pole Cat. #	3-Pole Cat. #
225	KDB2225	KDB3225
250	KDB2250	KDB3250
300	KDB2300	KDB3300
350	KDB2350	KDB3350
400	KDB2400	KDB3400

Square D Type LAL

Amps*	2-Pole Cat. #	3-Pole Cat. #
250	LAL26250	LAL36250
300	LAL26300	LAL36300
350	LAL26350	LAL36350
400	LAL26400	LAL36400
400 MCS	LHL26000M	LHL36000M

Cutler-Hammer LD Frame

Amps*	2-Pole Cat. #	3-Pole Cat. #
225	LD2225	LD3225
250	LD2250	LD3250
300	LD2300	LD3300
350	LD2350	LD3350
400	LD2400	LD3400
400 MCS	LD2400N	LD3400N

General Electric Type TJJ

Amps*	2-Pole Cat. #	3-Pole Cat. #
225	TJJ426225WL	TJJ436225WL
250	TJJ426250WL	TJJ436250WL
300	TJJ426300WL	TJJ436300WL
350	TJJ426350WL	TJJ436350WL
400	TJJ426400WL	TJJ436400WL
400 MCS	TJJ426Y400	TJJ436Y400

600 A

Table 12A – Front connection terminals for all enclosures; interchangeable trip units. See chart at right.

Circuit Breaker Frame Type	Interrupting Ratings RMS Symmetrical Amperes † ◆		
	240 VAC	480 VAC	600 VAC
TJK	42,000	30,000	22,000
LD	65,000	35,000	25,000

General Electric Type TJK

Amps*	2-Pole Cat. #	3-Pole Cat. #
450	TJK626450WL	TJK636450WL
500	TJK626500WL	TJK636500WL
600	TJK626600WL	TJK636600WL
600 MCS	TJK626Y600	TJK636Y600

Cutler-Hammer LD Frame

Amps*	2-Pole Cat. #	3-Pole Cat. #
500	LD2500	LD3500
600	LD2600	LD3600
600 MCS	LD2600N	LD3600N

See pages 450 and 451 for explanation of breakers and their use.

◆ For additional information on interrupting ratings, refer to circuit breaker manufacturer's data.

* Lower ampere ratings available, consult Cooper Crouse-Hinds.

† Ratings do not apply to molded case switches.

‡ Cutler-Hammer LD frames: 600 VAC; G.E. TJJ: 600 VAC.

800/1000 A Frame, Thermal Magnetic 600 VAC/250 VDC 2-Pole, 3-Pole‡

Table 13 – Front connection terminals for all enclosures; interchangeable trip units. See chart at right.

Circuit Breaker Frame Type	Interrupting Ratings RMS Symmetrical Amperes † ◆		
	240 VAC	480 VAC	600 VAC
TKMA	42,000	30,000	22,000
MAL	42,000	30,000	22,000
ND	42,000	30,000	22,000

General Electric Type TKMA

Amps	2-Pole Cat. #	3-Pole Cat. #
300	TKMA826300WL	TKMA836300WL
350	TKMA826350WL	TKMA836350WL
400	TKMA826400WL	TKMA836400WL
500	TKMA826500WL	TKMA836500WL
600	TKMA826600WL	TKMA836600WL
700	TKMA826700WL	TKMA836700WL
800	TKMA826800WL	TKMA836800WL
800 MCS	TKMA826Y800	TKMA836Y800

Square D Type MAL (1,000 Amp Frame)

Amps*	2-Pole Cat. #	3-Pole Cat. #
450	MAL26450	MAL36450
500	MAL26500	MAL36500
600	MAL26600	MAL36600
600 MCS	MAL260006M	MAL360006M
700	MAL26700	MAL36700
800	MAL26800	MAL36800
800 MCS	MAL26008M	MAL36008M

Cutler-Hammer ND Frame, Rating Plugs and Terminals

Amps	Frame 2-Pole #	3-Pole #	Fixed Rating Plug Cat. #	Terminals ◆ ◆ Cat. #
400	ND2800FM	ND3800FM	8MC400	TA700MA1
500	ND2800FM	ND3800FM	8MC500	TA700MA1
600	ND2800FM	ND3800FM	8MC600	TA700MA1
700	ND2800FM	ND3800FM	8MC700	TA800MA2
800	ND2800FM	ND3800FM	8MC800	TA800MA2

See pages 450 and 451 for explanation of breakers and their use.

† Ratings do not apply to molded case switches.

◆ For additional information on interrupting ratings, refer to circuit breaker manufacturer's data.

* Lower ampere ratings available. Consult Cooper Crouse-Hinds.

◆ ◆ Two required per pole.

‡ Cutler-Hammer: 600 VAC MC frame.

Circuit Breakers Motor Circuit Protectors

3 to 250 Amp
600 VAC Max., 3 Pole

Application:

The MCP (motor circuit protector) is designed for application to individual motor circuits in combination with a magnetic motor starter. MCP's operate on an instantaneous magnetic trip principle. A current sensing coil reacts immediately to any overcurrent above a pre-selected level. The magnetic trip setting may be adjusted to the level required by a particular motor's operating characteristic. MCP's offer custom tailored protection for a particular motor.

As such, MCP's provide the fastest tripping possible in low-level faults while offering circuit breaker short circuit protection.

The three magnetic trip assemblies are closely calibrated sensing relays. Any excess current on any one of the three poles acts to trip the unit immediately. When the unit trips, all three poles immediately open, preventing single phasing.

The magnetic trip setting is adjusted by a single knob on the front of the device. This knob has position settings for different trip levels and is designed to comply with the National Electric Code® by providing a locking pin to limit the maximum trip setting to 1300% of the motor full load current. Refer to manufacturer's motor circuit protector data for proper MCP trip setting for intended application.

Table 14 – Motor Circuit Protectors

Cutler-Hammer F Frame

Continuous Amp Rating	Trip Range Amps	Use With Starter Size	MCP Cat. #	Current Limiter Suffix†
3	9-30	0	HMCP003A0	ELC3003R
7	21-70	0	HMCP007C0	ELC3007R
15	45-150	0	HMCP015E0	ELC3015R
30	90-300	1	HMCP030H1	ELC3030R
50	150-500	2	HMCP050K2	ELC3050R
70	210-700	2	HMCP070M2	ELC3100R
100	300-1000	3	HMCP100R3	ELC3100R
150	450-1500	4	HMCP150T4	ELC3150R
150	750-2500	4	HMCP150U4	ELC3150R

Interrupting Ratings – MCP only

240VAC – 100,000 Amps RMS Symmetrical
480VAC – 65,000 Amps RMS Symmetrical
600VAC – 25,000 Amps RMS Symmetrical

MCP with Current Limiter

Up to 600VAC – 200,000 Amps RMS Symmetrical

Square D FAL/KAL

Continuous Amp Rating	Trip Range Amps	Use With Starter Size	MCP Cat. #
3	8-28	0	FAL3600311M
7	18-70	0	FAL3600712M
15	50-180	0	FAL3601513M
30	50-180	1	FAL3603013M
30	100-350	1	FAL3603015M
50	75-260	2	FAL3605014M
50	150-580	2	FAL3605016M
100	150-580	3	FAL3610016M
100	300-1100	3	FAL3610018M
150	750-1500	4	FAL3615026M
250	400-800	4	KAL3625021M
250	500-1000	4	KAL3625022M
250	625-1250	4	KAL3625025M
250	750-1500	4	KAL3625026M
250	875-1750	5	KAL3625029M
250	1000-2000	5	KAL3625030M
250	1125-2250	5	KAL3625031M
250	1250-2500	5	KAL3625032M

Interrupting Ratings – MCP only

Type FAL – 240VAC – 25,000 Amps RMS Symmetrical
480VAC – 18,000 Amps RMS Symmetrical
600VAC – 14,000 Amps RMS Symmetrical

Type KAL – 240VAC – 42,000 Amps RMS Symmetrical
480VAC – 25,000 Amps RMS Symmetrical
600VAC – 22,000 Amps RMS Symmetrical

* G.E. Type TBC with Current Limiter

Cutler-Hammer J Frame

Continuous Amp Rating	Trip Range Amps	Use With Starter Size	MCP Cat. #
250	350-700	5	HMCP250A5
250	450-900	5	HMCP250C5
250	500-1000	5	HMCP250D5
250	625-1250	5	HMCP250F5
250	750-1500	5	HMCP250G5
250	875-1750	5	HMCP250J5
250	1000-2000	5	HMCP250K5
250	1125-2250	5	HMCP250L5
250	1250-2500	5	HMCP250W5

Interrupting Ratings – MCP only

240VAC – 100,000 Amps RMS Symmetrical
480VAC – 65,000 Amps RMS Symmetrical
600VAC – 25,000 Amps RMS Symmetrical

General Electric Type TFC/TBC

Continuous Amp Rating	Trip Range Amps	Use With Starter Size	MCP Cat. #*
225	600-1400	4	TFC36225
225	1000-2250	4	TFC36225A
225	550-1670	4	TBC43225F14F

Interrupting Ratings – MCP only

Type TFC – 240VAC – 25,000 Amps RMS Symmetrical
480VAC – 22,000 Amps RMS Symmetrical
600VAC – 18,000 Amps RMS Symmetrical

Type TBC – Up to 600VAC – 100,000 Amps RMS Symmetrical (with Current Limiter)

General Electric Type TEC

Continuous Amp Rating	Trip Range Amps	Use With Starter Size	MCP Cat. #§	Current Limiter Suffix†
3	8-38	0	TEC36003	TECL36003
7	18-90	0	TEC36007	TECL36007
15	42-198	0	TEC36015	TECL36015
30	90-390	1	TEC36030	TECL36030
50	180-660	2	TEC36050	TECL36050
100	300-1300	3	TEC36100	TECL36100
150	600-2700	4	TEC36150	TECL36150

Interrupting Ratings – MCP only:

Up to 600 VAC – 10,000 Amps RMS Symmetrical

MCP with current limiter:

Up to 600 VAC – 100,000 Amps RMS Symmetrical

§ Type TEC magnetic break only.

† Add the suffix to the basic MCP Cat. No. when the additional current limiter is desired.

Table 15

Cutler-Hammer File C361

Switch Rating Amps	Fusible			Non-Fusible Cat. #
	Clip Rating	Volts	Cat. #	
30	30	250	C361-SC21	C361-NC
	30	600	C361-SC61	
	30	600	C361-SD22	
60	60	250	C361-SD22	C361-ND
	60	600	C361-SD62	
	100	250/600	C361-SE263	
100	100	250/600	C361-SE263	C361-NE

General Electric Type QMW†

Switch Rating Amps	Fusible			Basic Switch Cat. #	NEC Fuse Kit Cat. #	No-Fuse Kit Cat. #
	Clip Rating Amps	Volts				
30	30	250		THMC31	THMC3121	THMC3100
	30	600		THMC31	THMC3161	
	60	250		THMC31	THMC3222	
	60	600		THMC31	THMC3262	
	60	250		THMC32	THMC3222	
	60	600		THMC32	THMC3262	
60	100	250		THMC32	THMC3363	THMC3200
	100	600		THMC32	THMC3363	
	100	250		THMC33	THMC3363	
	100	600		THMC33	THMC3363	
	200	250		THMC33	THMC3364	
	200	600		THMC33	THMC3364	
100	200	250		THMC34	THMC3464	THMC3400
	200	600		THMC34	THMC3464	

Square D Class 9422

Switch Rating Amps	Fusible			Non-Fusible Cat. #
	Clip Rating Amps	Volts	Cat. # (Type)	
30	30	250	TCF30	TCN30
	30	600	TCF33	
	60	250	TCF33	
60	30	600	TDF60	TDN60
	60	250	TDF60	
	60	600	TDF63	
100	100	250/600	TEF10	TEN10

NOTE: Specify Class 9422 and Type when ordering.

Cutler-Hammer Type DS

Switch Rating Amps	Fusible*				Non-Fusible	
	Clip Rating Amps	Volts	Cat. #*	Style #	Cat. #*	Style #
30	30	250	DS121R	1230C28G04	DS16U	1230C28G01
	30	600	DS161R	1230C28G06		
	60	250	DS122	1230C28G05		
	60	600	DS162	1230C28G07		
60	60	250	DS222R	1230C28G08	DS26U	1230C28G02
	60	600	DS262R	1230C28G09		
100	100	250/600	DS263	1230C28G10	DS36U	1230C28G03
	100	250/600	DS363R	1230C28G11		
	200	250/600	DS364	1230C28G12		
200	200	250/600	DS464R		DS46U	

NOTE: Specify Cat. No. and Style No. when ordering.

† Order basic switch plus fuse kit for fusible or basic switch plus no-fuse kit for non-fusible

‡ Accommodates Class J fuses only

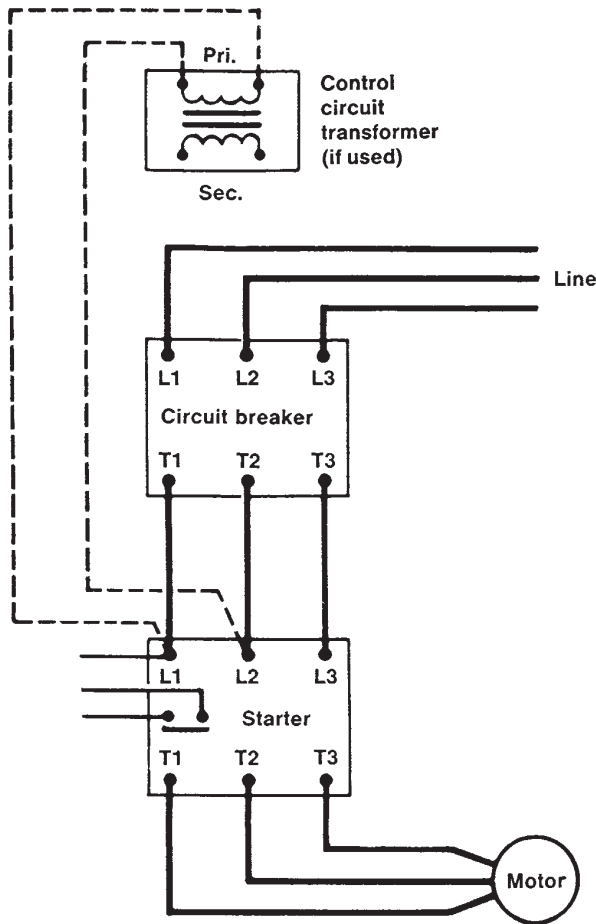
* Base mounting hardware to be ordered with switch:
 30, 60, 100 Amp. fusible or non-fusible – Style #624B375G17
 200 Amp. fusible – Style #624B375G08
 200 Amp. non-fusible – Style #624B375G07

6C Control Circuit Diagrams

Single-Speed Non-Reversing Starters

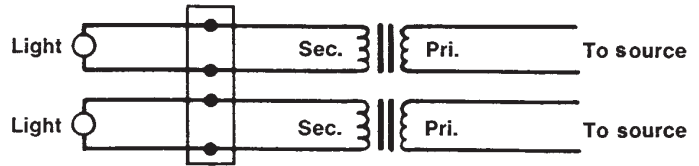
6C Technical Data

Power wiring*



NOTE: For starter only, omit wiring from circuit breaker to starter and wire line direct to L1, L2, and L3 of starter

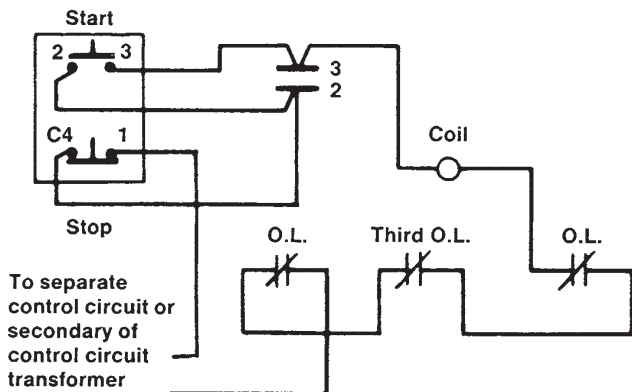
Pilot lights with transformers



Terminal block

NOTE: Extra interlocks on starters for control of pilot lights are optional. Information on request

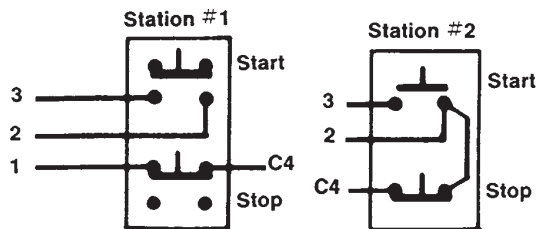
Connections for separate control circuit or control circuit transformer*



NOTE: If starter is wired with a jumper between L2 and overload relay contact, this jumper must be removed

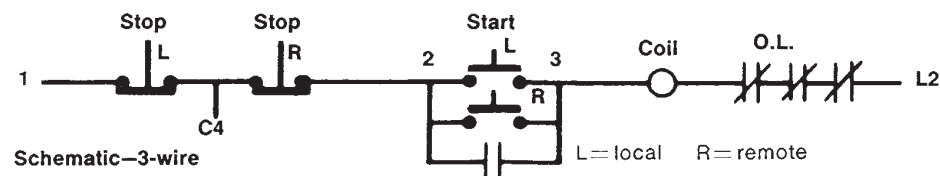
* Overcurrent protection of internal primary and secondary control circuit conductors and transformers must be provided in accordance with National Electrical Code® (ANSI/NFPA70-1993) and any other applicable standards.

Control station connections



Local or remote
If only station #1 is used, jumper 2-C4

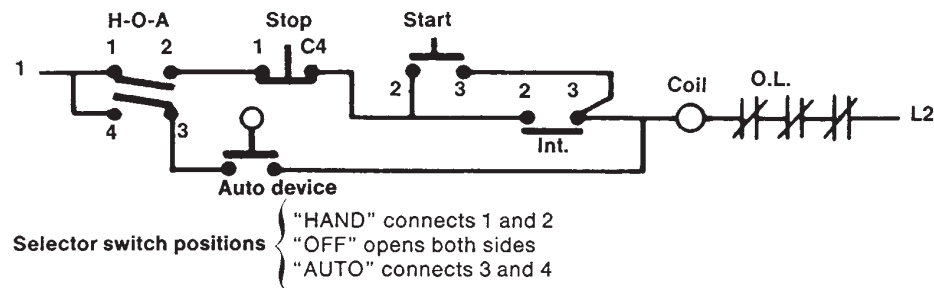
Remote
If only station #2 is used, connect C-4 to "1" at starter



2-wire control – maintained contact



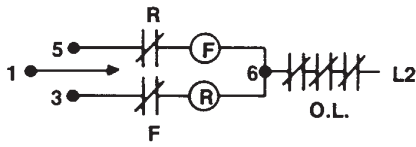
HAND-OFF-AUTO selector switch with START-STOP station



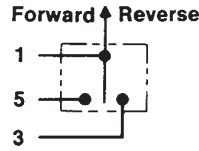
6C Control Circuit Diagrams

Reversing Starters

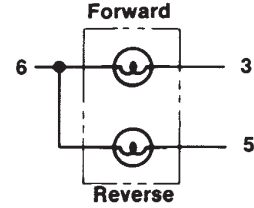
Schematic 2-wire



Connections for 2-wire control



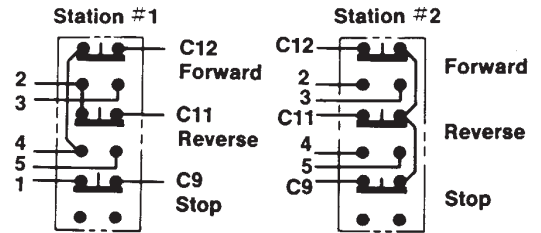
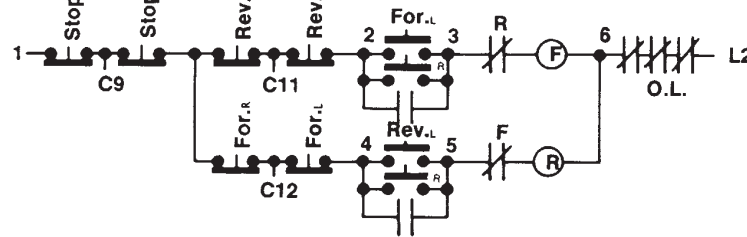
Pilot lamp connections



6C Technical Data

Schematic 3-wire/Case 1

Using two 3-button control stations, one local built-in & one remote or two remote. May change direction without using stop button.

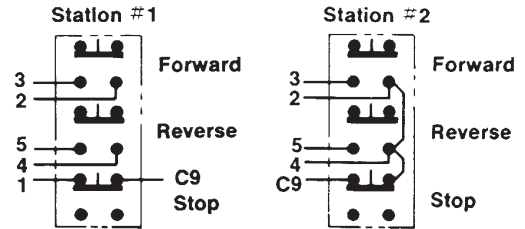
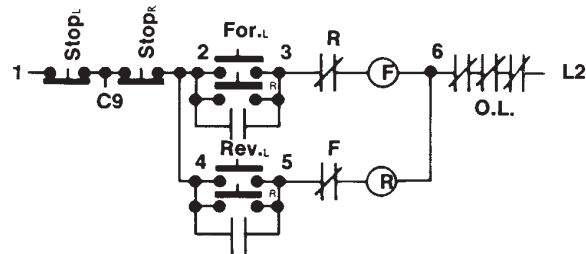


Local or remote
If only station #1 is used jumper C9-C11-C12

Remote
If only station #2 is used jumper C11-2, C12-4 & conn. C9-“1” at starter

Schematic 3-wire/Case 2

Using two 3-button control stations, one local built-in & one remote or two remote. Must use stop button to change direction.

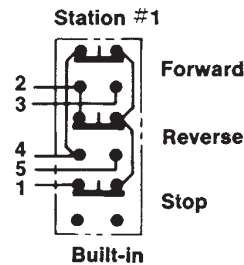
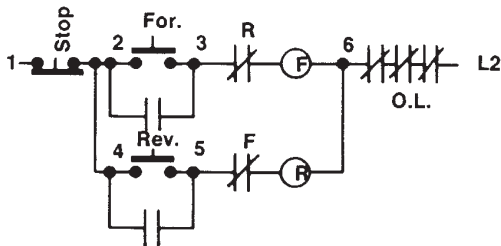


Local or remote
If only station #1 is used jumper C9-2-4

Remote
If only station #2 is used conn. C9-“1” at starter

Schematic 3-wire/Case 3

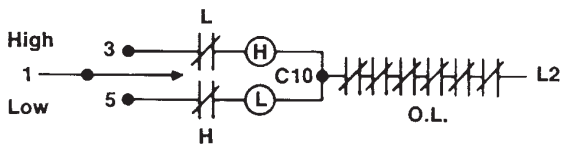
Using one built-in 3-button control station. May change direction without using stop button.



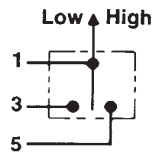
NOTE: Sub-letters on schematics indicate — “L” for local & “R” for remote stations

Two-Speed Starters

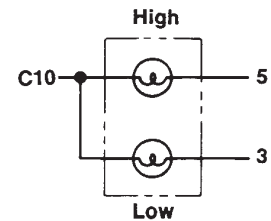
Schematic 2-wire



Connections for 2-wire control

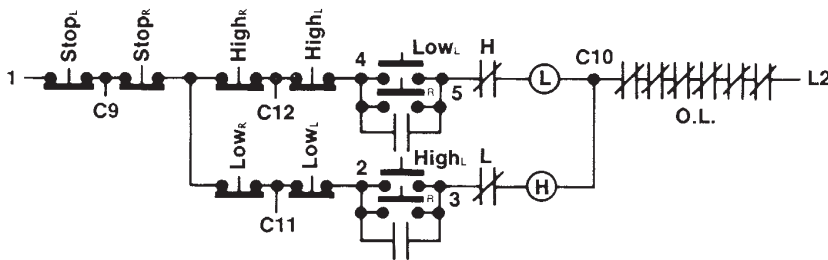


Pilot lamp connections

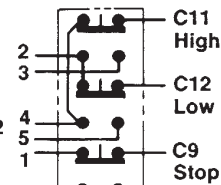


Schematic 3-wire/Case 1

Using two 3-button control stations, one local built-in & one remote or two remote. May change speeds without using stop button.



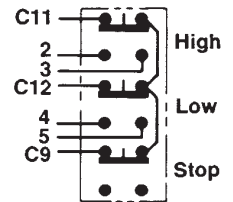
Station #1



Local or remote

If only station #1 is used jumper C9-C11-C12

Station #2

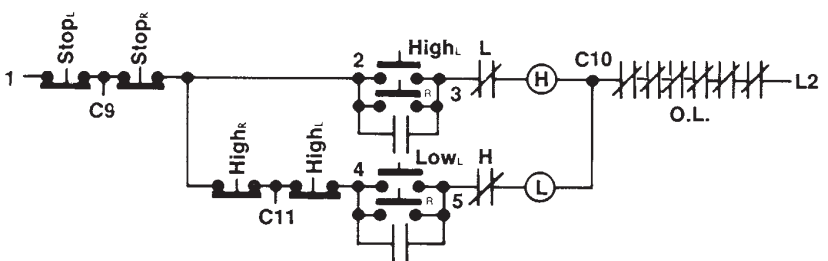


Remote

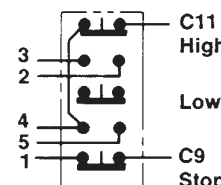
If only station #2 is used jumper C11-4, C12-2 & conn. C9-“1” at starter

Schematic 3-wire/Case 2

Using two 3-button control stations, one local built-in & one remote or two remote. Must use stop button to change from high to low speed.



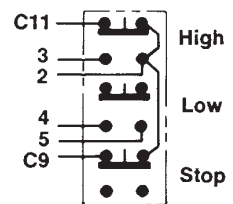
Station #1



Local or remote

If only station #1 is used jumper C9-C11-2

Station #2

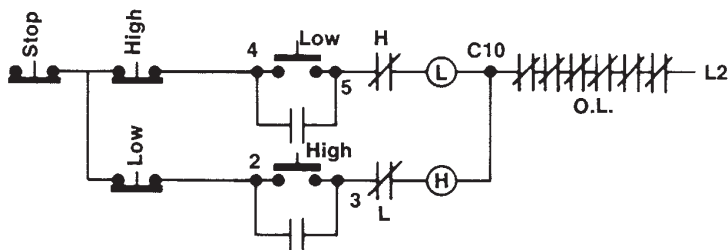


Remote

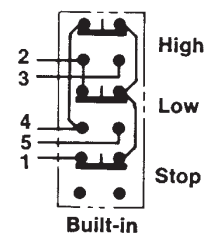
If only station #2 is used jumper C11-4 & conn. C9-“1” at starter

Schematic 3-wire/Case 3

Using one built-in 3-button control station. May change speeds without using stop button.



Station #1



Built-in

NOTE: Sub-letters on schematics indicate — “L” for local & “R” for remote stations