MACHINERY OEM / CONTROL PANELBUILDER'S HANDBOOK

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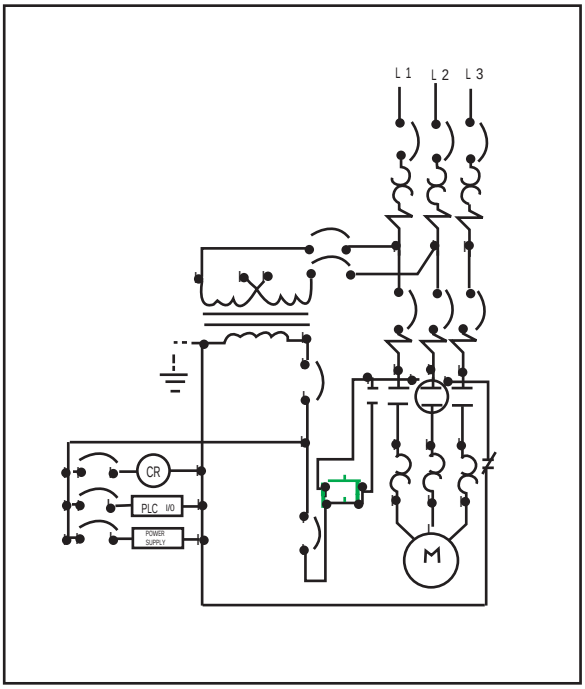
Cutler-Hammer

EATON

Machinery OEM Control Panelbuilder's Handbook



Cutler-Hammer

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NEC MOTOR BRANCH CIRCUITS

NEC Articles 430-101

NFPA 79 Clause 7 - Line B

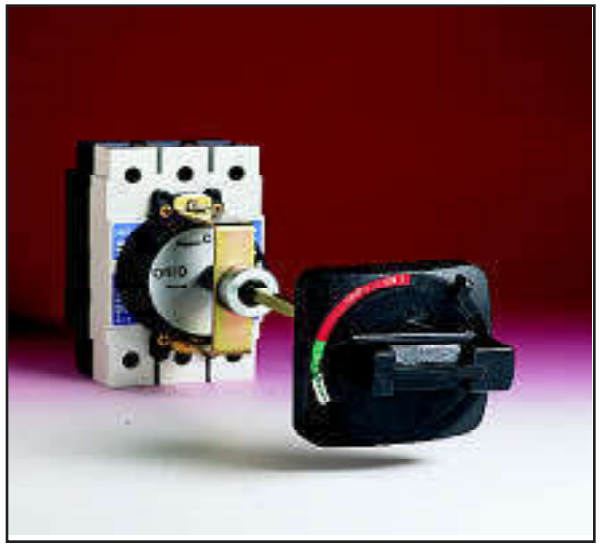
Requires a disconnecting means for motors and controllers from the circuit.

NEC Article 430-51

NFPA Clause 8.2 - Line C

Requires devices to protect motor branch circuit conductors, the motor control apparatus and the motors against overcurrent due to short circuits or grounds.

Panel FLA	Series C Part Number	Vari-Depth Handle Mechanism
15	GD3015	HRGCV14L
20	GD3020	HRGCV14L
25	GD3025	HRGCV14L
30	GD3030	HRGCV14L
35	GD3035	HRGCV14L
40	GD3040	HRGCV14L
45	GD3045	HRGCV14L
50	GD3050	HRGCV14L
60	GD3060	HRGCV14L
70	GD3070	HRGCV14L
80	GD3080	HRGCV14L
90	GD3090	HRGCV14L
100	GD3100	HRGCV14L



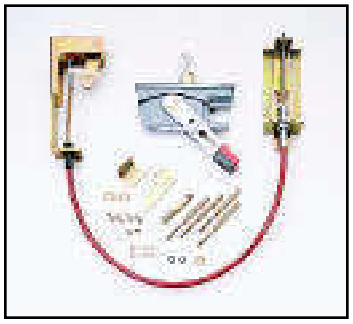
Rated 22KAIC @ 480 VAC

Panel FLA	Series C Part Number (1)	Flex Shaft Part Number(2)	Series C Rotary Rotary Part Number (3) &(4)
15	FD3015LM04	F1S03C	HM1R06
20	FD3020LM04	F1S03C	HM1R06
25	FD3025LM04	F1S03C	HM1R06
30	FD3030LM04	F1S03C	HM1R06
35	FD3035LM04	F1S03C	HM1R06
40	FD3040LM04	F1S03C	HM1R06
45	FD3045LM04	F1S03C	HM1R06
50	FD3050LM04	F1S03C	HM1R06
60	FD3060LM04	F1S03C	HM1R06
70	FD3070LM04	F1S03C	HM1R06
80	FD3080LM04	F1S03C	HM1R06
90	FD3090LM04	F1S03C	HM1R06
100	FD3100LM04	F1S03C	HM1R06
110	FD3110LM04	F1S03C	HM1R06
125	FD3125LM04	F1S03C	HM1R06
150	FD3150LM04	F1S03C	HM1R06
175	FD3175LM04	F1S03C	HM1R06
200	FD3200LM04	F1S03C	HM1R06
225	FD3225LM04	F1S03C	HM1R06
250	JD3250LM04	F2S03C	HM3R06
300	KD3300LM04*	F3S03C	HM3R06
350	KD3350LM04*	F3S03C	HM3R06
400	KD3400LM04*	F3S03	HM3R06

Rated 25KAIC * 35KAIC @ 480VAC

(1) MCCB Includes: Line and Load lugs, Mounting hardware
(2) Flex Shaft Operator includes 3’ cable (4’ to 10’ available)
(3) Rotary Shaft Operator fits panels up to 8” deep (12” available)
(4) Add “X” to end of catalog number for NEMA 4X

Flex Shaft Handle Mechanism



Flex ShaftHandle Mechanisms make installing and operating enclosure mounted F- through R-Frame breakers easier than ever. Installation and adjustment of this flange mounted mechanism can be accomplished in about 10 minutes or less.

Rotary Door Mounted Handle Mechanism

Rotary handle mechanisms are available for F- through N-Frame breakers. This rugged through-the-door rotary handle mechanism is designed to accommodate a gloved hand.

Quick Connect Multi-wire Lugs

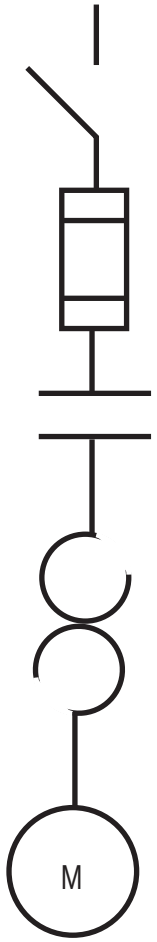
Quick Connect Multi-wire Lug Kits save valuable panel space by eliminating ternminal blocks. They are available in 150 and 225 ampere ratings and provide for terminating either three (#14-#2) or six (#14-#6) wires per phase to the load side of F- and J-Frame circuit breakers.

Control Wire Terminal Kit

UL accepted method of connecting control circuit wiring to the line or load side terminals of Series C F- through L-Frame circuit breakers.

MOTOR CIRCUIT PROTECTION

NEC Article 430, NFPA 79 Clause 7, 8.2
Requires that each motor branch circuit contain the following components or functions:



1. Disconnecting Means
   (MCCB, MCP, or Switch)
   Line B (NFPA-79)

2. Branch Short Circuit Protection
   (MCCB, MCP, or Fuse)
   Line C (NFPA-79)

3. Motor Controller
   (Contactor)
   Line F (NFPA-79)

4. Motor Overload Protection
   (Overload Relay)
   Line G (NFPA-79)

   Wiring System
   Line H (NFPA-79)

Motor HP	Full Load Current	Current 460V Motor Circuit Protector	NEMA Starter Size	C-H Part Number
1/2	1.1	GMCP003A0C	00	AN16ANOAC
3/4	1.6	GMCP003A0C	00	AN16ANOAC
1	2.1	GMCP003A0C	00	AN16ANOAC
1-1/2	3.0	GMCP007C0C	00	AN16ANOAC
2	3.4	GMCP007C0C	00	AN16ANOAC
3	4.8	GMCP007C0C	0	AN16BNOAC
5	7.6	GMCP015E0C	0	AN16BNOAC
7-1/2	11	GMCP015E0C	1	AN16DNOAC
10	14	GMCP030H1C	1	AN16DNOAC
15	21	GMCP030H1C	2	AN16GNOAB
20	27	GMCPS050K2C	2	AN16GNOAB
25	34	GMCPS050K2C	2	AN16GNOAB
30	40	GMCPS050K2C	3	AN16KNOA
40	52	GMCP063M2C	3	AN16KNOA
50	65	GMCP063M2C	3	AN16KNOA
60	77	HMCP100R3	4	AN16NNOAB
75	96	HMCP150T4	4	AN16NNOAB
100	124	HMCP150T4	4	AN16NNOAB
125	156	HMCP250L5	5	AN16SNOAB
150	180	HMCP250L5	5	AN16SNOAB
200	240	HMCP400R5	5	AN16SNOAB

Motor HP	Full Load Current 460V	460V Series C Motor Circuit Protector	IEC Starter Size	C-H Part Number
1/2	1.1	GMCP003A0C	A	AE16ANSOAC
3/4	1.6	GMCP003A0C	A	AE16ANSOAC
1	2.1	GMCP003A0C	A	AE16ANSOAC
1-1/2	3.0	GMCP007C0C	A	AE16ANSOAC
2	3.4	GMCP007C0C	A	AE16ANSOAC
3	4.8	GMCP007C0C	A	AE16ANSOAC
5	7.6	GMCP015E0C	B	AE16BNSOAC
7-1/2	11	GMCP015E0C	C	AE16CNSOAC
10	14	GMCP030H1C	D	AE16DNSOAC
15	21	GMCP030H1C	E	AE16ENSOAC
20	27	GMCPS050K2C	F	AE16FNSOAC
25	34	GMCPS050K2C	G	AE16GNSOAB
30	40	GMCPS050K2C	H	AE16HNSOAB
40	52	GMCP063M2C	J	AE16JNSOAB
50	65	GMCP063M2C	K	AE16KNSOAB
60	77	HMCP100R3	L	AE16LNOA
75	96	HMCP150T4	M	AE16MNOA
100	124	HMCP150T4	N	AE16NNOA
125	156	HMCP250L5	P	AE16PNOA
150	180	HMCP250L5	R	AE16RNOA
200	240	HMCP400R5	S	AE16SNOA

STANDARD TRIP — CLASS 20

Overload Relay Size	Motor Full Load Ampere Rating — Dial Position A	B	C	D	Catalog Number (Includes 3 Heater Packs)	Price
FOR USE W/ NEMA SIZES 00-0 SERIES C,NEMA SIZES 1-2 SERIES B; I.E.C. SIZES A-F SERIES C, I.E.C. SIZES G-K SERIES B						
32 A or 75 A	.254	.306	.359	.411	**H2001B-3**	$ 27.
	.375	.452	.530	.607	**H2002B-3**	
	.560	.676	.791	.907	**H2003B-3**	
	.814	.983	1.15	1.32	**H2004B-3**	
	1.20	1.45	1.71	1.96	**H2005B-3**	
	1.79	2.16	2.53	2.90	**H2006B-3**	
	2.15	2.60	3.04	3.49	**H2007B-3**	
	3.23	3.90	4.56	5.23	**H2008B-3**	
	4.55	5.50	6.45	7.40	**H2009B-3**	
	6.75	8.17	9.58	11.0	**H2010B-3**	
	9.14	10.8	12.4	14.0	**H2011B-3**	
	14.0	16.9	19.9	22.8	**H2012B-3**	
	18.7	22.7	26.7	30.7	**H2013B-3**	
	23.5	28.5	33.5	38.5	**H2014B-3**	
FOR USE WITH NEMA SIZE 2, I.E.C. SIZES G-K ONLY — SERIES B						
75 A	29.0	34.0	39.1	44.1	**H2015B-3**	27.
	39.6	45.5	51.5	57.4	**H2016B-3**	
	53.9	60.9	67.9	74.9	**H2017B-3**	
FOR USE WITH NEMA SIZES 3-4 I.E.C. SIZES L-N ONLY — SERIES A						
105 A or 144 A	18.0	20.2	22.3	24.5	**H2018-3**	27.
	24.6	27.6	30.5	33.4	**H2019-3**	
	33.5	37.5	41.5	45.6	**H2020-3**	
	45.7	51.2	56.7	62.1	**H2021-3**	
	62.2	69.7	77.1	84.6	**H2022-3**	
	84.7	95.0	105.0	115.0	**H2023-3**	
	106.0	118.0	131.0	144.0	**H2024-3**	
FOR USE WITH SIZE 5 STARTERS ONLY — SERIES B						
32 A ❶	49	59	69	79	**H2004B-3**	27.
	72	87	103	118	**H2005B-3**	
	107	130	152	174	**H2006B-3**	
	129	156	182	209	**H2007B-3**	
	194	234	274	- - -	**H2008B-3**	
FOR USE WITH SIZE 6 STARTERS ONLY — SERIES B						
32 A ❶	144	174	205	235	**H2005B-3**	27.
	215	259	304	348	**H2006B-3**	
	258	312	365	419	**H2007B-3**	
	388	468	547	- - -	**H2008B-3**	
FOR USE WITH SIZE 7 STARTERS ONLY — SERIES B						
32 A ❶	163	197	230	264	**H2004B-3**	27.
	240	290	342	392	**H2005B-3**	
	358	432	506	580	**H2006B-3**	
	430	520	608	698	**H2007B-3**	
	646	780	912	- - -	**H2008B-3**	
FOR USE WITH SIZE 8 STARTERS ONLY — SERIES B						
32 A ❶	244	295	345	396	**H2004B-3**	27.
	360	435	513	588	**H2005B-3**	
	537	648	759	870	**H2006B-3**	
	645	780	912	1047	**H2007B-3**	
	969	1170	1368	- - -	**H2008B-3**	

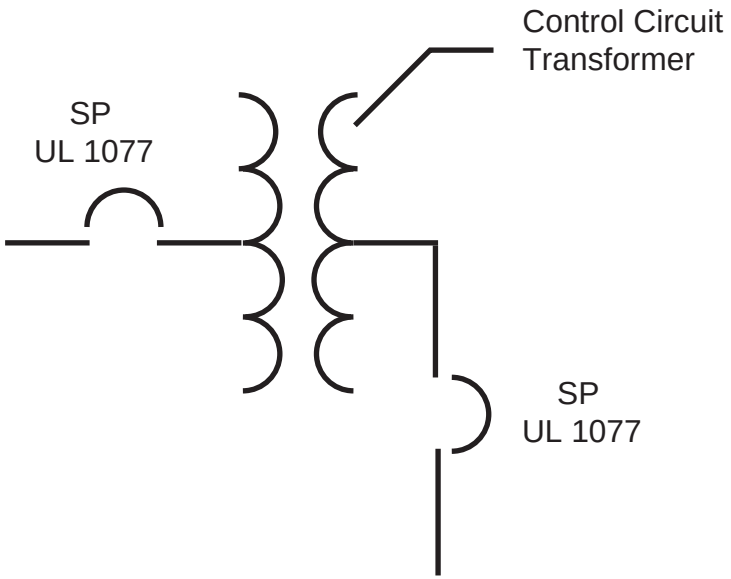
❶ Sizes 5-8 use the 32 ampere overload relay with current transformers.

Motor HP	Full Load Current 460 V	460V Series C Earth Leakage Circuit Breaker	NEMA Starter Size	C-H Number	IEC Starter Size	C-H Part Number
1/2	1.1	ELHFD3015L	00	AN16ANOAC	A	AE16ANSOAC
3/4	1.6	ELHFD3015L	00	AN16ANOAC	A	AE16ANSOAC
1	2.1	ELHFD3015L	00	AN16ANOAC	A	AE16ANSOAC
1-1/2	3.0	ELHFD3015L	00	AN16ANOAC	A	AE16ANSOAC
2	3.4	ELHFD3015L	00	AN16ANOAC	A	AE16ANSOAC
3	4.8	ELHFD3015L	0	AN16BNOAC	A	AE16ANSOAC
5	7.6	ELHFD3015L	0	AN16BNOAC	B	AE16BNSOAC
7-1/2	11	ELHFD3020L	1	AN16DNOAC	C	AE16CNSOAC
10	14	ELHFD3035L	1	AN16DNOAC	D	AE16DNSOAC
15	21	ELHFD3045L	2	AN16GNOAB	E	AE16ENSOAC
20	27	ELHFD3060L	2	AN16GNOAB	F	AE16FNSOAC
25	34	ELHFD3070L	2	AN16GNOAB	G	AE16GNSOAB
30	40	ELHFD3080L	3	AN16KNOA	H	AE16HNSOAB
40	52	ELHFD3100L	3	AN16KNOA	J	AE16JNSOAB
50	65	ELHFD3125L	3	AN16KNOA	K	AE16KNSOAB
60	77	ELHFD3125L	4	AN16NNOAB	L	AE16LNOA
75	96	ELHFD3150L	4	AN16NNOAB	M	AE16MNOA
100	124	ELHJD3175	4	AN16NNOAB	N	AE16NNOA
125	156	ELHJD3225	5	AN16SNOAB	P	AE16PNOA
150	180	ELHJD3250	5	AN16SNOAB	R	AE16RNOA
200	240	ELHKD3350	5	AN16SNOAB	S	AE16SNOA

CONTROL TRANSFORMER PROTECTION AND SELECTION

NEC 430 Part F, NFPA 79 Clause 8.12 - Line E
Applies to the particular conditions of motor control circuits.

Definition of Motor Control Circuit
The circuit of a control apparatus or system that carries the electric signals directing the performance of the controller, but does not carry the main power currrent.



CONTROL TRANSFORMER VA	C-H MTE PART NUMBER	PRIMARY SUPPLEMENTARY PROTECTOR	SECONDARY SUPPLEMENTARY PROTECTOR
50	C0050E3D	SPHM2HM00R5	SPCL1C00
75	C0075E3D	SPHM2HM0R75	SPCL1C01
100	C0100E3D	SPHM2HM0001	SPCL1C01
150	C0150E3D	SPHM2HM0001	SPCL1C02
200	C0200E3D	SPHM2HM0002	SPCL1C02
250	C0250E3D	SPHM2HM02R5	SPCL1C03
300	C0300E3D	SPHM2HM0003	SPCL1C04
350	C0350E3D	SPHM2HM0003	SPCL1C04
500	C0500E3D	SPHM2HM0005	SPCL1C07
750	C0750E3D	SPHM2HM07R5	SPCL1C010

SELECTING AND SIZING YOUR INDUSTRIAL CONTROL TRANSFORMER

For proper selection of the transformer, the following three characteristics must be identified:

- Sealed VA (Steady State VA)
- Total inrush VA
- Power factor

NEMA standards require electromagnetic components to operate successfully at 85% of rated voltage (refer to NEMA ICS2-110). While contactors and relays may indicate that many control devices will close reliably at 60% of their coil ratings, closing at less than 85% voltage will shorten contact life.

Follow these steps to properly select your transformer:

- Identify the **Supply Voltage** . Attached is the chart for 480-120 V, at 60 or 50-60 Hz, at 25 degree C ambient temperature and 20% power factor. Other supply voltage information is available upon request.
- Determine the **Sealed VA** of the control circuit. Add the VA requirements of all components that will be energized together (as supplied by the control device manufacturer).
- Determined the **Inrush VA** of all components to be energized together, including the components that do not have an elevated inrush VA (like lamps).

Example:

Qty	Description	Sealed VA	Inrush VA
1	Size 1 Contactor	22	175
2	Size 3 Contactors	86	1156
2	Relays	55	65
1	Timers	38	38
6	Indicating Lights	42	42
	Total	243	1476

- The Transformer Selection VA is calculated as follows:

$$\text{Selection VA} = \sqrt{(\text{Sealed VA})^2 + (\text{Inrush})^2}$$
$$= \sqrt{(243)^2 + (1476)^2}$$
$$= \sqrt{2{,}237{,}625}$$
$$= 1496$$

- Refer to the **Industrial Control Transformer Selection Chart** . Based upon your maximum allowable load voltage drop, refer to the 95, 90 or 85% secondary required voltage column. Go down the column until you reach your determined Selection VA.

- Refer to the far left column and you have your Transformer VA.

Table 1

Motor Control Circuit Transformer Overcurrent Protection Selection Guide (Transformers 600 Volts Nominal or Less)				
	Transformer Primary Current	Primary Overcurrent Device Ampacity must not Exceed	Secondary Overcurrent Device Ampacity must not Exceed	Transformer Secondary Current
Primary Overcurrent Protection Only	Less Than 2 Amperes	500% (Note 1) See Table 2	Optional (Note 2)	No Qualifications
	2 Amperes to Less Than 9 Amperes	167% See Table 3		
	9 Amperes or More	125% Or next higher rating (Note 3) See Table 3		
Primary and Secondary Overcurrent Protection	Less Than 2 Amperes	500% (Note 1) See Table 2	167% See Table 5	Less Than 9 Amperes
	No Qualifications	250% See Table 4	125% Or next higher rating (Note 3) See Table 5	9 Amperes or More

Note 1 NEC 430-72(c) exception 2 permits a 500% primary overcurrent device when control circuit transformer primary current less than 2 amps.

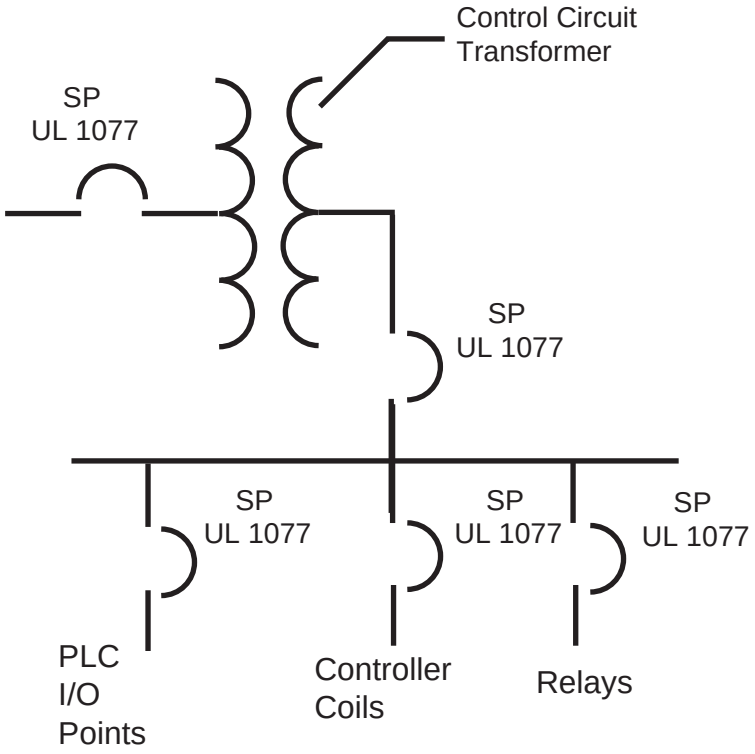
Note 2 Although protection of the transformer secondary is optional, overcurrent protection of the secondary conductors may be required. Secondary overcurrent protection no more than 100% of the secondary conductor should be considered.

Note 3 Where 125% does not correspond to a standard current rating, the next standard rating is permitted per NEC 240-6.

MOTOR CONTROL CIRCUIT AND APPARATUS PROTECTION

NEC 430 Part F, NFPA 79 Clause 8.3 - Line D
Applies to the particular conditions of motor control circuits.

Definition of Motor Control Circuit
The circuit of a control apparatus or system that carries the electric signals directing the performance of the controller, but does not carry the main power current.



Supplementary Protector
Type SPCL
Current Limiting

CATALOG NUMBERING SYSTEM

SPCL 1 C 20

Type
Supplementary
Protector
Current Limiting

Poles
1= 1 pole
2= 2 pole
3= 3 pole
4= 4 pole

Curve Type (Applications)
B = B Curve (Low Inrush)
C = C Curve (General/Industrial)

Current Rating

00 = 0.5 Amp*	06 = 6 Amp	20 = 20 Amp
01 = 1 Amp*	07 = 7 Amp*	25 = 25 Amp
02 = 2 Amp*	08 = 8 Amp*	32 = 32 Amp
03 = 3 Amp*	10 = 10 Amp	40 = 40 Amp
04 = 4 Amp*	13 = 13 Amp	50 = 50 Amp
05 = 5 Amp*	16 = 16 Amp	63 = 63 Amp

* Available curve type C only.

Applications
SPCL supplementary protectors are IEC current limiting type breakers that provide thermal magnetic protection in applications from 0.5 to 63 amperes at 120 to 480 volts AC.

Equipment Protection
The SPCL can provide thermal overload protection unique to the equipment that the backup branch circuit protective device cannot. Its current limiting performance provides for quick interruption of short circuits, reducing the let-through energy, stress, and damage.

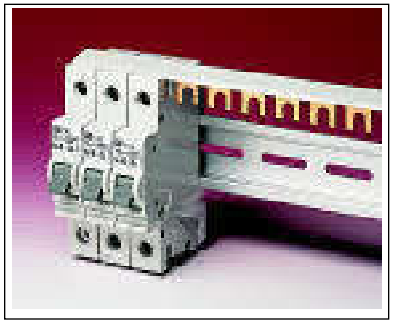
Control Circuits
SPCL current limiting performance current ratings below 10 amperes are an attractive, resettable alternative in protecting control circuits.
- o Motor Control Circuits (per NEC 430-71, Part F)
- o Control Circuit Transformers
- o PLC I/O Points
- o Contactor Coils
- o Relays

ACCESSORIES

Lock-off Devices

To lock-off any SPCL protector, use padlockable device Catalog Number SPCLPLDEV and padlock with key Catalog Number SPCLOCKEY.

Bus Bar Systems



Sigle-phase bus bars for control circuit applications are available in lengths of one meter. Use Catalog Number SPCL1PB10MM (10mm2 density) or SPCL1PB16MM (16mm2 density)

Auxiliary/Signal Switch Kit

Auxiliary/signal switch kit is field installable to the left side of an SPCL protector and is selectable between auxiliary and signal switch modes. Use Catalog Number SPCLUAUX.

CATALOG NUMBERING SYSTEM

Supplementary Protector
Type SPHM
Hydralic Magnetic

SPHM 3 H M 0030 _ _ _ _

Type
Supplementary Protector Hydraulic Magnetic

Poles
1 = 1 pole
2 = 2 pole
3 = 3 pole
4 = 4 pole

1/2 Cycle Inrush Tolerence

Code	Delay	Voltage
H	8X	50/60 Hz
R	18X	50/60 Hz
Y(4)	25X	50/60 Hz
J	8X	DC
S	18X	DC
Z(4)	25X	DC
S	Switch	DC 50/60 Hz

Overcurrent Curve

Code	Delay	Curve (3)
M	Medium	2
S	Short	3
L	Long	10
M	Medium	20
S	Short	30
L	Long	251
M	Medium	252
S	Short	253
M	Medium	2
S	Short	3
L	Long	10
M	Medium	20
S	Short	30
L	Long	251
M	Medium	252
S	Short	253
W	Switch	

Auxiliary Switch (Optional)
A (1) = Current Normally Open (2)
B (1) = Current Normally Closed (2)

Continuous Current Reading (5)
00R1 = 0.10 Amp
0R25 = 0.25 Amp
0R50 = 0.50 Amp
0R75 = 0.75 Amp
0001 = 1 Amp
0002 = 2 Amp
02R5 = 2.5 Amp
0003 = 3 Amp
0004 = 4 Amp
0005 = 5 Amp
0006 = 6 Amp
0007 = 7 Amp
07R5 = 7.5 Amp
0008 = 8 Amp
0010 = 10 Amp
0015 = 15 Amp
0020 = 20 Amp
0025 = 25 Amp
0030 = 30 Amp
0035 = 35 Amp(3)
0040 = 40 Amp(3)
0045 = 45 Amp(3)(4)
0050 = 50 Amp(3)(4)

1. One A or B contact maximum per pole. Contacts will be arranged left to right, e.g. BAB suffix on 3 pole breaker.
2. Contact position when breaker is in open condition. Contacts rated 10 amperes at 250 volts AC.
3. UL recognized to 250 volts AC, 5kA.
4. Maximum of 40 amperes available at 25 times inrush.
5. Contact Cutler-Hammer for copies of time-current curves
   Long Delay Extended Inrush
   Medium Delay General/Industrial
   Short Delay Electronics
6. For special current ratings not shown, contact Cutler-Hammer

Applications
SPHM supplementary protectors provide magnetic only overcurrent protection for applications from 0.1 to 30 amperes at 277/480 volts and 35 to 50 amperes at 250 volts AC.

Precise Overload Protection
Protection is not affected by ambient temperatures (-40 to 85 C). The protector will hold in at 100% rated current, eliminating nuisance tripping at higher ambients and will not allow higher than rated current at lower ambients.

Immediate Reset
The protector can be reset (closed) immediately after an overcurrent trip, maximizing continuity to the affected circuit.

Equipment and Control Circuit Protection
Long, medium, and short delay overcurrent curves provide for close overcurrent protection in applications like:

- Electronics
- Motor Control Circuits (per NEC 430-71, Part F)
- Control Circuit Transformers
- PLC I/O Points
- Contactor Coils
- Relays

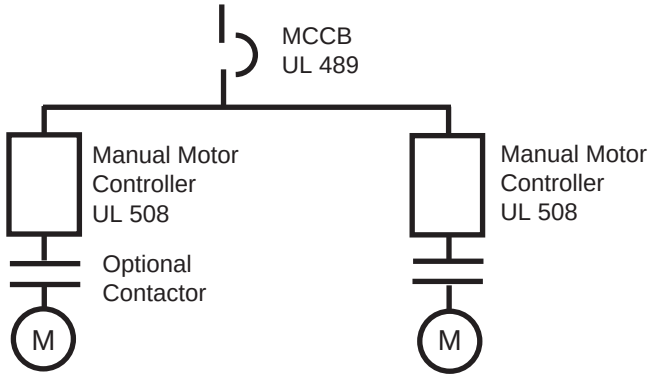
GROUP MOTOR PROTECTION

NEC 430, NFPA 79 Clause 8.5
A single disconnecting means may be permitted to serve a group of motors where:

- The group of motors drive several parts of a single machine or piece of apparatus.

- A group of motors is in a single room within sight of the disconnecting means.

- Several motors, each not exceeding a one horsepower rating, are used on a single branch circuit protected at 20 amperes maximum for 120 volts branch circuit or 15 amperes maximum up to 600 volts per NEC 430-53(a).



NEC 430-53(c)
A single short circuit and ground fault protective device is permitted for a group of motors if each motor controller and each motor overlaod device is listed for group installations with a specified rating of fuse or inverse time circuit breaker, or both.

A302 Manual Starters/Protectors

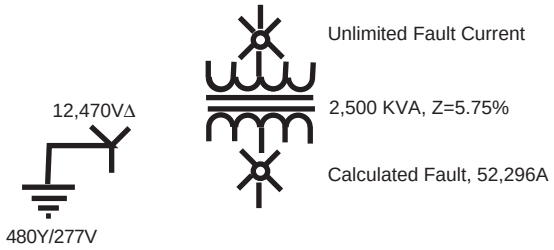
The A302 is a UL 508 listed maual motor starter ideal for single or group motor applications from 0.1 to 25 amperes, 600 volts AC. The A302 provides motor stop/start, adjustable Class 10 thermal overload protection, and can be Din Rail or panel mounted. Accessories include alarm and auxiliary contacts, undervoltage realease, shunt trip, bus bars, etc.

TYPE A302 MANUAL MOTOR STARTER AND PROTECTOR

Adjustable Thermal Current Range (Amperes)	Maximum Single Phase Horsepower ❶			Maximum 3 Phase Horsepower				Maximum Backup Protection (Amperes)				Maximum RMS Symmetrical Short Circuit Amperes 480V ac ❸	Catalog Number
								Single Motor 600V Maximum		Group Motor Applications 480V Maximum ❷			
	115V	200V	230V	200V	230V	460V	575V	Maximum Fuse Amperes	Maximum Circ. Brk. Amperes	Maximum Fuse Amperes	Maximum Circ. Brk. Amperes		
0.10 - 0.16	- - -	- - -	- - -	- - -	- - -	- - -	- - -	Select Fuses Per N.E.C. Article 430-52 Based Upon Motor FLA	15	1200	1200	5,000	**A302AN**
0.16 - 0.25	- - -	- - -	- - -	- - -	- - -	- - -	- - -		15	1200	1200	5,000	**BN**
0.25 - 0.4	- - -	- - -	- - -	- - -	- - -	- - -	- - -		15	1200	1200	5,000	**CN**
0.40 - 0.63	- - -	- - -	- - -	- - -	- - -	- - -	- - -		15	1200	1200	5,000	**DN**
0.63 - 1.0	- - -	- - -	- - -	- - -	- - -	1/2	1/2		15	1200	1200	5,000	**EN**
1.0 -1.6	- - -	- - -	1/10	- - -	- - -	3/4	1		15	1200	1200	5,000	**A302FN**
1.6 - 2.5	- - -	1/8	1/6	1/2	1/2	1	1-1/2		15	1200	1200	5,000	**GN**
2.5 - 4.0	1/8	1/4	1/3	3/4	1	2	3		15	1200	1200	5,000	**HN**
4.0 - 6.3	1/4	1/2	1/2	1-1/2	1-1/2	3	5		25	1200	1200	5,000	**JN**
6.3 - 10.0	1/2	1	1-1/2	2	3	5	7-1/2		40	1200	1200	5,000	**KN**
10.0 - 16.0	1	2	2	3	5	10	10		60	1200	1200	5,000	**A302LN**
16.0 - 20.0	1-1/2	3	3	5	- - -	- - -	15		80	1200	1200	5,000	**MN**
20.0 - 25.0	2	- - -	- - -	- - -	7-1/2	15	20		100	1200	1200	5,000	**NN**

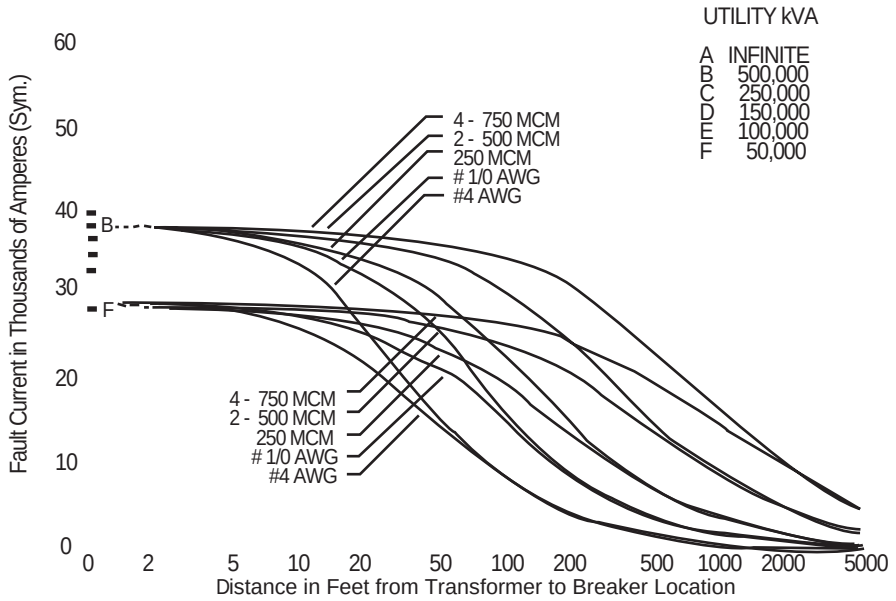
❶ Single phase horsepower ratings are based on wiring the 3 starter poles in series.
❷ 480V maximum ratings shown. For maximum Backup Protection Ratings at 600V see ratings table on **Page E-4.**
❸ For High Fault Interrupting Current Ratings at 480V, see ratings table on **Page E-4.**

Short Circuit Calculations



$$I_{sc} = \frac{kVA}{VxZ} = \frac{2,500 \times 1,000 \times 100}{480 \sqrt{3} \times 5.75} = 52,296\ A$$

Chart 12 - 1500 kVA Transformer / 5.5% Impedance/480 Volts



APPENDIX

Motor Locked-Rotor Current Amperes*								
Single Phase				Two or Three Phase			Max. HP Rating	
115V	230V	115V	200V	230V	460V	575V		
58.8	29.4	24	18.8	12	6	4.8	1/2	
82.8	41.4	33.6	19.3	16.8	804	6.6	3/4	
96	48	43.2	24.8	21.6	10.8	8.4	1	
120	60	62	35.9	31.2	15.6	12.6	1 1/2	
144	72	81	46.9	40.8	20.4	16.2	2	
204	102		66	58	26.8	23.4	3	
336	168		105	91	45.6	36.6	5	
480	240		152	132	66	54	7 1/2	
600	300		193	168	84	66	10	
			290	252	126	102	15	
			373	324	162	132	20	
			469	408	204	162	25	
			552	480	240	192	30	
			718	624	312	246	40	
			897	780	390	312	50	
			1063	924	462	372	60	
			1325	1152	576	462	75	
			1711	1488	744	594	100	
			2153	1872	936	750	125	
			2484	2160	1080	864	150	
			3312	2880	1440	1152	200	

MOTORS, MOTOR CIRCUITS, CONTROLLERS - ARTICLE 430
Table 430-152. Maximum Rating or Setting of Motor Branch-Circuit Short-Circuit and Ground-Fault Protective Devices

Type of Motor		Percent of Full-Load Current			
		Nontime Delay Fuse	Dual Element (Time-Delay) Fuse	Instantaneous Trip Breaker	Inverse Time Breaker
Single-phase, all types					
	No code letter	300	175	700	250
All ac single-phase and polyphase squirrel-cage and synchronous motors with full-voltage, resistor or reactor starting:					
	No code letter	300	175	700	250
	Code letter F to V	300	175	700	250
	Code letter b to E	250	175	700	200
	Code letter A	150	150	700	150
All ac squirrel-cage and synchronous motors with autotransformer starting:					
Not more than 30 amps					
	No code letter	250	175	700	200
More than 30 amps					
	No code letter	200	175	700	200
	Code letter f to V	250	175	700	200
	Code letter b to E	200	175	700	200
	Code letter A	150	150	700	150
High-reactance squirrel-cage					
Not more than 30 amps					
	No code letter	250	175	700	250
More than 30 amps					
	No code letter	200	175	700	200
Wound-rotor-					
	No code letter	150	150	700	150
Direct-current (constant voltage)					
No more than 50 hp					
	No code letter	150	150	250	150
More than 50 hp					
	No code letter	150	150	175	150

TABLES AND EXAMPLES
Table 8 Conductor Properties

Size AWG/ kcmil	Area Cir. Mils	Conductors				DC Resistance at 75 C (167 F)		
		Stranding		Overall		Copper		Aluminum
		Quantity	Diam In.	Diam In.	Area In.	Uncoated ohm/MFT	Coated ohm/MFT	ohm/MFT
18	1620	1		0.04	0.001	7.77	8.08	12.8
18	1620	7	0.015	0.046	0.002	7.95	8.45	13.1
16	2580	1		0.051	0.002	4.89	5.08	8.05
16	2580	7	0.019	0.058	0.003	4.99	5.29	8.21
14	4110	1		0.064	0.003	3.07	3.19	5.06
14	4110	7	0.024	0.073	0.004	3.14	3.26	5.17
12	6530	1		0.081	0.005	1.93	2.01	3.18
12	6530	7	0.03	0.092	0.006	1.98	2.05	3.25
10	10380	1		0.102	0.008	1.21	1.26	2
10	10380	7	0.038	0.116	0.011	1.24	1.29	2.04
8	16510	1		0.128	0.013	0.764	0.786	1.26
8	16510	7	0.049	0.146	0.017	0.778	0.809	1.28
6	26240	7	0.061	0.184	0.027	0.491	0.51	0.808
4	41740	7	0.077	0.232	0.042	0.308	0.321	0.508
3	52620	7	0.087	0.26	0.053	0.245	0.254	0.403
2	66360	7	0.097	0.292	0.067	0.194	0.201	0.319
1	83690	19	0.066	0.332	0.087	0.154	0.16	0.253
1/0	105600	19	0.074	0.373	0.109	0.122	0.127	0.201
2/0	133100	19	0.084	0.419	0.138	0.0967	0.101	0.159
3/0	167800	19	0.094	0.47	0.173	0.0766	0.0797	0.126
4/0	211600	19	0.106	0.528	0.219	0.0608	0.0626	0.1
250		37	0.082	0.575	0.26	0.0515	0.0535	0.0847
300		37	0.09	0.63	0.312	0.0429	0.0446	0.0707
350		37	0.097	0.681	0.364	0.0367	0.0382	0.0605
400		37	0.104	0.728	0.416	0.0321	0.0331	0.0529
500		37	0.116	0.813	0.519	0.0258	0.0265	0.0424
600		61	0.099	0.893	0.626	0.0214	0.0223	0.0353
700		61	0.107	0.964	0.73	0.0184	0.0189	0.0303
750		61	0.111	0.998	0.782	0.0171	0.0176	0.0282
800		61	0.114	1.03	0.834	0.0161	0.0166	0.0265
900		61	0.122	1.09	0.94	0.0143	0.0147	0.0235
1000		61	0.128	1.15	1.04	0.0129	0.0132	0.0212
1250		91	0.117	1.29	1.3	0.0103	0.0106	0.0169
1500		91	0.128	1.41	1.57	0.00858	0.00883	0.0141
1750		127	0.117	1.52	1.83	0.00735	0.00756	0.0121
2000		127	0.126	1.63	2.09	0.00643	0.00662	0.0106

Table 9 AC Resistance and Reactance for 600V Cables, 3 phase, 60, Hz, 75 C (167 F) - Three Single Conductors in Conduit

Size AWG/ kcmil	Ohms to neutral per 1000 feet														Size AWG/ kcmil
	X (Reactance) for All Wires		AC Resistance for Uncoated Copper Wires			AC Resistance for Aluminum Wires			Effective Z at .85 PF for Uncoated Copper Wires			Effective Z at .85 PF for Aluminum Wires			
	PVC, Al. Conduits	Steel Conduit	PVC Conduit	Al. Conduit	Steel Conduit	PVC Conduit	Al. Conduit	Steel Conduit	PVC Conduit	Al. Conduit	Steel Conduit	PVC Conduit	Al. Conduit	Steel Conduit	
14	0.058	0.073	3.1	3.1	3.1				2.7	2.7	2.7				14
12	0.054	0.068	2	2	2	3.2	3.2	3.2	1.7	1.7	1.7	2.8	2.8	2.8	12
10	0.05	0.063	1.2	1.2	1.2	2	2	2	1.1	1.1	1.1	1.8	1.8	1.8	10
8	0.052	0.065	0.78	0.78	0.78	1.3	1.3	1.3	0.69	0.69	0.7	1.1	1.1	1.1	8
6	0.051	0.064	0.49	0.49	0.49	0.81	0.81	0.81	0.44	0.45	0.45	0.71	0.72	0.72	6
4	0.048	0.06	0.31	0.31	0.31	0.51	0.51	0.51	0.29	0.29	0.3	0.46	0.46	0.46	4
3	0.047	0.059	0.25	0.25	0.25	0.4	0.41	0.4	0.23	0.24	0.24	0.37	0.37	0.37	3
2	0.045	0.057	0.19	0.2	0.2	0.32	0.32	0.32	0.19	0.19	0.2	0.3	0.3	0.3	2
1	0.046	0.057	0.15	0.16	0.16	0.25	0.26	0.25	0.16	0.16	0.16	0.24	0.24	0.25	1
1/0	0.044	0.055	0.12	0.13	0.12	0.2	0.21	0.2	0.13	0.13	0.13	0.19	0.2	0.2	1/0
2/0	0.043	0.054	0.1	0.1	0.1	0.16	0.16	0.16	0.11	0.11	0.11	0.16	0.16	0.16	2/0
3/0	0.042	0.052	0.077	0.082	0.079	0.13	0.13	0.13	0.088	0.092	0.094	0.13	0.13	0.14	3/0
4/0	0.041	0.051	0.062	0.067	0.063	0.1	0.11	0.1	0.074	0.078	0.08	0.11	0.11	0.11	4/0
250	0.041	0.052	0.052	0.057	0.054	0.085	0.09	0.086	0.056	0.07	0.073	0.094	0.098	0.1	250
300	0.041	0.051	0.044	0.049	0.045	0.071	0.076	0.072	0.059	0.063	0.065	0.082	0.086	0.088	300
350	0.04	0.05	0.038	0.043	0.039	0.061	0.066	0.063	0.053	0.058	0.06	0.073	0.077	0.08	350
400	0.04	0.049	0.033	0.038	0.035	0.054	0.059	0.055	0.049	0.053	0.056	0.066	0.071	0.073	400
500	0.039	0.048	0.027	0.032	0.029	0.043	0.048	0.045	0.043	0.048	0.05	0.057	0.061	0.064	500
600	0.039	0.048	0.023	0.028	0.025	0.036	0.041	0.038	0.04	0.044	0.047	0.051	0.055	0.058	600
750	0.038	0.048	0.019	0.024	0.021	0.029	0.034	0.031	0.036	0.04	0.043	0.045	0.049	0.052	750
1000	0.037	0.046	0.015	0.019	0.018	0.023	0.027	0.025	0.032	0.036	0.04	0.039	0.042	0.046	1000

CONDUCTORS FOR GENERAL WIRING - ARTICLE 310
Table 310-13 Conductor Application and Insulations

Trade Name	Type Letter	Max. Operating Temp.	Applications Provisions	Insulation	AWG or kcmil	Thickness of Insulation	Mils	
Fluorinated Ethylene Propylene	FEP or FEPB	90 C 194 F	Dry and damp locations	Fluorinated Ethylene Propylene	14-10		20	Outer Covering
		200 C 392 F	Dry locations - special applications		8-2		30	
				Fluorinated Ethylene Propylene	14-8		14	None
					6-2		14	Glass Braid
Mineral Insulation M(Metal Sheathed)	MI	90 C 194 F 250 C 482 F	Dry and wet locations For special application	Magnesium Oxide	16-10		36	Asbestos or other suitable braid material
					9-4		50	
					3-250		55	Copper or Alloy Steel
Moisture, Heat and Oil-Resistant Thermoplastic	MTW	60 C 140 F	Machine tool wiring in wet locations as permitted in NFPA Standard No. 79 (See Article 670)	Flame Retardant, Moisture, Heat and Oil-Resistant Thermoplastic		(A)	(B)	(A) None (B) Nylon jacket or equivalent
					22-12	30	15	
					10	30	20	
		90 C 194 F	Machine tool wiring in wet locations as permitted in NFPA Standard No. 79 (See Article 670)		8	45	30	
					6	60	30	
					4-2	60	40	
					1-4/0	80	50	

Trade Name	Type Letter	Max. Operating Temp.	Applications Provisions	Insulation	AWG or kcmil	Thickness of Insulation	Mils	Outer Covering
					501-1000	110	70	
Paper		85 C 185 F	For underground service conductors, or by special permission	Paper				Lead sheath
Perfluoroalkoxy	PFA	90 C 194 F	Dry and damp locations	Perfluoroalkoxy	14-10		20	
					8-2		30	None
		200 C 392 F	Dry locations - special applications		1-4/0		45	
Perfluoroalkoxy	PFAH	250 C 482 F	Dry locations only. Only for leads within apparatus or within raceways connected to apparatus. (Nickel or nickel-coated copper only)	Perfluoroalkoxy	14-10		20	
					8-2		30	None
					1-4/0		45	
Heat-Resistant Rubber	RH	75 C 167 F	Dry and damp locations	Heat Resistant Rubber	**14-12		30	*Moisture-resistant, flame-retardant, non-metallic covering
					10		45	
					8-2		60	
Heat-Resistant Rubber	RHH	90 C 194 F	Dry and damp locations		1-4/0		80	
					213-500		95	
					501-1000		110	
					1001-2000		125	
					For 601-2000 volts, see Table 310-62			
Moisture-and Heat-Resistant Rubber	RHW	75 C 167 F	Dry and wet locations For over 2000 volts insulation shall be ozone-resistant	Moisture- and Heat-Resistant Rubber	14-10		45	Moisture-resistant, flame-retardant, non-metallic covering
					8-2		60	
					1-4/0		80	
					213-500		95	
					501-1000		110	
					1001-2000		125	
					For 601-2000 volts, see Table 310-62			

ARTICLE 310 - CONDUCTORS FOR GENERAL WIRING

Table 310-16 - Ampacities of Insulated Conductors Rated 0-2000 Volts, 60 to 90 C (140 to 194 F) Not More Than Three Conductors in Raceway or Cable or Earth (Directly Buried), Based on Ambient Temperature of 30 C (86 F)

Size	Temperature Rating of Conductor, See Table 310-13.								Size
	60C (140 F)	75C (167 F)	85C (185 F)	90C (194 F)	60C (140 F)	75C (167 F)	85C (185 F)	90C (194 F)	
AWG kcmil	TYPES TW UF	TYPES FEPW RH, RHW THHW THW THWN XHHW USE, ZW	TYPES V	TYPES TA, TBS, SA SIS, FEP, FEPB, RHH, THHN, THHW, XHHW	TYPES TW UF	TYPES RH, RHW, THHW, WHE, WHEN, XHHW, USE	TYPE V	TYPES TA, TBS, SA, SIS, RHH, THHW, THHN, XHHW	AWG kcmil
	COPPER				**ALUMINUM OR COPPER-CLAD ALUMINUM**				
18	---	---	---	14	---	---	---	---	
16	---	---	18	18	---	---	---	---	
14	20	20	25	25	---	---	---	---	
12	25	25	30	30	20	20	25	25	12
10	30	35	40	40	25	30	30	35	10
8	40	50	55	55	30	40	40	45	8
6	55	65	70	75	40	50	55	60	6
4	70	85	95	95	55	65	75	75	4
3	85	100	110	110	65	75	85	85	3
2	95	115	125	130	75	90	100	100	2
1	110	130	145	150	85	100	110	115	1
1/0	125	150	165	170	100	120	130	135	1/0
2/0	145	175	190	195	115	135	145	150	2/0
3/0	165	200	215	225	130	155	170	175	3/0
4/0	195	230	250	260	150	180	195	205	4/0

250	215	255	275	290	170	205	220	230	250
300	240	285	310	320	190	230	250	255	300
350	260	310	340	350	210	250	270	280	350
400	280	335	365	380	225	270	295	305	400
500	320	380	415	430	260	310	335	350	500
600	355	420	460	475	285	340	370	385	600
700	385	460	500	520	310	375	405	420	700
750	400	475	515	535	320	385	420	435	750
800	410	490	535	555	330	395	430	450	800
900	435	520	565	585	355	425	465	480	900
1000	455	545	590	615	375	445	485	500	1000
1250	495	590	640	665	405	485	525	545	1250
1500	520	625	680	705	435	520	565	585	1500
1750	545	650	705	735	455	545	595	615	1750
2000	560	665	725	750	470	560	610	630	2000
AMPACITY CORRECTION FACTORS									
Ambient Temp. C	**For ambient temperatures othe than 30 C (86 F), multiply the ampacities shown above by the appropriate factor shown below.**								**Ambient Temp. F**
21-25	1.08	1.05	1.04	1.04	1.08	1.05	1.04	1.04	70-77
26-30	1	1	1	1	1	1	1	1	79-86
31-35	0.91	0.94	0.95	0.96	0.91	0.94	0.95	0.96	88-98
36-40	0.82	0.88	0.9	0.91	0.82	0.88	0.9	0.91	97-104
41-45	0.71	0.82	0.85	0.87	0.71	0.82	0.85	0.87	106-113
46-50	0.58	0.75	0.8	0.82	0.58	0.75	0.8	0.82	115-122
51-55	0.41	0.67	0.74	0.76	0.41	0.67	0.74	0.76	124-131
56-60		0.58	0.67	0.71		0.58	0.67	0.71	133-140
61-70		0.33	0.52	0.58		0.33	0.52	0.58	142-158
71-80			0.3	0.41			0.3	0.41	160-176

CONDUCTORS FOR GENERAL WIRING - ARTICLE 310
Table 310-17 Ampacities of Single Insulated Conductors, Rated 0 through 2000 Volts, In Free Air Based on Ambient Air Temperature of 30 C (86 F)

Size	Temperature Rating of Conductor, See Table 310-13								Size
	60 C (140 F)	75 C (167 F)	85 C (185 F)	90 C (194 F)	60 C (140 F)	75 C (167 F)	85 C (185 F)	90 C (194 F)	
	TYPE TW, UF	TYPES FEPW, RH, RHW, THHW, THW, THWN XHHW, ZW	TYPE V	TYPES TA, TBS, SA, SIS, FEP, FEPB, RHH, THHN, THHW, XHHW, MI	TYPE TW, UF	TYPES RH, THW, THHW, THW, THWN, XHHW	TYPE V	TYPES TA, TBS, SA, SIS, RHH, THHN, THHW, XHHW, MI	
AWG kcmil									AWG kcmil
	COPPER				**ALUMINUM OR COPPER-CLAD ALUMINUM**				
18	---	---	---	18	---	---	---	---	---
16	---	---	23	24	---	---	---	---	---
14	25	30	30	35	---	---	---	---	---
12	30	35	40	40	25	30	30	35	12
10	40	50	55	55	35	40	40	40	10
8	60	70	75	80	45	55	60	60	8
6	80	95	100	105	60	75	80	80	6
4	105	125	135	140	80	100	105	110	4
3	120	145	160	165	95	115	125	130	3
2	140	170	185	190	110	135	145	150	2
1	165	195	215	220	130	155	165	175	1
1/0	195	230	250	260	150	180	195	205	1/0
2/0	225	265	290	300	175	210	225	235	2/0
3/0	260	310	335	350	200	240	265	275	3/0
4/0	300	360	390	405	235	280	305	315	4/0
250	340	405	440	455	265	315	345	355	250
300	375	445	485	505	290	350	380	395	300

350	420	505	550	570	330	395	430	445	350
400	455	545	595	615	355	425	465	480	400
500	515	620	675	700	405	485	525	545	500
600	575	690	750	780	455	540	595	615	600
700	630	755	825	855	500	595	650	675	700
750	655	785	855	885	515	620	575	700	750
8/00	680	815	885	920	535	645	700	725	800
900	730	870	950	985	580	700	760	785	900
1000	780	935	1020	1055	625	750	815	845	1000
1250	890	1065	1160	1200	710	855	930	960	1250
1500	980	1175	1275	1325	795	950	1035	1075	1500
1750	1070	1280	1395	1445	875	1050	1145	1185	1750
2000	1155	1385	1505	1560	960	1150	1250	1335	2000

AMPACITY CORRECTION FACTORS

Ambient Temp. C	**For ambient temperatures other than 30 C (86 F), multiply the ampacities shown above by the appropriate factor shown below**								**Ambient Temp F**
21-25	1.08	1.05	1.04	1.04	1.08	1.05	1.04	1.04	70-77
26-30	1	1	1	1	1	1	1	1	79-86
31-35	0.91	0.94	0.95	0.96	0.91	0.94	0.95	0.96	88-95
36-40	0.82	0.88	0.9	0.91	0.82	0.88	0.9	0.91	97-104
41-45	0.71	0.82	0.85	0.87	0.71	0.82	0.85	0.87	106-113
46-50	0.58	0.75	0.8	0.82	0.58	0.75	0.8	0.82	115-122
51-55	0.41	0.67	0.74	0.76	0.41	0.67	0.74	0.76	124-131
56-60	---	0.58	0.67	0.71	---	0.58	0.67	0.71	133-140
61-70	---	0.33	0.52	0.58	---	0.33	0.52	0.58	142-158
71-80	---	---	0.3	0.41	---	---	0.3	0.41	160-176

ARTICLE 310 - CONDUCTORS FOR GENERAL WIRING
Table 310-18 Ampacities of Three Single Insulated Conductor Rated 0 through 2000 Volts, 150 to 250 C (302 to 482 F), in Raceway or Cable Based on Ambient Air Temperature of 40 C (104 F)

Size	Temperature Rating of Conductor, See Table 310-13				Size
	150 C 302 F	200 C 392 F	250 C 482 F	150 C 302 F	
AWG kcmil	TYPE Z	TYPES FEP, FEPB, PFA	TYPES PFAH, TFE	TYPE Z	AGW kcmil
	COPPER		NICKEL OR NICKEL-COATED COPPER	ALUMINUM OR COPPER-CLAD ALUMINUM	
14	34	36	39	---	14
12	43	45	54	30	12
10	55	60	73	44	10
8	76	83	93	57	8
6	96	110	117	75	6
4	120	125	148	94	4
3	143	152	166	109	3
2	160	171	191	124	2
1	186	197	215	145	1
1/0	215	229	244	169	1/0
2/0	251	260	273	198	2/0
3/0	288	297	308	227	3/0
4/0	332	346	361	260	4/0
250	---	---	---	---	250
300	---	---	---	---	300
350	---	---	---	---	350
400	---	---	---	---	400
500	---	---	---	---	500
600	---	---	---	---	600
700	---	---	---	---	700
750	---	---	---	---	750
800	---	---	---	---	800
1000	---	---	---	---	1000
1500	---	---	---	---	1500
2000	---	---	---	---	2000

41-50	0.95	0.97	0.98	0.95	106-122
51-60	0.9	0.94	0.95	0.9	124-140
61-70	0.85	0.9	0.93	0.85	142-158
71-80	0.8	0.87	0.9	0.8	160-176
81-90	0.74	0.83	0.87	0.74	177-194
91-100	0.67	0.79	0.85	0.67	195-212
101-120	0.52	0.71	0.79	0.52	213-248
121-140	0.3	0.61	0.72	0.3	249-284
141-160	---	0.5	0.65	---	285-320
161-180	---	0.35	0.58	---	321-356
181-200	---	---	0.49	---	357-392
201-225	---	---	0.35	---	393-437

CONDUCTORS FOR GENERAL WIRING - ARTICLE 310
Table 310-19 Ampacities for Single Insulated Conductors
Rated 0 through 2000 Volts, 150 to 250 C (302 to 482 F)
in Free Air Based on Ambient Air Temperature of 40 C (104 F)

Size	Temperature Rating of Conductor. See Table 310-13						Size
AWG kcmil	150 C 302 F TYPE Z	200 C 392 F TYPES FEP, FEPB, PFA	Bare or covered conductors	250 C 482 F TYPES PFAH, TFE	150 C 302 F TYPE Z	Bare or covered conductors	AWG kcmil
	COPPER			NICKEL OR NICKEL-COATED COPPER	ALUMINUM OR COPPER-CLAD ALUMINUM		
14	46	54	30	59		25	14
12	60	68	35	78	47	30	12
10	80	90	50	107	63	35	10
8	106	124	70	142	83	55	8
6	155	165	95	205	112	75	6
4	190	220	125	278	148	100	4
3	214	252	150	327	170	120	3
2	255	293	175	381	198	135	2
1	293	344	200	440	228	160	1
1/0	339	399	235	532	263	185	1/0
2/0	390	467	275	591	305	215	2/0
3/0	451	546	320	708	351	250	3/0
4/0	529	629	370	830	411	285	4/0
250			415			325	250
300			460			360	300
350			520			405	350
400			560			435	400
500			635			495	500

Size	Temperature Rating of Conductor. See Table 310-13						Size
AWG kcmil	150 C 302 F TYPE Z	200 C 392 F TYPES FEP, FEPB, PFA	Bare or covered conductors	250 C 482 F TYPES PFAH, TFE	150 C 302 F TYPE Z	Bare or covered conductors	AWG kcmil
	COPPER			NICKEL OR NICKEL-COATED COPPER	ALUMINUM OR COPPER-CLAD ALUMINUM		
600			710			560	600
700			780			615	700
750			805			635	750
800			835			660	800
900			865			715	900
1000			895			770	1000
1500			1205			980	1500
2000			1420			1215	2000
AMPACITY CORRECTION FACTORS							
Ambient Temp C	For ambient temperatures other than 40 C (104 F), multiply the ampacities shown above by the appropriate factor shown below						Ambient Temp F
41-50	0.95	0.97		0.98	0.95		106-122
51-60	0.9	0.94		0.95	0.9		124-140
61-70	0.85	0.9		0.93	0.85		142-158
71-80	0.8	0.87		0.9	0.8		160-176
81-90	0.74	0.83		0.87	0.74		177-194
91-100	0.67	0.79		0.85	0.67		195-212
101-120	0.52	0.71		0.79	0.52		213-248
121-140	0.3	0.61		0.72	0.3		249-284
141-160		0.5		0.65			285-320
161-180		0.35		0.58			321-356
181-200				0.49			357-392
201-225				0.35			393-437

Cutler-Hammer® E22 22.5mm Industrial *Pushbutton Selection Guide*

Quick Selection Guide for Commonly Ordered E22 Assembled Devices. For a complete E22 product listing, see the Eaton Corp Cutler-Hammer Industrial Control Catalog. UL Listed — File #E131568, Guide NKCR.

PUSHBUTTON OPERATORS with Chrome Bezel — For Black Bezel, see Cutler-Hammer Industrial Control Catalog

Description	Color	Catalog Number Operator Only	Assembled Operator with Contact Blocks — Catalog Number				
			NO	NC	NO-NC	2 NO	2 NC
 Flush	Black Red Green	E22P1 P2 P3	E22P1A P2A P3A	E22P1B P2B P3B	E22P1C P2C P3C	E22P1D P2D P3D	E22P1E P2E P3E
 Extended	Black Red Green	E22E1 E2 E3	E22E1A E2A E3A	E22E1B E2B E3B	E22E1C E2C E3C	E22E1D E2D E3D	E22E1E E2E E3E
 40 mm Mushroom	Black Red Green	E22L1 L2 L3	E22L1A L2A L3A	E22L1B L2B L3B	E22L1C L2C L3C	E22L1D L2D L3D	E22L1E L2E L3E
 40 mm Twist-to-Release Mushroom	Black Red Green	E22LL1 LL2 LL3	E22LL1A LL2A LL3A	E22LL1B LL2B LL3B	E22LL1C LL2C LL3C	E22LL1D LL2D LL3D	E22LL1E LL2E LL3E
 50 mm Jumbo Mushroom	Black Green Red Red Emerg. Stop Red Emerg. Stop Aluminum	E22JP1 JP3 JP2 JP2N8 J2N8	E22JP1A JP3A JP2A JP2N8A J2N8A	E22JP1B JP3B JP2B JP2N8B J2N8B	E22JP1C JP3C JP2C JP2N8C J2N8C	E22JP1D JP3D JP2D JP2N8D J2N8D	E34JP1E JP3E JP2E JP2N8E J2N8E

INDICATING LIGHTS, ILLUMINATED PUSHBUTTON OPERATORS

with Chrome Bezel — For Black Bezel, see Cutler-Hammer Industrial Control Catalog

Description	Color	Indicating Light — Catalog Number		Illuminated Pushbutton w/ Contact Blocks — Catalog Number			
		Standard	Prestest	NC	NO-NC	2 NO	2 NC
 24 V ac/dc Full Voltage	Red Green White Blue Amber Clear	E22H2X4 H3X4 H5X4 H6X4 H9X4 H0X4	E22T2X28 T3X28 T5X28 T6X28 T9X28 T0X28	E22T2X4B T3X4B T5X4B T6X4B T9X4B T0X4B	E22T2X4C T3X4C T5X4C T6X4C T9X4C T0X4C	E22T2X4D T3X4D T5X4D T6X4D T9X4D T0X4D	E22T2X4E T3X4E T5X4E T6X4E T9X4E T0X4E
 120 V ac/dc Resistor Unit	Red Green White Blue Amber Clear	E22H2X10 H3X10 H5X10 H6X10 H9X10 H0X10	E22T2X26 T3X26 T5X26 T6X26 T9X26 T0X26	E22T2X10B T3X10B T5X10B T6X10B T9X10B T0X10B	E22T2X10C T3X10C T5X10C T6X10C T9X10C T0X10C	E22T2X10D T3X10D T5X10D T6X10D T9X10D T0X10D	E22T2X10E T3X10E T5X10E T6X10E T9X10E T0X10E
 120 V Transformer Ac - 50/60 Hz	Red Green White Blue Amber Clear	E22H2X11 H3X11 H5X11 H6X11 H9X11 H0X11	E22T2X27 T3X27 T5X27 T6X27 T9X27 T0X27	E22T2X11B T3X11B T5X11B T6X11B T9X11B T0X11B	E22T2X11C T3X11C T5X11C T6X11C T9X11C T0X11C	E22T2X11D T3X11D T5X11D T6X11D T9X11D T0X11D	E22T2X11E T3X11E T5X11E T6X11E T9X11E T0X11E

PUSH-PULL OPERATORS with Chrome Bezel — For Black Bezel, see Cutler-Hammer Industrial Control Catalog

Description	Typical Application			NON-ILLUMINATED		ILLUMINATED			Contact Block Used
	Pulled	Center	Pushed	Button Color	Catalog Number	Lens Color	Catalog Number 120 V ac Transformer Type	Catalog Number 120 V ac/dc Resistor Type	
3 Position Momentary Push & Pull				Black Red Green	E22FD1S FD2S FD3S	Red Green Amber	E22HD2X11S HD3X11S HD9X11S	E22HD2X10S HD3X10S HD9X10S	E22B1 & E22B4
3 Position Momentary Push & Pull				Black Red Green	E22FD1T FD2T FD3T	Red Green Amber	E22HD2X11T HD3X11T HD9X11T	E22HD2X10T HD3X10T HD9X10T	E22B1 & E22B6
2 Position Maintained Push & Pull		Non-intermediate Position		Black Red Red Emerg. Stop Green	E22FD1B FD2B FD2N8B FD3B	Red Red Emerg. Stop Green Amber	E22GD2X11B GD2N8X11B GD3X11B GD9X11B	E22GD2X10B GD2N8X10B GD3X10B GD9X10B	E22B1

CONTACT BLOCKS

Contacts →	NO	NC	NO-NC	2ND	ECNO	LCNO
 Screw Terminal	E22B2	E22B1	E22B11	E22B20	E22B3	E22B4
Quick Connect	E22BF2	E22BF1	E22BF11	E22BF20	E22BF3	E22BF4

NO = Normally Open, NC = Normally Closed, LO = Late Opening, EC = Early Opening

LIGHT UNITS

Description	Catalog Number
120 V Transformer 120 V Resistor Full Voltage w/o Lamp	E22TL1 R2 D
24 V Full Voltage 120 V Full Voltage 120 V LED — Red 120 V LED — Green 120 V LED — Yellow	E22D24 D120 DL120R DL120G DL120Y

2 POSITION SELECTOR SWITCHES — ASSEMBLED with Chrome Bezel —

For Black Bezel, see Cutler-Hammer Industrial Control Catalog


Knob


Lever

Description	Operator Type (Black ❶)	Catalog Number				
		0X	X0 0X	0X 0X	0X X0 0X X0	0X 0X 0X 0X
Maintained	Knob	E22XF1A VF1A	E22XF1C VF1C	E22XF1D VF1D	E22XF1WW VF1WW	E22XF1VV VF1VV
	Lever	E22X51A V51A	E22X51C V51C	E22X51D V51D	E22X51WW V51WW	E22X51VV V51VV
Spring Return from Right	Knob	E22XE1A VE1A	E22XE1C VE1C	E22XE1D VE1D	E22XE1WW VE1WW	E22XE1VV VE1VV
	Lever	E22X61A V61A	E22X61C V61C	E22X61D V61D	E22X61WW V61WW	E22X61VV V61VV

3 POSITION SELECTOR SWITCHES — ASSEMBLED with Chrome Bezel —

For Black Bezel, see Cutler-Hammer Industrial Control Catalog

Description	Operator Type (Black ❶)	Catalog Number			
		X00 00X	X0X 00X	X00 0X0 00X	X00 X00 0X0 00X
Maintained	Knob	E22XG1D VG1D	E22XH1D VH1D	E22XG1RR VG1RR	E22XG1VV VG1VV
Spring Return From Right	Knob	E22XN1D VN1D	E22XP1D VP1D	E22XN1RR VN1RR	E22XN1VV VN1VV
Spring Return Right and Left	Knob	E22XL1D VL1D	E22XM1D VM1D	E22XL1RR VL1RR	E22XL1VV VL1VV
Spring Return From Left	Knob	E22XJ1D VJ1D	E22XK1D VK1D	E22XJ1RR VJ1RR	E22XJ1VV VJ1VV

❶ To order with an alternate color, replace 6th digit (1) of listed catalog number with Code No. from table below. Example: 3 position operator with red knob, E22XG2D

4 POSITION ROTARY CAM SELECTOR SWITCHES with

Chrome Bezel — For Black Bezel, see Cutler-Hammer Industrial Control Catalog

Circuit	Operator Type (Black ❶)	Catalog Number
X0E0 0X0X 0X0C 0X00	Knob Lever	E22LDN1 J0N1

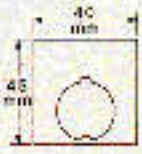
FOR OPERATOR(S) WITH BLACK BEZEL, SEE CUTLER-HAMMER INDUSTRIAL CONTROL CATALOG

Color	Code	Color	Code	Color	Code	Color	Code	Color	Code	Color	Code	Color	Code
Red	2	Green	3	Yellow	4	White	5	Blue	6	Gray	7	Orange	8

BLANK LEGEND PLATES

Field Color		Lettering Color After Engraving	Catalog Number				
			Aluminum		Plastic Enclosure (Self Adhesive)	Plastic Reversible	
Side 1	Side 2		Standard	Jumbo		Standard	Jumbo
Black	Red	Black or Silver	E22NS36 NS37	E22NL36 NL37	E22NC36 NC37	---	---
White Red	Silver Black	Black White	---	---	---	E22NSP76 NSP77	E22NLP76 NLP77
FOR PUSH-PULL OPERATORS							
Green	Red	Black or Silver	E22NP77	---	---	---	---

Standard



Jumbo

ENGRAVED LEGEND PLATES

Legend	Catalog Number				
	Aluminum		Plastic Enclosure (Self Adhesive)	Plastic Reversible	
	Standard	Jumbo		Standard	Jumbo
EMERG. STOP ❷ HAND-OFF-AUTO JOG OFF-ON OFF-ON	E22NS13 NS61 NS19 NS42 NS105	E22NL13 NL61 NL19 NL42 NL105	E22NC13R NC61 NC19 NC42 NC105	E22NSP13R NSP61 NSP19 NSP42 NSP105	E22NLP13R NLP61 NLP19 NLP42 NLP105
POWER ON RESET START STOP ❷	E22NS80 NS29 NS33 NS34	E22NL80 NL29 NL33 NL34	E22NC80 NC29 NC33 NC34R	E22NSP80 NSP29 NSP33 NSP34R	E22NLP80 NLP29 NLP33 NLP34R

❷ Red Red

ENCLOSURES & ASSEMBLED STATIONS — Polycarbonate, rated UL

Listed Type 1,2, 3, 3R, 4, 4X, 12, 13

	Description	Cat. No.
	1 Element 2 Element 3 Element	E22CDP1 CDP2 CDP3
ASSEMBLED STATIONS		
	Green Flush PB START — 1NO	E22ASB106
	Latch-in, Twist To Release EMERG. STOP Yellow Cover — 1NC	E22ASB106
	Green Flush PB START — 1NO Red Extended PB STOP — 1NC	E22ASB204

Cutler-Hammer® 10250T 30.5 mm Oiltight Pushbutton Selection Guide

Quick Selection Guide for Commonly Ordered 10250T Assembled Devices. For a complete 10250T product listing, see the Eaton Corp. Cutler-Hammer Industrial Control Catalog. 10250T devices UL Listed Type 1, 2, 3, 3R, 4, 4X, 12, 13 when mounted in enclosure rated for these same applications. UL File #E131568, Guide NKCR. CSA File #LR68551

PUSHBUTTON OPERATORS

Description		Color	Catalog Number — Operator Only	Assembled Operator with Contact Blocks — Catalog Number: NO	NC	NO-NC	2 NO	2 NC
	Flush	Black	10250T101	10250T73B	10250T101-51X	10250T30B	10250T101-2X	10250T101-3X
		Red	T102	T23R	T102-51X	T30R	T102-2X	T102-3X
		Green	T103	T23G	T103-51X	T30G	T103-2X	T103-3X
		Yellow	T104	T23Y	T104-51X	T30Y	T104-2X	T104-3X
	Extended	Black	10250T111	10250T25B	10250T111-51X	10250T31B	10250T111-2X	10250T111-3X
		Red	T112	T112-53X	T25R	T31R	T112-2X	T112-3X
		Green	T113	T25G	T113-51X	T31G	T113-2X	T113-3X
		Yellow	T120	T25Y	T120-51X	T31Y	T120-2X	T120-3X
	Mushroom*	Black	10250T121	10250T26B	10250T121-51X	10250T32B	10250T121-2X	10250T121-3X
		Red	T122	T122-53X	T26R	T32R	T122-2X	T122-3X
		Green	T123	T26G	T123-51X	T32G	T123-2X	T123-3X
		Yellow	T124	T26Y	T124-51X	T32Y	T124-2X	T124-3X
	Jumbo Mushroom*	Black	10250T171	10250T27B	10250T171-51X	10250T33B	10250T171-2X	10250T171-3X
		Red	T172	T172-53X	T27R	T33R	T172-2X	T172-3X
		Red Emerg. Stop	T17213	T17213-53X	T29	T33	T17213-2X	T17213-3X
		Green	T173	T27G	T173-51X	T33G	T173-2X	T173-3X
		Yellow	T174	T27Y	T174-51X	T33Y	T174-2X	T174-3X

INDICATING LIGHTS, ILLUMINATED PUSHBUTTON OPERATORS

Description		Color	Indicating Light — Catalog Number: Standard	Prestest	Illuminated Pushbutton w/ Contact Blocks — Catalog Number: NO	NO-NC	2 NO	2 NC
 Incandescent Light	24 V AC/DC Full Voltage	Red	10250T206NC1NX	10250T236NC21X	10250T476C21-51X	10250T476C21-1X	10250T476C21-2X	10250T476C21-3X
		Green	T206NC2NX	T235NC22X	T476C22-51X	T476C22-1X	T476C22-2X	T476C22-3X
		White	T206NC6NX	T235NC26X	T476C26-51X	T476C26-1X	T476C26-2X	T476C26-3X
		Blue	T206NC4NX	T235NC24X	T476C24-51X	T476C24-1X	T476C24-2X	T476C24-3X
		Amber	T206NC19NX	T235NC43X	T476C43-51X	T476C43-1X	T476C43-2X	T476C43-3X
		Clear	T206NC5NX	T235NC25X	T476C25-51X	T476C25-1X	T476C25-2X	T476C25-3X
 Illuminated Pushbutton PrestTest	120 V Transformer AC - 50/60 Hz	Red	10250T34R	10250T74NR	10250T77R	10250T76R	10250T411C21-2X	10250T411C21-3X
		Green	T34G	T74NG	T77G	T76G	T411C22-2X	T411C22-3X
		White	T34N	T74NW	T77W	T76W	T411C26-2X	T411C26-3X
		Blue	T34B	T74NB	T77B	T76B	T411C24-2X	T411C24-3X
		Amber	T34A	T74NA	T77A	T76A	T411C43-2X	T411C43-3X
		Clear	T34C	T74NC	T77C	T76C	T411C25-2X	T411C25-3X
	240 V Transformer AC - 50/60 Hz	Red	10250T182NC1NX	10250T222NC21X	10250T412C21-51X	10250T412C21-1X	10250T412C21-2X	10250T412C21-3X
		Green	T182NC2NX	T222NC22X	T412C22-51X	T412C22-1X	T412C22-2X	T412C22-3X
		White	T182NC6NX	T222NC26X	T412C26-51X	T412C26-1X	T412C26-2X	T412C26-3X
		Blue	T182NC4NX	T222NC24X	T412C24-51X	T412C24-1X	T412C24-2X	T412C24-3X
		Amber	T182NC19NX	T222NC43X	T412C43-51X	T412C43-1X	T412C43-2X	T412C43-3X
		Clear	T182NC5NX	T222NC25X	T412C25-51X	T412C25-1X	T412C25-2X	T412C25-3X

PUSH-PULL OPERATORS

Description	Typical Application: Pulled	Center	Pushed	NON-ILLUMINATED: Button Color	Catalog Number	ILLUMINATED 120 V Transformer — AC 50-60 Hz: Lens Color	Catalog Number	Contact Block Used
Momentary Push & Pull				Black	10250T4900-3X	Red	10250T463C47-3X	10250T3
				Red	T4902-3X	Green	T463C48-3X	
				Green	T4901-3X	Amber	T463C50-3X	
Momentary Push & Pull				Black	10250T10860-1X	Red	10250T1063C47-1X	10250T1
				Red	T10862-1X	Green	T1063C48-1X	
				Green	T10861-1X	Amber	T1063C50-1X	
Maintained Push & Pull		No Intermediate Position		Black	10250T5900-51X	Red	10250T563C47-51X	10250T5
				Red	T5902-51X	Red Emerg. Stop	T563C53-51X	
				Red Emerg. Stop	T5903-51X	Green	T563C48-51X	
				Green	T5901-51X	Amber	T563C50-51X	
Maintained Push Momentary Pull				Black	10250T9900-3X	Red	10250T963C47-3X	10250T3
				Red	T9902-3X	Green	T963C48-3X	
				Green	T9901-3X	Amber	T963C50-3X	

CONTACT BLOCKS — With Screw Terminals

Contacts		NO	NC	NO-NC	2NO	2NC	2NO-2NC	LCNO-ECNO	2LCNO	2LONC
	Diagram									
	Standard	10250T53	10250T51	10250T1	10250T2	10250T3	10250T44	10250T55	10250T57	10250T45
	Logic Level & Corr. Resist.	10250T53E	10250T51E	10250T1E	10250T2E	10250T3E		10250T55E	10250T57E	10250T45E

NO = Normally Open, NC = Normally Closed, LC = Late Opening, EC = Early Closing

ORDERING ASSEMBLED TYPE 10250T OPERATORS

Devices listed in this publication are shipped factory assembled. Any 10250T operator listed as a component in the Industrial Control Catalog may be ordered factory assembled by following the numbering sequence shown at right. Add "X" to end of composite number to indicate factory assembled. Selector switches include suffix indicating the contact sequence of the assembled device

Example: Illuminated Pushbutton Device — Catalog Number 10250T411C21-153S34X

10250T411	C21	—	1 53	S34	X
Illuminated Pushbutton Operator	Red Lens 10250TC21	Insert Hyphen Before Contact Block(s)	Contact Blocks 10250T1 and 10250T53	Legend Plate 10250TS34	Specifies Factory Assembled


Knob — 2 Position


Knob — 3 Position


Key Operator

2 POSITION SELECTOR SWITCHES — ASSEMBLED

Description	Operator Type	Catalog Number XO OX	XO OX	XO OX XO OX	OX OX OX OX
Maintained 60° Throw	Knob	10250T20KB	10250T1311-X2	10250T1311-X3	10250T1311-X4
	Lever	T20LB	T3011-X2	T3011-X3	T3011-X4
	Key	T15113-X1	T15113-X2	T15113-X3	T15113-X4
Spring Return From Right 60° Throw	Knob	10250T1371-X1	10250T1371-X2	10250T1371-X3	10250T1371-X4
	Lever	T3071-X1	T3071-X2	T3071-X3	T3071-X4
	Key	T15712-X1	T15712-X2	T15712-X3	T15712-X4

3 POSITION SELECTOR SWITCHES — ASSEMBLED

Description (All 60° Throw)	Operator Type	Catalog Number XOO OOX	XOO XOX	XOO OXO OOX	XOO OXX XOO OXX	XOO OXX XOX OXX	XOO OXX XOX OXX
Maintained	Knob	10250T21KB	10250T1322-Y3	10250T22KB	10250T1323-Y4	10250T1323-Y5	10250T1323-Y6
	Lever	T21LB	T3022-Y3	T22LB	T3023-Y4	T3023-Y5	T3023-Y6
	Key	T15227-Y1	T15227-Y3	T15237-Y2	T15237-Y4	T15237-Y5	T15237-Y6
Spring Return From Right	Knob	10250T1353-Y1	10250T1352-Y3	10250T1353-Y2	10250T1353-Y4	10250T1353-Y5	10250T1353-Y6
	Lever	T3053-Y1	T3052-Y3	T3053-Y2	T3053-Y4	T3053-Y5	T3053-Y6
	Key	T16536-Y1	T16528-Y3	T16536-Y2	T16536-Y4	T16536-Y5	T16536-Y6
Spring Return Right and Left	Knob	10250T1343-Y1	10250T1342-Y3	10250T1343-Y2	10250T1343-Y4	10250T1343-Y5	10250T1343-Y6
	Lever	T3043-Y1	T3042-Y3	T3043-Y2	T3043-Y4	T3043-Y5	T3043-Y6
	Key	T15434-Y1	T15424-Y3	T15434-Y2	T15434-Y4	T15434-Y5	T15434-Y6
Spring Return From Left	Knob	10250T1333-Y1	10250T1332-Y3	10250T1333-Y2	10250T1333-Y4	10250T1333-Y5	10250T1333-Y6
	Lever	T3033-Y1	T3032-Y3	T3033-Y2	T3033-Y4	T3033-Y5	T3033-Y6
	Key	T15335-Y1	T15325-Y3	T15335-Y2	T15335-Y4	T15335-Y5	T15335-Y6

4 POSITION SELECTOR SWITCHES — ASSEMBLED

Operator	Catalog Number XOOO OXOO OOXO OOOX
40° Throw	
Knob	10250T46KB
Lever	T46LB
Key	T16727-Z1

ILLUMINATED SELECTOR SWITCHES — ASSEMBLED

Operator	Catalog Number 2 POSITION	3 POSITION		4 POSITION
	XO OX 60° Throw	XOO OOX 60° Throw	XOO OXO OOX 60° Throw	XOOO OXOO OOXO OOOX 40° Throw
120 V ac 50/60 Hz TEA/SHORMER TYPE				
Knob	10250ED1117-KB	10250ED1117-2KB	10250ED1117-3KB	10250ED1117-4KB
Lever	10250ED1117-LB	10250ED1117-2LB	10250ED1117-3LB	10250ED1117-4LB

SELECTOR SWITCHES ON THIS CHART ARE VERTICAL MOUNT, WITH BLACK KNOBS AND LEVERS. ON KEY SELECTOR SWITCHES THE KEY REMOVAL IS IN ALL MAINTAINED POSITIONS. REFER TO THE EATON CUTLER-HAMMER INDUSTRIAL CONTROL CATALOG FOR OPTIONAL COLORS, LEVERS AND KEY REMOVAL CODES

ENGRAVED LEGEND PLATES — White lettering on Black Field except where noted

FOR PUSHBUTTON OPERATORS AND INDICATING LIGHTS					FOR SELECTOR SWITCH OPERATORS			FOR PUSH-PULL OPERATORS		
Legend	Catalog Number Square	1/2 Round	Legend	Catalog Number Square	1/2 Round	Legend	Catalog Number Square	1/2 Round	Legend	Catalog Number Square	1/2 Round
DOWN	10250TS74	10250TM12	ON	10250TS26	10250TM25	HAND AUTO	10250TS39	10250TM39	PULL START	10250	10250
EVERG. STOP ❶	TS13	TM13	RESET	TS29	TM29	OFF ON	TS42	TM42	PUSH STOP	TPP2	TR2
FORWARD	TS15	TM15	REVERSE	TS36	TM36	OPEN CLOSE	TS43	TM43			
IN/OUT	TS18	TM18	RUN	TS31	TM31	START STOP	TS47	TM47	PULL ON		
JOG	TS19	TM19	START	TS33	TM33	UP DOWN	TS48	TM48	PUSH OFF	TPP5	TR5
JOG FOR/ LOWER	10250TS20 TS23	10250TS20 TS23	STOP TEST	10250TS34 TS83	10250TM34 TM83	FOR OFF REV HAND OFF AUTO	10250TS50 TS51	10250TM50 TM51	PULL OPEN PUSH CLOSE	10250 TPP6	10250 TR6
MOTOR RUN	TS61	TS61	TRANSFER	TS93	TM93	RUN SAFE JOG	TS70	TM70	PULL UP -		
MOTOR STOP	TS62	TS62	UP	TS35	TM35	UP OFF DOWN	TS71	TM71	PUSH DOWN	TPP11	TR11

❶ Red lens.