PRACTICAL APPLICATION INFORMATION

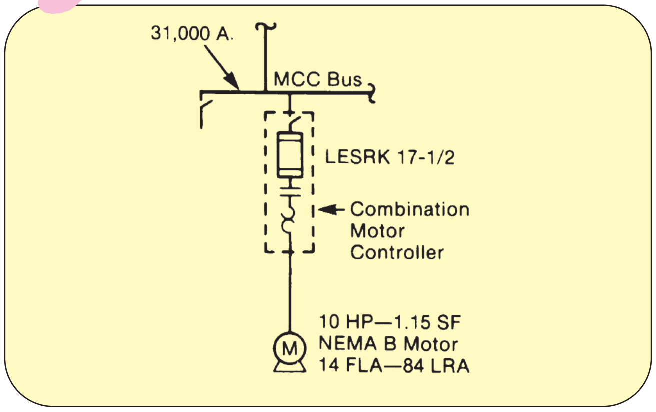


Figure 19

The EDISON LESRK 17-1/2 fuses have about 12 seconds delay characteristic at 100% loaded motor starting current to about 6 times motor FLA = 84 amperes (Figure 20 and 21). This allows full normal operation of the motor without oversizing the fuses.

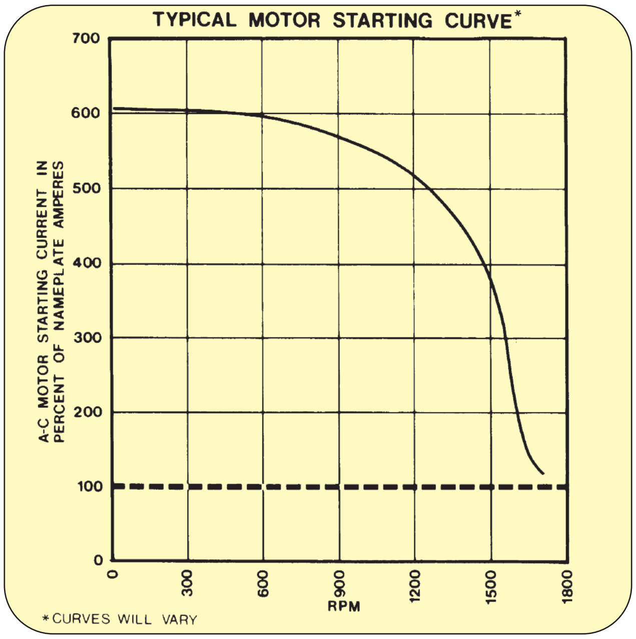


Figure 20

The LESRK 17-1/2 fuses may provide the following "back-up" motor overload protection, as an illustration, only with the understanding that variables of motor type, percent loading, type load, voltage, ambient temperature, frequency of on-off cycling, etc., may affect fuse sizing and fuse operating current and therefore may affect motor overload protection. These comments are true of any motor overload protection device.

Locked Rotor: Refer to Figures 21 and 22. This overload of about 600% (6x14A) may open the fuses in about 11 seconds.

Balanced Overload:
A balanced overload of, say 300% may open the LESRK 17-1/2 fuses in about 80 seconds.

"Single-Phased" Condition
Overload current flowing in the remaining two energized motor windings may vary from 1.73 to 2.0 times the normal 14 ampere full load current. A typical value may be 2 x F.L.A. (actual loaded motor current). The LESRK 17-1/2 fuses may open in about 225 seconds for a single-phase current of 28 amperes.

+Contact Edison Fusegear for latest data.

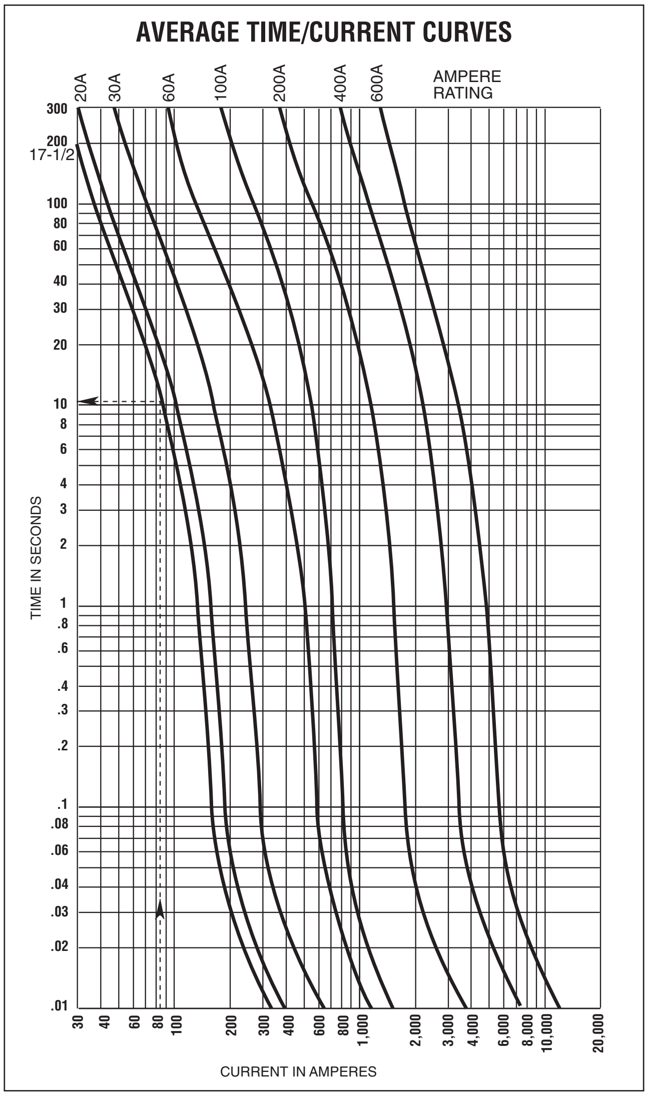
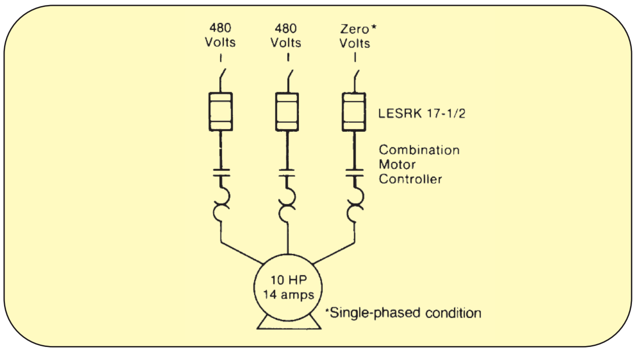


Figure 21

Figure 22



PRACTICAL APPLICATION INFORMATION

There are several ways that three-phase motors may be "single-phased". The worst condition for potential motor damage is the loss of one phase voltage that affects all motors. Multi-Purpose fuses specified for primary or "backup" motor overload protection, as described, may provide the protection for any of the ways in which a motor may be "single-phased", including a phase-to-ground fault between the motor and fuses.

Three-phase motors that are operated with...
- excess ambient
- unbalanced voltage
- no load for more than 30 minutes
- a light load
- an inertia load causing long acceleration
- on-off starting more frequent than 30 minutes
- jogging, reversing, screw load, etc.

...require special overload protection consideration.

All other common types of **overcurrent protection devices** specified for individual motor circuit application must be oversized. This is because of the lack of ability to override motor starting current which includes a "spike" during the first one-half cycle of about 20 times the motor F.L.A. for "standard" motors and about 25 for an "energy efficient" motor. Oversizing of such devices may be required up to the N.E.C. maximum of 1300% to allow motor starting. Such oversizing both decreases protection and increases cost.

Since adequate motor running protection design is part of good engineering practice, it is not generally good practice to deliberately design total building power loss to prevent motor "single-phasing" when motor overload protection has already been provided.

Fuses do not provide lightning protection for motors or other electrical equipment.

Application for U.L. Equipment Short-Circuit Current Ratings. EDISON Class R fuses provide excellent, low cost protection for equipment so that U.L. and NEC 110-3b labeling requirements are met. Also, use of these fuses ensures that U.L. test current values are not exceeded in actual applications.

Example:

The standard U.L. short-circuit current ratings for typical "off-the-shelf" motor controllers (i.e. motor starters) are shown in Figure 23.

U.L. SHORT-CIRCUIT WITHSTAND TEST AMPERES FOR "OFF THE SHELF" MOTOR CONTROLLERS*	
HORSEPOWER	**TEST AMPERES**
0-1	1,000
1½-50	5,000
51-200	10,000
201-400	18,000

Figure 23

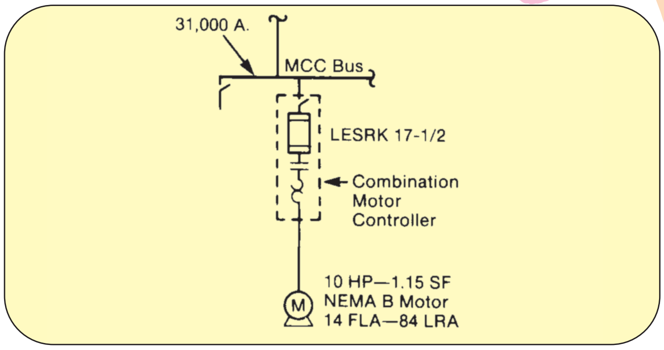


Figure 24

When the calculated available short-circuit current at a motor controller exceeds a standard U.L. controller rating (as in Figure 24) special protection considerations are required to meet N.E.C. 110-10 requirements.

For example, the EDISON LESRK 17½ fuses in Figure 24 will limit the available 31,000 amperes fault current to about 1,500 amperes. That is well below the 5,000 amperes U.L. limit for standard "off-the-shelf" motor controllers for motors up to 50 HP. Additionally, the LESRK 17½ fuses will provide a degree of motor overload protection, including single-phasing, provided the motor is not too lightly loaded or allowed to idle at no load for too long. Motor circuit conductor overload protection is also provided.

Overload protection is reduced for fuse oversizing, but short-circuit protection is not lost for N.E.C. requirements. For example, if a EDISON ECSR 30 (Class RK5) fuse were installed, the fault current would be limited to about 2,600 amperes–well below the U.L. 5,000 amperes limit. In addition, fault current could grow to 200,000 amperes and N.E.C. requirements would still be met.

Class J Fuse Application

EDISON JFL Class J fast-acting fuses and JDL Class J time-delay fuses are more current limiting than Class RK1 fuses. JFL fuses are recommended for non-inductive loads and circuit breaker protection. JDL fuses are recommended for protecting motor and transformer circuits.

The primary differences between Class J and Class RK1 fuses are that Class J fuses have one voltage rating of 600 or less, are smaller size and are not physically interchangeable with any other fuse. The lack of interchangeability makes them desirable where the installation of a fuse with less current limitation is undesirable.

The JDL and JFL fuses have some space advantage over Class R 250 volt fuses, but have about 45% advantage over Class R 600 volt fuses.

Fuse Application Tips

Fuse Voltage Ratings: Apply fuses at any circuit voltage less than or equal to the AC voltage rating.

Fuse Current Ratings: Select fuse types to provide the sizing of current (ampere) ratings as low as practical for a circuit without incurring unnecessary fuse opening for normal circuit operation. This provides optimum overcurrent protection.

PRACTICAL APPLICATION INFORMATION

FUSE APPLICATION TIPS, CONT.

Fuse Interrupting Ratings: Apply fuses where the maximum available short-circuit current magnitude is not expected to exceed the fuse interrupting rating. When a calculation for maximum short-circuit current is not made, selection of EDISON Class L, R, or J fuses with 200,000 amperes interrupting rating will satisfy N.E.C. 110-9 for most systems.

Fuse Current Limiting Ratings: UL requires that the designation “Current Limiting” only be shown on fuses which are not interchangeable with devices of lower interrupting ratings. Such EDISON products are Classes L, R and J fuses. Current limiting fuses open extremely fast for high magnitude short-circuit current conditions and will limit the short-circuit current magnitude in the current limiting range of the fuse to provide best protection. See N.E.C. Section 110-10.

Class R Fuses: Class R fuses will fit standard fuse clips to upgrade existing systems; however, the use of rejection type Class R fuse clips in Class R fuse clips in Class R rated switches is recommended.

Fuse “Time-Delay” Rating: “Time-Delay” fuses have some opening “delay” designed into the overload range (up to 10 times fuse rating). This reduces the possibility of nuisance fuse opening for harmless current surges caused by inductive loads such as motors and transformers. Such fuses in Class L, Class J and Class R types, however, are current limiting and provide fast short-circuit protection.

Fuse “Fast Acting” Rating: Fuses with no designed “time delay” built into the overload range, usually used for noninductive loads. The practice of oversizing “fast acting” fuses to accommodate inrush currents of inductive loads may reduce desired overcurrent protection.

Transformer Circuit Fuse Sizing: Use “time delay” fuses for transformer primary circuits at 125% or less of transformer primary rated current when no secondary protection is provided (N.E.C. 450-3). When secondary fuse protection is provided at 125% or less of transformer secondary rating, primary fuses may be sized at 250% or less of transformer primary current rating. For estimating transformer primary in-rush current, consider an effective current in-rush magnitude of 12 times transformer primary current rating for 0.1 second duration, and 25 times for .01 seconds..

Motor Circuit Fuse Sizing: Class R dual-element fuses are recommended for motor and motor circuit protection. The following tables for “Sizing Fuse Protection for Motors and Motor Circuits” are based on N.E.C. Article 430. These tables are for reference only since the degree of motor and motor circuit protection is variable within N.E.C. Limits and motor types, applications and ambient conditions. Sizing dual element fuses for motor overload and running protection may be influenced by variables in applied voltage, actual motor circuit current (power factor, power factor correction capacitors, less than nameplate motor load), type motor load, jogging, reversing, frequent on-off cycles, ambient temperatures at motor and fuse, motor winding insulation thermal limit, etc. Usually, motor starter thermal overload relays are sized to provide primary motor overload and running protection for each specific installation requirement. Edison Dual Fuses are commonly sized to “back up” the starter relay's motor overload protection as well as to provide excellent, dependable, short-circuit protection at minimum cost. Dual Element fuses may be sized for primary motor overload protection instead of “back up” for starter relays.

115 Volts, Single-Phase, AC(2) (See page Z-120)
Use 250 Volt ECNR or LENRK Fuses or 600V JDL Fuses

Motor		Fuse Amperes		
HP	Full Load Amperes (Nominal)	For 1.15 S.F. or Less. 40°C Rise or Less (125% F.L.A.)(1)	All Other Motors (115% F.L.A.)(1)	Max. N.E.C. Fuse Ratings(1)(4)
1/6	4.4	5-6/10	5	8
1/4	5.8	7	7	10
1/3	7.2	9	8	15
1/2	9.8	12	12	17-1/2
3/4	13.8	17-1/2	15	25
1	16	20	17-1/2	30
1-1/2	20	25	25	35
2	24	30	30	45
3	34	45	40	60
5	56	70	70	100
7-1/2	80	100	90	150
10	100	125	110	175

*For reference only – see N.E.C. 430-6 and 430-32

230 Volts, Single-Phase, AC(2) (See page Z-120)
Use 250 Volt ECNR or LENRK Fuses or 600V JDL Fuses

Motor		Fuse Amperes		
HP	Full Load Amperes (Nominal)	For 1.15 S.F. or Less. 40°C Rise or Less (125% F.L.A.)(1)	All Other Motors (115% F.L.A.)(1)	Max. N.E.C. Fuse Ratings(1)(4)
1/6	2.2	2-8/10	2-1/2	4
1/4	2.9	4	3-2/10	5-6/10
1/3	3.6	4-1/2	4	7
1/2	4.9	6	5-6/10	9
3/4	6.9	9	8	15
1	8	10	9	15
1-1/2	10	12	12	17-1/2
2	12	15	15	25
3	17	20	20	30
5	28	35	30	50
7-1/2	40	50	45	70
10	50	70	60	90

*For reference only – see N.E.C. 430-6 and 430-32

200 Volts, Three-Phase, AC(3) (See page Z-120)
(Induction, Squirrel Cage & Wound Rotor)
Use 250 Volt ECNR or LENRK Fuses or 600V JDL Fuses

Motor		Fuse Amperes			
				Max. N.E.C. Rating(1)	
HP	Full Load Amperes (Nominal)	For 1.15 S.F. or Less. 40°C Rise or Less (125% F.L.A.)(1)	All Other Motors (115% F.L.A.)(1)	Code Letter A Wound Rotor, No Letter(4)	All Others(4)
1/2	2.3	2-8/10	2-1/2	3-1/2	4
3/4	3.2	4	3-1/2	5	5-6/10
1	4.1	5	4-1/2	6	7
1-1/2	6	7-1/2	7	9	10
2	7.8	10	9	12	15
3	11	15	12	17-1/2	20
5	17.5	20	20	25	30
7-1/2	25	30	30	40	45
10	32	40	35	50	60
15	48	60	60	75	90
20	62	80	70	90	110
25	78	90	90	110	125
30	92	110	100	125	150
40	120	150	125	175	200
50	150	175	175	225	250
60	177	225	200	250	300
75	221	300	250	350	400
100	285	350	325	400	450
125	359	450	400	500	600
150	414	500	450	600	Class L

*For reference only – see N.E.C. 430-6 and 430-32

PRACTICAL APPLICATION INFORMATION

208 Volts, Three-Phase, AC(3) (See below)

(Induction, Squirrel Cage & Wound Rotor)
Use 250 Volt ECNR or LENRK Fuses or 600V JDL Fuses

Motor		Fuse Amperes			
		For 1.15 S.F. or Less. 40°C Rise or Less (125% F.L.A.)(1)	All Other Motors (115% F.L.A.)(1)	Max. N.E.C. Rating(1)	
HP	Full Load Amperes (Nominal)			Code Letter A Wound Rotor, No Letter(4)	All Others(4)
1/2	2.2	2-8/10	2-1/2	3-1/2	4
3/4	3.1	4	3-1/2	5	5-6/10
1	4	5	4-1/2	6-1/4	7
1-1/2	5.7	7	6-1/4	9	10
2	7.5	9	9	12	15
3	10.6	15	12	17-1/2	20
5	16.7	20	17-1/2	25	30
7-1/2	24	30	30	35	45
10	31	40	35	45	60
15	46	60	50	70	80
20	59	70	70	90	110
25	75	90	80	125	150
30	88	110	100	150	175
40	114	150	125	175	200
50	143	175	175	225	250
60	169	225	200	250	300
75	211	250	225	350	400
100	272	350	300	450	500
125	335	400	400	500	600
150	396	500	450	600	600

*For reference only – see N.E.C. 430-6 and 430-32

230 Volts, Three-Phase, AC(3)

(Induction, Squirrel Cage & Wound Rotor)
Use 250 Volt ECNR or LENRK Fuses or 600V JDL Fuses

Motor		Fuse Amperes			
		For 1.15 S.F. or Less. 40°C Rise or Less (125% F.L.A.)(1)	All Other Motors (115% F.L.A.)(1)	Max. N.E.C. Rating(1)	
HP	Full Load Amperes (Nominal)			Code Letter A Wound Rotor, No Letter(4)	All Others(4)
1/2	2	2-1/2	2-1/4	3-2/10	3-1/2
3/4	2.8	3-1/2	3-2/10	4-1/2	5
1	3.6	4-1/2	4	5-6/10	7
1-1/2	5.2	7	6-1/4	8	10
2	6.8	9	8	10	12
3	9.6	12	12	15	17-1/2
5	15.2	20	17-1/2	25	30
7-1/2	22	30	25	35	40
10	28	35	35	45	50
15	42	50	50	70	80
20	54	70	60	90	100
25	68	90	80	110	125
30	80	100	90	125	150
40	104	125	125	175	200
50	130	175	150	200	250
60	154	200	175	250	300
75	192	250	225	300	350
100	248	300	300	400	450
125	312	400	350	500	600
150	360	450	400	500	600
200	480	600	600	Class L	Class L

*For reference only – see N.E.C. 430-6 and 430-32

460 Volts, Three-Phase AC(3)

(Induction, Squirrel Cage & Wound Rotor)
Use 600 Volt ECSR or LESRK Fuses or 600V JDL Fuses

Motor		Fuse Amperes			
		For 1.15 S.F. or Less. 40°C Rise or Less (125% F.L.A.)(1)	All Other Motors (115% F.L.A.)(1)	Max. N.E.C. Rating(1)	
HP	Full Load Amperes (Nominal)			Code Letter A Wound Rotor, No Letter(4)	All Others(4)
1/2	1	1-1/4	1-1/8	1-1/2	1-8/10
3/4	1.4	1-8/10	1-6/10	2	2-1/2
1	1.8	2-1/4	2	3	3-2/10
1-1/2	2.6	3-2/10	3	4	4-1/2
2	3.4	4	4	5	6
3	4.8	6	5-6/10	7	8
5	7.6	10	9	12	15
7-1/2	11	15	12	17-1/2	20
10	14	17-1/2	17-1/2	20	25
15	21	25	25	30	35
20	27	35	35	40	50
25	34	40	40	50	60
30	40	50	45	60	70
40	52	70	60	80	90
50	65	80	70	100	110
60	77	100	90	110	125
75	96	125	110	150	175
100	124	150	150	175	200
125	156	200	175	225	250
150	180	225	200	300	300
200	240	300	300	350	400

*For reference only – see N.E.C. 430-6 and 430-32

575 Volts, Three-Phase, AC(3)

(Induction, Squirrel Cage & Wound Rotor)
Use 600 Volt ECSR or LESRK Fuses or 600V JDL Fuses

Motor		Fuse Amperes			
		For 1.15 S.F. or Less. 40°C Rise or Less (125% F.L.A.)(1)	All Other Motors (115% F.L.A.)(1)	Max. N.E.C. Rating(1)	
HP	Full Load Amperes (Nominal)			Code Letter A Wound Rotor, No Letter(4)	All Others(4)
1/2	0.8	1	1	1-1/4	1-4/10
3/4	1.1	1-1/4	1-1/8	1-6/10	2
1	1.4	1-8/10	1-6/10	2	2-1/2
1-1/2	2.1	2-1/2	2-1/2	3	3-1/2
2	2.7	3-1/2	3-2/10	4	5
3	3 9	5	4-1/2	6	7
5	6.1	7	7	9	10
7-1/2	9	12	10	15	15
10	11	15	12	17-1/2	17-1/2
15	17	20	20	30	35
20	22	30	25	35	40
25	27	35	30	40	45
30	32	40	35	50	60
40	41	50	45	60	70
50	52	70	60	80	90
60	62	80	70	90	100
75	77	100	90	110	125
100	99	125	110	150	175
125	125	150	150	200	225
150	144	175	175	225	250
200	192	250	225	300	350

*For reference only – see N.E.C. 430-6 and 430-32

Notes:

(1) Where thermal overload relays are not used as primary running protection, size dual-element fuses at 100% of nameplate ampere rating for 1.0 Service Factor (115% for 1.15 S.F.). Motor applications above 600 amperes, and unusual application variables, require special consideration. (2) N E C. Table 430-148, (3) N.E.C. Table 430-150, (4) N.E.C. Table 430-152

Motor Circuit Capacitor Sizing for Power Factor Correction

Line Current Reduction for Sizing Equipment and Overload Protection Nominal Motor Speed

	3600 r/min		1800 r/min		1200 r/min		900 r/min	
Induction Motor Rating (hp)	**Capacitor Rating (kvar)**	**Line Current Reduction (%)**	**Capacitor Rating (kvar)**	**Line Current Reduction (%)**	**Capacitor Rating (kvar)**	**Line Current Reduction (%)**	**Capacitor Rating (kvar)**	**Line Current Reduction (%)**
3	1.5	14	1.5	23	2.5	28	3	38
5	2	14	2.5	22	3	26	4	31
7-1/2	2.5	14	3	20	4	21	5	28
10	4	14	4	18	5	21	6	27
15	5	12	5	18	6	20	7.5	24
20	6	12	6	17	7.5	19	9	23
25	7.5	12	7.5	17	8	19	10	23
30	8	11	8	16	10	19	14	22
40	12	12	13	15	16	19	18	21
50	15	12	18	15	20	19	22.5	21
60	18	12	21	14	22.5	17	26	20
75	20	12	23	14	25	15	28	17
100	22.5	11	30	14	30	12	35	16
125	25	10	36	12	35	12	42	14
150	30	10	42	12	40	12	52.5	14
200	35	10	50	11	50	10	65	13
250	40	11	60	10	62.5	10	82	13
300	45	11	68	10	75	12	100	14
350	50	12	75	8	90	12	120	13
400	75	10	80	8	100	12	130	13
450	80	8	90	8	120	10	140	12
500	100	8	120	9	150	12	160	12

*Check with motor manufacturer to verify maximum allowable power factor correction capacitor that can be used.

PRACTICAL APPLICATION INFORMATION

Point-of-Application Method for Calculating Short-Circuit Current for a Building Radial Power Distribution System–600 Volts or Less

P-O-A Method for Three-Phase

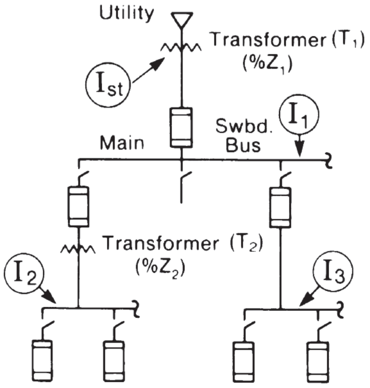


Figure 25

Nomenclature Identification for Calculation Equations Shown Below

$I_{1,2,3}$ = CALCULATED SHORT-CIRCUIT CURRENT.
%Z = TRANSFORMER IMPEDANCE IN PERCENT.
I_{st} = AVAILABLE SHORT-CIRCUIT CURRENT AT THE MAIN TRANSFORMER SECONDARY TERMINALS.
C,D,F,G = VALUES FROM TABLES, PAGE A18.
L = LENGTH OF CONDUCTOR IN FEET.
N = NUMBER OF PARALLEL CONDUCTORS PER PHASE.
KV = TRANSFORMER SECONDARY L-L VOLTS/1000.
MC = TOTAL CONNECTED FULL LOAD MOTOR AMPS x 4. (From NEMA Standard AB-1).

NOTE: *The minor Ohms of switches, fuses, breakers, current transformers and short lengths of large conductors are ignored.*

Flexible Calculation Procedure

(Refer to Figure 25)

A utility, on request, will usually provide short- circuit calculation information for a specific building service. The information is usually (A.) or (B.) below.

A. Provide primary KVA short-circuit capability for use in Equation (1a) and the main transformer impedance value in percent for use in Equation (1b.)

EQUATION (1a):

$$Z_u = \frac{10{,}000}{\text{Utility KVA}}$$

EQUATION (1b):

$$Z_{t1} = \%Z_1 \text{ X } D$$

B. Provide the available short-circuit current in amperes at the secondary terminals of the main transformer for a specific building for use in Equation (2.)

EQUATION (2):

$$Z_{st} = \frac{G}{I_{st}}$$

C. When utility information (A.) or (B.) above is not available, use only Equation (1b). Select a value of $\%Z_1$, from Table Z, page A18, corresponding to transformer (T_1) KVA size and assume utility infinite KVA primary.

D. Equation for the per-unit impedance of the main service conductor:

$$Z_{C1} = \frac{L \text{ x } C \text{ x } F}{N \text{ x } 1000}$$

E. I_1 Calculation using (A.) and (D.)

$$I_1 = \frac{G}{Z_u + Z_{t1}\ Z_{C1}} + MC$$

F. I_1 Calculation using (B.) and (D.)

$$I_1 = \frac{G}{Z_{st} + Z_{C1}} + MC$$

G. I_1 Calculation using (C.) and (D.)

$$I_1 = \frac{G}{Z_{t1} + Z_{C1}} + MC$$

H. The following equation provides the value of total impedance in per-unit ohms for use in calculating short-circuit current at feeder and branch circuit fault locations:

$$Z_{T1} = \frac{10{,}000}{I_1 \text{ x } KV \text{ x } 1.73}$$

J. I_2 Calculation

$$Z_{t2} = \%Z_2 \text{ X } D^*$$

$$Z_{C2} = \frac{L \text{ x } C \text{ x } F}{N \text{ x } 1000}$$

$$Z_{T2} = Z_{T1} + Z_{t2} + Z_{C2}$$

$$I_2 = \frac{G}{Z_{T2}}$$

*When $\%Z_2$ of the transformer (T_2) to be installed is not known, select this value from Table Z, page A18.

Note: *When transformer (T2) is single-phase, calculate I2 as three-phase and multiply result by 0.87.*

K. I_3 Calculation

$$Z_{C3} = \frac{L \text{ x } C \text{ x } F}{N \text{ x } 1000}$$

$$Z_{T3} = Z_{T1} + Z_{C3}$$

$$I_3 = \frac{G}{Z_{T3}}$$

Note: *Follow the same procedure as for I_3 above for other feeder and branch circuits that do not have transformers. Use I_2 procedure above for other circuits with a transformer.*
See page Z-125 for example of single-phase and three-phase calculations.

Refer to the IEEE Gray Book (Standard 241-1991) if background information is desired on the EDISON "P-O-A" method. Other references are the 1993 N.E.C., NEMA Standard AB-1 and other industry publications.

PRACTICAL APPLICATION INFORMATION

Data for Edison "P-O-A" Fault Current Calculation Method

Table C
Three Single Conductors

Copper (1)			Aluminum (1)		
AWG or MCM	In Magnetic Duct	In-non/ Magnetic Duct	AWG or MCM	In Magnetic Duct	In-non/ Magnetic Duct
8	0.782	0.781	8	–	–
6	0.493	0.492	6	0.812	0.811
4	0.315	0.313	4	0.513	0.512
3	0.246	0.244	3	0.403	0.402
2	0.197	0.194	2	0.324	0.323
1	0.159	0.156	1	0.255	0.253
1/0	0.130	0.127	1/0	0.206	0.204
2/0	0.110	0.104	2/0	0.167	0.165
3/0	0.092	0.085	3/0	0.139	0.135
4/0	0.077	0.071	4/0	0.110	0.107
250	0.071	0.064	250	0.098	0.093
300	0.064	0.057	300	0.085	0.080
350	0.060	0.053	350	0.077	0.072
400	0.057	0.050	400	0.070	0.064
500	0.053	0 045	500	0.062	0.057
600	0.052	0.043	600	0.058	0.051
750	0.049	0.039	750	0.053	0.045
1000	0.047	0.038	1000	0.049	0.041
Busway (Feeder) (2)			**Busway (Plug-in) (2)**		
Amps	**Copper**	**Alum.**	**Amps**	**Copper**	**Alum.**
225	0.055	0.060	225	0.069	0.070
400	0.030	0.035	400	0.032	0.040
600	0.023	0.027	600	0.030	0.035
800	0.016	0.020	800	0.024	0.028
1000	0.013	0.017	1000	0.022	0.026
1200	0.011	0.013	1200	0.020	0.022
1350	0.010	0.011	1350	0.016	0.018
1600	0.008	0.010	1600	0.011	0.012
2000	0.006	0.007	2000	0.008	0.009
2500	0.005	0.005	2500	0.008	0.009
3000	0.005	0.005	3000	0.005	0.006
4000	0.003	0.003	4000	–	0.004
5000	0.002	–	–	–	–

(1) Cable impedance ohm values were obtained from N.E.C. Values are for 1000 feet to neutral, 75 degrees C., 60 Hz, 600V, three-phase, unshielded, Class B stranding, close spacing, copper cables are 100% IACS uncoated copper. Aluminum cables are 61% IACS aluminum. Ohm values will be different for different temperature or spacing. Capacitative reactance is negligible.

(2) Busway impedance ohm values are for 1000 feet to neutral, 75 degrees C., 60 Hz, three-phase 600V. Values are average from various sources. A specific manufacturers product may be different

Table D

Transformer KVA	"D" (5) Values
37-1/2	2.667
45	2.222
50	2.000
75	1.333
100	1.000
112-1/2	0.889
150	0.667
167	0.600
225	0.444
300	0.333
333	0.300
400	0.250
500	0.200
750	0.133
1000	0.100
1500	0.067
2000	0.050
2500	0.040

(5) D = $\frac{100}{KVA}$

Table Z (6)

Transformer KVA	Three Phase %Z	Single Phase %Z	Dry(7) Type
37-1/2	–	1.3	2
45	–	–	2
50	1.5	1.4	2
75	1.5	1.4	2
100	1.5	1.4	2
112-1/2	–	–	2
150	1.6	–	2
167	–	1.6	–
225	1.6	1.6	2
250	1.7	1.9	–
300	1.3	–	2
333	–	2.1	–
500	1.7	–	2
750	5.0	–	–
1000	5.0	–	–
1500	5.2	–	–
2000	5.2	–	–
2500	5.5	–	–

(6) Typical lowest transformer %Z values, specific products may vary.

(7) Secondary transformer in system with primary 600 volts or less.

Table F

System Voltage	Phase	"F" (3) Values
480	3	43.4
240	3	174
208	3	231
240	1	174
120	2	694

(3) F = $\frac{10}{(KV)^2}$

Table G

System Voltage	Phase	"G" (4) Values
480	3	12,000
240	3	24,000
208	3	27,800
240	1	41,667
120	1	83,300

(4) G (3Ø) = $\frac{10,000}{1.73 \times KV}$

(for 1Ø systems delete 1.73)

Transformer Full Load Amps
Three-Phase Transformers
(208V) amps = 2.78 x KVA
(240V) amps = 2.41 x KVA
(480V) amps = 1.20 x KVA

Single-Phase Transformers
(120V) amps = 8.33 x KVA
(240V) amps = 4.17 x KVA
(480V) amps = 2.08 x KVA

PRACTICAL APPLICATION INFORMATION

Example Calculations for 3Ø Systems

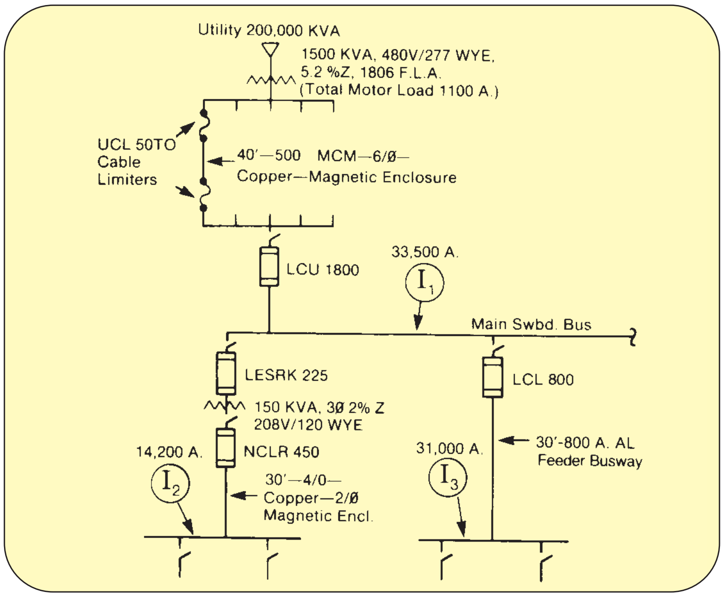


Figure 26

Equations from Page A20 for Calculating Short-Circuit Values Shown in Figure 26 Above

I_1 CALCULATIONS EQUATIONS

$$Z_u = \frac{10{,}000}{\text{Utility KVA}}$$

$$Z_{t1} = \%Z_1 \times D$$

$$Z_{C1} = \frac{L \times C \times F}{N \times 1000}$$

$$I_1 = \frac{G}{Z_u + Z_{t1} + Z_{C1}} = MC$$

$$Z_{T1} = \frac{10{,}000}{I_1 + KV + 1.73}$$

I_2 CALCULATIONS EQUATIONS

$$Z_{t2} = Z\%_2 \times D$$

$$Z_{C2} = \frac{L \times C \times F}{N \times 1000}$$

$$Z_{T2} = Z_{T1} + Z_{t2} + Z_{C2}$$

$$I_2 = \frac{C}{Z_{T2}}$$

I_3 CALCULATIONS EQUATIONS

$$Z_{C3} = \frac{L \times C \times F}{N \times 1000}$$

$$Z_{T3} = Z_{T1} + Z_{C3}$$

$$I_3 = \frac{C}{Z_{T3}}$$

Calculations Using the Equations at Left and of C, D, F and G Values from Tables on this page

I_1 CALCULATIONS

$$Z_u = \frac{10{,}000}{200{,}000} = 0.05$$

$$Z_{t1} = 5.2 \times 0.067 = 0.348$$

$$Z_{C1} = \frac{40 \times 0.053 \times 43.4}{6 \times 1000} = 0.015$$

$$I_1 = \frac{12{,}000}{0.05 + 0.348 + 0.015} + (4 \times 1100) = 33{,}500\text{A}$$

$$Z_{T1} = \frac{10{,}000}{33{,}500 \times 0.48 \times 1.73} = 0.36$$

I_2 CALCULATIONS

$$Z_{t2} = 2.0 \times 0.667 = 1.33$$

$$Z_{C2} = \frac{30 \times 0.077 \times 231}{2 \times 1000} = 0.27$$

$$Z_{T2} = 0.36 + 1.33 + 0.27 = 1.96$$

$$I_2 = \frac{27{,}800}{1.96} = 14{,}200\text{A}$$

I_3 CALCULATIONS

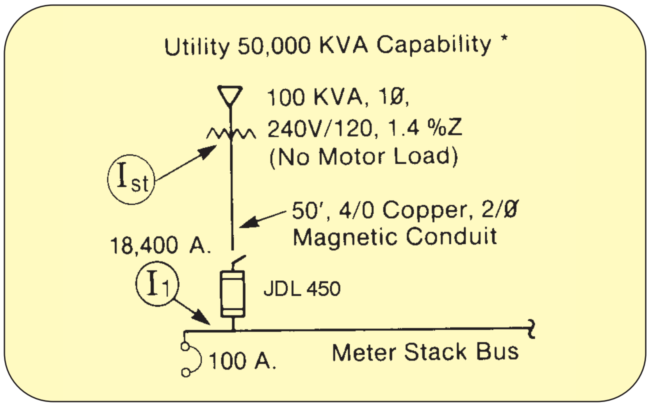
$$Z_{C3} = \frac{30 \times 0.02 \times 43.4}{1 \times 1000} = 0.026$$

$$Z_{T3} = 0.36 + 0.026 = 0.386$$

$$I_3 = \frac{12{,}000}{0.386} = 31{,}000\text{A}$$

PRACTICAL APPLICATION INFORMATION

P.O.A. Method for Single Phase



Assume Utility 50,000 KVA Capability and 1.4%Z Transformer Percent Impedance Information Obtained from Utility.

Figure 27

At the secondary terminals of a single-phase center tapped transformer, the L-N available short-circuit current is an average of 50% greater than the L-L short-circuit current. At some distance from the transformer, depending on conductor size and length to fault location considered, the L-L short-circuit current is greater.

Therefore, it is necessary to calculate both the L-N and L-L short-circuit current (at the point-of-application of overcurrent protection devices considered) and use the highest short-circuit current calculated to determine safe interrupting rating of the overcurrent protection devices to be installed.

The simple equations listed here show the calculation procedure.

I_1 120V L-N CALCULATIONS**

$$Z_u = \frac{10{,}000}{\text{Utility } 3Ø \text{ KVA}} = \frac{10{,}000}{50{,}000} = 0.2$$

$$I_{st} = \frac{G \times 1.5}{\%Z \times 0} = \frac{41{,}667 \times 1.5}{1.4 \times 1.0} = 44{,}600\text{A}$$

$$Z_{T1} = \frac{G}{I_{st}} = \frac{83{,}300}{44{,}600} = 1.87$$

$$Z_{C1} = \frac{2^{(1)} \times L \times C \times F}{N \times 1000} = \frac{2 \times 50 \times 0.077 \times 694}{2 \times 1000} = 2.67$$

$$Z_{LN} = Z_u + Z_{t1} + Z_{C1} = 0.2 + 1.87 + 2.67 = 4.74$$

$$I_1 \text{ (L-N)} = \frac{G}{Z_{LN}} = \frac{83{,}300}{4.74} = 17{,}600\text{A}$$

I_2 240V L-L CALCULATIONS**

$$Zu = \frac{10{,}000}{\text{Utility } 3Ø \text{ KVA}} = \frac{10{,}000}{50{,}000} = 0.2$$

$$Z_{t1} = Z\% \times D = 1.4 \times 1.0 = 1.4$$

$$Z_{C1} = \frac{2^{(1)} \times L \times C \times F}{N \times 1000} = \frac{2 \times 50 \times 0.077 \times 174}{2 \times 1000} = 0.67$$

$$Z_{LL} = Z_u + Z_{t1} + Z_{C1} = 0.2 + 1.4 + 0.67 = 2.27$$

$$I_1 \text{ (L-N)} = \frac{G}{Z_{LL}} = \frac{41{,}667}{2.27} = 18{,}400\text{A}$$

***ALWAYS CALCULATE BOTH L-N AND L-L SHORT-CIRCUIT CURRENT VALUES AND USE THE HIGHEST VALUE.*

(1) Multiply length by 2 because 2 conductors carry fault current.

NOTE: Neutral conductor considered same size as line conductors.

Application Tips

1. To find the maximum available short-circuit current at the secondary terminals of a three-phase transformer:*

$$I_{st} = \frac{G}{\%Z \text{ of Transformer}}$$

*For a single-phase transformer multiply 1_{st} by 1.5.

2. To find the value of short-circuit current (I_{SC2}) at the load end of a three-phase conductor when the value of short-circuit current (I_{SC1}) is known at the line end:*

$$Z_{SC1} = \frac{G}{I_{SC1}}$$

$$Z_C = \frac{L \times C \times F}{N \times 1000}$$

$$I_{SC2} = \frac{G}{Z_{SC1} + Z_C}$$

**For two conductors from a three-phase source, multiply I_{SC2} by 0.87. For a single-phase source (I_{SC1}) multiply ZC by 2 and I_{SC1} by 1.73.*

3. The EDISON condensed “Point-of-Application” method for calculating short-circuit current values in a building power distribution system is offered as a simple, practical, flexible and time/cost conserving procedure.

4. The EDISON method does not produce finite results. It is very difficult, if not impossible, to obtain finite results from any method because of the unpredictable and uncontrollable calculation parameters and variables.

5. There is an occasional tendency to believe that current limiting fuse performance must be included in fault current value calculations. This may produce serious error, so ignore fuses during calculations.

6. There is also a tendency to believe that N.E.C. 110-9 and good engineering practice can be served by ignoring “worst case bolted” fault conditions for calculations in favor of some undefined “estimate” of lower values. “Bolted” faults are rare, but other types of faults also produce high values. Phase-to-phase-to-ground or phase-to-ground faults may produce current flow over 90% of a “bolted” fault and phase-to-phase faults may produce 87% of “bolted” fault values.

7. When non-limiting type overcurrent protection devices with nominal interrupting rating are specified, it is generally considered good engineering practice to increase calculated fault current values by at least 20%.

Recommendation

EDISON FUSEGEAR current limiting fuses, with 200,000 amperes interrupting rating, are a low cost, excellent protection, dependable solution to design concerns about meeting N.E.C. 110-9 and good engineering practice. The ability of EDISON current limiting fuses to interrupt any value of fault current up to 200,000 RMS symmetrical amperes greatly reduces the possibility of safety obsolescence caused by fault current growth.

FUSE TERMINOLOGY

Ambient Temperature*
The temperature of the air surrounding the fuse.

Arcing Time
The amount of time that passes from the instant the fuse element or link has melted until the overcurrent is interrupted or cleared.

Asymmetrical Current
Refer to ALTERNATING CURRENT. A-C current is asymmetrical when the loops about a zero axis are unequal (offset). This condition is usually associated with the first five or less cycles of fault current flow in a circuit that has inductive reactance. All power distribution systems have a variable amount of inductive reactance.

Body*
The part of the fuse which encloses the fuse elements and supports the contacts. Also referred to as cartridge, tube or case.

Bolted Fault
This refers to a zero impedance fault considered at locations in a power system where the maximum value of available fault current is calculated.

Bridge
The specially designed narrow portion of a fuse link that heats fastest under overcurrent conditions to open first.

Cartridge Fuse*
A fuse consisting of a current responsive element inside a fuse body with contacts on both ends.

Cartridge Size*
The range of voltage and ampere ratings assigned to a cartridge of specific dimensions and shape.

Clearing I^2t (Ampere Squared Seconds)*
The measure of heat energy developed as a result of current flow between the time that current begins to flow and until the fuse clears the circuit. "I^2" stands for the square of the effective let-through current and "t" stands for the time of current flow in seconds. The term I^2t also applies during the melting or arcing portions of the clearing time and is referred to as melting or arcing I^2t respectively. Clearing I^2t is the sum of melting I^2t and arcing I^2t.

Clearing Time
This is the total opening time of a fuse from the occurrence of an overcurrent until the fuse stops current flow. This is the sum of link melting and arcing time.

Contacts*
The external metallic parts of the fuse used to complete the circuit. Also referred to as ferrules, caps, blades or terminals.

Current Limitation
A fuse provides current limitation when the link melts under short-circuit conditions to interrupt the current flow before the peak of the first one-half cycle of prospective current and the current flow is stopped within one-half cycle.

Current-Limiting Fuse*
A fuse that meets the following three conditions: 1) interrupts all available overcurrents within its interrupting rating; 2) within its current-limiting range, limits the clearing time at rated voltage to an interval equal to, or less than, the first major or symmetrical current loop duration; and 3) limits peak let-through current to a value less than the available peak current.

Current-Limiting Range*
A range of available currents from the threshold current to the interrupting current rating of a fuse.

Current Rating*
The A-C or D-C ampere rating which the fuse is capable of carrying continuously under specified conditions.

Delay
This refers to intentional "delay" designed into the overload range operation of a fuse and is meaningless except as defined by a fuse manufacturer. Other words used to indicate delay but not U.L. defined may be "Time-Lag", "Delay Type", etc..

Dual Element Fuse
The words "Dual Element" and "Time-Delay" appear on the labels of Class R fuses to indicate that the fuse has U.L. defined delay in the overload operation range of a minimum of 10 seconds at 500% of the fuse amperes rating. A "Dual Element" fuse has separate overload and short-circuit elements and is considered a "true time-delay fuse" design as opposed to other types of construction to obtain delay.

Effective Current (I_e)
"Effective" and "RMS" both refer to the heating effect value of an A-C current equivalent to a steady flow of a D-C current. "Effective let-through amperes" (I_e) refers to the heating effect value of the current allowed to flow during the clearing of a short-circuit current.

Eutectic Alloy
This is an alloy of lead, tin and other metals that, by metallurgical definition, changes from a solid directly to a liquid when its melting point is reached. This alloy is used in EDISON Class R fuses for dependable overload element operation.

Fast-Acting Fuse
This is a fuse with no intentional time-delay designed into the overload range. Sometimes referred to as a "single element fuse" or "non-delay fuse".

Fault Current
Short-circuit current that flows partially or entirely outside the intended normal load current path of a circuit or component. Values may be from hundreds to many thousands of amperes.

Ferrule
The cylindrical brass, bronze or copper mounting terminals of fuses with amps ratings up to 60 amperes. The cylindrical terminals at each end of a fuse fit into fuse clips.

Filler*
A material used to fill a section or sections of a fuse which aids in arc extinction.

Fuse*
A protective device which opens by the melting of a current sensitive element during specified overcurrent conditions.

Heat Sink
A mass of metal, usually copper or a eutectic alloy, used in the overload element of Class R fuses to provide accurate time delay by absorbing heat from an overload current flow through a fuse.

High Rupturing Capacity (HRC)
HRC is used by Canadian and British Standards as an equivalent to the U.S. interrupting rating of a fuse. HRC must be at least 100,000 amperes.

**From ANSI/NEMA FU1-86*

FUSE TERMINOLOGY

I^2t (Amperes Squared Seconds)

This is a value obtained by multiplying an effective current squared by the time of flow of the current in seconds. It is not a heat energy value, but represents heat energy for comparison purposes. Some common uses are to determine fuse selectivity and to select current limiting fuses that will limit this value to be compatible with the withstandability of semi-conductors that have n I^2t rating.

Interrupting Rating*

A rating based upon the highest rms alternating current or direct current which the fuse is required to interrupt under specific conditions.

Knife Blade

A flat copper mounting blade (terminal) at each end of fuses rated 70 through 6000 amperes. Knife blades may be mounted in fuse clips or bolted in place via blade holes, depending on the fuse type.

Limiter

Limiters have internal construction like fuses but provide only short-circuit protection and no overload protection. They are intended for special applications such as Cable Limiters and Welder Limiters.

Link

The fusible portion of the fuse which melts, or reacts by other means, to clear the circuit during an overcurrent condition. Also referred to as an element.

Magnetic Stress

When thousands of amps of short-circuit current flows through equipment and conductors, strong magnetic fields are developed that may cause serious damage unless adequate physical bracing is applied. Force is proportional to the value of peak current squared. This force is usually reduced by current limiting fuses as compared to other overcurrent protective devices.

Maximum Energy*

A condition under which, in a specified time, the maximum amount of heat possible is generated in the fuse before clearing.

Melting Time*

The time from the initiation of an overcurrent to the instant arcing begins inside a fuse.

Nonrenewable Fuse*

A fuse which cannot be restored for service after operation.

Normal Frequency Recovery Voltage*

The normal frequency rms voltage impressed upon the fuse after the circuit has been interrupted and after high frequency transients have subsided.

One-Line Diagram

An electrical diagram that shows one line to represent two or more conductors for simplification.

One-Time Fuse

A term used to identify a non-renewable Class H fuse as opposed to a Class H fuse with replaceable links. See “non-renewable fuse”.

Overcurrent*

Any current in excess of the fuse current rating.

Overload

A value of overcurrent usually considered to be up to about 10 times the ampere rating of an overcurrent protection device or circuit ampere rating.

Peak Arc Voltage*

The maximum peak voltage across the fuse during the arcing time.

Peak Let-Through Current (I_p)*

The maximum instantaneous current through a fuse during interruption in its current-limiting range.

Rating*

A designated limit of operating characteristics based on definite conditions.

Rejection Feature*

The physical characteristic of a fuse and fuseholder (slot, groove pin or overall dimension) which prevents substitution by other classes of fuses.

Renewable Fuse*

A fuse which can be readily restored for service after operation by the replacement of the renewal elements.

Renewal Element (Renewal Link)*

That part of a renewable fuse that is replaced after each interruption to restore the fuse to operating condition.

Short-Circuit Current

Refer to Fault Current.

Single-Element Fuse

Refer to Fast-Acting Fuse.

Supplemental Fuse (UL)

A U.L. fuse class per Standard 198G that defines certain small fuses not intended for branch circuit protection.

Thermal Stress

Heat builds up in equipment and conductors during the time of overcurrent flow that may cause thermal stress and potential thermal (heat) damage if overcurrent protection devices do not operate fast enough.

Threshold Current*

The minimum rms symmetrical available current of the current-limiting range, where melting of the fuse element occurs at approximately 90 degrees on the symmetrical current wave, and total clearing time is less than one-half cycle.

Threshold Ratio*

The threshold current divided by the fuse current rating.

Time-Delay Fuse*

A fuse capable of carrying a specific overcurrent for a minimum time.

Total Clearing Time*

Refer to Clearing Time.

Voltage Rating*

The maximum rms ac voltage or the maximum dc voltage at which the fuse is designed to operate.

**From ANSI/NEMA FU1-86*

APPLICATION INFORMATION BRITISH SEMICONDUCTOR FUSES

Fuses In Series

It is important that each fuse should be capable of clearing, on its own, the full voltage that can arise under fault conditions.

In many cases two fuses in series clear the fault e.g. two individual arm fuselinks in a 3 phase bridge with single semiconductors. For the coordination of I^2t the let-through by the fuse can be determined at a voltage of:

$$\frac{Vf \times 1.3 = 0.65\ Vf}{2}$$

The 1.3 is an empirical voltage sharing factor and Vf is the voltage to be cleared in the fault circuit.

Fuses In Parallel

The use of fuses in parallel can be advantageous.

- To obtain higher current ratings than existing ranges.
- To minimize the variety of fuses stocked.
- To increase the surface area for heat dissipation.

The following aspects should be borne in mind.

Mechanical Connections

It is desirable to make the connections to the parallel fuses as symmetrical as possible to assist in obtaining good current sharing between fuses. The temperature coefficient of resistance of the fuses does, however, greatly assist in this aspect.

Additional conductors required to make the connections should be of plated copper and of at least the same cross sectional area and surface area as the fuse tags. It is prudent to allow for a 5% de-rating on the maximum current rating for each parallel path, to take account of the proximity of the fuses. Only identical types of fuses should be used in parallel.

Time Current Characteristics

The time current characteristics of the combination of the fuses can be derived by taking the operating current of specific pre-arcing times for a single fuse and multiplying these currents by the number of parallel paths.

I^2t Characteristics

The I^2t of the combination of fuses is the I^2t of the single fuse multiplied by the square of the number of parallel fuses i.e.

by 4 for two fuses in parallel.
by 9 for three fuses in parallel.

Fuse Selection In Semiconductor Convertors

Rectifiers

The majority of applications will be fed from the AC mains supply, the standardized system voltages in various parts of the world are:

Single-Phase	Three-Phase
120	208
220	380
240	415
277	480 (460)
	660

In general for these applications fuses are only exposed to AC fault conditions and the fuse voltage rating is selected to be equal or greater than the supply line-to-line voltage. In the case of the three phase double Wye (star) arrangement with interphase transformer, the voltage rating of the fuse must be twice the line to neutral voltage.

For large rectifiers multi-parallel paths are used each with its associated fuse. In such applications the fuselink is used to isolate a faulty semiconductor and the I^2t of the fuse must be:

a. less than the explosion rating of the semiconductor.
b. such as not to cause other fuses in the healthy circuits to operate.

DC Drives

The non regenerative thyristor drive is widely used for variable speed control of motors. In these applications the coordination of fuses and semiconductors is often more critical than for rectifiers. The fuses are usually positioned in each arm of the bridge or the supply lines and will generally only see an AC fault.

In regenerative thyristor DC drives the fuses in the inverter bridge or in the AC input lines can see DC faults in addition to the AC fault, DC faults arise under shoot-through conditions in the inverter bridge or with loss of the AC supply. In addition a combined AC and DC fault occurs with a commutation fault. Due allowance for these conditions must be made in the selection of the voltage rating of the fuses.

AC Drives

These are becoming increasingly popular and are usually fed from the normal AC mains. Fuses are often used in the DC circuit of the converter and the associated approximate DC circuit voltages for the common 3-phase systems are:

A.C. Systems	D.C. Circuit
380	510
415	560
480 (460)	650 (620)

A very fast fuse is required for this application and the fuse elements should melt before the peak of the fault current. The high rate of rise of the fault current is equivalent to a DC fault with a short time constant.

The Edison E70S range is ideally suited for applications at the above voltages.

UPS System

The DC circuit voltage in UPS applications is governed by the battery voltage and in 3 phase applications special input transformers are often used. The DC circuit voltage is usually limited to a voltage of approximately 450V DC. Edison E50S semiconductor protection fuses are suitable for applications up to 500V DC circuit voltage.

APPLICATION INFORMATION BRITISH SEMICONDUCTOR FUSES

Soft Starters

Although soft starters reduce the magnitude of the motor starting current, these currents are still considerably larger than the motor full load current. In such applications the fuse has to be selected to withstand this motor starting current which may be of a repetitive nature. This action defines the fuse rating which in turn may have an I^2t-let-through approaching that of the power semiconductor.

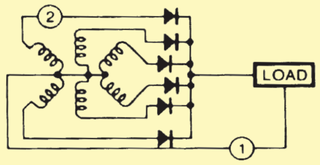
Traction Applications

Each application tends to have its specific requirement and full technical details should be forwarded to Edison Fusegear for evaluation. Third rail d.c. applications are particularly difficult where the time constants sometimes approach 100 m.s.

Mean and R.M.S. Currents

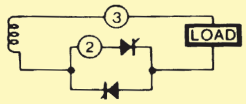
Care must be taken in coordinating fuse currents with the circuit currents. Fuse currents are always given in r.m.s. values, while it is common practice to treat diodes and thyristors in terms of mean values. In rectifier circuits, fuses are either placed in series with the diodes or thyristors in the a.c. supply lines or least commonly in the d.c. output line. The relationship of the currents in these three positions for commonly used rectifier circuits as shown in the diagrams.

Six Phase Star



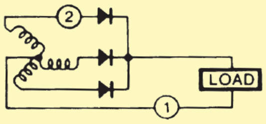
DC Load Current (1): 1.0
RMS Diode Current (2): 0.41

Anti-Parallel AC Controller—Single phase



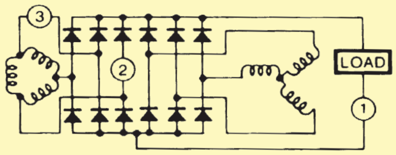
RMS Diode Current (2): 0.71
RMS Line Current (3): 1.0

Three Phase Wye



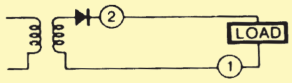
DC Load Current (1): 1.0
RMS Diode Current (2): 0.58

Six Phase Parallel Bridge (without IPT)



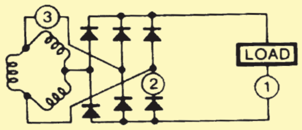
DC Load Current (1): 1.0
RMS Diode Current (2): 0.41
RMS Line Current (3): 0.58

Single Phase Half Wave



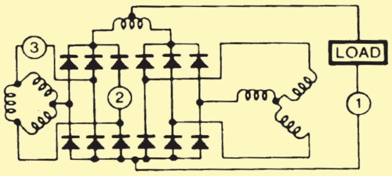
DC Load Current (1): 1.0
RMS Diode Current (2): 1.6

Three Phase Bridge



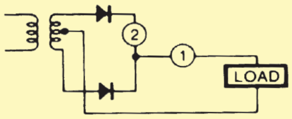
DC Load Current (1): 1.0
RMS Diode Current (2): 0.58
RMS Line Current (3): 0.82

Six Phase Parallel Bridge (with IPT)



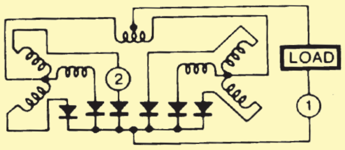
DC Load Current (1): 1.0
RMS Diode Current (2): 0.29
RMS Line Current (3): 0.41

Single Phase Full Wave Centre Tap



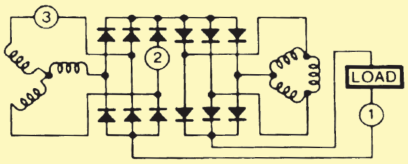
DC Load Current (1): 1.0
RMS Diode Current (2):
Resistive Load: 0.79
Inductive Load: 0.71

Three Phase Double Wye



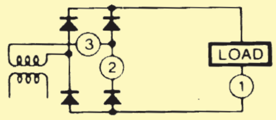
DC Load Current (1): 1.0
RMS Diode Current (2): 0.29

Six Phase Series Bridge



DC Load Current (1): 1.0
RMS Diode Current (2): 0.58
RMS Line Current (3): 0.82

Single Phase Bridge



DC Load Current (1): 1.0
RMS Diode Current (2)
Resistive Load: 0.79
Inductive Load: 0.71
RMS Line Current (3)
Resistive Load: 1.1
Inductive Load: 1.0

ELEMENTS OF A PRACTICAL FUSE SPECIFICATION

Low Voltage (600 Volts or Less) Fuse Specification

General

The contractor shall install UL “listed” fuses of the correct UL Class, type and ampere ratings in switches or place in spare fuses cabinet(s) as indicated on the plans and/or as specified below. All installed and spare fuses shall be in their original new, clean, dry and unused condition when installed and when placed in a spare fuses cabinet(s). The contractor shall thoroughly clean, mechanically check and electrically test, as required, all equipment and components before installing fuses and energizing.

UL Class L Bolt-On Fuses Rated 601 to 6000 Amperes

To mount UL Class L fuse types and amps ratings as shown on the plans, use stainless steel bolts of correct number, diameter and length, stainless steel spring washers on each side of the bolt and stainless steel nuts. The nuts shall be tightened to the torque recommended by ASTM Standards for the bolt size used. The bolts shall have the largest diameter that will fit the bolt holes and length to allow full nut thread engagement. Bolts shall be installed in each fuse mounting hole or slot. Class L fuses shall have silver links. The quality benchmark for Class L fuses shall be Edison Fusegear Cat. No. LCL time-delay type or Cat. No. LCU fast acting type as shown on the plans. Edison Class L fuses are quality engineered and constructed, using Statistical Process Control, for foolproof filler retention without “O” rings. Edison quality engineered and constructed fuses do not expel gases.

UL Class R Fuses Rated Up to 600 Amperes

UL Class RK1 dual element, time-delay fuse type and ratings shall be installed in Class R switches as shown on the plans. Class RK1 dual element fuses shall not use springs in the overload elements in ratings 70 amperes and larger; they shall have non-ferrous end caps for energy efficiency. The quality benchmark for Class RK1 dual element fuses shall be Edison Fusegear Cat. No. LENRK(AMP)(250V) or LESRK(AMP) (600V).

UL Class J Fuses Rated Up to 600 Amperes and 300V Class T Fuses Rated 35 to 800 Amperes

Protection of circuit breakers requires the use of Class J or Class T fuses as shown on the plans. These fuse Classes are not interchangeable with fuses having less current limiting ability. The quality benchmark for these fuses shall be Edison Fusegear Cat. No. JFL (Class J fast acting type) or Cat. No. TJN (300V Class T fast acting type).

Fuse Classes, Types and Ratings

All fuses have been specified as to UL Class, type, volts and ampere rating on the plans when the project was engineered. No fuse types or ratings will be changed in the field without approval from the project design engineer. Generally, the fuse types commonly specified are Class L time-delay type, Class RK1 dual element type and Class J fast acting type. Class L fast acting, Class RK1 fast acting and 300V Class T fast acting fuses may be specified for special conditions.

Interchangeability of Specified Fuses

The fuse brand specified is the quality benchmark and is preferred. All installed and spare fuses shall be both electrically and physically interchangeable with the same specific Classes, types and ratings of any other brand of fuses that are UL “listed” per the appropriate UL Standard for Safety without creating a safety hazard for the public and/or building occupants. Otherwise, a fuse-protected power distribution system design can not meet the requirements of good engineering practice, as applied during the design of this project, and can not meet the requirements of the National Electrical Code during the life of the installation. The contractor shall place an instruction label inside the door of each switch (do not cover other instructions) identifying the UL Class, Type, Volts and Ampere rating of originally installed fuses. Labels are available from Edison Fusegear.

Spare Fuses

A metal spare fuse cabinet(s) shall be provided as required, surface mounted, with lockable handle. 10% of each type and rating of installed fuses shall be duplicated as spare fuses, or a minimum of 3 fuses of each type and rating, and placed in a Edison Cat. No. ESFC spare fuse cabinet(s) and locked.

Engineering Plans and Specifications

A copy of the pertinent sheets of the plans and the pages of specifications pertaining specifically to installed fuses information shall be placed inside one of the Edison spare fuse cabinets for maintenance reference purposes.

CROSS REFERENCE GUIDE

By manufacturers type reference or series number.
Ampere ratings must be added for ordering purposes

CROSS REFERENCE GUIDE

		VOLT	EDISON	BRUSH/ DORMAN	BUSSMANN	GEC/ CEFCO	GOULD	LITTELFSE.	FUSETEK	SIEMENS	NORAM	AEROFLEX
UL CLASS CURRENT LIMITING FUSES (CSA CLASS)												
RK1	Fast Acting	250	NCLR	NCLR	KTN-R	C-HG	A2KR, HNR	KLNR	RHN	—	—	HB
(HRCI-R)		600	SCLR	SCLR	KTS-R	C-HR	A6KR, HSR	KLSR	RHS	—	—	HA
RK1	Time Delay	250	LENRK	LENRK	LPN-RK-SP	LON-RK	A2D-R	LLNRK	—	—	2R-D	—
(HRCI-R)		600	LESRK	LESRK	LPS-RK-SP	LOS-RK	A6D-R	LLSRK	—	—	6R-D	—
RK5	Time Delay	250	ECNR	ECNR	FRN-R	CRNR	TRNR, TR	FLN-R	RDN	—	—	—
(HRCI-R)		600	ECSR	ECSR	FRS-R	NRSR	TRSR,TRS	FLS-R IDSR	RDS	—	—	—
L	Fast Acting	600	LCU	LCU	KTU	CL, CLU	A4BQ	—	LFA	—	6L-F	L8, L12
(HRCI-L)	Time Delay	600	LCL	LCL	KLU	CLL	A4BY,A4BT	KLPC, KLLU	—	—	6L-D	L16, L20
J	Fast Acting	600	JFL	JCL, CJ	JKS	C-J	A4J, CJ	JLS	JFC	3NW2-71-	6J-F	JA
(HRCI-J)	Time Delay	600	JDL	—	LPJ	—	AJT	JTD	—	—	J-D	—
T	Fast Acting	300	TJN	TJN	JJN	—	A3T	JLLN	—	—	—	—
(HRCI-T)		600	TJS	TJS	JJS	—	A6T	JLLS	—	—	—	—
G	Time Delay	480	SEC	—	SC	—	AG5	SLC	—	—	—	—
CC	Time Delay	600	EDCC	—	LP-CC	—	ATDR	CCMR	—	—	6M-S	—
(HRCI-CC)	Time Delay	600	HCTR	—	FNQ-R	—	ATQR	KLDR	—	—	6CC-S	—
	Fast Acting	600	HCLR	HCLR	KTK-R	CTK-R	ATMR	KLKR	FLKR	—	6CC-F	—
UL CLASS GENERAL PURPOSE FUSES												
H	Fast Acting	250	KON	KON	NON	50KOTN	OTN	NLN	OFN	—	—	—
and K5		600	KOS	KOS	NOS	50KOTS	OTS	NLS	OFS	—	—	—
H	Time Lag	250	ERN	ERN	REN	—	RFN	RLN	—	—	—	—
Renewable		600	ERS	ERS	RES	—	RFS	RLS	—	—	—	—
H	Fuse Links	250	ELNE	ELN	LKN	—	RLN	LKN	—	—	—	—
Renewable		600	ELS	ELS	LKS	—	RLS	LKS	—	—	—	—
Midget	Fast Acting	600	MCL	MCL	KTK	CTK	ATM	KLK	FLK	—	6M-S	—
		600	EBS	EBS	BBS	—	SBS	BLS	—	—	6N-F	—
		250	MOL	MOL	BAF/BAN	—	OTM	BLF	FLF	—	—	—
Midget	Time Delay	500	MEQ	MEQ	FNQ	—	ATQ	FLQ	—	—	—	—
		250	MEN	MEN	FNM	—	TRM	FLM	FRM	—	—	—
		125/250	MID	MID	FNA	—	GFN	FLA	—	—	—	—
CANADIAN FUSES												
Code/	One Time	250	KON/PONC	KON/PON	KON/PON	50KOTN	NRN OTN	NLN	OFN	—	—	—
Standard		600	KOS	KOS	NOS	50KOTS	NRS OTS	NLS	OFS	—	—	—
10K AIR	Time Delay	250	CDNC	CDN	CDN	—	CRN	FLN	ODN	—	—	—
		600	CDSC	CDS	CDS	—	CRS	FLS	ODS	—	—	—
TYPE K	Offset	600	CIH07	CIH07	CIH07	C-K	ESK	—	—	—	—	—
Class C	Blade		CIK07	CIK07	CIK07	C-K	ESK	—	—	—	—	—
			CIL14	CIL14	CIL14	C-K	ESK	—	—	—	—	—
HRCI-CA	Fast Acting	600	CIF21	CIF21	CIF21	C-N	MS	—	—	3NWOMFS2	6CA-F	—
HRCI-CB	Fast Acting	600	CIF06	CIF06/NK	CIF06	CNS	GNS	—	NIC	3NWOMFS1	6CB-F	—
			EK	EK	EK	CES	—	—	—	—	—	—
HRC-II FUSES												
HRC-II-C	Offset	600	H07C	H07C, AAO	CGL, H07C	CIA	FES,GIA	—	2CO	3NW2-11	6C-F	932
	Blade		K07C	K07C, BAO	CGL, K07C	CIS	FES, GIS	—	2CO	3NW2-12	6C-F	933
			L14C	L14C, CEO	CGL, L14C	CCP	FES, GCP	—	2CO	3NW2-13	6C-F	944
	Center	600	M09C	M09C, DD	CGL, M09C	CF	FESC, GF	—	2CC	3NW2-23	6C-F	965
	Blade		P11C	P11C, EF	CGL, P11C	CM	FESC, GM	—	2CC	3NW2-31	6C-F	976
			R11C	R11C, FF	CGL, R11C	CLM	FESC, GLM	—	2CC	3NW2-34	6C-R	977
	Offset	600	K07CR	K07CR, OSD	K07CR	—	—	—	—	—	—	—
HRC-II	Center		L09C	L09C, CD	L09C	CC	FESC, GC	—	2CM	3NW2-22	—	964
MISC	Offset		M14C	M14C, DEO	M14C	CFP	FES, GFP	—	2CM	3NW2-14	—	945
	Center		P09C	P09C, ED	P09C	CMF	FESF, GMF	—	2CM	3NW2-25	—	966
Miniature	Offset	600	CIF21	F21, NITD	NITD	NIT	GIT	—	N2B	—	—	—
Blade			CIF06	F06,NSD,NSC	NK	NS	NSG	—	N2C	—	—	—

SMALL DIMENSION FUSES

Size	Description	EDISON		BRUSH	BUSS	GEC/ CEFCO	GOULD	LITTELFSE.	FUSETEK	NORAM	
		new	old								
5 x 20mm	Time Delay, Glass	GDC	BDC	BDC	GDC	CMB	GDG	218	SD6	SE-S	
	Fast Acting, Glass	GMA	BMA	BMA	GMA	CMA	GGM	235	MQ4	SE-F	
	Fast Acting, Glass	GDB	BDB	BDB	GDB	—	GSB	217	—	—	
	Fast Acting, Glass	GDA	—	—	GDA	—	—	216	—	—	
	Time Delay, Glass	GMC	—	—	GMC	—	GSC	—	—	—	
	Time Delay, Glass	GMD	—	—	GMD	—	GSC	239	—	—	
1/4 x 1"	Fast Acting, Glass	AGX	BGX	BGX	AGX	8AG	GGX	361/2	SL4	—	
1/4 x 1-1/4"	Fast Acting, Glass	AGC	BGC	BGC	AGC	3AG	GGC	312	SS2/SS6	SU-F	
	Fast Acting, Cer.	ABC	BBC	BBC	ABC	3AB	GAB	314	CES14	—	
	V Fast Acting, Cer.	GBB	—	—	GBB	—	—	322	—	—	
	Time Delay, Glass	MDL	BDL	BDL	MDL	3AG-SB	GDL	313	SD4	SU-S	
	Time Delay, Cer.	MDA	BDA	—	MDA	—	GSA	326	—	—	

CROSS REFERENCE GUIDE

By manufacturers type reference or series number.
Ampere ratings must be added for ordering purposes

CROSS REFERENCE GUIDE

KV	DIMENSIONS		EDISON	GEC	GOULD	BUSSMANN	B & S	CGE	GE	WESTINGHOUSE	WESTINGHOUSE
POTENTIAL TRANSFORMER FUSES (FERRULE MOUNTING)											
3.6	5.6"	1"	3.6ABWNA	—	—	3.6ABWNA	OMBNN	—	—	—	—
5.5	5.6"	1"	5.5ABWNA	—	A500T	5.5ABWNA	OMBNN	—	—	—	—
5.5	5.6"	13/16"	5.5AMWNA	—	A480T	JCE	——	—	—		
7.2	5.6"	1"	7.2ABWNA	VTF6.6	—	7.2ABWNA	OMBNN	—	—	—	—
7.2	7.69"	1"	7.2ABCNA	VTF11	—	7.2ABCNA	OMDNN	—	—	—	—
12.0	7.69"	1"	12ABCNA	VTF11	—	12ABCNA	OMDNN	—	—	—	—
15.5	10.00"	1"	15.5ABFNA	VTF15	—	15.5ABFNA	OMFNN	—	—	—	—
17.5	14.13"	1"	17.5ABGNA	—	—	17.5ABGNA	OMGNN	—	—	—	—
24.0	14.13"	1"	24ABGNA	—	—	24ABGNA	OMGNN	—	—	—	—
5.5	7.375"	1.63"	5.5CAVH0.5E	—	—	JCW0.5E	FC464-0.5E	328L497-G7	—	—	—
			5.5CAVH1E	—	—	JCW1E	FC464-1E	328L497-G8	—	—	—
			5.5CAVH2E	—	—	JCW2E	FC464-2E	328L497-G9	—	—	—
15.5	12.87"	1.63"	15.5CAVH0.5E	—	—	JCT0.5E	FC467-0.5E	328L497-G19	9F60BHH905	758C433A21	677C452G03
			15.5CAVH1E	—	—	JCT1E	FC467-1E	328L497-G20	9F60BHH001	758C433A26	677C452G08
			15.5CAVH2E	—	—	JCT2E	FC467-2E	328L497-G21	—	—	—
			15.5CAVH3E	—	—	JCT3E	FC467-3E	328L497-G22	—	—	
38.0	17.32"	1.63"	38CAVH0.5E	—	—	38CAVH0.5E	SCA22-.0.5E	—	—	758C433A22	677452G04
			38CAVH1E	—	—	38CAVH1E	SCA22-.1E	—	—	758C433A24	677452G09

		EDISON	EDISON/BRUSH	GOULD				CGE	CGE
KV	BODIES	new	old	new	GOULD	BUSSMANN	WESTINGHOUSE	new	old
MEDIUM VOLTAGE DISTRIBUTION FUSES (N.A. DIMENSIONS)									
5.5	1	MV055F1DAX30E	5.5FFNHA 30E	A055F1DORO-30E	A550X30E-1	JCY-30E	151D978 G01	9F60FJD 030	6193406 G11
	1	MV055F1DAX40E	5.5FFNHA 40E	A055F1DORO-40E	A550X40E-1	JCY-40E	—	—	6193406 G12
	1	MV055F1DAX50E	5.5FFNHA 50E	A055F1DORO-50E	A550X50E-1	JCY-50E	151D978 G02	9F60FJD 050	6193406 G13
	1	MV055F1DAX65E	5.5FFNHA 65E	A055F1DORO-65E	A550X65E-1	JCY-65E	151D978 G03	9F60FJD 065	6193406 G14
	1	MV055F1DAX80E	5.5FFNHA 80E	A055F1DORO-80E	A550X80E-1	JCY-80E	151D978 G04	9F60FJD 080	6193406 G15
	1	MV055F1DAX100E	5.5FFNHA 100	A055F1DORO-100E	A550X100E-1	JCY-100E	151D978 G05	9F60FJD 100	6193406 G16
	1	MV055F1DAX150E	5.5FFNHA 150	A055F1DORO-150E	A550X150E-1	JCY-150E	151D978 G07	9F60HJD 150	6193406 G18
	1	MV055F1DAX200E	5.5FFNHA 200	A055F1DORO-200E	—	JCY-200E	151D978 G08	9F60HJD 200	6193406 G19
	2	MV055F2DAX250E	5.5FFNHK 250	A055F2DORO-250E	A550X250E-1	JCY-250E	151D978 G11	9F60GJC 250	178L611 G12
	2	MV055F2DAX300E	5.5FFNHK 300	A055F2DORO-300E	A550X300E-1	JCY-300E	151D978 G12	9F60GJC 300	178L611 G14
	2	MV055F2DAX400E	5.5FFNHK 400	A055F2DORO-400E	A550X400E-1	JCY-400E	151D978 G13	9F60GJC 400	178L611 G18
8.25	1	8.25FFNHA 20E	8.25FFNHA 20E	—	A825X20E-1	JDZ-20E	—	9060FJE 020	6193481 G9
	1	8.25FFNHA 25E	8.25FFNHA 25E	—	A825X25E-1	JDZ-25E	—	9060FJE 025	6193481 G10
	1	8.25FFNHA 30E	8.25FFNHA 30E	—	A825X30E-1	JDZ-30E	677C573 G01	9060FJE 030	6193481 G11
	1	8.25FFNHA 40E	8.25FFNHA 40E	—	A825X40E-1	JDZ-40E	677C573 G02	9060FJE 040	6193481 G12
	1	8.25FFNHA 50E	8.25FFNHA 50E	—	A825X50E-1	JDZ-50E	677C573 G03	9060FJE 050	6193481 G13
	1	8.25FFNHA 65E	8.25FFNHA 65E	—	A825X65E-1	JDZ-65E	677C573 G04	9060FJE 065	6193481 G14
	1	8.25FFNHA 80E	8.25FFNHA 80E	—	A825X80E-1	—	677C573 G05	9060FJE 080	6193481 G15
	1	8.25FFNHA 100E	8.25FFNHA 100E	—	A825X100E-1	—	677C573 G06	9060FJE 100	6193481 G16
	2	8.25FFNHK 100E	8.25FFNHK 100E	—	—	JDZ-100E	—	—	—
	2	8.25FFNHK 150E	8.25FFNHK 150E	—	A825X150E-1	—	—	9060HJE 150	6193481 G18
	2	8.25FFNHK 200E	8.25FFNHK 200E	—	A825X200E-1	—	—	9060HJE 200	6193481 G19
15.5	1	MV155F1DBX15E	15.5FFVHA 15E	A155F1DORO-15E	A1550X15E-1	JDN-15E	—	9060FMH 015	6193496 G8
	1	MV155F1DBX20E	15.5FFVHA 20E	A155F1DORO-20E	A1550X20E-1	JDN-20E	—	9060FMH 020	6193496 G9
	1	MV155F1DBX25E	15.5FFVHA 25E	A155F1DORO-25E	A1550X25E-1	JDN-25E	—	9060FMH 025	6193496 G10
	1	MV155F1DBX30E	15.5FFVHA 30E	A155F1DORO-30E	A1550X30E-1	JDN-30E	—	9060FMH 030	6193496 G11
	1	MV155F1DBX40E	15.5FFVHA 40E	A155F1DORO-40E	A1550X40E-1	JDN-40E	—	9060FMH 040	6193496 G12
	1	MV155F1DBX50E	15.5FFVHA 50E	A155F1DORO-50E	A1550X50E-1	JDN-50E	—	9060FMH 050	6193496 G13
	1	MV155F1DBX65E	15.5FFVHA 65E	A155F1DORO-65E	—	JDN-65E	—	—	—
	2	MV155F2DBX100E	15.5FFVHK 100E	A155F1DORO-100E	A1550X100E-1	15.5FFVHK100E	—	9060FMH 100	6193496 G16
	2	MV155F2DBX150E	15.5FFVHK 150E	A155F1DORO-150E	—	15.5FFVHK150E	—	—	—

AMPS	MOUNTING	EDISON	OLD BRUSH		GEC	FUSETEK
FUSEHOLDERS (600V)						
30	Front	CM20CF	CIF15F	CIF15A	CRS15H	MF20F
	Front/2 Pole	2xCM20CF + GLP	—	—	C2RS15H	—
	Back	CM20CF + 2 of 30BS	CF15BS	CIF15B	—	—
	Front/Back	CM20CF +1 of 30BS	CIF15FBS	CIF15C	—	—
30	Front	CM630CF	C30AF	CCH30A	C30H or CFR30H	MF30F
	Back	CM30CF + 2 of 20BS	C30ABS	CCH30B	C30P	MF30B
	Front/Back	CM30CF + 1 of 20BS	C30AFBS	CCH30C	C30PH	MF30FB
60	Front	CM60CF	C60BF	CCK60A	C60H or CRS60H	MF60F
	Back	CM60CF + 2 of 60/100BS	C60BBS	CCK60B	C60P	MF60B
	Front/Back	CM60CF + 1 of 60/100BS	C60BFBS	CCK60C	C60PH	MF60FB
100*	Front	CM100CF	C100CF	CCL100A	C100H or CRS100H	MF100F
	Back	CM100CF + 2 of 60/100BS	C100BS	CCL100B	C100P	MF100B
	Front/Back	CM100CF + 1 of 60/100BS	C100FBS	CCL100C	C100PH	MF100FB
30	Front	C30F	C30F	—	CSC30H	MD30F
	Back	C30BS	C30BS	—	CSC30P	MD30B
	Front/Back	C30FBS	C30FBS	—	—	MD30FB
60	Front	C60F	C60F	—	CSC60H	—
	Back	C60BS	C60BS	—	—	—
	Front/Back	C60FBS	C60FBS	—	—	—

*Edison uses compact fuse.

NOTE: This Cross Reference is a general guide based on dimensions and fuse type. Fuse characteristics can vary between manufacturers and should be evaluated for critical applications.

CROSS REFERENCE GUIDE

By manufacturers type reference or series number.
Ampere ratings must be added for ordering purposes

CROSS REFERENCE GUIDE

FUSE	VOLT	EDISON	BRUSH	OLD RELIANCE/ BRUSH	GEC/CEFCO	GOULD	BUSSMANN	IR	FERRAZ	FUSETEK	LITTELFUSE
SEMICONDUCTOR FUSES											
U.S.A. Dimensions	130/150	E13S, E15SF, E15S	XL-SF13X	RFA	CSF-15X	A13X	KAA, FWA	SF13X	A013FA	RF13X	L15S, KLW, KLA
	250	E25S, E25SF	XL25X	RFN	CSF25X	A25X	KAB, FWX	SF25X	A025FA	RF25X	L25S, KLB
	500	E50S, E50SF	XL50F	RFV	CSF50P	A50P	KBH, FWH	SF50P	A050FA	RF50X	L50S, KLH
	600	E60S, E60SF	XL60X	RFS	CSF60X	A60X	KBC	SF60X	A060FA	RF60X	L60S
	600	E60C	XL60C	RFC	—	A60X-4K	KAC	SF60C	—	—	—
	700	E70S, E70SF	XL70F	RFL	CSF70P	A70P	KBP, FWP	SF70P	A070FA	RF70P	L70S
	1000	E100S, E100SF	XL100P	RFK	CSF100P	A100P	—	SF100P	A070FB	RF100P	—
European Dimensions	240	LCT	LCT	—	GSA	—	LCT	A350	—	URE	—
		LET	LET	—	GSA & GSD	—	LET	L350	—	URGS	—
		LMT	LMT	—	GSA & GSD	—	LMT	T350	—	URGGT	—
		LMMT	LMMT	—	GSA & GSD	—	LMMT	TT350	—	URGHT	—
	660	FC	CT, FC	—	GSB	—	FC	B1000	—	6.6URE	—
		FE	ET, FE	—	GSB	—	FE	E100	—	6.6URS	—
		FEE, EET	EET, FEE	—	GSGB	—	FEE	EE1000	—	6.6URT	—
		FM	MT, FM	—	GSB, GSGB	—	FM	M1000	—	6.6URGLT	—
		FMM	MMT, FMM	—	GSB, GSGB	—	FMM	MM1000	—	6.6URGMT	—
Trip Indicators	500	TI500	TI500	—	GS700	—	TI500	I700	—	—	—
	700	TI700	TI700	—	CSL1000	—	TI700	I1000	—	—	—

KV	BODIES	EDISON	BRUSH	GOULD	BUSS	GE	CGE	WESTING-HOUSE	WESTING-HOUSE	GEC/CEFCO	NELSON	CHAMBERS	FUSETEK
MEDIUM VOLTAGE “R” RATED MOTOR CIRCUIT FUSES													
4.8/ 5.5	1	5.5VFNHA2R	5.5VFNHA2R	A480-2R	JCL-2R	9F60LJD802	328L493G14	151D241G02	208D512G02	5.5KDAX2R	70-2M-1C-5.5	48-FM-2X-4	MRP1.2R
	1	5.5VFNHA3R	5.5VFNHA3R	A480-3R	JCL-3R	9F60LJD803	328L493G16	151D241G03	208D512G03	5.5KDAX3R	100-3M-1C-5.5	48-FM-3X-4	MRP1.3R
	1	5.5VFNHA4R	5.5VFNHA4R	A480-4R	JCL-4R	9F60LJD804	328L493G17	151D241G04	208D512G04	5.5KDAX4R	130-4M-1C-5.5	48-FM-4X-4	MRP1.4R
	1	5.5VFNHA6R	5.5VFNHA6R	A480-6R	JCL-6R	9F60LJD806	328L493G19	151D241G06	208D512G06	5.5KDAX6R	170-6M-1C-5.5	48-FM-6X-4	MRP1.6R
	1	5.5VFNHA9R	5.5VFNHA9R	A480-9R	JCL-9R	9F60LJD809	328L493G21	151D961G01	208D522G01	5.5KDAX9R	200-9M-1C-5.5	48-FM-9X-4	MRP1.9R
	1	5.5VFNHA12R	5.5VFNHA12R	A480-12R	JCL-12R	9F60LJD812	328L493G23	151D961G02	208D522G02	5.5KDAX12R	230-12M-1C-5.5	48-FM-12X-4	MRP1.12R
	2	5.5VFNHK18R	5.5VFNHK18R	A480-18R	JCL-18R	9F60MJD818	328L493G25	151D961G03	208D522G02	5.5KDBX18R	390-18M-2C-5.5	48-FM-18X-5	MRP1.18R
	2	5.5VFNHK24R	5.5VFNHK24R	A480-24R	JCL-24R	9F60MJD824	328L493G27	151D961G04	208D522G03	5.5KDBX24R	450-24M-2C-5.5	48-FM-24X-5	MRP1.24R
2.4/ 2.75	1	2.75VFRHA2R	2.75VFRHA2R	A240-2R	JCK-2R	9F60LCB802	328L492G14	591C812G02	208D480G02	—	70-2M-1C-2.75	24-FM-2X-4	FC6005.2R
	1	2.75VFRHA3R	2.75VFRHA3R	A240-3R	JCK-3R	9F60LCB803	328L492G16	591C812G03	208D480G03	—	100-3M-1C-2.75	24-FM-3X-4	FC6005.3R
	1	2.75VFRHA4R	2.75VFRHA4R	A240-4R	JCK-4R	9F60LCB804	328L492G17	591C812G04	208D480G04	—	130-4M-1C-2.75	24-FM-4X-4	FC6005.4R
	1	2.75VFRHA6R	2.75VFRHA6R	A240-6R	JCK-6R	9F60LCB806	328L492G19	591C812G06	208D480G06	—	170-6M-1C-2.75	24-FM-6X-4	FC6005.6R
	1	2.75VFRHA9R	2.75VFRHA9R	A240-9R	JCK-9R	9F60LCB809	328L492G21	591C812G07	208D480G07	—	200-9M-1C-2.75	24-FM-9X-4	FC6005.9R
	1	2.75VFRHA12R	2.75VFRHA12R	A240-12R	JCK-12R	9F60LCB812	328L492G23	591C812G08	208D480G08	—	230-12M-1C-2.75	24-FM-12X-4	FC6005.12R
	2	2.75VFRHK18R	2.75VFRHK18R	A240-18R	JCK-18R	9F60MCB818	328L492G25	591C812G01	208D480G09	—	390-18M-2C-2.75	24-FM-18X-5	FC6005.18R
	2	2.75VFRHK24R	2.75VFRHK24R	A240-24R	JCK-24R	9F60MCB824	328L492G27	591C812G02	208D480G10	—	450-24M-2C-2.75	24-FM-24X-5	—

KV	BODY LENGTH	AMPS	EDISON	GEC	B & S	DELLE
H.V. DIN DISTRIBUTION FUSES						
3.6	292mm	6-40	3.6ADLSJ	—	SOLDD	—
		50-125	3.6WDLSJ	—	SOLDD	—
		160-200	3.6WFLSJ	—	SRLDD	—
		250-400	3.6WKLSJ	—	SRLDD	—
7.2	292mm	6-31	7.2SDLSJ	DSSAX	SOLDD	FD3
		40-63	7.2SDLSJ	DSSAX	SRLDD	FD3
		180-100	7.2SFLSJ	DSSAX	SRLDD	FD3
		125-160	7.2SFLSJ	DSSBX	SRLDD	—
	442mm	200-355	7.2WKMSJ	DSLBX	SRMDD	—
12	292mm	6-50	12SDLSJ	DESAGX	—	FD4
		50-80	12SFLSJ	DESAX	—	FD4
		100	12SDLSJ	DESBX		
		125	12SKLSJ	—	—	—
17.5	292mm	6-25	17.5SDLSJ	—	SOLDD	—
		31-50	17.5SFLSJ	—	SFLDD	—
	442mm	6-40	17.5SDMSJ	DFLAX	SOMDD	FD5
		40-63	17.5SFMSJ	DFLAX	SRMDD	FD5
		80	17.5SFMSJ	DFLBX	SRMDD	—
15.5	442mm	100-125	15.5SFMSJ	DFLBX		
25	442mm	6-31	24SDMSJ	DTLAX	—	FD6
		40-50	24SFMSJ	DTLAX	—	FD6
		63-71	24SFMSJ	DTLBX	—	FD6
36	537mm	3-25	36SDQSJ	DHMBX	—	FD7
		31-56	36SFQSJ	BHMBX	—	FD7

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