How To Use Current-Limitation Charts

Analysis of Current-Limiting Fuse Let-Through Charts

The degree of current-limitation of a given size and type of fuse depends, in general, upon the available short-circuit current that can be delivered by the electrical system. Current-limitation of fuses is best described in the form of a let-through chart that, when applied from a practical point of view, is useful to determine the let-through currents when a fuse opens.

Fuse let-through charts are plotted from actual test data. The test circuit that establishes line A-B corresponds to a short circuit power factor of 15%, that is associated with an X/R ratio of 6.6. The fuse curves represent the cutoff value of the prospective available short-circuit current under the given circuit conditions. Each type or class of fuse has its own family of let-through curves.

The let-through data has been generated by actual short- circuit tests of current-limiting fuses. It is important to understand how the curves are generated, and what circuit parameters affect the let-through curve data. Typically, there are three circuit parameters that can affect fuse let-through performance for a given available short-circuit current. These are:

1. Short-circuit power factor
2. Short-circuit closing angle
3. Applied voltage

Current-limiting fuse let-through curves are generated under worst case conditions, based on these three variable parameters. The benefit to the user is a conservative resultant let-through current (both I_p and I_{RMS}). Under actual field conditions, changing any one or a combination of these will result in lower let-through currents. This provides for an additional degree of reliability when applying fuses for equipment protection.

Current-Limiting Let-Through Charts for Cooper Bussmann fuses are near the back of this book.

Prior to using the Fuse Let-Through Charts, it must be determined what let-through data is pertinent to equipment withstand ratings.

Equipment withstand ratings can be described as: How Much Fault Current can the equipment handle, and for How Long? Based on standards presently available, the most important data that can be obtained from the Fuse Let-Through Charts and their physical effects are the following:

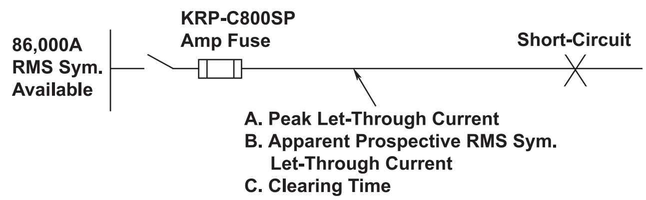
A. Peak let-through current: mechanical forces

B. Apparent prospective RMS symmetrical let-through current: heating effect

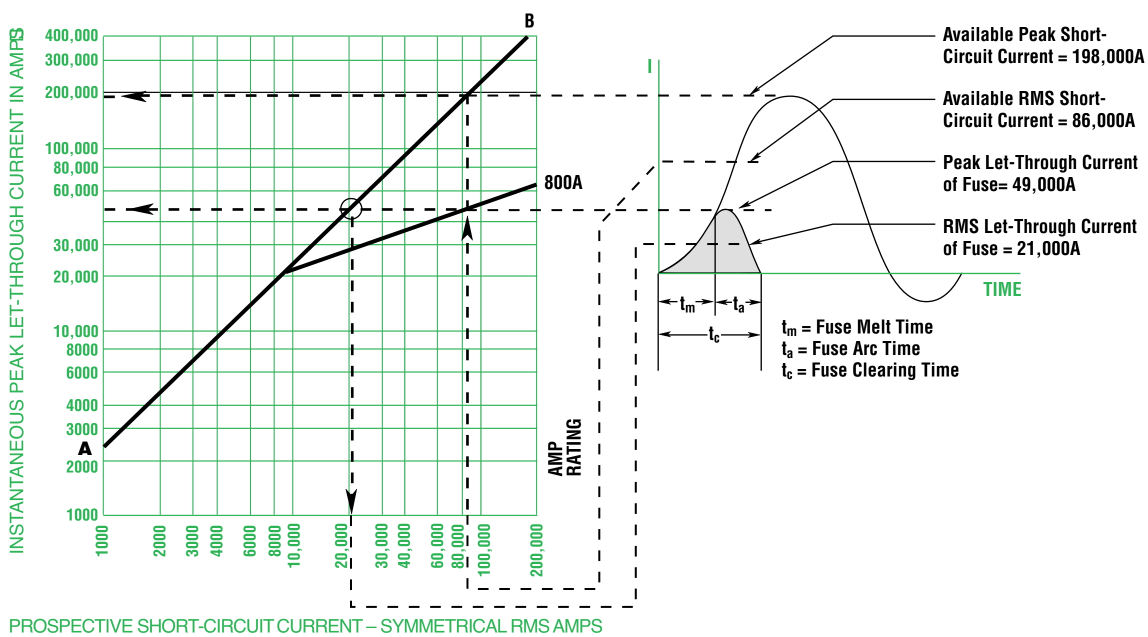
C. Clearing time: less than ½ cycle when fuse is in it's current-limiting range (beyond where fuse curve intersects A-B line).

This is a typical example showing the short-circuit current available to an 800A circuit, an 800A Low-Peak current-limiting time-delay fuse, and the let-through data of interest.

800 Amp Low-Peak® Current-Limiting Time-Delay Fuse and Associated Let-Through Data



Analysis of a Current-Limiting Fuse



How To Use Current-Limitation Charts

How to Use the Let-Through Charts

Using the example given, one can determine the pertinent let-through data for the KRP-C-800SP amp Low-Peak fuse. The Let-Through Chart pertaining to the 800A Low-Peak fuse is illustrated.

A. Determine the PEAK let-through CURRENT.

Step 1. Enter the chart on the Prospective Short-Circuit current scale at 86,000 amps and proceed vertically until the 800A fuse curve is intersected.

Step 2. Follow horizontally until the Instantaneous Peak Let-Through Current scale is intersected.

Step 3. Read the PEAK let-through CURRENT as 49,000A. (If a fuse had not been used, the peak current would have been 198,000A.)

B. Determine the APPARENT PROSPECTIVE RMS SYMMETRICAL let-through CURRENT.

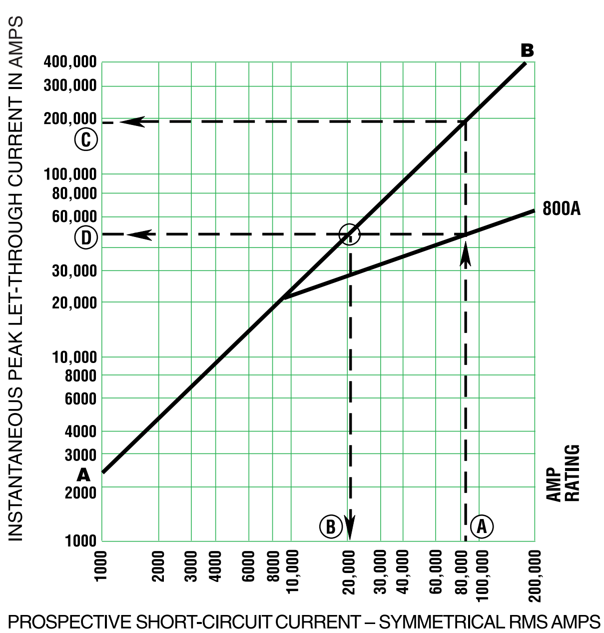
Step 1. Enter the chart on the Prospective Short-Circuit current scale at 86,000A and proceed vertically until the 800A fuse curve is intersected.

Step 2. Follow horizontally until line A-B is intersected.

Step 3. Proceed vertically down to the Prospective Short-Circuit Current.

Step 4. Read the APPARENT PROSPECTIVE RMS SYMMETRICAL let-through CURRENT as 21,000A. (The RMS SYMMETRICAL let-through CURRENT would be 86,000A if there were no fuse in the circuit.)

Current-Limitation Curves — Cooper Bussmann Low-Peak Time-Delay Fuse KRP-C-800SP



(A) I_{RMS} Available = 86,000 Amps
(B) I_{RMS} Let-Through = 21,000 Amps
(C) I_p Available = 198,000 Amps
(D) I_p Let-Through = 49,000 Amps

Most electrical equipment has a withstand rating that is defined in terms of an RMS symmetrical-short-circuit current, and in some cases, peak let-through current. These values have been established through short circuit testing of that equipment according to an accepted industry standard. Or, as is the case with conductors, the withstand rating is based on a mathematical calculation and is also expressed in an RMS short-circuit current.

If both the let-through currents (I_{RMS} and I_p) of the current-limiting fuse and the time it takes to clear the fault are less than the withstand rating of the electrical component, then that component will be protected from short circuit damage.

The following Table shows typical assumed short-circuit current ratings for various unmarked components.

Typical Short-Circuit Current Ratings For Unmarked Components*

Component	Short- Circuit Rating, kA
Industrial Control Equipment:	
a. Auxiliary Devices	5
b. Switches (other than Mercury Tube Type)	5
c. Mercury Tube Switches	
Rated over 60 amperes or over 250 volts	5
Rated 250 volts or less, 60 amperes or less, and over 2kVA	3.5
Rated 250 volts or less and 2kVA or less	1
Meter Socket Base	10
Photoelectric Switches	5
Receptacle (GFCI Type)	10
Receptacle (other than GFCI Type)	2
Snap Switch	5
Terminal Block	10
Thermostat	5

*Based upon information in UL 891 (Dead-Front Switchboards)

The following components will be analyzed by establishing the short-circuit withstand data of each component and then selecting the proper current-limiting fuses for protection:

- Wire and Cable
- Bus (Busway, Switchboards, Motor Control Centers and Panelboards)
- Transfer Switches
- HVAC Equipment
- Ballasts
- Circuit Breakers

A detailed analysis of motor circuit component protection is provided later in the section on motor circuits.

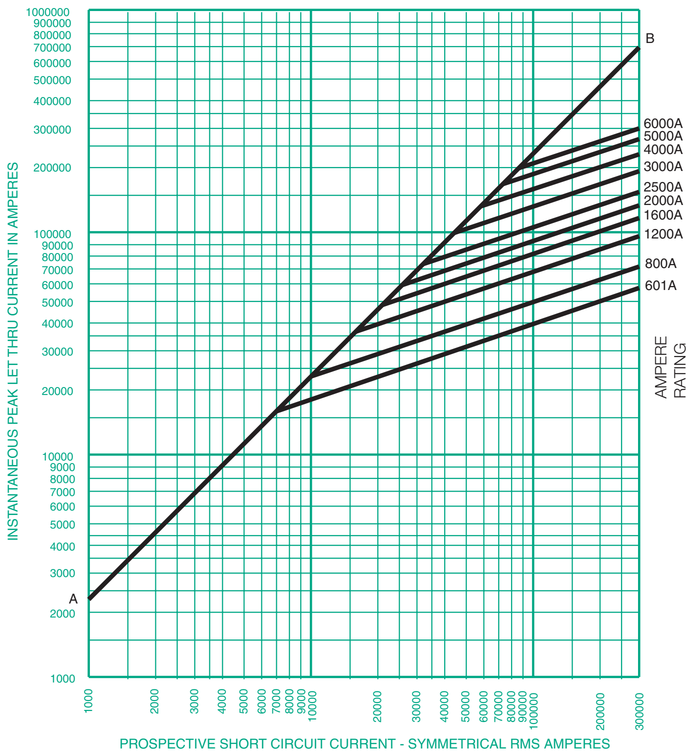
C. Clearing time

If the RMS Symmetrical available is greater than the point where the fuse characteristic curve intersects with the diagonal A-B line, then the fuse clearing time is ½ cycle or less. In this example, the intersection is approximately 9500A; so for short-circuit currents above approximately 9500A, this KRP-C-800SP fuse is current-limiting.

The current-limiting charts and tables for Cooper Bussmann fuses are in the rear of this book under “Current-Limiting Let-Through Charts.” Refer to these tables when analyzing component protection in the following sections.

See pages 67 to 69 for current-limiting definition and how to analyze these charts.

Low-Peak Class L Time-Delay Fuses KRP-C_SP

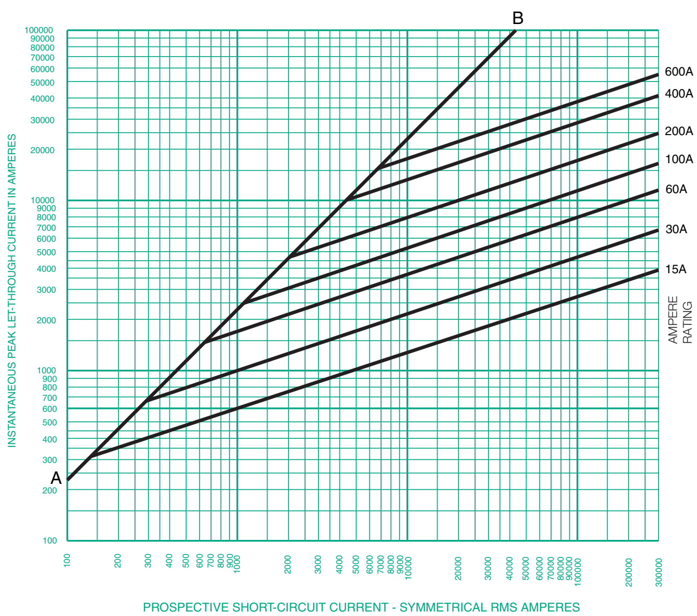


KRP-C_SP Fuse – RMS Let-Through Currents (kA)

Prosp. Short C.C.	Fuse Size									
	601	800	1200	1600	2000	2500	3000	4000	5000	6000
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
5,000	5	5	5	5	5	5	5	5	5	5
10,000	8	10	10	10	10	10	10	10	10	10
15,000	9	12	15	15	15	15	15	15	15	15
20,000	10	13	17	20	20	20	20	20	20	20
25,000	11	14	19	22	25	25	25	25	25	25
30,000	11	14	20	24	27	30	30	30	30	30
35,000	12	15	21	25	29	35	35	35	35	35
40,000	13	16	22	26	30	35	40	40	40	40
50,000	14	17	23	28	32	37	50	50	50	50
60,000	15	18	25	30	34	40	49	60	60	60
70,000	15	19	26	32	36	42	52	62	70	70
80,000	16	20	27	33	38	44	54	65	76	80
90,000	17	21	29	34	39	45	56	67	79	90
100,000	17	22	30	36	41	47	58	70	81	100
150,000	20	25	34	41	47	54	67	80	93	104
200,000	22	27	37	45	51	59	73	87	102	114
250,000	24	29	40	49	55	64	79	94	110	123
300,000	25	31	43	52	59	68	84	100	117	30

Note: For I_{RMS} value at 300,000 amperes, consult Factory.

Low-Peak Class J, Dual-Element Time-Delay Fuses LPJ_SP



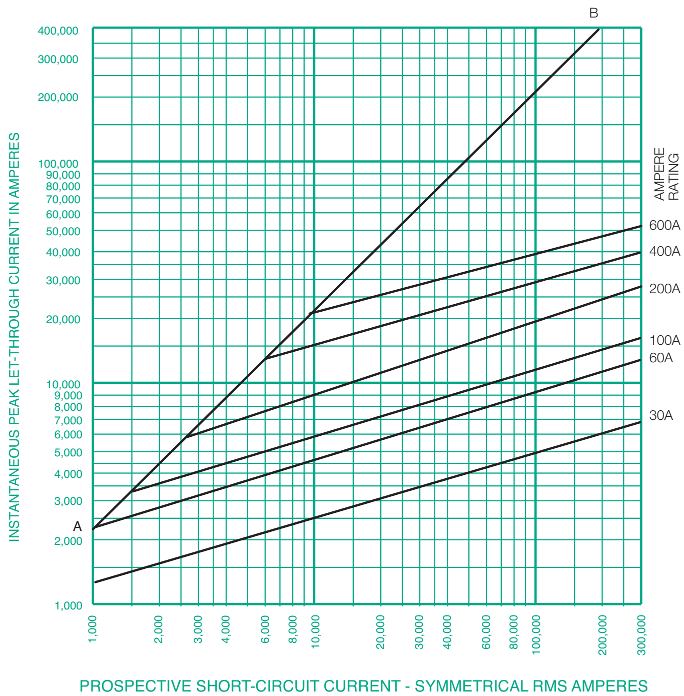
LPJ_SP Fuse – RMS Let-Through Currents (kA)

Prosp. Short C.C.	Fuse Size						
	15	30	60	100	200	400	600
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
1,000	1	1	1	1	1	1	1
3,000	1	1	1	2	2	3	3
5,000	1	1	1	2	3	5	5
10,000	1	1	2	2	4	6	8
15,000	1	1	2	3	4	7	9
20,000	1	1	2	3	4	7	10
25,000	1	1	2	3	5	8	10
30,000	1	1	2	3	5	8	11
35,000	1	1	2	4	5	9	12
40,000	1	2	3	4	6	9	12
50,000	1	2	3	4	6	10	13
60,000	1	2	3	4	6	11	14
80,000	1	2	3	5	7	12	15
100,000	1	2	4	5	8	12	17
150,000	1	2	4	6	9	14	19
200,000	2	3	4	6	9	16	21
250,000	2	3	5	7	10	17	23
300,000	2	3	5	7	11	18	24

Note: For I_{RMS} value at 300,000 amperes, consult Factory.

See pages 67 to 69 for current-limiting definition and how to analyze these charts.

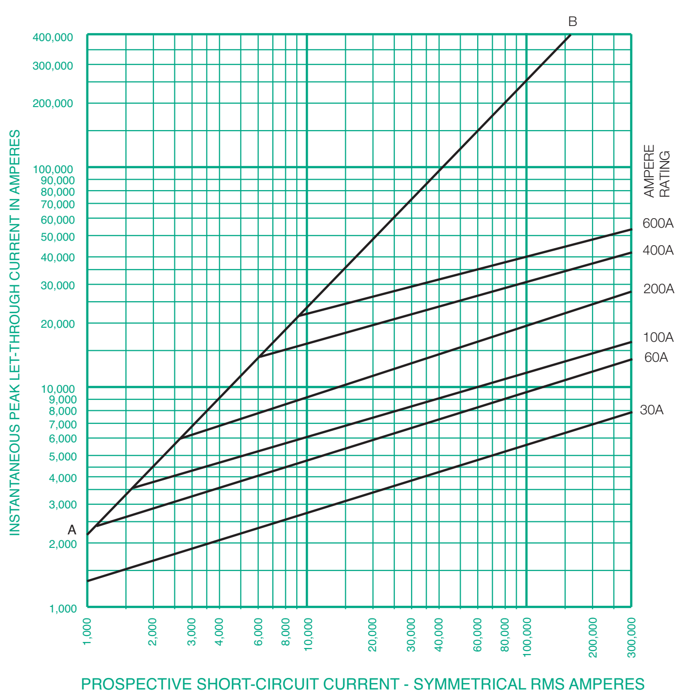
Low-Peak Class RK1 Dual-Element Time-Delay Fuses LPN-RK_SP



LPN-RK_SP – RMS Let-Through Currents (kA)

Prosp. Short C.C.	Fuse Size					
	30	60	100	200	400	600
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
1,000	1	1	1	1	1	1
2,000	1	1	2	2	2	2
3,000	1	1	2	3	3	3
5,000	1	2	2	3	5	5
10,000	1	2	3	4	7	9
15,000	1	2	3	5	8	11
20,000	1	3	3	5	8	11
25,000	1	3	3	5	9	12
30,000	2	3	4	6	9	12
35,000	2	3	4	6	10	13
40,000	2	3	4	6	10	13
50,000	2	3	4	7	11	14
60,000	2	3	4	7	11	16
70,000	2	3	4	7	12	16
80,000	2	4	5	8	12	16
90,000	2	4	5	7	13	17
100,000	2	4	5	8	13	17
150,000	2	4	6	9	15	19
200,000	3	5	6	11	16	20
250,000	3	5	7	11	17	21
300,000	3	6	7	12	18	22

Low-Peak Class RK1 Dual-Element Time-Delay Fuses LPS-RK_SP



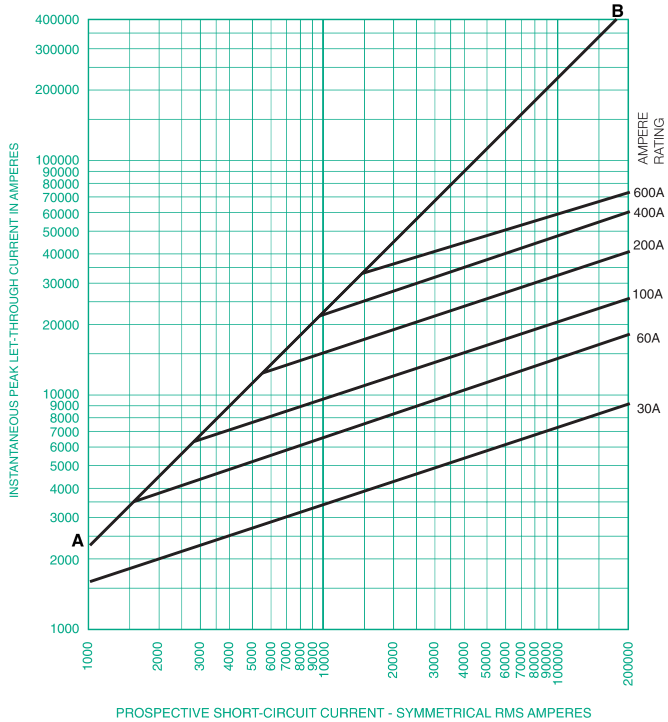
LPS-RK_SP – RMS Let-Through Currents (kA)

Prosp. Short C.C.	Fuse Size					
	30	60	100	200	400	600
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
1,000	1	1	1	1	1	1
2,000	1	1	2	2	2	2
3,000	1	1	2	3	3	3
5,000	1	2	2	3	5	5
10,000	1	2	3	4	7	10
15,000	1	2	3	5	8	11
20,000	2	3	3	5	9	12
25,000	2	3	4	6	9	12
30,000	2	3	4	6	10	13
35,000	2	3	4	6	10	13
40,000	2	3	4	6	10	14
50,000	2	3	5	7	11	15
60,000	2	4	5	7	12	15
70,000	2	4	5	8	13	16
80,000	2	4	5	8	13	16
90,000	2	4	5	8	13	17
100,000	2	4	6	9	14	17
150,000	3	5	6	10	15	19
200,000	3	5	7	11	16	21
250,000	3	6	7	12	17	22
300,000	3	6	7	12	18	23

Cooper Bussmann Current-Limiting Fuse Let-Through Data

See pages 67 to 69 for current-limiting definition and how to analyze these charts.

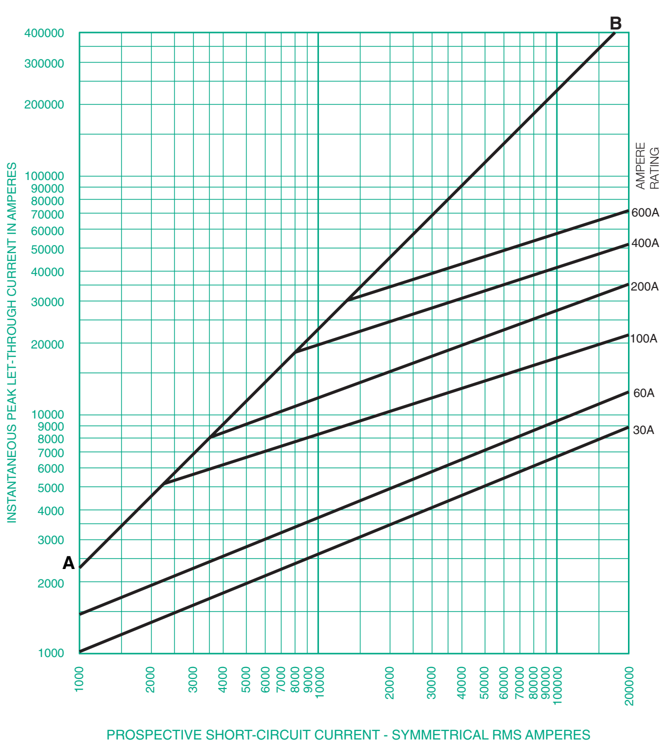
Fusetron Class RK5 Dual-Element Time-Delay Fuses FRN-R



FRN-R – RMS Let-Through Currents (kA)

Prosp. Short C.C.	Fuse Size 30	60	100	200	400	600
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
5,000	1	2	3	5	5	5
10,000	2	3	4	7	10	10
15,000	2	3	5	8	11	15
20,000	2	4	5	8	12	16
25,000	2	4	6	9	13	17
30,000	2	4	6	10	14	18
35,000	2	4	6	10	15	19
40,000	2	5	7	11	15	20
50,000	3	5	7	11	17	21
60,000	3	5	8	12	18	22
70,000	3	6	8	13	19	23
80,000	3	6	8	13	19	24
90,000	3	6	9	14	20	25
100,000	3	6	9	14	21	26
150,000	4	7	10	16	24	29
200,000	4	8	11	18	26	32

Fusetron Class RK5 Dual-Element Time-Delay Fuses FRS-R

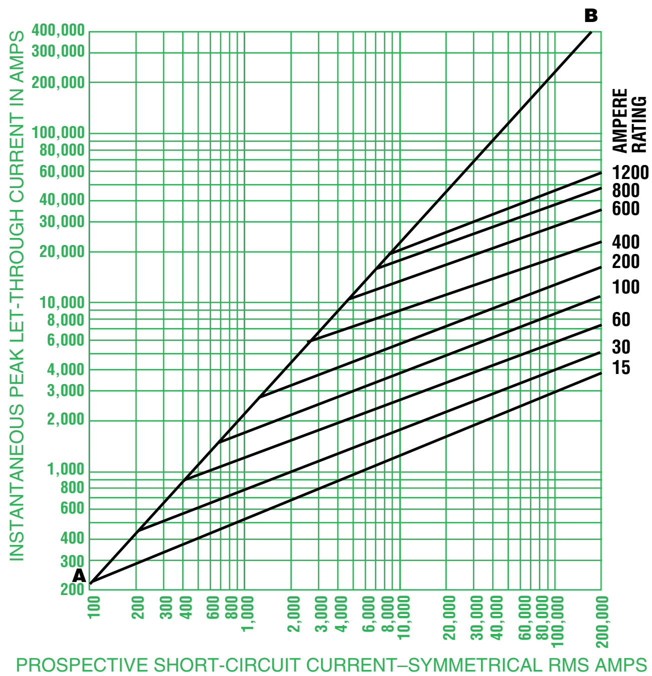


FRS-R – RMS Let-Through Currents (kA)

Prosp. Short C.C.	Fuse Size 30	60	100	200	400	600
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
5,000	1	1	3	4	5	5
10,000	1	2	4	5	9	10
15,000	1	2	4	6	10	14
20,000	2	2	5	7	11	15
25,000	2	2	5	7	12	17
30,000	2	3	5	8	13	18
35,000	2	3	5	8	13	18
40,000	2	3	6	9	14	19
50,000	2	3	6	9	14	20
60,000	2	3	6	10	15	22
70,000	3	4	7	11	17	23
80,000	3	4	7	12	17	23
90,000	3	4	7	12	17	24
100,000	3	4	8	13	18	25
150,000	3	5	9	14	21	27
200,000	4	6	9	16	23	32

See pages 67 to 69 for current-limiting definition and how to analyze these charts.

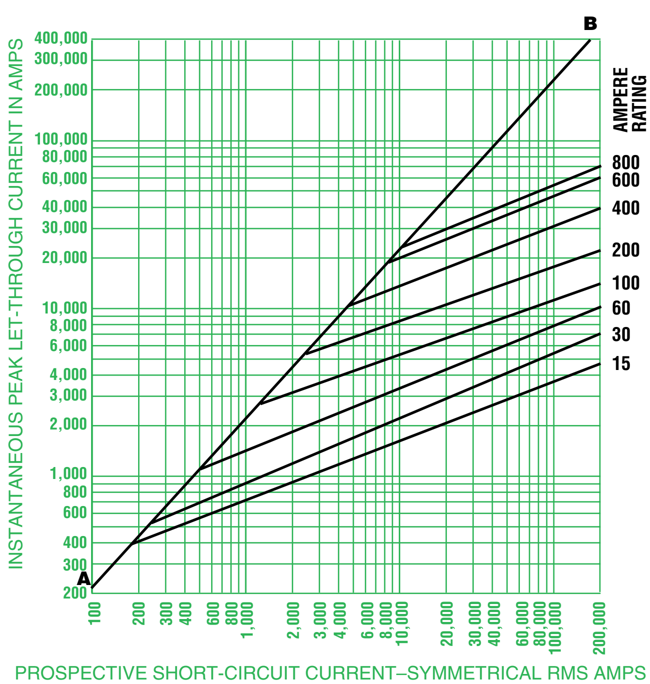
Tron Class T Fast-Acting Fuses
JJN



JJN – RMS Let-Through Current (kA)

Prosp. Short C.C.	Fuse Size								
	15	30	60	100	200	400	600	800	1200
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
500	1	1	1	1	1	1	1	1	1
1,000	1	1	1	1	1	1	1	1	1
5,000	1	1	1	1	2	3	5	5	5
10,000	1	1	1	2	2	4	6	7	9
15,000	1	1	1	2	3	4	6	9	10
20,000	1	1	1	2	3	5	7	10	11
25,000	1	1	2	2	3	5	7	10	12
30,000	1	1	2	2	3	5	8	11	13
35,000	1	1	2	3	4	6	8	11	13
40,000	1	1	2	3	4	6	9	11	13
50,000	1	1	2	3	4	7	9	12	15
60,000	1	1	2	3	4	7	10	13	16
70,000	1	1	2	3	5	7	10	14	17
80,000	1	2	2	3	5	8	11	15	17
90,000	1	2	2	3	6	8	11	15	18
100,000	1	2	2	4	6	8	12	16	19
150,000	1	2	3	4	6	9	13	17	22
200,000	2	2	3	4	7	9	15	19	23

Tron Class T Fast-Acting Fuses
JJS

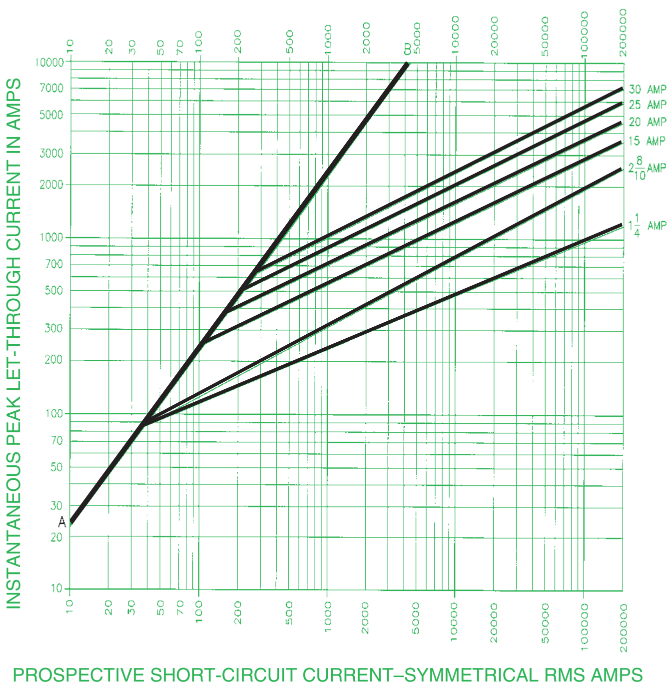


JJS – RMS Let-Through Current (kA)

Prosp. Short C.C.	Fuse Size							
	15	30	60	100	200	400	600	800
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
500	1	1	1	1	1	1	1	1
1,000	1	1	1	1	1	1	1	1
5,000	1	1	1	2	3	4	5	5
10,000	1	1	1	2	3	6	8	9
15,000	1	1	2	3	4	7	10	11
20,000	1	1	2	3	4	7	10	12
25,000	1	1	2	3	5	7	11	13
30,000	1	1	2	3	5	8	12	14
35,000	1	1	2	3	5	9	13	15
40,000	1	2	2	4	5	9	13	15
50,000	1	2	2	4	6	10	14	17
60,000	1	2	3	4	6	10	16	18
70,000	1	2	3	4	7	11	17	19
80,000	1	2	3	4	7	11	17	20
90,000	1	2	3	4	7	12	18	21
100,000	2	2	3	5	7	12	19	22
150,000	2	3	4	6	8	14	22	25
200,000	2	3	4	6	9	16	24	28

See pages 67 to 69 for current-limiting definition and how to analyze these charts.

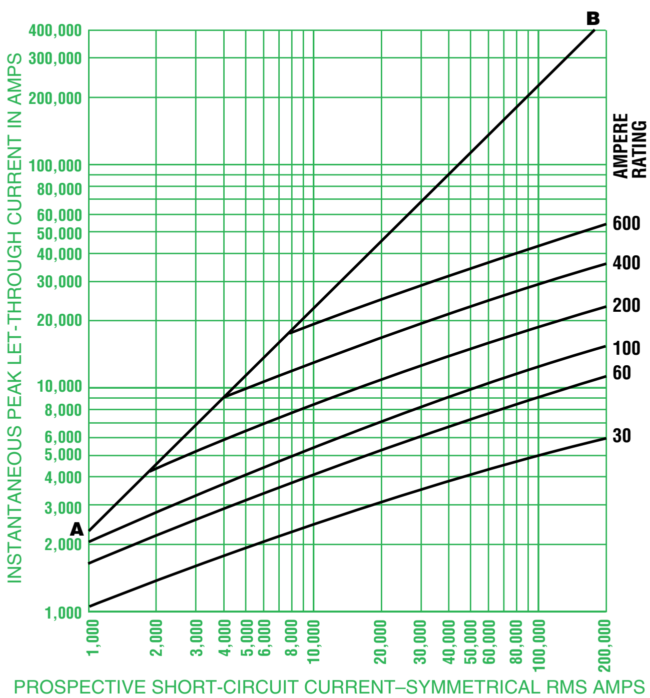
Low-Peak Class CC Time-Delay Fuses
LP-CC



LP-CC – RMS Let-Through Currents (A)

Prosp. Short C.C.	Fuse Size					
	$1\frac{1}{4}$	$2\frac{8}{10}$	15	20	25	30
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
1,000	100	135	240	305	380	435
3,000	140	210	350	440	575	580
5,000	165	255	420	570	690	710
10,000	210	340	540	700	870	1000
20,000	260	435	680	870	1090	1305
30,000	290	525	800	1030	1300	1520
40,000	315	610	870	1150	1390	1700
50,000	340	650	915	1215	1520	1820
60,000	350	735	1050	1300	1650	1980
80,000	390	785	1130	1500	1780	2180
100,000	420	830	1210	1600	2000	2400
200,000	525	1100	1600	2000	2520	3050

Limitron Class J Fast-Acting Fuses
JKS



JKS – RMS Let-Through Currents (kA)

Prosp. Short C.C.	Fuse Size					
	30	60	100	200	400	600
	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}	I_{RMS}
5,000	1	1	2	3	4	5
10,000	1	2	3	4	6	9
15,000	1	2	3	4	7	10
20,000	1	2	3	5	8	11
25,000	2	3	3	6	9	12
30,000	2	3	3	6	9	13
35,000	2	3	4	6	9	13
40,000	2	3	4	7	10	14
50,000	2	3	4	7	10	15
60,000	2	3	5	7	11	16
70,000	2	3	5	8	11	17
80,000	2	3	5	8	12	17
90,000	2	4	6	9	13	18
100,000	2	4	6	9	13	18
150,000	2	5	6	9	14	22
200,000	3	5	7	10	16	24