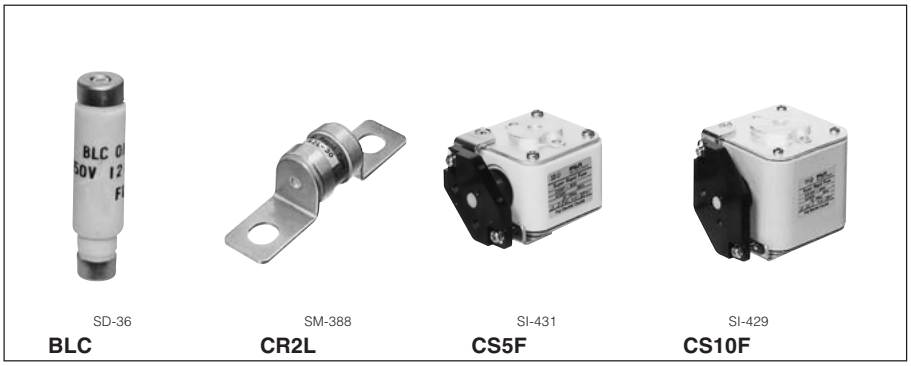
BLC, CR and CS types
Super Rapid Fuses
150–1500 Volts AC
10–4700 Amps



■ Description
The FUJI BLC, CR and CS types are extremely reliable fuses which have been specially developed to provide protection for silicon diodes and thyristors and are suitable for inverters using semiconductors or transformers-rectifiers. FUJI Super Rapid Fuses are designed with a very small total I^2t value which gives them a high speed interrupting action in the face of abnormal currents.
In addition the arc voltage generated at the time of interruption has a low value so that faults will not influence related electric machinery and equipment.
These fuses can carry out the protection of many types of circuits rating from the semiconductor overcurrents to destructive short-circuiting faults-i.e. when the semiconductors short or circuits fail the sound elements will be quickly isolated from the fault circuits.

■ Features
- The total clearing I^2t is small and the semiconductor circuit is completely protected.
- Since the peak arc voltage at the time of interruption is low damage to other equipment does not occur.
- High interrupting capacity of 200kA at 1000V AC
- The CS type is provided with a blown fuse indicator. An alarm contact block (1NO or 1NC) can also be attached.

■ **UL recognized**: CR2L/UL,CR2LS/UL, CR6L/UL
(File No. E92312)
CSA certificated: CR2LS/UL
(File No. LO4000-4090)
TÜV: CR2LS/UL (10-100A),
CR2L/UL (150-350A)
(Rep. No. E9450643E02)
CR6L/UL (50-300A)
(Rep. No. E9560543E02)

■ Specifications

Rated current (A)	Rated voltage	Peak arc voltage (V)	Max. interrupting I^2t (Amp^2×sec.) × 10^3	Watt loss (W)	Fuse-link Type
12	550V	1550	0.09	5.1	**BLC012-1**
20	AC	1550	0.27	8.5	**BLC020-1**
23		1550	0.39	10	**BLC023-1**
45		1380	1.8	19	**BLC045-1**
75		1250	5	32	**BLC075-1**
90		1250	11.5	38	**BLC090-1**
120		1200	33	51	**BLC120-1**
140		1200	100	59	**BLC140-1**
30	250V	Max.	0.35	4.0	**CR2L-30**
50	AC	500	0.85	6.0	**CR2L-50**
75			2.3	9.0	**CR2L-75**
100			4.0	12.0	**CR2L-100**
125			6.5	14.0	**CR2L-125**
140			7.0	16.0	**CR2L-140**
150			9.5	18.0	**CR2L-150**
175			13	21.0	**CR2L-175**
200			17	23.0	**CR2L-200**
225			22	26.0	**CR2L-225**
260			27	30.0	**CR2L-260**
300			38	35.0	**CR2L-300**
325			49	37.0	**CR2L-325**
350			60	37.0	**CR2L-350**
400			103	39.0	**CR2L-400**
450			140	46.0	**CR2L-450**
500			160	48.0	**CR2L-500**
550			200	51.0	**CR2L-550**
600			215	56.0	**CR2L-600**

Interrupting capacity
BLC ..... 100kA at 550V AC
CR2L .... 100kA at 250V AC

Rated current (A)	Rated voltage	Peak arc voltage (V)	Max. interrupting I^2t (Amp^2×sec.) × 10^3	Watt loss (W)	Fuse-link Type
10	250V	Max.	0.04	1.2	**CR2LS-10**
20	AC	500	0.17	3.0	**CR2LS-20**
30			0.35	4.0	**CR2LS-30**
50			0.85	6.0	**CR2LS-50**
75			2.3	9.0	**CR2LS-75**
100			4.0	12.0	**CR2LS-100**
20	600V	Max.	0.14	4.0	**CR6L-20**
30	AC	1200	0.35	7.0	**CR6L-30**
50			1.8	9.0	**CR6L-50**
75			3.0	12.5	**CR6L-75**
100			7.0	15	**CR6L-100**
150			18	22.0	**CR6L-150**
200			30	34.0	**CR6L-200**
250			70	37.0	**CR6L-250**
300			95	40.0	**CR6L-300**
350			150	45.0	**CR6L-350**
400			200	55	**CR6L-400**
500			390	60	**CR6L-500**
600			700	70	**CR6L-600**

Interrupting capacity
CR2LS . 100kA at 250V AC
CR6L .... 100kA at 600V AC

■ Specifications

Rated current (A)	Interrupting capacity (kA)	Max. interrupting I^2t (Amp^2×sec.) × 10^3	Watt loss (W)	Fuse-link Type
4700	150 at 125V AC	14000	310	**CS1F-4700**
2000	150 at	1950	124	**CS2F-2000**
3000	250V AC	5500	216	**CS2F-3000**
40	200 at	1	6.4	**CS5F-40**
75	500V AC	3.5	12	**CS5F-75**
100		5	17	**CS5F-100**
150		10	25	**CS5F-150**
200		18.5	34	**CS5F-200**
250		33	42	**CS5F-250**
300		64	45	**CS5F-300**
350		85	56	**CS5F-350**
400		122	57	**CS5F-400**
450		131	62	**CS5F-450**
500		159	73	**CS5F-500**
600		257	80	**CS5F-600**
800		600	114	**CS5F-800**
1000		1200	110	**CS5F-1000**
1000		843	167	**CS5F-1000-P**
1200		1800	114	**CS5F-1200**
1200		1311	200	**CS5F-1200-P**
1500		3600	209	**CS5F-1500**
1000	200 at	1800	125	**CS8F-1000**
1200	800V AC	2500	176	**CS8F-1200**
1500		4400	220	**CS8F-1500**
80	200 at	10	17	**CS10F-80**
100	1000V AC	16	21	**CS10F-100**
150		37	27	**CS10F-150**
200		63	37	**CS10F-200**
250		110	44	**CS10F-250**
300		148	53	**CS10F-300**
350		211	70	**CS10F-350**
400		307	74	**CS10F-400**
500		420	90	**CS10F-500**
560		410	102	**CS10F-560**
630		450	135	**CS10F-630**
750		640	156	**CS10F-750**
800		1259	211	**CS10F-800-P**
1000		1722	245	**CS10F-1000-P**
1250		2250	330	**CS10F-1250-P**
1500		3200	334	**CS10F-1500-C**
450	100 at	350	134	**CS15F-450**
630	1500V AC	760	170	**CS15F-630**
900		1400	280	**CS15F-900-P**
1250		3050	350	**CS15F-1250-P**

Note:
- Peak arc voltage
  CS1F ..... Max. 450V
  CS2F ..... Max. 750V
  CS5F ..... Max. 1000V
  CS8F ..... Max. 2000V
  CS10F ... Max. 2000V
  CS15F ... Less than 3000V
- An alarm contact block AHX2905 (1NO) or AHX2915 (1NC) can be attached to CS type. (Sold separately) *See page 08/44.*

Note: UL recognized fuse
In the UL recognized fuses, a fuse with a blown inidcation fuse, or a fuse both with a blown indication fuse and a precision switch is also UL recognized.
Examples: CR2L-200G/UL
CR2LS-30S/UL
CR6L-100G/UL

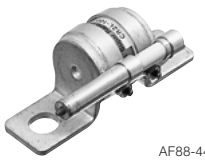
■ Specifications (UL-recognized, CSA certified, TÜV)

Rated current (A)	Rated voltage	Interrupting capacity (kA)	Max. interrupting I^2t (Amp^2×sec.) × 10^3	Watt loss (W)	Fuse-link Type
10	250V AC	10 at AC	0.04	1.2	**CR2LS-10/UL**
20	400V DC	(pf: 0.8)	0.17	3.0	**CR2LS-20/UL**
30		10 at DC	0.35	4.0	**CR2LS-30/UL**
50		(L/R: 2ms)	0.85	6.0	**CR2LS-50/UL**
75			2.3	9.0	**CR2LS-75/UL**
100			4.0	12.0	**CR2LS-100/UL**
150			9.5	18.0	**CR2L-150/UL**
200			17	23.0	**CR2L-200/UL**
260			27	30.0	**CR2L-260/UL**
350			60	37.0	**CR2L-350/UL**
400			103	39.0	**CR2L-400/UL**
450			140	46.0	**CR2L-450/UL**
500			160	48.0	**CR2L-500/UL**
550			200	51.0	**CR2L-550/UL**
600			215	56.0	**CR2L-600/UL**
20	600V AC	100 at AC	0.14	4.0	**CR6L-20/UL**
30	680V DC	(pf: 0.8) 10 at DC (L/R: 2ms)	0.35	7.0	**CR6L-30/UL**
50			1.8	9.0	**CR6L-50/UL**
75			3.0	12.5	**CR6L-75/UL**
100			7.0	15.0	**CR6L-100/UL**
150		100 at AC (pf: 0.8)	18	22.0	**CR6L-150/UL**
200		50 at DC (L/R: 2ms)	30	34.0	**CR6L-200/UL**
300			95	40.0	**CR6L-300/UL**

Note:
- Peak arc voltage
  CR2LS, CR2L .... Max. 500V
  CR6L ..... Max. 1200V
- The peak arc voltage is obtained by interruption caused by the listed interrupting current at rated voltage.
- This indcates the values when the conductors specified in UL Standards are connected and rated current apply.
- TÜV: CR2LS, 2L: Up to 350A
  CR6L: 50 to 300A

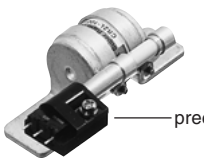
■ CR type fuse with optional accessory

Fuse with blown indication fuse
CR2L (S)- □ G



AF88-446

Fuse with blown indication fuse and precision switch
CR2L (S)- □ S



AF88-445

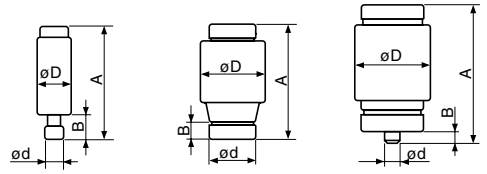
Precision switch (SPDT)
CRX-1

AF88-442

■ Dimensions, mm

● BLC

BLC012, 020, 023 **BLC045** **BLC075 to 140**



Type	Rated current (A)	A	B	øD	ød	Color of indicator	Mass (g)
BLC012-1	12	50	10	13	10	Grey	12
BLC020-1	20	50	10	13	14	Yellow	12
BLC023-1	23	50	10	13	14	Violet	12
BLC045-1	45	50	10	27	20	White	62
BLC075-1	75	63	6	34	5	Silver	120
BLC090-1	90	63	6	34	8	Red	120
BLC120-1	120	63	6	47	8	Yellow	120
BLC140-1	140	63	6	47	8	Light red	215

Note: The BLC type fuse link requires a holder in use. The size of the holder differs according to the fuse ratings. Select the most suitable one after referring to the Table on *page 08/44*.
For drawings see *page 08/32*.

■ Ordering information

Specify the following:
1. Type number

■ Type number nomenclature

BLC 012-1

Rated current: 12 to 140A
Plug-in type super rapid fuse

CS 10F-1000 □-P/ UL

UL recognized (CR2L, CR2LS, CR6L)
CSA certificated (CR2LS)
TÜV (CR2LS, CR2L, CR6L)

2-fuse connected parallel

Optional accessory *(See page 08/44)*
G: With blown indication fuse
S: With blown indication fuse and precision switch

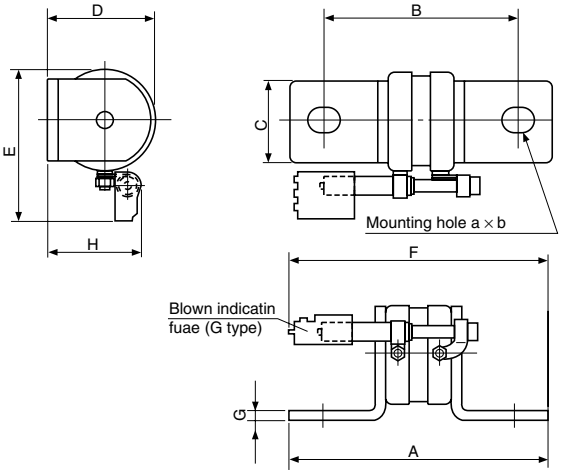
Rated current
10 to 4700A

Rated voltage

2L, 2LS:	250V AC,	6L:	600V AC
1F:	150V AC,	2F:	250V AC
5F:	500V AC,	8F:	800V AC
10F:	1000V AC,	15F:	1500V AC

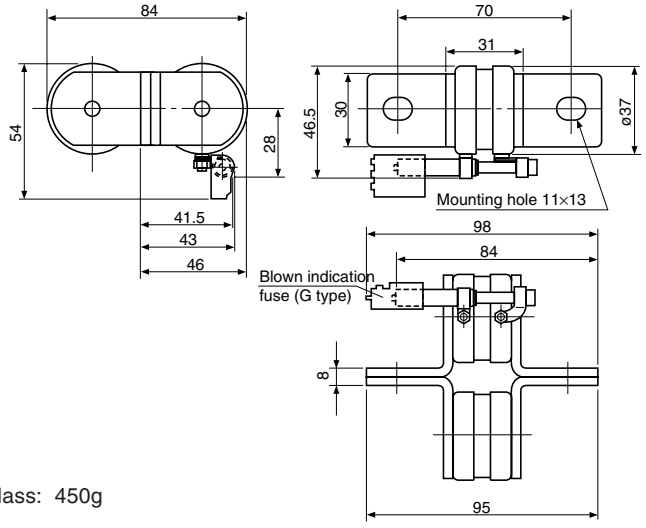
CR: Barrel-shaped super rapid fuse
CS: Cubic-shaped super rapid fuse

● CR2L-450 or smaller, CR2LS



Type	A	B	C	D	E	a×b	F	G	H	Mass
CR2L-30 CR2L-50	80	58	18	21.5	37	9×11	90	1.5	26.5	42g
CR2L-75 CR2L-100 CR2L-125 CR2L-140 CR2L-150 CR2L-175	80	58	20	30.5	44	9×11	90	3	32.5	100g
CR2L-200 CR2L-225 CR2L-260 CR2L-300 CR2L-325	85	60	25	33.5	47	11×13	93	3.2	33.5	130g
CR2L-350 CR2L-400 CR2L-450	95	70	30	42	54	11×13	98	4	39	220g
CR2LS-10 CR2LS-20 CR2LS-30 CR2LS-50 CR2LS-75 CR2LS-100	56	42	12	18.5	34.5	6.5×8.5	78	2	25	28g

● CR2L-500 to -600



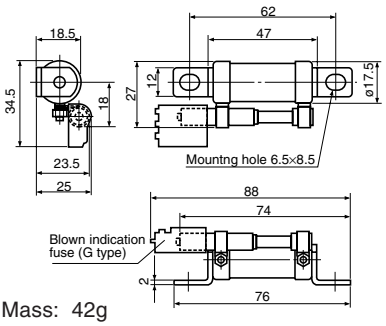
Mass: 450g

Dimensions for reference only. Confirm before construction begins.

Note: The dimensions of the fuses with suffix. UL are the same as those of the standard ones.

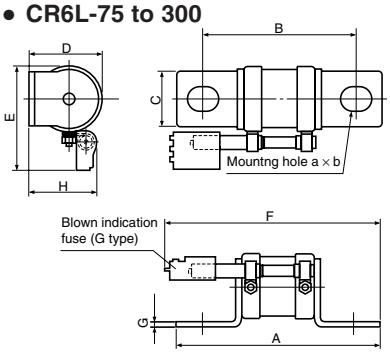
■ Dimensions, mm

● CR6L-20, CR6L-30, CR6L-50

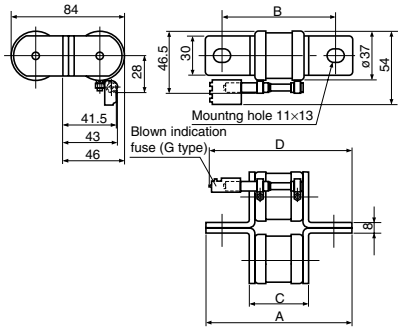


Mass: 42g

● CR6L-75 to 300



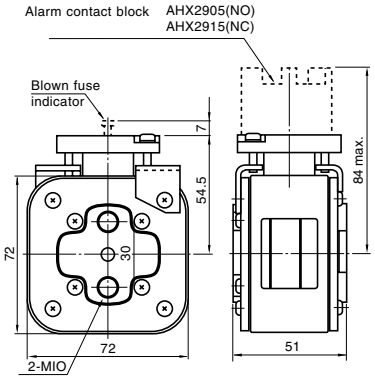
● CR6L-350 to 600



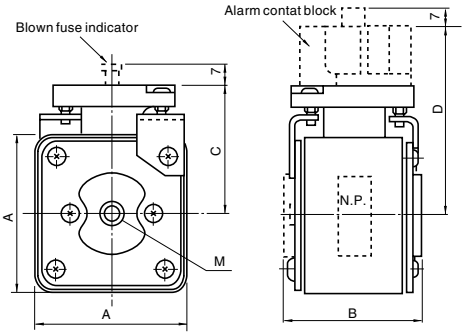
Type	A	B	C	D	E	F	G	H	a×b	Mass (g)
CR6L-75 CR6L-100 CR6L-150	95	70	25	34	47	102	3.2	33.5	11×13	150
CR6L-200 CR6L-250 CR6L-300	107	82	30	42	54	107	4	39	11×13	246

Type	A	B	C	D	Mass (g)
CR6L-350	107	82	43	107	493
CR6L-400 CR6L-500	121	96	43	114	522
CR6L-600	121	96	47.4	114	545

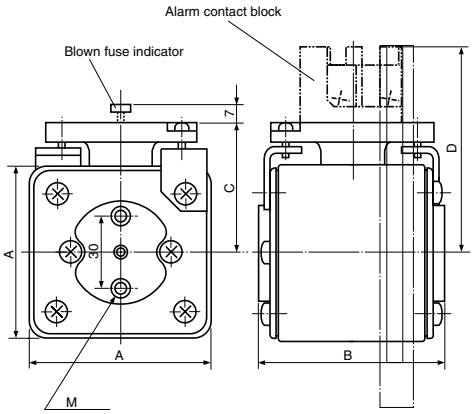
● CS1F-4700
CS2F-2000, 3000



● CS5F-40 to 1500
CS10F-80 to 750
CS15F-450, 630



● CS8F-1000, 1200, 1500



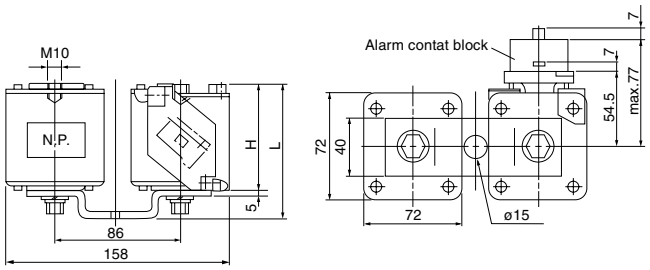
Mass: 800g

Voltage	Type	A	B	C	D (Max.)	M	Mass (g)
500V	CS5F-40 CS5F-75 CS5F-100 CS5F-150 CS5F-200	47	47	42.5	65.5	M8	320
	CS5F-250 CS5F-300 CS5F-350	57	51	47	70	M8	510
	CS5F-400 CS5F-450 CS5F-500 CS5F-600 CS5F-800	72	51	54.5	77	M10	800
	CS5F-1000 CS5F-1200 CS5F-1500	72	51	54.5	77	M12	830

Voltage	Type	A	B	C	D (Max.)	M	Mass (g)
800V	CS8F-1000 CS8F-1200	72	74	54.5	84	M12	1060
	CS8F-1500	72	82	54.5	84	M8	1150
1000V	CS10F-80 CS10F-100	47	71	42.5	65.5	M8	420
	CS10F-150 CS10F-200 CS10F-250	57	74	47	70	M8	690
	CS10F-300 CS10F-350 CS10F-400 CS10F-500 CS10F-630 CS10F-750	72	74	54.5	77	M10	1060
1500V	CS15F-450 CS15F-630	72	105	54.7	77	M10	1400

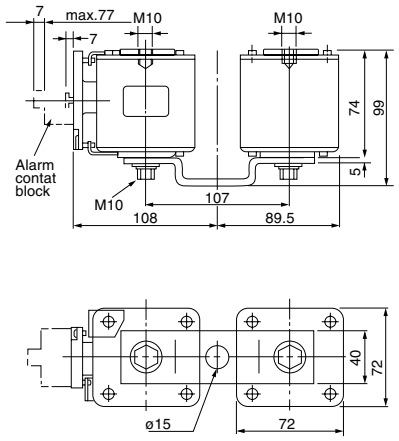
■ Dimensions, mm

• CS5F-P CS10F-P, CS15F-P



Voltage	Type	H	L	Mass (g)
500V	CS5F-1000-P CS5F-1200-P	51	69	1900
1000V	CS10F-800-P CS10F-1000-P CS10F-1250-P	74	92	2420
1500V	CS15F-900-P CS15F-1250-P	105	123	3100

• CS10F-1500-C

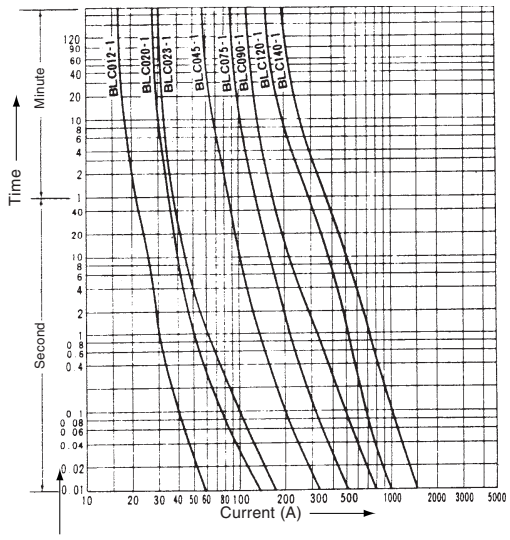


Mass: 2500g

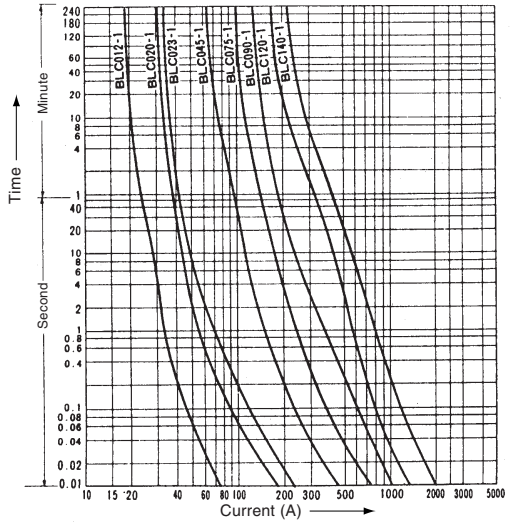
■ Characteristic curves

BLC

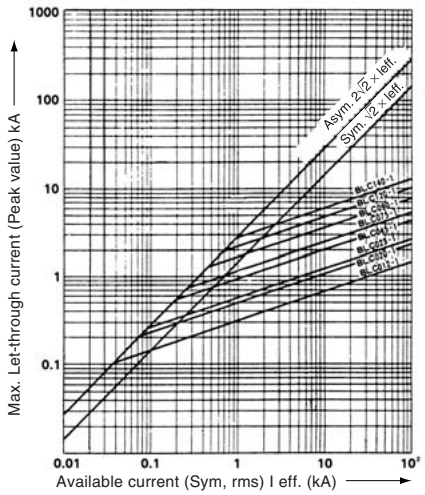
Melting time-current characteristic



Operating time-current characteristic

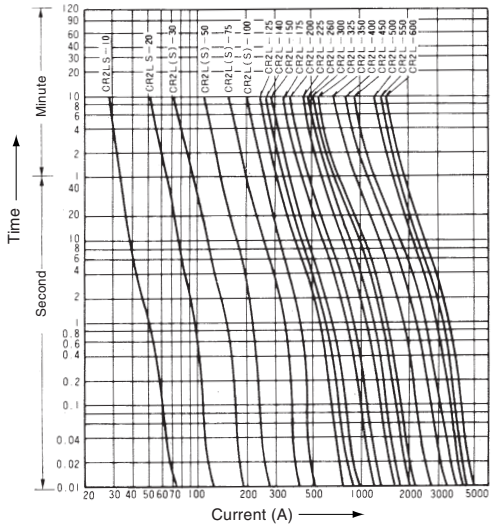


Current-limiting characteristic

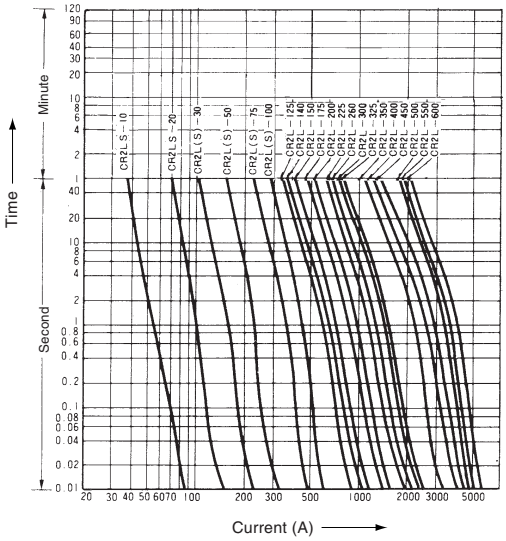


■ Characteristic curves

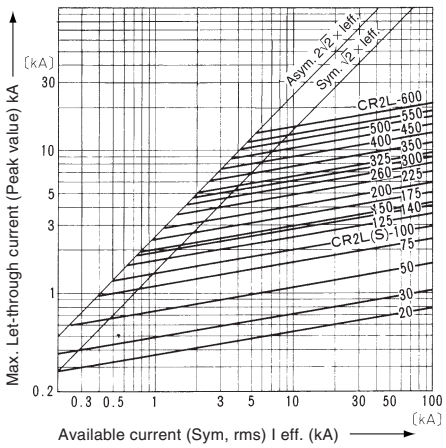
CR2L, CR2LS
Melting time-current characteristic



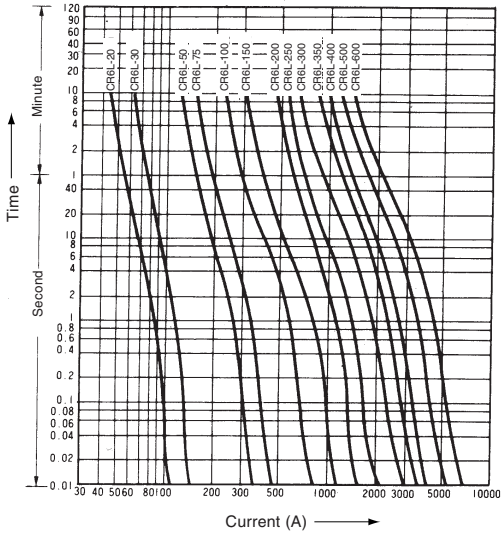
Operating time-current characteristic



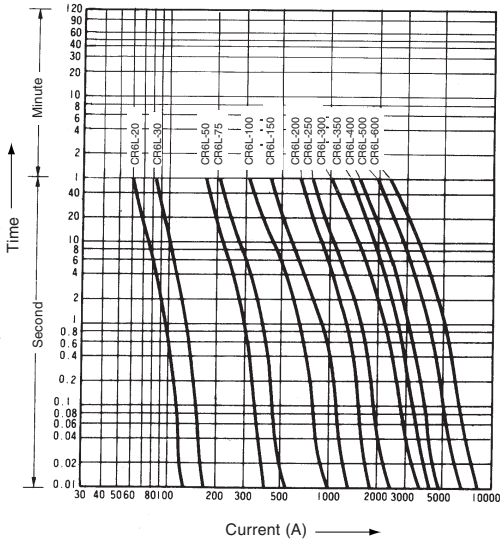
Current-limiting characteristic



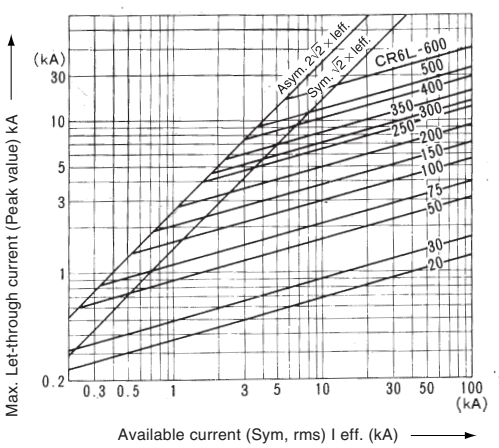
CR6L
Melting time-current characteristic



Operating time-current characteristic



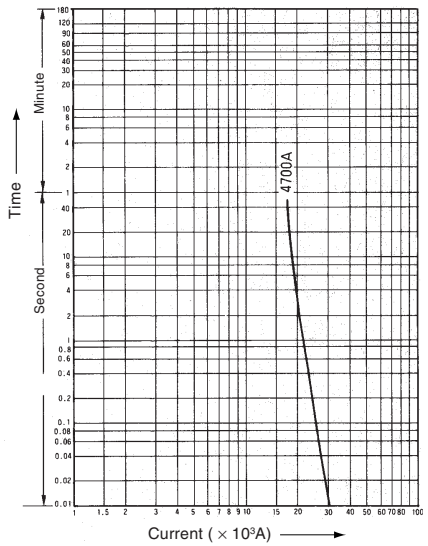
Current-limiting characteristic



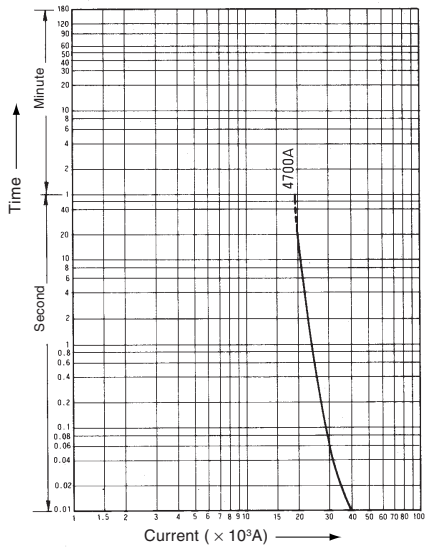
■ Characteristic curves

CS1F

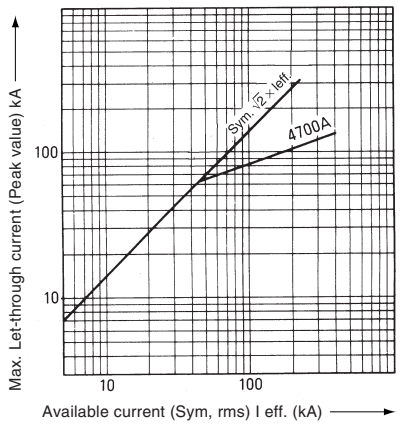
Melting time-current characteristic



Operating time-current characteristic

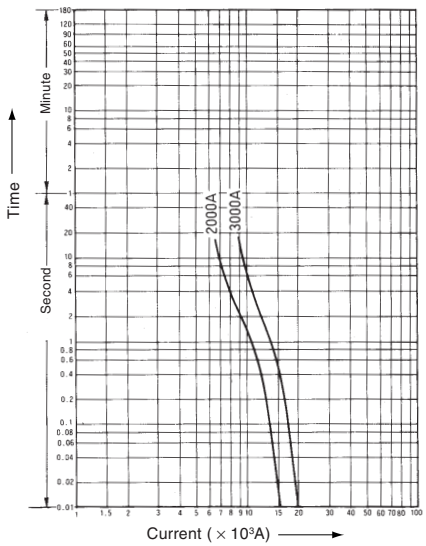


Current-limiting characteristic

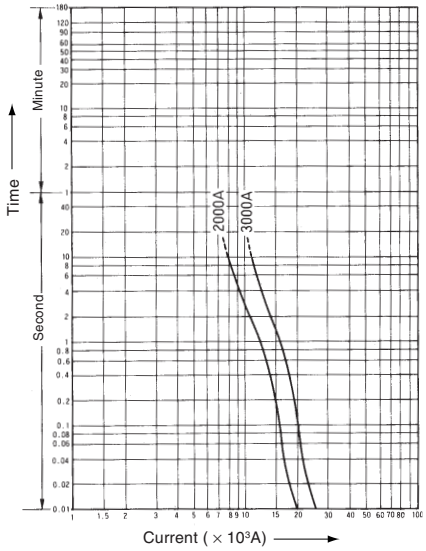


CS2F

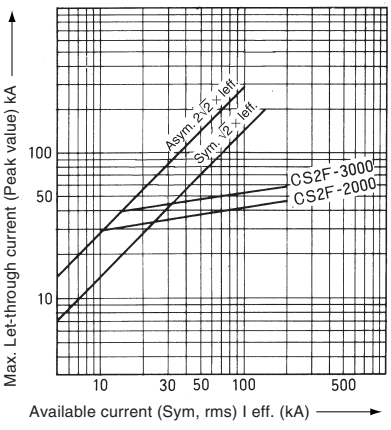
Melting time-current characteristic



Operating time-current characteristic



Current-limiting characteristic

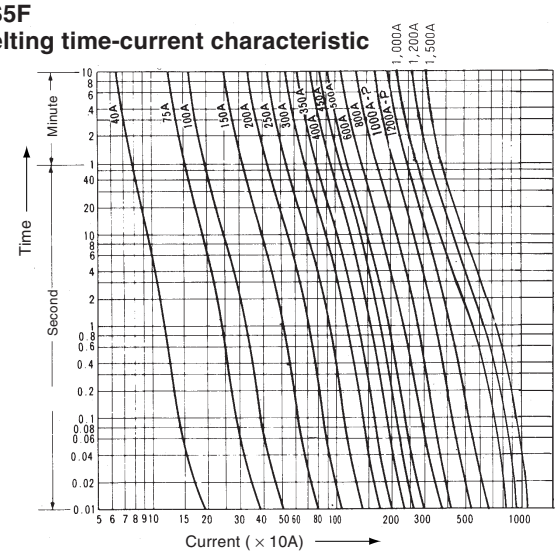


08

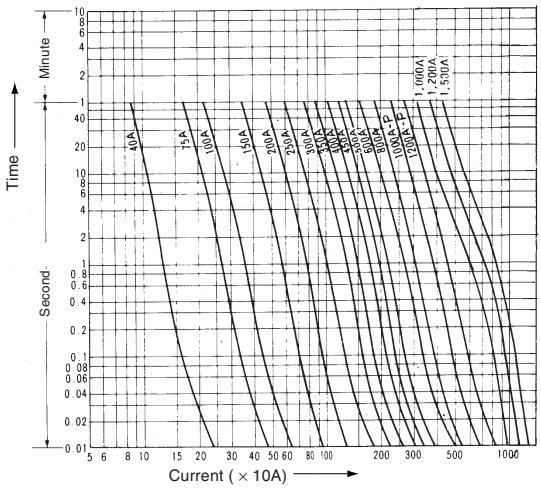
■ Characteristic curves

CS5F

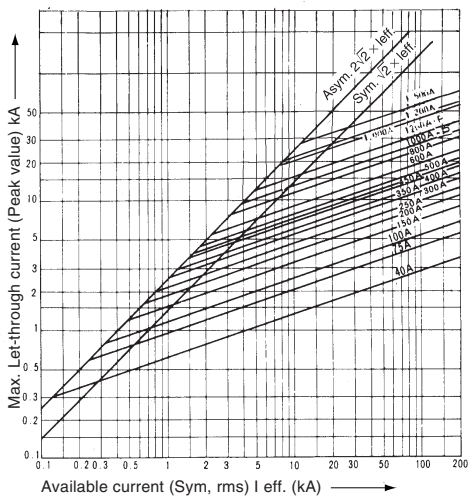
Melting time-current characteristic



Operating time-current characteristic

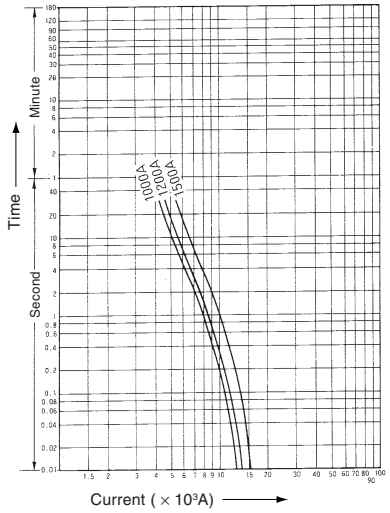


Current-limiting characteristic

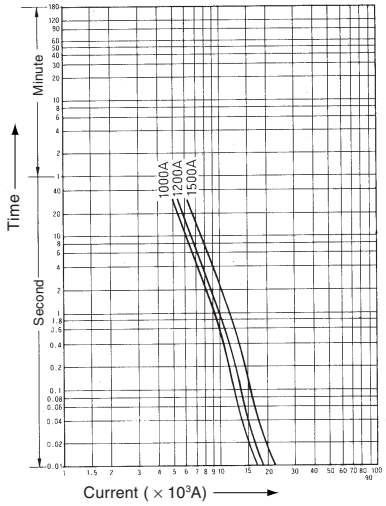


CS8F

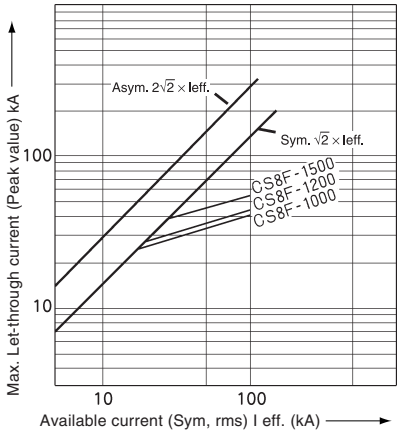
Melting time-current characteristic



Operating time-current characteristic



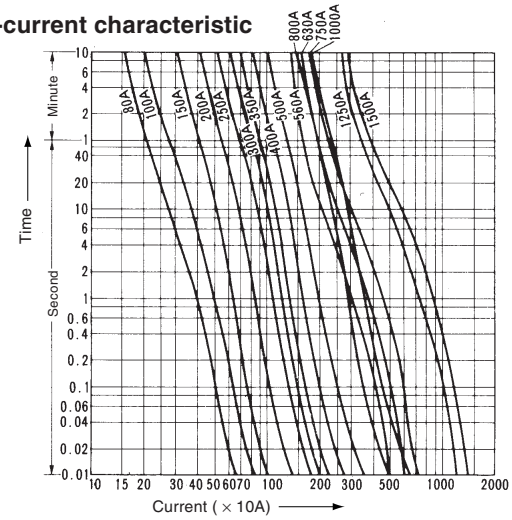
Current-limiting characteristic



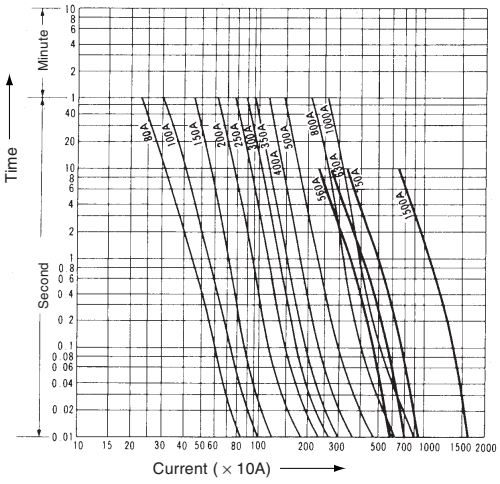
■ Characteristic curves

CS10F

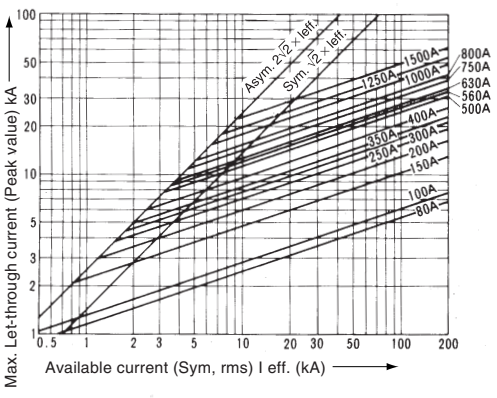
Melting time-current characteristic



Operating time-current characteristic

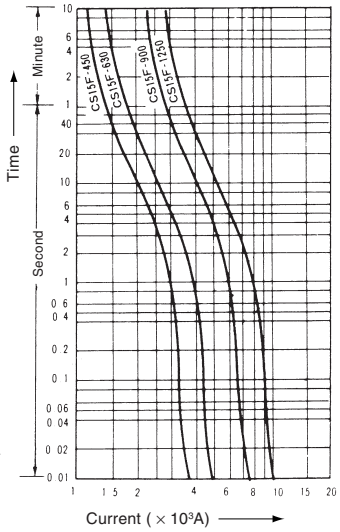


Current-limiting characteristic

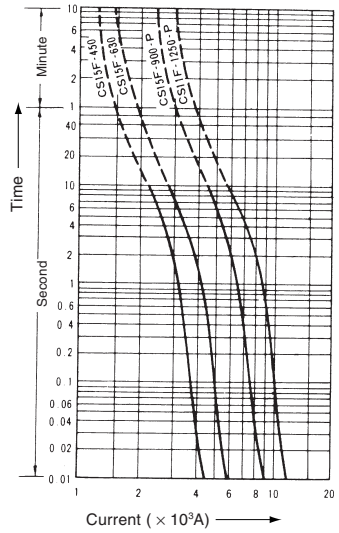


CS15F

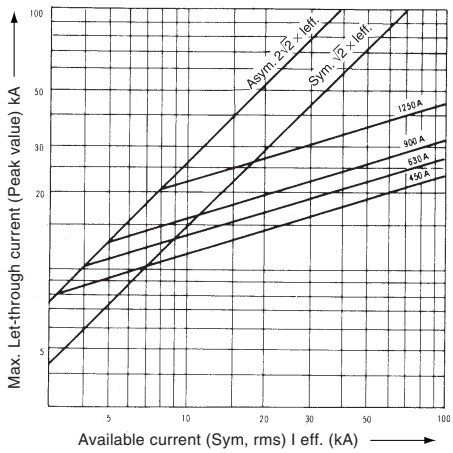
Melting time-current characteristic



Operating time-current characteristic



Current-limiting characteristic



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■ Operating indication

• Blown fuse indication

FUJI Super Rapid Fuses are available in BLC, CR and CS types. These types have different methods of indicating a blown fuse.

• BLC type

A blown fuse is indicated by the color tip on the ferrule of the fuse being ejected as shown in Fig. 1. This can be seen through the window of the fuse holder.

• CR type

This fuse does not have a blown indicator but if a trigger fuse is connected as shown in Fig. 2 this will provide the alarm for blown fuse.

• CS type

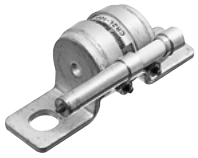
This fuse is provided with a blown fuse indicator. In this case a pin in the contact pad is ejected after the fuse has been blown. If electrical connections for lamps or alarms are required fit the contact block (1NO or 1NC) to the pad as shown in Fig. 3.

Fig. 1

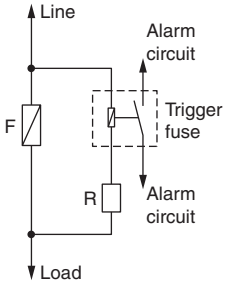
SD-36

BLC type

Fig. 2



AF88-446



CR type

Fig. 3

Alarm contact block AHX2905, 2915

SM-385

CS10F

SH-384

CS 10F with alarm contact block

■ Alarm contact block ratings

Type	Contact	Rated voltage (V)	AC		DC			
			Inductive cosφ=0.3~1		Resistive load		Inductive load	
			Rated operational current (A)	Rated capacity (VA)	Rated operational current (A)	Rated capacity (W)	Rated operational current (A)	Rated capacity (W)
AHX2905	1NO	24	6	150	6	150	6	150
		110	6	660	2.5	275	1.3	140
		220	6	1320	1	220	0.45	100
AHX2915	1NC	440	2.5	1100	0.4	175	0.2	85
		550	2	1100	0.3	165	0.15	85

■ Fuse holder for BLC type fuse

FUJI BLC fuses require special holders. Select the most suitable one which corresponds to the rated current of the fuse.

Dimensions: *See page 08/32*.

SD-36

Fuse link BLC

AF88-439

Fuse holder Surface connection

Fuse link Type	Rated current (A)	Base Surface connection Type	Base Rear connection Type	Screw cap Type	Adaptor ring Type
BLC012-1	12	AFa30	Ba30	Pa30	R20
BLC020-1	20	AFa30	Ba30	Pa30	–
BLC023-1	23	AFa30	Ba30	Pa30	–
BLC045-1	45	AFa60	Ba60	Pa60	–
BLC075-1	75	AFa100	Ba100	Pa100	R75
BLC090-1	90	AFa100	Ba100	Pa100	–
BLC120-1	120	AFa200	Ba200	Pa200	–
BLC140-1	140	AFa200	Ba200	Pa200	–

■ Application and selection guide BLC, CR and CS-type – Super rapid fuse

When selecting fuses for semiconductor rectifier circuit protection the following conditions must be satisfied.
For additional details contact FUJI.

■ Conditions of application

1. The rated interrupting current of the fuse must be greater than the estimated short circuit current of the circuit.

   Available short circuit current of rectifier circuit $<$ Rated interrupting current of fuse

2. The let-thru current value of fuse must be less than the allowable 1/2 cycle surge current value.

   Fuse let-thru current value $\leqq$ Semiconductor – 1/2 cycle allowable surge current 10ms (at 50Hz)

3. The total clearing I^2t value which the fuse requires to complete interruption must be less than the allowable I^2t value of semiconductor.

   Fuse – total clearing I^2t $\leqq$ Semiconductor – I^2t

4. The rated current of the fuse must be greater than the average forward current of the semiconductor.

   Fuse – rated current $>$ Semiconductor – average forward current

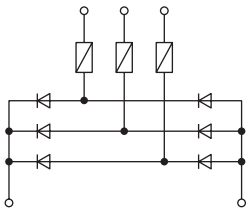
5. The rated current and voltage of the fuse must be greater than those of the rectifier circuit.

   Fuse – rated current and voltage $>$ Rectifier circuit – current and voltage

Method of application

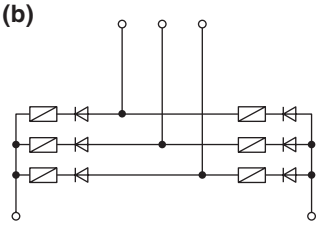
Semiconductor rectifier equipment has a variety of rectifier circuits. Taking the 3-phase bridge rectifier circuit as an example – Fig. (a) and (b) as shown in the following.
Although the number of fuses used in the line fuse method (a) is half the number used in the element fuse method (b), the fuses must have a larger current capacity.

Fig. (a)



Line fuse method
In this method the fuses are connected to the AC line side.

Fig. (b)



Element fuse method
In this method the fuses are connected in series to the semiconductor element.

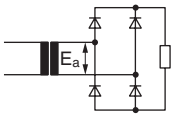
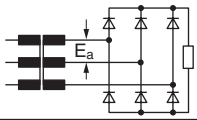
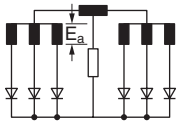
■ Fuse ratings

When selecting fuses various factors such as protection, coordination and load, etc. must be considered.
However, in this catalog the main matters such as voltage, current and I^2t only are explained.

• Rated voltage

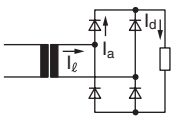
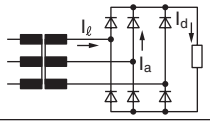
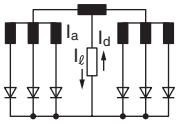
The rated voltage of the fuse indicates the maximum operational voltage and this also indicates the root-mean-square value of the AC sinusoidal wave voltage. Select fuses having a rated voltage exceeding the voltage obtained by the formula shown in the following table. (Fig. 1)
Do not select current-limiting fuses with rated voltages drastically exceeding the rectifier circuit voltage. It is necessary to consider the arc voltage.

Fig. 1 Rated voltage required by fuses

Wire connection type	Wiring diagram	Rated voltage of Fuse (V_{FN} rms) For line fuse	For element fuse
Single-phase bridge		$V_{FN} \geqq a \cdot E_a$	$V_{FN} \geqq a \cdot E_a$
3-phase bridge		$V_{FN} \geqq a \cdot E_a$	$V_{FN} \geqq a \cdot E_a$
3-phase, double star		$V_{FN} \geqq a \cdot \sqrt{3} \cdot E_a$	$V_{FN} \geqq a \cdot \sqrt{3} \cdot E_a$

Remarks: The 'a' is a coefficient where the regulation of the AC input voltage is taken into account. This is a=1.1 in case of voltage regulation ±10%.

Fig. 2 Element current and line current

Wire connection type	Wiring diagram	Element fuse method Element current I_a	Line fuse method Line current I_ℓ
Single-phase bridge		$Ia = \frac{Id}{\sqrt{2}} = 0.707d$	$I\ell = d$
3-phase bridge		$Ia = \frac{Id}{\sqrt{3}} = 0.577dI$	$I\ell = \sqrt{\frac{2}{3}}\ Id = 0.816dI$
3-phase, double star		$I\ell = Ia = \frac{Id}{2\sqrt{3}} = 0.289dI$	

08

• Rated current
The current values in fuses in the line fuse system and the element fuse system are different. Obtain the correct current value from the table on *page 08/48* (Fig. 2).
When selecting the rated current of a fuse choose a fuse having an amperage rating greater than the current which flows in the semiconductor if the load is continuous and a fixed current.
If the current which flows in the semiconductor is greater than the rated current of the fuse connect the fuses in parallel. However, in this case, if the numbers of fuses arranged in parallel are 'n', then the I^2t value of the fuse will be $n^2 \cdot I^2t$ and n^2 times the I^2t value of one fuse. This should be taken into consideration when protective coordination is taken into account.
In the case of the circuit where the load rapidly varies the fuse element will suffer from mechanical deterioration and be damaged by thermal stress. In loads of this type the deterioration characteristics of the fuse must be closely considered.
Moreover if the fuse current – time characteristics of the fuse selected is less than the overload characteristics of the semiconductor element then complete protection can be obtained. However, if the semiconductor element has a large capacity then protective cooperation is very difficult to arrange. The fuses are used to isolate the shorted semiconductor element circuit from sound operating circuits.

■ Total clearing I^2t
The total clearing I^2t of fuse is a very important factor when considering the protective coordination of the semiconductor. This total clearing I^2t is the value where the arcing I^2t is added to the melting I^2t. Therefore it is necessary to satisfy the following formula.

Fuse – total clearing I^2t $\leqq$ Semiconductor I^2t

The total clearing I^2t of fuse depends upon the operational voltage and interrupting current.

Therefore, for this reason if a 500 Volts fuse is used in a 300 Volts circuit the total clearing I^2t is reduced by 50–70%. However, the reduction rate varies according to the type of fuse construction. This must be checked and confirmed once more.

Example
I^2t
All I^2t values are ampere^2 seconds.

The I^2t data for silicon diodes or thyristor elements are normally given in their respective catalogs. If the A^2S data is not given in their catalog obtain the value in the following manner. If protection is needed for a 250V, 150A (I_o) diode having a maximum allowable peak half sine wave current of 2700A, it is important that the fuse has a total I^2t value lower than that of the diode.

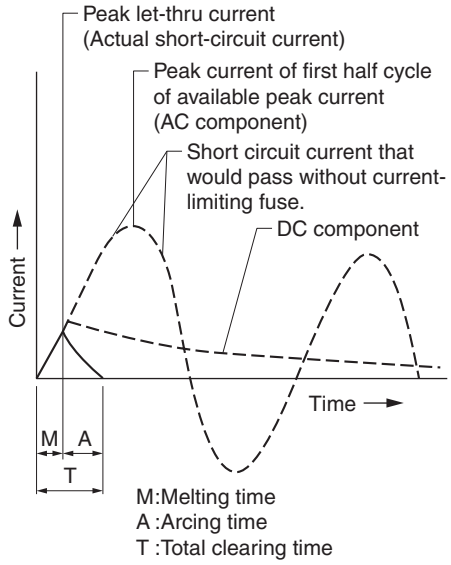
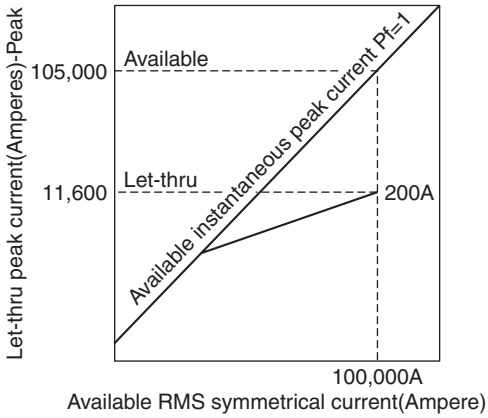
Calculation

$$\text{Maximum } I^2t \text{ diode} = \left(\frac{1 \text{ Peak}}{2}\right)^2 0.0167$$
$$= \left(\frac{2700}{2}\right)^2 0.0167$$
$$= 30{,}400A^2 \text{ Sec.}$$

From the table (*Page 08/38*), the fuse with a total I^2t nearest to 30,400A^2 Sec. is the 260 Ampere fuse (CR 2L-260).

■ Interrupting current
The rated interrupting current of the fuse must exceed the maximum value (Symmetrical RMS value) of the estimated circuit fault current.

■ Peak arc voltage
In the case of the current-limiting fuse an arc voltage (overvoltage) is generated at the time of interruption due to its fusible element construction. It is necessary to check that this peak arc voltage does not exceed the semiconductor's maximum (Non-repetitive peak) reverse voltage value.

■ Current limitation
Select a fuse whose let-thru current value does not exceed the allowable 1/2 cycle surge current of the semiconductor. The allowable surge current is the peak value of the current which in case at 50Hz is allowed to flow for 10ms. In the current-limiting fuse the fault must be cleared in the shortest possible time or in the first 1/2 cycle.
Available current is the current which would flow if the fuse were not current-limiting.
This would cause damage to equipment. Let-thru current is the actual current allowed to flow by the current limiting action of the fuse. A number of let-thru current graphs are given in this catalog and example is given in the following paragraph. The method of reading this graph is provided for your reference.

How to find a let-thru current – Example
Fuse: 200 Amps 500V
Available R.M.S symmetrical current:
100,000 Amps
Let-thru peak current (Instantaneous):
11,600 Amps
Let-thru R.M.S. current
11,600 ÷ 1.7 = 6,800 Amps
This example clearly shows that while a 100kA (rms, sym) current is available, the fuse limits the current let-thru to 6,800 Amperes (rms, sym).