

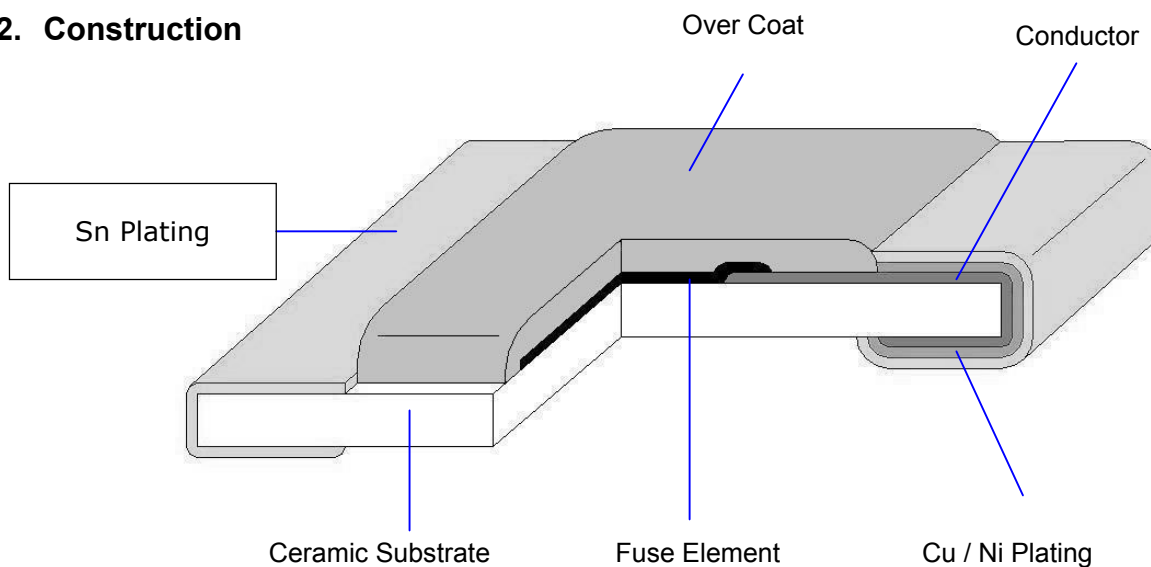
Lead Free Thin Film Chip Fuse

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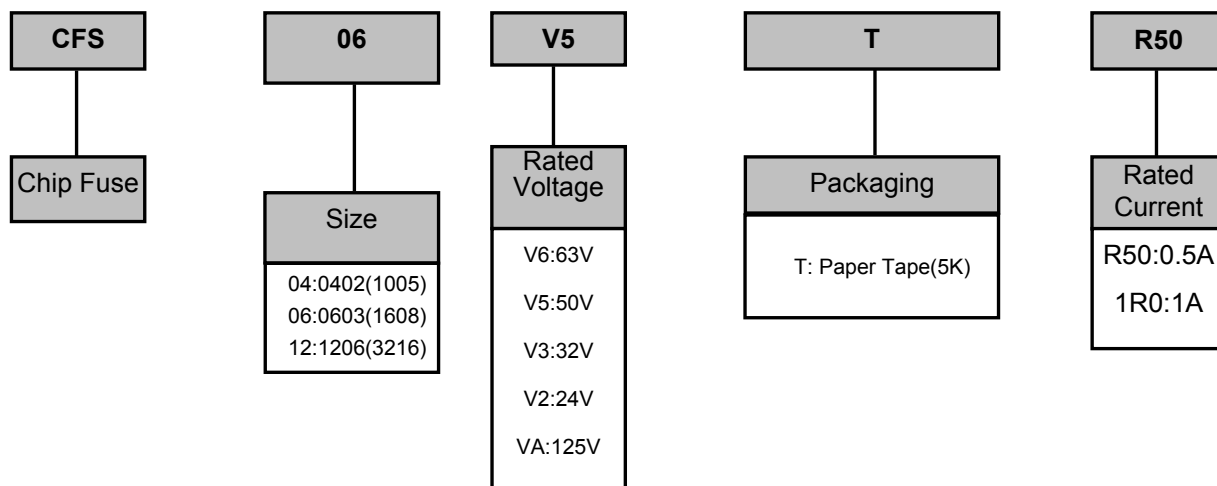
1. Scope

This specification applies for the Lead-Free fuse series of thin film chip fuse made by TA-I.

2. Construction



3. Type Designation



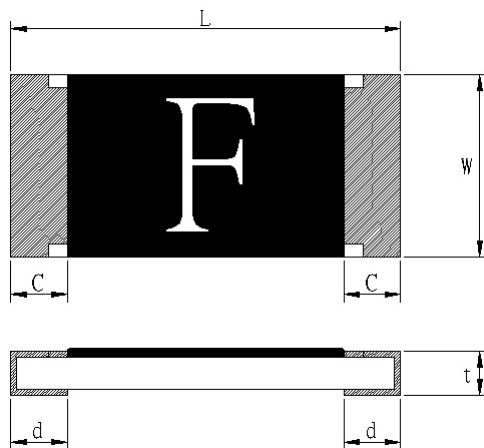
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4. Dimensions



Unit: mm

Type (Inch Size code)	Dimensions (mm)				
	L	W	C	d	t
CFS04V (0402)	1.0±0.1	0.52±0.05	0.2±0.1	0.25±0.1	0.35±0.05
CFS06V (0603)	1.6±0.1	0.8±0.1	0.3±0.2	0.35±0.2	0.45±0.1
CFS12V (1206)	3.1±0.1	1.55±0.1	0.5±0.3	0.5±0.2	0.6±0.1

5. Applications and ratings

Part Designation	Marking	Rated Current	Fusing Time	Resistance (mΩ) Typ.*	Rated Voltage	Breaking Capacity	Body Temperature rising
CFS04V2TR50	F	0.50A	Open within 5sec.at250% rated current	235	DC 24V	DC24V 35A	<75°C at 100% rated current
CFS04V2TR80	K	0.80A		86			
CFS04V2T1R0	L	1.00A		64			
CFS04V2T1R25	M	1.25A		45			
CFS04V2T1R50	P	1.50A		35			
CFS04V2T1R60	N	1.60A		32			
CFS04V2T2R0	S	2.00A		24			
CFS04V2T2R50	T	2.50A		19			
CFS04V2T3R00	3	3.00A		15			
CFS04V2T3R15	U	3.15A		14			
CFS04V2T4R0	W	4.00A		10.5			

*Resistance value was measured with less than 10% of rated current

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Part Designation	Marking	Rated Current	Fusing Time	Resistance (mΩ) Typ.*	Rated Voltage	Breaking Capacity	Body Temperature rising
CFS06V5TR50	F	0.50A	Open within 5sec.at250% rated current	175	DC 50V	DC50V 50A	<75℃ at 100% rated current
CFS06V3TR63	I	0.63A		130	DC 32V	DC32V 50A	
CFS06V3TR80	K	0.80A		93			
CFS06V3T1R0	L	1.00A		65			
CFS06V3T1R25	M	1.25A		47			
CFS06V3T1R50	P	1.50A		36			
CFS06V3T1R60	N	1.60A		34			
CFS06V3T2R0	S	2.00A		26			
CFS06V3T2R50	T	2.50A		20			
CFS06V3T3R00	3	3.00A		16			
CFS06V3T3R15	U	3.15A		15			
CFS06V3T4R0	W	4.00A		12			
CFS06V3T5R0	Y	5.00A		9			

*Resistance valve was measured with less than 10% of rated current

Part Designation	Marking	Rated Current	Fusing Time	Resistance (mΩ) Typ.*	Rated Voltage	Breaking Capacity	Body Temperature rising
CFS12V6TR50	F	0.50A	Open within 5sec.at250% rated current	385	DC 63V	DC63V 50A	<75℃ at 100% rated current
CFS12V6TR80	K	0.80A		165			
CFS12V6T1R0	L	1.00A		108			
CFS12V6T1R25	<u>M</u>	1.25A		76			
CFS12V6T1R50	P	1.50A		51			
CFS12V6T2R0	S	2.00A		32			
CFS12V3T2R50	T	2.50A		26	DC 32V	DC32V 50A	
CFS12V3T3R00	3	3.00A		20	DC 24V	DC24V 50A	
CFS12V2T4R0	W	4.00A		14			
CFS12V2T5R0	Y	5.00A		10			
CFS12V2T7R0	Z	7.00A		6.5			

*Resistance valve was measured with less than 10% of rated current

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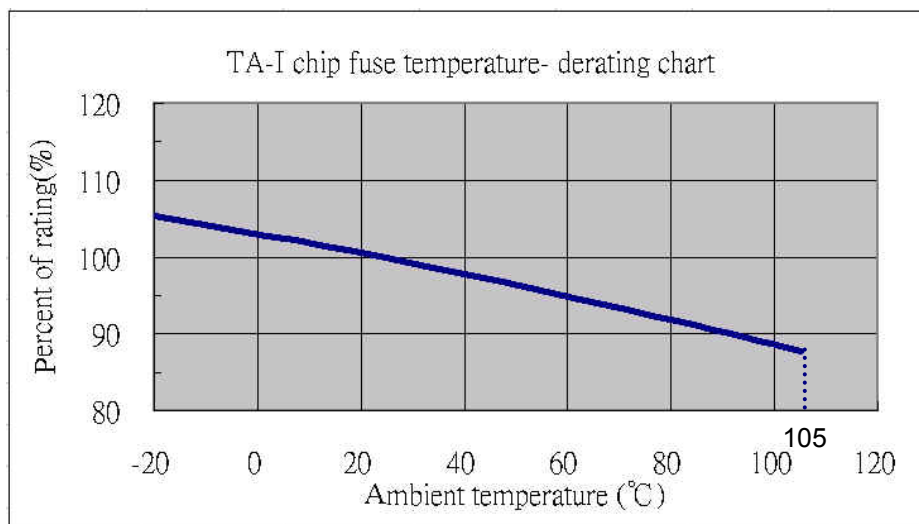
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6. Temperature Derating Curve

6.1 Normal Ambient Temperature: 25°C

6.2 Operating Temperature: -20°C~105°C, with proper Derating factor as below:



7. Reliability Tests

Parameter	Requirement	Test Method
Carrying capacity	No fusing	Rated current ,4hr
Fusing Time	Within 5sec	250% of its rated current
Interrupting Ability	No mechanical damages	After the fuse is interrupted ,rated voltage applied for 30sec again
Bending Test	No mechanical damages	Distance between holding points: 90mm, Bending:3mm,1time ,30sec
Resistance to solder Heat	±20%	260°C±5°C,10seconds ±1second
Solder ability	95% coverage minimum	235°C±5°C, 2±0.5second 245°C±5°C, 2±0.5second (Lead Free)
Temperature Rise	<75°C	100% of its rated current, Measure of surface temperature
Resistance to Dry Heat	±20%	105°C±5°C,1000 hrs
Resistance to Solvent	No evident damages on protective coating and marking	23°C±5°C of Isopropyl alcohol 90second
Residual Resistance	10kΩ and more	Measure DC resistance after fusing
Thermal Shock	ΔR< 10 %	-20°C/ +25°C/+125°C/+25°C , 10 cycles

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8. Marking

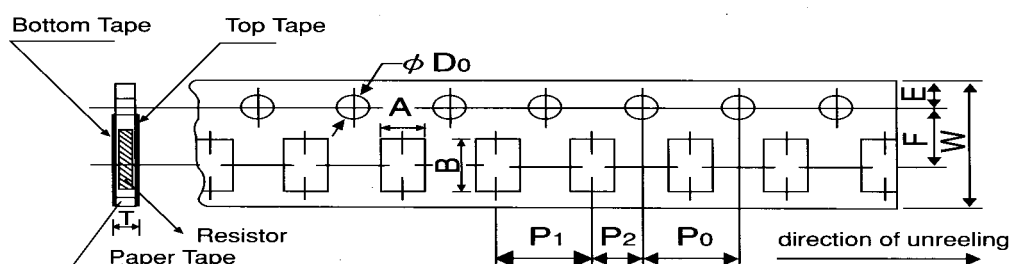
Symbol for Rating Current

Symbol	F	I	K	L	<u>M</u>	P	N	S	T	3	U	W	Y	Z
Rating Current(A)	0.5	0.63	0.8	1	1.25	1.5	1.6	2	2.5	3	3.15	4	5	7

9. Taping & Reel

9.1 Taping Dimensions

4mm pitch paper



Packing	Type	A	B	W	F	E	P ₁	P ₂	P ₀	D ₀	T
Paper Tape	CFS04V	0.7±0.05	1.2±0.05	8.0±0.2	3.5±0.05	1.75±0.1	2.0±0.1	2.0±0.05	4.0±0.1	$\phi 1.5^{+0.1}_0$	0.45±0.1
Paper Tape	CFS06V	1.1±0.1	1.9±0.1	8.0±0.2	3.5±0.05	1.75±0.1	4.0±0.1	2.0±0.05	4.0±0.1	$\phi 1.5^{+0.1}_0$	0.64±0.1
Paper Tape	CFS12V	2.0±0.15	3.6±0.2	8.0±0.2	3.5±0.05	1.75±0.1	4.0±0.1	2.0±0.05	4.0±0.1	$\phi 1.5^{+0.1}_0$	0.84±0.1

Unit: mm

Type Size		Paper Tape
		2 mm pitch
		180mm/R
CFS	04V	10000

Type series		Paper Tape
		4 mm pitch
		180mm/R
CFS	06V	5000
CFS	12V	5000

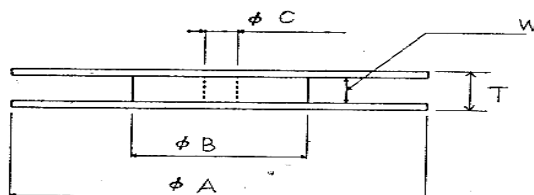
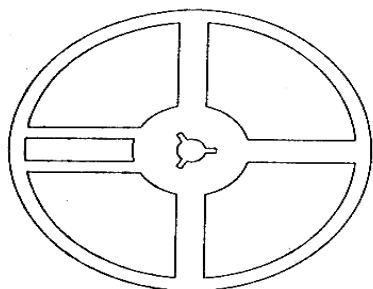
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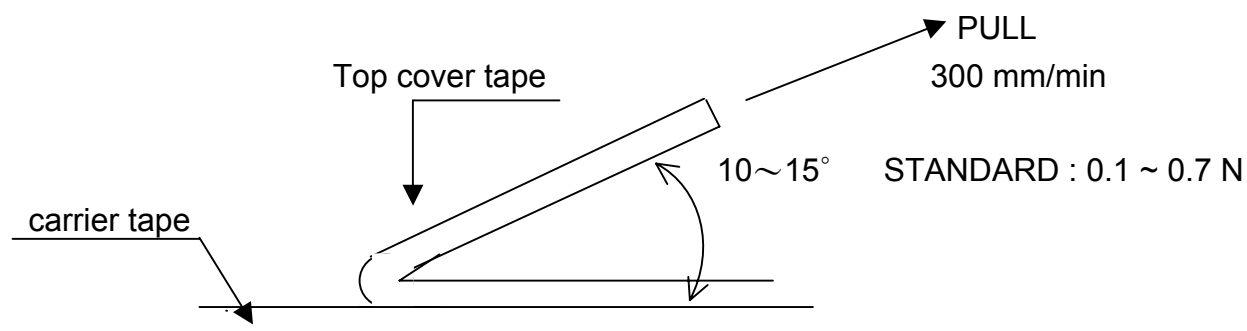
9.2 Reel Specifications



Unit: mm

Series	ϕA	ϕB	ϕC	W	T
CFS04V CFS06V CFS12V	180^{+0}_{-3}	60 min	13.0 ± 1.0	9.0 ± 1.0	11.4 ± 2.0

9.3 Peel –off force :



10. Storage Conditions:

Temperature: 5°C~35°C, Humidity: 40%~75%

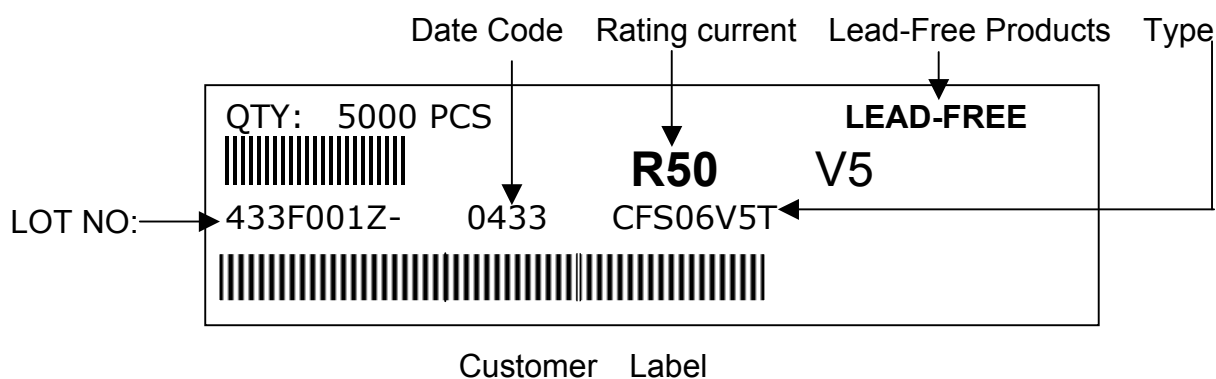
11. Shelf Life:

2 years from manufacturing date

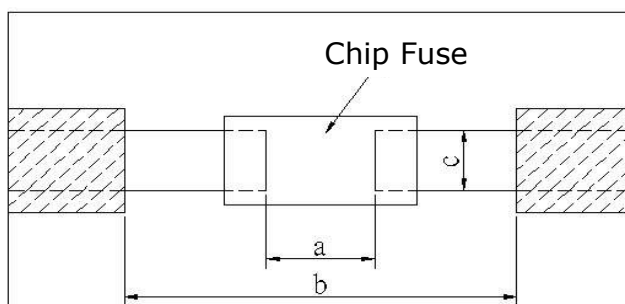
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12. Label



13. Recommended land patterns

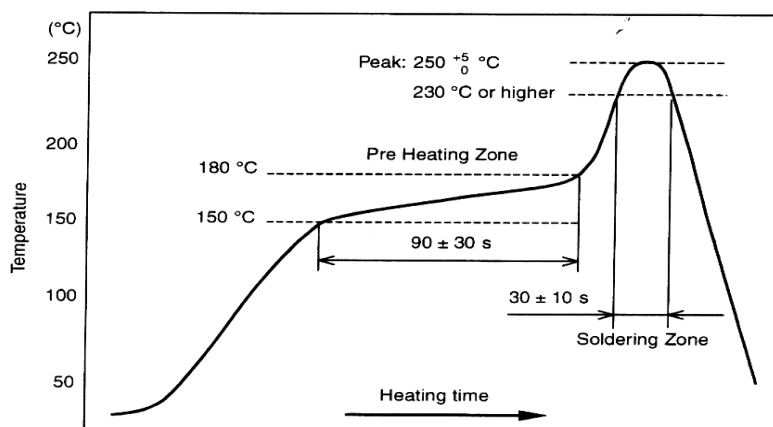


Type	Land pattern Size	Dimension		
		a	b	c
CFS	04 (0402)	0.5~0.6	1.4~1.6	0.4~0.6
CFS	06 (0603)	0.7~0.9	2.0~2.2	0.8~1.0
CFS	12 (1206)	2.0~2.4	4.4~5.0	1.2~1.8

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14. Recommend IR – Reflow profile : (solder : Sn96.5 / Ag3 / Cu0.5)



Peak : $250 \begin{smallmatrix} +5 \\ -0 \end{smallmatrix} ^\circ\text{C}$, 5 sec

Pre – heat Zone : 150 to 180 °C, 90±30 sec

Soldering Zone : 230°C or higher , 30±10 sec

15. Approval by UL248-14

The fuses have been approved by UL.

File No. of UL Recognition is E241710

16. ECN

Engineering Change Notice: The customer will be informed with ECN if there is significant modification on the characteristics and materials described in Approval Sheet.

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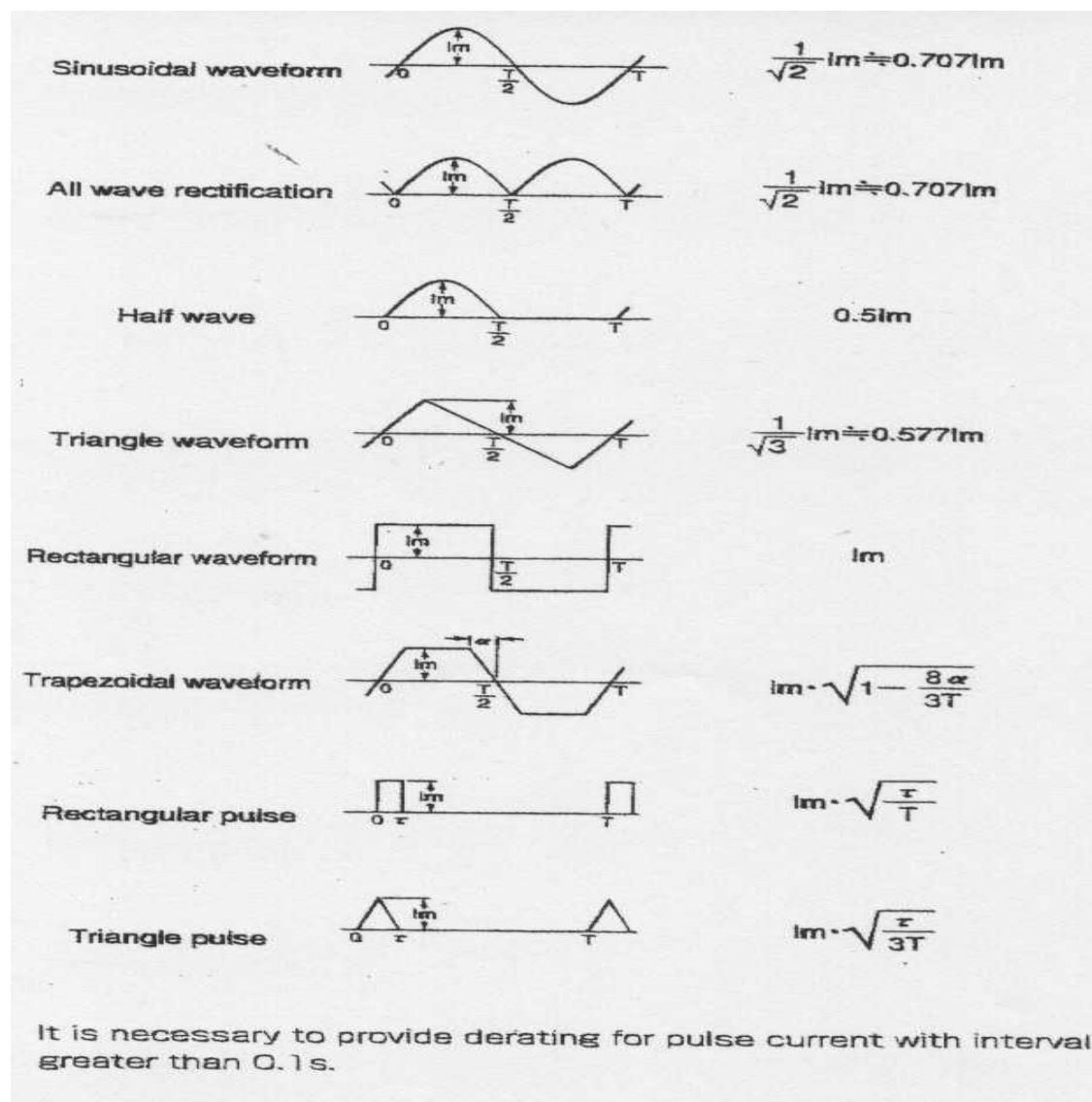
★ Selection Guideline of Fuse:

■ Checklist of selection factors

- ⊙ Normal operating current
- ⊙ Normal operating voltage (AC or DC)
- ⊙ Ambient Temperature
- ⊙ Overload current and length of time in which the fuse must open .
- ⊙ Type of fuse (SMD or Tube) and physical size limitation (0603 or 1206)
- ⊙ Agency Approval required (e.g., UL248-14)

■ Normal operating current

e.g., Rectangular Wave , If $I_p = 1.5 \text{ A}$, Normal operating current = 1.5 A



Lead Free Thin Film Chip Fuse

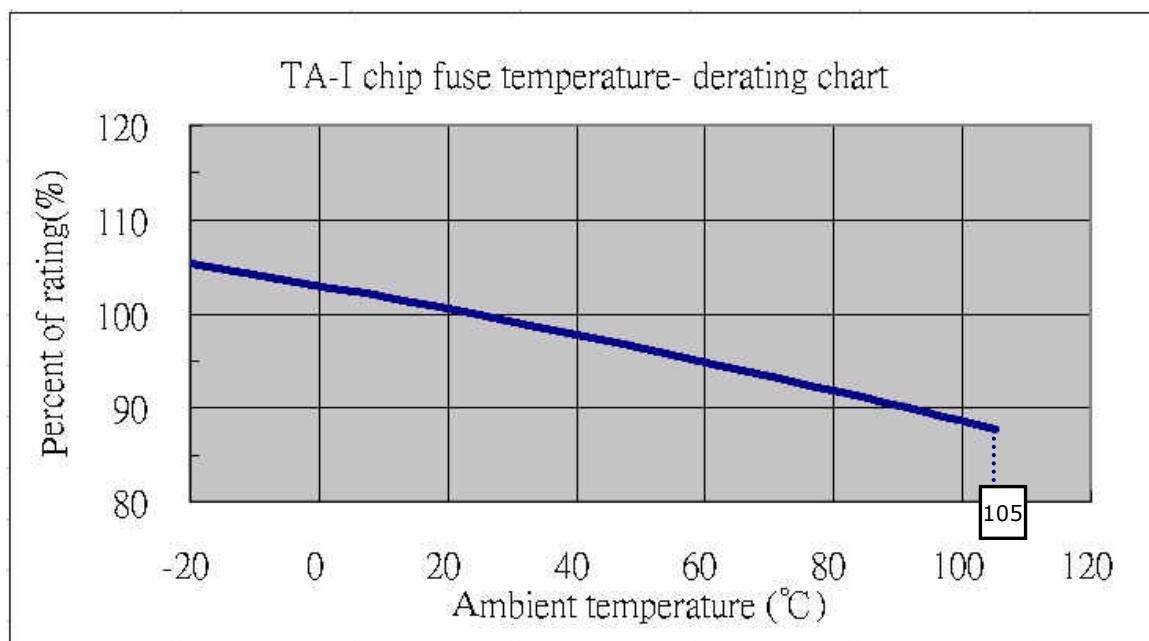
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Derating ratio for different ambient Temperature

- Referring to bottom figure and select the appropriate derating ratio :

e.g., Ambient temperature is 60 degree C

the derating ratio $\approx$ 0.95



Calculating the required rating of fuse needed .

- Safety coefficient : 70 % is safety coefficient from practical experience

$$\frac{\text{Normal Operating Current}}{0.7 \times \text{derating ratio}} < \text{rating current of fuse}$$

↓
↓
Safety coefficient
Ambient temperature

e.g.,

Condition : Normal operating current = 1.5 A

Ambient temperature 40 °C : Derating ratio $\approx$ 0.95

$$\frac{1.5}{0.7 \times 0.95} < \text{rating current of fuse}$$

2.255 < rating current of fuse

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■ Determination of the type of fuse

e.g., Condition :

- ◆ Calculating value = 2.255 A , 2.255A < rating current of fuse
- ◆ Normal operating voltage : DC 12 V
- ◆ Following bottom index-table :

Suggesting use CFS06V3T2R50 .

Part Designation	Marking	Rated Current	Rated Voltage	Part Designation	Marking	Rated Current	Rated Voltage	Part Designation	Marking	Rated Current	Rated Voltage
CFS04V2TR50	F	0.5A	24V	CFS06V5TR50	F	0.5A	50V	CFS12V6TR50	F	0.50A	63V
CFS04V2TR80	K	0.80A	24V	CFS06V3TR63	I	0.63A	32V	CFS12V6TR80	K	0.80A	63V
CFS04V2T1R0	L	1.00A	24V	CFS06V3TR80	K	0.80A	32V	CFS12V6T1R0	L	1.00A	63V
CFS04V2T1R25	<u>M</u>	1.25A	24V	CFS06V3T1R0	L	1.00A	32V	CFS12V6T1R25	<u>M</u>	1.25A	63V
CFS04V2T1R50	P	1.50A	24V	CFS06V3T1R25	<u>M</u>	1.25A	32V	CFS12V61R50	P	1.50A	63V
CFS04V2T1R60	N	1.60A	24V	CFS06V3T1R50	P	1.50A	32V	CFS12V6T2R0	S	2.00A	63V
CFS04V2T2R0	S	2.00A	24V	CFS06V3T1R60	N	1.60A	32V	CFS12V3T2R50	T	2.50A	32V
CFS04V2T2R50	T	2.50A	24V	CFS06V3T2R0	S	2.00A	32V	CFS12V3T3R00	3	3.00A	32V
CFS04V2T3R00	3	3.00A	24V	CFS06V3T2R50	T	2.50A	32V	CFS12V2T4R0	W	4.00A	24V
CFS04V2T3R15	U	3.15A	24V	CFS06V3T3R00	3	3.00A	32V	CFS12V2T5R0	Y	5.00A	24V
CFS04V2T4R0	W	4.00A	24V	CFS06V3T3R15	U	3.15A	32V	CFS12V2T7R0	Z	7.00A	24V
				CFS06V3T4R0	W	4.00A	32V				
				CFS06V3T5R0	Y	5.00A	32V				

■ Inrush current :

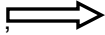
- ◆ Considering inrush waveform & calculate I^2t (A²s) value
- ◆ Choosing fuse's I^2t (A²s) value > calculate I^2t (A²s) value
- ◆ Considering Ratio of I^2t repeat numbers to blowing .
- ◆ Confrim with us.

e.g., choosing 0603 Fuse

Condition :

1. Rectangular Wave , $I_p = 4$ A , $t = 1$ (ms) ,

$$\text{Calculate } I_p^2t = 4^2 \times 1 \times 10^{-3} \text{ (A)} = 0.016 \text{ (A}^2\text{s)}$$

2. Choosing CFS06V3T2R5 ($I^2t = 0.200$ (A²s))  **Page 12 index-table**

3. Inrush shock : 100,000 times (≈ 0.35)  **Inrush derating ratio**

Calculating :

 **Inrush 100,000 times**

1. Choosing fuse's I^2t (A²s) value X Derating ratio > calculate I^2t (A²s) value

$$2. 0.200 \times 0.35 = 0.070 \text{ (A}^2\text{s)}$$

$$3. 0.070 > 0.016$$

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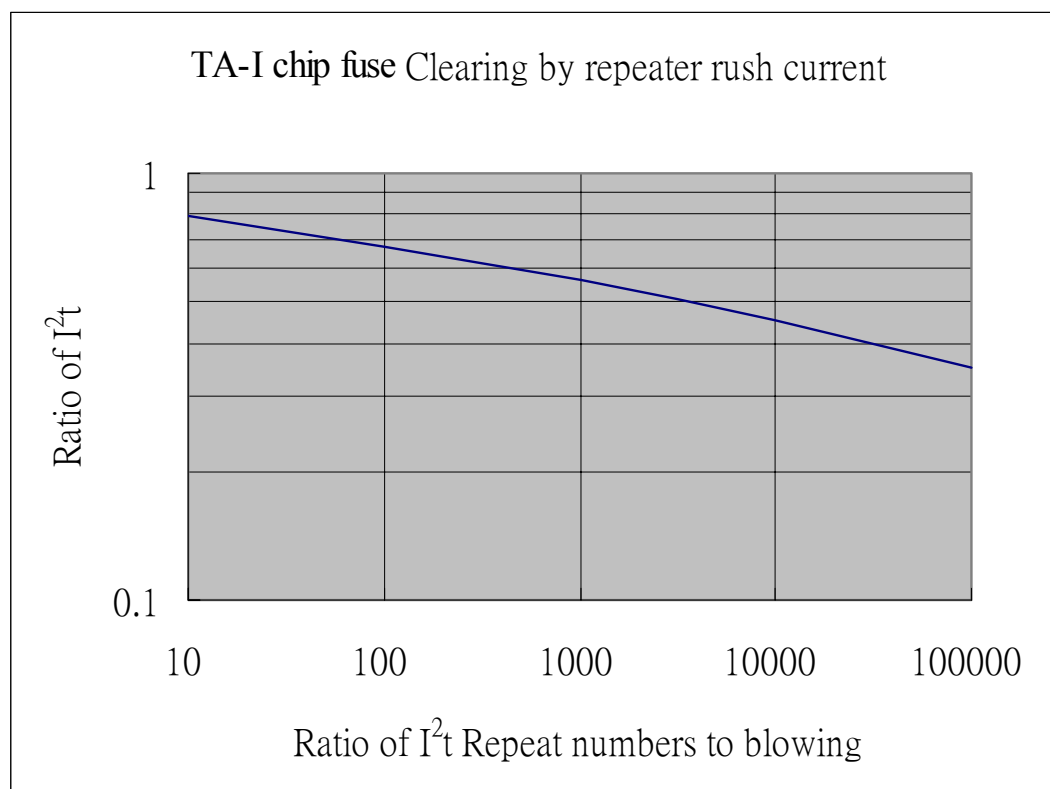
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The fuse is able to meet circuit 's application

TA-I FUSE I^2t (A ² s)					
Part Number	Typical I^2t (A ² s)*	Part Number	Typical I^2t (A ² s)*	Part Number	Typical I^2t (A ² s)*
CFS04V2TR50	0.00370	CFS06V5TR50	0.009	CFS12V6TR50	0.030
CFS04V2TR80	0.00947	CFS06V3TR63	0.017	CFS12V6TR80	0.068
CFS04V2T1R0	0.01479	CFS06V3TR80	0.024	CFS12V6T1R0	0.098
CFS04V2T1R25	0.02310	CFS06V3T1R0	0.026	CFS12V6T1R25	0.155
CFS04V2T1R50	0.02400	CFS06V3T1R25	0.057	CFS12V6T1R50	0.236
CFS04V2T1R60	0.03734	CFS06V3T1R50	0.081	CFS12V6T2R0	0.339
CFS04V2T2R0	0.04040	CFS06V3T1R60	0.086	CFS12V3T2R50	0.605
CFS04V2T2R50	0.06760	CF06V3T2R0	0.115	CFS12V3T3R00	0.933
CFS04V2T3R0	0.09860	CFS06V3T2R50	0.200	CFS12V2T4R0	1.537
CFS04V2T3R15	0.10868	CFS06V3T3R00	0.210	CFS12V2T5R0	2.533
CFS04V2T4R0	0.11450	CFS06V3T3R15	0.279	CFS12V2T7R0	5.684
		CFS06V3T4R0	0.326		
		CFS06V3T5R0	0.622		

Note*: Typical I^2t value is measured at 10x-rated current, Application with surge over 10x-rated current.

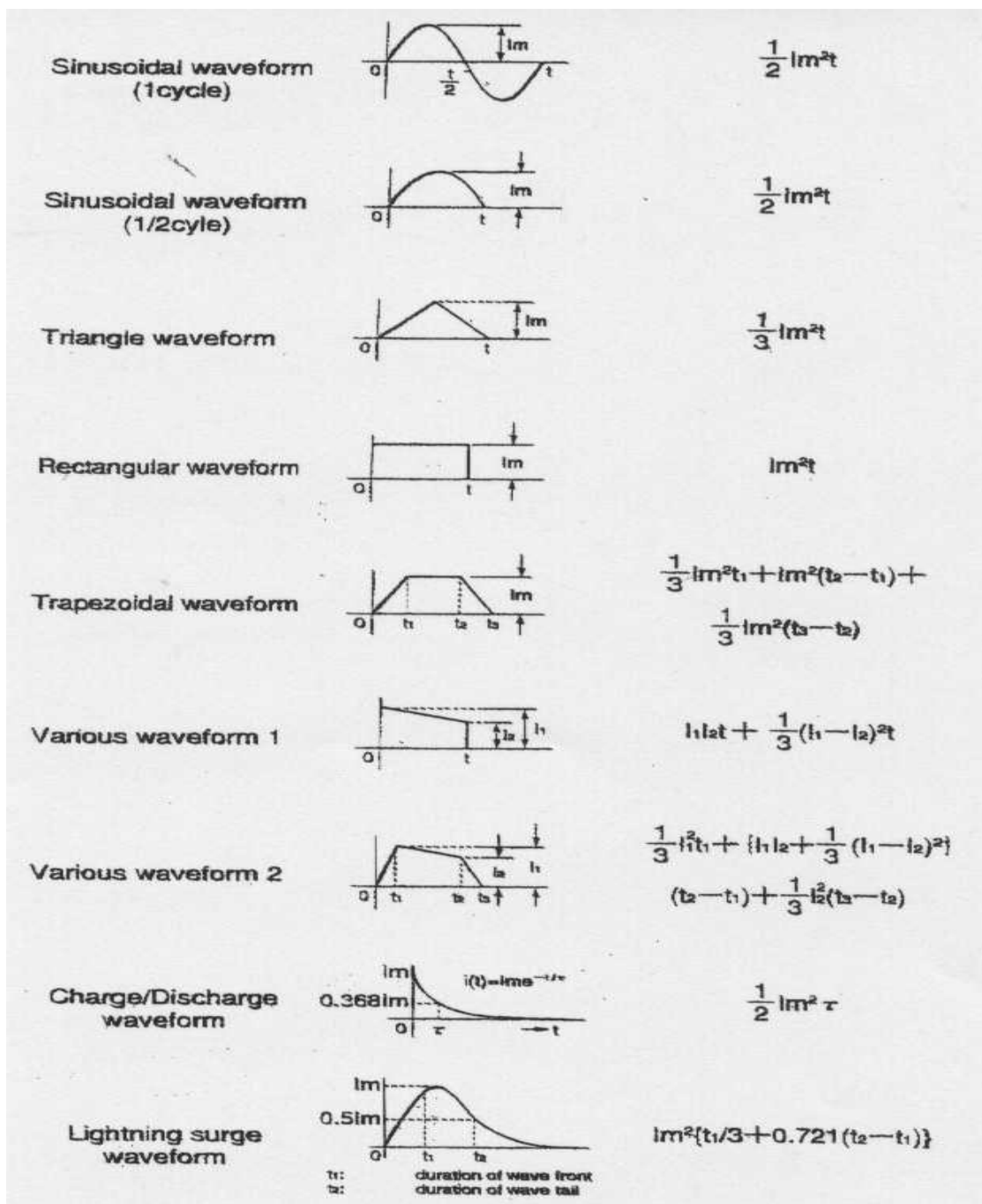
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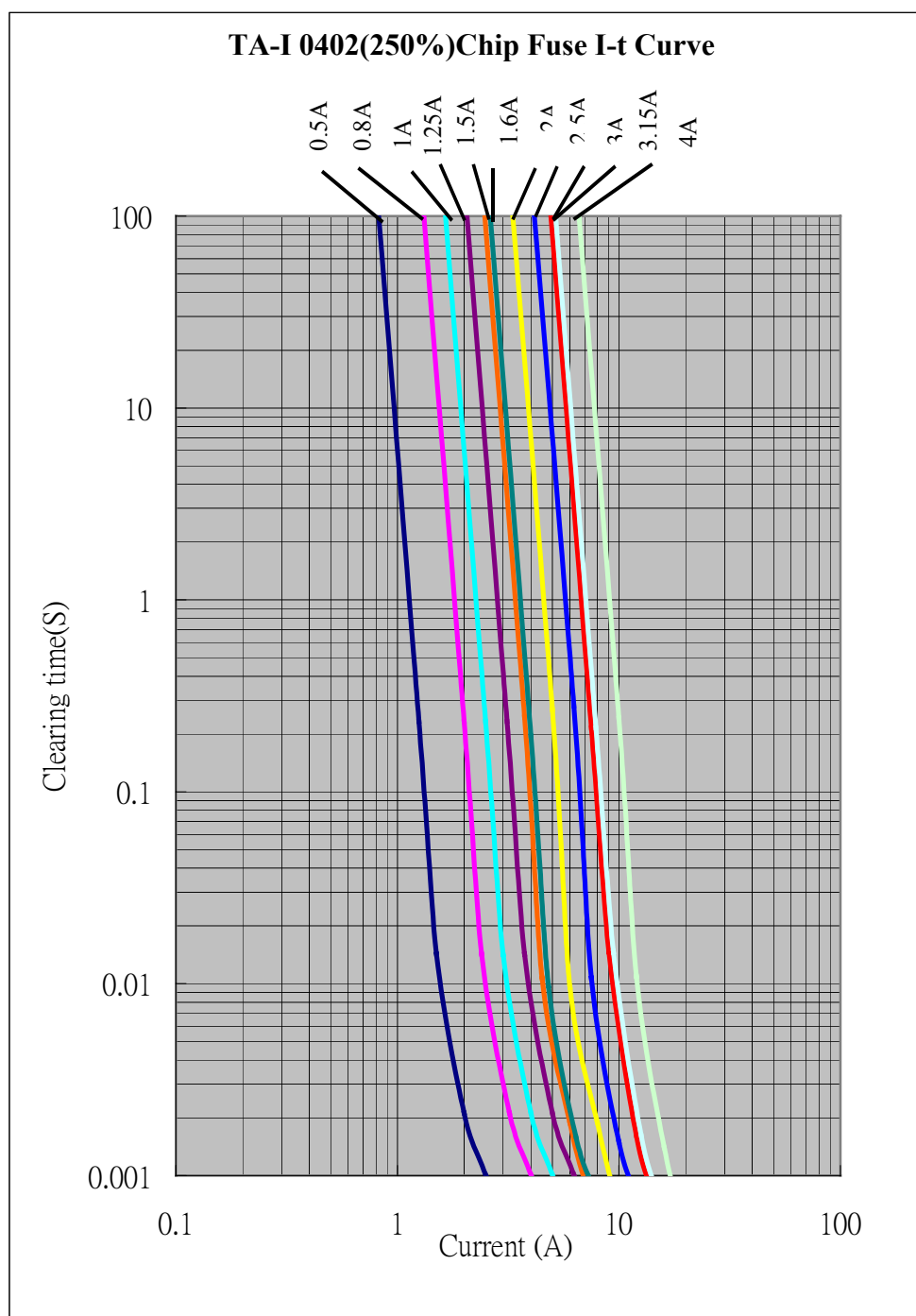
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Inrush Waveform



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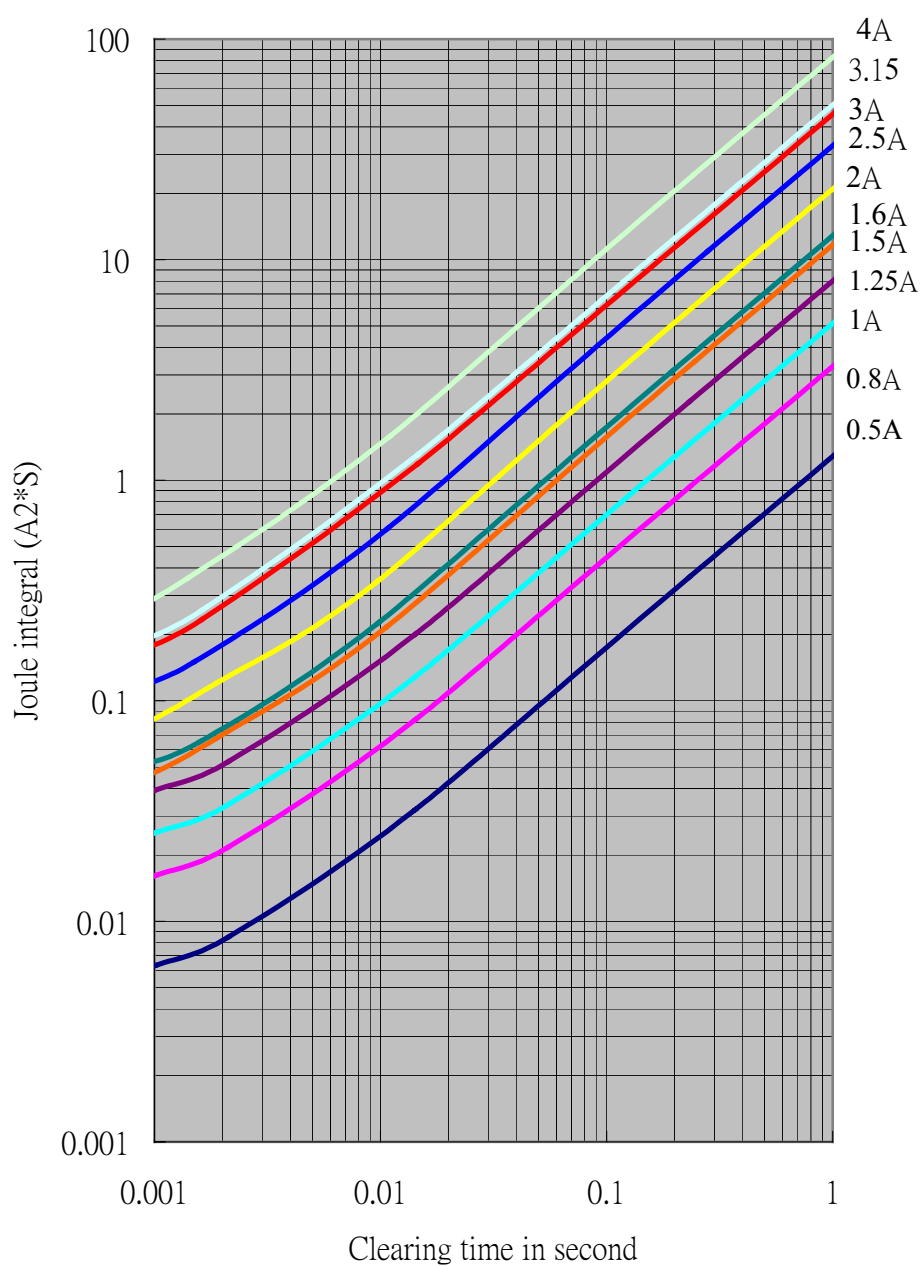
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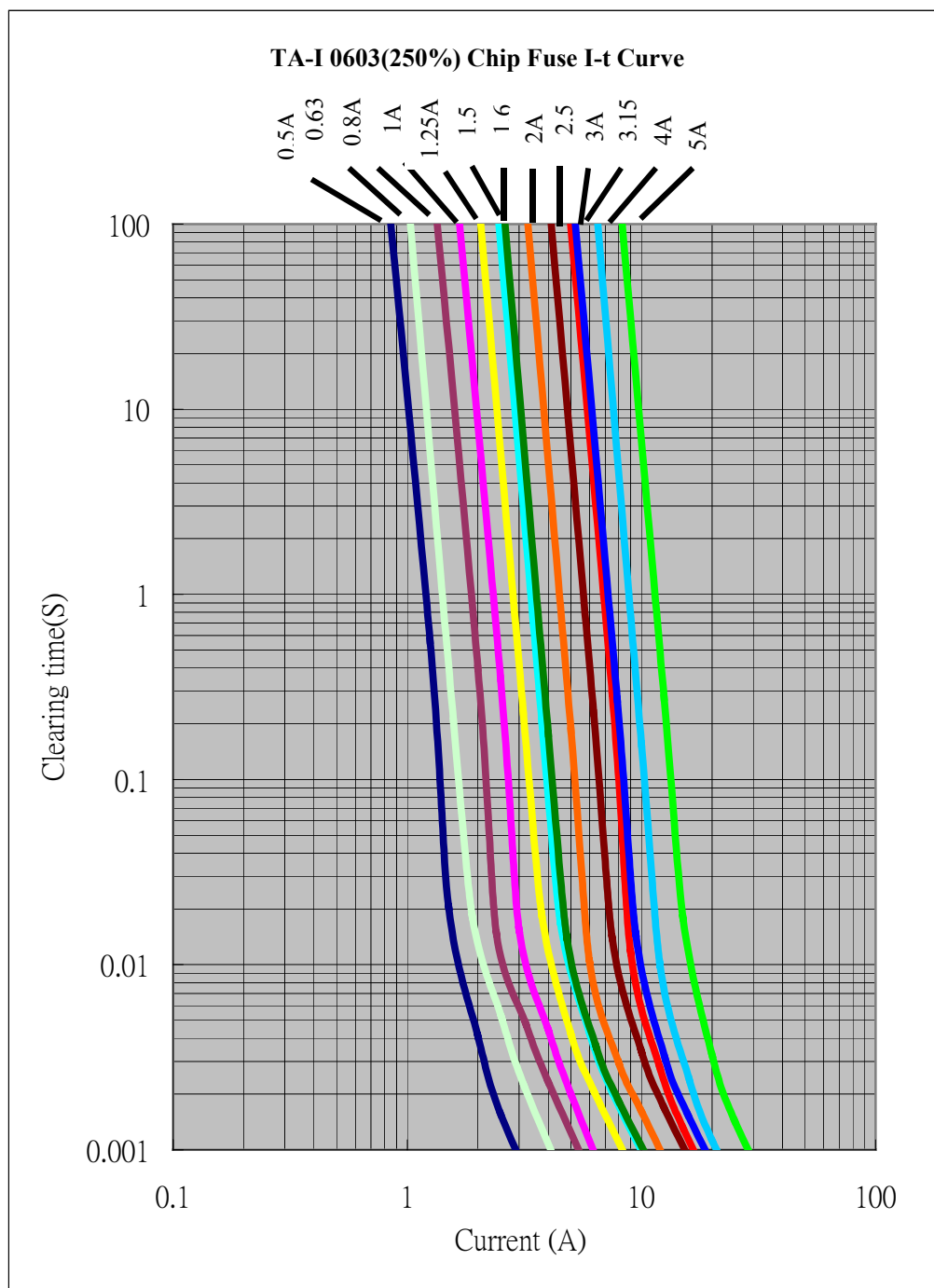
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TA-I 0402(250%) Chip Fuse I²-t Curve



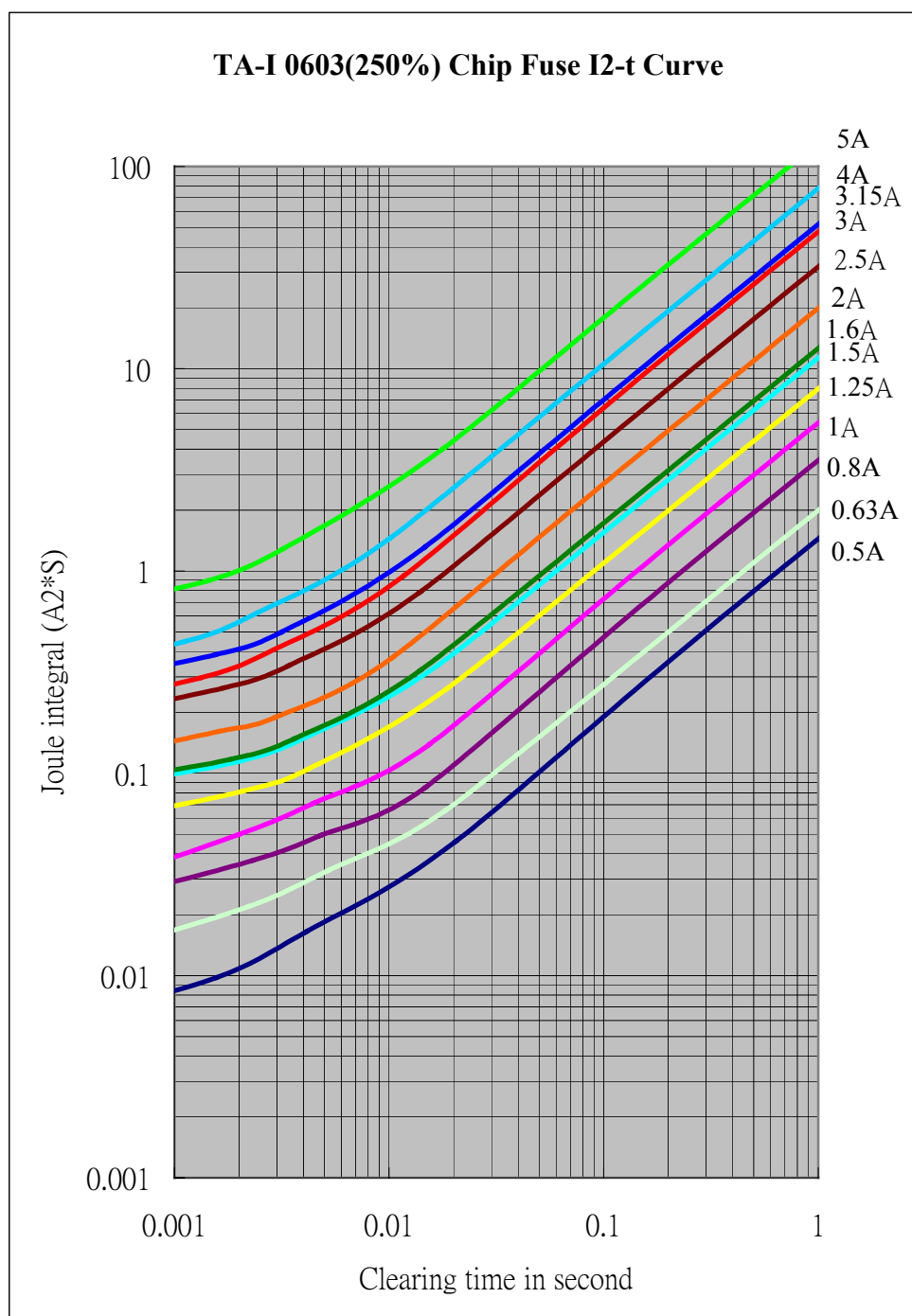
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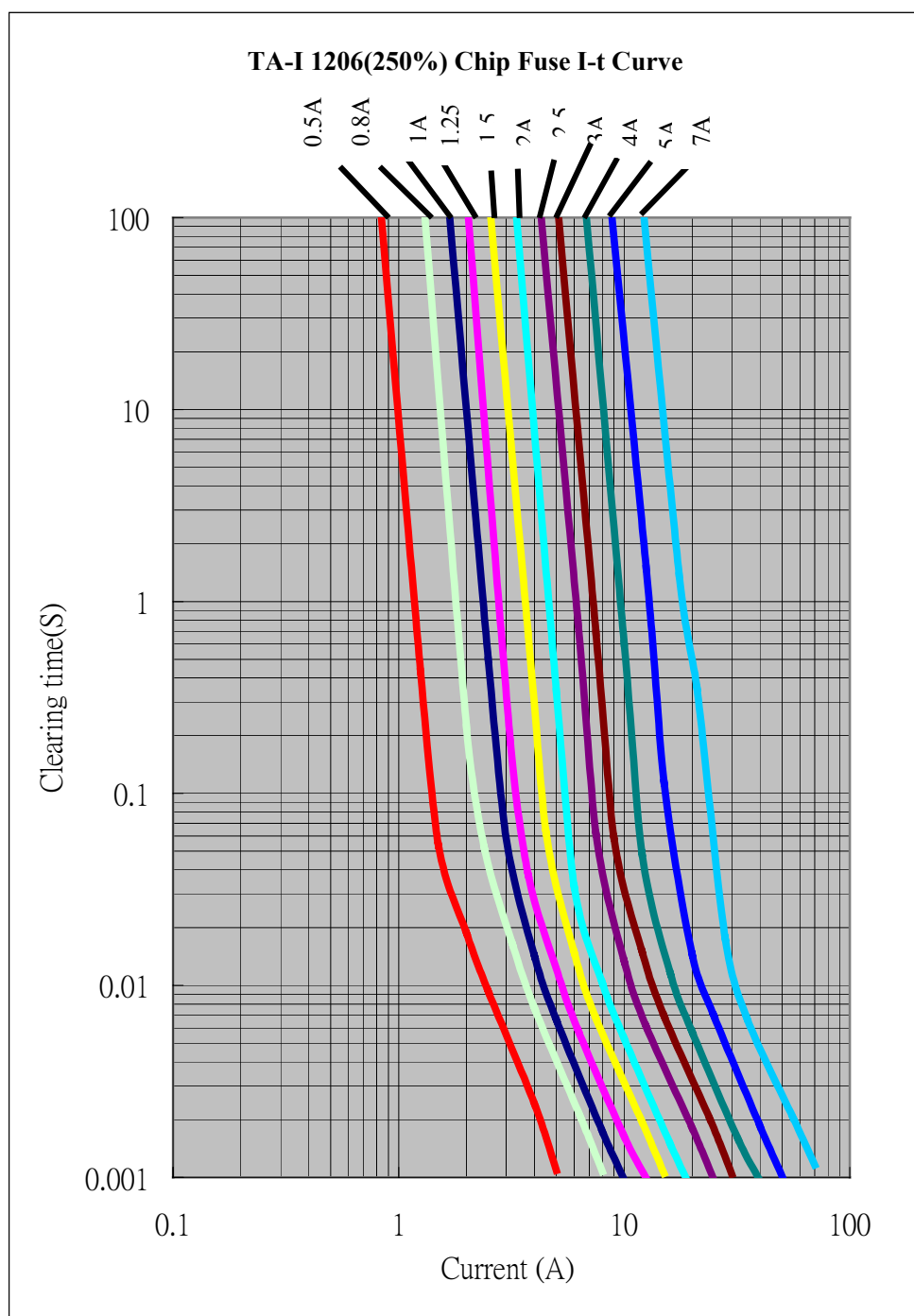
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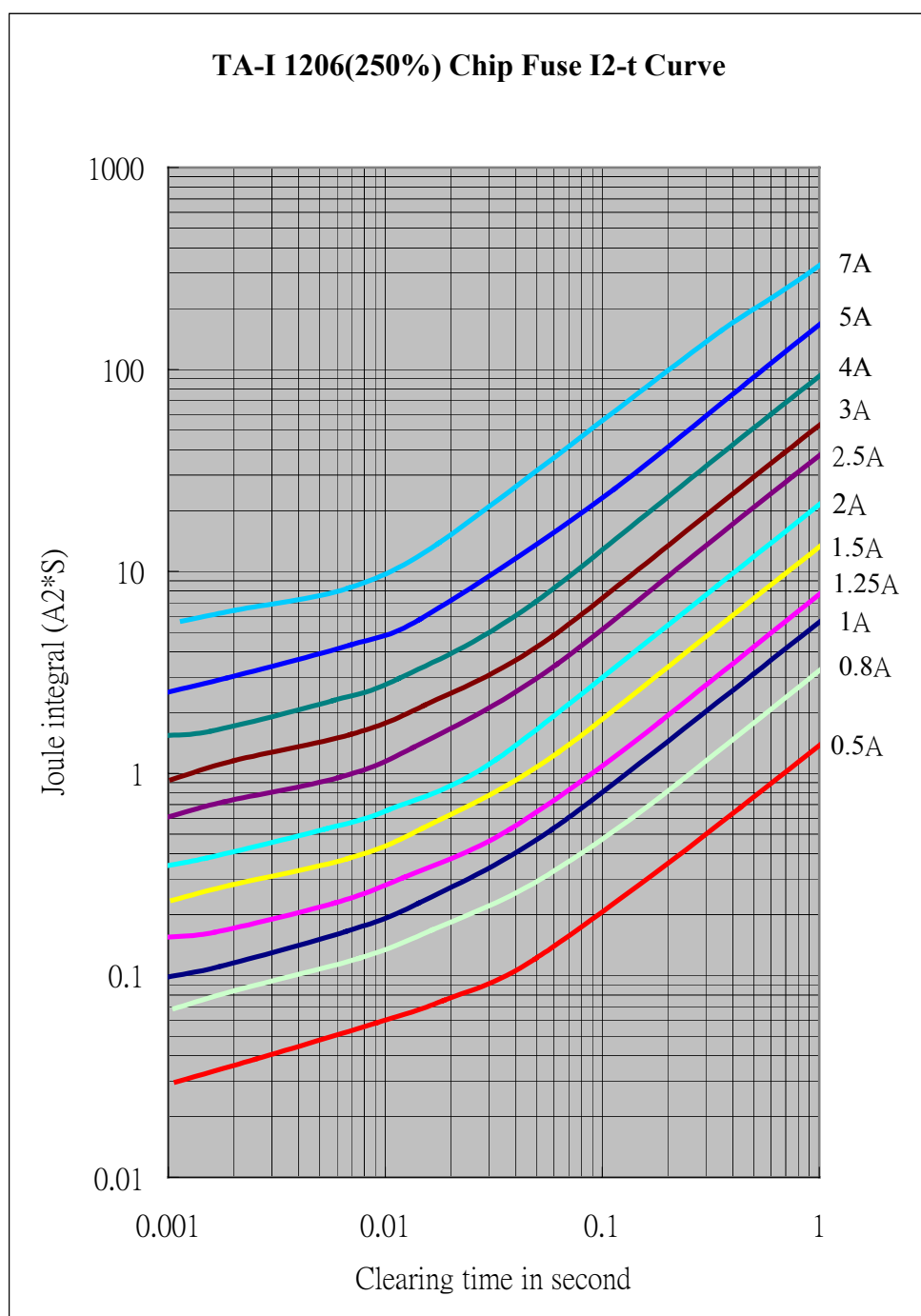
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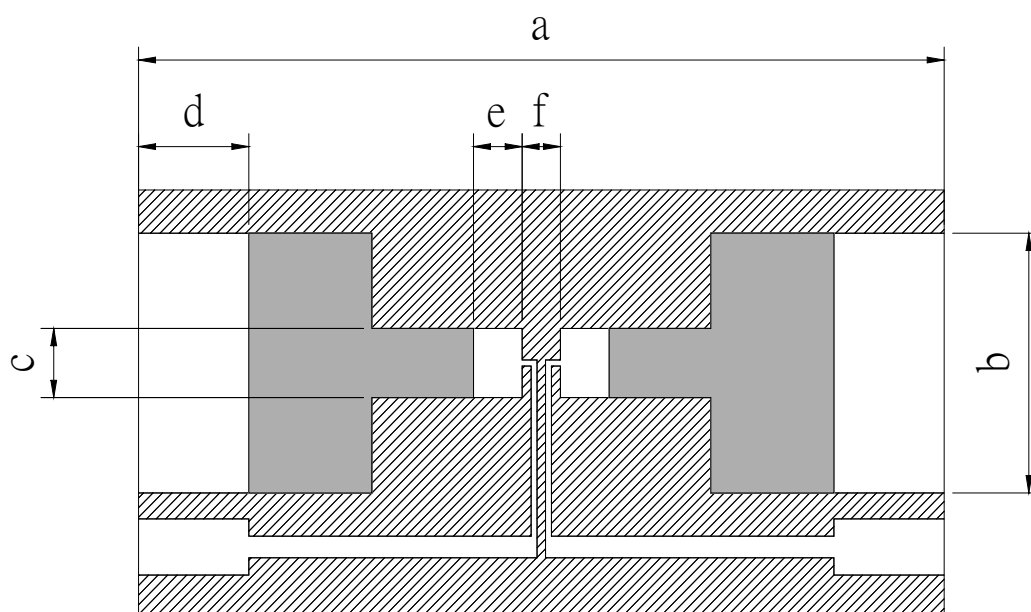
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Tset Circuit Borad



Type	a	b	c	d	e	f
CFS0402	19	6	0.84	2.6	0.61	0.6
CFS0603	19	6	1.6	2.6	1.15	0.9
CFS1206	19	6	2.4	2.6	1.9	1

Unit:mm