



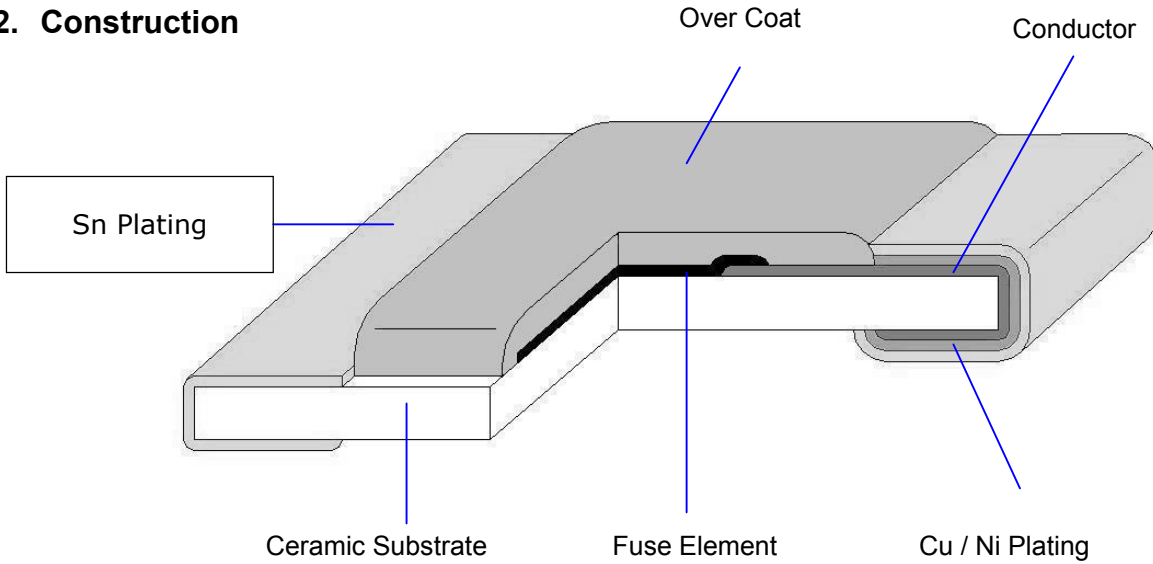
Lead Free Thin Film Chip Fuse

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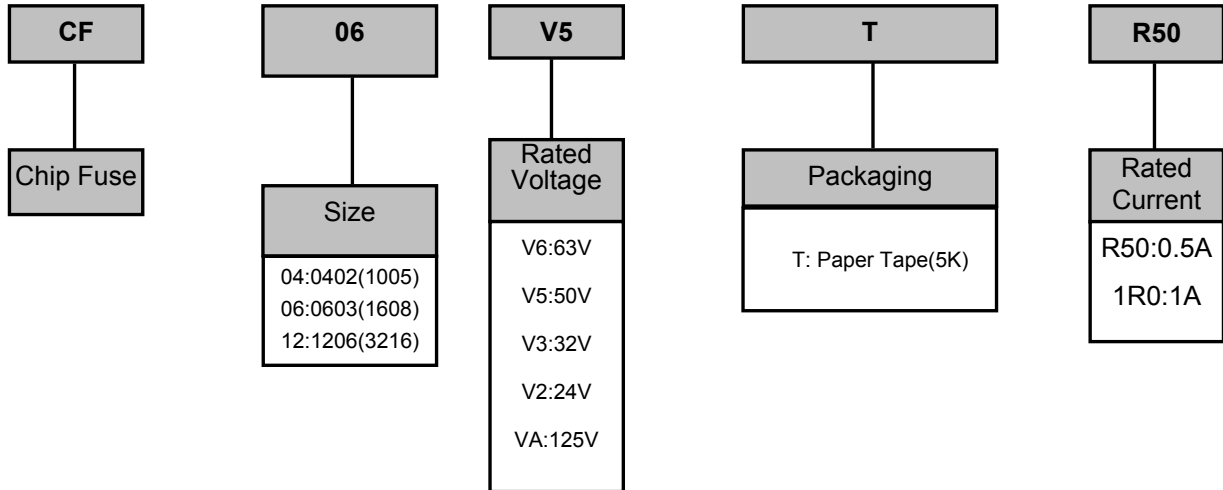
1. Scope

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

2. Construction

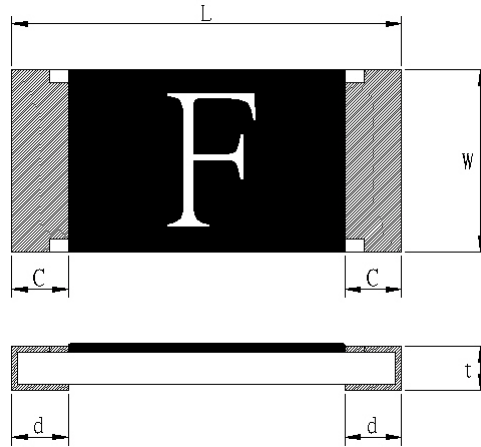


3. Type Designation





4. Dimensions



Unit: mm

| Type (Inch Size code) | Dimensions (mm) | | | | |
|--------------------------|-----------------|-----------|---------|----------|-----------|
| | L | W | C | d | t |
| CF04V (0402) | 1.0±0.1 | 0.52±0.05 | 0.2±0.1 | 0.25±0.1 | 0.35±0.05 |
| CF06V (0603) | 1.6±0.1 | 0.8±0.1 | 0.3±0.2 | 0.35±0.2 | 0.45±0.1 |
| CF12V (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 |
|------------------|---------|---------------|---|--------------------------|---------------|-------------------|--------------------------------|
| CF04V2TR50 | F | 0.50A | Open within 1min.at200% rated current | 320 | DC 24V | DC24V 35A | <75°C at 100% rated current |
| CF04V2TR80 | K | 0.80A | | 120 | | | |
| CF04V2T1R0 | L | 1.00A | | 90 | | | |
| CF04V2T1R25 | M | 1.25A | | 67 | | | |
| CF04V2T1R50 | P | 1.50A | | 51 | | | |
| CF04V2T1R60 | N | 1.60A | | 46 | | | |
| CF04V2T2R0 | S | 2.00A | | 33 | | | |
| CF04V2T2R50 | T | 2.50A | | 25 | | | |
| CF04V2T3R00 | 3 | 3.00A | | 20 | | | |
| CF04V2T3R15 | U | 3.15A | | 19 | | | |
| CF04V2T4R0 | W | 4.00A | | 16 | | | |

*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 |
|------------------|----------|---------------|---------------------------------------|-----------------------|---------------|-------------------|-----------------------------|
| CF06V5TR50 | F | 0.50A | Open within 1min.at200% rated current | 250 | DC 50V | DC50V 50A | <75°C at 100% rated current |
| CF06V3TR63 | I | 0.63A | | 173 | DC 32V | DC32V 50A | |
| CF06V3TR80 | K | 0.80A | | 115 | | | |
| CF06V3T1R0 | L | 1.00A | | 88 | | | |
| CF06V3T1R25 | <u>M</u> | 1.25A | | 63 | | | |
| CF06V3T1R50 | P | 1.50A | | 45 | | | |
| CF06V3T1R60 | N | 1.60A | | 42 | | | |
| CF06V3T2R0 | S | 2.00A | | 33 | | | |
| CF06V2T2R50 | T | 2.50A | | 24 | | | |
| CF06V2T3R00 | 3 | 3.00A | | 21 | | | |
| CF06V2T3R15 | U | 3.15A | | 19 | | | |
| CF06V3T4R0 | W | 4.00A | | 15 | DC 32V | DC32V 50A | |
| CF06V3T5R0 | Y | 5.00A | | 12 | | | |

*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 |
|------------------|----------|---------------|---------------------------------------|-----------------------|---------------|-------------------|-----------------------------|
| CF12V6TR50 | F | 0.50A | Open within 1min.at200% rated current | 590 | DC 63V | DC63V 50A | <75°C at 100% rated current |
| CF12V6TR80 | K | 0.80A | | 225 | | | |
| CF12V6T1R0 | L | 1.00A | | 130 | | | |
| CF12V6T1R25 | <u>M</u> | 1.25A | | 88 | | | |
| CF12V6T1R50 | P | 1.50A | | 65 | | | |
| CF12V6T2R0 | S | 2.00A | | 38 | | | |
| CF12V3T2R50 | T | 2.50A | | 32 | DC 32V | DC32V 50A | |
| CF12V3T3R00 | 3 | 3.00A | | 23 | DC 24V | DC24V 50A | |
| CF12V2T4R0 | W | 4.00A | | 15 | | | |
| CF12V2T5R0 | Y | 5.00A | | 11 | | | |
| CF12V2T7R0 | Z | 7.00A | | 7 | | | |

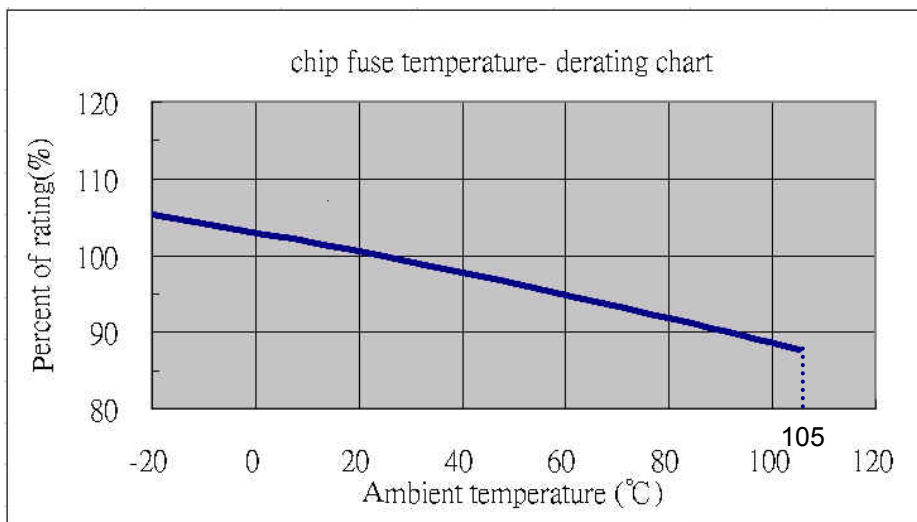
*Resistance valve was measured with less than 10% of rated current



6. Temperatuer Derating Curve

6.1 Normal Ambient Temperature: 25°C

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



7. Reliability Tests

| Parameter | Requirement | Test Method | Reference standard |
|---------------------------|--|--|--------------------|
| Carrying capacity | No fusing | Rated current ,4hr | UL-248-14 |
| Fusing Time | Within 1 minute | 200% of its rated current | UL-248-14 |
| Interrupting Ability | No mechanical damages | After the fuse is interrupted ,rated voltage applied for 30sec again | UL-248-14 |
| Bending Test | No mechanical damages | Distance between holding points: 90mm, Bending:3mm,1time ,30sec | JIS-C5202-6.1 |
| Resistance to solder Heat | ±20% | 260°C±5°C, 10seconds ±1second | JIS-C5202-6.10 |
| Solderability | 95% coverage minimum | 235°C±5°C, 2±0.5second 245°C±5°C, 2±0.5second (Lead Free) | JIS-C5202-6.11 |
| Temperature Rise | <75°C | 100% of its rated current, Measure of surface temperature | UL-248-14 |
| Resistance to Dry Heat | ±20% | 105°C±5°C, 1000 hrs | JIS-C5202-7.2 |
| Resistance to Solvent | No evident damages on protective coating and marking | 23°C±5°C of Isopropyl alcohol 90second | JIS-C5202-6.4 |
| Residual Resistance | 10kΩ and more | Measure DC resistance after fusing | |
| Thermal Shock | ΔR< 10 % | -20°C/ +25°C/+125°C/+25°C , 10 cycles | JIS-C5202-7.2 |



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8. Marking

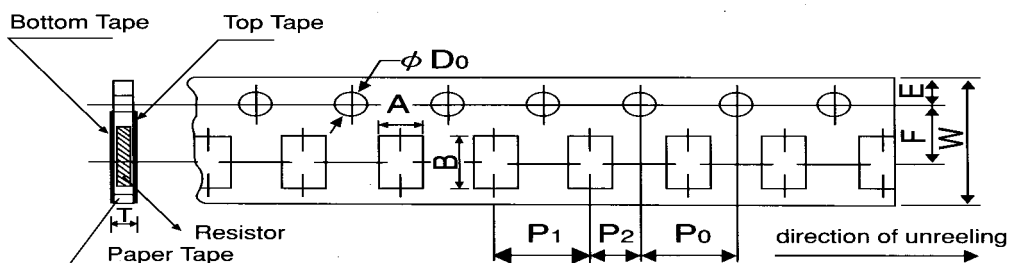
Symbol for Rating Current

| 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 | CF04V | 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 | CF06V | 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 | CF12V | 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 |
| CF | 04V | 180mm/R |
| | | 10000 |

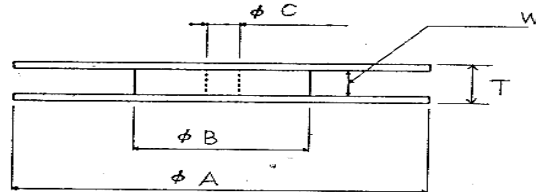
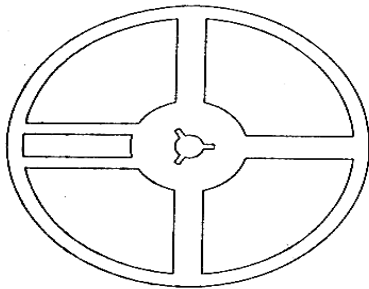
| | | |
|-------------|-----|------------|
| Type series | | Paper Tape |
| | | 4 mm pitch |
| CF | 06V | 5000 |
| | 12V | 5000 |



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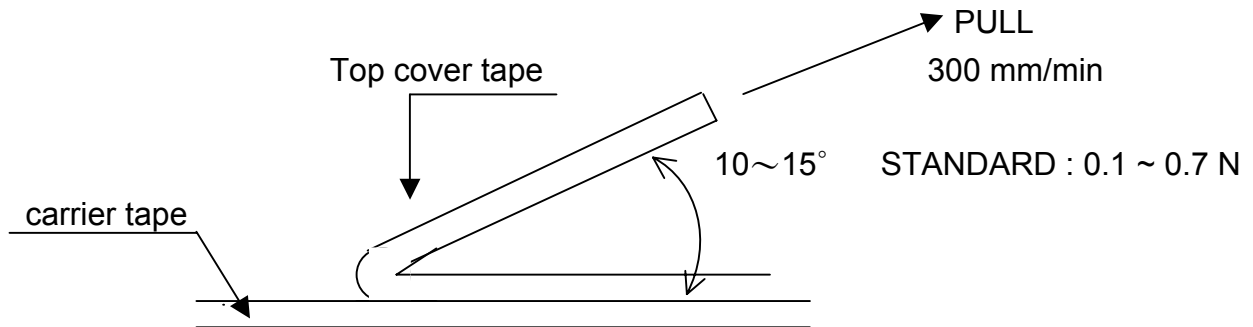
9.2 Reel Specifications



Unit: mm

| Series | ϕA | ϕB | ϕC | W | T |
|-------------------------|---------------------------------|----------|----------|---------|----------|
| CF04V CF06V CF12V | 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:

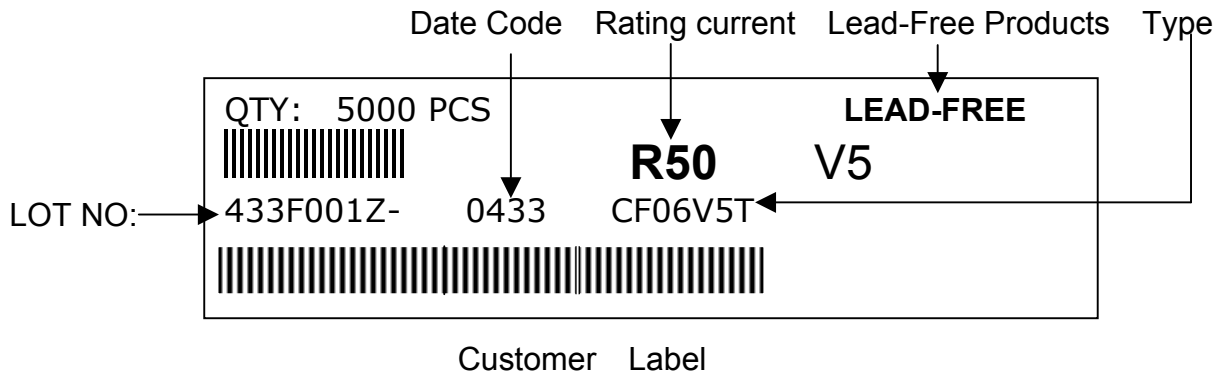
2 years from manufacturing date



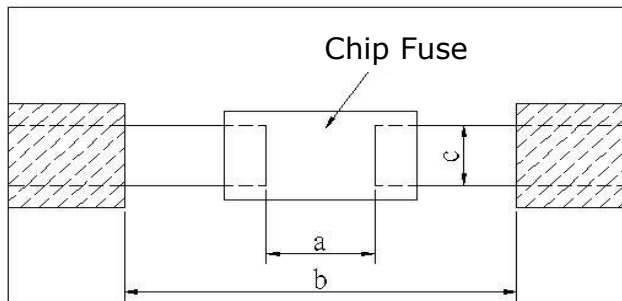
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12. Label



13. Recommended land patterns

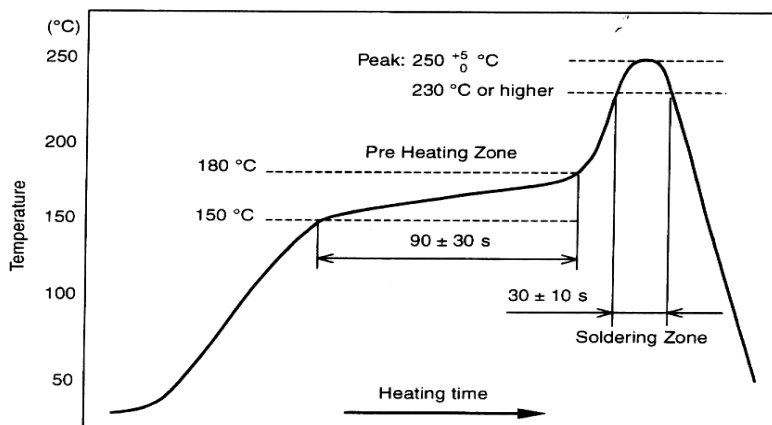


| Type | Land pattern Size | Dimension | | |
|------|----------------------|-----------|---------|---------|
| | | a | b | c |
| CF | 04 (0402) | 0.5~0.6 | 1.4~1.6 | 0.4~0.6 |
| CF | 06 (0603) | 0.7~0.9 | 2.0~2.2 | 0.8~1.0 |
| CF | 12 (1206) | 2.0~2.4 | 4.4~5.0 | 1.2~1.8 |



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



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

17. Manufacturing Country & City :

FORTUNE TASK RESISTOR FACTORY (China – ShenZhen)

Tel : 86-755-81469544 Fax : 86-755-89635672

Associated companies :

SHENZHEN MEILONG ELECTRONIC CO.,LTD.

Tel: 86-755-82533555 Fax : 86-755-82533444



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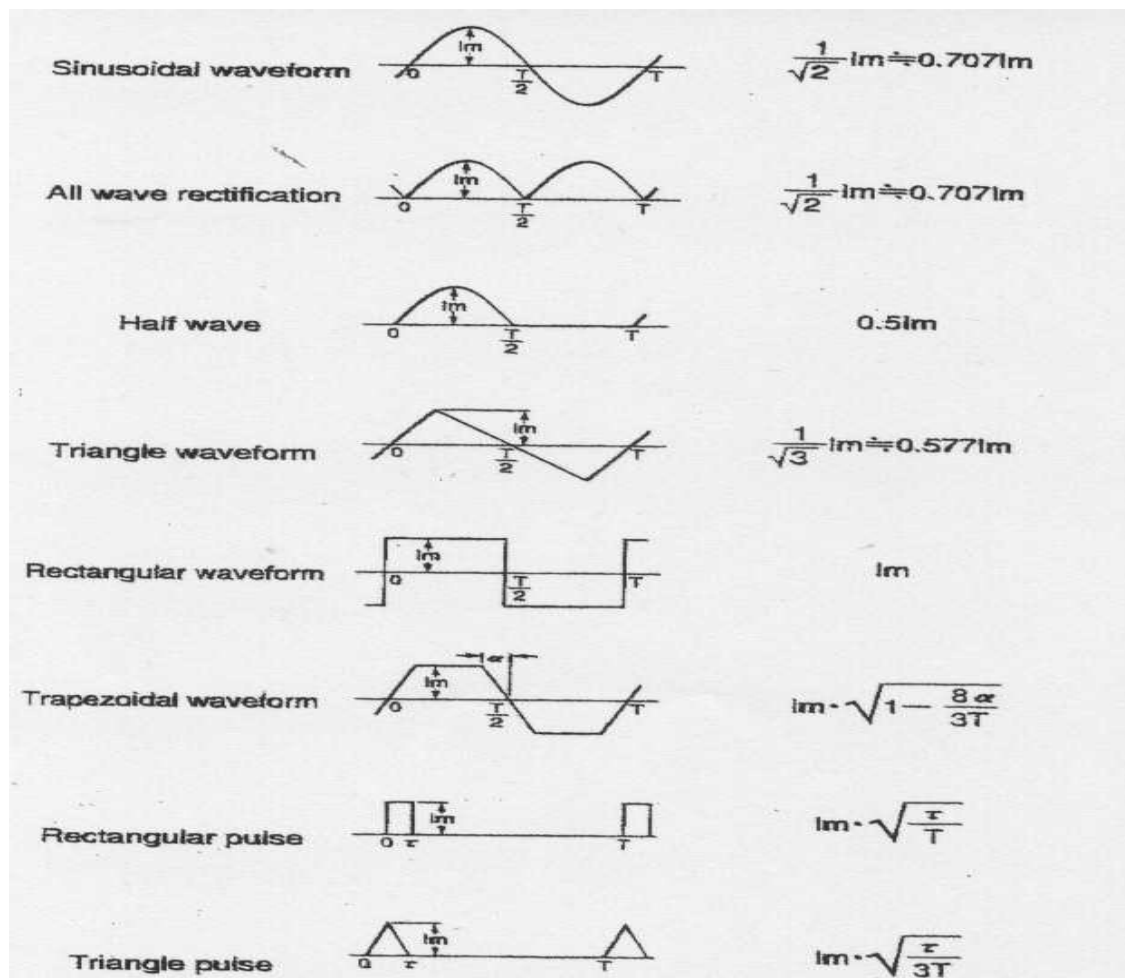
★ Selection Guideline of Fuse:

■ 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 $I_p = 1.5 A$, Normal operating current = 1.5 A



It is necessary to provide derating for pulse current with interval greater than 0.1 s.



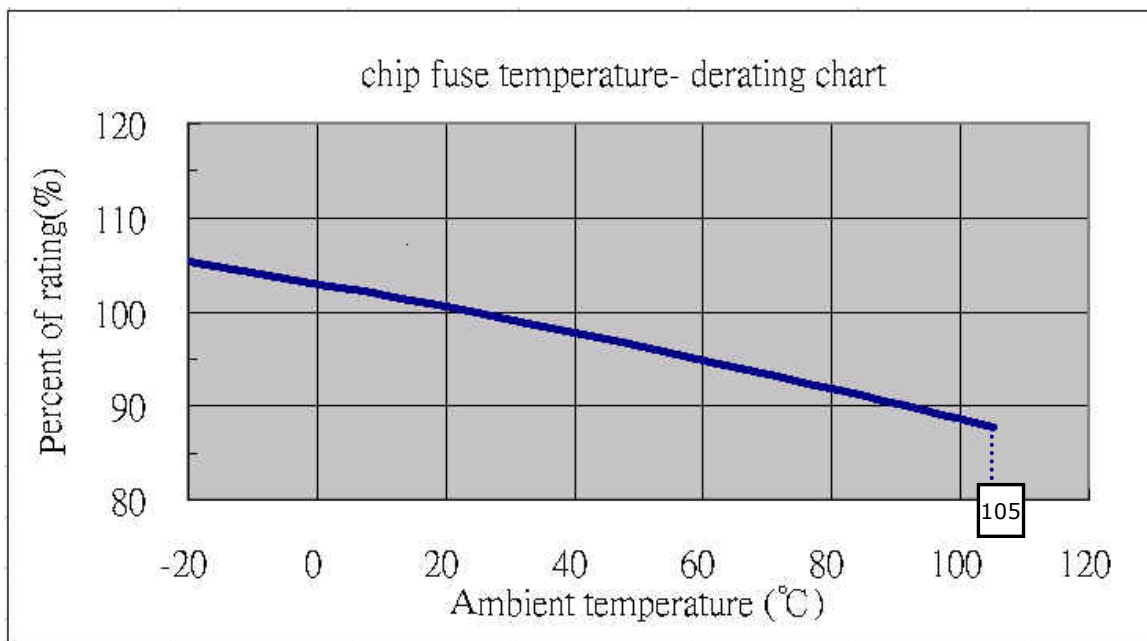
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Derating ratio for different ambient Temperature

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 CF06V2T2R50 .

| Part Designation | Marking | Rated Current | Rated Voltage | Part Designation | Marking | Rated Current | Rated Voltage | Part Designation | Marking | Rated Current | Rated Voltage |
|------------------|----------|---------------|---------------|------------------|----------|---------------|---------------|------------------|----------|---------------|---------------|
| CF04V2TR50 | F | 0.5A | 24V | CF06V5TR50 | F | 0.5A | 50V | CF12V6TR50 | F | 0.50A | 63V |
| CF04V2TR80 | K | 0.80A | 24V | CF06V3TR63 | I | 0.63A | 32V | CF12V6TR80 | K | 0.80A | 63V |
| CF04V2T1R0 | L | 1.00A | 24V | CF06V3TR80 | K | 0.80A | 32V | CF12V6T1R0 | L | 1.00A | 63V |
| CF04V2T1R25 | <u>M</u> | 1.25A | 24V | CF06V3T1R0 | L | 1.00A | 32V | CF12V6T1R25 | <u>M</u> | 1.25A | 63V |
| CF04V2T1R50 | P | 1.50A | 24V | CF06V3T1R25 | <u>M</u> | 1.25A | 32V | CF12V61R50 | P | 1.50A | 63V |
| CF04V2T1R60 | N | 1.60A | 24V | CF06V3T1R50 | P | 1.50A | 32V | CF12V6T2R0 | S | 2.00A | 63V |
| CF04V2T2R0 | S | 2.00A | 24V | CF06V3T1R60 | N | 1.60A | 32V | CF12V3T2R50 | T | 2.50A | 32V |
| CF04V2T2R50 | T | 2.50A | 24V | CF06V3T2R0 | S | 2.00A | 32V | CF12V3T3R00 | 3 | 3.00A | 32V |
| CF04V2T3R00 | 3 | 3.00A | 24V | CF06V2T2R50 | T | 2.50A | 24V | CF12V2T4R0 | W | 4.00A | 24V |
| CF04V2T3R15 | U | 3.15A | 24V | CF06V2T3R00 | 3 | 3.00A | 24V | CF12V2T5R0 | Y | 5.00A | 24V |
| CF04V2T4R0 | W | 4.00A | 24V | CF06V2T3R15 | U | 3.15A | 24V | CF12V2T7R0 | Z | 7.00A | 24V |
| | | | | CF06V3T4R0 | W | 4.00A | 32V | | | | |
| | | | | CF06V3T5R0 | 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 , $I_p = 4 A$, $t = 1 (ms)$,

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

2. Choosing CF06V2T2R5 ($I^2t = 0.055 (A^2s)$) \Rightarrow Page 12 index-table

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

Calculating :

\curvearrowright Inrush 100,000 times

1. Choosing fuse's I^2t (A²s) value X Derating ratio > calculate I^2t (A²s) value
2. $0.055 \times 0.35 = 0.01925 (A^2s)$



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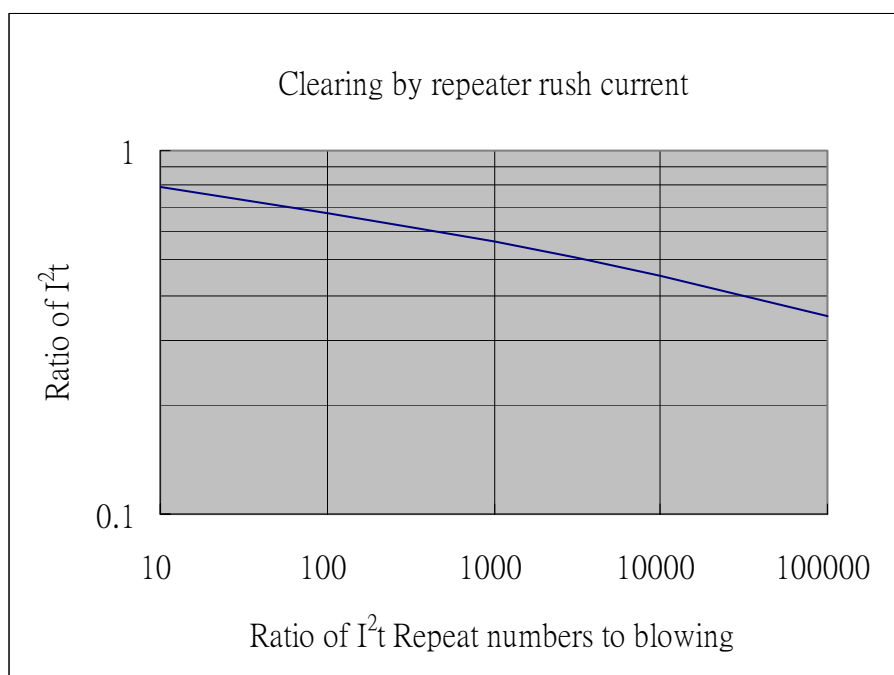
4. $0.01925 > 0.016$

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) |
| CF04V2TR50 | 0.00317 | CF06V5TR50 | 0.005 | CF12V6TR50 | 0.011 |
| CF04V2TR80 | 0.00532 | CF06V3TR63 | 0.007 | CF12V6TR80 | 0.031 |
| CF04V2T1R0 | 0.00724 | CF06V3TR80 | 0.014 | CF12V6T1R0 | 0.034 |
| CF04V2T1R25 | 0.01344 | CF06V3T1R0 | 0.016 | CF12V6T1R25 | 0.062 |
| CF04V2T1R50 | 0.01356 | CF06V3T1R25 | 0.027 | CF12V6T1R50 | 0.144 |
| CF04V2T1R60 | 0.01672 | CF06V3T1R50 | 0.037 | CF12V6T2R0 | 0.181 |
| CF04V2T2R0 | 0.01983 | CF06V3T1R60 | 0.041 | CF12V3T2R50 | 0.351 |
| CF04V2T2R50 | 0.03763 | CF06V3T2R0 | 0.044 | CF12V3T3R00 | 0.501 |
| CF04V2T3R00 | 0.05427 | CF06V2T2R50 | 0.055 | CF12V2T4R0 | 0.954 |
| CF04V2T3R15 | 0.06304 | CF06V2T3R00 | 0.082 | CF12V2T5R0 | 0.966 |
| CF04V2T4R0 | 0.0896 | CF06V2T3R15 | 0.089 | CF12V2T7R0 | 3.25 |
| | | CF06V3T4R0 | 0.239 | | |
| | | CF06V3T5R0 | 0.433 | | |

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

Please confirm with us.





Inrush Waveform

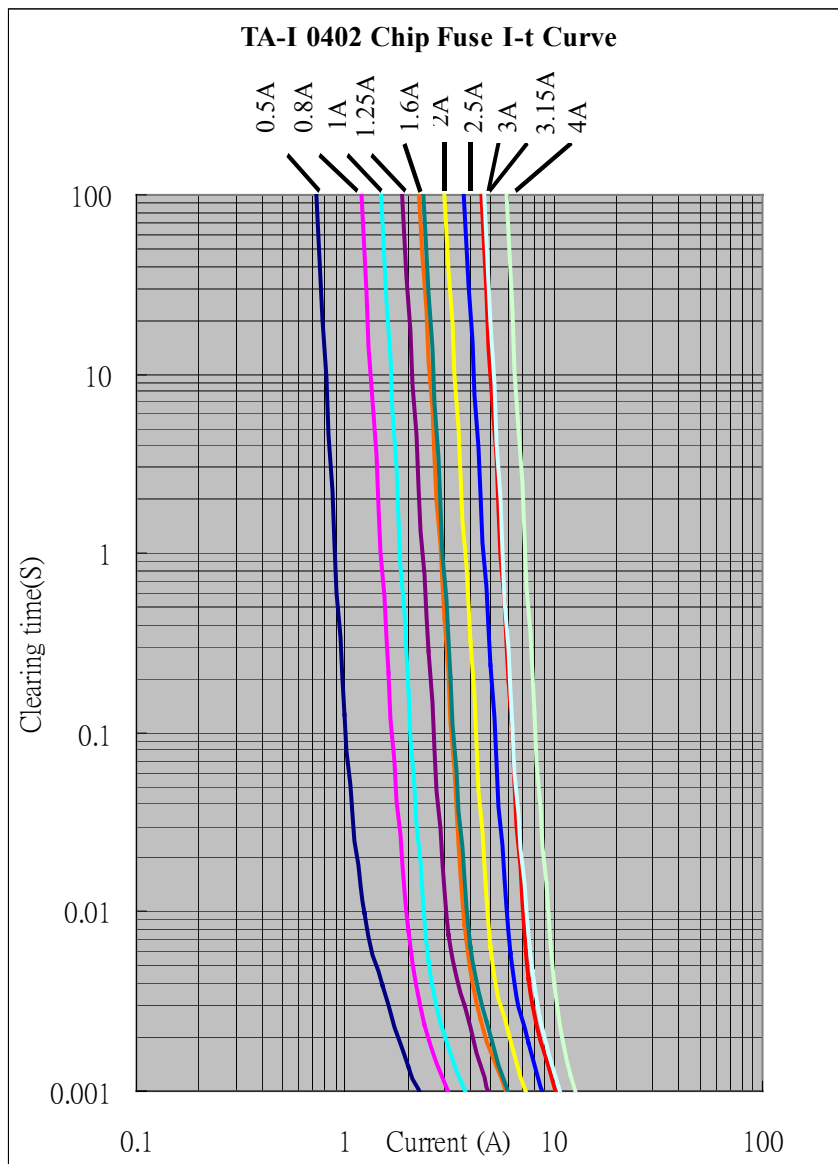
| | | |
|------------------------------------|--|---|
| Sinusoidal waveform (1 cycle) | | $\frac{1}{2} Im^2 t$ |
| Sinusoidal waveform (1/2 cycle) | | $\frac{1}{2} Im^2 t$ |
| Triangle waveform | | $\frac{1}{3} Im^2 t$ |
| Rectangular waveform | | $Im^2 t$ |
| Trapezoidal waveform | | $\frac{1}{3} Im^2 t_1 + Im^2 (t_2 - t_1) + \frac{1}{3} Im^2 (t_3 - t_2)$ |
| Various waveform 1 | | $I_1 I_2 t + \frac{1}{3} (I_1 - I_2)^2 t$ |
| Various waveform 2 | | $\frac{1}{3} I_1^2 t_1 + \{I_1 I_2 + \frac{1}{3} (I_1 - I_2)^2\} (t_2 - t_1) + \frac{1}{3} I_2^2 (t_3 - t_2)$ |
| Charge/Discharge waveform | | $\frac{1}{2} Im^2 \tau$ |
| Lightning surge waveform | | $Im^2 \{t_1/3 + 0.721 (t_2 - t_1)\}$ |

t_1 : duration of wave front
 t_2 : duration of wave tail



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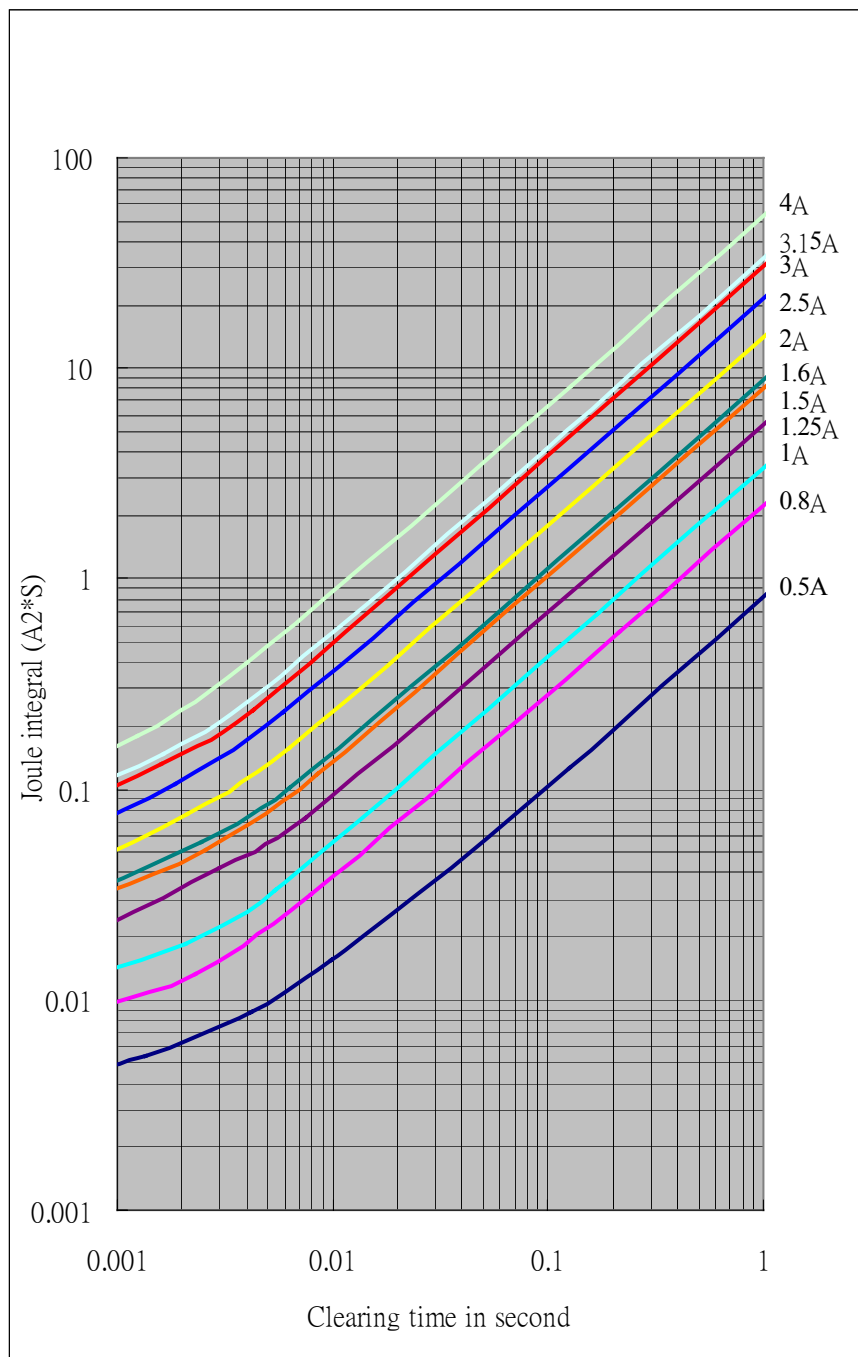
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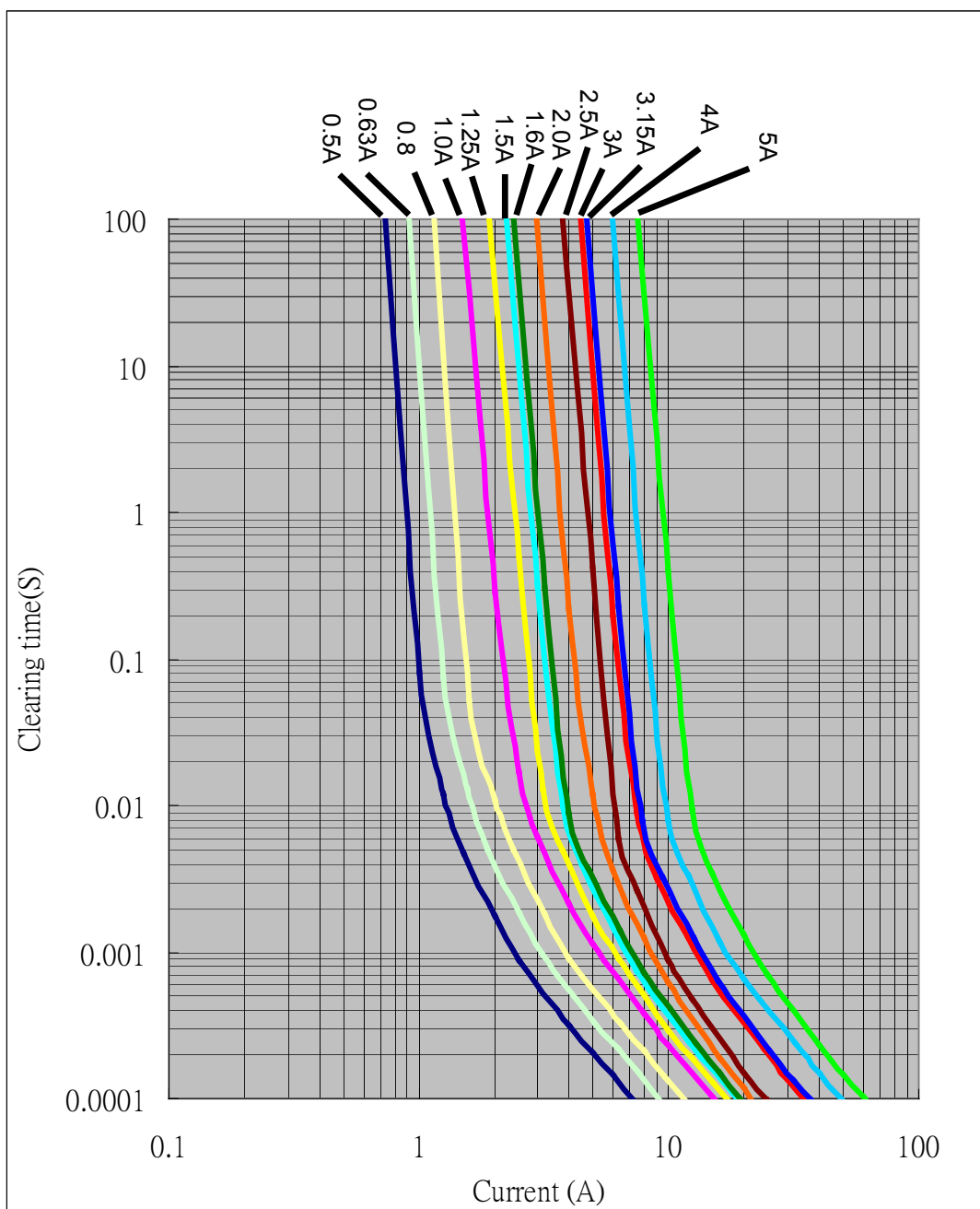
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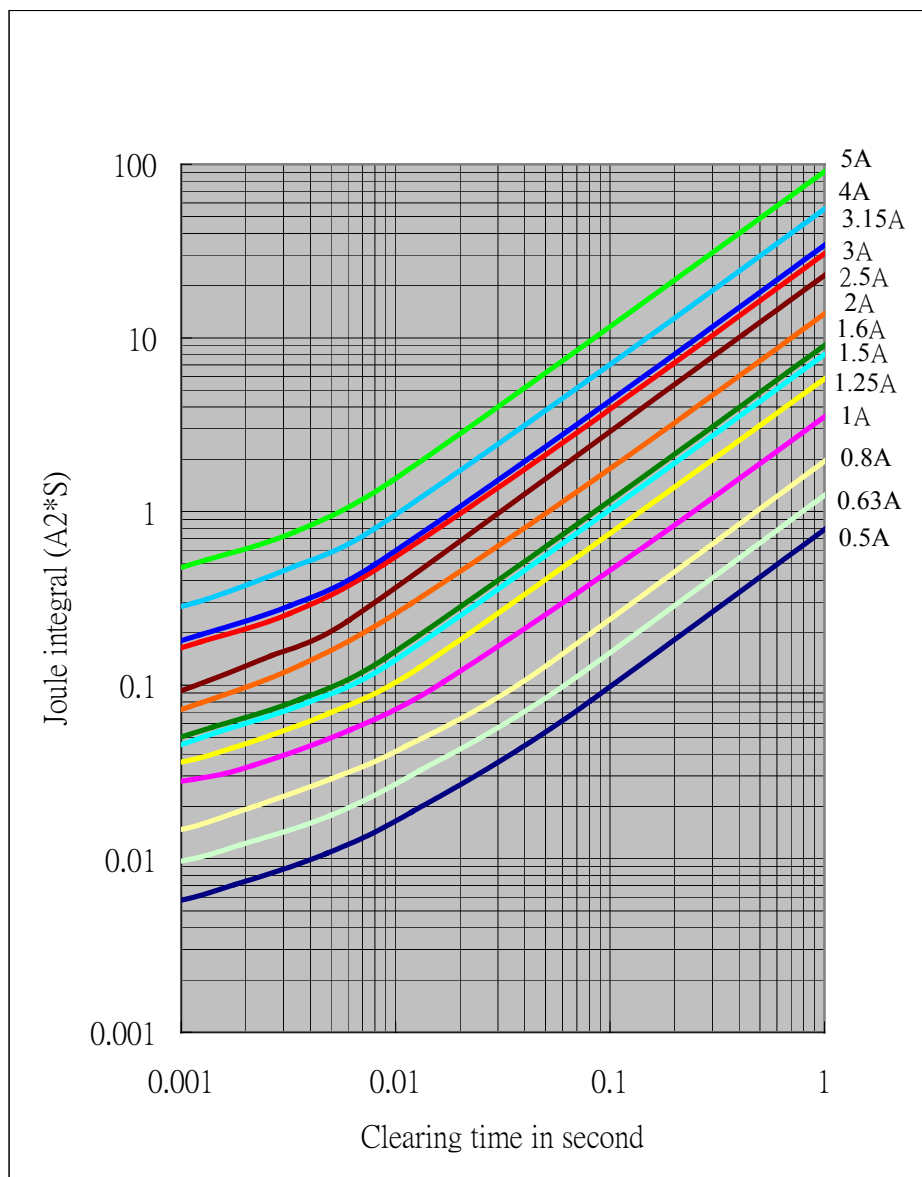
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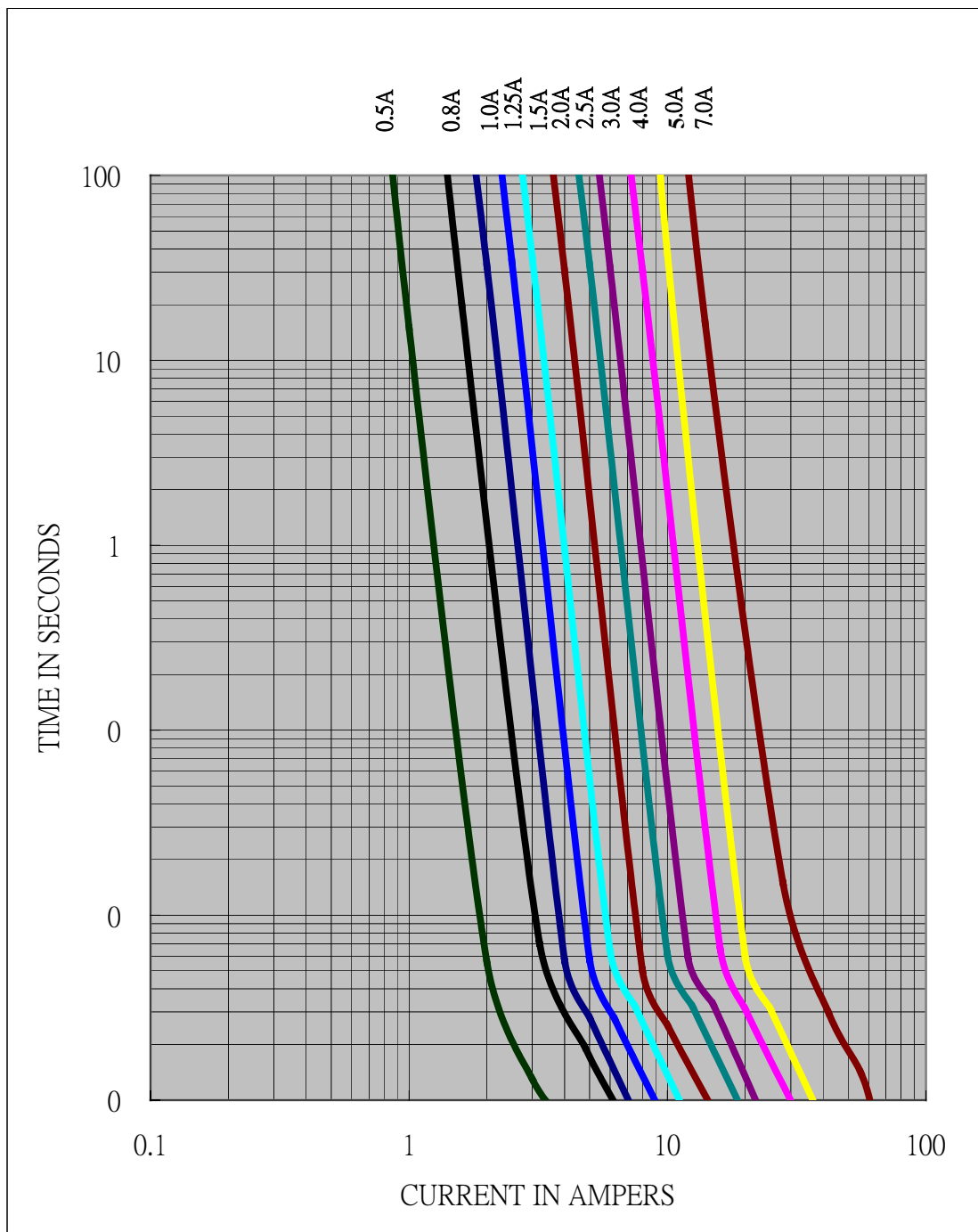
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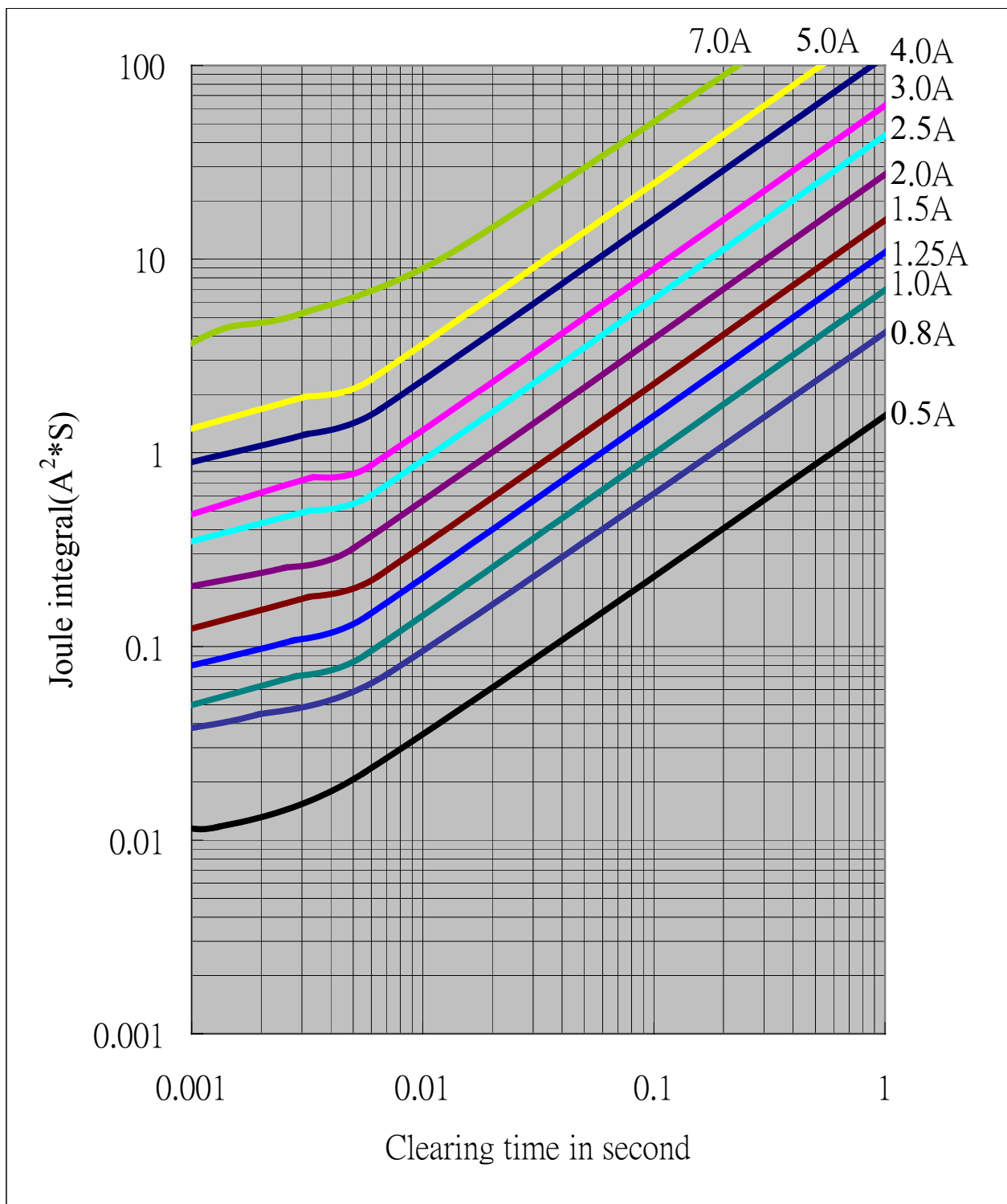
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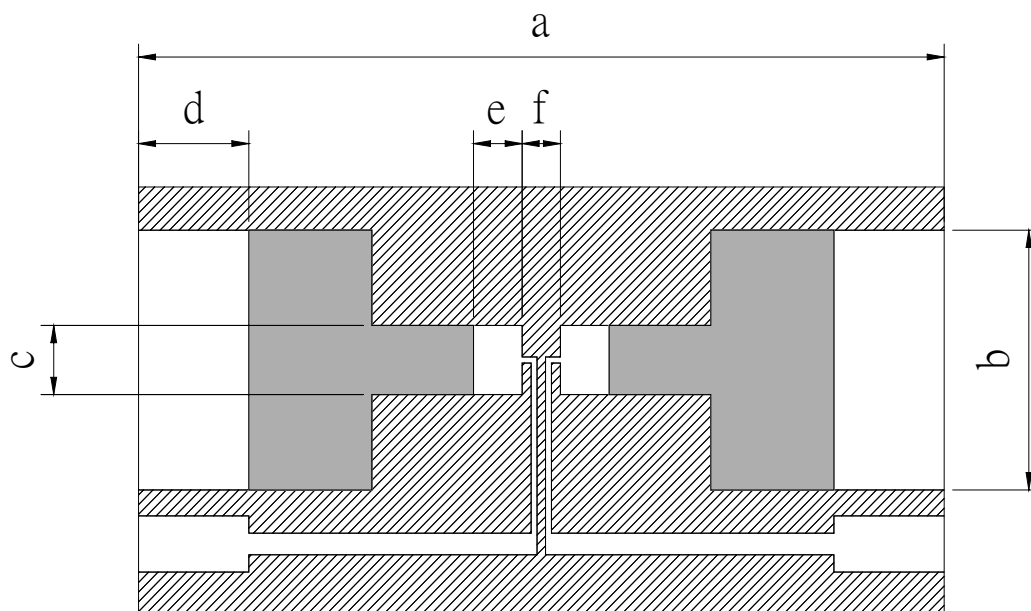




Lead Free Thin Film Chip Fuse

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Tset Circuit Borad



| Type | a | b | c | d | e | f |
|--------|----|---|------|-----|------|-----|
| CF0402 | 19 | 6 | 0.84 | 2.6 | 0.61 | 0.6 |
| CF0603 | 19 | 6 | 1.6 | 2.6 | 1.15 | 0.9 |
| CF1206 | 19 | 6 | 2.4 | 2.6 | 1.9 | 1 |

Unit:mm