



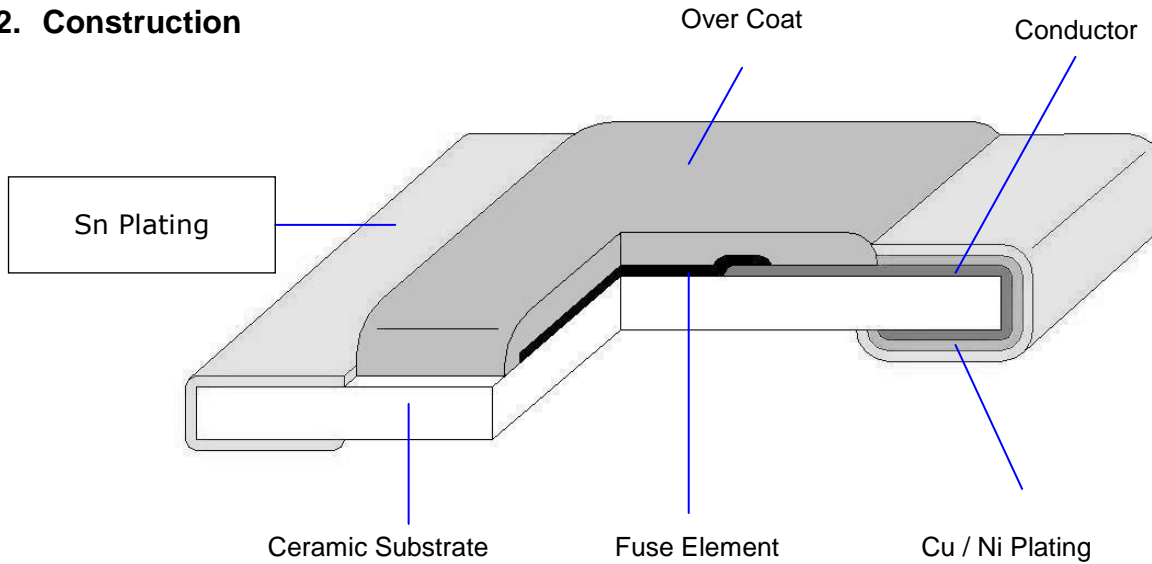
# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 1/20          |

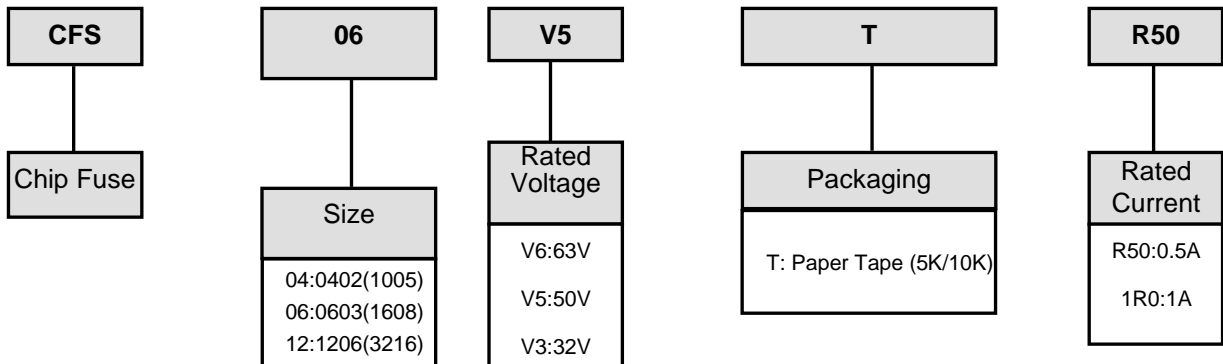
## 1. Scope

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

## 2. Construction



## 3. Type Designation

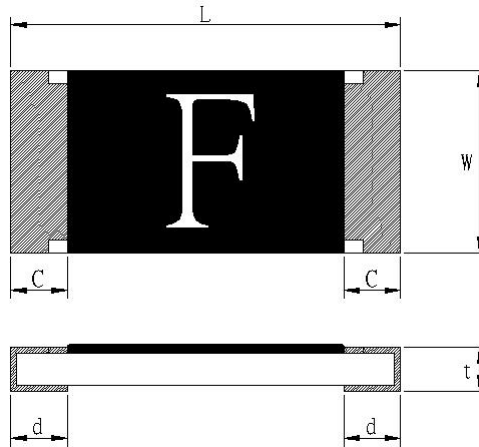




# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 2/20          |

## 4. Dimensions



Unit: mm

| Type<br>(Inch Size code) | Dimensions (mm) |           |         |          |           |
|--------------------------|-----------------|-----------|---------|----------|-----------|
|                          | L               | W         | C       | d        | t         |
| CFS04<br>(0402)          | 1.0±0.1         | 0.52±0.05 | 0.2±0.1 | 0.25±0.1 | 0.35±0.05 |
| CFS06<br>(0603)          | 1.6±0.1         | 0.8±0.10  | 0.3±0.2 | 0.35±0.2 | 0.45±0.10 |
| CFS12<br>(1206)          | 3.1±0.1         | 1.55±0.10 | 0.5±0.3 | 0.50±0.2 | 0.60±0.10 |

## 5. Applications and ratings

| Part Designation | Marking | Rated Current | Fusing Time                                 | Resistance (mΩ)<br>Tolerance±25% | Rated Voltage | Breaking Capacity | Body Temperature rising           |
|------------------|---------|---------------|---|----------------------------------|---------------|-------------------|-----------------------------------|
| CFS04V3TR50      | F       | 0.50A         | Open within<br>5sec.at250%<br>rated current | 300                              | DC 32V        | DC32V<br>35A      | <75°C at<br>100% rated<br>current |
| CFS04V3TR80      | K       | 0.80A         |   | 78                               |               |                   |                                   |
| CFS04V3T1R0      | L       | 1.00A         |   | 75                               |               |                   |                                   |
| CFS04V3T1R25     | M       | 1.25A         |   | 44                               |               |                   |                                   |
| CFS04V3T1R50     | P       | 1.50A         |   | 34.5                             |               |                   |                                   |
| CFS04V3T1R60     | N       | 1.60A         |   | 29.5                             |               |                   |                                   |
| CFS04V3T2R0      | S       | 2.00A         |   | 23                               |               |                   |                                   |
| CFS04V3T2R50     | T       | 2.50A         |   | 18                               |               |                   |                                   |
| CFS04V3T3R0      | 3       | 3.00A         |   | 15                               |               |                   |                                   |
| CFS04V3T3R15     | U       | 3.15A         |   | 14                               |               |                   |                                   |
| CFS04V3T4R0      | W       | 4.00A         |   | 10                               |               |                   |                                   |

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



# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 3/20          |

| Part Designation | Marking  | Rated Current | Fusing Time                                 | Resistance (mΩ)<br>Tolerance±25% | Rated Voltage | Breaking Capacity      | Body Temperature rising           |
|------------------|----------|---------------|---|----------------------------------|---------------|------------------------|-----------------------------------|
| CFS06V5TR40      | <u>E</u> | 0.4A          | Open within<br>5sec.at250%<br>rated current | 350                              | DC 50V        | 50A<br>DC50V/<br>AC35V | <75°C at<br>100% rated<br>current |
| CFS06V5TR50      | F        | 0.50A         |   | 232                              |               |                        |                                   |
| CFS06V3TR63      | I        | 0.63A         |   | 150                              | DC 32V        | 50A<br>DC32V/<br>AC35V |                                   |
| CFS06V3TR70      | J        | 0.70A         |   | 148                              |               |                        |                                   |
| CFS06V3TR80      | K        | 0.80A         |   | 113                              |               |                        |                                   |
| CFS06V3T1R0      | L        | 1.00A         |   | 67                               |               |                        |                                   |
| CFS06V3T1R25     | <u>M</u> | 1.25A         |   | 50                               |               |                        |                                   |
| CFS06V3T1R50     | P        | 1.50A         |   | 42                               |               |                        |                                   |
| CFS06V3T1R60     | N        | 1.60A         |   | 40                               |               |                        |                                   |
| CFS06V3T2R0      | S        | 2.00A         |   | 27                               |               |                        |                                   |
| CFS06V3T2R50     | T        | 2.50A         |   | 19.5                             |               |                        |                                   |
| CFS06V3T3R00     | 3        | 3.00A         |   | 16                               |               |                        |                                   |
| CFS06V3T3R15     | U        | 3.15A         |   | 15                               |               |                        |                                   |
| CFS06V3T4R0      | W        | 4.00A         |   | 11                               |               |                        |                                   |
| CFS06V3T5R0      | Y        | 5.00A         |   | 8                                |               |                        |                                   |
| CFS06V3T6R0      | <u>6</u> | 6.00A         |   | 6                                |               |                        |                                   |

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

| Part Designation | Marking  | Rated Current | Fusing Time                                 | Resistance (mΩ)<br>Tolerance±25% | Rated Voltage | Breaking Capacity | Body Temperature rising           |
|------------------|----------|---------------|---|----------------------------------|---------------|-------------------|-----------------------------------|
| CFS12V6TR50      | F        | 0.50A         | Open within<br>5sec.at250%<br>rated current | 596                              | DC<br>63V     | DC63V<br>50A      | <75°C at<br>100% rated<br>current |
| CFS12V6TR80      | K        | 0.80A         |   | 165                              |               |                   |                                   |
| CFS12V6T1R0      | L        | 1.00A         |   | 132                              |               |                   |                                   |
| CFS12V6T1R25     | <u>M</u> | 1.25A         |   | 90                               |               |                   |                                   |
| CFS12V6T1R50     | P        | 1.50A         |   | 79                               |               |                   |                                   |
| CFS12V6T2R0      | S        | 2.00A         |   | 41                               |               |                   |                                   |
| CFS12V3T2R50     | T        | 2.50A         |   | 33                               | DC<br>32V     | DC32V<br>50A      |                                   |
| CFS12V3T3R00     | 3        | 3.00A         |   | 23                               |               |                   |                                   |
| CFS12V3T4R0      | W        | 4.00A         |   | 15.5                             |               |                   |                                   |
| CFS12V3T5R0      | Y        | 5.00A         |   | 13                               |               |                   |                                   |
| CFS12V3T7R0      | Z        | 7.00A         |   | 7                                |               |                   |                                   |

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



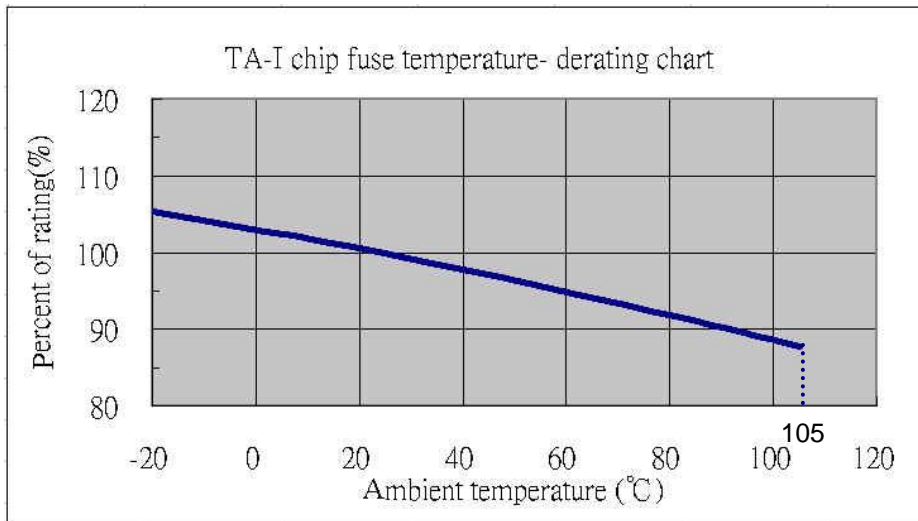
# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 4/20          |

## 6. Temperature 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  |
|---------------------------|--|--|
| 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,10±1second   |
| Solder ability            | 95% coverage minimum                                 | 235°C±5°C, 2±0.5second<br>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                                  |



# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 5/20          |

## 8. Marking

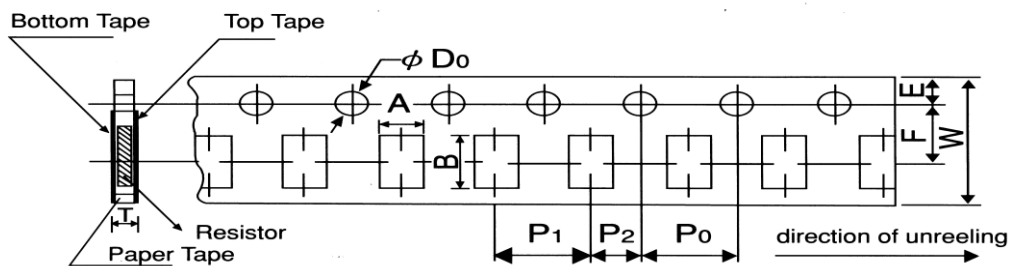
Symbol for Rating Current

| Symbol            | <u>E</u> | F   | I    | J   | K   | L | <u>M</u> | P   | N   | S | T   | 3 | U    | W | Y | Z |
|-------------------|----------|-----|------|-----|-----|---|----------|-----|-----|---|-----|---|------|---|---|---|
| Rating Current(A) | 0.4      | 0.5 | 0.63 | 0.7 | 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 <sub>1</sub> | P <sub>2</sub> | P <sub>0</sub> | D <sub>0</sub>      | T        |
|------------|-------|----------|----------|---------|----------|----------|----------------|----------------|----------------|---------------------|----------|
| Paper Tape | CFS04 | 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 | CFS06 | 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 | CFS12 | 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  | 04   | 10000      |

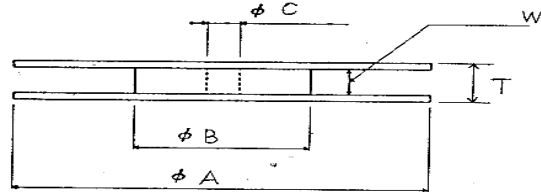
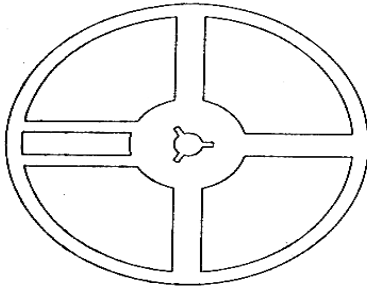
|             |    |            |
|-------------|----|------------|
| Type series |    | Paper Tape |
|             |    | 4 mm pitch |
|             |    | 180mm/R    |
| CFS         | 06 | 5000       |
| CFS         | 12 | 5000       |



# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 6/20          |

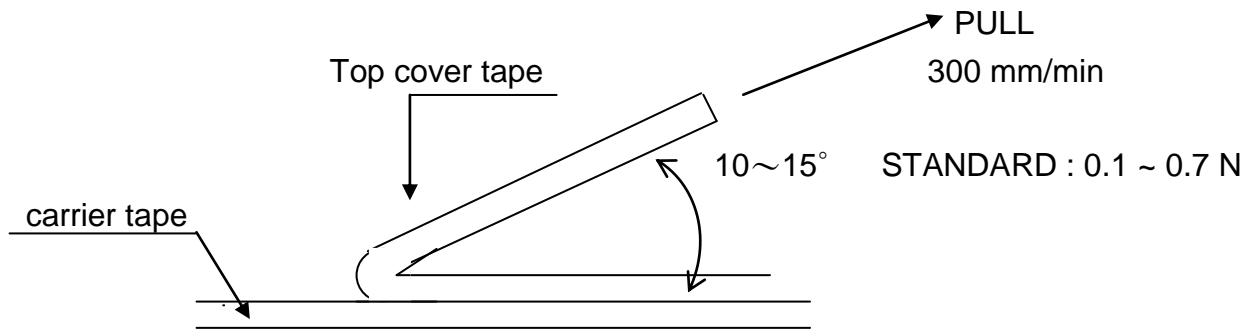
## 9.2 Reel Specifications



Unit: mm

| Series                  | $\phi A$      | $\phi B$       | $\phi C$       | W             | T              |
|-------------------------|---------------|----------------|----------------|---------------|----------------|
| CFS04<br>CFS06<br>CFS12 | 178 $\pm$ 2.0 | 60.0 $\pm$ 1.0 | 13.0 $\pm$ 1.0 | 9.0 $\pm$ 1.0 | 11.4 $\pm$ 2.0 |

## 9.3 Peel –off force :



## 10. Storage Conditions:

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

## 11. Shelf Life:

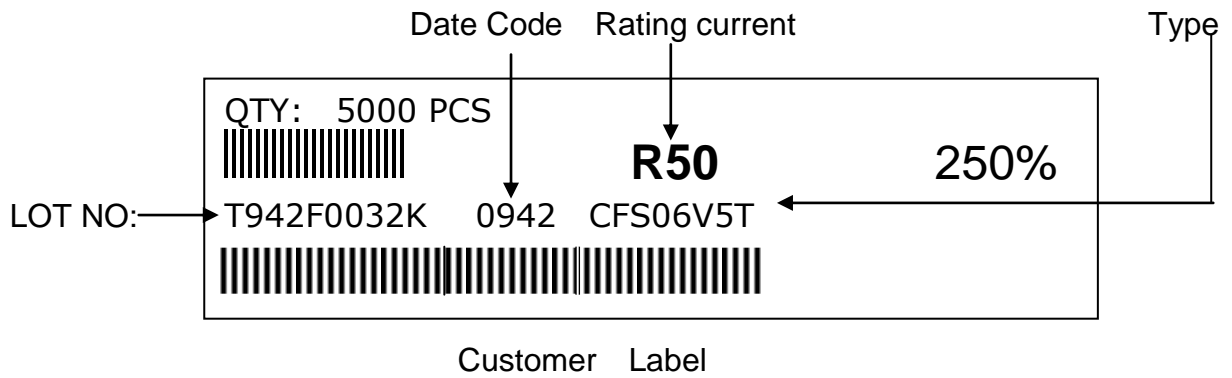
2 years from manufacturing date



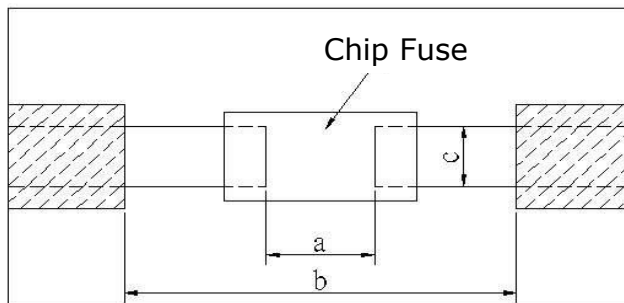
# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 7/20          |

## 12. Label



## 13. Recommended land patterns



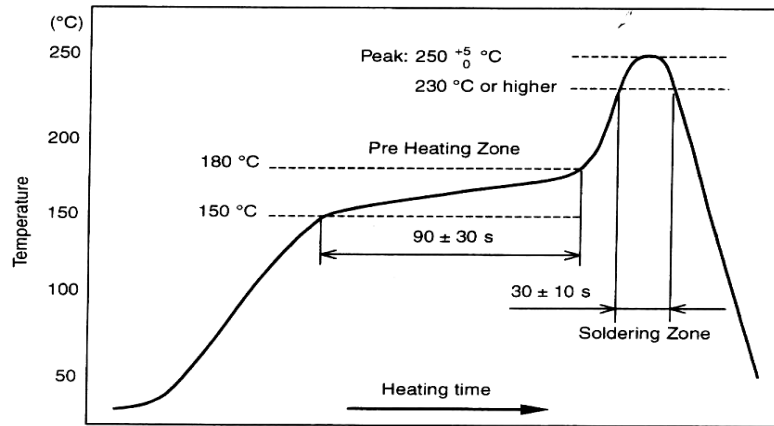
| Type | Land pattern<br>Size | Dimension |         |         |
|------|----------------------|-----------|---------|---------|
|      |                      | a         | b       | c       |
| CFS  | 04 ( 0402 )          | 0.5~0.6   | 1.4~1.6 | 0.4~0.6 |
| CFS  | 06 ( 0603 )          | 0.7~0.9   | 2.0~2.2 | 0.8~1.0 |
| CFS  | 12 ( 1206 )          | 2.0~2.4   | 4.4~5.0 | 1.5~1.8 |



# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 8/20          |

## 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 :

TA-I TECHNOLOGY CO., LTD. ( Taiwan– Tao Yuan )

Tel: (+886) 3-3246169 Fax : (+886) 3-3246167

### Associated companies :

(1)TA-I TECHNOLOGY ( SU ZHOU ) CO., LTD. ( China – Su Zhou)

Tel : (+86) 512-63457879 Fax : (+86) 512-63457869

(2) TA-I TECHNOLOGY ELECTRONIC (DONGGUAN) CO., LTD. ( China –Dongguan )

Tel : (+86) 769-8339-4790~3 Fax : (+86) 769-8339-4794

(3) FORTUNE TASK RESISTOR FACTORY ( China – Dongguan )

Tel : (+86) 769-8339-4790~3 Fax : (+86) 769-8339-4794

(4) TAI OHM ELECTRONICS ( M ) SDN. BHD. ( Malaysia – Penang )

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(5) P.T.TAI ELECTRONIC Indonesia ( Indonesia – Jakarta )

Tel : (+62) 21-44820254 Fax : (+62) 21-44820256





|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 9/20          |

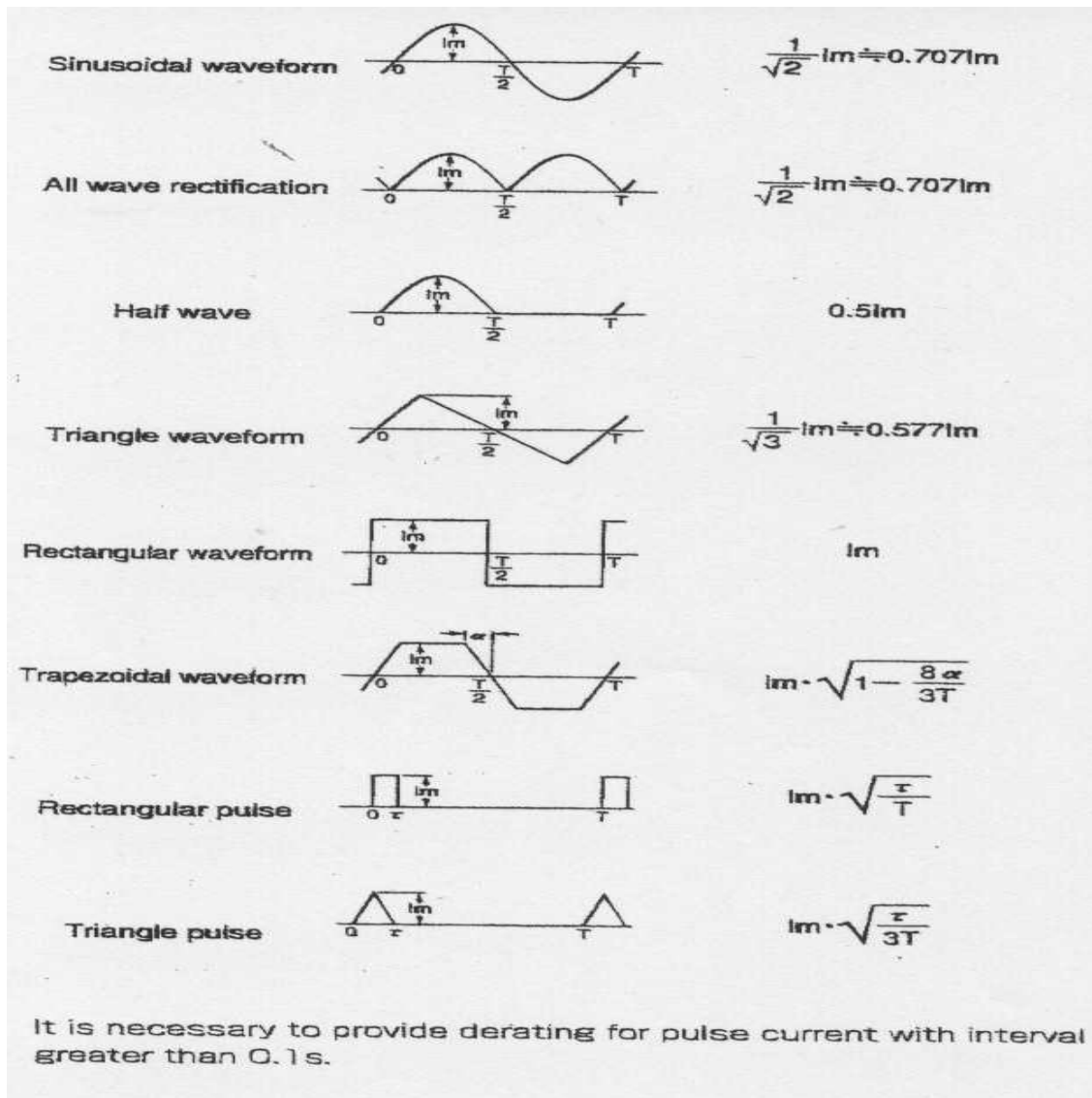
## ★ Selection Guideline of Fuse:

### ■ 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



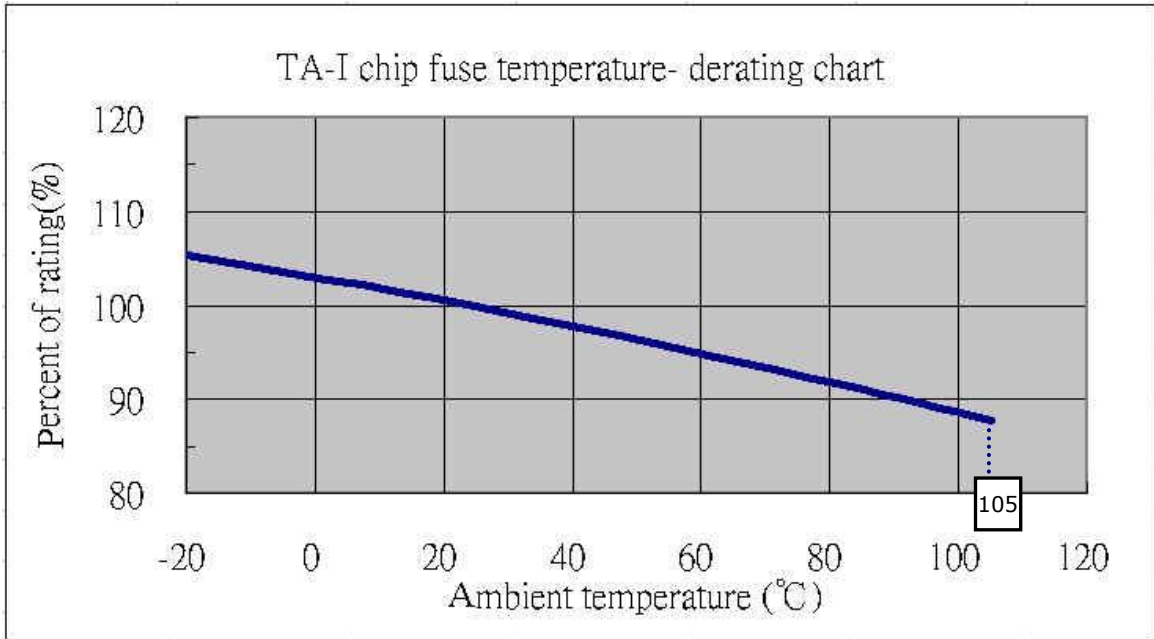


# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 10/20         |

## 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**



# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 11/20         |

## ■ 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 |
|------------------|---------|---------------|---------------|------------------|---------|---------------|---------------|------------------|---------|---------------|---------------|
| CFS04V3TR50      | F       | 0.5A          | 32V           | CFS06V5TR40      | E       | 0.40A         | 50V           | CFS12V6TR50      | F       | 0.50A         | 63V           |
| CFS04V3TR80      | K       | 0.80A         | 32V           | CFS06V5TR50      | F       | 0.5A          | 50V           | CFS12V6TR80      | K       | 0.80A         | 63V           |
| CFS04V3T1R0      | L       | 1.00A         | 32V           | CFS06V3TR63      | I       | 0.63A         | 32V           | CFS12V6T1R0      | L       | 1.00A         | 63V           |
| CFS04V3T1R25     | M       | 1.25A         | 32V           | CFS06V3TR70      | J       | 0.7A          | 32V           | CFS12V6T1R25     | M       | 1.25A         | 63V           |
| CFS04V3T1R50     | P       | 1.50A         | 32V           | CFS06V3TR80      | K       | 0.80A         | 32V           | CFS12V6T1R50     | P       | 1.50A         | 63V           |
| CFS04V3T1R60     | N       | 1.60A         | 32V           | CFS06V3T1R0      | L       | 1.00A         | 32V           | CFS12V6T2R0      | S       | 2.00A         | 63V           |
| CFS04V3T2R0      | S       | 2.00A         | 32V           | CFS06V3T1R25     | M       | 1.25A         | 32V           | CFS12V3T2R50     | T       | 2.50A         | 32V           |
| CFS04V3T2R50     | T       | 2.50A         | 32V           | CFS06V3T1R50     | P       | 1.50A         | 32V           | CFS12V3T3R00     | 3       | 3.00A         | 32V           |
| CFS04V3T3R0      | 3       | 3.00A         | 32V           | CFS06V3T1R60     | N       | 1.60A         | 32V           | CFS12V3T4R0      | W       | 4.00A         | 32V           |
| CFS04V3T3R15     | U       | 3.15A         | 32V           | CFS06V3T2R0      | S       | 2.00A         | 32V           | CFS12V3T5R0      | Y       | 5.00A         | 32V           |
| CFS04V3T4R0      | W       | 4.00A         | 32V           | CFS06V3T2R50     | T       | 2.50A         | 32V           | CFS12V3T7R0      | Z       | 7.00A         | 32V           |
|                  |         |               |               | CFS06V3T3R00     | 3       | 3.00A         | 32V           |                  |         |               |               |
|                  |         |               |               | CFS06V3T3R15     | U       | 3.15A         | 32V           |                  |         |               |               |
|                  |         |               |               | CFS06V3T4R0      | W       | 4.00A         | 32V           |                  |         |               |               |
|                  |         |               |               | CFS06V3T5R0      | Y       | 5.00A         | 32V           |                  |         |               |               |
|                  |         |               |               | CFS06V3T6R0      | 6       | 6.00A         | 32V           |                  |         |               |               |

## ■ Inrush current :

- ◆ Considering inrush waveform & calculate  $I^2t$  (A<sup>2</sup>s) value
- ◆ Choosing fuse's  $I^2t$  (A<sup>2</sup>s) value > calculate  $I^2t$  (A<sup>2</sup>s) value
- ◆ Considering Ratio of  $I^2t$  repeat numbers to blowing .
- ◆ Confirm with us.

e.g., choosing 0603 Fuse

Condition :

1. Rectangular Wave ,  $I_p = 4 \text{ A}$  ,  $t = 1 \text{ (ms)}$  ,  
 Calculate  $I_p^2t = 4^2 \times 1 \times 10^{-3} = 0.016 \text{ (A}^2\text{s)}$
2. Choosing CFS06V3T2R50 (  $I^2t = 0.200 \text{ (A}^2\text{s)}$  )  $\Rightarrow$  Page 12 index-table
3. Inrush shock : 100,000 times (  $\approx 0.35$  )  $\Rightarrow$  Inrush derating ratio



# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 12/20         |

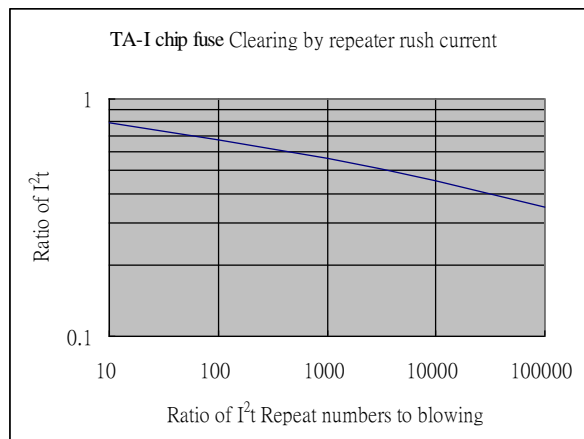
#### 4. Calculating :

1. Choosing fuse's  $I^2t$  (A<sup>2</sup>s) value X Derating ratio > calculate  $I^2t$  (A<sup>2</sup>s) value
2.  $0.200 \times 0.35 = 0.070$  (A<sup>2</sup>s)  **Inrush 100,000 times**
3.  $0.070 > 0.016$

The fuse is able to meet circuit's application

| TA-I FUSE $I^2t$ (A <sup>2</sup> s) |                                    |              |                                    |              |                                    |
|-------------------------------------|------------------------------------|--------------|------------------------------------|--------------|------------------------------------|
| Part Number                         | Typical $I^2t$ (A <sup>2</sup> s)* | Part Number  | Typical $I^2t$ (A <sup>2</sup> s)* | Part Number  | Typical $I^2t$ (A <sup>2</sup> s)* |
| CFS04V3TR50                         | 0.00370                            | CFS06V5TR40  | 0.004                              | CFS12V6TR50  | 0.030                              |
| CFS04V3TR80                         | 0.00947                            | CFS06V5TR50  | 0.009                              | CFS12V6TR80  | 0.068                              |
| CFS04V3T1R0                         | 0.01479                            | CFS06V3TR63  | 0.017                              | CFS12V6T1R0  | 0.098                              |
| CFS04V3T1R25                        | 0.02310                            | CFS06V3TR70  | 0.023                              | CFS12V6T1R25 | 0.155                              |
| CFS04V3T1R50                        | 0.02400                            | CFS06V3TR80  | 0.024                              | CFS12V6T1R50 | 0.236                              |
| CFS04V3T1R60                        | 0.03734                            | CFS06V3T1R0  | 0.026                              | CFS12V6T2R0  | 0.339                              |
| CFS04V3T2R0                         | 0.04040                            | CFS06V3T1R25 | 0.057                              | CFS12V3T2R50 | 0.605                              |
| CFS04V3T2R50                        | 0.06760                            | CFS06V3T1R50 | 0.081                              | CFS12V3T3R00 | 0.933                              |
| CFS04V3T3R0                         | 0.09860                            | CFS06V3T1R60 | 0.086                              | CFS12V3T4R0  | 1.537                              |
| CFS04V3T3R15                        | 0.10868                            | CFS06V3T2R0  | 0.115                              | CFS12V3T5R0  | 2.533                              |
| CFS04V3T4R0                         | 0.11450                            | CFS06V3T2R50 | 0.200                              | CFS12V3T7R0  | 5.684                              |
|                                     |                                    | CFS06V3T3R00 | 0.210                              |              |                                    |
|                                     |                                    | CFS06V3T3R15 | 0.279                              |              |                                    |
|                                     |                                    | CFS06V3T4R0  | 0.326                              |              |                                    |
|                                     |                                    | CFS06V3T5R0  | 0.622                              |              |                                    |
|                                     |                                    | CFS06V3T6R0  | 2.700                              |              |                                    |

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





## Inrush Waveform

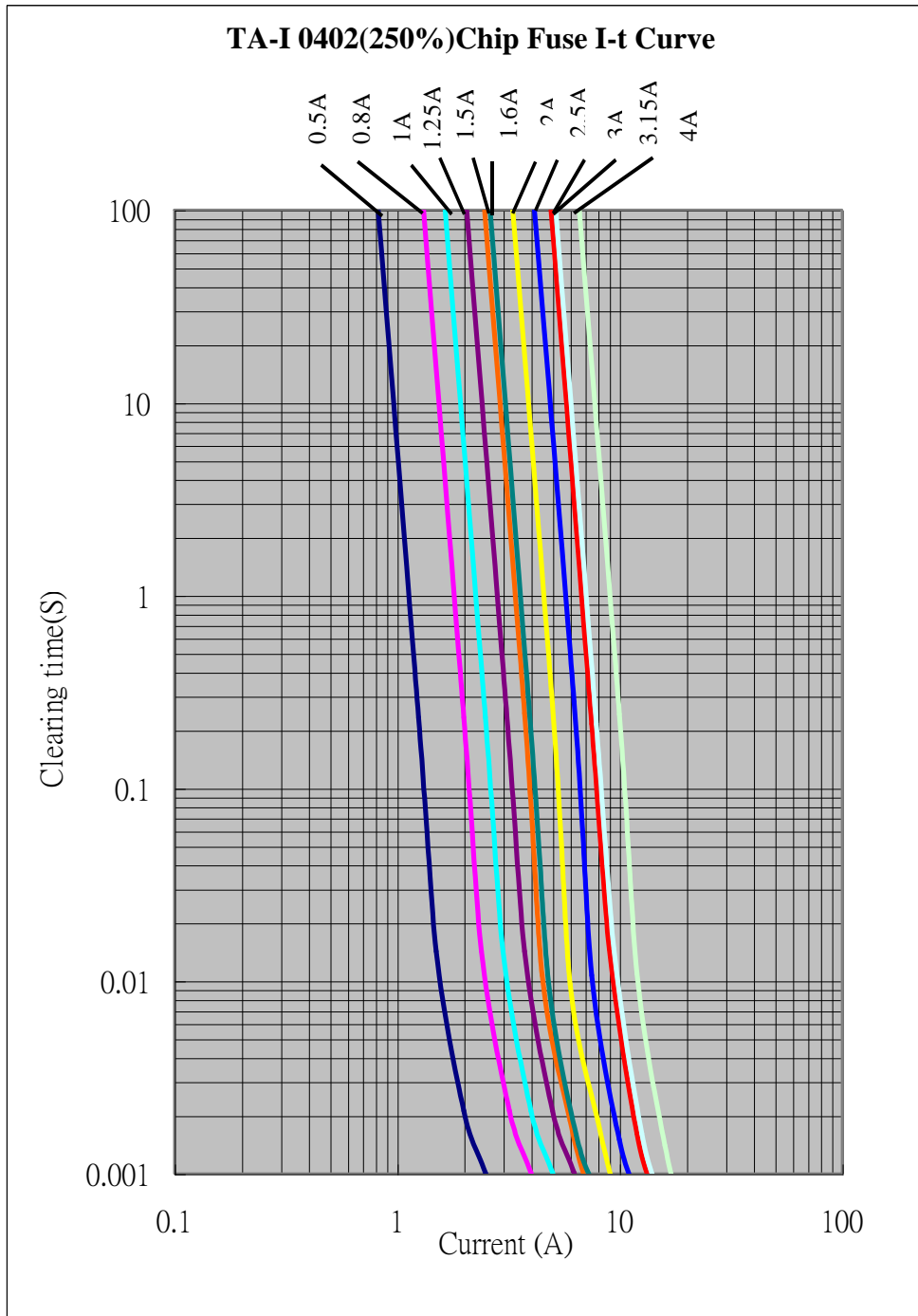
|                                    |  |   |
|------------------------------------|--|---|
| Sinusoidal waveform<br>(1 cycle)   |  | $\frac{1}{2} Im^2 t$  |
| Sinusoidal waveform<br>(1/2 cycle) |  | $\frac{1}{2} Im^2 t$  |
| Triangle waveform                  |  | $\frac{1}{3} Im^2 t$  |
| Rectangular 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



# Thin Film Chip Fuse

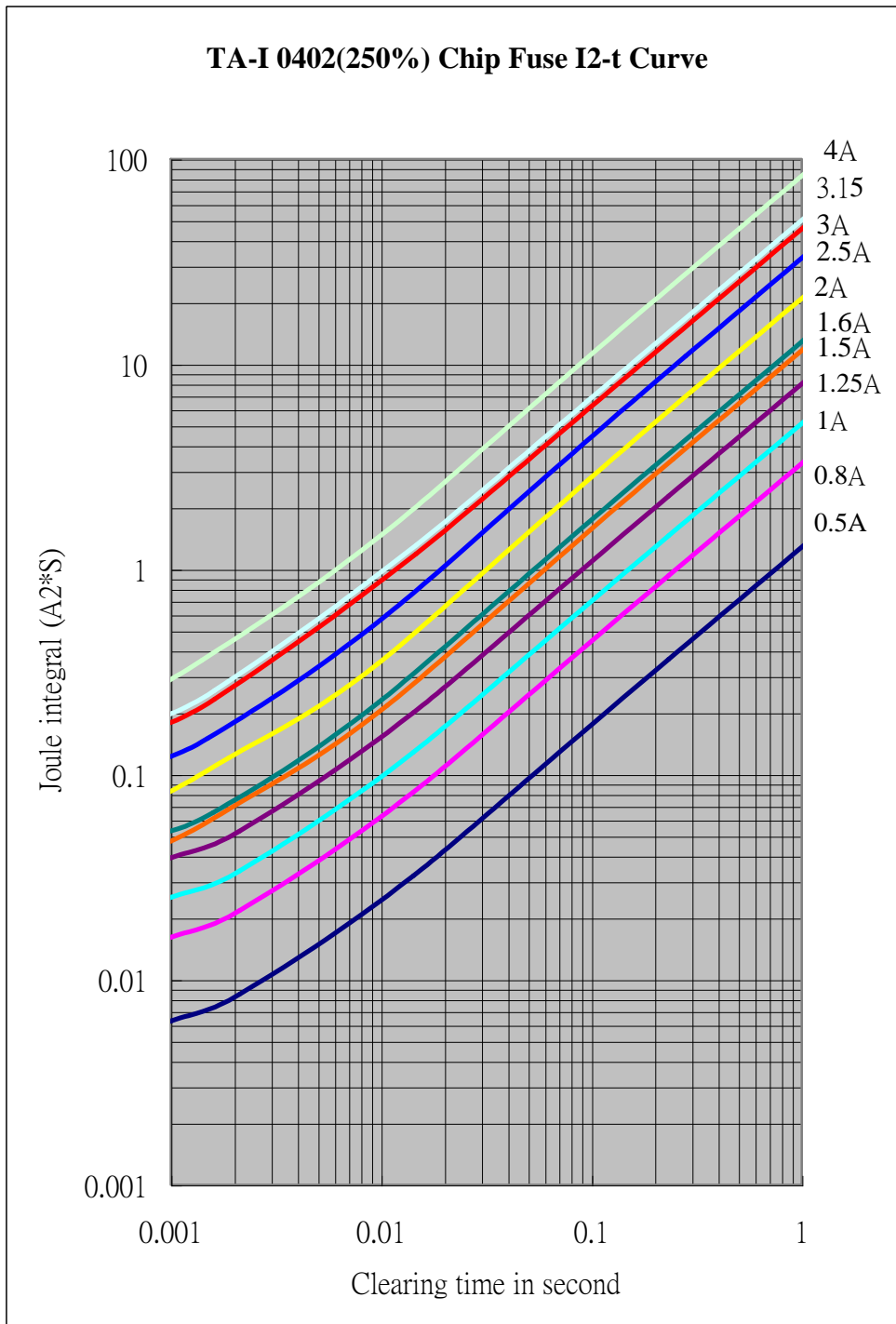
|             |               |
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| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 14/20         |





# Thin Film Chip Fuse

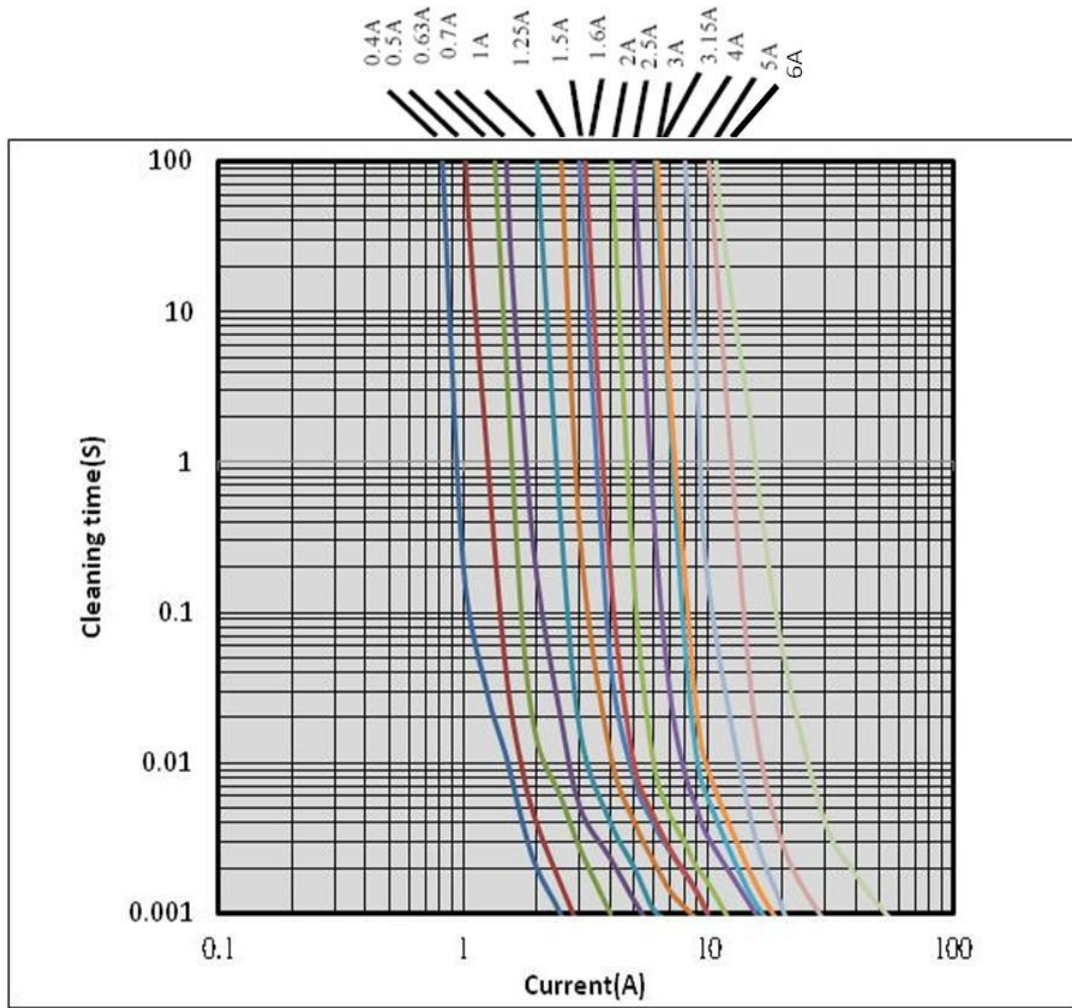
|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 15/20         |





|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 16/20         |

### TA-I 0603 (250%) Chip Fuse I-t Curve



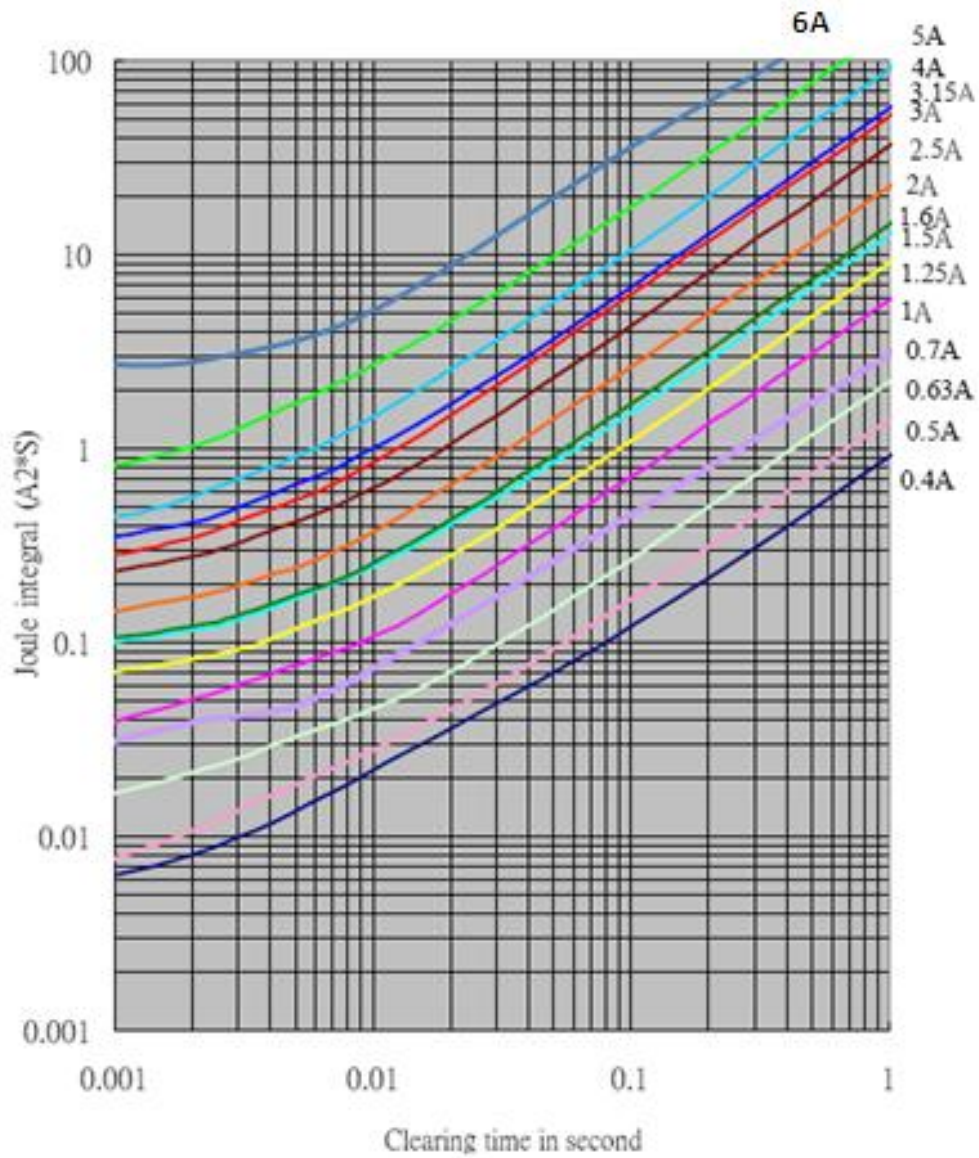




# Thin Film Chip Fuse

|             |               |
|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 17/20         |

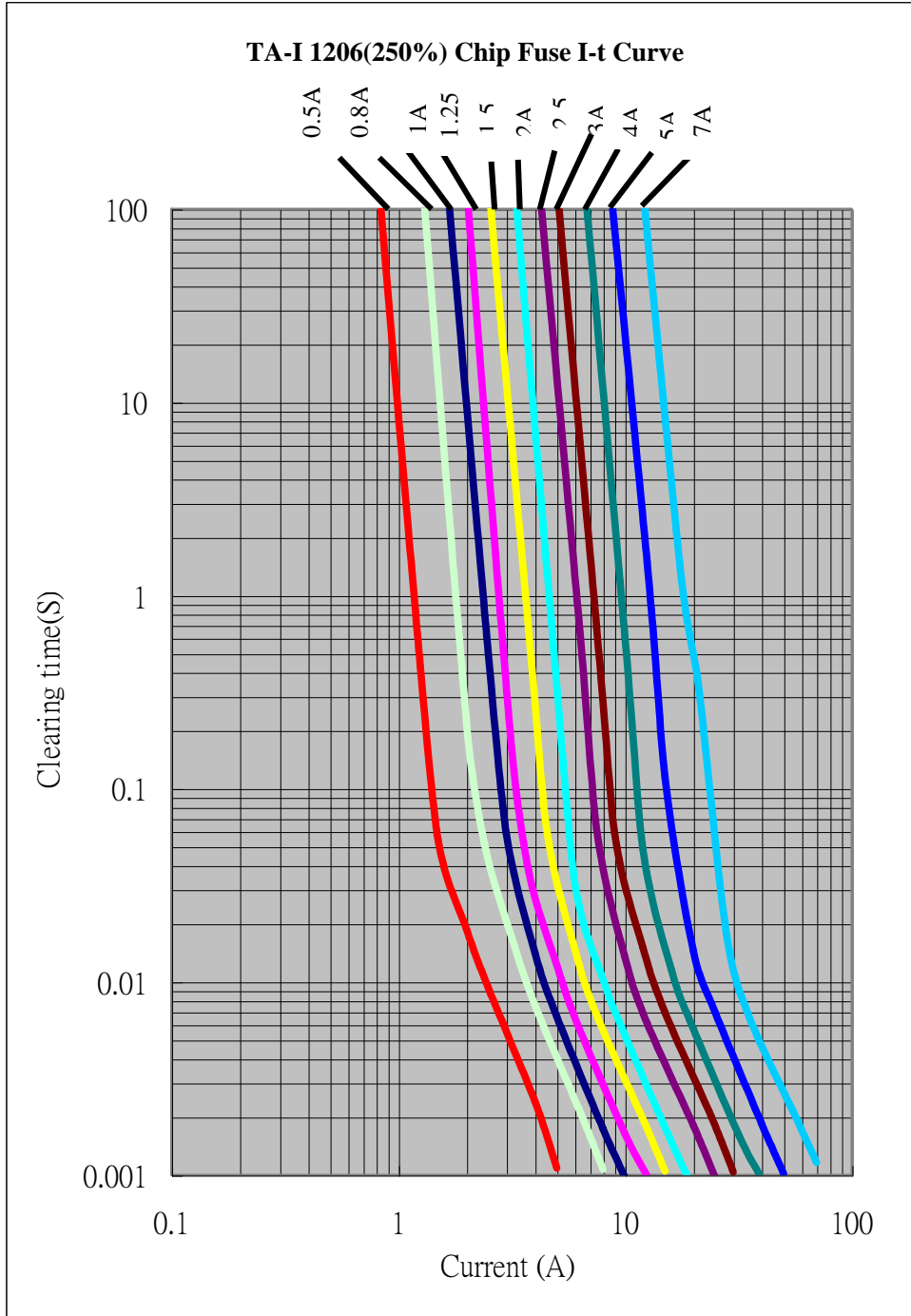
TA-I 0603 (250%) Chip Fuse I<sup>2</sup>-t Curve





# Thin Film Chip Fuse

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|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 18/20         |

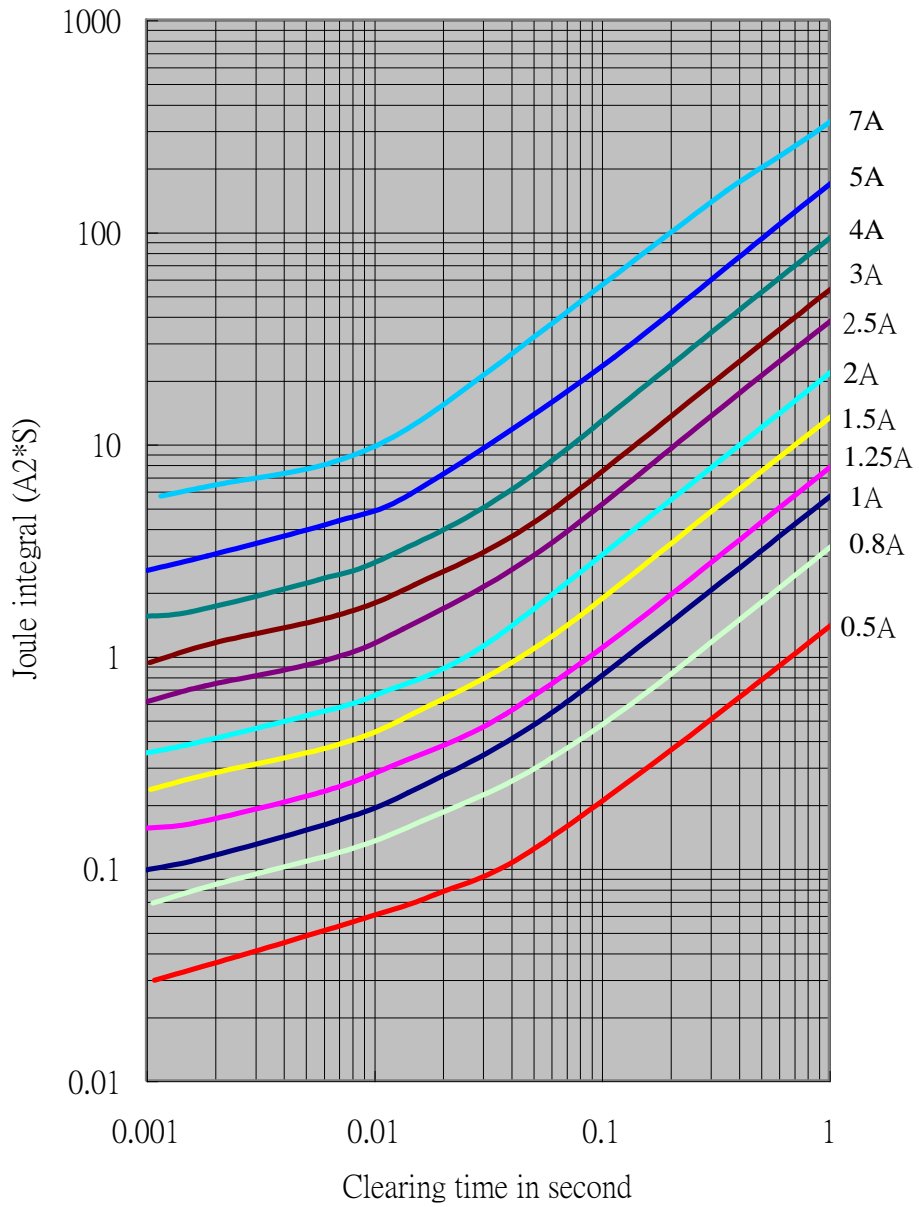




# Thin Film Chip Fuse

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| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 19/20         |

### TA-I 1206(250%) Chip Fuse I<sup>2</sup>-t Curve

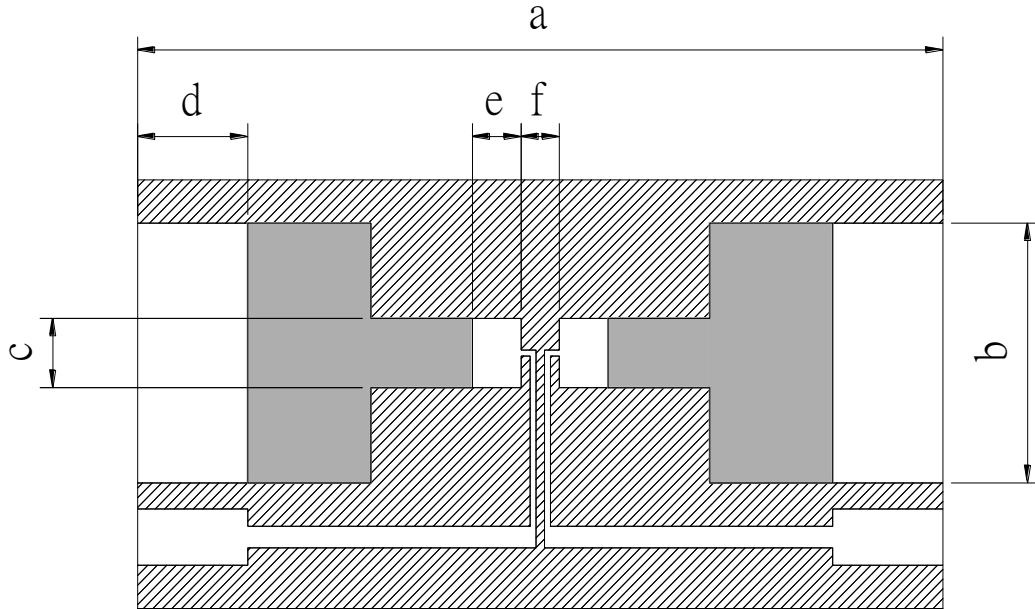




# Thin Film Chip Fuse

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|-------------|---------------|
| Document No | TCFS-XX0S004I |
| Issued date | 2012/11/26    |
| Page        | 20/20         |

## Test Circuit Board



| Type    | a  | b | c    | d   | e    | f   |
|---------|----|---|------|-----|------|-----|
| CFS0402 | 19 | 6 | 0.84 | 2.6 | 0.61 | 0.6 |
| CFS0603 | 19 | 6 | 1.60 | 2.6 | 1.15 | 0.9 |
| CFS1206 | 19 | 6 | 2.40 | 2.6 | 1.90 | 1.0 |

Unit: mm