# Surface-Mount Fuses
## Fundamentals

### Overview

TE Circuit Protection offers the widest selection of surface-mount fuses available for addressing a broad range of overcurrent protection applications. Helping to prevent costly damage and promote a safe environment for electronic and electrical equipment, our single-use chip fuses provide performance stability to support applications with current ratings from .5A up to 20A.

TE Circuit Protection also offers the telecom FT600 fuse for telecommunications applications. This telecom fuse helps comply with North American overcurrent protection requirements, including Telcordia, GR-1089, TIA-968-A (formerly FCC Part 68), and UL60950 3rd edition.


### Multi-layer Design for Chip Fuses

The multi-layer design has the benefit of exposing more fuse element surface area to the glass-ceramic absorption material. When the fuse elements open, there is more material for the vaporizing fuse metals to absorb into, resulting in a very efficient and effective quenching of the fuse arc.

Figure SF1 compares the multi-layer design of our SFF fuses with standard glass coated designs. The glass coated designs rely on the coating on only one side of the fuse element to absorb the vaporizing fuse material when it opens. Therefore, there is much less absorption material available to absorb the fuse metals. The result can be prolonged arcing and possible coating breach.

Figure SF2 shows how the absorption characteristics of the two designs differ. The multi-layer design indicates a clean separation with the fuse element evenly diffusing into the surrounding ceramic substrate. In the glass coated design, the element diffusion takes place in a small portion of the device and is only absorbed by the glass material directly above the area of failure.

**Figure SF1**

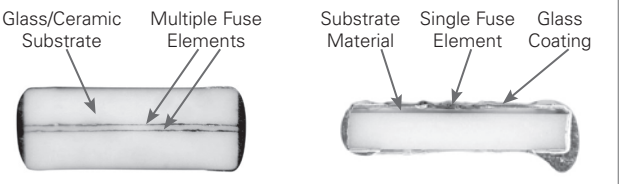
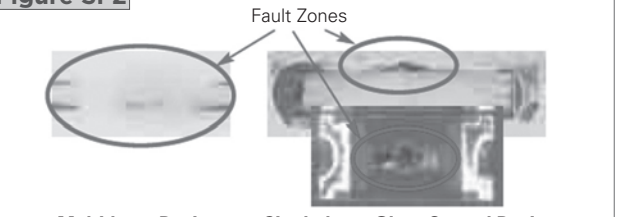



**Figure SF2**



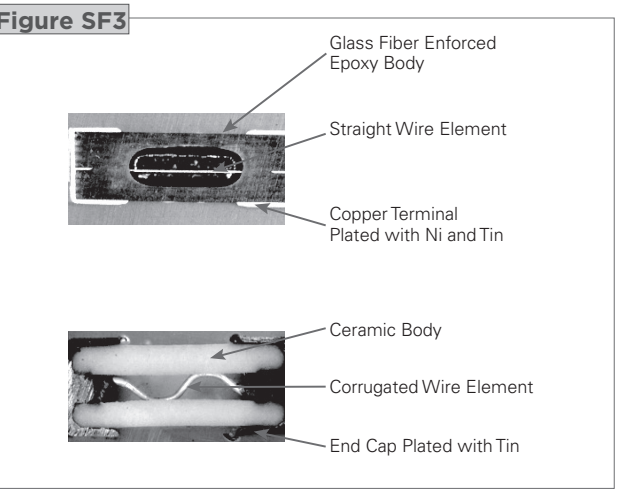

### Wire-In-Air Design for 2410SFV Fuses

The 2410(6125) is a Wire-In-Air SMD fuse that is suitable for secondary level overcurrent protection applications.

Figure SF3 compares our straight wire element design 2410SFV fuses with normal corrugated wire design fuse. The straight wire element in air provides consistent fusing and cutting characteristics together with inrush current withstanding capability.

By introducing PCB assembly technology into the 2410SFV fuse design and manufacturing process, lead-free compliance has been achieved without the problems associated with end caps on traditional ceramic devices.

**Figure SF3**



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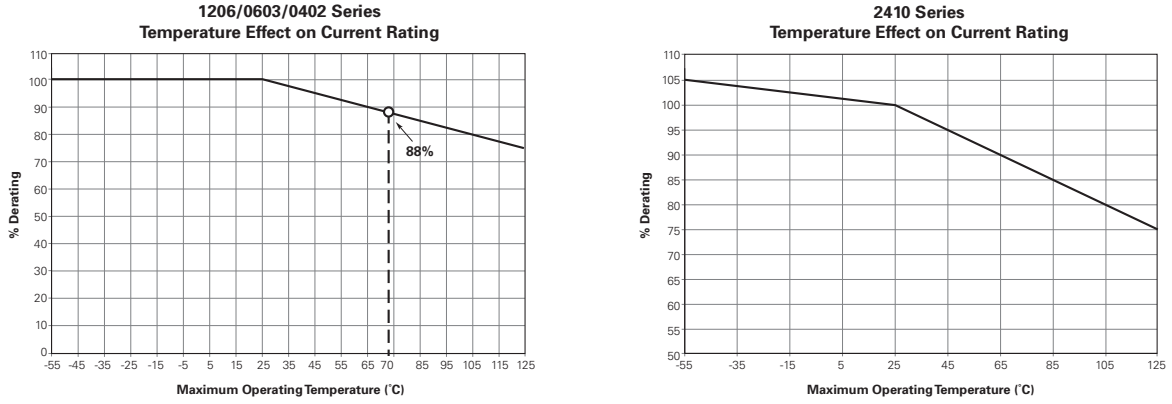
## Temperature Derating

A fuse is a temperature sensitive device. Therefore, operating temperature will have an effect on fuse performance and lifetime. Operating temperature should be taken into consideration when selecting the fuse current rating. The Thermal Derating Curve for surface-mount fuses is presented in Figure SF4. Use it to determine the derating percentage based on operating temperature and apply it to the derated system current.

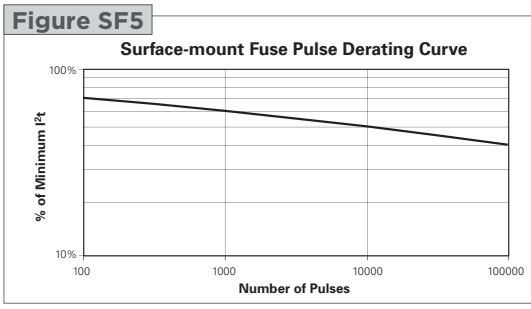
**Figure SF4**




## Pulse Cycle Derating

Once the $I^2t$ value for the application waveform has been determined, it must be derated based on the number of cycles expected over the system lifetime. Since the stress induced by the current pulse is mechanical in nature, the number of times the stress is applied has significant bearing on how much derating must be applied to the fuse rating. Figure SF5 presents the current pulse derating curve for our surface-mount chip fuses up to 100,000 cycles.

**Figure SF5**




## Selecting Surface-mount Fuses

Fuse selection seems straightforward, in that you pick one which has a current rating just a bit higher than your worst case system operating current. Unfortunately, it is not that simple. There are derating considerations for operating current and application temperature. Turn-on and other system operations (like processor speed changes or motor start up) cause current surges or spikes that also require consideration when selecting a fuse. So selecting the right fuse for your application is not as simple as knowing the nominal current drawn by the system.

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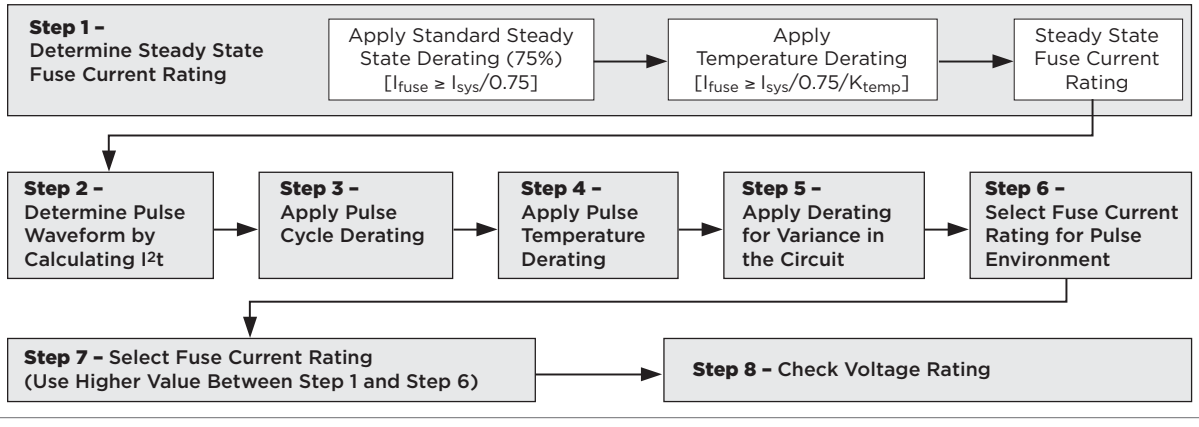
## Fuse Selection Flowchart

However, the basic considerations for fuse selection are shown in the flow chart presented in Figure SF6. Following this flow chart will help you select a fuse best suited for your application conditions. For a detailed example of this process you can download our Fuse Selection Guide available on our website.

**Figure SF6**





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# Surface-Mount Fuses
## Pulse Tolerant Chip Fuses

NEW

Pulse Tolerant Chip Fuses have high inrush current withstand capability and provide overcurrent protection for DC power systems. These devices combine a silver fusing element and monolithic, multilayer design to provide strong arc suppression characteristics.

These RoHS-compliant surface-mount devices can help facilitate the development of more reliable, high-performance consumer electronics such as laptops, multimedia devices, cell phones and other portable electronics.


### Benefits

- High inrush current withstand capability
- Ceramic monolithic structure
- Silver fusing element and silver termination with nickel and tin plating
- Temperature stability
- Strong arc suppression characteristics

### Features

- Lead free materials and RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### Applications

- Laptops
- Digital cameras
- Cell phones
- Printers
- DVD players
- Portable electronics
- Game systems
- LCD monitors
- Scanners

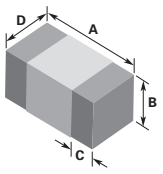
## Table FP1 Clear Time Characteristics for Pulse Tolerant Chip Fuses

| % of rated current | Clear time at 25°C | |
|---|---|---|
| 100% | 4 hrs (min) | |
| 200% | 1 s (min) | 60 s (max) |
| 1000% | 0.0002 s (min) | 0.02 s (max) |

## Table FP2 Typical Electrical Characteristics and Dimensions for Pulse Tolerant Chip Fuses

### 0603 (1608 mm) Pulse Tolerant Chip Fuses

**Shape and Dimensions**
mm (in)

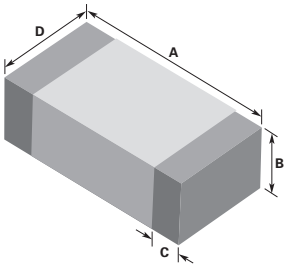



| | A | | B | | C | | D | |
|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | Min | Max |
| mm | 1.45 | 1.75 | 0.65 | 0.95 | 0.21 | 0.51 | 0.65 | 0.95 |
| in | (0.057) | (0.069) | (0.026) | (0.037) | (0.008) | (0.020) | (0.026) | (0.037) |

| | Typical Electrical Characteristics | | | Max Interrupt Ratings | |
|---|---|---|---|---|---|
| Part Number | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal $I^2t$ ($A^2s$)† | Voltage ($V_{DC}$) | Current (A) |
| 0603SFP100F/32-2 | 1.0 | 0.210 | 0.08 | 32 | 50 |
| 0603SFP150F/32-2 | 1.5 | 0.101 | 0.11 | 32 | 50 |
| 0603SFP200F/32-2 | 2.0 | 0.057 | 0.24 | 32 | 50 |
| 0603SFP250F/32-2 | 2.5 | 0.042 | 0.56 | 32 | 50 |
| 0603SFP300F/32-2 | 3.0 | 0.030 | 0.72 | 32 | 50 |
| 0603SFP350F/32-2 | 3.5 | 0.022 | 1.10 | 32 | 50 |
| 0603SFP400F/32-2 | 4.0 | 0.018 | 2.08 | 32 | 50 |
| 0603SFP450F/32-2 | 4.5 | 0.014 | 2.63 | 32 | 50 |
| 0603SFP500F/32-2 | 5.0 | 0.013 | 3.25 | 32 | 50 |
| 0603SFP600F/32-2 | 6.0 | 0.010 | 4.00 | 32 | 70 |

### 1206 (3216 mm) Pulse Tolerant Chip Fuses

**Shape and Dimensions**
mm (in)




| | A | | B | | C | | D | |
|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | Min | Max |
| mm | 3.00 | 3.40 | 0.77 | 1.17 | 0.26 | 0.76 | 1.40 | 1.80 |
| in | (0.118) | (0.134) | (0.030) | (0.046) | (0.010) | (0.030) | (0.055) | (0.071) |

| | Typical Electrical Characteristics | | | Max Interrupt Ratings | |
|---|---|---|---|---|---|
| Part Number | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal $I^2t$ ($A^2sec$)† | Voltage ($V_{DC}$) | Current (A) |
| 1206SFP100F/63-2 | 1.0 | 0.340 | 0.11 | 63 | 50 |
| 1206SFP150F/63-2 | 1.5 | 0.150 | 0.33 | 63 | 50 |
| 1206SFP200F/63-2 | 2.0 | 0.090 | 0.80 | 63 | 50 |
| 1206SFP250F/32-2 | 2.5 | 0.070 | 1.19 | 32 | 50 |
| 1206SFP300F/32-2 | 3.0 | 0.035 | 1.35 | 32 | 50 |
| 1206SFP350F/32-2 | 3.5 | 0.029 | 1.84 | 32 | 50 |
| 1206SFP400F/32-2 | 4.0 | 0.023 | 2.74 | 32 | 50 |
| 1206SFP450F/32-2 | 4.5 | 0.021 | 3.20 | 32 | 50 |
| 1206SFP500F/32-2 | 5.0 | 0.017 | 5.50 | 32 | 50 |
| 1206SFP600F/24-2 | 6.0 | 0.013 | 12.50 | 24 | 80 |
| 1206SFP700F/24-2 | 7.0 | 0.010 | 30.00 | 24 | 80 |
| 1206SFP800F/24-2 | 8.0 | 0.009 | 60.00 | 24 | 80 |

* Measured at ≤10% of rated current and 25°C ambient temperature.
† Melting $I^2t$ at 0.001 sec clear time.





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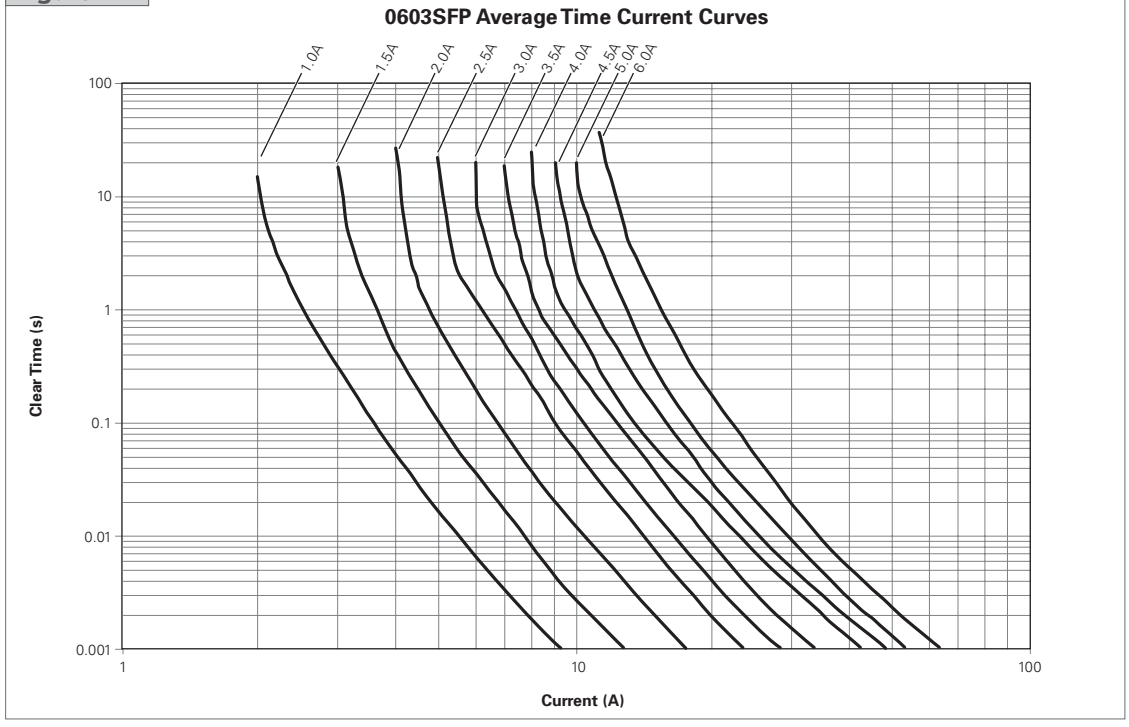
## Figures FP1-FP4 Family Performance Curves for Pulse Tolerant Chip Fuses

**Figure FP1**




**Note:** Curves are nominal.

**Figure FP2**

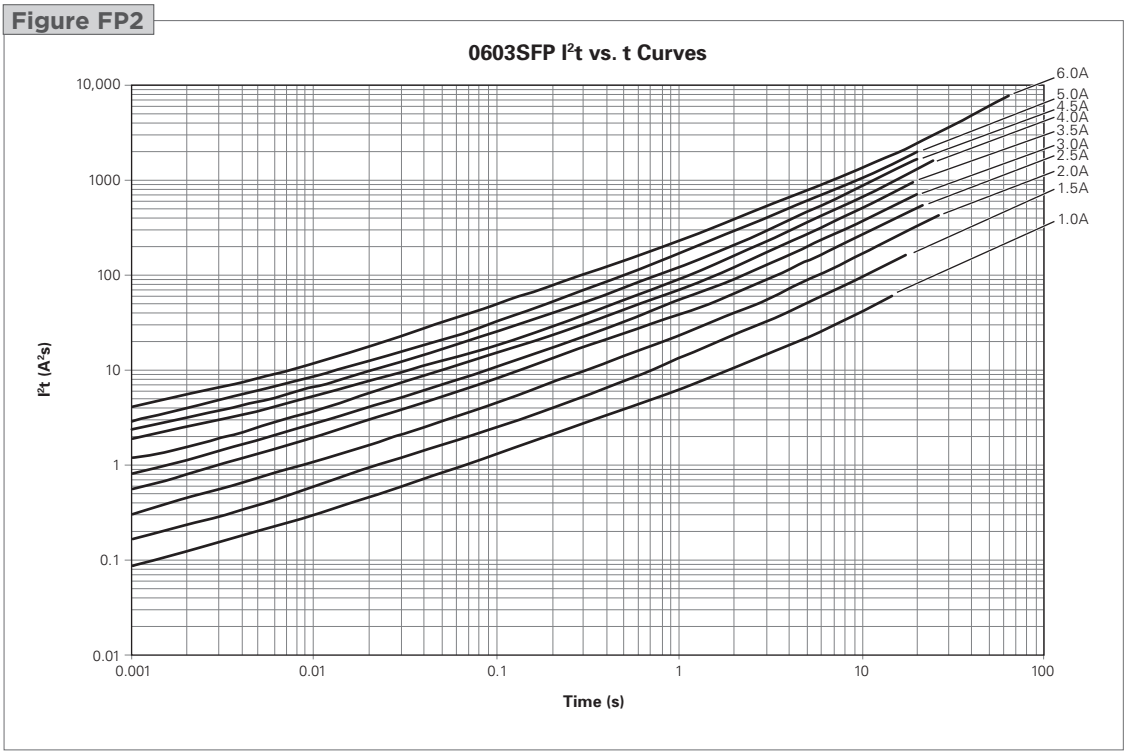


**Figure FP3**

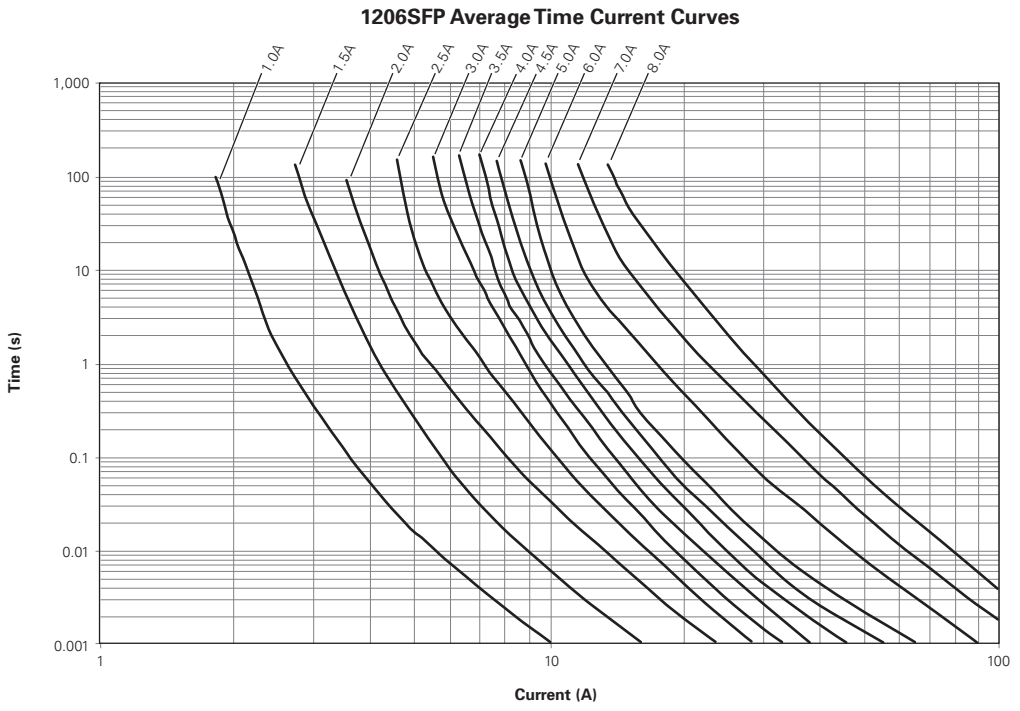
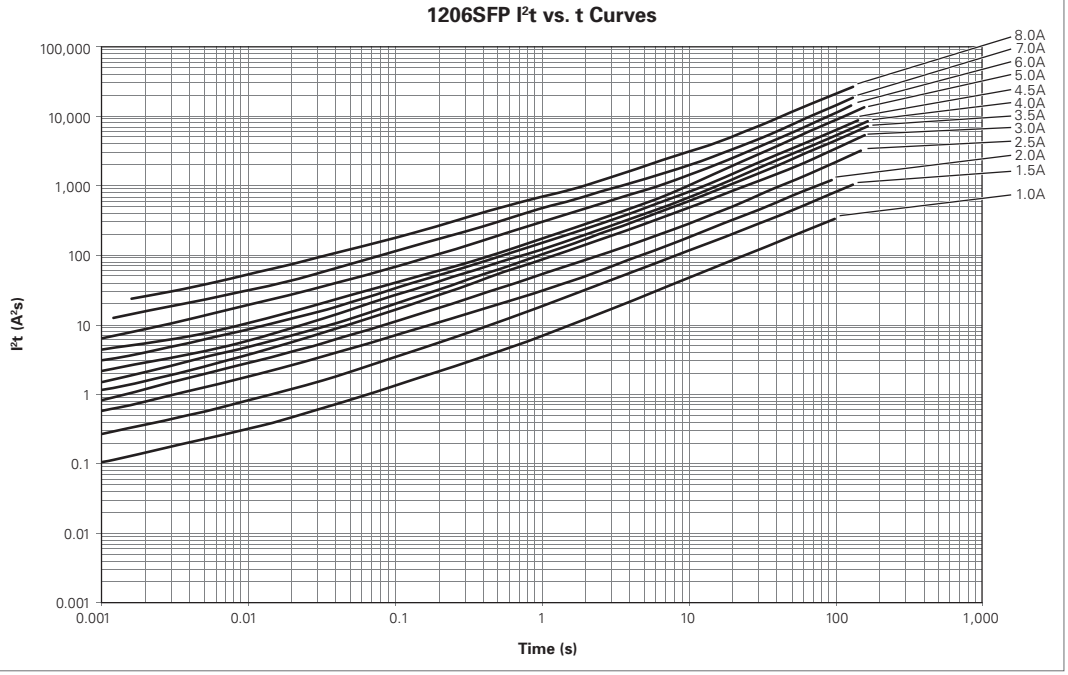



**Figure FP4**




**Note:** Curves are nominal.

➔ **Please go to page 129 for more information about Pulse Tolerant Chip Fuses.**

# Surface-Mount Fuses
## 0603 Very Fast-Acting Chip Fuses

NEW

Very fast-acting chip fuses help provide overcurrent protection for systems using DC power sources up to $32V_{DC}$. The fuse's monolithic, multilayer design helps provide the highest hold current in the smallest footprint, reduce diffusion-related aging, improve product reliability and resilience, and enhance high-temperature performance in a wide range of circuit designs.

These RoHS-compliant surface-mount devices offer strong arc suppression characteristics and facilitate the development of more reliable, high-performance consumer electronics such as laptops, multimedia devices, cell phones and other portable electronics.


### Benefits

- Very fast acting at 200% and 300% overloads
- Inrush current withstand capability at high overloads
- Thin body for space-limited applications
- Glass ceramic monolithic structure
- Silver fusing element and silver termination with nickel and tin plating
- RoHS compliant and lead-free materials
- Symmetrical design with marking on both sides (optional)

### Features

- Lead-free materials and RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### Applications

- Laptops
- Digital cameras
- Cell phones
- Printers
- DVD players
- Portable electronics
- Game systems
- LCD monitors
- Scanners

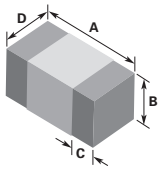
## Table FV1 Clear Time Characteristics for Very Fast-Acting Chip Fuses

| % of Rated Current | Clear Time at 25°C | |
|---|---|---|
| 100% | 4 hrs (min) | |
| 200% | 0.01 s (min) | 5 s (max) |
| 300% | 0.001 s (min) | 0.2 s (max) |

## Table FV2 Typical Electrical Characteristics and Dimensions for Very Fast-Acting Chip Fuses

### 0603 (1608mm) Very Fast-Acting Chip Fuses

**Shape and Dimensions**
mm (in)



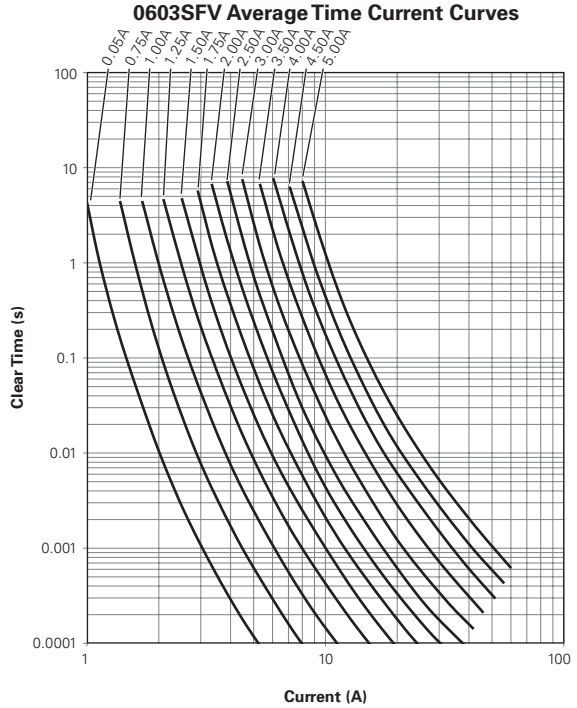

| | A | | B | | C | | D | |
|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | Min | Max |
| mm | 1.45 | 1.75 | 0.22 | 0.48 | 0.21 | 0.51 | 0.65 | 0.95 |
| in | (0.057) | (0.069) | (0.009) | (0.019) | (0.008) | (0.020) | (0.025) | (0.037) |

| | Typical Electrical Characteristics | | | Max Interrupt Ratings | |
|---|---|---|---|---|---|
| Part Number | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal $I^2t$ ($A^2s$) | Voltage ($V_{DC}$) | Current (A) |
| 0603SFV050F/32-2 | 0.5 | 0.860 | 0.0093 | 32 | 50 |
| 0603SFV075F/32-2 | 0.8 | 0.450 | 0.0191 | 32 | 50 |
| 0603SFV100F/32-2 | 1.0 | 0.280 | 0.0360 | 32 | 50 |
| 0603SFV125F/32-2 | 1.3 | 0.205 | 0.0630 | 32 | 35 |
| 0603SFV150F/32-2 | 1.5 | 0.143 | 0.0950 | 32 | 35 |
| 0603SFV175F/32-2 | 1.8 | 0.095 | 0.1400 | 32 | 35 |
| 0603SFV200F/32-2 | 2.0 | 0.073 | 0.2100 | 32 | 35 |
| 0603SFV250F/32-2 | 2.5 | 0.046 | 0.3000 | 32 | 35 |
| 0603SFV300F/32-2 | 3.0 | 0.039 | 0.4600 | 32 | 35 |
| 0603SFV350F/32-2 | 3.5 | 0.028 | 0.7300 | 32 | 35 |
| 0603SFV400F/32-2 | 4.0 | 0.023 | 1.1500 | 32 | 35 |
| 0603SFV450F/32-2 | 4.5 | 0.019 | 1.6800 | 32 | 35 |
| 0603SFV500F/32-2 | 5.0 | 0.015 | 2.6200 | 32 | 35 |

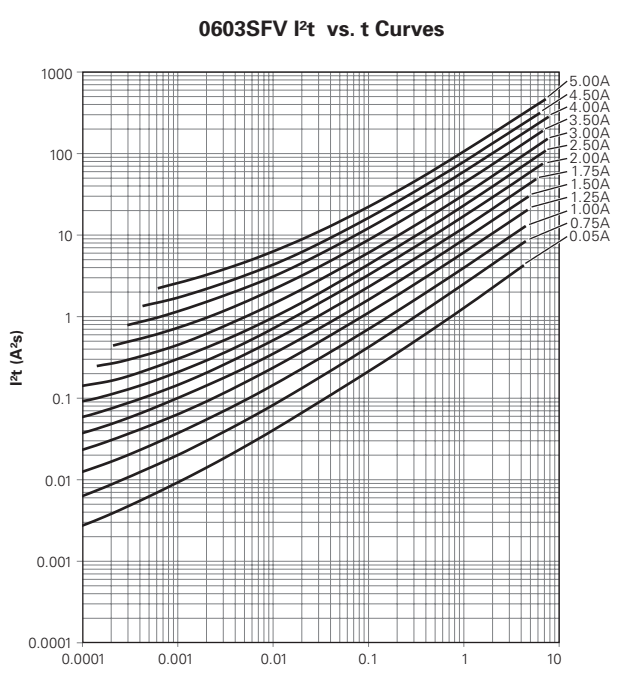
* Measured at 10% of rated current and 25°C.

## Figures FV1-FV2 Family Performance Curves for Very Fast-Acting Chip Fuses

### Figure FV1




### Figure FV2




**Note:** Curves are nominal.

➔ **Please go to page 129 for more information about Very Fast-Acting Chip Fuses.**



RoHS Compliant, ELV Compliant HF Halogen Free

# Surface-Mount Fuses
## Fast-Acting Chip Fuses

Fast-acting chip fuses help provide overcurrent protection for systems using DC power sources up to $63V_{DC}$. The fuse's monolithic, multilayer design helps provide the highest hold current in the smallest footprint, reduce diffusion-related aging, improve product reliability and resilience, and enhance high-temperature performance in a wide range of circuit designs.

These RoHS-compliant surface-mount devices offer strong arc suppression characteristics and help facilitate the development of more reliable, high-performance consumer electronics such as laptops, multimedia devices, cell phones and other portable electronics.


### Benefits

- Small size with high-current ratings
- Temperature stability
- High reliability and resilience
- Strong arc suppression characteristics

### Features

- Lead-free and RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### Applications

- Laptops
- Digital cameras
- Cell phones
- Printers
- DVD players
- Portable electronics
- Game systems
- LCD monitors
- Scanners

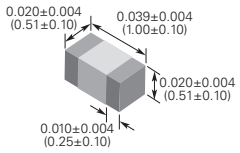
## Table FF1 Clear Time Characteristics for Fast-Acting Chip Fuses

| % of Rated Current | Clear Time at 25°C |
|---|---|
| 100% | 4 hrs min |
| 250% | 5 s max |
| 400% | 0.05 s max |

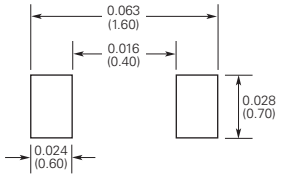
## Table FF2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Fast-Acting Chip Fuses

### 0402 (1005mm) Fast-Acting Chip Fuses

**Shape and Dimensions** in (mm)



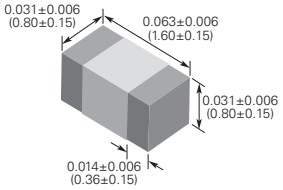

**Recommended Pad Layout** in (mm)



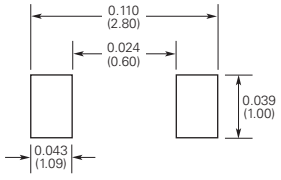

| | Typical Electrical Characteristics | | | Max Interrupt Ratings | |
|---|---|---|---|---|---|
| Part Number | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal $I^2t$ ($A^2s$)† | Voltage ($V_{DC}$) | Current (A) |
| 0402SFF100F/24 | 1.00 | 0.120 | 0.0170 | 24 | 35 |
| 0402SFF150F/24 | 1.50 | 0.056 | 0.0490 | 24 | 35 |
| 0402SFF200F/24 | 2.00 | 0.035 | 0.0700 | 24 | 35 |
| 0402SFF300F/24 | 3.00 | 0.021 | 0.1250 | 24 | 35 |
| 0402SFF400F/24 | 4.00 | 0.014 | 0.2250 | 24 | 35 |

### 0603 (1608mm) Fast-Acting Chip Fuses

**Shape and Dimensions** in (mm)



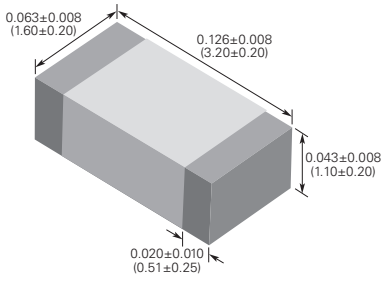

**Recommended Pad Layout** in (mm)



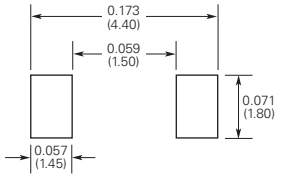

| | Typical Electrical Characteristics | | | Max Interrupt Ratings | |
|---|---|---|---|---|---|
| Part Number | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal $I^2t$ ($A^2s$)† | Voltage ($V_{DC}$) | Current (A) |
| 0603SFF050F/32 | 0.50 | 0.485 | 0.0029 | 63 | 35 |
| 0603SFF075F/32 | 0.75 | 0.254 | 0.0064 | 63 | 35 |
| 0603SFF100F/32 | 1.00 | 0.147 | 0.0160 | 63 | 35 |
| 0603SFF150F/32 | 1.50 | 0.059 | 0.0300 | 63 | 35 |
| 0603SFF200F/32 | 2.00 | 0.044 | 0.0600 | 32 | 35 |
| 0603SFF250F/32 | 2.50 | 0.032 | 0.1150 | 32 | 35 |
| 0603SFF300F/32 | 3.00 | 0.025 | 0.1900 | 32 | 35 |
| 0603SFF350F/32 | 3.50 | 0.024 | 0.2950 | 32 | 35 |
| 0603SFF400F/32 | 4.00 | 0.018 | 0.4000 | 32 | 35 |
| 0603SFF500F/32 | 5.00 | 0.013 | 0.7000 | 32 | 35 |
| 0603SFF600F/24 | 6.00 | 0.010 | 1.1250 | 24 | 35 |

### 1206 (3216mm) Fast-Acting Chip Fuses

**Shape and Dimensions** in (mm)




**Recommended Pad Layout** in (mm)




| | Typical Electrical Characteristics | | | Max Interrupt Ratings | |
|---|---|---|---|---|---|
| Part Number | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal $I^2t$ ($A^2s$)† | Voltage ($V_{DC}$) | Current (A) |
| 1206SFF050F/63 | 0.50 | 0.730 | 0.0021 | 63 | 50 |
| 1206SFF075F/63 | 0.75 | 0.513 | 0.0052 | 63 | 50 |
| 1206SFF100F/63 | 1.00 | 0.220 | 0.0120 | 63 | 50 |
| 1206SFF150F/63 | 1.50 | 0.120 | 0.0250 | 63 | 50 |
| 1206SFF175F/63 | 1.75 | 0.100 | 0.0450 | 63 | 50 |
| 1206SFF200F/63 | 2.00 | 0.050 | 0.0700 | 63 | 50 |
| 1206SFF250F/32 | 2.50 | 0.035 | 0.1400 | 32 | 50 |
| 1206SFF300F/32 | 3.00 | 0.031 | 0.2200 | 32 | 50 |
| 1206SFF400F/32 | 4.00 | 0.022 | 0.3800 | 32 | 45 |
| 1206SFF500F/32 | 5.00 | 0.015 | 0.6000 | 32 | 45 |
| 1206SFF600F/32 | 6.00 | 0.013 | 1.0000 | 32 | 50 |
| 1206SFF700F/32 | 7.00 | 0.011 | 1.7500 | 32 | 50 |
| 1206SFF800F/32 | 8.00 | 0.008 | 2.5000 | 32 | 50 |
| 1206SFF600F/24 | 6.00 | 0.013 | 1.0000 | 24 | 45 |
| 1206SFF700F/24 | 7.00 | 0.011 | 1.7500 | 24 | 45 |
| 1206SFF800F/24 | 8.00 | 0.008 | 2.5000 | 24 | 45 |

* Measured at ≤10% of rated current and 25°C ambient temperature.
† Melting $I^2t$ at 0.001 sec clear time.

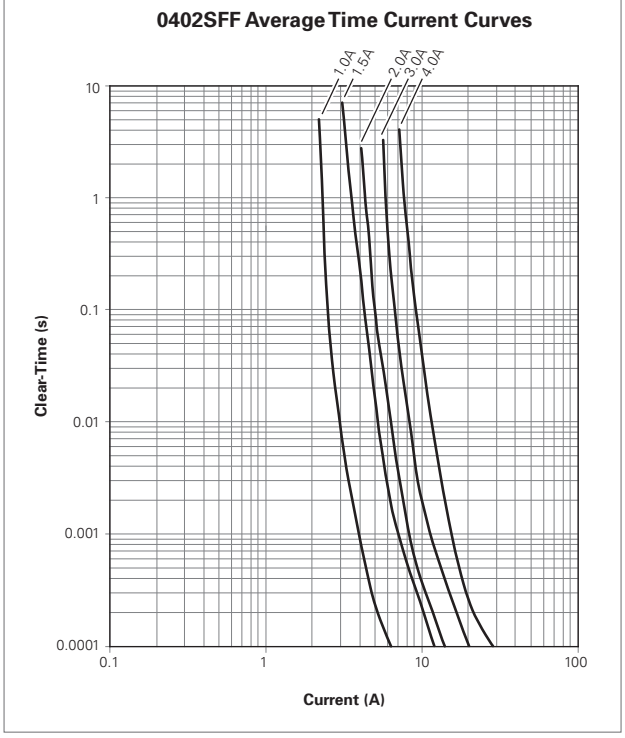




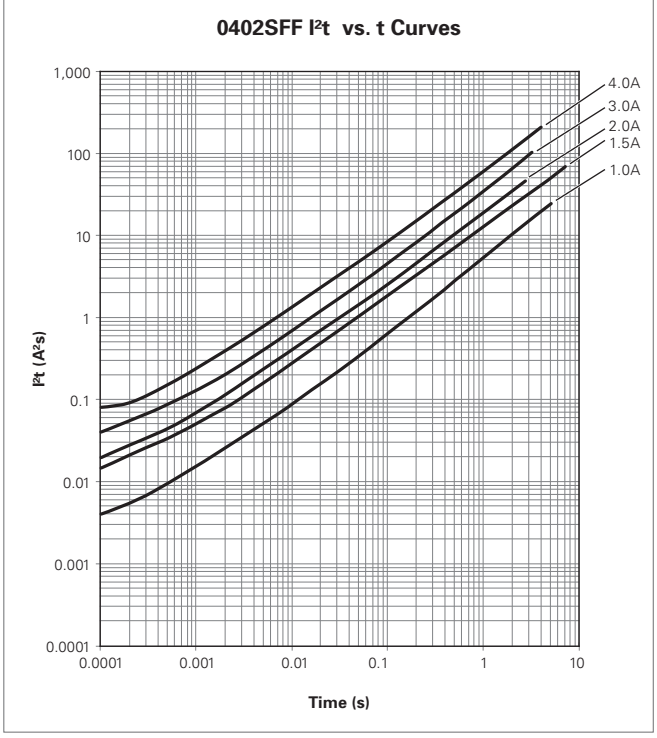
RoHS Compliant, ELV Compliant HF Halogen Free

## Figures FF1-FF6 Family Performance Curves for Fast-Acting Chip Fuses

### Figure FF1

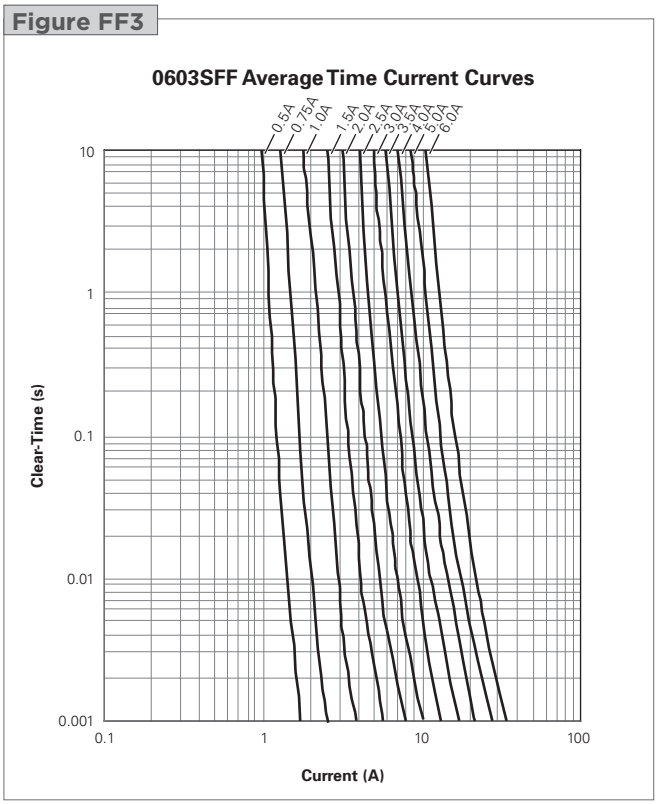



### Figure FF2

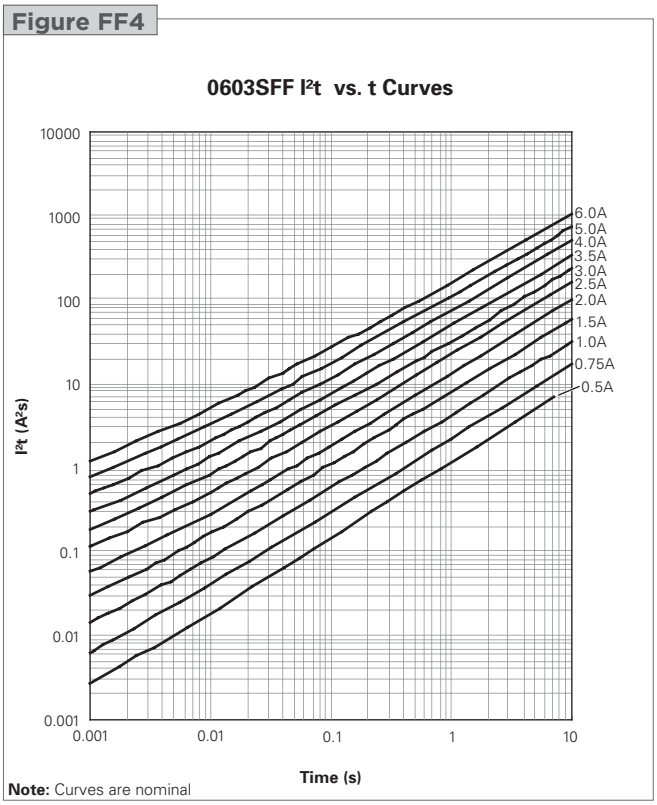



**Note:** Curves are nominal

### Figure FF3

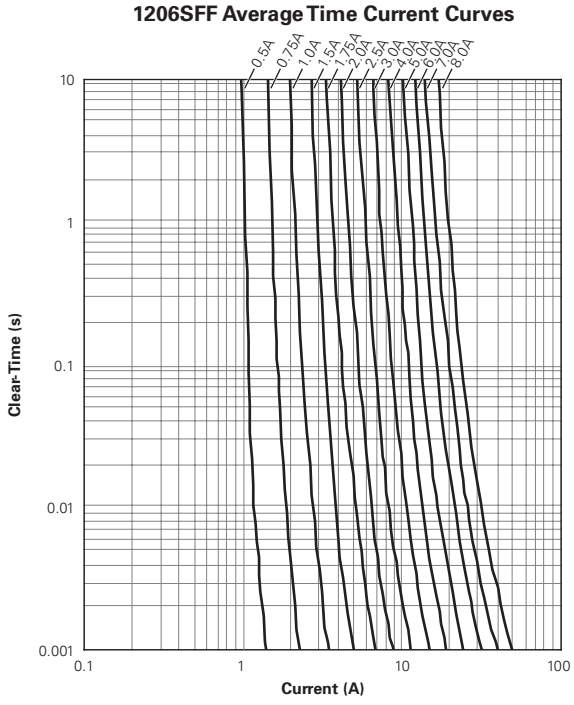



### Figure FF4

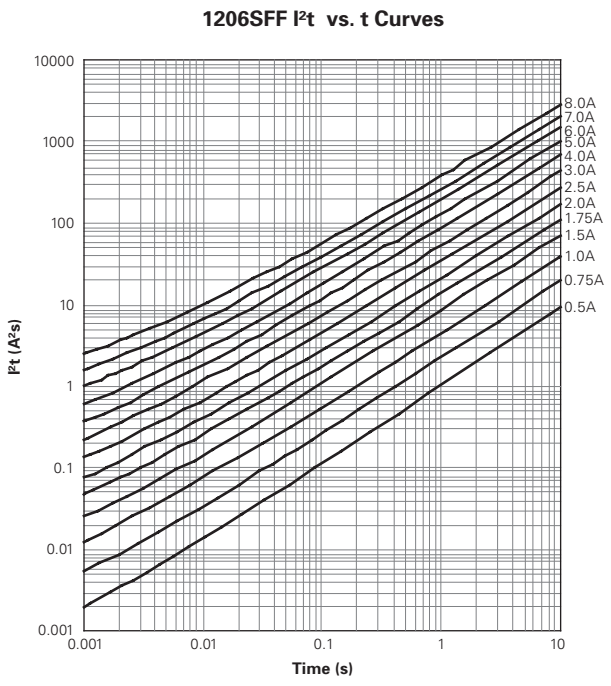



**Note:** Curves are nominal

## Figure FF5




## Figure FF6

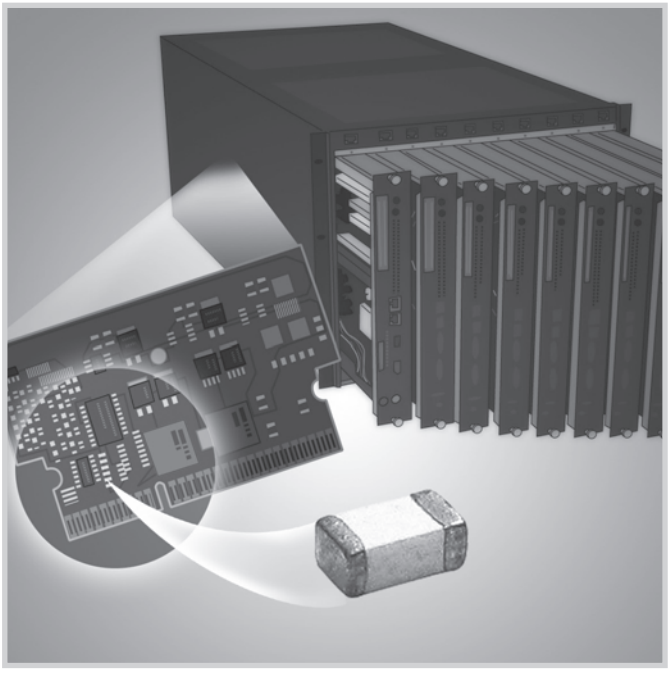



**Note:** Curves are nominal.

➔ **Please go to page 129 for more information about Fast-Acting Chip Fuses.**

# Surface-Mount Fuses
## High-Current-Rated Chip Fuses

The monolithic multilayer design of the TE Circuit Protection high-current-rated chip fuses helps to provide some of the highest current ratings available in the 1206 size and enhances high-temperature performance in a wide range of circuit protection designs. The devices' small size, high reliability and strong arc suppression characteristics make them suitable for overcurrent protection of power supplies, servers, communications equipment, voltage regulator modules, and other high-current, small size applications.



### Benefits

- Glass ceramic monolithic structure provides stability in application cycling
- High-current rating in a small package allows more efficient use in system space
- Strong arc suppression in overcurrent conditions

### Features

- Lead-free materials and RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### Applications

- Communications equipment
- Voltage regulator modules
- Power supplies
- Servers

## Table FH1 Clear Time Characteristics for High-Current-Rated Chip Fuses

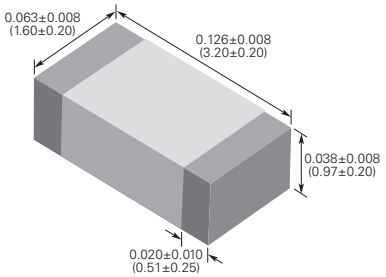
### 1206SFH Series

| % of Rated Current | Clear Time at 25°C |
|---|---|
| 100% | 4 hrs (min) |
| 250% | 5 s (max) |

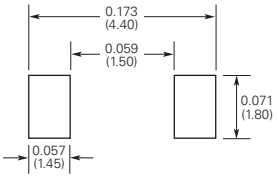
## Table FH2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for High-Current-Rated Chip Fuses

### 1206 (3216mm) High-Current-Rated Chip Fuses

**Shape and Dimensions**
in (mm)




**Recommended Pad Layout**
in (mm)

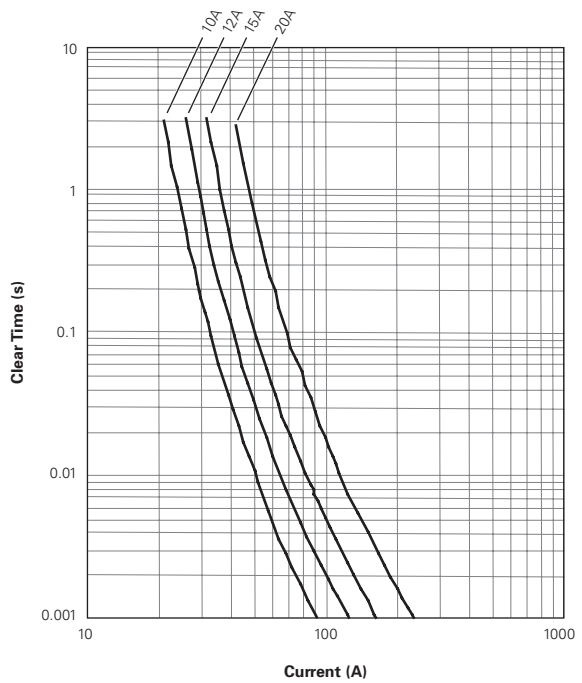



| Part Number | Typical Electrical Characteristics: Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal $I^2t$ ($A^2s$)† | Max Interrupt Ratings: Voltage ($V_{DC}$) | Current (A) |
|---|---|---|---|---|---|
| 1206SFH100F/24 | 10 | 0.010 | 9 | 24 | 100 |
| 1206SFH120F/24 | 12 | 0.008 | 14 | 24 | 100 |
| 1206SFH150F/24 | 15 | 0.005 | 26 | 24 | 100 |
| 1206SFH200F/24 | 20 | 0.003 | 56 | 24 | 100 |

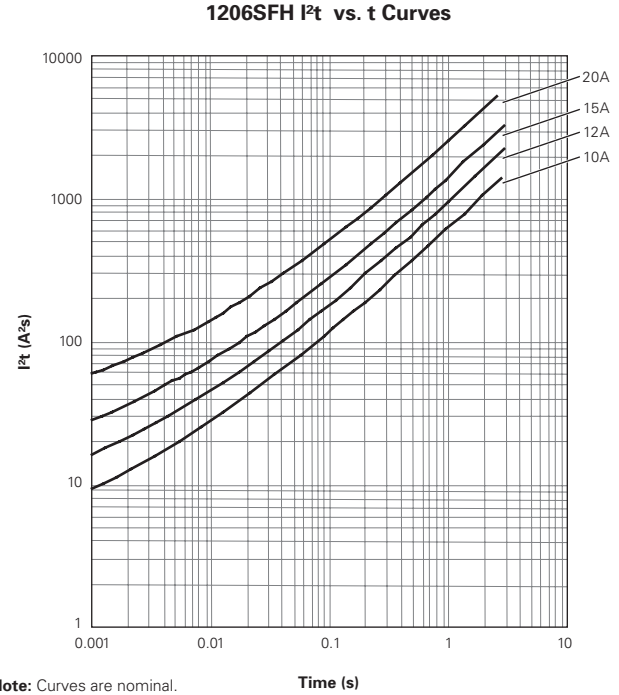
* Measured at ≤10% of rated current and 25°C ambient temperature.
† Melting $I^2t$ at 0.001 sec clear time.

## Figures FH1-FH2 Family Performance Curves for High-Current-Rated Chip Fuses

### Figure FH1




### Figure FH2




**Note:** Curves are nominal.

➔ **Please go to page 129 for more information about High-Current-Rated Chip Fuses.**

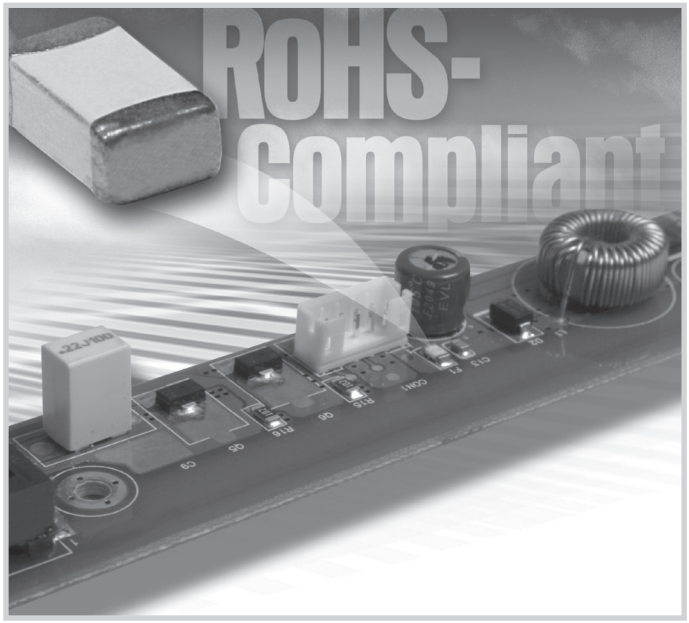


RoHS Compliant, ELV Compliant HF Halogen Free

# Surface-Mount Fuses
## Slow-Blow Chip Fuses

Available in industry standard 1206 and 0603 chip sizes, TE Circuit Protection's slow-blow chip fuses help provide overcurrent protection on systems that experience large and frequent current surges as part of their normal operation.

The slow-blow chip fuse's monolithic, multilayer design helps provide some of the highest current ratings available in the 1206 and 0603 footprints and enhances high-temperature performance in a wide range of circuit protection designs. The devices' small size, high reliability and strong arc suppression characteristics make them suitable for overcurrent protection of power supplies, capacitor filter banks, Liquid Crystal Display (LCD) backlight inverters, electric motors and portable electronics.




### Benefits

- Time-delayed design help prevent nuisance openings in pulsed and high inrush current applications
- Small size with high-current ratings
- Strong arc suppression characteristics

### Features

- Lead-free materials and RoHS compliant
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### Applications

- Small motor systems
- Portable electronics
- Input power ports
- Power over Ethernet (PoE)
- Test equipment
- POL converter protection
- Computer drives
- Displays
- Printers

## Table FS1 Clear Time Characteristics for Slow-Blow Chip Fuses

### 0603SFS Series

| % of Rated Current | Clear Time at 25°C | |
|---|---|---|
| 100% | 4 hrs (min) | |
| 200% | 1 s (min) | 120 s (max) |
| 300% | 0.1 s (min) | 3 s (max) |
| 800%(1.0A-1.5A) | 0.0005 s (min) | 0.05 s (max) |
| 800%(2.0A-5.0A) | 0.001 s (min) | 0.05 s (max) |

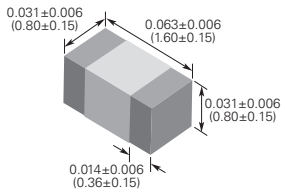
### 1206SFS Series

| % of Rated Current | Clear Time at 25°C | |
|---|---|---|
| 100% | 4 hrs (min) | |
| 200% | 1 s (min) | 120 s (max) |
| 300% | 0.1 s (min) | 3 s (max) |
| 800%(1.0A-1.5A) | 0.0016 s (min) | 0.05 s (max) |
| 800%(2.0A-8.0A) | 0.002 s (min) | 0.05 s (max) |

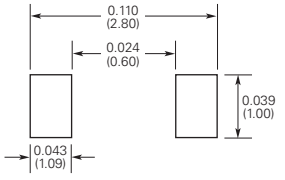
## Table FS2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Slow-Blow Chip Fuses

### 0603 (1608mm) Slow-Blow Chip Fuses

**Shape and Dimensions** in (mm)



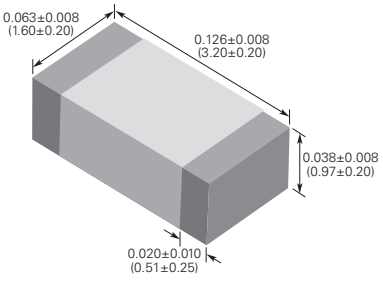

**Recommended Pad Layout** in (mm)



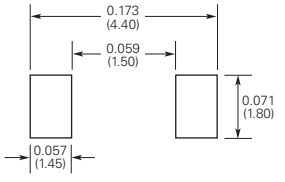

| Part Number | Typical Electrical Characteristics: Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal $I^2t$ ($A^2s$)† | Max Interrupt Ratings: Voltage ($V_{DC}$) | Current (A) |
|---|---|---|---|---|---|
| 0603SFS100F/32 | 1.0 | 0.200 | 0.093 | 32 | 50 |
| 0603SFS150F/32 | 1.5 | 0.100 | 0.18 | 32 | 50 |
| 0603SFS200F/32 | 2.0 | 0.052 | 0.32 | 32 | 50 |
| 0603SFS250F/32 | 2.5 | 0.041 | 0.63 | 32 | 50 |
| 0603SFS300F/32 | 3.0 | 0.031 | 0.87 | 32 | 50 |
| 0603SFS350F/32 | 3.5 | 0.021 | 1.20 | 32 | 50 |
| 0603SFS400F/32 | 4.0 | 0.017 | 2.30 | 32 | 50 |
| 0603SFS450F/32 | 4.5 | 0.015 | 2.70 | 32 | 50 |
| 0603SFS500F/32 | 5.0 | 0.013 | 3.20 | 32 | 50 |

### 1206 (3216mm) Slow-Blow Chip Fuses

**Shape and Dimensions** in (mm)




**Recommended Pad Layout** in (mm)




| Part Number | Typical Electrical Characteristics: Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal $I^2t$ ($A^2s$)† | Max Interrupt Ratings: Voltage ($V_{DC}$) | Current (A) |
|---|---|---|---|---|---|
| 1206SFS100F/63 | 1.0 | 0.360 | 0.11 | 63 | 50 |
| 1206SFS125F/63 | 1.25 | 0.200 | 0.22 | 63 | 50 |
| 1206SFS150F/63 | 1.5 | 0.150 | 0.23 | 63 | 50 |
| 1206SFS200F/63 | 2.0 | 0.088 | 0.63 | 63 | 50 |
| 1206SFS250F/32 | 2.5 | 0.065 | 0.90 | 32 | 50 |
| 1206SFS300F/32 | 3.0 | 0.034 | 1.20 | 32 | 50 |
| 1206SFS350F/32 | 3.5 | 0.028 | 1.60 | 32 | 50 |
| 1206SFS400F/32 | 4.0 | 0.024 | 2.20 | 32 | 50 |
| 1206SFS450F/32 | 4.5 | 0.020 | 3.60 | 32 | 50 |
| 1206SFS500F/32 | 5.0 | 0.016 | 5.30 | 32 | 50 |
| 1206SFS550F/24 | 5.5 | 0.014 | 6.40 | 24 | 50 |
| 1206SFS600F/24 | 6.0 | 0.011 | 8.50 | 24 | 60 |
| 1206SFS700F/24 | 7.0 | 0.010 | 10.00 | 24 | 60 |
| 1206SFS800F/24 | 8.0 | 0.009 | 16.90 | 24 | 60 |

* Measured at ≤10% of rated current and 25°C ambient temperature.
† Melting $I^2t$ at 0.001 s clear time.

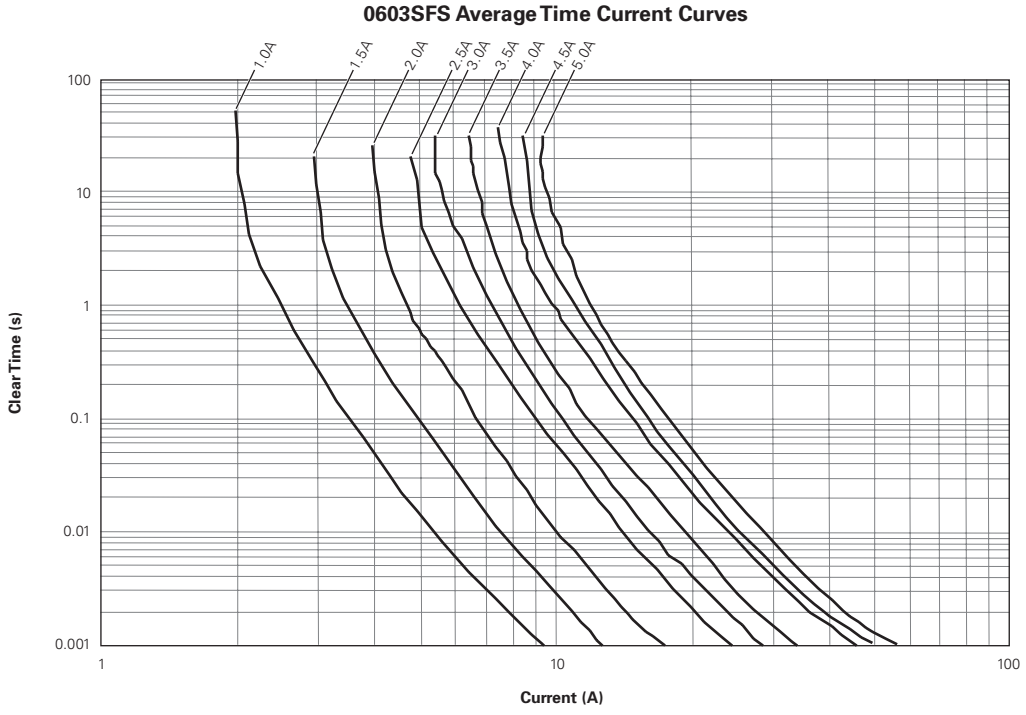




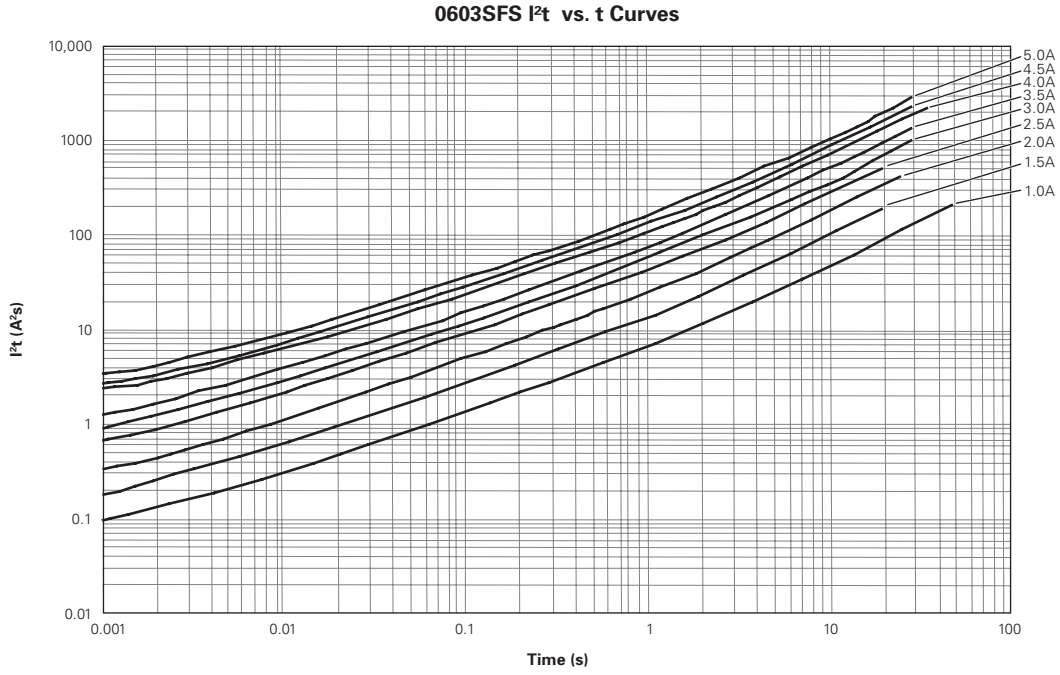
RoHS Compliant, ELV Compliant HF Halogen Free

## Figures FS1-FS4 Family Performance Curves for Slow-Blow Chip Fuses

### Figure FS1

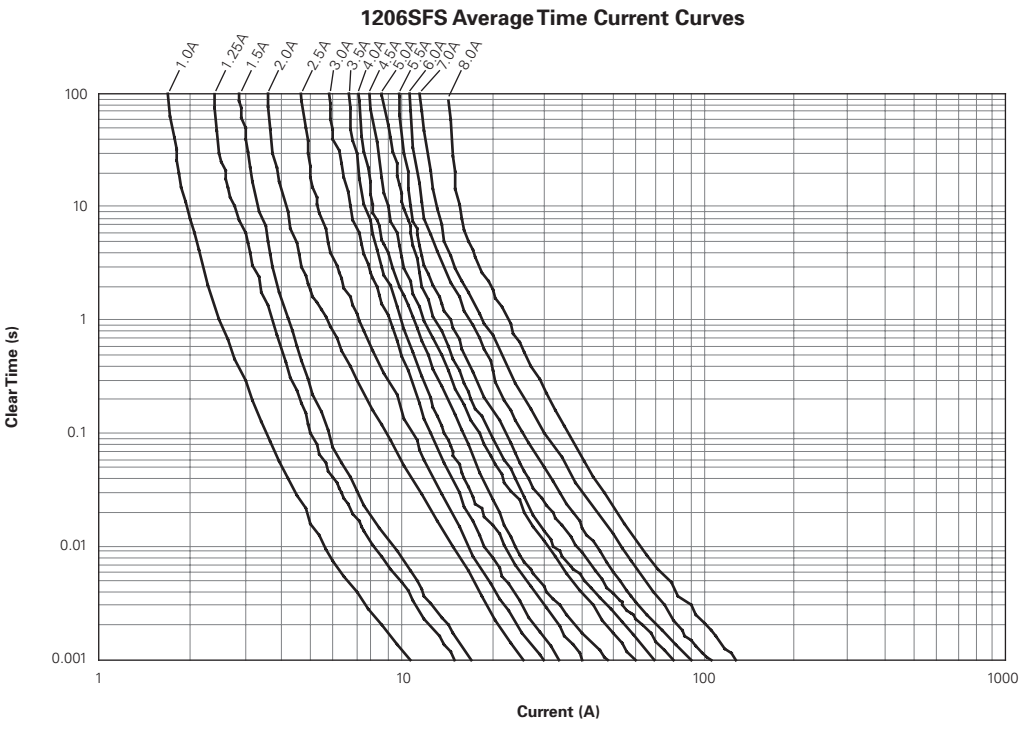



### Figure FS2

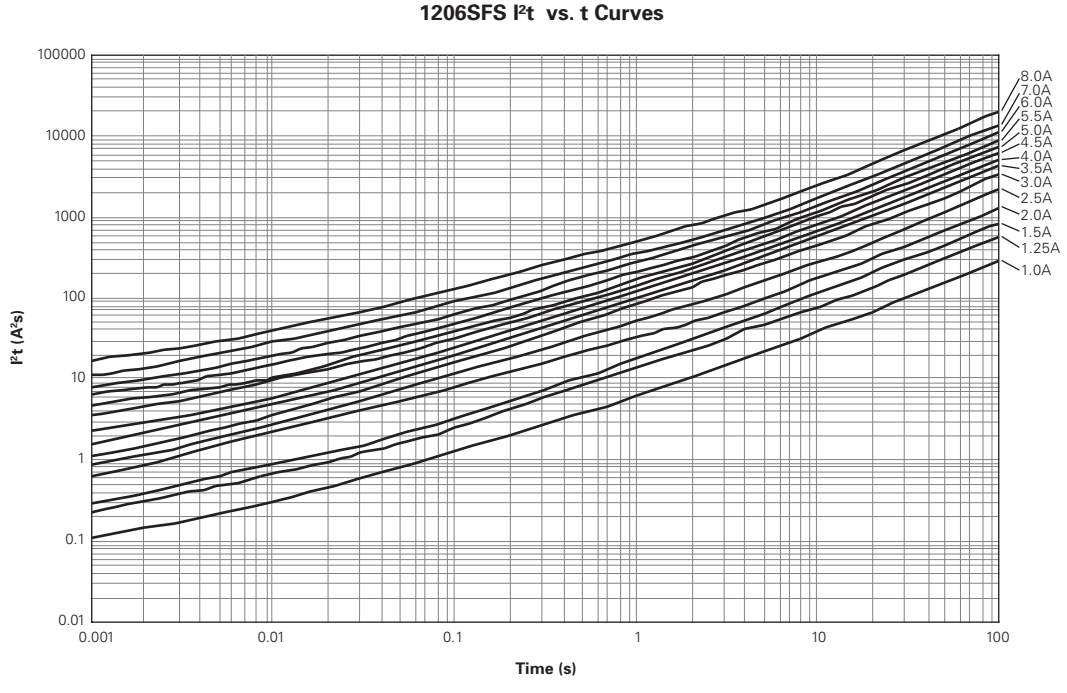



**Note:** Curves are nominal.

## Figure FS3




## Figure FS4




**Note:** Curves are nominal

➔ **Please go to page 129 for more information about Slow-Blow Chip Fuses.**


# Surface-Mount Fuses
## 2410 Very Fast-Acting Fuses

NEW

The 2410 (6125mm) Wire-in-Air (WIA) SMD Fuse is suitable for secondary-level overcurrent protection applications.

These lead-free surface-mount devices offer increased reliability and avoid the risk of end caps falling off. Their straight wire element in air performs consistent fusing and cutting characteristics.


### Benefits

- Very fast acting at 200% overload current level
- Excellent inrush current withstand capability
- High reliability and resilience
- Strong arc suppression characteristics
- Copper terminal with nickel and tin plating

### Features

- Halogen free, RoHS compliant and 100% lead free
- Copper or copper alloy composite fuse link
- Fiberglass enforced epoxy fuse body
- Wide range of current rating
- -55°C to +125°C operating temperature range (with de-rating)

### Applications

- Industrial equipment
- LCD/PDP TV
- Backlight inverter
- Power supplier
- Telecom system
- Networking
- Game systems
- White goods
- Automotive

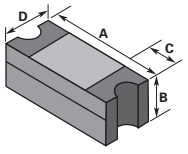
## Table SFV1 Clear Time Characteristics for 2410 Very Fast-Acting Fuses

| % of Rated Current | Clear Time at 25°C | |
|---|---|---|
| 100% | 4 hrs (min) | |
| 200% (0.5A-10.0A) | 0.01 s (min) | 5 s (max) |
| 200% (12.0A-20.0A) | 0.01 s (min) | 20 s (max) |

## Table SFV2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for 2410 Very Fast-Acting Fuses

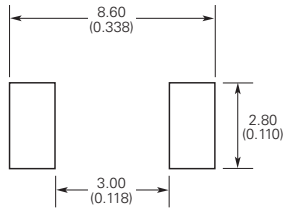
### 2410 (6125mm) Very Fast-Acting Fuse

**Shape and Dimensions**
mm (in)




| | A | | B | | C | | D | |
|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | Min | Max |
| mm | 5.95 | 6.25 | 1.96 | 2.36 | 0.97 | 1.73 | 2.34 | 2.64 |
| in | (0.234) | (0.246) | (0.077) | (0.093) | (0.038) | (0.068) | (0.092) | (0.104) |

**Recommended Pad Layout**
mm (Inch)




| Part Number | Marking Code | Rated Current (A) | Interrupt Rating | Voltage Rating (V) | | Nominal Cold DC Resistance (DCR) (Ω)* | Nominal $I^2t$ ($A^2s$) |
|---|---|---|---|---|---|---|---|
| | | | | AC | DC | | |
| 2410SFV0.50FM/125 | C | 0.5 | **UL:** 0.5~2A 100A @ 250$V_{AC}$ **2.5~8A** 50A @ 125$V_{AC}$ **0.5~8A** 50A @ 125$V_{DC}$ 300A @ 32$V_{DC}$ **TUV:** **0.5~2A** 100A @ 250$V_{AC}$ 50A @ 125$V_{DC}$ **CQC:** **0.5A, 1A, 2A** 100A @ 250$V_{AC}$ 50A @ 125$V_{DC}$ | 250 | 125 | 0.231 | 0.1 |
| 2410SFV0.63FM/125 | S | 0.63 | | 250 | 125 | 0.174 | 0.16 |
| 2410SFV0.75FM/125 | D | 0.75 | | 250 | 125 | 0.148 | 0.23 |
| 2410SFV1.00FM/125 | E | 1 | | 250 | 125 | 0.093 | 0.59 |
| 2410SFV1.25FM/125 | F | 1.25 | | 250 | 125 | 0.07 | 0.96 |
| 2410SFV1.50FM/125 | G | 1.5 | | 250 | 125 | 0.062 | 1.19 |
| 2410SFV2.00FM/125 | I | 2 | | 250 | 125 | 0.042 | 2.75 |
| 2410SFV2.50FM/125 | J | 2.5 | | 125 | 125 | 0.031 | 1.21 |
| 2410SFV3.00FM/125 | K | 3 | | 125 | 125 | 0.0249 | 1.73 |
| 2410SFV3.15FM/125 | V | 3.15 | | 125 | 125 | 0.0232 | 2.2 |
| 2410SFV3.50FM/125 | L | 3.5 | | 125 | 125 | 0.022 | 2.5 |
| 2410SFV4.00FM/125 | M | 4 | | 125 | 125 | 0.0172 | 4.1 |
| 2410SFV5.00FM/125 | N | 5 | | 125 | 125 | 0.0143 | 5.9 |
| 2410SFV6.30FM/125 | O | 6.3 | | 125 | 125 | 0.01 | 12.5 |
| 2410SFV7.00FM/125 | P | 7 | | 125 | 125 | 0.0094 | 14.2 |
| 2410SFV8.00FM/125 | R | 8 | | 125 | 125 | 0.0086 | 20.3 |
| 2410SFV10.0FM/125 | Q | 10 | **UL:** 35A @ 125$V_{AC}$ 50A @ 125$V_{DC}$ 300A @ 32$V_{DC}$ | 125 | 125 | 0.0066 | 29.2 |
| 2410SFV12.0FM/065 | X | 12 | **UL:** 50A @ 65$V_{AC}$ 50A @ 65$V_{DC}$ 300A @ 32$V_{DC}$ | 65 | 65 | 0.0053 | 49.2 |
| 2410SFV15.0FM/065 | Y | 15 | | 65 | 65 | 0.0038 | 102.5 |
| 2410SFV20.0FM/065 | Z | 20 | **UL:** 50A @ 65$V_{AC}$ 100A @ 65$V_{DC}$ 300A @ 32$V_{DC}$ | 65 | 65 | 0.0034 | 126.2 |

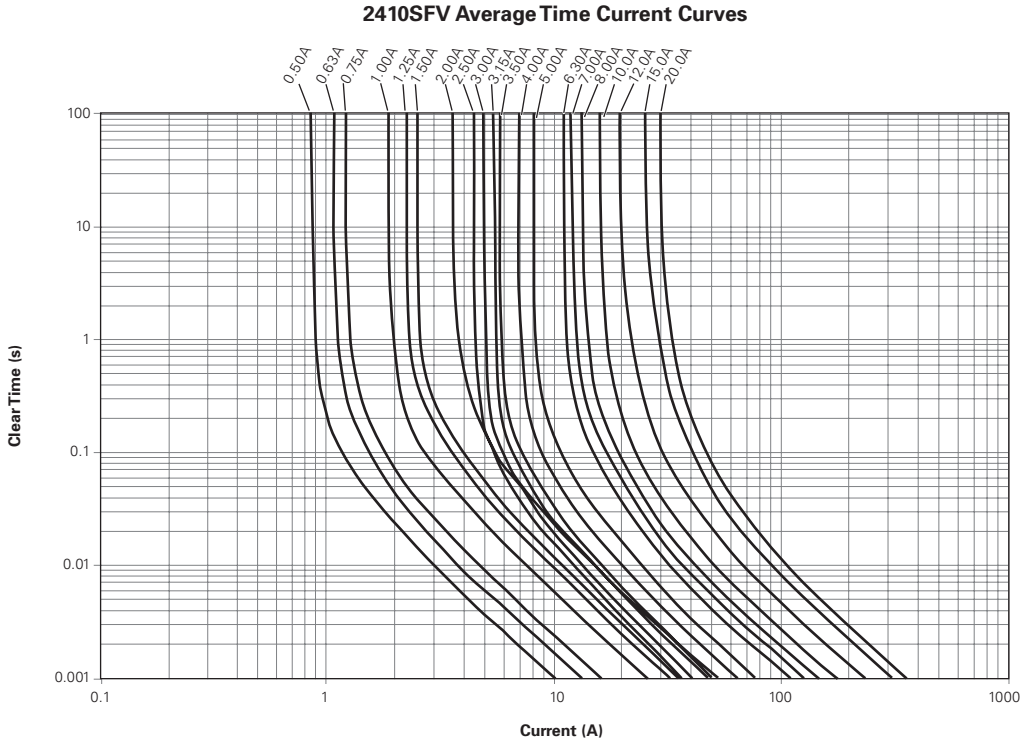
* Measured at ≤10% of rated current and 25°C ambient



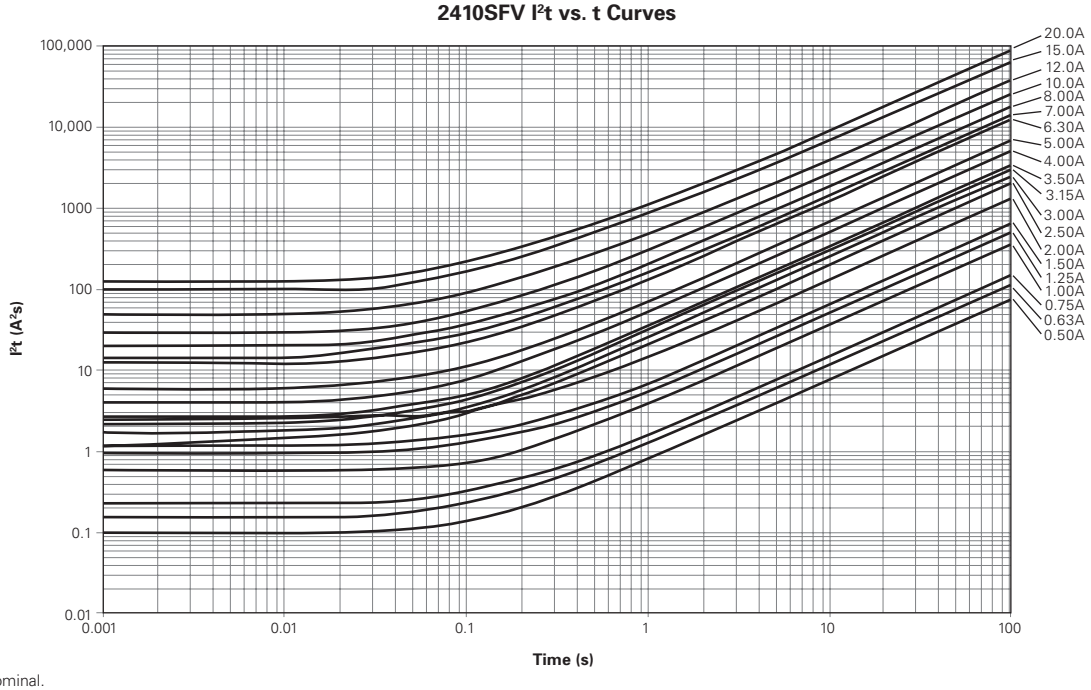

RoHS Compliant, ELV Compliant HF Halogen Free

## Figures SFV1-SFV2 Family Performance Curves for 2410 Very Fast-Acting Fuses

### Figure SFV1




### Figure SFV2




**Note:** Curves are nominal.

➔ **Please go to page 129 for more information about 2410 Fast-Acting Fuses.**

RoHS Compliant, ELV Compliant HF Halogen Free

# Specifications, Packaging Information, Agency Approvals and Part Numbering Systems for All Fuses

## Table F1 Environmental Specifications for All Fuses

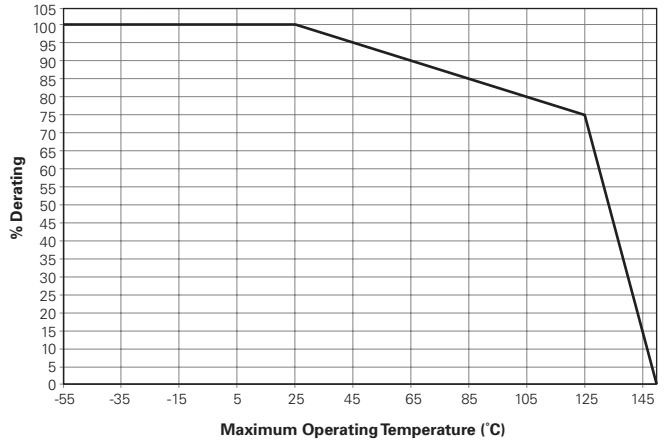
| | |
|---|---|
| Operating Temperature | -55°C to +125°C |
| Mechanical Vibration | Withstands 5-3000 Hz at 30Gs when evaluated per Method 204 of MIL-STD-202 |
| Mechanical Shock | Withstands 1500Gs, 0.5 millisecond half-sine pulses when evaluated per Method 213 of MIL-STD-202 |
| Thermal Shock | Withstands 100 cycles from -65°C to +125°C when evaluated per Method 107 of MIL-STD-202 |
| Resistance to Soldering Heat | Withstands 60 seconds at +260°C when evaluated per Method 210 of MIL-STD-202 |
| Solderability | Meets 95% minimum coverage requirement when evaluated per Method 208 of MIL-STD-202 |
| Moisture Resistance | Withstands 10 cycles when evaluated per Method 106 of MIL-STD-202 |
| Salt Spray | Withstands 48-hour exposure when evaluated per Method 101 of MIL-STD-202 |
| Storage Temperature | ≤30°C/ 85% RH |
| Storage Humidity | Per MIL-STD-202F, Method 106F |

## Table F2 Material Specifications for All Fuses

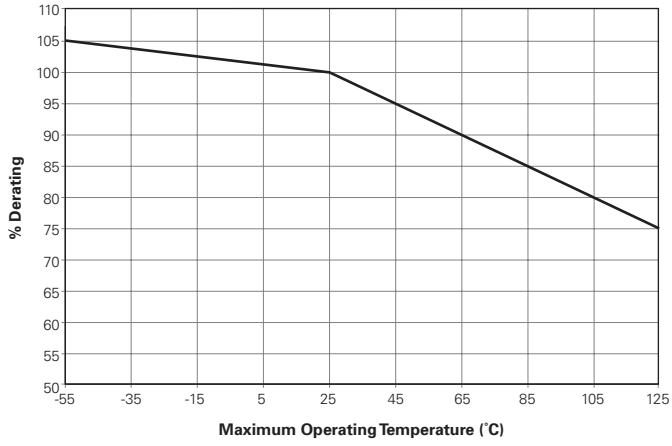
| | |
|---|---|
| Construction Body Material | Ceramic (1206/0603/0402); Fiberglass/Epoxy (2410) |
| Termination Material | Silver, Nickel, Tin |
| Fuse Element | Silver(1206/0603/0402); Copper/Copper Alloy (2410) |

## Figure F1 Thermal Derating Current for All Fuses

**1206/0603/0402 Series**
**Temperature Effect on Current Rating**




**2410 Series**
**Temperature Effect on Current Rating**



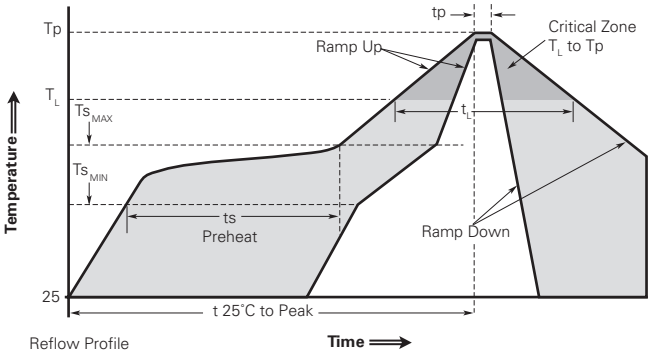

## Table F3 Electrical Specifications for All Fuses

| | |
|---|---|
| Insulation Resistance after Opening | 20,000Ω minimum @ rated voltage. Fuse clearing under low-voltage conditions may result in lower post-clearing insulation values. Under normal fault conditions TE Circuit Protection fuses help provide sufficient insulation resistance for circuit protection. |
| Current Carrying Capacity | Withstands 100% rated current at +25°C ambient for 4 hours when evaluated per MIL-PRF-23419. |

## Table F4 Packaging Information for All Fuses

| Size | Reel Quantity (pcs) | Reel Diameter | Reel Width | Carrier Tape Size | Tape Type | Reels per Outside Shipment Box | Outside Shipment Boxes per Overpack |
|---|---|---|---|---|---|---|---|
| 0402 (1005) | 10,000 | 178mm White Plastic | 9.0 ± 0.5mm | 8.00 ± 0.10mm | Paper | 5 | 1 to 10 |
| 0603 (1608) | 4,000 | 178mm White Plastic | 9.0 ± 0.5mm | 8.00 ± 0.10mm | Paper | 5 | 1 to 10 |
| 0603SFV (1608) | 6,000 | 178mm White Plastic | 9.0 ± 0.5mm | 8.00 ± 0.10mm | Paper | 5 | 1 to 10 |
| 1206 (3216) | 3,000 | 178mm White Plastic | 9.0 ± 0.5mm | 8.00 ± 0.10mm | Plastic | 5 | 1 to 10 |
| 2410 (6125) | 2,000 | 178mm White Plastic | 13.4 ± 0.5mm | 12.00 ± 0.10mm | Plastic | 4 | 1 to 10 |

## Figure F2 Recommended Soldering Temperature Profile for All Fuses




### Classification Reflow Profiles

| Profile Feature | 1206/0603/0402 | 2410 |
|---|---|---|
| **Average Ramp Up Rate ($Ts_{MAX}$ to Tp)** | 3°C/second max | 3°C/second max |
| **Preheat** | | |
| • Temperature min ($Ts_{MIN}$) | 150°C | 150°C |
| • Temperature max ($Ts_{MAX}$) | 200°C | 200°C |
| • Time ($ts_{MIN}$ to $ts_{MAX}$) | 60-180 seconds | 40-100 seconds |
| **Time Maintained Above:** | | |
| • Temperature ($T_L$) | 217°C | 200°C |
| • Time ($t_L$) | 60-150 seconds | 30-90 seconds |
| **Peak/Classification Temperature (Tp)** | 260°C max | 250°C max |
| **Time Within 5°C of Actual Peak Temperature** | | |
| Time (tp) | 20-40 seconds | 30-40 seconds |
| **From 25°C to Preheating (150°C)** | 8 minutes max | 40-100 seconds |
| **Ramp Down Rate** | 4°C/seconds max | Natural Cooling |

**Recommended Conditions for Hand Soldering:**

1. Using a hot air rework station that can reflow the solder on both terminations at the same time is strongly recommended; do not directly contact the chip termination with the tip of soldering iron.
2. Preheating: 150°C, 60s (min)
   Appropriate temperature (max) of soldering iron tip/soldering time (max): 280°C /10s or 350°C /3s.

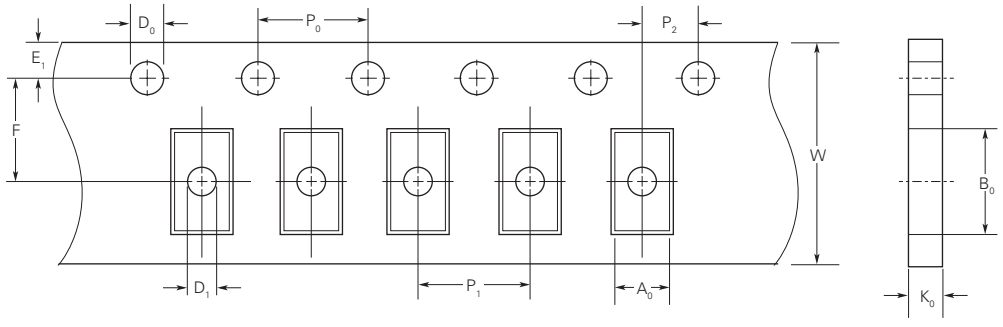
## Table F4 Packaging Information for All Fuses (Cont'd)

Dimension in in (mm)

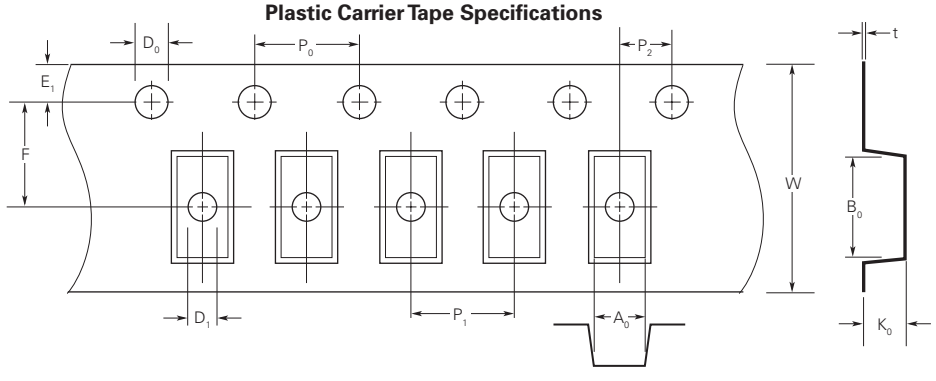
| Mark | 0402 (1005) | 0603 (1608) | 1206 (3216) | 0603SFV (1608) | 2410 (6125) |
|---|---|---|---|---|---|
| $E_1$ | 0.069 ± 0.004 (1.75 ± 0.10) | 0.069 ± 0.004 (1.75 ± 0.10) | 0.069 ± 0.004 (1.75 ± 0.10) | 0.069 ± 0.004 (1.75 ± 0.10) | 0.069 ± 0.004 (1.75 ± 0.10) |
| F | 0.138 ± 0.002 (3.50 ± 0.05) | 0.138 ± 0.002 (3.50 ± 0.05) | 0.138 ± 0.002 (3.50 ± 0.05) | 0.138 ± 0.002 (3.50 ± 0.05) | 0.217 ± 0.004 (5.50 ± 0.10) |
| W | 0.315 ± 0.004 (8.00 ± 0.10) | 0.315 ± 0.004 (8.00 ± 0.10) | 0.315 ± 0.004 (8.00 ± 0.10) | 0.315 ± 0.004 (8.00 ± 0.10) | 0.472 ± 0.004 (12.00 ± 0.10) |
| $P_1$ | 0.079 ± 0.004 (2.00 ± 0.10) | 0.157 ± 0.004 (4.00 ± 0.10) | 0.157 ± 0.004 (4.00 ± 0.10) | 0.157 ± 0.004 (4.00 ± 0.10) | 0.157 ± 0.004 (4.00 ± 0.10) |
| $P_0$ | 0.157 ± 0.004 (4.00 ± 0.10) | 0.157 ± 0.004 (4.00 ± 0.10) | 0.157 ± 0.004 (4.00 ± 0.10) | 0.157 ± 0.004 (4.00 ± 0.10) | 0.157 ± 0.004 (4.00 ± 0.10) |
| $P_2$ | 0.079 ± 0.002 (2.00 ± 0.05) | 0.079 ± 0.002 (2.00 ± 0.05) | 0.079 ± 0.002 (2.00 ± 0.05) | 0.079 ± 0.002 (2.00 ± 0.05) | 0.079 ± 0.004 (2.00 ± 0.10) |
| $D_0$ | 0.059 ± 0.004 (1.50+0.10/-0.00) | 0.059 ± 0.004 (1.50+0.10/-0.00) | 0.059 ± 0.004 (1.50+0.10/-0.00) | 0.059 ± 0.004 (1.50+0.10/-0.00) | 0.059 ± 0.004 (1.50+0.10/-0.00) |
| $D_1$ | — | — | 0.039 max (1.00 max) | — | 0.61 ± 0.004 (1.55 ± 0.10) |
| t | — | — | 0.009 ± 0.001 (0.23 ± 0.02) | — | 0.010 ± 0.002 (0.25 ± 0.05) |
| $A_0$ | 0.026 ± 0.004 (0.67 ± 0.10) | 0.039 ± 0.004 (0.98 ± 0.10) | 0.071 ± 0.004 (1.80 ± 0.10) | 0.039 ± 0.004 (0.98 ± 0.10) | 0.112 ± 0.004 (2.85 ± 0.10) |
| $B_0$ | 0.046 ± 0.004 (1.17 ± 0.10) | 0.071 ± 0.004 (1.80 ± 0.10) | 0.138 ± 0.004 (3.50 ± 0.10) | 0.071 ± 0.004 (1.80 ± 0.10) | 0.252 ± 0.004 (6.40 ± 0.10) |
| $K_0$ | 0.025 ± 0.004 (0.63 ± 0.10) | 0.037 ± 0.003 (0.95 ± 0.08) | 0.050 ± 0.004 (1.27 ± 0.10) | 0.024 ± 0.003 (0.60 ± 0.08) | 0.093 ± 0.004 (2.35 ± 0.10) |

## Figure F3 Component Tape Dimensions for All Fuses

**Paper Carrier Tape Specifications**

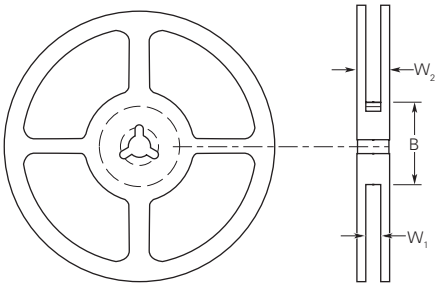



**Plastic Carrier Tape Specifications**



## Figure F4 Reel Dimensions for All Fuses

| Dimension Description | Mark | Dimension (mm) 1206/0603/0402 | 2410 |
|---|---|---|---|
| Hub Outer Diameter | B | 60 | 60.2 |
| Reel Inside Width | $W_1$ | 9 | 13.4 |
| Reel Outside Width | $W_2$ | 11.4 | 16 |
| Tape Width | | 8 | |




## Agency Approvals for All Fuses

UL: All fuses
CQC: File # 12012078873 (for 2410SFV 0.5A, 1A, 2A)
TUV: File # 50236400 (for 2410SFV 0.5A, 0.63A, 1A, 1.25A, 2A)

## Part Numbering System for Fast-Acting, Slow-Blow and 0603 Very Fast-Acting Chip Fuses

**1206 SF F 400 F / 24 -2**

**Packaging**
-2 = Tape and Reel

**Typical Voltage Rating**
24 = $24V_{DC}$

**Special Code**
F = RoHS Compliant
FM = RoHS Compliant + Marked Part

**Rated Current**
050 = 0.50A
400 = 4A

**Fuse Blow Type**
F = Fast Acting
S = Slow Blow

**SF = Surface-Mount Fuse**

**Size (1206, 0603, 0402)**

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## Part Numbering System for High-Current-Rated Chip Fuses

**1206 SF H 100 F / 24 -2**

**Packaging**
-2 = Tape and Reel

**Typical Voltage Rating**
24 = $24V_{DC}$

**Special Code**
F = RoHS Compliant
FM = RoHS Compliant + Marked Part

**Rated Current**
100 = 10A

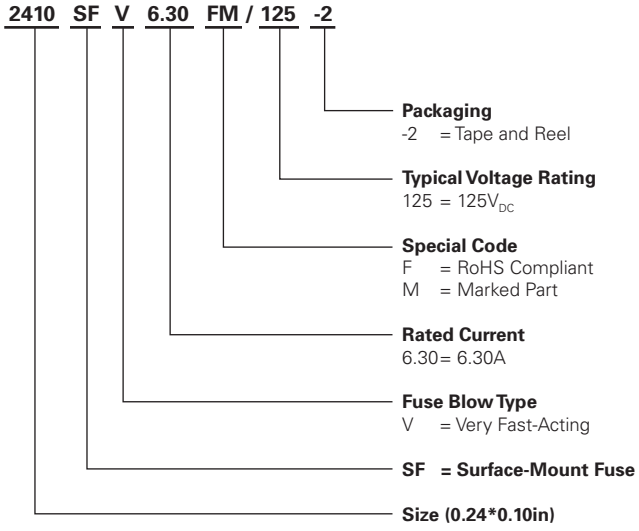
**Fuse Blow Type**
H = High Current

**SF = Surface-Mount Fuse**

**Size (1206)**


RoHS Compliant, ELV Compliant HF Halogen Free

## Part Numbering System for 2410 Very Fast-Acting Fuses








RoHS Compliant, ELV Compliant  HF Halogen Free