# Metal Oxide Varistor for Automotive: TVM-C Series

## SMD Type for Transient Overvoltage Protection

## ■ Features

1. Qualification based on AEC-Q200 Rev-C
2. High surge suppression capability for automotive application (load dump)
3. No temperature derating up to 125 °C
4. Bidirectional and symmetrical V/I characteristics
5. Stability in high-temperature and high-humidity environment
6. RoHS & Halogen Free (HF) compliant

## ■ Recommended Applications

Transient overvoltage protection in automotive applications: engine management, airbag, control units, electro hydraulic brake, ABS/ESP, sunroof

## ■ Part Number Code

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Product Type | |
|---|---|
| TVM | THINKING SMD Varistor TVM Series |

| Size(EIA) | |
|---|---|
| 0 | 0402 |
| 1 | 0603 |
| 2 | 0805 |
| 3 | 1206 |
| 4 | 1210 |
| 5 | 1812 |
| 6 | 2220 |
| 7 | 3025 |

| Max. Continuous Voltage($V_{DC}$) | |
|---|---|
| 5R5 | 5.5V |
| 090 | $9x10^0$=9V |
| 330 | $33x10^0$=33V |

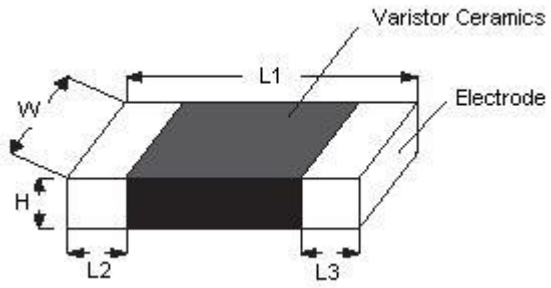
| Series | |
|---|---|
| C | Automotive Series |

| Typical Capacitance | |
|---|---|
| M330 | $33x10^0$pF=33pF (@1MHz) |
| K102 | $10x10^2$pF=1000pF (@1KHz) |

| Packaging | |
|---|---|
| R | Reel |
| B | Bulk |

| Optional Suffix |
|---|
| 001 ~ZZZ |

## ■ Structures and Dimensions




(Unit: mm)

| Part No. | Size (EIA) | L1 | W | H max. | L2 and L3 |
|---|---|---|---|---|---|
| TVM0 | 0402 | 1.00±0.15 | 0.50±0.10 | 0.60 | 0.20±0.10 |
| TVM1 | 0603 | 1.60 ±0.15 | 0.80±0.15 | 0.95 | 0.35±0.15 |
| TVM2 | 0805 | 2.00 ±0.20 | 1.25±0.20 | 1.20 | 0.40±0.20 |
| TVM3 | 1206 | 3.20 ±0.30 | 1.60±0.20 | 1.50 | 0.50±0.20 |
| TVM4 | 1210 | 3.20 ±0.30 | 2.50±0.25 | 1.50 | 0.50±0.20 |
| TVM5 | 1812 | 4.50 ±0.40 | 3.20±0.30 | 2.00 | 0.60±0.30 |
| TVM6 | 2220 | 5.70±0.40 | 5.00±0.30 | 2.50 | 0.60±0.30 |
| TVM7 | 3025 | 7.50±0.50 | 6.30±0.40 | 2.50 | 0.60±0.30 |

## ■ Electrical Characteristics

### ● 0402 Series

| Part No. | Varistor Voltage | Max. Continuous Voltage | | Max. Clamping Voltage (8/20μs) | | Max. Surge Current (8/20μs) | Max. Energy (10/1000μs) | Typical Capacitance | | Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{1mA}$ | $V_{AC}$ | $V_{DC}$ | $V_P$ | $I_P$ | $I_{max}$ | $W_{max}$ | 1KHz | 1MHz | (°C) |
| | (V) | (V) | (V) | (V) | (A) | (A) | (J) | (pF) | (pF) | |
| TVM0C5R5M330R | 8.8~13.2 | 4 | 5.5 | 31 | 1 | 4 | 0.02 | -- | 33±30% | -55~+125 |
| TVM0C5R5M900R | 8.8~13.2 | 4 | 5.5 | 30 | 1 | 10 | 0.05 | -- | 90±30% | |
| TVM0C140K800R | 16~21 | 11 | 14 | 35 | 1 | 10 | 0.05 | 80±30% | -- | |
| TVM0C180M120R | 22~28 | 14 | 18 | 55 | 1 | 2 | 0.03 | -- | 12±30% | |
| TVM0C180M400R | 22~28 | 14 | 18 | 50 | 1 | 20 | 0.05 | -- | 40±30% | |
| TVM0C180M500R | 22~28 | 14 | 18 | 50 | 1 | 20 | 0.05 | -- | 50±30% | |
| TVM0C180M600R | 22~28 | 14 | 18 | 50 | 1 | 20 | 0.05 | -- | 60±30% | |
| TVM0C180M650R | 22~28 | 14 | 18 | 50 | 1 | 20 | 0.05 | -- | 65±30% | |

### ● 0603 Series

| Part No. | Varistor Voltage | Max. Continuous Voltage | | Max. Clamping Voltage (8/20μs) | | Max. Surge Current (8/20μs) | Max. Energy (10/1000μs) | Typical Capacitance | | Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{1mA}$ | $V_{AC}$ | $V_{DC}$ | $V_P$ | $I_P$ | $I_{max}$ | $W_{max}$ | 1KHz | 1MHz | (°C) |
| | (V) | (V) | (V) | (V) | (A) | (A) | (J) | (pF) | (pF) | |
| TVM1C5R5M271R | 8~12 | 4 | 5.5 | 25 | 1 | 20 | 0.1 | -- | 270±30% | -55~+125 |
| TVM1C090M491R | 11~16 | 7 | 9 | 29 | 1 | 30 | 0.1 | -- | 490±30% | |
| TVM1C160K561R | 21.6~26.4 | 12 | 16 | 45 | 1 | 30 | 0.1 | 560±30% | -- | |
| TVM1C180M120R | 23~30 | 14 | 18 | 55 | 1 | 2 | 0.03 | -- | 12±30% | |
| TVM1C180K150R | 23~30 | 14 | 18 | 55 | 1 | 2 | 0.03 | 15±30% | -- | |
| TVM1C180M150R | 23~30 | 14 | 18 | 55 | 1 | 2 | 0.03 | -- | 15±30% | |
| TVM1C180K300R | 23~30 | 14 | 18 | 52 | 1 | 4 | 0.03 | 30±30% | -- | |
| TVM1C180M300R | 23~30 | 14 | 18 | 52 | 1 | 4 | 0.03 | -- | 30±30% | |
| TVM1C180M900R | 23~30 | 14 | 18 | 48 | 1 | 30 | 0.1 | -- | 90±30% | |
| TVM1C180K101R | 23~30 | 14 | 18 | 48 | 1 | 30 | 0.1 | 100±30% | -- | |
| TVM1C180K431R | 23~30 | 14 | 18 | 45 | 1 | 50 | 0.1 | 430±30% | -- | |
| TVM1C220K530R | 25~40 | 17 | 22 | 50 | 1 | 30 | 0.1 | 53±30% | -- | |
| TVM1C220K101R | 25~33 | 17 | 22 | 50 | 1 | 30 | 0.1 | 100±30% | -- | |
| TVM1C260M111R | 31~38 | 20 | 26 | 60 | 1 | 30 | 0.1 | -- | 110±30% | |
| TVM1C310K900R | 35.1~42.9 | 25 | 31 | 67 | 1 | 30 | 0.3 | 90±30% | -- | |
| TVM1C320M100R | 51.9~70.1 | 25 | 32 | 120 | 1 | 5 | 0.05 | -- | 10±30% | |

### ● 0805 Series

| Part No. | Varistor Voltage | Max. Continuous Voltage | | Max. Clamping Voltage (8/20μs) | | Max. Surge Current (8/20μs) | Max. Energy (10/1000μs) | Typical Capacitance | $V_{jump}$ (5min) | $W_{LD}$ (10x) | Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{1mA}$ | $V_{AC}$ | $V_{DC}$ | $V_P$ | $I_P$ | $I_{max}$ | $W_{max}$ | 1KHz | (V) | (J) | (°C) |
| | (V) | (V) | (V) | (V) | (A) | (A) | (J) | (pF) | | | |
| TVM2C160K651R | 21.6~26.4 | 12 | 16 | 40 | 1 | 120 | 0.3 | 650±20% | 24.5 | 1 | -55~+125 |
| TVM2C180K651R | 23~28 | 14 | 18 | 44 | 1 | 120 | 0.3 | 650±20% | 24.5 | 1 | |
| TVM2C180K751R | 23~28 | 14 | 18 | 44 | 1 | 120 | 0.3 | 750±20% | 24.5 | 1 | |
| TVM2C260K501R | 29.7~36.3 | 20 | 26 | 56 | 1 | 80 | 0.3 | 500±20% | 27 | 1 | |
| TVM2C310K251R | 35.1~42.9 | 25 | 31 | 67 | 1 | 80 | 0.3 | 250±20% | 29 | 0.5 | |

### ● 1206 Series

| Part No. | Varistor Voltage | Max. Continuous Voltage | | Max. Clamping Voltage (8/20μs) | | Max. Surge Current (8/20μs) | Max. Energy (10/1000μs) | Typical Capacitance | $V_{jump}$ (5min) | $W_{LD}$ (10x) | Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{1mA}$ | $V_{AC}$ | $V_{DC}$ | $V_P$ | $I_P$ | $I_{max}$ | $W_{max}$ | 1KHz | (V) | (J) | (°C) |
| | (V) | (V) | (V) | (V) | (A) | (A) | (J) | (pF) | | | |
| TVM3C160K102R | 21.6~26.4 | 12 | 16 | 40 | 1 | 200 | 0.6 | 1000±20% | 24.5 | 1.5 | -55~+125 |
| TVM3C160K242R | 21.6~26.4 | 12 | 16 | 38 | 1 | 400 | 0.6 | 2400±20% | 24.5 | 2 | |
| TVM3C180K102R | 22.95~28.05 | 14 | 18 | 42 | 1 | 150 | 0.6 | 1000±20% | 24.5 | 1.5 | |
| TVM3C260K801R | 29.7~36.3 | 20 | 26 | 54 | 1 | 200 | 0.7 | 800±20% | 27.5 | 1.2 | |
| TVM3C260K132R | 29.7~36.3 | 20 | 26 | 54 | 1 | 250 | 0.7 | 1300±20% | 27.5 | 1.5 | |
| TVM3C340K551R | 42.3~51.7 | 26 | 34 | 77 | 1 | 200 | 0.4 | 550±20% | 50 | 1.5 | |
| TVM3C450K301R | 50.4~61.6 | 35 | 45 | 90 | 1 | 100 | 0.4 | 300±20% | 59 | 1.2 | |
| TVM3C480K271R | 55.8~68.2 | 37 | 48 | 100 | 1 | 100 | 0.4 | 270±20% | 59 | 1.2 | |
| TVM3C560K251R | 61.2~74.8 | 40 | 56 | 110 | 1 | 100 | 0.5 | 250±20% | 65 | 1.5 | |

### ● 1210 Series

| Part No. | Varistor Voltage | Max. Continuous Voltage | | Max. Clamping Voltage (8/20μs) | | Max. Surge Current (8/20μs) | Max. Energy (10/1000μs) | Typical Capacitance | $V_{jump}$ (5min) | $W_{LD}$ (10x) | Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{1mA}$ | $V_{AC}$ | $V_{DC}$ | $V_P$ | $I_P$ | $I_{max}$ | $W_{max}$ | 1KHz | (V) | (J) | (°C) |
| | (V) | (V) | (V) | (V) | (A) | (A) | (J) | (pF) | | | |
| TVM4C160K242R | 21.6~26.4 | 12 | 16 | 40 | 2.5 | 400 | 1.6 | 2400±20% | 24.5 | 3 | -55~+125 |
| TVM4C180K312R | 22.95~28.05 | 14 | 18 | 42 | 2.5 | 500 | 1.6 | 3100±20% | 27.5 | 3 | |
| TVM4C260K152R | 29.7~36.3 | 20 | 26 | 54 | 2.5 | 400 | 1.9 | 1500±20% | 27 | 3 | |
| TVM4C310K122R | 35.1~42.9 | 25 | 31 | 65 | 2.5 | 300 | 1.7 | 1200±20% | 29 | 3 | |
| TVM4C340K112R | 42.3~51.7 | 26 | 34 | 75 | 2.5 | 300 | 2.3 | 1100±20% | 50 | 3 | |
| TVM4C450K601R | 50.4~61.6 | 35 | 45 | 90 | 2.5 | 250 | 2 | 600±20% | 60 | 1.5 | |

- **1812 Series**

| Part No. | Varistor Voltage | Max. Continuous Voltage | | Max. Clamping Voltage (8/20μs) | | Max. Surge Current (8/20μs) | Max. Energy (10/1000μs) | Typical Capacitance | $V_{jump}$ (5min) | $W_{LD}$ (10x) | Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{1mA}$ | $V_{AC}$ | $V_{DC}$ | $V_P$ | $I_P$ | $I_{max}$ | $W_{max}$ | 1KHz | (V) | (J) | (°C) |
| | (V) | (V) | (V) | (V) | (A) | (A) | (J) | (pF) | | | |
| TVM5C160K452R | 21.6~26.4 | 12 | 16 | 40 | 5 | 800 | 2.4 | 4500±20% | 24.5 | 6 | -55~+125 |
| TVM5C260K322R | 29.7~36.3 | 20 | 26 | 54 | 5 | 800 | 3 | 3200±20% | 30 | 6 | |
| TVM5C300K172R | 35~43 | 23 | 30 | 77 | 5 | 600 | 3.8 | 1700±20% | 45 | 6 | |

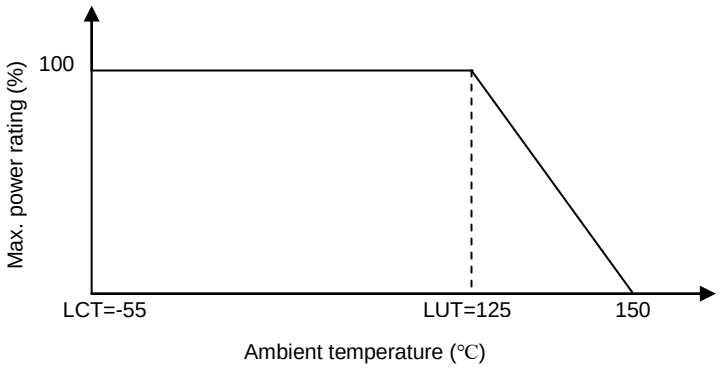
- **2220 Series**

| Part No. | Varistor Voltage | Max. Continuous Voltage | | Max. Clamping Voltage (8/20μs) | | Max. Surge Current (8/20μs) | Max. Energy (10/1000μs) | Typical Capacitance | $V_{jump}$ (5min) | $W_{LD}$ (10x) | Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{1mA}$ | $V_{AC}$ | $V_{DC}$ | $V_P$ | $I_P$ | $I_{max}$ | $W_{max}$ | 1KHz | (V) | (J) | (°C) |
| | (V) | (V) | (V) | (V) | (A) | (A) | (J) | (pF) | | | |
| TVM6C160K103R | 21.6~26.4 | 12 | 16 | 42 | 10 | 1200 | 5.8 | 10000±20% | 24.5 | 12 | -55~+125 |
| TVM6C160K203R | 21.6~26.4 | 12 | 16 | 42 | 10 | 1200 | 10 | 20000±20% | 24.5 | 25 | |
| TVM6C340K652R | 42.3~51.7 | 26 | 34 | 77 | 10 | 1200 | 12 | 6500±20% | 50 | 12 | |
| TVM6C380K302R | 42.3~51.7 | 30 | 38 | 77 | 10 | 1000 | 12 | 3000±20% | 50 | 12 | |

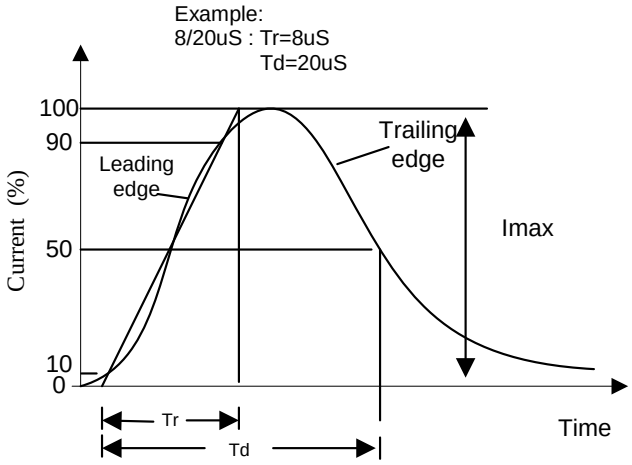
- **3025 Series**

| Part No. | Varistor Voltage | Max. Continuous Voltage | | Max. Clamping Voltage (8/20μs) | | Max. Surge Current (8/20μs) | Max. Energy (10/1000μs) | Typical Capacitance | $V_{jump}$ (5min) | $W_{LD}$ (10x) | Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{1mA}$ | $V_{AC}$ | $V_{DC}$ | $V_P$ | $I_P$ | $I_{max}$ | $W_{max}$ | 1KHz | (V) | (J) | (°C) |
| | (V) | (V) | (V) | (V) | (A) | (A) | (J) | (pF) | | | |
| TVM7C260K153R | 31.5~38.5 | 20 | 26 | 57 | 10 | 1400 | 15 | 15000±20% | 30 | 30 | -55~+125 |
| TVM7C380K332R | 42.3~51.7 | 29 | 38 | 80 | 10 | 1000 | 15 | 3300±20% | 50 | 30 | |

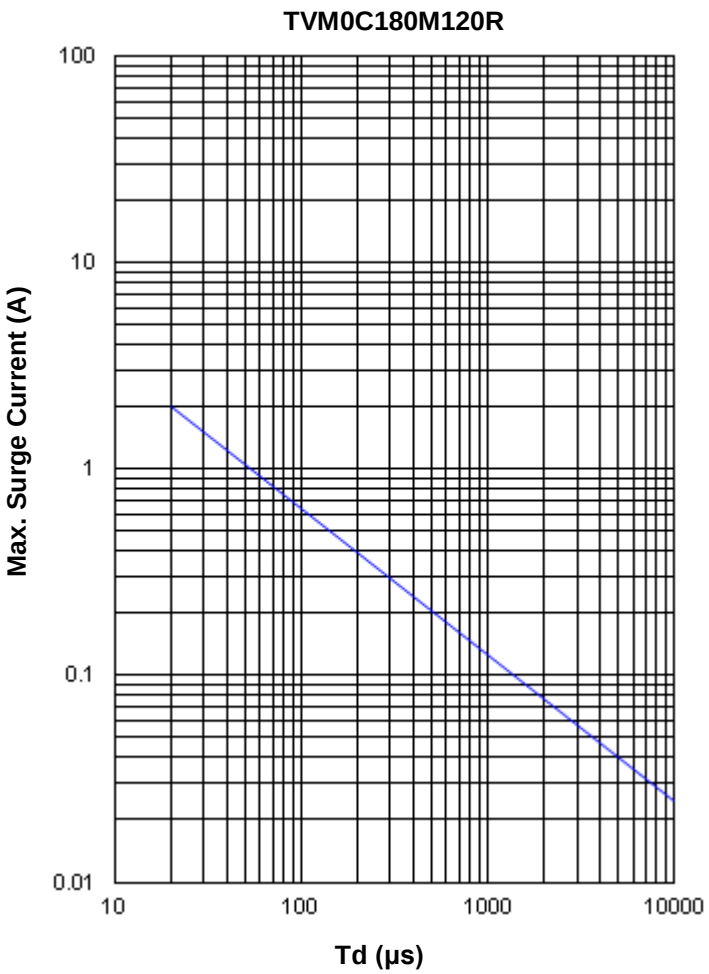
### ■ Power Derating Curve

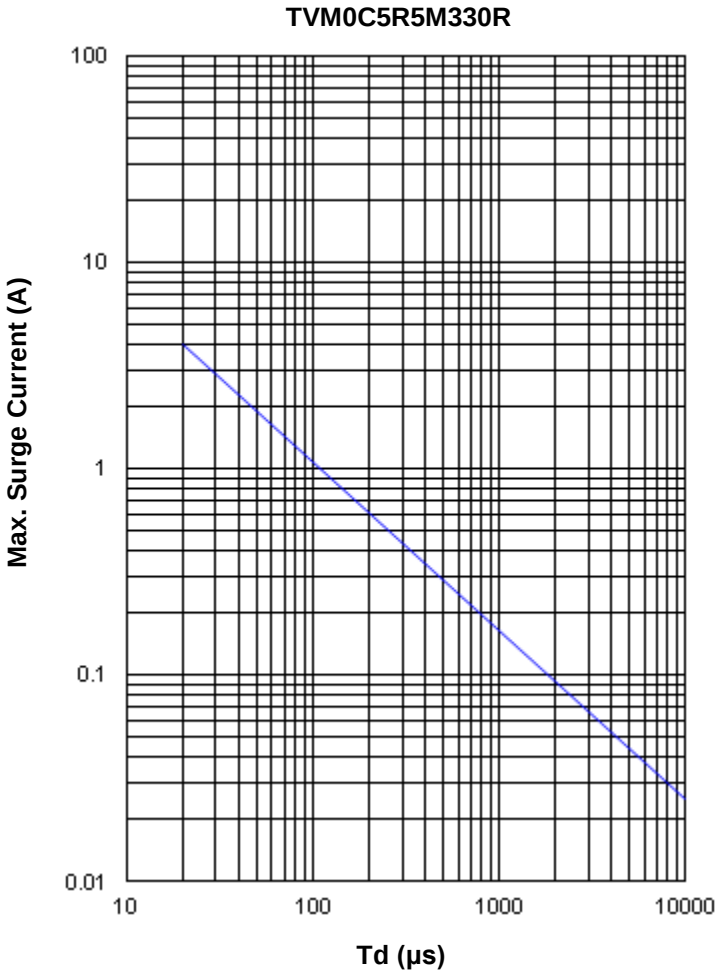



### ■ Surge Current Standard Waveform



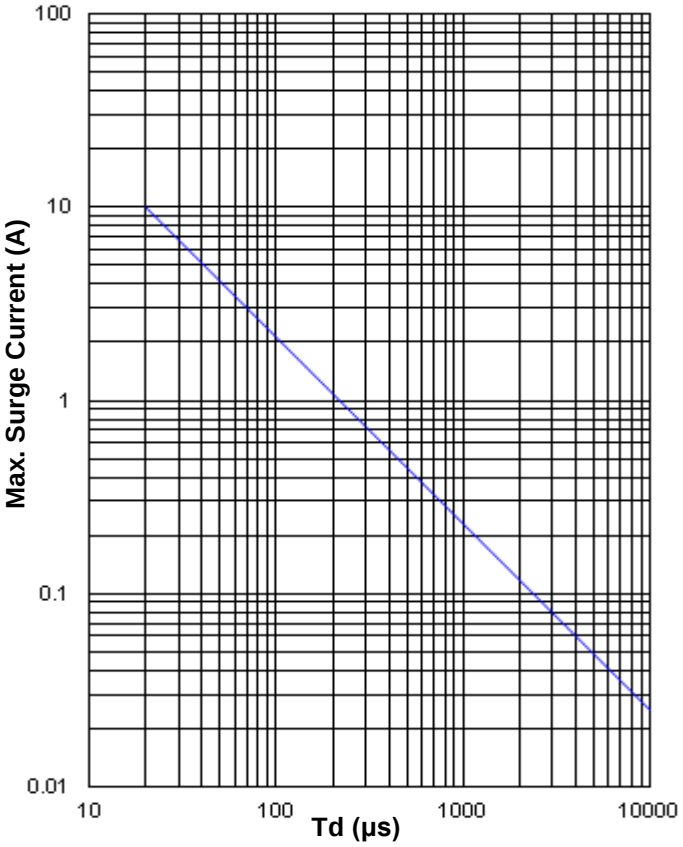

### ■ Max. Surge Current Derating Curves



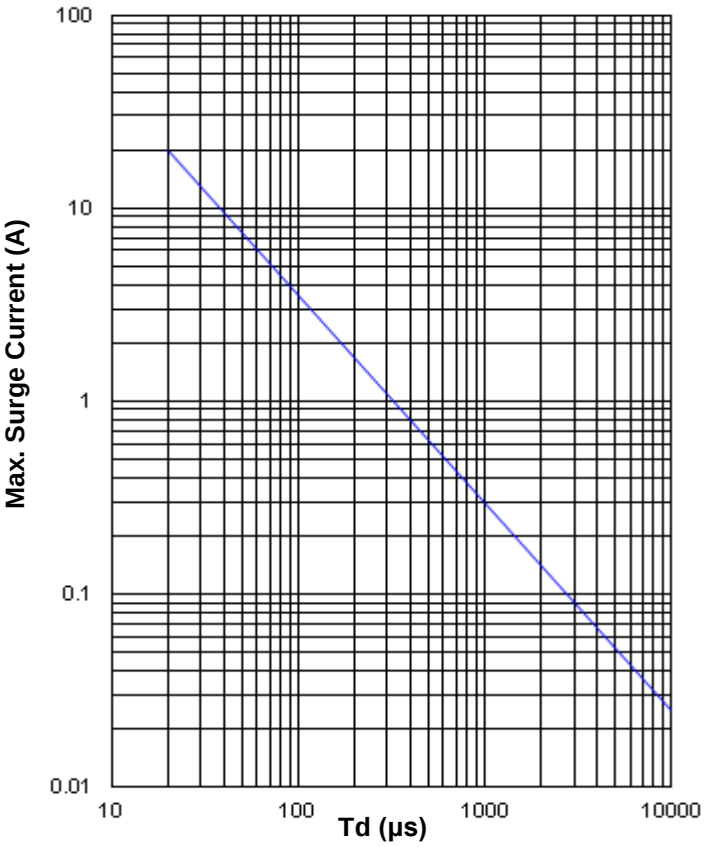



### ■ Max. Surge Current Derating Curves

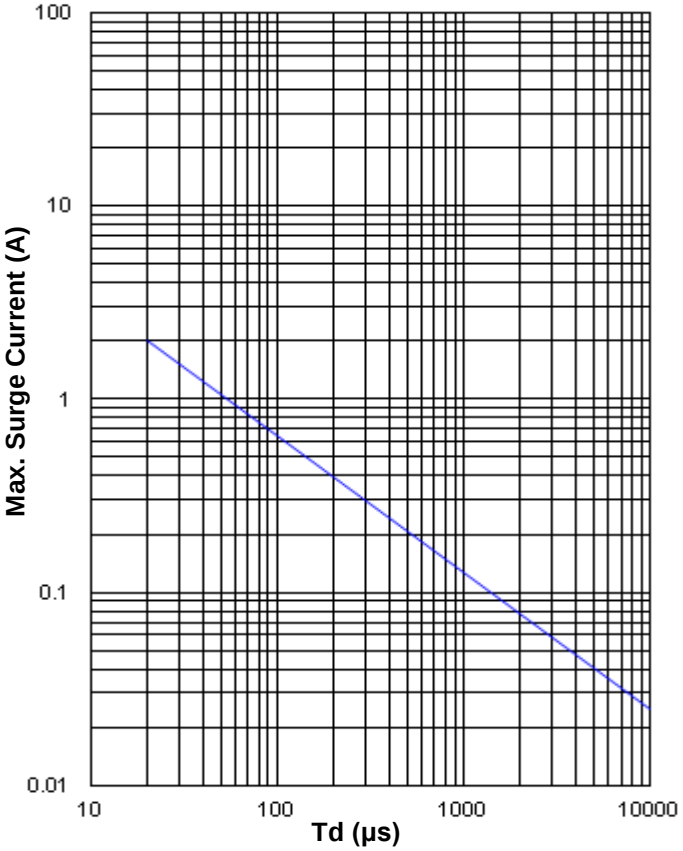
**TVM0C5R5M900R / TVM0C140K800R**



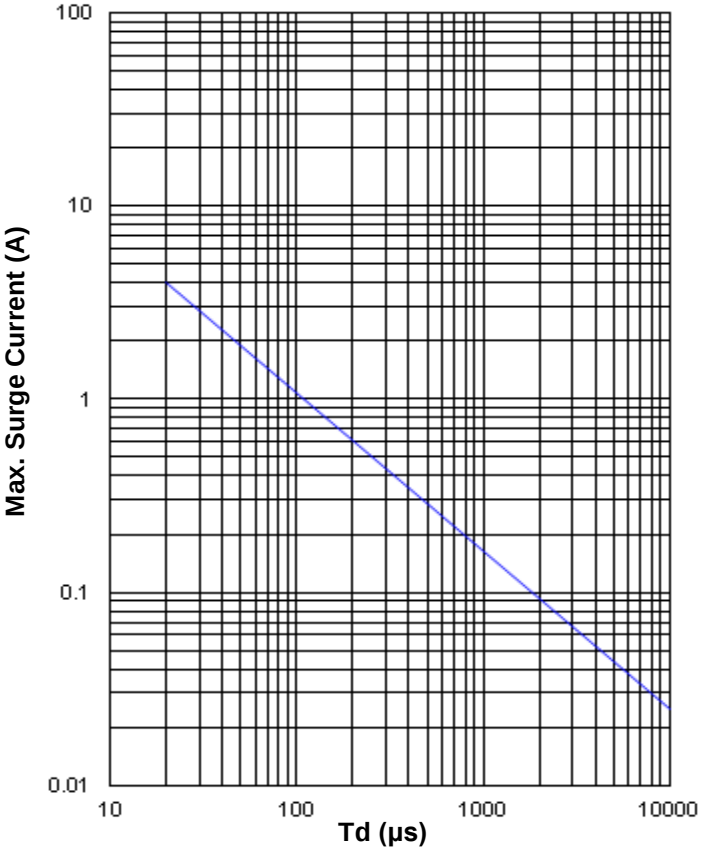

**TVM0C180M400R~TVM0C180M650R**




**TVM1C180K150R/ TVM1C180M120R / TVM1C180M150R**

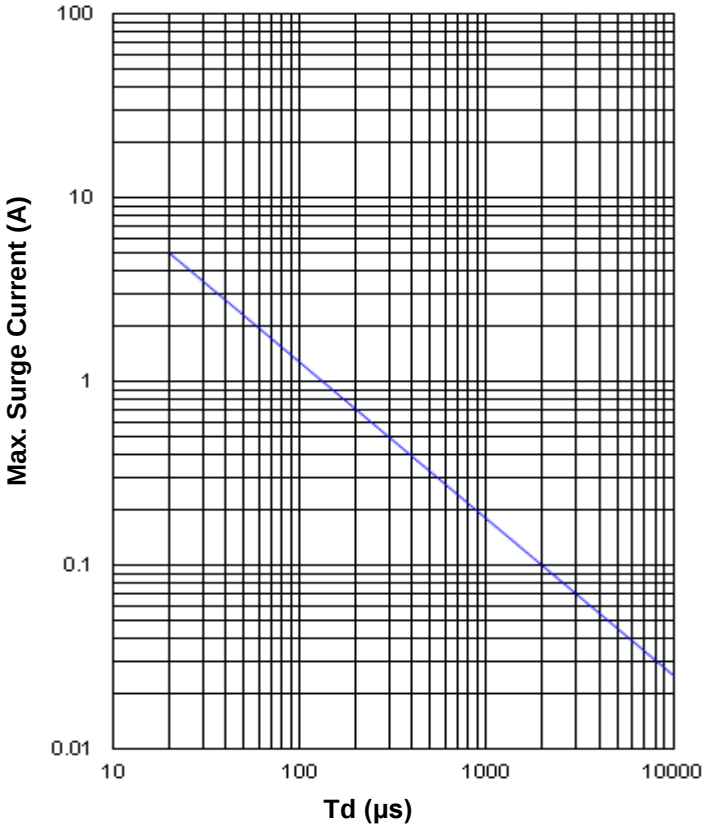



**TVM1C180K300R/TVM1C180M300R**

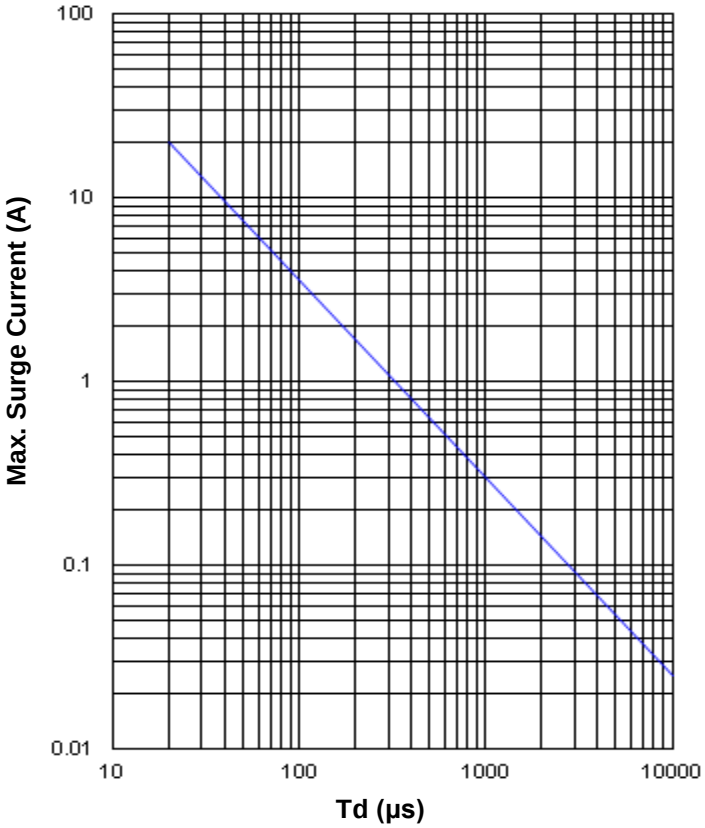


### ■ Max. Surge Current Derating Curves

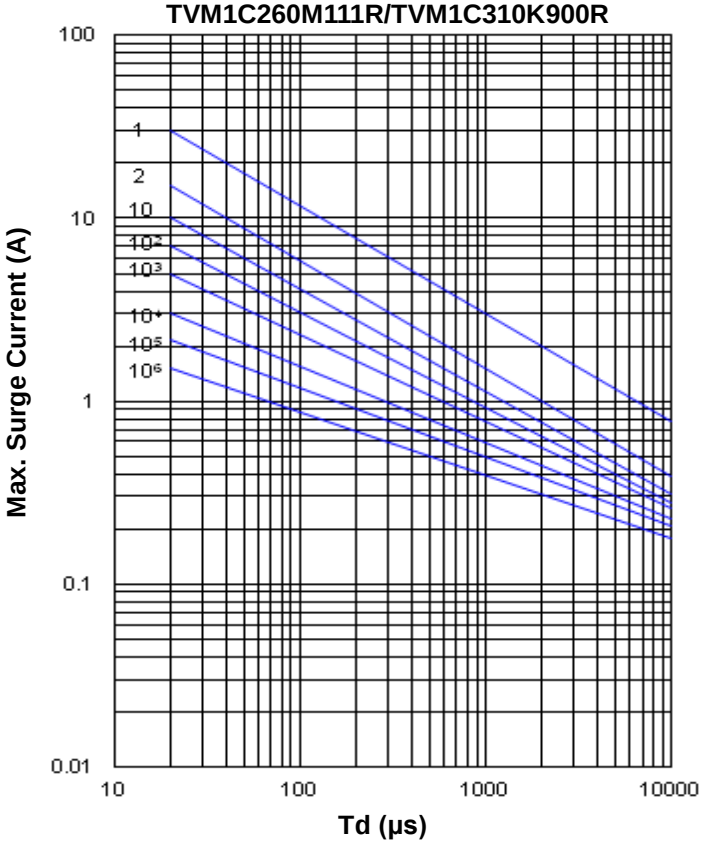
**TVM1C320M100R**



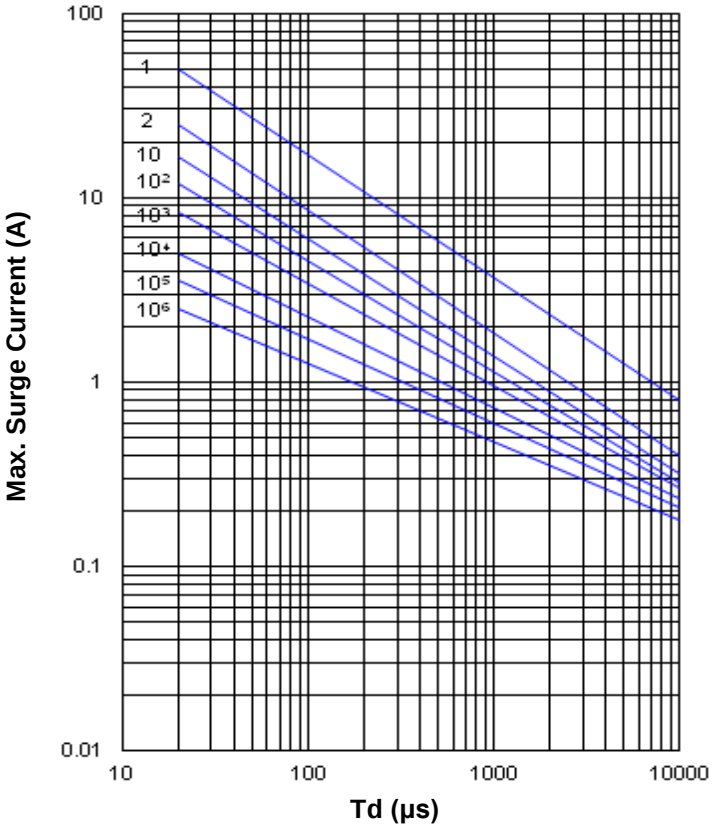

**TVM1C5R5M271R**




**TVM1C090M491R/TVM1C160K561R/ TVM1C180M900R/TVM1C180K101R/ TVM1C220K530R/TVM1C220K101R/ TVM1C260M111R/TVM1C310K900R**

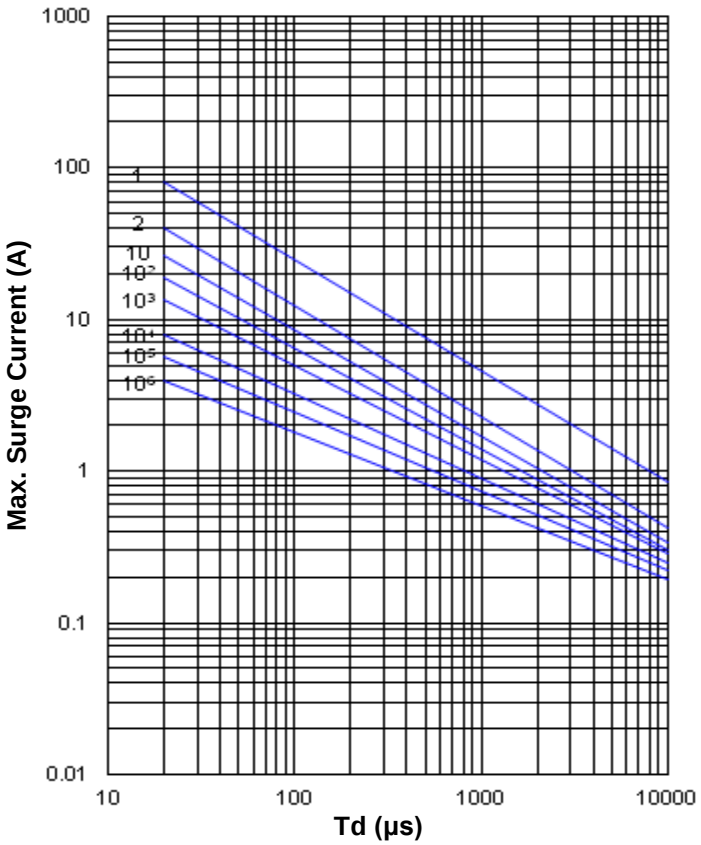



**TVM1C180K431R**

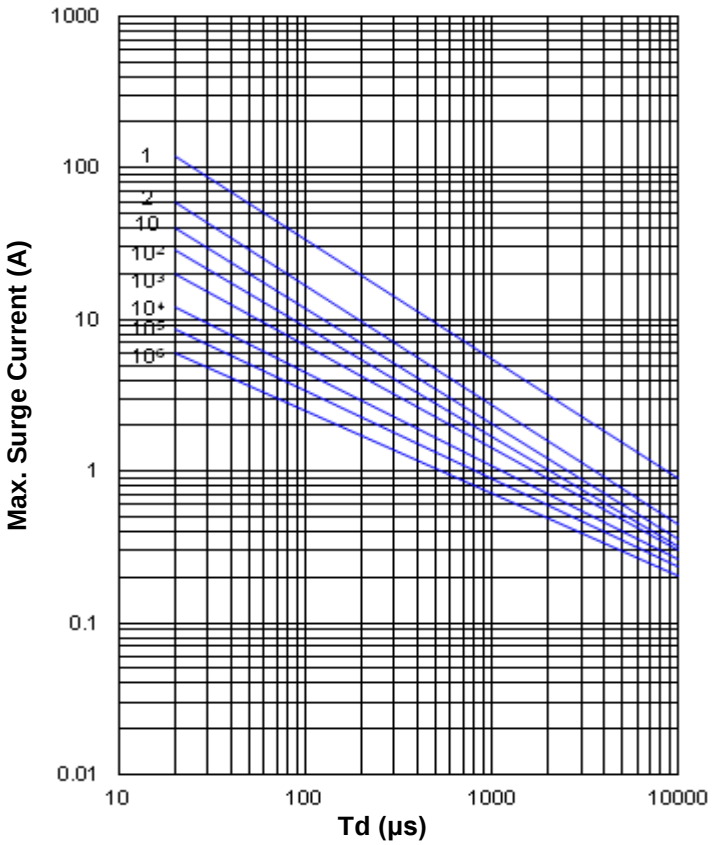


### ■ Max. Surge Current Derating Curves

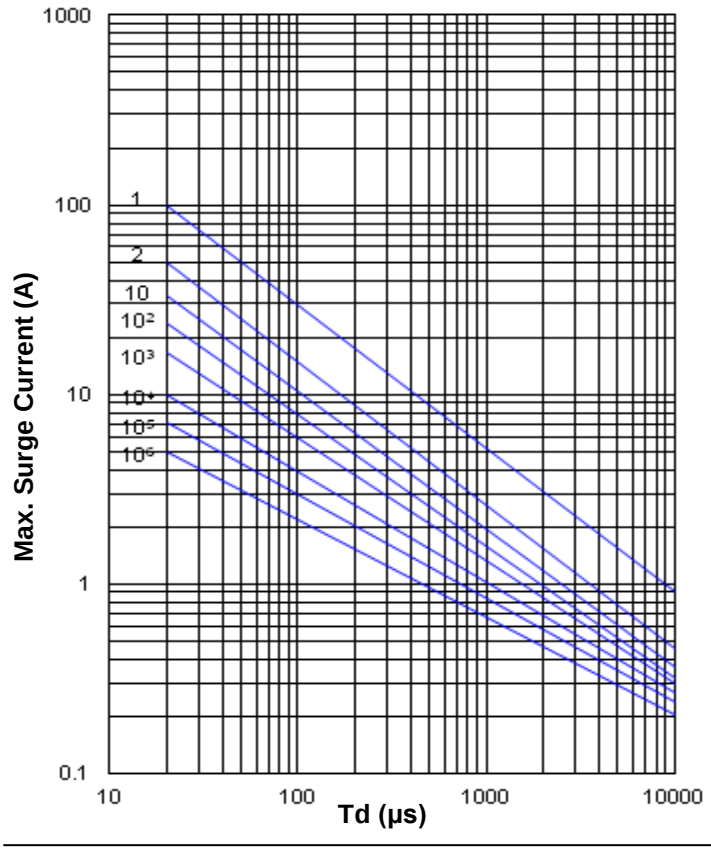
**TVM2C260K501R**
**TVM2C310K251R**



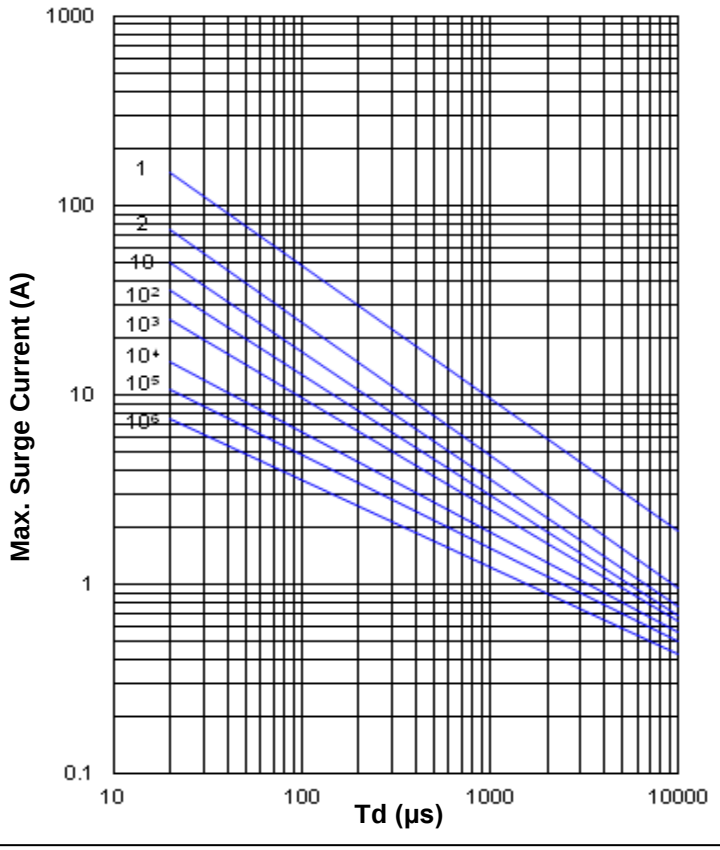

**TVM2C160K651R**
**TVM2C180K651R / TVM2C180K751R**




**TVM3C450K301R/TVM3C480K271R/**
**TVM3C560K251R**

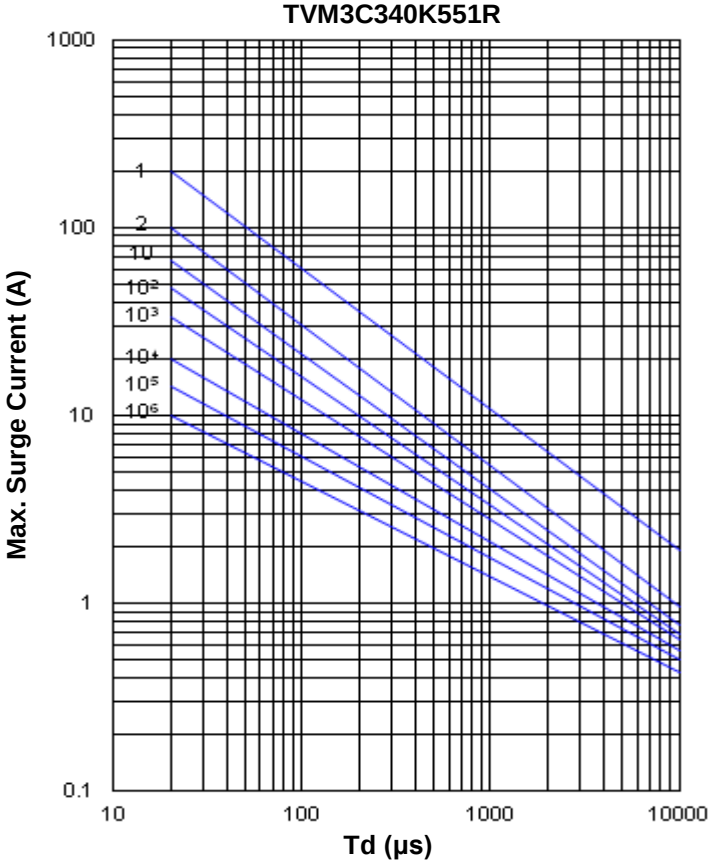



**TVM3C180K102R**

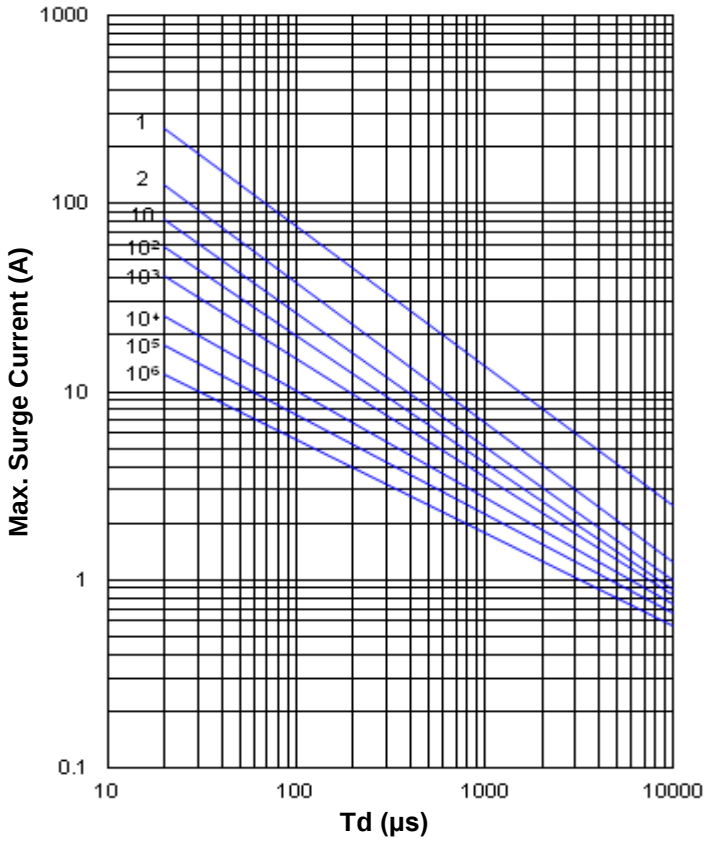


### ■ Max. Surge Current Derating Curves

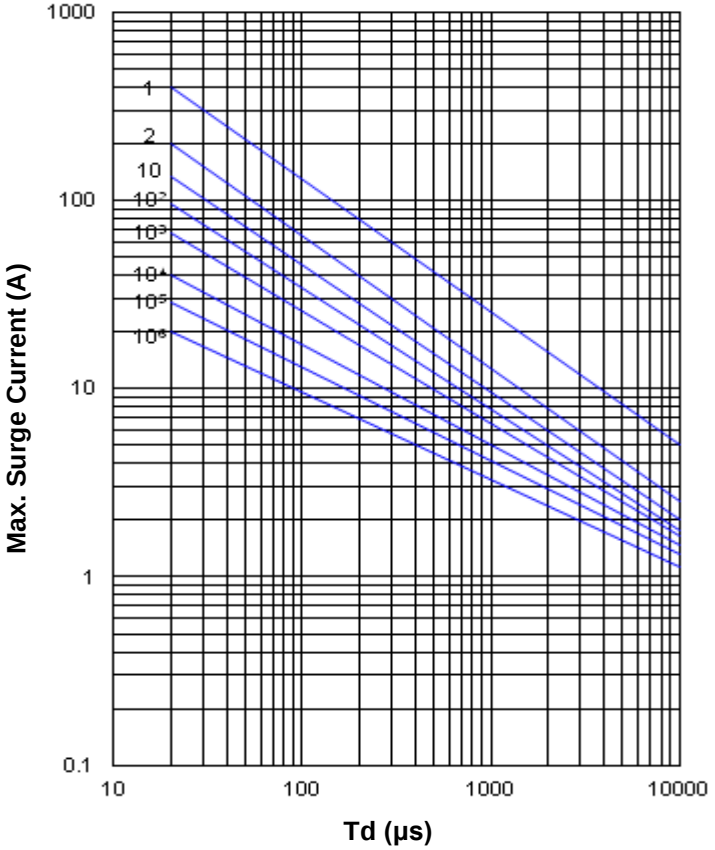
**TVM3C160K102R/TVM3C260K801R/ TVM3C340K551R**



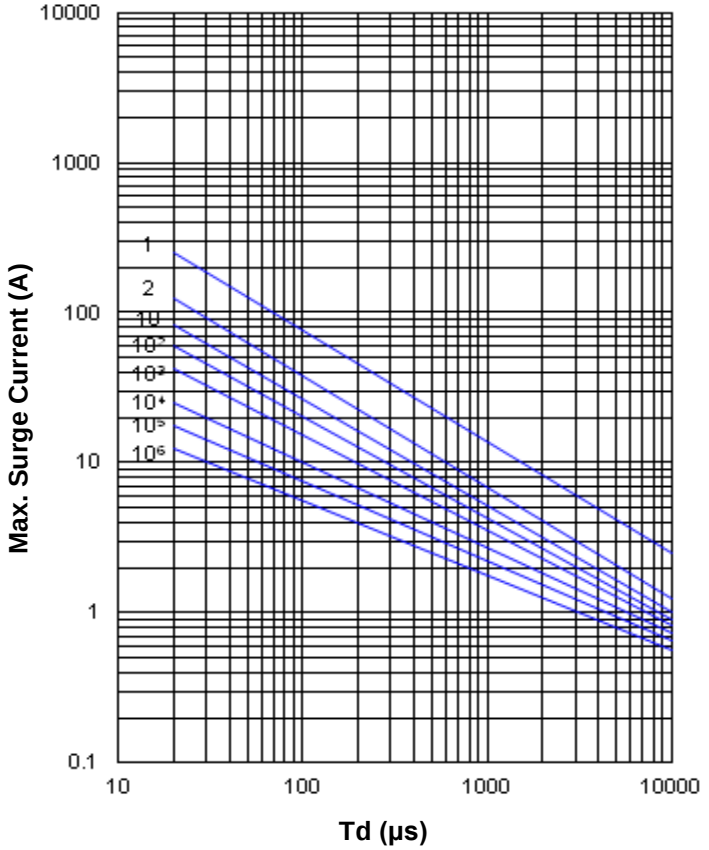

**TVM3C260K132R**




**TVM3C160K242R**

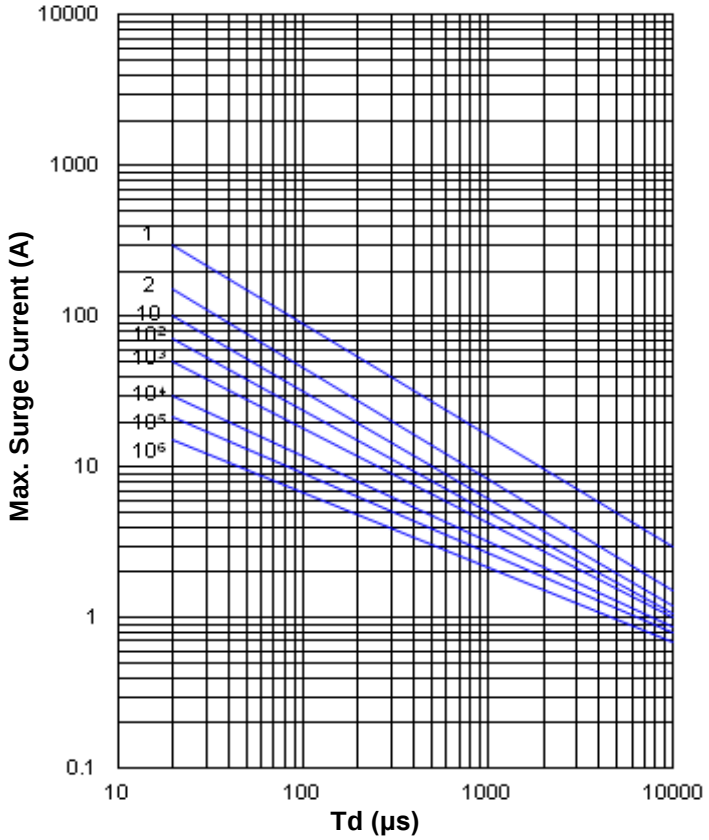



**TVM4C450K601R**

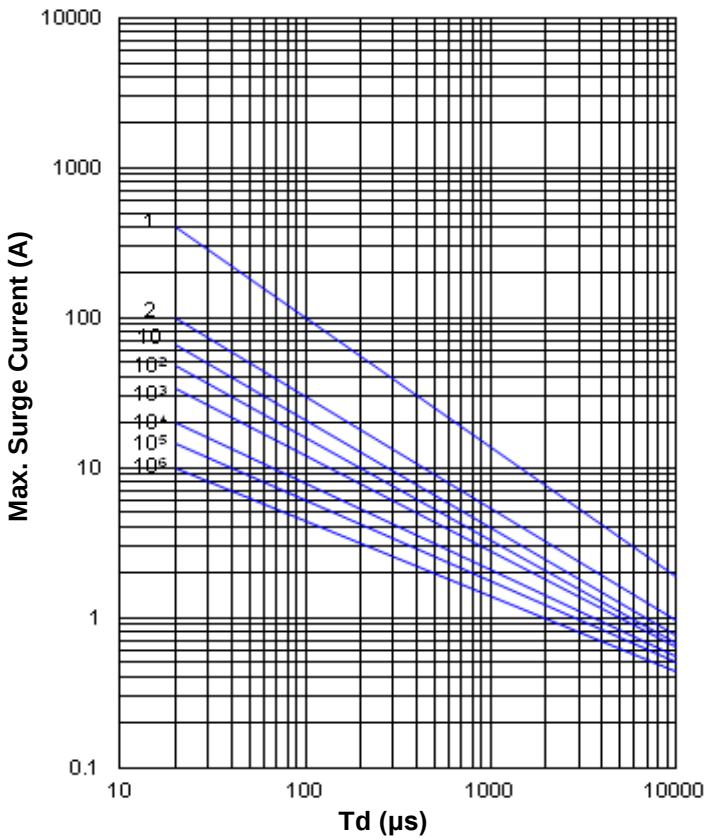


### ■ Max. Surge Current Derating Curves

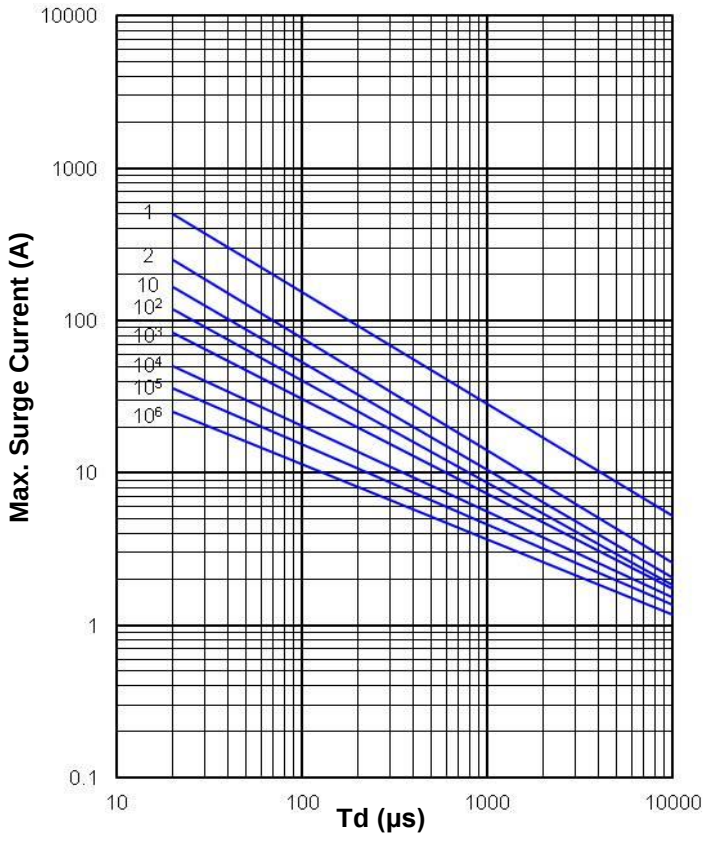
**TVM4C310K122R/TVM4C340K112R**



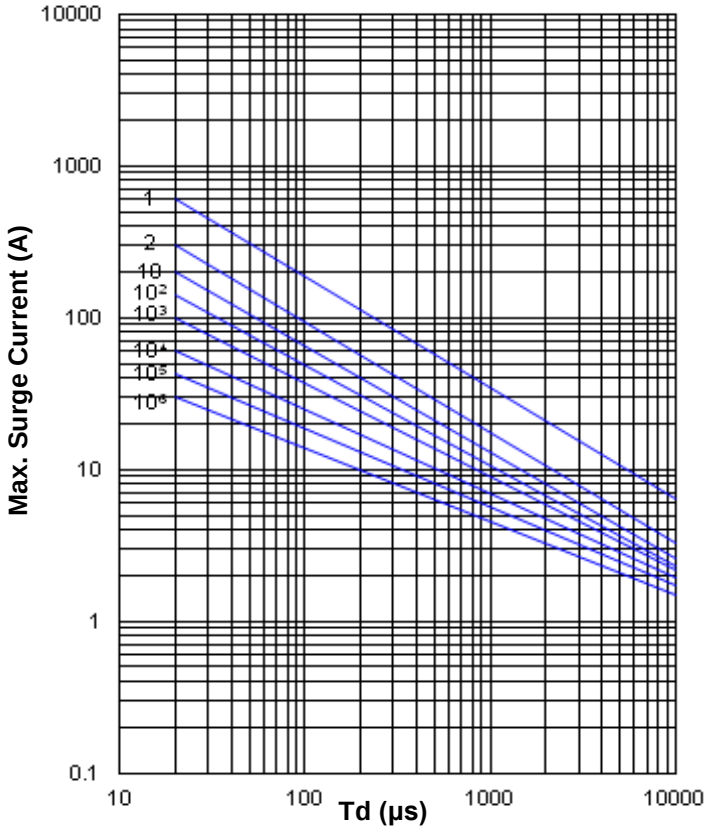

**TVM4C160K242R/TVM4C260K152R**




**TVM4C180K312R**

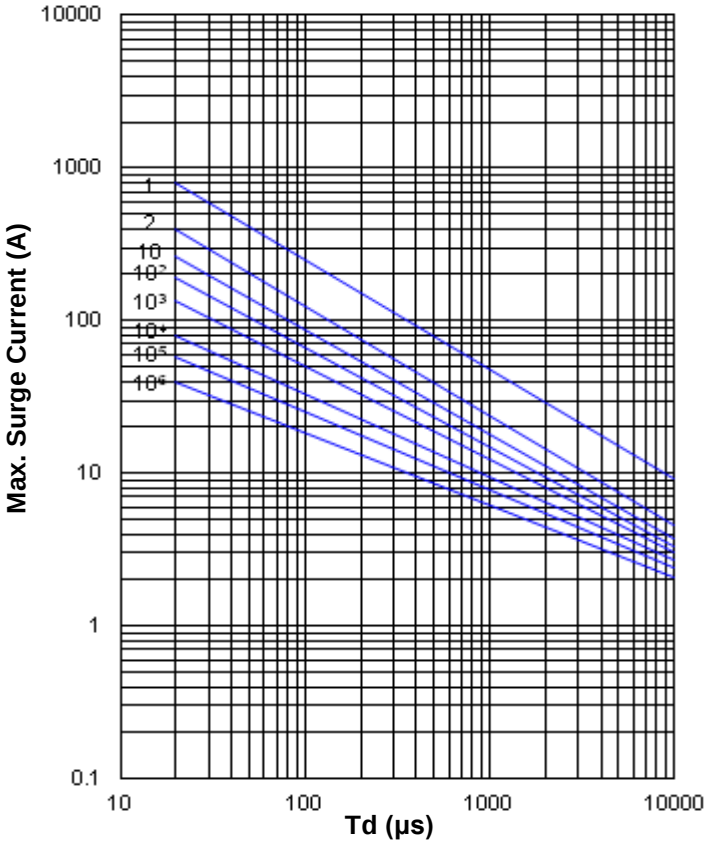



**TVM5C300K172R**

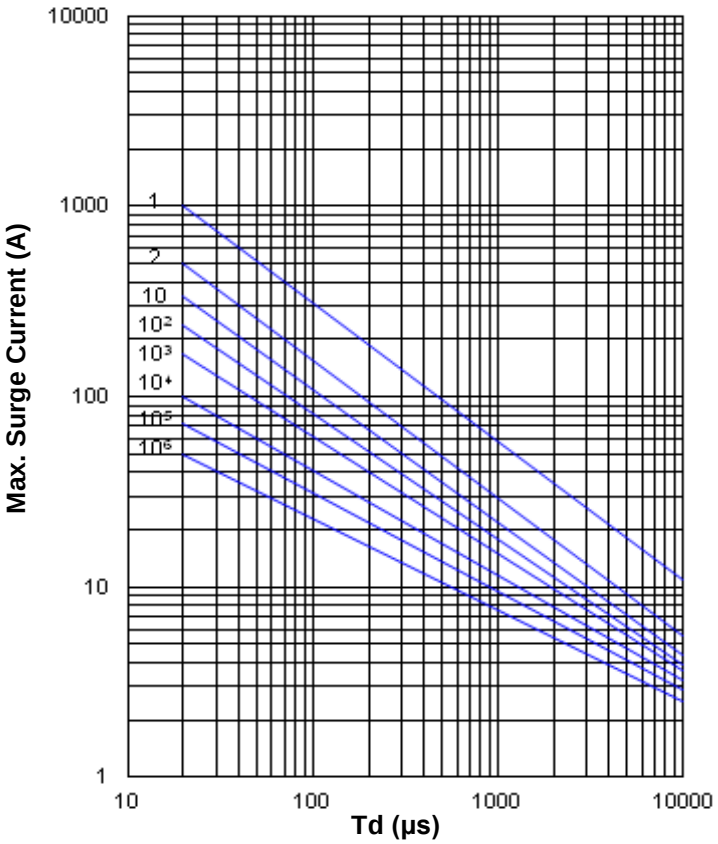


### ■ Max. Surge Current Derating Curves

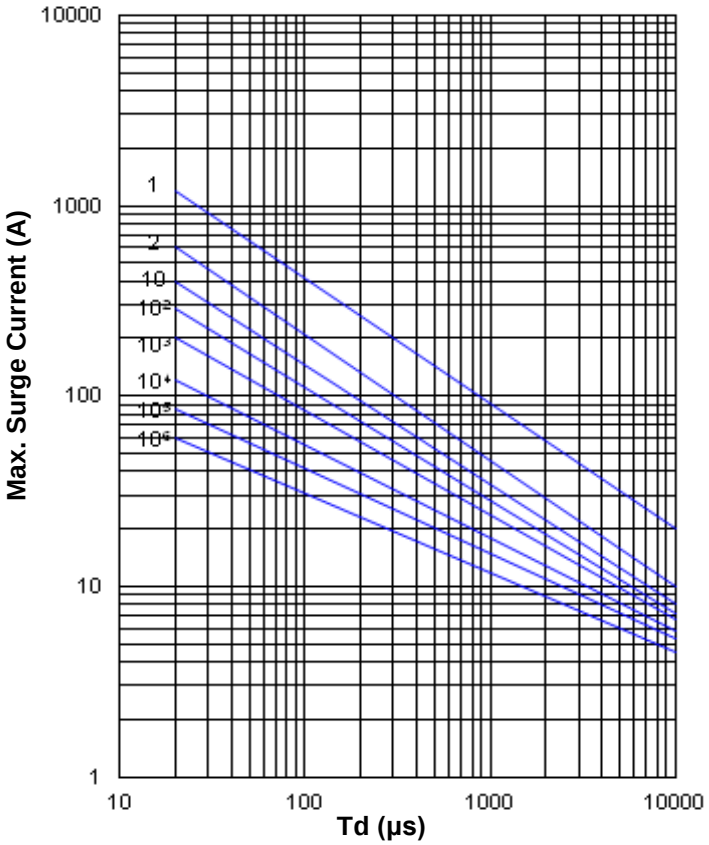
**TVM5C160K452R/TVM5C260K322R**



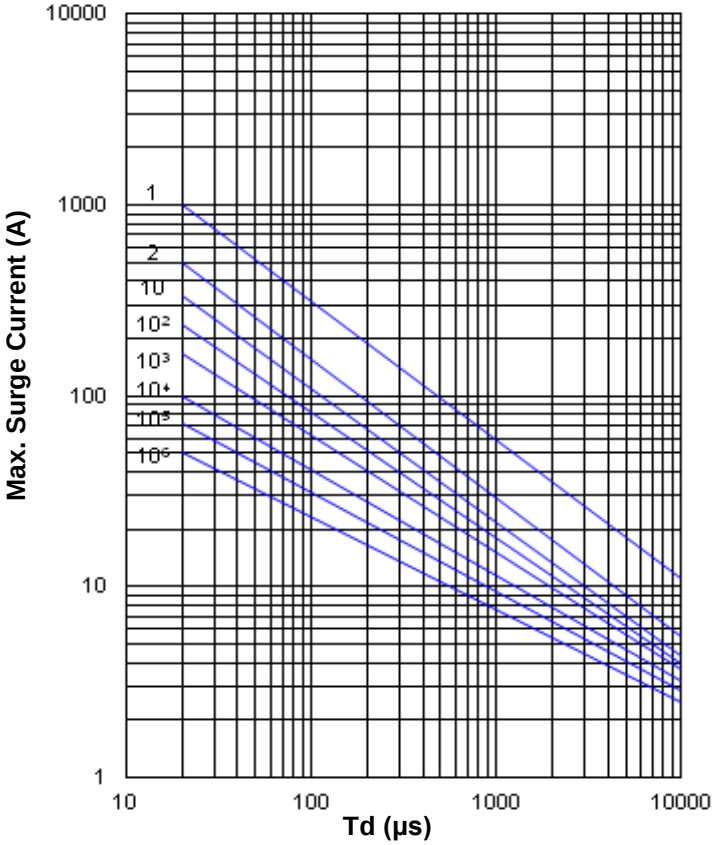

**TVM6C380K302R**



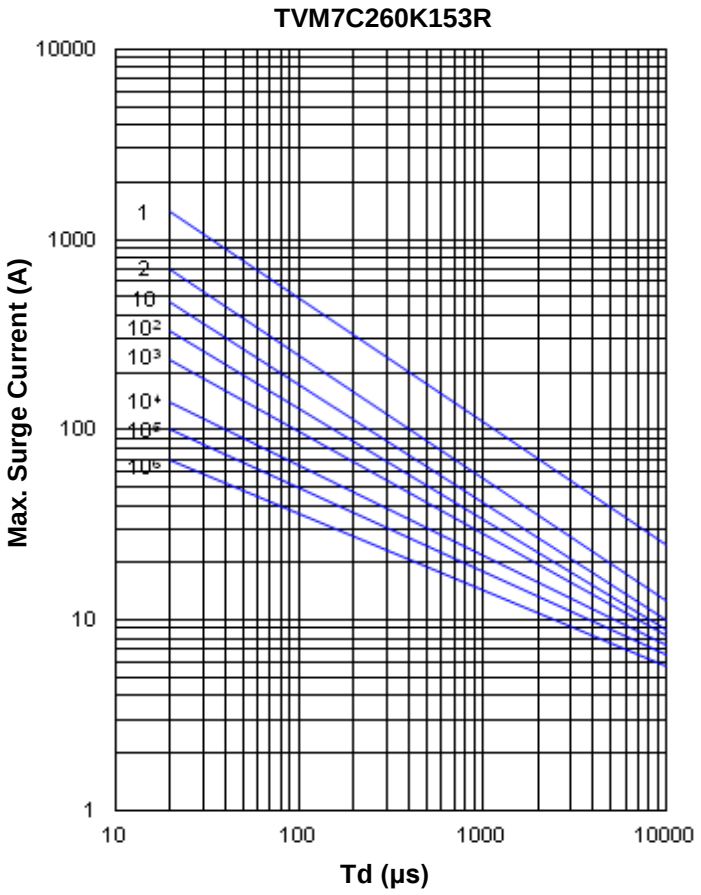

**TVM6C160K103R/TVM6C160K203R/ TVM6C340K652R**



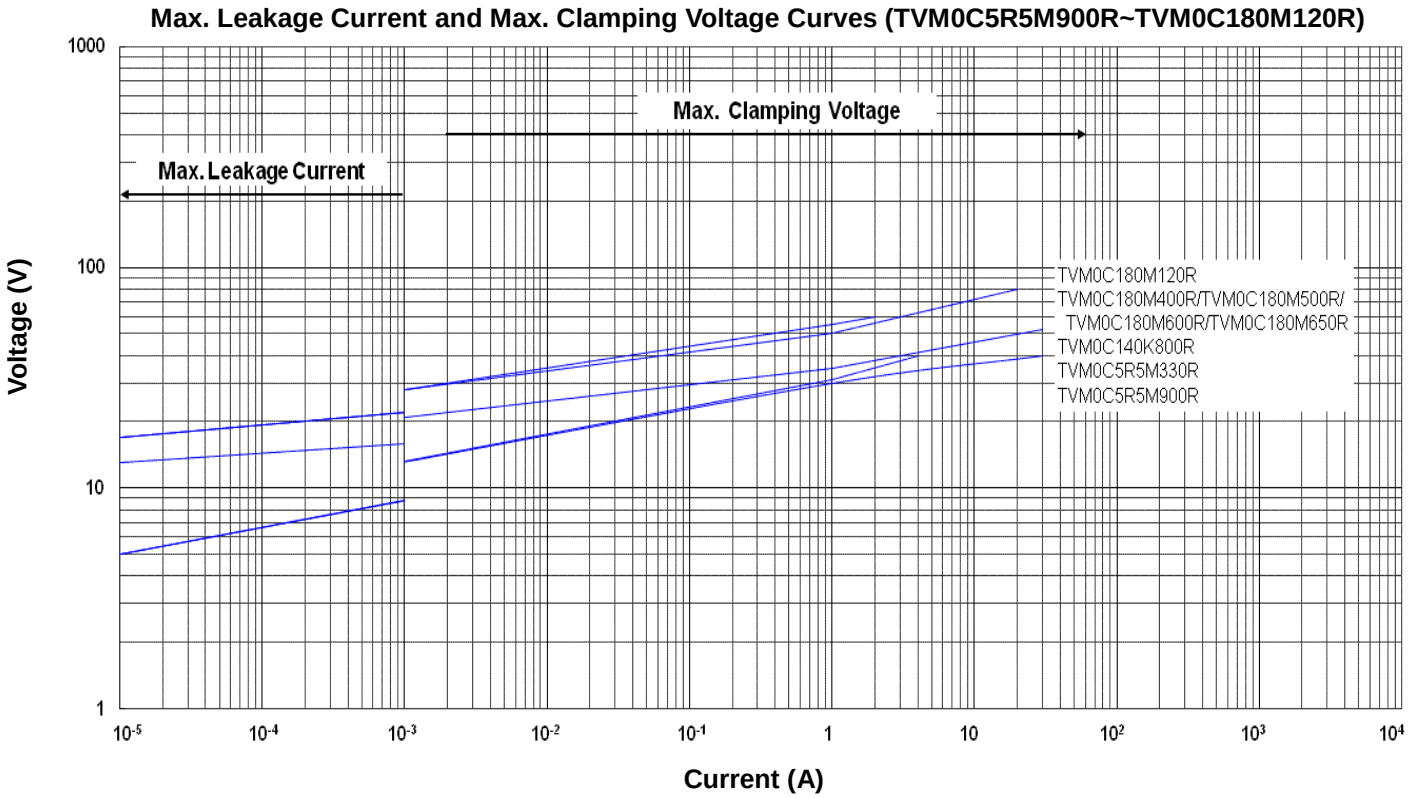

**TVM7C380K322R**



## ■ Max. Surge Current Derating Curves

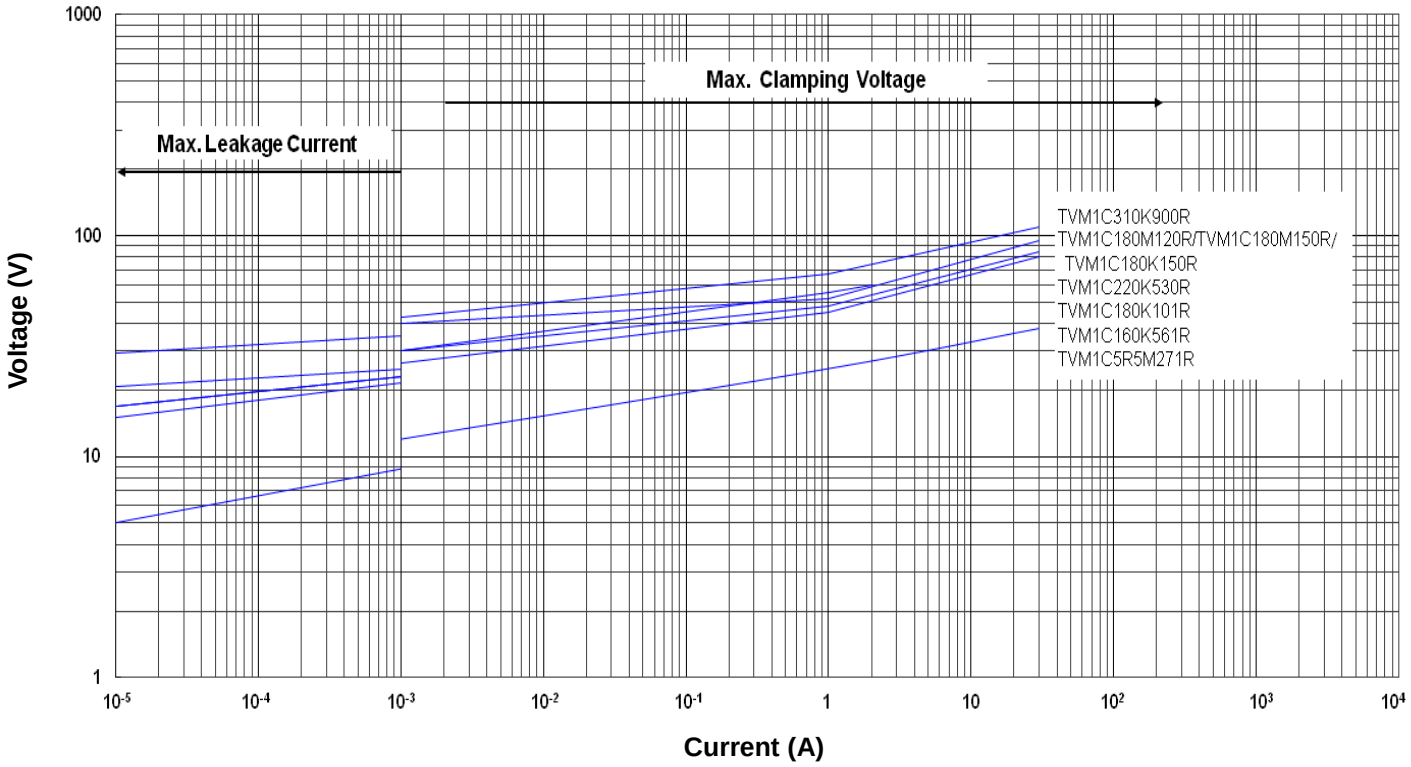



## ■ Max. Leakage Current and Max. Clamping Voltage Curves

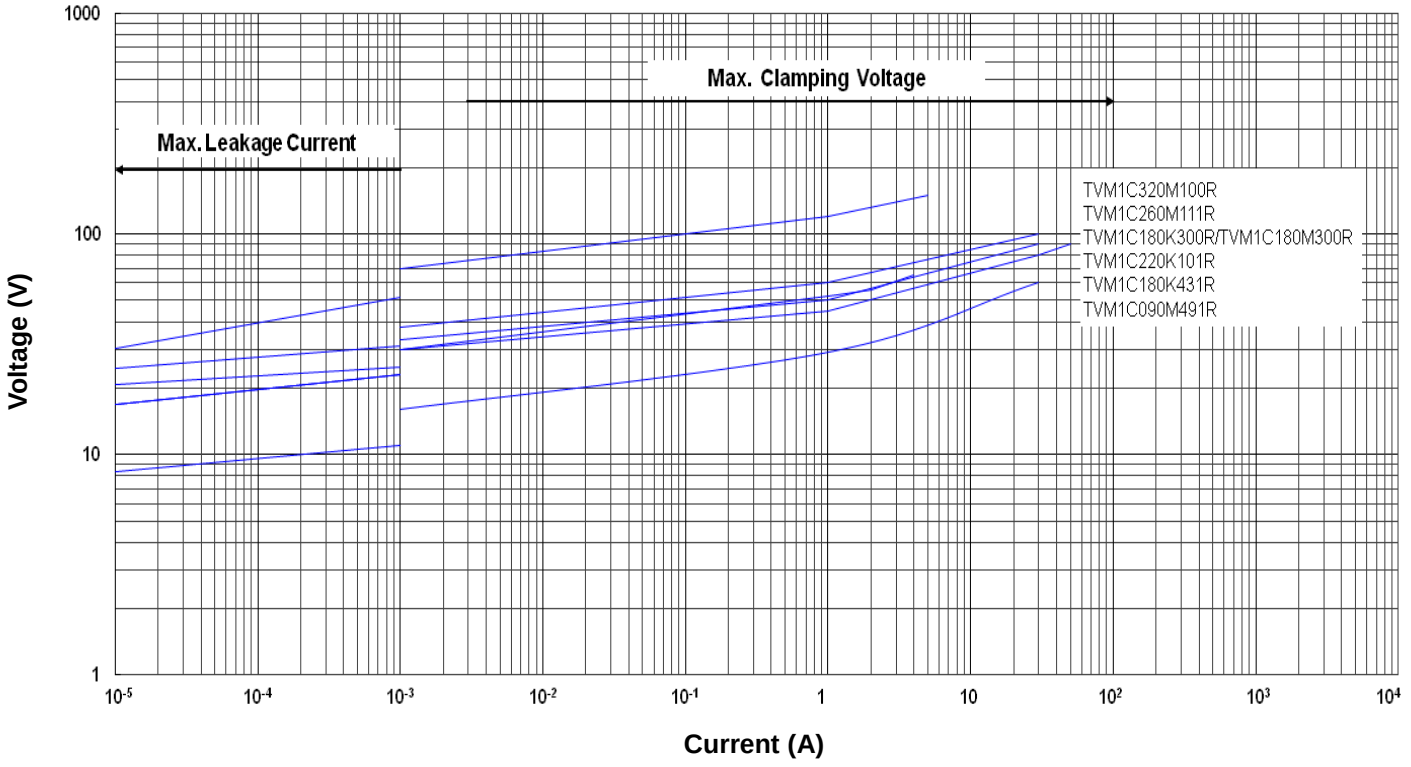


## ■ Max. Leakage Current and Max. Clamping Voltage Curves

### Max. Leakage Current and Max. Clamping Voltage Curves (TVM1C5R5M271R~TVM1C310K900R)

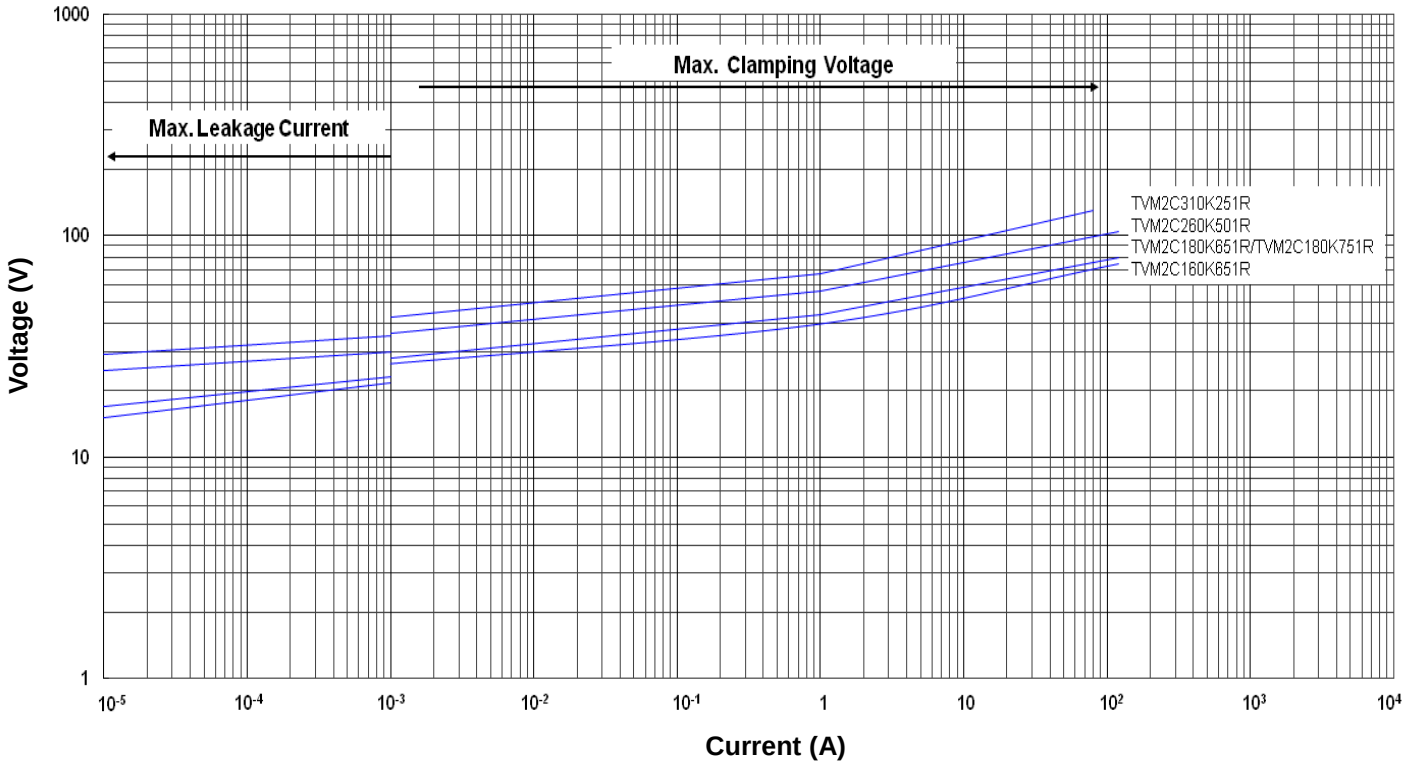



### Max. Leakage Current and Max. Clamping Voltage Curves (TVM1C090M491R~TVM1C320M100R)

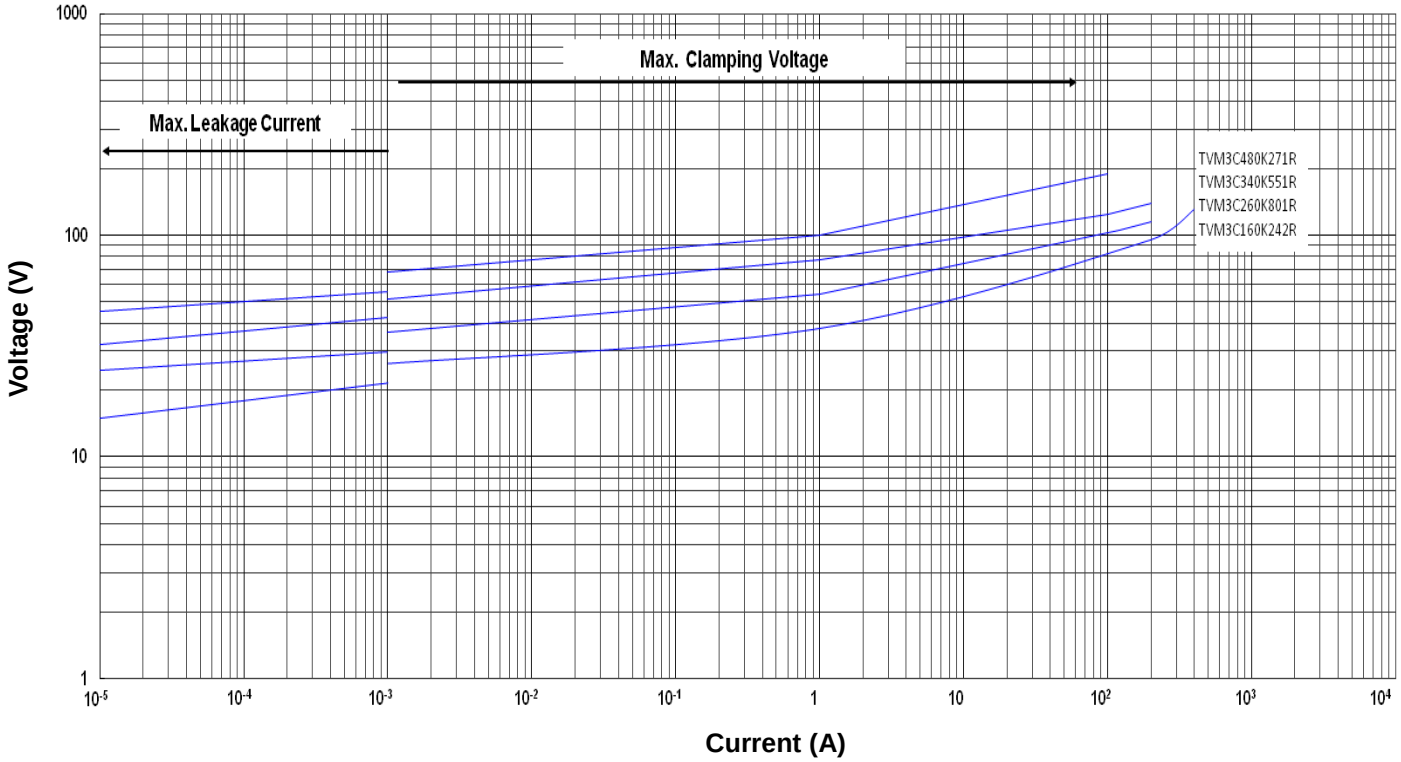


## ■ Max. Leakage Current and Max. Clamping Voltage Curves

**Max. Leakage Current and Max. Clamping Voltage Curves (TVM2C160K651R~TVM2C310K251R)**

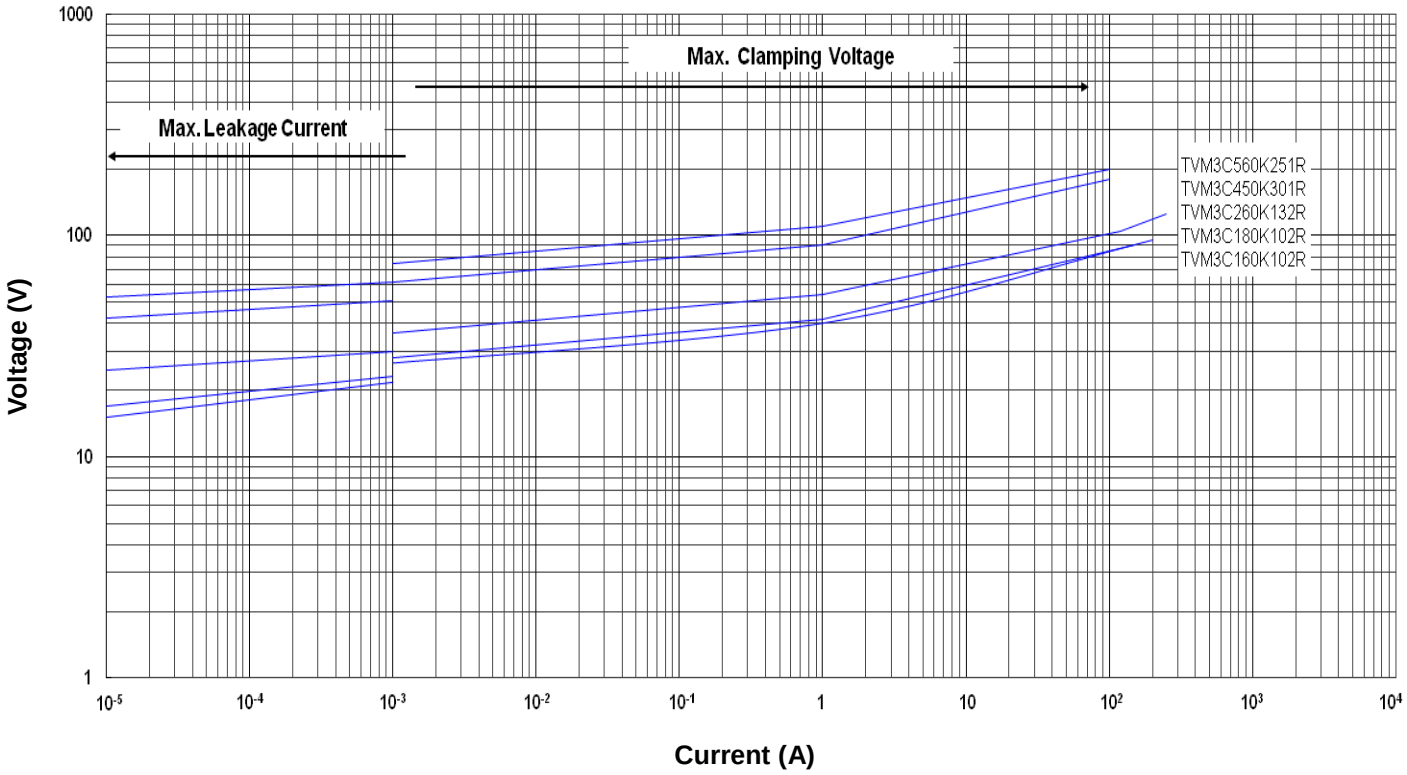



**Max. Leakage Current and Max. Clamping Voltage Curves (TVM3C160K242R~TVM3C480K271R)**

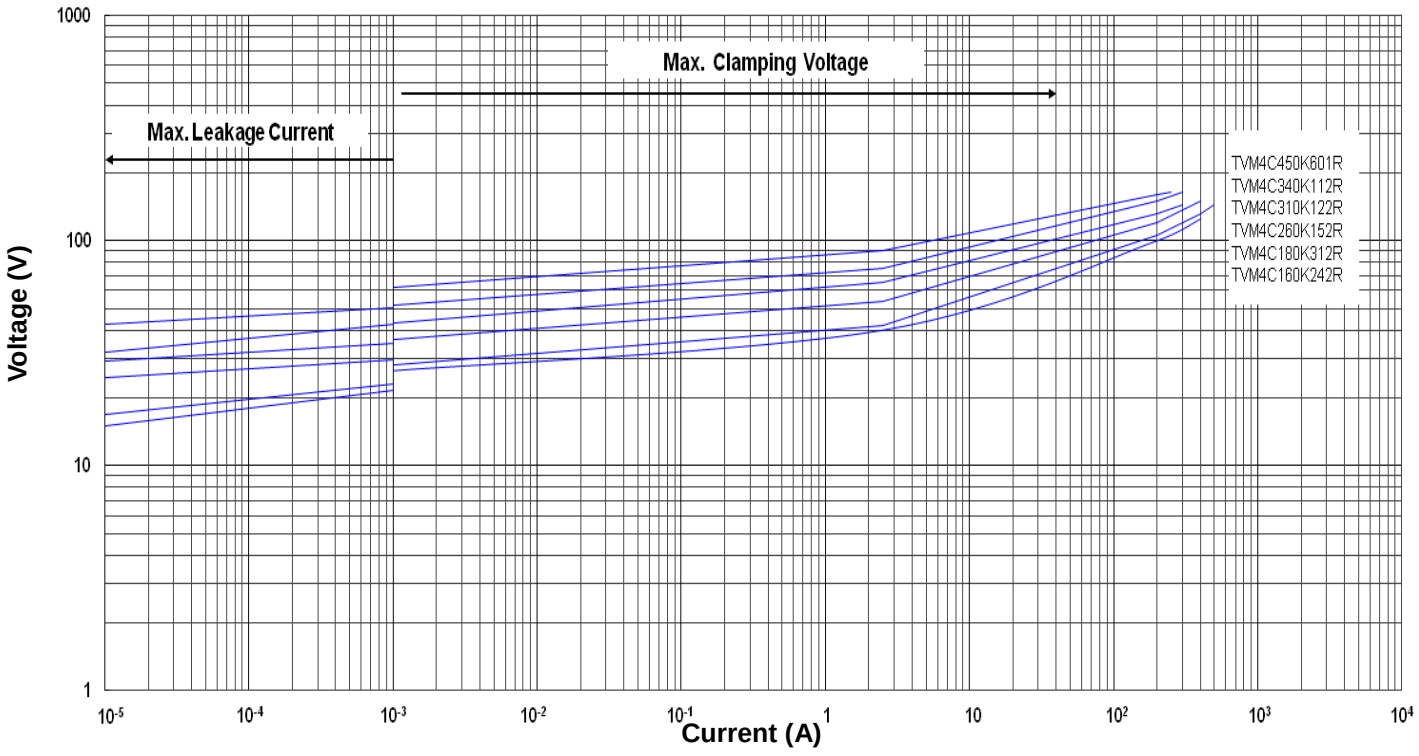


## ■ Max. Leakage Current and Max. Clamping Voltage Curves

**Max. Leakage Current and Max. Clamping Voltage Curves (TVM3C160K102R~TVM3C560K251R)**

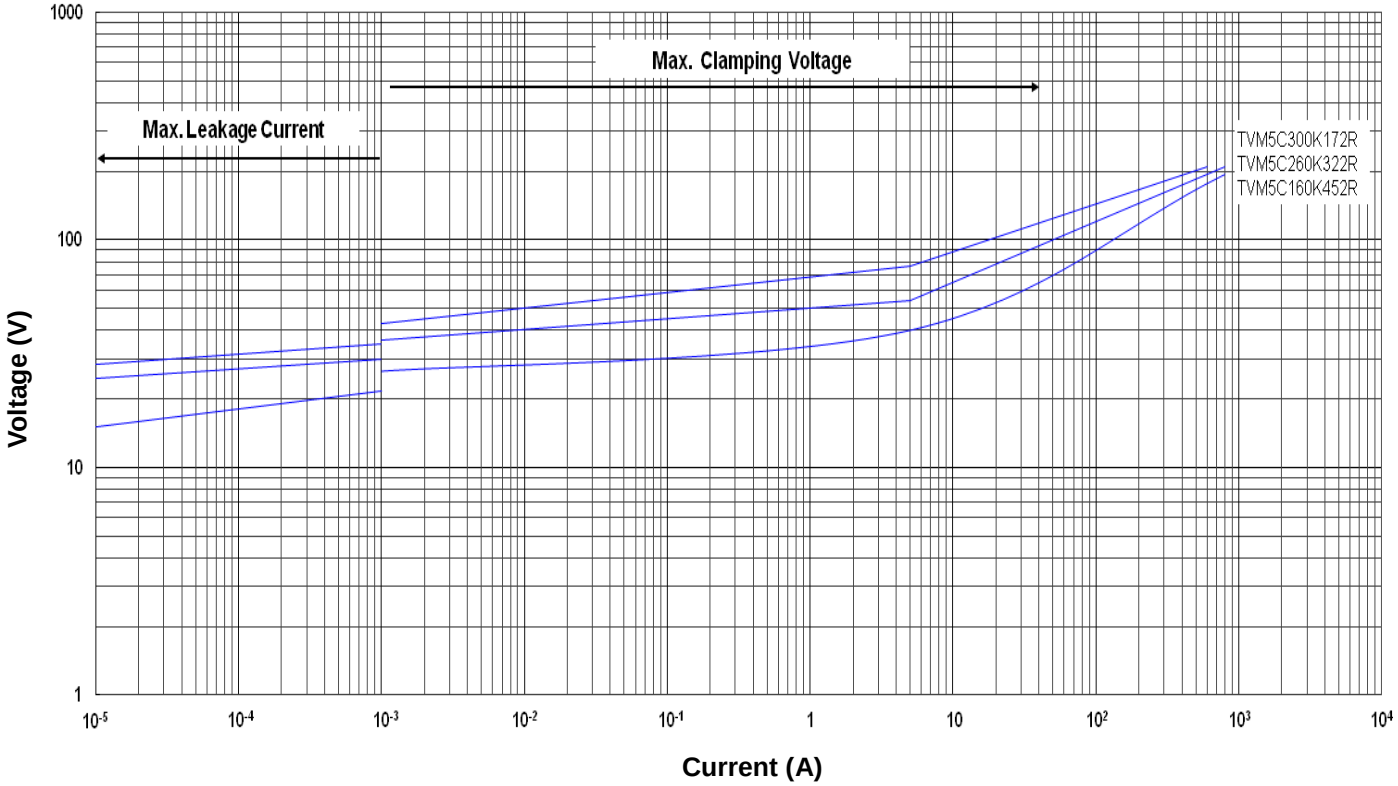



**Max. Leakage Current and Max. Clamping Voltage Curves (TVM4C160K242R~TVM4C560K601R)**

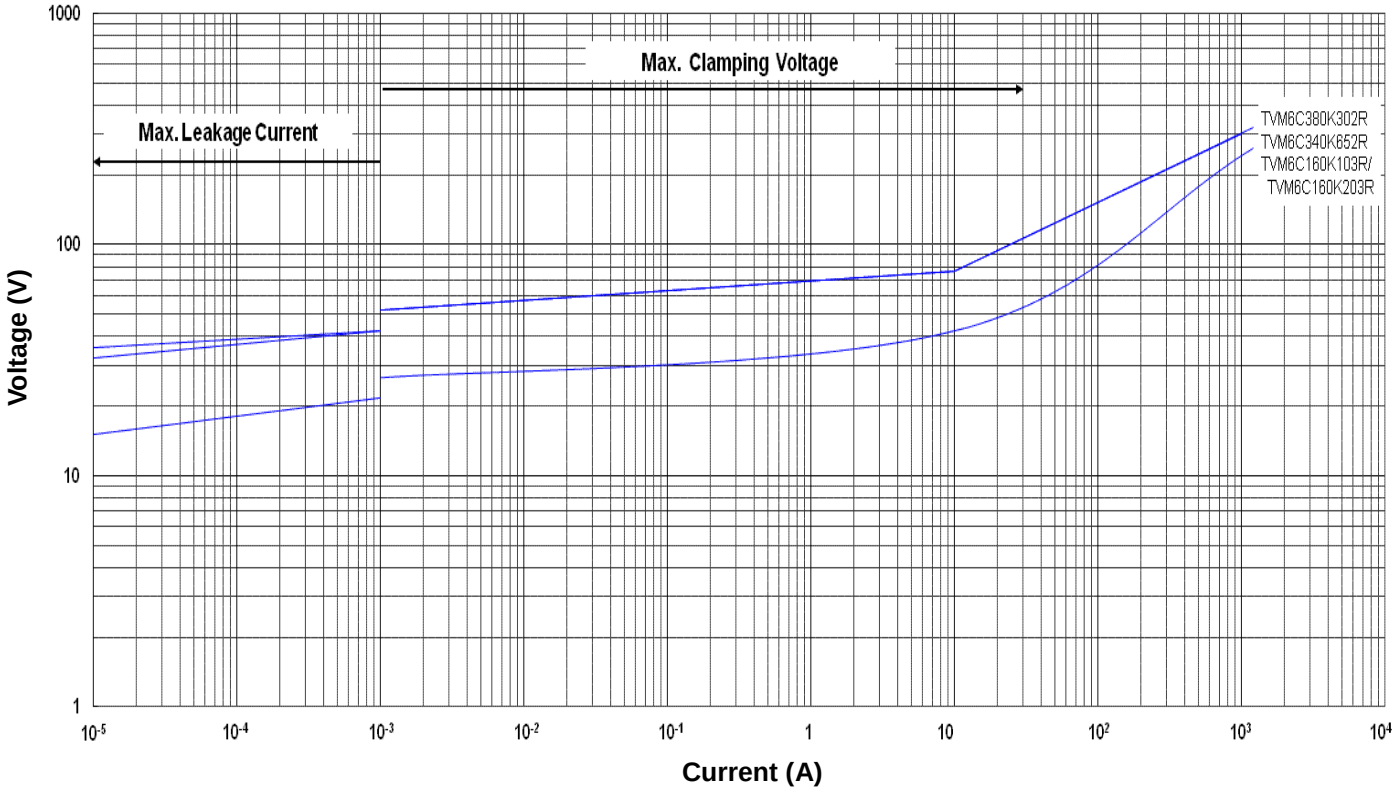


## ■ Max. Leakage Current and Max. Clamping Voltage Curves

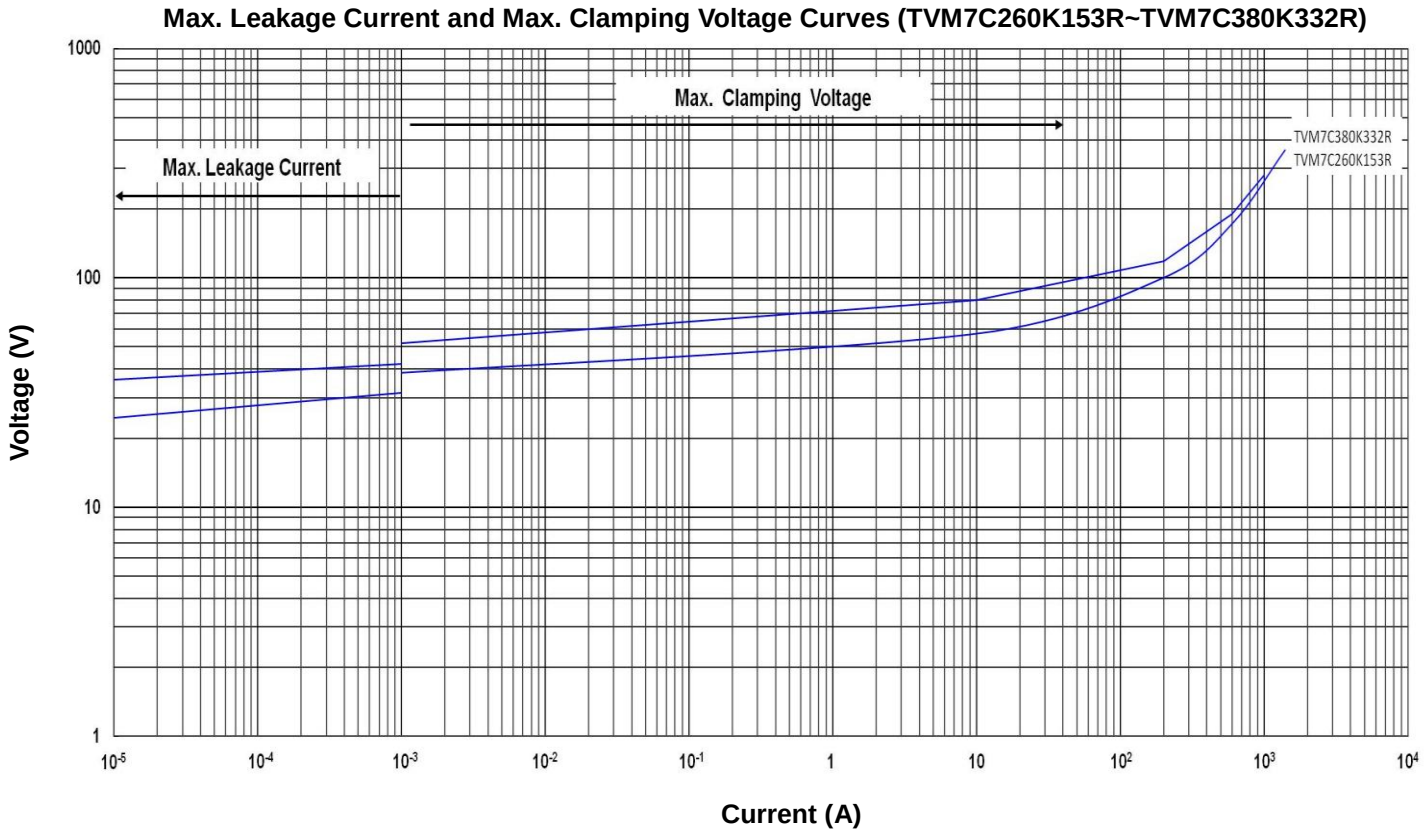
### Max. Leakage Current and Max. Clamping Voltage Curves (TVM5C160K452R~TVM5C300K172R)




### Max. Leakage Current and Max. Clamping Voltage Curves (TVM6C160K203R~TVM6C380K302R)

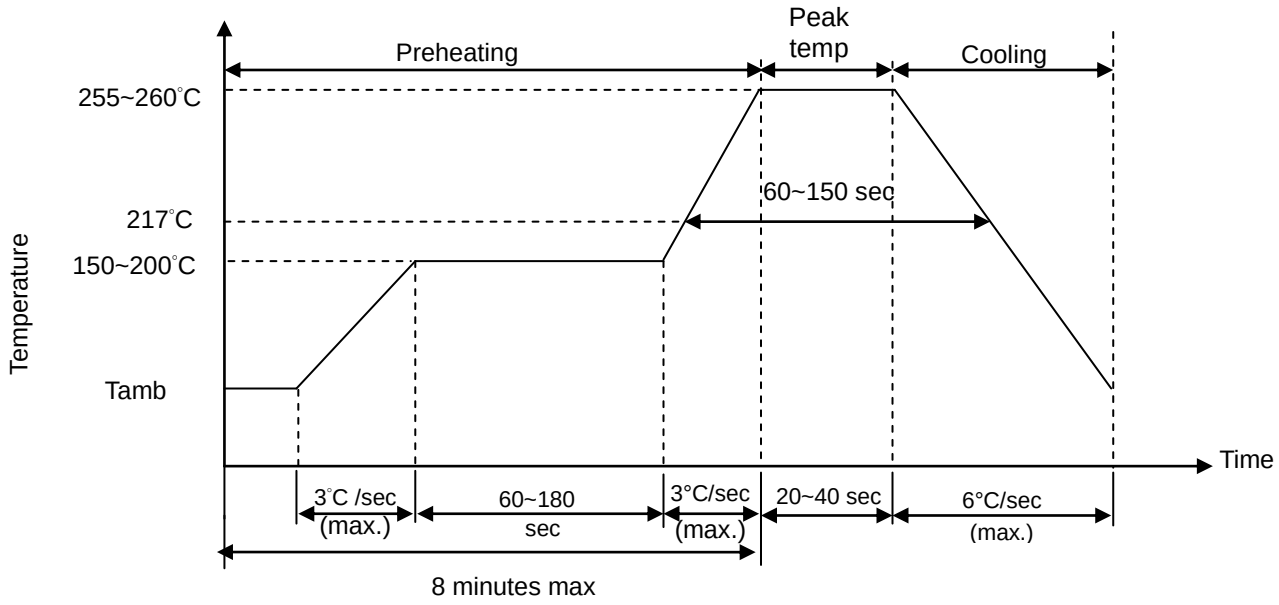


## ■ Max. Leakage Current and Max. Clamping Voltage Curves




## ■ Soldering Recommendation

### ● IR-Reflow Soldering Profile

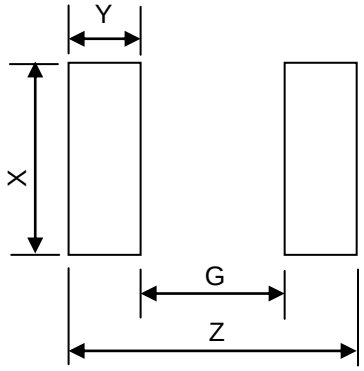


● **Reworking Conditions with Soldering Iron**

| Item | Conditions |
|---|---|
| Temperature of Soldering Iron-tip | 360℃ (max.) |
| Soldering Time | 3 sec (max.) |
| Diameter of Soldering Iron-tip | Φ3mm (max.) |

Caution: Do not touch the component surface with soldering iron directly to prevent it from damage.

## ■ Recommended Soldering Pad Dimensions




| Size | Z (mm) | G (mm) | X (mm) | Y (mm) |
|---|---|---|---|---|
| 0402 | 1.7 | 0.5 | 0.6 | 0.6 |
| 0603 | 2.8 | 0.8 | 1.0 | 1.0 |
| 0805 | 3.4 | 1.0 | 1.4 | 1.2 |
| 1206 | 4.5 | 2.1 | 1.8 | 1.2 |
| 1210 | 4.5 | 2.1 | 2.8 | 1.2 |
| 1812 | 6.0 | 3.0 | 3.6 | 1.5 |
| 2220 | 7.2 | 4.2 | 5.5 | 1.5 |
| 3025 | 11.7 | 8.7 | 6.8 | 1.5 |

## ■ Reliability (based on AEC-Q200 Rev-C)

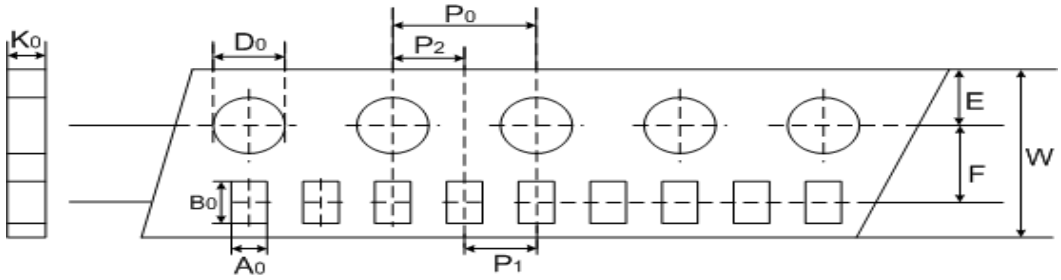
<table>
<tr><th>Item</th><th>Standard</th><th>Test conditions / Methods</th><th>Specifications</th></tr>
<tr><td>High Temperature Exposure (Storage)</td><td>MIL-STD-202 Method 108</td><td>Test temp. : 150 +3/-0°C<br>Duration: 1000 h Unpowered<br>Measurement at 24±2 hours after test conclusion.</td><td>No visible damage<br>$|\triangle V_{1mA}/V_{1mA}| \leqq 10\%$</td></tr>
<tr><td>Temperature Cycling</td><td>JESD22 Method JA-104</td><td>Lower test temp. : -40 +0/-3°C<br>Upper test temp. : 125 +3/-0°C<br>Soak time at lower or upper temp. : 1 min<br>Cycle time: 2 Cycles/hr<br>Number of cycles: 1000<br>Measurement at 24±2 hours after test conclusion.</td><td>No visible damage<br>$|\triangle V_{1mA}/V_{1mA}| \leqq 10\%$</td></tr>
<tr><td>Moisture Resistance</td><td>MIL-STD-202 Method 106</td><td>Duration of 1 cycle: 24 h<br>Number of cycles: 10， Unpowered<br>Measurement at 24±2 hours after test conclusion.
<table>
<tr><th rowspan="2">Step</th><th colspan="2">Temp. (°C)</th><th>Humidity</th><th>Period</th></tr>
<tr><th>Start</th><th>Finish</th><th>(%)</th><th>(hr)</th></tr>
<tr><td>1</td><td>25</td><td>65</td><td>90~100</td><td>2.5</td></tr>
<tr><td>2</td><td>65</td><td>65</td><td>90~100</td><td>3</td></tr>
<tr><td>3</td><td>65</td><td>25</td><td>80~100</td><td>2.5</td></tr>
<tr><td>4</td><td>25</td><td>65</td><td>90~100</td><td>2.5</td></tr>
<tr><td>5</td><td>65</td><td>65</td><td>90~100</td><td>3</td></tr>
<tr><td>6</td><td>65</td><td>25</td><td>80~100</td><td>2.5</td></tr>
<tr><td>7</td><td>25</td><td>25</td><td>80~100</td><td>8</td></tr>
</table></td><td>No visible damage<br>$|\triangle V_{1mA}/V_{1mA}| \leqq 10\%$</td></tr>
<tr><td>Biased Humidity</td><td>MIL-STD-202 Method 103</td><td>Test temp. : 85°C<br>Rel. humidity of air: 85%<br>Duration: 1000 h<br>Bias at Working Voltage Vdc.<br>Measurement at 24±2 hours after test conclusion.</td><td>No visible damage<br>$|\triangle V_{1mA}/V_{1mA}| \leqq 10\%$</td></tr>
</table>

| Item | Standard | Test conditions / Methods | Specifications |
|---|---|---|---|
| Operational Life | MIL-STD-202 Method 108 | Test temp.: 125 +3/-0°C<br>Duration: 1000 h<br>Bias at Working Voltage Vdc.<br>Measurement at 24±2 hours after test conclusion. | No visible damage<br>$\lvert \triangle V_{1mA}/V_{1mA} \rvert \leqq 10\%$ |
| External Visual | MIL-STD-883 Method 2009 | Inspect device construction, marking and workmanship. | No visible damage |
| Physical Dimension | JESD22 Method JB-100 | Verify physical dimensions to the applicable device specification. | Within the specified values |
| Resistance to Solvents | MIL-STD-202 Method 215 | Per MIL-STD-202 Method 215<br>Solvent 1: 1 part (by volume) of isopropyl alcohol 3 part (by volume) of mineral spirits. | No visible damage |
| Mechanical Shock | MIL-STD -202-213 | Test Condition F<br>Peak value: 1500g's<br>Half sine Waveform<br>Normal duration (D) : 0.5ms<br>In 3 directions perpendicularly intersecting each other (total 18 times). | No visible damage<br>$\lvert \triangle V_{1mA}/V_{1mA} \rvert \leqq 10\%$ |
| Vibration | MIL-STD-202 Method 204 | Acceleration: 5 g's<br>Sweep time: 20 min<br>Frequency range: 10 to 2000 Hz<br>3×12 cycles | No visible damage<br>$\lvert \triangle V_{1mA}/V_{1mA} \rvert \leqq 10\%$ |
| Resistance to Soldering Heat | MIL-STD-202 Method 210 | Condition B No pre-heat of samples.<br>Temperature: 260±5°C,Time：10±1s<br>Immersion and emersion rate：25mm/s ±6 mm/s<br>Number of heat cycles: 1 | No visible damage<br>$\lvert \triangle V_{1mA}/V_{1mA} \rvert \leqq 5\%$ |
| Thermal Shock | MIL-STD-202 Method 107 | Lower test temp. : -55 +0/-3°C<br>Upper test temp. : 125 +3/-0°C<br>Maximum transfer time: 20 seconds.<br>Dwell time: 15 minutes. Air-Air.<br>Number of cycles: 300 | No visible damage<br>$\lvert \triangle V_{1mA}/V_{1mA} \rvert \leqq 10\%$ |

| Item | Standard | Test conditions / Methods | Specifications |
|---|---|---|---|
| ESD | AEC-Q200 -002 | Discharge capacitance: 150 pF<br>Charging voltage: 6 KV<br>Contact discharge<br>1 pulse in each polarity | No visible damage<br>$\lvert \triangle V_{1mA}/V_{1mA} \rvert \leqq 10\%$ |
| Solderability | IEC 60068-2-58 J-STD-002 | a) 4 h @ 155°C dry heat<br>Dip @245±5°C 3±0.3sec<br>b)Steam aging 8h±15min @93±3°C<br>Dip @260±5°C 7±0.5sec | 95% of termination wetted |
| Electrical Characterization | Specifications | V1mA(-55°C), V1mA(25°C), V1mA(125°C) | Within the specified values |
| Board Flex | AEC-Q200 -005 (JIS-C-6429) | Bend the board: 2mm (Min.)<br>Duration: 60 (+5) Sec | No visible damage<br>$\lvert \triangle V_{1mA}/V_{1mA} \rvert \leqq 10\%$ |
| Terminal Strength | AEC-Q200 -006 (JIS-C-6429) | Apply force:<br>0402=0.5kg (5 N)<br>0603=1.0kg (10 N)<br>Chip size>0805=1.8kg (17.7 N)<br>Duration of the applied forces: 60 (+1) Sec | No visible damage<br>$\lvert \triangle V_{1mA}/V_{1mA} \rvert \leqq 10\%$ |
| Electrical Transient Conduction | ISO-7637-2 | Test pulses 5a<br>Number of pulses: 10<br>Test Energy: $W_{LD}$ (Load dump ) | No visible damage<br>$\lvert \triangle V_{1mA}/V_{1mA} \rvert \leqq 15\%$ |

## ■ Packaging

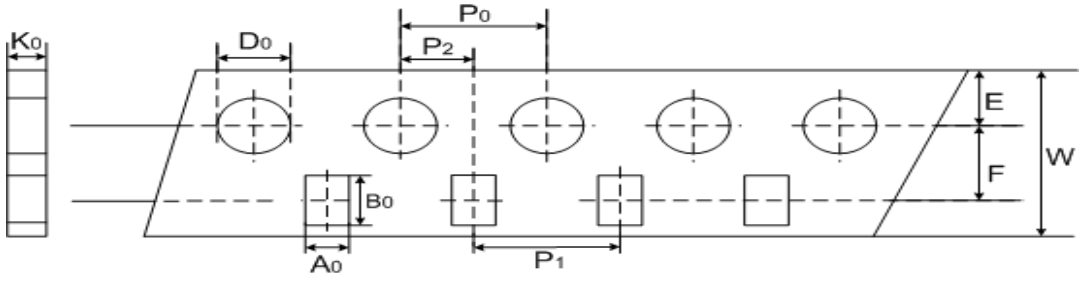
### ● Taping Specification (SMD 0402)




(Unit: mm)

| Index / Size | $A_0$ ±0.05 | $B_0$ ±0.12 | W ±0.2 | E ±0.1 | F ±0.05 | $P_1$ ±0.1 | $P_2$ ±0.05 | $P_0$ ±0.1 | $D_0$ ±0.1 | $K_0$ ±0.1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0402 | 0.62 | 1.12 | 8 | 1.75 | 3.5 | 2 | 2 | 4 | 1.55 | 0.60 |

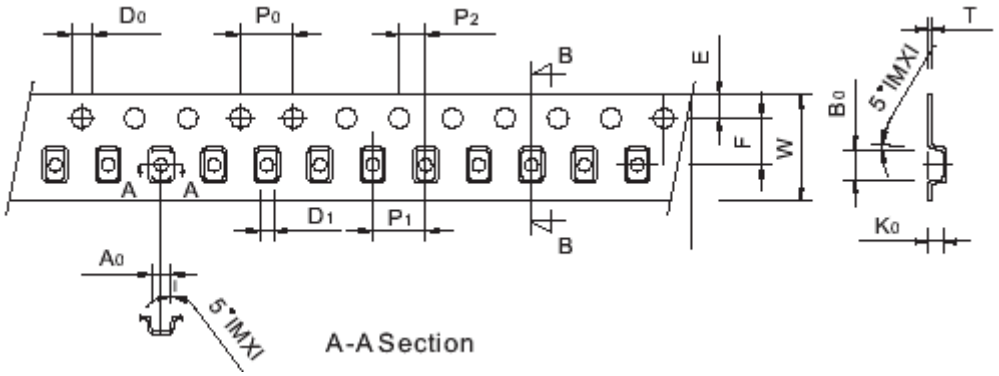
### ● Taping Specification (SMD 0603 & 0805)




(Unit: mm)

| Index / Size | $A_0$ ±0.2 | $B_0$ ±0.2 | W ±0.2 | E ±0.1 | F ±0.05 | $P_1$ ±0.1 | $P_2$ ±0.05 | $P_0$ ±0.1 | $D_0$ ±0.1 | $K_0$ ±0.1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0603 | 1.1 | 1.9 | 8 | 1.75 | 3.5 | 4 | 2 | 4 | 1.55 | 0.95 |
| 0805 | 1.5 | 2.3 | 8 | 1.75 | 3.5 | 4 | 2 | 4 | 1.55 | 1.0 |

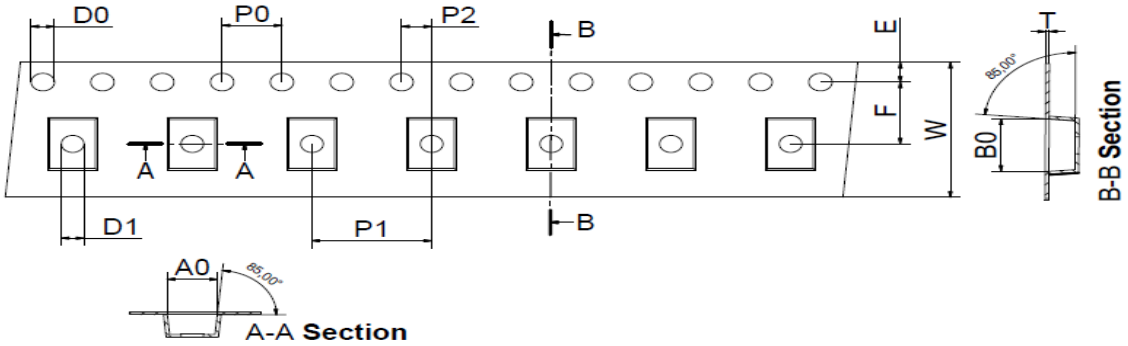
- **Taping Specification(SMD 1206 & 1210)**




(Unit: mm)

| Index / Size | $A_0$ ±0.2 | $B_0$ ±0.2 | W ±0.2 | E ±0.1 | F ±0.05 | $P_1$ ±0.1 | $P_2$ ±0.05 | $P_0$ ±0.1 | $D_0$ ±0.1 | $D_1$ ±0.1 | T ±0.1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1206 | 1.85 | 3.45 | 8 | 1.75 | 3.5 | 4 | 2 | 4 | 1.55 | 1 | 0.25 |
| 1210 | 2.75 | 3.55 | 8 | 1.75 | 3.5 | 4 | 2 | 4 | 1.55 | 1 | 0.25 |

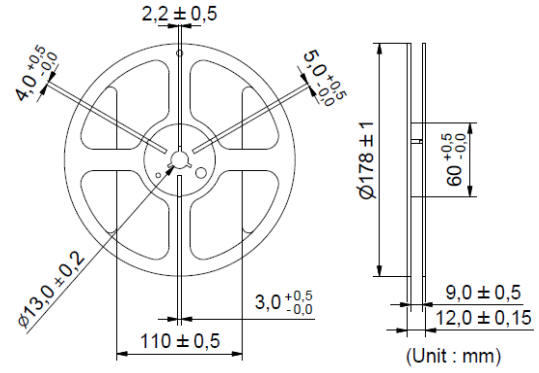
- **Taping Specification(SMD 1812 ~ 3025)**




(Unit: mm)

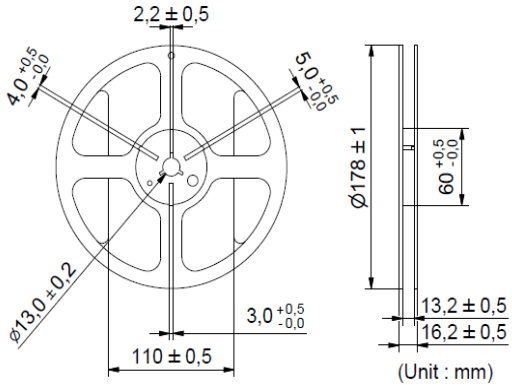
| Index / Size | $A_0$ ±0.2 | $B_0$ ±0.2 | W ±0.3 | E ±0.1 | F ±0.05 | $P_1$ ±0.1 | $P_2$ ±0.05 | $P_0$ ±0.1 | $D_0$ ±0.1 | $D_1$ ±0.1 | T ±0.1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1812 | 3.65 | 4.96 | 12 | 1.75 | 5.5 | 8 | 2 | 4 | 1.55 | 1.5 | 0.25 |
| 2220 | 5.50 | 6.25 | 12 | 1.75 | 5.5 | 8 | 2 | 4 | 1.55 | 1.5 | 0.25 |
| 3025 | 6.75 | 8.30 | 16 | 1.75 | 7.5 | 8 | 2 | 4 | 1.55 | 1.6 | 0.3 |

- **Quantity**
  - **0402 ~ 1210**



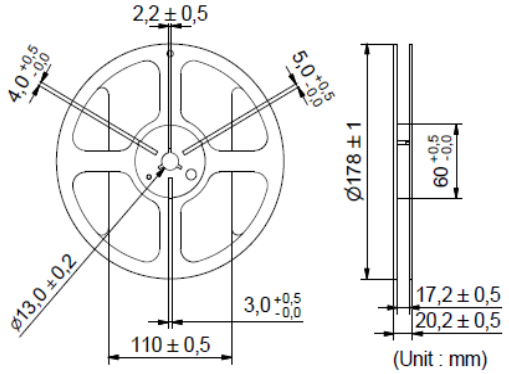

| Type | Quantity (pcs/reel) |
|---|---|
| 0402 | 10,000 |
| 0603 | 4,000 |
| 0805 | 3,000 |
| 1206 | 2,000 |
| 1210 | 2,000 |

  - **1812~2220**




| Type | Quantity (pcs/reel) |
|---|---|
| 1812 | 1,000 |
| 2220 | 800 |

  - **3025**




| Type | Quantity (pcs/reel) |
|---|---|
| 3025 | 800 |

## ■ Warehouse Storage Conditions of Products

- Storage Conditions :

  1. Storage Temperature: -10℃~+40℃

  2. Relative Humidity: ≦75%RH

  3. Keep away from corrosive atmosphere and sunlight.

- Period of Storage : 1 year