

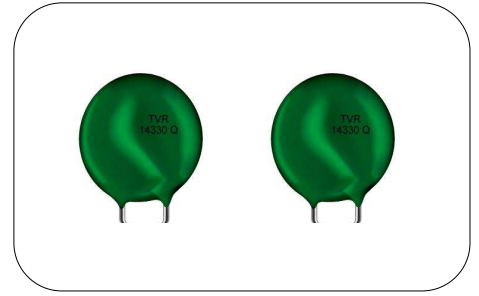
Metal Oxide Varistor : TVR-Q Series



Disc Type Varistor for Automotive Applications

■ Features

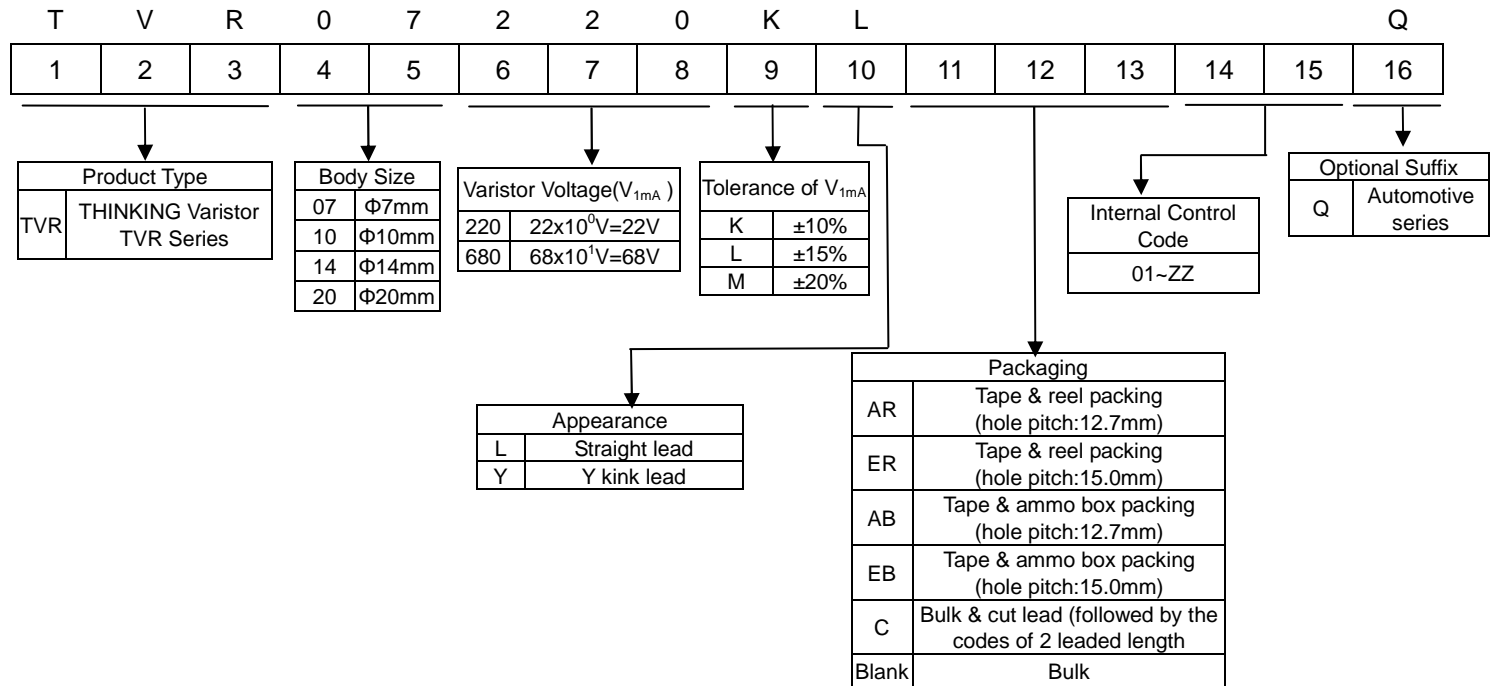
1. Qualification based on AEC-Q200 Rev-C
2. Body size: $\Phi 7\sim\Phi 20\text{mm}$
3. Wide operating voltage range: 12Vdc, 24Vdc, 42Vdc
4. Operating temperature range: $-40 \sim +125^\circ\text{C}$
5. Storage temperature range: $-40\sim +150^\circ\text{C}$
6. RoHS & Halogen-free compliant



■ Recommended Applications

1. Automotive information and entertainment system

■ Part Number Code



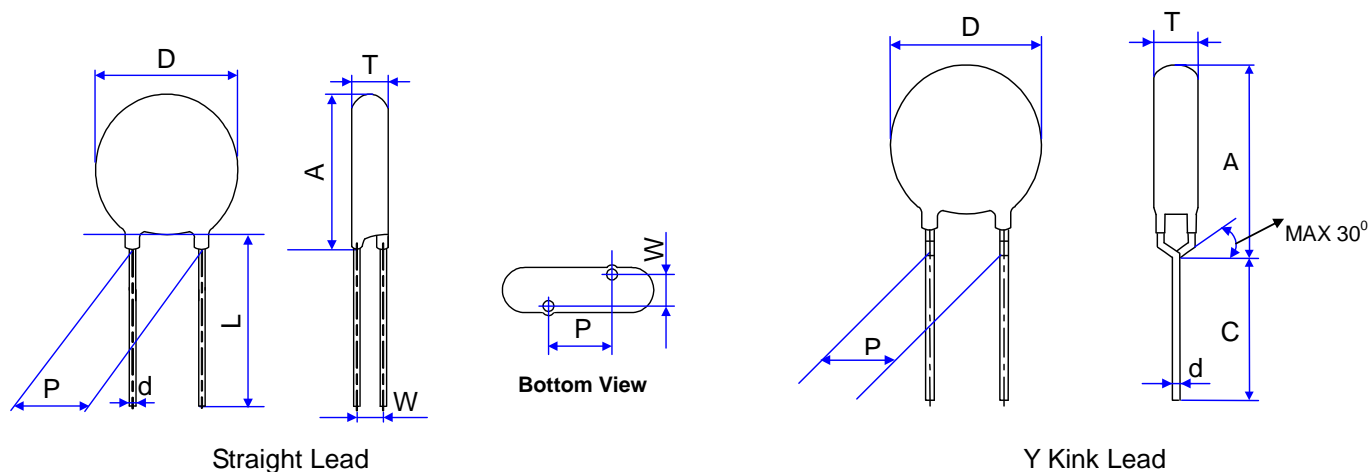
Note: Optional suffix will be the 11th digit if packaging and internal control codes are not coded.

Metal Oxide Varistor : TVR-Q Series

Disc Type Varistor for Automotive Applications



Structures and Dimensions



(Unit: mm)

| Part | Dmax | Amax | | P (±0.5) | W (±1.0) | Lmin | Φd (±0.05) | T | |
|------------|------|---------------|-------------|-------------|-------------|------|---------------|-----|-----|
| | | Straight Lead | Y Kink Lead | | | | | Min | Max |
| TVR07220-Q | 9.0 | 11.0 | 11.5 | 5.0 | 1.4 | 25 | 0.6 | 2.4 | 4.1 |
| TVR10220-Q | 12.0 | 14.5 | 15.5 | 7.5 | 1.4 | 25 | 0.8 | 2.8 | 4.5 |
| TVR14220-Q | 15.5 | 18.5 | 19.0 | 7.5 | 1.4 | 25 | 0.8 | 2.8 | 4.5 |
| TVR20220-Q | 21.5 | 25.5 | 26.5 | 10.0 | 1.4 | 25 | 1.0 | 3.2 | 4.9 |
| TVR10270-Q | 12.0 | 14.5 | 15.5 | 7.5 | 1.5 | 25 | 0.8 | 3.0 | 4.7 |
| TVR14270-Q | 15.5 | 18.5 | 19.0 | 7.5 | 1.5 | 25 | 0.8 | 3.0 | 4.7 |
| TVR20270-Q | 21.5 | 25.5 | 26.5 | 10.0 | 1.5 | 25 | 1.0 | 3.4 | 5.1 |
| TVR14390-Q | 15.5 | 18.5 | 19.0 | 7.5 | 1.8 | 25 | 0.8 | 3.2 | 4.9 |
| TVR20390-Q | 21.5 | 25.5 | 26.5 | 10.0 | 1.8 | 25 | 1.0 | 3.6 | 5.3 |
| TVR14470-Q | 15.5 | 18.5 | 19.0 | 7.5 | 1.8 | 25 | 0.8 | 3.5 | 5.4 |
| TVR20470-Q | 21.5 | 25.5 | 26.5 | 10.0 | 1.8 | 25 | 1.0 | 3.9 | 5.8 |
| TVR14680-Q | 15.5 | 18.5 | 19.0 | 7.5 | 2.2 | 25 | 0.8 | 3.3 | 5.0 |
| TVR20680-Q | 21.5 | 25.5 | 26.5 | 10.0 | 2.2 | 25 | 1.0 | 3.7 | 5.4 |

Metal Oxide Varistor : TVR-Q Series

Disc Type Varistor for Automotive Applications



● Electrical Characteristics

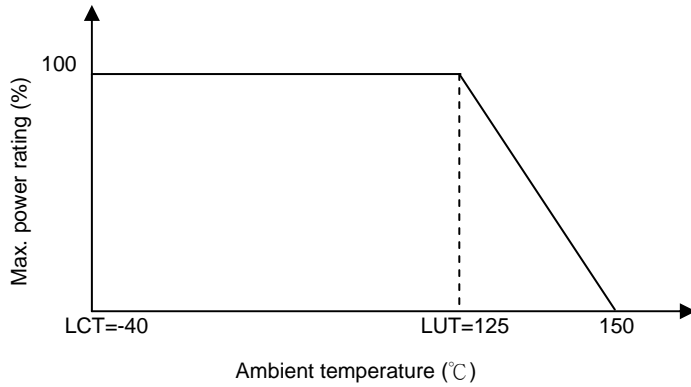
| Part no | Varistor Voltage (@ 1mA DC) | Max. Operating Voltage | Max. Clamping Voltage(8/20μs) | | Max. Surge Current(8/20μs) | V _{jump} (5min) | Load dump Energy ISO7637 Pulse 5, 10times |
|-------------------------|--------------------------------|------------------------|-------------------------------|----------------|----------------------------|-----------------------------|--|
| | V _{1mA} | V _{dc} | V _p | I _p | I _{max} | (V) | (J) |
| | (V) | (V) | (V) | (A) | (A) | | |
| For 12Vdc system | | | | | | | |
| TVR07220-Q | 22±15% | 16 | 43 | 2.5 | 500 | 25 | 12 |
| TVR10220-Q | 22±15% | 16 | 43 | 5 | 1000 | 25 | 25 |
| TVR14220-Q | 22±15% | 16 | 43 | 10 | 2000 | 25 | 50 |
| TVR20220-Q | 22±15% | 16 | 43 | 20 | 3000 | 25 | 100 |
| TVR10270-Q | 27±10% | 22 | 53 | 5 | 1000 | 30 | 25 |
| TVR14270-Q | 27±10% | 22 | 53 | 10 | 2000 | 30 | 50 |
| TVR20270-Q | 27±10% | 22 | 53 | 20 | 3000 | 30 | 100 |
| For 24Vdc system | | | | | | | |
| TVR14390-Q | 39±10% | 31 | 77 | 10 | 2000 | 42 | 50 |
| TVR20390-Q | 39±10% | 31 | 77 | 20 | 3000 | 42 | 100 |
| TVR14470-Q | 47±10% | 38 | 93 | 10 | 2000 | 50 | 50 |
| TVR20470-Q | 47±10% | 38 | 93 | 20 | 3000 | 50 | 100 |
| For 42Vdc system | | | | | | | |
| TVR10680-Q | 68±10% | 56 | 135 | 5 | 1000 | 65 | 25 |
| TVR14680-Q | 68±10% | 56 | 135 | 10 | 2000 | 65 | 50 |
| TVR20680-Q | 68±10% | 56 | 135 | 20 | 3000 | 65 | 100 |

Metal Oxide Varistor : TVR-Q Series

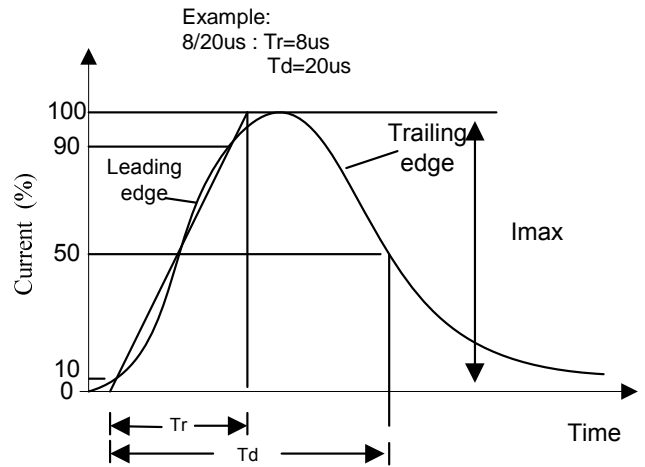


Disc Type Varistor for Automotive Applications

■ Power Derating Curve

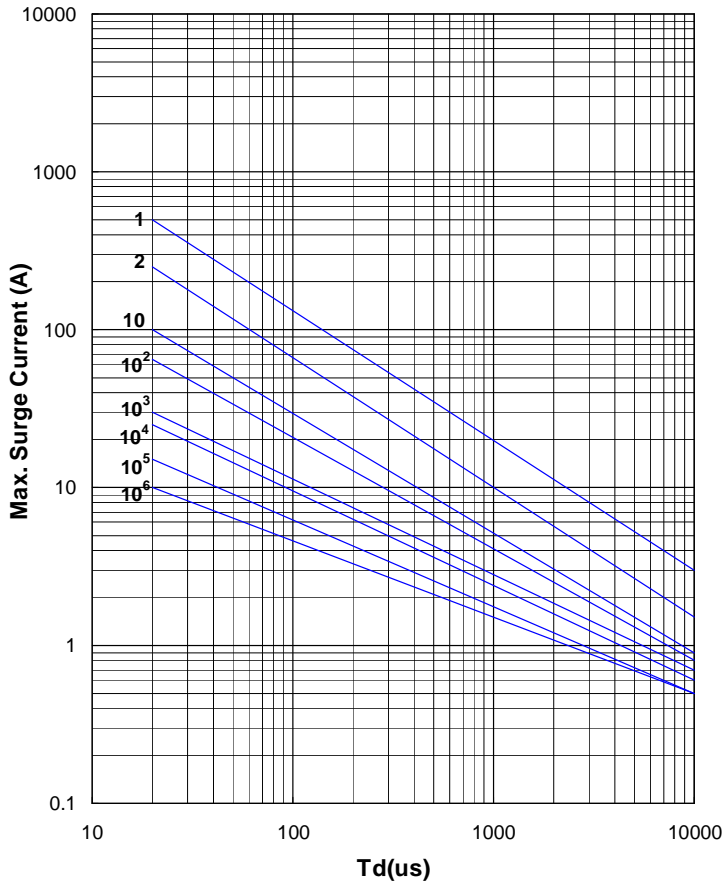


■ Surge Current Standard Waveform

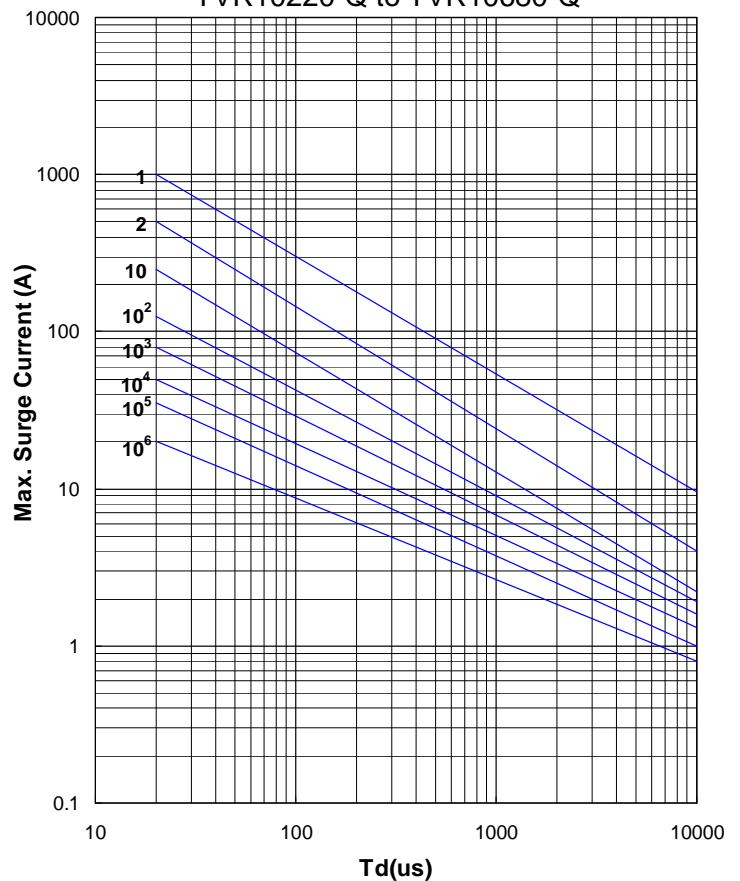


■ Max. Surge Current Derating Curves

TVR07220-Q



TVR10220-Q to TVR10680-Q

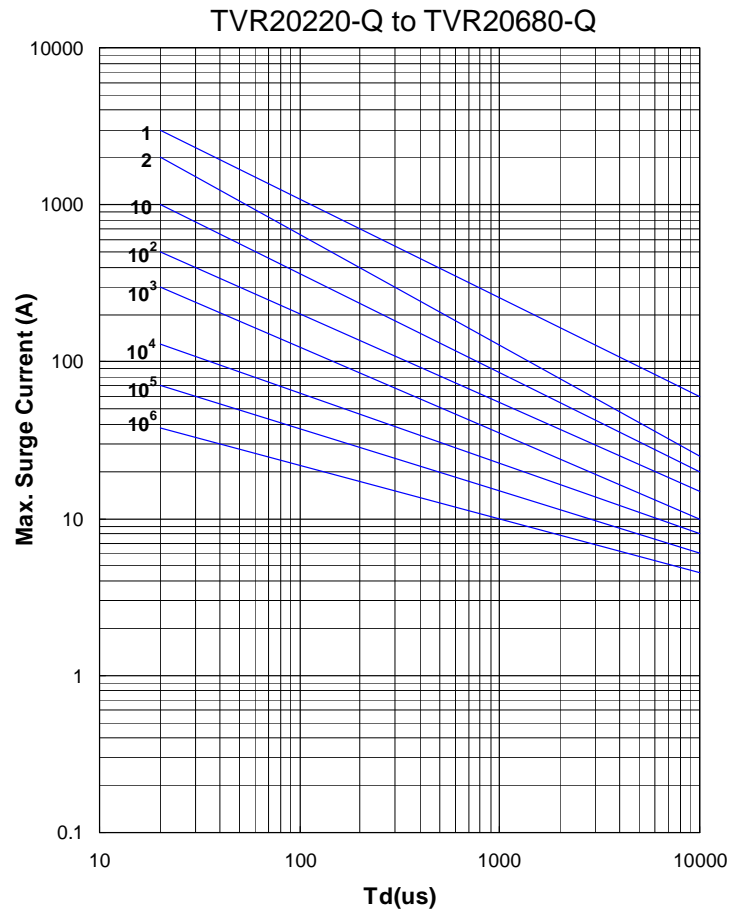
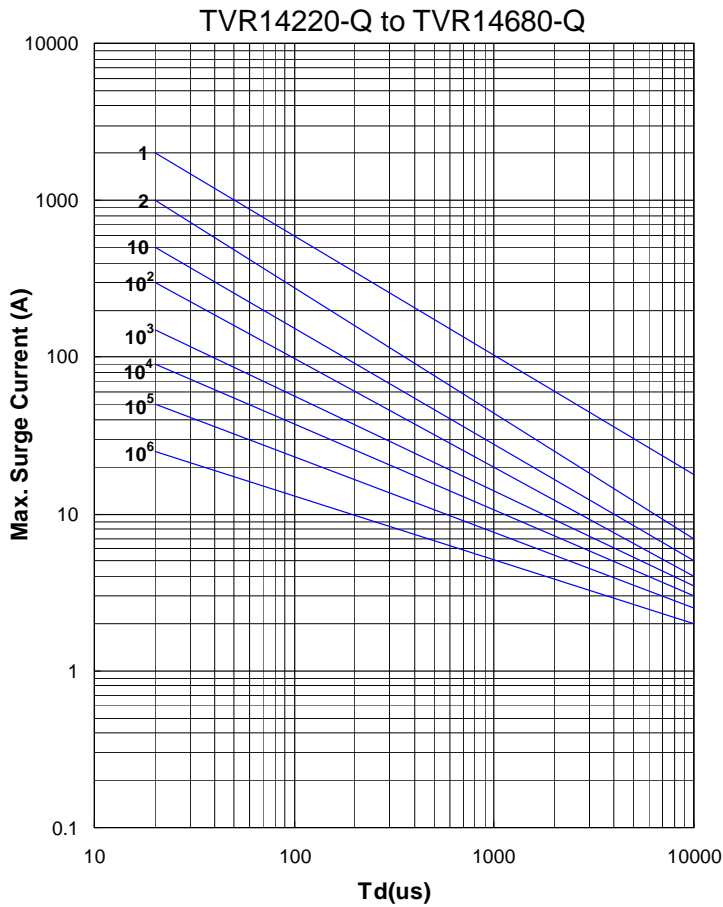


Metal Oxide Varistor : TVR-Q Series

Disc Type Varistor for Automotive Applications

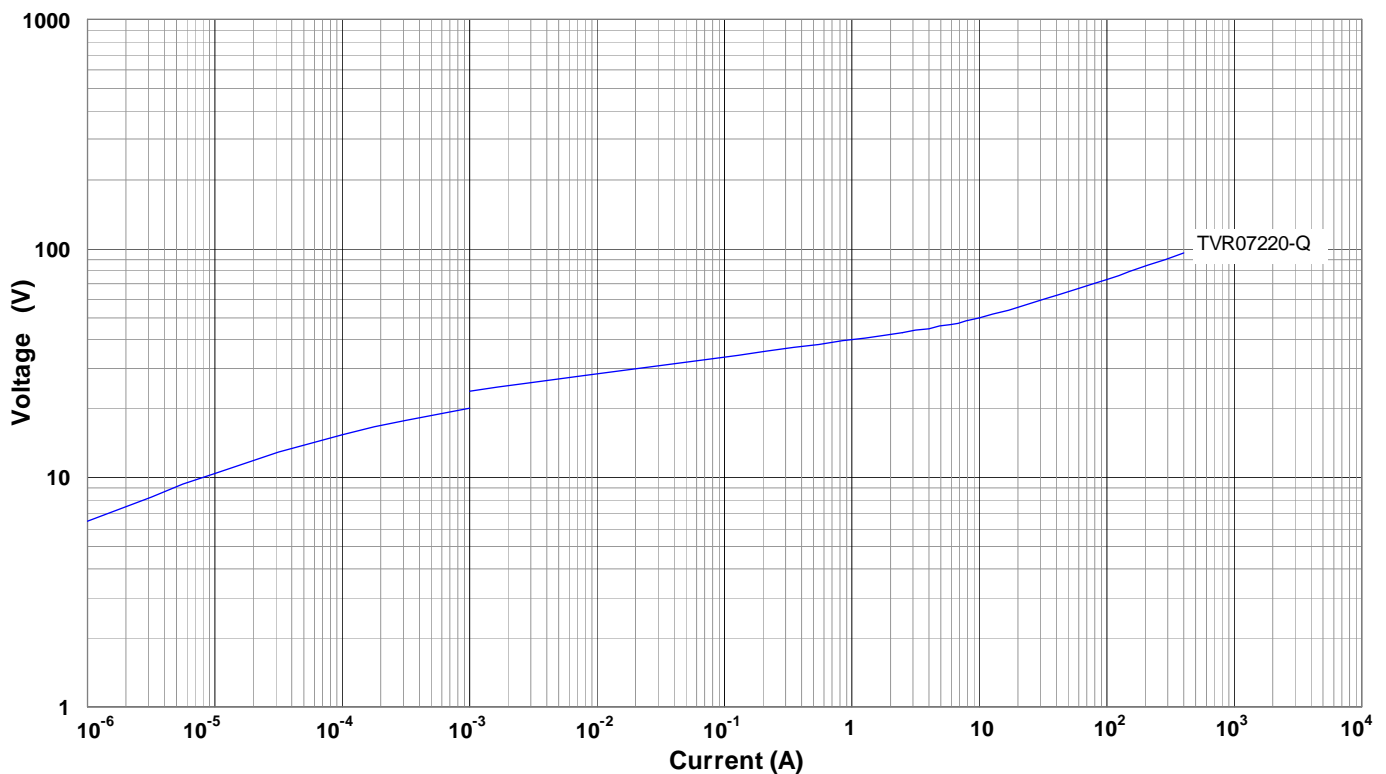


Max. Surge Current Derating Curves



Max. Leakage Current and Max. Clamping Voltage Curves

Max. Leakage Current and Max. Clamping Voltage Curves (TVR07220-Q)

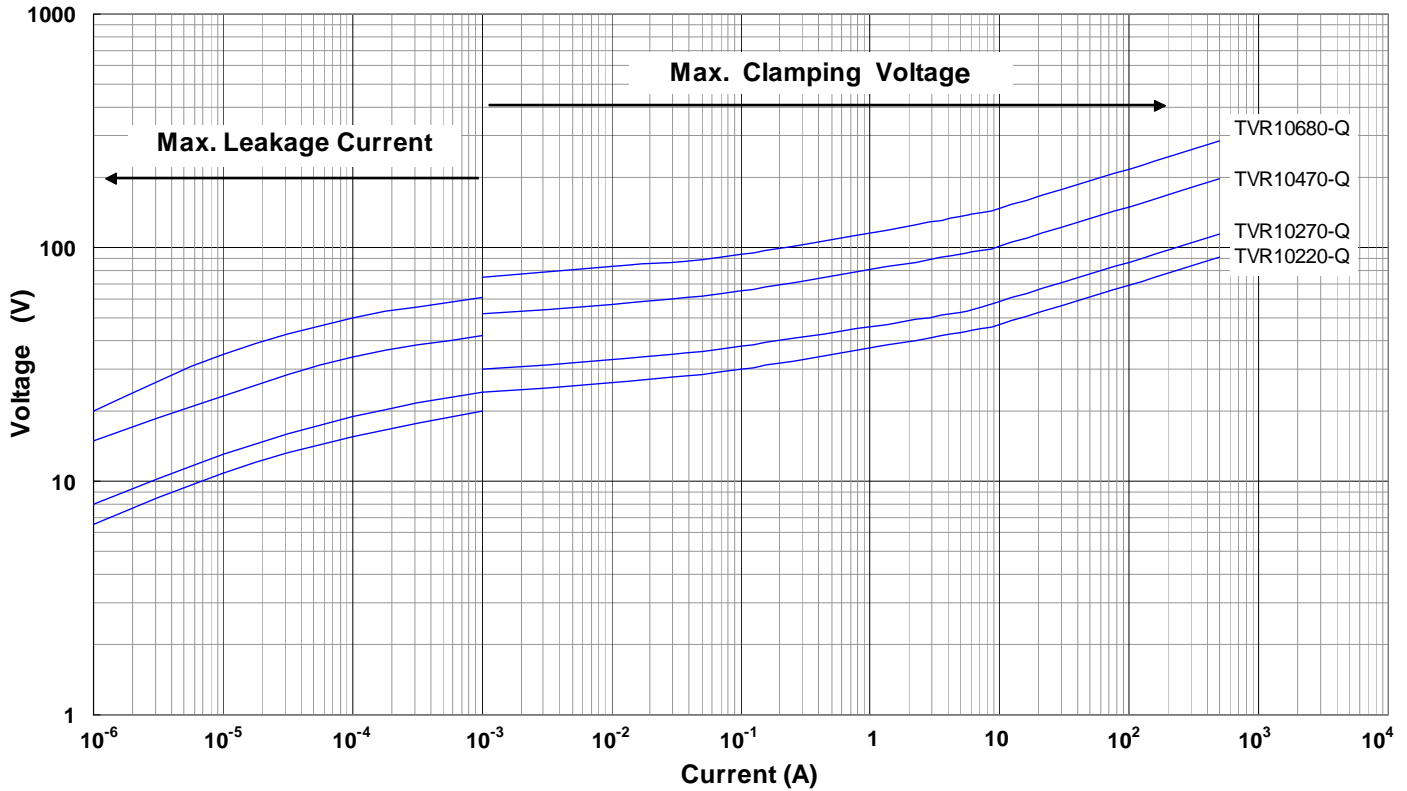


Metal Oxide Varistor : TVR-Q Series

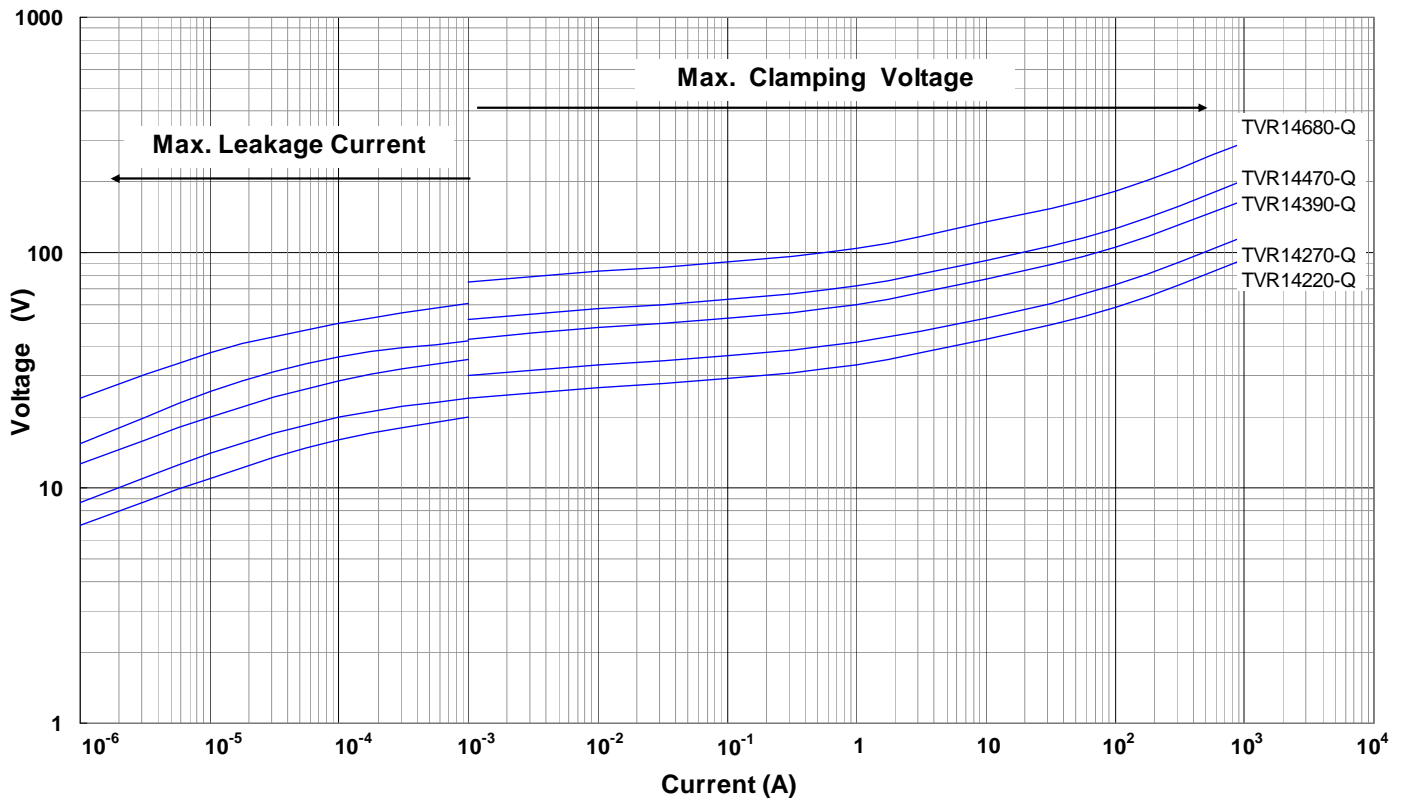
Disc Type Varistor for Automotive Applications



Max. Leakage Current and Max. Clamping Voltage Curves (TVR 10 220-Q to TVR 10 680-Q)



Max. Leakage Current and Max. Clamping Voltage Curves (TVR14 220-Q to TVR14 680-Q)

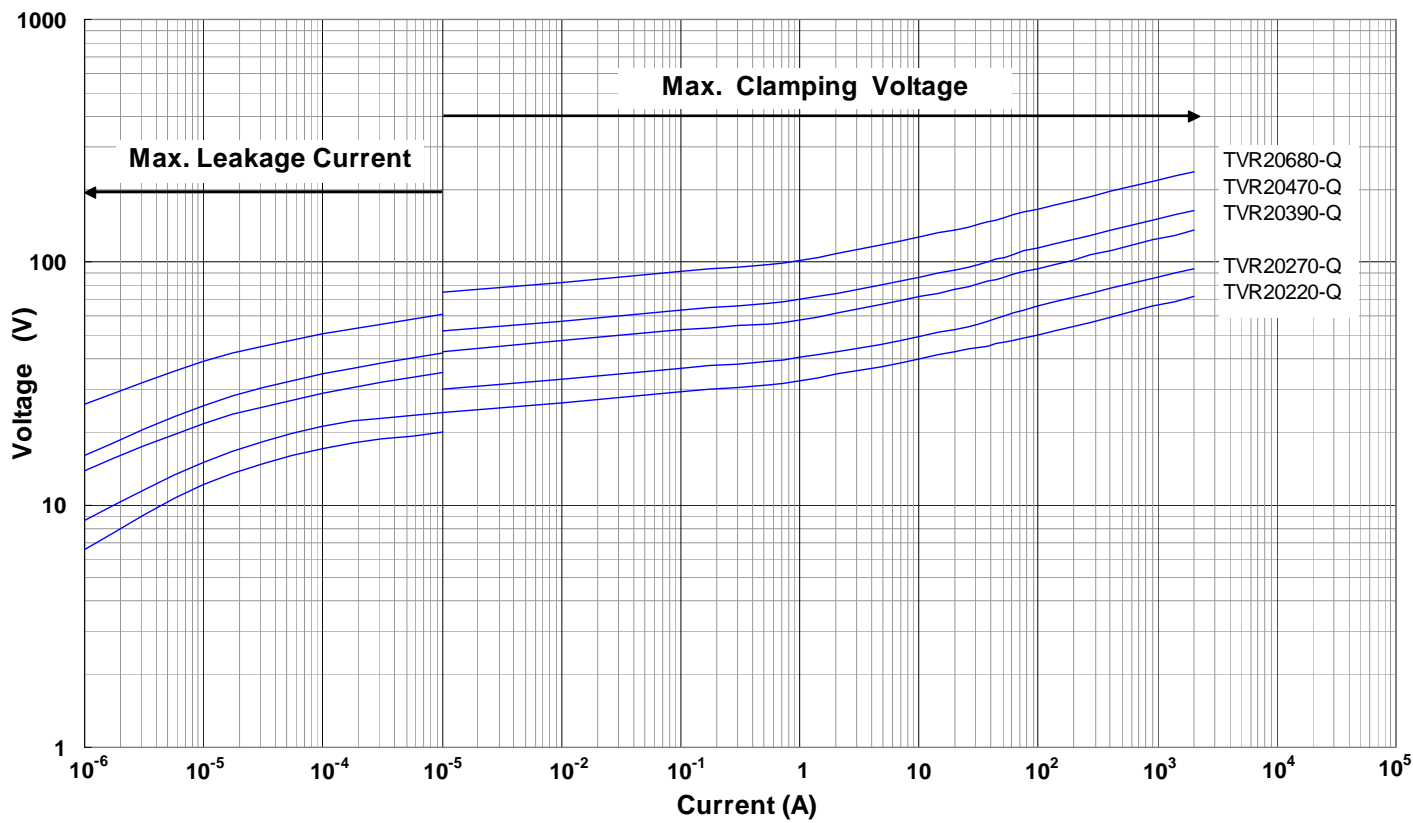


Metal Oxide Varistor : TVR-Q Series

Disc Type Varistor for Automotive Applications



Max. Leakage Current and Max. Clamping Voltage Curves (TVR 20 220-Q to TVR 20 680-Q)



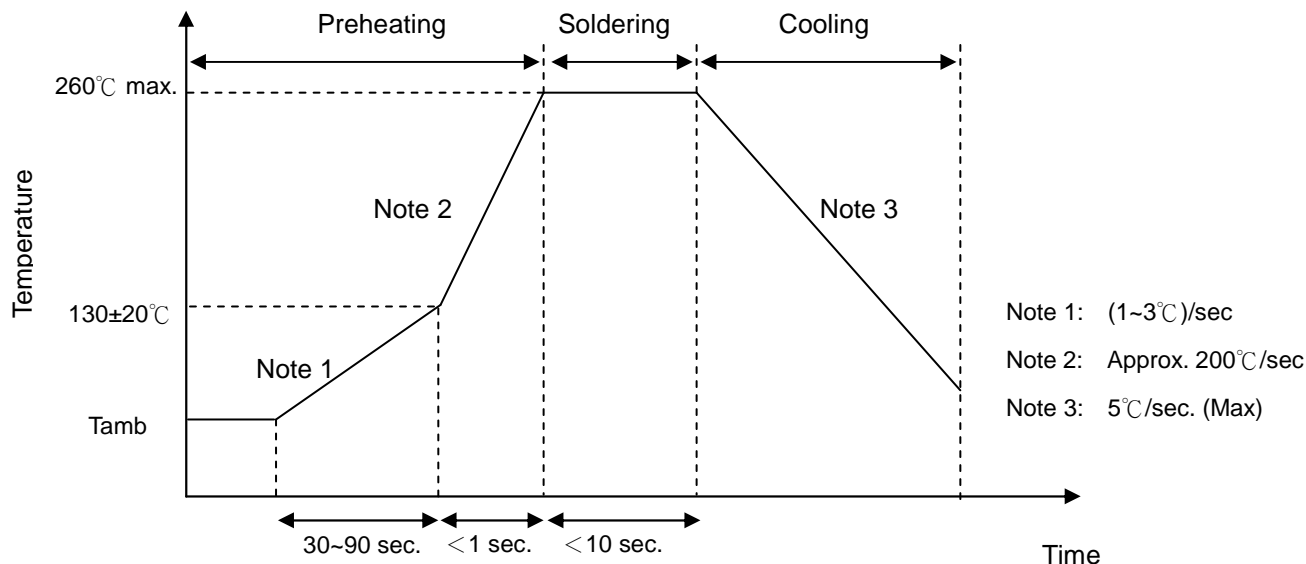
Metal Oxide Varistor : TVR-Q Series

Disc Type Varistor for Automotive Applications



■ Soldering Recommendation

● Wave Soldering Profile



● Recommended Reworking Conditions with Soldering Iron

| Item | Conditions |
|-----------------------------------|----------------------------|
| Temperature of Soldering Iron-tip | 360°C (max.) |
| Soldering Time | 3 sec (max.) |
| Distance from Varistor | 2 mm (min.) |

Metal Oxide Varistor : TVR-Q Series

Disc Type Varistor for Automotive Applications



■ Reliability

| Item | Standard | Test conditions / Methods | Specifications | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------------|-------------------------|---|---|----------|--------|----------|--------|-------|--------|-----|------|---|----|----|--------|-----|---|----|----|--------|-----|---|----|----|--------|-----|---|----|----|--------|-----|---|----|----|--------|-----|---|----|----|--------|-----|---|
| High Temperature Exposure (Storage) | MIL-STD-202 Method 108 | Test temp.: 150+3/-0°C Duration: 1000 hrs, Unpowered Measurement at 24±2 hours after test conclusion. | No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤ 10% $\Delta V_{clamp}/V_{clamp}$ ≤ 10% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Temperature Cycling | JESD22 Method JA-104 | Lower test temp. : -40°C (+0/-10) Upper test temp. : 125°C (+15/-0) Soak Time at Lower or Upper Temp. : 15 min Transfer time: ≤1 min Number of cycles: 1000 Measurement at 24±2 hours after test conclusion. | No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤ 10% $\Delta V_{clamp}/V_{clamp}$ ≤ 10% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Moisture Resistance | MIL-STD-202 Method 106 | Duration of 1 cycle: 16 hrs Number of cycles: 10, Unpowered Measurement at 24±2 hours after test conclusion. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th rowspan="2">Step</th> <th colspan="2">Temp.</th> <th>humidity</th> <th>Period</th> </tr> <tr> <th>Start</th> <th>Finish</th> <th>(%)</th> <th>(hr)</th> </tr> </thead> <tbody> <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>3.0</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>3.0</td> </tr> <tr> <td>6</td> <td>65</td> <td>25</td> <td>80~100</td> <td>2.5</td> </tr> </tbody> </table> | Step | Temp. | | humidity | Period | Start | Finish | (%) | (hr) | 1 | 25 | 65 | 90~100 | 2.5 | 2 | 65 | 65 | 90~100 | 3.0 | 3 | 65 | 25 | 80~100 | 2.5 | 4 | 25 | 65 | 90~100 | 2.5 | 5 | 65 | 65 | 90~100 | 3.0 | 6 | 65 | 25 | 80~100 | 2.5 | No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤ 10% $\Delta V_{clamp}/V_{clamp}$ ≤ 10% |
| Step | Temp. | | | humidity | Period | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Start | Finish | (%) | (hr) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 25 | 65 | 90~100 | 2.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 65 | 65 | 90~100 | 3.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 65 | 25 | 80~100 | 2.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 25 | 65 | 90~100 | 2.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 65 | 65 | 90~100 | 3.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 65 | 25 | 80~100 | 2.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Biased Humidity | MIL-STD-202 Method 103 | Test temp.:85°C Rel. humidity of air: 85% Duration: 1000 hrs Test Power: Bias at 85% (+5%/-0%) of rated varistor voltage Measurement at 24±2 hours after test conclusion. | No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤ 10% $\Delta V_{clamp}/V_{clamp}$ ≤ 10% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Operational Life | MIL-STD-202 Method 108 | Test temp.: 125°C (+3/-0) Duration: 1000 hrs Test Power: Bias at 85% (+5%/-0%) of rated varistor voltage Measurement at 24±2 hours after test conclusion. | No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤ 10% $\Delta V_{clamp}/V_{clamp}$ ≤ 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 detail specification. | Within the specified values | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Terminal Strength (Leaded) | MIL-STD-202 Method 211 | 1. Pull test (2.27 kg), 2. Wire-lead bend test (227 g) Duration of the applied forces: 10 ±1sec | No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤ 10% $\Delta V_{clamp}/V_{clamp}$ ≤ 10% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Resistance to Solvents | MIL-STD-202 Method 215 | Add aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents. | No visible damage | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Metal Oxide Varistor : TVR-Q Series

Disc Type Varistor for Automotive Applications



| Item | Standard | Test conditions / Methods | Specifications |
|---------------------------------|------------------------|--|---|
| Mechanical Shock | MIL-STD-202-213 | Peak value: 100g's Half sine Waveform Normal duration (D): 6ms 3 shocks in per axis ($\pm X$, $\pm Y$, $\pm Z$), 3 times. | No visible damage $\Delta V_{1mA}/V_{1mA}$ $\leq 10\%$ $\Delta V_{clamp}/V_{clamp}$ $\leq 10\%$ |
| Vibration | MIL-STD-202 Method 204 | Acceleration: 5 g's Sweep time: 20 min Frequency range: 10Hz~2KHz~10Hz 3x12 cycles | No visible damage $\Delta V_{1mA}/V_{1mA}$ $\leq 10\%$ $\Delta V_{clamp}/V_{clamp}$ $\leq 10\%$ |
| Resistance to Soldering Heat | MIL-STD-202 Method 210 | No pre-heat of samples. Temperature: 260 $\pm 5^\circ\text{C}$, Time: 10 ± 1 s Immersion and emersion rate: 25mm/s ± 6 mm/s Number of heat cycles: 1 | No visible damage $\Delta V_{1mA}/V_{1mA}$ $\leq 10\%$ $\Delta V_{clamp}/V_{clamp}$ $\leq 10\%$ |
| Thermal Shock | MIL-STD-202 Method 107 | Lower test temp.: -55 $+0/-3^\circ\text{C}$ Upper test temp.: 125 $+3/-0^\circ\text{C}$ Maximum transfer time: 20 seconds. Dwell time: 15 minutes. Air-Air. Number of cycles : 300 | No visible damage $\Delta V_{1mA}/V_{1mA}$ $\leq 10\%$ $\Delta V_{clamp}/V_{clamp}$ $\leq 10\%$ |
| Solderability | J-STD-002 | Steam aging 8hr@93 $\pm 3^\circ\text{C}$, 245 $\pm 5^\circ\text{C}$, 5 $+0/- 0.5\text{sec}$ | At least 95% of terminal electrode is covered by new solder |
| Electrical Characterization | Specifications | Varistor voltage and clamping voltage | Within the specified values |
| Flammability | UL94 | V-0 | UL certified coating material |
| Electrical Transient Conduction | ISO-7637-1 | Test pulses 5 | No visible damage $\Delta V_{1mA}/V_{1mA}$ $\leq 10\%$ $\Delta V_{clamp}/V_{clamp}$ $\leq 10\%$ |
| Jump Start | Specification Standard | Test voltage: For TVR**220-Q, $V_{jump} = 25$ Vdc For TVR**270-Q, $V_{jump} = 30$ Vdc For TVR**390-Q, $V_{jump} = 42$ Vdc For TVR**470-Q, $V_{jump} = 50$ Vdc For TVR**680-Q, $V_{jump} = 65$ Vdc Duration Time: 5 minutes | $\Delta V/V_{1mA}$ $\leq 15\%$ No visible damage |

Metal Oxide Varistor : TVR-Q Series



Disc Type Varistor for Automotive Applications

■ Packaging

● Taping Specification S Type (Straight lead)

Figure A

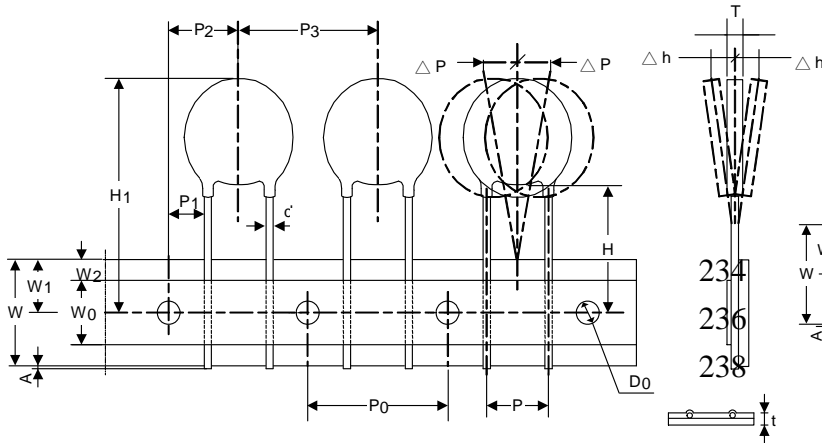


Figure C

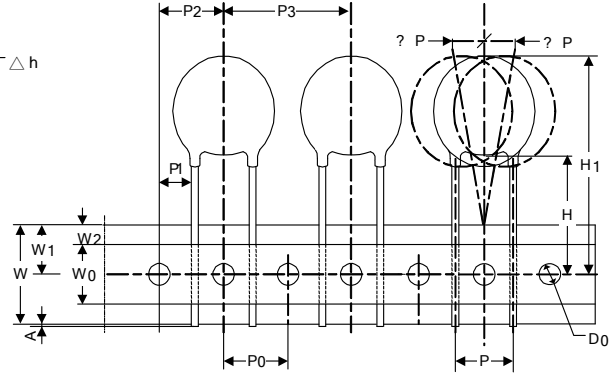


Figure B

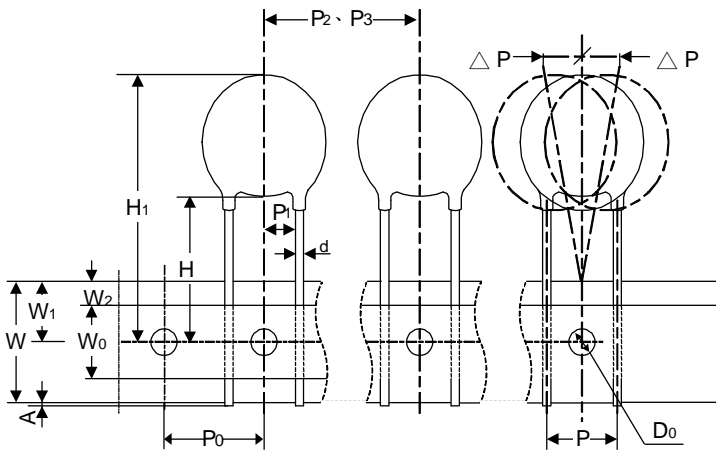
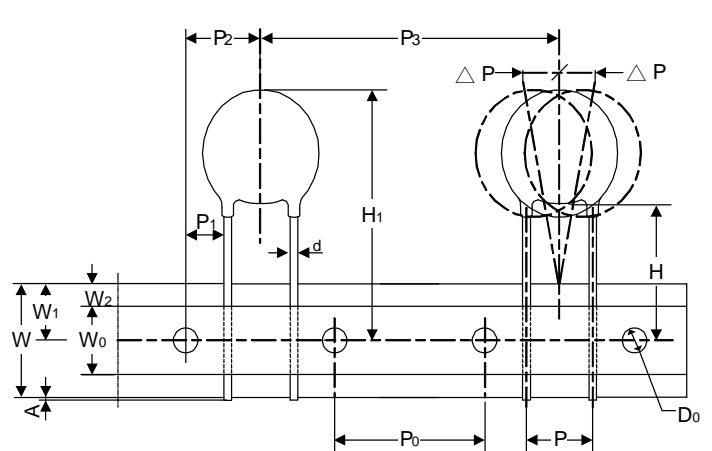


Figure D



(Unit: mm)

| Taping Code | Body Size | P ₀ ±0.3 | P ±1 | P ₁ ±1 | P ₂ ±1.3 | P ₃ ±1 | H +2/-0 | H ₁ Max. | d ±0.02 | W ₀ ±1 | W ₁ +0.75/-0.5 | W ₂ Max. | W ±1 | ΔP Max. | Δh Max. | A Max. | D ₀ ±0.2 | t ±0.2 | Figure |
|-----------------------------|-----------|------------------------|---------|----------------------|------------------------|----------------------|------------|------------------------|------------|----------------------|------------------------------|------------------------|---------|------------|------------|-----------|------------------------|-----------|--------|
| A (P ₀ =12.7) | 07 | 12.7 | 5 | 3.55 | 6.35 | 12.7 | 18 | 30 | 0.6 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | A |
| | 10 | 12.7 | 7.5 | 3.35 | 12.7 | 12.7 | 18 | 33.5 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | B |
| | 14 | 12.7 | 7.5 | 8.55 | 12.7 | 25.4 | 18 | 38 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | C |
| | 20 | 12.7 | 7.5 | 8.55 | 12.7 | 25.4 | 18 | 40.5 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | B |
| | 20 | 12.7 | 10 | 7.20 | 12.7 | 38.1 | 18 | 40.5 | 1.0 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | B |
| E (P ₀ =15.0) | 07 | 15 | 5 | 4.7 | 7.5 | 15 | 18 | 30 | 0.6 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | A |
| | 10 | 15 | 7.5 | 3.35 | 7.5 | 15 | 18 | 33.5 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | A |
| | 14 | 15 | 7.5 | 3.35 | 7.5 | 30 | 18 | 38 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | D |
| | 20 | 15 | 7.5 | 3.35 | 7.5 | 30 | 18 | 40.5 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | D |

Metal Oxide Varistor : TVR-Q Series

Disc Type Varistor for Automotive Applications



F Type (Y kink lead)

Figure A

Figure C

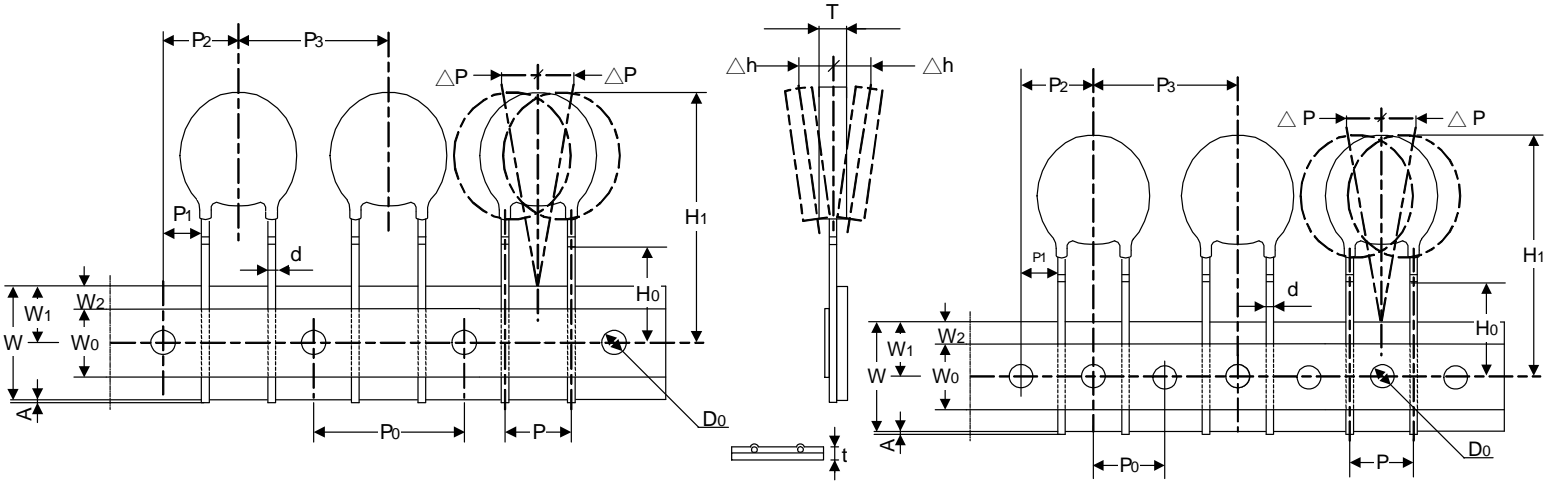
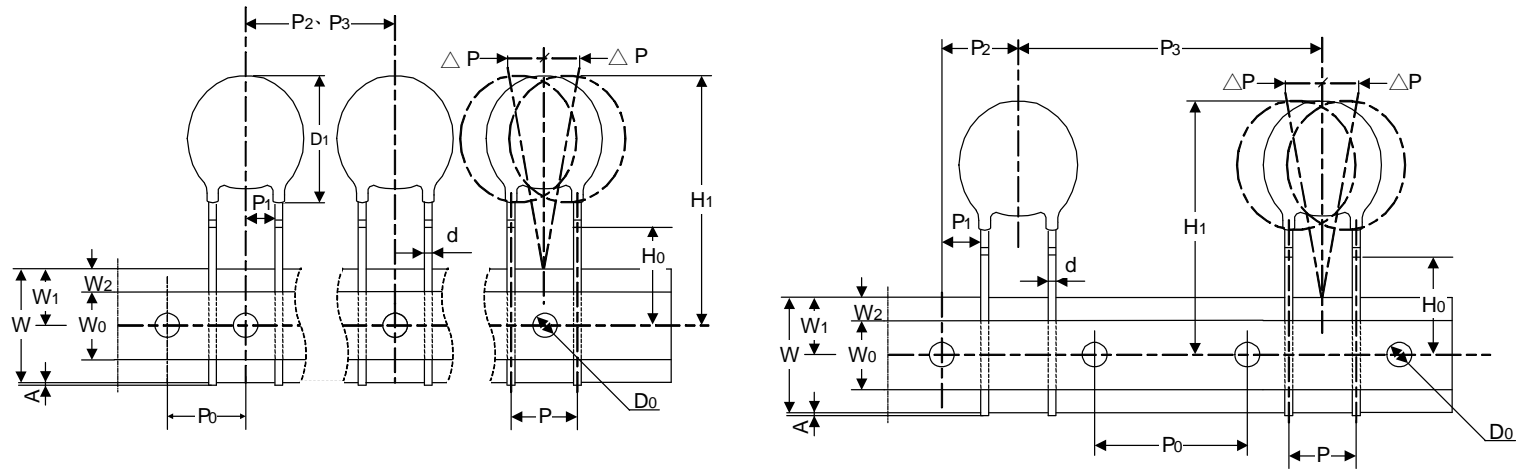


Figure B

Figure D



(Unit: mm)

| Taping Code | Body Size | P ₀ | P | P ₁ | P ₂ | P ₃ | H ₀ | H ₁ | d | W ₀ | W ₁ | W ₂ | W | ΔP | Δh | A | D ₀ | t | Figure |
|-----------------------------|-----------|----------------|-----|----------------|----------------|----------------|----------------|----------------|-------|----------------|----------------|----------------|----|------|------|------|----------------|------|--------|
| | | ±0.3 | ±1 | ±1 | ±1.3 | ±1 | ±0.5 | Max. | ±0.02 | ±1 | +0.75/ -0.5 | Max. | ±1 | Max. | Max. | Max. | ±0.2 | ±0.2 | |
| A (P ₀ =12.7) | 07 | 12.7 | 5 | 3.55 | 6.35 | 12.7 | 16 | 30 | 0.6 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | A |
| | 10 | 12.7 | 7.5 | 3.35 | 12.7 | 12.7 | 16 | 33.5 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | B |
| | 14 | 12.7 | 7.5 | 8.55 | 12.7 | 25.4 | 16 | 38 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | C |
| | 20 | 12.7 | 7.5 | 8.55 | 12.7 | 25.4 | 16 | 44.5 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | B |
| | 20 | 12.7 | 10 | 7.20 | 12.7 | 38.1 | 16 | 44.5 | 1.0 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | B |
| E (P ₀ =15.0) | 07 | 15 | 5 | 4.7 | 7.5 | 15 | 16 | 30 | 0.6 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | A |
| | 10 | 15 | 7.5 | 3.35 | 7.5 | 15 | 16 | 33.5 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | A |
| | 14 | 15 | 7.5 | 3.35 | 7.5 | 30 | 16 | 38 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | D |
| | 20 | 15 | 7.5 | 3.35 | 7.5 | 30 | 16 | 44.5 | 0.8 | 12 | 9 | 3 | 18 | 1 | 2 | 0.5 | 4 | 0.6 | D |

Metal Oxide Varistor : TVR-Q Series



Disc Type Varistor for Automotive Applications

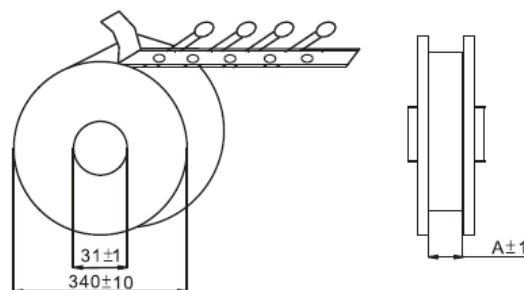
Quantity

Bulk Packing

| Body Size | Straight Lead Type Quantity (pcs/ bag) | Cut Lead Type Quantity (pcs/ bag) | Kink Type Quantity (pcs/ box) |
|-----------|---|--------------------------------------|----------------------------------|
| TVR07 | 250 | 250 | 200 |
| TVR10 | 200 | 200 | 200 |
| TVR14 | 100 | 100 | 100 |
| TVR20 | 50 | 50 | 50 |

Reel Packing

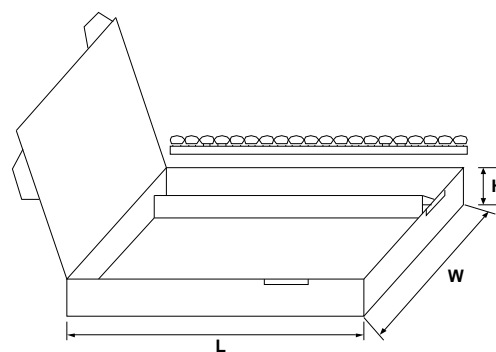
| Body Size | W (mm) | Quantity (pcs/reel) |
|-----------|-----------|------------------------|
| TVR07 | 46 | 1,500 |
| TVR10 | | 1,000 |
| TVR14 | | 1,000 |
| TVR20 | 55 | 500 |



(Unit: mm)

Ammo Packing

| Body Size/mm | Quantity (pcs/ box) |
|--------------|------------------------|
| TVR07 | 1,000 |
| TVR10 | 750 |
| TVR14 | 500 |
| TVR20 | 500 |



(Unit: mm)

| Body Size | L±5 | W±5 | H±5 |
|------------|-----|-----|-----|
| Φ 07~ Φ 20 | 348 | 185 | 60 |
| | 348 | 275 | 60 |
| | 300 | 270 | 62 |

Storage Conditions of Products

- Storage Conditions :
 1. Storage Temperature : -10°C ~ +40°C
 2. Relative Humidity : ≤ 75%RH
 3. Keep away from corrosive atmosphere and sunlight.
- Period of Storage: 1 year.