# SMD Transient Voltage Suppressors

## Part Number Designation

| VCR | 1206 | ML | 240 | C |
|---|---|---|---|---|
| Comment Code<br>VCR<br>Metal Oxide Varistor<br>Surge Absorber | **Areas of Element**<br>0402 = 1.0±0.1,0.5±0.1(mm)<br>0603 = 1.6±0.15,0.8±0.1(mm)<br>0805= 2.0±0.2,1.25±0.15(mm)<br>1206 = 3.2±0.2,1.6±0.15(mm)<br>1210 = 3.2±0.2,2.5±0.2(mm)<br>1812 = 4.5±0.2,3.2±0.2(mm)<br>2220 = 5.7±0.2,5.0±0.2(mm)<br>3220 = 8.0±0.3,5.0±0.3(mm) | **Application Code**<br>**ML**=Mulitilayer<br>**SL**=Single Layer | **Varistor Voltage**<br>Example<br>**330**<br>$33x10^0$=33V<br>**471**<br>$47x10^1$=470V | **Series Code**<br>**A** Series= 8.0$V_{RMS}$(11.0$V_{DC}$) to 35.0$V_{RMS}$(45.0$V_{DC}$) High surge absorption, low clamping voltage<br>**C** Series= 2.5$V_{RMS}$(3.3$V_{DC}$) to 95.0$V_{RMS}$(127.0$V_{DC}$) Wide range application<br>**K** Series= 11$V_{RMS}$(14$V_{DC}$) to 300$V_{RMS}$(385$V_{DC}$) Single Layer |

## ● A Series High surge absorption

| Model Number | Working Voltage (MAX) | | Breakdown Voltage | Peak Current | Clamping Voltage (MAX) | | Energy Absorption | Typical Capacitance ※ |
|---|---|---|---|---|---|---|---|---|
| Unit / Condition | AC ($V_{RMS}$) | DC (V) | 1mA (V) | 8/20μs (A) | (A) | (V) | 10/1000 (J) | 1KHz (pF) |
| 1206ML150A | 8.0 | 11.0 | 15(12.75~17.25) | 200 | 1 | 25 | 0.4 | 1700 |
| 1206ML180A | 11.0 | 14.0 | 18(15.3~20.7) | 200 | 1 | 30 | 0.5 | 1500 |
| 1206ML220A | 12.0 | 16.5 | 22(19.8~24.2) | 200 | 1 | 36 | 0.5 | 1280 |
| 1206ML240A | 14.0 | 18.0 | 24(21.6~27) | 200 | 1 | 39 | 0.5 | 1160 |
| 1206ML270A | 17.0 | 22.0 | 27(24.3~29.8) | 200 | 1 | 44 | 0.6 | 1080 |
| 1206ML330A | 20.0 | 26.0 | 33(29.7~36.3) | 200 | 1 | 54 | 0.7 | 680 |
| 1206ML390A | 25.0 | 30.0 | 39(35.1~42.9) | 200 | 1 | 65 | 1.0 | 620 |
| 1206ML470A | 30.0 | 38.0 | 47(42.3~51.7) | 200 | 1 | 77 | 1.1 | 550 |
| 1206ML560A | 35.0 | 45.0 | 56(50.4~61.6) | 200 | 1 | 90 | 0.8 | 400 |
| 1210ML150A | 8.0 | 11.0 | 15(12.75~17.25) | 400 | 2.5 | 25 | 1.0 | 4050 |
| 1210ML180A | 11.0 | 14.0 | 18(15.3~20.7) | 400 | 2.5 | 30 | 1.2 | 3860 |
| 1210ML220A | 12.0 | 16.5 | 22(19.8~24.3) | 400 | 2.5 | 36 | 1.4 | 2600 |
| 1210ML240A | 14.0 | 18.0 | 24(21.6~27) | 400 | 2.5 | 39 | 1.4 | 2380 |
| 1210ML270A | 17.0 | 22.0 | 27(24.3~29.8) | 400 | 2.5 | 44 | 1.7 | 2100 |
| 1210ML330A | 20.0 | 26.0 | 33(29.7~36.3) | 400 | 2.5 | 54 | 1.9 | 1400 |
| 1210ML390A | 25.0 | 30.0 | 39(35.1~42.9) | 400 | 2.5 | 65 | 1.7 | 1180 |
| 1210ML470A | 30.0 | 38.0 | 47(42.3~51.7) | 400 | 2.5 | 77 | 2.0 | 1000 |
| 1210ML560A | 35.0 | 45.0 | 56(50.4~61.6) | 400 | 2.5 | 90 | 2.0 | 660 |
| 1812ML150A | 8.0 | 11.0 | 15(12.75~17.25) | 800 | 5 | 25 | 1.8 | 8450 |
| 1812ML180A | 11.0 | 14.0 | 18(15.3~20.7) | 800 | 5 | 30 | 1.9 | 7030 |
| 1812ML220A | 12.0 | 16.5 | 22(19.8~24.3) | 800 | 5 | 36 | 2.3 | 5080 |
| 1812ML240A | 14.0 | 18.0 | 24(21.6~27) | 800 | 5 | 39 | 2.3 | 4650 |
| 1812ML270A | 17.0 | 22.0 | 27(24.3~29.8) | 800 | 5 | 44 | 2.7 | 4150 |
| 1812ML330A | 20.0 | 26.0 | 33(29.7~36.3) | 800 | 5 | 54 | 3.0 | 3400 |
| 1812ML390A | 25.0 | 30.0 | 39(35.1~42.9) | 800 | 5 | 65 | 3.7 | 2950 |
| 1812ML470A | 30.0 | 38.0 | 47(42.3~51.7) | 800 | 5 | 77 | 4.2 | 2550 |
| 1812ML560A | 35.0 | 45.0 | 56(50.4~61.6) | 800 | 5 | 90 | 4.2 | 2400 |

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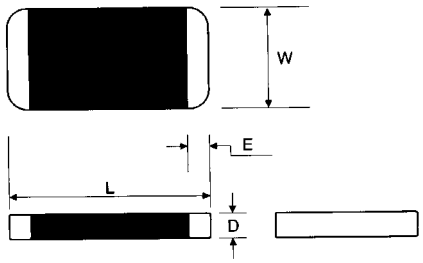
# METAL OXIDE VARISTORS

## Transient voltage surge suppressors

## ● A Series High surge absorption

| Model Number | Working Voltage (MAX) | | Breakdown Voltage | Peak Current | Clamping Voltage (MAX) | | Energy Absorption | Typical Capacitance ※ |
|---|---|---|---|---|---|---|---|---|
| Unit Condition | AC ($V_{RMS}$) | DC (V) | 1mA (V) | 8/20μs (A) | (A) | (V) | 10/1000 (J) | 1KHz (pF) |
| 2220ML150A | 8.0 | 11.0 | 15(12.75~17.25) | 1200 | 10 | 25 | 4.2 | 21200 |
| 2220ML180A | 11.0 | 14.0 | 18(15.3~20.7) | 1200 | 10 | 30 | 5.4 | 17700 |
| 2220ML220A | 12.0 | 16.5 | 22(19.8~24.2) | 1200 | 10 | 36 | 5.8 | 14500 |
| 2220ML240A | 14.0 | 18.0 | 24(21.6~27) | 1200 | 10 | 39 | 5.8 | 13600 |
| 2220ML270A | 17.0 | 22.0 | 27(24.3~29.8) | 1200 | 10 | 44 | 7.2 | 12000 |
| 2220ML330A | 20.0 | 26.0 | 33(29.7~36.3) | 1200 | 10 | 54 | 7.8 | 10500 |
| 2220ML390A | 25.0 | 30.0 | 39(35.1~42.9) | 1200 | 10 | 65 | 9.6 | 8900 |
| 2220ML470A | 30.0 | 38.0 | 47(42.3~51.7) | 1200 | 10 | 77 | 12.0 | 5700 |
| 2220ML560A | 35.0 | 45.0 | 56(50.4~61.6) | 1200 | 10 | 90 | 7.7 | 4800 |




| Type | L mm | W mm | D mm | E mm |
|---|---|---|---|---|
| 1206ML | 3.2±0.20 | 1.6±0.15 | 1.5max. | 0.5+0.2/-0.2 |
| 1210ML | 3.2±0.20 | 2.5±0.20 | 1.5max. | 0.5+0.2/-0.2 |
| 1812ML | 4.5±0.20 | 3.2±0.20 | 2.0max. | 0.5+0.3/-0.1 |
| 2220ML | 5.7±0.20 | 5.0±0.20 | 2.5max. | 0.5+0.3/-0.1 |

**NOTE:**

1. **Tolerance of breakdown Voltage: 15~18V=±15%,22~56V=±10%**
2. **Tolerance of capacitance Voltage: ±20%**
3. **Typical leakage at 25$^0$C<50** μA, maximum leakage 100 μA
4. In order to satisfy the applications of customer in various fields ,the capacitance range

※ can be designed during manufacturing according to the request , please contact our ales department if needed.

## ● C Series Wide range Application

| Model Number | Working Voltage (MAX) | | Breakdown Voltage | Peak Current | Clamping Voltage (MAX) | | Energy Absorption | Typical Capacitance ※ |
|---|---|---|---|---|---|---|---|---|
| Unit Condition | AC ($V_{RMS}$) | DC (V) | 1mA (V) | 8/20μs (A) | (A) | (V) | 10/1000 (J) | 1KHz (pF) |
| 0402ML050C | 2.5 | 3.3 | 5(4.0~6.0) | 20 | 1 | 10 | 0.05 | 390 |
| 0402ML080C | 4 | 5.5 | 8(6.4~9.0) | 20 | 1 | 16 | 0.05 | 295 |
| 0402ML120C | 6 | 9 | 12(9.6~14.4) | 20 | 1 | 20 | 0.05 | 190 |
| 0402ML150C | 8 | 11 | 15(12.75~17.25) | 20 | 1 | 25 | 0.05 | 160 |
| 0402ML180C | 11 | 14 | 18(15.3~20.7) | 20 | 1 | 30 | 0.05 | 135 |
| 0402ML220C | 12 | 16.5 | 22(19.8~24.2) | 20 | 1 | 36 | 0.05 | 105 |
| 0402ML240C | 14 | 18 | 24(21.6~27) | 20 | 1 | 40 | 0.05 | 93 |
| 0402ML270C | 17 | 22 | 27(24.3~29.8) | 20 | 1 | 45 | 0.05 | 75 |
| 0402ML330C | 20 | 26 | 33(29.7~36.3) | 20 | 1 | 54 | 0.05 | 54 |
| 0402ML390C | 25 | 30 | 39(35.1~42.9) | 20 | 1 | 65 | 0.05 | 45 |
| 0402ML470C | 30 | 38 | 47(42.3~51.7) | 20 | 1 | 77 | 0.05 | 27 |
| 0603ML050C | 2.5 | 3.3 | 5(4.0~6.0) | 30 | 1 | 10 | 0.1 | 1250 |
| 0603ML080C | 4 | 5.5 | 8(6.4~9.0) | 30 | 1 | 16 | 0.1 | 800 |
| 0603ML120C | 6 | 9 | 12(9.6~14.4) | 30 | 1 | 20 | 0.1 | 680 |
| 0603ML150C | 8 | 11 | 15(12.75~17.25) | 30 | 1 | 25 | 0.1 | 460 |
| 0603ML180C | 11 | 14 | 18(15.3~20.7) | 30 | 1 | 30 | 0.1 | 350 |
| 0603ML220C | 12 | 16.5 | 22(19.8~24.2) | 30 | 1 | 36 | 0.1 | 300 |
| 0603ML240C | 14 | 18 | 24(21.6~27) | 30 | 1 | 40 | 0.1 | 270 |
| 0603ML270C | 17 | 22 | 27(24.3~29.8) | 30 | 1 | 45 | 0.1 | 235 |
| 0603ML330C | 20 | 26 | 33(29.7~36.3) | 30 | 1 | 54 | 0.1 | 200 |
| 0603ML390C | 25 | 30 | 39(35.1~42.9) | 30 | 1 | 65 | 0.1 | 120 |
| 0603ML470C | 30 | 38 | 47(42.3~51.7) | 30 | 1 | 77 | 0.1 | 100 |
| 0603ML560C | 35 | 45 | 56(50.4~61.6) | 30 | 1 | 90 | 0.1 | 80 |

TO BE CONTINUED

## ● C Series Wide range Application

| Model Number | Working Voltage (MAX) | | Breakdown Voltage | Peak Current | Clamping Voltage (MAX) | | Energy Absorption | Typical Capacitance ※ |
|---|---|---|---|---|---|---|---|---|
| Unit Condition | AC ($V_{RMS}$) | DC (V) | 1mA (V) | 8/20μs (A) | (A) | (V) | 10/1000 (J) | 1KHz (pF) |
| 0805ML050C | 2.5 | 3.3 | 5(4.0~6.0) | 40 | 1 | 10 | 0.1 | 2450 |
| 0805ML080C | 4 | 5.5 | 8(6.4~9.0) | 80 | 1 | 16 | 0.1 | 1600 |
| 0805ML120C | 6 | 9 | 12(9.6~14.4) | 80 | 1 | 20 | 0.1 | 1180 |
| 0805ML150C | 8 | 11 | 15(12.75~17.25) | 100 | 1 | 25 | 0.1 | 1050 |
| 0805ML180C | 11 | 14 | 18(15.3~20.7) | 100 | 1 | 30 | 0.1 | 750 |
| 0805ML220C | 12 | 16.5 | 22(19.8~24.2) | 100 | 1 | 36 | 0.2 | 680 |
| 0805ML240C | 14 | 18 | 24(21.6~27) | 100 | 1 | 39 | 0.2 | 550 |
| 0805ML270C | 17 | 22 | 27(24.3~29.8) | 100 | 1 | 44 | 0.2 | 400 |
| 0805ML330C | 20 | 26 | 33(29.7~36.3) | 100 | 1 | 54 | 0.3 | 350 |
| 0805ML390C | 25 | 30 | 39(35.1~42.9) | 100 | 1 | 65 | 0.3 | 310 |
| 0805ML470C | 30 | 38 | 47(42.3~51.7) | 100 | 1 | 77 | 0.3 | 280 |
| 0805ML560C | 35 | 45 | 56(50.4~61.6) | 80 | 1 | 90 | 0.3 | 195 |
| 0805ML680C | 40 | 56 | 68(61.2~74.8) | 80 | 1 | 110 | 0.3 | 145 |
| 0805ML820C | 50 | 65 | 82(73.8~90.2) | 60 | 1 | 135 | 0.3 | 85 |
| 1206ML050C | 2.5 | 3.3 | 5(4.0~6.0) | 60 | 1 | 10 | 0.1 | 3850 |
| 1206ML080C | 4 | 5.5 | 8(6.4~9.0) | 100 | 1 | 16 | 0.2 | 3200 |
| 1206ML120C | 6 | 9 | 12(9.6~14.4) | 100 | 1 | 20 | 0.2 | 2200 |
| 1206ML150C | 8 | 11 | 15(12.75~17.25) | 100 | 1 | 25 | 0.2 | 1300 |
| 1206ML180C | 11 | 14 | 18(15.3~20.7) | 100 | 1 | 30 | 0.3 | 1150 |
| 1206ML220C | 12 | 16.5 | 22(19.8~24.2) | 100 | 1 | 36 | 0.3 | 1000 |
| 1206ML240C | 14 | 18 | 24(21.6~27) | 100 | 1 | 38 | 0.3 | 900 |
| 1206ML270C | 17 | 22 | 27(24.3~29.8) | 100 | 1 | 44 | 0.4 | 840 |
| 1206ML330C | 20 | 26 | 33(29.7~36.3) | 100 | 1 | 54 | 0.5 | 490 |
| 1206ML390C | 25 | 30 | 39(35.1~42.9) | 100 | 1 | 65 | 0.6 | 440 |
| 1206ML470C | 30 | 38 | 47(42.3~51.7) | 100 | 1 | 77 | 0.7 | 400 |
| 1206ML560C | 35 | 45 | 56(50.4~61.6) | 100 | 1 | 90 | 0.8 | 310 |
| 1206ML680C | 40 | 56 | 68(61.2~74.8) | 100 | 1 | 110 | 1.0 | 280 |
| 1206ML820C | 50 | 65 | 82(73.8~90.2) | 100 | 1 | 135 | 0.5 | 240 |
| 1206ML101C | 60 | 85 | 100(90~110) | 100 | 1 | 165 | 0.6 | 160 |
| 1206ML111C | 70 | 90 | 110(99~121) | 100 | 1 | 180 | 0.6 | 120 |

TO BE CONTINUED

## ● C Series Wide range Application

| Model Number | Working Voltage (MAX) | | Breakdown Voltage | Peak Current | Clamping Voltage (MAX) | | Energy Absorption | Typical Capacitance ※ |
|---|---|---|---|---|---|---|---|---|
| Unit Condition | AC ($V_{RMS}$) | DC (V) | 1mA (V) | 8/20μs (A) | (A) | (V) | 10/1000 (J) | 1KHz (pF) |
| 1210ML080C | 4 | 5.5 | 8(6.4~9.0) | 250 | 2.5 | 16 | 0.4 | 6200 |
| 1210ML120C | 6 | 9 | 12(9.6~14.4) | 250 | 2.5 | 20 | 0.5 | 4400 |
| 1210ML150C | 8 | 11 | 15(12.75~17.25) | 250 | 2.5 | 25 | 0.6 | 3520 |
| 1210ML180C | 11 | 14 | 18(15.3~20.7) | 250 | 2.5 | 30 | 0.7 | 3260 |
| 1210ML220C | 12 | 16.5 | 22(19.8~24.2) | 250 | 2.5 | 36 | 0.8 | 2100 |
| 1210ML240C | 14 | 18 | 24(21.6~27) | 250 | 2.5 | 39 | 0.8 | 1950 |
| 1210ML270C | 17 | 22 | 27(24.3~29.8) | 250 | 2.5 | 44 | 1.0 | 1720 |
| 1210ML330C | 20 | 26 | 33(29.7~36.3) | 250 | 2.5 | 54 | 1.2 | 1090 |
| 1210ML390C | 25 | 30 | 39(35.1~42.9) | 250 | 2.5 | 65 | 1.4 | 920 |
| 1210ML470C | 30 | 38 | 47(42.3~51.7) | 250 | 2.5 | 77 | 1.6 | 780 |
| 1210ML560C | 35 | 45 | 56(50.4~61.6) | 250 | 2.5 | 90 | 2.0 | 470 |
| 1210ML680C | 40 | 56 | 68(61.2~74.8) | 250 | 2.5 | 110 | 2.3 | 390 |
| 1210ML820C | 50 | 65 | 82(73.8~90.2) | 250 | 2.5 | 135 | 1.2 | 320 |
| 1210ML101C | 60 | 85 | 100(90~110) | 250 | 2.5 | 165 | 1.4 | 220 |
| 1210ML111C | 70 | 90 | 110(99~121) | 250 | 2.5 | 180 | 1.4 | 200 |
| 1812ML120C | 6 | 9 | 8(6.4~9.0) | 500 | 5 | 20 | 0.9 | 9150 |
| 1812ML150C | 8 | 11 | 12(9.6~14.4) | 500 | 5 | 25 | 1.2 | 7320 |
| 1812ML180C | 11 | 14 | 15(12.75~17.25) | 500 | 5 | 30 | 1.4 | 6100 |
| 1812ML220C | 12 | 16.5 | 18(15.3~20.7) | 500 | 5 | 36 | 1.6 | 4300 |
| 1812ML240C | 14 | 18 | 22(19.8~24.2) | 500 | 5 | 39 | 1.7 | 3930 |
| 1812ML270C | 17 | 22 | 24(21.6~27) | 500 | 5 | 44 | 2.0 | 3500 |
| 1812ML330C | 20 | 26 | 27(24.3~29.8) | 500 | 5 | 54 | 2.5 | 2900 |
| 1812ML390C | 25 | 30 | 33(29.7~36.3) | 500 | 5 | 65 | 2.9 | 2500 |
| 1812ML470C | 30 | 38 | 39(35.1~42.9) | 500 | 5 | 77 | 3.5 | 2200 |
| 1812ML560C | 35 | 45 | 47(42.3~51.7) | 500 | 5 | 90 | 4.2 | 1950 |
| 1812ML680C | 40 | 56 | 56(50.4~61.6) | 500 | 5 | 110 | 4.8 | 1650 |
| 1812ML820C | 50 | 65 | 68(61.2~74.8) | 400 | 5 | 135 | 4.5 | 1060 |
| 1812ML101C | 60 | 85 | 82(73.8~90.2) | 400 | 5 | 165 | 5.8 | 870 |
| 1812ML111C | 70 | 90 | 100(90~110) | 400 | 5 | 180 | 5.8 | 790 |
| 1812ML151C | 95 | 127 | 110(99~121) | 300 | 5 | 248 | 5.8 | 420 |

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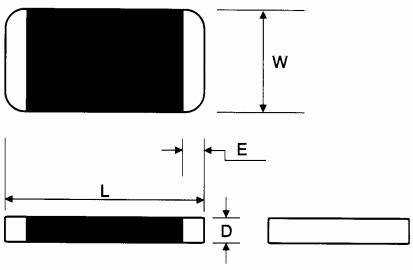
## Transient voltage surge suppressors

## ● C Series Wide range Application

| Model Number | Working Voltage (MAX) | | Breakdown Voltage | Peak Current | Clamping Voltage (MAX) | | Energy Absorption | Typical Capacitance ※ |
|---|---|---|---|---|---|---|---|---|
| Unit Condition | AC ($V_{RMS}$) | DC (V) | 1mA (V) | 8/20μs (A) | (A) | (V) | 10/1000 (J) | 1KHz (pF) |
| 2220ML120C | 6 | 9 | 12(9.6~14.4) | 1000 | 10 | 20 | 1.9 | 36500 |
| 2220ML150C | 8 | 11 | 15(12.75~17.25) | 1000 | 10 | 25 | 2.3 | 18400 |
| 2220ML180C | 11 | 14 | 18(15.3~20.7) | 1000 | 10 | 30 | 2.7 | 15300 |
| 2220ML220C | 12 | 16.5 | 22(19.8~24.2) | 1000 | 10 | 36 | 2.9 | 12500 |
| 2220ML240C | 14 | 18 | 24(21.6~27) | 1000 | 10 | 38 | 3.1 | 11800 |
| 2220ML270C | 17 | 22 | 27(24.3~29.8) | 1000 | 10 | 44 | 3.8 | 10400 |
| 2220ML330C | 20 | 26 | 33(29.7~36.3) | 1000 | 10 | 54 | 4.3 | 8900 |
| 2220ML390C | 25 | 30 | 39(35.1~42.9) | 1000 | 10 | 65 | 5.5 | 7500 |
| 2220ML470C | 30 | 38 | 47(42.3~51.7) | 1000 | 10 | 77 | 6.3 | 4600 |
| 2220ML560C | 35 | 45 | 56(50.4~61.6) | 1000 | 10 | 90 | 7.7 | 4000 |
| 2220ML680C | 40 | 56 | 68(61.2~74.8) | 1000 | 10 | 110 | 8.8 | 3500 |
| 2220ML820C | 50 | 65 | 82(73.8~90.2) | 800 | 10 | 135 | 5.6 | 2850 |
| 2220ML101C | 60 | 85 | 100(90~110) | 800 | 10 | 165 | 6.8 | 1800 |
| 2220ML111C | 70 | 90 | 110(99~121) | 800 | 10 | 180 | 6.8 | 1500 |




| Type | L mm | W mm | D Mm | E Mm |
|---|---|---|---|---|
| 0402 | 1.0±0.10 | 0.5±0.10 | 0.6max. | 0.25+0.1/-0.1 |
| 0603 | 1.6±0.15 | 0.8±0.10 | 0.9max. | 0.3+0.1/-0.1 |
| 0805 | 2.0±0.20 | 1.25±0.15 | 1.2max. | 0.3+0.1/-0.1 |
| 1206 | 3.2±0.20 | 1.6±0.15 | 1.5max. | 0.5+0.2/-0.2 |
| 1210 | 3.2±0.20 | 2.5±0.20 | 1.5max | 0.5+0.2/-0.2 |
| 1812 | 4.5±0.20 | 3.2±0.20 | 2.0max. | 0.5+0.3/-0.1 |
| 2220 | 5.7±0.20 | 5.0±0.20 | 2.5max. | 0.5+0.3/-0.1 |

**NOTE:**

1. **Tolerance of breakdown Voltage: 15~18V=±15%,22~56V=±10%**
2. **Tolerance of capacitance Voltage: ±20%**
3. **Typical leakage at 25$^0$C<50** μA, maximum leakage 100 μA
4. In order to satisfy the applications of customer in various fields ,the capacitance range

※ Can be designed during manufacturing according to the request , please contact our ales department if needed.

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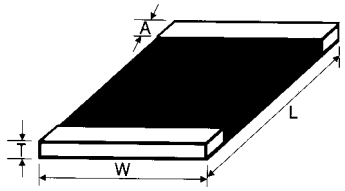
# METAL OXIDE VARISTORS

## Transient voltage surge suppressors

## ● K Series

| MODEL NUMBER | MAXIMUM RATING(TA=125$^0$C) | | | | CHARACTERESTICS(TA=25$^0$C) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Model Number** | MAX. ALLOWABLE VOLTAGE | | SURGE CURRENT | ENERGY ABSORPTION (10/1000 μ S) | MAX. CLAMPING VOLTAGE | | VARISTOR VOLTAGE | TYPICAL CPACITANCE | Thickness T±1 |
| Unit Condition | AC ($V_{RMS}$) | DC (V) | 8/20μs (A) | (J) | (A) | (V) | (V) | PF(MHz) | (mm) |
| 3220SL 180K | 11 | 14 | 250 | 0.8 | 5 | 40 | 18(16~20) | 3300 | 1.5 |
| 3220SL 220K | 14 | 18 | 250 | 1.0 | 5 | 46 | 22(20~34) | 1750 | 1.5 |
| 3220SL 270K | 14 | 22 | 250 | 1.0 | 5 | 56 | 27(24~30) | 1500 | 1.5 |
| 3220SL 330K | 20 | 16 | 250 | 1.2 | 5 | 67 | 33(30~36) | 1200 | 1.5 |
| 3220SL 390K | 25 | 31 | 250 | 1.5 | 5 | 76 | 39(35~43) | 820 | 1.5 |
| 3220SL 470K | 30 | 38 | 250 | 1.8 | 5 | 90 | 47(42~30) | 660 | 1.5 |
| 3220SL 560K | 35 | 45 | 250 | 2.3 | 5 | 106 | 56(50~62) | 530 | 2.0 |
| 3220SL 680K | 40 | 56 | 250 | 3.0 | 5 | 124 | 68(62~74) | 360 | 2.0 |
| 3220SL 820K | 50 | 65 | 500 | 4.0 | 10 | 135 | 82(74~90) | 250 | 1.5 |
| 3220SL 101K | 65 | 85 | 500 | 5.0 | 10 | 165 | 100(90~110) | 225 | 1.5 |
| 3220SL 121K | 75 | 102 | 500 | 6.0 | 10 | 198 | 120(108~132) | 200 | 1.5 |
| 3220SL 151K | 95 | 127 | 500 | 8.0 | 10 | 248 | 150(135~165) | 150 | 1.5 |
| 3220SL 181K | 115 | 153 | 500 | 10.0 | 10 | 292 | 180(162~198) | 110 | 1.5 |
| 3220SL 201K | 130 | 175 | 500 | 11.0 | 10 | 340 | 200(180~220) | 100 | 1.5 |
| 3220SL 221K | 140 | 180 | 500 | 12.0 | 10 | 356 | 220(193~242) | 94 | 1.5 |
| 3220SL 241K | 150 | 200 | 500 | 13.0 | 10 | 390 | 240(216~264) | 86 | 1.5 |
| 3220SL 271K | 175 | 225 | 500 | 14.0 | 10 | 450 | 270(243~297) | 76 | 1.5 |
| 3220SL 301K | 190 | 250 | 500 | 15.0 | 10 | 495 | 300(270~330) | 64 | 1.5 |
| 3220SL 331K | 210 | 275 | 500 | 16.0 | 10 | 545 | 330(297~363) | 52 | 1..5 |
| 3220SL 361K | 230 | 300 | 500 | 20.0 | 10 | 593 | 360(324~396) | 45 | 2.0 |
| 3220SL 391K | 250 | 330 | 500 | 21.0 | 10 | 647 | 390(351~429) | 42 | 2.0 |
| 3220SL 431K | 275 | 369 | 500 | 23.0 | 10 | 705 | 430(387~473) | 39 | 2.5 |
| 3220SL 471K | 300 | 385 | 500 | 25.0 | 10 | 775 | 470(423~517) | 35 | 2.5 |




| **Type** | **Length L** | **Width W** | **Electrode A** |
|---|---|---|---|
| 3220SL(mm) | 8.0±0.30 | 0.5±0.30 | 0.8+0.5/-0.1 |
| 3220(inches) | 0.315±0.118 | 0.8±0.118 | 0.0315+0.196/-0.039 |

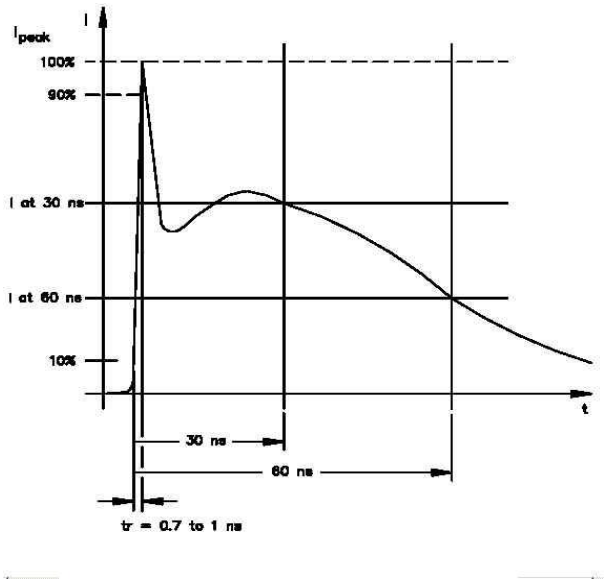
## Temperature and humidity

| | |
|---|---|
| Operating<br>Temperature range | $-55^0C$~$+125^0C$ |
| Storage<br>Temperature range | $-55^0C$~$+150^0C$ |
| Max. relative humidity<br>(Without condensation) | <75%annual average,<br><95%on max. 30 days per annum. |

Overheat of the element:

Due to the unpredictable nature of transients, a transient voltage suppressor may be Overload, although it was carefully selected. Overload may result in package rupture Expulsion of hot material. For this reason the TVS should be physically shielded from Adjacent components. The TVS can be additionally protected by a thermal fuse, which is Connected to the TVS body.

### ESD Wave Form




### IEC61000-4-2 STANDARDS

| SEVERITY LEVEL | AIRDIRCHARGE | DIRECT DISCHARGE |
|---|---|---|
| 1 | 2 KV | 2 KV |
| 2 | 4 KV | 4 KV |
| 3 | 8 KV | 6 KV |
| 4 | 15 KV | 8 KV |

## Environmental Reliability Test

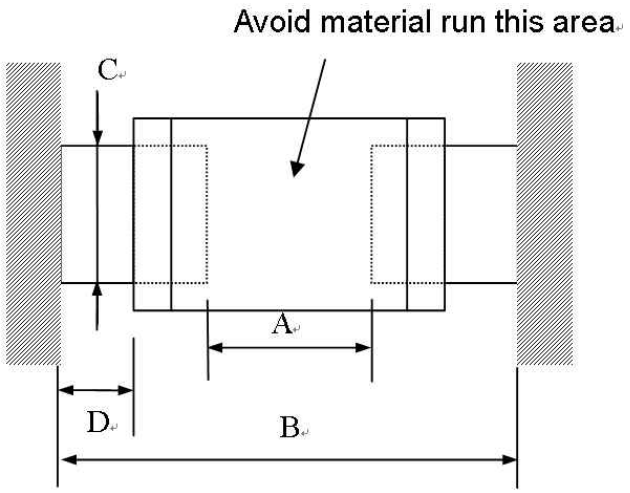
<table>
<tr><th>Characteristic</th><th colspan="4">Test method and description</th></tr>
<tr><td>High Temperature Storage</td><td colspan="4">The specimen shall be subjected to 150 ± 2℃ for 1000 ± 12 hours in a thermostatic bath without load and then stored at room temperature and humidity for 1 to 2 hours. The change of varistor voltage shall be within 10 % .</td></tr>
<tr><td rowspan="5">Temperature Cycle</td><td colspan="2" rowspan="5">The temperature cycle of specified temperature shall be repeated five times and then stored at room temperature and humidity for one or two hours. the change of varistor voltage shall be within 10 % and mechanical damage shall be examined.</td><td>Step</td><td>Temperature</td><td>Period</td></tr>
<tr><td>1</td><td>-40±3℃</td><td>30Min±3</td></tr>
<tr><td>2</td><td>Room Temperature</td><td>1~2 hours</td></tr>
<tr><td>3</td><td>125±2℃</td><td>30Min±3</td></tr>
<tr><td>4</td><td>Room Temperature</td><td>1~2 hours</td></tr>
<tr><td>High Temperature Load</td><td colspan="4">After being continuously applied the maximum allowable voltage at 125 ± 2℃ for 1000± 2 hours, the specimen shall be stored at room temperature and humidity for one or two hours, the change of varistor voltage shall be within 10% .</td></tr>
<tr><td>Damp Heat Load/ Humidity Load</td><td colspan="4">The specimen should be subjected to 40 ± 2℃, 90 to 95 % RH environment, and the maximum allowable voltage applied for 1000 hours, then stored at room temperature and humidity for one or two hours. the change of varistor voltage shall be within 10%</td></tr>
<tr><td>Low Temperature Storage</td><td colspan="4">The specimen should be subjected to 40 ± 2℃, without load for 1000 hours and then stored at room temperature for one or two hours. the change of varistor voltage shall be within 10 %</td></tr>
</table>

## Soldering Recommendations

1 Recommended solder pad layout

（Unit：mm）

| | A | B | C | D |
|---|---|---|---|---|
| 0402 | 0.4~0.6 | 1.6~1.8 | 0.5~0.6 | 0.2~0.4 |
| 0603 | 0.8~1.2 | 2.5~3.0 | 0.6~1.0 | 0.3~0.6 |
| 0805 | 1.0~1.5 | 3.2~3.8 | 1.2~1.4 | 0.3~0.6 |
| 1206 | 1.8~2.5 | 4.2~5.8 | 1.2~1.6 | 0.4~0.8 |
| 1210 | 1.8~2.5 | 4.2~5.8 | 1.8~2.5 | 0.5~1.0 |
| 1812 | 2.5~3.5 | 5.5~6.1 | 2.3~3.2 | 0.6~1.1 |
| 2220 | 3.5~4.6 | 6.0~7.2 | 4.8~5.5 | 1.2~2.3 |

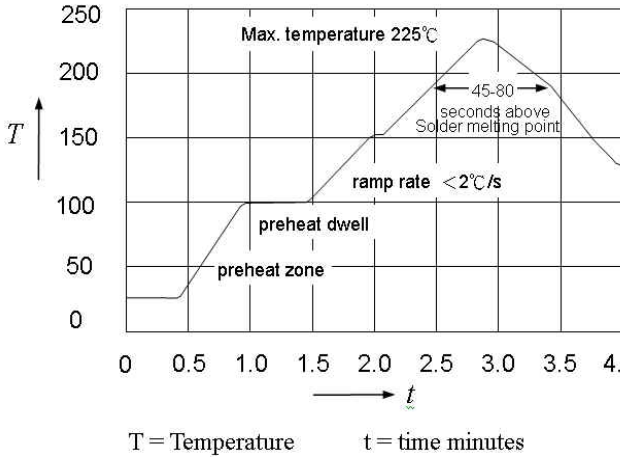



2 The solder paste shall be printed in a thickness of 150 to 200μm.

3 The SIR test of the solder paste shall be done（Based on JIS-Z-3284）

4 IR Orderings

Rapid heating, partial heating or rapid cooling will easily cause defect of the component. So preheating and gradual cooling process is suggested. IR soldering has the highest yields due to controlled heating rates and solder liquid us times. Make sure that the element is not subjected to a thermal gradient steeper than 4 degrees per second. 2 degrees per second is the ideal gradient. During the soldering process, pre-heating to within 100 degrees of the solders peak temperature is essential to minimize thermal shock.




（a）Preheat
1.The temperature rising speed is suggested to be 2~4℃/s.
2.Appropriate preheat time will be from 60 to 120 seconds.

（b）Heating
1.Careful about sudden rise in temperature as it may worsen the solder ability.
2.Set the peak temperature in the range from 215 ℃ to 225℃.

（c）Cooling
1.Careful about slow cooling as it may cause the position shift of component.

※Perform adequate test in advance as the reflow temperature profile will vary according to the conditions of the manufacturing process, and the specification of the reflow furnace

5.5 Hand Soldering

In hand soldering of the Varistors. Large temperature gradient between preheated the Varistors and the tip of soldering iron may cause electrical failures and mechanical damages such as cracklings or breakings of the devices. The soldering shall be carefully controlled and carried out so that the temperature gradient is kept minimum with following recommended conditions for hand soldering.

1 Recommended Soldering Condition 1

（1） Solder ：
1mm Thread solder (sn63:pb37) with soldering flux in the core.
Rosin-based and non-activated flux is recommended.

（2） Preheating
The Varistors shall be preheated so that Temperature Gradient between the devices and the tip of soldering iron is 150C or below.

（3）Soldering Iron
Rated Power of 20w max with 3mm soldering tip in diameter.
Temperature of soldering iron tip 300C max ( The required amount of solder shall be melted in advance on the soldering tip.)

（4）Cooling
After soldering. The Varistors shall be cooled gradually at room ambient temperature.

2 Recommended Soldering Condition 2（Without preheating）

（1）Solder iron tip shall not directly touch to ceramic dielectrics.
（2）Solder iron tip shall be fully preheated before soldering while soldering iron tip to the external electrode of Varistors.

5.6 Post Soldering Cleaning

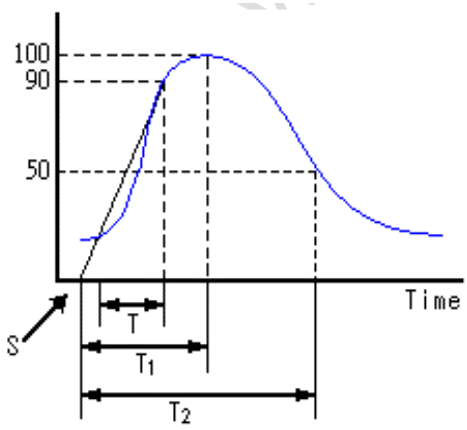
1 Residues of corrosive soldering fluxes on the PC board after cleaning may greatly have influences on the electrical characteristic and the reliability (such as humidity resistance)of the Varistors which have been mounted on the board. It shall be confirmed that the characteristic and the reliability of the devices are not affected by the applied cleaning conditions.

2. When an ultrasonic cleaning is applied to the mounted Varistors on PC Boards. Following conditions are recommended for preventing failures or damages of the devices due to the large vibration energy and the resonance caused by the ultrasonic waves.

（1）Frequency 29MHz max
（2）Radiated Power 20w/lithr max
（3）Period 5minuets max

The definition and test method of Varistor's main characteristics are illustrated below:

| Characteristic | Test Method and Description |
|---|---|
| Standard Test Condition | Environmental condition under which every measuring is done without doubt On the measuring results. Unless specially specified, temperature, relative Humidity are 5 to 35$^0$C, 45 to 85% RH. |
| Max. Working Voltage | Maximum steady-state DC operating voltage the device can maintain and Typical leakage current at 25$^0$C not exceed 50μ A. |
| Varistor Voltage | With the specified measuring current of 1mA DC applied |
| Max. Clamping Voltage※ | Maximum peak voltage across the varistor with a specified impulse current (8/20μ s ) applied. |
| Surge Current※ | Maximum peak current which may be applied with the specified waveform (8/20μ s ) without device failure. |
| Energy Absorption※ | Maximum energy which may be dissipated with a specified waveform (10/100μ s ) without device failure. |
| Typical Capacitance | Device capacitance measured with zero voltage bias 1.5VRMS and 1KHZ |
| DC Leakage Current | Maximum current with rated DC voltage applied. |
| Average Power Dissipation | The power that can be applied in the specified ambient temperature. |
| Response Time | Time lag between application of surge and varistor's "turn-on" conduction |



Peak pulse current test waveform

※S=Virtual Origin of test wave
T=Time from 10% to 90% of the peak
T1=Virtual from time =1.25 X t
T2=Virtual time to half value (Impulse duration)

Example

Current Waveform (Umit: μs)

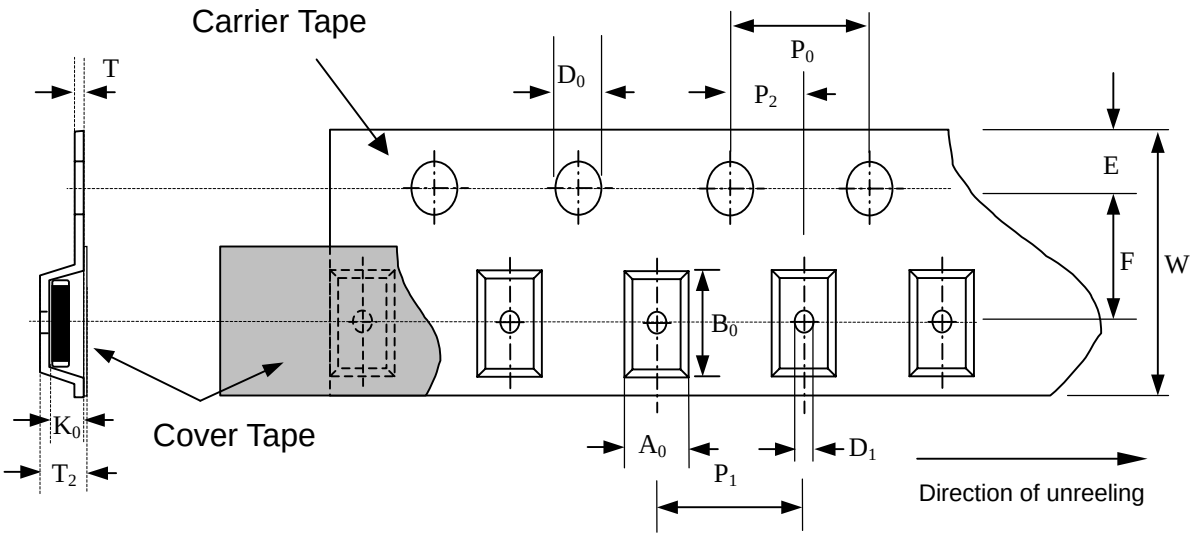
| Type | 8/20μ s | 10/1000μ s |
|---|---|---|
| T1 | 8 | 10 |
| T2 | 20 | 1000 |

## 1. Packaging Specification Series

1.1 Carrier tape and transparent cover tape should be heat-sealed to carry the products, and the reel should be used to reel the carrier tape.

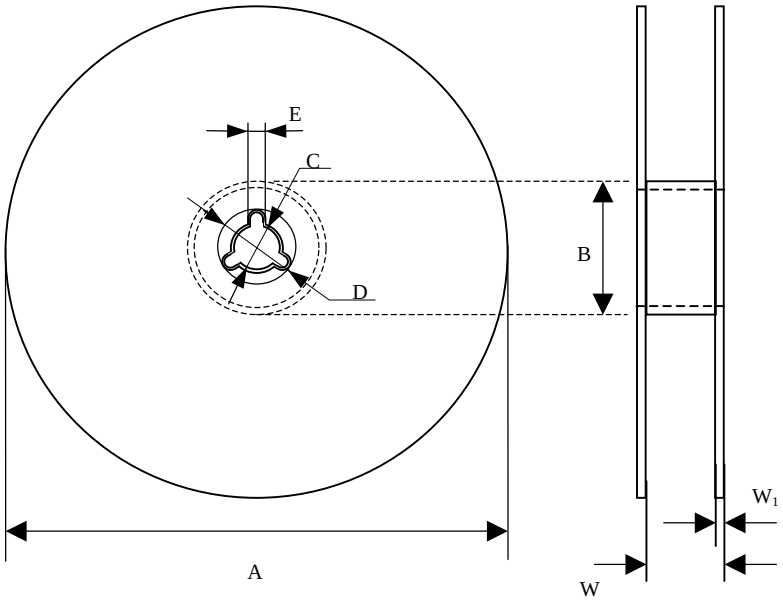
1.2 The adhesion of the heat-sealed cover tape shall be 40 + 20/ – 15grams.

1.3 Both the head and the end portion of the taping shall be empty for reel package and SMT auto-pickup machine. And a normal paper tape shall be connected in the head of taping for the operator to handle.




| Symbol | $A_0$ ±0.10 | $B_0$ ±0.10 | $K_0$ ±0.10 | T ±0.05 | $T_2$ ±0.05 | $D_0$ +0.10 -0.00 | $D_1$ ±0.05 | $P_1$ ±0.10 | $P_2$ ±0.05 | $P_0$ ±0.05 | W ±0.20 | E ±0.10 | F ±0.05 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0402** | 1.08 | 1.88 | 1.04 | 0.22 | 0.10 | 1.50 | 1.00 | 4.00 | 2.00 | 4.00 | 8.00 | 1.75 | 3.50 |
| **0603** | 1.08 | 1.88 | 1.04 | 0.22 | 0.10 | 1.50 | 1.00 | 4.00 | 2.00 | 4.00 | 8.00 | 1.75 | 3.50 |
| **0805** | 1.42 | 2.30 | 1.04 | 0.22 | 0.10 | 1.50 | 1.00 | 4.00 | 2.00 | 4.00 | 8.00 | 1.75 | 3.50 |
| **1206** | 1.88 | 3.50 | 1.27 | 0.2 | 0.10 | 1.50 | 1.00 | 4.00 | 2.00 | 4.00 | 8.00 | 1.75 | 3.50 |
| **1210** | 2.18 | 3.46 | 1.45 | 0.22 | 0.10 | 1.50 | 1.00 | 4.00 | 2.00 | 4.00 | 8.00 | 1.75 | 3.50 |
| **1812** | 3.66 | 4.95 | 1.74 | 0.25 | 0.10 | 1.50 | 1.50 | 8.00 | 2.00 | 4.00 | 12.00 | 1.75 | 5.50 |
| **2220** | 5.10 | 5.97 | 2.80 | 0.25 | 0.10 | 1.50 | 1.50 | 8.00 | 2.00 | 4.00 | 12.00 | 1.75 | 5.50 |

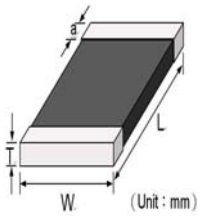
## 2.Reel Dimension




| Symbol | A | B | C | D | E | W | $W_1$ |
|---|---|---|---|---|---|---|---|
| **0402** | 178.0±1.0 | 60.0±0.5 | 13.0±0.2 | 21.0±0.2 | 2.0±0.5 | 9.0±0.50 | 1.5±0.15 |
| **0603** | 178.0±1.0 | 60.0±0.5 | 13.0±0.2 | 21.0±0.2 | 2.0±0.5 | 9.0±0.50 | 1.5±0.15 |
| **0805** | 178.0±1.0 | 60.0±0.5 | 13.0±0.2 | 21.0±0.2 | 2.0±0.5 | 9.0±0.50 | 1.5±0.15 |
| **1206** | 178.0±1.0 | 60.0±0.5 | 13.0±0.2 | 21.0±0.2 | 2.0±0.5 | 9.0±0.50 | 1.5±0.15 |
| **1210** | 178.0±1.0 | 60.0±0.5 | 13.0±0.2 | 21.0±0.2 | 2.0±0.5 | 9.0±0.50 | 1.5±0.15 |
| **1812** | 178.0±1.0 | 60.0±0.5 | 13.5±0.1 | 21.0±0.2 | 2.0±0.5 | 13.6±0.2 | 1.5±0.15 |
| **2220** | 178.0±1.0 | 60.0±0.5 | 13.5±0.1 | 21.0±0.2 | 2.0±0.5 | 13.6±0.2 | 1.5±0.15 |

## 3 .Size

| **Model** | **0402(1005)** | **0603(1608)** | **0805(2012)** | **1206(3216)** | **1210(3225)** | **1812(4532)** | **2220(5750)** |
|---|---|---|---|---|---|---|---|
| Length(L) | 1.00 ±0.10 | 1.60±0.15 | 2.00±0.20 | 3.20±0.20 | 3.20±0.20 | 4.50±0.20 | 5.70±0.20 |
| Width(W) | 0.50 ±0.10 | 0.80±0.10 | 1.25±0.15 | 1.60±0.15 | 2.50±0.20 | 3.20±0.20 | 5.00±0.20 |
| Thickness(T) | 0.60 max | 0.90 max | 1.20 max | 1.50 max | 1.50 max | 2.00 max | 2.50 max |

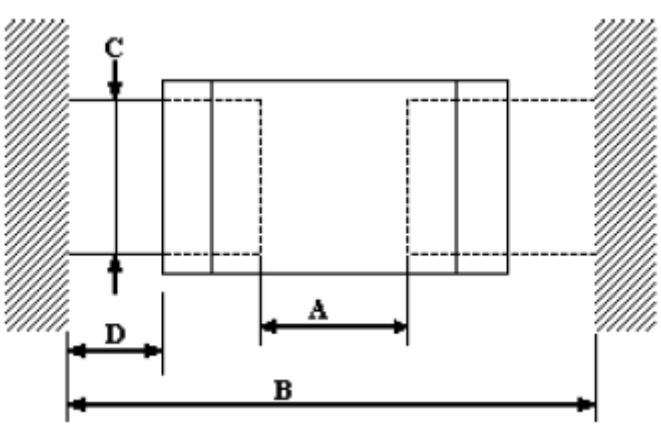


# Multilayer Ceramic SMD Varistor

*Recommendation for Soldering*

## Recommended solder pad layout

| Type | Solder pad layout | | | |
|---|---|---|---|---|
| | A | B | C | D |
| 0402 | 0.4~0.6 | 1.6~1.8 | 0.5~0.52 | 0.2~0.4 |
| 0603 | 0.8~1.2 | 2.5~3.0 | 0.6~1.0 | 0.3~0.6 |
| 0805 | 1.0~1.5 | 3.2~3.8 | 1.2~1.4 | 0.3~0.6 |
| 1206 | 1.8~2.5 | 4.2~5.8 | 1.2~1.6 | 0.4~0.8 |
| 1210 | 1.8~2.5 | 4.2~5.8 | 1.8~2.5 | 0.5~1.0 |
| 1812 | 2.5~3.5 | 5.5~6.1 | 2.3~3.2 | 0.6~1.1 |
| 2220 | 3.5~4.6 | 6.0~7.2 | 4.8~5.5 | 1.2~2.3 |



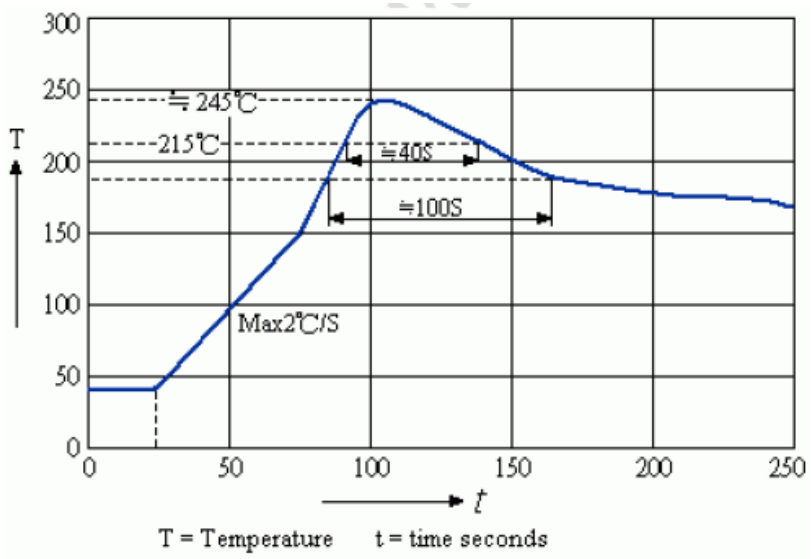

(Unit : mm)

## Soldering Recommendations :

| | |
|---|---|
| **Material** | **63/37 Sn/Pb or 62/36/2 Sn/Pb/Ag** |
| **Temperature** | **260$^0$C,5 seconds max** |
| **Flux** | **Non Activated.** |

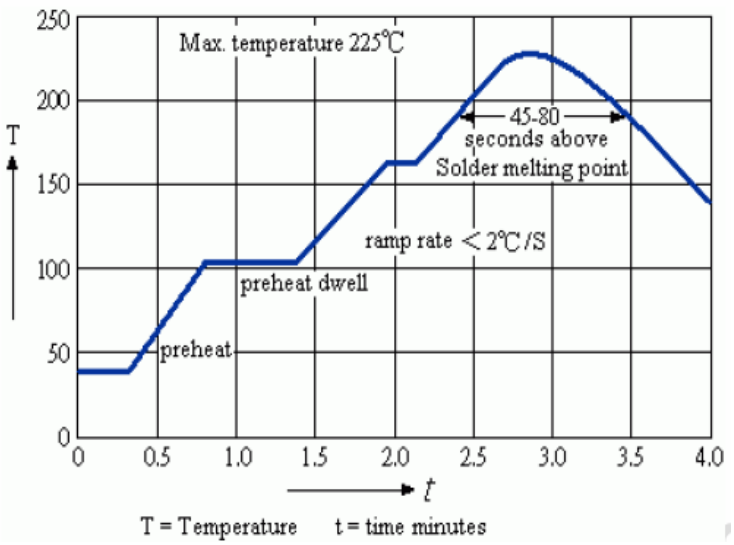
## Recommended soldering temperature profile

### 1. Vapor Phase Solder Profile



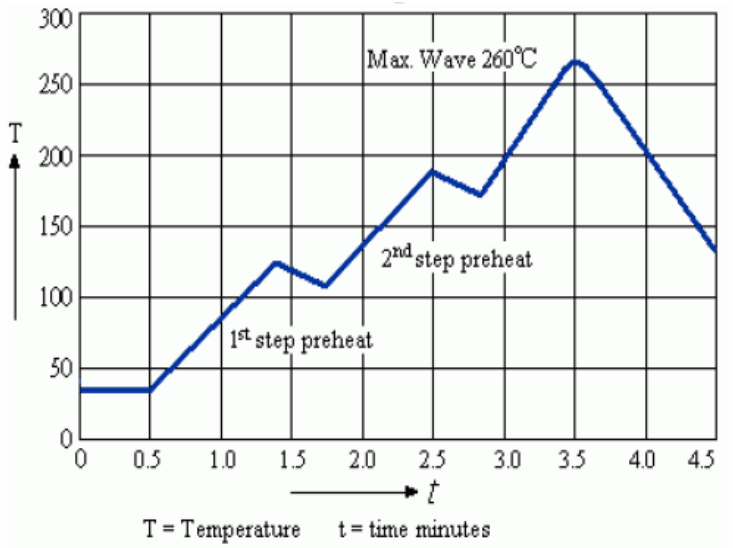

**Vapor Phase Soldering** has the Second highest heat transfer rate so Care must be taken. It is needed that Preheating the assembly and Minimizing the dwell time above The solder liquid us temperature to avoid defects.

## 2.Reflow Solder Profile




**IR Soldering** has the highest yields due to controlled heating rates and solder liquid us times. Make sure that the element is not subjected to a thermal gradient steeper than 4 degrees per second. 2 degrees per second is the ideal gradient. During the soldering process, preheating to within 100 degrees of the solders peak temperature is essential to minimize thermal shock.

## 3.Wave Solder Profile




**Wave Soldering** has the highest Solder temperature and heat transfer rates whose temperature limits are determined by parts like ESD suppressor and integrated circuits. In order to avoid the possibility of generating stresses to thermal shock, a preheat is recommended in the soldering process, and the peak temperature should be under controlled rigidly in the solder process.