

# DATA SHEET

## SURFACE-MOUNT CERAMIC MULTILAYER CHIP VARISTORS

VRS0402/0603

5.5 V TO 38 V

RoHS compliant & Halogen Free



SCOPE

This specification describes chip varistors with lead-free terminations.

APPLICATIONS

- Consumer electronic equipment
- Telecommunications
- Notebook
- Electronic data processing

FEATURES

- Excellent clamping voltage
- Excellent energy dissipation capability
- Quick response time (<1n sec.)
- Adjustable capacitance values
- High reliability
- High transient current capability
- Symmetrical voltage-current characteristics

ORDERING INFORMATION-GLOBAL PART NUMBER, PHYCOMP

CTC & I2NC

All part numbers are identified by the series, size, tolerance, TC material, packing style, voltage, process code, termination and capacitance value.

**YAGEO BRAND ordering code**

**GLOBAL PART NUMBER (PREFERRED)**

**VRS** xxxx x **R** xxx xxx x  
 (1) (2) (3) (4) (5)

**(1) SIZE – INCH BASED (METRIC)**

0402 (1005)

0603 (1608)

**(2) TOLERANCE**

K = ±10%

L = ±15%

M = ±20%

S = Normal range

**(3) WORKING VOLTAGE**

2 significant digits+number of zeros

The 3rd digit signifies the multiplying factor, and letter R is decimal point

Example: 55R = 55 × 10<sup>-1</sup> = 5.5 V, 380 = 38 × 10<sup>1</sup> = 38 V

**(4) CAPACITANCE VALUE**

2 significant digits+number of zeros The 3rd digit signifies the multiplying factor, and letter R is decimal point

Example: 121 = 12 × 10<sup>1</sup> = 120 pF

**(5) PROCESS CODE**

N = Cap. ±30%

K = Cap. ±10%

L = Cap. ±15%

M = Cap. ±20%

**CONSTRUCTION**

- Lead Free terminations, NiSn terminations
- Surface mount multilayer surge suppressor
- Very short response time (<1.0 nsec)
- Bidirectional clamping
- Low capacitance for high frequency applications
- Very low leakage current

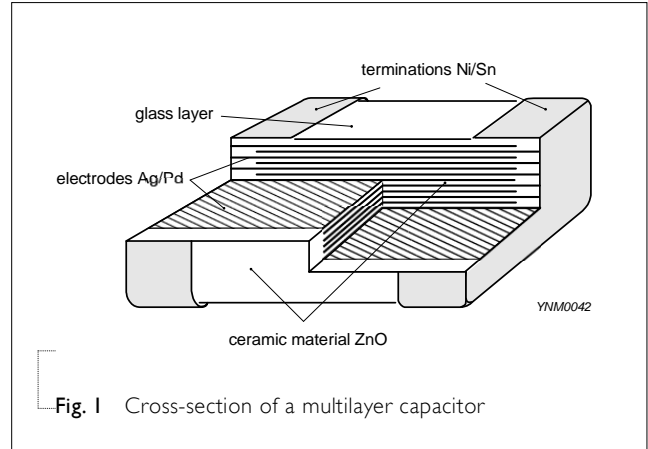


Fig. 1 Cross-section of a multilayer capacitor

**DIMENSION**

Table I For outlines see fig. 2

| TYPE | L <sub>1</sub> (mm) | W (mm)    | T (MM)    | L <sub>2</sub> / L <sub>3</sub> (mm) |      | L <sub>4</sub> (mm) |
|------|---------------------|-----------|-----------|--------------------------------------|------|---------------------|
|      |                     |           |           | min.                                 | max. | min.                |
| 0402 | 1.0 ±0.10           | 0.5 ±0.10 | 0.5 ±0.10 | 0.15                                 | 0.30 | 0.40                |
| 0603 | 1.6 ±0.15           | 0.8 ±0.15 | 0.8 ±0.10 | 0.20                                 | 0.60 | 0.40                |

**OUTLINES**

For dimension see Table I

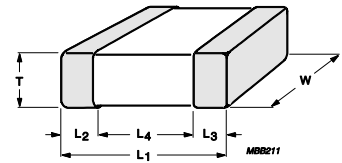


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

**ELECTRICAL CHARACTERISTICS**
**Table 2** Size 0402

| PART NUMBER      | VARISTOR/<br>BREAKDOWN<br>VOL. | MAX. WORKING<br>VOL. | CLAMPING<br>VOL.@1A | PEAK<br>CURRENT | LEAKAGE CURRENT<br>R.T. (15~35 °C) |         | CAPACITANCE<br>@ 1V (RMS) |        |
|------------------|--------------------------------|----------------------|---------------------|-----------------|------------------------------------|---------|---------------------------|--------|
|                  | DC @1mA                        | D.C (max.)           | 8/20 μS (max.)      | 8/20 μS (max.)  | Voltage                            | Current | 1KHz                      | 1MHz   |
| VRS0402SR55R220N | 10 V ~ 14 V                    | 5.5 V                | 22 V                | 2 A             | 5.5 V                              | 10 μA   | 22 pF                     | 12 pF  |
| VRS0402SR55R330N | 10 V ~ 14 V                    | 5.5 V                | 22 V                | 4 A             | 5.5 V                              | 10 μA   | 33 pF                     | 20 pF  |
| VRS0402SR55R500N | 10 V ~ 14 V                    | 5.5 V                | 22 V                | 6 A             | 5.5 V                              | 10 μA   | 50 pF                     | 30 pF  |
| VRS0402SR55R101N | 10 V ~ 14 V                    | 5.5 V                | 22 V                | 10 A            | 5.5 V                              | 10 μA   | 100 pF                    | 60 pF  |
| VRS0402MR55R101N | 7.2 V ~ 10.8 V                 | 5.5 V                | 18 V                | 10 A            | 5.5 V                              | 10 μA   | 100 pF                    | 60 pF  |
| VRS0402MR55R201N | 7.2 V ~ 10.8 V                 | 5.5 V                | 18 V                | 15 A            | 5.5 V                              | 10 μA   | 200 pF                    | 130 pF |
| VRS0402MR55R301N | 7.2 V ~ 10.8 V                 | 5.5 V                | 18 V                | 15 A            | 5.5 V                              | 10 μA   | 300 pF                    | ---    |
| VRS0402MR55R361N | 7.2 V ~ 10.8 V                 | 5.5 V                | 18 V                | 20 A            | 5.5 V                              | 10 μA   | 360 pF                    | 220 pF |
| VRS0402MR55R481N | 7.2 V ~ 10.8 V                 | 5.5 V                | 18 V                | 20 A            | 5.5 V                              | 10 μA   | 480 pF                    | 290 pF |
| VRS0402MR55R651N | 7.2 V ~ 10.8 V                 | 5.5 V                | 18 V                | 30 A            | 5.5 V                              | 10 μA   | 650 pF                    | 390 pF |
| VRS0402KR090500N | 10.8 V ~ 13.2 V                | 9 V                  | 22 V                | 6 A             | 9 V                                | 20 μA   | 50 pF                     | 30 pF  |
| VRS0402LR090500N | 10.2 V ~ 13.8 V                | 9 V                  | 22 V                | 6 A             | 9 V                                | 20 μA   | 50 pF                     | 30 pF  |
| VRS0402LR090201N | 10.2 V ~ 13.8 V                | 9 V                  | 22 V                | 15 A            | 9 V                                | 20 μA   | 200 pF                    | 120 pF |
| VRS0402SR140500N | 18 V ~ 24 V                    | 14 V                 | 38 V                | 7 A             | 14 V                               | 20 μA   | 50 pF                     | 30 pF  |
| VRS0402SR140101N | 18 V ~ 24 V                    | 14 V                 | 38 V                | 15 A            | 14 V                               | 20 μA   | 100 pF                    | 60 pF  |
| VRS0402SR140121N | 18 V ~ 24 V                    | 14 V                 | 38 V                | 15 A            | 14 V                               | 20 μA   | 120 pF                    | 72 pF  |
| VRS0402MR140161N | 14.4 V ~ 21.6 V                | 14 V                 | 35 V                | 20 A            | 14 V                               | 20 μA   | 160 pF                    | 96 pF  |
| VRS0402KR140161N | 16.2 V ~ 19.8 V                | 14 V                 | 33 V                | 20 A            | 14 V                               | 20 μA   | 160 pF                    | 96 pF  |
| VRS0402SR180010N | 90 V ~ 135 V                   | 18 V                 | 250 V               | 1 A             | 18 V                               | 10 μA   | ---                       | 1 pF   |
| VRS0402SR180030N | 50 V ~ 80 V                    | 18 V                 | 130 V               | 1 A             | 18 V                               | 10 μA   | 3 pF                      | 2 pF   |
| VRS0402SR180050N | 50 V ~ 80 V                    | 18 V                 | 130 V               | 2 A             | 18 V                               | 10 μA   | 5 pF                      | 3 pF   |
| VRS0402SR180100N | 24 V ~ 34 V                    | 18 V                 | 66 V                | 3 A             | 18 V                               | 10 μA   | 10 pF                     | 5.5 pF |
| VRS0402SR180150N | 24 V ~ 34 V                    | 18 V                 | 66 V                | 3 A             | 18 V                               | 10 μA   | 15 pF                     | 9 pF   |
| VRS0402SR180220N | 24 V ~ 34 V                    | 18 V                 | 66 V                | 3 A             | 18 V                               | 10 μA   | 22 pF                     | 13 pF  |
| VRS0402SR180270N | 24 V ~ 34 V                    | 18 V                 | 66 V                | 4 A             | 18 V                               | 10 μA   | 27 pF                     | 15 pF  |
| VRS0402SR180400N | 24 V ~ 34 V                    | 18 V                 | 66 V                | 4 A             | 18 V                               | 10 μA   | 40 pF                     | 22 pF  |
| VRS0402SR180500N | 24 V ~ 34 V                    | 18 V                 | 66 V                | 4 A             | 18 V                               | 10 μA   | 50 pF                     | 30 pF  |
| VRS0402KR180820N | 21.6 V ~ 26.4 V                | 18 V                 | 56 V                | 10 A            | 18 V                               | 35 μA   | 82 pF                     | 50 pF  |
| VRS0402SR180121N | 24 V ~ 34 V                    | 18 V                 | 66 V                | 15 A            | 18 V                               | 10 μA   | 120 pF                    | 72 pF  |
| VRS0402SR190500N | 27 V ~ 38 V                    | 19 V                 | 60 V                | 15 A            | 19 V                               | 4 μA    | 50 pF                     | ---    |
| VRS0402SR300030N | 50 V ~ 80 V                    | 30 V                 | 130 V               | 1 A             | 18 V                               | 10 μA   | 3 pF                      | ---    |

**ELECTRICAL CHARACTERISTICS**
**Table 3** Size 0603

| PART NUMBER      | VARISTOR/<br>BREAKDOWN | MAX. WORKING<br>VOL. | CLAMPING<br>VOL. @ 1A | PEAK<br>CURRENT | LEAKAGE CURRENT<br>R.T. (15~35 °C) |         | CAPACITANCE<br>@ 1V (RMS) |        |
|------------------|------------------------|----------------------|-----------------------|-----------------|------------------------------------|---------|---------------------------|--------|
|                  | DC @ 1mA               | D.C (max.)           | 8/20 μS (max.)        | 8/20 μS (max.)  | Voltage                            | Current | 1KHz                      | 1MHz   |
| VRS0603SR55R181N | 10 V ~ 14 V            | 5.5 V                | 20 V                  | 12 A            | 5.5 V                              | 10 μA   | 180 pF                    | 100 pF |
| VRS0603MR55R301N | 7.2 V ~ 10.8 V         | 5.5 V                | 18 V                  | 15 A            | 5.5 V                              | 10 μA   | 300 pF                    | 180 pF |
| VRS0603MR55R361N | 7.2 V ~ 10.8 V         | 5.5 V                | 18 V                  | 20 A            | 5.5 V                              | 10 μA   | 360 pF                    | 180 pF |
| VRS0603SR55R471N | 10 V ~ 14 V            | 5.5 V                | 20 V                  | 30 A            | 5.5 V                              | 10 μA   | 470 pF                    | 280 pF |
| VRS0603MR55R681N | 7.2 V ~ 10.8 V         | 5.5 V                | 18 V                  | 30 A            | 5.5 V                              | 10 μA   | 680 pF                    | 410 pF |
| VRS0603MR55R801N | 7.2 V ~ 10.8 V         | 5.5 V                | 18 V                  | 30 A            | 5.5 V                              | 10 μA   | 800 pF                    | 480 pF |
| VRS0603MR55R901N | 7.2 V ~ 10.8 V         | 5.5 V                | 18 V                  | 30 A            | 5.5 V                              | 10 μA   | 900 pF                    | 540 pF |
| VRS0603SR090090N | 18 V ~ 24 V            | 9 V                  | 36 V                  | 3 A             | 9 V                                | 20 μA   | 9 pF                      | 5.5 pF |
| VRS0603KR140351N | 16.2 V ~ 19.8 V        | 14 V                 | 33 V                  | 30 A            | 14 V                               | 20 μA   | 350 pF                    | ---    |
| VRS0603SR180030N | 50 V ~ 80 V            | 18 V                 | 130 V                 | 1 A             | 18 V                               | 10 μA   | 3 pF                      | 2 pF   |
| VRS0603SR180050N | 50 V ~ 80 V            | 18 V                 | 130 V                 | 2 A             | 18 V                               | 10 μA   | 5 pF                      | 3 pF   |
| VRS0603SR180100N | 24 V ~ 32 V            | 18 V                 | 66 V                  | 5 A             | 18 V                               | 10 μA   | 10 pF                     | 6 pF   |
| VRS0603SR180150N | 24 V ~ 32 V            | 18 V                 | 66 V                  | 3 A             | 18 V                               | 10 μA   | 15 pF                     | 10 pF  |
| VRS0603SR180121N | 24 V ~ 32 V            | 18 V                 | 66 V                  | 20 A            | 18 V                               | 10 μA   | 120 pF                    | 72 pF  |
| VRS0603KR300121N | 35.1 V ~ 42.9 V        | 30 V                 | 86 V                  | 20 A            | 30 V                               | 35 μA   | 120 pF                    | 72 pF  |
| VRS0603KR310161N | 35.1 V ~ 42.9 V        | 31 V                 | 86 V                  | 20 A            | 31 V                               | 35 μA   | 160 pF                    | 96 pF  |

**STANDARD TESTING CONDITION**

1. Temperature: 15 °C to 35 °C
2. Humidity: 25% RH to 85% RH
3. Atmospheric pressure: 86 to 106 kPa

**ESD (ELECTROSTATIC DISCHARGE) TEST**

ESD discharge circuit according to IEC 61000-4-2

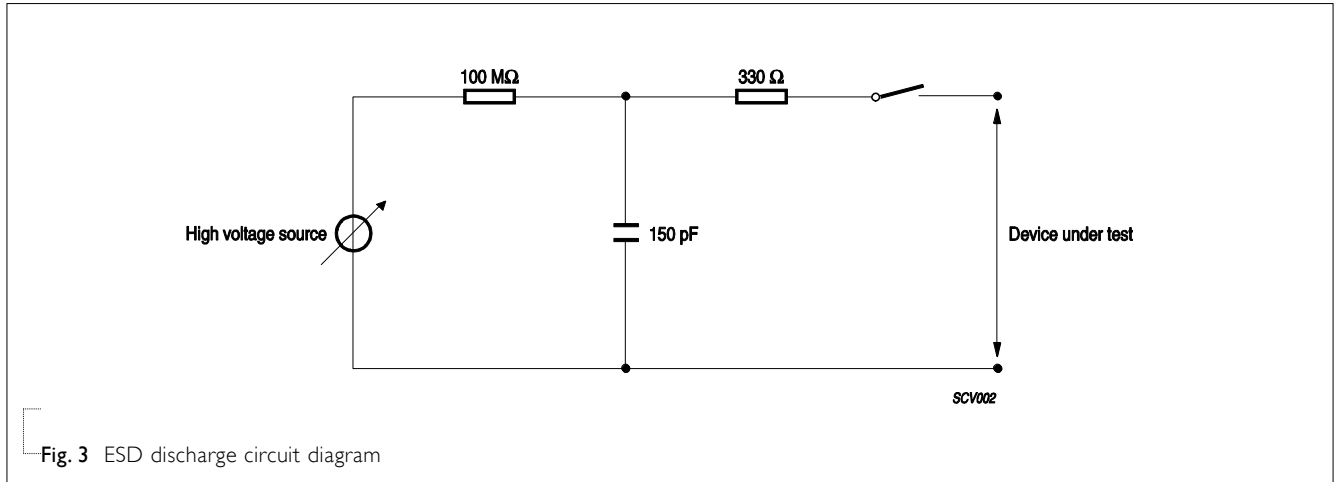


Fig. 3 ESD discharge circuit diagram

**SPECIFICATION OF ELECTROSTATIC DISCHARGE (ESD) TEST:**

According to standard EN 61000-4-2, up to 8 KV direct contact (contact discharge)

**THICKNESS CLASSES AND PACKING QUANTITY**

Table 4

| SIZE CODE | THICKNESS CLASSIFICATION | TAPE WIDTH<br>QUANTITY PER REEL | Ø180 MM / 7 INCH<br>(PAPER) |
|-----------|--------------------------|---------------------------------|-----------------------------|
| 0402      | 0.5 ±0.03 mm             | 8 mm                            | 10,000                      |
| 0603      | 0.8 ±0.1 mm              | 8 mm                            | 4,000                       |

**METHOD OF MOUNTING**

For normal use the varistor may be mounted on printed-circuit boards or ceramic substrates by applying wave soldering, reflow soldering (including vapour phase soldering) or conductive adhesive in accordance with CECC 00802 classification A. For advised soldering profiles see Figs 4, 5, and 6.

An improper combination of soldering, substrate and chip size can lead to a damaging of the component. The risk increases with the chip size and with temperature fluctuations (>100 °C). More detailed information is available on request.

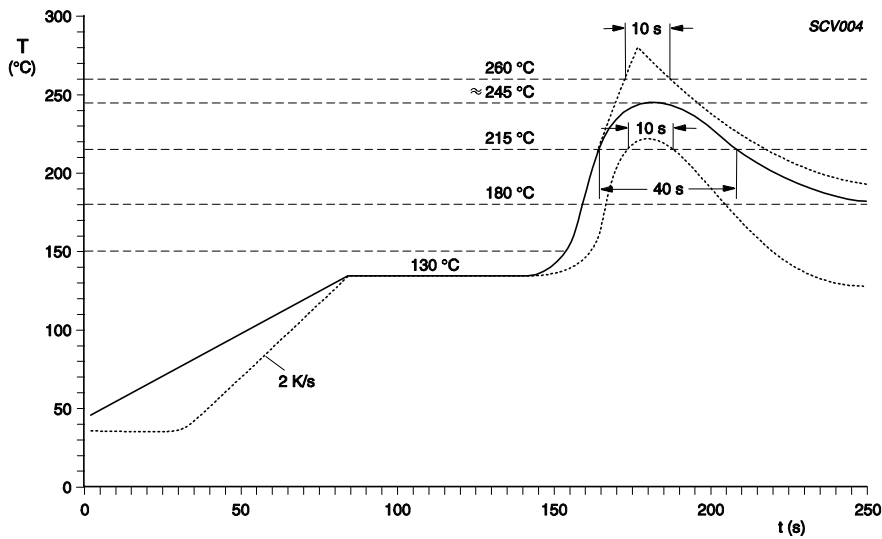


Fig. 4 Reflow soldering Typical values (solid line) Process limits (dotted lines)

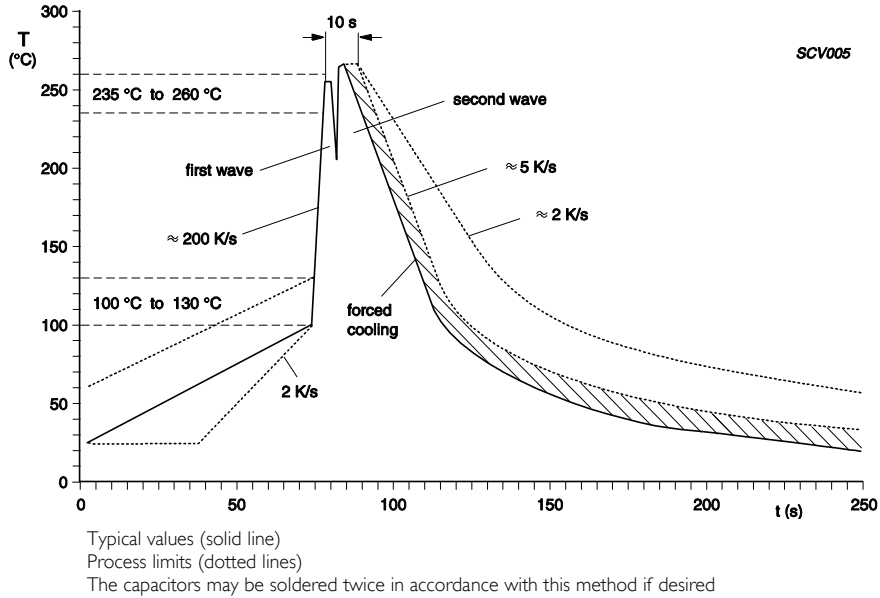


Fig. 5 Double wave soldering

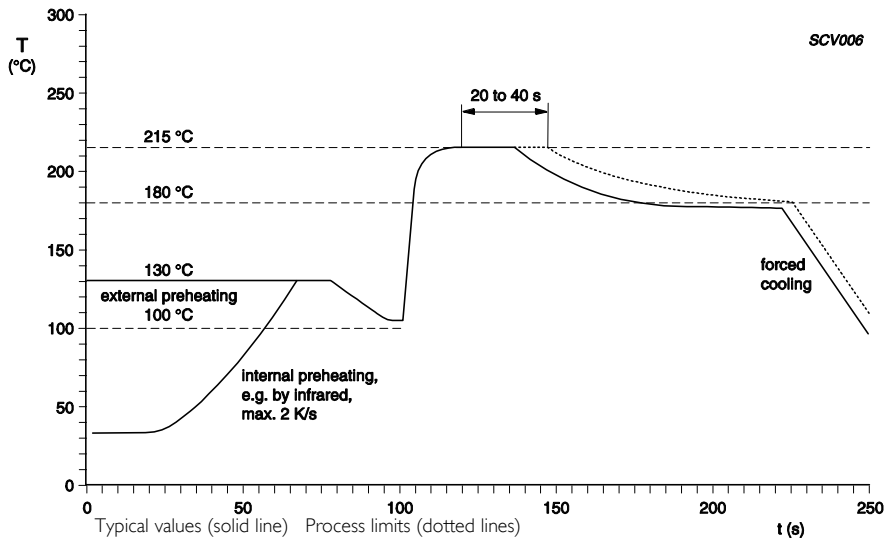


Fig. 6 Vapour phase soldering

**TESTS AND REQUIREMENTS**
**Table 5** Test procedures and requirements



| TEST                                    | TEST METHOD         | PROCEDURE  | REQUIREMENTS   |
|---|---------------------|--|--|
| Capacitance                             | CECC4200<br>4.6     | IEC1051<br>4.7<br>f = 1 KHz / 1 MHz<br>Measuring voltage 1 Vrms at 25 °C   | > 5 pF: ±30% at 1KHz<br>3 pF to 5 pF: +80% / -20% at 1KHz<br>< 3 pF: +80% / -20% at 1MHz |
| Bond Strength of Plating on End Face    | 4.9                 | 4.10<br>To be soldered on the glass-epoxy (thickness 1.6 mm), the load shall be put on the board bends 1 mm        | No visible damage  |
| Solderability                           | 4.10                | 4.11<br>Unmounted chips completely immersed for 2 ±0.5 seconds (dipping time) in a solder bath at 235 ±2 °C        | The termination should be well tinned  |
| Resistance to Soldering Heat            | 4.10.2              | 4.12<br>Solder bath temperature: 260 ±5 °C<br>Dipping time: 10 ±0.5 seconds  | Δ V I mA / V I mA   < 10%  |
| Rapid Change of Temperature             | 4.12                | 4.13<br>5 cycles with following detail<br>30 minutes at -40°C<br>30 minutes at +85 °C                              | Δ V I mA / V I mA   < 10%  |
| Damp Heat with U <sub>r</sub> Load      | 4.17                | 4.18<br>Duration and conditions:<br>500 ±12 hours at 40 ±2 °C<br>90 to 95% RH; U <sub>r</sub> applied              | Δ V I mA / V I mA   < 10%  |
| Endurance                               | 4.19                | 4.20<br>Duration and conditions:<br>500 ±12 hours at 85 °C; U <sub>r</sub> applied                                 | Δ V I mA / V I mA   < 10%  |
| Endurance at Upper Category Temperature | 4.20                | 4.20<br>Duration and conditions:<br>1,000 ±12 hours at 85 °C   | Δ V I mA / V I mA   < 10%  |
| Adhesion                                | IEC 60384-1<br>4.34 | A force of 2N applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate | No visible damage  |
| Cold Temperature Storage                | 4.25                | Duration and conditions<br>1,000 ±12 hours at -40 ±2 °C  | Δ V I mA / V I mA   < 10%  |

**REVISION HISTORY**







| REVISION  | DATE          | CHANGE NOTIFICATION | DESCRIPTION   |
|-----------|---------------|---------------------|---|
| Version 7 | Aug. 14, 2014 | -                   | - VRS0402SRI80220N added<br>- Product range update<br>- Process code update<br>- VRS0402SRI80100S, VRS0402SRI80100E deleted |
| Version 6 | May 16, 2013  | -                   | - VRS0402SRI90500N added  |
| Version 5 | Jan 03, 2012  | -                   | - Product range updated<br>- Leakage current updated<br>- Working voltage updated   |
| Version 4 | Oct 19, 2011  | -                   | - Product range and dimension updated   |
| Version 3 | Aug 05, 2011  | -                   | - Product range updated   |
| Version 2 | Dec 02, 2010  | -                   | - Dimension updated<br>- Leakage current updated<br>- VRS0805KR260251N added  |
| Version 1 | Jul 22, 2010  | -                   | - Dimension updated   |
| Version 0 | Jun 08, 2010  | -                   | - New   |

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

-  [View VRS0402KR140161N on WIN SOURCE](#)
-  [Yageo Information](#)

## Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management