



Pages 1 to 13

**RESISTOR, FIXED, CHIP, THICK FILM**

**BASED ON TYPE CHP**

**ESCC Detail Specification No. 4001/026**

|         |              |
|---------|--------------|
| Issue 4 | October 2010 |
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| DCR No. | CHANGE DESCRIPTION  |
|---------|---|
| 595     | Specification updated to incorporate editorial changes per DCR. |

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**1. GENERAL**

**1.1 SCOPE**

This specification details the ratings, physical and electrical characteristics and test and inspection data for the component type variants and/or the range of components specified below. It supplements the requirements of, and shall be read in conjunction with, the ESCC Generic Specification listed under Applicable Documents.

**1.2 APPLICABLE DOCUMENTS**

The following documents form part of this specification and shall be read in conjunction with it:

- (a) ESCC Generic Specification No. 4001.

**1.3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS**

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply.

**1.4 THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS**

**1.4.1 The ESCC Component Number**

The ESCC Component Number shall be constituted as follows:

Example: 4001026012490F4

- Detail Specification Reference: 4001026
- Component Type Variant Number: 01 (as required)
- Characteristic code: Resistance Value (249Ω): 2490 (as required)
- Characteristic code: Resistance Tolerance (±1%): F (as required)
- Characteristic code: Temperature Coefficient (±100x10<sup>-6</sup>/°C): 4 (as required)

**1.4.1.1 Characteristics and/or Ratings Codes**

Characteristics and/or ratings to be codified as part of the ESCC Component Number shall be as follows:

- (a) Resistance Value expressed by means of the following codes in accordance with ESCC Basic Specification No. 21700. The unit quantity shall be ohm (Ω):

| Resistance Value (Ω) | Code |
|----------------------|------|
| X.XX                 | XRXX |
| XX.X                 | XXRX |
| XXX                  | XXX0 |
| XXX 10 <sup>1</sup>  | XXX1 |
| XXX 10 <sup>2</sup>  | XXX2 |
| XXX 10 <sup>3</sup>  | XXX3 |

| Resistance Value ( $\Omega$ ) | Code |
|-------------------------------|------|
| XXX $10^4$                    | XXX4 |
| XXX $10^5$                    | XXX5 |

(b) Resistance Tolerance expressed by the following codes in accordance with ESCC Basic Specification No. 21700:

| Tolerance ( $\pm$ %) | Code Letter |
|----------------------|-------------|
| 1                    | F           |
| 2                    | G           |
| 5                    | J           |

(c) Temperature Coefficient expressed by the following codes in accordance with ESCC Basic Specification No. 21700:

| Temperature Coefficient ( $\pm 10^{-6}/^{\circ}\text{C}$ ) | Code |
|--|------|
| 100  | 4    |
| 200  | 6    |

1.4.2 Component Type Variants and Range of Components

The component type variants and range of components applicable to this specification are as follows:

| Variant Number | Style (Note 1) | Resistance Range $R_n$ (Note 2) |                   | Tolerance ( $\pm$ %) (Note 2) | Temperature Coefficient TC ( $\pm 10^{-6}/^{\circ}\text{C}$ ) (Note 2) | Critical Resistance (k $\Omega$ ) | Terminal Material and Finish | Weight max (g) |
|----------------|----------------|---------------------------------|-------------------|-------------------------------|--|-----------------------------------|------------------------------|----------------|
|                |                | Min ( $\Omega$ )                | Max (M $\Omega$ ) |                               |  |                                   |                              |                |
| 01             | 0603           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 25                                | E4                           | 0.002          |
| 02             | 0805           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 50                                | E4                           | 0.004          |
| 03             | 1206           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 160                               | E4                           | 0.008          |
| 04             | 2010           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 180                               | E4                           | 0.026          |
| 05             | 2512           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 112.5                             | E4                           | 0.042          |
| 06             | 0603           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 25                                | E2                           | 0.002          |
| 07             | 0805           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 50                                | E2                           | 0.004          |
| 08             | 1206           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 160                               | E2                           | 0.008          |
| 09             | 2010           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 180                               | E2                           | 0.026          |
| 10             | 2512           | 1                               | 10                | 1, 2, 5                       | 100, 200   | 112.5                             | E2                           | 0.042          |

**NOTES:**

1. See Physical Dimensions.
- 2.

| Resistance ( $\Omega$ )   | Value Series   | Available Tolerance ( $\pm\%$ ) | Available Temperature Coefficient ( $\pm 10^{-6}/^{\circ}\text{C}$ ) |
|---------------------------|--|---------------------------------|--|
| $1 \leq R_n < 10$         | Any value in the resistance range to 3 significant figures | 2, 5                            | 200  |
| $10 \leq R_n < 1\text{M}$ |  | 1, 2, 5                         | 100, 200   |
| $R_n \geq 1\text{M}$      |  | 2, 5                            | 200  |

1.5

MAXIMUM RATINGS

The maximum ratings shall not be exceeded at any time during use or storage.

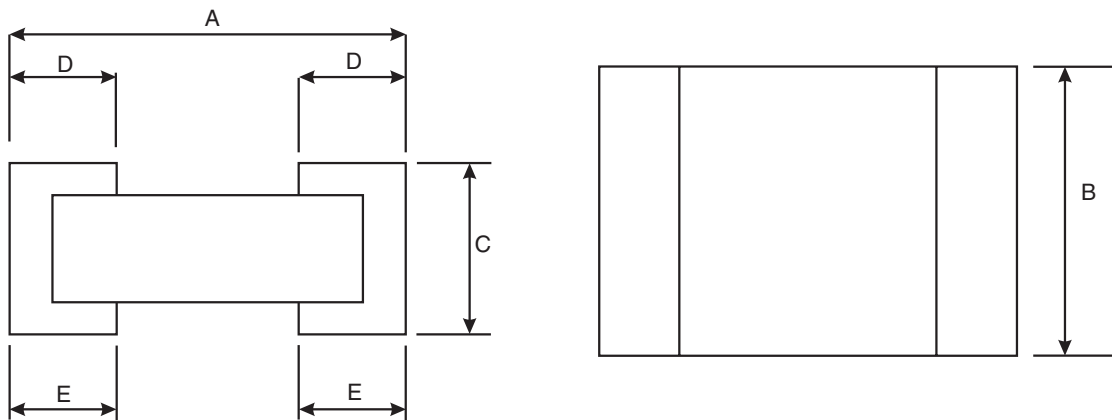
Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

| Characteristics             | Variant Number | Style | Symbols   | Limits                    | Units              | Remarks   |
|-----------------------------|----------------|-------|-----------|---------------------------|--------------------|-----------|
| Rated Dissipation           | 01, 06         | 0603  | $P_n$     | 100                       | mW                 | Note 1    |
|                             | 02, 07         | 0805  |           | 200                       |                    |           |
|                             | 03, 08         | 1206  |           | 250                       |                    |           |
|                             | 04, 09         | 2010  |           | 500                       |                    |           |
|                             | 05, 10         | 2512  |           | 800                       |                    |           |
| Limiting Element Voltage    | 01, 06         | 0603  | $U_L$     | 50                        | V                  | -         |
|                             | 02, 07         | 0805  |           | 100                       |                    |           |
|                             | 03, 08         | 1206  |           | 200                       |                    |           |
|                             | 04, 09         | 2010  |           | 300                       |                    |           |
|                             | 05, 10         | 2512  |           | 300                       |                    |           |
| Rated Voltage               | All            | All   | $U_R$     | $\sqrt{(P_n \times R_n)}$ | V                  | Note 2    |
| Isolation Voltage           | 01, 06         | 0603  | $U_I$     | 100                       | V                  | -         |
|                             | 02, 07         | 0805  |           | 200                       |                    |           |
|                             | 03, 08         | 1206  |           | 300                       |                    |           |
|                             | 04, 09         | 2010  |           | 300                       |                    |           |
|                             | 05, 10         | 2512  |           | 300                       |                    |           |
| Operating Temperature Range | All            | All   | $T_{op}$  | -55 to +155               | $^{\circ}\text{C}$ | $T_{amb}$ |
| Storage Temperature Range   | All            | All   | $T_{stg}$ | -55 to +155               | $^{\circ}\text{C}$ | -         |
| Soldering Temperature       | All            | All   | $T_{sol}$ | +260                      | $^{\circ}\text{C}$ | Note 3    |

**NOTES:**

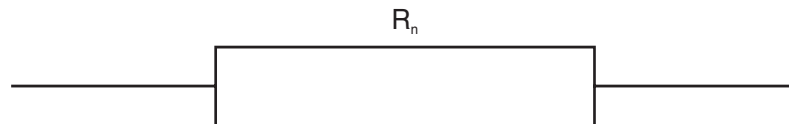
1. At  $T_{amb} \leq +70^{\circ}C$ . For  $T_{amb} > +70^{\circ}C$  derate linearly to 0W at  $T_{amb} = +155^{\circ}C$ .
2. Shall never exceed Limiting Element Voltage.  $R_n$  = Rated Resistance.
3. Duration 10 seconds maximum.

1.6 PHYSICAL DIMENSIONS



| Variant Number | Style | Dimensions (mm) |      |      |      |      |      |      |      |
|----------------|-------|-----------------|------|------|------|------|------|------|------|
|                |       | A               |      | B    |      | C    |      | D, E |      |
|                |       | Min             | Max  | Min  | Max  | Min  | Max  | Min  | Max  |
| 01, 06         | 0603  | 1.36            | 1.68 | 0.72 | 0.98 | 0.38 | 0.53 | 0.25 | 0.51 |
| 02, 07         | 0805  | 1.75            | 2.07 | 1.14 | 1.4  | 0.38 | 0.53 | 0.25 | 0.51 |
| 03, 08         | 1206  | 2.89            | 3.21 | 1.47 | 1.73 | 0.38 | 0.53 | 0.25 | 0.51 |
| 04, 09         | 2010  | 4.92            | 5.24 | 2.41 | 2.67 | 0.5  | 0.63 | 0.25 | 0.64 |
| 05, 10         | 2512  | 6.19            | 6.51 | 2.93 | 3.32 | 0.5  | 0.63 | 0.25 | 0.64 |

1.7 FUNCTIONAL DIAGRAM



1.8 MATERIALS AND FINISHES

1.8.1 Body

Each resistive element deposited on the alumina substrate shall be covered with a suitable coating.



### 1.8.2 Terminations

The terminal material and finish shall be as specified in Component Type Variants and Range of Components in accordance with the requirements of ESCC Basic Specification No. 23500.

## 2. REQUIREMENTS

### 2.1 GENERAL

The complete requirements for procurement of the components specified herein are as stated in this specification and the ESCC Generic Specification. Permitted deviations from the Generic Specification, applicable to this specification only, are listed below.

Permitted deviations from the Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESCC requirement and do not affect the component's reliability, are listed in the appendices attached to this specification.

#### 2.1.1 Deviations from the Generic Specification

##### 2.1.1.1 *Deviations from Screening Tests (Chart F3)*

(a) Para. 8.2, Non-Linearity: Not applicable.

##### 2.1.1.2 *Deviations from Qualification and Periodic Tests (Chart F4)*

(a) Para. 8.9, Vibration: Not applicable.

### 2.2 MARKING

The marking of all components delivered to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 21700. When the component is too small to accommodate all of the marking specified, as much as space permits shall be marked and the marking information, in full, shall accompany each component in its primary package.

The information to be marked and the order of precedence, shall be as follows:

- (a) The ESCC qualified components symbol (for ESCC qualified components only).
- (b) The ESCC Component Number.
- (c) Traceability information.

### 2.3 OVERLOAD

The test conditions for Overload, tested as specified in the ESCC Generic Specification, shall be as follows:

Voltage:  $\sqrt{6.25P_n \times R_n}$  or  $2U_L$ , whichever is less.  
Duration: 2s minimum.

2.4 ROBUSTNESS OF TERMINATIONS - SUBSTRATE BENDING TEST

The test conditions for the Substrate Bending Test, tested as specified in the ESCC Generic Specification, shall be as follows:

- Number of bends: 10.
- Deflection: 2mm (Variants 01, 02, 03, 06, 07, 08)  
1mm (Variants 04, 05, 09, 10)
- Duration: 5±1s

2.5 RESISTANCE TO SOLDERING HEAT

The test conditions for Resistance to Soldering Heat, tested as specified in the ESCC Generic Specification, shall be as follows:

- Temperature: 260°C
- Duration: 10(+0-1)s

2.6 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

2.6.1 Room Temperature Electrical Measurements

The measurements shall be performed at  $T_{amb}=+22 \pm 3^{\circ}C$ .

| Characteristics       | Symbols        | ESCC 4001 Test Method and Conditions | Tolerance (± %) | Limits              |                     | Units |
|-----------------------|----------------|--------------------------------------|-----------------|---------------------|---------------------|-------|
|                       |                |                                      |                 | Min                 | Max                 |       |
| Resistance            | R <sub>A</sub> | Para. 8.3.1.1                        | 1               | 0.99 R <sub>n</sub> | 1.01 R <sub>n</sub> | Ω     |
|                       |                |                                      | 2               | 0.99 R <sub>n</sub> | 1.02 R <sub>n</sub> |       |
|                       |                |                                      | 5               | 0.95 R <sub>n</sub> | 1.05 R <sub>n</sub> |       |
| Insulation Resistance | R <sub>I</sub> | Para. 8.3.1.2<br>V=100V<br>Note 1    | All             | 1000                | -                   | MΩ    |

**NOTES:**

1. Guaranteed but not tested during Screening Tests.

2.6.2 High and Low Temperatures Electrical Measurements

| Characteristics  | Symbols          | ESCC 4001 Test Method and Conditions (Note 1)     | Limits |       | Units |
|--|------------------|---|--------|-------|-------|
|  |                  |   | Min    | Max   |       |
| Resistance Change between -55 (+3-0)°C and +22 ± 3°C   | $\Delta R_A/R_A$ | Para. 8.3.1.1<br>TC = ±100 x 10 <sup>-6</sup> /°C | -0.8   | +0.8  | %     |
|  |                  | TC = ±200 x 10 <sup>-6</sup> /°C                  | -1.6   | +1.6  |       |
| Resistance Change between +155 (+0 -3)°C and +22 ± 3°C | $\Delta R_A/R_A$ | Para. 8.3.1.1<br>TC = ±100 x 10 <sup>-6</sup> /°C | -1.36  | +1.36 | %     |
|  |                  | TC = ±200 x 10 <sup>-6</sup> /°C                  | -2.72  | +2.72 |       |

**NOTES:**

- The measurements shall be performed on a sample of 5 components selected from the total production lot.

2.7 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

The components shall be mounted as specified in the ESCC Generic Specification.

Unless otherwise specified, the measurements shall be performed at T<sub>amb</sub>=+22 ±3°C.

Unless otherwise specified the test methods and test conditions shall be as per the corresponding test defined in Room Temperature Electrical Measurements.

| Test Reference per ESCC No. 4001   | Characteristics                    | Symbols                   | Limits   |     | Units |
|--|------------------------------------|---------------------------|--|-----|-------|
|  |                                    |                           | Min  | Max |       |
| Rapid Change of Temperature<br>Initial Measurement<br>Final Measurement  | Resistance<br>Change in Resistance | $R_A$<br>$\Delta R_A/R_A$ | Record Values<br>±(0.25 + 0.05Ωx100/R <sub>n</sub> ) |     | %     |
| Robustness of Terminations<br>Initial Measurement<br>Final Measurement   | Resistance<br>Change in Resistance | $R_A$<br>$\Delta R_A/R_A$ | Record Values<br>±(0.25 + 0.05Ωx100/R <sub>n</sub> ) |     | %     |
| Resistance to Soldering Heat<br>Initial Measurement<br>Final Measurement | Resistance<br>Change in Resistance | $R_A$<br>$\Delta R_A/R_A$ | Record Values<br>±(0.5 + 0.05Ωx100/R <sub>n</sub> )  |     | %     |
| Solderability<br>Initial Measurement                                     | Resistance                         | $R_A$                     | Record Values  |     |       |

| Test Reference per ESCC No. 4001       | Characteristics                      | Symbols          | Limits                                  |     | Units      |
|--|--------------------------------------|------------------|---|-----|------------|
|  |                                      |                  | Min                                     | Max |            |
| Final Measurement                      | Change in Resistance                 | $\Delta R_A/R_A$ | $\pm(0.25 + 0.05\Omega \times 100/R_n)$ |     | %          |
| Climatic Sequence                      |                                      |                  |   |     |            |
| Initial Measurements (Procedure 1)     | Resistance (after drying)            | $R_A$            | Record Values                           |     |            |
| Final Measurements                     | Change in Resistance                 | $\Delta R_A/R_A$ | $\pm(1 + 0.05\Omega \times 100/R_n)$    |     | %          |
|  | Insulation Resistance ( $V_T=100V$ ) | $R_I$            | 1000                                    | -   | M $\Omega$ |
| Operating Life                         |                                      |                  |   |     |            |
| Initial Measurement (0 hour)           | Resistance                           | $R_A$            | Record Values                           |     |            |
| Intermediate Measurements (1000 hours) | Change in Resistance                 | $\Delta R_A/R_A$ | $\pm(1 + 0.05\Omega \times 100/R_n)$    |     | %          |
| Final Measurements (2000 hours)        | Change in Resistance                 | $\Delta R_A/R_A$ | $\pm(1.5 + 0.05\Omega \times 100/R_n)$  |     | %          |
|  | Insulation Resistance ( $V_T=100V$ ) | $R_I$            | 1000                                    | -   | M $\Omega$ |

2.8 BURN-IN CONDITIONS

| Characteristics     | Symbols   | Test Conditions   | Units       |
|---------------------|-----------|---|-------------|
| Ambient Temperature | $T_{amb}$ | $+70 \pm 3$   | $^{\circ}C$ |
| Test Voltage        | $V_T$     | $\sqrt{(P_n \times R_n)}$ or $U_L$<br>whichever is less | V           |

**NOTES:**

1. After Burn-in, the components shall be removed from the chamber and allowed to cool under normal atmospheric conditions for a minimum of 4 hours.

2.9 OPERATING LIFE CONDITIONS

The conditions shall be as specified for Burn-in.

**APPENDIX A****AGREED DEVIATIONS FOR VISHAY S.A. Division Sfernice (F)**

| Items Affected   | Description of Deviations   |
|--|---|
| Deviations from Generic Specification:<br><br>Production Control (Chart F2)<br><br>Qualification and Periodic Tests (Chart F4) | Para. 5.2.1, Dimension Check: Guaranteed but not tested.<br><br>Para. 8.1, Permanence of Marking: Not applicable. |