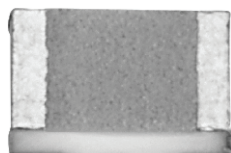


# ESCC (e) 4001/023 Qualified R Failure Rate High Precision (10 ppm/°C, 0.05 %) Thin Film Chip Resistors


**HALOGEN  
FREE**

## FEATURES

- Load life stability at  $\pm 70^{\circ}\text{C}$  for 2000 h: 0.25 % under  $P_n$
- Temperature coefficient to: 10 ppm/°C
- Very low noise ( $< -35\text{ dB}$ ) and voltage coefficient ( $< 0.01\text{ ppm/V}$ )
- Resistance range: 100  $\Omega$  to 3.01 M $\Omega$  (depending on size)
- Tolerances down to 0.05 %
- SnPb terminations over nickel barrier
- ESCC 4001 (generic specification)
- ESCC 4001/023 (detail specification)
- ESCC qualified
- R failure rate (0.01 % per 1000 h)
- SMD wraparound chip resistor
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

## LINKS TO ADDITIONAL RESOURCES



Vishay Sfernice Thin Film division holds ESCC QML qualification (ESCC technology flow qualification).

These HiRel components are ideal for low noise and precision applications, superior stability, low temperature coefficient of resistance, and low voltage coefficient, Vishay Sfernice's precision thin film wraparound resistors exceed requirements of MIL-PRF-55342G characteristics Y ( $\pm 10\text{ ppm/}^{\circ}\text{C}$ ).

## STANDARD ELECTRICAL SPECIFICATIONS

| MODEL         | SIZE | ESCC VARIANT NUMBER | RESISTANCE RANGE $\Omega$ | RATED POWER AT $+70^{\circ}\text{C}$ ( $P_n$ ) W | LIMITING ELEMENT VOLTAGE (UL) V | INSULATION VOLTAGE ( $U_i$ ) V | TOLERANCE $\pm \%$ | TEMPERATURE COEFFICIENT $\pm \text{ppm/}^{\circ}\text{C}$ |
|---------------|------|---------------------|---------------------------|--------------------------------------------------|---------------------------------|--------------------------------|--------------------|-----------------------------------------------------------|
| PFRR 0402 (e) | 0402 | 15                  | 100 to 150K               | 0.05                                             | 40                              | 50                             | 0.05, 0.1          | 10, 25                                                    |
| PFRR 0603 (e) | 0603 | 09                  | 100 to 500K               | 0.1                                              | 50                              | 100                            | 0.05, 0.1          | 10, 25                                                    |
| PFRR 0805 (e) | 0805 | 10                  | 100 to 750K               | 0.125                                            | 100                             | 200                            | 0.05, 0.1          | 10, 25                                                    |
| PFRR 1206 (e) | 1206 | 11                  | 100 to 3.5M               | 0.25                                             | 150                             | 300                            | 0.05, 0.1          | 10, 25                                                    |
| PFRR 2010 (e) | 2010 | 12                  | 100 to 6M                 | 0.50                                             | 200                             | 300                            | 0.05, 0.1          | 10, 25                                                    |

## CLIMATIC SPECIFICATIONS

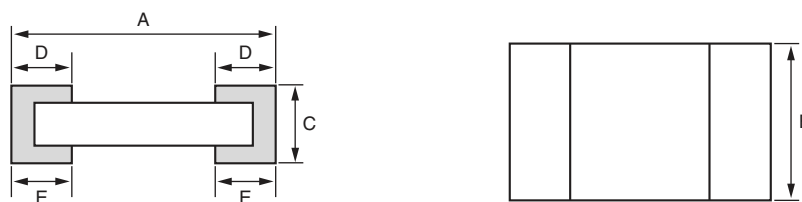
|                                     |                                             |
|-------------------------------------|---------------------------------------------|
| Operating temperature range         | $-55^{\circ}\text{C}; +155^{\circ}\text{C}$ |
| Soldering temperature ( $T_{sol}$ ) | $260^{\circ}\text{C}$ , immersion 10 s      |

## MECHANICAL SPECIFICATIONS

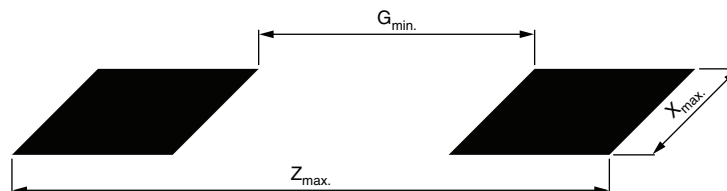
|                    |                                                           |
|--------------------|-----------------------------------------------------------|
| Substrate material | Alumina                                                   |
| Technology         | Thin Film                                                 |
| Film               | <b>Nickel Chromium</b> with mineral passivation           |
| Protection         | Epoxy and Silicon                                         |
| Terminations       | <b>B type:</b> SnPb over nickel barrier for solder reflow |

## QUALIFIED OHMIC RANGE: MAX. VALUE

| PFRR0402       | PFRR0603       | PFRR0805       | PFRR1206     | PFRR2010        |
|----------------|----------------|----------------|--------------|-----------------|
| 100 k $\Omega$ | 261 k $\Omega$ | 301 k $\Omega$ | 1 M $\Omega$ | 3.01 M $\Omega$ |

**DIMENSIONS** in millimeters


| VARIANT NUMBER | STYLE | A    |      | B    |      | C    |      | D    |      | E    |      |
|----------------|-------|------|------|------|------|------|------|------|------|------|------|
|                |       | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| 09             | 0603  | 1.39 | 2.16 | 0.62 | 1.01 | 0.25 | 1.02 | 0.17 | 0.51 | 0.25 | 0.51 |
| 10             | 0805  | 1.78 | 2.55 | 1.14 | 1.53 | 0.25 | 1.02 | 0.17 | 0.51 | 0.25 | 0.51 |
| 11             | 1206  | 2.87 | 3.64 | 1.47 | 1.86 | 0.25 | 1.02 | 0.17 | 0.51 | 0.25 | 0.51 |
| 12             | 2010  | 4.95 | 5.72 | 2.41 | 2.8  | 0.25 | 1.02 | 0.35 | 0.85 | 0.35 | 0.85 |
| 15             | 0402  | 0.87 | 1.64 | 0.47 | 0.86 | 0.25 | 1.02 | 0.09 | 0.38 | 0.12 | 0.38 |

**LAND PATTERN DIMENSIONS** in millimeters


| CHIP SIZE | Z <sub>max</sub> | G <sub>min</sub> | X <sub>max</sub> |
|-----------|------------------|------------------|------------------|
| 0402      | 1.55             | 0.15             | 0.73             |
| 0603      | 2.37             | 0.35             | 0.98             |
| 0805      | 2.76             | 0.74             | 1.40             |
| 1206      | 3.91             | 1.85             | 1.73             |
| 2010      | 5.93             | 3.71             | 2.67             |

**Note**

- Suggested land pattern: According to IPC-7351

**TRACEABILITY DEFINITIONS**

The two major traceability elements are defined as:

- The primary process lot number named Front End lot (FE lot). One "FE lot" is composed of several wafers issued from the same thin film deposition sequence.
- The date code named Batch Number (BN). The "BN" is defined after completion of the end of production testing sequence. The lot homogeneity is given by the "FE lot" and not by the "BN".

According to the applied rules validated by the ESCC through the product qualification, the following situations are agreed:

- Parts coming from different "FE lot" might have the same "BN".
- A maximum of two different "BN" might be applied to the same "FE lot" to enable the use of overruns from a previous PO.
- Unless requested / approved by the customer the "BN" will be 2 years old maximum.

**SPECIFIC TRACEABILITY REQUIREMENTS**

The following specific requirements have to be treated as:

- A customer who requires "Lot Homogeneity" has to mention it on the PO as "SINGLE PRODUCTION LOT".
- A customer who requires "Lot Homogeneity" in addition to a "Single Batch Number" has to mention it on the PO as "SINGLE PRODUCTION LOT AND OPTION R0101".

**END OF PRODUCTION TESTING**

Mandatory testing performed at the end of the production process:

- 100 % overload: Voltage  $\sqrt{(6.25 P_n \times R_n)}$  or  $2 U_L$  whichever is less - duration 2 s

**GLOBAL PART NUMBER INFORMATION**

New Global Part Numbering: PFRR0603Y1003BBT (preferred part number format)

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | F | R | R | 0 | 6 | 0 | 3 | Y | 1 | 0 | 0 | 3 | B | B | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

## TYPE

PFRR0402  
PFRR0603  
PFRR0805  
PFRR1206  
PFRR2010

## TCR

Y =  $\pm 10$  ppm/ $^{\circ}$ C  
E =  $\pm 25$  ppm/ $^{\circ}$ C

OHMIC  
VALUE

The first three digits are significant figures and the last digit specifies the number of zeros to follow.  
Example:

3901 = 3900  $\Omega$   
1004 = 1 M $\Omega$

## TOLERANCE

W =  $\pm 0.05$  %  
B =  $\pm 0.10$  %

## TERMINATION

B: SnPb over nickel barrier

## PACKAGING

For more information see Codification of Packaging table

**CODIFICATION OF PACKAGING**

## CODE 18

## PACKAGING

## WAFFLE PACK

|    |                                                  |
|----|--------------------------------------------------|
| W  | 100 min., 1 mult                                 |
| WA | 100 min., 100 mult (available only in size 1206) |

## PLASTIC TAPE (in standard for all sizes)

|    |                                                 |
|----|-------------------------------------------------|
| T  | 100 min., 1 mult                                |
| TA | 100 min., 100 mult                              |
| TB | 250 min., 250 mult                              |
| TC | 500 min., 500 mult                              |
| TD | 1000 min., 1000 mult                            |
| TE | 2500min., 2500 mult                             |
| TF | Full tape (quantity depending on size of chips) |

## PAPER TAPE (Available for 0402, 0603, 0805 and 1206. Please consult Vishay Sfernice for 2010 size.)

|                                  |                                                 |
|----------------------------------|-------------------------------------------------|
| PT                               | 100 min., 1 mult                                |
| PA                               | 100 min., 100 mult                              |
| PB                               | 250 min., 250 mult                              |
| PC                               | 500 min., 500 mult                              |
| PD (not available for size 0402) | 1000 min., 1000 mult                            |
| PE (not available for size 0402) | 2500min., 2500 mult                             |
| PF (not available for size 0402) | Full tape (quantity depending on size of chips) |

**GLOBAL PART NUMBER INFORMATION**

## ESCC Code

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 0 | 0 | 1 | 0 | 2 | 3 | 0 | 9 | R | 1 | 0 | 0 | 3 | B | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

## ESCC SPEC

4001023

## VARIANT

0402 = 15  
0603 = 09  
0805 = 10  
1206 = 11  
2010 = 12

## FAILURE RATE

R

## OHMIC VALUE

The first three digits are significant figures and the last digit specifies the number of zeros to follow.  
Example:

3901 = 3900  $\Omega$   
1004 = 1 M $\Omega$

## TOLERANCE

W =  $\pm 0.05$  %  
B =  $\pm 0.10$  %

## TCR

1 =  $\pm 10$  ppm/ $^{\circ}$ C  
2 =  $\pm 25$  ppm/ $^{\circ}$ C



Vishay Sfernice thin film is the first passive manufacturer to hold the ESCC Technology Flow Qualification, official certificate is available on ESCIES web site <https://escies.org/ReadArticle?docId=727>.

This qualification open the door to a new concept at ESA: The Failure Rate option (similar to the one offered in the MIL system), for instance R failure rate: 0.01 % per 1000 h.

New specifications describing this new concept have been released by the ESA:

2544001: Requirements for the Technology Flow Qualification of Film Resistors

<https://escies.org/escs/specifications/2544001.pdf>

26000: Failure Rate Level Sampling Plans and Procedures

<https://escies.org/escs/specifications/26000.pdf>

21300: Terms, Definitions, Abbreviations, Symbols and Units  
<https://escies.org/escs/specifications/21300.pdf>

21700: General Requirements for the Marking of the ESCC Components

<https://escies.org/escs/specifications/21700.pdf>

4001: Generic Specification Resistors Fixed Film  
<https://escies.org/escs/specifications/4001.pdf>

4001023: Resistors, Fixed, Chip, Thin Film, Type PHR and PFRR

<https://escies.org/escs/specifications/4001023.pdf>

Parts are delivered with space C.O.C.

Parts undergo 100 % overload at end of production process.

## ESCC/PFRR CODIFICATION CORRESPONDANCE TABLES

| VARIANT | MODEL | CASE SIZE | TERMINATION  |
|---------|-------|-----------|--------------|
| 15      | PFRR  | 0402      | B (tin/lead) |
| 09      | PFRR  | 0603      | B (tin/lead) |
| 10      | PFRR  | 0805      | B (tin/lead) |
| 11      | PFRR  | 1206      | B (tin/lead) |
| 12      | PFRR  | 1210      | B (tin/lead) |

| TEMPERATURE COEFFICIENT       | ESCC CODE | PFRR CODE |
|-------------------------------|-----------|-----------|
| 10 ppm/°C (- 55 °C; + 155 °C) | 1         | Y         |
| 25 ppm/°C (- 55 °C; + 155 °C) | 2         | E         |

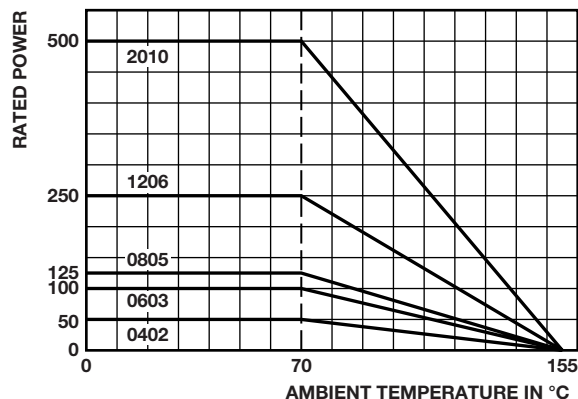
| TOLERANCE | MODEL | CASE SIZE |
|-----------|-------|-----------|
| 0.1 %     | B     | B         |
| 0.05 %    | W     | W         |

## PACKAGING

Two types of packaging are available: waffle-pack and tape and reel.

| SIZE | NUMBER OF PIECES PER PACKAGE |               | TAPE WIDTH |      |
|------|------------------------------|---------------|------------|------|
|      | WAFFLE PACK<br>2" x 2"       | TAPE AND REEL |            |      |
|      |                              | MIN.          |            | MAX. |
| 0402 | 340                          | 100           | 5000       | 8 mm |
| 0603 | 100                          |               |            |      |
| 0805 |                              |               | 4000       |      |
| 1206 | 140                          |               |            | 2000 |
| 2010 | 60                           |               |            |      |

## POWER DERATING CURVE



## EXTENDED FEATURES

You may consult Vishay Sfernice for chip sizes, ohmic values and tolerances outside of the qualified range.



| PERFORMANCE                                                             |                                                                                       |                                                                         |                                    |                                                          |
|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------|----------------------------------------------------------|
| TEST                                                                    | CONDITIONS                                                                            | REQUIREMENTS                                                            |                                    | TYPICAL                                                  |
|                                                                         |                                                                                       | ESA/SCC 4001/023                                                        | MIL-PRF-55342G                     |                                                          |
| Short time overload                                                     | $U = \sqrt{(6.25 \text{ Pr} \times R_n)}$<br>$U_{\max.} < 2 \text{ UL} - 2 \text{ s}$ | $\pm 0.05 \% + (0.05 \Omega \times 100/R_n)$                            | 0.10 %                             | $\pm 0.01 \%$                                            |
| Rapid temperature change                                                | - 55 °C/+ 155 °C 5 cycles<br>CEI 66-2-14 Test Na                                      | $\pm 0.05 \% + (0.05 \Omega \times 100/R_n)$                            | 0.1 %<br>(for 100 cycles)          | $\pm 0.01 \%$<br>$\pm 0.015 \% \text{ (for 500 cycles)}$ |
| Soldering<br>(thermal shock)                                            | 260 °C/10 s<br>CEI 68-2-20 A Test T6 (met. 1A)                                        | $\pm 0.05 \% + (0.05 \Omega \times 100/R_n)$                            | -                                  | $\pm 0.005 \%$                                           |
| Terminal strength:<br>Adhesion bend<br>strength of end<br>plated facing | CEI 115-1 Clause 4.32<br>CEI 115-1 Clause 4.33                                        | $\pm 0.05 \% + (0.05 \Omega \times 100/R_n)$                            | -                                  | $\pm 0.01 \%$                                            |
| Climatic sequence                                                       | CEI 67-2-1/CEI 68-2-2<br>CEI 67-2-13/CEI 68-2-30                                      | $\pm 0.10 \% + (0.05 \Omega \times 100/R_n)$                            | -                                  | $\pm 0.02 \%$<br>Insulation resistance > 1 GΩ            |
| Load life                                                               | 2000 h Pr at + 70 °C<br>90°/30° cycle<br>8000 h                                       | $\pm 0.25 \% + (0.05 \Omega \times 100/R_n)$<br>1 % + (0.05 Ω x 100/Rn) | 0.5 %                              | $\pm 0.05 \%$ (8000 h)<br>Insulation resistance > 1 GΩ   |
| High temperature exposure                                               | 2000 h Pr at + 155 °C<br>CEI 68-2-20A Test B                                          | $\pm 0.15 \% + (0.05 \Omega \times 100/R_n)$                            | $\pm 0.10 \%$<br>(duration 1000 h) | $\pm 0.05 \%$<br>Insulation resistance > 1 GΩ            |

| CODIFICATION OPTIONS ON TWO DIGITS |                 |
|------------------------------------|-----------------|
| OPTION                             | OPTION 2 DIGITS |
| ...                                | ...             |
| 0099                               | 99              |
| 0100                               | 0A              |
| 0101                               | 0B              |
| 0102                               | 0C              |
| 0103                               | 0D              |
| 0104                               | 0E              |
| 0105                               | 0F              |
| ...                                | ...             |
| 0124                               | 0Y              |
| 0125                               | 0Z              |
| 0126                               | 1A              |
| 0127                               | 1B              |
| 0128                               | 1C              |
| ...                                | ...             |
| 0320                               | 8M              |
| 0321                               | 8N              |
| 0322                               | 8O              |
| 0323                               | 8P              |
| 0324                               | 8Q              |
| 0325                               | 8R              |
| ...                                | ...             |

| CODIFICATION OF SIZES |         |
|-----------------------|---------|
| CODE 18               | CODE 40 |
| 9                     | 0402    |
| C                     | 0603    |
| D                     | 0805    |
| H                     | 1206    |
| J                     | 2010    |



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