

# SMD PTC - Nickel Thin Film Linear Thermistors



## FEATURES

- Alumina substrate base with nickel based PTC thin film element
- 0603, 0805, and 1206 sizes available
- Available in tape and reel packaging
- Standard  $R_{25}$  tolerances:  $\pm 0.5\%$ ,  $\pm 1\%$ ,  $\pm 5\%$
- Operation range  $-55\text{ }^{\circ}\text{C}$  to  $+150\text{ }^{\circ}\text{C}$
- High stability over the entire temperature range
- cUL recognized component: File E148885
- AEC-Q200 qualified (grade 1)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

| QUICK REFERENCE DATA   |                                   |           |            |                    |
|--|-----------------------------------|-----------|------------|--------------------|
| PARAMETER  | VALUE                             |           |            | UNIT               |
| DESCRIPTION  | TFPT0603                          | TFPT0805  | TFPT1206   |                    |
| Resistance value at $25\text{ }^{\circ}\text{C}$ <sup>(2)</sup>                      | 100 to 1K                         | 100 to 5K | 100 to 10K | $\Omega$           |
| Tolerance on $R_{25}$ -value <sup>(2)</sup>  | $\pm 0.5$ ; $\pm 1$ ; $\pm 5$     |           |            | %                  |
| TCR at $25\text{ }^{\circ}\text{C}$  | 4110                              |           |            | ppm/K              |
| Tolerance on TCR at $25\text{ }^{\circ}\text{C}$ <sup>(1)</sup>                      | $\pm 400$                         |           |            |                    |
| Operating temperature range:<br>at rated power<br>at zero dissipation <sup>(4)</sup> | $-55$ to $+70$<br>$-55$ to $+150$ |           |            | $^{\circ}\text{C}$ |
| Dissipation factor $\delta$ (for information only)                                   | 1.8                               | 2.3       | 4          | mW/K               |
| Maximum rated power at $70\text{ }^{\circ}\text{C}$ ( $P_{70}$ )                     | 75                                | 100       | 125        | mW                 |
| Maximum working voltage RCWV <sup>(3)</sup>  | 30                                | 40        | 50         | V                  |
| Climatic category (LCT/UCT/days)   | 55/150/56                         |           |            | -                  |
| Weight   | 2                                 | 5.5       | 10         | mg                 |

### Notes

- (1) Contact Vishay if closer TCR lot tolerance is desired.
- (2) Other  $R_{25}$ -values and tolerances are available upon request.
- (3) Rated continuous working voltage is maximum working voltage or  $\sqrt{P_{70} \times R}$  whichever is less.
- (4) Zero power or zero dissipation is considered as measuring power max. 1% of rated power  $P_{70}$ .

| STANDARD RESISTANCE VALUES at $25\text{ }^{\circ}\text{C}$ in $\Omega$ |     |     |     |      |      |      |      |       |  |
|--|-----|-----|-----|------|------|------|------|-------|--|
| 100  | 180 | 330 | 560 | 1.0K | 1.8K | 3.3K | 5.0K | 8.2K  |  |
| 120  | 220 | 390 | 680 | 1.2K | 2.2K | 3.9K | 5.6K | 10.0K |  |
| 150  | 270 | 470 | 820 | 1.5K | 2.7K | 4.7K | 6.8K |       |  |

### Note

- Rated continuous working voltage is maximum working voltage or  $\sqrt{P_{70} \times R}$  whichever is less.

| GLOBAL PART NUMBER INFORMATION  |   |   |   |                |   |                  |   |   |   |   |  |   |   |   |
|---|---|---|---|----------------|---|------------------|---|---|---|---|--|---|---|---|
| Global Part Numbering: TFPT1206L1002FM (preferred part number format) |   |   |   |                |   |                  |   |   |   |   |  |   |   |   |
| T   | F | P | T | 1              | 2 | 0                | 6 | L   | 1 | 0 | 0  | 2 | F | M |
| GLOBAL MODEL  |   |   |   | CHARACTERISTIC |   | RESISTANCE VALUE |   | TOLERANCE CODE                                    |   |   | PACKAGING  |   |   |   |
| TFPT0603<br>TFPT0805<br>TFPT1206                                      |   |   |   | L = Linear     |   | 1002 = 10K       |   | D = $\pm 0.5\%$<br>F = $\pm 1\%$<br>J = $\pm 5\%$ |   |   | M = Lead (Pb)-free, T/R (5000 pieces)<br>V = Lead (Pb)-free, T/R (1000 pieces)<br>Z = Tin/lead, T/R (5000 pieces)<br>Y = Tin/lead, T/R (1000 pieces) |   |   |   |

**DIMENSIONS** in millimeters


| PART NUMBER | A              | B              | C              | D              | E              |
|-------------|----------------|----------------|----------------|----------------|----------------|
| TFPT 0603   | 1.55<br>± 0.10 | 0.80<br>± 0.10 | 0.45<br>± 0.10 | 0.30<br>± 0.20 | 0.30<br>± 0.20 |
| TFPT 0805   | 2.00<br>± 0.15 | 1.25<br>± 0.15 | 0.45<br>± 0.10 | 0.40<br>± 0.20 | 0.40<br>± 0.20 |
| TFPT 1206   | 3.05<br>± 0.15 | 1.50<br>± 0.15 | 0.55<br>± 0.10 | 0.50<br>± 0.25 | 0.50<br>± 0.25 |

**CONSTRUCTION**

**Note**

- Zero power is considered as measuring power max. 1 % of rated power  $P_{70}$ .

| <b>TESTS AND REQUIREMENTS</b>       |  |  |
|-------------------------------------|--|--|
| TEST                                | CONDITIONS <sup>(1)</sup>  | REQUIREMENTS<br>MAX $ \Delta R_{25}/R_{25} $ |
| High temperature exposure (storage) | AEC-Q200, 1000 h at 150 °C   | 0.25 %                                       |
| Temperature cycling                 | AEC-Q200, 1000 cycles -55 °C / +125 °C                             | 0.25 %                                       |
| Biased humidity                     | 1000 h, 1 mA biased at 85 °C / 85 % RH                             | 0.25 %                                       |
|                                     | 1000 h, 1 mA biased at 40 °C / 95 % RH                             | 0.25 %                                       |
| Operational life                    | 1000 h, $P_{70}$ max biased at 85 °C                               | 0.25 %                                       |
| Mechanical shock and vibration      | MIL-STD 202, method 213 - 204                                      | 0.50 %                                       |
| Resistance to soldering heat        | MIL-STD 202, method 210, solderbath dipping 10 s at 260°C          | 0.25 %                                       |
| ESD <sup>(2)</sup>                  | AEC-Q200-002, HBM (CD) 0.5 kV (0603), 1.0 kV (0805), 1.0 kV (1206) | 0.25 %                                       |
| Board flex                          | AEC-Q200-005, 2 mm during 60 s                                     | 0.25 %                                       |
| Terminal strength                   | AEC-Q200-006, shear test 17.7 N during 60 s                        | 0.25 %                                       |

**Notes**

- <sup>(1)</sup> Environmental performance specifications use test procedures as outlined in MIL-R23648D, MIL-STD 202 and AEC-Q200.  
<sup>(2)</sup> TFPTs are ESD sensitive.



| <b>AVERAGE RATIO R/R<sub>25</sub> TFPT ALL SIZES AND VALUES</b> |                   |       |                   |           |                   |       |                   |       |                   |
|---|-------------------|-------|-------------------|-----------|-------------------|-------|-------------------|-------|-------------------|
| TEMP.   | R/R <sub>25</sub> | TEMP. | R/R <sub>25</sub> | TEMP.     | R/R <sub>25</sub> | TEMP. | R/R <sub>25</sub> | TEMP. | R/R <sub>25</sub> |
|   |                   | -20   | 0.825             | 20        | 0.980             | 60    | 1.150             | 100   | 1.337             |
|   |                   | -19   | 0.828             | 21        | 0.984             | 61    | 1.155             | 101   | 1.342             |
|   |                   | -18   | 0.832             | 22        | 0.988             | 62    | 1.159             | 102   | 1.347             |
|   |                   | -17   | 0.836             | 23        | 0.992             | 63    | 1.164             | 103   | 1.352             |
|   |                   | -16   | 0.839             | 24        | 0.996             | 64    | 1.168             | 104   | 1.357             |
| -55   | 0.702             | -15   | 0.843             | <b>25</b> | <b>1.000</b>      | 65    | 1.173             | 105   | 1.362             |
| -54   | 0.705             | -14   | 0.847             | 26        | 1.004             | 66    | 1.177             | 106   | 1.367             |
| -53   | 0.708             | -13   | 0.851             | 27        | 1.008             | 67    | 1.182             | 107   | 1.372             |
| -52   | 0.712             | -12   | 0.854             | 28        | 1.012             | 68    | 1.186             | 108   | 1.377             |
| -51   | 0.715             | -11   | 0.858             | 29        | 1.017             | 69    | 1.191             | 109   | 1.382             |
| -50   | 0.719             | -10   | 0.862             | 30        | 1.021             | 70    | 1.196             | 110   | 1.387             |
| -49   | 0.722             | -9    | 0.866             | 31        | 1.025             | 71    | 1.200             | 111   | 1.392             |
| -48   | 0.725             | -8    | 0.869             | 32        | 1.029             | 72    | 1.205             | 112   | 1.397             |
| -47   | 0.729             | -7    | 0.873             | 33        | 1.033             | 73    | 1.209             | 113   | 1.402             |
| -46   | 0.732             | -6    | 0.877             | 34        | 1.037             | 74    | 1.214             | 114   | 1.407             |
| -45   | 0.736             | -5    | 0.881             | 35        | 1.042             | 75    | 1.219             | 115   | 1.412             |
| -44   | 0.739             | -4    | 0.885             | 36        | 1.046             | 76    | 1.223             | 116   | 1.417             |
| -43   | 0.743             | -3    | 0.889             | 37        | 1.050             | 77    | 1.228             | 117   | 1.422             |
| -42   | 0.746             | -2    | 0.892             | 38        | 1.054             | 78    | 1.232             | 118   | 1.427             |
| -41   | 0.749             | -1    | 0.896             | 39        | 1.059             | 79    | 1.237             | 119   | 1.432             |
| -40   | 0.753             | 0     | 0.900             | 40        | 1.063             | 80    | 1.242             | 120   | 1.437             |
| -39   | 0.756             | 1     | 0.904             | 41        | 1.067             | 81    | 1.246             | 121   | 1.442             |
| -38   | 0.760             | 2     | 0.908             | 42        | 1.071             | 82    | 1.251             | 122   | 1.448             |
| -37   | 0.763             | 3     | 0.912             | 43        | 1.076             | 83    | 1.256             | 123   | 1.453             |
| -36   | 0.767             | 4     | 0.916             | 44        | 1.080             | 84    | 1.261             | 124   | 1.458             |
| -35   | 0.771             | 5     | 0.920             | 45        | 1.084             | 85    | 1.265             | 125   | 1.463             |
| -34   | 0.774             | 6     | 0.924             | 46        | 1.089             | 86    | 1.270             | 126   | 1.468             |
| -33   | 0.778             | 7     | 0.927             | 47        | 1.093             | 87    | 1.275             | 127   | 1.473             |
| -32   | 0.781             | 8     | 0.931             | 48        | 1.097             | 88    | 1.280             | 128   | 1.478             |
| -31   | 0.785             | 9     | 0.935             | 49        | 1.102             | 89    | 1.284             | 129   | 1.484             |
| -30   | 0.788             | 10    | 0.939             | 50        | 1.106             | 90    | 1.289             | 130   | 1.489             |
| -29   | 0.792             | 11    | 0.943             | 51        | 1.110             | 91    | 1.294             | 131   | 1.494             |
| -28   | 0.796             | 12    | 0.947             | 52        | 1.115             | 92    | 1.299             | 132   | 1.499             |
| -27   | 0.799             | 13    | 0.951             | 53        | 1.119             | 93    | 1.303             | 133   | 1.505             |
| -26   | 0.803             | 14    | 0.955             | 54        | 1.124             | 94    | 1.308             | 134   | 1.510             |
| -25   | 0.806             | 15    | 0.959             | 55        | 1.128             | 95    | 1.313             | 135   | 1.515             |
| -24   | 0.810             | 16    | 0.963             | 56        | 1.133             | 96    | 1.318             | 136   | 1.520             |
| -23   | 0.814             | 17    | 0.967             | 57        | 1.137             | 97    | 1.323             | 137   | 1.526             |
| -22   | 0.817             | 18    | 0.971             | 58        | 1.141             | 98    | 1.328             | 138   | 1.531             |
| -21   | 0.821             | 19    | 0.975             | 59        | 1.146             | 99    | 1.333             | 139   | 1.536             |
|   |                   |       |                   |           |                   |       |                   |       |                   |

**RATIO FORMULA**

$$R_T = R_{25} \times (9.0014 \times 10^{-1} + 3.87235 \times 10^{-3} (\text{°C})^{-1} \times T + 4.86825 \times 10^{-6} (\text{°C})^{-2} \times T^2 + 1.37559 \times 10^{-9} (\text{°C})^{-3} \times T^3)$$

$$T_{(\text{°C})} = 28.54 \times (R_T/R_{25})^3 - 158.5 \times (R_T/R_{25})^2 + 474.8 \times (R_T/R_{25}) - 319.85$$

| <b>RATIO TOLERANCES</b> |            |         |
|-------------------------|------------|---------|
| LOW TEMP.               | HIGH TEMP. | TOL.    |
| -55 °C                  | +150 °C    | ± 4 %   |
| -40 °C                  | +125 °C    | ± 3 %   |
| -20 °C                  | +85 °C     | ± 2 %   |
| 0 °C                    | +55 °C     | ± 1 %   |
| +12 °C                  | +40 °C     | ± 0.5 % |

**RATIO TOLERANCE EXAMPLES:**

At 40 °C, ratio = 1.063 ± 0.5 % (0.005)  
 so, ratio = 1.058 to 1.068

At 125 °C, ratio = 1.460 ± 3 % (0.044)  
 so, ratio = 1.416 to 1.504





## **Disclaimer**

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.