

# 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

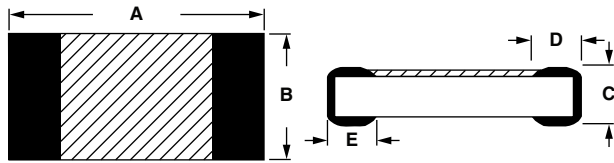
- (1) Contact Vishay if closer TCR lot tolerance is desired.
- (2) Other  $R_{25}$ -values and tolerances are available upon request.
- (3) Rated continuous working voltage is maximum working voltage or  $\sqrt{P_{70} \times R}$  whichever is less.
- (4) Zero power or zero dissipation is considered as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

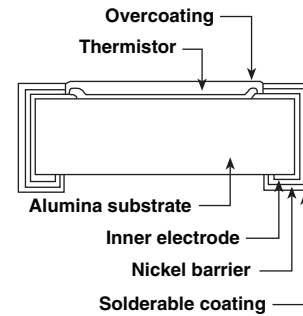
### Note

- 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  $P_{70}$ .

| TESTS AND REQUIREMENTS              |  |  |
|-------------------------------------|--|--|
| 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 <math>R/R_{25}</math> TFPT ALL SIZES AND VALUES</b> |            |       |            |           |              |       |            |       |            |     |       |
|--|------------|-------|------------|-----------|--------------|-------|------------|-------|------------|-----|-------|
| TEMP.  | $R/R_{25}$ | TEMP. | $R/R_{25}$ | TEMP.     | $R/R_{25}$   | TEMP. | $R/R_{25}$ | TEMP. | $R/R_{25}$ |     |       |
|  |            | -20   | 0.825      | 20        | 0.980        | 60    | 1.150      | 100   | 1.337      | 140 | 1.541 |
|  |            | -19   | 0.828      | 21        | 0.984        | 61    | 1.155      | 101   | 1.342      | 141 | 1.547 |
|  |            | -18   | 0.832      | 22        | 0.988        | 62    | 1.159      | 102   | 1.347      | 142 | 1.552 |
|  |            | -17   | 0.836      | 23        | 0.992        | 63    | 1.164      | 103   | 1.352      | 143 | 1.557 |
|  |            | -16   | 0.839      | 24        | 0.996        | 64    | 1.168      | 104   | 1.357      | 144 | 1.563 |
| -55  | 0.702      | -15   | 0.843      | <b>25</b> | <b>1.000</b> | 65    | 1.173      | 105   | 1.362      | 145 | 1.568 |
| -54  | 0.705      | -14   | 0.847      | 26        | 1.004        | 66    | 1.177      | 106   | 1.367      | 146 | 1.574 |
| -53  | 0.708      | -13   | 0.851      | 27        | 1.008        | 67    | 1.182      | 107   | 1.372      | 147 | 1.579 |
| -52  | 0.712      | -12   | 0.854      | 28        | 1.012        | 68    | 1.186      | 108   | 1.377      | 148 | 1.584 |
| -51  | 0.715      | -11   | 0.858      | 29        | 1.017        | 69    | 1.191      | 109   | 1.382      | 149 | 1.590 |
| -50  | 0.719      | -10   | 0.862      | 30        | 1.021        | 70    | 1.196      | 110   | 1.387      | 150 | 1.595 |
| -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**

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

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

| <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 =  $1.063 \pm 0.5\%$  (0.005)  
 so, ratio = 1.058 to 1.068

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





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