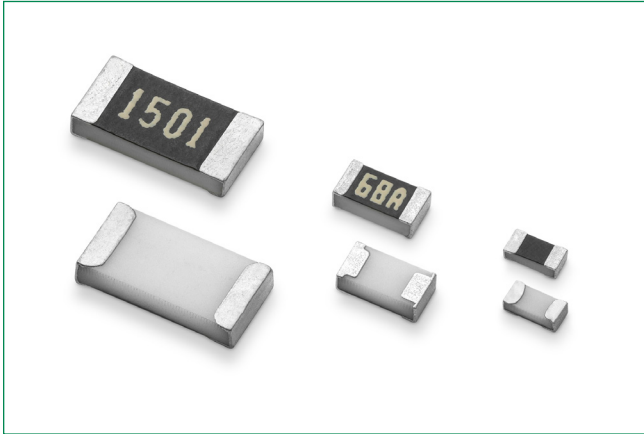


# Thin Film Precision Chip Resistor

## TFR Series

HF RoHS Pb



### Web Resources



Download ECAD models, order samples, and find technical resources at [www.littelfuse.com](http://www.littelfuse.com)

### Description

Littelfuse TFR Series is a thin film resistor with tight tolerances and low temperature coefficient of resistance. This makes them suited for use in high precision applications.

### Features

- Advanced thin film technology
- Very tight tolerance down to  $\pm 0.01\%$
- Extremely low TCR down to  $\pm 5\text{PPM}/^\circ\text{C}$  (down to  $\pm 1\text{ppm}/^\circ\text{C}$  on requests)
- Wide resistance range  $1\text{ohm} \sim 3\text{MOhm}$
- Miniature size 0201 available

### Benefits

- Small size
- High accuracy and stability during operation

### Application

- Medical Equipment
- Testing/Measurement Equipment
- Printer Equipment
- Automatic Equipment Controller
- Converters
- Communication Device, Cell Phone, GPS, PDA

# Thin Film Precision Chip Resistor

## TFR Series

### Electrical Specifications

| Item / Type  | Power Rating at 70°C | Operating Temp. Range | Max. Operating Voltage | Max. Overload Voltage | Resistance Range |            |               |          | TCR^ (PPM/°C) |
|--------------|----------------------|-----------------------|------------------------|-----------------------|------------------|------------|---------------|----------|---------------|
|              |                      |                       |                        |                       | ±0.01%           | ±0.05%     | ±0.1%         | ±0.5%    |               |
| TFR0201      | 1/20 W               | -55 ~ +155 °C         | 25 V                   | 50 V                  | —                |            | 22Ω–75kΩ      |          | ±25           |
| TFR0402      | 1/10 W               | -55 ~ +155 °C         | 50 V                   | 100 V                 | 49.9Ω–4.99kΩ     |            |               | —        | ±1, ±2, ±3    |
|              |                      |                       |                        |                       | 49.9Ω–20kΩ       |            |               |          | ±5            |
|              |                      |                       |                        |                       | 49.9Ω–12kΩ       |            | 49.9Ω–100kΩ   |          | ±10           |
|              |                      |                       |                        |                       | —                | 49.9Ω–12kΩ | 4.7Ω~255kΩ    |          | ±25           |
| TFR0603      | 1/10 W               | -55 ~ +155 °C         | 75 V                   | 150 V                 | 24.9Ω–15kΩ       |            |               | —        | ±1, ±2, ±3    |
|              |                      |                       |                        |                       | 24.9Ω–60kΩ       |            |               |          | ±5            |
|              |                      |                       |                        |                       | 24.9Ω– 100kΩ     | 4.7Ω–332kΩ | 4.7Ω–511kΩ    |          | ±10           |
|              |                      |                       |                        |                       |                  |            | 1Ω–1MΩ        |          | ±25           |
|              | 1/6 W                | -55 ~ +155 °C         | 100 V                  | 150 V                 | —                | 10Ω–332kΩ  |               |          | ±25           |
| TFR0805      | 1/8 W                | -55 ~ +155 °C         | 150 V                  | 300 V                 | 24.9Ω–30kΩ       |            |               | —        | ±1, ±2, ±3    |
|              |                      |                       |                        |                       | 24.9Ω–150kΩ      |            |               |          | ±5            |
|              |                      |                       |                        |                       | 24.9Ω– 200kΩ     | 4.7Ω–511kΩ | 4.7Ω–1MΩ      |          | ±10           |
|              |                      |                       |                        |                       |                  |            | 1Ω–2MΩ        |          | ±25           |
|              | 1/4 W                | -55 ~ +155 °C         | 150 V                  | 300 V                 | —                | 10Ω–499kΩ  |               |          | ±25           |
| TFR1206      | 1/4 W                | -55 ~ +155 °C         | 200 V                  | 400 V                 | 24.9Ω–49.9kΩ     |            |               | —        | ±1, ±2, ±3    |
|              |                      |                       |                        |                       | 24.9Ω–300kΩ      |            |               |          | ±5            |
|              |                      |                       |                        |                       | 24.9Ω– 499kΩ     | 4.7Ω–1MΩ   |               |          | ±10           |
|              |                      |                       |                        |                       |                  | 1Ω - 1MΩ   | 1Ω–3MΩ        |          | ±25           |
|              | 1/3 W                | -55 ~ +155 °C         | 200 V                  | 400 V                 | —                | 10Ω ~1MΩ   |               |          | ±25           |
| TFR1210      | 1/3 W                | -55 ~ +155 °C         | 200 V                  | 400 V                 | 24.9Ω–49.9kΩ     |            |               | —        | ±1, ±2, ±3    |
|              |                      |                       |                        |                       | 24.9Ω–300kΩ      |            |               |          | ±5            |
|              |                      |                       |                        |                       | 24.9Ω– 499KΩ     | 4.7Ω - 1MΩ |               |          | ±10           |
|              |                      |                       |                        |                       |                  | 1Ω–1MΩ     | 1Ω–3MΩ        |          | ±25           |
|              |                      |                       |                        |                       | TFR2010          | 1/3 W      | -55 ~ +155 °C | 200 V    | 400 V         |
| 24.9Ω–300kΩ  |                      |                       |                        | ±5                    |                  |            |               |          |               |
| 24.9Ω– 499kΩ | 4.7Ω–1MΩ             |                       |                        | ±10                   |                  |            |               |          |               |
|              | 1Ω–1MΩ               | 1Ω–3MΩ                |                        | ±25                   |                  |            |               |          |               |
| 1/2 W        | -55 ~ +155 °C        | 200 V                 | 400 V                  | 24.9Ω–2kΩ             |                  | 4.7Ω–1MΩ   |               | 1Ω–1MΩ   | ±10           |
|              |                      |                       |                        | 24.9Ω–2kΩ             |                  | 4.7Ω–1MΩ   | 4.7Ω–3MΩ      | 1Ω–1MΩ   | ±25           |
| TFR2512      | 3/4 W                | -55 ~ +155 °C         | 200 V                  | 400 V                 | 24.9Ω–2kΩ        | 4.7Ω–2kΩ   |               | 1Ω–2KΩ   | ±10, ±25      |
|              | 1 W                  | -55 ~ +155 °C         | 200 V                  | 400 V                 | 24.9Ω–2kΩ        | 4.7Ω–1MΩ   |               | 1Ω–1MΩ   | ±10           |
|              |                      |                       |                        |                       | 24.9Ω–2kΩ        | 4.7Ω–1MΩ   |               | 4.7Ω–3MΩ | ±25           |

Note: <sup>Δ</sup>TCR of ±1, ±2, ±3 are available on request

# Thin Film Precision Chip Resistor

## TFR Series

### Environmental Characteristics

| Item                                           | Requirement                         |              | Test Method                                                                                           |
|------------------------------------------------|-------------------------------------|--------------|-------------------------------------------------------------------------------------------------------|
|                                                | Tol. ≤ 0.05%                        | Tol. > 0.05% |                                                                                                       |
| Temperature Coefficient of Resistance (T.C.R.) | As Spec.                            |              | MIL-STD-202 Method 304<br>+25/-55/+25/+125/+25 °C                                                     |
| Short Time Overload                            | ΔR±0.05%                            | ΔR±0.2%      | JIS-C-5201-1 4.13<br>RCWV*2.5 or Max. overload voltage whichever is lower for 5 seconds               |
|                                                | ΔR±0.2% for high power rating       |              |                                                                                                       |
| Insulation Resistance                          | >9999 MΩ                            |              | MIL-STD-202 Method 302<br>Apply 100 VDC for 1 minute                                                  |
| Endurance                                      | ΔR±0.05%                            | ΔR±0.2%      | MIL-STD-202 Method 108A<br>70±2 °C, RCWV for 1000 hrs with 1.5 hrs “ON” and 0.5 hrs “OFF”             |
|                                                | ΔR±0.5% for high power rating       |              |                                                                                                       |
|                                                | 0201: >7kΩ →ΔR±0.5%<br>≤7kΩ→ΔR±0.2% |              |                                                                                                       |
| Damp Heat with Load                            | ΔR±0.05%                            | ΔR±0.3%      | MIL-STD-202 Method 103B<br>40±2 °C, 90~95% R.H. RCWV for 1000 hrs with 1.5 hrs “ON” and 0.5 hrs “OFF” |
|                                                | ΔR±0.5% for high power rating       |              |                                                                                                       |
| Bending Strength                               | ΔR±0.05%                            | ΔR±0.1%      | JIS-C-5201-1 4.33<br>Bending amplitude 3 mm for 60 seconds<br>2010 2512 sizes: 2 mm Other sizes: 3 mm |
| Solderability                                  | 95% min. coverage                   |              | MIL-STD-202 Method 208H<br>245±5 °C for 3 seconds                                                     |
| Resistance to Soldering Heat                   | ΔR±0.05%                            | ΔR±0.1%      | MIL-STD-202 Method 210E<br>260±5 °C for 10 seconds                                                    |
| Dielectric Withstand Voltage                   | By Type                             |              | MIL-STD-202 Method 301<br>Maximum overload voltage for 1 minute                                       |
| Low Temperature Operation                      | ΔR±0.05%                            | ΔR±0.2%      | JIS-C-5201-1 4.36<br>1 hour, -65 °C, followed by 45 minutes of RCWV                                   |
|                                                | ΔR±0.5% for high power rating       |              |                                                                                                       |
| High Temperature Exposure                      | ΔR±0.5%                             |              | MIL-STD-202 Method 108<br>at +155 °C for 1000 hrs                                                     |

**Note:**

RCWV (Rated continuous working voltage) =  $\sqrt{P \cdot R}$  or maximum operating voltage whichever is lower.

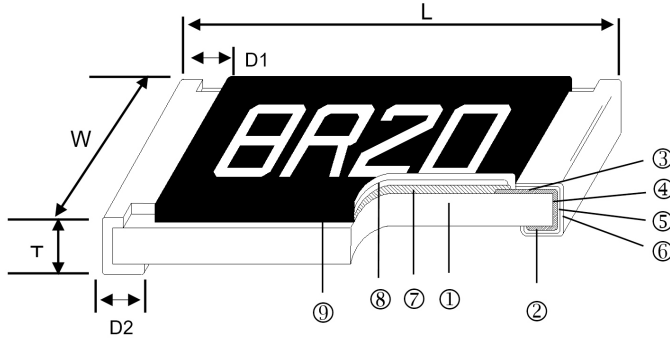
■ Storage Temperature: 15~28°C; Humidity < 80%RH.

■ Shelf Life: 2 years from production date.

# Thin Film Precision Chip Resistor

## TFR Series

### Construction



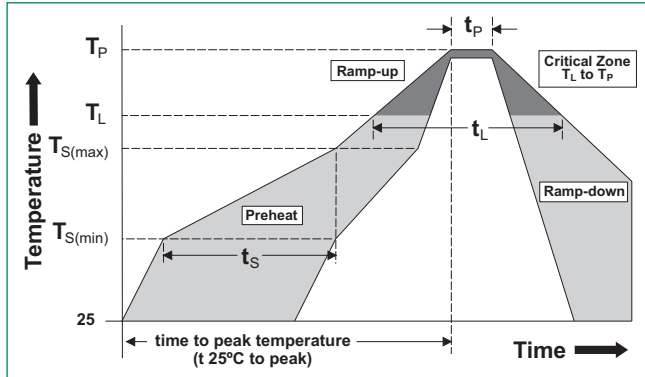
|   |                   |   |                    |
|---|-------------------|---|--------------------|
| 1 | Alumina Substrate | 6 | External Electrode |
| 2 | Bottom Electrode  | 7 | Resistor Layer     |
| 3 | Top Electrode     | 8 | Overcoat           |
| 4 | Edge Electrode    | 9 | Marking            |
| 5 | Barrier Layer     |   |                    |

| Type                    | Size (Inch)  | L         | W         | T         | D1        | D2        | Weight (g) (1000pcs) |
|-------------------------|--------------|-----------|-----------|-----------|-----------|-----------|----------------------|
| TFR0201                 | 0201         | 0.58±0.05 | 0.29±0.05 | 0.23±0.05 | 0.12±0.05 | 0.15±0.05 | 0.14                 |
| TFR0402                 | 0402         | 1.00±0.05 | 0.50±0.05 | 0.30±0.05 | 0.20±0.10 | 0.20±0.10 | 0.54                 |
| TFR0603                 | 0603         | 1.55±0.10 | 0.80±0.10 | 0.45±0.10 | 0.30±0.20 | 0.30±0.20 | 1.83                 |
| TFR0805                 | 0805         | 2.00±0.15 | 1.25±0.15 | 0.55±0.10 | 0.30±0.20 | 0.40±0.20 | 4.71                 |
| TFR1206                 | 1206         | 3.05±0.15 | 1.55±0.15 | 0.55±0.10 | 0.42±0.20 | 0.35±0.25 | 9.02                 |
| TFR1210                 | 1210         | 3.10±0.15 | 2.40±0.15 | 0.55±0.10 | 0.40±0.20 | 0.55±0.25 | 10                   |
| TFR1200                 | 2010         | 4.90±0.15 | 2.40±0.15 | 0.55±0.10 | 0.60±0.30 | 0.50±0.25 | 23.61                |
| TFR2010 (1/2 W)         | 2010 (1/2 W) | 4.90±0.15 | 2.40±0.15 | 0.55±0.10 | 0.60±0.30 | 2.20±0.25 | 26.68                |
| TFR2512                 | 2512         | 6.30±0.15 | 3.10±0.15 | 0.55±0.10 | 0.60±0.30 | 0.50±0.25 | 38.06                |
| TFR2512 (1W) 1~100Ω     | 2512 (1W)    | 6.30±0.15 | 3.10±0.15 | 0.55±0.10 | 0.60±0.30 | 0.50±0.25 | 44.65                |
| TFR2512 (1W) 101Ω above | 2512 (1W)    | 6.30±0.15 | 3.10±0.15 | 0.55±0.10 | 0.60±0.30 | 2.50±0.25 | 44.65                |

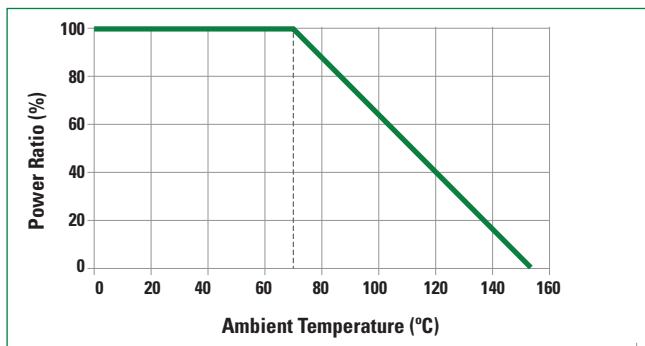
# Thin Film Precision Chip Resistor

## TFR Series

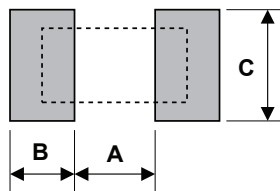
### Soldering Condition (IPC/JEDEC J-STD-020)



### Temperature De-rating Curve



### Recommend Land Pattern



| Type                    | A    | B    | C        |
|-------------------------|------|------|----------|
| TFR0201                 | 0.25 | 0.30 | 0.40±0.2 |
| TFR0402                 | 0.50 | 0.50 | 0.60±0.2 |
| TFR0603                 | 0.80 | 1.00 | 0.90±0.2 |
| TFR0805                 | 1.00 | 1.00 | 1.35±0.2 |
| TFR1206                 | 2.00 | 1.15 | 1.70±0.2 |
| TFR1210                 | 2.00 | 1.15 | 2.50±0.2 |
| TFR2010                 | 3.60 | 1.40 | 2.50±0.2 |
| TFR2010 (1/2W)          | 1.00 | 2.70 | 2.50±0.2 |
| TFR2512                 | 4.90 | 1.60 | 3.10±0.2 |
| TFR2512 (1W) 1~100Ω     | 4.90 | 1.60 | 3.10±0.2 |
| TFR2512 (1W) 101Ω above | 1.00 | 3.55 | 3.10±0.2 |

|                                                        |                                    |                   |
|--------------------------------------------------------|------------------------------------|-------------------|
| Reflow Condition                                       |                                    | Pb-free assembly  |
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150 °C            |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200 °C            |
|                                                        | - Time (Min to Max) ( $t_s$ )      | 60–120 seconds    |
| Average Ramp-up Rate (Liquidus Temp ( $T_L$ ) to peak) |                                    | 3 °C/second max.  |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 53 °C/second max. |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217 °C            |
|                                                        | - Temperature ( $t_L$ )            | 60–150 seconds    |
| Peak Temperature ( $T_p$ )                             |                                    | 260 °C            |
| Time within 5°C of actual peak Temperature ( $t_p$ )   |                                    | 30 seconds        |
| Ramp-down Rate                                         |                                    | 6 °C/second max.  |
| Time 25 °C to peak Temperature ( $T_p$ )               |                                    | 8 minutes max.    |

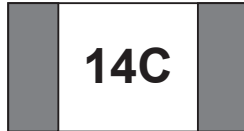
### Part Numbering System

|                         |  |                   |  |                                                    |  |                                                      |  |                                                                                                                                   |  |
|-------------------------|--|-------------------|--|----------------------------------------------------|--|------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------|--|
| TFR 0201 B H A 1001 N R |  |                   |  |                                                    |  |                                                      |  |                                                                                                                                   |  |
| Series                  |  | Dimensions (Inch) |  | Resistance Tolerance                               |  | TCR (PPM/°C)                                         |  | Packaging Code                                                                                                                    |  |
|                         |  |                   |  | E: ±0.01 %<br>A: ±0.05 %<br>B: ±0.1 %<br>D: ±0.5 % |  | A: ±1<br>B: ±2<br>C: ±3<br>E: ±5<br>F: ±10<br>H: ±25 |  | R: Reel<br>Blank: Bulk                                                                                                            |  |
|                         |  |                   |  |                                                    |  |                                                      |  | Quantity Code                                                                                                                     |  |
|                         |  |                   |  |                                                    |  |                                                      |  | N: 5000<br>K: 10000                                                                                                               |  |
|                         |  |                   |  |                                                    |  |                                                      |  | Resistance                                                                                                                        |  |
|                         |  |                   |  |                                                    |  |                                                      |  | 0010: 1Ω<br>4R70: 4.7Ω<br>1001: 1KΩ<br>1004: 1MΩ                                                                                  |  |
|                         |  |                   |  |                                                    |  |                                                      |  | Power Rating                                                                                                                      |  |
|                         |  |                   |  |                                                    |  |                                                      |  | : Standard                                                                                                                        |  |
|                         |  |                   |  |                                                    |  |                                                      |  | A: 1/20 W<br>B: 1/16 W<br>C: 1/10 W<br>D: 1/8 W<br>E: 1/6 W<br>F: 1/5 W<br>G: 1/4 W<br>H: 1/3 W<br>I: 1/2 W<br>J: 3/4 W<br>K: 1 W |  |

# Thin Film Precision Chip Resistor

## TFR Series

### Part Marking



**0603:** Three digit product marking. For example:

**14C** = 13K7Ω

**13C** = 13K3Ω

**68B** = 4K99Ω

**68X** = 49.9Ω

**0603:** Three digit product marking for **E24**. For example:

**101** = 100Ω

**102** = 1KΩ

| E24 | 10 | 11 | 12 | 13 | 15 | 16 | 18 | 20 | 22 | 24 | 27 | 30 |
|-----|----|----|----|----|----|----|----|----|----|----|----|----|
|     | 33 | 36 | 39 | 43 | 47 | 51 | 56 | 62 | 68 | 75 | 82 | 91 |

**0805~2512** 4digit marking. For example:

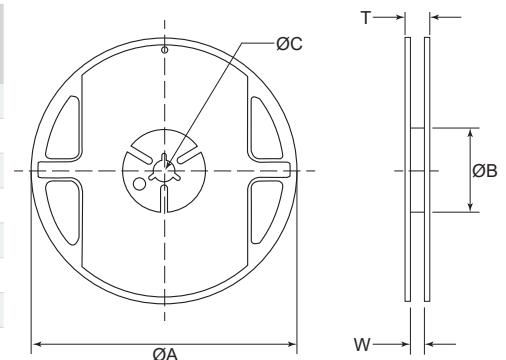
| Resistance | 100Ω | 2.2KΩ | 10KΩ | 49.9KΩ | 100KΩ |
|------------|------|-------|------|--------|-------|
| Marking    | 1000 | 2201  | 1002 | 4992   | 1003  |

### Marking Table

| Code       | E96             |  | Code            | E96             |                 | Code            | E96             |                 | Code            | E96 |                  |                  |                  |
|------------|-----------------|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----|------------------|------------------|------------------|
| 01         | 100             |  | 25              | 178             |                 | 49              | 316             |                 | 73              | 562 |                  |                  |                  |
| 02         | 102             |  | 26              | 182             |                 | 50              | 324             |                 | 74              | 576 |                  |                  |                  |
| 03         | 105             |  | 27              | 187             |                 | 51              | 332             |                 | 75              | 590 |                  |                  |                  |
| 04         | 107             |  | 28              | 191             |                 | 52              | 340             |                 | 76              | 604 |                  |                  |                  |
| 05         | 110             |  | 29              | 196             |                 | 53              | 348             |                 | 77              | 619 |                  |                  |                  |
| 06         | 113             |  | 30              | 200             |                 | 54              | 357             |                 | 78              | 634 |                  |                  |                  |
| 07         | 115             |  | 31              | 205             |                 | 55              | 365             |                 | 79              | 649 |                  |                  |                  |
| 08         | 118             |  | 32              | 210             |                 | 56              | 374             |                 | 80              | 665 |                  |                  |                  |
| 09         | 121             |  | 33              | 215             |                 | 57              | 383             |                 | 81              | 681 |                  |                  |                  |
| 10         | 124             |  | 34              | 221             |                 | 58              | 392             |                 | 82              | 698 |                  |                  |                  |
| 11         | 127             |  | 35              | 226             |                 | 59              | 402             |                 | 83              | 715 |                  |                  |                  |
| 12         | 130             |  | 36              | 232             |                 | 60              | 412             |                 | 84              | 732 |                  |                  |                  |
| 13         | 133             |  | 37              | 237             |                 | 61              | 422             |                 | 85              | 750 |                  |                  |                  |
| 14         | 137             |  | 38              | 243             |                 | 62              | 432             |                 | 86              | 768 |                  |                  |                  |
| 15         | 140             |  | 39              | 249             |                 | 63              | 442             |                 | 87              | 787 |                  |                  |                  |
| 16         | 143             |  | 40              | 255             |                 | 64              | 453             |                 | 88              | 806 |                  |                  |                  |
| 17         | 147             |  | 41              | 261             |                 | 65              | 464             |                 | 89              | 825 |                  |                  |                  |
| 18         | 150             |  | 42              | 267             |                 | 66              | 475             |                 | 90              | 845 |                  |                  |                  |
| 19         | 154             |  | 43              | 274             |                 | 67              | 487             |                 | 91              | 866 |                  |                  |                  |
| 20         | 158             |  | 44              | 280             |                 | 68              | 499             |                 | 92              | 887 |                  |                  |                  |
| 21         | 162             |  | 45              | 287             |                 | 69              | 511             |                 | 93              | 909 |                  |                  |                  |
| 22         | 165             |  | 46              | 294             |                 | 70              | 523             |                 | 94              | 931 |                  |                  |                  |
| 23         | 169             |  | 47              | 301             |                 | 71              | 536             |                 | 95              | 953 |                  |                  |                  |
| 24         | 174             |  | 48              | 309             |                 | 72              | 549             |                 | 96              | 976 |                  |                  |                  |
| Code       | A               |  | B               | C               | D               | E               | F               | G               | H               |     | X                | Y                | Z                |
| Multiplier | 10 <sup>0</sup> |  | 10 <sup>1</sup> | 10 <sup>2</sup> | 10 <sup>3</sup> | 10 <sup>4</sup> | 10 <sup>5</sup> | 10 <sup>6</sup> | 10 <sup>7</sup> |     | 10 <sup>-1</sup> | 10 <sup>-2</sup> | 10 <sup>-3</sup> |

### Packing Quantity and Reel Specifications

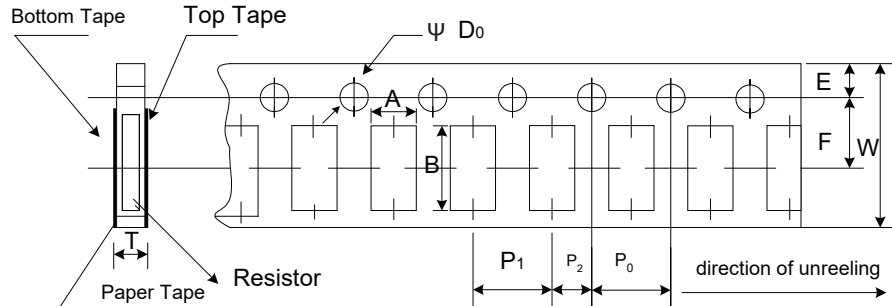
| Type    | ØA        | ØB       | ØC       | W        | T        | Paper Tape (EA) | Emboss Plastic Tape (EA) |
|---------|-----------|----------|----------|----------|----------|-----------------|--------------------------|
| TFR0201 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0  | 11.5±1.0 | 10,000          | —                        |
| TFR0402 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0  | 11.5±1.0 | 10,000          | —                        |
| TFR0603 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0  | 11.5±1.0 | 5,000           | —                        |
| TFR0805 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0  | 11.5±1.0 | 5,000           | —                        |
| TFR1206 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0  | 11.5±1.0 | 5,000           | —                        |
| TFR1210 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0  | 11.5±1.0 | 5,000           | —                        |
| TFR2010 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 13.5±1.0 | 15.5±1.0 | —               | 4,000                    |
| TFR2512 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 13.5±1.0 | 15.5±1.0 | —               | 4,000                    |



# Thin Film Precision Chip Resistor

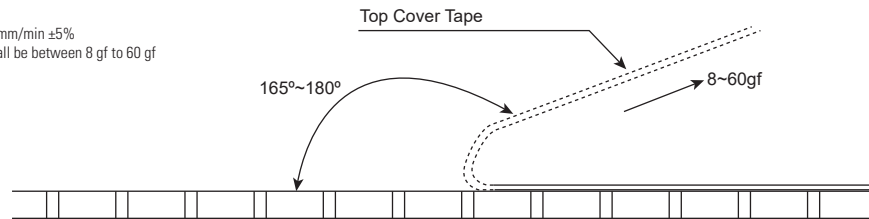
## TFR Series

### Paper Tape Specifications

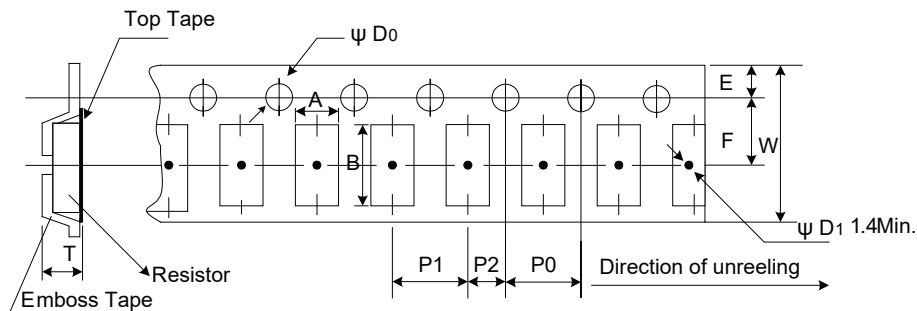


| Type    | A         | B         | W         | E         | F        | P0        | P1        | P2        | ØD0       | T         |
|---------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|
| TFR0201 | 0.40±0.05 | 0.70±0.05 | 8.00±0.10 | 1.75±0.05 | 3.5±0.05 | 4.00±0.10 | 2.00±0.05 | 2.00±0.05 | 1.55±0.03 | 0.42±0.02 |
| TFR0402 | 0.70±0.05 | 1.16±0.05 | 8.00±0.10 | 1.75±0.05 | 3.5±0.05 | 4.00±0.10 | 2.00±0.05 | 2.00±0.05 | 1.55±0.05 | 0.40±0.03 |
| TFR0603 | 1.10±0.05 | 1.90±0.05 | 8.00±0.10 | 1.75±0.05 | 3.5±0.05 | 4.00±0.10 | 4.00±0.10 | 2.00±0.05 | 1.55±0.05 | 0.60±0.03 |
| TFR0805 | 1.60±0.05 | 2.37±0.05 | 8.00±0.10 | 1.75±0.05 | 3.5±0.05 | 4.00±0.10 | 4.00±0.10 | 2.00±0.05 | 1.55±0.05 | 0.75±0.05 |
| TFR1206 | 2.00±0.05 | 3.55±0.05 | 8.00±0.10 | 1.75±0.05 | 3.5±0.05 | 4.00±0.10 | 4.00±0.10 | 2.00±0.05 | 1.55±0.05 | 0.75±0.05 |
| TFR1210 | 2.75±0.05 | 3.40±0.05 | 8.00±0.10 | 1.75±0.05 | 3.5±0.05 | 4.00±0.05 | 4.00±0.10 | 2.00±0.05 | 1.60±0.10 | 0.75±0.05 |

- Peel force of top cover tape
- The peel speed shall be about 300 mm/min ±5%
- The peel force of top cover tape shall be between 8 gf to 60 gf

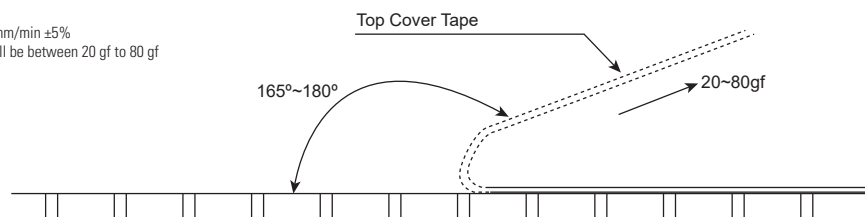


### Emboss Plastic Tape Specifications



| Type    | A         | B         | W         | E         | F        | P0        | P1        | P2        | ØD0       | T         |
|---------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|
| TFR2010 | 2.85±0.10 | 5.45±0.10 | 12.0±0.10 | 1.75±0.10 | 5.5±0.05 | 4.00±0.05 | 4.00±0.10 | 2.00±0.05 | 1.50±0.10 | 1.00±0.20 |
| TFR2512 | 3.40±0.10 | 6.65±0.10 | 12.0±0.10 | 1.75±0.10 | 5.5±0.05 | 4.00±0.05 | 4.00±0.10 | 2.00±0.05 | 1.50±0.10 | 1.00±0.20 |

- Peel force of top cover tape
- The peel speed shall be about 300 mm/min ±5%
- The peel force of top cover tape shall be between 20 gf to 80 gf



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