

## Data Sheet

Customer :

Product : Thin Film Current Sensing Chip Resistor –TCS Series

Size : 0402/0603/0805/1206/2010/2512

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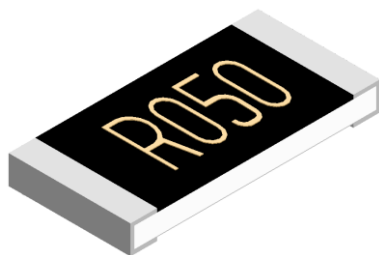
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| 1-Jul-24            | 1-Jul-24           | 1-Jul-24            | 1-Jul-24               |                           |
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## Thin Film Current Sensing Chip Resistor (TCS Series)



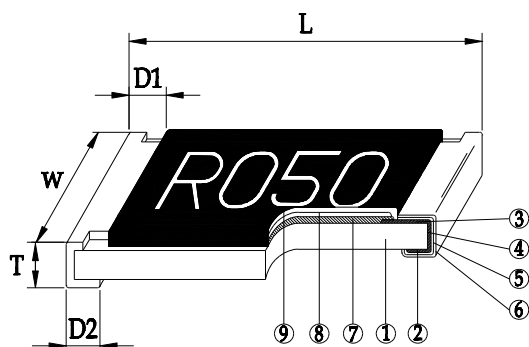
### ■ Features

- Thin film process
- High power rating up to 3 Watts in 2512 size
- Tight tolerance down to  $\pm 0.5\%$
- Extremely low TCR down to  $\pm 50$  PPM/ $^{\circ}\text{C}$
- Resistance values from 50m to 1ohm
- High purity alumina substrate for high power dissipation

### ■ Applications

- Power Management Applications
- Switching Power Supply
- Over Current Protection in Audio Applications
- Voltage Regulation Module (VRM)
- DC-DC Converter, Battery Pack, Charger, Adaptor
- Disk Driver
- Portable Devices (PDA, Cell Phone)

### ■ Construction



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

### ■ Dimensions

Unit: mm

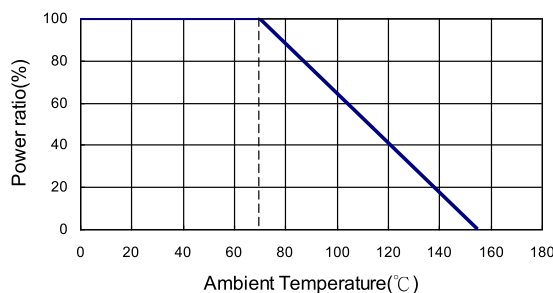
| Type      | Size (Inch) | L               | W               | T               | D1              | D2              | Weight (g)<br>(1000pcs) |
|-----------|-------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------------|
| TCS02     | 0402        | 1.00 $\pm$ 0.05 | 0.50 $\pm$ 0.05 | 0.32 $\pm$ 0.10 | 0.25 $\pm$ 0.10 | 0.20 $\pm$ 0.10 | 0.56                    |
| TCS03     | 0603        | 1.60 $\pm$ 0.10 | 0.80 $\pm$ 0.10 | 0.45 $\pm$ 0.10 | 0.30 $\pm$ 0.20 | 0.30 $\pm$ 0.20 | 3.1                     |
| TCS05     | 0805        | 2.00 $\pm$ 0.15 | 1.25 $\pm$ 0.15 | 0.55 $\pm$ 0.10 | 0.30 $\pm$ 0.20 | 0.40 $\pm$ 0.25 | 5.6                     |
| TCS06     | 1206        | 3.05 $\pm$ 0.15 | 1.55 $\pm$ 0.15 | 0.55 $\pm$ 0.10 | 0.50 $\pm$ 0.30 | 0.40 $\pm$ 0.25 | 12.3                    |
| TCS10     | 2010        | 5.00 $\pm$ 0.20 | 2.45 $\pm$ 0.15 | 0.60 $\pm$ 0.15 | 0.60 $\pm$ 0.30 | 0.50 $\pm$ 0.25 | 26.7                    |
| TCS12     | 2512        | 6.35 $\pm$ 0.20 | 3.15 $\pm$ 0.15 | 0.60 $\pm$ 0.10 | 0.60 $\pm$ 0.30 | 0.55 $\pm$ 0.25 | 49.6                    |
| TCS12(3W) | 2512        | 6.35 $\pm$ 0.20 | 3.15 $\pm$ 0.15 | 0.75 $\pm$ 0.10 | 0.60 $\pm$ 0.30 | 0.55 $\pm$ 0.25 | 49.6                    |

## Part Numbering

| TCS          | 12                                                                   | F                    | T                         | E                            |                                      | R050                                  |                             |
|--------------|----------------------------------------------------------------------|----------------------|---------------------------|------------------------------|--------------------------------------|---------------------------------------|-----------------------------|
| Product Type | Dimensions (L×W)                                                     | Resistance Tolerance | Packaging Code            | TCR (PPM/°C)                 | Power Rating                         | Resistance                            | Marking                     |
|              | 02: 0402<br>03: 0603<br>05: 0805<br>06: 1206<br>10: 2010<br>12: 2512 | D: ±0.5%<br>F: ±1%   | T: Taping Reel<br>B: Bulk | D: ±50<br>E: ±100<br>F: ±200 | : Standard*<br>(See Remark)<br>R: 3W | R050: 0.05Ω<br>R100: 0.1Ω<br>1R00: 1Ω | : Standard<br>N: No Marking |

\*Remark: Standard part no need for power rating code.

## Derating Curve



## Standard Electrical Specifications

| Item<br>Type | Power Rating<br>at 70°C | Operating<br>Temp. Range | Resistance Range<br>(mΩ)            |          | TCR<br>(PPM/°C)     |
|--------------|-------------------------|--------------------------|-------------------------------------|----------|---------------------|
|              |                         |                          | ±0.5%                               | ±1%      |                     |
| TCS02 (0402) | 1/16W                   | -55~+155°C               | 500 - 1000                          |          | ±100<br>±50         |
| TCS03 (0603) | 1/10W                   | -55~+155°C               | 200 - 300<br>301 - 1000             |          | ±100<br>±50         |
| TCS05 (0805) | 1/8W                    |                          | 200 - 300<br>301 - 1000             |          | ±100<br>±50         |
| TCS06 (1206) | 1/4W                    | -55~+155°C               | —                                   | 50 - 100 | ±200<br>±100<br>±50 |
|              |                         |                          | 101 - 300<br>301 - 1000             |          |                     |
| TCS10 (2010) | 3/4W                    | -55~+155°C               | 50 - 100<br>101 - 300<br>301 - 1000 |          | ±200<br>±100<br>±50 |
| TCS12 (2512) | 1W                      | -55~+155°C               | 50 - 100<br>101 - 300<br>301 - 1000 |          | ±200<br>±100<br>±50 |

## High Power Rating Electrical Specifications

| Type \ Item  | Power Rating at 70°C | Operating Temp. Range | Resistance Range (mΩ) |     | TCR (PPM/°C) |
|--------------|----------------------|-----------------------|-----------------------|-----|--------------|
|              |                      |                       | ±0.5%                 | ±1% |              |
| TCS12 (2512) | 3W                   | -55~+155°C            | 100 - 1000            |     | ±100         |

Operating Voltage= $\sqrt{P \cdot R}$

Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$

■ Viking is capable of manufacturing the optional spec based on customer's requirement.

## ■ Environmental Characteristics

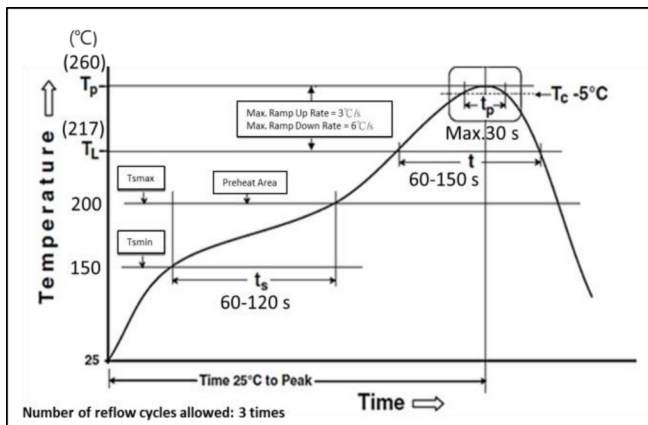
| Item                                           | Requirement       | Test Method                                                                                                  |
|------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------------|
| Temperature Coefficient of Resistance (T.C.R.) | As Spec.          | <b>MIL-STD-202 Method 304</b><br>+25/-55/+25/+125/+25°C                                                      |
| Short Time Overload                            | ±1%               | <b>JIS-C-5201-1 4.13</b><br>RCWV*2.5 or Max. overload voltage whichever is lower for 5seconds                |
| Insulation Resistance                          | >1000MΩ           | <b>MIL-STD-202 Method 302</b><br>Apply 100V <sub>DC</sub> for 1 minute                                       |
| Endurance                                      | ±1%               | <b>MIL-STD-202 Method 108A</b><br>70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"              |
| Damp Heat with Load                            | ±0.5%             | <b>MIL-STD-202 Method 103B</b><br>40±2°C, 90~95% R.H., RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF" |
| Bending Strength                               | As Spec.          | <b>JIS-C-5201-1 4.33</b><br>Bending amplitude 3mm for 10 seconds                                             |
| Solderability                                  | 95% min. coverage | <b>MIL-STD-202 Method 208H</b><br>245±5°C for 3 seconds                                                      |
| Resistance to Soldering Heat                   | ±0.5%             | <b>MIL-STD-202 Method 210E</b><br>260±5°C for 10 seconds                                                     |
| Dielectric Withstand Voltage                   | By Type           | <b>MIL-STD-202 Method 301</b><br>Apply Max. Overload Voltage for 1 minute                                    |
| Thermal Shock                                  | ±0.5%             | <b>MIL-STD-202 Method 107G</b><br>-55°C ~150°C, 100 cycles                                                   |
| Low Temperature Operation                      | ±0.5%             | <b>JIS-C-5201-1 4.36</b><br>1 hour, -65°C followed by 45 minutes of RCWV                                     |

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

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

■ **Shelf Life: 2 years from production date.**

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



## ■ Marking

### 0603 3digit marking

Example :

| Resistance | 1Ω  | 0.1Ω | 0.15Ω | 0.01Ω | 0.101Ω     | 0.035Ω     |
|------------|-----|------|-------|-------|------------|------------|
| Codes      | 1R0 | R10  | R15   | R01   | <u>101</u> | <u>035</u> |

### 0805~2512 4digit marking

Example :

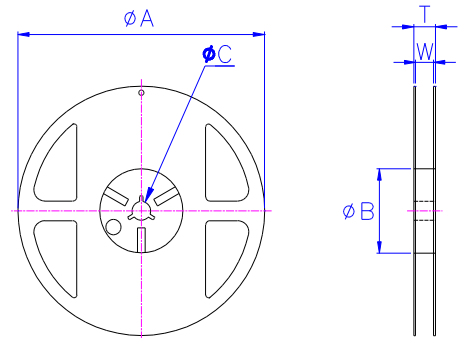
| Resistance | 1Ω   | 0.1Ω | 0.05Ω | 0.015Ω | 0.01Ω |
|------------|------|------|-------|--------|-------|
| Codes      | 1R00 | R100 | R050  | R015   | R010  |

## Packaging

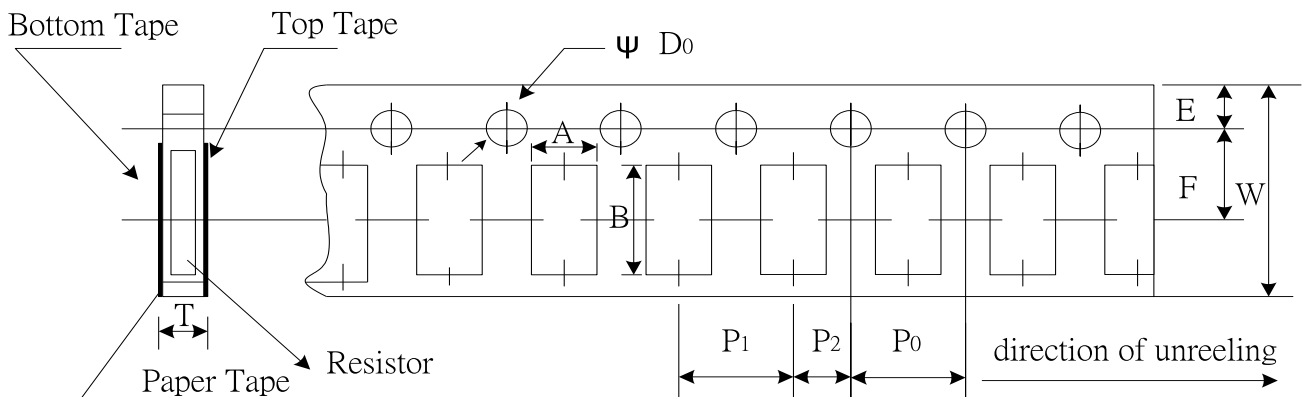
### Packaging Quantity & Reel Specifications

Unit : mm

| Type  | nA        | nB       | nC       | W         | T        | Paper Tape (EA) | Emboss Plastic Tape (EA) |
|-------|-----------|----------|----------|-----------|----------|-----------------|--------------------------|
| TCS02 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0   | 11.5±1.0 | 10,000          |                          |
| TCS03 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0   | 11.5±1.0 | 5,000           | -                        |
| TCS05 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0   | 11.5±1.0 | 5,000           | -                        |
| TCS06 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±1.0   | 11.5±1.0 | 5,000           | -                        |
| TCS10 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 13.5±1.00 | 15.5±1.0 | -               | 4,000                    |
| TCS12 | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 13.5±1.00 | 15.5±1.0 | -               | 4,000                    |



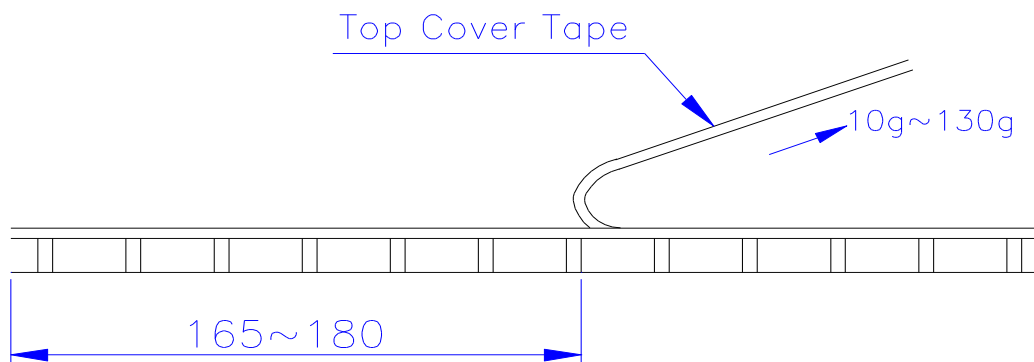
### Paper Tape Specifications



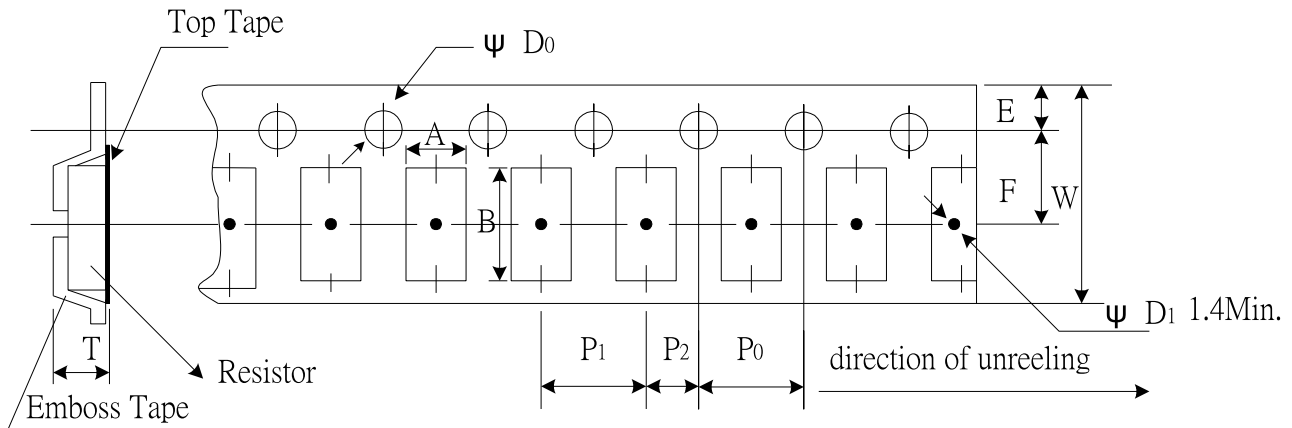
Unit: mm

| Type  | A         | B         | W         | E         | F        | P0        | P1        | P2        | ψD0       | T         |
|-------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|
| TCS02 | 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 |
| TCS03 | 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 |
| TCS05 | 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 |
| TCS06 | 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 |

- Peel force of top cover tape
- The peel speed shall be about 300mm/min±5%
- The peel force of top cover tape shall be between 10 to 100g



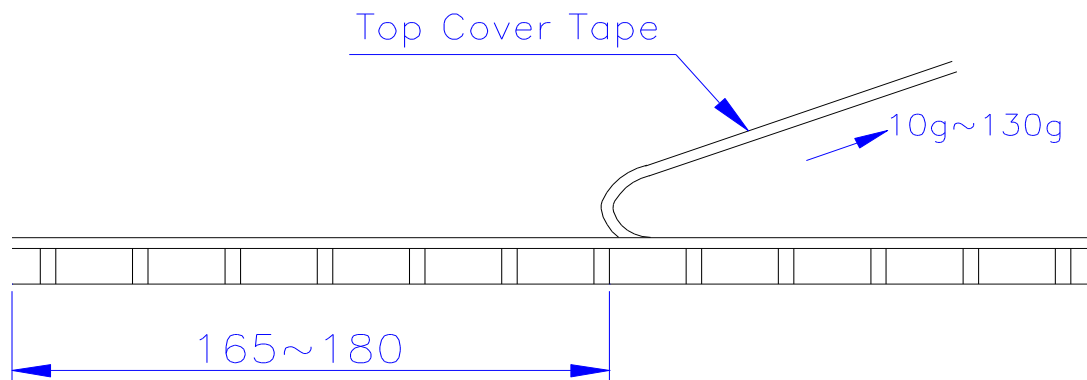
Emboss Plastic Tape Specifications



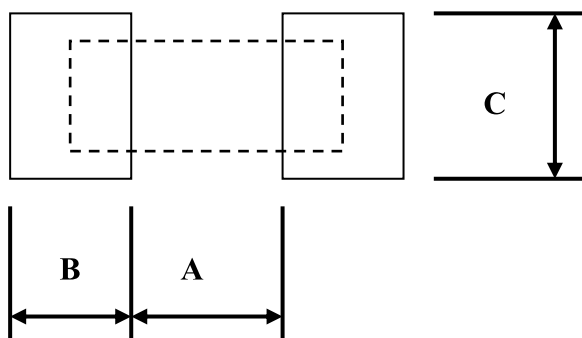
Unit: mm

| Type  | A         | B         | W         | E         | F        | P <sub>0</sub> | P <sub>1</sub> | P <sub>2</sub> | ψD <sub>0</sub> | T         |
|-------|-----------|-----------|-----------|-----------|----------|----------------|----------------|----------------|-----------------|-----------|
| TCS10 | 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 |
| TCS12 | 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 300mm/min±5%
- The peel force of top cover tape shall be between 10 to 130g



■ Recommend Land Pattern



Unit : mm

| Type  | A    | B    | C        |
|-------|------|------|----------|
| TCS02 | 0.50 | 0.50 | 0.60±0.2 |
| TCS03 | 0.80 | 1.00 | 0.90±0.2 |
| TCS05 | 1.00 | 1.00 | 1.35±0.2 |
| TCS06 | 2.00 | 1.15 | 1.70±0.2 |
| TCS10 | 3.60 | 1.40 | 2.50±0.2 |
| TCS12 | 4.90 | 1.60 | 3.10±0.2 |

**REVISION HISTORY**

| <b>REVISION</b> | <b>DATE</b>  | <b>CHANGE NOTIFICATION</b> | <b>DESCRIPTION</b>                                                                         |
|-----------------|--------------|----------------------------|--------------------------------------------------------------------------------------------|
| Version B2      | May 08,2015  | -                          | - Correct the element of Top Electrode.                                                    |
| Version B3      | July 10,2015 | -                          | - Add 0.5% tolerance for High Power Rating Electrical Specifications                       |
| Version B4      | Mar 02, 2016 | -                          | - Modify Storage Temperature.<br>- Remove Material Description.                            |
| Version B5      | Nov 10, 2017 | -                          | - Correct the reference standard in Environmental Characteristics.                         |
| Version B6      | Aug 24, 2020 | -                          | - Add dimensions specification for TCS12(3W) product.                                      |
| Version B7      | Jan 28, 2022 | -                          | - Modify IR reflow profile to comply IPC/JEDEC J-STD-020.<br>- Add shelf life description. |