

# SMD CURRENT SENSE METAL CHIP RESISTOR

## TYPE TLM SERIES

### INTRODUCTION

TE Connectivity (TE) has extended our low ohmic metal chip resistor TLM series with the High Power TLMQ. This series is designed for current sense circuits in power electronic systems which now also has a more advanced primary overcoat applied on both its top and bottom side which offers higher reliability, accuracy and durability. Supplied as standard on tape and reel for automatic insertion processes.



### FEATURES

- Low resistance resistor for current detection
- Small size to power ratio
- Metal foil construction ensures high reliability and performance with very low and stable TCR
- Designed for current sense circuits in power electronic systems
- Pb-Free to meet RoHS Requirements
- High Power Series AEC-Q200 Compliant
- Moisture Sensitivity Level - MSL1

### APPLICATIONS

- Power Management Applications
- Switching Power Supply
- Over Current Protection in Audio Applications
- Voltage Regulation Module (VRM)
- DC-DC Converter, Battery Pack, Charger, Adaptor

**Note:** SMD (Surface mount devices) resistors and inductors should be kept in their original packaging to protect them from ESD (Electrostatic Discharge). The full reels can be broken into smaller quantities, without exposing them to ESD, as long as the components are still in the plastic or paper tape. These resistors and inductors should not be removed from the plastic or paper tape unless they are in an ESD protected environment.

SMD Current Sense Metal Chip Resistor

Type TLM Series

ELECTRICAL CHARACTERISTICS

Standard Series

| Type  | Power Rating @ 70°C | Operating Temp. Range | Resistance Range (mΩ) |    | TCR (PPM/°C) | Weight (mg) |
|-------|---------------------|-----------------------|-----------------------|----|--------------|-------------|
|       |                     |                       | ±1%                   | 5% |              |             |
| TLM1J | 0.125 W             | -55~+155°C            | 10 - 19               |    | ±100         | 2.63        |
|       |                     |                       | 20 - 100              |    | ±50          | 2.53        |
| ±100  |                     |                       |                       |    |              |             |
| TLM2A | 0.25 W              |                       | 10 - 19               |    | ±100         | 6.24        |
|       |                     |                       | 20 - 100              |    | ±50          | 5.63        |
| ±100  |                     |                       |                       |    |              |             |
| TLM2B | 0.5 W               |                       | 10 - 19               |    | ±100         | 13.30       |
|       |                     |                       | 20 - 100              |    | ±50          | 11.63       |
| ±100  |                     |                       |                       |    |              |             |
| TLM2H | 0.75 W              |                       | 10 - 19               |    | ±100         | 31.42       |
|       |                     |                       | 20 - 100              |    | ±50          | 28.35       |
| ±100  |                     |                       |                       |    |              |             |
| TLM3A | 1 W                 |                       | 10 - 19               |    | ±100         | 45.21       |
|       |                     |                       | 20 - 100              |    | ±50          | 43.49       |
| ±100  |                     |                       |                       |    |              |             |

Operating Voltage= $\sqrt{(P \cdot R)}$  ; Overload Voltage= $2.5 \cdot \sqrt{(P \cdot R)}$  ; Operating Current= $\sqrt{(P/R)}$

High Power Series

| Type   | Power Rating @<br>70 °C | Operating<br>Temp.<br>Range | Max. Overload<br>Current | Resistance Range (mΩ) |     | TCR (PPM/°C) | Weight<br>(mg) |
|--------|-------------------------|-----------------------------|--------------------------|-----------------------|-----|--------------|----------------|
|        |                         |                             |                          | ±1%                   | ±5% |              |                |
| TLMQ1J | 0.5 W                   | -55~+170°C                  | 15.8 A                   | 10 - 18               |     | ±100         | 2.63           |
|        |                         |                             |                          | 19 - 100              |     |              | 2.53           |
| TLMQ2A | 0.75 W                  |                             | 19.4 A                   | 10 - 18               |     | ±50          | 6.24           |
|        |                         |                             |                          | 19 - 100              |     |              | 5.63           |
| TLMQ2B | 1 W                     |                             | 22.4 A                   | 10 - 18               |     |              | 13.30          |
|        |                         |                             |                          | 19 - 100              |     |              | 11.63          |
| TLMQ2H | 1.5 W                   |                             | 27.4 A                   | 10 - 18               |     |              | 31.42          |
|        |                         |                             |                          | 19 - 100              |     |              | 28.35          |
| TLMQ3A | 2 W                     |                             | 28.3 A                   | 10 - 18               |     |              | 45.21          |
|        |                         |                             |                          | 19 - 100              |     |              | 43.49          |

# SMD Current Sense Metal Chip Resistor

Type TLM Series

## ENVIRONMENTAL CHARACTERISTICS

### Standard Series

| Item                                        | Requirement                                                            | Test Method                                                                                                                    |
|---------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Temperature Coefficient of Resistance (TCR) | As Spec.                                                               | JIS-C-5201-1 4.8<br>IEC-60115-1 4.8<br>-55°C~+125°C, 25°C is the reference temperature                                         |
| Short Term Overload                         | $\pm(0.5\%+0.05\Omega)$                                                | JIS-C-5201-1 4.13<br>IEC-60115-1 4.13<br>2512 size: 4 X Rated Power for 5 seconds<br>Other size: 5 X Rated Power for 5 seconds |
| Insulation Resistance                       | $\geq 10G$                                                             | JIS-C-5201-1 4.6<br>IEC-60115-1 4.6<br>Max. overload voltage for 1 minute                                                      |
| Endurance                                   | $\pm(1.0\%+0.05\Omega)$                                                | MIL-STD-202 Method 108A<br>70 $\pm$ 2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"                                 |
| Damp Heat with Load                         | $\pm(1.0\%+0.05\Omega)$                                                | JIS-C-5201-1 4.24<br>IEC-60115-1 4.24<br>40 $\pm$ 2°C, 90-95% R.H. RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"       |
| Dry Heat                                    | $\pm(0.5\%+0.05\Omega)$                                                | JIS-C-5201-1 4.23<br>IEC-60115-1 4.23.2<br>at +155°C for 1000 hrs                                                              |
| Bending Strength                            | $\pm(1.0\%+0.05\Omega)$                                                | JIS-C-5201-1 4.33<br>Bending once for 60 seconds<br>2010, 2512 sizes: 2mm Other sizes: 3mm                                     |
| Solderability                               | 95% min. coverage                                                      | JIS-C-5201-1 4.17<br>IEC-60115-1 4.17<br>245 $\pm$ 5°C for 3 seconds                                                           |
| Resistance to Soldering Heat                | $\pm(0.5\%+0.05\Omega)$                                                | JIS-C-5201-1 4.18<br>IEC-60115-1 4.18<br>260 $\pm$ 5°C for 10 seconds                                                          |
| Voltage Proof                               | No breakdown or flashover                                              | JIS-C-5201-1 4.7<br>IEC-60115-1 4.7<br>1.42 times Max. Operating Voltage for 1 minute                                          |
| Leaching                                    | Individual leaching area $\leq 5\%$<br>Total leaching area $\leq 10\%$ | JIS-C-5201-1 4.18<br>IEC-600068-2-58 8.2.1<br>260 $\pm$ 5°C for 30 seconds                                                     |
| Rapid Change of Temperature                 | $\pm(0.5\%+0.05\Omega)$                                                | JIS-C-5201-1 4.19<br>IEC-60115-1 4.19<br>-55°C to +155°C, 5 cycles                                                             |

Storage Temperature: 25 $\pm$ 3°C; Humidity < 80%RH

Shelf Life: 2 years from production date

# SMD Current Sense Metal Chip Resistor

Type TLM Series

## High Power Series

| Item                                        | Requirement                                                        | Test Method                                                                                                                                                                 |
|---------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature Coefficient of Resistance (TCR) | As Spec.                                                           | <b>JIS-C-5201-1 4.8</b><br><b>IEC-60115-1 4.8</b><br>-55°C~+125°C, 25°C is the reference temperature                                                                        |
| Short Term Overload                         | $\Delta R \leq \pm 1\%R$                                           | <b>JIS-C-5201-1 4.13</b><br><b>IEC-60115-1 4.13</b><br>5 X Rated Power for 5 seconds<br>2512 size: 4* Rated Power for 5 seconds<br>Other size: 5* Rated Power for 5 seconds |
| Insulation Resistance                       | $\geq 1000M\Omega$                                                 | <b>JIS-C-5201-1 4.6</b><br><b>IEC-60115-1 4.6</b><br>Max. overload voltage for 1 minute                                                                                     |
| Operational Life                            | $\Delta R \leq \pm 1\%R$                                           | <b>MIL-STD-202 Method 108</b><br>Condition D Steady State $T_A = 125^\circ\text{C}$ at derated power.<br>Measurement at 24 $\pm$ 4 hours after test conclusion              |
| Biased Humidity                             | $\Delta R \leq \pm 1\%R$                                           | <b>MIL-STD-202 Method 103</b><br>85°C/85%R.H., 1000 hrs apply 10% of operating power (current) or limiting element current whichever is lower                               |
| High Temperature Exposure                   | $\Delta R \leq \pm 1\%R$                                           | <b>MIL-STD-202 Method 108</b><br>At +155°C for 1000 hours                                                                                                                   |
| Temperature Cycling                         | $\Delta R \leq \pm 1\%R$                                           | <b>JESD22 Method JA-104</b><br>-55°C to +125°, 1000 cycles                                                                                                                  |
| Bending Strength (Board Flex)               | $\Delta R \leq \pm 1\%R$                                           | <b>JIS-C-5201-1 4.33</b><br>Bending once for 60 seconds<br>2010, 2512 sizes: 2mm Other sizes: 3mm                                                                           |
| Solderability                               | 95% min. coverage                                                  | <b>JIS-C-5201-1 4.17</b><br><b>IEC-60115-1 4.17</b><br>245 $\pm$ 5°C for 3 seconds                                                                                          |
| Resistance to Soldering Heat                | $\Delta R \leq \pm 1\%R$                                           | <b>JIS-C-5201-1 4.18</b><br><b>IEC-60115-1 4.18</b><br>260 $\pm$ 5°C for 10 seconds                                                                                         |
| Voltage Proof                               | No breakdown or flashover                                          | <b>JIS-C-5201-1 4.7</b><br><b>IEC-60115-1 4.7</b><br>1.42 times Max. Operating Voltage for 1 minute                                                                         |
| Resistance To Solvents                      | Marking unsmeared                                                  | <b>MIL-STD-202 Method 215</b><br>Add Aqueous wash chemical – OKEM Clean or equivalent. Do not use banned solvents                                                           |
| Mechanical Shock                            | $\Delta R \leq \pm 1\%R$                                           | <b>MIL-STD-202 Method 213</b><br>Wave Form: Tolerance for half sine shock pulse.<br>Peak value is 100g's. Normal duration (D) is 6                                          |
| Vibration                                   | $\Delta R \leq \pm 1\%R$                                           | <b>MIL-STD-202 Method 204</b><br>5 g's for 20 min. 12 cycles each of 3 orientations,<br>10-2000 Hz                                                                          |
| ESD                                         | $\Delta R \leq \pm 1\%R$                                           | <b>AEC-Q200-002</b><br>Human body model 2KV                                                                                                                                 |
| Flammability                                | No ignition of the tissue paper or scorching of the pinewood board | <b>UL-94</b><br>V-0 or V-1 are acceptable. Electrical test not required                                                                                                     |
| Terminal Strength                           | Not broken                                                         | <b>AEC-Q200-006</b><br>Force of 1.8kg for 60 seconds                                                                                                                        |

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

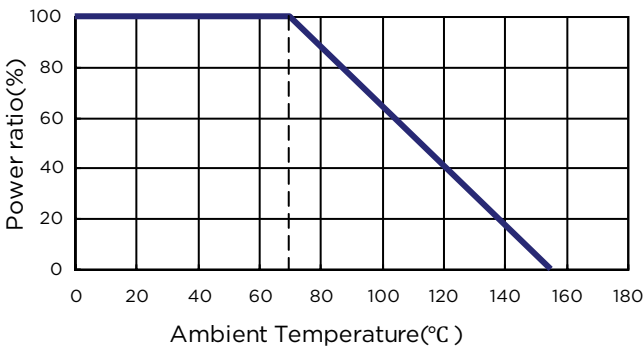
Shelf Life: 2 years from production date

# SMD Current Sense Metal Chip Resistor

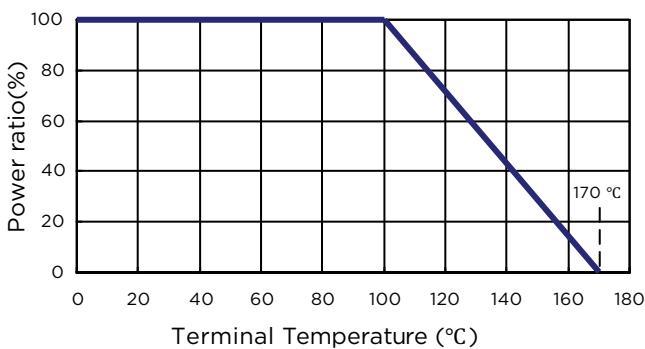
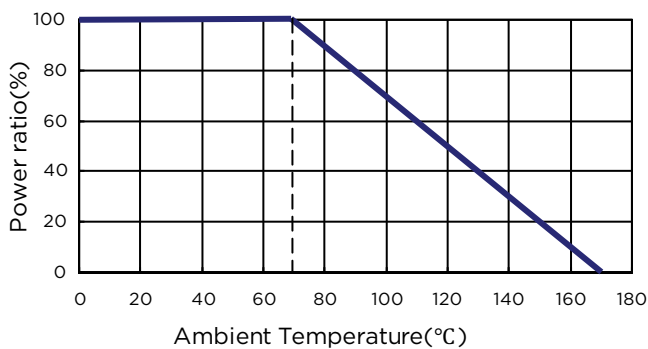
Type TLM Series

## DERATING CURVE

### Standard Series

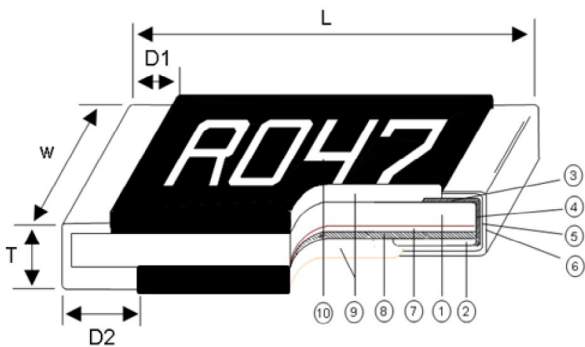


### High Power Series



**Note:** For resistors operated at an ambient temperature of 70°C or higher, the power rating shall be derated in accordance with the above derating curve.

## CONSTRUCTION AND DIMENSIONS



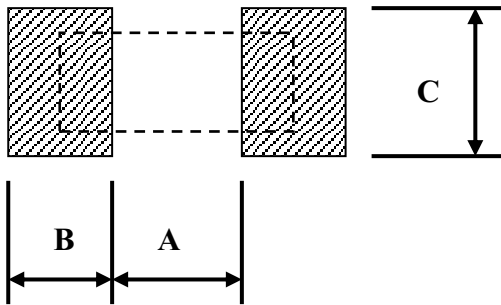
|   |                       |   |                         |    |                          |
|---|-----------------------|---|-------------------------|----|--------------------------|
| 1 | Alumina Substrate     | 5 | Barrier Layer (Ni)      | 9  | Primary Overcoat (Epoxy) |
| 2 | Bottom Electrode (Cu) | 6 | External Electrode (Sn) | 10 | Marking (Epoxy)          |
| 3 | Top Electrode (NiCr)  | 7 | Adhesive (Acrylic)      |    |                          |
| 4 | Edge Electrode (NiCr) | 8 | Resistor Layer (Alloy)  |    |                          |

# SMD Current Sense Metal Chip Resistor

Type TLM Series

| Type     | Resistance Range (mΩ) | L         | W         | T         | D1        | D2        |
|----------|-----------------------|-----------|-----------|-----------|-----------|-----------|
| TLM(Q)1J | 10 - 18               | 1.60±0.15 | 0.85±0.15 | 0.45±0.15 | 0.30±0.25 | 0.35±0.25 |
|          | 19 - 100              | 1.60±0.15 | 0.85±0.15 | 0.40±0.15 | 0.30±0.25 | 0.35±0.25 |
| TLM(Q)2A | 10 - 18               | 2.05±0.15 | 1.25±0.15 | 0.60±0.15 | 0.30±0.25 | 0.35±0.25 |
|          | 19 - 100              | 2.05±0.15 | 1.25±0.15 | 0.60±0.15 | 0.30±0.25 | 0.35±0.25 |
| TLM(Q)2B | 10 - 18               | 3.10±0.15 | 1.55±0.15 | 0.60±0.15 | 0.50±0.25 | 0.60±0.30 |
|          | 19 - 100              | 3.10±0.15 | 1.55±0.15 | 0.60±0.15 | 0.50±0.25 | 0.60±0.30 |
| TLM(Q)2H | 10 - 18               | 5.00±0.20 | 2.50±0.20 | 0.60±0.15 | 0.60±0.30 | 0.80±0.30 |
|          | 19 - 100              | 5.00±0.20 | 2.50±0.20 | 0.60±0.15 | 0.60±0.30 | 0.80±0.30 |
| TLM(Q)3A | 10 - 18               | 6.40±0.20 | 3.20±0.20 | 0.60±0.15 | 0.70±0.30 | 0.80±0.30 |
|          | 19 - 100              | 6.40±0.20 | 3.20±0.20 | 0.60±0.15 | 0.70±0.30 | 0.80±0.30 |

## RECOMMENDED LAND PATTERN (Unit:mm)



| Type     | Resistance Range (mΩ) | A    | B    | C    | t (μm) |
|----------|-----------------------|------|------|------|--------|
| TLM(Q)1J | 10 - 100              | 0.70 | 1.05 | 0.90 | 35     |
| TLM(Q)2A | 10 - 100              | 1.00 | 1.00 | 1.35 | 70     |
| TLM(Q)2B | 10 - 100              | 1.50 | 1.40 | 1.70 | 105    |
| TLM(Q)2H | 10 - 100              | 2.80 | 1.80 | 2.50 | 105    |
| TLMQ3A   | 10 - 100              | 3.80 | 2.25 | 3.20 | 105    |

t: Copper foil minimum thickness of PCB

## MARKING

### FOR TLM(Q)1J

| Type | Code   |
|------|--------|
| R10  | 0.100Ω |
| R01  | 0.010Ω |
| O35  | 0.035Ω |
| O05  | 0.005Ω |

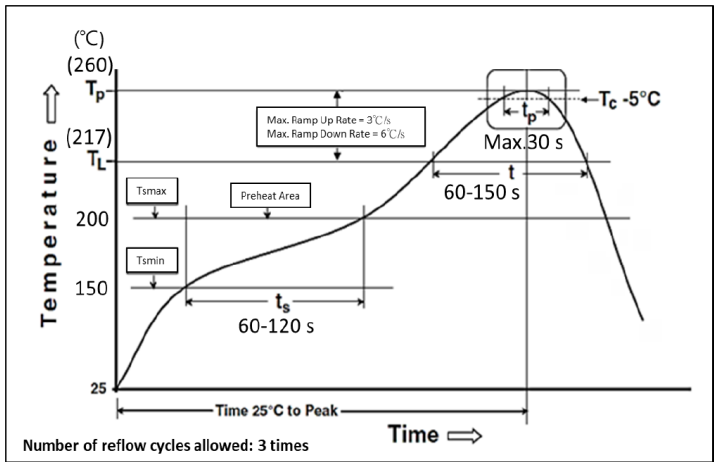
### FOR TLM(Q)2A -TLM(Q)3A

| Type | Code   |
|------|--------|
| R100 | 0.100Ω |
| R050 | 0.050Ω |
| R010 | 0.010Ω |
| R005 | 0.005Ω |

SMD Current Sense Metal Chip Resistor

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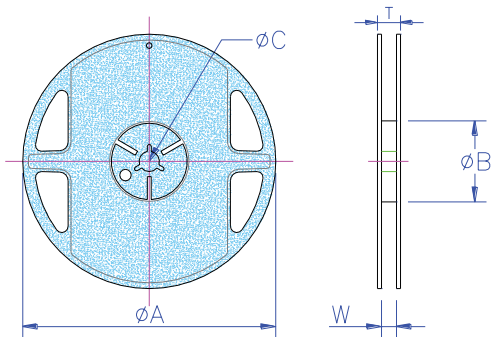
SOLDERING REFLOW PROFILE



| Profile Feature                                                                  | Pb-Free Assembly |
|----------------------------------------------------------------------------------|------------------|
| Preheat                                                                          |                  |
| Min. Temperature ( $T_{smin}$ )                                                  | 150 °C           |
| Max Temperature ( $T_{smax}$ )                                                   | 200 °C           |
| Preheating time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ )                      | 60-120 seconds   |
| Ramp-up rate ( $T_L$ to $T_p$ )                                                  | 3 °C/second max. |
| Liquidous temperature ( $T_L$ )                                                  | 217 °C           |
| Time ( $t_L$ ) maintained above $T_L$                                            | 60-150 seconds   |
| Min. Peak temperature ( $T_p$ min)                                               | 235 °C           |
| Max. Peak temperature ( $T_p$ max)                                               | 260 °C           |
| Time ( $t_p$ ) within 5 °C of the specified classification temperature ( $T_c$ ) | 30 seconds max.  |
| Ramp-down rate ( $T_p$ to $T_L$ )                                                | 6 °C/second max. |
| Time 25 °C to peak temperature                                                   | 8 minutes max.   |

PACKAGING

Packaging Quantity and Reel Dimensions (mm)

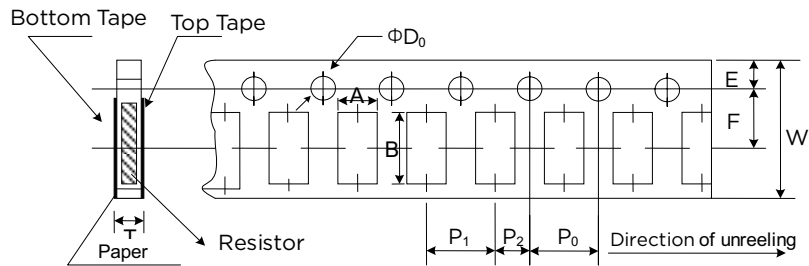


| Type     | ΦA        | ΦB       | ΦC       | W        | T        | Paper Tape (EA) | Embossed Plastic Tape (EA) |
|----------|-----------|----------|----------|----------|----------|-----------------|----------------------------|
| TLM(Q)1J | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±0.1  | 11.5±1.0 | 5,000           | -                          |
| TLM(Q)2A | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±0.1  | 11.5±1.0 | 5,000           | -                          |
| TLM(Q)2B | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 9.5±0.1  | 11.5±1.0 | 5,000           | -                          |
| TLM(Q)2H | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 13.5±1.0 | 15.5±1.0 | -               | 4,000                      |
| TLM(Q)3A | 178.0±1.0 | 60.0±1.0 | 13.5±0.7 | 13.5±1.0 | 15.5±1.0 | -               | 4,000                      |

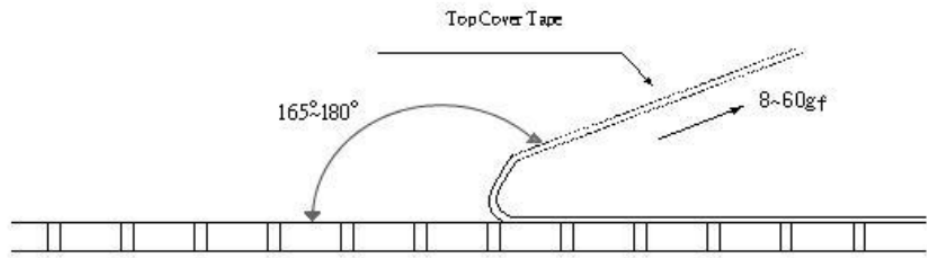
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Type TLM Series

## Paper Tape Dimensions (mm)

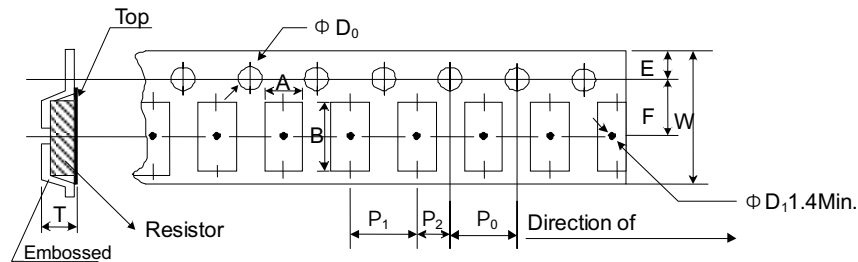


| Type     | A          | B          | W         | E          | F          | P <sub>0</sub> | P <sub>1</sub> | P <sub>2</sub> | $\Phi D_0$   | T          |
|----------|------------|------------|-----------|------------|------------|----------------|----------------|----------------|--------------|------------|
| TLM(Q)1J | 1.10 ±0.10 | 1.85 ±0.10 | 8.0 ±0.20 | 1.75 ±0.10 | 3.50 ±0.05 | 4.00 ±0.10     | 4.00 ±0.05     | 2.00 ±0.05     | 1.50 +0.1 -0 | 0.60 ±0.10 |
| TLM(Q)2A | 1.60 ±0.10 | 2.35 ±0.20 | 8.0 ±0.20 | 1.75 ±0.10 | 3.50 ±0.05 | 4.00 ±0.10     | 4.00 ±0.05     | 2.00 ±0.05     | 1.50 +0.1 -0 | 0.95 ±0.10 |
| TLM(Q)2B | 1.90 ±0.10 | 3.50 ±0.20 | 8.0 ±0.20 | 1.75 ±0.10 | 3.50 ±0.05 | 4.00 ±0.10     | 4.00 ±0.05     | 2.00 ±0.05     | 1.50 +0.1 -0 | 0.95 ±0.10 |

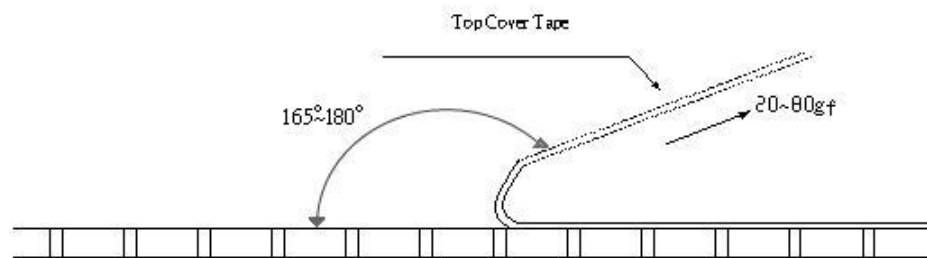


- Peel force of top cover tape
- The peel speed shall be about 300 mm/min±5%
- The peel force of top cover tape shall be between 8gf to 60gf

## Embossed Plastic Tape Dimensions (mm)

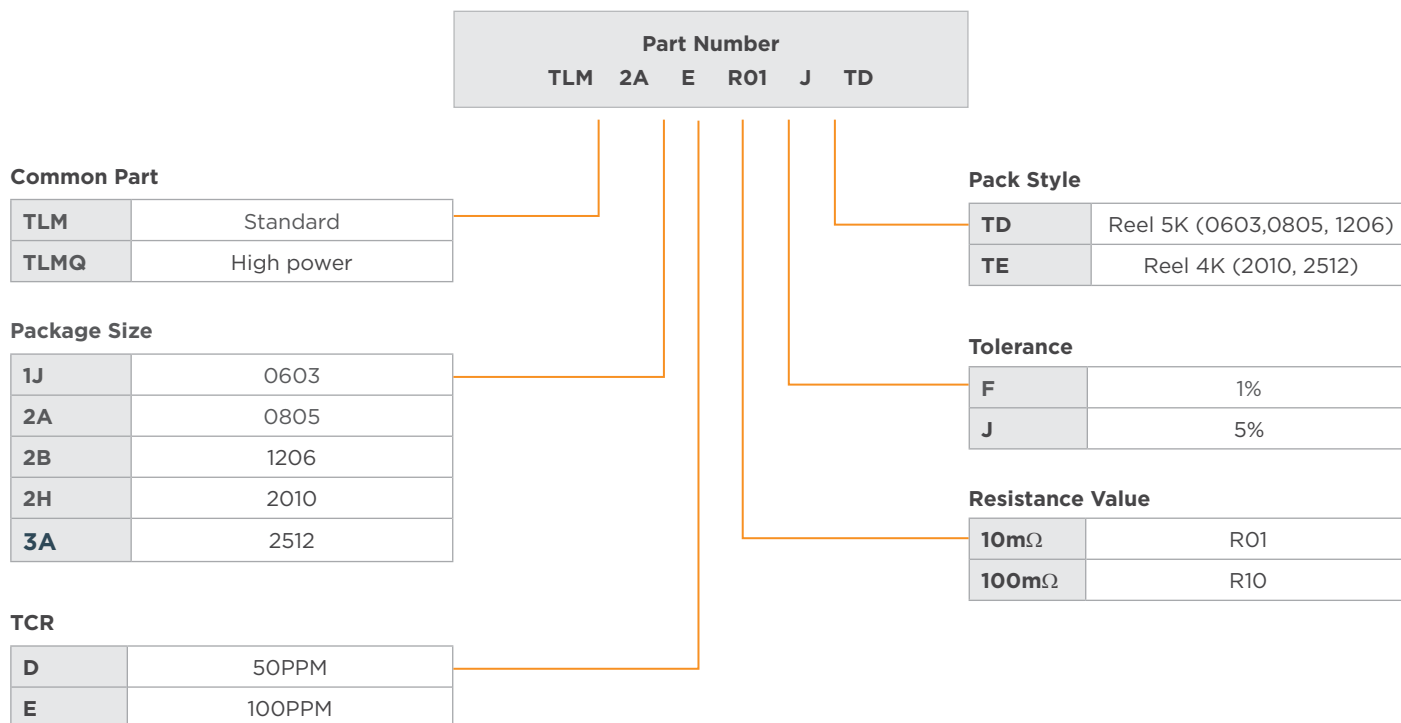


| Type     | A          | B          | W          | E          | F          | P <sub>0</sub> | P <sub>1</sub> | P <sub>2</sub> | $\Phi D_0$ | T          |
|----------|------------|------------|------------|------------|------------|----------------|----------------|----------------|------------|------------|
| TLM(Q)2H | 2.80 ±0.10 | 5.50 ±0.10 | 12.0 ±0.10 | 1.75 ±0.10 | 5.50 ±0.05 | 4.00 ±0.05     | 4.00 ±0.10     | 2.00 ±0.05     | 1.50 ±0.10 | 1.00 ±0.20 |
| TLM(Q)3A | 3.50 ±0.10 | 6.70 ±0.20 | 12.0 ±0.10 | 1.75 ±0.10 | 5.50 ±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

## ORDERING INFORMATION



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