

Data Sheet

Customer:

Product: High Voltage Thick Film Chip Resistor - HVR Series

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

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|---------------------|-----------------|---------------------|------------------------|---------------------------|
| 10-Mar-21 | 10-Mar-21 | 10-Mar-21 | | |
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High Voltage Thick Film Chip Resistor



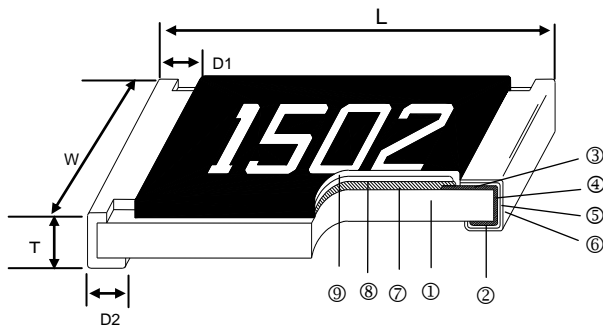
Scope

- This specification applies to all sizes of rectangular-type fixed chip resistors with Ruthenium-base as material.

Features

- Highly reliable multilayer electrode construction
- Higher component and equipment reliability
- Excellent performance at high voltage
- Reduced size of final equipment
- IEC 62368-1 & IEC 60950-1 Safety Certificate issued by UL Demko

Construction



Applications

- Inverter
- Outdoor Equipments
- Converter
- High Pulse Equipment

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

Dimensions

| Type | Size (Inch) | L (mm) | W (mm) | T (mm) | D1 (mm) | D2 (mm) | Weight (g) (1000pcs) |
|-------|-------------|-----------|-----------|-----------|-----------|-----------|----------------------|
| HVR02 | 0402 | 1.00±0.05 | 0.50±0.05 | 0.35±0.05 | 0.20±0.10 | 0.20±0.10 | 0.620 |
| HVR03 | 0603 | 1.60±0.10 | 0.80±0.10 | 0.45±0.10 | 0.30±0.20 | 0.30±0.20 | 2.042 |
| HVR05 | 0805 | 2.00±0.10 | 1.25±0.10 | 0.50±0.10 | 0.35±0.20 | 0.40±0.20 | 4.368 |
| HVR06 | 1206 | 3.10±0.10 | 1.55±0.10 | 0.55±0.10 | 0.50±0.25 | 0.50±0.20 | 8.947 |
| HVR0A | 2010 | 5.00±0.10 | 2.50±0.15 | 0.55±0.10 | 0.60±0.25 | 0.50±0.20 | 24.241 |
| HVR12 | 2512 | 6.35±0.10 | 3.10±0.15 | 0.55±0.10 | 0.60±0.25 | 0.50±0.20 | 39.448 |

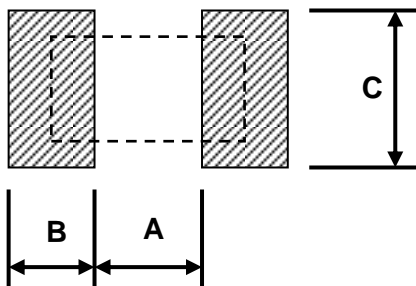
IEC 62368-1 & IEC 60950-1 Safety Certificate Scope

| | HVR02 | HVR03 | HVR05 | HVR06 | HVR0A | HVR12 |
|-----------------------------|----------|----------|-----------|-----------|----------|----------|
| G.10.2 (2.5KV impulse test) | 10M~100M | 10M~100M | 100K~100M | 470K~100M | 51K~100M | 30K~100M |
| G.10.3.2 (10KV surge) | | | 10M~100M | | | |
| G.10.3.3 (5KV impulse) | | | 100K~100M | | | |

Part Numbering

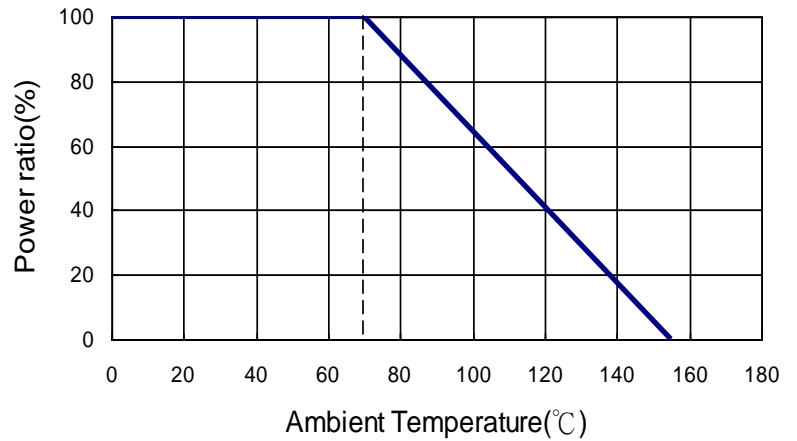
| HVR | 03 | F | T | E | X | 1003 |
|--------------|--|------------------------------|---|--|--|--|
| Product Type | Dimensions | Resistance Tolerance | Packaging Code | TCR (PPM/C) | Power Rating | Resistance |
| | 02: 0402 03: 0603 05: 0805 06: 1206 0A: 2010 12: 2512 | F: $\pm 1\%$ J: $\pm 5\%$ | T: 7" Taping Reel V: 10" Taping Reel W: 13" Taping Reel | E: ± 100 F: ± 200 H: ± 400 | Y: 1/16W X: 1/10W W: 1/8W V: 1/4W U: 1/2W T: 1W | 1003: 100K Ω 1004: 1M Ω 1005: 10M Ω |

Recommend Land Pattern

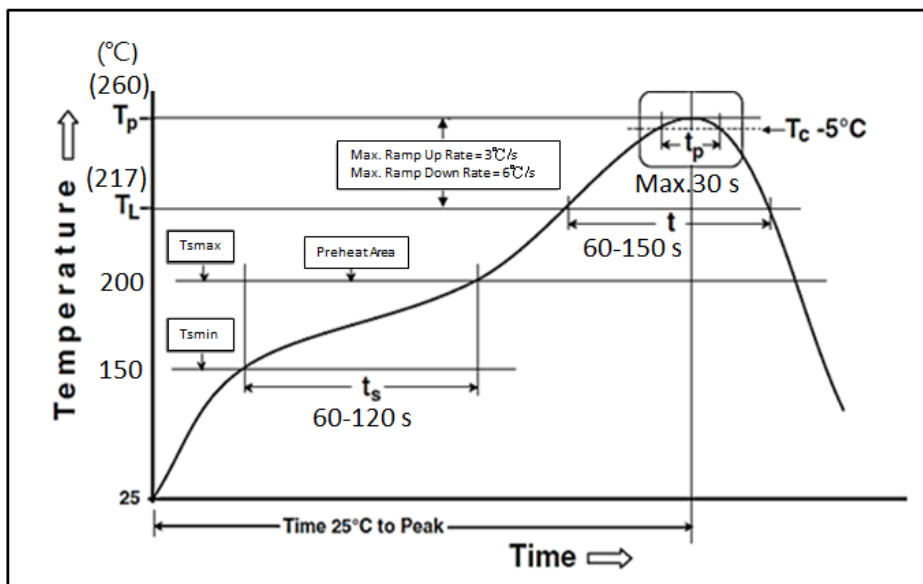


| Type | A (mm) | B (mm) | C (mm) |
|-------|--------|--------|--------|
| HVR02 | 0.50 | 0.45 | 0.60 |
| HVR03 | 0.90 | 0.60 | 0.90 |
| HVR05 | 1.20 | 0.70 | 1.30 |
| HVR06 | 2.00 | 0.90 | 1.60 |
| HVR0A | 3.80 | 0.90 | 2.80 |
| HVR12 | 4.90 | 1.60 | 3.50 |

Derating Curve



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



■ Standard Electrical Specifications

| Type | Item | Power Rating at 70°C | Operating Temp. Range | Max. Operating Voltage | Max. Overload Voltage | Resistance Range | | TCR (PPM/°C) |
|--------------|-------|----------------------|-----------------------|------------------------|-----------------------|------------------|--------------|--------------|
| | | | | | | ±1%(E24、E96) | ±5%(E24) | |
| HVR02 (0402) | 1/16W | | -55 ~ +155°C | 100V | 200V | 39KΩ - 1MΩ | | ±100 |
| | | | | | | 1.02MΩ - 10MΩ | 1.1MΩ - 20MΩ | ±200 |
| | | | | | | - | 22MΩ - 100MΩ | ±400 |
| HVR03 (0603) | 1/10W | | | 200V | 400V | 56KΩ - 1MΩ | | ±100 |
| | | | | | | 1.02MΩ - 10MΩ | 1.1MΩ - 20MΩ | ±200 |
| | | | | | | - | 22MΩ - 100MΩ | ±400 |
| HVR05 (0805) | 1/8W | | | 400V | 800V | 100KΩ - 1MΩ | | ±100 |
| | | | | | | 1.02MΩ - 10MΩ | 1.1MΩ - 20MΩ | ±200 |
| | | | | | | - | 22MΩ - 100MΩ | ±400 |
| HVR06 (1206) | 1/4W | | | 500V | 1000V | 100KΩ - 1MΩ | | ±100 |
| | | | | | | 1.02MΩ - 10MΩ | 1.1MΩ - 20MΩ | ±200 |
| | | | | | | - | 22MΩ - 100MΩ | ±400 |
| HVR0A (2010) | 1/2W | | 2000V | 3000V | 51KΩ - 1MΩ | | ±100 | |
| | | | | | 1.02MΩ - 20MΩ | 1.1MΩ - 20MΩ | ±200 | |
| | | | | | - | 22MΩ - 100MΩ | ±400 | |
| HVR12 (2512) | 1W | | 3000V | 4000V | 30KΩ - 1MΩ | | ±100 | |
| | | | | | 1.02MΩ - 20MΩ | 1.1MΩ - 20MΩ | ±200 | |
| | | | | | - | 22MΩ - 100MΩ | ±400 | |

Operating Voltage= $\sqrt{P \cdot R}$ or Max. Operating Voltage listed above, whichever is lower.

Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$ or Max. Overload Voltage listed above, whichever is lower.

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

Environmental Characteristics

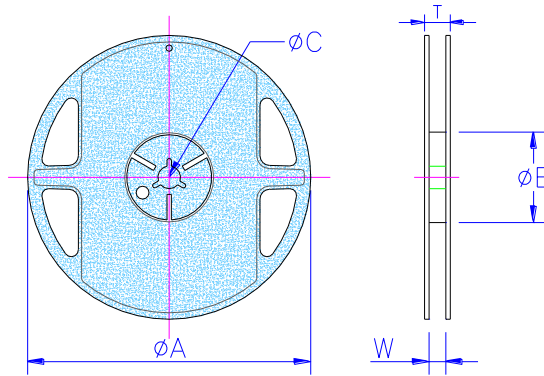
| Item | Requirement | | Test Method |
|--|--|---------------|---|
| | ±1% | ±5% | |
| Temperature Coefficient of Resistance (T.C.R.) | As Spec. | | JIS-C-5201-1 4.8 IEC-60115-1 4.8 At 25°C/-55°C and 25°C/+125°C, 25°C is the reference temperature |
| Short Time Overload | ±(1.0%+0.05Ω) | ±(2.0%+0.05Ω) | JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or Max. Overload Voltage whichever is lower for 5 seconds |
| Insulation Resistance | ≥10G | | JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload Voltage for 1 minute |
| Endurance | ±(2.0%+0.10Ω) | ±(3.0%+0.10Ω) | JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" |
| Damp Heat with Load | ±(2.0%+0.10Ω) | ±(3.0%+0.10Ω) | JIS-C-5201-1 4.24 IEC-60115-1 4.24 40±2°C, 90~95% R.H., RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" |
| Dry Heat | ±(1.0%+0.05Ω) | ±(1.5%+0.10Ω) | JIS-C-5201-1 4.23 IEC-60115-1 4.23.2 at +155°C for 1000 hrs |
| Bending Strength | ±(1.0%+0.05Ω) | ±(1.0%+0.05Ω) | JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 60 seconds 2010, 2512 sizes: 2mm Other sizes: 3mm |
| Solderability | 95% min. coverage | | JIS-C-5201-1 4.17 IEC-60115-1 4.17 245±5°C for 3 seconds |
| Resistance to Soldering Heat | ±(0.5%+0.05Ω) | ±(1.0%+0.05Ω) | JIS-C-5201-1 4.18 IEC-60115-1 4.18 260±5°C for 10 seconds |
| Voltage Proof | No breakdown or flashover | | JIS-C-5201-1 4.7 IEC-60115-1 4.7 HVR02: 150V for 1 minute HVR03: 300V for 1 minute HVR05/HVR06/HVR0A/HVR12: 500V for 1 minute |
| Leaching | Individual leaching area ≤ 5% Total leaching area ≤ 10% | | JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds |
| Rapid Change of Temperature | ±(0.5%+0.05Ω) | ±(1.0%+0.05Ω) | JIS-C-5201-1 4.19 IEC-60115-1 4.19 -55°C to +155°C, 5 cycles |

RCWV(Rated Continuous Working Voltage)=√(P*R) or Max. Operating Voltage whichever is lower.

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

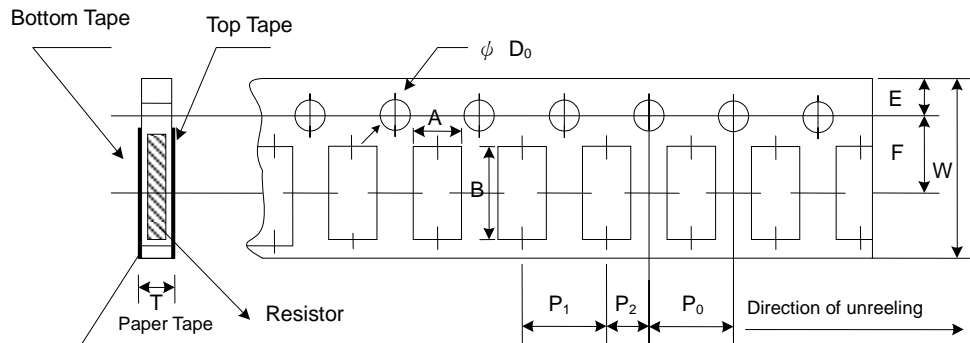
■ Packaging

Reel Specifications & Packaging Quantity



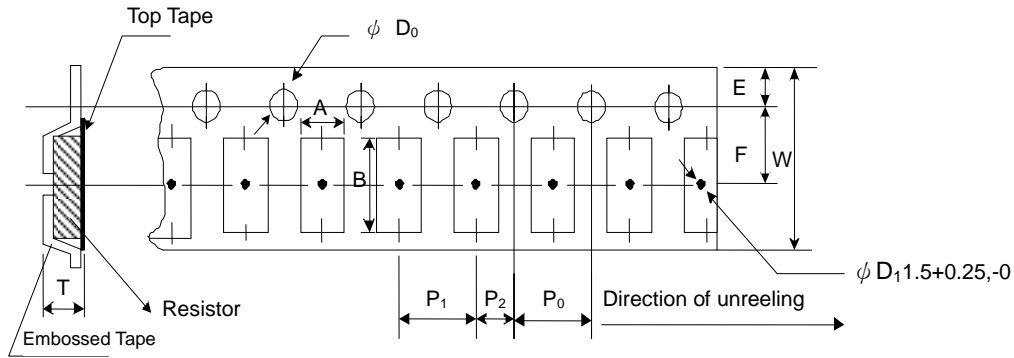
| Type | Packaging Quantity | Tape Width | Reel Diameter | ΦA (mm) | ΦB (mm) | ΦC (mm) | W (mm) | T (mm) | |
|-------------------------|--------------------|------------|---------------|---------|-----------|---------------------|----------|----------|----------|
| HVR02 | Paper | 10K | 8mm | 7 inch | 178.5±1.5 | 60 ^{+1/-0} | 13.0±0.2 | 9.0±0.5 | 12.5±0.5 |
| | | 20K | 8mm | 10 inch | 254±1.0 | 100±0.5 | 13.0±0.2 | 9.5±0.5 | 13.5±0.5 |
| | | 40K | 8mm | 13 inch | 330±1.0 | 100±0.5 | 13.0±0.2 | 9.5±0.5 | 13.5±0.5 |
| HVR03 HVR05 HVR06 | Paper | 5K | 8mm | 7 inch | 178.5±1.5 | 60 ^{+1/-0} | 13.0±0.2 | 9.0±0.5 | 12.5±0.5 |
| | | 10K | 8mm | 10 inch | 254±1.0 | 100±0.5 | 13.0±0.2 | 9.5±0.5 | 13.5±0.5 |
| | | 20K | 8mm | 13 inch | 330±1.0 | 100±0.5 | 13.0±0.2 | 9.5±0.5 | 13.5±0.5 |
| HVR0A HVR12 | Embossed | 4K | 12mm | 7 inch | 178.5±1.5 | 60 ^{+1/-0} | 13.0±0.5 | 13.0±0.5 | 15.5±0.5 |
| | | 8K | 12mm | 10 inch | 250±1.0 | 62±0.5 | 13.0±0.5 | 12.5±0.5 | 16.5±0.5 |

Paper Tape Specifications



| Type | A (mm) | B (mm) | W (mm) | E (mm) | F (mm) | P ₀ (mm) | P ₁ (mm) | P ₂ (mm) | ΦD ₀ (mm) | T (mm) |
|-------|-----------|-----------|-----------|-----------|-----------|---------------------|---------------------|---------------------|----------------------|-----------|
| HVR02 | 0.65±0.10 | 1.15±0.10 | 8.00±0.20 | 1.75±0.10 | 3.50±0.05 | 4.00±0.10 | 2.00±0.05 | 2.00±0.05 | 1.50+0.1,-0 | 0.45±0.10 |
| HVR03 | 1.10±0.10 | 1.90±0.10 | 8.00±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 | 0.70±0.10 |
| HVR05 | 1.60±0.10 | 2.40±0.20 | 8.00±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 | 0.85±0.10 |
| HVR06 | 1.90±0.10 | 3.50±0.20 | 8.00±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 | 0.85±0.10 |

Embossed Plastic Tape Specifications



| Type | A (mm) | B (mm) | W (mm) | E (mm) | F (mm) | P ₀ (mm) | P ₁ (mm) | P ₂ (mm) | ΦD ₀ (mm) | T (mm) |
|-------|-----------|-----------|-----------|-----------|-----------|---------------------|---------------------|---------------------|----------------------|-------------------|
| HVR0A | 2.80±0.10 | 5.40±0.20 | 12.0±0.30 | 1.75±0.10 | 5.50±0.05 | 4.00±0.10 | 4.00±0.10 | 2.00±0.05 | 1.50+0.1, -0 | 1.2 ⁺⁰ |
| HVR12 | 3.50±0.10 | 6.70±0.10 | 12.0±0.30 | 1.75±0.10 | 5.50±0.05 | 4.00±0.10 | 4.00±0.10 | 2.00±0.05 | 1.50+0.1, -0 | 1.2 ⁺⁰ |

■ Marking

No Marking for 0402

1% for 0805/1206/2010/2512: 4 digits marking

Example:

| Resistance | 49.9KΩ | 100KΩ | 1MΩ | 4.99MΩ | 10MΩ |
|------------|--------|-------|------|--------|------|
| Marking | 4992 | 1003 | 1004 | 4994 | 1005 |

5% for 0603/0805/1206/2010/2512: 3 digits marking in E24

Example: 124=120KΩ 106=10MΩ (1st and 2nd are E24 code and 3rd code is multiplier)

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

1% for 0603: 3 digits marking in E96



3 digits marking for Example: 75C=59KΩ 39E=2.49MΩ

■ 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 | X | Y | | |
| Multiplier | 10 ⁰ | 10 ¹ | 10 ² | 10 ³ | 10 ⁴ | 10 ⁵ | 10 ⁻¹ | 10 ⁻² | | |

REVISION HISTORY

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
|-----------------|--------------|----------------------------|--|
| Version B | Jun 03, 2014 | - | - Environmental Characteristics updated |
| Version B1 | Oct 27, 2014 | - | - Standard Electrical Specifications updated - Environmental Characteristics updated |
| Version B2 | Jul 15, 2016 | - | - Remove Material Description - Modify Storage Temperature |
| Version B3 | Jan 12, 2018 | - | - Increase IEC 62368-1 & IEC 60950-1 Safety Certificate Scope |
| Version B4 | May 20, 2019 | - | - Modify TCR Test description |
| Version B5 | Mar 10, 2021 | - | - Modify Bending Test description - Increase large reel packaging code - modify 2010 Embossed Plastic Tape B Specification - modify Soldering Condition (IPC/JEDEC J-STD-020) |