FrelTec GmbH

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# Thin Film Chip Resistor
# SMD
# Precision (1% and 0,5%)
# Low TCR (25 and 50 ppm)

# SMD Thin Film Chip Resistors

SPECIFICATION

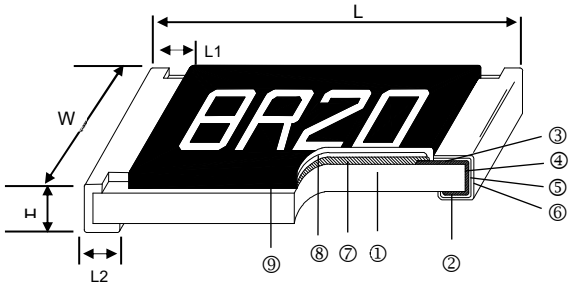
## Part Number

| 037 | 05* | 1001* | F* | T05** | D | C |
|---|---|---|---|---|---|---|
| Type | Size | Value | Tolerance | Packing | TCR | Power Rating |
| 037 : SMD Thin Film Chip Resistor | 02 : 0402 | The last digit is the multiplier | F : ±1% | T05: Tape and Reel for 5k pc (7”reel) | D : ±25ppm/°C | B: 1/16W |
| High Precision Low TCR | 03 : 0603 | which denotes the number of zero following | D : ±0,5% | T10: Tape and Reel for 10kpc (7”reel) | E : ±50ppm/°C | C: 1/10W |
| | 05 : 0805 | | C : ±0,25% | | | D: 1/8W |
| | 06 : 1206 | | B : ±0,1% | | | E: 1/4W |
| | | Example: | | * not all combination is possible | | |
| | | 97R6= 97,6Ohm | | ** T10 0402 all Paper Type | | |
| | | 9760 = 976Ohm | | ** T05 for 0603 to 1206 all Paper Type | | |
| | | 1001 = 1kOhm | | | | |

**All products according to RoHS (2015/863/EU)**

# THIN FILM CHIP RESISTORS

## Construction



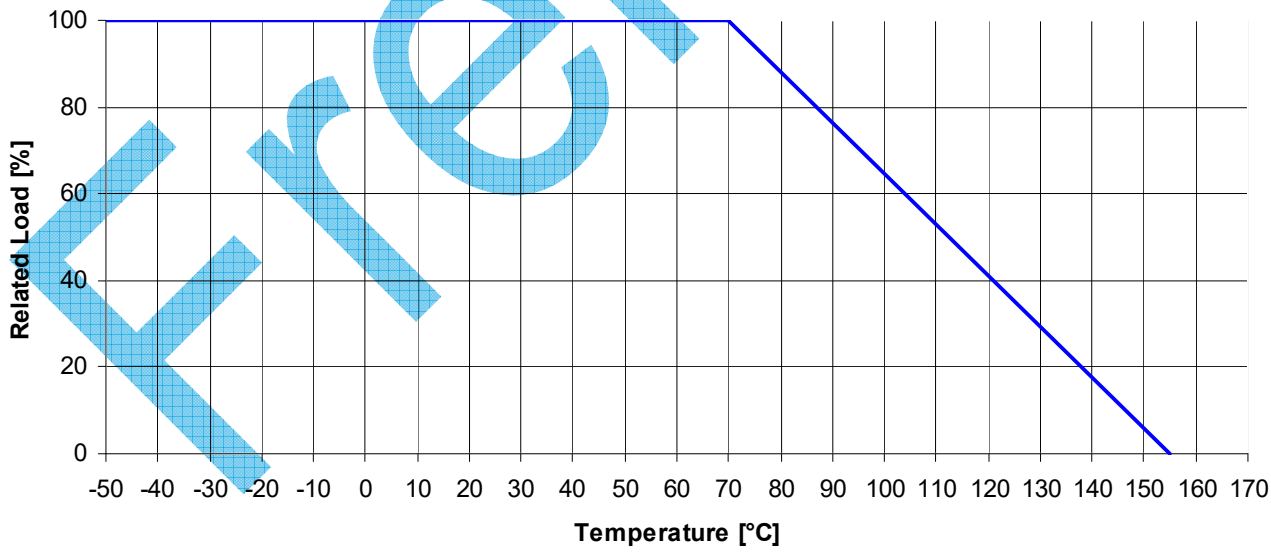

| | | | | | |
|---|---|---|---|---|---|
| ① | Alumina Substrate | ③ | Edge Electrode | ⑤ | Resistor Layer |
| ② | Bottom Electrode | ④ | Barrier Layer | ⑥ | Overcoat |
| ③ | Top Electrode | ⑥ | External Electrode | ⑨ | Marking |

## Dimensions

| Size | L | W | H | L1 | L2 |
|---|---|---|---|---|---|
| 0402 | 1,00±0,05 | 0,50±0,05 | 0,30±0,10 | 0,20±0,10 | 0,20±0,10 |
| 0603 | 1,60±0,10 | 0,80±0,10 | 0,45±0,10 | 0,30±0,20 | 0,30±0,20 |
| 0805 | 2,00±0,15 | 1,25±0,15 | 0,50±0,10 | 0,30±0,20 | 0,40±0,20 |
| 1206 | 3,10±0,15 | 1,55±0,15 | 0,55±0,10 | 0,42±0,20 | 0,35±0,25 |

## Power Derating Curve

For resistors operated in ambient temperatures above 70 °C , power rating shall be derated in accordance with figure below, Operating Temperature Range : -55°C 155°C



# THIN FILM CHIP RESISTORS

## *Rating*

## 038 *Series*

### GENERAL PURPOSE CHIP RESISTORS

| Type | Size | Power Rating at 70°C | Max. Operating Voltage | Max. Overload Voltage | Temperature Coefficient [TCR; ppm/°C] | Resistance Range [Ω] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ±0,1% E24, E96* | ±0,25% E24, E96* | ±0,5% E24, E96* | ±1% E24, E96 |
| 037 02 | 0402 | 1/16W | 50V | 100V | ±25 | 4,7Ω ~ 255kΩ | | | |
| | | | | | ±50 | 4,7Ω ~ 255kΩ | | | |
| 037 03 | 0603 | 1/10W | 75V | 150V | ±25 | 1Ω ~ 1MΩ | | | |
| | | | | | ±50 | 1Ω ~ 1MΩ | | | |
| 037 05 | 0805 | 1/8W | 150V | 300V | ±25 | 1Ω ~ 2MΩ | | | |
| | | | | | ±50 | 1Ω ~ 2MΩ | | | |
| 037 06 | 1206 | 1/4W | 200V | 400V | ±25 | 1Ω ~ 2,49MΩ | | | |
| | | | | | ±50 | 1Ω ~ 2,49MΩ | | | |

*E192 Series no marking on chip, availability need checking with sales
Operating Voltage=√(P*R) or Max. operating voltage listed above, whichever is lower.
Overload Voltage=2,5*√(P*R) or Max. overload voltage listed above, whichever is lower.
(Lower Resistance: 1~10Ω, High Power Rating)

# SMD Thin Film Chip Resistors

SPECIFICATION

**1Ohm and higher**

size 0402 no marking

0805 to 1206


4 digit marking, first three digits marking are significant figures; forth digit is multiplier ($10^X$),

examples: 1542 = 154x10²=15,400 Ohm=15,4kOhm

0603 E-96 series


examples: 12C (Table below) = 130×10² = 13kOhm


0603 E-24 series

3 digit marking, first two digits marking are significant figures; third digit is multiplier ($10^X$),

examples: 222 = 22×10² = 2,2kOhm

## 3 digit Marking Table E96

| 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 |

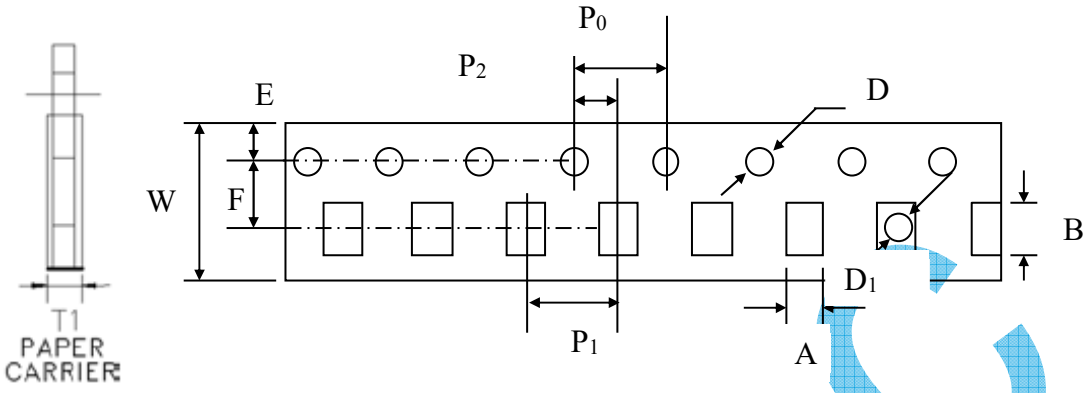
| Code | A | B | C | D | E | F | G | H | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Multiplier | $10^0$ | $10^1$ | $10^2$ | $10^3$ | $10^4$ | $10^5$ | $10^6$ | $10^7$ | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ |

## 3 digit Marking Table E24

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

SPECIFICATION

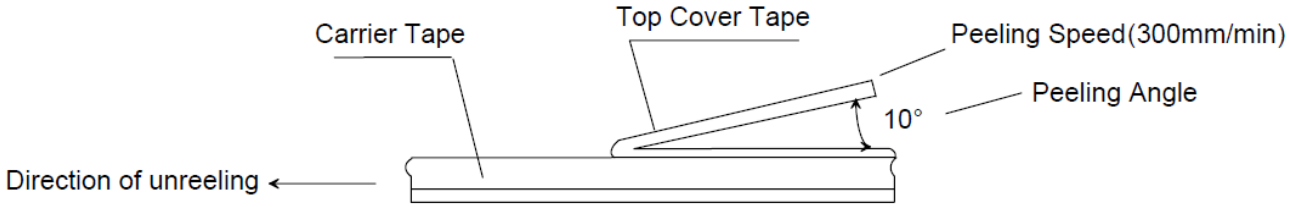
## *Tape And Reel Package*

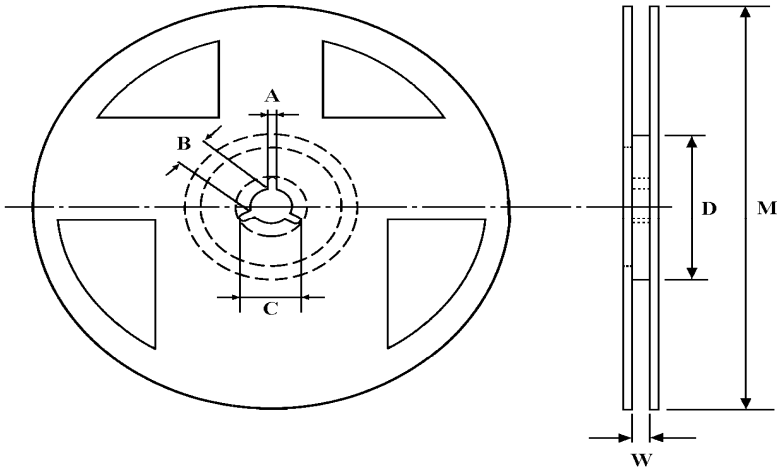



| Type | A | B | W | E | F | $P_0$ | $P_1$ | $P_2$ | ΦD | T1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0402 | 0,70±0,05 | 1,16±0,05 | 8,00±0,10 | 1,75±0,05 | 3,5±0,05 | 4,00±0,10 | 2,00±0,05 | 2,00±0,05 | 1,55±0,05 | 0,40±0,03 |
| 0603 | 1,10±0,05 | 1,90±0,05 | 8,00±0,10 | 1,75±0,05 | 3,5±0,05 | 4,00±0,10 | 4,00±0,10 | 2,00±0,05 | 1,55±0,05 | 0,60±0,03 |
| 0805 | 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 |
| 1206 | 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 |

**Cover Tape Peel off Strength**

Specifications: 0402, 0603, 0805, 1206 – peel force of top cover tape shall be between 8 to 60gf
The peel speed shall be about 300mm/min±5%



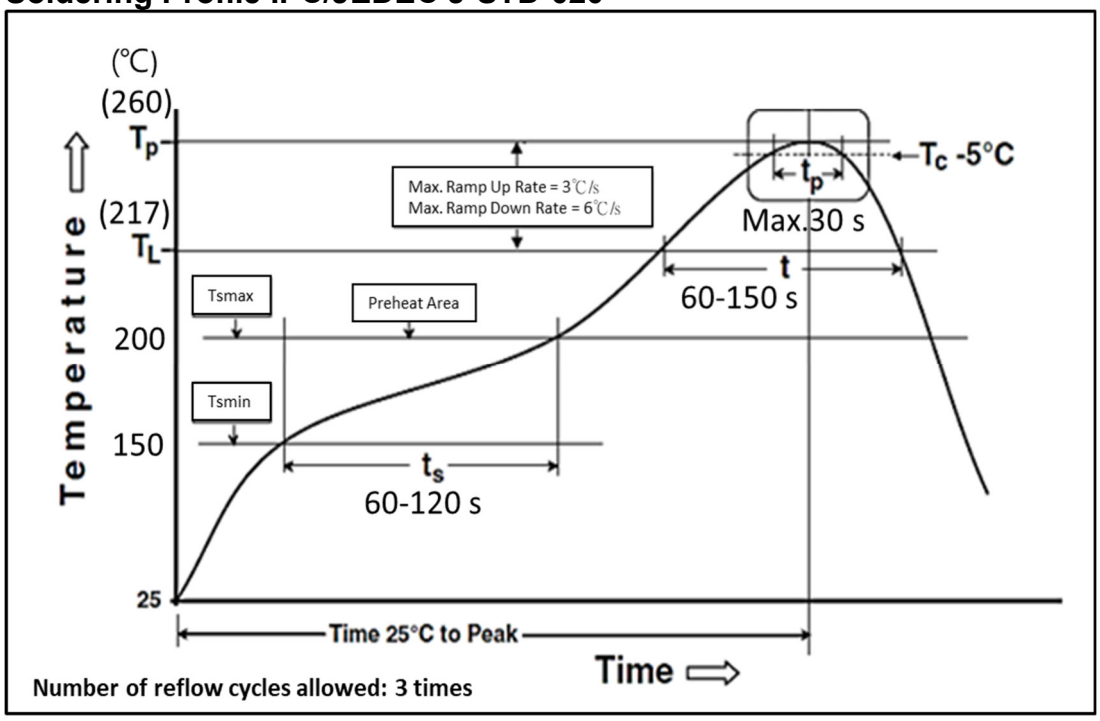




| Type | Packaging | M | B | D | W | T |
|---|---|---|---|---|---|---|
| 037 02 … T10 | Paper | 178,0±1,0 | 13,5±0,7 | 60,0+1,0 | 9,5±1,0 | 11,5±1,0 |
| 037 03 … T05 | | | | | | |
| 037 05 … T05 | | | | | | |
| 037 06 … T05 | | | | | | |

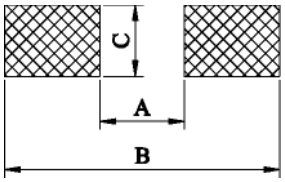
**Stock period**

The performance of these products, including the solderability, is guaranteed for 24 months, provided that they remain packed as they were when delivered and stored at a temperature of 15°C ~28°C and a relative humidity less than 80%RH

## Soldering Profile IPC/JEDEC J-STD-020




## Recommended Land Pattern Design (mm):




| Size | A | B | C |
|---|---|---|---|
| 0402 | 0,50 | 1,50 | 0,60±0,2 |
| 0603 | 0,80 | 2,80 | 0,90±0,2 |
| 0805 | 1,00 | 3,00 | 1,35±0,2 |
| 1206 | 2,00 | 4,30 | 1,70±0,2 |

## Environmental Characteristics

| Item | Requirement | Test Method |
|---|---|---|
| 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±0,2% | JIS-C-5201-1.4.33<br>RCWV*2,5 or Max. overload voltage whichever is lower for 5 seconds |
| Insulation Resistance | >9999 MΩ | MIL-STD-202 Method 302<br>Apply 100$V_{DC}$ for 1 minute |
| Endurance | ΔR±0,5% | MIL-STD-202 Method 108A<br>70±2°C, RCWV for 1000 hrs with 1,5 hrs “ON” and 0,5 hrs “OFF” |
| Damp Heat with Load | ΔR±0,5% | 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” |
| Bending Strength | ΔR±0,1% | JIS-C-5201-1 4.33<br>Bending amplitude 3 mm for 10 s |
| Solderability | 95% min. coverage | MIL-STD-202 Method 208H<br>245±5°C for 3 s |
| Resistance to Soldering Heat | ΔR±0,1% | MIL-STD-202 Method 210E<br>260±5°C for 10 s |
| Dielectric Withstand Voltage | By Type | MIL-STD-202 Method 301<br>Max. overload voltage for 1 minute |
| Thermal Shock | ΔR±0,2% | MIL-STD-202 Method 107G<br>-55°C ~150°C, 100 cycles |
| Low Temperature Operation | ΔR±0,5% | JIS-C-5201-1 4.36<br>1 hour, -65°C, followed by 45 minutes of RCWV |
| High Temperature Exposure | ΔR±0,5% | MIL-STD-202 Method 108<br>55°C ~150°C, 1000hrs |

RCWV (Rated continuous working voltage) = √ (P*R) or Max Operating voltage whichever is lower

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