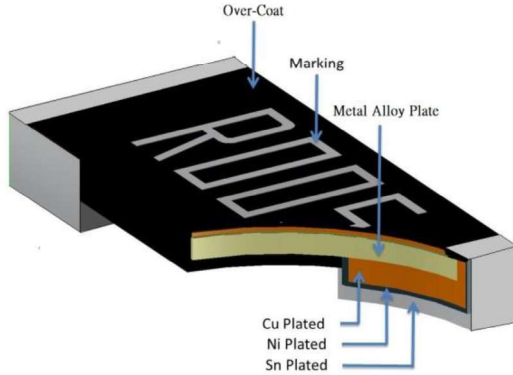




MA Series Metal Alloy Low-Resistance Resistor Product Specifications

| | |
|----------------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 1/10 |

■ Metal Alloy Low Resistance Chip Resistor — MA Series



■ Application

- Entertainment product
- Power supply
- Measuring instrument
- Industrial product
- Battery management system

■ Features

- Low Resistance / Low TCR
- Excellent long term stability
- RoHs compliant and halogen free.
- Lead free.
- High precision current sensing and voltage division.

■ Parts Number Explanation

■ Example:

| | | | | | | |
|---------------------|--------------------------------------|--|--|--|--|------------------|
| MA | 2512 | 20 | F | R001 | M | Z |
| Product Type | Size (Inch) | Rated Power | Tolerance | Resistance | Material | Optional |
| | 1206 2512 2725 2728 4527 | 07= 0.75 W 10= 1.00 W 20= 2.00 W 30= 3.00 W 40= 4.00 W 50= 5.00 W | D : ±0.5 % F : ±1 % G : ±2 % J : ±5 % | 0m20= 0.2 mR 2m50= 2.5 mR R000= 0 mR R005= 5.0 mR R100= 100 mR R500= 500 mR | S : MnCuSn M : MnCu F : FeCrAl C : Cu | Z : Default code |



MA Series Metal Alloy Low-Resistance Resistor Product Specifications

| | |
|---------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 2/10 |

Standard Electrical Specifications

| TYPE | Rating Power at 70°C | T.C.R. (ppm/°C) | Max. Rating Current | Max. Overload Current | Resistance Range (mΩ) | | Material | Operating Temperature Range (°C) |
|--------|----------------------|-----------------|---------------------|-----------------------|-----------------------|----------------------------------|---|----------------------------------|
| | | | | | 0.5% (D) | 1.0% (F) 2.0% (G) 5.0% (J) | | |
| MA1206 | 0.75W | ≤±50 | 3.83 | 7.66 | 51~100 | 51~100 | R051~R100 : FeCrAl | -55~+170°C |
| | 1W | | 31.62 | 63.24 | 7~50 | 1~50 | R001 : MnCuSn R002~R007 : MnCu R008~R050 : FeCrAl | |
| | 1.5W | | 38.72 | 77.49 | 7~10 | 1~10 | R001 : MnCuSn R002~R007 : MnCu R008~R010 : FeCrAl | |
| MA2512 | 1W | ≤±75 | 44.72 | 100.00 | --- | 0.5~0.75 | R0005~R00075 : MnCuSn | |
| | 1W | ≤±50 | 31.62 | 70.71 | 7~450 | 1~450 | R001~R006 : MnCu R007~R450 : FeCrAl | |
| | 2W | ≤±75 | 63.24 | 141.42 | --- | 0.5~0.75 | R0005~R00075 : MnCuSn | |
| | 2W | ≤±50 | 44.72 | 100.00 | 7~450 | 1~450 | R001~R006 : MnCu R007~R450 : FeCrAl | |
| | 3W | ≤±75 | 77.45 | 154.91 | --- | 0.5~0.75 | R0005~R00075 : MnCuSn | |
| | 3W | ≤±50 | 54.77 | 109.54 | 7~100 | 1~100 | R001~R006 : MnCu R007~R100 : FeCrAl | |
| MA2725 | 4W | ≤±75 | 126.49 | 252.98 | --- | 0.25~0.3 | R00025~R0003 : MnCuSn | |
| | | ≤±50 | 89.44 | 178.88 | | 0.5~3 | R0005~R0025 : MnCu R003 : FeCrAl | |
| MA2728 | 4W | ≤±50 | 31.62 | 63.24 | 7~450 | 4~450 | R004~R450 : FeCrAl | |
| MA4527 | 2W | ≤±75 | 63.24 | 141.42 | --- | 0.5 | R0005 : MnCuSn | |
| | 2W | ≤±50 | 44.72 | 100.00 | 7~100 | 1~100 | R001~R005 : MnCu R006~R100 : FeCrAl | |
| | 3W | ≤±75 | 77.45 | 173.20 | --- | 0.5 | R0005 : MnCuSn | |
| | 3W | ≤±50 | 54.77 | 122.47 | 7~60 | 1~60 | R001~R005 : MnCu R006~R060 : FeCrAl | |
| | 5W | ≤±75 | 100.00 | 173.20 | --- | 0.5 | R0005 : MnCuSn | |
| | 5W | ≤±50 | 70.71 | 122.47 | 7~500 | 1~500 | R001~R005 : MnCu R006~R500 : FeCrAl | |



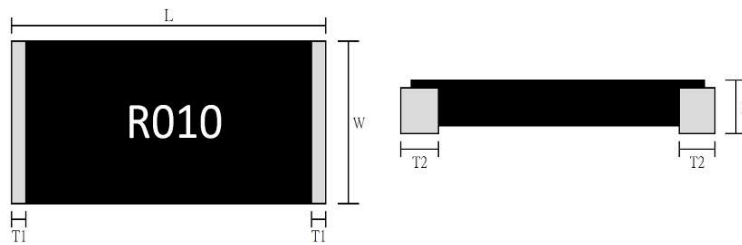
MA Series Metal Alloy Low-Resistance Resistor Product Specifications

| | |
|---------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 3/10 |

Jumper Specifications

| Type | Rating Power at 70°C | Max. Rating Current | Resistance (mΩ) | Material | Operating Temperature Range (°C) |
|--------|----------------------|---------------------|-----------------|-------------|----------------------------------|
| MA1206 | 1W | 70.7A | ≤0.2 | Jumper : Cu | -55~+170°C |
| MA2512 | 2W | 100A | | | |

Type Dimension



FOR MA1206~4527

Dimension

Unit : mm

| Type | Power Rating | Resistance Range | L | W | H | T1 | T2 |
|--------|--------------|------------------|-------------|-------------|-------------|-------------|-------------|
| MA1206 | 0.75W | 51~75mΩ | 3.200±0.254 | 1.650±0.254 | 0.400±0.254 | 0.508±0.254 | 0.508±0.254 |
| | | 76~100mΩ | | | 0.350±0.254 | | |
| | 1W | 1mΩ | | | 0.770±0.254 | | |
| | | 2mΩ | | | 0.650±0.254 | | |
| | | 3~20mΩ | | | 0.550±0.254 | | |
| | | 21~50mΩ | | | 0.470±0.254 | | |
| | 1.5W | 1mΩ | | | 0.770±0.254 | | |
| | | 2mΩ | | | 0.650±0.254 | | |
| | | 3~10mΩ | | | 0.550±0.254 | | |
| | | | | | 0.550±0.254 | | |
| MA2512 | 1W 2W | 0.5mΩ | 6.350±0.254 | 3.050±0.254 | 0.770±0.254 | 1.15±0.254 | 2.200±0.254 |
| | | 0.75 mΩ | | | 0.650±0.254 | | 1.980±0.254 |
| | | 1mΩ | | | | | 2.200±0.254 |
| | | 1.5mΩ | | | 0.670±0.254 | | 1.400±0.254 |
| | | 2mΩ | | | | | 1.150±0.254 |
| | | 2.5~6mΩ | | | 0.550±0.254 | 1.100±0.254 | |
| | | 7~10mΩ | | | 0.600±0.254 | | |
| | | 11~75mΩ | | | 0.600±0.254 | | 1.05±0.254 |
| | | 76~100mΩ | | | 0.550±0.254 | | |
| | | 101~135mΩ | | | 0.470±0.254 | 0.75±0.254 | |
| | | 136~200mΩ | | | | | |
| | | 201~450mΩ | | | 0.400±0.254 | | 0.850±0.254 |



MA Series Metal Alloy Low-Resistance Resistor Product Specifications

| | |
|---------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 4/10 |

| Type | Power Rating | Resistance Range | L | W | H | T1 | T2 |
|--------|--------------|------------------|--------------|-------------|-------------|-------------|-------------|
| MA2512 | 3W | 0.5mΩ | 6.350±0.254 | 3.050±0.254 | 0.770±0.254 | 1.150±0.254 | 2.200±0.254 |
| | | 0.75mΩ | | | 0.650±0.254 | | 1.980±0.254 |
| | | 1mΩ | | | 0.670±0.254 | | 2.200±0.254 |
| | | 1.5mΩ | | | | | 1.400±0.254 |
| | | 2mΩ | | | 0.75±0.254 | 1.150±0.254 | |
| | | 2.5~6mΩ | | | | 0.550±0.254 | 1.100±0.254 |
| | | 7~75mΩ | | | | 0.600±0.254 | |
| | | 76~100mΩ | | | | 0.550±0.254 | |
| MA2725 | 4W | 0.25mΩ | 6.800±0.254 | 6.350±0.254 | 0.770±0.254 | 1.15±0.254 | |
| | | 0.3mΩ | | | 0.650±0.254 | | 1.800±0.254 |
| | | 0.5mΩ | | | | | 2.300±0.254 |
| | | 1mΩ | | | 0.550±0.254 | | 1.800±0.254 |
| | | 1.5mΩ | | | | | 1.500±0.254 |
| | | 2~3mΩ | | | | | |
| MA2728 | 4W | 4~450mΩ | 6.600±0.254 | 6.700±0.254 | | 0.580±0.254 | 0.40±0.254 |
| MA4527 | 2W | 0.5mΩ | 11.300±0.500 | 6.600±0.500 | 0.770±0.254 | 0.90±0.254 | 3.000±0.254 |
| | | 1mΩ | | | 0.650±0.254 | | 2.000±0.254 |
| | | 1.5~5mΩ | | | | | |
| | | 6~100mΩ | | | 0.550±0.254 | | |
| | 3W | 0.5mΩ | | | 0.90±0.254 | 0.770±0.254 | 3.000±0.254 |
| | | 1mΩ | | | | 0.650±0.254 | 2.000±0.254 |
| | | 1.5~5mΩ | | | | | |
| | | 6~60mΩ | | | | 0.550±0.254 | |
| | 5W | 0.5mΩ | | | 0.65±0.254 | 0.800±0.254 | 3.000±0.254 |
| | | 1mΩ | | | | 0.680±0.254 | 2.000±0.254 |
| | | 1.5~5mΩ | | | | | |
| | | 6~450mΩ | | | | 0.580±0.254 | |

■ Jumper Dimension

Unit : mm

| Type | Power Rating | Resistance Range | L | W | H | T1 | T2 |
|--------|--------------|------------------|-------------|-------------|-------------|-------------|-------------|
| MA1206 | 1W | < 0.2mΩ | 3.200±0.254 | 1.650±0.254 | 0.650±0.254 | 0.508±0.254 | 0.508±0.254 |
| MA2512 | 2W | < 0.2mΩ | 6.350±0.254 | 3.050±0.254 | 0.650±0.254 | 1.15±0.254 | 1.100±0.254 |



MA Series Metal Alloy Low-Resistance Resistor Product Specifications

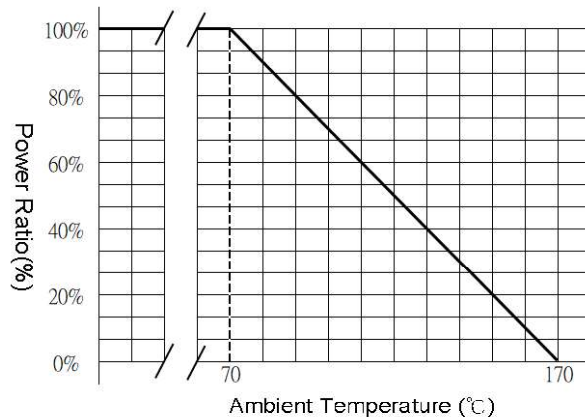
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|---------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 5/10 |

■ Performance Characteristics

Power Derating Curve

The Operating Temperature Range: $-55^{\circ}\text{C} \sim +170^{\circ}\text{C}$.

For resistors operated in ambient temperatures above 70°C , power rating must be derating in accordance with the curve below.



■ Rating Current

The following equation may be used to determine the DC (Direct Current) or AC (Alternating Current) (RMS, root mean square value) of normal rated power. However, if the result value exceeds the highest current of regulated standards (paragraph 5), the highest normal rated power is to be used.

$$I = \sqrt{P/R}$$

I = Rating current (A)
 P = Rating Power (W)
 R = Resistance (Ω)

■ Marking Format:

- All the other products marking are 4 digits.
- "R" designates the decimal location in ohms
e.g. $1\text{m}\Omega$ the product marking is R001.
 $25\text{m}\Omega$ the product marking is R025.
 $100\text{m}\Omega$ the product marking is R100.
- "m" designates the decimal location in milli-ohms
e.g. $0.25\text{m}\Omega$ the product marking is 0m25.
 $0.5\text{m}\Omega$ the product marking is 0m50.
 $5.5\text{m}\Omega$ the product marking is 5m50.
 $25.5\text{m}\Omega$ the product marking is 25m5.
- 0Ω product marking is 0R.
- The criteria to distinguishing the mark on the surface of products are that characters can be identified.



MA Series Metal Alloy Low-Resistance Resistor Product Specifications

| | |
|---------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 6/10 |

Reliability test and requirement

| Test Item | Test Method | Procedure | Requirements |
|---|---|---|--|
| Temperature Coefficient of Resistance (T.C.R) | JIS-C-5201-1 4.8 IEC-60115-1 4.8 | At 25°C /+150°C, 25°C is the reference temperature | As Spec |
| Short Time Overload | JIS-C-5201-1 4.13 IEC-60115-1 4.13 | The number of rated power are as follows: <ul style="list-style-type: none"> MA1206-0.75W: 4 times of rated power MA1206-1W: 4 times of rated power MA1206-1.5W: 4 times of rated power MA2512-1W: 5 times of rated power MA2512-2W: 5 times of rated power MA2512-3W: 5 times of rated power^(Note) MA2725-4W: 4 times of rated power MA2728-4W: 4 times of rated power MA4527-2W: 5 times of rated power MA4527-3W: 5 times of rated power MA4527-5W: 3 times of rated power for 5 seconds. | <ul style="list-style-type: none"> MA4527: $\Delta R/R1 \leq \pm 2.0\%$ The others: $\Delta R/R1 \leq \pm 0.5\%$ |
| High Temperature Exposure | JIS-C5201-1 4.25 IEC 60068-2-2 | At 170°C for 1000 hours. | <ul style="list-style-type: none"> MA4527: $\Delta R/R1 \leq \pm 2.0\%$ The others: $\Delta R/R1 \leq \pm 1.0\%$ |
| Resistance to Soldering Heat | JIS-C-5201-1 4.18 IEC-60115-1 4.18 | 260±5°C for 10 seconds. | $\Delta R/R1 \leq \pm 0.5\%$ |
| Temperature Cycling | JESD22 Method JA-104 | 1000 Cycles (-55°C to +155°C) Measurement at 24±4 hours after test conclusion. 30min maximum dwell time at each temperature extreme. | $\Delta R/R1 \leq \pm 0.5\%$ |
| Biased Humidity | MIL-STD-202 Method 103 | 1,000 hours; 85°C / 85% RH, 10% of operating power. Measurement at 24±4 hours after test conclusion. | $\Delta R/R1 \leq \pm 0.5\%$ |
| Load Life (Endurance) | JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 | 70±2°C, RCWV or Max. working voltage whichever is less for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" . | <ul style="list-style-type: none"> MA4527: $\Delta R/R1 \leq \pm 2.0\%$ The others: $\Delta R/R1 \leq \pm 1.0\%$ |
| Solderability | JIS-C-5201-1 4.17 IEC-60115-1 4.17 | 245±5°C for 3 seconds. | >95% coverage |
| Dielectric Withstanding Voltage | JIS-C5201-1 4.7 | Applied 500VAC for 1 minute. | No short or burned on the appearance. |
| Core Body Strength | JIS-C5201-1 4.15 | Central part pressurizing force : 5N , 10 seconds | No broken |
| Terminal Strength (SMD) | AEC Q200-006 | Pressurizing force 17.7N for 60 seconds | No broken |
| Bending Strength | JIS-C-5201-1 4.33 IEC-60115-1 4.33 | Bending once 2mm for 10 seconds | $\Delta R/R1 \leq \pm 0.5\%$ No broken |
| Moisture Resistance | MIL-STD 202 Method 106 | T=24 hours / Cycle , 10Cycles . Steps 7a& 7b not required. Unpowered . (Figure 1) | $\Delta R/R1 \leq \pm 0.5\%$ |

*Note: This test is a destructive experiment. The top protective layer is prone to damage and peculiar smell during, in the 50mR~100mR resistance test. The resistance change rate can meets the specifications.



MA Series Metal Alloy Low-Resistance Resistor Product Specifications

| | |
|---------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 7/10 |

For Jumper

| Test Item | Test Method | Procedure | Requirements |
|---------------------------|---|--|-------------------|
| Short Time Overload | JIS-C-5201-1 4.13 IEC-60115-1 4.13 | 4 times of rated power for 5 seconds. | $\leq 0.2m\Omega$ |
| Temperature Cycling | JESD22 Method JA-104 | 1000 Cycles (-55°C to +155°C) Measurement at 24±4 hours after test conclusion. 30min maximum dwell time at each temperature extreme. | $\leq 0.2m\Omega$ |
| High Temperature Exposure | JIS-C5201-1 4.25 IEC 60068-2-2 | At 170°C for 1000 hours. | $\leq 0.2m\Omega$ |
| Biased Humidity | MIL-STD-202 Method 103 | 1,000 hours; 85°C / 85% RH, 10% of operating power. Measurement at 24±4 hours after test conclusion. | $\leq 0.2m\Omega$ |
| Load Life (Endurance) | JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 | 70±2°C, RCWV or Max. working voltage whichever is less for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" . | $\leq 0.2m\Omega$ |
| Solderability | JIS-C-5201-1 4.17 IEC-60115-1 4.17 | 245±5°C for 3 seconds. | >95% coverage |

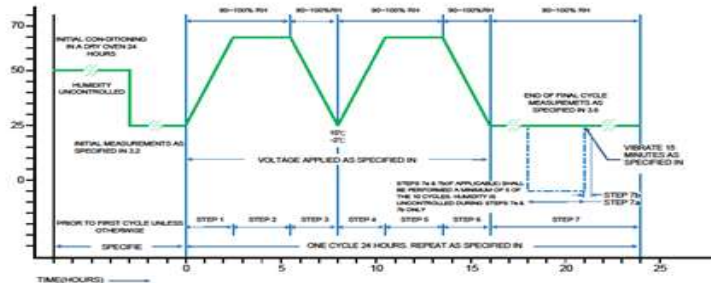
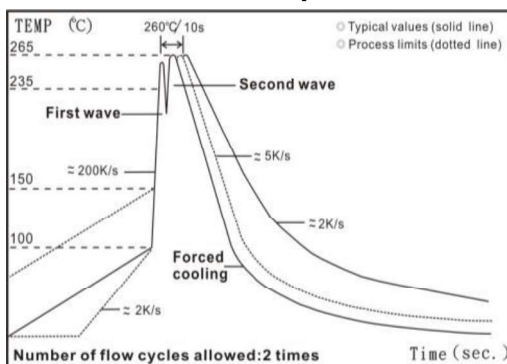


Figure 1

Recommended Customer Soldering Parameters

Wave solder Temperature condition

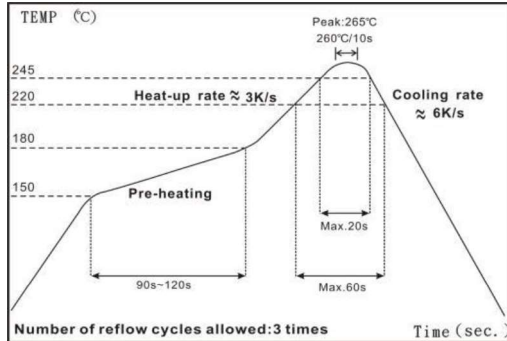




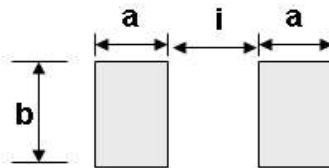
MA Series Metal Alloy Low-Resistance Resistor Product Specifications

| | |
|---------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 8/10 |

■ Solder reflow Temperature condition



■ Recommend Land Pattern Design



■ Dimension

Unit: mm

| TYPE | Resistance Range | a | b | i |
|--------------------------|--|------|------|------|
| MA1206 – 0.75W, 1W, 1.5W | Jumper : $\leq 0.2m\Omega$ | 1.46 | 2.15 | 1.68 |
| | 1m Ω ~100m Ω | 1.46 | 2.15 | 1.68 |
| MA2512 -1W, 2W, 3W | Jumper : $\leq 0.2m\Omega$ | 2.30 | 3.68 | 3.15 |
| | 0.5m Ω ~1m Ω | 3.40 | 3.68 | 0.95 |
| | 1.5 m Ω | 2.35 | 3.68 | 1.35 |
| | 2 m Ω | 2.10 | 3.68 | 2.55 |
| | 2.5m Ω ~200m Ω | 2.30 | 3.68 | 3.15 |
| | 201m Ω ~450m Ω | 2.05 | 3.68 | 3.65 |
| MA2725 - 4W | 0.25m Ω : 0.5m Ω | 3.25 | 6.85 | 1.70 |
| | 0.3m Ω ; 1m Ω ~3m Ω | 2.75 | 6.85 | 2.70 |
| MA2728 - 4W | 4m Ω ~450m Ω | 2.05 | 7.20 | 3.90 |
| MA4527 – 2W, 3W, 5W | 0.5m Ω ~1.5m Ω | 4.50 | 8.74 | 4.50 |
| | 2.0m Ω ~100m Ω | 3.50 | 8.74 | 6.50 |
| | 101m Ω ~500m Ω | 3.50 | 8.74 | 6.50 |



MA Series Metal Alloy Low-Resistance Resistor Product Specifications

| | |
|---------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 9/10 |

■ Packing Quantity

| TYPE | PCS /Reel | Parts Number Explanation |
|-------------|-------------|--------------------------|
| MA1206 | 5000 | Z: 5000PCS |
| MA1206- 001 | 4000 | Z: 4000PCS |
| MA2512 | 4000 | Z: 4000PCS |
| MA2725 | 2000 /1000 | Z: 2000PCS 1: 1000PCS |
| MA2728 | 2000 / 1000 | Z: 2000PCS 1: 1000PCS |
| MA4527 | 1000 / 500 | Z: 1000PCS 0: 500PCS |

■ Plating Thickness:

Ni: $\geq 2 \mu\text{m}$

Sn(Tin): $\geq 3 \mu\text{m}$

■ Label :





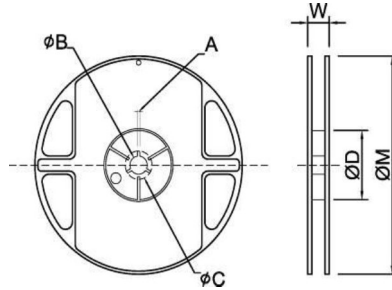
MA Series Metal Alloy Low-Resistance Resistor Product Specifications

| | |
|---------------|---------------|
| Document No. | S-10-12-05-20 |
| Revision Date | 2020/08/12 |
| Page No. | 10/10 |

Appendix For SMD Chip Resistor

Packaging Information

Reel Dimensions

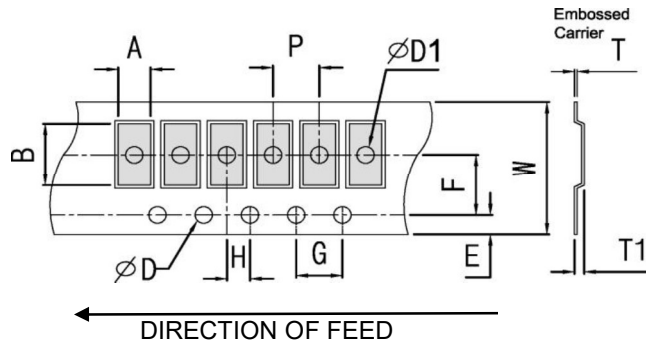


Dimension

Unit: mm

| Reel Type / Tape | A | φ B | φ C | φ D | W | φ M |
|---|---------|----------|----------|----------|----------|---------|
| 7" reel for 8 mm embossed (for MA1206) | 2.0±0.5 | 13.2±0.5 | 17.7±0.5 | 60.0±0.5 | 12.0±0.5 | 178±1.0 |
| 7" reel for 12 mm embossed | 2.5±0.5 | 13.5±0.5 | 17.7±0.5 | 60.0±0.5 | 16.2±0.5 | 178±1.0 |
| 7" reel for 24 mm embossed | 2.0±0.5 | 13.2±0.5 | 17.7±0.5 | 60.0±0.5 | 24.4±2.0 | 178±1.0 |

Embossed Dimensions



Dimension

Unit: mm

| Item | Resistance Range (mΩ) | W | P | E | F | φ D | φ D1 | G | H | A | B | T1 | T |
|--------|-----------------------|-----------|-----------|-----------|-----------|-----------------------------------|-----------|----------|----------|-----------|-----------|-----------|-----------|
| MA1206 | 1mΩ | 8.0±0.30 | 4.0±0.10 | 1.75±0.10 | 3.5±0.10 | 1.50 ^{+0.1} ₀ | 1.0±0.10 | 4.0±0.10 | 2.0±0.10 | 2.03±0.10 | 3.55±0.10 | 1.10±0.10 | 0.20±0.05 |
| MA1206 | 2~100mΩ | 8.0±0.30 | 4.0±0.10 | 1.75±0.10 | 3.5±0.10 | | 1.0±0.10 | 4.0±0.10 | 2.0±0.10 | 2.03±0.10 | 3.55±0.10 | 0.85±0.10 | 0.20±0.05 |
| MA2512 | 0.5~2mΩ | 12.0±0.30 | 4.0±0.10 | 1.75±0.10 | 5.5±0.10 | | 1.55±0.10 | 4.0±0.10 | 2.0±0.10 | 3.50±0.10 | 6.75±0.10 | 1.10±0.10 | 0.20±0.05 |
| MA2512 | 3~450mΩ | 12.0±0.30 | 4.0±0.10 | 1.75±0.10 | 5.5±0.10 | | 1.55±0.10 | 4.0±0.10 | 2.0±0.10 | 3.50±0.10 | 6.75±0.10 | 0.90±0.10 | 0.20±0.05 |
| MA2725 | 0.25~3mΩ | 12.0±0.30 | 8.0±0.10 | 1.75±0.10 | 5.5±0.10 | | 1.55±0.10 | 4.0±0.10 | 2.0±0.10 | 6.81±0.10 | 7.16±0.10 | 1.05±0.10 | 0.25±0.05 |
| MA2728 | 4~450mΩ | 12.0±0.30 | 8.0±0.10 | 1.75±0.10 | 5.5±0.10 | | 1.55±0.10 | 4.0±0.10 | 2.0±0.10 | 7.10±0.10 | 7.05±0.10 | 0.95±0.10 | 0.20±0.05 |
| MA4527 | 0.5~500mΩ | 24.0±0.30 | 12.0±0.10 | 1.75±0.10 | 11.5±0.10 | | 1.50±0.10 | 4.0±0.10 | 2.0±0.10 | 7.38±0.10 | 12.0±0.10 | 1.05±0.10 | 0.30±0.10 |

Storage Temperature

Storage time at the environment temp: 25±5°C & humidity: 60±20% is valid for one year from the date of delivery