

DATA SHEET

ANTI-SULFURATED CHIP RESISTORS AUTOMOTIVE GRADE

AF series

5%, 1%, 0.5%

sizes 0100/0201/0402/0603/0805/1206/1210/1218/2010/2512

RoHS compliant & Halogen free



SCOPE

This specification describes AF0100 to AF2512 chip resistors with anti-sulfuration capabilities.

APPLICATIONS

- Industrial Equipment
- Power Application
- Networking Application
- High-end Computer & Multimedia Electronics in high sulfur environment
- Automotive electronics

FEATURES

- AEC-Q200 qualified
- Superior resistance against sulfur containing atmosphere
- Halogen free product and production
- RoHS compliant
- Reduces environmentally hazardous waste
- High component and equipment reliability
- Saving of PCB space
- Moisture sensitivity level: MSL 1
- 50ppm available

ORDERING INFORMATION - GLOBAL PART NUMBER

Part number is identified by the series name, size, tolerance, packaging type, temperature coefficient, taping reel and resistance value.

GLOBAL PART NUMBER

AF XXXX X X X XX XXXX L
 (1) (2) (3) (4) (5) (6) (7)

(1) SIZE

0100/0201/0402/0603/0805/1206/1210/1218/2010/2512

(2) TOLERANCE

- D = ±0.5%
- F = ±1%
- J = ±5% (for jumper ordering, use code of J)

(3) PACKAGING TYPE

- R = Paper taping reel
- K = Embossed plastic tape reel

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

- = Base on spec
- E = ±50 ppm/°C

(5) TAPING REEL

- 07 = 7 inch dia. Reel
- 13 = 13 inch dia. Reel
- 7W = 7 inch dia. Reel & 2 x standard power

(6) RESISTANCE VALUE

There are 2~4 digits indicated the resistance value. Letter R/K/M is decimal point. Detailed resistance rules are displayed in the table of "Resistance rule of global part number".

(7) DEFAULT CODE

Letter L is system default code for ordering only ^(Note)

| Resistance rule of global part number | |
|---------------------------------------|--|
| Resistance coding rule | Example |
| XRXX (1 to 9.76 Ω) | 1R = 1 Ω 1R5 = 1.5 Ω 9R76 = 9.76 Ω |
| XXRX (10 to 97.6 Ω) | 10R = 10 Ω 97R6 = 97.6 Ω |
| XXXR (100 to 976 Ω) | 100R = 100 Ω |
| XKXX (1 to 9.76 KΩ) | 1K = 1,000 Ω 9K76 = 9760 Ω |
| XMXX (1 to 9.76 MΩ) | 1M = 1,000,000 Ω 9M76 = 9,760,000 Ω |

ORDERING EXAMPLE

The ordering code for an AF0402 chip resistor, value 100 KΩ with ±1% tolerance, supplied in 7-inch tape reel with 10Kpcs quantity is: AF0402FR-07100KL.

NOTE

1. All our R-Chip products are RoHS compliant and Halogen free. "LFP" of the internal 2D reel label states "Lead-Free Process"
2. On customized label, "LFP" or specific symbol can be printed

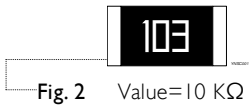
MARKING

AF0100 / AF0201 / AF0402



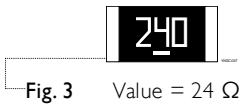
No marking

AF0603 / AF0805 / AF1206 / AF1210 / AF2010 / AF2512

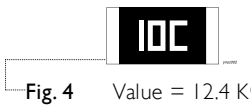


E-24 series: 3 digits, ±5%, ≥10Ω
First two digits for significant figure and 3rd digit for number of zeros

AF0603

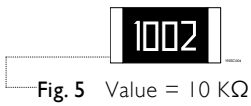


E-24 series: 3 digits, ±1%
One short bar under marking letter



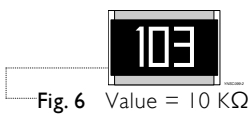
E-96 series: 3 digits, ±1%
First two digits for E-96 marking rule and 3rd letter for number of zeros

AF0805 / AF1206 / AF1210 / AF2010 / AF2512

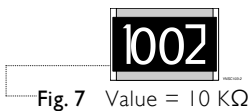


Both E-24 and E-96 series: 4 digits, ±1%
First three digits for significant figure and 4th digit for number of zeros

AF1218



E-24 series: 3 digits, ±5%
First two digits for significant figure and 3rd digit for number of zeros



Both E-24 and E-96 series: 4 digits, ±1%
First three digits for significant figure and 4th digit for number of zeros

NOTE

For further marking information, please see special data sheet “Chip resistors marking”. Marking of AF series is the same as RC series

CONSTRUCTION

The resistors are constructed on top of a high grade ceramic body. Internal metal electrodes are added at each end and connected by a resistive glaze. The resistive glaze is covered by a glass.

The composition of the glaze is adjusted to give the approximate required resistance value and laser trimming of this resistive glaze achieves the value within tolerance.

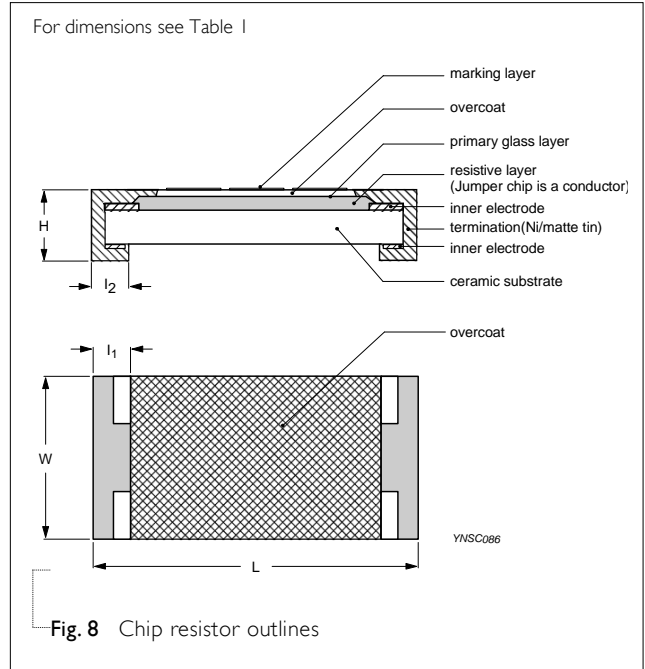
The whole element is covered by a protective overcoat. Size 0603 and bigger is marked with the resistance value on top. Finally, the two external terminations (Ni / matte tin) are added. See fig.8

DIMENSIONS

Table I For outlines see fig. 8

| TYPE | L (mm) | W (mm) | H (mm) | l ₁ (mm) | l ₂ (mm) |
|--------|-----------|-----------|-----------|---------------------|---------------------|
| AF0100 | 0.40±0.02 | 0.20±0.02 | 0.14±0.02 | 0.10±0.03 | 0.10±0.03 |
| AF0201 | 0.60±0.03 | 0.30±0.03 | 0.23±0.03 | 0.12±0.05 | 0.15±0.05 |
| AF0402 | 1.00±0.05 | 0.50±0.05 | 0.35±0.05 | 0.20±0.10 | 0.25±0.10 |
| AF0603 | 1.60±0.10 | 0.80±0.10 | 0.45±0.10 | 0.25±0.15 | 0.25±0.15 |
| AF0805 | 2.00±0.10 | 1.25±0.10 | 0.50±0.10 | 0.35±0.20 | 0.35±0.20 |
| AF1206 | 3.10±0.10 | 1.60±0.10 | 0.55±0.10 | 0.45±0.20 | 0.50±0.20 |
| AF1210 | 3.10±0.10 | 2.60±0.15 | 0.57±0.10 | 0.45±0.20 | 0.50±0.20 |
| AF1218 | 3.10±0.10 | 4.60±0.10 | 0.57±0.10 | 0.45±0.20 | 0.50±0.20 |
| AF2010 | 5.00±0.10 | 2.50±0.15 | 0.57±0.10 | 0.55±0.20 | 0.55±0.20 |
| AF2512 | 6.35±0.10 | 3.20±0.15 | 0.57±0.10 | 0.60±0.20 | 0.60±0.20 |

OUTLINES



ELECTRICAL CHARACTERISTICS

Table 2

| TYPE | POWER | CHARACTERISTICS | | | | | | |
|--------|--------|-----------------------------|----------------------|-----------------------|---------------------------------|--|--|-----------------------|
| | | Operating Temperature Range | Max. Working Voltage | Max. Overload Voltage | Dielectric Withstanding Voltage | Resistance Range | Temperature Coefficient | Jumper Criteria |
| AF0100 | 1/32 W | -55 °C to 125°C | 15V | 30V | 30V | 5% (E24) 10Ω ≤ R ≤ 1MΩ | 10Ω ≤ R < 100Ω ±300 ppm/°C | Rated Current 0.5A |
| | | | | | | 1% (E24/E96) 10Ω ≤ R ≤ 1MΩ Jumper < 50mΩ | 100Ω ≤ R ≤ 1MΩ ±200 ppm/°C | Max. Current 1.0A |
| AF0201 | 1/20 W | | 25V | 50V | 50V | 5% (E24) 1Ω ≤ R ≤ 10MΩ | 1Ω ≤ R ≤ 10Ω -100/+350 ppm/°C | Rated Current 0.5A |
| | | | | | | 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper < 50mΩ | 10Ω < R ≤ 10MΩ ±100 ppm/°C | Max. Current 1.0A |
| AF0402 | 1/16 W | | 50V | 100V | 100V | 5% (E24) 1Ω ≤ R ≤ 22MΩ | 1Ω ≤ R ≤ 10Ω ±200 ppm/°C | Rated Current 1A |
| | | | | | | 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper < 50mΩ | 10Ω < R ≤ 10MΩ ±100 ppm/°C 10MΩ < R ≤ 22MΩ ±200 ppm/°C 100Ω ≤ R ≤ 1MΩ ±50 ppm/°C | Max. Current 2A |
| AF0603 | 1/8W | | 50V | 100V | 100V | 5% (E24) 1Ω ≤ R ≤ 10MΩ | 1Ω ≤ R ≤ 10Ω ±200 ppm/°C | Rated Current 1A |
| | | | | | | 0.5%, 1%, (E24/E96) 1Ω ≤ R ≤ 10MΩ | 10Ω < R ≤ 10MΩ ±100 ppm/°C | Max. Current 2A |
| AF0805 | 1/10 W | | 75V | 150V | 150V | 5% (E24) 1Ω ≤ R ≤ 22MΩ | 1Ω ≤ R ≤ 10Ω ±200 ppm/°C | Rated Current 1A |
| | | | | | | 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper < 50mΩ | 10Ω < R ≤ 10MΩ ±100 ppm/°C 10MΩ < R ≤ 22MΩ ±200 ppm/°C 100Ω ≤ R ≤ 10MΩ ±50 ppm/°C | Max. Current 2A |
| AF0805 | 1/5 W | -55 °C to 155 °C | 75V | 150V | 150V | 5% (E24) 1Ω ≤ R ≤ 10MΩ | 1Ω ≤ R ≤ 10Ω ±200 ppm/°C | Rated Current 2A |
| | | | | | | 0.5%, 1%, (E24/E96) 1Ω ≤ R ≤ 10MΩ | 10Ω < R ≤ 10MΩ ±100 ppm/°C | Max. Current 5A |
| AF1206 | 1/8 W | | 150V | 300V | 300V | 5% (E24) 1Ω ≤ R ≤ 22MΩ | 1Ω ≤ R ≤ 10Ω ±200 ppm/°C | Rated Current 2A |
| | | | | | | 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper < 50mΩ | 10Ω < R ≤ 10MΩ ±100 ppm/°C 10MΩ < R ≤ 22MΩ ±200 ppm/°C 100Ω ≤ R ≤ 10MΩ ±50 ppm/°C | Max. Current 10A |
| AF1206 | 1/4 W | | 150V | 300V | 300V | 5% (E24) 1Ω ≤ R ≤ 10MΩ | 1Ω ≤ R ≤ 10Ω ±200 ppm/°C | Rated Current 2A |
| | | | | | | 0.5%, 1%, (E24/E96) 1Ω ≤ R ≤ 10MΩ | 10Ω < R ≤ 10MΩ ±100 ppm/°C | Max. Current 10A |
| AF1206 | 1/4 W | | 200V | 400V | 500V | 5% (E24) 1Ω ≤ R ≤ 22MΩ | 1Ω ≤ R ≤ 10Ω ±200 ppm/°C | Rated Current 2A |
| | | | | | | 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper < 50mΩ | 10Ω < R ≤ 10MΩ ±100 ppm/°C 10MΩ < R ≤ 22MΩ ±200 ppm/°C 100Ω ≤ R ≤ 10MΩ ±50 ppm/°C | Max. Current 10A |
| AF1206 | 1/2 W | | 200V | 400V | 500V | 5% (E24) 1Ω ≤ R ≤ 10MΩ | 1Ω ≤ R ≤ 10Ω ±200 ppm/°C | Rated Current 2A |
| | | | | | | 0.5%, 1%, (E24/E96) 1Ω ≤ R ≤ 10MΩ | 10Ω < R ≤ 10MΩ ±100 ppm/°C | Max. Current 10A |

ELECTRICAL CHARACTERISTICS

Table 2

| TYPE | POWER | CHARACTERISTICS | | | | | | |
|--------|-------|-----------------------------|----------------------|-----------------------|---------------------------------|--|---|---------------------|
| | | Operating Temperature Range | Max. Working Voltage | Max. Overload Voltage | Dielectric Withstanding Voltage | Resistance Range | Temperature Coefficient | Jumper Criteria |
| AF1210 | 1/2 W | | 200V | 500V | 500V | 5% (E24) $1\Omega \leq R \leq 10M\Omega$ | $1\Omega \leq R \leq 10\Omega$ $\pm 200 \text{ ppm}/^\circ\text{C}$ | Rated Current 2A |
| | | | | | | 0.5%, 1% (E24/E96) $1\Omega \leq R \leq 10M\Omega$ Jumper < 50m Ω | $10\Omega < R \leq 10M\Omega$ $\pm 100 \text{ ppm}/^\circ\text{C}$ $100\Omega \leq R \leq 1M\Omega$ $\pm 50 \text{ ppm}/^\circ\text{C}$ | Max. Current 10A |
| AF1218 | 1 W | | 200V | 500V | 500V | 5% (E24) $1\Omega \leq R \leq 1M\Omega$ | $1\Omega \leq R \leq 10\Omega$ $\pm 200 \text{ ppm}/^\circ\text{C}$ | Rated Current 2A |
| | | | | | | 0.5%, 1% (E24/E96) $1\Omega \leq R \leq 1M\Omega$ Jumper < 50m Ω | $10\Omega < R \leq 1M\Omega$ $\pm 100 \text{ ppm}/^\circ\text{C}$ $100\Omega \leq R \leq 2.2M\Omega$ $\pm 50 \text{ ppm}/^\circ\text{C}$ | Max. Current 10A |
| | | -55 °C to 155 °C | | | | | | |
| AF2010 | 3/4 W | | 200V | 500V | 500V | 5% (E24) $1\Omega \leq R \leq 10M\Omega$ | $1\Omega \leq R \leq 10\Omega$ $\pm 200 \text{ ppm}/^\circ\text{C}$ | Rated Current 2A |
| | | | | | | 0.5%, 1% (E24/E96) $1\Omega \leq R \leq 10M\Omega$ Jumper < 50m Ω | $10\Omega < R \leq 10M\Omega$ $\pm 100 \text{ ppm}/^\circ\text{C}$ $100\Omega \leq R \leq 10M\Omega$ $\pm 50 \text{ ppm}/^\circ\text{C}$ | Max. Current 10A |
| AF2512 | 1 W | | 200V | 500V | 500V | 5% (E24) $1\Omega \leq R \leq 10M\Omega$ | $1\Omega \leq R \leq 10\Omega$ $\pm 200 \text{ ppm}/^\circ\text{C}$ | Rated Current 2A |
| | | | | | | 0.5%, 1% (E24/E96) $1\Omega \leq R \leq 10M\Omega$ Jumper < 50m Ω | $10\Omega < R \leq 10M\Omega$ $\pm 100 \text{ ppm}/^\circ\text{C}$ $100\Omega \leq R \leq 10M\Omega$ $\pm 50 \text{ ppm}/^\circ\text{C}$ | Max. Current 10A |

FOOTPRINT AND SOLDERING PROFILES

For recommended footprint and soldering profiles of AF-series is the same as RC-series. Please see the special data sheet “Chip resistors mounting”.

PACKING STYLE AND PACKAGING QUANTITY

Table 3 Packing style and packaging quantity

| PACKING STYLE | REEL DIMENSION | AF0100 | AF0201 | AF0402 | AF0603 AF0805 AF1206 | AF1210 | AF1218 AF2010 AF2512 |
|--------------------------|----------------|--------|---------------|---------------|----------------------------|--------|----------------------------|
| Paper taping reel (R) | 7" (178 mm) | 20,000 | 10,000/20,000 | 10,000/20,000 | 5,000 | 5,000 | -- |
| | 13" (330 mm) | -- | 50,000 | 50,000 | 20,000 | 20,000 | -- |
| Embossed taping reel (K) | 7" (178 mm) | -- | -- | -- | -- | -- | 4,000 |

NOTE

I. For paper/embossed tape and reel specification/dimensions, please see the special data sheet “Chip resistors packing”.

FUNCTIONAL DESCRIPTION

OPERATING TEMPERATURE RANGE

AF0100 Range: -55°C to + 125°C

AF0201 - AF2512 Range: -55°C to + 155°C

POWER RATING

Each type rated power at 70°C:

AF0100=1/32W (0.03125W)

AF0201=1/20W (0.05W)

AF0402=1/16 W (0.0625W); 1/8W (0.125W)

AF0603=1/10 W (0.1W); 1/5W (0.2W)

AF0805=1/8 W (0.125W); 1/4W (0.25W)

AF1206=1/4 W (0.25W); 1/2W (0.5W)

AF1210=1/2W (0.5W)

AF1218=1W

AF2010=3/4W (0.75W)

AF2512=1W

RATED VOLTAGE

The DC or AC (rms) continuous working voltage corresponding to the rated power is determined by the following formula:

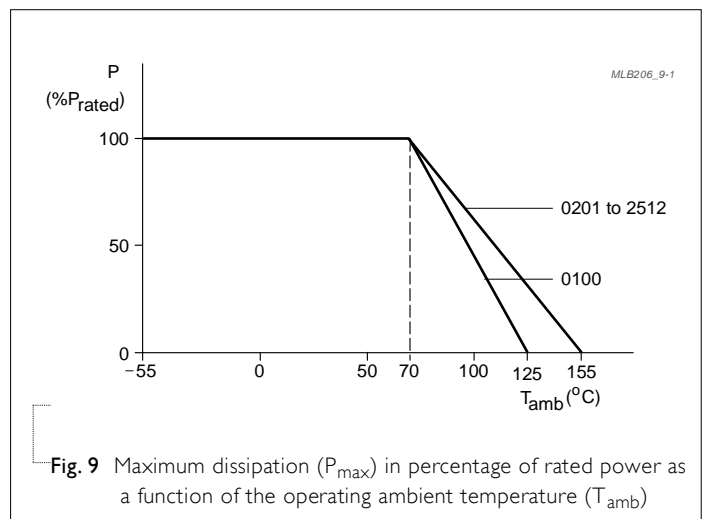
$$V = \sqrt{(P \times R)}$$

Where

V = Continuous rated DC or AC (rms) working voltage (V)

P = Rated power (W)

R = Resistance value (Ω)



TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|--|--|--|--|
| Temperature Coefficient of Resistance (T.C.R.) | IEC 60115-1 4.8 MIL-STD-202 Method 304 | At +25/-55°C and +25/+125°C Formula: $T.C.R = \frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}$ Where $t_1 = +25^\circ\text{C}$ or specified room temperature $t_2 = -55^\circ\text{C}$ or $+125^\circ\text{C}$ test temperature $R_1 =$ resistance at reference temperature in ohms $R_2 =$ resistance at test temperature in ohms | Refer to table 2 |
| Life/Endurance | IEC 60115-1 4.25 MIL-STD-202 Method 108 | At $70 \pm 2^\circ\text{C}$ for 1,000 hours, RCWV applied for 1.5 hours on, 0.5 hour off, still-air required | 0100: $\pm(3.0\% + 0.05 \Omega)$ Others: $\pm(1.0\% + 0.05 \Omega)$ <100 m Ω for Jumper |
| High Temperature Exposure | MIL-STD-202 Method 108 | 0100: 1,000 hours at 125°C Others: 1,000 hours at $155 \pm 3^\circ\text{C}$ unpowered | 0100: $\pm(2.0\% + 0.05 \Omega)$ <50 m Ω for Jumper Others: $\pm(1.0\% + 0.05 \Omega)$ <100 m Ω for Jumper |
| Moisture Resistance | MIL-STD-202 Method 106 | Each temperature / humidity cycle is defined at 8 hours, 3 cycles / 24 hours for 10d. with $25^\circ\text{C} / 65^\circ\text{C}$ 95% R.H, without steps 7a & 7b, unpowered Parts mounted on test-boards, without condensation on parts | 0100: $\pm(2.0\% + 0.05 \Omega)$ <50 m Ω for Jumper Others: $\pm(0.5\% + 0.05 \Omega)$ for 0.5%, 1% tol. $\pm(1.0\% + 0.05 \Omega)$ for 5% tol. <100 m Ω for Jumper |
| Thermal Shock | MIL-STD-202 Method 107 | $-55 / +125^\circ\text{C}$ Number of cycles required is 300. Devices mounted Maximum transfer time is 20 seconds. Dwell time is 15 minutes | 0100: $\pm(1.0\% + 0.05 \Omega)$ <50 m Ω for Jumper Others: $\pm(0.5\% + 0.05 \Omega)$ for 0.5%, 1% tol. $\pm(1\% + 0.05 \Omega)$ for 5% tol. <100 m Ω for Jumper |
| Short Time Overload | IEC60115-1 4.13 | 2.5 times of rated voltage or maximum overload voltage whichever is less for 5 seconds at room temperature | 0100: $\pm(2.0\% + 0.05 \Omega)$ Others: $\pm(1.0\% + 0.05 \Omega)$ <50 m Ω for Jumper No visible damage |
| Bending | IEC 60115-1 4.33 | Chips mounted on a 90 mm glass epoxy resin PCB (FR4) Bending : 0100/0201/0402: 5 mm 0603/0805: 3 mm 1206 & above: 2 mm Bending time: 60 ± 5 seconds | $\pm(1.0\% + 0.05 \Omega)$ 0100: <50 m Ω for Jumper Others: <100 m Ω for Jumper No visible damage |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|--------------------------------|--|---|---|
| Biased Humidity | MIL-STD-202 method 103 | 1,000 hours; 85°C /85%R.H., 10% of operating power. Measurement at 24±4 hours after test conclusion. | 0100: ±(5%+0.05Ω) <50 mΩ for Jumper Others: 1Ω ≤ R ≤ 1MΩ: ±(3%+0.05Ω) 1MΩ < R ≤ 10MΩ: ±(5%+0.05Ω) <100 mΩ for Jumper |
| Solderability | | Condition B, no pre-heat of samples | 0100: ±(1.0%+0.05Ω) |
| - Resistance to Soldering Heat | IEC 60115-1 4.18 MIL-STD-202 Method 215 | Lead-free solder, 260±5°C, 10±1 seconds immersion time Procedure 2 for SMD: devices fluxed and cleaned with isopropanol | Others: ±(0.5%+0.05Ω) for 0.5%, 1% tol. ±(1.0%+0.05Ω) for 5% tol. <50 mΩ for Jumper No visible damage |
| - Wetting | J-STD-002 | Electrical test not required Magnification 10X SMD conditions: Others: (a) Method B, aging 4 hours at 155°C dry heat, lead-free solder bath at 245°C (b) Method B, dipping at 215°C for 3 seconds 0100: 1 st step: Method B, aging 4 hours at 155°C dry heat 2 nd step: Lead free solder bath at 245°C | Well tinned (≥95% covered) No visible damage |
| FOS | ASTM-B-809-95* * Modified | Sulfur 750 hours, 105°C. unpowered | 0100: ±(5.0%+0.05Ω) Others: ±(4.0%+0.05Ω) <100 mΩ for Jumper |

REVISION HISTORY

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
|-----------|---------------|---------------------|--|
| Version 8 | Mar. 26, 2021 | - | - Add TCR 50ppm and size 01005 extend |
| Version 7 | Nov. 1, 2019 | - | - Add in AF double power |
| Version 6 | Sep. 05, 2019 | - | - Updated dimensions |
| Version 5 | Jun. 21, 2016 | - | - Update test and requirement |
| Version 4 | Dec. 24, 2015 | - | - Update Dielectric Withstanding Voltage& Resistance value |
| Version 3 | Apr. 01, 2015 | - | - Modified test and requirements |
| Version 2 | Nov. 20, 2014 | - | - Tests and requirement update |
| Version 1 | Sep. 27, 2013 | - | - Size 0201/1210/1218/2010/2512 extend |
| Version 0 | Jan 07, 2011 | - | - First issue of this specification |

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