



DATA SHEET

ANTI-SULFURATED CHIP RESISTORS

AF series 5%, 1% sizes 0402/0603/0805/1206 RoHS compliant & Halogen free





YAGEO Phícomp

Chip Resistor Surface Mount AF SERIES 0402 to 1206

<u>SCOPE</u>

This specification describes AF0402 to AF1206 chip resistors with anti-sulfuration capabilities.

APPLICATIONS

- Environments exposed to high levels of contamination, such as industrial control systems
- Car electronics, sensors, electric instrumentation and communication base stations

FEATURES

- Superior resistance against sulfur containing atmosphere
- Halogen free product and production
- RoHS compliant
 - Products with lead free terminations meet RoHS requirements
 - Pb-glass contained in electrodes, resistor element and glass are exempted by RoHS
- Reduces environmentally hazardous waste
- High component and equipment reliability
- Saving of PCB space

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 | <u>XXXX</u> | <u>X</u> | <u>X</u> | <u>X</u> | <u>XX</u> | <u>XXXX</u> | L |
|----|-------------|----------|----------|----------|-----------|-------------|---|
|----|-------------|----------|----------|----------|-----------|-------------|---|

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | |
|----------|----------|------|------|-----|-----|-----|--|
| (I) SIZE | | | | | | | |
| 0402 / | 0603 / (| 0805 | / 12 | 06 | | | |

(2) TOLERANCE

 $F = \pm 1\%$

 $| = \pm 5\%$

(3) PACKAGING TYPE

R = Paper taping reel

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

– = Base on spec

(5) TAPING REEL

| 07 = 7 inch dia. Reel | |
|------------------------|--|
| 13 = 13 inch dia. Reel | |

10 = 10 inch dia. Reel 7D = 7 inch Dia. Reel with double quantity

(6) RESISTANCE VALUE

I Ω to 22 M Ω

There are $2\sim4$ digits indicated the resistance value. Letter R/K/M is decimal point, no need to mention the last zero after R/K/M, e.g. IK2, not I K20.

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 r | ule Example |
| XRXX (I to 9.76 Ω) | R = Ω R5 = .5 Ω 9R76 = 9.76 Ω |
| XXRX (10 to 97.6 Ω) | IOR = IO Ω 97R6 = 97.6 Ω |
| XXXR (100 to 976 Ω) | 100R = 100 Ω |
| XKXX (1 to 9.76 K Ω) | IK = 1,000 Ω 9K76 = 9760 Ω |
| XMXX (1 to 9.76 MΩ) | $ M = 1,000,000 \Omega$ 9M76= 9,760,000 Ω |

ORDERING EXAMPLE

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

NOTE

- All our RSMD 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

| YAGEO | Phicomp | | | | | | | | Pro | oduct specifica | |
|-------------|-----------------------------|---|----|--------|-------|----------|------------|------------|-----------|-----------------|---|
| | Chip Resistor | Surface Mount | AF | SERIES | 04 | 02 to 12 | 06 | | | | 8 |
| | | | | | | | | | | | |
| MARKING | | | | | | | | | | | |
| AF0402 | | | | | | | | | | | |
| Fig. I | tan a | No marking | | | | | | | | | |
| AF0603 / AF | -0805 / AF1206 | | | | | | | | | | |
| Fig. 2 Va | 103 alue=10 KΩ | E-24 series: 3 dig First two digits fo | | | | and 3 | rd digit f | or numbe | er of zer | os | |
| AF0603 | | | | | | | | | | | |
| Fig. 3 Va | $\frac{240}{2} = 24 \Omega$ | E-24 series: 3 dig One short bar ur | | | etter | | | | | | |
| | alue = 12.4 K Ω | E-96 series: 3 dig First two digits fo | | | ıg ru | le and | 3rd lette | er for nun | nber of : | zeros | |
| AF0805 / AF | 1206 | | | | | | | | | | |
| Fig. 5 Val | 1002 lue = 10 KΩ | Both E-24 and E- First three digits | | | | | 4th digit | for numb | per of ze | eros | |

NOTE

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



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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 lead-free 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.6

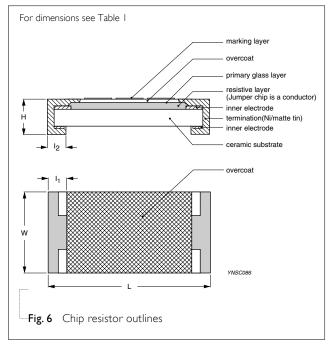
DIMENSIONS

Table 2

Table I For outlines see fig. 6

| TYPE | L (mm) | W (mm) | H (mm) | l⊨(mm) | l₂ (mm) |
|--------|------------|------------|------------|------------|------------|
| AF0402 | 1.00 ±0.05 | 0.50 ±0.05 | 0.32 ±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 | 0.40 ±0.20 |

OUTLINES



| | | CHARACTERISTICS | | | | | | |
|--------|--|--------------------------------|----------------------------|-----------------------------|---------------------------------------|--|--|--|
| ТҮРЕ | RESISTANCE RANGE | Operating Temperature Range | Max. Working Voltage | Max. Overload Voltage | Dielectric Withstanding Voltage | Temperature Coefficient of Resistance | | |
| AF0402 | | | 50 V | 100 V | 100 V | | | |
| AF0603 | ±5% (E24), I Ω to 22 M Ω | -55 ℃ to +155 ℃ - | 50 V | 100 V | 100 V | $I \Omega \le R \le I0 \Omega, \pm 200 \text{ ppm/°C}$ | | |
| AF0805 | \pm 1% (E24/E96), 1 Ω to 10 MΩ Zero Ohm Jumper < 0.05 Ω | | 150 V | 300 V | 300 V | $10 \ \Omega < R \le 10 \ M\Omega, \pm 100 \ ppm/^{\circ}C$ $10 \ M\Omega < R \le 22 \ M\Omega, \pm 200 \ ppm/^{\circ}C$ | | |
| AF1206 | | _ | 200 V | 400 V | 500 V | | | |

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 | AF0402 | AF0603 | AF0805 | AF1206 | | |
| Paper taping reel (R) | 7" (178 mm) | 10,000/20,000 | 5,000 | 5,000 | 5,000 | | |
| | 10" (254 mm) | 20,000 | 10,000 | 10,000 | 10,000 | | |
| | 13" (330 mm) | 50,000 | 20,000 | 20,000 | 20,000 | | |

ΝΟΤΕ

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



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FUNCTIONAL DESCRIPTION

OPERATING TEMPERATURE RANGE

Range: -55 °C to +155 °C

POWER RATING

Each type rated power at 70 °C: AF0402=1/16 W (0.0625W) AF0603=1/10 W (0.1W) AF0805=1/8 W (0.125W) AF1206=1/4 W (0.25W)

RATED VOLTAGE

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

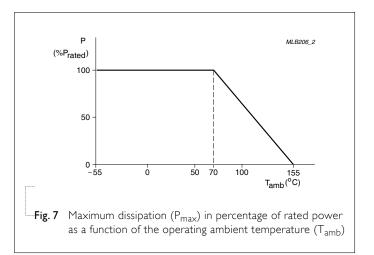
 $V = \sqrt{P \times R}$

Where

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

P = Rated power (W)

 $R = Resistance value (\Omega)$



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TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|--|------------------------|---|--|
| Temperature Coefficient of Resistance | IEC 60115-14.8 | At +25/–55 °C and +25/+125 °C Formula: | Refer to table 2 |
| (T.C.R.) | | T.C.R= $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}$ | |
| | | Where $t = 125$ %C are a side of a set to the set of t | |
| | | t_1 = +25 °C or specified room temperature | |
| | | $t_2 = -55$ °C or +125 °C test temperature | |
| | | R_1 =resistance at reference temperature in ohms | |
| | | R ₂ =resistance at test temperature in ohms | |
| _ife/Endurance | IEC 60115-1 4.25 | At 70±2 °C for 1,000 hours, RCWV applied for | ±(1.0%+0.05 Ω) |
| | MIL-STD-202 Method 108 | 1.5 hours on, 0.5 hour off, still air required | <100 m Ω for Jumper |
| High | MIL-STD-202 Method 108 | 1,000 hours at 155±5 °C, unpowered | ±(1.0%+0.05 Ω) for 1% tol. |
| Temperature | | | \pm (1.0%+0.05 Ω) for 5% tol. |
| Exposure/ Endurance at Upper Category Temperature | | | <100 m Ω for Jumper |
| Moisture | MIL-STD-202 Method 106 | Each temperature / humidity cycle is defined at 8 | ±(0.5%+0.05 Ω) for 1% tol. |
| Resistance | | hours, 3 cycles / 24 hours for 10d. with 25 °C / 65 °C 95% R.H, without steps 7a & 7b, unpowered | $\pm(1.0\%{+}0.05~\Omega)$ for 5% tol. ${<}100~m\Omega$ for Jumper |
| | | Parts mounted on test-boards, without condensation on parts | |
| Thermal Shock | MIL-STD-202 Method 107 | _55 / +125 ℃ | ±(0.5%+0.05 Ω) for 1% tol. |
| | | Number of cycles required is 300. Devices unmounted | \pm (1%+0.05 Ω) for 5% tol. <100 mΩ for Jumper |
| | | Maximum transfer time is 20 seconds. Dwell time is 15 minutes | |
| 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 | ±(1.0%+0.05 Ω) |
| | | temperature | No visible damage |
| Bending | IEC 60115-1 4.33 | Chips mounted on a 90 mm glass epoxy resin | ±(1.0%+0.05 Ω) |
| | IEC 60068-2-21 | PCB (FR4) | <100 m Ω for Jumper |
| | | Bending: 0402: 5 mm 0603/0805: 3 mm 1206: 2 mm | No visible damage |
| | | Bending time: 60±5 seconds | |

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7 8 Product specification

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|-------------------|------------------------------------|--|--|
| Biased Humidity | IEC 60115-1 4.37 | I,000 hours at 85 °C / 85% R.H. | ±(3.0%+0.05 Ω) |
| (steady state) | MIL-STD-202 Method 103 | 10% operating power | |
| | | Measurement at 24±2 hours after test conclusion | |
| Solderability | | | |
| - Resistance to | IEC 60115-1 4.18 | Condition B, no pre-heat of samples | $\pm(0.5\%{+}0.05~\Omega)$ for 1% tol. |
| Soldering Heat | MIL-STD-202 Method 215 | Lead-free solder, 260 \pm 5 °C, 10 \pm 1 seconds immersion time | \pm (1.0%+0.05 Ω) for 5% tol. <50 mΩ for Jumper |
| | | Procedure 2 for SMD: devices fluxed and cleaned with isopropanol | No visible damage |
| - Wetting | J-STD-002 | Electrical test not required | Well tinned (≥95% covered) |
| - | | Magnification 10X | No visible damage |
| | | SMD conditions: | |
| | | (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 | |
| ESD | AEC-Q200-002 | Human body model, | ±(3.0%+0.05 Ω) |
| | | l pos. + l neg. discharges: | |
| | | 0402/0603: 1 KV 0805/1206: 2 KV | |
| Terminal Strength | IEC 60115-1 4.32 IEC 60068-2-21 | A force of 5N applied for 10±1 seconds | ±(1.0%+0.05 Ω) |
| FOS | ASTM-B-809-95 | Sulfur (saturated vapor) 1,000 hours, 60±2 °C, 91-93% R.H., unpowered | ±(1.0%+0.05 Ω) |



| YAGEO | Product specification 8 | | | | | |
|-------|-----------------------------|----|--------|--------------|--|---|
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<u>REVISION HISTORY</u>

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
|-----------|--------------|---------------------|-------------------------------------|
| Version 0 | Jan 07, 2011 | - | - First issue of this specification |

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