

# DATA SHEET

## ANTI-SULFURATED CHIP RESISTORS

AF122 (4Pin/2R) / AF124 (8Pin/4R) /  
AF162 (4Pin/ 2R)/ AF164 (8Pin/ 4R)

5%, 1%

sizes 2 × 0402, 4 × 0402, 2 × 0603, 4 × 0603

RoHS compliant



SCOPE

This specification describes AF122/AF124/AF162/AF164 (convex)series chip resistor arrays with lead-free terminations made by thick film process.

APPLICATIONS

- Terminal for SDRAM and DDRAM
- High-end Computer & Multimedia Electronics in high sulfur environment
- Consume electronic equipments: PDAs, PNDs
- Mobile phone, telecom...

FEATURES

- AEC-Q200 qualified
- RoHS compliant
- Reducing environmentally hazardous wastes
- High component and equipment reliability
- Saving of PCB space
- None forbidden-materials used in products/production
- Halogen Free Epoxy
- Moisture sensitivity level: MSL 1

ORDERING INFORMATION - GLOBAL PART NUMBER & 12NC

Both part numbers are identified by the series, size, tolerance, packing type, temperature coefficient, taping reel and resistance value.

**YAGEO BRAND ordering code**

**GLOBAL PART NUMBER (PREFERRED)**

**AF XX X - X X X XX XXXX L**

(1) (2) (3) (4) (5) (6) (7)

**(1) SIZE**

12 = 0402 × 2 (0404)

12 = 0402 × 4 (0408)

16 = 0603 × 2 (0606)

16 = 0603 × 4 (0612)

**(2) NUMBER OF RESISTORS**

2 = 2 resistors

4 = 4 resistors

**(3) TOLERANCE**

F = ±1%

J = ±5% (for Jumper ordering, use code of J)

**(4) PACKAGING TYPE**

R = Paper taping reel

**(5) TEMPERATURE COEFFICIENT OF RESISTANCE**

- = Base on spec

**(6) TAPING REEL**

07 = 7 inch dia. Reel

13 = 13 inch dia. Reel

**(7) RESISTANCE VALUE**

There are 2~4 digits indicated the resistor value. Letter R/K/M is decimal point, no need to mention the last zero after R/K/M, e.g.1K2, not 1K20.

Detailed resistance rules show in table of "Resistance rule of global part number".

**Resistance rule of global part number**

| Resistance code rule | Example          |
|----------------------|------------------|
| OR                   | OR = Jumper      |
| XRXX                 | 1R = 1 Ω         |
| (1 to 9.76 Ω)        | 1R5 = 1.5 Ω      |
|                      | 9R76 = 9.76 Ω    |
| XXRX                 | 10R = 10 Ω       |
| (10 to 97.6 Ω)       | 97R6 = 97.6 Ω    |
| XXXR                 | 100R = 100 Ω     |
| (100 to 976 Ω)       |                  |
| XKXX                 | 1K = 1,000 Ω     |
| (1 to 9.76 KΩ)       | 9K76 = 9760 Ω    |
| XM                   | 1M = 1,000,000 Ω |
| (1 MΩ)               |                  |

**ORDERING EXAMPLE**

The ordering code of a AF122 convex chip resistor array, value 1,000Ω with ±5% tolerance, supplied in 7-inch tape reel is: AF122-JR-071KL.

**NOTE**

1. All our R-Chip products meet RoHS compliant. "LFP" of the internal 2D reel label mentions "Lead Free Process"
2. On customized label, "LFP" or specific symbol printed and the optional "L" at the end of GLOBAL PART NUMBER

**MARKING**

**AF122**



No marking

**AF124 / AF162 / AF164**



I-Digit marking



1% E-24/E-96:  $R \geq 100\Omega$  4digits  
First three digits for significant figure and 4th digit for number of zeros



5% E-24:  $R \geq 10\Omega$   
First two digits for significant figure and 3rd digit for number of zeros

For further marking information, please refer to data sheet “Chip resistors marking”.

**CONSTRUCTION**

The resistor is constructed on top of a high-grade ceramic body. Internal metal electrodes are added on each end to make the contacts to the thick film resistive element. The composition of the resistive element is a noble metal embedded into a glass and covered by a glass. The resistor is laser trimmed to the rated resistance value. The resistor is covered with a protective epoxy coat, finally the external terminations (matte tin on Ni-barrier) are added as shown in Fig.4.

**OUTLINES**



Fig. 4 Chip resistor outlines

**DIMENSIONS**

Table I

| TYPE                | AF122           | AF124     | AF162     | AF164     |
|---------------------|-----------------|-----------|-----------|-----------|
| B (mm)              | 0.24±0.10       | 0.25±0.15 | 0.35±0.10 | 0.35±0.15 |
| H (mm)              | 0.30+0.10/-0.05 | 0.45±0.05 | 0.30±0.10 | 0.65±0.05 |
| H <sub>1</sub> (mm) | ---             | 0.30±0.05 | --        | 0.50±0.15 |
| P (mm)              | 0.67±0.05       | 0.50±0.05 | 0.80±0.05 | 0.80±0.05 |
| L (mm)              | 1.00±0.10       | 2.00±0.10 | 1.60±0.10 | 3.20±0.15 |
| T (mm)              | 0.30±0.10       | 0.45±0.10 | 0.40±0.10 | 0.60±0.10 |
| W <sub>1</sub> (mm) | 0.25±0.10       | 0.30±0.15 | 0.30±0.10 | 0.30±0.15 |
| W <sub>2</sub> (mm) | 1.00±0.10       | 1.00±0.10 | 1.60±0.10 | 1.60±0.15 |

For dimension, please refer to Table I

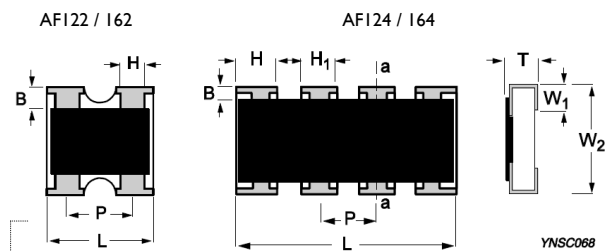


Fig. 5 AF122/124/162/164 series chip resistors dimension

**SCHEMATIC**



**ELECTRICAL CHARACTERISTICS**

**Table 2**

| CHARACTERISTICS          | AF122                                                               | AF124                                                              | AF162                                                              | AF164                                                              |
|--------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|
| Operating Temperature    | -55 °C to +155 °C                                                   | -55 °C to +155 °C                                                  | -55 °C to +155 °C                                                  | -55 °C to +155 °C                                                  |
| Rated Power              | 1/16 W                                                              | 1/16 W                                                             | 1/16W                                                              | 1/16W                                                              |
| Maximum Working Voltage  | 50 V                                                                | 25 V                                                               | 50V                                                                | 50V                                                                |
| Maximum Overload Voltage | 100 V                                                               | 50 V                                                               | 100V                                                               | 100V                                                               |
| Dielectric Withstanding  | 100 V                                                               | 100 V                                                              | 100V                                                               | 100V                                                               |
| Resistance Range         | 5% (E24) 1 Ω to 1 MΩ<br>1% (E24/E96) 10 Ω to 1 MΩ<br>Jumper < 50 mΩ | 5% (E24) 1 Ω to 1 MΩ<br>1% (E24/E96) 1 Ω to 1 MΩ<br>Jumper < 50 mΩ | 5% (E24) 1 Ω to 1 MΩ<br>1% (E24/E96) 1 Ω to 1 MΩ<br>Jumper < 50 mΩ | 5% (E24) 1 Ω to 1 MΩ<br>1% (E24/E96) 1 Ω to 1 MΩ<br>Jumper < 50 mΩ |
| Temperature Coefficient  | 1 Ω ≤ R ≤ 10 Ω ±250 ppm/°C<br>10 Ω ≤ R ≤ 1 MΩ ±200 ppm/°C           |                                                                    |                                                                    | ±250 ppm/°C                                                        |
| Jumper Criteria          | Rated Current 0.5 A<br>Maximum Current 1.0 A                        | Rated Current 1.0 A<br>Maximum Current 2.0 A                       | Rated Current 1.0 A<br>Maximum Current 2.0 A                       | Rated Current 1.0A<br>Maximum Current 2.0A                         |

**FOOTPRINT AND SOLDERING PROFILES**

For recommended footprint and soldering profiles, please refer to data sheet “Chip resistors mounting”.

**PACKING STYLE AND PACKAGING QUANTITY**

**Table 3** Packing style and packaging quantity

| PACKING STYLE         | REEL DIMENSION | AF122        | AF124        | AF162       | AF164        |
|-----------------------|----------------|--------------|--------------|-------------|--------------|
| Paper Taping Reel (R) | 7" (178 mm)    | 10,000 units | 10,000 units | 5,000 units | 5,000 units  |
|                       | 13" (330 mm)   | 50,000 units | 40,000 units | ---         | 20,000 units |

**NOTE**

I. For paper tape and reel specification/dimensions, please refer to data sheet “Chip resistors packing”.

**FUNCTIONAL DESCRIPTION**

**POWER RATING**

AF122 / AF124 / AF162 / AF164 rated power at 70 °C is 1/16 W

**RATED VOLTAGE**

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

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

or max. working voltage whichever is less

Where

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

P=Rated power (W)

R=Resistance value (Ω)



Fig. 7 Maximum dissipation (P) in percentage of rated power as a function of the operating ambient temperature (T<sub>amb</sub>)

**TESTS AND REQUIREMENTS**
**Table 4** Test condition, procedure and requirements

| TEST                         | TEST METHOD                                | PROCEDURE                                                                                                                                                                                                                                                                                                | REQUIREMENTS                                           |
|------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Life/<br>Endurance           | MIL-STD-202-method 108<br>IEC 60115-1 4.25 | 1,000 hours at 70±2 °C applied RCWV<br>1.5 hours on, 0.5 hour off, still air required                                                                                                                                                                                                                    | ±(2%+0.05 Ω)<br><100 mΩ for Jumper                     |
| High Temperature<br>Exposure | MIL-STD-202-method 108                     | 1,000 hours at maximum operating<br>temperature depending on specification,<br>unpowered<br><br>Tolerances: 155±3 °C                                                                                                                                                                                     | ±(1%+0.05 Ω)<br><50 mΩ for Jumper                      |
| Moisture<br>Resistance       | MIL-STD-202-method 106                     | Each temperature / humidity cycle is defined at<br>8 hours (method 106G), 3 cycles / 24 hours<br>for 10d with 25 °C / 65 °C 95% R.H, without<br>steps 7a & 7b, unpowered<br><br>Parts mounted on test-boards, without<br>condensation on parts<br><br>Measurement at 24±2 hours after<br>test conclusion | ±(2%+0.05 Ω)<br><100 mΩ for Jumper                     |
| Thermal Shock                | MIL-STD-202-method 107                     | -55/+125 °C<br><br>Note: Number of cycles required is 300.<br>Devices mounted<br><br>Maximum transfer time is 20 seconds. Dwell<br>time is 15 minutes. Air – Air                                                                                                                                         | ±(1%+0.05 Ω)<br><50 mΩ for Jumper                      |
| Short Time<br>Overload       | IEC60115-1 4.13                            | 2.5 times RCWV or maximum overload<br>voltage whichever is less for 5 sec at room<br>temperature                                                                                                                                                                                                         | ±(2%+0.05 Ω)<br><50 mΩ for Jumper<br>No visible damage |
| Board Flex/<br>Bending       | IEC60115-1 4.33                            | Device mounted on PCB test board as<br>described, only 1 board bending required<br><br>3 mm bending<br><br>Bending time: 60±5 seconds<br><br>Ohmic value checked during bending                                                                                                                          | ±(1%+0.05 Ω)<br><50 mΩ for Jumper<br>No visible damage |

| TEST                              | TEST METHOD                                | PROCEDURE                                                                                                                                                                                                        | REQUIREMENTS                                            |
|-----------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Solderability<br>- Wetting        | J-STD-002 test B                           | Electrical Test not required                                                                                                                                                                                     | Well tinned ( $\geq 95\%$ covered)<br>No visible damage |
|                                   |                                            | Magnification 50X<br>SMD conditions:<br>1 <sup>st</sup> step: method B, aging 4 hours at 155 °C<br>dry heat<br>2 <sup>nd</sup> step: leadfree solder bath at 245 $\pm$ 3 °C<br>Dipping time: 3 $\pm$ 0.5 seconds |                                                         |
| - Leaching                        | J-STD-002 test D                           | Leadfree solder, 260 °C, 30 seconds<br>immersion time                                                                                                                                                            | No visible damage                                       |
| - Resistance to<br>Soldering Heat | IEC 60115-1 4.18<br>MIL-STD-202 Method 215 | Condition B, no pre-heat of samples                                                                                                                                                                              | $\pm(1\%+0.05\Omega)$                                   |
|                                   |                                            | Leadfree solder, 260 °C, 10 seconds<br>immersion time<br>Procedure 2 for SMD: devices fluxed and<br>cleaned with isopropanol                                                                                     | <50 m $\Omega$ for Jumper<br>No visible damage          |
| FOS                               | ASTM-B-809-95*<br>*Modified                | Sulfur 750 hours, 105°C, unpowered                                                                                                                                                                               | $\pm(4.0\%+0.05\Omega)$<br><100m $\Omega$ for Jumper    |

REVISION HISTORY

| REVISION  | DATE          | CHANGE NOTIFICATION | DESCRIPTION                                   |
|-----------|---------------|---------------------|-----------------------------------------------|
| Version 5 | Mar. 20, 2017 | -                   | - Modify AF124/164 Equivalent Circuit Diagram |
| Version 4 | Jun. 23, 2016 | -                   | - AEC-Q200 qualified                          |
| Version 3 | Nov. 17, 2015 | -                   | - Add in AF162                                |
| Version 2 | May 29, 2015  | -                   | - Add in AF164                                |
| Version 1 | Aug. 15, 2014 | -                   | - Update AF124 dimensions                     |
| Version 0 | Oct. 02, 2013 | -                   | - First issue of this specification           |

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