Innovative Service Around the Globe YAGEO

# DATA SHEET

## ANTI-SULFURATED ARRAY CHIP RESISTORS AUTOMOTIVE GRADE

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

5%, 1%

**sizes 2 × 0402, 4 x 0402, 2 x 0603, 4 x 0603**

**RoHS compliant**

YAGEO

Product specification – April 21, 2021 V.6

## 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 x 2 (0404)
12 = 0402 x 4 (0408)
16 = 0603 x 2 (0606)
16 = 0603 x 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 |
|---|---|
| 0R | 0R = Jumper |
| XRXX (1 to 9.76 Ω) | 1R = 1 Ω<br>1R5 = 1.5 Ω<br>9R76 = 9.76 Ω |
| XXRX (10 to 97.6 Ω) | 10R = 10 Ω<br>97R6 = 97.6 Ω |
| XXXR (100 to 976 Ω) | 100R = 100 Ω |
| XKXX (1 to 9.76 KΩ) | 1K = 1,000 Ω<br>9K76 = 9760 Ω |
| XM (1 MΩ) | 1M = 1,000,000 Ω |

### ORDERING EXAMPLE

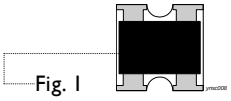
The ordering code of a AF122 convex chip resistor array, value 1,000Ω with ±5% tolerance, supplied in 7-inch tape reel is: AF122-JR-071KL.

### NOTE

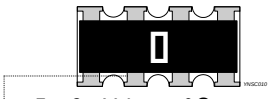
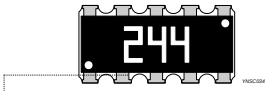
1. All our R-Chip products meet RoHS compliant. "LFP" of the internal 2D reel label mentions "Lead Free Process"
2. On customized label, "LFP" or specific symbol printed and the optional "L" at the end of GLOBAL PART NUMBER

## MARKING

AF122

| | |
|---|---|
|  Fig. 1 | No marking |

AF124 / AF162 / AF164

| | |
|---|---|
|  Fig. 2 Value = 0Ω | 1-Digit marking |
|  Fig. 3 Value = 316KΩ | 1% E-24/E-96: R≧ 100Ω 4digits<br>First three digits for significant figure and 4th digit for number of zeros |
|  Fig. 3 Value = 240KΩ | 5% E-24: R≧ 10Ω<br>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**

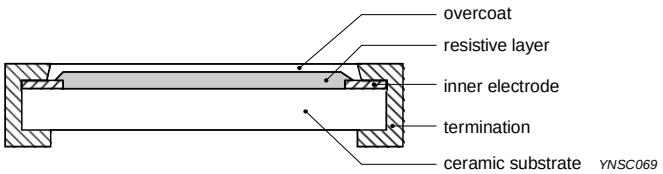



Fig. 4 Chip resistor outlines

## DIMENSIONS

Table 1

| 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 |
| $H_1$ (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 |
| $W_1$ (mm) | 0.25±0.10 | 0.30±0.15 | 0.30±0.10 | 0.30±0.15 |
| $W_2$ (mm) | 1.00±0.10 | 1.00±0.10 | 1.60±0.10 | 1.60±0.15 |

For dimension, please refer to Table 1

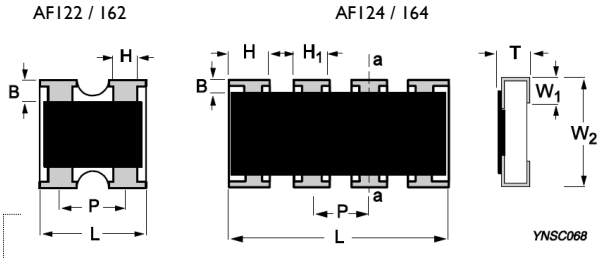



Fig. 5 AF122/124/162/164 series chip resistors dimension

## SCHEMATIC

For dimension, please refer to Fig. 5 and Table 1

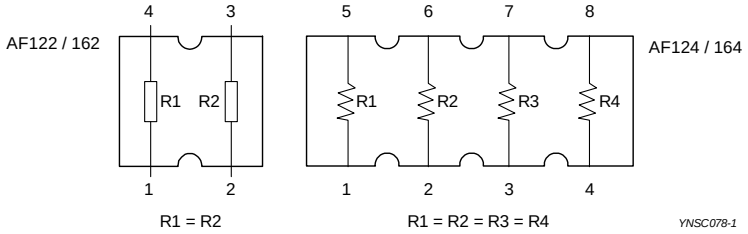



**Fig. 6** Equivalent circuit diagram

## 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 | 50 V | 50V | 50V |
| Maximum Overload Voltage | 100 V | 100 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 | | | |
| 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**

1. 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)

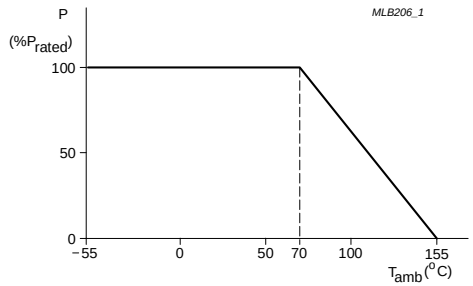



Fig. 7 Maximum dissipation (P) in percentage of rated power as a function of the operating ambient temperature ($T_{amb}$)

## TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---|---|---|---|
| High Temperature Exposure | AEC-Q200 Test 3<br>MIL-STD-202 Method 108 | 1,000 hours at $T_A$ = 155 °C, unpowered | ±(2.0%+0.05Ω)<br><50 mΩ for Jumper |
| Moisture Resistance | AEC-Q200 Test 6<br>MIL-STD-202 Method 106 | Each temperature / humidity cycle is defined at 8 hours (method 106F), 3 cycles / 24 hours for 10d. with 25 °C / 65 °C 95% R.H, without steps 7a & 7b, unpowered | ±(2.0%+0.05Ω)<br><100 mΩ for Jumper |
| Biased Humidity | AEC-Q200 Test 7<br>MIL-STD-202 Method 103 | 1,000 hours; 85 °C / 85% RH<br>10% of operating power<br>Measurement at 24±4 hours after test conclusion | ±(3.0%+0.05Ω)<br><100 mΩ for Jumper |
| Operational Life | AEC-Q200 Test 8<br>MIL-STD-202 Method 108 | 1,000 hours at 125 °C, derated voltage applied for 1.5 hours on, 0.5 hour off, still-air required | ±(3.0%+0.05Ω)<br><100 mΩ for Jumper |
| Resistance to Soldering Heat | AEC-Q200 Test 15<br>MIL-STD-202 Method 210 | Condition B, no pre-heat of samples<br>Lead-free solder, 260±5 °C, 10±1 seconds immersion time<br>Procedure 2 for SMD: devices fluxed and cleaned with isopropanol | ±(1.0%+0.05Ω)<br><50 mΩ for Jumper<br>No visible damage |
| Thermal Shock | AEC-Q200 Test 16<br>MIL-STD-202 Method 107 | -55/+125 °C<br>Number of cycles is 300. Devices mounted<br>Maximum transfer time is 20 seconds. Dwell time is 15 minutes. Air – Air | ±(1.0%+0.05Ω)<br><50 mΩ for Jumper |
| ESD | AEC-Q200 Test 17<br>AEC-Q200-002 | Human Body Model,<br>1 $_{pos.}$ + 1 $_{neg.}$ discharges<br>122/124: 500V<br>162/164: 1KV | ±(3.0%+0.05 Ω)<br><50 mΩ for Jumper |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---|---|---|---|
| Solderability<br>- Wetting | AEC-Q200 Test 18<br>J-STD-002 | Electrical Test not required Magnification 50X<br>SMD conditions:<br>(a) Method B, aging 4 hours at 155 °C dry heat, dipping at 235±3 °C for 5±0.5 seconds.<br>(b) Method B, steam aging 8 hours, dipping at 215±3 °C for 5±0.5 seconds.<br>(c) Method D, steam aging 8 hours, dipping at 260±3 °C for 30±0.5 seconds. | Well tinned (≥95% covered)<br>No visible damage |
| Board Flex | AEC-Q200 Test 21<br>AEC-Q200-005 | Chips mounted on a 90mm glass epoxy resin PCB (FR4)<br>3mm<br>Holding time: minimum 60 seconds | ±(1.0%+0.05Ω)<br><50 mΩ for Jumper |
| Temperature Coefficient of Resistance (T.C.R.) | MIL-STD-202 Method 304 | At +25/–55 °C and +25/+125 °C<br>**Formula:**<br>$T.C.R=\frac{R_2-R_1}{R_1(t_2-t_1)}\times 10^6$ (ppm/°C)<br>Where<br>$t_1$=+25 °C or specified room temperature<br>$t_2$=–55 °C or +125 °C test temperature<br>$R_1$=resistance at reference temperature in ohms<br>$R_2$=resistance at test temperature in ohms | Refer to table 2 |
| Short Time Overload | IEC60115-1 4.13 | 2.5 times of rated voltage or maximum overload voltage whichever is less for 5 sec at room temperature | ±(2.0%+0.05Ω)<br><50 mΩ for Jumper |
| FOS | ASTM-B-809-95*<br>*Modified | Sulfur 750 hours, 105°C, unpowered | ±(4.0%+0.05Ω)<br><100mΩ for Jumper |

## REVISION HISTORY

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
|---|---|---|---|
| Version 6 | Apr. 21, 2021 | - | - Upgrade to Automotive Grade and voltage of AF124 updated, TCR of AF164 updated. |
| 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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