

# **DATA SHEET**

THICK FILM CHIP RESISTORS
AUTOMOTIVE GRADE

AC series ±5%, ±1%, ±0.5%

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

RoHS compliant & Halogen free



YAGEO Phícomp



SERIES

### **SCOPE**

This specification describes AC0201 to AC2512 chip resistors with leadfree terminations made by thick film process.

### **APPLICATIONS**

- All general purpose applications
- · Car electronics, industrial application

#### **FEATURES**

- Comply with AEC-Q200 standard
- Moisture sensitivity level: MSL I
- AC series soldering is compliant with J-STD-020D
- Halogen free epoxy
- RoHS compliant
  - Products with lead-free terminations meet RoHS requirements
  - Pb-glass contained in electrodes, resistor element and glass are exempted by RoHS
- Reduce environmentally hazardous waste
- High component and equipment reliability
- The resistors are 100% performed by automatic optical inspection prior to taping.

### ORDERING INFORMATION - GLOBAL PART NUMBER

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

(7)

### **GLOBAL PART NUMBER**

### AC XXXX X X X XX XXXX L

(1) (2) (3) (4) (5)

(I) SIZE

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

# (2) TOLERANCE

 $D = \pm 0.5\%$ 

 $F = \pm 1\%$ 

 $J = \pm 5\%$  (for Jumper ordering, use code of J)

### (3) PACKAGING TYPE

R = Paper taping reel

K = Embossed taping reel

### (4) TEMPERATURE COEFFICIENT OF RESISTANCE

- = Base on spec

### (5) TAPING REEL

07 = 7 inch dia. Reel

13 = 13 inch dia. Reel

### (6) RESISTANCE VALUE

 $I\Omega$  to 22  $M\Omega$ 

There are 2~4 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.1K2, not 1K20.

Detailed coding rules of resistance are shown in the table of "Resistance rule of global part number".

### (7) DEFAULT CODE

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

number Resistance coding rule	Example
XRXX (I to 9.76 Ω)	IR = I Ω IR5 = I.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 976R = 976 Ω
XKXX (I to 9.76 KΩ)	IK = 1,000 Ω 9K76 = 9760 Ω
XMXX (I to 9.76 MΩ)	IM = 1,000,000 Ω 9M76= 9,760,000 Ω
XXMX (10 MΩ)	IOM = 10,000,000 Ω

Resistance rule of global part

# **ORDERING EXAMPLE**

The ordering code for an AC0402 chip resistor, value 100 K $\Omega$  with ±1% tolerance, supplied in 7-inch tape reel is: AC0402FR-07100KL.

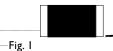
## NOTE

- I. 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.
- 3. AC series with ±0.5% tolerance is also available. For further information, please contact sales.

**Chip Resistor Surface Mount** AC SERIES 0201 to 2512



### AC0201 / AC0402



No marking

### AC0603 / AC0805 / AC1206 / AC1210 / AC2010 / AC2512



E-24 series: 3 digits, ±5%

First two digits for significant figure and 3rd digit for number of zeros

AC0603



E-24 series: 3 digits, ±1% & ±0.5% One short bar under marking letter

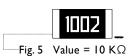
Fig. 3 Value = 24  $\Omega$ 



E-96 series: 3 digits, ±1% & ±0.5%

First two digits for E-96 marking rule and 3rd letter for number of zeros

## AC0805 / AC1206 / AC1210 / AC2010 / AC2512



Both E-24 and E-96 series: 4 digits, ±1% & ±0.5%

First three digits for significant figure and 4th digit for number of zeros

# AC1218



E-24 series: 3 digits, ±5%

First two digits for significant figure and 3rd digit for number of zeros

Fig. 6 Value =  $10 \text{ K}\Omega$ 

Both E-24 and E-96 series: 4 digits, ±1% & ±0.5%

First three digits for significant figure and 4th digit for number of zeros

Fig. 7 Value =  $10 \text{ K}\Omega$ 

# NOTE

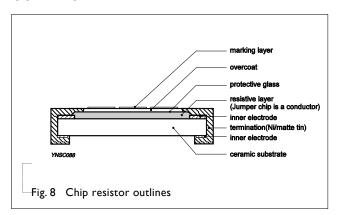
For further marking information, please refer to data sheet "Chip resistors marking". Marking of AC series is the same as RC series.

10

### **CONSTRUCTION**

The resistors are constructed on top of an automotive 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 approximately 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, as shown in Fig.8.

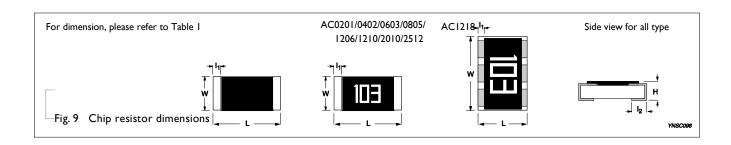
#### **OUTLINES**



### **DIMENSIONS**

Table I For outlines, please refer to Fig. 9

TYPE	L (mm)	W (mm)	H (mm)	I <sub>I</sub> (mm)	I <sub>2</sub> (mm)
AC0201	0.60±0.03	0.30±0.03	0.23±0.03	0.12±0.05	0.15±0.05
AC0402	1.00 ±0.05	0.50 ±0.05	0.32 ±0.05	0.20 ±0.10	0.25 ±0.10
AC0603	1.60 ±0.10	0.80 ±0.10	0.45 ±0.10	0.25 ±0.15	0.25 ±0.15
AC0805	2.00 ±0.10	1.25 ±0.10	0.50 ±0.10	0.35 ±0.20	0.35 ±0.20
AC1206	3.10 ±0.10	1.60 ±0.10	0.55 ±0.10	0.45 ±0.20	0.40 ±0.20
AC1210	3.10 ±0.10	2.60 ±0.15	0.50 ±0.10	0.45 ±0.15	0.50 ±0.20
AC1218	3.10 ±0.10	4.60 ±0.10	0.55 ±0.10	0.45 ±0.20	0.40 ±0.20
AC2010	5.00 ±0.10	2.50 ±0.15	0.55 ±0.10	0.55 ±0.15	0.50 ±0.20
AC2512	6.35 ±0.10	3.10 ±0.15	0.55 ±0.10	0.60 ±0.20	0.50 ±0.20



5 10

Chip Resistor Surface Mount | AC | SERIES | 0201 to 2512

# **ELECTRICAL CHARACTERISTICS**

_	_			_
	la	b	le	2

Table 2							
				CHA	RACTERISTICS	S	
TYPE	RESISTANCE RANGE	Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Temperature Coefficient of Resistance	Jumper Criteria
AC0201			25V	50V	50V	IΩ≤R≤I0Ω, -100/+350ppm/°C I0Ω <r≤i0mω,< td=""><td>Rated Current</td></r≤i0mω,<>	Rated Current
		_				±200ppm/°C	Max. Current 1.0A
AC0402			50 V	100 V	100 V		Rated Current
		=				=	Max. Current 2A
AC0603			75V	150 V	150 V		Rated Current
	5% (E24)	_				_	Max. Current 2A
AC0805	$I\Omega \le R \le 22M\Omega$ (0201: Max. 10M $\Omega$ .		150 V	300 V	300 V		Rated 2A Current
	`1218: Max. 1MΩ)	_					Max. Current 5A
AC1206	$1\% \text{ (E24/E96)}$ $1\Omega \leq R \leq 10\text{M}\Omega$	–55 °C to +155 °C	200 V	400 V	500 V	I Ω≤ R ≤ I0 Ω,	Rated Current 2A
	(1218: Max. IMΩ) 0.5% (E24/E96)	0.5% (E24/E96)		±200 ppm/°C	Max. Current 10A		
AC1210	10Ω ≤ R≤ 1MΩ 10Ω ≤ R≤ 1MΩ		200 V	500 V	500 V	10 Ω< R ≤ $10 ΜΩ$ , ± $100 ppm/°C$	Rated 2A Current
	, ,	_				_	Max. Current 10A
AC1218			200 V	500 V	500 V		Rated Current 6A
							Max. Current 10A
AC2010		-	200 V	500 V	500 V	_	Rated 2A Current
				,			Max. Current 10A
AC2512	12	-	200 V	500 V	500 V	_	Rated Current
		200 v 300				Max. Current 10A	

### FOOTPRINT AND SOLDERING PROFILES

Phicomp

Recommended footprint and soldering profiles of AC-series is the same as RC-series. Please refer to data sheet "Chip resistors mounting".

### PACKING STYLE AND PACKAGING QUANTITY

Table 3 Packing style and packaging quantity

PACKING STYLE	REEL DIMENSION	AC0201	AC0402	AC0603	AC0805	AC1206	AC1210	AC1218	AC2010
Paper taping reel (R)	7" (178 mm)	10,000	10,000	5,000	5,000	5,000	5,000		
	13" (330 mm)	50,000	50,000	20,000	20,000	20,000	20,000		
Embossed taping reel (K)	7" (178 mm)							4,000	4,000

#### NOTE

### **FUNCTIONAL DESCRIPTION**

### **OPERATING TEMPERATURE RANGE**

Range: -55 °C to +155 °C

### **POWER RATING**

Each type rated power at 70 °C:

AC0201=1/20W (0.05W)

AC0402=1/16W (0.0625W)

AC0603=1/10W (0.1W)

AC0805=1/8W (0.125W)

ACI206=I/4W (0.25W)

AC1210=1/2W (0.5W)

AC1218=1W

AC2010=3/4W (0.75W)

AC2512=1 W

### **RATED VOLTAGE**

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

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

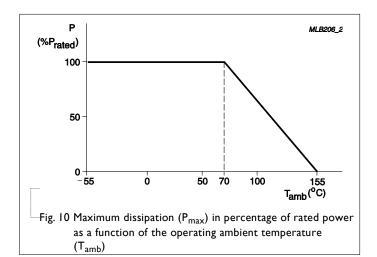
Or Maximum working voltage whichever is less

# Where

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

P = Rated power (W)

 $R = Resistance value (\Omega)$ 



<sup>1.</sup> For paper/embossed tape and reel specifications/dimensions, please refer to data sheet "Chip resistors packing".



Chip Resistor Surface Mount AC SERIES 0201 to 2512

# TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
High Temperature Exposure	AEC-Q200 Test 3 MIL-STD-202 Method 108	1,000 hours at $T_A$ = 155 °C, unpowered	$\pm$ (1.0%+0.05 $\Omega$ ) for D/F tol $\pm$ (2.0%+0.05 $\Omega$ ) for J tol <50 m $\Omega$ for Jumper
Moisture Resistance	AEC-Q200 Test 6 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 Parts mounted on test-boards, without condensation on parts	$\pm$ (0.5%+0.05 $\Omega$ ) for D/F tol $\pm$ (2.0%+0.05 $\Omega$ ) for J tol <100 m $\Omega$ for Jumper
Biased Humidity	AEC-Q200 Test 7 MIL-STD-202 Method 103	1,000 hours; 85 °C / 85% RH 10% of operating power Measurement at 24±4 hours after test conclusion.	$\pm$ (1.0%+0.05 $\Omega$ ) for D/F tol $\pm$ (3.0%+0.05 $\Omega$ ) for J tol <100 m $\Omega$ for Jumper
Operational Life	AEC-Q200 Test 8 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	$\pm$ (1.0%+0.05 $\Omega$ ) for D/F tol $\pm$ (3.0%+0.05 $\Omega$ ) for J tol <100 m $\Omega$ for Jumper
Resistance to Soldering Heat	AEC-Q200 Test 15 MIL-STD-202 Method 210	Condition B, no pre-heat of samples Lead-free solder, 260±5 °C, 10±1 seconds immersion time Procedure 2 for SMD: devices fluxed and cleaned with isopropanol	$\pm$ (0.5%+0.05Ω) for D/F tol $\pm$ (1.0%+0.05Ω) for J tol <50 mΩ for Jumper No visible damage
Thermal Shock	AEC-Q200 Test 16 MIL-STD-202 Method 107	-55/+125 °C  Number of cycles is 300. Devices mounted  Maximum transfer time is 20 seconds.  Dwell time is 15 minutes. Air – Air	$\pm$ (0.5%+0.05Ω) for D/F tol $\pm$ (1.0%+0.05Ω) for J tol <50 mΩ for Jumper
ESD	AEC-Q200 Test 17 AEC-Q200-002	Human Body Model,  I pos. + I neg. discharges  0201: 500V  0402/0603: IKV  0805 and above: 2KV	$\pm$ (3.0%+0.05 Ω) <50 mΩ for Jumper

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Solderability			
- Wetting	AEC-Q200 Test 18	Electrical Test not required Magnification 50X	Well tinned (≥95% covered)
	J-STD-002	SMD conditions:	No visible damage
		<ul><li>(a) Method B, aging 4 hours at 155 °C dry heat, dipping at 235±3 °C for 5±0.5 seconds.</li></ul>	
		(b) Method B, steam aging 8 hours, dipping at $215\pm3~^{\circ}\text{C}$ for $5\pm0.5$ seconds.	
		(c) Method D, steam aging 8 hours, dipping at $260\pm3$ °C for $7\pm0.5$ seconds.	
Board Flex	AFC 0200 T 21	Chi and a second a se	L/L00/L0.0FQ)
board riex	AEC-Q200 Test 21	Chips mounted on a 90mm glass epoxy resin PCB (FR4)	±(1.0%+0.05Ω)
	AEC-Q200-005	Bending for 0201/0402: 5 mm	<50 m $\Omega$ for Jumper
		0603/0805: 3 mm	
		1206 and above: 2 mm	
		Holding time: minimum 60 seconds	
Temperature Coefficient of Resistance (T.C.R.)	MIL-STD-202 Method 304	At +25/-55 °C and +25/+125 °C	Refer to table 2
resistance (1.C.rt.)		Formula:	
		T.C.R= $\frac{R_2-R_1}{R_1(t_2-t_1)} \times 10^6 \text{ (ppm/°C)}$	
		Where t <sub>1</sub> =+25 °C or specified room temperature	
		$t_2$ =-55 °C or +125 °C test temperature	
		R <sub>1</sub> =resistance at reference temperature in	
		ohms	
		R <sub>2</sub> =resistance at test temperature in ohms	
Short Time Overload	IEC60115-1 4.13	2.5 times of rated voltage or maximum overload voltage whichever is less for 5 sec	$\pm (1.0\% + 0.05\Omega)$ for D/F tol $\pm (2.0\% + 0.05\Omega)$ for J tol
		at room temperature	<50 m $\Omega$ for Jumper
FOS	ASTM-B-809-95	Sulfur (saturated vapor) 500 hours, 60±2°C, unpowered	±( 1.0%+0.05Ω)

# REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 4	May 25, 2015	-	- Remove 7D packing
			- Extend resistance range
			- Add in AC0201
			- Update FOS test and requirements
Version 3	Feb 13, 2014	-	- Feature description updated
			- add ±0.5%
			- delete 10" taping reel
Version 2	Feb. 10, 2012	-	- Jumper criteria added
			- AC1218 marking and outline figure updated
Version I	Feb. 01, 2011	-	- Case size 1210, 1218, 2010, 2512 extended
			- Test method and procedure updated
			- Packing style of 7D added
Version 0	Nov. 10, 2010	-	- First issue of this specification

# Chip Resistor Surface Mount

AC SERIES

0201 to 2512

### LEGAL DISCLAIMER

Yageo, its distributors and agents (collectively, "Yageo"), hereby disclaims any and all liabilities for any errors, inaccuracies or incompleteness contained in any product related information, including but not limited to product specifications, datasheets, pictures and/or graphics. Yageo may make changes, modifications and/or improvements to product related information at any time and without notice.

Yageo makes no representation, warranty, and/or guarantee about the fitness of its products for any particular purpose or the continuing production of any of its products. To the maximum extent permitted by law, Yageo disclaims (i) any and all liability arising out of the application or use of any Yageo product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for a particular purpose, non-infringement and merchantability.

Yageo statements regarding the suitability of products for certain types of applications are based on Yageo's knowledge of typical operating conditions for such types of applications in a generic nature. Such statements are neither binding statements of Yageo nor intended to constitute any warranty concerning the suitability for a specific customer application or use. They are intended for use only by customers with requisite knowledge and experience for determining whether Yageo products are the correct products for their application or use. In addition, unpredicatable and isolated cases of product failure may still occur, therefore, customer application or use of Yageo products which requires higher degree of reliability or safety, shall employ additional protective safeguard measures to ensure that product failure would not result in personal injury or property damage.

Yageo products are not designed for application or use in medical, life-saving, or life-sustaining devices or for any other application or use in which the failure of Yageo products could result in personal injury or death. Customers using or selling Yageo products not expressly indicated for above-mentioned purposes shall do so at their own risk and agree to fully indemnify Yageo and hold Yageo harmless.

Information provided here is intended to indicate product specifications only. Yageo reserves all the rights for revising this content without further notification, as long as products are unchanged. Any product change will be announced by PCN.