



DATA SHEET

THICK FILM CHIP RESISTORS Automotive grade

AC series 5%, 1% sizes 0402/0603/0805/1206/ 1210/1218/2010/2512 RoHS compliant & Halogen free





YAGEO Phícomp

Chip Resistor Surface Mount AC SERIES 0402 to 2512

SCOPE

This specification describes AC0402 to AC2512 chip resistors with lead-free terminations made by thick film process.

APPLICATIONS

- All general purpose applications
- Car electronics, industrial application

FEATURES

- Comply with AEC-Q200 standard
- Superior resistance against sulfur containing atmosphere
- MSL class: 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
- Save PCB space
- 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.

GLOBAL PART NUMBER

AC XXXX X X X XX XXXX L

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

(I) SIZE

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

(2) TOLERANCE

F = +1%

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

(3) PACKAGING TYPE

R = Paper/PE taping reel

K = Embossed taping reel

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

- = Base on spec

(5) TAPING REEL

- 07 = 7 inch dia. Reel
- 10 = 10 inch dia. Reel
- 13 = 13 inch dia, Reel

- 7D = 7 inch dia. Reel with double quantity

(6) RESISTANCE VALUE

I Ω to I 0 M Ω

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)

Resistance rule of global part number Resistance coding Example rule $|R = |\Omega|$ XRXX

(I to 9.76 Ω)	$IR5 = I.5 \Omega$
	9R76 = 9.76 Ω
XXRX	$IOR = IO \Omega$
(10 to 97.6 Ω)	97R6 = 97.6 Ω
XXXR	$100R = 100 \Omega$
(100 to 976 Ω)	976R = 976 Ω
XKXX	IK = 1,000 Ω
(Ι to 9.76 KΩ)	9K76 = 9760 Ω
XMXX	$IM = I,000,000 \Omega$
(I to 9.76 MΩ)	9M76= 9,760,000 Ω
	$10M = 10,000,000 \Omega$

 $(10 M\Omega)$

ORDERING EXAMPLE

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

NOTE

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

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<u>MARKING</u> AC0402	
Fig. I	No marking
AC0603 / AC0805 / AC1206 / /	AC1210 / AC2010 / AC2512
Γig. 2 Value=10 KΩ	E-24 series: 3 digits, $\pm 5\%$ First two digits for significant figure and 3rd digit for number of zeros
AC0603	
Fig. 3 Value = 24 Ω	E-24 series: 3 digits, ±1% One short bar under marking letter
Fig. 4 Value = 12.4 KΩ	E-96 series: 3 digits, $\pm 1\%$ First two digits for E-96 marking rule and 3rd letter for number of zeros
AC0805 / AC1206 / AC1210 / /	AC2010 / AC2512
Fig. 5 Value = 10 K Ω	Both E-24 and E-96 series: 4 digits, $\pm 1\%$ First three digits for significant figure and 4th digit for number of zeros
AC1218	
Fig. 6 Value = 10 KΩ	E-24 series: 3 digits, $\pm 5\%$ First two digits for significant figure and 3rd digit for number of zeros
Fig. 7 Value = 10 K Ω	Both E-24 and E-96 series: 4 digits, $\pm 1\%$ First three digits for significant figure and 4th digit for number of zeros

ΝΟΤΕ

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

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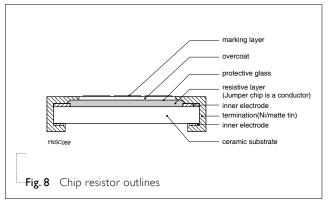
Chip Resistor Surface Mount AC SERIES

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CONSTRUCTION

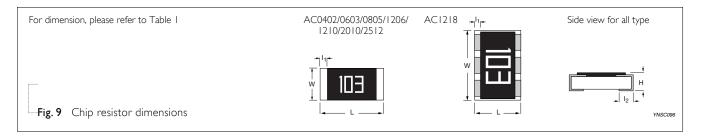
The resistors are constructed on top of an automotive grade ceramic body. Internal metal electrodes are added at each end and connected by a resistive glaze. The resistive glaze is covered by a lead-free glass. The composition of the glaze is adjusted to give the approximately required resistance value 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)	l⊨(mm)	l ₂ (mm)
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



ELECTRICAL CHARACTERISTICS

Table 2	2							
	CHARACTERISTICS							
TYPE	RESISTANCE RANGE	Operating Temperature Range	Working	Max. Overload Voltage	Dielectric Withstanding Voltage	Temperature Coefficient of Resistance	Jumper Criteria	
AC0402			50 V	100 V	100 V		Rated Current IA Max. Current 2A	
AC0603		MQ -55 °C to +155 °C	50 V	100 V	100 V		Rated Current IA Max. Current 2A	
AC0805	-		150 V	300 V	300 V		Rated Current 2A Max. Current 5A	
AC1206	5% (E24), 1% (E24/E96) Ι Ω to 10 ΜΩ Jumper < 0.05 Ω			200 V	400 V	500 V	- I Ω≤R≤I0Ω, ±200 ppm/°C	Rated Current 2A Max. Current 10A
AC1210			200 V	500 V	500 V	$10 \ \Omega < R \le 10 \ M\Omega,$ ±100 ppm/°C		
AC1218			200 V	500 V	500 V	-	Rated Current 6A Max. Current 10A	
AC2010	-		200 V	500 V	500 V	-	Rated Current 2A Max. Current 10A	
AC2512	-		200 V	500 V	500 V		Rated Current 2A Max. Current 10A	

FOOTPRINT AND SOLDERING PROFILES

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
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PACKING STYLE	REEL DIMENSION	AC0402	AC0603	AC0805	AC1206	AC1210	AC1218	AC2010	AC2512
Paper/PE taping reel (R)	7" (178 mm)	10,000 20,000	5,000	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	20,000			
Embossed taping reel (K)	7" (178 mm)						4,000	4,000	4,000

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I. For paper/PE/embossed tape and reel specifications/dimensions, please refer to 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: AC0402=1/16 W (0.0625W) AC0603=1/10 W (0.1W) AC0805=1/8 W (0.125W) AC1206=1/4 W (0.25W) AC1210=1/2 W (0.5W) AC1218=1 W AC2010=3/4 W (0.75W) AC2512=1 W

RATED VOLTAGE

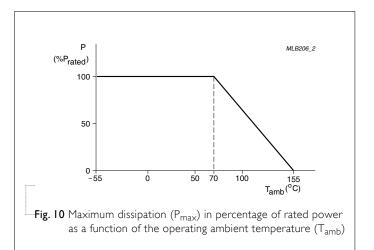
The DC or AC (rms) continuous working voltage corresponding to the rated power is determined by the following formula:

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

Or Maximum working voltage whichever is less

Where

- V = Continuous rated DC or AC (rms) working voltage (V)
- P = Rated power (W)
- $R = Resistance value (\Omega)$



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TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements						
TEST	TEST METHOD	PROCEDURE	REQUIREMENTS			
High Temperature	AEC-Q200 Test 3	1,000 hours at $T_A = 125$ °C, unpowered	±(1.0%+0.05 Ω)			
Exposure	MIL-STD-202 Method 108		<50 m Ω for Jumper			
Moisture	AEC-Q200 Test 6	Each temperature / humidity cycle is defined at	±(0.5%+0.05 Ω) for 1% tol.			
Resistance	MIL-STD-202 Method 106	8 hours (method 106F), 3 cycles / 24 hours for 10d. with 25 °C / 65 °C 95% R.H, without steps 7a & 7b, unpowered	\pm (2.0%+0.05 Ω) for 5% tol. <100 m Ω for Jumper			
		Parts mounted on test-boards, without condensation on parts				
Biased	AEC-Q200 Test 7	1,000 hours; 85 °C / 85% RH	±(1.0%+0.05 Ω)			
Humidity	MIL-STD-202 Method 103	10% of operating power	<100 m Ω for Jumper			
		Measurement at 24±4 hours after test conclusion.				
Operational Life	AEC-Q200 Test 8	1,000 hours at 125 °C, derated voltage 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			
Resistance to	AEC-Q200 Test 15	Condition B, no pre-heat of samples	±(0.5%+0.05 Ω) for 1% tol			
Soldering Heat	MIL-STD-202 Method 210	Lead-free solder, 260±5 °C, 10±1 seconds immersion time	\pm (1.0%+0.05 Ω) for 5% tol.			
		Procedure 2 for SMD: devices fluxed and cleaned with isopropanol	<50 m Ω for Jumper No visible damage			
T I I OL I	AFC 0200 T 1/	55/1125.00				
Thermal Shock	AEC-Q200 Test 16 MIL-STD-202 Method 107	-55/+125 °C	$\pm (1.0\% \pm 0.05 \Omega)$			
	MIL-51D-202 Method 107	Number of cycles is 300. Devices mounted Maximum transfer time is 20 seconds.	$<$ 50 m Ω for Jumper			
		Dwell time is 15 minutes. Air – Air				
ESD	AEC-Q200 Test 17	Human Body Model,	±(3.0%+0.05 Ω)			
	AEC-Q200-002	l pos. + l neg. discharges 0402/0603: l KV, 0805 and above: 2 KV	<50 m Ω for Jumper			

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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
		(a) Method B, aging 4 hours at 155 °C dry heat, dipping at 235±3 °C for 5±0.5 seconds.	
		(b) Method B, steam aging 8 hours, dipping at 215±3 °C for 5±0.5 seconds.	
		(c) Method D, steam aging 8 hours, dipping at 260±3 °C for 7±0.5 seconds.	
Board Flex	AEC-Q200 Test 21	Chips mounted on a 90mm glass epoxy resin	±(1.0%+0.05 Ω)
	AEC-Q200-005	PCB (FR4)	<50 m Ω for Jumper
		Bending for 0402: 5 mm 0603/0805: 3 mm 1206 and above: 2 mm	
		Holding time: minimum 60 seconds	
Temperature Coefficient of	IEC 60115-1 4.8	At +25/–55 °C and +25/+125 °C	Refer to table 2
Resistance (T.C.R.)		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 °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	
Short Time	IEC60115-14.13	2.5 times of rated voltage or maximum	±(1.0%+0.05 Ω)
Overload		overload voltage whichever is less for 5 sec at room temperature	$<$ 50 m Ω for Jumper



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<u>REVISION HISTORY</u>

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 2	Feb. 10, 2012		- Jumper criteria added
			- ACI218 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



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