

# 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



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

(1) SIZE

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

(2) TOLERANCE

F = ±1%  
 J = ±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

1Ω to 10 MΩ  
 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 rule	Example
XXXX	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)	976R = 976 Ω
XKXX	1K = 1,000 Ω
(1 to 9.76 KΩ)	9K76 = 9760 Ω
XMXX	1M = 1,000,000 Ω
(1 to 9.76 MΩ)	9M76 = 9,760,000 Ω
XXMX	10M = 10,000,000 Ω
(10 MΩ)	

**ORDERING EXAMPLE**

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

**NOTE**

1. 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.

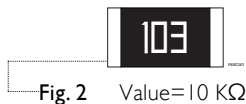
**MARKING**

**AC0402**



No marking

**AC0603 / AC0805 / AC1206 / AC1210 / AC2010 / AC2512**

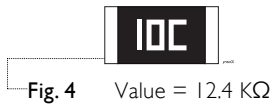


E-24 series: 3 digits, ±5%  
First two digits for significant figure and 3rd digit for number of zeros

**AC0603**

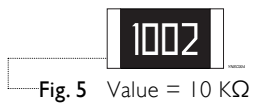


E-24 series: 3 digits, ±1%  
One short bar under marking letter



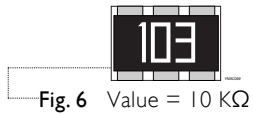
E-96 series: 3 digits, ±1%  
First two digits for E-96 marking rule and 3rd letter for number of zeros

**AC0805 / AC1206 / AC1210 / AC2010 / AC2512**

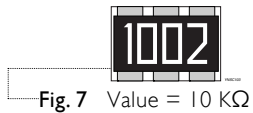


Both E-24 and E-96 series: 4 digits, ±1%  
First three digits for significant figure and 4th digit for number of zeros

**AC1218**



E-24 series: 3 digits, ±5%  
First two digits for significant figure and 3rd digit for number of zeros



Both E-24 and E-96 series: 4 digits, ±1%  
First three digits for significant figure and 4th digit for number of zeros

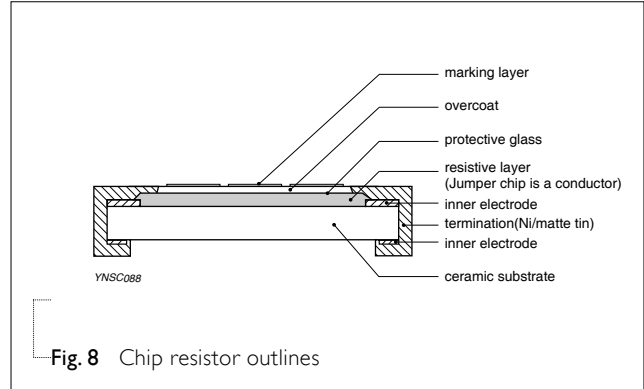
**NOTE**

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

**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.

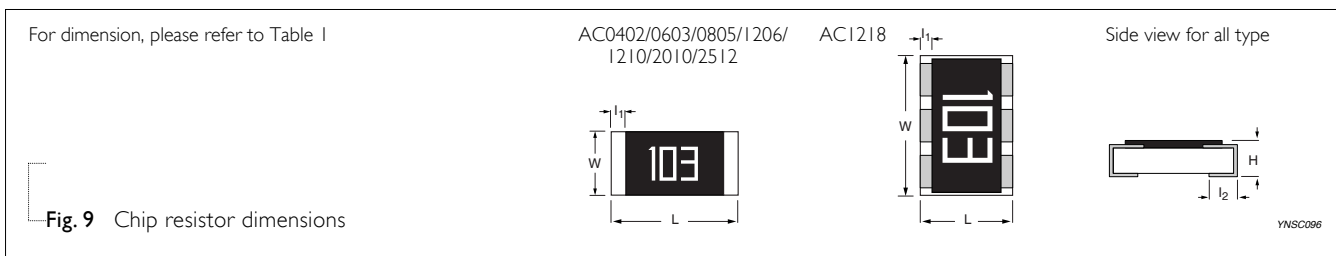
**OUTLINES**



**DIMENSIONS**

Table I For outlines, please refer to Fig. 9

TYPE	L (mm)	W (mm)	H (mm)	l <sub>1</sub> (mm)	l <sub>2</sub> (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

TYPE	RESISTANCE RANGE	CHARACTERISTICS					Temperature Coefficient of Resistance	Jumper Criteria
		Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage			
AC0402			50 V	100 V	100 V		Rated Current 1A Max. Current 2A	
AC0603			50 V	100 V	100 V		Rated Current 1A Max. Current 2A	
AC0805			150 V	300 V	300 V		Rated Current 2A Max. Current 5A	
AC1206	5% (E24), 1% (E24/E96) 1 Ω to 10 MΩ	-55 °C to +155 °C	200 V	400 V	500 V	1 Ω ≤ R ≤ 10 Ω, ±200 ppm/°C	Rated Current 2A Max. Current 10A	
AC1210	Jumper < 0.05 Ω		200 V	500 V	500 V		10 Ω < R ≤ 10 MΩ, ±100 ppm/°C	Rated Current 2A Max. Current 10A
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

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

**NOTE**

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

**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 (Ω)

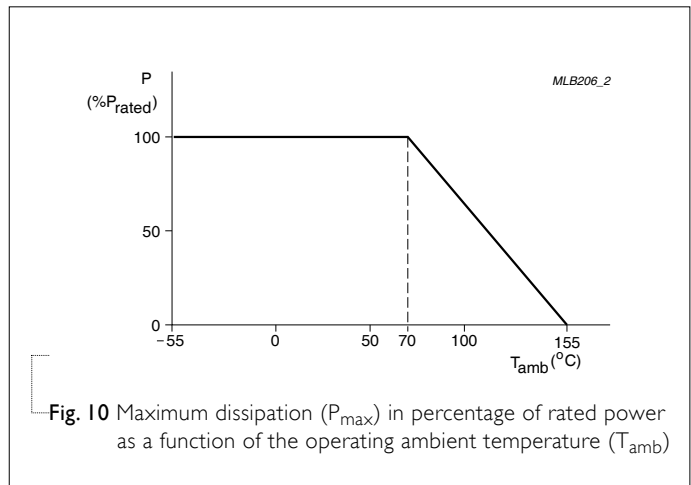


Fig. 10 Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the operating ambient temperature ( $T_{amb}$ )

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

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
High Temperature Exposure	AEC-Q200 Test 3 MIL-STD-202 Method 108	1,000 hours at $T_A = 125\text{ }^\circ\text{C}$ , unpowered	$\pm(1.0\%+0.05\ \Omega)$ <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 $25\text{ }^\circ\text{C}$ / $65\text{ }^\circ\text{C}$ 95% R.H, without steps 7a & 7b, unpowered  Parts mounted on test-boards, without condensation on parts	$\pm(0.5\%+0.05\ \Omega)$ for 1% tol. $\pm(2.0\%+0.05\ \Omega)$ for 5% tol. <100 m $\Omega$ for Jumper
Biased Humidity	AEC-Q200 Test 7 MIL-STD-202 Method 103	1,000 hours; $85\text{ }^\circ\text{C}$ / 85% RH 10% of operating power  Measurement at $24\pm 4$ hours after test conclusion.	$\pm(1.0\%+0.05\ \Omega)$ <100 m $\Omega$ for Jumper
Operational Life	AEC-Q200 Test 8 MIL-STD-202 Method 108	1,000 hours at $125\text{ }^\circ\text{C}$ , derated voltage applied for 1.5 hours on, 0.5 hour off, still-air required	$\pm(1.0\%+0.05\ \Omega)$ <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, $260\pm 5\text{ }^\circ\text{C}$ , $10\pm 1$ seconds immersion time  Procedure 2 for SMD: devices fluxed and cleaned with isopropanol	$\pm(0.5\%+0.05\ \Omega)$ for 1% tol. $\pm(1.0\%+0.05\ \Omega)$ for 5% tol. <50 m $\Omega$ for Jumper No visible damage
Thermal Shock	AEC-Q200 Test 16 MIL-STD-202 Method 107	$-55/+125\text{ }^\circ\text{C}$ Number of cycles is 300. Devices mounted Maximum transfer time is 20 seconds. Dwell time is 15 minutes. Air – Air	$\pm(1.0\%+0.05\ \Omega)$ <50 m $\Omega$ for Jumper
ESD	AEC-Q200 Test 17 AEC-Q200-002	Human Body Model, 1 pos. + 1 neg. discharges 0402/0603: 1 KV, 0805 and above: 2 KV	$\pm(3.0\%+0.05\ \Omega)$ <50 m $\Omega$ for Jumper

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
<b>Solderability</b> - Wetting	AEC-Q200 Test 18 J-STD-002	Electrical Test not required Magnification 50X SMD conditions: (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.	Well tinned (≥95% covered) No visible damage
<b>Board Flex</b>	AEC-Q200 Test 21 AEC-Q200-005	Chips mounted on a 90mm glass epoxy resin PCB (FR4) Bending for 0402: 5 mm 0603/0805: 3 mm 1206 and above: 2 mm Holding time: minimum 60 seconds	±(1.0%+0.05 Ω) <50 mΩ for Jumper
<b>Temperature Coefficient of Resistance (T.C.R.)</b>	IEC 60115-1 4.8	At +25/-55 °C and +25/+125 °C  <b>Formula:</b> $T.C.R = \frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}$ Where t <sub>1</sub> =+25 °C or specified room temperature t <sub>2</sub> =-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	Refer to table 2
<b>Short Time Overload</b>	IEC60115-1 4.13	2.5 times of rated voltage or maximum overload voltage whichever is less for 5 sec at room temperature	±(1.0%+0.05 Ω) <50 mΩ for Jumper



REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 2	Feb. 10, 2012		- Jumper criteria added - AC1218 marking and outline figure updated
Version 1	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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