



THICK FILM CHIP RESISTORS AUTOMOTIVE GRADE

AC series $\pm 5\%, \pm 1\%, \pm 0.5\%$ Sizes 0201/0402/0603/0805/1206/ 1210/1218/2010/2512

RoHS compliant & Halogen free



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<u>SCOPE</u>

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

APPLICATIONS

- All general purpose applications
- Car electronics, industrial application

<u>FEATURES</u>

- AEC-Q200 qualified
- 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.

GLOBAL PART NUMBER

AC XXXX X X X XX XXXX L

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

(I) SIZE

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

(2) TOLERANCE

$D = \pm 0.5\%$	
$F = \pm 1\%$	

(3) PACKAGING TYPE

K = Embossed taping reel

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

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

- = Base on spec

R = Paper taping reel

(5) TAPING REEL

07 = 7 inch dia. Reel	10 = 10 inch dia. Reel
13 = 13 inch dia. Reel	7W = 7 inch dia. Reel & 2 x standard power
	3W = 13 inch dia. Reel & 2 × standard power

(6) RESISTANCE VALUE

I Ω to 22 M Ω

There are $2\sim4$ 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. IK2, not IK20.

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

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

- 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.

MARKING

AC0201	/ AC0402	
Fig. 1		No marking
AC0603	/ AC0805 / AC1206 / A	AC1210 / AC2010 / AC2512
Fig. 2	1111 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	Ζ<u>Η</u>Ο Value = 24 Ω	E-24 series: 3 digits, ±1% & ±0.5% One short bar under marking letter
Fig. 4	Value = 12.4 KΩ	E-96 series: 3 digits, $\pm 1\%$ & $\pm 0.5\%$ First two digits for E-96 marking rule and 3rd letter for number of zeros
AC0805	/ ACI206 / ACI2I0 / A	AC2010 / AC2512
Fig. 5	1002 Value = 10 KΩ	Both E-24 and E-96 series: 4 digits, $\pm 1\% \& \pm 0.5\%$ First three digits for significant figure and 4th digit for number of zeros
AC1218		
Fig. 6	103 Value = 10 KΩ	E-24 series: 3 digits, ±5% First two digits for significant figure and 3rd digit for number of zeros
Fig. 7	11112 Value = 10 KΩ	Both E-24 and E-96 series: 4 digits, $\pm 1\% \& \pm 0.5\%$ 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.

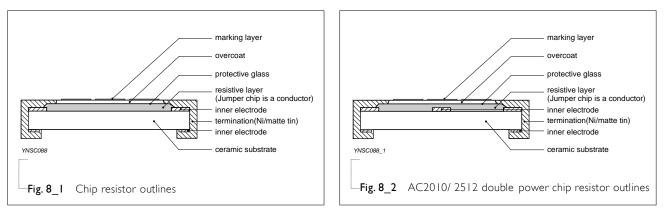




CONSTRUCTION

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 protective 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.

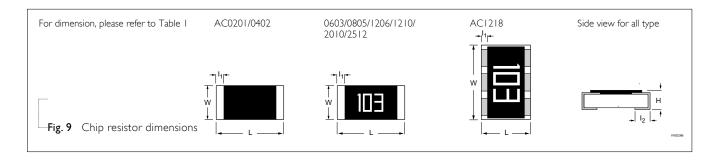
OUTLINES



DIMENSIONS

Table I For outlines, please refer to Fig. 9

ТҮРЕ	L (mm)	W (mm)	H (mm)	l⊢(mm)	l ₂ (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	0.55 ±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



 Chip Resistor Surface Mount
 AC
 SERIES
 0201 to 2512

ELECTRICAL CHARACTERISTICS

Table 2

	CHARACTERISTICS							
TYPE	POWER	Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range	Temperature Coefficient	Jumper Criteria
AC0201						5% (E24)	$ \Omega \le R \le 0\Omega $	Rated Current
						$ \Omega \le R \le 0M\Omega $	-100/+350ppm° C	0.5A
		-55 °C to				1% (E24/E96)	$10\Omega < R \le 10M$	Maximum
	1/20 W	155 °C	25V	50V	50V	$ \Omega \le R \le 0M\Omega $	±200ppm°C	Current
		100 0				0.5% (E24/E96)		1.0A
						$10\Omega \le R \le IM\Omega$		
						Jumper<50m Ω		
						5% (E24)	$ \Omega \leq R \leq 0\Omega $	Rated Current
						$I\Omega \le R \le 22M\Omega$	±200ppm°C	IA
	1/16W	-55 ℃ to 50V 155 ℃	FOV	100V	100V	0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	Maximum
			1000	100 v	$ \Omega \leq R \leq 0M\Omega $	±100ppm°C	Current	
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	2A
AC0402							±200ppm°C	
		-55 °C to ₩ 155 °C 155 °C		100V	100V	5% (E24)	$ \Omega \leq R \leq 0\Omega $	
	1/8W		75\/			$ \Omega \leq R \leq 0M\Omega $	±200 ppm°C	
	1/000		/30			0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	
					$ \Omega \le R \le 10M\Omega$	±100 ppm°C		
						5% (E24)	$ \Omega \leq R \leq 0\Omega $	Rated Current
						$I\Omega \leq R \leq 22M\Omega$	±200ppm°C	IA
		-55 °C to				0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	Maximum
	1/10W	155 °C	75V	150V	150V	$ \Omega \leq R \leq 10M\Omega$	±100ppm°C	Current
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	2A
AC0603							±200ppm°C	
						5% (E24)	$ \Omega \leq R \leq 0\Omega $	
		-55 °C to				$I\Omega \le R \le I0M\Omega$	±200 ppm°C	
	1/5 W	155 ℃	75V	150V	150V	0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	
						$ \Omega \le R \le 10M\Omega$	±100 ppm°C	

		CHARACTERISTICS						
TYPE	POWER	Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range	Temperature Coefficient	Jumper Criteria
						5% (E24)	$ \Omega \le R \le 0\Omega $	Rated Current
						$ \Omega \le R \le 22 M\Omega$	±200ppm°C	2A
		-55 °C to		2001	2001	0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	Maximum
	1/8 W	155 ℃	150V	300V	300∨	$ \Omega \leq R \leq 10M\Omega$	±100ppm°C	Current
						Jumper < 50m Ω	$10M\Omega < R \le 22M\Omega$	5A
AC0805							±200ppm°C	
						5% (E24)	$ \Omega \le R \le 0\Omega $	
	1/4 W	- 55 °C to	150V	300V	300V	$ \Omega \leq R \leq 10M\Omega$	±200 ppm°C	
	17 1 🗸	155 ℃	1500	5004	5004	0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	
						$ \Omega \le R \le 0M\Omega $	±100 ppm°C	
	1/4 W	-55 ℃ to 200\ 1/4 W 155 ℃				5% (E24)	$ \Omega \le R \le 0\Omega $	Rated Current
						$ \Omega \le R \le 22M\Omega$	±200ppm°C	2A
			2001/	400V	∨ 500∨	0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	Maximum
			200 v	5v 100v		$ \Omega \le R \le 0M\Omega $	±100ppm°C	Current
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	10A
AC1206							±200ppm°C	
				400V	500V	5% (E24)	$ \Omega \le R \le 0\Omega $	
		-55 ℃ to 200V 155 ℃	2221			$ \Omega \le R \le 10M\Omega$	±200 ppm°C	
	1/2 W		2000			0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	
					$ \Omega \le R \le 0M\Omega $	±100 ppm°C		
						5% (E24)	$ \Omega \le R \le 0\Omega $	Rated Current
						$ \Omega \le R \le 22M\Omega$	±200ppm°C	2A
		-55 °C to	2221	5001	5001	0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	Maximum
	1/2 W	155 ℃	200V	500V	500V	$ \Omega \leq R \leq 0M\Omega $	±100ppm°C	Current
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	10A
AC1210							±200ppm°C	
						5% (E24)	$ \Omega \le R \le 0\Omega $	
	1.1.4.7	-55 °C to	2001			$ \Omega \leq R \leq 0M\Omega $	±200 ppm°C	
	IW	155 °C	200V	500V	500V	0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	
						$ \Omega \le R \le 0M\Omega $	±100 ppm°C	

		CHARACTERISTICS						
TYPE	POWER	Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range	Temperature Coefficient	Jumper Criteria
						5% (E24)	$ \Omega \le R \le 0\Omega $	Rated Current
		-55 °C to				$ \Omega \leq R \leq M\Omega $	±200ppm°C	6A
	I W	-55 °C	200V	500V	500V	0.5%, 1% (E24/E96)	$10\Omega < R \le 1M\Omega$	Maximum
		155 C				$ \Omega \leq R \leq M\Omega $	±100ppm°C	Current
AC1218						Jumper<50m Ω		10A
						5% (E24)	$ \Omega \le R \le 0\Omega $	
	1.5W	-55 °C to	200V	500V	500V	$ \Omega \leq R \leq M\Omega $	±200 ppm°C	
	V V C, I	155 ℃	200 v	500 v	5004	0.5%, 1% (E24/E96)	$10\Omega < R \le 1M\Omega$	
						$ \Omega \leq R \leq M\Omega $	±100 ppm°C	
	3/4 W	-55 ℃ to 3/4 W I 55 ℃				5% (E24)	$ \Omega \le R \le 0\Omega $	Rated Current
				2001/ 5001/	V 500V	$ \Omega \le R \le 22M\Omega$	±200ppm°C	2A
			2001/			0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	Maximum
			200V	500V		$ \Omega \leq R \leq 10M\Omega$	±100ppm°C	Current
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	10A
AC2010							±200ppm°C	
		-55 ℃ to W 155 ℃			500V	5% (E24)	$ \Omega \leq R \leq 0\Omega $	
						$ \Omega \leq R \leq 0M\Omega $	±200 ppm°C	
	1.25W		200V	500V		0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	
						$ \Omega \le R \le 0M\Omega $	±100 ppm°C	
						5% (E24)	$ \Omega \le R \le 0\Omega $	Rated Current
						$I\Omega \leq R \leq 22M\Omega$	±200ppm°C	2A
		-55 °C to		5000	= 0 01 /	0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	Maximum
	IW	155 ℃	200V	500V	500V	$ \Omega \leq R \leq 0M\Omega $	±100ppm°C	Current
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	10A
AC2512							±200ppm°C	
						5% (E24)	$ \Omega \leq R \leq 0\Omega $	
	214	-55 °C to	2001	400V	F001/	$ \Omega \le R \le 10M\Omega$	±200 ppm°C	
	2 W	155 ℃	200V		500V	0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	
						$ \Omega \le R \le 0M\Omega $	±100 ppm°C	

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 AC0201 AC0402 AC0603 AC0805 AC1206 AC1210 AC1218 AC2010 AC2512 DIMENSION Paper taping reel (R) 7" (178 mm) 10,000 5,000 5,000 5,000 5,000 10,000 10" (254 mm) 20,000 20,000 10,000 10,000 10,000 10,000 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 4.000 ____

ΝΟΤΕ

I. For paper/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: AC0201=1/20W (0.05W) AC0402=1/16W (0.0625W); 1/8W (0.125W) AC0603=1/10W (0.1W); 1/5W (0.2W) AC0805=1/8W (0.125W); 1/4 W(0.25 W) AC1206=1/4W (0.25W); 1/2 W (0.5 W) AC1210=1/2W (0.5W); 1/2 W (0.5 W) AC1218=1W; 1.5W AC2010=3/4W (0.75W); 1.25W AC2512=1 W; 2W

RATED VOLTAGE

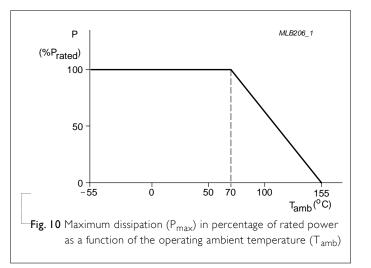
The DC or AC (rms) continuous working voltage corresponding to the rated power is determined by the following formula:

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

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)



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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%+0.05Ω) for D/F tol \pm (2.0%+0.05Ω) for J tol <50 mΩ 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	±(0.5%+0.05Ω) for D/F tol ±(2.0%+0.05Ω) for J tol <100 mΩ 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%+0.05Ω) for D/F tol ±(3.0%+0.05Ω) for J tol <100 mΩ 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	±(1.0%+0.05Ω) for D/F tol ±(3.0%+0.05Ω) for J tol <100 mΩ 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%+0.05 Ω) for D/F tol \pm (1.0%+0.05 Ω) for J tol <50 m Ω 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	±(0.5%+0.05Ω) for D/F tol ±(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	±(3.0%+0.05Ω) <50 mΩ for Jumper



TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Solderability - Wetting	AEC-Q200 Test 18 J-STD-002	Electrical Test not required Magnification 50X SMD conditions:	Well tinned (≥95% covered) 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 ℃ for 5±0.5 seconds.	
		(c) Method D, steam aging 8 hours, dipping at 260±3 °C for 30±0.5 seconds.	
Board Flex	AEC-Q200 Test 21 AEC-Q200-005	Chips mounted on a 90mm glass epoxy resin PCB (FR4)	±(1.0%+0.05Ω) <50 mΩ for Jumper
	ALC-Q200-003	Bending for 0201/0402: 5 mm 0603/0805: 3 mm 1206 and above: 2 mm	>30 mzz ior jumper
		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
, , , , , , , , , , , , , , , , , , ,		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%+0.05Ω) for D/F tol
Overload		overload voltage whichever is less for 5 sec at room temperature	\pm (2.0%+0.05 Ω) for J tol <50 m Ω for Jumper
FOS	ASTM-B-809-95	Sulfur (saturated vapor) 500 hours, 60±2°C, unpowered	±(1.0%+0.05Ω)

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 Chip Resistor Surface Mount
 AC
 SERIES
 0201 to 2512

<u>REVISION HISTORY</u>

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 8	Mar. 19, 2021	-	- Upgrade the working voltage of 0402 double power to 75V
Version 7	July 10, 2017	-	- Add "3W" part number coding for 13" Reel & double power
Version 6	May 31, 2017	-	- Add 10" packing
Version 5	Dec. 07, 2015	-	- Add in AC double power
			- Remove 7D packing
Version 4 M	May 25, 2015	-	- Extend resistance range
	,,		- Add in AC0201
			- Update FOS test and requirements
			- Feature description updated
Version 3	Feb 13, 2014	-	- add ±0.5%
			- delete 10" taping reel
			- Jumper criteria added
Version 2	Feb. 10, 2012	-	- ACI218 marking and outline figure updated
			- Case size 1210, 1218, 2010, 2512 extended
Version I	Feb. 01, 2011	-	- Test method and procedure updated
			- Packing style of 7D added
Version 0	Nov. 10, 2010	-	- First issue of this specification



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