Innovative Service Around the Globe YAGEO

DATA SHEET

THICK FILM CHIP RESISTORS AUTOMOTIVE GRADE

AC series

±5%, ±1%, ±0.5%, ±0.1% (Low TCR)

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

RoHS compliant & Halogen free



YAGEO

Product specification – November 17, 2023 V.11



SCOPE

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

FEATURES

- AEC-Q200 qualified
- Moisture sensitivity level: 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
- 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

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

(2) TOLERANCE

B = ± 0.1% for low TCR
D = ± 0.5%
F = ± 1%
J = ± 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
E = ± 50 ppm/°C

(5) TAPING REEL

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

(6) RESISTANCE VALUE

1Ω to 22 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 B is for bulk AOI ordering only. (Note)

Resistance rule of global part number

Resistance coding rule	Example
XRXX (1 to 9.76Ω)	1R = 1Ω 1R5 = 1.5Ω 9R76 = 9.76Ω
XXRX (10 to 97.6Ω)	10R = 10Ω 97R6 = 97.6Ω
XXXR (100 to 976Ω)	100R = 100Ω 976R = 976Ω
XKXX (1 to 9.76 KΩ)	1K = 1,000Ω 9K76 = 9760Ω
XMXX (1 to 9.76 MΩ)	1M = 1,000,000Ω 9M76= 9,760,000Ω
XXMX (10 MΩ)	10M = 10,000,000Ω

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 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 / AC1210 / AC2010 / AC2512



Fig. 2 Value=10 KΩ

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



Fig. 4 Value = 12.4 KΩ

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



Fig. 5 Value = 10 KΩ

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

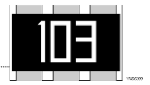


Fig. 6 Value = 10 KΩ

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

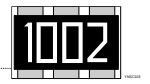


Fig. 7 Value = 10 KΩ

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

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 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

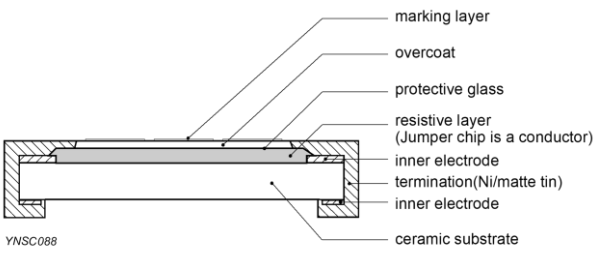


Fig. 8_1 Chip resistor outlines

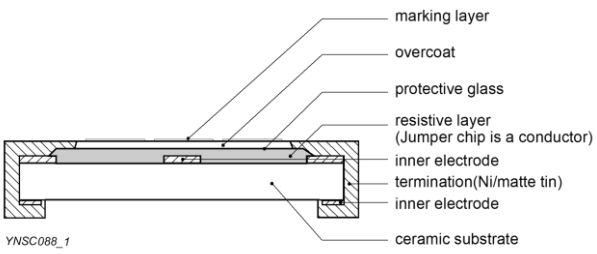


Fig. 8_2 AC2010/ 2512 double power chip resistor outlines

DIMENSIONS

Table 1 For outlines, please refer to Fig. 9

TYPE	L (mm)	W (mm)	H (mm)	I_1 (mm)	I_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	0.45 ±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	0.55 ±0.20
AC2512	6.35 ±0.10	3.10 ±0.15	0.55 ±0.10	0.60 ±0.20	0.60 ±0.20

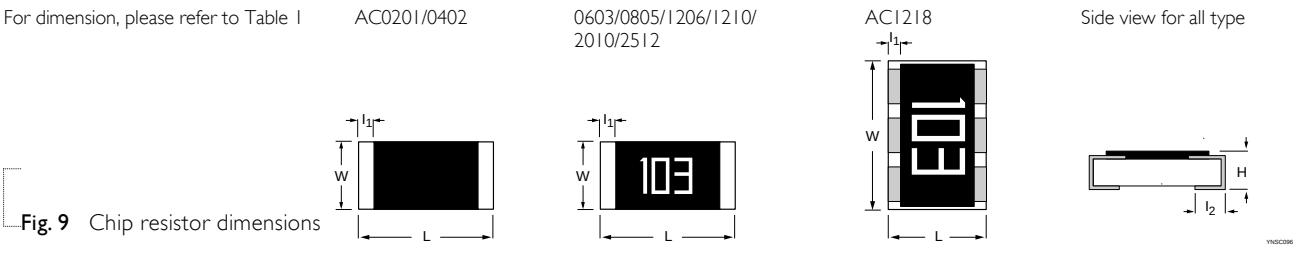


Fig. 9 Chip resistor dimensions

ELECTRICAL CHARACTERISTICS

Table 2

TYPE	POWER	CHARACTERISTICS						
		Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range	Temperature Coefficient	Jumper Criteria
AC0201	1/20 W	-55°C to 155°C	25V	50V	50V	5% (E24) 1Ω ≤ R ≤ 10MΩ 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ 0.5% (E24/E96) 10Ω ≤ R ≤ 1MΩ Jumper<50mΩ	1Ω ≤ R ≤ 10Ω -100/+350 ppm°C 10Ω < R ≤ 10M ±200 ppm°C	Rated Current 0.5A Maximum Current 1.0A
AC0402	1/16 W	-55°C to 155°C	50V	100V	100V	5% (E24) 1Ω ≤ R ≤ 22MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper<50mΩ	1Ω ≤ R ≤ 10Ω ±200 ppm°C 10Ω < R ≤ 10MΩ ±100 ppm°C 10MΩ < R ≤ 22MΩ ±200 ppm°C	Rated Current 1A Maximum Current 2A
	1/8W	-55°C to 155°C	75V	100V	100V	5% (E24) 1Ω ≤ R ≤ 10MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C	
AC0603	1/10 W	-55°C to 155°C	75V	150V	150V	5% (E24) 1Ω ≤ R ≤ 22MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper<50mΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C 10MΩ < R ≤ 22MΩ ±200 ppm°C	Rated Current 1A Maximum Current 2A
	1/5 W	-55°C to 155°C	75V	150V	150V	5% (E24) 1Ω ≤ R ≤ 10MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C	

TYPE	POWER	CHARACTERISTICS						
		Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range	Temperature Coefficient	Jumper Criteria
AC0805	1/8 W	-55°C to 155°C	150V	300V	300V	5% (E24) 1Ω ≤ R ≤ 22 MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper < 50mΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C 10MΩ < R ≤ 22MΩ ±200 ppm°C	Rated Current 2A Maximum Current 5A
	1/4 W	-55°C to 155°C	150V	300V	300V	5% (E24) 1Ω ≤ R ≤ 10MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C	
AC1206	1/4 W	-55°C to 155°C	200V	400V	500V	5% (E24) 1Ω ≤ R ≤ 22MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper<50mΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C 10MΩ < R ≤ 22MΩ ±200 ppm°C	Rated Current 2A Maximum Current 10A
	1/2 W	-55°C to 155°C	200V	400V	500V	5% (E24) 1Ω ≤ R ≤ 10MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C	
AC1210	1/2 W	-55°C to 155°C	200V	500V	500V	5% (E24) 1Ω ≤ R ≤ 22MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper<50mΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C 10MΩ < R ≤ 22MΩ ±200 ppm°C	Rated Current 2A Maximum Current 10A
	1 W	-55°C to 155°C	200V	500V	500V	5% (E24) 1Ω ≤ R ≤ 10MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C	

TYPE	POWER	CHARACTERISTICS						
		Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range	Temperature Coefficient	Jumper Criteria
AC1218	1 W	-55°C to 155°C	200V	500V	500V	5% (E24) 1Ω ≤ R ≤ 1MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 1MΩ Jumper<50mΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 1MΩ ±100 ppm°C	Rated Current 6A Maximum Current 10A
	1.5W	-55°C to 155°C	200V	500V	500V	5% (E24) 1Ω ≤ R ≤ 1MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 1MΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 1MΩ ±100 ppm°C	
AC2010	3/4 W	-55°C to 155°C	200V	500V	500V	5% (E24) 1Ω ≤ R ≤ 22MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper<50mΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100ppm°C 10MΩ < R ≤ 22MΩ ±200 ppm°C	Rated Current 2A Maximum Current 10A
	1.25W	-55°C to 155°C	200V	500V	500V	5% (E24) 1Ω ≤ R ≤ 10MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C	
AC2512	1 W	-55°C to 155°C	200V	500V	500V	5% (E24) 1Ω ≤ R ≤ 22MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ Jumper<50mΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C 10MΩ < R ≤ 22MΩ ±200 ppm°C	Rated Current 2A Maximum Current 10A
	2 W	-55°C to 155°C	200V	500V	500V	5% (E24) 1Ω ≤ R ≤ 10MΩ 0.5%, 1% (E24/E96) 1Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω ±200 ppm°C 10Ω ≤ R ≤ 10MΩ ±100 ppm°C	

Table 3 Table 3 for low TCR

TYPE	POWER	CHARACTERISTICS					
		Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range	Temperature Coefficient
AC0402	1/16 W	-55°C to 155°C	50V	100V	100V	0.1%, 0.5%, 1% (E24/E96) 10Ω ≤ R ≤ 1MΩ	±50 ppm°C
	1/8W	-55°C to 155°C	50V	100V	100V	0.1%, 0.5%, 1% (E24/E96) 10Ω ≤ R ≤ 1MΩ	±50 ppm°C
AC0603	1/10 W	-55°C to 155°C	75V	150V	150V	0.1%, 0.5%, 1% (E24/E96) 10Ω ≤ R ≤ 1MΩ	±50 ppm°C
	1/5 W	-55°C to 155°C	75V	150V	150V	0.1%, 0.5%, 1% (E24/E96) 10Ω ≤ R ≤ 1MΩ	±50 ppm°C
AC0805	1/8 W	-55°C to 155°C	150V	300V	300V	0.1%, 0.5%, 1% (E24/E96) 10Ω ≤ R ≤ 1MΩ	±50 ppm°C
	1/4 W	-55°C to 155°C	150V	300V	300V	0.1%, 0.5%, 1% (E24/E96) 10Ω ≤ R ≤ 1MΩ	±50 ppm°C
AC1206	1/4 W	-55°C to 155°C	200V	400V	500V	0.1%, 0.5%, 1% (E24/E96) 10Ω ≤ R ≤ 7.5MΩ	±50 ppm°C
	1/2 W	-55°C to 155°C	200V	400V	500V	0.1%, 0.5%, 1% (E24/E96) 10Ω ≤ R ≤ 7.5MΩ	±50 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 4 Packing style and packaging quantity

PACKING STYLE	REEL DIMENSION	AC0201	AC0402	AC0603	AC0805	AC1206	AC1210	AC1218	AC2010	AC2512
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	4,000
	13" (330 mm)	---	---	---	---	---	---	---	16,000	---

NOTE

1. 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); 1W
AC1218=1W; 1.5W
AC2010=3/4W (0.75W); 1.25W
AC2512=1 W; 2W

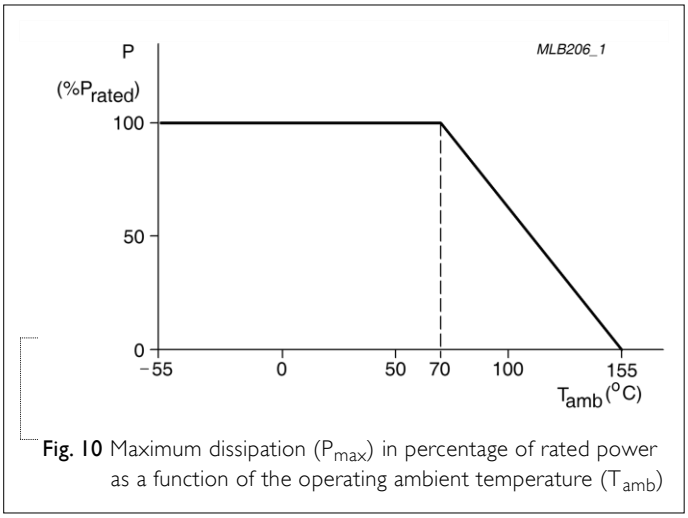


Fig. 10 Maximum dissipation (P_{max}) in percentage of rated power as a function of the operating ambient temperature (T_{amb})

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)

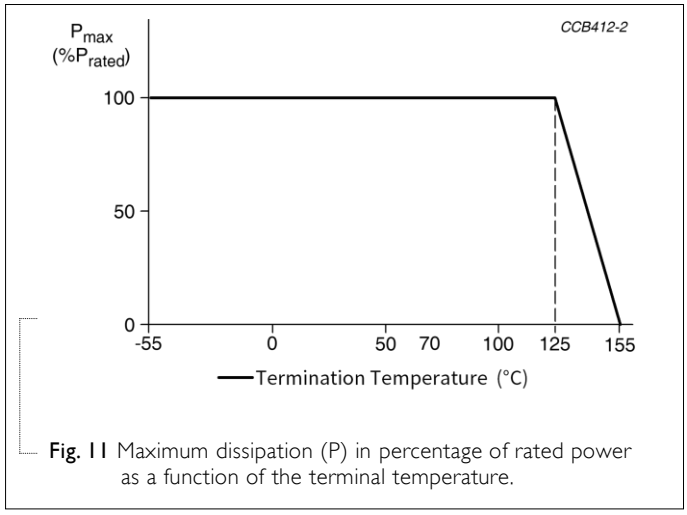


Fig. 11 Maximum dissipation (P) in percentage of rated power as a function of the terminal temperature.

TESTS AND REQUIREMENTS

Table 5 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	±(1.0%+0.05Ω) for D/F tol ±(2.0%+0.05Ω) for J tol <50 mΩ for Jumper
Moisture Resistance	MIL-STD-202 Method 106	Each temperature / humidity cycle is defined at 8 hours, 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.	±(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	±(0.5%+0.05Ω) for D/F tol ±(1.0%+0.05Ω) for J tol <50 mΩ for Jumper No visible damage
Thermal Shock	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, $1_{pos.}$ + $1_{neg.}$ discharges 0201: 500V 0402/0603: 1KV 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: (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 30±0.5 seconds.	Well tinned (≥95% covered) No visible damage
Board Flex	AEC-Q200 Test 21 AEC-Q200-005	Chips mounted on a 100mm × 40mm glass epoxy resin PCB (FR4) Bending for 0201/0402: 5 mm 0603/0805: 3 mm 1206 and above: 2 mm Holding time: minimum 60 seconds	±(1.0%+0.05Ω) <50 mΩ for Jumper
Temperature Coefficient of Resistance (T.C.R.)	MIL-STD-202 Method 304	At +25/–55 °C and +25/+125 °C Formula: $T.C.R=\frac{R_2-R_1}{R_1(t_2-t_1)}\times 10^6$ (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	Refer to table 2
Short Time Overload	IEC60115-1 8.1	2.5 times of rated voltage or maximum overload voltage whichever is less for 5 sec at room temperature	±(1.0%+0.05Ω) for D/F tol ±(2.0%+0.05Ω) for J tol <50 mΩ 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 11	Nov. 17, 2023	-	- Combine low TCR, upgrade TCR (60ppm to 50ppm) for AC1206-1Mohm to 7.5Mohm (low TCR) and add double power for low TCR. Add power rating of the terminal temperature.
Version 10	Jan. 04, 2023	-	- 10ohm TCR upgrade to 100ppm, for 0603~2512 normal power and 0402~2512 double power.
Version 9	Aug. 02, 2022	-	- 12 dimension updated, for size 1206, size 2010, size 2512.
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
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 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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