

DATA SHEET

HIGH VOLTAGE CHIP RESISTORS

RV series
0.5%, 1%, 5%

sizes 0603/0805/1206/2010/2512

RoHS compliant

IEC 62368-1 Safety Certificate issued by UL Demko:
sizes 0603/0805/1206



SCOPE

This specification describes RV0603/0805/1206/2010/2512 high voltage chip resistors with lead-free terminations made by thick film process.

APPLICATIONS

- Converter
- Printer equipment
- Battery charger
- Computer
- Power supply
- Car electronics

FEATURES

- AEC-Q200 qualified for 47ohm ≤ R < 5Mohm
- RoHS compliant
- Reducing environmentally hazardous wastes
- High component and equipment reliability
- Non-forbidden materials used in products/production
- Halogen Free Epoxy
- Moisture sensitivity level: MSL 1
- IEC 62368-1:2014 safety certificate (G.10.2) issued by UL Demko for the following sizes and resistance ranges:
 - 0603: 100KΩ to 10MΩ
 - 0805: 100KΩ to 22MΩ
 - 1206: 100KΩ to 27MΩ

*Please refer to UL certification

ORDERING INFORMATION - GLOBAL PART NUMBER & I2NC

Both part numbers are identified by the series, size, tolerance, packing type, temperature coefficient, taping reel and resistance value.

YAGEO BRAND ordering code

GLOBAL PART NUMBER (PREFERRED)

RV XXXX X X X XX XXXX L
 (1) (2) (3) (4) (5) (6) (7)

(1) SIZE

0603/0805/1206/2010/2512

(2) TOLERANCE

D = ±0.5%
 F = ±1%
 J = ±5%

(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

(6) RESISTANCE VALUE

There are 2~4 digits indicated the resistor 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 resistance rules show in table of "Resistance rule of global part number".

(7) DEFAULT CODE

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

| Resistance code rule | Example |
|-------------------------|--|
| XXKX (10 to 97.6 KΩ) | 10K = 10,000 Ω 97K6 = 97,600 Ω |
| XXXX (100 to 976 KΩ) | 100K = 100,000Ω 976K = 976,000Ω |
| XMXX (1 to 9.76 MΩ) | 1M = 1,000,000 Ω 9M76 = 9,760,000 Ω |
| XXMX (10 to 16 MΩ) | 10M = 10,000,000 Ω 27M = 27,000,000 Ω |

Resistance rule of global part number

ORDERING EXAMPLE

The ordering code of a RV1206 chip resistor, value 1 MΩ with ±5% tolerance, supplied in 7-inch tape reel is: RV1206JR-071ML.

NOTE

1. All our R-Chip products meet RoHS compliant. "LFP" of the internal 2D reel label mentions "Lead Free Process"
2. On customized label, "LFP" or specific symbol printed and the optional "L" at the end of GLOBAL PART NUMBER / I2NC can be added (both are on customer request)

PHYCOMP BRAND ordering codes

Both GLOBAL PART NUMBER (preferred) and I2NC (traditional) codes are acceptable to order Phycomp brand products.

GLOBAL PART NUMBER (PREFERRED)

For detailed information of GLOBAL PART NUMBER and ordering example, please refer to page 2.

I2NC CODE

| SIZE | TYPE | 2322 | | XXX XXXXX L | | | EMBOSSED (2) TAPE ON REEL 4,000 | PAPER/PE (2) TAPE ON REEL (units) 5,000 |
|------|---------|------|-----|-------------|-----|-------|---------------------------------------|---|
| | | (1) | (1) | (2) | (3) | (4) | | |
| 0805 | VRC11 | 2322 | ±5% | 47 | to | 10M Ω | - | 792 61xxx |
| | VRC12 | 2322 | ±1% | 47 | to | 10M Ω | - | 793 6xxxx |
| 1206 | VRC01 | 2322 | ±5% | 47 | to | 27M Ω | - | 790 61xxx |
| | VRC02 | 2322 | ±1% | 47 | to | 10M Ω | - | 791 6xxxx |
| 2512 | VPRC221 | 2322 | ±5% | 47 | to | 16M Ω | 762 98xxx | - |

| Resistance decade (3) | Last digit |
|-----------------------|------------|
| 0.01 to 0.0976 Ω | 0 |
| 0.1 to 0.976 Ω | 7 |
| 1 to 9.76 Ω | 8 |
| 10 to 97.6 Ω | 9 |
| 100 to 976 Ω | 1 |
| 1 to 9.76 KΩ | 2 |
| 10 to 97.6 KΩ | 3 |
| 100 to 976 KΩ | 4 |
| 1 to 9.76 MΩ | 5 |
| 10 to 97.6 MΩ | 6 |

- (1) The resistors have a 12-digit ordering code starting with 2322.
- (2) The subsequent 4 or 5 digits indicate the resistor tolerance and packaging.
- (3) The remaining 4 or 3 digits represent the resistance value with the last digit indicating the multiplier as shown in the table of "Last digit of I2NC".
- (4) "L" is optional symbol (Note).

ORDERING EXAMPLE

The ordering code of a VRC01 resistor, value 1 MΩ with ±5% tolerance, supplied in tape of 5,000 units per reel is: 232279061105L or RV1206JR-071ML.

Example:

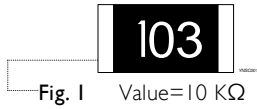
| | | |
|--------|---|-------------|
| 0.02 Ω | = | 0200 or 200 |
| 0.3 Ω | = | 3007 or 307 |
| 1 Ω | = | 1008 or 108 |
| 33 KΩ | = | 3303 or 333 |
| 10 MΩ | = | 1006 or 106 |

NOTE

- 1. All our R-Chip products are RoHS compliant. "LFP" of the internal 2D reel label mentions "Lead Free Process"
- 2. On customized label, "LFP" or specific symbol printed and the optional "L" at the end of GLOBAL PART NUMBER / I2NC can be added (both are on customer request)

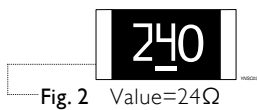
MARKING

RV0603/0805/1206/2010/2512

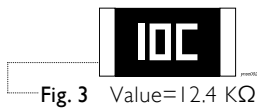


E-24 series: 3 digits, $\pm 5\%$
First two digits for significant figure and 3rd digit for number of zeros

RV0603

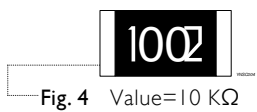


E-24 series: 3 digits, $\pm 0.5\%$ & $\pm 1\%$
Exception values 10/11/13/15/20/75 of E24 series
One short bar under marking letter



E-96 series: 3 digits, $\pm 0.5\%$ & $\pm 1\%$
Including values 10/11/13/15/20/75 of E24 series
First two digits for E-96 marking rule and 3rd letter for number of zeros

RV0805/1206/2010/2512



Both E-24 and E-96 series: 4 digits, $\pm 0.5\%$ & $\pm 1\%$
First three digits for significant figure and 4th digit for number of zeros

For further marking information, please refer to data sheet “Chip resistors marking”.

CONSTRUCTION

The resistor is constructed on top of a high-grade ceramic body. Internal metal electrodes are added on each end to make the contacts to the thick film resistive element. The composition of the resistive element is a noble metal imbedded into a glass and covered by a second glass to prevent environment influences. The resistor is laser trimmed to the rated resistance value. The resistor is covered with a protective epoxy coat, finally the two external terminations (matte tin on Ni-barrier) are added. See fig.5

DIMENSIONS

Table I For outlines see fig. 5

| TYPE | L (mm) | W (mm) | H (mm) | l ₁ (mm) | l ₂ (mm) |
|--------|------------|------------|------------|---------------------|---------------------|
| RV0603 | 1.60 ±0.10 | 0.80 ±0.10 | 0.45 ±0.10 | 0.25 ±0.15 | 0.25 ±0.15 |
| RV0805 | 2.00 ±0.10 | 1.25 ±0.10 | 0.50 ±0.10 | 0.35 ±0.20 | 0.35 ±0.20 |
| RV1206 | 3.10 ±0.10 | 1.60 ±0.10 | 0.55 ±0.10 | 0.45 ±0.20 | 0.40 ±0.20 |
| RV2010 | 5.00 ±0.10 | 2.50 ±0.15 | 0.55 ±0.10 | 0.55 ±0.15 | 0.50 ±0.20 |
| RV2512 | 6.35 ±0.10 | 3.10 ±0.15 | 0.55 ±0.10 | 0.60 ±0.20 | 0.50 ±0.20 |

OUTLINES

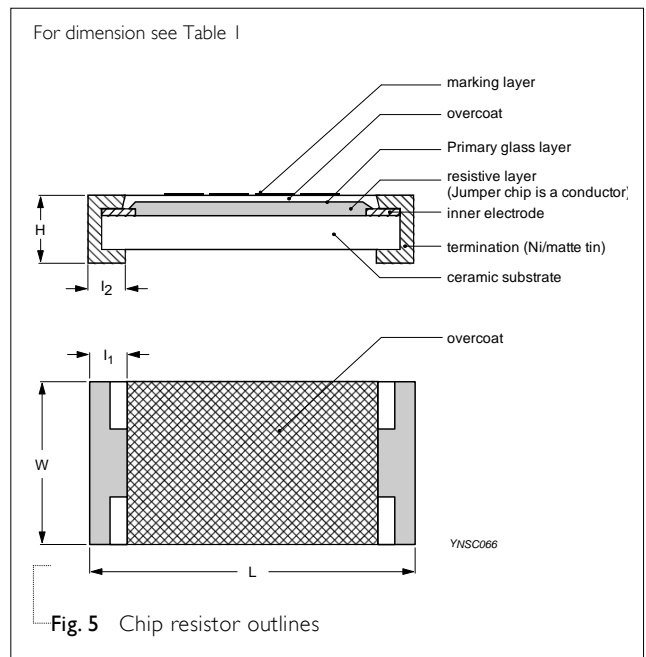


Fig. 5 Chip resistor outlines

ELECTRICAL CHARACTERISTICS

Table 2

| TYPE | RESISTANCE RANGE | CHARACTERISTICS | | | | | |
|--------|------------------------------|-----------------|-----------------------------|----------------------|-----------------------|---------------------------------|---------------------------------------|
| | | Rated Power | Operating Temperature Range | Max. Working Voltage | Max. Overload Voltage | Dielectric Withstanding Voltage | Temperature Coefficient of Resistance |
| RV0603 | 5% (E-24) 47Ω to 10MΩ | 1/10W | | 350V | 500V | 500V | |
| | 1% (E-24/E-96) 47Ω to 10MΩ | | | | | | |
| | 0.5% (E-24/E-96) 47Ω to 10MΩ | | | | | | |
| RV0805 | 5% (E-24) 47Ω to 22MΩ | 1/8 W | | 400 V | 800 V | 800 V | |
| | 1% (E-24/E-96) 47Ω to 22MΩ | | | | | | |
| | 0.5% (E-24/E-96) 47Ω to 10MΩ | | | | | | |
| RV1206 | 5% (E-24) 47Ω to 27MΩ | 1/4 W | -55 °C to +155 °C | 500 V | 1,000 V | 1,000 V | ±200 ppm/°C |
| | 1% (E-24/E-96) 47Ω to 27MΩ | | | | | | |
| | 0.5% (E-24/E-96) 47Ω to 15MΩ | | | | | | |
| RV2010 | 5% (E-24) 47Ω to 22MΩ | 3/4W | | 500 V | 1,000 V | 1,000 V | |
| | 1% (E-24/E-96) 47Ω to 22MΩ | | | | | | |
| | 0.5% (E-24/E-96) 47Ω to 10MΩ | | | | | | |
| RV2512 | 5% (E-24) 47Ω to 16MΩ | 1 W | | 500 V | 1,000 V | 1,000 V | |
| | 1% (E-24/E-96) 47Ω to 16MΩ | | | | | | |
| | 0.5% (E-24/E-96) 47Ω to 10MΩ | | | | | | |

FOOTPRINT AND SOLDERING PROFILES

For recommended footprint and soldering profiles, please refer to data sheet “Chip resistors mounting”.

PACKING STYLE AND PACKAGING QUANTITY

Table 3 Packing style and packaging quantity

| PACKING STYLE | REEL DIMENSION | RV0603 | RV0805 | RV1206 | RV2010 | RV2512 |
|--------------------------|----------------|--------|--------|--------|--------|--------|
| Paper/PE taping reel (R) | 7" (178 mm) | 5,000 | 5,000 | 5,000 | --- | --- |
| Embossed taping reel (K) | 7" (178 mm) | --- | --- | --- | 4,000 | 4,000 |

NOTE

I. For Paper/PE/Embossed tape and reel specification/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:

RV0603=1/10W; RV0805=1/8W; RV1206=1/4W;

RV2010=3/4W; RV2512=1W

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 max. working voltage whichever is less

Where

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

P = Rated power (W)

R = Resistance value (Ω)

Maximum working voltage can be applicable to resistors only if the resistance value is equal to or higher than the critical resistance value.

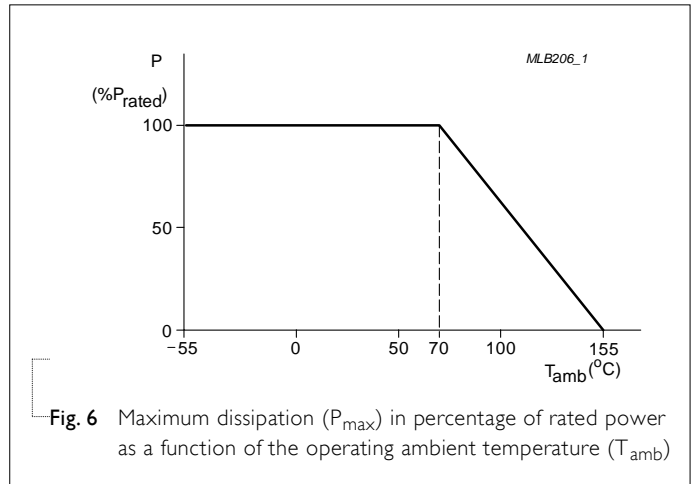


Fig. 6 Maximum dissipation (P_{max}) in percentage of rated power as a function of the operating ambient temperature (T_{amb})

TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements (AEC-Q200 report available for $47\text{ohm} \leq R < 5\text{Mohm}$)

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---|--------------------------|---|--|
| Life/ Operational Life/ Endurance | MIL-STD-202G-method 108A | 1,000 hours at 70 ± 5 °C applied RCWV | $\pm(2\%+0.05 \Omega)$ |
| | IEC 60115-1 4.25.1 | 1.5 hours on, 0.5 hour off, still air required | |
| | JIS C 5202-7.10 | | |
| High Temperature Exposure/ Endurance at upper category temperature | MIL-STD-202G-method 108A | 1,000 hours at maximum operating temperature | $\pm(1\%+0.05 \Omega)$ |
| | IEC 60115-1 4.25.3 | depending on specification, unpowered | |
| | JIS C 5202-7.11 | No direct impingement of forced air to the parts Tolerances: 155 ± 3 °C | |
| Moisture Resistance | MIL-STD-202G-method 106F | 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 Measurement at 24 ± 2 hours after test conclusion | $\pm(2\%+0.05 \Omega)$ |
| | IEC 60115-1 4.24.2 | | |
| Thermal Shock | MIL-STD-202G-method 107G | $-55/+125$ °C | $\pm(0.5\%+0.05 \Omega)$ for 10 K Ω to 10 M Ω $\pm(1\%+0.05 \Omega)$ for others |
| | | Note: Number of cycles required is 300. Maximum transfer time is 20 seconds. Dwell time is 15 minutes. Air – Air | |
| Short time overload | MIL-R-55342D-para 4.7.5 | 2.5 times RCWV or maximum overload voltage whichever is less for 5 sec at room temperature | $\pm(2\%+0.05 \Omega)$ No visible damage |
| | IEC60115-1 4.13 | | |
| Board Flex/ Bending | IEC60115-1 4.33 | Device mounted on PCB test board as described, only 1 board bending required | $\pm(1\%+0.05 \Omega)$ No visible damage |
| | | Bending for 0603 & 0805: 3mm 1206 & above: 2mm Holding time: minimum 60 seconds Ohmic value checked during bending | |
| Humidity | IEC 60115-1 4.24.8 | Steady state for 1,000 hours at 40 °C / 95% R.H. RCWV applied for 1.5 hours on and 0.5 hour off | $\pm(3.0\%+0.05 \Omega)$ |
| | AEC-Q200 Test 7 | for $47\text{ohm} \leq R < 5\text{Mohm}$, 1,000 hours; 85 °C / 85% RH 10% of operating power Measurement at 24 ± 4 hours after test conclusion | $\pm(5.0\%+0.05 \Omega)$ |
| | MIL-STD-202 Method 103 | | |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|-----------------------------------|--|--|---|
| Solderability - Wetting | IPC/JEDECJ-STD-002B test B IEC 60068-2-58 | Electrical Test not required Magnification 50X SMD conditions: 1 st step: method B, aging 4 hours at 155 °C dry heat 2 nd step: leadfree solder bath at 245±3 °C Dipping time: 3±0.5 seconds | Well tinned (≥95% covered) No visible damage |
| - Leaching | IPC/JEDECJ-STD-002B test D IEC 60068-2-58 | Leadfree solder, 260 °C, 30 seconds immersion time | No visible damage |
| - Resistance to Soldering Heat | MIL-STD-202G-method 210F IEC 60068-2-58 | Condition B, no pre-heat of samples Leadfree solder, 260 °C, 10 seconds immersion time Procedure 2 for SMD: devices fluxed and cleaned with isopropanol | ±(1%+0.05 Ω) No visible damage |

REVISION HISTORY

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
|-----------|---------------|---------------------|---|
| Version 8 | Nov .09, 2018 | - | - Add AEC-Q200 for 47ohm ≤ R < 5Mohm |
| Version 7 | Jul. 06, 2017 | - | - Add IEC62368-1 safety certificate declaration for sizes 0603/0805/1206 |
| Version 6 | Dec. 01, 2016 | - | - Extend resistor value of RV1206 0.5% |
| Version 5 | Aug. 27, 2015 | - | - Extend resistor range and add 0.5% |
| Version 4 | Jan. 27, 2014 | - | - RV0603 resistance range extend to 10MΩ - Add RV2010 |
| Version 3 | Aug. 26, 2013 | - | - Add RV0603 |
| Version 2 | Sep 29, 2011 | - | - Type error correction |
| Version 1 | Nov 19, 2008 | - | - Change to dual brand datasheet that describes RV0805/1206/2512 with RoHS compliant - Description of "Halogen Free Epoxy" added - Define global part number |
| Version 0 | Feb 14, 2006 | - | - New datasheet for high voltage chip resistors sizes of 0805/1206/2512, 5%, 1% tolerance with lead-free terminations - Replace the 0805/1206/2512 parts of pdf files: VRC01_02_11_12_51_3.pdf, VPRC221_5_3.pdf, and combine into a document. - Test method and procedure updated - PE tape added (paper tape will be replaced by PE tape) |

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