

# DATA SHEET

LOW OHMIC CHIP RESISTORS

RL series

5%, 2%, 1%

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

RoHS compliant & Halogen Free



**SCOPE**

This specification describes RL0402 to RL2512 low ohmic chip resistors with lead-free terminations made by thick film process.

**APPLICATIONS**

- Converters
- Printer equipment
- Server board
- Telecom
- Consumer

**FEATURES**

- 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
- Reducing environmentally hazardous wastes
- High component and equipment reliability
- Saving of PCB space
- None forbidden-materials used in products/production
- Low resistances applied to current sensing

**ORDERING INFORMATION - GLOBAL PART NUMBER & 12NC**

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)**

RL 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 =  $\pm 1\%$

G =  $\pm 2\%$

J =  $\pm 5\%$

**(3) PACKAGING TYPE**

R = Paper taping reel

K = Embossed taping reel

**(4) TEMPERATURE COEFFICIENT OF RESISTANCE**

– = Based on spec

**(5) TAPING REEL**

07 = 7 inch dia. Reel

10 = 10 inch dia. Reel

13 = 13 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 coding rules of resistance are shown in the table of "Resistance rule of global part number".

**(7) DEFAULT CODE**

Letter L is system default code for order only (Note)

Letter H is Halogen / Lead free (special code on request)

Resistance rule of global part number

| Resistance code rule   | Example                |
|------------------------|------------------------|
| 0RXXX                  | 0R1 = 0.1 $\Omega$     |
| (1 to 976 m $\Omega$ ) | 0R12 = 0.12 $\Omega$   |
|                        | 0R105 = 0.105 $\Omega$ |

**ORDERING EXAMPLE**

The ordering code of a RL0603 chip resistor, value 0.56  $\Omega$  with  $\pm 1\%$  tolerance, supplied in 7-inch tape reel is: RL0603FR-070R56L.

**NOTE**

1. All our RSMD products meet RoHS compliant and Halogen Free. "LFP" of the internal 2D reel label mentions "Lead Free Process"
2. On customized label, "LFP" or specific symbol can be printed

**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****2350 / 2390 / 2322 XXX XXXXX L**

(1) (2) (3) (4)

| SIZE | TYPE    | START IN <sup>(1)</sup> | TOL. (%) | RESISTANCE RANGE | EMBOSSED <sup>(2)</sup><br>TAPE ON REEL |           | PAPER/PE <sup>(2)</sup><br>TAPE ON REEL (units) |  |
|------|---------|-------------------------|----------|------------------|-----------------------------------------|-----------|-------------------------------------------------|--|
|      |         |                         |          |                  | 4,000                                   | 5,000     | 10,000                                          |  |
| 0402 | LRC31   | 2350                    | ±5%      | 0.05 to 1 Ω      | -                                       | -         | 513 20xxx                                       |  |
|      | LRC32   | 2350                    | ±1%      | 0.05 to 1 Ω      | -                                       | -         | 513 22xxx                                       |  |
| 0603 | LRC21   | 2350                    | ±5%      | 0.01 to 1 Ω      | -                                       | 512 10xxx | -                                               |  |
|      | LRC22   | 2350                    | ±1%      | 0.01 to 1 Ω      | -                                       | 512 12xxx | -                                               |  |
| 0805 | LRC11   | 2350                    | ±5%      | 0.01 to 1 Ω      | -                                       | 511 10xxx | -                                               |  |
|      | LRC12   | 2350                    | ±1%      | 0.01 to 1 Ω      | -                                       | 511 12xxx | -                                               |  |
| 1206 | LRC01   | 2350                    | ±5%      | 0.01 to 1 Ω      | -                                       | 510 10xxx | -                                               |  |
|      | LRC02   | 2350                    | ±1%      | 0.01 to 1 Ω      | -                                       | 510 12xxx | -                                               |  |
| 1210 | LPRC101 | 2390                    | ±5%      | 0.01 to 0.0976 Ω | -                                       | 735 90xxx | -                                               |  |
|      | LPRC101 | 2390                    | ±5%      | 0.1 to 1 Ω       | -                                       | 735 60xxx | -                                               |  |
|      | LPRC102 | 2390                    | ±1%      | 0.01 to 1 Ω      | -                                       | 735 3xxxx | -                                               |  |
| 1218 | LPRC201 | 2322                    | ±5%      | 0.01 to 1 Ω      | 735 64xxx                               | -         | -                                               |  |
|      | LPRC201 | 2322                    | ±1%      | 0.01 to 1 Ω      | 735 7xxxx                               | -         | -                                               |  |
| 2010 | LPRC111 | 2322                    | ±5%      | 0.01 to 0.0976 Ω | 760 90xxx                               | -         | -                                               |  |
|      | LPRC111 | 2322                    | ±5%      | 0.1 to 1 Ω       | 760 60xxx                               | -         | -                                               |  |
|      | LPRC111 | 2322                    | ±1%      | 0.01 to 0.0976 Ω | 761 90xxx                               | -         | -                                               |  |
|      | LPRC111 | 2322                    | ±1%      | 0.1 to 1 Ω       | 761 6xxxx                               | -         | -                                               |  |
| 2512 | LPRC221 | 2322                    | ±5%      | 0.01 to 0.0976 Ω | 762 90xxx                               | -         | -                                               |  |
|      | LPRC221 | 2322                    | ±5%      | 0.1 to 1 Ω       | 762 60xxx                               | -         | -                                               |  |
|      | LPRC221 | 2322                    | ±1%      | 0.01 to 0.0976 Ω | 763 90xxx                               | -         | -                                               |  |
|      | LPRC221 | 2322                    | ±1%      | 0.1 to 1 Ω       | 763 6xxxx                               | -         | -                                               |  |

Last digit of I2NC

| Resistance decade <sup>(3)</sup> | 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          |

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

**ORDERING EXAMPLE**

The ordering code of a RL0603 chip resistor, value 0.56 Ω with ±1% tolerance, supplied in tape of 5,000 units per reel is: 235051212567L or RL0603FR-070R56L.

**NOTE**

- All our RSMD products meet RoHS compliant and Halogen Free. "LFP" of the internal 2D reel label mentions "Lead Free Process"
- On customized label, "LFP" or specific symbol can be printed

- The resistors have a 12-digit ordering code starting with 2350/2390/2322.
- The subsequent 4 or 5 digits indicate the resistor tolerance and packaging. (In I2NC code, only 07" tape reel code is supplied. Supply of 10"/13" tape reel is requested in Global part number ordering code.)
- 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".
- Letter L is system default code for order only <sup>(Note)</sup>.  
Letter H is Halogen / Lead free (special code on request).

## MARKING

RL0805 / RL1206 / RL1210 / RL1218 / RL2010 / RL2512



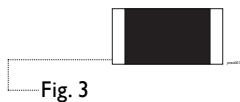
E-24 series / Non-E series (R= 25/40/50/60/250/400/500 mΩ): 4 digits  
The “R” is used as a decimal point; the other 3 digits are significant.

RL0603: R≥100 mΩ, R = 10/20/30/40/50/60 mΩ



E-24 series / Non-E series (R= 25/40/50/60/250/400/500 mΩ):3 digits  
The “R” is used as a decimal point; the other 2 digits are significant.

RL0402 / RL0603: R&lt;100 mΩ EXCEPT 10/20/30/40/50/60 mΩ



No marking

For further marking information, please see special data sheet “Chip resistors marking”.

## CONSTRUCTION

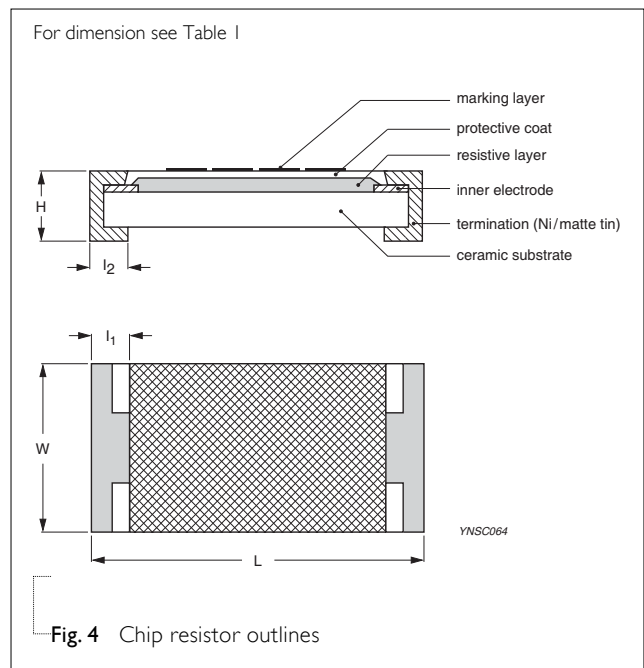
The resistors are constructed out of a high-grade ceramic body. Internal metal electrodes are added at each end and connected by a resistive paste. The composition of the paste is adjusted to give the approximate required resistance and laser cutting of this resistive layer that achieves tolerance trims the value. The resistive layer is covered with a protective coat and printed with the resistance value. Finally, the two external terminations (matte tin) are added. See fig. 4.

## DIMENSIONS

Table I For outlines see fig. 4

| TYPE   | L (mm)     | W (mm)     | H (mm)     | I <sub>1</sub> (mm) | I <sub>2</sub> (mm) |
|--------|------------|------------|------------|---------------------|---------------------|
| RL0402 | 1.00 ±0.10 | 0.50 ±0.05 | 0.35 ±0.05 | 0.20 ±0.10          | 0.25 ±0.10          |
| RL0603 | 1.60 ±0.10 | 0.80 ±0.10 | 0.45 ±0.10 | 0.25 ±0.15          | 0.25 ±0.15          |
| RL0805 | 2.00 ±0.10 | 1.25 ±0.10 | 0.50 ±0.10 | 0.35 ±0.20          | 0.35 ±0.20          |
| RL1206 | 3.10 ±0.10 | 1.60 ±0.10 | 0.55 ±0.10 | 0.45 ±0.20          | 0.40 ±0.20          |
| RL1210 | 3.10 ±0.10 | 2.60 ±0.15 | 0.55 ±0.10 | 0.50 ±0.20          | 0.50 ±0.20          |
| RL1218 | 3.05 ±0.15 | 4.60 ±0.20 | 0.55 ±0.10 | 0.45 ±0.25          | 0.50 ±0.25          |
| RL2010 | 5.00 ±0.10 | 2.50 ±0.15 | 0.55 ±0.10 | 0.60 ±0.20          | 0.50 ±0.20          |
| RL2512 | 6.35 ±0.10 | 3.20 ±0.15 | 0.55 ±0.10 | 0.60 ±0.20          | 0.50 ±0.20          |

## OUTLINES



**ELECTRICAL CHARACTERISTICS**

Table 2

| TYPE / RESISTANCE RANGE |           | TEMPERATURE COEFFICIENT OF RESISTANCE |  |               |  |               |  |
|-------------------------|-----------|---------------------------------------|--|---------------|--|---------------|--|
| RL0402                  | 50mΩ≤R<1Ω | 50mΩ≤R<100mΩ                          |  | 100mΩ≤R<500mΩ |  | 500mΩ≤R<1Ω    |  |
|                         |           | ±1000 ppm/°C                          |  | ±800 ppm/°C   |  | ±300 ppm/°C   |  |
| RL0603                  | 10mΩ≤R<1Ω | 10mΩ≤R≤36mΩ                           |  | 36mΩ<R≤91mΩ   |  | 91mΩ<R≤500mΩ  |  |
|                         |           | ±1,500 ppm/°C                         |  | ±1,200 ppm/°C |  | ±800 ppm/°C   |  |
| RL0805                  | 10mΩ≤R<1Ω | 10mΩ≤R≤18mΩ                           |  | 18mΩ<R≤47mΩ   |  | 47mΩ<R≤91mΩ   |  |
|                         |           | ±1,500 ppm/°C                         |  | ±1,200 ppm/°C |  | ±1,000 ppm/°C |  |
| RL1206                  | 10mΩ≤R<1Ω | 10mΩ≤R≤18mΩ                           |  | 18mΩ<R≤47mΩ   |  | 47mΩ<R≤91mΩ   |  |
|                         |           | ±1,500 ppm/°C                         |  | ±1,200 ppm/°C |  | ±1,000 ppm/°C |  |
| RL1210                  | 10mΩ≤R<1Ω | 10mΩ≤R≤18mΩ                           |  | 18mΩ<R≤47mΩ   |  | 47mΩ<R≤91mΩ   |  |
|                         |           | ±1,500 ppm/°C                         |  | ±1,200 ppm/°C |  | ±1,000 ppm/°C |  |
| RL2010                  | 10mΩ≤R<1Ω | 10mΩ≤R≤18mΩ                           |  | 18mΩ<R≤47mΩ   |  | 47mΩ<R≤91mΩ   |  |
|                         |           | ±1,500 ppm/°C                         |  | ±1,200 ppm/°C |  | ±1,000 ppm/°C |  |
| RL2512                  | 10mΩ≤R<1Ω | 10mΩ≤R≤18mΩ                           |  | 18mΩ<R≤47mΩ   |  | 47mΩ<R≤91mΩ   |  |
|                         |           | ±1,500 ppm/°C                         |  | ±1,200 ppm/°C |  | ±1,000 ppm/°C |  |
| RL1218                  | 10mΩ≤R<1Ω | 10mΩ≤R≤30mΩ                           |  | 30mΩ<R≤56mΩ   |  | 56mΩ<R≤180mΩ  |  |
|                         |           | ±2,000 ppm/°C                         |  | ±1,000 ppm/°C |  | ±700 ppm/°C   |  |

**FOOTPRINT AND SOLDERING PROFILES**

For recommended footprint and soldering profiles, please see the special data sheet “Chip resistors mounting”.

**PACKING STYLE AND PACKAGING QUANTITY**

Table 3 Packing style and packaging quantity

| PACKING STYLE            | REEL DIMENSION | RL0402 | RL0603 | RL0805 | RL1206 | RL1210 | RL1218 | RL2010 | RL2512 |
|--------------------------|----------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Paper taping reel (R)    | 7" (178 mm)    | 10,000 | 5,000  | 5,000  | 5,000  | 5,000  | ---    | ---    | ---    |
|                          | 10" (254 mm)   | 20,000 | 10,000 | 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**

1. For paper/embossed tape and reel specification/dimensions, please see the special data sheet “Chip resistors packing”.

## FUNCTIONAL DESCRIPTION

### OPERATING TEMPERATURE RANGE

Range: -55 °C to +125 °C

### POWER RATING

Each type rated power at 70 °C:

RL0402=1/16 W; RL0603=1/10 W; RL0805=1/8 W;

RL1206=1/4 W; RL1210=1/2 W; RL1218=1 W;

RL2010=3/4 W; RL2512=1 W.

### RATED VOLTAGE

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

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

Where

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

P = Rated power (W)

R = Resistance value ( $\Omega$ )

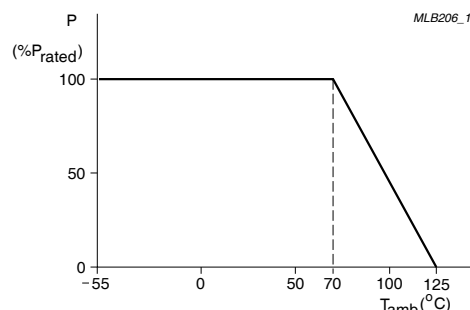


Fig. 5 Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the operating ambient temperature ( $T_{amb}$ )

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

| TEST                                                                        | TEST METHOD            | PROCEDURE                                                                                                                                                                                                                        | REQUIREMENTS             |
|-----------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Life/<br>Endurance                                                          | IEC 60115-1 4.25.1     | 1,000 hours at 70±2°C applied RCWV<br>1.5 hours on, 0.5 hour off, still air required                                                                                                                                             | ±2%                      |
| High Temperature<br>Exposure/<br>Endurance at upper<br>category temperature | IEC 60068-2-2          | 1,000 hours at maximum operating<br>temperature depending on specification,<br>unpowered<br><br>No direct impingement of forced air to the<br>parts<br><br>Tolerances: 125±5 °C                                                  | ±1%                      |
| Moisture Resistance                                                         | MIL-STD-202 Method 106 | Each temperature / humidity cycle is defined at<br>8 hours, 3 cycles / 24 hours for 10d with 25 °C<br>/ 65 °C 95% R.H, without steps 7a & 7b,<br>unpowered<br><br>Parts mounted on test-boards, without<br>condensation on parts | ±2%                      |
| Thermal Shock                                                               | MIL-STD-202 Method 107 | -55/+125 °C<br><br>Number of cycles required is 300.<br><br>Maximum transfer time is 20 seconds. Dwell<br>time is 15 minutes.                                                                                                    | ±1%                      |
| Short time overload                                                         | IEC60115-1 4.13        | 2.5 times RCWV or maximum overload<br>voltage whichever is less for 5 sec at room<br>temperature                                                                                                                                 | ±2%<br>No visible damage |
| Board Flex/<br>Bending                                                      | IEC 60068-2-21         | Device mounted on PCB test board as<br>described, only 1 board bending required<br><br>3 mm bending<br><br>Bending time: 60±5 seconds<br><br>Ohmic value checked during bending                                                  | ±1%<br>No visible damage |

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

**REVISION HISTORY**

| REVISION  | DATE          | CHANGE NOTIFICATION | DESCRIPTION                                                                                                             |
|-----------|---------------|---------------------|-------------------------------------------------------------------------------------------------------------------------|
| Version 6 | Apr 26, 2012  | -                   | - RL 0402 range extension                                                                                               |
| Version 5 | Mar 22, 2010  | -                   | - The statement of "Halogen Free" on the cover added<br>- Test methods updated                                          |
| Version 4 | Dec 11, 2008  | -                   | - Halogen Free Epoxy<br>- Update global part number definition                                                          |
| Version 3 | Aug 07, 2008  | -                   | - Change to dual brand datasheet that describe RL0402 to RL2512 with RoHS compliant<br>- Define global part number      |
| Version 2 | Jul 15, 2005  | -                   | - Ordering example revised                                                                                              |
| Version 1 | Apr 15, 2005  | -                   | - Size 1218 extended<br>- Test method and procedure updated<br>- PE tape added (paper tape will be replaced by PE tape) |
| Version 0 | Nov. 10, 2003 | -                   | - First issue of this specification                                                                                     |

*“Yageo reserves all the rights for revising the content of this datasheet without further notification, as long as the products itself are unchanged. Any product change will be announced by PCN.”*



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Наши преимущества:

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- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
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- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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