

# DATA SHEET

GENERAL PURPOSE CHIP RESISTORS

RC0402

5%, 1%

RoHS compliant & Halogen Free



**SCOPE**

This specification describes RC0402 series chip resistors with lead-free terminations made by thick film process.

**APPLICATIONS**

- All general purpose application

**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

**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)**

**RC0402** **X R - XX XXXX L**  
 (1) (2) (3) (4) (5) (6)

**(1) TOLERANCE**

F =  $\pm 1\%$

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

**(2) PACKAGING TYPE**

R = Paper / PE taping reel

**(3) TEMPERATURE COEFFICIENT OF RESISTANCE**

– = Base on spec

**(4) TAPING REEL**

07 = 7 inch dia. Reel

7D = 7 inch dia. Reel, 2 x Standard Quantity

10 = 10 inch dia. Reel

13 = 13 inch dia. Reel

**(5) RESISTANCE VALUE**

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 resistance rules show in table of "Resistance rule of global part number".

**(6) DEFAULT CODE**

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

| Resistance rule of global part number |                                            |
|---------------------------------------|--------------------------------------------|
| Resistance code rule                  | Example                                    |
| DI                                    | DI = Dummy                                 |
| 0R                                    | 0R = Jumper                                |
| XRX                                   | 1R = 1 $\Omega$                            |
| (1 to 9.76 $\Omega$ )                 | 1R5 = 1.5 $\Omega$<br>9R76 = 9.76 $\Omega$ |
| XXRX                                  | 10R = 10 $\Omega$                          |
| (10 to 97.6 $\Omega$ )                | 97R6 = 97.6 $\Omega$                       |
| XXXR                                  | 100R = 100 $\Omega$                        |
| (100 to 976 $\Omega$ )                |                                            |
| XKXX                                  | 1K = 1,000 $\Omega$                        |
| (1 to 9.76 K $\Omega$ )               | 9K76 = 9760 $\Omega$                       |
| XMXX                                  | 1M = 1,000,000 $\Omega$                    |
| (1 to 9.76 M $\Omega$ )               | 9M76 = 9,760,000 $\Omega$                  |

**ORDERING EXAMPLE**

The ordering code of a RC0402 chip resistor, value 56  $\Omega$  with  $\pm 1\%$  tolerance, supplied in 7-inch tape of 20,000 units per reel is: RC0402FR-7D56RL.

**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**

| 2322   |                   | XXX XXXXX L |            |                                                |
|--------|-------------------|-------------|------------|------------------------------------------------|
| (1)    |                   | (2)         | (3)        | (4)                                            |
| TYPE/  | START             | TOL.        | RESISTANCE | PAPER / PE TAPE ON REEL (units) <sup>(2)</sup> |
| 0402   | IN <sup>(1)</sup> | (%)         | RANGE      | 10,000      20,000/not preferred      50,000   |
| RC31   | 2322              | ±5%         | 1 to 22 MΩ | 705 70xxx      ---      705 87xxx              |
| RC32   | 2322              | ±1%         | 1 to 10 MΩ | 706 7xxxx      ---      706 8xxxx              |
| Jumper | 2322              | -           | 0 Ω        | 705 91001      ---      705 91007              |

- (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) Letter L is system default code for order only <sup>(Note)</sup>

**ORDERING EXAMPLE**

The ordering code of a RC32 resistor, value 56 Ω with ±1% tolerance, supplied in tape of 10,000 units per reel is: 232270675609L or RC0402FR-0756RL.

**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

| 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 |

## MARKING

RC0402



Fig. 1

No marking

For further marking information, please see special 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.2

## DIMENSIONS

Table I

| TYPE                | RC0402     |
|---------------------|------------|
| L (mm)              | 1.00 ±0.05 |
| W (mm)              | 0.50 ±0.05 |
| H (mm)              | 0.35 ±0.05 |
| l <sub>1</sub> (mm) | 0.20 ±0.10 |
| l <sub>2</sub> (mm) | 0.25 ±0.10 |

## OUTLINES

For dimension see Table I

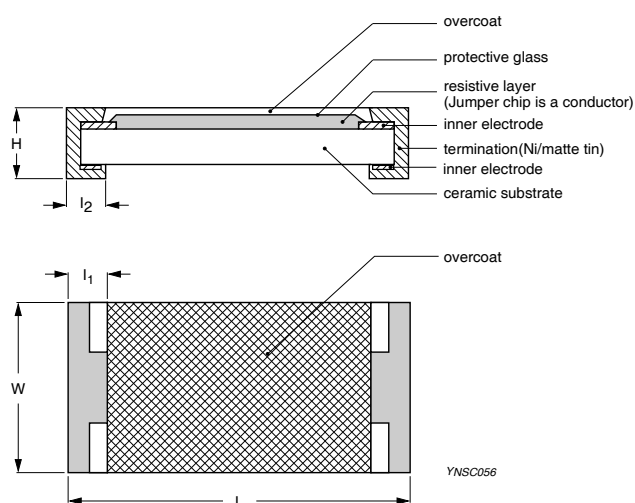


Fig. 2 Chip resistor outlines

**ELECTRICAL CHARACTERISTICS**

Table 2

| CHARACTERISTICS                 | RC0402 1/16 W                 |
|---------------------------------|-------------------------------|
| Operating Temperature Range     | -55 °C to +155 °C             |
| Maximum Working Voltage         | 50 V                          |
| Maximum Overload Voltage        | 100 V                         |
| Dielectric Withstanding Voltage | 100 V                         |
| Resistance Range                | 5% (E24) 1 Ω to 22 MΩ         |
|                                 | 1% (E24/E96) 1 Ω to 10 MΩ     |
|                                 | Zero Ohm Jumper < 0.05 Ω      |
| Temperature Coefficient         | 1 Ω ≤ R ≤ 10 Ω ±200 ppm/°C    |
|                                 | 10 Ω < R ≤ 10 MΩ ±100 ppm/°C  |
|                                 | 10 MΩ < R ≤ 22 MΩ ±200 ppm/°C |
| Jumper Criteria                 | Rated Current 1.0 A           |
|                                 | Maximum Current 2.0 A         |

**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

| PRODUCT TYPE | PACKING STYLE              | REEL DIMENSION | QUANTITY PER REEL   |
|--------------|----------------------------|----------------|---------------------|
| RC0402       | Paper / PE Taping Reel (R) | 7" (178 mm)    | 10,000/20,000 units |
|              |                            | 10" (254 mm)   | 20,000 units        |
|              |                            | 13" (330 mm)   | 50,000 units        |

**NOTE**

- For paper/PE tape and reel specification/dimensions, please see the special data sheet “Chip resistors packing”
- For size of 0402, standard quantity is 10,000 units per reel

**FUNCTIONAL DESCRIPTION****POWER RATING**

RC0402 rated power at 70°C is 1/16 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 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)

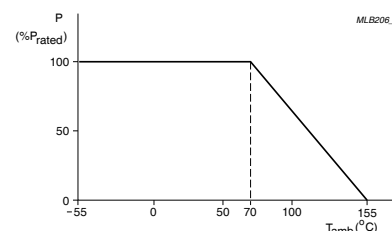


Fig. 3 Maximum dissipation (P) in percentage of rated power as a function of the operating ambient temperature ( $T_{amb}$ )

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

| TEST                                                              | TEST METHOD              | PROCEDURE                                                                                                                                                                                                                                                                                                                                                                           | REQUIREMENTS                                                                                       |
|-------------------------------------------------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Temperature Coefficient of Resistance (T.C.R.)                    | IEC 60115-1 4.8          | At +25/-55 °C and +25/+125 °C<br><br><b>Formula:</b><br>$T.C.R = \frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}$<br><br>Where<br>t <sub>1</sub> =+25 °C or specified room temperature<br>t <sub>2</sub> =-55 °C or +125 °C test temperature<br>R <sub>1</sub> =resistance at reference temperature in ohms<br>R <sub>2</sub> =resistance at test temperature in ohms | Refer to table 2                                                                                   |
| Life/Endurance                                                    | IEC 60115-1 4.25.1       | At 70±5 °C for 1,000 hours, RCWV applied for 1.5 hours on, 0.5 hour off, still air required                                                                                                                                                                                                                                                                                         | ±(1.0%+0.05 Ω) for 1% tol.<br>±(3.0%+0.05 Ω) for 5% tol.<br><100 mΩ for Jumper                     |
| High Temperature Exposure/Endurance at Upper Category Temperature | IEC 60068-2-2            | 1,000 hours at 155±5 °C, unpowered                                                                                                                                                                                                                                                                                                                                                  | ±(1.0%+0.05 Ω) for 1% tol.<br>±(2.0%+0.05 Ω) for 5% tol.<br><50 mΩ for Jumper                      |
| Moisture Resistance                                               | MIL-STD-202G Method-106G | 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<br><br>Parts mounted on test-boards, without condensation on parts<br><br>Measurement at 24±2 hours after test conclusion                                                                                                        | ±(0.5%+0.05 Ω) for 1% tol.<br>±(2.0%+0.05 Ω) for 5% tol.<br><100 mΩ for Jumper                     |
| Thermal Shock                                                     | MIL-STD-202G Method-107G | -55/+125 °C<br><br>Number of cycles required is 300. Devices unmounted<br><br>Maximum transfer time is 20 seconds, Dwell time is 15 minutes. Air – Air                                                                                                                                                                                                                              | ±(0.5%+0.05 Ω) for 1% tol.<br>±(1%+0.05 Ω) for 5% tol.<br><50 mΩ for Jumper                        |
| Short Time Overload                                               | 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) for 1% tol.<br>±(2.0%+0.05 Ω) for 5% tol.<br><50 mΩ for Jumper<br>No visible damage |

| TEST                               | TEST METHOD          | PROCEDURE                                                                                                                                                                                                                           | REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                              |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
|------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|----------------------|---------------------------|------------------|-------|------------------|-------|--------------------|-------|-------------------|-------|------------------|-------|
| Board Flex/<br>Bending             | IEC 60068-2-21       | Chips mounted on a 90mm glass epoxy resin PCB (FR4)<br><br>5 mm bending<br><br>Bending time: 60±5 seconds                                                                                                                           | ±(1.0%+0.05 Ω) for 1%, 5% tol.<br><br><50 mΩ for Jumper<br><br>No visible damage                                                                                                                                                                                                                                                                                          |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| Low<br>Temperature<br>Operation    | IEC 60068-2-1        | The resistor shall be subjected to a DC rated voltage for 1.5 h-on, 0.5 h-off, at -55±3 °C<br><br>This constitutes shall be repeated for 96 hours<br><br>However the applied voltage shall not exceed the maximum operating voltage | ±(0.5%+0.05 Ω) for 1% tol.<br>±(1.0%+0.05 Ω) for 5% tol.<br><br>No visible damage                                                                                                                                                                                                                                                                                         |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| Insulation<br>Resistance           | IEC 60115-1 4.6      | Rated continuous overload voltage (RCOV) for 1 minute<br><br><table><tr><td>Type</td><td>RC0402</td></tr><tr><td>Voltage (DC)</td><td>100 V</td></tr></table>                                                                       | Type                                                                                                                                                                                                                                                                                                                                                                      | RC0402          | Voltage (DC) | 100 V                | ≥10 GΩ                    |                  |       |                  |       |                    |       |                   |       |                  |       |
| Type                               | RC0402               |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| Voltage (DC)                       | 100 V                |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| Dielectric<br>Withstand<br>Voltage | IEC 60115-1 4.7      | Maximum voltage (V <sub>rms</sub> ) applied for 1 minute<br><br><table><tr><td>Type</td><td>RC0402</td></tr><tr><td>Voltage (AC)</td><td>100 V<sub>rms</sub></td></tr></table>                                                      | Type                                                                                                                                                                                                                                                                                                                                                                      | RC0402          | Voltage (AC) | 100 V <sub>rms</sub> | No breakdown or flashover |                  |       |                  |       |                    |       |                   |       |                  |       |
| Type                               | RC0402               |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| Voltage (AC)                       | 100 V <sub>rms</sub> |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| Resistance to<br>Solvent           | IPC/JEDEC J-STD-020D | Isopropylalcohol (C <sub>3</sub> H <sub>7</sub> OH) followed by brushing                                                                                                                                                            | No smeared                                                                                                                                                                                                                                                                                                                                                                |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| Noise                              | IEC 60115-1 4.12     | Maximum voltage (V <sub>rms</sub> ) applied                                                                                                                                                                                         | <table><tr><th>Resistors range</th><th>Value</th></tr><tr><td>R &lt; 100 Ω</td><td>10 dB</td></tr><tr><td>100 Ω ≤ R &lt; 1 KΩ</td><td>20 dB</td></tr><tr><td>1 KΩ ≤ R &lt; 10 KΩ</td><td>30 dB</td></tr><tr><td>10 KΩ ≤ R &lt; 100 KΩ</td><td>40 dB</td></tr><tr><td>100 KΩ ≤ R &lt; 1 MΩ</td><td>46 dB</td></tr><tr><td>1 MΩ ≤ R ≤ 22 MΩ</td><td>48 dB</td></tr></table> | Resistors range | Value        | R < 100 Ω            | 10 dB                     | 100 Ω ≤ R < 1 KΩ | 20 dB | 1 KΩ ≤ R < 10 KΩ | 30 dB | 10 KΩ ≤ R < 100 KΩ | 40 dB | 100 KΩ ≤ R < 1 MΩ | 46 dB | 1 MΩ ≤ R ≤ 22 MΩ | 48 dB |
| Resistors range                    | Value                |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| R < 100 Ω                          | 10 dB                |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| 100 Ω ≤ R < 1 KΩ                   | 20 dB                |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| 1 KΩ ≤ R < 10 KΩ                   | 30 dB                |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| 10 KΩ ≤ R < 100 KΩ                 | 40 dB                |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| 100 KΩ ≤ R < 1 MΩ                  | 46 dB                |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| 1 MΩ ≤ R ≤ 22 MΩ                   | 48 dB                |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |
| Humidity                           | IEC 60115-1 4.21     | Steady state for 1000 hours at 40 °C / 95% R.H.<br>RCWV applied for 1.5 hours on and 0.5 hour off                                                                                                                                   | ±(1.0%+0.05 Ω) for 1% tol.<br>±(2.0%+0.05 Ω) for 5% tol.<br><100 mΩ for Jumper                                                                                                                                                                                                                                                                                            |                 |              |                      |                           |                  |       |                  |       |                    |       |                   |       |                  |       |

| TEST                           | TEST METHOD                 | PROCEDURE                                                                                                                                                                                                                                      | REQUIREMENTS                                                                                                                     |
|--------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Intermittent Overload          | IEC 60115-1 4.39            | 2.5 times of rated voltage or maximum overload voltage whichever is less for 1 second on and 25 seconds off; total 10,000 cycles                                                                                                               | $\pm(1.0\%+0.05\ \Omega)$ for 1% tol.<br>$\pm(2.0\%+0.05\ \Omega)$ for 5% tol.<br><100 m $\Omega$ for Jumper                     |
| Solderability<br>- Wetting     | IPC/JEDEC J-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 dry heat<br>2 <sup>nd</sup> step: lead-free solder bath at 245 $\pm$ 3 °C<br>Dipping time: 3 $\pm$ 0.5 seconds | Well tinned ( $\geq$ 95% covered)<br>No visible damage                                                                           |
| - Leaching                     | IPC/JEDEC J-STD-002B test D | Lead-free solder, 260 °C, 30 seconds immersion time                                                                                                                                                                                            | No visible damage                                                                                                                |
| - Resistance to Soldering Heat | IEC 60068-2-58              | Condition B, no pre-heat of samples<br>Lead-free solder, 260 °C, 10 seconds immersion time<br>Procedure 2 for SMD: devices fluxed and cleaned with isopropanol                                                                                 | $\pm(0.5\%+0.05\ \Omega)$ for 1% tol.<br>$\pm(1.0\%+0.05\ \Omega)$ for 5% tol.<br><50 m $\Omega$ for Jumper<br>No visible damage |

**REVISION HISTORY**

| REVISION  | DATE         | CHANGE NOTIFICATION | DESCRIPTION                                                                                                                                                                                                                                             |
|-----------|--------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Version 6 | Jan 05, 2011 | -                   | - Typo updated                                                                                                                                                                                                                                          |
| Version 5 | Apr 27, 2010 | -                   | - Updated test items and methods<br>- Add new taping reel code of 7 inch dia. reel with double standard quantity (20,000 units per reel)                                                                                                                |
| Version 4 | Jul 21, 2009 | -                   | - Test items and methods updated<br>- Test requirements upgraded                                                                                                                                                                                        |
| Version 3 | Jul 15, 2008 | -                   | - Change to dual brand datasheet that describe RC0402 with RoHS compliant<br>- Description of "Halogen Free Epoxy" added<br>- Define global part number                                                                                                 |
| Version 2 | Sep 03, 2004 | -                   | - New datasheet for 0402 thick film 1% and 5% with lead-free terminations<br>- Replace the 0402 part of pdf files: RC01_11_21_31_5, RC02_12_22_32_10<br>- Test method and procedure updated<br>- PE tape added (paper tape will be replaced by PE tape) |

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