



**THE DATASHEET OF
WW06XR100FTL**



APPROVAL SHEET

WW12X, WW08X, WW06X, WW04X

±1%, ±5%

Thick Film Low Ohm Chip Resistors

Size 1206, 0805, 0603, 0402

RoHS 2 Compliant with exemption 7C-I
Halogen free



FEATURE

1. High power rating and compact size
2. High reliability and stability
3. Reduced size of final equipment
4. RoHS 2 Compliant with exemption 7C-I and Halogen free products

APPLICATION

- Power supply
- PDA
- Digital meter
- Computer
- Automotives
- Battery charger
- DC-DC power converter

DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum oxide). Internal metal electrodes are added at each end and connected by a resistive paste that is applied to the top surface of the substrate. The extra protective metal film is added onto top side electrodes to protect termination from sulfuration. The composition of the paste is adjusted to give the approximate resistance required and the value is trimmed to within tolerance by laser cutting of this resistive layer.

The resistive layer is covered with a protective coat. Finally, the two external end terminations are added. For ease of soldering the outer layer of these end terminations is a Tin (lead free) alloy.

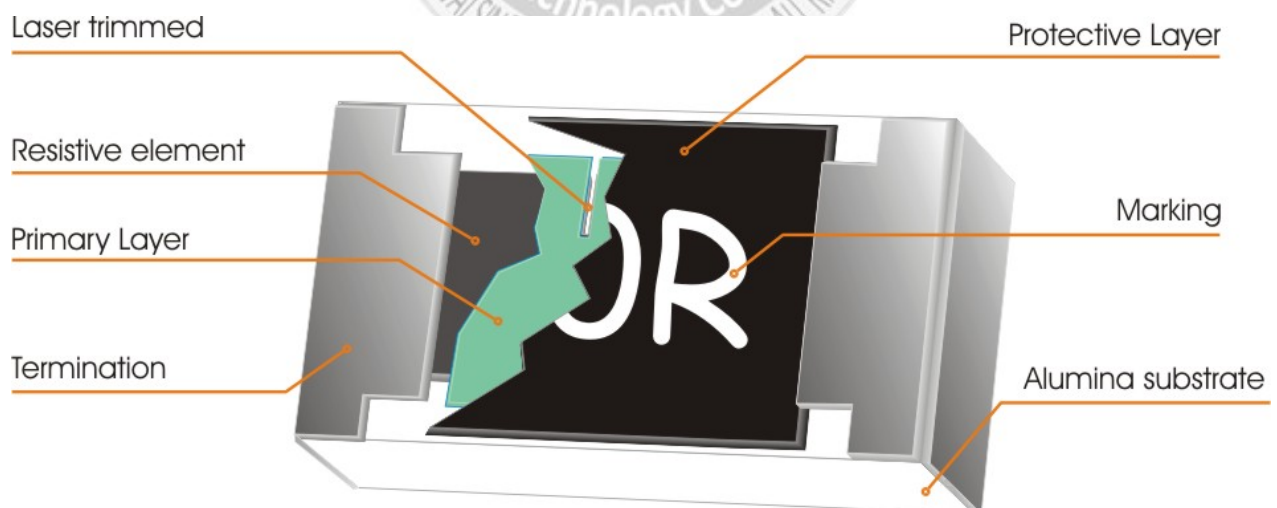


Fig 1. Construction of a Chip-R

QUICK REFERENCE DATA

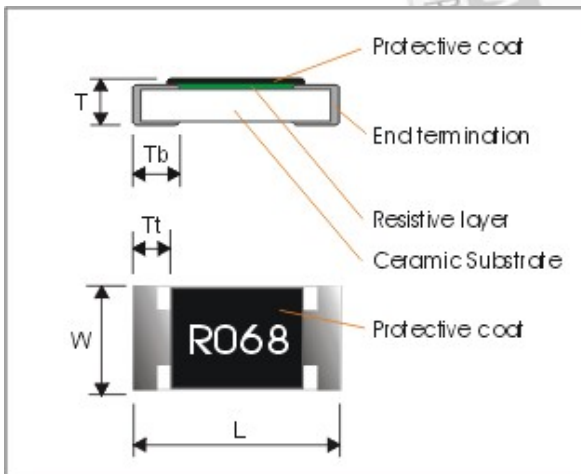
| Item | General Specification | | | |
|--|-----------------------|-----------------|----------------|--------------|
| Series No. | WW12X | WW08X | WW06X | WW04X |
| Size code | 1206 (3216) | 0805 (2012) | 0603 (1608) | 0402(1005) |
| Resistance Tolerance | ±5%, ±1% | | | |
| Resistance Range | 0.010Ω ~ 0.976Ω | 0.020Ω ~ 0.976Ω | 0.10Ω ~ 0.976Ω | |
| TCR (ppm/°C) | 0.01Ω ≤ Rn < 0.05Ω | ≤ 2100 ppm/°C | ≤ 1500 ppm/°C | N/a |
| | 0.05Ω ≤ Rn < 0.10Ω | ≤ 1000 ppm/°C | ≤ 1000 ppm/°C | N/a |
| | 0.10Ω ≤ Rn < 0.50Ω | ≤ 500 ppm/°C | ≤ 500 ppm/°C | ≤ 500 ppm/°C |
| | 0.50Ω ≤ Rn < 1Ω | ≤ 400 ppm/°C | ≤ 300 ppm/°C | ≤ 600 ppm/°C |
| Max. dissipation at T _{amb} =70°C | 1/4 W | 1/8 W | 1/10 W | 1/16 W |
| Max. Operation Voltage (DC or RMS) | 200V | 100V | 50V | |
| Max. Overload voltage (DC or RMS) | 400V | 200V | 100V | |
| Climatic category (IEC 60068) | 55/155/56 | | | |

Note :

1. This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8"
2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}} \text{ or Max. RCWV listed above, whichever is lower.}$$

DIMENSIONS (unit : mm)



| Symbol | WW12X | WW08X | WW06X | WW04X |
|--------|-------------|-------------|-------------|-------------|
| L | 3.10 ± 0.10 | 2.00 ± 0.10 | 1.60 ± 0.10 | 1.00 ± 0.05 |
| W | 1.60 ± 0.10 | 1.25 ± 0.10 | 0.80 ± 0.10 | 0.50 ± 0.05 |
| T | 0.60 ± 0.15 | 0.50 ± 0.15 | 0.45 ± 0.15 | 0.35 ± 0.05 |
| Tt | 0.50 ± 0.20 | 0.40 ± 0.20 | 0.30 ± 0.10 | 0.20 ± 0.10 |
| Tb | 0.45 ± 0.20 | 0.40 ± 0.20 | 0.30 ± 0.20 | 0.25 ± 0.10 |

CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

| WW12 | X | R020 | F | T | L |
|--|--------------------------------|---|---|--|---|
| Size code WW12 : 1206 WW08 : 0805 WW06 : 0603 WW04 : 0402 | Type code X : Normal | Resistance code E96 +E24: R is first digit followed by 3 significant digits. 0.020Ω = R020 0.510Ω = R510 0.025Ω = R025 | Tolerance code J : ±5% F : ±1% | Packaging code T : 7" Reel taping Q : 10" Reel taping G : 13" Reel taping D : 7" reel 20Kpcs only for 0402 | Termination code L = Sn base (leadfree) |

Tape packaging:

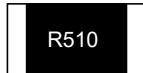
WW12,WW08,WW06 : 8mm width paper taping 5,000pcs per 7" reel; 10,000pcs per 10" reel; 20,000pcs per 13" reel.

WW04: 8mm width paper taping 10,000pcs per 7" reel; 20,000pcs per 7" reel; 70,000pcs per 13" reel.

MARKING

- WW04X series has no marking on the product overcoat for both 5% & 1%.
- 4-digit marking for 1206, 0805 size

Each resistor is marked with a four-digit code on the protective coating to designate the nominal resistance value.



R010 = 0.010Ω (10mΩ)
R510 = 0.510Ω (510mΩ)

- 3-digit marking for 0603 size

| Rule | Series | Resistance Range | Example | Table |
|---|------------------|------------------|--|---------|
| "R" followed by 2 significant digits if the 4th digit is "0" | E24 | 100mΩ ~910mΩ | 110mΩ= R10 220mΩ= R22 510mΩ= R51 | Table-1 |
| The 1st two digit codes are referring to the CODE on the table, the 3rd code is the index of resistance value : "Z" | E96 | 100mΩ ~976mΩ | 178mΩ= 25Z 221mΩ= 34Z | Table-2 |
| Others are no marking printed. | Out of E24 & E96 | 100mΩ ~976mΩ | 400mΩ= No marking | - |

■ Table-1 0603 E24 100mΩ ~910mΩ

| Series | R value | Marking | Series | R value | Marking | Series | R value | Marking | Series | R value | Marking |
|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|
| E24 | 100mΩ | R10 | E24 | 200mΩ | R20 | E24 | 390mΩ | R39 | E24 | 680mΩ | R68 |
| E24 | 110mΩ | R11 | E24 | 220mΩ | R22 | E24 | 430mΩ | R43 | E24 | 750mΩ | R75 |
| E24 | 120mΩ | R12 | E24 | 240mΩ | R24 | E24 | 470mΩ | R47 | E24 | 820mΩ | R82 |
| E24 | 130mΩ | R13 | E24 | 270mΩ | R27 | E24 | 500mΩ | R50 | E24 | 910mΩ | R91 |
| E24 | 150mΩ | R15 | E24 | 300mΩ | R30 | E24 | 510mΩ | R51 | | | |
| E24 | 160mΩ | R16 | E24 | 330mΩ | R33 | E24 | 560mΩ | R56 | | | |
| E24 | 180mΩ | R18 | E24 | 360mΩ | R36 | E24 | 620mΩ | R62 | | | |

■ Table-2 0603 E96 100mΩ ~976mΩ

| Code | R value | Marking | Code | R value | Marking | Code | R value | Marking | Code | R value | Marking |
|------|---------|---------|------|---------|---------|------|---------|---------|------|---------|---------|
| 02 | 102mΩ | 02Z | 28 | 191mΩ | 28Z | 52 | 340mΩ | 52Z | 75 | 590mΩ | 75Z |
| 03 | 105mΩ | 03Z | 29 | 196mΩ | 29Z | 53 | 348mΩ | 53Z | 76 | 604mΩ | 76Z |
| 04 | 107mΩ | 04Z | 31 | 205mΩ | 31Z | 54 | 357mΩ | 54Z | 77 | 619mΩ | 77Z |
| 06 | 113mΩ | 06Z | 32 | 210mΩ | 32Z | 55 | 365mΩ | 55Z | 78 | 634mΩ | 78Z |
| 07 | 115mΩ | 07Z | 33 | 215mΩ | 33Z | 56 | 374mΩ | 56Z | 79 | 649mΩ | 79Z |
| 08 | 118mΩ | 08Z | 34 | 221mΩ | 34Z | 57 | 383mΩ | 57Z | 80 | 665mΩ | 80Z |
| 09 | 121mΩ | 09Z | 35 | 226mΩ | 35Z | 58 | 392mΩ | 58Z | 81 | 681mΩ | 81Z |
| 10 | 124mΩ | 10Z | 36 | 232mΩ | 36Z | 59 | 402mΩ | 59Z | 82 | 698mΩ | 82Z |
| 11 | 127mΩ | 11Z | 37 | 237mΩ | 37Z | 60 | 412mΩ | 60Z | 83 | 715mΩ | 83Z |
| 13 | 133mΩ | 13Z | 38 | 243mΩ | 38Z | 61 | 422mΩ | 61Z | 84 | 732mΩ | 84Z |
| 14 | 137mΩ | 14Z | 39 | 249mΩ | 39Z | 62 | 432mΩ | 62Z | 86 | 768mΩ | 86Z |
| 15 | 140mΩ | 15Z | 40 | 255mΩ | 40Z | 63 | 442mΩ | 63Z | 87 | 787mΩ | 87Z |
| 16 | 143mΩ | 16Z | 41 | 261mΩ | 41Z | 64 | 453mΩ | 64Z | 88 | 806mΩ | 88Z |
| 17 | 147mΩ | 17Z | 42 | 267mΩ | 42Z | 65 | 464mΩ | 65Z | 89 | 825mΩ | 89Z |
| 19 | 154mΩ | 19Z | 43 | 274mΩ | 43Z | 66 | 475mΩ | 66Z | 90 | 845mΩ | 90Z |
| 20 | 158mΩ | 20Z | 44 | 280mΩ | 44Z | 67 | 487mΩ | 67Z | 91 | 866mΩ | 91Z |
| 21 | 162mΩ | 21Z | 45 | 287mΩ | 45Z | 68 | 499mΩ | 68Z | 92 | 887mΩ | 92Z |
| 22 | 165mΩ | 22Z | 46 | 294mΩ | 46Z | 69 | 511mΩ | 69Z | 93 | 909mΩ | 93Z |
| 23 | 169mΩ | 23Z | 47 | 301mΩ | 47Z | 70 | 523mΩ | 70Z | 94 | 931mΩ | 94Z |
| 24 | 174mΩ | 24Z | 48 | 309mΩ | 48Z | 71 | 536mΩ | 71Z | 95 | 953mΩ | 95Z |
| 25 | 178mΩ | 25Z | 49 | 316mΩ | 49Z | 72 | 549mΩ | 72Z | 96 | 976mΩ | 96Z |
| 26 | 182mΩ | 26Z | 50 | 324mΩ | 50Z | 73 | 562mΩ | 73Z | | | |
| 27 | 187mΩ | 27Z | 51 | 332mΩ | 51Z | 74 | 576mΩ | 74Z | | | |

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E24& E96 series for resistors with a tolerance of $\pm 0.5\%$, $\pm 0.1\%$. The values of the E24/E96 series are in accordance with "IEC publication 60063"

Derating

The power that the resistor can dissipate depends on the operating temperature; see Fig.2

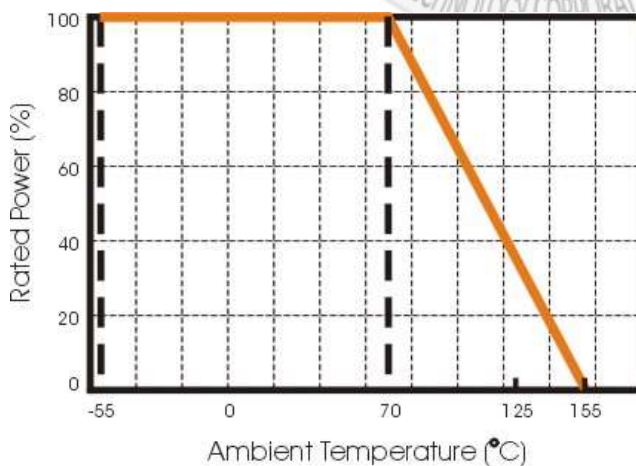


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

MOUNTING

Due to their rectangular shapes and small tolerances, Surface Mountable Resistors are suitable for handling by automatic placement systems.

Chip placement can be on ceramic substrates and printed-circuit boards (PCBs).

Electrical connection to the circuit is by individual soldering condition.

The end terminations guarantee a reliable contact.

Storage and Handling Conditions:

1. Products are recommended to be used up within two years since operation date as ensured shelf life. Check solderability in case shelf life extension is needed.

2. To store products with following condition:

Temperature :5 to 40°C

Humidity :20 to 70% relative humidity

3. Caution:

a. Don't store products in a corrosive environment such as sulfide, chloride gas, or acid.

It may cause oxidation of electrode, which easily be resulted in poor soldering.

b. To store products on the shelf and avoid exposure to moisture.

c. Don't expose products to excessive shock, vibration, direct sunlight and so on.

SOLDERING CONDITION follows J-STD-020D

The robust construction of chip resistors allows them to be completely immersed in a solder bath of 260°C for 10 seconds. Therefore, it is possible to mount Surface Mount Resistors on one side of a PCB and other discrete components on the reverse (mixed PCBs).

Surface Mount Resistors are tested for solderability at 235°C during 2 seconds. The test condition for no leaching is 260°C for 30 seconds.

Typical examples of soldering processes that provide reliable joints without any damage are given in Fig 3.

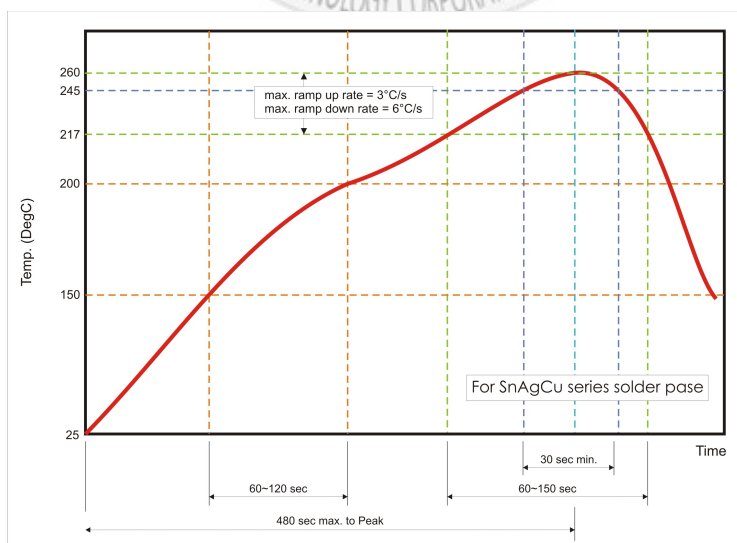


Fig 3. Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste

TEST AND REQUIREMENTS(JIS C 5201-1 : 1998)

Essentially all tests are carried out according to the schedule of IEC publication 115-8, category **LCT/UCT/56**(rated temperature range : Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days). The testing also meets the requirements specified by EIA, EIAJ and JIS.

The tests are carried out in accordance with IEC publication 68, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to IEC 60068-1, sub-clause 5.3. Unless otherwise specified, the following value supplied :

Temperature: 15°C to 35°C.

Relative humidity: 45% to 75%.

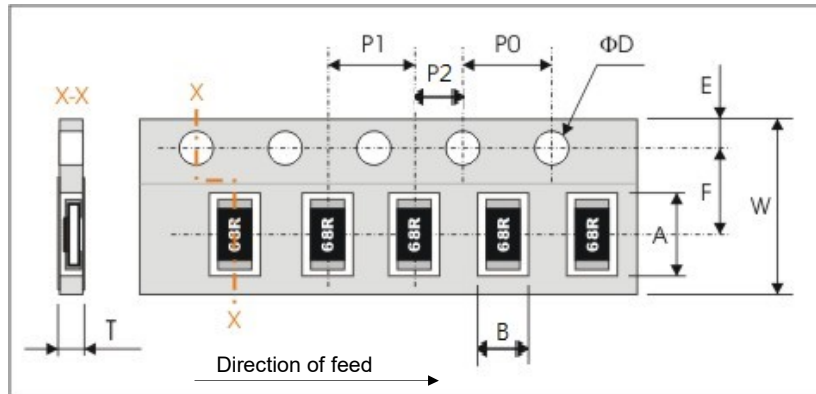
Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

All soldering tests are performed with mildly activated flux.

| TEST | PROCEDURE / TEST METHOD | REQUIREMENT |
|--|--|---|
| Temperature Coefficient of Resistance (T.C.R) Clause 4.8 | Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/}^\circ\text{C)}$ t1 : 20°C+5°C-1°C R1 : Resistance at reference temperature R2 : Resistance at test temperature | Refer to "QUICK REFERENCE DATA" |
| Short time overload (S.T.O.L) Clause 4.13 | Permanent resistance change after a 5second application of a voltage 2.5 times RCWV or the maximum overload voltage specified in the above list, whichever is less. | $\Delta R/R$ max. $\pm(2\%+0.005\Omega)$ WW04X max $\pm(2\%+0.010\Omega)$ |
| Resistance to solderingheat(R.S.H) Clause 4.18 | Un-mounted chips completely immersed for 10±1 second in aSAC solder bath at 260°C±5°C | no visible damage $\Delta R/R$ max. $\pm(1\%+0.005\Omega)$ WW04X max $\pm(1\%+0.010\Omega)$ |
| Solderability Clause 4.17 | Un-mounted chips completely immersed for 2±0.5 second in aSAC solder bath at 235°C±5°C | good tinning (>95% covered) no visible damage |
| Temperature cycling Clause 4.19 | 30 minutes at -55°C±3°C, 2~3 minutes at 20°C+5°C-1°C, 30 minutes at +155°C±3°C, 2~3 minutes at 20°C+5°C-1°C, total 5continuous cycles | no visible damage $\Delta R/R$ max. $\pm(1\%+0.005\Omega)$ WW04X max $\pm(1\%+0.010\Omega)$ |
| Load life (endurance) Clause 4.25 | 1000 +48/-0 hours, loaded with RCWV or Vmax in chambercontroller 70±2°C, 1.5 hours on and 0.5 hours off | $\Delta R/R$ max. $\pm(3\%+0.005\Omega)$ WW04X max $\pm(5\%+0.010\Omega)$ |
| Load life in Humidity Clause 4.24 | 1000 +48/-0 hours, loaded with RCWV or Vmax in humidity chamber controller at 40°C±2°C and 90~95% relative humidity, 1.5hours on and 0.5 hours off | $\Delta R/R$ max. $\pm(3\%+0.005\Omega)$ WW04X max $\pm(5\%+0.010\Omega)$ |
| Bending strength Clause 4.33 | Resistors mounted on a 90mm glass epoxy resin PCB(FR4);bending : 2 mm, once for 10 seconds | $\Delta R/R$ max. $\pm(1\%+0.005\Omega)$ WW04X max $\pm(1\%+0.010\Omega)$ |
| Adhesion Clause 4.32 | Pressurizing force: 5N, Test time: 10±1sec. | No remarkable damage or removal of the terminations |
| Insulation Resistance Clause 4.6 | Apply the maximum overload voltage (DC) for 1minute | $R \geq 10G\Omega$ |
| Dielectric Withstand Voltage Clause 4.7 | Apply the maximum overload voltage (AC) for 1 minute | No breakdown or flashover |

PACKAGING

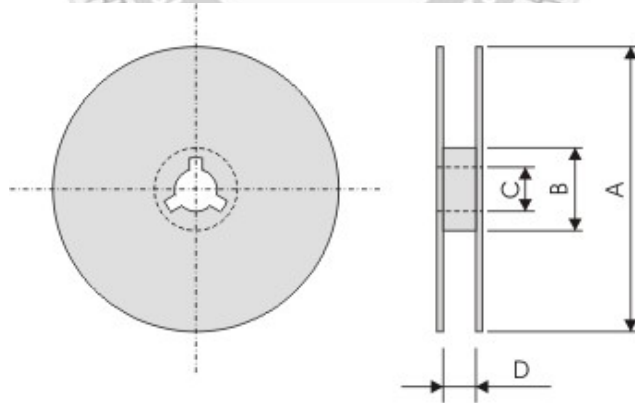
Tape specifications (unit :mm)



| Series No. | A | B | W | F | E |
|------------|-----------|-----------|-----------|-----------|-----------|
| WW12X | 3.60±0.20 | 2.00±0.20 | 8.00±0.30 | 3.50±0.20 | 1.75±0.10 |
| WW08X | 2.40±0.20 | 1.65±0.20 | | | |
| WW06X | 1.90±0.20 | 1.10±0.20 | | | |
| WW04X | 1.20±0.10 | 0.70±0.10 | | | |

| Series No. | P1 | P0 | P2 | ΦD | T |
|---------------|-----------|-----------|-----------|---------------------------------------|-----------|
| WW12X / WW08X | 4.00±0.10 | 4.00±0.10 | 2.00±0.10 | Φ1.50 ^{+0.1} _{-0.0} | 0.80±0.1 |
| WW06X | | | | | 0.70±0.05 |
| WW04X | 2.00±0.10 | 4.00±0.10 | | | 0.50±0.05 |

Reel dimensions (unit :mm)



| Symbol | A | B | C | D |
|----------|------------|------------|----------|---------|
| 7" Reel | Φ178.0±2.0 | Φ60.0±1.0 | 13.0±0.2 | 9.0±0.5 |
| 10" Reel | Φ254.0±2.0 | Φ100.0±1.0 | 13.0±0.2 | 9.0±0.5 |
| 13" Reel | Φ330.0±2.0 | Φ100.0±1.0 | 13.0±0.2 | 9.0±0.5 |

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