

## 1. Part Numbering System:

<u>CL</u>	<u>05</u>	<u>J</u>	<u>B</u>	<u>R22</u>
<u>Series Name</u> Chip Resistor: CL : Thick Film Low Ohm (High power rating and low TCR )	<u>Type</u> Inch (mm) 02-0402(1005) 03-0603(1608) 05-0805(2012) 06-1206(3216) 10-1210(3225) 0A-2010(5025) 12-2512(6432)	<u>Tolerance</u> F= ± 1% J= ± 5 %	<u>Package</u> A=4Kpcs/7"Reel B=5Kpcs/7"Reel C=10Kpcs/7"Reel	<u>Resistance</u> R05=0.05Ω R22=0.22Ω

## 2. FEATURE

- 1) High power rating and low TCR
- 2) High reliability and stability
- 3) Reduced size of final equipment
- 4) RoHS exemption free and Lead free products

## 3. APPLICATION

- 1) Power supply / Battery Pack
- 2) Battery charger/ PC
- 3) DC-DC power converter

**4. 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 composition of the paste is adjusted to give the approximate resistance required and the value is trimmed to nominated value within tolerance which controlled by laser trimming 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 Tin (lead free) alloy.

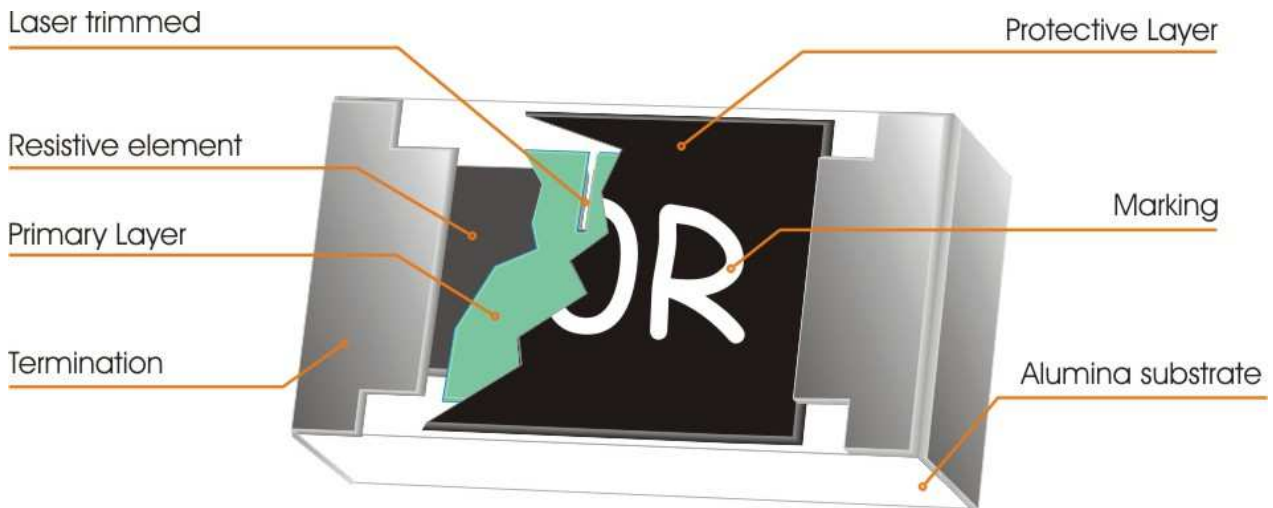
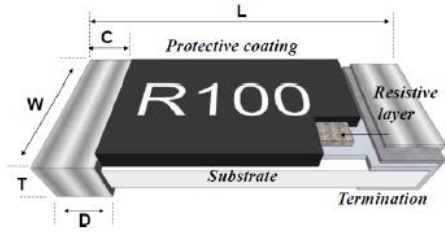


Fig 1. Construction of Chip-R

**5. QUICK REFERENCE DATA**

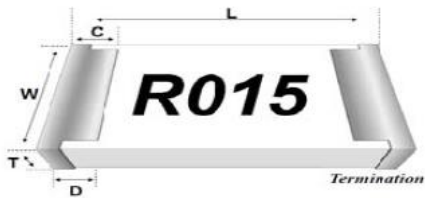
Item	General Specification					
	CL12	CL0A	CL10	CL06	CL05	CL03
Series No.	CL12	CL0A	CL10	CL06	CL05	CL03
Size code	2512	2010	1210	1206	0805	0603
Resistance Tolerance	±5%, ±1%					
Resistance Range	0.010Ω ~ 0.910Ω, E24					0.050Ω ~ 0.910Ω, E24
TCR (ppm/°C)	10 - 20mΩ: ±1000 22 - 39mΩ: ±600 40 - 47mΩ: ±200 50 - 91mΩ: ±100 100 - 910mΩ: ±100	10 - 20mΩ: ±1000 22 - 39mΩ: ±600 40 - 47mΩ: ±200 50 - 91mΩ: ±100 100 - 910mΩ: ±100	10 - 20mΩ: ±600 22 - 39mΩ: ±400 40 - 47mΩ: ±200 50 - 91mΩ: ±100 100 - 910mΩ: ±100	10 - 20mΩ: ±1000 22 - 39mΩ: ±600 40 - 47mΩ: ±200 50 - 91mΩ: ±100 100 - 910mΩ: ±100	10 - 20mΩ: ±1000 22 - 39mΩ: ±600 40 - 47mΩ: ±400 50 - 91mΩ: ±200 100 - 910mΩ: ±100	50 - 91mΩ: ±400 100 - 910mΩ: ±200
Max. dissipation at T <sub>amb</sub> =70°C	1 W	3/4W	2/3 W	1/3 W	1/4 W	1/8 W
Operation temperature	-55 ~ +155°C					

**6. MECHANICAL DATA**



**R value  $\geq$  40mohm**

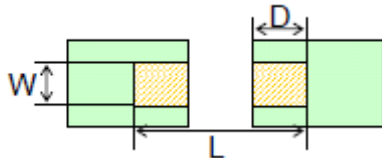
Symbol	CL12	CL0A	CL10	CL06	CL05	CL03
L	6.30 ± 0.20	5.00 ± 0.20	3.10 ± 0.10	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10
W	3.10 ± 0.20	2.50 ± 0.20	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10
T	0.60 ± 0.15	0.60 ± 0.10	0.55 ± 0.10	0.55 ± 0.10	0.50 ± 0.10	0.45 ± 0.10
C	0.60 ± 0.25	0.60 ± 0.25	0.50 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20
D	0.90 ± 0.25	0.60 ± 0.25	0.50 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20



**R value  $\leq$  39mΩ**

Symbol	CL12	CL0A	CL10	CL06	CL05
L	6.40 ± 0.20	5.00 ± 0.20	3.10 ± 0.15	3.10 ± 0.15	2.00 ± 0.10
W	3.10 ± 0.20	2.50 ± 0.20	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10
T	0.60 ± 0.15	0.60 ± 0.10	0.60 ± 0.10	0.55 ± 0.10	0.60 ± 0.10
C	0.25 ± 0.25	0.25 ± 0.25	0.25 ± 0.25	0.25 ± 0.20	0.25 ± 0.20
D	1.80 ± 0.30	1.10 ± 0.25	0.90 ± 0.25	0.90 ± 0.25	0.65 ± 0.20

**6.1 RECOMMENDED SOLDERING PAD**



Symbol	CL12	CL0A	CL10	CL06	CL05	CL03
WL	3.70mm	3.00mm	3.00mm	1.80mm	1.30mm	0.90mm
D	1.60mm	1.50mm	1.30mm	1.30mm	1.15mm	1.00mm
L	7.60mm	6.80mm	4.70mm	4.70mm	3.50mm	3.00mm

**7. FUNCTIONAL DESCRIPTION**

**7.1 Product characterization**

Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of  $\pm 5\%$  &  $\pm 1\%$ . The values of the E24 series are in accordance with "IEC publication 60063".

**7.2 Derating curve**

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

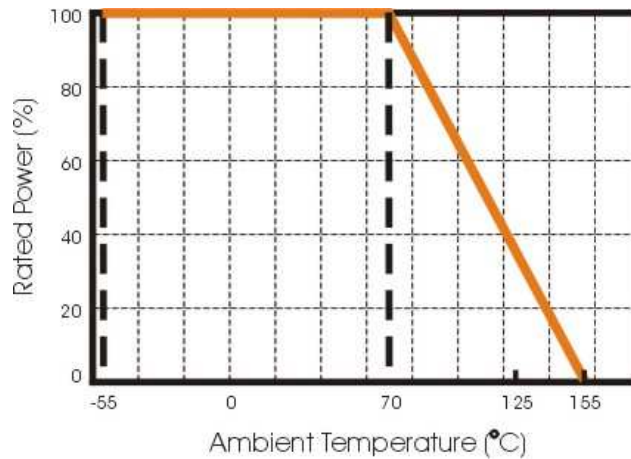


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

**7.3 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.

**7.4 SOLDERING CONDITION**

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.

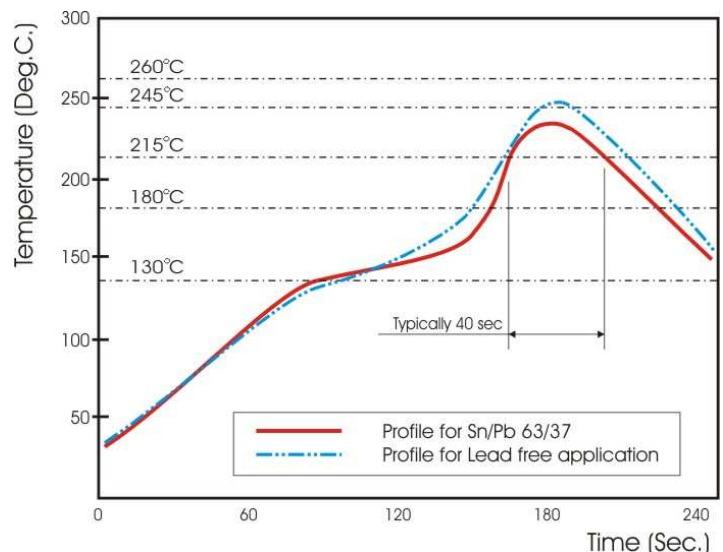


Fig 3. Infrared soldering profile

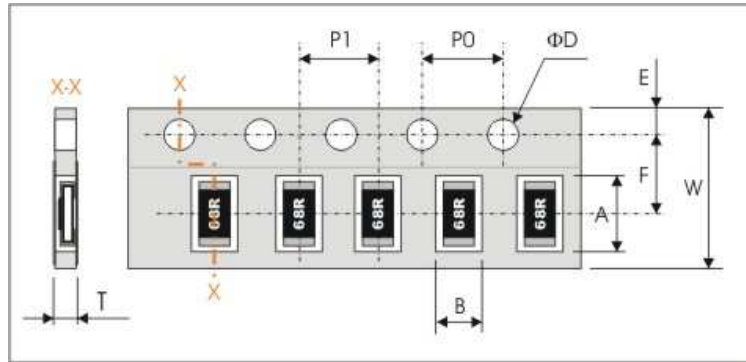


**7.5 TEST AND REQUIREMENTS(JIS C 5201-1 : 1998)**

TEST	PROCEDURE	REQUIREMENT
Temperature Coefficient of Resistance(T.C.R) <b>Clause 4.8</b>	Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/}^\circ\text{C)}$ $t_1 : 25^\circ\text{C}$ $R_1$ : Resistance at reference temperature $25^\circ\text{C}$ $R_2$ : Resistance at test temperature $155^\circ\text{C}$	Refer to "QUICK REFERENCE DATA"
Short time overload (S.T.O.L) <b>Clause 4.13</b>	Permanent resistance change after a 5second application of a 5 times rated power.	J: $\Delta R/R$ max. $\pm(2\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$
Solderability <b>Clause 4.17</b>	Un-mounted chips completely immersed for $3\pm 0.5$ second in a SAC solder bath at $245^\circ\text{C} \pm 2^\circ\text{C}$	good tinning (>95% covered) no visible damage
Resistance to soldering heat(R.S.H) <b>Clause 4.18</b>	Un-mounted chips completely immersed for $10\pm 1$ second in a SAC solder bath at $260^\circ\text{C} \pm 5^\circ\text{C}$	no visible damage J: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5\text{m}\Omega)$
Temperature cycling <b>Clause 4.19</b>	30 minutes at $-55^\circ\text{C} \pm 3^\circ\text{C}$ , 2~3 minutes at $20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$ , 30 minutes at $+155^\circ\text{C} \pm 3^\circ\text{C}$ , 2~3 minutes at $20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$ , total 5 continuous cycles	no visible damage J: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5\text{m}\Omega)$
Load life (endurance) <b>Clause 4.25</b>	1000 +48/-0 hours, loaded with RCWV or Vmax in chamber controller $70\pm 2^\circ\text{C}$ , 1.5 hours on and 0.5 hours off	J: $\Delta R/R$ max. $\pm(3\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$
Load life in Humidity <b>Clause 4.24</b>	1000 +48/-0 hours, loaded with RCWV or Vmax in humidity chamber controller at $40^\circ\text{C} \pm 2^\circ\text{C}$ and 90~95% relative humidity, 1.5hours on and 0.5 hours off	J: $\Delta R/R$ max. $\pm(3\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$
Bending strength <b>Clause 4.33</b>	Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending : 3mm for 0603/0805, 2mm for 1206 and above sizes, once for 10 seconds	no visible damage J: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5\text{m}\Omega)$
Adhesion <b>Clause 4.32</b>	Pressurizing force: 5N, Test time: $10\pm 1$ sec.	No remarkable damage or removal of the terminations
Insulation Resistance <b>Clause 4.6</b>	Test voltage: $100\pm 15\text{V}$	$I.R \geq 1\text{G}\Omega$

**8. PACKAGING**

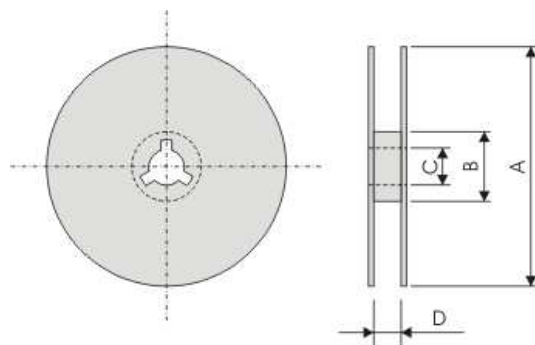
**8.1 Paper Tape specifications (unit :mm)**



Series No.	A	B	W	F	E
CL12	6.70±0.20	3.50±0.20	12.00±0.30	3.50±0.20	1.75±0.10
CL0A	5.50±0.20	2.80±0.20	12.00±0.30		
CL10	3.60±0.20	3.00±0.20	8.00±0.30		
CL06	3.60±0.20	2.00±0.20			
CL05	2.40±0.20	1.65±0.20			
CL03	1.90±0.20	1.10±0.20			

Series No.	P1	P0	ΦD	T
CL12	4.00±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.2
CL0A				Max. 1.2
CL10				Max. 1.0
CL06				Max. 1.0
CL05				Max. 1.0
CL03				Max. 0.8

**8.2 Reel dimensions**



Symbol	A	B	C	D
7" reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.5	10.0±1.5 ( 8mm tape )
10" reel	Φ254.0±2.0	Φ100.0±1.0		13.8±1.5 (12mm tape)
13: reel	Φ330.0±2.0	Φ100.0±1.0		

**8.3 Taping Quantity:**

Tape	Paper Tape						Embossed Tape	Bulk Cassette
	4mm pitch			2mm pitch			4mm pitch	
	7"	10"	13"	7"	10"	13"	7"	
0603	5000	10000	20000	10000	20000	-	-	20000
0805	5000	10000	20000	-	-	-	-	10000
1206	5000	10000	20000	-	-	-	-	5000
1210	5000	10000	20000	-	-	-	-	5000
2010	4000	-	-	-	-	-	-	5000
2512	4000	-	-	-	-	-	-	5000

**9. Performance of Taping :**

**9.1. Strength of Carrier Tape and Top Cover Tape**

**-Carrier Tape**

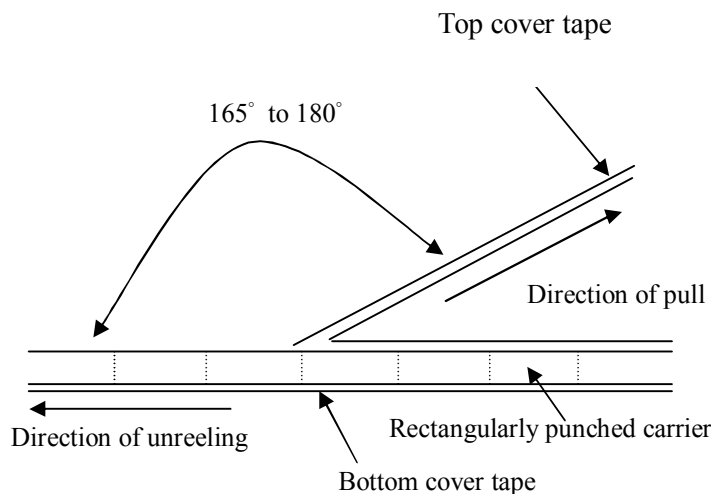
When a tensile force 1.02kgf is applied in the direction of unreeling the tape, the tape shall withstand this force.

**-Top cover Tape**

When a tensile force 1.02kgf is applied to the tape, the tape shall withstand this force.






**9.2 Peel Force of Top Cover Tape**

Unless otherwise specified, the peel force of top cover tape shall be 10.2 to 71.4 g f when the top cover tape is pulled at a speed of 300mm/min with the angle between the taped during peel and the direction of unreeling maintained at 165 to 180° as illustrated in Fig.



**10. Resistance Marking Explanation:**

<b>2512 (6432)</b>	4-digits marking
<b>2010 (5025)</b>	4-digits marking
<b>1210 (3225)</b>	4-digits marking
<b>1206 (3216)</b>	4-digits marking
<b>0805 (2012)</b>	4-digits marking
<b>0603 (1608)</b>	3-digits marking

Size	E-24 ±5%, ±1%
0603	
0805	
1206	
1210	
2010	
2512	

**Example**

<b>RESISTANCE</b>	0.10 Ω	0.15Ω	0.020Ω
<b>3-digits marking</b>	R10	R15	20M
<b>4-digits marking</b>	R100	R150	R020