

## CML: Series Low Resistance Chip Resistor Specification

### 1. Scope

This specification applies to CML\*\*\*\* Series Low Resistance Chip Resistor for use in electric equipment. \*\*\*\*METAL FOIL\*\*\*\*

### 2. Part number

**CML 1632 - C - R050 - F - T\***  
 (1) (2) (3) (4) (5) (6)

- (1) Product series
- (2) Size designator
- (3) Product type

C: Higher operating temperature type  
 M: Low thermal EMF type

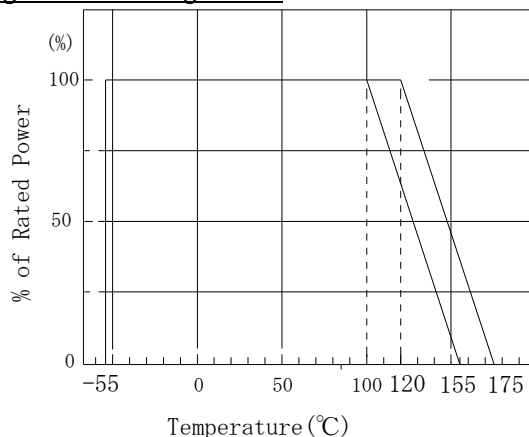
- (4) Nominal resistance value: Explanation of resistance value E.g.) 10mΩ -> R010
- (5) Resistance tolerance: F (±1.0%), G (±2.0%), J (±5.0%)
- (6) Taping quantity/reel: T1=1,000pcs/reel, T5=5,000pcs/reel  
 (Note: T1 only for CML50110 and CML11050)

### 3. Specification

Parameter	A: Short side electrode			B: Long side electrode		
	Part Number	Inch Size	Power Rating	Part Number	Inch Size	Power Rating
Inch Size & Power Rating	CML0816	(0603)	0.3W	CML2012	(0805)	1.0W
	CML1220	(0805)	0.5W	CML3216	(1206)	1.5W
	CML1632	(1206)	0.75W	CML5025	(2010)	2.0W
	CML2550	(2010)	1.5W	CML6432	(2512)	3.0W
	CML3264	(2512)	2.0W	CML7638	(3015)	4.0W
	CML50110	(4320)	5.0W	CML9045	(3518)	5.0W
				CML11050	(4320)	6.0W
Resistance Value Range	CML0816	10~500mΩ (E-12) and *1		CML2012	1~10mΩ (1mΩ step), 10~500mΩ (E-6) and *1	
	CML1220	5~10mΩ (1mΩ step),				
	CML1632	10~500mΩ (E-12) and *1				
	CML2550	5~10mΩ (1mΩ step),				
	CML3264	10~1000mΩ (E-12) and *1				
	CML50110			CML7638		
				CML9045		
				CML11050		
	*1: 20mΩ, 25mΩ, 50mΩ					
Resistance Tolerance	5~9mΩ	G: ±2.0%		1mΩ	J: ±5.0%	
	10mΩ	F: ±1.0%		2mΩ	G: ±2.0%	
				3mΩ~	F: ±1.0%	
TCR	5~9mΩ	±100ppm/°C		1mΩ	±150ppm/°C	
	10mΩ~	±50ppm/°C		2mΩ	±100ppm/°C	
				3mΩ~	±50ppm/°C	

Parameter	Specification
Rated ambient temperature	Type C: +120°C Type M: +100°C Refer to Derating curve, Figure-1
Operating temperature	Type C: -55~+175°C Type M: -55~+155°C
Rated Voltage	$\sqrt{\text{Power} \times \text{Resistance Value (V)}}$

Figure-1 Derating curve:

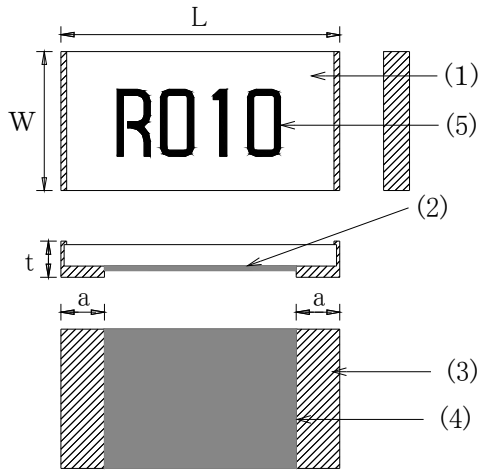


#### 4. Structure

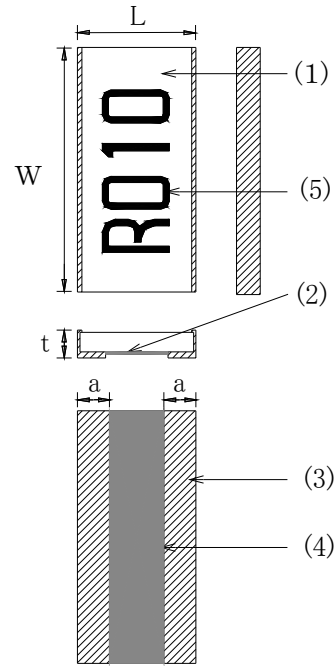
Metal alloy (Ni-Cu) foil resistive element is adhered to the ceramic substrate. The terminals are formed by tin-plating on the foil.

#### 5. Dimensions

A: Short side electrode



B: Long side electrode



No.	Components	Material / process
(1)	Substrate	Alumina 96%
(2)	Resistor	Ni-Cu alloy
(3)	Terminals	Plated Sn+Ni (on Cu)
(4)	Protection coat	Epoxy resin (Green)
(5)	Marking	Epoxy resin (Black) *No Marking in CML0816

#### Standard dimension

Type of Electrode	Part Number	Resistance Value Range	Dimensions (mm)			
			L	W	a	t
A: Short side electrode	CML0816	10mΩ~18mΩ	1.60±0.20	0.80±0.20	0.70±0.15	0.50±0.20
		20mΩ~39mΩ			0.55±0.15	
		43mΩ~			0.30±0.15	
	CML1220	5mΩ~	2.00±0.20	1.25±0.20	0.40±0.20	0.50±0.20
	CML1632	5mΩ~8mΩ	3.20±0.20	1.60±0.20	1.10±0.20	0.50±0.20
		9mΩ~			0.50±0.20	
	CML2550	5mΩ~8mΩ	5.00±0.20	2.50±0.20	1.40±0.20	0.50±0.20
9mΩ~		0.60±0.20				
CML3264	3mΩ~8mΩ	6.30±0.20	3.10±0.20	1.90±0.20	0.50±0.20	
	9mΩ~			1.00±0.20		
CML50110	5mΩ~7mΩ	11.0±0.20	5.00±0.20	3.60±0.30	0.65±0.20	
	8mΩ~			2.36±0.30		
B: Long side electrode	CML2012	1mΩ	1.25±0.20	2.00±0.20	0.55±0.20	0.50±0.20
		2mΩ~			0.30±0.20	
	CML3216	1mΩ	1.60±0.20	3.20±0.20	0.55±0.20	0.50±0.20
		2mΩ~			0.30±0.20	
	CML5025	1mΩ	2.50±0.20	5.00±0.20	0.55±0.20	0.50±0.20
		2mΩ~			0.90±0.20	
	CML6432	1mΩ	3.10±0.20	6.30±0.20	1.20±0.20	0.50±0.20
		2mΩ~			0.50±0.20	
	CML7638	1mΩ	3.80±0.20	7.60±0.20	1.35±0.20	0.50±0.20
		2mΩ~			0.60±0.20	
CML9045	1mΩ	4.50±0.20	9.00±0.20	1.60±0.20	0.50±0.20	
	2mΩ~			0.70±0.20		
CML11050	1mΩ	5.00±0.20	11.0±0.20	1.60±0.20	0.50±0.20	
	2mΩ~			0.80±0.20		

6. Marking

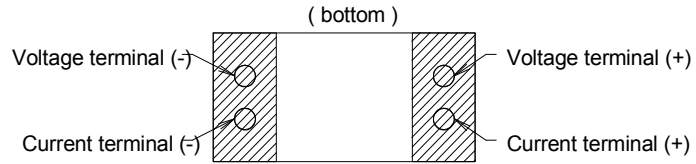
Resistance value code is marked on the top surface.

Note: No marking in CML0816.

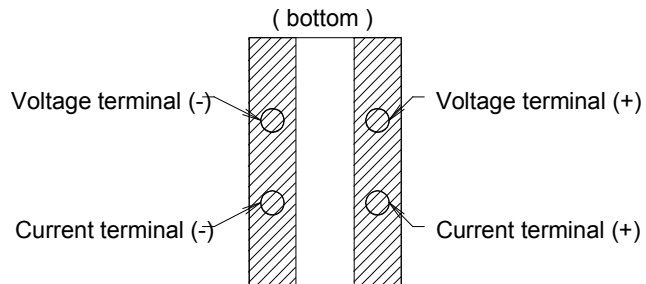
E.g.) 5mΩ -> R005  
 10mΩ -> R010  
 100mΩ -> R100

7. Schematic Diagram, Measurement (probing) area

A: Short side electrode



B: Long side electrode



8. Reliability Characteristics

Test Item	Test Conditions		Specification
Maximum Over current	Apply surge current, calculated in the following equation for 10 ms for 10 times with 60s interval. Refer to Table-1 for maximum current for each part. $I = \sqrt{P/R}$ [A] P = Maximum power (W) R = Resistance value (Ω)		±(1.0%+0.0005Ω)
Load life	Rated power on for 90 min, off for 30 min at 70±3°C for 1000h.		±(1.0%+0.0005Ω)
Moisture Load life	Rated power for 90 min, off for 30 min at 60±2°C, relative humidity of 90% for 1000h.		±(2.0%+0.0005Ω)
Temperature Cycle	[-55°C 30 min -> R.T. 3 min -> +155°C 30 min -> R.T. 3 min]	100 cycles	±(1.0%+0.0005Ω)
		1000 cycles	±(2.0%+0.0005Ω)
Resistance to soldering heat	260±5°C solder, 10±1sec dip		±(0.5%+0.0005Ω)
Board Bending	Test board length: 90mm Bend depth: 2mm Test board: Glass-Epoxy t=1.6mm		±(1.0%+0.0005Ω)
Solderability	245±5°C solder, 3+1/-0 sec dip.		90% terminal surface coverage by fresh solder

Table-1: Maximum current

<Condition> Impression time 10 m sec, Repetition 10 times, and Interval 60sec.

A: Short side electrode

Part number	Max dissipation	Max current
CML0816	2.5W	15A
CML1220	6.5W	25A
CML1632	12W	35A
CML2550	30W	55A
CML3264	56W	70A
CML50110	96W	120A

B: Long side electrode

Resistance range	$\leq 10\text{m}\Omega$		$>10.1\text{m}\Omega$ & $<100\text{m}\Omega$		$\geq 100\text{m}\Omega$ & $<200\text{m}\Omega$		$\geq 200\text{m}\Omega$ & $<500\text{m}\Omega$		$\geq 500\text{m}\Omega$ & $\leq 1000\text{m}\Omega$		
Part number	Max dissipation	Max current	Max dissipation	Max current	The Max Power is common.						
					Max dissipation	Max current					
CML2012	20W	45A	14W	20A	3W	6A	4A	2.4A			
CML3216	56W	64A	36W	35A	14W	10A	7A	5A			
CML5025	88W	100A	56W	47A	22W	11A	8A	7A			
CML6432	225W	125A	150W	70A	36W	19A	14A	8A			
CML7638	325W	150A	210W	80A	50W	23A	17A	10A			
CML9045	440W	180A	300W	100A	72W	27A	20A	12A			
CML11050	600W	240A	440W	120A	100W	33A	23A	14A			

Calculation of the maximum over-current

Maximum Over current =  $\sqrt{(\text{Maximum dissipation} \div \text{Resistance Value})}$

Or it becomes which of the maximum current, or a small value.

Example) CML9045 30mΩ

Maximum Over current =  $\sqrt{(300\text{W} \div 0.03\Omega)} =$

100A CML3216 1mΩ

Maximum Over current =  $\sqrt{(56\text{W} \div 0.001\Omega)} = 237\text{A}$

Since the maximum current is specified as 64A

An over-current is set to 64A at the maximum moment.

## 9. Country of origin

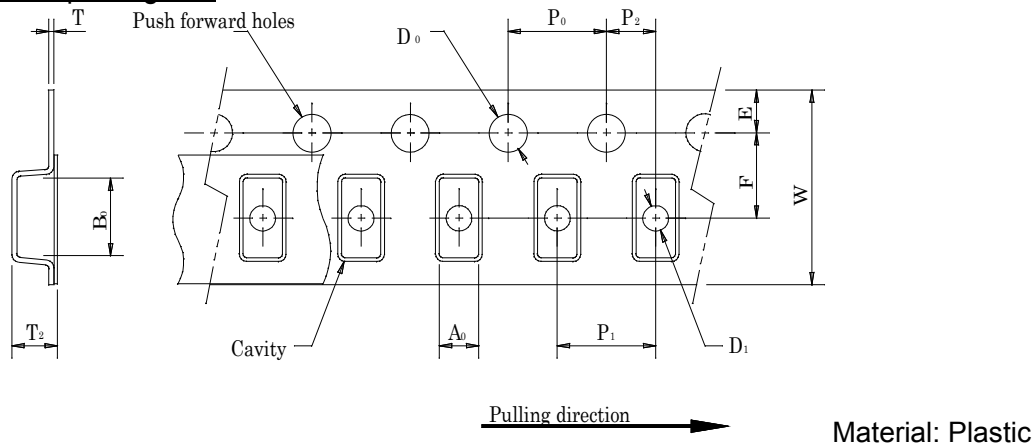
Country of origin : Japan

## 10. Packaging

Packing quantity: 1,000 or 5,000pieces/reel (1000/reel only for CML11050 and CML50110)

Tape diagram/dimension	Figure-2
Peeling strength of sealed tape	Figure-3
Reel diagram/dimension	Figure-4
Taping direction	Figure-5

Figure-2 Tape diagram:



Tape dimension (mm): Short / (Long) electrode

Symbol	0816	1220 (2012)	1632 (3216)	2550 (5025)	3264 (6432)	(7638)	(9045)	50110 (11050)
A0	0.95±0.05	1.45±0.1	1.90±0.1	2.9±0.20	3.43±0.2	4.15±0.10	4.85±0.10	5.40±0.10
B0	1.85±0.05	2.3±0.1	3.50±0.1	5.3±0.20	6.63±0.2	7.95±0.10	9.35±0.10	11.5±0.10
W	8.0±0.1	8.0±0.2/-0	8.0±0.2	12.0±0.3	12.0±0.3	16.00±0.30	16.00±0.30	24.0±0.30
F	3.5±0.05	3.50±0.05	3.50±0.05	5.5±0.05	5.50±0.05	7.50±0.10	7.50±0.10	11.5±0.10
E	1.75±0.1	1.75±0.1	1.75±0.1	1.75±0.1	1.75±0.1	1.75±0.10	1.75±0.10	1.75±0.10
P0	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.10	4.0±0.10	4.0±0.10
P1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	8.00±0.10	8.00±0.10	8.00±0.10
P2	2.0±0.05	2.0±0.05	2.0±0.05	2.0±0.05	2.0±0.05	2.00±0.10	2.00±0.10	2.00±0.10
D0	1.5±0.1/-0	1.5±0.1/-0	1.5±0.1/-0	1.5±0.1/-0	1.5±0.1/-0	1.50±0.10	1.50±0.10	1.50±0.10
D1	0.6±0.05	-	1.0±0.2/-0	1.5±0.2/-0	1.5±0.2/-0	1.50±0.10	1.50±0.10	1.50±0.10
T	0.2±0.05	0.20±0.05	0.20±0.05	0.3Max	0.20±0.05	0.30±0.05	0.30±0.05	0.30±0.05
T2	0.55±0.05	0.65±0.1	0.75±0.1	1.5Max	0.76±0.1	1.2±0.15	1.2±0.15	1.2±0.15

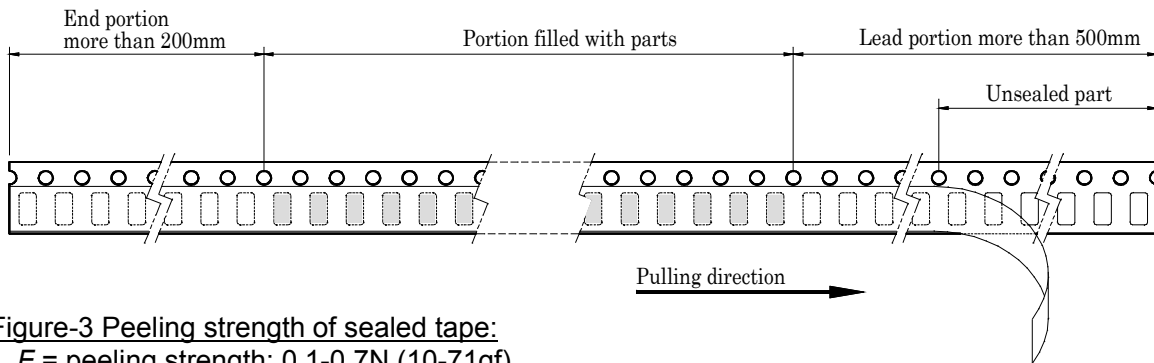


Figure-3 Peeling strength of sealed tape:

F = peeling strength: 0.1-0.7N (10-71gf)

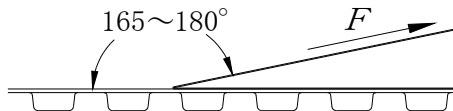
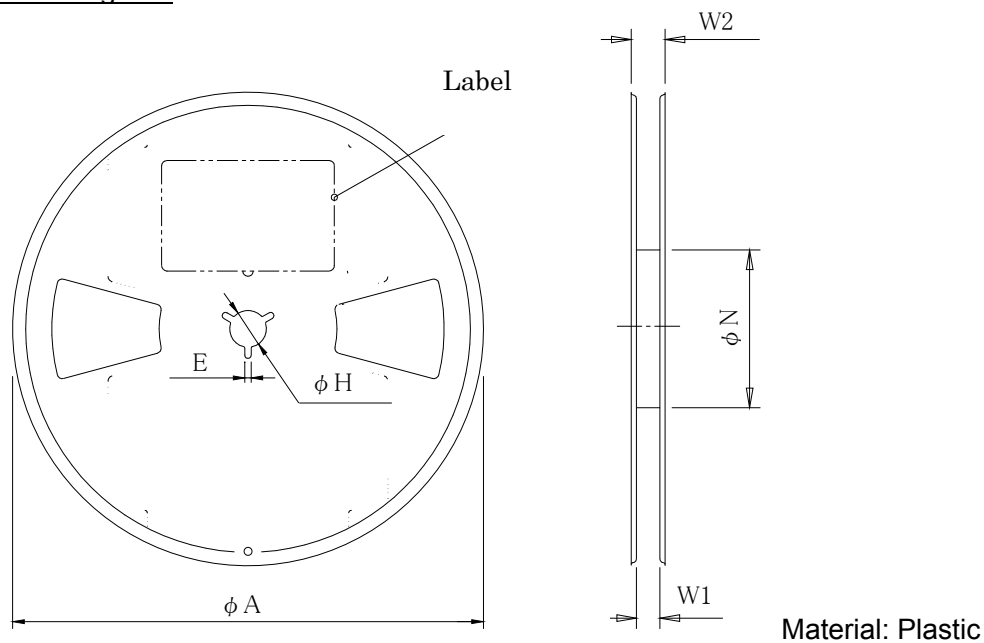


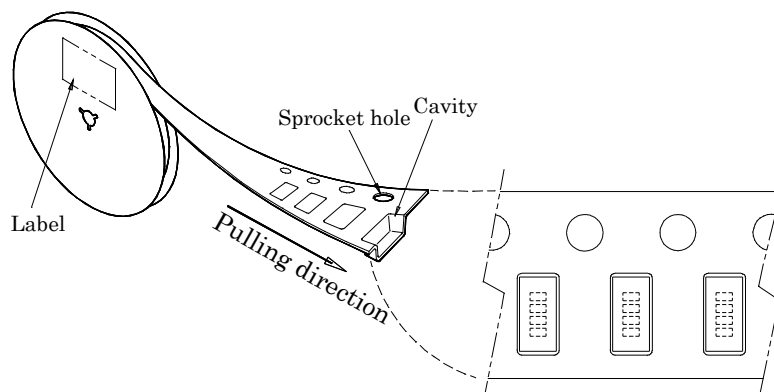
Figure-4 Reel diagram:



Reel dimension (mm): Short / (Long) electrode

Size	0816, 1220, 1632 (2012), (3216)	2550, 3264 (5025), (6432)		(7638), (9045)		50110 (11050)
Pieces	1,000 / 5,000	1,000	5,000	1,000	5,000	1,000
φA	180+0.0/-3.0	180+0.0/-3.0	255±1.0	180+0.0/-3.0	330±2.0	330±2.0
φH	13.0±0.2	13.0±0.2	13.0±0.3	13.0±0.2	13.0±0.2	13.0±0.2
E	2.0±0.5	2.0±0.5	2.0±0.2	2.0±0.5	2.0±0.5	2.0±0.5
φN	60+1.0/-0.0	60+1.0/-0.0	80±0.5	60+1.0/-0.0	80±1.0	100±1.0
W1	9.0±0.3	13.0±0.3	13.5±1.0	17.0±0.3	17.4±1.0	25.4±1.0
W2	13.0±1.4	17.0±1.4	Less than 18.4	19.4±1.0	21.4±1.0	29.4±1.0

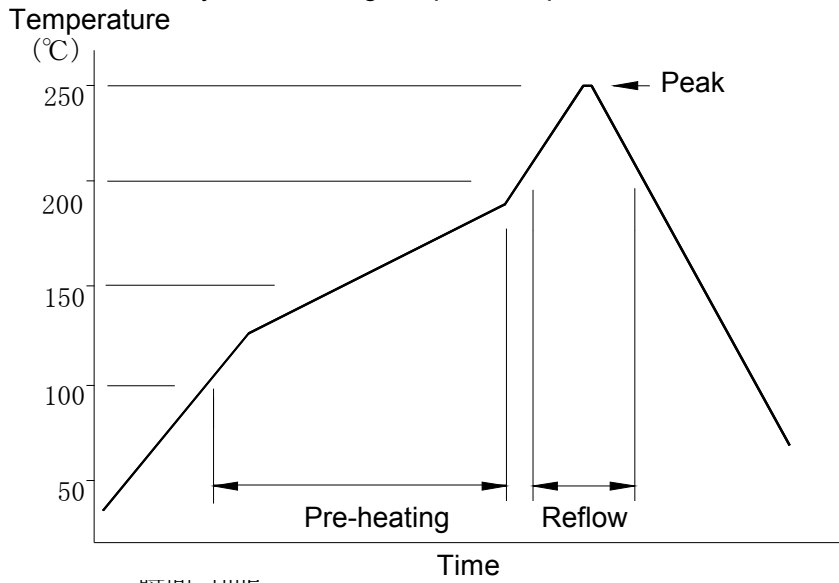
Figure-5 Taping direction:



11. Recommended implementation temperature profile

11.1 Reflow temperature profile

Twice reflows are allowed by the following temperature profile



Surface temperature of resistance and time

Pre-heating	130~180°C	60~90sec
Reflow	220°C Max	30~90sec
Peak	240~260°C	10sec Max

11.2 Flow temperature profile

Less than 260°C 10sec Max

11.3 Hand solder attachment conditions

Work in 3 seconds or less is [temperature of 350°C] possible.

When soldering with a soldering iron, heating is performed on a land and the point does not hit the main part of a product. Please carry out.

## 12. Recommended land pattern (for current sensing)

Board materials: Glass epoxy (FR-4) t=0.6mm

Note:

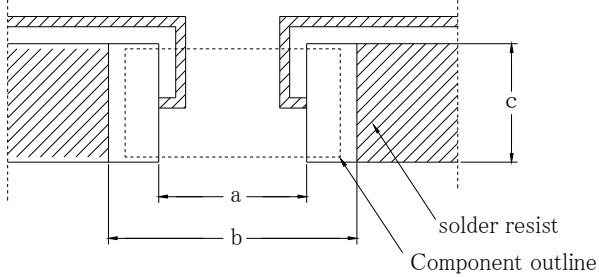
The terminal temperature should not exceed 100°C (M type) or 120°C (C type) at the rated power.

Note:

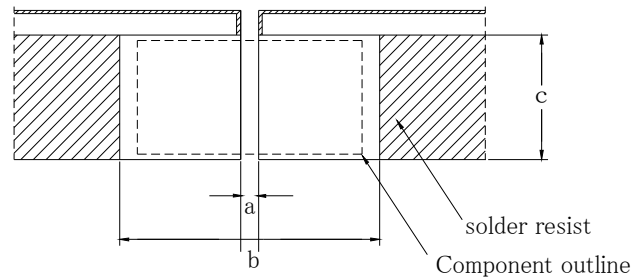
M\* type, C\* type: Product Type ----- See Part number (4)

<Recommended land pattern>

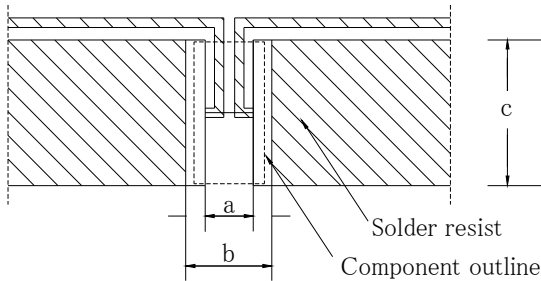
A: Short side electrode



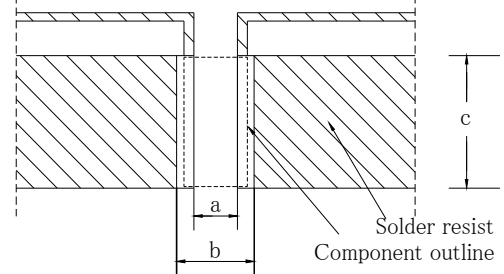
(\*1) CML0816 10~39mΩ



B: Long side electrode



(\*2) CML2012, CML3216,  
CML5025, CML6432 Series: 1.0mΩ



Type of electrode	Part number	Resistance Value Range	Thickness of copper foil (um)	Dimensions (mm)		
				a	b	c
A: Short side electrode	CML0816	10~18mΩ (*1)	35	0.10	2.20	1.00
		20~39mΩ (*1)		0.50		
		43mΩ~	100	0.90		
	CML1220	5mΩ~	100	1.20	2.70	1.50
	CML1632	5~8mΩ		1.00	4.00	1.90
		9mΩ~		2.00		
	CML2550	5~8mΩ		2.20	6.00	2.80
		9mΩ~		3.80		
CML3264	5~8mΩ	2.50		7.40	3.50	
	9mΩ~	4.40				
CML50110	5~7mΩ	2.80	14.0	5.75		
	8mΩ~	5.00				
B: Long side electrode	CML2012	1mΩ (*2)	100	0.25	2.00	2.20
		2mΩ~	35	0.60		
	CML3216	1mΩ (*2)	100	0.40	2.40	3.40
		2mΩ~	35	0.60		
	CML5025	1mΩ (*2)	100	0.70	4.00	5.20
		2mΩ~		1.20		
	CML6432	1mΩ (*2)		0.70	4.20	6.60
		2mΩ~		2.20		
	CML7638	1mΩ		1.10	4.60	7.80
		2mΩ~		2.60		
	CML9045	1mΩ		1.30	5.10	9.20
		2mΩ~		3.10		
CML11050	1mΩ	1.80		5.60	11.2	
	2mΩ~	3.60				



13. Storage note

- (1) To maintain good solderability, Store the components in the temperature and humidity controlled room.  
Temperature: 5~35°C Humidity: 45~85% RH
- (2) Store the components at the place avoiding moisture, dust and corrosive harmful gas (hydrogen chloride, sulfurous acid gas and hydrogen sulfide) that may cause the decrease in solderability.
- (3) Store the components at the place avoiding direct sunlight.