TDK

MULTILAYER CERAMIC CHIP CAPACITORS

CLL Series
Ultra Low Inductance Capacitors

Type: CLLC1A
CLLE1A

Issue date: April 2011

TDK MLCC
US Catalog

Version B11

REMINDERS

Please read before using this product

SAFETY REMINDERS

REMINDERS

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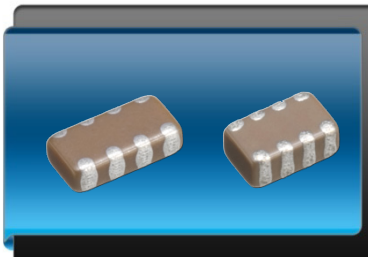


CLL Series

Ultra Low Inductance Capacitors

Type: CLLC1A (C1608), CLLE1A (C2012)

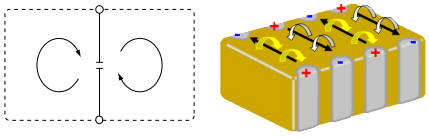
Features

- Features a unique internal structure that cancels magnetic fields to reduce equivalent series inductance
- Eight side terminal electrodes in one capacitor

Applications

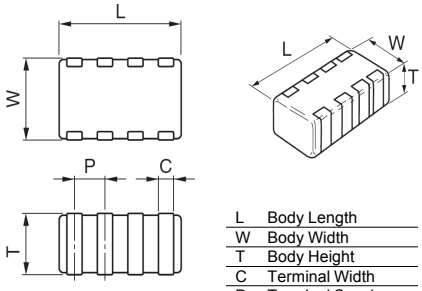
- Decoupling CPU power line
- High speed digital IC/decoupling
- GPU/CPU

Structure



	ULI		FLIP	STD
Chip Size	C1608	C2012	C1632	C2012
Cap.	1µF	1µF	1µF	1µF
W.V.	0G (4V)	0G (4V)	1A (10V)	1A (10V)
ESL	65pH	70pH	180pH	850pH

Shape & Dimensions



Dimensions in mm

L	Body Length
W	Body Width
T	Body Height
C	Terminal Width
P	Terminal Spacing

Part Number Construction

CLLC1A X7R 0J 105 M T XXXX

Series Name

Case Code	Length	Width
CLLC1A	1.60 ± 0.10	0.80 ± 0.10
CLLE1A	2.00 ± 0.15	1.25 ± 0.15

Temperature Characteristic

Temperature Characteristics	Capacitance Change	Temperature Range
X7R	± 15%	-55 to +125ºC
X7S	± 22%	-55 to +125ºC

Rated Voltage (DC)

Voltage Code	Voltage (DC)
0G	4V
0J	6.3V
1A	10V

Internal Codes

Packaging Style

Packaging Code	Style
T	Tape & Reel

Capacitance Tolerance

Tolerance Code	Tolerance
M	± 20%

Nominal Capacitance (pF)

The capacitance is expressed in three digit codes and in units of pico Farads (pF). The first and second digits identify the first and second significant figures of the capacitance. The third digit identifies the multiplier. R designates a decimal point.

Capacitance Code	Capacitance
0R5	0.5pF
010	1pF
102	1,000pF (1nF)
105	1,000,000pF (1µF)

Capacitance Range Chart

CLLC1A [EIA CC0603]

Capacitance Range Chart

Temperature Characteristics: X7S (± 22)

Rated Voltage: 4V (0G)

Capacitance (pF)	Cap Code	Tolerance	X7S 0G (4V)
330,000	334	M: ± 20%	
470,000	474		
680,000	684		
1,000,000	105		

Standard Thickness

0.50 mm

Capacitance Range Table

CLLC1A [EIA CC0603]

Class 2 (Temperature Stable)

Temperature Characteristics: X7S (-55 to +125ºC, ±22%)

TDK Part Number (Ordering Code)	Temperature Characteristics	Rated Voltage	Capacitance (pF)	Capacitance Tolerance	Thickness (mm)
CLLC1AX7S0G334M	X7S	4V	330,000	± 20%	0.50 ± 0.10
CLLC1AX7S0G474M	X7S	4V	470,000	± 20%	0.50 ± 0.10
CLLC1AX7S0G684M	X7S	4V	680,000	± 20%	0.50 ± 0.10
CLLC1AX7S0G105M	X7S	4V	1,000,000	± 20%	0.50 ± 0.10

Capacitance Range Chart

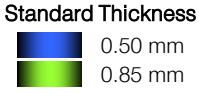
CLLE1A [EIA CC0805]

Capacitance Range Chart

Temperature Characteristics: X7R (± 15%), X7S (± 22)

Rated Voltage: 10V (1A), 6.3V (0J), 4V (0G)

Capacitance (pF)	Cap Code	Tolerance	X7R		X7S
			1A (10V)	0J (6.3V)	0G (4V)
100,000	104	M: ± 20%			
150,000	154				
220,000	224				
330,000	334				
470,000	474				
680,000	684				
1,000,000	105				
1,500,000	155				
2,200,000	225				
4,700,000	475				



Capacitance Range Table

CLLE1A [EIA CC0805]

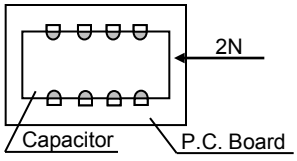
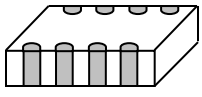
Class 2 (Temperature Stable)

Temperature Characteristics: X7R (-55 to +125ºC, ±15%), X7S (-55 to +125ºC, ±22%)

TDK Part Number (Ordering Code)	Temperature Characteristics	Rated Voltage	Capacitance (pF)	Capacitance Tolerance	Thickness (mm)
CLLE1AX7R1A104M	X7R	10V	100,000	± 20%	0.50 ± 0.10
CLLE1AX7R1A154M	X7R	10V	150,000	± 20%	0.50 ± 0.10
CLLE1AX7R1A224M	X7R	10V	220,000	± 20%	0.50 ± 0.10
CLLE1AX7R1A334M	X7R	10V	330,000	± 20%	0.50 ± 0.10
CLLE1AX7R0J474M	X7R	6.3V	470,000	± 20%	0.50 ± 0.10
CLLE1AX7R0J684M	X7R	6.3V	680,000	± 20%	0.50 ± 0.10
CLLE1AX7R0J105M	X7R	6.3V	1,000,000	± 20%	0.85 ± 0.10
CLLE1AX7R0J155M	X7R	6.3V	1,500,000	± 20%	0.85 ± 0.10
CLLE1AX7S0G105M	X7S	4V	1,000,000	± 20%	0.50 ± 0.10
CLLE1AX7S0G155M	X7S	4V	1,500,000	± 20%	0.50 ± 0.10
CLLE1AX7S0G225M/0.50	X7S	4V	2,200,000	± 20%	0.50 ± 0.10
CLLE1AX7S0G225M/0.85	X7S	4V	2,200,000	± 20%	0.85 ± 0.10
CLLE1AX7S0G475M	X7S	4V	4,700,000	± 20%	0.85 ± 0.10

General Specifications

CLL Series – ULI Capacitors

No.	Item	Performance	Test or Inspection Method
1	**External Appearance**	No defects which may affect performance.	Inspect with magnifying glass (3×).
2	**Insulation Resistance**	100MΩ•μF min.	Apply rated voltage for 60s. Measure 8 terminal electrodes at the same time.
3	**Voltage Proof**	Withstand test voltage without insulation breakdown or other damage.	2.5 times rated voltage (DC) shall be applied for 1 to 5s. Charge / discharge current shall not exceed 50mA. Measure 8 terminal electrodes at the same time.
4	**Capacitance**	Within the specified tolerance at 1000hrs age (Per IEC-384-9).	**Measuring Frequency** / **Withstanding Voltage** / **Measuring voltage** 1kHz±10% / 10V / 1.0 ± 0.2 V_{rms} 1kHz±10% / ≤ 6.3V / 0.5 ± 0.2 V_{rms} Measure 8 terminal electrodes at the same time.
5	**Dissipation Factor (Class 2)**	**T.C.** / **D.F.** X7R, X7S / 0.10 max.	See No.4 in this table for measuring condition.
6	**Temperature Characteristics of Capacitance (Class 2)**	Capacitance Change (%) **No DC Voltage Applied** X7R: ± 15% X7S: ± 22%	Capacitance shall be measured by the steps shown in the following table after thermal equilibrium is obtained for each step. ΔC be calculated ref. STEP 3 reading **Step** / **Temperature (ºC)** 1 / Reference temp. ± 2 2 / Min. operating temp. ± 2 3 / Reference temp. ± 2 4 / Max. operating temp. ± 2
7	**Robustness of Terminations**	No sign of termination coming off, breakage of ceramic, or other abnormal signs.	Reflow solder the capacitor on P.C. board (shown in Appendix 1 and 2) and apply a pushing force of 2N for 10±1s. 
8	**Solderability**	All terminations shall exhibit a continuous solder coating free from defects for a minimum of 75% of the surface area of any individual termination. Anomalies other than dewetting, non-wetting, and pin holes are not cause for rejection. Ceramic surface of A sections shall not be exposed due to melting or shifting of termination material. 	Completely soak both terminations in solder at 235±5°C for 2±0.5s. Solder : H63A (JIS Z 3282) Flux : Isopropyl alcohol (JIS K 8839) Rosin (JIS K 5902) 25% solid solution.

General Specifications

CLL Series – ULI Capacitors

<table>
<tr><th>No.</th><th>Item</th><th>Performance</th><th>Test or Inspection Method</th></tr>
<tr><td>9</td><td>Resistance to solder heat</td><td></td><td rowspan="5">Completely soak both terminations in solder at 260±5ºC for 5±1s.
Preheating condition
Temp. : 150±10ºC
Time : 1 to 2min.
Flux : Isopropyl alcohol (JIS K 8839)
Rosin (JIS K 5902) 25% solid solution.
Solder : H63A (JIS Z 3282)
Leave the capacitor in ambient conditions for 24±2h before measurement.</td></tr>
<tr><td></td><td>External appearance</td><td>No cracks are allowed and terminations shall be covered at least 60% with new solder</td></tr>
<tr><td></td><td>Capacitance</td><td><table><tr><th>Characteristics</th><th>Change from the value before test</th></tr><tr><td>X7R
X7S</td><td>± 7.5 %</td></tr></table></td></tr>
<tr><td></td><td>D.F. (Class 2)</td><td>Meet the initial spec.</td></tr>
<tr><td></td><td>Insulation Resistance</td><td>Meet the initial spec.</td></tr>
<tr><td>10</td><td>Vibration</td><td></td><td rowspan="4">Reflow solder the capacitor on a P.C. board (shown in Appendix 1 and 2) before testing.
Vibrate the capacitor with amplitude of1.5mm P-P sweeping the frequencies from 10Hz to 55Hz and back to 10Hz in about 1 minute.
Repeat this for 2h each in 3 perpendicular directions (6h in total).</td></tr>
<tr><td></td><td>External appearance</td><td>No mechanical damage.</td></tr>
<tr><td></td><td>Capacitance</td><td><table><tr><th>Characteristics</th><th>Change from the value before test</th></tr><tr><td>X7R
X7S</td><td>± 7.5 %</td></tr></table></td></tr>
<tr><td></td><td>D.F. (Class 2)</td><td>Meet the initial spec.</td></tr>
<tr><td>11</td><td>Temperature cycle</td><td></td><td rowspan="5">Reflow solder the capacitors on a P.C. board (shown in Appendix 1 and 2) before testing.
Expose the capacitor in the condition step1 through step 4, and repeat 5 times consecutively.
Leave the capacitor in ambient conditions for 24±2h before measurement.<table><tr><th>Step</th><th>Temperature (ºC)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. operating temp. ±3</td><td>30 ± 3</td></tr><tr><td>2</td><td>Reference Temp.</td><td>2 – 5</td></tr><tr><td>3</td><td>Max. operating temp. ± 2</td><td>30 ± 2</td></tr><tr><td>4</td><td>Reference Temp.</td><td>2 - 5</td></tr></table></td></tr>
<tr><td></td><td>External appearance</td><td>No mechanical damage.</td></tr>
<tr><td></td><td>Capacitance</td><td><table><tr><th>Characteristics</th><th>Change from the value before test</th></tr><tr><td>X7R
X7S</td><td>± 7.5 %</td></tr></table></td></tr>
<tr><td></td><td>D.F. (Class 2)</td><td>Meet the initial spec.</td></tr>
<tr><td></td><td>Insulation Resistance</td><td>Meet the initial spec.</td></tr>
<tr><td></td><td>Voltage Proof</td><td>No insulation breakdown or other damage.</td></tr>
</table>

General Specifications

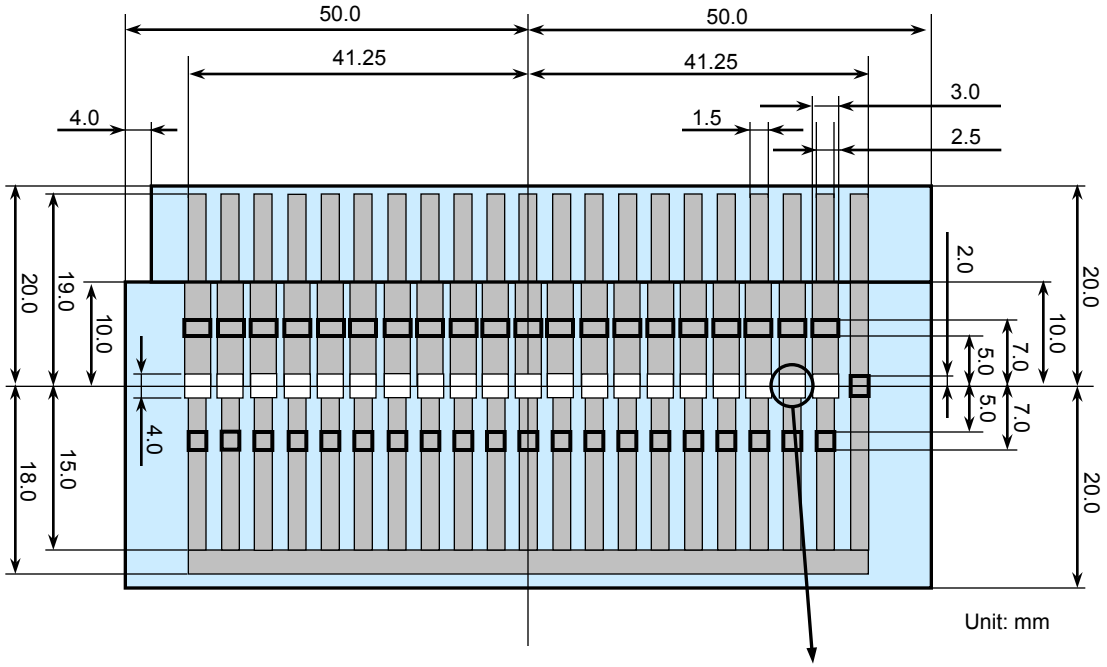
CLL Series – ULI Capacitors

No.	Item	Performance	Test or Inspection Method
12	**Moisture Resistance (Steady State)**		Reflow solder the capacitor on P.C. board (shown in Appendix 1 and 2) before testing. Leave at temperature 40±2ºC and 90 to 95%RH for 500 +24,0h. Leave the capacitor in ambient condition for 24±2h before measurement.
	External appearance	No mechanical damage.	
	Capacitance	**Characteristics** / **Change from the value before test**: X7R, X7S / ± 12.5 %	
	D.F. (Class 2)	Characteristics: X7R: 200% of initial spec. max. X7S: 200% of initial spec. max.	
	Insulation Resistance	10MΩ·μF min.	
13	**Moisture Resistance**		Reflow solder the capacitors on P.C. board (shown in Appendix 1 and 2) before testing. Apply the rated voltage at temperature 40±2ºC and 90 to 95%RH for 500 +24,0h. Charge/discharge current shall not exceed 50mA. Leave the capacitor in ambient conditions for 48±4h before measurement. Voltage conditioning: Voltage treat the capacitors under testing temperature and voltage for 1 hour. Leave the capacitors in ambient condition for 24±2h before measurement. Use this measurement for initial value.
	External appearance	No mechanical damage.	
	Capacitance	**Characteristics** / **Change from the value before test**: X7R, X7S / ± 12.5 %	
	D.F. (Class 2)	Characteristics X7R: 200% of initial spec. max. X7S: 200% of initial spec. max.	
	Insulation Resistance	5MΩ·μF min.	
14	**Life**		Reflow solder the capacitor on P.C. board (shown in Appendix 1 and 2) before testing. Apply 1 x rated voltage at 125±2ºC for 1,000 +48, 0h. Charge/discharge current shall not exceed 50mA. Leave the capacitors in ambient condition for 24±2h before measurement. Voltage conditioning: Voltage treat the capacitor under testing temperature and voltage for 1 hour. Leave the capacitor in ambient conditions for 48±4h before measurement. Use this measurement for initial value.
	External appearance	No mechanical damage.	
	Capacitance	**Characteristics** / **Change from the value before test**: X7R, X7S / ± 15 %	
	D.F. (Class 2)	Characteristics X7R: 200% of initial spec. max. X7S: 200% of initial spec. max.	
	Insulation Resistance	10MΩ·μF min.	

Appendix - 1

P.C. Board for reliability test

Applied for CLLC1A



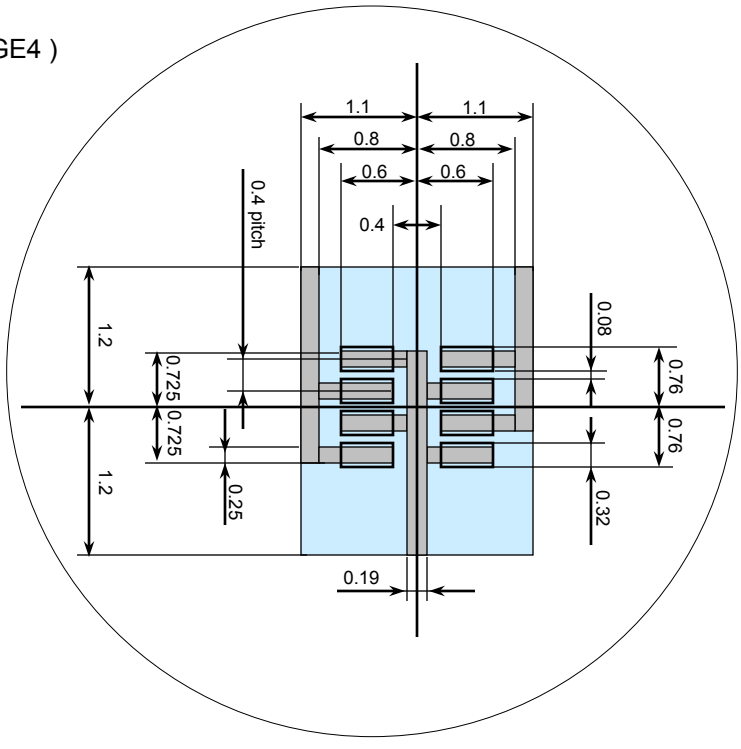
Unit: mm

Material: Glass Epoxy (As per JIS C6484 GE4)

P.C. Board thickness: 0.8mm

Copper (thickness 0.035mm)

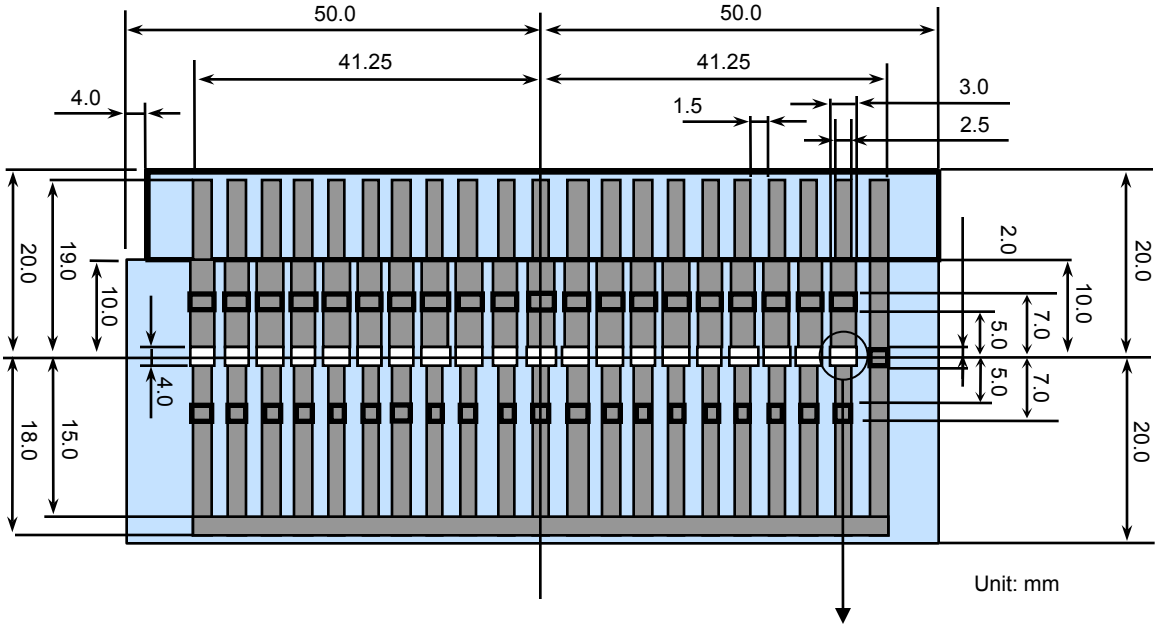
Solder resist



Appendix - 2

P.C. Board for reliability test

Applied for CLLE1A



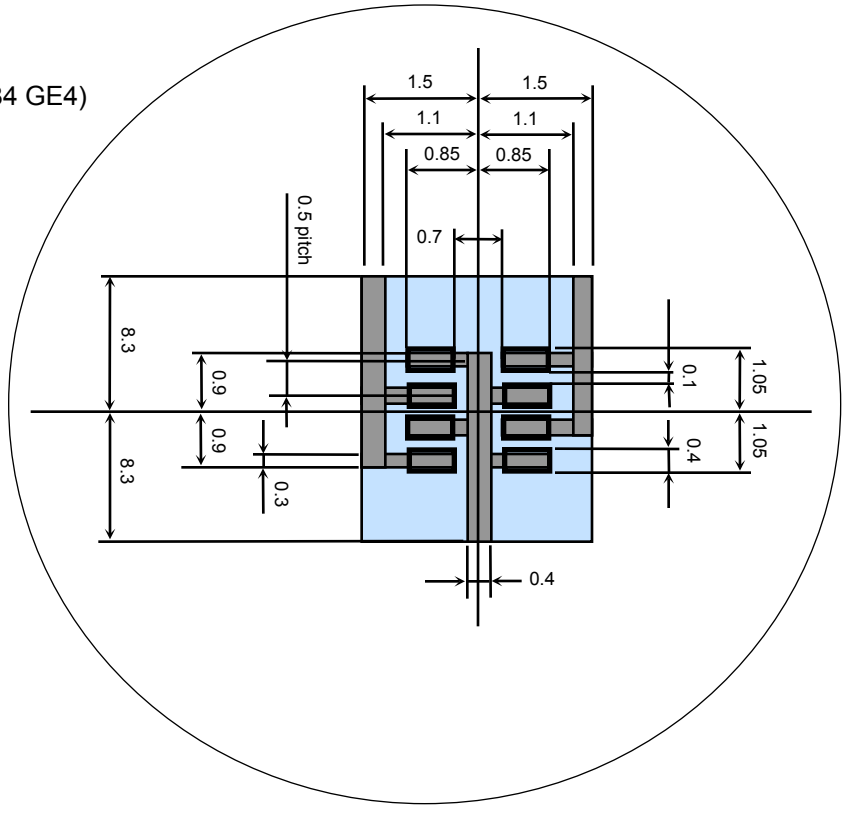
Unit: mm

Material: Glass Epoxy (As per JIS C6484 GE4)

P.C. Board thickness: 1.6mm

Copper (thickness 0.035mm)

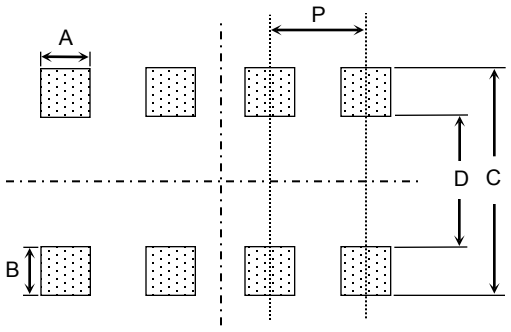
Solder resist



Soldering Information

CLL Series – ULI Capacitors

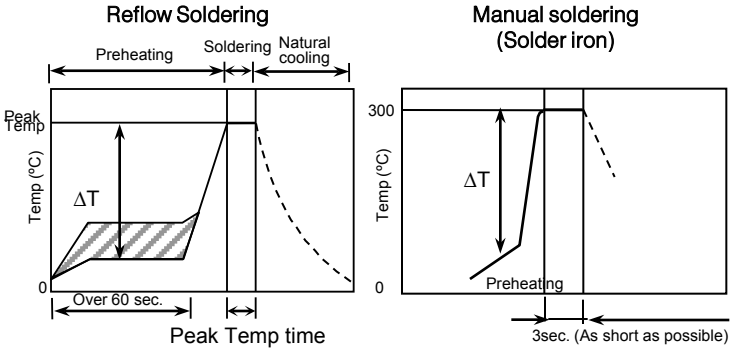
• Recommended Soldering Land Pattern



Reflow Soldering Unit: mm

Symbol \ Type	CLLC1A (C1608/CC0603)	CLLE1A (C2012/CC0805)
A	0.25	0.3
B	0.4	0.3 ~ 0.6
C	1.2	1.3 ~ 1.8
D	0.4	0.5 ~ 0.8
P	0.4	0.5

• Recommended Soldering Profile



Recommended soldering duration

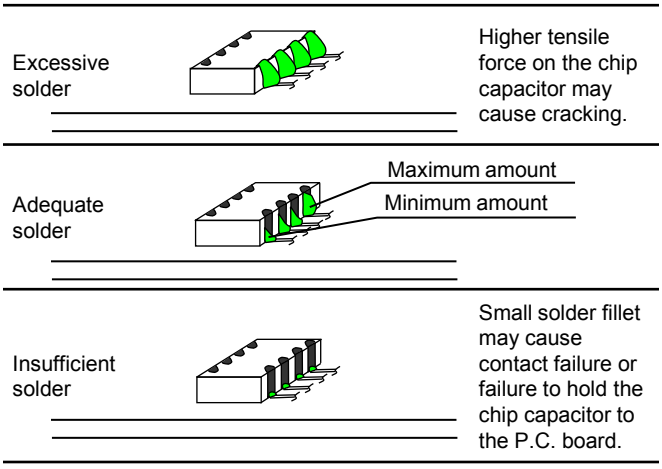
Solder \ Temp./Dura.	Reflow Soldering	
	Peak temp (°C)	Duration (sec.)
Sn-Pb Solder	230 max.	20 max.
Lead-Free Solder	260 max.	10 max.

Recommended solder compositions
Sn-37Pb (Sn-Pb solder)
Sn-3.0Ag-0.5Cu (Lead Free Solder)

Preheating Condition

Soldering	Temp. (°C)
Reflow soldering	ΔT ≤ 150
Manual soldering	ΔT ≤ 150

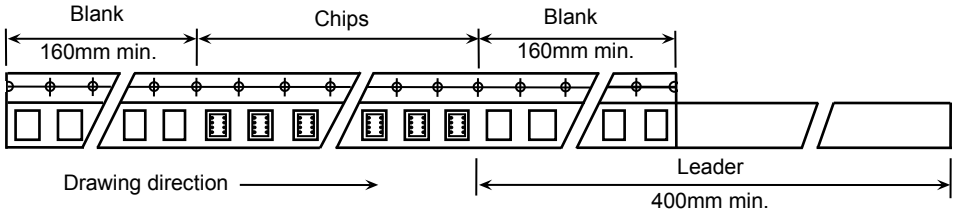
• Recommended Solder Amount



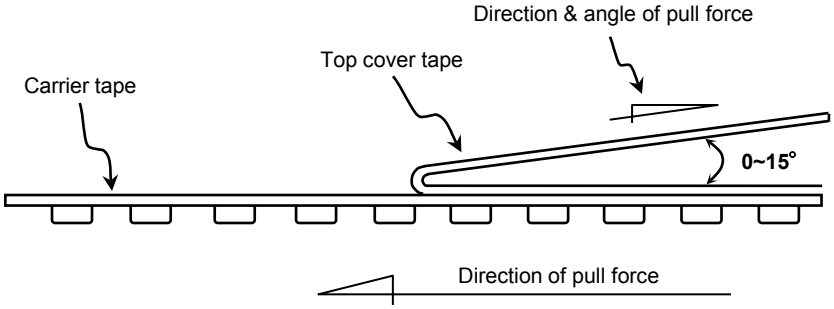
Packaging Information

CLL Series – ULI Capacitors

- Carrier Tape Configuration

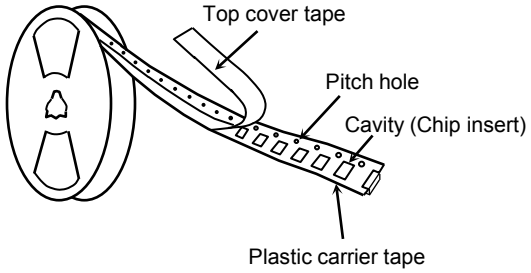


- Peel Back Force (Top Tape)



- Carrier tape shall be flexible enough to be wound around a minimum radius of 30mm with components in tape.
- The missing of components shall be less than 0.1%
- Components shall not stick to the cover tape.
- The cover tape shall not protrude beyond the edges of the carrier tape and shall not cover the sprocket holes.

- Chip Quantity Per Reel and Structure of Reel

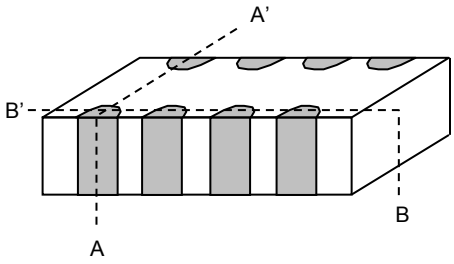


Series	Taping Material	Chip quantity (pcs.)	
		φ178mm (7") reel	φ330mm (13") reel
CLLC1A	Plastic	4,000	10,000
CLLE1A		4,000	10,000

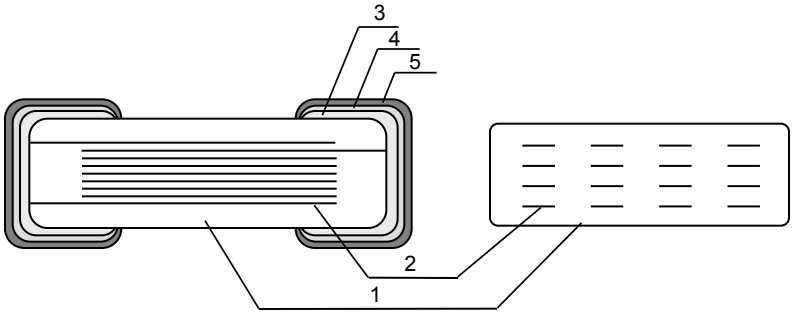
Additional Information

CLL Series – ULI Capacitors

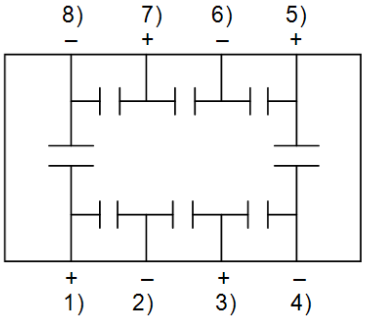
• Inside Structure & Material System



No.	NAME	MATERIAL
		Class 2
(1)	Ceramic Dielectric	$BaTiO_3$
(2)	Internal Electrode	Nickel (Ni)
(3)	Termination	Copper (Cu)
(4)		Nickel (Ni)
(5)		Tin (Sn)



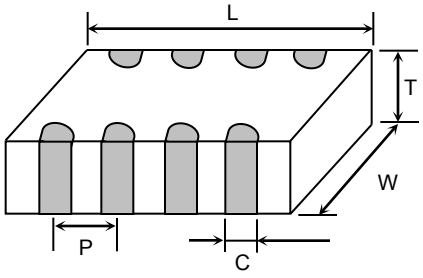
• Equivalent Circuit



+ 1) 3) 5) 7)
- 2) 4) 6) 8)

8 terminals are connected and measured at the same time.

• Shape & Dimensions



Case Code			Dimensions (mm)				
Series	JIS	EIA	L	W	T	P	C
CLLC1A	C1608	CC0603	1.60	0.80	0.55 max.	0.40	0.25
CLLE1A	C2012	CC0805	2.00	1.25	0.95 max.	0.50	0.25

• Environmental Information

TDK Corporation established internal product environmental assurance standards that include the six hazardous substances banned by the EU RoHS Directive[1] enforced on July 1, 2006 along with additional substances independently banned by TDK and has successfully completed making general purpose electronic components conform to the RoHS Directive[2].

1. Abbreviation for Restriction on Hazardous Substances, which refers to the regulation EU Directive 2002/95/EC on hazardous substances by the European Union (EU) effective from July 1, 2006. The Directive bans the use of six specific hazardous substances in electric and electronic devices and products handled within the EU. The six substances are lead, mercury, cadmium, hexavalent chromium, PBB (polybrominated biphenyls), and PBDE (polybrominated diphenyl ethers).

2. This means that, in conformity with the EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

For REACH (SVHC : 15 substances according to ECHA / October 2008) : All TDK MLCC do not contain these 15 substances.

For European Directive 2000/53/CE and 2005/673/CE : Cadmium, Hexavalent Chromium, Mercury, Lead are not contained in all TDK MLCC.

For European Directive 2003/11/CE : Pentabromodiphenyl-ether, Octabromodiphenyl-ether are not contained in all TDK MLCC.