

# DELIVERY SPECIFICATION

SPEC. No. A-Glue-e

D A T E : Jun., 2022

To

## Non-Controlled Copy

CUSTOMER'S PRODUCT NAME	TDK PRODUCT NAME MULTILAYER CERAMIC CHIP CAPACITORS (Conductive glue) Bulk and Tape packaging 【RoHS compliant】 CGA2, CGA3, CGA4, CGA5, CGA6 Type C0G, NP0, X7R, X8R Characteristics
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Please return this specification to TDK representatives with your signature.

If orders are placed without returned specification, please allow us to judge that specification is accepted by your side.

## RECEIPT CONFIRMATION

DATE: \_\_\_\_\_ YEAR \_\_\_\_\_ MONTH \_\_\_\_\_ DAY \_\_\_\_\_

Test conditions in this specification based on AEC-Q200 for automotive application.

TDK Corporation

Sales

Electronic Components

Sales & Marketing Group

Engineering

Electronic Components Business Company

Ceramic Capacitors Business Group

APPROVED	Person in charge	APPROVED	CHECKED	Person in charge

**SCOPE**

This delivery specification shall be applied to Multilayer ceramic chip capacitors to be delivered to \_\_\_\_\_.

**PRODUCTION PLACES**

Production places defined in this specification shall be TDK Corporation, TDK(Suzhou)Co.,Ltd and TDK Components U.S.A.,Inc.

**PRODUCT NAME**

The name of the product to be defined in this specifications shall be CGA◇◇◇○○○△△□□×◎※※※B.

**REFERENCE STANDARD**

JIS C 5101-1 : 2010	Fixed capacitors for use in electronic equipment-Part 1: Generic specification
C 5101-21 : 2014	Fixed capacitors for use in electronic equipment-Part21 : Sectional specification : Fixed surface mount multilayer capacitors of ceramic dielectric,Class1
C 5101-22 : 2014	Fixed capacitors for use in electronic equipment-Part22 : Sectional specification : Fixed surface mount multilayer capacitors of ceramic dielectric,Class 2
C 0806-3 : 2014	Packaging of components for automatic handling - Part 3: Packaging of surface mount components on continuous tapes
JEITA RCR-2335 C 2014	Safety application guide for fixed ceramic capacitors for use in electronic equipment

**COONTENTS**

1. CODE CONSTRUCTION
2. COMBINATION OF RATED CAPACITANCE AND TOLERANCE
3. OPERATING TEMPERATURE RANGE
4. STORING CONDITION AND TERM
5. CAUTION FOR CONDUCTIVE GLUE MOUNTING PRODUCTS
6. INDUSTRIAL WASTE DISPOSAL
7. PERFORMANCE
8. INSIDE STRUCTURE AND MATERIAL
9. PACKAGING
10. CAUTION
11. TAPE PACKAGING SPECIFICATION

**<EXPLANATORY NOTE>**

When the mistrust in the spec arises, this specification is given priority. And it will be confirmed by written spec change after conference of both posts involved.

This specification warrants the quality of the ceramic chip capacitor. Capacitors should be evaluated or confirmed a state of mounted on your product.

If the use of the capacitors goes beyond the bounds of this specification, we can not afford to guarantee.

Division	Date	SPEC. No.
Ceramic Capacitors Business Group	June, 2022	A-Glue-e

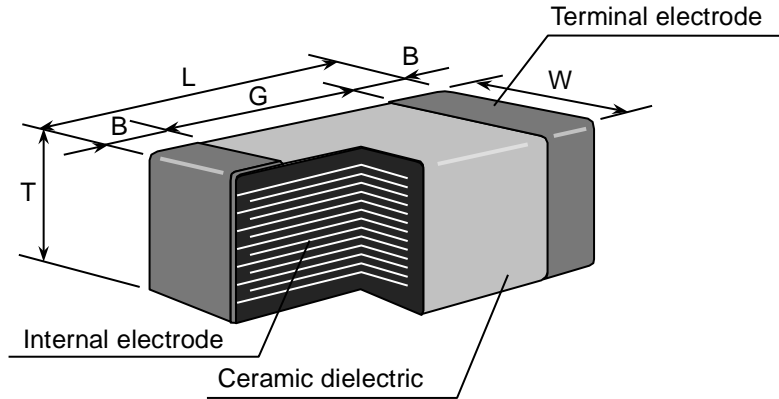
## 1. CODE CONSTRUCTION

(Example) CGA 3 E 2 X8R 1 H 103 K T ※※※B  
 (1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

(1) Series

Symbol	Series
CGA	For automotive application

(2) Case size



Case size Symbol	Case size (EIA style)	Dimensions (Unit : mm)				
		L	W	T	B	G
2	CGA2 (CC0402)	1.00±0.15	0.50±0.10	0.50±0.10	0.10 min.	0.30 min.
3	CGA3 (CC0603)	1.60±0.15	0.80±0.15	0.80±0.15	0.20 min.	0.30 min.
4	CGA4 (CC0805)	2.00±0.25	1.25±0.25	0.60±0.15	0.20 min.	0.50 min.
				0.85±0.15		
				1.25±0.25		
		2.00 <sup>+0.35</sup> <sub>-0.25</sub>	1.25 <sup>+0.30</sup> <sub>-0.25</sub>	1.25 <sup>+0.30</sup> <sub>-0.25</sub>		
5	CGA5 (CC1206)	3.20 <sup>+0.30</sup> <sub>-0.10</sub>	1.60 <sup>+0.30</sup> <sub>-0.10</sub>	0.60±0.15	0.20 min.	1.00 min.
				0.85±0.15		
				1.15±0.15		
				1.60 <sup>+0.30</sup> <sub>-0.10</sub>		
6	CGA6 (CC1210)	3.20±0.45	2.50±0.30	1.60±0.20	0.20 min.	—
				2.00±0.20		
				2.50±0.30		

\*As for each item, please refer to detail page on TDK web.

(3) Thickness

Symbol	Dimension(mm)	Symbol	Dimension(mm)
B	0.50	J	1.25
C	0.60	L	1.60
E	0.80	M	2.00
F	0.85	P	2.50
H	1.15		

## (4) Voltage condition in the life test

\* Details are shown in table1 No.13 at 7.PERFORMANCE.

Symbol	Condition
1	Rated Voltage
2	Rated Voltage x 2
3	Rated Voltage x 1.5

## (5) Temperature Characteristics

\* Details are shown in table 1 No.6 and No.7 at 7.PERFORMANCE.

## (6) Rated Voltage

Symbol	Rated Voltage
2 A	DC 100 V
1 H	DC 50 V
1 V	DC 35 V
1 E	DC 25 V
1 C	DC 16 V
0 J	DC 6.3 V

## (7) Rated Capacitance

(Example)

Stated in three digits 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 is designated for a decimal point.

Symbol	Rated Capacitance
2R2	2.2 pF
106	10,000,000 pF

## (8) Capacitance tolerance

\* M tolerance shall be standard for over 10uF.

Symbol	Tolerance	Capacitance
C	± 0.25 pF	10pF and under
D	± 0.5 pF	
J	± 5 %	Over 10pF
K	± 10 %	
*M	± 20 %	

## (9) Packaging

Symbol	Packaging
B	Bulk
T	Taping

## (10) TDK internal code

※※※ B

└──┬── B : For conductive glue mounting

└──┬── These TDK internal codes are subject to change without notice.

## 2. COMBINATION OF RATED CAPACITANCE AND TOLERANCE

Class	Temperature Characteristics	Capacitance tolerance		Rated capacitance
1	C0G NP0	10pF and under	C ( $\pm 0.25\text{pF}$ )	1, 1.5, 2, 2.2, 3, 3.3, 4, 4.7, 5
			D ( $\pm 0.5\text{pF}$ )	6, 6.8, 7, 8, 9, 10
		Over 10pF	J ( $\pm 5\%$ ) K ( $\pm 10\%$ )	E – 12 series
2	X7R X8R	K ( $\pm 10\%$ ) M ( $\pm 20\%$ )		E – 6 series

### Capacitance Step in E series

E series	Capacitance Step											
E-6	1.0		1.5		2.2		3.3		4.7		6.8	
E-12	1.0	1.2	1.5	1.8	2.2	2.7	3.3	3.9	4.7	5.6	6.8	8.2

## 3. OPERATING TEMPERATURE RANGE

T.C.	Min. operating Temperature	Max. operating Temperature	Reference Temperature
C0G	-55°C	125°C	25°C
NP0	-55°C	150°C	25°C
X7R	-55°C	125°C	25°C
X8R	-55°C	150°C	25°C

## 4. STORING CONDITION AND TERM

Storing temperature	Storing humidity	Storing term
5~40°C	20~70%RH	Within 6 months upon receipt.

## 5. INDUSTRIAL WASTE DISPOSAL

Dispose this product as industrial waste in accordance with the Industrial Waste Law.

## 6. CAUTION FOR CONDUCTIVE GLUE MOUNTING PRODUCTS

This product is to be mounted by glue including Ag (Silver) as a conductive material.

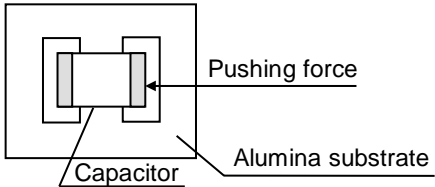
To avoid electromigration of Ag and failures caused by corrosive gas, chip capacitors on P.C boards should be protected by moisture proof-sealing, such as silicon or equivalent, and/or a sealed package.

## 7. PERFORMANCE

Table 1

No.	Item	Performance	Test or inspection method												
1	External Appearance	No defects which may affect performance.	Inspect with magnifying glass (3×)												
2	Insulation Resistance	10,000MΩ or 500MΩ·μF min. (As for the capacitors of rated voltage 16V DC and lower, 100MΩ·μF min.,) whichever smaller.	Measuring voltage : Rated voltage Voltage application time : 60s.												
3	Voltage Proof	Withstand test voltage without insulation breakdown or other damage.	Class 1 : 3 times of rated voltage Class 2 : 2.5 times of rated voltage Voltage application time : 1s. Charge / discharge current : 50mA or lower												
4	Capacitance	Within the specified tolerance.	《Class 1》 <table border="1"> <thead> <tr> <th>Capacitance</th> <th>Measuring frequency</th> <th>Measuring voltage</th> </tr> </thead> <tbody> <tr> <td>1000pF and under</td> <td>1MHz±10%</td> <td rowspan="2">0.5 ~ 5 Vrms.</td> </tr> <tr> <td>Over 1000pF</td> <td>1kHz±10%</td> </tr> </tbody> </table> 《Class 2》 <table border="1"> <thead> <tr> <th>Measuring frequency</th> <th>Measuring voltage</th> </tr> </thead> <tbody> <tr> <td>1kHz±10%</td> <td>1.0±0.2Vrms</td> </tr> </tbody> </table> As for the capacitors of rated voltage 6.3V DC, 0.5Vrms is applied.	Capacitance	Measuring frequency	Measuring voltage	1000pF and under	1MHz±10%	0.5 ~ 5 Vrms.	Over 1000pF	1kHz±10%	Measuring frequency	Measuring voltage	1kHz±10%	1.0±0.2Vrms
Capacitance	Measuring frequency	Measuring voltage													
1000pF and under	1MHz±10%	0.5 ~ 5 Vrms.													
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5	<table border="1"> <tr> <td>Q</td> <td>Class1</td> </tr> <tr> <td>Dissipation Factor</td> <td>Class2</td> </tr> </table>	Q	Class1	Dissipation Factor	Class2	Please refer to detail page on TDK web.	See No.4 in this table for measuring condition.								
Q	Class1														
Dissipation Factor	Class2														
6	Temperature Characteristics of Capacitance (Class1)	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Temperature Coefficient (ppm/°C)</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>0 ± 30</td> </tr> <tr> <td>NP0</td> <td>0 ± 30</td> </tr> </tbody> </table> <table border="1"> <tr> <td>Capacitance drift</td> <td>Within ± 0.2% or ± 0.05pF, whichever larger.</td> </tr> </table>	T.C.	Temperature Coefficient (ppm/°C)	C0G	0 ± 30	NP0	0 ± 30	Capacitance drift	Within ± 0.2% or ± 0.05pF, whichever larger.	Temperature coefficient shall be calculated based on values at 25°C and 85°C temperature.  Measuring temperature below 25°C shall be -10°C and -25°C.				
T.C.	Temperature Coefficient (ppm/°C)														
C0G	0 ± 30														
NP0	0 ± 30														
Capacitance drift	Within ± 0.2% or ± 0.05pF, whichever larger.														

(continued)

No.	Item	Performance	Test or inspection method																		
7	Temperature Characteristics of Capacitance (Class2)	<p style="text-align: center;">Capacitance Change (%)</p> <hr/> <p style="text-align: center;">No voltage applied</p> <hr/> <p style="text-align: center;">X7R : ± 15 X8R : ± 15</p> <hr/>	<p>Capacitance shall be measured by the steps shown in the following table after thermal equilibrium is obtained for each step. ΔC be calculated ref. STEP3 reading</p> <table border="1" data-bbox="975 376 1442 647"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Reference temp. ± 2</td> </tr> <tr> <td>2</td> <td>Min. operating temp. ± 3</td> </tr> <tr> <td>3</td> <td>Reference temp. ± 2</td> </tr> <tr> <td>4</td> <td>Max. operating temp. ± 2</td> </tr> </tbody> </table> <p>As for Min./ Max. operating temp. and Reference temp., please refer to "3.OPERATING TEMPERATURE RANGE". As for measuring voltage, please contact with our sales representative.</p>	Step	Temperature(°C)	1	Reference temp. ± 2	2	Min. operating temp. ± 3	3	Reference temp. ± 2	4	Max. operating temp. ± 2								
Step	Temperature(°C)																				
1	Reference temp. ± 2																				
2	Min. operating temp. ± 3																				
3	Reference temp. ± 2																				
4	Max. operating temp. ± 2																				
8	Robustness of Terminations	No sign of termination coming off, breakage of ceramic, or other abnormal signs.	<p>Mount the capacitors on an Alumina substrate shown in Appendix 1 with conductive glue. Apply a pushing force gradually at the center of a specimen in a horizontal direction of P.C.board. Pushing force : 5N (2N is applied for CGA2 type.) Holding time : 10±1s.</p>  <p>The diagram shows a rectangular capacitor mounted on a larger rectangular alumina substrate. A horizontal arrow labeled 'Pushing force' points to the center of the capacitor. Labels 'Capacitor' and 'Alumina substrate' are connected to their respective parts by lines.</p>																		
9	Vibration	<table border="1" data-bbox="331 1323 938 1883"> <tr> <td data-bbox="331 1323 499 1406">External appearance</td> <td colspan="2" data-bbox="499 1323 938 1406">No mechanical damage.</td> </tr> <tr> <td data-bbox="331 1406 499 1682">Capacitance</td> <td data-bbox="499 1406 699 1682"> <table border="1"> <thead> <tr> <th>Characteristics</th> <th>Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>Class1 COG NP0</td> <td>± 2.5% or ± 0.25pF, whichever larger.</td> </tr> <tr> <td>Class2 X7R X8R</td> <td>± 7.5 %</td> </tr> </tbody> </table> </td> <td data-bbox="699 1406 938 1682"></td> </tr> <tr> <td data-bbox="331 1682 499 1787">Q (Class1)</td> <td colspan="2" data-bbox="499 1682 938 1787">Meet the initial spec.</td> </tr> <tr> <td data-bbox="331 1787 499 1883">D.F. (Class2)</td> <td colspan="2" data-bbox="499 1787 938 1883">Meet the initial spec.</td> </tr> </table>	External appearance	No mechanical damage.		Capacitance	<table border="1"> <thead> <tr> <th>Characteristics</th> <th>Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>Class1 COG NP0</td> <td>± 2.5% or ± 0.25pF, whichever larger.</td> </tr> <tr> <td>Class2 X7R X8R</td> <td>± 7.5 %</td> </tr> </tbody> </table>	Characteristics	Change from the value before test	Class1 COG NP0	± 2.5% or ± 0.25pF, whichever larger.	Class2 X7R X8R	± 7.5 %		Q (Class1)	Meet the initial spec.		D.F. (Class2)	Meet the initial spec.		<p>Applied force : 5G max. Frequency : 10~2,000Hz Reciprocating sweep time : 20 min. Cycle : 12 cycles in each 3 mutually perpendicular directions.</p> <p>Mount the capacitors on an Alumina substrate shown in Appendix 1 with conductive glue before testing.</p>
External appearance	No mechanical damage.																				
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Q (Class1)	Meet the initial spec.																				
D.F. (Class2)	Meet the initial spec.																				

(continued)

No.	Item	Performance	Test or inspection method	
10	Temperature cycle	External appearance	No mechanical damage.	
	Capacitance	Characteristics	Change from the value before test	
		Class1	C0G NP0	Please contact with our sales representative.
		Class2	X7R X8R	
		Q (Class1)	Meet the initial spec.	
D.F. (Class2)	Meet the initial spec.			
Insulation Resistance	Meet the initial spec.		Leave the capacitors in ambient condition for Class 1 : 6~24h Class 2 : 24±2h before measurement.	
Voltage proof	No insulation breakdown or other damage.		Mount the capacitors on an Alumina substrate shown in Appendix 1 with conductive glue before testing.	
11	Moisture Resistance (Steady State)	External appearance	No mechanical damage.	
	Capacitance	Characteristics	Change from the value before test	
		Class1	C0G NP0	Please contact with our sales representative.
		Class2	X7R X8R	
		Q (Class1)	Capacitance	
D.F. (Class2)	200% of initial spec. max.			
Insulation Resistance	1,000MΩ or 50MΩ·μF min. (As for the capacitors of rated voltage 16V DC and lower, 10MΩ·μF min.,) whichever smaller.		Test temp. : 40±2°C Test humidity : 90~95%RH  Test time : 500 +24,0h  Leave the capacitors in ambient condition for Class 1 : 6~24h Class 2 : 24±2h before measurement.  Mount the capacitors on an Alumina substrate shown in Appendix 1 with conductive glue before testing.	

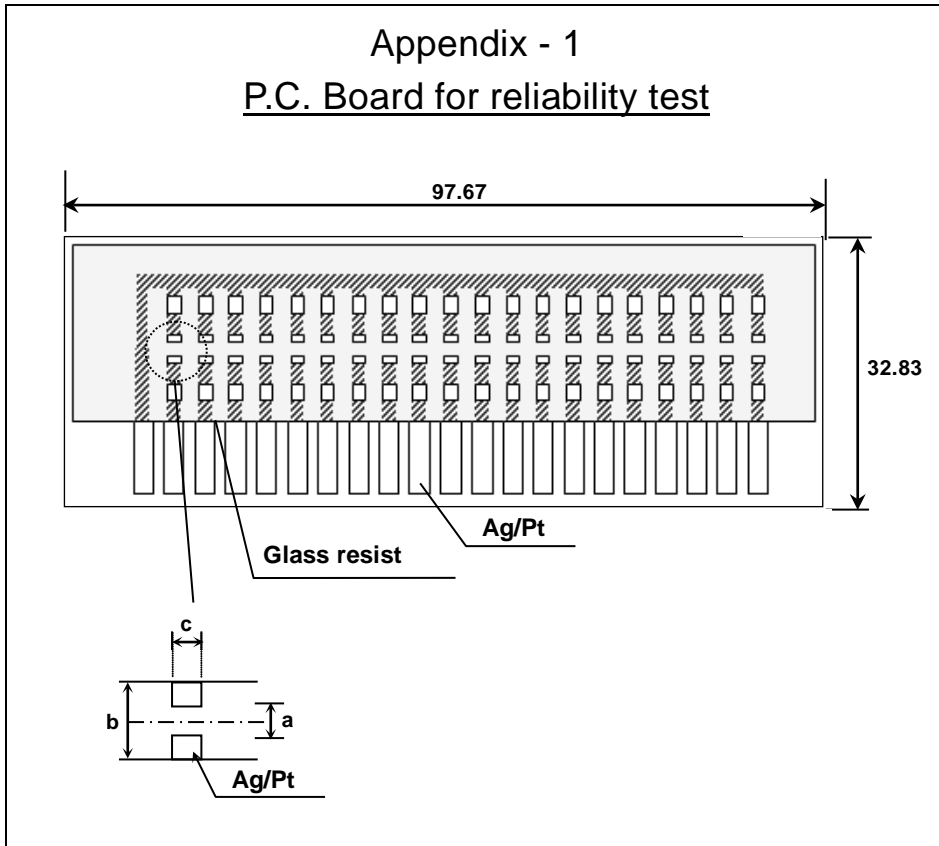


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No.	Item		Performance		Test or inspection method	
12	Moisture Resistance	External appearance	No mechanical damage.		Test temp. : 85±2°C Test humidity : 85%RH Applied voltage : Rated voltage Test time : 1,000 +48,0h  Charge/discharge current : 50mA or lower  Leave the capacitors in ambient condition for Class 1 : 6~24h Class 2 : 24±2h before measurement.  Mount the capacitors on an Alumina substrate shown in Appendix 1 with conductive glue before testing.  Initial value setting (only for class 2) Voltage conditioning «After 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.	
		Capacitance	Characteristics			Change from the value before test
			Class1	C0G NP0		Please contact with our sales representative.
			Class2	X7R X8R		
		Q (Class1)	Capacitance	Q		
30pF and over	200 min.					
Under 30pF	100+10/3×C min.					
C : Rated capacitance (pF)						
D.F. (Class2)	200% of initial spec. max.					
Insulation Resistance	500MΩ or 25MΩ·μF min. (As for the capacitors of rated voltage 16V DC and lower, 5MΩ·μF min.,) whichever smaller.					
13	Life	External appearance	No mechanical damage.		Test temp. : Maximum operating temperature±2°C Applied voltage : Please contact with our sales representative. Test time : 1,000 +48,0h  Charge/discharge current : 50mA or lower  Leave the capacitors in ambient condition for Class 1 : 6~24h Class 2 : 24±2h before measurement.  Mount the capacitors on an Alumina substrate shown in Appendix 1 with conductive glue before testing.  Initial value setting (only for class 2) Voltage conditioning «After 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.	
		Capacitance	Characteristics			Change from the value before test
			Class1	C0G NP0		Please contact with our sales representative.
			Class2	X7R X8R		
		Q (Class1)	Capacitance	Q		
30pF and over	350 min.					
10pF and over under 30pF	275+5/2×C min.					
C : Rated capacitance (pF)						
D.F. (Class2)	200% of initial spec. max.					
Insulation Resistance	1,000MΩ or 50MΩ·μF min. (As for the capacitors of rated voltage 16V DC and lower, 10MΩ·μF min.,) whichever smaller.					

\*As for the initial measurement of capacitors (Class2) on number 7,9,10 and 11 leave capacitors at 150 0,-10°C for 1 hour and measure the value after leaving capacitors for 24±2h in ambient condition.

Appendix - 1  
P.C. Board for reliability test

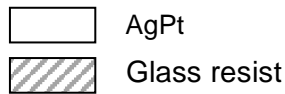


(Unit : mm)

Symbol	Dimensions		
	a	b	c
CGA2 (CC0402)	0.5	1.4	0.5
CGA3 (CC0603)	0.7	2.2	1.2
CGA4 (CC0805)	0.7	2.7	1.75
CGA5 (CC1206)	1.7	3.9	2.05
CGA6 (CC1210)	1.8	4.4	3.0

1. Material : Alumina substrate

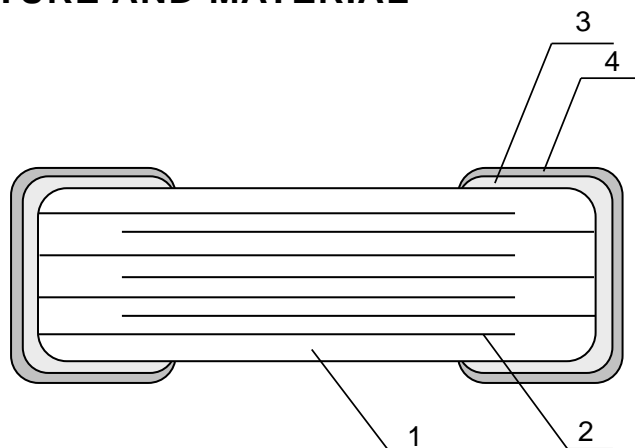
2. Thickness : 0.8mm



3. Caution for mounting with conductive glue

(Refer to the page 13.)

## 8. INSIDE STRUCTURE AND MATERIAL



No.	NAME	MATERIAL	
		Class1	Class2
1	Dielectric	CaZrO <sub>3</sub>	BaTiO <sub>3</sub>
2	Electrode	Nickel (Ni)	
3	Termination	Copper (Cu)	
4		AgPdCu	

## 9. PACKAGING

Packaging shall be done to protect the components from the damage during transportation and storing, and a label which has the following information shall be attached.

9.1 Each plastic bag for bulk packaging contains 1000pcs. And the minimum quantity for Bulk packaging is 1000pcs.

9.2 Tape packaging is as per 11. TAPE PACKAGING SPECIFICATION.

\* CGA2 [CC0402] type is applicable to tape packaging only.

- 1) Inspection No.
- 2) TDK P/N
- 3) Customer's P/N
- 4) Quantity

\*Composition of Inspection No.

Example     F 2 A - 23 - 001  
                   (a) (b) (c)        (d)        (e)

- (a) Line code
- (b) Last digit of the year
- (c) Month and A for January and B for February and so on. (Skip I)
- (d) Inspection Date of the month.
- (e) Serial No. of the day

\*Composition of new Inspection No.

(Implemented on and after May 1, 2019 in sequence)

Example     

I	F	2	E	2	3	A	0	0	1
---	---	---	---	---	---	---	---	---	---


  
                   (a) (b) (c) (d)    (e)        (f)        (g)


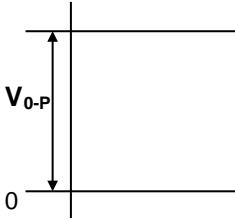
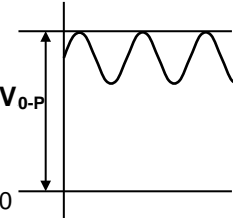
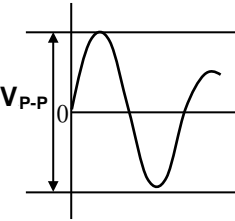
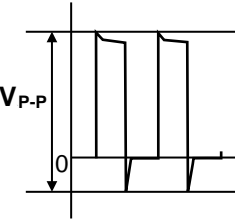
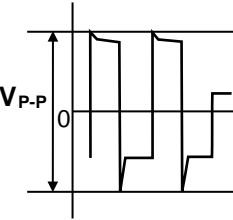
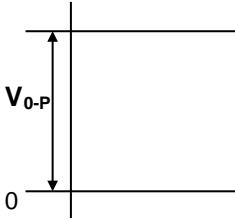
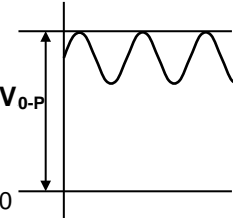
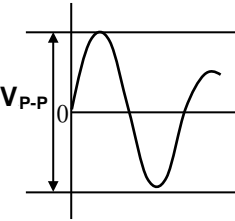
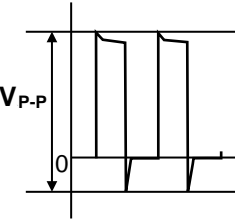
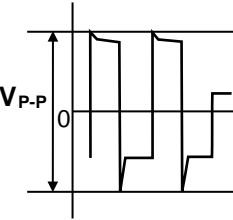
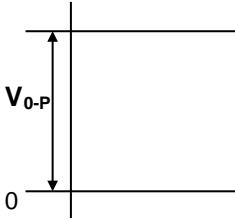
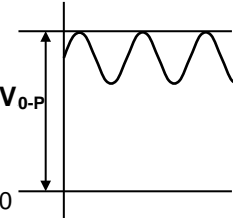
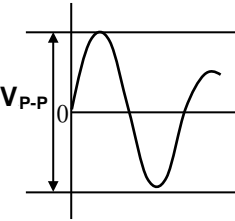
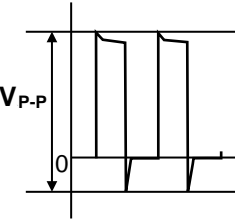
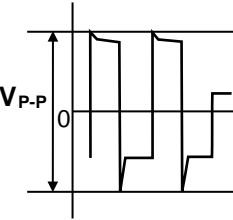
- (a) Prefix
- (b) Line code
- (c) Last digit of the year
- (d) Month and A for January and B for February and so on. (Skip I)
- (e) Inspection Date of the month.
- (f) Serial No. of the day(00 ~ ZZ)
- (g) Suffix(00 ~ ZZ)

\* It was shifted to the new inspection No. on and after May 2019, but the implementation timing may be different depending on shipment bases.

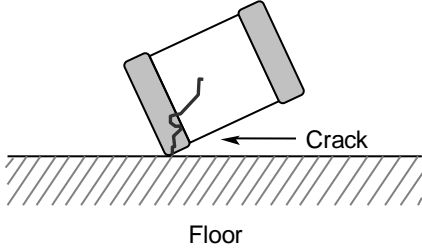
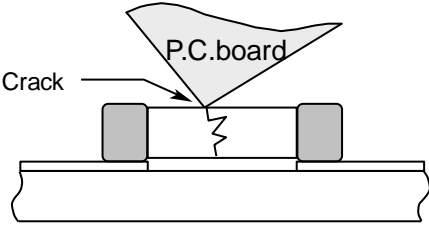
Until the shift is completed, either current or new composition of inspection No. will be applied.


## 10. CAUTION

No.	Process	Condition
1	Operating Condition (Storage, Use, Transportation)	<p>1-1. Storage, Use</p> <p>The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. JIS C 60721-3-1 Class 1K2 should be followed for the other climatic conditions.</p> <ol style="list-style-type: none"> <li>1) High temperature and humidity environment may affect a capacitor's performance. Therefore, SMD capacitors shall be used within 6 months. For capacitors with terminal electrodes consisting of silver or silver-palladium which tend to become oxidized or sulfurized, use as soon as possible, such as within one month after opening the bag.</li> <li>2) During storage, keep the minimum packaging unit in its original packaging without opening it. Do not deviate from the above temperature and humidity conditions even for a short term.</li> <li>3) Corrosive gasses in the air or atmosphere may result in deterioration of the reliability. Do not store capacitors where they will be exposed to corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine ammonia etc.)</li> <li>4) Electrical performance may deteriorate due to photochemical change in the terminal electrode if stored in direct sunlight, or due to condensation from rapid changes in humidity. The capacitors especially which use resin material must be operated and stored in an environment free of dew condensation, as moisture absorption due to condensation may affect the performance.</li> <li>5) Refer to JIS C 60721-3-1, class 1K2 for other climate conditions.</li> </ol> <p>1-2. Handling in transportation</p> <p>In case of the transportation of the capacitors, the performance of the capacitors may be deteriorated depending on the transportation condition. (Refer to JEITA RCR-2335C 9.2 Handling in transportation)</p>
2	Circuit design  Caution	<p>2-1. Operating temperature</p> <ol style="list-style-type: none"> <li>1) Upper category temperature (maximum operating temperature) is specified. It is necessary to select a capacitor whose rated temperature is higher than the operating temperature. Also, it is necessary to consider the temperature distribution in the equipment and seasonal temperature variation.</li> <li>2) Surface temperature including self heating should be below maximum operating temperature. Due to dielectric loss, capacitors will heat itself when AC is applied due to ESR. Especially at high frequencies, please be careful that the heat might be so extreme. Also, even if the surface temperature of the capacitor includes self-heating and is the maximum operating temperature or lower, excessive heating of the capacitor due to self-heating may cause deterioration of the characteristics and reliability of the capacitor. The self-heating temperature rise of the capacitor changes depending on the difference in heat radiation due to the mounting method to the device, the ambient temperature, the cooling method of the device and circuit board material and the design, etc. The load should be contained so that the self-heating temperature rise of the capacitor body in a natural convection environment at an ambient temperature of 25°C remain below 20°C.</li> </ol> <p>When using in a high-frequency circuit or a circuit in which a capacitor generates heat, such as when a high-frequency ripple current flows, pay attention to the above precautions. (Note that accurate measurement may not be possible with self-heating measurement when the equipment applies cooling other than natural convection such as a cooling fan.)</p>

No.	Process	Condition														
2	Circuit design  Caution	<p>3) The electrical characteristics of the capacitors will vary depending on the temperature. The capacitors should be selected and designed in taking the temperature into consideration.</p> <p>2-2. When overvoltage is applied                      Applying overvoltage to a capacitor may cause dielectric breakdown and result in a short circuit. The duration until dielectric breakdown depends on the applied voltage and the ambient temperature.</p> <p>2-3. Operating voltage                      1) Operating voltage across the terminals should be below the rated voltage.                      When AC and DC are super imposed, <math>V_{0-P}</math> must be below the rated voltage. — (1) and (2)                      AC or pulse with overshooting, <math>V_{P-P}</math> must be below the rated voltage. — (3), (4) and (5)                      When the voltage is started to apply to the circuit or it is stopped applying, the irregular voltage may be generated for a transit period because of resonance or switching. Be sure to use the capacitors within rated voltage containing these Irregular voltage.</p> <table border="1" data-bbox="469 768 1444 1041"> <thead> <tr> <th data-bbox="469 768 659 813">Voltage</th> <th data-bbox="659 768 919 813">(1) DC voltage</th> <th data-bbox="919 768 1181 813">(2) DC+AC voltage</th> <th data-bbox="1181 768 1444 813">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="469 813 659 1041">Positional Measurement (Rated voltage)</td> <td data-bbox="659 813 919 1041">  </td> <td data-bbox="919 813 1181 1041">  </td> <td data-bbox="1181 813 1444 1041">  </td> </tr> </tbody> </table> <table border="1" data-bbox="469 1070 1182 1344"> <thead> <tr> <th data-bbox="469 1070 659 1115">Voltage</th> <th data-bbox="659 1070 919 1115">(4) Pulse voltage (A)</th> <th data-bbox="919 1070 1182 1115">(5) Pulse voltage (B)</th> </tr> </thead> <tbody> <tr> <td data-bbox="469 1115 659 1344">Positional Measurement (Rated voltage)</td> <td data-bbox="659 1115 919 1344">  </td> <td data-bbox="919 1115 1182 1344">  </td> </tr> </tbody> </table> <p>2) Even below the rated voltage, if repetitive high frequency AC or pulse is applied, the reliability of the capacitors may be reduced.</p> <p>3) The effective capacitance will vary depending on applied DC and AC voltages. The capacitors should be selected and designed in taking the voltages into consideration.</p> <p>4) Abnormal voltage (surge voltage, static electricity, pulse voltage, etc.) shall not exceed the rated voltage.</p> <p>5) When capacitors are used in a series connection, it is necessary to add a balancing circuit such as voltage dividing resistors in order to avoid an imbalance in the voltage applied to each capacitor.</p> <p>2-4. Frequency                      When the capacitors (Class 2) are used in AC and/or pulse voltages, the capacitors may vibrate themselves and generate audible sound.</p>	Voltage	(1) DC voltage	(2) DC+AC voltage	(3) AC voltage	Positional Measurement (Rated voltage)				Voltage	(4) Pulse voltage (A)	(5) Pulse voltage (B)	Positional Measurement (Rated voltage)		
Voltage	(1) DC voltage	(2) DC+AC voltage	(3) AC voltage													
Positional Measurement (Rated voltage)																
Voltage	(4) Pulse voltage (A)	(5) Pulse voltage (B)														
Positional Measurement (Rated voltage)																

No.	Process	Condition
3	Designing Alumina Substrate	<p>The amount of glue at the terminations has a direct effect on the reliability of the capacitors.</p> <ol style="list-style-type: none"> <li>1) The greater the amount of glue with low thickness of land, the higher risk of electrical connection by conductive glue. Design of land and the amount of glue must be considered well.</li> <li>2) Avoid using common land for multiple terminations and provide individual land for each terminations.</li> </ol>
4	Mounting	<p>4-1. Stress from mounting head</p> <ol style="list-style-type: none"> <li>1) If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitor to result in cracking. Please take following precautions.</li> <li>2) Adjust the bottom dead center of the mounting head to reach on the Alumina substrate surface and not press it.</li> <li>3) Adjust the mounting head pressure to be 1 to 3N of static weight.</li> </ol> <p>4-2. Amount of conductive glue</p> <p>Excessive glue will make a electrical connection under the chip. In sufficient glue may detach the capacitor from the Alumina substrate.</p> <hr/> <div style="display: flex; justify-content: space-between; align-items: center;"> <div data-bbox="501 1012 624 1070">Excessive glue</div> <div data-bbox="671 1003 1082 1106"> </div> <div data-bbox="1107 1012 1433 1070">Electrical connection will be made under the chip.</div> </div> <hr/> <div style="display: flex; justify-content: space-between; align-items: center;"> <div data-bbox="501 1182 624 1214">Adequate</div> <div data-bbox="671 1160 1082 1263"> </div> </div> <hr/> <div style="display: flex; justify-content: space-between; align-items: center;"> <div data-bbox="501 1330 624 1388">Insufficient glue</div> <div data-bbox="671 1321 1082 1424"> </div> <div data-bbox="1107 1303 1433 1406">Low robustness may cause contact failure or chip capacitor comes off the Alumina substrate.</div> </div> <hr/>

No.	Process	Condition
5	Coating and molding of the Alumina substrate	<p>1) When the Alumina substrate is coated, please verify the quality influence on the product.</p> <p>2) Please verify carefully that there is no harmful decomposing or reaction gas emission during curing which may damage the chip capacitors.</p> <p>3) Please verify the curing temperature.</p>
6	Handling of loose chip capacitors	<p>1) If dropped the chip capacitors may crack. Once dropped do not use it. Especially, the large case sized chip capacitors are tendency to have cracks easily, so please handle with care.</p>  <p>2) Piling the Alumina substrate after mounting for storage or handling, the corner of the Alumina substrate may hit the chip capacitors of another board to cause crack.</p> 
7	Capacitance aging	The capacitors (Class 2) have aging in the capacitance. They may not be used in precision time constant circuit. In case of the time constant circuit, the evaluation should be done well.
8	Estimated life and estimated failure rate of capacitors	<p>As per the estimated life and the estimated failure rate depend on the temperature and the voltage. This can be calculated by the equation described in JEITA RCR-2335C Annex F (Informative) Calculation of the estimated life time and the estimated failure rate. ( Voltage acceleration coefficient : 3 multiplication rule, Temperature acceleration coefficient : 10°C rule)</p> <p>The failure rate can be decreased by reducing the temperature and the voltage but they will not be guaranteed.</p>

No.	Process	Condition
9	Caution during operation of equipment	<p>1) A capacitor shall not be touched directly with bare hands during operation in order to avoid electric shock. Electric energy held by the capacitor may be discharged through the human body when touched with a bare hand. Even when the equipment is off, a capacitor may stay charged. The capacitor should be handled after being completely discharged using a resistor.</p> <p>2) The terminals of a capacitor shall not be short-circuited by any accidental contact with a conductive object. A capacitor shall not be exposed to a conductive liquid such as an acid or alkali solution. A conductive object or liquid, such as acid and alkali, between the terminals may lead to the breakdown of a capacitor due to short circuit</p> <p>3) Confirm that the environment to which the equipment will be exposed during transportation and operation meets the specified conditions. Do not to use the equipment in the following environments.</p> <p>(1) Environment where a capacitor is spattered with water or oil (2) Environment where a capacitor is exposed to direct sunlight (3) Environment where a capacitor is exposed to Ozone, ultraviolet rays or radiation (4) Environment where a capacitor exposed to corrosive gas(e.g. hydrogen sulfide, sulfur dioxide, chlorine. ammonia gas etc.) (5) Environment where a capacitor exposed to vibration or mechanical shock exceeding the specified limits. (6) Atmosphere change with causes condensation</p>
10	Others  Caution	<p>The product listed in this specification is intended for use in automotive applications under-normal operation and usage conditions.</p> <p>The product is not designed or warranted to meet the requirements of application listed below, whose performance and/or quality requires a more stringent level of safety or reliability, or whose failure, malfunction or defect could cause serious damage to society, person or property. Please understand that we are not responsible for any damage or liability caused by use of the products in any of the applications below or for any other use exceeding the range or conditions set forth in this specification sheet. If you intend to use the products in the applications listed below or if you have special requirements exceeding the range or conditions set forth in this specification, please contact us.</p> <p>(1) Aerospace/Aviation equipment (2) Transportation equipment (electric trains, ships etc.) (3) Medical equipment (Excepting Pharmaceutical Affairs Law classification Class1, 2) (4) Power-generation control equipment (5) Atomic energy-related equipment (6) Seabed equipment (7) Transportation control equipment (8) Public information-processing equipment (9) Military equipment (10) Electric heating apparatus, burning equipment (11) Disaster prevention/crime prevention equipment (12) Safety equipment (13) Other applications that are not considered general-purpose applications</p> <p>When designing your equipment even for general-purpose applications, you are kindly requested to take into consideration securing protection circuit/device or providing backup circuits in your equipment.</p> <p>In addition, although the product listed in this specification is intended for use in automotive applications as described above, it is not prohibited to use for general electronic equipment, whose performance and/or quality doesn't require a more stringent level of safety or reliability, or whose failure, malfunction or defect could not cause serious damage to society, person or property.</p> <p>Therefore, the description of this caution will be applied, when the product is used in general electronic equipment under a normal operation and usage conditions.</p>



# 11. TAPE PACKAGING SPECIFICATION

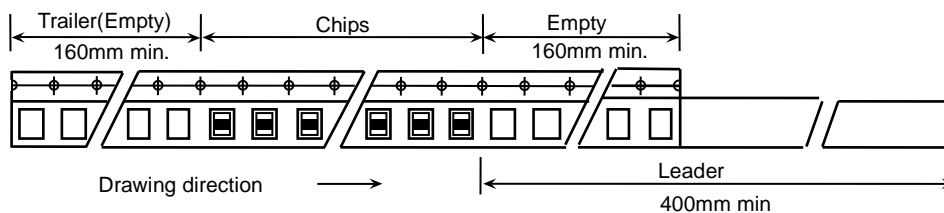
## 1. CONSTRUCTION AND DIMENSION OF TAPING

### 1-1. Dimensions of carrier tape

Dimensions of paper tape shall be according to Appendix 2, 3.

Dimensions of plastic tape shall be according to Appendix 4.

### 1-2. Bulk part and leader of taping

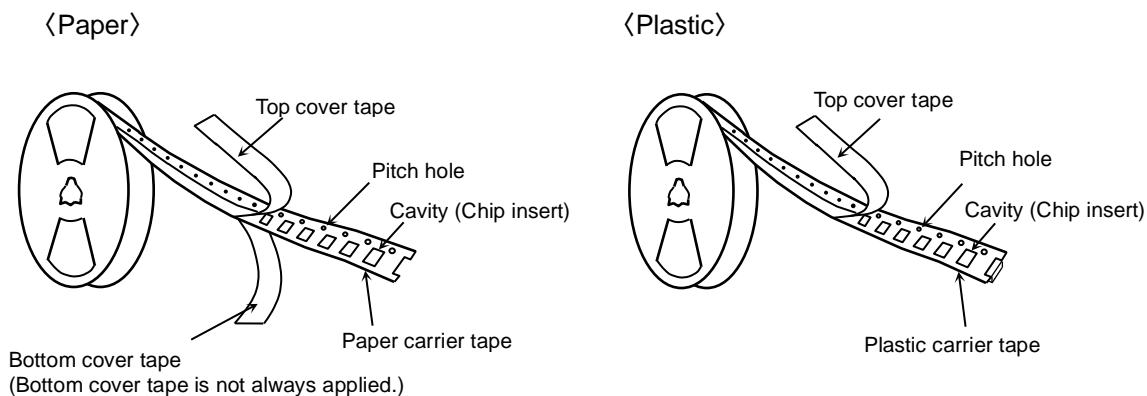


### 1-3. Dimensions of reel

Dimensions of  $\varnothing 178$  reel shall be according to Appendix 5, 6.

Dimensions of  $\varnothing 330$  reel shall be according to Appendix 7, 8.

### 1-4. Structure of taping



## 2. CHIP QUANTITY

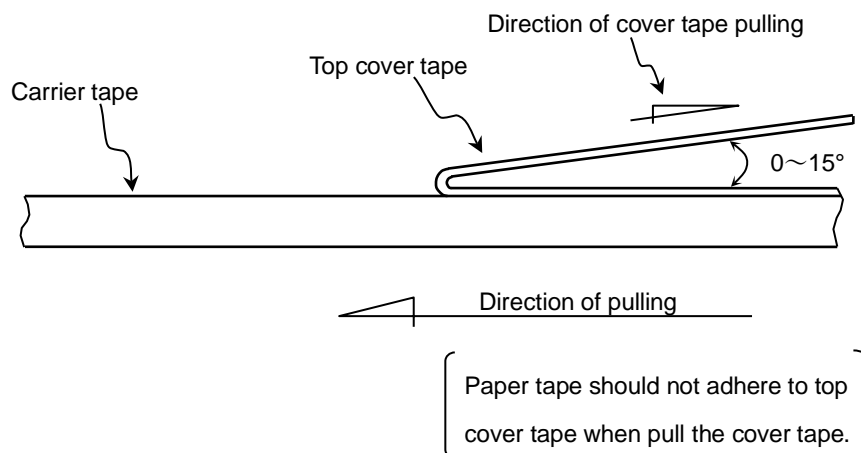
Please refer to detail page on TDK web.

### 3. PERFORMANCE SPECIFICATIONS

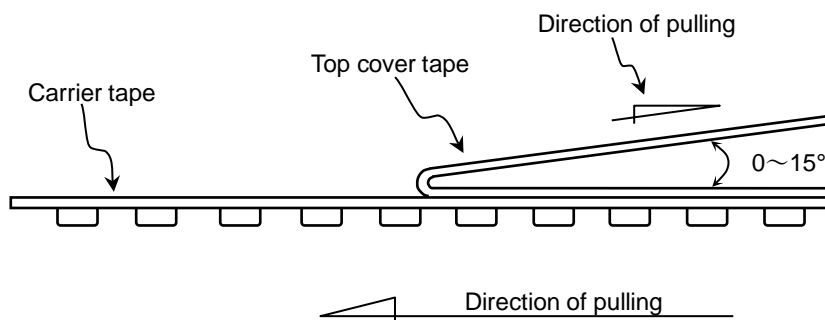
#### 3-1. Fixing peeling strength (top tape)

$$0.05\text{N} < \text{Peeling strength} < 0.7\text{N}$$

〈Paper〉



〈Plastic〉



3-2. Carrier tape shall be flexible enough to be wound around a minimum radius of 30mm with components in tape.

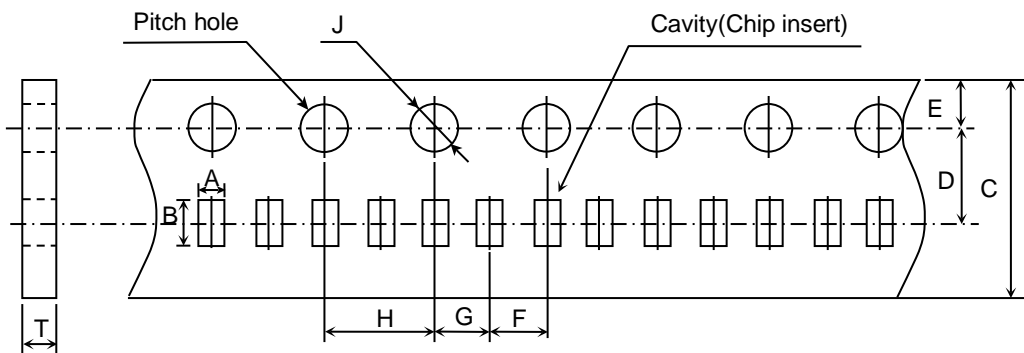
3-3. The missing of components shall be less than 0.1%

3-4. Components shall not stick to fixing tape.

3-5. When removing the cover tape, there shall not be difficulties by unfitting clearance gap, burrs and crushes of cavities. Also the sprocket holes shall not be covered by absorbing dust into the suction nozzle.

### Appendix 2

#### Paper Tape



(Unit : mm)

Symbol	A	B	C	D	E	F
Case size CGA2 (CC0402)	( 0.65 )	( 1.15 )	8.00 ± 0.30	3.50 ± 0.05	1.75 ± 0.10	2.00 ± 0.05

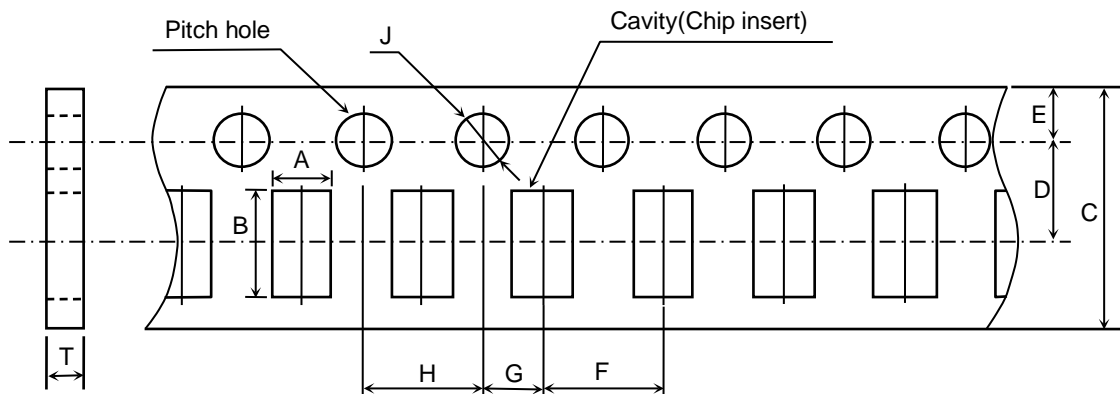
  

Symbol	G	H	J	T
Case size CGA2 (CC0402)	2.00 ± 0.05	4.00 ± 0.10	∅ 1.50 <sup>+0.10</sup> <sub>0</sub>	0.60 ± 0.15

( ) Reference value.

### Appendix 3

#### Paper Tape



(Unit : mm)

Symbol	A	B	C	D	E	F
Case size CGA3 (CC0603)	( 1.10 )	( 1.90 )	8.00 ± 0.30	3.50 ± 0.05	1.75 ± 0.10	4.00 ± 0.10
Case size CGA4 (CC0805)	( 1.50 )	( 2.30 )				
Case size CGA5 (CC1206)	( 1.90 )	( 3.50 )				

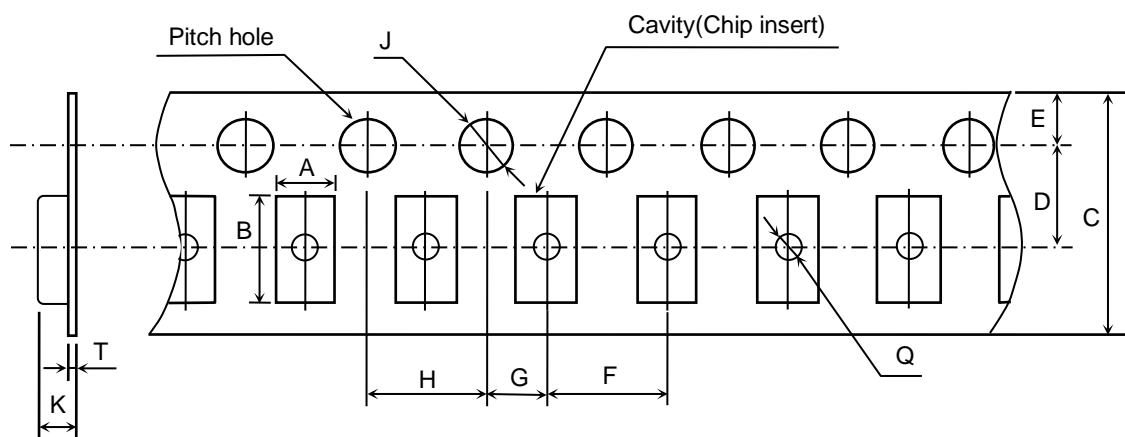
  

Symbol	G	H	J	T
Case size CGA3 (CC0603)	2.00 ± 0.05	4.00 ± 0.10	∅ 1.50 <sup>+0.10</sup> <sub>0</sub>	1.20 max.
Case size CGA4 (CC0805)				
Case size CGA5 (CC1206)				

( ) Reference value.

## Appendix 4

### Plastic Tape



(Unit : mm)

Symbol	A	B	C	D	E	F
Case size						
CGA3 (CC0603)	( 1.10 )	( 1.90 )	8.00 ± 0.30	3.50 ± 0.05	1.75 ± 0.10	4.00 ± 0.10
CGA4 (CC0805)	( 1.50 )	( 2.30 )				
CGA5 (CC1206)	( 1.90 )	( 3.50 )				
CGA6 (CC1210)	( 2.90 )	( 3.60 )				
			* 12.0 ± 0.30	* 5.50 ± 0.05		
Symbol	G	H	J	K	T	Q
Case size						
CGA3 (CC0603)	2.00 ± 0.05	4.00 ± 0.10	∅ 1.50 <sup>+0.10</sup> <sub>0</sub>	1.50 max.	0.60 max.	∅ 0.50 min.
CGA4 (CC0805)				2.50 max.		
CGA5 (CC1206)						
CGA6 (CC1210)				3.40 max.		

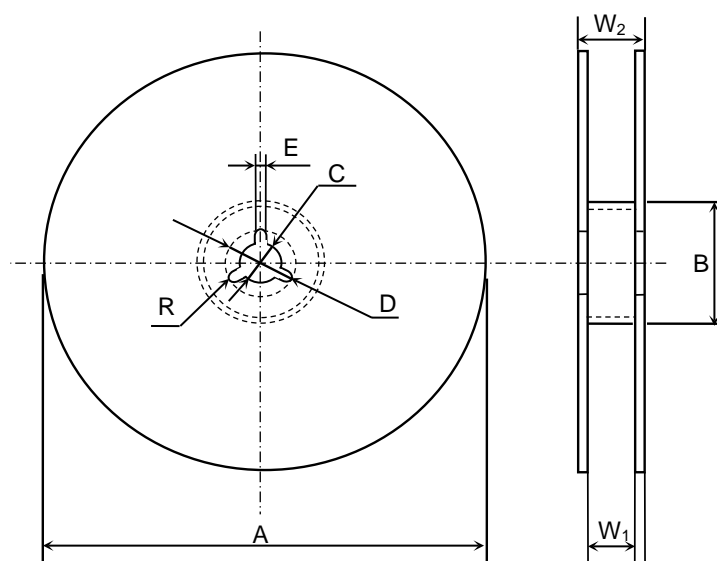
( ) Reference value.

Exceptionally no hole in the cavity is applied. Please inquire if hole in cavity is mandatory.

\* Applied to thickness, 2.5mm products.

## Appendix 5

Dimensions of reel (Material : Polystyrene)  
CGA2, CGA3, CGA4, CGA5, CGA6

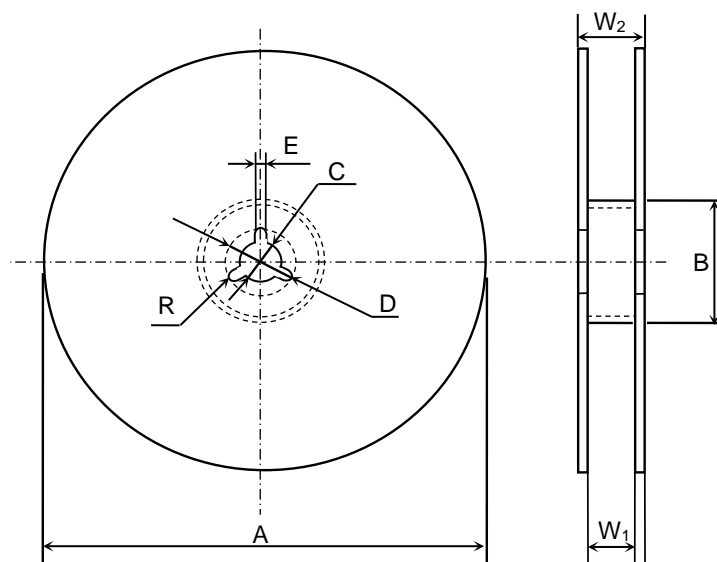


(Unit : mm)

Symbol	A	B	C	D	E	W <sub>1</sub>
Dimension	Ø178 ± 2.0	Ø60 ± 2.0	Ø13 ± 0.5	Ø21 ± 0.8	2.0 ± 0.5	9.0 ± 0.3
Symbol	W <sub>2</sub>	R				
Dimension	13.0 ± 1.4	1.0				

## Appendix 6

Dimensions of reel (Material : Polystyrene)  
CGA6(2.5mm thickness products)



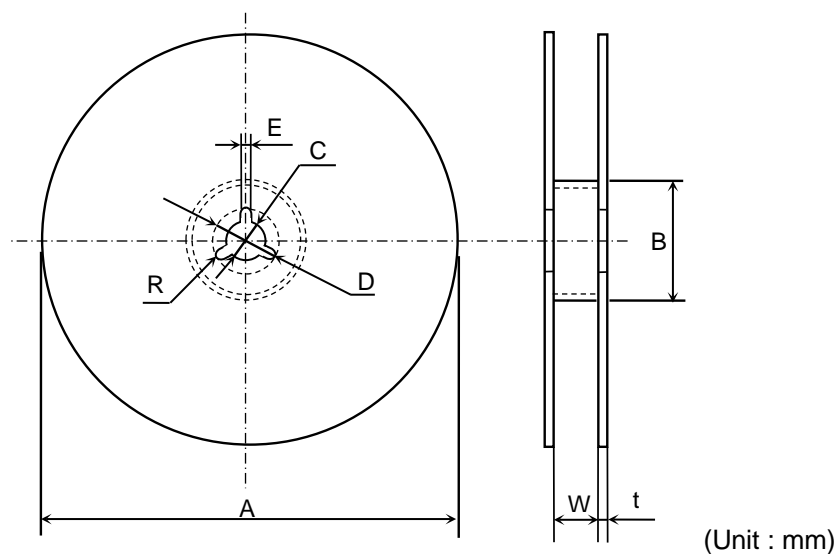
(Unit : mm)

Symbol	A	B	C	D	E	W <sub>1</sub>
Dimension	Ø178 ± 2.0	Ø60 ± 2.0	Ø13 ± 0.5	Ø21 ± 0.8	2.0 ± 0.5	13.0 ± 0.3
Symbol	W <sub>2</sub>	R				
Dimension	17.0 ± 1.4	1.0				

## Appendix 7

Dimensions of reel (Material : Polystyrene)

CGA2, CGA3, CGA4, CGA5, CGA6

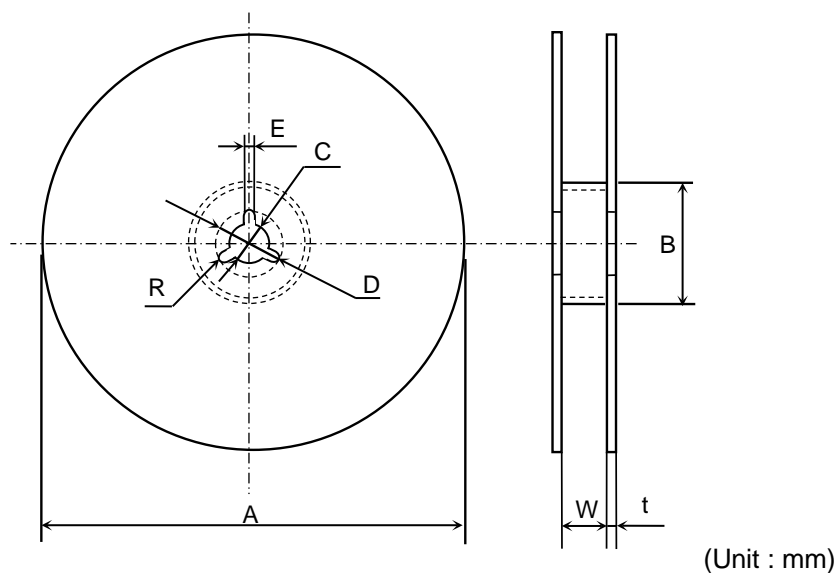


Symbol	A	B	C	D	E	W
Dimension	Ø382 max. (Nominal Ø330)	Ø50 min.	Ø13 ± 0.5	Ø21 ± 0.8	2.0 ± 0.5	10.0 ± 1.5
Symbol	t	R				
Dimension	2.0 ± 0.5	1.0				

## Appendix 8

Dimensions of reel (Material : Polystyrene)

CGA6(2.5mm thickness products)



Symbol	A	B	C	D	E	W
Dimension	Ø382 max. (Nominal Ø330)	Ø50 min.	Ø13 ± 0.5	Ø21 ± 0.8	2.0 ± 0.5	14.0 ± 1.5
Symbol	t	R				
Dimension	2.0 ± 0.5	1.0				