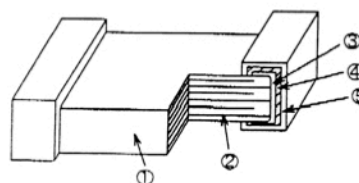
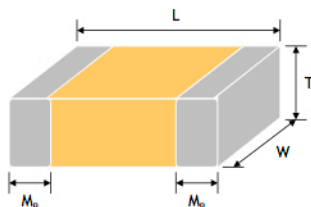




# High Q/Low ESR Multilayer Ceramic Chip Capacitors - GHQ Series

## Construction and Dimensions



### Scope

- Used at high frequencies, small temperature coefficient of capacitance, typical within +/-30ppm/C required for NPO (COG) classification.
- Excellent conductivity internal electrode

### Features

- High Q and low ESR performance at high frequency.
- Quality improvement of telephone calls for low power loss and better performance.

### Applications

- Mobile telecommunication; mobile phones, WLAN
- RF module: power amplifier, VCO
- Tuners

No.	Name	NPO*	NPO
①	Ceramic material	CaZrO <sub>3</sub> / BaTiO <sub>3</sub> based	
②	Inner electrode	AgPd alloy	Ni
③	Termination	Inner layer	Ag
④		Middle layer	Ni
⑤		Outer layer	Sn

\* Partial NPO items are with Ag/Ni/Sn(NME) terminations, please ref to product range for detail.

Size Inch(mm)	L (mm)	W (mm)	T (mm)	Remark	M <sub>a</sub> (mm)
0402 (1005)	1.00±0.05	0.50±0.05	0.50±0.05	#	0.25 +0.05/-0.10
0603 (1608)	1.60±0.10	0.8±0.10	0.80±0.07		0.40±0.15
	1.60 +0.15/-0.10	0.80 +0.15/-0.10	0.80 +0.15/-0.10		
0805 (2012)	2.00±0.15	1.25±0.10	0.60±0.10		0.50±0.20
			0.80±0.10		
			1.25±0.10	#	

#Reflow soldering only is recommended

GHQ	10	CG	101	J	100	N	T
Product Type	Size	Dielectric	Capacitance	Tolerance	Rated Voltage	Termination	Packaging
	04: 0402 (1005) 10: 0603 (1608) 21: 0805 (2012)	CG: NPO (COG)	Two significant digits followed by no. of zeros. Use R in place of decimal point	A: ±0.05pF B: ±0.1pF C: ±0.25pF D: ±0.5pF F: ±1% G: ±2% J: ±5%	25: 25VDC 50: 50VDC 100: 100VDC 200: 200VDC 250: 250VDC 500: 500VDC 630: 630VDC	N: Ag/Ni/Sn	T: 7" reel TD: 13" reel

\* Two significant digits followed by no. of zeros. And R is in place of decimal point.

## ■ Capacitance Range

DIMENSION (MM)		GHQ04			GHQ10				GHQ21					
L(L1)		1.00±0.05			1.60±1.0		1.60+0.15/-0.10		2.00±0.15					
W		0.50±0.05			0.80±0.10		0.80+0.15/-0.10		1.25±0.10					
BW(L2/L3)		0.25+0.05/-0.10			0.40±0.15				0.50±0.20					
Dielectric		COG			COG				COG					
H (max)		0.55			0.87		0.95		0.9			1.35		
Rated Voltage		16	25	50	16	25	50	100	50	100	200	250	500	630
Cap. Range														
0.5pF	0R5													
0.6	0R6													
0.7	0R7													
0.8	0R8													
0.9	0R9													
1	1R0													
1.2	1R2													
1.5	1R5													
1.8	1R8													
2.2	2R2													
2.7	2R7													
3.3	3R3													
3.9	3R9													
4.7	4R7													
5.6	5R6													
6.8	6R8													
8.2	8R2													
10pF	100													
12	120													
15	150													
18	180													
22	220													
27	270													
33	330													
39	390													
47	470													
56	560													
68	680													
82	820													
100	101													
120	121													
150	151													
180	181													
220	221													
270	271													
330	331													
390	391													
470	471													
560	561													
680	681													
820	821													
1000	102													
1200	122													
1500	152													
1800	182													
2200	222													
2700	272													
3300	332													

1. 0402, Capacitance <0.5pF; on request
2. For more information about products with special capacitance or other data, please contact your Cal-Chip Sales Representative.

## ■ General Electrical Data

<b>Dielectric</b>	NP0
<b>Size</b>	0402, 0603, 0805
<b>Capacitance*</b>	0402: 0.5pF to 470pF** 0603: 0.5pF to 3300pF 0805: 0.5pF to 390pF
<b>Capacitance tolerance</b>	Cap $\leq$ 5pF <sup>#1</sup> : A ( $\pm$ 0.05pF), B ( $\pm$ 0.1pF), C ( $\pm$ 0.25pF) 5pF<Cap<10pF: C ( $\pm$ 0.25pF), D ( $\pm$ 0.5pF) Cap $\geq$ 10pF: F ( $\pm$ 1%), G ( $\pm$ 2%), J ( $\pm$ 5%)
<b>Rated voltage (WVDC)</b>	16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V
<b>Q*</b>	Cap<30pF: Q $\geq$ 400+20C Cap $\geq$ 30pF: Q $\geq$ 1000
<b>Insulation resistance at Ur</b>	$\geq$ 10G $\Omega$ or RxC $\geq$ 100 $\Omega$ -F whichever is smaller.
<b>Operating temperature</b>	-55 to +125°C
<b>Capacitance change</b>	$\pm$ 30ppm
<b>Termination</b>	Ni/Sn (lead-free termination)

#1: NP0, 0.1pF product only provide B tolerance

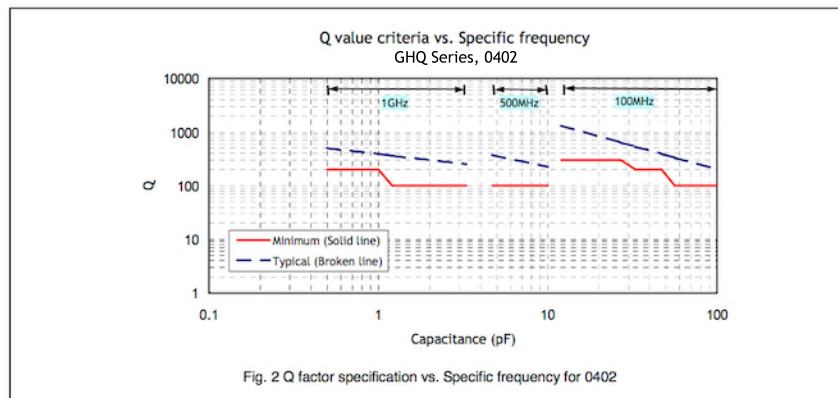
\* Measured at the conditions of 25°C ambient temperature and 30~70% related humidity.

Apply 1.0 $\pm$ 0.2Vrms, 1.0MHz $\pm$ 10% for Cap $\leq$ 1000pF and 1.0 $\pm$ 0.2Vrms, 1.0kHz $\pm$ 10% for Cap>1000pF.

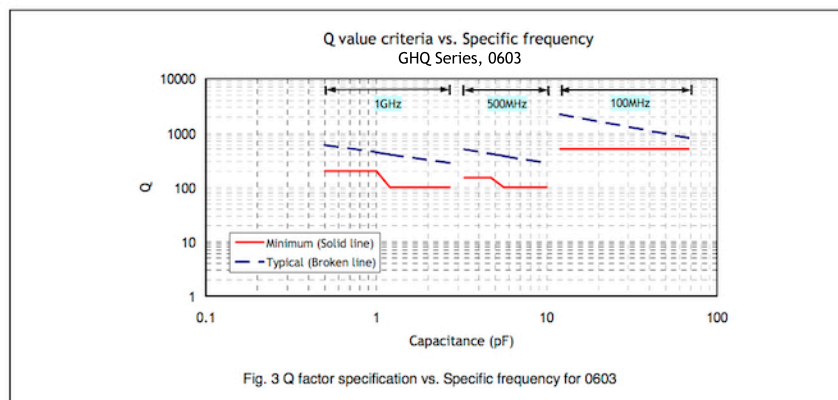
\*\* 0402, Capacitance <0.5pF: On request.

## ■ Electrical Characteristics

### ■ Q factor specification vs. Specific frequency



### ■ Q factor specification vs. Specific frequency



## General Electrical Data

### Typical ESR vs. Frequency

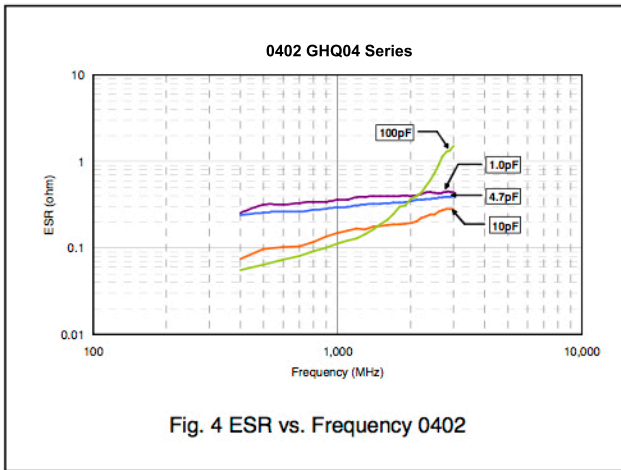


Fig. 4 ESR vs. Frequency 0402

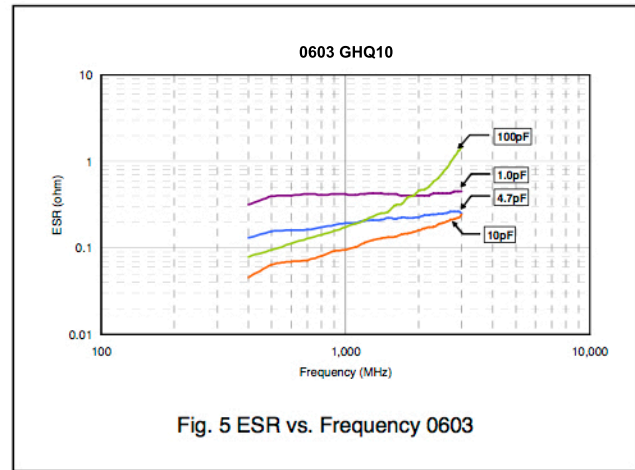


Fig. 5 ESR vs. Frequency 0603

### Typical Impedance vs. Frequency

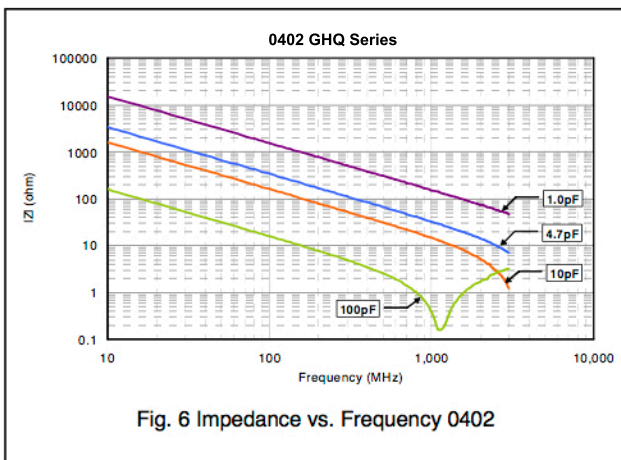


Fig. 6 Impedance vs. Frequency 0402

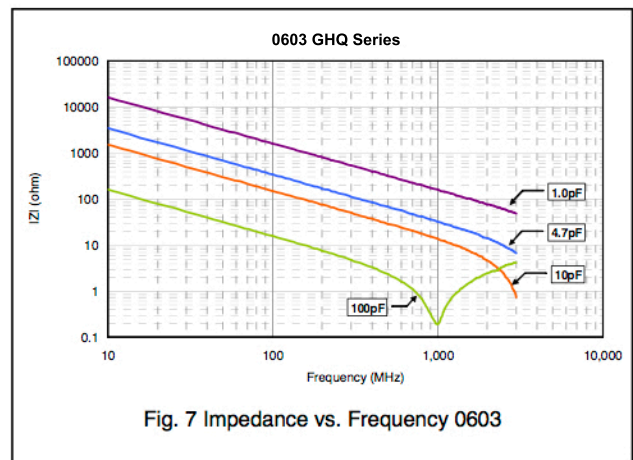


Fig. 7 Impedance vs. Frequency 0603

### SRF vs. Capacitance

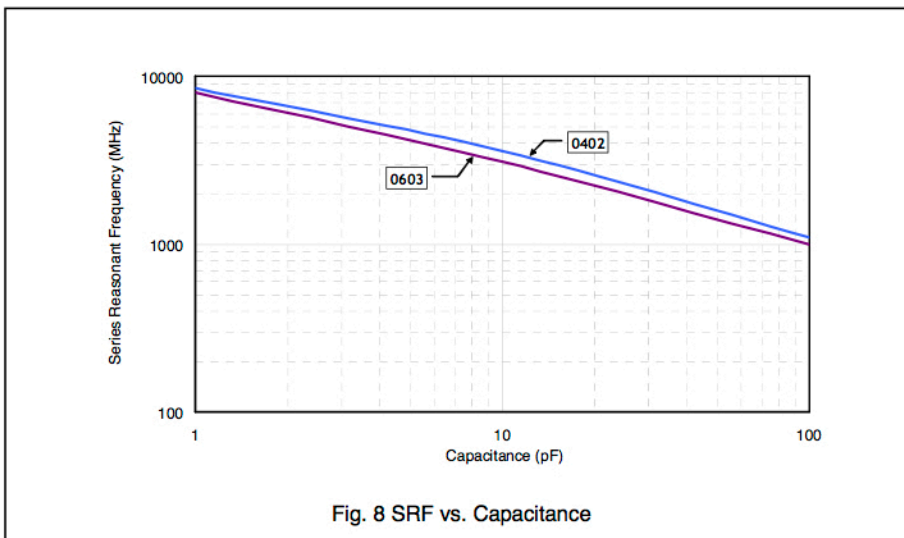


Fig. 8 SRF vs. Capacitance

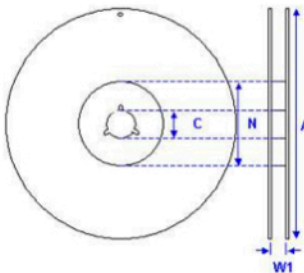


## ■ Reliability Test Conditions and Requirements

No.	Item	Test Conditions	Requirements
1.	Visual and Mechanical	---	<ul style="list-style-type: none"> <li>* No remarkable defect.</li> <li>* Dimensions to conform to individual specification sheet.</li> </ul>
2.	Capacitance	Cap≤1000pF, 1.0±0.2Vrms, 1MHz±10%	<ul style="list-style-type: none"> <li>* Shall not exceed the limits given in the detailed spec.</li> </ul>
3.	Q/ D.F. (Dissipation Factor)	Cap>1000pF, 1.0±0.2Vrms, 1KHz±10% At 25°C ambient temperature.	<ul style="list-style-type: none"> <li>* NPO: Cap≥30pF, Q≥1000; Cap&lt;30pF, Q≥400+20C</li> </ul>
4.	Dielectric Strength	<ul style="list-style-type: none"> <li>* To apply voltage: ( ≤100V ) 250% of rated voltage.</li> <li>* Duration: 1 to 5 sec.</li> <li>* Charge and discharge current less than 50mA.</li> <li>* To apply voltage: 200V~300V        ≥2 times VDC 500V~999V       ≥1.5 times VDC</li> <li>* Cut-off, set at 10mA</li> <li>* TEST= 15 sec.</li> <li>* RAMP=0</li> </ul>	<ul style="list-style-type: none"> <li>* No evidence of damage or flash over during test.</li> </ul>
5.	Insulation Resistance	Rated voltage:<200V To apply rated voltage for max. 120 sec. Rated voltage:200~630V To apply rated voltage (500V max.) for 60 sec.	≥10GΩ ≥10GΩ or RxC≥100Ω-F whichever is smaller
6.	Temperature Coefficient	With no electrical load. Operating temperature: -55~125°C at 25°C	<ul style="list-style-type: none"> <li>* Capacitance change: within ±30ppm/°C</li> </ul>
7.	Adhesive Strength of Termination	<ul style="list-style-type: none"> <li>* Pressurizing force : 5N (≤0603) and 10N (&gt;0603)</li> <li>* Test time: 10±1 sec.</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage or removal of the terminations.</li> </ul>
8.	Vibration Resistance	<ul style="list-style-type: none"> <li>* Vibration frequency: 10~55 Hz/min.</li> <li>* Total amplitude: 1.5mm</li> <li>* Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs.</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change and Q/D.F.: To meet initial spec.</li> </ul>
9.	Solderability	<ul style="list-style-type: none"> <li>* Solder temperature: 235±5°C</li> <li>* Dipping time: 2±0.5 sec.</li> </ul>	95% min. coverage of all metalized area.
10.	Bending Test	<ul style="list-style-type: none"> <li>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs.</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: within ±5.0% or ±0.5pF whichever is larger. (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</li> </ul>
11.	Resistance to Soldering Heat	<ul style="list-style-type: none"> <li>* Solder temperature: 260±5°C</li> <li>* Dipping time: 10±1 sec</li> <li>* Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.</li> <li>* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs.</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: within ±2.5% or ±0.25pF whichever is larger.</li> <li>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</li> <li>* 25% max. leaching on each edge.</li> </ul>

No.	Item	Test Condition	Requirements															
12.	Temperature Cycle	<ul style="list-style-type: none"> <li>* Conduct the five cycles according to the temperatures and time.</li> </ul> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr style="background-color: #ADD8E6;"> <th style="width: 10%;">Step</th> <th style="width: 60%;">Temp. (°C)</th> <th style="width: 30%;">Time (min.)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td>Min. operating temp. +0/-3</td> <td style="text-align: center;">30±3</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Room temp.</td> <td style="text-align: center;">2~3</td> </tr> <tr> <td style="text-align: center;">3</td> <td>Max. operating temp. +3/-0</td> <td style="text-align: center;">30±3</td> </tr> <tr> <td style="text-align: center;">4</td> <td>Room temp.</td> <td style="text-align: center;">2~3</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs.</li> </ul>	Step	Temp. (°C)	Time (min.)	1	Min. operating temp. +0/-3	30±3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30±3	4	Room temp.	2~3	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change : within ±2.5% or ±0.25pF whichever is larger.</li> <li>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</li> </ul>
		Step	Temp. (°C)	Time (min.)														
1	Min. operating temp. +0/-3	30±3																
2	Room temp.	2~3																
3	Max. operating temp. +3/-0	30±3																
4	Room temp.	2~3																
13.	Humidity (Damp Heat) Steady State	<ul style="list-style-type: none"> <li>* Test temp.: 40±2°C</li> <li>* Humidity: 90~95% RH</li> <li>* Test time: 500+24/-0hrs.</li> </ul> <ul style="list-style-type: none"> <li>* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs.</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: within ±5.0% or ±0.5pF whichever is larger.</li> <li>* Q/D.F. value: NP0: Cap≥30pF, Q≥350; 10pF≤Cap&lt;30pF, Q≥275+2.5C Cap&lt;10pF; Q≥200+10C</li> <li>* I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.</li> </ul>															
		14.	Humidity (Damp Heat) Load	<ul style="list-style-type: none"> <li>* Test temp.: 40±2°C</li> <li>* Humidity: 90~95%RH</li> <li>* Test time: 500+24/-0 hrs.</li> <li>* To apply voltage : rated voltage (Max. 500V)</li> </ul> <ul style="list-style-type: none"> <li>* Before initial measurement (Class II only): To apply test voltage for 1hr at 40°C and then set for 24±2 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs.</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: within ±7.5% or ±0.75pF whichever is larger.</li> <li>* Q/D.F. value: NP0: Cap≥30pF, Q≥200; Cap&lt;30pF, Q≥100+10/3C</li> <li>* I.R.: ≥500MΩ or RxC≥25Ω-F whichever is smaller.</li> </ul>													
15.	High Temperature Load (Endurance)			<ul style="list-style-type: none"> <li>* Test temp.:</li> </ul> <p style="margin-left: 20px;">NP0: 125±3°C</p> <ul style="list-style-type: none"> <li>* To apply voltage:</li> </ul> <p style="margin-left: 20px;">(1) &lt;500V: 200% of rated voltage. (2) 500V: 150% of rated voltage. (3) ≥630V: 120% of rated voltage.</p> <ul style="list-style-type: none"> <li>* Test time: 1000+24/-0 hrs.</li> </ul> <ul style="list-style-type: none"> <li>* Before initial measurement (Class II only): To apply test voltage for 1hr at test temp. and then set for 24±2 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: within ±3.0% or ±0.3pF whichever is larger.</li> <li>* Q/D.F. value: NP0: Cap≥30pF, Q≥350 10pF≤Cap&lt;30pF, Q≥275+2.5C Cap&lt;10pF, Q≥200+10C</li> <li>* I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.</li> </ul>													

## ■ Packaging

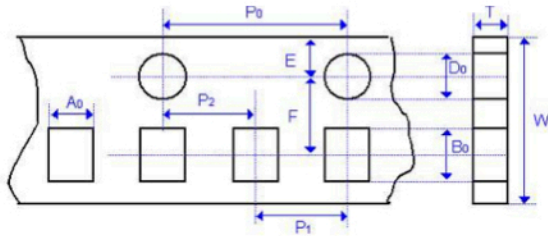


Size	Thickness (mm)	Paper Tape		Plastic Tape	
		7" reel	13" reel	7" reel	13" reel
0402	0.50±0.05	10K	50K		
0603	0.80±0.07	4K	15K		
	0.80 +0.15/-0.10	4K	15K		
0805	0.60±0.10	4K	15K		
	0.80±0.10				
	1.25±0.10			3K	10K

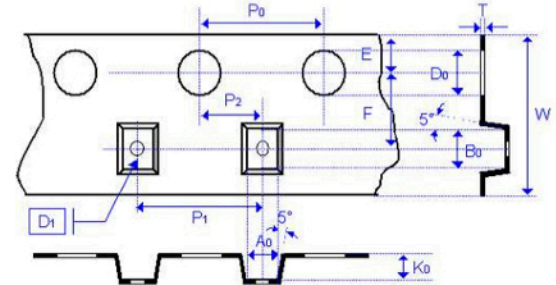
## Tape and Reel Dimensions

Size	0402, 0603, 0805		
Reel size	7"	10"	13"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W <sub>1</sub>	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0
A	178.0±0.10	250.0±1.0	330.0±1.0
N	60.0+1.0/-0	100.0±1.0	100±1.0

## Paper Tape Dimensions



## Plastic Tape Dimensions



Size	0402	0603	0805		
Thickness	N	S, X	A	B	C, D, I
A <sub>0</sub>	0.62±0.05	1.02±0.05	1.50±0.10	1.50±0.10	<1.57
B <sub>0</sub>	1.12±0.05	1.80±0.05	2.30±0.10	2.30±0.10	<2.40
T	0.60±0.05	0.95±0.05	0.75±0.05	0.95±0.05	0.23±0.05
K <sub>0</sub>	-	-	-	-	<2.50
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P <sub>0</sub>	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP <sub>0</sub>	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10
P <sub>1</sub>	2.00±0.05	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
P <sub>2</sub>	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D <sub>0</sub>	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05	1.50±0.05
D <sub>1</sub>	-	-	-	-	1.00±0.10
E	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.10
F	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05

## Storage and Handling Conditions

- To store products at 5 to 40°C ambient temperature and 20 to 70% related humidity conditions.
- The product is recommended to be used within one year after shipment. Check solderability in case of shelf life extension is needed.

### Cautions:

- The corrosive gas reacts on the terminal electrodes of capacitors, and results in the poor solderability. Do not store the capacitors in the ambience of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)
- In corrosive atmosphere, solderability might be degraded, and silver migration might occur to cause low reliability.
- Due to the dewing by rapid humidity change, or the photochemical change of the terminal electrode by direct sunlight, the solderability and electrical performance may deteriorate. Do not store capacitors under direct sunlight or dewing condition. To store products on the shelf and avoid exposure to moisture.



## Recommended Soldering Conditions

The lead-free termination MLCCs are not only to be used on SMT against lead-free solder paste, but also suitable against lead-containing solder paste. If the optimized solder joint is requested, increasing soldering time, temperature and concentration of N<sub>2</sub> within oven are recommended.

