

DATA SHEET

SURFACE-MOUNT CERAMIC
MULTILAYER CAPACITORS

Hi Q Series

Class 1, NP0

16 V TO 250 V

0.2 pF to 100 pF

RoHS compliant & Halogen Free



SCOPE

This specification describes NPO series chip capacitors with lead-free terminations.

APPLICATIONS

- Consumer electronics for example
 - Tuners
 - Television receivers
 - All types of cameras
- Telecommunications
- Data processing

FEATURES

- Supplied in tape on reel
- Nickel-barrier end termination
- RoHS compliant
- Halogen Free compliant

ORDERING INFORMATION – GLOBAL PART NUMBER, PHYCOMP CTC & 12NC

All part numbers are identified by the series, size, tolerance, TC material, packing style, voltage, process code, termination and capacitance value.

YAGEO/ PHYCOMP BRAND ordering code

GLOBAL PART NUMBER (PREFERRED)

CQ xxxx x x **NPO** x **BN** xxx
 (1) (2) (3) (4) (5)

(1) SIZE – INCH BASED (METRIC)

- 0201 (0603)
- 0402 (1005)
- 0603 (1608)
- 0805 (2012)

(2) TOLERANCE

- 0.2pF to 2.0pF
 - A = ±0.05 pF
 - B = ±0.1 pF
 - C = ±0.25 pF
- 2.1pF to 4.9pF
 - A = ±0.05 pF (by request)
 - B = ±0.1 pF
 - C = ±0.25 pF
 - D = ±0.5 pF
- 5.0pF to 9.9pF
 - B = ±0.1 pF
 - C = ±0.25 pF
 - D = ±0.5 pF
- 10pF and over
 - F = ±1%
 - G = ±2%
 - J = ±5%

(3) PACKING STYLE

- R = Paper/PE taping reel; Reel 7 inch
- P = Paper/PE taping reel; Reel 13 inch

(4) RATED VOLTAGE

- 7 = 16 V 0=100V
- 8 = 25 V A=200V
- 9 = 50 V Y=250V

(5) CAPACITANCE VALUE

2 significant digits + number of zeros
 The 3rd digit signifies the multiplying factor, and letter R is decimal point
 Example: 121 = 12 × 10¹ = 120 pF

CONSTRUCTION

The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved metal electrodes are contained. This structure gives rise to a high capacitance per unit volume.

The inner electrodes are connected to the two end terminations and finally covered with a layer of plated tin (NiSn). The terminations are lead-free. A cross section of the structure is shown in Fig.1.

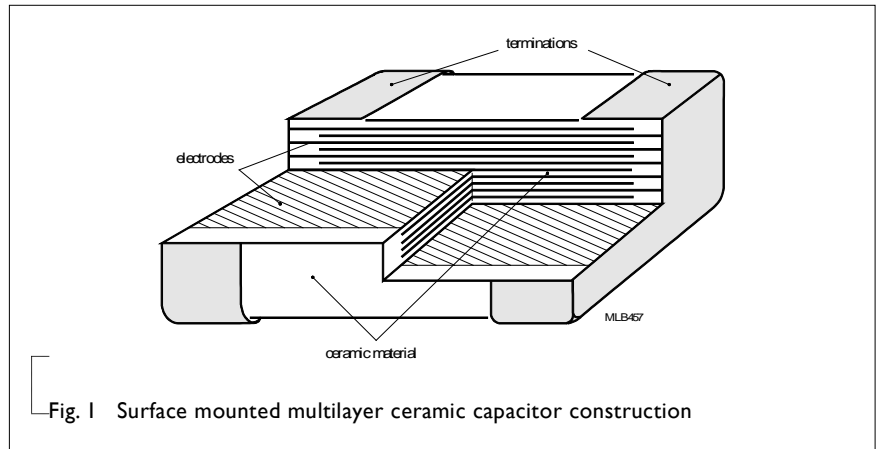


Fig. 1 Surface mounted multilayer ceramic capacitor construction

DIMENSION

Table I For outlines see fig. 2

TYPE	L ₁ (mm)	W (mm)	T (MM)	L ₂ / L ₃ (mm)		L ₄ (mm)
				min.	max.	min.
0201	0.6 ±0.03	0.3 ±0.03	Refer to table 2 to 5	0.10	0.20	0.20
0402	1.0 ±0.05	0.5 ±0.05		0.20	0.30	0.40
0603	1.6 ±0.10	0.8 ±0.10		0.20	0.60	0.40
0805	2.0 ±0.20	1.25 ±0.20		0.25	0.75	0.55

OUTLINES

For dimension see Table I

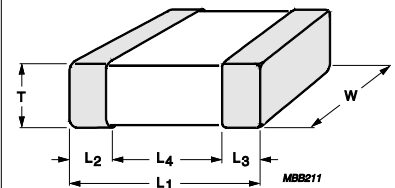


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

CAPACITANCE RANGE & THICKNESS FOR NPO

Table 2 Sizes from 0201 to 0402

CAP.	0201	0402	CAP.	0201	0402
	25 V	50 V		25 V	50 V
0.2 pF			2.6 pF		
0.3 pF			2.7 pF		
0.4 pF			2.8 pF		
0.5 pF			2.9 pF		
0.6 pF			3.0 pF		
0.7 pF			3.1 pF		
0.8 pF			3.2 pF		
0.9 pF			3.3 pF		
1.0 pF			3.4 pF		
1.1 pF			3.5 pF		
1.2 pF			3.6 pF		
1.3 pF			3.7 pF		
1.4 pF	0.3±0.03	0.5±0.05	3.8 pF	0.3±0.03	0.5±0.05
1.5 pF			3.9 pF		
1.6 pF			4.0 pF		
1.7 pF			4.1 pF		
1.8 pF			4.2 pF		
1.9 pF			4.3 pF		
2.0 pF			4.4 pF		
2.1 pF			4.5 pF		
2.2 pF			4.6 pF		
2.3 pF			4.7 pF		
2.4 pF			4.8 pF		
2.5 pF			4.9 pF		
			5.0 pF		
Tape width	8mm		Tape width	8mm	

NOTE

I. Values in shaded cells indicate thickness class in mm

CAPACITANCE RANGE & THICKNESS FOR NP0

Table 3 Sizes from 0201 to 0402

CAP.	0201 25 V	0402 50 V	CAP.	0201 25 V	0402 50 V
5.1 pF			7.8 pF		
5.2 pF			7.9 pF		
5.3 pF			8.0 pF		
5.4 pF			8.1 pF		
5.5 pF			8.2 pF		
5.6 pF			8.3 pF		
5.7 pF			8.4 pF		
5.8 pF			8.5 pF		
5.9 pF			8.6 pF		
6.0 pF			8.7 pF		
6.1 pF			8.8 pF		
6.2 pF			8.9 pF	0.3±0.03	
6.3 pF			9.0 pF		
6.4 pF	0.3±0.03	0.5±0.05	9.1 pF		
6.5 pF			9.2 pF		0.5±0.05
6.6 pF			9.3 pF		
6.7 pF			9.4 pF		
6.8 pF			9.5 pF		
6.9 pF			9.6 pF		
7.0 pF			9.7 pF		
7.1 pF			9.8 pF		
7.2 pF			9.9 pF		
7.3 pF			10 pF		
7.4 pF			12 pF		
7.5 pF			15 pF		
7.6 pF			18 pF		
7.7 pF			22 pF		
			27 pF		
			33 pF		
Tape width 8mm			Tape width 8mm		

NOTE

2. Values in shaded cells indicate thickness class in mm

CAPACITANCE RANGE & THICKNESS FOR NP0

Table 4 Sizes from 0603 to 0805

CAP.	0603					0805				
	25 V	50 V	100V	200V	250V	25 V	50 V	100V	200V	250V
0.22 pF										
0.47 pF										
0.56 pF										
0.68 pF										
0.82 pF										
1.0 pF										
1.2 pF										
1.5 pF										
1.8 pF										
2.2 pF										
2.7 pF										
3.3 pF										
3.9 pF	0.8±0.1	0.8±0.1	0.8±0.1	0.8±0.1	0.8±0.1					
4.7 pF										
5.6 pF						0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1
6.8 pF										
8.2 pF										
10 pF										
12 pF										
15 pF										
18 pF										
22 pF										
27 pF										
33 pF										
39 pF										
47 pF										
56 pF										
68 pF										
82 pF										
100 pF										
Tape width						8mm				

NOTE

I. Values in shaded cells indicate thickness class in mm

THICKNESS CLASSES AND PACKING QUANTITY

Table 5

SIZE CODE	THICKNESS CLASSIFICATION	TAPE WIDTH QUANTITY PER REEL	Ø180 MM / 7 INCH		Ø330 MM / 13 INCH		QUANTITY PER BULK CASE
			Paper/PE	Blister	Paper/PE	Blister	
0201	0.3 ±0.03 mm	8 mm	15,000	---	50,000	---	---
0402	0.5 ±0.05 mm	8 mm	10,000	---	50,000	---	---
0603	0.8 ±0.1 mm	8 mm	4,000	---	15,000	---	---
0805	0.6 ±0.1 mm	8 mm	4,000	---	20,000	---	---

ELECTRICAL CHARACTERISTICS

NP0 DIELECTRIC CAPACITORS; NISN TERMINATIONS

Unless otherwise stated all electrical values apply at an ambient temperature of 20±1 °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%.

Table 6

DESCRIPTION	VALUE
Capacitance range	0.2 pF to 100 pF
Capacitance tolerance	
C < 10 pF	±0.05 pF, ±0.1 pF, ±0.25 pF, ±0.5 pF
C ≥ 10 pF	±2%, ±5%
Q value	
C < 30 pF	Q ≥ (400 + 20C) C: pF
C ≥ 30 pF	Q ≥ 1000
Insulation resistance after 1 minute at U _r (DC)	R _{ins} ≥ 10 GΩ or R _{ins} × C _r ≥ 500 seconds whichever is less
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):	±30 ppm/°C
Operating temperature range:	-55 °C to +125 °C

SOLDERING RECOMMENDATION

Table 7

SOLDERING METHOD	SIZE 0201	0402	0603	0805
Reflow	○	○	○	○
Wave	---	---	○	○

TESTS AND REQUIREMENTS

Table 8 Test procedures and requirements

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Mounting	IEC 60384-21/22	4.3 The capacitors may be mounted on printed-circuit boards or ceramic substrates	No visible damage
Visual inspection and dimension check		4.4 Any applicable method using × 10 magnification	In accordance with specification
Capacitance		4.5.1 Class I: f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V _{rms} at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V _{rms} at 20 °C	Within specified tolerance
Q value		4.5.2 Class I: f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V _{rms} at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V _{rms} at 20 °C	In accordance with specification
Insulation resistance		4.5.3 At U _r (DC) for 1 minute	In accordance with specification

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS												
Temperature coefficient	4.6	<p>Capacitance shall be measured by the steps shown in the following table.</p> <p>The capacitance change should be measured after 5 min at each specified temperature stage.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>25±2</td> </tr> <tr> <td>b</td> <td>Lower temperature±3°C</td> </tr> <tr> <td>c</td> <td>25±2</td> </tr> <tr> <td>d</td> <td>Upper Temperature±2°C</td> </tr> <tr> <td>e</td> <td>25±2</td> </tr> </tbody> </table> <p>(1) Class I</p> <p>Temperature Coefficient shall be calculated from the formula as below</p> $\text{Temp. Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/°C]}$ <p>C1: Capacitance at step c C2: Capacitance at 125°C ΔT: 100°C(=125°C-25°C)</p> <p>(2) Class II</p> <p>Capacitance Change shall be calculated from the formula as below</p> $\Delta C = \frac{C2 - C1}{C1} \times 100\%$ <p>C1: Capacitance at step c C2: Capacitance at step b or d</p>	Step	Temperature(°C)	a	25±2	b	Lower temperature±3°C	c	25±2	d	Upper Temperature±2°C	e	25±2	<p><General purpose series></p> <p>Class I: Δ C/C: ±30ppm</p> <p>Class2: X7R: Δ C/C: ±15% Y5V: Δ C/C: 22~-82%</p> <p><High Capacitance series></p> <p>Class2: X7R/X5R: Δ C/C: ±15% Y5V: Δ C/C: 22~-82%</p>
Step	Temperature(°C)														
a	25±2														
b	Lower temperature±3°C														
c	25±2														
d	Upper Temperature±2°C														
e	25±2														
Adhesion	4.7	<p>A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate</p>	<p>Force</p> <p>size ≥ 0603: 5N size = 0402: 2.5N size = 0201: 1N</p>												
Bond strength of plating on end face	4.8	<p>Mounting in accordance with IEC 60384-22 paragraph 4.3</p> <hr/> <p>Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 340 mm</p>	<p>No visible damage</p> <hr/> <p><General purpose series></p> <p>ΔC/C</p> <p>Class I: NPO: within ±1% or 0.5 pF whichever is greater</p>												
ESR		<p>Measuring frequency: 1 ± 0.2GHz at room temperature.</p> <hr/> <p>Measuring frequency: 500 ± 50MHz at room temperature.</p>	<p>0.2pF ≤ C ≤ 1pF :350mΩ max 1pF < C ≤ 5pF :300mΩ max 5pF < C ≤ 10pF :250mΩ max</p> <hr/> <p>10pF < C ≤ 100pF :400mΩ max</p>												

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Resistance to soldering heat	IEC 60384-21/22 4.9	<p>Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature</p> <p>Preheating: for size ≤ 1206: 120 °C to 150 °C for 1 minute</p> <p>Preheating: for size >1206: 100 °C to 120 °C for 1 minute and 170 °C to 200 °C for 1 minute</p> <p>Solder bath temperature: 260 ±5 °C</p> <p>Dipping time: 10 ±0.5 seconds</p> <p>Recovery time: 24 ±2 hours</p>	<p>Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned</p> <hr/> <p><General purpose series> $\Delta C/C$ Class I: NPO: within ±0.5% or 0.5 pF whichever is greater</p> <hr/> <p>D.F. within initial specified value R_{ins} within initial specified value</p>
Solderability	4.10	<p>Preheated the temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.</p> <p>Test conditions for lead containing solder alloy Temperature: 235 ±5 °C Dipping time: 2 ±0.2 seconds Depth of immersion: 10 mm Alloy Composition: 60/40 Sn/Pb Number of immersions: 1</p> <p>Test conditions for lead-free containing solder alloy Temperature: 245 ±5 °C Dipping time: 3 ±0.3 seconds Depth of immersion: 10 mm Alloy Composition: SAC305 Number of immersions: 1</p>	<p>The solder should cover over 95% of the critical area of each termination</p>
Rapid change of temperature	4.11	<p>Preconditioning: 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature</p> <p>5 cycles with following detail: 30 minutes at lower category temperature 30 minutes at upper category temperature</p> <p>Recovery time 24 ±2 hours</p>	<p>No visual damage</p> <hr/> <p><General purpose series> $\Delta C/C$ Class I: NPO: within ±1% or 1 pF whichever is greater</p> <hr/> <p>D.F. meet initial specified value R_{ins} meet initial specified value</p>

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Damp heat with U_r load	IEC 60384-21/22	<p>4.13</p> <ol style="list-style-type: none"> Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp Initial measure: Spec: refer to initial spec C, D, IR Damp heat test: 500 ±12 hours at 40 ±2 °C; 90 to 95% R.H. 1.0 U_r applied Recovery: Class I: 6 to 24 hours Final measure: C, D, IR <p>P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be preconditioned according to "IEC 60384 4.1" and then the requirement shall be met.</p>	<p>No visual damage after recovery</p> <hr/> <p><General purpose series> $\Delta C/C$ Class I: NP0: within ±2% or 1 pF whichever is greater D.F. Class I: NP0: ≤ 2 x specified value R_{ins} Class I: NP0: ≥ 2,500 MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less</p>
Endurance		<p>4.14</p> <ol style="list-style-type: none"> Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp Initial measure: Spec: refer to initial spec C, D, IR Endurance test: Temperature: NP0: 125 °C Specified stress voltage applied for 1,000 hours: Applied 2.0 x U_r for general product. Recovery time: 24 ±2 hours Final measure: C, D, IR <p>P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be preconditioned according to "IEC 60384 4.1" and then the requirement shall be met.</p>	<p>No visual damage</p> <hr/> <p><General purpose series> $\Delta C/C$ Class I: NP0: within ±2% or 1 pF whichever is greater D.F. Class I: NP0: ≤ 2 x specified value R_{ins} Class I: NP0: ≥ 4,000 MΩ or $R_{ins} \times C_r \geq 40s$ whichever is less</p>
Voltage proof	IEC 60384-1	<p>4.6</p> <p>Specified stress voltage applied for 1 minute</p> <p>$U_r \leq 100$ V: series applied 2.5 U_r 100 V < $U_r \leq 200$ V series applied (1.5 U_r + 100) 200 V < $U_r \leq 500$ V series applied (1.3 U_r + 100) $U_r > 500$ V: 1.3 U_r I: 7.5 mA</p>	No breakdown or flashover

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 11	Mar 19, 2014	-	- Size update
Version 10	Mar 19, 2014	-	- Tests and requirements
Version 9	Feb. 27, 2014	-	- Tolerance update
Version 8	Oct. 28, 2013	-	- Rated voltage update
Version 7	Oct. 09, 2013	-	- Rated voltage update
Version 6	Jun. 24, 2013	-	- Tolerance update
Version 5	Apr. 15, 2013	-	- Tolerance update
Version 4	Mar. 28, 2013	-	- Capacitance range & thickness update
Version 3	Feb. 07, 2013	-	- Capacitance range & thickness update
Version 2	Dec. 25, 2012	-	- Capacitance range & thickness update
Version 1	Dec. 03, 2012	-	- Capacitance range & thickness update
Version 0	Nov. 23, 2012	-	- New datasheet for HiQ NP0 series with RoHS compliant