

Innovativ

**YAGEO**

# DATA SHEET

## **SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS**

General purpose

Class 1, NP0

16 V TO 50 V

0.22 pF to 100 nF

RoHS compliant & Halogen Free



**YAGEO**  
**hcom**

Product Specification – March 7, 2017 V.16

**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 & I2NC**

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

**YAGEO BRAND ordering code**

**GLOBAL PART NUMBER (PREFERRED)**

**CC    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)
- 1206 (3216)
- 1210 (3225)
- 1812 (4532)

**(2) TOLERANCE**

- B = ±0.1 pF
- C = ±0.25 pF
- D = ±0.5 pF
- F = ±1%
- G = ±2%
- J = ±5%
- K = ±10%

**(3) PACKING STYLE**

- R = Paper/PE taping reel; Reel 7 inch
- K = Blister taping reel; Reel 7 inch
- P = Paper/PE taping reel; Reel 13 inch
- F = Blister taping reel; Reel 13 inch
- C = Bulk case

**(4) RATED VOLTAGE**

- 7 = 16 V
- 8 = 25 V
- 9 = 50 V

**(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 x 10<sup>1</sup> = 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.

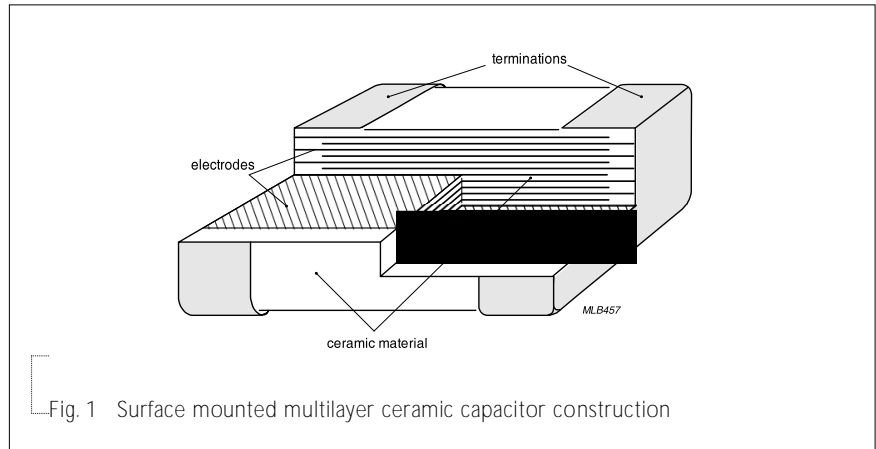


Fig. 1 Surface mounted multilayer ceramic capacitor construction

**DIMENSION**

Table 1 For outlines see fig. 2

TYPE	L <sub>1</sub> (mm)	W (mm)	T (MM)	L <sub>2</sub> / L <sub>3</sub> (mm)		L <sub>4</sub> (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 ± 0.10 <sup>(1)</sup>	1.25 ± 0.10 <sup>(1)</sup>		0.25	0.75	0.70
	2.0 ± 0.20 <sup>(2)</sup>	1.25 ± 0.20 <sup>(2)</sup>				
1206	3.2 ± 0.15 <sup>(1)</sup>	1.6 ± 0.15 <sup>(1)</sup>		0.25	0.75	1.40
	3.2 ± 0.30 <sup>(2)</sup>	1.6 ± 0.20 <sup>(2)</sup>				
1210	3.2 ± 0.20	2.5 ± 0.20		0.25	0.75	1.40
1812	4.5 ± 0.20	3.2 ± 0.20		0.25	0.75	2.20

**OUTLINES**

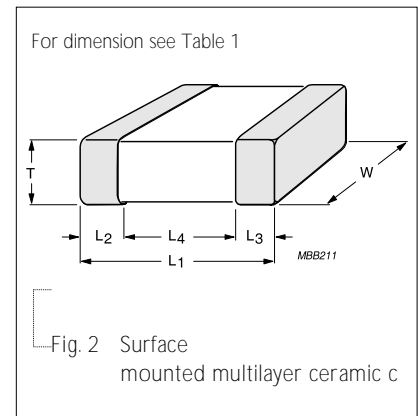


Fig. 2 Surface mounted multilayer ceramic capacitor outlines

**NOTE**

1. Dimension for size 0805 and 1206, C ≤ 1 nF
2. Dimension for size 0805 and 1206, C > 1 nF





**CAPACITANCE RANGE & THICKNESS FOR NPO**

Table 4 Sizes from 0805 to 1812

CAP.	0805			1206			1210		1812
	16 V	25 V	50 V	16 V	25 V	50 V	25 V	50 V	50 V
0.22 pF									
0.47 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
0.82 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
1.0 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
1.2 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
1.5 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
1.8 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
2.2 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
2.7 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
3.3 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
3.9 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
4.7 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
5.6 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
6.8 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
8.2 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
10 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
12 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
15 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
18 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
22 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
27 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
33 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
39 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1			
47 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	
56 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
68 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
82 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
100 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request

**Surface-Mount Ceramic Multilayer Capacitors**

General Purpose

NPO

**16 V to 50 V**

CAP.	0805			1206			1210		1812
	16 V	25 V	50 V	16 V	25 V	50 V	25 V	50 V	50 V
120 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
150 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
180 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
220 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
270 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
330 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
390 pF	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	1.25±0.2
470 pF									

THICKNESS CLASSES AND PACKING QUANTITY

Table 6

SIZE  
CODE



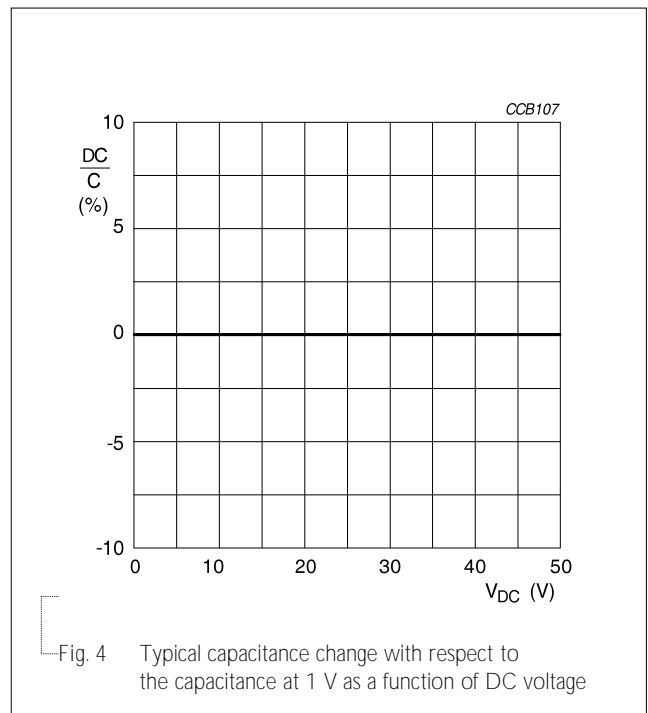
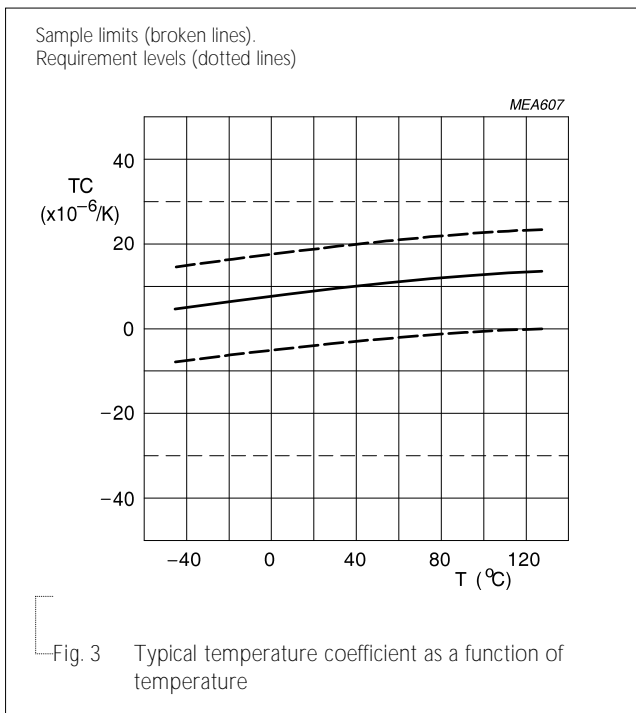
**ELECTRICAL CHARACTERISTICS**

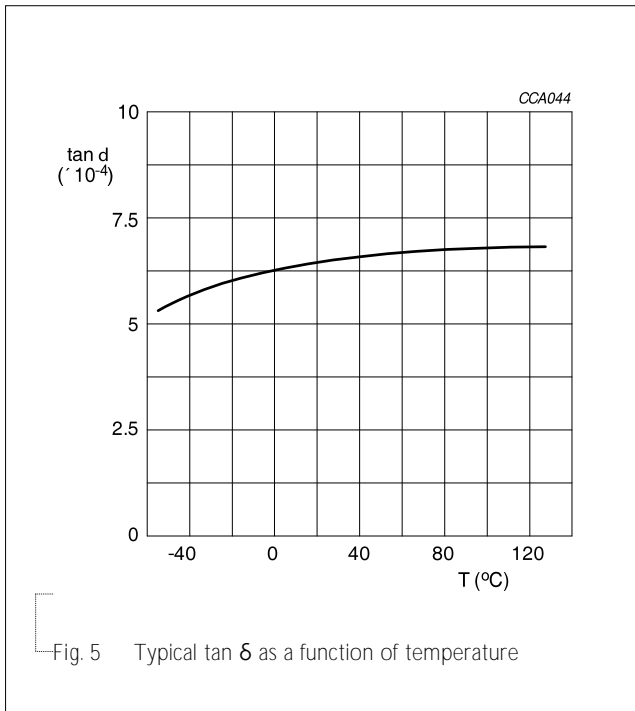
**NP0 DIELECTRIC CAPACITORS; NISN TERMINATIONS**

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 7

DESCRIPTION	VALUE
Capacitance range	0.22 pF to 100 nF
Capacitance tolerance	
C < 10 pF	± 0.1 pF, ± 0.25 pF, ± 0.5 pF
<b>C ≥ 10 pF</b>	± 1%, ± 2%, ± 5%, ± 10%
Dissipation factor (D.F.)	
C < 30 pF	≤ 1 / ( 400 + 20C )
<b>C ≥ 30 pF</b>	≤ 0.1 %
Insulation resistance after 1 minute at U <sub>r</sub> (DC)	R <sub>ins</sub> ≥ 10 GΩ or R <sub>ins</sub> × C <sub>r</sub> ≥ 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 8

SOLDERING METHOD	SIZE					
	0201	0402	0603	0805	1206	≥ 1210
Reflow	Reflow only	≥ 0.1 μF	≥ 1.0 μF	≥ 2.2 μF	≥ 4.7 μF	Reflow only
Reflow/Wave	---	< 0.1 μF	< 1.0 μF	< 2.2 μF	< 4.7 μF	---

**TESTS AND REQUIREMENTS**

Table 9 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 1: f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C	Within specified tolerance												
Dissipation factor (D.F.)	4.5.2	Class 1: f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C	In accordance with specification												
Insulation resistance	4.5.3	At U <sub>r</sub> (DC) for 1 minute	In accordance with specification												
Temperature coefficient	4.6	Capacitance shall be measured by the steps shown in the following table. The capacitance change should be measured after 5 min at each specified temperature stage.	<General purpose series> Class1: Δ C/C: ± 30ppm  Class2: X7R: Δ C/C: ± 15% Y5V: Δ C/C: 22~-82%												
		<table border="1"> <thead> <tr> <th>Step</th> <th>Temperature( )</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>25± 2</td> </tr> <tr> <td>b</td> <td>Lower temperature± 3</td> </tr> <tr> <td>c</td> <td>25± 2</td> </tr> <tr> <td>d</td> <td>Upper Temperature± 2</td> </tr> <tr> <td>e</td> <td>25± 2</td> </tr> </tbody> </table>	Step	Temperature( )	a	25± 2	b	Lower temperature± 3	c	25± 2	d	Upper Temperature± 2	e	25± 2	<High Capacitance series> Class2: X7R/X5R: Δ C/C: ± 15% Y5V: Δ C/C: 22~-82%
Step	Temperature( )														
a	25± 2														
b	Lower temperature± 3														
c	25± 2														
d	Upper Temperature± 2														
e	25± 2														
		(1) Class I Temperature Coefficient shall be calculated from the formula as below $\text{Temp. Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/ ]}$ C1: Capacitance at step c C2: Capacitance at 125 ΔT: 100 (=125 -25 )													
		(2) Class II Capacitance Change shall be calculated from the formula as below $\Delta C = \frac{C2 - C1}{C1} \times 100\%$ C1: Capacitance at step c C2: Capacitance at step b or d													

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Adhesion	4.7	A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate	Force size ≥ 0603: 5N size = 0402: 2.5N size = 0201: 1N

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Damp heat with $U_r$ load	IEC 60384-21/22	4.13 <ol style="list-style-type: none"> <li>Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ± 1 hour at room temp</li> <li>Initial measure: Spec: refer to initial spec C, D, IR</li> <li>Damp heat test: 500 ± 12 hours at 40 ± 2 °C; 90 to 95% R.H. 1.0 <math>U_r</math> applied</li> <li>Recovery: Class 1: 6 to 24 hours</li> <li>Final measure: C, D, IR</li> </ol> <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>	No visual damage after recovery <hr/> <General purpose series> $\Delta C/C$ Class 1: NPO: within ± 2% or 1 pF whichever is greater D.F. Class 1: NPO: ≤ 2 x specified value $R_{ins}$ Class 1: NPO: ≥ 2,500 MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less
Endurance		4.14 <ol style="list-style-type: none"> <li>Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ± 1 hour at room temp</li> <li>Initial measure: Spec: refer to initial spec C, D, IR</li> <li>Endurance test: Temperature: NPO: 125 °C Specified stress voltage applied for <b>1,000</b> hours: Applied 2.0 x <math>U_r</math> for general product.</li> <li>Recovery time: 24 ± 2 hours</li> <li>Final measure: C, D, IR</li> </ol> <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>	No visual damage <hr/> <General purpose series> $\Delta C/C$ Class1: NPO: within ± 2% or 1 pF whichever is greater D.F. Class1: NPO: ≤ 2 x specified value $R_{ins}$ Class1: NPO: ≥ 4,000 MΩ or $R_{ins} \times C_r \geq 40s$ whichever is less
Voltage proof	IEC 60384-1	4.6 Specified stress voltage applied for 1 minute $U_r \leq 100$ 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: 10 V: 1 500 V:	

**REVISION HISTORY**

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 16	Mar. 7, 2017	-	- 0805 L4 spec updated
Version 15	Nov. 21, 2016	-	- Product range updated
Version 14	Jul. 22, 2016	-	- Add 0805/8.2nF and 10nF/ 16V to 50V, T=1.25mm
Version 13	May. 16, 2016	-	- Product range updated
Version 12	Feb. 16, 2016	-	- Product range updated
Version 11	Sep. 11, 2014	-	- Product range updated
Version 10	Feb. 18, 2014	-	- Product range updated
Version 9	Jun. 17, 2013	-	- Product range updated
Version 8	Aug 05, 2011	-	- Dimension updated
Version 7	Jun 14, 2011	-	- Size1210 T=1.0mm SPO added - Dimension updated
Version 6	Jan 06, 2011	-	- Dimension updated
Version 5	Dec 29, 2010	-	- Dimension updated
Version 4	Nov 23, 2010	-	- Dimension updated
Version 3	Apr 20, 2010	-	- The statement of "Halogen Free" on the cover added - Dimension updated
Version 2	Oct 26, 2009	-	- Typo updated
Version 1	Jun 02, 2009	-	- 12NC code updated
Version 0	Apr 15, 2009	-	- New datasheet for general purpose NPO series with RoHS compliant - Replace the "16V to 50V" part of pdf files: NPO_16V_7, NPO_16V-to-100V_6, NPO_25V_7, NPO_50-to-500V_11 - Combine 0201 from pdf files: UP-NPOX5RX7RY5V_0201_6.3-to-50V_2 and UY-NPOX5RX7RY5V_0201_6.3-to-50V_2 - Define global part number - Description of "Halogen Free compliant" added