

**Passive  
Components for  
Industrial & Medical  
Applications**

[www.yageo.com](http://www.yageo.com)

# Introduction

## Power/Industrial

All electronic devices have one thing in common: the need for POWER. As a leader in SMD and high voltage MLCC technology, Yageo is able to offer a wide range of passive components for power management applications, such as chip resistors, MLCCs, leaded resistors and electrolytic capacitors, to fulfill all the power requirements with a greater need for efficiency, smaller footprints and lower costs, including DC/DC converters, modems, and DC and AC power supplies.

Power Supply applications generally involve power adapters, desktop power, or server power. Power supplies require passive components, which are highly stable when exposed to temperature fluctuations, and boast very low ESR (equivalent series resistance) values and high ripple current ratings. This enables low impedance at high frequency to support excellent noise suppression and ripple absorption in a wide array of applications in which space is critical and cost per placement and maximum throughput are priorities.

Safety certified MLCCs are AC rated high voltage capacitors designed for surge and impulse protection. The rating of the capacitors depends on their usage in the circuit (X for line-to-line, Y for line-to-ground) as well as their impulse rating (X1, X2, Y1, Y2). Safety certified MLCCs are used as EMI filters in AC/DC power supplies and telecom, sizes from 1808 and 1812, rated as X1/Y2 or X2/Y3.

The Industrial market consists of factory & machine automation, packaging equipment, industrial control, facility management and process control, just to name a few. Yageo offers a complete portfolio of products with high reliability and stability to fulfill versatile requirements under extreme temperature and humidity conditions.



## Lighting

The lighting industry is undergoing rapid changes in the quest for energy efficiency, longer life, and performance. As the world's leading supplier of passive components, Yageo offers full range of reliable, efficient and innovative components for illumination and lighting applications.

Our components are suitable for a wide variety of indoor and outdoor applications: archtainment & hospitality lighting, home lighting, shop lighting, office lighting, street lighting, industrial lighting and horticultural lighting.

This brochure provides product recommendations for key applications, and will be an important tool to guide you choose the right products for your system.



## Medical

Medical, clinical and healthcare settings have unique requirements for electronic products in terms of longevity, certification, reliability, and adherence to strict rules and regulations.

With specific know-how and technology expertise, Yageo offers a broad range of high performance, safety certified products for innovative and effective medical devices, such as: patient monitoring, point-of-care, imaging equipment, and mobile nursing care, etc.

# Applications & Requirements

## Applications



- Converters (DC/DC, AC/DC)



- Battery Management



- SMPS



- Smart Grid Electric Power Meter



- Computing Server



- LED Lighting



- Medical



- Industrial Automation

## Requirements

- High Power Rating
- Low TCR
- Low Thermo EMF
- IEC-60950 (Safety Certification)
- High Capacitance for Transient Input
- High Ripple Current, Low ESR
- Optimized Thermal Performance
- Long Life, High Reliability
- Current Detection
- EMI Filtering
- Safety Approvals (TUV & UL standard certified)
- IEC-60065 (qualified for high voltage chip resistors)

# Recommended Products

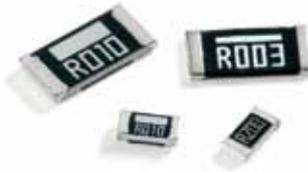
## Thin Film Precision Chip Resistors - RT series



### Features & Benefits

- High reliability: 40°C/95%RH, 1000h  $\Delta R < \pm 0.5\%$
- High heat resistance: 155°C, 1000h  $\Delta R < \pm 0.5\%$
- Tolerances:  $\pm 0.05\%$ ,  $\pm 0.1\%$ ,  $\pm 0.25\%$ ,  $\pm 0.5\%$ ,  $\pm 1\%$
- T.C.R.:  $\pm 10$  ppm/°C,  $\pm 15$  ppm/°C,  $\pm 25$  ppm/°C,  $\pm 50$  ppm/°C
- Sizes: 0402, 0603, 0805, 1206, 1210, 2010, 2512
- For signal conditioning, computing servers

## Low-Ohmic Current Sensors - RL, PA, PF, PR, PH series



### Features & Benefits

- Low TCR and high precision
- Ultra low ohm down to 0.0005  $\Omega$
- High power rating
- Sizes: 0603, 0805, 1206, 2010, 2512, 4527;  
Wide terminal type: 0612, 0815, 0830
- PE series: 0603, 0805, 1206, 2512 (low thermo EMF)
- Current sensing for DC/DC, SPS, lighting

## High Voltage Chip Resistors - RV series



### Features & Benefits

- High maximum working voltage (MWV)
- Reliable electrode construction
- Compatible with lead containing and lead free soldering processes
- Highly stable in auto-placement surface mounting
- Sizes: 0805, 1206, 2010, 2512
- Power supplies & battery chargers

## Surge Chip Resistors - SR series



### Features & Benefits

- Excellent performance at pulse loading
- High power rating & ESD resistance
- High reliability & stability
- Sizes: 0805, 1206, 2010, 2512
- For converters, industrial applications

# Recommended Products

## Anti-Sulfurated Resistors - AF series



### Features & Benefits

- Superior resistance against sulfur containing environment
- Anti-FOS test: ASTM-B-809-95
- Moisture resistance to MIL-STD-202 method 106
- Load life stability 1000 hours at 125°C
- Sizes: 0402, 0603, 0805, 1206
- Computing servers, base stations

## High Capacitance MLCC ( $\geq 1\mu\text{F}$ )



### Features & Benefits

- Materials: X5R, X7R and Y5V
- Sizes: 0402 to 1812
- Capacitance from 1  $\mu\text{F}$  to 100  $\mu\text{F}$
- Rated working voltage from 6.3V to 50V
- Inverters, UPS, medical equipment

## High Voltage MLCC ( $\geq 100\text{V}$ )



### Features & Benefits

- Materials: NP0 and X7R
- <Common High Voltage Series>
- Sizes: 0603 to 1812, voltage from 100V to 3kV
- High DC withstanding voltage ( $\geq 1.2\text{V}$  Rated)
- <Safety Certification Series>
- TUV certification for 1808 and 1812 size (X1/Y2 & X2/Y3)
- UL certification for 1808 and 1812 size (X1/Y2)
- Noise Suppression, Primary-secondary coupling

## MLV (Multi-Layer Varistor)



### Features & Benefits

- Excellent clamping voltage & energy dissipation capability
- Quick response time ( $< 1\text{n sec.}$ )
- Adjustable capacitance values
- High transient current capability
- Symmetrical voltage-current characteristics
- ESD protection, LED lighting

### Screw Type Electrolytic Capacitors\*



**Features & Benefits**

- High ripple current, large power source, converter circuit, etc.
- Long life, wide temperature (up to 5,000 hours at 105°C)
- Higher voltage with compact size
- Low leakage current
- Industrial & power applications

### Snap-in (Radial) Electrolytic Capacitors\*



**Features & Benefits**

- Ideally suitable for using in switching power supplies and other industrial/commercial applications
- For printed circuit board, high performance
- Smoothing circuit, TV, monitor, adapter, SMPS

### Miniature Electrolytic Capacitors\*



**Features & Benefits**

- Low impedance, low ESR
- High frequency applications
- Switching regulator, LED street lighting applications

### Chip Antennas\*



**Features & Benefits**

- Embedded antenna with moderate gain and efficiency performance
- Ultra compact available in different sizes for various applications
- Surface mount, meet the compact and low-profile requirements
- Omni directional radiation, suitable for short-range wireless applications

**Note:** \* For Electrolytic Capacitors and Chip Antennas, please refer to [www.yageo.com](http://www.yageo.com) for detailed information.

# Recommended Products

## High Voltage/Ohmic Leaded Resistors - HHV series\*



### Features & Benefits

- Metal glazed film
- Higher power rating
- Higher working voltage
- High pulse loading capability
- Resistance to high temp/humidity
- Highly stable performance and highly reliable
- Flameproof multilayer coating (UL94V-0)
- Power & industrial applications

## Melf Metal Leaded Resistors - MMF, MMP series\*



### Features & Benefits

- SMD technology in metal film
- Suitable for reflow and wave soldering
- Miniature & ultra miniature size
- Higher power rating & wide resistance range
- Narrow tolerance and low TCR
- Electronic ballast, signal conditioning

## Wirewound Leaded Resistors - PNP, PNP V series\*



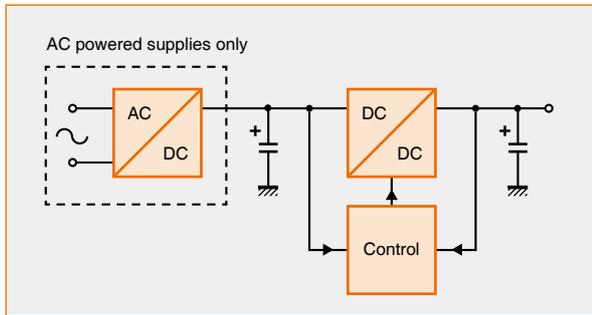
### Features & Benefits

- Ultra miniature size
- Higher power rating
- Wide resistance range
- Low TCR
- Highly stable performance and highly reliable
- Flameproof multilayer coating (UL94V-0)
- Suitable for automatic machine insertion

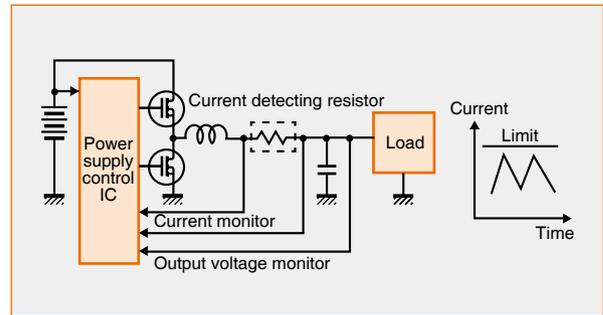
**Note:** \* For Leaded Resistors, please refer to [www.yageo.com](http://www.yageo.com) for detailed information.

# Component Solutions

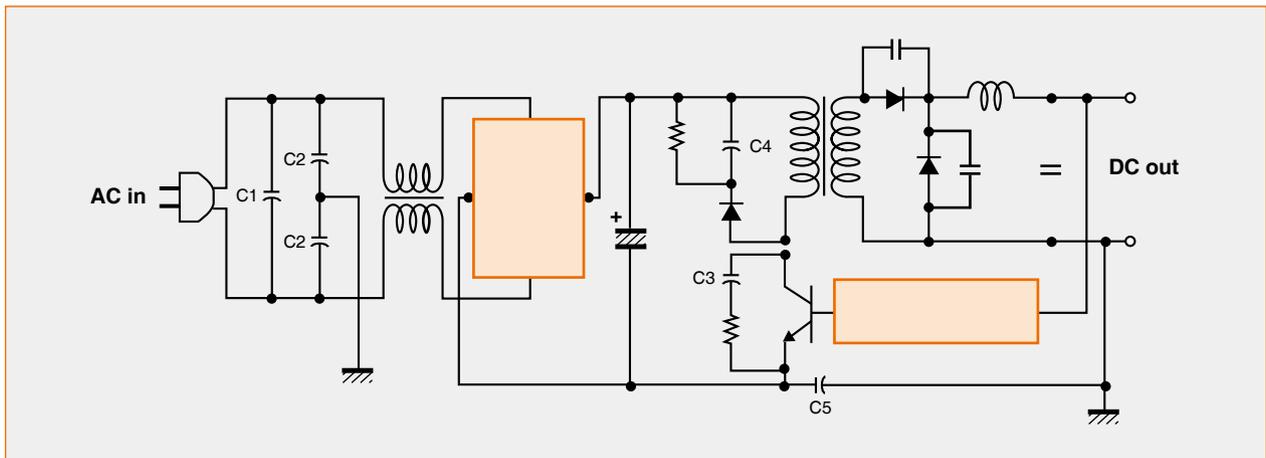
## 1. Basic Topology of Power Supplies



## 2. DC/DC Converter Circuit



## 3. Switching Power Supplies



### Resistors

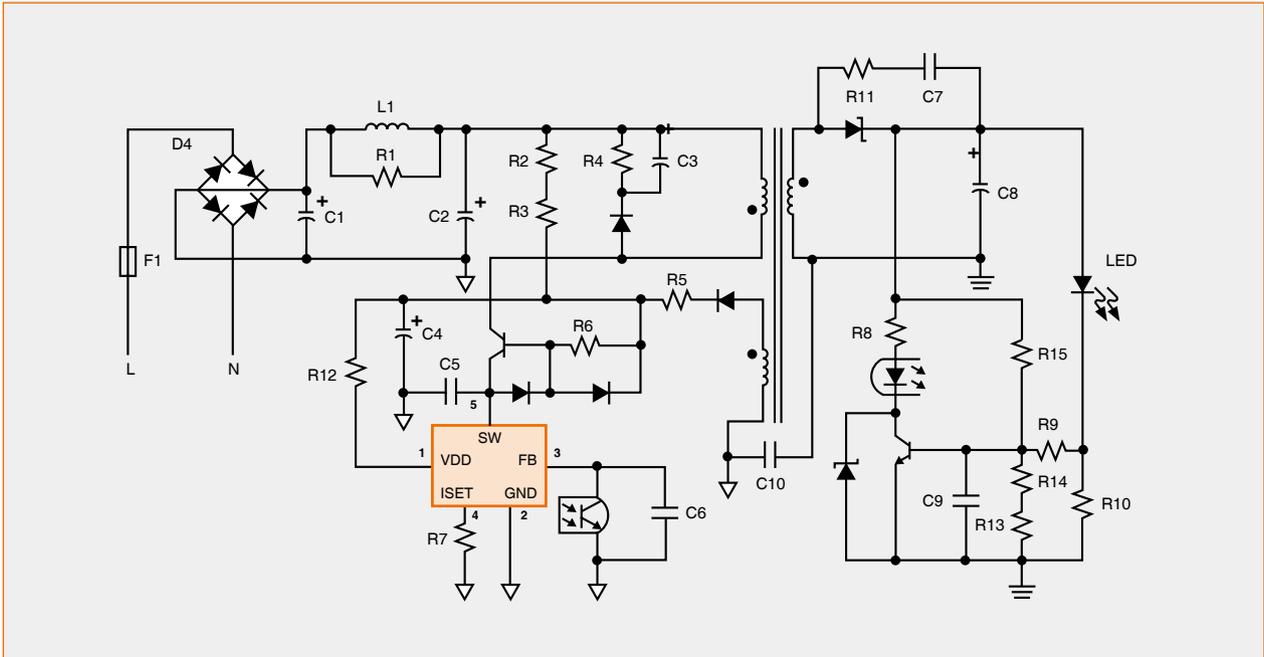
- RT series: RT0402 ~ RT2512 (5.1Ω-1.5MΩ)
- PF series: PF0603 ~ PF2512 (1mΩ-100mΩ)
- PR series: PR1206 ~ PR2512 (0.5mΩ-100mΩ)

### MLCC

- CC series: CC0402 ~ CC1206 (50V-1kV)
- SC series: SC1808, 1812 (X1/Y2, X2/Y3)

# Component Solutions

## 4. LED Lighting



### Resistors

-  RL series: RL0805 ~ RL1206 (10mΩ-1Ω)
-  SR series: SR0805 ~ SR2512 (1Ω-100KΩ)
-  PR series: PR1206 ~ PR2512 (0.5mΩ-100mΩ)

### MLCC

-  CC series: CC0402 ~ CC1206 (50V-1kV)
-  SC series: SC1808, 1812 (X1/Y2, X2/Y3)



# Product Information - Chip Resistors

Electrical characteristics										
Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range	Tolerance	T. C. R.		
RT0402xRx07xxxxL	RT	0402	1/16W	50V	-55°C to 155°C	$10\Omega \leq R \leq 121K\Omega$	±0.05% ±0.1% ±0.25% ±0.5% ±1% (E24/E96)	±10 ppm/°C ±15 ppm/°C ±25 ppm/°C ±50 ppm/°C		
RT0603xRx07xxxxL		0603	1/10W	75V		$5.1\Omega \leq R \leq 681K\Omega$				
RT0805xRx07xxxxL		0805	1/8W	150V		$5.1\Omega \leq R \leq 1.5M\Omega$				
RT1206xRx07xxxxL		1206	1/4W	200V	-55°C to 125°C	$5.1\Omega \leq R \leq 1.5M\Omega$				
RT1210xRx07xxxxL		1210	1/4W			$5.1\Omega \leq R \leq 1M\Omega$				
RT2010xKx07xxxxL		2010	1/2W			$10\Omega \leq R \leq 1M\Omega$				
RT2512xKx07xxxxL		2512	3/4W			$10\Omega \leq R \leq 1M\Omega$				
PR1206xKx07xxxxxx	PR	1206	1/4W	(PxR) <sup>1/2</sup>	-55°C to 155°C	$1m\Omega \leq R \leq 6m\Omega$	±1% ±2% ±5% (E24)	±50 ppm/°C		
PR1206xKx7Wxxxxxx			1/2W						$1m\Omega \leq R < 100m\Omega$	
PR1206xKx47xxxxxx			1W							
PR2010xKx07xxxxxx		2010	1/2W			$0.5m\Omega \leq R \leq 5m\Omega$		$0.5m\Omega \leq R \leq 2m\Omega$ ±200 ppm/°C		
PR2010xKx7Wxxxxxx			1W						$3m\Omega \leq R \leq 5m\Omega$ ±100 ppm/°C	
PR2512xKx07xxxxxx		2512	1W			$0.5m\Omega \leq R \leq 10m\Omega$		±50 ppm/°C		
PR2512xKx7Wxxxxxx			2W							
PR2512xKx7Txxxxxx			3W							
PR2512DKx07xxxxxx			1W							
PR2512DKx7Wxxxxxx			2W							
PA2512xKF07xxxxL		PA	2512			1W		(PxR) <sup>1/2</sup>	-55°C to 155°C	$1m\Omega \leq R \leq 10m\Omega$
PA2512xKF7WxxxxL	2W									
PA2512xKF7TxxxxL	3W									
PF0603xRx57xxxxxx	PF	0603	1/2W	(PxR) <sup>1/2</sup>	-55°C to 155°C	$5m\Omega \leq R \leq 100m\Omega$	±1% ±2% ±5% (E24)	±75 ppm/°C		
PF0805xRx07xxxxxx			0805						1/8W	$4m\Omega \leq R \leq 100m\Omega$
PF0805xRx7Wxxxxxx									1/4W	
PF0805xRx7Txxxxxx		1/3W								
PF0805xRx47xxxxxx		1/2W								
PF1206xxx07xxxxxx		1206				1/4W			$3m\Omega \leq R < 100m\Omega$	
PF1206xxx7Wxxxxxx			1/2W			$5m\Omega \leq R < 100m\Omega$				
PF2010xKx7Wxxxxxx			2010							1W
PF2512xKx07xxxxxx		2512	1W						$1m\Omega \leq R < 100m\Omega$	
PF2512xKx7Wxxxxxx			2W							
PF2512xKx7Txxxxxx			3W			$1m\Omega \leq R \leq 50m\Omega$				
PF4527xKx7Wxxxxxx			4527							3W

# Product Information - Chip Resistors

Electrical characteristics								
Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range	Tolerance	T. C. R.
PF0612xKx07xxxxxx	PF (Wide)	0602	1W	(PxR)^1/2	-55°C to 155°C	1mΩ ≤ R ≤ 50mΩ	±1% ±2% ±5% (E24)	±75 ppm/°C
PF0815xKx7Wxxxxxx		0815	1W			1mΩ ≤ R ≤ 20mΩ		
PF0830xKx07xxxxxx		0830	2W			1mΩ ≤ R ≤ 100mΩ		
PH0805xRx07xxxxxx	PH	0805	4/5W	(PxR)^1/2	-55°C to 155°C	4mΩ ≤ R ≤ 50mΩ	±1% ±2% ±5% (E24)	±75 ppm/°C
PH1206xRx07xxxxxx		1206	1W					
PE0603xRx57xxxxxx	PE	0603	1/2W	(PxR)^1/2	-55°C to 155°C	5mΩ ≤ R < 100mΩ	±1% ±2% ±5% (E24)	±75 ppm/°C
PE0805xRx47xxxxxx		0805	1/2W			4mΩ ≤ R < 100mΩ		
PE1206xRx47xxxxxx		1206	1W			3mΩ ≤ R < 100mΩ		
PE2512xKx7Wxxxxxx		2512	2W			1mΩ ≤ R < 100mΩ		
SR0805xR-07xxxxL	SR	0805	1/8W	150V	-55°C to 155°C	1Ω ≤ R ≤ 100KΩ	±5% ±10% ±20% (E24)	±200 ppm/°C
SR1206xR-07xxxxL		1206	1/4W	200V				
SR1218xK-07xxxxL		1218	1W					
SR2010xK-07xxxxL		2010	3/4W					
SR2512xK-07xxxxL		2512	1W					
RV0805xR-07xxxxL	RV	0805	1/8W	400V	-55°C to 155°C	100KΩ ≤ R ≤ 10MΩ	±1% (E24/E96) ±5% (E24)	±200 ppm/°C
RV1206xR-07xxxxL		1206	1/4W	500V		10KΩ ≤ R ≤ 27MΩ	Max.: 10MΩ ±1% (E24/E96) Max.: 27MΩ ±5% (E24)	
RV2512JK-07xxxxL		2512	1W			4.7MΩ ≤ R ≤ 16MΩ	±5% (E24)	
AF0402xR-07xxxxL	AF	0402	1/16W	50V	-55°C to 155°C	1Ω ≤ R ≤ 22MΩ Jumper < 50mΩ	Max.: 10MΩ ±1% (E24/E96) Max.: 22MΩ ±5% (E24)	1Ω ≤ R ≤ 10Ω
AF0603xR-07xxxxL		0603	1/10W					±200 ppm/°C
AF0805xR-07xxxxL		0805	1/8W	150V				10Ω < R ≤ 10MΩ
AF1206xR-07xxxxL		1206	1/4W	200V				±100 ppm/°C
								10MΩ < R ≤ 22MΩ
								±200 ppm/°C



## Explanation of ordering code

**RT 0603 D R E 07 56R L**

### Series name (code 1-2)

RT = Thin film high precision high stability  
 PR/PA/PF/PH/PE = Current sensor - low T. C. R.  
 SR = Surge  
 RV = High voltage  
 AF = Anti-sulfurated

### Size code (code 3-6)

(inch / metric)  
 0402 = 1.0 × 0.5  
 0603 = 1.6 × 0.8  
 0612 = 1.6 × 3.2  
 0805 = 2.0 × 1.25  
 0815 = 2.15 × 3.75  
 0830 = 2.0 × 7.5  
 1206 = 3.2 × 1.6  
 1210 = 3.2 × 2.6  
 1218 = 3.2 × 4.5  
 2010 = 5.0 × 2.5  
 2512 = 6.35 × 3.2  
 4527 = 11.0 × 7.0

### Tolerance (code 7)

W = ±0.05%  
 B = ±0.1%  
 C = ±0.25%  
 D = ±0.5%  
 F = ±1%  
 G = ±2%  
 J = ±5% (for AF Jumper ordering)

### Packing style (code 8)

R = Paper tape reel  
 K = Embossed plastic tape reel

### Default code (code 17)

L / Z = Default code

### Resistance (code 12-16)

0R = Jumper  
 0R01 = 0.01Ω  
 0R1 = 0.1Ω  
 1R = 1Ω  
 10R = 10Ω  
 100R = 100Ω  
 1K = 1 000Ω  
 1M = 1 000 000Ω  
 100M = 100 000 000Ω

### Taping reel (code 10-11)

07 = 7 inch Dia. reel  
 10 = 10 inch Dia. reel  
 13 = 13 inch Dia. reel  
 7W = 7 inch Dia. reel  
     2 × standard power type  
 7T = 7 inch Dia. reel  
     3 × standard power type  
 47 = 7 inch Dia. reel  
     4 × standard power type  
 57 = 7 inch Dia. reel  
     5 × standard power type

### T. C. R. (code 9)

B = ±10 ppm/°C (on request)  
 C = ±15 ppm/°C (on request)  
 D = ±25 ppm/°C  
 E = ±50 ppm/°C  
 M = ±75 ppm/°C  
 F = ±100 ppm/°C  
 G = ±200 ppm/°C  
 “—” = Based on spec.  
 (— for SR/RV/AF only)

**Note:** Please contact with sales office, distributors and representatives in your region before ordering.

# Product Information - MLCC

Electrical characteristics						
Global part number	Size	TC	Operating Temp range	Capacitance range	Voltage range	Tolerance
CC0201xxNPOxxxxxx	0201	NPO	-55°C to 125°C	10pF~100pF	50 V	±5%
CC0201xxX7Rxxxxxx		X7R	-55°C to 125°C	100pF~10nF	10V~50V	±10%, ±20%
CC0201xxX5Rxxxxxx		X5R	-55°C to 85°C	100pF~1μF	4V~50V	±10%, ±20%
CC0402xxNPOxxxxxx	0402	NPO	-55°C to 125°C	10pF~1nF	50V~100V	±5%
CC0402xxX7Rxxxxxx		X7R	-55°C to 125°C	100pF~1μF	6.3V~50V	±10%, ±20%
CC0402xxX5Rxxxxxx		X5R	-55°C to 85°C	100pF~10μF	6.3V~50V	±10%, ±20%
CC0603xxNPOxxxxxx	0603	NPO	-55°C to 125°C	10pF~4.7nF	50V~250V	±5%
CC0603xxX7Rxxxxxx		X7R	-55°C to 125°C	100pF~4.7μF	10V~100V	±10%, ±20%
CC0603xxX5Rxxxxxx		X5R	-55°C to 85°C	100pF~22μF	6.3V~50V	±10%, ±20%
CC0805xxNPOxxxxxx	0805	NPO	-55°C to 125°C	10pF~10nF	50V~1000V	±5%
CC0805xxX7Rxxxxxx		X7R	-55°C to 125°C	220pF~10μF	10V~500V	±10%, ±20%
CC0805xxX5Rxxxxxx		X5R	-55°C to 85°C	220pF~47μF	6.3V~50V	±10%, ±20%
CC1206xxNPOxxxxxx	1206	NPO	-55°C to 125°C	10pF~33nF	50V~2000V	±5%
CC1206xxX7Rxxxxxx		X7R	-55°C to 125°C	220pF~22μF	6.3V~2000V	±10%, ±20%
CC1206xxX5Rxxxxxx		X5R	-55°C to 85°C	220pF~100μF	6.3V~50V	±10%, ±20%
CC1210xxNPOxxxxxx	1210	NPO	-55°C to 125°C	10pF~22nF	50V~2000V	±5%
CC1210xxX7Rxxxxxx		X7R	-55°C to 125°C	2.2nF~1μF	6.3V~500V	±10%, ±20%
CC1210xxX5Rxxxxxx		X5R	-55°C to 85°C	2.2nF~100μF	6.3V~50V	±10%, ±20%
CC1808xxNPOxxxxxx	1808	NPO	-55°C to 125°C	10pF~4.7nF	100V~3000V	±5%
CC1808xxX7Rxxxxxx		X7R	-55°C to 125°C	3.3nF~100nF	100V~3000V	±10%, ±20%
CC1812xxNPOxxxxxx	1812	NPO	-55°C to 125°C	10pF~22nF	50V~3000V	±5%
CC1812xxX7Rxxxxxx		X7R	-55°C to 125°C	1nF~1μF	50V~3000V	±10%, ±20%
SC1808xxNPOxxxxxx	SC1808	NPO	-55°C to 125°C	4.7pF~1nF	X1/Y2, X2/Y3	±5%
SC1808xxX7Rxxxxxx		X7R	-55°C to 125°C	150pF~1.5nF	X1/Y2, X2/Y3	±10%
SC1812xxNPOxxxxxx	SC1812	NPO	-55°C to 125°C	15pF~470pF	X1/Y2, X2/Y3	±5%
SC1812xxX7Rxxxxxx		X7R	-55°C to 125°C	220pF~1.5nF	X1/Y2, X2/Y3	±10%



## Explanation of ordering code

**CC 0201 K R X7R 8 B B 102**

### Series name (code 1-2)

CC = Multilayer chip capacitors  
SC = Safety certification capacitors

### Size code (code 3-6)

(inch / metric)  
0201 = 0.6 × 0.3  
0402 = 1.0 × 0.5  
0603 = 1.6 × 0.8  
0805 = 2.0 × 1.25  
1206 = 3.2 × 1.6  
1210 = 3.2 × 2.6  
1808 = 4.5 × 2.0  
1812 = 4.5 × 3.2

### Tolerance (code 7)

B = ±0.1 pF  
C = ±0.25 pF  
D = ±0.5 pF  
F = ±1%  
G = ±2%  
J = ±5%  
K = ±10%  
M = ±20%

### Packing style (code 8)

R = Paper / PE tape reel Ø7 inch  
P = Paper / PE tape reel Ø13 inch  
K = Embossed plastic tape reel Ø7 inch  
F = Embossed plastic tape reel Ø13 inch  
C = Bulk case

### TC material (code 9-11)

NP0  
X5R  
X7R  
Y5V

### Capacitance value (code 15-17)

102 = 1 000 pF  
(2 significant digits+number of zeros; the 3rd digit signifies the multiplying factor, and letter R is decimal point)  
0 = × 1  
1 = × 10<sup>1</sup>  
2 = × 10<sup>2</sup>  
3 = × 10<sup>3</sup>  
4 = × 10<sup>4</sup>  
5 = × 10<sup>5</sup>  
6 = × 10<sup>6</sup>  
7 = × 10<sup>7</sup>  
X X R = Special capacitance  
(X X: capacitance before decimal point)

### Process code (code 14)

N = NP0  
B = Class 2 product

### Termination (code 13)

B = Ni-Barrier

### Rated voltage (code 12)

5 = 6.3 V  
6 = 10 V  
7 = 16 V  
8 = 25 V  
9 = 50 V  
0 = 100 V  
A = 200 V  
B = 500 V  
C = 1 kV  
D = 2 kV  
E = 3 kV  
G = 35 V  
S = 2.5 kV  
T = X2 / Y3 for TUV / UL  
W = X1 / Y2 for TUV / UL  
Y = 250 V  
Z = 630 V

## YAGEO - A GLOBAL COMPANY

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