

## Electronic Components for Power Supplies and LED Lighting



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

# About Yageo



Founded in 1977, the Yageo Corporation has become a world-class provider of passive component services with capabilities on a global scale, including production and sales facilities in Asia, Europe and the Americas.

Yageo currently ranks as the world No.1 in chip-resistors, No. 3 in MLCCs and No. 4 in ferrite products, with a strong global presence: 21 sales offices in 15 countries, 9 production sites, 8 JIT logistic hubs, and 2 R&D centers worldwide. Ferroxcube and Vitrohm, who produce ferrites and leaded resistors, are also a part of the Yageo group.

We support our customers with extensive literature including datasheets, brochures and application notes, which are also available electronically on our website at: [www.yageo.com](http://www.yageo.com)

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# Introduction

## Enabling High-efficiency Power Electronics

Power supplies require passive components to lower overall energy consumption, must be highly stable under fluctuations in temperature, and must support noise suppression. Leading in SMD technology, Yageo's chip resistors, leaded resistors, and multilayer ceramic and electrolytic capacitors meet the needs of power electronics requirements for energy-saving, reliability, smaller footprints and lower costs. They are well-suited to applications such as switching power supplies, lighting ballasts and LED drivers, DC/DC converters, AC/DC power modules, and battery management.

Yageo current sensing chip resistors help with current measurement in low voltage power and battery management for circuit control, protection, monitoring, and performance enhancement. Anti-surge chip resistors are good for power dissipation and surge protection capabilities. Safety-certified MLCCs are AC-rated, high-voltage capacitors designed for surge and impulse protection. High-voltage MLCCs are capable of operating at high-voltage levels in power transmitting and receiving devices or equipment.

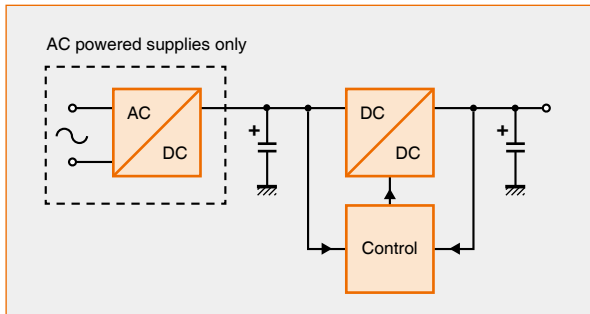


### Requirements for Power Supplies and LED Lighting

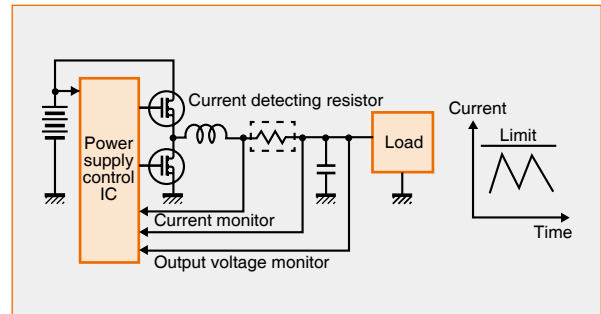
- High Power Rating
- Low TCR
- Low Thermal EMF
- IEC-60950 (Safety certification)
- High Capacitance for Transient Input
- High Ripple Current, Low ESR
- Optimized Thermal Performance
- Long Life, High Reliability
- Current Detection
- EMI Filtering
- Safety Approvals (TUV & UL standard-certified)
-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

# Component Solutions

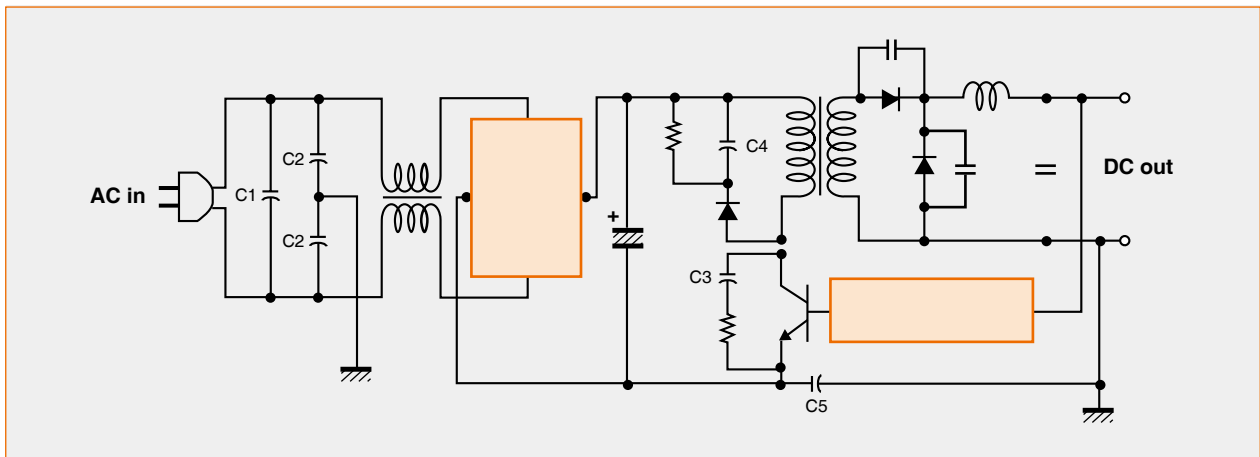
## 1. Basic Topology of Power Supplies






## 2. DC/DC Converter Circuit





## 3. Switching Power Supplies



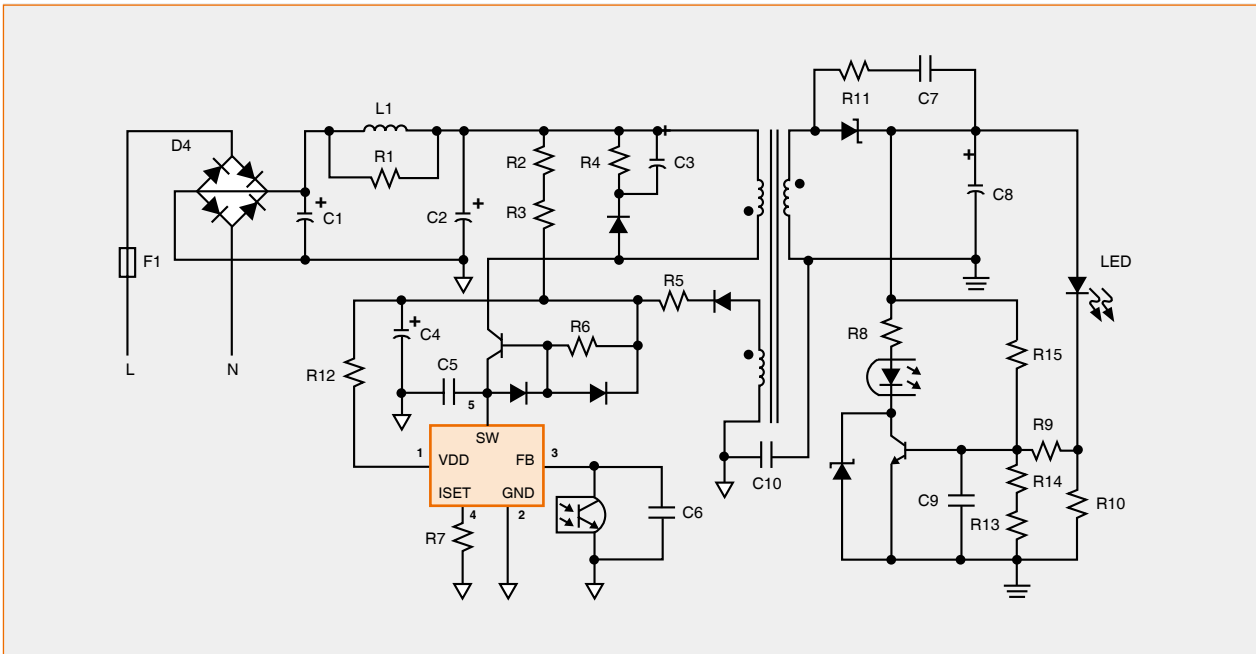
### Resistors

-  RT series: RT0201 ~ RT2512 (5.1Ω~1.5MΩ)
-  PE series: PE0402 ~ PE4527 (1mΩ~910mΩ)
-  PA/PR series: PR1206 ~ PA2512 (0.5mΩ~5mΩ)




### MLCC

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



## 4. LED Lighting



### Resistors

-  PE series: PE0402 ~ PE4527 (1mΩ~910mΩ)
-  SR series: SR0402 ~ SR2512 (1Ω~100KΩ)
-  PR/PA series: PR1206 ~ PA2512 (0.5mΩ~5mΩ)

### MLCC

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

# 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: 0201, 0402, 0603, 0805, 1206, 1210, 2010, 2512
- For signal conditioning, computing servers

## Low-Ohmic Current Sensors - PE/PR/PA Series



### Features & Benefits

- Low TCR and high precision
- Ultra low ohmic down to 0.001Ω
- High power rating
- PE Size: 0402, 0603, 0805, 1206, 2010, 2512, 4527
- Wide terminal: 0306, 0508, 0612, 0815, 0830, 1225
- PR Size: 1206, 2010
- PA Size: 2512
- Low thermal EMF

## 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: 0603, 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: 0402, 0603, 0805, 1206, 1210, 1218, 2010, 2512
- For converters, industrial applications

## Sulfur Resistant Chip Resistors - AF Series



### Features & Benefits

- Superior resistance against sulfur containing environment
- FOS test: ASTM-B-809-95
- Sizes: 0201, 0402, 0603, 0805, 1206, 1210, 1218, 2010, 2512
- Computing servers, base stations

## High Capacitance MLCCs



### Features & Benefits

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

## High Voltage MLCCs ( $\geq 100$ V)



### Features & Benefits

- Materials: NP0 and X7R
- <Common High Voltage Series>
- Sizes: 0603 to 1812, voltage from 100V to 3kV
  - High DC withstanding voltage ( $\geq 1.2$ 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 (<1n sec.)
- Adjustable capacitance values
- High transient current capability
- Symmetrical voltage-current characteristics
- ESD protection, LED lighting



# Recommended Products

## Screw Type Aluminum 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)
- Low leakage current
- Industrial & power applications

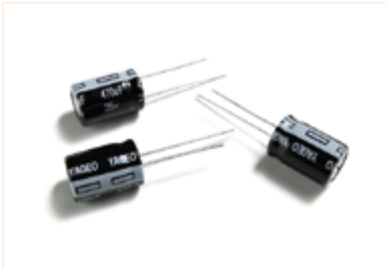
## Snap-in Aluminum Electrolytic Capacitors\*



### Features & Benefits

- Ideally suitable for using in switching power supplies and other industrial/commercial applications
- Long life, wide temperature up to 7,000 hours at 105°C
- For printed circuit board, high performance
- Smoothing circuit, TV, monitor, adapter, SMPS

## Miniature Aluminum Electrolytic Capacitors\*



### Features & Benefits

- Low impedance, low ESR
- Long life, wide temperature up to 10,000 hours at 105°C
- High frequency applications
- Switching regulator, LED street lighting applications

## Chip & PCB 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.



## High Voltage/Ohmic Through-hole 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

## Wirewound Through-hole Resistors - PNP/PNPV 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

## Aluminium Housed Resistors – AHB Series



### Features & Benefits

- Heatsink mounted type
- Reduced size
- Aluminum case are corrugated for added strength and power dissipation
- Higher power rating & wider resistance range
- Anti-corrosion/good performance at severe environment
- Power & Industrial applications

## Trapezium Aluminum Housed Resistors Compact Size – AHC Series



### Features & Benefits

- Higher power rating & wider resistance range
- Anti-surge
- Anti-corrosion
- Compact size
- Energy discharge application
- Power & Industrial segment

# Product Information - Chip Resistors

Electrical characteristics												
Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range	Tolerance	T. C. R.				
RT0201xRx07xxxxL	RT	0201	1/20W	25V	-55°C to 125°C	22Ω ≤ R ≤ 33KΩ	±0.1% ±0.25% ±0.5% ±1% (E24/E96)	±25 ppm/°C ±50 ppm/°C				
RT0402xRx07xxxxL		0402	1/16W	50V	-55°C to 155°C	10Ω ≤ R ≤ 121KΩ	±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		5.1Ω ≤ R ≤ 681KΩ						
RT0805xRx07xxxxL		0805	1/8W	150V		5.1Ω ≤ R ≤ 1.5MΩ						
RT1206xRx07xxxxL		1206	1/4W	200V	-55°C to 125°C	5.1Ω ≤ R ≤ 1.5MΩ						
RT1210xRx07xxxxL		1210	1/4W			5.1Ω ≤ R ≤ 1MΩ						
RT2010xKx07xxxxL		2010	1/2W			10Ω ≤ R ≤ 1MΩ						
RT2512xKx07xxxxL		2512	3/4W			10Ω ≤ R ≤ 1MΩ						
PR1206xKx07xxxxxx	PR	1206	1/4W	(PxR)^1/2	-55°C to 170°C	1mΩ ≤ R ≤ 4mΩ			±1% ±2% ±5%	±50 ppm/°C		
PR1206xKx7Wxxxxxx			1/2W									
PR1206xKx47xxxxxx			1W									
PR2010xKx07xxxxxx		2010	1/2W			1mΩ ≤ R < 4mΩ						
PR2010xKx7Wxxxxxx			1W									
PA2512xKF07xxxxL	PA	2512	1W	(PxR)^1/2	-55°C to 155°C	1mΩ ≤ R ≤ 5mΩ	±1% ±5%	±100 ppm/°C				
PA2512xKF7WxxxxL			2W									
PA2512xKF7TxxxxL			3W									
PE0306xRM07xxxxZ	PE (Wide)	0306	1W	(PxR)^1/2	-55°C to 170°C	5mΩ ≤ R ≤ 100mΩ	±1% ±2% ±5%	±75 ppm/°C ±100 ppm/°C				
PE0508xRM07xxxxZ		0508	1.2W			3mΩ ≤ R ≤ 100mΩ						
PE0612xKx7Wxxxxxx		0612	2W			1mΩ ≤ R ≤ 300mΩ						
PE0815xKx7Wxxxxxx		0815	1W			1mΩ ≤ R ≤ 100mΩ						
PE0830xKx7Wxxxxxx		0830	3W			1mΩ ≤ R ≤ 100mΩ						
PE1225xKM7WxxxxZ		1225	3W			1mΩ ≤ R ≤ 100mΩ						
PE0402xRx47xxxxxx		PE	0402			1/4W		(PxR)^1/2	-55°C to 170°C	10mΩ ≤ R ≤ 50mΩ	±1% ±2% ±5%	±100 ppm/°C
PE0603xRx57xxxxxx			0603			1/2W				5mΩ ≤ R ≤ 100mΩ		
PE0805xRx47xxxxxx			0805			1/2W				4mΩ ≤ R ≤ 100mΩ		
PE1206xxx47xxxxxx			1206			1W				4mΩ ≤ R ≤ 100mΩ		
PE2010xKx7Wxxxxxx	2010		1W	5mΩ ≤ R ≤ 100mΩ								
PE2512xKx7Wxxxxxx	2512		2W	6mΩ ≤ R ≤ 100mΩ								
PE4527xKx7Wxxxxxx	4527		3W	5mΩ ≤ R ≤ 910mΩ								
												±50 ppm/°C ±75 ppm/°C ±100 ppm/°C



### Electrical characteristics

Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range	Tolerance	T. C. R.						
SR0402xR-07xxxxL	SR	0402	1/16W	50V	-55°C to 155°C	1Ω ≤ R ≤ 100KΩ	±5% ±10% ±20%	±200 ppm/°C						
SR0402xR-7WxxxxL			1/8W											
SR0603xR-07xxxxL		0603	1/10W	50V										
SR0603xR-7WxxxxL			1/5W											
SR0805xR-07xxxxL		0805	1/8W	150V										
SR0805xR-7WxxxxL			1/4W											
SR1206xR-07xxxxL		1206	1/4W	200V										
SR1206xR-7WxxxxL			1/2W											
SR1210xR-07xxxxL		1210	1/2W	200V										
SR1218xK-07xxxxL		1218	1W	200V										
SR2010xK-07xxxxL		2010	3/4W	200V										
SR2512xK-07xxxxL		2512	1W	200V										
RV0603xR-07xxxxL	RV	0603	1/10W	350V	-55°C to 155°C	10KΩ ≤ R ≤ 10MΩ	±1%	±200 ppm/°C						
RV0805xR-07xxxxL		0805	1/8W	400V		100KΩ ≤ R ≤ 10MΩ	±5%							
RV1206xR-07xxxxL		1206	1/4W	500V		100KΩ ≤ R ≤ 27MΩ	Max.: 10MΩ ±1% Max.: 27MΩ ±5%							
RV2010xKx-07xxxxL						2010	3/4W			100KΩ ≤ R ≤ 10MΩ	±1%, ±5%			
RV2512JK-07xxxxL		2512	1W	4.7MΩ ≤ R ≤ 16MΩ		±5%								
AF0201xR-07xxxxL	AF	0201	1/20W	25V	-55°C to 125°C	1Ω ≤ R ≤ 10MΩ Jumper < 50mΩ	±1% ±5%	1Ω ≤ R ≤ 10Ω 10Ω < R ≤ 10MΩ	-100/+350 ppm/°C ±200 ppm/°C					
AF0402xR-07xxxxL		0402	1/16W	50V	-55°C to 155°C	1Ω ≤ R ≤ 22MΩ Jumper < 50mΩ	Max: 10MΩ ±1% Max: 22MΩ ±5%	1Ω ≤ R ≤ 10Ω 10Ω < R ≤ 10MΩ 10MΩ < R ≤ 22MΩ	±200 ppm/°C ±100 ppm/°C ±200 ppm/°C					
AF0603xR-07xxxxL		0603	1/10W	50V										
AF0805xR-07xxxxL		0805	1/8W	150V										
AF1206xR-07xxxxL		1206	1/4W	200V										
AF1210xR-07xxxxL		1210	1/2W	200V										
AF1218xK-07xxxxL		1218	1W	200V										
AF2010xK-07xxxxL		2010	3/4W	200V										
AF2512xK-07xxxxL		2512	1W	200V										
AF122-xR-07xxxxL		2*0402	1/16W	50V						-55°C to 125°C	1Ω ≤ R ≤ 1MΩ	±1%	1Ω ≤ R ≤ 10Ω	±250 ppm/°C
AF124-xR-07xxxxL		4*0402	1/16W	25V						-55°C to 155°C	Jumper < 50mΩ	±5%	10Ω < R ≤ 1MΩ	±200 ppm/°C

# Product Information - Chip Resistors

## Ordering Code Definition

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

### Series name (code 1-2)

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

### Size code (code 3-6)

(inch / metric)  
 0201 = 0.6 x 0.3  
 0306 = 0.8 x 1.6  
 0402 = 1.0 x 0.5  
 0508 = 1.25 x 2.0  
 0603 = 1.6 x 0.8  
 0612 = 1.6 x 3.2  
 0805 = 2.0 x 1.25  
 0815 = 2.15 x 3.75  
 0830 = 2.0 x 7.5  
 1206 = 3.2 x 1.6  
 1210 = 3.2 x 2.6  
 1218 = 3.2 x 4.5  
 1225 = 3.2 x 6.35  
 2010 = 5.0 x 2.5  
 2512 = 6.35 x 3.2  
 4527 = 11.0 x 7.0

### Tolerance (code 7)

W =  $\pm 0.05\%$   
 B =  $\pm 0.1\%$   
 C =  $\pm 0.25\%$   
 D =  $\pm 0.5\%$   
 F =  $\pm 1\%$   
 G =  $\pm 2\%$   
 J =  $\pm 5\%$  (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 = 0.01 $\Omega$   
 0R1 = 0.1 $\Omega$   
 1R = 1 $\Omega$   
 10R = 10 $\Omega$   
 100R = 100 $\Omega$   
 1K = 1 000 $\Omega$   
 1M = 1 000 000 $\Omega$   
 100M = 100 000 000 $\Omega$

### Taping reel (code 10-11)

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

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

B =  $\pm 10$  ppm/ $^{\circ}$ C (on request)  
 C =  $\pm 15$  ppm/ $^{\circ}$ C (on request)  
 D =  $\pm 25$  ppm/ $^{\circ}$ C  
 E =  $\pm 50$  ppm/ $^{\circ}$ C  
 M =  $\pm 75$  ppm/ $^{\circ}$ C  
 F =  $\pm 100$  ppm/ $^{\circ}$ C  
 G =  $\pm 200$  ppm/ $^{\circ}$ C  
 “—” = Based on spec.  
 (— for SR/RV/AF only)

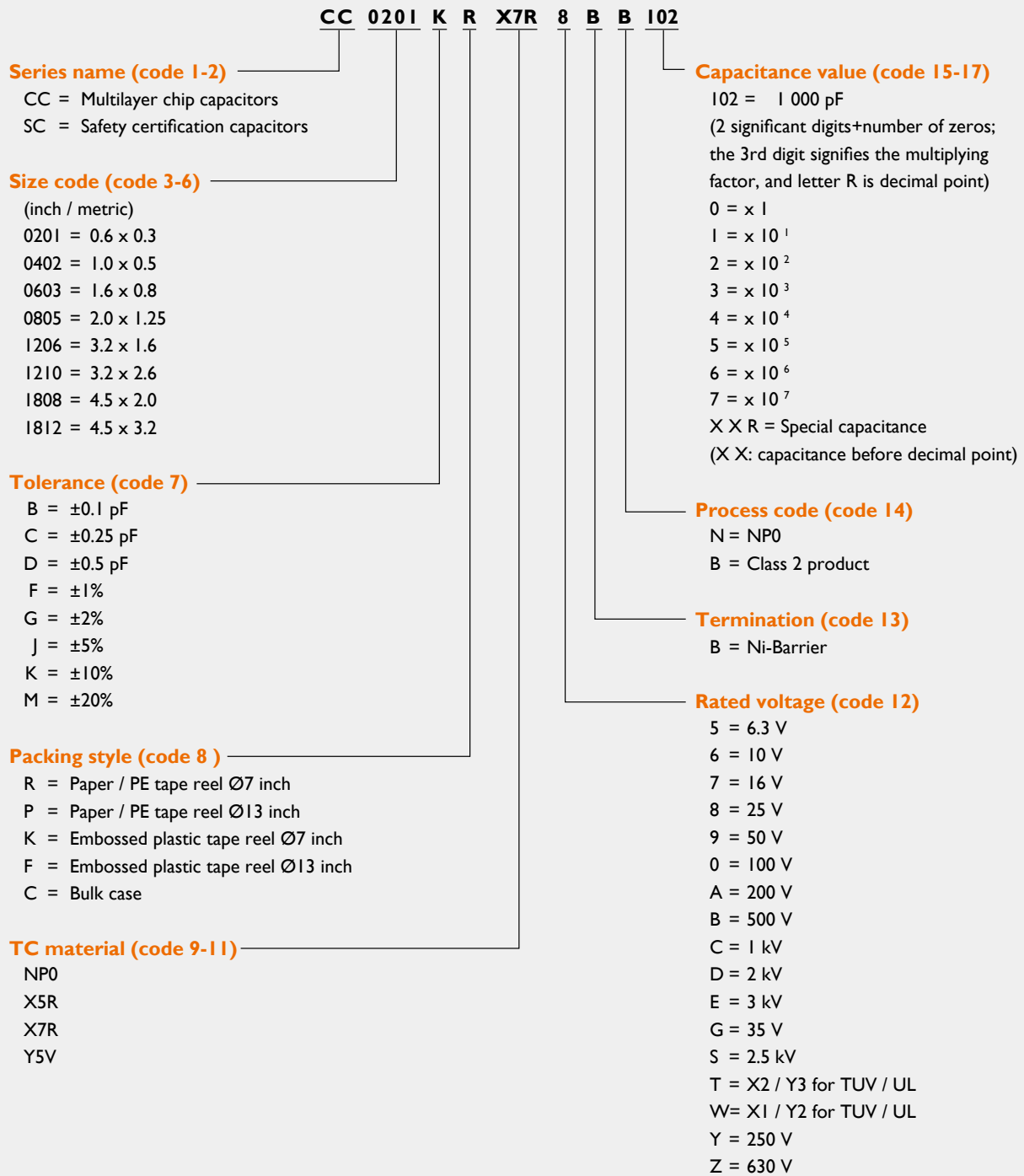
**Note:** Please contact with sales office, distributors and representatives in your region before ordering.



# Product Information - MLCCs

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	50V	±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%

## Ordering Code Definition





## Customer Support & Distribution Network

We bring to the market a proven innovative tradition and a commitment to service second to none.

Yageo sales representatives are available to visit you to discuss the technical and commercial issues appropriate to your project or requirement. Customer service can initiate new orders, change orders, request air shipments or drop shipments, product samples, and generally support your business on a day to day basis.

Our sales/services offices are strategically located to serve our customers worldwide and our international distributor network improves our product availability, delivery lead time and our service anywhere in the world.

Please see the back cover for contact details of your local Yageo organization.

We support our customers with extensive literature including datasheets, brochures and application notes, which are also available electronically on our website at: **[www.yageo.com](http://www.yageo.com)**

In addition, our field application engineers constantly strive wherever possible, to work closely with customers to aid them with design-in and provide them with the support they need to remain competitive in their markets.

## Disclaimer

All product specifications, statements, information and data (collectively, the "Information") are subject to change without notice.

All Information given herein is believed to be accurate and reliable, but is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on our knowledge of typical operating conditions for such applications, but are not intended to constitute -and we specifically disclaim-any warranty concerning suitability for a specific customer application or use. This Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by us with reference to the use of our products is given gratis, and we assume no obligation or liability for the advice given or results obtained.

Although we design and manufacture our products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product-related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.



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