Innovative Service Around the Globe YAGEO

High Capacitance MLCCs

www.yageo.com

YAGEO Phycomp

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.

The corporation is uniquely positioned to provide one-stop shopping, offering its complete product portfolio of resistors, capacitors and high frequency products in both commodity and specialty versions to meet the diverse requirements of customers.

Yageo currently ranks as the world No.1 in chip-resistors, No. 3 in MLCCs and No. 3 in ferrite products, with 27 sales/service offices in 18 countries, 8 manufacturing sites, 5 JIT logistic outfits and 3 R&D centers worldwide. Ferroxcube and Vitrohm are part of Yageo group, who produce ferrites and leaded resistors.

In the fast-paced electronics field, with its trend toward miniaturization and shorter product cycles for consumer electronics and telecommunication applications, it became clear that future growth would demand globalization, and the ability to become part of customer supply chains through enhanced service. The corporation's global deployment strategy has thus always been based on providing customers with comprehensive passive component solutions.

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Introduction

Thanks to unique material technology, Yageo offers many types of Multi-Layer Ceramic Capacitors (MLCCs), including commodity, high capacitance, high voltage, soft-termination, X2Y and MLV (multi-layer varistor). The dielectric material of Yageo's CC series ranges through NP0, X5R, X7R and Y5V, with standard EIA chip sizes available, a wide range of capacitances for various circuit needs, rugged terminations (lead-free), and the capability to be used in both reflow and wave soldering systems.

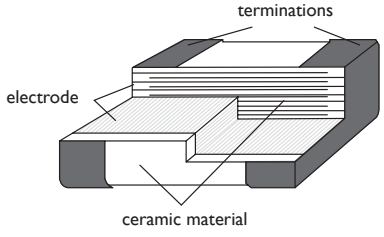
Yageo MLCCs provide outstanding performance, reliability and cost advantages for circuit designers. The capacitors are for both paper and plastic-embossed, tape-and-reel packaging for automatic SMD placement.

High capacitance MLCCs are high-end products in terms of capacitance to accommodate the trend in electronic industry towards convergence, multi-function, and miniaturization.

In this subcategory, we cover 1μF - 100μF depending on the case size. The available capacitance range is expanding year by year, particularly focused on the smaller MLCCs, with the continuous R&D of the core technologies for thinner layers.

Features

- Materials: X5R, X7R and Y5V
- Wide selection of size: from 0201 to 1812
- Capacitance range from 1μF to 100μF
- Rated working voltage from 6.3V - 50V
- Highly reliable tolerance and high speed automatic chip placement on PCBs
- Highly resistant termination metal
- Tape & reel for surface mount assembly



Surface mount multilayer ceramic capacitor construction

Functionality

Electrical signals contain various noise components such as EMI or equipment generated noise. This noise can cause many problems such as crosstalk, false-triggering, or incorrect logic levels. High capacitance MLCC can be used to reduce these noise signals and provide a more stable operating system.

High-cap MLCC has the following functions:

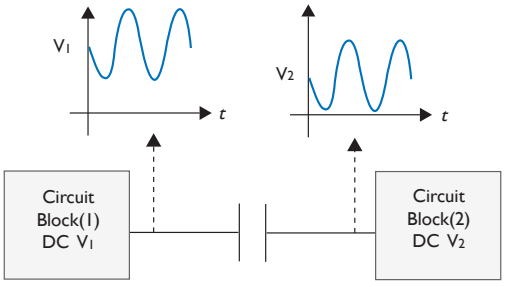
1. Bypassing: used in filtering circuits, the MLCC having low capacitance change vs. frequency works to reduce the unwanted signals (high-frequency noise) off the supply voltage to ICs, transistors, or other devices.

2. Decoupling: in addition to noise reduction, the MLCC works to keep the voltage level from independent of each other with the proper capacitor (low-pass) filtering the supply line. The capacitance should be large enough to absorb any load shift of a device.

3. Smoothing: when AC signals are changed to DC signals, if the voltage waveform contains too much ripple then a capacitor is used to smooth (absorb) this voltage before being sent to other circuits. The capacitance should be large enough to absorb the ripple current.

Signal Coupling

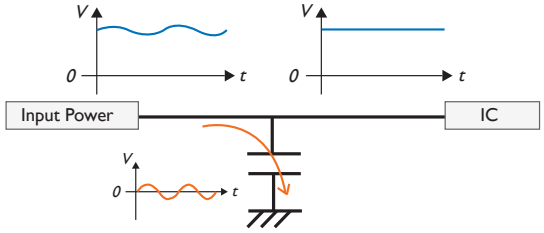
Because capacitors pass AC but block DC signals (when charged up to the applied DC voltage), they are often used to separate the AC and DC components of a signal. It is widely used for separating and joining two circuit blocks.



Coupling capacitor separates DC voltages of circuit blocks but couples AC signal.

Decoupling (bypass)

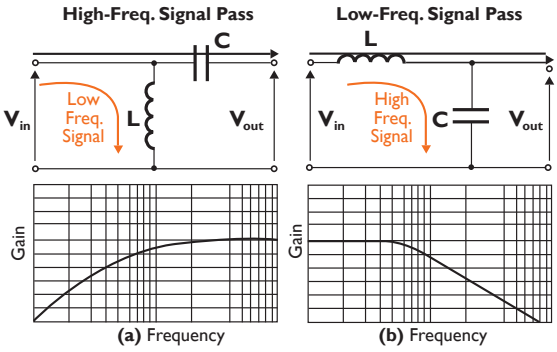
A decoupling capacitor is a capacitor used to decouple one part of a circuit from another. Noise caused by other circuit elements is shunted through the capacitor, reducing the effect they have on the rest of the circuit. It is most commonly used between the power supply and ground. An alternative name is bypass capacitor as it is used to bypass the power supply or other high impedance component of a circuit.



Noise Filter and Snubbers

When an inductive circuit is opened, the current through the inductance collapses quickly, creating a large voltage across the open circuit of the switch or relay. A snubber capacitor across the newly opened circuit creates a path for this impulse to bypass the contact points, thereby preserving their life; these were commonly found in contact breaker ignition systems, for instance.

Similarly, in smaller scale circuits, the spark may not be enough to damage the switch but will still radiate undesirable radio frequency interference (RFI), which a filter capacitor absorbs. Snubber capacitors are usually employed with a low-value resistor in series, to dissipate energy and minimize RFI. Such resistor-capacitor combinations are available in a single package.

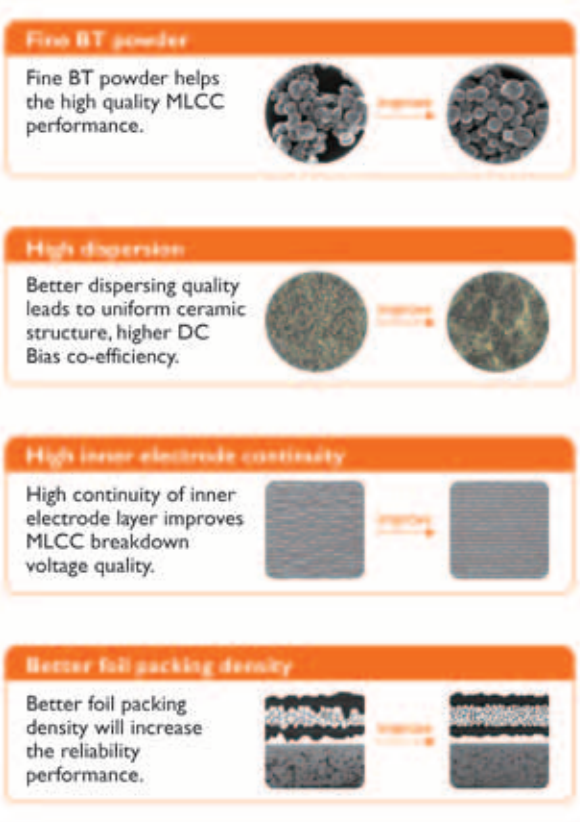


Filtering functions of capacitor coupled with inductor
(a) High Pass Filter (b) Low Pass Filter

Technology Trend

The four cornerstones of technology required to manufacture high performance and high reliability high-cap MLCCs are: material technology, thin film processing technology, production technology and base metal technology.

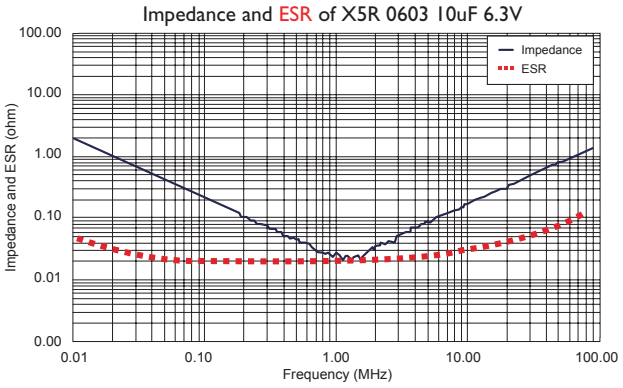
Being vertically integrated from material processing to production technology, Yageo is able to manufacture high performance and high reliability high-cap MLCC controlling the production process from beginning to the end. Below graphics indicate the material development trend of advanced high-cap MLCCs.

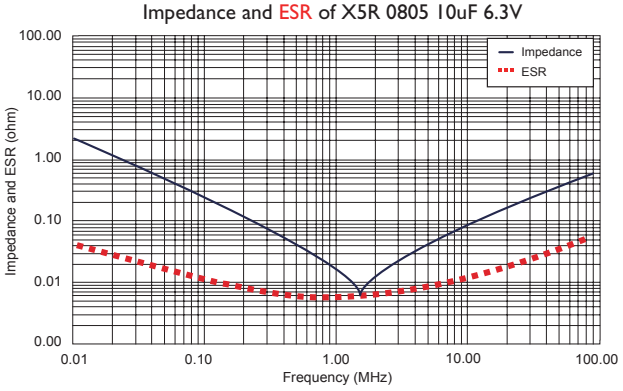


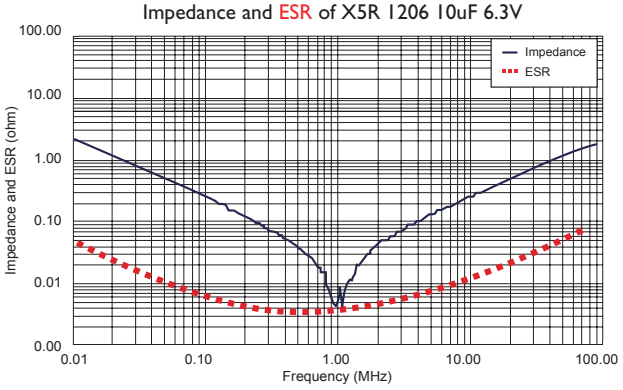
ESR vs Frequency Characteristics

Power losses are in part caused by the inherent resistive elements of capacitors. In the case of an MLCC, the ESR is a function of the electrode resistivity and the dielectric loss, which decreases as the frequency increases.

Lower dielectric losses result in a higher self-resonance frequency, a higher quality factor, reduced self-heating , better reliability and performance characteristics.

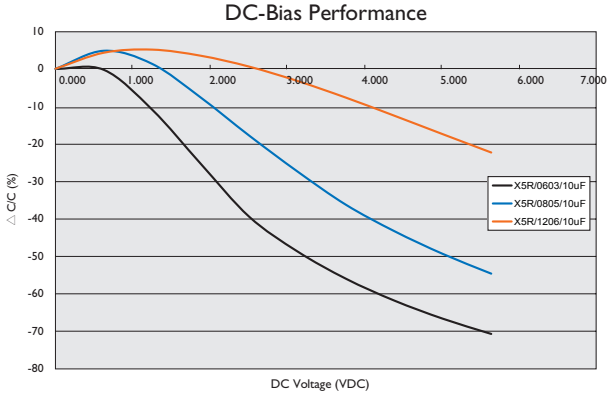






Capacitance vs DC Bias Voltage

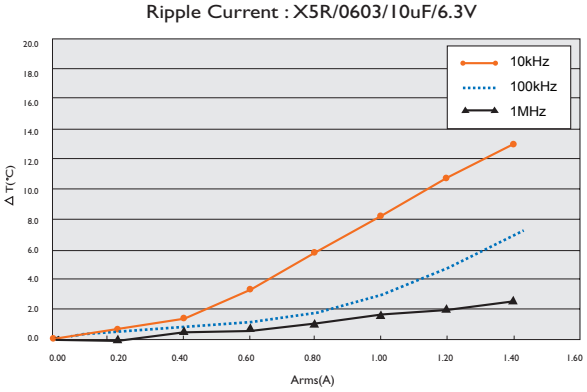
Another consideration when selecting a MLCC is the inherent characteristics of capacitance change versus DC bias voltage. For Class II capacitors (X5R, X7R, Y5V, etc.), larger case size components with equal capacitance have less capacitance change versus DC bias voltage than smaller size components.



Ripple Current

One requirement of any high-frequency capacitor is its ability to withstand high ripple currents. In almost all cases, the current rating is constrained by the allowable temperature rise of the capacitor. The heat generated in a capacitor is dependent solely on its ESR value.

Because the ESR of the MLCC is lower compared to other capacitor technologies, the component operating temperature of self-heating is reduced, effectively increasing the life and reliability of the user's module or product.



Applications

For consumer, industrial and communications, with often very different mounting and soldering processes and different substrates, they are exposed to a wide range of application conditions. It is therefore necessary to relate their characteristics to typical applications and to consider the application limitations. In the search of new components, the quest for further miniaturization, improved processing, etc., surface-mount technology is at a dynamic stage of development.

Industrial

- Industrial drives and controls
- Factory automation
- Facility management

Power Management

- SMPS
- Smart grid meters
- DC/DC converters

Lighting

- Street lighting
- LED lighting
- Industrial lighting

Computing

- Notebook/Tablet
- Servers

Mobile

- Smartphones
- Handheld devices

Alternative Energy

- Solar inverters
- Wind turbines

Telecom

- Base stations
- Set-top-Box
- Modems

Medical

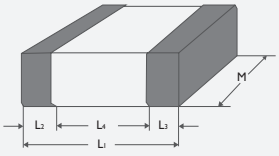
- Point-of-Care
- Imaging equipment
- Patient monitoring

Product Information

Electrical characteristics

Type	TC	Operating Temp range	Capacitace range	Voltage range	Tolerance
CC0201	X5R	-55°C to 85°C	1uF	6.3V	±20%
CC0402	X5R	-55°C to 85°C	1uF ~ 10uF	6.3V ~ 25V	±10%, ±20%
	Y5V	-30°C to 85°C	1uF ~ 2.2uF	6.3V ~ 10V	+80% ~ -20%
CC0603	X5R	-55°C to 85°C	1uF ~ 22uF	6.3V ~ 50V	±10%, ±20%
	X7R	-55°C to 125°C	1uF ~ 4.7uF	6.3V ~ 50V	±10%
	Y5V	-30°C to 85°C	1uF ~ 10uF	10V ~ 16V	+80% ~ -20%
CC0805	X5R	-55°C to 85°C	1uF ~ 47uF	6.3V ~ 50V	±10%, ±20%
	Y5V	-30°C to 85°C	1uF ~ 47uF	6.3V ~ 50V	+80% ~ -20%
	X7R	-55°C to 125°C	1uF ~ 10uF	6.3V ~ 50V	±10%
CC1206	X5R	-55°C to 85°C	1uF ~ 100uF	6.3V ~ 50V	±10%, ±20%
	X7R	-55°C to 125°C	1uF ~ 22uF	6.3V ~ 50V	±10%
	Y5V	-30°C to 85°C	1uF ~ 47uF	10V ~ 50V	+80% ~ -20%
CC1210	X5R	-55°C to 85°C	1uF ~ 100uF	6.3V ~ 50V	±10%, ±20%
	X7R	-55°C to 125°C	1uF ~ 100uF	6.3V ~ 50V	±10%
	Y5V	-30°C to 85°C	10uF ~ 100uF	6.3V ~ 25V	+80% ~ -20%
CC1812	X7R	-55°C to 125°C	1uF	50V	±10%

Dimensions



Inch-based	Metric	L1 (mm)	W (mm)	L2 / L3 (mm)		L4 (mm)
				min.	max.	min.
0201	0603M	0.6 ±0.03	0.3 ±0.03	0.1	0.2	0.2
0402	1005M	1.0 ±0.05	0.5 ±0.05	0.15	0.3	0.4
0603	1608M	1.6 ±0.10	0.8 ±0.10	0.2	0.6	0.4
0805	2012M	2.0 ±0.10	1.25 ±0.10	0.25	0.75	0.55
1206	3216M	3.2 ±0.15	1.6 ±0.15	0.25	0.75	1.4
1210	3225M	3.2 ±0.20	2.5 ±0.20	0.25	0.75	1.4
1812	4532M	4.5 ±0.20	3.2 ±0.20	0.25	0.75	2.2

Note : Actual product specifications, please refer to datasheet

X7R Product Range

Size(mm)Cap	0603	0805	1206	1210	1812
1uF	50V	50V	50V	50V	50V
2.2uF	10V	25V	50V	50V	---
4.7uF	6.3V	25V	50V	50V	---
10uF	---	16V	25V	50V	---
22uF	---	---	10V	25V	---
47uF	---	---	---	10V	---
100uF	---	---	---	6.3V	---

X5R Product Range

Size(mm)Cap	0201	0402	0603	0805	1206	1210
1uF	6.3V	25V	50V	50V	50V	50V
2.2uF	---	16V	25V	25V	50V	50V
4.7uF	---	6.3V	16V	25V	50V	50V
10uF	---	6.3V	10V	25V	25V	50V
22uF	---	---	6.3V	10V	16V	25V
47uF	---	---	---	6.3V	10V	16V
100uF	---	---	---	---	6.3V	16V

Y5V Product Range

Size(mm)Cap	0402	0603	0805	1206	1210
1uF	---	---	---	---	---
2.2uF	10V	16V	50V	50V	---
4.7uF	---	16V	25V	50V	---
10uF	---	10V	16V	16V	---
22uF	---	---	16V	16V	25V
47uF	---	---	10V	16V	16V
100uF	---	---	---	---	6.3V

Thickness classes and packing quantities							
Size code	Thickness classification (mm)	Tape width	180mm / Ø7" reel		330mm / Ø13" reel		Quantity per bulk case
			Paper	Blister	Paper	Blister	
0201	0.3 ±0.03 / ±0.05	8 mm	15 000	---	50 000	---	---
0402	0.5 ±0.05 / ±0.15 / ±0.20		10 000	---	50 000	---	50 000
0603	0.8 ±0.1 / ±0.2		4 000	---	15 000	---	15 000
0805	0.6 ±0.1		4 000	---	20 000	---	10 000
	0.85		4 000	---	15 000	---	8 000
	1.25 ±0.2		---	3 000	---	10 000	5 000
1206	0.6 ±0.1		4 000	---	20 000	---	---
	0.85 ±0.1		4 000	---	15 000	---	---
	1.15 ±0.1		---	3 000	---	10 000	---
	1.25 ±0.2		---	3 000	---	10 000	---
	1.6 ±0.2		---	2 000	---	10 000	---
1210	0.6		---	4 000	---	15 000	---
	0.85 ±0.1		---	4 000	---	10 000	---
	1.25 ±0.2		---	3 000	---	---	---
	1.6		---	2 000	---	---	---
1812	1.6 ±0.2	12 mm	---	1 000	---	---	---

Cross Reference

Size	Yageo	Murata	SEMCO	TDK	TaiyoYuden
0201	CC02021	GRM03	SL03	C0603	MK063
0402	CC0402	GRM15	SL05	C1005	MK105
0603	CC0603	GRM18	SL10	C1608	MK107
0805	CC0805	GRM21	SL21	C2012	MK212
1206	CC1206	GRM31	SL31	C3216	MK316
1210	CC1210	GRM32	SL32	C3225	MK325
1812	CC1812	GRM43	SL43	C4532	---

Explanation of ordering code

Ordering example : CC0402KRX5R8BB105

Series name (code 1-2)
CC = Multilayer chip capacitors

Size code (code 3-6)
0201
0402
0603
0805
1206
1210
1812

Capacitance tolerance (code 7)
K= ±10%
M = ±20%
Z= +80%~-20%

Packing style (code 8)
R = Paper / PE tape reel Ø7 inch
P = Paper / PE tape reel Ø13 inch
K = Embossed plastic tape reel Ø7inch
F = Embossed plastic tape reel Ø13inch
C = Bulk case

TC material (code 9-11)
X5R
X7R
Y5V

Capacitance value (code 15-17)
105 = 1 000 pF
(2 significant digits+number of zeros; the 3rd digit signifies the multiplying factor, and letter R is decimal point)
0 = x 1
1 = x 10^1
2 = x 10^2
3 = x 10^3
4 = x 10^4
5 = x 10^5
6 = x 10^6
7 = x 10^7
X X R = Special capacitance
(X X: capacitance before decimal point)

Process code (code 14)
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

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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 improve our product availability, delivery lead time and our service anywhere in the world.

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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**

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.

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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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