

Yageo MLCC Introduction

MLCC PM Team
July 2018

Introduction

Purpose

- To give overview of multilayer ceramic capacitors (MLCC)

Objectives

- To provide an overview of Yageo MLCC offering
- To explain different MLCC types & their applications
- To explore Yageo's part number breakdowns

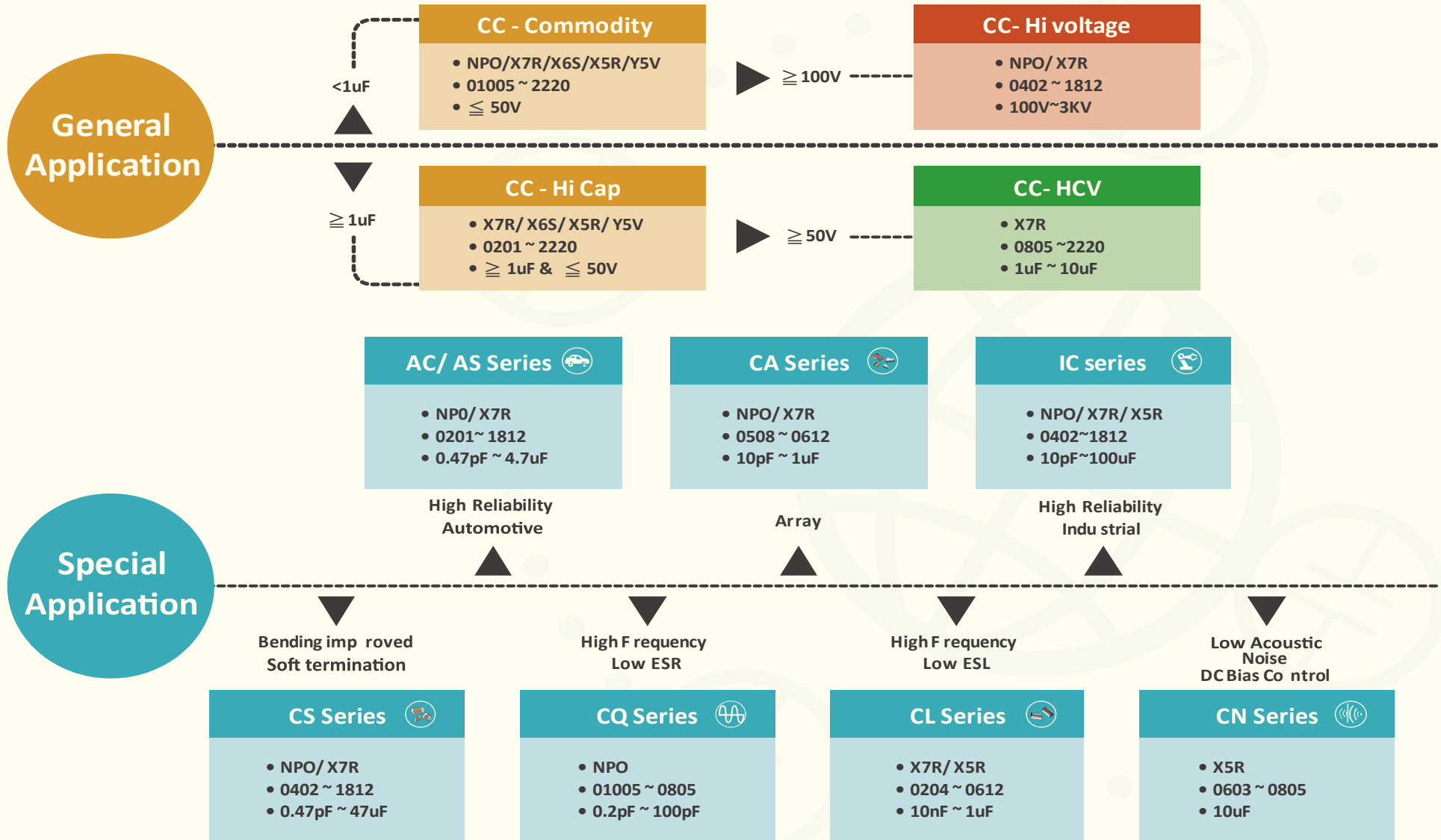
Content

- 24 pages

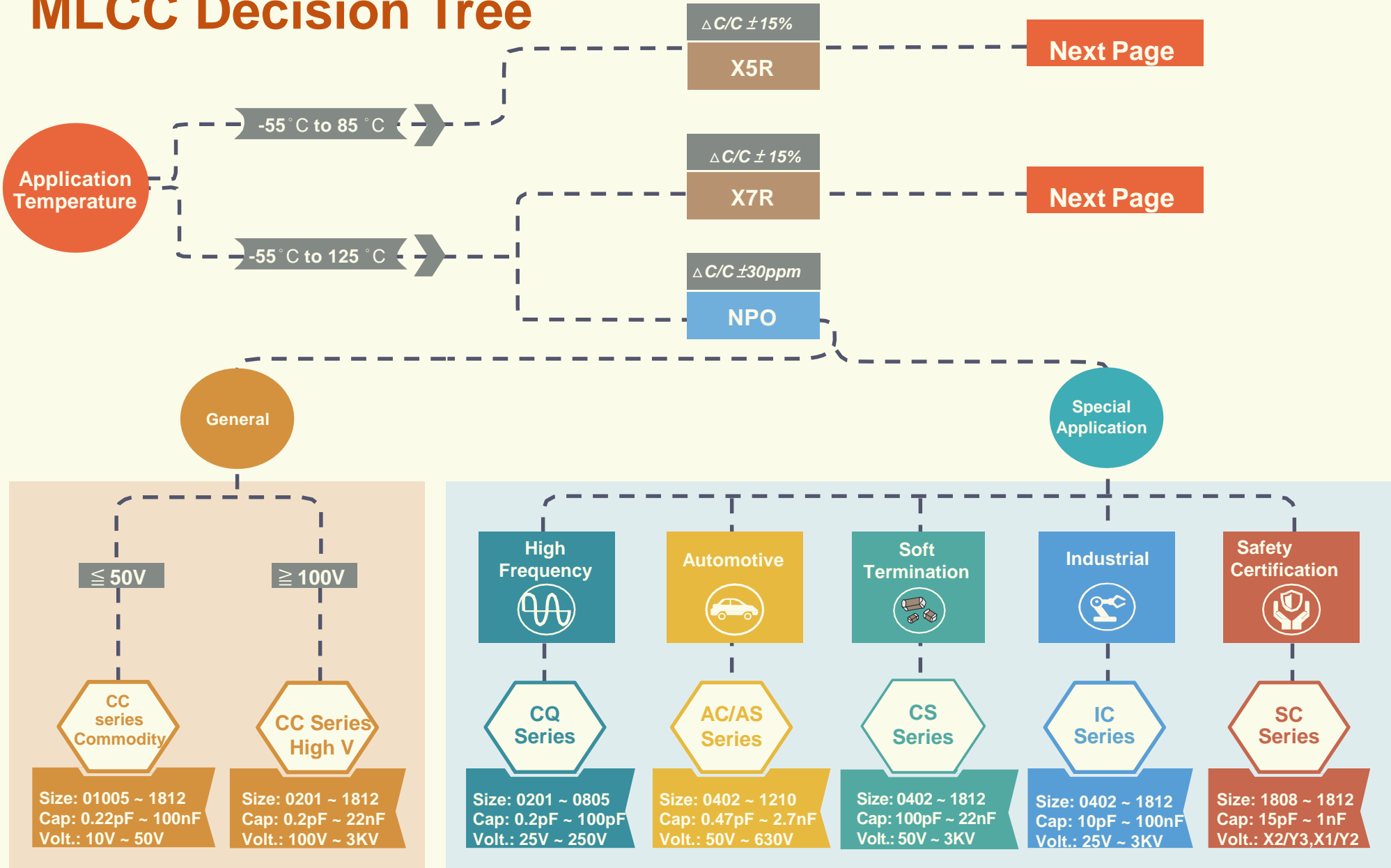
Learning Time

- 10 minutes

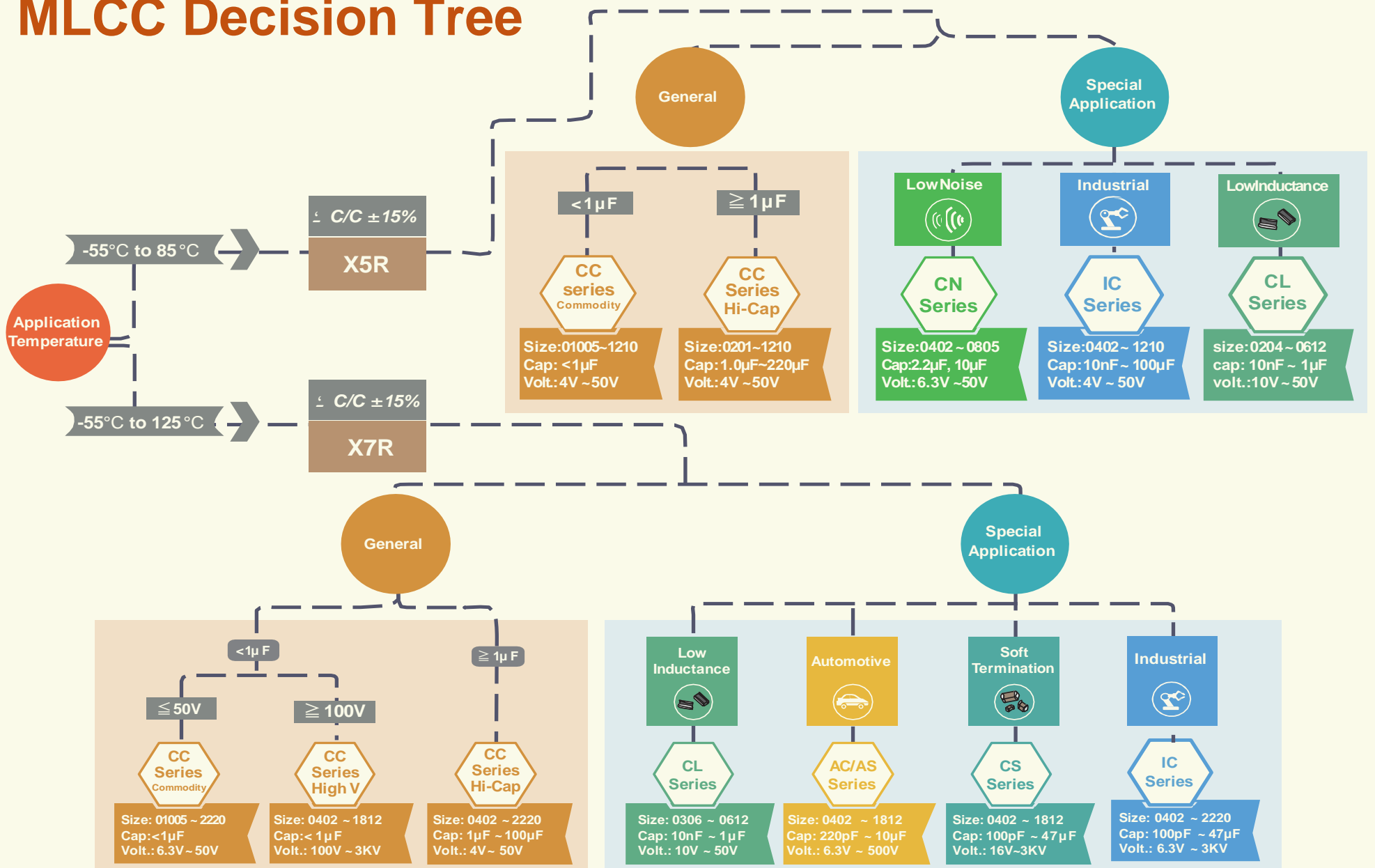
MLCC Selection Guide









MLCC Decision Tree



MLCC Decision Tree



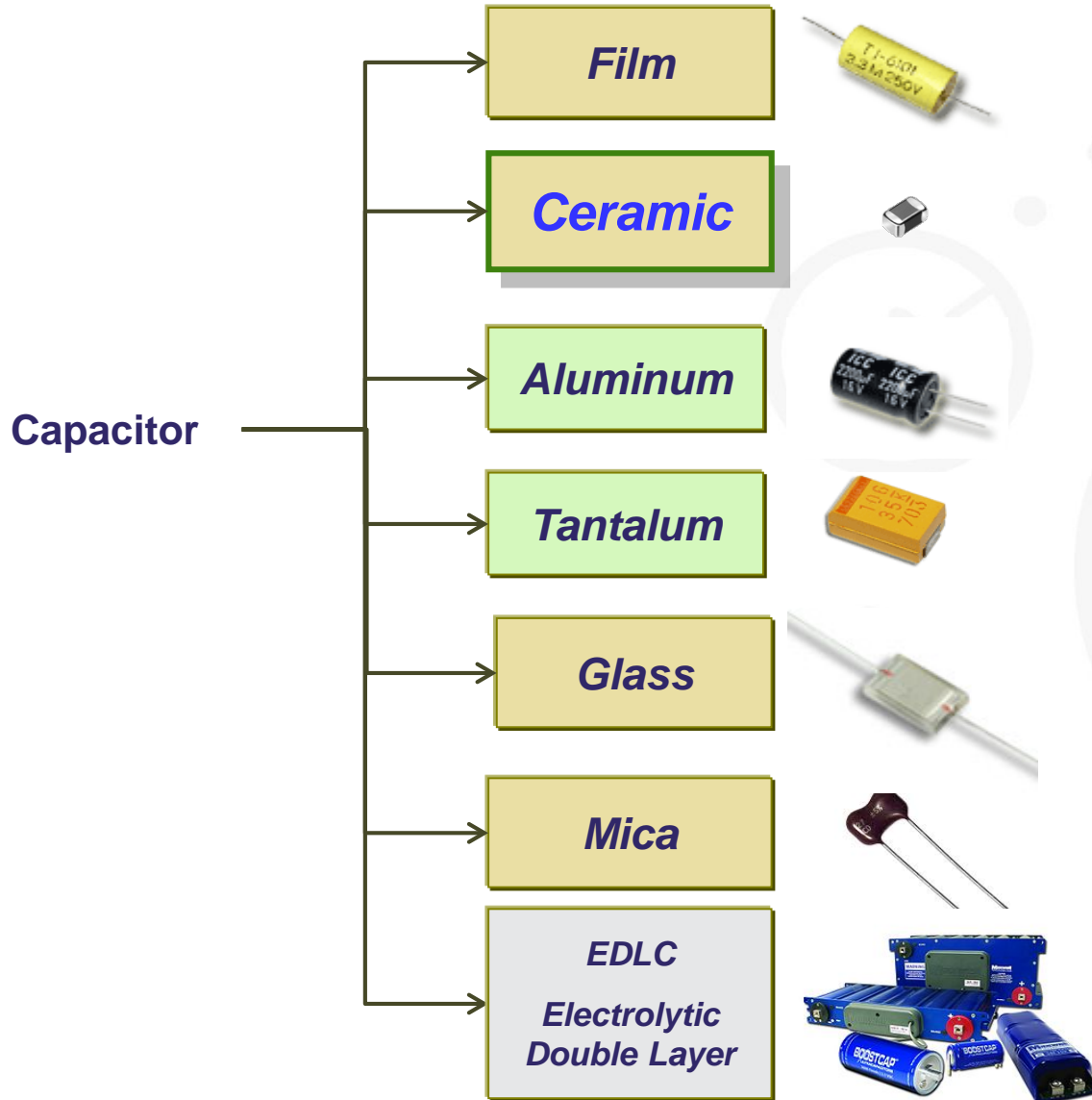
MLCC Product Snapshot

Type	Series	Features	Segment Application	Specification			
				TC	Size	Cap	Voltage
General Purpose 	CC	<ul style="list-style-type: none"> * Impedance Matching * Decoupling * Smoothing * Filtering 	<ul style="list-style-type: none"> * NB and Tablet * Wireless Networking * Consumer Electronics * Computing 	NPO X5R X6S X7R Y5V	01005 ~ 2220	0.47pF~2 20μF	4V~50V
High Voltage 	CC	<ul style="list-style-type: none"> * Capable of operating at high voltage levels * Decoupling/ Smoothing function * For high frequency snubber 	<ul style="list-style-type: none"> * Lighting * Power * LCD * Digital Consumer 	NPO X7R	0402 ~ 1812	10pF ~ 820nF	100 ~ 3KV
HCV 	CC	<ul style="list-style-type: none"> * Decoupling/ Smoothing function * Support $\geq 1\mu\text{F}$ capacitance. 	<ul style="list-style-type: none"> * Lighting * Power * LCD * Networking 	X7R	1206 ~ 1210	1uF ~ 4.7μF	100V
High Frequency 	CQ	<ul style="list-style-type: none"> * For high frequency applications * High Q and Low ESR * Support smallest size (01005) 	<ul style="list-style-type: none"> * Mobile Computing * NB and Tablet * Telecomm 	NPO	01005 ~ 0805	0.2pF ~ 100pF	16 ~ 250V
Soft Termination 	CS	<ul style="list-style-type: none"> * Flexible termination system * Improved resistance to thermal stress * increase resistance to mechanical stress 	<ul style="list-style-type: none"> * Lighting * Power * Industrial 	X7R	0402 ~ 1812	0.47pF ~ 47μF	16 ~ 3kV
High Reliability 	AC/AS	<ul style="list-style-type: none"> * AEC-Q200 qualified * Enhance bending performance * Stable quality level * Approval Process (PPAP) * High Reliability * Enhanced Mechanical Strength (Bending) 	<ul style="list-style-type: none"> * Automotive 	X7R NPO	0201 ~ 1812 Array	0.47pF ~ 10μF	6.3 ~ 630V

Application Mapping Summary

Product series		Focus Range	Automotive	Power	Telecom	Smart meter related	Testing Equipment & General Industrial	Mobile/ Pad/NB
CC	Commodity	0201~2220 <1uF / ≤50V		✓		✓	✓	✓
	Miniaturization (01005)	NPO/X5R/X7R, 10pF~220nF , 4V~16V						✓
	Hi-Capacitance	0201~2220, 1uF~220uF , ≤50V		✓		✓		✓
	Hi-Voltage	NPO/X7R, 100V~3KV		✓	✓			
	HCV	0805~2220 1uF~10uF (50~100V)		✓				
CS	Soft Termination	0603~1206, 100pF~220nF		✓				
SC	Safety Cap	1808~1812, 15pF~1.5nF		✓			✓	
CN	Low DC bias/ Acoustic control	X5R 0603~1206 ,1uF~10uF			✓			✓
CQ	High Frequency (Low ESR)	NPO 0201~0805 / 0.2pF~100pF			✓			✓
AC/AS	Automotive	NPO/X7R 0402 ~1812 6.3V ~ 630V 0.47 pF ~ 1.0 uF	✓					

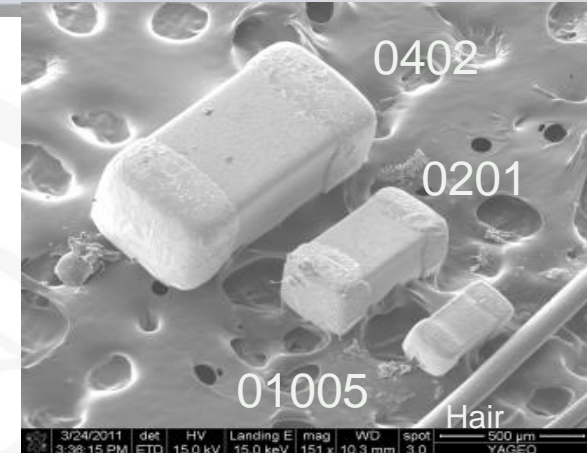
Capacitor Classification



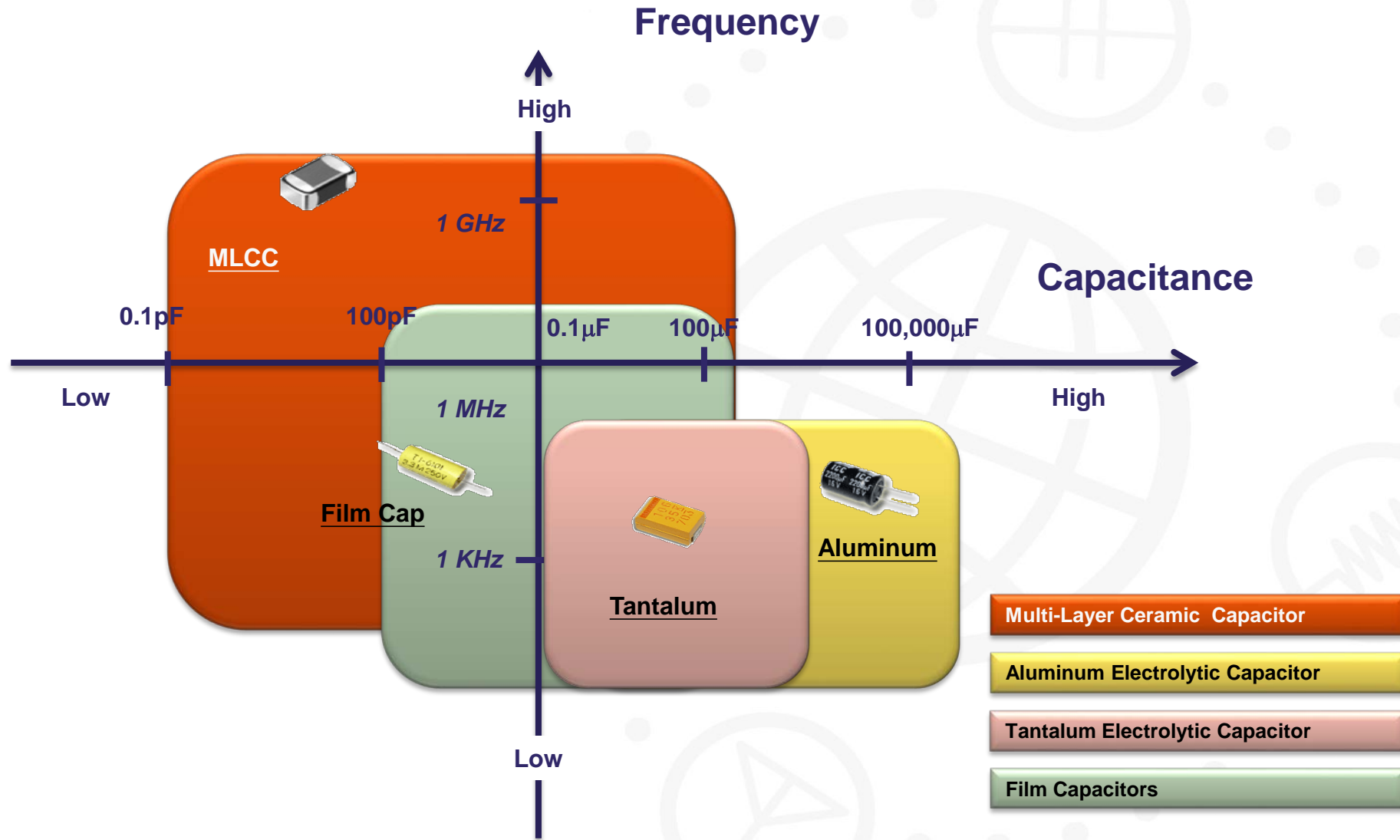
MLCC

(Multi-Layer Ceramic Capacitor)

Ceramic as multiple dielectric layers, metal co-fired as inner electrodes and outer terminals, non-polarized and non-organic capacitors.



Capacitor Application Coverage



Capacitor Performance Comparison

Item	MLCC	Aluminum Capacitor	Tantalum Capacitor	Film Capacitor
Size	Excellent	Poor	Good	Poor
Breakdown Voltage	Excellent	Fair	Fair	Good
Reliability	Excellent	Poor	Good	Good
Ripple current	Excellent	Fair	Fair	Good
Impedance- frequency	Excellent	Fair	Fair	Good
Polarity	No polarity	polarity	polarity	No polarity
Price	Excellent	Good	Poor	Poor
Cap. Range	Good	Excellent	Good	Fair
Temp. Characteristic	Good	Fair	Good	Excellent
DC Bias performance	Fair	Good	Good	Good
TAM (Millions USD/Year)	9,280	4,268	2,040	2,044
Market share (AMT)	52%	24%	11%	11%
Market share (Quantity)	90.9%	6.6%	1.2%	1%
CAGR(2009~2013)	7.8%	-3.1%	-0.4%	-5.4%

Commodity & High Cap - CC Series Introduction

Description

- **Case Size (Inch) :**
 - 01005 ~ 2220
- **Vr Range :**
 - 4V ~ 50V
- **Capacitance Range :**
 - 0.22pF ~ 220 μ F
- **Temp. Characteristics :**
 - Temperature compensating type : C0G/ NPO
 - High dielectric constant type : X7R/ X5R/ X6S/ Y5V

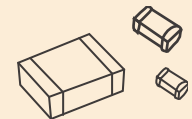
Features

- High reliability and no polarity
- RoHS & halogen free compliant
- Supplied in tape on reel



Applications

- Mobile phone
- Game console
- Hard disk
- NB
- LCD
- Data processing
- Server



High Voltage

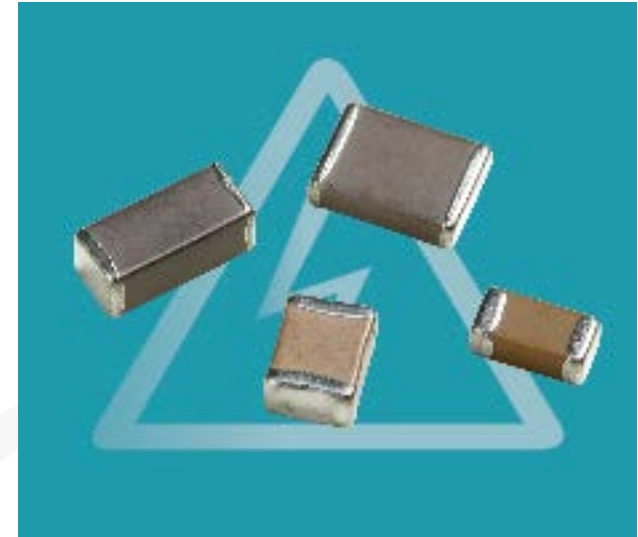
- CC Series Introduction

Description

- **Case Size (Inch) :**
 - 0201 ~ 1812
- **Vr Range :**
 - 100V ~ 3KV
- **Capacitance Range :**
 - 0.2pF ~ 2.2 μ F
- **Temp. Characteristics :**
 - NPO/ X7R

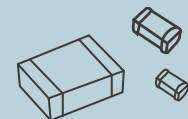
Features

- Operates at high voltage
- For high frequency snubber
- Wide case size available
- High reliability with no polarity

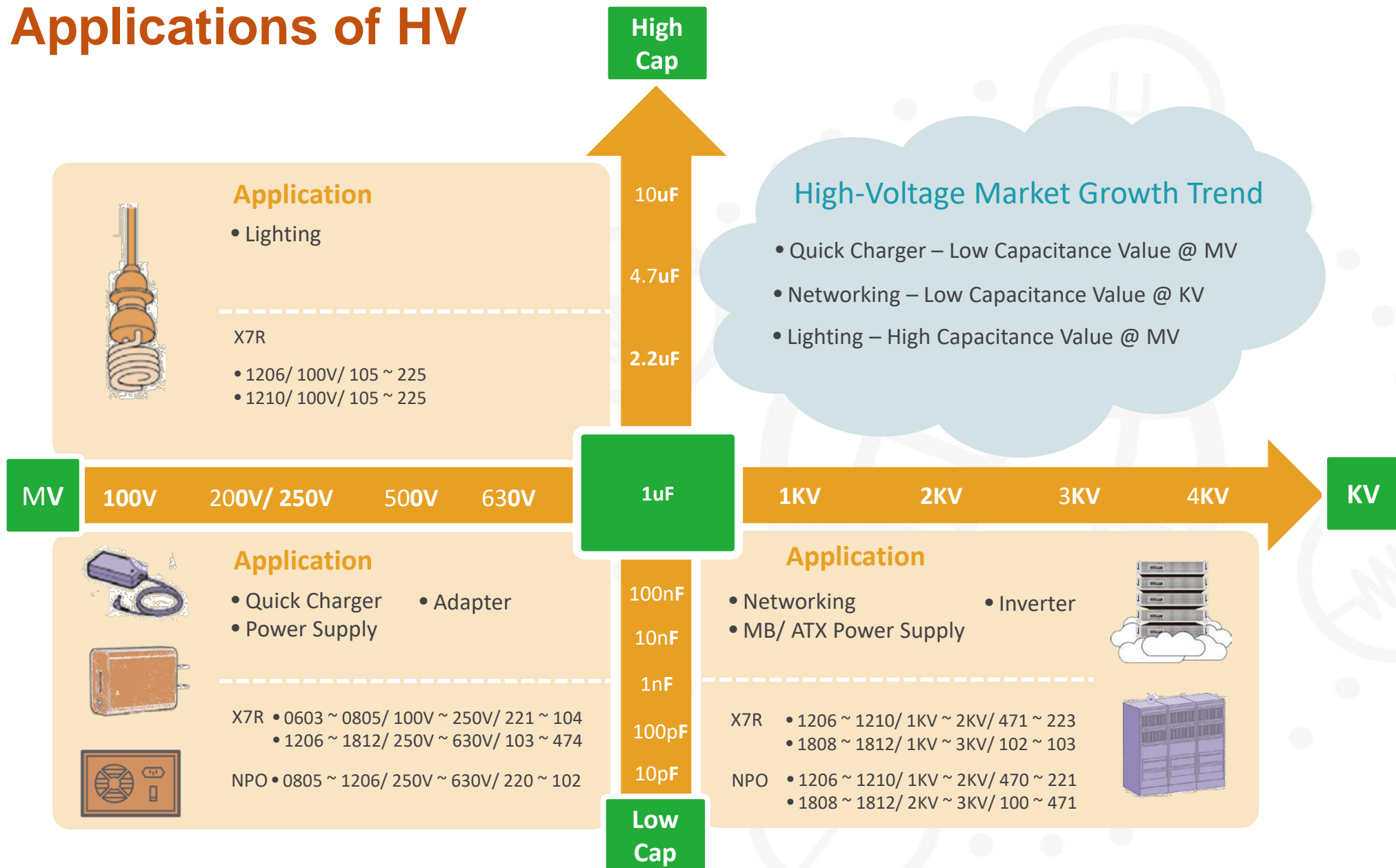


Applications

- Power supply, adapter, charger
- TV/Monitor backlight
- Networking
- Lighting



Applications of HV

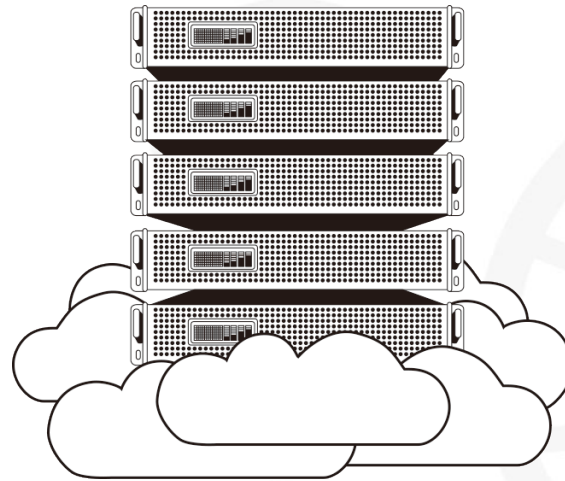


High CV

- CC Series Introduction

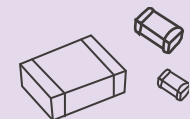
Description

- **Case Size (Inch) :**
 - 0805 ~ 2220
- **Vr Range :**
 - 50V ~ 100V
- **Capacitance Range :**
 - 1 μ F ~ 10 μ F
- **Temp. Characteristics :**
 - X7R



Applications

- Lighting
- Power
- LCD
- DC-DC converter



Features

- High capacitance and high DC voltage
- High energy density
- High reliability with no polarity

Safety Certificate Capacitor (TUV/UL) - SC Series Introduction

Description

- **Case Size (Inch) :**

- 1808 & 1812

- **Vr Range :**

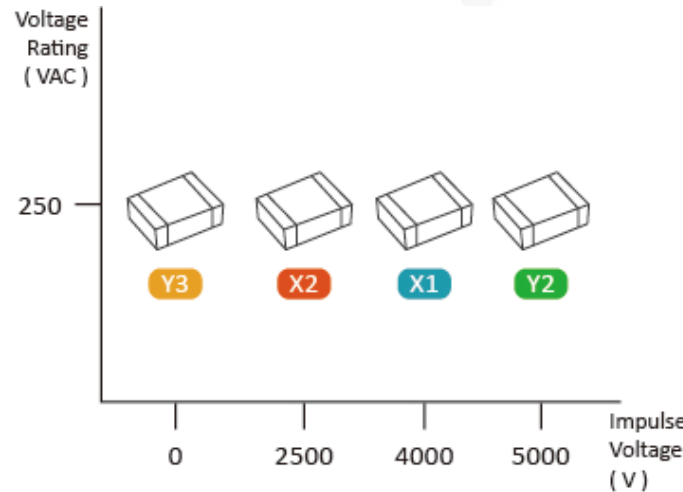
- X1/Y2, X2/Y3

- **Capacitance Range :**

- 15pF ~ 1.5nF

- **Temp. Characteristics :**

- NPO/ X7R

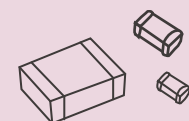


Applications

- Industrial
- Networking
- Power
- Consumer

Features

- Capable of operating at high voltage levels
- Surge protection
- TUV/ UL certificate



Soft Termination

- CS Series Introduction

Description

- **Case Size (Inch) :**

- 0402 ~ 1812

- **Vr Range :**

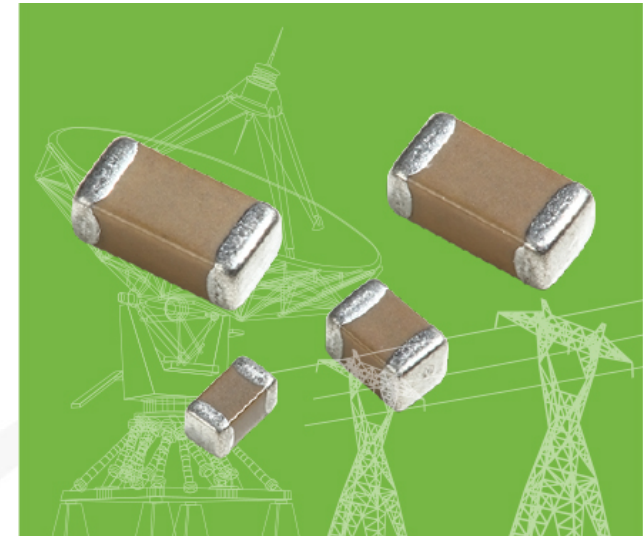
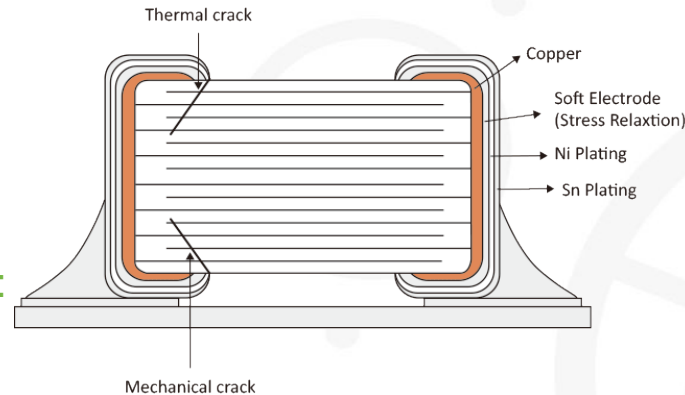
- 16V ~ 3KV

- **Capacitance Range :**

- 0.47pF ~ 47 μ F

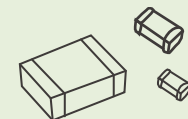
- **Temp. Characteristics :**

- NPO/ X7R



Applications

- High flexure stress circuit boards
- Switch power supplies
- Telecom base station
- Power



Features

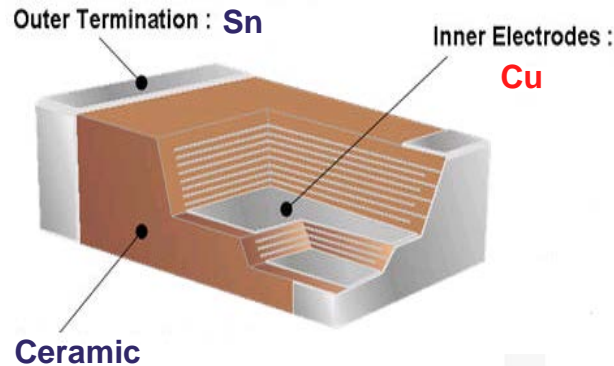
- Flexible termination system
- RoHS compliant & halogen-free
- Improved resistance to thermal stresses
- Increased mechanical performance

High Q

- CQ Series Introduction

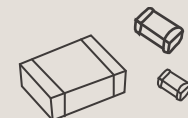
Description

- **Case Size (Inch) :**
 - 01005 ~ 0805
- **Vr Range :**
 - 16V ~ 250V
- **Capacitance Range :**
 - 0.1pF ~ 100pF
- **Temp. Characteristics :**
 - NPO



Applications

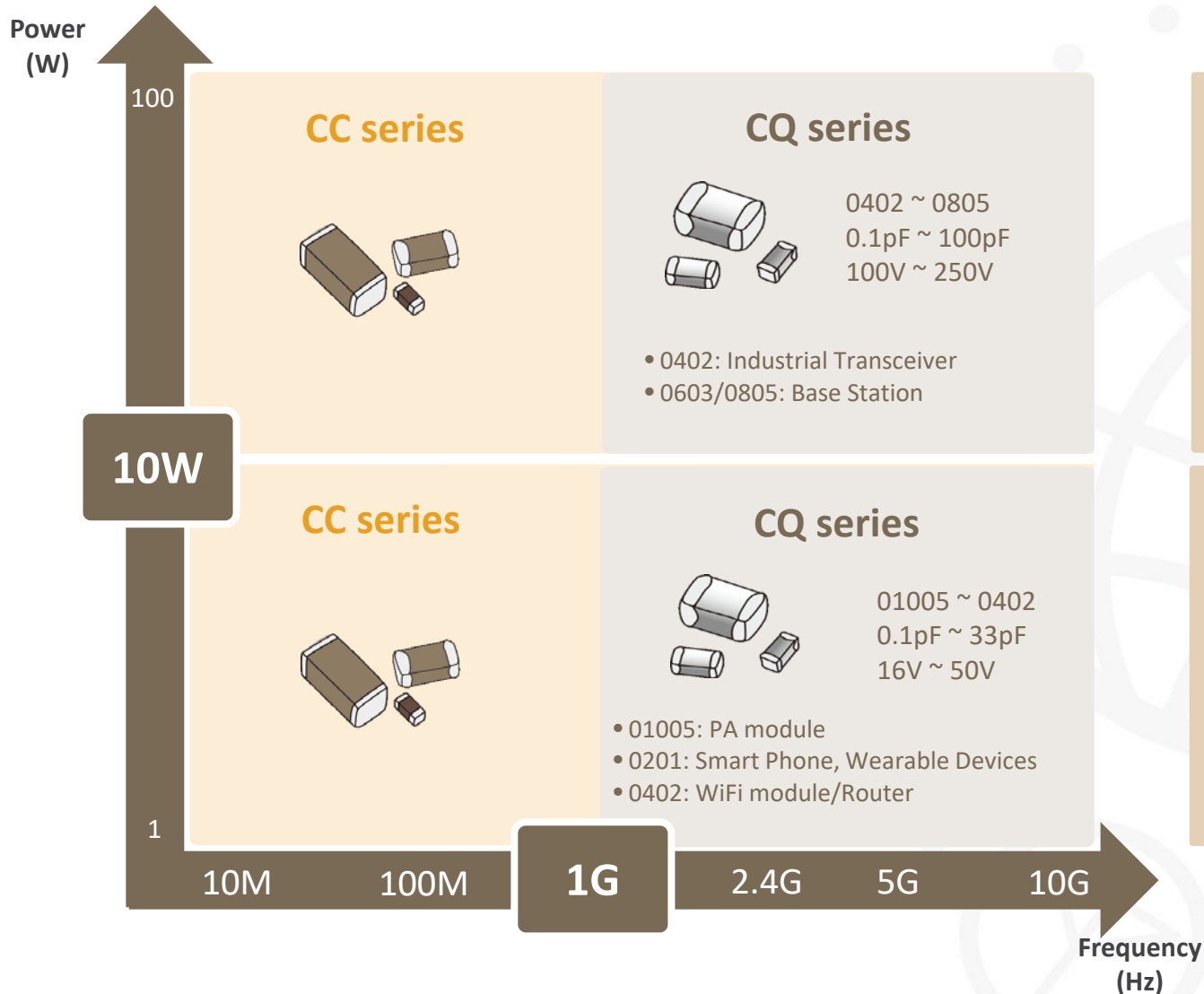
- Mobile front end
- NB and tablet
- Wireless networking
- Power amplifier design
- M2M
- Others....



Features

- BME process with copper inner electrodes
- HiQ and low ESR in VHF, UHF and microwave
- Tight tolerance (min. +/- 0.05pF)
- High reliability with no polarity

Applications of Hi-Frequency MLCC



Applications

- Telecomm Infrastructure
- Industrial Transceiver
- Power Amplifier
- Base Station

Applications

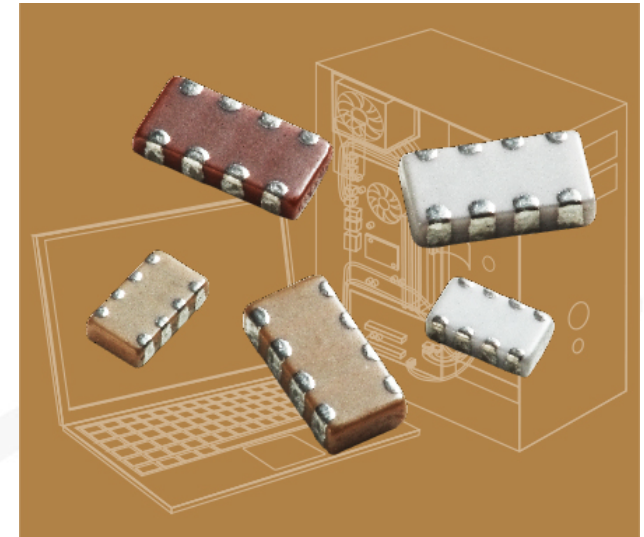
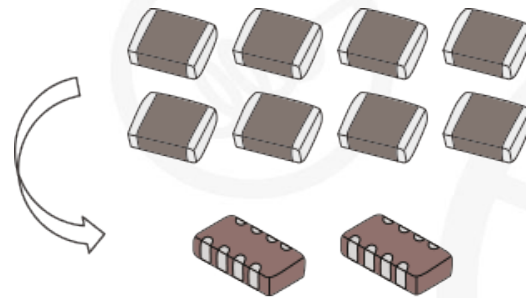
- Wearable Devices
- Smart Phone
- Router
- PA Module
- WiFi Module

4-C Array

- CA Series Introduction

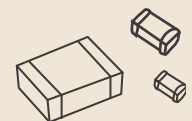
Description

- **Case Size (Inch) :**
 - 0508 ~ 0612
- **Vr Range :**
 - 6.3V ~ 100V
- **Capacitance Range :**
 - 10pF ~ 100nF
- **Temp. Characteristics :**
 - NPO/ X7R



Applications

- High density consumer electronics
- RF products
- Laptop
- Telecom and datacom application
- Feature phone



Features

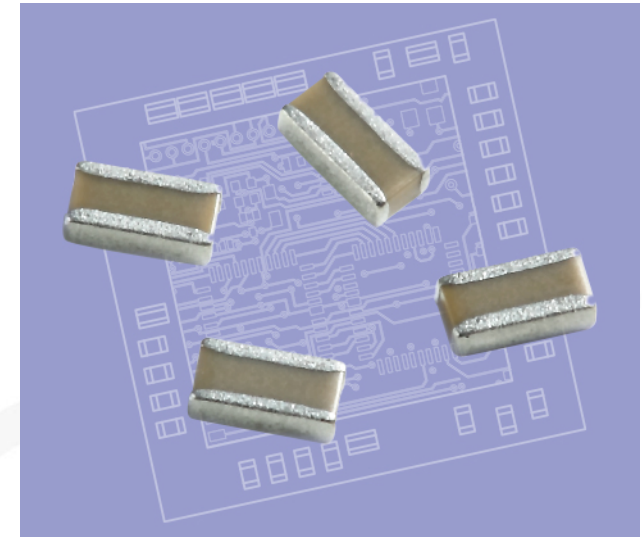
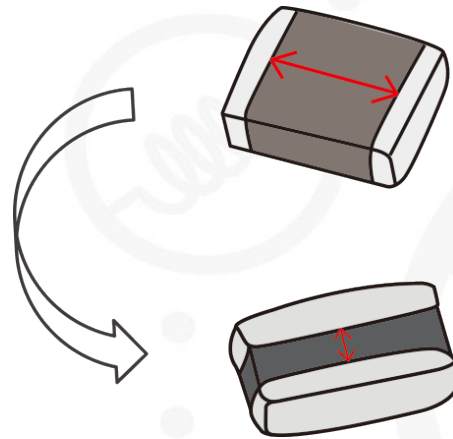
- Board space saving
- Time saving during mounting process
- Reduction in number of solder joints
- Easier PCB design

Low ESL

- CL Series Introduction

Description

- **Case Size (Inch) :**
 - 0204, 0306, 0508, 0612
- **Vr Range :**
 - 10V ~ 50V
- **Capacitance Range :**
 - 10nF ~ 1 μ F
- **Temp. Characteristics :**
 - X7R/ X5R

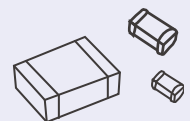


Applications

- IC package/ Module
- Telecom
- Data processing

Features

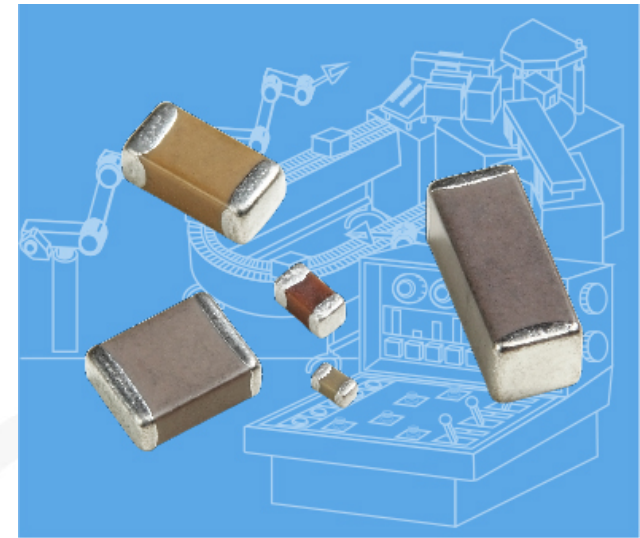
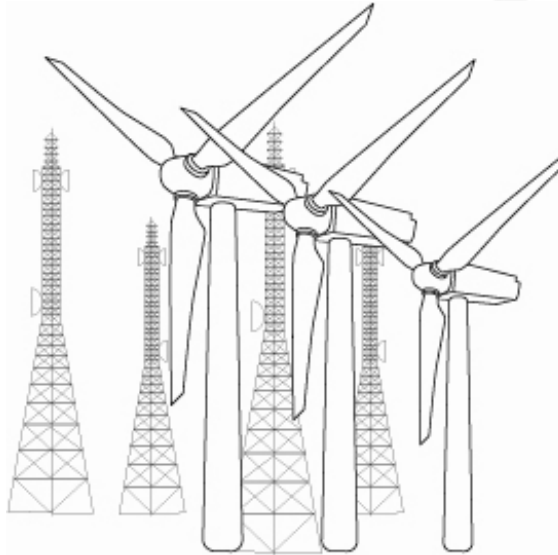
- Low ESL capacitor
- For high frequency decoupling applications



Industrial - IC Series Introduction

Description

- **Case Size (Inch) :**
 - 0402 ~ 1812
- **Vr Range :**
 - 4V ~ 3KV
- **Capacitance Range :**
 - 10pF ~ 47 μ F
- **Temp. Characteristics :**
 - NPO/ X7R/ X5R

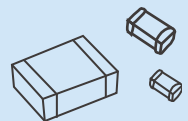


Applications

- Alternative energy
- Telecom base station
- Automation
- Metering

Features

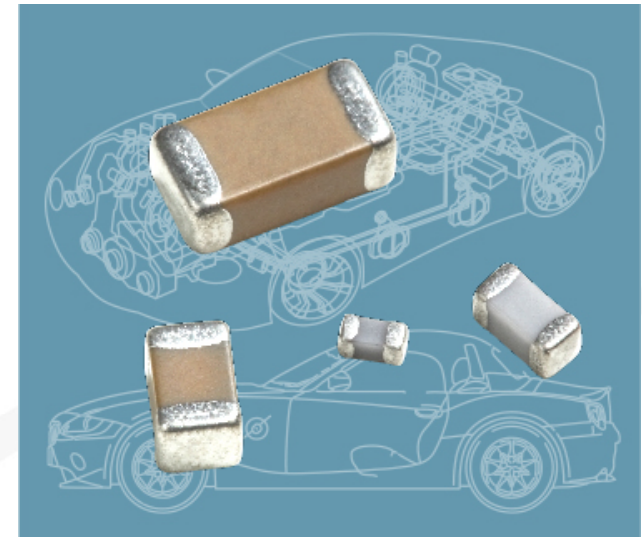
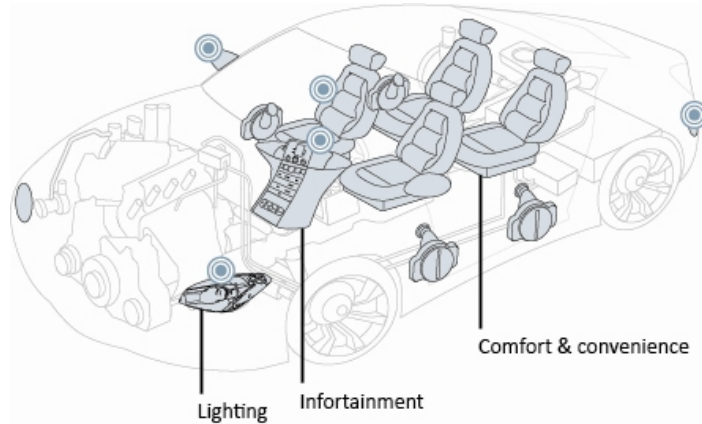
- High reliability with no polarity
- Biased load humidity with 85 °C/ 85% RH
- 100% AOI & SPC monitor



Automotive Grade - AC/AS Series

Description

- **Case Size (Inch) :**
 - 0201 ~ 1812
- **Vr Range :**
 - 6.3V ~ 630V
- **Capacitance Range :**
 - 0.47pF ~ 10 μ F
- **Temp. Characteristic :**
 - NPO/ X7R

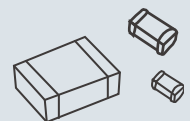


Application

- Audio and video systems
- Remote vehicle control
- Navigation
- Comfort

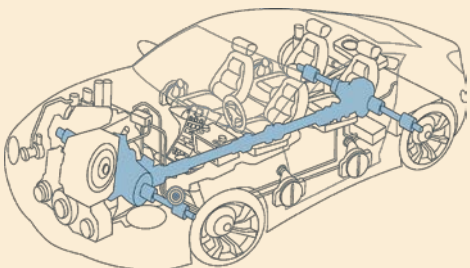
Feature

- With AEC-Q200 qualified & PPAP ready
- Dedicated production line and operators
- 100% AOI & SPC monitor
- Factory QMS : IOS/ TS16949 certified
- Special design tightened in line material and process control.
- Strict quality control gate applied to ensure the superior quality level



Automotive Applications

Powertrain & Safety

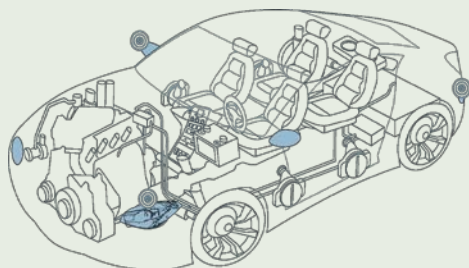


- Application**
- ECU
 - Motor
 - EPS
 - ESC/ESP
 - ABS
 - TPMS
 - Fuel Injection System
 - Airbag

- Description**
- Series: AC, AS, AO
 - Size: 0603 ~ 1812
 - TC: X7R, NPO, X8R, X8G
 - Cap: 2.2pF ~ 1μF
 - Vr: 16V ~ 1KV

- Feature**
- High Reliability
 - Anti-Bending
 - Fail-Safe
 - High-Temp.

Body Electronics



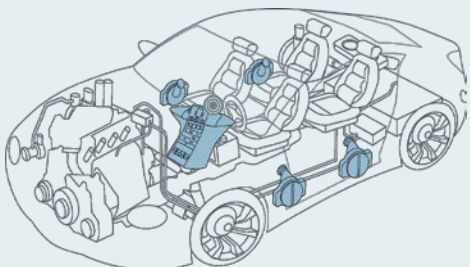
- Application**
- Lamp
 - Wipers
 - Parking Assistant
 - Dashboard Systems
 - Car Alarm
 - Light Sensor
 - Air Control
 - Heating

- Description**
- Series: AC, AS, AO
 - Size: 0402 ~ 1812, 0612
 - TC: X7R, NPO
 - Cap: 2.2pF ~ 22μF
 - Vr: 6.3V ~ 1KV

- Feature**
- High Reliability
 - Anti-Bending
 - Space Saving
 - Fail-Safe



Comfort & Infotainment

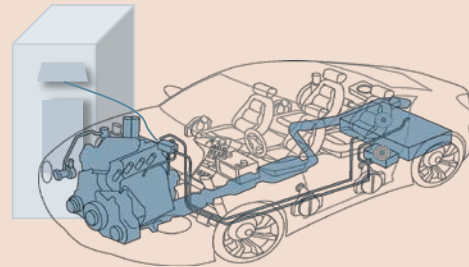


- Application**
- HUD
 - Navigation
 - GPS
 - Remote Keyless
 - Cruise Control
 - A/V Entertainment
 - Electric Seat Control
 - Electric Mirror Control

- Description**
- Series: AC, AS, AQ
 - Size: 0201 ~ 1210
 - TC: X7R, NPO, X6S, X5R
 - Cap: 0.5pF ~ 22μF
 - Vr: 6.3V ~ 100V

- Feature**
- Space Saving
 - Anti-Bending
 - Decoupling
 - High Frequency

E-Mobility (HEV/PHEV/EV)



- Application**
- BMS
 - Charger
 - Electric Pump
 - Inverter
 - DC/ DC Converters

- Description**
- Series: AC, AS
 - Size: 0402 ~ 1812
 - TC: X7R, NPO
 - Cap: 2.2pF ~ 2.2μF
 - Vr: 16V ~ 3KV

- Feature**
- Hash Environment
 - High Voltage
 - High Reliability
 - Anti-Bending

Yageo MLCC Global Part Number (CTC)

CC		0805		K		K		X7R		9		B		B		105	
Code 1 ~ 2		Code 3 ~ 6		Code 7		Code 8		Code 9 ~ 11		Code 12		Code 13		Code 14		Code 15 ~ 17	
Series		Size		Capacitance Tolerance		Packing Style		TC Material		Rated Voltage		Special Code		Process		Capacitance Value	
CC	General Purpose	0100	0402	B	±0.1pF	R	Paper/ PE φ 7 inch	NPO	-55~125°C	4	4V	B	Standard	N	NPO	R50	0.5pF
AC	Automotive	0201	0603	C	±0.25pF	P	Paper/ PE φ 13 inch	X7R	-55~125°C	5	6.3V			B	Class II	1R0	1.0pF
CS	Soft Termination	0402	1005	D	±0.5pF	K	Embossed Plastic φ 7 inch	X6S	-55~105°C	6	10V					105	1uF
CQ	High Frequency	0603	1608	F	±1%	F	Embossed Plastic φ 13 inch	X5R	-55~85°C	7	16V					XRX	R =decimal point
CA	4xCap. Array	0805	2012	G	±2%			Y5V	-35~85°C	8	25V					XX0	x 1
CL	Low Inductance	1206	3216	J	±5%					9	50V					XX1	x 10 ¹
SC	Safety Capacitor	1210	3225	K	±10%					0	100V					XX2	x 10 ²
CN	Low Noise	1808	4520	M	±20%					Y	250V					XX3	x 10 ³
IC	Industrial	1812	4532	Z	-20% ~ +80%					B	500V					XX4	x 10 ⁴
		2220	5750							Z	630V					XX5	x 10 ⁵
										C	1KV					XX6	x 10 ⁶
										D	2KV					XX7	x 10 ⁷
										E	3KV						

2 significant digits
+ number of zeros



Summary

- **Yageo offers many types of capacitors including high voltage, high capacitance, high frequency and soft termination, automotive grade MLCC**
- **Yageo's miniaturization is leading to higher, thinner, smaller, shorter designs**