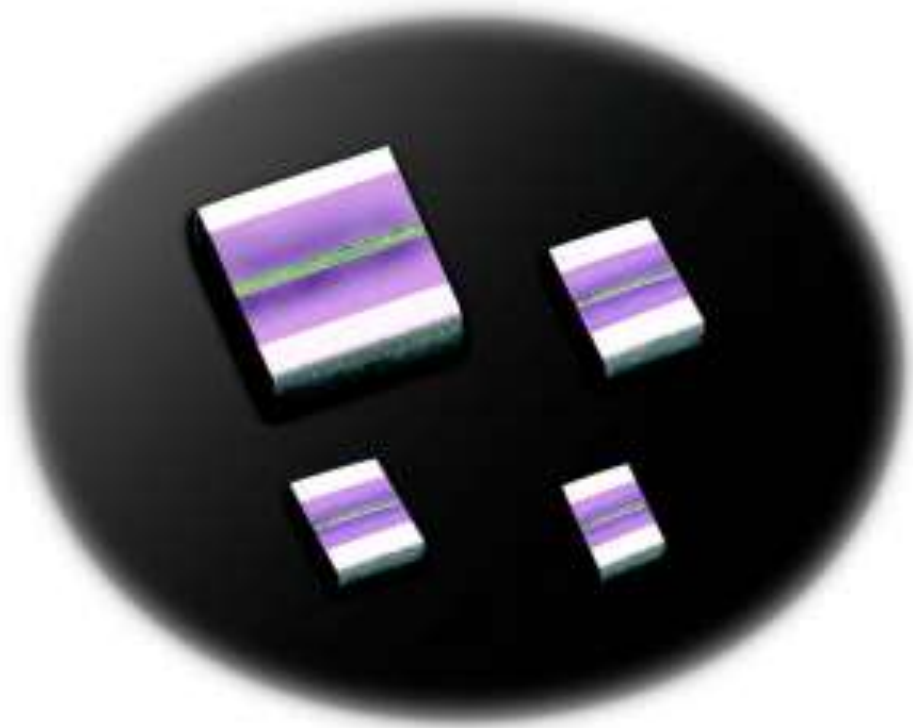




*Rubycon*



# PML-Cap® Polymer Multi Layer CAPACITORS



High Performance Alternative to  
Tantalum, MLCC, Smd/Radial Film

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• **Quality** • **Reliability** • **Precision**





# Rubycon

# PML-Cap® Polymer Multi Layer CAPACITORS



TUCSON  
ARIZONA



*PML-Cap®*  
A NEW CAPACITOR CONCEPT IS BORN  
IN TUCSON ARIZONA



*RUBYCON R&D CENTER- MID 2000'S*



**Rubycon PML Division**  
Rubycon Electronics  
(Matsukawa, Nagano)



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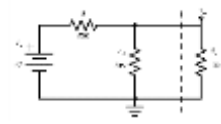
**CLICK TO ADVANCE  
PRESENTATION IN SLIDE SHOW MODE**



INTRODUCTION



VS. OTHER CAP TYPES



EQUIVALENT CIRCUIT



FEATURING



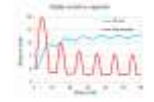
MFG. PROCESS



MU SERIES SPECS.



LEAKAGE CURRENT



RIPPLE CURRENT



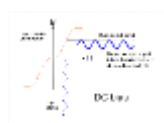
TEMP CHARACTERISTICS



DIELECTRIC ABSORB.



ESR VS FREQUENCY



DC BIASING



SIZE VS. TANTALUUM



SAFETY – IGNITION TEST

PCB BEND TEST



APPLICATIONS



16-100V ESR VS FQ(MU)



85/85 (MS SERIES)



FAMILY CHART



CAPACITANCE RANGE

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CAPACITORS







# PML-Cap® Polymer Multi Layer CAPACITORS



## Introduction..

*PMLCAP® (Polymer Multi-Layer) Capacitors - introduced by Rubycon. Employing a new patented process which is unlike anything currently in capacitor manufacturing today. With a traditional MLCC (Multi Layer Ceramic) around 100 Layers are common, PMLCAP® use up to 6000 layers which allows for ultimate design performance and reliability.*

*PMLCAP® have stable and excellent characteristics across a broad temperature range (up to 125°C) by employing an ultra thin polymer of less than 1 micron thick. PMLCAP® achieve a high degree of miniaturization, with weight of approximately ¼ that of MLCC's. High wave distortion characteristics make the PMLCAP® ideal for audio applications that demand the best sound and pure tone quality. A state-of-the-art manufacturing process is utilized for this truly unique capacitor.*



*Conventional film capacitors are featured by their excellent electrical characteristics. However, their sizes are too big which limits their range of possible applications. Vacuum deposition technology, which is one of our key-technologies used to develop PML-CAP, enable Rubycon to achieve ultra-miniaturization.*



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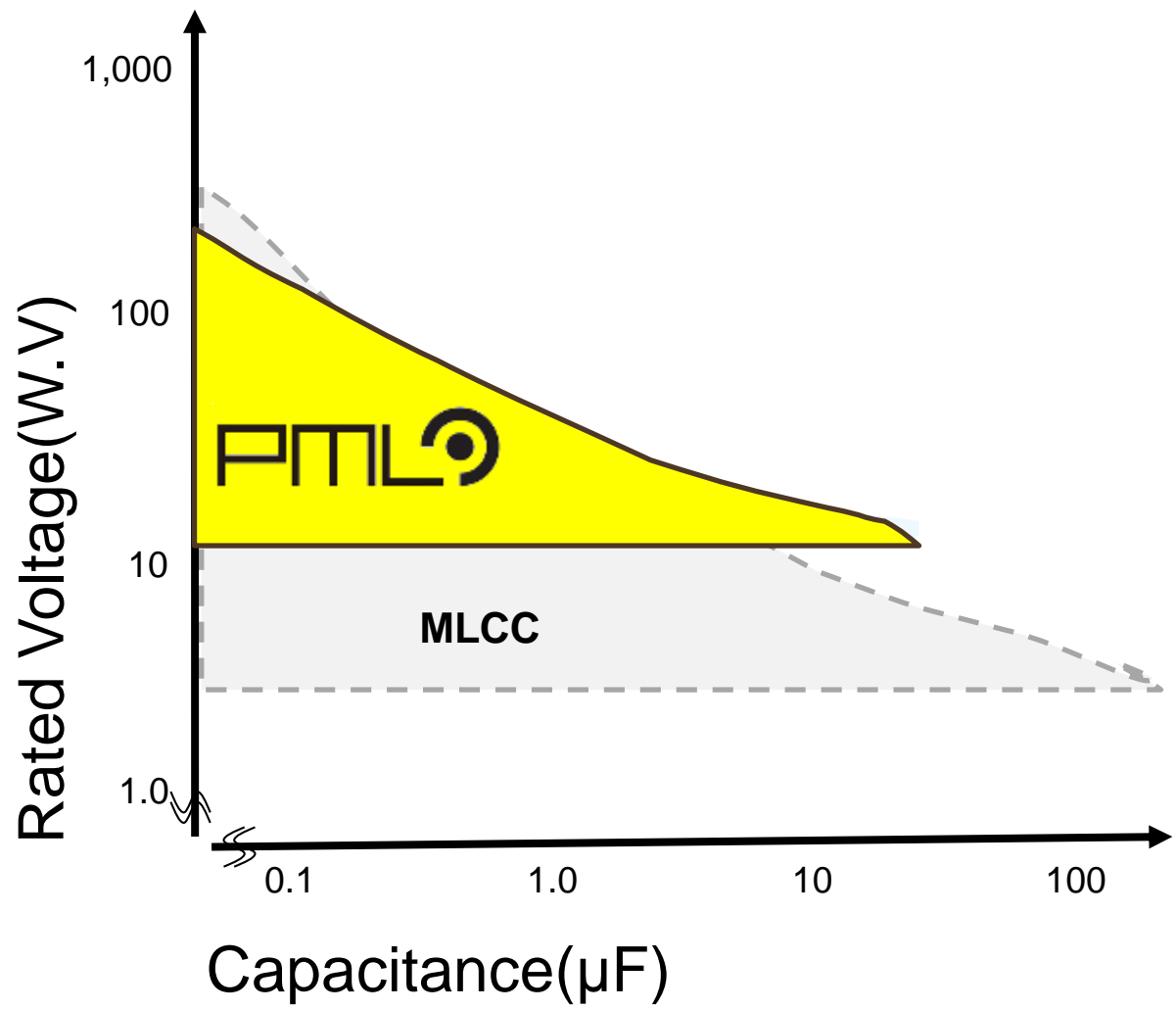


## COMPARISON:



ATTRIBUTE	<b>PMLCAP™</b> 	<b>Multi-layer Film</b>	<b>MLCC</b>
Dielectric	Radiation curable resin (Acryl)	Resin film (PEN, PPS)	Ceramic (BaTiO <sub>3</sub> )
Thickness	< 1um/layer	> 3um/layer	< 1um/layer
ε	3	3	2,000 – 5,000
Inner Electrode	Metalized Aluminum	Metalized Aluminum	Nickel paste
Outer Electrode	Multi-layer of metals (Brass/Conductive paste/Sn)	Multi-layer of metals (Metal / Solder)	Multi-layer of metals (Cu/Ni/Sn)
Rated Voltage	16V <sub>DC</sub> – 100V <sub>DC</sub>	10V <sub>DC</sub> – 250V <sub>DC</sub>	2.5V <sub>DC</sub> – 3150V <sub>DC</sub>
Cap. range	0.1uF – 22uF	0.1uF – 1uF	0.1pF – 100uF
Temp range	-55 deg C - +125 deg C	-55 deg C - +125 deg C	-55 deg C - +150 deg C
Size	Middle	Big	Small
Feature	* No piezoelectricity * Smaller than conventional film capacitors	* No piezoelectricity * Bigger size	* Capacitance change by piezoelectricity * Smaller size





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## PML-Cap® EQUIVALENT CIRCUIT

### APPLICATIONS:

- ▲ Low Pass Filter of PLL circuit (low dielectric absorption)
- ▲ LED Driver circuit of LCD,
- ▲ Voltage Regulator Module of consumer devices
- ▲ Decoupling Circuit
- ▲ Low Pass Filter
- ▲ Storage Capacitor where ultra low leakage current is necessary

C:	Capacitance
R <sub>d</sub> :	Resistance by dielectric loss
R <sub>P</sub> :	Insulation resistance
R <sub>e</sub> :	Resistance by electrode
LESL :	Equivalent series inductance

\*ESR=R<sub>d</sub>+R<sub>e</sub>



**EQUIVALENT CIRCUIT**



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CAPACITORS

SLIDE NAVIGATION







## KEY FEATURES:

### Adaption of New vacuum deposition technology



- ✓ High Temperature Operation
  - New dielectric materials featuring high heat resistance and stable characteristics to temperature change (-55 to +125C)
  
- ✓ Safe Failure Mode
  - Failure mode is OPEN
  - Relief of risk by fume and ignition
  - Self Healing
  
- ✓ Performance
  - Light weight, Miniaturization, Low ESR, Low ESL, Low Leakage Current. Capacitance stable across temp range. No DC Biasing Characteristics.



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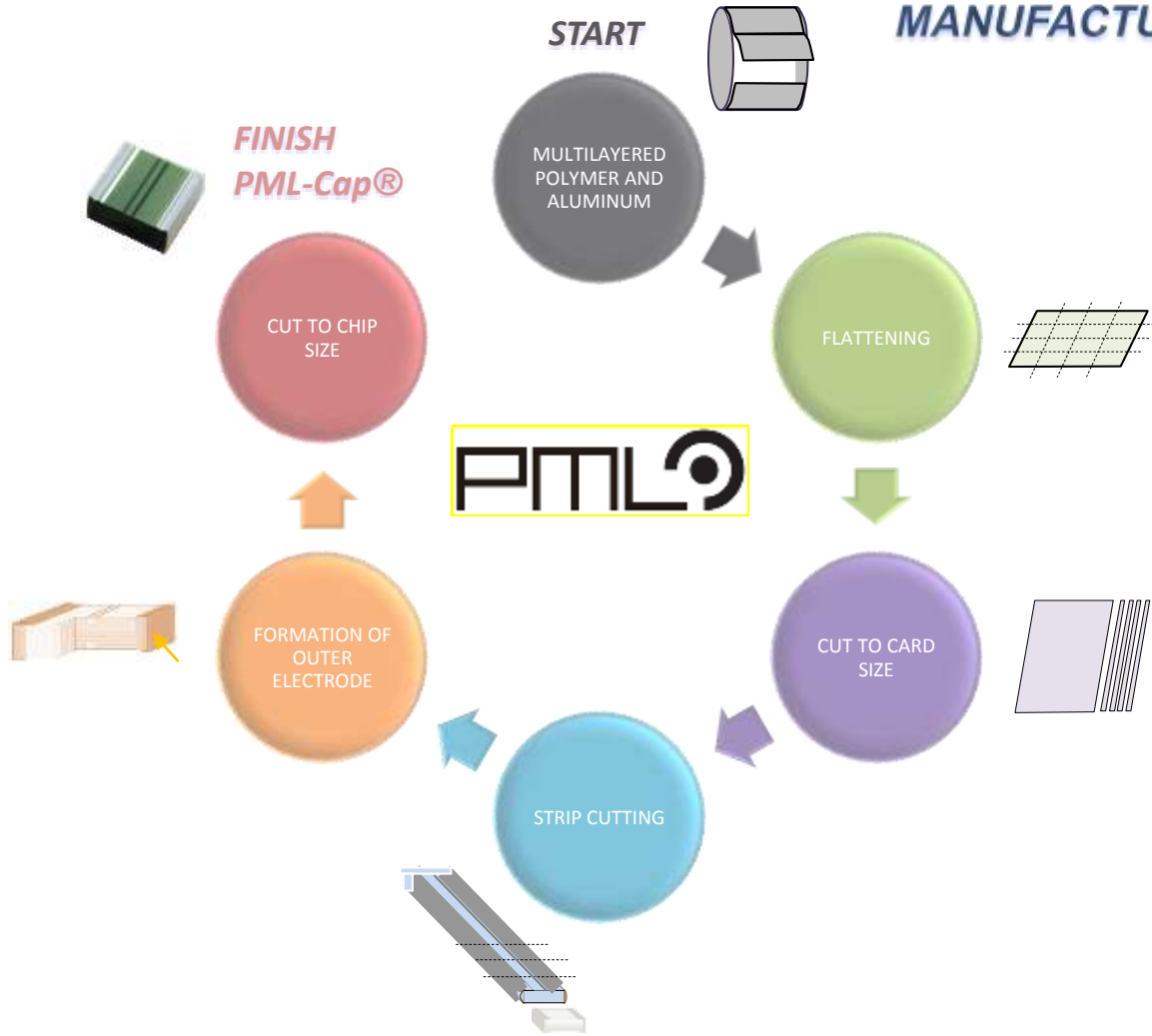
• **Quality** • **Reliability** • **Precision**







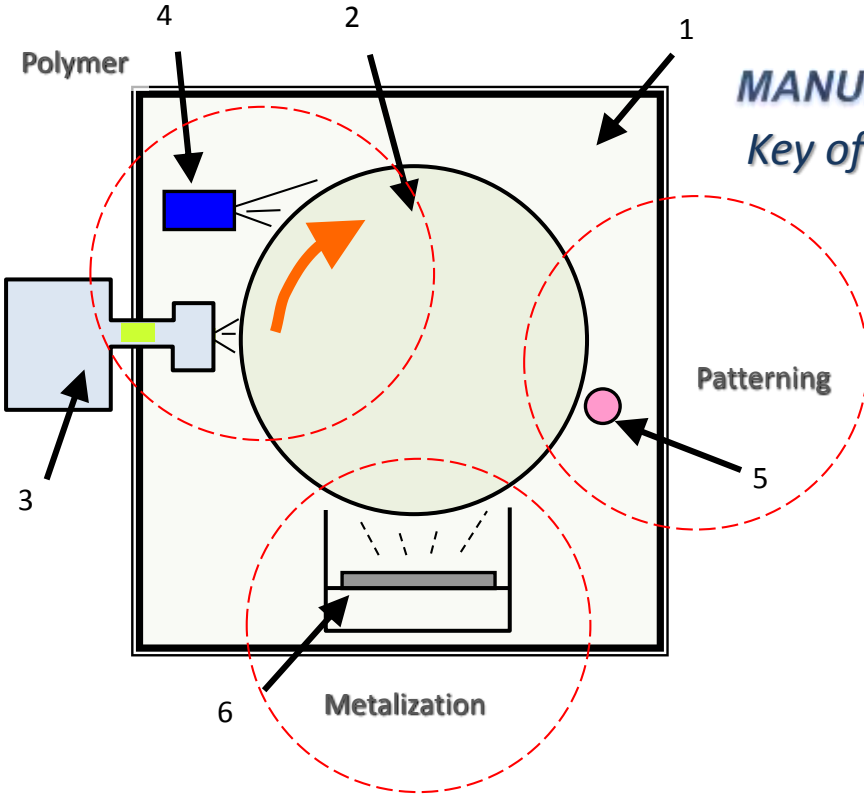
## PML-Cap® MANUFACTURING PROCESS



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**PML-Cap®**  
**MANUFACTURING PROCESS CONTINUED**  
*Key of this Technology is Vacuum Deposition*

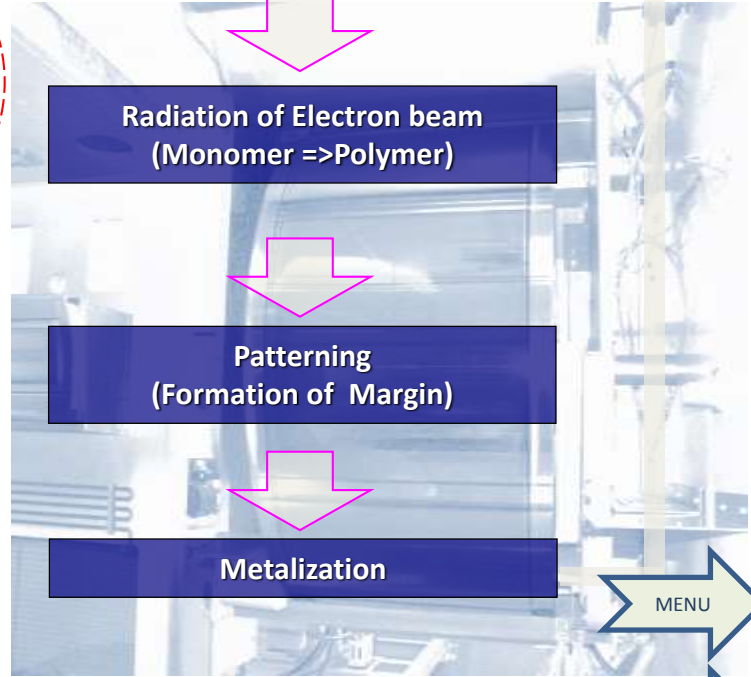
Deposition of Monomer

Radiation of Electron beam  
 (Monomer => Polymer)

Patterning  
 (Formation of Margin)

Metalization

- 1 : Vacuum Chamber
- 2 : Drum
- 3 : Monomer Delivery System
- 4 : Electron-Gun
- 5 : Patterning System
- 6 : Metalizer



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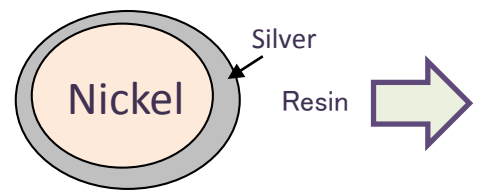
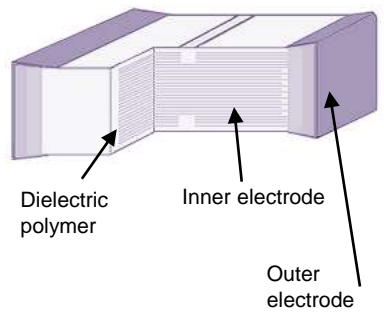




## PML-Cap® MU SERIES FOR AUDIO CIRCUITS

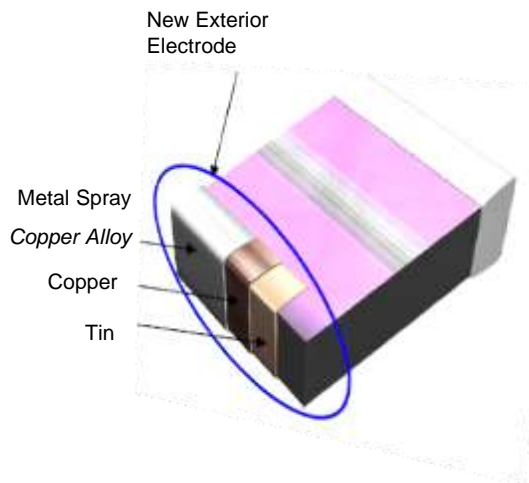
*Elimination of silver coated nickel particle for the resin conductivity.*

### Excellent for Digital Signal Processing



Nickel is classified as ferromagnetic substance. However, since ferromagnetic substances supposedly reduce sound quality we designed the ferromagnetic free PMLCAP MU-Series, without using Nickel.

Exterior Electrode has **3** layers



LAYER ▼	TYPE ▶	Prior Generation	MU
1		METAL SPRAY (BRASS)	
2		Conductive Resin	Copper Plating
3		TIN PLATING	



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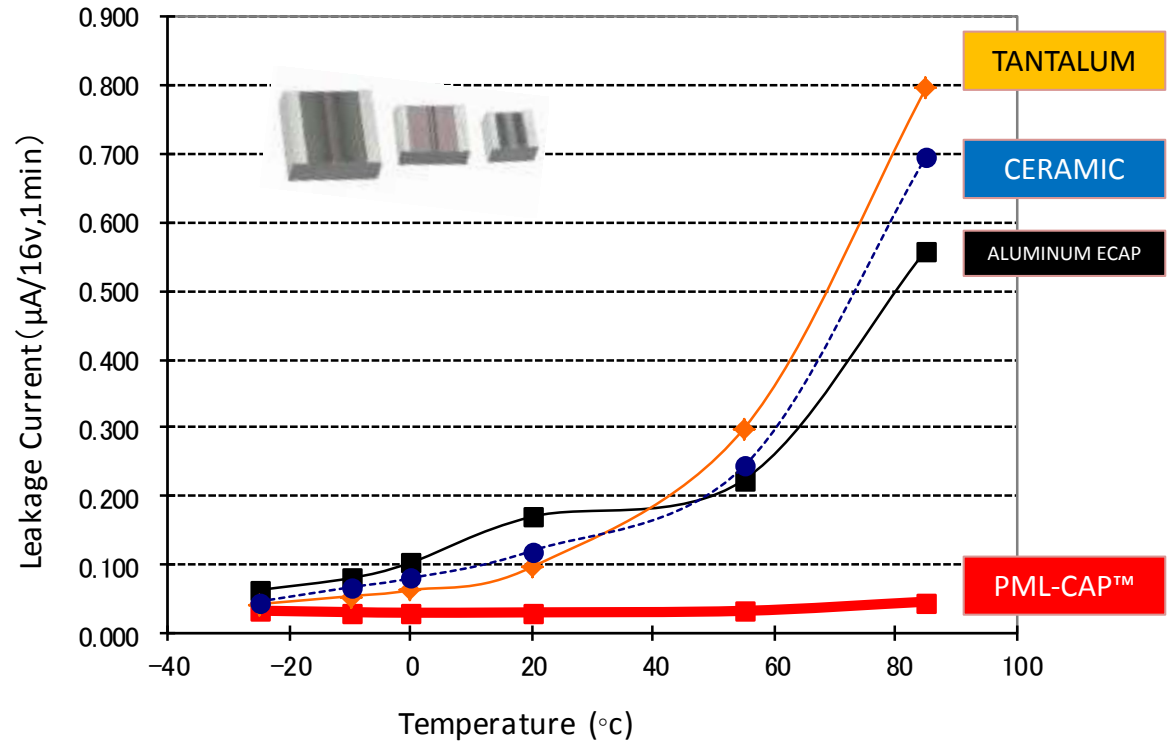
• **Quality** • **Reliability** • **Precision**







## PML-Cap® LEAKAGE CURRENT



Graph shows the comparison of leakage current among various capacitors (16v 22uF)

PMLCAP has ultra low characteristics (high insulation resistance), Suitable for storage capacitor of Energy Harvesting application.

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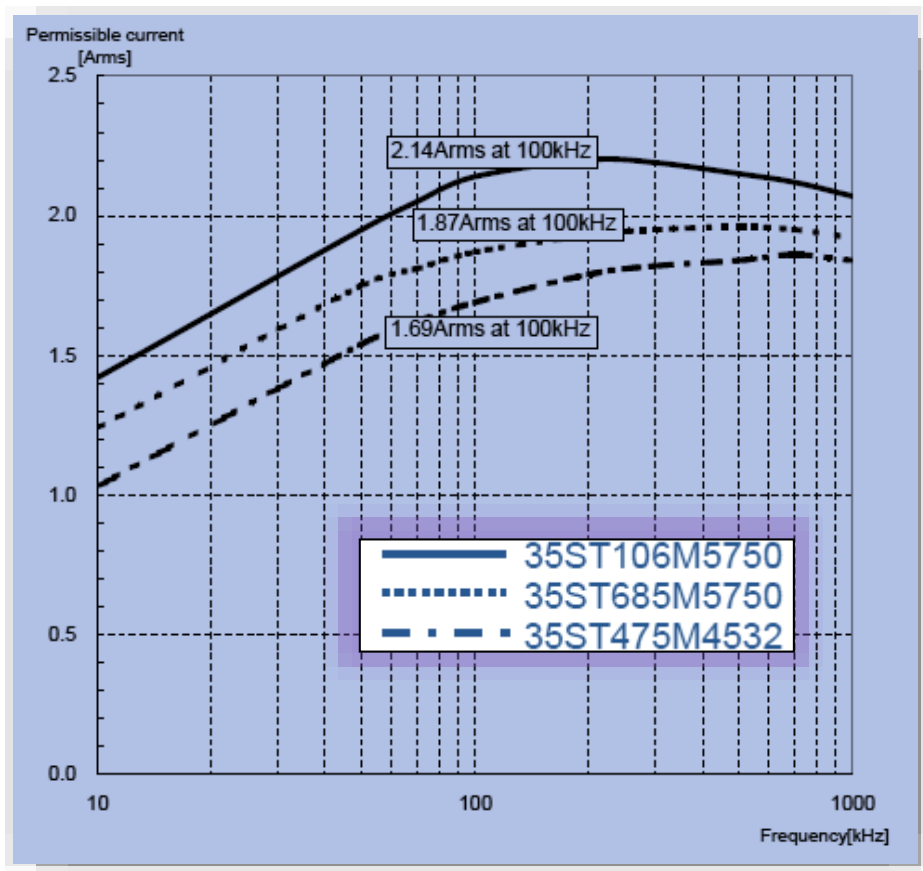
• **Quality** • **Reliability** • **Precision**







## PML-Cap® RIPPLE CURRENT CHARACTERISTICS



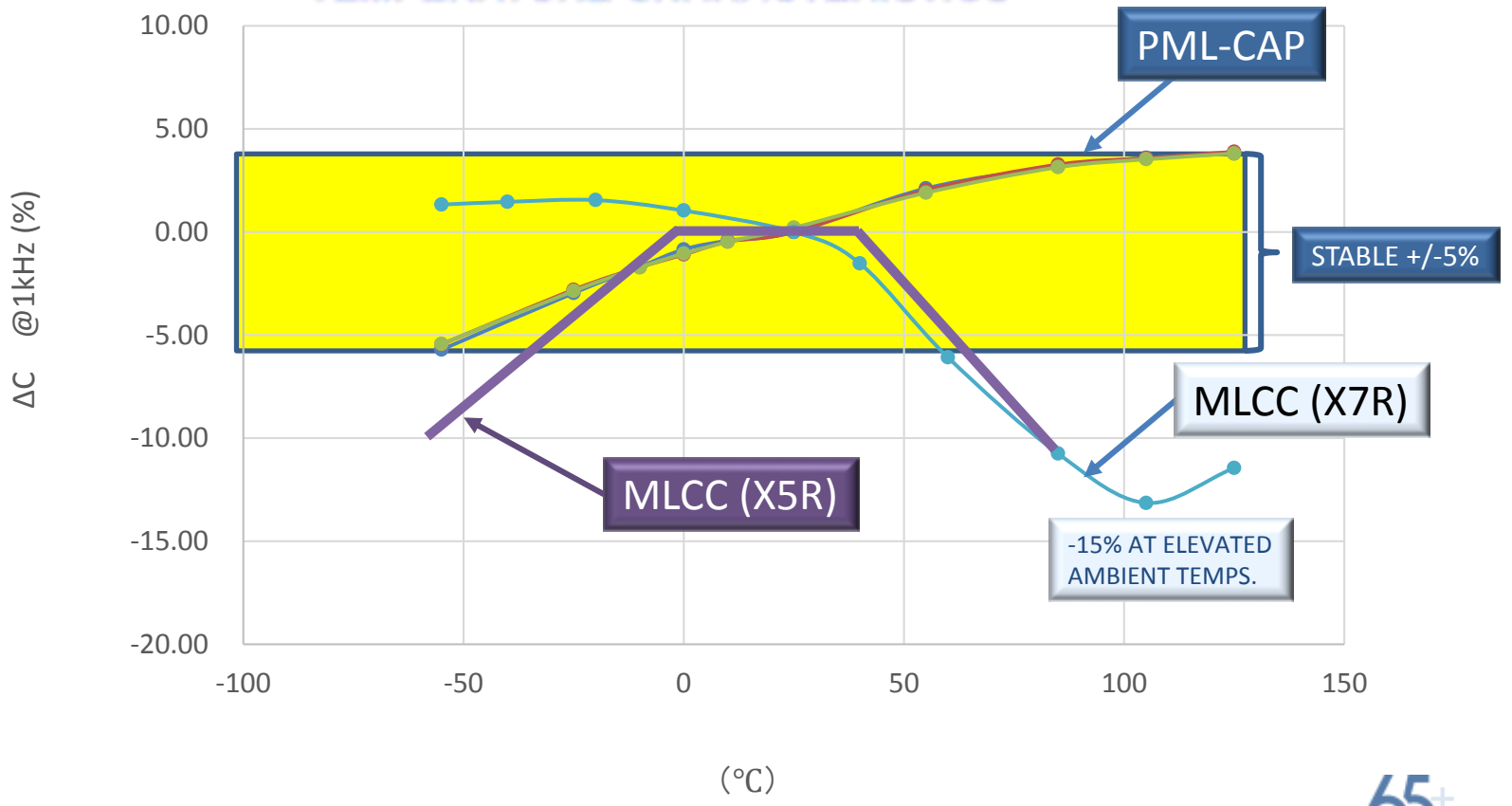
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## PML-Cap® TEMPERATURE CHARACTERISTICS



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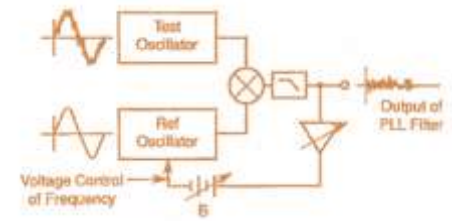




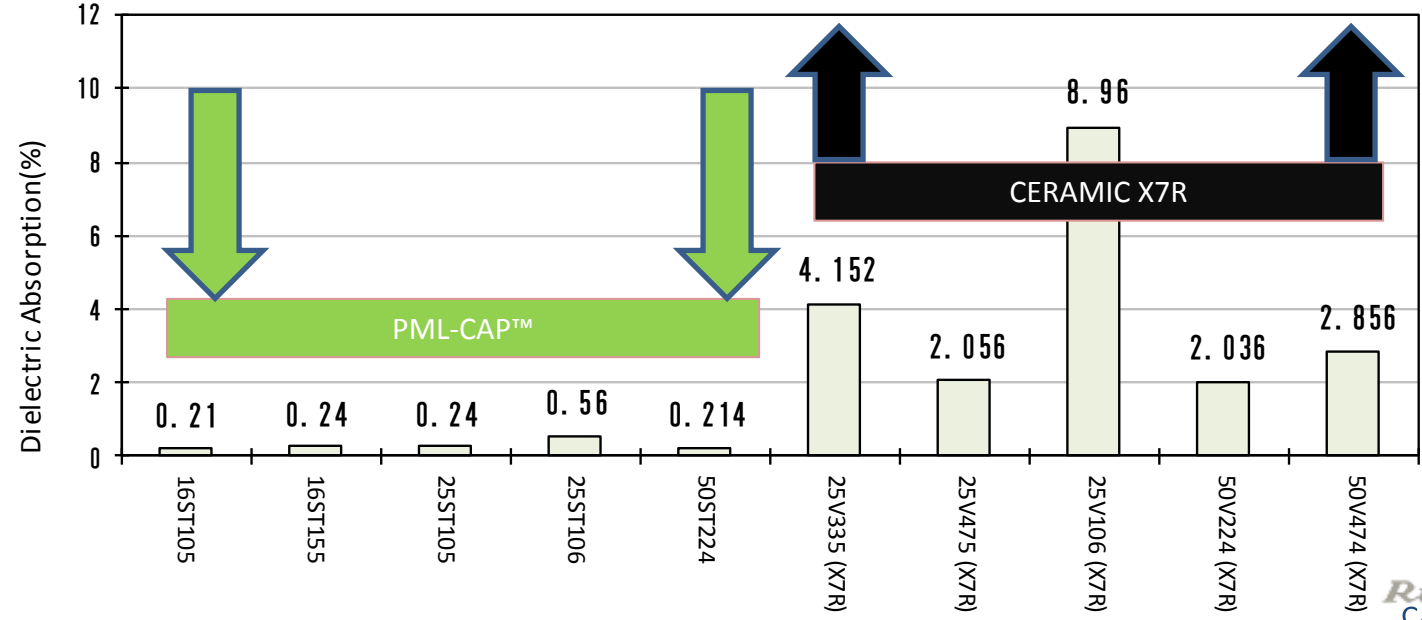
## Applications:

- \*A/D Converters
  - \*Sample/Hold Circuitry
  - \*Analog Integrators
  - \* Phase Lock Loop Circuits
  - \*Decoupling/Filtering/ High Frequency Circuits
- \*\*\*PML = Quick Response\*\*\***

## PML-Cap® DIELECTRIC ABSORPTION



Polarization behavior of polymer material affects dielectric absorption.



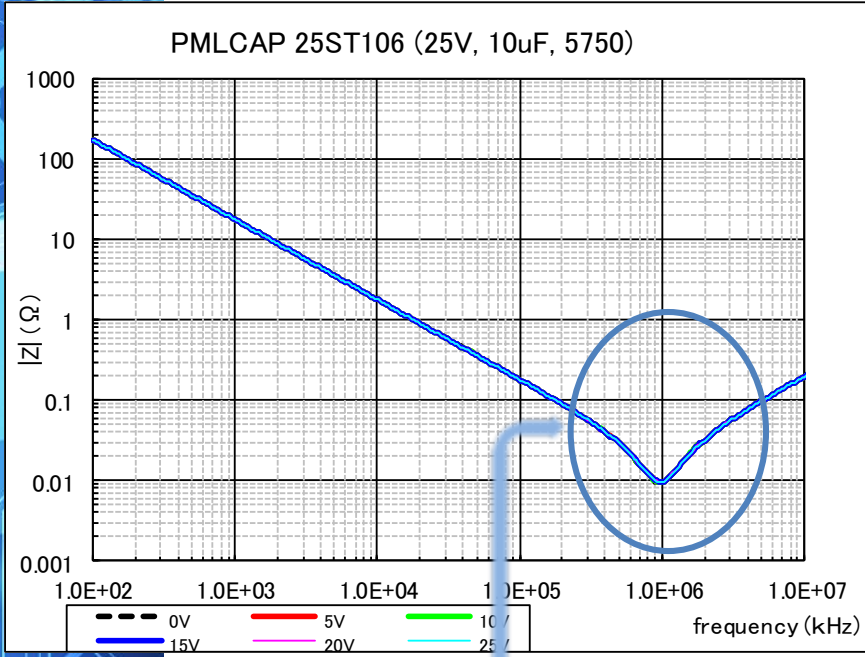
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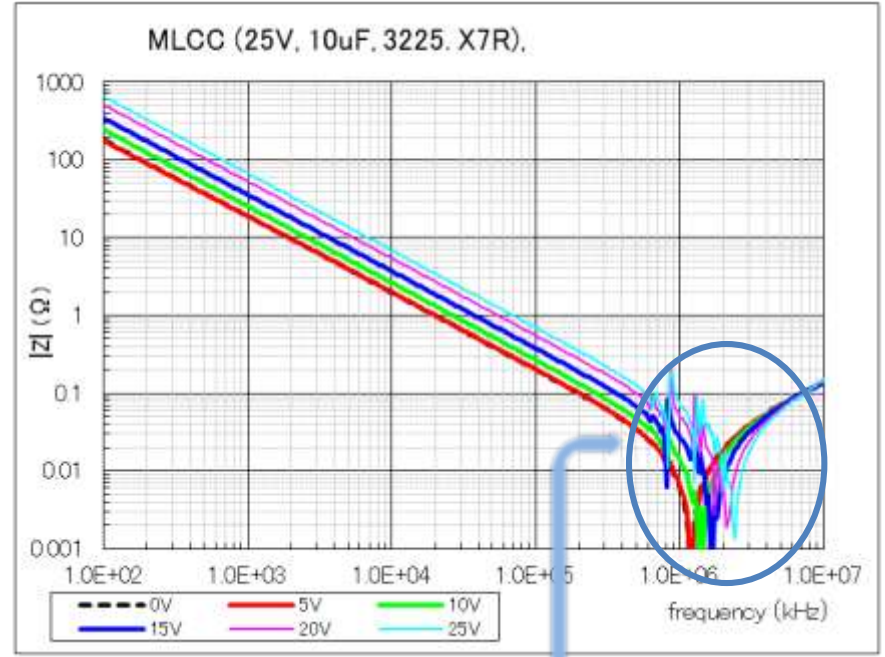




## PML-Cap® FREQUENCY CHARACTERISTICS ESR



**STABLE**



*Resonant Point shifts with DC Bias  
Fluctuation in Impedance Characteristics*



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CAPACITORS



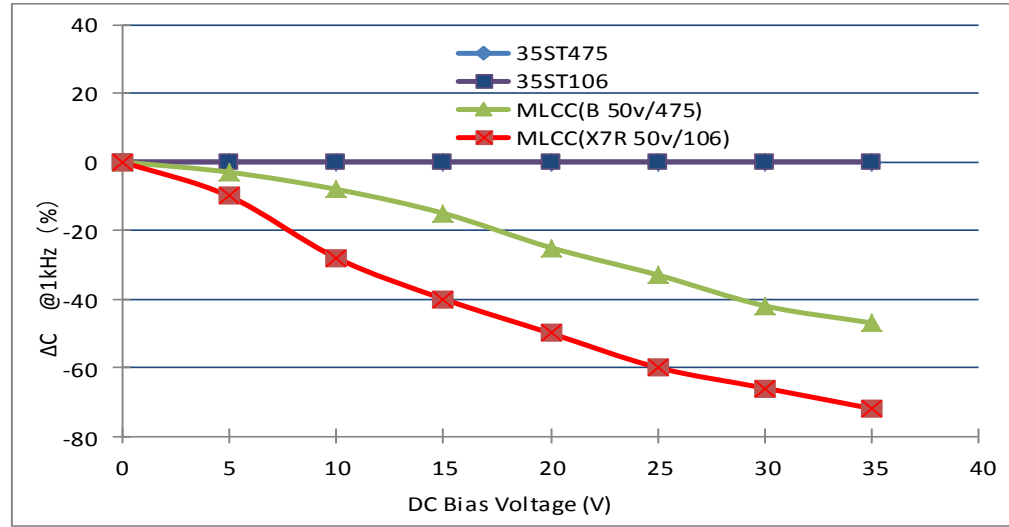




## PML-Cap® DC BIASING AND NOISE

### DC BIASING

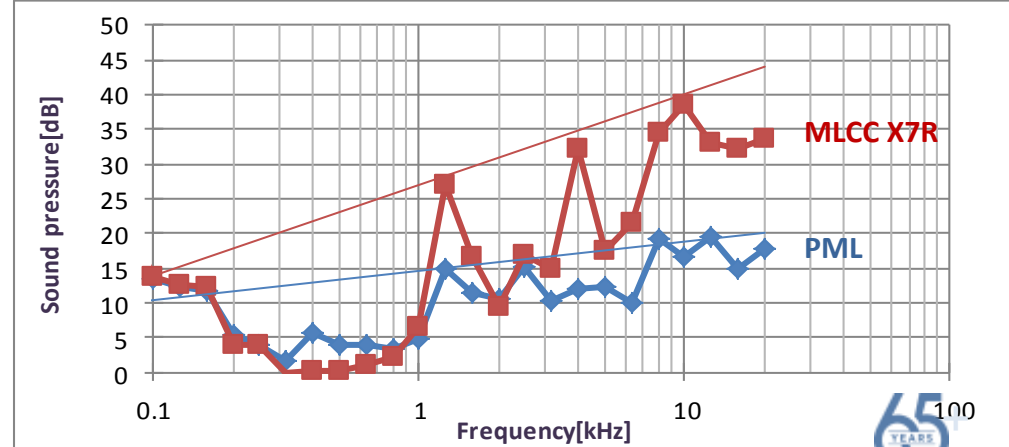
Bias characteristics are critical in decoupling circuits. PMLCAP shows stable capacitance against DC bias. Big advantage compared to X7R etc.



### SUPPRESSING AUDIBLE NOISE

Graph shows comparison of audible noise when applying square wave. MLCC(X7R) generates audible noise because of piezo effect.

PMLCAP shows less audible noise!



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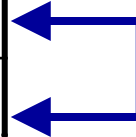


# PML-Cap® Polymer Multi Layer CAPACITORS



## PML-Cap® Vs Tantalum - Size

Capacitors	Rating	Size(mm)	Cap.per volume (uF/mm <sup>3</sup> )
PMLCAP®	35v 10uF	5.7x5.0x2.6	0.13
	25v 10uF	5.7x5.0x1.8	0.19
MnO <sub>2</sub> Ta	35v 10uF	6.0x3.2x2.5	0.21
	25v 10uF	6.0x3.2x1.4	0.37



Voltage de-rating is needed for Tantalum capacitors due to reliability consideration

No derating needed for PML-Caps

For example → 25V Nominal Voltage Required

Tantalum 35V: 60% de-rating      35X0.6=21v

PMLCAP 25V: No voltage de-rating    25X1.0=25v



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# PML-Cap® Polymer Multi Layer CAPACITORS



## PML-Cap® SAFETY TEST

Before Test

### Test:

Excess ripple current applied with high frequency 30kHz sine wave distributed.

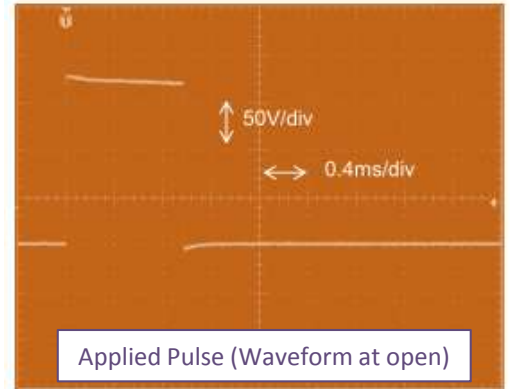
25V, 10µFd Capacitor



### PMLCAP®

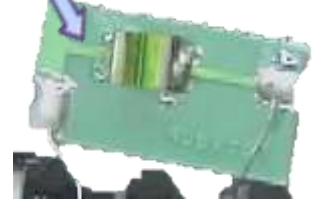
**Self Healing Properties**  
If an excessive voltage pulse is applied to PMLCAP® due to a short, insulation will be recovered through a healing process.

The surge current concentrates to the defect point, causing the spread of dielectric and deposited metal.

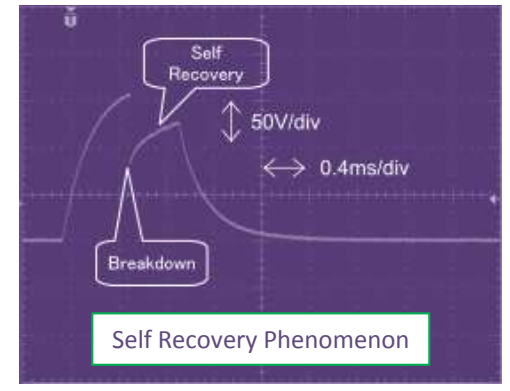


Tantalum (MnO2)

After Test



**No Effect**  
**A Safe Alternative!**



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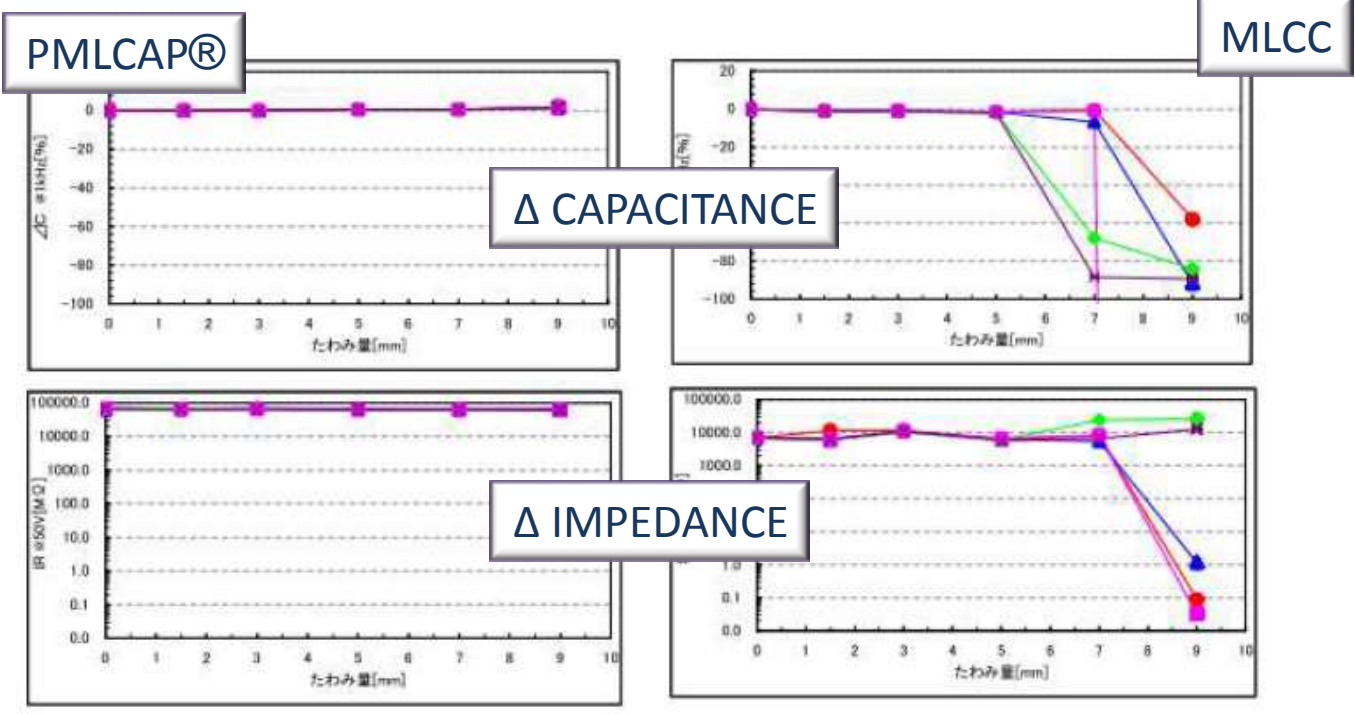


# PML-Cap® Polymer Multi Layer CAPACITORS



## PML-Cap® PCB BEND STRESS

The dielectric material along with high quality external electrodes allow for higher durability against board bend stress.



PMLCAP® does not incur short circuit nor insulation resistance deduction.

\* Product specification is 1mm for both PMLCAP · MLCC



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## PML-Cap® APPLICATIONS

MLCC audible noise  
Suppressing MLCC audible noise (piezoeffect causes noise)  
LED Driver circuit of LCD, VRM of laptop, tablet PC



Pure sound  
Coupling, LPF application of Audio amplifier  
Car Navigation, Home theatre, Microphone

Energy Harvest  
Storage capacitor (Ultra low L.C and high cap required)  
Building smart switch, Bridge Monitoring Systems



Telecommunication  
LPF of PLL circuit (low dielectric absorption)  
Radio communication, Broadcasting equipment



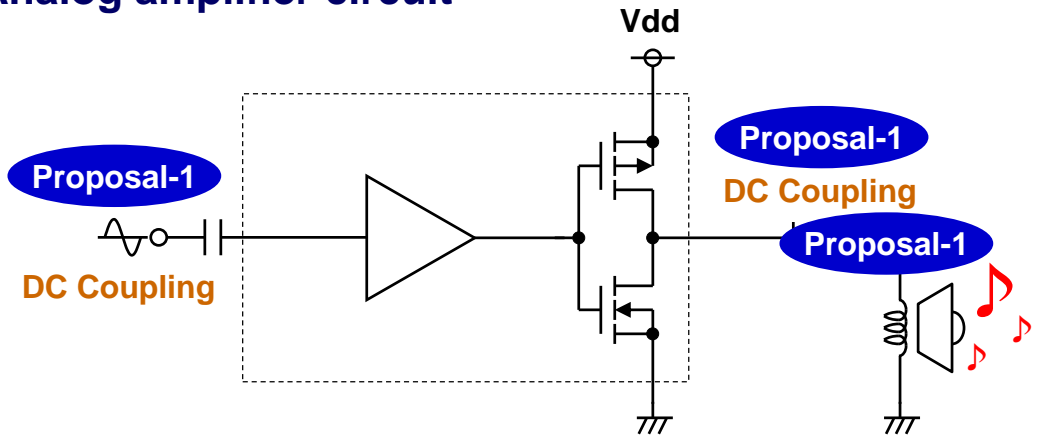
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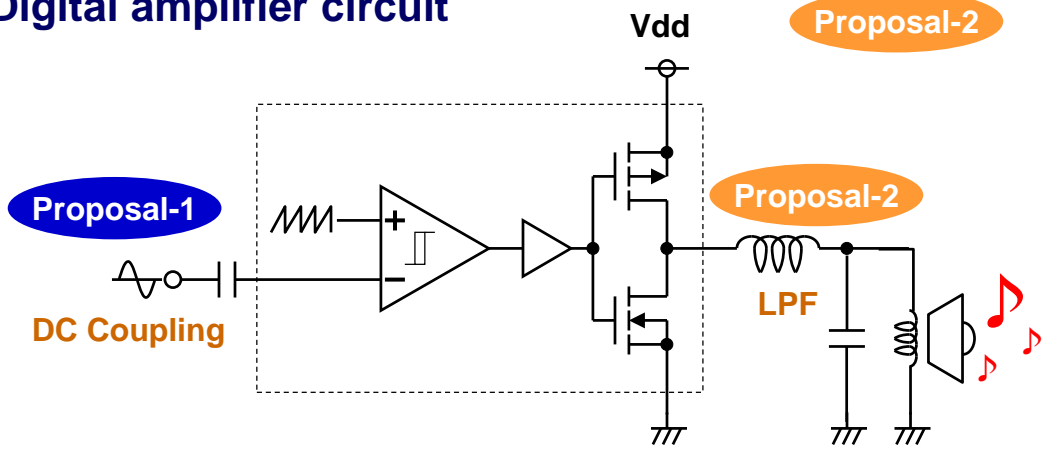


## ◆ Analog amplifier circuit



**DC Coupling Capacitor**  
 Demand: high sound quality, Low ESR, miniaturization  
 Recommendation: **PML MU series**

## ◆ Digital amplifier circuit



**Capacitance for Low Pass Filter (LPF)**  
 Demand: Low ESR, high sound quality, miniaturization  
 Recommendation: **PML MU series**

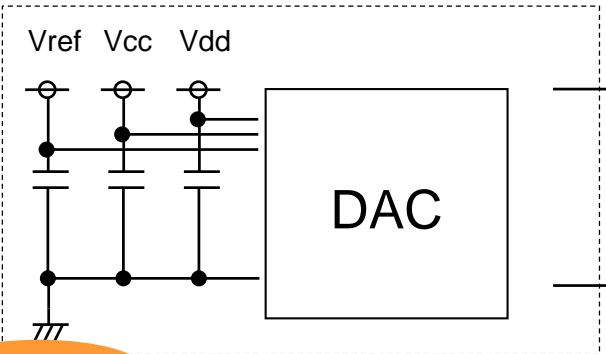




## ◆ Digital to Analog Converter Circuit

Decoupling Capacitor

Proposal-3



Proposal-2

**Capacitance for Low Pass Filter(LPF)**  
 Demand: Low ESR, high sound quality, miniaturization  
 Recommendation: **PML MU series**

Proposal-3

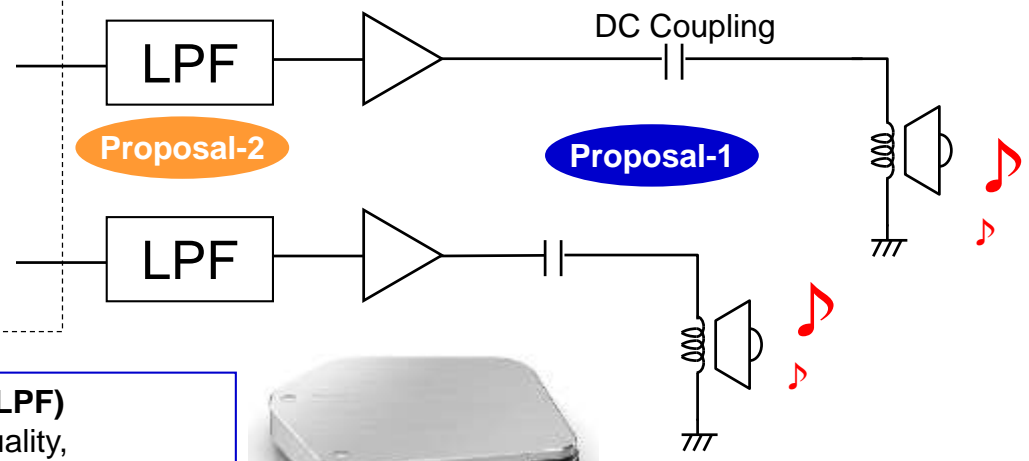
**Decoupling Capacitor**  
 Demand: high sound quality, Low ESR, miniaturization  
 Recommendation: **PML MU series, PZ-CAP**

Proposal-1

**DC Coupling Capacitor**  
 Demand: high sound quality, Low ESR, miniaturization  
 Recommendation: **PML MU series**

Proposal-2

Proposal-1



PIONEER  
USB DAC AMP.  
APS-DA101J







# PML-Cap® Polymer Multi Layer CAPACITORS



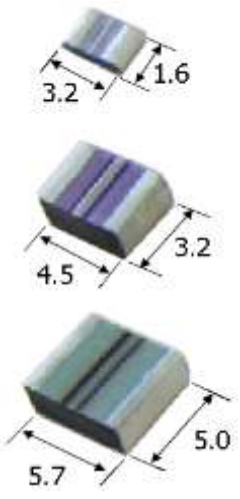
ALSO AVAILABLE

Code	Capacitance
101	100 pF
151	150
221	220
331	330
471	470
681	680
102	1,000
152	1,500
222	2,200
332	3,300
472	4,700
682	6,800

METRIC	INCH
1608	0603
2012	0605
3216	1206
3225	1210
4532	1812
5750	2220

## ◆ PML-CAP “MU” series chart

### ● PKG Size chart



Size Code	H(mm)	LxW(mm)
Y1	0.8	1.6x0.8
Z1	0.8	2.0x1.25
Z2	1.0	
A1	1.0	3.2x1.6
A2	1.4	
B1	1.4	3.2x2.5
B2	1.8	
B3	2.0	

Size Code	H(mm)	LxW(mm)
C1	1.4	4.5x3.2
C2	1.8	
C4	2.6	
D1	1.8	5.7x5.0
D3	2.6	

Code: Capacitance		Rated Voltage Range											
		16V D.C		25V D.C		35V D.C		50V D.C		63V D.C		100V D.C	
Capacitance Range		H	L x W	H	L x W	H	L x W	H	L x W	H	L x W	H	L x W
103	0.010 μF							Y1	1608	Z1	2012	A1	3216
153	0.015					Y1	1608			Z1	2012	A1	3216
223	0.022					Y1	1608			Z1	2012	A1	3216
333	0.033			Y1	1608			Z2	2012	Z1	2012	A1	3216
473	0.047	Y1	1608			Z1	2012	Z2	2012	A1	3216	A2	3216
683	0.068					Z2	2012			A1	3216	B1	3225
104	0.10			Z2	2012	Z2	2012	A1	3216	A1	3216	B2	3225
154	0.15	Z2	2012	Z2	2012			A1	3216	A1	3216		
224	0.22	Z2	2012					A1	3216	A2	3216		
334	0.33							A2	3216	B1	3225		
474	0.47					A1	3216	B1	3225	B2	3225		
684	0.68			A2	3216	A2	3216	B2	3225	C1	4532		
105	1.0	A2	3216	A2	3216	B1	3225	C1	4532	C2	4532		
155	1.5	A2	3216	B2	3225	B3	3225	C2	4532	C4	4532		
225	2.2	B2	3225	B2	3225	C1	4532	C4	4532	D1	5750		
335	3.3	B3	3225	C1	4532	C2	4532	D1	5750	D3	5750		
475	4.7	C1	4532	C2	4532	C4	4532	D3	5750				
685	6.8	C2	4532	C4	4532	D1	5750						
106	10	C4	4532	D1	5750	D3	5750						
156	15	D1	5750	D3	5750								
226	22	D3	5750										



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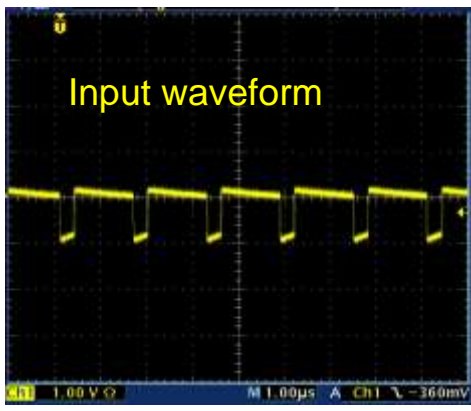
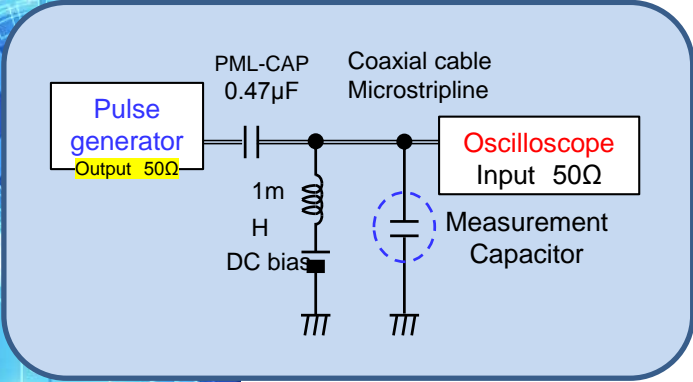






● Noise wave pattern decrement characteristic PML-CAP vs MLCC

Comparison of output waveform



Frequency=625kHz,  
Duty=80%, Vin=1Vp-p

<p><b>PML-CAP</b> 16MU106M C44532</p>	<p>0V DC bias</p>	<p>16V DC bias</p>
<p><b>Stable control properties!!</b></p>		
<p><b>MLCC</b> 50V-10μF Temp. class : B PKG : 3216</p>	<p>0V DC bias</p>	<p>16V DC bias (68% Derating)</p>
<p><b>Increase of high frequency noise!!</b></p>		
<p>Frequency=625kHz</p>		
<p><b>MLCC</b> 10V-10μF Temp. class : X7R PKG : 3216</p>	<p>0V DC bias</p>	<p>10V DC bias</p>
<p><b>Increase of high frequency noise!!</b></p>		
<p>Frequency=494kHz</p>		





## ◆ PML-CAP “MU” series “High voltage” items

### ● Series Line-up

### ● Specifications (Tentative)

Rated voltage range	100, 160, 200 V.DC
Nominal capacitance range	250 (25pF) ~ 683 (0.068μF)
Capacitance tolerance	K(±10%) / M(±20%)
Category temp. range	-55 ~ +125 deg.C

**Update!!**

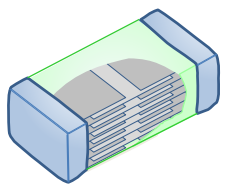
#### New PKG Line-up

Size code	H(mm)	LxW(mm)
C1	1.4	3.2x4.5
C2	1.8	
C3	2.2	
C4	2.6	

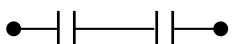
### ● Features

• Achieved high voltage items to adopted new structure !!

(Internal structure image)



Internal circuit structure



Direct circuit

			Rated voltage							
			100V D.C		160V D.C		200V D.C			
Code	Unit		H	L x W	H	L x W	H	L x W		
Nominal Capacitance	250	100	pF					A1	3216	
	101	100						A1	3216	
	151	150						A1	3216	
	221	220						A1	3216	
	331	330						A1	3216	
	471	470						A1	3216	
	681	680						A1	3216	
	102	1,000		A1	3216			A1	3216	
	152	1,500		A1	3216			A1	3216	
	222	2,200		A1	3216			A1	3216	
	332	3,300		A1	3216			A1	3216	
	472	4,700		A1	3216			A1	3216	
	682	6,800		A1	3216			A1	3216	
	103	0.010		μF	A1	3216	A1	3216	A2	3216
	153	0.015			A1	3216	A2	3216	B1	3225
223	0.022	A1	3216		B1	3225	B2	3225		
333	0.033	A1	3216		B2	3225	C1	3245		
473	0.047	A2	3216		B3	3225	C3	3245		
683	0.068	B1	3225		C2	3245	C4	3245		
104	0.10	B2	3225		C4	3245				



The existence catalog line-up

**Update!!**



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● Quality ● Reliability ● Precision





# PML-Cap® Polymer Multi Layer CAPACITORS



## ◆ PML-CAP New items High humidity quality “MS” series

Rated voltage range	10, 16, 25, 35, 50 V.DC
Nominal capacitance range	102 (1,000pF) ~ 225 (2.2μF)
Capacitance tolerance	K(±10%) / M(±20%)
Category temp. range	-55 ~ +125 deg.C
Humidity specification	<b>85deg.C 85%R.H 1,000hrs</b>

			Rated voltage									
			10V D.C		16V D.C		25V D.C		35V D.C		50V D.C	
Code: Unit			Code	L x W	Code	L x W	Code	L x W	Code	L x W	Code	L x W
Nominal Capacitance	102	1,000	pF						Z1	2012	A1	3216
	152	1,500							Z1	2012	A1	3216
	222	2,200							Z1	2012	A1	3216
	332	3,300							Z1	2012	A1	3216
	472	4,700							Z1	2012	A1	3216
	682	6,800							Z1	2012	A1	3216
	103	0.010	μF						Z1	2012	A1	3216
	153	0.015							Z1	2012	A1	3216
	223	0.022							Z1	2012	A1	3216
	333	0.033							Z2	2012	A1	3216
	473	0.047					Z2	2012	A1	3216	A2	3216
	683	0.068			Z1	2012			A1	3216	B1	3225
	104	0.10			Z2	2012			A1	3216	B2	3225
	154	0.15		Z2	2012				A1	3216		
	224	0.22					A1	3216	A2	3216		
	334	0.33					A2	3216	B1	3225		
	474	0.47				A1	3216	B1	3225	B2	3225	
	684	0.68				A2	3216	B2	3225			
	105	1.0		A2	3216	B1	3225					
	155	1.5		B1	3225							
225	2.2		B2	3225								



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GRACIAS

TERIMA KASIH

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감사

ขอขอบคุณ

MERCI

DANKE

65+  
YEARS  
Rubycon  
CAPACITORS

*Rubycon*

THANK YOU!



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• **Quality** • **Reliability** • **Precision**

SLIDE NAVIGATION





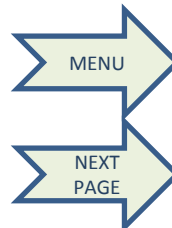


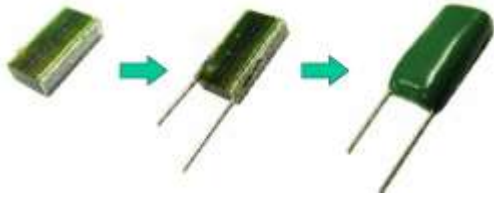
CAP CODE	CAPACITANCE	16V	25V	35V	50V	63V	100V
101	100pF				0603	0805	
151	150pF				0603	0805	
221	220pF				0603	0805	
331	330pF				0603	0805	
471	470pF				0603	0805	
681	680pF				0603	0805	
102	1000pF				0603	0805	1206
152	1500pF				0603	0805	1206
222	2200pF				0603	0805	1206
332	3300pF				0603	0805	1206
472	4700pF				0603	0805	1206
682	6800pF				0603	0805	1206
103	0.01uF				0603	0805	1206
153	0.015uF			0603		0805	1206
223	0.022uF			0603		0805	1206
333	0.033uF		0603		0805	0805	1206
473	0.047uF	0603		0805	0805	1206	1206

CAP CODE	CAPACITANCE	16V	25V	35V	50V	63V	100V
683	0.068uF			0805		1206	1210
104	0.1uF		0805	0805	1206	1206	1210
154	0.15uF	0805	0805		1206	1206	
224	0.22uF	0805			1206	1206	
334	0.33uF				1206	1210	
474	0.47uF			1206	1210	1210	
684	0.68uF		1206	1206	1210	1812	
105	1uF	1206	1206	1210	1812	1812	
155	1.5uF	1206	1210	1210	1812	1812	
225	2.2uF	1210	1210	1812	1812	2220	
335	3.3uF	1210	1812	1812	2220	2220	
475	4.7uF	1812	1812	1812	2220		
685	6.8uF	1812	1812	2220			
106	10uF	1812	2220	2220			
156	15uF	2220	2220				
226	22uF	2220					

Size Code Conversion

mm	inch
2012	0805
3216	1206
3225	1210
4532	1812
5750	2220





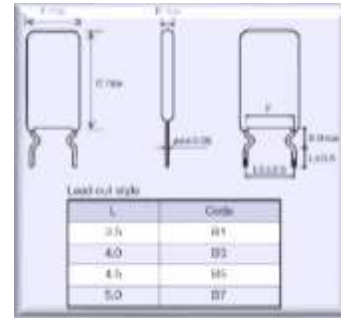
Case type film capacitor is currently used for DC/DC converter control unit of automotive application as smoothing circuit, but case size is big.



LDT contributes to size reduction of your circuit board !!

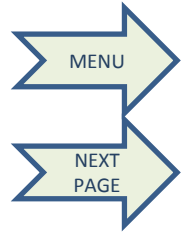


Size and weight are about 1/10 compare with conventional film capacitor.



◆STANDARD SIZE

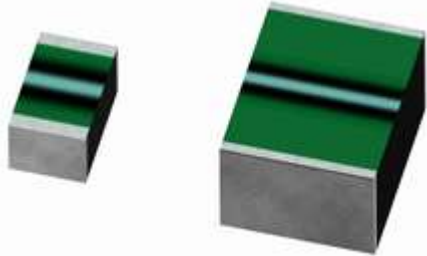
Radial (VDC)	Capacitance (μF)	Size (mm)						Part No.
		A	B	C	F±1.5	G±0.5	H±0.5	
10	47	8.5	5.2	14.6	6.0	5.0	0.6	10LDT476M**
	33	8.5	5.2	14.6	6.0	5.0	0.6	16LDT336M**
25	15	8.6	5.2	11.1	6.0	5.0	0.6	25LDT156M**
	22	8.5	5.2	14.6	6.0	5.0	0.6	25LDT226M**
35	4.7	8.7	5.2	8.6	6.0	5.0	0.6	35LDT475M**
	6.8	8.6	5.2	11.1	6.0	5.0	0.6	35LDT685M**
	10	8.5	5.2	14.6	6.0	5.0	0.6	35LDT106M**



# MS series

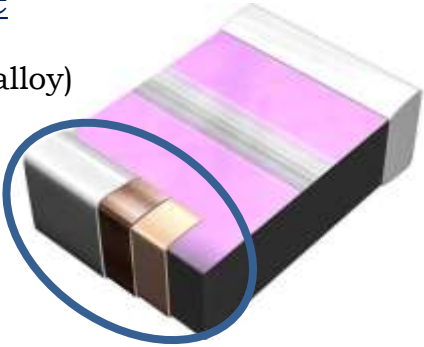
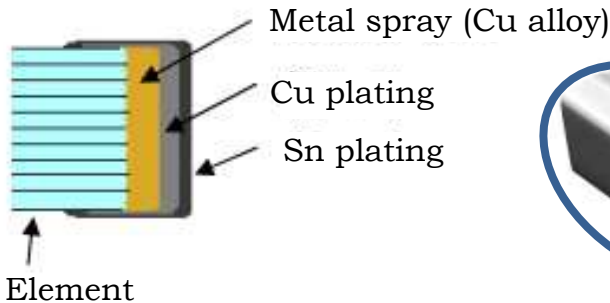
## Product outline

- Temp. Range : -55 to 125°C
- Rated Voltage : 10 to 50Vdc
- Capacitance : 0.001 to 2.2μF
- Size (mm) : 2012, 3216, 3225 (0805, 1206, 1210 in inch)
- Reflow / Flow soldering is available
- Humidity resistance : 85°C85%RH 1000Hrs



(Cap. change within ±20%)

## External electrode structure

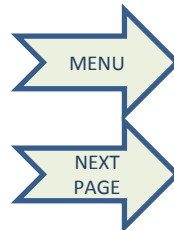
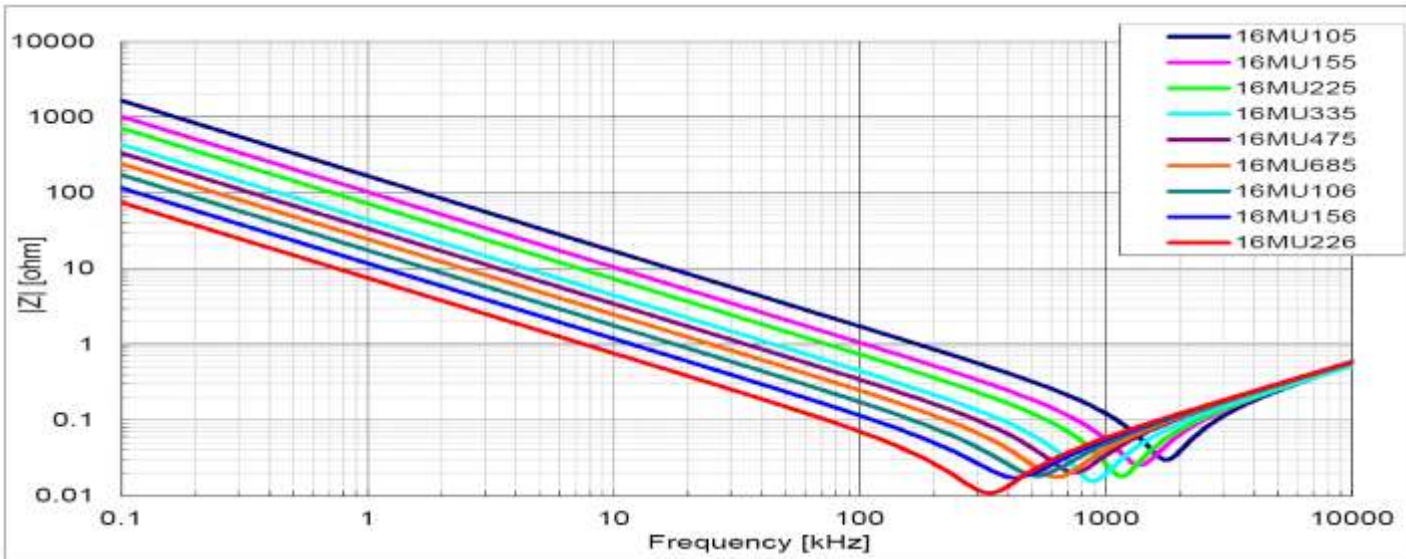
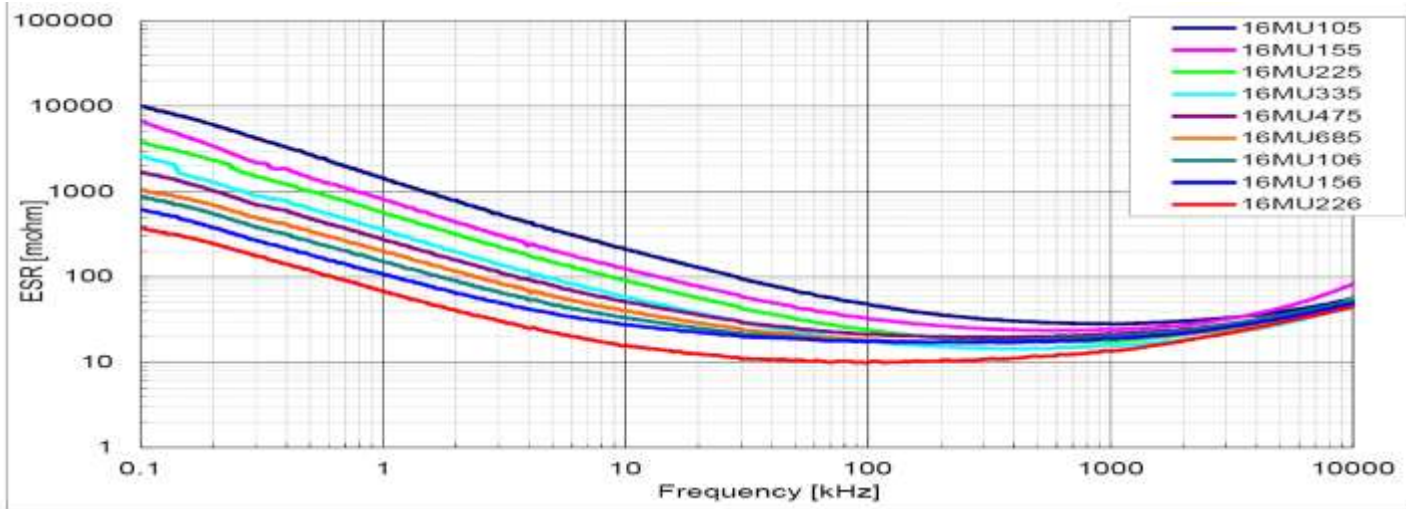


Exterior : Ferromagnetic-Free

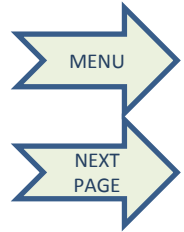
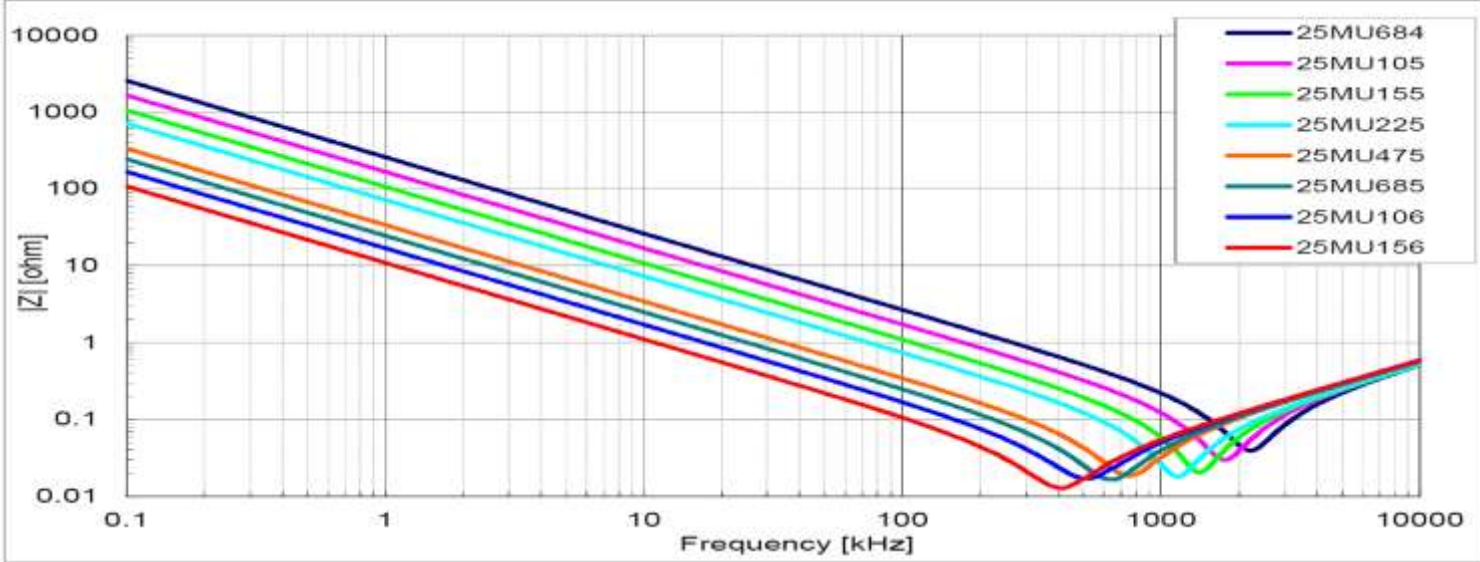
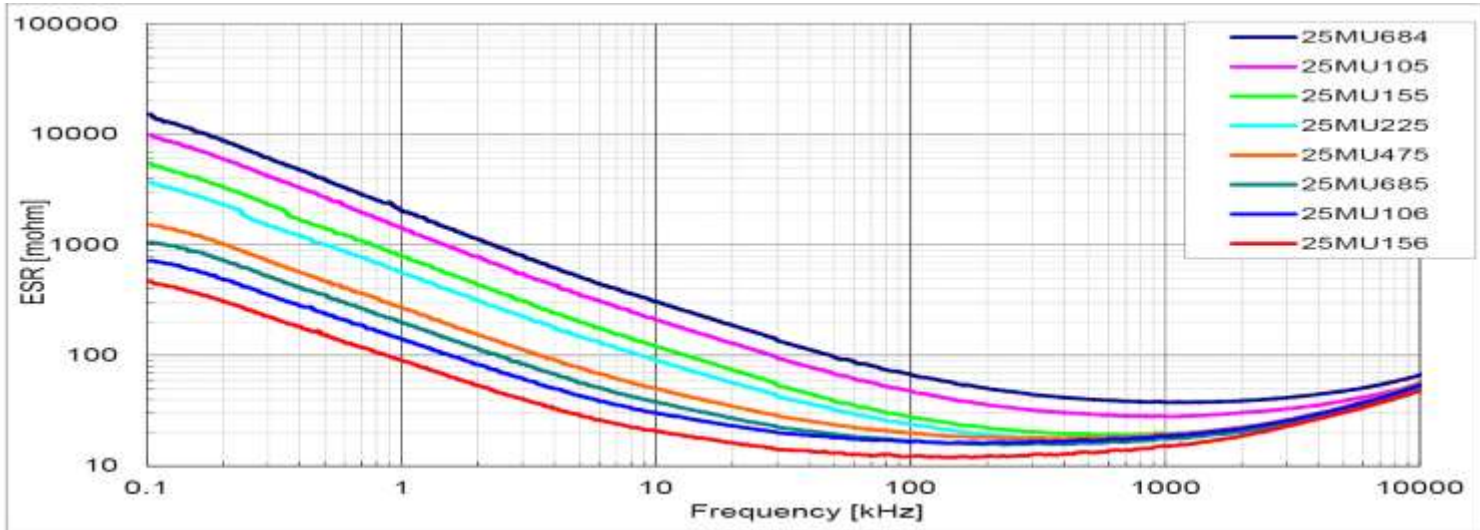
定格電圧 Rated Voltage (Vdc)	静電容量 Capacitance (μF)	外形寸法 Size		
		L (mm)	W (mm)	H (mm)
10	0.15	2.0	1.25	1.0
	1.0	3.2	1.6	1.4
	1.5	3.2	2.5	1.4
	2.2	3.2	2.5	1.8
16	0.068	2.0	1.25	0.8
	0.10	2.0	1.25	1.0
	0.47	3.2	1.6	1.0
	0.68	3.2	1.6	1.4
25	1.0	3.2	2.5	1.4
	0.047	2.0	1.25	1.0
	0.22	3.2	1.6	1.0
	0.33	3.2	1.6	1.4
35	0.47	3.2	2.5	1.4
	0.68	3.2	2.5	1.8
	0.0010	2.0	1.25	0.8
	0.0015	2.0	1.25	0.8
	0.0022	2.0	1.25	0.8
	0.0033	2.0	1.25	0.8
	0.0047	2.0	1.25	0.8
	0.0068	2.0	1.25	0.8
	0.010	2.0	1.25	0.8
	0.015	2.0	1.25	0.8
	0.022	2.0	1.25	0.8
	0.033	2.0	1.25	1.0
50	0.047	3.2	1.6	1.0
	0.068	3.2	1.6	1.0
	0.10	3.2	1.6	1.0
	0.15	3.2	1.6	1.0
	0.22	3.2	1.6	1.4
	0.33	3.2	2.5	1.4
	0.47	3.2	2.5	1.8
	0.0010	3.2	1.6	1.0
	0.0015	3.2	1.6	1.0
	0.0022	3.2	1.6	1.0
	0.0033	3.2	1.6	1.0
	0.0047	3.2	1.6	1.0
0.0068	3.2	1.6	1.0	
0.010	3.2	1.6	1.0	
0.015	3.2	1.6	1.0	
0.022	3.2	1.6	1.0	
0.033	3.2	1.6	1.0	
0.047	3.2	1.6	1.4	
0.068	3.2	2.5	1.4	
0.10	3.2	2.5	1.8	

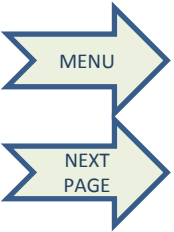
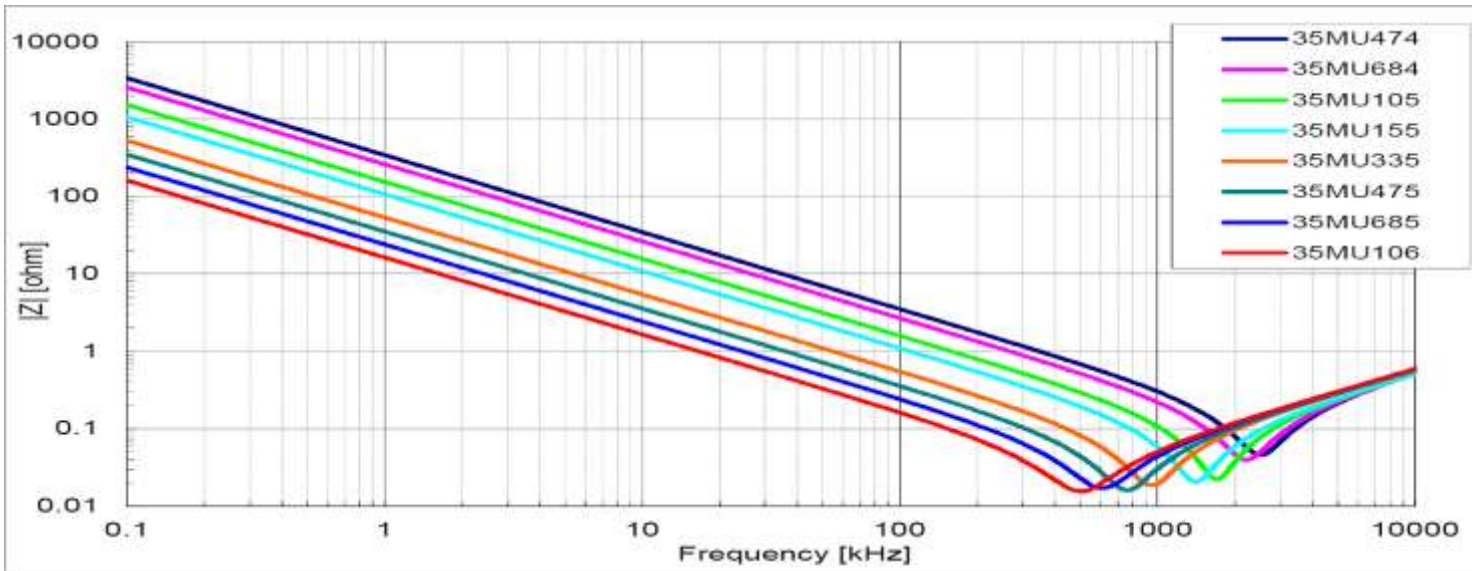
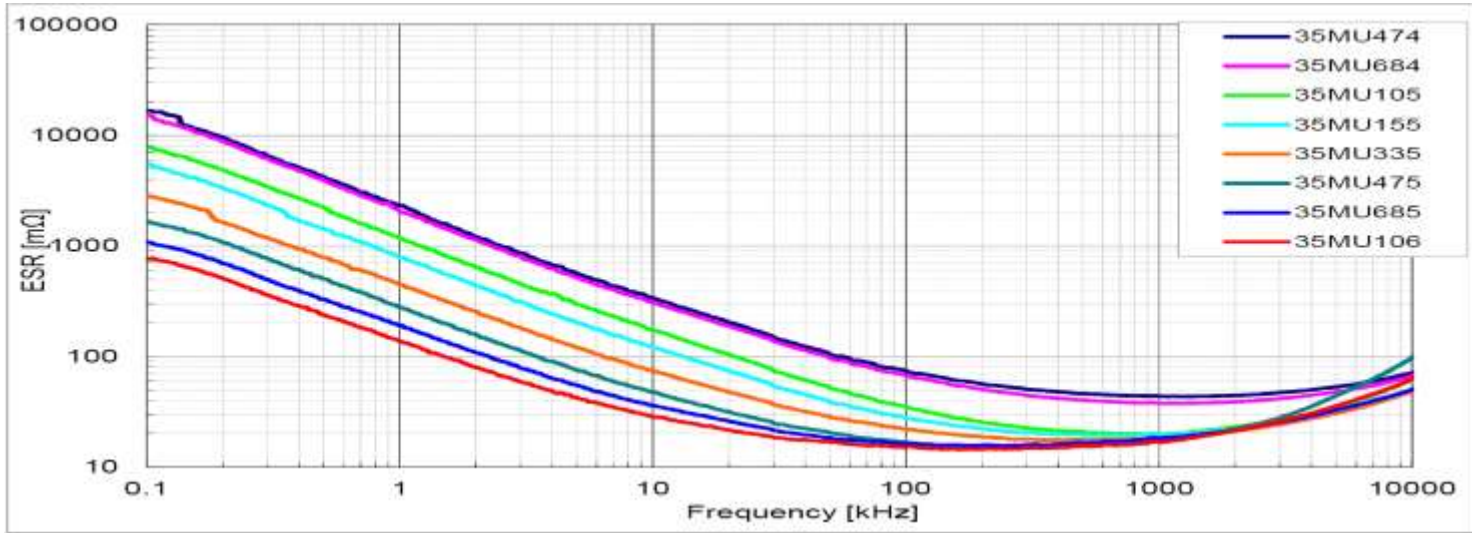




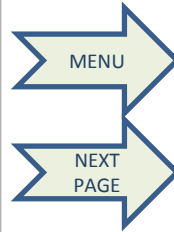
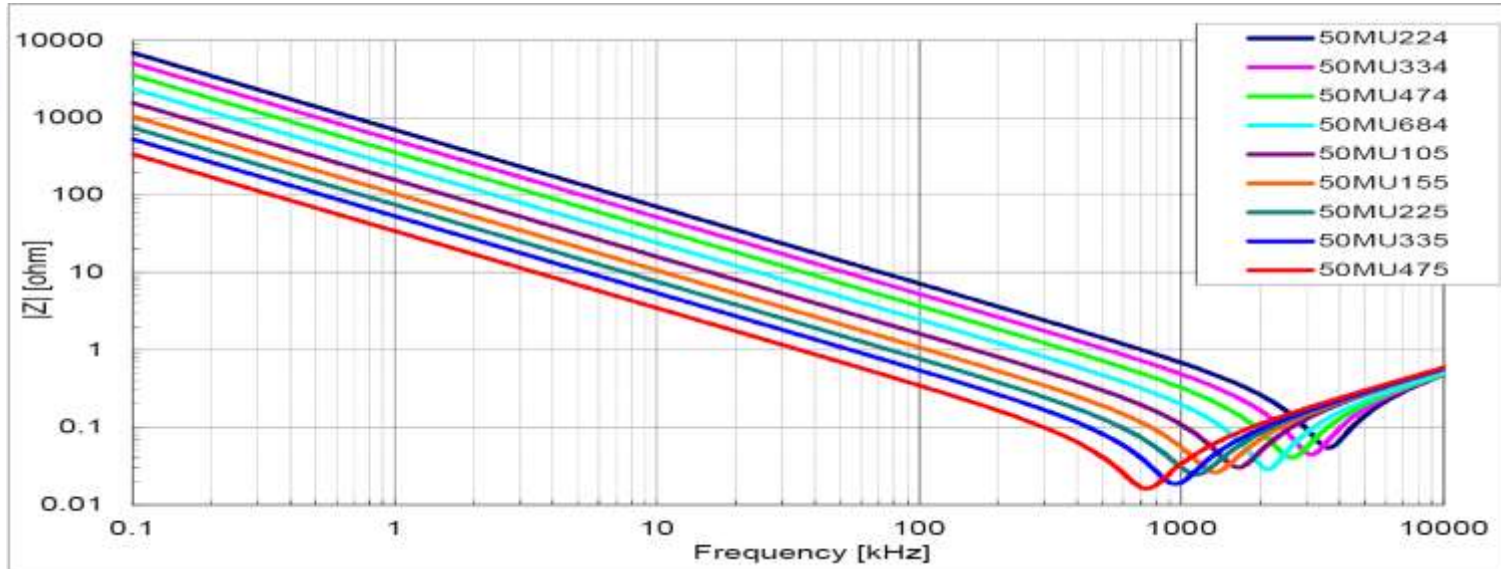
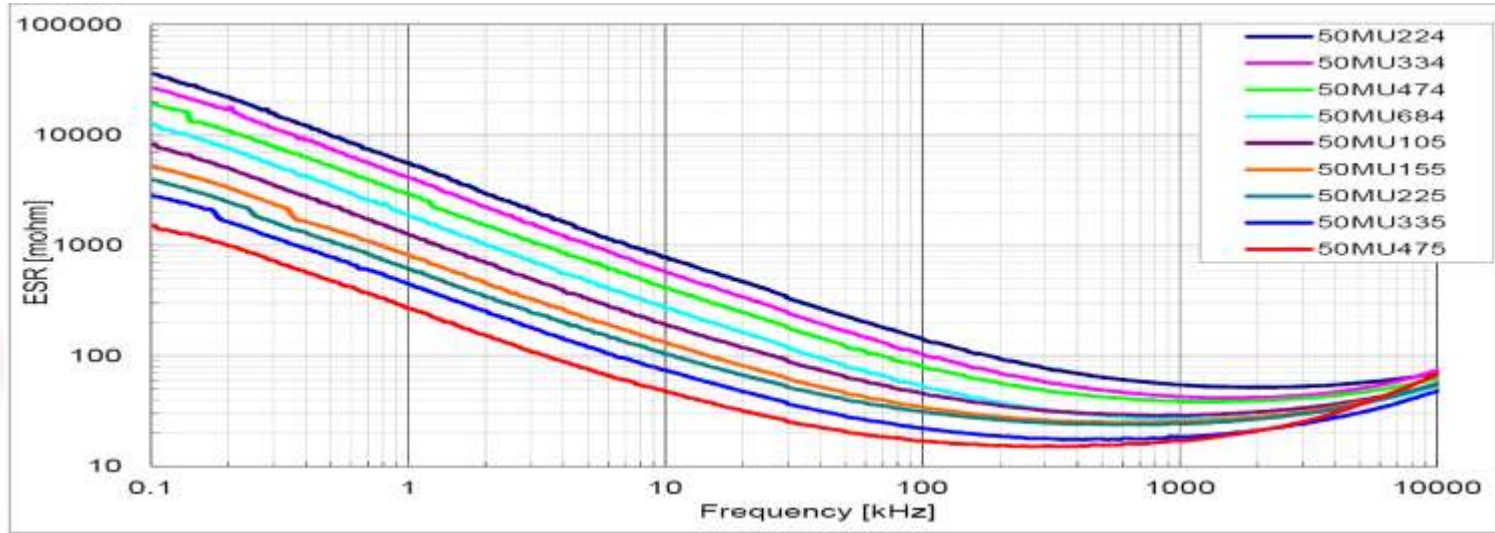


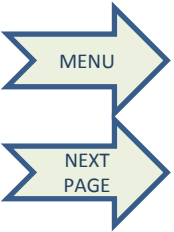
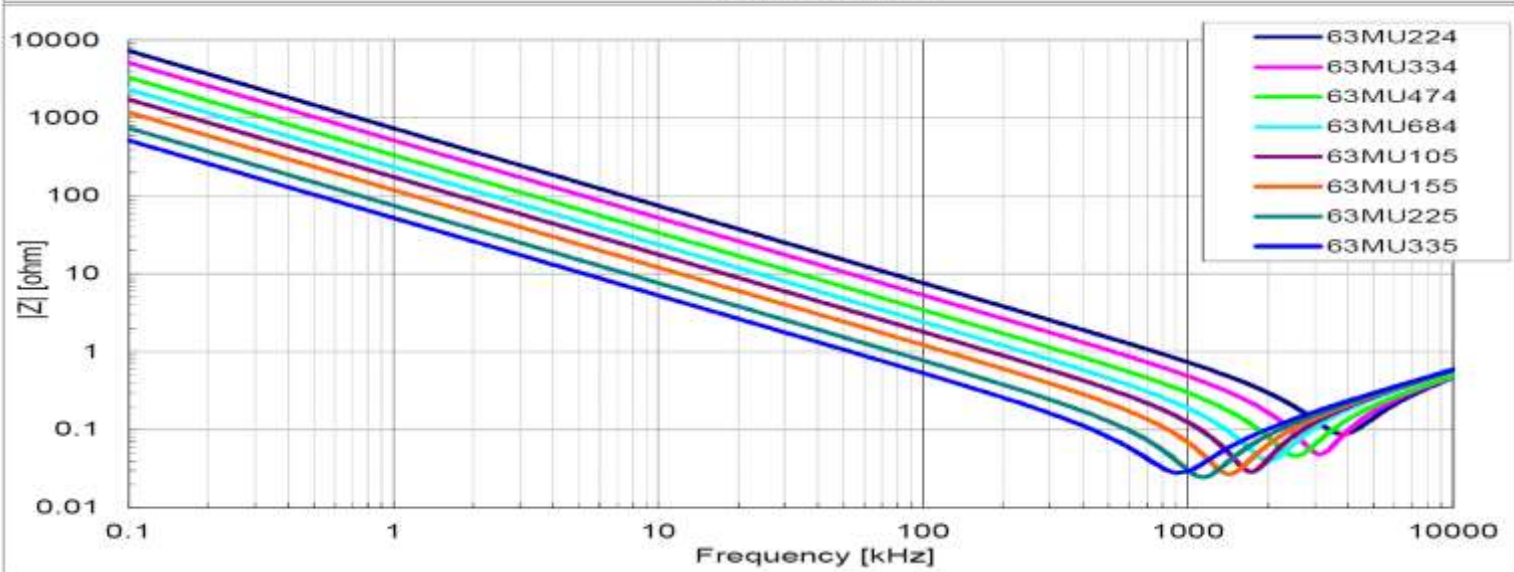
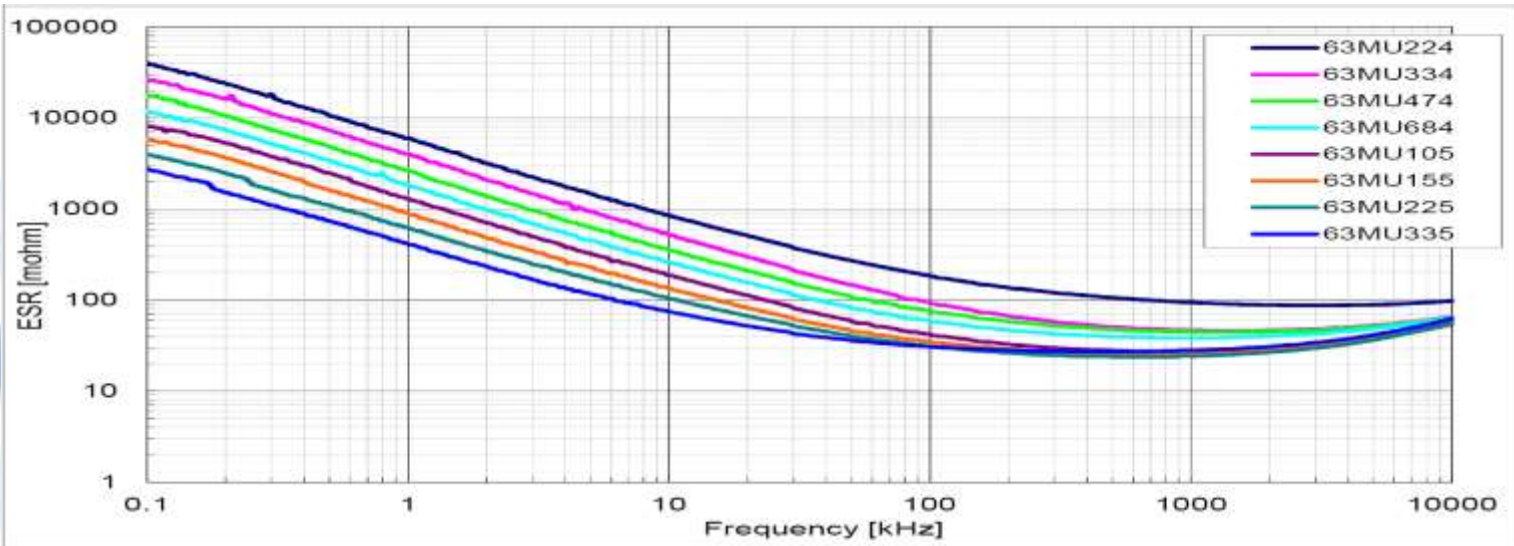




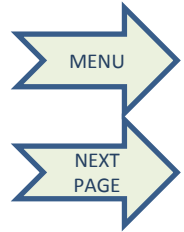
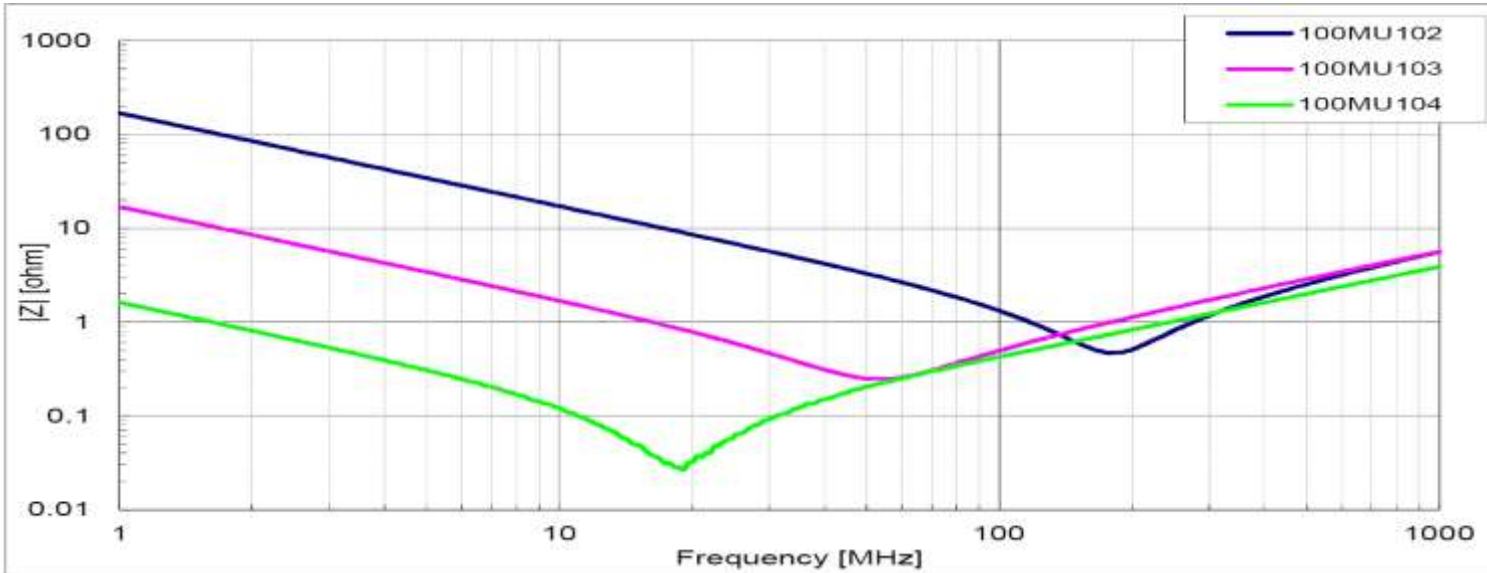
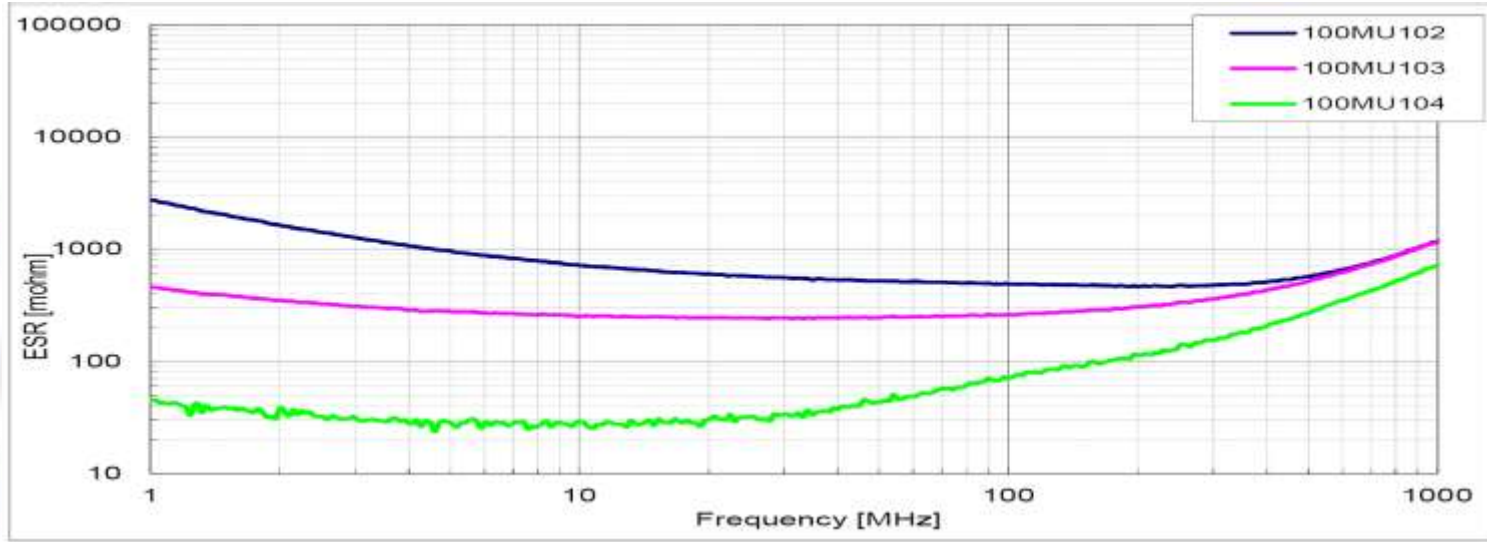












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THANK YOU!

