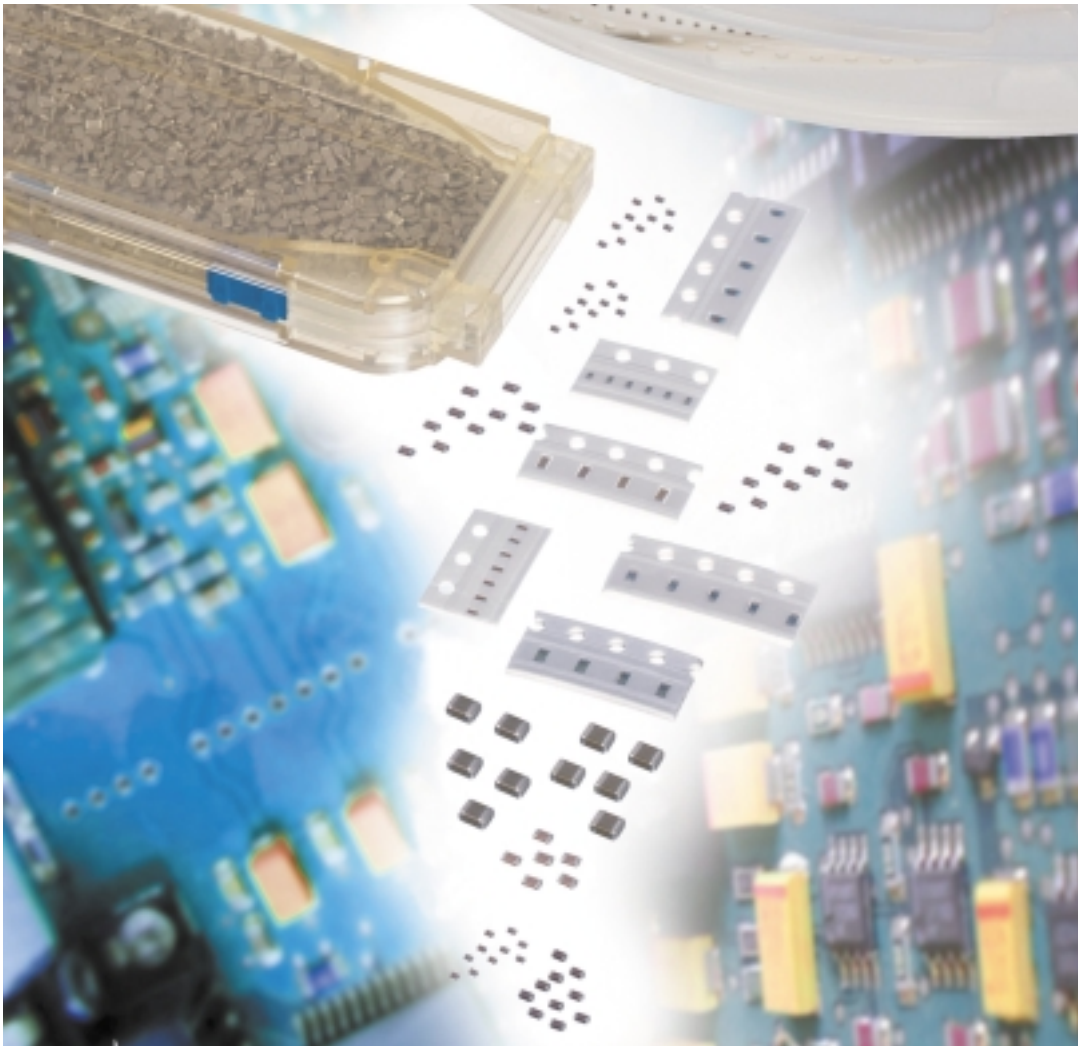


# CHIP MONOLITHIC CERAMIC CAPACITORS AS ALTERNATIVES FOR CHIP TANTALUM CAPACITORS

C-24-C

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### Comparative Capacitance Table

Capacitor	EIA	Size (mm)			Capacitance					
		L	W	T	1nF	10nF	100nF	1uF	10uF	100uF
Murata MLCC	0201	0.6	0.3	0.3	█					
	0402	1.0	0.5	0.5	█	█				
	0603	1.6	0.8	0.8	█	█	█			
	0805	2.0	1.25	1.25	█	█	█	█		
	1206	3.2	1.6	1.6	█	█	█	█		
	1210	3.2	2.5	2.5		█	█	█	█	
	1812	4.5	3.2	2.5			█	█	█	
	2220	5.7	5.0	3.2				█	█	█
TA (X)	P	2.0	1.25	1.1				█		
	A2	3.2	1.6	1.1				█		
	A	3.2	1.6	1.6				█		
	B2	3.5	2.8	1.9					█	
	C	6.0	3.2	2.5					█	
	V	7.3	4.3	1.9					█	
	D	7.3	4.3	2.8					█	█
TA (Y)	CD(thin type)	7.3	4.3	1.5				█		
	CD Series	7.3	4.3	1.8				█	█	
	UD Series	7.3	4.3	3.1					█	
	UE Series	7.3	4.3	4.2						█
Organic Semi- Conductive	A	7.3	4.6	4.6				█		
	B	7.3	5.6	5.6					█	
	C	9.0	7.0	7.0					█	
	D	12.0	7.0	7.0					█	
	E	13.0	8.8	8.8						█

# Basic Function and Applications for High Capacitance Components



### Basic Function

Electrical signals contain various noise components such as EMI or equipment-generated noise.

High Capacitance can be used to reduce these noise signals and provide a more stable operating system.

The most prominent functions for high capacitance are shown below:

### Smoothing

DC signals are cleaned by using high capacitance to absorb ripple voltage.



### Bypassing

When high capacitance is used in a filtering circuit, unwanted signals can be routed away from certain equipment, e.g., bypassing high frequency noise.



### Coupling

Coupling between neighbor circuits to stop DC and pass AC

### Advantages of MLCC in comparison to TA/AL capacitors.

- Noise Absorption of MLCC is excellent compared to Ta/AL Capacitors.
- Self Heating of MLCC is small compared to TA/AL Capacitors.
- Capacitance of MLCC does not change over a wide frequency range.
- Break down Voltage of MLCC is higher compared to TA/AL Capacitors.

## Recommended Murata MLCC P/N's For Replacement of TA/AL Chips

### Smoothing / By-passing: $\leq 100\text{kHz}$

TA /AL	MLCC	6.3V	10V	16V	25V	35V / 50V
0.1uF → 0.047uF		-->	GRM36X7R473K010A_	-->	GRM39X7R473K025A_	GRM40X7R473K050A_
		-->	GRP155R71A473KA01_	-->	GRM188R71E473KA01_	GRM21BR71H473KA01_
0.22uF → 0.1uF		-->	GRM36X5R104K010A_	-->	GRM39X7R104K025A_	GRM40X7R104K050A_
		-->	GRP155R61A104KA01_	-->	GRM188R71E104KA01_	GRM21BR71H104KA01_
0.47uF → 0.22uF		-->	GRM39X7R224K010A_	-->	GRM40X7R224K025A_	GRM40X7R224K050A_
		-->	GRM188R71A224KA01_	-->	GRM219R71E224KC01_	GRM21BR71H224KA01_
1.0uF → 0.47uF		GRM39X5R474K63A_	GRM40X7R474K016A_	GRM40X7R474K016A_	GRM40X7R474K025A_	GRM42-6X7R474K050A_
		GRM188R60J474KA01_	GRM219R71C474KA01_	GRM219R71C474KC01_	GRM21BR71E474KC01_	GRM31MR71H474KA01_
2.2uF → 1.0uF		GRM39X5R105K63A_	-->	GRM40X7R105K016A_	GRM42-6X7R105K025A_	GRM42-2X7R105K050A_
		GRM188R60J105KA01_	-->	GRM21BR71C105KA01_	GRM31MR71E105KC01_	GRM32RR71H105KA01_
4.7uF → 2.2uF		GRM40X5R225K63A_	GRM42-6X5R225K010A_	GRM42-6X7R225K016A_	GRM42-2X7R225K025A_	
		GRM21BR60J225KC01_	GRM31MR61A225KA01_	GRM31MR71C225KC11_	GRM32RR71E225KC01_	
10uF → 4.7uF		GRM40-034X5R475K63A_	GRM42-6X5R475K010A_	GRM42-6X5R475K016A_	GRM42-2X5R475K025A_	GRM44-1X7R475K050A_
		GRM21BR60J475KA11_	GRM31CR61A475KA01_	GRM31CR61C475KA45_	GRM32RR61E475KC31_	GRM55ER71H475KA01_
22uF → 10uF		GRM42-6X5R106K63A_	GRM42-2X5R106K010A_	GRM42-2X5R106K016A_	GRM43-2X5R106K025A_	
		GRM31CR60J106KC01_	GRM32ER61A106KC01_	GRM32ER61C106KC31_	GRM43DR61E106KA01_	
47uF → 22uF		GRM42-2X5R226K63A_				
		GRM32DR60J226KA01_				
100uF → 47uF				Under Development		
220uF → 100uF		GRM44-1X5R107K63A_				
		GRM55XR60J107KA01_				

→ Due to the lower Z and ESR of MLCCs, capacitance values less than half that of the TA can be used in many by-passing or decoupling applications.

### Coupling: $\leq 100\text{kHz}$

TA /AL	MLCC	6.3V	10V	16V	25V	50V
0.1uF	0.1uF	-->	GRM36X5R104K010A_	-->	GRM39X7R104K025A_	GRM40X7R104K050A_
		-->	GRP155R61A104KA01_	-->	GRM188R71E104KA01_	GRM21BR71H104KA01_
0.22uF	0.22uF	-->	GRM39X7R224K010A_	-->	GRM40X7R224K025A_	GRM40X7R224K050A_
		-->	GRM188R71A224KA01_	-->	GRM219R71E224KC01_	GRM21BR71H224KA01_
0.47uF	0.47uF	GRM39X5R474K63A_	-->	GRM40X7R474K016A_	GRM40X7R474K025A_	GRM42-6X7R474K050A_
		GRM188R60J474KA01_	-->	GRM219R71C474KC01_	GRM21BR71E474KC01_	GRM31MR71H474KA01_
1.0uF	1.0uF	GRM39X5R105K63A_	-->	GRM40X7R105K016A_	GRM42-6X7R105K025A_	GRM42-2X7R105K050A_
		GRM188R60J105KA01_	-->	GRM21BR71C105KA01_	GRM31MR71E105KC01_	GRM32RR71H105KA01_
2.2uF	2.2uF	GRM40X5R225K63A_	GRM42-6X5R225K010A_	GRM42-6X7R225K016A_	GRM42-2X7R225K025A_	
		GRM21BR60J225KC01_	GRM31MR61A225KA01_	GRM31MR71C225KC11_	GRM32RR71E225KC01_	
4.7uF	4.7uF	GRM40-034X5R475K63A_	GRM42-6X5R475K010A_	GRM42-6X5R475K016A_	GRM42-2X5R475K025A_	GRM44-1X7R475K050A_
		GRM21BR60J475KA11_	GRM31CR61A475KA01_	GRM31CR61C475KA45_	GRM32RR61E475KC31_	GRM55ER71H475KA01_
10uF	10uF	GRM42-6X5R106K63A_	GRM42-2X5R106K010A_	GRM42-2X5R106K016A_	GRM43-2X5R106K025A_	
		GRM31CR60J106KC01_	GRM32ER61A106KC01_	GRM32ER61C106KC31_	GRM43DR61E106KA01_	
22uF	22uF	GRM42-2X5R226K63A_				
		GRM32DR60J226KA01_				
47uF	47uF			Under Development		
100uF	100uF	GRM44-1X5R107K63A_				
		GRM55XR60J107KA01_				

Contact Murata Electronics for development plans of items not listed.

Legend	North America P/N	Contact Murata or an Authorized Representative for complete P/N including packaging "*" suffix.
	Global P/N <b>Effective 6/01</b>	

All part numbers shown are for commercial, non-critical applications only.

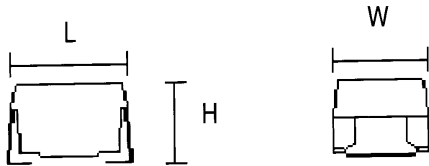


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## Case Size and Part Numbering Description

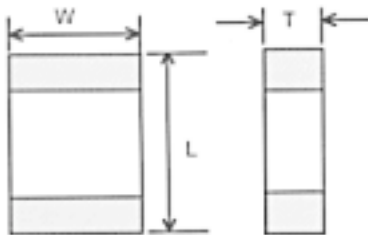
### (1) TA Chip Dimension



Case Code	Size		TA DIMENSION (mm)		
	(mm)	(in.)	L	W	H
P	2012	0805	2.0±0.2	1.25±0.2	1.2 max.
A (S*)	3216	1206	3.2±0.2	1.6±0.2	1.6±0.2
B (T*)	3528	1411	3.5±0.2	2.8±0.2	1.9±0.2
C (U*)	6032	2412	6.0±0.3	3.2±0.3	2.5±0.3
D (V*/X*)	7343	2917	7.3±0.3	4.3±0.3	2.8±0.3
E	7260	2917	7.3±0.3	6.0±0.3	3.6±0.3

(\*Low or High profile case sizes)

### (2) MLC Chip Dimension



Murata Type	Size		MLCC DIMENSION (mm)		
	(mm)	(in.)	L	W	H
GRM36	1005	0402	1.0±0.05	0.5±0.05	0.5±0.05
GRM39	1608	0603	1.6±0.1	0.8±0.1	0.8±0.1
GRM40	2012	0805	2.0±0.15	1.25±0.15	1.4 max.
GRM42-6	3216	1206	3.2±0.2	1.6±0.2	1.8 max.
GRM42-2	3225	1210	3.2±0.3	2.5±0.2	2.7 max.
GRM43-2	4532	1812	4.5±0.4	3.2±0.3	2.7 max.
GRM44-1	5750	2220	5.7±0.43	5.0±0.4	3.4 max.

### North America -vs- Global Part Numbering Comparison

Packaging										
Marking Digit (A = no marking)										
Rated Voltage										
Capacitance Tolerance										
Capacitance										
Temperature Characteristic										
Case Size										
Product Series ID										
<b>North America PIN</b> →	<b>GRM</b>	<b>40</b>	<b>X7R</b>	<b>105</b>	<b>K</b>	<b>016</b>	<b>A</b>	<b>L</b>		
<b>Global PIN (Effective 6/01)</b> →	<b>GR</b>	<b>M</b>	<b>21</b>	<b>B</b>	<b>R7</b>	<b>1C</b>	<b>105</b>	<b>K</b>	<b>A01</b>	<b>L</b>
Product ID										
Series/Terminal										
Dimension (L x W)										
Dimension (T)										
Temperature Characteristic										
Rated Voltage										
Capacitance										
Capacitance Tolerance										
Individual Specification										
Packaging										

**The above example is for explanatory purposes only. Please consult Murata's catalog or Authorized Sales Representative to determine Murata part numbers.**



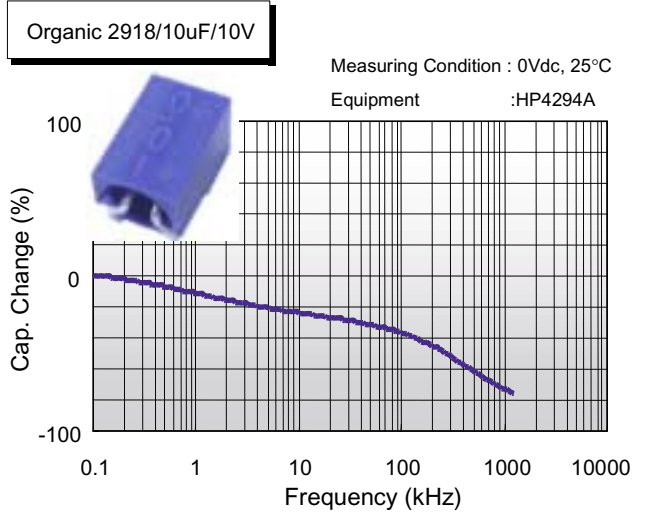
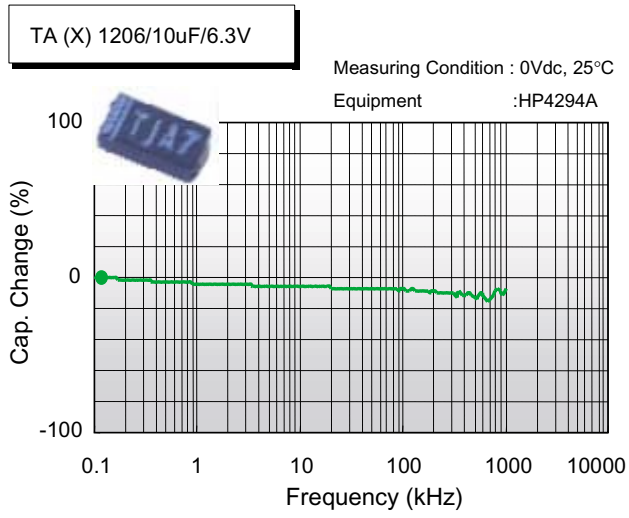
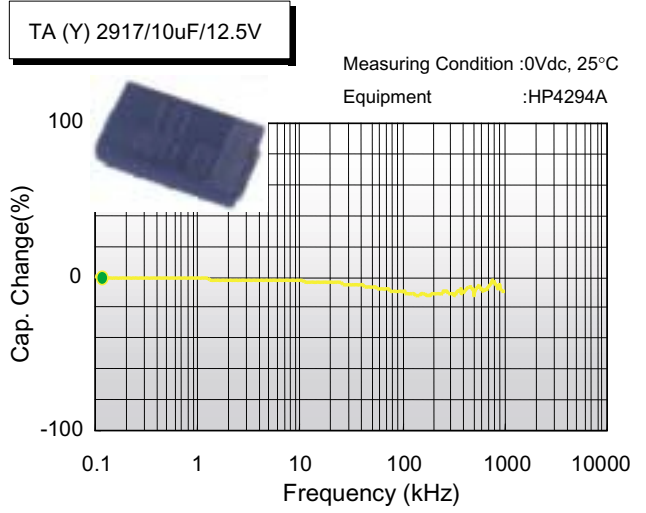
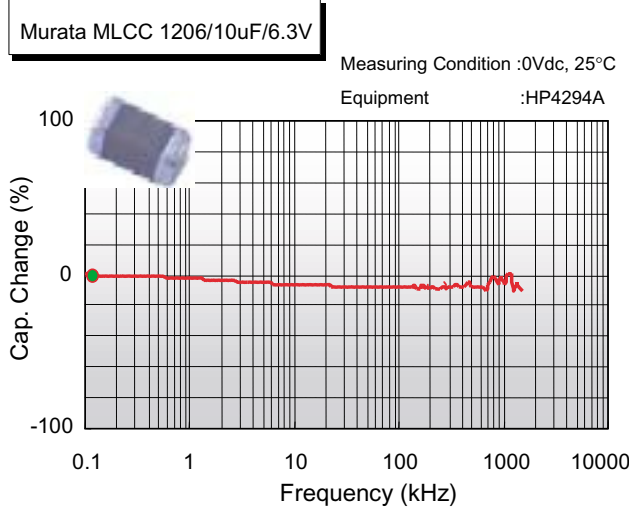


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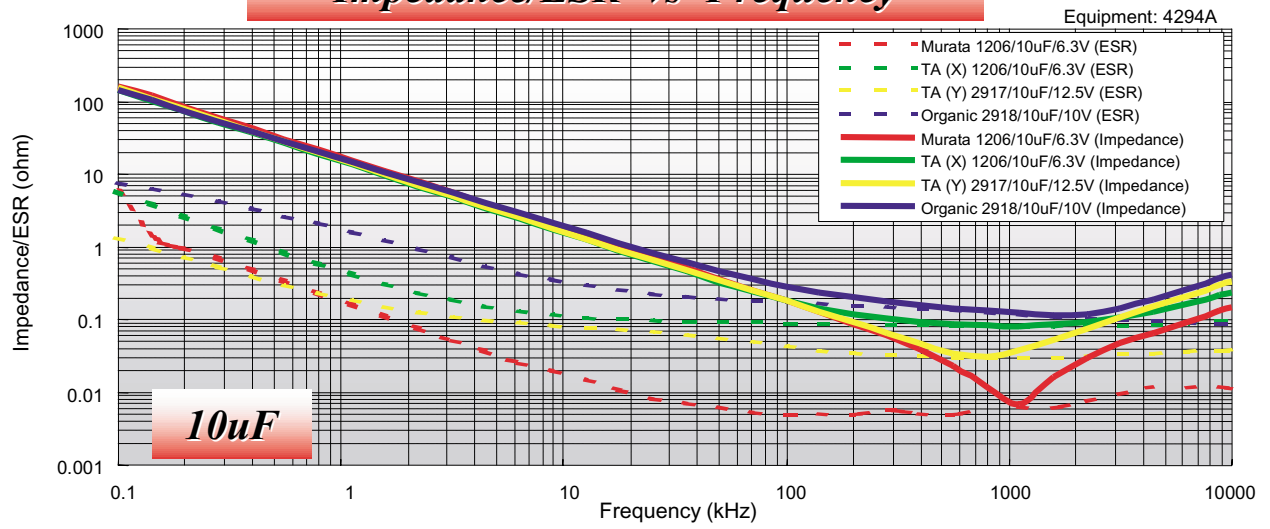
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# Capacitance -vs- Frequency

## 10uF

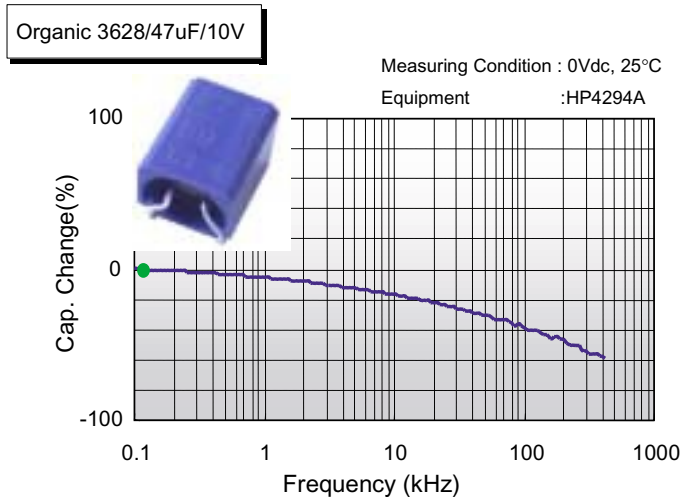
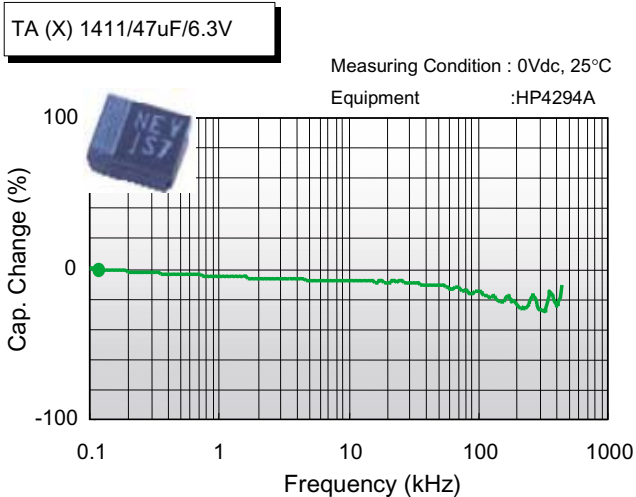
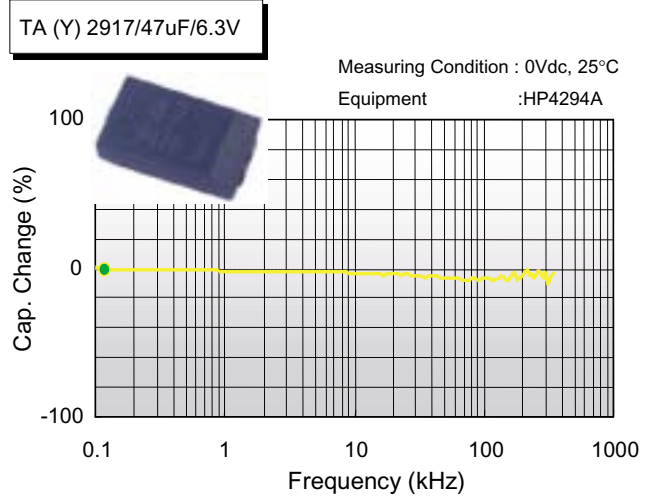
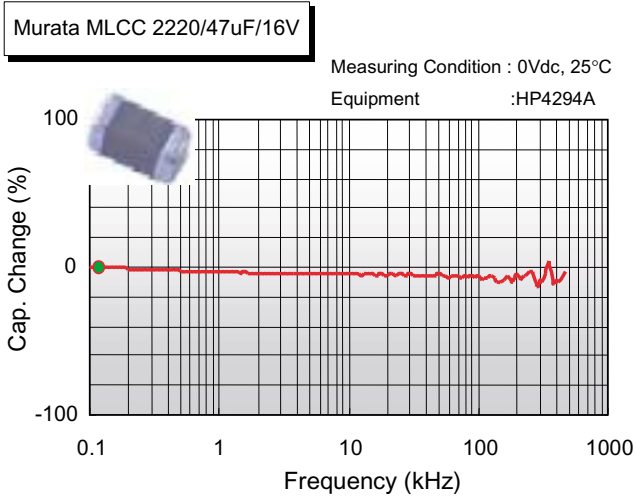


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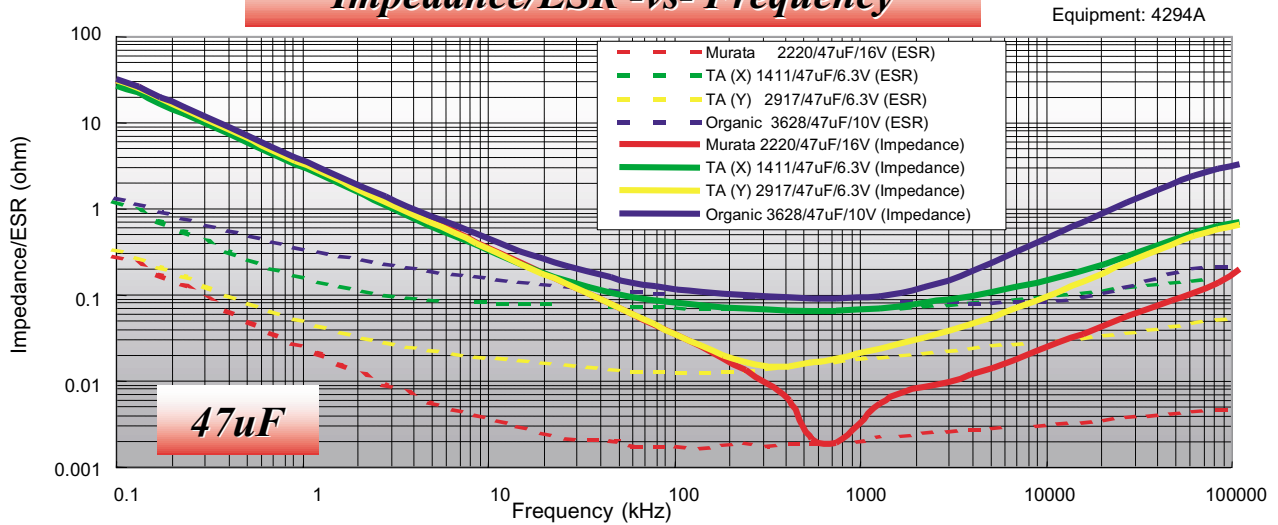


# Capacitance -vs- Frequency

## 47uF



# Impedance/ESR -vs- Frequency



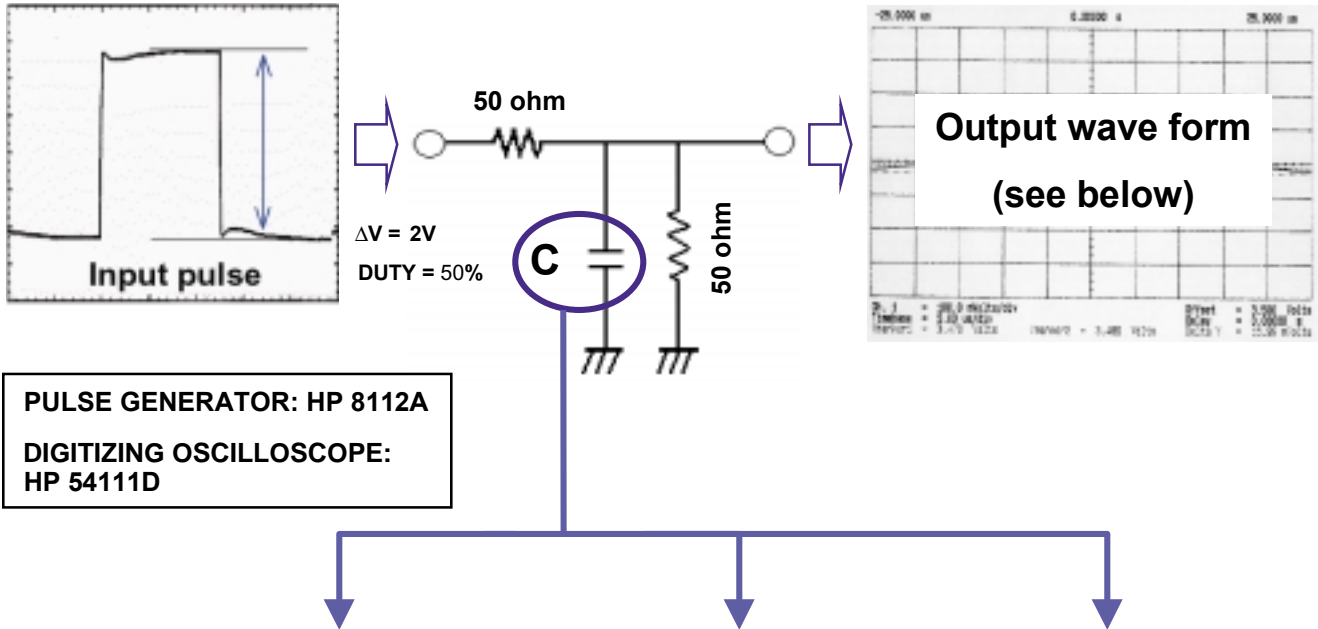





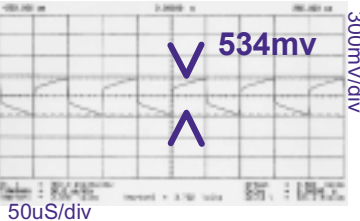
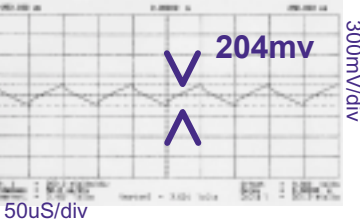
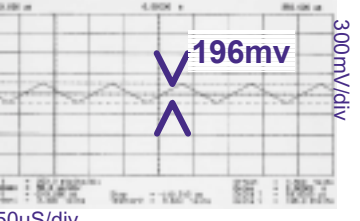
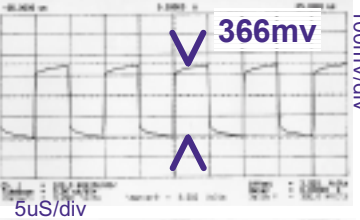
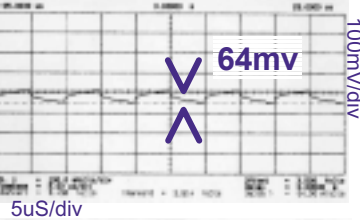
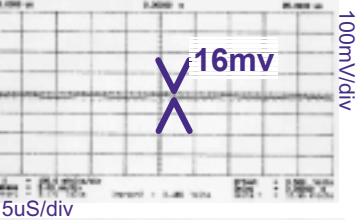
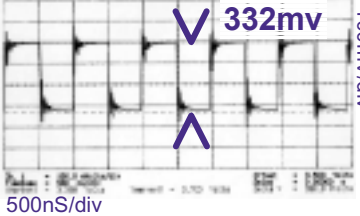
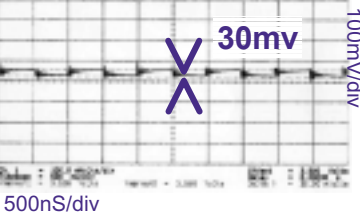
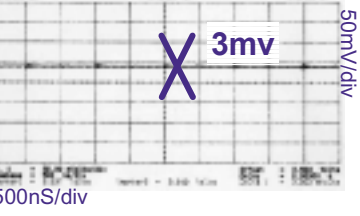
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# Noise Absorption Comparison 10uF (10kHz to 1MHz)

## <Measurement Method>

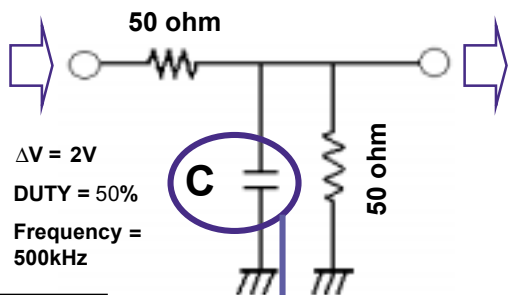
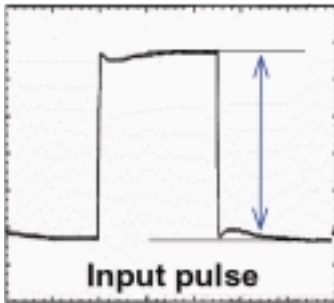


Capacitor frequency	10uF AL 	10uF TA 	10uF MLCC 
10KHz Output wave	 534mv 300mV/div 50uS/div	 204mv 300mV/div 50uS/div	 196mv 300mV/div 50uS/div
100KHz Output wave	 366mv 100mV/div 5uS/div	 64mv 100mV/div 5uS/div	 16mv 100mV/div 5uS/div
1MHz Output wave	 332mv 100mV/div 500nS/div	 30mv 100mV/div 500nS/div	 3mv 50mV/div 500nS/div

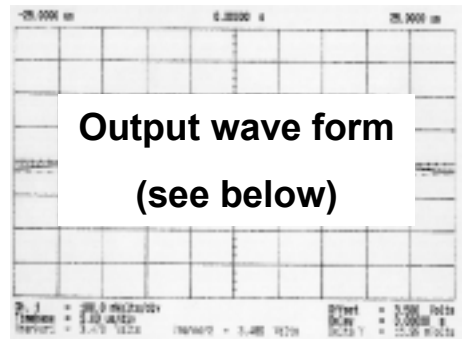


**Noise Absorption Comparison**  
**10uF (Low-pass filter characteristic)**

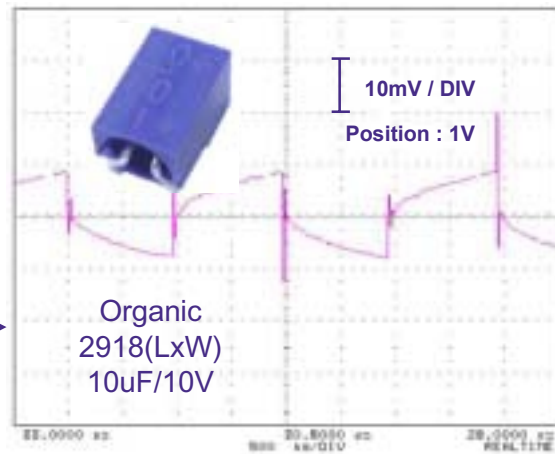
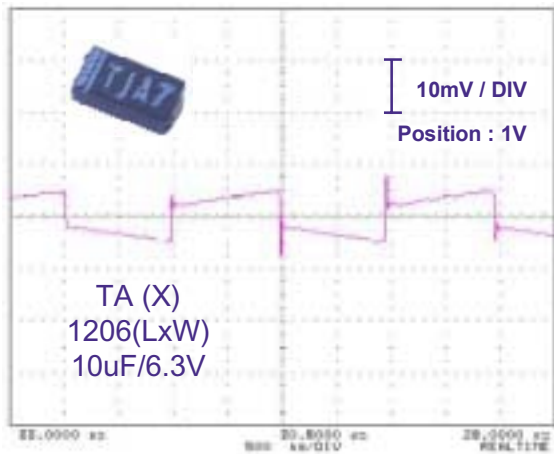
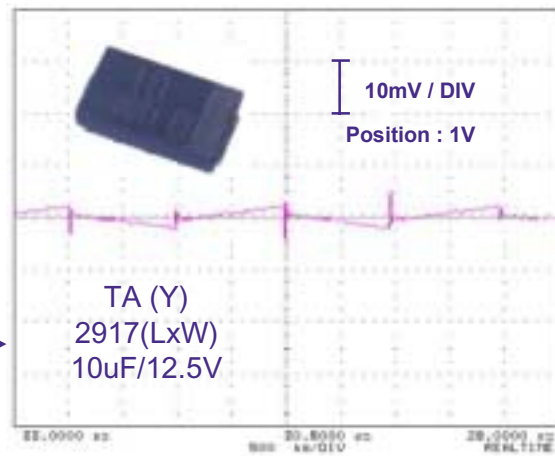
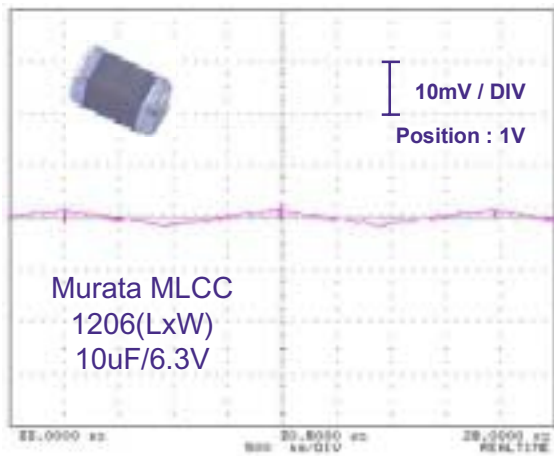
**<Measurement Method>**



$\Delta V = 2V$   
DUTY = 50%  
Frequency = 500kHz

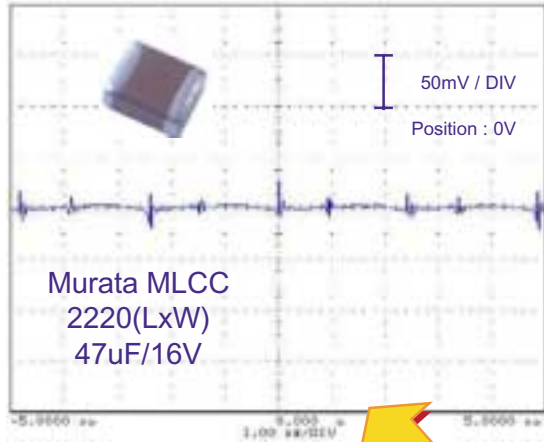


**PULSE GENERATOR: HP 8112A**  
**DIGITIZING OSCILLOSCOPE: HP 54111D**

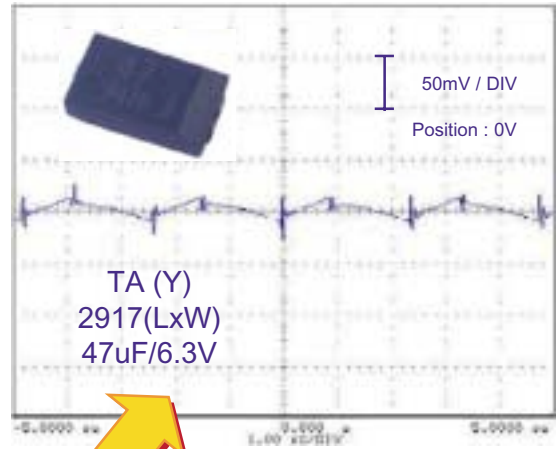


**Noise Absorption / Smoothing  
Comparison  
47uF**

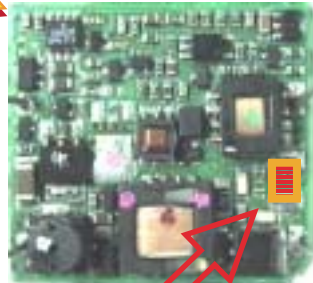
**Output wave form**



**Output wave form**



**Non-resonance type  
forward method DC-DC  
converter**



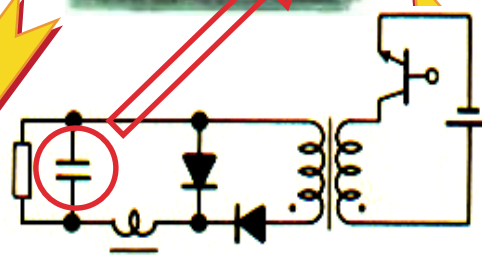
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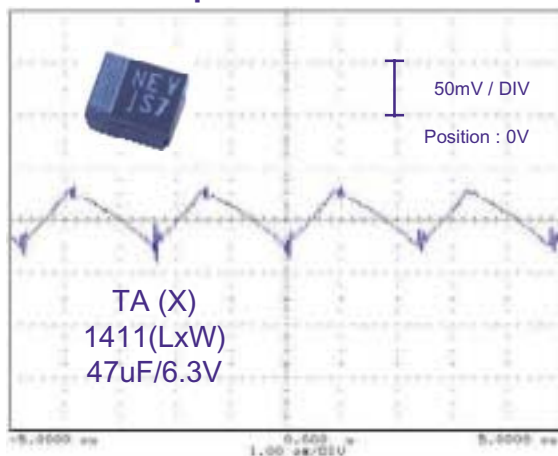
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Output : 5V x 4A (20W)

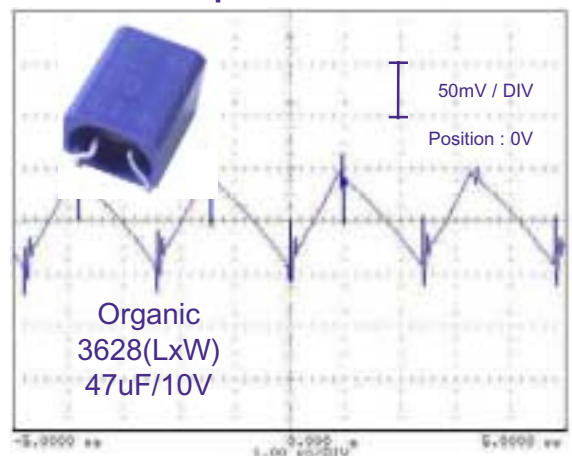
Switching freq.: 400kHz



**Output wave form**

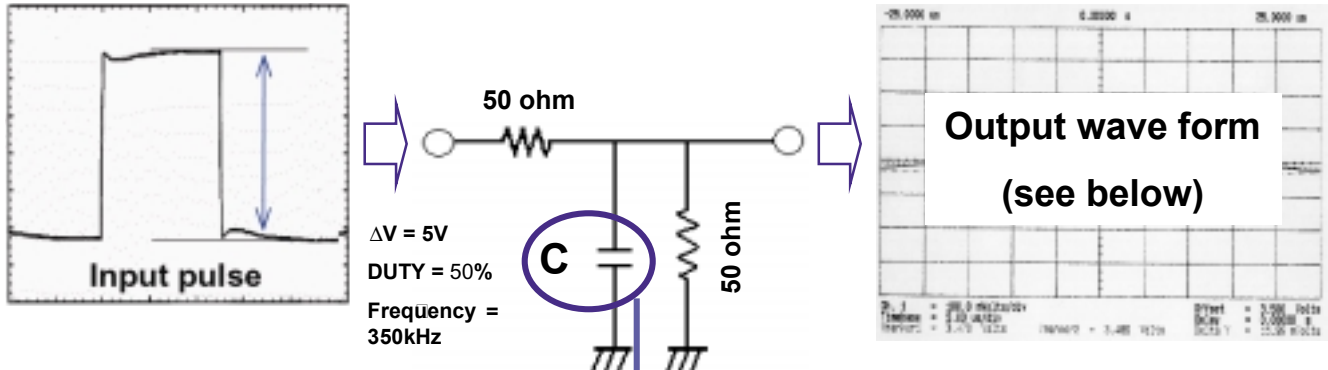


**Output wave form**

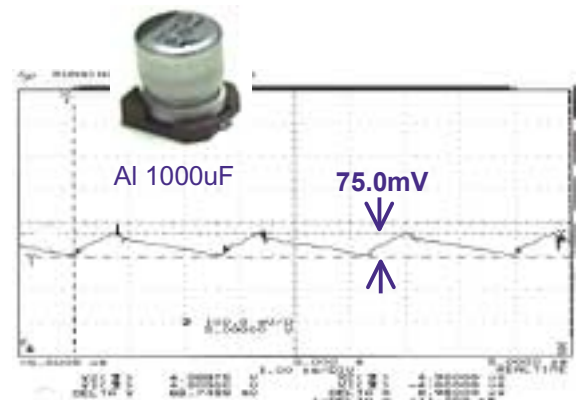
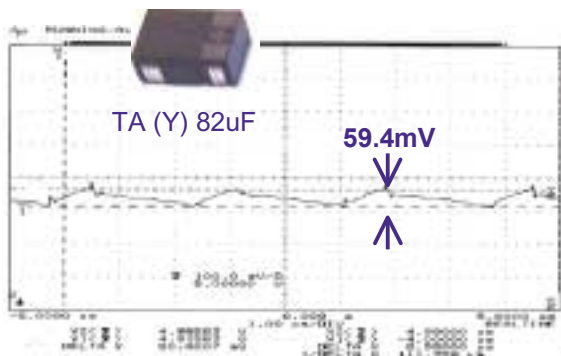
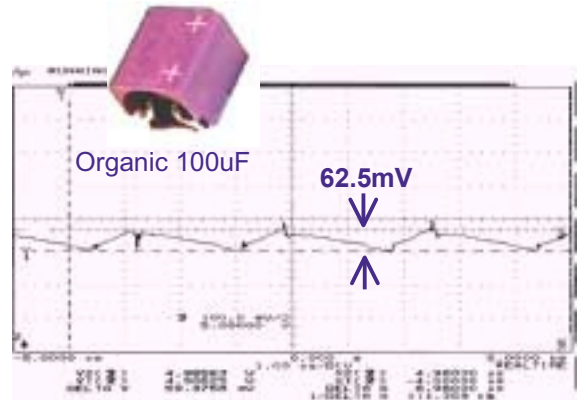
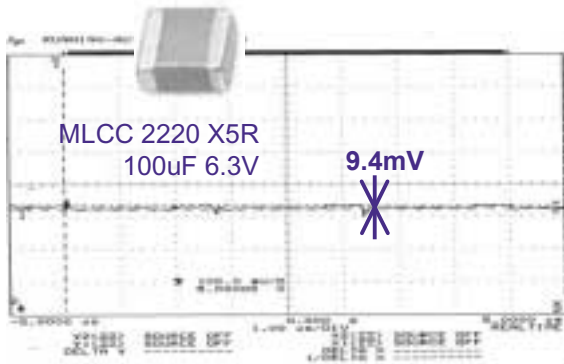


# Noise Absorption Comparison 100uF (Low-pass filter characteristic)

## <Measurement Method>



PULSE GENERATOR: HP 8112A  
DIGITIZING OSCILLOSCOPE:  
HP 54111D



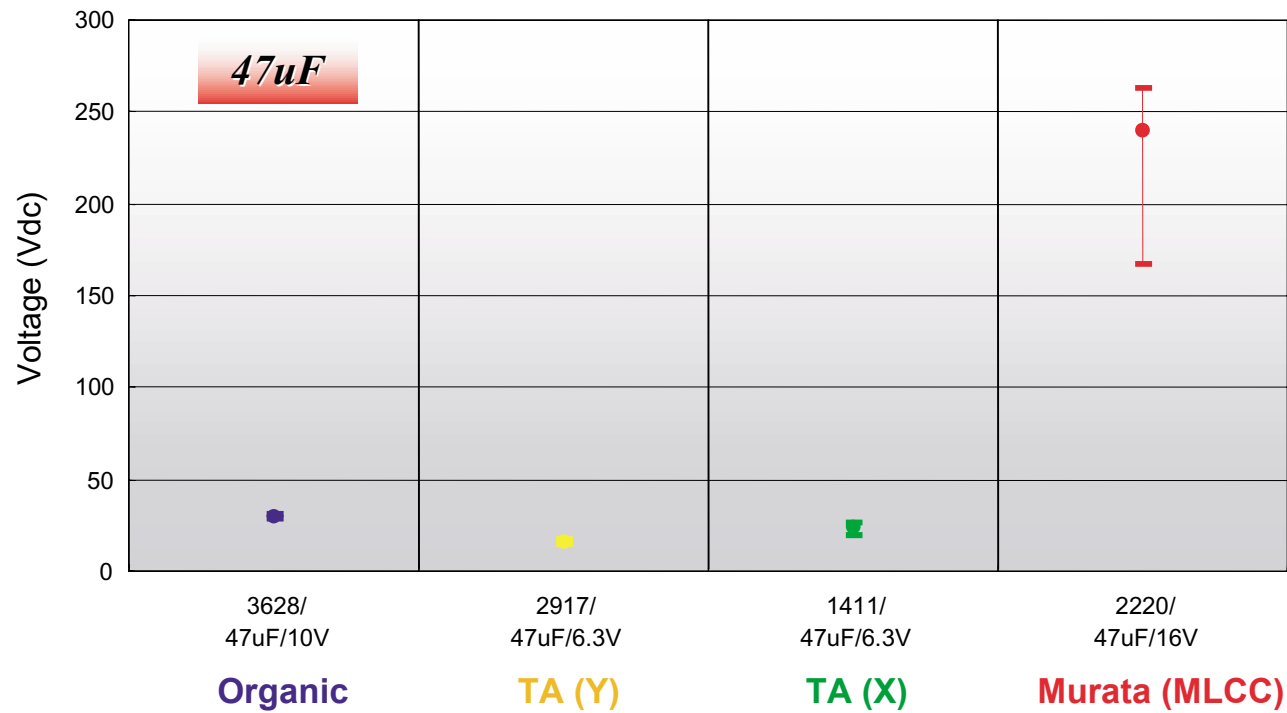
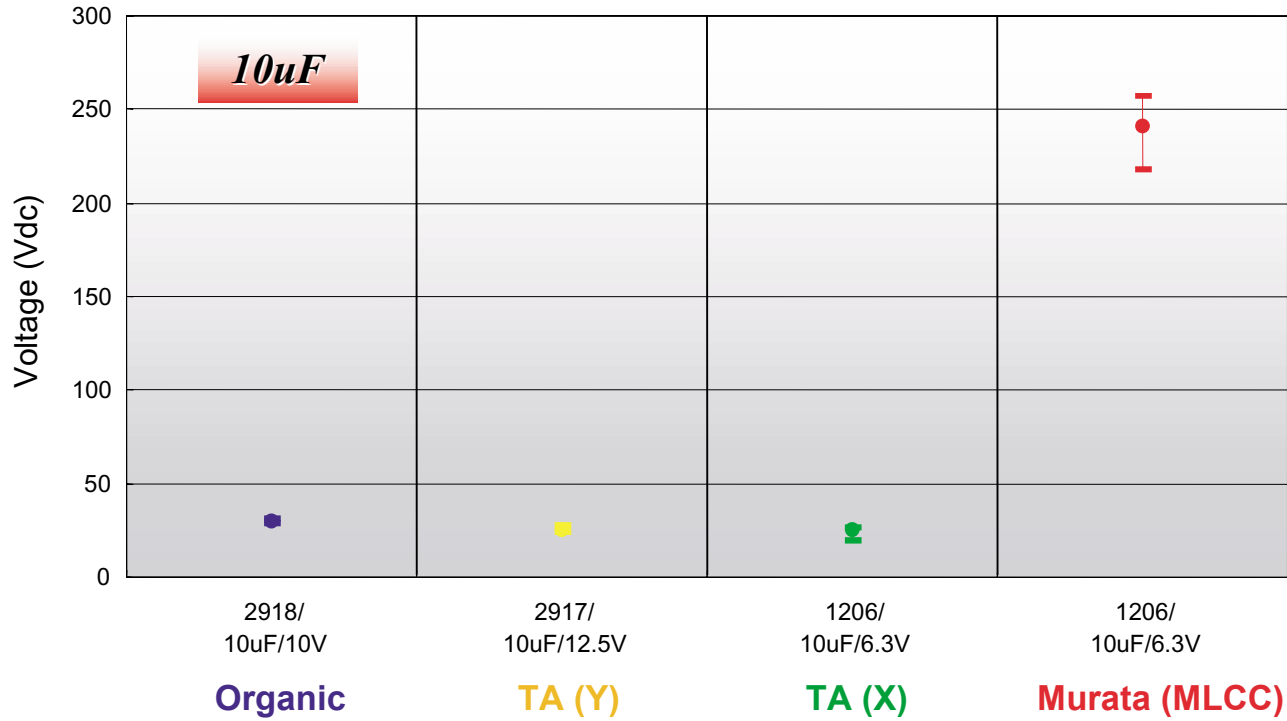


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# Break Down Voltage

Murata Electronics  
North America, Inc.

Equipment : GP0160-1



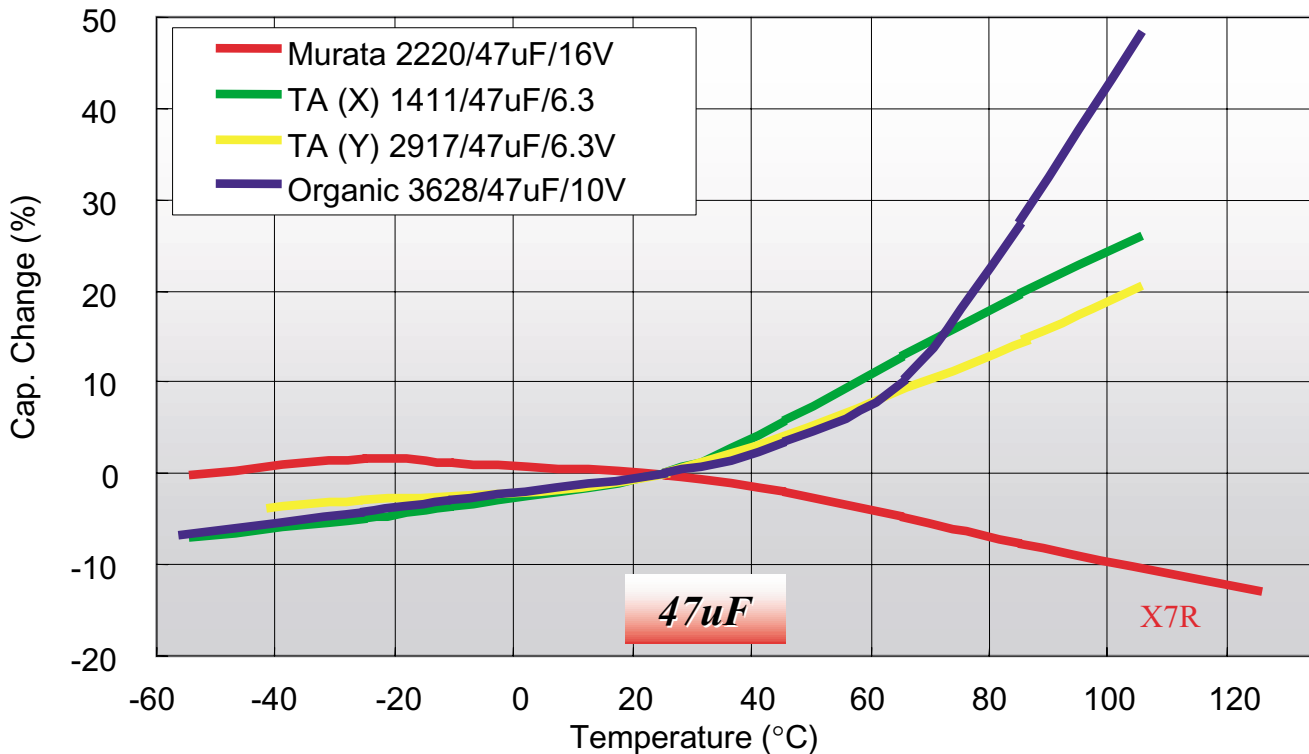
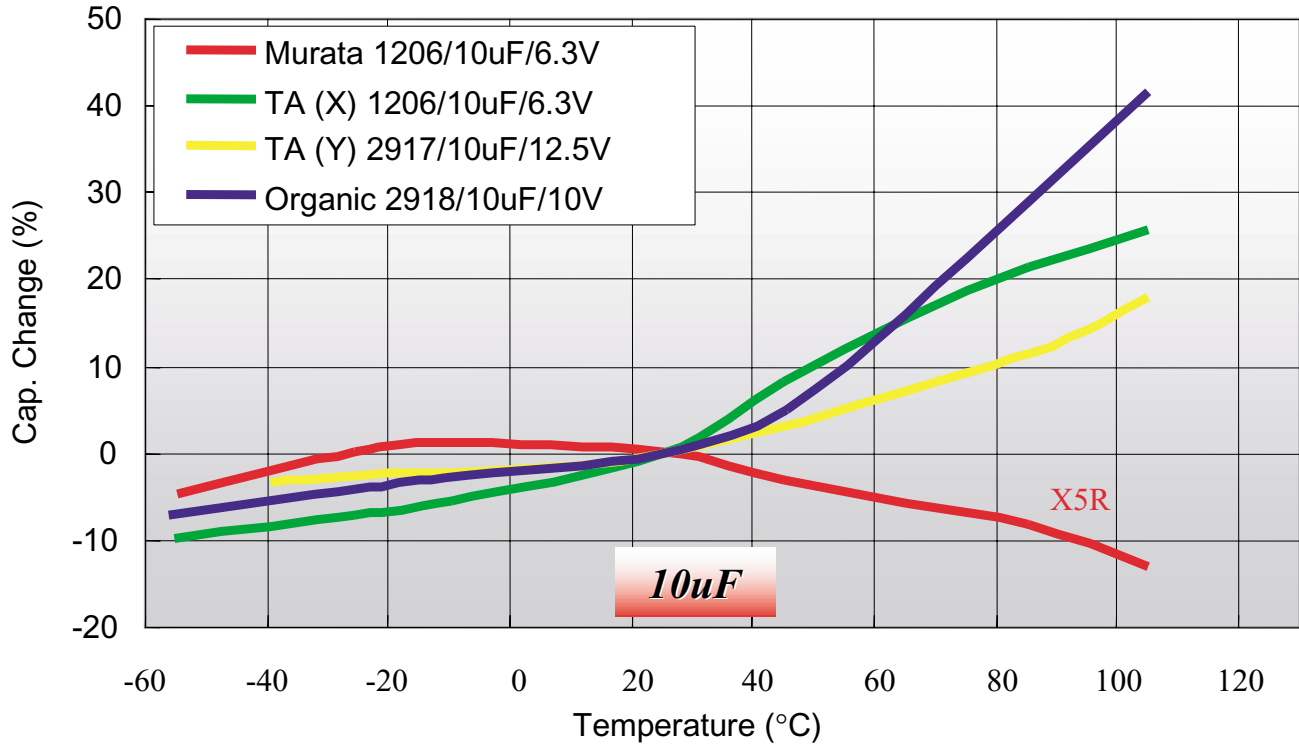


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North America, Inc.

## Capacitance -vs- Temperature

Measuring Condition: 120Hz, 0.5Vrms  
Equipment: 4284A







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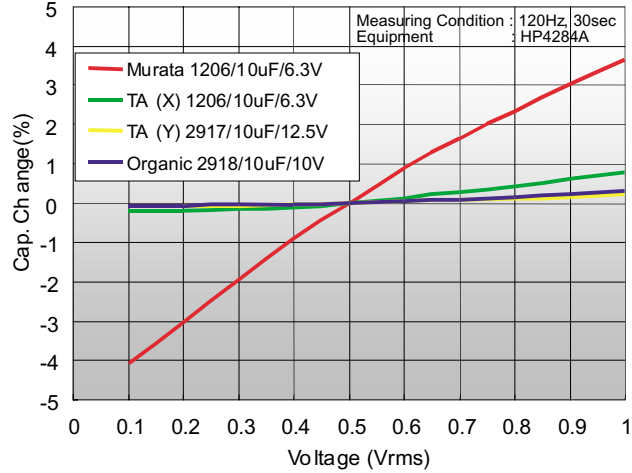
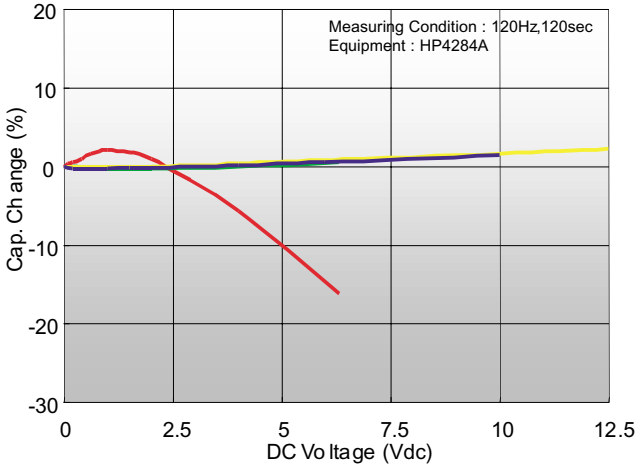
# Voltage Characteristics

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North America, Inc.

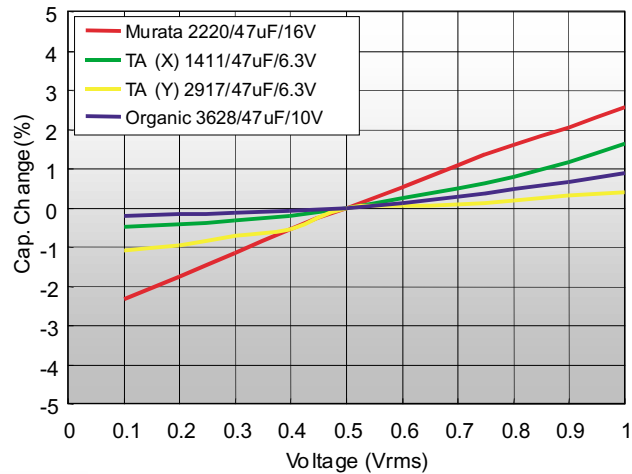
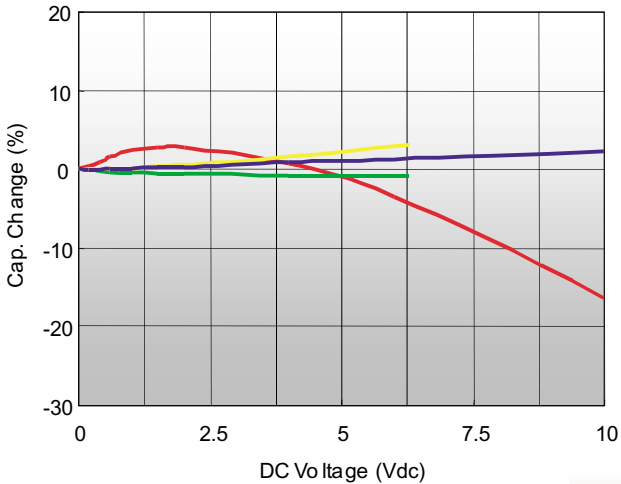
## DCV

## 10uF

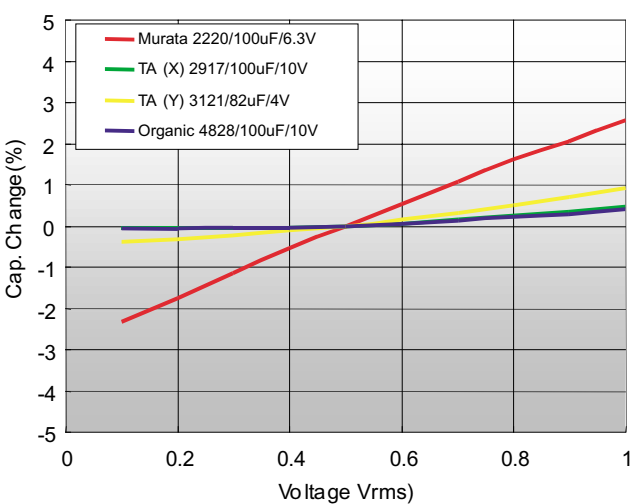
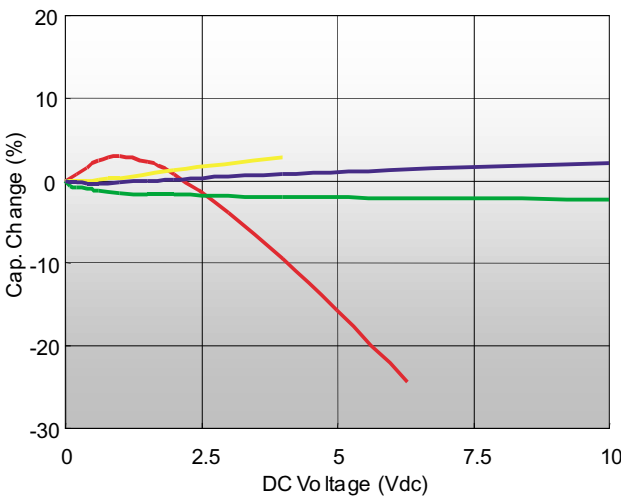
## ACVrms



## 47uF



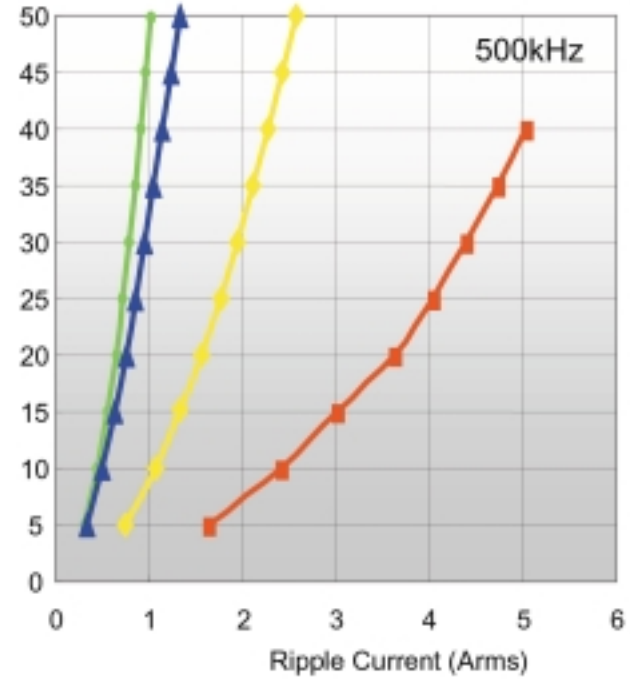
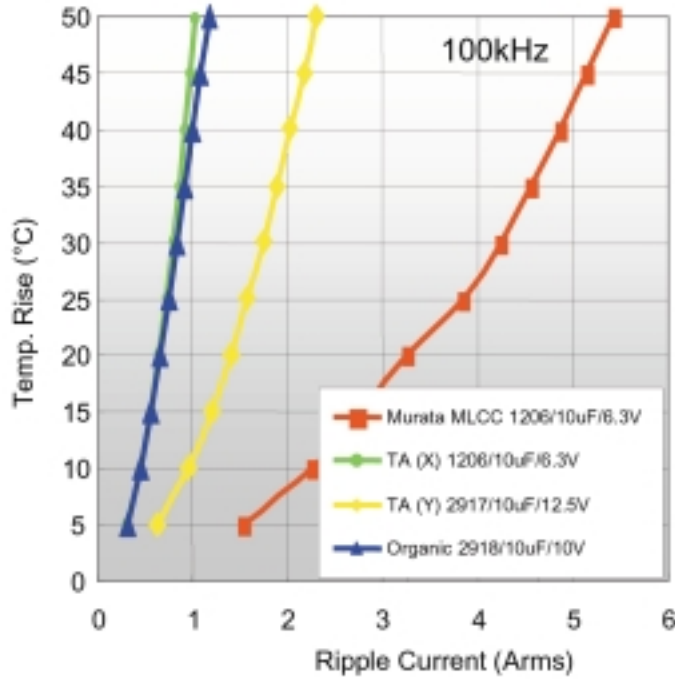
## 100uF



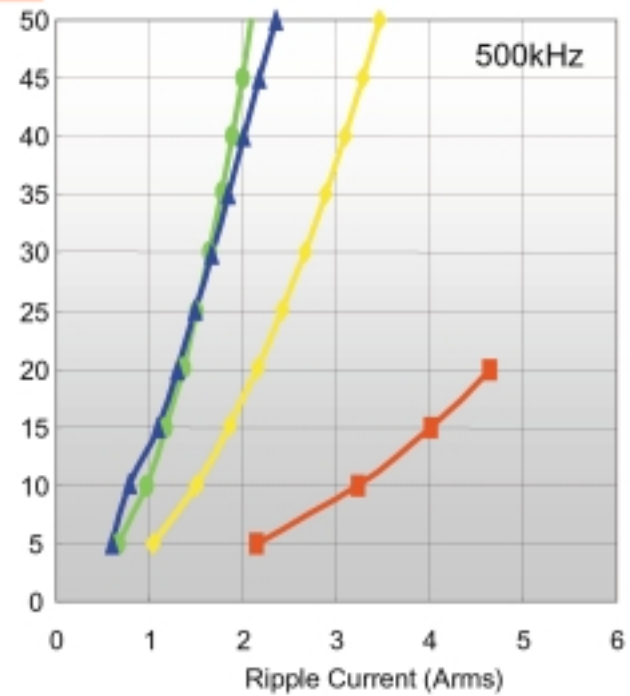
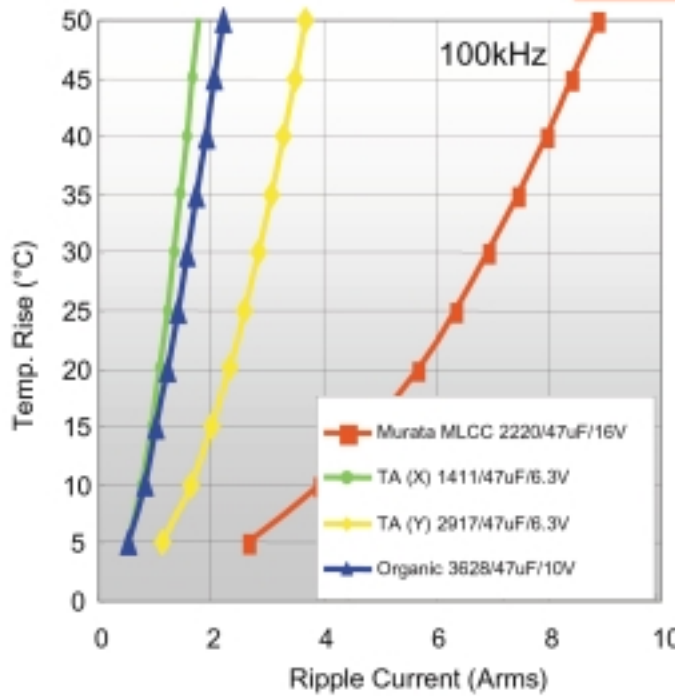
# Self Heating -vs- Ripple Current

## 10uF

Equipment : CVHF - 400



## 47uF





**Murata Electronics  
North America, Inc.**

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