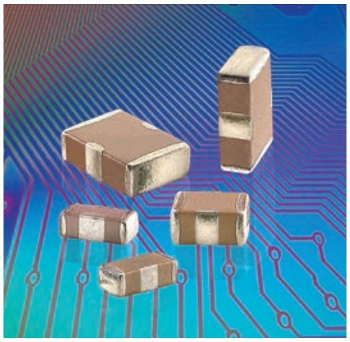
EMI® FILTER & DECOUPLING CAPACITORS

RoHS



EMI® filter capacitors employ a unique, patented low inductance design featuring two balanced capacitors that are immune to temperature, voltage and aging performance differences.
These components offer superior decoupling and EMI filtering performance, virtually eliminate parasitics, and can replace multiple capacitors and inductors saving board space and reducing assembly costs.

ADVANTAGES

- One device for EMI suppression or decoupling
- Replace up to 7 components with one EMI
- Differential and common mode attenuation
- Matched capacitance line to ground, both lines
- Low inductance due to cancellation effect

APPLICATIONS

- Amplifier Filter & Decoupling
- High Speed Data Filtering
- EMC I/O Filtering
- FPGA / ASIC / µ-P Decoupling
- DDR Memory Decoupling

Automotive version (AEC-Q200) available for many values: please see details in the below table of capacitance values. Please contact us if another value is needed for automotive application

EMI Filtering (1 Y-Cap.)		<10pF	10pF	22pF	27pF	33pF	47pF	100pF	220pF	470pF	1000pF	1500pF	2200pF	4700pF	.010µF	.015µF	.022µF	.039µF	.047µF	0.10µF	0.18µF	0.22µF	0.33µF	0.40µF	0.47µF	1.0µF
Power Bypass (2 Y-Caps.)		<20pF	20pF	44pF	54pF	66pF	94pF	200pF	440pF	940pF	2000pF	3000pF	4400pF	9400pF	.020µF	.030µF	.044µF	.078µF	.094µF	0.20µF	0.36µF	0.44µF	0.66µF	0.80µF	0.94µF	2.0µF
SIZE	CAP. CODE	XRX	100	220	270	330	470	101	221	471	102	152	222	472	103	153	223	393	473	104	184	224	334	404	474	105
0402 (X07)	NP0	50	50	50	50	50	50	50																		
	X7R								50	50	50	50	50	50	16											
0603 (X14)	NP0	100	**100**	100	100	100	100	50	50																	
	X7R						**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**50**	**25**	**25**		**16**	**10**		**10**				
0805 (X15)	NP0		100	100	100	100	100	100	100	50																
	X7R							**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**50**	**50**		**50**	**25**						
1206 (X18)	NP0										100															
	X7R														**100**	**100**	**100**		**100**	**100***		16	16		10	
1210 (X41)	X7R														500					100		100	100		25	16
1410 (X44)	X7R															500								100		
1812 (X43)	X7R																	500							**100**	

VOLTAGE RATINGS
6.3 = 6.3 VDC
10 = 10 VDC
16 = 16 VDC
25 = 25 VDC
50 = 50 VDC
100 = 100 VDC
500 = 500 VDC

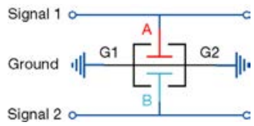
☐ Automotive version currently available for those values only
* Also proposed with a 50V rating (500X18W104MV4E) instead of 100V
Contact factory for part combinations not shown.
Filtering capacitance is specified as Line-to-Ground (Terminal A or B to G)
Power Bypass capacitance is specified Power-to-Ground (A + B to G)
Rated voltage is from line to ground in Circuit 1, power to ground in Circuit 2 .

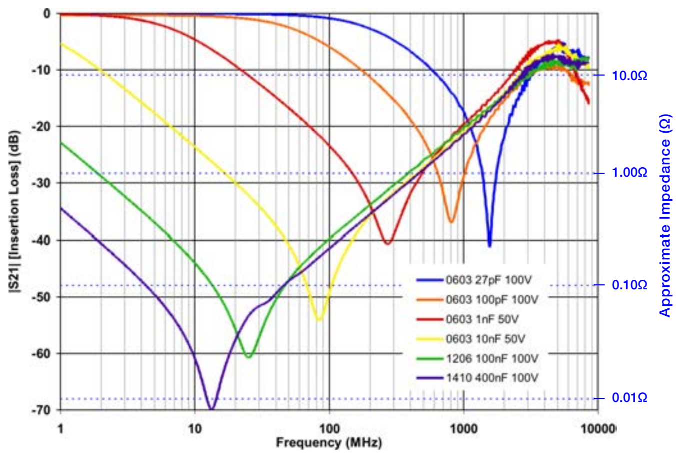
HOW TO ORDER EMI® CAPACITORS

P/N written: 101X14W102MV4T

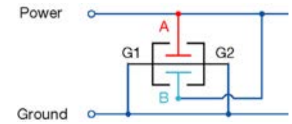
100	X14	W	102	M	V	4	T	+AQ
VOLTAGE	SIZE	DIELECTRIC	CAPACITANCE	TOLERANCE	TERMINATION	MARKING	PACKING	QUALIFICATION
6R3 = 6.3 V 100 = 10 V 160 = 16 V 250 = 25 V 500 = 50 V 101 = 100 V 501 = 500 V	X07 = 0402 X14 = 0603 X15 = 0805 X18 = 1206 X41 = 1210 X44 = 1410 X43 = 1812	N = NP0 W = X7R	1st two digits are significant; third digit denotes number of zeros, R = decimal. 102 = 1000 pF 104 = 0.10 µF 5R6 = 5.6pF	M = ± 20% * D = ± 0.50 pF *Values < 10 pF only	V = NI Barrier with 100% Tin Plating (Matte) F = Polyterm flexible termination T = SnPb	4 = Unmarked (Not available)	E = Embossed 7" T = Punched 7" No code = bulk Tape specs. per EIA RS481	AEC-Q200 Qualification * (optional)

EMI Filtering Scc21

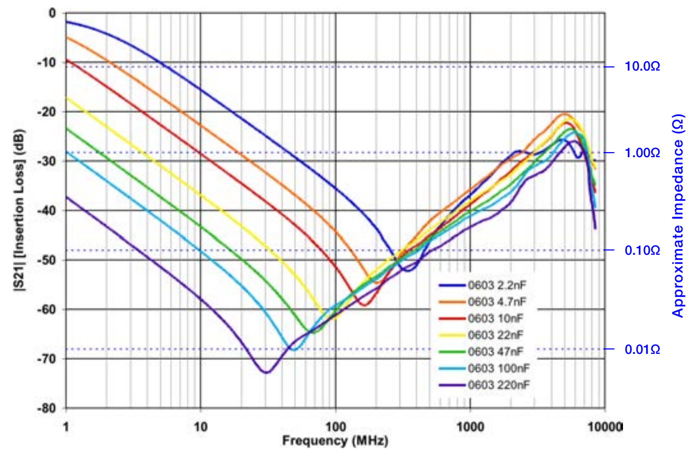




Power Bypass S21



Labeled capacitance values below follow the P/N order code (single Y cap value)
Effective capacitance measured in Circuit 2 is 2X of the labled single Y cap value.

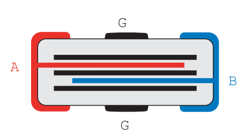


More data at https://s21plotter.johansondielectrics.com/

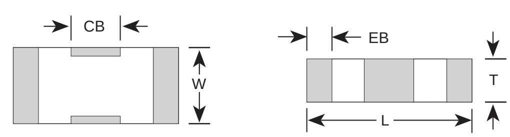
Electrical Characteristics

	NP0	X7R
TEMPERATURE COEFFICIENT:	0±30ppm/°C (-55 to +125°C)	±15% (-55 to +125°C)
DIELECTRIC STRENGTH:	Vrated ≤100VDC: DWV = 2.5 X WVDC, 25°C, 50mA max. Vrated = 500VDC: DWV = 1.5 X WVDC, 25°C, 50mA max.	
DISSIPATION FACTOR:	0.1% max.	WVDC ≥ 50 VDC: 2.5% max. WVDC = 25 VDC: 3.5% max. WVDC = 10-16 VDC: 5.0% max. WVDC = 6.3 VDC: 10% max.
INSULATION RESISTANCE (MIN. @ 25°C, WVDC)	C≤ 0.047µF: 1000 ΩF or 100 GΩ, whichever is less C> 0.047µF: 500 ΩF or 10 GΩ, whichever is less	
TEST CONDITIONS:	C > 100 pF; 1kHz ±50Hz; 1.0±0.2 VRMS C ≤ 100 pF; 1Mhz ±50kHz; 1.0±0.2 VRMS	1.0kHz±50Hz @ 1.0±0.2 Vrms
OTHER:	See page 81 for additional dielectric specifications.	

Cross-sectional View



Dimensional View



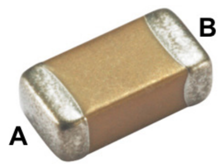
Case Size

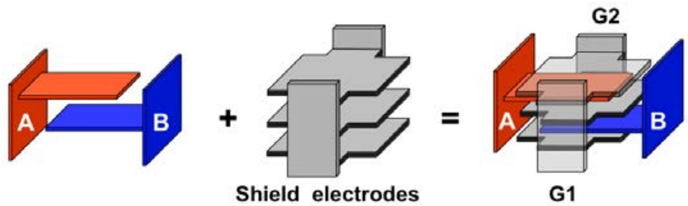
	0402 (X07)		0603 (X14)		0805 (X15)		1206 (X18)		1210 (X41)		1410 (X44)		1812 (X43)	
	IN	MM	IN	MM	IN	MM	IN	MM	IN	MM	IN	MM	IN	MM
L	0.045 ± 0.003	1.143 ± 0.076	0.064 ± 0.005	1.626 ± 0.127	0.080 ± 0.008	2.032 ± 0.203	0.124 ± 0.010	3.150 ± 0.254	0.125 ± 0.010	3.175 ± 0.254	0.140 ± 0.010	3.556 ± 0.254	0.174 ± 0.010	4.420 ± 0.254
W	0.025 ± 0.003	0.635 ± 0.076	0.035 ± 0.005	0.889 ± 0.127	0.050 ± 0.008	1.270 ± 0.203	0.063 ± 0.010	1.600 ± 0.254	0.098 ± 0.010	2.489 ± 0.254	0.098 ± 0.010	2.490 ± 0.254	0.125 ± 0.010	3.175 ± 0.254
T	0.020 max	0.508 max	0.026 max	0.660 max	0.040 max	1.016 max	0.050 max	1.270 max	0.070 max	1.778 max	0.070 max	1.778 max	0.090 max	2.286 max
EB	0.008 ± 0.003	0.203 ± 0.076	0.010 ± 0.006	0.254 ± 0.152	0.012 ± 0.008	0.305 ± 0.203	0.016 ± 0.010	0.406 ± 0.254	0.018 ± 0.010	0.457 ± 0.254	0.018 ± 0.010	0.457 ± 0.254	0.022 ± 0.012	0.559 ± 0.305
CB	0.012 ± 0.003	0.305 ± 0.076	0.018 ± 0.004	0.457 ± 0.102	0.022 ± 0.005	0.559 ± 0.127	0.040 ± 0.005	1.016 ± 0.127	0.045 ± 0.005	1.143 ± 0.127	0.045 ± 0.005	1.143 ± 0.127	0.045 ± 0.005	1.143 ± 0.127

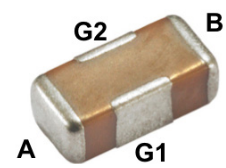
EMI Filter & Decoupling Capacitors

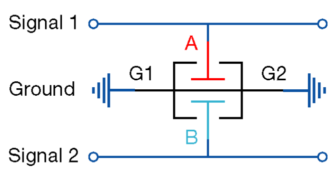
The EMI Design - A Balanced, Low ESL, “Capacitor Circuit”

The EMI capacitor design starts with standard 2 terminal MLC capacitor’s opposing electrode sets, A & B, and adds a third electrode set (G) which surround each A & B electrode. The result is a highly vesatile three node capacitive circuit containing two tightly matched, low inductance capacitors in a compact, four-terminal SMT chip.



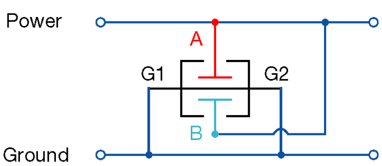






EMI Filtering:

The EMI component contains two shunt or “line-to-ground” Y capacitors. Ultra-low ESL (equivalent series inductance) and tightly matched inductance of these capacitors provides unequaled high frequency Common-Mode noise filtering with low noise mode conversion. EMI components reduce EMI emissions far better than unbalanced discrete shunt capacitors or series inductive filters. Differential signal loss is determined by the cut off frequency of the single line-to-ground (Y) capacitor value of an EMI.



Power Bypass / Decoupling

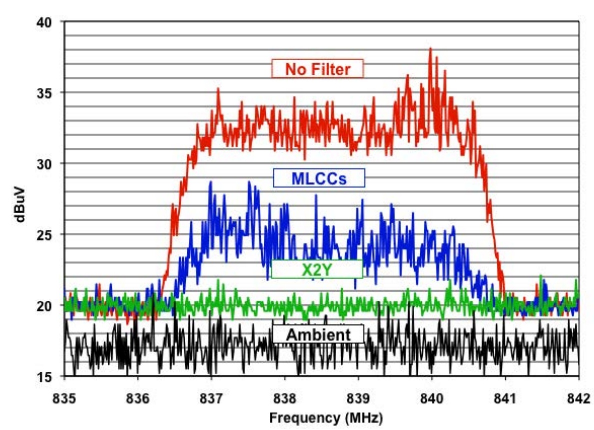
For Power Bypass applications, EMI’s two “Y” capacitors are connected in parallel. This doubles the total capacitance and reduces their mounted inductance by 80% or 1/5th the mounted inductance of similar sized MLC capacitors enabling high-performance bypass networks with far fewer components and vias. Low ESL delivers improved High Frequency performance into the GHz range.

GSM RFI Attenuation in Audio & Analog

GSM handsets transmit in the 850 and 1850 MHz bands using a TDMA pulse rate of 217Hz. These signals cause the GSM buzz heard in a wide range of audio products from headphones to concert hall PA systems or “silent” signal errors created in medical, industrial process control, and security applications. Testing was conducted where an 840MHz GSM handset signal was delivered to the inputs of three different amplifier test circuit configurations shown below whose outputs were measured on a HF spectrum analyzer.

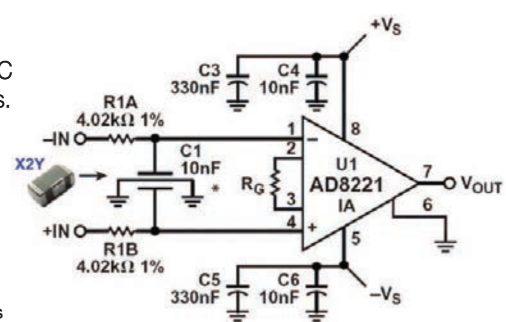
1) No input filter, 2 discrete MLC 100nF power bypass caps.
2) 2 discrete MLC 1nF input filter, 2 discrete MLC 100nF power bypass caps.
3) A single EMI 1nF input filter, a single EMI 100nF power bypass cap.

EMI configuration provided a nearly flat response above the ambient and up to 10 dB imrpoved rejection than the conventional MLCC configuration.



Amplifier Input Filter Example

In this example, a single Johanson EMI component was used to filter noise at the input of a DC instrumentation amplifier. This reduced component count by 3-to-1 and costs by over 70% vs. conventional filter components that included 1% film Y-capacitors.



Parameter	EMI 10nF	Discrete 10nF, 2 @ 220 pF	Comments
DC offset shift	< 0.1 μV	< 0.1 μV	Referred to input
Common mode rejection	91 dB	92 dB	

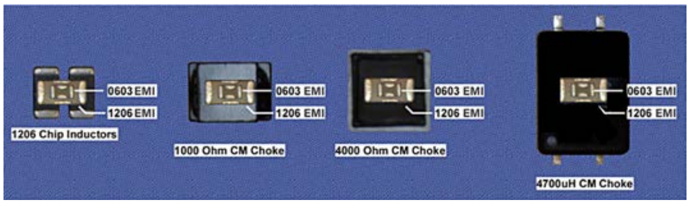
Source: Analog Devices, “A Designer’s Guide to Instrumentation Amplifiers (2nd Edition)” by Charles Kitchin and Lew Counts

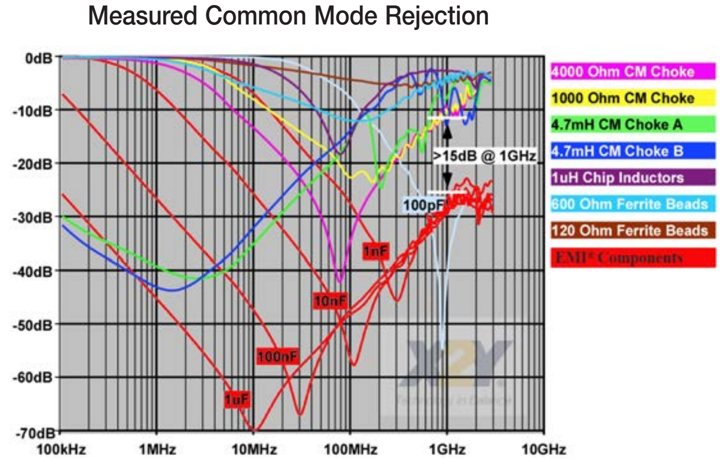
EMI® Filter & Decoupling Capacitors

Common Mode Choke Replacement

- Superior High Frequency Emissions Reduction
- Smaller Sizes, Lighter Weight
- No Current Limitation
- Vibration Resistant
- No Saturation Concerns

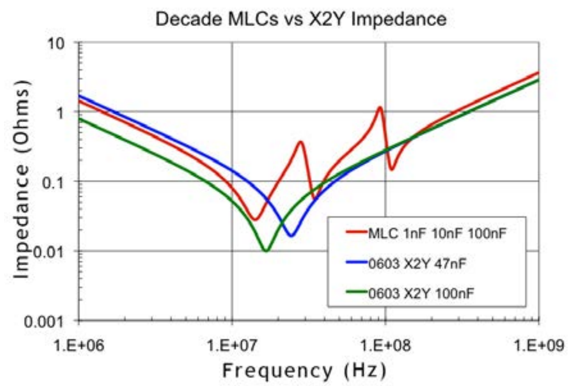
See our website for a detailed application note with component test comparisons and circuit emissions measurements.





Parallel Capacitor Solution

A common design practice is to parallel decade capacitance values to extend the high frequency performance of the filter network. This causes an unintended and often over-looked effect of anti-resonant peaks in the filter networks combined impedance. EMI's very low mounted inductance allows designers to use a single, higher value part and completely avoid the anti-resonance problem. The impedance graph on right shows the combined mounted impedance of a 1nF, 10nF & 100nF 0402 MLC in parrallel in RED. The MLC networks anti-resonance peaks are nearly 10 times the desired impedance. A 100nF and 47nF EMI are plotted in BLUE and GREEN. (The total capacitance of EMI (Circuit 2) is twice the value, or 200nF and 98nF in this example.) The sigle EMI is clearly superior to the three paralleled MLCs.



EMI High Performance Power Bypass - Improve Performance, Reduce Space & Vias

Actual measured performance of two high performance SerDes FPGA designs demonstrate how a 13 component EMI bypass network significantly out performs a 38 component MLC network.