

X2Y[®] Component Connection and PCB Layout Guidelines

Best practices for EMI filtering and IC bypass/
decoupling applications

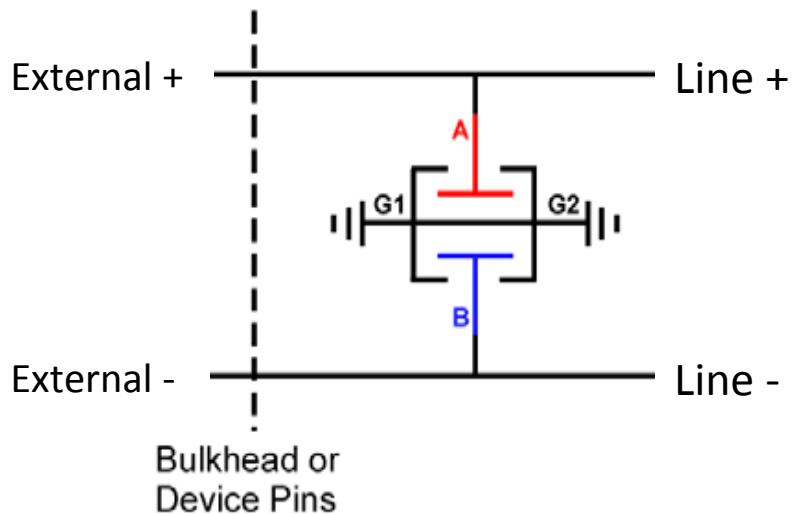
Common X2Y[®] Circuit Uses

EMI FILTERING

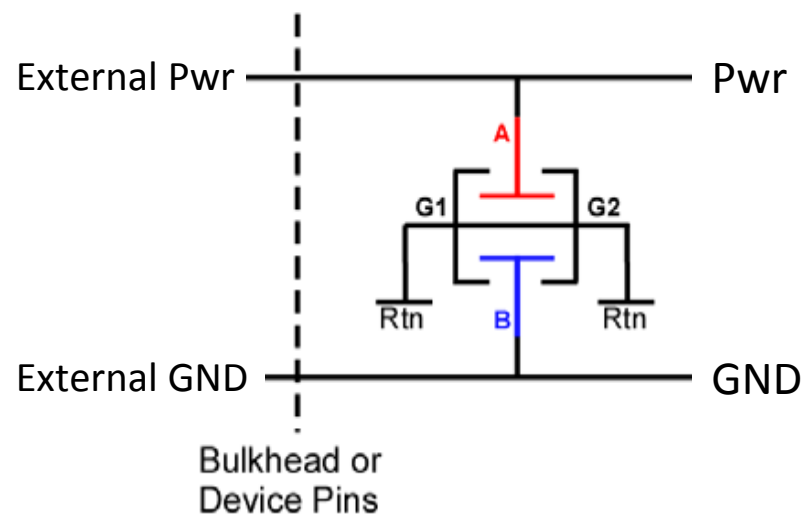
Conducted and Radiated Emission Filtering
RFI Susceptibility Filtering



Systems with separate ground



Systems without separate ground

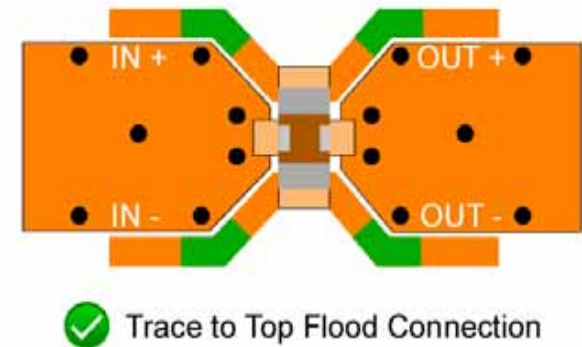
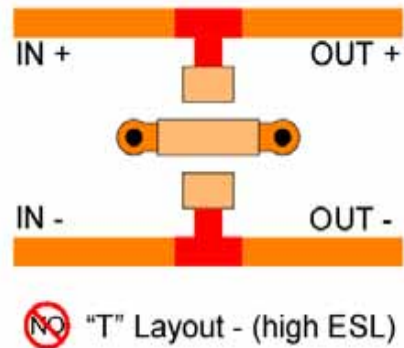
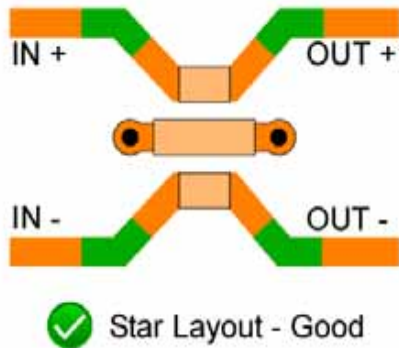
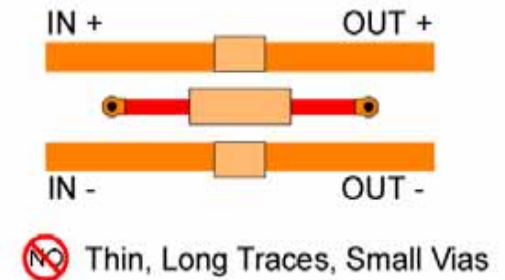
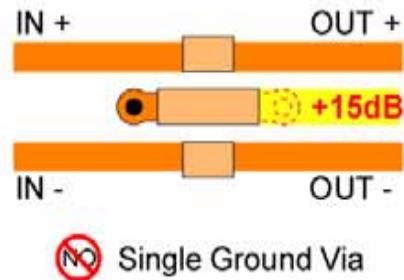
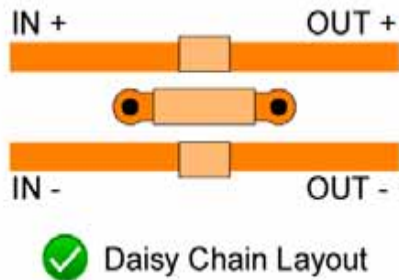


A/B terminations attach to pairs of signal or power conductors
G1/G2 terminations attach to GND (0V reference)

For circuits having just power and GND (two conductors only), the A/B terminations attach to the power & GND return wires and the G1/G2 terminations attach to the board GND (0V reference)

Trace - Via Layouts, EMI Filtering

The following are key elements of Good Mounting Practice when applying X2Y components with traces and vias on the PCB.

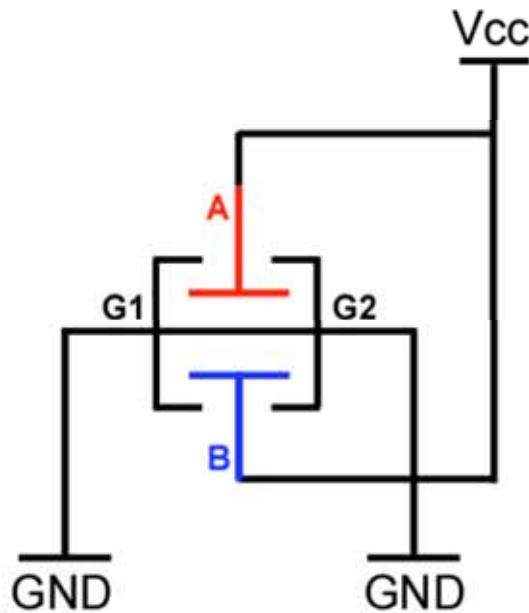


Source: [NEW - X2Y EMI Filter Evaluation & Design Guide for comprehensive information](#)

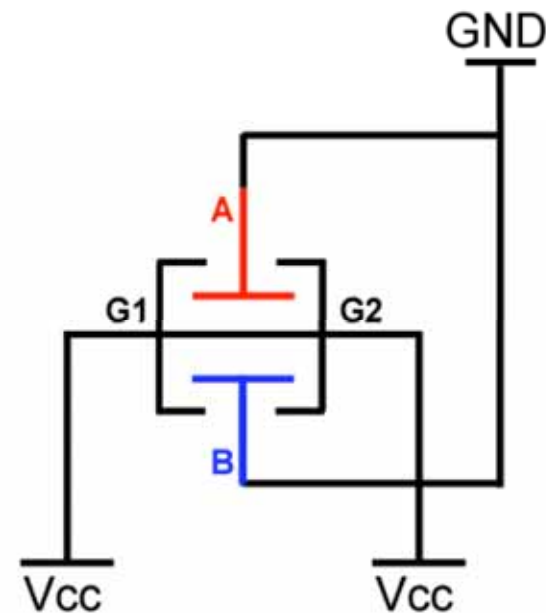
Common X2Y[®] Circuit Uses

BYPASS / DECOUPLING

There are two basic connection options for power bypass, either is equally effective.



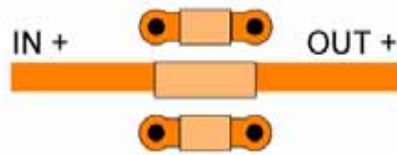
Often used for inner-plane bypassing



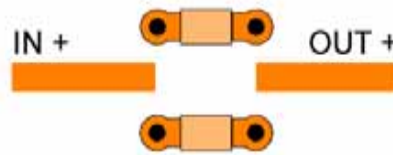
More convenient when bypassing a surface power trace

Trace - Via Layouts, Bypass / Decoupling

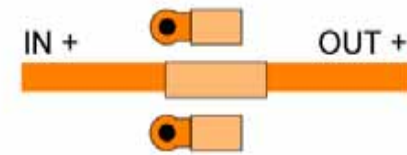
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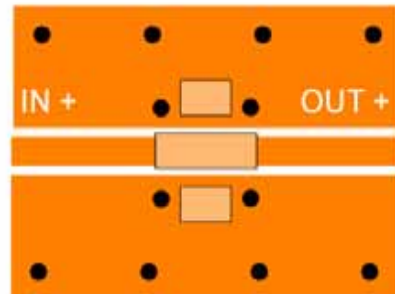
✓ Continuous Trace Under X2Y®, vias to inner plane



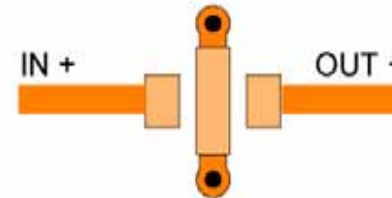
✗ Broken Trace Under X2Y®



✗ Single Via Per Pad



✓ Continuous Trace Under X2Y®, top flood connection



✗ Blocks DC Current Flow

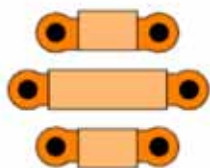
Source: Source: [NEW - X2Y EMI Filter Evaluation & Design Guide for comprehensive information](#)

Via Layouts, Bypass / Decoupling

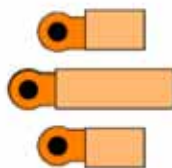
The following are key elements of Good Mounting Practice when applying X2Y components with vias on the PCB.

✓ Good Practice

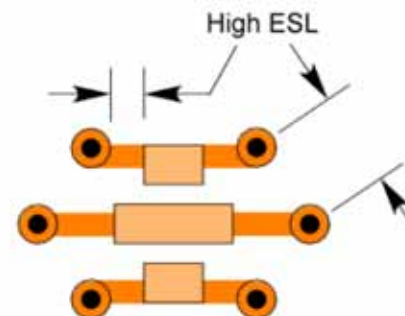
✗ Bad Practice



✓ 6-via 0603



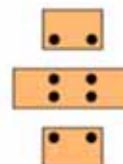
✗ 3-via 0603



✗ Long trace connections, large via spacing



✓ 8-via Large Component

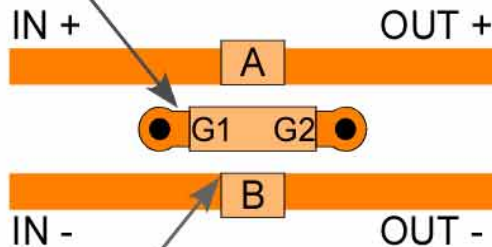


✓ 8-via 0603 via-in-pad

Trace - Via Layout Summary

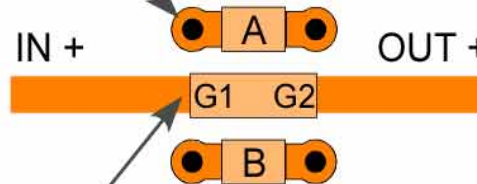
The following are key elements of Good Mounting Practice when applying X2Y components with traces and vias on the PCB.

Keep vias as close to component terminations as possible



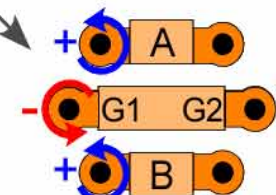
Route traces to the inner most edge of the A&B pads

Use the largest drill diameter suitable for the manufacturing process



Keep trace continuous (unbroken) under X2Y®

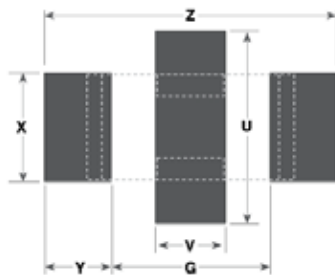
Locate opposite polarity vias as close together as possible.



Use two vias per pad minimum

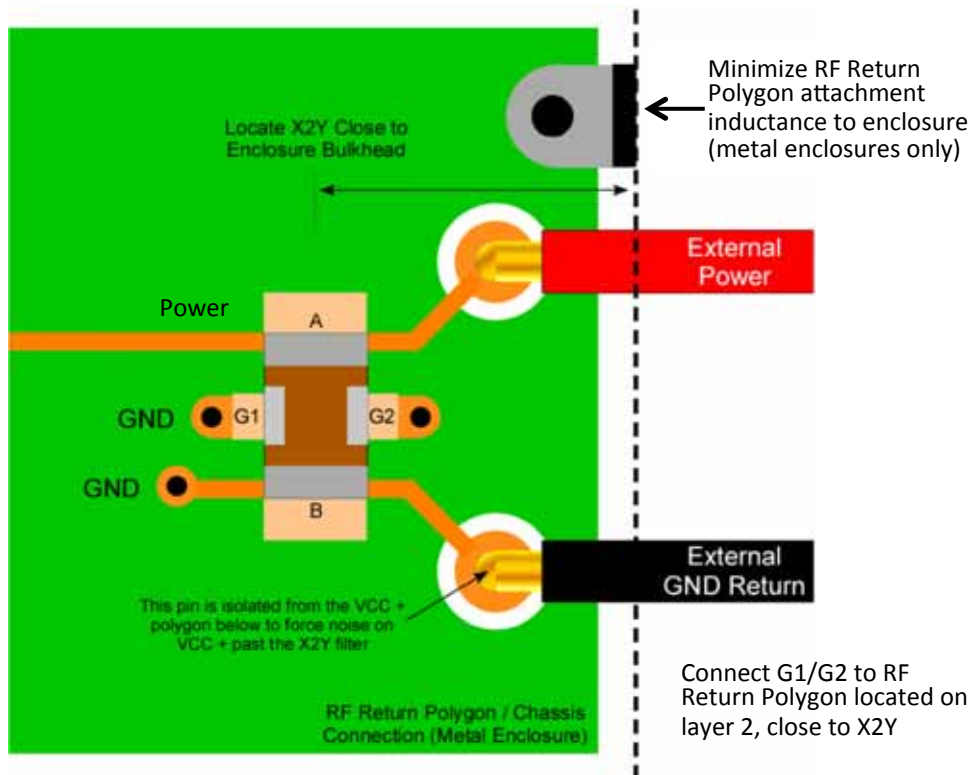
X2Y Component & Pad Sizes

PHYSICAL DIMENSIONS		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
CHIP	L	0.045 ±.003	1.143 ±.076	0.064 ±.005	1.626 ±.127	0.080 ±.008	2.032 ±.203	0.124 ±.010	3.150 ±.254	0.125 ±.010	3.175 ±.254	0.140 ±.010	3.556 ±.254	0.174 ±.010	4.420 ±.254
	W	0.025 ±.003	0.635 ±.076	0.035 ±.005	0.889 ±.127	0.050 ±.008	1.270 ±.203	0.063 ±.010	1.600 ±.254	0.098 ±.010	2.489 ±.254	0.098 ±.010	2.490 ±.254	0.125 ±.010	3.175 ±.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 ±.003	0.203 ±.076	0.010 ±.006	0.254 ±.152	0.012 ±.008	0.305 ±.203	0.016 ±.010	0.406 ±.254	0.018 ±.010	0.457 ±.254	0.018 ±.010	0.457 ±.254	0.022 ±.012	0.559 ±.305
	CB	0.012 ±.003	0.305 ±.076	0.018 ±.004	0.457 ±.102	0.022 ±.005	0.559 ±.127	0.040 ±.005	1.016 ±.127	0.045 ±.005	1.143 ±.127	0.045 ±.005	1.143 ±.127	0.045 ±.005	1.143 ±.127
SOLDER PAD	X	0.020	0.51	0.035	0.89	0.050	1.27	0.065	1.65	0.100	2.54	0.100	2.54	0.125	3.18
	Y	0.020	0.51	0.025	0.64	0.035	0.89	0.040	1.02	0.040	1.02	0.040	1.02	0.040	1.02
	G	0.024	0.61	0.040	1.02	0.050	1.27	0.080	2.03	0.080	2.03	0.100	2.54	0.130	3.30
	V	0.015	0.38	0.020	0.51	0.022	0.56	0.040	1.02	0.045	1.14	0.045	1.14	0.045	1.14
	U	0.039	0.99	0.060	1.52	0.080	2.03	0.120	3.05	0.160	4.06	0.160	4.06	0.190	4.83
	Z	0.064	1.63	0.090	2.29	0.120	3.05	0.160	4.06	0.160	4.06	0.180	4.57	0.210	5.33

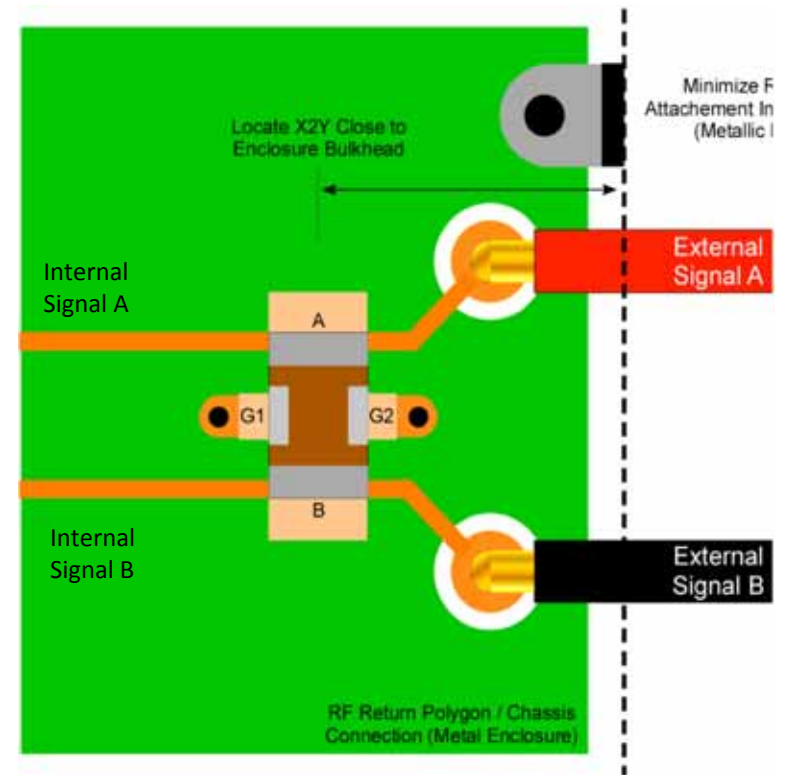


Solder mask beneath component should be avoided or minimized to reduce flux & contaminant entrapment.

Examples 1, 2: Dual-Line EMI Filtering



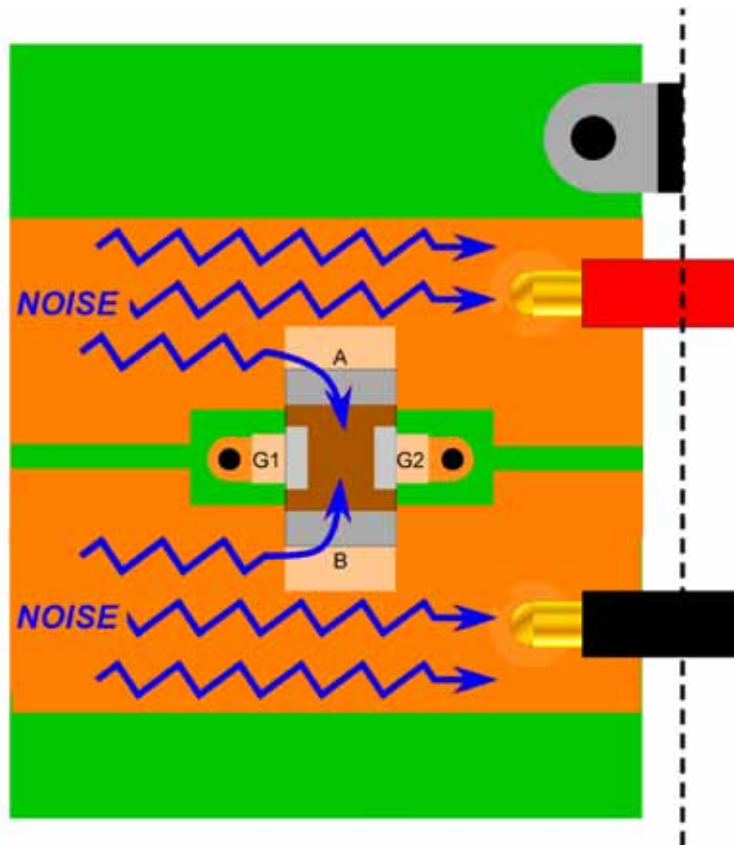
1) Dual-Line EMI filtering of two conductor power feed.



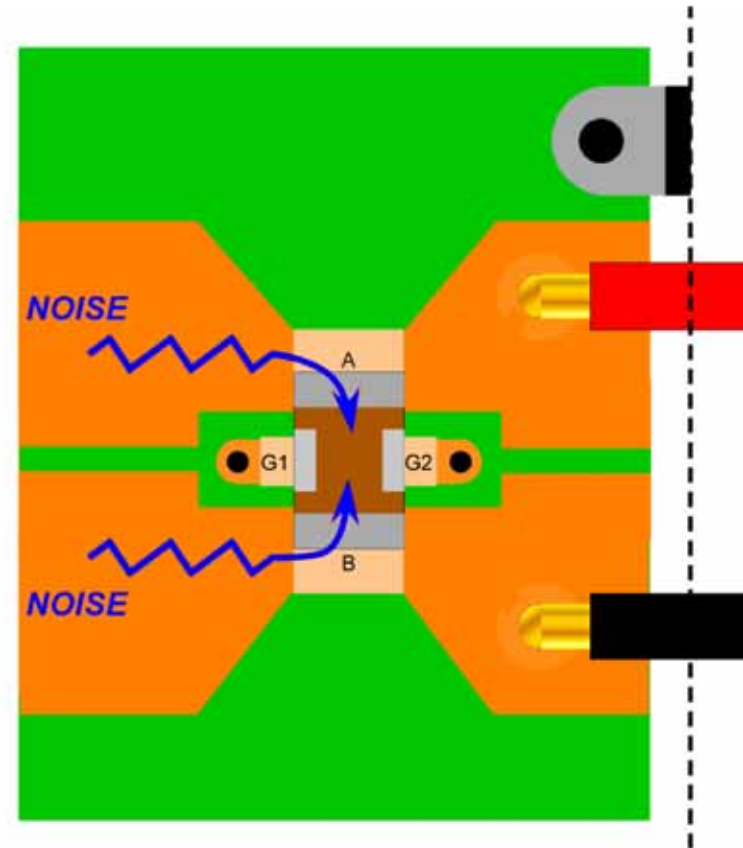
2) Dual-Line EMI filtering of two conductor signal feed.

Note: Read [X2Y® Capacitors vs. Common Mode Filters](#) (slides 75-78)

Dual-Line EMI Filtering Example 3

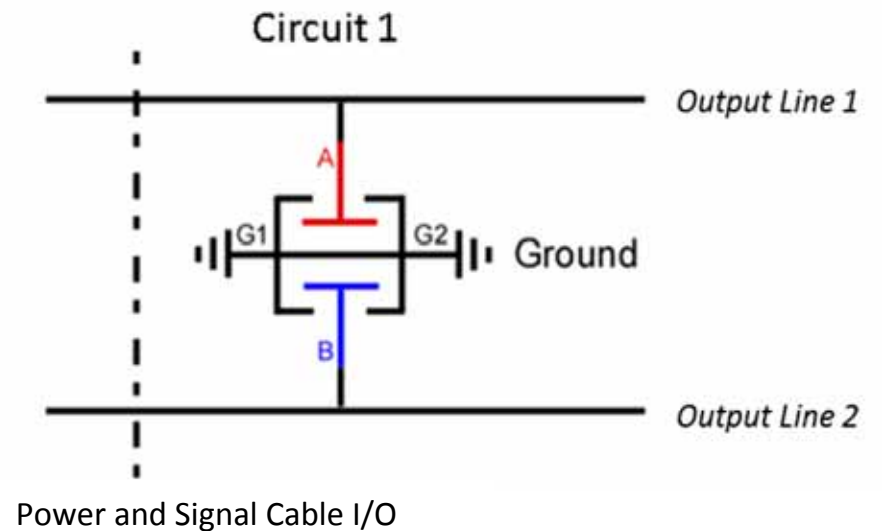
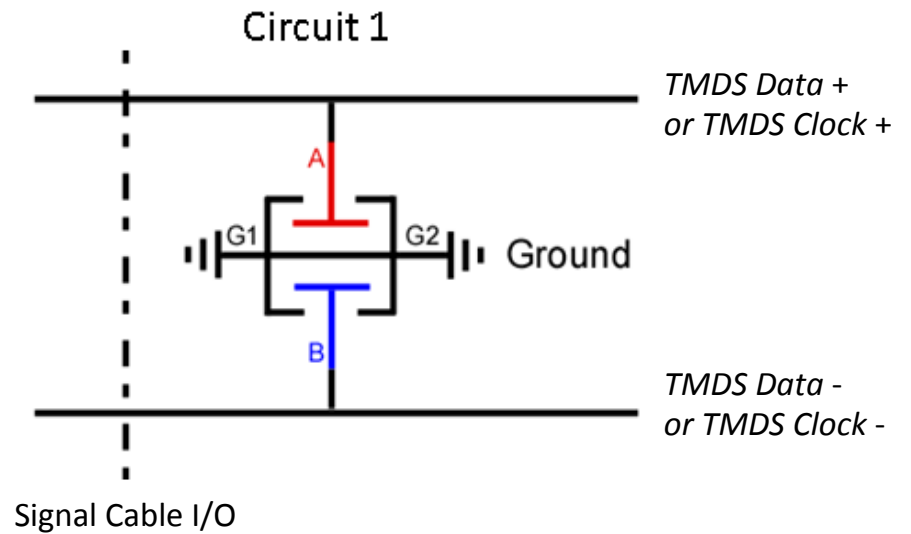
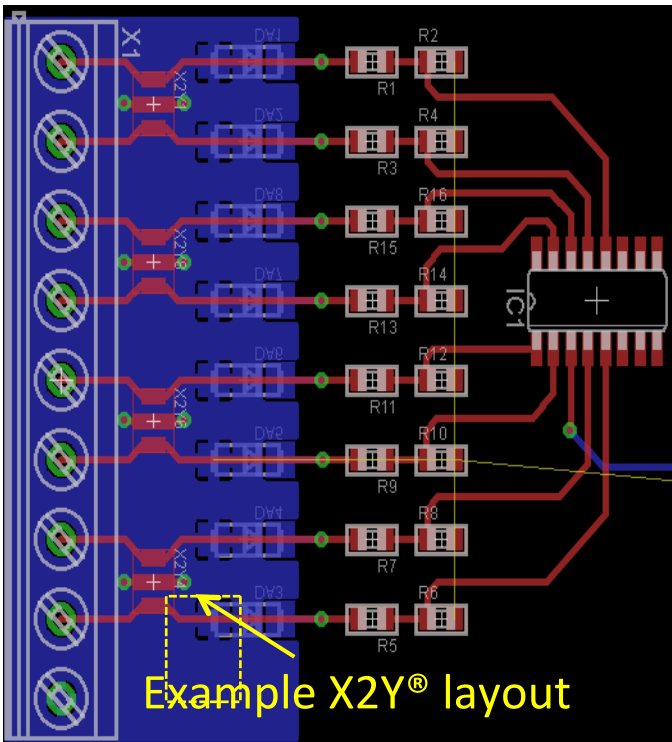
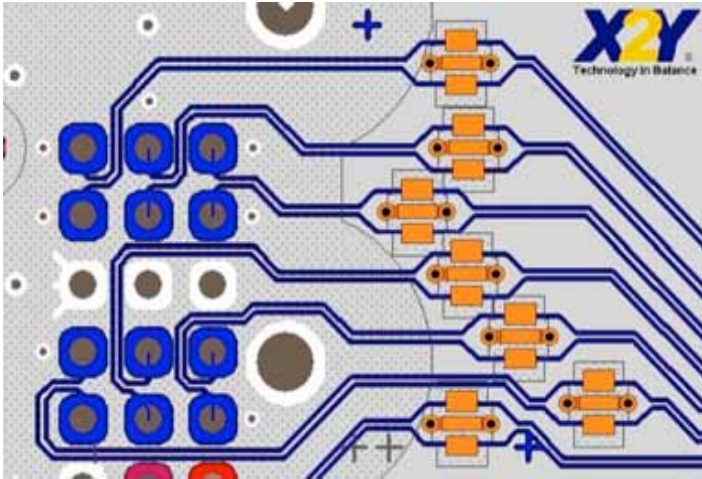


 This design allows RF noise energy to bypass X2Y filter.

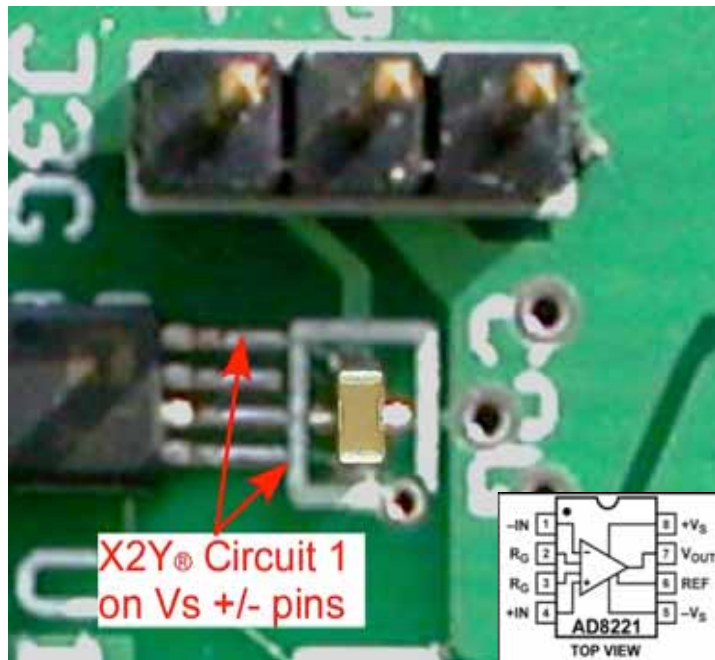


 This design focuses the RF noise energy to X2Y filter

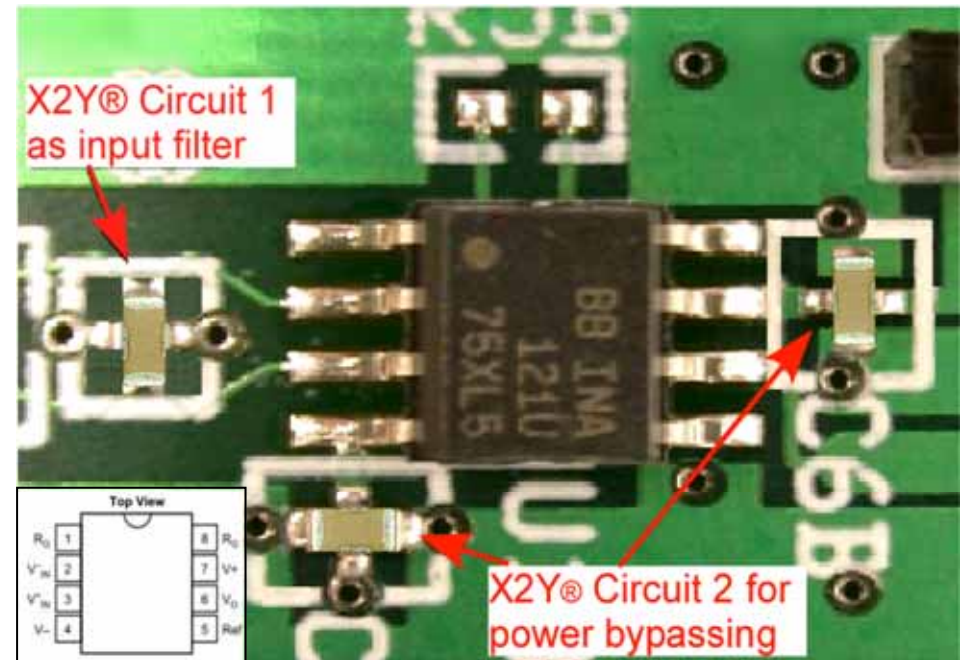
Examples 4,5: Dual Line EMI Filtering



Example 6: EMI Filter & Pwr Bypass



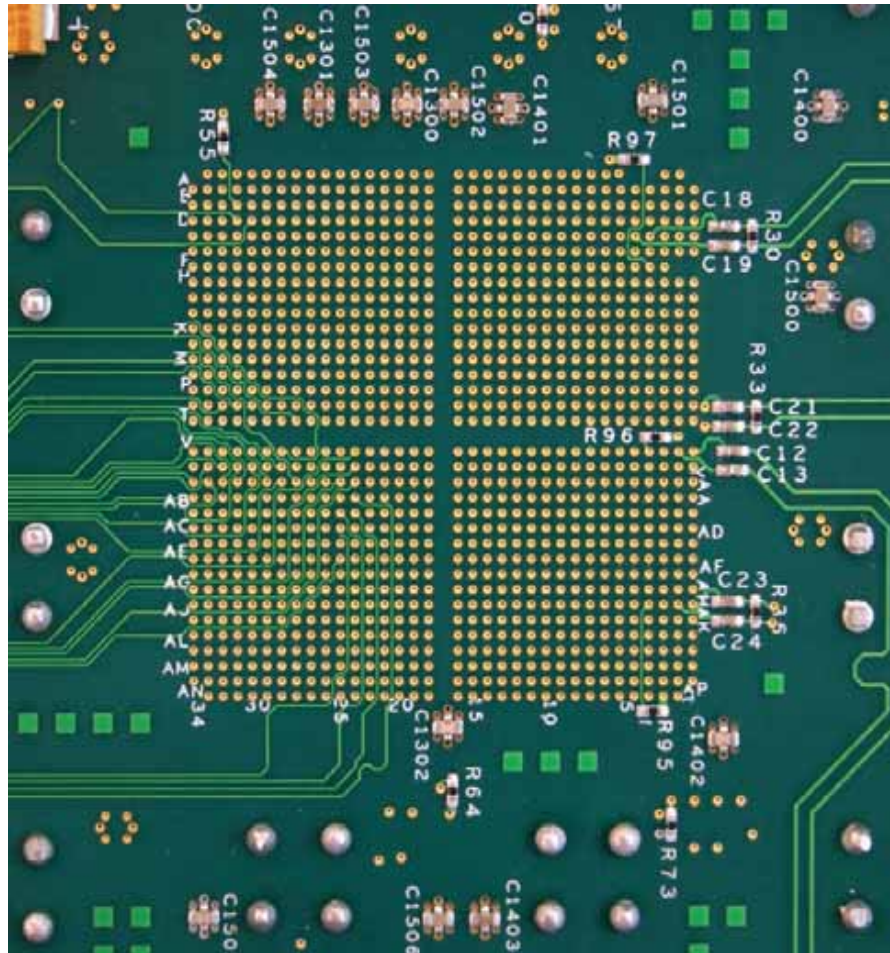
IC +/- power pins on same side:
Single X2Y replaces 4 MLCCs,
bypassing both the power rails.



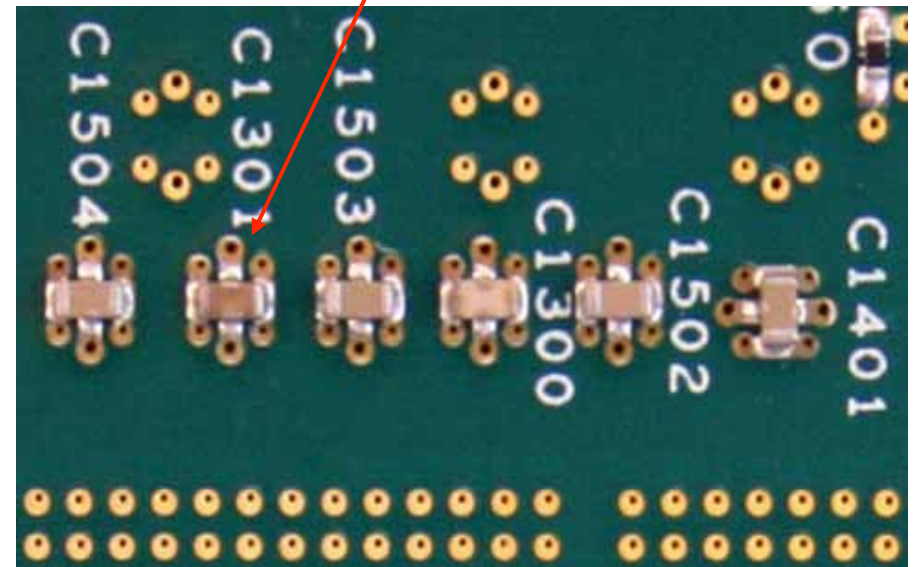
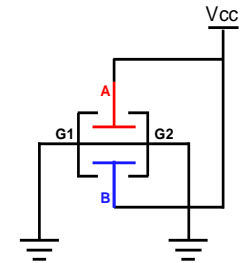
X2Y applied as dual-line input filter. IC +/-
power pins on opposite sides, X2Y is
applied in bypass on each power rail.

IC Power Bypass: Inner Planes Attachment

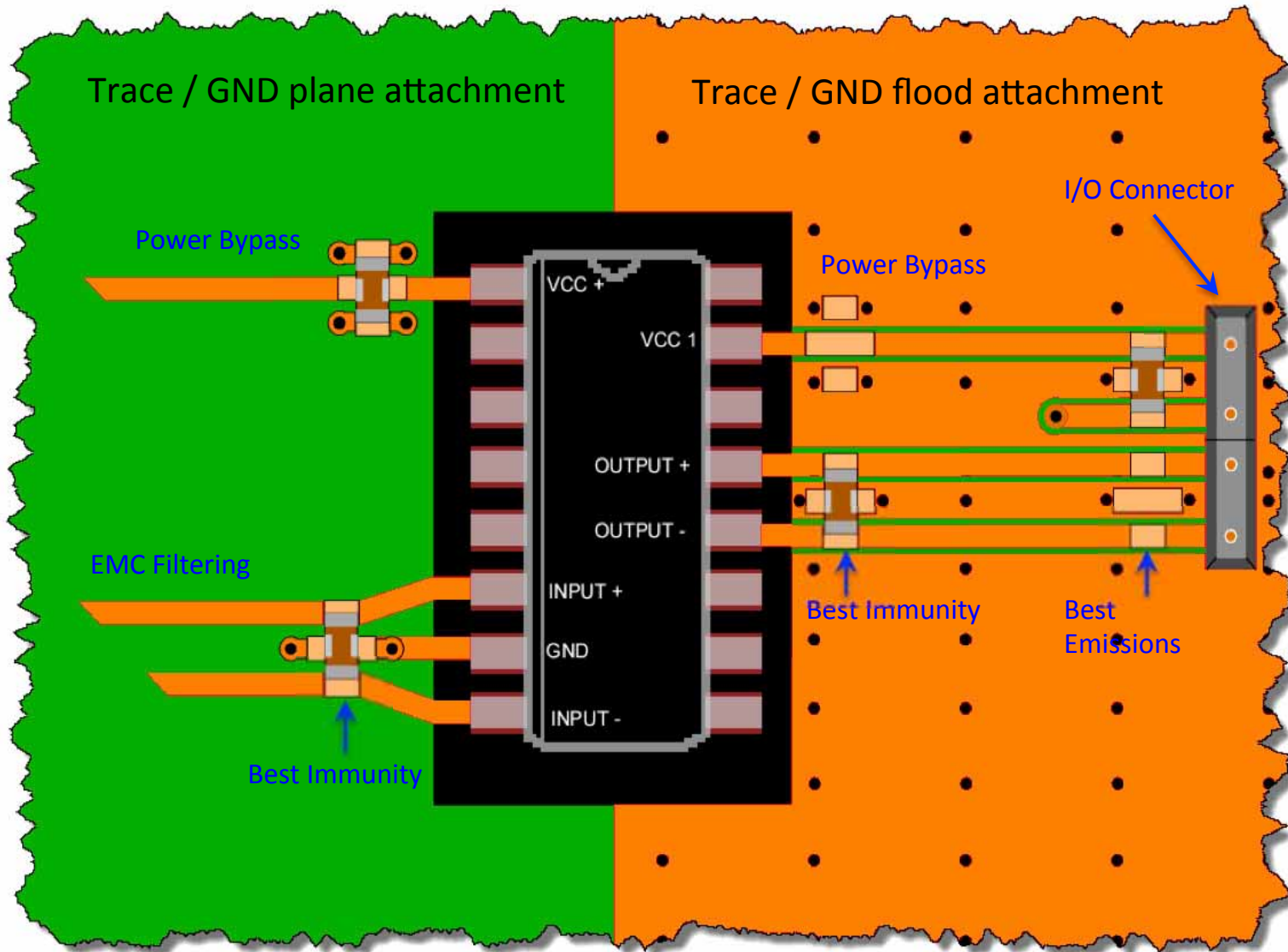
Multiple X2Y components are attached between the inner Vcc and GND planes on this PCB for FPGA power bypassing.



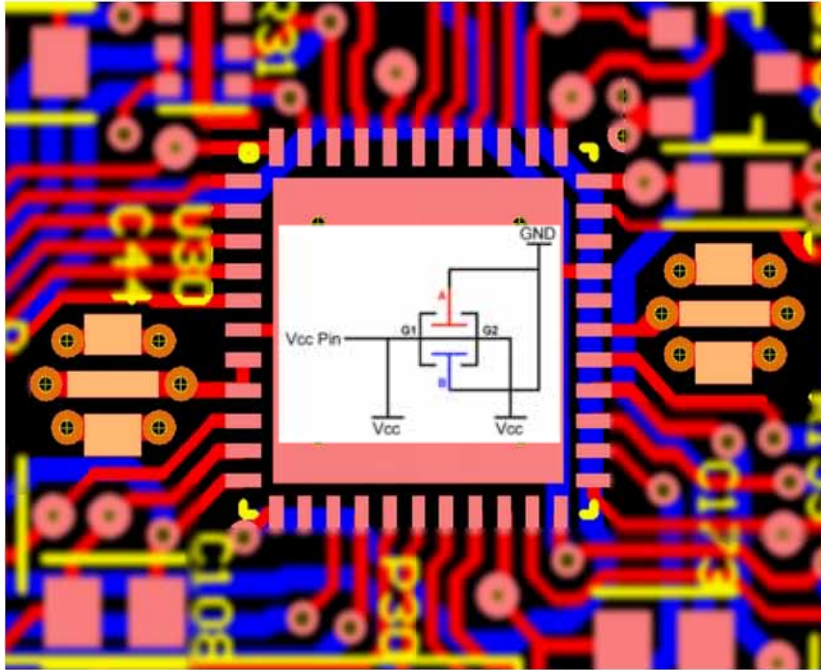
IC Power Bypass / Decoupling



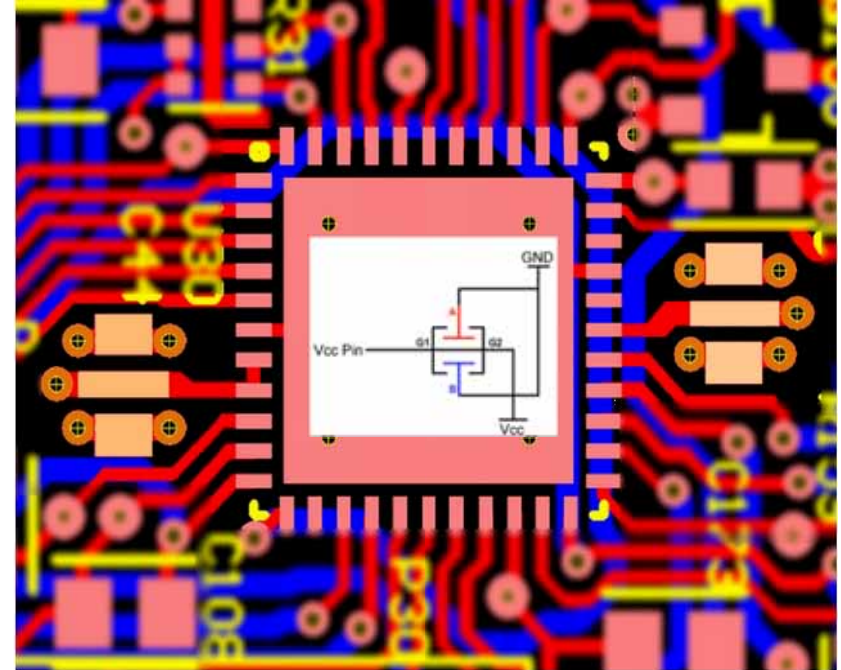
IC & Connector Pin Placement



IC Power Bypass : Reduced EMC



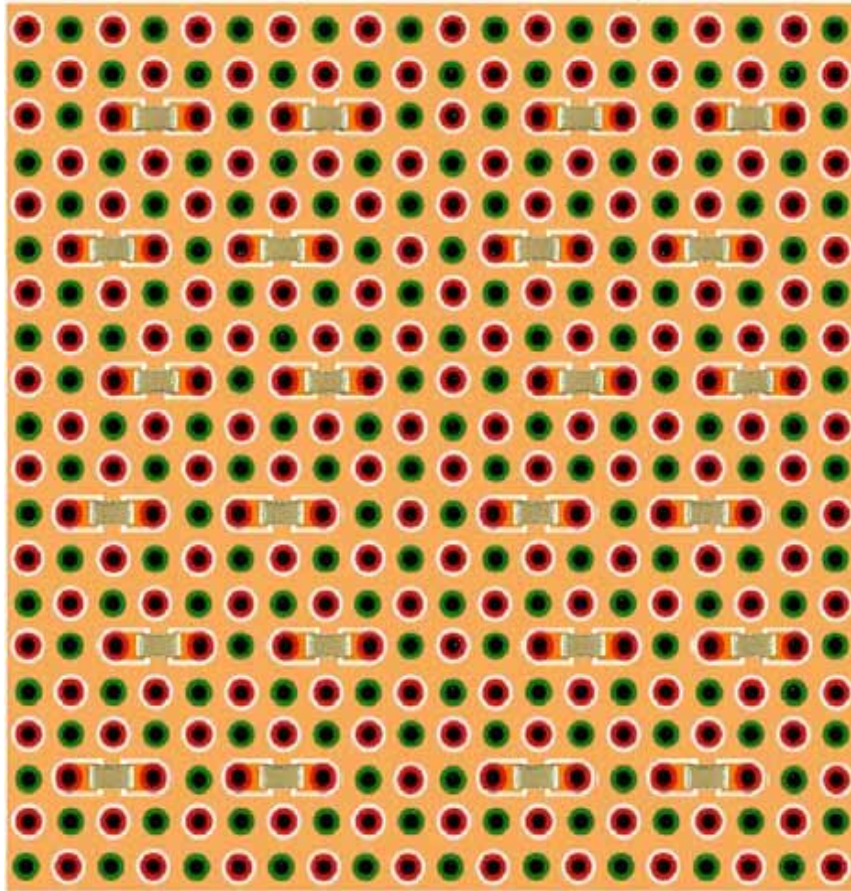
Using **6-vias** and a continuous trace under the X2Y results in the **lowest PDN impedance** to GND



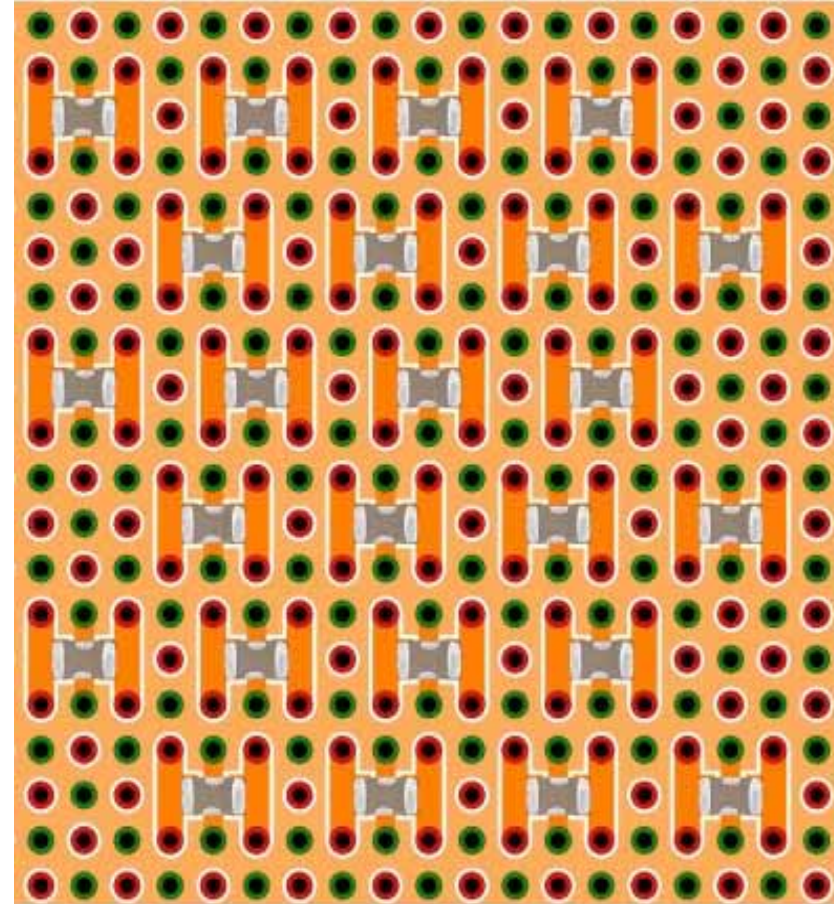
Using **5-vias**, removing via between the IC pin and X2Y, maximizes **RF noise immunity**. All noise must first go through the X2Y filter before reaching the IC power pin.

IC Power Bypass: BGA Layout with X2Y

0402 Size X2Y, 1 mm pitch



0603 Size X2Y, 1mm pitch



Source: [X2Y® Capacitors in IC Back-Side Mounting Applications](#)

We're here to help

Johanson provides first time adopters with application engineering assistance including part selection, schematic design review and PCB layout review.

Contact your local field sales representative for more information.

Thank You for your interest in the X2Y® Solution



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