



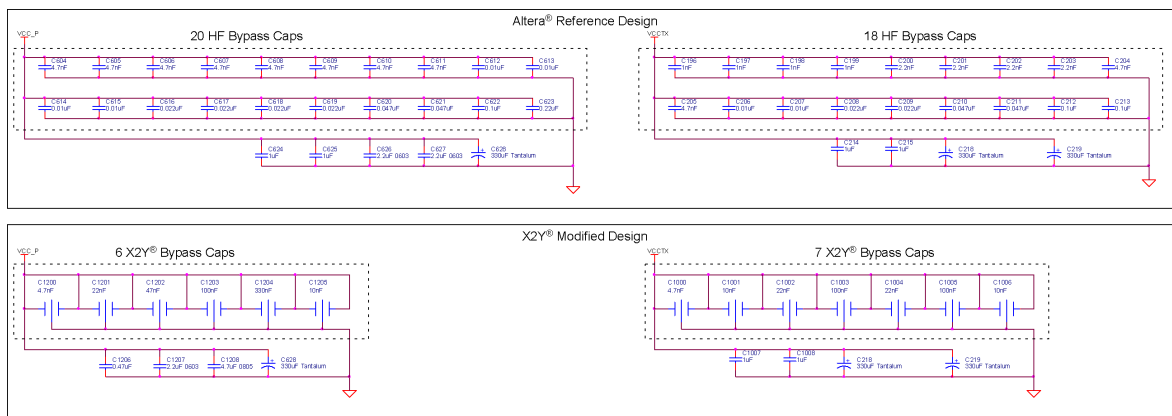
X2Y[®] FPGA SerDes Bypass

Simplified design and improved performance using X2Y[®] capacitors w/ Altera StratixII GX SerDes

Steve Weir, Consultant with Teraspeed[®] Consulting Group LLC and X2Y Attenuators, LLC, has more than 20 years of experience in the Electronics Industry, holds 17 U.S. patents and has architected a number of packet and TDM switching products. Steve has participated as a TecPanelist at several DesignCon Symposiums and authored numerous technical papers on the subject of bypass capacitor application for PDN design. Steve is a frequent contributor to the Si-List message reflector, dedicated to signal and power integrity.

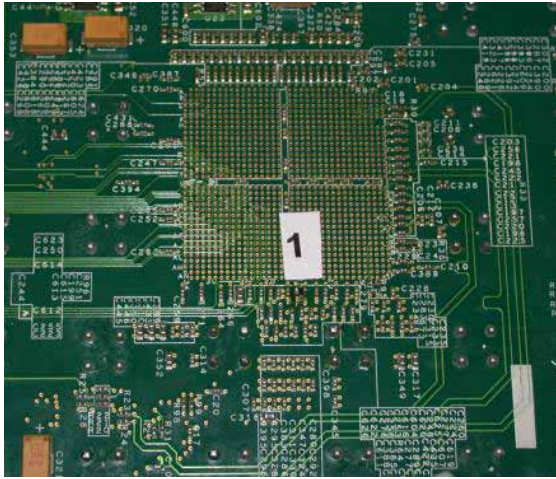
Comparative Bypass Networks

- SERDES transmit power supplies:
 - 13 X2Y[®] Capacitors replace 38 0402 caps
 - Plane inductance saturation for each supply is achieved w/ 2 X2Y[®] capacitors

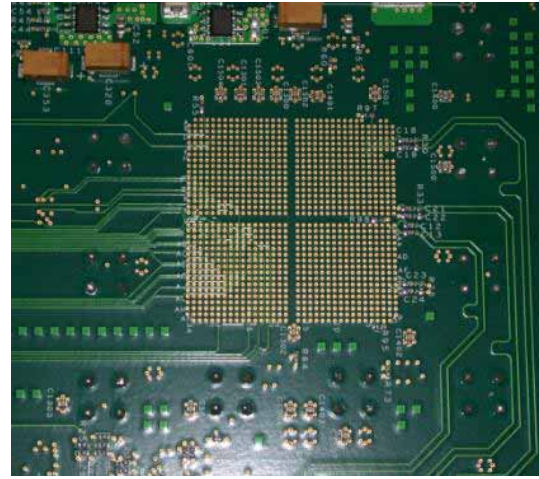


X2Y v. MLCCs

MLCC Design

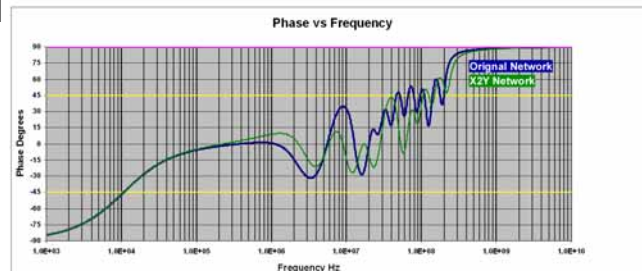
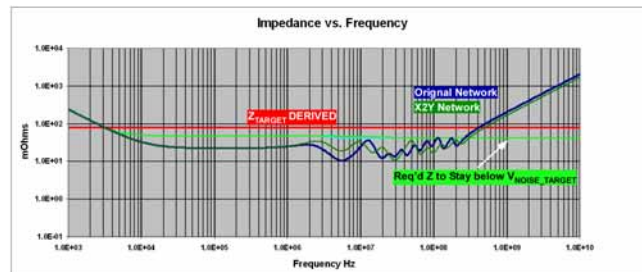


X2Y® Design



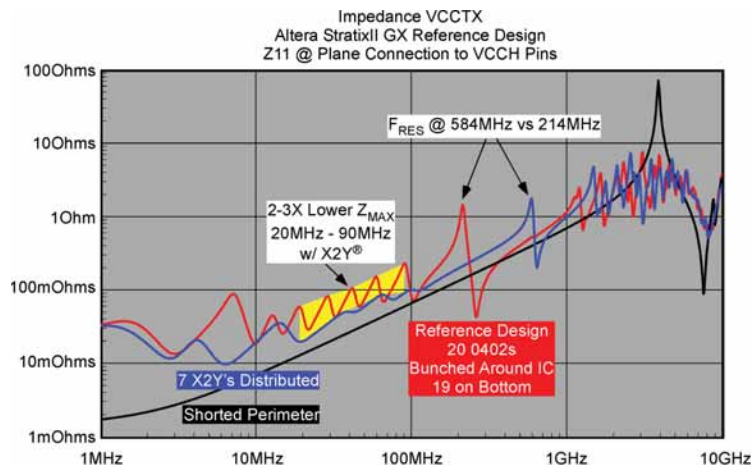
Transmit Analog: VCCH

- X2Y® Design
 - 2 x 330uF tantalum caps
+ 2 MLCCs + 7 X2Y®
 - 1D < 80mOhms
equivalent resistive to
250MHz
 - Ignores spatial effects and IC parasitics
 - Spatial effects dominate above 10MHz



Impedance Comparisons w/o IC

- 2-3X lower impedance 20MHz-100MHz w/ 7 caps instead of 20
 - >2.5:1 Higher F_{RES}
 - 2.5:1 reduction in Q



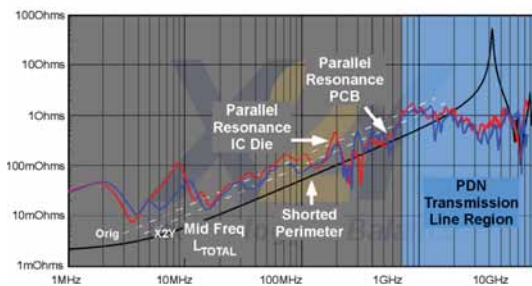
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Original VCCTX and X2Y® Networks

Measured VCCTX Networks vs Simulated Shorted Perimeter



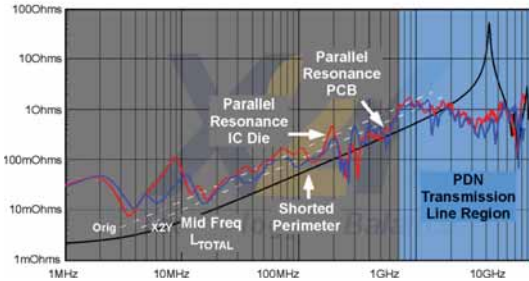
- Original network, FDTIM
 - L_{BYPASS} decreases with increasing freq.
 - Near 20MHz about L_{TOTAL} about 220pH
 - Die / bypass PRF near 200MHz
 - Bypass / PCB PRF near
- X2Y® network selective zeroes
 - Lower L_{BYPASS} @ 20MHz up
 - Zero for Die / bypass PRF
 - Zero for PCB / bypass PRF

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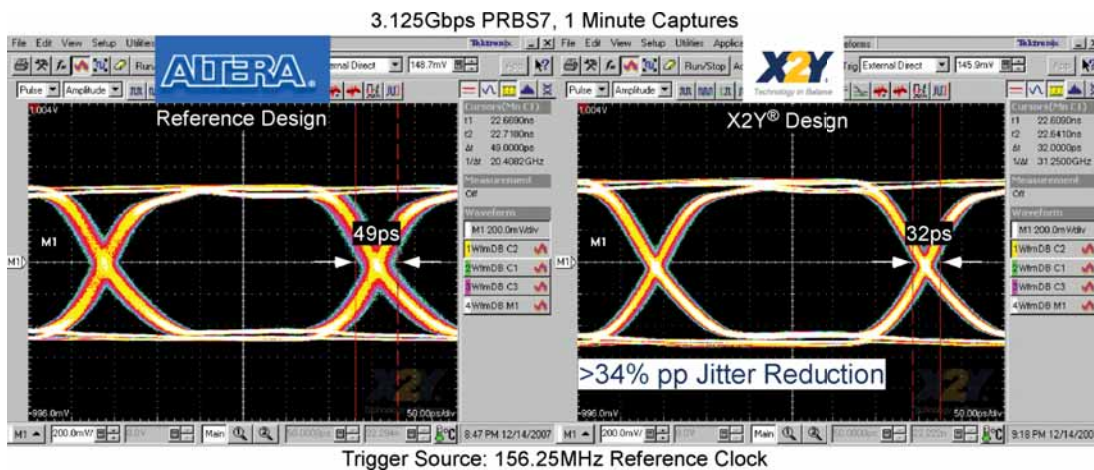
Measured VCCTX Networks vs Simulated Shorted Perimeter



- Original network
 - @ relatively low PRF
- X2Y® Network
 - Lower distributed L of 6/7
 - X2Y® caps raises to 580MHz
 - Suppressed w/ single 100pF rated X2Y®
 - Good suppression w/ conventional caps difficult due to high Q
 - Measured results, PRF completely suppressed

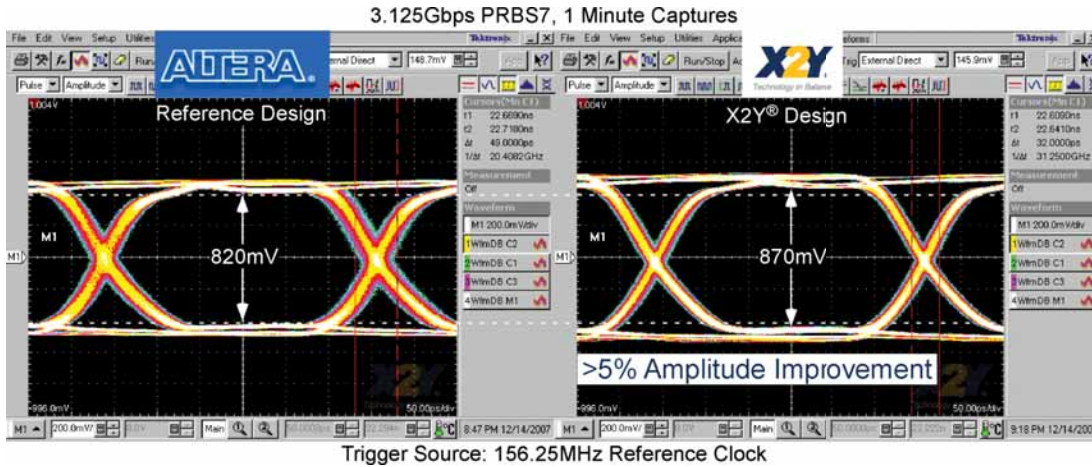
3.125Gbps Performance PRBS7

- X2Y® Reduces jitter to 32ps p-p jitter
 - vs 49ps in reference design



3.125Gbps Performance PRBS7

- X2Y® improves better eye amplitude >5%
 - 870mV pp @ sample point vs 820mV pp reference



3.125Gbps Performance PRBS23

- Shows same improvements in jitter and eye amplitude:
 - X2Y® 32ps p-p jitter vs 49ps in reference design
 - X2Y® 870mV pp vs 820mV pp in reference design

