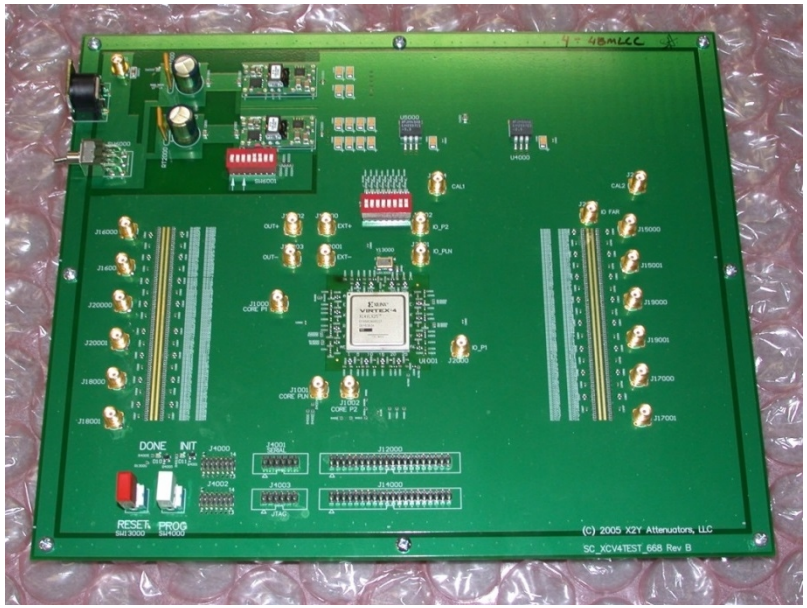
X2Y® vs. Feedthroughs In Digital Bypass Applications

Test comparisons, X2Y® 0603 capacitors versus feedthrough capacitors in digital decoupling

X2Y® vs. Feed-throughs

- X2Y has a FPGA demo board used to make digital bypass comparisons of standard 0402 MLCCs vs. X2Y 0603 components.
  - X2Y Live FPGA Power Bypass,
- We can also populate the board's 4 terminal X2Y positions with 4 terminal feedthroughs to make performance comparisons



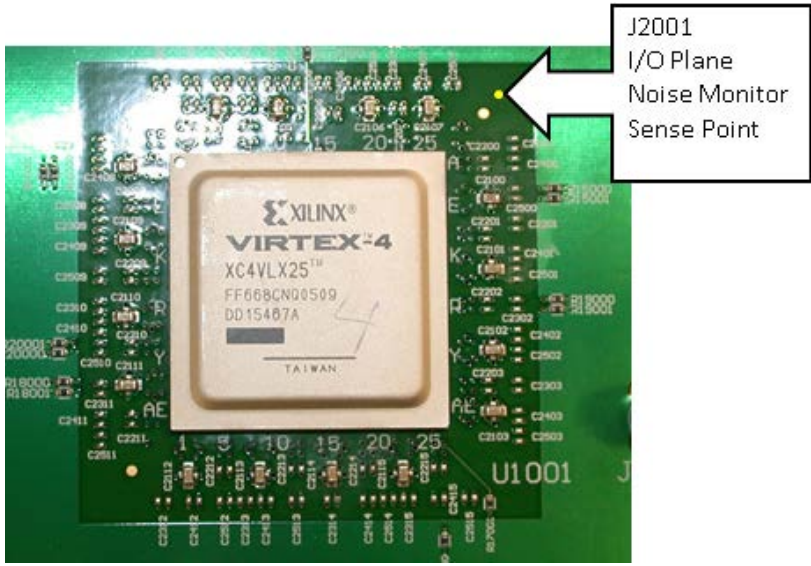
X2Y designed test vehicle

- Virtex 4 XC4VLX25
- 360 simultaneously switching I/Os
- SSTLII 2.5V
- Thevenin far-end terminations
- I/O power plane PCB layer 2
- Gnd plane PCB layer 3
- Top surface PCB, break-out and gnd fill
- One PCB used for both X2Y® and feed-through tests
  - Tested w/ X2Y® and then repopulated w/ feed-throughs

- DUTs compared
  - X2Y 0603 0.1uF 6.3V 20% X7R (0.2uF total)
  - Feedthrough 0603 0.22uF 6.3V 20% X7R

Test vehicle I/O plane

- 16 X2Y or feed-through capacitor positions
- Plane test point is just outside capacitor ring
  - Matched distance for alternate population conventional 0402 capacitors
  - Very low inductance from capacitors to sense point
  - Almost no noise generated outside the capacitor rings
- Plane area restricted to match nominal areal density of capacitors in a real application



- DUTs compared
  - X2Y 0603 0.1uF 6.3V 20% X7R (0.2uF total)
  - Feedthrough 0603 0.22uF 6.3V 20% X7R

Noise Comparison

Qty 16_200nF **X2Y®** (100nF rating) 109mV pp

Qty 16_220nF **feed-through** 184mV pp

- 360 I/Os SSTLII 2.5V simultaneously switching
  - Simple 2/8 pulse stream, 125Mbps bit rate
  - Allows full settling each interval

- **Feedthrough noise 69% higher than X2Y®**