Crosstalk on Signal-Return Loops

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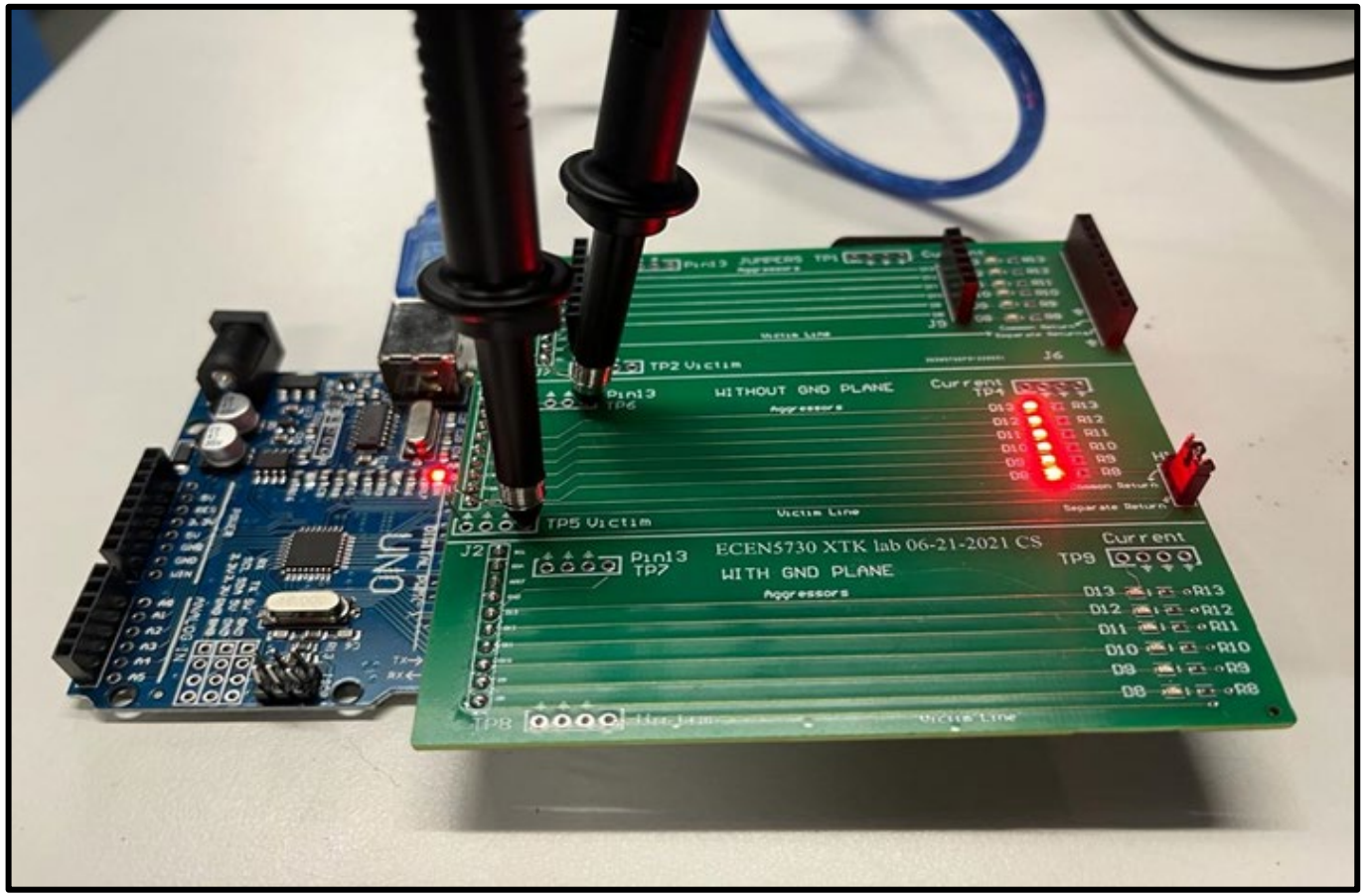
Agenda

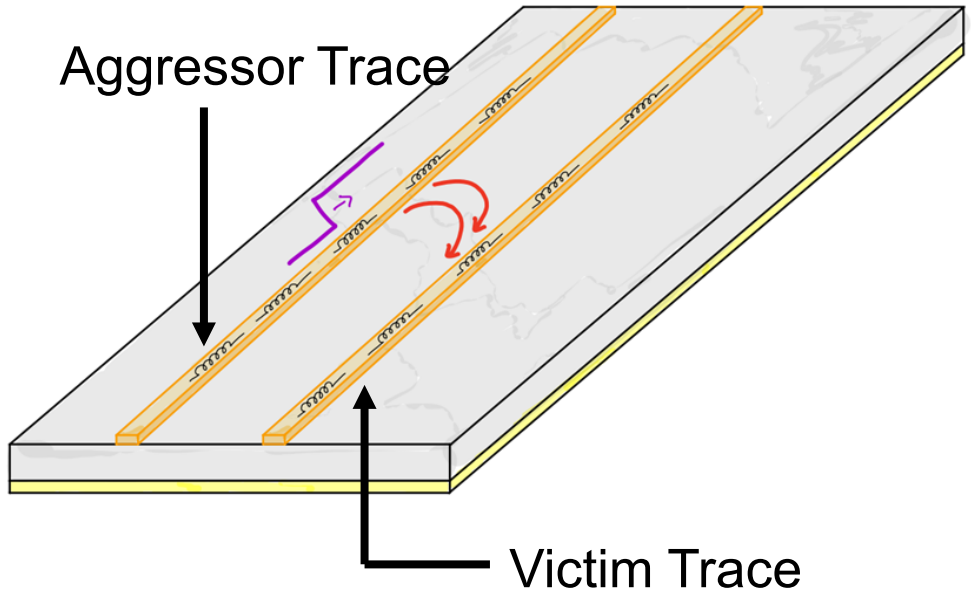
- What is Crosstalk?
- Different Return Path Geometries
- Varying No. of Aggressors
- Best Design Practices



Crosstalk

- Changing current in the aggressor loops creates changing magnetic field.
- Changing Magnetic field in Aggressor Loop induces voltage in the victim line.

$$V_{victim} = M \times n \times \frac{dI_{aggressor}}{dt}$$



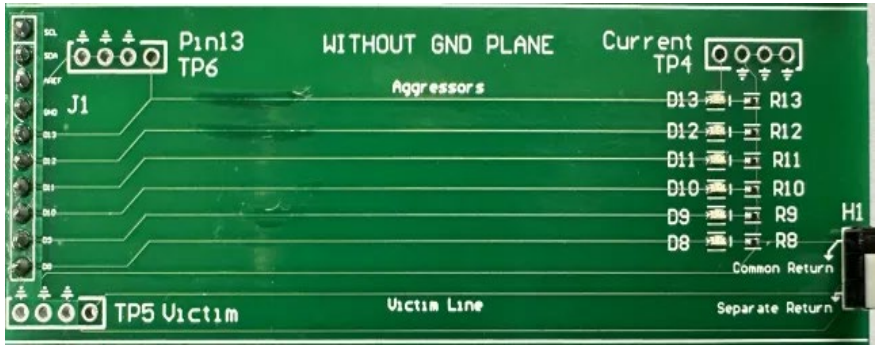
M = mutual loop inductance between Aggressor & victim loops

n = Number of simultaneously switching aggressors

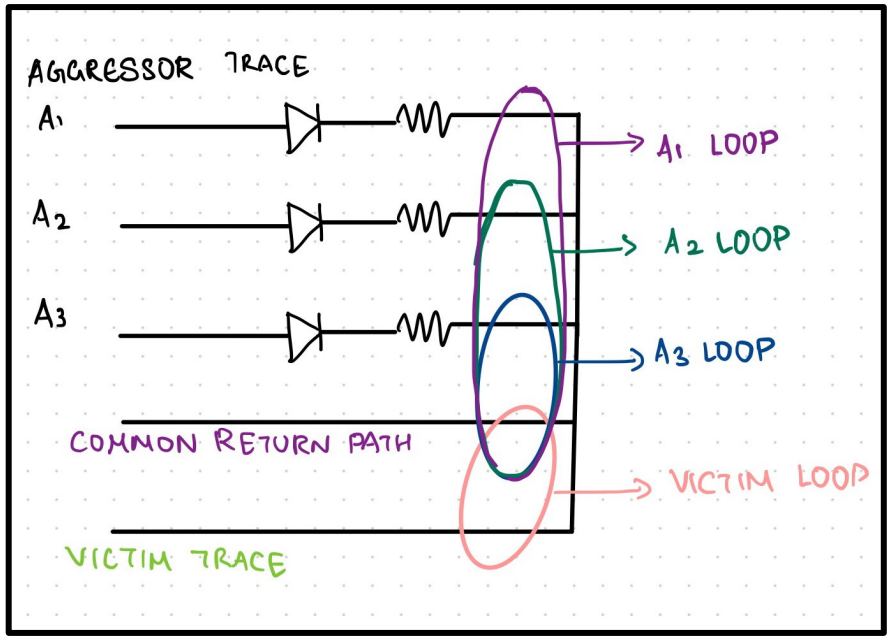
$dI_{aggressor}$ = current change in each aggressor

dt = rise or fall time of the aggressor

Shared & Separate Return Traces

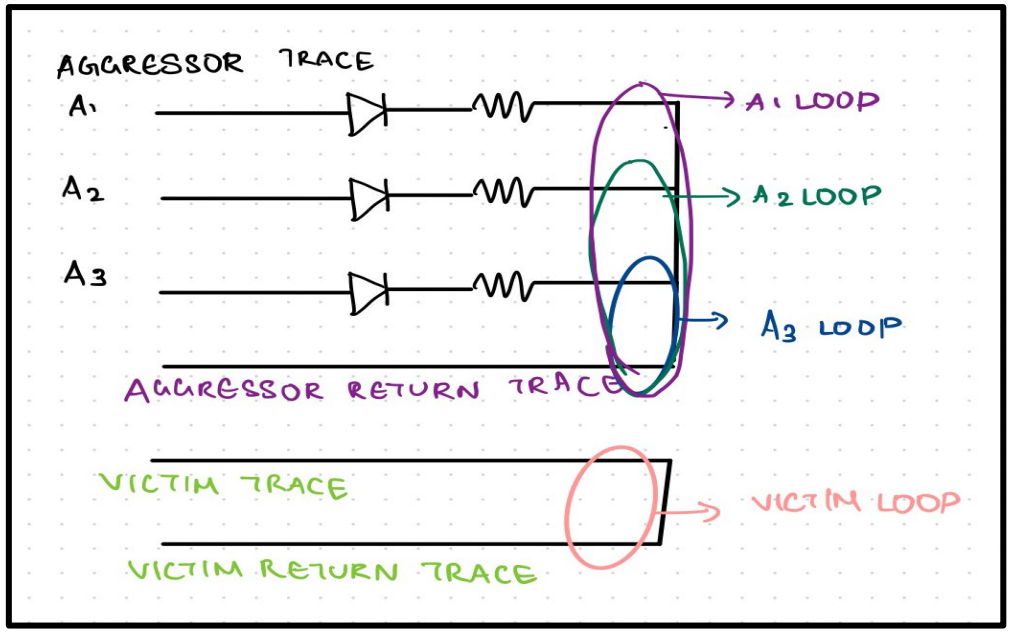


Continuous Return Trace
Equivalent circuit

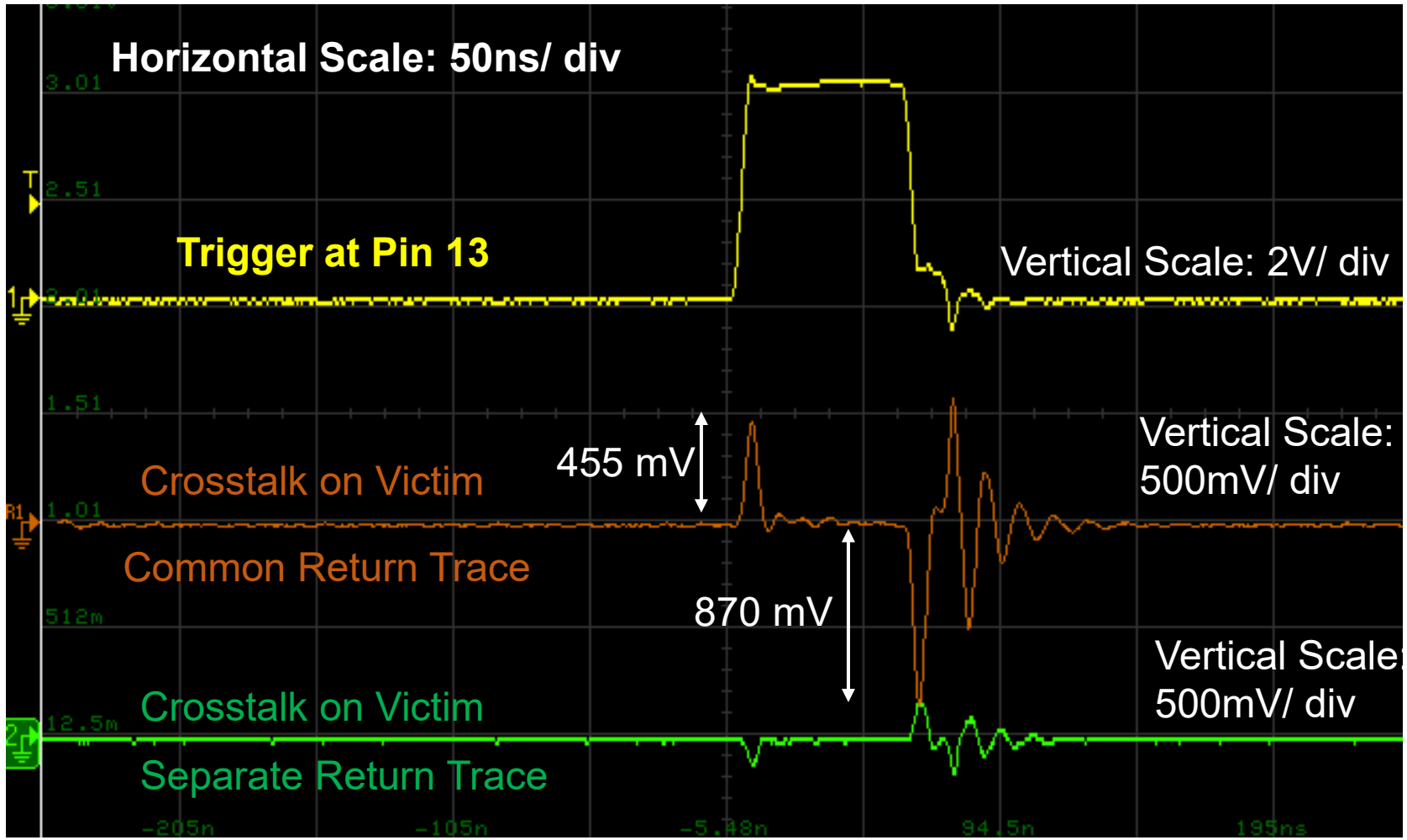


- ✓ Use a 10x probe
- ✓ Use spring tips

Separate Return Trace
Equivalent circuit



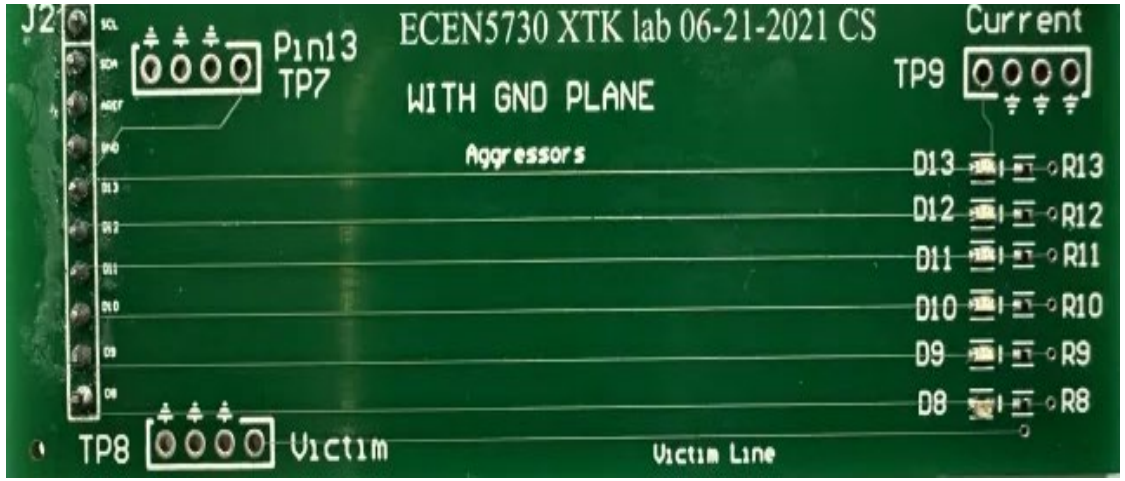
Crosstalk with Common & Separate Return Traces

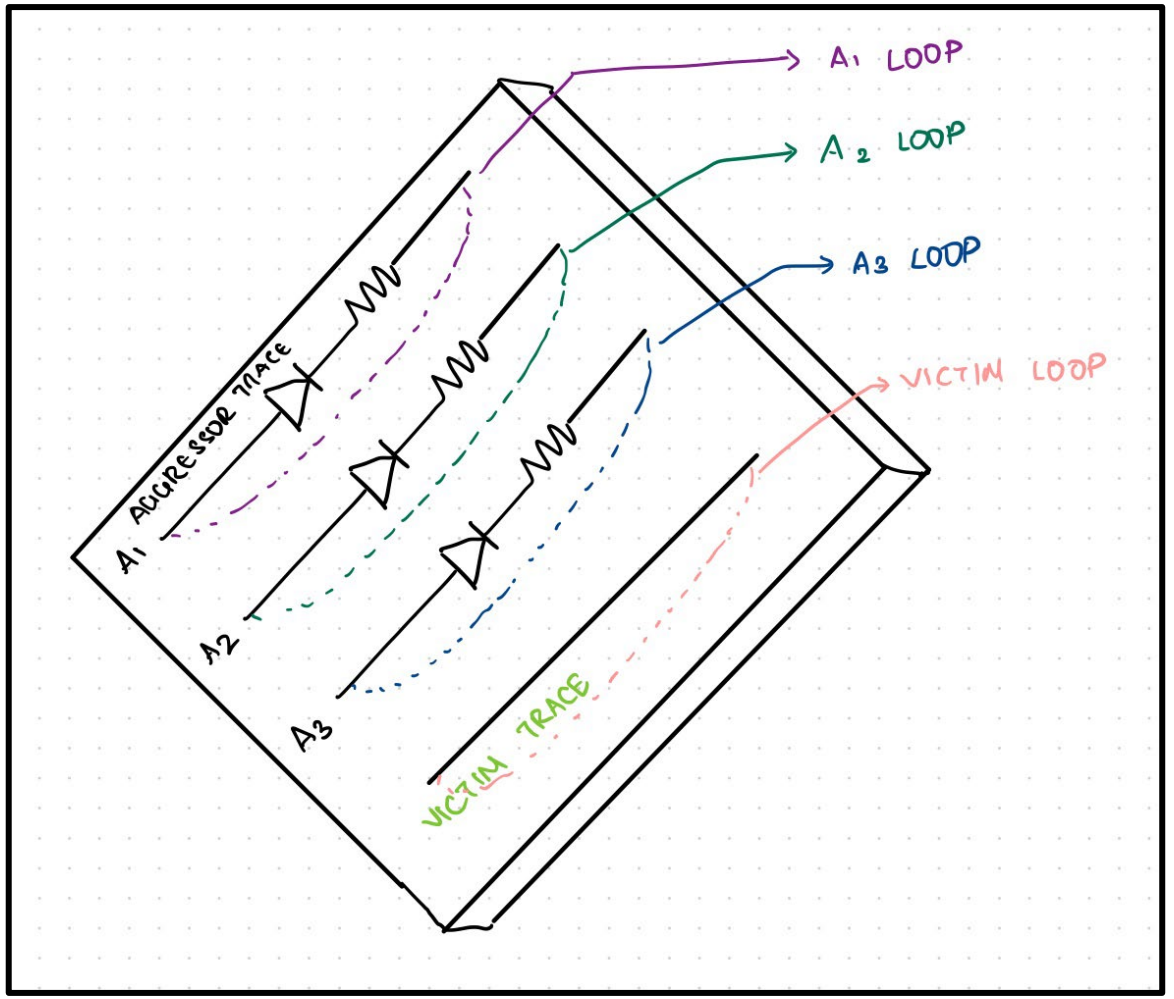


Return Path Geometry	Crosstalk (in mV)
Common Trace	870
Separate Traces	180

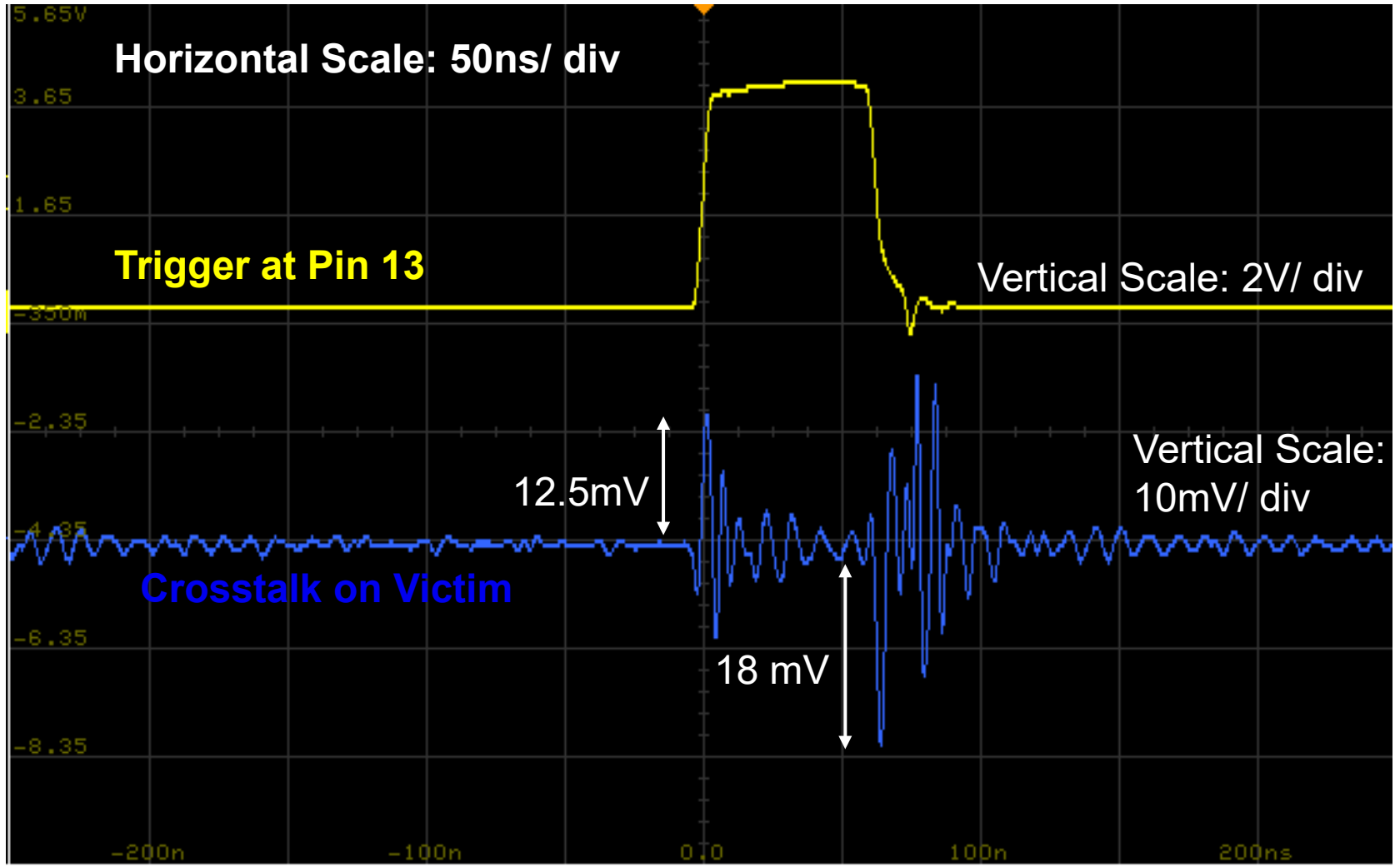
- Crosstalk on victim line reduces using separate return trace.
- More crosstalk observed on the falling edge as compared to the rising edge.

Continuous Return Plane





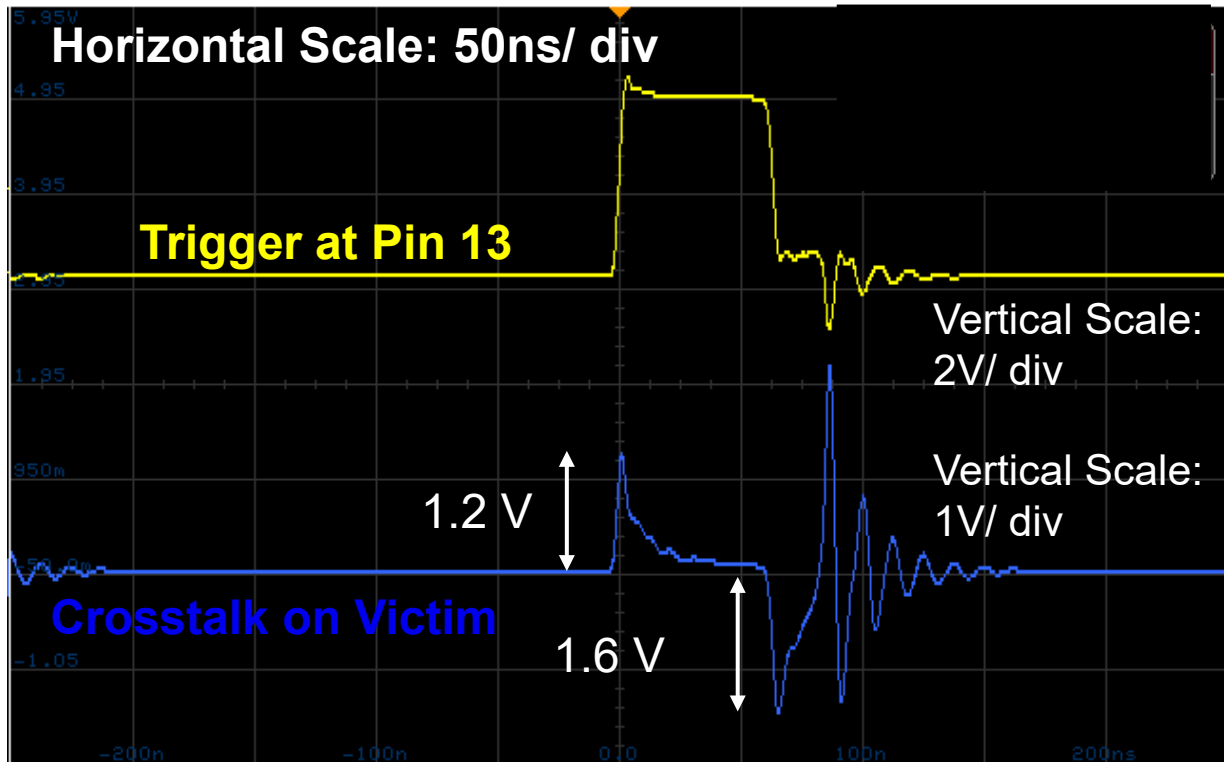
Crosstalk with Continuous Return Plane

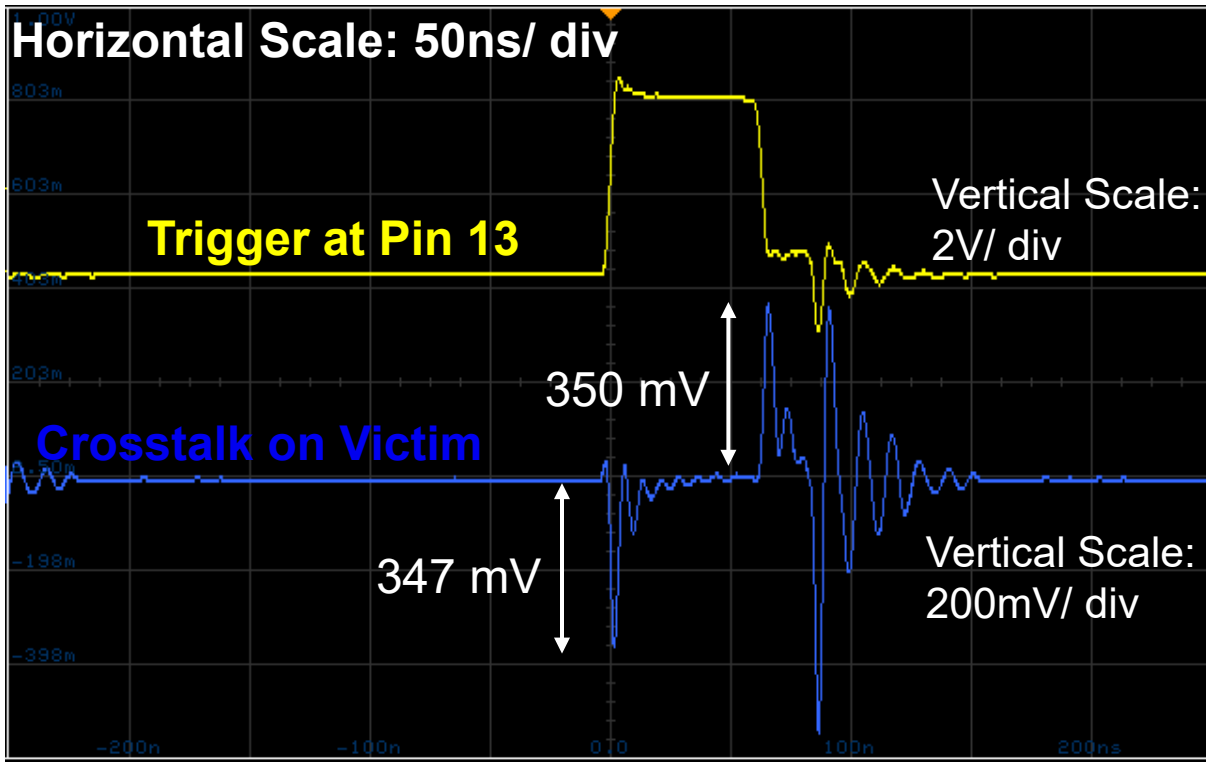


Return Path Geometry	Crosstalk (in mV)
Common Trace	870
Separate Traces	180
Continuous Return Plane	18

- Continuous return plane shows least crosstalk on the victim line.
- Best design practice to have continuous return plane in PCB.

No. of Simultaneously Switching Aggressors

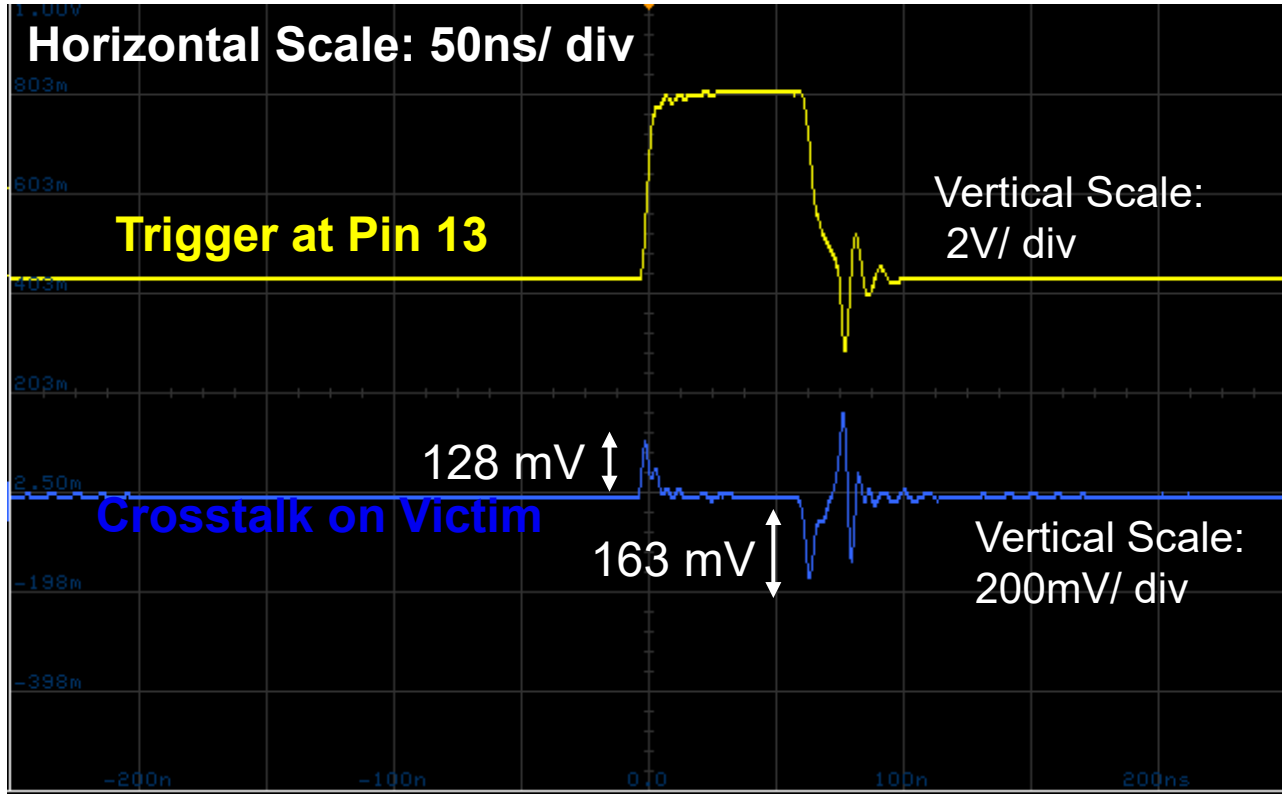




Common Return Trace

Separate Return Traces

No. of Simultaneously Switching Aggressors



Continuous Return Plane

Return Path Geometry	Crosstalk (in mV)	Crosstalk (in mV)
Common Trace	870	1600
Separate Traces	180	350
Continuous Return Plane	18	163

$$V_{victim} = M \times n \times \frac{dI_{aggressor}}{dt}$$

- Crosstalk increases with increase in the number of aggressors.
- Continuous return plane shows least crosstalk on the victim line.

Best Design Practices to Reduce Crosstalk:

- Do not share return paths between the signal-return loops of the aggressor and victim. Use a separate return conductor.
- Reduce the loop mutual inductance between aggressor and victim signal-return paths by keeping the loops far apart.
- Reduce the number of simultaneously switching signals which have mutual inductance to the victim loop.
- Use a Continuous Return Plane on a PCB to reduce the self-inductance in the signal-return path and mutual loop inductance between aggressor and victim traces.

Questions?