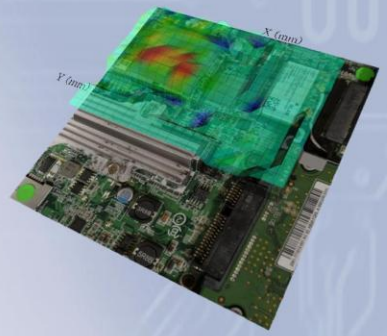


APREL System Demonstration Results
ESD-Launch Performance Evaluation

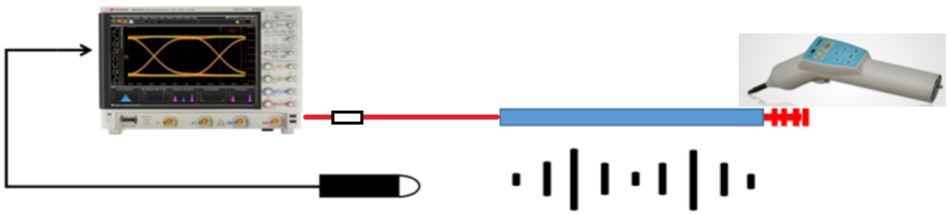
March 2020

Introduction

- This presentation has been created to support the data from a new build for the EM-ISight-ESD and launch pad
- Test results relate to the measurements taken on the APREL reference MSL module
- Purpose is to demonstrate the ESD Gun Corona reduction when using the Launch Pad compared to directly discharging the ESD gun onto the MSL reference module
- For the ESD Launch analysis the following measurements were taken
  - Conducted measurements of the ESD gun discharging on the MSL (setup#1)
  - Conducted measurements of the ESD gun discharging on the Launch Pad (setup#2)
  - Conducted measurements of the ESD gun discharging on the Launch Pad to the MSL (setup #4)
  - Course scan of ESD gun on MSL (setup #7), Inducted measurement (Probe response), 137.50x14.50 mm, 0.50 mm step resolution
  - Course scan of ESD gun on Launch Pad to MSL (setup #5), Inducted measurement (Probe to scope response), 137.50x14.50 mm, 0.50 mm step resolution
  - Course scan of ESD gun on Launch Pad to Probe (setup #6), Immunity measurement (MSL to scope response), 137.50x14.50 mm, 0.50 mm step resolution

Conducted Reference no ESD Launch

Setup#1: Conducted Validation of ESD gun on MSL



- This setup relates to the standard setup without the ESD Launch module
- Peak Voltage within limits
- Rise Time within Limits
- 30ns Voltage within limits
- 60ns Voltage within limits

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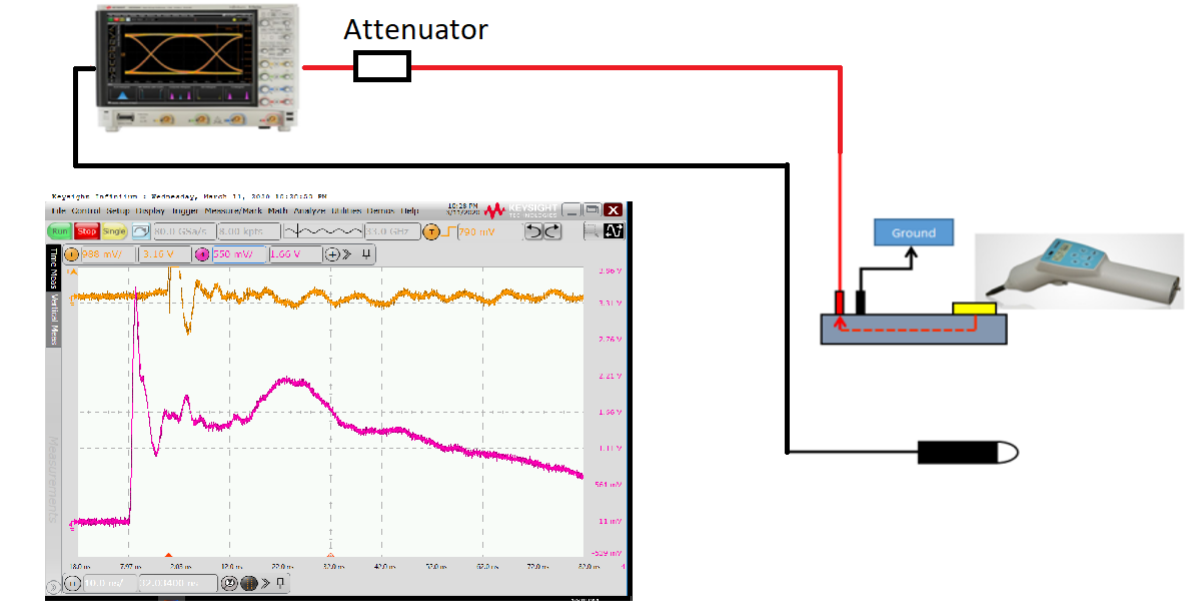
Conducted ESD Setup Using Launch

Setup#2: ESD Conducted validation of Launch Pad



- For conducted ESD this setup was used where the ESD gun was located below the EM-ISight-ESD workstation @ 2kV

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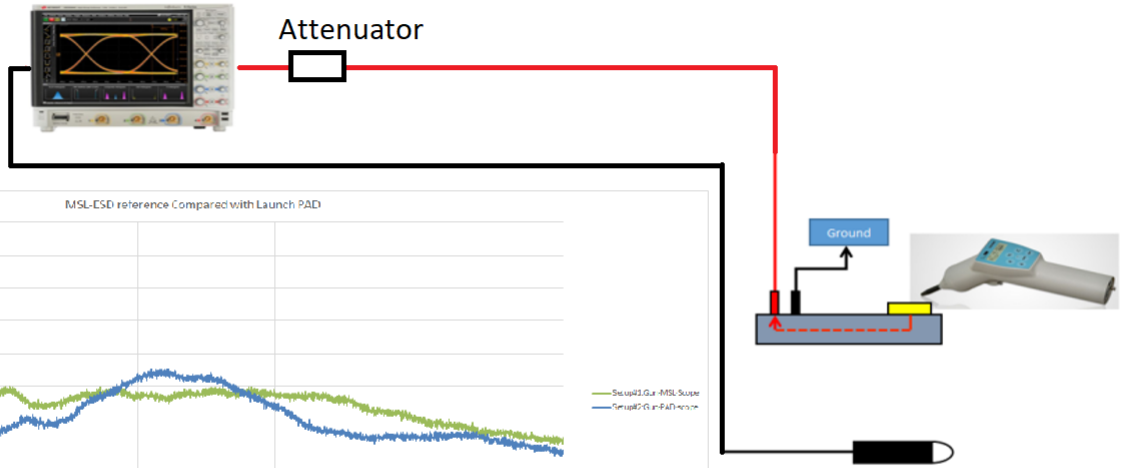
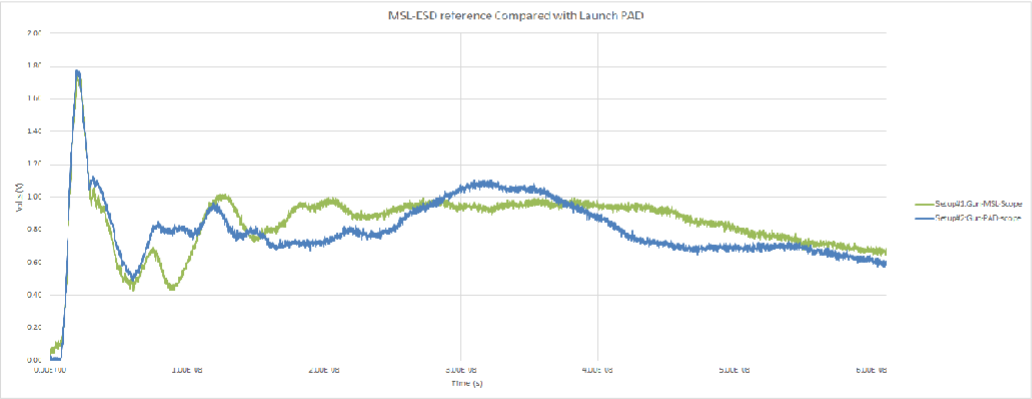
Conducted Performance of Launch Pad

Setup#2: ESD Conducted validation of Launch Pad





	Efficiency = output/input %		
	change% =	((output/input)-1)*100	
	#1	#2	%
Peak (V)	1.720	1.770	2.9
30ns (V)	0.960	1.050	9.4
60ns (V)	0.665	0.616	-7.4
SUM	7300.000	7030.000	96.3

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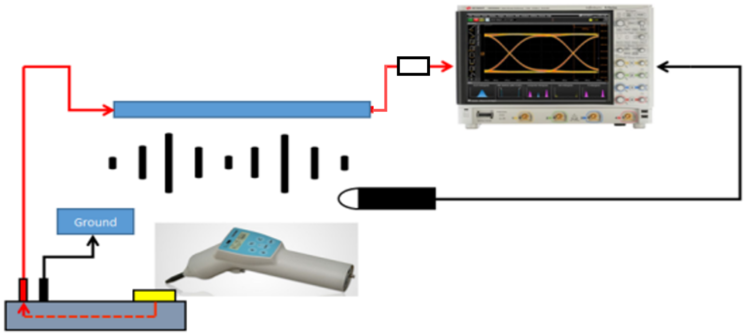
Conducted Launch Pad to MSL-ESD

Setup#4: Conducted Launch PAD ESD validation on MSL-ESD



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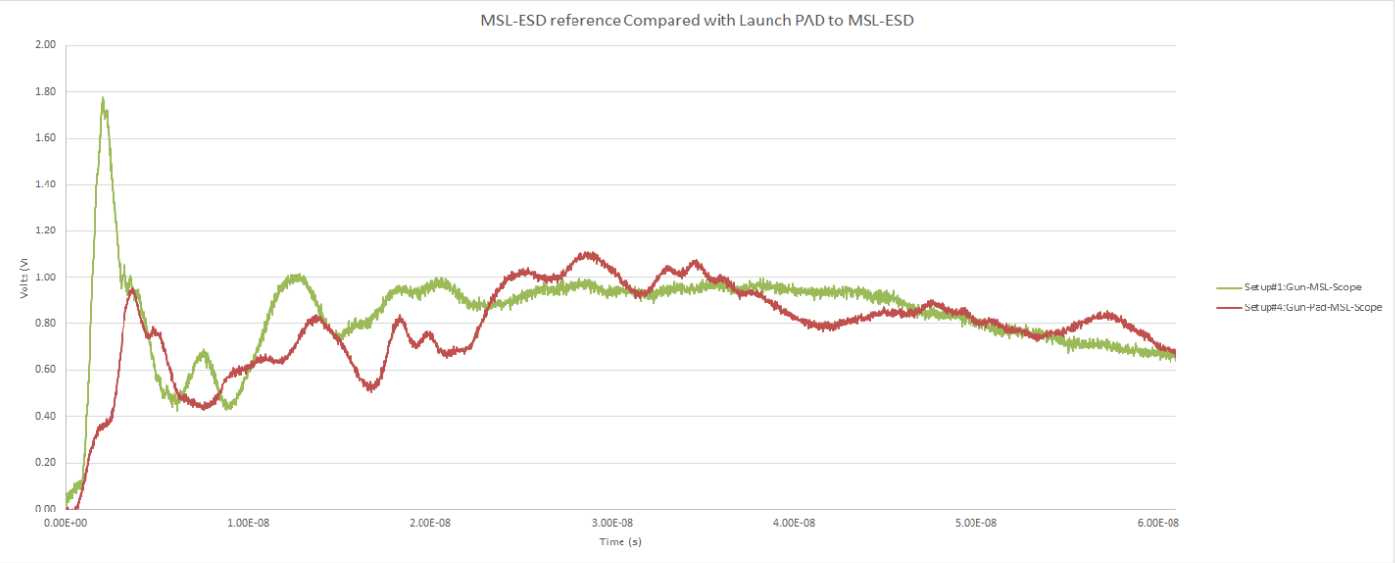
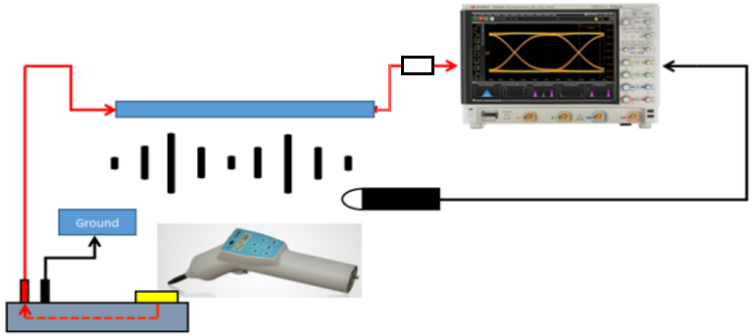
Conducted Launch Pad to MSL-ESD

Setup#4: Conducted Launch PAD ESD validation on MSL-ESD



	#1	#4	%
Peak (V)	1.720	0.929	-46.0
30ns (V)	0.960	1.040	8.3
60ns (V)	0.665	0.707	6.3
SUM	7300.000	6920.000	94.8



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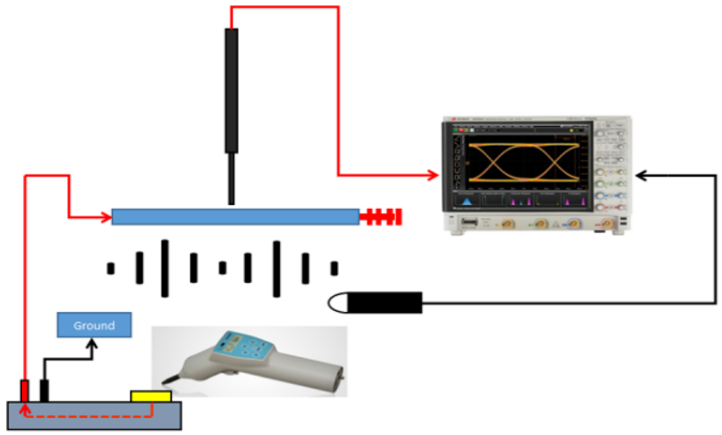
Launch Pad validation

- ESD Gun on Launch Pad to MSL, probe to Oscilloscope
- Setup # 5 Version 2.0 of the HxyESD probe was used

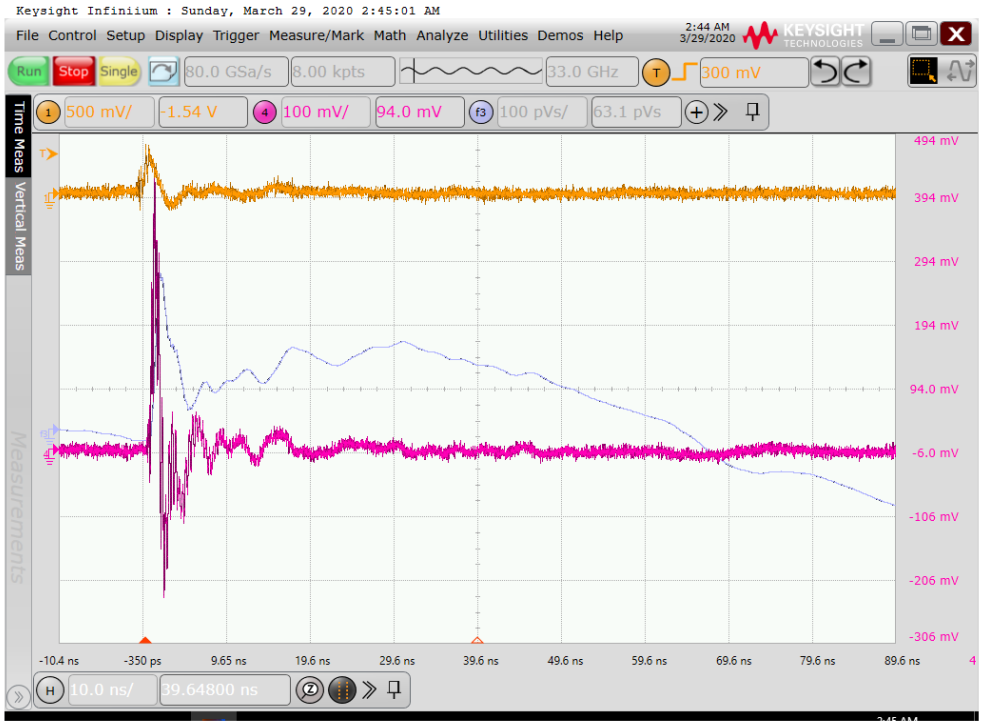
Validation of Launch with ESD Vector Probe

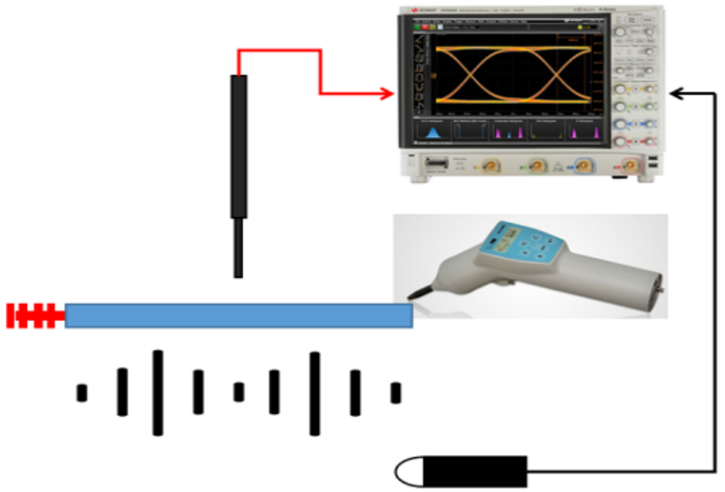


Inducted Measurement (Probe to scope) Wave Form

- Setup7

Validation of Design





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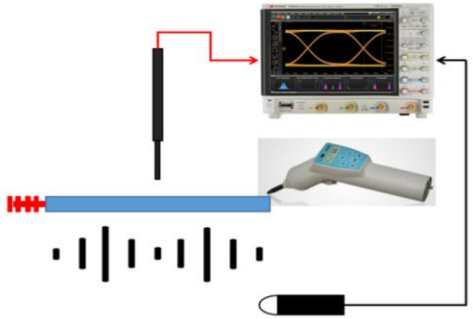
Probe Inducted measurement (mV): Desired Peak Signal to Undesired Signal Peak Noise Analysis

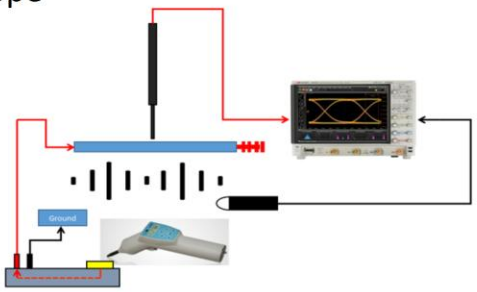
Peak Signal Analysis			
	Gun on MSL	Gun on LPD to MSL	
	Setup#7	Setup#5	% improvement
Desired peak (V)	0.57517	0.13698	
Noise Peak (V)	0.1976	0.02442	
Peak Noise % of Peak Signal	34.4	17.8	16.5

Signal Power Analysis			
	Gun on MSL	Gun on LPD to MSL	
	Setup#7	Setup#5	% improvement
SUM desired Peak	12.865	16.732	
SUM noisePk	-1.351	0.991	
Peak SUM - Noise SUM	14.216	15.742	
Peak Noise % of Peak Signal	9.5	5.9	3.6

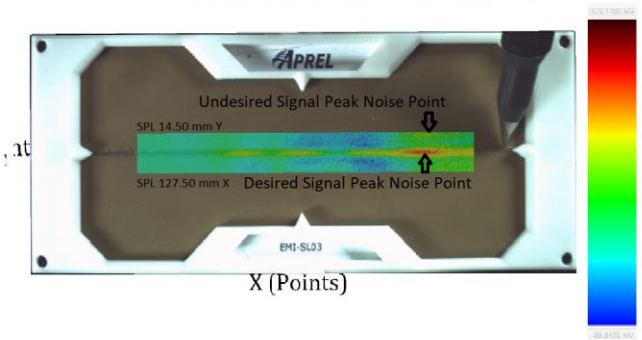
Setup#7: Gun to MSL, probe to Scope



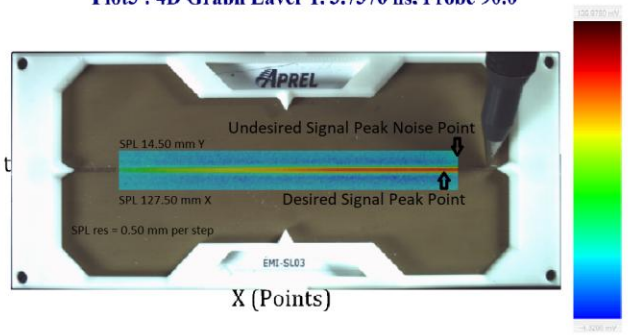
Setup#5: gun to Launch Pad to MSL, probe to Scope

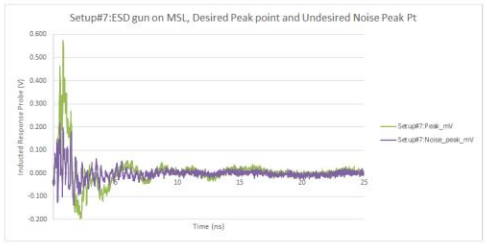


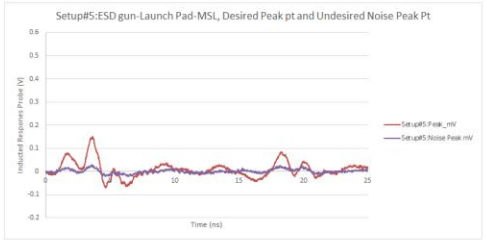
Plot3 : 4D Graph Layer 1, 0.7750 ns, Probe 90.0



Plot3 : 4D Graph Layer 1, 3.7376 ns, Probe 90.0







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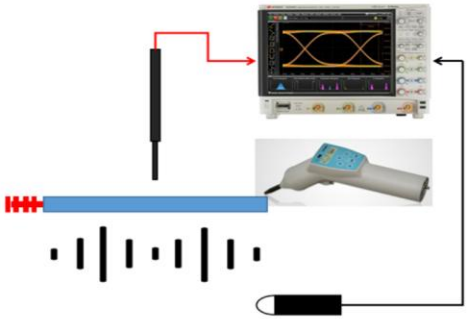
Probe Inducted measurement (integral nsV): Desired Peak Signal to Undesired Signal peak noise Analysis

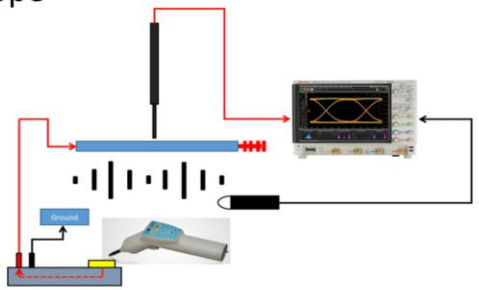
Peak Signal Analysis			
	Gun on MSL	Gun on LPD to MSL	
	Setup#7	Setup#5	% improvement
Desired peak (nsV)	0.37275	0.19595	
Noise Peak (nsV)	0.11268	0.02747	
Peak Noise % of Peak Signal	30.2	14.0	16.2

Signal Power Analysis			
	Gun on MSL	Gun on LPD to MSL	
	Setup#7	Setup#5	% improvement
SUM desired Peak	367.303	265.159	
SUM noisePk	85.979	4.963	
Peak SUM - Noise SUM	281.324	260.196	
Peak Noise % of Peak Signal	23.4	1.9	21.5

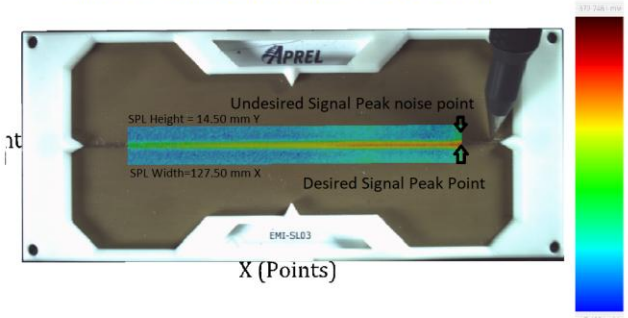
Setup#7: Gun to MSL, probe to Scope



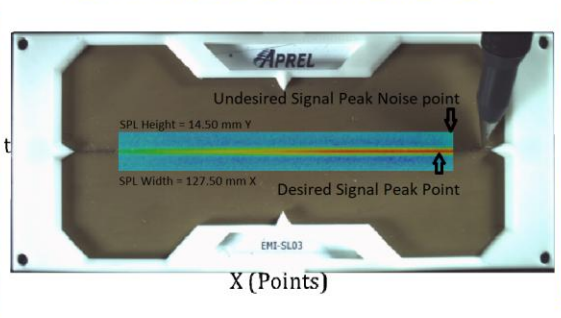
Setup#5: gun to Launch Pad to MSL, probe to Scope

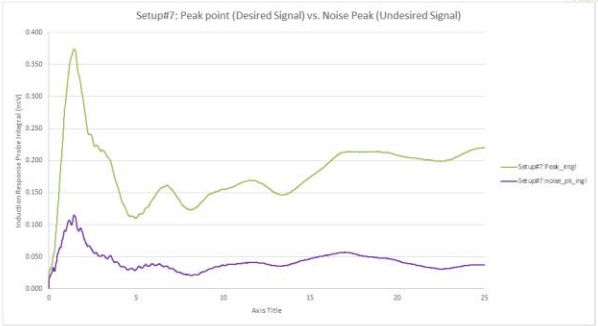


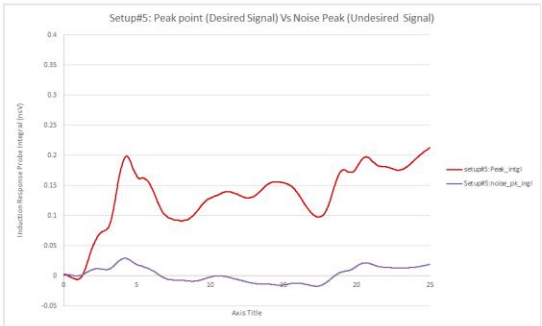
Plot1 : 4D Graph Layer 1, 1.0375 ns, Probe 90.0



Plot3 : 4D Graph Layer 1, 3.7376 ns, Probe 90.0







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Summary

- MSL reference (Setup#1) compared to Launch Pad (setup#2) conducted ESD discharge to scope (Slide 5)
  - 2.9% reduction of peak
  - 3.7% reduction of power
- MSL reference (setup#1) compared to Launch Pad to MSL-ESD (setup #4) conducted Discharge (Slide 7)
  - 46% reduction of peak voltage
  - 5.2% reduction of power
- Probe Inducted Measurement (mV): MSL reference (setup#7) compared to Launch Pad to MSL (setup#5) peak to noise point comparison (Slide 10)
  - Launch Pad ESD Gun Noise to Peak Voltage reduction = 16.5%
  - Launch Pad ESD Gun Noise to Peak Power reduction = 3.6%
- Probe Inducted Measurement integral(nsV): MSL reference (setup#7) compared to Launch Pad to MSL (setup#5) peak to noise point comparison (Slide 11)
  - Launch Pad ESD Gun Noise to Peak Voltage reduction = 16.2%
  - Launch Pad ESD Gun Noise to Peak Power reduction = 21.5%