

# F1951 Transitions

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- AT0139

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# Agenda

- Introduction
- Test Plan
- Test Setup
- Data
- Conclusion



# Introduction

- Customer would like to know if maximum transient is consistent over all states for the F1951 digital step attenuator.
- The F1951 digital step attenuator has 6 bits with a 0.5 dB least significant bit.

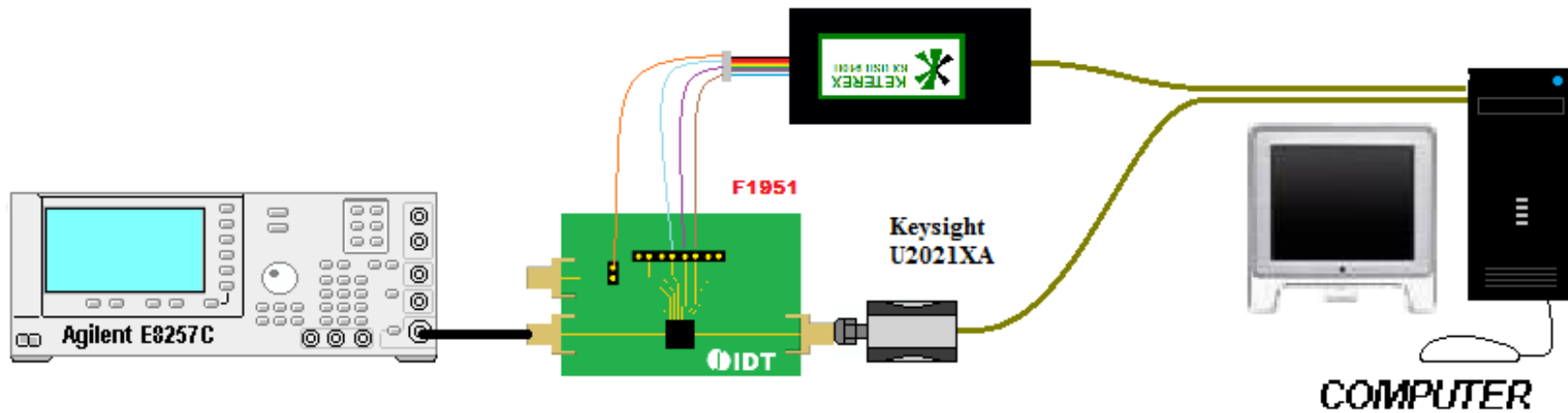


# Test Plan

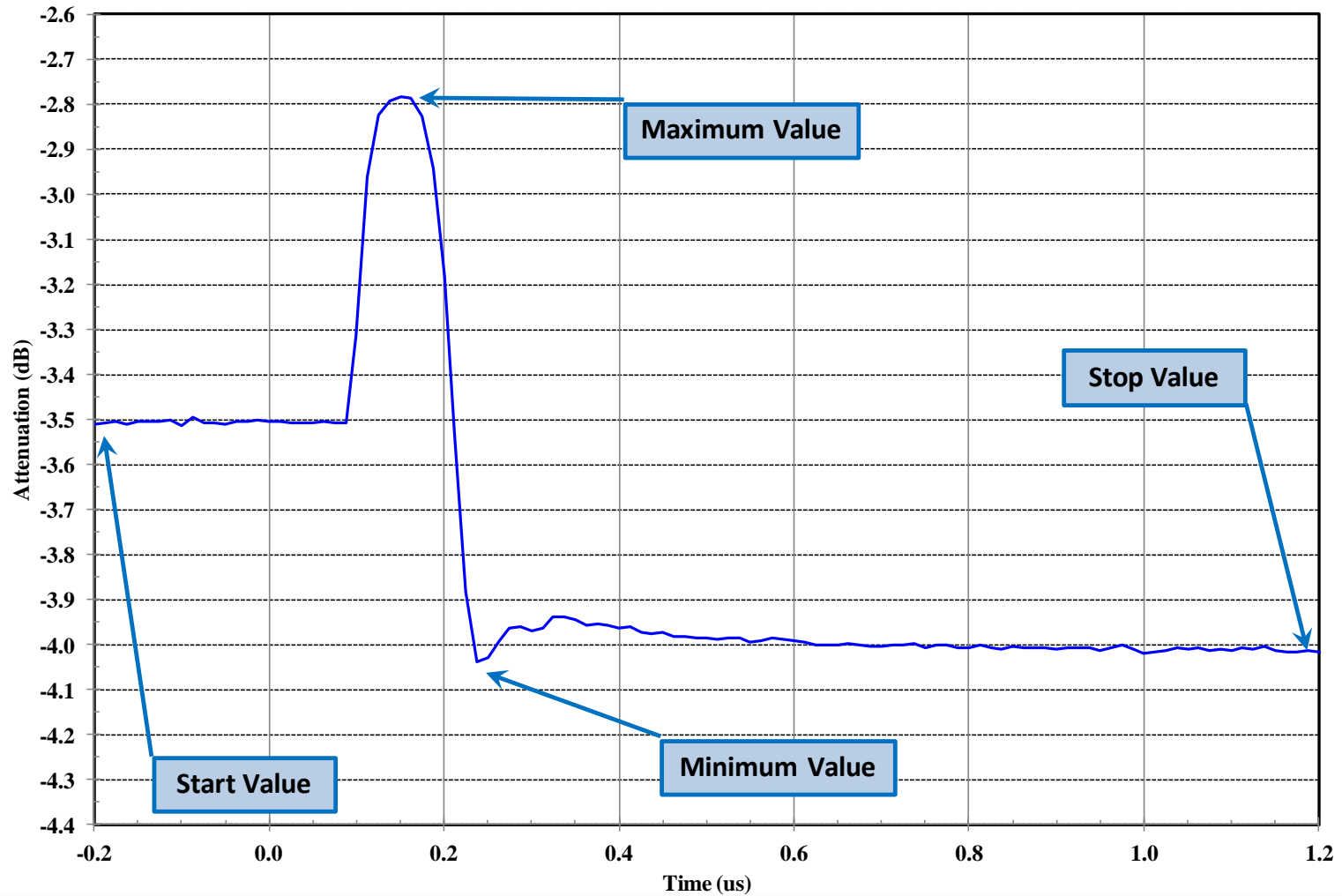
- A six bit device has 2016 transitions.
- This needs to be doubled to account for both directions.
- We can not test all transitions but will select some states transitions that are should yield the worse overshoot.
  
- Data will be taken at 1 GHz.
  - Output Power set for +18 dBm.
- Data will be taken with a Keysight (Agilent) U2021XA peak power detector.
  - Data collection is every 12.5 ns.
  - Power range is -30 to + 20 dBm.



# Test Setup



# General Description of Data



# Data collected

- A total of 106 states (53 transitions) were measure.
  - All major bits turn on with the other bits set to the low logic state.
  - All major bits turn on with the other bits set to the high logic state.
  - Many of 0.5 dB transitions.
  - A few random states.
- Maximum positive peak is 0.741 dB.
- Maximum negative peak is -0.381 dB.
- The following table highlights the maximum peak and transitions within 0.10 dB.



# 0.5 dB Transitions

Start	Stop	Start to Stop Transition						Stop to Start Transition					
		Start Value	Stop Value	Min Value	Max Value	Neg Peak	Pos Peak	Start Value	Stop Value	Min Value	Max Value	Neg Peak	Pos Peak
0.0	0.5	-0.005	-0.490	-0.498	0.000	-0.008	0.004	-0.486	0.003	-0.490	0.012	-0.004	0.008
0.5	1.0	-0.484	-1.015	-1.024	-0.480	-0.009	0.004	-1.018	-0.490	-1.026	-0.481	-0.008	0.009
1.0	1.5	-1.007	-1.527	-1.536	-1.002	-0.010	0.005	-1.522	-1.002	-1.528	-0.992	-0.006	0.009
1.5	2.0	-1.523	-1.999	-2.179	-0.786	-0.180	0.737	-1.989	-1.514	-2.215	-1.372	-0.226	0.142
2.0	2.5	-1.984	-2.475	-2.487	-1.981	-0.012	0.004	-2.470	-1.984	-2.476	-1.975	-0.006	0.009
3.5	4.0	-3.506	-4.007	-4.039	-2.783	-0.033	0.723	-4.003	-3.500	-4.223	-3.349	-0.221	0.151
4.0	4.5	-4.004	-4.490	-4.502	-3.995	-0.012	0.009	-4.480	-3.999	-4.485	-3.987	-0.005	0.012
7.5	8.0	-7.500	-7.986	-8.100	-6.759	-0.114	0.741	-7.980	-7.500	-8.203	-7.241	-0.224	0.259
8.0	8.5	-7.979	-8.454	-8.469	-7.972	-0.015	0.007	-8.459	-7.981	-8.467	-7.967	-0.008	0.014
15.5	16.0	-15.488	-15.976	-15.997	-14.760	-0.021	0.728	-15.968	-15.488	-16.195	-15.197	-0.227	0.290
16.0	16.5	-15.978	-16.444	-16.465	-15.968	-0.021	0.010	-16.452	-15.976	-16.463	-15.964	-0.011	0.012
30.5	31.0	-30.489	-31.021	-31.251	-30.389	-0.230	0.100	-31.018	-30.538	-31.165	-30.274	-0.147	0.264
31.0	31.5	-30.968	-31.456	-31.724	-30.817	-0.268	0.151	-31.518	-30.978	-31.694	-30.813	-0.177	0.165





# 1.0 to 2.0 dB Transitions

Start	Stop	Start to Stop Transition						Stop to Start Transition					
		Start Value	Stop Value	Min Value	Max Value	Neg Peak	Pos Peak	Start Value	Stop Value	Min Value	Max Value	Neg Peak	Pos Peak
0.0	1.0	0.002	-1.017	-1.024	0.006	-0.007	0.004	-1.004	0.008	-1.010	0.016	-0.006	0.008
1.5	2.5	-1.531	-2.487	-2.788	-1.525	-0.301	0.006	-2.470	-1.511	-2.475	-1.327	-0.005	0.183
3.0	4.0	-2.992	-4.015	-4.030	-2.565	-0.015	0.427	-4.005	-2.983	-4.228	-2.941	-0.222	0.042
3.5	4.5	-3.508	-4.496	-4.747	-3.504	-0.250	0.004	-4.483	-3.497	-4.489	-3.298	-0.006	0.199
7.5	8.5	-7.513	-8.467	-8.759	-7.501	-0.292	0.011	-8.463	-7.498	-8.473	-7.216	-0.010	0.282
30.5	31.5	-30.516	-31.575	-31.754	-30.359	-0.179	0.158	-31.533	-30.422	-31.733	-30.272	-0.200	0.151
0.5	2.0	-0.489	-2.017	-2.028	-0.320	-0.011	0.168	-2.003	-0.479	-2.217	-0.471	-0.214	0.009
29.5	31.0	-29.482	-30.989	-31.251	-29.371	-0.262	0.110	-31.016	-29.556	-31.172	-29.316	-0.156	0.240
0.0	2.0	-0.002	-2.019	-2.025	0.002	-0.006	0.004	-1.989	0.023	-1.996	0.032	-0.007	0.008
2.0	4.0	-1.992	-4.030	-4.038	-1.986	-0.008	0.007	-4.006	-1.971	-4.009	-1.962	-0.004	0.009
27.5	29.5	-27.437	-29.473	-29.652	-27.346	-0.179	0.092	-29.486	-27.495	-29.564	-27.373	-0.078	0.121
29.5	31.5	-29.495	-31.450	-31.831	-29.437	-0.381	0.057	-31.487	-29.534	-31.649	-29.335	-0.162	0.199



# 3.5 to 8.5 dB Transitions

Start	Stop	Start to Stop Transition						Stop to Start Transition					
		Start Value	Stop Value	Min Value	Max Value	Neg Peak	Pos Peak	Start Value	Stop Value	Min Value	Max Value	Neg Peak	Pos Peak
0.5	4.0	-0.495	-4.053	-4.063	-0.328	-0.009	0.167	-4.018	-0.457	-4.204	-0.448	-0.186	0.008
27.5	31.0	-27.481	-31.018	-31.224	-27.419	-0.206	0.062	-31.011	-27.478	-31.194	-27.377	-0.183	0.101
0.0	4.0	-0.001	-4.049	-4.059	0.002	-0.009	0.004	-4.004	0.043	-4.008	0.050	-0.003	0.007
4.0	8.0	-3.996	-8.001	-8.017	-3.991	-0.016	0.004	-7.973	-3.976	-7.981	-3.962	-0.007	0.014
23.5	27.5	-15.488	-27.471	-27.599	-15.481	-0.128	0.006	-27.488	-23.464	-27.538	-23.403	-0.051	0.061
27.5	31.5	-27.474	-31.553	-31.754	-27.425	-0.201	0.049	-31.492	-27.467	-31.691	-27.354	-0.199	0.113
2.0	8.0	-1.988	-8.029	-8.040	-1.986	-0.012	0.002	-7.982	-1.950	-7.994	-1.941	-0.011	0.009
23.5	29.5	-23.483	-29.542	-29.654	-23.447	-0.112	0.036	-29.507	-23.467	-29.606	-23.429	-0.099	0.038
0.5	8.0	-0.495	-8.062	-8.076	-0.354	-0.015	0.141	-7.994	-0.439	-8.142	-0.430	-0.148	0.010
8.5	16.0	-8.464	-15.989	-16.006	-8.329	-0.017	0.134	-15.981	-8.444	-16.106	-8.430	-0.125	0.013
23.5	31.0	-23.462	-31.013	-31.276	-23.439	-0.263	0.024	-30.981	-23.474	-31.067	-23.419	-0.086	0.056
0.0	8.0	-0.014	-8.062	-8.082	-0.010	-0.019	0.004	-7.997	0.048	-8.003	0.059	-0.006	0.011
8.0	16.0	-7.978	-15.988	-16.003	-7.969	-0.016	0.008	-15.974	-7.965	-15.986	-7.951	-0.012	0.015
15.5	23.5	-15.491	-23.483	-23.541	-15.481	-0.058	0.011	-23.450	-15.484	-23.490	-15.463	-0.039	0.021
23.5	31.5	-23.462	-31.489	-31.810	-23.441	-0.321	0.021	-31.519	-23.451	-31.621	-23.410	-0.102	0.041
7.5	16.0	-7.506	-16.000	-16.014	-6.811	-0.014	0.695	-15.973	-7.486	-16.108	-7.364	-0.135	0.121



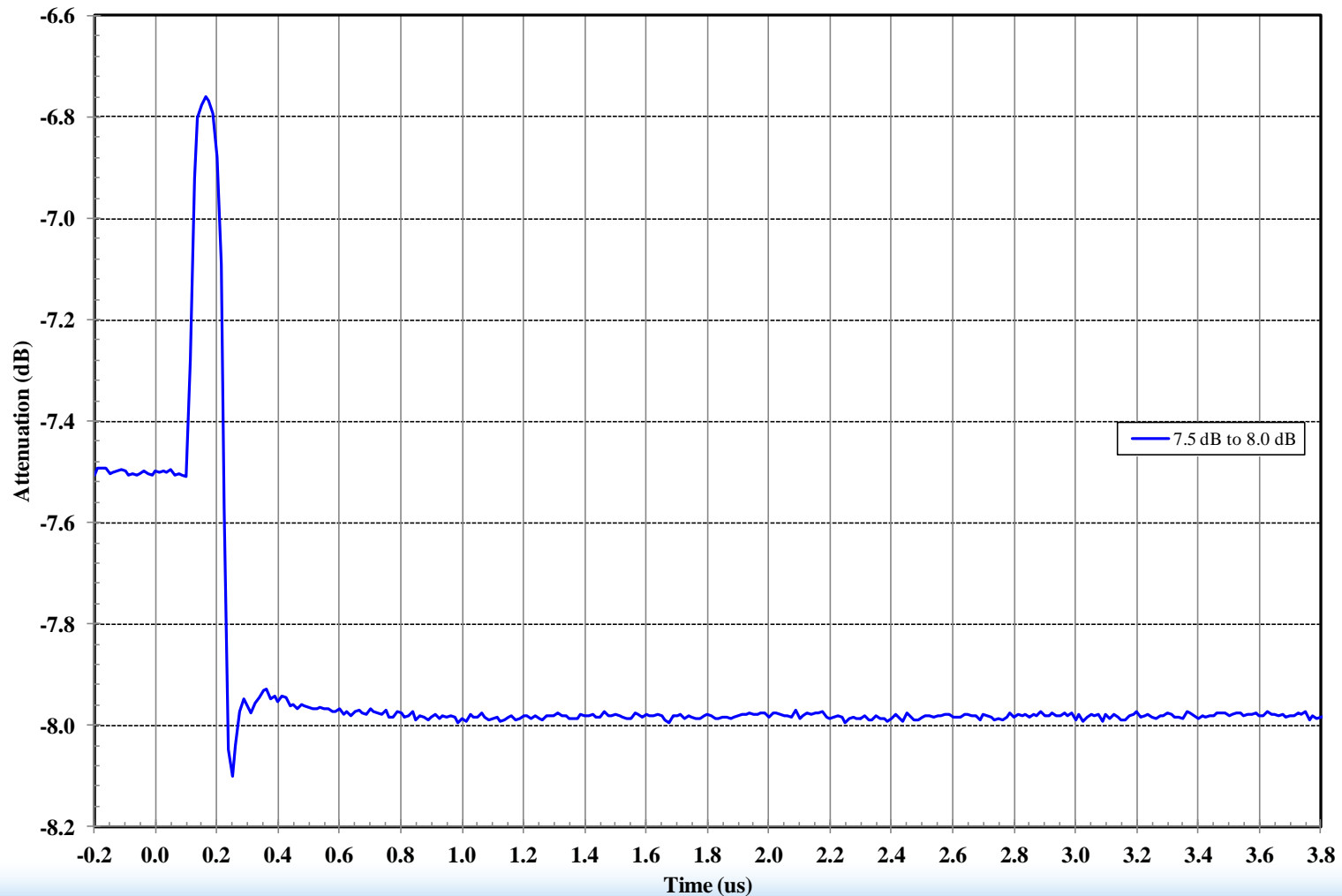
# Greater than 12 dB Transitions

Start	Stop	Start to Stop Transition						Stop to Start Transition					
		Start Value	Stop Value	Min Value	Max Value	Neg Peak	Pos Peak	Start Value	Stop Value	Min Value	Max Value	Neg Peak	Pos Peak
4.0	16.0	-3.999	-16.021	-16.033	-3.996	-0.011	0.004	-15.971	-3.963	-15.979	-3.952	-0.008	0.011
2.0	16.0	-1.990	-16.050	-16.062	-1.986	-0.012	0.004	-15.972	-1.936	-15.981	-1.930	-0.009	0.006
0.5	16.0	-0.497	-16.079	-16.095	-0.384	-0.016	0.114	-15.988	-0.427	-16.036	-0.419	-0.048	0.009
15.5	31.0	-15.505	-31.086	-31.333	-15.498	-0.247	0.007	-31.009	-15.497	-31.089	-15.480	-0.079	0.017
31.5	16.0	-31.491	-15.968	-31.709	-15.956	-0.218	0.012	-15.973	-31.538	-31.835	-15.963	-0.297	0.010
0.0	16.0	-0.003	-16.076	-16.087	0.000	-0.011	0.003	-15.977	0.075	-15.989	0.084	-0.012	0.009
15.5	31.5	-15.501	-31.662	-31.900	-15.489	-0.238	0.013	-31.576	-15.494	-31.716	-15.480	-0.140	0.014
0.0	20.0	0.000	-20.096	-20.123	0.004	-0.027	0.004	-19.963	0.074	-19.986	0.083	-0.024	0.009
8.0	31.5	-7.981	-31.636	-31.971	-7.972	-0.335	0.009	-31.528	-7.961	-31.666	-7.955	-0.139	0.006
4.0	31.5	-4.001	-31.945	-32.229	-3.995	-0.284	0.005	-31.539	-3.971	-31.637	-3.963	-0.097	0.008
2.0	31.5	-1.991	-32.034	-32.298	-1.986	-0.264	0.005	-31.597	-1.939	-31.775	-1.933	-0.179	0.006
0.5	31.5	-0.495	-32.307	-32.425	-0.489	-0.118	0.006	-31.507	-0.429	-31.577	-0.427	-0.071	0.003
0.0	31.5	-0.002	-32.107	-32.486	0.002	-0.379	0.004	-31.433	0.076	-31.610	0.079	-0.178	0.004



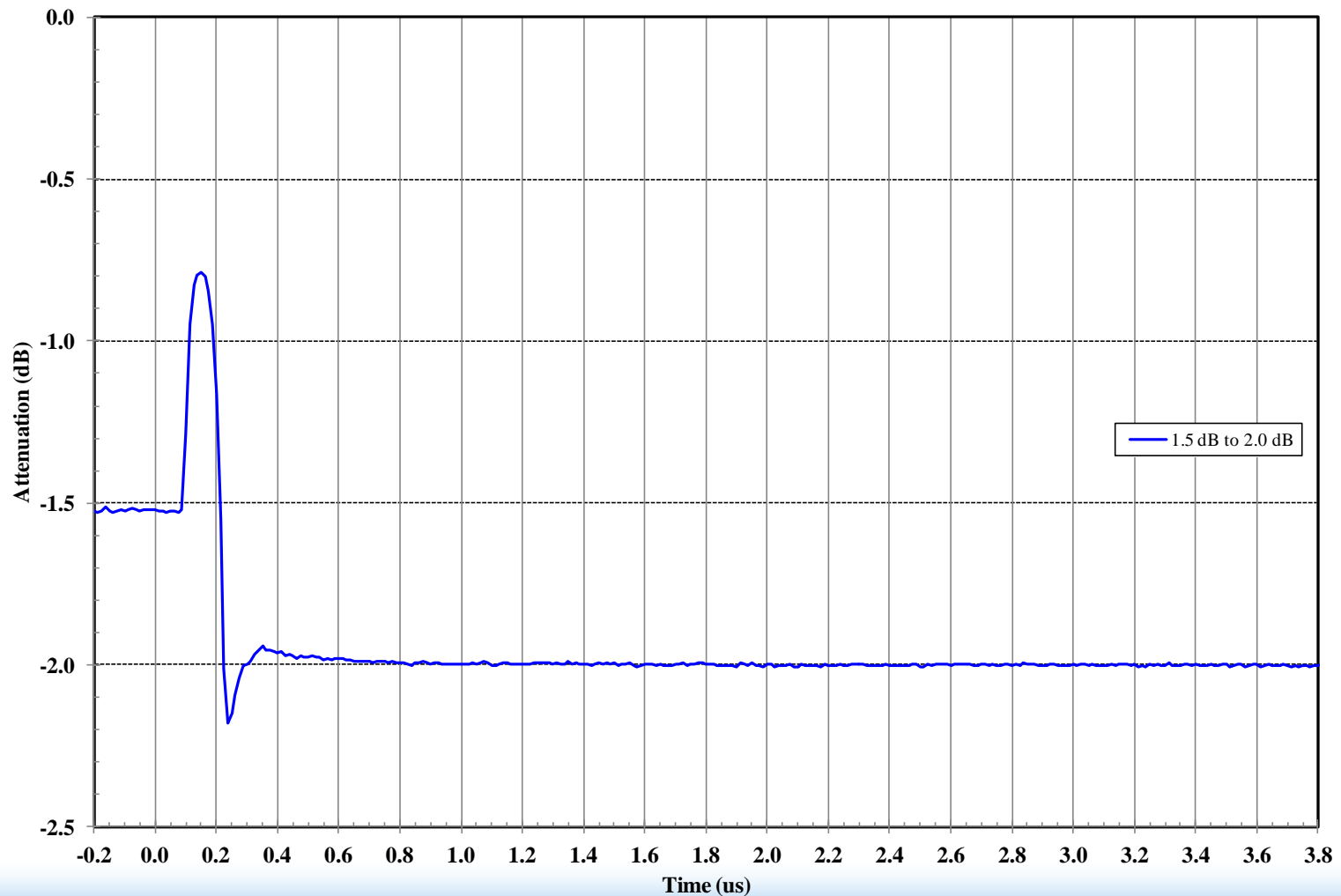
# Maximum Positive Peak: 7.5 to 8.0 dB

F1951 - Transition between  
7.5 dB to 8.0 dB



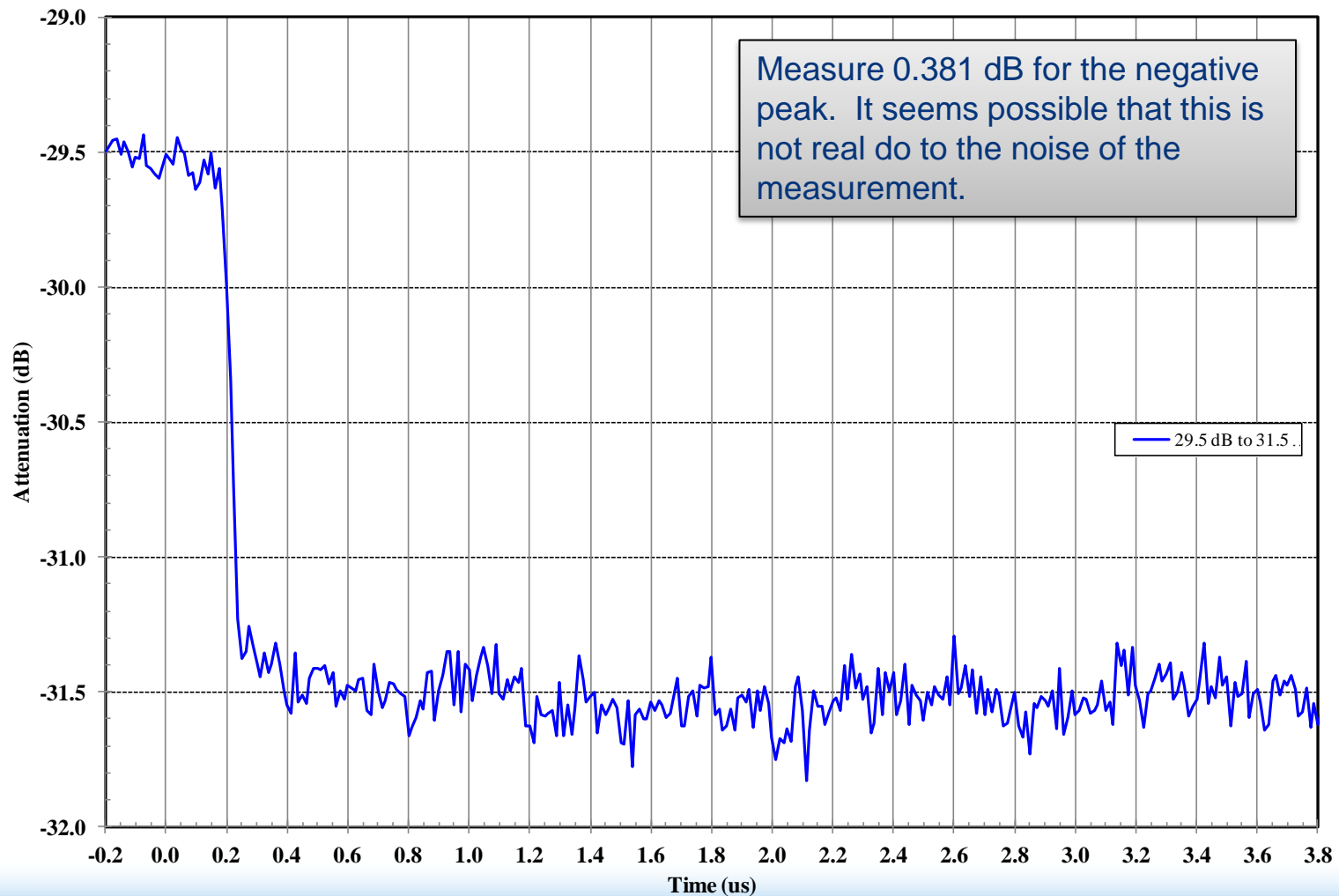
# Maximum Positive Peak: 1.5 to 2.0 dB

F1951 - Transition between  
1.5 dB to 2.0 dB



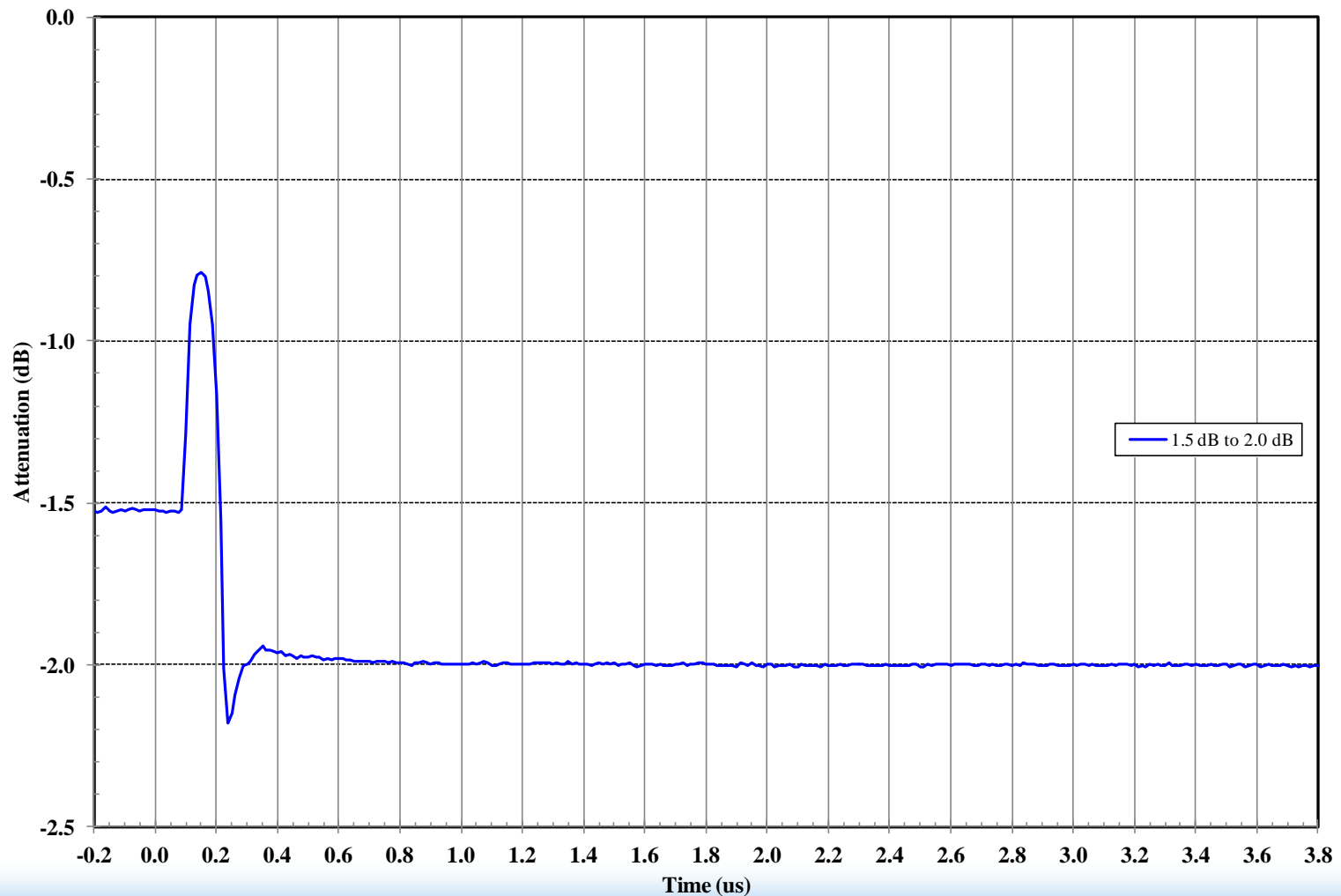
# Maximum Positive Peak: 15.5 to 16.0 dB

F1951 - Transition between  
29.5 dB to 31.5 dB



# Maximum Positive Peak: 1.5 to 2.0 dB

F1951 - Transition between  
1.5 dB to 2.0 dB



# Conclusion

- The maximum positive peak found was 0.741 dB and is consistent with previous measurement.
- The maximum positive peak was also found to occur during the 0.5 dB transition.
- The maximum negative peak found was -0.381 dB and is consistent with previous measurement.
  - Some measurements may not be real due to the noise measured at the high attenuation states ( >29 dB),
- The maximum negative peak was also found to occur during the 0.5 dB transition.

