



Considerations for Transition time and slew time for C2M

January 27th 2021

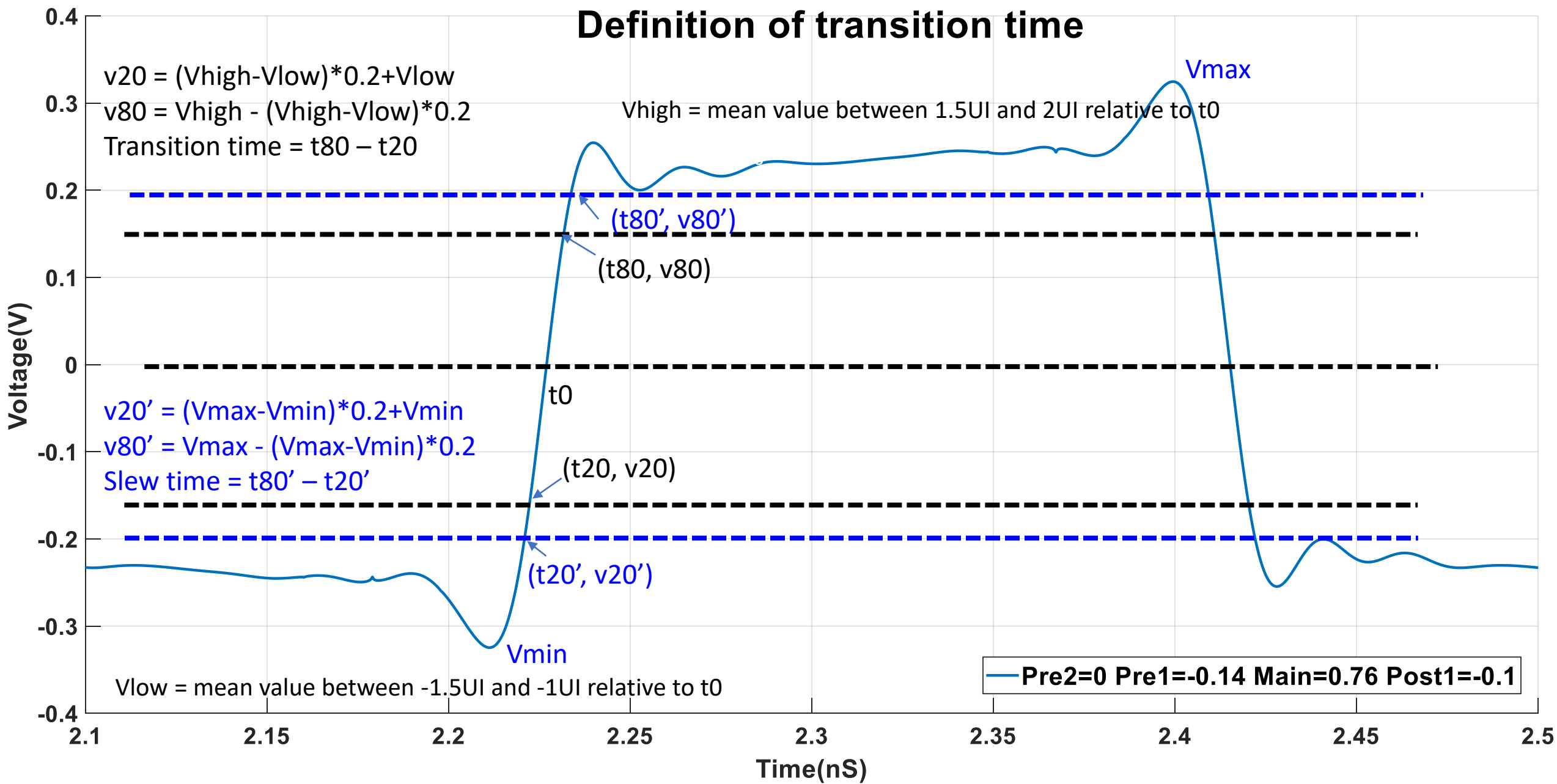
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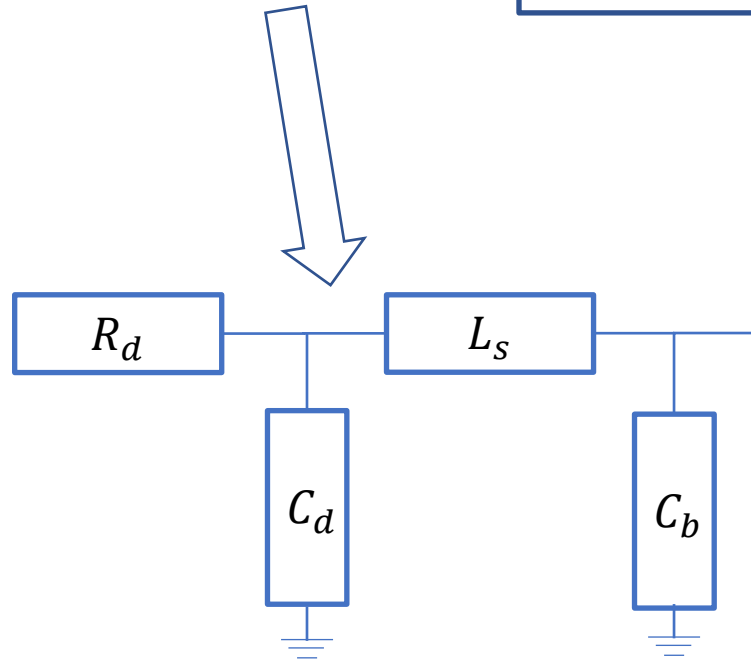
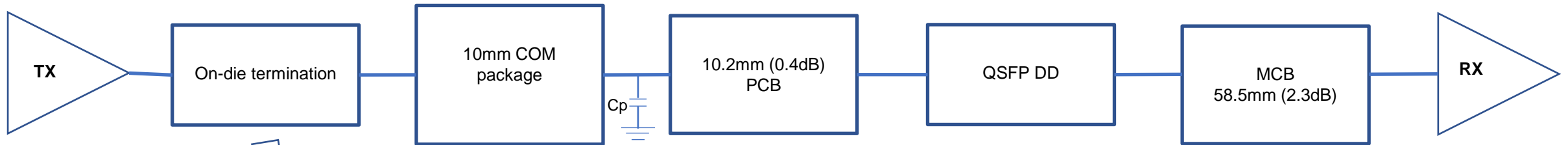
Introduction

- This presentation shows the results of simulations to determine the appropriate minimum transition time and slew rate specifications for the C2M interface.
- The simulation concentrates on the Module to Chip interface, but the Chip to Module using SERDES/Repeater near the connector will have similar results to the near-end results presented.
- For the purposes of this presentation it is assumed that slew time thresholds are 20-80% of the peak to peak voltage.

Definition of transition time



Module to Chip Near-end Block Diagram



On-die inductor termination

Parameter	Setting	Unit
Rd	50	Ohm
Cd	0.085	pF
Ls	120	pH
Cb	0.03	pH
Cp	0.065	pH

Far end replaces the MCB with a 2.3dB+9.6dB trace i.e. 303.2mm long.

Transition time and Slew time simulated results:

Cpre2	Cpre1	Cmain	Cpost1	Transition Time(pS)	Pk2Pk(V)	Slew Time(pS)	Near end VEC(dB)	Near end VEO(mV)	Far end VEC(dB)	Far end VEO(mV)
0.00	-0.08	0.82	-0.10	10.152	0.575	12.168	37.716	2.054	10.343	19.578
0.00	-0.08	0.83	-0.09	10.382	0.59	12.398	25.153	8.842	10.245	20.082
0.00	-0.08	0.84	-0.08	10.529	0.606	12.629	20.316	15.641	10.29	20.315
0.00	-0.08	0.85	-0.07	10.713	0.622	12.861	17.311	22.4	10.113	20.961
0.00	-0.08	0.86	-0.06	10.901	0.637	13.102	12.096	40.418	10.048	21.406
0.00	-0.08	0.87	-0.05	11.084	0.653	13.343	9.931	52.894	10.005	21.8
0.00	-0.08	0.88	-0.04	11.306	0.668	13.588	9.082	59.069	9.956	22.215
0.00	-0.08	0.89	-0.03	11.488	0.684	13.838	8.684	62.614	10.397	19.441
0.00	-0.08	0.90	-0.02	11.672	0.699	14.097	8.218	66.637	10.326	19.853
0.00	-0.08	0.91	-0.01	11.854	0.715	14.359	8.077	68.328	10.265	20.244
0.00	-0.08	0.92	0.00	11.996	0.731	14.627	8.12	68.806	10.21	20.625

* Slew times thresholds are 20% and 80% of the Pk2Pk(V)

Transition time and Slew time simulated results:

Cpre2	Cpre1	Cmain	Cpost1	Transition Time(pS)	Pk2Pk(V)	Slew Time(pS)	Near end VEC(dB)	Near end VEO(mV)	Far end VEC(dB)	Far end VEO(mV)
0.02	-0.14	0.68	-0.16	7.629	0.419	10.463	Closed eye	Closed eye	37.854	0.719
0.02	-0.14	0.69	-0.15	7.875	0.434	10.716	Closed eye	Closed eye	13.67	11.83
0.02	-0.14	0.7	-0.14	8.121	0.45	10.975	Closed eye	Closed eye	11.69	15.141
0.02	-0.14	0.71	-0.13	8.403	0.465	11.232	Closed eye	Closed eye	10.156	18.401
0.02	-0.14	0.72	-0.12	8.636	0.481	11.497	Closed eye	Closed eye	8.879	21.624
0.02	-0.14	0.73	-0.11	8.825	0.496	11.762	Closed eye	Closed eye	8.087	24.03
0.02	-0.14	0.74	-0.1	9.097	0.511	12.031	Closed eye	Closed eye	7.926	24.829
0.02	-0.14	0.75	-0.09	9.323	0.527	12.309	Closed eye	Closed eye	8.034	23.795
0.02	-0.14	0.76	-0.08	9.55	0.542	12.589	Closed eye	Closed eye	7.901	24.565
0.02	-0.14	0.77	-0.07	9.773	0.557	12.875	Closed eye	Closed eye	7.79	25.209
0.02	-0.14	0.78	-0.06	10.035	0.573	13.172	Closed eye	Closed eye	7.743	25.756
0.02	-0.14	0.79	-0.05	10.255	0.588	13.473	Closed eye	Closed eye	7.724	26.223
0.02	-0.14	0.8	-0.04	10.473	0.604	13.784	44.738	0.916	7.677	27.936
0.02	-0.14	0.81	-0.03	10.687	0.619	14.105	22.206	12.539	7.87	24.531
0.02	-0.14	0.82	-0.02	10.904	0.635	14.442	18.918	18.573	7.784	25.143
0.02	-0.14	0.83	-0.01	11.119	0.65	14.788	16.633	24.506	7.728	25.674
0.02	-0.14	0.84	0	11.373	0.665	15.151	14.877	30.419	7.691	26.156

* Slew times thresholds are 20% and 80% of the Pk2Pk(V)

Mated MCB/HCB (to generate crosstalk for testing output and calibrating stressed input).

Source risetime(pS)	Cpre2	Cpre1	Cmain	Cpost1	Transition Time(pS)	Pk2Pk(V)	Slew Time(pS)	Source risetime(pS)	Cpre2	Cpre1	Cmain	Cpost1	Transition Time(pS)	Pk2Pk(V)	Slew Time(pS)
7	0	-0.3	1	-0.3	6.753	0.581	11.093	10	0	-0.3	1	-0.3	7.933	0.541	12.082
7	0	-0.3	1	-0.25	7.429	0.62	12.082	10	0	-0.3	1	-0.25	8.715	0.58	13.246
7	0	-0.3	1	-0.2	8.194	0.659	13.304	10	0	-0.3	1	-0.2	9.556	0.619	14.698
7	0	-0.3	1	-0.15	8.961	0.698	15.005	10	0	-0.3	1	-0.15	10.351	0.658	16.755
7	0	-0.3	1	-0.1	9.773	0.736	67.001	10	0	-0.3	1	-0.1	11.314	0.697	43.538
7	0	-0.25	1	-0.3	7.24	0.569	10.761	10	0	-0.25	1	-0.3	8.498	0.534	11.727
7	0	-0.25	1	-0.25	7.909	0.608	11.623	10	0	-0.25	1	-0.25	9.229	0.573	12.736
7	0	-0.25	1	-0.2	8.63	0.647	12.64	10	0	-0.25	1	-0.2	9.979	0.612	13.923
7	0	-0.25	1	-0.15	9.353	0.685	13.899	10	0	-0.25	1	-0.15	10.804	0.651	15.394
7	0	-0.25	1	-0.1	10.155	0.724	15.629	10	0	-0.25	1	-0.1	11.628	0.69	17.397
7	0	-0.2	1	-0.3	7.712	0.584	11.118	10	0	-0.2	1	-0.3	9.076	0.537	11.72
7	0	-0.2	1	-0.25	8.367	0.598	11.321	10	0	-0.2	1	-0.25	9.751	0.568	12.421
7	0	-0.2	1	-0.2	9.084	0.637	12.208	10	0	-0.2	1	-0.2	10.448	0.607	13.451
7	0	-0.2	1	-0.15	9.795	0.675	13.25	10	0	-0.2	1	-0.15	11.259	0.646	14.659
7	0	-0.2	1	-0.1	10.545	0.714	14.541	10	0	-0.2	1	-0.1	12.068	0.685	16.136
7	0	-0.15	1	-0.3	8.306	0.618	11.947	10	0	-0.15	1	-0.3	9.667	0.57	12.568
7	0	-0.15	1	-0.25	8.92	0.596	11.272	10	0	-0.15	1	-0.25	10.283	0.566	12.267
7	0	-0.15	1	-0.2	9.552	0.63	11.945	10	0	-0.15	1	-0.2	10.968	0.606	13.192
7	0	-0.15	1	-0.15	10.248	0.668	12.858	10	0	-0.15	1	-0.15	11.716	0.645	14.244
7	0	-0.15	1	-0.1	10.988	0.707	13.928	10	0	-0.15	1	-0.1	12.467	0.684	15.471
7	0	-0.1	1	-0.3	8.935	0.651	12.863	10	0	-0.1	1	-0.3	10.308	0.604	13.479
7	0	-0.1	1	-0.25	9.499	0.63	12.077	10	0	-0.1	1	-0.25	10.873	0.587	12.745
7	0	-0.1	1	-0.2	10.113	0.626	11.834	10	0	-0.1	1	-0.2	11.537	0.609	13.132
7	0	-0.1	1	-0.15	10.758	0.665	12.658	10	0	-0.1	1	-0.15	12.228	0.648	14.08
7	0	-0.1	1	-0.1	11.477	0.704	13.6	10	0	-0.1	1	-0.1	12.997	0.687	15.157

Conclusions

- Specifying a minimum transition time much longer than 7.5ps would significantly impact module design, however it could probably be increased to 8.5 or 9 ps without significant impact.
- With emphasis the slew time is always slower than the transition time (if the slew time thresholds are 20/80% of the peak to peak voltage) and there are no advantages to using slew time.
- **Propose to use transition time with a value of 8.5ps for all the specifications.** Suggest to evaluate whether a slower value should be used for crosstalk for far end (equivalent to long host output) in working group ballot.
- Significantly increasing post tap degrades VEO and VEC even for far end in these results but the peak to peak voltage is dropping. See next slide.

Transition time and Slew time simulated results:

A _v (V)	Cpre2	Cpre1	Cmain	Cpost1	Transition Time(pS)	Pk2Pk(V)	Slew Time(pS)	Near end VEC(dB)	Near end VEO(mV)	Far end VEC(dB)	Far end VEO(mV)
0.659	0.020	-0.140	0.680	-0.160	7.599	0.665	10.463	2.451	-154.493	31.627	2.34
0.636	0.020	-0.140	0.690	-0.150	7.893	0.666	10.716	3.11	-140.771	13.159	19.228
0.614	0.020	-0.140	0.700	-0.140	8.142	0.665	10.975	3.795	-127.884	11.308	23.407
0.594	0.020	-0.140	0.710	-0.130	8.384	0.666	11.232	4.509	-115.996	9.864	27.237
0.575	0.020	-0.140	0.720	-0.120	8.600	0.666	11.497	7.725	-79.672	8.632	30.827
0.558	0.020	-0.140	0.730	-0.110	8.837	0.667	11.762	8.799	-69.477	7.879	33.095
0.540	0.020	-0.140	0.740	-0.100	9.080	0.665	12.031	9.969	-59.743	7.738	33.016
0.524	0.020	-0.140	0.750	-0.090	9.342	0.665	12.309	11.261	-50.778	7.86	30.651
0.510	0.020	-0.140	0.760	-0.080	9.551	0.666	12.589	12.715	-42.477	7.749	30.721
0.495	0.020	-0.140	0.770	-0.070	9.800	0.665	12.875	14.402	-34.49	7.664	30.509
0.482	0.020	-0.140	0.780	-0.060	10.059	0.665	13.172	16.401	-27.094	7.633	30.294
0.469	0.020	-0.140	0.790	-0.050	10.228	0.665	13.473	18.918	-20.036	7.635	29.938
0.458	0.020	-0.140	0.800	-0.040	10.472	0.666	13.784	43.414	1.177	7.608	31.077
0.446	0.020	-0.140	0.810	-0.030	10.726	0.665	14.105	22.131	13.593	7.81	26.545
0.436	0.020	-0.140	0.820	-0.020	10.904	0.667	14.442	18.889	19.579	7.745	26.533
0.425	0.020	-0.140	0.830	-0.010	11.123	0.666	14.788	16.627	25.113	7.704	26.367
0.415	0.020	-0.140	0.840	0.000	11.373	0.665	15.151	14.877	30.419	7.691	26.156

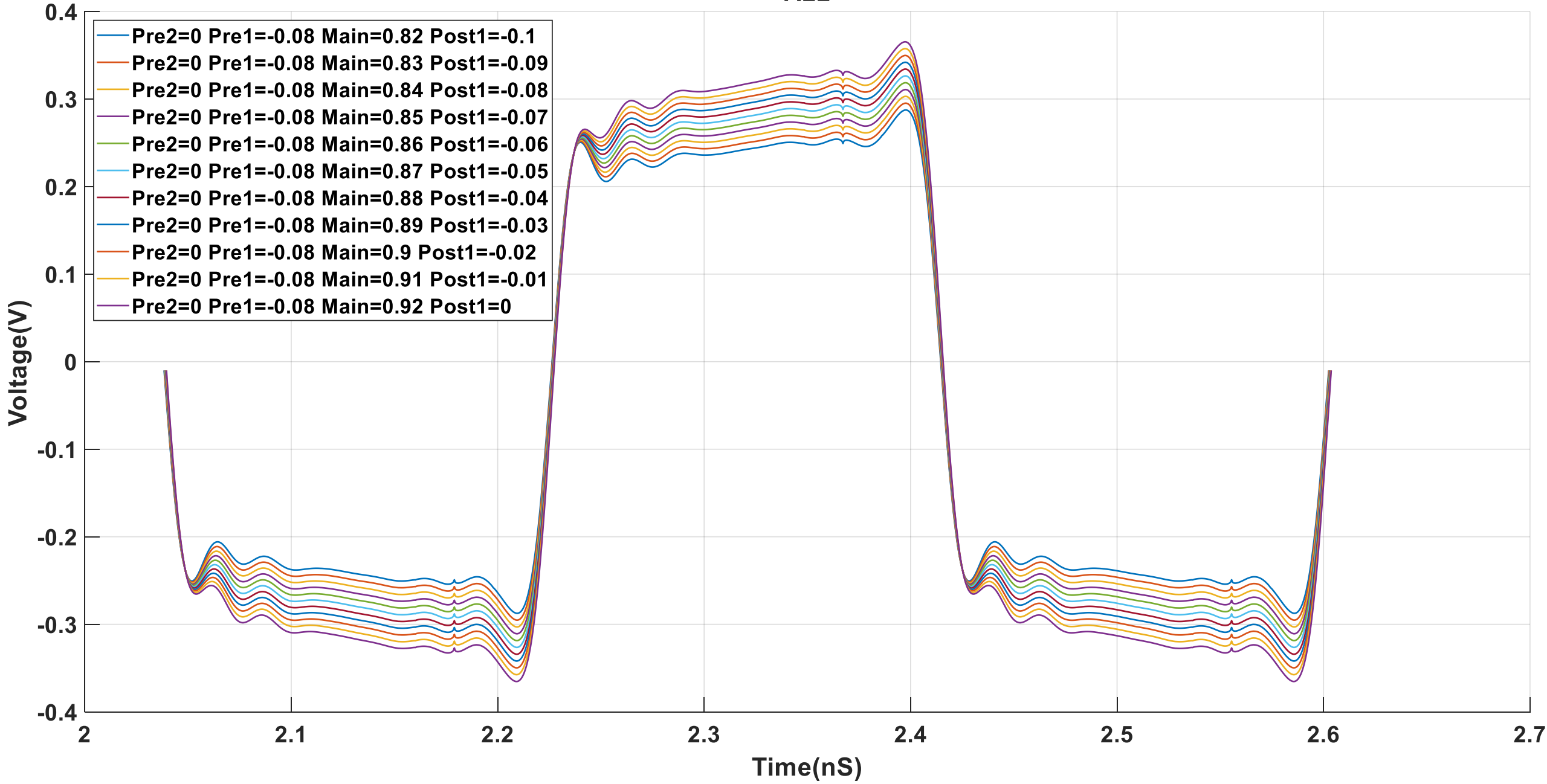
* Slew times thresholds are 20% and 80% of the Pk2Pk(V)

Extra Conclusion

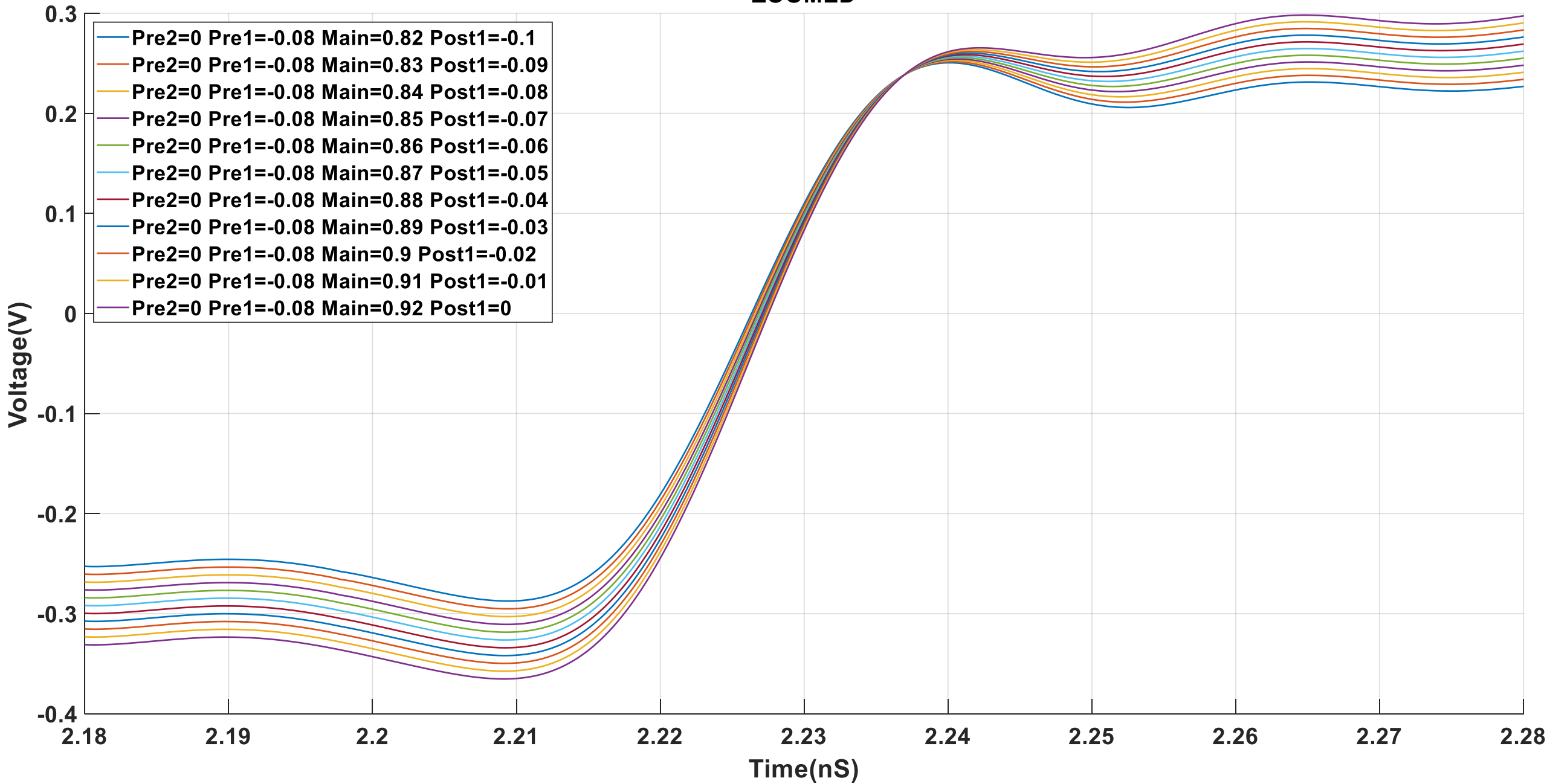
- Increasing the post-tap improves VEC and VEO for the same peak to peak output amplitude for the far-end results but not by much.

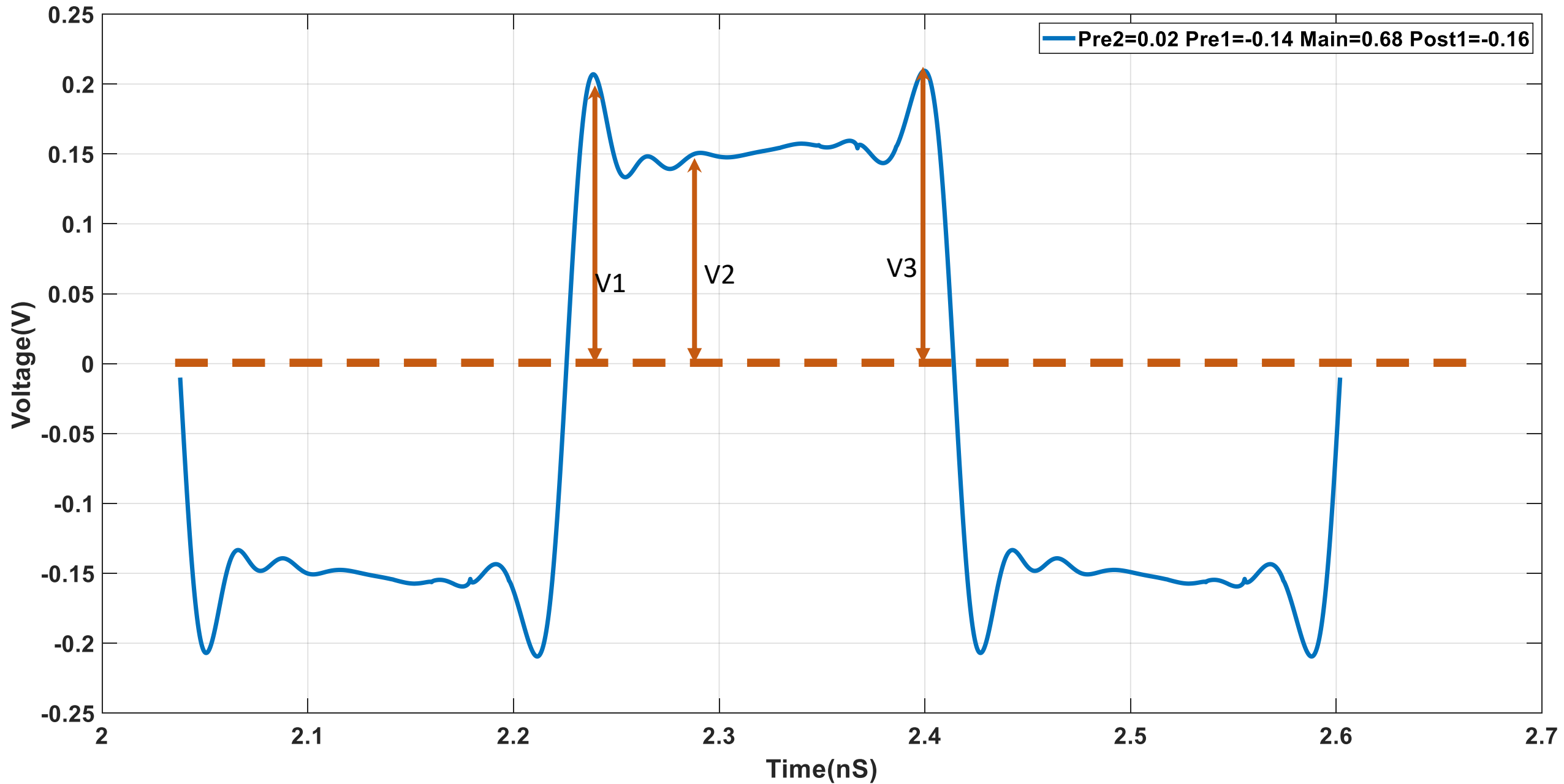
Backup.

ALL



ZOOMED





TX FIR settings:

Cpre2 = 0

Cpre1 = -0.08

Cpost1 = -0.1 to 0 w/step of 0.01

Cpre1	Cmain	Cpost1	0% level (V)	100% level (V)	Transition Time(pS)	V1(V)	V2(V)	V3(V)	V1/V2	V3/V2	Vmax(V)	Vmin(V)	Pk2Pk(V)	Slew Time(pS)
-0.08	0.82	-0.1	-0.273	0.221	10.152	0.251	0.232	0.287	1.082	1.241	0.287	-0.287	0.575	12.168
-0.08	0.83	-0.09	-0.281	0.228	10.382	0.252	0.239	0.295	1.055	1.238	0.295	-0.295	0.59	12.398
-0.08	0.84	-0.08	-0.289	0.234	10.529	0.253	0.246	0.303	1.03	1.234	0.303	-0.303	0.606	12.629
-0.08	0.85	-0.07	-0.298	0.241	10.713	0.254	0.253	0.311	1.007	1.23	0.311	-0.311	0.622	12.861
-0.08	0.86	-0.06	-0.306	0.248	10.901	0.256	0.26	0.319	0.985	1.227	0.319	-0.319	0.637	13.102
-0.08	0.87	-0.05	-0.314	0.255	11.084	0.257	0.267	0.326	0.964	1.224	0.326	-0.326	0.653	13.343
-0.08	0.88	-0.04	-0.322	0.262	11.306	0.259	0.274	0.334	0.945	1.221	0.334	-0.334	0.668	13.588
-0.08	0.89	-0.03	-0.33	0.268	11.488	0.26	0.281	0.342	0.927	1.218	0.342	-0.342	0.684	13.838
-0.08	0.9	-0.02	-0.339	0.275	11.672	0.262	0.288	0.35	0.91	1.216	0.35	-0.35	0.699	14.097
-0.08	0.91	-0.01	-0.347	0.282	11.854	0.264	0.295	0.358	0.894	1.213	0.358	-0.358	0.715	14.359
-0.08	0.92	0	-0.355	0.289	11.996	0.265	0.302	0.365	0.879	1.21	0.365	-0.365	0.731	14.627

TX FIR settings:

Cpre2 = 0.02

Cpre1 = -0.14

Cpost1 = -0.16 to 0 w/step of 0.01

Cpre2	Cpre1	Cmain	Cpost1	0% level (V)	100% level (V)	Transition Time(pS)	V1(V)	V2(V)	V3(V)	V1/V2	V3/V2	Vmax(V)	Vmin(V)	Pk2Pk(V)	Slew Time(pS)
0.02	-0.14	0.68	-0.16	-0.174	0.14	7.629	0.207	0.146	0.21	1.416	1.434	0.21	-0.21	0.419	10.463
0.02	-0.14	0.69	-0.15	-0.183	0.147	7.875	0.208	0.153	0.217	1.356	1.418	0.217	-0.217	0.434	10.716
0.02	-0.14	0.7	-0.14	-0.192	0.153	8.121	0.208	0.16	0.225	1.302	1.405	0.225	-0.225	0.45	10.975
0.02	-0.14	0.71	-0.13	-0.201	0.16	8.403	0.209	0.167	0.233	1.252	1.392	0.233	-0.233	0.465	11.232
0.02	-0.14	0.72	-0.12	-0.209	0.167	8.636	0.21	0.174	0.24	1.207	1.38	0.24	-0.24	0.481	11.497
0.02	-0.14	0.73	-0.11	-0.217	0.174	8.825	0.211	0.181	0.248	1.165	1.369	0.248	-0.248	0.496	11.762
0.02	-0.14	0.74	-0.1	-0.226	0.18	9.097	0.212	0.188	0.256	1.127	1.359	0.256	-0.256	0.511	12.031
0.02	-0.14	0.75	-0.09	-0.235	0.187	9.323	0.213	0.195	0.263	1.092	1.35	0.263	-0.263	0.527	12.309
0.02	-0.14	0.76	-0.08	-0.243	0.194	9.55	0.214	0.202	0.271	1.06	1.341	0.271	-0.271	0.542	12.589
0.02	-0.14	0.77	-0.07	-0.252	0.201	9.773	0.215	0.209	0.279	1.03	1.333	0.279	-0.279	0.557	12.875
0.02	-0.14	0.78	-0.06	-0.26	0.208	10.035	0.217	0.216	0.286	1.002	1.325	0.286	-0.286	0.573	13.172
0.02	-0.14	0.79	-0.05	-0.268	0.214	10.255	0.218	0.223	0.294	0.977	1.318	0.294	-0.294	0.588	13.473
0.02	-0.14	0.8	-0.04	-0.277	0.221	10.473	0.219	0.23	0.302	0.953	1.311	0.302	-0.302	0.604	13.784
0.02	-0.14	0.81	-0.03	-0.286	0.228	10.687	0.221	0.237	0.31	0.931	1.305	0.31	-0.31	0.619	14.105
0.02	-0.14	0.82	-0.02	-0.294	0.235	10.904	0.223	0.244	0.317	0.911	1.299	0.317	-0.317	0.635	14.442
0.02	-0.14	0.83	-0.01	-0.302	0.242	11.119	0.224	0.251	0.325	0.892	1.293	0.325	-0.325	0.65	14.788
0.02	-0.14	0.84	0	-0.311	0.249	11.373	0.226	0.258	0.333	0.875	1.287	0.333	-0.333	0.665	15.151