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Stanford Research Systems

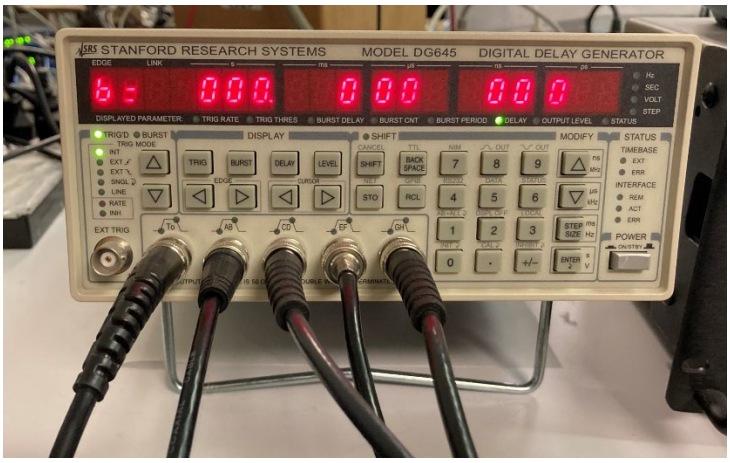
SIM980 Typical Propagation Delay and Jitter

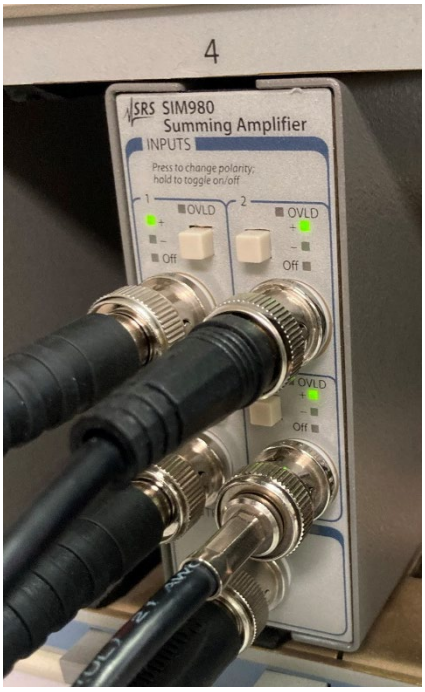
A DG645 Digital Delay Generator was used to characterize a production model SIM980 Summing Amplifier for pulse propagation delay and jitter. This note summarizes the results.

Setup

A DG645 was configured in internal trigger mode, with a repetition rate of 10 kHz. 4 delayed pulses were generated, at T0 + 0µs, T0 + 1µs, T0 + 2µs, and T0 + 3µs. Each pulse was initially configured for 500ns duration, and amplitude -2 V (negative-going pulses). Jitter (15 ps) and rise/fall time (< 2ns) of the DG645 are negligible compared to the 1 MHz signal bandwidth and 40 V/µs input slew rate of the SIM980, and are ignored.

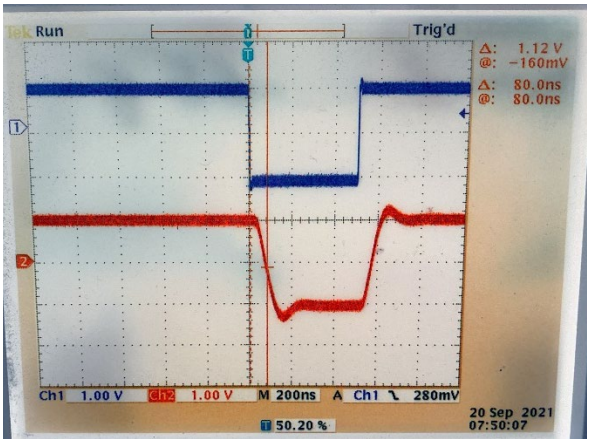
The four pulse outputs of the DG645 (AB, CD, EF, and GH) were connected to the four input BNCs of the SIM980. Each SIM980 channel was configured for non-inverting input, and enabled. An oscilloscope (Tektronix TDS30345, 300 MHz) was triggered by the T0 output of the DG645, and the output of the SIM980 separately measured by the 'scope.

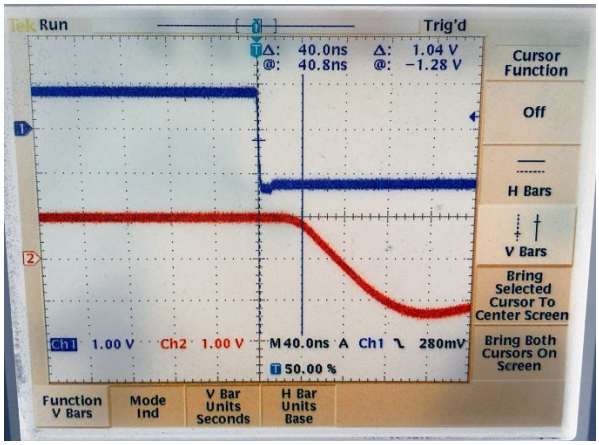




Propagation Delay

To measure propagation delay, two channels of the DG645 were first aligned in time to coincide on the scope display within < 2 ns, with the second channel connected through two RG-58 cables coupled by a BNC "barrel". Once timing was established, the barrel was removed, and the section of coax coming from the DG645 was connected to the input of the SIM980, while the second length, leading to the scope, was connected to the SIM980 output. The following scope traces are the result:



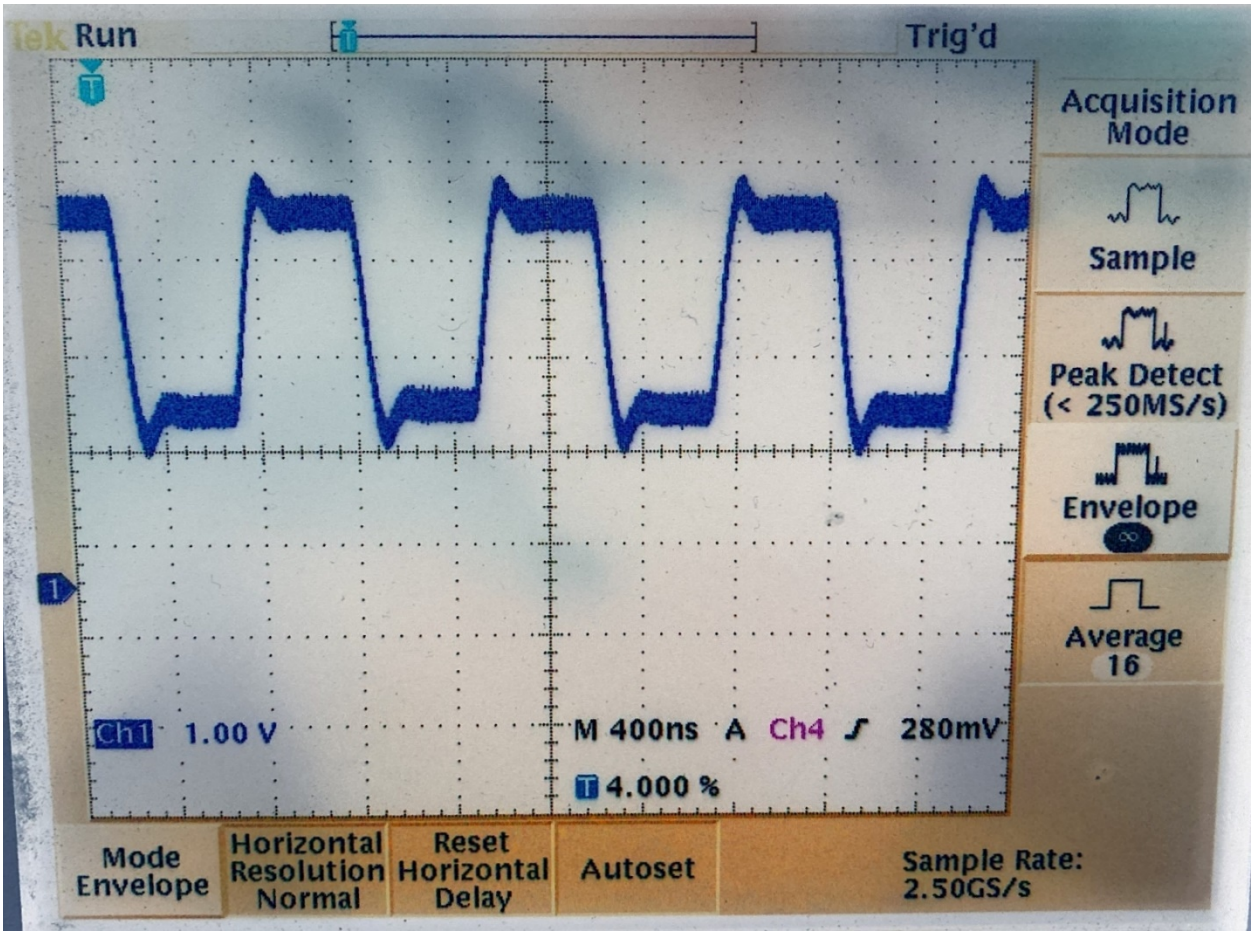


From the first trace, the propagation delay from input to the 50% output point is seen as 80 ns; while the second trace shows the delay from the input to the beginning of output transition of about 40 ns. This initial delay of 40 ns corresponds to the small-signal propagation delay of the SIM980; the additional 40 ns to reach the 50% point is due to the 40 V/µs input slew rate limit of the SIM980.

Jitter

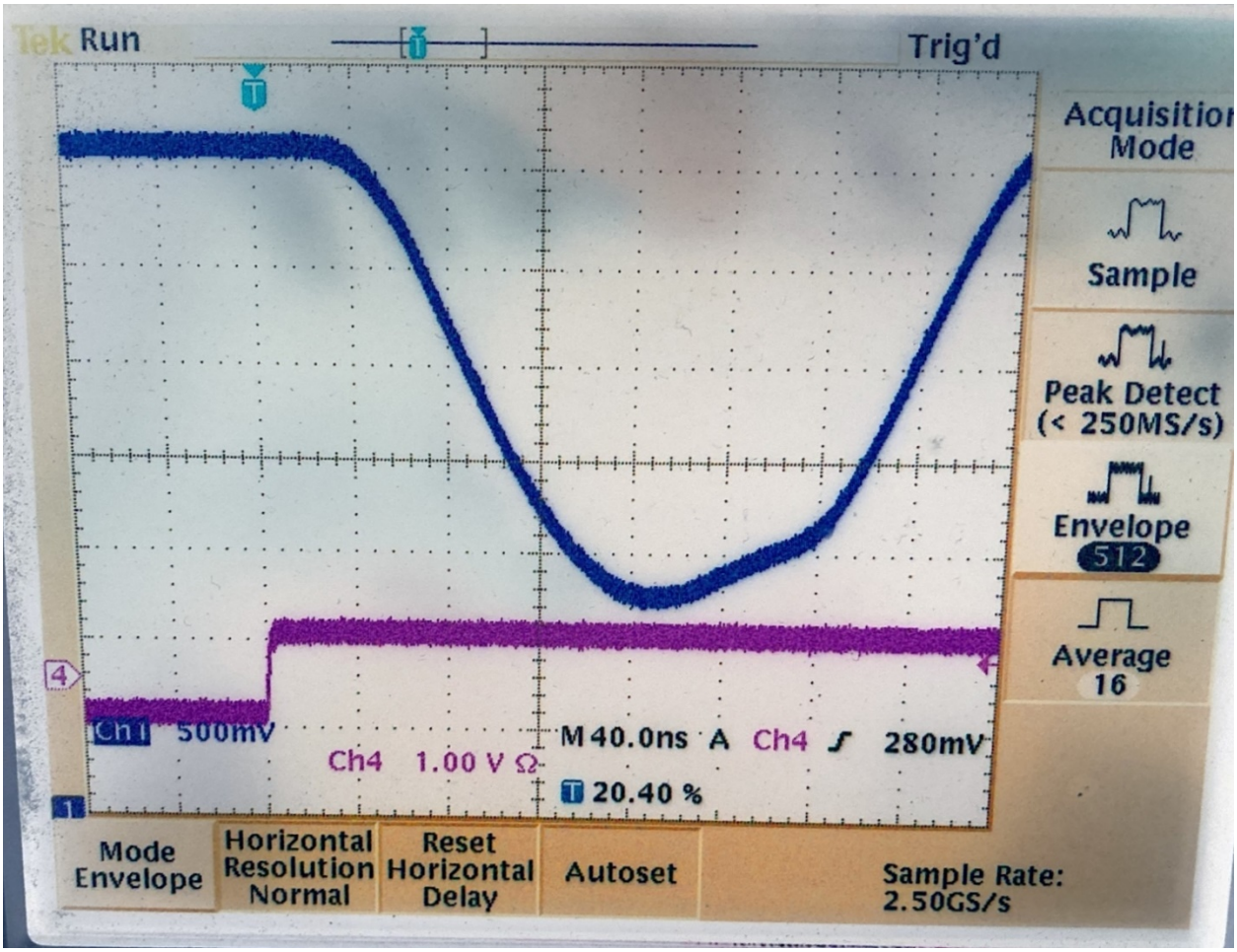
To estimate timing jitter, the oscilloscope's "Envelope" acquisition mode was used to provide trace persistence over multiple triggers. This provides an upper bound on jitter introduced by the SIM980.

For these measurements, the four pulse outputs from the DG645, coming every 1µs and of 500ns width, were connected to the four separate inputs of the SIM980. The scope was triggered using the T0 output of the DG645, and the SIM980 output was measured on Channel 1 of the scope in Envelope acquisition mode.



From the above scope trace, at 400ns/division, the minor grid dots correspond to 80ns each. The vertical transitions of the summed pulse train are less than half a grid dot, or < 40ns jitter. But, we can do better by zooming in to a single output pulse.

In the following scope trace, we have expanded the timebase of the scope to 40ns/division. Note also the pulse duration from the DG645 was decreased to 200ns, to allow both falling and rising edges to be observed simultaneously. For a 2V peak amplitude, 200ns is approximately the minimum pulse duration that can be measured through the SIM980 without attenuating the amplitude.



At 40 ns/div, the minor ticks correspond to 8 ns. For both the falling and rising edges, the envelope of the trace can be seen to be less than one minor tick. A reasonable upper bound on the jitter is about < 5ns jitter.