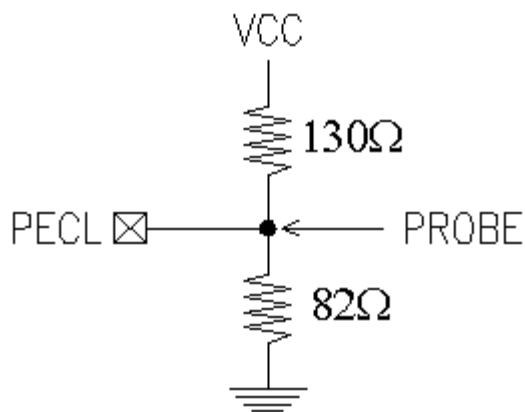


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Author: Eddy van Keulen

Date: 1-Jul-04

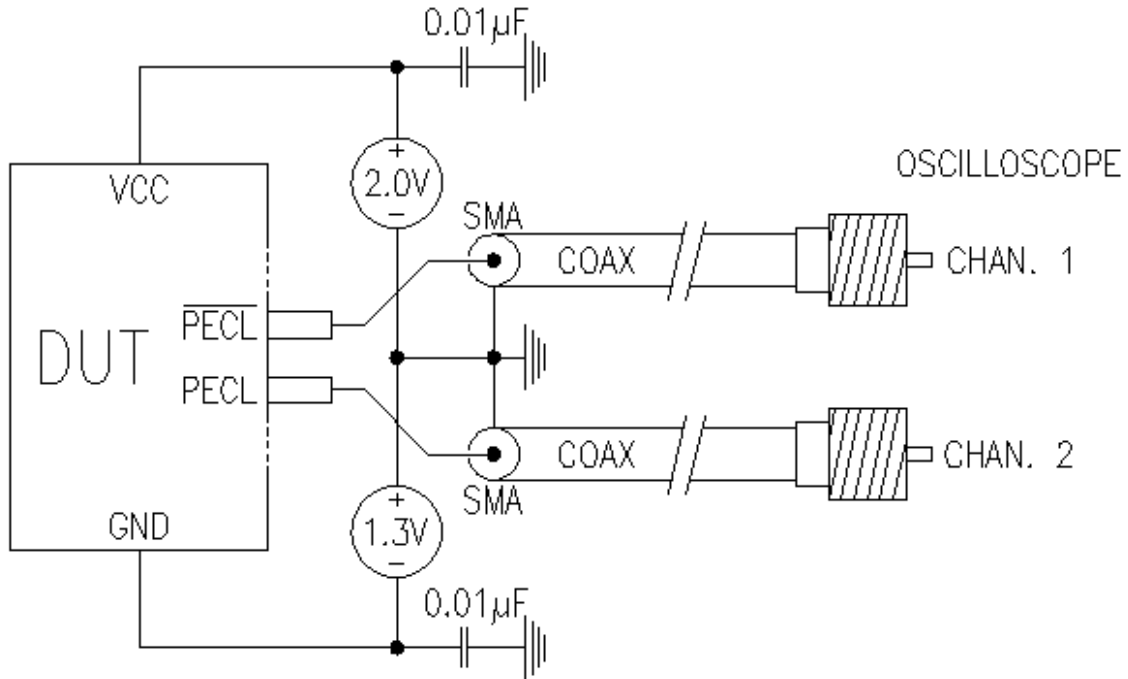
PECL waveform properties are difficult to measure because of the loading of  $50\Omega$  to  $VCC-2V$ . The original PECL output is an open emitter of a bipolar transistor and this way of loading provides the proper bias for the output buffer transistor. The most popular method of realizing this load is to use a  $130\Omega/82\Omega$  resistor network like:



If you make the calculation, then it shows  $50.3\Omega$  for  $130\Omega$  and  $82\Omega$  in parallel and the resistor divider makes  $1.28V$  ( $3.3-2=1.3$ ). This is OK for a “quick and dirty” measurement, where the speed is not too high and where you do not have to worry about  $20mV$  errors. You can of course construct the actual accurate values:  $126.92\Omega$  and  $82.50\Omega$ . If you place  $220\Omega$  and  $300\Omega$  in parallel, you get  $126.92\Omega$ . If you place  $100\Omega$  and  $470\Omega$  in parallel, you get  $82.46\Omega$ . Considering 1% resistor tolerance, this should be good enough. Now you have a more accurate loading and ‘low’ frequency ( $<200MHz$ ) testing should be accurate.

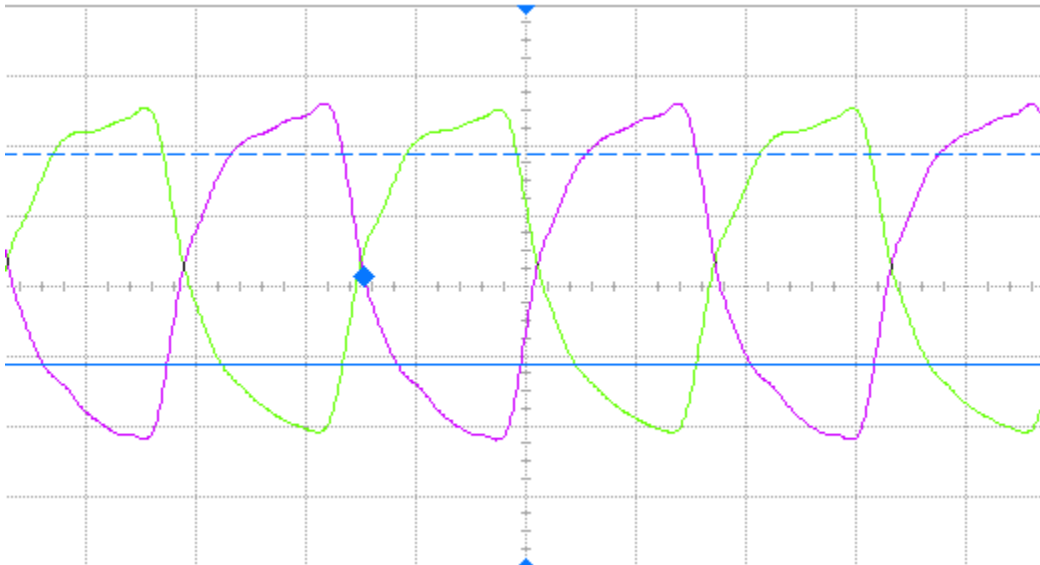
The next ‘weak’ link would be the probe and its capacitance. With fast rise and fall times, probes cause ringing, which can significantly distort the waveform at high frequencies and prevent accurate measurement of waveform properties like rise/fall times, duty cycle and low/high levels.

With very fast PECL signals >500MHz, I prefer using following circuit:



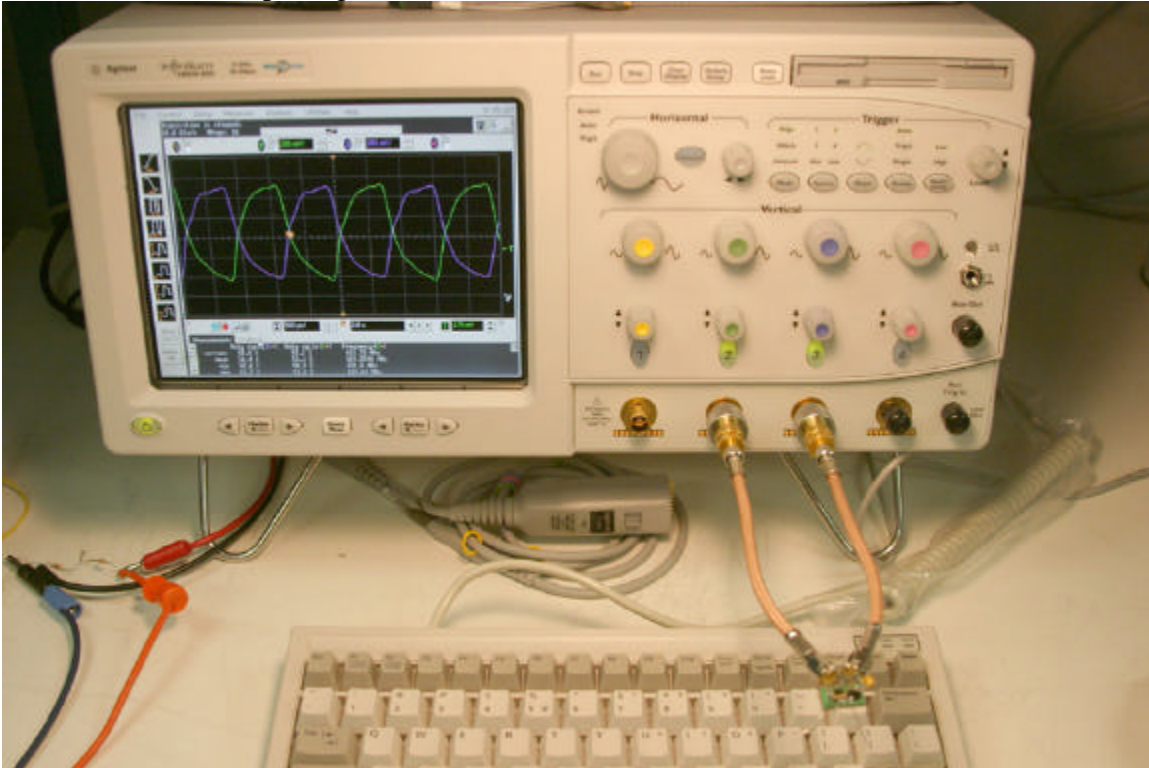
Instead of using probes, the PECL outputs are connected directly to 50Ω coax. This configuration causes less ringing and produces an accurate waveform.

Below waveform is from a Phaselink VCSCO at 622.08MHz and was measured, using the Agilent 54855A oscilloscope. The horizontal timebase is 0.5ns/div and the vertical scale is 200mV/div with 600mV in the center.



The blue horizontal lines are the max low level of VCC-1.62V and the min high level of VCC-1.025V. The “0V” of the oscilloscope is now VCC-2V and the levels that are measured have to be corrected as such. The VCC-1.025V appears at 0.975V on the oscilloscope and VCC-1.62V appears as 0.38V.

Picture of oscilloscope (Agilent 54855A) with a small test board:

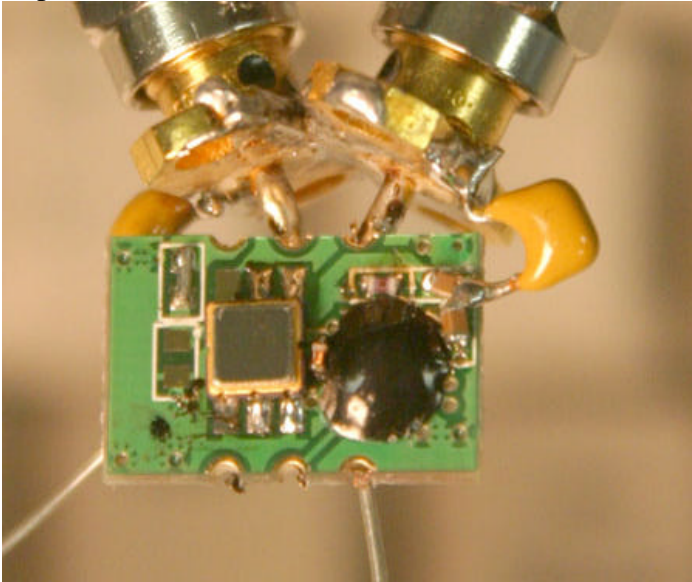


Zoom in on test board and connection to oscilloscope:



The DUT die is assembled on a 9x14mm PCB. The two SMA connectors are soldered straight to the Q and Qbar pads of the board to minimize parasitics. Short high quality coax was used for the connection to the oscilloscope. It is important that the coax is short to minimize losses. We want to know the waveform levels to at least 10mV accurate! Currents from the PECL output can be as high as 50mA and only  $0.2\Omega$  resistance already creates 10mV loss. Both pieces of coax need to be of equal length to accurately measure skew between outputs.

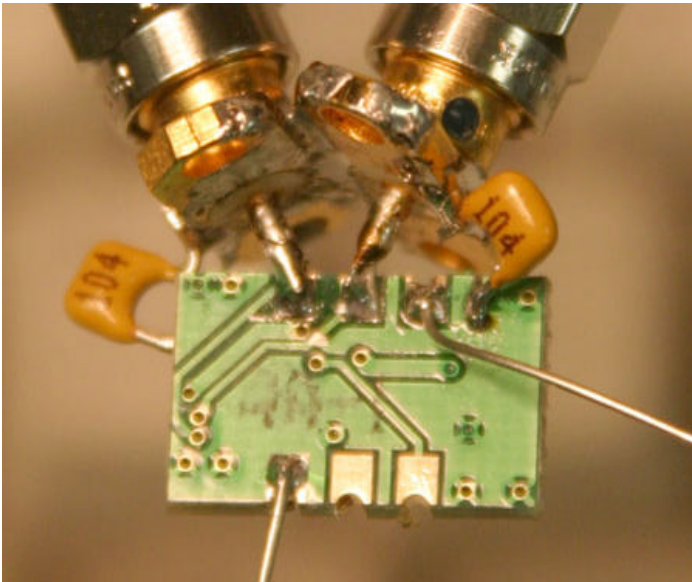
Top View of 9x14mm test board with 622.08MHz SAWR:



All components are placed as close as possible to the die. There are two decoupling capacitors, two inductors and the SAWR. The SMA connector ground is also decoupled with 0.1 $\mu$ F leaded capacitors.

In the past we have tried packaging this chip in TSSOP but it didn't work at 622MHz because of parasitics. This assembly on the small 9x14mm board however works well.

Bottom View of 9x14mm test board:

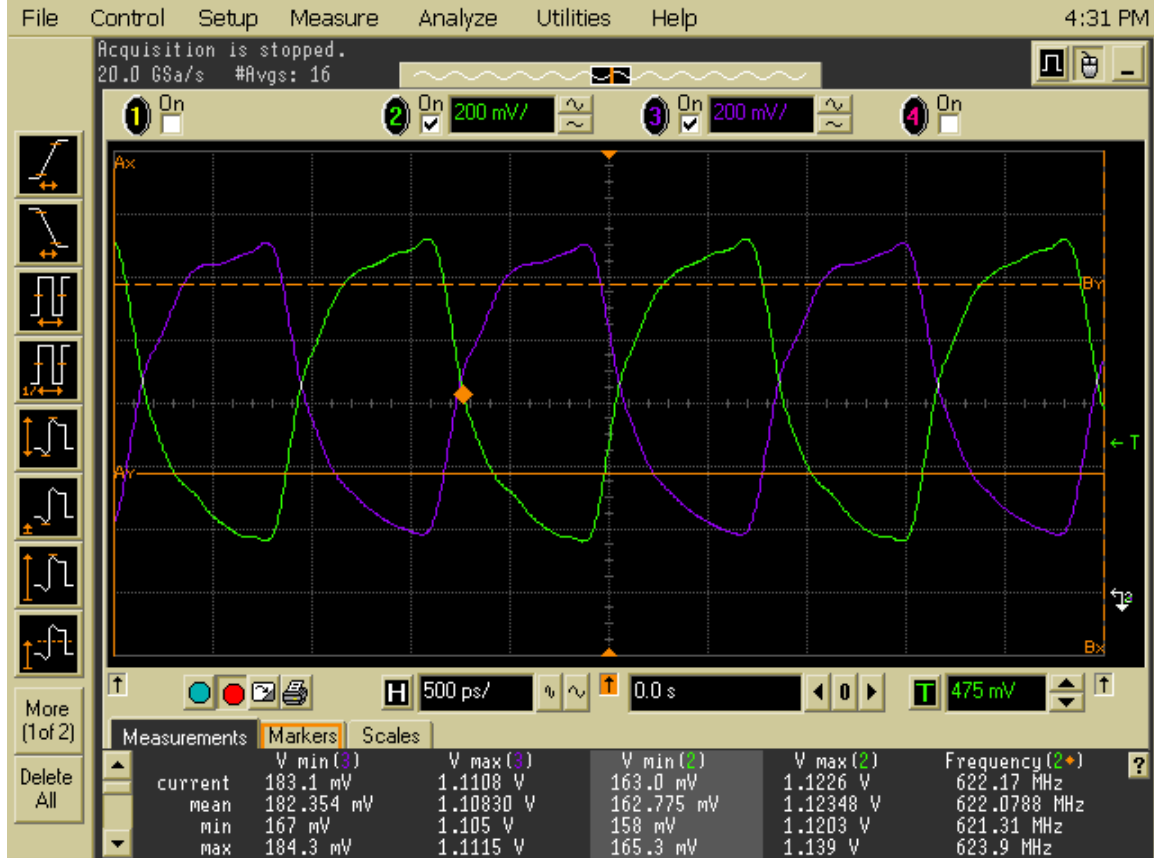


The connection from the PCB to the SMA connectors was constructed as short as possible. I have used this method also with 5x7mm packages.

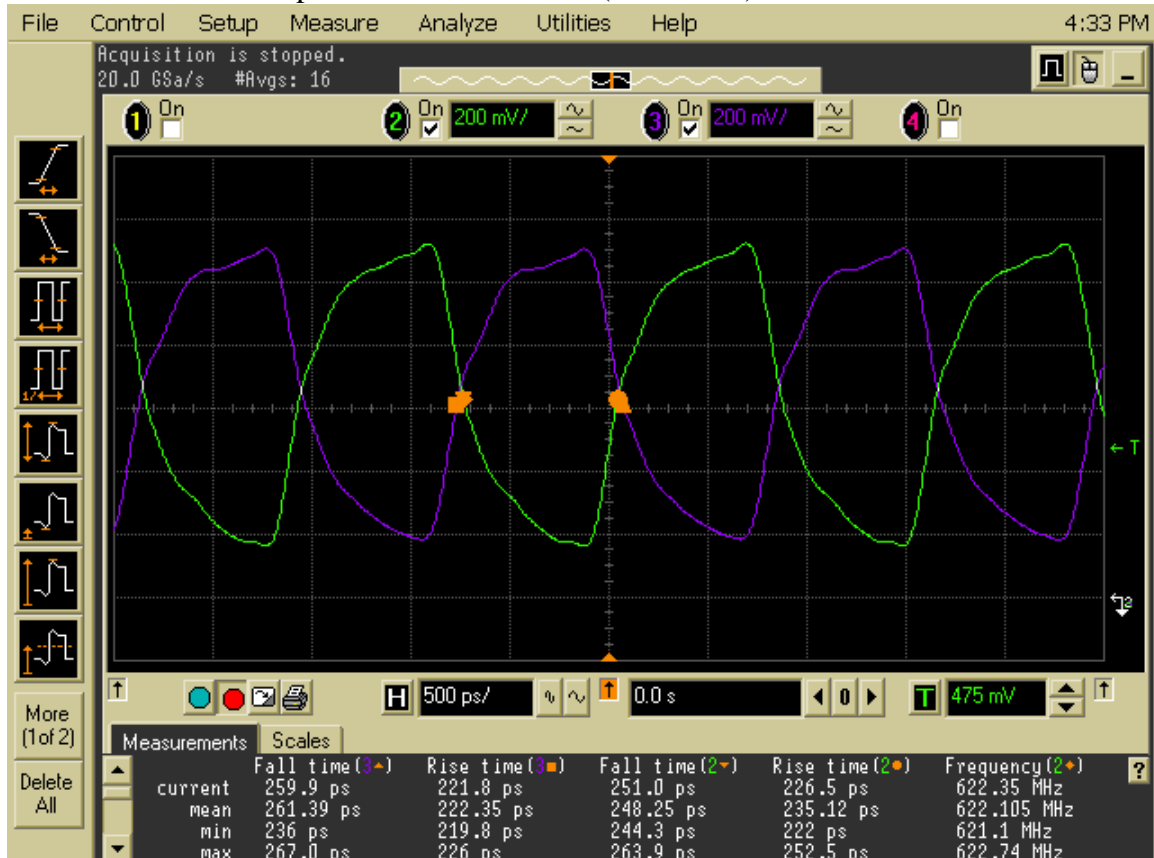
The two wires sticking out are VDD and GND connections.

## Appendix for Epson: Pictures of P570 Waveform and Test Fixture.

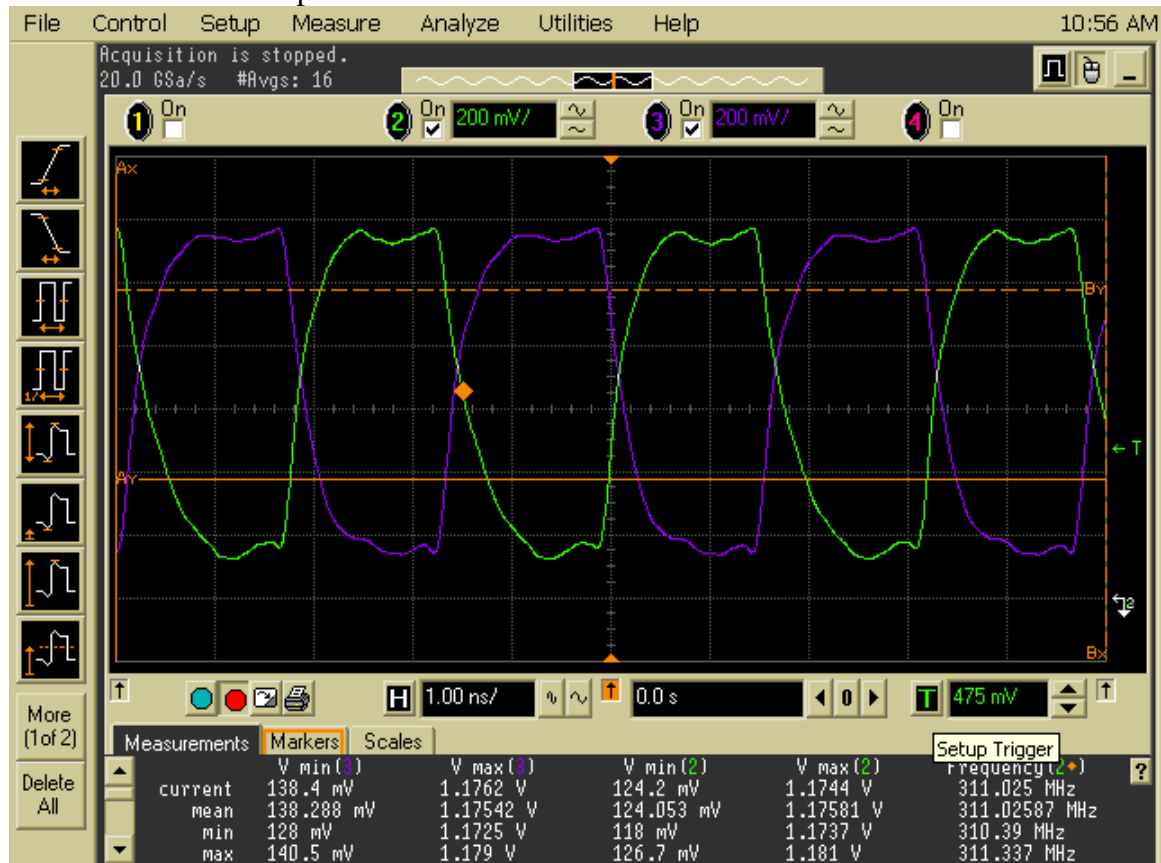
### P570-AAAA-AA Output Levels:



### P570-AAAA-AA Output Rise and Fall times (20%~80%):



### P570-AAAA-AC Output Levels:



### P570-AAAA-AC Rise and Fall times (20%~80%):

