Mat 288S Optoelectronic Measurements Spring 2010

Laboratory 2: Time Domain Measurements

Introduction

This lab exercise concerns a useful technique known as Time Domain Reflectometry (TDR). You will use an electrical step function propagating on a coaxial transmission line to characterize impedance discontinuities on the line. This approach is useful to measure the parasitic response of discreet components, to find spurious reflections in monolithic and hybrid microwave circuits, and to locate damaged sections in long transmission lines (including optical fibers, in which case the technique is renamed OTDR.)

Specialized TDR instruments are available with very short rise times, allowing very high temporal resolution. In your lab, however, you will simply use a 50 MHz pulse generator and a 500 MHz digital sampling oscilloscope.

Resources

Function Generator: HP8116A 50 MHz function generator

1. Based on the specified bandwidth, what step rise time do you expect from this instrument?
2. Select the desired waveform from the buttons labeled with waveform shapes.
3. You must turn off the DISABLE button, to enable the output (LED off = output on.)
4. Select the desired repetition rate (freq), pulse width or duty cycle, amplitude and offset or High and Low pulse levels using the appropriate buttons.

Oscilloscope: HP 84503A Digital Sampling Oscilloscope

This scope is misbehaving. Please do not turn off the power.

1. This is an equivalent-time sampling scope. What does this mean?
2. Press the VERT Menu button to bring up the vertical scale and DC offset options.
3. Press the HORIZ Menu button to bring up the time base options.
4. Press the TRIG Menu button to select triggering modes and levels. When you are using a sharp step, you can trigger directly from the input channel, using the AUTO trigger mode. Alternatively, you can connect the trigger output from the function generator to one of the scope channels, and then trigger from that channel.

Experiments

1. Play with the function generator, scope, and miscellaneous passive components, to gain familiarity with the instruments.
2. Try the 220 Ohm series extension cable (short Coax with a 470 Ohm resistor spliced in), between the function generator output and the scope. Why?
3. Generate a sine wave at 1 MHz and observe it on the scope. Increase the time base to observe more periods of the wave, until the number of periods exceeds the number of data points across the screen. What happens?
4. Set the function generator to give a rising edge and long pulse (long relative to what?) Connect the function generator and scope to one input of the mystery box and examine the resulting waveform. Based on the response, determine *quantitatively* what is connected inside the box. Repeat for all of the ports.

Report

Simply report quantitatively what you think is connected inside the box. Use figures where appropriate. The lab report is due Monday Mon May 3, 2010.