A simple and inexpensive microcontroller based pulse generator for generating Time Domain Reflectivity (TDR) plots using a Digital Storage Oscilloscope (DSO)

To obtain a TDR plot one simply applies a short pulse to the input end of the cable or antenna system of interest and looks at the pulse and it's reflection on an oscilloscope. The length of time from the beginning of the pulse to the received reflection of the pulse is obviously the time for the pulse to travel to the end of the cable and return and thus represents twice the length of the cable. One simply applies the cable velocity factor (V_f) to the speed of light in a vacuum to the time elapse and divides by 2 to obtain the length of the cable. The following parameters were used, C = 983,571,057 ft/s and V_f = 0.66. This yields 649,156,897 ft/s for the velocity of signal propagation in the cable.

To perform a measurement, connect the coax under test to the SO-239 connector and the oscilloscope input to the BNC. Adjust the oscilloscope appropriately to observe pulse and it's reflection. Keep in mind that although a short piece of coax can be used from the pulse generator to the oscilloscope it will not be compensated and not 10X, therefore you may want to use the oscilloscope probe to connect to the signal at the BNC.

Shown in Figures 1 and 2 are two TDR plots of a 38.5 foot length of open ended RG-213 coaxual cable (connector end to connector end.) Large grid divisions are 50 ns on first plot and 20 ns on second plot. On the first plot you can see multiple reflections until the value gets clamped close to Vdd. The plots were captured with an OWON PDS6062T DSO.

At about 119 ns the length comes out to be 38.625 feet ((649.156897*0.119)/2). Not to bad at all.

A Microchip PIC 12F510 microcontroller is used to generate the pulses on 4 outputs, which are combined for the TDR pulse, and 1 output to flash the LED power on indicator. Although a 4 microsecond pulse will allow for measurements over 2000 feet, I initially used a 100 ms pulse to save a few lines of code (really, two or three) and flash the LED at a rate visible. I later changed the pulse rate to 10 microseconds repeated at 50 ms intervals as indicated on the schematic. The 4 outputs each have 201 Ohm series SMT resistors on the bottom, the LED has a 360 Ohm series resistor. There is a 10 M Ohm resistor paralleled with a 240 pF capacitor from the output pulse connector (SO239) to the BNC for the scope vertical.

In keeping with the upcoming Christmas season, I chose an appropriate season colorful cabinet - shown in the third picture. The forth picture shows the inside with the time proven "hot glue" construction method.

The fifth picture shows the circuit schematic.

Here are some links describing Time Domain Reflectometry.

http://literature.agilent.com/litweb/pdf/5966-4855E.pdf

http://en.wikipedia.org/wiki/Time-domain_reflectometry

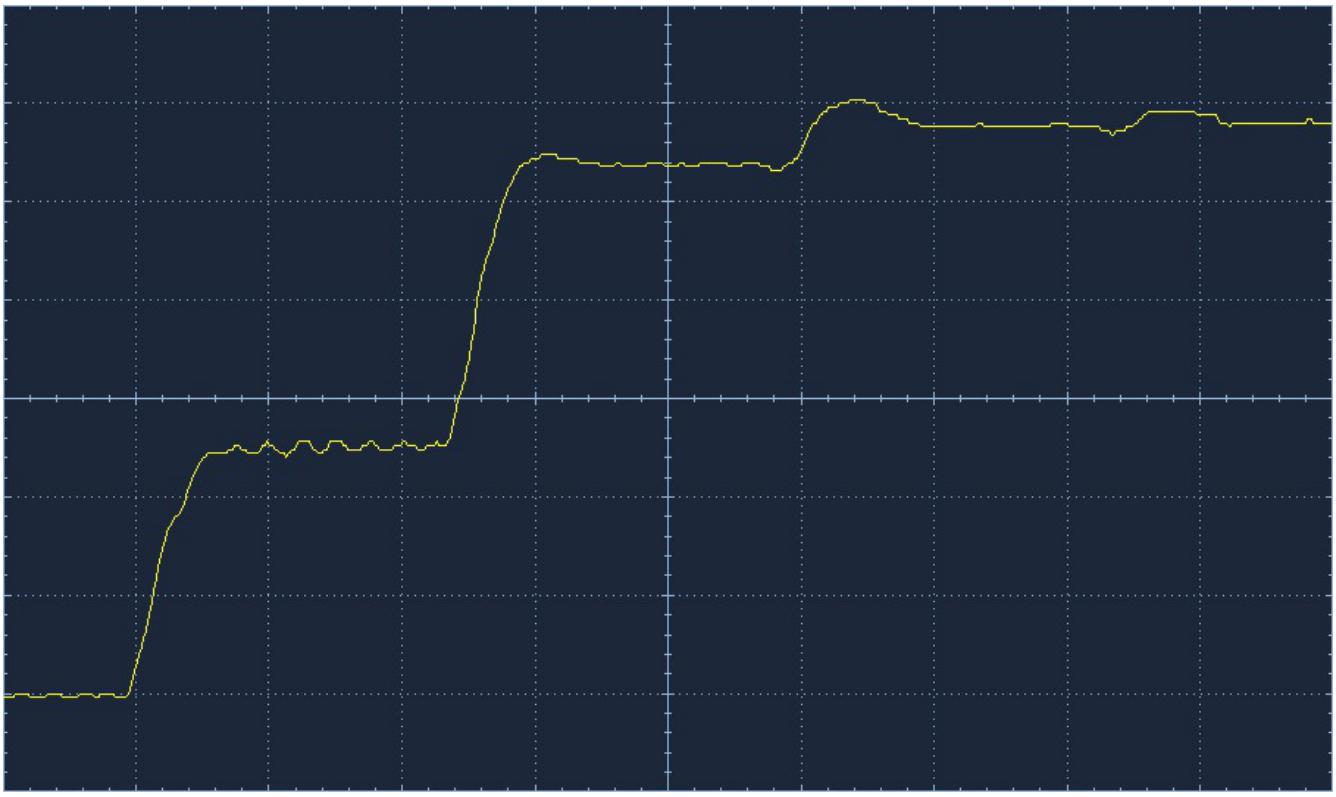

Figure 1. TDR plot of 38.5 feet long RG-213, 50 ns per division.

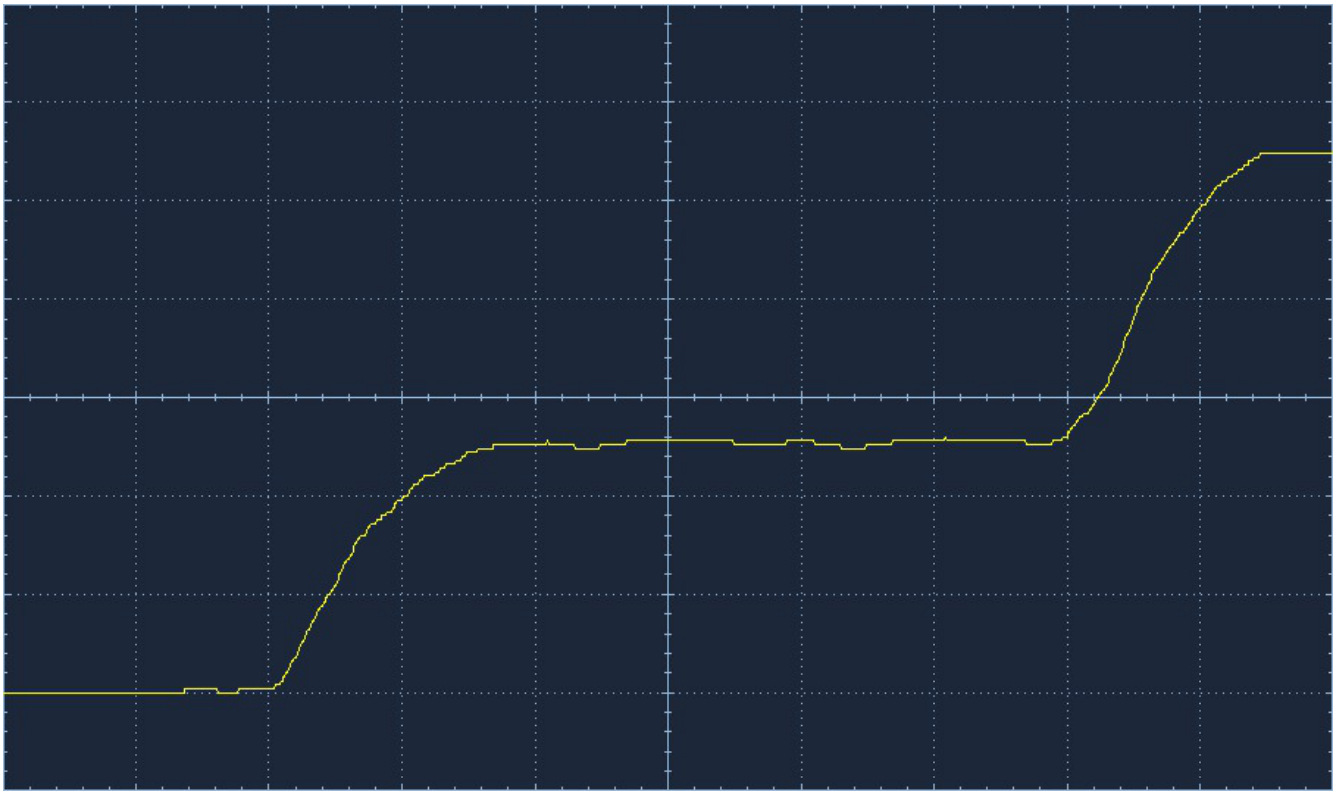

Figure 1. TDR plot of 38.5 feet long RG-213, 20 ns per division.

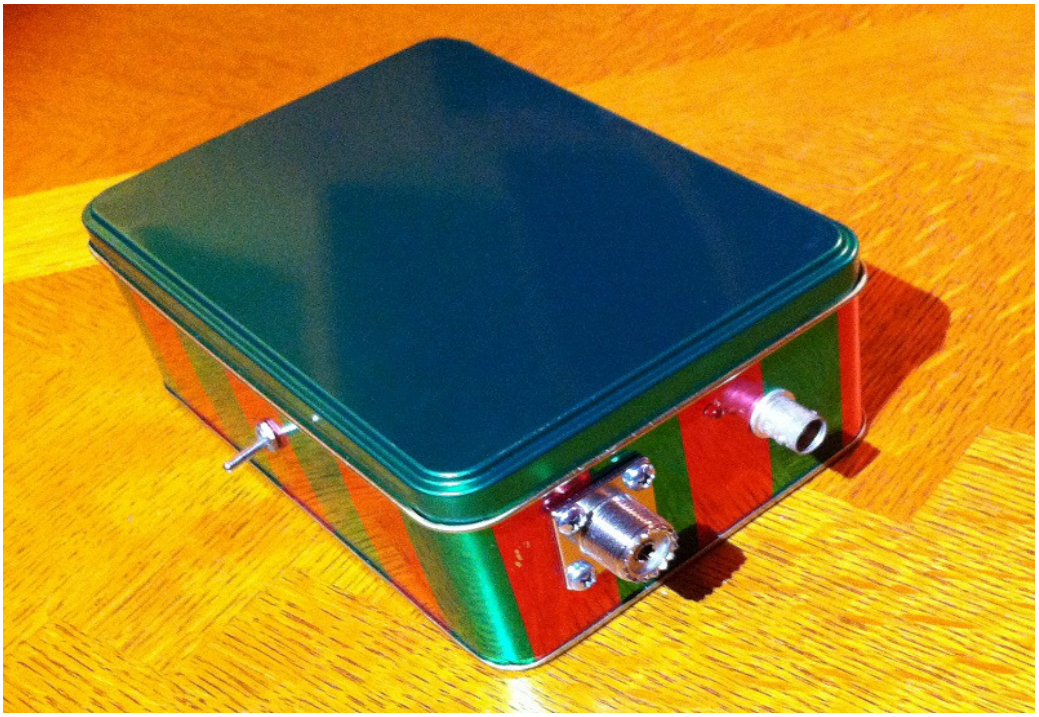

Figure 3. Completed TDR pulse generator housed in a Christmas tin.

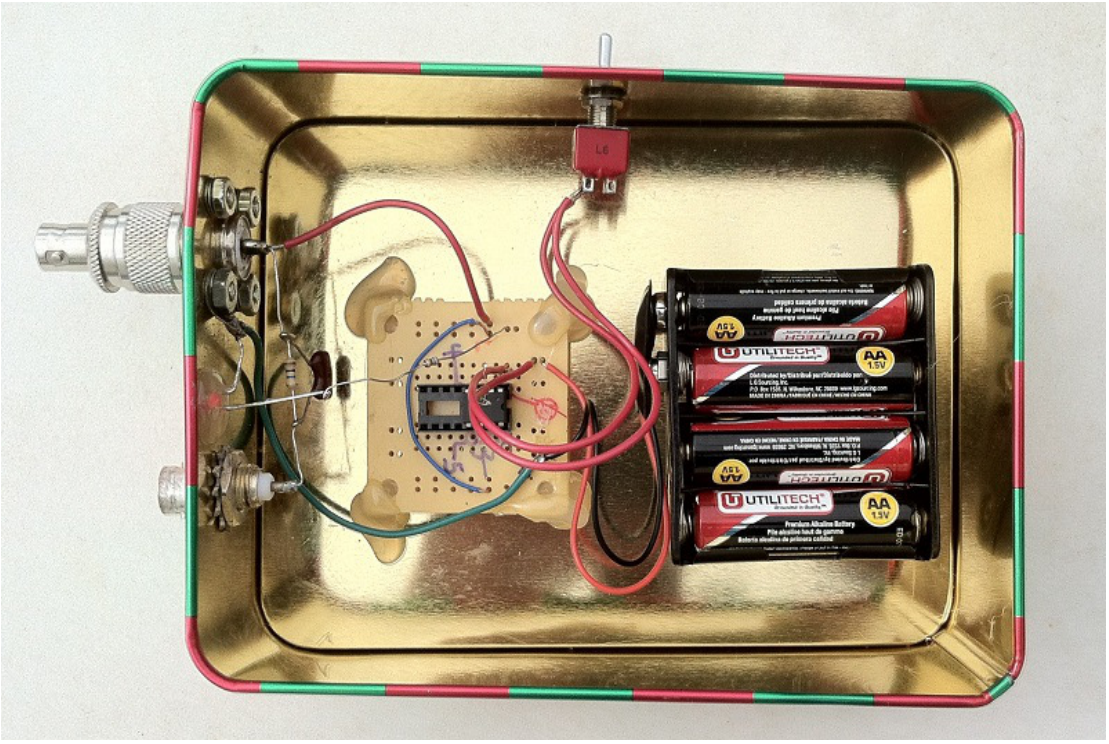

Figure 4. Inside completed TDR pulse generator..

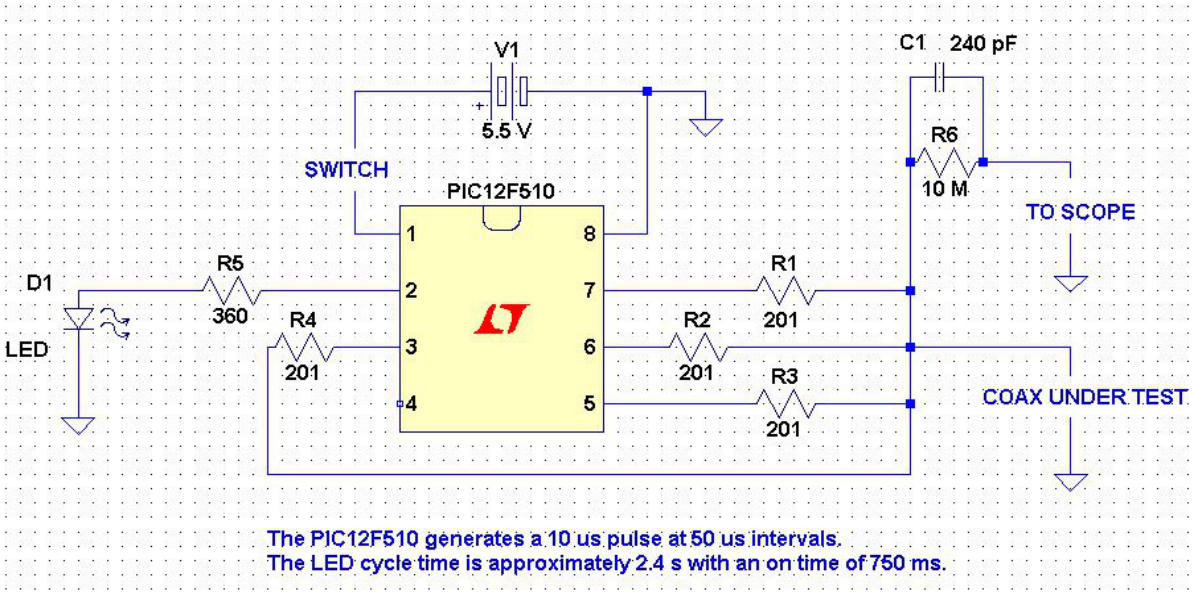

Figure 5. Schematic of TDR pulse generator.