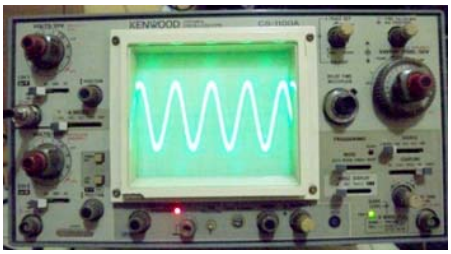
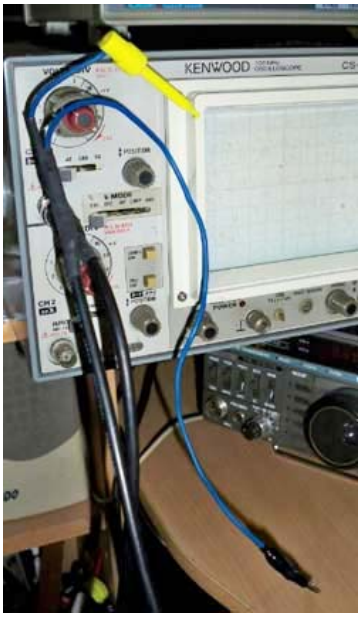
Homebrew Oscilloscope Probe

Written by Cholis Safrudin YD1CHS

17th October, 2010



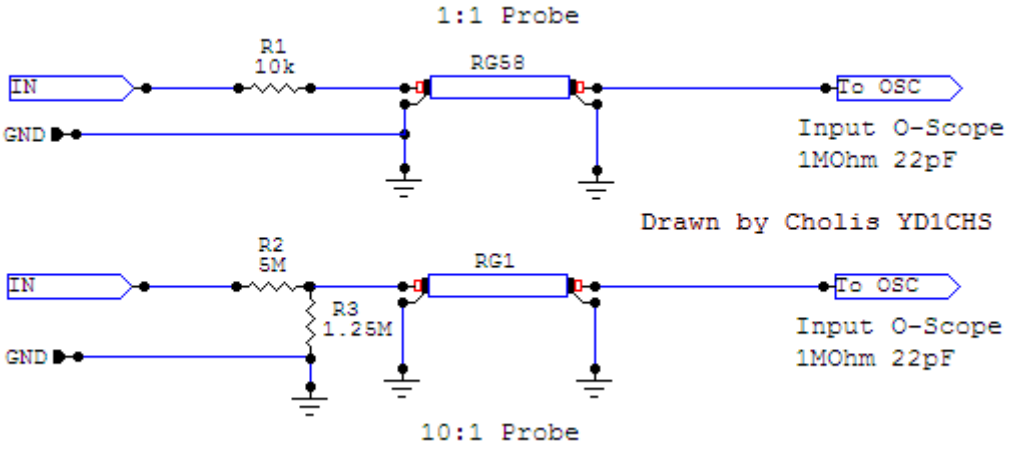
An Oscilloscope is a must for a homebrewer. This single tool can do multi-tasking measurement started from AC or DC voltage, frequency, phase and the most important task is capability to see a signal waveform. By adding a simple external interface, it can be used to see signal at the frequency domain, means a homebrew spectrum analyzer.



My Oscilloscope is quite old tool, i.e. Kenwood CS-1100A. I bought it at second hand condition without probes. Its price was only US$150 at that time. It has bandwidth of 100MHz, enough for my HF homebrewing activities. I was wonder why a second probe cost about US$20 each and I didn't know the price for the new one, that was why I decided to build homebrew 1X and 10X probes for my oscilloscope.

To build pair of homebrew 1X and 10X oscilloscope probes is cost less than US$3, components were need: a piece of RG-58 50 Ohm coax, oscilloscope style clipper, crocodile clipper, several 1% resistors (6x1M, 4x500K and 2x10k) and small switches for changing from 1X to 10X and vice versa. Since I don't use them for professional need, so that the probes had been satisfied my requirement.

My oscilloscope has input impedance os 1M Ohm 22pf, it is seem to be general for almost oscilloscopes outside there. Knowledge of the oscilloscope's input impedance is quite important to design voltage divider circuit to get a 1X, 10X, 100X or other probes.



The 1X Oscilloscope Probe

Since the oscilloscope input impedance has value of 1M Ohm, to get a 1X probes is only done by adding a 10K Ohm 1% serial with the inner RG58 coax. A voltage divider formula says:

Vscope = Vin * Rscope / (Rscope + Rserial) = Vin * 1M / (1M + 10k)
Attenuation = Vin / Vscope = (1M + 10k) / 1M = 1.01 (closed to 1X)

The 10X Oscilloscope Probe

Using the same equation, we could determine resistors used for the 10X probe. We need a 1.25M Ohm resistor paralel with the Scope, then a 5M Ohm serial with Scope. The equation says:

R1 = Rparalel // Rscope = 1 / (1/Rparalel + 1/Rscope) = 1 / (1/1.25M + 1/1M) = 555.555,556 Ohm, then

Vscope = Vin * R1 / (R1 + Rserial) = Vin * 555.555,556 / (555.555,556 + 1M)
Attenuation = Vin / Vscope = (555.555,556 + 1M) / 555.555,556 = 10

I didn't add any compensated capacitor paralel with serial resistor, but it is still OK for my week end activities to measure HF sinusional waveform. However, if you need more perfect probe, you can add a 2-10 pf compensated trimmed capacitor.

Intentionally my probes were not designed as professional purpose, I was only interested in observing the RF signal waveform briefly to make sure what is going on in the circuit. Hence, this simple homebrew probes had satisfied my requirement.

Anyway, Life is preference …

Best Regards,
Cholis Safrudin YD1CHS