Electro-Resales LLC

RF Sampler with Demodulation Port

A Little Background

We manufacture and sell several different types of RF sampler to allow for the easy visualization of modulated RF on an oscilloscope or for measurement with other instruments such as a Spectrum Analyzer. The present offering differs from the samplers we currently sell in that it has an additional port that provides a demodulated RF signal that allows the operator to visualize the demodulated RF in conjunction with the modulated RF on a 2 channel 'scope. It also allows for the generation of useful linearity checking by creation of the 'Trapezoid' pattern if the 'scope is set into XY mode. An additional feature is that the demodulation port can be connected directly to a multimeter to determine RF voltage without the need to introduce an RF probe.

Operation and Usage

The sampler has BNC receptacles for connection to the RF source and test equipment; these are illustrated in the photo below. The pass through socket is for connecting to the incoming RF and the other socket connects to a load or antenna. It is recommended that for initial tests a dummy load is connected to one of these ports, the load should be able to sink at least the full output of the RF source, and preferably at least have a margin of +10% more power handling.

Image 1 – The Sampler with key parts noted

The sampled RF port can be connected directly to an input on an oscilloscope for monitoring of the sampled RF; this can be any modulation type (AM, SSB, DSB, FM).

The demodulation port is for use in determining linearity of the transmitted signal through use of the Trapezoid pattern and a 'scope set to XY mode. The operation of the unit for this is explained later in this document.

Initial set up

It is recommended that initial tests are conducted with the unit arranged to sample an incoming RF signal, starting this way allows the operator to understand the unit operation and best settings. Included with this sampler is a BNC to BNC adapter, this is used to directly connect the RF sampling port to the oscilloscope, and greatly reduces the losses that can occur in cables.

Image 2 – Connection to Oscilloscope using BNC-BNC adapter

The RF signal can be fed into either of the pass through ports and the other port is then connected to a 50Ω dummy load or an antenna, we recommend starting with a 50Ω dummy load and an input power of around 25 watts. In the next images typical waveforms are shown for various emission modes.

Image 3a – AM input at approx. 50 Watts

Image 3b – CW (Dah) at 100 watts

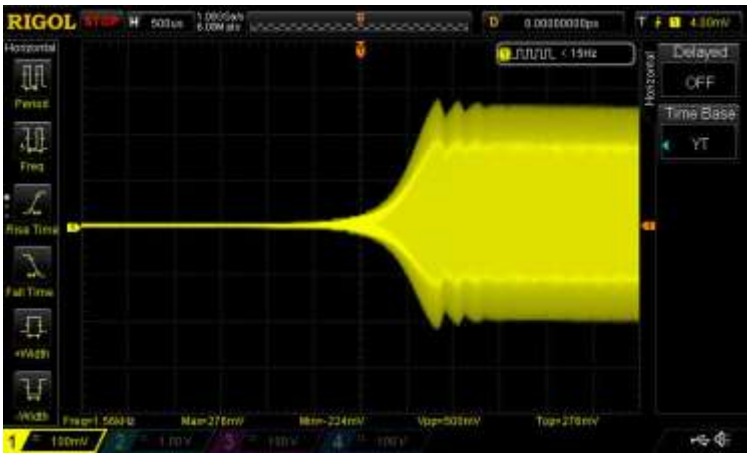
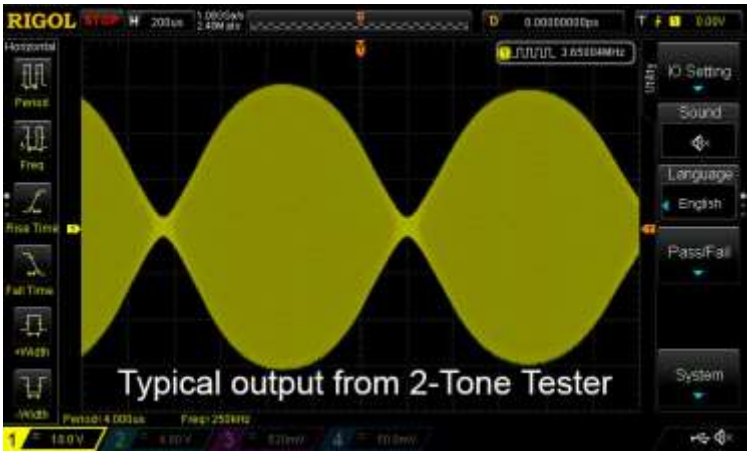


Image 3c – Two Tone signal with SSB input



The exact settings required by the test equipment the sampler is connected to will be dependent on the model of equipment used, as such we are unable to advise on the settings or adjustments needed.

Using the Demodulation port

The demodulation port allows the user to employ the sampler to determine certain characteristics of the transmit chain, in particular linearity of the signal using a Trapezoid pattern. To set up for this determination; first the oscilloscope needs to be set to XY mode. The exact settings required will depend on your model of oscilloscope; please refer to the user manual for your 'scope to determine the settings needed. The sampled RF output is connected to the Y or vertical input on the 'scope and the demodulated output connected to the X of horizontal input. Application of a signal to the transmitter will result in a display as shown in image 4, below.

Image 4 – Trapezoid signal display, 100% modulation.

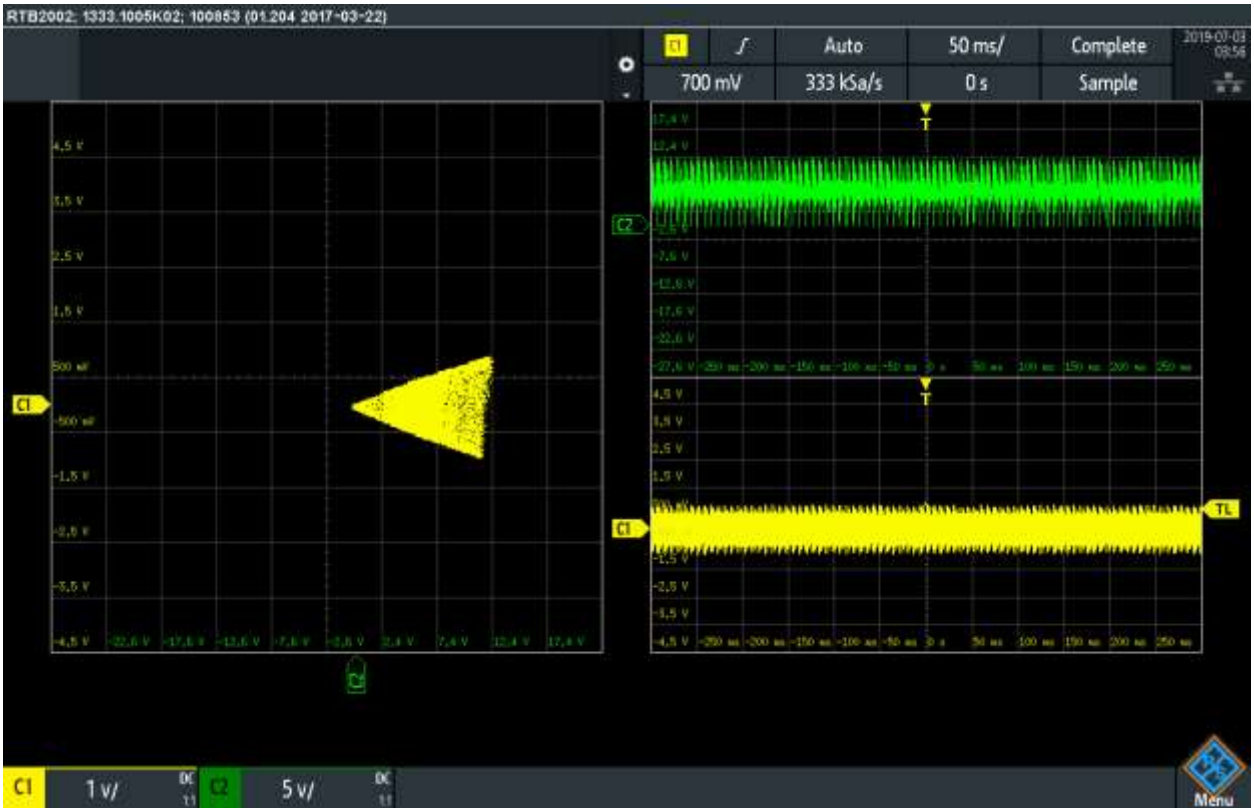
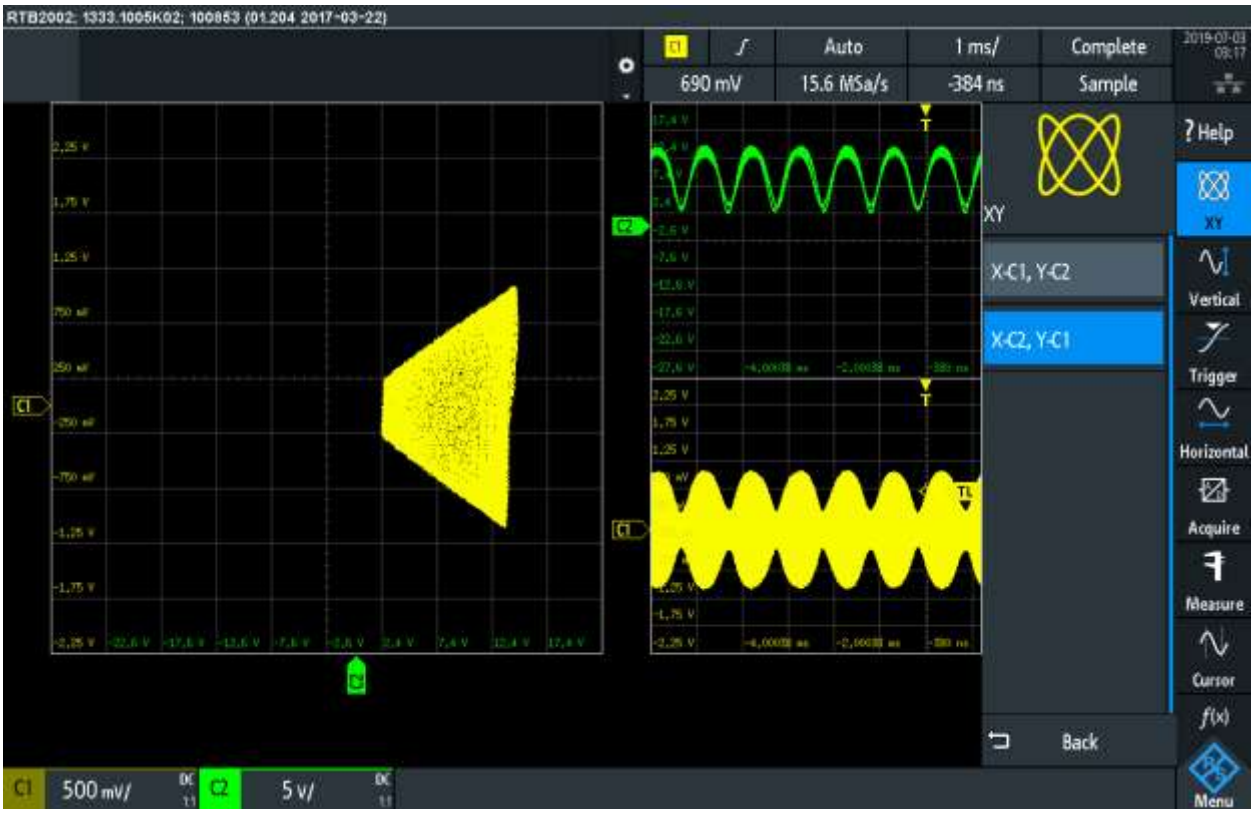


Image 4 shows a 100% modulated AM signal while image 5 shows the result for a 56% modulated signal

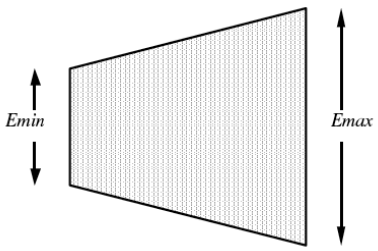
Image 5 – Trapezoid at approx. 56% modulation



The % modulation in image 5 has been determined by using the following calculation:

$$\frac{Emax - Emin}{Emax + Emin}\ x\ 100$$

Using this methodology to determine Emax and Emin;



From the data in image 5, $E_{max} \approx 4.5$ & $E_{min} \approx 1.25$

Hence % Mod = $\frac{4.5 - 1.25}{4.5+1.25}\ x\ 100 \approx 56.5\%$

(Please note these are approx. values for this example as denoted by the symbol ≈)

The information given in this guide has been with the sampling port attached to an oscilloscope, it is also possible to use the sampler with a spectrum analyzer or other measuring equipment; however that is beyond the scope of this guide.

Image 6 below shows a typical connection arrangement for the sampler.

Image 6 – Using the sampler with a typical RF set up.

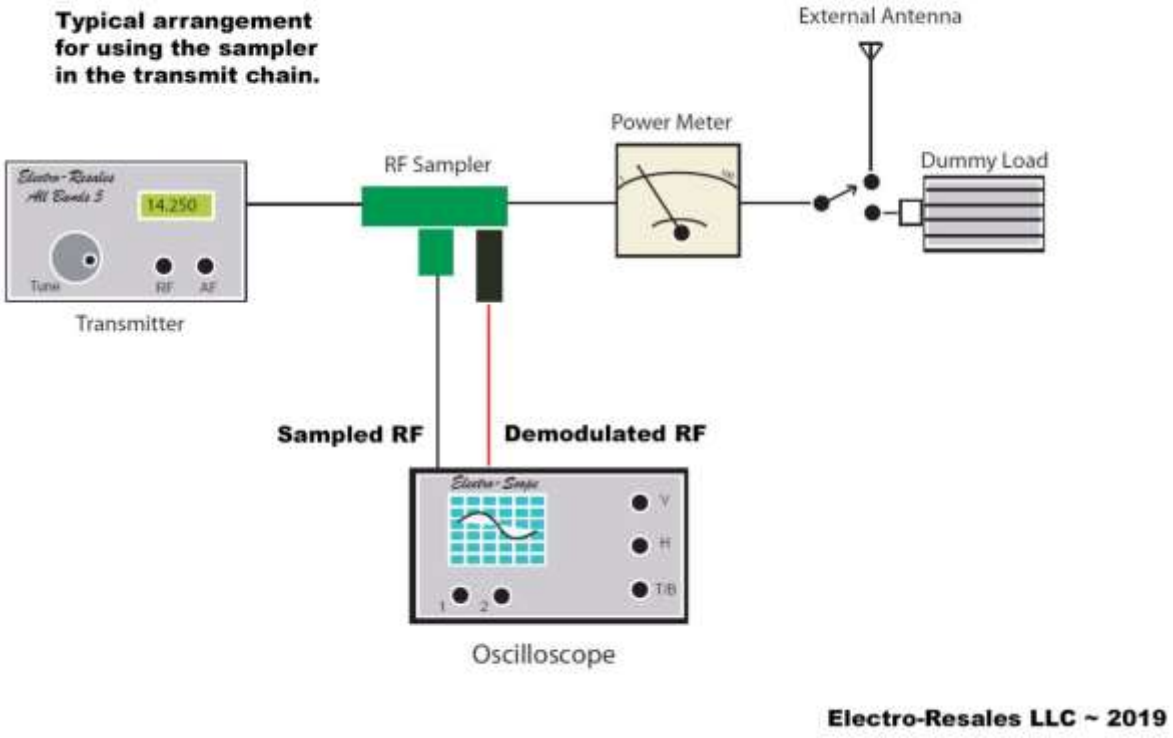
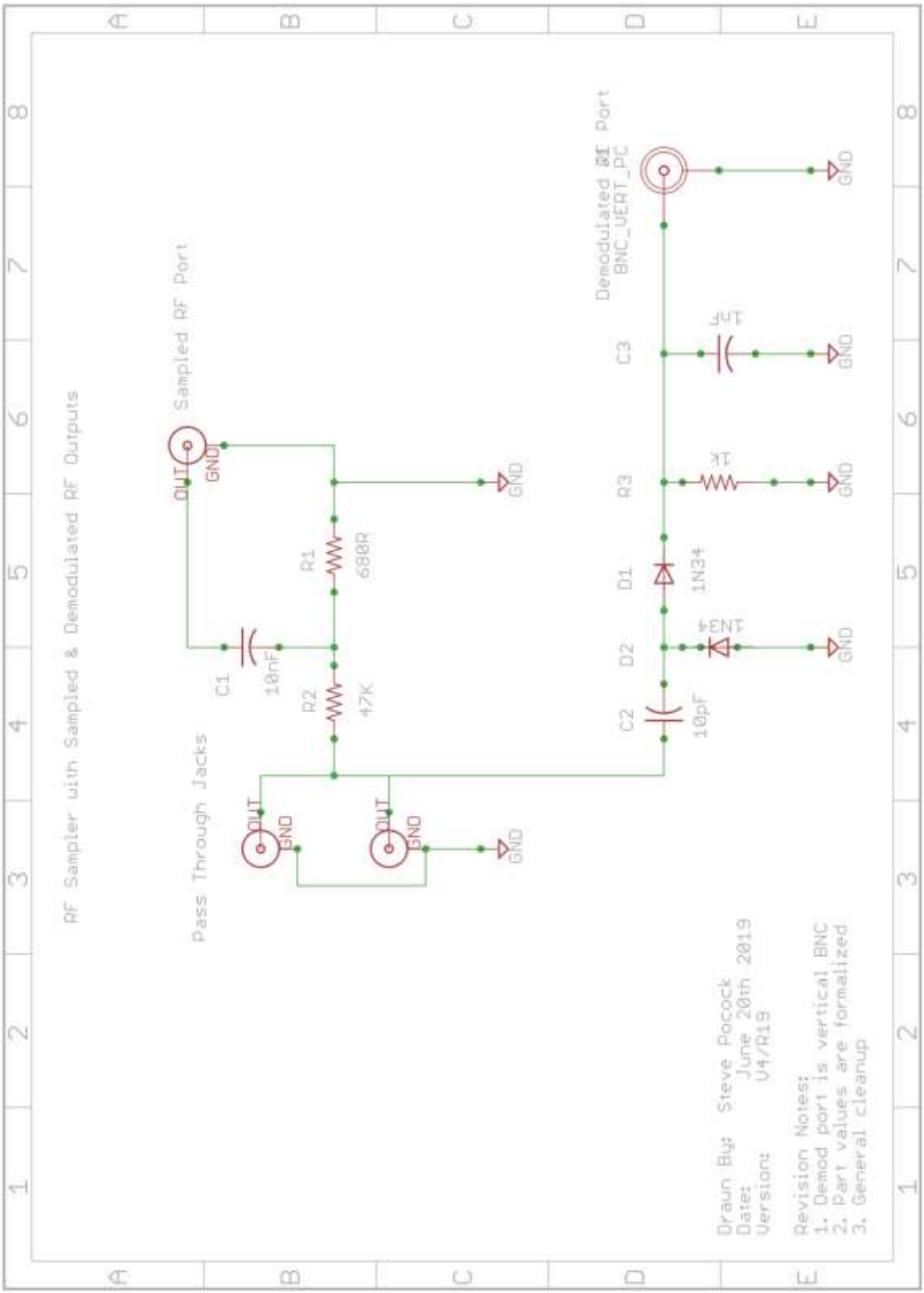


Image 7 – Generalized schematic as of June 2019



Final Words

The sampling port is designed to provide an easy way to monitor the signal coming from a transmitter to either a dummy load or antenna, as damage to delicate equipment front ends is possible through the incorrect use of this sampling port, it should always be checked for correct connection to the equipment in use/test, and the port itself should be periodically examined to make sure it is in good working condition.

Never connect the ‘Pass Thru’ sockets to the monitoring device, as full RF load is on these sockets!

The small Print

DISCLAIMER

Any person who constructs or works on electronic equipment may be exposed to hazards, including physical injury, the risk of electric shock or electrocution.. These hazards can result in health problems, injury, or death. Only qualified persons who understand and are willing to bear these risks themselves should attempt the construction of electronic equipment. By purchasing this item, the buyer acknowledges these risks.

There is a risk of electric shock, electrocution, burns, or fires that is inherent in the construction and use of electronic equipment. By purchasing this item, the buyer acknowledges these risks.

IN NO EVENT SHALL THE SELLER BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE including, but not limited to, property damage, personal injury, death or legal expenses. Buyer's recovery from Seller for any claim shall not exceed the purchase price paid by Buyer for the goods, irrespective of the nature of the claim, whether in warrant, contract or otherwise. By purchasing this item, BUYER AGREES TO INDEMNIFY, DEFEND AND HOLD SELLER HARMLESS FROM ANY CLAIMS BROUGHT BY ANY PARTY REGARDING ITEMS SUPPLIED BY SELLER AND INCORPORATED INTO THE BUYER'S PRODUCT