

Electro-Resales

2-Tone Audio Oscillator for SSB Tests

Background

This 2 Tone generator has been designed to provide 2 non-harmonically related signals as an audio source for testing SSB transmitters and associated equipment. 2 Tone generators are most often used to measure transmission linearity (purity).

When connected to the 2 tone generator, the SSB output will ideally consist of only two frequencies. For USB, this would be the carrier frequency plus Tone # 1 and the carrier frequency plus Tone #2. LSB transmissions will be carrier minus Tone #1 and carrier minus Tone #2.

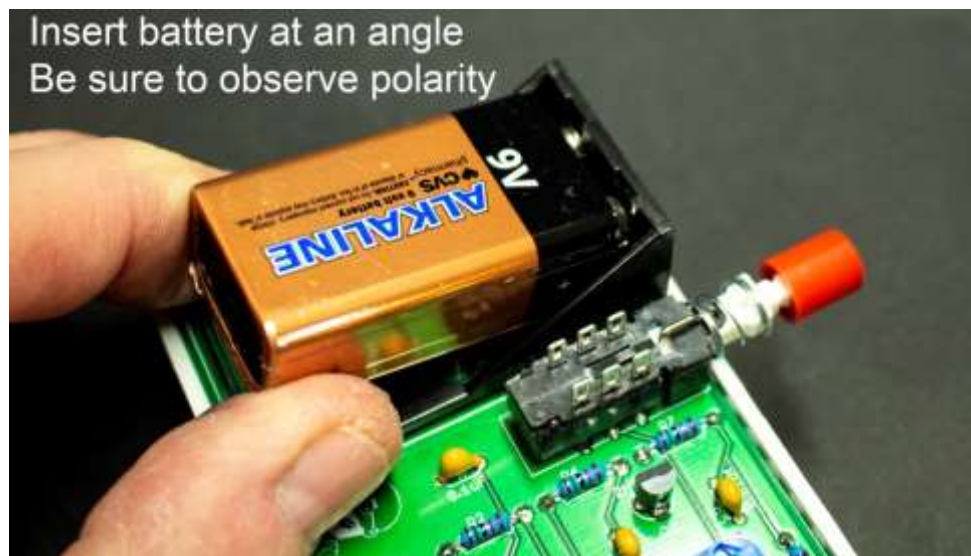
In practice a typical transmitter will have additional third order and fifth order products, these spurious products are the Intermodulation distortion or IMD products.

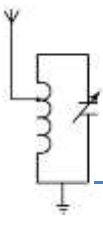
Initial Set up

Please refer to the photos' for extra guidance when reading these notes.

The 2 Tone generator, as supplied, requires a 9 Volt battery to operate, a convenient battery holder is installed at the top of the PCB enclosure assembly for this battery. To insert the battery, first ensure the on off switch is fully out or in the off position, then, making sure to observe polarity, insert the battery at an angle so as to engage the battery terminals first, then press the back end of the battery down when the terminals have engaged to fully seat the battery.

Battery Insertion





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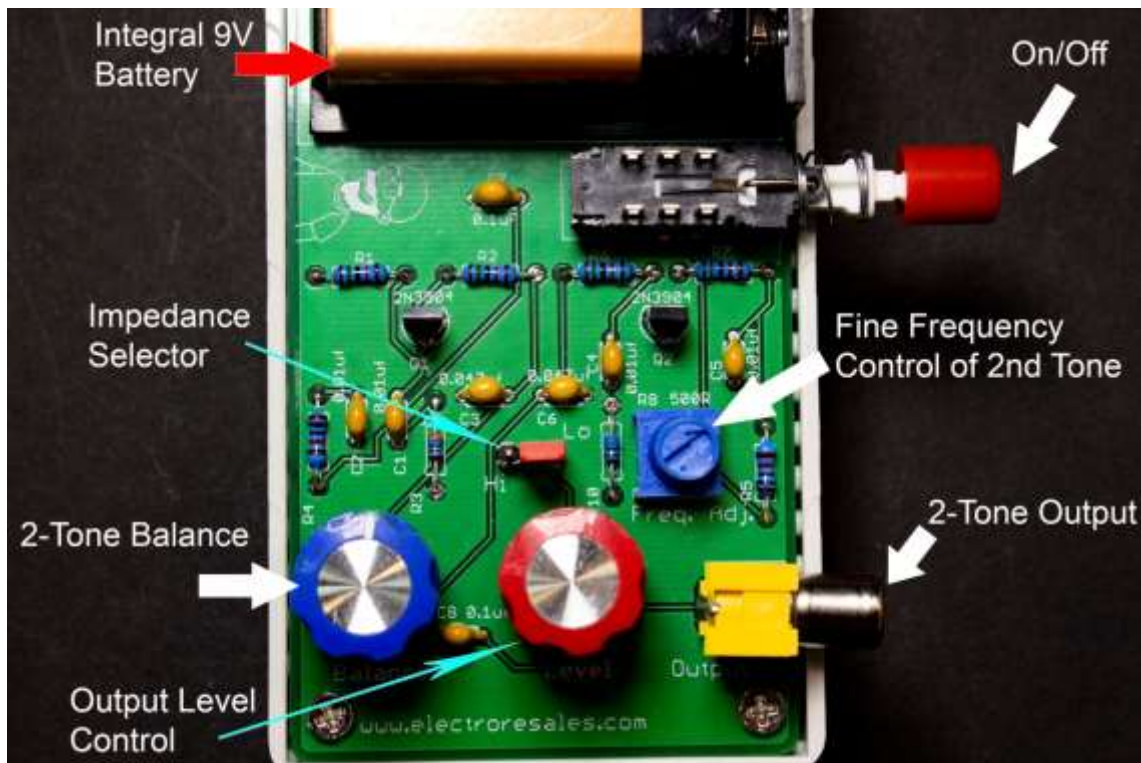
After inserting the battery, it will 'float' a little but be assured the battery connection is firm and will not be a source of issues in normal use.

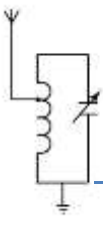
Press down to ensure battery is properly seated



Before turning on the generator for the first time, familiarize yourself with the operation controls. Take a look at the next photo, and compare to the device in front of you. At manufacture and during our QC testing the controls have been set correctly, however, these may move in transit and will likely need some adjustment for correct operation.

Photo of basic controls;





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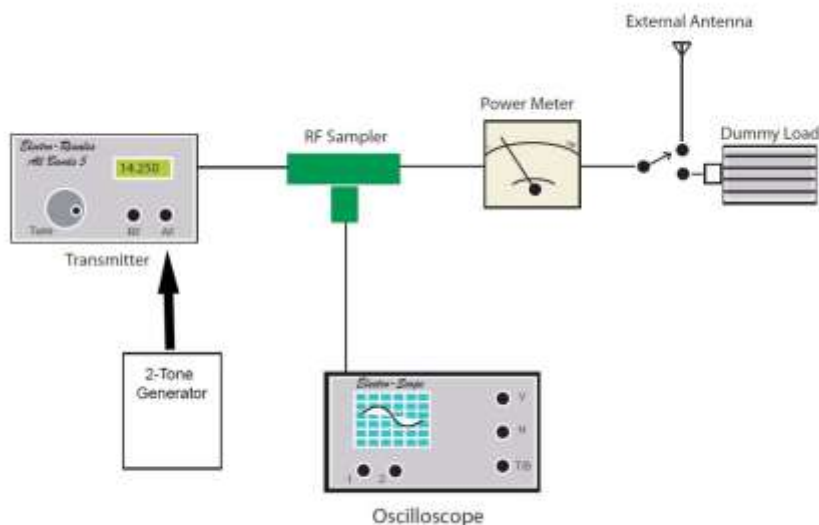
Explanation of controls

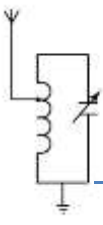
1. On/Off Push button – This is a latching switch, press in to latch and turn on, Press in again to unlatch and turn off.
2. Impedance Selector – The 3 way header located in the lower center of the PCB, allows the output impedance to be set High (~10K Ω) or Low (~600 Ω). Use of this header allows for use with microphone jacks on modern or more vintage transmitters or to use the remote input jacks (ACC) often found on more recent transceivers.
3. Fine Frequency control – This control allows the 2nd Tone frequency to be increased or decreased as needed. In general use this control should not need to be touched.
4. 2-Tone Balance – This potentiometer sets the balance of the output tones, fully anticlockwise outputs Tone # 1, fully clockwise outputs Tone #2. Generally this control will be best set at the 1 O'clock position.
5. Output Level – This potentiometer sets the mixed tone output level. In use this control is best left at center or 12 O'clock position.
6. 2-Tone Output – The RCA jack has the output tones available for use with the transmitter.

Test Setup

In order to use the 2 tone tester with a transmitter to observe the effect of changes to the transmitter settings when the 2-Tone signal is applied requires some other equipment. Signals from the 2-Tone generator need to be applied to the microphone input of the transmitter, and an RF sampler placed in line with the output. The output of the sampler then can feed an oscilloscope or spectrum analyzer for examination of the output envelope or for more detailed examination of the output.

Typical test setup





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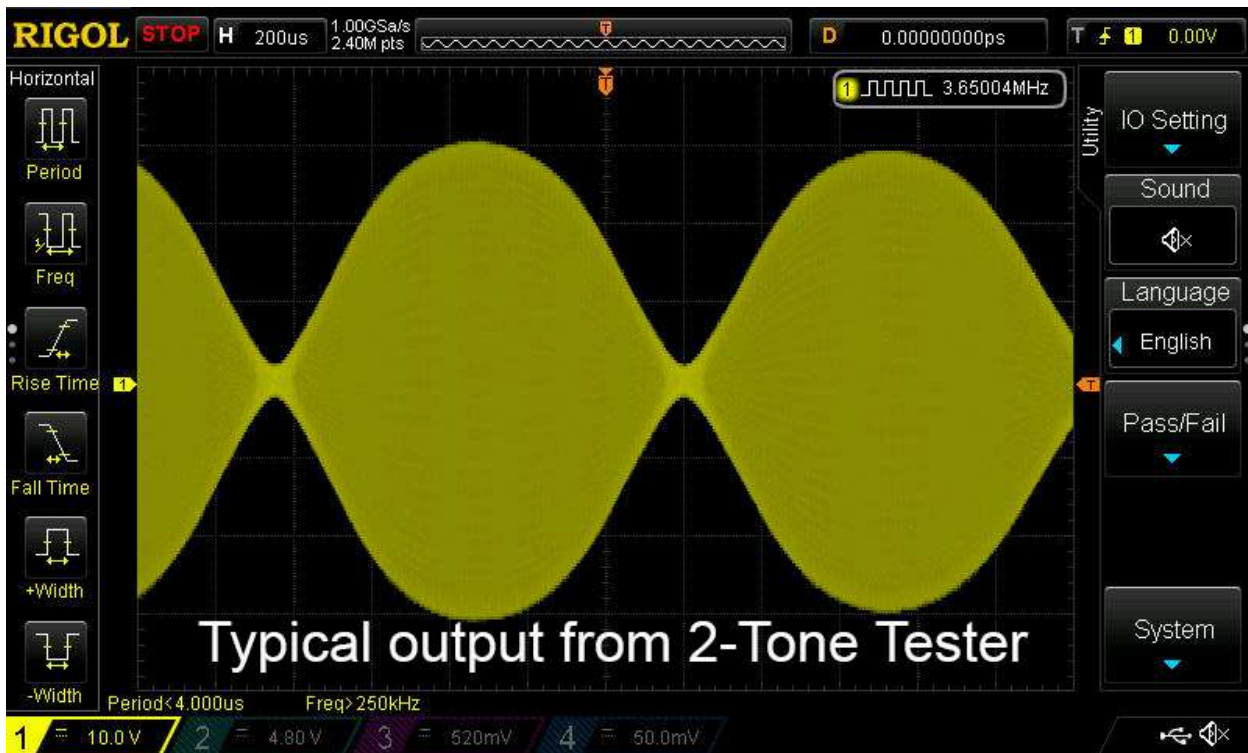
This setup will allow the transmitter output to be examined and then any effect altering the transmitter controls has on the output signal. It should be noted that modern transceivers have sophisticated audio shaping circuitry that may need to be compensated for by altering the balance control, and/or the transceiver controls. This will need some experimentation depending on the transmitter under test.

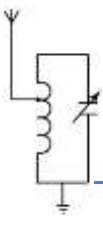
Typical results

The following oscilloscope traces were derived using production versions of the 2-Tone tester, using both digital and analog oscilloscopes. The 2-Tone signal was fed to the microphone socket of an IC7300 for these tests and the output coupled via an Electro-Resales[®] brand RF sampler using a toroid coil transformer.

Output from an Icom IC7300

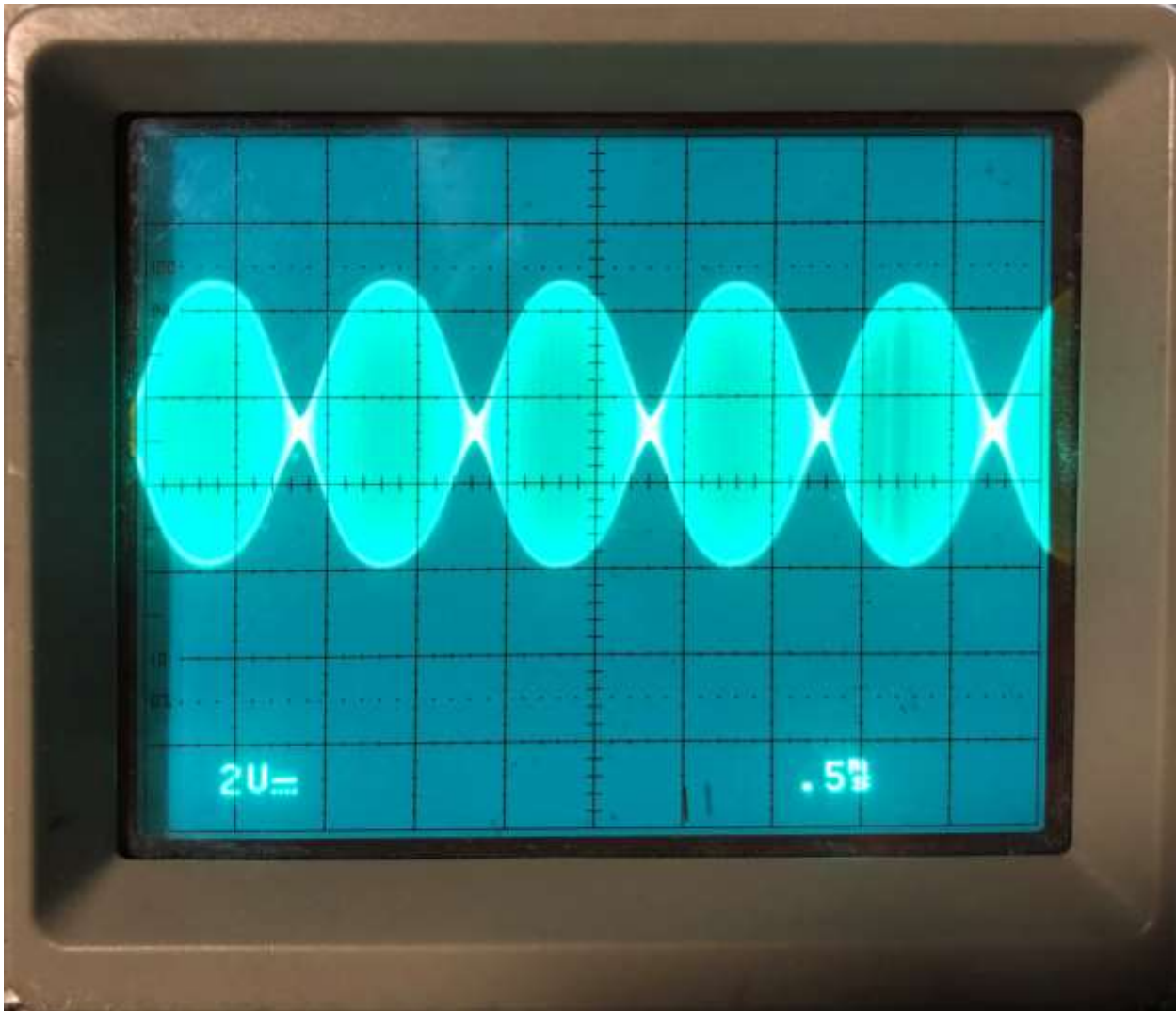
Note the round tops to the envelopes, flat-topping is not present which is created by over driving the transmitter or excess compression.

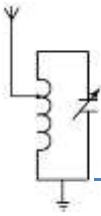




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The above picture was obtained using a digital scope. The next photo is from a Tektronix 2245A analog oscilloscope. This demonstrates a more traditional 2-Tone output from the Icom IC7300 transceiver fed with the 2-Tone signal (note the elongated trace envelope).





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Impedance selection

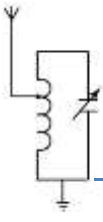
The impedance of microphone inputs is generally different for transmitters that are based on vacuum tubes compared to modern solid state units. A higher impedance is often found on vacuum tube devices, compared to modern transceivers. Typically a solid state transmitter has a microphone impedance of around 600 Ω , while vacuum tube transmitters have an impedance of around 50K Ω . Additionally the ACC socket on a modern transceiver have an input impedance of around 10K Ω .

To compensate for this the installed header can be moved to either the Lo or Hi position as required to allow for these impedance differences.

Troubleshooting

The basic operation described in the previous sections is designed to get the user up and running with the 2-Tone generator, however problems can occur and the following suggestions are designed to provide simple troubleshooting solutions. If they do not help please contact us at: resalese@gmail.com

1. No output – Check the output level control is not set fully anti-clockwise, ensure a new battery is used.
2. Only one tone appears to be being generated – Check the balance control is roughly set to 12 O'clock position.
3. Output trace appears to be very small.
 - a. Check transmitter output is more than 5 watts
 - b. Check transmitter microphone level control is set to at least 50%
 - c. Ensure your RF sampler port can generate sufficient drive for your measuring 'scope.
 - d. Adjust oscilloscope controls to increase trace height.
4. Trace appears 'jittery' or will not trigger.
 - a. Digital 'scopes can exhibit this issue; a simple solution is to run the 'scope in single shot mode, or;
 - i. Adjust the trigger level/point on the 'scope.
 - ii. Adjust the timebase speed.



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Specifications:

Voltage: 9 volts

Current: 1.5mA

Tone 1 Frequency: 1140 Hz

Tone 2 Frequency: 2200 Hz

Tone # 2: Fractional adjustment range

Impedance range: 600Ω - 10KΩ