

DK7IH Amateur Radio Website – Ham radio for builders.

Amateur projects for the radio draftsman. QRP, QRO and more radio stuff that YOU can build.

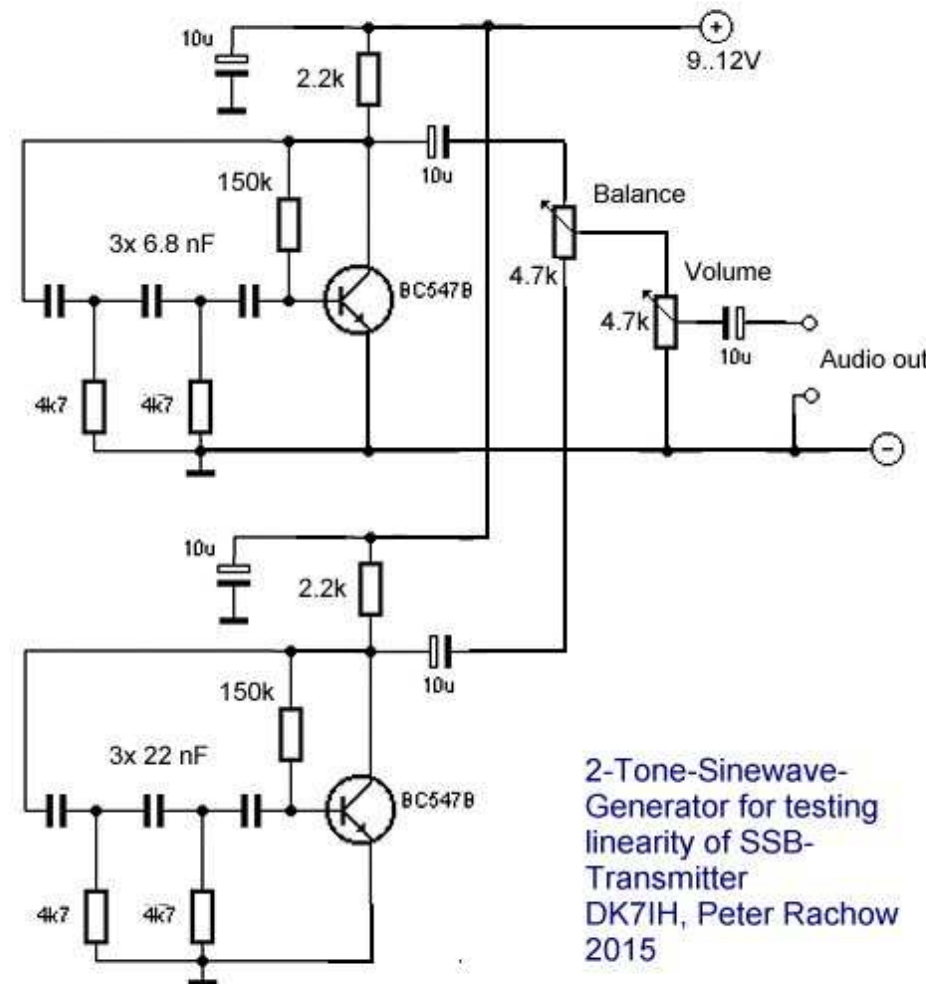
A simple 2-tone-generator for testing the linearity of SSB transmitters

7. JANUARY 201630. MARCH 2016 ~ DK7IH

This device is as simple as useful. With 2 transistors and an oscilloscope it is fairly easy to test the linearity of your SSB transmitter. The 2-tone-method is a standardized test method that can be used to determine the maximum output and the amplification characteristics of a sideband transmitter.

The method involves 2 audio tones simultaneously applied to the microphone input of the DUT (device under test). The two frequencies must not be harmonically related and must both fall within the audio passband of the transmitter. Also they should have a significant spacing in the audio spectrum. 850 Hz and 2200 Hz are a good choice, for example. If you own a spectrum analyzer with an appropriate resolution the *Third Order Intermodulation* products (IM3) can also be made visible. I'll refer to that in a later post, today we want to talk about the amplitude side only.

First, here's the circuit:

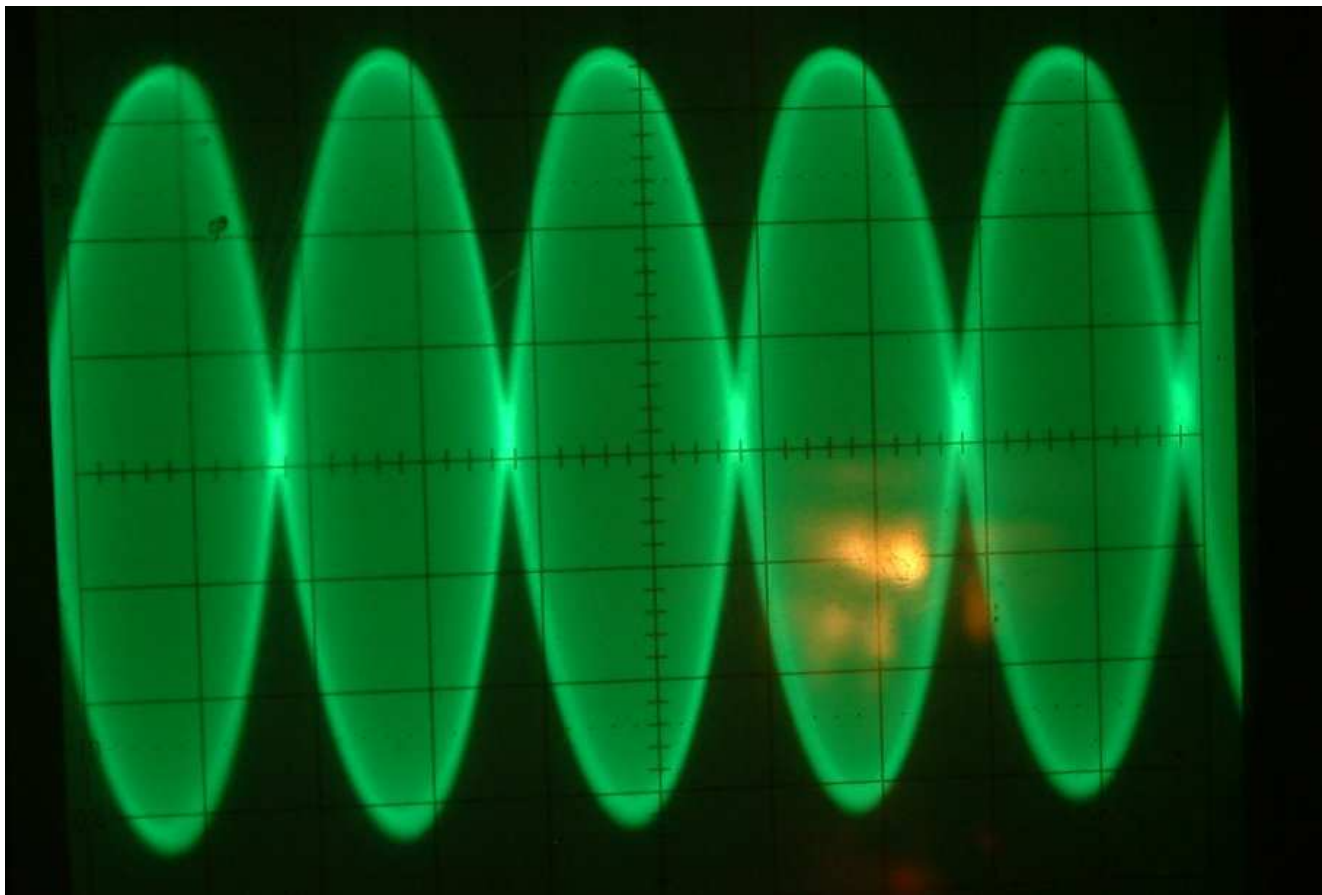


(<https://radiotransmitter.files.wordpress.com/2016/01/wien-oszillator.jpg>)

Wien bridge oscillator used as a two-tone-test generator for checking SSB transmitters' linearity

The heart of the device are two Wien-Bridge-Oscillators. They produce 2 sine waves which generate a new waveform that is formed by superposition of the 2 single signals. It resembles an amplitude modulated carrier and should look like this when displayed with an

oscilloscope:

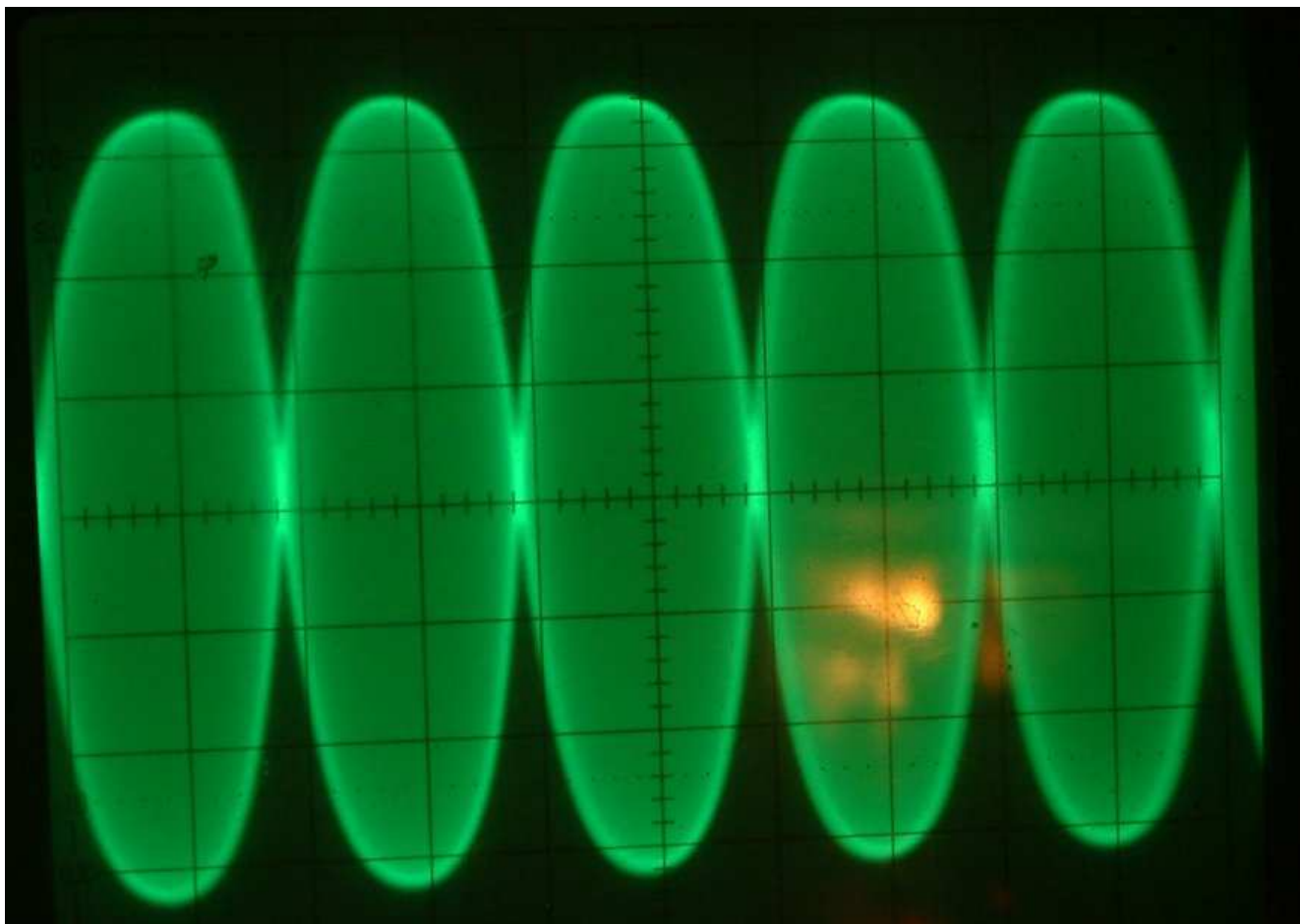


<https://radiotransmitter.files.wordpress.com/2016/01/ssb-2-tone-test-signal1.jpg>

SSB 2-tone test signal: Transmitter correctly adjusted

The “balance” of the tone generator circuit must be carefully adjusted to regulate the amplitudes of the two audio signals in a manner that the cross section centering the waveform is as sharp as possible. Then the two audio signals are nearly 100% equal which will result in the demonstrated signal amplitude waveform.

Wrong adjustments of the transmitter can be easily observed like the following pictures show. First one is an amplifier that is overdriven:

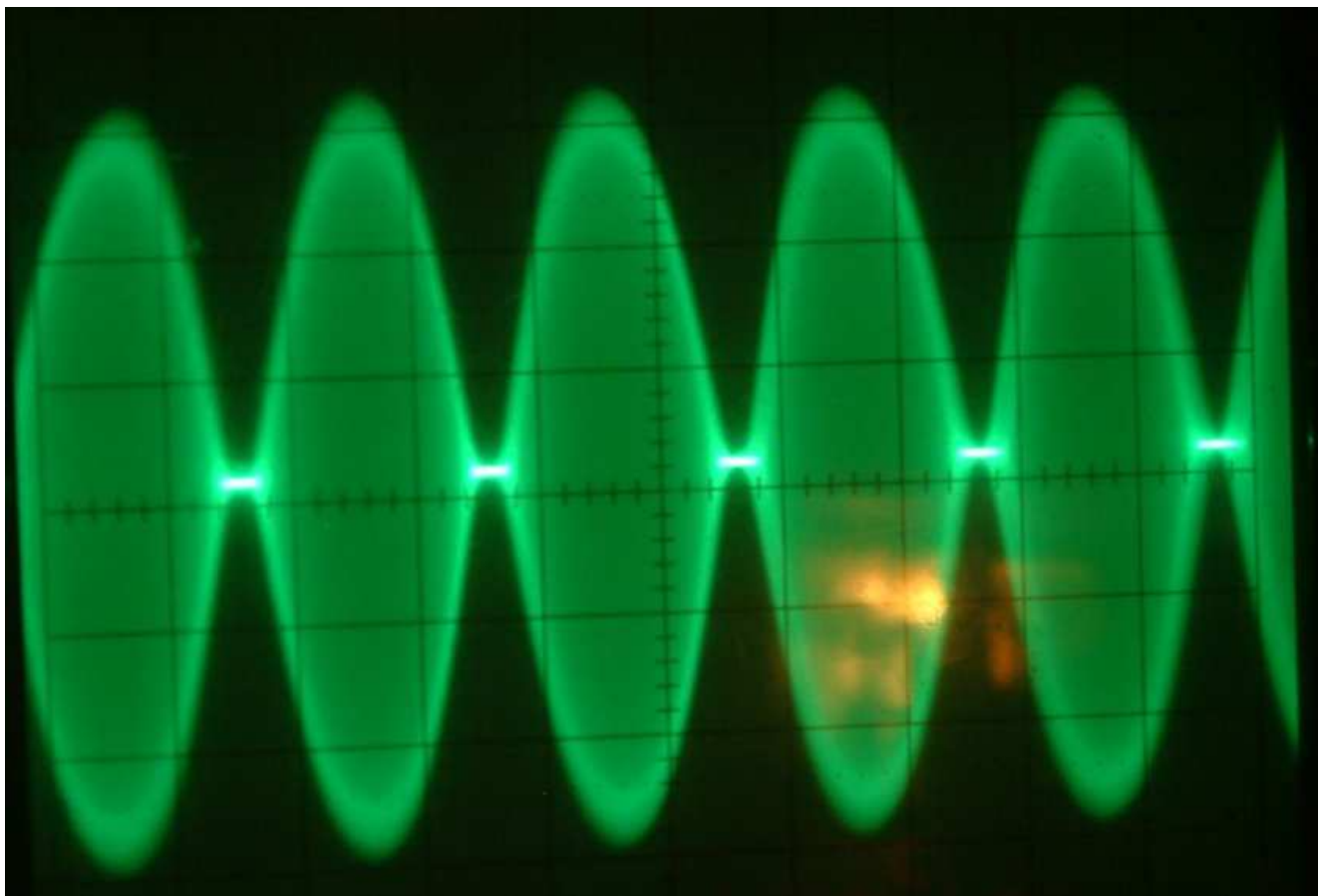


(<https://radiotransmitter.files.wordpress.com/2016/01/overdriven-ssb-transmitter1.jpg>)

Overdriven SSB transmitter operating close to saturation

This is a sample of the classical “flat topping”. At least one amplifier stage in the exciter is running in saturated mode thus not being able to deliver proper amplification of the signal’s higher amplitudes. The transmitter will sound very distorted. Also a high set of IM3 products will appear thus make your signal much wider than acceptable.

The following picture shows an SSB amplifier running with inadequate bias setting:



(<https://radiotransmitter.files.wordpress.com/2016/01/wrong-bias-in-ssb-exciter1.jpg>)

Wrong bias in SSB exciter, increase of quiescent current strongly recommended!

The bias in this case is much too low so that lower voltage areas of the amplitude are not amplified sufficiently. Bias setting must be increased to ensure proper amplification.

To measure the peak output of your transceiver you can either use the amplitude reading of your oscilloscope. Divide the peak-to-peak voltage by 2.81 (two times the square root of 2) to convert p.-p- voltage to effective voltage, square it and then divide the result by your 50 ohm resistive load.

$$V_{eff.} = V_{pp.} / 2.81 \text{ (I)}$$

$$P = V_{eff.}^2 / R \text{ (II)}$$

Or you use a VTVM (valve tube voltmeter) with an RF probe that gives you an RMS reading of the transmitter's output voltage.

Keep in mind: The power you'll get is half of the peak output power of your transmitter!

If you managed calculus, then it's quite clear why. 😊

73 de Peter!



Weekly Penny

You Should Never Shop On Amazon Without Using This Trick - Here's Why

REPORT THIS AD



Weekly Penny

You Should Never Shop On Amazon Without Using This Trick - Here's Why

REPORT THIS AD

POSTED IN [DK7IH](#), [HAM RADIO](#), [HOMEBREW](#), [HOMEMADE](#), [SSB](#), [UNCATEGORIZED](#)
[QRP](#) [SSB TRANSMITTER](#) [TWO TONE TEST GENERATOR](#)



Published by DK7IH

[View all posts by DK7IH](#)

5 thoughts on “A simple 2-tone-generator for testing the linearity of SSB transmitters”

1. **William C. Colvin**

SAYS:

[9. DECEMBER 2016 AT 3:22](#)

Does not say what size coax to use on this project, and what is good for inside of radios.

[Reply](#)

1. **[Peter Rachow \(DK7IH \)](#)**

SAYS:

[9. DECEMBER 2016 AT 18:34](#)

Hi,

concerning coax: Any shielded cable for audio purposes is sufficient. And I would not build it inside a radio. It's a piece of test equipment.

[Reply](#)

2. **davecasler**

SAYS:

[20. JANUARY 2017 AT 21:35](#)

If I were to use 2N2222 transistors, what changes would I need to make?

Reply

1. **Peter Rachow (DK7IH)**

SAYS:

21. JANUARY 2017 AT 0:04

Hi Dave,

you can use a 2N2222 instead of a BC547 like any other AF transistor. 73 de Peter

Reply

3. **Brian**

SAYS:

17. OCTOBER 2017 AT 23:37

The oscillators aren't Wien Bridge. They are phase shift oscillators.

Reply

CREATE A FREE WEBSITE OR BLOG AT WORDPRESS.COM.