

## Transmit audio quality part 2

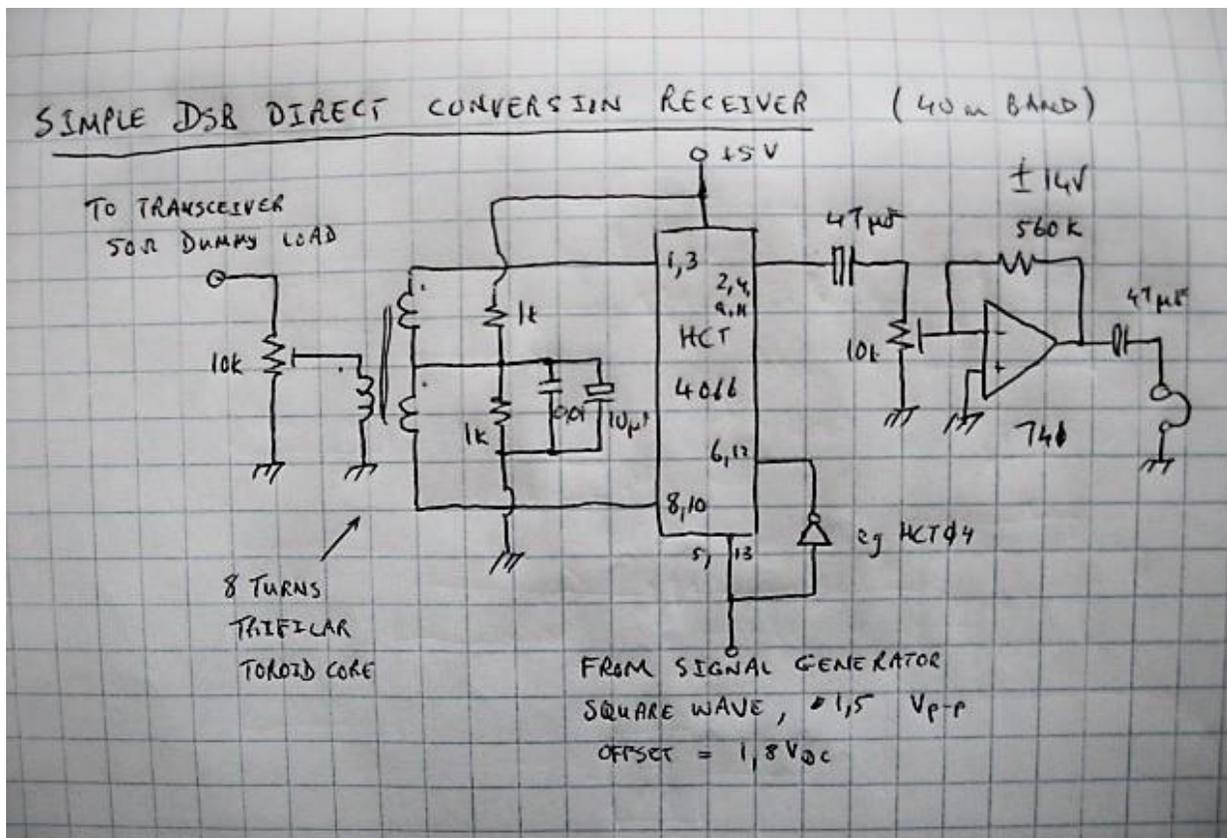
By Juan H la Grange, ZS6SZ

### 1. Introduction

With the changes described in the previous document, plus the purchase of a new microphone, the transmit audio quality was better but still unsatisfactory.

The audio quality in Transmit was good up to the balanced mixers as could be easily measured. Because the Receive audio quality was good and the previous changes addressed the audio levels, the conclusion was that the problem was at RF. But how to hear one's own transmission which could assist with finding the problem?

It was decided to build a breadboard simple direct conversion Double Side Band (DSB) receiver, consisting of 3 chips and a few passive components, to connect to the Transmit output of the transceiver as connected to a dummy load. It is based on a design by Tasic Sinisa-Tasa YU1LM [[www.yu1lm.qrpradio.com](http://www.yu1lm.qrpradio.com)], as follows:



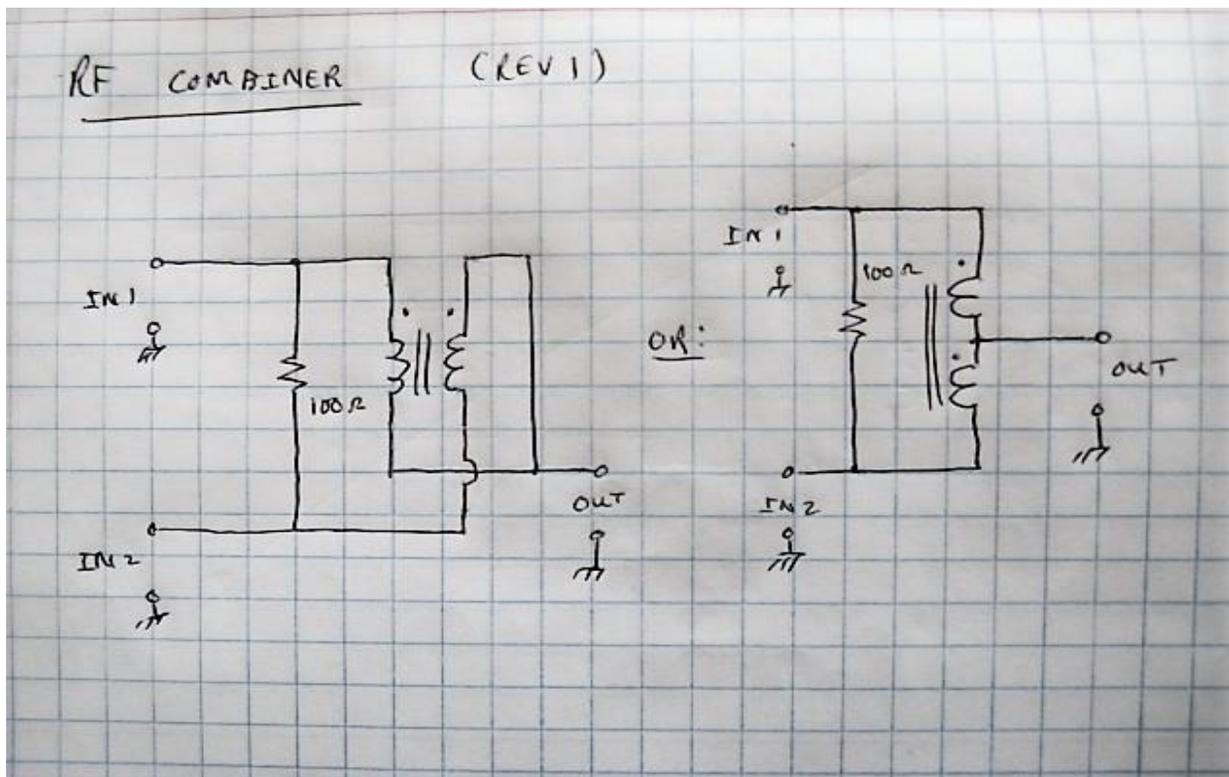
This receiver worked well and the audible Transmit voice quality problems were: The audio sounded distorted, higher frequency tones were missing, low amplitude tones were also missing and there was a 3 Hz modulation imposed. It was initially not clear what could cause this.

The attention immediately went to the only RF component used in Transmit and not in Receive, being the passive combiner. It was tested on the breadboard and performed well. When the input signals are in phase, as would happen for the desired sideband, these are combined. When the input signals are 180 degrees out of phase, as would the case be for the undesired sideband, they are blocked.

BUT.....

## 2. Passive RF combiner.

The typical circuit for a passive RF combiner is as follows:



The author could not understand the purpose of the 100-ohm resistor for his application and omitted it. The related internet articles mentioned that the purpose of the resistor is to protect the second channel when the first one fails, which is not relevant in this case. But the resistor is actually essential, to omit it was a mistake.

For combining the desired, in-phase signals, this resistor plays no role, there is always zero volt across it, as can be seen when studying the right-hand diagram above. Thus, the combiner can function with or without it.

On the other hand, without the resistor, when the undesired out-of-phase signals arrive at the combiner, they each see a high impedance and are reflected back to the balanced mixers, where they cause the distortion.

With the resistor inserted, the out-of-phase signals see it as two 50-ohm resistors connected in series with a virtual ground in the middle. Thus, they are correctly terminated by 50 ohm each and no reflections occur.

The diagram above depicts the two ways in which a combiner circuit can be drawn. It was the second depiction which helped the author finally see the problem, after much contemplation. He could not see or identify the issue of the reflections on an oscilloscope. It was after remembering that reflections also caused a problem much earlier, when the RF was not properly terminated in the low noise AF amplifier and similar audio distortions occurred, that insight slowly came.

### **3. RF power amplifier**

In addition to the above, it was found that the RF power amplifier had seemingly degraded from class AB to class C, also adding significant distortion. The pre-set bias to the MOSFET transistors was increased, which solved the problem. (But not before damaging quite a number of transistors due to mistakes and poor understanding.... The two power transistors must obviously be matched well; if not, the one will take most of the load and burn itself out very quickly.)