

Addition of Digimodes capability

By Juan H la Grange, ZS6SZ

1. Introduction

The digital modes (Digimodes in this document) available to radio amateurs have proven to be quite popular, even though a WhatsApp or similar cell phone app message can also be communicated around the world with ease utilising the high reliability and reach of the internet.

But the attractiveness of Digimodes consists of course of two challenges, firstly the technical challenge and secondly digging into the radio wave propagation “secrets” which allows for these typically weak signals to be heard and answered in distant locations while voice communication on that frequency is simply not possible at that time. Thus, very good DX possibilities exist with Digimodes.

So, after reading an excellent book on the subject, being “Get on the Air with HF Digital” by WB8IMY Steve Ford and the ARRL Inc, the author decided to add Digimodes capability his HF transceiver.

2. The Interface

To work the Digimodes a transceiver, a standard PC or laptop with the appropriate free (or otherwise) software installed, and an Interface between the two are required. The details can be found in the above book or other references and will not be repeated here at length.

The transceiver is home built and did not contain any PC interface capability. The requirements for the Interface are to get the transceiver audio into the PC through a PC Microphone port; to get the Digimodes audio signal from the PC Speaker port into the transceiver at its microphone input; and to be able to switch the transceiver between Rx and Tx when the PC software wants to.

The loudspeaker output of the transceiver is simply taken to the microphone input of the PC. Because the PC's own sound ports could not be used, an external USB to audio device was purchased, having a PC microphone input jack and a PC loudspeaker/phono output jack.

It was initially decided to design a Voice Operated Switch (VOX) to enable the PC to switch the transceiver from Rx to Tx and back again. The audio output from the PC is a mostly constant-amplitude signal of about 2Vp-p in this instance.

Since the transceiver uses double coil change over relays to switch between Rx and Tx, the VOX needs to output a pulse to the Tx coils when required, and another pulse to the Rx coils to go into Rx mode. After considering various design options, it was decided that the simplest one would be to program a 16F1619 microchip to be the VOX and output the pulses. It was also decided to use the microchip to drive the LCD display unit of the transceiver, which was previously the frequency meter, but which became redundant with the addition of the external VFO which has its own frequency indication. A few Digimodes messages would be displayed on the LCD display, for example the audio level from the PC.

The audio from the PC goes to the ADC of the microchip and the microphone splitter of the transceiver. The pre-set pot can be adjusted for the best RF transient response to the step audio input.

The audio from the transceiver goes to the microphone input of the PC through an isolating transformer, to convert from a balanced, non-earthed loudspeaker output to an earthed PC input.

3. Transient blocking

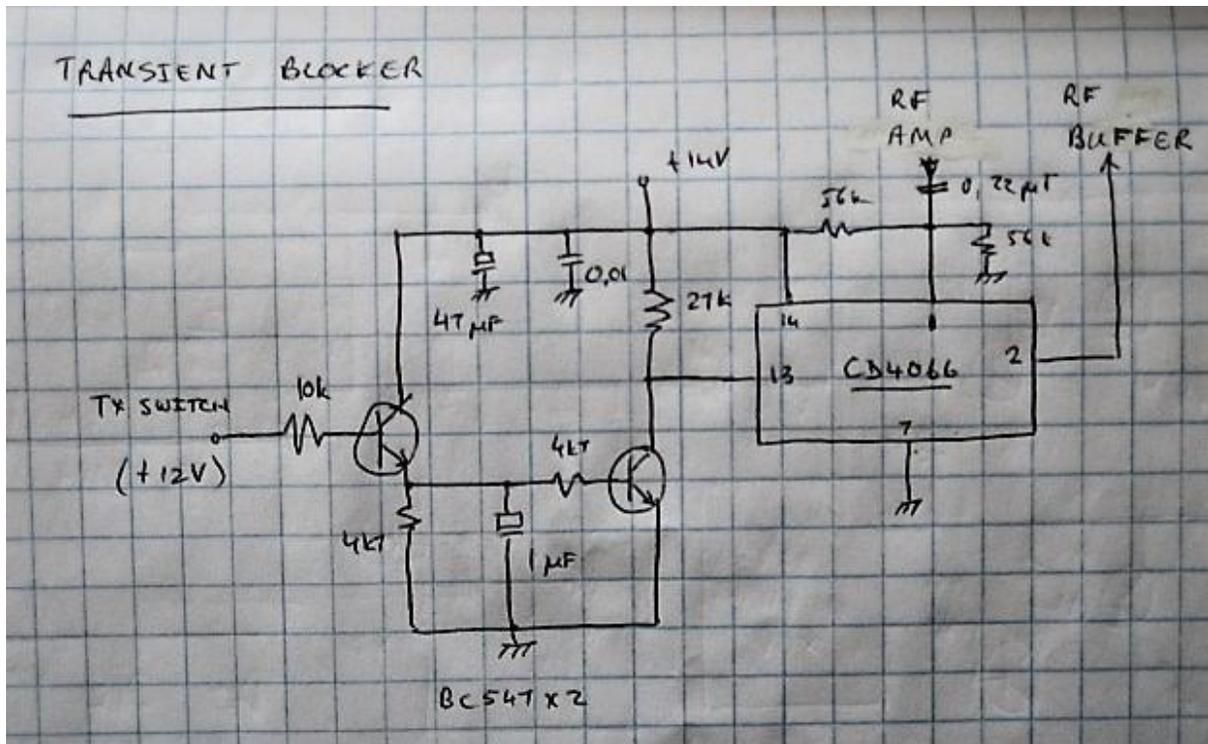
It was noticed, even before converting to Digimode, that there was a transient pulse transmitted when switching the transceiver from Rx to Tx. The duration was very short, maybe 10ms at the transceiver output, so it was ignored. since it would only be heard as a short noise burst. It was thought it was caused by the digital filter emptying its history.

Upon closer investigation it was seen that the transient caused the power transmitted from the RF Power Amp to be the maximum and this caused some resonance- related ringing into the antenna for quite a long period. So, it was undesirable and had to be eliminated. Even more important, it garbled the first part of the Digimode transmission.

The cause was found to be a DC transient into the AGC stage due to different DC conditions in the different stages coupled to AGC for Rx and Tx. The high gain of the AGC stage greatly amplified the small transient.

Many alternative solutions were investigated but the most viable one was found to be to block the signal between the RF Amplifier and the RF Buffer for the duration of the transient. A relay was found to be too slow, so an electronic switch was required.

A CD4066 electronic switch was used as follows. The switching pulse is at least 35ms long and the 1 microfarad capacitor is used to extend the blocking period somewhat and can be increased to cover the transient period. One switch of the CD4066 is used, the "off" transient signal is adequately reduced by some 70%. To correctly transfer and switch this analog signal, the CD4066 input had to be biased around midpoint (+7V) by the two 56k resistors.



4. Operation

FT8, being the most popular of the Digimodes with radio amateurs, was tried first. Listening in Rx mode and looking at the decoded messages from the software on the PC screen is the obvious first place to start.

Transmission of the constant amplitude tone can be quite onerous on the RF power amplifier which is probably designed for much the more intermittent output of SSB. Thus, power needed to be reduced to some 30 W, which is recommended for the Digimodes anyway.

The continuous signal led to the discovery of some underrated components in the ATU, including coax cable and a ferrite core. When these were replaced, it was found that the SWR was unacceptable and the length of the end-fed antenna had to be increased by some 2,5m to solve the problem.