

The Latest

Multiband Transverter LO

Up

Posted by AG6QV Frank

Tags:

Operating on multiple microwave bands requires a lot of equipment. Each band has a common IF radio, a transverter and a Local Oscillator (LO). My first radio for 10 GHz had all these components built into a box, a fully enclosed unit like any commercial radio for HF or VHF. It just require a power source and I'm on the air on 10 GHz, very simple and light weight. If multiple bands are needed this system would add duplication of the common components that can be shared. Thus reducing the weight of the equipment but also ads complexity as there is a need for more cables.

A radio often used as the IF radio is the Yeasu FT 817/818 or the newer Icom IC 705. Both radios cover HF and VHF/UHF frequencies with a relatively low RF power level. In my case I'll be using the Yeasu FT 817 as that is the one I currently own.

Instead of building on LO for each band I decided to use a synthesized chip (ADF 4351) from Analog devices. There are fully assembled boards available on Amazon and eBay or you can purchase the chip from Mouser or Digi Key and create your own board. In either case this chip will have to be programmed at startup in order to generate the desired frequency. The chip is capable of generating frequencies from 35-4400 MHz.

The microwave bands I plan to be active on are 33cm, 23cm, 13cm, 9cm, 6cm, 3cm and 1.25cm. Depending on how microwave is defined 33 and 23cm might not count but I have transverters for those so I included these bands in my LO design.

Another design consideration is to be able to change the IF frequency in the field. When multiple stations operate from the same location the IF radios might receive the IF signal directly. To avoid this it will be helpful to chose a different IF frequency. That will change the required LO frequency in order to stay on the same microwave frequency. Since the IF radio supports multiple bands I implemented 4 options for the IF frequency (25, 50, 144 and 432MHz). It would be possible to use any non standard IF frequency as well.

The ADF 4351 board is using 3.3V logic and in the past I had used a 3.3V Arduino Nano compatible board to control the chip. I used this to generate a GPS locked weak signal source. I bring this into the field when I use my old 10 GHz radio. This radio was built in 1991 and the LO or IF components are not locked to any reference frequency. This causes the radio to be temperature sensitive. It drifts ~15 kHz from power on to semi stable and will drift further on a hot summer day. Not a big problem when I have a known stable frequency source to check

the offset against.

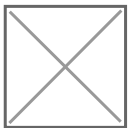
Instead of the Arduino Nano compatible boards I switched to STM32 micro controllers. In this case the board STM32F103C8T6 also known as Blue Pill. This board has a 72 MHz CPU and 64kb memory and operates with 3.3V logic, so no need to switch levels to control the ADF 4351 chip. It is also possible to program with the Arduino IDE. In fact the exact same code I used for my first boards used in the weak signal source and other projects.

The requirements for the LO was to have a single LO source that could be used with HAM microwave HAM bands from 900 MHz to 10 GHz and to be able to use 4 different IF frequencies (28, 50, 144 and 432 MHz). After writing the first version of the code I decided to expand it to also cover the IF needed to work on 24 GHz as I plan to build a transverter/system for that band as well. For the 3 highest bands (5, 10 and 24 GHz) the ADF 4351 will not be able to provide the actual LO frequency needed as the maximum frequency is 4400 MHz. For these bands there need to be a x2, x3 and x6 frequency multiplier built into the transverter, but that should be recently straight forward.

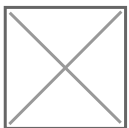
The First image below shows the internals. The ADF 4351 board is to the left and the Blue Pill STM32 board to the right. There are two RF outputs from the synthesizer and the microcontroller is installed on a small breakout board that includes a 5V regulator.



Programming the STM32 board require moving one of the jumpers and using a special connection or a programming dongle. I'll create another post about that. Both boards are mounted on a 3D printed carrier. The next image is the front of the unit. The display bezel is also 3D printed with a thin clear acrylic plastic to cover the actual display.



The switch on the left is a 3 position (on/off/on) that is used to chose the IF frequency. This allows me to control two input bits with the values 00, 01 or 10. In order to get the forth option 11 for the last IF frequency I added another switch on the back side. That switch is monted in the hole seen on the next picture.

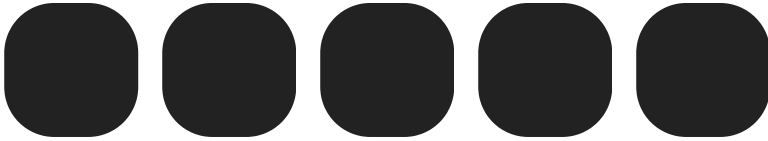


Finally the unit is powered up and connected to the 10 MHz GPS locked reference in the box below.



The 10 MHz reference system will be described in a future blog post. The display shows UTC time and a few parameters (frequency, internal temperature, voltages and the grid square).

Link to this Post



Microwave Activity

Up

Posted by AG6QV Frank

Tags: [10 GHz](#) | [PNW Microwave](#)

The PNW-Microwave group took to the mountains this past Sunday to operate 10 and 24 GHz between USA (WA) and Canada (BC). I created a description of the event over on the groups [web page](#).

Below is a list of the contacts I made.

Link to this Post



Interference from AM Station

Up

Posted by AG6QV Frank

Tags: [HAM](#) | [HF](#)

I have an AM station less than 5 miles from my location. During the daytime the transmitter is operation at 50 kW, which makes it almost impossible for me to hear anything on the HF bands, especially when using the long end-fed dipole. I have no problem receiving on the 23 foot vertical, but the radiation pattern on that antenna is far from optimal. I have worked a few stations transmitting on the end-fed and listening on the vertical, but that is a bit tricky, especially on digital modes where there is little time between the RC and TX cycles.

So in order to get rid of the unwanted AM signal below 1.8 MHz I decided to build a high pass filter and insert it into the feed line close to the station. That way it will work on both of my HF/6m antennas, or any of the additional antennas I'll connect to the 6-way remote switch I have installed close to the feed point to avoid running to many coax cables.

In the past I have used the [LC Filter design](#) tools provides by Marki Microwave. After a bit of experimentation I ended up with an 11th order Chebyshev configuration with 6 capacitors and 5 inductors. The inductors was created by 13 and 15 turns on a T106-2 toroid and the capacitors are SMD 1206 100V MLCC. This should have no issue handling the 100W power I will be putting through the filter when transmitting.

1.8 MHz High pass filter

I created a PCB layout in KiCAD. It had been a couple of months since I used KiCAD so I started by updating to the latest version (9.0). If I ever get good at using this tool I hope to use it to design microwave boards in the future.

1.8 MHz High pass filter (KiCAD)

The PCB Layout is relatively simple and is almost identical to the schematic.

1.8 MHz High pass filter (PCB Layout)

The fabricated PCB arrived today from JCL PCB.

1.8 MHz High pass filter (PCB Layout)

And after a few minutes of soldering the board was assembled at placed in-line of the coax cable.

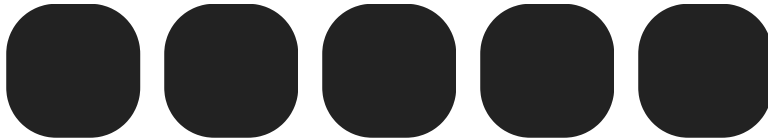
1.8 MHz High pass filter (PCB Layout)

It was now ready for the big test. To start with I recorded 10 seconds of audio without the filter in place. This was recorded on 30m (10 MHz) with the radio tuned to the FT8 Frequency.

Then I installed the filter and recorded another 10 seconds of audio:

For some both of these files might sound like noise but for me there is a clear difference and the S9 noise is now gone and with this filter in place I'm now able to receive stations even with the AM station operating at 50 kW just 5 miles from my QTH. Next project will be to find an enclosure or simply 3D print a small box for it.

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