The Latest

Multiband Transverter LO

Up

Posted by AG6QV Frank
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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.

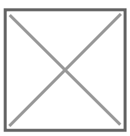
Another design consideration is to be able to change the IF frequency in the field. When multiple stations operate from the same location the IF radios might receive the IF signal directly. To avoid this it will be helpful to chose a different IF frequency. That will change the required LO frequency 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.

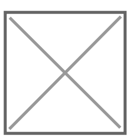
Instead of the Arduino Nano compatible boards I switched to STM32 micro controllers. In this case the board STM32F103C8T6 alto known as Blue Pill. This board has a72 MHz CPU and 64kb memory and operates with 3.3V logic, so no need to switch levels to control the ADF 4351 chip. It is also possible to 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.

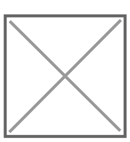
The First image below shows the internals. The ADF 4351 board is to the left and the Blue Pill STM32 board to the right. There are two RF outputs from the synthesizer and the microcontroler is installed on a small breakout board that includes a 5V regulator.



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 squere).

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