A clock for your shack

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I can remember long ago hearing someone say that he adjusted his alarm clock five minutes fast so that he would not be late for work. I suspect it had more to do with the uncertainty of getting accurate time. Time signals on the radio were about our only source of accurate time. When my father retired from work many years ago, he got a job as caretaker at the local church, which had a tower with a pendulum clock in it. He went to great pains to adjust this clock to be as accurate as he could and eventually this was a source of reliable time for the local community, until he had to give up that job and the clock then became less reliable again.

Nowadays it is easy to buy a clock controlled by a quartz crystal and have fairly reliable time. In my shack I have such a clock, but it gains a second or two per day and when I need accurate time, like when I relay bulletins, I have a clock on my computer screen that obtains it's time from the Internet. Even this clock has a problem because it sometimes skips a second and then jumps two seconds to get it right again. I suspect it has to do with the data through the internet not being 100% reliable.

Another source of accurate time is GPS. The GPS satellites use very accurate oscillators and can be received world wide. And nowadays there are wrist watches that have built in GPS receivers that set the watch once a day but also sets the time zone.

In some countries time signals are broadcast on very low frequencies that can be received by clocks with suitable receiving systems and they can then be synchronised once a day and keep good time. Countries with such systems are the USA, the UK, Germany, China and Japan. The USA transmitter transmits on 60kHz and is situated in Fort Collins, Colorado. During daytime the signal does not travel so far but at night it can be received in Canada end Mexico. The clocks then update around 01:00 every night but how they know when it is 01:00 and not 13:00 is a mystery to me!

The Fort Collins system uses a Caesium oscillator which is accurate to around one in ten to the power twelve. The USA military needed an accurate oscillator and nowadays an oscillator can be bought in quite a small package and at a reasonable price. But I think we can safely expect that one day there could be a Caesium oscillator that will fit into a wrist watch!

The clocks that receive these signals use quartz crystals for timekeeping but because quartz crystals drift with temperature and time, the clock needs to be corrected regularly, usually once per day at night. In this way one can have a clock that is accurate enough for most people. I must say that modern crystal oscillators for clocks, seem to have been improved considerably if I see how well my not so expensive wrist watch keeps time!

I see that manufacturers of wrist watches now produce watches that can either be corrected by the long wave signals or by GPS. The GPS system works anywhere on earth of course and in my view that is the preferred system, your watch is set once a day when you go outdoors!

There is a clock module available that keeps very good time, the DS3231. This uses a temperature compensated crystal, is also a calendar clock and has a battery that lasts for years. It needs a display and there are Arduino circuits on the Internet that use the DS3231 for making a nice reliable clock.

In my searches for a clock for an amateur's shack, I came across a device called a Chronvertor2. It is manufactured by Unusual Electronics in Britain. https://unusualelectronics.co.uk. It consists mainly of the DS3231 module with a PIC added. It costs twenty British pounds with a little added for postage. The PIC takes the time from the DS3231 and generates long wave signals to simulate the USA, British, German, Chinese and Japanese long wave signals, at very low levels of course. It can also be set by a GPS so that it can be very accurate.

One uses a terminal program to communicate with this device and then you can set the time and date and which protocol to use and a few other parameters as well. A back up battery keeps the time going when the module is not externally powered.

I designed a PC board that has room for the Chronvertor2, a USB to serial convertor, a GPS, a DC to DC convertor and an amplifier circuit. Power can be supplied by the USB socket but a separate power supply can also be used.

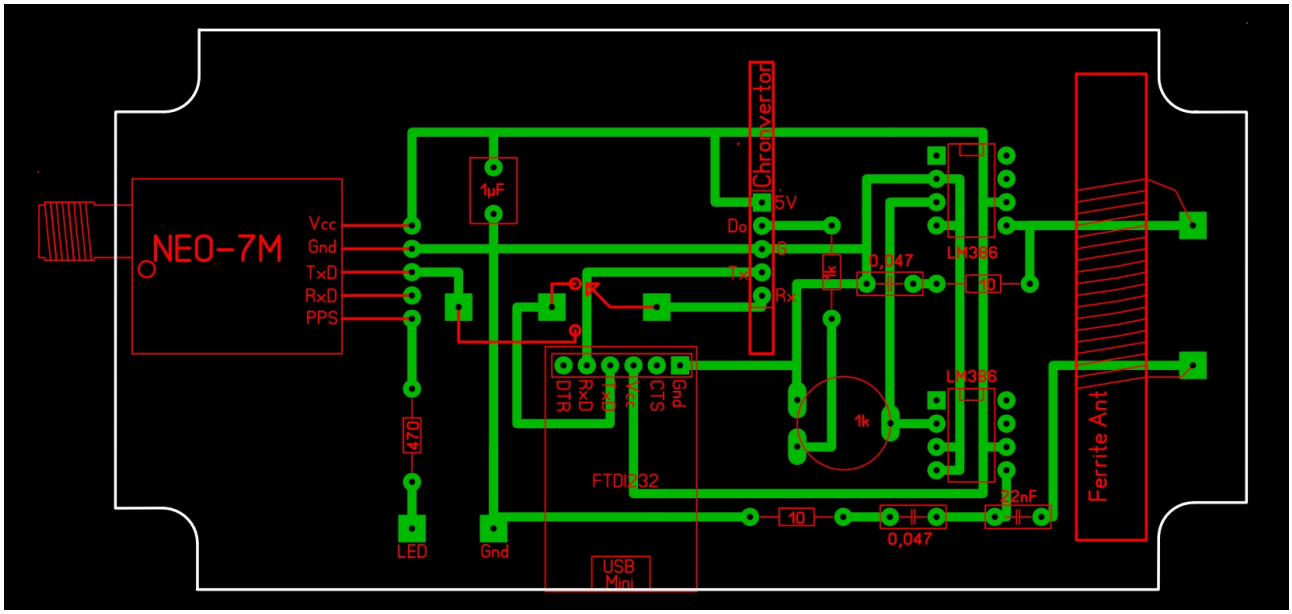
The amplifier consists of two LM386 integrated circuits that run in push-pull mode with the ferrite antenna connected in series wih a capacitor so that it becomes a series resonant circuit at 60kHz. This is to better match it to the low output impedance of the LM386s. There is a toggle switch to switch the Chronvertor to the USB port for setting up.

The amplifier generates enough signal to cover my house and now I have seven clocks that keep perfect time in my house! A neighbour who lived in Germany for a while and owns three clocks that run on the German protocol, reports that one of his clocks is set by my system.

The pc board is mounted in a small plastic enclosure with one LED that flashes once a second to show the GPS working. It is powered by my 12V battery that I use for amateur radio purposes. That battery allows me to use my radios during power failures when the bands are wonderfully quiet!

Do I need an accurate clock in my shck? Definitely NOT! I am just having fun.

PC Board:



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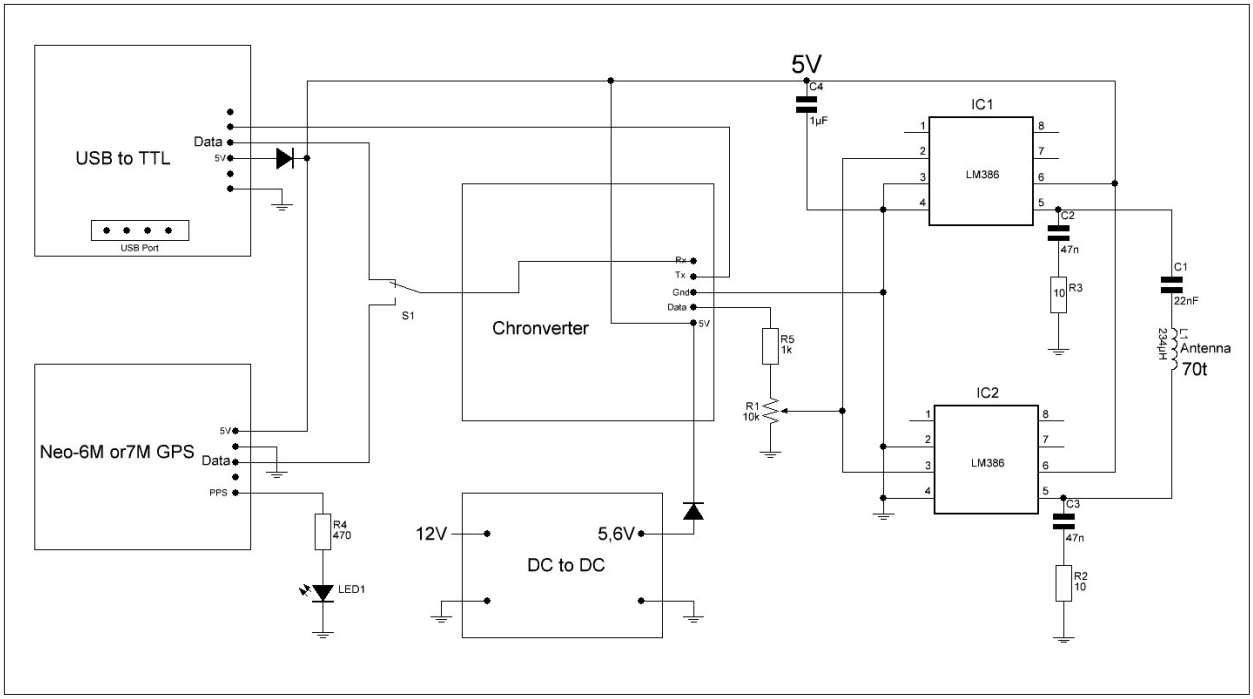
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USB Port
S1
Chronverter
Rx
Tx
Gnd
Data
5V
5V
C4
1µF
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C2
47n
R3
10
C1
22nF
L1
24µH
Antenna
70t
R5
1k
R1
10k
IC2
LM386
C3
47n
R2
10
Neo-6M or7M GPS
5V
Data
PPS
R4
470
LED1
12V
5,6V
DC to DC