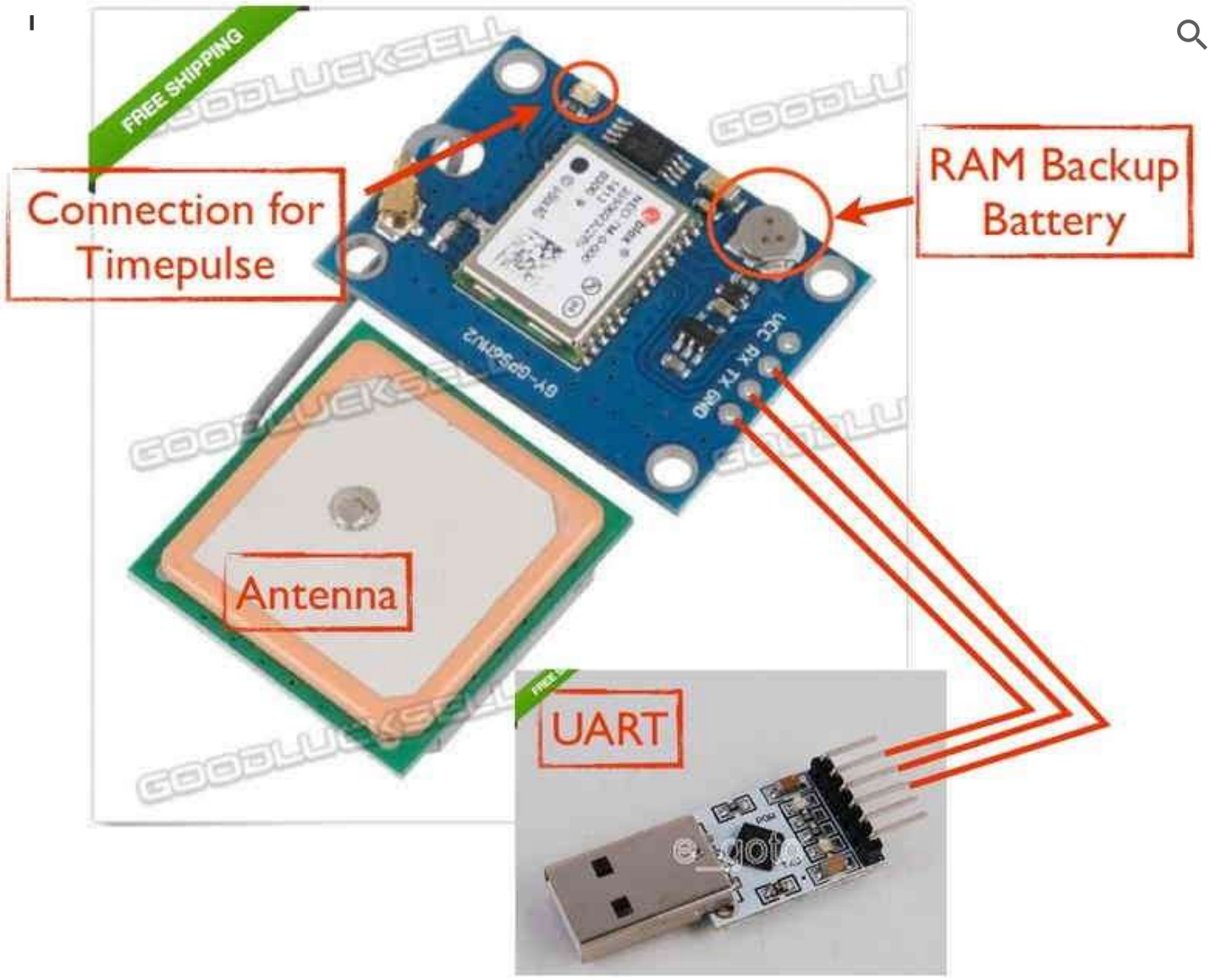
u-Blox_NEO-6-7

2020 Note the more recent **V.KEL VK2828U7G5LF** module with memory that stores configuration in flash, no backup required, more below.

Warren, 9V1TD, alerted the Softrock group of these modules in early 2014. "Frequency agile GPS reference for less than $30" (Currently less than 8UKP) This page is a compilation of information from this discussion.

A configurable, 0.25Hz to 10MHz GPS referenced generator. Yes, the picture below shows all you need! Note this is NOT a GPSDO, a NCO is used. The output is accurate, ideal for a frequency reference. But the basic signal is not clean enough for a receiver local oscillator.


FREE SHIPPING
Connection for Timepulse
RAM Backup Battery
Antenna
UART

A picture from an Ebay supplier (goodlucksell).No longer selling Search for Ublox NEO-7M or the later, better V.KEL model as described further down this page.

Ignore the red "wires" on the picture. Four connections:-

The 3V3 on the UART can go to VCC on the NEO-7. My NEO-7 has a regulator but it is low drop-out (Mine drops 0V1 with 3V3 input) Provided you are certain your GPS module does have a regulator the 5V from the UART can be used.

Gnd connect together.

RXD to TXD twice. (Transmit to receive on each.) Look at Dick's picture further down this page.

WARNING Ensure the UART has a CP2102 chip. This is a 3V3 device but other UARTs may not be.

For some time the u-Blox modules have had an option to configure the pulse output.

Usually 1 PPS but the series 5 may be configured at 0.25-999Hz. The series 6T (only) and 7 0.25Hz-10MHz. So the series 6T and 7 may output any frequency up to 10MHz with GPS precision. There is likely to be a lot of jitter, a PLL will be required for use as anything other than an accurate frequency reference.

Ebay is a source of modules a search for Ublox NEO 7 will find them. Also note the **V.KEL VK2828U7G5LF,** details near the bottom of this page.

Note the UART like https://www.ebay.com/... search for USB2.0 to TTL UART. It will act as a cheap, simple interface for many GPS modules even supplying 3V3 or 5V to power them. In fact my ones have all COM port connections available, they are full USB to serial TTL adaptors.

The SiLabs CP2102 is used in these modules. The data sheet and drivers (If Windows does not install them) may be obtained from their web site. https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers

After installing the u-Blox software https://www.u-blox.com/en/product/u-center-windows and starting, checking configuration, the window fills with information charts.

Drag them out to view. Other information windows in "View".

If the GPS module is not locked then it will output NMEA sentences which may be seen. "View" - Text Console.

You may find that sometimes the GPS stream is interpreted to be a serial mouse by Windows plug and play. The cursor jumps about uncontrollably. Try disconnecting the GPS from the UART while the "serial mouse" is active. Do not unplug the UART. Disable the serial mouse in Device Manager.

First setup:-

"Receiver" - Port - If in doubt he UART port may bee seen in "Device Manager".

"Receiver" - Baud Rate - The default seems to be 9600

"Receiver" - Generation - NEO-7

The time pulse is set, "View" - Configuration - TP and after setting the figures - Send. (Picture at bottom of page.)

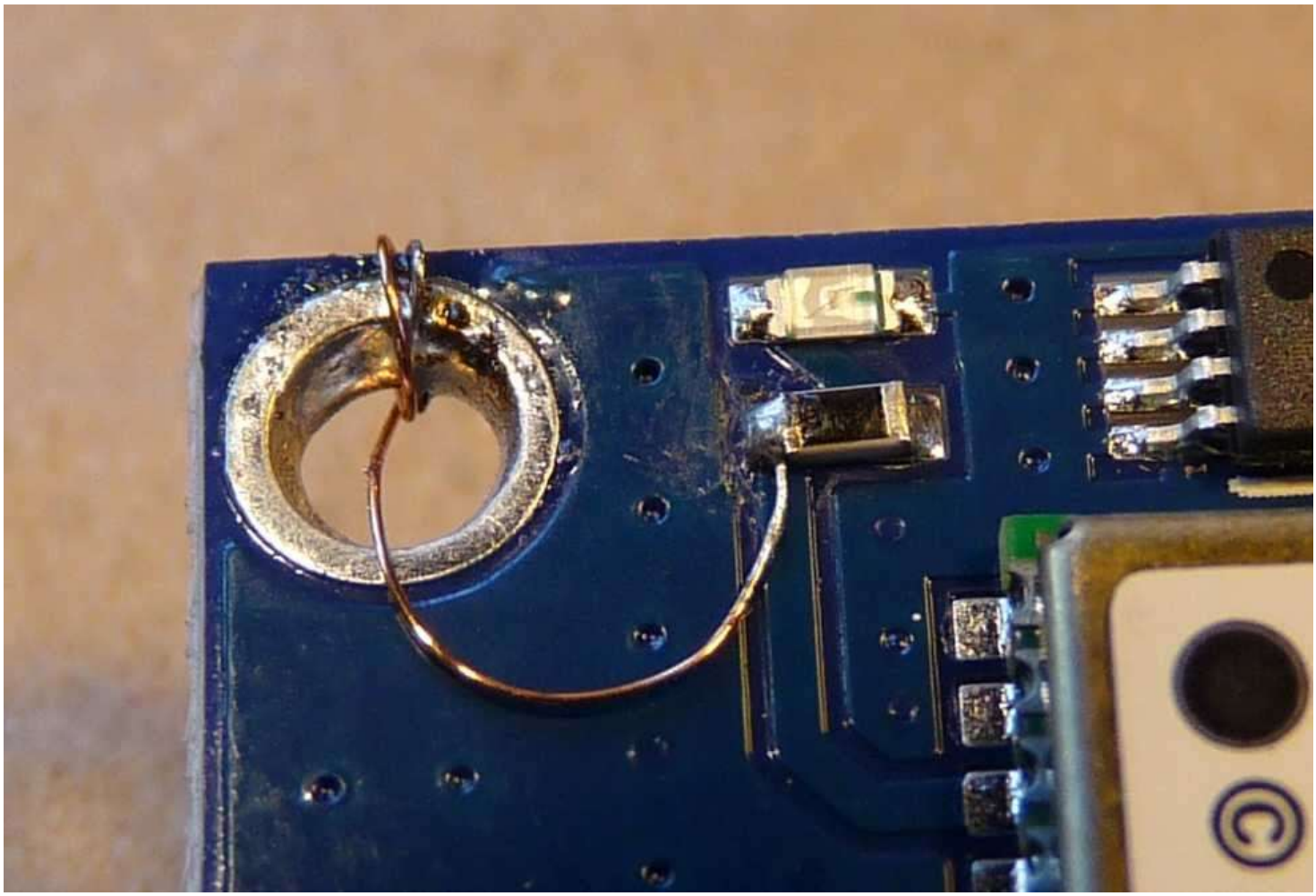
Milt:- In the Configuration tab "**Save current configuration**" with 0-BBR and 1-FLASH highlighted - save.

And, as Warren says "Receiver - Action - **Save config**" does the same.

Use "Revert to default" to start again.

All this, and much more, is in the documentation.

The default is no O/P if not locked.



The pulse take-off.

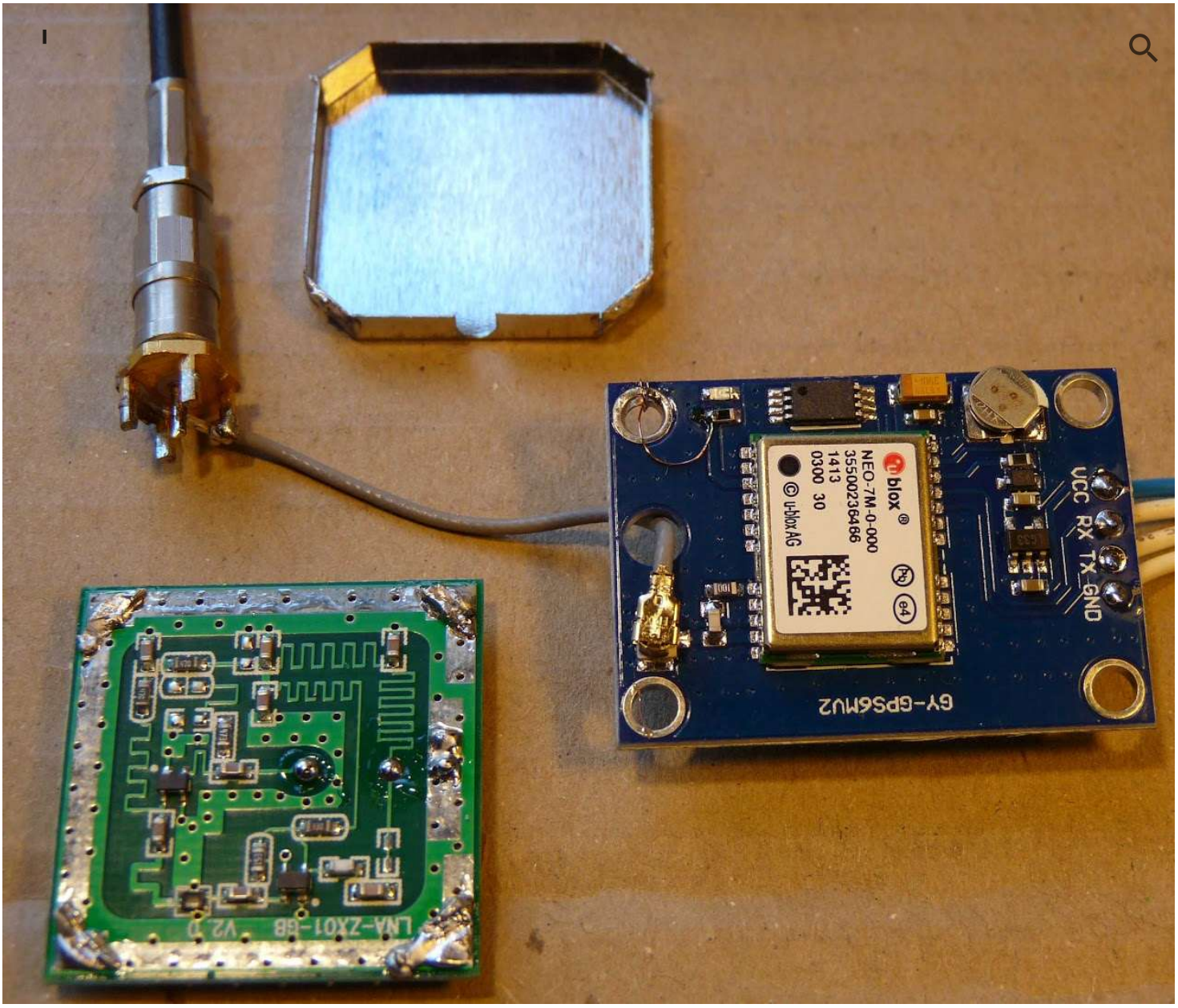
A BIG enlargement! The wire is 38 gauge, the resistor 2mm. This looks really challenging but I achieved this first time with the edge of a hot bit. A touch of solder, then a quick dab soldered the ready-tinned wire. Softrock training helps:)

The print around the 2.5mm hole is not connected to anything and forms a suitable connection point. Later I scraped the paint from the ground plane next to the hole for a connection to the shield of the output cable.

For simple RX calibration the signal most likely may be picked up without any modification, just a wire close to the module.

The pulse output LED continues to work showing a constant light at higher frequencies.

My UART has 3 LEDs, USB power, RX data -flashes when receiving data from the GPS, TX data - flashes when you command the GPS.


blox
NEO-7M-0-000
355002364 66
1413
0300 30
© u-blox AG
VCC
RX
TX
GND
GY-GPS6MV2
LNA-ZX01-GB V2.0

Reception on my bench was not possible. Note these are fairly sensitive and may work inside, using "View - Docking Windows - Satellite Level" will show reception.

I removed the cover from the antenna, it has an amplifier. I unsoldered the coax and connected it to a plug for an external powered antenna.

I think that the coax could probably be extended and the original antenna fixed in a suitable, sheltered position.

Note:- My module supplies the 3V3 for an active antenna, other modules MAY need a modification.

Graham, VE3GTC tells us how to do it properly:-

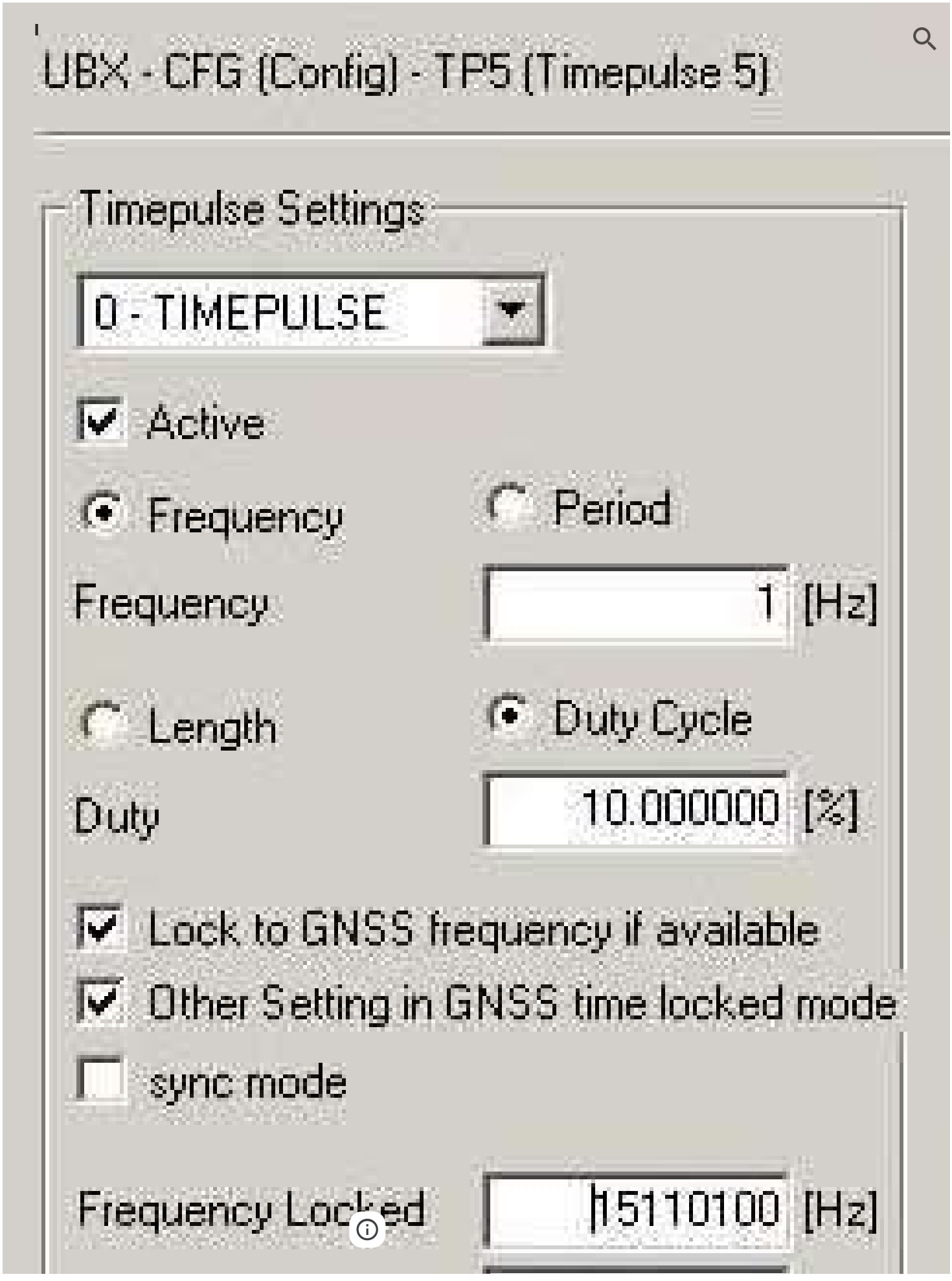
"The little connector on the GPS boards into which that wee tiny coax plugs is a U.fl or U.FL or u.FL (whatever you prefer) connector, one of the Ultra Miniature Coax Connectors (UMCC) and is the abbreviation used by the maker Hirose of Japan, also referred to as an IPX or IPEX connector by some.

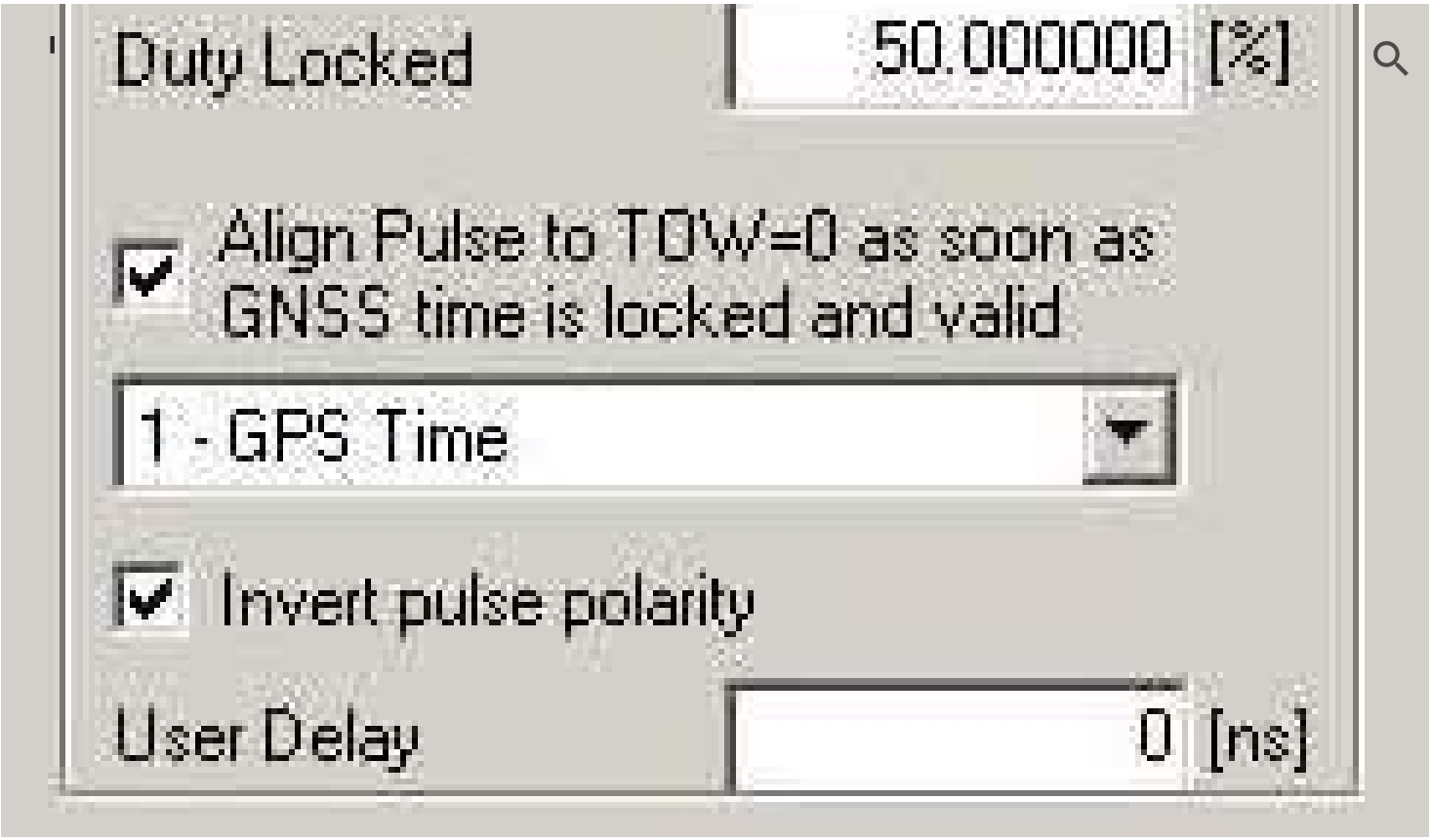
The coax used is RG178 (teflon and not RG174 or RG316 which is twice the size or RG178) or 1.13 cable (not teflon). A quick search of eBay will find plenty of pigtail adapters U.FL to SMA, or BNC, or Type N, or TNC, or type F, or (whatever). Be careful with SMA connectors, there are two types, the normal regularones and the RP ones. RP stands for reverse polarity and swaps the male for the female end and vice versa. RP connectors do not work with non-RP connectors.

A six or twelve inch U.FL to SMA connector will let you easily connect your board to an remote GPS antenna which you may already have or may wish to purchase so that you can place your antenna in a nearby window while you experiment with the GPS board on your workbench."

Note:- this module labelled GY-NEO6MV2 was originally fitted with a NEO-6M.

U-Center Frequency setting


UBX - CFG (Config) - TP5 (Timepulse 5)
Timepulse Settings
0 - TIMEPULSE
Active
Frequency
Period
Frequency
1
[Hz]
Length
Duty Cycle
Duty
10.000000
[%]
Lock to GNSS frequency if available
Dther Setting in GNSS time locked mode
sync mode
Frequency Locked
15110100
[Hz]

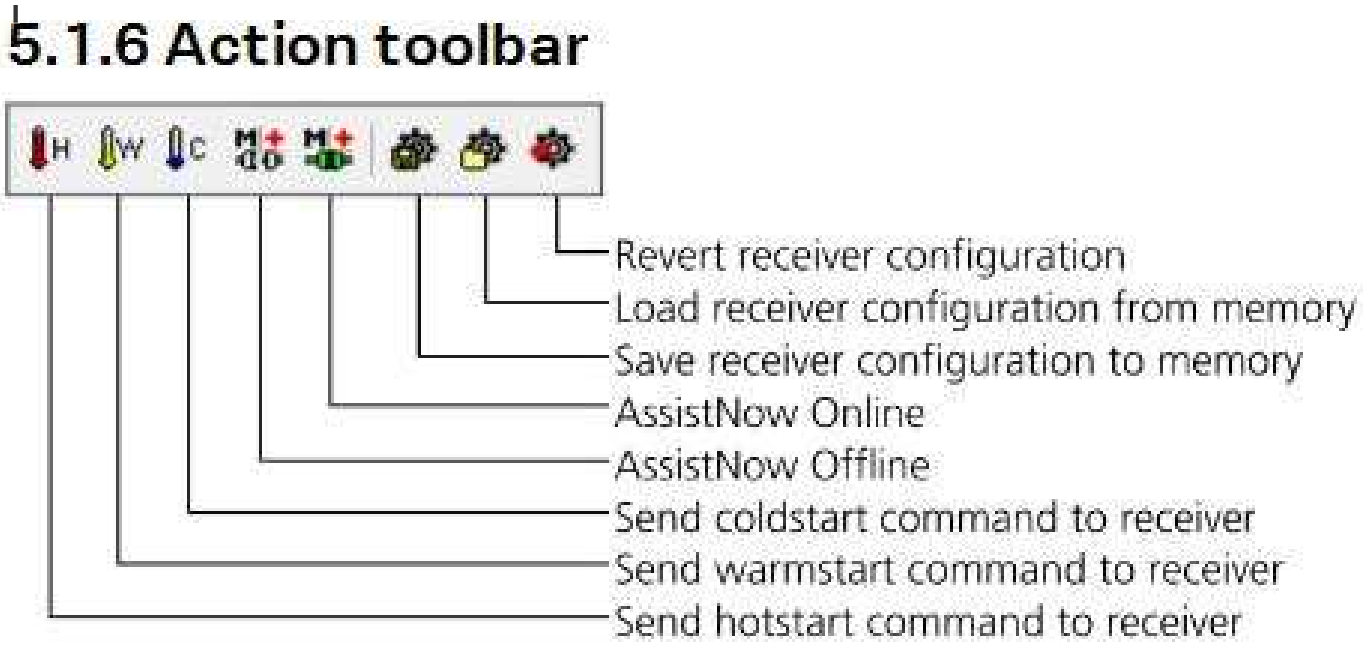


Picture:- The Timepulse configuration setting. Note the ticks against Frequency and Duty Cycle make it easy. With settings like this saved the module will start with 1 PPS pulses, then when locked, go to the preset frequency. The NEO-7 I tested seemed to give a stable (disregarding jitter!) output up to 15MHz but only 10MHz is specified.

My NEO-5 worked a little above the specified 999Hz.

The minimum step is 1Hz.

Enter the frequency and click "Send"



To save the configuration (requires the backup battery) use Action Toolbar, Lower right. Third from right = Save configuration to memory.

Or, Receiver - Action - Save Config.

"Poll" on the Configuration window shows the actual configuration of a module.

The exact frequency setting is useful for calibrating a frequency counter. Mine, with 8 digits is difficult at 10MHz, switching from 0.1Hz to 1Hz resolution. Setting the u-Blox to 9999999Hzmakes it easy to set to 0.1Hz. (After a year or more the Isotemp OCXO was 0.2Hz in error.)

For receiver calibration harmonics will be easily detected, Warren says up to GHz. But I have found that care is required when using harmonics, many signals may be seen from the u-Blox output, the required harmonic may not be the strongest! Many times harmonics will have to be selected near to a wanted frequency as the fundamental has a minimum step of 1Hz.

A use I might consider is to discipline a receiver's reference oscillator. A PLL will be required.

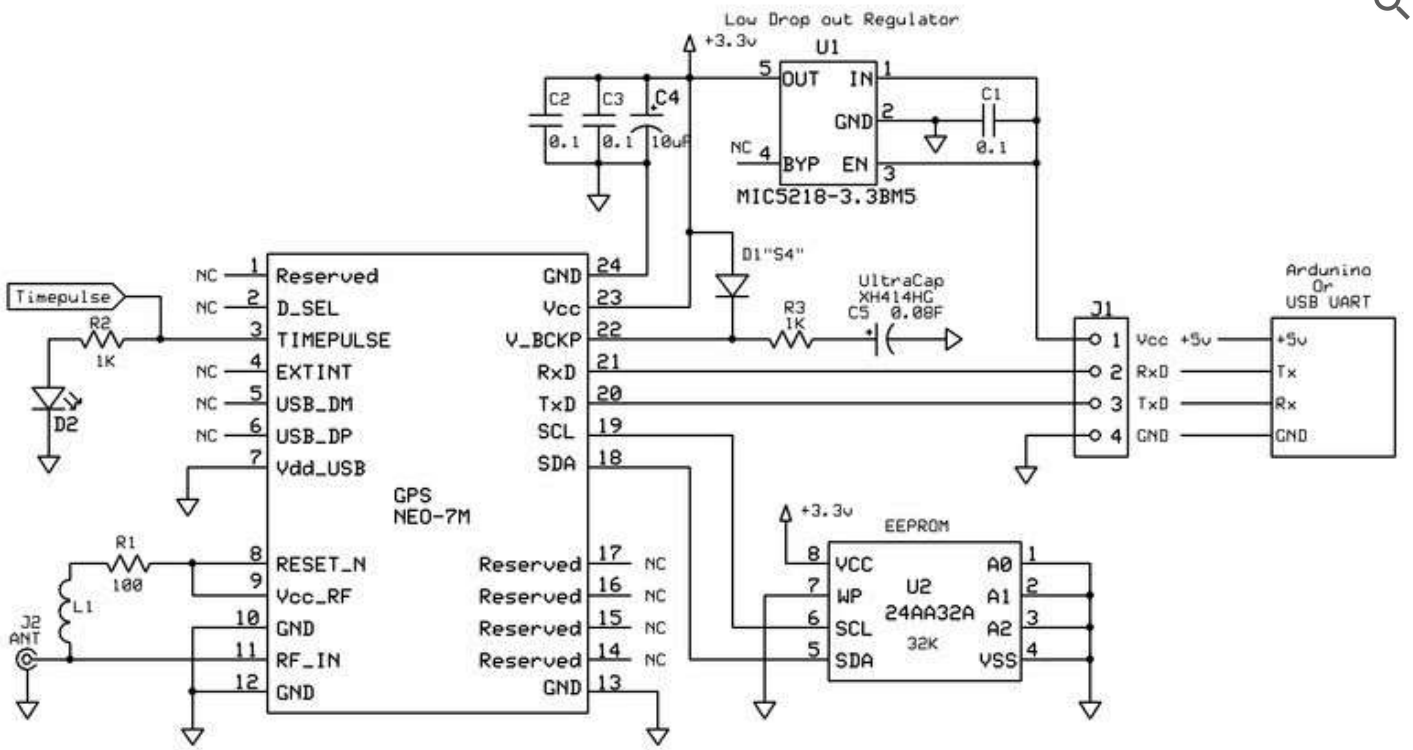
The basic module just requires 30mA at 3V3.

Below some settings for WSPR frequency checks using harmonics above 15MHz.

USB Dial/BAND	Centre	Check Freq	On Waterfall RH edge +Hz
0.136000/2200m	0.137500		
0.474200/	0.475700		
1.836600/160m	1.838100	1838220	+20
3.568600/80m	3.570100	3570220	+20
5.287200/60m	5.288700	5288820	+20
5.364700/60m	5.366200	5366320	+20
7.038600/40m	7.040100		
10.138700/30m	10.140200		
13.553900/22m	13.555400		
14.095600/20m	14.097100	14097220	+20
18.104500/17m	18.106100	6035407	+21
21.094600/15m	21.096100	7032073	+19
24.924600/12m	24.926100	8308740	+20
28.124600/10m	28.126100	9375407	+21
50.293000/6m	50.294500	10058924	+20
70.091000/4m	70.092500	14018524	+20
144.489000/2m	144.490500	13135511	+20
432.300000/70cm			
1296.500000			

Module Schematic

From Dick, K9IVB. Includes UART connections


Low Drop out Regulator
+3.3v
U1
OUT
IN
GND
BYP
EN
MIC5218-3.3BM5
C1
C2
C3
C4
0.1
0.1
10uF
0.1
NC
D1"S4"
UltraCap
XH414HC
C5 0.08F
R3
1K
J1
Arduino
Or
USB UART
Vcc +5v
RxD
TxD
GND
+5v
Tx
Rx
GND
Timepulse
R2
1K
D2
GPS
NEO-7M
Reserved
D_SEL
TIMEPULSE
EXTINT
USB_DM
USB_DP
Vdd_USB
RESET_N
Vcc_RF
GND
RF_IN
GND
GND
Vcc
V_BCKP
RxD
TxD
SCL
SDA
Reserved
Reserved
Reserved
Reserved
GND
R1
100
L1
J2
ANT
+3.3v
EEPROM
U2
24AA32A
32K
VCC
WP
SCL
SDA
A0
A1
A2
VSS

Links, Discussion

Also http://imgs.inkfrog.com/pix/ebayimage2012/25249-4.jpg Not quite the same as mine, but this is a NEO-6 schematic.

There is a lot of documentation:- Try https://www.u-blox.com/en/product-selector?category=Position%2520%2526%2520Time&product_class=Module links have changed a few times since I started this page, or Google.

Basic Information

/Product_Docs/NEO-7_ProductSummary_(GPS.G7-HW-11003).pdf

Module Data

http://versalogic.com/support/Downloads/MPEu-G2/NEO-7_DataSheet_(GPS.G7-HW-11004).pdf

Receiver protocol, timing output, configuration.

www.u-blox.com/images/downloads/Product_Docs/u-blox7-V14_ReceiverDescriptionProtocolSpec_Public_(GPS.G7-SW-12001).pdf

Hardware Connections, Power, p11 USB, p10 backup.

Search_HardwareIntegrationManual_%28UBX-13003704%29.pdf

Module Info /products/documents/NEO-7_DataSheet_%28UBX-13003830%29.pdf

u-Blox:- Considerations regarding timing pulse. This refers to the 6T version but should be the same for the NEO-7

Note that above 1MHz it is recommended to use 50 ohm conditions for transmission without degradation.

Configuration utility

October 2017 This changed page https://www.u-blox.com/en/product/u-center-windows has the required links.

https://www.u-blox.com/en/product/u-center-windows

Download, Info, Usage, Release notes

Old links (dead) These are probably still on the u-blox site.

http://www.u-blox.com/images/downloads/Product_Docs/ucenter_ProductSummary_(UBX-13003929).pdf

http://www.u-blox.com/images/downloads/Product_Docs/u-Center_User_Guide_(UBX-

13005250).pdf

http://www.u-blox.com/images/downloads/Product_Docs/u-center-v8.11_PublicReleaseNotes_(UBX-14002780).pdf

Discussion

Here http://comments.gmane.org/gmane.comp.time.nuts/39436 is a discussion.

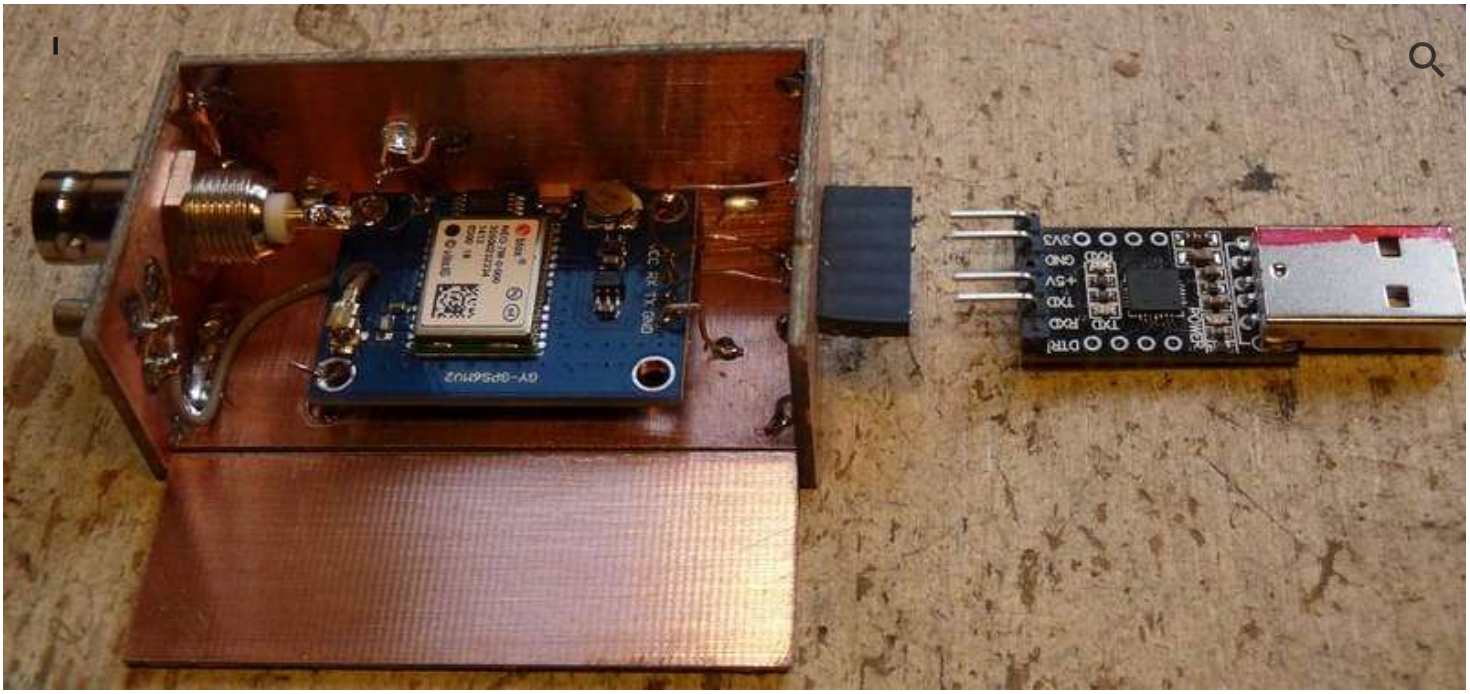
Other pages, I'm sure there will be many.... http://vk4zxi.blogspot.co.uk/2014/09/cheap-gps-disciplined-10-mhz-oscillator.html

This page in Russian shows **tests of the output** http://www.ra3apw.ru/proekty/ublox-neo-7m/ Use Google Chrome, it will offer a translation. As other tests have shown only 24.000 MHz 16.000 MHz 12.000 MHz 8.000 MHz 6.000 MHz 4.000 MHz 3.000 MHz 2.000 MHz provide anything like a clean signal. (The 3 higher are outside the u-Blox specification, mine do not go much above 15MHz) But Karen is hopeful that a PLL willl be disciplined by other frequencies.

It has been suggested that the uBlox might be adequate for a LF receiver. If set to a high frequency then divided down the jitter is reduced. The question about the many spurious frequencies present remains.

One device has appeared since Warren found the u-Blox. This variation on the "Ultimate" series of beacon transmitters uses the 1PPS from any GPS to "Huff puff" control a cheap Ebay DDS. It has a possible accuracy of +/- 0.029Hz. http://www.qrp-labs.com/ultimate3/u3mods/u3gpsref.html This is now superceded, the QRP Labs VFO or Progrock are similar. The output is much cleaner than the uBlox.

Another module http://www.jackson-labs.com/index.php/products/lte_lite A GPSDO 10, 19.2, 20, 26, 30.72, or 40MHz for 50$


GY-GPS6MV2
VCC RX TX GND
3V3
GND
+5V
TXD
RXD
DTR
TXD
RXD
POWER

My box

My stand-alone box. Afterwards I realised that swapping the gender of the plug/socket would have been better. I removed unwanted pins from the UART and blocked the corresponding ones on the socket to avoid incorrect assembly.

I can either plug in the UART or just a power lead.

My NEO-7 module has a low-drop regulator (marked LG33) so any voltage from 3V3 may be used. But check!

I removed the on-board LED and connected one mounted on the box. It flashed brightly with the 1 PPS but did not show anything at high frequencies, something different from the original... Replacing with a red one, a lower voltage device, lit with high frequencies.

In my module the "RAM backup battery" is an 80mF 3V3 super-cap. XH414HG. On my two modules these have a high leakage current and do not save the configuration for long. I have removed them and the diode ("D1 "S4"" in the schematic above) and found a 1.5V dry cell is adequate. A lithium cell will be smaller and more elegant. This backup is only required if you wish to store a frequency or other configuration so the module starts up using it. The backup does save recent satellite data enabling a fast lock when restarting.

Note on Backup

Supercaps need "forming", leakage current reduces after some, maybe many, hours.

I have a 10F capacitor, an on-line calculator reckons at 10uA it will take about 20 days to discharge from 3 to 1.3 volts.

5 volt 0.47F about 22 hours.

Voltage is a factor, mine is marked 2.7 volts,

If lower voltage capacitors are used it may be a good idea to feed a charging diode from a 3.3 volt supply. Possibly two diodes with a resistor to ground at the connection between them to ensure 0.6 volt drop. At low currents the voltage drop of a diode will be very much lower than the "normal" 0.6 volts. Easier to ensure 5 volt capacitors are used.

Primary lithium cells:-

Some time in 2014 I used a 25x12mm cell retrieved from an old circuit board to backup a u-Blox 7 module. December 2022 it still is doing the job with about 1.8 volts remaining.

Note my **V.KEL VK2828U7G5LF** module, see below, has memory that stores the configuration indefinitely.

Module Frequency Ranges

I suggested the NEO-6 could be used but Andy, ZL3AG, sent this list, of U-Blox modules types along with their configurable timepulse output specs. Only the 6T goes to 10MHz.

AMY-6 ?

UC-530 1Hz

UP-501 1Hz

IT-530 1Hz

LEA-5 0.25Hz - 999Hz

LEA-6 0.25Hz - 1kHz

LEA-6T 0.25Hz - 10MHz

LEA-7 0.25Hz - 1kHz

LEA-M8F 0.25Hz - 2Hz

LEA-M8S 0.25Hz - 10MHz

MAX-M5Q 1Hz

MAX-6 0.25Hz - 1kHz

MAX-7 0.25Hz - 1kHz

MAX-M8 0.25Hz - 10MHz

NEO-6G/Q/M/P/V 0.25Hz - 1kHz

NEO-6T 0.25Hz - 10MHz

NEO-7M 0.25Hz - 10MHz

NEO-7N 0.25Hz - 10MHz

NEO-7P 0.25Hz - 10MHz

NEO-M8 0.25Hz - 10MHz

PAM-7Q 0.25Hz - 1kHz

CAM-M8Q 0.25Hz - 10MHz

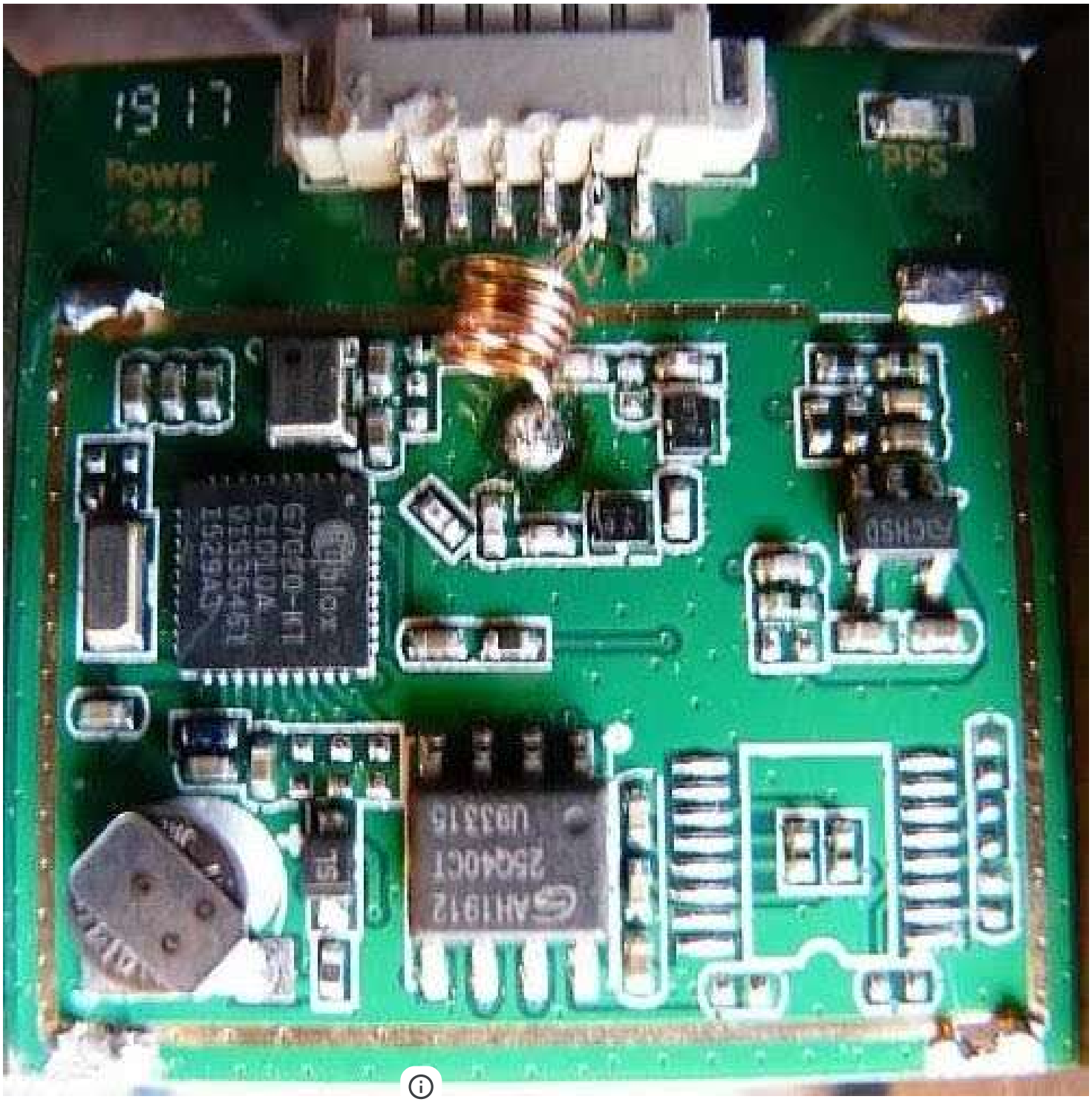
EVA-7M 0.25Hz - 10MHz

V.KEL VK2828

V.KEL VK2828U7G5LF module

V.KEL VK2828U7G5LF Small, cheap integrated Antenna/Receiver with PPS. It is reasonably sensitive. Most sellers say just 10PPS but mine confirms what the data sheet says. It has a M8030-KT chip, can be set to above 10MHz with u-Center. I later removed the cover, the chip is actually a uBlox G7020KT Series 7. **Notes below, an interesting module that saves configuration in memory.**

Note the added inductor, this mod is in order to connect an external powered antenna. See hints below for the connection.



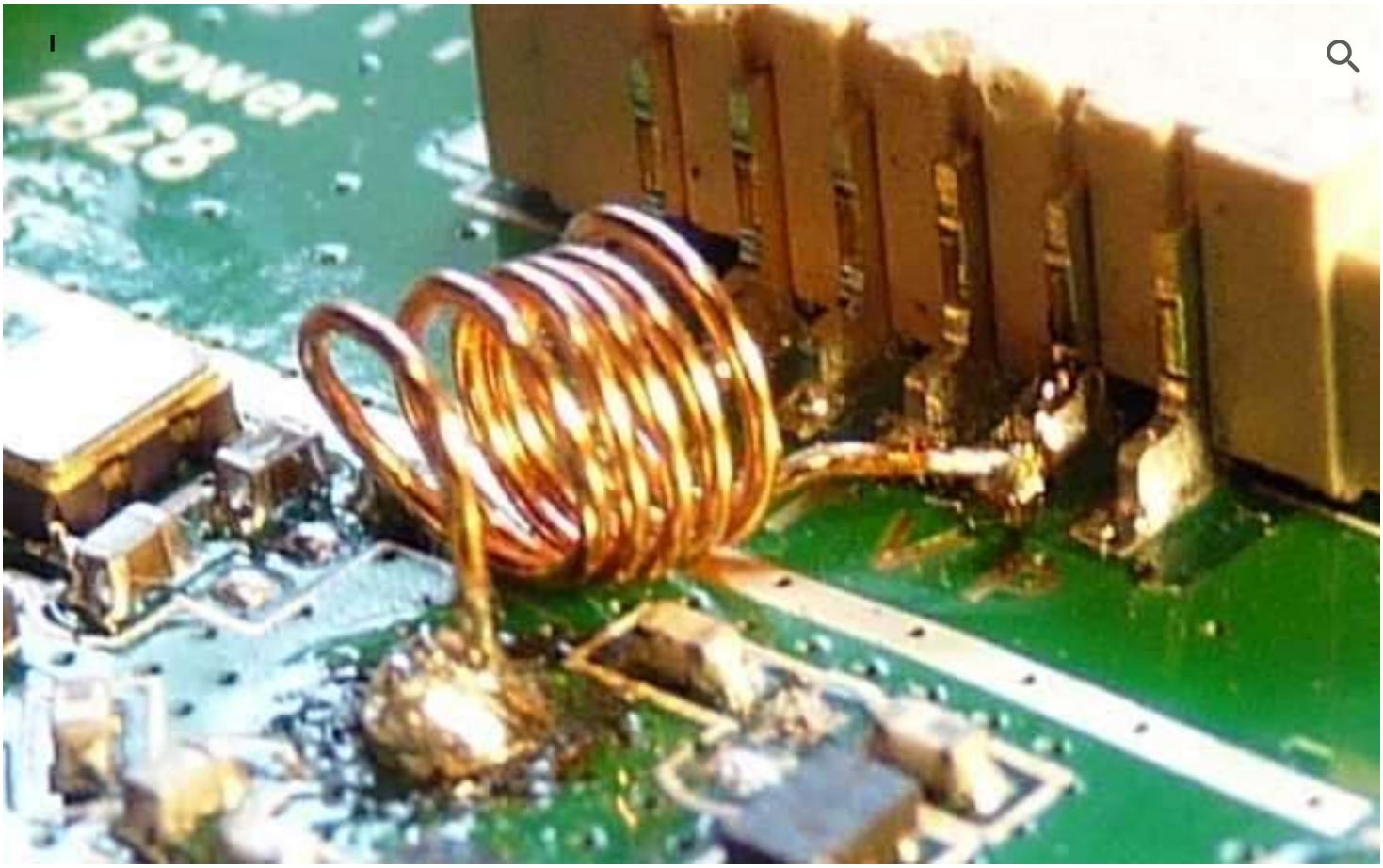
25Q40CT 4M bit serial flash 100,000 writes - 20 years.

G7020-KT GPS chip.

CH5D I think a low dropout 3.3 volt regulator. Check this if you want to power with 5 volts or more.

Antenna isolated 23pF so if antenna is removed (it is stuck on with double-sided tape) then all that is needed to use an external powered antenna is an inductor going to the 3.3 volt input. Like this it worked well. Note there is no short circuit protection, consider some sort of current limit if it worries you.

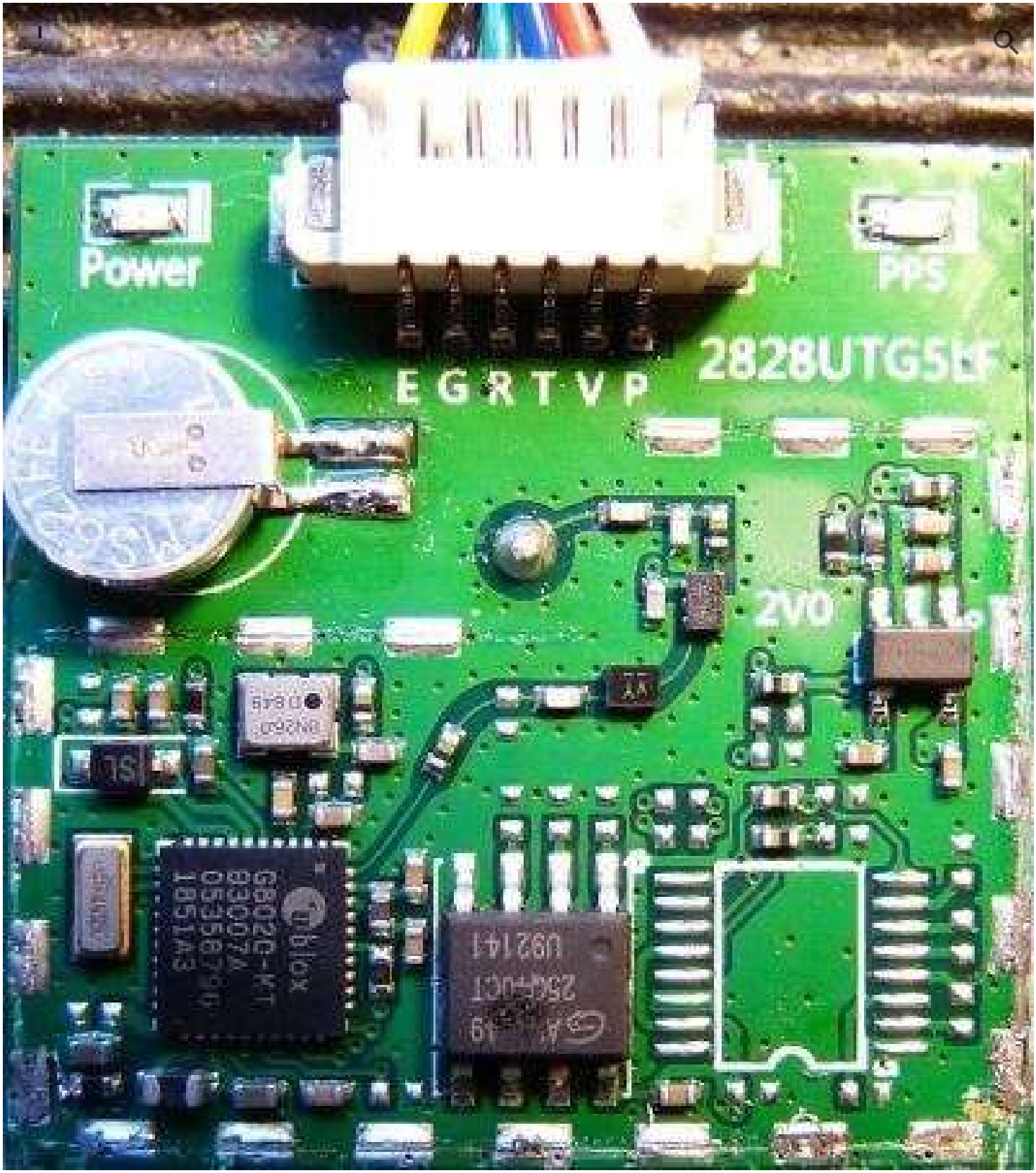

V.KEL
TTL
VK2828U7G5LF
S/N:1509U00751


Power
2828


TTL
VK2828U7G5LF
SN:1507U00396

I find that my particular module will retain configuration settings with no backup. The supercap just powers the RTC for a few hours giving fast hot starts. There is a memory chip that **stores the configuration indefinitely** provided it is saved as described in my U-center section above.

June 2019 I have also tried another version with a lithium rechargeable with similar results. https://www.ebay.co.uk/itm/VK2828U7G5LF-GPS-Module-with-Antenna-TTL-1-10Hz-with-FLASH-Flight-Control-Model/191898153186?hash=item2cae0570e2:g:eXkAAOSw8tZch1gS


Power
PPS
EGRTVP
2828UTG5
2V0

These marked 2828UTG5LF have a different PCB but perform the same.

A MS621FE battery is exposed. MS621FE - Rechargeable Battery, 3 V, Lithium Manganese Dioxide, 5.5 mAh.

After removing the cover (I do not recommend this nothing like so safe or easy!) the following are seen:-

G8020-KT

25Q40CT

CHRL Low dropout 3.3 volt regulator?

With this model it is not necessary to remove the cover to convert to an external antenna. The antenna is isolated in the same way, the connection is not covered by the screen cover.

A metal plate underneath these models with integral antennas will significantly improve satellite reception. A utility like u-centre will show the ideal spacing for maximum strength.

Connections:-

E Enable N/A pulled up.

G ground

R RXD (Input)

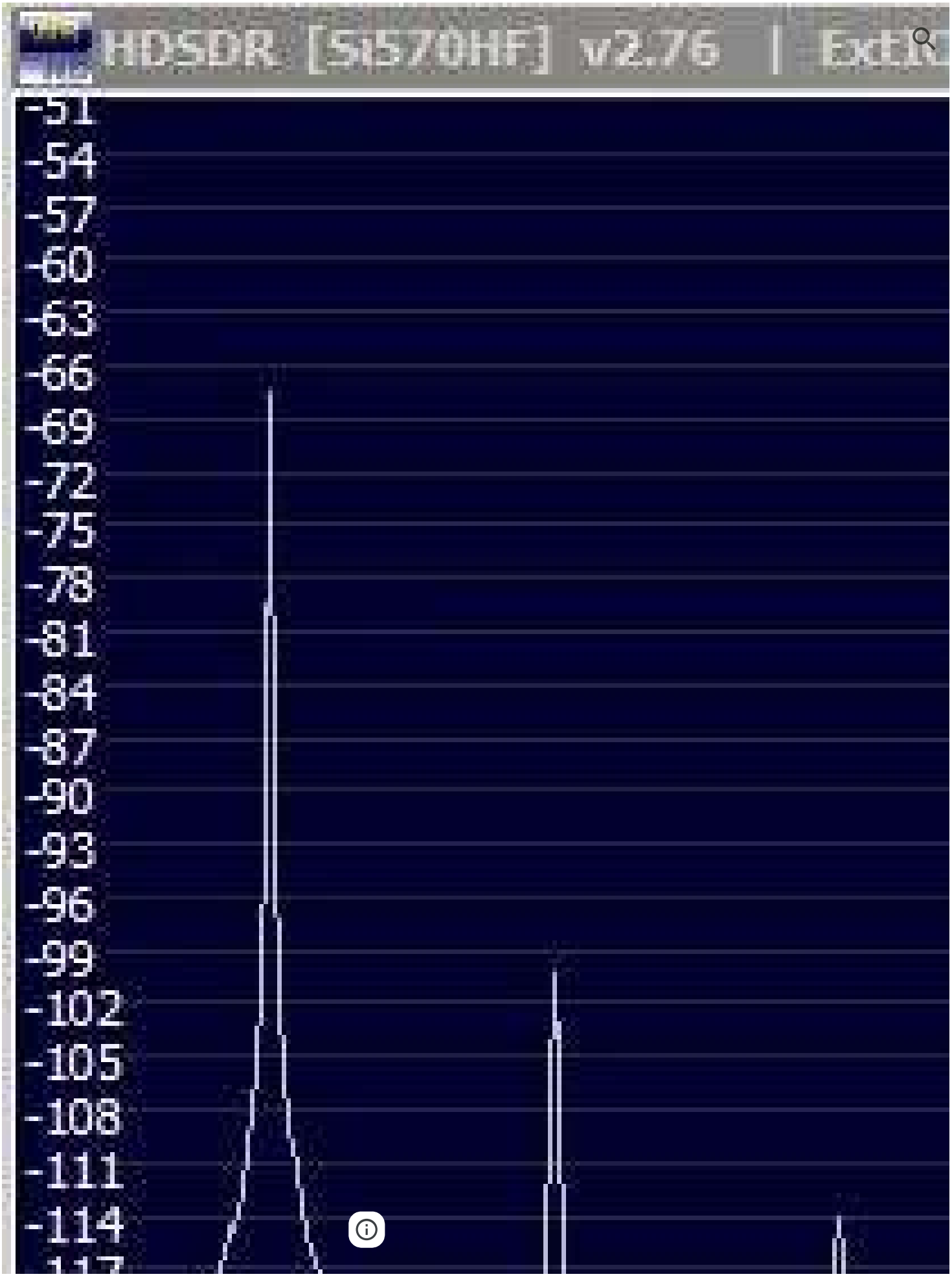
T TXD (Output)

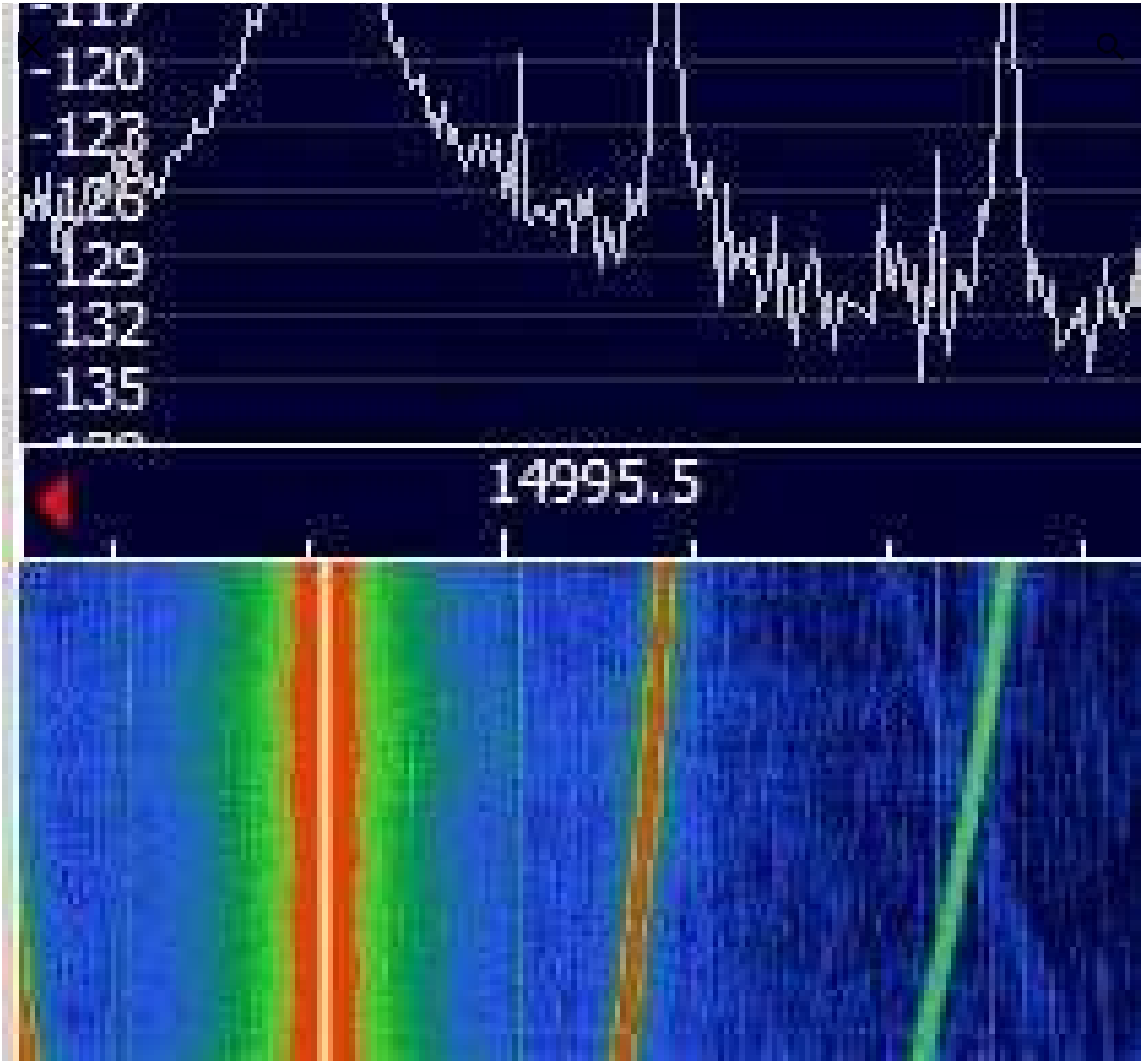
V Voltage input 3.3-5V+ Unknown specification of on-board regulator.

P Pulse 0.25Hz-10MHz specified, Most operate higher but I'm not sure how much.

Note the "P" pulse output is connected to the LED. It has a resistor in series like the NEO7 schematic above. Unless you take an output before this (a minute SM under the cover of, maybe, 1K) then a 50 Ohm attenuator will cause the LED to extinguish. While an attenuator works values will be meaningless.

It has been suggested that chips in Chinese modules may be fake. They work properly as far as I can tell. Their markings are clear unlike definite fakes.


HDSDR [Si570HF] v2.76
-51
-54
-57
-60
-63
-66
-69
-72
-75
-78
-81
-84
-87
-90
-93
-96
-99
-102
-105
-108
-111
-114



A typical Neo-7 spectrum. Very accurate fundamental frequency but many spurii, some only about 30dB down.

G4ZFQ AUGUST 2014

August 2021

Using a uBlox as a reference to modify and calibrate an inaccurate Chinese "0.1-60MHz 20MHz~2.4GHz RF Signal Frequency Counter Cymometer Tester LED Display" at HF:-
https://groups.io/g/QRPLabs/message/70530