GPS Performance Degradation by Noise Generated by the U3

I checked very close to a naked test U3 performing all tasks, using a VHF / UHF hand held with a rubber duck antenna on 2m and 70cm. There is not an excessive amount of radiation at any time, a little more during calibration.

Since v3.06 we have a self diagnosing system for GPS performance.
I decided to take a look at U3 noise effects to a GPS module connected to another U3 by, yes, 2m of cheap screened cable.

Prior to testing the GPS module was on the window sill producing :

A - 3D - fix 9 - track 10 - strength 25

The test GPS module sits gaffer taped on an 80mm cube of Pelltogyne timber hence it is clear of brickwork fixings etc floating 80mm in the air, or rather on the hardest driest most impervious wood in the world. No aluminium foils were used underneath.

Moving the cube and GPS down onto a desk under the window I placed it **150mm from the naked U3**. The GPS module sits to the left of the U3 window side, at the level of the top of the U3.

-----U3 with GPS on Test----------U3 used as Signal Source
A - 3D - fix 9 - track 10 - strength 24------- Park Mode freq 6.25 MHz
A - 3D - fix 9 - track 10 - strength 23--------TX 28MHz CW
1PPs Solid Calibrate 120s of Huff Puff---TX 28MHz WSPR
A - 3D - fix 7 - track 9 - strength 24----------Calibrating
A - 3D - fix 7 - track 9 - strength 24----------Park Mode freq 6.25 MHz

Conclusion no effect, the fix varying figures must be due to movement of GPS sats.

The GPS module was removed from the cube and placed on top of the U3.

-----U3 with GPS on Test----------U3 used as Signal Source
A - 3D - fix 6 - track 6 - strength 23------- Park Mode freq 6.25 MHz
A - 3D - fix 5 - track 5 - strength 21--------TX 28MHz CW
1PPs Solid Calibrate 120s of Huff Puff---TX 28MHz WSPR
A - 3D - fix 6 - track 6 - strength 23----------Calibrating
A - 3D - fix 6 - track 7 - strength 24----------Park Mode freq 6.25 MHz

Conclusion the environment 150mm further into the in the room and on top of the U3 degrades GPS performance a little.

The GPS module was placed in front of the U3 display.

-----U3 with GPS on Test----------U3 used as Signal Source
A - 3D - fix 3 - track 3 - strength 15------- -Park Mode freq 6.25 MHz
A - - fix 1 - track 2 - strength 18---------TX 28MHz CW
1PPs Stop Calibrate Fail----------TX 28MHz WSPR
A - - fix 2 - track 2 - strength 15----------Calibrating
A - 3D - fix 3 - track 3 - strength 15----------Park Mode freq 6.25 MHz

Conclusion the area in front of the U3 display with the patch antenna looking through and over the

U3 is poor.

The GPS module was moved to the side of the U3 with the patch antenna at 45 degrees looking away from the sky and toward the U3.

-----U3 with GPS on Test----------U3 used as Signal Source
A - 3D - fix 3 - track 3 - strength 21------- Park Mode freq 6.25 MHz
A - 3D - fix 5 - track 5 - strength 21--------TX 28MHz CW
1PPs Solid Calibrate 120s of Huff Puff--TX 28MHz WSPR
A - 3D - fix 4 - track 4 - strength 19---------Calibrating
A - 3D - fix 4 - track 4 - strength 19----------Park Mode freq 6.25 MHz

Conclusion the area alongside left, sky side, of the U3 is reasonable despite angling the patch antenna toward the U3.

The GPS module was hung over the back of the U3 slanting toward the desk at 45 deg, patch antenna looking through the wall under the window to the sky.

A - 3D - fix 9 - track 10 - strength 25

Performance consistent throughout all U3 operations.

These results are not at variance with the experience of G0FTD who found that a GPS module mounted in the same plastic box was obliterated during Calibration.

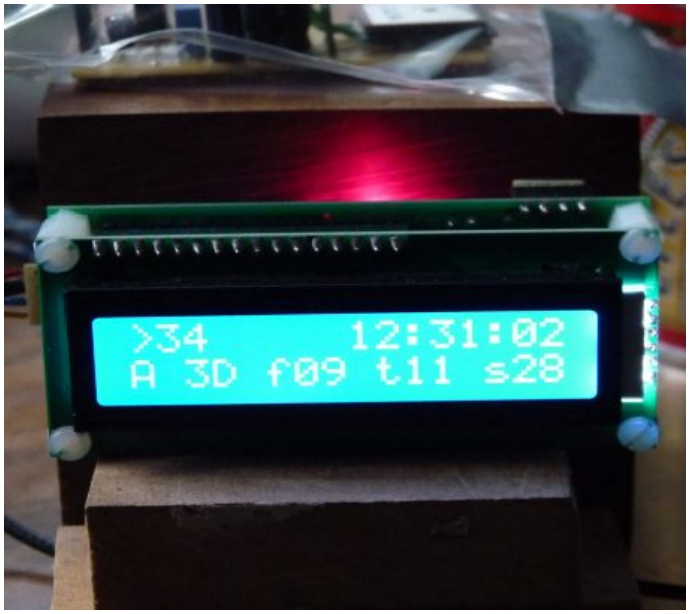
I consider they prove the conclusions from the U2 days that the major source of interference to a GPS module connected to a U2 / U3 is conducted. This can be avoided by moving the GPS module away from the U3 connected by screened cable and providing decoupling of the supply lines.
With the U2 it was often considered necessary to place ferrite beads on all leads at both ends.
The U3 has improved earth arrangements and has caused less problems.

The worse case scenario must be a GPS module close to the U3 connected by short wires which will act as antennas. The very 1PPS pulse that we wish to uses for accuracy, also will cause voltage and current changes which must be reflected back to the module.

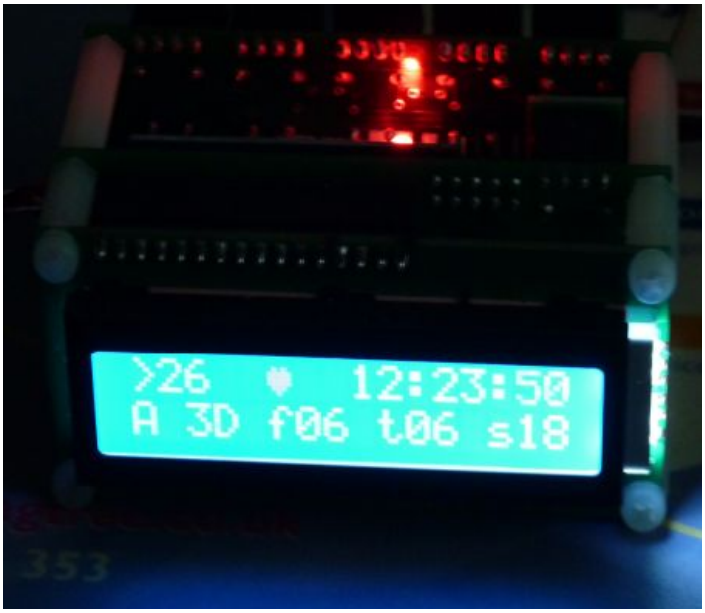
Photographs

I later set up with the GPS module on the cube behind the signal source U3. The module is 5mm above the U3 top level and 10mm behind.

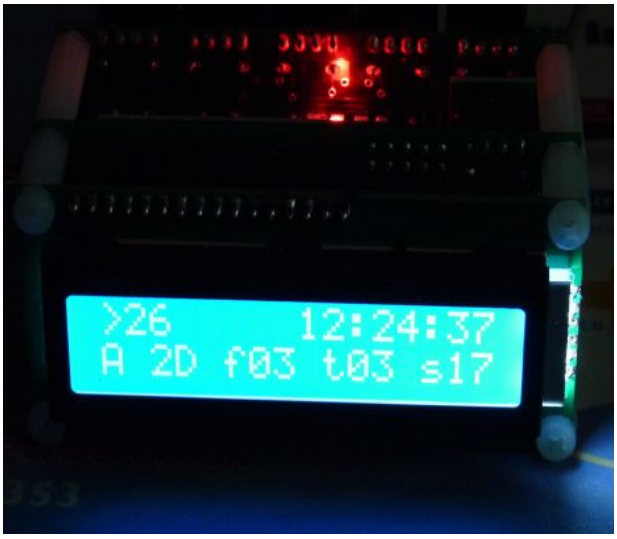
There was a period when visible satellites were few and 3D lock variable and photographs were taken as the tests continued under these marginal conditions.



The signal source U3 waiting to start, GPS behind.



The Test U3 with no transmissions from the signal source U3



The Test U3 with 28MHz PI4 MGM transmission from the signal source U3. PI4 is a wide mode liable to produce sideband noise. Satellite numbers have dropped but is it due to TX noise.

The Test U3 with 28MHz Carrier transmission from the signal source U3, the narrowest mode.

The Test U3 with 28MHz WSPR transmission from the signal source U3. The Test U3 has just completed a successful calibration during the WSPR.

The Test U3 did a 10 second Calibration after the 28MHz WSPR transmission from the signal source U3. The 1PPS continued during the Calibration period and there was a 3D lock. This photograph is 1min 13sec after any source U3 activity, satellite signals have varied throughout the period and become marginal now. Further observation showed how poor a position the GPS was in and satellite number fell to fix 1 - track 1.
I finally took pity on the Test U3 when it alternately flashed messages in Latin, Calo – Lato – Lngo followed by the complete display character set. And moved the GPS back to the window.