

# Steps Towards The Moon: LNA, Phase Locking, GPS, Trailer

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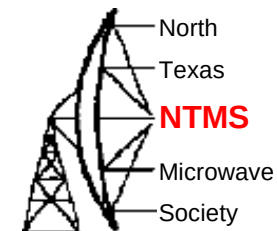
Apr 3, 2020

# Recap



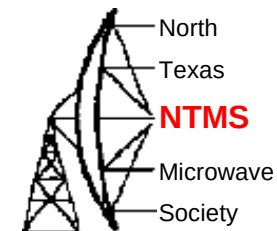
- The overall plan is to make something like this Verizon trailer as a portable ham shack with an 23 cm EME capability
- Expect other bands/modes can be included as a bonus by sharing electrical power, radios, etc

# Progress



- Rotator K3NG System
  - No action
- G4DDK LNA Kit
  - Assembled PCB
- Phase Locking
  - Verified Leo Bodnar kit functioning
- Ublox High Precision Differential GPS
  - Possible Azimuth solution
- Trailer
  - Completed lower section framing
  - Lift mechanism thoughts
- Overall timeline

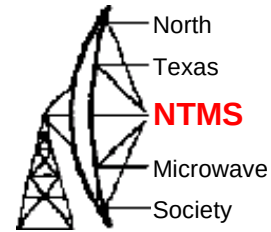
# G4DDK LNA Kit 23 cm



Generally I do about an hour of these surface mounts then my eyesight and coordination are used up for the day. The tan caps are the “largest” components.

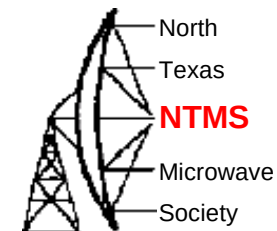
Color coded components  
Well thought out kit  
Community testing & development  
Well documented

# Phase Locking



- Verified Icom-9700 holds frequency at 23 cm under alternating key down conditions
  - One minute full power 10 watts @23 cm, then observe receive for drift
  - Used Rubidium standard w DEMI PLL as test signal
  - Rb standard previously checked against GPSDO for 8 hours on oscilloscope no observed phase variation in XY mode
- Observed ~75 Hz frequency variation with Leo Bodnar kit off
  - No other reference applied
- Could not easily detect any frequency variation with LB kit on
  - Waterfall scale of ~ 1 khz
- Kit does require initial oscillator to be near (~100Hz) locking signal in frequency for phase to lock up
  - Hear a buzz tone on test signal if LB PLL not getting solid lock
  - Easily adjusted with built in radio adjustment controls

# Weak Signal Frequency Standard

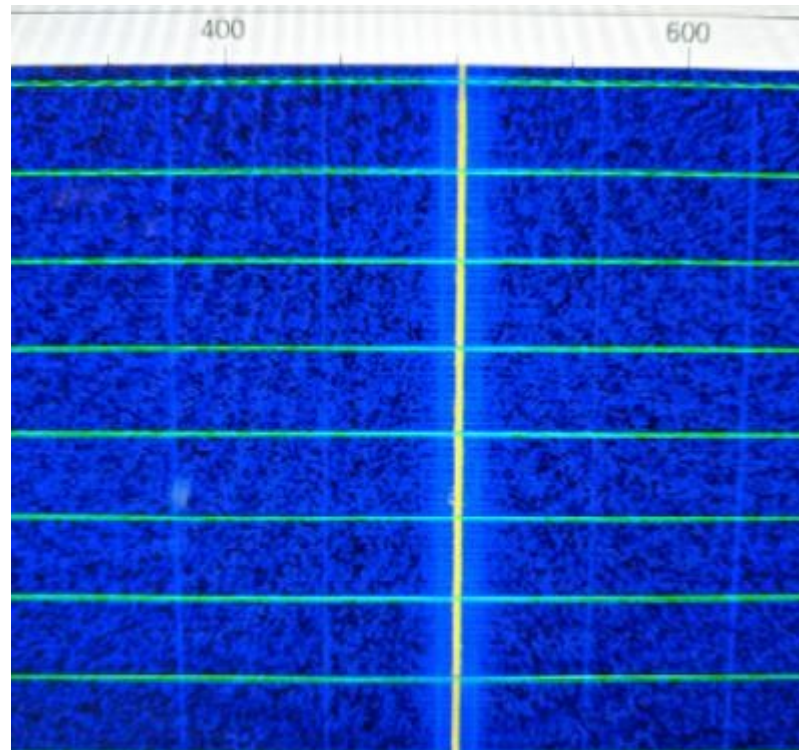
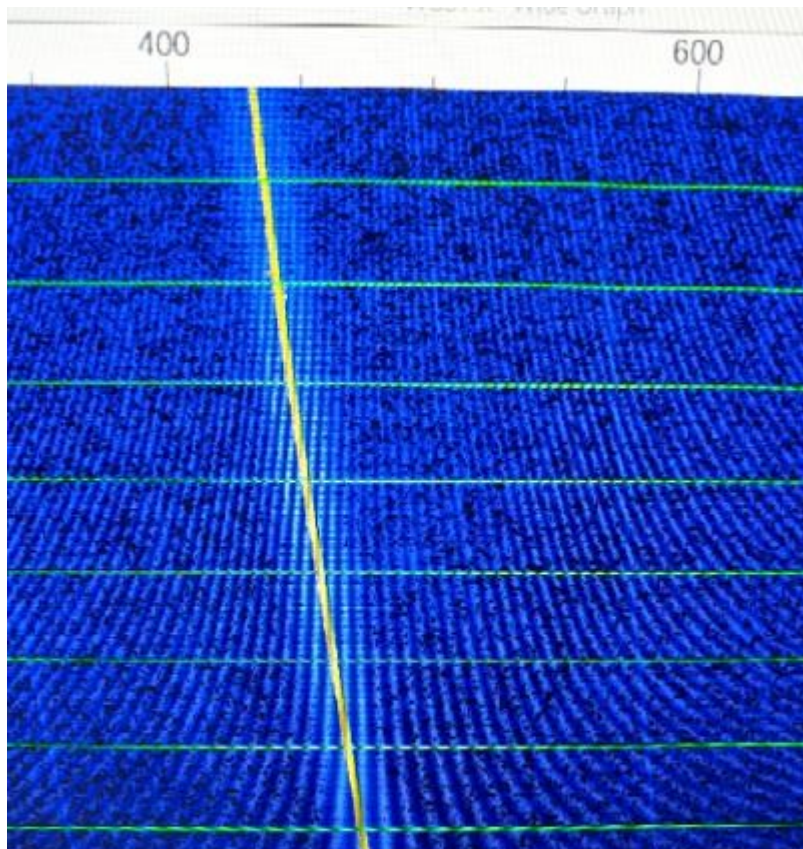
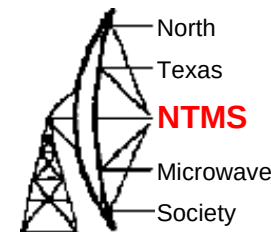


- Rubidium Lamp  
10 MHz frequency  
standard
- DEMI A32 PLL
- DIP Switches set  
for 1296.1
- Attenuator for  
reference level !

# 23 cm Stability Tests

## One minute XMT, then RCV

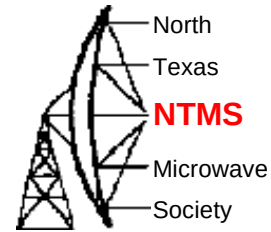
### 15 second intervals vs Hz



WSJTX  
Waterfall  
Display

- Leo Bodnar Kit PLL Off
- LB Kit PLL On

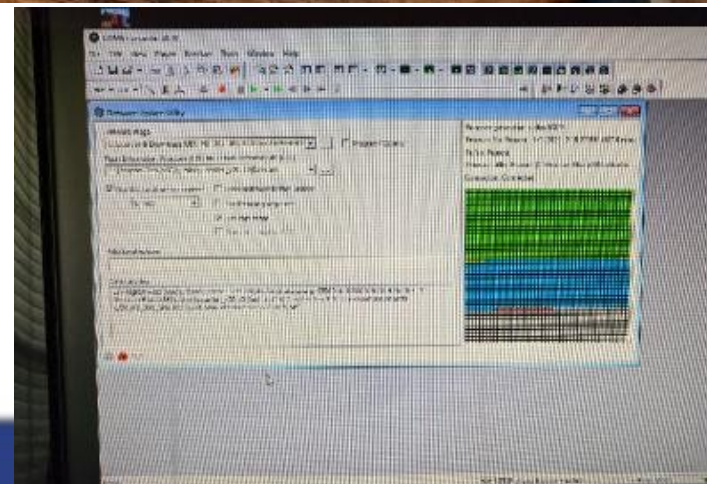
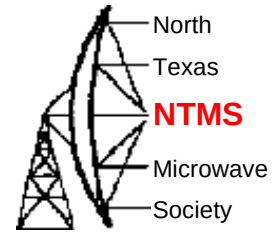
# Real Time Kinematics GPS



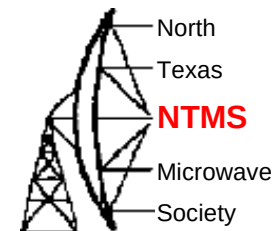
- High precision microwave rover azimuth
- Exceptional accuracy
  - 0.2 degrees over 5 meter baseline
- David Smith VK3HZ, Rex Moncour VK7MO
  - <https://vk7tw.wordpress.com/2019/07/18/gippstech-2019/>
- Did not originally plan to go to this level but..
- Thanks to Eric Haskell AG5XV for alerting me to a set of uBlox units at a discount price on e-bay



# Ublox GPS Kit

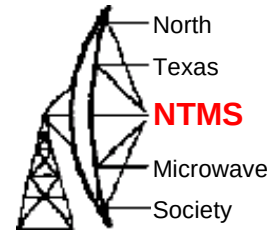


# ublox RTK



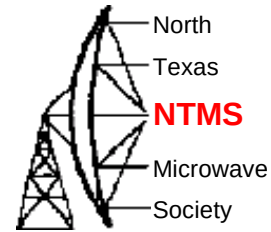
- Hardware seems very good
  - Only GPS in 10 years to work inside my house due to foil-coated insulation
- Since it was working tried to break it with a firmware update
  - Almost did!
- Software was difficult on my windows 10 system
  - 32 bits may indicate it was not originally written for windows 10
  - Software went non-responsive after successful and failed firmware updates
    - Had to reboot. Application would not exit or relinquish control of com ports
  - Update provides access to Galileo sats in addition to US and Russian birds
  - Additional options on configuration menu indicated firmware changed
  - Maybe reading the directions first might have helped
  - Changing the default firmware update rate from 9600 baud to 900kbs helped
  - GPS units are highly configurable devices
- Documentation seems very detailed, 48 page quick start guide
  - Using RTK depends on configuration and linking two units by 933 MHz radio
  - Definitely following documentation for config – way out of my GPS comfort zone

# Trailer



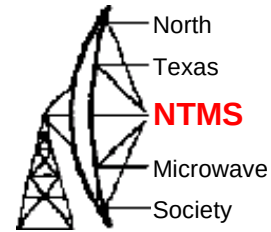
- Low Section Framing Complete

# Trailer

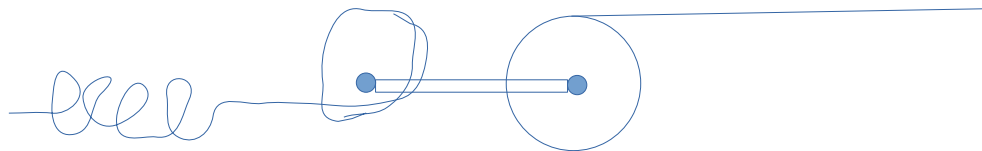


- Plywood built up box beam has pluses and minuses – ok not great
- Total Boat Epoxy and Loctite 8x Fast Grab adhesives working
  - Taken apart many test joints. Stronger than the wood 9 out of 10 times
- Vertical clearance tight
  - Need to test clearance vs moving in and out of garage
  - Gained 1” height by adjusting garage door opener
  - Aiming for 6 foot head room inside trailer
  - Antenna mounting hardware vertical budget is 3 inches
  - Dish depth is 13 inches
  - There is an assumption the feed will fit under the dish
- Tongue weight looking a little high at this point
  - Putting generator up front on trailer fork is about half the tongue weight budget
  - Plan option to move antenna rotator to back of trailer, re-check after upper framing
- “Never make a rectangle when you can make two triangles”

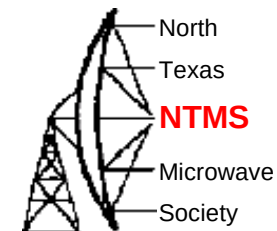
# Trailer Pop-Up Mechanism



- Top will be a wooden framework much like lower section
- Want the top to pop-up easily, quickly, reliably
  - RV solutions exist and replacement parts are available
  - Using those is a plan B
- Something similar to spring-compensated garage door
  - Already have a set of garage door springs & pulleys
- Something like a clockwork 'fusee' or compound bow cam to make force approximately uniform through ~1m of spring travel



# Overall Timeline Considerations



- Not a precise schedule – enjoy the journey
- Factors to Consider
- ARRL EME Contests in Oct/Nov
- Allow two lunar cycles for integration – Aug, Sep
- Epoxy working times may be an issue in warmer weather, slow catalyst about right currently
- Continue trailer as priority in April & May
- Plan for more electronics & rotator June/July