

Ham Radio and Sport Rockets



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<https://kw4wz.com>



<https://www.ssl.berkeley.edu/about/>



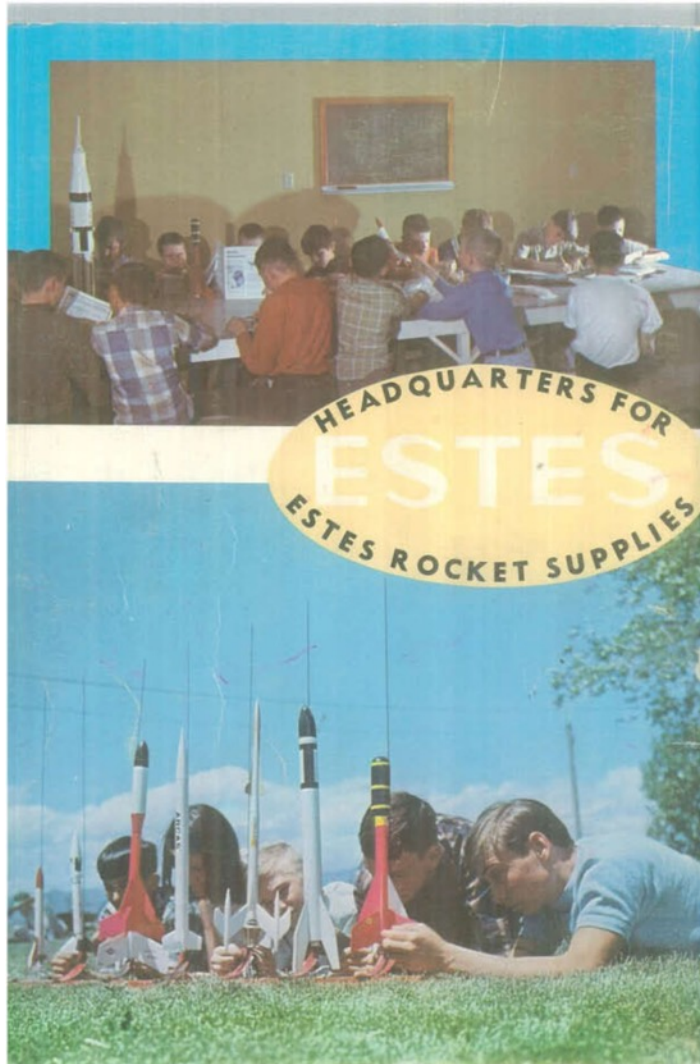
- B.S. Computer Science-
UNH
- M.S. Space Studies-
UND



Courtesy of Orbital Sciences Corporation

- SPHEREx
- TRACERS
- MOAB

Hobby Rocketry



- Origin 1957
- Legally different from fireworks
- Low and High Power classes
- Treated separately by FAA



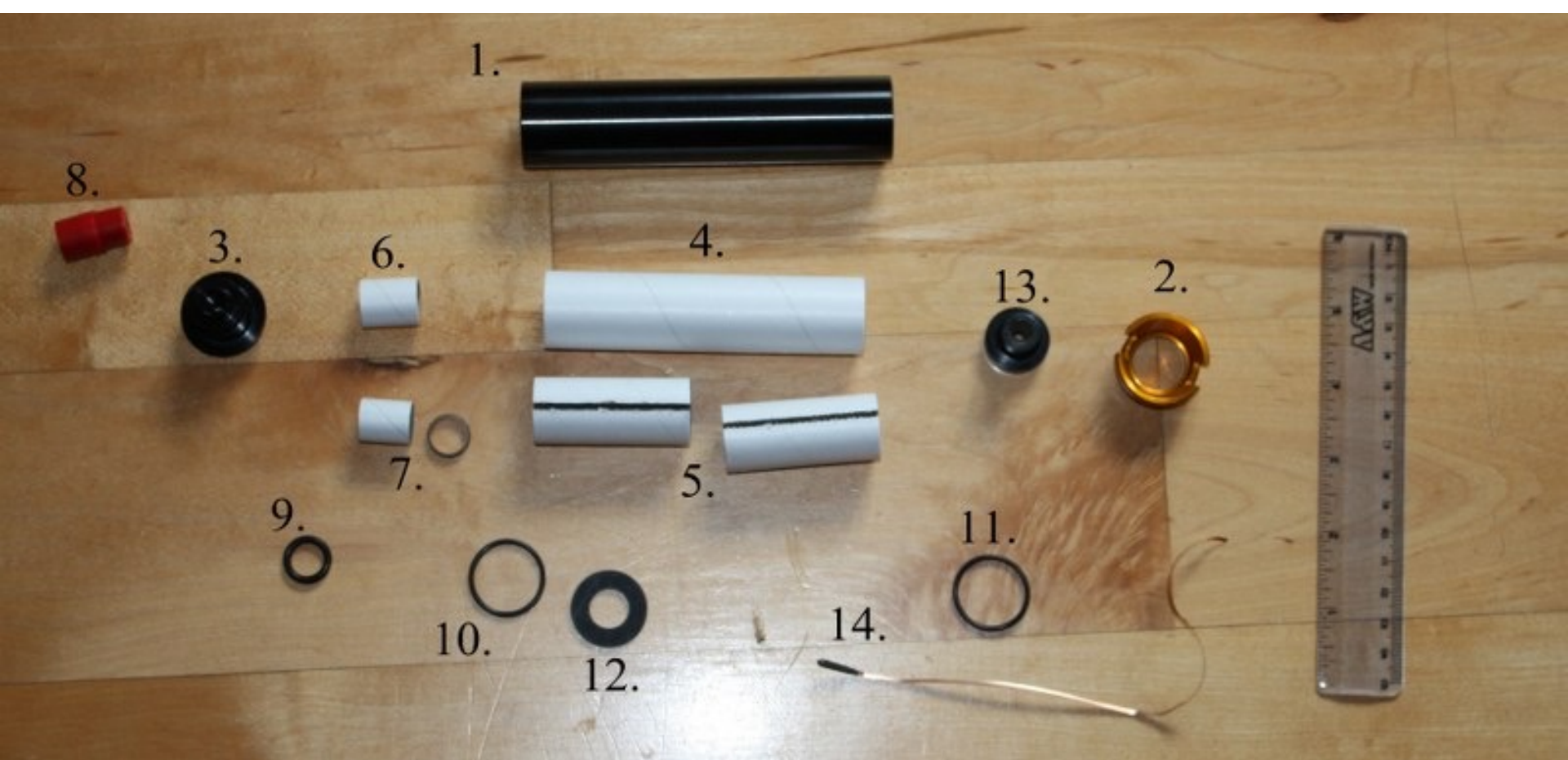


Rocket Motor Types

- Black Powder
 - Smaller motors
- APCP
 - Larger motors
- Hybrid
 - Compressed Nitrous Oxide liquid oxidizer
 - Plastic or wax fuel grain

Single Use vs Reloadable





The components of a motor made by Aerotech Consumer Aerospace for a 29/40-120 casing. 1. Motor Casing 2. Aft Closure 3. Forward Closure 4. Propellant Liner 5. Propellant Grains (C-Slot Geometry) 6. Delay Insulator 7. Delay Grain and Delay Spacer 8. Black Powder Ejection Charge 9. Delay O-Ring 10 & 11. Forward and Aft O-Rings 12. Forward Insulator 13. Nozzle 14. Electric Starter



The American Rocketry Challenge



NASA Student Launch Initiative

<https://www.nasa.gov/stem/studentlaunch/home/index.html>

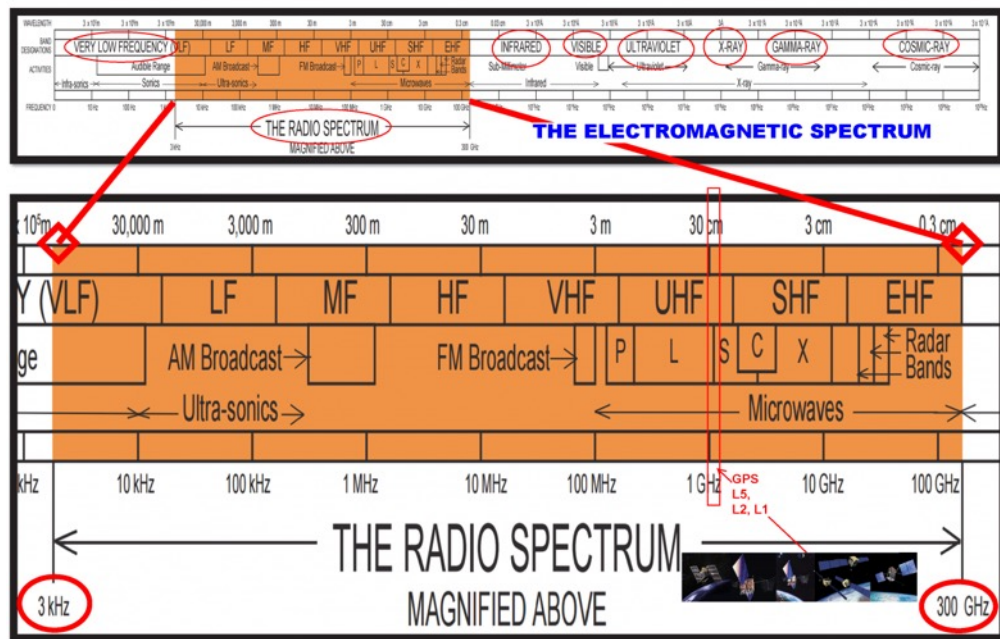
Radio Use in Rockets

- Remote Control
 - 2.4 GHz spread spectrum
 - 27, 53, 72, 75 MHz
 - 50 MHz ham band
- Telemetry
 - Science Data
 - Location Data
- Tracking
 - Direction Finding (DF)
 - GPS



Frequency bands

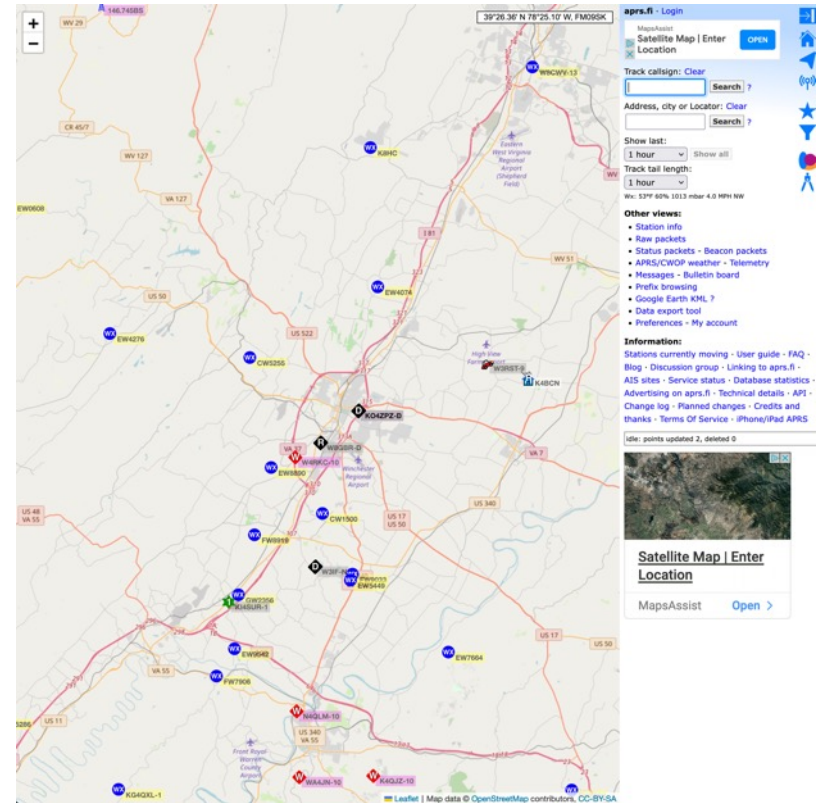
- 145 MHz “ham radio”
- 216-219 “wildlife tracking”
- 222-225 ham band
- 440 MHz ham band
- 443.92 MHz
- 900 MHz
- 2 GHz spread spectrum



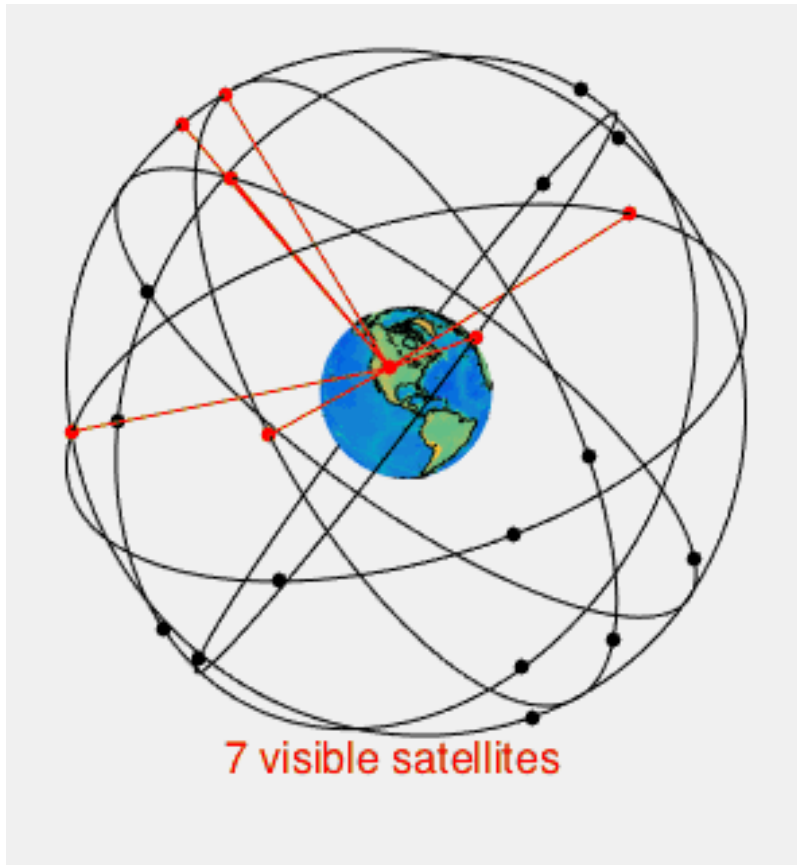
<https://www.transportation.gov/pnt/what-radio-spectrum>

Protocols

- Proprietary
 - Lots of hardware
 - Non-Ham
- APRS
 - 144.39 in the USA
 - 145.825 in space
 - No fixed 70cm



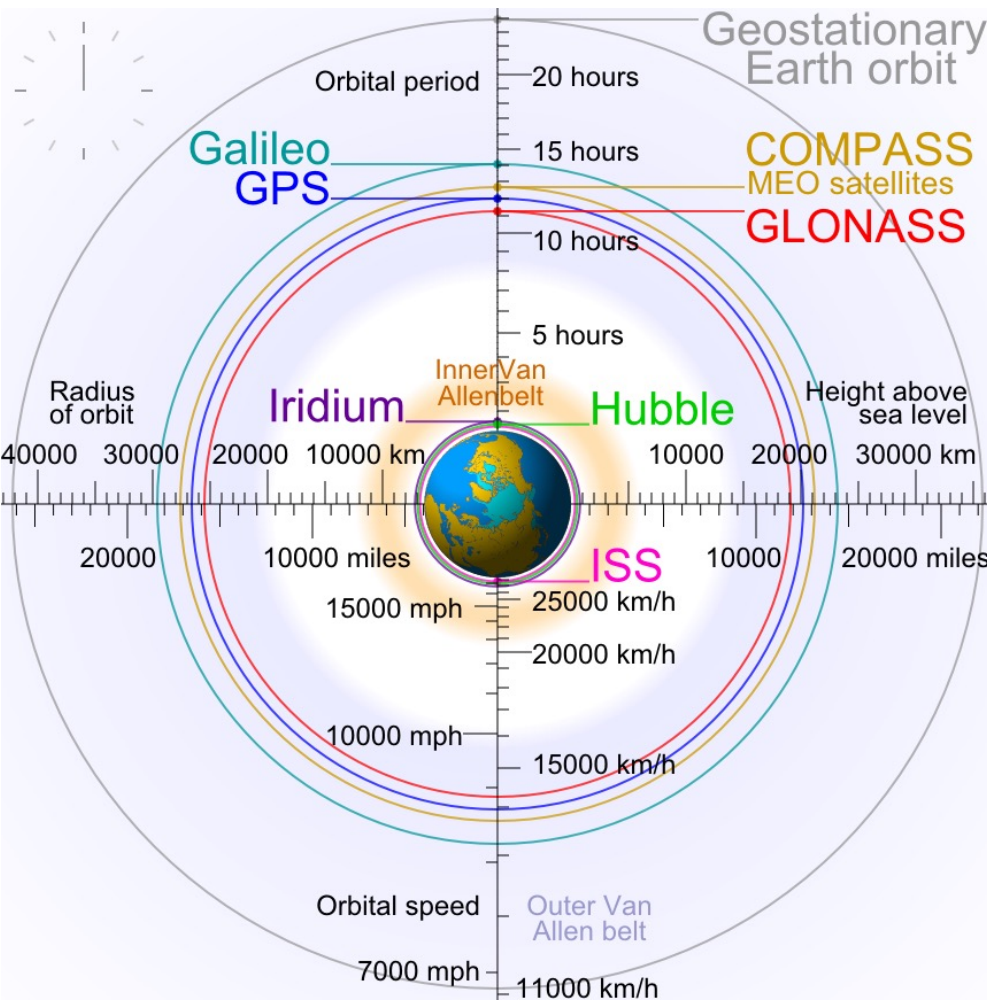
What is GPS?



- Satellite based
- Global
- Time, position, velocity
- Receive only
- Military with civilian subset
- Compatible systems: GLONASS, Galileo, Beidou

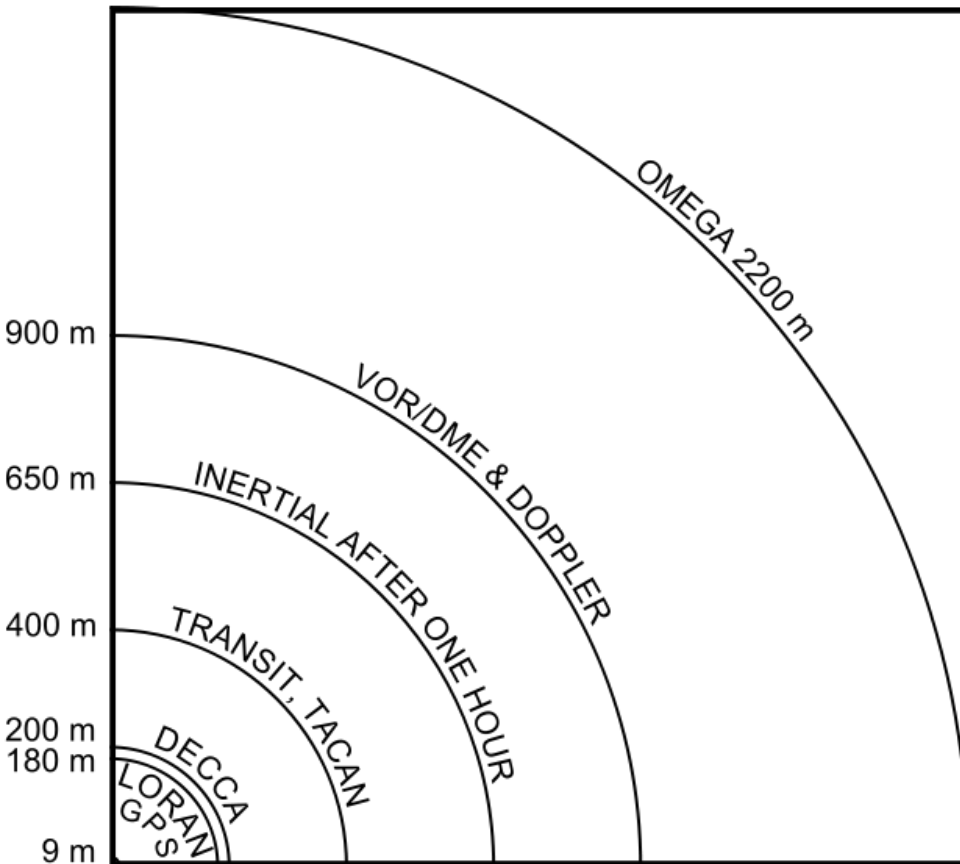
History of GPS

- Precision targeting
- Replaces celestial, radio, and early satellite navigation systems
- First launch 1978



GPS Limitations

ACCURACY OF NAVIGATION SYSTEMS
(2-dimensional)



- Accuracy:
 - Selective Availability
 - Ionosphere
 - Geometry
- Signal blockage

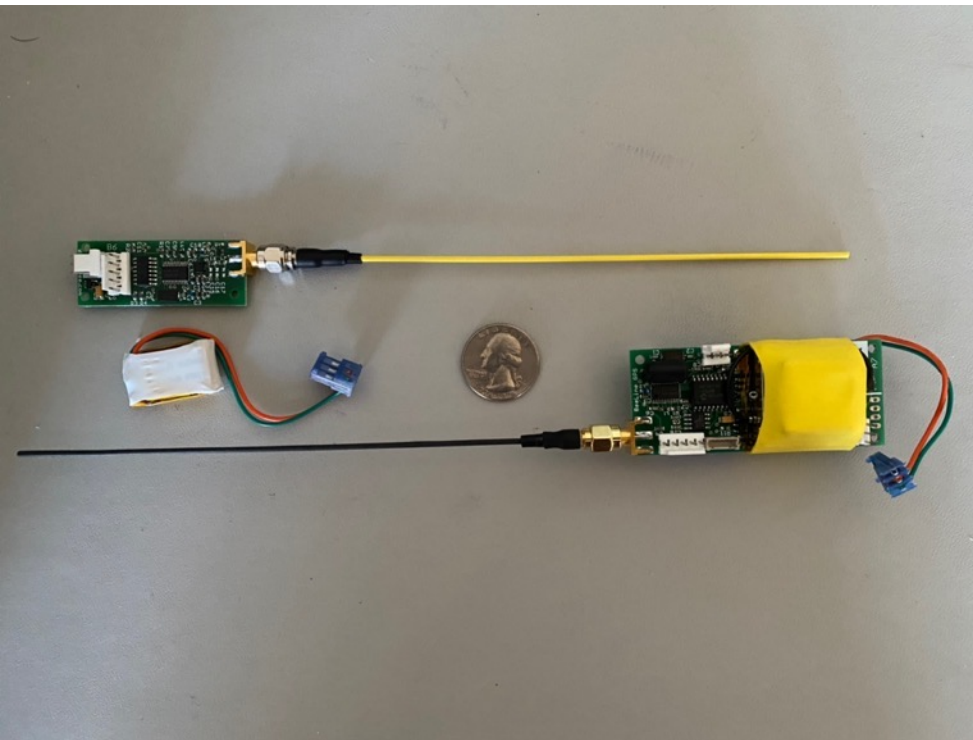
GPS Limitations (cont)



- Need telemetry for tracking
- Altitude & speed lockouts: 18km & 515 m/s
- Jerk

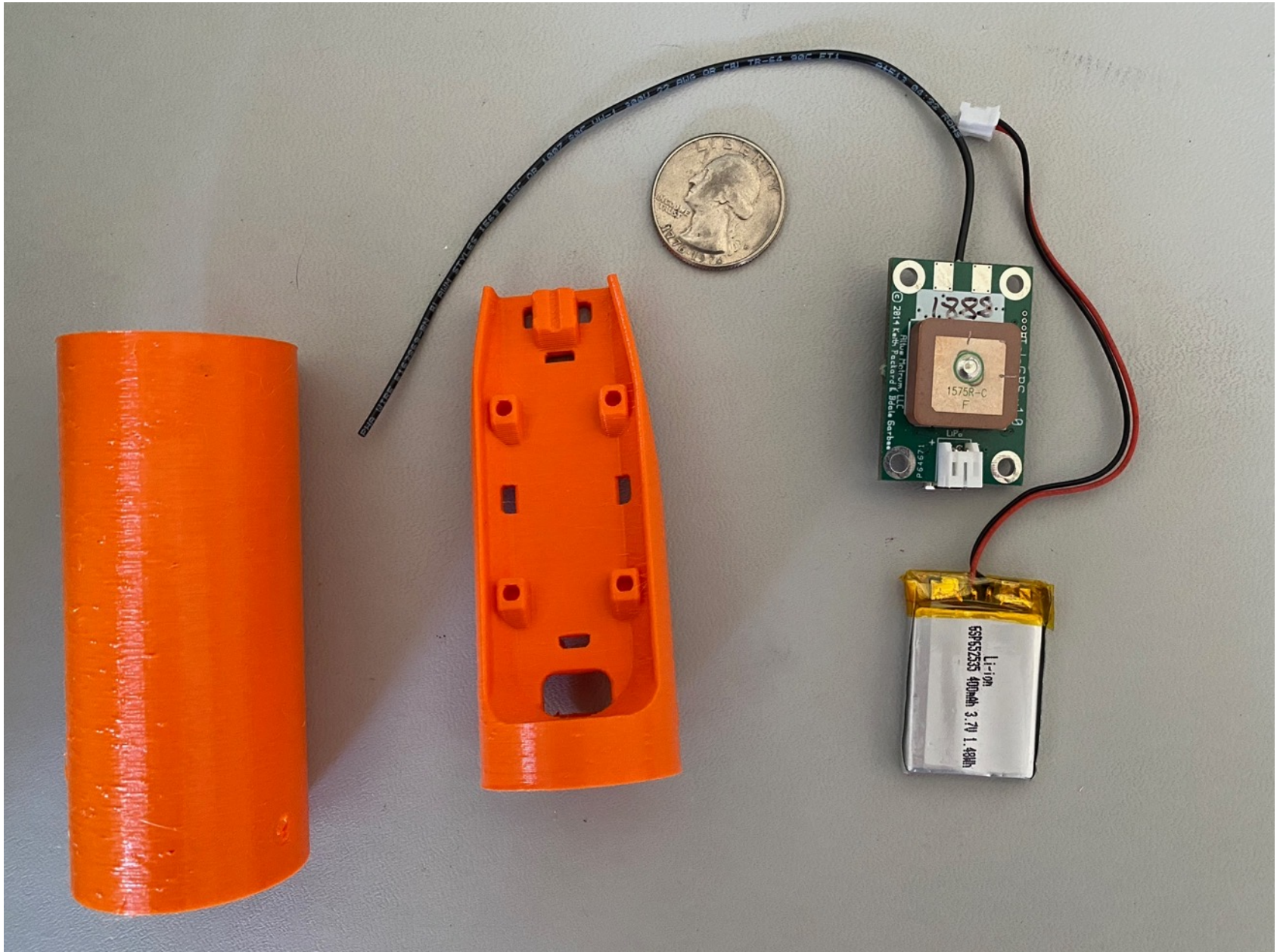
Current Products

- Consumer
- UAS Platforms
- Rocketry specific



<http://www.bigredbee.com/>

Altus Metrum GPS



Dowel and Wood Size Chart



Airplane Specification Conversion Chart

Engine Sizes: 1/2 to 1/2 inches by 1/2
Example: 1/2 cu in engine



Bolt, Screw, Drill and Tap Information Table

Bolt	Bolt Dia.	Clearance Hole	Drill To Tap (Size) (#)	(nearest 64th.)
2-56	.083	3/32	#50	5/64
4-40	.108	1/8	#43	3/32
6-32	.135	5/32	#36	7/64
8-32	.162	3/16	#29	9/64
10-24	.181	13/64	#25	5/32
1/4-20	.250	17/64	#10	13/64

Bolt	Clearance Hole	(#)	Pilot Hole
3/32		#52	1/16
1/8		#44	3/32 or 5/64
9/64 or 5/32		#36	7/64
11/64		#30	1/8

Cut your covering piece into a circle the diameter of the star you will be making. Place the circle over the template. Sketch the lines until they intersect. This forms the outline of your star. Use your

HOBBIKO
PRECISION MODELING TOOLS

Builder's Cutting Mat (24"x18")

Stock #HCA0455



FLIGHT CARD

Before each flight, fill out one card and bring it with your rocket.

Owner's Name: Will Marchant

Model's Name: Estes Green Eggs

☒ Parachute ☐ Streamer ☐ Tumble ☐ Helicopter ☐ Glider

☒ Single-Stage ☐ Multi-Stage ☐ Clustered

Engine(s): D12-5 Payload: Ardu

Comments/Features:

SAFETY CHECK USE ONLY

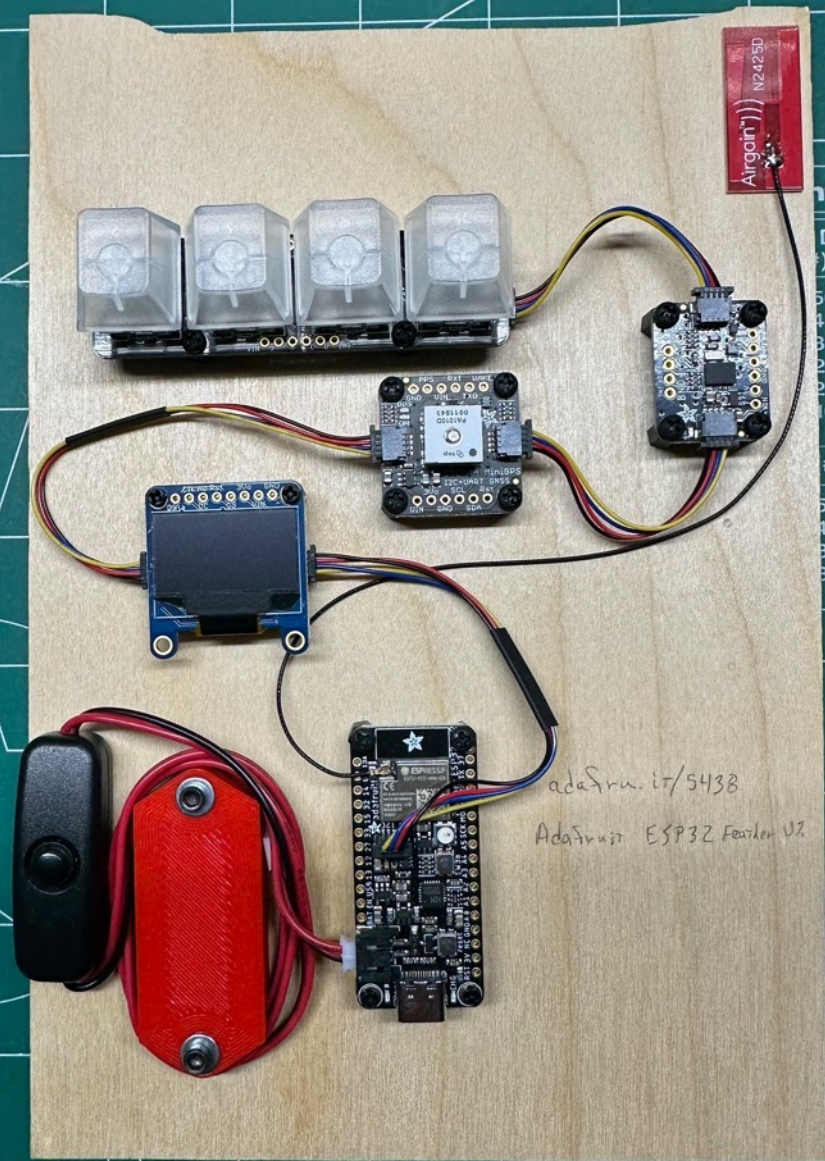
SAFETY OK (Initials) ✓ PAD # ☐ 1/8 ☐ 3/16

NOVAAR Member? ☒ Yes ☐ \$1 fee paid

SAFE UNSAFE: ☐ CATO ☐ UNSTABLE ☐ SHRED ☐ Motor Ejected



telemetry on ground station
button on FlightSketch Mini.
ct with FlightSketch app
arduino sled into avionics bay and pin
ghtSketch to prepare for flight
cket and flight card to checkin. Remind that there's some
cket onto pad and prepare for flight
tting telemetry? Wait for GPS acquisition.
lac screen recording shift-command-5
nnection pulldown to "capture to text/binary file"
orter name into the Telemetry Capture folder on desktop
" command just before flight.
rocket
nding send the "s" command.
the rocket.
meter into laptop
the "u" command
or "EXT FLASH" drive to appear
csv file(s) to desktop before deleting and unmounting the
oolTerm Connection menu to stop telemetry recording
screen recording shift-command-5
Download FlightSketch data
Save FlightSketch data to internal
Put notes in FlightSketch entry about motor and location before
Unplug and power down everything.



References

- <https://kw4wz.com/NARCON/>
- <https://narhams.org/>
- Email: kw4wz@arrl.net