Receive Cool Satellite Stuff

A Guide For Beginners,

By A Beginner

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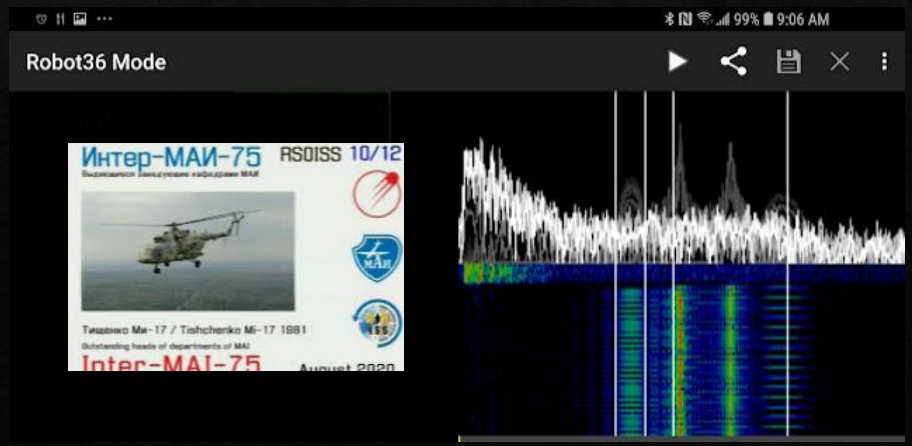
What are we doing?



Why?

- Why not?
- Fun, easy, quick, cheap
- Have something to show when you're done
- Get kids involved
- "I received this image from SPACE"

ISS SSTV Example Images (Best of Gallery)

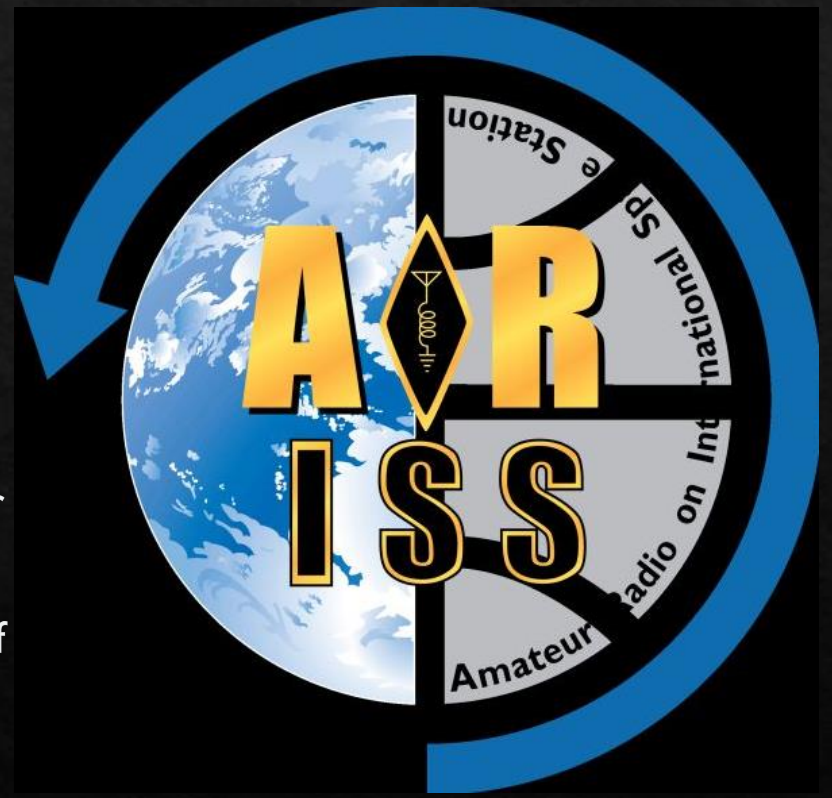
DH5RUM

M0AEU

ISS SSTV Example Images (Mine)

ARISS

- Amateur Radio on the International Space Station
- Inspire an interest in science, technology, engineering and math (STEM) subjects and in STEM careers among young people;
- Provide an educational opportunity for students, teachers and the general public to learn about space exploration, space technologies and satellite communications;
- Provide an educational opportunity for students, teachers and the general public to learn about wireless technology and radio science through Amateur Radio
- Provide an opportunity for Amateur Radio experimentation and evaluation of new technologies.
- Provide a contingency communications system for NASA and the ISS crew.
- Provide crew with another means to directly interact with a larger community outside the ISS, including friends and family.



Fun Facts

- 2020 – Passed a record 1000 new satellites/year with 1300
- 2021 – Have already launched 1400 new satellites as of September
- StarLink and OneWeb planning 40,000 more in the coming years for internet constellations
- More than 100 countries have at least 1 satellite

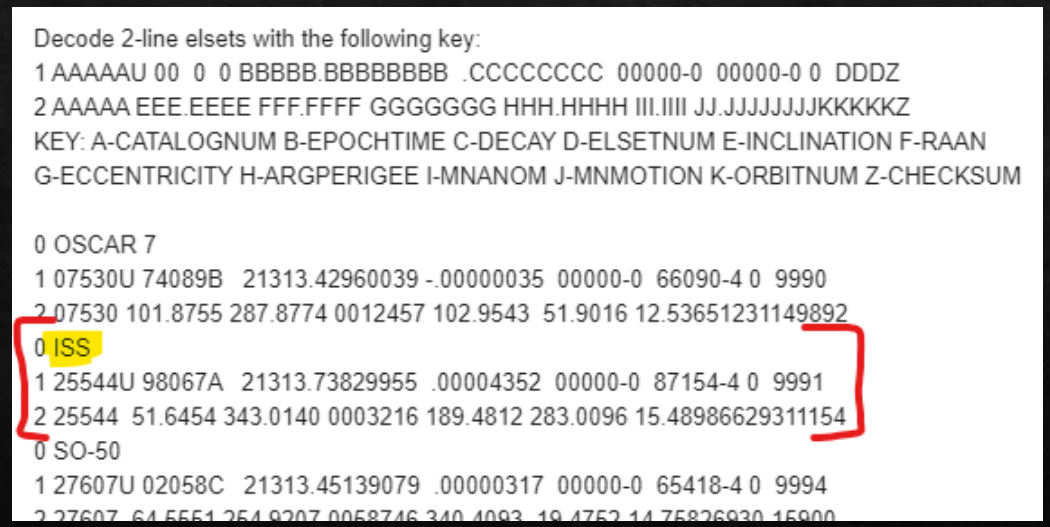
- ISS travels at ~17,500 mph, or 4.76 miles per second
- ISS orbits ~250 miles above Earth, one of the lower satellite orbits

Orbit Info

- Low Earth Orbit (LEO) – 160-1000km altitude.
  - ISS! ~90 min orbit, circles the earth ~16 times/day (it'll pass over you 7-8 times a day)
  - Polar orbit – travel past Earth in North-to-South (and vice versa) motion, going up and around the poles (or within 10-20 or so degrees from them)
  - Sun Synchronous orbit (SSO) - type of LEO polar orbit that stays synchronous with the sun, visiting the same spot at the same time each day (give or take). NOAA weather satellites are SSO
- Medium Earth Orbit (MEO) - 20km above Earth, 12hr orbit (rotates 2x/day) – GPS/Navigation
  - Molniya – Observing high altitudes. An extreme ellipse passing close to Earth then shooting out to an apogee altitude around 40k
- Geostationary (GEO) – Travel along equator, stationary above a certain point (~24hr rotation). 3km/sec, altitude 35.7km (very high). Telecom (TV, etc) and stationary weather monitoring - Geostationary Operational Environmental Satellite (GOES)

Satellite Orbit Drift

- Satellite orbits change – drift, decay
- They're tracked, repositioned regularly (some twice a year), but orbit never exactly the same after. Small drift is expected and simply dealt with by updating known orbital elements
- Keplerian elements describe an orbit (https://en.wikipedia.org/wiki/Orbital_elements)
- If you're a member of ARRL and signed up for every newsletter (!) you probably get a newsletter twice a week with updated Keplerian elements. That's from folks that track this stuff.



Automated Satellite Radio Transmission

- Weather satellite transmissions
  - APT – Automatic Picture Transmission (NOAA weather satellites), analog, typically VHF
  - LRPT – Low Rate Picture Transmission, digital, also VHF, superseded APT
  - HRPT – High Resolution Picture Transmission – 1.6-1.7 GHz
- SSTV
- Telemetry
- Beacons

Complexities of Receiving from Satellites

- **Line of sight -** You won't be receiving much before a satellite rises over the horizon, and also not much after it sets below the opposing horizon.
- **Weak Signals vs Obstacles** – Transmitted signals are rather weak; any trees, houses, people, almost anything, will block signals. Receiving in your home is possible, but will be weak. Windows may block entirely. Outside is definitely best (at least the antenna).
- **Doppler shifting** – a direct overhead pass of a VHF transmission (such as ISS SSTV and NOAA weather images) will start at the horizon more than 2 kHz than the transmitted frequency.
- **Polarity changing** – Small to no issue with ISS and weather satellites (whose antennas typically point toward Earth). More of an issue with ham radio satellites which tumble through space.
- **Antenna Nulls -** Verticals (including HT rubber ducks) pointed up have a null straight up. Best signal will come from holding vertical/HT antenna perpendicular to direction of satellite
- **Out of VHF Antenna Sweet Spot** – ISS usually transmits SSTV at 145.8, perfect! Other satellites are at different frequencies further away from the ideal center of the antenna. NOAA APT weather images are transmitted in the 137-138 MHz range

Complexities of Receiving ISS SSTV

- **SSTV Transmit Infrequent**
  - The ISS only send SSTV transmissions a couple times a year. They will set in advance a window of time that they'll be transmitting.
  - Typically posted on ARISS' Blog site (in UTC time), probably other enthusiast sites and social media outlets (ie, reddit) as well.
- **Pass to Transmit Overlap**
  - The ISS makes passes over your location regularly (7-8 times a day!), but which of those passes will they be making the SSTV transmissions? You have to figure it out and plan ahead!

Satellite info you need to know

For good satellite receiving you'll need to plan ahead:

- **What** ...frequency I need to be listening on (145.8 usually for ISS)
- **When** ...will it be passing over me (pass start and end times)
- **Where** ...do I need to look in the sky? (pass path – or azimuth direction and elevation)

Sites where you can get satellite details

- AMSAT.org
- N2YO.com (https://www.n2yo.com/satellites/?c=18)
- ARISS Blog (http://ariss-sstv.blogspot.com/) and related
- Gallery of cool ISS images (https://www.spaceflightsoftware.com/ARISS_SSTV/index.phP)
- (Software is easier, but these sites are good reference)

Useful Tracking Software

Android

- Heavens Above
- ISS Tracker

IOS/iPad

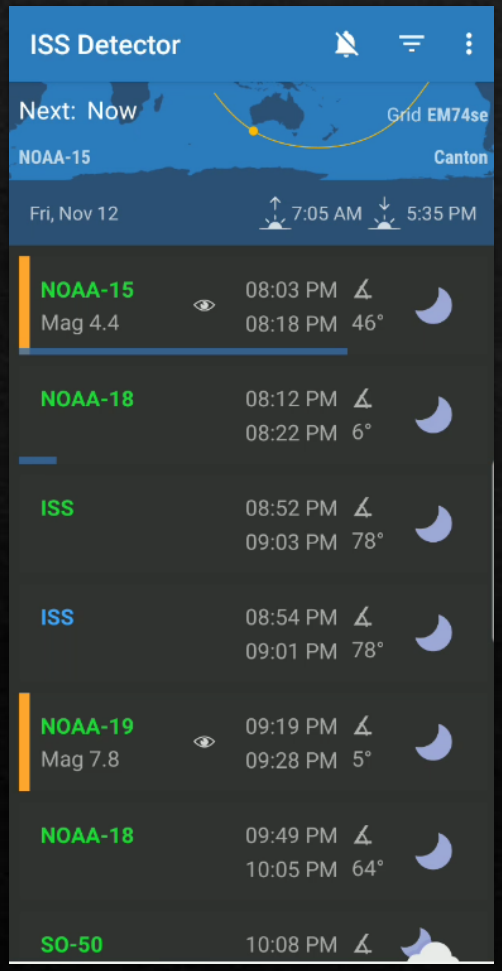
- GoSatWatch

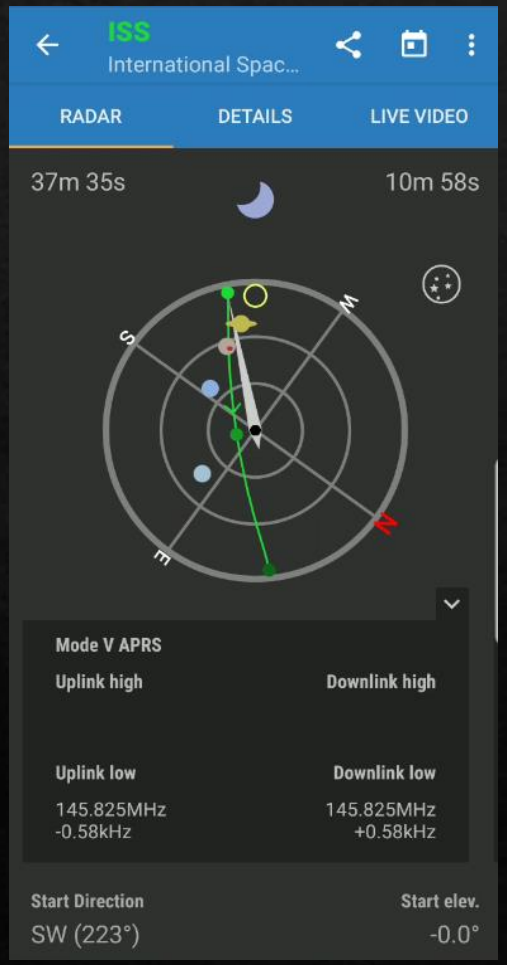
Windows

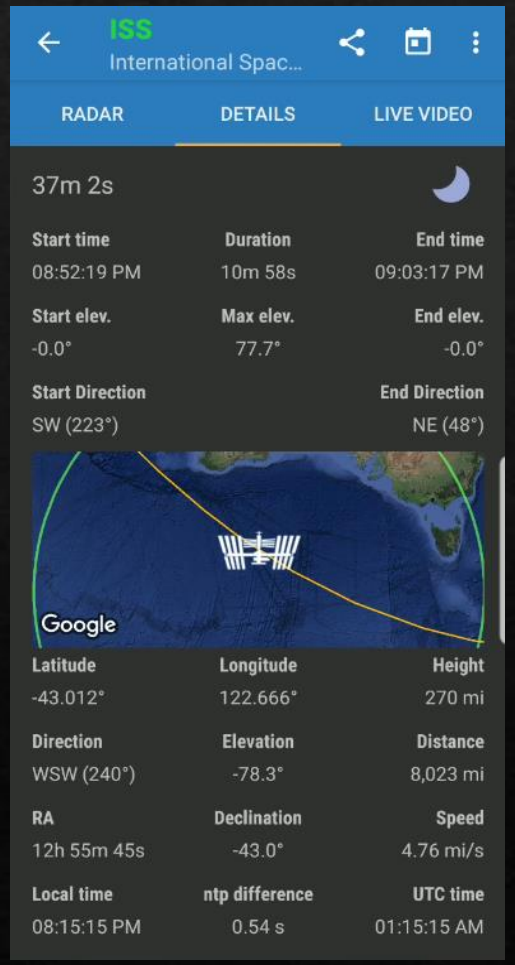
- WxToImgRestored - for NOAA weather satellite tracking and APT decoding, won't go into this but ask me if you'd like to know more

Many others, these are my recommendations

ISS Tracker

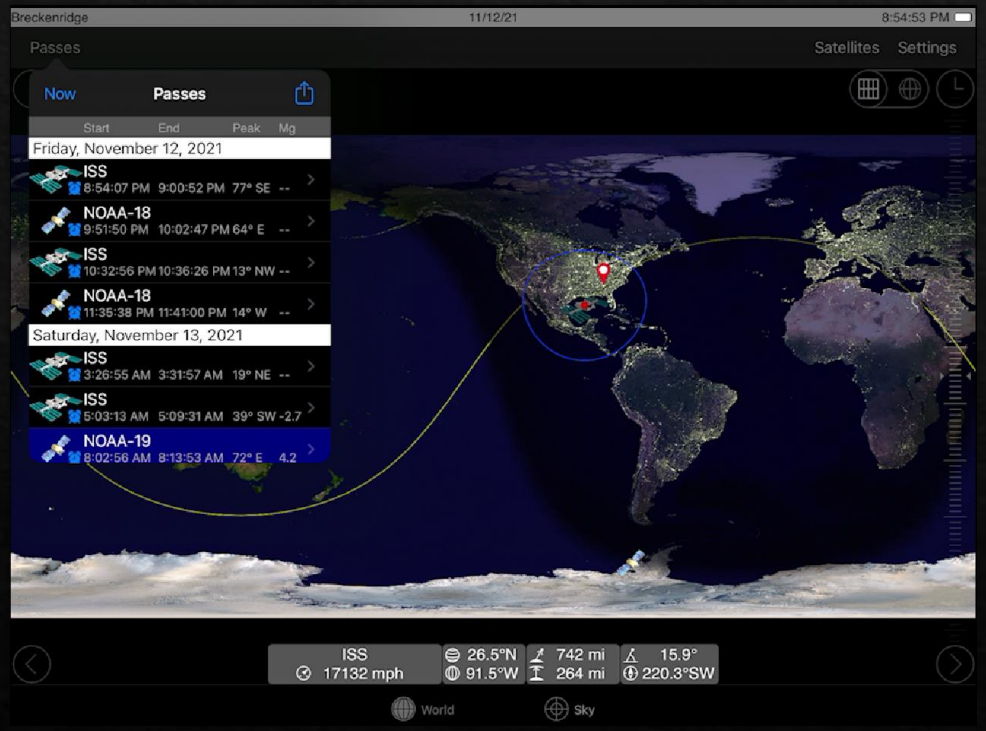

ISS Detector
Next: Now
Grid EM74se
NOAA-15
Canton
Fri, Nov 12
7:05 AM
5:35 PM
NOAA-15
Mag 4.4
08:03 PM
08:18 PM
46°
NOAA-18
08:12 PM
08:22 PM
6°
ISS
08:52 PM
09:03 PM
78°
ISS
08:54 PM
09:01 PM
78°
NOAA-19
Mag 7.8
09:19 PM
09:28 PM
5°
NOAA-18
09:49 PM
10:05 PM
64°
SO-50
10:08 PM

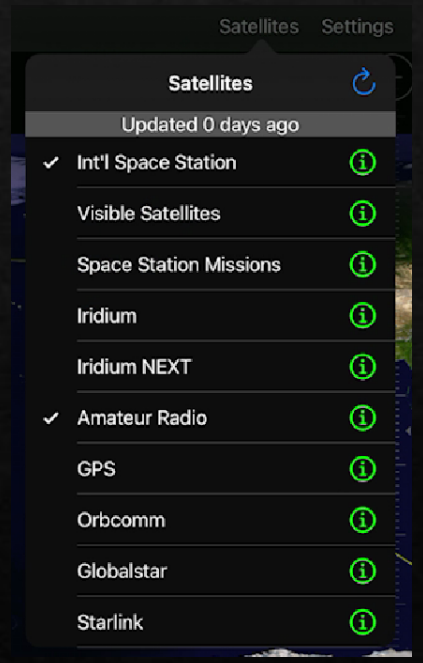

ISS
International Spac...
RADAR
DETAILS
LIVE VIDEO
37m 35s
10m 58s
S
W
N
E
Mode V APRS
Uplink high
Downlink high
Uplink low
Downlink low
145.825MHz
-0.58kHz
145.825MHz
+0.58kHz
Start Direction
SW (223°)
Start elev.
-0.0°

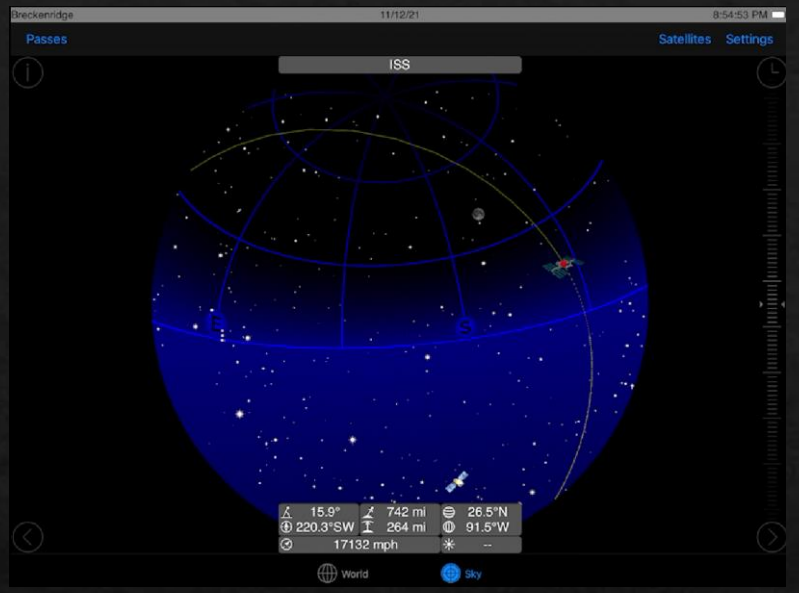

ISS
International Spac...
RADAR
DETAILS
LIVE VIDEO
37m 2s
Start time
08:52:19 PM
Duration
10m 58s
End time
09:03:17 PM
Start elev.
-0.0°
Max elev.
77.7°
End elev.
-0.0°
Start Direction
SW (223°)
End Direction
NE (48°)
Google
Latitude
-43.012°
Longitude
122.666°
Height
270 mi
Direction
WSW (240°)
Elevation
-78.3°
Distance
8,023 mi
RA
12h 55m 45s
Declination
-43.0°
Speed
4.76 mi/s
Local time
08:15:15 PM
ntp difference
0.54 s
UTC time
01:15:15 AM

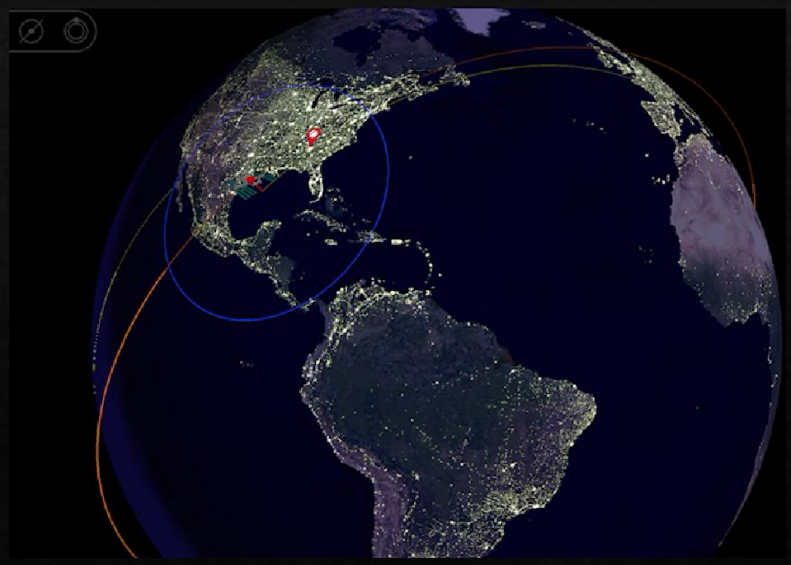

ISS
International Spac...
RADAR
DETAILS
LIVE VIDEO
32m 22s
HD
SD
LIVE
DAY
Your browser is out of date.
Update your browser to continue watching videos on this page.

GoSatWatch


Breckenridge
11/12/21
8:54:53 PM
Passes
Satellites
Settings
Now
Passes
Start
End
Peak
Mg
Friday, November 12, 2021
ISS
8:54:07 PM 9:00:52 PM 77° SE --
NOAA-18
9:51:50 PM 10:02:47 PM 64° E --
ISS
10:32:56 PM 10:36:26 PM 13° NW --
NOAA-18
11:35:38 PM 11:41:00 PM 14° W --
Saturday, November 13, 2021
ISS
3:26:55 AM 3:31:57 AM 19° NE --
ISS
5:03:13 AM 5:09:31 AM 39° SW -2.7
NOAA-19
8:02:56 AM 8:13:53 AM 72° E 4.2
ISS
17132 mph
26.5°N
91.5°W
742 mi
264 mi
15.9°
220.3°SW
World
Sky


Satellites
Settings
Satellites
Updated 0 days ago
Int'l Space Station
Visible Satellites
Space Station Missions
Iridium
Iridium NEXT
Amateur Radio
GPS
Orbcomm
Globalstar
Starlink

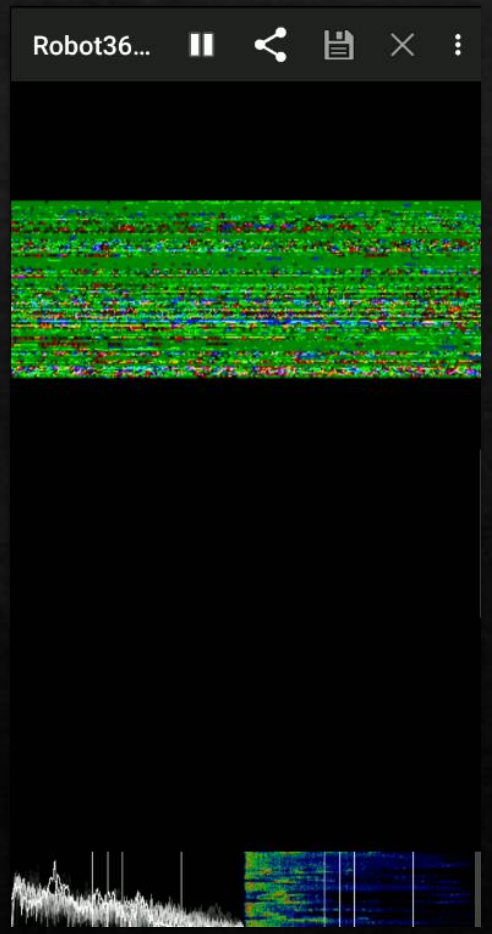

Breckenridge
11/12/21
8:54:53 PM
Passes
Satellites
Settings
ISS
15.9°
220.3°SW
742 mi
264 mi
26.5°N
91.5°W
17132 mph
World
Sky



Decoding Software

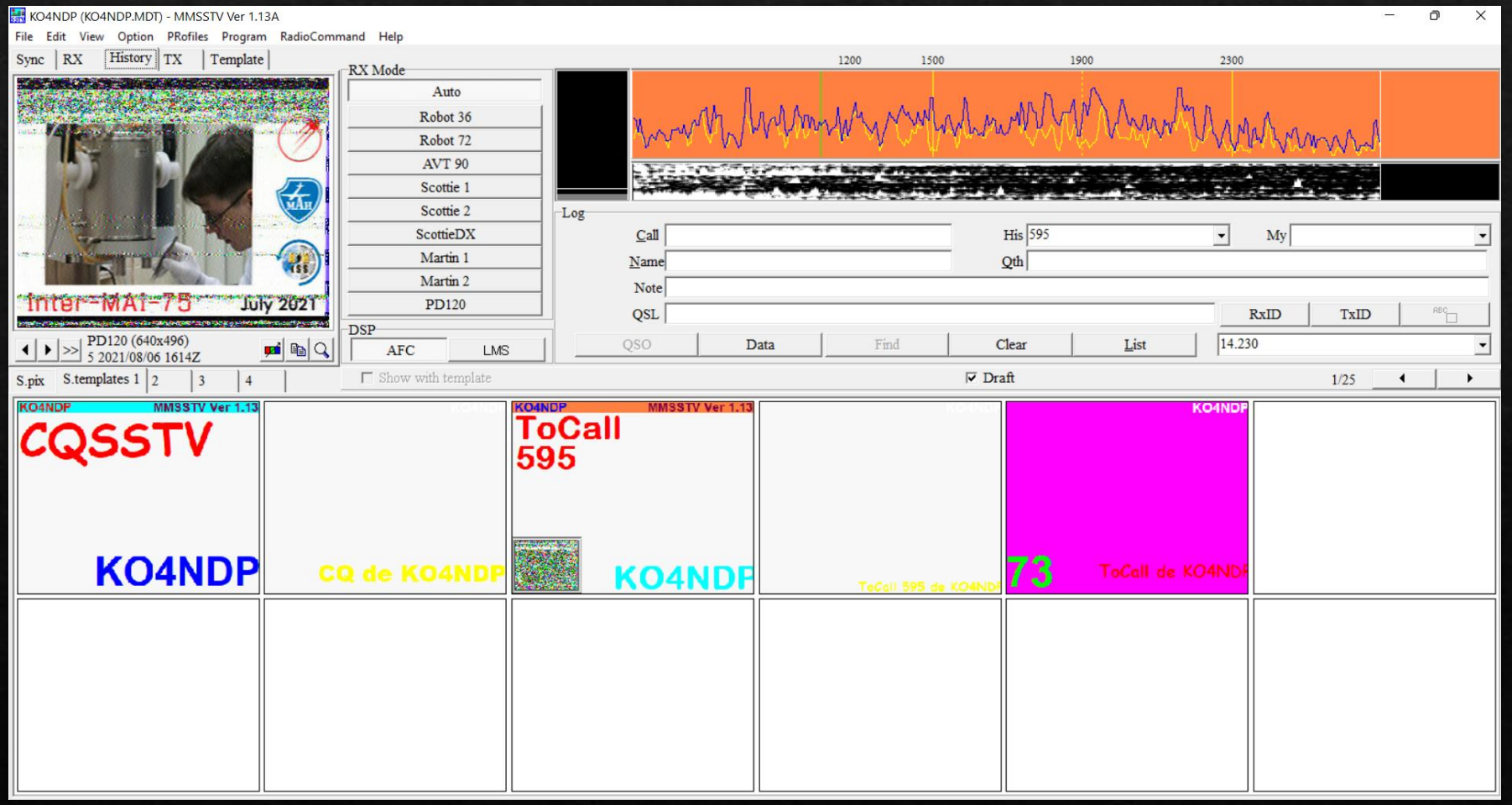
- Android
  - Robot36 – the go-to Android software for decoding SSTV. Automatically chooses the correct mode (PD120 for ISS) and options, very easy to use
- Windows
  - MMSSTV – the go-to Windows software for decoding SSTV. BE CAREFUL WHERE YOU DOWNLOAD IT FROM. There are lots of sites offering downloads, it's been reported there are viruses and/or malware in some. Ask folks in Cherokee Amateur Radio Group for a copy of their known good, working, and virus-free version.
  - Rx-SSTV (I believe it's a front end for MMSSTV, haven't tried it)
  - WxToImgRestored - for APT decoding of NOAA weather satellites
  - NOAA-APT – also for NOAA APT decoding, easier to use than WxToImg but less bells and whistles (also for Linux & pi, open source - https://noaa-apt.mbernardi.com.ar/download.html)

Robot36


Robot36...


PD180...
RS0ISS
Первая космическая пресс-конференция Алексея Леонова и Томаса Стаффорда. Снимок сделан с экрана телевизора.

MMSSTV


KO4NDP (KO4NDP.MDT) - MMSSTV Ver 1.13A
File Edit View Option PRofiles Program RadioCommand Help
Sync RX History TX Template
RX Mode
Auto
Robot 36
Robot 72
AVT 90
Scottie 1
Scottie 2
ScottieDX
Martin 1
Martin 2
PD120
DSP
AFC LMS
PD120 (640x496)
5 2021/08/06 1614Z
1200 1500 1900 2300
Log
Call His 595 My
Name Qth
Note
QSL
RxID TxID
QSO Data Find Clear List
14.230
S.pix S.templates 1 2 3 4
Show with template
Draft
1/25
KO4NDP MMSSTV Ver 1.13
CQSSTV
KO4NDP
CQ de KO4NDP
KO4NDP MMSSTV Ver 1.13
ToCall
595
KO4NDP
ToCall 595 de KO4NDP
KO4NDP
73
ToCall de KO4NDP

How To #1 – HT to Phone (Robot36)

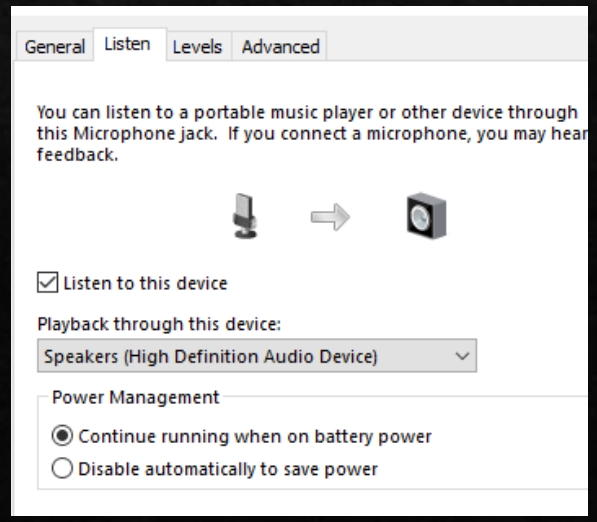
- Easiest!
- Be Ready!
  - Have HT set to proper frequency, medium volume
  - Start Robot36 – it'll be scanning right away, let it
  - Track ISS, know where it'll be rising over the horizon, which direction it'll be going
- Hold HT a few inches from phone's mic
- Best to not move phone or HT while receiving/decoding, nor change volume
- When Robot36 recognizes signal, it'll start an image. When it no longer recognizes signal, it'll stop. You may also pause it if you know it's done but it's continuing and you want to be done.
- Save or Share from Robot36 – so easy

How To #2 – MMSSTV from Saved Audio

- Hold HT near phone while receiving transmission
- Record audio on phone to audio recorder
- Transfer saved audio file to computer
- Open file in MMSSTV (may require audio conversion?)
  - File => "Play sound from file"

How To #3 – HT to MMSSTV over Cable

- Connect radio to computer via cable and decode in real time
  - Need the proper cable – for a Baofeng, the BTech APRS cable is the one you're looking for
  - Need to be able to listen to the audio input so you can hear the transmission and know it's working, and adjust the antenna if needed. In sound settings, Device Properties for the audio input, Additional Device Properties, Listen tab, check "Listen to this device" and set the appropriate playback device
  - I like using a Bluetooth device (earbuds, Bluetooth speaker, etc)



How To #4 – HT to MMSSTV over Mic

- Same as with a cable, just... without a cable. Which also eliminates the complications of outputting the audio input.
- Use the laptop's microphone as the audio input.

Next steps after "beginner proficiency"

- RTL-SDR (maybe even web SDR!)
- APT – NOAA weather satellites (starter images, easy, similar steps as tracking/receiving/decoding ISS SSTV images just different software basically)
- Better antennas - yagi, helix, loop/eggbeater, but just a better vertical can work just fine

- Even more next steps...
  - Listening to ham radio satellite repeaters
  - Working them!