Amateur Satellites

Getting Started

By Rob Smith W6GRV

Agenda

The following is based on my experience

- Initial Thoughts
- Station Equipment
  - Basic / Minimal – Equipment
  - Simple Full Duplex FM Satellite setup
  - Antenna Options
  - Tracking Software
- Satellites
  - AMSAT website
  - Overview of Satellites Currently Available
- FM Satellite Operations
  - Pre Pass Prep: Satellite pass times, pointing predicts, & equipment check
  - An FM Satellite Pass: Antenna Pointing, Doppler, & The Exchange
  - Post Pass: playback recording, log, lessons learned
- Logging Satellite contacts

Initial Thoughts

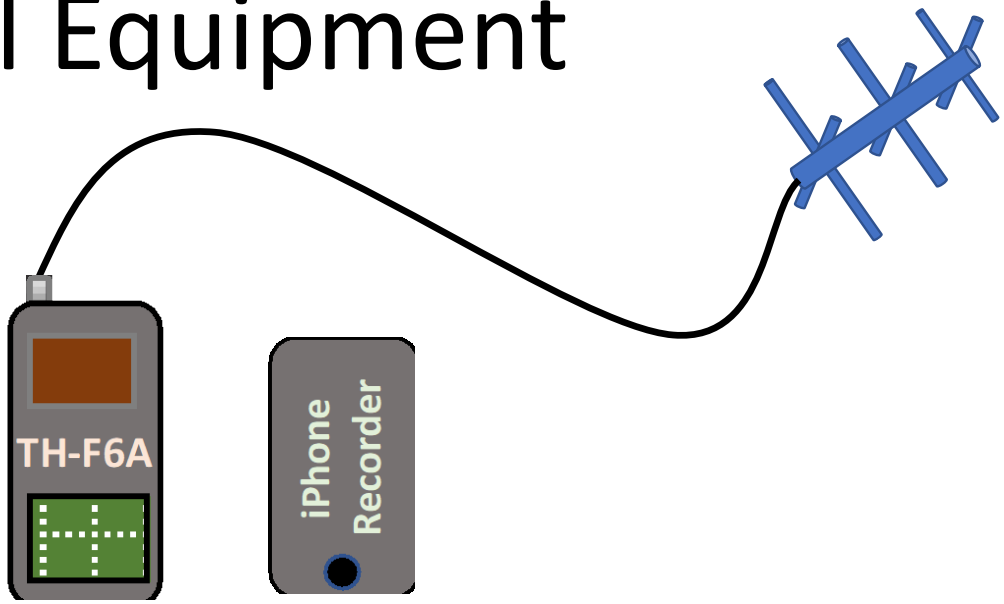
- What license class is needed
- Does it take a lot of expensive equipment?
- Does it take years of experience?
- It is too complicated to learn
- But I have Condo Restrictions & can't put up an antenna

- How would I even start?
- Which satellites are currently available & working?
- How do I use Keplerian Elements (sounds difficult)?
- How far away are the stations I can talk to?

Minimal Equipment

Kenwood TH-F6
435.### Mhz U/L
Mode = FM
Tone = 67.0 Hz.
Power = 5 Watts

145.### Mhz D/L
Mode = FM



Antenna
- 435 Mhz & 145 Mhz.
- Ex.: Arrow Antenna or Elk Log Periodic
  - (For Arrow, need Diplexer –if using single radio) for 435 Mhz. & 145 Mhz.

FM Transceiver
- 145 & 435 Mhz., cross band split, about 3 to 5 Watts out, tuning step 5hz. (or less)
- Example: Kenwood TH-F6A

Tracking Software
- iPhone: HamSat or GoSatWatch

Recorder
- Recorder+ (comes with iPhone), or use other app, such as “Voice Record”

Radio: TH-F6

Lock Functions

Lock Functions:

Press and hold: **[F]** for 1 secon

Toggles lock ON and

TX Inhibit:

Press: **[MNU]**, Turn **Tuning Cor**

Select **Menu #8** (TX INHIBIT)

Press: **[MNU]**, Turn **Tuning Cor**

Select "ON" (or "OFF")

Press: **[MNU]** to store, or **[PTT]**

Battery Saver:

Press: **[MNU]**, Turn **Tuning Cor**

Select **Menu #17** (BAT SAVER)

Press: **[MNU]**, Turn **Tuning Cor**

Select setting (1.0 is default)

Press: **[MNU]** to store, or **[PTT]**

Misc./Radio Specific:

Keyboard Beep Tone Or

Press: **[MNU]**, Turn **Tuning Control**

Select **Menu #19** (KEY BEEP)

Press: **[MNU]**, Turn **Tuning Control**

Select "ON" (or "OFF")

Press: **[MNU]** to store, or **[PTT]** to cancel

Squelch Adjust:

Press: **[SQL]**, Turn **Tuning Control**

To adjust Squelch Level

Press: **[MNU]** to store, or **[PTT]** to cancel

Band Selection:

Select Band:

Press: **[A/B]**

Select Receive Freq.:

Press: **[VFO]**, **[ENT]** (select the desired band)

Store to Memory:

Press: **[F]** The **F** and a **memory#** (blinks)

Turn **Tuning Control** to select memory

Press: **[MR]** or **[MNU]** to store

Dual Band Receive:

Press:**[F]**, **[A/B]** To toggle single or dual

Press: **[A/B]** To toggle transmit band

Press: **[BAL]** , Turn **Tuning Control**

To adjust Volume Balance between A & B

Satellite Configuration

- Dual Band
  - Transmit (Uplink) on A
    - Simplex – no offset
    - Set Tone
    - Power at High (5 watts)
    - Turn down A volume
  - Receive (Downlink) on B
    - Simplex
    - Turn up B volume
- Open Squelch

Power:

Press: **[LOW]** Toggles: H > L > EL

Cross Band (ex. Satellite):

Set for Dual Band

Press:**[F]**, **[A/B]** To toggle single or dual

Press: **[A/B]** To toggle Up & Down band

Set A to Uplink and B to Downlink

Select No Offset for each

Press: **[F]**, **[REV]** No "+" or "-" shown

Select Tone for A (uplink)

Press: **[TONE]** The **T** is toggled on/off

Press: **[MNU]** to store, or **[PTT]** to cancel

Adjust Volume – listen to B (downlink)

Adjust Volume – not listen to A (uplink)

Press: **[BAL]** , Turn **Tuning Control**

To adjust Volume Balance between A & B

Final setup (for Satellite):

VFO set to A (uplink), low volume

Transmit set to A, Tone on, no offset

Power is set to High (5 watts)

B (downlink) has high volume

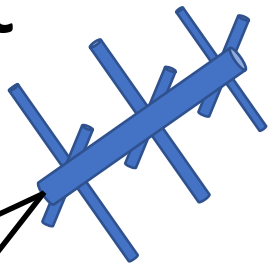
Squelch is opened up

Main Frequencies:

WR6JPL	Pasadena	147.150	100.0 (+)
WR6JPL	Pasadena	224.080	156.7 (-)
WR6JPL	Pasadena	224.070	114.8 (-)
WR6JPL	Pasadena	445.200	103.5 (-)
WR6AZN	Table Mtn.	145.280	131.8 (-)
WR6AZN	Table Mtn.	223.960	156.7 (-)
WR6AZN	Table Mtn.	447.200	94.8 (-)

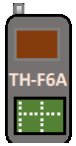
W6VIO / KHA920

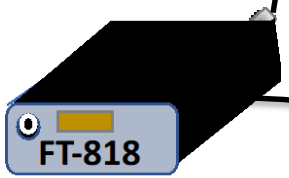
Full Duplex Equipment



For Elk antenna, need a splitter

Kenwood TH-F6
435.### Mhz U/L
Mode = FM
Tone = 67.0 Hz.
Power = 5 Watts

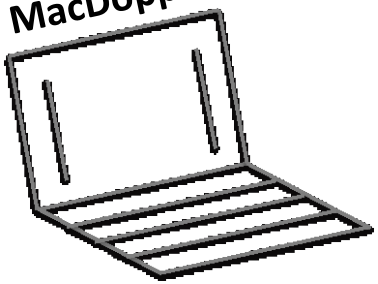




Yaesu FT-818
145.### Mhz D/L
Mode = FM

TASCAM DR-05 Recorder

SatPC32 or MacDoppler



Simple Antenna Options

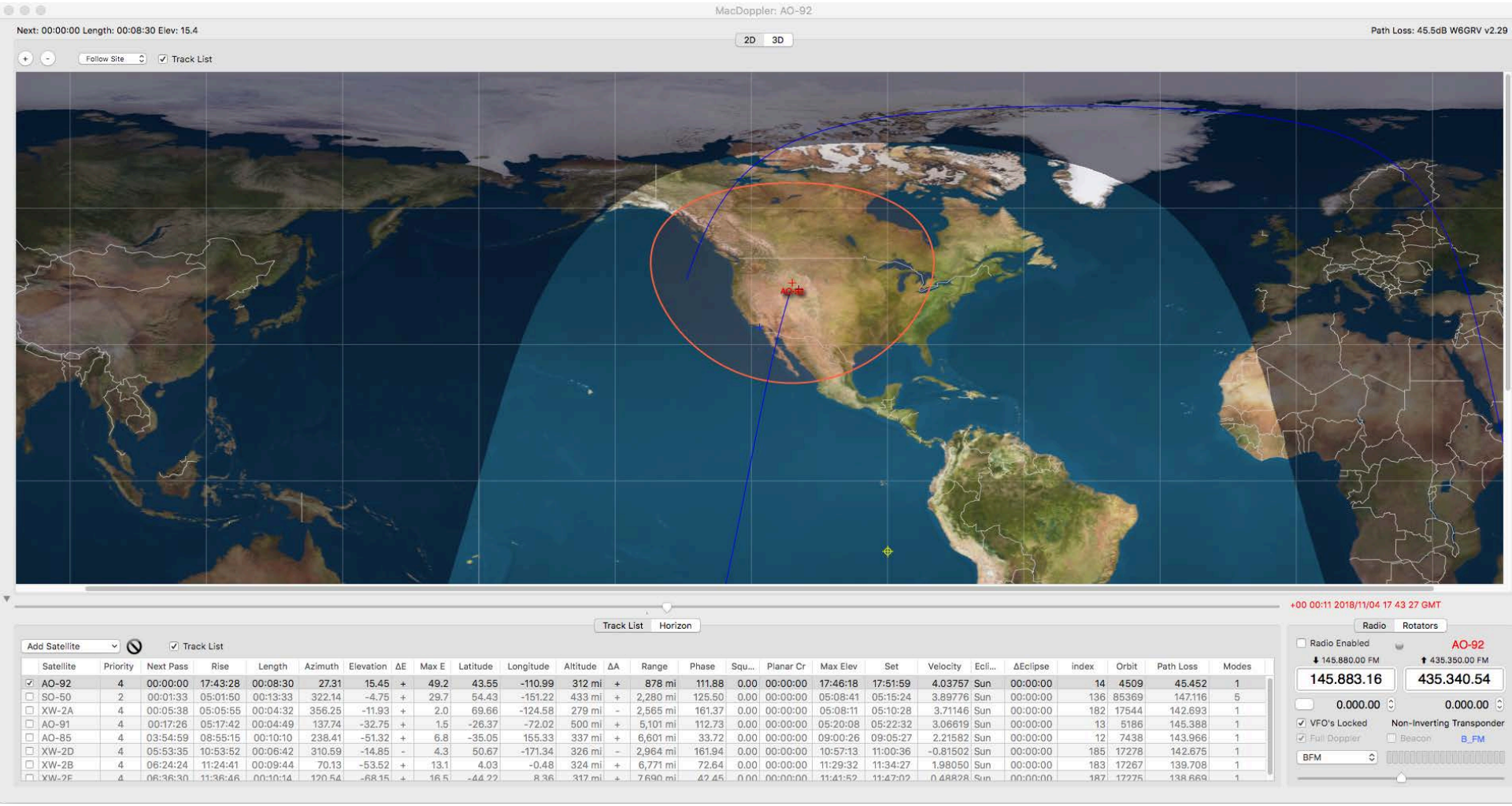
- Arrow Antenna
  - Separate Yagi antennas for 435 Mhz. & 145 Mhz.
  - Single radio connects using a diplexer
  - Separate radios connect directly (Full Duplex - one uplink & one downlink)

- Elk Antenna
  - Log periodic Yagi covering 145 & 435 Mhz.
  - Single radio connects directly for both uplink & downlink
  - Separate radios connect using a duplexer (for Full Duplex)

- Vertical Antenna
  - Not the best option, but can be used
  - points to the horizon, not above
  - Have used a vertical antenna to make FM satellite contacts

PC: SatPC32
Mac: MacDoppler
iPhone apps: HamSat

Tracking Software



AMSAT Website - Overview

"Operating FM Satellites"

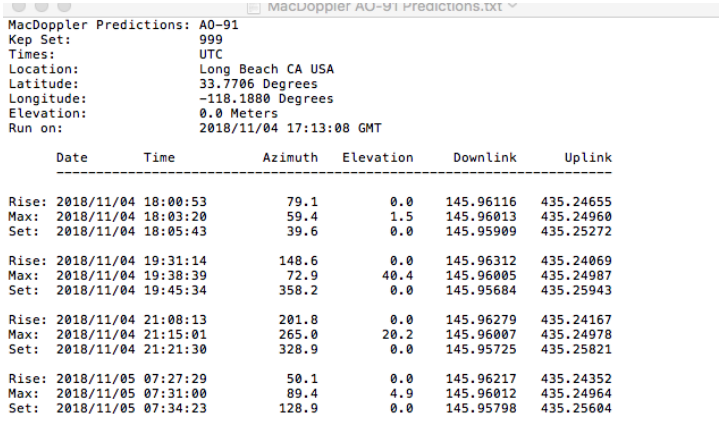
Current Popular Satellites

Satellite	Downlink Mhz.	Uplink Mhz.	PL Tone Hz.	Satellite Mode	Transmission Mode
AO-85	145.980	435.172$_5$	67.0	UV	FM
AO-91	145.960	435.250	67.0	UV	FM
AO-92	145.880	435.350	67.0	UV	FM
SO-50	436.795	145.850	67.0	VU	FM
ISS	*145.800*	*144.490*	---	---	*FM, when active*
XW-2A	145.665 – 145.685	435.030 – 435.050	---	UV	SSB - Linear Transponder
XW-2B	145.730 – 145.750	435.090 – 435.100	---	UV	SSB - Linear Transponder
XW-2C	145.795 – 145.815	435.150 – 435.170	---	UV	SSB - Linear Transponder
XW-2D	145.860 – 145.880	435.210 – 435.230	---	UV	SSB - Linear Transponder
XW-2E	145.915 – 145.935	435.270 – 435.290	---	UV	*Telemetry Only*
XW-2F	145.980 – 146.000	435.330– 435.350	---	UV	SSB - Linear Transponder

Note: *Typical FM mode is shown, however spacecraft may operate at other modes & frequencies.*

Pass Prep

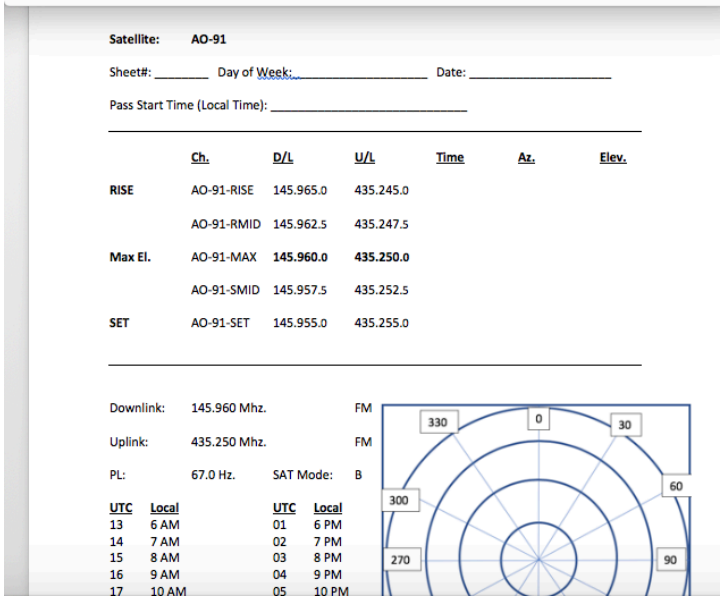
- Generate Pass Predicts – Up to a couple of days prior to pass
  - Pass Times for Rise, Peak, & Set
  - Direction and Elevation
  - Doppler / Frequencies to use during pass
  - Print out any desired predict or pass information
- Charge Equipment



MacDoppler Predictions.txt

```
MacDoppler Predictions: AO-91
Kep Set:                999
Times:                  UTC
Location:               Long Beach CA USA
Latitude:               33.7706 Degrees
Longitude:              -118.1880 Degrees
Elevation:              0.0 Meters
Run on:                 2018/11/04 17:13:08 GMT

      Date       Time          Azimuth   Elevation     Downlink      Uplink
      ------------------------------------------------------------------------

Rise: 2018/11/04 18:00:53          79.1         0.0    145.96116   435.24655
Max:  2018/11/04 18:03:20          59.4         1.5    145.96013   435.24960
Set:  2018/11/04 18:05:43          39.6         0.0    145.95909   435.25272

Rise: 2018/11/04 19:31:14         148.6         0.0    145.96312   435.24069
Max:  2018/11/04 19:38:39          72.9        40.4    145.96005   435.24987
Set:  2018/11/04 19:45:34         358.2         0.0    145.95684   435.25943

Rise: 2018/11/04 21:08:13         201.8         0.0    145.96279   435.24167
Max:  2018/11/04 21:15:01         265.0        20.2    145.96007   435.24978
Set:  2018/11/04 21:21:30         328.9         0.0    145.95725   435.25821

Rise: 2018/11/05 07:27:29          50.1         0.0    145.96217   435.24352
Max:  2018/11/05 07:31:00          89.4         4.9    145.96012   435.24964
Set:  2018/11/05 07:34:23         128.9         0.0    145.95798   435.25604
```

- Setup Equipment – Just prior to pass
  - Connect proper antenna to RX and TX equipment
  - Connect Recorder
  - Headset
  - Power on equipment & Set to Rise frequencies
  - Open receiver's Squelch
- Dry Run – just prior to pass
  - With the equipment setup,
    point the antenna through the pass track
    Be sure you are clear of overhead power lines
  - Know where Rise, peak, and set will be
  - Check radio settings (frequencies, mode, tone, squelch, …)
  - Check for cable issues
  - Assess ability to talk into transmit equipment
- Start the recorder(s)
  - Be sure they are recording
  - Add a verbal time stamp



Satellite: **AO-91**

Sheet#: _____ Day of Week: _____ Date: _____

Pass Start Time (Local Time): _____

	Ch.	D/L	U/L	Time	Az.	Elev.
RISE	AO-91-RISE	145.965.0	435.245.0			
	AO-91-RMID	145.962.5	435.247.5			
Max El.	AO-91-MAX	**145.960.0**	**435.250.0**			
	AO-91-SMID	145.957.5	435.252.5			
SET	AO-91-SET	145.955.0	435.255.0			

Downlink: 145.960 Mhz. FM

Uplink: 435.250 Mhz. FM

PL: 67.0 Hz. SAT Mode: B

UTC	Local	UTC	Local
13	6 AM	01	6 PM
14	7 AM	02	7 PM
15	8 AM	03	8 PM
16	9 AM	04	9 PM
17	10 AM	05	10 PM

FM Satellite Pass

- Satellite Rise & Set
  - Point the antenna just above the horizon in the direction of S/C rise
  - Move the antenna around & Rotate to account for polarization
  - Listen for the spacecraft downlink
  - Keep tracking the spacecraft
    - It may take until S/C is up 10 degrees, or approx. 2-3 minutes before you hear it.
  - Do not transmit if you do not hear the spacecraft
  - Adjust for doppler during the pass. (Closest to center frequency at mid pass.)
  - If full duplex, listen for your downlink
- Exchange
  - Instead of CQ, just say your Call & Grid once: "W6VIO DM04"

    Whiskey Six Victor India Oscar Delta Mike Zero Four
  - QSO: Consists of Callsign and Grid Square

Station 1 (W6VIO)	Station 2 (KB6A)
W6VIO DM04	
	W6VIO KB6A DM13
KB6A W6VIO DM04	
	W6VIO Thank you KB6A

Post Pass

- Stop & Save Recording
- Disconnect equipment
- Fill out logs (Playback recording)

- Consider keeping a notebook listing
  - Date & Pass information
  - Equipment used
  - What worked well
  - What did not work well

Logging Satellite Contacts