

SATELLITE OPERATIONS

Walter Holmes walterh@k5wh.net
K5WH

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AREAS TO COVER

- **Typical ground station requirements**
- **Most popular radios**
- **Most popular antennas**
- **Most popular digital interfaces**
- **Most popular software**
- **Different modes of operation**
- **How to get involved**
- **Important Links**

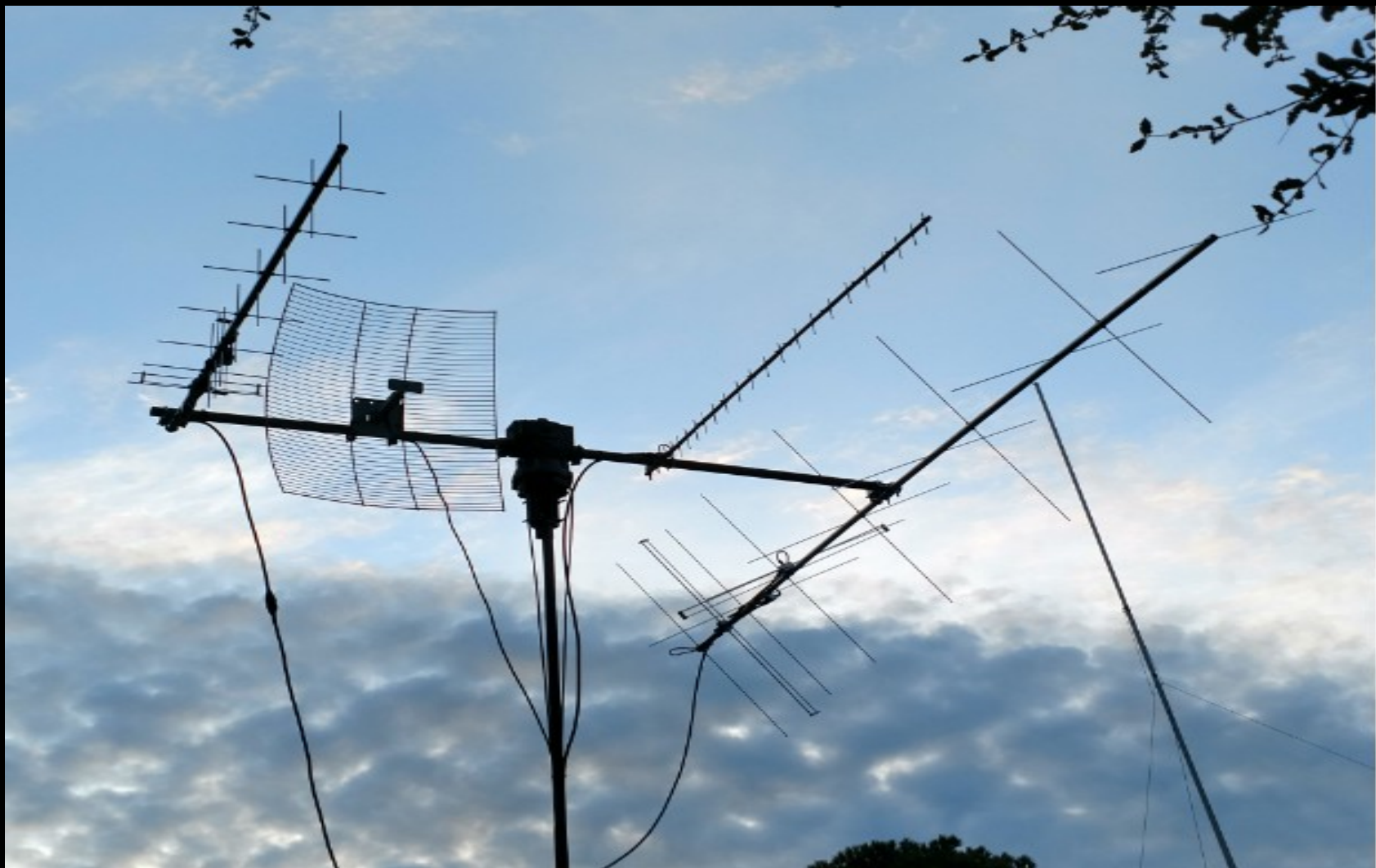
TYPICAL GROUND STATION REQUIREMENTS



AUTOMATED SATELLITE STATION



MULTIBAND COVERAGE



W5HRH



MOBILE ROVER



PORTABLE



MOST POPULAR RADIOS

- **Satellite Radios**
 - **TS-2000, IC-9100, IC-9700, FT-847, FT-817's, and many others**
- **HT 's**
 - **TH-72 (full duplex) TH-74 (all mode receive) VX-8dr, and most any other dual-band ht**

KENWOOD TS-2000



ICOM IC-9100



ICOM IC-9700



YAESU FT-847



YAESU FT-817ND



KENWOOD TH-D72A



KENWOOD TH-D74A



YAESU VX-8DR

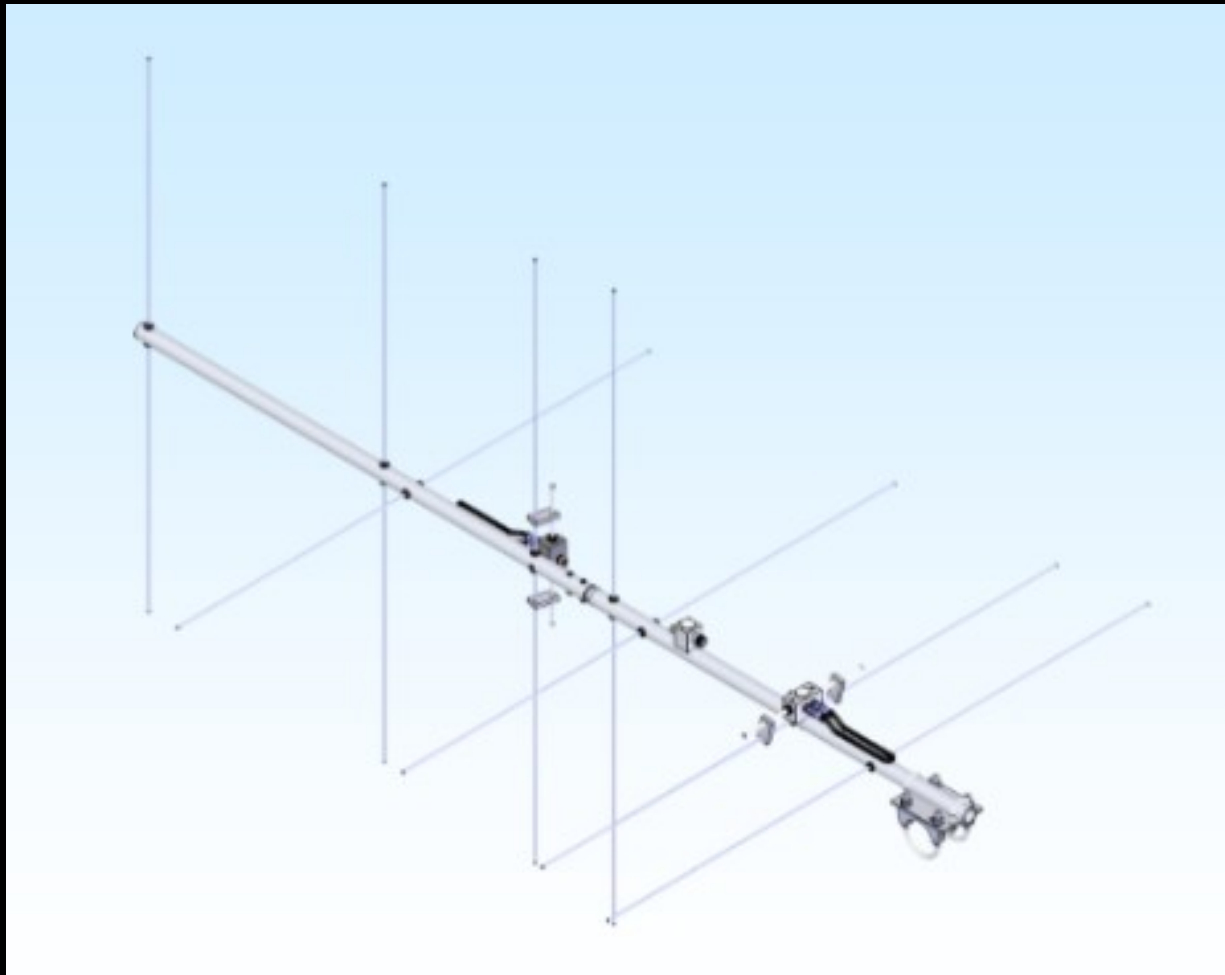


MOST POPULAR ANTENNAS

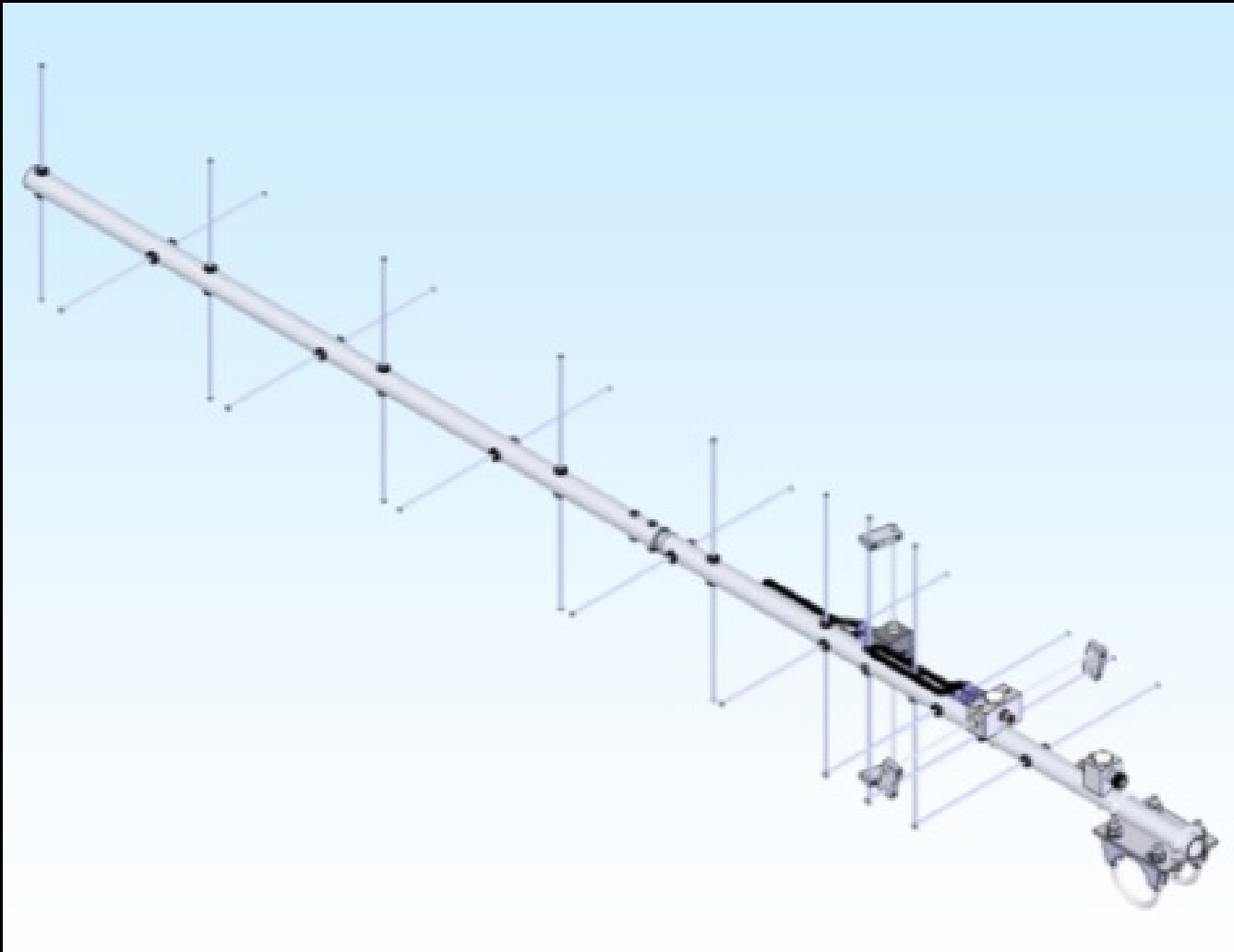
- **M2 , 2MCP8A, 436CP16, or Leo-Pack,
or 2M-440xpss**
- **Arrow (hand-held)**
- **Elk-Arrow (longer hand-held)**
- **Extended antenna for ht**

- **Yaesu G-5500 az/el rotor**

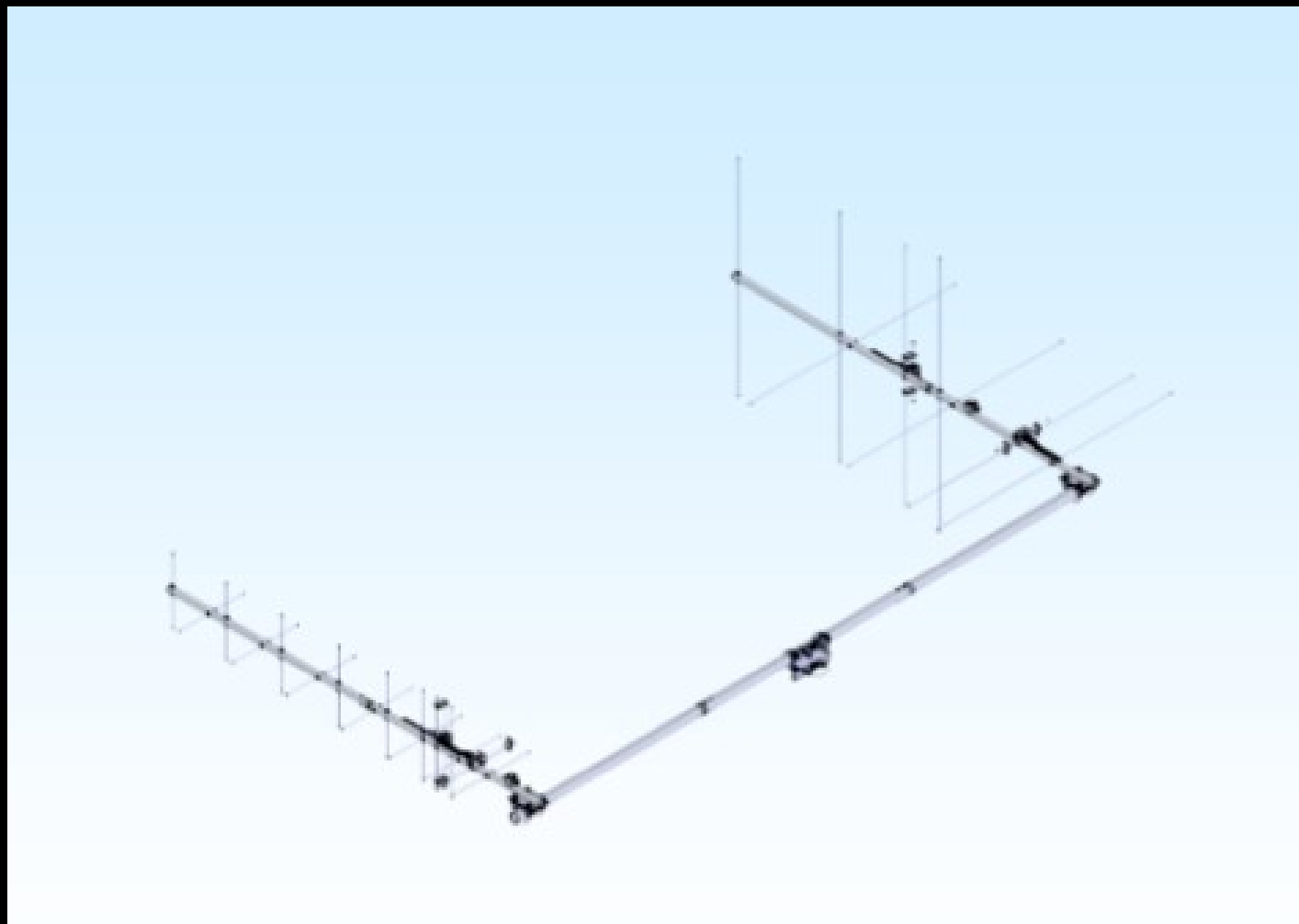
M2 2MCP8A



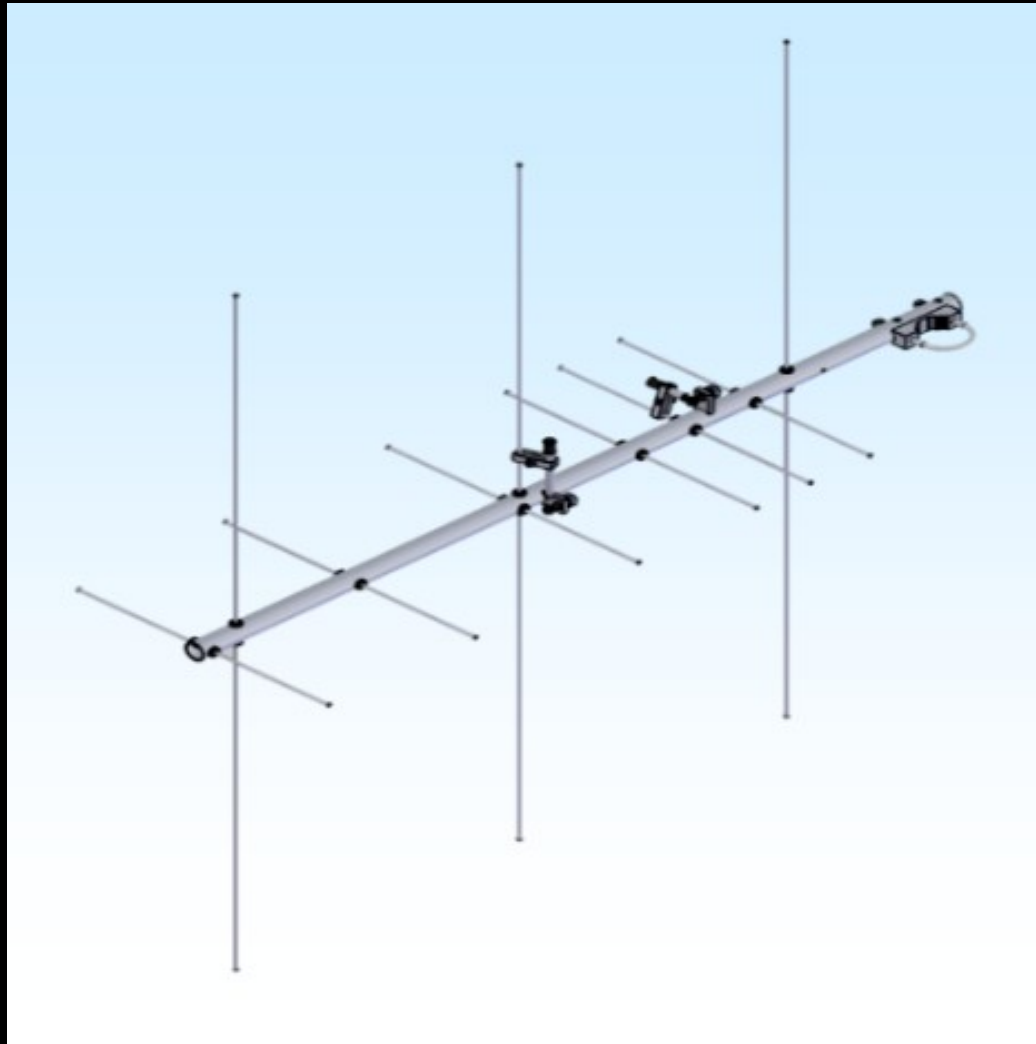
M2 436CP16



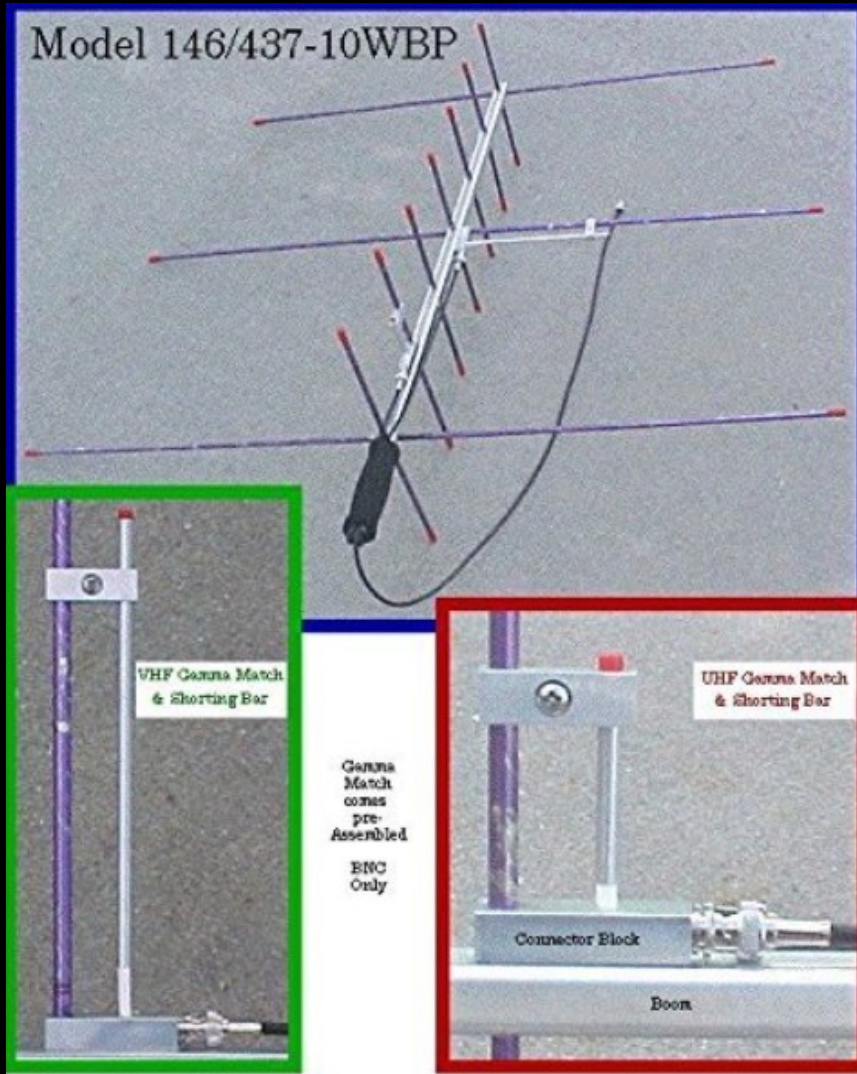
M2 LEO-PACK



M2 2M-440XP-SS



ARROW HAND-HELD



MOST POPULAR DIGITAL INTERFACES

- **Signalink**



- **Rig Blaster**



- **MFJ-1204**



- **Hardware or Software modem for Packet**

MOST POPULAR SOFTWARE

- **SatPC32 (join Amsat for a free copy)**
- **AmsatDroid (android devices)**
- **Satellite Tracker ProSat (IOS)**
- **Gpredict (Linux)**
- **MacDoppler (Apple)**
- **UISS (APRS/packet radio)**
- **MMSSTV (slow scan tv SSTV)**
- **Audacity (recording audio)**
- **Robot36 (SSTV for android)**
- **SSTV (SSTV for IOS)**

SATPC32

SatPC32 V. 12.8d [Registered to Walter Holmes, K5WH]

File Tracking Satellites CAT Rotor Mode Setup Programs Accy ?

P: JO-97

R-C-A-U T1 L Ct CW-

M+ Z1 G- S+ D+ W4 P1 2D

Downlink 0 Corr.(+/-) 0 Uplink 20 100 500 1K 5K

1459898.765 435099.936

33.765 -10.064

Sat eclipsed

11.04.2019

23:24:39 L

Azimuth Elevation MA Height Range Lon Lat Orbit Squint Aos Los MaxE

171.8 5.9 129.8 594 2246 -93 11 1932 -- 00:11 75

A B C D E F G H I J K L M N O P Q R S T U V W X


Obs.: -95.5 / 30.0

Config. I Grp. Standard

Keys: nasa.all 4/11/2019

Doppl.Corr.: Upl/Dwnl

VOICE SATELLITE QSO

- **FM sat** 
- **FM sat2** 
- **SSB sat** 
- **ISS School Contact** 

FM REPEATER SATELLITES

- SO-50 (SaudiSat-1C)
- AO-85 (Fox-1A) Off until further notice due to low battery
- AO-91 (RadFxSat / Fox-1B)
- AO-92 (Fox-1D)
- FUNcube on ESEO In commissioning
- LilacSat-2 (CAS-3H) Transponder activations sporadic
- IO-86 (LAPAN-A2) In equatorial orbit, activations by schedule
- Diwata-2 Just activated as PO-101

FM REPEATER SATELLITES

FM Satellite Frequency Summary

AMSAT Fox-1 Satellites

	Uplink FM (67 Hz CTCSS)	Downlink FM	Comments
AO-85 (Fox-1A)	435.170 MHz	145.980 MHz	Off until further notice as of 2/6/19. Due to diminished battery capacity, only active during periods of continuous sunlight. Next period of continuous sunlight begins approximately June 9, 2019. See https://www.amsat.org/ao-85-status-update/
AO-91 (RadFxSat / Fox-1B)	435.250 MHz	145.960 MHz	Operational
AO-92 (Fox-1D)	435.350 MHz & 1267.359 MHz*	145.880 MHz	Operational

* Switchable by command station. Not operational simultaneously.

TRANSPONDER SATELLITES SSB

- AO-7
- FO-29 (JAS-2)
- AO-73 (FUNcube-1) Transponder active on weekends
- XW-2A (CAS-3A)
- XW-2B (CAS-3B)
- XW-2C (CAS-3C)
- XW-2D (CAS-3D)
- XW-2F (CAS-3F)
- LO-87 (LUSEX / ÑuSat-1) Transponder active sporadically over Europe and Latin America
- EO-88 (Nayif-1 / FUNcube on Nayif-1) Transponder active in eclipse only
- CAS-4A
- CAS-4B
- JO-97 (JY1Sat) In commissioning
- FO-99 (NEXUS) In commissioning
- QO-100 (Es'hail-2 / P4A) Geostationary at 25.9 degrees east.

TRANSPONDER SATELLITES

Linear Satellite Frequency Summary

AO-7 Mode A – V/a Non-Inverting Analog SSB/CW

Uplink USB	145.850 MHz	through	145.950 MHz
Downlink USB	29.400 MHz	through	29.500 MHz
Active only in sunlight. Generally only active when periods of constant sunlight permit the 24 hour timer to switch between Modes A and B or when the satellite switches from Mode B. Beacon 29.502 MHz			

AO-7 Mode B – U/v Inverting Analog SSB/CW

Uplink LSB	432.125 MHz	through	432.175 MHz
Downlink USB	145.975 MHz	through	145.925 MHz
Active only in sunlight. Beacon 145.975 MHz			

AO-73 (FUNcube-1) – U/v Inverting Analog SSB/CW

Uplink LSB	435.150 MHz	through	435.130 MHz
Downlink USB	145.950 MHz	through	145.970 MHz

Beacon 145.935 MHz telemetry. Transponder generally only operational when satellite is in eclipse or on weekends. Transponder currently off during period of full sunlight.

See [FUNcube Data Warehouse](#) for current status. [Download FUNcube Telemetry Dashboard software](#)

DIGITAL SATELLITES

- FalconSAT-3 (9600 baud)
- NO-44 (PCsat) Sporadically active (built using Radio Shack components)
- NO-84 (PSAT) PSK31 active continuously / Digipeater when power permits
- LO-90 (LilacSat-1) FM up / Codec2 digital voice down Linux Live Image for downlink Click [Here](#) (just re-entered/died)
- IO-86 (LAPAN-A2) In equatorial orbit, activations by schedule
- ISS Frequency Summary digipeater via ARISS
- ISS Ham TV Currently inoperative
- ISS using SSTV at different schedules
- AISat 1 Recently activated for APRS
- Diwata-2 Just activated as PO-101 APRS/FM Voice

FUNCUBE-1 (AO-73)

The screenshot displays the FUNCUBE-1 Dashboard with the following sections and data:

- Sun Sensors:** Panel X+, Panel Y+, Panel Y-, Panel Z+, Panel Z-, Total Panel Current, Battery Voltage.
- Data Collection:** Antenna Bus 1 (AntS) OK, Antenna Bus 2 (AntS) OK, Power Supply (EPS) OK, Radio Board (RF) OK, Power Amplifier (PA) OK, Material Sci (MSE) OK, Interface Board (ASIB) OK.
- Antenna (AntS):** Temperature A: 17.8 °C, Temperature B: 17.8 °C, Antenna 1 Status: Deployed, Antenna 2 Status: Deployed, Antenna 3 Status: Deployed, Antenna 4 Status: Deployed.
- Satellite Mode:** In Eclipse: 0, In Safemode: 0, Apply before flight: ON, SW deployment: Disabled, SW deployment delay: OFF.
- Radio Board (RF):** CMD RX Doppler: 167 kHz, CMD RX RSSI: 182 dBm, Temp: 27.41 °C, 3v3 RX Current: 41 mA, 3.3v TX Current: 51 mA, 5v TX Current: 24 mA.
- Power (ASIB):** 3.3v Current: 149.00 mA, 3.3v Voltage: 3276.00 mV, 5.0v Voltage: 4956.00 mV.
- Battery:** Voltage: 8282 mV, Temp: 27 °C.
- Power Amp (PA):** Forward Power: 320.91 mW, Reverse Power: 44.36 mW, Temp: 43.2 °C, Bus Current: 104.77 mA.
- Y Panels:** Voltage: 4365 mV, + Sun Sensor: 1.20 Log Lux, + Temp: 24.96 °C, - Temp: 23.18 °C.
- X Panels:** Voltage: 4360 mV, + Sun Sensor: 1.44 Log Lux, + Temp: 23.91 °C, - Temp: 24.87 °C.
- Z Panels:** Voltage: 4343 mV, + Sun Sensor: 3.37 Log Lux.
- Power (EPS):** Bus Current: 210 mA, Panel Current: 205 mA, Boost Conv1 Temp: 28 °C, Boost Conv2 Temp: 27 °C, Boost Conv3 Temp: 28 °C, Reboot Count: 1318, Error Count: 0, Reset Cause: Watchdog, Latch Count 3.3v: 0, Latch Count 5.0v: 0, Power Tracking Mode: MPPT.

At the bottom, there are tabs for 'Debug' and 'Tuning'.

NAYIF-1 TELEMETRY (EO-88)

The screenshot displays the NAYIF-1 Dashboard interface, which is a web-based monitoring tool. The dashboard is organized into several panels, each displaying different types of telemetry data. The left sidebar contains a navigation menu with categories like Sun Sensors, iMTQ Magnetometer, and various boards. The main content area is divided into multiple data blocks, each with a title and a list of metrics. The data is presented in a clean, organized manner with clear labels and values.

NAVIF-1 Dashboard
File Capture Window Help

Whole O... High... Fitter Messages Realtime

- Sun Sensors
 - Panel X+
 - Panel X-
 - Panel Y+
 - Panel Y-
 - Panel Z+
 - Panel Z-
- iMTQ Magnetometer
 - Magnetic Field X
 - Magnetic Field Y
 - Magnetic Field Z

Data Collection
[Antenna Bus 1 \(AntS\)](#) OK
[Antenna Bus 2 \(AntS\)](#) OK
[Power Supply \(EPS\)](#) OK
[Radio Board \(RF\)](#) OK
[Power Amplifier \(PA\)](#) OK
[iMTQ](#) Failed
[Interface Board \(ASIB\)](#) OK

Antenna (AntS)
[Temperature A](#) 13.0 °C
[Temperature B](#) 10.5 °C
[Antenna 1 Status](#) Deployed
[Antenna 2 Status](#) Deployed
[Antenna 3 Status](#) Deployed
[Antenna 4 Status](#) Deployed

Decoding
[Error count](#) 0
[Frequency](#) 0

Satellite Mode
[In Eclipse](#) 0
[In Safemode](#) 0
[Apply before flight](#) ON
[SW deployment](#) Disabled
[SW deployment delay](#) OFF

Power (CCT)
[3.3v Voltage](#) 3300.00 mV
[5.0v Voltage](#) 4911.33 mV

iMTQ
[Mode](#) Self test
[Error](#) 5
[Config set](#) ON
[MCU temp.](#) 85 °C
[Up Time](#) 349525 Sec.

Radio Board (RF)
[CMD RX Doppler](#) 137 kHz
[CMD RX RSSI](#) 255 dBm
[Temp](#) 1.98 °C
[3v3 RX Current](#) 40.07 mA
[3.3v TX Current](#) 49.61 mA
[5v TX Current](#) 27.35 mA

Battery
[Voltage](#) 8261 mV
[Temp](#) 0 °C

Power Amp (PA)
[Forward Power](#) 460.70 mW
[Reverse Power](#) 27.47 mW
[Temp](#) 10.0 °C
[Bus Current](#) 126.20 mA

X Panels
[Voltage](#) 4554 mV
[Current](#) 229 mA
[+ Sun Sensor](#) 5 Raw
[- Sun Sensor](#) 101 Raw

Y Panels
[Voltage](#) 4388 mV
[Current](#) 400 mA
[+ Sun Sensor](#) 15 Raw
[- Sun Sensor](#) 191 Raw

Z Panels
[Voltage](#) 4401 mV
[Current](#) 236 mA
[+ Sun Sensor](#) 10 Raw
[- Sun Sensor](#) 108 Raw

Power (EPS)
[Bus Current](#) 271 mA
[Panel Current](#) 409 mA
[Boost Conv1 Temp](#) 1 °C
[Boost Conv2 Temp](#) 2 °C
[Boost Conv3 Temp](#) 3 °C
[Reboot Count](#) 71
[Reset Cause](#) Watchdog
[Channel current 5.0v](#) 3 mA
[Latch Count 5.0v](#) 0
[Power Tracking Mode](#) MPPT

Debug Tuning

JY1SAT TELEMETRY (JO-97)

JY1-Sat Dashboard

File Capture Window Help

Whole Orbit High Re... ved Images/Audio Fitter Messages Realtime X

HR Panel Sun Sensor

[Panel X+ \(raw\)](#)

[Panel X- \(raw\)](#)

[Panel Y+ \(raw\)](#)

[Panel Y- \(raw\)](#)

[Panel Z+ \(raw\)](#)

[Panel Z- \(raw\)](#)

HR iMTQ Magnetometer

[Magnetic Field X](#)

[Magnetic Field Y](#)

[Magnetic Field Z](#)

Antenna Collection

[Antenna Bus 1 \(AntS\)iMTQ](#)

Failed

[Antenna Bus 2 \(AntS\)Interface Board \(ASIB\)](#)

OK

[Power Supply \(EPS\)](#)

ed

[Radio Board \(RF\)](#)

[Power Amplifier \(PA\)](#)

Antenna (AntS)

[Temperature A](#) [Antenna 4 Status](#)

-8.7 °C Deployed

[Temperature B](#)

-8.7 °C

[Antenna 1 Status](#)

Deployed

[Antenna 2 Status](#)

Deployed

[Antenna 3 Status](#)

Deployed

Satellite Mode

[In Eclipse](#)

0

[In Safemode](#)

1

[Apply before flight](#)

ON

[SW deployment](#)

Disabled

[SW deployment delay](#)

OFF

iMTQ

[Mode](#)

Self test

[Error](#)

5

[Config set](#)

ON

[MCU temp.](#)

85 °C

[Up Time](#)

349525.00 Sec.

Radio Board (RF)

[CMD RX Doppler5v TX Current](#)

175 kHz 27.98 mA

[CMD RX RSSI](#)

255 dBm

[Temp](#)

7.22 °C

[3v3 RX Current](#)

40.70 mA

[3.3v TX Current](#)

60.42 mA

Power Amp (PA)

[Forward Power](#)

2.94 mW

[Reverse Power](#)

19.46 mW

[Temp](#)

15.1 °C

[Bus Current](#)

63.55 mA

Y Panels

[Voltage](#)

0 mV

[Current](#)

0 mA

[+ Sun Sensor](#)

4 Raw

[- Sun Sensor](#)

3 Raw

Power (EPS)

[Bus Current](#)

0 mA

[Reboot Count](#)

0

[Panel Current](#)

0 mA

[Reset Cause](#)

Unknown r

[Boost Conv1 TempChannel curren](#)

0 °C

[TempChannel curren](#)

0 mA

[Boost Conv2 TempLatch Count 5.0](#)

0 °C

[Boost Conv3 TempPower Tracking](#)

0 °C

HW default

Decoding

[Error count](#)

0

[Frequency](#)

0 Hz

Power (CCT)

[3.3v Voltage](#)

3293.55 mV

[5.0v Voltage](#)

0.00 mV

Battery

[Voltage](#)

0 mV

[Temp](#)

0 °C

X Panels

[Voltage](#)

0 mV

[Current](#)

0 mA

[+ Sun Sensor](#)

4 Raw

[- Sun Sensor](#)

3 Raw

Z Panels

[Voltage](#)

0 mV

[Current](#)

0 mA

[+ Sun Sensor](#)

4 Raw

[- Sun Sensor](#)

4 Raw

Debug Tuning X

JY1SAT IMAGE (JO-97)



WHAT DOES TELEMETRY LOOK LIKE

- Play back a telemetry session file

MMSSTV & SSTV FROM ISS

K5WH (K5WH.MDT) - MMSSTV Ver 1.13A

File Edit View Option PProfiles Program RadioCommand Help

Sync | RX | **History** | TX | Template

Commemorating the 35th Anniversary of First Ham Operations from the Space Shuttle—December 1983

STS-9 with Owen Garriott W5LFL on-board

RSOISS NA1SS 10:12

RX Mode

- Auto
- Robot 36
- Robot 72
- AVT 90
- Scottie 1
- Scottie 2
- ScottieDX
- Martin 1
- Martin 2
- PD120

DSP

- AFC
- LMS

1200 1500 1900 2300

Log

Call: His: 595 My:

Name: Qth:

Note:

QSL: RxID TxID

QSO Data Find Clear List 14.230

PD120 (640x496)
26 2019/02/16 1424Z

S.pix | S.templates 1 | 2 | 3 | 4 | Show with template Draft 1/25

NASA On The Air
Atlanta and Mir

RSOISS NA1SS 4:10

NASA On The Air
International Space Station

RSOISS NA1SS 4:10

NASA On The Air
Apollo 0 50th Anniversary - Earth Rise

RSOISS NA1SS 4:10

NASA On The Air
Atlanta and Mir

RSOISS NA1SS 4:10

NASA On The Air
Hubble Space Telescope

RSOISS NA1SS 4:10

NASA On The Air
Apollo 12

RSOISS NA1SS 4:10

Commemorating the 35th Anniversary of First Ham Operations from the Space Shuttle—December 1983

RSOISS NA1SS 10:12

Commemorating the 35th Anniversary of First Ham Operations from the Space Shuttle—December 1983

RSOISS NA1SS 10:12

Commemorating the 35th Anniversary of First Ham Operations from the Space Shuttle—December 1983

RSOISS NA1SS 10:12

NASA On The Air
Apollo 0 50th Anniversary

RSOISS NA1SS 4:10

NASA On The Air
Apollo 0 50th Anniversary - Earth Rise

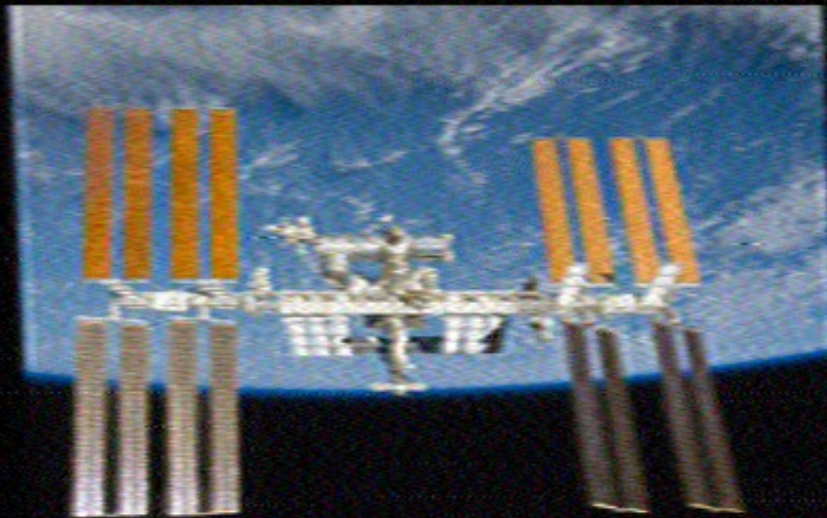
RSOISS NA1SS 4:10

NASA On The Air
Apollo 0 50th Anniversary

RSOISS NA1SS 4:10

SSTV IMAGE FROM ISS

NASA On The Air International Space Station



nasaontheair.wordpress.com

RSOISS

NA1SS

5/12

WHAT DOES SSTV LOOK LIKE

- Play back an SSTV capture file

APRS VIA ISS, NO-84, AISAT-1, PO-101

The screenshot displays the UISS v5.4 software interface. The title bar reads "UISS v5.4 By ON6MU (c)2001-2018 > Pro-Edition Registered To Walter K5WH*". The interface includes a menu bar (File, Edit, Send, Filters, Find, Options, MHeard, Modules, View, Setup, Help) and a status bar (Communication Ports: TX-1 / RX-1). The main window is divided into several sections:

- TX Text/Data:** Shows "Text: Walter, Houston, Tx. EL29FX".
- TX APRS Position:** Shows "Text: Walter, Houston, Tx.".
- TX APRS Message:** Shows "For: BLN" and "Message: Walter in Houston, Tx.".
- Monitor:** A large text area displaying a log of APRS transmissions. The log shows several messages from K5WH-3 to QST via ARISS and to CQ via AISAT*, along with responses from AISAT-1 and BPHG5160 IGate.
- MHeard:** A list of heard stations including K5WH-3, AISAT-1, and W9QD.
- Right Panel:** Features a "LAN" status indicator, a "By ON6MU" logo, and a satellite image of the International Space Station (ISS) orbiting Earth.

The Monitor log contains the following text:

```
Fm K5WH-3 To QST Via ARISS <UI pid=F0 Len=40 >[22:47:38]
-2958.10N/09534.90W Walter, Houston, Tx.

Fm K5WH-3 To QST Via ARISS <UI pid=F0 Len=40 >[22:47:43]
-2958.10N/09534.90W Walter, Houston, Tx.

Fm K5WH-3 To QST Via ARISS <UI pid=F0 Len=40 >[22:47:56]
-2958.10N/09534.90W Walter, Houston, Tx.

Fm K5WH-3 To QST Via ARISS <UI pid=F0 Len=40 >[22:48:17]
-2958.10N/09534.90W Walter, Houston, Tx.

Fm K5WH-3 To CQ Via AISAT*, <UI pid=F0 Len=55 >[22:48:19]
:CQ-0      :-2958.10N/09534.90W Walter, Houston, Tx.{821

Fm K5WH-3 To QST Via ARISS <UI pid=F0 Len=44 >[22:48:25]
-I?@JT6?YU& BPHG5160 IGate {UISS Ver 5.4.2}

Fm AISAT-1 To CQ Via , <UI pid=F0 Len=64 >[22:48:30]
:CQ-0      :From AMSAT INDIA & Exseed Space |677417|37|35|42{823

Fm K5WH-3 To QST Via ARISS <UI pid=F0 Len=40 >[22:48:31]
-2958.10N/09534.90W Walter, Houston, Tx.

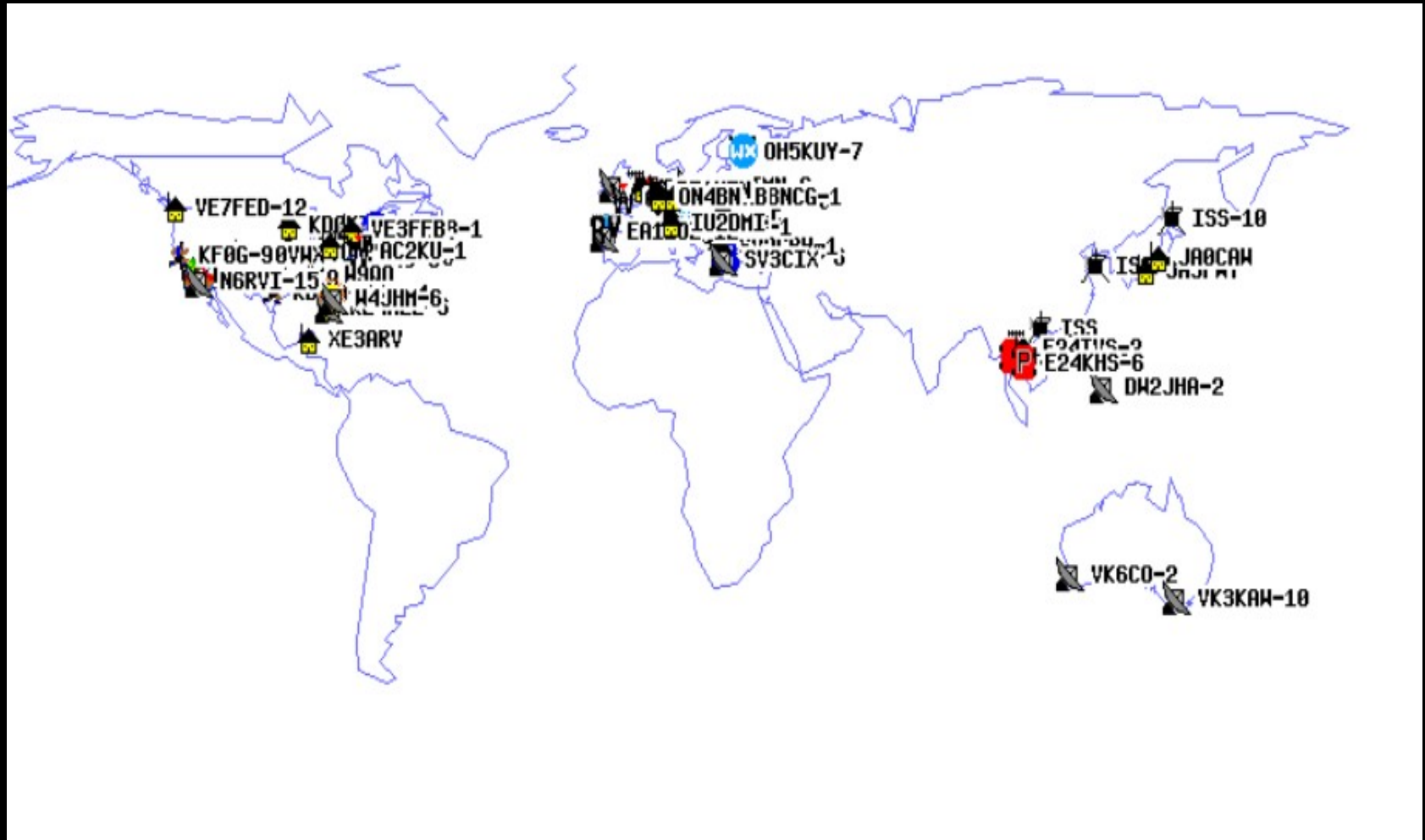
Fm K5WH-3 To CQ Via AISAT*, <UI pid=F0 Len=55 >[22:48:34]
:CQ-0      :-2958.10N/09534.90W Walter, Houston, Tx.{824

Fm K5WH-3 To QST Via ARISS <UI pid=F0 Len=44 >[22:48:40]
-I?@JT6?YU& BPHG5160 IGate {UISS Ver 5.4.2}

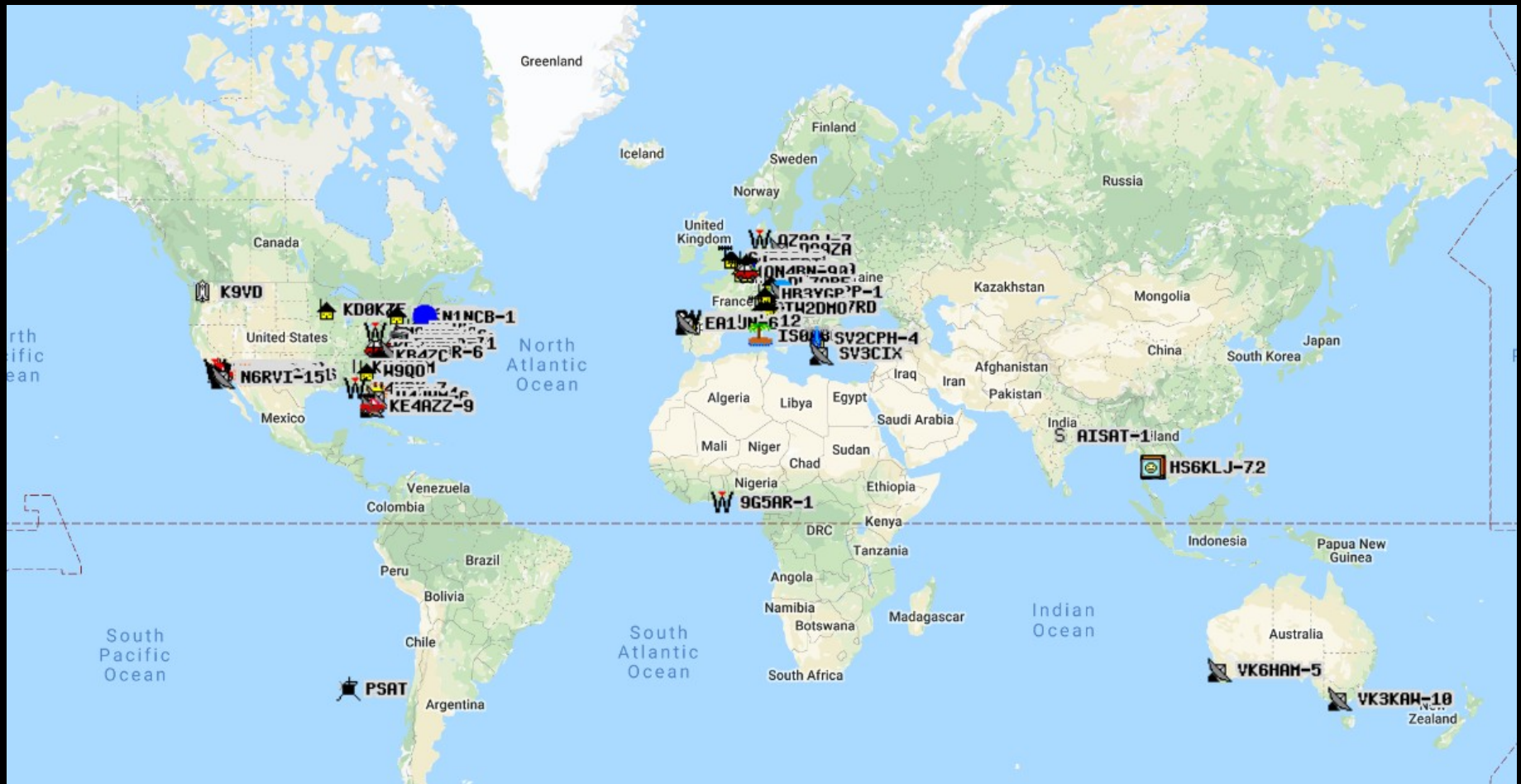
Fm K5WH-3 To CQ Via AISAT*, <UI pid=F0 Len=59 >[22:48:43]
:CQ-0      :-I?@JT6?YU& BPHG5160 IGate {UISS Ver 5.4.2}{825

Fm K5WH-3 To QST Via ARISS <UI pid=F0 Len=27 >[22:49:06]
Walter, Houston, Tx. EL29FX
```

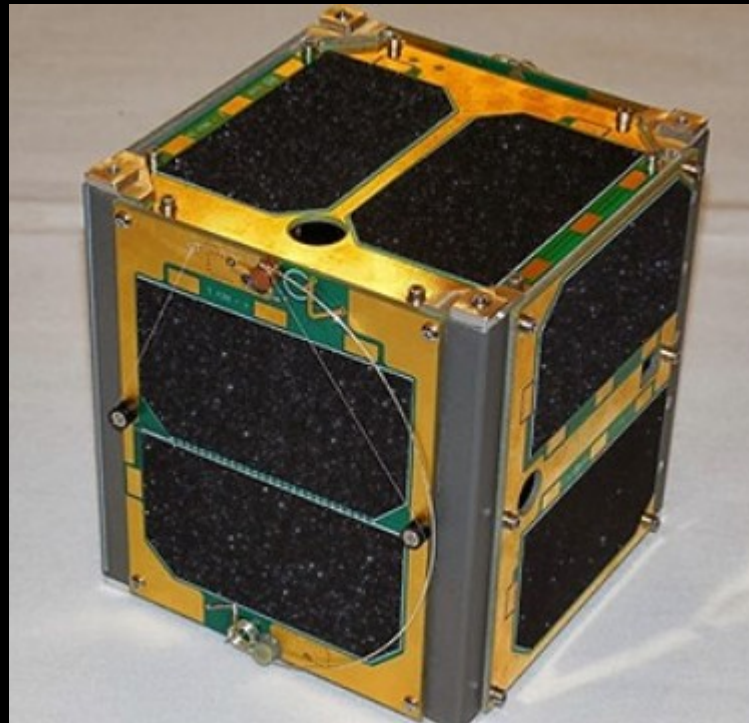
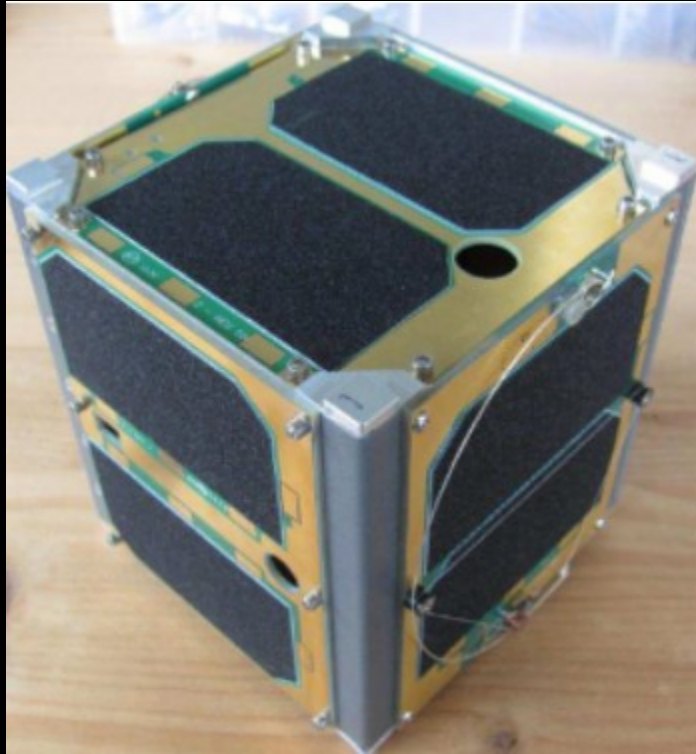
APRS VIA ISS



APRS VIA AISAT-1



CUBESATS, FOX SERIES



HOW TO GET INVOLVED

- **Houston Amsat Net Tuesday night 8pm 145.45**
 - **Or via Echolink, access AMSAT conference**
- **HF Amsat Net Sunday 1900 UTC 14.282**
- **Amsat.org website**

- **DMR Talk group 98006 AMSAT**
- **Fusion Reflector YSF 11689 US AMSAT**

IMPORTANT LINKS

[HTTPS://GROUPS.IO/G/HAM-RADIO-TECH-NOTES/FILES/TECHNICAL%20PRESENTATIONS](https://groups.io/g/HAM-RADIO-TECH-NOTES/FILES/TECHNICAL%20PRESENTATIONS)

- Amsat <http://Amsat.org>
- ARISS <http://ariss.net>
- AISat-1 <http://www1.findu.com/cgi-bin/pcsat.cgi>
- M2 Antennas <https://www.m2inc.com/>
- Arrow Antennas <http://www.arrowantennas.com/>
- Signalink <http://www.tigertronics.com/>
- Rigblaster <http://www.westmountainradio.com/>
- MFJ-1204 <https://www.mfjenterprises.com/>
- FUNcube Telemetry Dash Boards
<https://funcube.org.uk/working-documents/funcube-telemetry-dashboard/>
- Email: walterh@k5wh.net