

S.A.T. SATELLITE TRACKING GREENCUBE (RIP) HORUS



W4OVH CLUB MEETING

20 MAY, 2025

KN4GDX, BRUCE



TOPICS

- **Brief History of Amateur Satellite Communications**
- **Basic Satellite Access, Operations, and Modes**
- **Why Satellite? And What's New and Coming Soon**
- **Amateur Satellite Configuration Comparisons**
- **What is S.A.T.?**
- **Typical S.A.T. Controls and Options**
- **What *is Was* Greencube?**
- **Greencube Operations**
- **Greencube Software**
- **Greencube Operations Examples**
- **Horus Amateur 4FSK UHF Payload Tracking**
- **Questions?**



VERY BRIEF HISTORY OF AMATEUR SATELLITE COMMUNICATIONS

- **OSCAR Association Formed in 1960**
 - Orbiting Satellite Carrying Amateur Radio
 - OSCAR-1 Launch 12 Dec, 1961
- **Hundreds of Low Earth Orbiting Satellites Since**
- **A Few 'High Altitude' Satellites**
 - Phase 3-D in Mid-90s – Molniya, or Highly Elliptical Orbit
 - Recent Q-100 Geosynchronous Hamsat over Eastern Hemisphere
- **Strong Desire for US/Western Hemisphere High Altitude Capability**
 - AmSat GOLF – Greater Orbit, Larger Footprint
 - Plans Currently Underway
- **SmallSats, MicroSats, and CubeSats Proliferate Today**



BASIC SATELLITE ACCESS, OPERATIONS, AND MODES

- Access and Planning Tools Proliferate
 - Ephemeris and Access Time and Geometry
 - Satellite Doppler and Frequency Controls
 - Antenna Rotor and Transceiver CAT Controls
 - Uplink and Downlink Diversity Across HF/VHF/UHF/+
- Modes: FM, SSB, CW, Packet, Digital – FT8/4, SSTV, etc.
- International Scope and Participation – ISS, etc.
- Amateur Organizations, Universities, Governments
- Cost of Launch and Deployment Drives Smaller Form Factors

Transponder/Repeater active	Telemetry/Beacon only		No signal		Conflicting reports		ISS Crew (Voice) Active	
	Nov 18	Nov 17	Nov 16	Nov 15	Nov 14	Nov 13		
AO-109	1	1 1 1	1					
AO-27				1				
AO-73			1		1		1 1	
AO-7[A]	1	1	1 1		1 1 1 1		1 1	
AO-7[B]	1 1	1 1 1	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1	1 1
AO-91	4 2 1 1	1 1 1 1 4 2 1 2	2 2 1 1 3 3 3	1 1 2 3 1 1 1 2	1 5 3 2 1 1 1 1 1 1	2 4 3 1 1 1 1 1		
AO-92_U/V		1		1 1				1
CAS-4B		1			1		1	
Delfi-C3								1 1
FO-29		1			1		1	
HO-113					1			1
IO-117	1 6 7	2 2 1 4 1 7 1 7 3 4 7	1 6 2 2 1 4 1 4 1	2 1 2 1 3 1	1 1 7 3 1 2 5 2 1 1 5 1 3	2 3 1 3 1 6 1 1		
ISS-DATA		1 1	1	1 1	1	1 1 1	1 1 1	1
ISS-FM	3	2 2 3 1 3 3 6 4 3 4 5 2 3 3 1 1 1 4 3 2 3 2 1 1 1 4	3 3 1 6 5 1	3 3 2 3	1 2 2 3 5 4	1 6 3 1 5 4 8 9 2 1	1 1 3	
ISS-SSTV			1		1			



WHY SATELLITE? WHAT'S NEW?

- **Radio Amateurs Want to be Part of Every Novel Technology**
 - **Strive for Advanced Technology and Techniques**
- **Enhanced Geographic Access**
- **Low Power and Efficient, High Gain Antennas**
- **Limited HT 'Rubber Duck' Capability – Even ISS SSTV**
- **Advancements in Educational Programs at Middle School and University – Strong ISS/ARISS Programs and Participation**
- **Now: Available and Growing High Altitude/Long Duration Contacts via IO-117/Greencube, Q-100, GOLF, etc.**



TYPICAL CONFIGURATION – ‘SHACK’ COMMON



TYPICAL CONFIGURATION – 'REMOTE' S.A.T.



WAN/LAN



POWER AND GPS

CONTROL CABLE

REMOTE CONTROL



ROTOR CONTROLS

VHF/UHF COAX



WHAT IS S.A.T. (CSN TECHNOLOGIES)?

- **WiFi Enabled Complete Solution**
 - Access Prediction and Satellite Pass Geometry
 - Complete Rotor and Radio CAT Control
 - Integrated GPS and USB Interfaces
 - USB/5V Operation
 - Standard Yaesu Rotor Interfaces
- **Comparable Cost to Common Alternatives**
 - \$150-\$300
- **Easily Available and in Broad Use (DX Engineering,**)
- **'Tailored' for 'Common' Icom/Yaesu Satellite Shack**
 - **Alternatives TBD**



TYPICAL S.A.T. CONTROLS AND OPTIONS

← → ↻ 🏠 Not secure | 192.168.1.206 🔍 📁 ⭐ ⚙️ 🗄️ B ⋮

📱 Apps 📄 DuckDuckGo — Pri... 📅 Google Calendar ... 📰 NEWS 📧 Mail 🗳️ POL FEAT 📡 WX 📡 MICROs 📡 SOL PHY 📡 Qiskit IBMid 📡 PIKIWI 📡 HAMGEN 📡 HAMSCI 📡 HAMEQ 📡 TOPICAL ⋮

MAP

POLAR

Antenna
AOS
LOS
Satellite

KN4GDX-FM18CS
©CSN Technologies S.A.T.

GROUND

AOS LOS Antenna Satellite

TRACK

NAME:

[Satellite Status](#) [SatNOGS Map](#) [OrbTrack](#)

SAT POS: AZ: 100.1° / EL: -50.6°↓

ANT POS: AZ: 0.0° / EL: 0.0°

RANGE: 10385.1 Km / 6453.0 Mi

AOS: 15:59:22 @ 171.5° (TTGO 07:56:09)

LOS: 16:07:04 @ 79.6° (TTGO 08:03:51)

MAX EL: 7.1°

TIME: 11/18/2023 08:03:11

LAST MSG

GPS STAT: 7 SATS FM18cs

RADIO

⌵

PWR 100% ⌵ TBW ⌵ TX PL ⌵ MAIN ⌵ SUB ⌵

ACTIVE Mode V/U FM - Voice Repeat

FREQ 145.990 / 437.800 DOP 33Hz / -101Hz BW

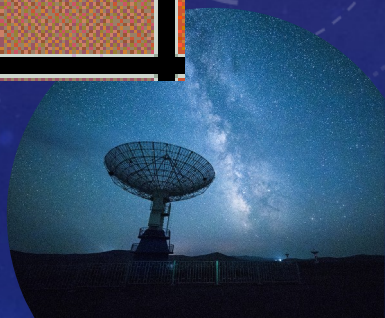
Descr	Up / Mode	Down / Mode
Mode V/U FM - Voice Repeat	145.990	437.800
Mode V APRS	145.825	145.825
Mode V/V FM (crew R1)	145.200	145.800
Mode V/V FM (crew R2+3)	144.490	145.800
VHF-1 Soyuz Communication -	0.000	143.625
IORS Telemetry	0.000	437.800
School Contact Downlink	0.000	437.525
ICARUS Animal-Tracker Exper	0.000	468.100
Mode V Imaging	0.000	145.800
Mode U - Possibly Voice	0.000	435.400
Mode U - Imaging	0.000	437.800
Suit 3	0.000	139.208
Soyuz-TM and Progress M-1 T	0.000	166.000

LOG

#	DATE	SAT	CALL	GRID	COMMENT
---	------	-----	------	------	---------

TYPICAL S.A.T. CONTROLS AND OPTIONS

AO-07 AOS: 07:40:47 LOS: 07:58:07 DUR 17:20 MAX EL: 16.38° EL NOW: 8.04° ↓	CubeSat-1 AOS: 07:49:32 LOS: 07:59:04 DUR 09:32 MAX EL: 22.93° EL NOW: 21.35° ↓	EOS-7 AOS: 07:51:20 LOS: 08:00:03 DUR 08:43 MAX EL: 9.84° EL NOW: 9.52° ↑	NIUSat AOS: 07:51:48 LOS: 08:02:03 DUR 10:15 MAX EL: 52.95° EL NOW: 19.67° ↑	NIUSat AOS: 07:51:48 LOS: 08:02:03 DUR 10:15 MAX EL: 52.95° EL NOW: 19.67° ↑		XW-2F AOS: 07:55:18 LOS: 08:05:01 DUR 09:43 MAX EL: 24.21° EL NOW: -1.43° ↑	
AO-16 AOS: 08:04:00 LOS: 08:11:35 DUR 07:35 MAX EL: 3.92° EL NOW: -18.87° ↑	UmKA 1 (RS40S) AOS: 08:05:19 LOS: 08:13:56 DUR 08:37 MAX EL: 7.72° EL NOW: -23.55° ↑	RANGE-A AOS: 08:06:00 LOS: 08:12:01 DUR 06:01 MAX EL: 2.91° EL NOW: -22.44° ↑	AO-27 AOS: 08:08:12 LOS: 08:21:44 DUR 13:32 MAX EL: 21.09° EL NOW: -31.15° ↑	AO-27 AOS: 08:08:12 LOS: 08:21:44 DUR 13:32 MAX EL: 21.09° EL NOW: -31.15° ↑		CO-57 AOS: 08:11:28 LOS: 08:23:17 DUR 11:49 MAX EL: 12.5° EL NOW: -37.49° ↑	
METEOR-M 3 AOS: 08:17:53 LOS: 08:30:44 DUR 12:51 MAX EL: 15.75° EL NOW: -48.11° ↑	ESEO AOS: 08:18:09 LOS: 08:25:17 DUR 07:08 MAX EL: 4.32° EL NOW: -46.39° ↑	CO-55 AOS: 08:18:37 LOS: 08:29:46 DUR 11:09 MAX EL: 10.27° EL NOW: -51.03° ↑	Lapan A3 AOS: 08:19:03 LOS: 08:28:55 DUR 09:52 MAX EL: 16.75° EL NOW: -54.81°	AO-27 AOS: 08:08:12 LOS: 08:21:44 DUR 13:32 MAX EL: 21.09° EL NOW: -31.15° ↑		CO-57 AOS: 08:11:28 LOS: 08:23:17 DUR 11:49 MAX EL: 12.5° EL NOW: -37.49° ↑	
HRBE AOS: 08:24:56 LOS: 08:33:13 DUR 08:17 MAX EL: 7.63° EL NOW: -61.72° ↑	Changshagaoxin AOS: 08:25:16 LOS: 08:35:30 DUR 10:14 MAX EL: 35.11° EL NOW: -68.4° ↑	YUSAT 1 AOS: 08:25:37 LOS: 08:31:09 DUR 05:32 MAX EL: 2.95° EL NOW: -59.87° ↑	MinXSS-2 AOS: 08:30:40 LOS: 08:36:31 DUR 05:51 MAX EL: 2.71° EL NOW: -66.03°	AO-27 AOS: 08:08:12 LOS: 08:21:44 DUR 13:32 MAX EL: 21.09° EL NOW: -31.15° ↑		CO-57 AOS: 08:11:28 LOS: 08:23:17 DUR 11:49 MAX EL: 12.5° EL NOW: -37.49° ↑	
SOMP 2b AOS: 08:34:56 LOS: 08:43:27 DUR 08:31 MAX EL: 8.98° EL NOW: -76.41° ↑	AISTechSat 3 AOS: 08:35:44 LOS: 08:40:37 DUR 04:53 MAX EL: 2.47° EL NOW: -74.74° ↑	GRBA1pha AOS: 08:38:13 LOS: 08:43:44 DUR 05:31 MAX EL: 2.74° EL NOW: -75.79° ↑	GOMX-1 AOS: 08:41:07 LOS: 08:55:09 DUR 14:02 MAX EL: 32.24° EL NOW: -76.78° ↓	AO-27 AOS: 08:08:12 LOS: 08:21:44 DUR 13:32 MAX EL: 21.09° EL NOW: -31.15° ↑	CO-57 AOS: 08:11:28 LOS: 08:23:17 DUR 11:49 MAX EL: 12.5° EL NOW: -37.49° ↑	AO-27 AOS: 08:08:12 LOS: 08:21:44 DUR 13:32 MAX EL: 21.09° EL NOW: -31.15° ↑	CO-57 AOS: 08:11:28 LOS: 08:23:17 DUR 11:49 MAX EL: 12.5° EL NOW: -37.49° ↑
AO-27 AOS: 08:48:13 LOS: 08:59:16 DUR 05:40 MAX EL: 2.97° EL NOW: -73.63° ↓	CO-57 AOS: 08:57:49 LOS: 09:08:13 DUR 12:35 MAX EL: 5.77° EL NOW: -67.36° ↓	AO-27 AOS: 08:08:12 LOS: 08:21:44 DUR 13:32 MAX EL: 21.09° EL NOW: -31.15° ↑	CO-57 AOS: 08:11:28 LOS: 08:23:17 DUR 11:49 MAX EL: 12.5° EL NOW: -37.49° ↑	AO-27 AOS: 08:08:12 LOS: 08:21:44 DUR 13:32 MAX EL: 21.09° EL NOW: -31.15° ↑	CO-57 AOS: 08:11:28 LOS: 08:23:17 DUR 11:49 MAX EL: 12.5° EL NOW: -37.49° ↑	AO-27 AOS: 08:08:12 LOS: 08:21:44 DUR 13:32 MAX EL: 21.09° EL NOW: -31.15° ↑	CO-57 AOS: 08:11:28 LOS: 08:23:17 DUR 11:49 MAX EL: 12.5° EL NOW: -37.49° ↑



TYPICAL S.A.T. CONTROLS AND OPTIONS

RADIO

PWR 100% TBW TX PL MAIN SUB

ACTIVE Mode V/U FM - Voice Repeat

FREQ 145.990 / 437.800 DOP 101Hz / -305Hz BW

Descr	Up / Mode	Down / Mode
Mode V/U FM - Voice Repeat	145.990	437.800
Mode V APRS	145.825	145.825
Mode V/V FM (crew R1)	145.200	145.800
Mode V/V FM (crew R2+3)	144.490	145.800
VHF-1 Soyuz Communication -	0.000	143.625
IORS Telemetry	0.000	43
School Contact Downlink	0.000	43
TCARIS Animal-Tracker Exper	0.000	46

CHOOSE DISPLAY

TRACK

NAME **IO-117**

[Satellite Status](#) [SatNOGS Map](#)

SAT POS AZ: 239.3° / EL: -34.1°

ANT POS AZ: 0.0° / EL: 0.0°

RANGE 14581.88 Km / 9060.76 Mi

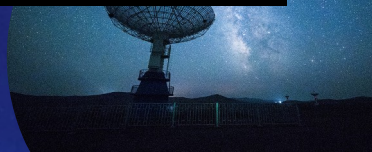
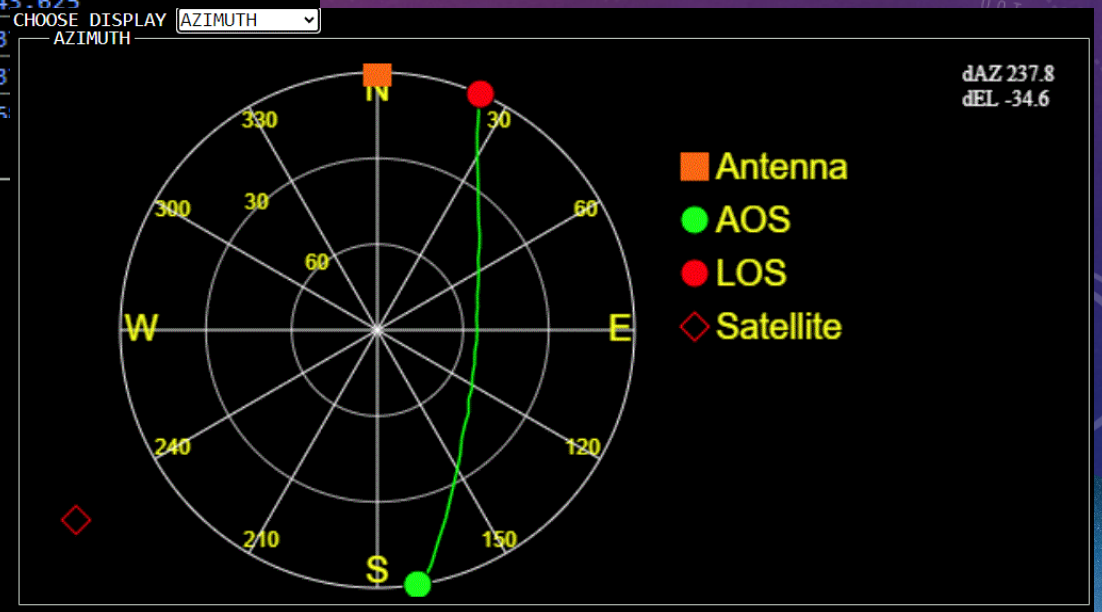
AOS 13:03:08 @ 171.0° (TTGO 05:04:05)

LOS 14:15:29 @ 23.6° (TTGO 06:16:26)

MAX EL 55.8°

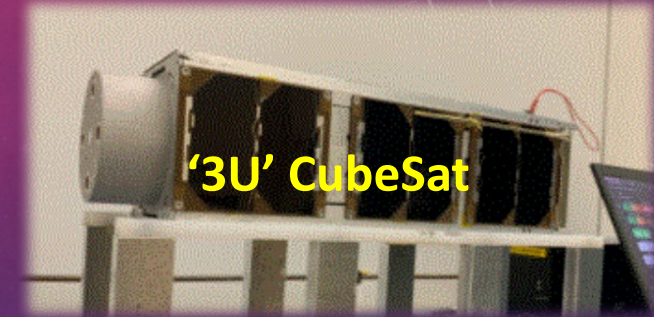
TIME 11/18/2023 07:59:04

LAST MSG



WHAT ~~IS~~ WAS GREENCUBE?

- 2022 Launch – Sapienza University, Rome
- European Space Agency (ESA) Launch Vehicle
- Medium Earth Orbit – 4 Hour, $i=70^{\circ}$
 - Provides 70+ Minute Access
 - **Trans-Continental Contacts**
- Multiple Daily Visibilities from US, Global
- Amateur Packet Payload
 - Real Time; Store/Forward
 - USB, 435.310 MHz
 - Simplex, +/- Doppler
 - Uplink **and** Downlink Correction is Critical
- **Fall of 2024 – Greencube/IO-117 Fails**
 - <https://amsat-uk.org/2024/09/15/greencube-io-117-update/>
 - **5500KM a.s.l – Top of lower Van Allen Belt – Impacts of SC25**



'3U' CubeSat

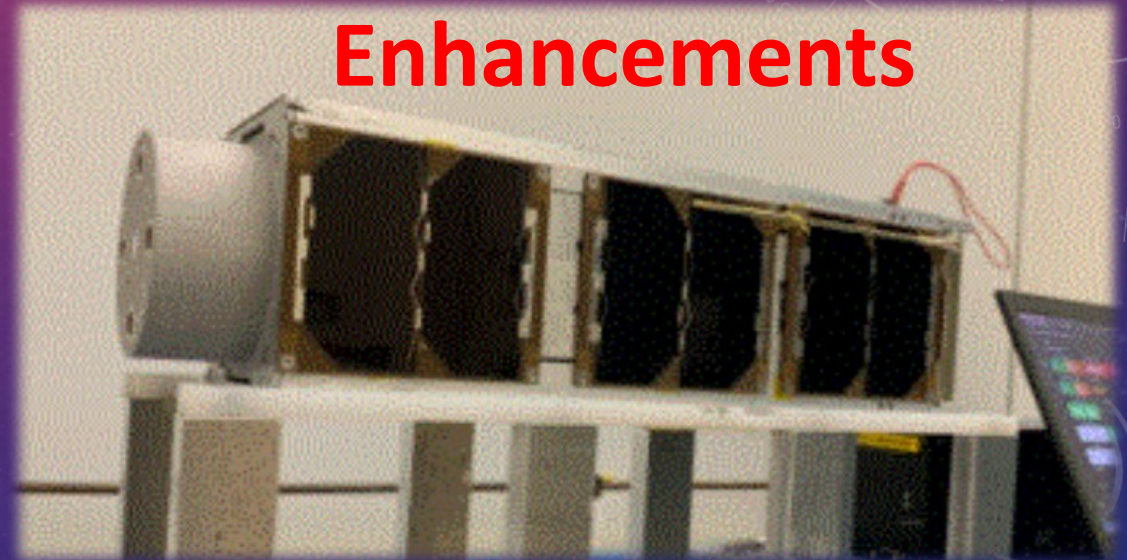
P ~ 4 hours
e ~ 0 degrees
5500x5500 KM a.s.l.
I ~ 70 degrees



GREENCUBE SOFTWARE AND OPERATIONS

- Greencube Terminal – by OZ9AAR
- Sound Modem – by UZ7HO (**ssb.v9**)
- 1200 Baud Packet
- Color Coded Message Reporting
 - CQ, MyTX, To Me, etc
- Contact Quality Statistics
- Contact .CSV Export
- Live QSO Viewer
- Debug and Monitor Logs

Numerous Packet Radio Enhancements



GREENCUBE REMOTE ACCESS EXAMPLE

Greencube Terminal - by OZ9AAR (version 1.0.0.75) - [IO-117]

Settings Functions About...

Shortcuts: F1: CQ F2: GRID F3: RR73

Send message: To CQ MSG FM18cs Bruce

Statistics: Unique callsigns: 44, My own TX: 4, My own RX: 0, My digipeat success: 0.0%, My #CQ: 0, Digipeated pkt. RX: 248, My #CQ: 16, My #CQ: 31, Average Signal Quality: 66.4%, TLM RX RQ value: 43.2%

Station info - IO-117: KN4GDX FM18cs LOS: 00:18:53 240.6° 23.4° Rng 8186 km R/T -2077/+2077

Link Quality:

Time (UTC) From To Message Delay

Time (UTC)	From	To	Message	Delay
13:21:14	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8.298V]	0 (31 %)
13:21:24	RU9GH/MM	PJ2BR	RRR	2 (94 %)
13:21:29	N9FN	PJ2BR	EN60 - pse for DXCC - LoTW	0 (69 %)
13:21:37	KB6LTY	PJ2BR	DM14JL	0 (75 %)
13:22:07	VA7LM	PJ2BR	CO54	0 (19 %)
13:22:28	N1RCN	CQ	EL87	1 (81 %)
13:22:29	KB6LTY	RU9GH/MM	DM14JL	0 (56 %)
13:22:34	RU9GH/MM	W5CBF	RRR	2 (75 %)
13:22:35	N8RO	PJ2BR	EM00 Texas QSL?	0 (56 %)
13:22:41	W5CBF	RU9GH/MM	RR EM30 73!	0 (88 %)
13:22:44	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8.298V]	0 (94 %)
13:22:47	N7AY	RU9GH/MM	DN13, QSL?	0 (94 %)
13:22:58	N9FN	PJ2BR	EN60 - pse for DXCC - LoTW	0 (56 %)
13:23:18	K5ENG	FG80J	599 EL29 fm Charlie	5 (31 %)
13:23:22	N8JCM	RU9GH/MM	EN72	0 (63 %)
13:23:27	W5CBF	RU9GH/MM	RR EM30 73!	0 (6 %)
13:23:28	AB1OC	CQ	FN42 New Hampshire	0 (25 %)
13:23:29	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8.279V]	0 (13 %)
13:23:36	KG0D	RU9GH/MM	CN88	0 (50 %)
13:23:41	KE9AJ	RU9GH/MM	EN50 IL	0 (69 %)
13:23:42	VA7LM	PJ2BR	CO54	0 (94 %)
13:23:51	AB1OC	RU9GH/MM	FN42 NH QSL?	0 (81 %)
13:23:59	N3GS	RU9GH/MM	EM28 KS	4 (100 %)
13:24:00	N3GS	RU9GH/MM	EM28 KS	4 (88 %)
13:24:00	KP3V	K5ENG	599 fm FK78 TU	1 (100 %)
13:24:01	N6PAZ	RU9GH/MM	EM28 KS	2 (100 %)
13:24:02	KP3V	RU9GH/MM	EM28 KS	1 (94 %)
13:24:02	K5ENG	AB1OC	599 EL29 fm Charlie	5 (88 %)
13:24:07	N8RO	PJ2BR	EM00 Texas QSL?	0 (100 %)
13:24:10	PJ2BR	AB1OC	RRR	2 (0 %)
13:24:11	AB1OC	SEB	TU 73 Logged	0 (94 %)
13:24:14	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8.307V]	0 (100 %)
13:24:18	W5CBF	RU9GH/MM	RR EM30 73!	0 (100 %)
13:24:19	W3RZ	RU9GH/MM	UR 599 EL29	0 (88 %)
13:24:20	K5ENG	KP3V	TU 73 Charlie EL29	5 (100 %)
13:24:26	AB1OC	PJ2BR	TU 73 Logged	0 (94 %)
13:24:29	W9SV	CQ	EN52	0 (94 %)
13:24:30	KB6LTY	PJ2BR	DM14JL	0 (94 %)
13:24:37	WI6K	PJ2BR	DM14 QSL?	0 (94 %)
13:24:42	N7MJ	PJ2BR	WY DN71	0 (94 %)
13:24:42	XE1UYS	CQ	CQ EK19	1 (94 %)
13:24:43	N9FN	PJ2BR	EN60 - pse for DXCC - LoTW	0 (19 %)
13:24:50	N8RO	PJ2BR	EM00 Texas QSL?	0 (88 %)
13:24:53	RU9GH/MM	W5CBF	73! TU	2 (100 %)
13:24:59	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8.298V]	0 (63 %)
13:25:00	AB1OC	RU9GH/MM	FN42 NH QSL?	0 (0 %)
13:25:10	KB6LTY	PJ2BR	DM14JL	0 (63 %)
13:25:14	N9FN	RU9GH/MM	EN60 QSL?	0 (38 %)

Call Grid Ele LOS

Call	Grid	T.Since	#CQ	Ele	State	LoTW
N9FN	EN60	00:21	1	31.1°	*	
KB6LTY	DM14	00:25	1	50.4°	*	
AB1OC	FN42	00:35	4	16.6°	*	
RU9GH/MM	FK24	00:42	1	28.3°	*	
N8RO	EM00	00:45	0	53.5°	*	
N7MJ	DN71	00:53	3	39.9°	*	
XE1UYS	EK19	00:53	2	62.5°	*	
WI6K	DM14	00:58	0	50.8°	*	
W9SV	EN52	01:06	6	30.5°	*	
K5ENG	EL29	01:15	0	50.6°	*	
W3RZ	EL29	01:16	1	50.6°	*	
W5CBF	EM30	01:17	0	47.2°	*	
PJ2BR	FK52	01:25	0	20.2°	*	
KP3V	FK78	01:33	2	16.3°	*	
N6PAZ	EM28	01:33	2	48.7°	*	
N3GS	EM28	01:33	0	39.0°	*	
VA7LM	CO54	01:53	1	18.7°	*	
KE9AJ	EN50	01:54	2	32.6°	*	
KG0D	CN88	01:59	0	27.9°	*	
N8JCM	EN72	02:13	0	27.6°	*	
N7AY	DN13	02:48	2	36.6°	*	
N1RCN	EL87	03:07	2	37.1°	*	
K7NT	DN46	04:23	2	33.0°	*	45 days
VE2PLE	FN46	04:47	0	14.3°	*	
AG2J	FM29	04:57	1	20.5°	*	
KF2T	FM19	05:42	2	23.4°	*	
WC7V	DN45	06:35	0	34.5°	*	
W4BCX	EL98	07:22	0	32.4°	*	
W3AVP	FN10	09:00	1	22.7°	*	
KB2M	FM29	11:03	1	21.6°	*	
FG80J	FK96	11:43	0	11.6°	*	
NZ2MTM	EL96	14:50	0	35.0°	*	
KO4MA	EL88	16:34	0	36.6°	*	
W8LR	EM88	17:24	1	29.5°	*	
XE2YWH	DL92	19:41	2	66.6°	*	
HR1JBR	--	21:37	0	--	*	

Normal To me CQ My TX My DP --

Dupe Grid Initial COSI

Digipeater is ON Soundmodem connected TCP Log disconnected ACLog disconnected UTC 29/09/23 13:25:34 UTC

RS-BA1 Remote Control

File View Option Help

Connect Remote Memory Voice CW Keyer Scope Set Mode Connect Set Exit

ICOM REMOTE CONTROL SOFTWARE RS-BA1

TRANSMIT BAND 1.8 FILTER

TUNER EXT-P.AMP P.AMP ATT NOTCH 3.5 TWINPBT

TUNE 11% AGC-OFF 7

ANT USB FIL1 TS-100 10

MONI 435.306.775 14

BK-IN MEMO 1: W4VA VHF RS-BA1 0.000 18

P.AMP GROUP 1: Basic VHF UHF 21

ATT S/Po 0 10 25 50 100% 24

IP+ ALC COMP 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 144

AGC SWR 1.5 2 3 4 5 6 7 8 9 10 1200 144

NB RF POWER CW PITCH MP-W MP-R A/B A-B

NR AF-SQL RF GAIN MEMO GROUP XFC XFC

COMP DOWN UP DOWN UP A/B A-B

TBW MIC SET TPF

SET MUTE MW M-CLR TS

SIGNALING ITON/DSQ VSC

SOUND MODEM BY UZ7HO - Ver 0.09b - [GreenCube 1200bd]

Settings View Clear monitor Calibration About

A: [GreenCube 1200bd] 1506 DCD threshold Hold pointers

[priority:2 src:1 src_port:48 dest:9 dest_port:29 len:45 H's_err:0] 82 97 70 00 1D 03 48 42 36 4C 54 59 3E 50 44 32 42 52 2C 20 47 72 65 65 6E 43 75 62 65 2C 20 53 54 4F 52 45 3D 30 20 44 4D 31 34 4A 4C

1: [GREENCUBE] [09:25:14R] [priority:2 src:1 src_port:58 dest:9 dest_port:29 len:49 RS_err:10] 82 97 7A 00 1D 03 4E 39 46 4E 3E 52 55 39 47 48 2F 4D 4D 2C 20 47 72 65 65 6E 43 75 62 65 2C 20 53 54 4F 52 45 3D 30 20 45 4E 36 30 20 51 53 4C 3F

MyCall	DestCall	Status	Sent pkts	Sent bytes	Rcvd pkts	Rcvd bytes	Rcvd FC	CPS TX	CPS RX	Dir

SoundModem

1000 2000 3000

GREENCUBE OPERATIONS EXAMPLES

18.04.23 14:30:23.889 W5HRH CQ EL29ft RX:5

18.04.23 14:30:26.250 W5HRH CQ EL29ft RX:5

18.04.23 14:30:35.571 LU4FTA W5HRH Hi, 599 FF96 Qsl? RX:1

18.04.23 14:30:36.685 Telemetry: eps/obc/radio

boot=157/4363/497, Vbat=8.279V

18.04.23 14:30:42.185 N9ZTS CQ EN82 RX:0

18.04.23 14:30:47.535 FG8OJ CQ FK96 RX:0

18.04.23 14:30:56.411 W5HRH LU4FTA 599 de Rudy, EL29 RX:5

18.04.23 14:31:02.589 LU4FTA W5HRH ur 599 qso

logged ,LoTW TNX 73!! RX:1

18.04.23 14:31:03.262 KG0D CX1AA R CN88 RX:0

18.04.23 14:31:08.300 LU4FTA W5HRH RRR TU 73!! RX:1

18.04.23 14:31:09.581 LU4FTA W5HRH RRR TU 73!! RX:1

18.04.23 14:31:21.845 Telemetry: eps/obc/radio

boot=157/4363/497, Vbat=8.298V

18.04.23 14:31:27.632 W5HRH LU4FTA TNX de Rudy EL29 RX:5

18.04.23 14:31:31.135 W5HRH LU4FTA TNX de Rudy EL29 RX:5

Telemetry
90 Sec Interval

France
Calling CQ

Argentina Working
US - W5



HORUS AMATEUR 4FSK UHF PAYLOAD TRACKING

- **Horus Payload is Unique Among High Altitude Balloon Payloads**
- **Majority of Amateur HAB:**
 - **APRS (Link into -IS via Hundreds of G/Ss, e.g. W4VA-13)**
 - **WSPR – on various HF bands**
- **Horus – Rare, but Increasing; Often Ride-Share with Science HABs**
 - **UHF ~ 431-434 MHz**
 - **4FSK Modulation**
 - **Rx via SoundModem -SSB & Reporting via Horus App**
- **All Amateur HAB Methods and Reporting on amateur.sondehub.org**

HORUS EXAMPLE CAPTURE

Horus Telemetry GUI - v0.3.15

Audio Device: Primary Sound Capture Driver (Dir)

Sample Rate (Hz): 48000

Input Level (dBFS): -19 GOOD

Modem

Mode: Horus Binary v1/v2

Baudrate: 100

Enable Mask Estim.:

Tone Spacing (Hz): 270

Manual Estim. Limits:

Stop

SondeHub | Other | Rotator

Enable SondeHub-Ham Upload:

Callsign: KN4GDX

Lat/Lon: 38.78 -77.77

Altitude: 215

Antenna: Vertical Base Amateur UHF

Radio: IC-9700

Radio Dial Freq (MHz): 431.05

Re-upload Position

Log

05:10:30 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.6 seconds.

05:10:39 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.3 seconds.

05:10:51 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.3 seconds.

05:11:11 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.3 seconds.

05:11:20 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.3 seconds.

05:11:30 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.3 seconds.

05:11:40 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.3 seconds.

05:11:50 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.3 seconds.

Save Settings

Spectra

Frequency (kHz)

SNR (dB)

9.3

SNR Plot

Time (s)

Latest Packet (Raw): 4A019902090B30A65C184200F499C2695A24CFE68C6A010000000000000FBFA (10.1 dB SNR)

Latest Packet (Decoded): \$SKB3ZOX,665,09:11:48,38.09048,-76.97656,23145,36,207,-26,2.75,3.62,0.0,0,0.0*CE65

Last Packet Age: 00:00:18

Callsign	Time	Latitude	Longitude	Altitude	Bearing	Elevation	Range (km)
KB3ZOX	09:11:48	38.09048	-76.97656	23145	137.7	12.0	105.9

RS-BA1 Remote Control

File View Option Help

Connect Remote Memory Voice CW Keyer Scope Set Mode Connect Set Exit

ICOM REMOTE CONTROL

TRANSMIT BW 1.5k SFT 0

EXT-P.AMP P.AMP ATT NOTCH

TUNER IP+ AGC-MID

TUNE 88% DUP

ANT TX RX USB FIL2 TS-1k

MONI 431.048.93

BK-IN MEMO 5: SIMPLEX 520

P.AMP GROUP 1: Basic VHF UHF

ATT S/Po 0 10 25 50 100%

AGC ALC COMP 0 5 10 15 20 dB

MODE SSB CW RTTY PSK AM FM DV

RF POWER CW PITCH MEMORY SPLIT DUP

MP-W MP-R A/B A-B

MEMO GROUP XFC

DOWN UP DOWN UP AFC

1Hz TS

MUTE MUTE

GENE 10 14 18 21 24 28 50 144 430 1200

SIGNALING TON/DSQ VSC

RIT RIT

CLEAR CLEAR

Spectrum Scope

IR T HOLD SPECTRUM SCOPE CENTER Grid 1k/10dB

-5.0k +5.0k

431.044 431.046 431.048 431.050 431.052

FILTER

SSB FIL2

BW Roofing Adjust

Type SHARP

1.5k

ON REF Level +20.0 dB VBW NAR Averaging 2 MAX HOLD CLEAR SET

Volume: 25%

RECEIVING AND REPORTING HORUS

- **Equipment Requirement is Simple**
 - SDR, or any UHF SSB Receiver
 - UHF Antenna – Some Use a Simple $\frac{1}{4}$ Wave Vertical
 - Horus Software for Demodulation and Reporting
 - <https://github.com/projecthorus>
- **Watch amateur.sondehub.org for Activity; or Engage Users**
- **Fine Tune on UHF to Get Signal into Pass Band**
 - Online Reports are Generally Filter-Center
 - Take Advantage of Locations, View Angles, etc.

RECEIVING AND REPORTING HORUS- WEBSITE

Browser: SondeHub Amateur
URL: amateur.sondehub.org/#!mt=Mapnik&mz=8&qm=12h&mc=38.7209,-76.64702&f=KB3ZOX

Call sign: 38.9847
-77.5619

KB3ZOX

-0.0 m/s 0.0 m/s
RATE VIH

10 m (54 m)
ALTITUDE (MAX)

2025-03-05 11:15:04
DATE/TIME (LOCAL)

38.01628, -75.64749
COORDINATES

0.3 m/s
ASCENT RATE ⌀

2.55 V
BATTERY VOLTAGE

432.6517 MHz
FREQUENCY ⌀

206
GNSS SVS USED

35°C
TEMPERATURE

Horus Binary v2
MODULATION

5
SPEED

0°C
TEMPERATURE, EXTERNAL

0%
RELATIVE HUMIDITY, EXTERNAL

0 hPa
PRESSURE, EXTERNAL

Received 11m ago via:
- COWBOYJOHNNYHD (19 DB, 432.6517 MHz)

Map: **KN4GDX**
Software: Horus-GUI-0.3.15
Radio: Horus-GUI v0.3.15 IC-9700
Antenna: Vertical Base Amateur UHF
Last Contact: 2025-03-05T16:25:26.398969Z

Map coordinates: UTC: 2025-03-05 16:26:31
Local: 2025-03-05 11:26:31 -5
Azimuth: 122.28° S 58° E
Elevation: -0.89° 198.4 km

Map controls: 12 hours, Path, Share, Plots, Telemetry Graph, 30 km, websocket | 1 msg/s

SERENDIPITY STRIKES! 06 MARCH LAUNCH

Browser Tabs: SondeHub Amateur, KN4GDX_3_AUTO_RX - Radios, SondeHub Tracker

URL: amateur.sondehub.org/#!mt=Mapnik&mz=8&qm=12h&mc=38.8611,-75.12451&f=KB3ZOW

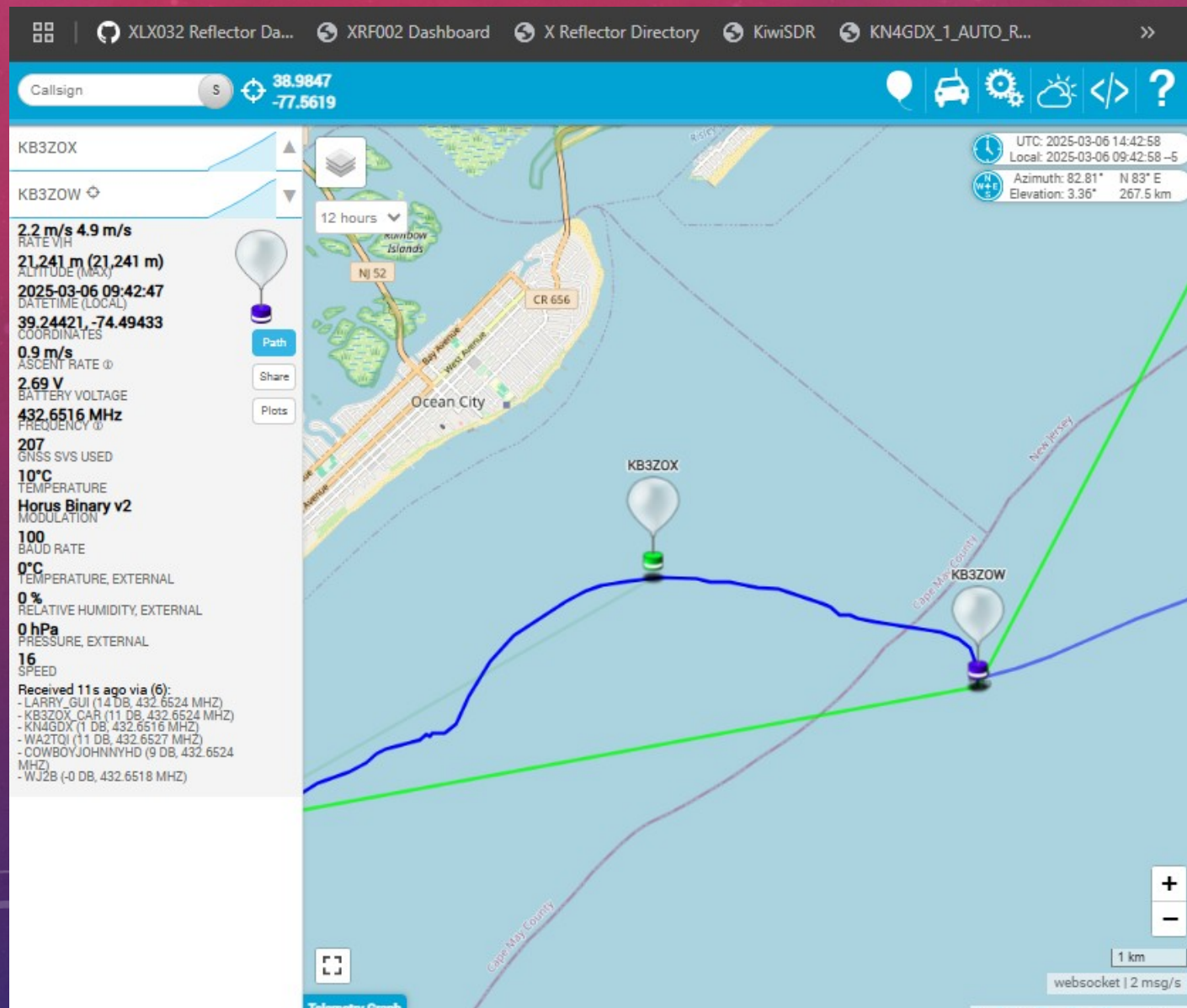
Call Sign: 38.9847 -77.5619

Station Data:
KB3ZOX
KB3ZOW
1.8 m/s 31.5 m/s RATE VIH
10,475 m (10,475 m) ALTITUDE (MAX)
2025-03-06 08:17:39 DATETIME (LOCAL)
38.8974, -75.10672 COORDINATES
2.61 m/s ASCENT RATE @
2.75 V BATTERY VOLTAGE
432.6524 MHz FREQUENCY @
105 GNSS SVS USED
19°C TEMPERATURE
Horus Binary v2 MODULATION
121 SPEED
0°C TEMPERATURE, EXTERNAL
0% RELATIVE HUMIDITY, EXTERNAL
0 hPa PRESSURE, EXTERNAL
100 BAUD RATE
Received 16s ago via (4):
- COWBOYJOHNNYHD (6 DB, 432.6516 MHZ)
- WJ2B (-0 DB, 432.6511 MHZ)
- KN4GDX (-1 DB, 432.6516 MHZ)
- WA2TQI (7 DB, 432.6524 MHZ)

Map Labels: Larry_GUI, WJ2B, WA2TQI, KB3ZOX_Car, KN4GDX, CowboyJohnnyHD

Weather Map: ventusky, Premium myVentusky About, Today: 20250306

FINALLY SNR ABOVE 0DB



- Tracking on Horus SSB
 - 1.5-3KHz Filter
 - -8db is Possible
- NOAA RS41, DFM17
 - +7 to +8 Lower Limit
 - Narrow FM
- 'ZOX and ZOW' Same Payload with RS41 Platform

TRACKING DETAILS AT +2.2DB SNR

Horus Telemetry GUI - v0.3.15

Audio Device: ICOM_VAUDIO-1 (Icom Virtual Aud...)

Sample Rate (Hz): 48000

Input Level (dBFS): -21 GOOD

Mode: Horus Binary v1/v2

Baudrate: 100

Enable Mask Estim.:

Tone Spacing (Hz): 270

Manual Estim. Limits:

Stop

Enable SondeHub-Ham Upload:

Callsign: K1V4GDX

Lat/Lon: 38.78 -77.77

Altitude: 215

Antenna: Vertical Base Amateur UHF

Radio: IC-9700

Radio Dial Freq (MHz): 432.65

Re-upload Position

Latest Packet (Raw): 4B018D040E2B2F9BF81C42CEFD94C27C5308CE09890CD100000000000004054 (2.2 dB SNR)

Latest Packet (Decoded): \$SKB3ZOW,1165,14:43:47,39.24278,-74.49571,21372,8,206,9,2.69,2.68,0,0,0,0,0*2407

Last Packet Age: 00:00:00

Callsign	Time	Latitude	Longitude	Altitude	Bearing	Elevation	Range (km)
KB3ZOW	14:43:47	39.24278	-74.49571	21372	78.7	2.9	288.8

09:42:44 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.3 seconds.
 09:42:54 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.2 seconds.
 09:43:15 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.4 seconds.
 09:43:25 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.3 seconds.
 09:43:35 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.1 seconds.
 09:43:45 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.2 seconds.
 09:43:54 [INFO] Sondehub Amateur Uploader - Uploaded 1 telemetry packets to Sondehub Amateur in 0.2 seconds.

Save Settings

Spectra

SNR (dB)

10 Sec Intervals

Spectrum Scope

10 Sec Intervals

RS-B1A Remote Control

ICOM REMOTE CONTROL SOFTWARE **RS-B1A**

TRANSMIT: BW 1.8k SFT 0

TUNER: EXT-P.AMP P.AMP ATT NOTCH

ANT: IP: AGC-MID

MONI: 86% TX RX USB FIL2 TS-100

BK-IN: 432.649.600

P.AMP: MEMO 1: W4VA VHF GROUP 1: Basic VHF UHF

ATT: S/Po 0 10 25 50 100% ALC COMP 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

MODE: SSB CW RTTY PSK AM FM DV

RF POWER: CW PITCH

MEMORY: MP-W MP-R

SPLIT: A/B A-B

DUP: XFC AFC 1Hz TS

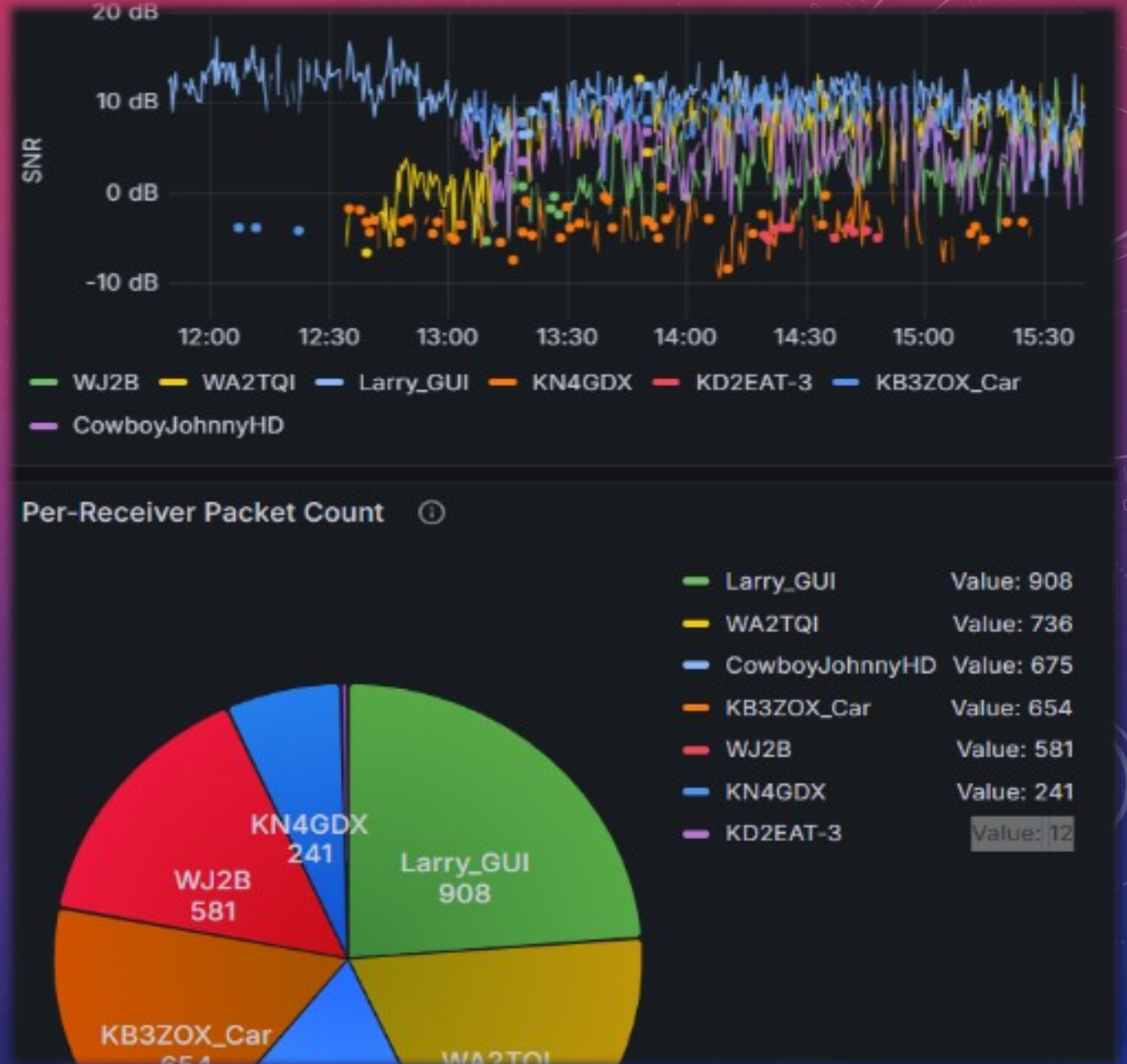
SIGNALING: I/TON/DSQ VSC

RIT: RIT CLEAR

packet-wirll...

KB3ZOW TRACKING HISTORY

- Four Hours Tracking
- KN4GDX Consistent
 - Disadvantaged
 - Low Elevation
 - Horizon Blocking
 - Range -8 to +2 SNR
- Detailed Data Sets for All Tracking Events



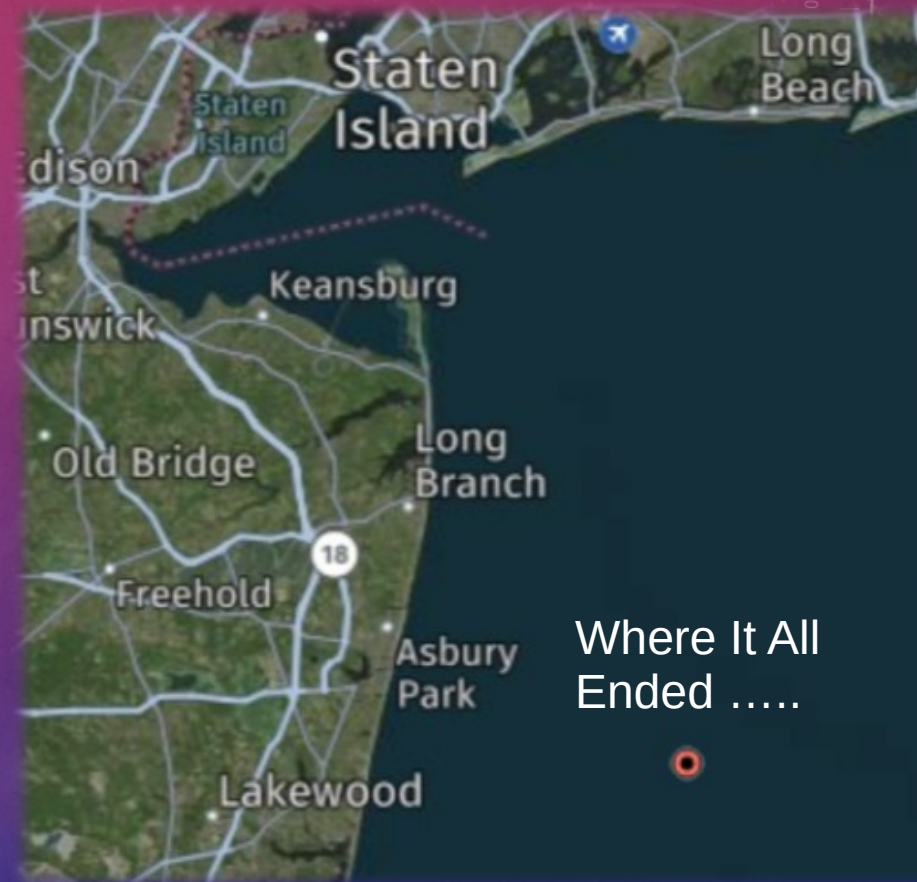
Name	Date modified	Type	Size
KB3ZOW.csv	3/6/2025 10:41 AM	OpenOffice.org 1.1 S...	1,553 KB
KB3ZOW.json	3/6/2025 10:41 AM	JSON File	3,431 KB
KB3ZOW.kml	3/6/2025 10:41 AM	KML File	29 KB

Thankyou!

Questions?

Bruce, KN4GDX

kn4gdx@gmail.com



Where It All
Ended

<https://maps.findmespot.com/s/YRP2#live/assets>

