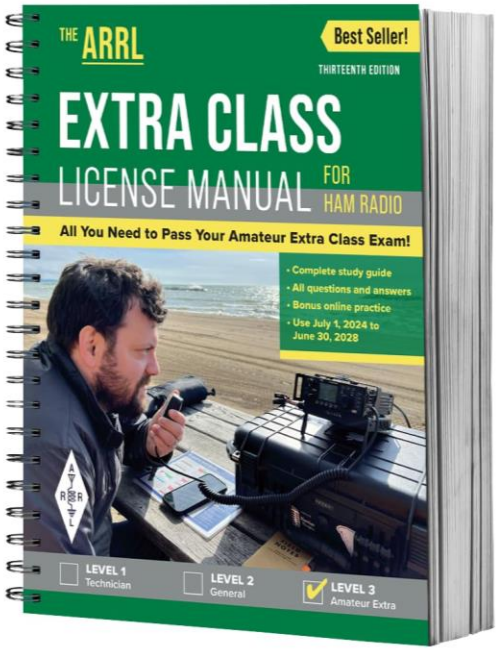
OPERATING PRACTICES CHAPTER 2



2.1 General Operating

- Frequencies available to Extra class
- DX and contest operating
- Using a remote station

2.2 Amateur Satellites

- Satellite orbits and signals
- Satellite transponders, frequencies, and modes

US Amateur Radio Bands

US AMATEUR POWER LIMITS — FCC 97.313 An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.

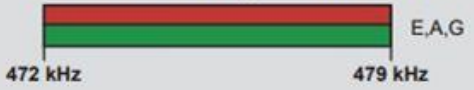
ARRL The National Association for Amateur Radio®

Amateurs wishing to operate on either 2,200 or 630 meters must first register with the Utilities Technology Council online at **https://utc.org/plc-database-amateur-notification-process/** You need only register once for each band.

2,200 Meters (135 kHz)

630 Meters (472 kHz)

5 W EIRP maximum, except in Alaska within 496 miles of Russia where the power limit is 1 W EIRP.

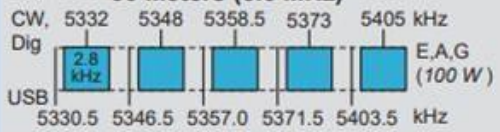


160 Meters (1.8 MHz)

Avoid interference to radiolocation operations from 1.900 to 2.000 MHz

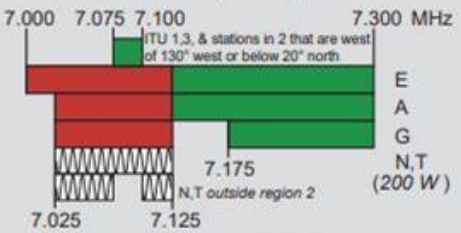
80 Meters (3.5 MHz)

60 Meters (5.3 MHz)



General, Advanced, and Extra licensees may operate on a secondary basis with a maximum ERP of 100 W (relative to a half-wave dipole antenna).

40 Meters (7 MHz)



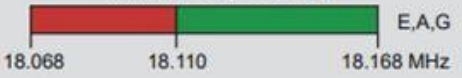
See Sections 97.305(c), 97.307(f)(11) and 97.301(e).These exemptions do not apply to stations in the continental US.

30 Meters (10.1 MHz)

Avoid interference to fixed services outside the US.

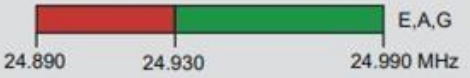
20 Meters (14 MHz)

17 Meters (18 MHz)

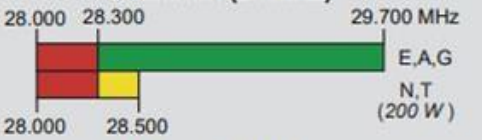


15 Meters (21 MHz)

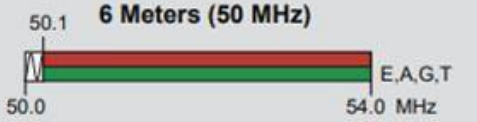
12 Meters (24 MHz)



10 Meters (28 MHz)

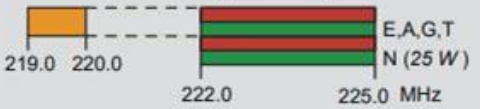


6 Meters (50 MHz)



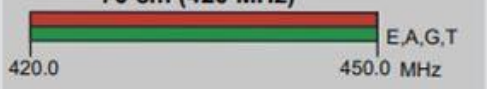
2 Meters (144 MHz)

1.25 Meters (222 MHz)

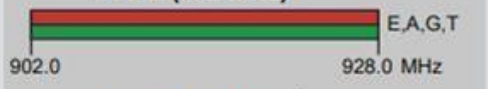


*Geographical and power restrictions may apply to all bands above 420 MHz. See FCC Part 97.303 for information about your area.

70 cm (420 MHz)*



33 cm (902 MHz)*



23 cm (1240 MHz)*

All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz ‡	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3400-3450 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

‡ No pulse emissions

KEY

Note:

CW operation is permitted throughout all amateur bands.

MCW is authorized above 50.1 MHz, except for 144.0-144.1 and 219-220 MHz.

Test transmissions are authorized above 51 MHz, except for 219-220 MHz

- = RTTY and data
- = phone and image
- = CW *only*
- = SSB phone
- = USB phone, CW, RTTY, and data
- = Fixed digital message forwarding systems *only*

E = Amateur Extra
A = Advanced
G = General
T = Technician
N = Novice

See *www.arrl.org/band-plan* for detailed band plans.

ARRL
We're At Your Service

ARRL Headquarters:
860-594-0200 (Fax 860-594-0259)
email: hq@arrl.org

Publication Orders:
www.arrl.org/shop
Toll-Free 1-888-277-5289 (860-594-0355)
email: orders@arrl.org

Membership/Circulation Desk:
www.arrl.org/membership
Toll-Free 1-888-277-5289 (860-594-0338)
email: membership@arrl.org

Getting Started in Amateur Radio:
Toll-Free 1-800-326-3942 (860-594-0355)
email: newham@arrl.org

Exams: 860-594-0300 email: vec@arrl.org

 rev. 07/25/2024

OPERATING PRACTICES
2.1 GENERAL OPERATING

Extra Class HF Frequencies

- Extra class only freq. = prime real estate for HF operator
- 80, 40, 20, and 15 meters: Major DX and contesting bands
- FCC rules still apply for: CW, data and phone
- Keep emissions inside the sub-band

OPERATING PRACTICES
2.1 GENERAL OPERATING

80 METER SUB-BAND

	FREQUENCY	DESCRIPTION
	3.500	Band Edge
DX	3.500-3.510	CW DX window
	3.560	QRP CW calling frequency
	3.570-3.600	RTTY/Data
	3.585-3.60	Automatically controlled data stations
DX	3.590	RTTY/Data DX
	3.790-3.800	DX window
	3.845	SSTV
	3.885	AM calling frequency
	3.985	QRP SSB calling frequency
	4.000	Band Edge

OPERATING PRACTICES
2.1 GENERAL OPERATING

Frequency Selection

- Check band conditions … MUF
- Check major contest … www.arrl.org/contests
- Check special event www.arrl.org/special-event-stations
- Check radio and antennas … interference

OPERATING PRACTICES
2.1 GENERAL OPERATING

DXing

- HF DXing: contacts outside your own country
- Continuous improvement: equipment, antennas, skills
- V/UHF “DXing”: beyond line-of-sight; making contacts 50-100 miles away
- EME DXing: half-world away

OPERATING PRACTICES
2.1 GENERAL OPERATING

QSL = a confirmation of a contact

- QSL methods
  - Traditional QSL Cards (via direct, outgoing, or W0 bureau)
  - ARRL's Logbook of the World (LoTW)
  - DX QSL Manager
  - Online QSL Request Service: OQRS
  - eLog contacts: QRZ.com, eQSL, email

The ARRL's QSL Service (www.arrl.org/qsl-service) handles both US-to-DX and DX-to-US QSLs, but not US-to-US cards because there would be too many and for which regular mail is available. [E2C08]

Many DX stations use the services of a QSL manager who confirms contacts and sends out requested QSL cards on behalf of a DX station. [E2C05]

"My log is being uploaded to LoTW frequently now. QSL direct via KX4R."

OPERATING PRACTICES
2.1 GENERAL OPERATING

DX Windows and Watering Holes (Table 2.1)

Band	Frequency (MHz)
160 meters	1.830-1.835
80 meters	3.505
75 meters	3.795-3.800
40 meters	7.005 (CW)
20 meters	14.005 and 14.020 (CW)
	14.190 - 14.200 (Phone)
15 meters	21.005 and 21.020 (CW)
	21.195 and 21.295 (Phone)
10 meters	28.495 (Phone)
6 meters	50.100 – 50.130
2 meters	144.200

OPERATING PRACTICES
2.1 GENERAL OPERATING

XT2MD DXpedition

Working **split** separates the signals of the calling stations from the DX station reducing interference and improving efficiency. [E2C10]

TX

"XT2MD Up 2"

RX

Tuning up and down
Picking calls out of the pile up

14.024

14.026

K1LID

AC6AC

DL5YL

K0NK

WB0CNK

KG9Y

KI0KK

KD0RIU

G4TFF

N0TU

The Pile up

RX

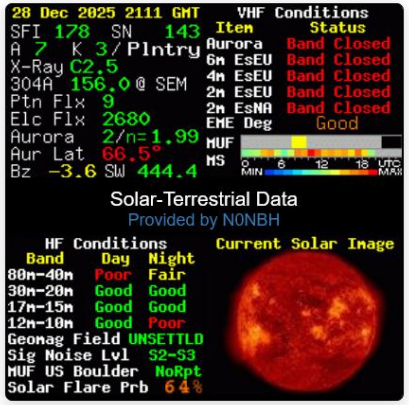
TX

DXers

Give your full callsign once or twice, then pause to listen for the DX station. [E2C11]

DXing Propagation

- Propagation varies by solar cycles, season, day-to-day, time of day.
- Indications the band about to close: contacts get weaker; exhibit rapid fading and fluttery sound. Max Usable Frequency (MUF) dropping, change to lower-frequency band.
- Solar conditions information
  - www.ncdxf.org
  - www.reversebeacon.net
  - www.dxmaps.com
  - www.spaceweather.com
  - www.swpc.noaa.gov/communities/radio-communications
  - www.hfradio.org



QRZ.COM

Resources for DXing

- ARRL's *Operating Manual* … DX chapter
- *The Complete DXer*, by Bob Locher W9KNI
- ARRL's DX Bulletin: www.arrl.org/w1aw-bulletins-archive-dx
- Ohio/Penn DX Bulletin: mailto:kb8nw@hotmail.com?subject=subscribe
- Daily DX: www.dailydx.com $
- 425 DX News: https://www.425dxn.org/

OPERATING PRACTICES
2.1 GENERAL OPERATING

DX News

E-Newsletter

FIJI, 3D2. Jim, WB2TJO will be QRV as 3D2JS from Taveuni Island, IOTA OC-016, beginning from December 2016 to March 2017. Activity will be on the HF bands and 6 meters using CW, SSB and some digital modes. QSL to home call.

WEST MALAYSIA, 9M2. A group of operators will be QRV as 9M4LI from Lalang Island, IOTA AS-072, from November 25 to 27. Activity will be on the HF bands. QSL via operators' instructions.

EAST MALAYSIA, 9M6. Saty, JE1JKL will be QRV as 9M6NA from Labuan Island, IOTA OC-133, in the CQ World Wide DX CW contest as a Single Op/Single Band entry on 20 meters. QSL to home call.

OMAN, A4. Special call sign A44A will be QRV in the CQ World Wide DX CW contest as a Multi-2 entry. QSL via A47RS.

BHUTAN, A5. Nobuaki, JA0JHQ is QRV as A52NH from the Dochula Resort in Paro until November 27. Activity is on 160 to 6 meters using CW, SSB and RTTY. This includes a possible entry in the CQ World Wide DX CW contest. QSL to home call.

CAPE VERDE, D4. Raul, EA2SS is QRV as D44TBC from Sal Island, IOTA AF-086, until November 28. Activity is holiday style on 20 and 30 meters. QSL to home call.

DX WEB SITES FOR YOUR TOOLBOX

DX Software	www.dxlabsuite.com
DX Cluster	www.nc7j.com
DX Summit	www.dxsummit.fi
DX Entities	www.arrl.org/dxcc
Propagation	http://dx.qsl.net/propagation/
Forecast	http://www.swpc.noaa.gov/forecast.html
Time & Gray-line	www.time.gov
DX Real-Time Maps	www.dxmaps.com
DX-pedition tracking	http://www.ng3k.com/misc/adxo.html
The Daily DX	www.dailyDX.com
QRZ direct linking info	http://qrz.com/i/linking.html
DX World	http://dx-world.net/

DX WEB SITES FOR YOUR TOOLBOX

NG3K Home | ADXO | Contest | DXCC | CIS-Pfx

Announced DX Operations: 2025

[About ADXO] [ADXO Text Version] [Abbreviations] RSS
[Submit a Dxpedition]
iCal DXCAL: https://www.danplanet.com/dxcal.ics (Tnx to KK7DS)

Active/Upcoming	Expired	Previous Years
Expired Contest and Special Operations (1996+)		

Last updated: Monday, 05-Jan-2026 11:53:55 EST
[Currently Active Operations]
[Spots provided courtesy of DX Watch]

Start Date	End Date	DXCC Entity	Call	QSL via	Reported by	Info
2025						
December						
2025 Dec07	2026 Jan05	**Guatemala**	**TG** [spots]	LoTW	TDDX 20250605	By AF4CZ as TG9/AF4CZ; 40-10m;; FT8 FT4, perhaps SSB; spare time operation
2025 Dec22	2026 Jan15	**French Guiana**	**TO2FY** [spots]	LoTW	OPDX 20251213	By F4GPK fm Kourou (GJ35pe); 40 20 15 10m; SSB
2025 Dec22	2026 Jan18	**Cambodia**	**XU7O** [spots]	LoTW	OPDX 20251214	By DL7BO; 160-6m, focus on low bands; CW SSB FT8; QSL via Club Log OQRS or DL4WK
2025 Dec28	2026 Jan09	**St Kitts & Nevis**	**V4** NEW [spots]	G4DVB Direct	DXW.Net 20260101	By G4DVB as V4/G4DVB fm Calypso Bay, St Kitts I; @V47JA; HF; CW SSB FT8
2026						
January						
2026 Jan01	2026 Feb16	**Grenada**	**J38WG** [spots]	LoTW	OPDX 20251025	By WE9G fm IOTA NA-024 (FK92ef); 160-6m; mainly FT8, some CW SSB; QSL via Club Log OQRS or WE9G (B/d)
2026 Jan02	2026 Jan06	**French Polynesia**	**FO** [spots]	LoTW	OPDX 20251229	By JI1JKW as FO/JI1JKW fm IOTA OC-066; 40 20 17 15 12 10 6m; SSB CW FT8; 200w; QSL via JI1JKW; holiday style operation
2026 Jan03	2026 Jan10	**French Polynesia**	**FO** NEW [spots]	F6HCM (B/d)	OPDX 20260103	By F6HCM as FO/F6HCM fm Moorea I (IOTA OC-046); HF
2026 Jan04	2026 Jan11	**Burkina Faso**	**XT2MAX** NEW [spots]	LoTW	TDDX 20260101	By DK1MAX fm Ouagadougou; mainly 20-6m; CW SSB FT4 FT8; QSL via Club Log OQRS or EA5GL
2026 Jan05	2026 Jan31	**Honduras**	**HR9** NEW [spots]	LoTW	OPDX 20260105	By VE3VSM as VE3VSM/HR9 fm Roatan I (IOTA NA-057); HF; CW FT8; holiday style operation; QSL via VE3VSM

Contesting

- **Purpose:** Enhance communication and operating skills.
- **General goal for contests:** Make many contacts as possible … within time limits … adhering to rules.
- **Reasons for you to try contesting:**
  - Competitive outlet
  - Quick increase to WAS and DXCC totals.
  - Honing skill and station equip. for public service or emergency operating.
- **What to send:**
  - The Exchange … info sent during a contest
  - Can be any or all of the following
    - Callsigns
    - Signal report (59 or 5nn)
    - QTH (ARRL Section, CQ Zone, grid, county)
    - Serial number (sequential, year licenses)
    - Digital contests may substitute Grid Square for signal report [E2D02]

Contest Information

- QST contesting page, "Contest Corral" www.arrl.org/contests
- Calendars
  - **WA7BNM Contest Calendar** https://www.contestcalendar.com/
  - **SM3CER Contest Service** www.sk3bg.se/contest
- HF contesting … centered around low-end … CW and Phone.
- Digital contest … centered around digital calling frequencies for that mode.

2026	
January 1 Straight Key Night 3 Kids Day 3-4 RTTY Roundup 17-19 January VHF	**February** 9-13 School Club Roundup 21-22 International DX – CW
March 7-8 International DX-Phone	**April** 19 Rookie Roundup-Phone
May (no ARRL Contests)	**June** 6-7 Intl Digital Contest 13-15 June VHF 20 Kids Day 27-28 Field Day
July 11-12 IARU HF World Championship	**August** 1-2 222 MHz and Up Distance Contest 8-9 EME - 2.3 GHz & Up 15-17 10 GHz & Up – Round 1 16 Rookie Roundup RTTY
September 5-6 EME - 2.3 GHz & Up 12-14 September VHF 19-21 10 GHz & Up - Round 2	**October** 3-4 Collegiate QSO Party 19-23 School Club Roundup Oct 31/Nov 1 EME - 50 to 1296 MHz
November 7-9 Nov Sweepstakes–CW 28-29 EME - 50 to 1296 MHz 21-23 Nov Sweepstakes–Phone	**December** 4-6 160 Meter 12-13 10 Meter 20 Rookie Roundup–CW

Contesting Dos and Don'ts

- No contesting on 60, 30, 17, and 12 bands by general agreement. [E2C03]
- V/UHF contests … centered around weak signal / low-end of the bands and near the CW/SSB calling frequencies. [E2C06]
- Repeater contacts are not allowed.
- FM simplex contacts allowed but are discouraged on FM calling frequencies.

OPERATING PRACTICES
2.1 GENERAL OPERATING

Operating in a Contest

- Tuning up and down a band for stations to contact (**search**), then working them (**pounce**).
- Stations **running** … calling "CQ Contest" or "CQ Kansas QSO Party" … stationary on one frequency.
- Cadence of the calls/responses … KS0KS 3A KS.
- World-wide/daytime … 10, 15, 20.
- Low sunspot cycle/nighttime … 40, 80, 160.

Submitting a Contest Log

- Read and follow the rules
- Few QSOs: go ahead and submit a log
- Submit Cabrillo format or ADIF format per contest instructions

Make contacts – whether you intend to submit a log to the contest sponsors or not – no entry is required.

The Cabrillo format is a standard for organizing the information in a submitted contest log so that the sponsor can check and score the QSOs. [E2C07]

Amateur Data Interchange Format (ADIF) is a frequently used file format for exchanging amateur radio log data. It is vendor-neutral and compatible with a variety of activities and logging systems. [E2C02]

CABRILLO FILE

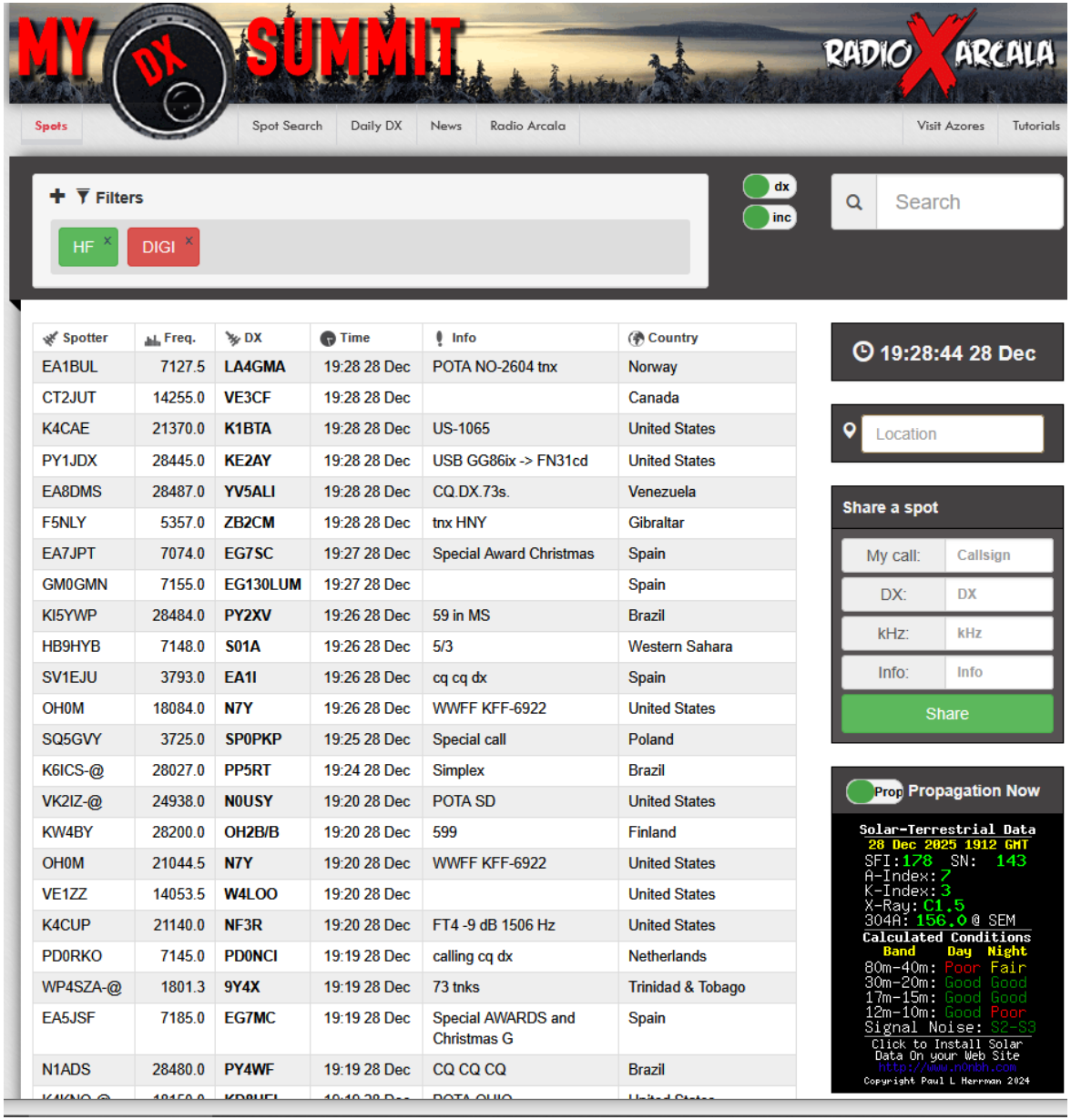
```
START-OF-LOG: 3.0
CONTEST: ARRL-SS-CW
CALLSIGN: W1AW
LOCATION: CT
CLUB: ARRL
OPERATORS: W1AW
CATEGORY-OPERATOR: SINGLE-OP
CATEGORY-TRANSMITTER: ONE
CATEGORY-ASSISTED: NON-ASSISTED
CATEGORY-BAND: ALL
CATEGORY-POWER: LOW
CATEGORY-MODE: CW
CATEGORY-STATION: FIXED
CLUB: ARRL
NAME: Hiram Maxim
ADDRESS: 225 Main St.
ADDRESS: Newington, CT 06111

QSO: 14000 CW 2009-11-07 2100 W1AW      1 M 38 CT K8MM      1 Q 92 MI
QSO: 14000 CW 2009-11-07 2101 W1AW      2 M 38 CT K3TX       1 A 59 EPA
QSO: 14000 CW 2009-11-07 2104 W1AW      3 M 38 CT W4DAN      1 A 77 TN
QSO: 14000 CW 2009-11-07 2106 W1AW      4 M 38 CT K1BG       2 U 68 WMA
QSO: 14000 CW 2009-11-07 2106 W1AW      5 M 38 CT K5AF      10 A 60 STX
END-OF-LOG:
```

Using Spotting Networks

- Check rules if use of spotting is permitted.
  - *Single-Operator Assisted* (or *Single-Operator Unlimited*): an entry category that permits use of spotting networks.
- Self-spotting is **not** allowed in most contests.
- Dxsummit.fi or www.reversebeacon.net
  - stations listening to the bands
  - report what stations they hear, when, and how well.

DXSUMMIT.FI


MY DX SUMMIT
RADIO ARCALA
Spots
Spot Search
Daily DX
News
Radio Arcala
Visit Azores
Tutorials
Filters
HF
DIGI
dx
inc
Search
Spotter
Freq.
DX
Time
Info
Country
EA1BUL 7127.5 LA4GMA 19:28 28 Dec POTA NO-2604 tnx Norway
CT2JUT 14255.0 VE3CF 19:28 28 Dec Canada
K4CAE 21370.0 K1BTA 19:28 28 Dec US-1065 United States
PY1JDX 28445.0 KE2AY 19:28 28 Dec USB GG86ix -> FN31cd United States
EA8DMS 28487.0 YV5ALI 19:28 28 Dec CQ.DX.73s. Venezuela
F5NLY 5357.0 ZB2CM 19:28 28 Dec tnx HNY Gibraltar
EA7JPT 7074.0 EG7SC 19:27 28 Dec Special Award Christmas Spain
GM0GMN 7155.0 EG130LUM 19:27 28 Dec Spain
KI5YWP 28484.0 PY2XV 19:26 28 Dec 59 in MS Brazil
HB9HYB 7148.0 S01A 19:26 28 Dec 5/3 Western Sahara
SV1EJU 3793.0 EA1I 19:26 28 Dec cq cq dx Spain
OH0M 18084.0 N7Y 19:26 28 Dec WWFF KFF-6922 United States
SQ5GVY 3725.0 SP0PKP 19:25 28 Dec Special call Poland
K6ICS-@ 28027.0 PP5RT 19:24 28 Dec Simplex Brazil
VK2IZ-@ 24938.0 N0USY 19:20 28 Dec POTA SD United States
KW4BY 28200.0 OH2B/B 19:20 28 Dec 599 Finland
OH0M 21044.5 N7Y 19:20 28 Dec WWFF KFF-6922 United States
VE1ZZ 14053.5 W4LOO 19:20 28 Dec United States
K4CUP 21140.0 NF3R 19:20 28 Dec FT4 -9 dB 1506 Hz United States
PD0RKO 7145.0 PD0NCI 19:19 28 Dec calling cq dx Netherlands
WP4SZA-@ 1801.3 9Y4X 19:19 28 Dec 73 tnks Trinidad & Tobago
EA5JSF 7185.0 EG7MC 19:19 28 Dec Special AWARDS and Christmas G Spain
N1ADS 28480.0 PY4WF 19:19 28 Dec CQ CQ CQ Brazil
19:28:44 28 Dec
Location
Share a spot
My call:
Callsign
DX:
DX
kHz:
kHz
Info:
Info
Share
Prop
Propagation Now
Solar-Terrestrial Data
28 Dec 2025 1912 GMT
SFI:178 SN: 143
A-Index:7
K-Index:3
X-Ray: C1.5
304A: 156.0 @ SEM
Calculated Conditions
Band Day Night
80m-40m: Poor Fair
30m-20m: Good Good
17m-15m: Good Good
12m-10m: Good Poor
Signal Noise: S2-S3
Click to Install Solar Data On your Web Site
http://www.hamqsl.com
Copyright Paul L Herrman 2024

Remote Stations

- Operate via Internet to remote transmitter.
- You must:
  - Be licensed to TX from that location.
  - Have permission to use that station.
- Station identification
  - TX the U.S.: use your call. [E2C01]
  - TX in another country (Brazil): use PY/your call.
- Need low delay (low latency) to operate remotely. [E2C12]

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

CubeSat (Experimental)

AO-40

SATELLITE	UPLINK	DOWNLINK	COMMENT
AO-51	145.92	435.3	
AO-27	145.85	436.795	
SO-50	145.85	436.795	67.0 tone

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Amateur Satellites

Satellite communication achieved by modest equipment (HT and hand-held antenna).

More information …

www.amsat.org.

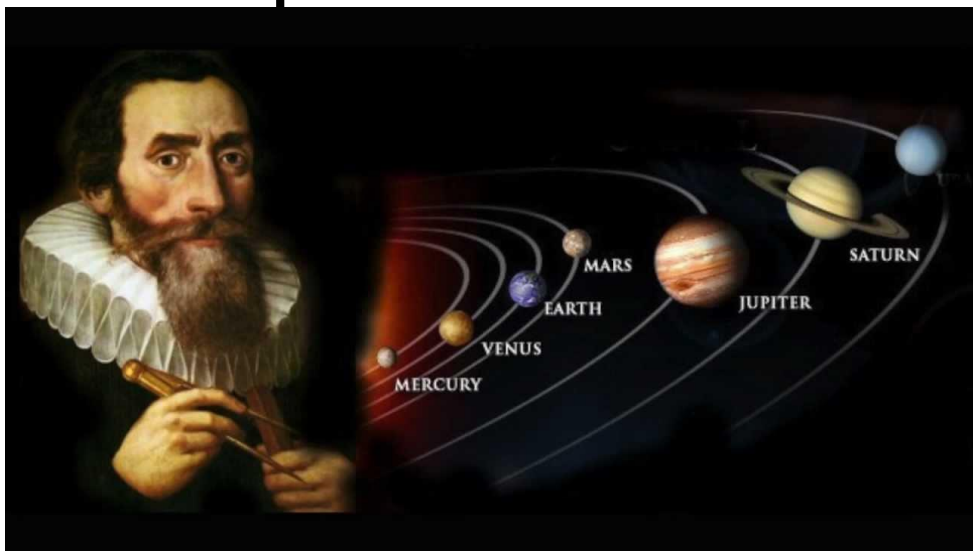
OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Understanding Satellite Orbits

- **Inertia** … force tends to keep a body moving in a straight line.
- **Gravity** … force tends to pull the body toward the Earth.
- Inertia and gravity are balanced … path is a stable orbit around the Earth.
- One complete revolution about the Earth … orbital period.

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Johannes Kepler

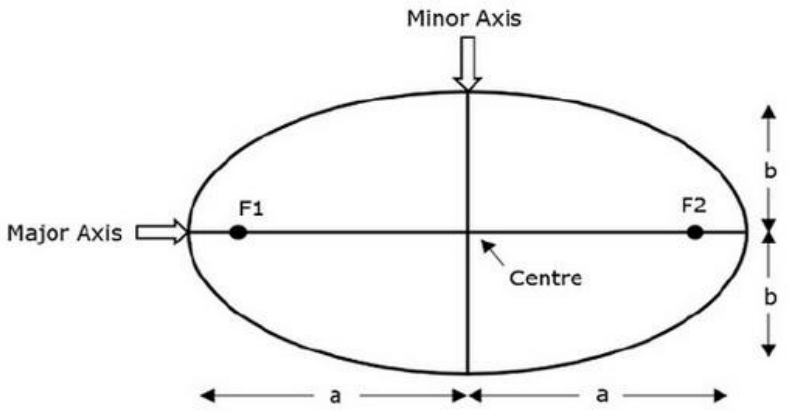


- Described the mechanics of the orbits of the planets mathematically.
- Created three laws of planetary motion … describe lunar orbit and orbits of artificial Earth satellites.

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Kepler's First Law (shape):

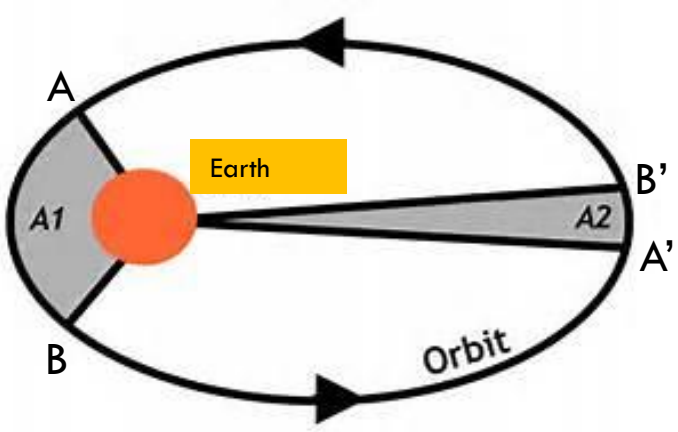
- The path a satellite follows is an ellipse.
- Center of one of the focal points is the Earth.
- *Eccentricity*: a value from 0 to 1…larger the eccentricity, the thinner the ellipse



OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Kepler's Second Law (time-speed-area):

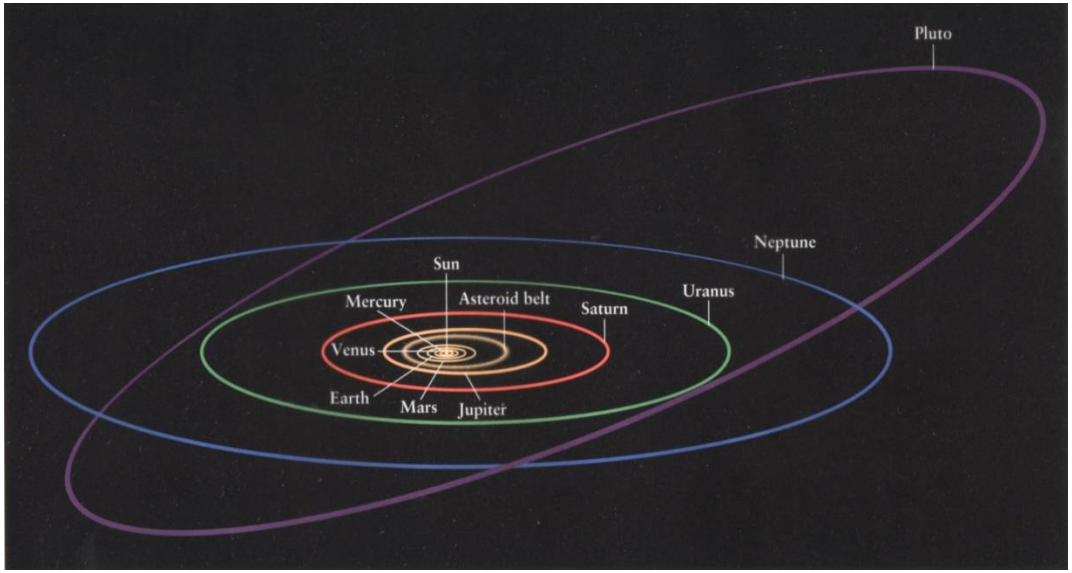
- Time travel from A to B equals time from A' to B'
- Speed faster A to B (closer to Earth) than A' to B'
- Area of section A1 = area of section A2



OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Kepler's Third Law (distance):

- Greater distance from Earth, the longer orbital period.
- Low Earth Orbit (LEO) satellites complete an orbit ~90 minutes



Fun Fact: Pluto orbits the Sun every 248 years!

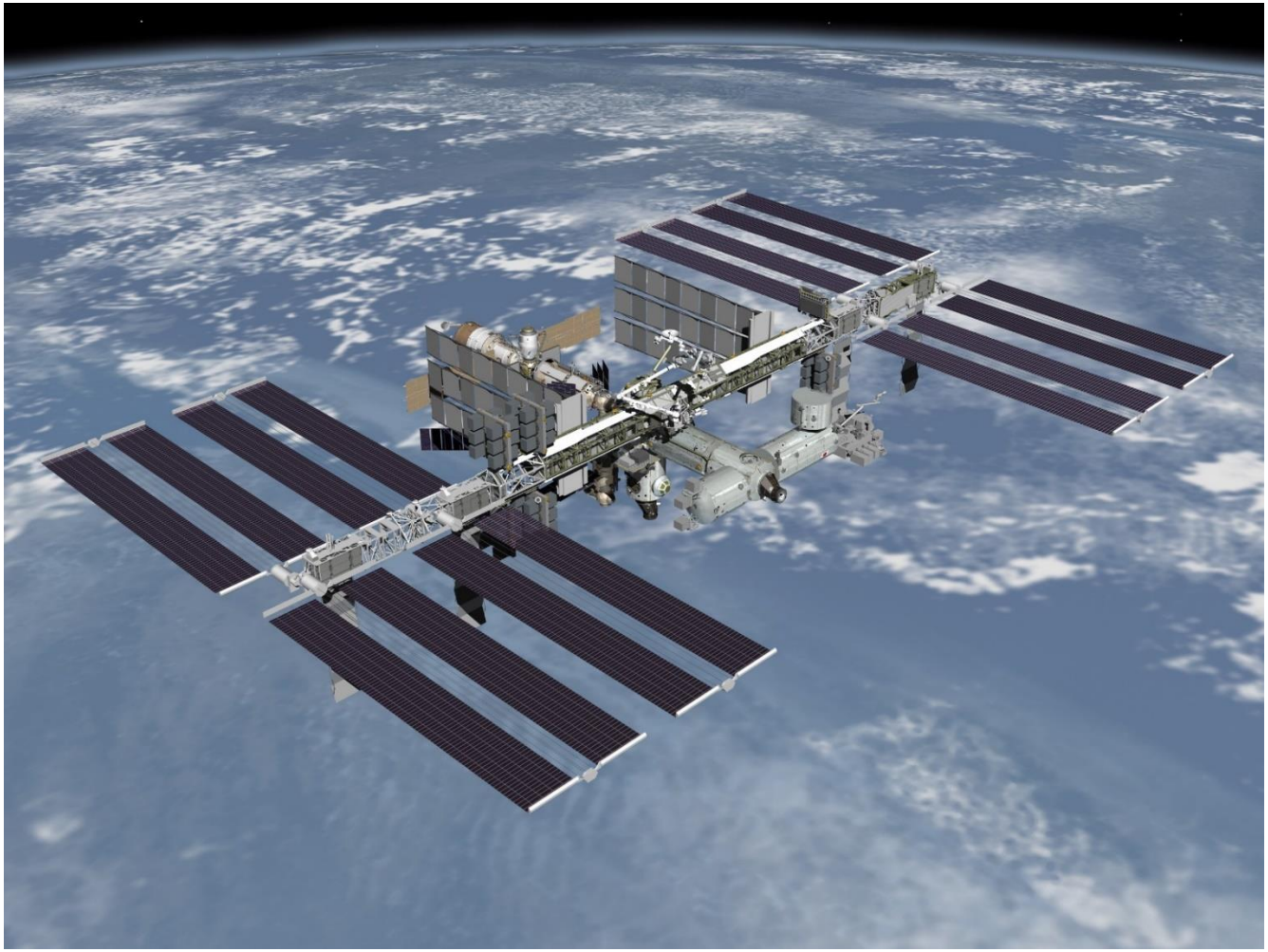
OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Keplerian Elements:

- Laws expressed mathematically, if you know the values of a set of measurements of the satellite orbit, you can calculate the position of the satellite.
- Keplerian elements are parameters that define the orbit of a satellite. [E2A06]
- Point your antenna at the satellite position.
- Display on map on a computer monitor … updated every few seconds … track satellite movement.
- Refresh Keplerian elements monthly … orbits change slowly over time.

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

- ISS orbits the Earth every 90 minutes.

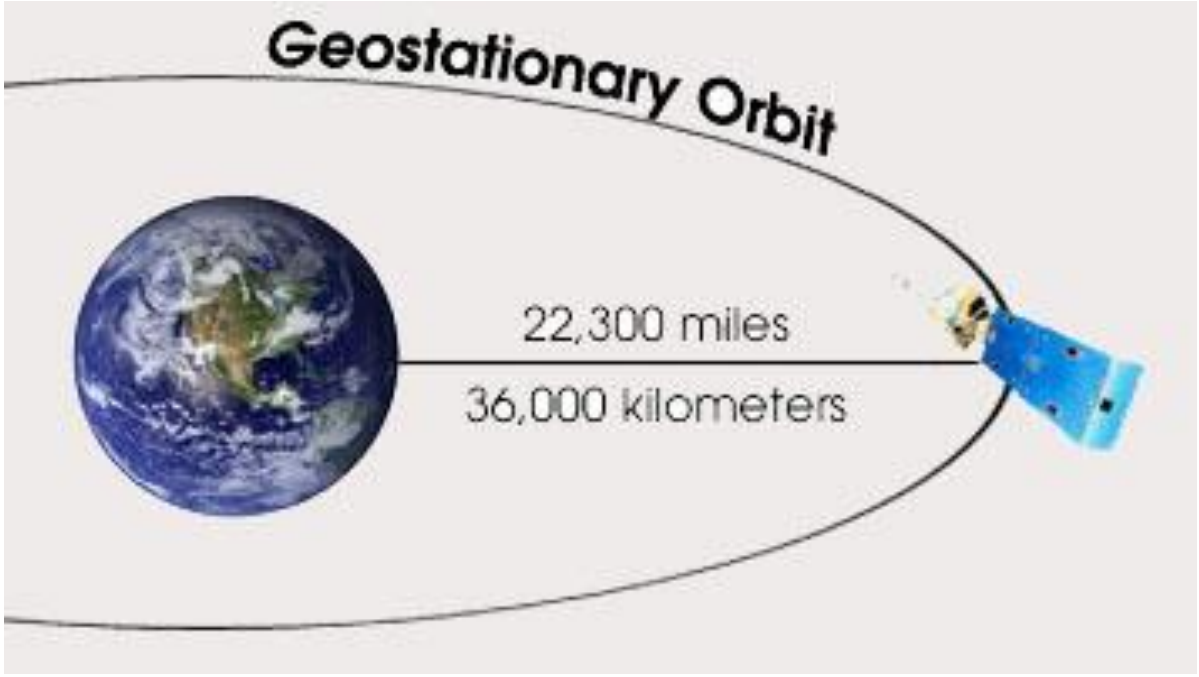


OPERATING PRACTICES
2.2 AMATEUR SATELLITES

AO-40 … high elliptical orbit … 19 hours.

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Orbit high and circular … geosynchronous … aka geostationary … same point over the Earth as the Earth rotates. [E2A10]



Orbit period = 24 hours

2Line Orbital Elements

SB KEPS @ AMSAT $ORB17012.N
2Line Orbital Elements 17012.AMSAT

HR AMSAT ORBITAL ELEMENTS FOR AMATEUR SATELLITES IN NASA FORMAT
FROM WA5QGD FORT WORTH,TX January 12, 2017
BID: ORB17012.N

DECODE 2-LINE ELSETS WITH THE FOLLOWING KEY:
1 AAAAAU 00 0 0 BBBBB.BBBBBBBB .CCCCCCCC 00000-0 00000-0 0 DDDZ
2 AAAAA EEE.EEEE FFF.FFFF GGGGGGG HHH.HHHH III.IIII JJ.JJJJJJJJKKKKKZ
KEY: A-CATALOGNUM B-EPOCHTIME C-DECAY D-ELSETNUM E-INCLINATION F-RAAN
G-ECCENTRICITY H-ARGPERIGEE I-MNANOM J-MNMOTION K-ORBITNUM Z-CHECKSUM

TO ALL RADIO AMATEURS BT

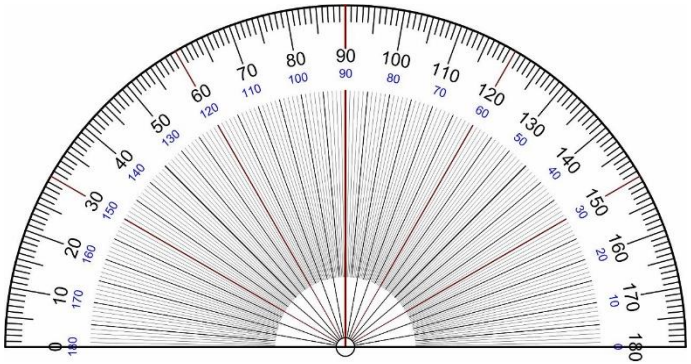
HUBBLE
1 20580U 90037B 17011.96673389 .00000503 00000-0 20112-4 0 9993
2 20580 028.4707 319.6982 0002513 293.8221 144.8373 15.08643848266585

AO-73
1 39444U 13066AE 17012.10782319 .00000259 00000-0 38784-4 0 9992
2 39444 97.6537 62.5969 0059843 58.5769 302.1277 14.81305296168500


Kansas City 1/9/26 08:06:43
Now
Passes
Start End Peak Mg
Saturday, January 10, 2026
ARCTICSAT 1 (RS74S)
08:03:29 08:06:09 12° E 5.2
CAS-4A
08:06:31 08:06:31 58° N 0.1
CO-55
08:14:58 08:20:50 15° NW 4.6
OOV-CUBE (TUBSAT-30)
08:21:06 08:22:00 10° W 4.8
AO-91
08:22:51 08:31:00 55° E 3.7
LILACSAT-2
08:23:26 08:29:34 54° W 2.1
RADIO ROSTO (RS-15)
08:34:51 08:56:04 51° NW 5.4
FO-29
08:37:27 08:51:15 78° W 4.4
CAS-4B
08:38:22 08:38:22 90° SW 0.3
TUSUR GO (RS78S)
08:48:39 08:54:49 68° E 2.6
POLYTECH-UNIVERSE 3 (R*)
08:54:59 08:57:10 11° E 6.0
RS-30
09:02:59 09:16:48 25° NE 6.6

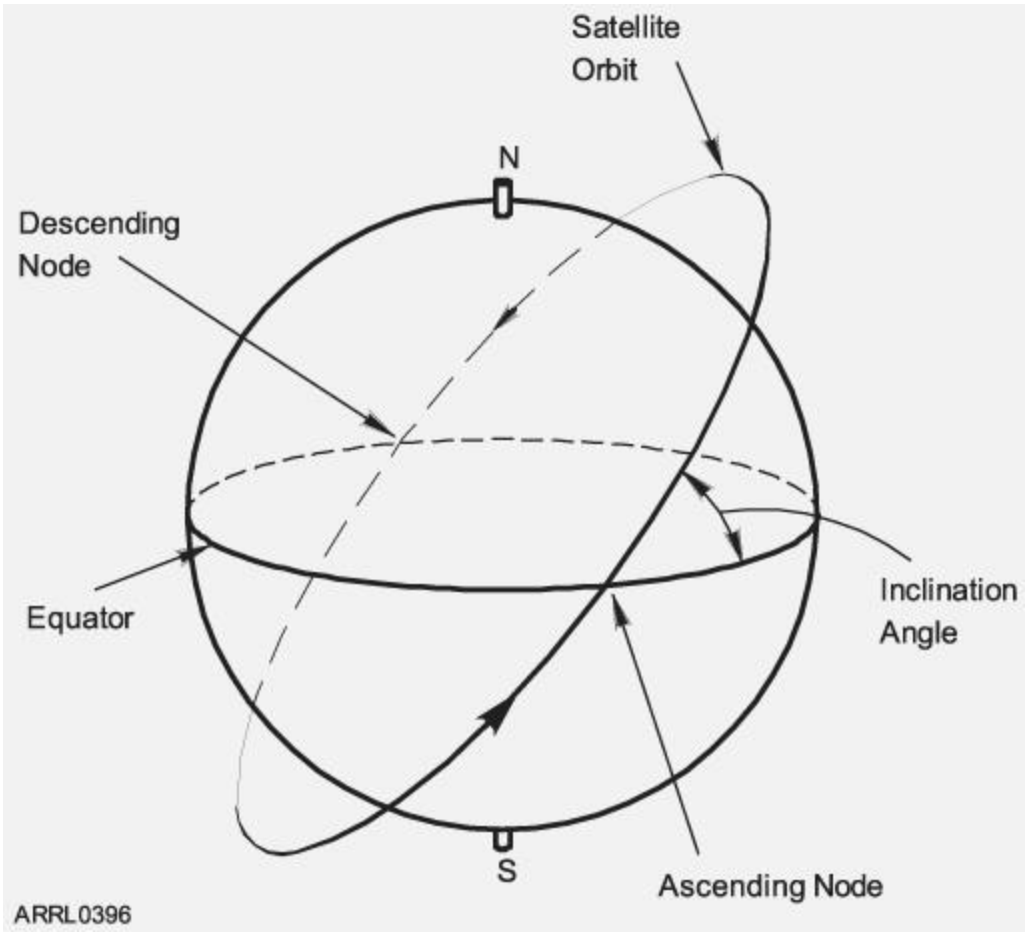
OPERATING PRACTICES
2.2 AMATEUR SATELLITES

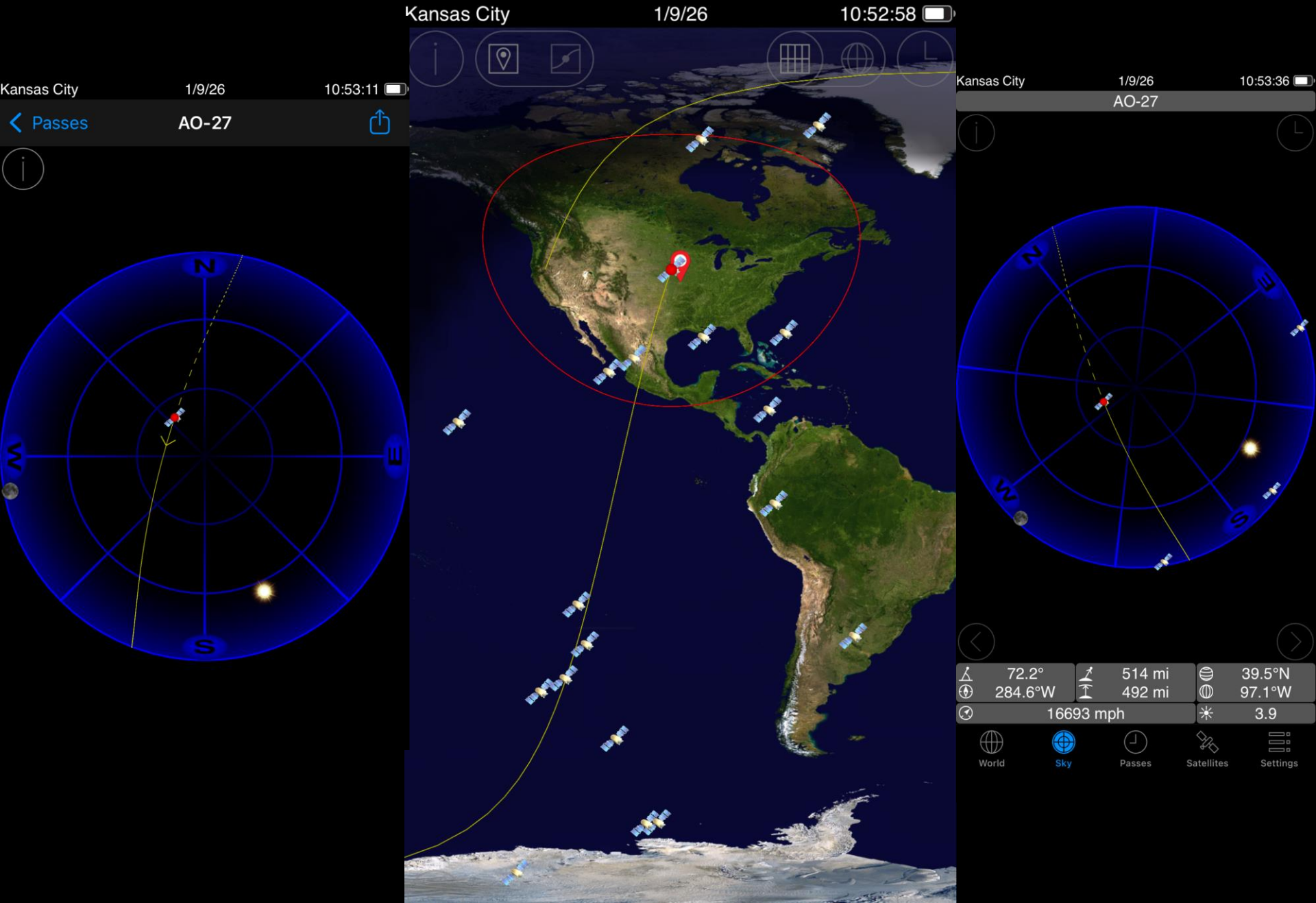
Orbital Mechanics



Protractor

When the satellite is within range of your location, it is common to describe the pass as either an **ascending pass** (traveling south to north over your area) or a **descending pass** (traveling north to south). [E2A01]



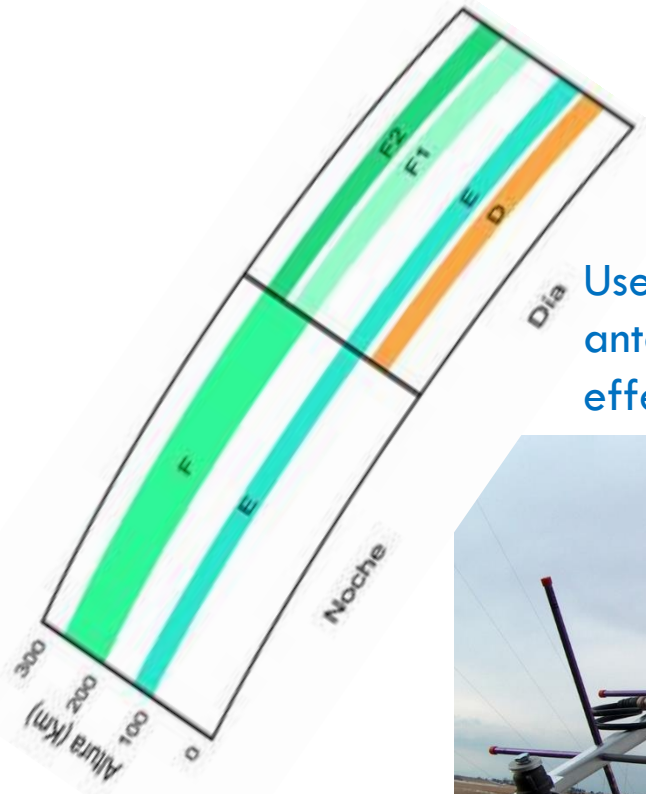

Kansas City 1/9/26 10:52:58
Kansas City 1/9/26 10:53:11
Passes
AO-27
N
E
S
W
Kansas City 1/9/26 10:53:36
AO-27
N
E
S
W
72.2°
284.6°W
514 mi
492 mi
39.5°N
97.1°W
16693 mph
3.9
World
Sky
Passes
Satellites
Settings

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Faraday Rotation and Spin Modulation

Polarization of a radio signal changes as it passes through the ionosphere—Faraday rotation. Heard as fairly rapid, pulsed signal fading.

Spinning satellite with spin axis not pointing at your station causes amplitude and polarization changes—Spin Modulation.



Use circularly polarized antennas to counteract effects. [E2A11]

Satellite Operation

Satellite components

Batteries,
solar panels,
controllers

Repeaters,
transponders, and
store-and-forward
systems

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Repeaters

Works similar to terrestrial repeater

Cross-band repeater eliminates need for heavy cavity duplexers

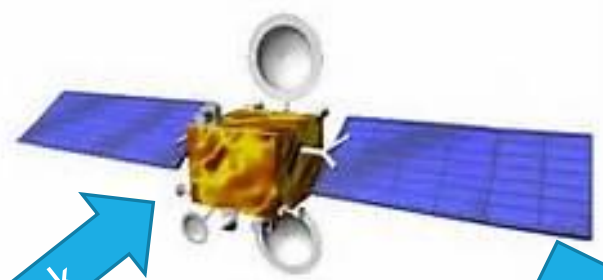
2m up
440 down

RX and TX on specific frequency

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

Transponders





Receiving 3 signals 23 cm uplink
Transmitting 3 signals 13 cm downlink

A transponder can receive several signals at once and convert them to a new range. Whatever mode is received is retransmitted. [E2A07]



Because all users must share the power output, continuous-carrier modes such as FM and RTTY generally are not used through (transponder-equipped) amateur satellites. Limit your transmitted ERP, too. [E2A08]

OPERATING PRACTICES
2.2 AMATEUR SATELLITES

An inverting linear transponder uses a difference product of a mixer's output to invert the uplink signals before sending them. If you send to the satellite at the bottom of the uplink band pass your signal is reversed to the top of the downlink.

Your uplink is USB; your downlink is LSB. This counteracts effects of Doppler shift of the signals.

An increase in uplink frequency results in a corresponding decrease in downlink frequency. [E2A02, E2A03]

Satellites called PACSATS can receive a message and store it for retrieval by someone else at a different time. These store-and-forward systems act almost like a bulletin board forwarding system. [E2A12, E2A13]

OPERATING PRACTICES 2.2 AMATEUR SATELLITES

Satellite Operating Frequencies (Table 2.2)

	BAND	FREQUENCY	MODE	U/V	V/U	L/U	V/H	H/S	L/S	L/X	C/X
HF	15-10 METERS	21-30 MHz	H				TX	RX			
VHF	2 METERS	144-146 MHz	V	TX	RX		RX				
UHF	70 cm	435-438 MHz	U	RX	TX	TX					
UHF	23 cm	1.26-1.27 GHz	L			RX			RX	RX	
UHF	13 cm	2.4-2.45 GHz	S					TX	TX		
UHF	5 cm	5.8 GHz	C								RX
UHF	3 cm	10.45 GHz	X							TX	TX
UHF	1.5 cm	24 GHz	K								

Transponders identified by MODE. The operating mode of a satellite identifies the uplink and downlink frequency bands the satellite is using. [E2A04]

Mode U/V: the uplink band (satellite receive) is always the first letter.

U-UHF / V-VHF/ L-Band 23cm/S-Band 13cm [E2A05, E2A09]

Q & A

QUESTIONS & ANSWERS