DUTCH FORK AMATEUR RADIO GROUP
LITTLE MOUNTAIN, SC

DFARG Signal

Volume 1, Issue 8

September 17, 2019

Go Fly a Kite!

The suspension of a vertical antenna from a kite is an idea that dates back to the very birth of radio. When Guglielmo Marconi received the first transatlantic radio transmission in 1901, his receiving antenna was suspended from a Baden-Powell Levitor kite. The use of kites to suspend meteorological instruments and even human observers was widespread in the 19th and early 20th century. Adapting to radio use was a logical next step.

Though not practical for a fixed installation, suspending a vertical antenna from a kite can be a fun and interesting project. For the homebrew enthusiast, a kite antenna can be flown for less than $20 (minus the antenna itself) and an afternoon's work. Alternatively, for $69.99, an entire set-up (minus antenna) can be had from SOTABeams, via DX Engineering.

The SOTABeams kit uses a sled-type kite. These are easily transportable, light, and, in keeping with an important principle of kite antennas, allow for a system which can fail safely. In this case that means that, should the flying line break, the sled antenna will collapse and make a beeline for the ground. Unfortunately, they tend to do the same thing if there is a momentary drop in wind, as well.

Rigid box-type kites are very stable, good lifters, and tend to be more forgiving of momentary wind-speed drops. In the case of a line break, however, they may fly for a considerable distance before returning to earth. Box kites are easily made from scratch with material readily and cheaply available.

A consideration unique to vertical antennas suspended from kites is that of the accumulation of a significant static charge, even in clear weather. To avoid a potentially damaging surge, connecting a 2 watt, 100K or greater ohm non-inductive resistor between the antenna and the ground will act as an effective of static bleed resistor. As with any other end-fed vertical antenna, the use of radials is recommended.

The antenna should never be used as the flying line. A kite sailing away trailing a long piece of wire present significant safety issues.

Best performance can be achieved by attaching the antenna to the flying line a few feet short of the kite, preferably using some narrow diameter (~5mm) shock cord, with additional shock cord at the opposite end, as well. Screw-in dog stakes make great anchors for both the flying line and the antenna. A good kite line reel is not absolutely essential, but will the process much easier!

Find a clearing well away from trees and power lines and screw your first stake into the ground, Attach your kite reel to the stake, pay out 20 feet or so of line, then lock the reel.

See "Kite" on p.4

Inside this issue:

Monthly meeting is September 19th at 7:00 at the shack in Little Mountain. Kevan Nason, N4XL, will discuss contesting and logging

Upcoming Regional Hamfests and Conventions

09/20/2019 | W4DXCC, DX and Contest Convention
Location: Pigeon Forge, TN

09/21/2019 | Coal Country Amateur Radio Club HamFest
Location: Madison, WV

09/28/2019 | ARCS Hamfest
Location: Paintsville, KY

09/28/2019 | Pasco Co HamFest
Location: Odessa, FL

10/05/2019 | 7th Annual TailgateFest
Location: Hollywood, MD

10/05/2019 | 8th Annual Vette City Hamfest
Location: Bowling Green, KY

10/05/2019 | Pinecastle Hamfest
Location: Orlando, FL

10/05/2019 | Rock Hill Hamfest
Location: Rock Hill, SC

10/05/2019 | Trident Amateur Radio Club Tailgate
Location: Goose Creek, SC

10/11/2019 | ARRL Florida State Convention, 54th Annual Melbourne Hamfest
Location: Melbourne, FL

10/12/2019 | Deep South Amateur Radio Club Hamfest
Location: Chickasaw, AL

10/12/2019 | Parkersburg, Wood County Hamfest
Location: Mineral Wells, WV

10/12/2019 | W4NC Fall-Fest
Location: Winston-Salem, NC

10/18/2019 | Delta Division Convention (Hamfest Chattanooga 2019)
Location: East Ridge, TN

10/19/2019 | CARES Tailgate & Hamfest
Location: Gaffney, SC

10/19/2019 | Headland Tailgate
Location: Headland, AL

Regional Net Schedule

All Times in Eastern Time Zone

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	South Carolina SSB Net 1900 3.915						
	Coastal Carolina Emergency Net 1900 3.907						
	South Coast Amateur Radio Service 0800-1100 7.251						
	Intercontinental Amateur Traffic Net 0700-1100 14.300						
		Salvation Army Team Emergency Radio Network 1100 14.265					
		7240 Club 1000-1200 7.240					
1930		Little Mountain 147.210 + T156.7					
2000		Kershaw ARC 146.775 - T156.7	Sandlapper SSB 50.250		Calhoun ARES 146.670 - T 156.7		
2030	Columbia ARC 147.33 + T 156.7		Lexington ARES 147.000 + T123.0	Columbia ARC 147.33 + T 156.7			
2100	Ridge ARC 146.550 Simplex				Greenwood ARS 147.165 + T 107.2		Ridge ARC First Saturday 3.959
	Ridge ARC 147.255 + T123.0 after simplex						

DFARG Monthly Meeting, July 18, 2019

1. David Graham, President of DFARG, called the meeting to order at 7:00 pm.

2. David Graham, as is customary, called the Secretary, Jim Walters, to read the Minutes for the July 18, 2019, Meeting. The Secretary announced that a member suggested that reading of the Minutes be discontinued as it required too much time which time could be better used for other matters of interest to the Group. Also, It was noted that members could read the Minutes themselves when posted on w4dfg.org and on DFARG's email newsletter, the Signal. The Secretary explained that he was concerned that verification of members reading the proposed Minutes posted to w4dfg.org and the Signal, which Minutes would be subject to correction and approval at the next meeting, was too speculative.

To resolve the issue, two questions were asked of the Group, (a) how many of you read the proposed July 15, 2019, Minutes posted to w4dfg.org, or in the Signal, and, (b) do you have any corrections to the proposed Minutes. It was determined by a show of hands that a majority of members in attendance at the August 15, 2019, meeting had read the proposed July 18, 2019, Minutes posted to w4dfg.org and the Signal and had no corrections to the Minutes. Therefore, a motion was made and seconded to approve the proposed July 18, 2019, Minutes posted to w4dfg.org, and the Signal which motion carried unanimously.

Consequently, hereafter proposed Minutes will not be read at the next ensuing meeting if a majority of members in attendance at such meeting indicate that they have read the proposed Minutes posted to w4dfg.org and the Signal. That being the case, a motion will be made to approve the Minutes as posted to w4dfg.org and the Signal. Corrections to the Minutes, if any, will be included in the motion for approval and the Secretary will make such corrections in the approved minutes prior to filing.

3. Hugh Sammons advised that he had received a warranty offer of $200.00/year from the company that had repaired DFARG's A/C. The offer was rejected as those officers the Treasurer conferred with felt it was best to pay for repairs as needed.

4. New members, Clifford Conti, K2CCC, and Marcus Hill, KL2EY, were recognized and welcomed by President Graham. Later they were processed by the Treasurer and their information was added to the Roster by the Secretary. Also noted, seated on the front row, were visitors Richard Baiser, KC4AKN, and Bob Smith, KN4FXT.

5. Jack Jackson spoke with affection of the loss of DFARG's 104 year old member Marvin Bernstein, W2PAT. who passed away last week of pneumonia. Marvin, first licensed in 1932, remained a active amateur radio operator and participated in Air Force MARS as RTTY net control until recently. As a recognized expert on quartz crystal frequency control he made many presentations on the subject and traveled post WWII Europe during his thirty year stint with the Signal Corp. In 1957 Marvin set up a listening station to monitor Russia's Sputnik satellite which preceded the 1961 launch of OSCAR 1. W2PAT treasured his association with DFARG and regularly attended meetings until his daughter decided it was best for him to stay home. In his obituary Marvin's family asked that In lieu of flowers contributions be made to DFARG. Marvin's daughter told Jack she is aware that DFARG is a 501(c)(3) charity and wants to donate Marvin's radio equipment to DFARG when probate is concluded.

6. Jim Walters explained that he and Hugh Sammons, Treasurer, have been trying to update and correct the DFARG Roster. A request was made of members to, "please check all your information for accuracy on the sign-in sheet located at the front door before leaving". Jim stated that we are all part of the DFARG family and there will be times when we need to contact each other. Accurate name, email and call sign information on a roster made available to all members make that possible. When updated the Roster will be sent to each member as an Excel file attached to email. Open the file and click on the email addresses of choice on the roster to activate your "New Mail" message app. Advise Jim If you aren't using a Windows O/S with Excel or equivalent spread sheet program or cannot open the file and he will mail you a hard copy of the Roster.

7. Charlie Brown presented a well prepared, comprehensive program on OSCAR (Orbiting Satellite Carrying Amateur Radio) communication. Topics addressed were: (a) OSCAR History, (b) Satellite Orbits and Tracking, (c) Satellite Communication Systems; and (d) Ground Station Design and Operation. A summary of these subjects can be found on page 6

8. The meeting was adjourned at approximately 8:05 pm.

Treasurer's Report

Beginning Balance	1,159.14
Dues Collection	+15.00
Closing Balance	1,174.14

Kite, from p.1

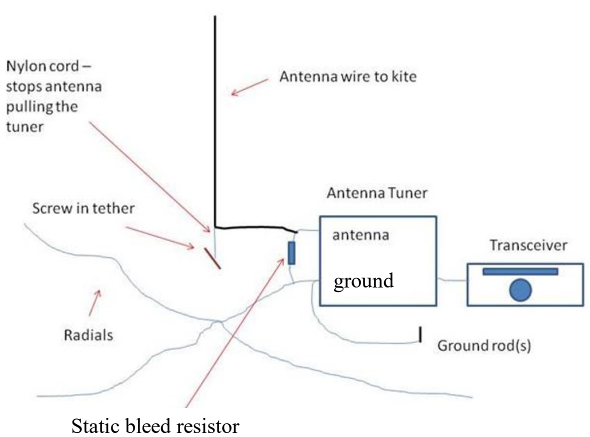
Carry your kite and your antenna downwind to the extent of the line you paid out. Attach your antenna, zig-zag your wire on the ground, face into the wind, and let your kite go. Forget all that running around you did as a kid to your kite up. If it doesn't rise out of your hands, you've picked the wrong day!

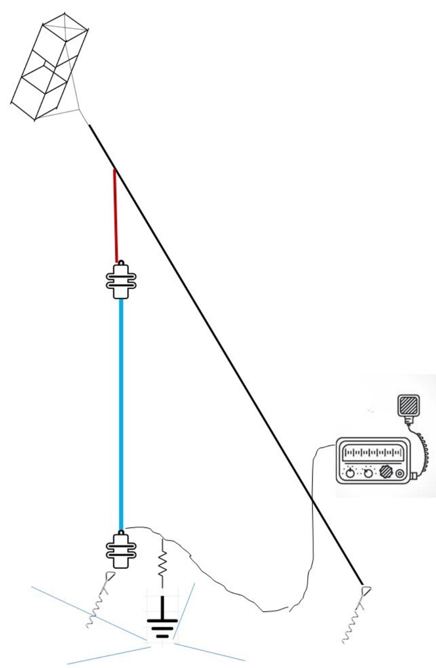
Move back to your anchor, unlock your reel, and let your kite carry your antenna up until your bottom insulator is just above ground level, then lock your reel again.

Move to the base of your antenna and screw in your second stake. USE CARE IN DISCHARGING YOUR ANTENNA TO THE GROUND BEFORE CONNECTING. A charge of a a few hundred volts can accumulate, even on clear days, even under a 300 feet.

Lay out your radials, attach your ground and static bleed resistor, hook up your lead line and you're off to the races!

When the time comes to end operations, using a carabiner is much easier than reeling in your flying line against the pressure your kite is generating. Simply snap the carabiner around the line, then walk downwind holding the carabiner. You will simply and easily walk your kite to the ground.





Upcoming Contests

September
21-22 10 GHz & Up - Round 2
21-22 EME - 2.3 GHz & Up
21-22 Collegiate QSO Party
21-22 New Hampshire QSO Party
21-22 New Jersey QSO Party
28-29 CQ Worldwide DX-RTTY
28-29 Maine QSO Party

October
5-6 California QSO Party
12-13 Nevada QSO Party
12-13 Pennsylvania QSO Party
12-13 Arizona QSO Party
12-13 South Dakota QSO Party
19-20 New York QSO Party

WE'RE ON THE WEB!
WWW.W4DFG.ORG

Upcoming DXpeditions:

For more information go to https://www.ng3k.com/

Start	End	DX Entity	Call	Bands/Modes
Sep12	Sep18	Liechtenstein	HB0/DL4APJ, /DJ2AX, /DL5ARG	80-10m; CW SSB PSK RTTY FT8 FT4
Sep12	Sep20	Palau	T88MK	160-6m; CW SSB JT65 JT9 FT8 FM
Sep14	Sep25	Palau	T88/RR, /MK, 8/VV, /HY, /FM, /NC	160-6m; CW SSB RTTY
Sep15	Sep22	Mariana Is	WH0RU	40-10m; CW SSB RTTY
Sep15	Sep30	eSwatini	3DA0AO	80-10m; CW RTTY FT8
Sep16	Sep21	Tonga	A35J4	HF; SSB
Sep16	Sep25	Nauru	C21WW	160-6m; CW SSB RTTY FT8
Sep20	Sep25	Hawaii	KH6/IK5SRF	HF; mainly CW, some SSB
Sep20	Sep25	South Cook Is	E51SFS	40-10m; CW FT8
Sep20	Oct03	Crete	SV9/PH2M	
Sep20	Oct07	Honduras	HQ9X	All bands, incl 60m (50w, USB); all modes; sked requests to W1UE
Sep21	Sep27	Isle of Man	MD/OP2D	160-6m SSB CW FT8 RTTY
Sep21	Sep28	Guyana	8R1CW	HF
Sep21	Oct07	Belize	V31US	80-20m + 10m; SSB + digital
Sep23	Sep27	Fiji	3D2VR	HF; SSB
Sep24	Oct06	Tonga	A35JT	160-6m; SSB CW FT8 RTTY 6m EME
Sep24	Oct08	St Pierre & Miquelon	FP/KV1J	160-6m; mainly SSB RTTY FT8; some CW
Sep25	Sep30	Minami Torishima	JD1BNA	160-17m; CW SSB FT8
Sep27	Oct03	Vietnam	3W9KJ	HF; FT8 FT4
Sep29	Oct05	Tanzania	5H3MB	HF; SSB CW RTTY
Sep29	Oct05	Tanzania	5H3/CA, /RRC	160-10m; CW SSB
Sep29	Oct06	Malta	9H3GK	By DL7OO DO5GS DO2SS; HF; holiday style operation
Sep29	Oct13	Cape Verde Is	D44TWO	160-10m; FT8 PSK31 JT65 RTTY + some QRS CW;
Sep30	Oct11	Liberia	A82X	; 160-10m; CW SSB + digital (A82Z on digital)
Oct01	Oct19	Lesotho	7P8AO	80-10mmainly CW FT8
Oct02	Oct11	Tokelau	ZK3A	160-6m; CW SSB RTTY PSK31 FT8
Oct02	Oct14	St Pierre & Miquelon	TO80SP	160-10m; CW SSB + digital
Oct03	Oct10	Vanuatu	YJ0BCP	40-6m; CW SSB FT8; QSL FT8
Oct03	Oct13	Cyprus	5B/DL2SBY	80-6m; SSB CW + digital
Oct04	Oct13	Br Virgin Is	VP2V	160-10m; mainly CW, RTTY FT8 FT4 SSB
Oct05	Oct12	Belize	V31CC	HF
Oct05	Oct12	Belize	V31JW	HF
Oct05	Oct12	Market Reef	OJ0W	80-30m; CW SSB

Upcoming DXpeditions, cont'd:

Start	End	DX Entity	Call	Bands/Modes
Oct07	Oct23	West Kiribati	T30GC	160-10m; CW SSB RTTY
Oct08	Nov04	Norfolk I	VK9N	HF; CW SSB + digital
Oct12	Oct15	Bermuda	W9HT/VP9	HF + 6m; SSB CW FT8
Oct15	Oct30	San Andres & Providencia	5K0K	160-10m; CW SSB FT8
Oct17	Oct31	Aruba	P4/PA7DA	40 20 10m; FT8 SSB CW

Ham Satellites

OSCAR History: With the support of the ARRL and the U.S. Air Force a small group of California amateurs organized as Project OSCAR built 10 pound OSCAR 1 in their garages and basements. As ballast OSCAR 1 successfully launched aboard Discover 36 from Vandenberg AFB and obtained low Earth orbit on the morning of December 12, 1961. OSCAR 1 carried a small CW beacon transmitter that allowed 570 amateurs in 28 countries to measure radio propagation through the atmosphere. The beacon also transmitted telemetry indicating the internal temperature of the satellite.

Since OSCAR 1 more than 70 OSCARs classified by the Phase of their design and flight characteristics have launched. **Phase I** designs comprised the low Earth orbit (LEO), short lifetime, predominately beacon oriented satellites such as OSCARs 1 through 4 which failed to attain its intended orbit in 1965.

In 1969, the Radio Amateur Satellite Corporation (AMSAT) consisting of volunteers from many nations was formed to provide technical assistance in the design and development of OSCARs. AMSAT volunteers have pioneered a wide variety of new communication technologies including voice transponders and advanced "store-and-forward" digital messaging (Mailbox) techniques and have participated in the vast majority of satellite projects in the U.S. and internationally.

Phase II OSCARs are also LEO birds, but are launched into somewhat higher orbits and are designed for longer lifetimes. These AMSAT satellites included OSCARs 6,7 and 8, as well as, UoSAT OSCARs 9 and 11, built by AMSAT members and students at the University of Surrey in England. These OSCARs were followed by a series of analog and packet satellites built by AMSAT members from several countries that were launched into similar orbits. Microsats a subset of Phase II, consist of small one square foot cubes or rectangular shaped satellites that make up the bulk of the OSCARs now in orbit.

Satellite Orbits and Tracking: Amateur satellites, excepting geostationary satellites which remain in a fixed position above the earth's equator, are in circular orbits at altitudes 400 to 600 miles above earth, or in elliptical orbits which take them from a 1000 mile perigee to apogee 22,000, miles into space. As the orbital speed of LEO (Low Earth Orbit) and HEO (High Earth Orbit) OSCARs vary from that of Earth's rotation, they rise above the horizon where signals may be acquired (AOS), soar to zenith altitude (peak elevation), then set below the horizon with loss of signal (LOS).

An inclined orbit is inclined with respect to the Earth's equator. A sun-synchronous orbit circles the Earth's north and south poles allowing at least one high elevation pass per day for every ground station (observer). A dawn-to-dusk orbit positions the satellite mostly in sun light with little time spent in eclipse, better for recharging solar cells. The Molniya orbits, pioneered by the Soviet Union, may carry a bird 22,000 miles into space. The footprint of a Molniya orbit satellite at apogee is the entire hemisphere of the planet allowing most observers to enjoy long, leisurely conversations spanning thousands of miles here on Earth. Although no longer active, Oscar 10 and 13 using inverting SSB transponders were the most popular of the elliptical orbit satellites. Due to the high cost of design, development, construction, launching and maintenance there are no active Molniya satellites at this time. LEO satellites such as Saudi OSCAR 50 (SO-50), a FM repeater, are currently the most popular.

The area of the Earth that is visible to the satellite, it's footprint, can vary considerably depending on its altitude. Low orbiting ISS has a 375 mile diameter footprint while the higher orbiting Saudi-Oscar 50 has a footprint over 900 miles across. The amount of time an observer has to communicate (duration) depends on how long the ground station remains within the footprint. Oscar 50 orbits the Earth every 98 minutes providing ten windows of seven to fourteen minutes duration each day.

Tracking software necessary to determine how long and when SO-50 is in view of a ground station (time between AOS and LOS) that also provides beacon, uplink and downlink frequencies together with azimuth and elevation bearings to aim the antennas is available from many sources. Windows tracking programs, Nova, SCRAP, and SatPC32, are available from amsat.org (store). Ham Radio Deluxe another popular windows tracking program may be found at hrd.ham-radio.ch. SatScape a Java based windows program can be down loaded from satscape.co.uk/classic.html. WinOrbit can be downloaded from sat-net.com/winorbit. MacDoppler, dogparksoftware.com/MacDoppler.html is available for Mac operating systems. All programs graphically display orbital tracks on a Earth overlay. A few of these programs support radio control of doppler shift correction, as well as, azimuth and elevation tracking control of antenna arrays.

Doppler Shift: Due to the high speed of amateur satellites relative to a Earth bound observer, the uplink and downlink frequencies will vary during a satellite pass. This phenomenon is known as the Doppler effect. While the satellite is moving toward the ground station the downlink frequency will appear incrementally higher than normal to the observer. Therefore, the ground station receiver must be adjusted incrementally higher to continue receiving the satellite. Correspondingly, the satellite will be receiving the uplink signal at a higher frequency incrementally than normal so the ground station's transmitted uplink frequency must be incrementally lowered to be received by the satellite. After the satellite passes overhead through it's zenith and begins to move away, this process is reversed. The downlink frequency will appear lower and the uplink frequency will need to be incrementally adjusted higher.

As an alternative to installing a tracking program on your computer an online tracking service may be used thus avoiding the complexity and hassle of downloading and setting up software on your PC. Although online programs are not as powerful or flexible as PC installed software you will find that amsat.org/amsat-new/tools/predict/ is all that is needed to accurately track the FM-LEOs. After the online app loads simply choose a satellite from a drop down menu, ex. SO-50, enter the decimal latitude and longitude coordinates and altitude in meters of your location, then, click on the Predict button. Print out the resulting tabular data and go work SO-50.

Computer tracking programs use Keplerian elements to calculate a satellite's orbit. A satellite's orbit can be affected by small periodic and sporadic perturbations due to atmospheric drag, magnetic storms and other factors. Consequently, orbital elements need be updated from time to time. Ground stations using either a low gain beam or omnidirectional antenna working a linear transponder on a satellite in a low altitude circular orbit, such as SO-50, will find that a set of orbital elements will provide reliable tracking for three to six months for satellites above 600 miles.

Continued on next page

For satellites with orbital altitudes between 375 miles and 500 miles updating every second month should be sufficient. For satellites such as ISS orbiting below 300 miles daily updating is often required.

Satellite Communication Systems: From their vantage point in space amateur satellites employ VHF, UHF and microwave links to process a tremendous volume of analog and digital information. Unlike terrestrial HF communication OSCARs do not require large antennas or hefty power systems and operate free of the vagaries of ionosphere propagation. Also, Technician class licensees may operate on OSCAR frequencies.

A typical OSCAR consist of Beacon, Command and Transponder systems. In telemetry mode beacons report the health and functionality of on board devises, such as, solar cell current levels, temperature of various modules and battery condition); in the communication mode beacons can be used for store-and-forward digital packet broadcast; in either mode they can used for tracking, propagation measurements, Doppler shift studies and as a reference signal for testing and adjusting ground station receivers. Beacon power levels at 146 and 435 Mhz are 40 to 100 mW on LEOs and 500 mW to 1.0 W On HEOs. Satellite Command and Control systems are utilized by authorized volunteer ground stations to: (a) turn off malfunctioning transmitters causing harmful interferences to other services; (b) upload command software to on board computers; and (c) make orbital changes and attitude adjustments necessary for the health of the satellite.

Three types of **transponders**, the system permitting the satellite to relay signals, presently in use are **bent-pipe, linear and digital**. Bent-pipe transponders receive a signal on a uplink frequency then instantly retransmits it on an associated downlink frequency. Bent-pipe transponders are mostly found on FM repeater LEOs. The principal advantage of a bent-pipe satellite transponder is that it is compatible with common amateur radio FM transceivers used to work terrestrial FM repeaters.
The principal disadvantage of a bent pipe transponder is that it is a single channel system. It can only relay one signal at a time and due to the FM capture effect, as with terrestrial FM repeaters, the strongest uplink/input signal captures the repeater to the exclusion of all others on frequency. At the present time OSCAR 50 is the go to LEO, VU mode (2 meters uplink/70 cm downlink) FM repeater as OSCAR 51, 27 and 67 are reported lost or inactive. Unlike bent-pipe transponders, a linear transponder receives signals in a narrow slice of RF spectrum (15 kHz – 100 kHz), shifts the frequency of the passband, amplifies all signals linearly, then, retransmits the entire slice. The stated uplink and downlink frequency of a linear transponder are passband centered. Linear transponders downlink and uplink frequencies are usually inverted to minimize the Doppler effect.

In general, LEOs (300 miles to 1000 miles altitude) that use passive magnetic stabilization and omnidirectional antennas provide reasonable downlink performance with from 1 to 10 W PEP at frequencies between 29 and 435 MHz, using a 50 to 100 kHz passband transponder. High-altitude (22.000 mile apogee or geo-stationary) spin stabilized satellites that use 7 to 10 dB gain antennas should function well with 5 W PEP output using a 300-kHz-wide downlink at 146 to 435 MHz.

Digital transponders demodulate the incoming digital signal which is stored aboard the satellite in its “Mailbox” or immediately regenerate it as a digital downlink signal. The store-and-forward mailbox service is best suited to low altitude satellites. Digipeating is more effective on high altitude satellites.

Ground Station Design and Operation: Basic components of an observers ground station are the **transceiver, antenna system and a computer**. Of these the antenna system is the most important contributing greatly to successful satellite communications. A simple antenna system may consist of a medium gain , hand held, dual band yagi used with a dual band hand held transceiver to work low earth orbit FM repeaters. A costly sophisticated tower attached, computer controlled azimuth/elevation rotated, separate circular polarized high gain yagis with mast mounted receive preamps, feed with low loss hardline antenna system is best suited to work HEOs. Azimuth only rotated high gain yagis set at a fixed elevation of 25 degrees is a workable alternative to computer controlled azimuth/elevation systems. However, if the beam width of the high gain antennas is too narrow accurate tracking will be more difficult to achieve.

Dual band, full duplex transceivers, whether hand held, mobile or fixed, that are able to transmit and receive on 2 meters and 70 cm independently are available from Icom, Kenwood and Yaesu. As an alternative to a single fully integrated transceiver with separate antenna connections for 2 meters and 70 cm, many ground stations use separate hand held transceivers with the popular manually aimed, Arrow crossed yagi gain antenna to work the LEO FM repeaters. The transceiver should have a built in packet radio terminal node controller (TNC) for use with digital transponders.

Transceivers used to communicate with SO-50 must have a CTCSS tone encoder. Two CTCSS tones are transmitted to SO-50 first to open the repeater and a second tone to pass each transmission. A computer will be needed to generate from either a downloaded tracking program or online service, time of AOS, duration and azimuth/elevation information necessary to determine where and when and for how long the ground station will be in the footprint of AO-50 and aim the antennas.