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Our Cover: The USSR pavilion at TELECOM-79, a large telecommunications exhibition which preceded WARC-79 in Geneva in September of that year, featured an Amateur Radio display which included this blue-and-white package identified as an RS-Satellite Transponder. Is it one of those now in orbit as RS-3 through RS-8? (Photo by Dave Sumner, K1ZZ).
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OSCAR

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TECHNOLOGY OF TODAY TO HELPING THE
YOUNG NOVICE GET HIS FIRST SIGNAL ON THE AIR.

AND OUR OSCAR 8 & 9 ORBITAL DATA
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Ellipsis...

AN EDITORIAL BY VERN RIPORTELLA, WA2LQQ*

Symbols. Life abounds with them. Some say life is nought but symbolism. Even if that pronunciation is untrue, symbols do play an astoundingly complex role in everything we are and everything we do. Apparently symbols have always been important to human beings. Cave paintings from France, tool adornments from Peru and the great Pyramids of Egypt are easily viewed as symbols. The Pyramids were symbolic to the builders, and the owners (some of whom later became the occupants). Furthermore, the great philosophers and prophets of antiquity spoke in a language rich with symbols. Jesus, Mohammed, Moses, Bhudda, Confucius and Zoraster spoke to their respective flocks in terms of symbols (parables). Indeed, the term “flock” is a symbol (metaphor) in itself. The question is, why use symbols at all? The prophets used symbols, no doubt, because in their wisdom they recognized explicitly the power of symbolism as effective communication tools; vehicles for conveying important yet abstract concepts such as ethics, metaphysics, etc.

“What,” you may well be asking, “has all this got to do with amateur satellites?”

Consider OSCAR a symbol. You needn’t select any OSCAR in particular; just OSCAR. Is it plausible that OSCAR obtains an enriched character, a dimensionality if you will, if viewed as a symbol?

At first blush it seems rather trivial to view OSCAR as a symbol. It is so widely recognized an image, however, that we might like to pursue the imagery beyond the superficial, trivial aspects.

Amateur Radio is a limited-edition ARRL publication sent largely to national policy makers and leaders in the Amateur Radio Community. Its cover design contains some interesting symbolism. (See below) The designer sees the amateur world in quarter spheres. The stylized United Nations symbol (Earth with olive branch) signifies international brotherhood; peace and understanding. The facial profile in conjunction with the HT denotes public service and emergency communications. The image of OSCAR 8 above the Earth symbolizes technical acumen; innovation. The ARRL logo in this context is seen as the unifying influence in binding the foregoing elements.

Why does OSCAR 8 appear as representing the technological arena? Is OSCAR 8 the most sophisticated Amateur Radio enterprise of all time? We suspect not. Its use as symbol, we find, is based on the richness of the image it conveys and the simplicity of the image itself. In other words it is another example of conveying a very complex subject (advanced technology) with a recognizable, simple symbol. Thus, OSCAR 8 in the context cited above, is an effective symbol. What’s more, we suspect that because it is an effective symbol, it assumes a general significance beyond that which it might inherently possess.

Now that we have broached the subject, let’s see what lies deeper. Freudian’s might suggest intriguing aspects of OSCAR symbolism resulting from its manner of “birth.” After a harrowing journey from Earth this new entity, OSCAR, emerges from a sleek, cylindrical rocket to find life in the Sun.

Other symbolic images connected with OSCAR seem much closer and practical. For example, I’ve wondered for some time at our marked predilection for knowing the precise time of rise/set of OSCAR. Come now! Are our lives really going to be lessened if OSCAR appears ten seconds later than expected? Yet I find myself, stop-watch in hand, breathing a sigh of relief as 8J peeps across the horizon at me precisely on schedule. Why? Seen symbolically, this apparently innocuous neurosis expresses a human need for assurance “that all is well with the world.” After all, if the “heavens” can’t keep its affairs in order, what can be expected from we mortals? Sure enough, though, the sun rises and sets in well-

*Editor, ORBIT Magazine

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SATELLITES & 73
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73 Magazine has more articles on satellites than any other ham magazine. A sampling of articles from the past shows why 73 has the leading edge:
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UoSAT OSCAR 9 is the new Amateur Scientific and Educational Spacecraft project managed by Dr. Martin N. Sweeting, G3YJO, at the University of Surrey in England. UoSAT was introduced in previous articles. It is jointly sponsored by the University of Surrey, AMSAT, the Radio Society of Great Britain, and the British Industry and Research Organization. UoSAT's Propagation Experiment is the subject of this article. We will deal with the magnetometer and radiation counter telemetry transmitted by the spacecraft's General and Engineering Beacons on 145.825 and 435.025 MHz, respectively. Our discussion includes an operational description of the on-board magnetometer and radiation counter, the telemetry format, and some suggestions for studying the received data together with signals from the HF and microwave beacons.

Radio propagation, particularly at HF, is closely linked to conditions within the ionosphere and Earth's magnetic field. The layers of ionized gases are being constantly modified by radiation from the sun. Radiation also has an effect on the Earth's magnetic field. Sunspot activity, solar flares, etc., often create Aurora and magnetic storms affecting the ionosphere. Shifting magnetic fields have been known to disrupt wire-line communications such as telegraph by creating heavy earth currents. Geomagnetic storms are well-known among Amateurs for disrupting HF radio communications for long periods.

The Propagation Experiment, consisting of a magnetometer, radiation counters, HF and microwave beacons aboard the UoSAT spacecraft, provides us with an opportunity to study, "firsthand", the effects of the sun's radiation on the Earth's magnetic field and subsequently on HF, VHF and UHF propagation. If you are interested in getting involved in some real basics, have an interest in research and want to learn how to make use of this "new tool" read on.

Magnetometer

During World War II, the need to protect ships from magnetic mines created the demand for a device that was sufficiently sensitive to measure very low intensity magnetic fields. This led to the development of the flux-gate magnetometer which subsequently became widely used in geophysical research. A wide-range, flux-gate magnetometer on-board UoSAT measures the fine structure of the earth's magnetic field in three axes, i.e., it provides analog signals representing X, Y and Z components of the Earth's magnetic field, or relative flux density. The device is located on the end of a boom extending from the spacecraft. It provides real-time data for transmission via the General Data Beacon (145.825 MHz) and with higher resolution on the Engineering Data Beacon (435.025 MHz).

The device produces three analog signals (X, Y and Z components) ranging between 0 and 5V once every second. An analog to digital (A/D) converter produces sixteen bit digital values for each of the three analog signals. The device also sends a 10 microsecond strobe pulse to the on-board computer following each A/D conversion. This pulse presents a calibration word to the computer. Six subsequent strobe pulses following at 20 millisecond intervals cause the computer to read the digital data in the following sequence:

X, most significant byte (MSB) 8 bits
X, least significant byte (LSB) 8 bits
Y, MSB
Y, LSB
Z, MSB
Z, LSB

Thus, one complete sampling cycle requires 160 milliseconds. Once in the computer, the data may be stored for later retransmission over the Engineering Data Beacon at higher speeds and finer resolution. For
more details refer to the article by Dr. M. H. Acuna appearing in ORBIT Magazine No. 8 (Aug./Sept. 81).

Radiation Counters

UoSAT is equipped with two Geiger counters. One is set to count electrons with energies of 20 keV and above while the other set to count only those with energies of 40 keV and above. These energies were chosen to give good resolution on Auroral activity associated energy ranges.

Output from this subsystem is available in two forms: 1) a 12 bit count reflecting electron count rate (computer output) and 2) analog output to the telemetry system. Radiation counts are accumulated from both counters (detectors) over a period of 100 ms. During the next 100 ms period, data is addressed to the computer data base. The information is also passed through a digital to analog (D/A) converter and the resulting analog level is made available for transmission on the General and Engineering Data Beacons.

HF and Microwave Beacons

HF beacons operating at 7.050, 14.002, 21.002 and 29.510 MHz and microwave beacons operating at 2.401 and 10.47 GHz provide the signal sources to be studied as part of the Propagation Experiment. The four hf signals are phase related. All four frequencies are derived from individual crystal oscillators. The 7 MHz oscillator output is chosen as the reference frequency. The other oscillators are phase compared and can be locked to the 7 MHz reference. These phase referenced signals enable the simultaneous investigation of transionospheric propagation on several different frequencies. All four signals are transmitted simultaneously and will be heard as steady carriers (A0) or will be modulated (A1) with modulation information controlled by the spacecraft’s computer. Output power of each is 100 mw.

The microwave signals provide an opportunity to examine the differences in propagation at 2.401 and 10.47 GHz. Admittedly the spacecraft-to-ground transmission link budget is extremely marginal. Considerable skill will be required to overcome Doppler shift and az/el tracking complications.

Telemetry Format

The UoSAT telemetry subsystem provides three types of information. First, it provides knowledge of the status of the spacecraft’s subsystems, i.e., whether the engineering beacon is ON or OFF, whether the hf antenna A is stowed or deployed etc. Secondly, it provides information regarding the performance of certain subsystems. For instance, battery voltages, charge/discharge current, temperatures, etc., can be telemetered. Finally, the telemetry system provides data collected by the various on-board experiments.

<table>
<thead>
<tr>
<th>Address</th>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>Radiation Detector A · Data</td>
<td>0-5V</td>
</tr>
<tr>
<td>04</td>
<td>Radiation Detector B · Data</td>
<td>0-5V</td>
</tr>
<tr>
<td>05</td>
<td>Magnetometer X Coarse Data</td>
<td>0-5V</td>
</tr>
<tr>
<td>06</td>
<td>Magnetometer Y Fine Data</td>
<td>0-5V</td>
</tr>
<tr>
<td>07</td>
<td>Magnetometer Y Coarse Data</td>
<td>0-5V</td>
</tr>
<tr>
<td>15</td>
<td>Magnetometer X Fine Data</td>
<td>0-5V</td>
</tr>
<tr>
<td>16</td>
<td>Magnetometer Z Coarse Data</td>
<td>0-5V</td>
</tr>
<tr>
<td>17</td>
<td>Magnetometer Z Fine Data</td>
<td>0-5V</td>
</tr>
</tbody>
</table>

A typical telemetry frame is pictured in Fig. 1. Note that the actual data is carried in the three digits following the address.

The data from the magnetometer and radiation detectors, for instance, are our chief concern here. These data are, however, made available only within the frames of information containing input from all available 60 channels of the telemetry system. The data of interest (the magnetometer and radiation detector output) are identified within each frame by unique addresses. The first two digits of each data block within a frame carry this address. The channels (addresses) of primary interest to us are shown in Table 1.

In addition, telemetry channels 00 to 09 only can be transmitted in Morse at 10 or 20 wpm. Table 2 contains a listing of all telemetry channels for those who may be interested in the whole picture.) At the highest data rate (1200 baud) about 8 seconds is required to transmit one complete frame. Since this is slightly less than the experimental instrument sample rate, instrument data are time-averaged and presented within the telemetry frame. (High time-resolution experimental data can be made available via the spacecraft computer for more detailed analysis.) High-speed data at 1200 bps are transmitted as phase-synchronous AFSK using 1200 Hz tones as “1” and 2400 Hz tones as “0”. At speeds other than 1200 bps the 1200 Hz tone represents “1” and the 2400 Hz tone represents “0” as before but the data transitions are asynchronous.

AMSAT 00000 00000 00000 00000 00000 00000 00000 00000 00000
AMSAT 00000 00000 00000 00000 00000 00000 00000 00000 00000
00000 01000 02000 03000 04000 05000 06000 07000 08000 09000
10000 11000 12000 13000 14000 15000 16000 17000 18000 19000
20000 21000 22000 23000 24000 25000 26000 27000 28000 29000
30000 31000 32000 33000 34000 35000 36000 37000 38000 39000
40000 41000 42000 43000 44000 45000 46000 47000 48000 49000
50000 51000 52000 53000 54000 55000 56000 57000 58000 59000

Radiation Data, Magnetometer Coarse Data, Magnetometer Fine Data

Telemetry data can be transmitted by both the General and Engineering Data Beacons at these rates:
1200 baud ASCII
300 baud ASCII
110 baud ASCII
45.5 baud BAUDOT

Fig. 1 Typical Telemetry Frame
Recording Data

The magnetometer data received over the telemetry link (frame blocks carrying addresses 05 through 09 and 15 through 17) will represent the strength of the Earth's magnetic field measured on each of three axes. These data are represented by coarse and fine values varying between 000 and 999. Keep in mind that these values represent relative magnitudes. Since we are interested in observing field changes and corresponding effects on propagation, absolute values of the field are of little consequence at this point. A process for converting these values to more meaningful ones is discussed below.

Similarly, the radiation detectors (telemetry addresses 03 and 04) will provide a value representing, in relative terms, the quantity of particles counted during each sample period with energies exceeding 20 keV and 40 keV, respectively. Here again we are primarily interested in observing relative changes rather than absolute values.

During each usable orbit a hard copy (printed copy) of UoSAT's telemetry will be required. The hard copy will consist of several frames of data each having the appearance of the sample shown in Fig. 1. At the more elaborately equipped stations this hard copy will be made by ASCII printers running at speeds up to 1200 baud. However, most will be relying on good old Morse or, at best, BAUDOT RTTY. Stations will be able to access usable orbits during mid-afternoon and again during the pre-dawn hours. While these are not particularly convenient times for those who work for a living, all is not lost. Since the telemetry on 145.825 MHz will be fm, a receiver's squelch circuit can be used to turn a recorder on and off. Doppler shift\(^1\) may cause a delayed acquisition of signal (AOS) and an early loss of signal (LOS), but at least some data can be gathered without your constant presence in the shack.

In addition to the telemetry hard copy, other data will be useful too. For instance, we will want to observe and note the times of AOS and of LOS for each pass. This is accomplished by observing the reception of the signals from the General Data Beacon or from the Engineering Data Beacon or both. While we are at it, we will want to note the condition of these signals paying particular attention to such things as Doppler Shift, fading and/or rapid flutter. Polarization of the received signals might be determined if your receiving antenna can be switched readily from horizontal to vertical or from left hand circular to right hand circular polarization. You will want to take copious notes regarding the status of the hf beacons and, if your equipment suite allows, the microwave beacons. Here again items to be noted should include AOS, LOS, signal strength, fading, flutter, etc. Finally, although it will require some really advanced instrumentation, we will want to observe the phase relationships of the hf beacon signals. We hope to be able to say more about this challenge in subsequent articles.

As you will note, that's a lot of data to be gathered in a rather short time. Accordingly, some thought has been given to getting it all down in some sort of orderly and useful fashion. Forms for doing this are pictured in Figs. 2 and 3. Each has been printed full size so that copies can be made as required. Recording data for each pass of UoSAT will require the use of one Form A (Fig. 2) and up to eight Form B's. For instance, eight will be required if signal data is gathered for all of the beacons, i.e., two telemetry, four hf and two microwave. If only one observation is made of each beacon during a particular pass, a single Form B can be employed noting Beacon copied in the remarks column.

A few words of explanation will help the data reduction process. For instance, keeping in mind that we are only interested in that portion of each telemetry frame reflecting magnetometer and radiation data, transcribe the required information from the hard copy printout to a copy of Form A. Data from a particular telemetry frame are recorded on each line. The appropriate time is reflected in the column headed "UTC" and should reflect the time at which the specific telemetry frame was received. Be sure to include appropriate information on each A Form to identify a specific orbit, i.e., orbit #, date and crossing information.

Columns headed "RDA" and "RDB" are for Radiation counter A and Radiation counter B raw data. Those headed "HXC", "HYC" and "HZC" provide space for magnetometer "coarse" data while those headed "HXF", "HYF" and "HZF" are for recording magnetometer "fine" data. Remember, Fine data (channels 15, 16, and 17) will not be available when copying telemetry in cw format.

Form A also has provisions for recording current WWV propagation data eighteen minutes after each hour, WWV transmits 2800 MHz solar flux measurements, geomagnetic activity, A Index and Solar K Index. A discussion of these data appears in the ARRL Handbook. Briefly, solar flux consists of radio noise whose magnitude corresponds to the range of energies that excites the E and F layers of the ionosphere. The A Index provides an indicator of the

\(^1\)At this writing detailed telemetry transmission schedules were not yet available.

\(^\text{About } 3\text{ kHz or } 9\text{ kHz maximum on the vhf and uhf beacons, respectively.}\)
### Telemetry Channel Allocations

<table>
<thead>
<tr>
<th>Channel</th>
<th>Parameter</th>
<th>Range</th>
<th>Cal. Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Secondary S/C Computer (F100L)</td>
<td>0-1A</td>
<td>[ \begin{align*} I &amp;= 1.2N \text{mA} (0.125A \leq I \leq 1A) \end{align*} ]</td>
</tr>
<tr>
<td>01</td>
<td>Solar Array Current + X</td>
<td>0-2A</td>
<td>[ I = 1.12N + 200 (\text{for Is less than 200 mA}) ]</td>
</tr>
<tr>
<td>02</td>
<td>Battery Half Voltage</td>
<td>0-10V</td>
<td>[ V = N/100 \times 101 ]</td>
</tr>
<tr>
<td>03</td>
<td>Radiation Detector A O/P</td>
<td>0-5V</td>
<td>Count = 40N \times 101 ]</td>
</tr>
<tr>
<td>04</td>
<td>Radiation Detector B O/P</td>
<td>0-5V</td>
<td>Count = 40N \times 101 ]</td>
</tr>
<tr>
<td>05</td>
<td>Magnetometer Expt. HX-Coarse</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>06</td>
<td>Magnetometer Expt. HY-Coarse</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>07</td>
<td>Magnetometer Expt. HZ-Coarse</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>08</td>
<td>Battery Pack-A Temperature</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>09</td>
<td>Spacecraft Facet Temperature + X</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>10</td>
<td>Visual Display Expt. &amp; CCD Current</td>
<td>0-1A</td>
<td>[ I = 1.2(N - 30) \text{mA} (0.125A \leq I \leq 1A) ]</td>
</tr>
<tr>
<td>11</td>
<td>Solar Array Current + Y</td>
<td>0-2A</td>
<td>[ I = 1.12N + 200 (\text{for Is less than 200 mA}) ]</td>
</tr>
<tr>
<td>12</td>
<td>2.4 GHz Beacon Expt. Power O/P</td>
<td>0-1000mW</td>
<td>[ P = (N - 99)/0.633 \text{mW} ]</td>
</tr>
<tr>
<td>13</td>
<td>Radiation Detectors Expt. EHT Volts</td>
<td>0-1000V</td>
<td>[ V = N \text{volts} ]</td>
</tr>
<tr>
<td>14</td>
<td>Radiation Detectors Expt. Current</td>
<td>0-250mA</td>
<td>[ I = N(0.983) \text{mA} ]</td>
</tr>
<tr>
<td>15</td>
<td>Magnetometer Expt. HX-Fine</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>16</td>
<td>Magnetometer Expt. HY-Fine</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>17</td>
<td>Magnetometer Expt. HZ-Fine</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>18</td>
<td>Battery Pack-B Temperature</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>19</td>
<td>Spacecraft Facet Temperature - X</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>20</td>
<td>Spacecraft Computer Current</td>
<td>0-1A</td>
<td>[ I = 1.2(N - 25) \text{mA} (0.125A \leq I \leq 1A) ]</td>
</tr>
<tr>
<td>21</td>
<td>Solar Array Current Ass Y</td>
<td>0-2A</td>
<td>[ I = 1.12N + 200 (\text{for Is less than 200 mA}) ]</td>
</tr>
<tr>
<td>22</td>
<td>Battery/BCR + 14V Bus</td>
<td>0-20V</td>
<td>[ V = N/50 \times 101 ]</td>
</tr>
<tr>
<td>23</td>
<td>Sun Sensor + Z Axis</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>24</td>
<td>10.4 GHz Beacon Expt. Current</td>
<td>0-250mA</td>
<td>[ (N - 40)/0.97 ]</td>
</tr>
<tr>
<td>25</td>
<td>Magnetometer Expt. Temperature</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>26</td>
<td>Magnetometer Expt. Current</td>
<td>0-250mA</td>
<td>[ I = (N - 15)/0.952 \text{mA} ]</td>
</tr>
<tr>
<td>27</td>
<td>Telemetry Command Receiver Current</td>
<td>0-250mA</td>
<td>[ I = (N - 15)/0.952 \text{mA} ]</td>
</tr>
<tr>
<td>28</td>
<td>Module Box Assy. Temperature + X1</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>29</td>
<td>Spacecraft Facet Temperature + Y</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>30</td>
<td>Battery Charge Current</td>
<td>0-5A</td>
<td>[ I = 3N \text{mA} ]</td>
</tr>
<tr>
<td>31</td>
<td>Solar Array Current - Y</td>
<td>0-2A</td>
<td>[ I = 1.12N + 200 (\text{for Is less than 200 mA}) ]</td>
</tr>
<tr>
<td>32</td>
<td>Power Conditioning Module + 10V</td>
<td>0-20V</td>
<td>[ V = N/60 \times 101 ]</td>
</tr>
<tr>
<td>33</td>
<td>Telemetry System Current</td>
<td>0-20mA</td>
<td>[ I = (N - 16)/0.1084 \text{mA} ]</td>
</tr>
<tr>
<td>34</td>
<td>2.4 GHz Beacon Expt. Current</td>
<td>0-250mA</td>
<td>[ I = 0.47(N - 11)/10.72 \text{mA} ]</td>
</tr>
<tr>
<td>35</td>
<td>145 MHz Data Beacon Power O/P</td>
<td>0-2000mW</td>
<td>[ P = (N - 82)/10.67 ]</td>
</tr>
<tr>
<td>36</td>
<td>145 MHz Data Beacon Current</td>
<td>0-250mA</td>
<td>[ I = (N - 7)/14 \times 101 ]</td>
</tr>
<tr>
<td>37</td>
<td>145 MHz Data Beacon Temperature</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>38</td>
<td>Module Box Assy. Temperature - X1</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>39</td>
<td>Spacecraft Facet Temperature - Y</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>40</td>
<td>+14V Line Current</td>
<td>0-5A</td>
<td>[ I = 2.86N \text{mA} ]</td>
</tr>
<tr>
<td>41</td>
<td>+5V Line Current</td>
<td>0-5A</td>
<td>[ I = 1.28(N - 50) \text{mA} (0.075A \leq I \leq 1A) ]</td>
</tr>
<tr>
<td>42</td>
<td>Power Conditioning Module + 5V</td>
<td>0-10V</td>
<td>[ V = 2N/3000 \times 101 ]</td>
</tr>
<tr>
<td>43</td>
<td>Sun Sensor - Z Axis</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>44</td>
<td>HF Beacons Expt. Current</td>
<td>0-250mA</td>
<td>[ I = (N - 36)/0.1038 \text{mA} ]</td>
</tr>
<tr>
<td>45</td>
<td>435 MHz Data Beacon Power O/P</td>
<td>0-2000mW</td>
<td>[ P = (N - 102)/1.792 \text{mA} ]</td>
</tr>
<tr>
<td>46</td>
<td>435 MHz Data Beacon Current</td>
<td>0-250mA</td>
<td>[ I = (N - 34)/10.53 \text{mA} ]</td>
</tr>
<tr>
<td>47</td>
<td>435 MHz Beacon Temperature</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>48</td>
<td>Module Box Assy. Temperature + Y1</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>49</td>
<td>Spacecraft Facet Temperature + Z</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>50</td>
<td>+10V Line Current</td>
<td>0-5A</td>
<td>[ I = 3N \text{mA} ]</td>
</tr>
<tr>
<td>51</td>
<td>+10V Line Current</td>
<td>0-5A</td>
<td>[ I = 1.3(N - 60) \text{mA} ]</td>
</tr>
<tr>
<td>52</td>
<td>Power Conditioning Module - 10V</td>
<td>0-20V</td>
<td>[ V = 0.0156N \times 0.0224'(N' of +10v line) ]</td>
</tr>
<tr>
<td>53</td>
<td>Navigation Magnetometer X-Axis</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>54</td>
<td>Navigation Magnetometer Y-Axis</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>55</td>
<td>Navigation Magnetometer Z-Axis</td>
<td>0-5V</td>
<td>[ V = N/200 \times 101 ]</td>
</tr>
<tr>
<td>56</td>
<td>Speec Synthesiser Current</td>
<td>0-250mA</td>
<td>[ I = (N-16)/10 \times 1009 \text{mA} ]</td>
</tr>
<tr>
<td>57</td>
<td>CCD Imager Temperature</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>58</td>
<td>Module Box Assy. Temperature - Y1</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
<tr>
<td>59</td>
<td>Spacecraft Facet Temperature - Z</td>
<td>-30 to +50°C</td>
<td>Temp = ((474 - N)/5 \times 101 ) Degrees C</td>
</tr>
</tbody>
</table>

1Determine vector as follows: \[ \begin{align*} B_1 &= -189.54(N_N - 336.55) \quad B_2 &= 183.486(N_N - 63.44) \quad B_3 &= -194.5(N_N - 496.5) \end{align*} \]
Table 3

Values for Converting Raw Magnetometer Data to B

<table>
<thead>
<tr>
<th>HXC</th>
<th>HYC</th>
<th>HZC</th>
<th>A₁</th>
<th>A₂</th>
<th>A₃</th>
<th>A₄</th>
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<tbody>
<tr>
<td>971</td>
<td>973</td>
<td>967</td>
<td>1</td>
<td>1</td>
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<td>905</td>
<td>907</td>
<td>901</td>
<td>1</td>
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<td>0</td>
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<td>840</td>
<td>842</td>
<td>836</td>
<td>1</td>
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<td>775</td>
<td>776</td>
<td>771</td>
<td>1</td>
<td>1</td>
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<td>646</td>
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</tbody>
</table>

The raw telemetry data representing HXF, HYF, and HZF (Fine data ranging from 000 to 999) are inserted directly into the expressions for Bₓ, Bᵧ, and Bz. For example, let's assume telemetry data recorded on your Form A reads as follows:

HXC HYF HYC HXF HZF
579 237 645 165 315 223

A₁, A₂, A₃, and A₄ to be used in the expressions for Bₓ, Bᵧ, and Bz from Table 3 would then be:

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₁</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>A₂</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>A₃</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

The condition of the ionosphere with respect to the reflection and absorption of radio signals. The K Index, which is updated every six hours, ranges from 0 to 9 and corresponds to A Index values of from 0 to 50. These data should prove helpful in the subsequent analysis of UoSAT propagation experiment data recorded on the B Forms.

Form B, signal information, should be completed using the following coding scheme. Signal strength should be reported in terms of dB above your noise floor. Signal polarization should be reported as Horizontal (H), Vertical (V), Left Hand Circular (LHC), Right Hand Circular (RHC) or non-determined (ND). Fade Rate may be reported in terms of cycles per second if rapid or in other appropriate terms if slower. Doppler Shift should be reported in terms of ± Hertz. Phase relationships between HF beacons should be recorded (using the 7 MHz beacon as the reference) in terms of ± degrees. Each Form B should also carry the Orbit # to serve as cross-reference.

Be sure to place your station ID on each form in the space provided in the upper left hand corner. A rubber stamp made for this purpose will prove convenient.

Analyzing Data

Now assume you have copied telemetry from either or both the General and Engineering Data Beacons. You have transcribed selected magnetometer and radiation detector data from your hard copy (c.w., RTTY) to Form A. You have recorded appropriate details regarding the General and/or Engineering beacon signals on a Form B. You completed additional Form B's; one for each HF beacon and have even completed a Form B for each microwave beacon. Now what? What do you do with all that paper?

Initially you probably will do little more than attempt to identify data on Form A that indicate unusual conditions or variations. You will want to compare these to data on Form B that reflect unusual propagation, i.e., changes in any one or more of the five parameters recorded. You may at first note nothing of significance. Be patient. Keep collecting data. Keep looking. That's the name of the game. That's the fun of it.

Data Reduction

For those interested in a more detailed view of the raw magnetometer data, we have to offer the following. Again you are referred to Dr. Acuna's article. The coarse and fine telemetry data representing X, Y and Z components of the Earth's magnetic field can be inserted into the following equations:

\[
\begin{align*}
B_x &= (A_1 \times 64822) + (A_2 \times 32411) + (A_3 \times 16213) + (A_4 \times 8131.1 - 64824 - 18.05107 (\text{HXF}) - 511) \\
B_y &= (A_1 \times 64432) + (A_2 \times 32220) + (A_3 \times 16114) + (A_4 \times 8062.5 - 64433 - 17.97 (\text{HYF}) - 510) \\
B_z &= (A_1 \times 64072) + (A_2 \times 32039) + (A_3 \times 16022) + (A_4 \times 8011.4 - 64072 - 17.7593 (\text{HZF}) - 510)
\end{align*}
\]

where B is the magnetic field expressed in nano Tesla (nT). 8000 nT = .08 Gauss, i.e. 1.0 nT = 10⁻⁵ Gauss. To put this in perspective, the strength of the geomagnetic field is approximately 30,000 nT at the equator and 60,000 nT at the poles.

A₁, A₂, A₃, and A₄ will be either 1 or 0 and may be determined by reference to Table 3. Appropriate values for use in determining Bₓ, Bᵧ, and Bz are read from the table opposite the number corresponding to the coarse telemetry data HXC, HYC or HZF.

After substituting ones and zeros (A values) and HXF, HYF and HZF in the appropriate expression, determining Bₓ, Bᵧ, and Bz is just a matter of arithmetic. If you have a computer, a simple program will take care of this nicely. A programmable calculator will also do a very nice job. Or how about a little arithmetic exercise for the small fry?

*Multipliers to A₁, A₂, A₃, and A₄, as well as the numbers in Table 3 assume an ideal 0-5 Volt, 10 bit A/D converter. These numbers should be adjusted by multiplying each by a factor equal to 1000/1024 or .9765626 to conform with the binary conversion utilized in the UoSAT telemetry system.
UoSAT Propagation Experiment
Radiation/Magnetometer Data

(Fig. 2 — Form A, one per orbit)

Station I.D.

Orbit Data: Date ________ Orbit ________ UTC ________ Eqx. ________ W. Long. ________

WWV Propagation Info.: Time Rcvd (UTC) ________ Flux ________ A Index ________ K Index ________

Raw data from telemetry frame:

<table>
<thead>
<tr>
<th>UTC Hr. Min.</th>
<th>RDA</th>
<th>RDB</th>
<th>HXC</th>
<th>HXF</th>
<th>HYC</th>
<th>HYF</th>
<th>HZC</th>
<th>HZF</th>
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10 Orbit
UoSAT Propagation Experiment
Beacon Signal Report

(Fig. 3 — Form B, one per orbit, per beacon)

Station I.D.:

**Orbit Data:** Date _______ Orbit _______ UTC _______ Eqx. _______ W. Long. _______

**Beacon copied:**

- [ ] 7 MHz
- [ ] 14 MHz
- [ ] 21 MHz
- [ ] 29 MHz
- [ ] 145 MHz
- [ ] 435 MHz
- [ ] 2.4 GHz
- [ ] 10.4 GHz

<table>
<thead>
<tr>
<th>UTC Hr. Min.</th>
<th>Signal Strength</th>
<th>Signal Polarity</th>
<th>Fade Rate</th>
<th>Doppler Shift</th>
<th>Phase Shift</th>
<th>Remarks Beacon Copied</th>
</tr>
</thead>
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</tbody>
</table>
UoSAT Propagation Experiment
Ground Station Details

(Fig. 4)

Operator Name ____________________________ Station Call ________________

Station Location:
Latitude ____________________________ Longitude __________________________
P.O.B./Street __________________________
City/Town ____________________________ State __________ Zip ________
Telephone Number __________________________

Report Summary:
Period covered: From ____________________________ to ____________________________
Number of sheets attached: Form A ______ Form B ________

Equipment used to copy UoSAT:
Antenna ____________________________ Receiving ____________________________

Remarks: ____________________________

____________________
____________________
____________________

12 Orbit
Data Collection Project

Now let's consider this. Let's suppose that each person collecting data were to make copies of his A and B forms and forward them to a central collection point for more detailed analysis. Some very interesting analysis would be possible perhaps leading to significant findings. If this strikes you as being worthwhile, the author would be more than pleased to act as "funnel" for AMSAT. Dr. Ron Parise, WA4SIR has also agreed to act as AMSAT's UoSAT coordinator of experimental data. Send your forms directly to AMSAT, P.O. Box 27, Washington, DC 20044.

If you choose to participate in the UoSAT Propagation Experiment data collection project, please forward details requested on the Cover Sheet depicted in Fig. 4 with each set of reports. Please note that your station location (latitude and longitude) is important. A description of equipment used to receive UoSAT will also be of value.

In conclusion, I would enjoy hearing of your experience with UoSAT and the Propagation Experiment. I hope to gather enough input to support future articles concerning UoSAT. All contributors will be gratefully acknowledged.

Acknowledgements

My thanks to Rich Zwirko, K1HTV for his encouragement and to Jan King, W3GEY, for his help concerning UoSAT telemetry system. Also my thanks to Dr. Martin N. Sweeting, G3YJO in England for his assistance.

Ellipsis... [The Editorial continues from page 3]

timed cycles. Our clocks tell us when. Thus the need for predictability in the appearance of heavenly elements (OSCAR included) arises from the unpredictability of more earthly events in the lives of men. This need apparently drives us to seek unnecessary, often unattainable, precision.

Further fascinating images arise when considering UoSAT OSCAR 9 (in particular) as a symbol. Perhaps we should refer to UO-9 as a nested symbol, a symbol within a symbol. That is, UO-9 is (as were its predecessors) an OSCAR. Thus the name is a symbol of technological achievement. Beyond that level, however, one discerns another, still richer meaning in UO-9 as symbolism. UoSAT denotes, at its base level, a rededication to one of the fundamental elements of our hobby: technical innovation. Significantly, the innovation in this case is directed at the development of new information rather than at providing a utility for amateurs. Whereas the prior OSCAR's (5 through 8) had as their primary objective the provision of reliable, over-the-horizon VHF communications, UoSAT OSCAR 9 seeks to advance technology for its own sake.

Can UoSAT advance our knowledge of the mesosphere? Perhaps. Perhaps not. A few of our more astute colleagues correctly point out that there is no new science aboard UO-9. "It's all been done before," they carp. But need there be new science aboard for UoSAT to be effective? As Program Manager G3YJO explains, one mighty objective of UoSAT is to partially redress the imbalance between operating radios and developing the radio science/technology. We suspect that UO-9 has a chance of achieving that noble objective in two ways: a) Directly and b) Indirectly.

The direct route assumes that new knowledge WILL result from UO-9. Although many of the areas explored by UO-9 have been explored before by other spacecraft, haven't some very exciting discoveries resulted from looking in the "wrong place at the wrong time?" About the most we can say about the "direct" route is that it's "chancey."

The indirect route to mission objective is more promising. It seems obvious UoSAT will go far to nourish the spirit of the adventurous, scientifically curious amateur both through access to mounds of telemetry data and through the powerful symbols it conveys. Just think of it. An Amateur Space Probe with a data output from the edge of the cosmos to the comfort of your shack. Talk about symbols! So, although no informed individual would suggest that UoSAT is symbol sans substance, it seems clear that OSCAR's main symbolic message, at least for the present, will eclipse its contribution to hard science. Even so, it has in fact made a major contribution and immeasurably enriched our hobby. It seems appropriate that it should be "born" on the 20th Anniversary of OSCAR 1's birth. And finally, if UoSAT, through its symbolism, galvanizes the adventurous spirit in a budding scientist, will it not have succeeded? We think so!
Refining Your Mode-J Reception Techniques

By Bill Clepper, W3HV

With the Phase IIIB satellite now less than a year away and the newer Phase IV concept not too far behind, it may be the right time to refine your reception techniques for the UHF spectrum (300 MHz - 3 GHz). Mode J of AMSAT-OSCAR 8 can be a bench-mark for those contemplating stations capable of using the Phase IIIB Mode X transponder. Mode X will use 1269 MHz on the uplink and 436 MHz on the downlink. By refining your system now, using Mode J as a proving ground, you can proceed into the Phase III era knowing what to expect in the way of performance from your 70 cm receive system. W3HV has been an AO-8 command station for ARRL for more than two years. The need to establish a first-rate Mode J receive capability in connection with my command responsibilities has provided some valuable object lessons. In the observations that follow, I would like to share with you some of the techniques I’ve found effective in refining Mode J reception.

It should be made clear from the beginning that when considering reception of Mode J, we are dealing with a weak UHF signal. To place the strength of the signal in a meaningful context, the following comparison may be helpful. Imagine your friend had a 2-meter hand-held transceiver with \( \frac{1}{2} \) watt output to a \( \frac{1}{4} \) wave antenna. Then imagine your friend is one or two thousand miles distant. What sort of receive system would be required at your QTH to reliably hear your friend on his HT? Certainly your receive system must be more sensitive than if your main interests were in local FM repeater work. Let’s just say on this point that you need not attempt to build an EME-grade 70 cm receive system but you’ll need to work to upgrade the performance of your bare-bones, off-the-shelf rig. With that guideline in mind, let us look at some helpful methods for refining your Mode J capabilities.

The basic idea is that to be successful we must absorb as much power at the antenna as possible and then transport that signal power to the shack. At every point we should be thinking in terms of maximizing gain and minimizing loss. Let’s start at the antenna and work our way to the shack.

The antenna is a critical component. In evaluating antennas one should consider such performance criteria as gain, beamwidth, polarization, bandwidth, and efficiency. There are many 70 cm antennas on the market but not all are suitable for satellite use. Antenna gain is a function of its directivity; the smaller the beam width, the higher the gain in the preferred direction. For satellite use, where AO-8 is a fast moving object to track, a beamwidth of perhaps 25 degrees should be considered the minimum practical. Sharper beams will usually result in tracking errors large enough to offset any potential gain benefits. A satisfactory array for Mode J having a half power beamwidth of 30 degrees will have a forward gain in the vicinity of 12 to 15 dB. ARRL suggests an antenna gain of 10 to 15 dB. Gain is closely related to boom length. Thus for well-designed yagis or helices, the longer the boom, the higher the gain. However, long booms flex and magnify stress on the rotors in wind loads so there is a practical limit to the length of boom one can employ successfully. Remember, this array will have to be rotated in two axes: azimuth and elevation. As a guide here, it is often easier to use a pre-amp behind the antenna to realize an

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1 AMSAT-OSCAR 8 is under the operational control of the ARRL.

1 Actually the 70 cm downlink is even weaker than this simple example would imply since free space path loss increases as the square of the frequency as well as the square of the distance. Thus, with each doubling of frequency, with fixed distance, path loss increases 6 dB.
additional dB or two than to cope with large, bulky antennas with excessively narrow beamwidths. However, because Phase IIIB will move slowly across the field of view (except at perigee) and Phase IV satellites will be geo-stationary, if you’re planning for the future, keep in mind that there is a place for the long yagi (or helix) in amateur space antennas with its high gain and narrow beam.

Next, let’s look briefly at antenna polarization. A signal originating at AO-8’s 435 MHz monopole antenna encounters a number of influences in its trip to Earth. A major effect of the passage of this signal through the Earth’s magnetic field is that the polarization is often modified substantially. In fact, if one were to measure the polarization of the Mode J signal during the course of an orbit, one would find that it was changing from moment to moment. This phenomenon is called Faraday Rotation. To reduce the effects of Faraday Rotation on the strength of the received signals, a circularly polarized receive antenna is strongly recommended. Using linearly polarized antennas I’ve seen the deep, long fades in signal that are evidence of the distorting effects and which cause such grief to Mode J newcomers. In the course of several years I’ve tried every conceivable polarization and have now concluded circular is the best for AO-8. Circular polarization can be produced in a number of ways. One popular method requires phasing crossed yagis to produce circular polarization. Another way is to use a helical antenna which yields circular polarization “naturally.” It seems a distinct advantage to be able to switch the sense of the polarization from Right Hand Circular Polarization (RHCP) to Left Hand Circular Polarization (LHCP). There have been occasions when the 100 mW, 435.1 MHz beacon would fade to an S9 on the S-meter. But when the polarization sense was reversed, the needle would bound up to S9. The KLM 420-450-18C I use at W3HV is available with a device called a circularity switch which switches this crossed yagi from RHCP to LHCP. Winding a helix for 70 cm is fun and relatively easily done. There is a drawback with helices, however, in that the sense cannot be reversed by switching. If you wound it for RHCP, that’s what you’ve got forever. One solution is to wind two helices on one boom; one RHCP, the other LHCP. Then you use a simple relay to select one or the other.

Our final point on antennas concerns efficiency. In this context efficiency means capturing as much of the energy in the field around your antenna as possible and shipping it down the transmission line with minimum loss. Probably the most important factor in losses at the antenna is the matching system. What is required here is a system that will match the impedance of the driven element(s) to that of the transmission line while exacting a very low price (in terms of power) in the process. It is my experience that the gamma matched 70 cm antennas exhibit excessive losses and are thus not very efficient. Put another way, I’ve never met a 70 cm gamma match I’ve liked. It would be well to steer clear of these antennas. Both the F9FT and KLM 70 cm yagis successfully employ folded dipole driven elements and provide matches from the nominal 300 ohm impedance to a 50 unbalanced line.

The next area of consideration following the antenna itself is one where considerable flexibility can be found. For example, one must decide if it is better to mount a pre-amp near the antenna or to install it closer to the receiver. As a general guide here, if the transmission line you wish to use to connect your antenna to your receiver is of the RG-213 (RG-8) family and that run is over about 20 or 25 feet, you likely would benefit from installing a pre amp on or near the antenna. Since most installations would require a transmission line of more than 25 feet, we will assume for the balance of this study.


4Losses in 25’ of RG-8 at 435 MHz are about 1.25 dB. That doesn’t sound like too much but remember our premise was we had very little signal to start with and every little loss hurts.
discussion that you will need to install your pre amp “topside.”

There is an annoying problem that enters the picture at this point. When using AO-8, you will be simultaneously transmitting on 2 meters and receiving on 70 cm. It often occurs that the 2 meter uplink signal is strong enough to produce severe distortion or desense in the first active stage of your receive system (pre-amp or converter first stage). To eliminate this problem a simple application of a bandpass filter is called for. One that is especially popular and easily built appears in the 1981 ARRL Handbook. It’s called the “4 x 3 x 5 MHz Filter” and was designed by W1JR. W1VD tested the unit and says it has about a 8 MHz bandwidth at 435 MHz. A schematic of the cavity filter is available from W9KDR at the ARRL for a #10 SASE. Janel Labs supplies a fine, low-loss version of this cavity filter which is factory tuned and sealed for exposure to the elements. The function of the cavity filter is to sharply attenuate signals outside the bandpass. Thus the interfering 2 meter uplink signal will no longer be a problem.

A good, low-noise pre amp is vital to a successful Mode J receive system. Models available currently have noise figures ranging from an incredible 0.4 dB to a rather mediocre 3 dB. Check the specs on your favorite closely. Get the lowest noise unit you can afford. The gain is less important but should be in the 15 to 18 dB range. Preamp with gain above 18 dB or so tend to become self-oscillatory and generally unstable. Many high performance devices must be gain-limited to increase stability. Finally, the preamp must be conditioned (packaged) for outdoor mounting. The reasons are obvious to anyone who has retrieved a rusted hulk from a mast in late Spring.

At this point we come to a question of additional difficult choices. We’ve talked about minimizing antenna losses and placement of the pre amp (hopefully very near the antenna). The choices we now face involve how to interconnect the four major components of our receive system, that is, the antenna, cavity, pre amp and receiver (converter). My philosophy in assembling W3HV for AO-8 command use was to spare no cost if .01 dB of signal could be saved in the process. The photos which accompany this article show the result of careful planning and execution. Note that the preamp is directly connected to the circularity switch to eliminate transmission line losses. Furthermore, all units on the mast are interconnected with RG-8 foam fitted with high-quality type N connectors. The point is that there were several alternatives to be considered for each component but my choice was guided by the desire to know that it was the best that could be achieved so that I would not have to wonder what Mode J would sound like “if only I had done this or that!”

The importance of using quality, suitable connectors should be emphasized here. Avoid the temptation of using the so-called UHF connectors known as PL-259. They are not suitable for use above about 250 MHz and will introduce very undesirable impedance “bumps” in your transmission line if used at 70 cm. These “bumps” are impedance discontinuities which will raise the line SWR and hinder the transfer of power from unit to unit in your receive system. The solution here is to use constant impedance connectors such as the type N mentioned earlier. Type BNC are almost as good at UHF, are a bit noisier, but have the virtue of being smaller and are of the quick disconnect, bayonet type. “All type N” would be the best way to go, of course.

Up to this point we have looked at all of the elements that would be on the mast in an optimum system. The good Mode J “front end” consists of a moderately high gain antenna with switchable polarization sense (either RHCP or LHCP). Next, a low-loss bandpass cavity filter is in place. Last, a first rate, low-noise, high-gain preamp is close to the cavity. And above all, these components are interconnected with the best transmission line and connectors you can afford. Remember that if you skimp here, you’ll always be wondering how much better Mode J could have sounded.
A further option should be mentioned. Even though mounting the preamp at the antenna will substantially improve your ability to hear the weak ones, you still have to contend with the transmission line losses incurred on the run from the pre amp to your converter. Remember that the losses in RG-8 at 435 MHz are nearly 5 dB per 100'. If you mount your converter at the antenna along with the preamp you can further reduce the losses and improve your system's noise figure. This improvement results from the fact that with the converter near the preamp, the transmission line to the shack will be carrying the i-f rather than the rf energy. Many converters use a 29 MHz i-f so the line losses would be only about 1.1 db per 100 feet rather than the 5 db if rf (435 MHz) is shipped to the shack. An intermediate solution would be to use a high grade of transmission line and keep the line short but place the converter in the shack out of the weather. I use a 15 foot run of 7/8" Heliax to minimize losses with the converter in the shack.

Moving on to the converter, you should insure that the noise figure is reasonable. If you use a good preamp ahead of it and the preamp has a power gain of about 18 dB, then a noise figure of 2 to 3 dB in the converter will be acceptable for good results. The conversion gain should be in the vicinity of 20 dB and an i-f rejection of 50 dB is suggested as a criterion. If you mount your converter at the antenna in close proximity to the pre amp you may find you have a problem with oscillations. This is caused by too much gain in too small a space. Adding a few feet of coax between the units will help. First, it will isolate the fields surrounding the two units and second, the coax will pad the levels down a bit to reduce the tendency to self oscillate.

Finally, we will take a quick look at the i-f receiver in the system. I use an old SB-301 that has seen better days. I revitalized this veteran by cleaning the hand switches, peaking the interstage transformers and all the rest of the circuits that were tunable. And, because some of the older hf receivers are not particularly sensitive in the 28 - 30 MHz region, a commercial 10 meter pre amp may just be the ticket.

To conclude this discussion, here are some tips that may give you an edge on solving other problems that may occur. 1) If you have a persistent dense problem, try mounting your antennas on a non-conductive boom such as wood or fiberglass. Also try increasing the inter array spacing. Use different routing for the 2 meter and 70 cm transmission lines. For example, use adjacent tower legs. 2) Use shielded cable for control lines. 3) Observe the power limitations on linear amplifiers (if used) and avoid overdriving as this will produce spurious outputs. 4) Insure all connections are weather proof. Seal both power and rf connections using a sealant such as duct seal or RTV silicon rubber (bathtub sealant). 5) As an added protection against the elements, wrap all connections and critical hardware with PVC tape. I wrapped the cavity in a large plastic garbage bag and then taped the entire assembly to the boom (See photo).

Use a weather seal at all connections. Here duct seal and PVC tape are used to prevent moisture from entering the end of the coaxial cable.

The question has often been asked of me: "How do I know when I'm hearing Mode J well?" The answer that most often comes to mind is that if you can hear the Mode J beacon from AOS to LOS, your system is working well. But if you can hear the small, residual carrier on the beacon at the time of closest approach (TCA), then yours is an excellent system.

Good luck and see you on Mode J, Mode X and Phase IV.

New Life Members

AMSAT gratefully acknowledges donations of $200 or more from the following new Life Members.

Serge Lescour, F6BLA  
Charles Pennington, K3NMF  
A.W. Amstutz, SN6ATT  
Luigi Catapano, JW0BAY  
"Doc" Nellig, WB2JAB  
Gary Blankenship, K42MBS  
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Richard Rosen, K1DS  
Masato Machida, JG1QVW  
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E. Moustacas - Greece  
Jay Whipple, Jr.  
W.L. Mustard, N4FO

January/February 1982  17
Fred had been reading all about OSCAR. He had seen articles about the satellites in all his favorite ham magazines and he wanted to have a go himself. His only problem was that he lived in an apartment.

Fred looked up a table of Reference Orbits and determined the time of the next OSCAR pass. As luck would have it, that very evening, Monday GMT, AMSAT-OSCAR 8 would be available for use in Mode A. Fred quickly strung a wire dipole for ten meters on his balcony and brought the feeder into his shack. He tested it by listening to some stations on the low end of ten. Then he waited for the satellite to come into range.

Time seemed to drag its feet.

At long last the clock in the shack showed the time cited for the AMSAT-OSCAR 8 reference orbit. Fred donned his headphones and tuned around between 29.40 to 29.50 MHz. All he heard was static, TV line frequency whistles and, after five futile minutes of straining his ears, Fred was about to give up. Then finally he heard something. He tuned across a faint signal. Eagerly he retuned and heard a faint “CO” in Morse code. Fred continued to tune across the band and soon was hearing signals on both ssb phone and Morse code but all of them were very weak; barely above the noise.

Once he even thought he copied some RTTY but it disappeared into the noise. After about 15 minutes, the signals disappeared completely and Fred was left with only the static and TV line frequency harmonics to fill his headphones. Fred tuned around for a few more minutes for luck and then gave up and waited for AMSAT-OSCAR 8’s next orbit.

As the time for the next orbit approached, Fred pricked up his ears and began tuning again. For about three minutes nothing; then suddenly faint signals. That’s all he heard; faint signals throughout the pass. Fred was overjoyed to have copied signals from OSCAR but still he felt something was wrong.

At the next Radio Club meeting Fred gave voice to his feelings. “Those signals were so faint” he said “that I could just about copy them.”

“Well Fred,” said Pat, “You’re not using the best of receiving setups and the OSCAR ten meter downlink is often marginal.”

“I know” replied Fred, “But many people do manage to work OSCAR. It can’t be that difficult!”

“It isn’t!” exclaimed Pat, “First you need a good receiving setup. What are you using?”

“A dipole on my balcony and a communications receiver” replied Fred. “Living in an apartment makes things difficult for HF antennas.”

“Guess you should try a preamp on ten to boost that received signal” suggested Mike, the Club President. “There was a neat one published in QST some time ago using a 40673 dual-gate mosfet.”

“Right” said Pat, “The circuit was simple and the preamp was built in a minibox.”

“I’ll try that” said Fred. “Can you sketch that circuit, please?”

“Sure” replied Pat. “It goes roughly like this.” He took out a pencil, tore a leaf from his notebook and sketched the schematic.

“Thanks” Fred said, picking up the schematic. “I bet I’ve got all these components in my parts box.”

The next evening Fred stopped by his local parts store and picked up a minibox. He built the preamp in a couple of hours. On Saturday afternoon Fred tuned into the low end of ten and found some South American stations. He tuned up his preamp on these signals and found that stations that were S1 without the preamp were now S6 with the preamp installed. That evening Fred again tuned for AMSAT-OSCAR 8. He tuned the top end of ten in vain, however, for that evening AMSAT-OSCAR 8 was in Mode J, and was relaying signals from 145.95 MHz to 435.15 MHz.

When Fred checked his orbit listing, he realized his mistake and gave vent to his feelings with several well-chosen Anglo-Saxon expletives. He then carefully checked the orbit predictions and confirmed them on two meter fm with Pat.
Next evening while AMSAT-OSCAR 8 was crossing the equator heading north, Fred was eagerly tuning; the noise was loud as were the TV harmonics. Fred was sure that he could hear the electrons bouncing on his wire antenna but no sign of any satellite signals!

Then, all at once the band came to life; signals were loud and clear. True, nothing exceeded S4 on his meter but they were all ‘copyable.’ Fred heard cw signals at the low end of the band, ssb at the top and a mixture in the center of the passband at about 29.45 MHz. He tuned around for about 15 minutes and then, as if a switch had shut off the ionosphere, signals vanished abruptly.

Fred called Pat on the telephone and told him of his success. “It was fantastic,” he said. “There I was, tuning across a dead band when suddenly, as if a big switch in the sky had been thrown, the band came to life. There were lots of signals in the passband for about 15 minutes and then that switch in the sky was again thrown and everything vanished all at once.”

“Did you hear the beacon?” asked Pat.

“I don’t think so,” replied Fred. “Signals were readable but nothing read more than S4 on my ‘S’ meter and there was a lot of QSB or fading not to mention TV line frequency harmonics.”

“Well,” said Pat, “You really have to be able to receive the beacon quite well before you should try transmitting.”

“Why?” Fred asked.

“Because you want to be able to hear people calling you,” was the answer. “The stations you heard were probably running about 100 watts or more radiated power. Many people use even less power. One or two

have even used less than one watt. Now that’s an extreme. But it does illustrate what a good receiving setup is capable of copy ing.”

“OK,” quipped Fred. “I’ve got one preamp in the antenna line; shall I put in another?”

“Will it do you any good, do you think?” Pat quizzed.

“I don’t know” said Fred. “That’s why I’m asking you.”

“Tell you what,” laughed Pat. “Why don’t you come over tomorrow night and discuss it. Lisa just got out of bed and needs some assistance so I’ve got to QRT.”

“OK. I’ll call you at work in the morning to set it up.” Fred concluded.

“Don’t bother” said Pat. “Any time after 7:00 PM will do fine.”

Then Pat hung up leaving Fred to think about ways of improving his Mode A reception and dream about actually working through OSCAR himself.

Fred eagerly drove over to Pat’s the next evening. Norma, Pat’s XYL, opened the front door. “Pat’s in the shack” she smiled. “There’s an OSCAR pass coming up. He said to join him there.” After some small talk, Fred wandered down to the shack.

“Just in time” said Pat as Fred entered. “AMSAT-OSCAR 8 crossed the equator four minutes ago and we should have AOS any second now. No sooner said than done!”

The speaker, which had been gushing noise suddenly burst forth with the song of innumerable cw signals.

“Here” Pat gestured. “You tune around.”

Fred sat down at the receiver and tuned. Since both he and Pat owned similar rigs he had no difficulty operating Pat’s. Fred tuned across the Mode A downlink passband and heard lots of signals. They ranged in strength from S1 to S9+. He even heard the beacon at S5 to S8. He was surprised to hear some countries that he had not even heard on hf. Occasionally, when signals faded, Pat would do something to an antenna switch and signals would magically reappear. Suddenly, without prior warning the receiver went dead. All signals vanished. Fred looked up at Pat who smiled ‘LOS’ at him.

(To be continued in a future issue)
Dear Editor:

A very nice cavity filter for Mode J receive use can be made from a cavity filter found in some surplus G.E. mobile units. They are designated PL74B7012G1 and were intended to filter the T-44 transmitter output at 450 MHz. The cavity is silver plated inside and out and 4½ inches long by 2½ inches in diameter. It is tuned by a ¼ inch diameter #28 thread screw about 2½ inches long. It has RCA type phono input and output connectors.

As it comes, it was designed for use in the 450 MHz range and will not tune down to 435 MHz. However it can be modified easily to do so. At the same time BNC coax fittings can be added to replace the phone jacks.

The modification procedure is as follows:
1. Remove top of cavity by removing three small phillips screws.
2. Remove and replace the tuning screw with one that is longer if possible. This will permit the cavity to be tuned lower in frequency than it can with the existing screw. If this isn't available then extend the length of the tuning screw by soldering a ¼ inch long piece of 5/16 inch OD, ¼ inch ID, glass tubing to the end of the screw extending into the cavity. The ¼ inch diameter tuning screw is a nice close fit inside the glass tubing and should extend into the tubing about ¼ inch before soldering.
3. Use a propane torch or heavy duty soldering iron to remove the RCA connectors. They are held in place in the cavity wall only by solder and will slip out easily. They cannot be completely removed however until the coupling lines are unsoldered from the bottom of the cavity. These lines extend through small holes in the bottom of the cavity where they are bent flat and soldered to the outside of the cavity bottom.
4. Un solder coupling lines and fully remove RCA connectors and lines. Clean small holes in the cavity bottom for use with the new lines.
5. Ream out RCA connector holes in the cavity wall to take new BNC coax connectors. The type having a small round shoulder and designed to be mounted by one large nut and lock washer work best. The nut and lock washer will not be used however.
6. Solder new coupling lines to the BNC connectors so this chore is done before the fittings are soldered into the cavity wall.
7. Position the BNC fittings in the reamed out holes. At the same time pass the free end of the coupling lines through the small holes in the bottom of the cavity. Solder the BNC fittings in place. Solder the lines to the bottom of the cavity. Replace the cavity top making sure the tuning screw and tube clear the inner walls of the coaxial sleeve in the cavity. This completes the cavity modification.

The cavity can be tuned to pass maximum signal at 435.15 MHZ by inserting it between a dummy load and a Mode B transmitter tuned to that frequency and tuning the cavity for maximum power to the dummy load. It is best done however by inserting the cavity ahead of the 435.15 MHz receiver/converter arrangement and tuning for best signal from a signal generator or OSCAR 83 pass.

The ¼ inch length of glass tubing added to the tuning screw causes the cavity to tune to 435.15 MHz with the screw withdrawn almost all the way out of the cavity. This was done so the cavity would also tune to 432 MHz if desired. The tubing can be shortened if it is desired to tune only in the 435 MHz range.

The finished product works very well and completely cured my Mode J desense problem. Maybe you have one of these little jewels stuck back somewhere like I did just waiting for Mode J.—WBSL

Dear Editor:

I think that you are aware that a Japanese weather satellite was launched recently. According to the information from TV news, newspapers and electronic magazine, the National Space Development Agency (of Japan) was successful in launching the Weather Satellite, Himawari No. 2 by using a N-11 rocket (made in Japan) on August 11, 1981.

Himawari No. 2, Geostationary Meteorological Satellite could be transferred from the transfer orbit to the drift orbit on August 12, 1981. After about one month, Himawari No. 2 will be staying around 160° East. On about December 20, 1981, Himawari No. 2 will be moved from 160° E to 140° E instead of Himawari. Himawari will become a spare weather satellite on December 20, 1981.

The frequencies of the Geostationary Meteorological Satellite Himraoi No. 2 are as follows:

uhf band (for transmission of picture): 1600 MHz band
Transmission output power: 10 watts (for VISSR, HR-FAX, LR-FAX); 2 watts (for telemetry)

uhf band (for transmission of weather data): 460 MHz band
Transmission output power: 4 watts

(Note: Himawari means Sun Flower, HR-FAX means High Resolution Facsimile, LR-FAX means Low Resolution Facsimile.)—Yasuo Nakamura

Dear Editor:

Ernie, VK3DET and Dick, VK3VU are planning an OSCAR DXpedition to SW1 (W. Samoa) 3 - 10 March 82, ZK2 (Nive) 10 -25 March and A3S (Tonga) 26 March - April. The airline tickets are booked and paid for and they are now awaiting call signs.

Thank you for ORBIT it is a fine publication.—VK3YQX

Dear Editor:

If I had to make a choice between quality and quantity or receiving it on a precise deadline, I prefer that the quality of articles and overall professional appearance of the publication be maintained. ORBIT is a publication anyone could be proud of. It must be quite a challenge.

My only suggestion is more on Japanese equipment and technology be included. I've heard rumors of substantial activity on 1296 MHz in a JARL contest. Any truth to this (any ssb activity?) Are there kits orderable from Japan for transverters for 435 and 1296? If they exist, they could represent a saving in time for some of us who don't have ready access to some of the usual construction equipment and supplies.

One very notable Japanese contribution was the excellent cover on ORBIT No. 6. Has anyone considered offering a full size poster like the original for sale or in exchange for a donation to AMSAT? It is not only an attractive work of art, but a useful representation of conventional and space-age communication techniques used in amateur radio.

I realize that what I'm suggesting is more work. The contributions to communications technology from Japan are even carried in everyday magazines—such as Business Week with advertisements for N.E.C. It would be interesting to hear more from "behind the scene" so to speak. I only regret that while I can suggest this, I cannot also bring fluency in Japanese or some other useful skill. This is a suggestion aimed at adding a new element to the already excellent international character of ORBIT.—WLSV
Satellite Log

By Geoffrey Falworth *

Satellite Log features launches into orbit since the beginning of 1980. The satellite name is that assigned by the launching agency (the international designation is in parenthesis) and the orbit (period, inclination to Earth's equator, apogee height, perigee height) is for shortly after launch; later maneuvers may modify this orbit. Transmissions are those which are publicly reported or assumed from the type of spacecraft involved.

Molniya 82 (1981-30A) launched on 1981 Mar 21; initial orbit: 728.60 min, 62.73, 404.3 km, 690 km; transmissions: 3650 to 3700 MHz, 3750 to 3800 MHz, 3850 to 3900 MHz. Molniya 3-class communications satellite.

Cosmos 1261 (1981-31A) launched on 1981 Mar 30; initial orbit: 710.47 min, 62.95, 394.06 km, 589 km; transmissions: 2292 MHz. Early warning satellite.

Cosmos 1262 (1981-32A) launched on 1981 Apr 7; initial orbit: 90.43 min, 72.87, 393 km, 197 km; transmissions: 19.989 MHz. Recoverable reconnaissance satellite.

Cosmos 1263 (1981-33A) launched on 1981 Apr 9; initial orbit: 109.09 min, 82.98, 1970 km, 397 km; transmissions: none reported. Military research satellite.

STS-1 (1981-34A) launched on 1981 Apr 12; initial orbit: 87.94 min, 40.35, 244 km, 106 km; transmissions: 2205.000 MHz, 2217.500 MHz, 2250.000 MHz, 2287.500 MHz. First Space Shuttle Orbital Flight Test.

Cosmos 1264 (1981-35A) launched on 1981 Apr 15; initial orbit: 90.47 min, 70.36, 386 km, 209 km; transmissions: 19.989 MHz. Recoverable reconnaissance satellite.

Cosmos 1265 (1981-36A) launched on 1981 Apr 16; initial orbit: 89.40 min, 72.85, 289 km, 200 km; transmissions: 19.989 MHz. Recoverable reconnaissance satellite.

Cosmos 1266 (1981-37A) launched on 1981 Apr 21; initial orbit: 89.66 min, 64.97, 268 km, 249 km; transmissions: 166 MHz. Nuclear-powered ocean reconnaissance satellite.

Operations 9993 (1981-38A) launched on 1981 Apr 24; initial orbit: 93.57 min, 62.70, 709 km, 190 km; transmissions: 244 to 270 MHz. Reported to be satellite data system spacecraft.


Cosmos 1268 (1981-40A) launched on 1981 Apr 28; initial orbit: 90.30 min, 70.41, 370 km, 210 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1269 (1981-41A) launched on 1981 May 7; initial orbit: 100.94 min, 74.06, 810 km, 796 km; transmissions: none reported. Electronic surveillance satellite.

Soyuz 40 (1981-42A) launched on 1981 May 14; initial orbit: 89.05 min, 51.62, 269 km, 192 km; transmissions: 20.008 MHz and 121.750 MHz. Manned spacecraft (crew: Leonid Popov, commander and Dmitri Pranariu, researcher-cosmonaut) docked with Salut 6 on 1981 May 15.

Meteor 37 (1981-43A) launched on 1981 May 14; initial orbit: 102.57 min, 81.29, 922 km, 836 km; transmissions: 137.300 MHz. Weather satellite.

Nova 1 (1981-44A) launched on 1981 May 15; initial orbit: 97.67 min, 90.16, 937 km, 354 km; transmissions: 149.988 MHz and 399.968 MHz. Navigation satellite.

Cosmos 1270 (1981-45A) launched on 1981 May 18; initial orbit: 89.71 min, 64.86, 348 km, 173 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1271 (1981-46A) launched on 1981 May 19; initial orbit: 97.57 min, 81.27, 650 km, 628 km; transmissions: none reported. Military weather satellite.

Cosmos 1272 (1981-47A) launched on 1981 May 21; initial orbit: 90.42 min, 70.37, 381 km, 210 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1273 (1981-48A) launched on 1981 May 22; initial orbit: 89.27 min, 82.29, 263 km, 210 km; transmissions: none reported. Recoverable reconnaissance satellite.

Goes 5 (1981-49A) launched on 1981 May 22; initial orbit: 1436.12 min, 07.46, 35863 km, 35718 km; transmissions: 468.850 MHz, 1681.600 MHz, 1684.000 MHz, 1687.100 MHz, 1688.200 MHz, 1696.200 MHz, 1691.000 MHz, 1694.000 MHz, 2209.068 MHz, 2214.000 MHz. Geostationary operational environmental satellite over longitude 84°, 74 West.

Intelsat 5B (FI) (1981-50A) launched on 1981 May 23; initial orbit: 1436.18 min, 07.46, 37959 km, 35788 km; transmissions: 3704 to 3781 MHz, 3789 to 3861 MHz, 3869 to 3941 MHz, 3947.500 MHz, 3952.500 MHz, 3959 to 4031 MHz, 4037 to 4073 MHz, 4077 to 4113 MHz, 4117 to 4153 MHz, 4157 to 4198 MHz, 10954 to 11031 MHz, 11119 to 11191 MHz, 11196.000 MHz, 11454.000 MHz, 11457 to 11698 MHz. International telecommunications satellite for service over Atlantic Ocean. Currently on test over longitude 3°, 12 East.

Satellite News: The news bulletin of satellites, spacecraft and space activity is available in four editions: Space Objects Digest, Military Space Digest, Space Operations Review, and Space Systems Digest. The price is 25 cents per issue; subscribe for as many issues as you like. Payments and orders by International Money Order, cash or check. Please add $2 to personal checks for UK bank charges. Orders should be sent to: Geoffrey Falworth, 12 Barn Croft, Penwortham, Preston PR 10 SX, England.

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* Type 105A/105C Illustrated

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INLINE INSTRUMENTS, INC. Box 473, Hooksett, N.H. 03106 Tel. (603) 622-0240

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A modulation monitor is a useful adjunct to any transmitter. Few are available, however, that work at uhf. Jan Martin Nolding, LA8AK, in his article in the Danish magazine OZ, December 1980, describes an interesting circuit that allows the use of any scope (with a bandwidth of only 1 MHz) as a modulation monitor up to 500 MHz. The circuit uses the downconversion method.

The transmission line is tapped and the signal is applied via a 400:1 capacitive voltage divider (C₁ and C₂) to a balanced modulator (mixer). The Local Oscillator operates about 1 MHz above or below the monitored frequency. The output of the mixer (f₁ - f₂) is now approximately 1 MHz; well within the bandpass of even a mediocre oscilloscope. The downconverted signal is amplified to a suitable level and applied to the vertical input of the scope. The circuit shown in Fig. 1 permits monitoring signals ranging from 10 to 120 W with an oscilloscope vertical sensitivity of 10 mV/cm. Resistor R₁, nominally 22 ohms, can be decreased in value if overloading of the mixer is experienced. The stability of the Local Oscillator is not of great importance. Therefore, either an RL oscillator or a signal generator can be employed.

Over a period of several years, Ernst Fendler, DJ1JK, conducted an extensive study of propagation of satellite signals. In particular he concentrated on the reasons for fading, "one way" propagation effect and the influence of the ionosphere. He published his findings in several past issues of CQ-DL Magazine (Germany). He proves that aside from the influence of the intensity of the ionization and polar absorption caused by solar activity, the orientation of the satellite in respect to the tracking station has a great effect on the quality of the Uplink and Downlink signals. Here it is in brief: The stabilization magnet on board the satellite is positioned along the axis of the spacecraft. This magnet behaves as a compass needle and aligns itself along the lines of the magnetic field of the earth. Obviously, the spacecraft must follow the magnet as shown on Fig. 2. One can also see that the orientation of the axis of the satellite will depend on the latitude of its subsatellite point. Namely, in the vicinity of the poles the axis of the spacecraft will point toward the earth and at the equator the axis will be parallel to the surface of the earth. During one orbit, the axis of the satellite will make a 180° "flip." All three OSCAR antennas have their own particular radiation patterns that are not necessarily compatible with one another. Because the orientation of the satellite changes continuously, the lobes and nulls of the antenna patterns will point in different directions during the pass. Consequently, a fixed tracking station may be experiencing fading of the signals because in certain conditions it may find itself in the lobe of the transmitting antenna of the satellite and at the same time in the null of the receiving antenna. As a result, an apparent "one way" propagation effect will occur. The reverse condition can also exist.

Although the above is fairly well understood by OSCAR users, DL1JK proves that because the orientation of the axis of the satellite depends on the instantaneous latitude of its subsatellite point, the passes of similar equatorial crossings will have similar propagation characteristics as observed from a particular QTH. This is the reason why some stations can never hear or access the satellite when the spacecraft is located at a certain azimuth and elevation. OSCAR users may plot the signal strength during consecutive passes and use the data in the future to predect their best or worst orbits, because the propagation characteristics will repeat.
AMSAT Software Exchange Online

By Robert Diersing, N5AHD

The AMSAT Software Exchange was first mentioned in ORBIT Number 4. In ORBIT Number 8, W9RUE described the library operation. He is establishing to store and distribute software for the handheld computers of the HP and TI types. I would like to describe here the operation of the AMSAT Software Exchange. Like all organizations that depend on volunteer work, the ASE has been slow to take shape. After much help and support from Rich Zwikro, K1HTV, of AMSAT and Jim Wiman, WD9ICG, I believe we are ready to begin operation. We have an initial plan for distribution of programs that may require modification at a later date. Any changes will be published in ORBIT as well as AMSAT Satellite Report. New programs available will also be published.

The address of the ASE is:
AMSAT Software Exchange
Box 338
Ashmore, IL 61912

The bulk of the administrative work will be handled by Jim Wiman, WD9ICG who can be contacted at the above address. ALL requests and remittance should be sent to Jim. The minimum prices for programs will be:
$15.00 for diskette
$10.00 for cassette
$5.00 for hardcopy listing

DO NOT send diskettes or tapes as these will be provided by the exchange for your particular system. These prices are listed as minimum since all excess will be donated to the Phase III project. Any additional donations will be appreciated. Foreign stations should allow for the extra mailing costs to overseas locations. IRCs are acceptable from foreign stations.

The ASE will operate as follows. All requests are to be mailed to the above address. Jim will forward your request to the appropriate person for production and mailing. ASE has identified persons to hand the various types of copies for different hard-ware, operating systems, and so forth. The appropriate person will supply the proper diskette/tape, make the copy, and forward it to you. Please be patient at first as we will have quite a few requests to honor in the first few months. Persons who have previously requested information from ASE will receive the listing of available programs published with this article.

ASE is in need of conversions of satellite related programs to different hardware and operating systems environments. We are particularly in need of a conversion for PET and probably the IBM personal computer once it becomes available. If you can make a different version available contact the ASE. Please indicate whether or not you could handle distribution for your particular type of machine.

What about the future of ASE? Our first concern will be to fine-tune this first distribution effort. We would appreciate your constructive comments via the addresses above. There is the possibility of the formation of an AMSAT/ASE computer bulletin board system in the future. Initially, it will probably be a method for message handling and comments. Hopefully it could later become an automated method for some of the program distribution. With all of the computer/satellite related projects on the horizon it would be extremely valuable source of timely information. More on this later.

Initially, the W3WI orbital data calculation program as described in ORBIT Magazine will be available in the following versions:
A. TRS-80 Level II BASIC under TRSDOS.
B. TRS-80 Level II BASIC on cassette tape.
C. North Star BASIC under North Star DOS for 5¼ inch hard sectored disks.
D. Microsoft BASIC Version 5.21 under CP/M, single density, soft sectored, 8 inch or 5¼ inch disks.
E. APPLE/II APPLSOFT BASIC, specify 13 or 16 sector DOS. (L)
F. PL/I-80 Version 1.3 under Cromemco CDS or CP/M, single density, soft sectored, 8 inch or 5¼ inch disks. (L)
G. HP41C calculator.
H. Texas Instruments calculator.

(L) indicates that a hardcopy listing only is available should you desire to do a conversion to another operating environment. Conversions to other operating systems and hard-ware are needed. If you have done a conversion that is not listed here contact ASE. Indicate whether or not you could handle distribution for that machine.

The persons listed below have been identified for copying and distribution of the various versions of AMSAT distributed software.

A. North Star Disk BASIC and TRS-80 Cassettes:
Jim Wiman, WD9ICG
AMSAT Software Exchange
Box 338
Ashmore, IL 61912

B. Microsoft BASIC and DEC RT/11:
William H. Calvin, WB7RAY
12759 42nd Avenue NE
Seattle, WA 98125

Alternate:
Robert J. Diersing, N5AHD
4129 Montego
Corpus Christi, TX 78411

C. TRS-80 Level II Diskette:
Jerry L. Owen, WB4ITL
132 S. 13th
Hopewell, VA 23860

Alternate:
Greg Roberts, ZS1BI
P.O. Box 9
Observatory, 7935
South Africa

John E. Fall, KL7GRF
6170 Downey Ave.
Long Beach, CA 90805

D. PL/I-80 and FORTAN:
Robert J. Diersing, N5AHD
4129 Montego
Corpus Christi, TX 78411

E. APPLE/II:
Bill McCaa, K0RZ
Box 3214
Albuquerque, CO 80307

F. HP41C:
Roy Welch, WØSL
908 Dutch Mill Drive
Manchester, MO 63011

G. TI/HP:
TI/HP Software Library
John Montague, W9RUE
Box 541
Willenon, MN 55090

January/February 1982
Worldwide Satellite Activity

By Pat Gowen, G3IOR

With the eventual apparent demise of veteran AMSAT-OSCAR 7, the number of DX stations being worked through the satellite medium and the actual distances worked have taken a severe tumble since July 1981, leaving AMSAT-OSCAR 8 alone to carry the traffic.

OSCAR 7 has for many years, since the passing of its design lifetime, been giving us continuous and excellent communications on both of its modes, and even the open circuit battery condition, which has been with us yet hardly noticed, has done little to affect the excellent transponder operations, thanks to the thoughtful planning of its designers in providing the spacecraft with a positive power budget.

A few problems were noticed each year as it went into Earth’s shadow in the Southern Hemisphere (resulting in some instability) but soon after when AO-7 saw sufficient illumination on its solar panels, she popped into full life again with very few problems in the Northern Hemisphere other than its insistence of staying in Mode ‘B’, which seemed to please the majority in any case.

This year it was not to be, as when it was well over halfway through its period of seeing a little darkness around 50° South each orbit in July, problems became evident. The general theory is that the thermal expansion and contraction experienced between solar illumination and darkness caused the previously open-circuited Ni-Cad cell to close-circuit, thus placing the remaining dead series of cells in the battery across the solar-cell output as a heavy load, dramatically dropping the voltage available for the circuitry. The actual loss was monitored by G4CUO, who had operated the two previous Mode ‘B’ orbits, and experienced very poor transponding with even an elevated power uplink producing a downlink little above the high noise level. As the satellite was over UA4, Northbound, there suddenly occurred a dramatic shutdown of both transponder and beacon.

Since then weak signals of pass-band noise have been observed on both Modes ‘A’ and ‘B’, with observers in W, G and VK hearing faint signals from the 435.095 MHz beacon but no transponding has been evidenced.

It was hoped that once the satellite saw continuous sunlight again it would fire up as before but even in September no signs of real life were present. As the potential cause of failure was once open circuit, there is a possibility that it may again occur or one of the other cells may similarly be affected. It is worthwhile looking and hoping still.

If we have lost our faithful old friend then we cannot complain as he was serving us long after when he was expected to expire; well outside the design life.

No further reports have come in of hearing the ‘RS’ ‘Radio’ satellites, and no definite information has been received on the launch date of their successor(s) although hopes were expressed that the end of November was a probable time. It is possible that by the time you are reading this column a valuable communications bridge between OSCAR 7 and Phase IIIB may be up and active providing a much desired boost in activity with lots of DX contacts and new stations expected.

OSCAR 8 has thus had to take an extra share of the activity levels with the result that some degree of hard work has been called for from the battery particularly when in dual mode. Many of the callsigns heard previously on ‘A’ and ‘B’ modes are now appearing on Mode ‘J’ especially those with antenna ready for the Phase III operation.

The very first Mode ‘J’ was has been accomplished by Jack, WA6VGS, who is now going to aim at working all Canadian provinces too!

GM4HJ, between his fascinating propagation experiments, has been hunting the ultimate on this mode by paying keen attention to the extreme horizon close to LOS as the satellite leaves him on lunchtime GMT orbits with the odd snappy QSO. You may remember him hearing W4AUZ during the ‘Bermuda High’ on ‘J’ Mode in September 1980 (Page 26, ORBIT No. 6) and that it was to be hoped that a QSO might be made in September 1981. It was, but even earlier! On 30 August Shep and John made a good RS55 ssb QSO from 1153 to 1154 UTC, at a time when super-refracting ducting was evidenced across the Irish Sea. John has often heard the 435 MHz downlink when his own uplink is absent, and good signals have been copied from WB9CNS and W9MNU both in Indiana, at extreme range. WB0CA has heard John, so some good DX QSO’s are anticipated. John believes that contacts with VE5NU and K9CIS should be possible, with...
The original yard antennas are shown, although these have been changed recently by adding vertical elements for 145 MHz and placement above a tribander 45 feet high.

Illinois, Minnesota, and even Winnipeg and the edge of the Dakotas workable. He will be looking on orbits emanating from 240 - 250° as the satellite approaches North America most days, normally on ssb.

UK4NA, the Kirow club station, is very active, with several operators, but although a good signal, it would appear that the need for a good pre-amp exists to aid the Mode 'J' work.

John, VE5JQ, is also now on Mode 'J' but finds activity rather low. Prior to the sad demise of AO-7, he worked both Asia and South America for five continents, but like Gordon, VE5XU, needed Africa. OK3MS on 7A ssb was John's 28th. DXCC country, while Gordon, with his earlier start has 53.

Dave, K7BBO, came back to satellining in April after a long absence, and found all new stations. The only 'old timers' that he worked again being JARDJ1 and G3IOR, having been early OSCAR 6 QSO's.

EP2FM is busy building a receiver, as commercial amateur-radio equipment is not easy to come by in Iran. He hopes to get on OSCAR one day, but at this time no permission is forthcoming to work frequencies above 30 MHz.

Jim, WAI2UB was busy with OSCAR 7A until the loss, and since early January this year had accomplished 46 states and 11 countries, including GW3NYY, CT2BO, KP4EGK, and EL16DT.

Bob, G6RH, is now on Mode 'J' also, and has worked W, VE, EA8, UA1, UA4 and U17. On 8A he worked VE8RCS and SB4AZ. Bob proposes that ARLL consider a Mainland WAS for stations outside North America, as KPH is quite impossible for satellite WAS in Europe, etc. With 42 states worked, and only Arkansas and Louisiana needed to complete the W5's, and some topping up with W7 states, Bob is pretty close to that coveted award! On the DXCC stakes, Bob had 93 confirmed from 96 countries worked, with many letters, plas, IRC's and extra cards to 5X5S, U98A, and RO50AA all failing to produce the three needed.

Wally, K4UAS had been switching polarization, finding LHCP best for the AO-7a uplink, and RHCP some 10 - 15 dB better on the 'B' downlink. OSCAR 8 behaved very differently, with LHCP best on approach and RHCP on the receding satellite on Mode 'A' uplink, but Mode 'J' seeming best on LHCP. Prior to AO-7 leaving us, Wally worked 370 stations in 49 states, with 21 countries (13 QSL confirmed) in 3 continents. Manfred, DC9ZP was the latest country and the first on mainland Europe.

Jorge, HI8JAF, uses a Microwave Modules transverter and converters to a pair of 13 element Tonnas on vhf and a pair of 21 elements on uhf, and has been making some good QSO's. Confirmed contacts include W1DJK, W2BSI, W3JPT, K4UAS, W04AML, K4C4W, W5HJO, K7ZOK (Nevalia), WB9GVX, VE2QO, VE3EFX, PY2AKJ, YV5APF, and DB1KC, the latter being a real long DX haul contact.

For those needing RI, Rick, KIDS, is the sole representative of that rare state now that Dom, N1D, has moved QTH to Boston, Mass. Rick is hearing Eu. regularly, but some of the Europeans are having problems with hearing his ten watts, giving the honor of only Eu's. worked to GM4HJ and G3JOR. It was K1DS who rewarded Jack, WA6VGS with that much needed 50th state for the first Mode 'J' WAS mentioned earlier.

Heinz, DL1CF, is now on Mode 'J' and getting a new $3000 GaAs FET pre-amplifier going to aid his up-to-now weak downlink. Previous 99% of operating time was on Mode 'B' on which G, GM, GI, GD, GJ, GW, F, CN9, I, IS, LA, OE, OK, OH, ON, OZ, PA, SM, SP, EA, EA6, EI, HB, HG, UL7, UA, YU, YO, CT, LZ, plus W1, 2, 3, 4, 8, 9, and 0, and VE1, 2, 3, 5, 6, and 7 have all been worked.

HC18I is now on Mode 'J' too, and has heard KL7JAI, WA8LPR/KL7, and WP4EGK on this mode.

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For Sale KLM antennas 144-150 16C with Circularity switcher and balun. $75.00. Also one 420-450 27 with balun $60.00. Spectrum International Converter MMC 432-435 -28 TC with internal relay for remote switching low noise $75.00. All equipment is in mint condition. Prices FOB 318 Windward Island, Clearwater, FL 33751. (813) 447-0276, Bob Convathy, K4QG, Mode J Club # 28.

KLM Echo 70. Brand new 70cm transceiver. $335 postpaid. KQSS, Box 8272, Dallas, TX 75205.

**OSCAR 'J' frequency comparator. Resolves inversion and approximates doppler. Templates and instructions. $1 and s.a.s.e. Dave Guimont, WB6LIO, 5030 July St., San Diego, CA 92110.**

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Learning and using successful techniques for uhf reception often involves recognizing system technical limitations and finding ways to work around them. Although these same limitations exist in hf receive systems, their importance at uhf and above is such that they can be neglected only at the risk of total failure of the receive system. Two examples may illustrate the point. Transmission line losses through, say, RG-213 (RG-8) can all be neglected for the hf band (3-30 MHz) for lengths of one hundred feet or less. On the other hand, at 435 MHz 100' of RG-213 will represent about 5 dB of loss. If you put 100 watts in at the near end, you'll get a meager 32 watts from the distant end! The second example concerns background noise. At hf the QRM and QRN provide an irreducible noise floor below which signals are masked from reliable reception. So it is fruitless to employ signal amplifiers that have internal noise levels far below the signal power of the QRM and QRN in the receiver's front end. On the other hand, in the uhf regime QRM and QRN are low. The limit on receiver usable gain then becomes the internal noise of the receiver itself. In other words, given a low enough system internal noise, you could arbitrarily raise the gain of your receive system to receive an arbitrarily weak signal.

These examples set the stage for this month's product review. The new Lunar Electronics PAG 432 (MM) seeks to counter the limitations cited in the examples with two fairly standard solutions. The degree with which these solutions achieve the objectives is worthy of note.

First, to offset the effects of transmission line loss, the preamplifier is mounted on the mast near to the antenna array. The advantage of mounting the preamp near the antenna increases with increasing frequency (and hence higher transmission line losses). And, while if you were considering the transmit line losses you might simply "turn up the wick" a bit to offset transmission line loss, once the receive signal is attenuated by the transmission line you're stuck. Sure, you can amplify the signal as much as you care to with a preamp at the receiver. But you also amplify the noise a similar amount. Thus it is the signal to noise ratio that is most important. By amplifying the signal at the antenna, ahead of the transmission line losses, you afford yourself the best possible signal to noise ratio. And that is what makes for "good hearing." A convenient visualization tool is this. Imagine that each foot of transmission line adds a small but known amount of noise to the signal/noise composite appearing at your receiver's antenna terminals. A preamp at the receiver amplifies the signal and noise at the antenna plus the transmission line noise while a preamp at the antenna amplifies just the signal and noise there.

Mounting a preamp at the antenna is simple if the antenna is to be used for receive only. If the antenna is to be used for transceive, however, a means must be provided to switch the preamp out of the circuit while transmitting. Doing this effectively is not easy. A pair of relays must be used to bypass the preamp. The relays must be both reliable and exhibit very low loss. The Lunar PAG 432 (MM) uses two Japanese SPDT relays to bypass the preamp. They are wired to bypass the preamp when power is removed. This is desirable to prevent static charge buildup when the preamp is not in use. With no power applied and the relays in the bypass position, the input and output of the preamp see a 50 ohm resistive load which precludes potentially damaging charges from accumulating. The relays are well-suited for this application. The loss of each relay is about 0.1 dB and the port to port isolation at 70 cm is about 60 dB. Lunar rates the relay for 750 watts at 70 cm. Each relay has two 'N' type connectors (for the bypass mode) and a single BNC connector for the preamp mode.

The preamp itself is a model Lunar has marketed for more than two years. It uses a high performance Gallium Arsenide FET (GaAs FET) as its sole active device. The evaluation unit was supplied with a test report indicating a calculated NF (noise figure) of 0.56 dB. The gain was 17.1 dB and the 1 dB compression point was +11.8 dBm. Until relatively recently a NF at 70 cm in the 0.5 dB range was the domain of the professionals alone. The general availability of GaAs FETs to hams has improved their receiver sensitivity to remarkable levels. The preamp is powered from the same 12 VDC source that activates the relays. The power input to the preamp is actively regulated and zener protected.

The unit is supplied in a black anodized aluminum weather proof box. All stainless steel attaching hardware is included. Using the mounting plate one may opt to mount the preamp on either a mast (vertical) or boom (horizontal). First quality hardware is used throughout. The connectors are chrome plated (not silver) but this likely matters little.
in overall performance. An improvement in the 12 vdc power connector is indicated. The evaluation unit has an RCA type connector which showed corrosion after a few weeks and the male did not mate properly at first. A small squeeze of a pliers remedied the latter.

As is amply noted in the instructions which accompany the preamp, care must be exercised in interfac ing the preamp to the rest of the station. Special care must be taken to ensure that all rigs are at the same chassis potential and that the shield of the preamp is kept at that same potential. Care also must be exercised in wiring the preamp to the transceiver or transverter so that power is removed from the preamp before the transmitter begins to produce rf. The GaAs FET is very sensitive and intolerant of stray voltages.

As an "accessory" to a station, the PAG 432 (MM) is not inexpensive. In terms of the performance improvement it provides for 70 cm reception it may be worth the investment. In terms of utility to the Amateur Satellite user, a preamp mounted at the antenna is very beneficial for Mode J use. With the advent of Phase IIIB with its 70 cm uplink on Mode B and its 70 cm downlink on Mode X, the mast mounted preamp with remote switching may be called for. The quality of materials, workmanship and design makes the Lunar PAG 432 (MM) unsurpassed in the Amateur field.

The PAG 432 (MM) has been in use at W4ZL QSO for several months with no problems encountered. Signals which are audibly below the preamp are well above the noise with the preamp in line. The result is that whereas Mode J formerly presented some problems, now I hear virtually everything from horizon to horizon. The nicest surprise was when I learned I could remove the cavity filter from the circuit. The GaAs FET preamp is highly resistant to overload from the 2 meter uplink. Thus I could remove the cavity and still not have the desense problem I had before. This may not be true in other installations where desense is a problem, but it helped in mine. Besides the very low NF, this is where the GaAs FET shines. It is also the reason that many repeater operators are turning to GaAs FETs on 2 meters and 70 cm. The GaAs FETs are highly resistant to overload and intermod products are very low. Both virtues help where a strong 2 meter uplink is used on a Mode J station.

**Specifications:**
- Frequency range: 432 MHz ± 21 MHz (3 dB bandwidth);
- Noise Figure: 0.8 dB max (59°K effective noise temp.);
- Power requirements: 12-14 vdc at 30 mA typical, protected to 28 vdc; Gain: 14-20 dB;
- Connectors: rf (2) Type N'; Power RCA; Price class: $280

**Special Note:** The GaAs FET is very unforgiving of even the shortest impulse of transmitter power. One must adequately account for T/R function switchover time. PIN diode switches, such as used in the ICOM IC-451A act so quickly that the preamp relay does not have time to release. Lunar has adequately alerted the user in the supplied documentation. The user should be aware, however, that the preamp may not be a mere strap-on accessory. Some analysis and adaptation of T/R switching may be necessary.

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International Crystal Mfg. Co., Inc.
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January/February 1982 27
AMSAT News

Organizational items of interest to all members of the Radio Amateur Satellite Corporation

AMSAT Net Directory

Beginning with this issue of ORBIT we will print a list of the active AMSAT (or related) on-the-air nets. The nets serve an especially important function within AMSAT. They provide timely information to a wide audience at low cost. Beyond informing members of recent events, satellite status and similar material, however, the nets also serve to introduce newcomers to AMSAT activities. Many individuals to whom "AMSAT" is only a name vaguely connected with OSCAR and other "exotic" are fascinated and perhaps encouraged to join in having been once exposed to AMSAT's various nets. Finally, the nets provide a convenient media by which the members obtain easy access to AMSAT managers and technical experts. Often a quick check will find the reason for a delayed magazine or a simple answer to a technical question will clear a log jam for a bewildered beginner. The nets do all these things. The nets listed below are but a sampling. We suspect that there are numerous local coverage nets which could be mentioned if we were aware of them. To have your net listed in a future edition, please provide the appropriate details to AMSAT's new Net Manager:

Wray Dudley, W8GQW
1617 W. McKaig Road
Troy, OH 45373

The most recent "startup" net is the AMSAT Espanol Net organized by Dave Liberman, XE1TU. Dave is particularly interested in promoting this net as a means of stimulating a large latent interest in Latin America. AMSAT feels that many potential members have been deterred by language difficulties. Dave hopes that a Spanish language net will catalyze that interest. Tune in on this net if Spanish is your primary language, amigo!

Special Net Note: It has been suggested by numerous individuals that the 20m and 15m International Nets could be much more effective if their time allocations were reversed. Therefore, beginning March 21, 1982, the 15m net will begin at 1800 followed by the 20m net at 1900.

AMSAT BoD Fall Meeting

The Fall meeting of the AMSAT Board of Directors was held at the Goddard Space Flight Center in Greenbelt, Maryland on October 18-19, 1981.

The Chairman, John Browning W6SP, declared the meeting open at 09h30 and an agenda was agreed to as follows:
1. Election of Officers
2. Awards
3. Financial report
4. AMSAT publications
5. Phase III status report
6. SYNCART status report
7. UoSAT
8. International affairs
9. Phase IIIB operating plans

Present were: John Browning, W6SP; Bill Brown, K9LF; Tom Clark, W3WI; Marty Davidoff, K2UBC; John Dubois, W1HDX; Pat Gowen, G3IOR; Gordon Hardman, KE3D; Molly Hardman, N3CHZ; John Henry, VE2VQ; Jan King, W3GEX; Bob Myers, W1XT; John Pronto, W6XN; Vern Ripperella, W2ALQQ; Roy Rosner, K4YV; Martha Saragovitz, Jim Skog, WD0EEL/4; Bill Tynan, W3XO; Rich Zwicko, K1HTV.

Resolution 1A/81: That the BoD elect the following people to hold office in 1981/82:
Chairman of the Board - W6SP, John Browning

Secretary to the BoD - N3CHZ, Molly Hardman
President - W3WI, Tom Clark
Executive VP - W2ALQQ, Vern Ripperella
VP for Operations - K1HTV, Rich Zwicko
VP for Special Projects - K9LF, Bill Brown
Corporate Secretary - Martha Saragovitz
Treasurer - K4YV, Roy Rosner
Proposed: Pat Gowen, G3IOR
Seconded: John Henry, VE2VQ
Resolution passed unanimously.

The Chairman then led discussion on the direction of the organization and commended W3WI on his effective leadership of AMSAT and W3GEX on the progress of the Phase III satellite construction. It was felt in general that there was a need to expand AMSAT's publicity. It was also recognized that it was necessary to have increased involvement of the general membership as the number of tasks to perform increased in number and complexity. It was recommended that the membership skills list be updated and that the method of finding suitable people to perform a particular task be formalized.

Resolution 1B/81: That the BoD award Honorary Life Membership of AMSAT to the following people:
W4PUJ, Dick Daniels - for his many contributions to all of AMSAT's satellites and

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1 This Net is a simulcast on the Goddard FM repeater W3ZM of the East Coast 75m Net. Repeater I/O is 146.235/835 MHz.
2 This Net is a simulcast of the West Coast 75m Net on ssb.

28 Orbit
for maintaining AMSAT’s historical archives.

G3JYO, Martin Sweeting - UoSAT Project Manager
LU9HBG, Mario Acuna - UoSAT magnetometer

W9HJO, Joe Sugarman - Fund raising
HS5WH, Bandi Gschwindt - Phase III BCR
Proposed: Tom Clark, W3WI
Seconded: Pat Gwenn, G3IOR

Resolution passed unanimously

Resolution 1C/81: That the Board commend the following people for their contributions to AMSAT particularly in the mentioned areas:

W4MID, WDF4AF - for their long-standing contributions, especially including their recent "This is AMSAT" video tape program VEHCRC - Oscar 7 command station ZS1BI - for unfailing devotion

W1XT - publishing ORBIT and ASK W6CC, W6CY, W2LQQ, W6GQW, K3ET, PARDO - net control stations KL7GDF - for his help with UoSAT launch support

Fred Moby - for design assistance with the gravity gradient boom for UoSAT
W4OWA - for his invaluable help with ALINS for UoSAT
WA6VOS - development of the Callsign badge and Patch programs

WD0EKK/4 - distribution of Callsign Badges WOZ - communications and liaison with overseas members

Proposed: Pat Gwenn
Seconded: John Henry, VE2VQ

Resolution passed unanimously

Roy Rosner, K4YY, reported that by exercising some caution, the funds were available to keep the organization healthy until launch in October 1982. He also suggested that 4 or 5 issues of ORBIT be published in the year leading up to launch, instead of 6.

It was decided that the membership would be solicited for donations at the end of the year. It was the consensus of the Board that a more vigorous approach should be made to get donations from industry.

Resolution 1D/81: That the BoD change the limit on expenditure by the President from $200 to $2500. The President should poll by telephone or telex all available directors on all commitments relating to fund raising or other non-operational expenses in excess of the above new limit. This limit is set by institutional conservatism and in no way is critical of Tom Clark who is doing an excellent job in his role of running AMSAT.

Proposed: Jan King, W3GEY
Seconded: Rich Zwirko, K1HTV

Resolution passed unanimously

Jan King then reported on the Phase IIIB status and reviewed the financial arrangements with AMSAT-DL.

The Phase IIIB schedule at present saw integration occurring about January 15, 1982. This was about five months later than originally envisaged, however, the launch date had also slipped 5-6 months. The delay had primarily been caused by problems getting the flight structure and the extra design work involved in incorporating the new liquid fuel kick motor. The spacecraft would be shipped to Germany about 1 April 1982, for pre-flight testing, probably to be done in Munich. Shipping to the launch site would take place August 1, 1982. The schedule could probably be put forward by two weeks if necessary.

Jan was going to Germany on October 21st for discussions on the new kick motor.

John Henry presented a report on SYNC ART activities and also presented a budget for the period up to December 31, 1981. John Pronko, W6XN, reported on the Bay area activities and also presented a document. He explained the limited financial involvement of Project OSCAR.

General discussion followed and the Board agreed to begin funding SYNCART as per the financial estimates presented.

At 15h45 John Browning left and passed the Chair to Rich Zwirko.

There ensued some discussion of UoSAT.

Resolution 1E/81: That the University of Surrey AMSAT group be congratulated for their diligent work and success with the creation of UoSAT-OSCAR 9 and recognizes the significant contribution from the AMSAT-UK organization.

Proposed: Pat Gwenn
Seconded: Jan King

Resolution passed unanimously

Resolution 1F/81: AMSAT offers thanks for the loan of equipment crucial to our support of the UoSAT launch to two firms, viz. Jim McNab and Bill Henry of Hal Communications for their loan of a CT-2100 terminal and John Horton of ICOM America and EEB for the loan of an IC-451 70 cm transceiver. Without their help, early orbit support and tracking of UoSAT OSCAR 9 would have been impossible.

Proposed: Tom Clark
Seconded: Jan King

Resolution passed unanimously

Pat Gwenn, G3IOR, presented a letter which he had sent to overseas member societies prior to attending the BoD meeting and reported that all seemed quiet and happy on the international front.

There followed general discussion of special service channels on the satellite bands.

The matter of an activity week on AO-8 was to be investigated by Pat Gwenn, G3IOR and he would notify the ARLI and AMSAT of his recommendations.

Rich Zwirko declared the meeting closed at 17h50.

Satellite Report Enclosed

We've enclosed a sample issue of AMSAT Satellite Report for you to review (just in case you haven't seen a copy lately). Subscription information is at the bottom of page 8 of this issue.

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OSCAR SYSTEMS FROM SPECTRUM INTERNATIONAL

Mode-A

TEN METER TRANSMITTER

MMI 144-28

TRANSMITTER

PA 28

LOW NOISE PRE-AMP

10W

10-METER BEAM

8XY/2M TWIST

Mode-B

TEN METER TRANSMITTER

MMt 432-28(S)

TRANSMITTER

MMI 144-28 or
MMc 144-28

RECEIVE CONVERTER

10W

50W

LINEAR AMPLIFIER
(if required)

70/MBM48 MULTIBEAM

8XY/2M TWIST

Mode-J

TEN METER TRANSMITTER

MMI 144-28

TRANSMITTER

MMI 432-28(S) or
MMc 432-28

RECEIVE CONVERTER

10W

10W

MMI 200

LOW-PASS FILTER

PSI 432

BANDPASS FILTER

8XY/2M TWIST

70M/MBM48 MULTIBEAM

CONVERTERS AND TRANSVERTERS FOR

OSCAR 7
OSCAR 8
PHASE III

Specifications:
Output Power: 10W
Receiver N.F. : 3 dB typ.
Receiver Gain: 30 dB typ.
Prime Power: 12 Vdc

Receive Converters:
MMc 144 $59.95
MMc 432-28(S) $81.50
MMc 432-28(TC) $79.95

Receive Preamplifier:
PA 28 $35.95

Mod. kit to adapt original MMt 432-28 FOR Mode-J operation: $26.50

Send 36 cents (two stamps) for full details of KVG crystal filters and other products to fill all of your VHF/UHF
equipment needs.

Preselector Filters ● Amplifiers ● SSB Transverters
Varactor Triplers ● Counters ● FM Transverters
Antennas ● Decade Prescalers ● VHF Converters
Oscillator Filters/Crystal Filters ● UHF Converters

Attention owners of the original MMI 432-28 models: Update your transverter to operate OSCAR 8 and
Phase III by adding the 434 TO 436 MHz range. Mod. kit
including full instructions is $26.50 plus $1.50 shipping.

ANTENNAS

2-Meter 8 + 8 Twist Model 8XY/2M
Phasing Harness Model PMH/2C
48 el. 70 Cm Multibeam Model 70-MBM-48
88 el. 70 Cm Multibeam Model 70-MBM-88

(ALL PRICES FOB CONCORD, MASSACHUSETTS)

Master Card, VISA Card accepted

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Post Office Box 1084R
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Lunar's transverter modules put you here!

Adding various combinations of transverter modules to your existing equipment allows you to expand your capabilities to work on many bands and frequencies, including Phase III receiver noise and one or two high-frequency transverters. You may purchase a different unit for each additional band you wish to cover.

Lunar's transverter modules are designed to operate with the basic down converter or to be used in a separate transverter for transmit. By using an appropriate local oscillator module, the desired bands can be tuned in to with modulated audio. The high-quality modules are easy to install and, if used in a separate transverter, can provide an additional means of tuning the system. For a complete list of modules, contact your nearest Lunar distributor.

Some examples of expected features include:

**EXAMPLE 1**
- Vfo 28
- 144 MHz
- 220 MHz
- 430 MHz
- 2.3 GHz

This concludes the first example.

**EXAMPLE 2**
- Vfo 20
- 220 MHz
- 2.3 GHz

Conversion gain: +6 dB
- Overall gain: +6 dB
- Selectivity: +6 dB

**EXAMPLE 3**
- Vfo 20
- 220 MHz
- 2.3 GHz

Conversion gain: +6 dB
- Overall gain: +6 dB
- Selectivity: +6 dB

**EXAMPLE 4**
- Vfo 20
- 220 MHz
- 2.3 GHz

Conversion gain: +6 dB
- Overall gain: +6 dB
- Selectivity: +6 dB

**EXAMPLE 5**
- Vfo 20
- 220 MHz
- 2.3 GHz

Conversion gain: +6 dB
- Overall gain: +6 dB
- Selectivity: +6 dB

For more information on Lunar transverter modules, contact your nearest Lunar distributor.

Lunar electronics®
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San Diego, CA 92102
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(800) 222-2797
Lunar Corporation
P.O. Box 12057
San Diego, CA 92111
The Official AMSAT QSL Card:

There are just two ways to make a QSL card stand out: (1) You can make it gaudy, or (2) You can make it simple but elegant. We've chosen simple elegance. If ever a picture spoke volumes, this QSL intones very special things about its owner. Most of all, it says its sender is a solid AMSAT supporter. It connotes the stark adventure we know as part of the “Hams In Space” theme.

We've combed the archives for photo images that would convey just that feeling because we know you want to share that spirit with others through your QSL.

As you see, the face of the QSL is clean, pure and simple. At once you get the notion of space adventure. And, your callsign appears unobtrusively in this important context.

We strongly believe the distinctive nature of this QSL is in keeping with the distinguished interests of our ardent supporters. Send today! For a copy of AMSAT's Official Order Form, please write to AMSAT QSL, P.O. Box 27, Washington, DC 20054.

AMSAT T-Shirts!

It's nearly spring and time to shed those winter coats. Just picture yourself in one of the new AMSAT "Ham's-In-Space" T-shirts!

What better way to show off your participation in hamdom's most exciting aspect... and help build satellites too!

Your $10 (min.) donation will reserve your T-shirt. Send today! (Please specify size.)

Check, money order, or VISA/MC to AMSAT, P.O. Box 27, Washington, DC 20044.
By Popular Demand...

Yaesu's All-New VHF/UHF Transceivers!

Yaesu is proud to introduce a new generation of computerized VHF and UHF equipment. With the features you have asked for and the quality you demand, these revolutionary transceivers are your passport to the newest frontiers in Amateur Radio!

**COMPLETE OSCAR STATION!**
- FT-480R - 143.5 to 148.5 MHz SSB/CW/FM
- FT-780R - 430-440 MHz SSB/CW/FM
- SC-1 Station Console w/Digital Clock

A complete microprocessor-based communication system with convenient switching of scanning and microphone controls, AC power supply, and 16 button tone pad.

**FT-290R 2M MULTIMODE PORTABLE!**
- Battery Powered (NiCd C-Cells Optional)
- LCD Display with Night Light
- USB/LSB/CW/FM with 2.5W RF Output

An entirely new concept in VHF operating! LCD display with full microprocessor control, 10 memories, two VFO's and multimode flexibility, all from a battery powered package. Telescoping antenna built in. Optional FL-2010 PA and FP-80A AC Supply.

**FT-208R**
2 METER FM HAND-HELD!
- LCD Display with Lithium Backup Cell
- Selectable 5 kHz/10 kHz Scanning
- 10 Memories with Auto/Resume Scan
- 16 Button Tone Encoder

Yaesu's latest thoroughbred for 2 FM is the FT-208R Hand-Held. Four digit LCD display, 10 memories, limited band scan, and priority channel make this the most versatile hand-held ever made available to the amateur fraternity.

**FT-690R**
6 M MULTIMODE PORTABLE!
- USB/CW/AM/FM Battery Portable
- LCD Frequency Display with Night Light
- 10 Memories with Lithium Backup Cell

Catch those exciting DX openings with the new FT-690R 6 meter portable. Repeater shift (1 MHz), two scanning steps per mode, and dual VFO's for top flexibility.

**FT-708R**
70 CM FM HAND-HELD!
- LCD Display with Lithium Backup Cell
- Selectable 25 kHz/50 kHz Scanning Steps
- 440-450 MHz with 10 Memories
- Memory/Band Scan and Limited Band Scan
- Resume Scan
- 16 Button Tone Encoder

Yaesu leads the way with its pioneering microprocessor controlled 440 MHz hand-held. Priced competitively against much simpler units, the FT-708R system includes a full line of accessories, including CTCSS, NiCd chargers, and remote speaker/microphone options.

Sporting unmatched engineering and manufacturing know-how, Yaesu's technical staff is committed to pushing the state of the art. Yaesu products are backed by a nationwide dealer network and two factory service centers for your long-term service needs. So when it's time to upgrade your station equipment, join the thousands of hams that are tired of compromise — join them by investing in Yaesu!

Some accessories pictured above are extra-cost options. See your Yaesu dealer.

Specifications Subject To Change Without Notice Or Obligation.

Yaesu Electronics Corp., 6851 Walthall Way, Paramount, CA 90723 • (213) 633-4007
Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246 • (513) 874-3100
Watt's new...on 2 meters?

All mode (FM/SSB/CW) 25 watts, plus....!!

TR-9130

The TR-9130 is a powerful, yet compact, 25 watt FM/USB/LSB/CW transceiver providing increased versatility of operation on the two meter band. It features six memories, memory scan, memory back-up capability, automatic band scan, all-mode squelch, CW semi break-in, and incorporates microprocessor technology. It is available with a 16-key autopatch UP/DOWN microphone (MC-46), or a basic UP/DOWN microphone.

TR-9130 FEATURES:

- **25 Watts RF output**
  All modes, (FM/SSB/CW), utilize a new high power linear module, for more reliable FM operation and increased DX on SSB or CW.

- **FM/USB/LSB/CW all mode operation**
  For added convenience in all modes of operation, the mode switch, in combination with the digital step (DS) switch, determines the size (100 Hz, 1 kHz, 5 kHz, 10 kHz) of the tuning step, and the number of digits displayed.

- **Six memories**
  On FM, memories 1 through 5 for simplex or ±600 kHz offset, with the OFFSET switch. Memory 6 for non-standard offset. All six memories may be operated simplex, any mode.

- **Memory scan**
  Scans memories in which data is stored. Stops on busy channels.

- **Internal battery memory back-up**
  With 9 volt Ni-Cd battery installed, (not KENWOOD supplied), memories will be retained approximately 24 hours, adequate for the typical move from base to mobile. A terminal is provided on the rear panel for connecting an external back-up supply.

- **Automatic band scan**
  Scans within whole 1 MHz segments (ie, 144.0-144.999 MHz), for improved scanning efficiency.

- **Dual digital VFO's**
  Incorporates two built-in digital VFO's, selected through use of the A/B switch, and individually tuned.

- **Transmit frequency tuning for OSCAR operations**
  On SSB or CW, the tuning knob or UP/DOWN buttons on the microphone may be used to adjust the transmit frequency during transmission.

- **16-key autopatch UP/DOWN microphone version**
  The TR-9130 is available with the MC-46 16-key autopatch UP/DOWN microphone, or with the basic UP/DOWN microphone. Manual UP/DOWN scan of entire band possible using either microphone.

- **Squelch circuit on all modes (FM/SSB/CW)**
  The squelch circuit is effective on SSB, CW, and FM.

- **Repeater reverse switch**
  For checking signals on the repeater output, on FM.

- **Tone switch**
  For activating a tone device, (not KENWOOD supplied).

- **CW semi break-in circuit with sidetone**
  Built-in, for convenience in CW operations.

- **Digital display with green LED's**

- **High performance receive-transmit design**
  The use of a low-noise dual-gate MOSFET plus two monolithic crystal filters in the receiver front-end results in excellent two signal characteristics. Care in transmitter design assures clean signals in all modes.

- **Compact size and light weight**
  170 (6-11/16) W x 68 (2-11/16) H x 241 (9-1/2) D mm (inch), 2.4 kg (5.3 lbs.) weight.

- **Extended frequency range**
  Covers 143.9 to 148.999 MHz, which includes certain MARS and CAP frequencies.

- **Transmit offset switch**

- **High performance noise blanker**
  Suppresses pulse-type noise on SSB and CW.

- **RF gain control**
  For all modes of operation.

- **RIT (Receiver Incremental Tuning) circuit**
  Useful during SSB/CW operations.

- **Amplified AGC**
  Enhances SSB and CW operation. The AGC time constant is automatically optimized for each mode of operation.

- **HI/LOW power switch**
  Selects 25 or 5 watts RF output on FM or CW.

- **Accessory terminal**
  A four pin accessory terminal is provided for use with a linear amplifier or other accessory.

- **Quick release mounting bracket**
  (Supplied)

More information on the TR-9130 is available from all authorized dealers of Trio Kenwood Communications 111 West Walnut Street, Compton, California 90220.

KENWOOD...

...pacesetter in amateur radio

Specifications and prices are subject to change without notice or obligation.