Spotlight on AO-7: The Record Reviewed

While it is certainly too early to begin writing AO-7's obituary, it might be appropriate to review the exemplary record AMSAT-OSCAR 7 has set forth. First, a few of the statistics and facts about AMSAT-OSCAR 7 to set the framework for its operational achievements.

AO-7 was launched 15 Nov. 74 at 1711 UTC from Vandenberg AFB, CA aboard a Delta launch vehicle. Its co-passengers were the NOAA-4 and ITOS-G satellites. AO-7 weighs 64 lbs (29 kg). As of 15 June, AO-7 had completed 30,120 orbits or 57,715 hours or 2405 days, or 6.6 years in orbit. Its design life was 3 years. It is even now among the longest lived of ALL spacecraft in orbit—an enviable record by anyone's standard. AO-7 is in an orbit which is very nearly circular having an ellipticity of only 0.0011158. The deviation from a perfectly circular orbit is approximately that of the equatorial bulge or oblateness of the earth caused by its spinning on axis. A recent measurement had apogee at 918 miles (1478 km) and perigee at 898 miles (1445 km). The orbit is inclined 101.4124 degrees. The Mode B transponder was built by AMSAT DL, the 435.1 MHz beacon by Canadians, the RTTY telemetry encoder by Australians, the SHF (2304 MHz) beacon and Mode A transponder by Americans. (The SHF beacon was never authorized for use by the FCC and was never turned on.) The Mode A transponder was rated at 2 watts PEP while the Mode B transponder could produce 10 watts PEP or 2.5 watts PEP (Mode C). Mode B was probably the most popular mode in all satellite history. It certainly was the most convenient downlink to listen to with its extraordinarily strong 2 meter signals audible even on a hand-held transceiver with "rubber duckie".

In the 6.6 years AO-7's been aloft, if there have been on average only 33 QSOs per orbit, then there have been more than a MILLION QSOs on AO-7. Other estimates are considerably higher. For example, it seems easy to visualize how an average of only 200 QSOs per orbit might transpire. That results in over 6,000,000 QSOs. Is that incredible? Looked at another way, it is likely that between 10,000 to 15,000 different amateurs have accessed AO-7 and actually put signals through it. Perhaps another 10,000 or so have monitored it on one occasion at least. Quite a record for a little 29 kg bird built in basements around the world!

Specific achievements on AO-7 are literally too numerous to mention. But here are a few of the prominent ones.

•A new VHF transequatorial propagation mode was discovered when YV5ZZ heard LU7DJZ's 2 meter uplink to AO-7A in November 76. The new ionospheric propagation mode was documented in *QST* for January 78 by W3XO in his column, "The World Above 50 MHz".

•In 1976 a series of experiments proved medical data (EKGs) could be sent by satellite when W6ELT sent data tapes to W3UN at the National Institute of Health station, K3YGG. The tapes had been provided by K7RGE of the University of Arizona, Tucson and were analyzed by W3QBC. Later in January 76, W2GN sent tapes from his mobile OSCAR station in Albany, New York to the Institute.

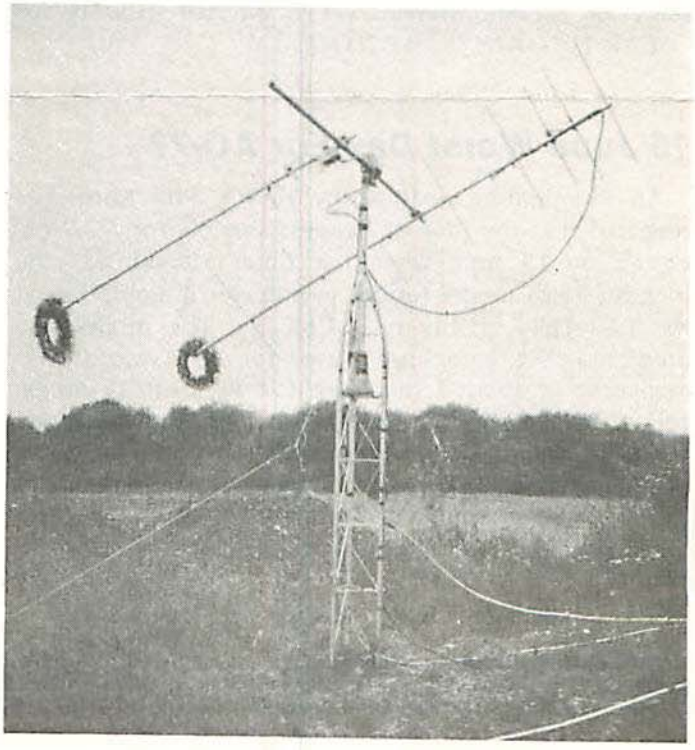
•In early February 76 began a dramatic series of demonstrations of a precedent setting nature when the first ever satellite to satellite links were accomplished by stations transmitting on the AO-7B uplink. These signals were then picked up by the then operative AO-6 Mode A receiver and transponded to 29.45 MHz. Dozens of contacts were thus made and the experiment was repeated on several occasions throughout that year when the two birds were close to each other in their respective orbits.

•APT satellite pictures were transmitted for European consumption in April/May 76 by DLØVB as part of an experiment which proved very successful.

•Many mobile tests were run using AO-7. W2GN plied his (in)famous automobile, W6OAL his aeromobile and WA4JID his marinemobile.

•QRP tests in June 76 on Mode B showed that a few milliwatts ERP were sufficient for a perceiveable downlink. Hundreds (thousands?) of QSOs transpired using 10 watts ERP or less on AO-7B.

•An STA was granted by the FCC for use of ASCII on AO-7 for the express purpose of allowing Phase III control staions to test the new PSK modulation scheme on AO-7.



When on Saturday, 13 June 81, it appeared that AO-7 was lost, this scene was photographed at WA2LQQ. Here is seen the array bowed in honor of a lost comrade much as is the tradition of a naval gunnery officer who lowers his armaments thus. Wreaths are seen adorning the "muzzle" end. If AO-7 could speak of its own accord, it might say (perhaps in RTTY with marks, spaces and twains): "Reports of my demise are somewhat premature."

•President of the United States Gerald Ford spoke through AO-7 during the dedication of the Air and Space Museum in Washington, D.C.
•AO-7 was used on both arctic and antarctic expeditions. To the north, AO-7 was used by the Arctic Geographic Cruise. (WA6PSR) On the southern extreme, ZS1FE heard his own AO-7 return dozens of times but could not QSO due to his remote QTH.
•Emergency Locator Transmitter (ELT) tests which had begun on AO-6 were continued on AO-7 with positive results.
•HA5WH demonstrated the feasibility of direct satellite to home FM boradcast in 1975.
•Voice bulletins to AMSAT members and to the general radio amateur population were accomplished by: (among a very large team) K2BZT, W1NU, W3BWU, K1HTV, W2GN, W4MOP, W6CG, W6ELT, W4BE, and with WA4JID doing his special hurricane-watch transmissions on AO-7.
•Educational uses of AO-7 in the grammar schools, high schools and at college level were evident. W2GN led the way with WØCY.
•Special events stations colored AO-7's proud history with an especially brilliant hue. From Space-Com to the Boy Scouts International Hamboree, AO-7 did the job well.
•Codestore messages carried everything from holiday greetings in several languages to 200th birthday greetings to the USA in 1976. Congratulations to UK's Queen Elizabeth were also in codestore.

Yes, AMSAT-OSCAR 7 has been a wonderful friend these years and we will, if absolutely required of us, part company with him. Yet we can't help wish that he would just stick around a bit longer so that we could have just one or two more FB QSOs on Mode B. Maybe. Time will tell the tale. We should know within a week or two whether this is goodbye to seven or if we will have a respite. In either case, we are grateful for the delight and sense of accomplishment we've all had. Hooray for OSCAR 7!!!—*K1HTV, WA2LQQ*

15 June Worst Day For AO-7?

An illuminating analysis by KA9Q, Phil Karn, has revealed that the time of deepest shadow for AO-7 occurred on 15 June when the time interval was the longest. Phil's model resides in a powerful computer at the Bell Labs facility near Chicago. The model had predicted that the eclipse season for AO-7 would commence on or about 1 June (see *ASR* #8, page 1). An excellent article which today takes on special relevancy appears in *ORBIT* #6 for March/April 81, page 21: AMSAT-OSCAR 7 Between Sunlight and Shadow by DL3ZK, Juergen Raddatz.

KA9Q's computer analysis also reveals reason to hope that the worst may have past. The data shows the onset of the eclipse season at 1 June and the end at 4 or 5 July with the maximum duration eclipse occurring on 15 June. AO-7's orbit is at present at a position to cause the satellite to fall into shadow once each orbit when the bird is near the South pole. Phil's model is a simple one and thus does not account for various optical effects encountered in the real world such as forward scattering of light, refraction by the atmosphere, etc. In effect, the model treats the earth as if it had no atmosphere and as if light were particulate (photon model). Thus, the earth in this model provides a clean "knife edge" and perfectly black shadows with no twilight zone. While this model is acknowledged to be deficient in these areas, it nevertheless provides valuable insight to the trends and relative insolation. Based on his model, Phil says the maximum eclipse interval duration is 7.5 to 8 minutes on 15 June and falls off to zero from this center point to 1 June and 5 July reasonably symmetrically. For example, on 4 June and 1 July the duration is predicted to be 5 minutes.

A longer view to trends was revealed by K1HTV and W3IWI who observed that the late spring season each year has seen AO-7 in deeper shadow (also interpreted as LONGER eclipse duration). Last year, this period was marked by failure of the telemetry beacon probably associated with falling power availability. AO-7 has been a wounded bird since a devastating battery failure in 1978 very nearly cost the entire mission. It is extremely fortunate that the cell that failed in 78 failed in the "open" mode, thus acting as a resistor in series with the remaining cells, rather than doing the typical NiCad failure routine of simply shorting out and drowning the entire supply. In effect, then, we have been getting gratis time for the last three years.

The present anomalies may indicate a change in the condition of that failed cell or it may indicate changes in other cells. K1HTV says that the telemetry he's been receiving shows a long term trend of rising voltage on the remaining cells. This is assumed to be a favorable omen perhaps indicating some healing going on in the cells. How the present difficulties will affect that trend is not at all clear at this time, said K1HTV. Words heard around AMSAT expressed hope that, if the present crisis were directly related to the duration of the eclipse interval, that upon emergence from this period in about 10 days, the satellite will be found to have suffered minimal permanent damage. Is it too much to hope that these conditions be reversible? We'll have to wait and see.

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