ARCI NEWS

www.antique-radios.org

THE ANTIQUE RADIO CLUB OF ILLINOIS

Affiliated AWA
Antique Wireless Association

Volume 38, Issue 6
December, 2019

HAPPY HOLIDAYS TO ALL!!

(Sony transistor products advertising, 1961)

UPCOMING INDOOR MEET DECEMBER 8, 2019

AMERICAN LEGION HALL

570 South Gary Avenue, Carol Stream, IL

December 8, 2019

7AM - 11AM

Donation Auction

Business Meeting

Janet LaVelle Holiday Party with Free Coffee, Cookies

2020 ARCI MEET SCHEDULE

February 23, 2020	**7AM-9:30AM Indoor Swap People's Choice Contest, Officers' Meeting 9AM**	**American Legion Hall Carol Stream, IL (See Map)**
April 26, 2020	**7AM-11AM Outdoor Swap Meet Inside Business Meeting 9:30AM**	**American Legion Hall Carol Stream, IL (See Map)**
June 21, 2020	**Outdoor - Gates Open 7AM Combined Meet With 6-Meter Club of Chicago**	**DuPage County Fairgrounds Wheaton, IL (See Advance Ticket Form & Map)**
August 7-8, 2020	**RADIOFEST**	**Medinah Shriners / Addison, IL**
October 4, 2020	**7AM-11AM Outdoor Swap Meet Business Mtg./Officer Election 10AM**	**American Legion Hall Carol Stream, IL (See Map)**
December 13, 2020	**7AM-11AM Indoor Swap Meet Business Meeting 10AM**	**American Legion Hall Carol Stream, IL (See Map)**

ARCI
MEMBERSHIP RENEWALS

PLEASE CIRCLE YOUR MEMBERSHIP:

Membership Option	***Dues***	***Benefits***
Annual Membership	$ 25	Full benefits: *ARCI News* subscription, Fee Discounts At Events, Seller Privileges at ARCI Events.
Spousal Annual Membership	$ 10	Discounts at Events.
Student Annual Membership	$ 5	Must Be 18 or Under, Full Benefits.
Lifetime Membership	$340	Full Membership Benefits For Life (non-transferable).

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P.O. Box 1139
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Emergency Contact Name:_____Phone:_____

PRESIDENT'S MESSAGE

Warmest Holiday Greetings from your ARCI President! Just like last year, I am writing this column on the heels of a November snowstorm accompanied by record cold temperatures. It is a not-so-gentle reminder that summer is over, and now is the time for us to put away the lawn mower and shift our thoughts back to the radio restoration tasks that we put off months ago because we had to mow the lawn! Your radio collection once again beckons for your undivided attention. ARCI has just the thing to focus your attention and to get you back on track at our December 8th swap meet.

Unlike last year, the October meet at the American Legion Hall in Carol Stream was held outdoors under sunshine and comfortable fall temperatures. It was another great meet with the number of enthusiastic buyers and sellers typical for an October gathering. Free coffee and donuts were available inside and are always appreciated. As always, the Donation Auction was a real highlight of the meet. I am always amazed at the number of radios and related items that our members make available for bidding. A special thanks to Mark Detgen for donating a Zenith Console to the club! As usual, Tom Kleinschmidt did a spectacular job with the auction and thanks go to him and to those who pitched in to help. The auction gave us a chance to use our new battery-operated portable sound system that we first used at *Radiofest* this year. Thanks to Rudy Hecker for setting that up so all could hear those bids. The donation auction helped raise $340 for ARCI. Everyone's participation is truly appreciated!

Here is some preliminary information about *Radiofest* 2020. We have already secured the venue and hotel, and are now in the process of assembling the teams that will manage the various events. Here is the news so far:

- **Our dates for *Radiofest 2020* will be Friday-Saturday, August 7 and 8.**
- **We will remain on the two-day schedule (Friday and Saturday only).** We will open with the Main Auction on Friday evening and hold the outdoor swap meet on Saturday through mid-afternoon. The speaker programs, display, and contest setup will take place during the day on Saturday. The awards banquet with entertainment will take place on Saturday night. The usual donation auction will be late Saturday afternoon to close the outdoor portion of the event.
- ***Radiofest 2020* will return to the Medinah Shriners facility in Addison, Illinois, with the adjacent Hilton Garden Inn providing overnight accommodations.** We look forward to returning once again to these superb facilities that have provided us with such a wonderful experience for the last three years.
- **We have already secured a block of rooms at the Hilton Garden Inn for Thursday-Saturday at a special $99 rate (same as last year)**. Watch the *ARCI* Web site www.antique-radios.org and upcoming *ARCI* News for information regarding online and over-the-phone hotel reservations. Make sure to mark your calendars for *Radiofest 2020*.

I hope to see all of you at our next meet on December 8th. This will be our fifth annual Janet LaVelle Holiday Party, and as in the past, it promises to be another great one. Our December meets have historically been some of our best, with many sellers and a great donation auction. Come out to Carol Stream and buy yourself or someone close to you a nice holiday gift.

Don't forget about our business meeting following the December 8th meet. This is an important meeting, and we invite all *ARCI* members to attend. In addition to numerous topics of discussion, we will be holding the final votes for our roster of 2020 club officers. If there is anything you would like to suggest for discussion regarding club activities or policies, this is the time to bring it up.

I have enjoyed serving the club during the past two years as your president. However, I have decided it is time to step down and focus my efforts on some of the many activities specific to *Radiofest*. Thank you for the opportunity to lead this wonderful Club, it has been an honor and great fun.

In February of 2020 (yes, next year!) *ARCI* will celebrate its 40th anniversary! Much has changed since our humble beginning 40 years ago, but *ARCI* has remained true to its stated purpose found in the *ARCI* By-Laws *"The purpose of this club shall be to preserve the history and enhance the knowledge of radio and related disciplines."* It is the enthusiastic support of the club's Officers, Directors, Volunteers, and members-at-large over the years that has contributed to the success of this club.

While we can celebrate and look back on our 40 years (and we should), it is also time to look forward to seriously consider the resources required to sustain our club at the current level. It is no secret that young people are not standing in line to join antique radio clubs. In fact, many organizations and service clubs are finding it difficult to remain viable due to lack of "new blood" as they say. ARCI is no different from other clubs in that having additional volunteers in key positions would go a long way to provide relief to those that perform tasks year after year or through normal attrition. If you think you might be able to volunteer in any way, please contact an officer or board member. Club sustainability is a timely topic that our organization will continue to address.

We look forward to our 40th Anniversary in 2020. Watch the *ARCI NEWS*, the ARCI Web Site and E-Mails for further information. Remember that the next meet on December 8th, 2019, is the annual Janet LaVelle Holiday Party. Janet was well-known to ARCI members for providing cookies at our swap meets. Cookies will be available at the December meet, but if you have cookies from a favorite recipe to share … please bring them along! As always, I welcome your thoughts, ideas and suggestions. Feel free to contact me at smuchow@att.net.

See You At The Next Meet,
Steve Muchow,
ARCI PRESIDENT

ARCI UPDATE

The President's Column - All The News That's Fit To Print

OFFICERS FOR 2020

ARCI will hold its annual business meeting and officer elections at the December meet. The following people are nominated to serve another year:

Board of Directors

Dr. Barry Janov, Chairman
David Bart
Art Bilski
Harry Blesy
Ed Huether
Tom Kleinschmidt
Steve Muchow
Robert Piekarz
Olin Shuler
John Stone
Jeff Aulik

Officers

Jeff Aulik, President
Jim Novak, Vice President
Mary Johnson, Secretary/Membership
Rudy Hecker, Treasurer

VOLUNTEERS FOR 2020

ARCI has been fortunate to have a great team of volunteers over the years who have faithfully and generously served the club. They deserve your thanks and recognition for all the support they provided. Remember, ARCI is your club and we need your help too! As we all pitch-in, the club will continue to improve for everyone's benefit. Please talk with one of the officers, Board Members or current volunteers for more information on how you can lend a hand. ARCI looks forward to working with the following during the upcoming year.

Nicholas Tillich, Radiofest Auction Coordinator
Jim Sargent, Radiofest Auctioneer
Tom Kleinschmidt, Bill Cohn, Donation Auction
Ed & Judy Huether, Radiofest Coordinators
Elaine Hecker, Registration
Gary Bernstein, Tom Kleinschmidt, Public Relations
Julia & David Bart, ARCI Newsletter Editors
John Stone, Radiofest Auction Coordinator
Jim Novak, WA9RCI Ham Radio Station
Ron Grams, WB9IMR, Trustee of FCC License WA9RCI
Rudy Hecker, Signage, People's Choice Contest
Jim Rajkovac, Webmaster
Cindy Fudge, ARCI Newsletter Publisher
Karl Johnson & Pete Nauseda, Parking & Information

YEAR END 2020 ANNUAL REPORT

By Steve Muchow, ARCI President

2020 ANNUAL REPORT

I am happy to report that ARCI continues to remain on solid ground throughout fiscal year 2019 with respect to membership, activities, and finances. Our membership levels remain solid, our meets are well attended by both buyers and sellers, and our finances have continued to strengthen. Here are some additional details about each of these areas.

MEMBERSHIP: ARCI's paid membership is now approximately 240 members, and continues to remain stable in an environment where many other clubs are experiencing substantial attrition. Due to our year round membership renewal schedule, there is considerable short-term variation in the number of active paid members. While renewals do occur all year, the bulk of them take place from just prior to *Radiofest* through our December regional meet. Between our mail-in renewals that accompany *Radiofest* applications and on-site membership renewals at *Radiofest* itself, we have totaled approximately 100 *Radiofest*-related membership renewals alone. We also hope to see somewhere between 20 and 30 total additional membership renewals taking place during the December meet. We received several life-memberships this year, as well as *Radiofest* Sponsor-Memberships and we want to extend our appreciation to those who pledged their support to the club in those ways. Please check your membership expiration date! If your membership has expired, please help your club by remembering to renew at the next meet or by mail. Your membership dues are critical to the health of our club and we cannot continue without your financial support. Thanks to all of you for your support of ARCI over these many years.

ACTIVITIES: Our meets, including both regional meets and *Radiofest*, remain very popular and well-attended events. Our regional meets in Carol Stream have an average of 25 seller spaces per meet and approximately 75-85 buyers and sellers in attendance, depending on the time of year. One of our most popular regional meets is our December indoor Janet LaVelle Memorial Holiday Party that features around 30 sellers and a large donation auction. *Radiofest.*2019 was a highly successful and well-attended event. Our venue and hotel were a hit, and we anticipate a repeat performance in 2020. Over 130 individual selling spaces were sold in our swap meet lot, with more than 400 estimated buyers in attendance from 18 different states plus Canada. The main auction was our best ever with a tallied gross sales of over $46,000 … the highest in ARCI history! Items consigned to the main and donation auctions helped us fully finance the costs of our auction facilities and support. This, in conjunction with our registration fees, again enabled us to completely self-fund Radiofest 2019 without tapping directly into the club's cash reserves. We have excellent working relationships with the Shriners, Hilton Garden Inn and the Carol Stream Legion and are confident these will continue.

FINANCES: One of the most important tasks for any ARCI president is to ensure the financial health and stability of the club. I am happy to report that the club's finances are still strong. We have improved our club's bottom line during the course of Fiscal Year 2019. Much of this year's increase is attributed to generous donations to the club (both in cash and items) for our donation auctions, proceeds from our *Radiofest* 2019 auction that helped make Radiofest self-funding in total, and the cost savings we have realized through our arrangements with the Medinah Shriners *Radiofest* venue. We also continue to evaluate how to best utilize equipment for our AV needs and by carefully selecting other vendors that offer us the highest value for our money. These savings give the club a much-needed financial buffer to weather issues like increasing costs for *Radiofest,* membership attrition, and other unforeseen challenges. We continue to look at ways to get more for each club dollar and welcome new ideas.

NEWS FROM THE HAMSHACK

By: Jim Novak, WA9FIH

THOSE HEATHKIT SINGLE BANDERS FROM THE 1960S

Back when I was a young ham in the early 1960s, voice operation on the HF – High Frequency bands (160 through 10 Meters) was still largely done with AM transmissions, but SSB – Single Sideband – was starting to take over as a more efficient way to operate, requiring. SSB required less bandwidth but also had more complex circuitry. And, instead of separate receivers and transmitters, manufacturers such as Collins and Hallicrafters were beginning to offer transceivers, with many common receive and transmit functions combined in one compact box.

Heathkit, based in Benton Harbor, Michigan, was a major producer of a wide variety of electronic kits, including "hi-fi" audio, consumer AM-FM radios, test equipment, and ham radio gear. Kitbuilding was popular back then, providing not only a great learning experience but also making equipment more affordable.

The Heathkit Single Bander transceivers were announced in late 1963 as the Model HW-12, HW-22, and HW-32, covering the voice portions – no CW (Morse code) of the 75, 40, and 20 Meter bands with a selling price of $119.95. The kit did not include required accessories such as a power supply – either 110 VAC or 12 V DC for mobile operation, microphone, and 100 kc crystal calibrator, which were available at extra cost.

Heathkit SSB Transceiver Model HW-12A.

Eighteen tubes, including two 6GE5 TV sweep tubes that were used as RF power output amplifiers running 200 Watts PEP (Peak Envelope Power), plugged into sockets mounted on a large, sturdy etched ("printed") circuit board. Front panel controls included a large tuning knob for the VFO (Variable Frequency Oscillator), receiver AF and RF Gain, a PTT (push-to-talk)-VOX (voice operated transmit)-Tune control switch, VOX sensitivity control, and a Final Tune knob to resonate the RF tuned output circuit. A sturdy mounting bracket was also included for mobile use, which could be attached to bottom of one's dash or atop the transmission hump.

Heathkit SSB Transceiver Model HW-22.

Chassis of Heathkit SSB Transceiver Model HW-22A.

Back Panel of Heathkit SSB Transceiver Model HW-32A.

After three years of production, an updated version of the Single Banders was announced as the HW-12A, -22A and -32A with revised front panel styling and some added features, such as a USB/LSB switch. Heath also announced the HW-18 series of similar radios which provided specific coverage of Civil Air Patrol (HW-18-1), MARS – Military Affiliate Radio Service (HW-18-2) – and the 160 Meter (1.8-2.0 Mc.) ham band (HW-18-3). These radios did not have a VFO, but were instead crystal controlled on two channels, adequate for CAP or MARS, but not a great idea for the 160 Meter ham band! Nevertheless, the "Hot Water" rigs, as they became known, were very popular in their day.

HISTORY ZONE

An Occasional Column on Historical Items of Interest

By: Keith Baker, KB1SF/VA3KSF and Dick Jansson, KD1K

EDITOR'S NOTE: In recognition of the 50th anniversary of AMSAT this past October, we bring you a historical overview of the amateur radio satellite program as documented by AMSAT.

A BRIEF HISTORY OF AMSAT

AMSAT is a worldwide group of Amateur Radio Operators (Hams) who share an active interest in building, launching and then communicating with each other through non-commercial Amateur Radio satellites. By any measure, AMSAT's track record has been impressive. Since its founding…now over 50 years ago… AMSAT has used predominantly volunteer labor and donated resources to design, construct, and, with the added assistance of international government and commercial agencies, successfully launch, over 60 Amateur Radio satellites into Earth orbit. Today, over 20 of these satellites are operational.

The AMSAT logos are each registered trademarks of the Radio Amateur Satellite Corporation.

The Radio Amateur Satellite Corporation (as AMSAT is officially known) was formed in 1969 as a not-for-profit, 501(c)(3) educational organization chartered in the District of Columbia. Its aim is to foster Amateur Radio's participation in space research and communication. Since that time, other like-minded groups throughout the world have formed to pursue the same goals. Many of these groups share the "AMSAT" name. While the affiliations between the various groups are not formal, they do cooperate very closely with one another. For example, international teams of AMSAT volunteers are often formed to help build each other's space hardware, or to help launch and control each other's satellites.

Since the very first OSCAR satellites (OSCAR stands for Orbiting Satellite Carrying Amateur Radio) were launched in the early 1960s, AMSAT's international volunteers, often working quite literally in their basements and garages, have pioneered a wide variety of new communications technologies that are now taken for granted in the world's satellite marketplace. These breakthroughs have included some of the very first satellite voice transponders as well as highly advanced digital "store-and-forward" messaging transponder techniques. All of these accomplishments have been achieved through close cooperation with international space agencies that often have provided launch opportunities at significantly reduced costs in return for AMSAT's technical assistance in developing new ways to launch paying customers. Spacecraft design, development and construction has also occurred in a fiscal environment of individual AMSAT member donations, thousands of hours of volunteer effort, and the creative use of leftover materials donated from aerospace industries worldwide.

This article will focus on some of the creative technical and managerial techniques that AMSAT has used to work with donated resources and international teams of volunteer talent to design, build and launch commercial grade communications satellites

in a not-for-profit environment. Indeed, over the years, some of these techniques have found their way into "for profit" and government space activities.

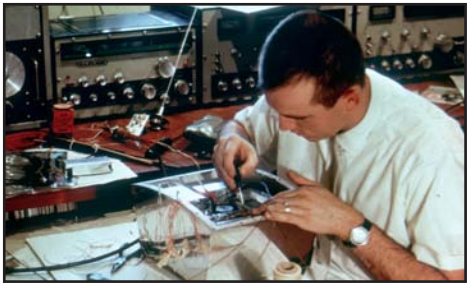
BEGINNINGS

The story of Amateur Radio satellites begins very near the beginning of America's other satellite programs. Barely four months after the successful launch of Russia's Sputnik I, the United States launched Explorer I on 31 January 1958. At about that same time, a West Coast group of Hams began toying with the idea of launching an Amateur Radio satellite into orbit. Far from being simply a "pipe" dream, this group later organized a group called Project OSCAR, with the expressed aim of building and launching amateur satellites.

Lance Ginner, K6GSJ, poses with the flight model of Amateur Radio's first satellite, OSCAR I. The blue, stick-on label on the top of the spacecraft reads: "OSCAR I – AMATEUR RADIO BEACON SATELLITE".

After a series of high level exchanges among Project OSCAR members, the American Radio Relay League (the largest Amateur Radio fraternal organization in North America), and the United States Air Force, a launch opportunity on Discoverer XXXVI from Vandenberg AFB, California was secured for the very first Amateur Radio satellite called OSCAR I. It was successfully launched into a low Earth orbit on the morning of December 12, 1961…barely four years after the launch of Sputnik I.

OSCAR I weighed in at 10 pounds. It was built, quite literally, in the basements and garages of the Project OSCAR team. It carried a small beacon transmitter that allowed ground stations to measure radio propagation through the ionosphere, as well as the internal temperature of the satellite.

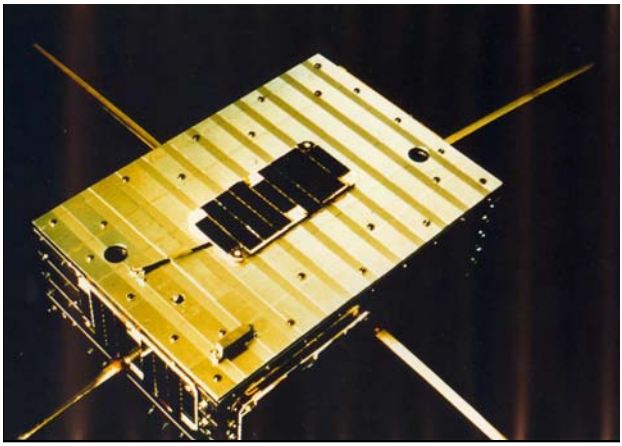


Lance Ginner, K6GSJ, builds OSCAR I in his basement workshop.

It also was the very first satellite to be ejected as a secondary payload from a primary launch vehicle and then enter a separate orbit. This was accomplished using a very high technology and thermally balanced ejection system…a $1.15 spring from Sears Roebuck!

OSCAR I was an overwhelming success. More than 570 amateurs in 28 countries forwarded observations to the Project OSCAR data reduction center. Unfortunately, OSCAR I lasted only 22 days in orbit before burning up as it re-entered the atmosphere. But Amateur Radio's "low tech" entry into the "high tech" world of space had been firmly secured. When scientific and other groups asked the Air Force for advice on secondary payloads, the Air Force suggested they study the OSCAR design. What's more, OSCAR I's "bargain basement" procurement approach and management philosophy would become the hallmark of all the OSCAR satellite projects that were to follow, even to this day.

OSCAR II was built by the same team, and although it was similar, both structurally and electrically, to OSCAR I, there were a number of improvements to OSCAR II. One such upgrade modified the internal temperature sensing mechanism for improved accuracy. Another improvement modified the external coating of the satellite to achieve a cooler internal environment. Yet another modification lowered the beacon transmitter output to extend the battery life of the satellite. Thus, the "continuous improvement" strategy that has also become a central part of the amateur satellite approach was set into place very early in the program.



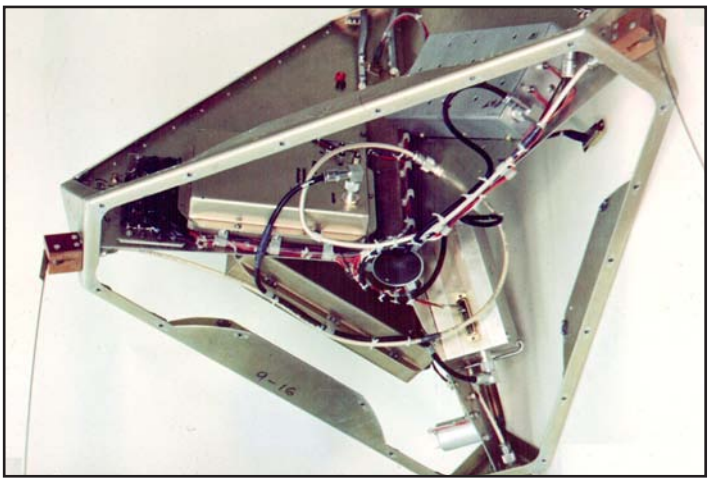
The OSCAR III Satellite.

OSCAR III quickly followed OSCAR II. OSCAR III would later become the first Amateur Radio satellite to carry a transponder. It was designed to receive a 50 KHz wide band of uplink signals near 146 MHz and then retransmit them (with a power of 1 watt!) near 144 MHz. This would allow amateurs with relatively modest Earth stations to communicate over much longer distances at these frequencies. In fact, it could be argued that the lure of talking over larger and larger distances at these frequencies remains

the single most important reason members of the Radio Amateur community have continued to support the construction, launch and use of these satellites over the years. Put another way, the lure of a "repeater in space" that virtually anyone with an entry level Amateur Radio license can use is a very powerful motivator for a group of people who like to communicate with each other as a hobby!

However, the thought of a "repeater in space" developed and launched by a group of "know-nothing Hams" working in their basements and garages wasn't always looked upon with favor. While details of the incident are sketchy, it's reported that the builders of TELSTAR I, the first commercial telecommunications satellite, were quite upset to learn that a "rag-tag" group of Hams were also working on a telecommunications satellite called OSCAR III as TELSTAR was nearing completion. For a while, it appeared that OSCAR III might possibly upstage their multi-million dollar TELSTAR effort by beating them to orbit! In fact, it's also reported that TELSTAR's builders did eventually change their public relations approach to include the word "commercial" in subsequent references to TELSTAR I as the "world's first telecommunications satellite".

OSCAR III's transponder operated for 18 days and about 1000 amateurs in 22 countries were heard operating through it. The satellite was the first to clearly demonstrate multiple stations could successfully use a satellite simultaneously, a technology that is largely taken for granted in satellite telecommunications today.



An Internal View of OSCAR IV.

The fourth Amateur Radio satellite, OSCAR IV, was targeted for a geostationary circular orbit 21,000 miles above the Earth. OSCAR IV would ride to space aboard a Titan III-C rocket. Unfortunately, despite a valiant effort on the part of the Hams and others involved, (most of whom were members of the TRW Radio Club of Redondo Beach, California), the top stage of the launch vehicle failed, and OSCAR IV never reached its intended orbit. However, despite this apparently "fatal" blow, OSCAR IV operated long enough for amateurs to successfully develop innovative workaround procedures to salvage as much use out of the satellite as possible.

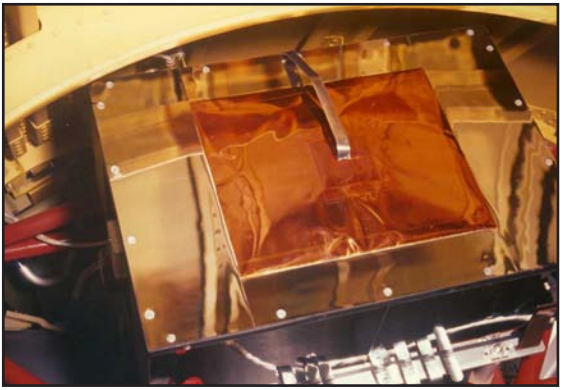
THE BIRTH OF AMSAT

The story of AMSAT actually begins in Australia. There, a group of students at the University of Melbourne had pieced together an amateur satellite that would evaluate the suitability of the 10-meter Amateur Radio band as a downlink frequency for future satellite transponders. It would also test a passive magnetic attitude stabilization scheme (another AMSAT first), and demonstrate the feasibility of controlling a spacecraft via uplink commands. Unfortunately, the completed satellite languished as launch delay followed launch delay.

The First AMSAT Board of Directors pose with OSCAR-5.

At about that same time, a group of Radio Amateurs with space-related experience in the Washington DC area met to form what initially became known as the East Coast version of the West Coast Project OSCAR Association.

As a result of this meeting, AMSAT, The Radio Amateur Satellite Corporation, was born. AMSAT was later chartered as a 501(c)(3) educational corporation in the District of Columbia on March 3, 1969. Its aim was (and is) to embrace and expand on the work started by Project OSCAR. The new AMSAT organization selected, as its first task, to arrange for the launch of OSCAR 5.

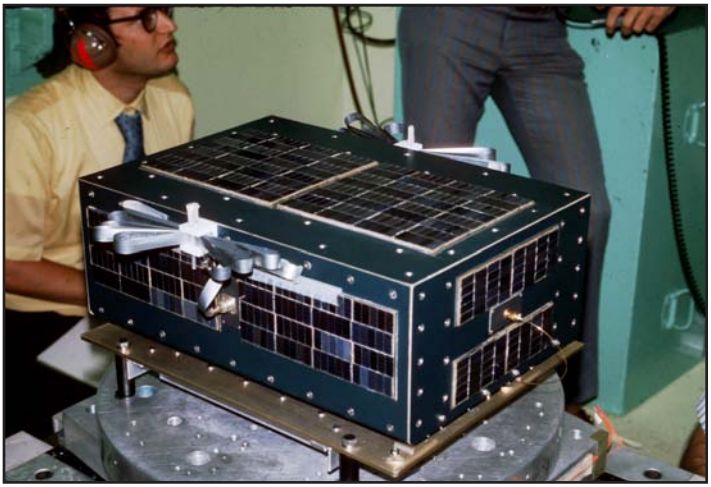


AUSTRAILIS OSCAR 5i shown here neatly tucked into its launch carrying structure.

After some modifications by AMSAT members (again working mostly in their basements and garages) OSCAR 5 (later to be called Australis-OSCAR 5, or simply AO-5) was successfully launched on a National Aeronautics and Space Administration (NASA) vehicle. Previous OSCARs had all been launched using US Air Force rockets. The OSCAR 5 satellite performed nearly flawlessly.

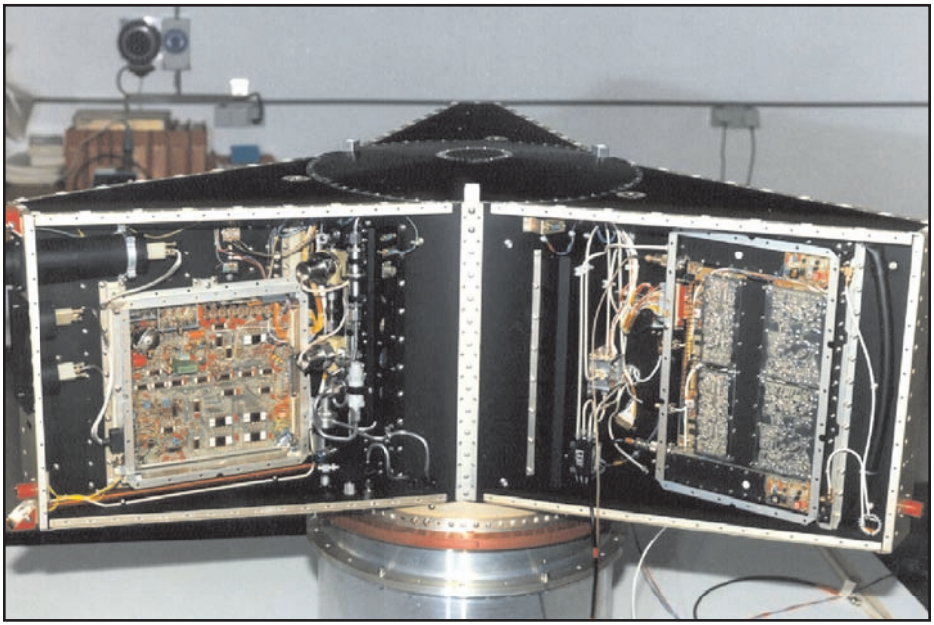
AMSAT-OSCAR SATELLITE PROGRAM PHASES

The many spacecraft designed and constructed by Radio Amateurs since 1961 can be roughly classified by their intended function into three Phases. Phase I designs comprised the low Earth orbit (LEO), short lifetime, predominantly beacon-oriented satellites such as OSCARs I, II, III, and the Russian Iskra 1 and 2 series of spacecraft.



AMSAT-OSCAR 6 undergoes shake testing. Note the stowed "carpenter's rule" 10 Meter antennas.

Phase II series OSCARs are also LEO "birds", but are launched into somewhat higher orbits, and are designed for much longer lifetimes. These AMSAT satellites included OSCARs 6, 7, and 8, as well as UoSAT OSCARs 9 and 11, both of which were built by a team of AMSAT members and students at the University of Surrey in England. These satellites have since been followed by a series of both analog and digital-capable radio satellites which were launched by a variety of AMSAT groups from several countries into similar orbits. Back in the early 1990s, a number of these Amateur Radio satellites sported a design AMSAT's experimenters pioneered called "MICROSATs'. This design consisted of small cubes, only 9 inches square and weighing in at about 20 pounds. They were designed to carry one or more store-and-forward digital transponders. This class of satellites has since given way to a whole new series of even smaller (and even less massive) satellites called "CubeSats". This class of Amateur Radio satellites now make up the bulk of the nearly 20 Amateur radio satellites currently in orbit…with more to follow.



The flight model AMSAT-OSCAR 13 is shown here during final integration in Germany.

AMSAT's Phase III satellites were each designed to be launched into a highly elliptical Molnya-type orbit first pioneered by the Soviet Union. These satellites included OSCARs 10, 13 and AO-40. These satellites offered their users much longer access time, higher power and more diverse communication transponders. What's a more, these so-called "high altitude" satellite also offer their users far larger communications footprints than their LEO counterparts. That's because Phase III satellites can "see" nearly an entire hemisphere of the Earth at the same time, allowing users the luxury of simultaneous contacts on one or more continents.

AMSAT-OSCAR SATELLITE NOMENCLATURE

While worldwide AMSAT organizations are now largely responsible for the design and construction of the modern day Amateur Radio satellites, the term "OSCAR" is still being applied to most satellites carrying Amateur Radio. However, most Amateur Radio satellites are not usually assigned their sequential OSCAR numbers until after they successfully achieve orbit and become operational. Even then, an OSCAR number is only assigned after its sponsor formally requests one. If the satellite subsequently fails in orbit, or it re-enters the Earth's atmosphere, its OSCAR number is usually retired, never to be issued again.

AMSAT MANAGEMENT APPROACH

Since its birth in 1969, AMSAT has grown into an international organization that has spun off a number of affiliate organizations in other countries. While the affiliations between the groups are not formal, they do often enter into one-time agreements to help each other with space-related projects.

That is, most of the subsequent work done on amateur satellites since OSCAR 5 has been by way of international efforts where teams of volunteers from one or more countries have helped build, launch, and/or control each other's satellites. Usually, one or more national group(s) define the basic spacecraft and its interface requirements. Then, teams are formed from the various international pools to be responsible for the various systems and subsystems of the spacecraft.

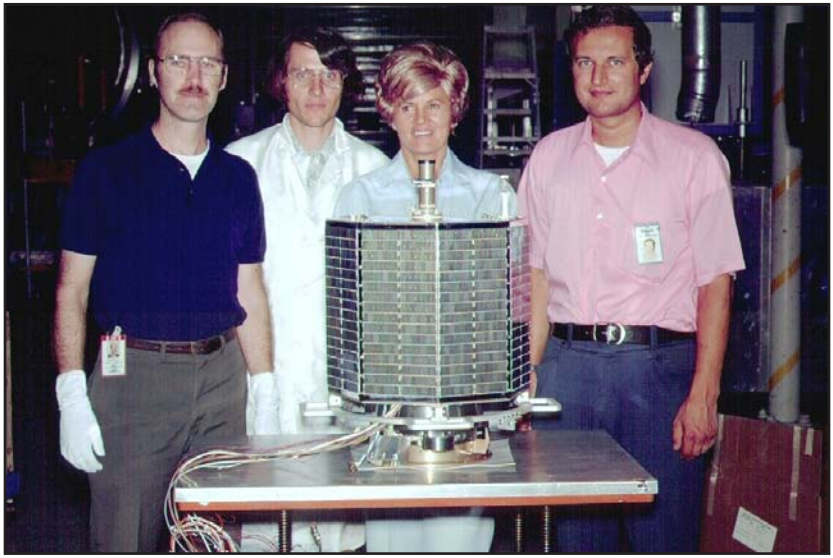
An international AMSAT team (from 6 of the 14 countries involved in the project) pose in their "bunny suits" in the ArianeSpace clean room facility in Kourou, French Guiana. The satellite is AMSAT's Phase 3-D which later became AMSAT OSCAR 40 on orbit.

This gives AMSAT's design engineers substantial flexibility to create and manufacture innovative subsystem designs. Usually, any design is acceptable as long as it meets AMSAT's basic operational criteria. This approach also allows each group to take maximum advantage of whatever materials and resources they already have on hand (or whatever they can find in the form of leftover materials or donations of materials from the aerospace industry!

AMSAT's major source of operating revenue is obtained by offering yearly or lifetime memberships in the various international AMSAT organizations. Membership is open to Radio Amateurs and to others interested in the amateur exploration of space. Modest donations are also sought for tracking software and other satellite related publications at Amateur Radio gatherings. In addition, specific spacecraft development funds are established from time to time to receive both individual and corporate donations to help fund major AMSAT spacecraft projects.

However, in corporate terms, these funds usually yield operating capital that's well below project budgets for comparable commercial satellite activities. For example, AMSAT-North America's entire operating budget for 2014, including all the development funding generated from member donations toward AMSAT's latest satellite project (the FOX Project) amounts to just a little more than $250,000.

From a personnel standpoint, AMSAT-North America is a true volunteer operation. The only person in the entire 3000-member organization drawing a regular paycheck is our office manager at our headquarters near Washington, DC. She conducts the day-to-day business of membership administration and other key organizational tasks. The rest of us, from the President of the Corporation, on down to the workers designing and building space hardware, all donate their time and talents to the organization.



Members of the AO-7 project team pose with the fruits of their labor. From left are Dick Daniels, W4PUJ (SK); Jan King, W3GEY; "hired hand" Marie Marr and AMSAT Founding President Perry Klein, W3PK

While use of a decentralized, "all volunteer" army does have its drawbacks in managing a space program, the dividends are enormous in that it allows a single project to draw on the talents of many highly capable and well-motivated people. Many of these volunteers are also aerospace professionals. To them, the aura of building, launching, controlling and then actually using the fruits of their labor once the satellite is in orbit is a powerful motivator for them to contribute their very best professional efforts.

Also, because vast sums of money are simply not available for development efforts, AMSAT's management philosophy encourages innovation and simplicity by not "over specifying" the spacecraft's design criteria. During development, subsystem designs are based predominantly on interface specifications with the rest of the spacecraft rather than by reams of detailed technical specifications at the subsystem level. The KISS approach…short for "Keep it Simple, Stupid"…is far more than just a buzzword for AMSAT's design engineers. KISS, quite literally, permeates the entire management and design philosophy of AMSAT's operations.

OSCAR SATELLITE CONSTRUCTION CHARACTERISTICS

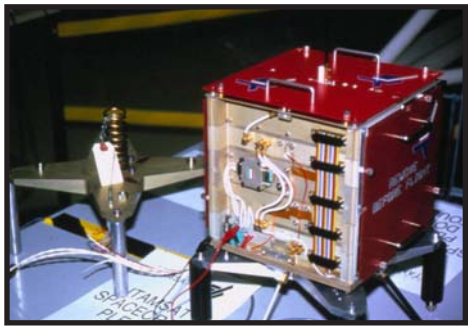
As would be expected over nearly four decades of technological improvements, substantial advancements have been made in the features and capabilities of the OSCARs. However, the "home brew" flavor of these satellites lives on even in the most current AMSAT spacecraft designs.

For example, a substantial number of the subsystems for the 1980s-era OSCAR 13, one of AMSAT's high altitude OSCARs, were concocted in home workshops. Several pieces of the spacecraft's structure were purchased from an electronic surplus store in the Orlando, Florida area. In addition, all of AO-13's fiberglass module's mounting rails were cured in the kitchen stove of one of our AMSAT Vice Presidents! Material for spacecraft thermal blankets were also donated to the cause, and were subsequently hand sewn together by yet another AMSAT volunteer in their basement workshop.

Elements for AMSAT's Phase 3-D spacecraft (that later became AO-40 on orbit) spacecraft structure were fabricated using similar "bargain basement" techniques. For example, although it was never deployed, AO-40's 20 foot solar array was to have been stabilized in orbit using a device no more complex than an ordinary "bar door" hinge.

AMSAT's Phase 3-D satellite is shown here during final integration. Note the "bar door" hinges on the solar panels.

The spacecraft's structure was made from ordinary sheet aluminum that was subsequently painted for thermal balance considerations. In addition, many of the spacecraft's antennas consisted of ordinary flexible steel carpenter's rule material and its kick motor and batteries consisted of leftover parts donated (or offered to AMSAT at substantially reduced cost) by aerospace corporations both in the USA and abroad.



The ITAMSAT Packet Radio satellite that later became ITALY OSCAR 26 on orbit. Note the highly advanced ejection system (consisting of a simple hardware-store spring!) on the mounting platform.

OSCAR PAYLOADS, CAPABILITIES, AND GROUND STATION REQUIREMENTS

Despite AMSAT's "low tech" approach to satellite procurement and construction, the degree of technical sophistication of AMSAT's satellites rivals that of many commercial satellites now flying. Over half of the 20 Amateur Radio satellites now in orbit carry what can best be described as "flying digital bulletin boards" Some of these satellites allow Radio Amateurs to connect and interact with them at speeds up to 9600 BPS using little more than laptop computers and "shoe box" sized radios.

The voice transponder capabilities of AMSAT satellites also offer users a variety of operating modes from Morse Code (CW) to Single Sideband (SSB) and Frequency Modulation (FM) voice. In addition, some OSCARs even allow their users to send and receive slow and fast scan television pictures to similarly equipped stations anywhere on the globe.

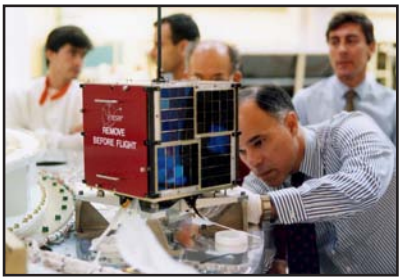
Ground station equipment to work these satellites is also easily obtainable and relatively inexpensive. For example, for about $3000 (much less if older or "home brew" gear is employed) any Ham can purchase enough commercial Amateur Radio equipment to assemble a ground station capable of interacting with any of the AMSAT satellites now in orbit. Whether for the digital or analog modes, this equipment can also usually be obtained off-the-shelf from any one of the hundreds of Amateur Radio dealers throughout the world.

ATTITUDE CONTROL AND STABILIZATION

As the missions of the OSCAR satellites have become more and more sophisticated, so, too, have the methods employed for OSCAR spacecraft attitude control and stabilization. However, they have not necessarily become more complex. Transponder antennas, even the fairly simple ones, have directivity characteristics. That's why spacecraft attitude control is important to maintain useful communication links.

OSCAR spacecraft stabilization techniques run the gamut from simple bar magnets to computer controlled, active electromagnet systems for spin stabilization and attitude control. The latter type of system was used on all three of AMSAT's Phase III spacecraft. It sensed both Earth and Sun positions, processed this data in an on-board computer, and then electronically controlled three sets of onboard electromagnets to achieve the proper spin rate and stabilization.

Other AMSAT spacecraft use gravity-gradient systems and magnetometry for attitude sensing. A rather elegant, yet simple design was employed by AMSAT's MICROSAT series.



Prior to launch, Dr. Dino Lorenzini, KC4YMG, performs a "fit check" on the "Eyesat" satellite that later became AMSAT-OSCAR 27 on orbit. Note the black and white paint on the spacecraft's "carpenter's rule" antennas.

These small satellites used simple bar magnets mounted along the sides of the spacecraft to achieve "up and down" stability while in orbit. As with many other AMSAT spacecraft, antennas for the MICROSATs were made from ordinary flexible steel carpenter's rule. However, while coating each antenna in the satellite's turnstile array, AMSAT engineers alternated use of white and black paint so that, in space, these satellites would act just like those little radiometers we all played with as children! This design proved to be both highly reliable and very effective in keeping the MICROSATs properly oriented. It employed yet another KISS approach to spacecraft control by using the spacecraft's onboard antennas to obtain spin stabilization energy directly from the Sun.

LAUNCH CONSIDERATIONS AND COSTS

AMSAT Echo (which later became AMSAT OSCAR-51 on orbit) was launched aboard .a Dnepr launch vehicle on June 29th, 2004 from the Baikonur Cosmodrome in Kazakhstan.

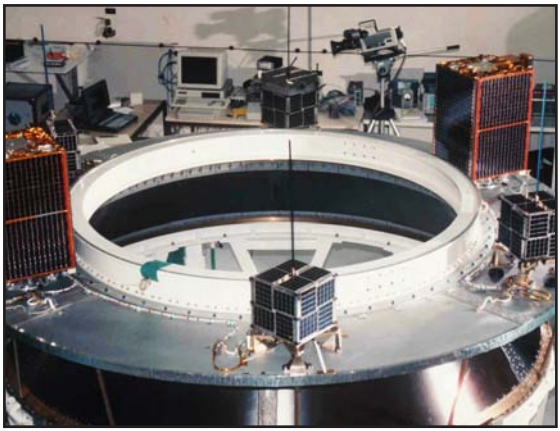
AMSAT Echo (AO-51) Launch.

While donated labor and salvaged materials help keep the cost of designing and building AMSAT satellites to a minimum, these are not the only areas of spacecraft operations that AMSAT has been able to achieve significant savings. In spite of all its other accomplishments, AMSAT does not have its own in-house launch capability! Most OSCAR satellites have been launched into orbit by riding as an extra passenger on a government or commercial agency's booster.

However, AMSAT has taken this "piggyback" concept one step further. By employing a number of innovative design techniques that trade knowledge, skill and manufacturing capacity for a reduction (or outright waiver) of launch costs, AMSAT has also helped create additional launch capabilities for commercial launch providers in return for significantly lower cost access to space.

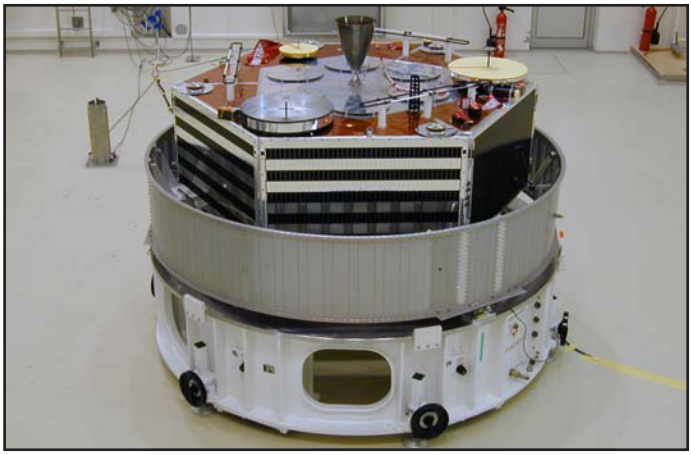
One of the most exciting examples of this concept was illustrated by the (Auxiliary Structure for Auxilliary Payloads) ASAP structure developed as a joint venture between the European Space Agency (ESA) and AMSAT. In the late 1980's, AMSAT was in the process of building its MICROSAT series of small satellites. Obtaining a launch opportunity for not one, but six of these planned satellites posed a rather daunting challenge. However, AMSAT volunteer engineers approached the Eurpopean Space Agency (ESA) with an idea of how they might exploit some of the then unused space on their Ariane IV launch vehicle.

To make a long story short, in partnership with ESA, AMSAT helped design and manufacture a very large carrying structure (the ASAP) for use in launching small satellites. The structure fits around the base of the Ariane IV's upper stage, and it served as the platform from which all six of AMSAT's first MICROSATs were placed into orbit by ESA in 1990. In return, AMSAT obtained a significant reduction in launch costs. ESA has since used the ASAP structure to launch similar, albeit mostly commercial, satellites into orbit.



The Ariane Structure for Auxiliary Payloads (ASAP) for the Ariane 4 carried four MICROSATS and two UOSATS as secondary payloads on the same launch in early 1990.

Thus, using a classic example of the "you scratch my back and I'll scratch yours" approach, AMSAT obtained a virtually gratis launch opportunity while also advancing the state of the art in the space sciences. At the same time, AMSAT helped a commercial launch agency find a new way to improve the quality of its launch services and generate added revenue.



AMSAT's Phase 3-D (AMSAT-OSCAR 40) is shown here in its Specific Bearing Structure (SBS) prior to launch from Kourou, French Guiana.

Another approach AMSAT uses for low cost access to space is to seek out test launches of new boosters or carrying structures. This technique has been employed with several OSCAR satellites, and was used again in conjunction with the development of another potentially attractive commercial carrying structure for the launch of AMSAT's new Phase 3-D satellite.

AMSAT Phase 3-D (later AMSAT-OSCAR 40) is launched from Kourou, French Guiana in 2000.

AMSAT's Phase 3-D satellite was launched into a geostationary transfer orbit (GTO) on an early launch of ESA's new Ariane V heavy lift booster from Korou, French Guyana in 2000. It occupied what would otherwise have been unused space on the Ariane V's upper stage by riding in an AMSAT designed cylinder underneath a "paying customer". In return for this development effort, AMSAT received a significant reduction in the overall launch cost for Phase 3-D. While AMSAT assumed additional risks by riding on an early test of a new launch vehicle, the reduced costs associated with such a launch become were very attractive and quite difficult for an organization like AMSAT to turn down.

The ill-fated AMSAT Phase 3-A satellite.

THE RISK OF FAILURE

While the loss of a satellite to a booster failure might be prohibitively expensive (in both monetary and political terms) to a commercial or military customer, AMSAT is in a much different position. If such a failure occurs, AMSAT simply loses the variable and direct costs of purchased materials and donations, and thousands of hours of concerted, yet still donated labor that's been put into the spacecraft prior to its launch.

Sadly, this unfortunate turn of events has happened to AMSAT in the past when the first of the Phase III series, Phase 3-A, ended up in a "sub-Atlantic orbit" due to a disastrous failure of the spacecraft's Ariane I booster during launch in May, 1980. Fortunately, Phase 3-A's builders had the foresight to build the spacecraft with relatively "low tech" materials. That is, many of the materials used in Phase 3-A's construction were readily available, or were already on hand when Phase 3-A was lost. Many had been used as test articles for the flight model spacecraft. Others could be obtained simply by making another trip to the surplus store! So, with a whole lot of additional volunteer effort, AMSAT Phase 3-B was successfully launched in June of 1983, and became AMSAT-OSCAR 10 upon reaching orbit.

Then, as noted earlier, in 2000, AMSAT's international Phase 3-D satellite (which later became AO-40 on orbit) met with near-disaster when its kick-motor (a bi-propellant device that was designed to boost the satellite into its final Molnya orbit) malfunctioned on orbit and caused what AMSAT experimenters believe was a near-fatal explosion. After several frantic weeks, the satellite was eventually recovered and went on to provide many years of useful service.

Because it is usually prohibitively expensive, launch insurance is seldom, if ever, purchased for AMSAT satellites. Rather, to minimize risk, AMSAT makes a concerted attempt to obtain or manufacture duplicate copies of structural or other components whenever possible, or to launch multiple satellites or duplicate transponders with the same or similar characteristics. This can be somewhat difficult to accomplish when donated items turn out to be "the last one we have" or are "one of a kind". For each satellite it proposes to launch, AMSAT usually builds at least two space frames. In many cases, engineering test items also serve as backups to actual flight hardware.

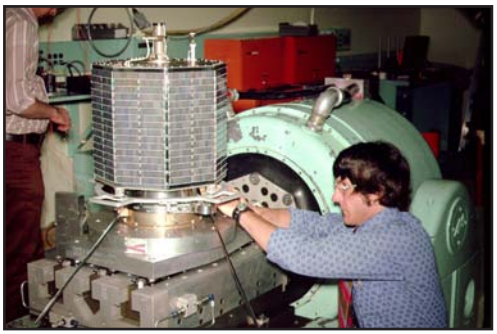
CLEANLINESS, QUALITY CONTROL AND RELIABILITY

Because AMSAT is operating at the "bargain basement" cost threshold, one would also think that skimping on quality control issues, operational testing, or standards of cleanliness would be a way of life. Such is not the case. AMSAT's volunteer engineers make every attempt to insure AMSAT spacecraft are designed for safe, contaminant free and reliable operation. However, AMSAT uses methods to achieve these goals that center on common sense and a "no-more-than-is-actually-needed" approach.

Dick Daniels, W4PUJ (SK), displays a partially assembled AMSAT-OSCAR 8 in his basement "clean room".

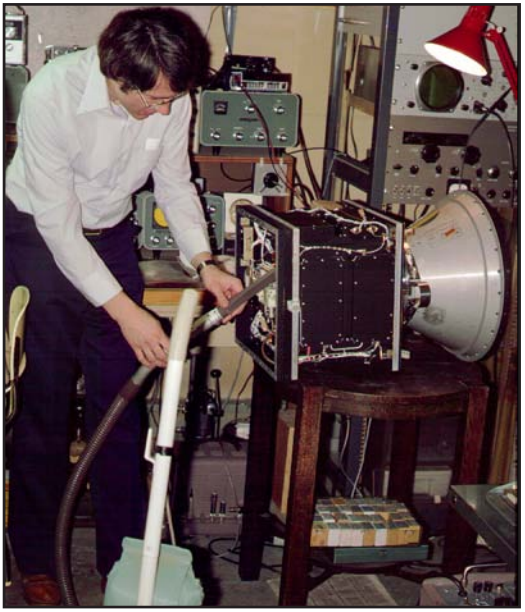
For example, clean room facilities used in the assembly of most AMSAT satellites are not at all sophisticated, but yet AMSAT's track record for cleanliness rivals that of any commercial spacecraft manufacturer. While a commercial clean room facility may consist of a special multi-million dollar, air conditioned complex, an AMSAT clean room assembly facility may simply be constructed from sheet plastic and 2×4 stud-quality lumber nailed together in someone's basement.

Where a commercial facility may have all the latest cleaning machinery, the equivalent AMSAT facility may employ cleaning equipment that's no more sophisticated than an ordinary household vacuum cleaner. It is interesting to note, however, that despite AMSAT's unsophisticated approach to cleanliness, not a single AMSAT satellite presented to a launch agency for subsequent launch has ever been rejected for lack of cleanliness or contaminated parts!



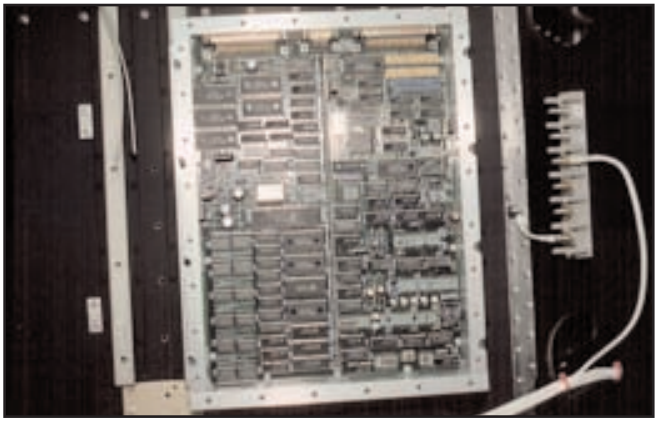
Jan King, W3GEY, prepares AMSAT-OSCAR 7 for a vibration test.

Each AMSAT spacecraft is subjected to most of the same tough environmental and thermal tests as their commercial and military counterparts to assure they are not a hazard to the launch mission. In addition, AMSAT engineers exercise great care in the selection and assembly of materials to insure they will not contaminate the spacecraft's environment or fail soon after launch. Environmental testing (so-called "Shake and Bake") time in commercial or governmental test facilities is often donated to AMSAT during "off peak" periods for this testing.



Jan King, K8GEY, gives the partially assembled AMSAT-OSCAR-8 a thorough cleaning n the basement of his home.

Also, where Mil-Specs or NASA Standards for components and procedures make sense, they are employed in the spacecraft's design and construction. If commercial quality (or surplus store quality!) will suffice, it, too, is employed. As a result, value considerations play a predominant role in AMSAT's spacecraft construction, and "gold plating", where determined necessary, is kept to an absolute minimum. Back-up systems and redundancy are frequently designed into the spacecraft, with emphasis on employing safe, reliable and proven designs, even if these designs would be considered "ancient" in the commercial world.



An early engineering model of Phase 3-D's Internal Housekeeping Unit (IHU).

For example, the onboard Internal Housekeeping Unit (IHU) computer for AMSAT's AO-40 satellite employed a simple computer design built around a single, radiation hardened "1802" microprocessor chip. This is the same design that was successfully previously used onboard both OSCARs 10 and 13. This single chip processor, with only 16K of memory was considered archaic by the computer processor standards even back in the early 1990s. However, as the IHU's tasks onboard many of AMSAT's satellites are relatively routine, they often do not require anything more sophisticated than a small amount of processing power to perform. What's more, much of the software code for many of AMSAT's satellites had already been written and extensively "de-bugged" for a number of previous satellite designs. In many cases, IHU hardware and software had already proven themselves to be "fail safe" and extremely reliable, even after running onboard similar satellites for many years. Put another way, AMSAT's IHU design wasn't broken, and AMSAT's engineers were not about to "fix" it!

DOCUMENTATION

Documentation and configuration control standards for AMSAT spacecraft take on a similar flavor. Common sense is the rule rather than the exception. For example, the entire spacecraft drawings and system descriptions for one of AMSAT's most sophisticated spacecraft design during the 1980s consisted of a single 234-page book. Simply called the "Red Book" by AMSAT engineers, it contained information that described the AO-13 satellite in enough detail so that a similar satellite could be built using the same drawings. In fact, such a feat was successfully accomplished when Phase 3-A was lost. AMSAT engineers used a similar book to design and construct Phase 3-B, which later became OSCAR 10 in 1983.

With the advent of more sophisticated design tools, AMSAT started using CAD techniques to design the Phase 3-D (later AO-40) satellite. However, even here, simplicity was rule. Before launch, Phase 3-D was conservatively estimated to have a commercial value exceeding $80 Million, yet the entire spacecraft's design (including its carrying structure for the Ariane V) was reflected in only 75 CAD drawings. What's more, strict change order control procedures were put in place to document and monitor changes to the design. However, these were "common sense" rules that are simple to implement and serve no other purpose than to protect the integrity of the Phase 3-D design for possible replication in the future.

EDUCATIONAL EFFORTS

In addition to its unmanned satellite efforts, AMSAT has also been active in several educational activities. One that has been particularly productive is our University Partnership Program. In this program, AMSAT establishes mutually productive working agreements with one or more universities around the world to help with satellite construction or other work in support of AMSAT's many projects.

For instance, the Phase 3-D spacecraft structure (along with its carrying structure) were built by a team of students at the Center for Aerospace Technology at Weber State University in Ogden, Utah.

Students at Weber State University in Ogden, Utah work on the Specific Bearing Structure (SBS) for the Phase 3-D spacecraft.

AMSAT's partnership with Weber was nothing short of a "win-win" situation for both parties. That is, Weber students got an invaluable, "hands on" educational experience building real flight hardware. In return, AMSAT got access to some very high quality student labor at a substantially reduced cost. Over the years, AMSAT has achieved great benefit from these arrangements, as the quality of student workmanship has usually far exceeded AMSAT's specifications.

Astronaut Ron Parise, WA4SIR (SK) makes an Amateur Radio contact from the Space Shuttle Columbia in 1990.

In another educational pursuit, AMSAT joined with the American Radio Relay League (ARRL) and the National Aeronautics and Space Administration (NASA), to developed new space-qualified Amateur Radio hardware for NASA's Space Shuttle, and later, for the International Space Station (ISS). What's more, AMSAT volunteers regularly donate their technical communications "know-how" to each flight involving Amateur Radio operations aboard the Shuttle. In recent years this program, called ARISS (which is short for Amateur Radio on the International Space Station), has been used to bring school children in a number of countries into direct radio contact with the orbiting Shuttle astronauts.

CONCLUSIONS

The story of AMSAT is one of simplicity, selfless donation of time and resources, and a pioneering spirit. The Amateur Radio Operators of Project OSCAR, and their later counterparts in AMSAT and other organizations, have built and launched over 60 OSCAR satellites since 1961. Their efforts are largely responsible for many of the commercial satellite technologies we take for granted today.

Real-time satellite communications technologies ranging from voice transponders to digital store-and-forward techniques to multiple satellite launch adapters that allow simultaneous launch of small satellites were all outgrowths of the vision of AMSAT members and the actual fabrication of space-qualified materials by many of them in their basement workshops.

What's more, AMSAT was pioneering small satellite technology when "big" satellites were being touted in the commercial and government sector as "the only way to go". Indeed, a number of billion dollar commercial ventures have launched constellations of hundreds of similar small satellites for digital store-and-forward messaging. These satellites exploit many of the technical breakthroughs that were first pioneered by AMSAT.

AMSAT's management approach is designed to optimize technical excellence in a "not-for-profit", "all-volunteer" environment. However, commercial and governmental agencies can still draw some valuable lessons from AMSAT's KISS approach. The results are simple, yet highly reliable, innovative and cost-effective designs for spacecraft hardware and software. Indeed, the lack of vast amounts of available working capital forces AMSAT designers to seek out the most cost- effective satellite hardware and software designs. In addition, the continued use of proven technologies for similar applications, even where those technologies might be viewed in the commercial world as "ancient", also keeps costs low. Finally, the creative use of redundancy and cooperative effort between AMSAT, universities, and launch agencies helps each activity keep their respective services cost-effective. Hardware and software documentation is kept to an absolute minimum. What is published is accomplished in only enough detail so that hardware or software items can be duplicated in the future if need be.

Many people may scoff at a bunch of "amateurs" who work in their basements and garages to build space satellites. However, the past and present volunteers of AMSAT are "amateurs" only in the sense that the Wright Brothers, Marconi or Robert Goddard were "amateurs". The latter were pioneers who used available materials and creativity to design, build and operate devices whose modern day counterparts we now take for granted. That same pioneering spirit has been a hallmark of AMSAT's technical and managerial approach since its founding in 1969.

For the past 40 years international AMSAT groups have played a key role in significantly advancing the state of the art in the space sciences, space education and space communications technology. Undoubtedly, the work now being done by AMSAT's volunteers throughout the world will continue to have far reaching, positive effects on the very future of Amateur Radio communication, as well as other governmental, scientific and commercial activities in the final frontier.

The nearly 20 operational OSCAR satellites now orbiting the Earth are a living testament to the spirit and vision of AMSAT's membership. Rarely has a group of volunteers managed to do so much …for so many…with so little.

SELECTED REFERENCES

Baker, Keith, and Jansson, Richard, Space Satellites from The World's Garage, The Story of AMSAT: Proceedings of National Aerospace and Electronics Conference (NAECON), 1994

Davidoff, Martin, The Satellite Experimenter's Handbook, Newington, CT: The American Radio Relay League, 1984.

Jansson, Richard, Spacecraft Technology Trends in the Amateur Satellite Service, Ogden, UT: Proceedings of the 1st Annual USU Conference on Small Satellites, 1987.

FURTHER INFORMATION

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CLUBBING AROUND

ANTIQUE WIRELESS ASSOCIATION

The Antique Wireless Association will have its next meeting in May 2020 at the AWA Museum in Bloomfield, New York. The AWA, our national affiliate, publishes the AWA Journal, the AWA Review and The AWA Gateway. The latest edition of The AWA Gateway is available for free at http://www.antiquewireless.org/awa-gateway.html. Dues are $35 per year. Information can be found at http://www.antiquewireless.org/.

WISCONSIN ANTIQUE RADIO CLUB, INC.

The next WARCI meeting will take place 8-11am on January 19, 2020 at the Hampton Inn & Suites Milwaukee West, 8201 W Greenfield Ave, West Allis. For information about the club, please see the web site at www.warci.org.

NORTHLAND ANTIQUE RADIO CLUB

The Minnesota Club has its next event is scheduled for February 23, 2020, a workshop and outdoor mini-swap meet. Radio Daze, the Upper Midwest's ultimate vintage radio collecting event, will be held in May 2020. For more information and the date, which will be announced, please see http://www.northlandantiqueradioclub.com/index.shtml.

MICHIGAN ANTIQUE RADIO CLUB

MARC's Vintage Electronic Expo is scheduled for 9am-4pm on February 1, 2020 at the Costick Center, 28600 Eleven Mile Road, Farmington Hills, Michigan. Details will be announced. Please see the MARC web site for more information at http://michiganantiqueradio.org/

INDIANA HISTORICAL RADIO SOCIETY

IHRS Winter Meet will be held late-February/early March 2020. For dates and additional information please see http://www.indianahistoricalradio.org/ihrsched.htm

ARCI NEWS

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