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THE OSCAR AMATEUR SATELLITE PROGRAM

By

NICHOLAS K. MARSHALL

EDUCASTING SYSTEMS

By

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THE RADIO CLUB OF AMERICA, INC.

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The Radio Club of America

ORGANIZED FOR INTERCHANGE OF KNOWLEDGE OF THE RADIO ART, THE PROMOTION OF GOOD FELLOWSHIP AMONG THE MEMBERS THEREOF, AND THE ADVANCEMENT OF PUBLIC INTEREST IN RADIO.

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PROCEEDINGS OF THE RADIO CLUB OF AMERICA

Volume 41 September, 1965 No. 2

THE AMATEUR SATELLITE PROGRAM

An Editorial

It was a very long time prior to the delivery of Nicholas Marshall's paper on the Oscar program before the Radio Club of America on May 20th, that its membership had been aroused to a high pitch of enthusiasm about amateur participation in a scientific project.

Nick opened the door to a new area of amateur activity reminiscent of the days when we built our own communications equipment and ventured into the wasteland of the higher frequencies.

Reflecting this new interest, the Club's Board of Directors, at its June meeting, voted modest financial support to two amateur scientific projects. It was also decided to seek a speaker for our 56th Annual Banquet in November who could give us an expert insight into the long term possibilities of amateur participation in the space program.

Elsewhere in this issue, we review Nick Marshall's paper. Your editor has concluded a rather extensive study of amateur publications to appraise whether space and satellite activity really offers the kind of opportunity that the early days of amateur radio communications did to advance scientific knowledge and the growth of the radio art.

Certainly participation in the space program involves experimentation and the development of new skills. Whether space experimentation can equal the thrill of breaking communications barriers in frequency used and in distance covered, using transmitters and receivers made with the amateur's own hands, is not yet a certainty.

The builders of Oscar satellites are professional engineers working on space projects; they are not amateurs except in connection with the Oscar program. Most, if not all of their aides, were recruited from the space program or are students in engineering schools of high standing.

However, there is considerable operating skill and manipulation of equipment involved in tracking space vehicles and in interpreting their telemetry. Understanding and predicting satellite orbits builds up essential mathematical adeptness now needed in every kind of scientific pursuit. Hence participation in amateur satellite programs does expand skills and may establish a direct path to careers.

Read the detailed report on "The Oscar Amateur Satellite Program," which recounts the pioneering effort in this area and the kind of participation opened to amateur scientists by it. Higher skills are called for and opportunities for individual performance are less conspicuous than with early amateur radio communications. But is this not the imprint of a more advanced and sophisticated age which calls for higher orders of skill, greater cooperation and organization for success?

In any event, we are grateful to Nick Marshall for his excellent paper, to Ralph Batcher, our past president, for taking the initial steps which brought him to our rostrum and to QST for its thorough reporting of Oscar project accomplishments. Without all this assistance, no appraisal, however inconclusive, of amateur satelitte activity would have been possible.

Edgar H. Felix

1909 RCA 1965

56th Anniversary Banquet

of

The Radio Club of America, Inc.

Friday, November 19th, 1965

At the

Seventh Regiment Armory

Park Avenue at 66th Street, New York City

STAG — INFORMAL

Speaker: Dr. Eberhardt Rechtin, Assistant Director, Deep Space Instrumentation Facility, Jet Propultion Laboratory, Pasadena, Cal. Wait for full details from the Banquet Committee. Reserve early. Save the date: November 19th, 1965 at 6 o'clock p.m.

THE OSCAR AMATEUR SATELLITE PROGRAM

By

NICHOLAS K. MARSHALL

As told to Edgar H. Felix, Editor,
Proceedings of the Radio Club of America

The address of Mr. Nicholas K. Marshall, President of the Naster Project at Nassau Community College, Garden City, N.Y. and former Technical Director of the Oscar satellite program at Sunnyvale, Cal., was not reduced to manuscript form. Therefore this article is based not only on notes made at the Radio Club's meeting of May 20th, 1965, but on interviews with Mr. Marshall subsequent to the meeting, a visit to the Nastar installation at Nassau Community College and a study of technical reports and magazine articles by members of the Oscar group, responsible for the first amateur satellite projects.

In its April 1959 issue, the magazine CQ carried an article by Don Stoner, W6TNS, suggesting that amateurs could build their own satellites, if only someone had a missile by means of which they could be launched.

In response, Fred Hicks, W6EJU, proposed that an association of amateurs be formed to carry out Stoner's suggestion, since Hicks believed that missile and satellite manufacturers would co-operate by furnishing equipment and by providing opportunities to launch small satellites, as a part of regular satellite launchings.

Formation of Project Oscar

The result of this initiative was the formation of Project Oscar, an acronym for Orbiting Satellite Carrying Amateur Radio. Members of five amateur associations on the West Coast joined the project, many of them experienced in space equipment design as employees of missile and space manufacturers. A program for a progressive series of satellites was developed by a technical and planning group, headed by Nick Marshall.

The co-operation of manufacturers and official agencies was obtained and an overall plan of long term objectives formulated, ranging from simple beacons to permit tracking in the 2-meter amateur band to soft landing experiments for the establishment of relay stations on the moon and, ultimately, amateur interplanetary communications.

By October, 1960, when Project Oscar was formally incorporated, its membership had already designed and was completing the building of Oscar I.

The First Amateur Satellite

This pioneer amateur satellite was launched into space on December 12, 1961 on a North-South orbit aboard Discoverer XXXVI at 2042 GMT and was heard by amateurs all over the world before it burned up in the earth's atmosphere on January 3, 1962.

In that period, as reported in QST in September, 1962, Oscar I had made 312 orbits around the earth; 5,200 reports of its progress were made by 570 amateur tracking stations located in 28 countries and 44 states. Considering that only a small proportion of amateurs are equipped to receive 145 megacycle signals, this was a remarkable initial response.

Performance of Oscar II

Long before Oscar I was launched, work had begun on Oscar II. This satellite, as described in a summation of its performance by William J. Orr, w6SAI in QST, April 1963, radiated 100 milliwatts on 145.85 megacycles. It was launched on June 2, 1962 at 0032 GMT, on a north-south orbit. The last report from Oscar II was received on Orbit 295 at 0910 GMT on June 20, 1962.

This satellite was destroyed by internal heating, evidenced by timing the "HI" signals which its transmitter emitted; the higher the keying rate, the higher the satellite's internal temperature. Of the 685 tracking stations reporting Oscar II, 282 were outside of the continental United States, as compared with only 111 foreign reporters for Oscar I.

Oscar III, the Relay Satellite

As with Oscar II, work began on the design and construction of Oscar III long before its predecessor was launched. Oscar III was naturally somewhat more sophisticated than its predecessors and it was built under somewhat more favorable conditions.

In the fall of 1963, Foothill College, at Los Altos, California, equipped a complete Space Science Laboratory, including a sixteen inch optical telescope, a 28-foot radio telescope and a planetarium and, above all, a new home for the Oscar project. These facilities provided convenient and accurate means for working out orbits from field reports. Furthermore, beginning with Oscar II, IBM, at San Jose, processed the incoming observer reports, greatly increasing the speed with which orbital information could be circulated to waiting amateur tracking stations.

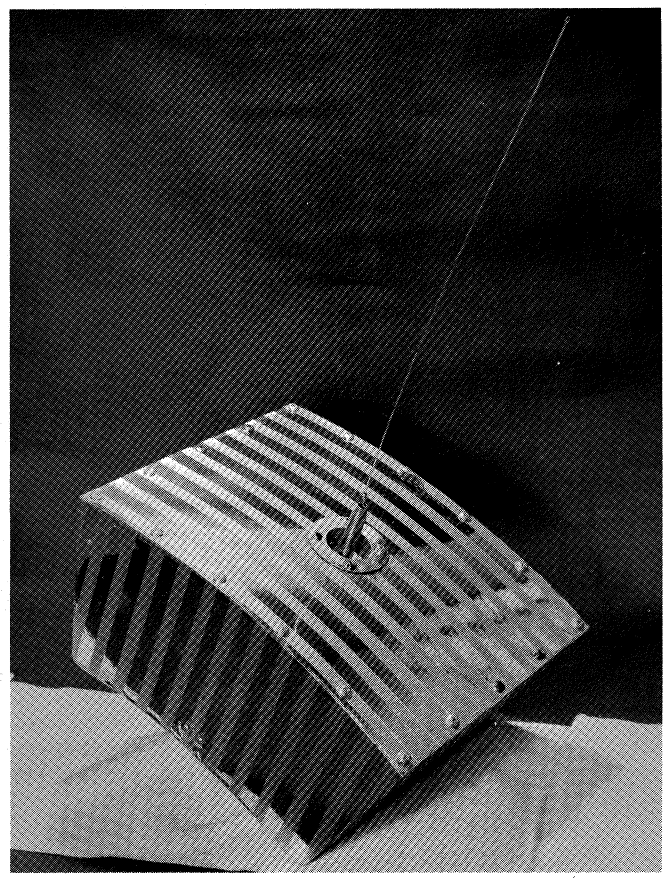
Oscar III was much more than a beacon transmitting limited telemetry. It was a relay station which received a band of frequencies in the amateur 2-meter band and transposed and transmitted the received signals in another adjacent band of frequencies. In addition, it carried two beacons, one on 145.850 megacycles, for transmitting the "HI" identifying signal and three channels of telemetry, one of them, as before, reflecting the satellite's internal temperature by controlling the HI keying rate, plus two groups of variable width pulses interspersed between the HI signals.

The other beacon provided a continuous tracking signal on 145.950 megacycles, which reveals its points of closest approach to the tracking station by means of the doppler effect.

Considerable technical information was released to amateurs prior to the launching of Oscar III, to assure that it would be used to the fullest possible extent. QST published articles on how to prepare maps for your own station location as soon as orbital information was available, to determine when the satellite would be within communicating range and over what area the transposed signal would be within receiving range. A little work with such data would certainly make the geography of space travel a great deal clearer to the amateur experimenter.

Accomplishments of Oscar III

Oscar III was launched on March 9, 1965 and its telemetry first heard at 2003 GMT. Its first European reception was logged on Orbit 3. The first two-way satellite repeater communication was between a Swiss and a German amateur station, HB9RG in Zurich, and DL6EZA at Schoerzingen, Germany. On Orbit 13, K9AAJ of Quincy,



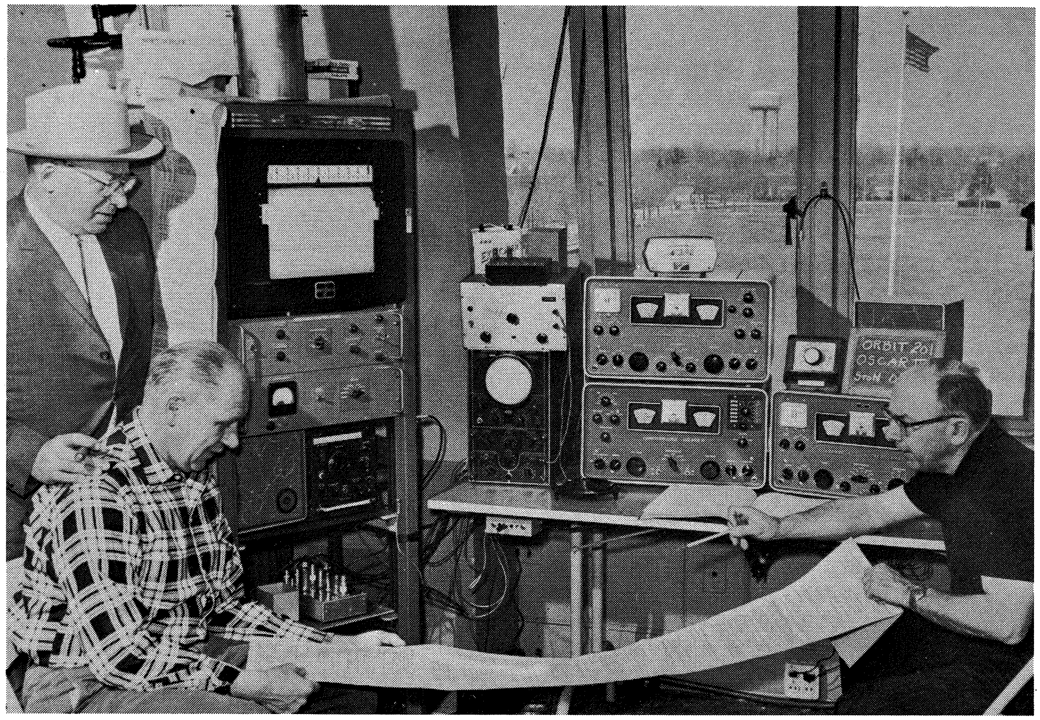
Oscar I, the world's first amateur satellite, launched into space aboard Discoverer XXXVI on December 12, 1961

Ill., exchanged greetings with K2IEJ at Oceanside, N.Y., the first American amateur satellite relayed two-way conversation.

Despite some delay in becoming familiar with the geographic requirements to establish contacts with distant stations on VHF, the amateur fraternity gradually became accustomed to using the satellite relay and its traffic ultimately became very heavy. With a 103 minute orbit, the satellite offered only a few minutes of relay time per orbital passage between any two points, with the result that all useful traffic had to be pre-arranged.

At this writing, Oscar III's beacons are still sending but the relay transmitter is no longer functioning. It will be some time yet before the accomplishments of Oscar III can be summarized. One thing is already clear: Oscar III is more than an American amateur satellite; it is a truly worldwide operation.

It would be possible to continue at length with study of what the Oscar satellites have accomp-



Nicholas K. Marshall studies teletype report at Nastar headquarters, Nassau Community College, during Oscar III's 201st orbit. The location was formerly the control tower at Mitchel Field.

lished. That satellite experimentation offers opportunities for interesting and profitable study is obvious. Just to give you an idea, I will later list the projects which Nick Marshall submitted in his first study to the Oscar group as a few of the possibilities for amateur activity in the future. But first, I want to mention two other things: how NASA co-operates with amateur projects and what is going on in the eastern part of the United States among amateurs in the space satellite field.

How to Launch a Satellite

In order to launch a satellite, it is essential to obtain a free ride aboard a launching vehicle set aloft by NASA or one of the military services. The ten or fifteen pound satellites which the Oscar group constructed are used in the launching rocket much like the balancing weights placed by your tire service man on the wheels of your car to keep them from vibrating at high speeds.

The satellite thus used for attaining static and dynamic balance for the launcher rocket must be suitably light and possess a configuration serving its balancing purpose. Furthermore, it must launch or eject itself from the booster when it has attained orbiting speeds. A simple spring trigger mechanism serves this purpose in the case of the small satellites of the Oscar projects.

The only further description merited here is that any acceptable amateur satellite must be most skillfully miniaturized and mechanically able to withstand the enormous thrust to which it is exposed on launching. Under the circumstances, it is quite certain that it will be some time before you can buy the parts to make your own satellite in kit form.

The Satellite Amateur

The designers of satellite payloads are all professionals. But, at such places as Foothill College at Los Altos and at Nassau Community College at Garden City, N.Y., groups of experts working on space projects at nearby NASA and military contractors are providing the needed leadership for designing and making amateur satellites and they are on the lookout for qualified help in construction and operation of space-related equipment.

That this is considered potentially useful in building up skilled talent for the space industry is evidenced by the fact that manufacturers in the field have donated valuable equipment freely to qualified amateur groups and that NASA has given its permission to launch amateur satellites to encourage interest in space technology.

The Nastar Project

My visit to the Nassau Community College and the Nastar project revealed the excellence of the facilities and the practical nature of the work carried out. Nastar, by the way, stands for NAssau Community College Satellite Tracking And Radio. It is an independent amateur group with quarters on the campus of the college for encouraging amateur experimental work in relation to the outer space program and to assist the College Science Department with educational projects of value to the student body.

The contribution of the group has been to establish satellite tracking facilities and to acquire communication equipment to utilize Oscar III. Nastar provided the East Coast relay link between Oscar headquarters in California and 4U1ITU, the International Telecommunication amateur station at Geneva. Nastar also provided broadcasting facilities for radiating announcements on Oscar's trajectory and how to use its relay capability. The Nastar group also utilized Oscar III for its own transmissions, in several transmission modes.

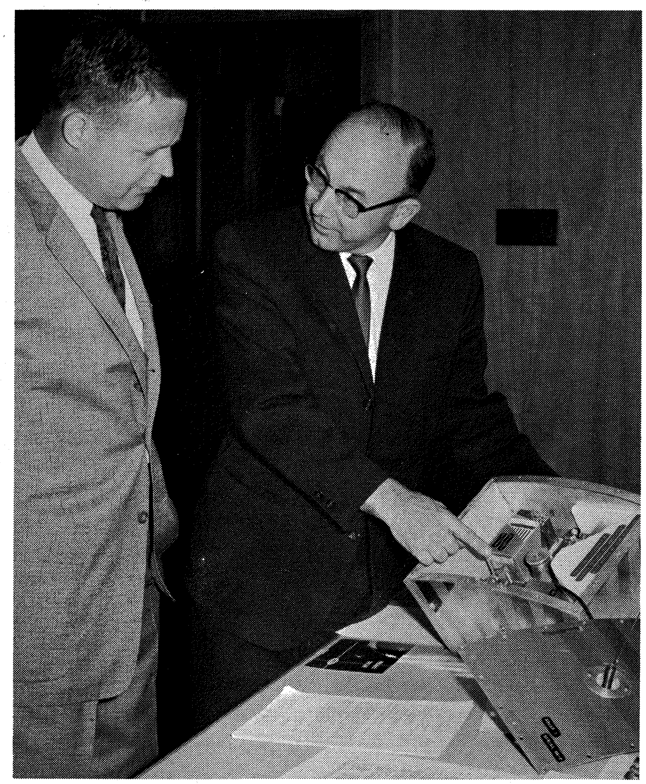
Other projects are under way, particularly in connection with forthcoming moon shots, to which Grumman, a major Long Island aircraft company, is contributing the LEM moon-landing capsule. This may afford opportunity to set up amateur band relay equipment on the moon, to which the Nastar group is now devoting planning and design effort.

An interesting fact about Nastar's installation at Nassau Community College is that it now occupies what was formerly the control tower for Mitchel Field, recently abandoned by the Air Force. The space is utilized for a very fine array of high frequency receivers, largely donated by interested radio manufacturers, tracking and broadcasting antennas and an extensive library of technical information.

An Amateur Satellite Program

To dispel any idea that amateur satellite activity is destined to decline as soon as moon shots become commonplace or are no longer needed, the following list of projects was prepared by Nick Marshall for consideration at the conclusion of the Oscar III series of amateur satellites:

1. Compact ruggedized amateur beacons
2. Tape recorder-playback voice relay unit
3. 2400 megacycle propagation tests
4. Earth albedo measurements
5. Non-ferrous unit for magnetic field measurements
6. Earth magnetic field for attitude control
7. Amateur orbital field strength measurement
8. Lunar, Mars or Venus rough landing beacon
9. Radiation or X-ray television
10. Weightlessness test platform
11. Whistler (VLF) research
12. 420 megacycle cloud cover sattelite
13. Non-magnetic proton-precession magnetometer
14. Velocity of propagation of gravitational fields
15. Lunar seismograph and noise-temperature measurements
16. Solar and radiation powered experiments
17. Optical gas maser for communication
18. Cryogenic environments at zero gravity
19. Einstein time-in-space theory experiments
20. Visual acquisition using sunlight
21. Remote control of trajectory
22. Thermoelectric, nuclear-magnetic resonance, laser and maser data
23. Time-of-crossing, WWV rebroadcast, satellite
24. Unfurlable satellite-borne long wire for LF and HF propagation
25. Solar activity experiments.



Mr. Marshall explaining some of the fine points regarding Oscar I just prior to launching

This list may not, on first inspection, appear to indicate a very practical program within the reach of amateur experimenters. However, since Nick Marshall prepared this list four years ago, at least two of the projects are now established realities in the space program. The TIROS weather satellites are stabilized by reliance on the earth's magnetic field, thereby assuring the focusing of the satellite's cameras on the earth's cloud cover rather than on sky and space. Remote control and adjustment of satellite trajectory after launch contributes far more to progress in space science than the capacity to launch tonnage into orbit.

These are by no means the only space programs which can be carried out by amateurs. We hope to present more such possible programs in later issues of the Radio Club Proceedings. As an instance, a group of amateur scientists at Columbia University is now erecting a radio telescope, the design of which took more than a year to complete and to obtain university approval.

This is amateur radio of the future and not of past decades, when the motto was to get the message through. This steps up the level of amateur experiment to physics and space, with radio communications still a main dependence and the right arm of successful space experimentation.

If the amateur is to make his mark in space as he already has in radio communications, it is because he can be recruited without outside pressure in response to his own curiosity and ambition.

To give a clue as to the nature and experience of these pioneer space experimenters, we give you their names, their amateur radio communications call letters and their jobs, as far as we have been able to ascertain them.

Beginning with the group seated around the table, the relaxed gentleman in the armchair is Harry Gabrielsen, w6HEK, a self-employed consulting engineer. Then, from left ro right around the table, are Chuck Towns, k6LFH, Lockheed Missile and Space Co., (hereafter called LMSC for short), Bernie Barrick, w6OON, Chief Radio Frequency Coordinator at LMSC; Dick Esnault w4IJC, Transistor Engineer at Philco WDD; Hugh McClain, k6SPK, a manufacturer's representative; and, at the far right along the table, Nick Marshall, w6OLO, then a Research Scientist at LMSC.

Going to those standing, from left to right, Bill Orr, w6SAI, Amateur Tube Division head, EIMAC; to his right and a little below, Tom Lott, ve2AGF; Tape-Recorder Designer, AMPEX; Harry Workman, k6JTC, Travelling-Wave Design Engineer, Alfred Electronics; standing at the end of the table, Fred Hicks, w6EJU, Radio Frequency Allocations Expert, LMSC; Walt Read, w6ASH, Instrumentation Engineer, Hewlett-Packard; Jerry Crosier, w6IGE, Antenna Design Engineer, LMSC; Alf Modine, k6TWF, Circuit Design Engineer, Alfred Electronics; Don Norgaard, w6VMH, Test Equipment Development Engineer, Hewlett-Packard; Lance Ginner, k6FEJ, Space Vehicle Test and Checkout, LMSC; Bob Mead, k6GZ, Instrumentation Engineer, Hewlett-Packard; Orv Dalton, k6JEY, Transmitter Designer, LMSC; Chuck Smallhouse, wa6MGZ, Transistor Circuit Expert, LMSC; and Gale Ganwish, Transistor Circuit Expert, Hewlett Packard.

EDUCASTING SYSTEMS

By

IRA KAMEN

President, TuTorTape Laboratories, Inc.

INTRODUCTION

Educasting Systems, conceived by TuTorTape Laboratories, Inc. and programmed by International Correspondence Schools, brings a new approach to teaching into homes, classrooms, and training rooms by creating a new mode of FM and TV educational station operation featuring active participation by the student throughout the learning situation.

Its educational programs were developed by experienced, professional programmers, and incorporate the newest techniques and tested methods of electronic teaching.

Educasting Systems make learning fascinating and are developed on a step-by-step basis as follows:

1. Programs are painstakingly created by the highly-trained professional staff of International Correspondence Schools.
2. These programs are then recorded by a narrator experienced in radio programming and education. This narration is recorded on a specially designed audio tape which can be presented over FM airwaves to an unlimited audience. Over CATV and CCTV bullseye area training may be done.
3. The audio (sound) portion of the instruction can be supplemented by workbooks written in clear, down-to-earth, easy-to-grasp style, and profusely illustrated.
4. The student, in the classroom or in his home, is provided with an individual tape playback or receiver equipped with four response buttons and an earphone for private listening.
5. "Planned Path Instruction" is presented on a step-by-step basis in logical sequence.

   After each step, the student is asked to respond to what he has heard. He can choose from four possible responses, which correspond to the four response buttons on his receiver.
6. The student is instructed to respond to each step in the learning process by pressing the button which corresponds to what he believes is the correct response.

   If the student's response is correct, he receives reinforcement of the concept, which makes his understanding more secure. Because of the reasoning behind the correct response being explained, the student who selects the correct response by chance moves, ahead with understanding.

   If the student's response is incorrect, he is given an explanation of why his response was incorrect, the correct answer, and the reasoning behind it.

Prior to Educasting Systems, programmed instruction merely provided the student with the information as to whether his response was correct or incorrect. If correct, he went ahead; if incorrect, he had to backtrack to find the reason why. Educasting Systems, by detailing the reasoning behind the correct or incorrect responses, offer a unique advantage that hastens real learning. The student is always going forward, never backward.

Criterion steps are built into Educasting Systems programs. These steps provide a constant check on the student's understanding throughout the entire program and assure complete knowledge of the subject covered.

Technical Facts on Educasting Systems

Educasting is an electronic method of communicating or transmitting the advanced learning technique called "Planned Path Instruction" as described above. It is accomplished through the aural sense or the combined aural and visual senses.

Electronic means, in all of the figures shown, are used to provide four separate channels of aural and visual information. The aural and visual information is synchronized with respect to time.

In all of the systems to be described a push-button examining box or machine allows the student to select any one aural channel or any one combined aural and visual channel at a time. Selection of a channel is dictated by the instructor during the lecturing process, and selection of a channel is determined by the student when he is being examined.

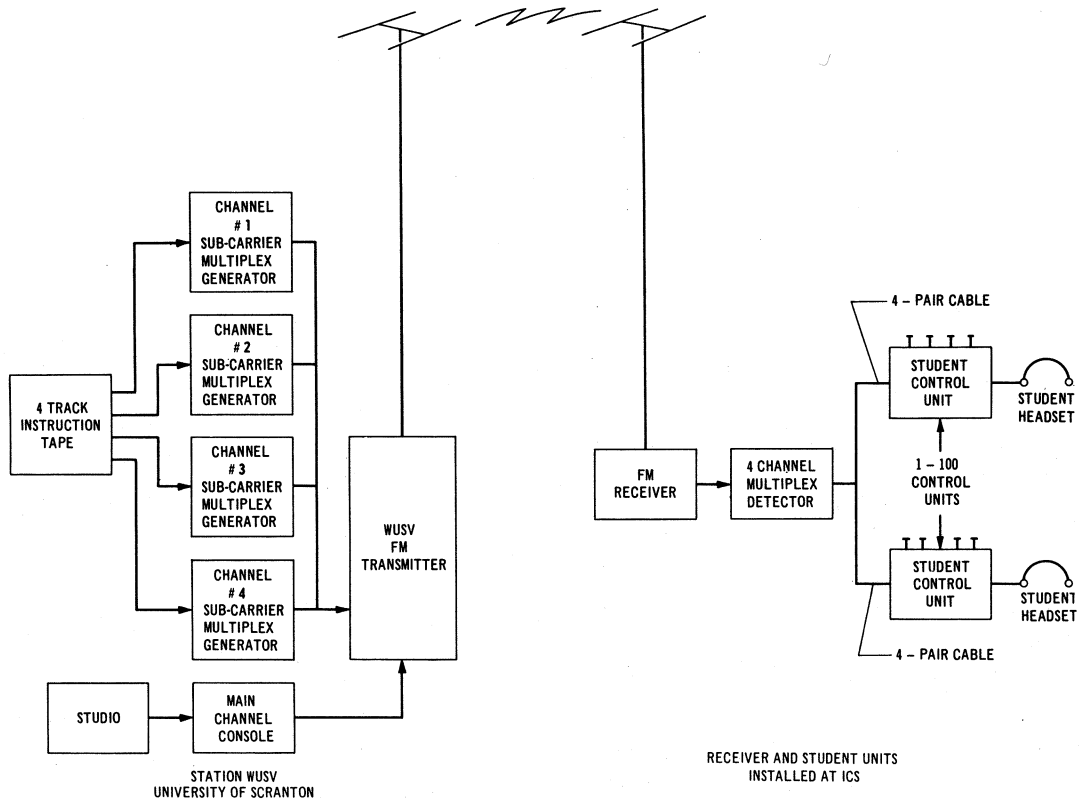


Fig. 1. Educasting System installed at Scranton, Pa.

As may be noted from Figures 1, 2 and 3, Educasting can originate from any of several sources. These sources, as shown in Figure 1 can be from broadcasting in accordance with SCA operation over an FM station; and as shown in Figure 2, from a closed circuit tape playback in a classroom, a closed circuit broadcast over a community antenna system, and a closed circuit tape playback and television system in a classroom. Another version of the visual technique uses SMP equipment or television equipment for legal training. This project is proceeding with the University of Tulsa for their dynamic training of lawyers who must develop proper response time for objecting to questions and presenting evidence in accordance with the upgraded laws in every area. Figure 3 shows another technique called the "Quadrant selecting Educasting System".

How Educasting Instruction is Received

Planned Path Instruction, using Educasting equipment, can be received in eight ways. The upper left corner of Figure 2 shows a student at home receiving instruction through a special FM receiver tuned to the Educasting FM station subcarriers. During the lesson period he would only depress the buttons marked "1", "2", "3", and "4". For entertainment he could listen to the main carrier program material by depressing the button with the FM station identification. The student, of course, could go to a library, YMCA, or other scholastic area where he could play the program material on an Educasting tape playback. He could also receive it at home with a special TV receiver which would be equipped to receive both the FM and TV transmission shown in Figure 3.

Classroom techniques are shown by Figure 3 which illustrates the actual equipment which performs in accordance with the diagramed layout shown in the lower right hand corner of Figure 2 for classroom application. The two additional techniques are the same as for television except they will have no pictures. Courses such as "Modern Management", "Elementary Arithmetic", "Office Protocol", etc. will be done with audio methods augmented by an "Edu-Tex", as visuals for this course material would not make a significant contribution to the effectiveness of the teaching.

Transmitting Systems

The FM system installed at FM broadcasting stations uses a four track audio tape and a four

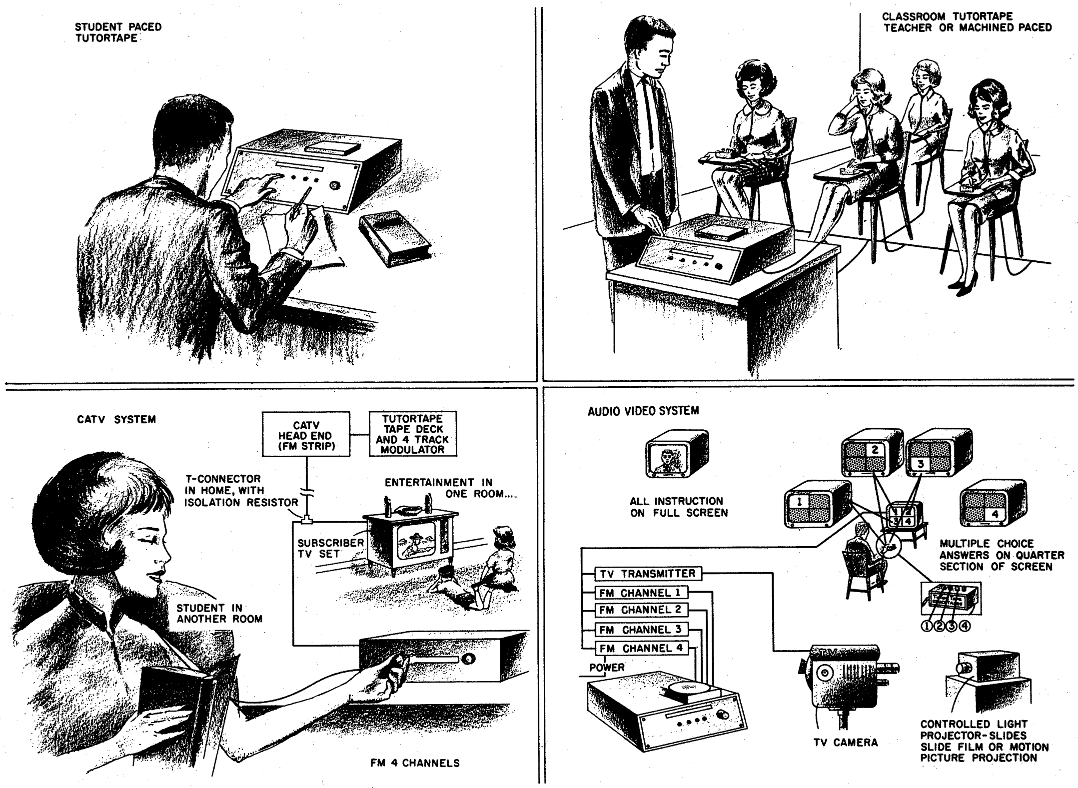


Fig. 2. Four Systems of Educasting

panel cabinet assembly to feed the four subcarrier generators which drive the exciter of the FM transmitter. This equipment is designed to work with FCC type approved exciters which, when properly adjusted, allow the simultaneous transmission of four audio messages with the regular FM program but do not interfere with the main carrier.

The FM-TV system shown in Figure 3, utilizes the equipment already described at the FM station; it is merely necessary to turn over to the TV station a film illustrating the FM Educasting sound program and to arrange for a synchronized signal between the FM and TV station.

CATV Systems

The Community Antenna Television Educasting system is essentially a closed circuit system. At the originating point of CATV signal distribution a TuTorTape playback deck and four FM modulators would be used to send the four audio tracks over the CATV line without interfering with the regular TV signals used for home entertainment.

The unusual growth of CATV in both urban and rural markets and the prediction that 20% of the American public will, within the next ten years,

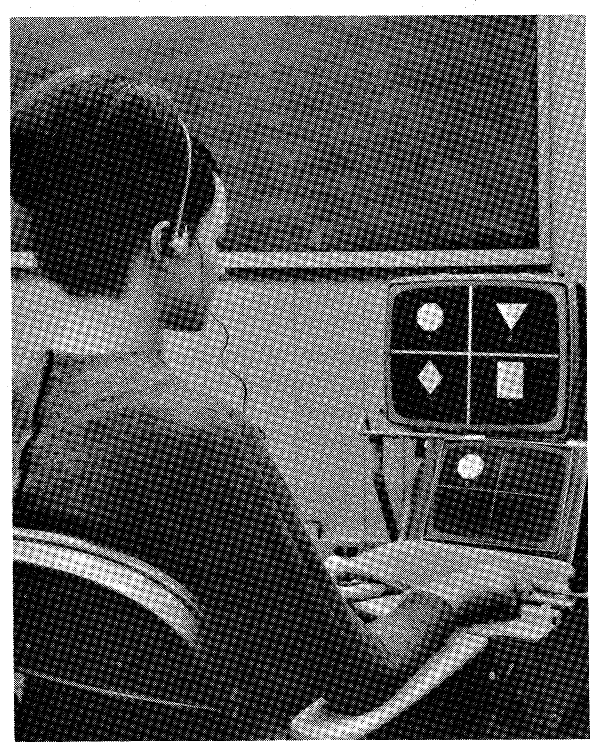


Fig. 3. The receiving unit used in quadrant selecting Educasting Systems

be on CATV, means that Educasting will be done to a great extent in accordance with the technique shown in the lower left hand corner of Figure 2.

GENERAL SPECIFICATIONS

The following are general specifications which apply to the systems shown which have been described in this paper.

1. The audio information is of telephone type quality with adequate consonant response in the 3500 to 5000 cycle range.

2. The video information is of standard TV quality.

3. The range of the FM station transmissions is about 30 miles which is normal for the average prime market of FM broadcast signals.

4. TuTorTape motion picture film can be passed through any standard TV film scanner.

5. Audio portions of the instruction can originate from a tape system at the TV studio or at the fm station.

6. Audio portions of the instruction may be placed on the film together with the pictures and thus be automatically synchronized.

7. The student push-button examining machine can be equipped with a punched card mechanism to record student responses.

8. The system is not restricted to two student answers — right or wrong. Four buttons are provided for additional answers, as needed.

9. Systems using both aural and visual information would use a five push-button examining machine. This will permit use of one button to receive a full screen TV picture during instruction periods.

10. Visual information is selected through sector blanking of the TV screen. Push-buttons select a sector (quadrant) to be scanned. The other three quadrants are blanked.

11. Detected multiplex FM signals are separated into respective signal channels by filters.

12. When pressed each of the selector buttons is connected to a respective band pass filter.

13. Tape mechanism runs at 3-3/4 inches per second and utilizes two 2-track playback heads operating simultaneously.

14. Typical modulating frequencies for the four multiplex audio signals may be 15 to 30 kc, 30 to 45 kc, 45 to 60 kc, 60 to 75 kc, but not each covering 15 kc bandwidth. Bandwidth would be somewhere within the 15 to 30 kc region for example, such as 18 to 22 kc.

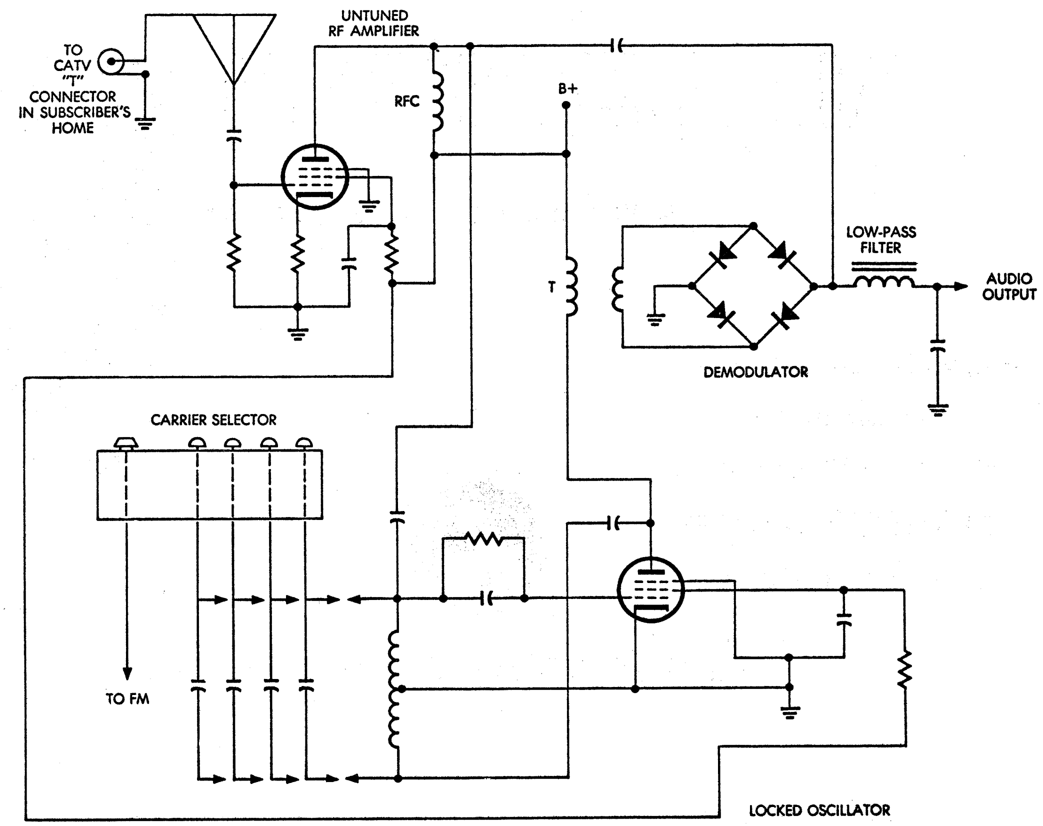
15. Modulation index of the four sub-carriers is kept at such a level that all sideband energy is confined to the first harmonic of the modulation signals.

16. The regular FM detector at the receiving set is connected to the input stage of another FM detector system comprised of grid controlled tubes (classroom receiver) or transistors (home type receiver). These control devices are arranged to constitute a "counter-type" FM detector through which the sinusoidal input waves from the standard FM detector are limited and clipped to convert them into square shaped wave at the output of the tubes. Each of these square waves is differentiated to produce a pulse. Only the positive spikes of the pulse are passed and integrated to create a voltage wave from which closely resembles the audio frequency envelope of the respective four audio signals.

SUMMARY

In July of 1965 the Educasting Systems were selected, along with the IBM computerized teaching system and the Westinghouse Phonovid, as one of the major breakthroughs in the training art. The American Management Association sponsored the installation of Educasting equipment for display during the AMA Conference on the Impact of Educational Technology. The U. S. Department of Commerce selected this system for demonstration at the Stockholm Trade Fair held in Stockholm, Sweden from August 17th through 26th, 1965.

The Educasting techniques offer great possibilities as a teaching device, and as a teaching format. An individual student can now have a personal tutor who will work around the clock, never lose his enthusiasm or get exasperated with slow, though earnest students. Educasting represents an exciting new approach to the technology of self-instruction in our advancing, competitive and highly complex society.



Synchrodyne adapter circuit, providing for four push-button selection facility to Educasting students

The system shown is a special synchrodyne adapter, with four push buttons which controls the resonant circuits of the general synchrodyne circuit, that may be alternately incorporated in the broadband of the FM detector circuits. (This unit may tap on to the CATV outlet, with a T fitting, without upsetting impedance.) By pressing the proper button, the desired one of the four supersonic signals transmitted may be selected by the synchrodyne circuits. The application of the synchrodyne receiver principle was to realize extreme simplicity, reliability and maintenance-free operation. The synchrodyne principle is similar to that of a superhytrodyne, except that the local oscillator is frequency locked to each of the four subcarrier frequencies.

This locking feature is vital to this principle, as the synchrodyne is an efficient technique for locking on to supersonic carriers or subcarriers with minimum parts. Actually, the output subcarriers from the broadband FM detector may have the four subcarriers as possibly 22.5 kc, 37.5 kc, 52.5 kc and 67.5 kc. This is accomplished most simply and effectively over a CATV system. In an over-the-air multiplex system, an FM broadcast station will be required to limit its deviation ratio based upon the broadcast standards set by the FCC. This may result in about a 10 to 12 db drop in apparent audio level. This is not a significant drop in level, as may be evidenced by the many stations which broadcast compatible stereo in the current state of the art. This loss need not be taken or considered in TuTor-Tape's CATV adapter.

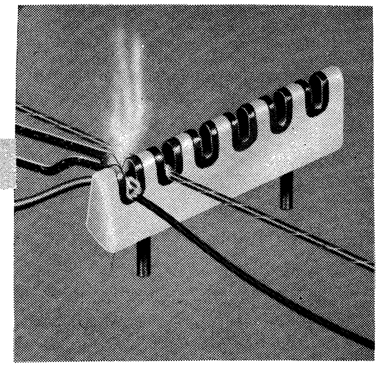
Operated over power line wires, the four track play back and the modulation technique will be similar to the circuit arrangement for operating over the air. However, the modulation will drive a carrier current transmitter, which is capable of broadcasting four carriers, between the power line and ground potential of possibly 22.5 kc, 37.5 kc, and 52.5 kc and 67.5 kc, with the limited modulation required for clear and reliable speech transmission and reception to overcome normal power line noise in this frequency range.

The transmission will be capable of broadcasting over a reasonable distance over normal power lines, but will operate well below the FCC Lambda over two Pi rule. The receiver, which connects to the power line, will be a broadband, low pass amplifier and speaker assembly, working in conjunction with a four channel selectable synchrodyne receiver circuit, so as to provide reliable and acceptable audio quality.

THE NEWS

ALCOSWITCH
LAWRENCE, MASSACHUSETTS

NEW CERAMIC TERMINAL STRIPS



Simplifies repairing. Resolder over and over again. Allows picking up test points very easily.

A wonderful new world of pleasure and convenience with

SPECTRUM

electronic products by

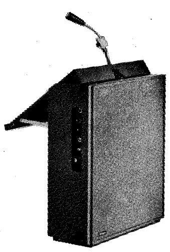
hallicrafters + The "Tornado" SR-500

LINEAR SYSTEMS

STELLAR SERIES

FREQUENCY-STABLE POWER INVERTERS

Half-cps variation with all-semiconductor circuitry for sensitive synchronous-drive applications



The SPEECH DIRECTOR—Portable lectern, self-contained public address system. Four-speaker Argos Sound Column—20 watt battery or A.C. powered transistor amplifier—deluxe dynamic microphone with built-in volume control. Blue-grey vinyl finish. Weighs 20 lbs. without batteries. Perfect for men or women "on-the-go" who want to take a fine P.A. system with them.
Model LSD-6040.

Argos PRODUCTS COMPANY
600 South Sycamore
GENOA, ILLINOIS

FINLAY SALES COMPANY

ELECTRONICS MANUFACTURERS' REPRESENTATIVES
LINCOLN BUILDING RIDGEWOOD, NEW JERSEY

MEASUREMENTS'
"FAMOUS FIRSTS"

1939 MODEL 54 STANDARD SIGNAL GENERATOR—Frequency range of 100 Kc. to 20 Mc. The first commercial signal generator with built-in tuning motor.

MODEL 65-B STANDARD SIGNAL GENERATOR—This instrument replaced the Model 54 and incorporated many new features including an extended frequency range of 75 Kc. to 30 Mc.

1940 MODEL 58 UHF RADIO NOISE AND FIELD STRENGTH METER—With a frequency coverage from 15 Mc. to 150 Mc. This instrument filled a long wanted need for a field strength meter usable above 20 Mc.

MODEL 79-B PULSE GENERATOR—The first commercially-built pulse generator.

1941 MODEL 75 STANDARD SIGNAL GENERATOR—The first generator to meet the need for an instrument covering the I.F. and carrier ranges of high frequency receivers. Frequency range, 50 Mc. to 400 Mc.

1942 SPECIALIZED TEST EQUIPMENT FOR THE ARMED FORCES. WORLD WAR II.

1943 MODEL 84 STANDARD SIGNAL GENERATOR—A precision instrument in the frequency range from 300 Mc. to 1000 Mc. The first UHF signal generator to include a self-contained pulse modulator.

1944 MODEL 80 STANDARD SIGNAL GENERATOR—With an output metering system that was an innovation in the field of measuring equipment. This signal generator, with a frequency range of 2 Mc. to 400 Mc. replaced the Model 75 and has become a standard test instrument for many manufacturers of electronic equipment.

1945 MODEL 78-FM STANDARD SIGNAL GENERATOR—The first instrument to meet the demand for a moderately priced frequency modulated signal generator to cover the range of 86 Mc. to 108 Mc.

1946 MODEL 67 PEAK VOLTMETER—The first electronic peak voltmeter to be produced commercially. This new voltmeter overcame the limitations of copper oxide meters and electronic voltmeters of the r.m.s. type.

1947 MODEL 90 TELEVISION SIGNAL GENERATOR—The first commercial wide-band, wide-range standard signal generator ever developed to meet the most exacting standards required for high definition television use.

1948 MODEL 59 MEGACYCLE METER—The familiar grid-dip meter, but its new design, wide frequency coverage of 2.2 Mc. to 420 Mc. and many other important features make it the first commercial instrument of its type to be suitable for laboratory use.

1949 MODEL 82 STANDARD SIGNAL GENERATOR—Providing the extremely wide frequency coverage of 20 cycles to 50 megacycles. An improved mutual inductance type attenuator used in conjunction with the 80 Kc. to 50 Mc. oscillator is one of the many new features.

1950 MODEL 111 CRYSTAL CALIBRATOR—A calibrator that not only provides a test signal of crystal-controlled frequency but also has a self-contained receiver of 2 microwatts sensitivity.

1951 MODEL 31 INTERMODULATION METER—With completely self-contained test signal generator, analyzer, voltmeter and power supply. Model 31 aids in obtaining peak performance from audio systems, AM and FM receivers and transmitters.

1952 MODEL 84 TV STANDARD SIGNAL GENERATOR—With a frequency range of 300-1000 Mc., this versatile new instrument is the first of its kind designed for the UHF television field.

1953 MODEL 59-UHF MEGACYCLE METER—With a frequency range of 420 to 940 megacycles, the first grid-dip meter to cover this range in a single band and to provide laboratory instrument performance.

1954 FM STANDARD SIGNAL GENERATOR. Designed originally for Military service. The commercial Model 95 is engineered to meet the rigid test requirements imposed on modern high quality electronic instruments. It provides frequency coverage between 50 Mc. and 400 Mc.

1955 RADIO INTERFERENCE MEASURING SET. An aperiodic noise meter useful to 1000 Mc.

1956 MODEL 505 STANDARD TEST SET FOR TRANSISTORS. A versatile transistor test set which facilitates the measurement of static and dynamic transistor parameters.

1957 RADIO FIELD STRENGTH AND INTERFERENCE MEASURING SET. A tuned radio interference and field strength set covering the frequency range of 150 Mc. to 1000 Mc.

1958 MODEL 560-FM STANDARD SIGNAL GENERATOR—First successful FM Signal Generator using solid state modulator.

1959 MODEL 700 FREQUENCY METER—A completely new concept of frequency measurement. An instrument capable of direct and continuous reading to one cycle in 25-1000 Mc range.

1960 MODEL 139 TEST OSCILLATOR—A compact, versatile, and portable instrument for rapid and accurate alignment of I.F. circuits in all types of radio receivers.

1961 MODEL 760 STANDARD FREQUENCY METER—An accurate, simple to operate, direct read-out, portable instrument designed for servicing two-way mobile radio equipment.

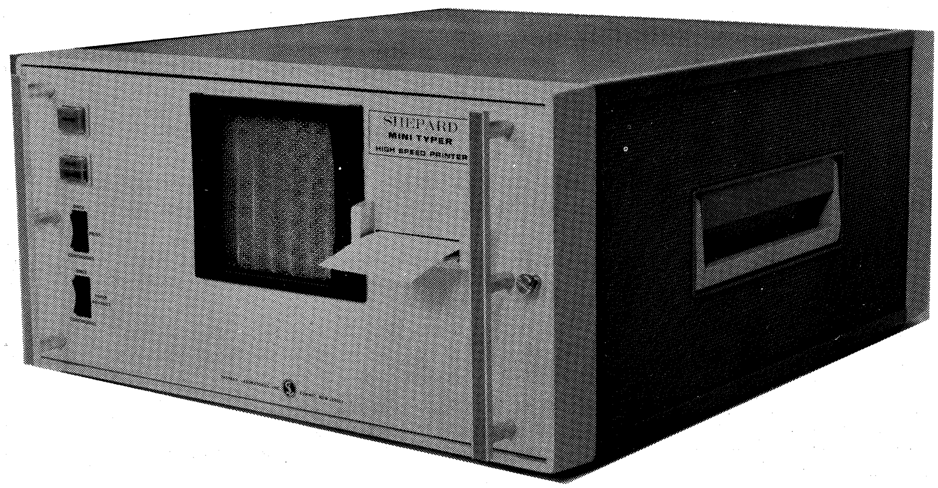
MEASUREMENTS
A McGRAW-EDISON DIVISION
BOONTON • NEW JERSEY • U.S.A.

SHEPARD LABORATORIES, INC.

PIONEERS IN

HIGH-SPEED PRINTERS

INTRODUCE HIGH PERFORMANCE, LOW COST "MINITYPERS"*



APPLICATIONS

- Analog to digital converter output (Voltage, Current, Frequency)
- BCD Counter Output
- Telemetry Printout
- Computer flip-flop printout

OTHER MODELS AVAILABLE

- Printout from computer memory, drum, delay line, core register, paper tape or magnetic tape.
- Printout from communications link, "Dataphone", etc.
- High Speed Label Printing System
- Ticket issuing machines
- Ticker-tape machines

FEATURES

- **Speed** — 20 lines/sec. alphanumeric
  40 lines/sec. numeric
- **Column Capacity** — 1 to 48 characters per line.
- **Compact Size** — Table top cabinet or 19″ rack mount.
- **Ultra-Reliability** — Patented design gives printing mechanism virtually infinite life.
- **Mode of Operation** — Synchronous or asynchronous. (Ready-Strobe Operation)
- **Input Logic** — Will accept any input codes of up to 6 binary digits in accordance with customer specifications. Logic levels at any two voltages, plus or minus, with difference in levels of greater than 3 volts.
- **Electronics** — All solid state; self-contained power supply.
- **Options** — Multi-part forms with pressure sensitive paper. Decimal point insertion. Zero suppression. Mixed input codes. Special type fonts. Expandable column capacity (up to 48). Speeds in excess of 40 lines/sec. with special font and electronics. Militarized construction for extreme environments.
- **Guarantee** — 1 year unconditional.

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480 MORRIS AVENUE, SUMMIT, N. J. 07901
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NEW SR-500 Tornado tri-band transceiver!

Own your own private tornado—*500 watts worth of sheer power* for the big, effortless signal you've always wanted in a transceiver. And that's just the beginning! You get:

Exclusive Hallicrafters AALC (Amplified Automatic Level Control) providing up to 12 db. of effective compression • RIT (Receiver Incremental Tuning) with ± 3 kc. for superior net and CW operation • A superbly designed crystal lattice filter which makes the most of the desirable SSB transmission characteristics • A built-in changeover relay permits direct operation with the HT-45 or other linear amplifier • Sensitivity is less than 1 μv for 20 db. S+N/N ratio • Receiver employs a separate AVC amplifier providing a figure of merit of 100 db. • Price: $395.00 less power supplies and mobile mounting kit.

Get the full story from your distributor or write for complete specifications today.

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Export: International Div., Hallicrafters
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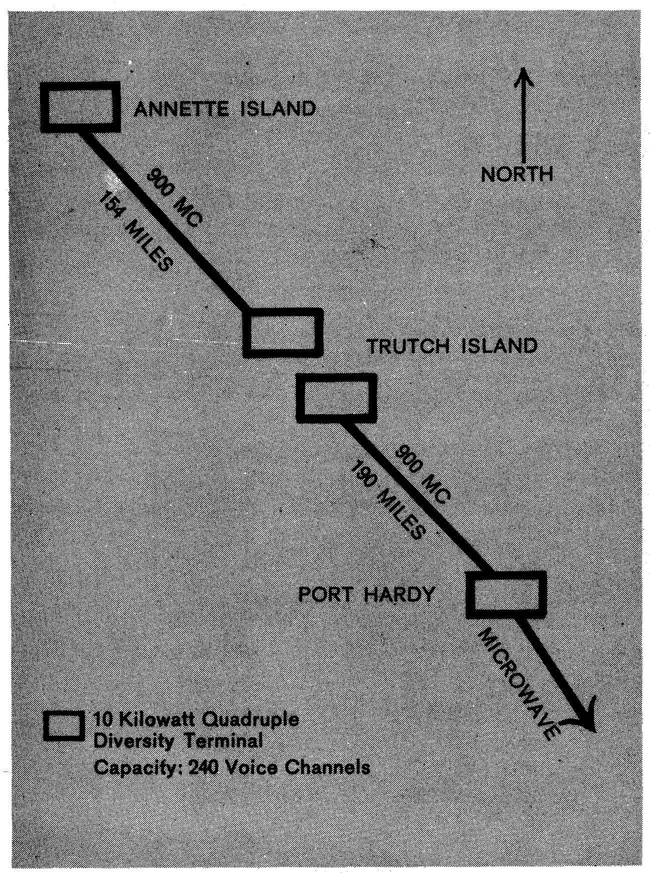
TROPO

CANADA

Province of British Columbia, Canada — focal point of a pioneering tropo scatter communications system connecting Alaska, British Columbia, and the Continental United States.

In creating this system, prime contractor Lenkurt Electric Company of Canada, Ltd., a GT&E subsidiary, selected internationally-proven tropo scatter radio relay equipment by REL.

Operated by the British Columbia Telephone Company and the Alaska Telephone Corporation, also GT&E subsidiaries, the privately financed system spans 344 miles in two giant leaps to provide a totally integrated commercial telecommunications network.

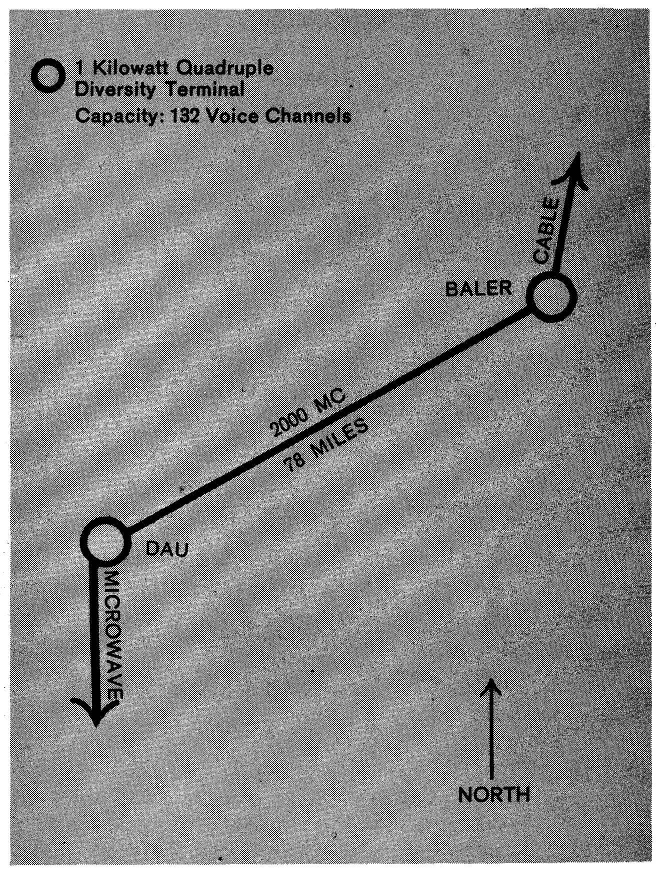


PHILIPPINES

Island of Luzon, Philippines — focal point of a tropospheric scatter system that provides a vital link in telecommunications between the Island Republic of the Philippines and the Continental United States.

Here again GT&E, through its Lenkurt International Division, selected radio relay equipment from REL — world leader in tropo scatter.

Operated by the Philippines Long Distance Telephone Company, the 132-channel system spans undeveloped mountain terrain to provide an economical and reliable communications link with international submarine cables to the United States.



Radio Engineering Laboratories (REL) is the world's only company devoted principally to the design, development, and production of tropo scatter and microwave radio relay equipment serving communications needs in over 20 nations.

REL's more than 40 years' experience can provide a most economical and reliable answer to your multichannel communications problems. Write for further information, and for REL's special brochure "Credentials in Tropo Scatter".

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DCA