Where an FCC license is required, a Model 8346 4.6-Meter Antenna (Figure 5) might be preferred and might also be the choice, along with the Model 8008 5-Meter Antenna for data applications, particularly for transmission of data. Both the Model 8346 and 8008 are available in economical prime-focus form.

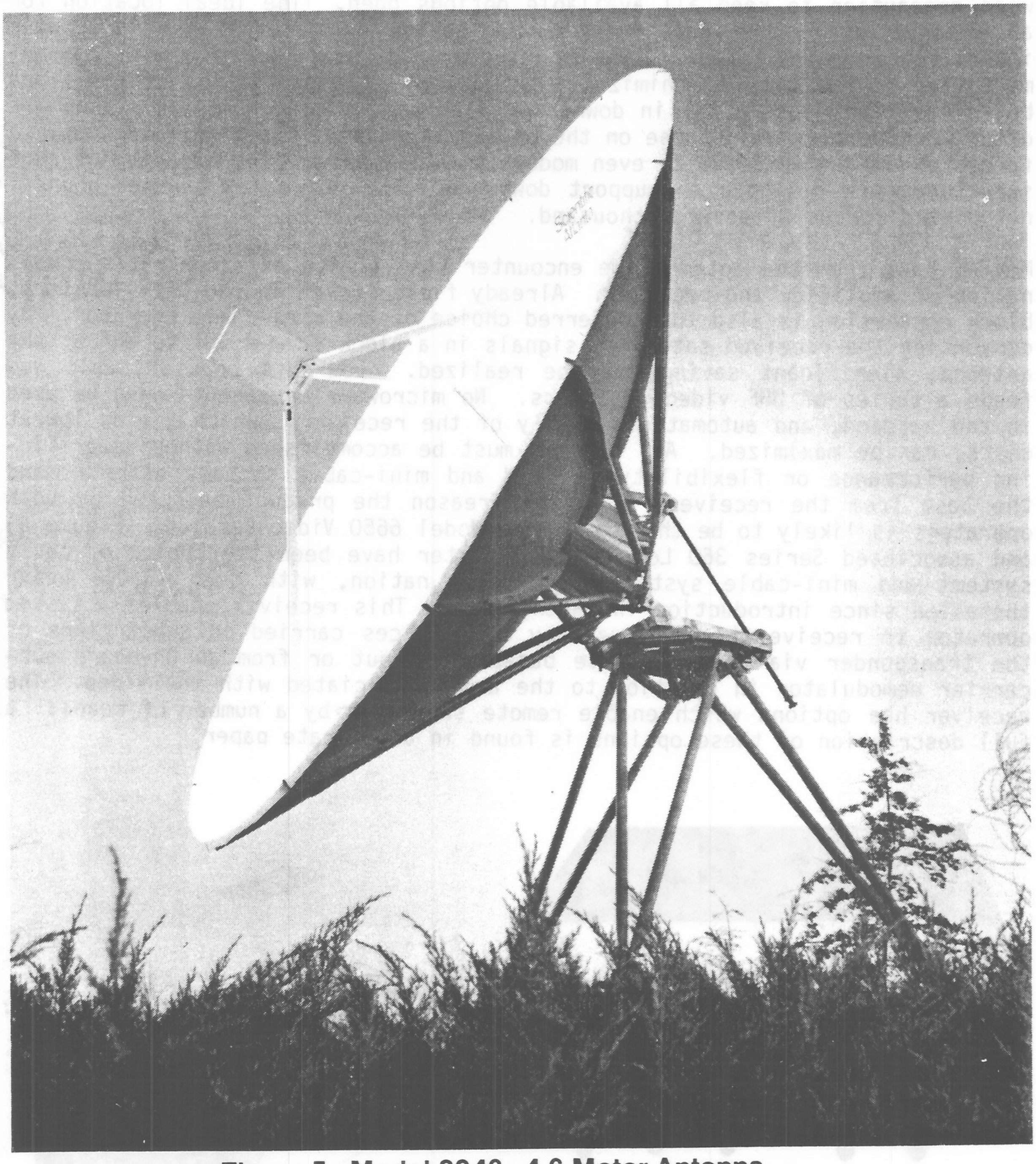
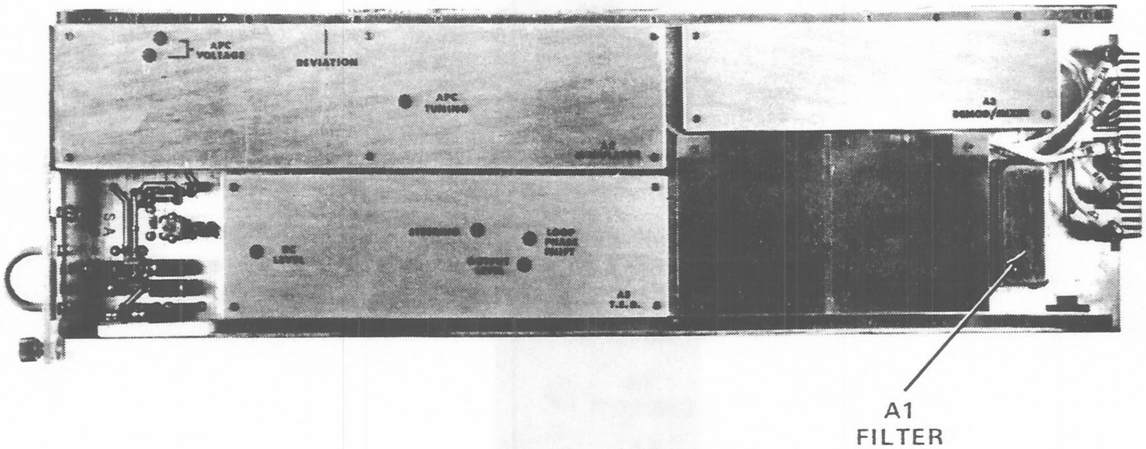


Figure 5. Model 8346 4.6 Meter Antenna



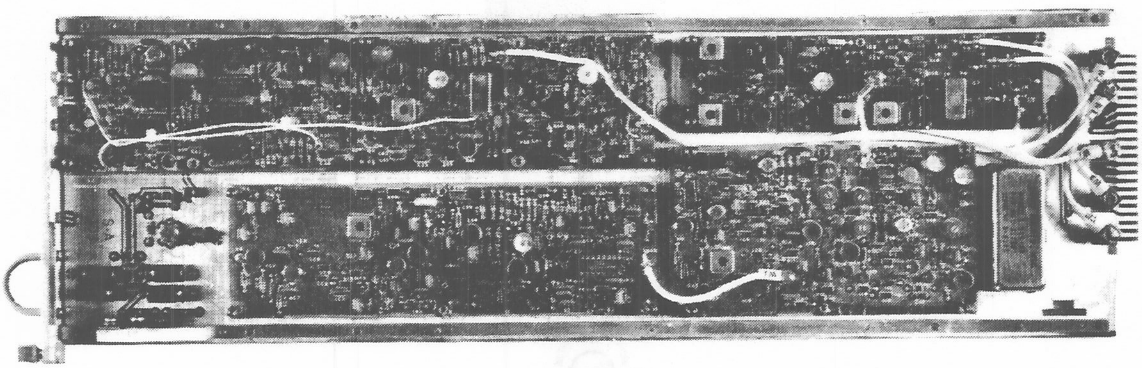


Figure 20. FM Modem—Interior

When installing an earth station, the location must be very carefully considered. The antenna must naturally have a clear line-of-sight to the satellite of interest, but the look angles to all other satellites must also be considered. With the changing state of the communications industry, it is a wise precaution to keep all available options open. The ideal location for an antenna is on the ground where protection from terrestrial microwave interference is maximized. While interference from the telephone company microwave routes can be minimized with filters, the protection of trees and buildings may be essential in downtown locations. Rooftop installations are often more complex than those on the ground because of the significant uplift forces on the antenna due to even moderate wind forces. The majority of roof structures are designed to support downward forces of a few hundred pounds, not upward forces of several thousand.

Moving back from the antenna, we encounter the receive electronics, a combination of amplifier and receiver. Already field-proven in the CATV industry, block conversion is also the preferred choice of the mini-cable operator. By converting the received satellite signals in a block from 4 GHz to UHF at the antenna, significant savings may be realized. Low-cost coaxial cable now feeds a series of UHF video receivers. No microwave components need be used in the headend, and automatic assembly of the receivers, which yields lowest costs, can be maximized. All of this must be accomplished without sacrificing performance or flexibility as CATV and mini-cable systems alike demand the best from the receiver. For this reason the product selected by both operators is likely to be the same. The Model 6650 Video Receiver (Figure 6) and associated Series 360 Low-Noise Converter have been the choice of cable systems and mini-cable systems across the nation, with over 15,000 being installed since introduction in March, 1981. This receiver enables a system operator to receive the wide variety of services carried on subcarriers of the transponder via the composite baseband output or from an on-board subcarrier demodulator in addition to the audio associated with the video. The receiver has options which enable remote switching by a number of means; a full description of these options is found in a separate paper.

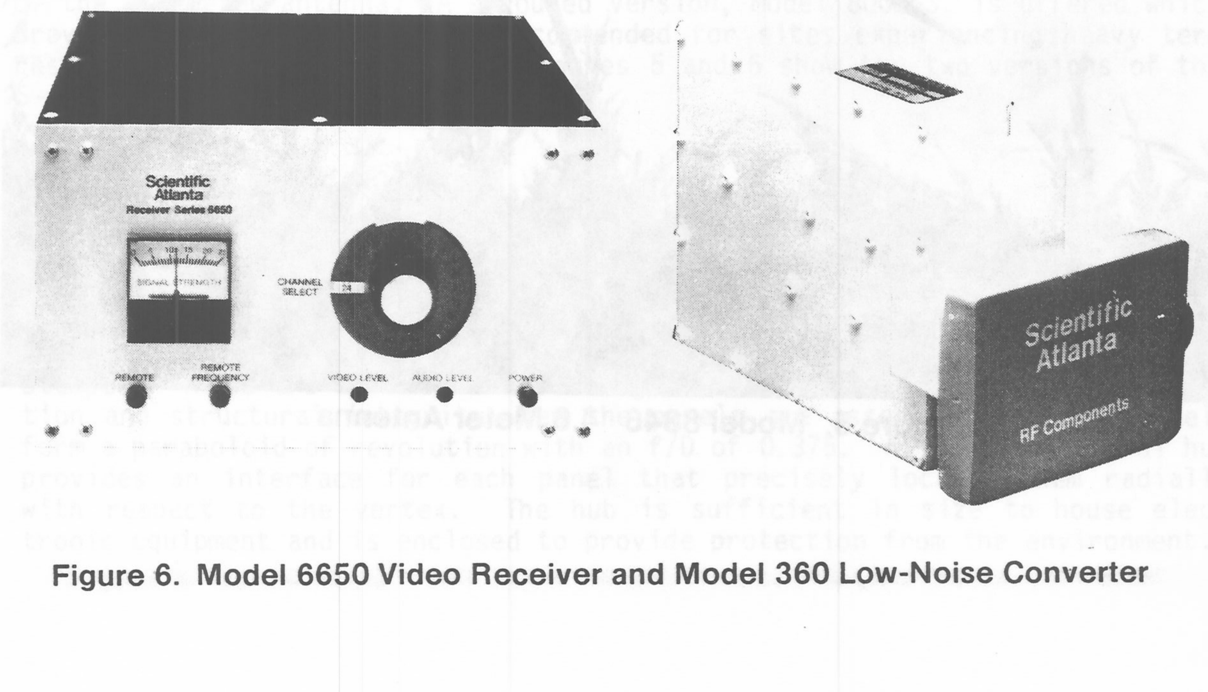


Figure 6. Model 6650 Video Receiver and Model 360 Low-Noise Converter

All remaining electronic modules are plug-in edge cards tied together electrically by a printed wiring board. Figure 3 shows the card rack area with interlaced sheet metal partitions. The Model 6603 looks identical to the 6602 except the remote tuning indicators are removed from the front panel.

Modular construction with interconnecting cards increases reliability, decreases cost, reduces hand-wiring labor to a minimum, and leads to efficient production and trouble location.

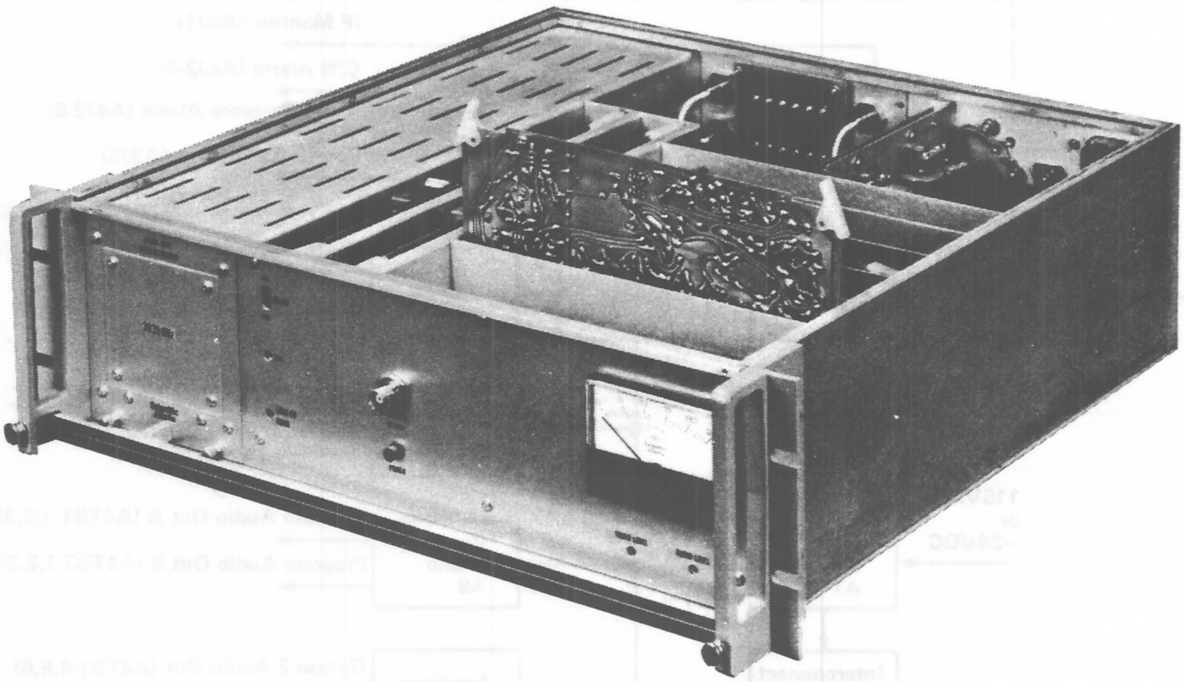


Figure 3.

Mount

The 5-meter mount features an elevation-over-azimuth configuration. A tripod design, utilizing the front leg as a kingpost for azimuth travel, provides independent adjustment of elevation and azimuth. Course and fine adjustment capability is built into each mechanism, making pointing and peaking easy. The standard mount provides continuous elevation coverage from 15° to 60°. Optional elevation adjustment mechanisms make it possible to achieve a maximum of 0° to 70° total elevation travel in two sectors. The two rear corners of the mount serve as attachment points for the azimuth adjustment mechanisms, providing full arc coverage (70° to 135°W) in two sectors. Since the azimuth axis is vertical, there is no weight imbalance that would cause rotation. Sector change-over and azimuth adjustments are easily accomplished.

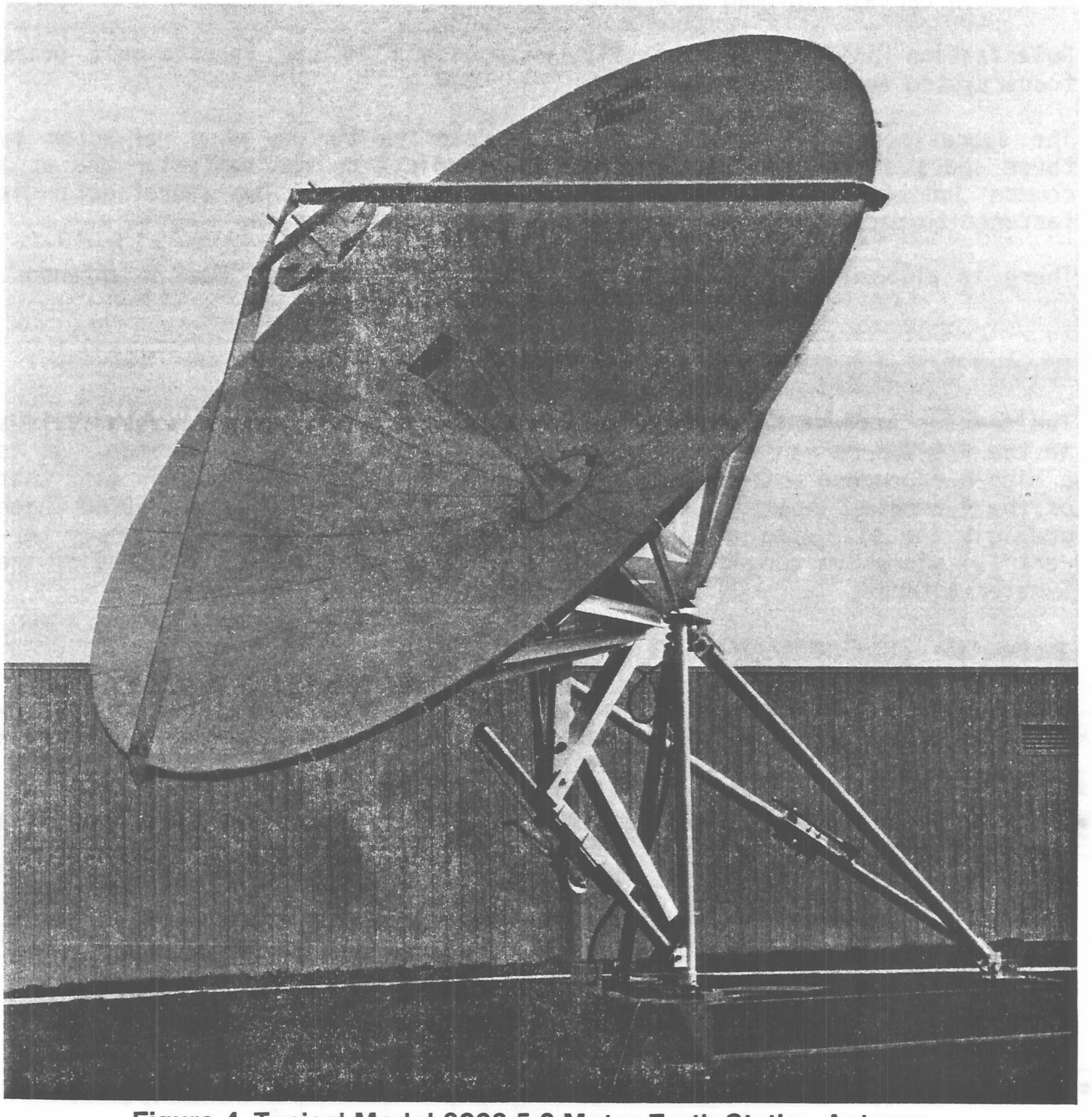


Figure 4. Typical Model 8008 5.0 Meter Earth Station Antenna

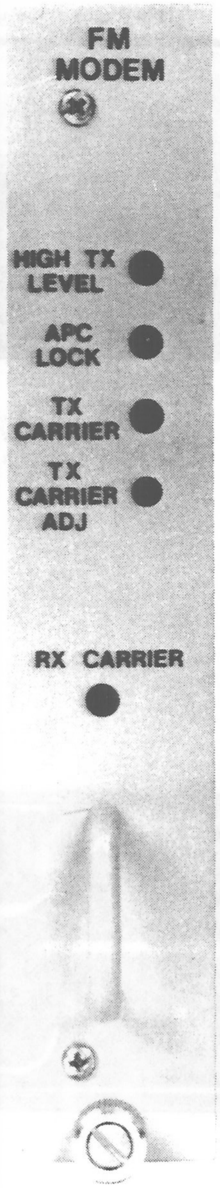


Figure 19. FM Modem, Indicators

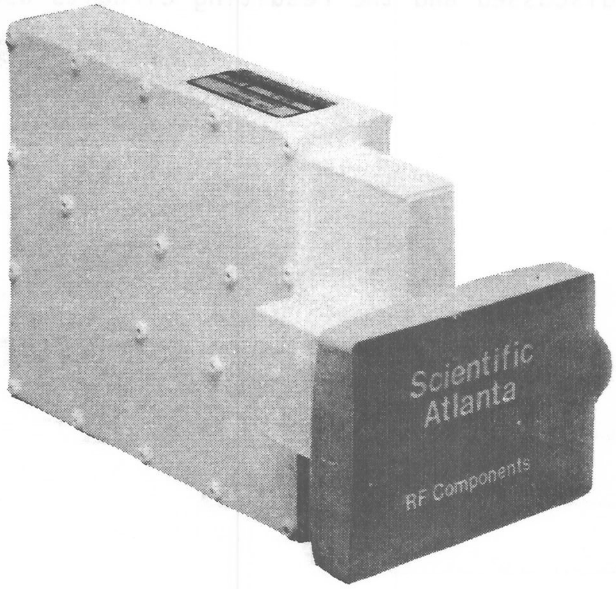
Specifications

The following pages detail the specifications for the Series 360 LNC.

Conversion gain is specified for the LNC instead of the usual simple gain to indicate that the input and output frequencies are different.

Image rejection, noise figure, and the other specifications have already been mentioned or are self-explanatory.

Frequency Range
  3.7 to 4.2 GHz
Input Level
  -75 dBm to -95 dBm per channel
Input Impedance
  50 ohm
Return Loss
  20 dB Min
Conversion Gain
  56 dB ±3 dB
Image Rejection
  50 dB Min
IF Frequency Band
  270 to 770 MHz
IF Output Impedance
  75 ohm
IF Return Loss
  17 dB Min
Temperature
  -40°C to +60°C full specification
Input Connector
  CPR 229G flanged
Output Connector
  Type F
Supply Voltage
  +15V to +21V
Power Requirements
  400 mA Max at 15 to 21 volts



Model No.	Noise Temperature	Noise Figure (25°C)
360-1	120K	1.5 dB Max
360-2	100K	1.3 dB Max
360-3	90K	1.2 dB Max

Model No.	Noise Temperature	Noise Figure (60°C)
360-1	140K	1.7 dB Max
360-2	120K	1.5 dB Max
360-3	110K	1.4 dB Max

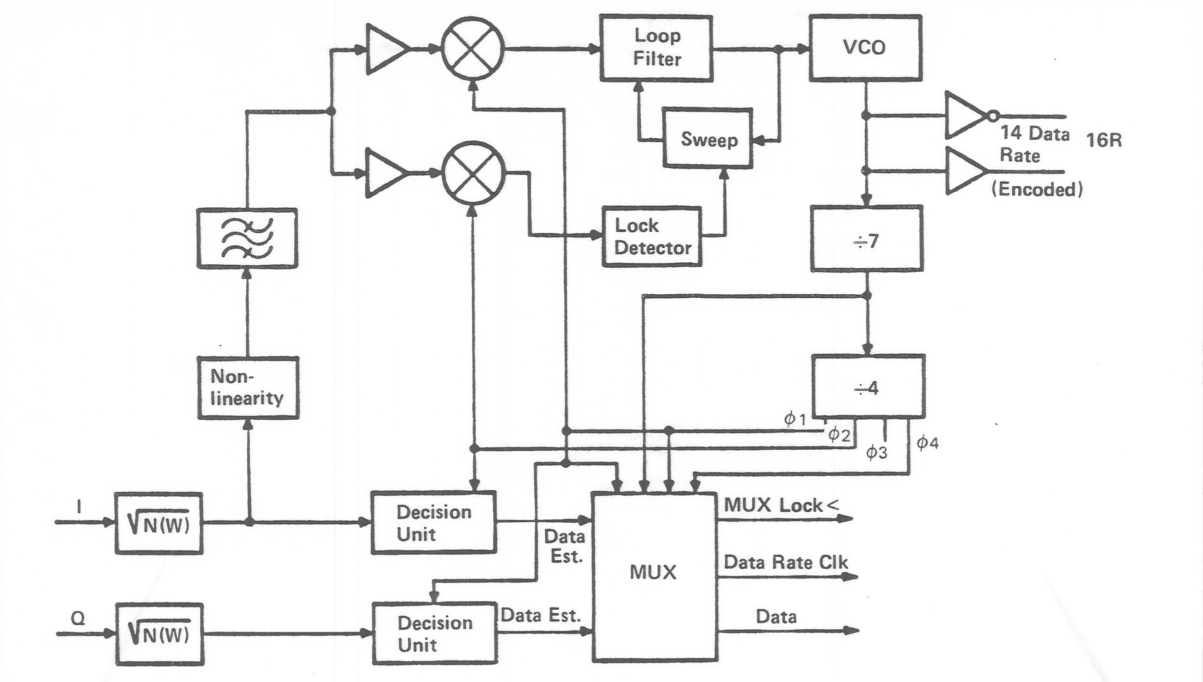


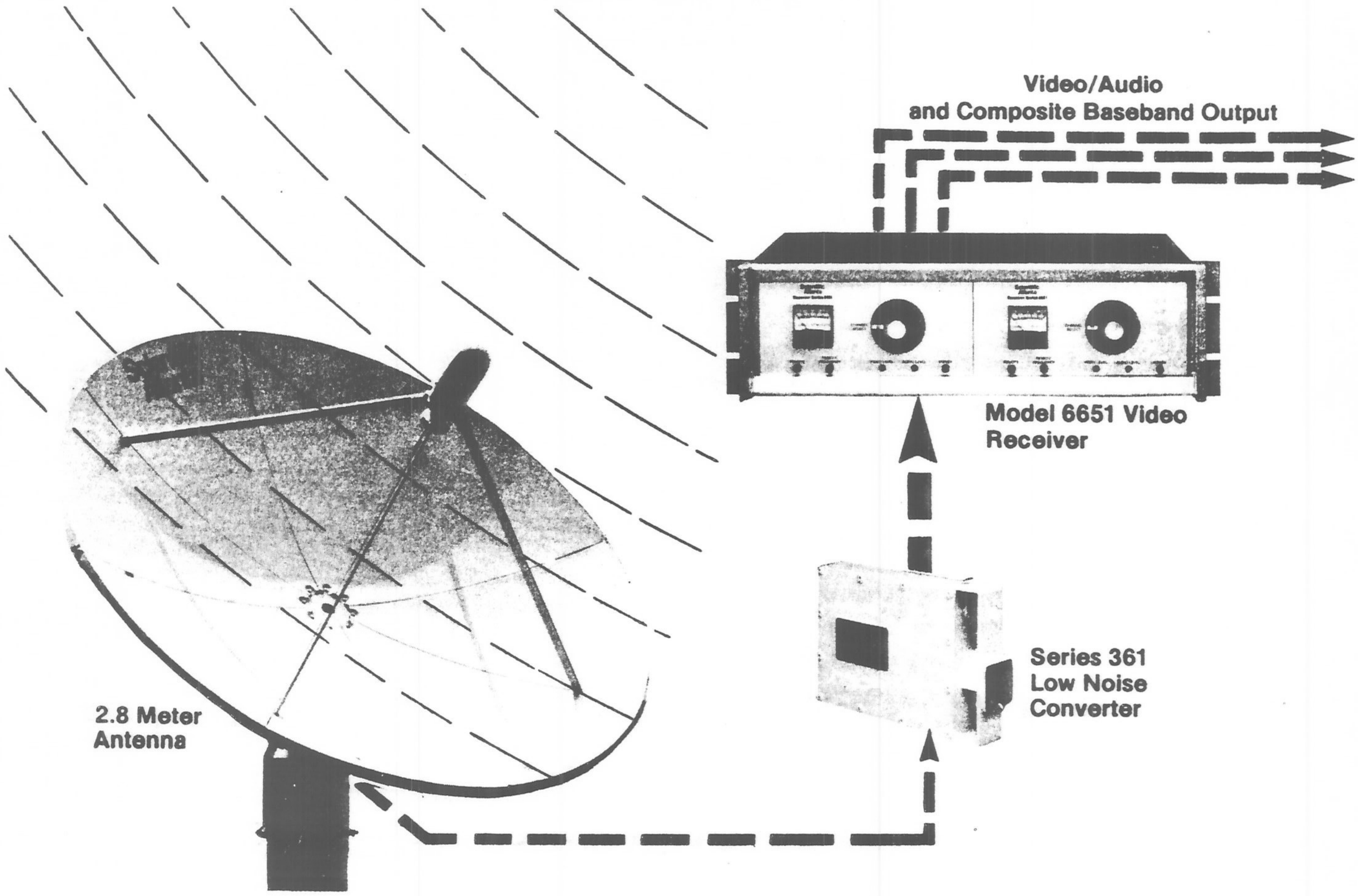
Figure 10. Bit Synchronizer Block Diagram

In the bit synchronizer, one of the coherent detectors is filtered and non-linearly processed to produce a bit-rate spectral component which is bandpass filtered. The bandpass filter output is the reference for a phase-lock loop. The 8/7 bit rate VCO output of the phase-lock loop is routed to the signal conditioner and is also provided as an output. An N-R clock is also provided to the decoder for its internal use.

In the long loop previously described, bandpass limited in the X2 circuitry and adaptive sweep circuitry in the phaselock filter are used to minimize false locking to data-induced spurs if the V.35 scrambling is bypassed. Careful attention has to be directed to such false locking in carrier regeneration circuitry.

The front panel of the demodulator is shown in Figure 11.

Ku-Band Receive-Only System



Scientific-Atlanta offers earth stations to receive satellite television transmissions from 11.7 to 12.2 GHz.

A typical Ku-band video receive terminal consists of the following:

- A Series 9000 Ku-band earth station antenna, with elevation-over-azimuth mount and single or dual polarized feed
- A Series 361 low noise converter
- A Model 6651 video receiver, with ANIK-C specifications (similar configurations for SBS, OTS, and other satellites are available)

Each system also includes 100 feet of coaxial cable to connect the low noise converter (LNC) to the video receiver, and installation and operation instructions. The Model 6651 receiver and Series 631 LNC specifications are listed on the following pages.

Video Broadcast Receiver, Series 7500

T.C. Mock

Introduction

Designed specifically for the broadcast and common carrier industry, the Scientific-Atlanta Series 7500 Video Receiver offers unmatched flexibility and performance at a low cost. Reception of satellite TV signals meeting RS-250B and NTC-7 performance requirements is made possible with the 7500.

For flexibility in control and interface with protection switches and remote control systems, the 7500 incorporates a microprocessor for monitor and control. It utilizes the SAbus control bus for remote interface.

General Description

The 7500 Receiver is all modular in design; all circuit cards (IF amplifier, video demodulator, video clamp, and subcarrier demodulators) plug in from the top of the unit. In addition, the downconverter is removable as a unit from the left side of the recevier. Three auxiliary slots are provided for additional subcarrier demodulators. Monitor and control of the 7500 is provided by a front-panel keyboard and display. Frequency is displayed with a 6-digit 7-segment display. Alarms are indicated by large back-lit LED indicators.

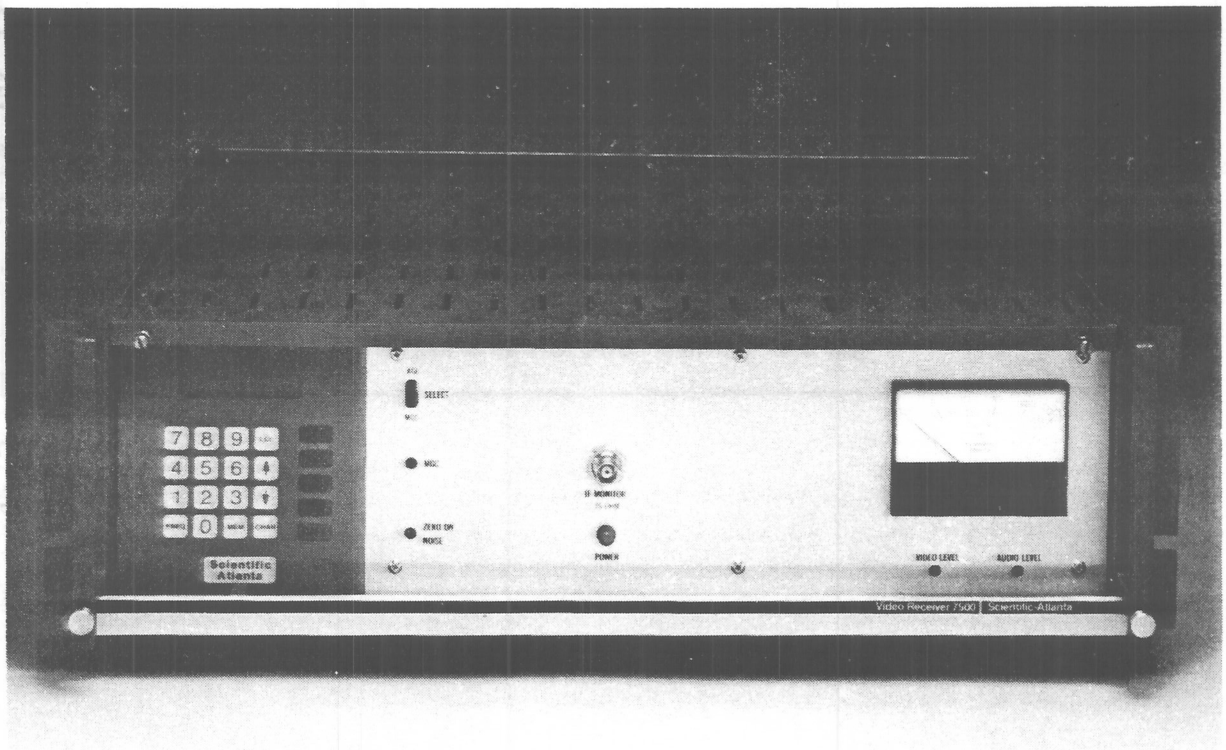


Figure 1. Series 7500 Video Broadcast Receiver

Video Exciter, Model 7550

T.C. Mock

Introduction

The 7550 Video Exciter is a new generation exciter designed for high performance and flexibility in modern broadcast and common carrier systems. It incorporates new circuit techniques which can improve video performance over a satellite link by a significant amount. Modular in design, it can accommodate a wide variety of plug-in modules, including up to three subcarrier modulators and an auxiliary group delay equalizer module.

General Description

Housed in a standard 5-1/4-inch rack-mounted chassis, the 7550 Exciter is designed with a clean mechanical style which provides maximum accessibility to circuit modules. A removable upconverter assembly with an integral front panel occupies the left-most quarter of the exciter mainframe. Functional circuit modules (such as the wideband modulator) plug into a card frame assembly located to the right of the upconverter. Each of these modules has front-panel status indicators and controls as appropriate to its function. During normal operation, the card frame and modules are hidden behind a blank panel which hinges downward for maintenance and adjustment.

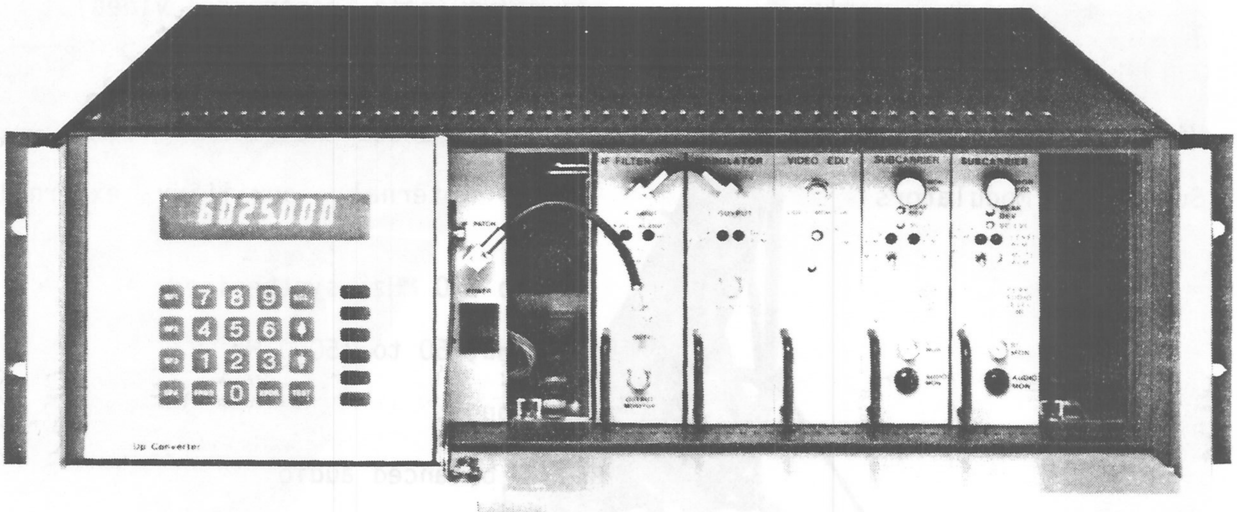


Figure 1. Model 7550 Video Exciter with Front Panel Lowered

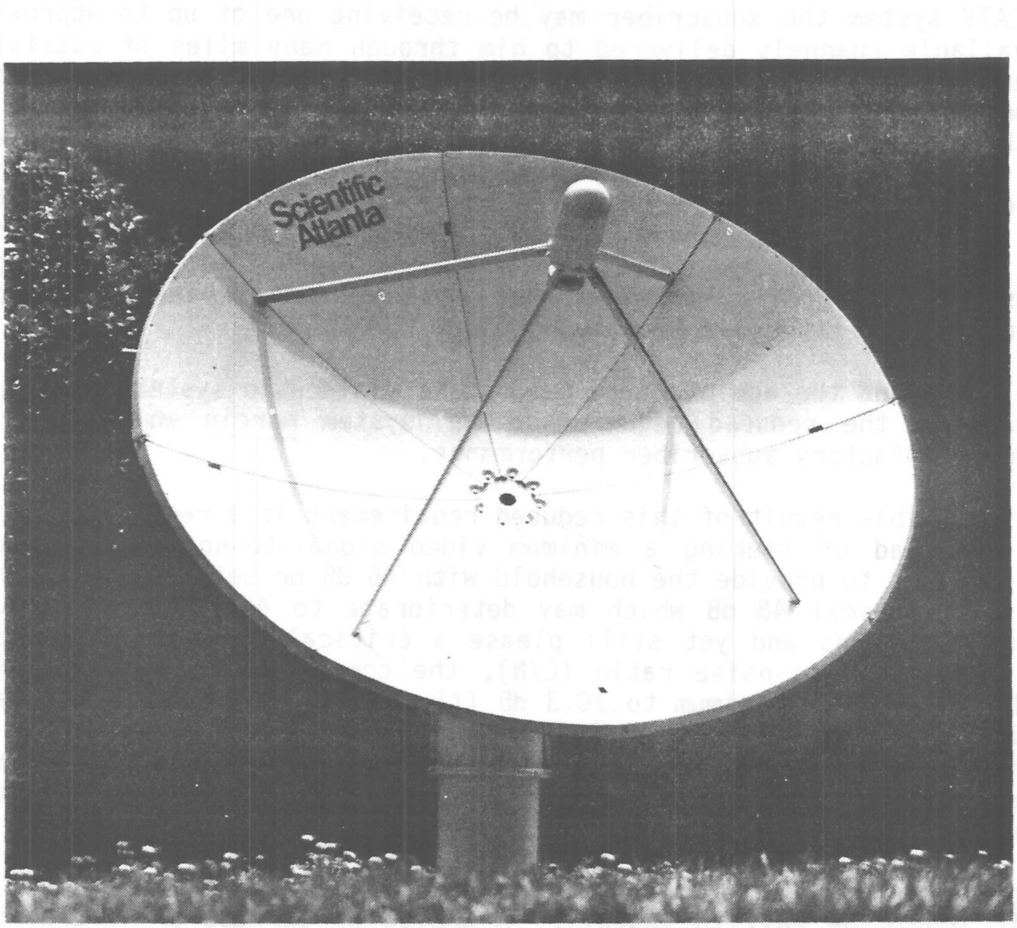


Figure 3. 2.8 Meter Series 9000 Antenna

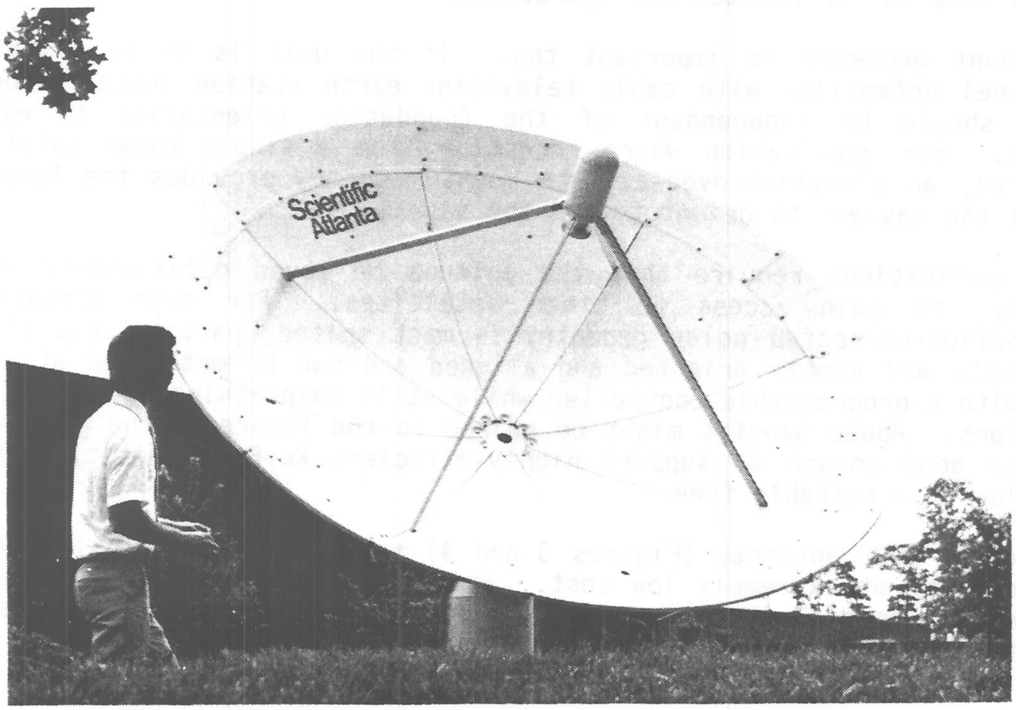
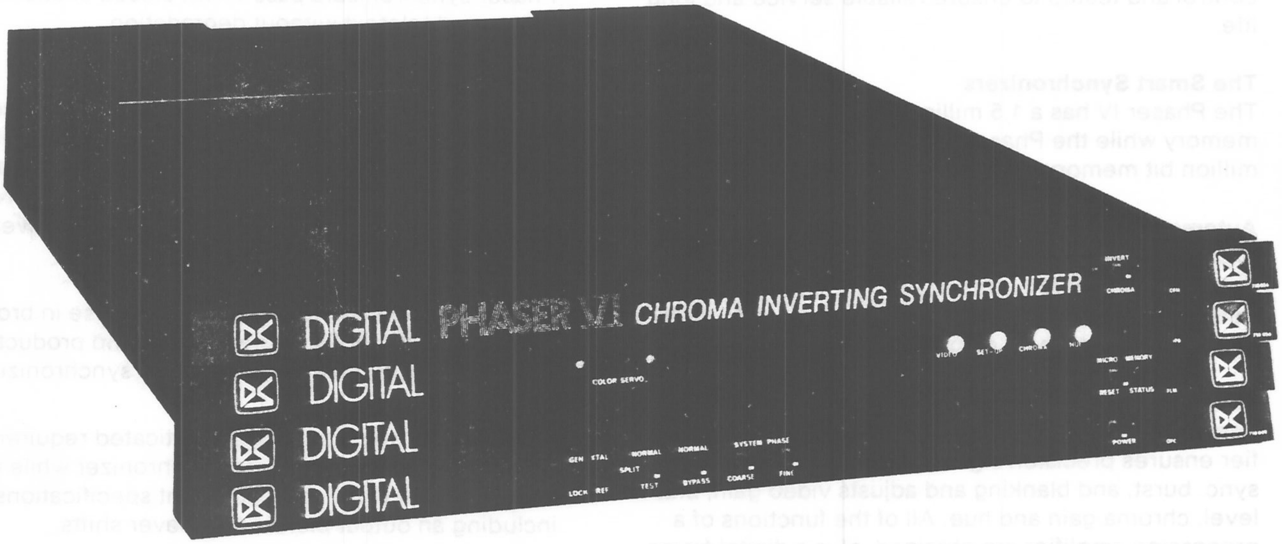


Figure 4. 3.2 Meter Series 9000 Antenna

Digital Frame Synchronizer, Phaser IV, V, and VI



Scientific-Atlanta, through its subsidiary, Digital Video Systems, offers a complete line of frame synchronizers for use in cable TV, LPTV, and broadcast applications. The Phaser IV, V, and VI series of synchronizers provide state-of-the-art technology in video synchronization.

The Phaser synchronizes input signals from an NTSC or black and white video source, including satellite, studio, network, remote camera, off-air, etc.

The Phaser lets the operator ignore time and distance, synchronizing signals automatically—such as Electronic News Gathering (ENG) programming transmitted via microwave—as if they originated in-house.

The Phaser eliminates complex signal routing and timing techniques. Signals from inaccessible cameras, remote vans, or moving vehicles are timed and synchronized into a fixed based control where they can be mixed, dissolved or used in chroma key or special effects with other sources.

With the Phaser, the operator can easily mix any live video inputs with studio programming, microwave, satellite, and VTR signals to produce a completely synchronized output without gen-locking.

The Phaser replaces the complex system of delay lines and pulse delay compensators which may now be used to time several studios through master control.

And for infinite switcher re-entry, which previously required very costly equipment, the Phaser is a breakthrough.

The Phaser IV with a 1.5 million bit RAM fieldstore memory is the basic "building block". Phaser V and Phaser VI employ the same modular design concept.

The Phaser V synchronizer builds onto the exceptional features of the Phaser IV. It has a framestore memory to provide double the memory capacity with half the number of components.

The Phaser VI takes the concept of synchronizing a step further, incorporating a new picture adaptive digital comb filter to provide the highest quality NTSC chroma inversion ever. It ensures virtually perfect decoding of the NTSC color TV signal as required in freeze frame applications or for studio-to-studio synchronization and switcher re-entry.

Rugged Packaging

The Phaser synchronizers are compact and rugged. Measuring only 3-1/2" high, they fit any surroundings, from studios and master control rooms to compact mobiles, and in standard headend equipment racks.

Simplicity Designed-In

Designed for ease of use, Phaser controls are conveniently placed on the front louvres in a logical arrangement. Functional controls located on the circuit boards are easily accessed and work at the flick of a switch. Adjustments are rarely necessary as one of the main benefits of the Phaser is the reduced need for service. Signals are phased automatically.

Easy Maintenance

LED's on the Phaser front louvres indicate operational status and simplify fault identification. If service is required, boards are quickly replaced to reduce downtime to a minimum.

The antenna hub consists of two machined cast aluminum end pieces welded to either end of a cylindrical shell. The shell is 1/8-inch aluminum sheet, rolled to 37-inch diameter and seam welded. The hub provides a suitable housing for RF components and a motorized feed rotator when the antenna is so equipped.

Figure 1. Model 8010C 7-Meter Earth Station Antenna

output data estimate and bit rate clock. Functionally, the 84.903-Mb/s and 15.062-Mb/s BSSCs are the same but will vary slightly in their implementation. The 15.062-Mb/s input is essentially non-bandlimited while the 84.903-Mb/s input is somewhat bandlimited. The use of time-invariant-matched filters allows the matched filter response to be easily altered to optimize performance with bandlimiting.

In Figure 15, a photograph of the resulting hardware is shown. The UQPSK demodulator is packaged in one chassis, and each bit synchronizer-signal conditioner is packaged in its own chassis. That is, the 84.903-Mb/s BSSC is in one chassis, and the 15.062-Mb/s BSSC is in a separate chassis. The units shown are first generation production units. In the second generation production units, the bit synchronizer-signal conditioners have shrunk to a 3-1/2-inch chassis as opposed to the original 5-1/4-inch chassis.

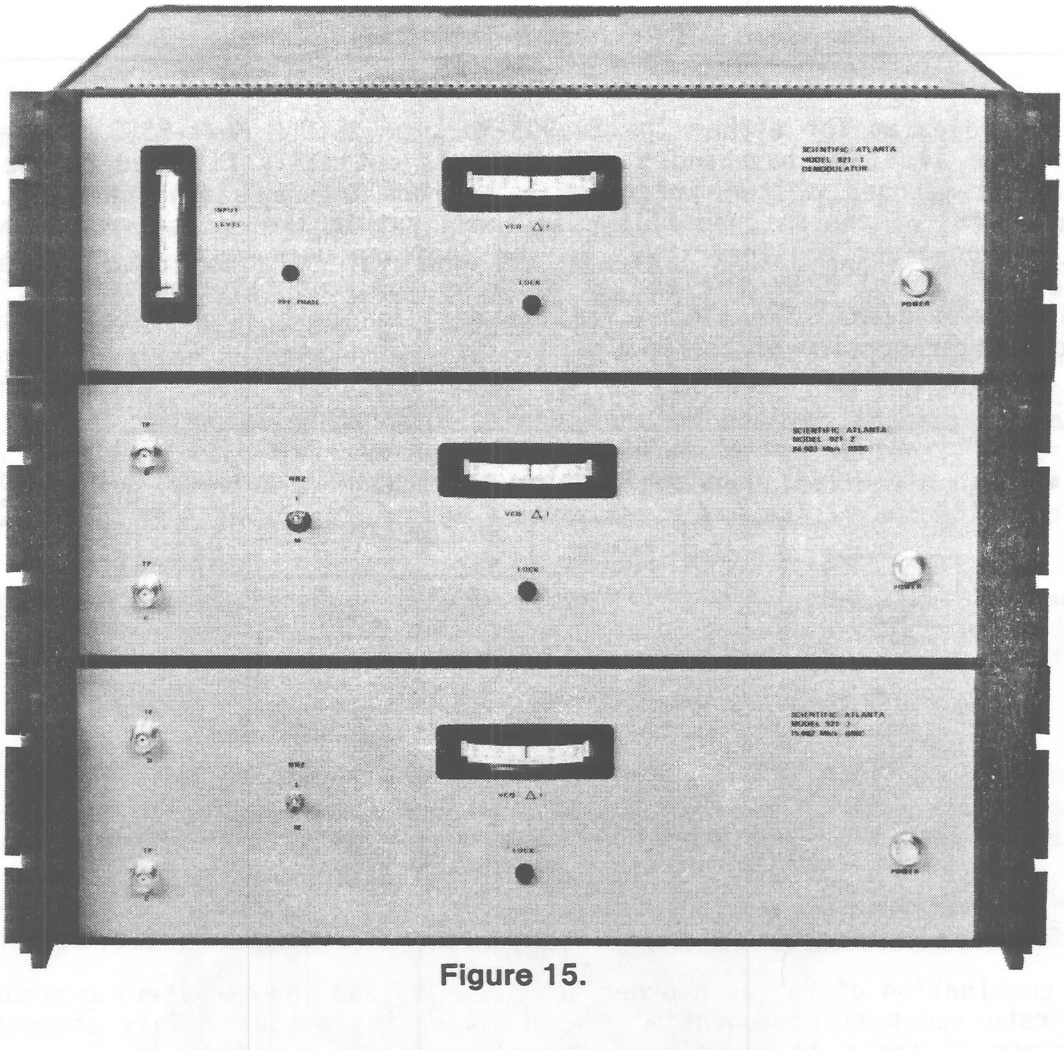


Figure 15.

Performance Results

The measured performance of the resulting UQPSK demodulator BSSC hardware is presented in Figure 16. In this particular figure, there are $(2^{23}-1)$ PN sequence data on each channel. Performance on both the I and the Q channel is within 1.2 dB from theory over a wide range of bit error rates. Specification limits of this hardware were 2.5 dB from theory.

MODEL 8851 1:N MODEM PROTECTION SWITCH

General. The Model 8851 1:N Modem Protection Switch (shown in Figure 14) is a microprocessor-based device which provides redundancy protection for a Series 8800 Digital Modem Subsystem containing from one to eight on-line units, with one frequency-agile backup unit. The switch is expandable to accommodate the desired number of on-line modem/codec units, by adding the required plug-in interface modules. The switch can be configured for transmit-only, receive-only, or full-duplex applications; in the duplex mode, transmit and receive switching operates independently. An option for a redundant internal clock is provided in the switch. This unit is contained in a 8-3/4-inch-high (22.23 cm) by 19-inch-wide (48.63 cm) rack-mounted package. Redundant internal power supplies are included.

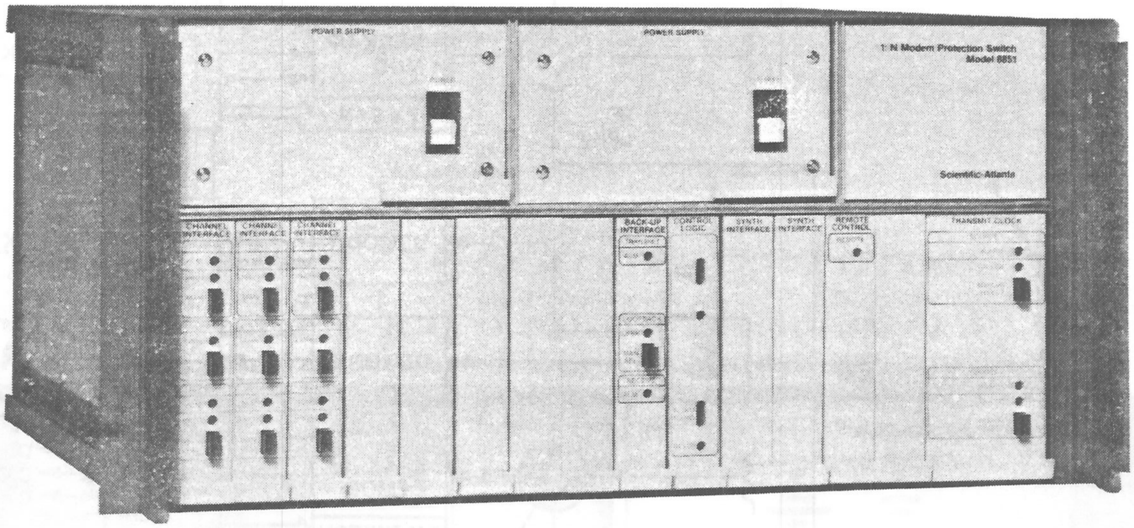


Figure 14. Model 8851 1:N Modem Protection Switch

The hub is designed with covered access openings in the side and rear end. The rear cover provides suitable holes for passage of waveguide, RF and electrical cables. This arrangement permits field assembly without the necessity for drilling holes. The side opening is designed for easy access to the hub for passage of components and for assembly work. This access is especially useful during antenna assembly, because it permits placement of

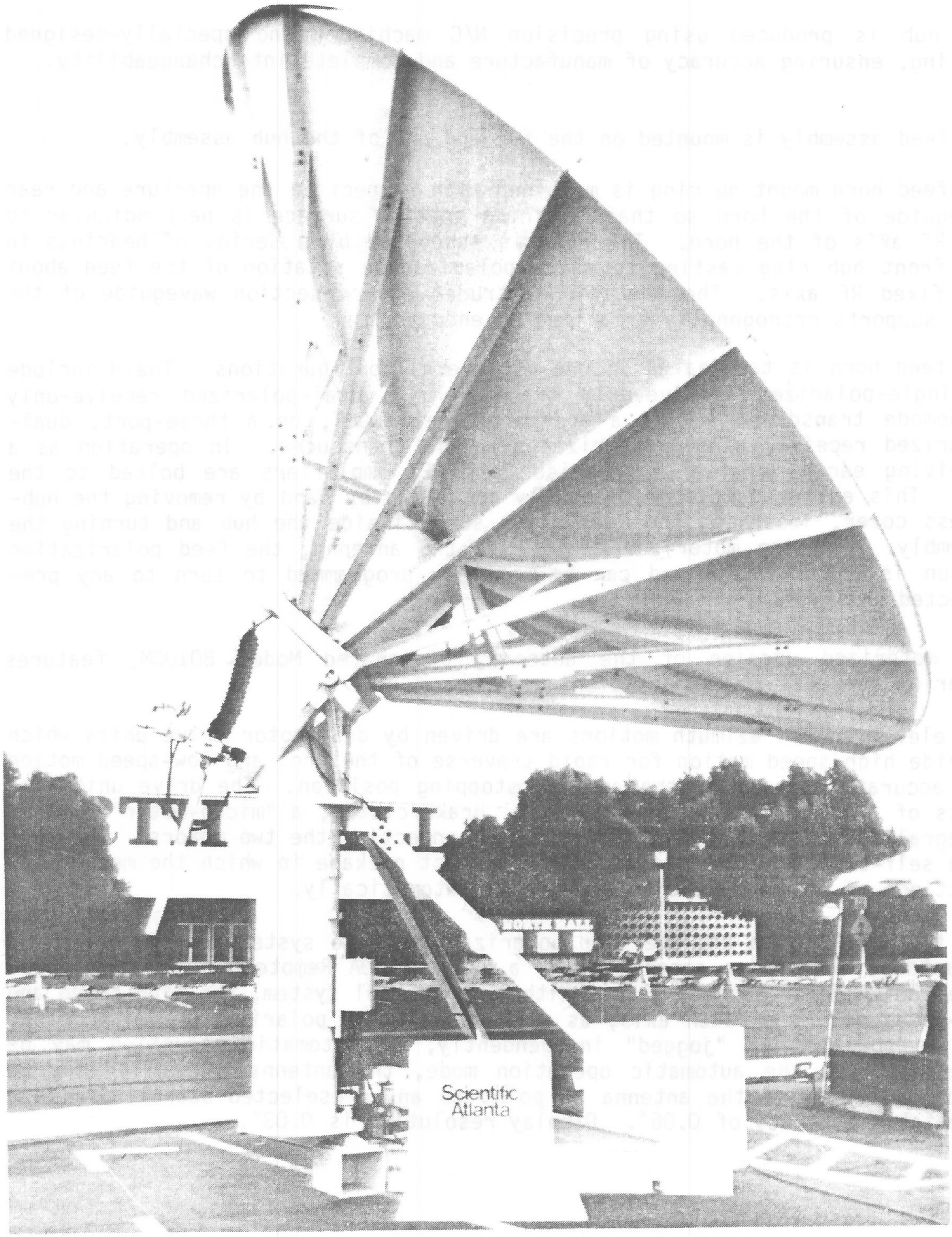


Figure 2. Side View of Model 8010CM Antenna

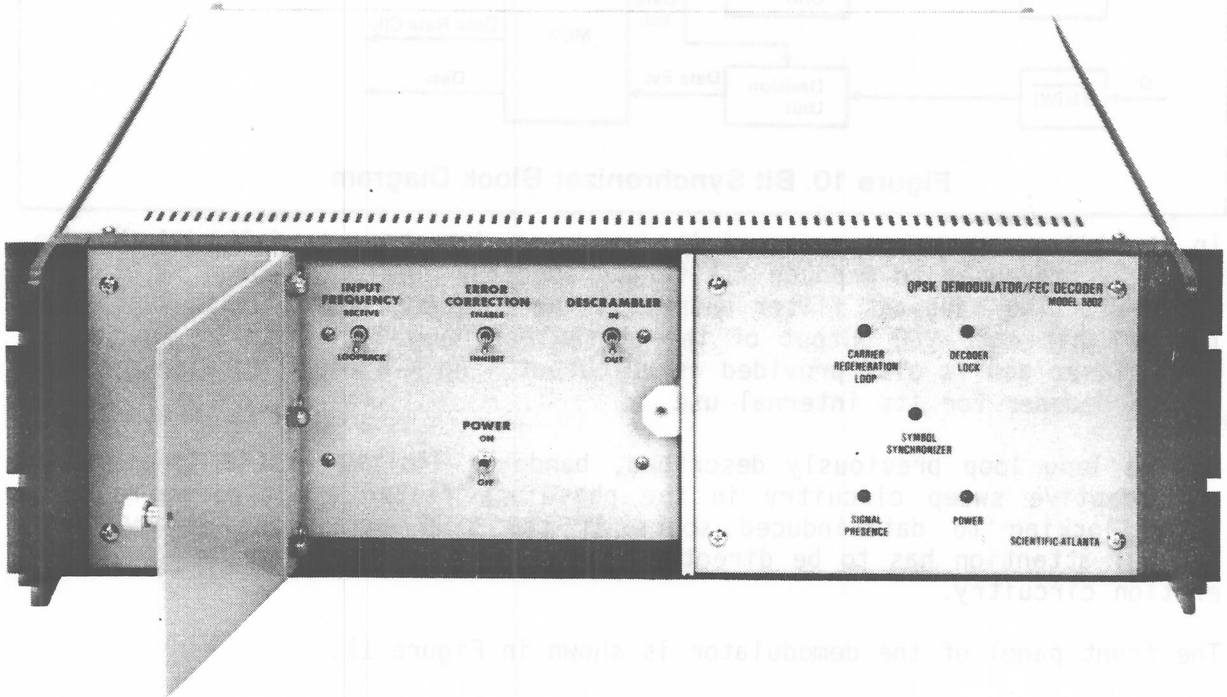


Figure 11. QPSK Demodulator/FEC Decoder

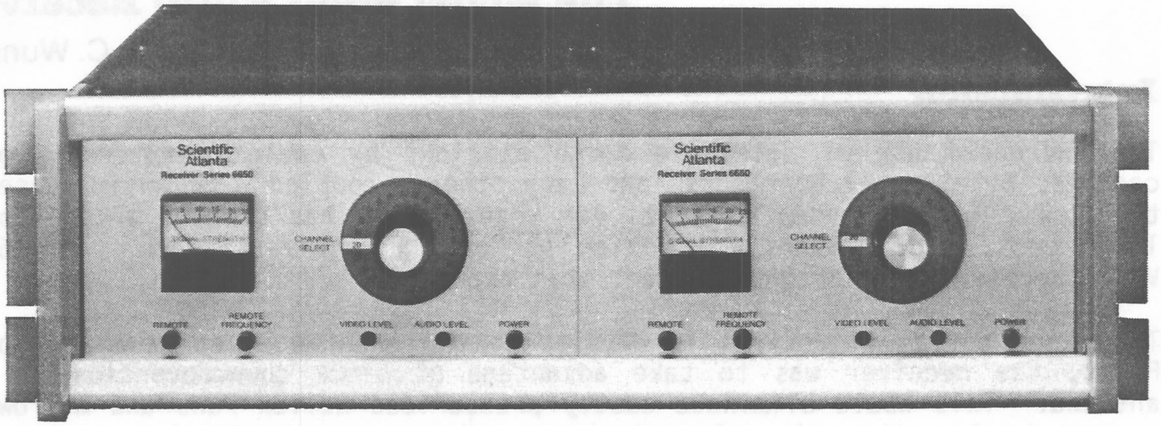


Figure 2. Model 6650 Video Receiver Dual Rack Configuration with Rack Adapter

Specific Design Goals

Early in the development of the 6650 Receiver, the following basic features were defined:

- The receiver would be modular in construction, facilitating lower cost production methods.

- Only a fully agile unit would be made available, thus eliminating the cost incurred when producing two versions of the same product.

- The polarization select relay should be contained in the unit, thus facilitating ease of installation.

- The IF frequency would be in the upper VHF range, allowing the use of a phase-locked loop demodulator, and reducing any image rejection problem that might occur.

- Several options would be provided, including remote control, space for extra subcarrier demodulators, a built-in type Class I TV modulator for the low-band channels, and a 4.5-MHz subcarrier modulator.

- The receiver would be designed with the latest integrated circuit and hybrid amplifier technology available.

These goals produced a sheet metal chassis with plug-in edge cards interconnected by a central printed-wiring board (PWB), shown in Figures 3 and 4. The power supply and RF converter modules also plug into the central PWB.

This construction increases reliability while decreasing production costs. It also allows easy fault isolation and in-field repair.

- Design from a manufacturing point of view was considered important for economical reasons. Assembly methods which interface with the latest automated production methods was to be foremost as a design team goal.

- The power module would have a 50% excess capacity for powering external equipment such as low-noise amplifiers and modulators.

- Remote tuning ability should be available with command inputs compatible with video protection switch logic and simple contact closures for "cherry-picking" applications.

These goals led to a sheet metal chassis with plug-in downconverter and power supply modules. The downconverter is installed from the receiver front panel. The power pack installs from the receiver rear panel. Figures 1 and 2 are Models 6601 and 6602, respectively.

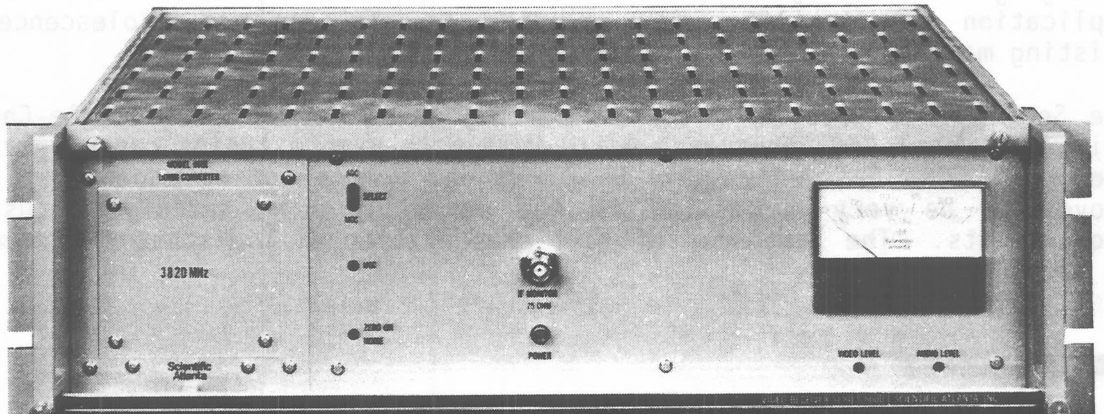


Figure 1. Model 6601 Single-Channel Receiver

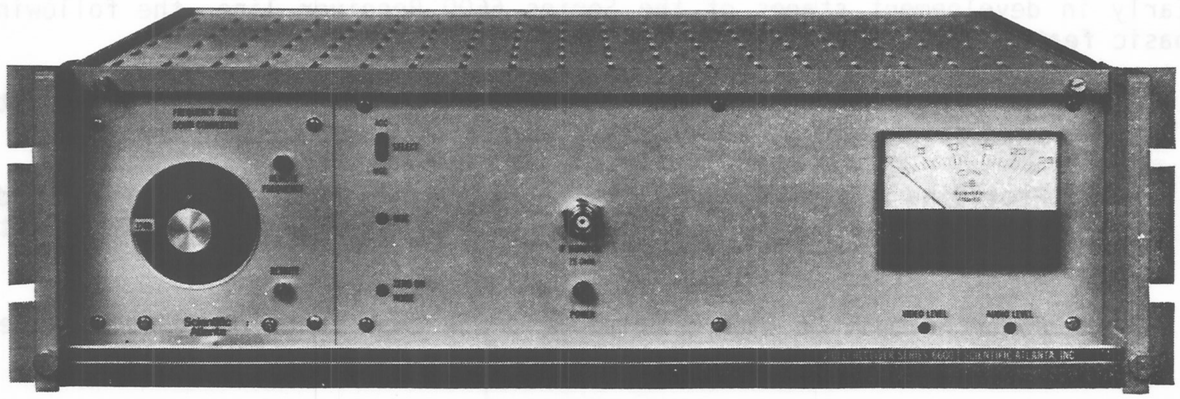


Figure 2. Model 6602 Agile Receiver

High Power Amplifiers (HPA)

High-power amplifiers, for digital applications, range in power from 1 watt to 600 watts. (A 75-watt HPA is shown in Figure 4.) HPAs in the 1- to 10-watt range are available in solid-state configurations while the 15- to 600-watt units are traveling wave tubes.

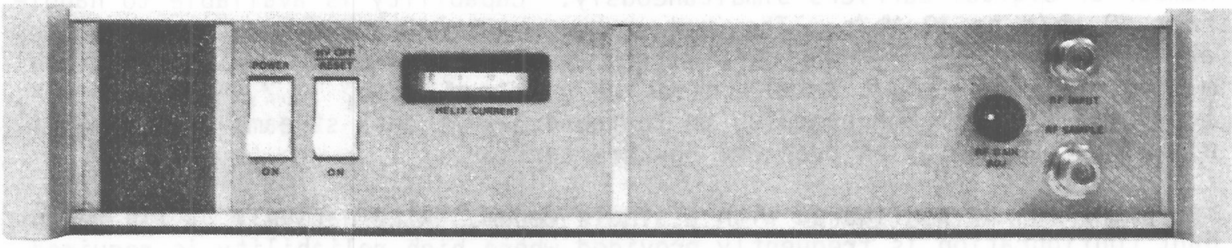


Figure 4. 75 Watt TWT HPA

The HPA size is dictated by the following parameters:

- Transmit antenna size
- Receive station G/T
- Transmit station location relative to satellite
- Number of carriers
- Carrier Bit Rate
- Required receive performance

Converters

Up- and downconverters are available in a dual-conversion configuration. The dual-conversion models permit easy and rapid change in operating frequency. This feature is critical, for example, when rapid restoration of service is required in the event of transponder failure.

The dual-conversion converter is shown in Figure 5. This unit can be tuned to any of six frequencies by a front-panel switch. This converter can also be tuned to any one of the six frequencies remotely.

Figure 5. Dual-Conversion Converter

The antenna loads are transferred by the mount to a three-point foundation that forms a 96-inch equilateral triangle. The mount utilizes structural steel and aluminum parts. For corrosion protection the steel parts are hot-dip galvanized, and the aluminum parts are iridited, primed with yellow zinc-chromate primer and painted.

Feed System

As with the 4.6-meter antenna, the 5-meter is available with a standard low-cost prime focus Feed or with an optional Cassegrain system.

The prime focus Feed offers unusual economy in a mid-sized earth station antenna while meeting the 29-25 log θ sidelobe specification for reduced satellite spacing. Typical first sidelobes are 22 dB below the beam peak.

Several options are available in the high-gain, dual-reflector Cassegrain feed system. The dual-frequency band feed is designed to operate in the 3.7 to 4.2 GHz receive band and the 5.925 to 6.425 GHz transmit band. A diagonal horn illuminates a shaped subreflector which provides efficient illumination of the 5-meter reflector aperture.

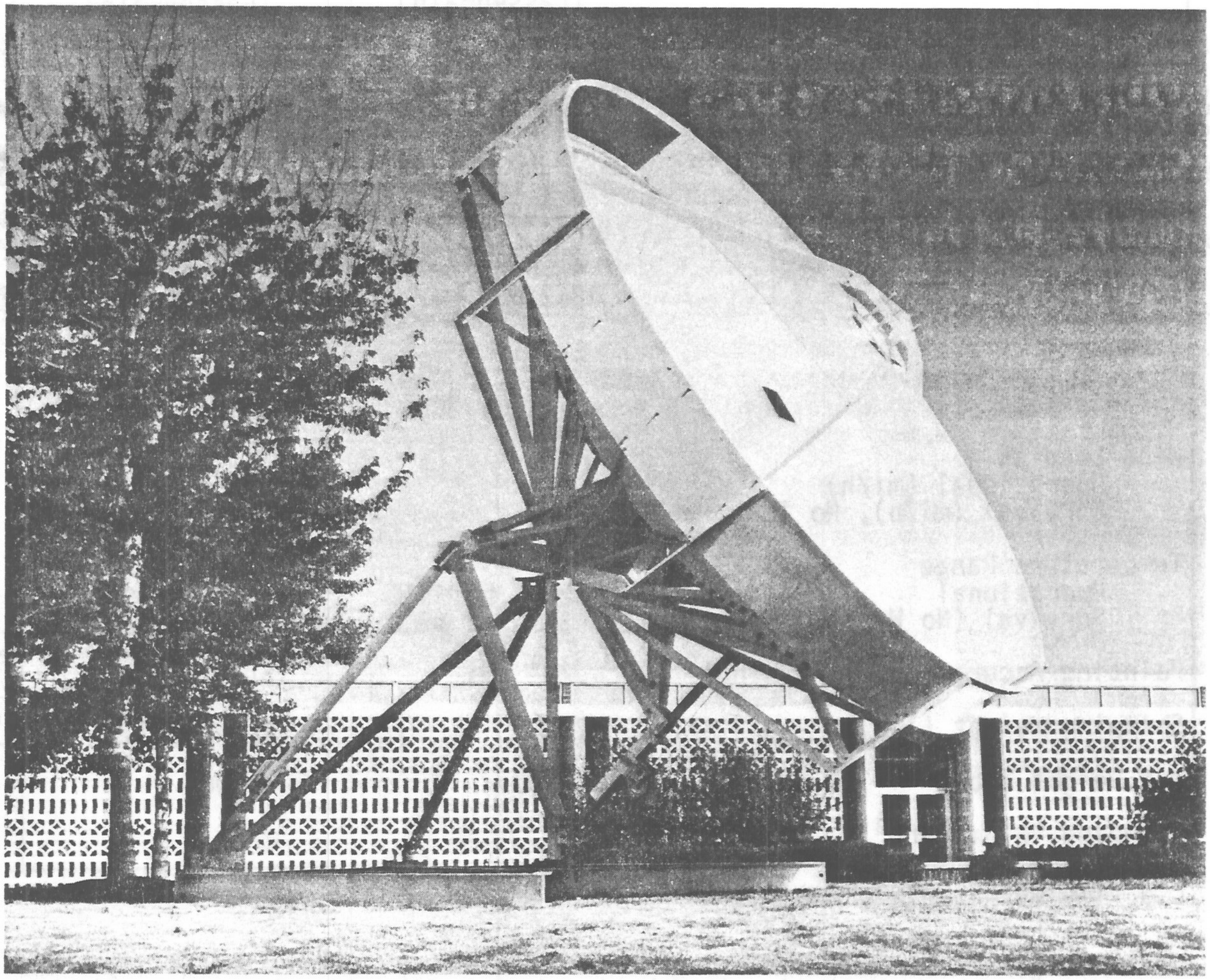


Figure 5. Typical Model 8008LS 5.0 Meter Earth Station Antenna

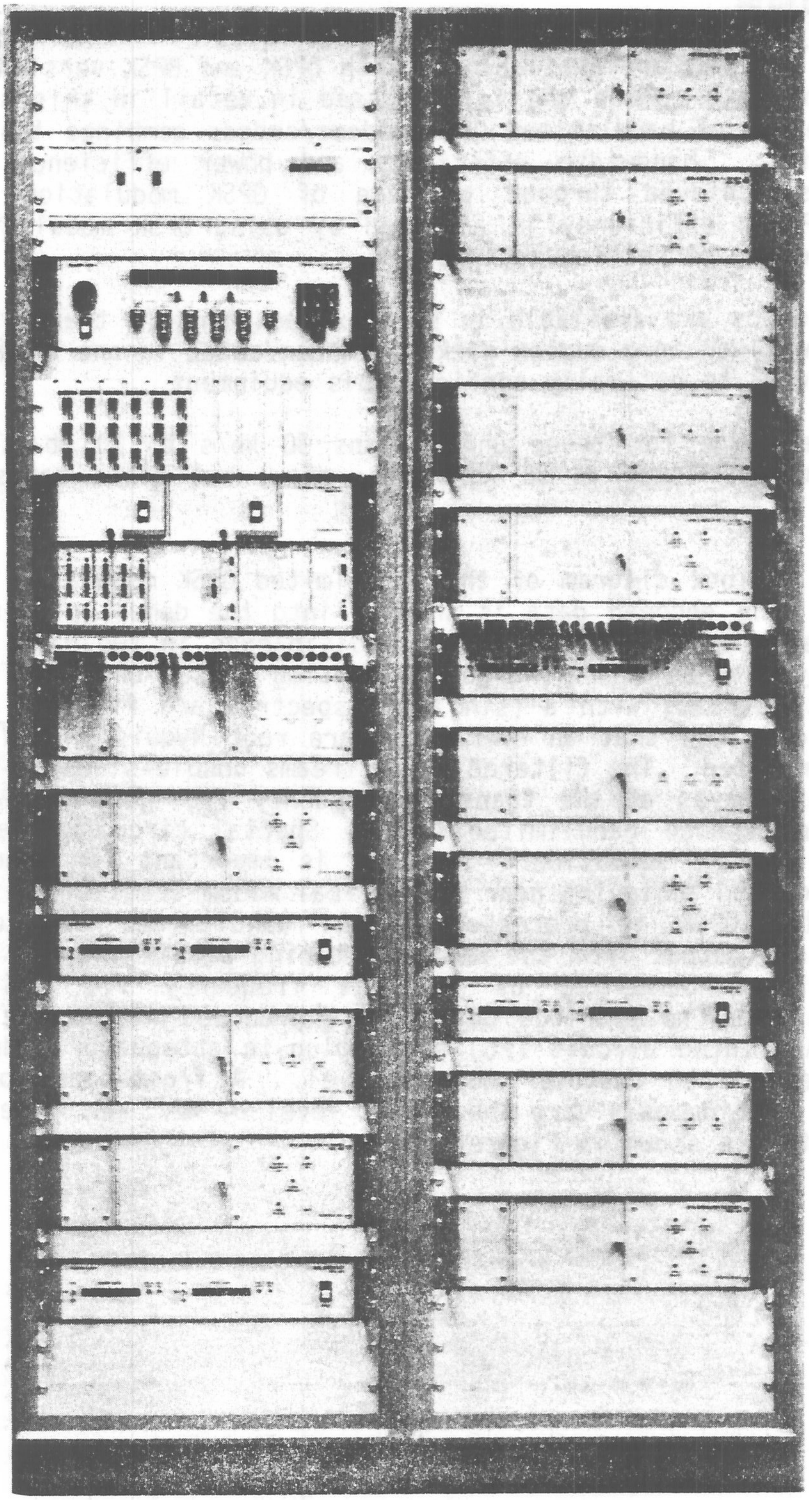


Figure 6. Typical Digital Equipment Rack Layout

Table 1. Low-Noise Converter Specifications - Continued

Characteristic	Specification
Temperature	-40°C to +60°C typical LNCs are exposed to a variety of outdoor temperatures and must function within specification at all temperatures.

Other requirements in the LNC design include designing the LNC to be weatherproof, providing adequate mechanical strength for bolting directly to the antenna, and providing for supplying dc power to the LNC. DC power is supplied to the LNC through the RF output connector. The Scientific-Atlanta Series 361 LNCs meet all of the preceding specifications.

LNC Description

Figure 1 is a photograph of the Scientific-Atlanta Series 361 LNC showing the waveguide input to the LNC which bolts directly to the antenna feed. On top of the waveguide section is the isolator which isolates the transistor amplifier from any antenna mismatches and provides a transition from the waveguide transmission mode to the microstrip mode required for the 12 GHz low-noise amplifier in the LNC.

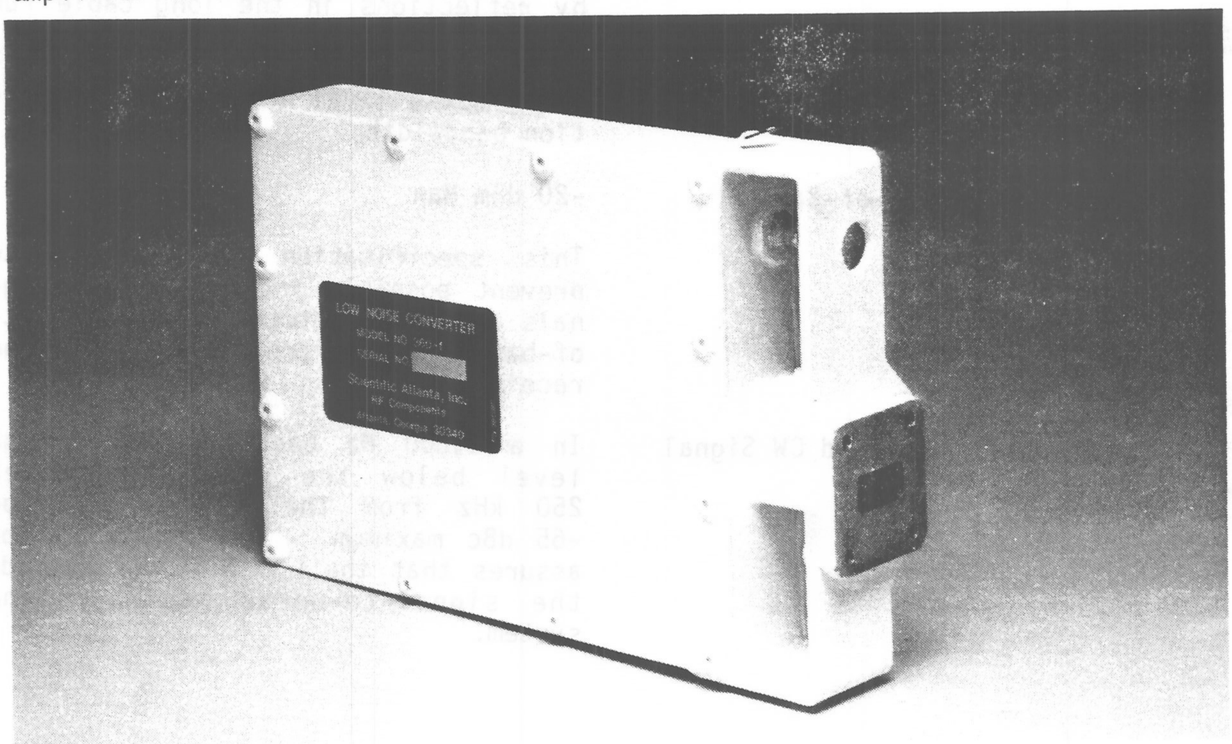


Figure 1. Series 361 Low-Noise Converter

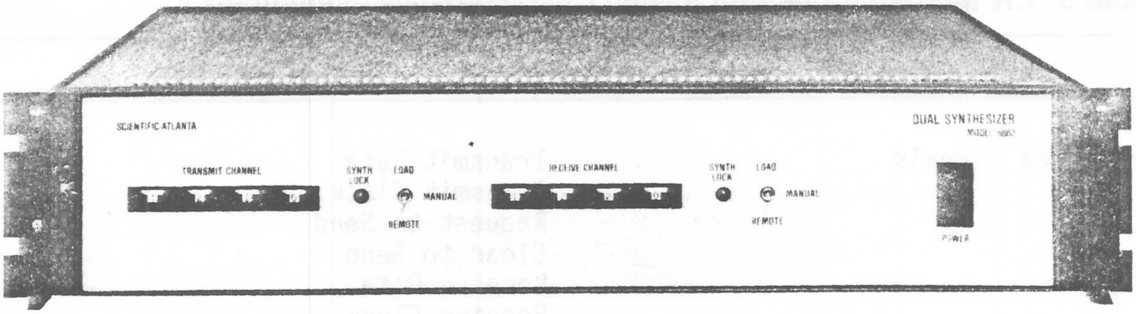


Figure 19. Model 8863 Dual Synthesizer

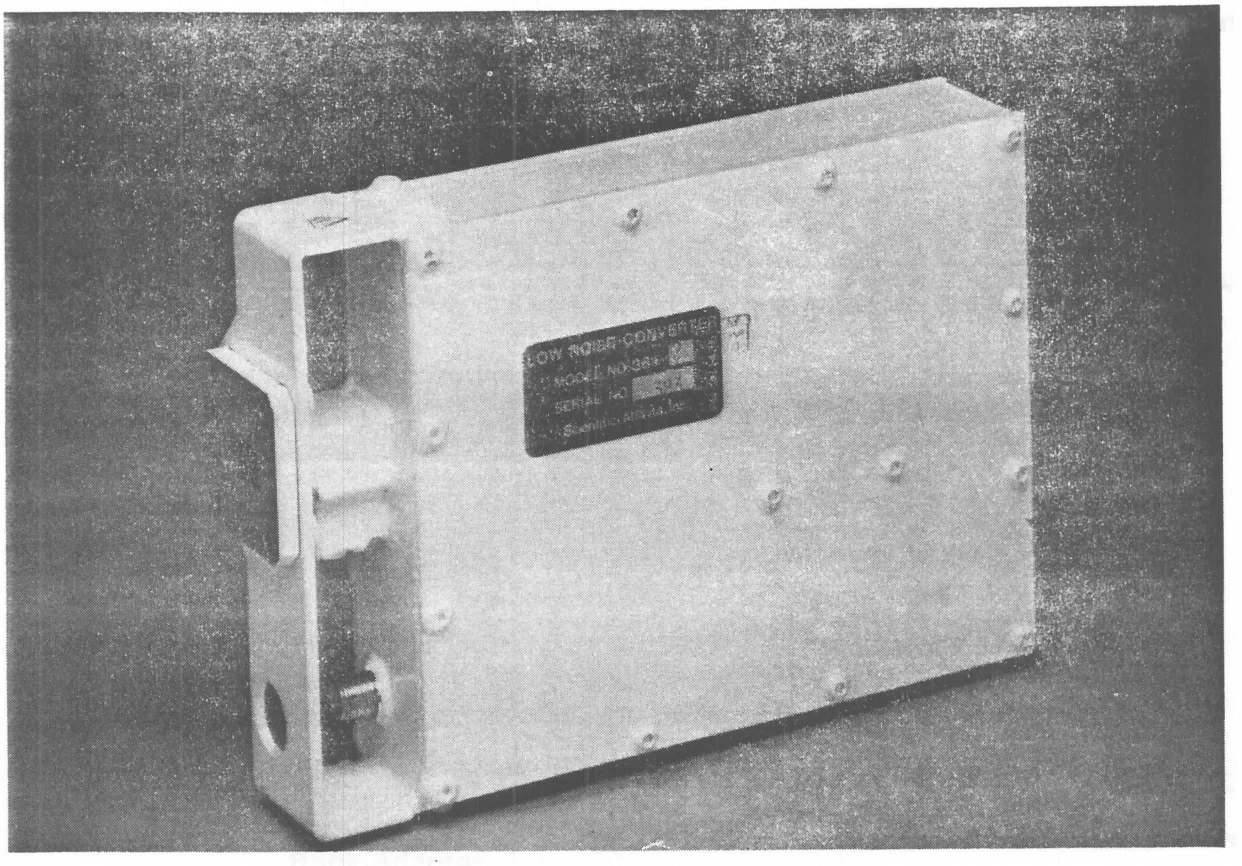
In the dual configuration, the Model 8863 is available in three versions: receive, transmit, transmit/transmit, and receive/receive. These versions are identified by dash numbers as shown in Table 4 below.

Table 4. Dual Synthesizer Configurations

Model	Configuration
8863-1	RX/TX
8863-2	TX/TX
8863-3	RX/RX

Description. Figure 20 shows a functional block diagram of one of the RF synthesizers. A 4.5-MHz crystal oscillator provides stable clock for the synthesizer and a modulus 180 or 200 counter divides this clock to generate 25.0-kHz or 22.5-KHz reference frequencies, respectively. An internal jumper selects the proper frequency. The reference frequency determines the channel frequency spacing. By using the fine frequency adjust and reference frequency test point, the reference frequency can be adjusted to precisely the correct value.

11.7 to 12.2 GHz Low Noise Converter
Series 361



The Series 361 Low Noise Converter (LNC) is designed for use with the Model 6651 video receiver to provide low cost, high performance satellite television reception. The LNC is a combination of a low noise GaAs FET amplifier and a block downconverter for optimum noise performance. The LNC converts the entire 500 MHz satellite band to UHF frequencies between 270-770 MHz at the antenna feed. This eliminates the need for microwave components in the receiver as well as expensive coaxial cable from the antenna to the headend. The result is a low-cost earth station electronics subsystem.

The LNC utilizes internal output isolation and an integral isolator to protect against antenna mismatch. A precision cast housing contains a low noise amplifier, microwave oscillator, microwave filters and power supply regulator. Protection is provided to withstand exposure to all weather conditions. Standard units are powered through the center conductor of the coaxial cable. The Series 361 LNC is available in 440K, 360K and 300K noise temperature ranges.

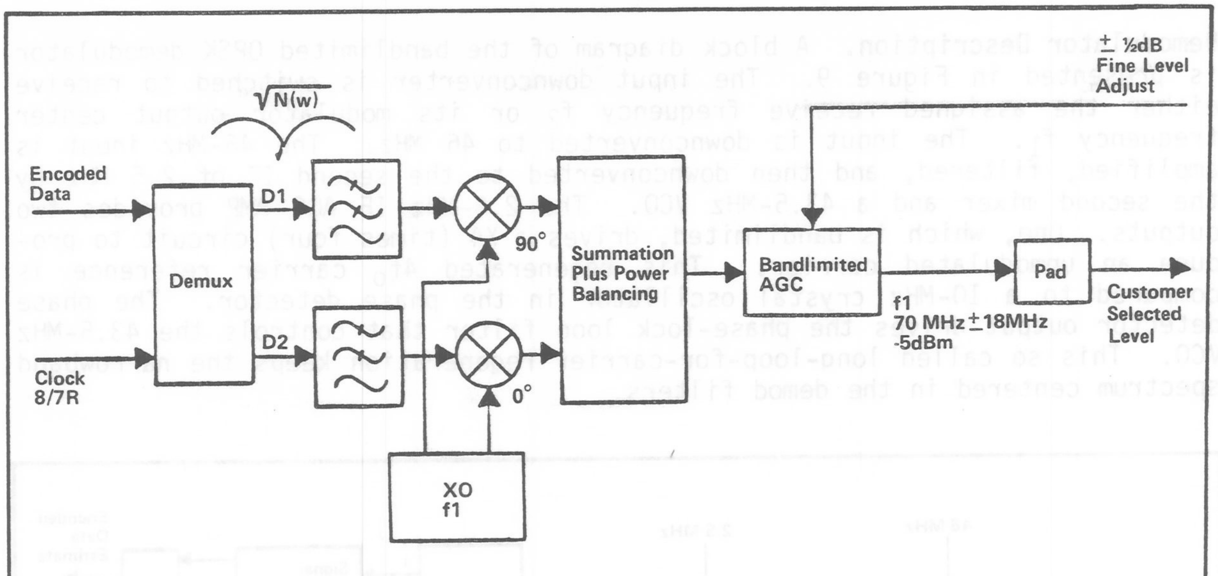


Figure 7. Bandlimited QPSK Modulator

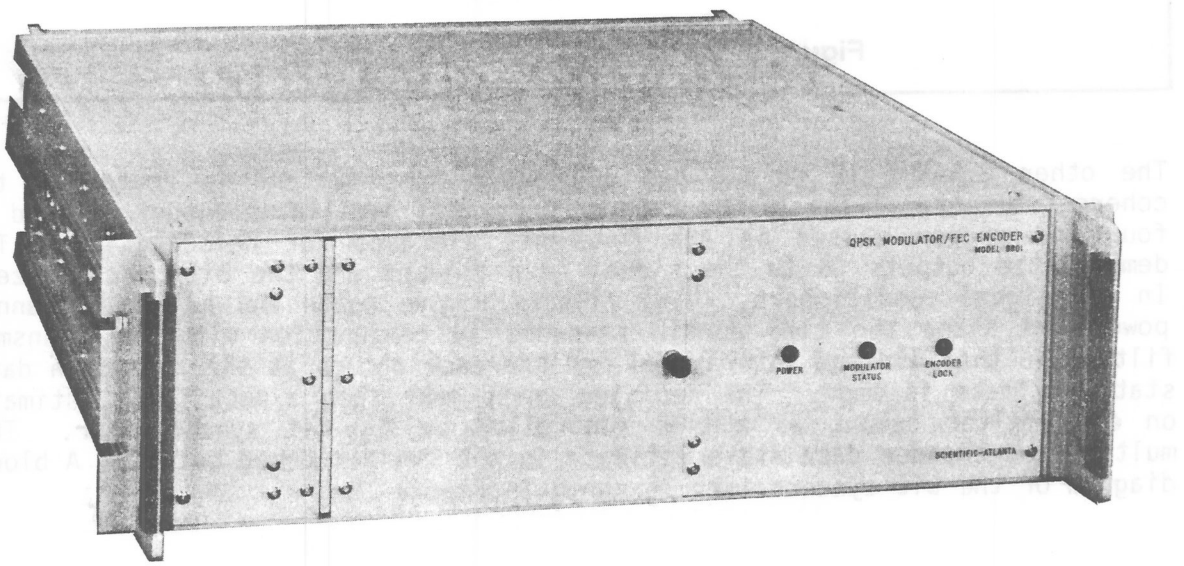


Figure 8. QPSK Modulator FEC Encoder

c. Alarms. The synthesizer extends any channel unit alarms after summary. The synthesizer alarms are:

- RX Synthesizer Phase-Lock Alarm
- TX Synthesizer Phase-Lock Alarm

d. DAMA Interface. The synthesizer interfaces with the DAMA system via the SAbus. In DAMA operation all of the functions already described may be controlled by the DAMA system. The synthesizer microprocessor carries out the DAMA commands and report successful accomplishment of all such commands.

Model 8331 Channel Unit Card Cage (Figure 25). The purpose of the Model 8331 Channel Unit Card Cage is to provide a housing and all necessary interconnecting circuitry for four channel units. Each channel unit consists of a Voice Processor, and FM Modem, and a Frequency Synthesizer. One extra slot, located on the extreme right-hand side, is provided to accept an additional module if required.

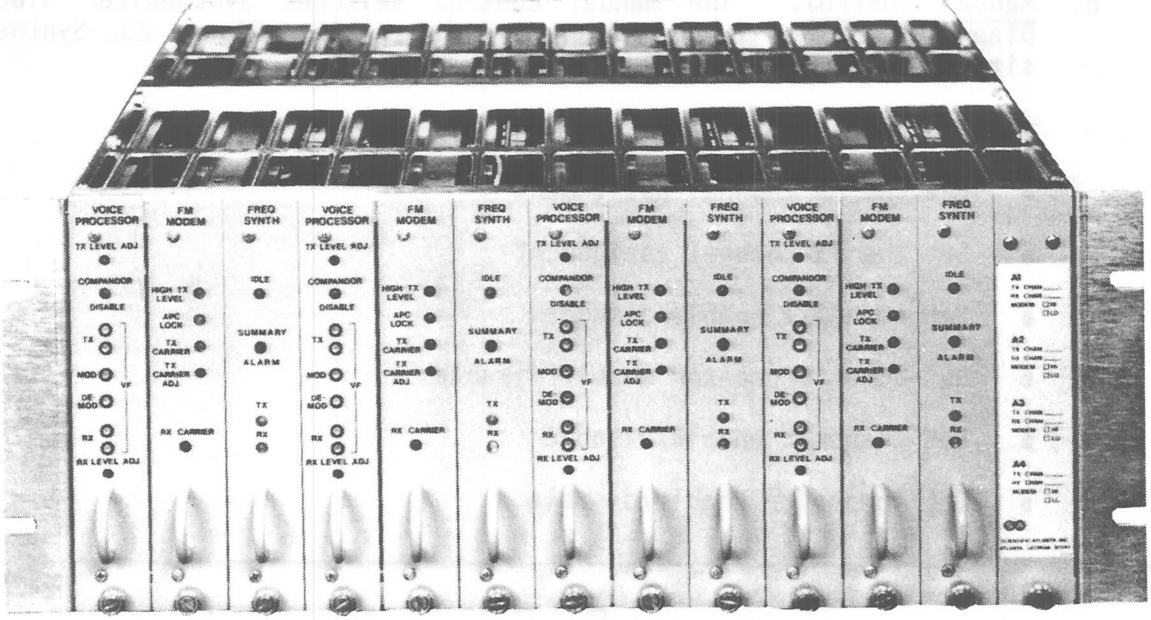


Figure 25. Channel Unit Shelf Assembly

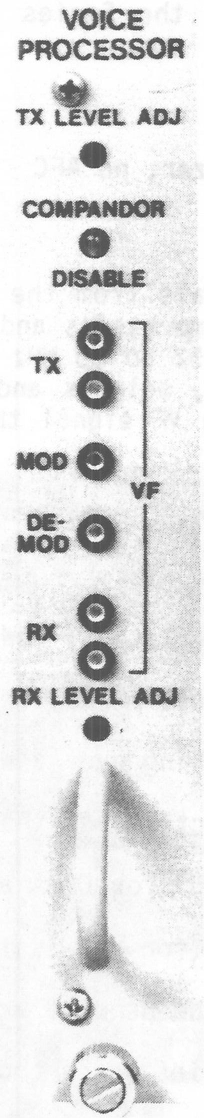


Figure 16. Voice Processor Controls, Indicator, and Monitoring Points

The voice processor features include:

- 2:1 companding (compatible with CCITT G162)
- Emphasis
- Choice of order for emphasis and companding
- Echo suppression

The Model 6650 Video Receiver

Kenneth C. Wunner

Introduction

The increased use of satellite earth stations by cable operators, broadcasters, hotel/motel operators, and many others, coupled with an increase in the number of subcarrier services per transponder, has created a need for a lower cost, more compact and better performing receiver system. The 6650 Video Receiver was designed to meet this need.

The major design objectives in developing the 6650 Receiver were fourfold. First, the receiver was to take advantage of block downconversion at the antenna. This would eliminate costly pressurized heliax runs and microwave components from the unit. Second, two receivers were to fit into a standard 19-inch rack, thus reducing the amount of space needed for mounting the units. Third, the video demodulator must perform well in the presence of multiple subcarrier signals. This would decrease the problem of reduced threshold performance on multiple subcarrier transponders. Fourth, the receiver must be of a high enough quality and reliability to meet all the demands placed upon it by Scientific-Atlanta's customers.

The 6650 Video Receiver (Figures 1 and 2) along with all of its options meets and/or exceeds these four objectives. The remainder of this paper will discuss the receiver in detail.

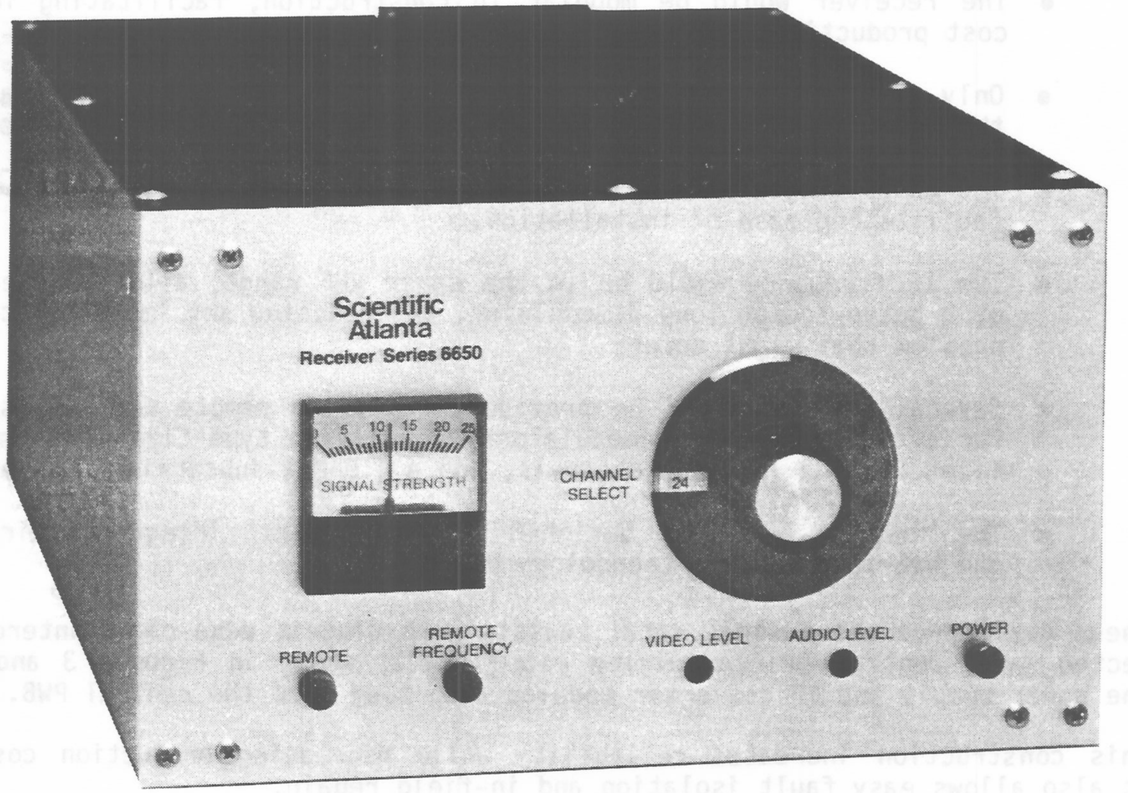


Figure 1. Model 6650 Video Receiver

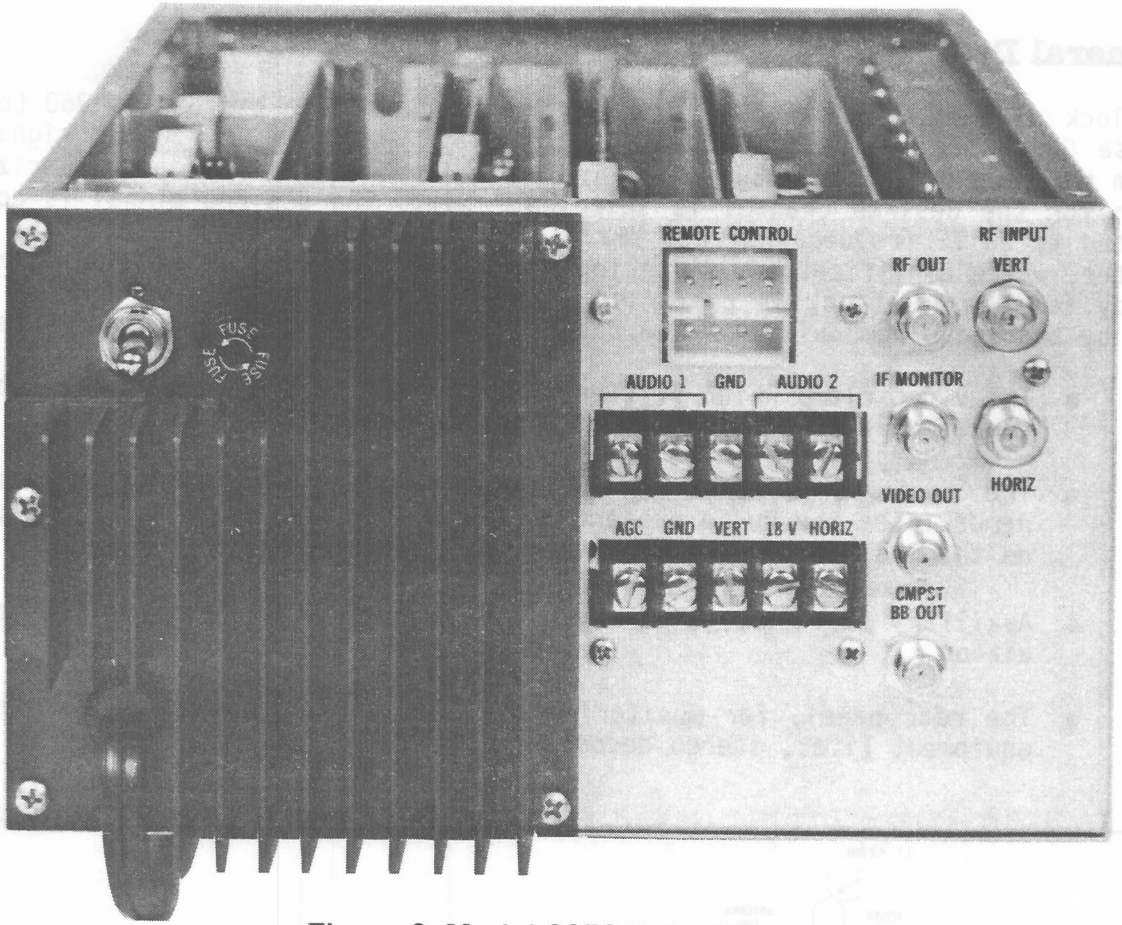


Figure 3. Model 6650 Video Receiver

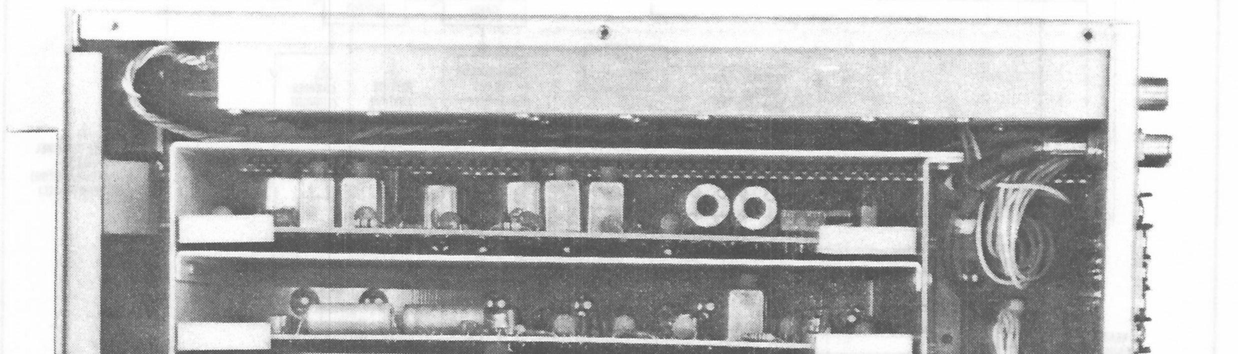


Figure 4. Model 6650 Video Receiver and its Card Cage

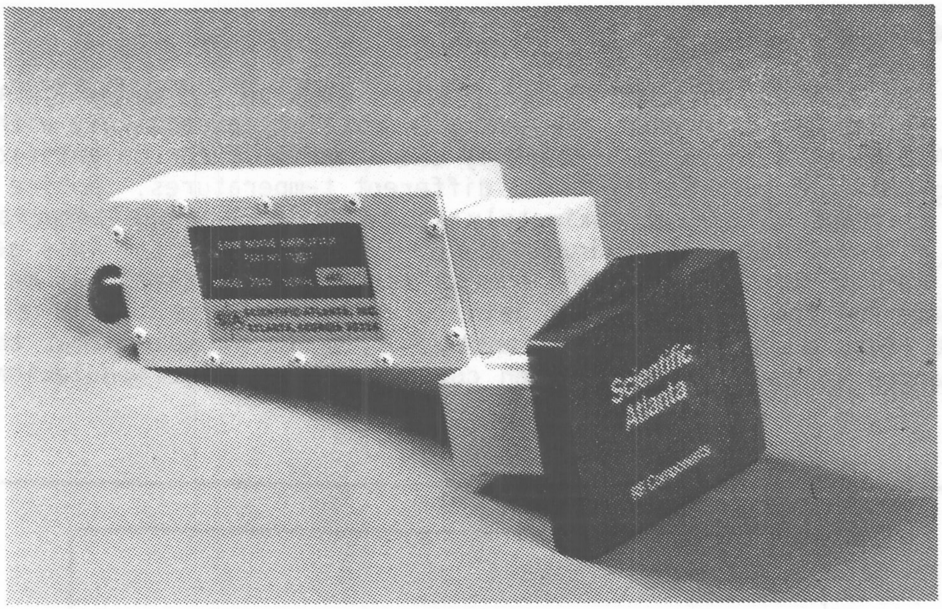


Figure 11. Scientific-Atlanta Production LNA

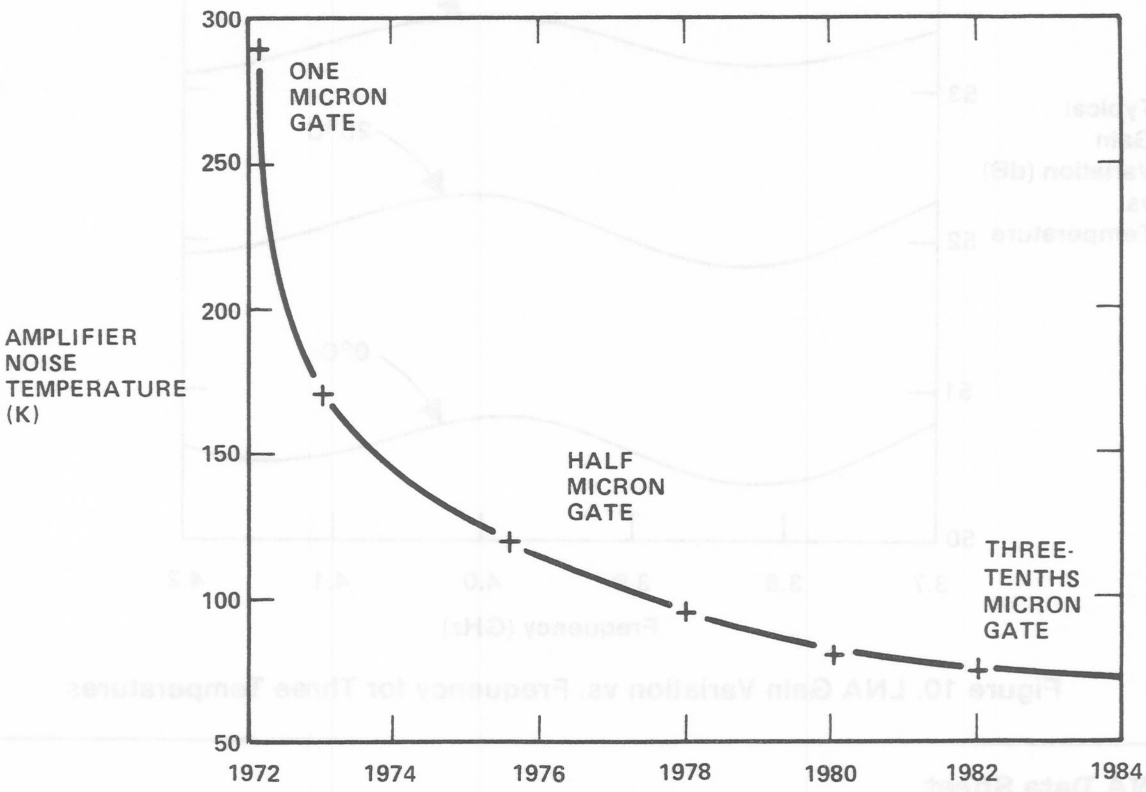


Figure 12. LNA Noise Temperature Vs. Time

55-A-4514

Clinometer-Bar Method

The surface conformity survey with clinometer bars is performed using a high-resolution, high-precision clinometer with a suitable quantity of especially fabricated bars of graduated lengths. Figure 16 illustrates the clinometer-bar method of surveying.

Figure 16. Measurement by Clinometer Bar

The selected bar is seated on the central pivoting fixture attached to the reflector hub, and the outboard contact is placed in contact with the reflector surface. After the clinometer is adjusted, the angle reading is recorded. The outdoor contact point is then rotated to a new angle Ø for the next reading. Six to twelve different bar lengths are usually employed to adequately cover the reflector surface.

Each bar is individually calibrated by a tilt adjustment on the clinometer seat, so that the clinometer reading accurately measures the inclination of the line from the contact point p to the center "O" of the cylindrical support.

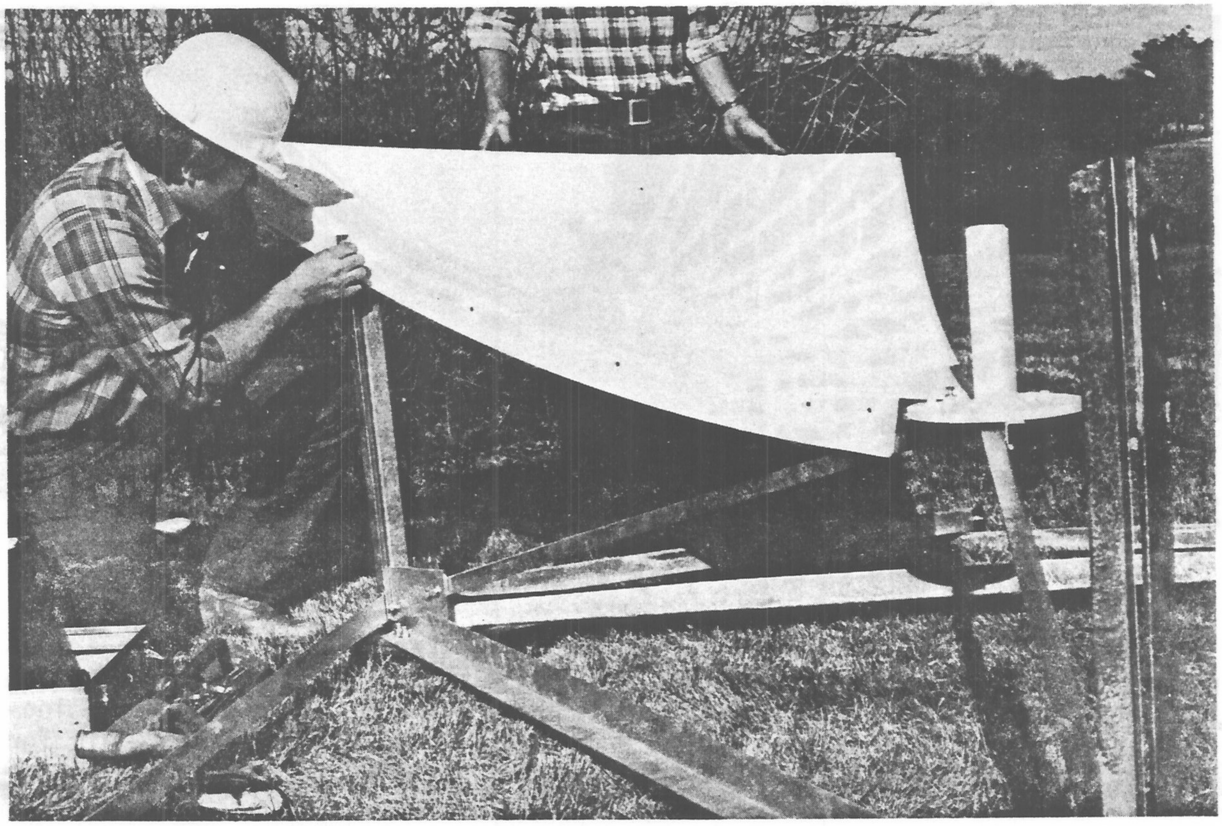


Figure 10. Stamped Panel

The radial truss and space frame are two approaches used by Scientific-Atlanta for making reflector backing structures. The radial truss system consists of precision-machined trusses attached to a machined central hub. The radial trusses are used when maximum stiffness and surface accuracy are desired (see Figure 11.) The trusses consist largely of lightweight tubular or H-section aluminum extrusions. Cover-plates reinforce the joints, and machined aluminum bar stock forms the terminal interface that will be bolted to the hub. All of these parts are clamped in a welding fixture to assure consistent dimensional control during welding. The welded trusses are allowed to cool for twenty-four hours to assure temperature equilibrium before machining.

The clinometer-bar system of measurement is different from most other systems in that the elevation angles are relative to a gravity-referenced horizontal plane. The reflector being measured is set approximately level before measurements begin. Reorientation of the gravity-based elevation angles to the reflector coordinate system is accomplished by the computer that is used to analyze the results.

Automated Surface Measuring System

The automated surface measuring system (ASMS) is designed to survey the surface deviations of an antenna reflector relative to a defined surface. Selected points on a reflector surface are surveyed by means of calibrated, adjustable-length arms attached to the turntable of a 19-bit encoder. The encoder is mounted on an axis of rotation that is approximately coincident with the reflector geometric axis (Figures 17 and 18).

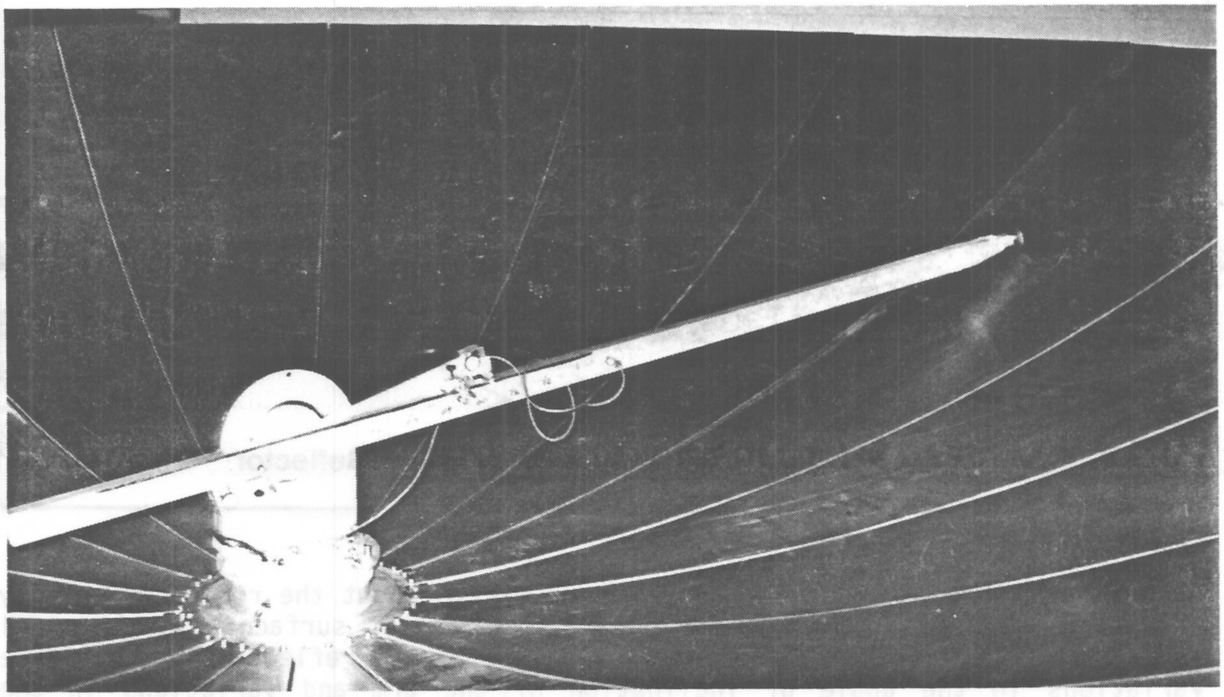


Figure 17. Automatic Surface Measurement System (ASMS) in a 7.7 Meter Reflector

Fabrication Methods

Scientific-Atlanta uses two methods for fabrication of panels for paraboloidal reflectors. Both methods result in precision panels which can be assembled without using special tools or instruments resulting in minimum installation time, guaranteed surface accuracy and interchangeability of parts in case of damage.

Panels used for reflectors which are about 7-1/2 meters or larger in diameter and are produced in limited volume are built up using sheet aluminum and custom-formed reinforcing sections. This method consists of dividing the panel surface into sections and fabricating aluminum panels for each section. These panel sections are placed face down on the panel fixture in their appropriate locations and held in position with clamps and weights. Radial and circumferential stiffeners are laid over the panels. The stiffeners are slotted approximately every two inches to allow them to conform to the panel sections. The stiffeners are then systematically welded and riveted to the panels and each other. Figure 8 shows a panel being assembled in the panel fixture. The permanent attachment of the panels and stiffeners results in a stiff structure which maintains its shape after removal from the panel fixture (see Figure 9). All required bolt holes are drilled in the panel parts using drill bushings that are accurately located in the panel fixture. After fabrication, each panel is carefully inspected using gauge bars with dial indicators to assure surface conformity.

Figure 8. Fabrication of Reflector Panel in Panel Fixture

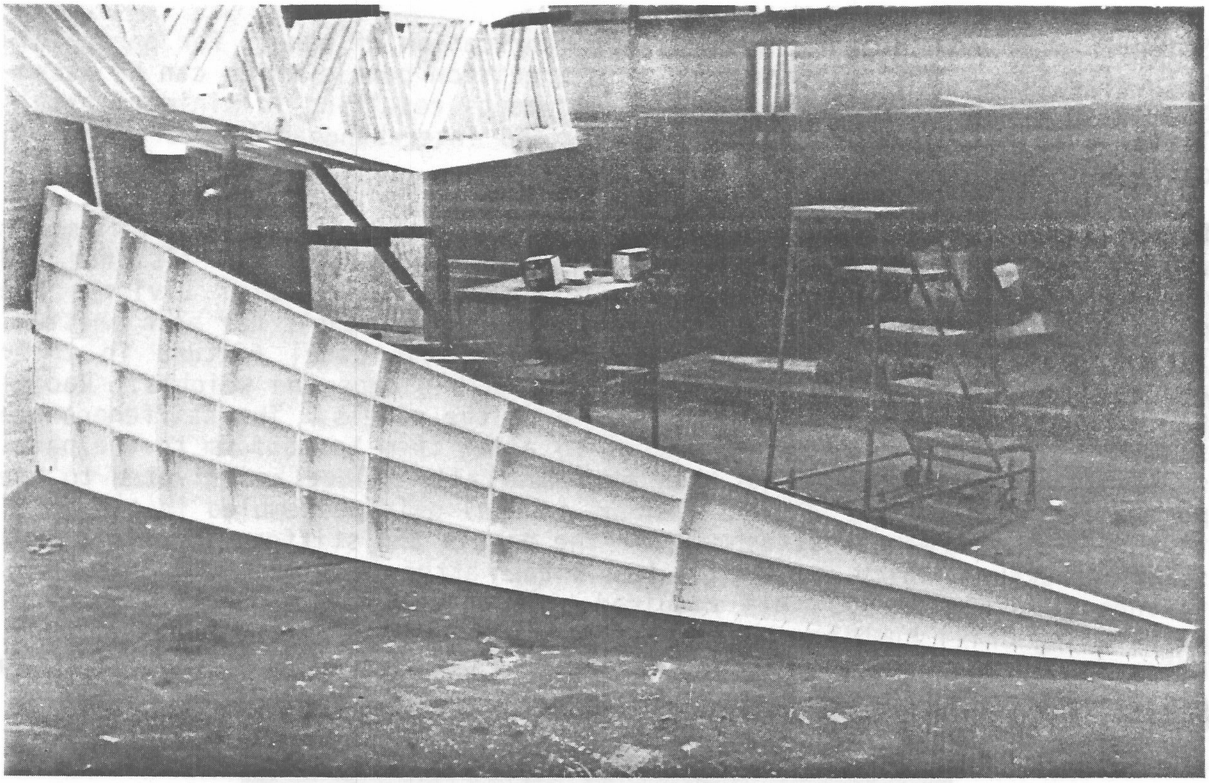


Figure 9. Fabricated Panel for 10-Meter Reflector

The panel fixture consists of radial and circumferential templates, which are assembled on massive tooled surfaces to maintain precision. The RF shape of the reflector is transformed by a computer into coordinates of the numerically-controlled machine which manufactures the template. Tooling holes are machined into the templates relative to the machined surface contour to facilitate accurate assembly. After assembly of the fixture, the surface is checked using optical measurement techniques.

The second fabrication method is to stamp the panels using matched dies. The application of this process to fabrication of reflector panels was developed by Scientific-Atlanta and has been used successfully on reflectors from three to seven meters in diameter. Reflectors with a surface accuracy of 0.015-inch rms have been assembled using stamped panels. The process consists of shearing a panel blank from aluminum sheet and then placing it between the matched forming dies. A single stroke of a giant press forms the concave reflector surface part of the panel, both side flanges and the outer edge flange.

Checking fixtures are used after stamping to verify surface accuracy. The formed panels are placed in drill jigs, which locate the precision attachment holes with respect to the panel surface (see Figure 10.)

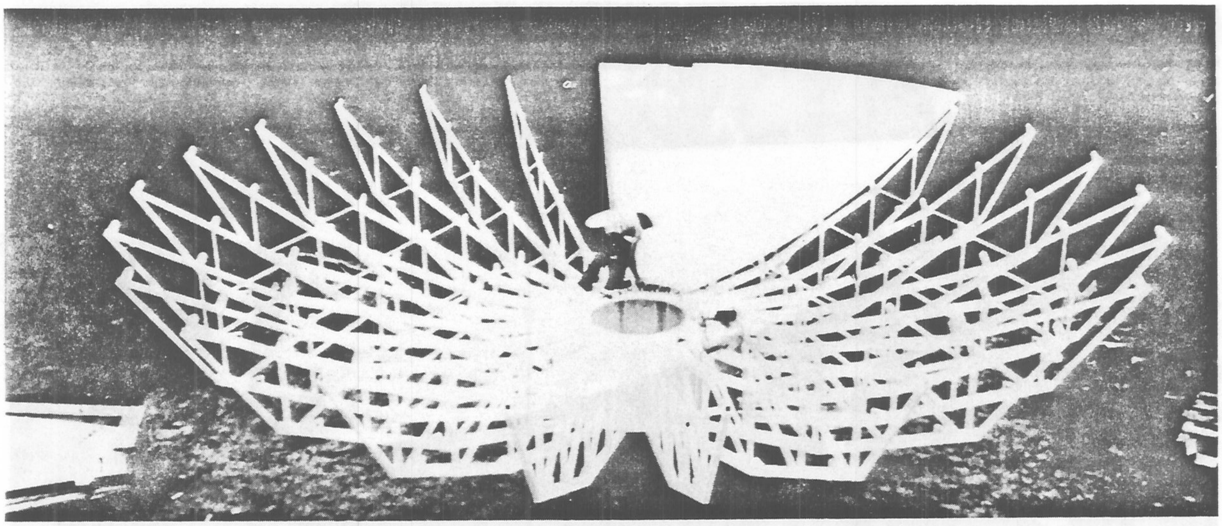


Figure 11. Hub and Truss Type Reflector Assembly

The truss-machining jig consists of a large steel table with precision-machined tooling points (see Figure 12). The welded truss is bolted by the hub pick-up points to the fixture, and the panel tab holes are precision-drilled. Each day a master truss is positioned in the jig to test it for accuracy.

Figure 12. Jig for Machining Trusses

The space-frame concept is based on the principle of interlocking tetrahedrons, with the geometry accurately controlled by the lengths of the three legs in each triangle. Precise effective lengths of the structural parts are maintained by accurate location of the close-tolerance holes. Accurate drill fixtures and hole-punching tools are employed for all operations.

This concept results in reflector backing structure nodes which are true within a few thousandths of an inch. Figure 13 illustrates a space-frame backing structure.

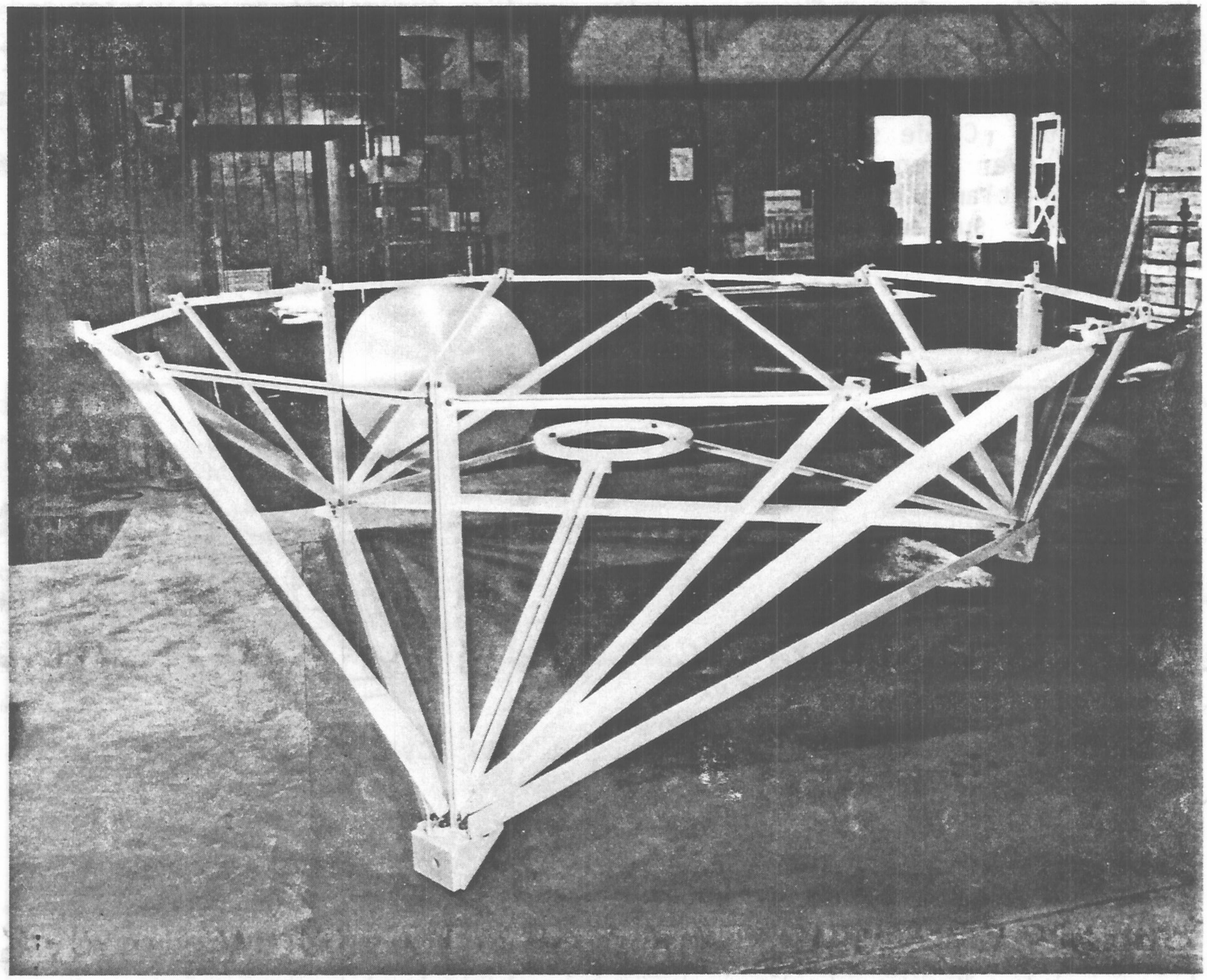


Figure 13. Space-Frame Structure for 4.6-Meter Reflector

Cable Television

Satellite broadcast to cable television systems is a classic example of a private enterprise system at its best. Equipment Manufacturers, program suppliers, satellite operators and CATV operators combined to bring significant strength to an industry that was otherwise rather stagnant.

The story goes as follows: In late 1972, Teleprompter Corporation became interested in using satellites to distribute television programs. They contracted with Scientific-Atlanta for a transportable earth station to be moved around the United States to demonstrate the excellence of TV distribution by satellite. This was successfully done. In 1975 a program supplier, Home Box Office (HBO), announced its intent to distribute programming by satellite. HBO signed an agreement with RCA, which in turn leased interim space on WESTAR I until its satellite was launched. Earth stations were purchased from Scientific-Atlanta by UA-Columbia and by ATC. Programming began on September 30, 1975, with the famous Ali-Frazer fight, the "Thrilla in Manila."

In 1976, HBO had about one-half million subscribers, with about one-eighth of these receiving the programs on 45 earth stations. HBO now has about 13 million subscribers on over 3,000 cable television systems, most of which use satellite earth stations for reception of the programming.

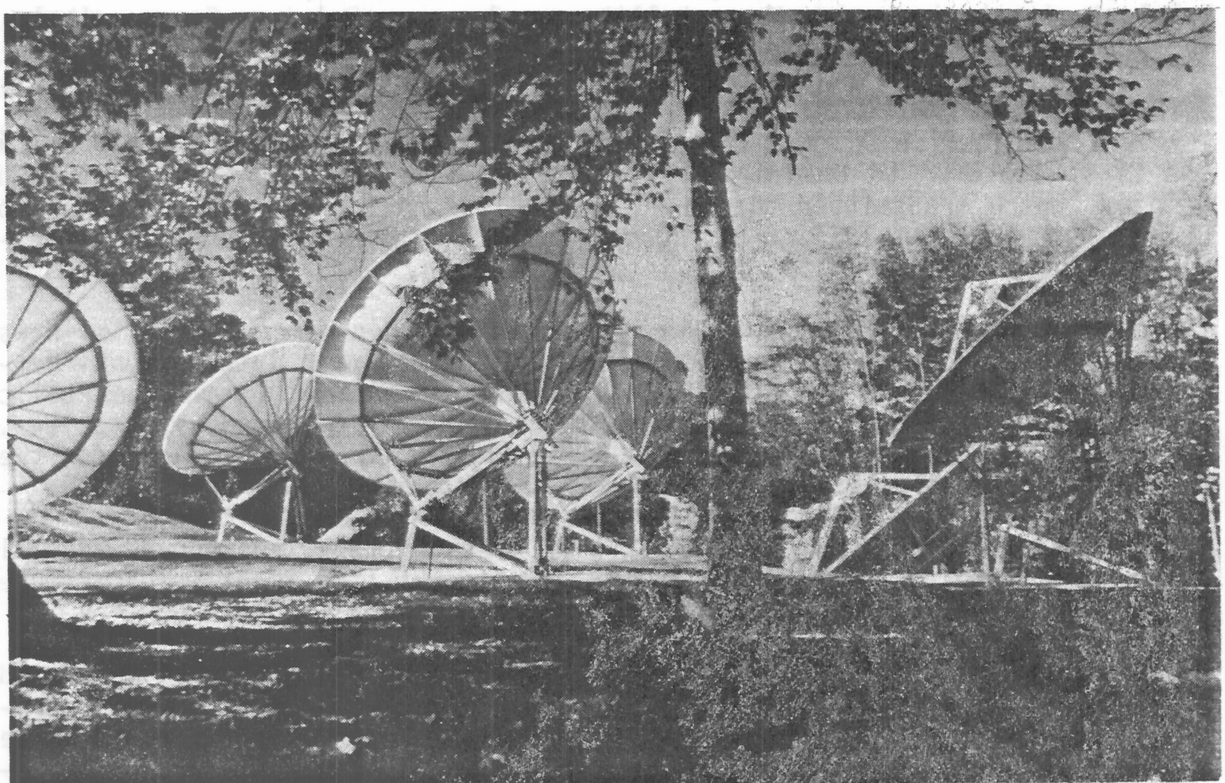


Figure 4. Cable News Network (CNN) Uses Multiple Earth Stations

When the C/N ratio at the discriminator is above the threshold level, there is a one-to-one ratio between video signal-to-noise power and IF carrier-to-noise power. As the IF C/N ratio passes through threshold, random noise peaks begin to cause the instantaneous envelope of the carrier-plus-noise voltage to pass through zero. When this occurs sudden phase excursions of the IF signal occur, which the discriminator interprets as being caused by large instantaneous frequency changes. This results in impulse noise spikes in the baseband signal, causing white-to-black and black-to-white streaks on the video display. The rate of occurrence increases as C/N decreases. As C/N decreases still further, loss of sync occurs, and the picture is lost. Satellite communications systems of other types, such as digital links, may or may not exhibit pronounced thresholds, depending on the demodulation process.

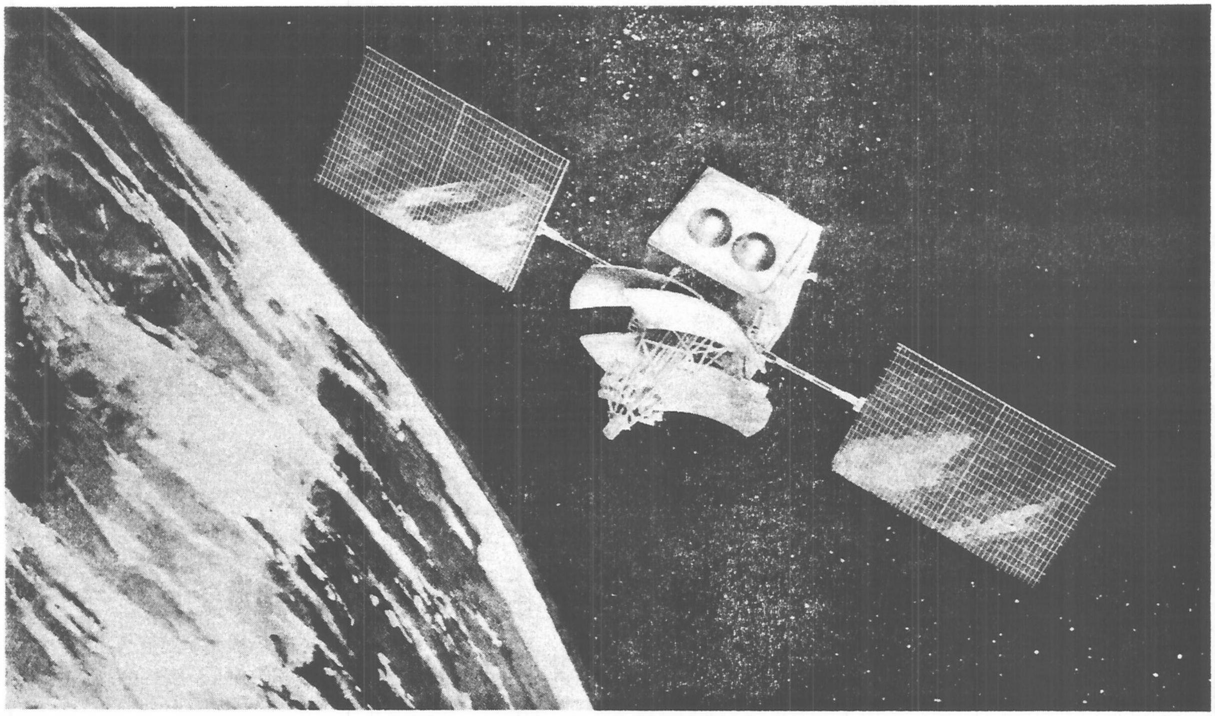


Figure 17. RCA Satcom Satellite

Satellites

The hypothetical satellite in our example was assumed to contain a single transponder for simplicity. As already stated, operational 6/4-GHz satellites in use over the U.S. have either 12 or 24 transponders.[6] They of course contain block converters, diplexers, and other circuits not shown in the simple satellite of Figure 8.

Figure 17 is a picture of an RCA SATCOM satellite, as an example, and Figure 18 is a transmit and receive frequency plan of its 24 transponders. The COMSTAR satellite also has 24 transponders, while the older generation WESTAR and ANIK satellites have 12 transponders. The 24 transponders in the newer satellites are made possible by the technique of frequency reuse, which is discussed in the next section.

Typical Multibeam Orbit Coverage

For a multibeam antenna to receive signals from the existing U.S. domestic satellites, a field of view of 30° is necessary. Within the orbital arc of 86° W to 136° W are eleven domestic satellites operating in the 6/4-GHz frequency band. These include the three Canadian ANIK satellites. Figure 16 shows the azimuth and elevation look angles to these satellites from a typical site in the Southeastern United States. For the multibeam configurations, the mutiple feeds would have to be placed on a scan axis such that the resultant beams are pointed to these azimuth and elevation coordinates. It is obvious that the feeds would necessarily be mounted at considerable height above the ground to traverse the required arc for the spherical reflector. For the torus antenna the offset reflector and the feed would be tilted with respect to the earth such that the feeds can traverse the required arc. The offset Cassegrain's reflector, subreflector and feed scan arc would also be tilted with respect to the earth to provide the desired arc coverage.

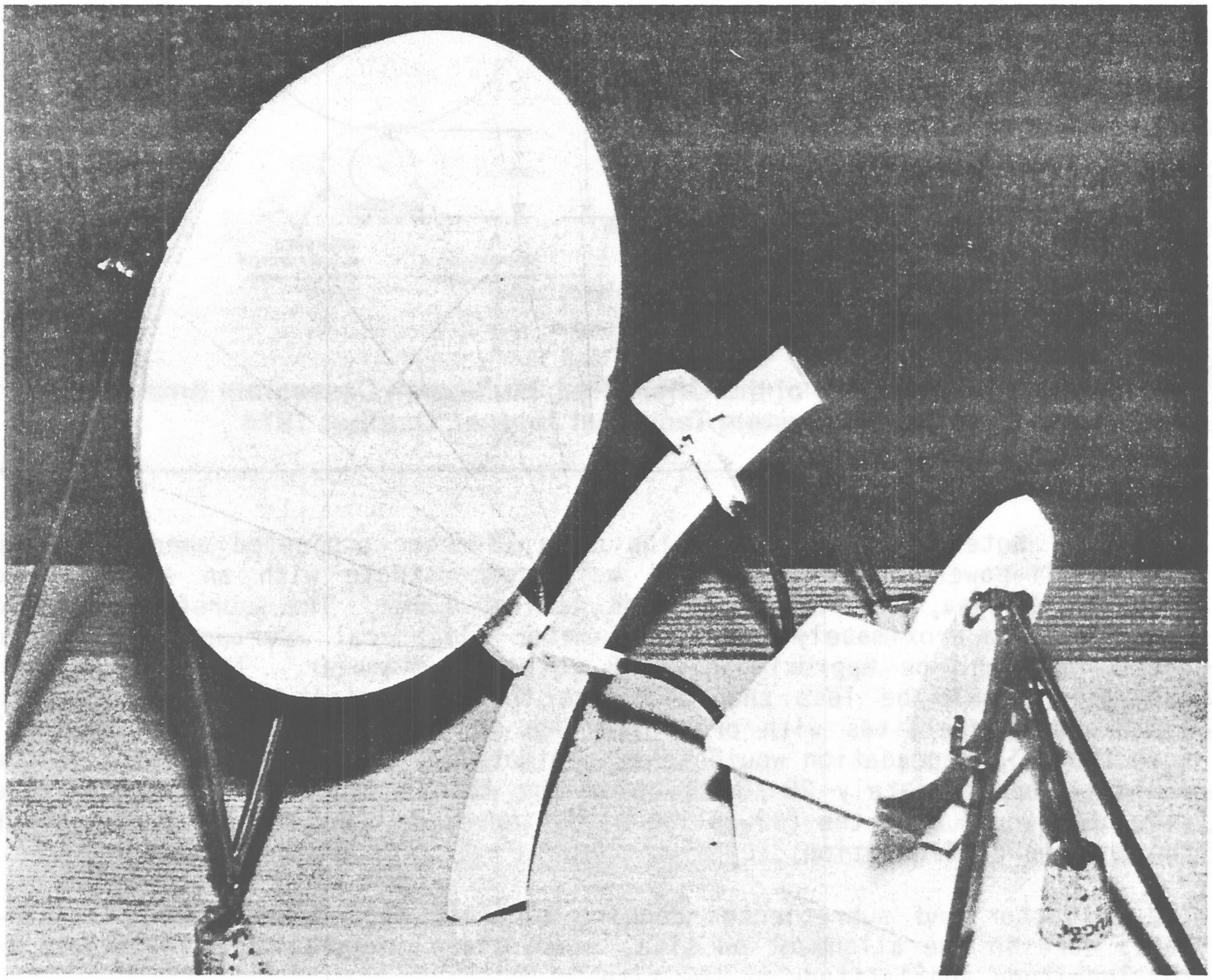


Figure 15. Model of Offset-Fed, Multibeam Cassegrain Antenna Configuration

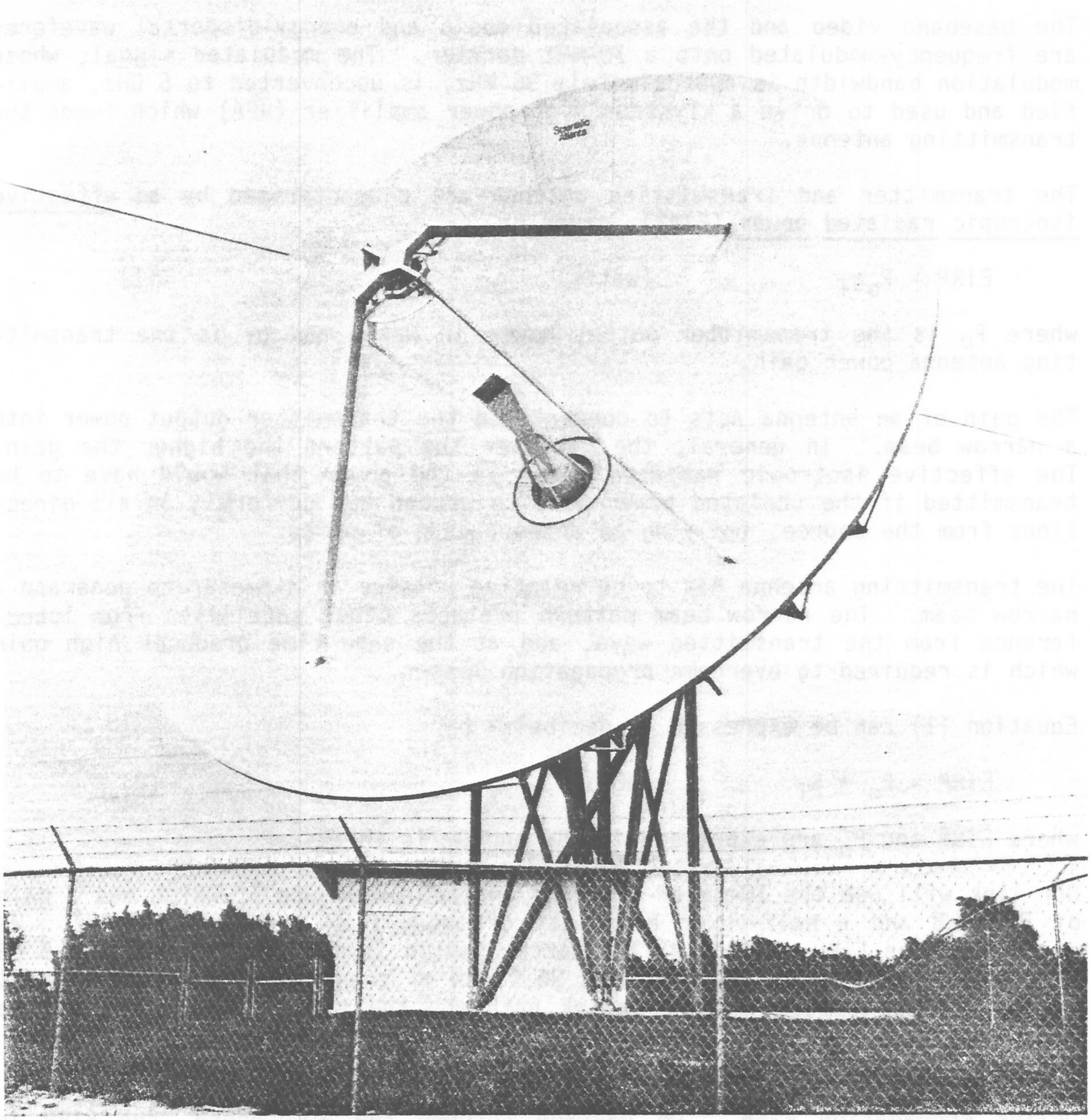


Figure 5. Scientific-Atlanta Earth Station Using 10-Meter-Diameter Antenna

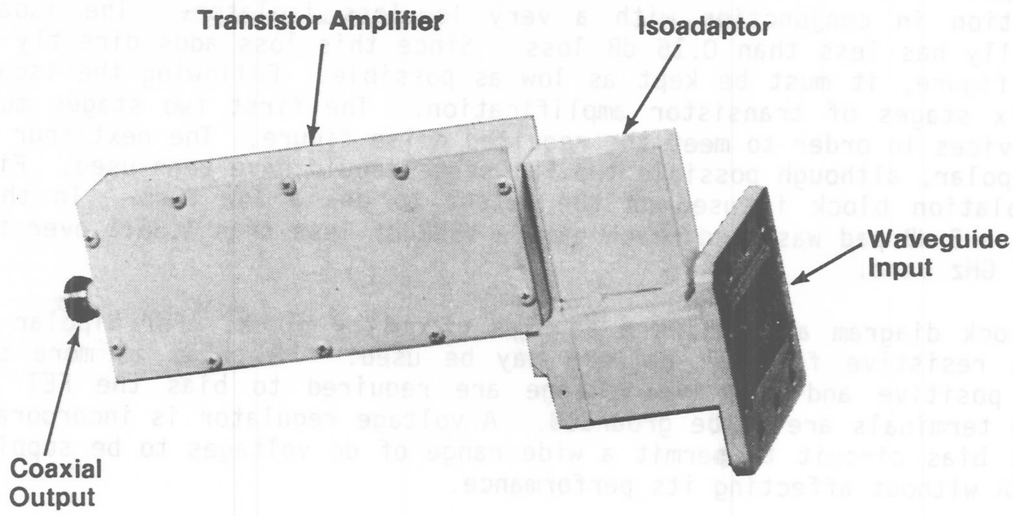


Figure 1. Photograph of Scientific-Atlanta Series 300 LNA

LNA BLOCK DIAGRAM

To show what are the component parts of a typical LNA, consider the block diagram of Figure 2.

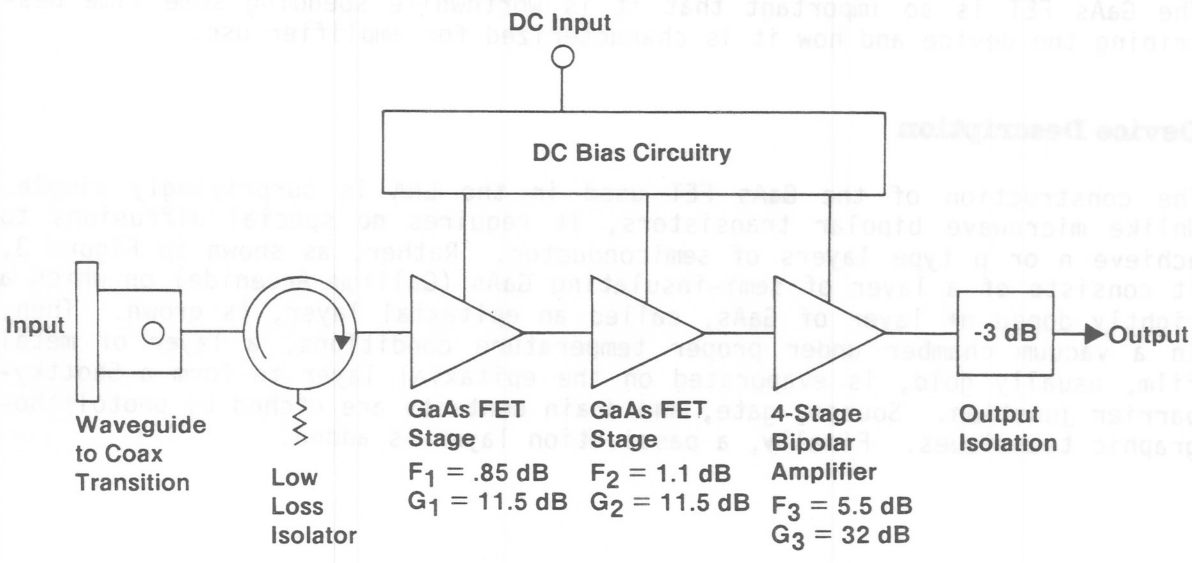


Figure 2. LNA Block Diagram

Alaskan Satellite Communications

Alaska is an ideal region for satellite communications. With the snow, ice, mountains and large territory, it is much easier to install satellite earth stations than to install repeater stations. Before satellites were available, HF radio provided the only communication, which was often unreliable due to frequent auroral disturbances. One use for satellite communications was planned in 1972 to provide voice and data communications for the Alaskan pipeline. The communication system was designed to be the world's most reliable, with a back-bone system of line-of-sight microwave and a satellite backup system. Ten-meter earth stations were installed in Valdez, Prudhoe Bay, and Fairbanks by RCA Alaska Communications to complement a 30-meter earth station near Anchorage which had been taken over from Intelsat. The communication system has indeed become as reliable as planned.

An issue continually facing Alaska is the health and education of the people living in remote areas. Experiments were conducted in the early 1970's using ATS-1 and ATS-6 satellites for reaching the remote areas. In 1975, the State of Alaska appropriated funds for the purchase of 100 small 4.5-meter earth stations to serve 100 remote villages, using one of the new domestic satellite systems. Alaska now receives telephone and television service using the small earth stations in the remote villages and a number of 10-meter earth stations in the larger communities. Live television from the contiguous U.S. (CONUS) is transmitted to the large communities, using two television signals on one satellite transponder. Other services are offered, including instructional television, teleconferencing, facsimile and computer data transmission. Alaska has one of the largest SCPC voice networks in the world. Alaska now has its own satellite, AURORA (SATCOM V), located at 143°W.

Figure 3. Alaskan Earth Station

Figure 2. 10-Meter Antenna

Earth Station Antennas

One of the major advantages of using geostationary satellites is the simplicity of the earth stations which are used with them. An earth station has to have a relatively narrow beam to let it pick out a particular satellite and to increase its effectiveness in transmission and/or reception of signals. Since the satellite appears stationary, the complex electronics and drive mechanisms are eliminated which would be required to keep the beam on a moving satellite.

A number of different types and sizes of earth-station antennas are used in satellite communications depending on the application. High information capacity and high-quality link performance tend to demand larger antennas. The largest antennas routinely used in satellite communications are 30 meters in diameter. These are used in INTELSAT A stations and in certain extremely high performance domestic systems. The antenna shown in Figure 9 is 10 meters in diameter.

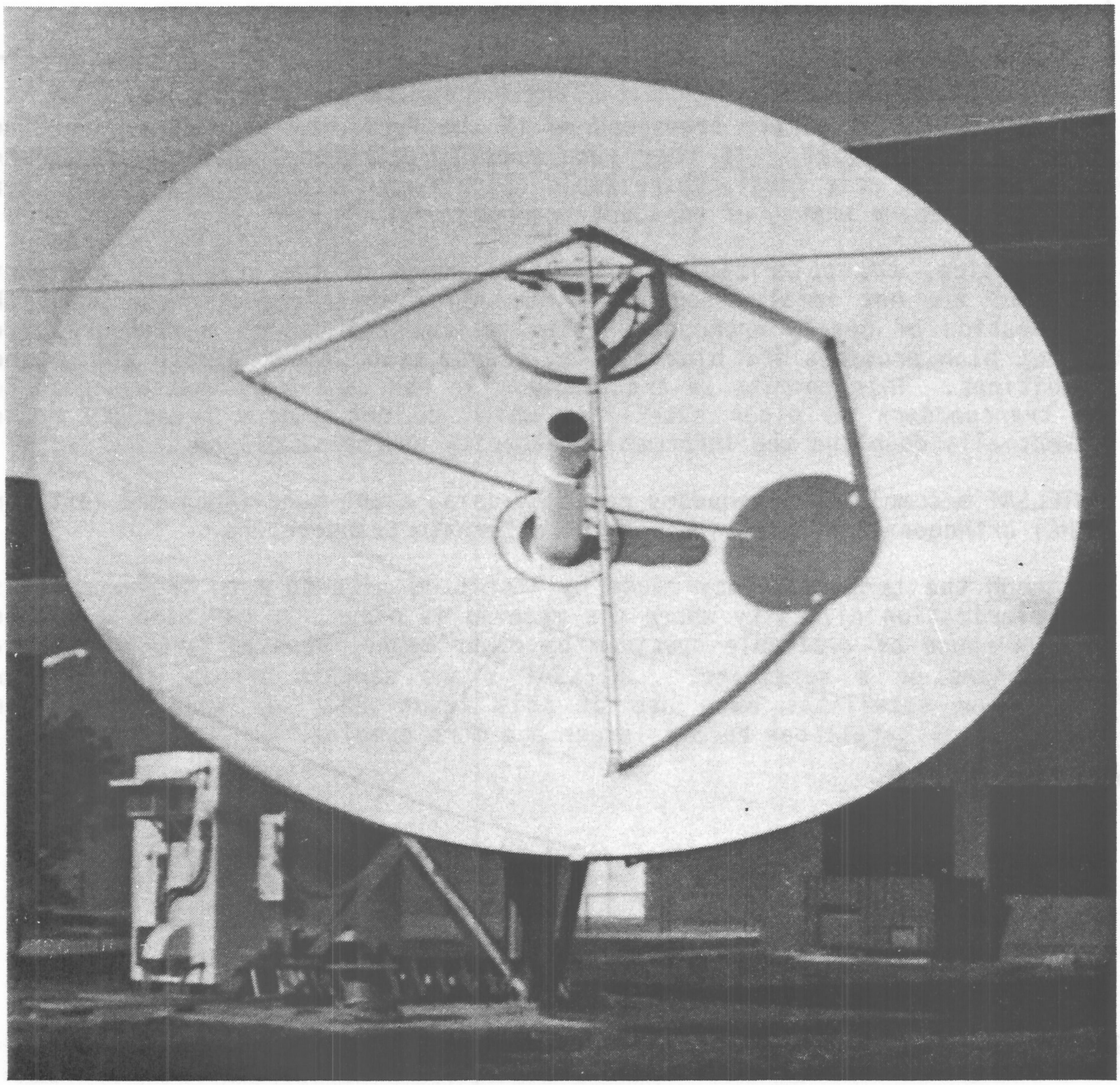


Figure 9. 10-Meter Antenna

- Data over voice option
- Linear limiting
- Voice-operated carrier control switch (VOX)

The voice processor is composed of a motherboard, an audio delay board, a receive rectifier and holdover board, and an optional data-over-voice board. (Figure 17).

The printed wiring boards plug into a receptacle on the backplane board at the rear of the channel unit shelf assembly.

The echo suppression option is implemented with the addition of the receive rectifier and holdover board and some components on the motherboard. These components include the level comparator, certain logic components, and those components necessary to implement the 6 dB receive echo suppression pad.

The emphasis and companding circuits can be strapped in any order, as desired. The emphasis, then, can precede or succeed the companding function.

No manipulation of controls is required for the voice processor during normal operation. If a change in RX or TX interface level is required, the 0 dBm0 level for these interfaces can be adjusted by means of the TX LEVEL ADJ and RX LEVEL ADJ controls on the front panel, refer to Photo No. 10103. The 0 dBm0 level for the transmit interface is variable from 0 to -16 dBm. For the receive signal interface, 0 dBm0 is variable from 0 to +10 dBm.

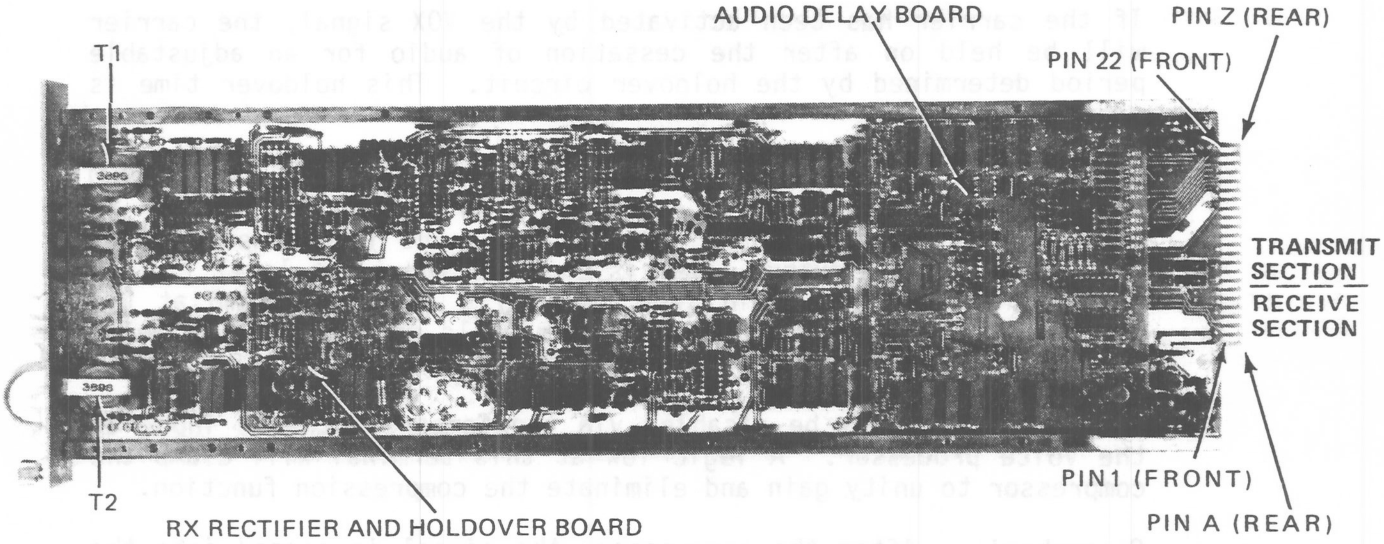


Figure 17. Model 8324 Voice Processor—Interior

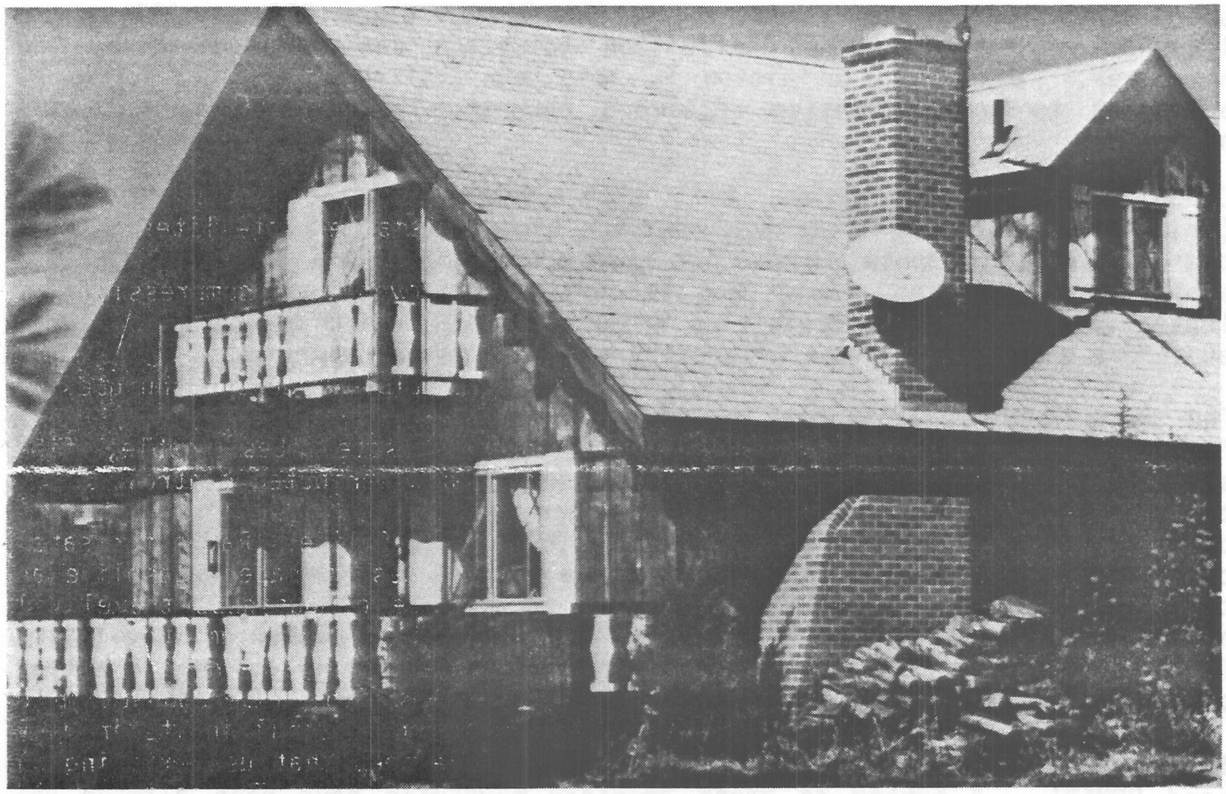


Figure 10. DBS Terminal (Photo courtesy Satellite Television Corporation)

Conclusion

The satellites to be launched in the next few years are reasonably well defined now. The principal improvements will be higher power TWTs, new antenna designs, switching flexibility and higher frequencies.

The push to higher frequencies will avoid the current terrestrial interference problem, making earth stations in the cities more practical. High frequency satellites also favor high power satellites because of a lack of interference with terrestrial microwave. The main disadvantage of the higher frequencies is susceptibility to rain outage. Techniques such as "diversity," the use of alternate transmission paths, or reduction of the data rate may be used to circumvent this problem.

In the more distant future, a number of technological advances will permit growth and performance improvement in satellite communications.

- High-gain, multiple-beam antennas for the satellite
- Very efficient, lightweight solar arrays
- High-power, Solid-state transponders
- Improved satellite battery life
- Satellite beam switching

Maritime Satellite Communications

Until the MARISAT system was initiated in 1976, radio communications with ships was in a primitive state, basically suffering from low capacity and poor reliability of conventional radio at the VLF, LF and HF bands. The MARISAT system opened a new era in communications by providing high-quality, highly reliable voice, data, facsimile and teleprinter service to ships at sea. The service is as simple to operate as ordinary telephone and telex and avoids the multiple hours that highly trained operators have to spend on the ship and on shore for a normal telegraph message. The system, now called INMARSAT, has revolutionized maritime communications and has enhanced the safety of ocean travel.

The INMARSAT commercial system consists of satellites over the Atlantic, Pacific and Indian Oceans and earth stations located on the coasts. Communication between the shore stations and the satellite is in the 4/6-GHz band. Communication between the ships and the satellite is in the 1.4/1.6-GHz region. The shipboard units are stabilized to keep the antennas pointed toward the satellite in the presence of roll, pitch and yaw motions of the ships.

Today there are over 1,900 INMARSAT terminals in operation on ships and offshore drilling rigs. The number of users is expected to exceed 10,000 by the mid-1990's.

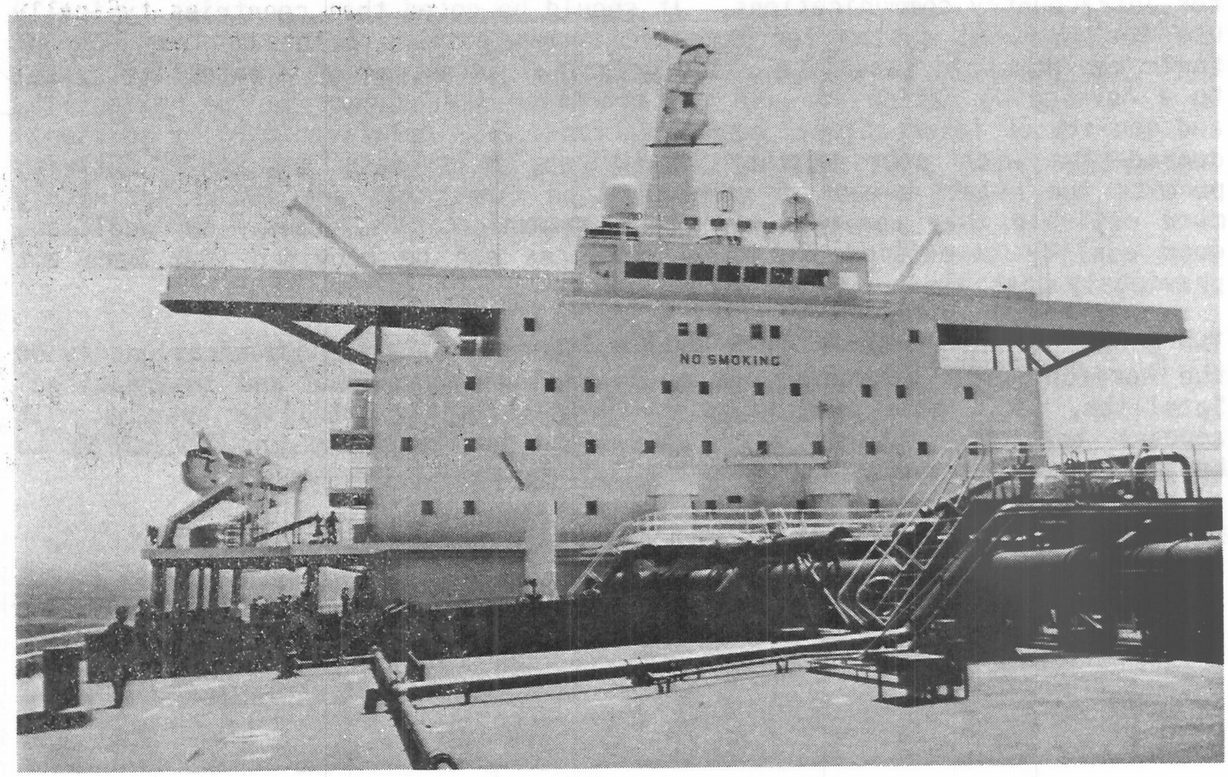


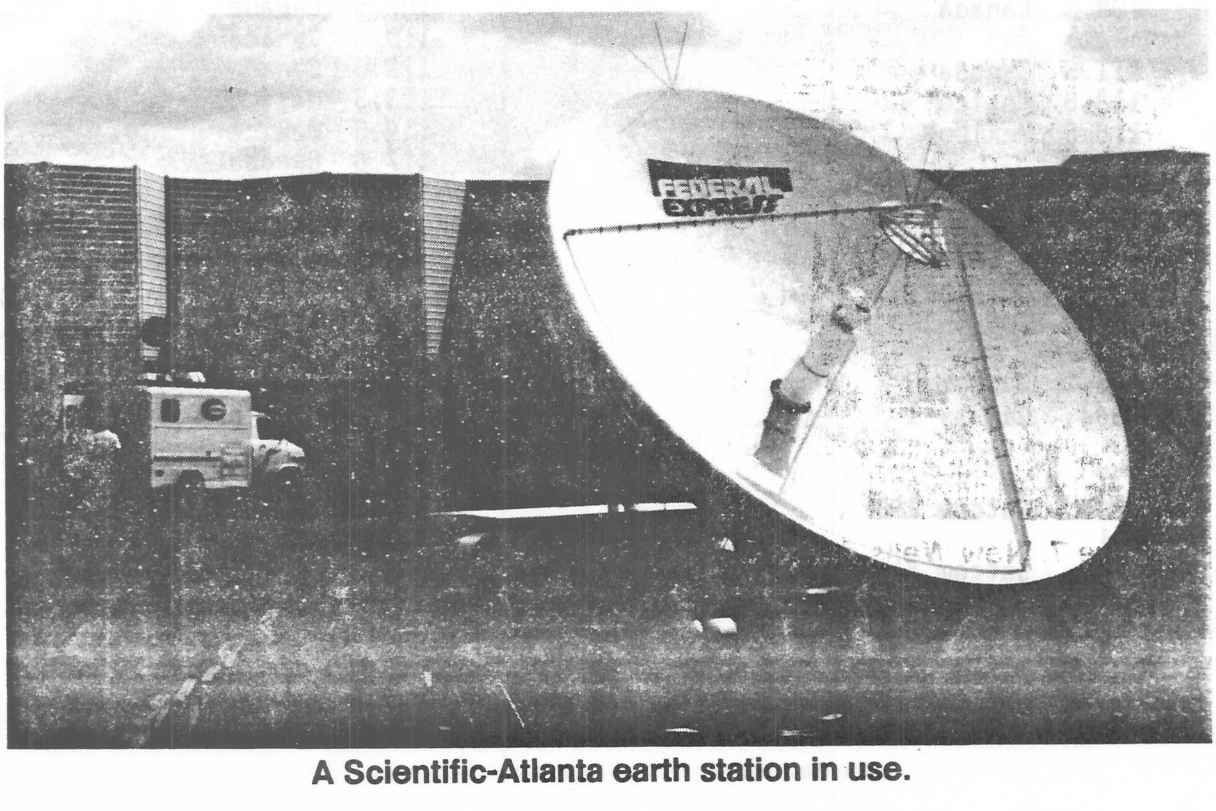
Figure 2. Twin MARISAT Antennas for Ship-to-Shore Communications via Satellite

Future Directions

The lack of available orbital positions for new satellites serving the United States and the demand for new voice, data, and video services have caused the FCC to adopt closer satellite spacing. The FCC will immediately implement uniform 2° orbital spacings for newly launched 12/14 GHz satellites. The current U.S. satellites in orbit using 12/14 GHz (Ku-band) are SBS1, SBS2, and SBS3 located at 100°W, 97°W, and 94°W, respectively. These satellites will be moved to 99°W, 97°W, and 95°W to accommodate new Ku-band satellites as shown in Table 1.

The costs and difficulties of immediately implementing 2° spacings at 4/6 GHz (C-band) have caused the FCC to adopt an interim spacing plan providing a combination of 3°, 2.5°, and 2° orbital spacing. Never-the-less, 2° was adopted as the long-term orbital spacing for C-band. The assigned orbit positions and the satellites expected to occupy these positions are shown in Table 1 for both C- and Ku-bands. It is noted that for C-band, 2° spacing is used in the eastern and far western part of the arc, 2.5° in the middle of the arc, and 3° in the western part of the arc. Note that Satcom 3-R which has more earth stations pointing toward it than any other satellite, does not have to relocate to accommodate the new satellites in the interim spacing plan.

From Table 1 it is seen that only nine C-band slots are unassigned and only 16 Ku-band slots are unassigned from 55°W to 143°W. The number of new satellite applicants is expected to greatly exceed the available orbital slots. Already in line for the remaining slots are CableSat General (3 satellites), Ford Aerospace (3), GTE (2), and Hughes (4), National Exchange (5), SBS (1), and Western Union (5). The FCC is expected to have to decide from among the many applicants who will receive the new orbital slots, something that it has sought to avoid.



A Scientific-Atlanta earth station in use.

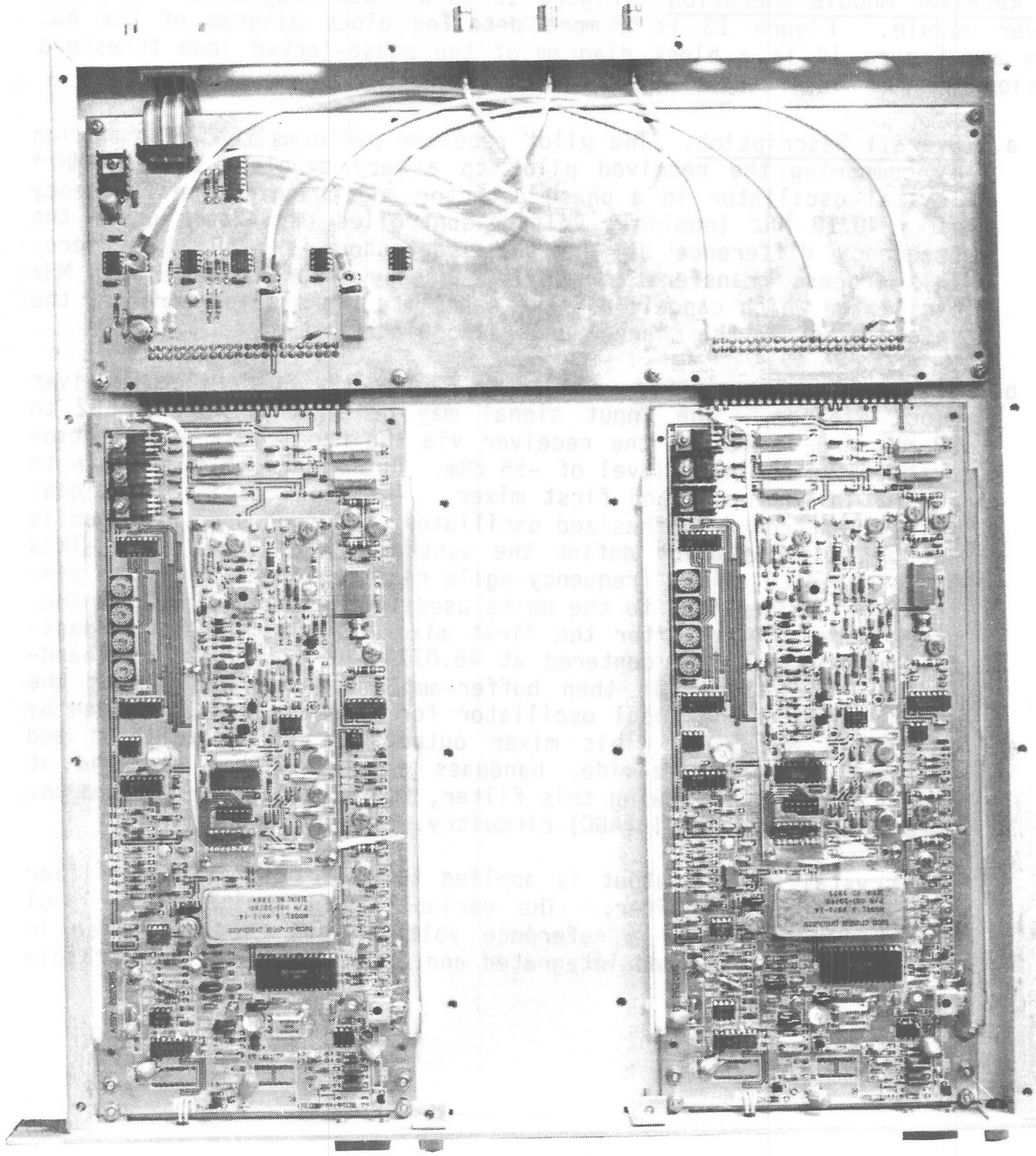


Figure 11. Top View of the Complete Pilot Receive System

In 1980 SBS, started implementing an extensive digital time-division-multiple-access (TDMA) system for transmitting voice, data, and image. The seven-billion-dollar intracompany business communications market is SBS's principal target. SBS offers complete voice, data, electronic mail, and teleconferencing services to large corporations. The earth stations operate in the 12/14-GHz frequency band so that they can be located in cities without frequency interference problems. The terminals are small (5.5-meter and 7.7-meter antennas) and can be located on customer premises.

The need of insurance companies to share data has stimulated the formation of a resale common carrier of SBS service. ISACOMM, which is majority owned by United Telecommunications, is selling communications services to smaller users, initially in the insurance industry. ISACOMM stated service through earth stations in Wausau, Wisconsin, and St. Louis, Missouri, in early 1981. The company anticipates a total network of 40 earth stations by 1984.

Telecommunications from shared earth stations can be distributed locally through cable that is being laid by the CATV system operators in the United States. New CATV operators are installing two-way business cables in addition to home entertainment cables. The new cables offer over 400 MHz of available communications capacity.

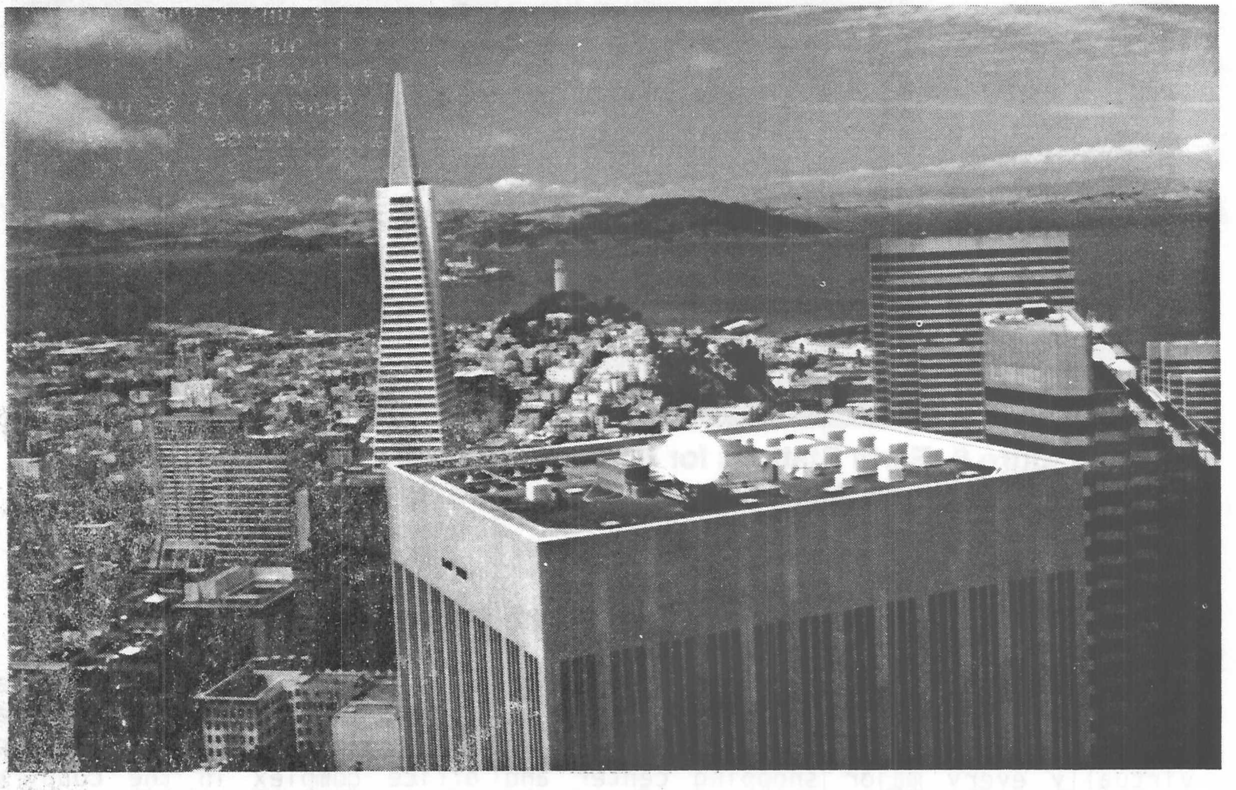


Figure 7. New Wells Fargo Bank in San Francisco Using SBS Earth Terminal

Radio broadcast programming is being distributed by satellite. Mutual Broadcasting System and National Public Radio have satellite distribution systems. The ABC, CBS, NBC and RKO radio networks have selected Scientific-Atlanta digital audio earth stations for distribution of programs to their affiliates. The digital service offers superior audio signal-to-noise, dynamic-range, distortion and crosstalk quality. Up to twenty 15-kHz audio channels can be transmitted through one transponder and received by inexpensive 2.8-meter earth stations. Over 1,500 earth stations have been installed by the end of 1983 in this program. The number of earth stations in use by radio broadcasters will probably exceed 5,000 by 1985.

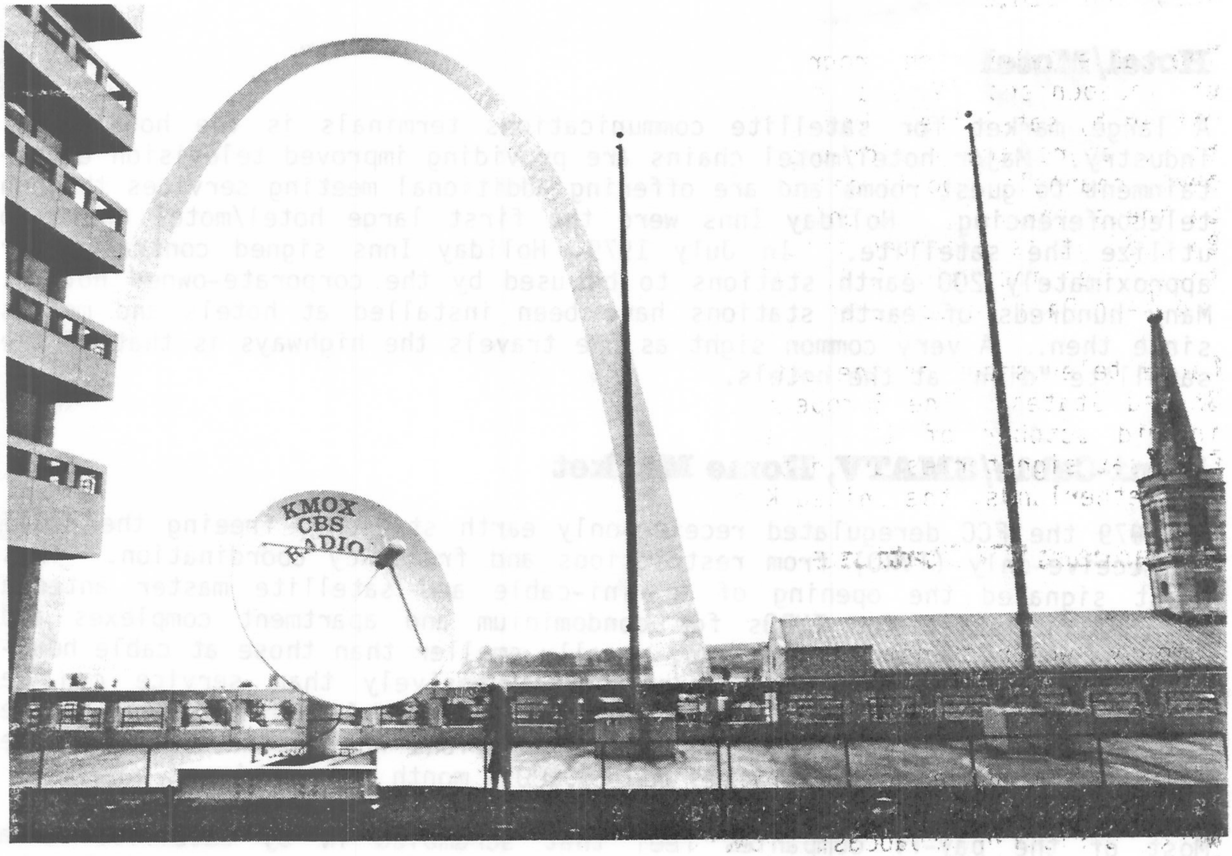


Figure 5. Digital Audio Earth Station

Low Noise Amplifier (LNA)

The low-noise amplifier, in conjunction with the antenna, determines the G/T or figure-of-merit of the station. A higher G/T requires less satellite power for given performance characteristics. The quality of a low-noise amplifier is a function of its noise temperature; the lower--the better. Two types of low-noise amplifiers are utilized--the parametric amplifier and GaAs FET amplifier in Figure 3.

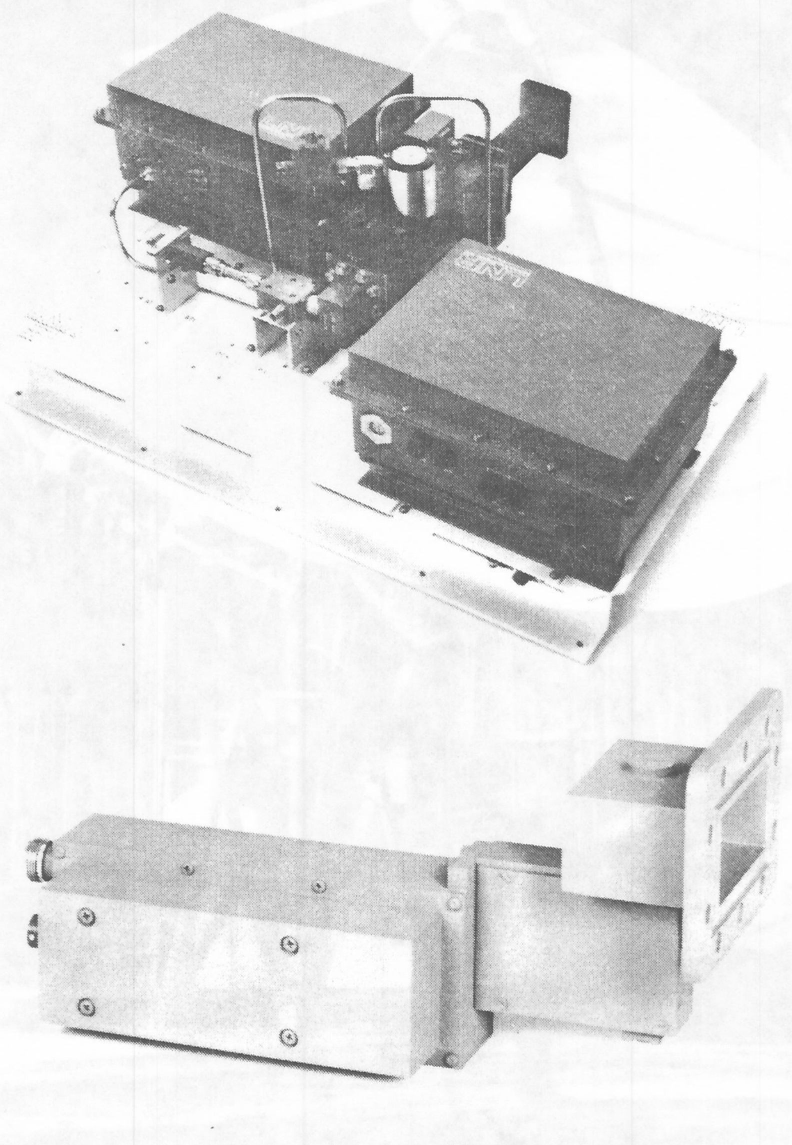


Figure 3. GaAs FET and Parametric Amplifier

Parametric amplifier noise temperatures range from 30K to 70K. The GaAs FET family of amplifiers range in temperature of 80 to 120K. A parametric amplifier is approximately ten times more expensive than the GaAs FET. Thus, the FET is the most common amplifier used with digital terminals.

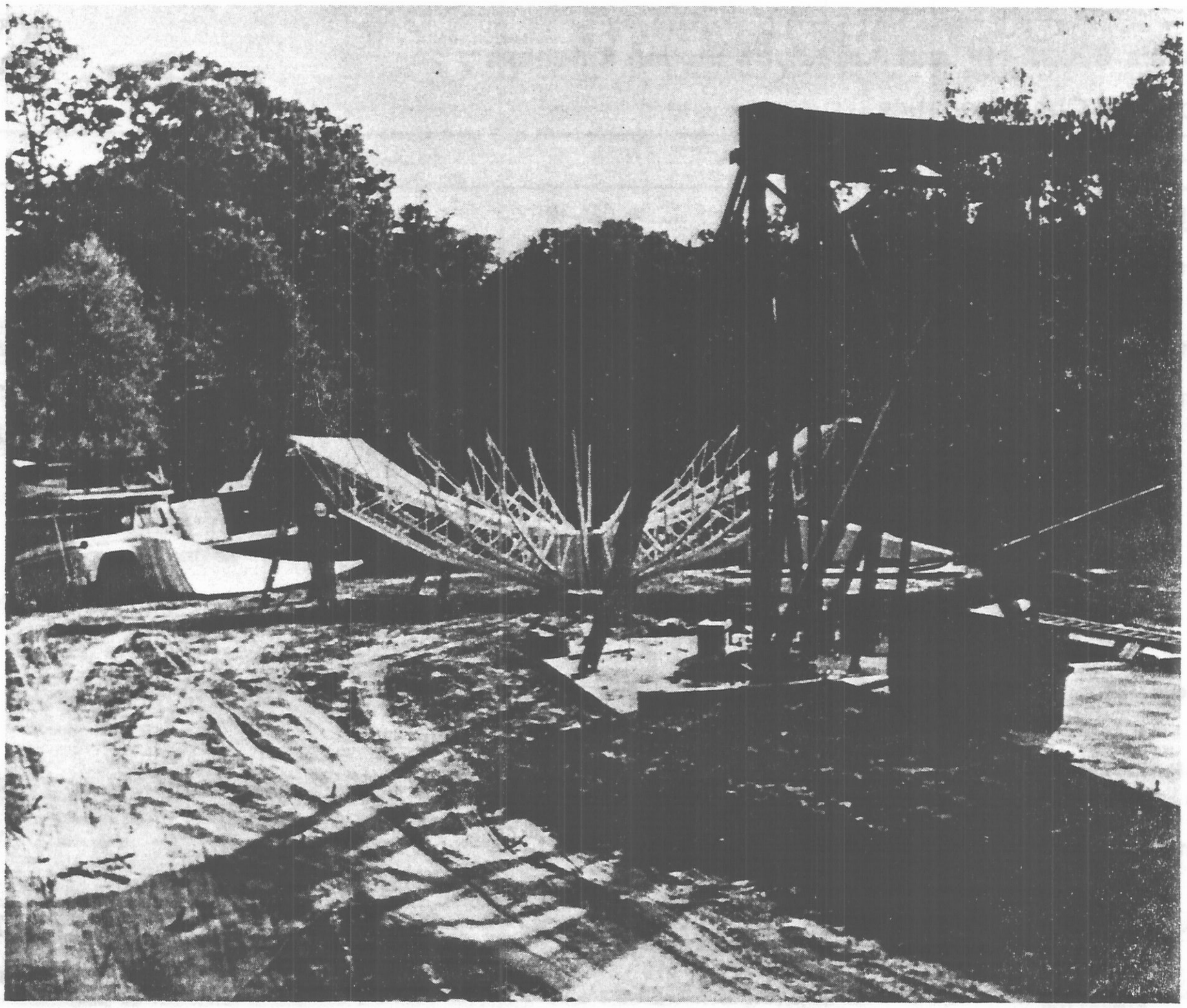


Figure 11. Installation of Series 8000 Earth Terminal Mount

Industry Standards

The antenna systems were designed to meet or exceed the following industry standards:

American National Standards Institute	A58.1
American National Standards Institute	A95.1
Electronic Industries Association	RS-195-B
American Institute of Steel Construction	
The Aluminum Association	

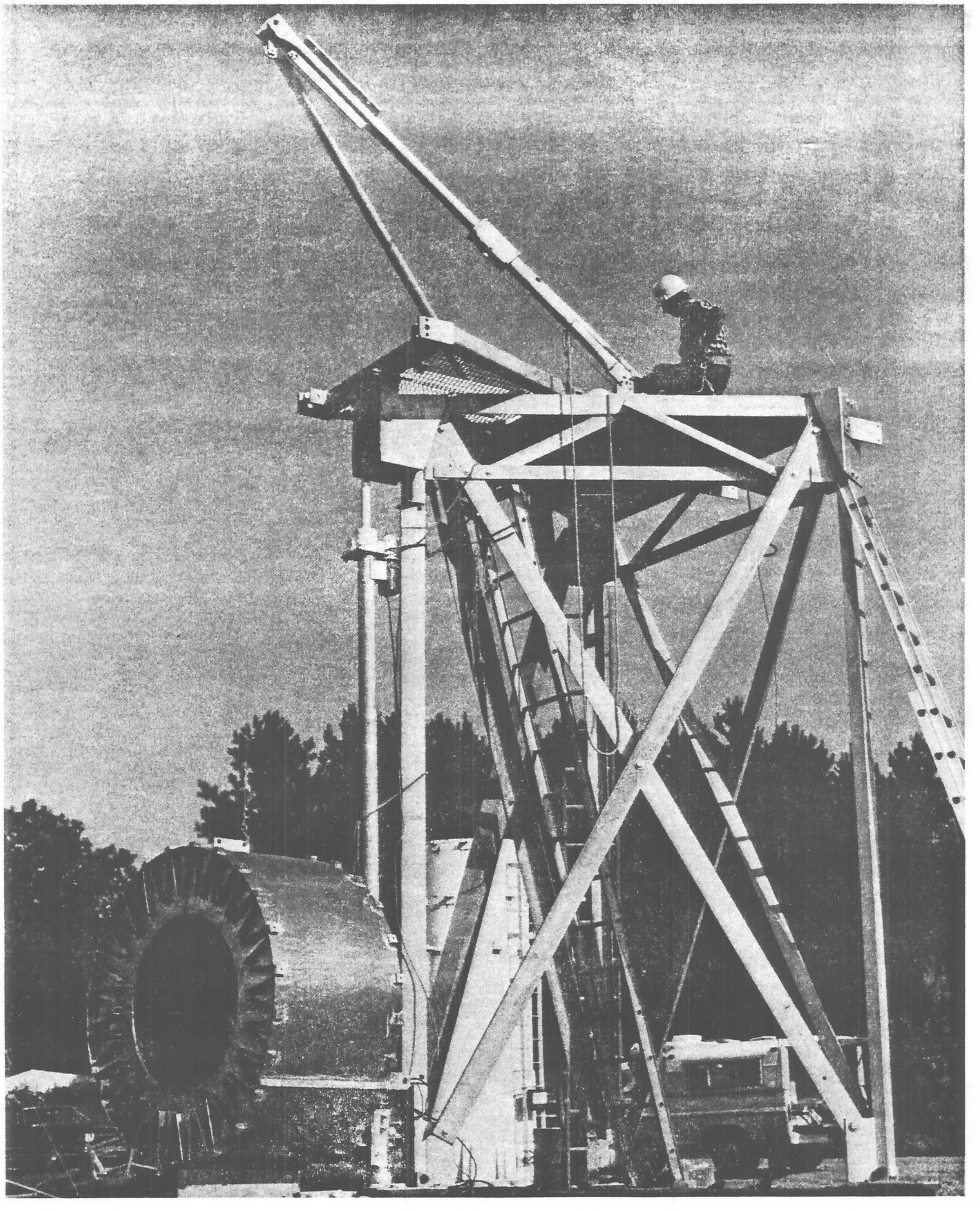


Figure 10. Scientific-Atlanta 10-Meter Antenna Installed Without Using Crane

The Series 8000 reflector designs have been proven in some of the most extreme environmental conditions recorded, and the reliability achieved continues to demonstrate the strength, stiffness, accuracy, and thermal stability of the design.

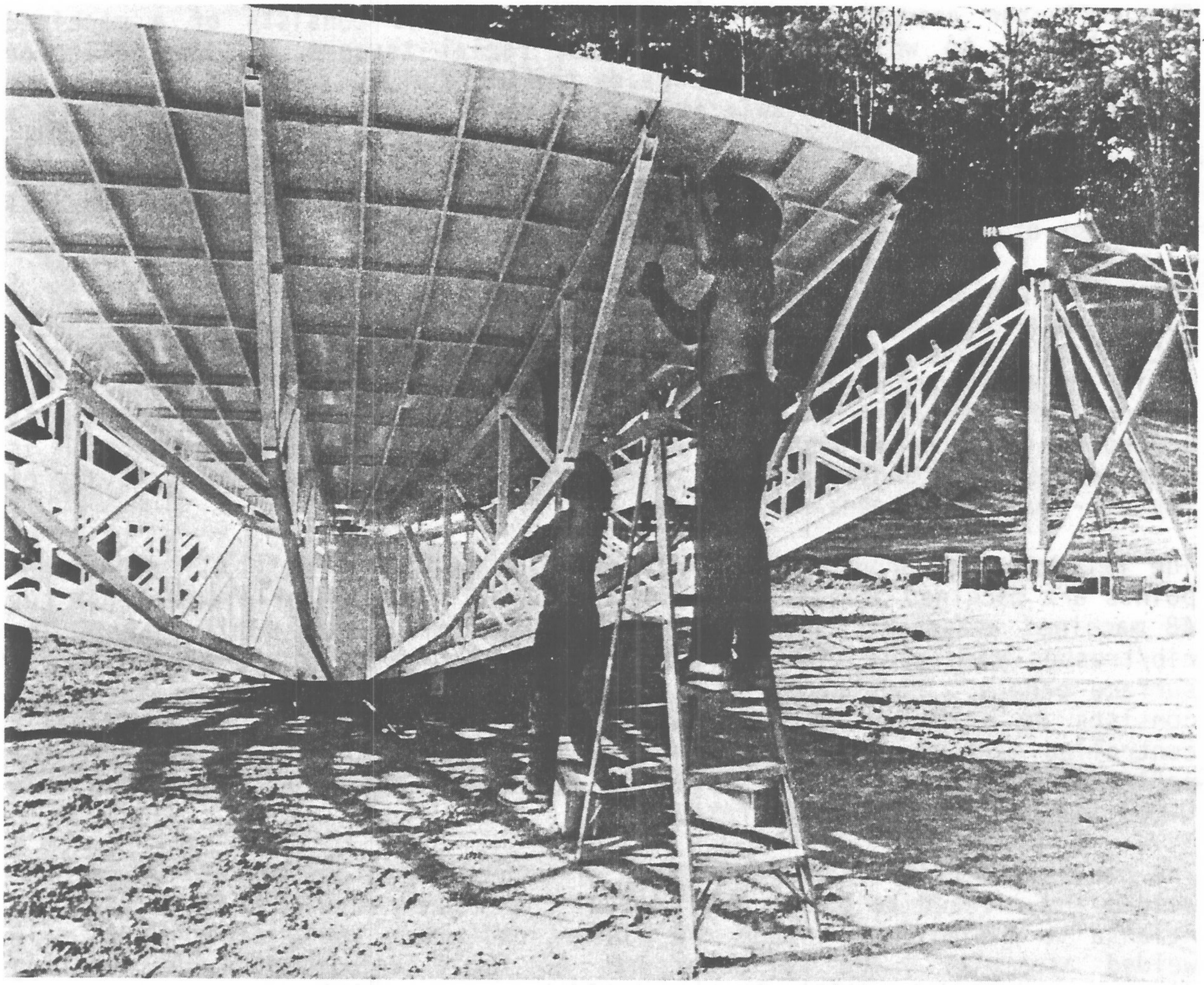


Figure 4. Installation of Series 8000 Earth Terminal Reflector

Feed Systems

The 10- and 11-meter feed systems consist of three major parts: (1) a radiating horn, (2) a diplexer or orthomode transducer (OMT), and (3) a specially-shaped subreflector which complements the shaped reflector. The feed system design is directed toward achieving high efficiency while maintaining an average sidelobe envelope beneath the 32-25 log θ gain curve in both frequency bands.

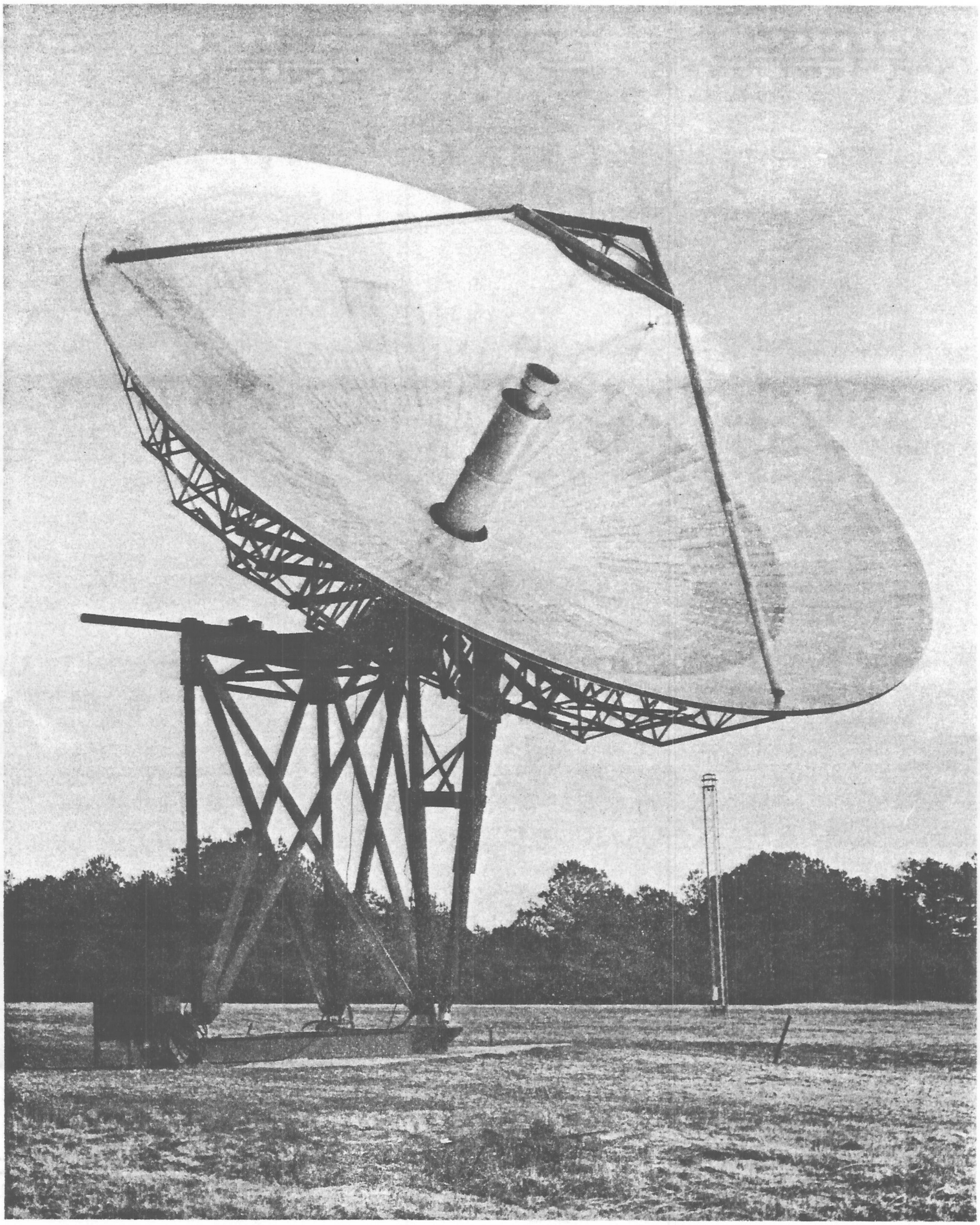


Figure 8. 11-Meter INTELSAT Standard B Earth Station

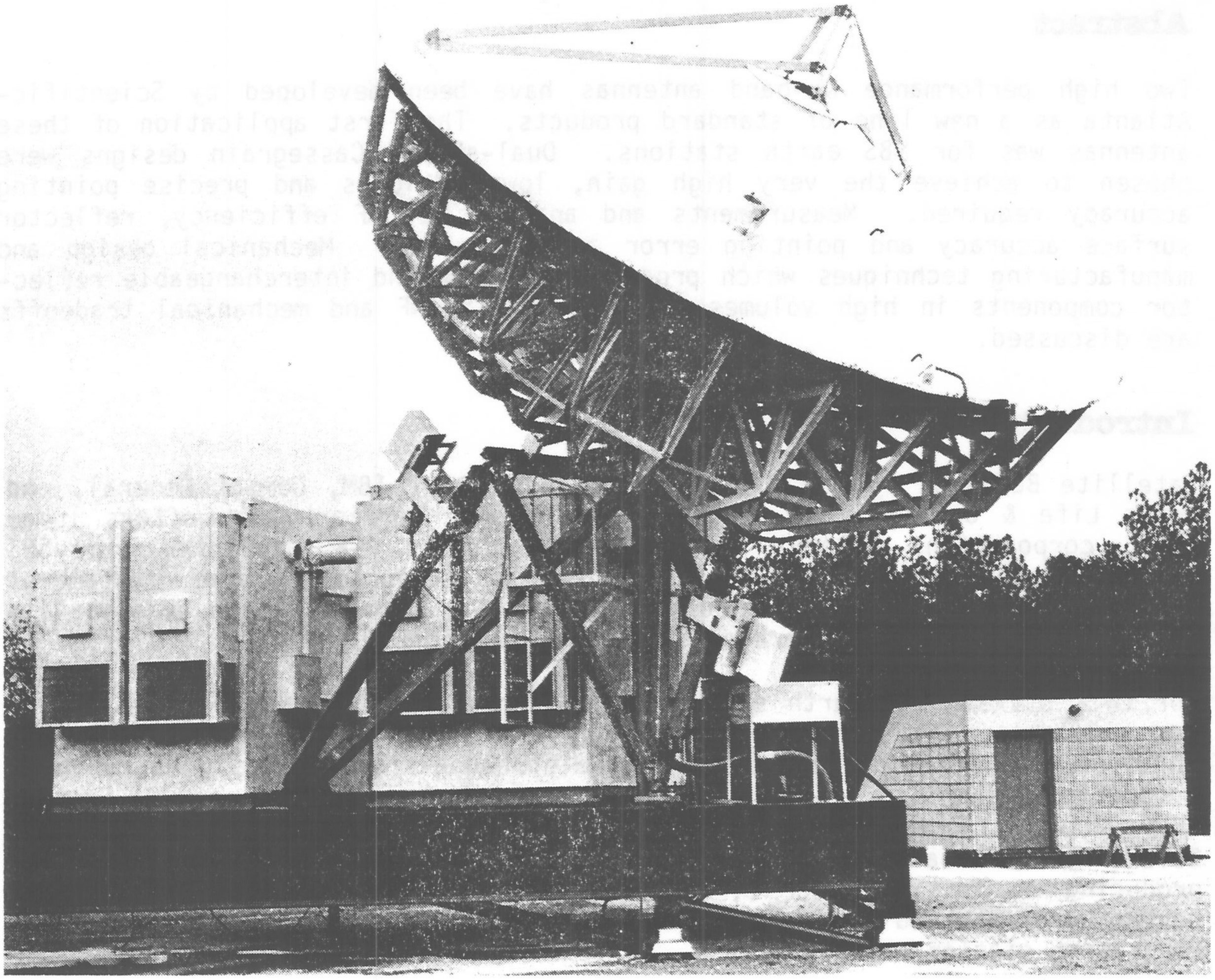


Figure 1. 5.5 Meter Earth Station Antenna

Figure 9. 11-Meter Intelsat Standard B Earth Station in Nigeria, Africa.

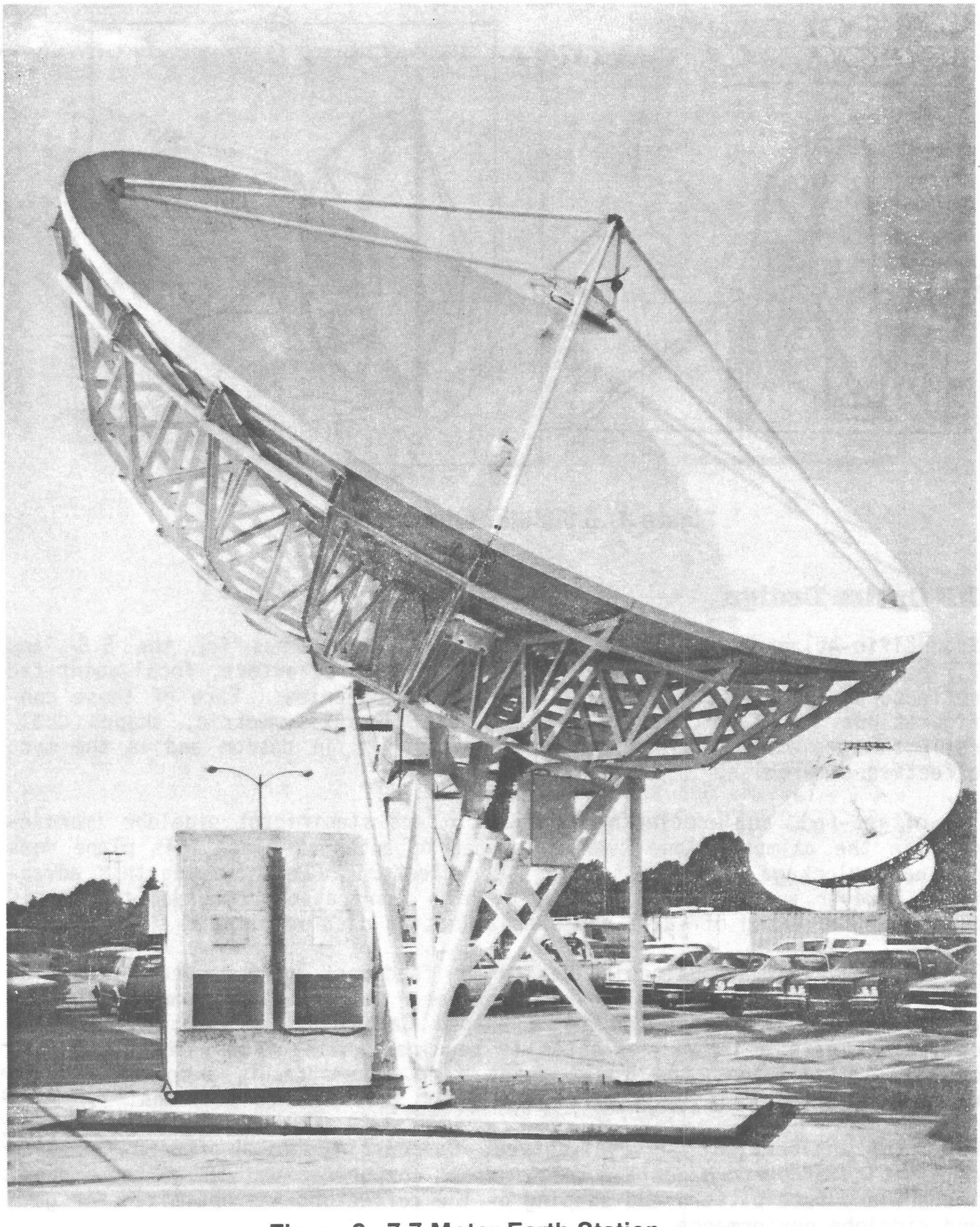


Figure 2. 7.7 Meter Earth Station

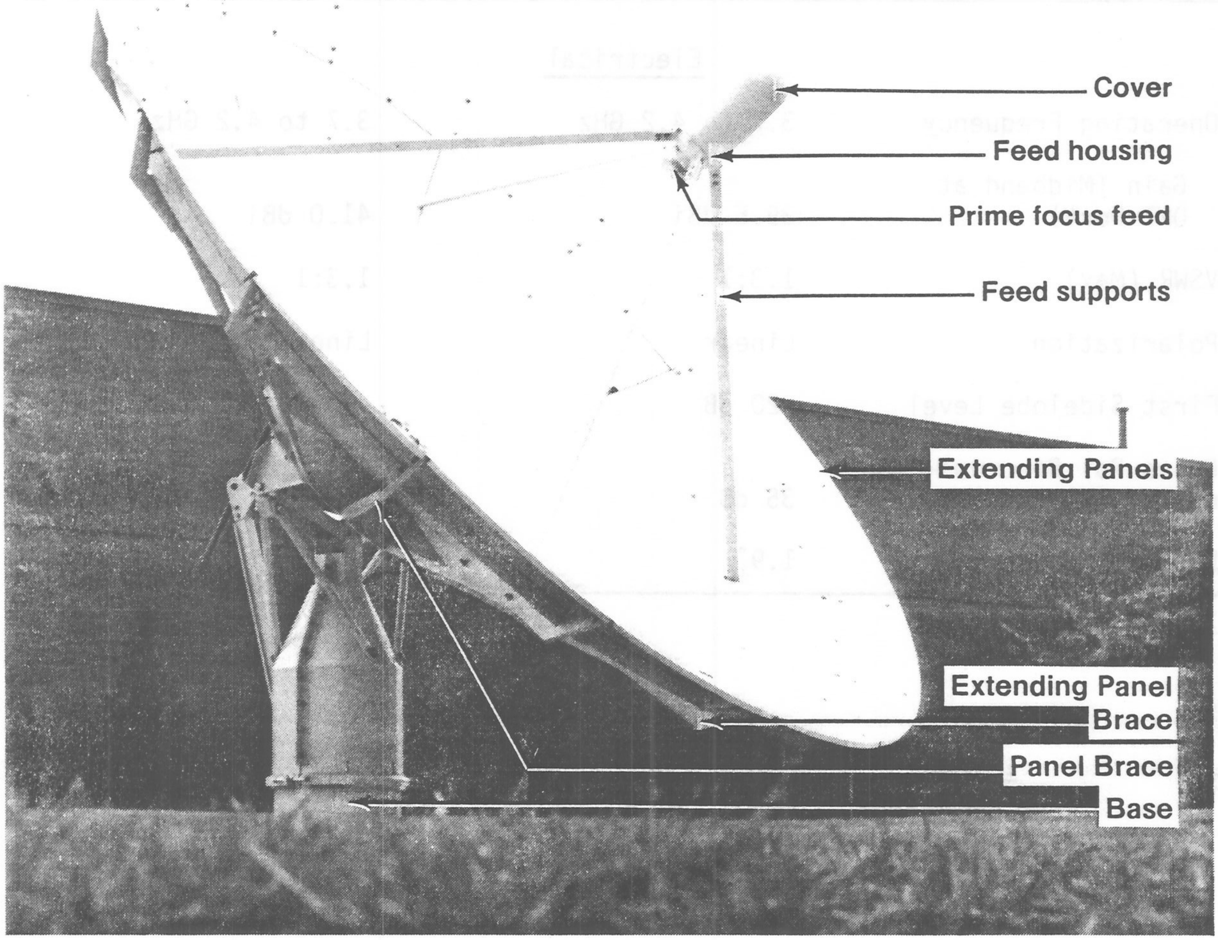


Figure 1. Feed Subsystem

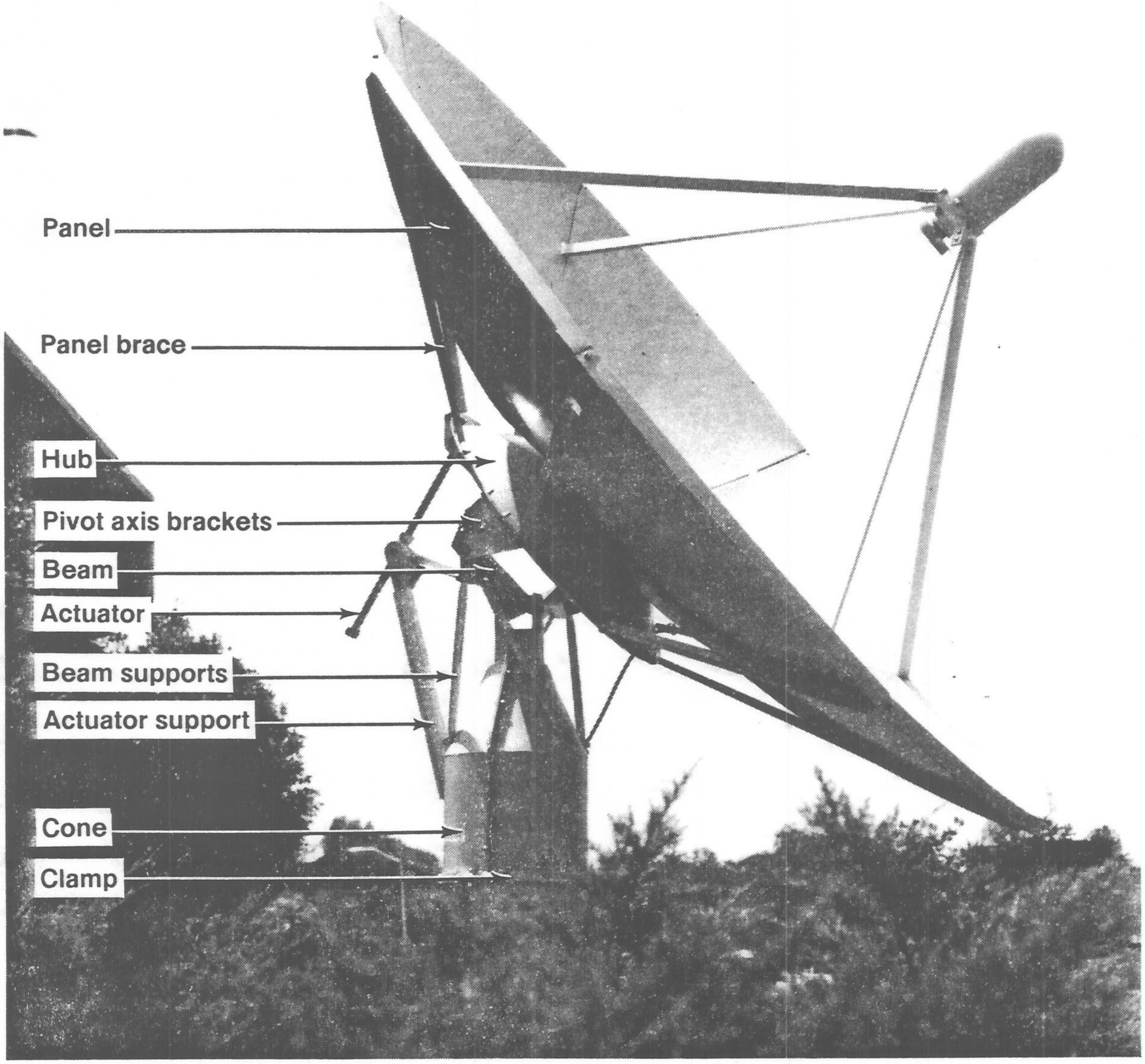

Panel
Panel brace
Hub
Pivot axis brackets
Beam
Actuator
Beam supports
Actuator support
Cone
Clamp

Figure 2.

The main reflector is a 10-meter-diameter paraboloidal surface with a focal-to-diameter (F/D) ratio of 0.39. The reflector fabrication techniques are the same as described in the "10- and 11-Meter Antenna" paper.

The subreflector is a 1.524-meter-diameter hyperboloidal surface with an eccentricity of 1.55 and a surface tolerance of 0.18 mm rms. The subreflector is supported by four 7.6 x 12.7 cm ogival cross-section spars which are attached directly to the reflector truss members. This allows the loads from the subreflector to be transferred through the truss members into the central hub without applying these forces to the main reflector surface.

LANDSAT-D Feed

The LANDSAT-D feed assembly, shown in figure 2, consists of four X-Band waveguide horns surrounded by four S-Band horns. The X-Band horns are 5.16 cm square apertures which taper to 2.85 cm square waveguide. A dielectric slab polarizer is placed diagonally across a section of the square waveguide followed by a horizontal resistive card and a square-to-rectangular waveguide transition. The dielectric polarizer converts a RHCP wave to a vertically polarized wave. Any residual horizontally polarized signal that would reflect off the transition is attenuated by the resistive card. The square-to-rectangular waveguide transition is a 4-step Tchebyschef transformer which produces a broadband impedance match. The ouput from each feed is a standard WR112 waveguide flange (UG 138 cover).

The four feed output flanges are in a square pattern and mate to the waveguide monopulse comparator located directly to the rear of the X-Band horns. This comparator provides a sum output by combining the four horn signals in phase and difference outputs by combining signals from each side of boresite 180° out-of-phase in the elevation and the azimuth planes.

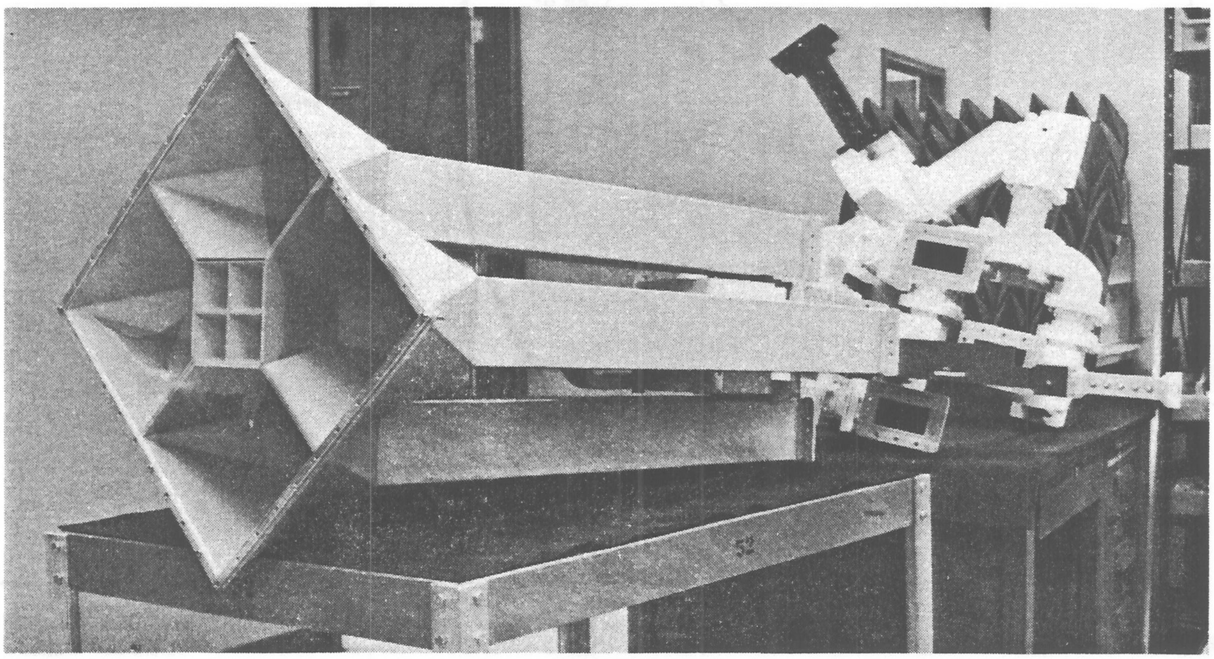
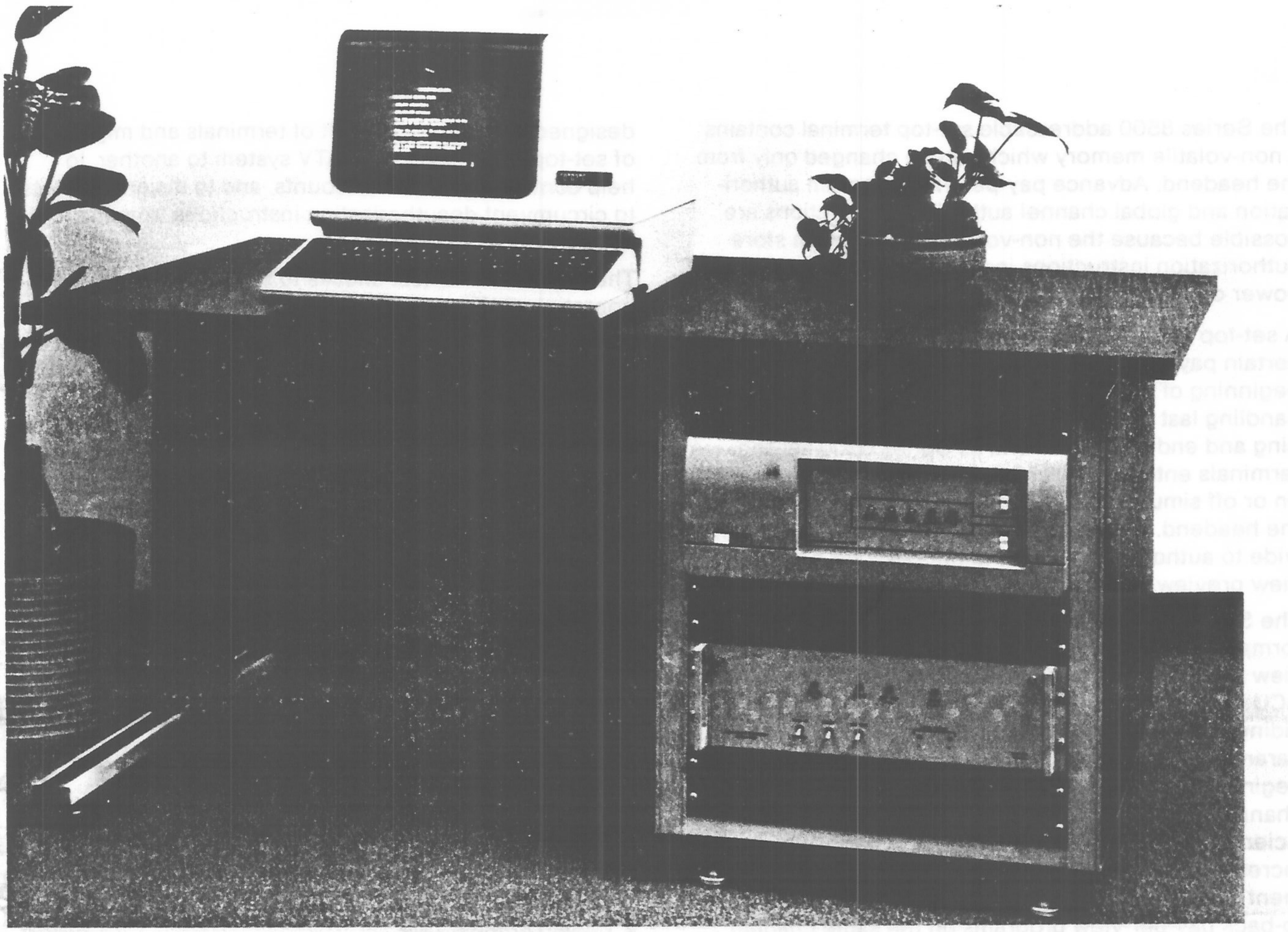


Figure 2.

Addressable Control Unit, Series 8552



The Series 8552 Addressable Control Unit (ACU) offers the CATV operator reliable computer hardware and software for managing systems using Scientific-Atlanta Series 8500 set-top terminals. The ACU is a device controller. It can function as an intelligent peripheral to a host computer, integrating converter-based addressable commands with a data processing and billing system. It can also serve as a stand-alone system in which subscriber information is cross-referenced in a manual filing system.

Scientific-Atlanta will assist the cable operator in evaluating his needs for addressable control systems. Extensive customer support includes site preparation, hardware installation, personnel training, full documentation, user-friendly software, and an interface document for a host computer system.

The ACU is based on an Intel 8085 microprocessor. The ACU stores all information necessary to control each Series 8500 Addressable set-top terminal individually, or to control addressable terminals in the cable system by global commands. The ACU has a non-volatile memory and retains all stored information until specifically updated. This prevents the loss of a data base in a power failure, or because the communications link with a host computer is temporarily broken.

The Addressable Control Unit can be configured to control up to 120,000 set-top units in a single cable system or up to 70,000 units in a dual cable system. The ACU uses a Digital Equipment Corporation (DEC) Series VT100 CRT and requires a standard RS-232C electrical interface. In stand-alone systems, all order entry is accomplished on this keyboard. In a host computer system, a CRT is used primarily for system status checks and system redundancy.

The ACU system also includes an Addressable Transmitter (ATX). The ATX, located at the headend, accepts converter control data from the ACU and transmits the data over the cable system. It operates at a standard frequency of 108.2 MHz. The unit also generates converter control signals needed to keep all legal Series 8500 Addressable set-top terminals active. Output data is transmitted as an FSK-modulated digital signal at a data rate of 19,200 baud. The ACU can serve multiple headends, with one ATX required at each headend. Two ATX's can be installed in tandem for system redundancy at each site.

Installation. The LNA is bolted directly to the OMT, with no "right side up" orientation necessary. All Scientific-Atlanta antennas with a Cassegrain feed system are equipped with a feed horn which must be pressurized. Because the feed cavity of the LNA is airtight, there is no need for a mylar "window" between the LNA and the OMT. The LNA gasket supplied must be properly installed in order to achieve a proper seal. Figure 5 shows two (2) LNAs being installed on a 3M feed equipped with an OMT.

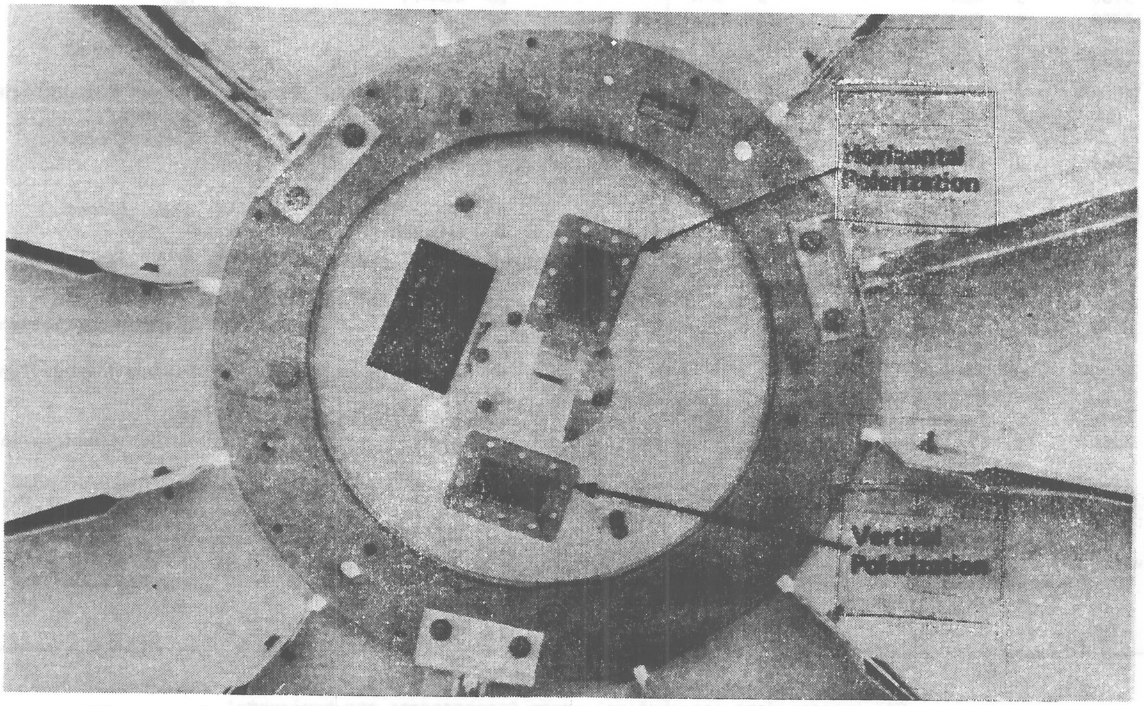


Figure 4. OMT Oriented for Maximum Signal at a Particular Site

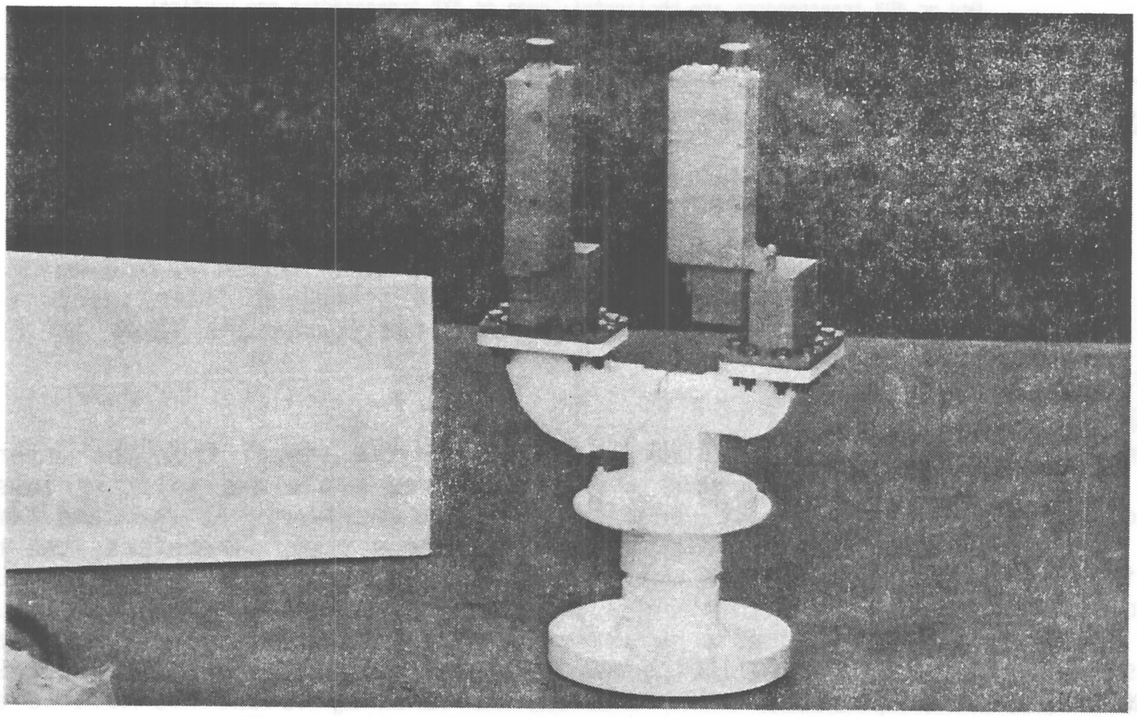
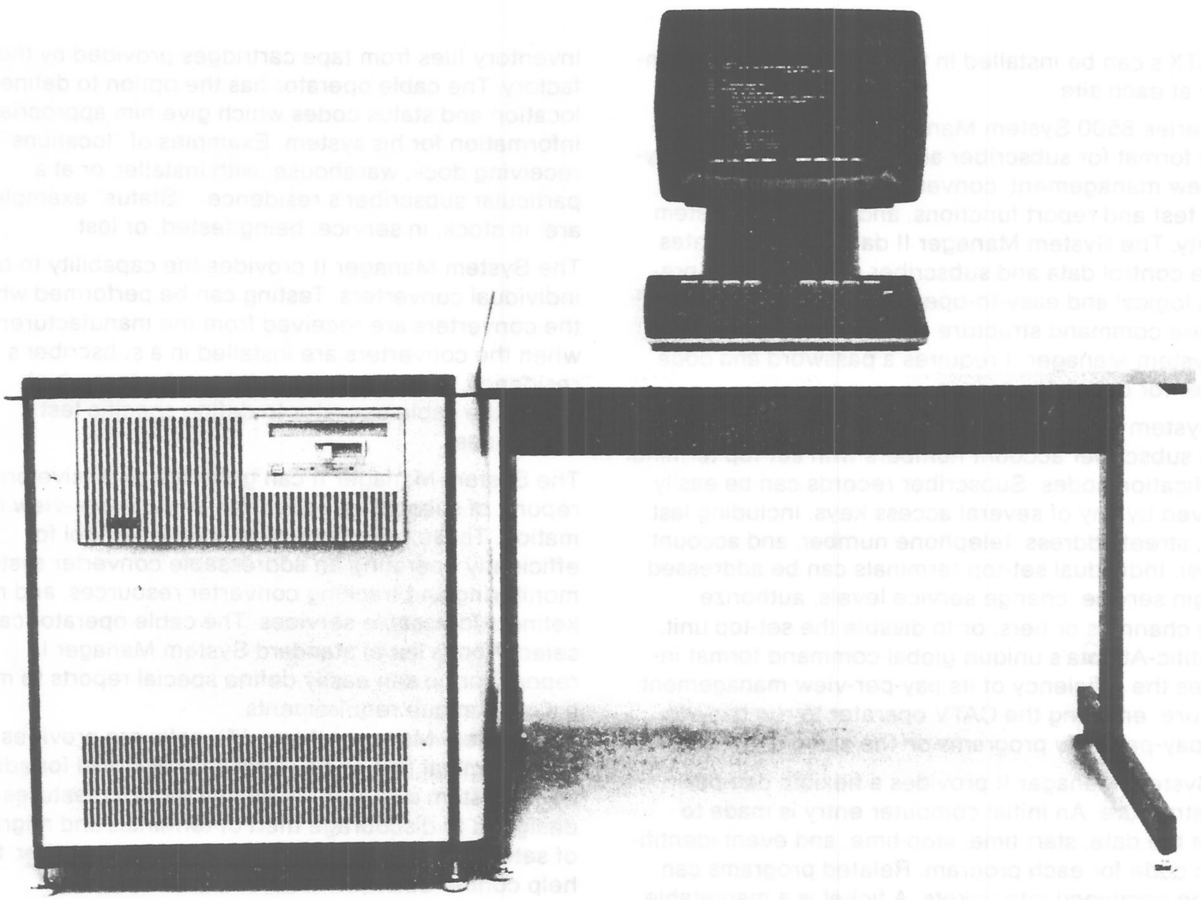


Figure 5. Two LNAs Installed on 3-Meter Feed

System Manager II



The System Manager II offers the CATV operator a comprehensive, user friendly computer hardware and software package for managing systems using Scientific-Atlanta 8500 Addressable set-top terminals. The System Manager II features integrated device control/subscriber information software and can perform subscriber management, pay-per-view management, inventory management, report, and test functions. The software uses pre-formatted CRT display screens for efficient keyboard entries.

The System Manager II can operate independently of a host billing computer or it can be linked to a host billing computer. As a stand-alone system, the System Manager II can generate subscriber reports that provide organized information to be entered into a billing computer. When the System Manager II is linked to a host computer, a single entry can be established.

Scientific-Atlanta will assist the cable operator in evaluating his needs for addressable control systems. Extensive customer support includes site preparation, hardware installation, personnel training, fully-documented software programs, and software updates.

System Manager II Components

The central component of the System Manager II is a Hewlett-Packard 1000 A600 disc-based computer. Subscriber disc capacity is determined by the cable operator's data base requirements. The disc storage can be backed up with a magnetic tape cartridge. The Hewlett-Packard 1000 A600 provides multiple-CRT ports for convenience and to help distribute work load effectively. These peripheral devices require a standard RS-232C electrical interface.

An addressable converter system incorporating the System Manager II also includes an Addressable Transmitter (ATX). The ATX, located at the headend accepts control data from the System Manager II computer and transmits the data over the cable system. The unit also generates converter control signals needed to keep all Series 8500 Addressable set-top terminals active. Output data is transmitted as an FSK-modulated digital signal at a data rate of 19,200 baud. It operates at a standard frequency of 108.2 MHz. The System Manager II can serve multiple headends, with one ATX required at each headend.

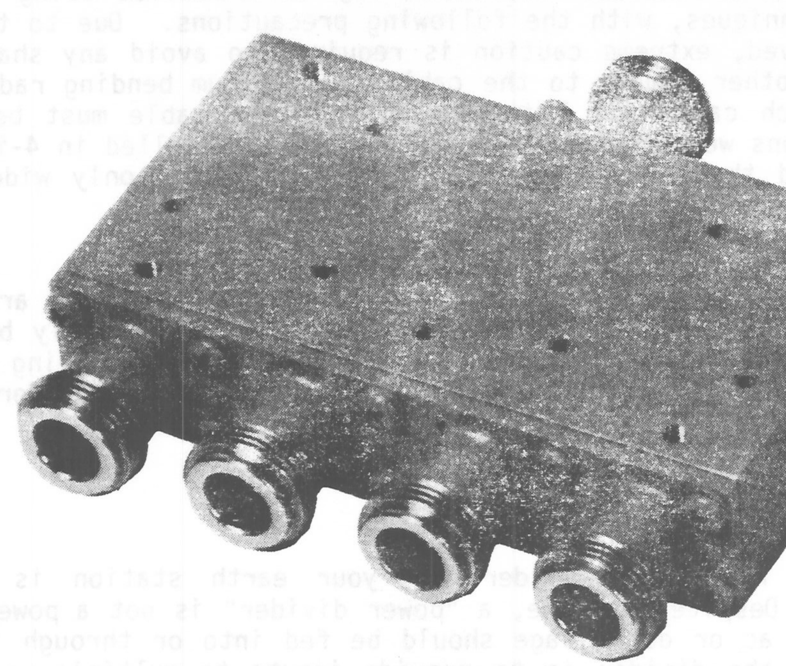


Figure 7. Four-Port Power Divider

Figure 8 illustrates the switch and identifies the proper connections.

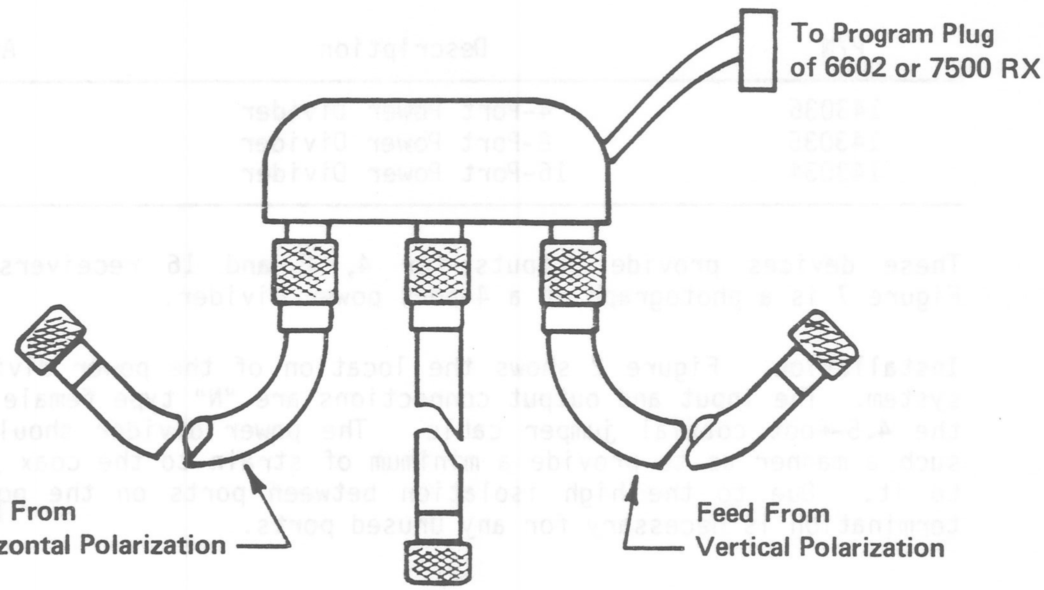


Figure 8. Relay Connections

In operation the switch selects between the two polarization feeds alternatively and in accordance with the frequency selecting dial on the front of the receiver, thus providing the correct input for the frequency selected. In the case of the 6602 and 7500 receivers, the appropriate input is also provided for a frequency selected via the remote interface.

4.6-Meter Earth Station Antenna

The 4.6-meter antenna is designed for receive or transmit applications in the 4- to 6-GHz range serving video, audio or data circuits from any satellite located above 5° elevation. Like other small Scientific-Atlanta antennas, it can be easily installed in a wide variety of locations with a minimum of site preparation.

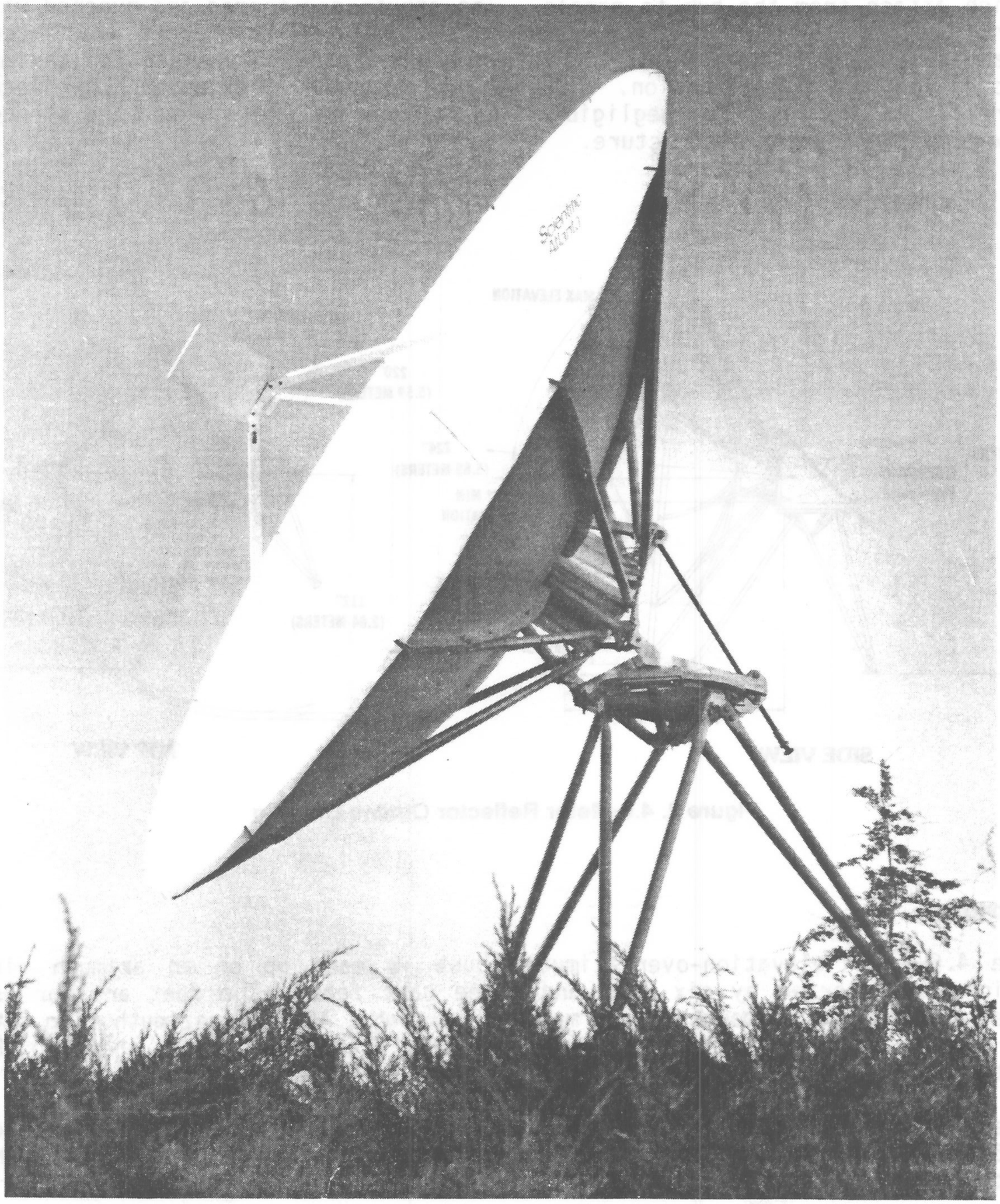
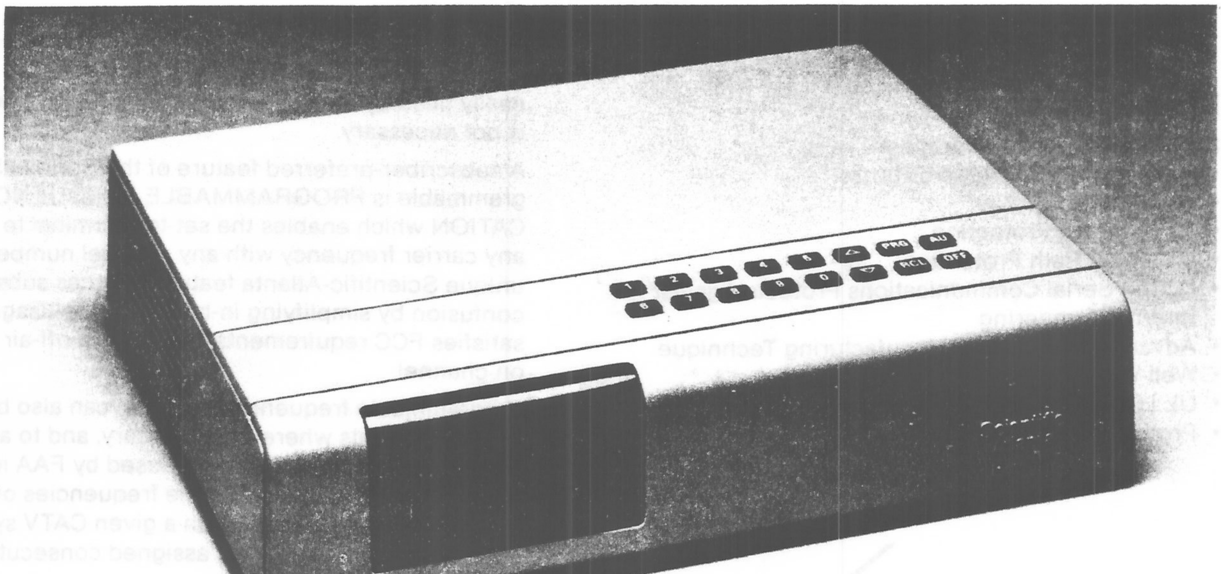


Figure 1. Typical Model 8346 4.6-Meter Earth Station Antenna Installation

Set-Top Terminal, Series 8500



The Series 8500 Scientific-Atlanta set-top terminals are available in three unique set-top models, all offering fully electronic, microprocessor-based control. Series 8500 set-top terminals operate at frequencies up to 440 MHz and can deliver 128 channels in a dual cable system.

The Series 8500 Programmable set-top terminal includes a long list of standard product line features, including programmable frequency allocation and a built-in remote control receiver.

The Series 8500 Programmable set-top terminal with Descrambling uses dynamic switched sync suppression for signal security. Dynamic switched sync suppression is an important Scientific-Atlanta innovation that provides economical security that is extremely difficult to defeat.

The Series 8500 Addressable set-top terminal is an advanced electronic set-top terminal providing headend control for service level authorizations and pay-per-view events. The addressable CATV system requires computer capability, software programs, several headend pieces, and personnel orientation. Scientific-Atlanta offers two versions of addressable control systems, with complete hardware and software, site preparation, and personnel training.

- The System Manager II is a comprehensive, stand-alone computer system providing connections for multiple CRT's and disc memory with a data base for subscriber information and inventory control. The System Manager II can operate independently as a fully automated central computer system and can interface with a host billing system.
- The Addressable Control Unit (ACU) is a microcomputer-based, addressable headend system. The ACU data base is keyed to converters only, and is designed to interface with a host computer containing both business and billing software. It can also be used in a partially automated addressable control system where subscriber data base information is managed from a manual filing system.

Control Key Functions — Both Set-Top Terminal and Series 8500 Remote Control Unit.

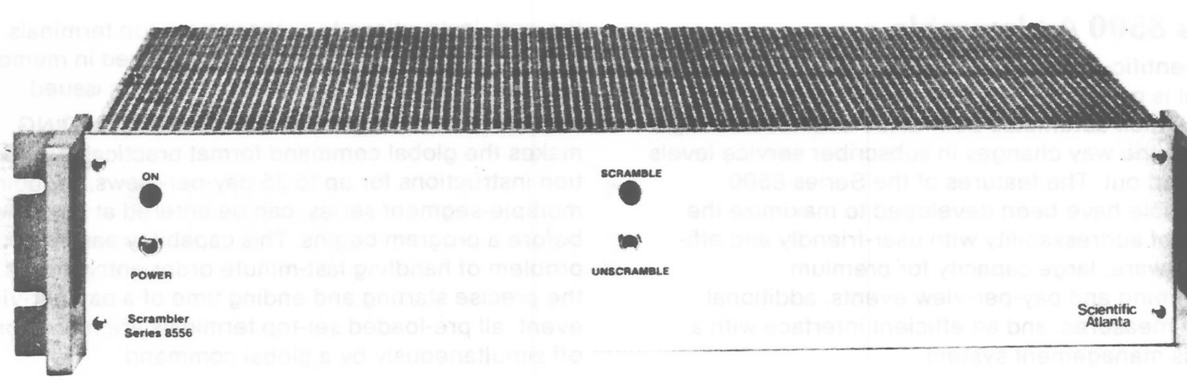
Increment/Decrement Keys — Steps up or down consecutively through all authorized channels.

RCL Key — Steps through up to 20 favorite channels in memory.

OFF Key — Switched ac feature permits on/off control of the television from the set-top unit.

AUTH Key — To request channels subject to parental discretion, press this key and enter a 5-digit secret code.

Program Key — To program favorite channel memory, press this key and enter desired channel number.



Series 8500 Programmable with Descrambling

The Scientific-Atlanta Series 8500 Programmable with Descrambling set-top terminal introduces virtually unbreakable signal security using broadband transmission, while incorporating all standard Series 8500 features. Scientific-Atlanta offers DYNAMIC SWITCHED SYNC SUPPRESSION, an innovative and now indispensible scrambling/descrambling method to secure premium programming and pay-per-view channels.

Dynamic switched sync suppression increases signal security by introducing random timing elements into the scrambling process. Because of the complexity of the scrambling technique, internal tampering and reproducible scrambling defeats are extremely difficult.

The Series 8500 descrambler uses a custom-manufactured timing chip to delay the restoration of the video sync tip a few microseconds after the reference pulse is received. The timing delay for every video frame is changed randomly. Because of this Scientific-Atlanta development, the CATV operator benefits from superior signal security.

Features

- Dynamic Switched Sync Suppression
- Full Line Headend Scrambling Accessories
- Custom-Manufactured Timing Chips that cannot be Purchased Commercially
- All Series 8500 Standard Product Features

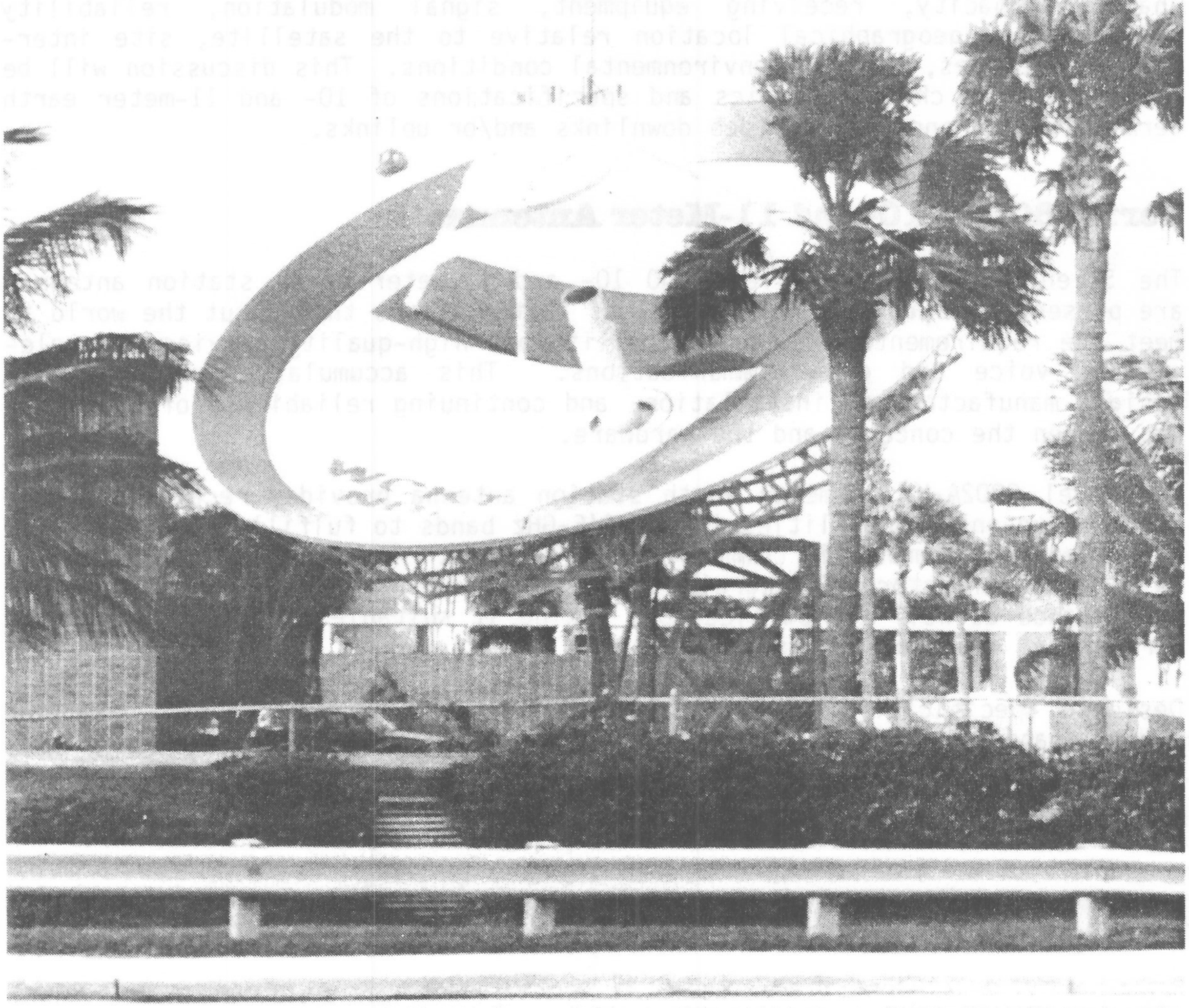
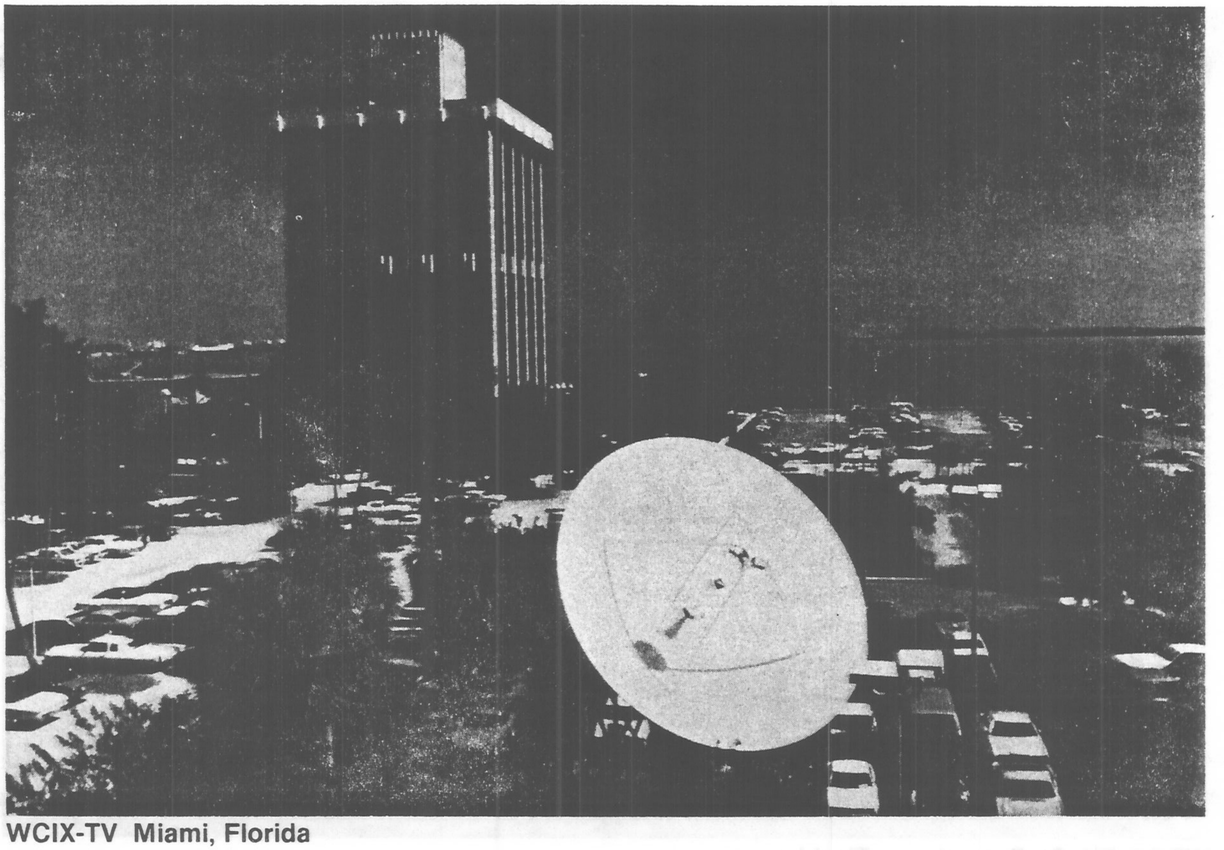


Figure 1. Scientific-Atlanta 10-Meter-Diameter Earth Station for Video Transmitting and Receiving


WCIX-TV Miami, Florida

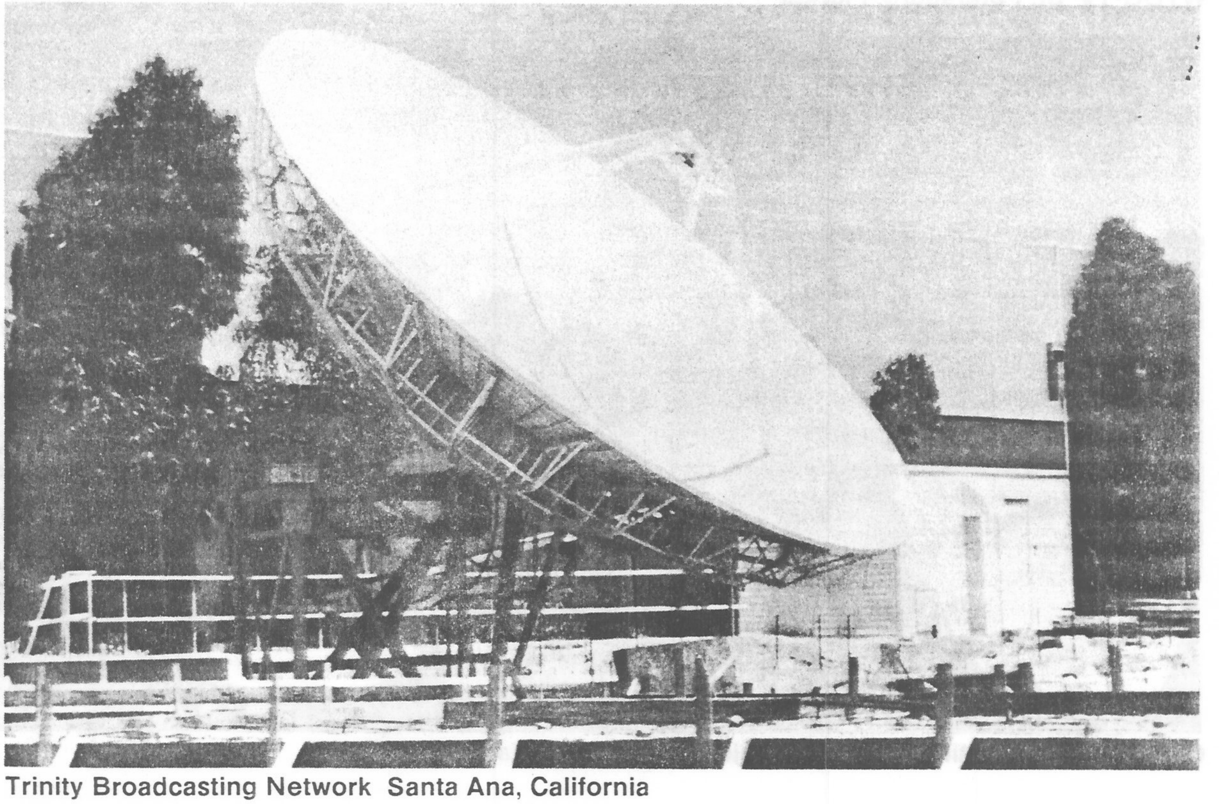
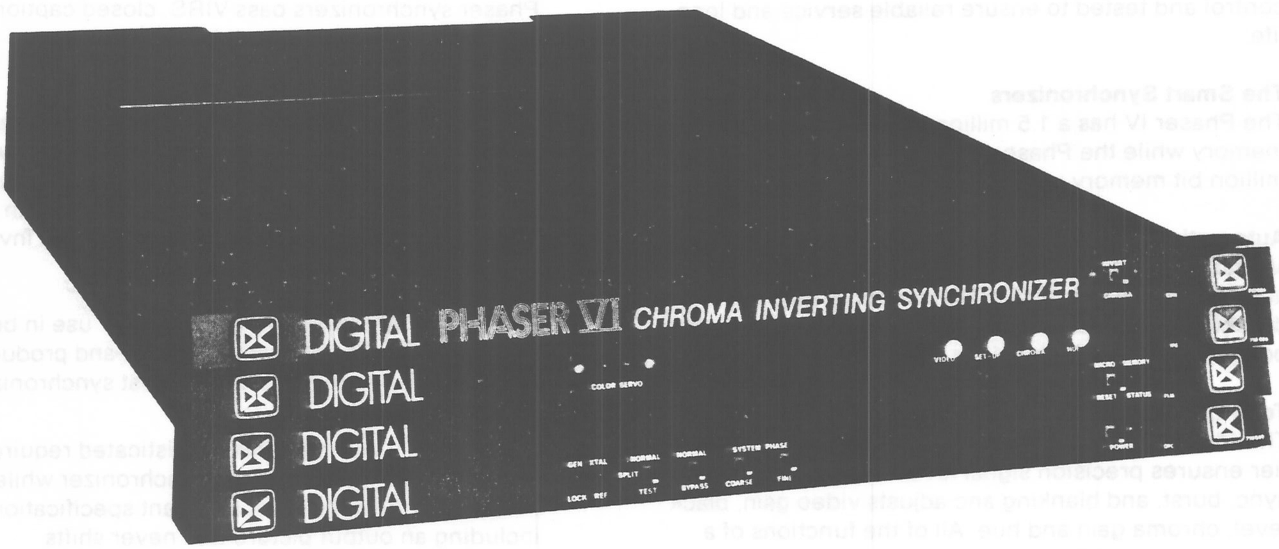

Trinity Broadcasting Network Santa Ana, California

Figure 2. Scientific-Atlanta Satellite Earth Stations for Television Broadcasters

Digital Frame Synchronizer, Phaser IV,V, and VI



Scientific-Atlanta, through its subsidiary, Digital Video Systems, offers a complete line of frame synchronizers for use in cable TV, LPTV, and broadcast applications. The Phaser IV, V, and VI series of synchronizers provide state-of-the-art technology in video synchronization.

The Phaser synchronizes input signals from an NTSC or black and white video source, including satellite, studio, network, remote camera, off-air, etc.

The Phaser lets the operator ignore time and distance, synchronizing signals automatically—such as Electronic News Gathering (ENG) programming transmitted via microwave—as if they originated in-house.

The Phaser eliminates complex signal routing and timing techniques. Signals from inaccessible cameras, remote vans, or moving vehicles are timed and synchronized into a fixed based control where they can be mixed, dissolved or used in chroma key or special effects with other sources.

With the Phaser, the operator can easily mix any live video inputs with studio programming, microwave, satellite, and VTR signals to produce a completely synchronized output without gen-locking.

The Phaser replaces the complex system of delay lines and pulse delay compensators which may now be used to time several studios through master control.

And for infinite switcher re-entry, which previously required very costly equipment, the Phaser is a breakthrough.

The Phaser IV with a 1.5 million bit RAM fieldstore memory is the basic "building block". Phaser V and Phaser VI employ the same modular design concept.

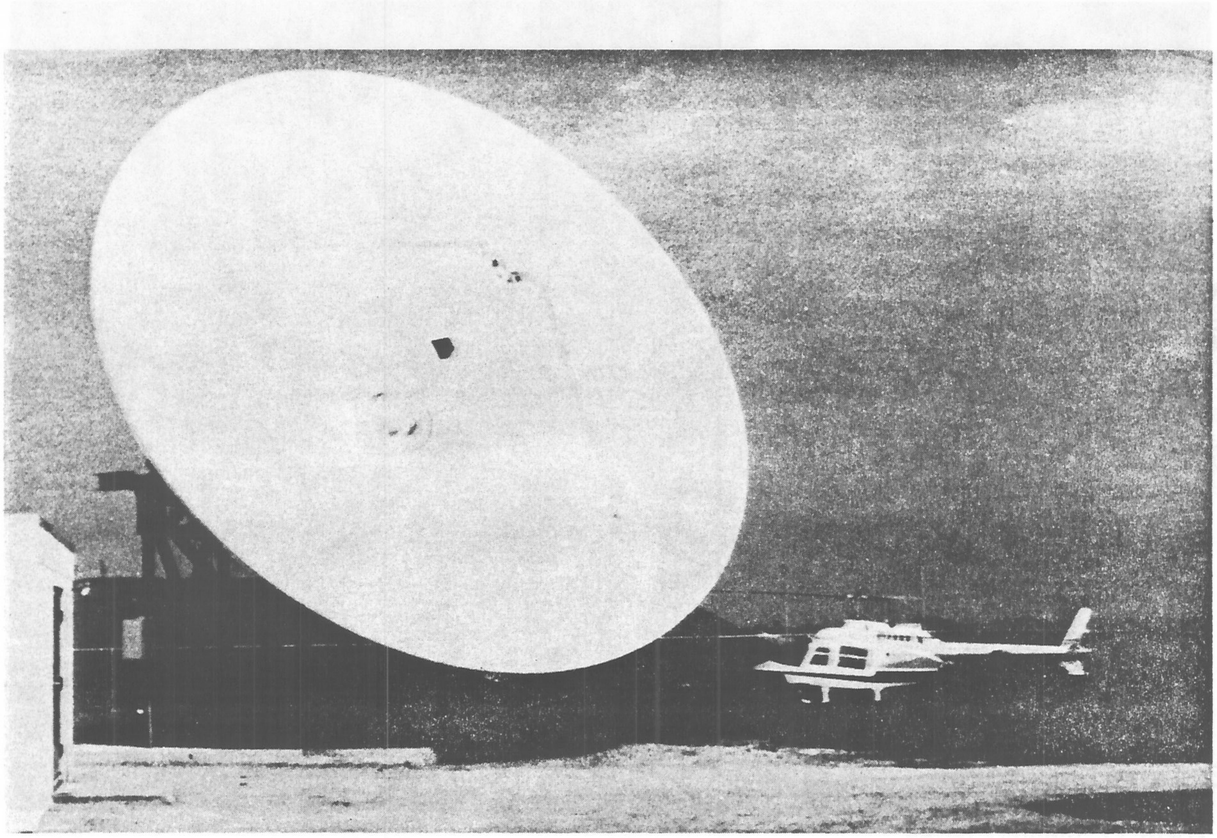
The Phaser V synchronizer builds onto the exceptional features of the Phaser IV. It has a framestore memory to provide double the memory capacity with half the number of components.

The Phaser VI takes the concept of synchronizing a step further, incorporating a new picture adaptive digital comb filter to provide the highest quality NTSC chroma inversion ever. It ensures virtually perfect decoding of the NTSC color TV signal as required in freeze frame applications or for studio-to-studio synchronization and switcher re-entry.

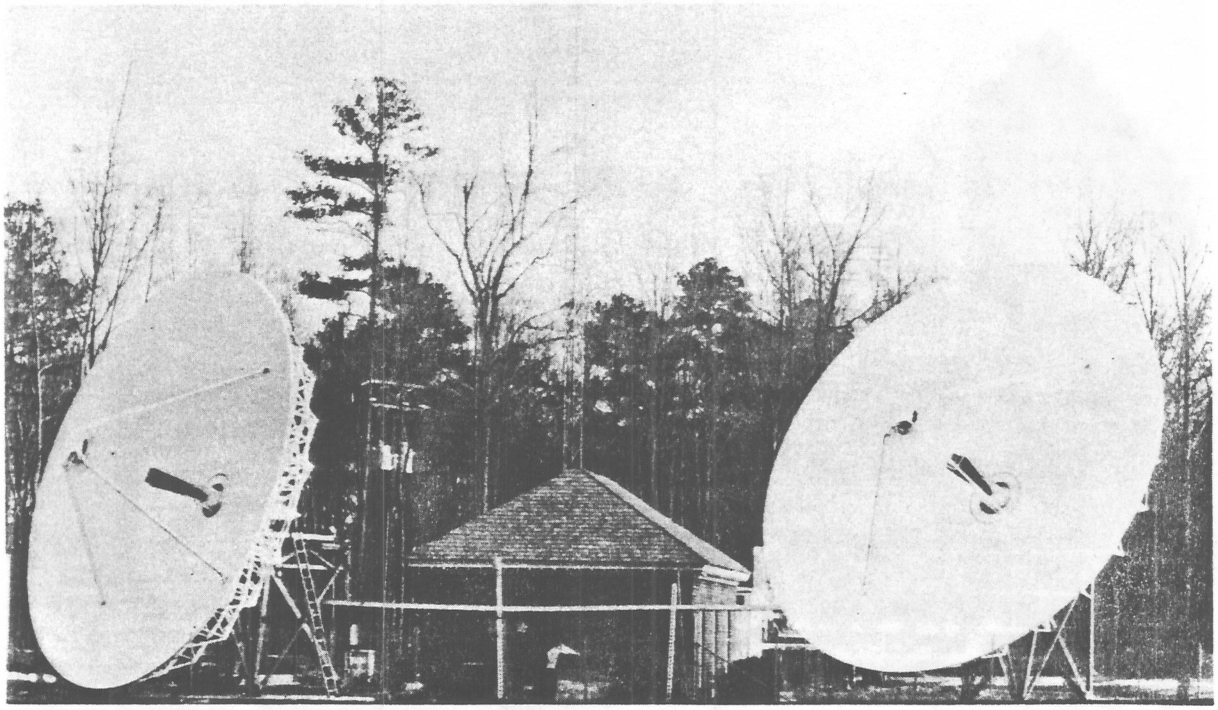
Rugged Packaging
The Phaser synchronizers are compact and rugged. Measuring only 3-1/2" high, they fit any surroundings, from studios and master control rooms to compact mobiles, and in standard headend equipment racks.

Simplicity Designed-In
Designed for ease of use, Phaser controls are conveniently placed on the front louvres in a logical arrangement. Functional controls located on the circuit boards are easily accessed and work at the flick of a switch. Adjustments are rarely necessary as one of the main benefits of the Phaser is the reduced need for service. Signals are phased automatically.

Easy Maintenance
LED's on the Phaser front louvres indicate operational status and simplify fault identification. If service is required, boards are quickly replaced to reduce downtime to a minimum.



WTOG-TV St. Petersburg, Florida



Christian Broadcasting Network Virginia Beach, Virginia

Figure 3. Scientific-Atlanta Satellite Earth Stations for Television Broadcasters

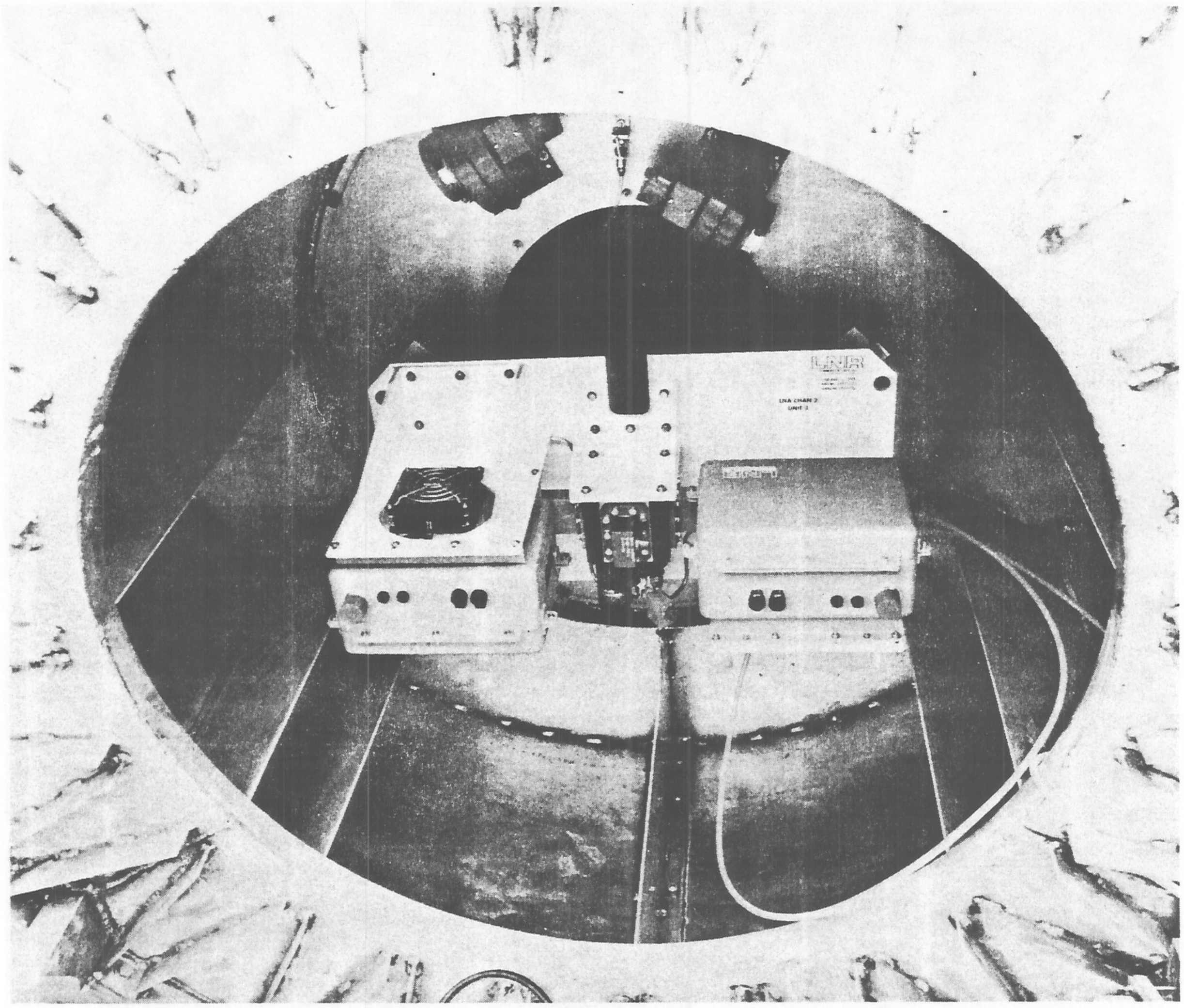
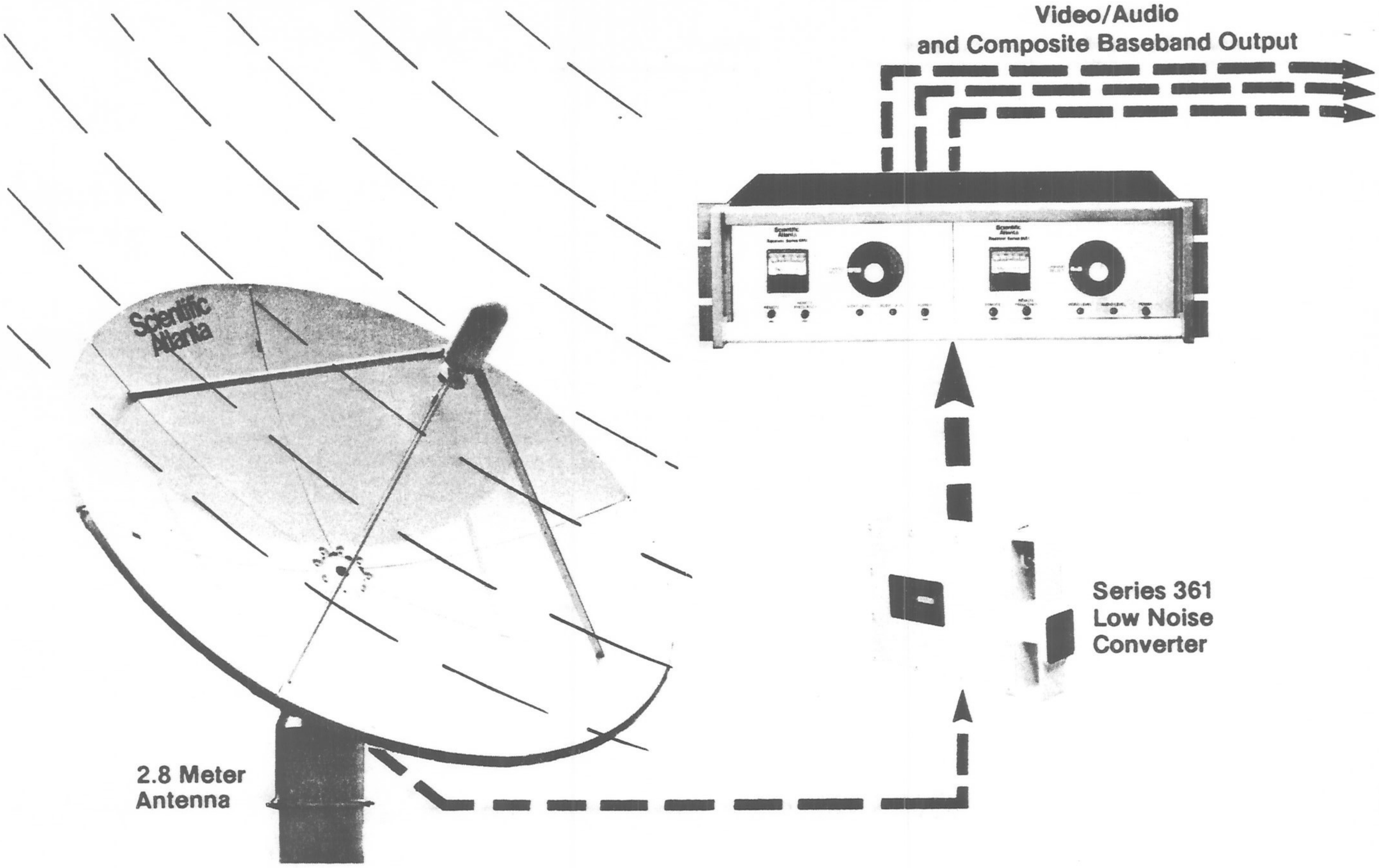


Figure 7. Redundant 4-GHz Parametric Amplifier System Installed in the Model 8111 10-Meter Hub (hub access covers removed)

Mount and Positioning System

The Models 8002A-HP and 8007 antennas use the conventional elevation-over-azimuth mounting configuration. The advantages of this configuration are the following:

- Easily understood coordinate system
- Tolerance of foundation sighting errors
- Applicable for use at any latitude and longitude
- One standard design with one foundation interface plan
- Capable of self-erection and assembly of reflector in place on mount
- Capable of having a horizontal work platform to conveniently service antenna hub mounted equipment.



Ku-Band Receive-Only System

Scientific-Atlanta offers earth stations to receive satellite television transmissions from 11.7 to 12.2 GHz.

A typical Ku-band video receive terminal consists of the following:

- A Series 9000 Ku-band earth station antenna, with elevation-over-azimuth mount and single or dual polarized feed
- A Series 361 low noise converter
- A Model 6651 video receiver, with ANIK-C specifications (similar configurations for SBS, OTS, and other satellites are available)

Each system also includes 100 feet of coaxial cable to connect the low noise converter (LNC) to the video receiver, and installation and operation instructions.

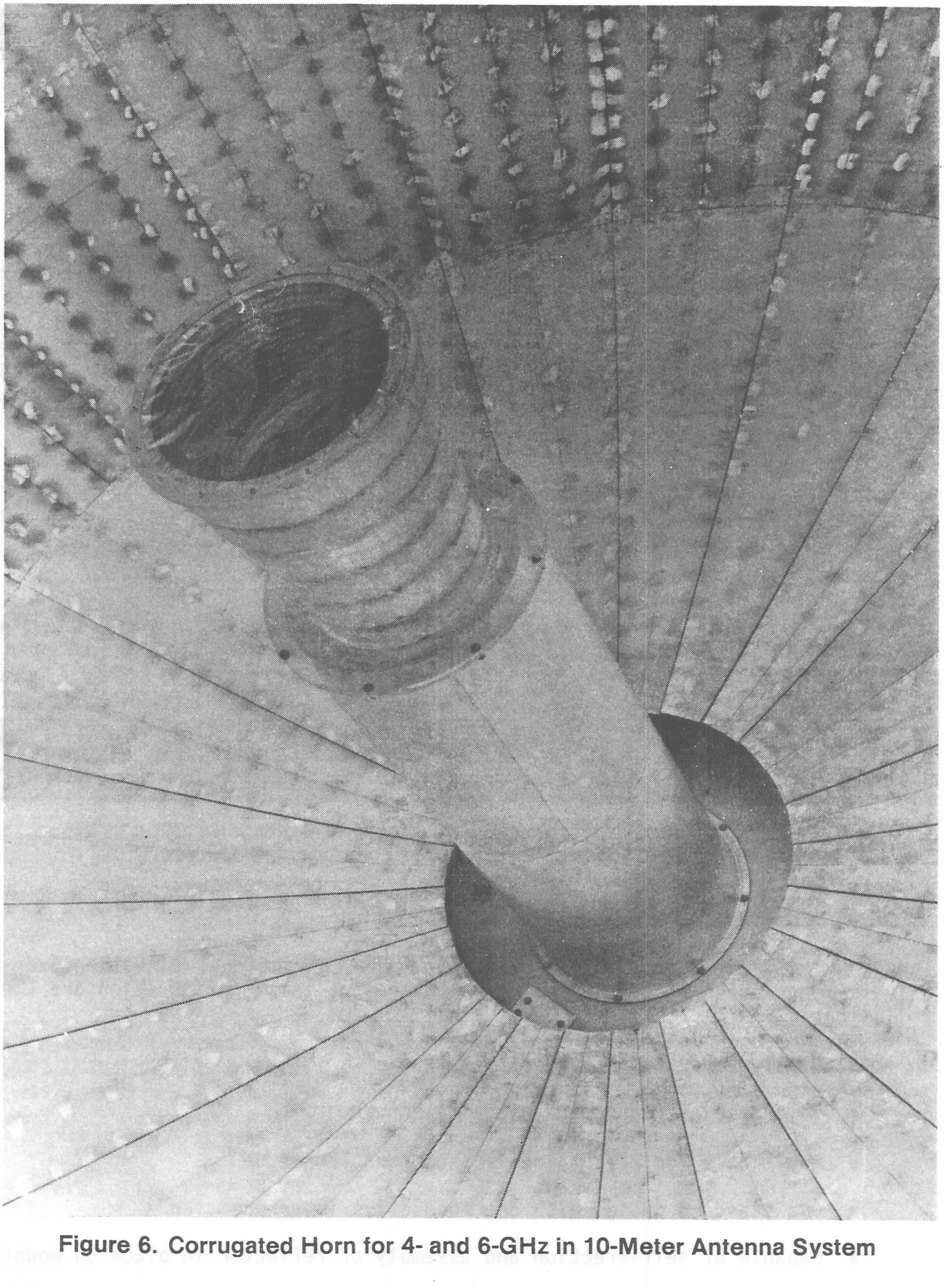
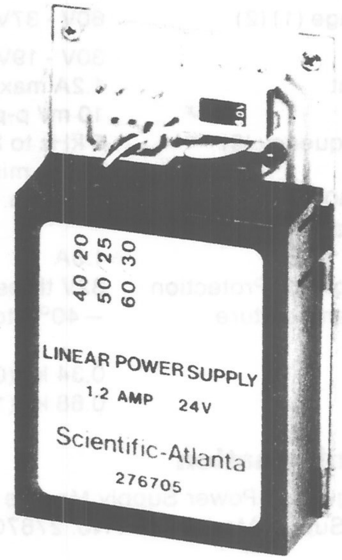


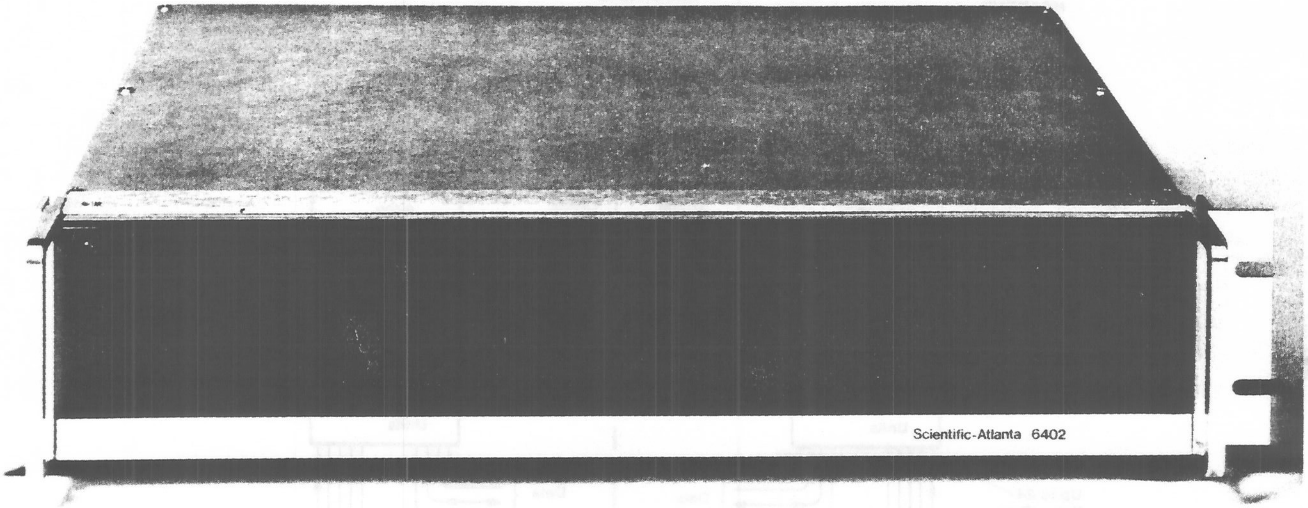
Figure 6. Corrugated Horn for 4- and 6-GHz in 10-Meter Antenna System

6501/6502 Power Supply Modules 276705 and 276715



Power supply modules 276705 and 276715 are used in the 6501/6502 distribution amplifier station to convert station ac input voltage to a well-regulated dc voltage for station powering. The switching regulated supply (276715) provides improved efficiency over the standard linear power supply (276705) which results in cost savings in operating expense. The switching regulated supply is a constant power device, meaning that it automatically adjusts its internal operating parameters for most efficient use of different levels of voltage and current within a system. The switching regulated supply automatically determines load power requirements and adjusts its operation so that only that amount of power is provided.

Broadband Data Modem, Model 6402



The Model 6402 broadband data modem is a high-speed modem designed to facilitate point-to-point data communications via coaxial cable. It enables the cable operator to lease to businesses bandwidth on entertainment or institutional systems. Because of the modem's bandwidth efficiency, many businesses can be accommodated in a small amount of cable spectrum. The Model 6402 is frequency agile and can be manually adjusted at the business site on both the transmit and receive frequencies.

Features

- High-Speed Standard T1 Data Rate
- Point-to-Point Data Communications
- Bandwidth Efficient
- Synchronous, Full Duplex Operating Mode

Specifications

General

Power
- 115V or 230V ac ±10%
- 100 watts, 50/60 Hz or −48V dc

Temperature
- +10°C to +50°C (+50°F to +122°F)

Size
- Standard 19-inch rack mount chassis
- Optional stand alone package

Modulation
- QASK-16

Transmitter
- Level
  - +20 dBmV to +50 dBmV
- Frequency Range
  - Standard 5 to 120 MHz
  - Optional 162 to 440 MHz

Receiver
- Level
  - −10 dBmV to +10 dBmV
- Frequency Range
  - Standard 162 to 440 MHz
  - Optional 5 to 120 MHz

Frequency Adjustment Resolution
- 250 kHz (Permits transmission in both HRC and IRC formats)

Performance
- Operational BER $< 10^{-9}$ at C/N $\geq$ 33 dB (NCTA)

Spectral Efficiency
- 750 kHz spacing

Operating Mode
- Synchronous, full-duplex

CATV System Compatibility
- Operates with conventional 2-way systems (Sub-split or mid-split)

Interface
- Standard Digital
  - RS-442 (RS-449 DT)
- Optional Digital
  - DS-1, V.35, RS-449 SR

RF
- BNC connector, 75 Ω impedance

Scrambling
- In accordance with CCITT V.35

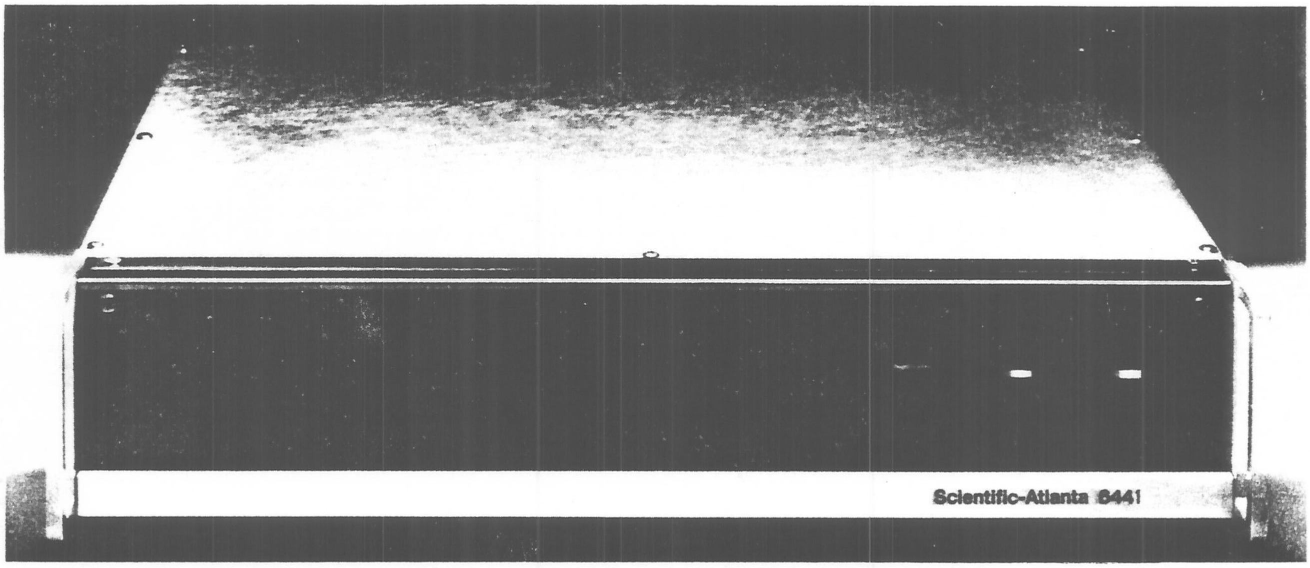
Controls
- Power
- Baseband Loopback
- Local Loopback

Indicators
- Power
- Baseband Loopback ON
- Local Loopback ON
- Lock Detect

Data Rate
- Standard T1 (1.544 Mbps)

Accessories
- Frequency synthesizer programmer

Frequency Translator, Model 6441



The Model 6441 frequency translator is designed to facilitate two-way communications via standard CATV systems in a mid-split configuration. The translator enables the cable operator to utilize any unoccupied channel in the entertainment or institutional system in a highly reliable, bandwidth-efficient manner. The Model 6441 functions as a modular headend unit which may be configured for the operator's specific bandwidth and channel allocation.

Features

- Flexible Frequency Translation
- 1,2, or 3-Channel Capacity
- Frequency Agile
- HRC and IRC Compatible
- Optional Fault Protection

Specifications

General

Power
  Standard 100V to 130V ac, 60 Hz
Temperature Range (to maintain specifications)
  0°C to +50°C (+32°F to +122°F)
Dimensions
  88.9H x 482.6W x 406.4D mm (3.5H x 19W x 16D in.)

Operational

Input Frequency Range
  5 to 120 MHz
Output Frequency Range
  162 to 440 MHz
Frequency Adjustment Resolution
  250 kHz
Translation Channel Capacity
  1, 2, or 3 adjacent channels
Effective Bandwidth
  5.5 MHz, 11.5 MHz, or 17.5 MHz
Frequency Stability (over temperature range)
  ±865 Hz
Input Level
  −10 dBmV to +10 dBmV
Output Level
  +20 dBmV to +50 dBmV
Spurious Outputs
  <−60 dBc
Adjacent Channel Rejection
  60 dB
Input/Output Impedance
  75 Ω nominal

Connectors

RF
  75Ω BNC
Test
  25-pin D-type
Controls
  Power
  Level adjust
Indicators
  Power
  Input channel frequency
  Output channel frequency
Accessories
  Frequency synthesizer programmer
  1:1 protection switch

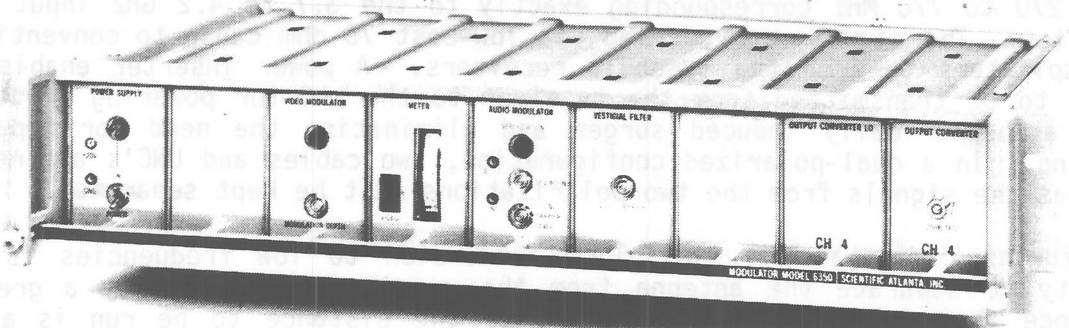


Figure 7. Model 6350 Video Modulator

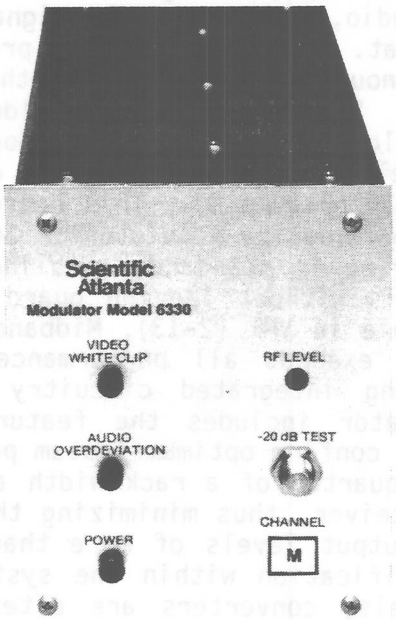


Figure 8. Model 6330 Video Modulator

The satellite portion of the mini-cable system is just a part of the whole. It must be combined with off-air signals from conventional UHF and VHF antennas. These signals are filtered and amplified, the UHF channels being translated to a lower frequency.

The Model 6130 Signal Processor (Figure 9), as a companion to the Model 6330 Modulator, is also designed to occupy one-quarter rack space. Important standard features include SAW filters, the ability to permit adjacent channel rejection, automatic gain control, adjustable sound carrier level and a high-level IF switch. Front-panel indicators and adjustments allow effective monitoring of unit operation and status of signal input. Extensive signal processing offers standard VHF, midband and superband output channels as well as VHF, midband, superband and UHF input channels.

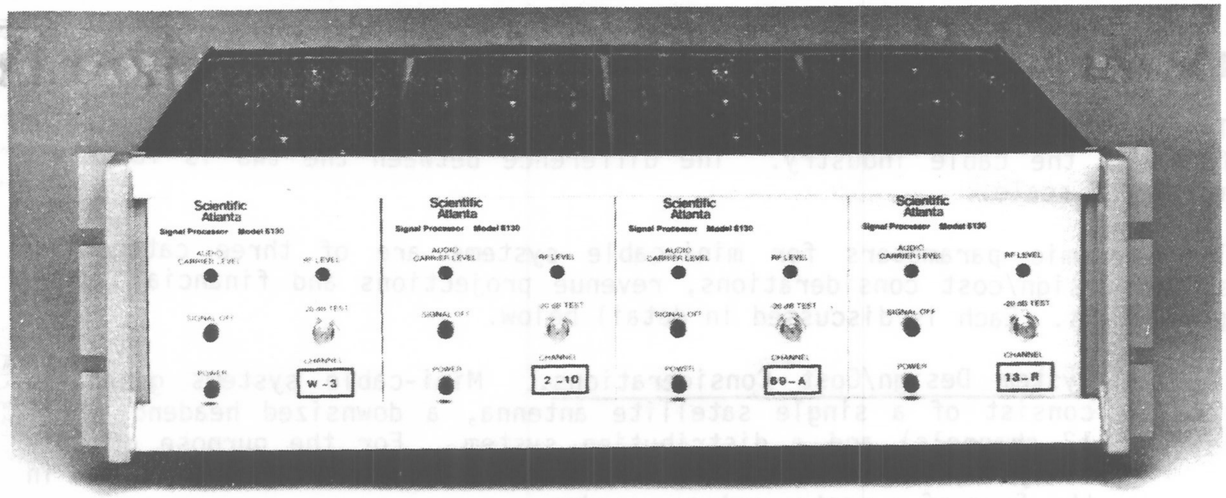


Figure 9. Model 6130 Signal Processor

Building a System

Off-air signals are combined with the satellite signals and possibly signals from a character generator or video tape player through a combining network or combining amplifier and, once on a single coaxial cable, distributed throughout the system. Further amplification may be provided by CATV line extenders or other low-cost broadband amplifiers. The "headend" electronics, as it is now known, is to be mounted in standard 19-inch racks with adequate spacing for optimum cooling and with ordered and labeled wiring. This will assist in an understanding of the system, as well as aiding in maintaining and troubleshooting the system.

If the rackup is designed and configured in the factory, the benefit of years of design experience may be utilized, and a record of the design is maintained to aid in system expansion at a later date. In addition, the system is tested and calibrated as a complete unit requiring only the addition of ac power.

The distribution system may take many forms. The older variety of daisy chain provides no security and may not always be capable of handling more than the VHF channels. A simple form of security can be provided by using "home-run" cabling. In this scheme, the household may be turned off simply by disconnection, although the cable costs are higher. For extensive systems or those with many channels or tiers, a conventional CATV network is most applicable.

A 36-channel converter is available from Scientific-Atlanta which provides security and flexiblity. For expanded needs, a 64-channel converter is also available in a programmable or addressable model. The option of addressability is open for pay-per-view and multi-tier systems. Thus, it is apparent that there are indeed similarities between the CATV and mini-cable network; the same quality of components, the same reliability backed by a vendor with extensive experience, technical expertise and a full field support program are required in both cases.