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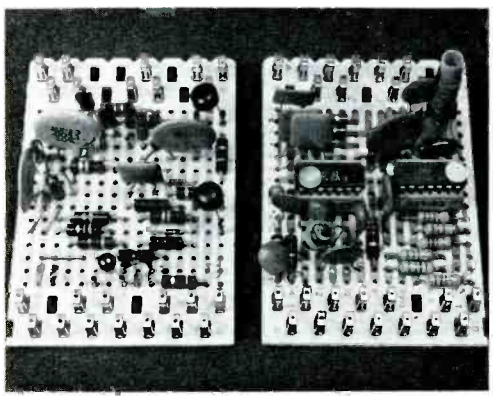
ELECTRONIC Servicing & Technology

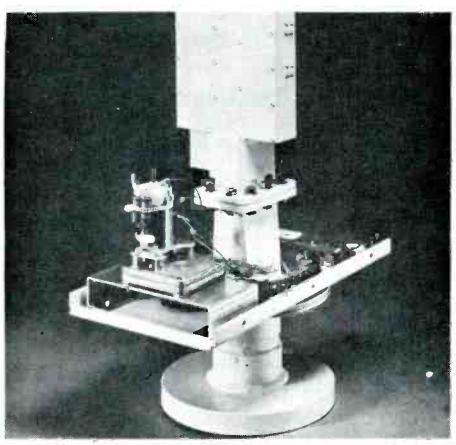
January 1982
Volume 2, Number 1

Satellite earth stations are bringing high quality TV transmission from around the world. See story on page 46. *(Photo courtesy of Heath Company)*

Page 11



Page 20



Page 46

DEPARTMENTS

ELECTRONIC SCANNER

Tandy reaches agreement with Matra S.A.

Tandy Corp. and Matra S.A. of France have announced that they have signed a definitive agreement to set up a manufacturing operation in France to initially manufacture TRS-80 model III microcomputers. The agreement is subject to approval of the boards of directors of both companies and formal approval of the French government.

Under the agreement a new corporation called Matra-Tandy Electronique, S.A. will be formed with initial capital of 20 million F.F. Capital will be contributed by each party pro rata to the respective percentage ownership. Matra and Tandy will appoint an equal number of directors for the new company.

The manufacturing company will operate from leased facilities in Colmar, France, near Strasbourg. Initial production should commence 60 to 90 days after French government approvals. Tandy Corp. will use all production of TRS-80 model IIIs in its European Economic Community retail store system. Matra-Tandy Electronique may also develop other new consumer and/or business electronics products for sale both to Tandy and others in the future.

Team becomes stocking distributor for RCA

Team Electronics Inc., a Long Island City, NY, Master Stocking Distributor, has announced that it has become one of the nation's Stocking Master Distributors for RCA video products. This now makes Team Electronics among the largest stocking distributors in the New York area for RCA's complete product line of CCTV equipment for the security and surveillance markets.

Fred M. Samuel, president of Team Electronics, indicated that "our continuing aggressive and creative marketing and sales efforts will be used to continue supplying high quality video systems and components to the security industry. Our continuing association with RCA has effectively strengthened our mutual efforts for a larger market share of this important industry."

Worcester Polytechnic Institute receives development system

Intel Corp. of Santa Clara, CA, has given Worcester Polytechnic Institute a complete Intellec floppy-disc based development system for developing software and testing 8086 micro processor designs.

"This will make it possible for the first time for our students to use the most current engineering practice in designing and testing their systems when using microprocessors in their required project activity," said Professor Donald Eteson of WPI's electrical engineering department.

Eteson heads the department's activities in teaching and developing microprocessor applications. "The Intellec system will be available to students in all academic disciplines, but we expect that the heavy users will be those in electrical engineering," said Eteson. "This system will enable us to do things not previously possible, greatly enhancing the learning experience.

"This system's use is directed toward the design function. It enables the engineer to try out a system design to be sure that it not only works as planned but that it works optimally. If there are flaws in the design circuitry, the Intellec system pinpoints them at an early stage. Once the design is optimized, the student may then proceed with the development of the application of a microprocessor to perform the specific task of his or her project," added Eteson.

Conrac monitors play role in reconnaissance

Video monitors manufactured by Conrac Division of Conrac Corp. played an important part in the recent flyby of the planet Saturn by the Voyager 2 spacecraft.

During the four-and-one-half month encounter period, more than 16,000 high-resolution photographs of Saturn, its satellites and rings were beamed back and displayed on a variety of these monitors at the Jet Propulsion Laboratory (JPL) Space Center in Pasadena, CA.

Scientists and the general public alike were enthralled with the image quality, revealing details previously unobserved with Earth-bound instrumentation. The high-resolution Conrac monitors were important in preserving the integrity of optical data transmitted over millions of miles of space.

In addition to the pictures, JPL's Conrac monitors were used to display data from the spacecraft in alphanumeric and graphical formats. The monitors are also part of an interactive computer processing system which performs graphic enhancement and alterations of the transmitted optical data.

Fuji perfects VHS 150-minute cassette

Fuji Film USA Inc. has announced the development of the first VHS 150-minute-long videocassette to receive the official sanction of the VHS license holder. Fuji's 2.5-hour (SP mode), NTSC-compatible VHS cassette will be sold to the duplicator market beginning early next year.

"While a few other manufacturers have begun to ship longer length videotapes, none currently on the market carries the sanction of the VHS license holder," said John Dale, vice president and general manager of the Fuji Magnetic Tape Division. "Fuji, working with leading hardware manufacturers over the past several years, has developed new technologies which have enabled us to manufacture a tape which satisfied the requirements of the licensor. We expect to see our VHS 150-minute cassette play an important role in the duplicator market, where it will allow lengthy feature films to be packaged on a single cassette."

Problems of tape transport, uneven winding and breakage inherent in thinner tapes have been overcome by Fuji through the development of a proprietary Duro-back coating and a unique lubricating surface treatment. Duro-back, introduced on Fuji's European E-240 videocassette last April, enhances the durability and running ability of the 17-microns-thick tape. The Fuji VHS 150-minute cassette performs comparably to the manufacturer's other fine-grain Beridox half-inch videocassettes.

New Nortronics' representative council convenes

Nortronics, manufacturer of magnetic tape heads and tape recorder maintenance products, has announced the inaugural meeting of its newly created Representative Council for the Recorder Care Division.

Ken Lubitz, national sales manager, discussed the primary motive for the council formation. "Our belief is that the reps can provide vital information for our sales growth goals. The sales reps possess first-hand knowledge of the retailers' needs. The council is, in effect, actually an advisory board. The four rep members received solicited information from our entire rep network. In essence, the views of over ninety people were expressed. They are all very much involved in our decision-making process and total market mix."

General topics reviewed at this unique meeting included the agreement of a council charter, incentive programs, trade show promotions, new products, pricing, merchandising and advertising. The group will reconvene every April and October in Minneapolis, along with reviewal meetings planned for the Consumer Electronic Shows. The council members will be alternated every two years with newly appointed representatives.

Tom Marchiano of TMC Sales commented on the success of the initial advisory board meeting. "Business is nothing more than person to person relationships involving specific products or services. When two groups join forces for a mutually constructive purpose, the industry as a whole benefits."

American satellite signs contract with Home Music Store

American Satellite Co. has announced that it will provide all-digital satellite transmission service for the Home Music Store, a new home recording service offered by Digital Music Company (DMC), a Washington, DC-based firm. The service will provide cable TV subscribers with master-tape-quality music for listening and licenses recording. The 5-year contract between American Satellite and the Home Music Store has a potential value of $30 million.

The service, scheduled for operation in July 1982, will be distributed to subscribers via

satellite using American Satellite digital transmission technology. The conversion of the music signal from analog to digital transmission guards against signal loss and background noise that would considerably lower the quality of the recording. A live demonstration of ASC's technical capabilities and the Home Music Service is scheduled for early May at the National Cable Television Association meeting in Las Vegas, NV.

RCA, Data Communications Corp. announce marketing agreement

RCA Broadcast Video Systems, Camden, NJ, and Data Communications Corporation, Memphis, TN, have announced a non-exclusive marketing agreement under which RCA will sell Data Communications Corporation's Master Control Automation system.

Carleton H. Musson, manager, studio products for the RCA activity, and Scott Pierce, president of DCC's Broadcast Division, said the agreement covers all segments of the television broadcast industry.

Master Control Automation is a fully integrated master control system, offering stations a data base common to both traffic and operations. The system allows operations personnel to automate on-air switching and machine assignments, verifies machine delegation and provides stations with up to five alternate schedule logs to support the main program log.

IECQ-system goes operational

A significant change in the international market for electronic components may occur because the International Electrotechnical Commission Quality Assessment System for Electronic Components (IECQ-System) became operational on January 1. This world-wide system should promote international trade in electronic components by offering purchasers an option to rely on the system's certification that a product meets a designated specification.

The system, ten years in planning, is expected to impact U.S. component manufacturers, whether or not they are active internationally, by giving users and buyers a wider selection of sources. As a result, competition should increase in both world and domestic markets.

Based on Commerce Department estimates, the electronic component world market included within the IECQ-System was more than $40 billion in 1980, and $26 billion of this production was in trade. U.S. production was $18 billion, with $3.7 billion in exports and $3.2 billion in imports.

J. R. Isken, Chairman of the Electronic Components Certification Board (ECCB), which is managing U.S. participation in the system, has characterized the system as "an opportunity to assure equal footing for U.S. and off-shore component manufacturers to compete in the world marketplace. In the longer view, it provides further opportunity to consolidate the ever expanding diversion of product approval requirements from the buying community."

General Instrument expects growth in cable electronics

General Instrument Corp. (GRL-NYSE) chairman and chief executive officer, Frank G. Hickey, told a meeting of security analysts that he expects continued growth in his company's cable TV electronics business in the future.

Hickey estimates that a total of 8.5 million cable TV subscriber terminals will be delivered by the industry this year.

"This is equal to 72% of all terminals installed during the previous 10 years. General Instrument expects to ship approximately 4.5 million subscriber terminals, or 53% of this year's industry total, once again attesting to the Jerrold Division's leadership position in the cable TV market," Hickey said.

R&D subsidiary formed by 3H Industries

3H Industries, a leading manufacturer and supplier of automatic test equipment (ATE), has announced the formation of a new research and development subsidiary. The new company will be called 3H Development Corporation.

The subsidiary was formed through an equal partnership investment between 3H and several private investors, but is wholly owned by 3H Industries. Halfon Hamaoui, president of 3H, will serve as president of the subsidiary.

According to Hamaoui, the new company will concentrate primarily on advanced product development in the power supply and analog component testing fields. It is currently being staffed with experienced ATE design engineers.

TELECOM and ifcom established as vital trade events

The first ifcom Cologne International Telecommunications Fair, held in conjunction with the telecom Germany '81 Congress for Telecommunications in Business and Industry, celebrated a successful premiere. After consultation with all those involved – users, manufacturers, associations and the German Federal Post Office – consideration is being given to the idea of extending ifcom in 1983 over an even broader basis.

The 3000 visitors from 20 countries attended the first ifcom, Nov. 7-9, 1981. The telecom Congress attracted 900 visitors from Germany and abroad.

Exhibitors from 134 firms and 13 countries came from the sectors of voice, data, visual, word and broad-band communication, radio equipment, communication systems, network management and training and research. In addition, there were representatives of the service and information processing equipment sectors as well as firms exhibiting components and sub-assemblies.

The exhibitors included 66 West German firms and 68 foreign firms, with the United States being the most strongly represented country (22 firms).

ES&T

ASSOCIATION NEWS

SAMPE presents electronic materials symposium

In recognition of the increasing importance of electronic materials to industry, the Society for the Advancement of Material & Process Engineering (SAMPE) has organized six technical sessions on electronic materials, comprising over thirty individual papers, to be presented at the 27th National SAMPE Symposium/Exhibition to be held May 4-6, 1982, at the Town & Country Hotel, San Diego, CA. This electronic materials thrust in SAMPE will offer unique informational and educational benefit to all of those involved in the many aspects of materials and processes engineering.

The sessions that will be conducted and their chairmen are:

- Printed Wiring Board Materials and Processes – Larry Hayes, McDonnell-Douglas;
- Materials in Microelectronics – James Licari, Rockwell International/Autonetics;
- Materials in High Performance Electronics – Phil Tjello, Boeing Aerospace;
- Materials in Space Electronics – Larry Sparrow, Comsat Laboratories;
- Metals and Ceramics in Electronics – Dean McKee, Naval Ocean Systems Command; and
- Resins and Coatings in Electronics – Jerry Bauer, M & T Chemical/Furane Products, and Stuart Lee, Ford Aerospace & Communications.

As can be seen, these sessions cover a broad and important range in electronic materials technologies. The area of printed wiring boards and substrates represents a basic building block for electronic circuitry packaging, and there are currently many important trends to meet the needs of emerging electronic technologies.

To meet new needs such as advanced hybrid microelectronic packaging, a session on materials for microelectronics has been included.

NEDA restructures officers, board and executive committee

In a significant restructuring of NEDA's top governing structure, the NEDA Board of Directors recently enacted bylaw changes that reduce the executive committee to seven members and the board of directors to 18 members. Two officer's positions were eliminated and three were changed to reflect functional responsibilities. Terms of office were lengthened to two years, beginning April 1, 1982.

In order to make the board a more workable size, the chapter director positions were eliminated, reflecting the fact that the 11 district directors have in recent years fulfilled the need for liaison between the chapters and the board. Now, district directors plus the national officers constitute the board.

The executive committee, which consisted of the officers plus the district directors, is now made up only of the officers. The purpose of this change was to make the committee better able to meet as needed without having to draw out as many people. It will now be easier for the committee to fulfill its role as an executive planning group to make policy and strategy recommendations to the board.

EIA/CEG elects 1982 officers

At the Electronic Industries Association's 58th Annual Fall Conference in San Francisco, the EIA/Consumer Electronic Group elected 1982 officers and reviewed all existing and proposed industry programs, according to Jack Wayman, senior vice president of EIA/CEG.

Ray Gates (Panasonic Co.) was elected chairman of the board of CEG and chairman of its Video Division, succeeding Lud Huck (General Electric) in both positions.

William E. Boss (RCA) was re-elected vice president of the EIA/Consumer Electronics Group.

Harry Elias (US JVC) was chosen chairman of the CEG Audio Division for 1982, succeeding Jeff Berkowitz (Panasonic/Technics). Reese Haggott (Alpine Electronics) will be chairman of the CEG Car Audio Subdivision in 1982, taking over the position held by Jack Doyle (Pioneer Electronics) in 1981.

Dick Komiyama (Sony) was elected chairman of the Video Systems Subdivision, succeeding Tony Mirabelli (Quasar Co.), and Don Rushin (3M Co.) was named chairman of the CEG Blank Tape Subdivision, taking over from Al Pepper (formerly with Memorex).

ETA aids in vocational competency project

The Electronic Technicians Association has included forms in their recent newsletter for the American Institutes for Research vocational competency project. The institute is asking employers and supervisors of electronics technicians to spend a few minutes reviewing a listing of job tasks for a new test they are developing. They want to make sure that this test covers the kinds of knowledge and performance capabilities that are actually required of electronics technicians.

The test is being developed under government sponsorship for nationwide use as a means of improving educational programs and providing information to students regarding their progress in acquiring specific occupational competencies. The test should also be useful to employers in selecting new employees and for objectively evaluating the training needs of present employees.

If you are interested in participating in the project, please contact Louis A. Armijo, Vocational Competency Project, American Institutes for Research, P.O. Box 1113, Palo Alto, CA 94302, (800) 227-8868 (toll-free, outside California) or (415) 493-3550 (person-to-person collect).

ES&T

READERS' EXCHANGE

Needed: Power transformer for Mercury model 204 tube tester, part #9967312. *Keith Zarin, Keith's TV Service, 285? Gallows Rd., Falls Church, VA 22042.*

Needed: Service manual and parts list for AKAI model M-9 tape recorder. Will buy or copy and return. *Vernon Tiger, Service Manager, Team Electronics, West Acres Mall, Fargo, ND 58103.*

Needed: Hickok model 388 CB in-line tester; B&K model 1077 TV analyst; schematic and service manual for EMC model 700 RF/AF crystal marker/generator. *Caswell Davis Jr., 601 Delmar, Apt. 2, San Antonio, TX 78210.*

Needed: Schematic for 1953 Seeburg amplifier, model MRA3-L6 (Seeburg jukebox model 100W). Will buy or copy and return. *Al Perea, 3368 Firestone Rd., Charleston Heights, SC 29405.*

Needed: B&K TV analyst, model 1077B. State condition and price. *Max Emerson, Rt. 2, Box 345, Weslaco, TX 78596.*

Needed: Schematic and service data for Dynaco stereo 120 audio amplifier. *J. R. Chaves, 9768 Michaels Way, Ellicott City, MD 21043.*

For sale: Approximately 250 boxed tubes (mostly new) for older radios and TVs, $45.00 plus shipping. *Gordon Handy Jr., 300 Vienna Drive, #214, Palm Springs, FL 33461.*

For sale: B&K CRT restorer and tester, model 465, $165.00 *Douglas Haustein, 94 Winans Ave., Cranford, NJ 07016.*

For sale: B&K 1077-B analyst, $200.00; RCA WO-33-A 3-inch scope, $65.00; Heathkit TT-1A with late adapter mutual conductance tube tester, $75.00, plus postage. *Ken Miller, 10027 Calvin St., Pittsburgh, PA 15235.*

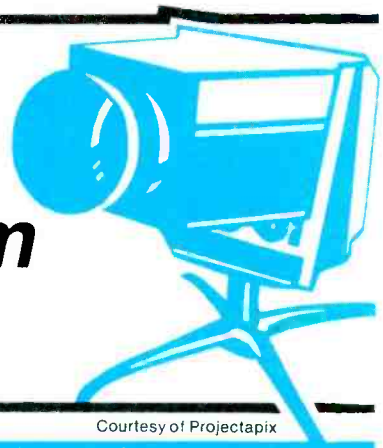
For sale: B&K 1230 color generator, $75.00; B&K 280 digital multimeter, $60.00; Sencore TF151 transistor tester, $70.00. *Robert Garrett, 1259 Carl St., Alton, IL 62002, 618-465-8950.*

For sale: Sencore SC60 wide-bander scope, $1550.00, 5 months old. Also a B&K 467 CRT tester and rejuvenator, $275.00. Price includes shipping. *George Lazoryszak, 4432 N. Chadwick St., Philadelphia, PA 19140.*

ES&T

How to build a giant screen TV system

by Bob Fischer, president, Projectapix, Ltd., New York



Courtesy of Projectapix

The technological breakthrough in projection TV lenses and screens, now lower in price because of mass-production techniques, has brought the trendy *do-it-yourselfer* into action. Now, for the first time, a technically oriented person can build a giant screen system at low cost and enjoy the life-size TV program viewing that other people have paid thousands of dollars to acquire.

If you've priced giant screen systems, you know how expensive they are. But, having one right in your own home now puts you into an era of breathtaking video viewing. For the sports-minded, it has no equal for watching spectator sports. In fact, it was the local taverns that first introduced giant screen projection television. Now, according to surveys, it's what everyone wants!

Lenses are ultra-fast screens brighter

Where once surplus lenses and movie screens were used by the early do-it-yourselfers, now there's no need to experiment and take chances. There's also no need to sit in total darkness in order to see a projected TV picture. New lenses are ultra-fast and deliver both brightness and sharpness, and new projection screens are highly efficient for gathering the lighted screen image and optically reflecting it back to the viewing audience because of the compound-curved surfaces.

The major expense is starting out with a color TV set from 10 inches to 17 inches, measured diagonally. After purchasing a projection lens and giant screen, the rest is up to you. If you can work with tools, particularly in woodworking to make a cabinet, chances are you'll be in the manufacturing business making additional systems for relatives, friends and neighbors. No matter how amateur your work, you will still be able to watch giant size screen action because the TV set, the lens and the projection screen are the three basics that don't change.

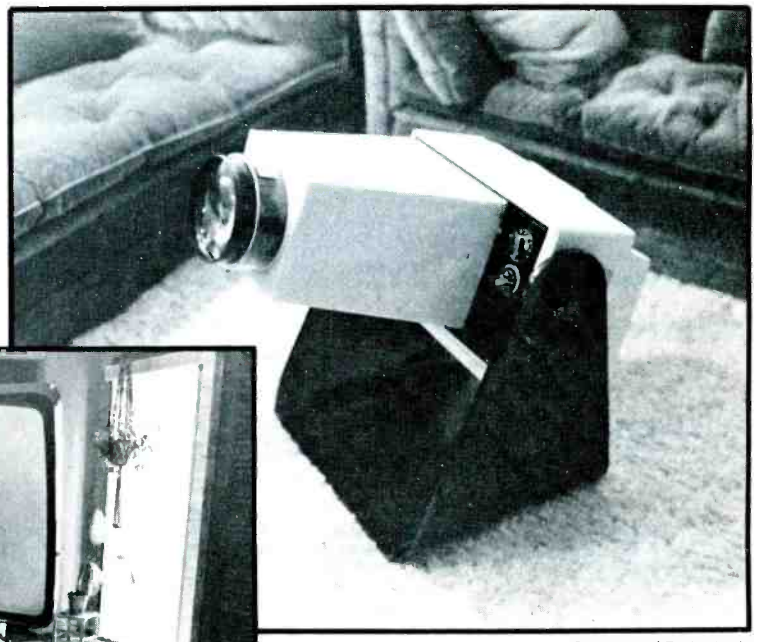
Purchasing a TV, lens and screen

For the past six years, a number of lenses and screens have come onto the market; some excellent and many unusable for intended projection. Many do not provide a sharp picture and are sold by promoters strictly as a gimmick. The worst thing that you can do is to act too quickly. Take your time in buying your lens, for it is an extremely important component in your system. Find out if there is a money-back guarantee so that you can return the lens if not satisfied with its performance. It's possible that you have no idea what should be expected. You can, therefore, possibly end up with an earlier year's lens and screen. You may even pay a lot more for these inferior components. Your purchase should incorporate the best in today's technology.

Determine the type of system you want

Basically, there are two types of projection systems: direct-to-screen and mirror reflective. You can go the easiest route to assemble a direct-to-screen or 2-piece system. You will then have a TV

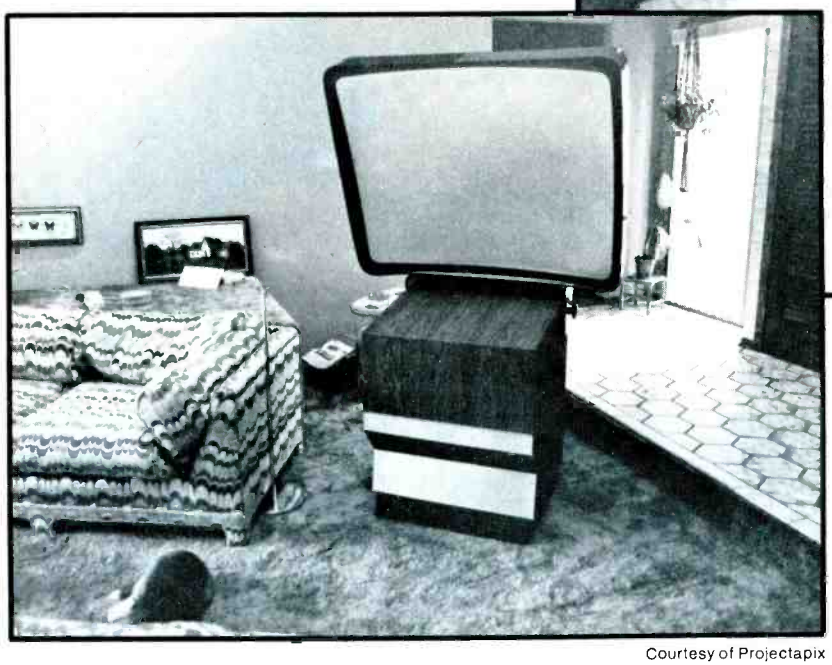
Giant screen TV



Courtesy of Projectapix

Figure 1. With a two-piece system, (right), the screen is separate from the TV set and lens.

Figure 2. The one-piece system, (below), contains all the required components in a single cabinet.



Courtesy of Projectapix

set, with hood and lens attached to it, resting on a base in front of you about seven feet from the screen. Or you can go the difficult route and construct a mirror-reflective (1-piece or stand-alone) system that has everything housed in a cabinet with a screen above it. The recommended way to go is to start with a 2-piece system, then slowly design and build your 1-piece.

Rear projection system

However, there *is* a third type that has entered the market called *rear projection* which projects through a special screen material from the back side and is viewed from the front. This rear screen fabric requires extremely bright light and is not suitable for 1-gun (CRT) systems.

The present systems are bulky and take up a good deal of space. Unless you have an extra-large living room or den, you are going to be overwhelmed by a huge projection system. It has its possibilities, and is ideally built into a wall with access for servicing that may be required at some later date. Small rear screen projection systems can be assembled where the brightness off the 1-tube (CRT) imagery is not spread out over a large screen area. Rear screen material is available in various intensities of very dark, dark, medium and light.

Before using this system, be sure to check out samples of rear screen material before deciding on the hue you will use. Light screens will produce washed-out color that may be disappointing; a darker screen produces dark color imagery turning to black. To date, rear screen projection still requires some improvement.

Starting with a bright color TV set

If you have an old TV set, preferably with a screen of 10 to 15 inches, you can start with this set, although you must remember that the picture tube becomes less bright with age. The new color TV sets are much brighter with a vertical rectangular matrix mask that delivers much more brightness than the old dotted matrix masks. Some of the better sets have an electronic beam lens built into the neck of the picture tube that adds sharpness. If you are going to just add a hood to the front of the TV set, make sure that there is some kind of a lip around the picture tube so that you can attach it easily to the set. If you are going to house the TV set in a cabinet, you have already solved your hood attachment problem.

The best place to look at new sets is in a large department store or TV discount outlet where a larger choice of brands are on display. Inspect the 13- and 15-inch sets, especially for brightness, for they are the best to work with. A TV set, if you can get the specifications on it, with the high voltage between 23 to 25kV is excellent. Most of the new sets have a picture tube with a slight curvature of the face, although there are a few with more extreme curves. If the picture tube has a severe face curve, stay away from it because it may present a problem of out-of-focus corners when used for projection.

Take your time in making your selection. The name of the game is good brightness. Don't let anyone raise the high voltage up for added brightness. It is not necessary in today's TV sets. This not only in-

creases the radiation hazard but will lower the life of the picture tube by years.

If you are purchasing a new set, try to get the store's service department to make the change your set will require. You will find the details covering this change further on in this article. If you want a good set for projection, Sony is the leader and the highest in price. Other off-brand TV sets, such as Gold Star, Citek, Bohsei, Portland and Samsung are ideal and are more economically priced to save you money.

Projectapix Component Book

Projectapix has a 12-page informative book (810510) covering projection screens and stands, screen fabric, floor bases, glass/acrylic/fresnel lenses and lens flanges. For a copy of book, enclosed 38¢ in stamps to cover the postage required so it may be promptly mailed.

Selecting the lens

You have a choice of three different types of lenses: glass, acrylic and fresnel.

Glass lenses are the sharpest, although they have the drawback of being lower in brightness (an average f/stop of f/2.4) and very expensive.

Acrylic lenses have optics similar to glass lenses; are moderately fast, with an f/stop of about f/1.85 to f/1.9; have a little less sharpness and are priced a little lower.

Fresnel lenses are recognized by their concentric grooves, similar to a phonograph record, and can be molded from acrylic in much larger diameters, giving greater brightness with an f/stop of about f/1.4 to f/1.5 for a double element 8-inch lens in a 8¼-inch housing.

The Projectapix fresnel lenses are relatively sharp, provide excellent brightness, and represent a technological breakthrough in that the finely spaced grooves can be molded because of advanced mold-making techniques available today. Nevertheless, there are numerous old elements that are worthless and are being sold for unbelievably high prices. In purchasing a lens, buy one from a reputable source of supply.

As a suggestion, start out with a fresnel lens first. It will be less costly and much brighter because of its large diameter. All lenses for projection should have a 12-inch (approximate) focal length for the best in results.

Selecting a projection screen

Five years ago, there was little choice to be made in a projection screen. Most were flat, beaded or lenticular movie screens, or sensitive, untouchable models that could be permanently marred by simply touching the reflective surface. The size was also limited to a 4-foot diagonal model (30" x 40"). Today, screens are touchable, washable and brighter (20-over-white). Their sizes can range from a 3½-footer to a super 7-footer.

If you are buying a screen, consider a 5- or 5½-footer rather than the 4-foot size of earlier years, unless your projection system is to be installed in a small room or study. The 6- and 7-foot sizes are for commercial installations and should not be considered for home use. A perfect screen is optically curved 30° vertically to reduce the light reflected and lost to the ceiling and floor where non-viewers are, and curved 60° horizontally so that all viewers who may be sitting on a long sofa will see the identical bright imagery on the projection screen.

If you are planning to mount your screen on the wall, try to borrow a screen stand when you purchase your screen. Set your screen up on it and move it around until you have determined exactly where the screen is to be mounted. Often, the screen is mounted in the wrong wall position, either too much to the right or the left, too high or too low. By using a stand, you can determine the precise position for its placement.

Projection requires subdued lighting

Any form of projection, whether it be home movies or a slide show, requires subdued lighting. Whether you own a very costly 3-tube projection system or a 1-tube type that you've just purchased or built, a low light level is important. Your projection screen is sensitive to light; 20 times more sensitive than the light that can be reflected off a flat white painted wall. For that reason, keep your lights at a low level and off to either side of the screen; never where it will desaturate the projection screen by combining with the projected light that is reflected back to the viewing audience with washed out colors. For pleasing effects, mount a fluorescent fixture behind the projection screen if a higher level of light is desired.

With today's bright TV sets, lenses and screens, you are not required to sit in an almost dark area, such as in a movie theater, although some light planning is

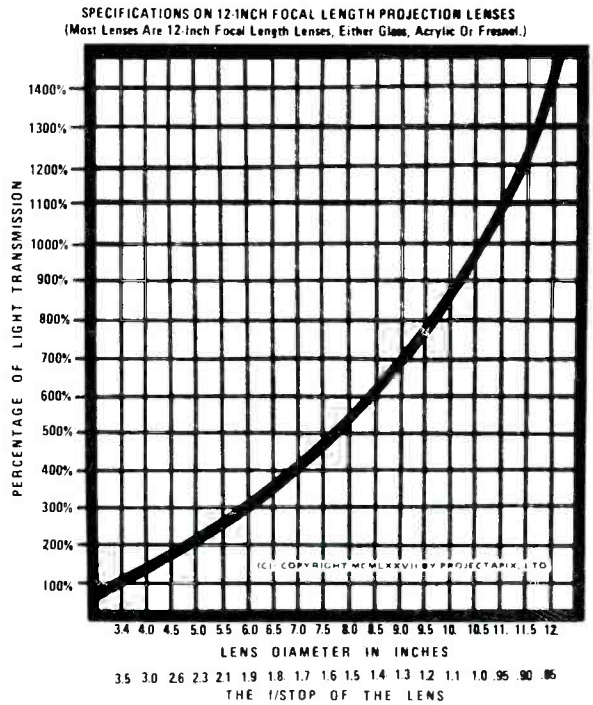
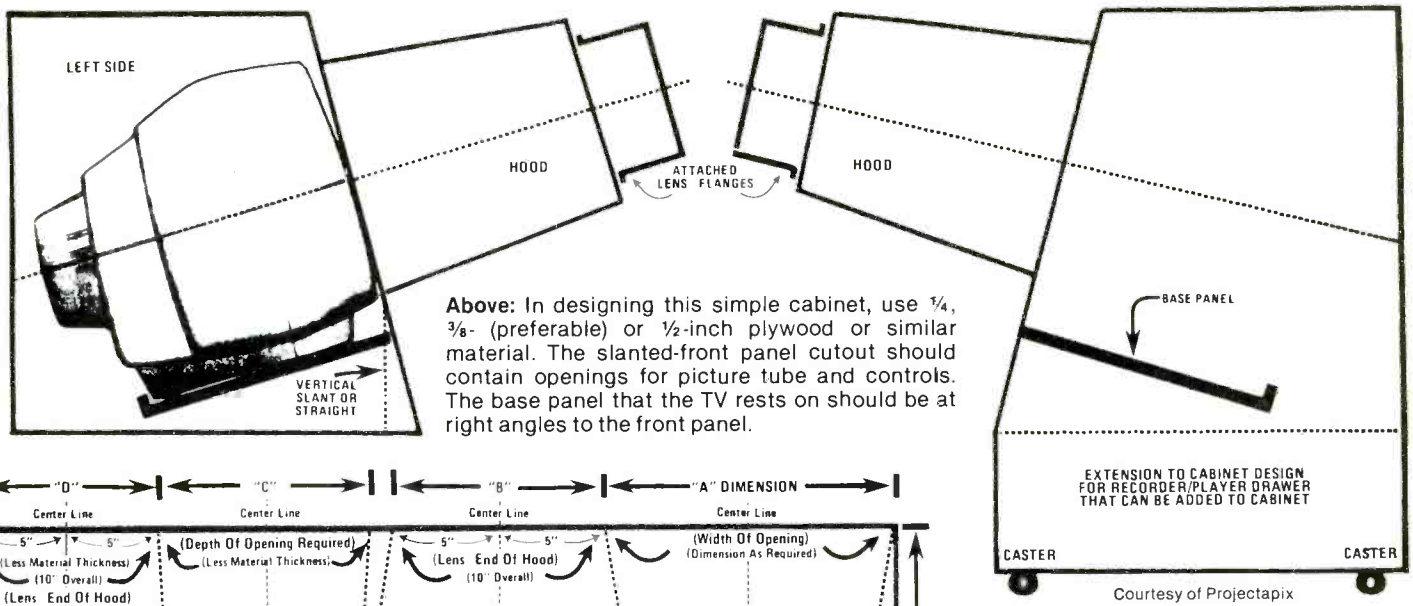


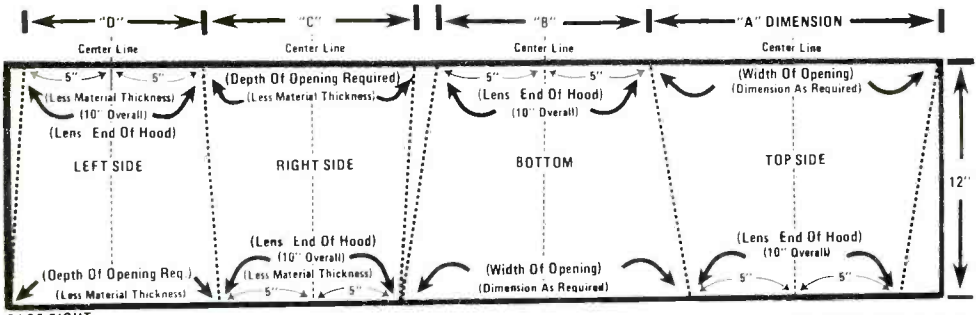
Figure 3. Most projection lenses are fixed at a 12-inch focal length, so this factor cannot change. The only measurement that can is the diameter of the lens, shown on this chart in inches. The f/stop is shown below the diameter measurements. The curved line shows the percentage of light transmission as the diameter of the lens increases. As an example, a f/1.0 lens must be 10½ inches in diameter, which means it must be in a housing with an 11-inch diameter.

Giant screen TV



Above: In designing this simple cabinet, use ¼, ⅜- (preferable) or ½-inch plywood or similar material. The slanted-front panel cutout should contain openings for picture tube and controls. The base panel that the TV rests on should be at right angles to the front panel.

Courtesy of Projectapix



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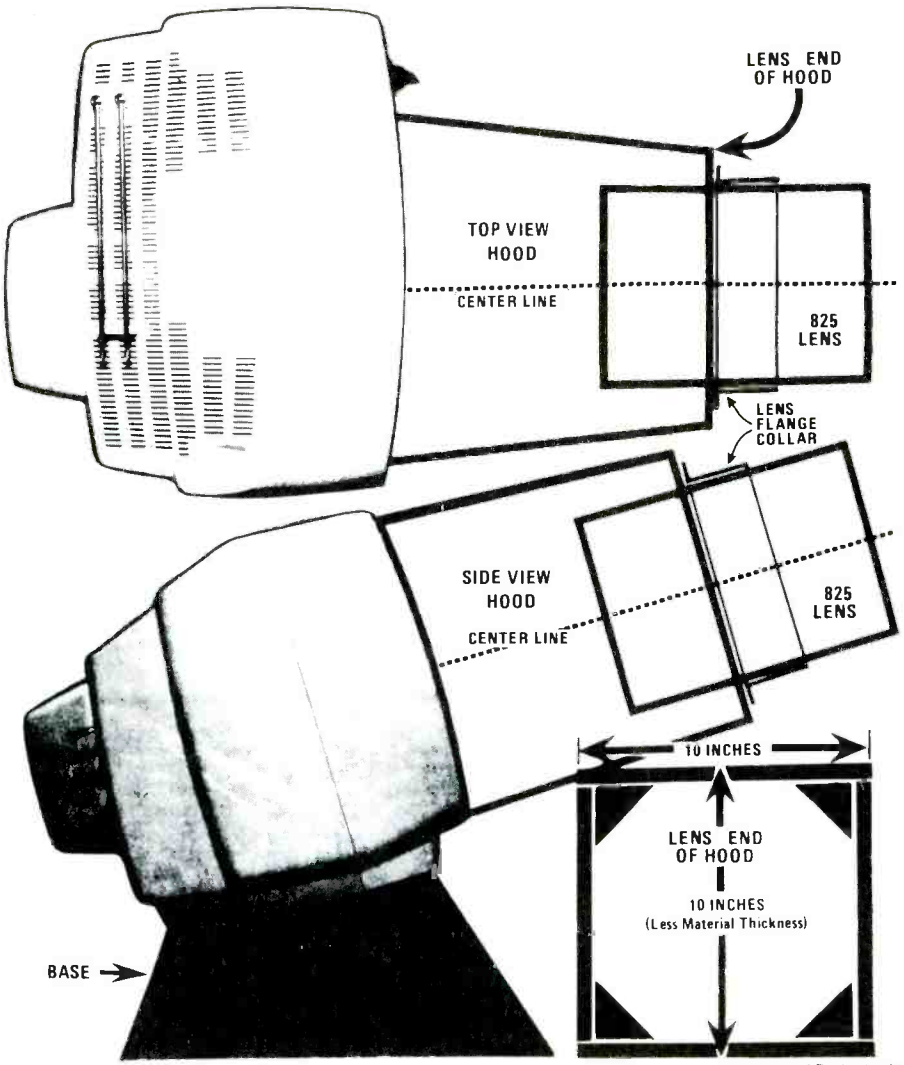


Courtesy of Projectapix

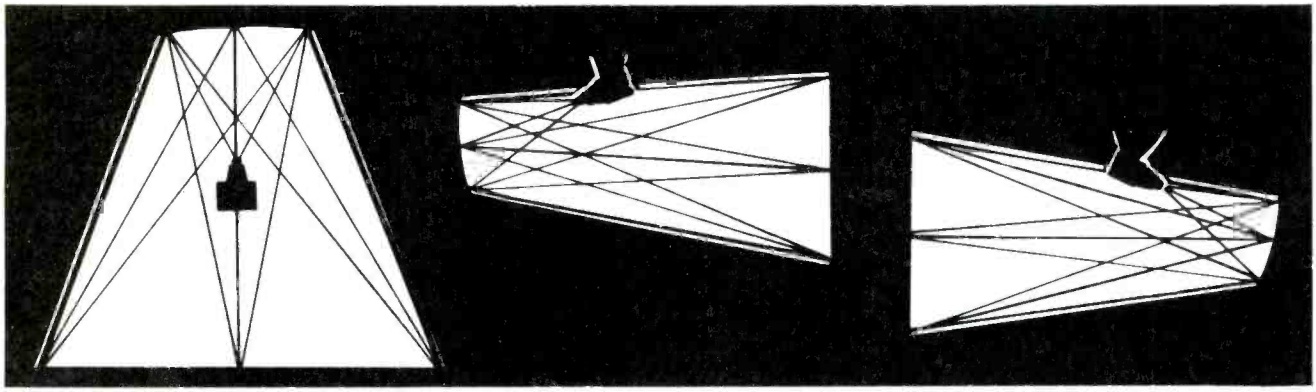
How to measure for the hood

Measure width necessary for your hood at open end side ("A" dimension nearest CRT) and mark. Divide this figure by two and use a square to mark center line. Lens end of hood should be 10 inches (5 inches on each side of center line). Bottom side of hood should be exactly the same, with lens hood end ("B") 10 inches wide. Open end of right side ("C") should measure depth required for hood, minus twice the thickness of the material being used. Top and bottom pieces always fit over the edges of the side pieces.

When completed, fasten together and add front 10"x10" lens mounting plate after making the hole required for the lens.

The basic cabinet design is outlined so that the home handyman can easily lay out, cut and assemble a cabinet to house the TV set being used for projection, preferably a 12- or 13-inch one. The design shown here has a low profile and will not interfere with viewing if placed in front of a sofa or chair. A larger table top may be added if desired. Illustration at right incorporates a drawer for a recorder/player that can pull out from either the front or back.

Plywood is best (⅜-inch, one side finished) because it can be nailed and glued easily. After it is completed, sand and paint, stain or cover with formica-type surface material. Add casters (1½ or 1¾ inches) to complete your project.



Courtesy of Projectapix

Figure 4. Projectapix screens cover a 60-degree horizontal area where brightness is required with little light loss to the non-viewing areas as illustrated (left). The paraboloid curve optically reflects concentrated brightness where it is required for best viewing enjoyment. By tilting the screen to the correct viewing angle (center and left), the 30-degree vertical projection directs reflected light into the viewing area for increased brightness and less loss to non-viewing area.

necessary to eliminate direct light from desaturating the projection screen surface.

Using a flat, roll-up type movie screen

In starting out, you may want to use a regular movie roll-up screen to try out your projection TV system. However, this flat screen, with a beaded (about 5-over-white) surface, is not efficient in reflecting TV imagery back to the viewing audience. A flat lenticular (about 7-over-white) screen is not much brighter. In a dark room, you will be able to view a program to test things out although the imagery will be dark. If you have access to a Kodak Ektalite Screen, this is very good and about the best without going into the paraboloid (compound-curved) projection screen required for projection television. At the same time, a screen that is flat may develop a hot center spot and present other problems. For test purposes, it is better than nothing but don't continue to use one.

When projecting through lenses

When you project anything through a projection system, whether it is color slides or home movies, the film is inserted in an upside-down, wrong-reading position. This is then corrected by the lens when it is projected onto the screen. One supply house, advertising a less expensive lens, suggests turning the set upside-down after building the hood and inserting the 1-element lens and an angled mirror to change "wrong reading" to "right reading" for proper viewing. However, this information does not take into consideration the earth's gravitational pull as it relates to the TV set's color trimming magnets, which are right behind the yoke and should never be touched unless you have a signal generator. Also, TV sets are designed for operation right-side up and should be kept that way.

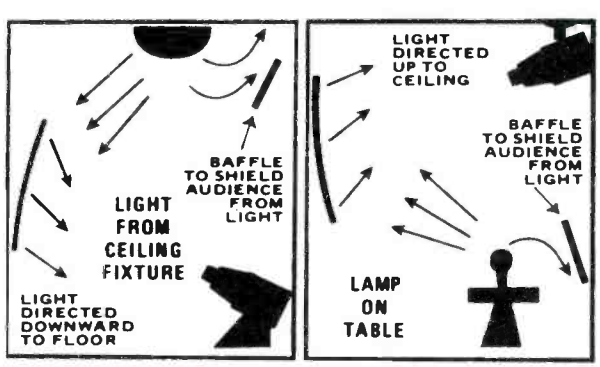
Modifying the new TV set for projection

To start out this section, we must offer you a word of caution. If you do not know how to make the vertical yoke change, don't attempt it. You can get involved in expensive repair work if you switch the incorrect wires. If you are an electronic technician, and have a Sam's spec sheet on your TV, you'll be able to find the vertical yoke wires. If you're a novice, we suggest you pay the price (about $15) to have this work done by a local TV shop or store. As suggested earlier, if you have just purchased your TV set, try to get the store's service department to throw in this modification work.

In modifying a TV set, you must change the picture tube imagery so that you have an upside-down, wrong-reading picture for direct-to-screen projection. When the imagery is projected through the lens, it is then changed. When a regular TV set, with a hood and lens added, is projected onto a projection screen you will see an upside-down, wrong-reading picture. To modify the TV for projection, two of the four wires going to the set's yoke are changed. In most sets the color-coded wires run red, yellow, blue and green, although some TV manufacturers use other colors to code their wiring. Some Sony sets have their vertical wires (which are changed) coded solid white and white with blue trace line. Switch the verticals for direct-to-screen projection and also switch the horizontals for 1-piece projection. The change is simple once you modify the first one.

Deciding on projection system

By now you've decided on what type of system you are going to build. If it's a direct-to-screen system, your troubles are few, particularly if you plan to simply attach a hood to the front of the TV set itself. If you plan to house it in a cabinet, suggestions on this follow. If it's a stand-alone (self-



Courtesy of Projectapix

Figure 5. Projectapix screens are sensitive to light. Because of this, room lighting should be planned to that ambient light reflects off to non-viewing area. Direct light, if improperly placed, will desaturate the screen and cause washed-out colors.

Self-contained systems

Stand-alone (self-contained) projection systems offer a challenge to anyone who is handy with tools, has a knowledge of cabinetry and is able to figure out distances and angles. Because the TV picture (CRT) tube size and the focal length of the lens doesn't change, the projection distance will only change if the size of the screen changes.

The practical approach is to construct a direct-to-screen (2-piece) system with a 5-foot screen. Then, while it is in operation, use the system for the take-off of all the measurements. Design the cabinet to accommodate the TV set size, preferably using one mirror rather than two, and with the TV set resting on its base as it does normally. Often, a TV set will present color problems because of the gravity change of the magnets when it is positioned on its back and first reflected upward to one mirror, then forward to the larger one that angles the imagery to the screen overhead. As it is, brightness is reduced each time a mirror is used (more than twice as much when two mirrors are used) because the projected imagery must pass through the glass thickness of a mirror twice. A ¼-inch plate glass mirror represents a ½-inch thickness of glass that the light must pass through. The same distance will remain, from CRT to screen, although you will be concerned with the distance from front lens element to the screen's surface.

Your drawer should be adjustable for fractional angling of the picture in order to frame imagery to fill up screen and adjustable for the distance of the line of projection. Each time the drawer is brought forward an inch, the projection line distance increases by two inches. Use a screen stand to hold the screen, before permanently installing it, and adjust height to its lowest obtainable position, angling it so its optical return reflection is at its brightest for viewing. Try to design your cabinet for a low profile so viewers do not have to raise their heads up too high to view the TV programming on the screen. The mirror for the drawer should measure approximately 14" x 18" overall and be 1/8- to 3/16-inch thick.

Giant screen TV

contained), your problems are many. First you must decide on the dimensions required for the TV set you expect to use in it; second, whether it will be a 1-mirror or 2-mirror system; third, you will need different measurements to use a 4- or 5-foot screen.

We suggest that you visit different showrooms and carefully inspect the various designs possible. Some suggestions are presented later to aid in your endeavors. Although Projectapix has some old plans available at a nominal price, we suggest that you put this project on the shelf until after March 1982 when Projectapix will offer a new design that may be an easy project to follow.

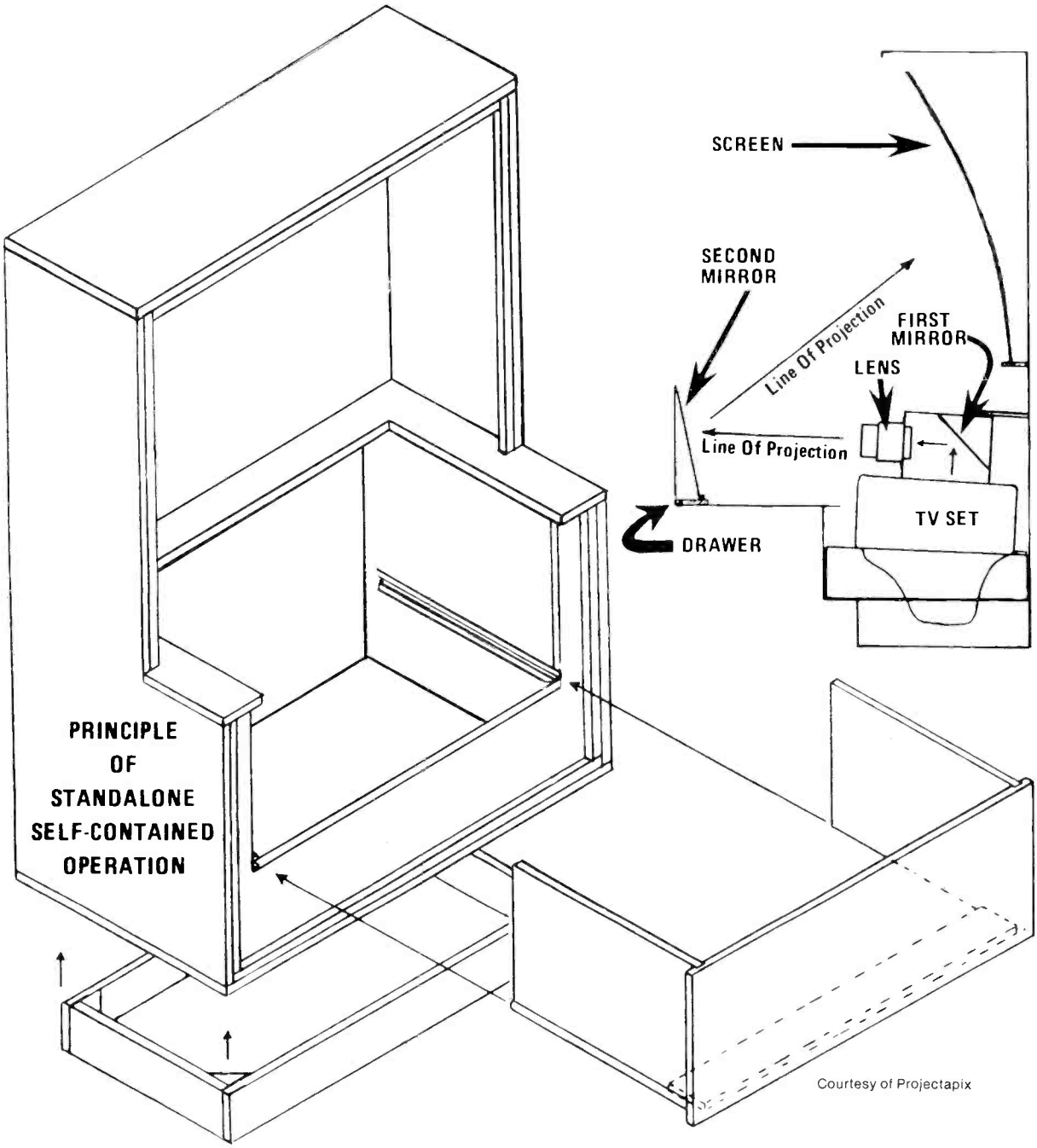
Whatever way you decide to go, take your time and try to turn out a professional job. You are building *a* TV projection system but, when you have finished your project, other members of your family, relatives, friends and business acquaintances will see what you have and will want one, too. If you do a good job, you may all of a sudden find you're in a new business venture. With technological breakthroughs in lenses and screens, the projection system you build will be economical, more likely to be trouble-free because you're using a solid-state TV set, and bright enough for anyone to enjoy. You are building a projection system that is within the reach of everyone. It's the newest way to view TV programming and a status symbol in neighborhoods everywhere. It's the newest, fastest industry going and there's plenty of room in it for a person familiar with basic electronics and who is handy with tools.

Constructing the projection hood

To construct the projection hood, first determine the type of material you are going to use. The hood may be attached directly to the TV set or contained in a cabinet that you will build. You may experiment with heavy artboard to determine angles, if necessary. Plywood, sheet metal or acrylic sheets can be used. It all depends on what you are experienced in working with. Your hood should project no more than 12 inches from the picture tube (CRT) face. The front part of the hood should converge into a 10" x 10" square so that you can use various sizes and types of lenses. The Projectapix "825" or "Pro-2" lenses are both ideally suited for your projection system and are excellent in brightness, clarity, imagery transfer and color resonance. You will require an 8⅜-inch hole for the 825 2-element lens and flange; a 6⅝-inch hood hole for the Pro-2 3-element lens and flange front assembly. When laying out the material, be sure to take into consideration material thickness used before cutting. To attach hood to TV set, your task is to figure out how to do it with the TV set you are using. Some TV sets have an extended lip that the hood can be screwed onto. Other sets may need some type of hardware to hold the hood on the TV set front panel. Projectapix side clips can be used for most attachment applications, either inside or outside the hood. They are available in sets of three; one each for the sides and bottom. If the set is inside a cabinet of your design, the attachment of the hood is no problem. Some builders use a long piano-type hinge (available in most hardware stores) that runs across the top of the hood. In this manner, the hood may be raised for periodic cleaning of the picture tube and hood section. Each TV set requires a different attachment solution, which changes as new TV sets are introduced into the marketplace. That is why no definite instructions can be given for a specific TV set as well as providing a standardized type of hood that can be universally used for all TV sets.

Finishing off lens front end of hood

If you have followed instructions, your hood should measure 10-inches square at the front end that holds the lens and lens flange. If not, it is not a problem. The big problem is the other open end. Does it fit the TV set front panel or the cabinet front you've built? If it does, simply make your lens panel to the dimensions required. Some builders use a sheet of acrylic for this front piece. Whatever you use, be sure that you make the proper hole for the lens before you attach it to the hood. Draw a diagonal line



Above left: Illustration shows a typical cabinet construction composed of a base, main structure and slide-out drawer. A one-mirror system consists of a TV set resting on its base and pointing forward to the large mirror, which angles it directly up to the screen above. Because the projection distance from lens to screen is a factor, a one-mirror system requires a long drawer.

Above right: Illustration depicts the design of a double-mirror, self-contained projection system. The TV set is positioned on its back, slightly off on an angle of 5°. The overhead hood contains a front surface mirror at a 45° angle, which then reflects the TV imagery through a lens onto a second, larger mirror. This mirror angles the image to the projection screen above.

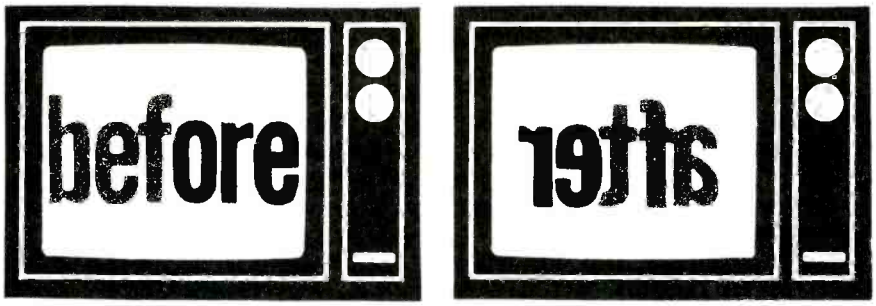


Figure 6. When projecting imagery through a lens, the image is inverted to an upside-down, wrong-reading picture. Therefore, before any television set can be used for video projection, it must be modified by making a change in the vertical yoke.
Courtesy of Projectapix

Giant screen TV

from each of the opposite corners to find hood center. Then use a compass to make the circular cutout needed. Use a coping saw and take your time making the cutout. When completed, check to see if lens slides through the opening freely. If everything appears to be okay, you can permanently glue and nail frontpiece to hood.

Fitting pieces together

If you seek a professional job, you must make a hood of exact dimensions required for the TV set. As you proceed in your hood building, you may be faced with other challenges. The set you are using may have a curved front. This will require a similar curve to match for the open hood to fit snugly against the case. If you encounter such a curve, try to do the work before you glue and nail the hood together permanently. Before attaching hood, spray the inside with a flat black paint to finish it up.

Attaching lens flange collar to hood

The lens flange collar should not present a problem to mount. Just make sure that it is centered over the hole properly before fastening into place with screws or nuts and bolts. Insert the lens into its flange and make sure it can be moved inward and outward freely. You will need this adjustment to focus the lens for sharp imagery on your projection screen.

Allow for ventilation

Whatever cabinet you decide to build for your projection system, be sure to allow some sort of ventilation for the heat that is generated by the TV set. For best cool air circulation, vent the bottom (or underneath) portion of the cabinet. Provide other vents at the top of each side or portion of the back panel. Heat rises so air intakes should be low, outlets should be higher up.

Front panel design, layout and cutting

The front panel cutout for the picture tube (CRT) must be planned so that it is evenly centered within frame; between top and bottom, between left and right side. Run a piece of tape diagonally from corners across the CRT face (refer to illustration in Figure 7) to aid in ascertaining center. Now, step back and look through the lens flange hole into hood and check to see if the "X" is exactly centered. Then, mark this position for attachment of hood. If the controls of your TV set are directly underneath the picture tube area, a long, narrow cutout should be made for access to the knobs. The control panel cutout, for changing the channels and On/Off/Volume, should be planned carefully so that there is sufficient, easy access to operate them. Before applying the finish, sand your cabinet and/or hood. If painting, follow the directions given on the paint can label, particularly for the undercoat that may be necessary. If you are finishing the surface with a formica-type overlay, follow the instructions from the manufacturer for its application. In this way you'll be assured of a lasting professional appearance.

Your project offers design creativity

You are making a "one-of-a-kind" projection system through your creative efforts. An instruction manual cannot provide complete step-by-step directions that cover every problem that you may encounter. Projectapix can supply the basic elements, such as the lens and screen. What you do with these two component parts is up to your creative ability. By knowing approximate distances required, you can design different projection systems. You can construct your coffe-table-type model, or build your system into an end table or perhaps hang it from the ceiling. You might even build a wall bookcase with your screen in the center of it. As you go along, you'll get ideas that you can incorporate into a distinctive system that is all your own. Naturally, after you build your first one, you can always improve upon it. That's what is nice about projection television, almost everybody wants one so you can sell it easily and start on your more improved one.

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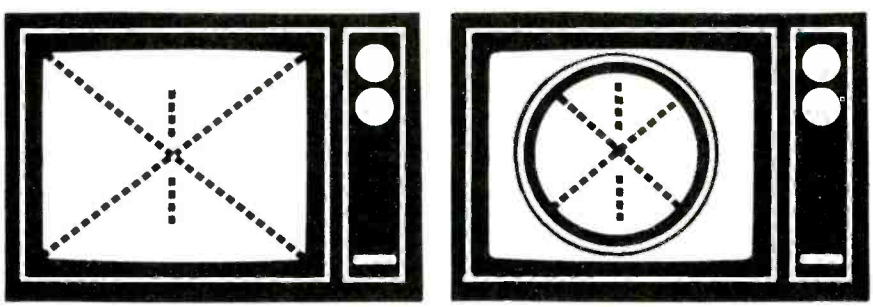

Figure 7. Before permanently attaching the hood to the TV set front panel, you must center it. Do this by running tape diagonally across the CRT from corner to corner, as illustrated. Then step back and look through the lens flange hole to the screen. The tape "X" should be in the exact center, as shown. Courtesy of Projectapix

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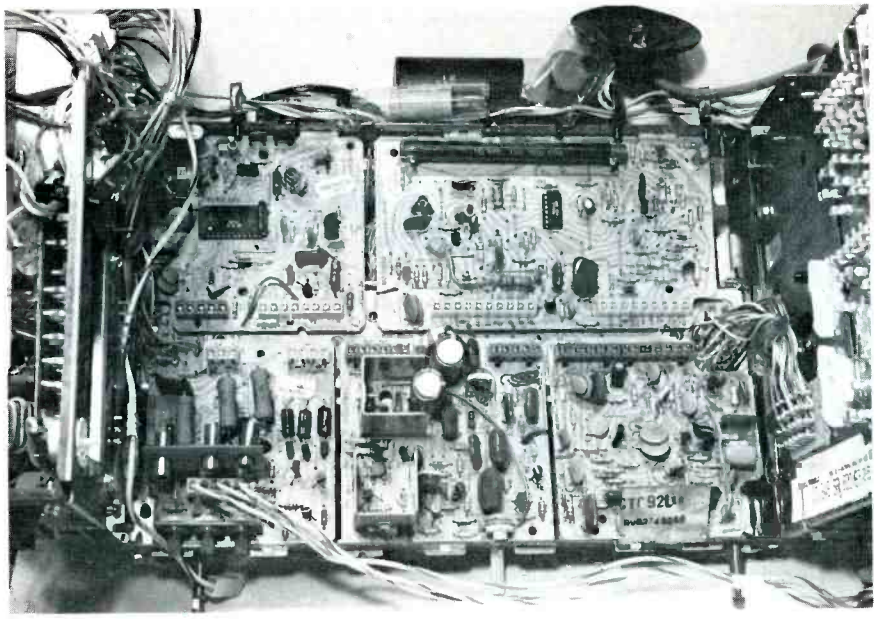


These are the plug-in modules of RCA CTC92L receivers: upper left, chroma module; upper right, luminance/video/sync module; lower left, matrixing/CRT-drive module; lower center, vertical module; and lower right, horizontal-oscillator module.

Servicing modular color TV receivers

The change to solid-state active components in color receivers eliminated easy testing of vacuum tubes by replacement. Some of this lost convenience has been restored in many newer color receivers by plug-in modules that permit the replacement of whole sections. Suggestions are given for efficient servicing of modular models.

By Homer L. Davidson

Servicing solid-state color TV receivers is greatly simplified when plug-in modules are employed. Analysis of the symptoms usually indicates which module is to be replaced. This is similar to the preliminary troubleshooting of older models, where a specific tube was suspected according to the symptoms observed. However, there is no standardization of modules. Zenith modules cannot be used in any other brand.

The lack of standardization produces some complications. One brand might place the vertical and horizontal circuits on one module. Another might have the vertical sweep, horizontal oscillator, sync separator, most of the video stages and the color/luminance matrixing stages on a larger module.

Modules are also connected and mounted by different methods. In one of the first RCA chassis that used modules, the modules were mounted edgewise to the main chassis by spring-loaded sockets (Figure 1). Some Zeniths had modules mounted parallel to the chassis by female spring-loaded sockets that mated with male socket prongs on the chassis (Figure 2). Several Magnavox models connected the modules by male and female spring-loaded sockets (Figure 3). These connectors were straight-inline and right-angle types that permitted edgewise or flat mounting of various modules.

Late-model RCA color receivers employ a single main chassis, but the electronic tuning systems have modular connectors. The male and female connectors between the tuners and the tuner-control shielded modules are shown in Figure 4. These connectors permit exchange of modules during servicing.

Current model Zenith System-3 color receivers have no actual chassis. Instead, a framework holds the modules in grooves, while the wiring passes through many spring connectors (Figure 5) that contact edge-connector sections on the modules. Module connectors are located and spaced to prevent accidental incorrect insertion of modules. Obviously, no module that is rotated 90° or 180° during replacement has the slightest chance of normal operation, but there is a strong possibility of damage to chassis or module components.

Another possible complication is the difficulty of a technician knowing what basic circuits are on the various modules. Some components are distinctive in appearance, and those identify a few circuits or systems. However, a system such as horizontal oscillator and deflection might be spread over two or three modules.

For these reasons, it is vital that each technician have a schematic with chassis and module layout drawings or photographs. If the data are not available during service calls, look for a module location and function chart inside the cabinet. This information is essential for troubleshooting by the symptoms.

The following sections offer suggestions for locating the defective module.

No sound and no picture

Symptoms of no raster and no sound can be caused by defects in the low-voltage power supply, the horizontal oscillator module or the horizontal-sweep circuit.

First, check the circuit breaker and all fuses. If these are normal, or are reset and replaced without any improvement, replace the low voltage module and (after an operating test) the horizontal-oscillator module. Also, an easily made dc-voltage test at the collec-

tor (case) of the horizontal-output transistor will prove whether or not the low voltage is reaching the output transistor. The horizontal sweep and high voltage system will not operate without this supply voltage.

Analyze the voltage measured at the horizontal-output transistor collector. Zero voltage indicates a power-supply defect or an open in wiring between the supply and the collector. Excessively high collector voltage hints at zero current in the output transistor. Alternately, the supply-voltage regulator might be defective, causing excessive dc voltage that may have triggered the shut-down protective circuit. Shut-down circuits that eliminate all horizontal sweep when activated are an innovation that began two or three years ago. Technicians are urged to study articles previously published in **Electronic Servicing & Technology** (formerly **Electronic Servicing**) because the circuits are too varied and complicated to be explained in a few words. Always keep in mind the possibility of a shut-down circuit defect or a normal reaction to excessive high voltage that has eliminated the horizontal sweep.

Low voltage modules consist principally of diodes, transistors, filter capacitors and resistors and can be repaired easily. Diodes and transistors can be tested in circuit, although ohmmeters are not the best instrument to use. A more accurate test is the voltage drop produced by a constant current flowing through a forward-biased diode junction, as described on pages 30-32 in the July 1980 issue of **Electronic Servicing.** Several digital multimeters include this excellent diode test that can evaluate individual diodes in a bridge, even in the presence of filter capacitors and other components.

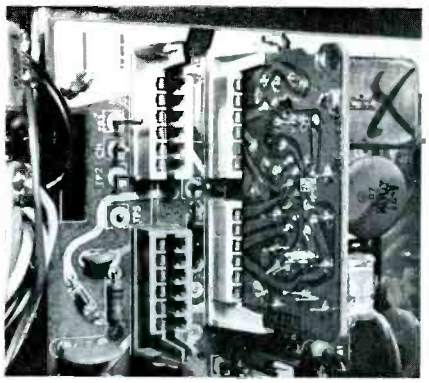


Figure 1 Early modular RCA receivers had many modules mounted edgewise to the chassis in spring-loaded sockets.

Resistors can be tested in-circuit, if the schematic shows no components that would invalidate the accuracy. Of course, all resistors should be examined visually for evidence of overheating. Voltage-regulator transistors should be removed for external tests of possible junction leakage or when suspected of intermittent operation.

Sound without raster or high voltage

Program sound (perhaps with buzz or noise) without high voltage generally indicates a total loss of horizontal sweep and/or high voltage. Therefore, those symptoms indicate problems on the supply regulator or horizontal-oscillator module. In most cases, replacement (rather than component repair) of both modules is recommended.

If the original symptoms remain after both modules are replaced, the horizontal-output collector voltage must be measured, followed by other dc-voltage tests and scope-waveform analysis to determine where the horizontal signal is lost. A normal stable drive waveform at the output transistor's base proves the horizontal-oscillator module is operating correctly. However, a slightly erratic drive waveform might hint at a defective filter capacitor that is producing critical horizontal or vertical locking or erratic deflection.

Insufficient height

Some models have all components of the vertical-sweep system (except deflection yoke) mounted on one module, so replacement of an original module with a known-good module usually eliminates the height problem. Some exceptions include defects in the supply voltage or voltages that power vertical sweep.

Careful external tests should be made on vertical-output transistors that are not mounted on the module (perhaps on the metal chassis). If one of a pair tests leaky, both should be replaced.

Another often-ignored cause of missing or insufficient height is the large-capacitance electrolytic that couples vertical-output signal to the deflection-yoke winding. Values range between 470μF and 4700μF. An open capacitor reduces the height severely or eliminates it. Capacitor leakage can cause failure of one or more of the vertical-output transistors.

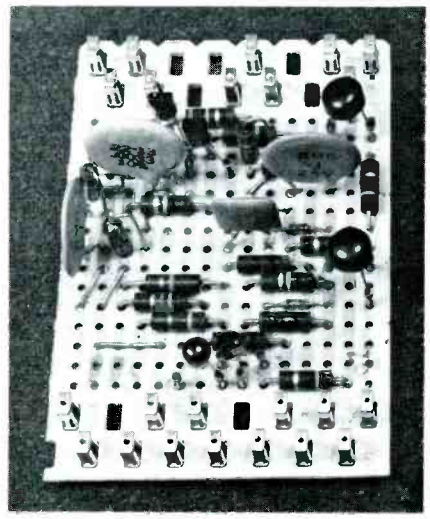


Figure 2 The first Zenith modular models used metal-prong connectors on the chassis that mated with these female spring-loaded connectors on the modules (which were parallel with the chassis).

No raster but HV is normal

These symptoms indicate problems in signals or voltages applied to the picture tube. Failure of the CRT screen-grid voltage or loss of heater voltage are two common possibilities. An open delay line usually eliminates the visible raster.

Most solid-state models employ pre-CRT matrixing followed by three power color amplifiers that drive three CRT grids or cathodes (usually cathodes). Therefore, a defect in the luminance channel (or some defects common to all three color amplifiers) can raise the dc voltages at the CRT cathodes and cut off all brightness. An early measurement of dc voltages at the CRT socket is recommended to localize the type of defect.

Module suspects include any that have luminance stages or matrixing/amplifier stages. Often the matrixing color amplifiers and one luminance driver transistor are placed on a module that includes the CRT socket and other components.

Modular color-TV receivers

Many problems of excessive brightness, insufficient brightness or incorrect gray-scale tracking (tinted raster color with color control turned down) originate in the matrixing/power-amplifier stages. Any defect that causes increased conduction in the three power color amplifiers (reduced collector voltages) raises the raster brightness, often causing picture blooming with poor focus and retrace lines.

Weak contrast perhaps with snow

Low contrast can originate in many sections of TV receivers, including tuner, IF amplifiers, video detector, luminance amplifiers or picture tube, but auxiliary symptoms are different for each.

Reduced contrast in tuners is often accompanied by excessive snow. Overload on strong signals occurs many times when IF stages produce low contrast. A defective video detector might overload on strong signals while weakening the contrast. Obviously, low gain in luminance stages will reduce the contrast. A weak-emission picture tube will exhibit low visible contrast, but usually with poor focus and improper gray-scale tracking.

AGC defects produce several symptoms, depending on the precise malfunction vs. the signal strength. Excessive AGC to the tuner causes excessive snow on carriers of moderate strength, and reduced AGC to the tuner might cause overload on strong signals. Logical evaluation of all symptoms is required to localize most of these problems.

Drifting fine tuning can originate in the tuner or, in electronic tuning units, the drifting can begin in the control circuits. Check by using a substitute test tuner (tuner subber) to prove the origin of the drifting.

Color defects

Almost all color problems originate in the color IFs and demodulator stages, and replacement of the chroma (or color) module should restore proper color operation. However, there are a few color problems that originate in other circuits.

Incorrect fine tuning weakens or eliminates the color when mistuned to one side and causes unstable pictures with beat patterns in the color if mistuned in the other direction.

Defective or misadjusted color-killer controls can cause the color

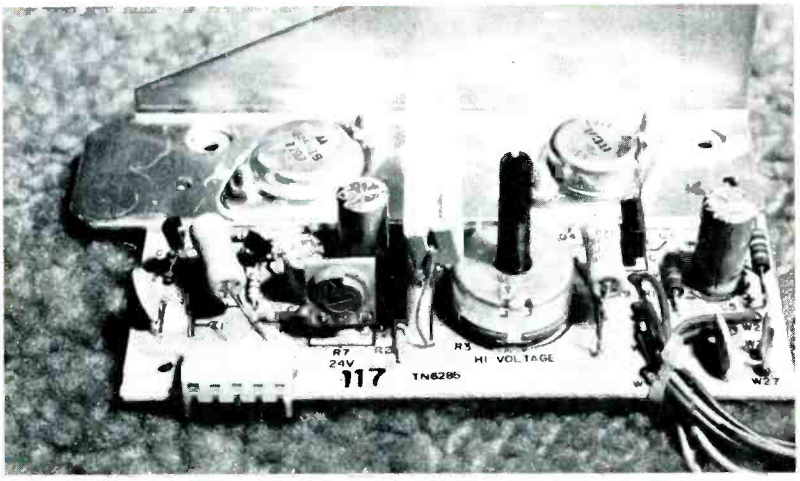


Figure 3 Spring-loaded connectors (one at left foreground) were used in many Maganavox modular receivers.

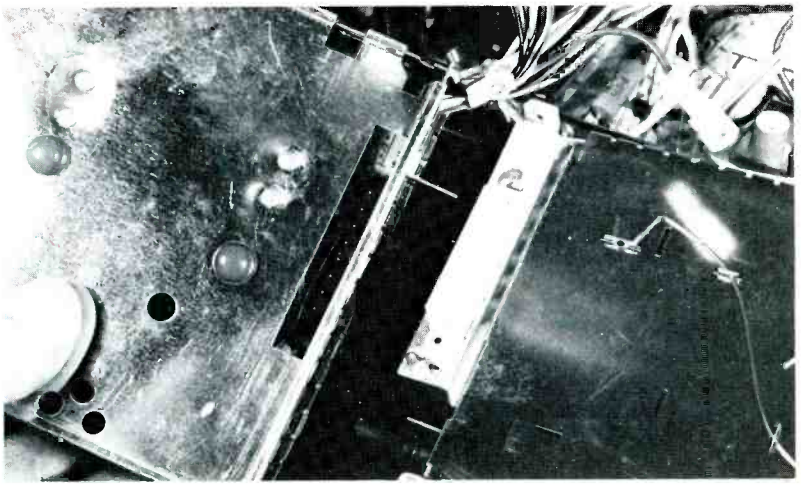


Figure 4 Late-model RCA receivers have one larger chassis, so are not true modular types. Connectors are used in the electronic-tuner system. The multipin connectors shown here are between tuner and tuner-control sections.

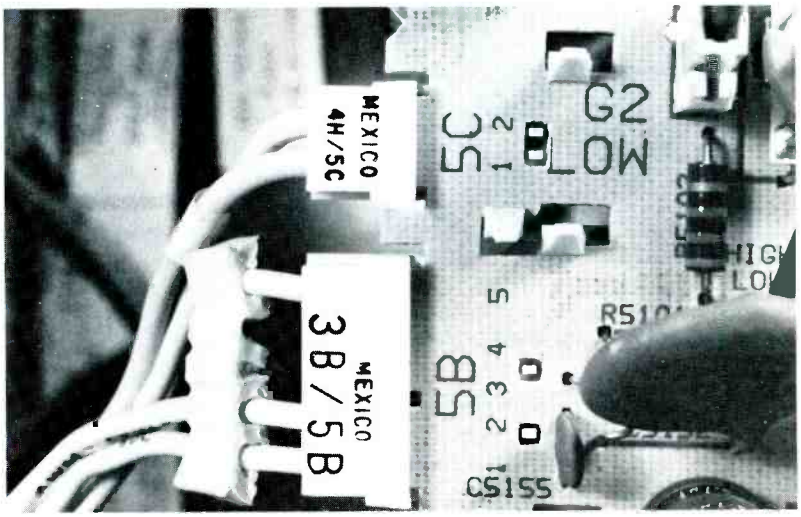


Figure 5 These clip-in cable connectors are the link between modules of the new Zenith System-3 models (which have no chassis).

to be erratic or missing. At the other extreme, a misadjusted or defective color killer that fails to eliminate the chroma gain during black-and-white broadcasts can allow confetti (color snow) to be visible. If the receiver has a color-killer control (some new models do not), it should be checked according to the manufacturer's specifications in all cases of intermittent color.

MODULAR SERVICING CHART

No sound or raster
- •check for open fuse
- •check circuit breaker
- •check or replace low-voltage module
- •check or replace horizontal module
- •check power-supply diodes
- •measure low-voltage supply
- •check regulator transistor

Sound but no raster
- •check for open CRT heater
- •check high voltage
- •check matrixing and color amps
- •check dc voltages at CRT socket
- •check for open CRT-screen fuseable resistor

No sound and no raster
- •check low-voltage supply and high voltage
- •check for shut-down condition
- •use low line voltage to stop shut-down
- •check for shorted damper diode or regulator transistor
- •check for shorted horizontal-output transistor
- •check horizontal-oscillator module

Normal sound and HV, but no raster
- •check for open heater in picture tube
- •check picture tube
- •check picture-tube dc voltages, especially screens
- •check for defective matrixing amplifiers

Weak contrast or snowy picture
- •replace the IF/AFT module
- •measure IF/RF AGC voltages
- •attempt to adjust AGC

False or weak colors
- •replace chroma module
- •test or replace matrixing/luminance circuits
- •check color killer and fine tuning

Horizontal is impossible to lock
- •replace AGC/sync module
- •replace horizontal-oscillator module
- •check for an X-ray safety hold-down operation
- •defeat hold-down temporarily to prove overvoltage condition

No height or poor linearity
- •replace vertical module
- •test and/or replace external output transistors
- •check electrolytic capacitor that feeds yoke
- •check for open yoke or convergence circuit

Vertical cannot be locked
- •replace AGC/sync module
- •replace vertical module
- •check fine-tuning adjustment
- •check for operation of safety hold-down circuit

Weak or distorted sound
- •replace sound module
- •replace IF module
- •check or replace speaker-coupling capacitor

Figure 6 This chart shows general procedures for servicing specific trouble symptoms in modular color TV receivers.

Sound problems

Replacement of the sound module should cure most sound problems. However, detector or IF defects can force video buzz into the program audio, even when the sound system is normal. Hum from a power-supply-filtering problem is sometimes heard, although the primary defect is not on the sound module.

Electrolytic capacitors that couple audio to the speaker should be checked if module replacement does not cure distortion. These might be outside the module.

Many new models have no individual transistors on the sound module. When one integrated circuit is the only active component, replacement of the IC usually eliminates the majority of sound defects. Intermittent ICs sometimes can be forced to malfunction or operate correctly by spraying coolant.

Speakers with rubbing voice coils can produce audible distortion, especially at low volume. Connect a test speaker to verify this possibility. Also, substitute the electrolytic-type capacitor that often couples audio to the speaker. This has been the source of many tinny or distorted sounds.

Comments

Use care when replacing modules. They can be cracked or broken by too much pressure or flexing.

Corrosion on module contacts can produce erratic symptoms. Do not use tuner spray on these contacts. The flat areas can be cleaned by rubbing with a clean pencil eraser. Do not apply liquid cleaner to any contact springs unless the type is specified by the manufacturer.

Problems are encountered occasionally when power-on tests are attempted on modules that are in crowded or inaccessible areas. Extension cables can help here. Most module circuits can be satisfactorily repaired by technicians who have proper service data and good test equipment.

ES&T

Satellite TV receivers:

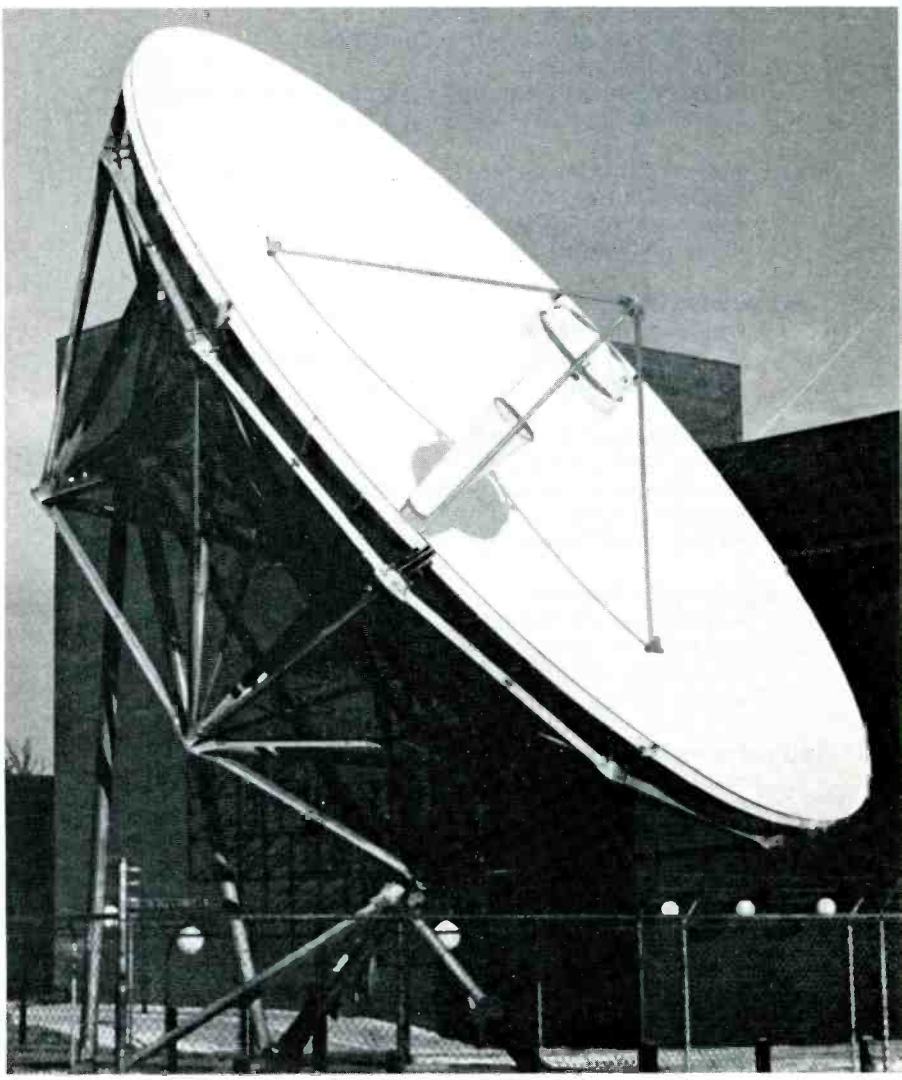
THE NEW MONEY MAKERS

By Rick Towers, *Clearwater, FL*

Our store is big in video gear. In one room, we show every big screen TV that is on the market today, so when we decided to invest in an earth station receiving system, it was natural to pipe the signals into that room. When people started switching through the dial, watching on a 7-foot screen, and knowing that they were looking at all those programs coming down from space, it really had quite an effect. People started saying, "I think I'd like one!"

Our first sale was to a ranch owner who could receive local TV, but not cable. When he asked me about it, I agreed to install a system for him. As I started to get deeper into it, I soon discovered that many suppliers, other than the commercial ones, really didn't know what they were doing. As with any new industry (remember that this one is only about a year-and-a-half old), there will be many advertisements that look good and promote low prices. Some were even small operations working out of a garage. I would order a piece of equipment only to find it was completely unacceptable. I'd send for a dish, and the mounting would be so sloppy that it required re-engineering. This first experience was so frustrating that I was about ready to give up. Yet, people kept asking, showing a definite interest.

On the first system we installed, we learned a great deal and probably took a bath financially, but my partner and I realized that if we were going to supply these systems, we would have to become well acquainted with the market place. We attended seminars and made contacts with the manufacturers and soon became aware of what comprised a good system and what was simply junk. To date we have successfully installed 19 earth stations; one of them for an ABC TV affiliate.



A transportable dish

Let's say your store is in a position to get a good deal of exposure. You might want to put an earth

station in front of your store – possibly on a trailer – and you may sell from it. If you're going to get into this business, you're probably going to need to have one to show because it's pretty hard to sell a customer on a concept alone. The idea of mounting the dish on a trailer allows you to tote it around and demonstrate the system without spending hours setting it up.

When we have a serious inquiry, we request an application fee to be paid on advance. Then we can take our demonstration dish to the customer, set it up where he believes he would like to have it and see if everything works. Remember that the signals involved with the earth station are really microwave-type signals. By taking a demonstration system to the prospective customer's location, you can find out if there will be an interference problem as a result of microwaves used on land for radio, television and telephone communications. There could be a link that runs right over the property that would cause problems.

Also, with a mobile demonstration dish, we can set it up at the buyer's location and check to see if anything is blocking the line-of-sight path to the satellite. The signals received by the earth station aren't like those from your local TV and radio stations. If a tree or building is in the road, you will have trouble. With our mobile station we have been able to check out a number of things that may have caused problems had we just brought a system out and installed it.

Finally, in the testing process, we can hook the system up to a television and see how the signal looks. For the customer to see it in our store on the 7-foot screen or on any of our sets is one thing, but for him to see it on his own television is another. The field demonstration gives him confidence in the final installation before final payment is made. If everything works and he still wants us to install the system, the application fee is applied to the purchase price. If he decides not to go ahead with the deal, the fee pays us for our time in making the tests.

Legality question

A number of people have asked if this type of system is legal. Well, if Channel Master has gone into it, and now Zenith is working with Heathkit to provide systems, it is certainly no longer a closet-type business. At first we told people that we wouldn't install systems because we weren't sure. But after extensive reading, we concluded it is not illegal to provide a customer with a downlink or receiving system. There are possible problems. Be careful about putting a system into a bar, a condominium or a hotel unless arrangements have been made for licensing. What you put into a home for private use is one thing, but distributing signals to neighbors or making videotapes and selling them is a different situation. Just tell the people that it's for private, noncommercial use only.

Earth stations vs. cable

What if you are in an area where cable TV distributes signals from an earth station? We don't believe that cable in the area will have much effect on sales and installations of earth station receiving systems. The cable company will deliver only what they have a practical market for. If they have one dish focused on one satellite, they have a potential to sell 10 or 12 of the channels. If there's a program on another satellite, they are not going to build another dish just for that channel unless there's a tremendous demand for it. But if you have your own dish, you can reposition it to face any satellite.

We are often asked about direct broadcast satellites (DBS) and what effect they might have on sales of systems. The DBS will be carried on the Comsat bird, using a higher frequency than the systems we are dealing with. The transmitted power from the satellite will be in the area of 100W. With higher power and higher frequency, they predict you will be able to use a 2-foot dish.

It is quite different from the satellite business today, however. There will be only three channels and by the time that system comes into being, the projected prices of $500 will amount to a great deal more with inflation. Also, we don't know what will be there worth watching. The cable companies charge from $40 to $50 a month for a full package. You can bet that that will be premium programming. In that case, the premium programming is not likely to be on the direct broadcast satellite because it is not likely that they will be able to get that kind of a market. The biggest advantage to direct broadcast satellites for the home will be in areas where good television from local signals is not possible.

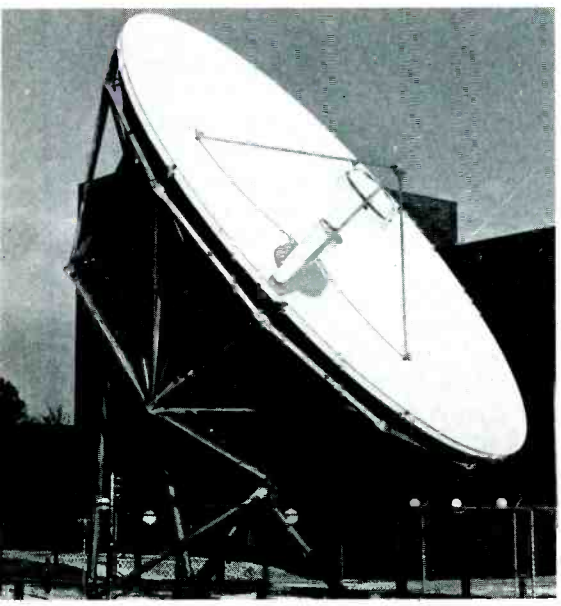
The question of fees and releases also comes up. According to our attorney, because we are not the builder or the ultimate user, we do not need to have a release from our customers. As far as any fees, we include in our brochure the statement that certain programs are protected by copyright law, and that viewing of copyright programming may require a license. Of all the programming sources, only Showtime has responded to any of our inquiries and they asked us to put the statement in the brochure.

We recommend that our customers join an organization called SPACE (Society for the Private And Commercial Earth stations) for about $25 a year. You join the association to protect your rights of having private earth stations. For your fee you get a monthly newsletter to let you know what kind of legislation they are fighting.

There are certain situations in which you could run into fees for particular channels being used. If you install a station in a public place, a fee may be charged to offer the movie channel or ESPN sports. If you write to ESPN and you are in a non-cabled area, they will give you a rate based on what they figure the average seating is in the establishment. The fee is about $2.20 per five years per user.

Generally, if the particular programming group is commercially sponsored, the fee they charge for use in a commercial establishment will be low. The movie channels, HBO, etc. have no other source of

Satellite Receivers



revenue so they need to charge a higher fee.

We have approached hotels and trailer parks with the idea of putting in a 24-hour movie service. The net cost to the operator is around $4 a month per hookup. It cannot operate on a paybox, keybox or with any exclusions. It must be there all the time, and cannot be controlled or charged for separately. You might raise your room rates accordingly, but you cannot knock off $4 a night for someone who doesn't want the service. The contracts are fairly liberal, as long as there is a controlled environment for the product. A set on a movie channel in the lobby of the hotel would not be accepted, according to their contract.

The equipment needed

Let's consider some of the equipment involved. As it turns out, the most popular programming right now is on Satcom 1, which is also the weakest of the signals to receive. It should soon be replaced by Satcom 3R, which will have more power. Generally, a 10-foot dish will work for almost every place in the United States.

The signal beamed down from the satellite is basically centered on the area covered. As you get closer to the edges of the area, generally the four corners of the continental United States, the signal will be weaker. The size of the dish needed will depend on the signal strength.

We have been selling the 13-foot dishes for the Clearwater, FL area. In Miami, where the strength is even less, they have been using the 15- and 16-foot diameter antennas. The larger size might also be necessary as you get into Oregon, Southern California, and New England. The ideal area of the country, however, is the Midwest, where the 10-foot size will give you a beautiful picture.

You might need a larger size in some areas because of earth noise. In the center of the United States dishes face up higher than in New England. The angle needed to see the Satcom satellite is generally 10 to 11 degrees from the horizon. Because the dish is looking close to the horizon, it is also looking through a longer path in the atmosphere. Therefore, the lower the angle, the more earth noise it will see. But as you get into the middle of the country, the signal must pass through about 7 or 8 miles of atmosphere, so the signal received is much better. The same thing applies if the antenna must point at a low angle toward the east or the west.

There are two popular types of antennas to select from. The *parabolic* antenna is the best because it requires less space and is easier to deal with. With the right kind of mounting and a proper installation, the antenna can be easily turned from one satellite to another. The low noise amplifier (LNA), for signal boosting, is essentially a part of the dish and moves with it in most cases. The parabolic kind does cost more, though.

The other type is called the *spherical*. The reflector for such an antenna can be made of a transparent, open-mesh material. It is easier to install, can be mounted on a roof and causes less wind loading than the parabolic. But it has the disadvantage that it cannot be re-aimed to another satellite. In order to receive more than one satellite, the customer must have more than one LNA or must move the pickup unit from one place to another. We have set up some where the LNA can sit on a post in front of the antenna. To get another satellite tuned in, you unlock the LNA from one post, move it to another and lock it down.

Zoning

Zoning laws should be checked to make sure the installation is not too close to property boundaries. To a limited extent, the mesh-type screen of the spherical antenna is an advantage because it can be easily camouflaged. Conceivably the customer could use the back side of it as a trellis. If necessary, though, users could put a fence around parabolic antennas.

LNAs and receivers

For the pickup device, the LNA, we generally use the workhorse of the industry, a 120-degree LNA. (The 120-degree refers to the amount of thermal noise that the LNA unit adds to the signal, measured in degrees Kelvin.) Channel Master uses a 100-degree LNA to make their system look

better, but the costs are higher. The best LNAs are rated 85-degrees, include a better amplifier and cost about $2000. The only improvement in the gain of the dish by the 85-degree unit is about 0.4dB. Better LNAs should not be used to compensate for using a dish that's too small. The 120-degree LNA at about half the price of the 85-degree one is usually acceptable.

The LNA is the most modern link in the system. These devices are made only by a few companies – usually Amplica, Avantek or Microwave Associates. The components have a 1-year warranty and are strictly factory repairable. We keep a spare receiver on hand in case a customer should have a problem with one. Don't drop one – the shape of the waveguide is so critical that the slightest change of the shape will kill some frequencies.

The LNA is just a wideband amplifier. The receiver is similar to the tuner on your TV set. It picks out one channel at a time from those available and converts it to video and audio. Then a modulator operating on whatever channel is available in a particular area creates the signal to attach to the customer's set.

On the system we sell, the LNA amplifies the signal by 50dB. The signal is still around 4GHz, so it cannot go far to reach the receiver. You are limited to about 100 feet of ⅞-inch or ½-inch cable to get to the receiver.

Most receivers have the availability of being split into a separate down converter. In that situation you can use a 12 to 14 piece of RG217 or RG213, a low loss flexible cable which looks much like RG11. It's a 50 Ω cable, but the high frequency attenuation is much lower than regular cable. You could use a regular cable, but the loss is terrific. The output from the down converter is at 70MHz. From it you can run RG59 cable and control wire, generally three or four wires, into the rest of the system.

The receiver only gets one channel at a time so how do you provide a customer with the ability to get more than one channel simultaneously? It's tough to put two receivers on one line. Because most of the receivers for the non-commercial installations with separate down converters are single-conversion systems, they tend to interfere on certain channels. As you dial through one receiver, it will cause an oscillation that will wipe out a channel on another one. Not all of them do it, but some do. There are various devices for isolation that you can use, but our recommendations in that situation are to use a commercial receiver or install a separate dish.

Also, when you get more than one person wanting to watch from an earth station system, they probably will not want to watch the same channel at the same time, and that involves switching. In order to watch all 24 channels on one satellite, you will need two amplifiers to have both vertical and horizontal polarizations with an electronic switcher so that each person can pick from the horizontal or vertical feed. It can be done, but it gets expensive. We charge about 65% of the cost of the original system to put in the second unit.

System safeguards

Other questions we receive deal with protection and positioning of the LNA. First, most LNAs come with lighting protection built in, but as with any antenna system, you should have some kind of surge protector. We sell an inline surge protector that should be available just about anywhere, and we recommend unplugging it during an electrical storm.

Some people, especially those who live in a high area and have had an LNA hit by a surge or lightning, use an automotive battery. The LNA runs on 12Vdc. If that seems tacky, use the surge protector and unplug the LNA.

It is not lightning that causes most of the problems. The dish is mostly fiberglass with a reflective surface, and is not a great attractor. A 12-foot dish is probably lower than a TV antenna. The real killers for the LNAs are power-line surges. Generally, the power for the LNA comes from the receiver, so using a surge protector usually solves the problem.

As far as positioning the LNA, with the parabolic dish system the LNA is fixed relative to the reflector. With the spherical reflector, it is very difficult to change satellites. Because you can't move the antenna, you must move the LNA.

For customers who choose to buy the parabolic dish antenna system, a polar mount is an easy way to change between satellites. There is a tilt access and if the mount is properly installed, people can follow the satellite arc with one simple adjustment. The angles are important: one part must be positioned due north. Once that is right, the mount will work properly. For installing the polar mount you will need a good magnetic compass.

There will never be a satellite further west than Satcom 1 or further east than Westar 3. So, once the polar mount is right, it's an easy matter for the customer to change among satellites.

We sell a motor rotation as an option for our dishes. It works well but we do not recommend an expensive digital locator. (Remember: A polar mount is not possible with the spherical antenna.)

One note for people who start out with the less-expensive spherical antenna is that the LNA and receiver equipment can be used with a parabolic dish antenna. Only a small change needs to be made to the LNA.

Earth stations systems have certainly created a good deal of traffic in our store. When prospects look at the pictures coming from 22,300 miles away, the first response is unbelief. Then they see what's there and want it.

We recommend that customers get a magazine called SatGuide. It is the TV Guide for satellites, and it's a must. It gives over a hundred pages of daily listings on seven movie channels, all the sports channels and all the specials. You might want to carry order forms for it in your store – one look at the magazine and customers are just about hooked!

ES&T

A strange problem with Sony vertical

The original symptoms pointed to a totally different defect than the one eventually found. Carefully study the correct general procedures and the temporary mistakes made during this repair, because many of the lessons illustrated here can be applied to the troubleshooting of other solid-state circuits.

By Carl Babcoke, *CET*

A Sony 17-inch model KV1712D color receiver was brought to the test bench by a competent technician who had made several preliminary tests during a service call in the customer's home. He reported two original symptoms. Resistor R556 had burned in two, and a replacement also operated too hot. However, the technician found that the receiver operated normally with the resistor disconnected.

Also the picture did not cover the screen completely. The top ¾-inch of the screen had no scanning lines.

The technician had examined the vertical linearity, looking for irregular scanning-line spacing, compression, VITS lines, or expanded sweep near the screen's top but found nothing noticeably abnormal. Therefore, his snap diagnosis was *the vertical centering is incorrect.* Unfortunately, his attempts to center the picture were not successful.

Although the vertical-centering control appeared to move the picture the usual distance, the bottom was overscanned by about two inches when the top edge of the screen was barely touched by the raster. Was the centering control failing to move the picture enough? Or was this merely a symptom of a more subtle condition?

These preliminary facts and symptoms were verified on the service bench. The mystery of the burning resistor was to be ignored until the centering problem was solved.

Checking centering

Vertical centering in the Sony KV1712D is accomplished by adjustment of the dc current through the vertical-yoke winding (Figure 1 from Photofact 1699-2). VR503 vertical-centering control has about +22V at one end and about +16V at the other. VR503's center lug is connected to the yoke's cold end. Coupling capacitor C513 provides an ac path for the sweep signal through R520 to ground as it isolates the dc voltage and current. The yoke's hot end is connected directly to the vertical-sweep signal at R514, R515 and the output-transistor emitters.

The vertical-output transistors place +20.9V at the hot end of the yoke winding, so an adjustment of VR503 centering control that applies +20.9V to the cold end of the vertical winding reduces the yoke's dc current to zero (as though there is no centering control). Then, the rotation of VR503 in one direction applies a dc voltage to the winding, producing dc current and moving the raster up or down. Conversely, rotation in the opposite direction moves the raster in the other direction.

There are two ways of finding the actual midpoint of centering. A slow method is to disconnect the centering control, which in this receiver is soldered to the circuit board. An easier way is by connecting a dc voltmeter between hot and cold leads of the yoke winding and adjusting VR503 to produce a zero-voltage reading. Notice that the zero-voltage reading becomes positive at one side of zero and negative when rotated to the other side of zero volts.

Zero yoke current should produce a raster position that is near correct centering. If zero voltage cannot be obtained between input and output yoke leads, coupling capacitor C513 might have excessive leakage and should be replaced. This test should prove whether or not the improper centering is caused by yoke current.

Zero current and voltage were obtained across the yoke of the Sony, however, the picture continued to show a black line at the top.

To allow measurement of total picture coverage, a crosshatch pattern of known number of bars was displayed on the screen. The height adjustment was varied

After proper repairs, the Sony KV1712D color receiver had full height and excellent vertical linearity.

through its range, while the bars of the pattern were counted. One horizontal bar always was missing from the pattern. This unexpected result indicated that part of the picture was blanked out, or otherwise eliminated.

Blanking waveforms vs. sweep

All solid-state color receivers have internal blanking of the picture tubes during vertical-retrace times. (Some models have a slow retrace time that might allow retrace ghosts to be visible otherwise.) Video with added vertical blanking can be scoped at the matrixing and power transistors that drive the picture tube cathodes. In the Sony KV1712D, the power transistors are on a circuit board that includes the CRT socket (at the top of Figure 2).

Scope waveforms are essential for testing blanking problems. Therefore, video without blanking obtained from the delay line and video from one CRT cathode (with internal blanking) were displayed on a dual-trace scope. Width of the CRT-video blanked area was almost triple the width of the blanking/vertical-retrace area in the delay-line video, *proving that a blanking defect was removing a section of the video* before it reached the CRT screen.

Internal vertical blanking is accomplished by injecting a clipped

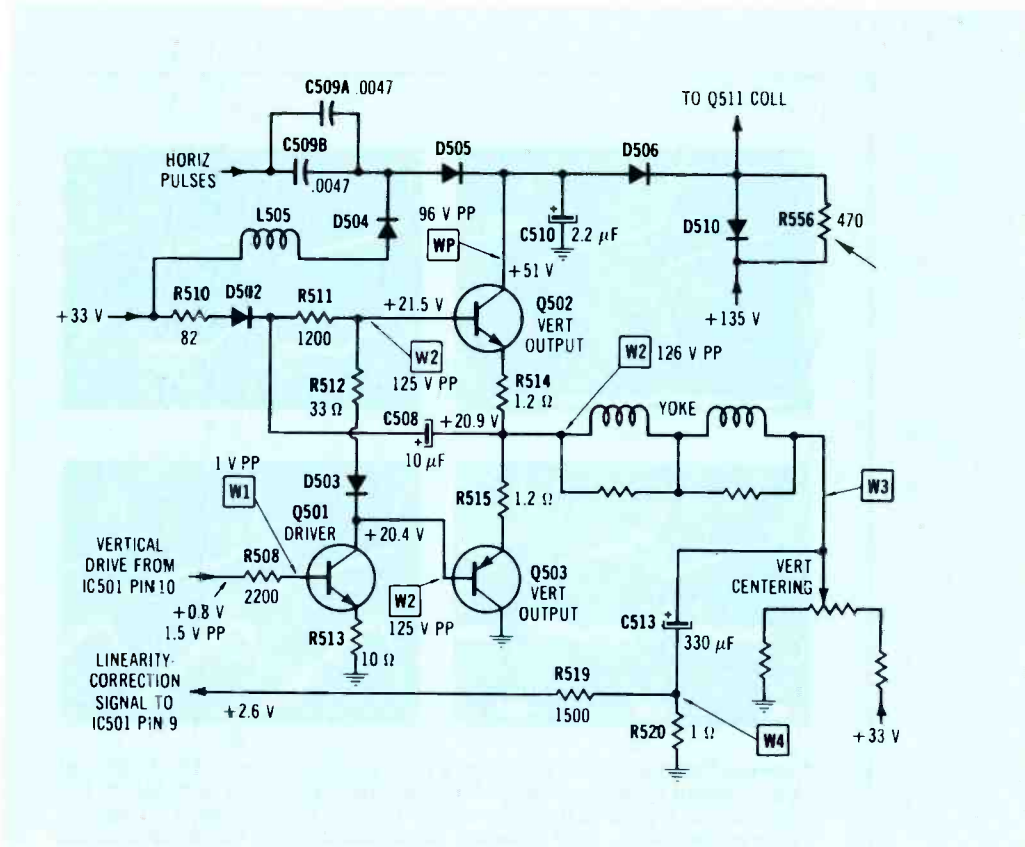


Figure 1 Correct voltages are shown for the Sony KV1712D vertical circuit.

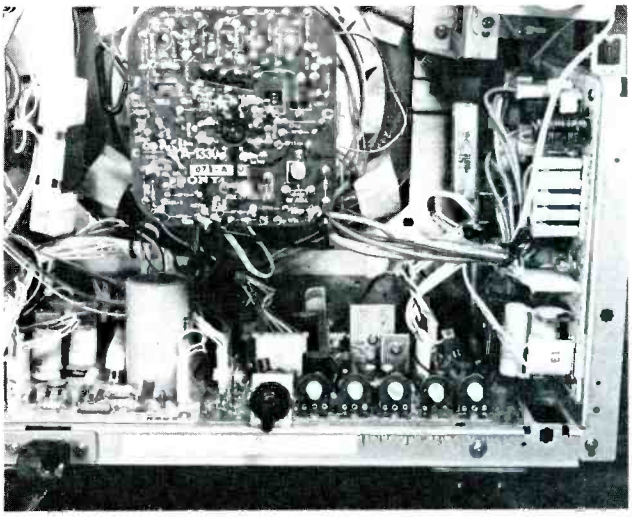


Figure 2 Composite video with internal blanking was scoped at the collector of one color power-amplifier transistor on the circuit board that includes the CRT socket. Most components of the vertical circuit are on a board below and slightly to the right of the CRT-socket board. Vertical-centering control is mounted edgewise directly under the CRT socket.

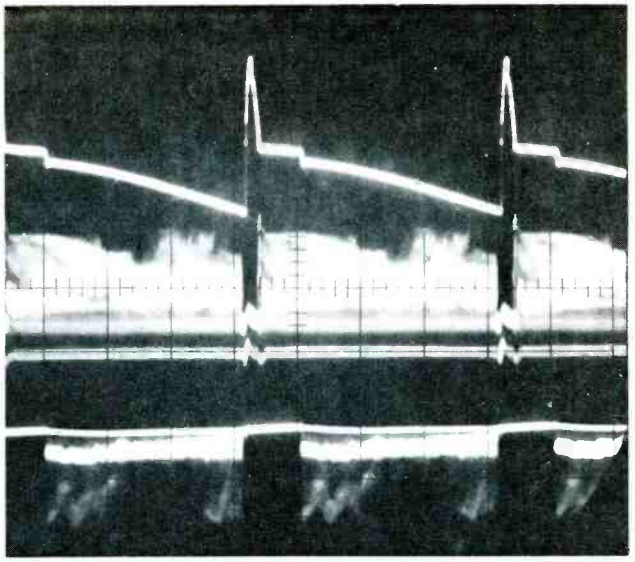


Figure 3 These waveforms show abnormalities in the vertical-sweep output signal, the video before blanking is inserted, and video at the picture tube. Top trace shows the vertical output signal, with insufficient pulse amplitude and a *step* at the left end of the sawtooth. Center trace shows the composite video at the delay line. It has only station blanking. Video at the CRT is shown by the bottom trace. Notice the wide vertical-blanking areas. They are almost triple the normal width, as compared to the vertical interval in the video waveform of the center trace. Notice that the output-signal step has the same width as the blanking in the CRT video. All waveforms were scoped at the vertical rate.

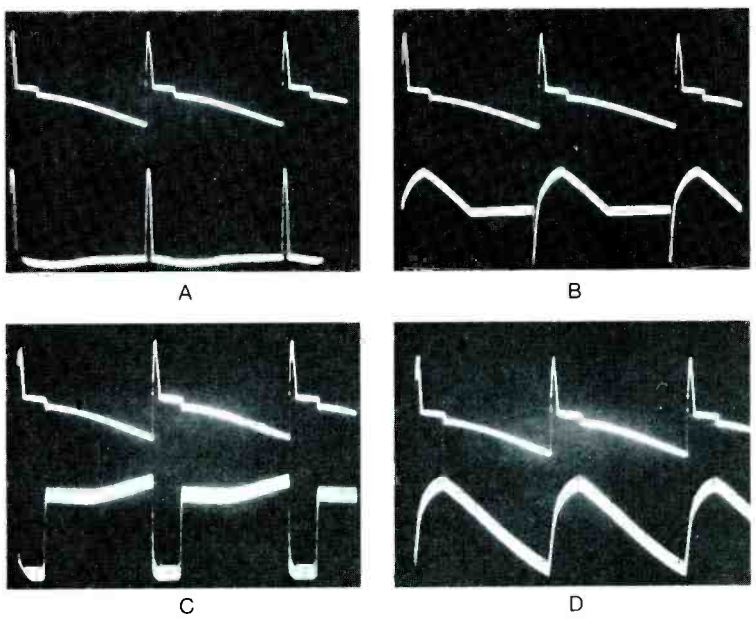


Figure 4 These incorrect waveforms were scoped in the KV1712D vertical circuit during troubleshooting steps. (A) Top trace is W2 in Figure 1, the waveform of the vertical-output signal. Bottom trace shows the positive-going pulses at the Q502 collector (waveform WP). (B) Top trace again is the W2 vertical-output waveform, while the bottom trace shows the Q502 emitter current. The sawtooth's rising edge should be straight, not rounding (see Figure 7B). (C) Top trace is W2 output waveform. Bottom trace shows the excessively broad negative-going W1 pulses at the Q501 base. Notice that the output step and the base pulses have the same width. (D) The W2 output pulses are shown by the top trace, while the W4 yoke-current waveform (taken across R520) current should be straight (see Figure 7C). The rounded edge of yoke current has the same width as the step in the output waveform.

Sony vertical

sample of vertical sweep into a luminance stage where it combines with the video. Therefore, variations of height and linearity can affect the amount and quality of the blanking. This possibility was checked by comparing the two video waveforms with the vertical-deflection output waveform (Figure 3).

Not only do the waveforms of Figure 3 show the abnormally wide blanked area in the CRT video, but they also reveal a distorted vertical-sweep waveform that has a *step* at the left end of the sawtooth (which corresponds to the picture's top). The unwanted step in the sweep waveform has the same width as the abnormal blanking does. So it is apparent that the excessively wide blanking is produced by the abnormal step in the deflection waveform. The remaining important question is *what defect is causing the step in the waveform?*

Troubleshooting vertical deflection

Dc-voltage readings and scope waveforms are vitally important when testing any vertical circuit

that is operating, but not perfectly. Five abnormal waveforms are shown in the four pairs of dual-trace waveforms in Figure 4. The sweep-output waveform should have an amplitude of about 120VPP, but actually measured about 60VPP because the pulse amplitude was compressed. Also as explained before, the sawtooth section has an unwanted step. Other waveforms show a severe compression of the sweep at the picture's top (as explained in Figure 4) but the compression is not seen on the screen because that part of the picture is blanked.

Several important dc voltages were completely out of tolerance. The Q502 collector should have about +50V, but this one had only +31V. Could the +50V figure be a misprint? After all, the Q502 collector is supplied from the +33V source through several chokes and diodes. Perhaps the additional +17V should come from the +135V supply through R556 (which now is disconnected) and D506. Although the reasoning appears promising, there is a barrier. Unless the polarity of D506 is drawn incorrectly (see Figure 1), D506 is reverse biased because +135V is far greater than +33V, and diode current cannot flow.

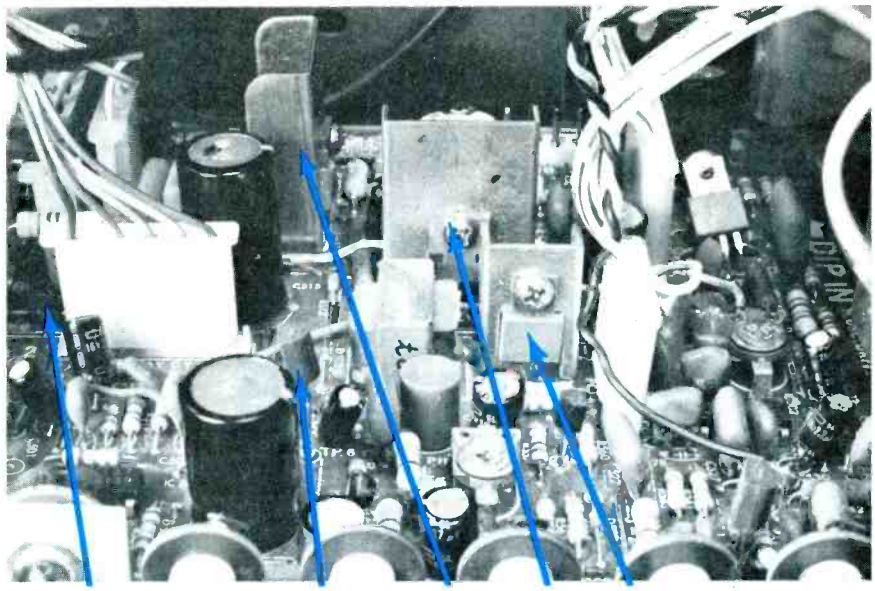


Figure 5 Arrows points to several important components of the Sony vertical-deflection system. The arrow at far left identifies R556, second arrow points to Q501 vertical driver, third arrow shows Q503 output transistor, fourth arrow points to Q502 Output transistor, and the fifth arrow shows Q5013, the pincushion amplifier transistor.

Inoperative voltage-doubler

Measurements using the voltage-drop diode test (in a Beckman digital meter) verified that diodes D502, D504, D505, D506 and D510 were not defective. Also, they were shown with correct polarity in Figure 1 and Photofact 1699-2. Unfortunately, the question remained unanswered: *What is the source of the missing +18V at the Q502 collector, and why is this voltage missing?*

The answer to the puzzle is found in the words *horiz pulses* at the top of the schematic. These horizontal pulses are coupled by C509A and C509B (in parallel) to diodes D504 and D505 that are connected in a voltage-doubler configuration. D504 clamps the pulse negative peaks to whatever dc voltage is present at the D504 anode (the +33V supply). The clamping produces about +49V at the D504 cathode because the pulse amplitude is a positive signal in series with the +33V supply. Further, the total +49V signal can be rectified and pass through D505 during the pulse peaks. C510 is the peak-reading filter capacitor, thus, the voltage doubler produces the added +18V needed to provide +51V for the vertical-output transistors.

However, the voltage doubler was not producing any increase of voltage. Instead, D504 and D505 each had about 0.6V drop from the Q502 current. The +33V supply was only about +31V at the Q502 collector.

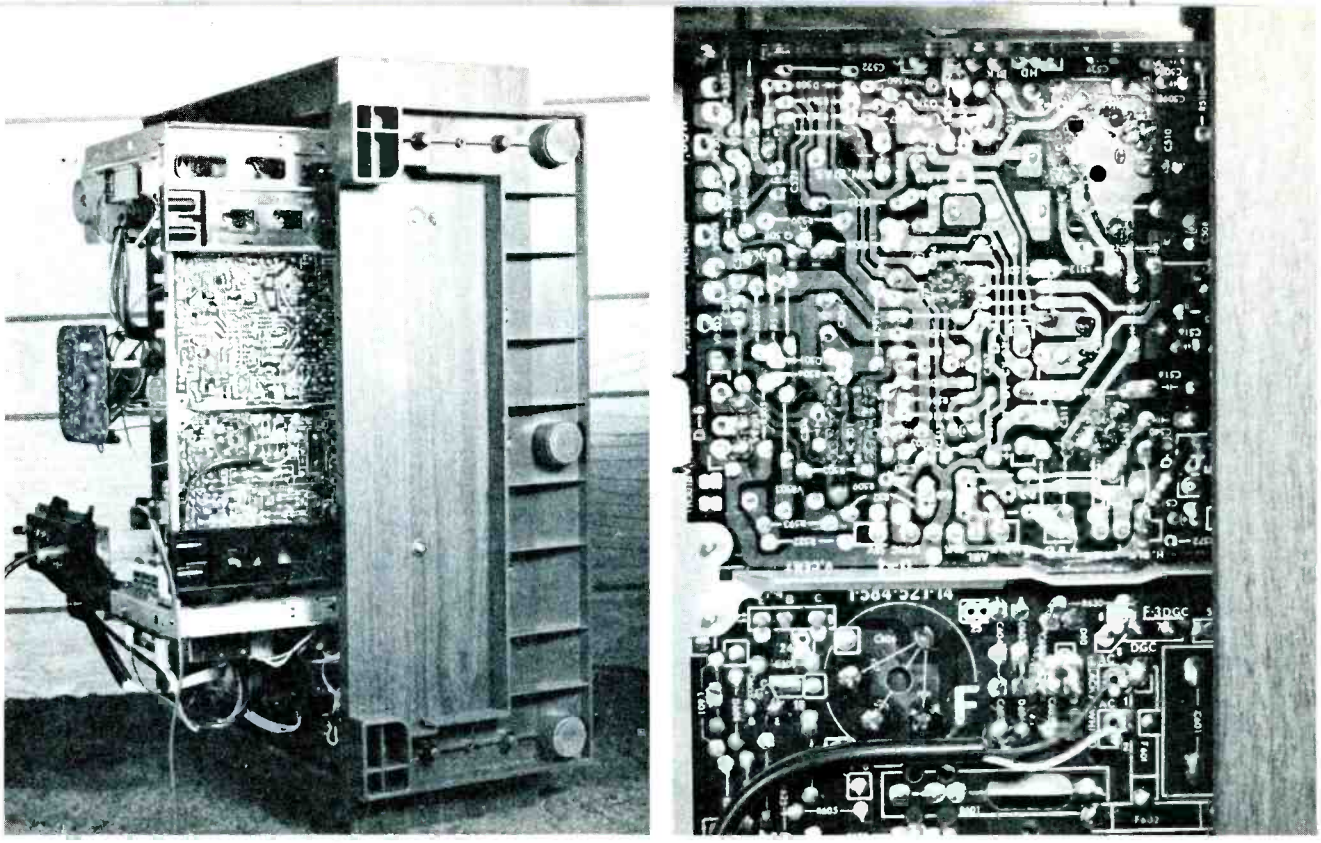
The previous question now is replaced by an equally puzzling one: *Why isn't the voltage-doubler circuit giving any dc voltage?* Perhaps one of the components is defective. However, C509A, C509B, L505, D504, D505, and C510 were checked (and also substituted) and all were perfect. D506 was disconnected to make sure the D510 circuit was not responsible. In addition, scope waveforms proved the pulses had proper amplitude and waveshape.

The problem seemed unsolvable. All components of the voltage doubler had been tested and even substituted without any improvement. One last possibility was not checked because the normal value was not known. What value of Q502 and Q503 current was being drawn through the voltage doubler? Finally, it was rationalized that the low supply voltage could not be causing the sweep distortion. At worst, the low voltage should only reduce the height. So, the subject was bypassed until the defective blanking could be repaired.

Back at the vertical sweep

The excessively wide pulses at the Q501 base (Figure 4C) became the prime suspect because the pulse width was identical to the step width in the output signal (Figure 4C). All dc voltages of IC501 vertical-oscillator integrated circuit were checked and found to be reasonably within tolerance.

In similar circuits, the sample of yoke current that is dropped across R520 is sent back to the IC (pin 9, in this case) to be compared against the oscillator sawtooth. From a comparison of the yoke sawtooth and the oscillator sawtooth, an error-correction signal is developed. The error correction changes the drive waveshape at the Q501 base to whatever is required to make the two sawteeth identical. Of course, the yoke saw-



A B

Figure 6 (A) Placing the Sony KV1712D color receiver on one side exposes the wiring side of two circuit boards. (B) This closeup photograph shows roadmapping of the Sony circuit boards. Components are easy to find from the roadmapping.

Sony vertical

tooth here was distorted. Could that be the reason for the distorted Q501 base signal, or is IC501 defective?

After many fruitless measurements, it was decided to replace IC501. Unfortunately, the wide-pulse Q501 base signal and the output signal with its step remained unchanged.

In desperation, several components (including C513 and C508) were replaced temporarily but there was no improvement.

Transistors Q501 driver, Q502 NPN output and Q503 PNP output (Figure 5) had been tested previously with an in-circuit checker. Also, diode voltage-drop tests had been made of the transistor junctions. None of these tests gave the slightest indication of bad transistors.

Most other components had been substituted without results. The decision was made to remove Q501, Q502 and Q503 for out-of-circuit testing. Of course, Q502 and Q503 were mounted on metal heat sinks that were soldered to the circuit board. It helped to be able to place the receiver on its side, which exposed the bottom of several circuit boards (Figure 6).

Transistors Q501 and Q503 tested normal out-of-circuit, but Q502 NPN output measurements showed C/E leakage of approximately 500Ω.

The two good transistors were re-installed, and a new replacement for Q502 was installed.

Normal sweep plus voltage doubling

When power was applied to the receiver, *a full picture was obtained, and the waveforms returned to normal* (Figure 7). Even more surprising was the +51V measured at the Q502 collector. The voltage doubler was operating correctly, giving the voltages shown in Figure 1.

It had been noted during previous tests of the voltage doubler that full pulse amplitude was obtained at the input of paralleled capacitors C509A and C509B, but at the cathode of D504 (output of the capacitors) there was virtually no pulse amplitude. This was attributed then (accurately, as it developed) to excessive load on the doubler circuit. In other words, the abnormal load was reducing the pulse amplitude, which eliminated any generation of dc voltage by the doubler circuit. When the sweep circuit was repaired, the load was lightened and the doubler could operate normally.

What about R556?

After the vertical-sweep and the voltage-doubler circuits were operating correctly, a new 470Ω resistor was installed across D510 (the old one had been removed because it was too hot). Surprisingly, the resistor developed the usual moderate heat rise.

When R556 was missing, the D510 anode measured +32V (from the 33V supply through D506) and the cathode measured +139V. It was reverse biased and therefore open. After the vertical was repaired and R556 installed, the D510 anode tested +138V and the cathode measured +139V. D510 remained reverse biased, while R556 now operated without heat because it had only about 1V across it.

At this point, it was difficult to know why R556 had burned when the vertical sweep was not

operating normally. A recap of the Q511 operation gives a hint.

The KV1712D ac-line-operated main power supply is regulated to +135V, which is sent to the collectors of Q902 horizontal-output and Q510 driver transistors only. All other dc voltages are produced by rectification of horizontal-deflection pulses. The horizontal-oscillator IC502 is powered from one pulse-rectified supply. Therefore, when power first is applied, the driver and output transistors have collector voltage but no base drive. Nothing happens, and the pulse-rectified supplies are dead until the oscillator IC is supplied with a temporary source of low voltage. The purpose of Q511 is to supply that start-up voltage from the regulated +135V supply.

A sample of dc voltage from a zener diode in the +135V regulator circuit is applied to the Q511 base as forward bias. Power from the +135V supply now flows through R556 to the Q511 collector, through the C/E conduction of Q511, and from the emitter to the supply voltage for IC502. Oscillation begins, and the sweep-rectified supplies have normal voltage. When the +18V supply reaches its peak, the Q511 emitter has a higher positive voltage than the base does. Q511 is reverse biased, stops conducting, and no longer furnishes power to the IC502 voltage supply. This completes the starting cycle.

The original overheating of R556 (when the vertical had a defect) remains a mystery. Perhaps the outside technician failed to tell all that happened. By the time anyone attempted to explain the R556 failure, the color receiver was not available for any additional tests.

Another question arose later about the function of Q511. If it is there to provide oscillator start-up power, and if this power comes from R556, how could the receiver start up dependably when R556 was missing? A careful examination of the schematic provided a logical explanation. The base-and-emitter diode junction in Q511 passed sufficient voltage (from a 12V zener in the +135V regulator circuit) to barely start the horizontal oscillation when the line voltage was 120V or higher. However, the B/E junction is not strong enough to supply sufficient start-up voltage when the line voltage is abnormally low. Extra power from the +135V source must be produced by the Q511 C/E path for dependable start-up under all conditions.

Comments

This case history illustrates the practical difficulties often encountered in deciding which of several symptoms should be investigated first. To some extent, a technician's knowledge of the circuits plus his past experiences will indicate the proper priorities.

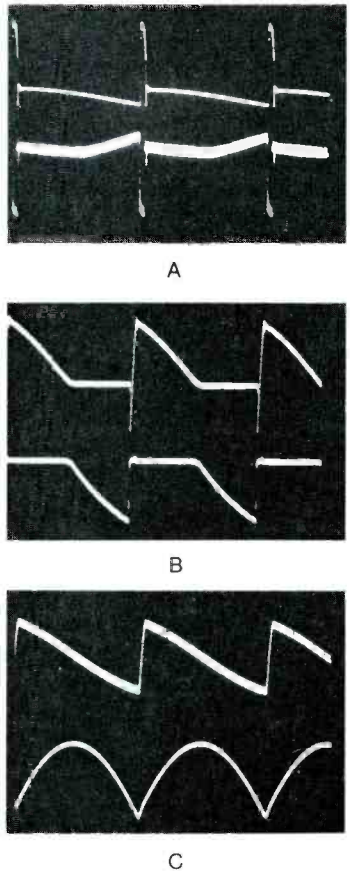
Another lesson is to employ tests that definitely prove or disprove each suspicion about a defect or bad condition. In this example, the picture with its top blanked out gave the wrong impression that the vertical centering was at fault. A definite test disproved the possibility of a centering defect, then the crosshatch display showed the missing picture area. Another good test of abnormal blanking is for the technician simultaneously to watch the same scene on the bad receiver and on a normal receiver. Any incorrect blanking of the picture can be identified quickly, easily and positively.

An effective test for defective blanking is to disconnect any resistor, capacitor or diode that brings the blanking signal into the luminance stage. Restoration of the blanked segment of the picture is proof of incorrect blanking.

The situation becomes more grim when vertical symptoms of bad linearity or insufficient height are encountered. Solid-state circuits do not have standard symptoms that apply to all brands and models, as was the case with tube-equipped circuits. The impossibility of a specific symptom infallibly pointing to failure of one certain component has inspired technicians to replace modules or whole circuit boards in many cases, rather than waste time finding and replacing discrete components.

When component-level troubleshooting is employed, a technician must understand how every circuit is designed to operate and how to check each circuit when it malfunctions. Also he must have test equipment that is as modern as the merchandise that needs repairs. Of course, a competent technician will understand when the test equipment is giving false answers. understand when the test equipment is giving false answers.

Other case histories that illustrate troubleshooting methods for basic solid-state TV circuits will be presented during the following months.



A

B

C

Figure 7 These are the correct Sony waveforms following vertical repairs. (A). Top trace is the W2 vertical-output waveform. Bottom trace shows the W1 Q501 base waveform. (B) Top trace is the Q502 emitter current, while the Q503 emitter current is shown by the bottom trace. Notice that each occupies half of the trace time between pulses. (C) Top trace shows the excellent yoke-current waveshape, and the C513 parabolic waveform is portrayed by the bottom trace.

Index of 1981 articles

Compiled by Warren G. Parker, Metairie, LA

Titles

ANTENNAS

COLOR TV

DIGITAL

HORIZONTAL & HIGH VOLTAGE

INDUSTRIAL ELECTRONICS

SYMCURE

Article index

Titles

Troubleshooting tips

Test equipment report

Product report

ES&T

Electronics firm shares PBX system for efficiency and economy

Jack Craig, vice president and general manager of PTS Electronics, describes the company's success in installing and subsequently sharing its Public Branch Exchange system.

PTS Electronics and its affiliate companies, Tronics 2000 and University Electronics, share the same PBX system, the Harris DTSD D1203. Calls for the three companies all come into the main console at PTS. However, they are immediately routed to the company being called, without ringing at the console. The D1203 also provides an intercom that connects all three companies to the accounting, advertising and computer services departments, which are shared.

PTS Electronics, supplier of TV tuner parts, recently installed a D1203 PBX system manufactured by Harris Corporation, Digital Telephone Systems Division (DTSD). The company has found an unusual way to save money – it shares its PBX system with two other companies.

"The D1203 has improved our telephone service considerably," said Jack Craig, vice president and general manager of PTS. "It is reliable, flexible and can be easily upgraded as the business grows."

Reliability problems with old system

PTS Electronics, which has experienced a 30% growth rate each year over the past six years, now consists of 40 branches throughout the United States and Canada. Its phone system serves not only as the communications link with these branches, but is shared with two affiliate companies.

The company's rapid growth rate was part of the reason for switching PBX systems. According to Craig, PTS had simply outgrown the old system. But, there was a more severe problem.

"Our old system wasn't reliable," Craig said. "We have a lot of storms in the Midwest. If there was a power outage as a result of a storm, or even a drop in power, we had trouble with the telephone system. We are dependent on the telephone for communicating with our 40 branch offices and for receiving service and parts orders. It wasn't acceptable to have the phone system on the blink, even for a short time."

At the suggestion of a representative of the Smithville Telephone Company, PTS checked the D1200 family of PBXs offered by the Harris Corporation, DTSD.

"The D1203 offered the flexibili-

The Harris DTSD D1203's special call-forwarding feature is particularly helpful in the parts department. If a parts clerk must leave the desk to check for a part, the phone can be forwarded to another by dialing two digits. When all lines are busy, the next incoming call is automatically placed on hold, then routed through to the first free number.

ty and the features we needed," Craig said, "and it also provided room for us to grow."

Features and flexibility

PTS Electronics shares its PBX with Tronics 2000, a TV service dealer franchise operation, and University Electronics, a local service dealer operating under the Tronics 2000 franchise.

"We needed a system that could serve all three businesses while providing each with its own set of numbers. We also required an intercom system that would connect the three companies, since they share accounting, advertising and computer services."

The D1203 was flexible enough to meet these needs. The system consists of 17 trunks, including seven WATS lines and 42 service lines. Tronics 2000 has six trunks, University Electronics has two and PTS has nine.

The WATS lines are set up with two incoming and one outgoing Band 5 lines at both Tronics and PTS. Also Tronics has an Indiana in-state line. All three companies have use of the WATS lines, which are easily accessible via a 2-digit code. The WATS calls are billed by Indiana Bell through Smithville Telephone Company.

When calls come in for any of the three companies, they go through the PBX console located at PTS. However, rather than ringing at the console, calls for Tronics and University Electronics are automatically routed through to those numbers, without requiring any effort on the part of the console operator.

Tronics' communications system consists of six telephones and five lines. All incoming calls ring into one push-button desk telephone on the secretary's desk. The secretary answers all calls and forwards them to the correct party by dialing a 3-digit extension.

University Electronics has two telephones and two incoming lines, which can be answered on either instrument.

Helpful features

"The call-forwarding feature has been particularly useful in our parts department, where replacement parts, rebuilt tuners and TV modules are ordered," Craig said. "The department consists of four employees who answer phones. If one of those employees is somewhere else in the building, the

phone can be forwarded to another number near them. The call-distribution feature is also efficient. If the parts department is really busy, the PBX will automatically place an incoming call on hold and ring it through to the first free number. With the old system, the operator had to keep trying until the number was reached."

Another time-saving feature is automatic callback. When making an outside call and all lines are busy, the system can be instructed to call back when a line is available. When an extension is busy, the caller simply dials a code and hangs up the phone. When the number or extension being dialed is free, the call rings through on both ends.

PTS also uses the system's capability to restrict calls at certain stations, thereby preventing unauthorized use of both regular and WATS lines.

"The intercom system is helpful to all three businesses," Craig said. "Because we are in three different locations, it would be really time-consuming for our advertising, computer and accounting departments to use the regular phone system. With the intercom, there is no problem."

Finally, the modularity of the D1203 is important in light of the company's rapid growth rate. To expand any system, a new line or trunk card is simply plugged in, thereby adding lines/trunks. Line or trunk cards add eight circuits per card. The D1200 system can accommodate as many as 1000 lines and trunks.

The system is also compact and quiet. The console, which is approximately twice the size of a regular telephone, fits easily onto any standard-sized office desk, while the equipment cabinet can simply be tucked into a corner.

Other PBX features

A number of other features are available on Harris DTSD D1200 PBXs, should PTS decide to upgrade its communications system. Most offer both time and money savings.

Automatic Route Selection (ARS), for example, will look at all routes available for a call – WATS, foreign exchange, tie line or direct distance dialing – select the least costly route, taking into consideration traffic loading, time of day, distance and user class of service.

Another money-saving feature is Automatic Number Identification (ANI), which establishes accountability for phone costs by individual station. ANI enables the telephone company to break out the charges made by each station, or to produce separate bills for each station.

"We are really pleased with the D1203," Craig said. "It can storm all it wants now, and we can depend on our telephone system to stay in service!"

BOOK REVIEWS

Editor's note: *Periodically* ***Electronic Servicing & Technology*** *presents reviews of books dealing with subjects of interest to our readers. Please direct inquiries and orders to the publisher at the address given in each review rather than to us.*

Solid State Circuit Files, Volumes 1 and 2, by Ed Noll; Howard W. Sams & Co. Inc.; 128 pages each; $7.95 each or the set for $14.50.

These two volumes bring together a file of circuits and experiments for the electronics student, technician, experimenter, radio amateur, hobbyist, teacher or computer enthusiast.

Volume 1 concentrates on bipolar transistors, field-effect transistors, and linear integrated circuits. Volume 2 covers TTL circuits and CMOS integrated circuits.

There are more than 100 basic and advanced circuits arranged for progressive experimentation and study. Each circuit is complete and comes with an explanation and often a suggested procedure for experimentation. Low-cost and readily available components are used. Circuits can be quickly constructed on a solderless breadboard.

Published by Howard W. Sams & Co. Inc., 4300 West 62nd St., Indianapolis, IN 46268.

Digital Counter Handbook, by Louis E. Frenzel Jr.; Howard W. Sams & Co. Inc.; 264 pages; $10.95 softbound (Canadian price slightly higher).

This book explains how digital counters work, so that the user can understand and apply them more effectively. Concepts such as precision, accuracy and stability are explained. There are also discussions of counter specifications, counter accessories, interfaces, high- and low-frequency counters, sources of error, and the proper ways to make test hookups.

Designed for engineers, service technicians or experimenters, the book places emphasis on digital counter tests and measuring instruments. Also explained are the elementary counters—basic flip-flops and gates—that are the building blocks from which more sophisticated counter-type instruments are made.

Both electronic and mechanical counters are covered. The book explains how counters are used for frequency measurement, time-interval measurement, tallying, and in numerous industrial applications. The use of calculators and microprocessors as counters is also explained.

Published by Howard W. Sams & Co. Inc., 4300 West 62nd Street, Indianapolis, IN 46268.

The Beginner's Guide to Amateur Radio, by the staff of The American Radio Relay League Inc.; Prentice-Hall Inc.; 182 pages; $16.95 hardback, $8.95 paperback.

Compiled by members of the headquarters staff of the American Radio Relay League, this book provides the beginner in amateur radio with easy-to-understand information on such areas as setting up a station, building a simple wire antenna, getting into a licensing class to prepare for an amateur radio license, and getting involved with many specialized activities such as satellite communications and DXing (communicating over long distances). A glossary of terms is also included.

In addition, the book illustrates the usefulness of amateur radio in a wide variety of situations, from aiding victims of the 1976 Guatemalan earthquake to helping a blizzard-bound Michigan couple deliver their child using instructions relayed over ham equipment.

Published by Prentice-Hall Inc., Englewood Cliffs, NJ 07632.

Designing with Field-Effect Transistors, edited by Arthur D. Evans; McGraw-Hill Book Company; 293 pages; $24.50 hardback.

This book provides the theory and basic design tools needed to use field-effect transistors (FETs) more effectively in electronic circuit design.

The book presents design examples for a wide range of applications including amplifiers, analog switches, voltage-controlled resistors, constant-current supplies, power switching and integrated circuits.

Semiconductor theory is provided to give insight into how the FET behaves under different conditions. Most of the book is devoted to the various types of FET applications in which FETs have shown they can outperform the bipolar device.

Chapters in the book include: field-effect transistor theory; parameters and specifications; low-frequency circuits; high frequency techniques; analog switching circuits; and voltage-controlled resistors and FET current sources.

Published by McGraw-Hill Book Co., 1221 Avenue of the Americas, New York, NY 10020.

Ac/Dc Electricity and Electronics Made Easy, by Victor F. Veley; Tab Books Inc.; 308 pages; $14.95 hardbound, $9.95 paperback.

For beginning and advanced electronics technicians, this is a practical guide to learning about ac/dc electricity and electronics practice. The book begins with basic measurement units and leads to the complex applications of waveform analysis.

Technical terms are defined in everyday English, and more involved formulas and symbols are explained, backed by detailed charts, drawings and diagrams. Every chapter gives summaries of terms, definitions and equations needed for mastering each topic.

In addition, two comprehensive appendices explore the decibel from power ratios to expression of attenuation in decibels and nepers, plus the science of waveform analysis from examination of Fourier's theorem to typical waveform identification.

Published by Tab Books Inc., Blue Ridge Summit, PA 17214.

CALENDAR OF EVENTS

January

7-10
Winter CES, Las Vegas Convention Center, Las Vegas, NV. Contact Consumer Electronics Shows, Two Illinois Center, Suite 1607, 233 North Michigan Avenue, Chicago, IL 60601 (312) 861-1040.

26-28
Spacecraft Electronic Conference, Hyatt Hotel, Los Angeles, CA. Contact Frank Mitchell, director, Requirements Committee, EIA Government Division, 2001 Eye St., N.W., Washington, DC 20006, (202) 457-4944.

February

2-4
Southcon '82, Orlando, FL, at the Sheraton/Hyatt. For more information call (800) 421-6816.

23-25
NEPCON WEST, Anaheim Convention Center, Anaheim, CA. For more information, contact Cahners Exposition Group, 222 W. Adams St., Chicago, IL 60606, (312) 263-4866.

March

19-21
Computer Fair, Civic Auditorium, Brooks Hall, San Francisco, CA. For more information call (415) 851-7075.

23-25
Southcon/82 Show and Convention, Sheraton Twin Towers Hotel, Orlando Hyatt Hotel and Holiday Inn International Drive, Orlando, FL. Call (800) 421-6816 for more information.

29-May 1
1982 Electronic Distribution Show and Conference, New Orleans Hilton, New Orleans, LA. Contact David L. Fisher, Electronic Industry Show Corp., 222 S. Riverside Plaza, Suite 1606, Chicago, IL 60606, (312) 648-1140.

April

23-25
Hamvention '82, Dayton Hara Arena, Dayton, OH. For more information call (513) 277-5314.

29-May 1
Electronic Distribution Show, New Orleans Hilton, New Orleans, LA. For more information call (312) 648-1140.

May

10-12
The 32nd Electronic Components Conference, Sheraton Harbor Island Hotel, San Diego, CA. Contact program chairperson D. J. Bendz, IBM Corp., Dept 649/014-4, 1701 North St., Endicott, NY 13760.

11-15
National Association of Television & Electronic Servicers of America (NATESA) 31st Annual Convention, Indian Lakes Resort, Bloomingdale, IL. Contact Frank J. Moch, 5930 S. Pulaski Rd., Chicago, IL 60629, 1-312-582-6350.

18-20
Northcon/82 Show and Convention, Seattle Center Coliseum, Seattle, WA. Call (800) 421-6816 for more information.

25-27
Electro '82, Hynes Auditorium, Boston, MA. For more information, call (800) 421-6816.

June

6-9
Summer CES '82, McCormick Place, Chicago, IL. Contact Consumer Electronics Shows, Two Illinois Center, Suite 1607, 233 North Michigan Avenue, Chicago, IL 60601, (312) 861-1040.

7-10
National Computer Conference '82, Astro Arena, Houston, TX. For more information call (703) 558-3600.

August

2-7
Joint convention of NESDA, ISCET, The Texas Electronics Association, the Louisiana Electronic Service Dealers Association, and Television Service Association of Arkansas. At the Hilton in New Orleans, LA. Contact The National Electronic Service Dealers Association, 2708 West Berry St., Ft. Worth, TX 76109, (817) 921-9061.

September

14-16
Wescon '82, Anaheim Convention Center, Anaheim, CA. For more information call (800) 421-6816.

October

11-13
EIA Fall Conference, Century Plaza Hotel, Los Angeles, CA. For more information contact the Electronic Industries Association, 2001 Eye Street N.E., Washington, D.C. 20006.

ES&T

Test your Microprocessor IQ

By Douglas M. Bonham, director,
Heathkit/Zenith Educational Systems.

The microprocessor exploded onto the scene in the early 1970s, and the world of electronics has not been the same since. If you are involved in electronics, your professional life has already been changed by this incredible new device. In the world of electronics, the battle is over, and the microprocessor has won.

Now that the microprocessor has consolidated its position in the electronics world, it is shifting the revolution to such traditionally stable fields as electromechanical, optical and chemical engineering. If you are employed in these fields, you have undoubtedly seen some inroads being made already. This process will continue and even accelerate in the years ahead.

What exactly is this device that has revolutionized the electronics and computer industries and promises to revolutionize a dozen other major industries? How will it affect your job? What opportunities and problems does it raise for you? Although this article cannot answer these questions fully, it may help you to identify where you stand in the coming revolution. Have you kept abreast of what the microprocessor is, how it works, and what it can do? To find out, take this test and then refer to the answers on the following page.

Microprocessor IQ Test

1

The microprocessor can be thought of as:
A. A computer on a tiny chip of silicon.
B. A universal logic element.
C. A new way of designing digital electronics devices.
D. All of the above.

2

Which of the following devices might contain a microprocessor?
A. A personal computer.
B. An automobile.
C. A washing machine.
D. All of the above.

3

Virtually every microprocessor application can be divided into four sections called:
A. CPU, RAM, ROM, I/O.
B. ROM, PROM, EPROM, RAM.
C. TTL, NMOS, PMOS, CMOS.
D. SSI, MSI, LSI, VLSI.

4

The actions performed by a microprocessor-based device are determined by the hardware design and:
A. A control program in ROM.
B. The instruction set of the microprocessor.
C. A control program in RAM.
D. The bus structure.

5

The characteristics of a microprocessor-based device can be updated or changed quickly and easily by changing:
A. The CPU.
B. The RAM.
C. The firmware.
D. The bus structure.

6

The "power" of a microprocessor is determined by:
A. Its clock speed.
B. Its instruction set and addressing modes.
C. Its word size.
D. All of the above.

7

In microprocessor jargon, an instruction is:
A. The most basic operation that the designer can instruct the microprocessor to perform.
B. One complete clock cycle.
C. One storage or retrieval cycle of information to or from memory.
D. All of the above.

8

"Addressing Mode" refers to the method by which the microprocessor determines the address:
A. At which a piece of data that is to be operated upon is located.
B. From which it fetches an instruction in memory.
C. At which it stores an instruction in the queue.
D. At which it stores data in ROM.

9

Popular word sizes of microprocessors are:
A. 2-bits, 4-bits and 6-bits.
B. 4-bits, 8-bits and 16-bits.
C. 5-bits, 10-bits and 15-bits.
D. All of the above.

10

What is the best way for someone unfamiliar with microprocessors to learn about them for the first time?
A. Read related magazine articles in the various electronic journals.
B. Attend manufacturers' seminars.
C. Read textbooks on the subject.
D. Combine a concentrated study of microprocessor theory with actual "hands-on" design and programming experience.

Answers to Microprocessor quiz

1

D. The microprocessor is a small but powerful computer on a tiny chip of silicon. The chip may be no more than 1/4-inch on a side. It is generally sealed inside a plastic or ceramic package. Approximately 40 metal pins connect the chip to the outside world.

Because the microprocessor is a computer, it can be programmed to perform virtually any logic function or any sequence of logic functions. Thus, it truly is a universal logic element. Unlike earlier logic circuits that could perform only a single function, the microprocessor can perform any sequence of mathematical or logical operations we can imagine.

The microprocessor's tremendous capability and flexibility provide a new way of designing electronic equipment. Complex devices that once required hundreds of separate logic circuits can be designed with fewer parts more quickly and more cost effectively with microprocessors.

2

D. If you have followed the explosion in microprocessors, you are aware of the so-called microcomputer. As you might expect, the microprocessor is the key to these small computers. However, the microprocessor has also invaded many additional areas.

Home appliances of all kinds now routinely use microprocessors where they once used relays and timers. The automobile is another good example. Squeezing every mile from a gallon of gasoline while holding pollutants to acceptable levels requires precise control of gasoline, air and spark. The microprocessor can provide the control needed. More manufacturers are employing the microprocessor in their new car designs.

3

A. Microprocessor jargon is an alphabet soup of acronyms and abbreviations. This is one of the reasons that microprocessors are so intimidating to the uninitiated. Once all those esoteric terms are defined, much of the mystery evaporates.

CPU stands for the Central Processing Unit. This is the part of the microprocessor that performs all processing functions and controls all the other parts.

RAM is the acronym for Random Access Memory. This is the type of memory the CPU uses to store and retrieve temporary data and intermediate results.

ROM is the abbreviation for Read Only Memory. This is the memory that contains the control program that tells the CPU exactly what to do. A large part of the job of designing a microprocessor-based device consists of writing this control program.

I/O refers to Input/Output. This section of the microprocessor circuitry accepts raw information from and delivers processed information to the outside world. Depending on the application, inputs may come from a variety of sources such as keyboards, switch settings, pressure, heat or light sensors. Outputs may take the form of display devices such as cathode ray tubes, numerical indicators or a printer. On the other hand, the output may be as simple as a relay closure, a solenoid actuation or the stepping of a motor.

Now let's look at the incorrect answers. The acronyms appearing in answer B refer to various types of memories.

The ROM, or Read Only Memory was mentioned above. This type of memory is preprogrammed to the user's specifications by its manufacturer. Its contents cannot be changed by the user. Thus. the microprocessor can retrieve information from it but can store nothing in it.

On the other hand, the PROM, or Programmable Read Only Memory can be programmed by the user in the field. A special device called a PROM burner can be used to "burn" the user's program into the device. However, once programmed, the contents cannot be easily changed.

The EPROM, or Erasable PROM, is somewhat more flexible in that it can be programmed in the field by the user and later erased if the user chooses to change its contents. The most common method of erasing is to shine an ultraviolet light through a tiny window on top of the device.

Finally, the RAM, or Random Access Memory, is a special type of memory that can be written into and read from with equal ease. All four types of memories have their own special characteristics, advantages and disadvantages. All find their own important niche in the world of microprocessor design.

Answer C refers to four different fabrication techniques used in the manufacture of integrated circuits (ICs) such as microprocessors. The acronyms TTL, NMOS, PMOS and CMOS stand for Transistor Transistor Logic; N-Channel Metal Oxide Semiconductor; P-Channel Metal Oxide Semiconductor; and Complementary Metal Oxide Semiconductor respectively.

Each fabrication technique has its own particular characteristics of operating speed, density, power consumption and cost.

Answer D refers to the relative complexity of integrated circuits. SSI, or Small Scale Integration, usually refers to an IC that has 10 or fewer logic elements. Medium Scale Integration (MSI), Large Scale Integration (LSI) and Very Large Scale Integration (VLSI) refer to increasingly complex ICs. Each category generally refers to a tenfold increase in complexity or number of logic elements.

4

A. Until the advent of the microprocessor, the actions performed by an electronics device were determined by the hardware.

A collection of various types of components were carefully blended to perform a desired result. An engineer could study the schematic diagram of the device and determine what it did.

This has changed to a large extent as a result of the microprocessor. Of course, the hardware components must still be interconnected properly, but the actions of the device are determined largely by a control program in a Read Only Memory. (See answer 5.)

5

C. As the previous answer points out, the control program in ROM determines the actions that the microprocessor performs. Incidentally, a program in ROM is often called firmware. This stems from computer jargon in which integrated circuits are called hardware and programs are called software.

The ROM itself is an integrated circuit or hardware while its program is software. Thus, the term firmware has been adopted to describe a program in ROM. One of the beauties of a microprocessor-based device is that its characteristics can be changed or updated by changing its firmware.

6

D. In microprocessor parlance, the word power is largely synonomous with speed. The faster it can do a particular job, the more powerful it is said to be. All of the items mentioned contribute to the microprocessor's power.

The clock speed determines how fast the microprocessor runs. Thus, for a given device, the faster the clock, the more powerful the processor. However, clock speeds alone can be misleading because different processors require different numbers of clock cycles to perform a particular operation.

The answers to questions 7 and 8 discuss instruction sets and addressing modes in more detail. As you will see, these two factors also contribute to the power of a microprocessor.

The word size of a microprocessor refers to the size of the number with which it normally works. As a general rule, the larger the word size, the more powerful the microprocessor is said to be. (See answer 9.)

7

A. An instruction is the most basic operation that the microprocessor can perform. A typical microprocessor has math instructions such as ADD and SUBTRACT and logical instructions such as AND and OR. It has instructions that move data from one place to another with names such as MOVE, LOAD and STORE. Some instructions allow the microprocessor to break out of its normal program sequence when certain conditions are met. These are called conditional JUMP or BRANCH instructions.

A typical microprocessor may have 200 or more different types of instructions. The instruction set is an important consideration in selecting a microprocessor for a particular job.

8

A. Most microprocessors have several addressing modes, or methods by which the location of data is determined. Memory is divided into thousands of separate locations, each of which is given a number called an address. There are several different methods by which an address can be specified. A variety of addressing modes gives the microprocessor more flexibility and power.

9

B. At their most basic level, microprocessors do not work with decimal numbers as we might expect, but with binary numbers. Binary is a special way of numbering that involves only ones and zeros. A single digit binary number is called a bit. The most popular microprocessors work with 4-bits, 8-bits or 16-bits at a time.

10

D. This is a somewhat subjective question and anyone who anticipates that microprocessors will eventually affect his or her job should participate in all the activities listed. However, years of experience have proved that the best way to learn about microprocessors is to use them. Indeed, the only way to become competent in programming and designing is to practice.

Fortunately, there are several good and inexpensive microprocessor training devices on the market today. Heathkit/Zenith Educational Systems offers two methods of learning this technology. Each consists of a microprocessors trainer and accompanying educational course.

For those with electronics background, there are the ET-3400 Microprocessor Interfacing and Programming Trainer and the EE-3401 Microprocessor Course. This course/trainer system teaches the design and programming of microprocessor-based devices. The student actually builds and experiments with a number of working circuits including microprocessor-controlled voltmeters, musical instruments, and digital clocks.

How did you rate? If you answered all the questions correctly and understood all the various terms and concepts, you have been able to keep yourself well informed. You obviously have a general idea of what microprocessors are and how they work. If you missed two or three, you have a marginal knowledge and should probably intensify your study of this subject. If you missed four or more, you need training.

ES&T

Anatomy of a satellite earth station

By Robert Ashton, P.E., Chief Engineer, Technical Products, Heath Company

Conventional TV transmission has one major disadvantage: Its range is limited. Because of this, millions of homes in the United States have either limited program selection, unacceptable picture quality, or even no television at all. The primary factor limiting the range of the TV signal is blockage caused by the curvature of the earth's surface or objects in the line-of-sight, e.g. mountains, buildings, etc. See Figure 1.

One way to obtain a wider signal coverage is to elevate the transmitting antenna as high as

possible. This obviously has practical limitations. If this antenna were an artificial satellite in space, its coverage would be much larger. See Figure 2.

This idea is not new. In a February 1945 issue of *Wireless World*, Arthur C. Clarke, a science fiction writer, wrote "An artificial satellite at the correct distance from the Earth would make one revolution every 24 hours; i.e., it would remain stationary above the same spot and would be within optical range of nearly half of the Earth's surface. Three repeater

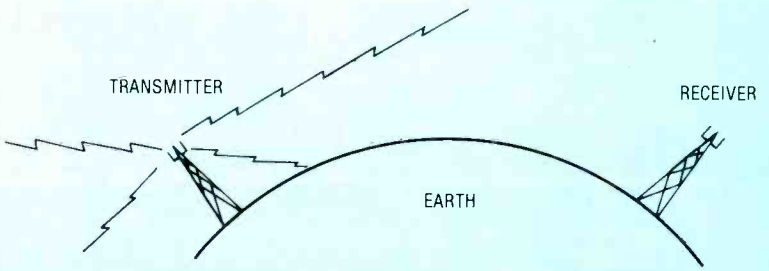


Figure 1. The signals are blocked by the earth's curvature.

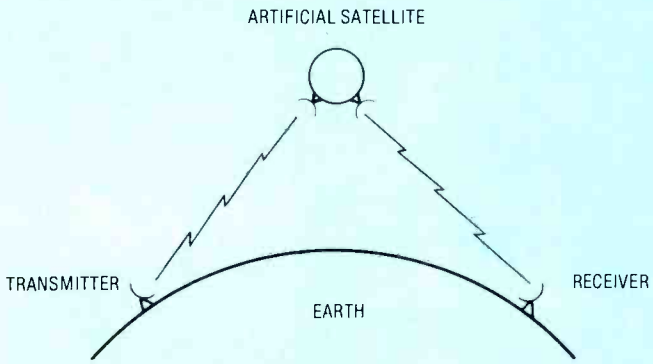


Figure 2. The artificial satellite acts like an extremely high antenna.

Anatomy of a satellite

stations, 120 degrees apart in the correct orbit, could give TV coverage to the entire planet."

At that time, it was science fiction, but in 1958 the first active communications satelite was launched. Within 25 years of the publication of that article, three satellites covered the entire globe with communications.

The orbit postulated in 1945 is called the *geostationary* or *geosynchronous* orbit. Some refer to it as *the Clarke orbit* in honor of the author. In order to be in this orbit, the satellite is positioned 22,300 miles from Earth, above the equator, and revolves around the earth once a day. At this altitude the centrifugal force created by the revolving satellite is cancelled by the gravitational force that pulls toward the earth. See Figures 3a and 3b.

When these satellites are used for TV transmission, the viewer can receive more channels and pictures are of unusually high quality. Because the satellite signals are line-of-sight and operate in the microwave frequency spectrum, they are not as affected by weather conditions, time of day or sunspot activity as the regular VHF or UHF TV signals.

In this article, the basic components of a satellite earth station will be discussed. In a future article, actual home installation of a TVRO (TV Receive Only) will be considered. Topics will include the site survey, which determines if your site is suitable for earth station placement, equipment selection and performance verification.

Figure 4 shows a typical communications link. The path from the transmitting earth station to the satellite is called the uplink. The North American domestic satellites, sometimes called DOMSATS, use an uplink frequency in the 6GHz (6 billion cycles per second) radio band. The path from the satellite to the receiving earth station is called the downlink. Downlink frequencies are in the 4GHz band. The satellite gets electrical power from solar panels.

Figure 5 shows a simplified block diagram of a typical earth station transmitter. The baseband standard video is processed to preemphasize high frequency components. This improves the video signal-to-noise ratio by compensating for the increased noise density with frequency characteristic of FM receiver demodulators.

An energy-dispersal waveform is also added. This is a triangular waveform that spreads the energy in the carrier over a wider band to avoid intermodulation among the multiple carriers present on the satellite. It also reduces interference to terrestrial microwave links by not concentrating energy over a narrow frequency band, especially during periods of low modulation.

Sound subcarriers are added to the processed video and the combination is upconverted (heteradyned or mixed) to the desired 6GHz channel. A high power klystron amplifier feeds this signal to the antenna. If the amplifier has a power output of 450W and is fed into a 10-meter-diameter antenna, the EIRP (effective isotropic radiated power) will be about 80dBw or 100,000,000W! The apparent multiplication of power is due to the directivity of the antenna. This power level is necessary to overcome the space loss to the satellite. The satellite receives these signals, converts them to 4GHz frequencies and retransmits the signals back to earth.

Current 6/4GHz satellites have 12 or 24 transponders. This means that they can handle 12 or 24 such signals at a time. Each transponder has an output of about 5W (about that of a CB radio). The 24-transponder satellites transmit on frequencies starting at 3720MHz (3.72GHz) for transponder #1, incremented in 20MHz steps to 4180MHz (4.18GHz) for transponder 24. Because the bandwidth of each transponder is 36MHz and the transponder spacing is only 20MHz, the signals must have different polarizations to avoid problems of signal overlap.

A radio wave is an electromagnetic wave. It consists of an oscillating electric wave and, an oscillating magnetic wave at right angles to it. The direction in which the electric wave oscillates is called its polarization. Two adjacent channels can be broadcast simultaneously on overlapping frequencies without interfering with each other if the carrier wave for one is polarized horizontally and

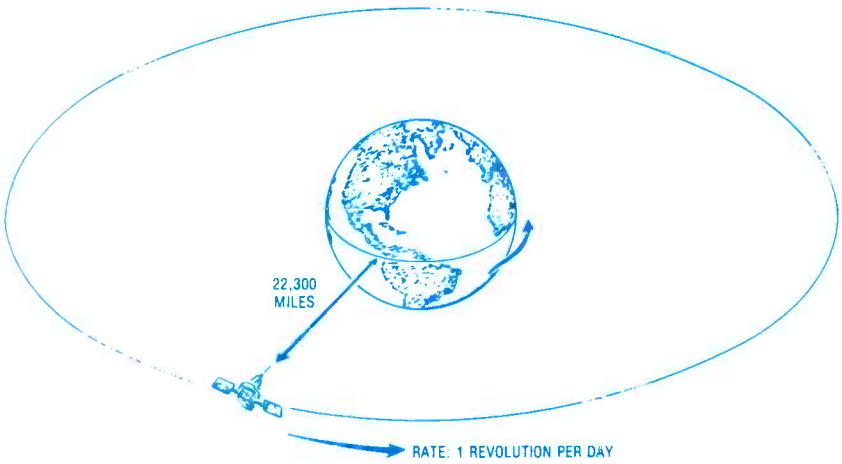


Figure 3a. A geosynchronous orbit. To an observer on earth, the satellite remains fixed in the sky.

the other is polarized vertically. Satellites use this principle to squeeze in 24 channels on a frequency band that would not normally carry that many channels. Figure 6 shows the frequencies and polarizations of typical 12- and 24- transponder satellites.

The signal that reaches an earth station antenna from a satellite may be 8000 times weaker than a local TV signal. The dish antenna collects these weak signals and focuses them on a central point called the feed assembly (shown in Figure 8). The surface of the dish is responsible for focusing the signals, so the curvature must be held to tight tolerances. For example, the surface of an antenna operating at 4GHz should be held to within 0.06 inches RMS of the designed curvature. If this tolerance is not maintained, the antenna will not work efficiently.

There are five basic parts of an earth station antenna: the reflector, backing structure, mount, earth anchor and feed assembly. We will start with a discussion of the reflector.

The reflector

The reflector can be one of several geometric shapes. The parabolic and spherical (Figures 8 and 9) are the most popular. The chief advantage of a parabolic reflector is that it has high performance for its size and has the feed assembly physically attached to it, making one compact unit.

The spherical antenna's main advantage is that it can receive more than one satellite at a time by adding more feed assemblies. Notice that the feeds are not attached to the reflector, but are positioned in front. This antenna is harder to aim and has poorer sidelobe performance (is less directional). This style is rarely used in commercial broadcast applications. The reflector material can be anything that will reflect the microwaves into the feed assembly. The two most commonly used materials are aluminum and fiberglass. Aluminum antennas are usually made by stamping the aluminum sheet into pie-shaped pieces, which are bolted together to form the

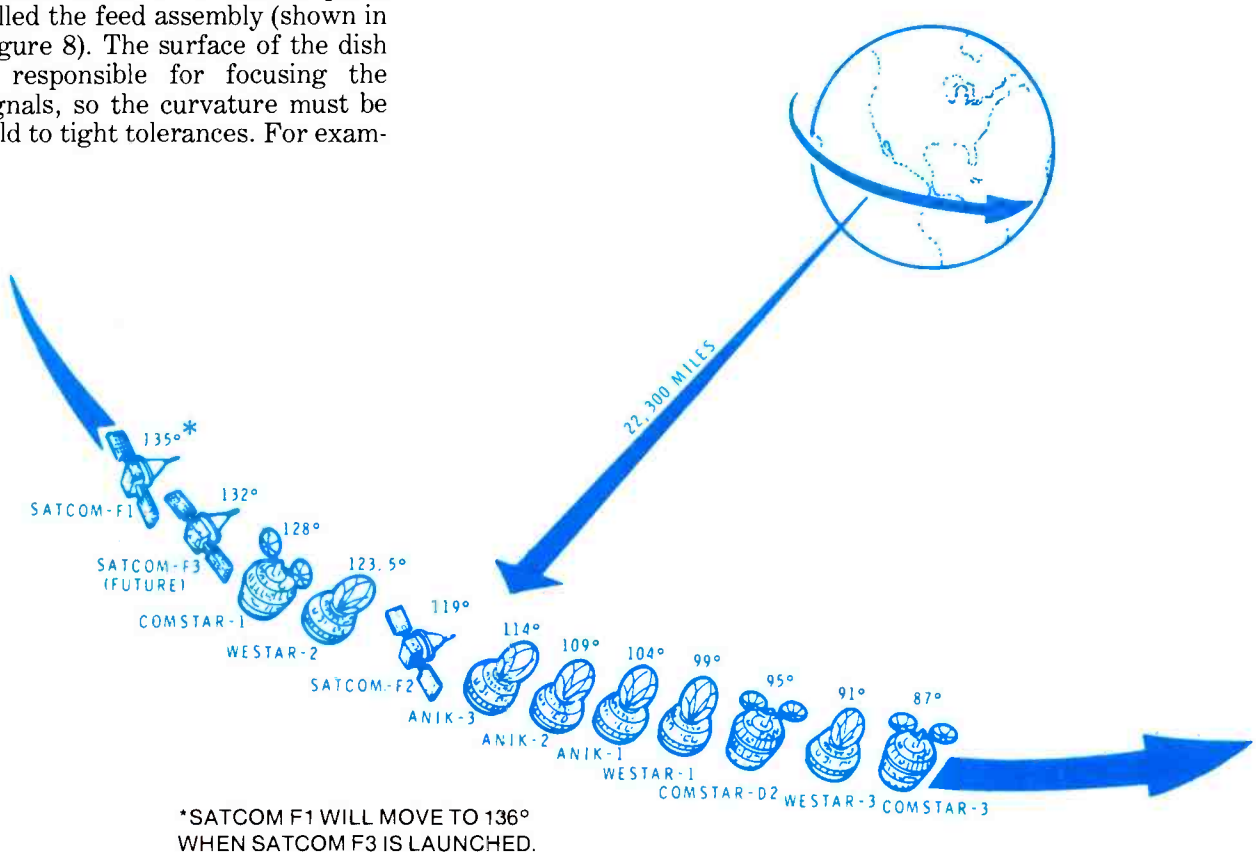


Figure 3b. The North American domestic satellites.

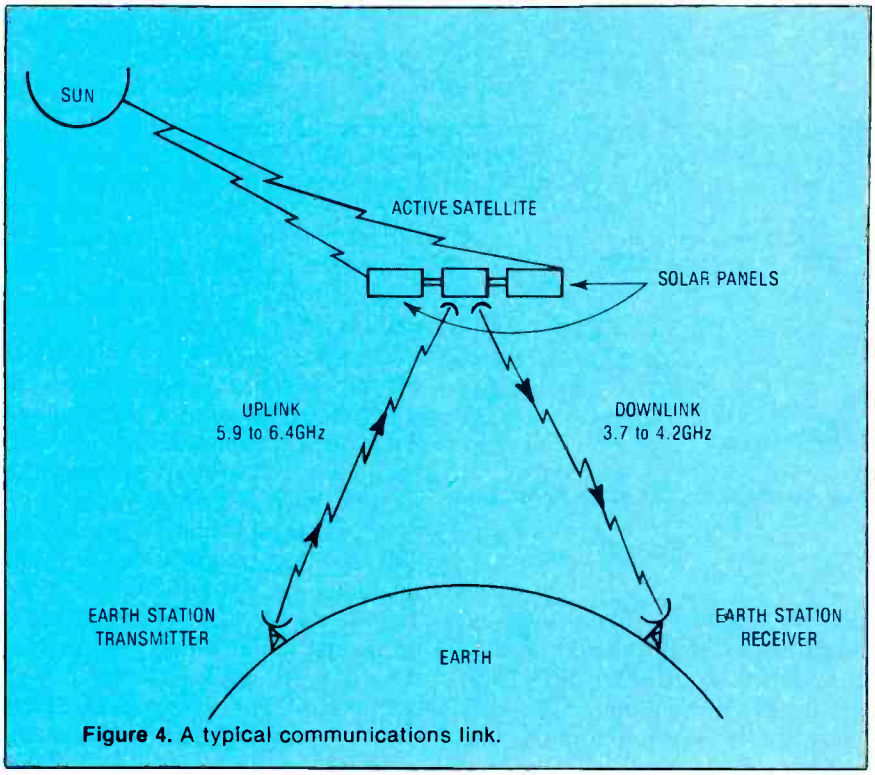


Figure 4. A typical communications link.

Anatomy of a satellite

reflector shape. Most antenna designs use from 4 to 24 sections to make the reflector. Large antennas are built similar to an airplane, using a ribbed frame with aluminum sheets riveted or welded to it.

Fiberglass antennas are generally made on a form, similar to a boat hull. The reflective coat is first sprayed on the form, which looks like an upside-down bowl. Fiberglass is then sprayed until the desired thickness is reached. The process is slow because the fiberglass must cure before it can be removed from the form. If the process is rushed and the antenna is removed too soon, the antenna may warp, making it useless.

The backing structure

The backing structure maintains proper mechanical support for the reflector. Without this, the antenna will lose its precise shape, especially during windy weather. This structure also mechanically connects the reflector to the mount.

is not difficult.

There are three basic types of mounts: elevation-over-azimuth (el-az), polar and single axis. Elevation can be defined as the angle between the horizon and the beam axis of the antenna. If the antenna is pointing on the horizon, the elevation is 0 degrees. An antenna pointing to zenith or straight up would have an elevation of 90 degrees, (Figure 10). Azimuth is the true geographic direction, in degrees, clockwise from true north. Thus, for a given spot on earth there are unique elevation and azimuth angles to each geosynchronous satellite. This assumes that the satellite is above the radio horizon. The formulas for determining these angles are shown in the box.

The advantage of the el-az mount is its easy installation. As long as the mount is on a reasonable level the antenna can be pointed to the satellite by first adjusting the elevation to the computed angle, then swinging the dish about its azimuth until a signal is received. The disadvantage is that it requires two adjustments every time one wishes to view another satellite.

A polar mount is shown in Figure 11. With this arrangement,

$$AZ = 180° + \text{ArcTan}\left[\text{Tan}(C)/\text{Sin}(\text{Lat})\right]$$

$$EL = \text{ArcTan}\left[\frac{\text{Cos}(C)\text{Cos}(\text{LAT}) - .15126}{\sqrt{\text{Sin}^2(C) + \text{Cos}^2(C)\text{x}\text{Sin}^2(\text{Lat})}}\right]$$

Where LAT is the site latitude. C is the satellite longitude – site longitude.

The mount

The purpose of the mount is to aim the reflector in the right direction. A typical satellite is only about 30 feet long and is more than 23,000 miles away. With a properly designed mount, however, this the polar axis is positioned to point due north, i.e. parallel to the earth's axis. A small declination angle is added between the reflector and the polar axis so the antenna will point toward the satellites over the equator.

The advantage of this mount is

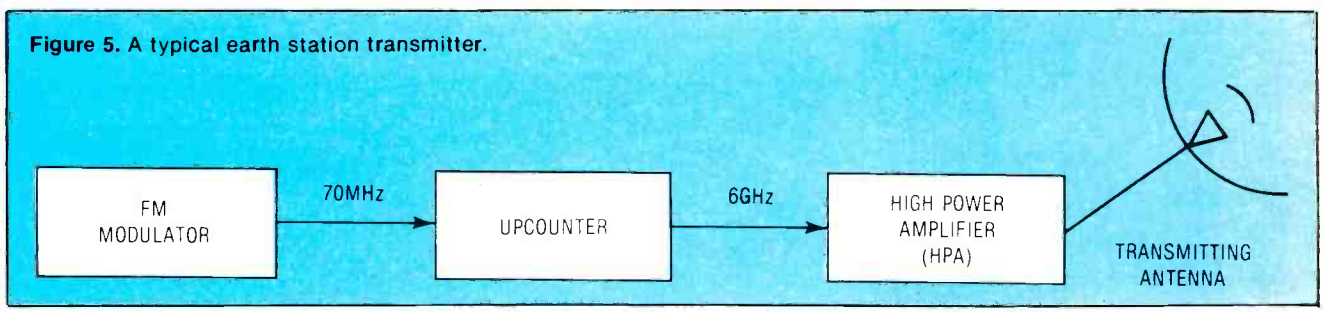


Figure 5. A typical earth station transmitter.

RCVR Channel Number	Frequency (MHZ) & Polarization	Satellite Designation	Satellite Designation	Satellite Designation
1	3720 V	1	1V	1(H)
2	3740 H	2	1H	
3	3760 V	3	2V	2(H)
4	3780 H	4	2H	
5	3800 V	5	3V	3(H)
6	3820 H	6	3H	
7	3840 V	7	4V	4(H)
8	3860 H	8	4H	
9	3880 V	9	5V	5(H)
10	3900 H	10	5H	
11	3920 V	11	6V	6(H)
12	3940 H	12	6H	
13	3960 V	13	7V	7(H)
14	3980 H	14	7H	
15	4000 V	15	8V	8(H)
16	4020 H	16	8H	
17	4040 V	17	9V	9(H)
18	4060 H	18	9H	
19	4080 V	19	10V	10(H)
20	4100 H	20	10H	
21	4120 V	21	11V	11(H)
22	4140 H	22	11H	
23	4160 V	23	12V	12(H)
24	4180 H	24	12H	

Figure 6. Comparison of receiver channel numbers with various satellite channel designations.

that one may sweep the entire goesynchronous arc by making only one adjustment. However, installation is critical. If the polar axis is not correct, the mount will not track the satellite arc. Due to magnetic declination (the true and magnetic north poles are not in the same place) and compass errors, it is easy to install the mount with the axis off north.

The single-axis mount is a modified polar-type mount. Like the polar mount, it will allow a change between satellites with only one adjustment. It is simpler to install but may only be adjusted to have zero error on two satellites, because it sweeps a plane in space rather than an arc. This is not a problem with smaller diameter dishes (under 15 feet) because their beams are broad enough to mask the small tracking error.

The earth anchor

The earth anchor attaches the mount to the ground. The antenna must remain in a fixed position while being subjected to wind loads. Otherwise its positioning may move off the satellite or break loose. Because of the large surface area of the reflector and its distance above the ground, the anchor must safely transfer the resulting sideways and overturning forces to the ground. One common method involves a pier-type construction. A number of holes are drilled in the ground extending below the frost line. A steel pier structure is placed in the holes and the holes are filled with concrete. The other method uses a reinforced concrete slab to weight the antenna down. Forces in excess of 3000 pounds can be realized from a 10-foot dish in high wind, so mounting on a rooftop is not recommended unless a competent structural engineer has designed a suitable anchor system.

The feed assembly

The feed assembly receives the microwave energy reflected from the dish and transmits it to a low-noise amplifier (Figure 12). The feed is designed to accept signals from the reflector but reject signals from other directions. For instance, if the feed were a light source illuminating the reflector surface, an optimum design would light up the complete surface but nothing past the edge. If the illumination pattern were too narrow, some of the reflector would be wasted because it is not illuminated. If the pattern were too large, energy would be wasted because some is lost beyond the edge. Figure 13 illustrates this point.

Figure 14 shows a typical feed assembly. The illumination pattern is determined by the corrugations

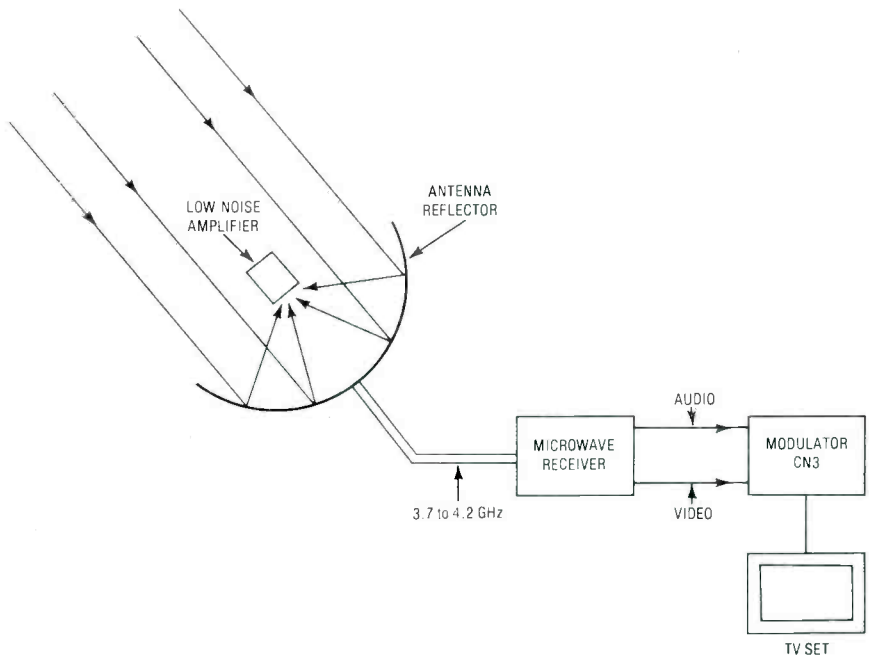


Figure 7. The basic parts of an earth station antenna.

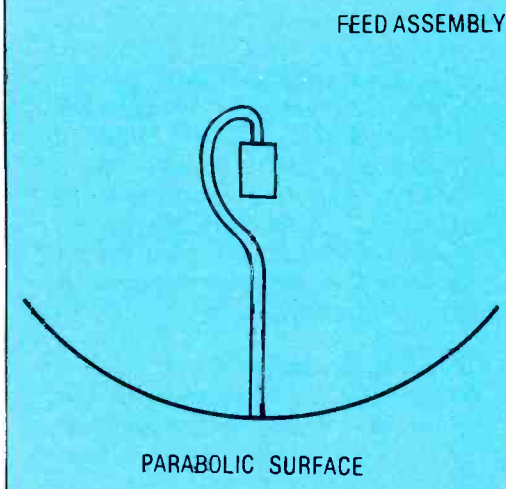


Figure 8. A parabolic antenna. The feed is physically attached to the antenna.

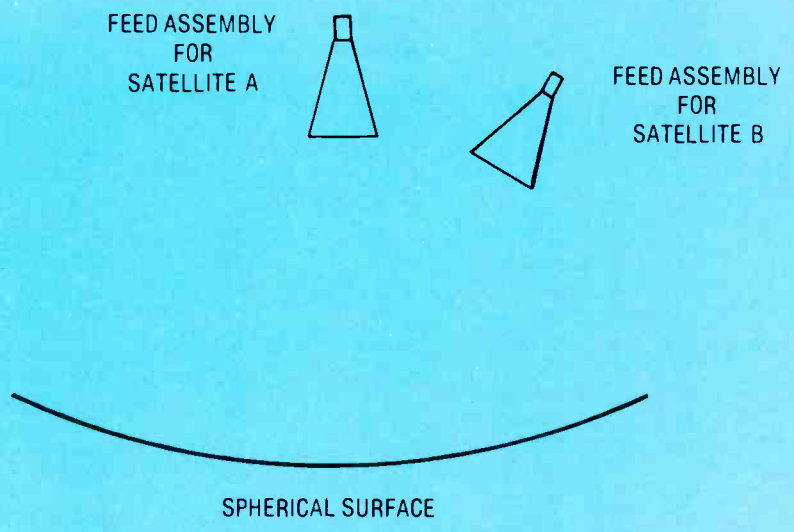


Figure 9. A spherical antenna. Receiving multiple satellites is possible.

Anatomy of a satellite

and the microwave energy enters through the window.

There are two basic types of feed arrangements: prime focus and Cassegrain. In a prime-focus antenna, the feed is positioned at the focal point in front of the parabola (Figure 15).

The efficiency can be increased by adding a second reflector of a hyperbolic or quasi-hyperbolic shape and moving the feed toward the main reflector (Figure 16). With this subreflector, energy is first reflected from the main reflector to the subreflector, then to the feed. The shapes of the reflectors and the design of the feed determine the illumination pattern of the antenna. This is called a Cassegrain design. Cassegrain antennas are used almost exclusively for commercial applications where antenna performance is important.

To better illustrate the concept of efficiency and illumination, think of the antenna as a flashlight working in reverse. When you look at a flashlight, notice how shiny the surface of the reflector is. This is because the surface is very smooth. A satellite antenna does not have to be this smooth because it operates at a much lower frequency and the surface tolerance is a direct function of frequency. (Light frequency is almost 100,000,000,000 times higher than the frequencies used by these satellites). Relatively speaking, if the antenna surface is not "shiny" to microwaves then it will not work well either.

When you point a good flashlight on a wall you see a very concentrated spot with little or no light past the edge. If you point a bad

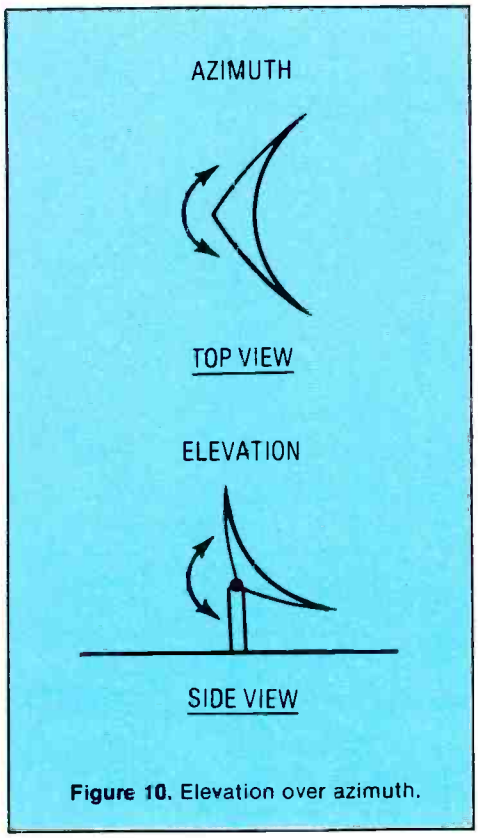


Figure 10. Elevation over azimuth.

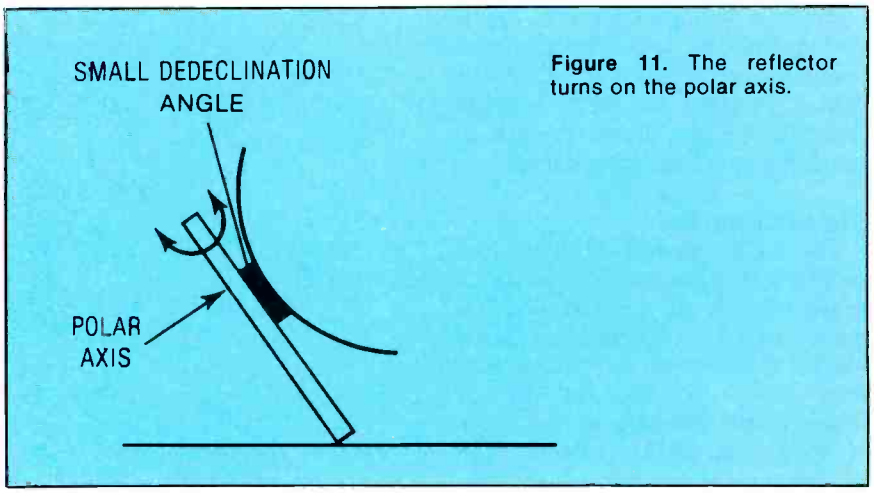


Figure 11. The reflector turns on the polar axis.

flashlight at the wall you see a fuzzy spot that may not be round. You may also see concentric circles past the edge of the spot. In antenna talk these circles are called sidelobes and they reduce the efficiency and directivity of the antenna.

A satellite antenna has to be like the good flashlight, concentrating a narrow beam. The beamwidth of a properly designed 10-foot-diameter antenna is less than 2 degrees. For a given frequency, the larger the antenna, the smaller the beamwidth. Large commercial antennas (30-foot-diameter) have beamwidths less than one half degree.

The main antenna specification is its gain. It is expressed in decibels above an isotropic radiator with the equation

Gain = 10 log(g)

where g is the power ratio of the antenna to an isotropic radiator. (An isotropic radiator is the simplest theoretical antenna, a paint source. It radiates equally in all directions). If the antenna is 10,000 times more effective than the isotropic radiator, then its gain is 10 log (10,000) or 10*4 or 40dbi. This is a typical gain for an 11-foot antenna.

The low noise amplifier (LNA)

The next block in the earth station diagram shown in Figure 7 is the low noise amplifier (LNA), which amplifies the weak signals coming from the feed assembly without adding much of its own noise. All electronic components add some noise to a system, but it is critical to minimize the noise so it does not overcome the signal.

Figure 17 shows a simplified block diagram of an LNA. The pickup probe is the *actual antenna* of the earth station; the object that we called the antenna in the above discussion is actually a *concentrator*. Its large area is used to collect the microwave signal and focus it to this tiny probe, which is less than an inch long. There are two types of probes – a voltage pickup and a magnetic pickup. The voltage or *E field* pickup is the most popular. The direction the probe points must match the polarization of the received signal. For instance, if an E field probe is used, it must be horizontal to receive horizontally polarized

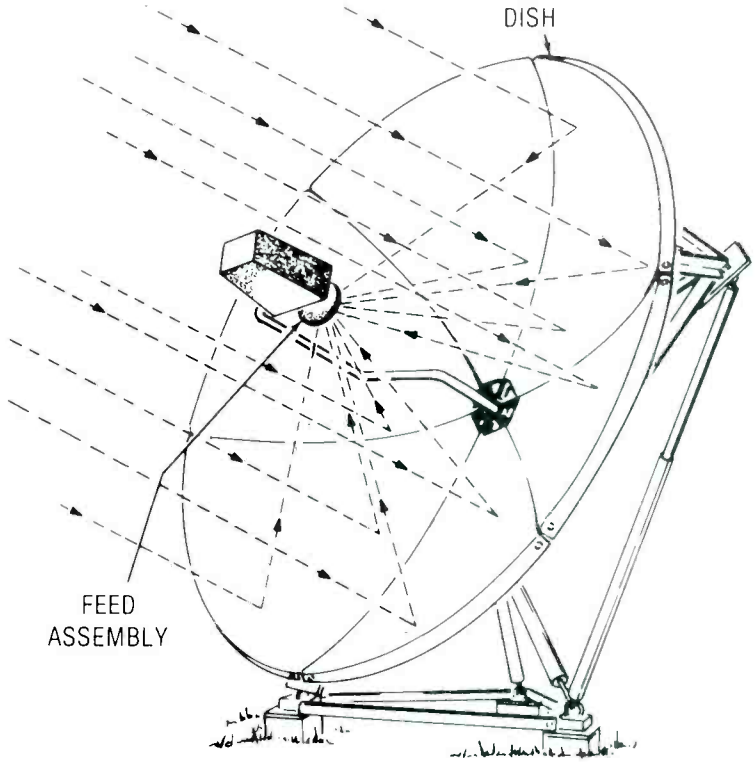


Figure 12. The feed assembly receives microwaves reflected from the dish.

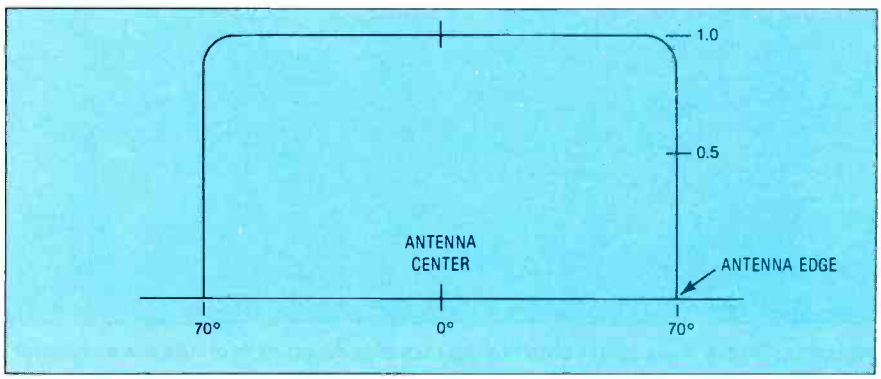


Figure 13. An ideal illumination pattern.

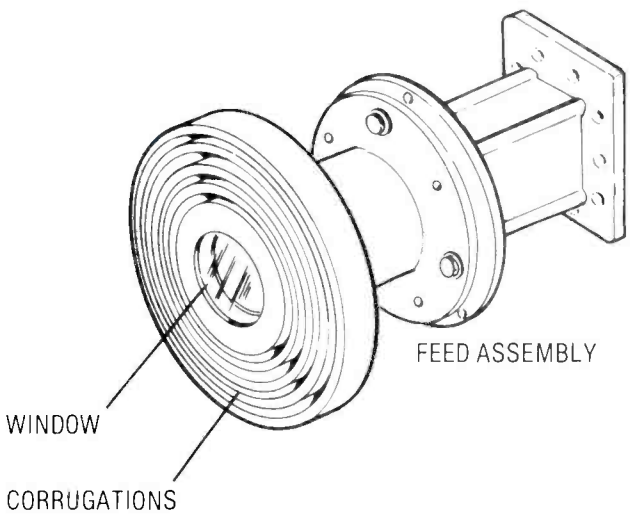


Figure 14. A typical feed assembly.

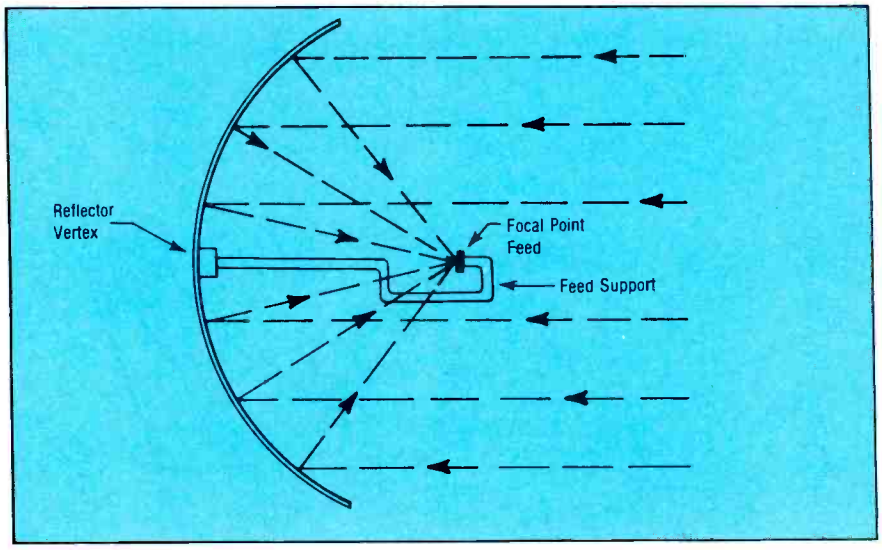


Figure 15. On a prime focus antenna the microwaves reflect right into the feed.

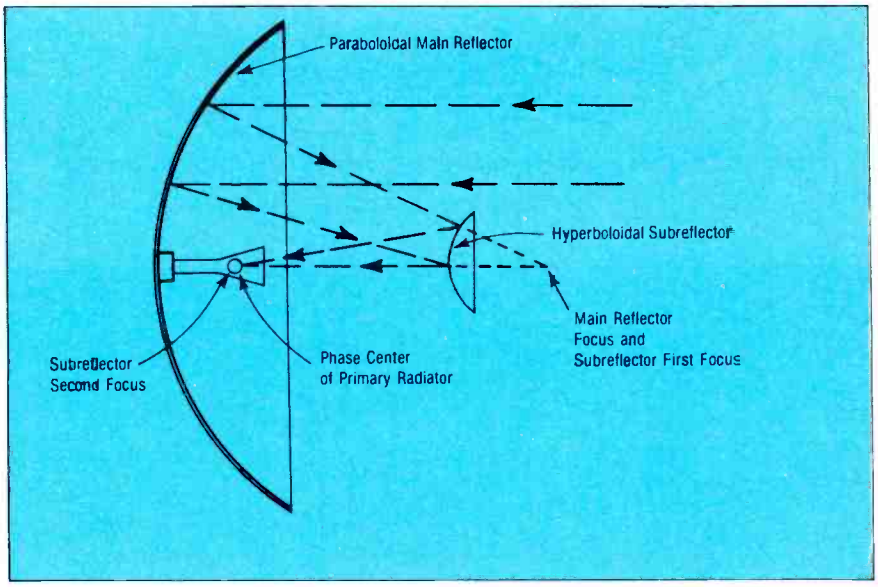


Figure 16. With a Cassegrain antenna the microwaves go from on the main reflector to the subreflector and then into the feed.

Anatomy of a satellite

signals, vertical for vertical signals. This means that in order to change from an odd to an even channel (on a 24-transponder satellite) the LNA must be rotated 90 degrees.

Figure 18 shows a feed assembly with attached amplifier. The gear motor and chain assembly rotate the amplifier to match polarizations when necessary. This fully automatic system was developed by Heath Company, Benton Harbor, MI.

The isolator shown in Figure 18 maintains a constant impedance at the input of the amplifier (usually 50Ω). This constant impedance is essential to keep the noise as low as possible. The following stages are a gallium arsenide field effect transistor (Gas FET) amplifier. Gas FETs are essential in keeping the noise to a minimum.

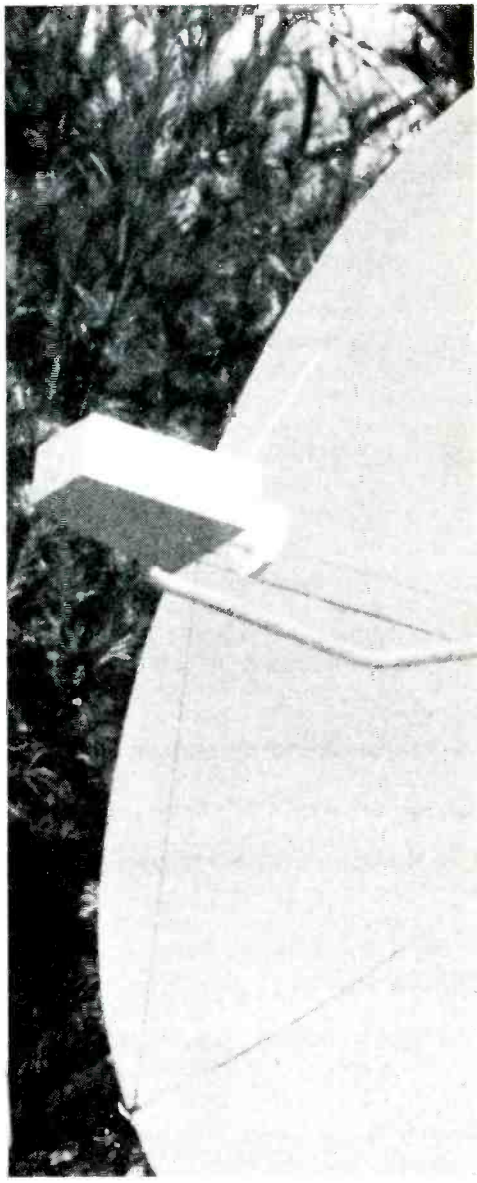
LNAs are classified according to their ability to keep appreciable noise low. This can be expressed as a noise figure in db or a noise temperature in Kelvin (degrees absolute). The lower the number the better. Technology has improved to the point that a 120 Kelvin (1.5 dB) LNA is the standard model. Although 90 Kelvin units are available, they may cost twice as much as the standard. Figure 19 gives various noise figures and corresponding noise temperatures.

LNAs are expensive because they are high technology components. Isolators alone cost about $80 in volume quantities. The Gas FETS are expensive, but due to technological advances, their prices are steadily dropping.

The lower noise units cost more because they use selected Gas FETs with tighter characteristic tolerances and prices climb rapidly.

The output frequency of the LNA is 3.7 to 4.2GHz. A special coaxial cable (commonly referred as Heliax) feeds this output to the receiver. This cable is expensive because it is designed to have low loss at those frequencies. It is also big and bulky and due to its inherent losses is limited in length.

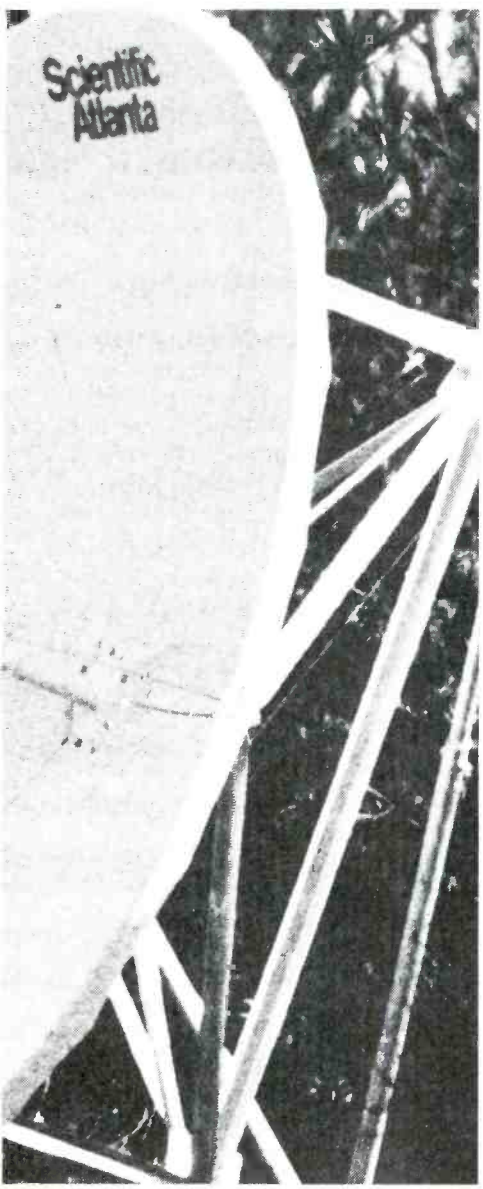
Some manufacturers add a frequency downconverter to their



LNA to transform the 3.7 to 4.2GHz frequencies to the VHF or UHF spectrum in order to use less expensive cable. These LNA/downconverters are commonly referred to as low noise converters (LNCs).

There are two common downconverter schemes. The block downconverter uses an integrated microwave local oscillator and a mixer to convert the whole 500MHz wide satellite spectrum to the UHF band. For example, Scientific Atlanta converts to a band between 270MHz to 770MHz with model 360 LNC. These LNCs are designed to be used with a dual conversion receiver with the first conversion at the LNC.

The second conversion takes



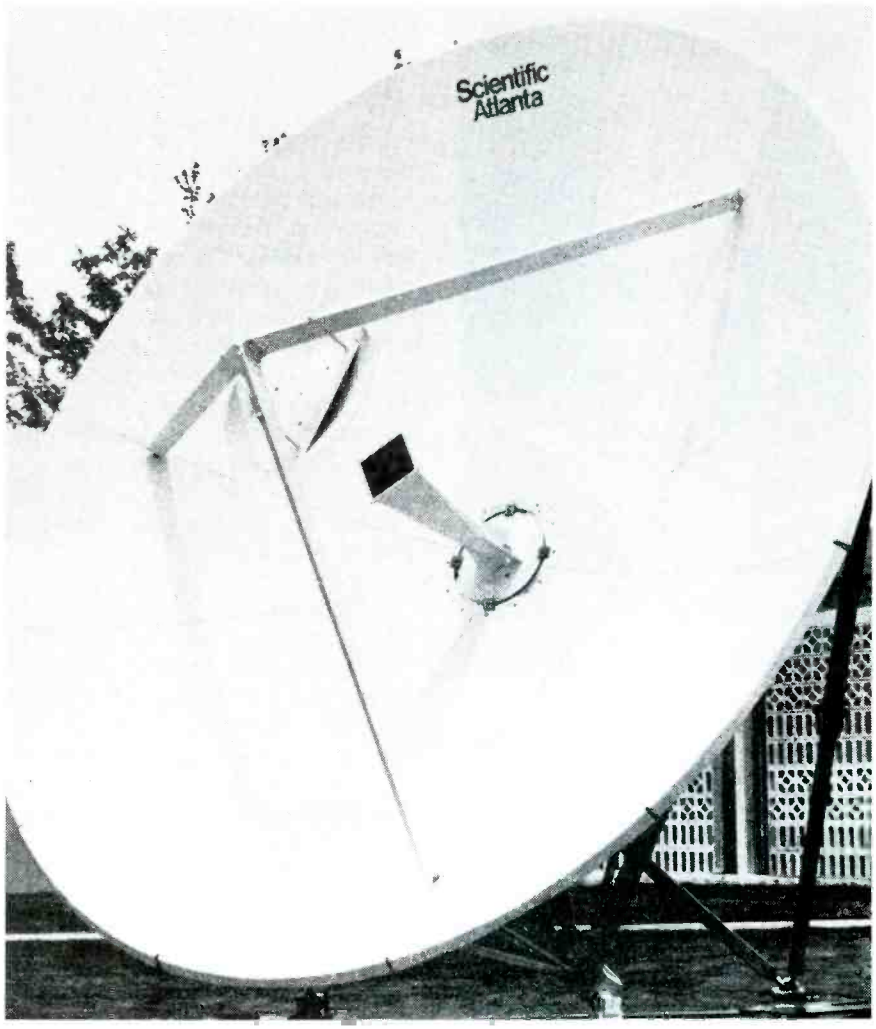
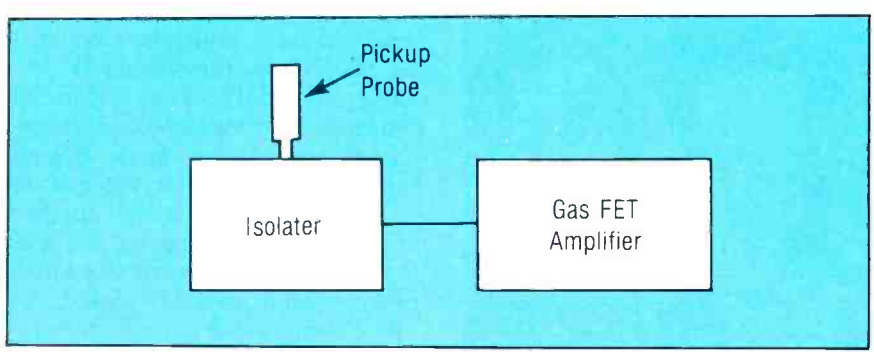


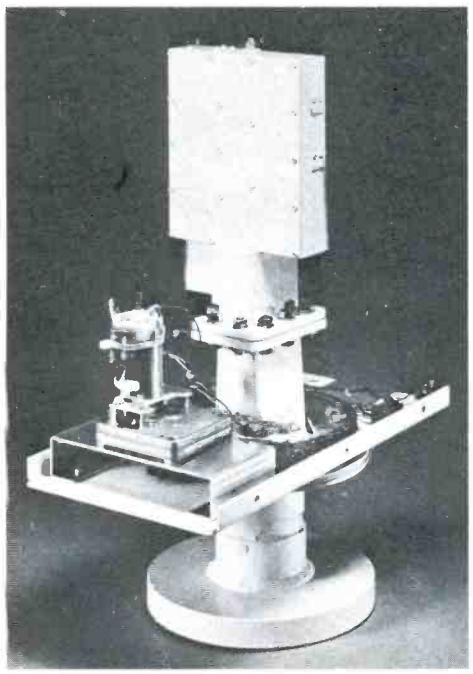
Figure 17. A simplified LNA block diagram.



place in the receiver. This second local oscillator, then, selects the transponder to be received and can easily be synthesized to be extremely stable.

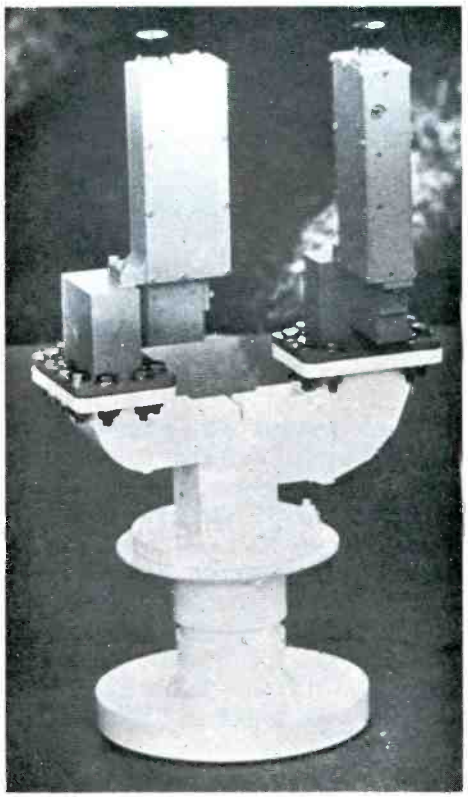
More than one receiver can be operated on different frequencies from a common LNC. The limitation is that in the case of a 24-transponder satellite, only odd or only even transponders can be viewed from a common LNC due to the different polarizations. Two LNCs are needed to view multiple transponders of different polarizations. In this case a special feed transition called an orthomode transducer (OMT) is used to separate horizontally polarized from vertically polarized signals. This transducer mounts between the feed and the two LNCs. (They also work with two LNAs). Figure 20 shows a picture of an OMT with two LNAs.

The second downconverter



Noise Figure	Noise Temperature
2.27dB	200°K
1.80dB	150°K
1.50dB	120°K
1.40dB	110°K
1.28dB	100°K
1.17dB	90°K
1.05dB	80°K

Figure 19



Anatomy of a satellite

scheme uses a voltage-controlled microwave oscillator and an image reject mixer to convert a single microwave frequency (transponder) to 70MHz. This system is less expensive but only one transponder can be viewed by a single LNC because the 70MHz IF frequency is capable of carrying the modulation of only one transponder. This configuration makes frequency synthesis impractical, resulting in a less stable receiver. Automatic fine tuning, used in some designs, minimizes this effect.

The receiver

The receiver further amplifies the signal, selects the received transponder and takes the video and audio information off the carrier signal. There are two types of receivers – single conversion and dual conversion. Each one may be designed for use with either an LNA or an LNC.

Figure 21 is a block diagram of a typical dual conversion receiver. The 3.7 to 4.2GHz signal from the LNA enters the frequency downconverter. A synthesized first local oscillator and mixer convert the desired frequency between 3.7 and 4.2GHz to the first IF frequency of 880MHz. A second local oscillator and mixer convert the 880MHz to the second IF frequency of 70MHz. This is done in two steps in order to reduce the requirements of the image filters. The 70MHz signal is filtered to shape the bandpass, is further amplified, and is fed to the FM demodulator to remove the video information from the IF signal.

A discriminator circuit is commonly used for this demodulation. Some manufacturers use a phase locked loop (PLL) scheme. The demodulated signal is then deemphasized to cancel the emphasis added in the uplink. Baseband information including video, program audio subcarrier, dispersal waveform (added at the uplink to prevent concentration of energy at a single frequency) and in some cases additional subcarriers are left.

A video clamp circuit removes the energy dispersal waveform. The output of the video clamp is straight video, which could be hooked up to a TV monitor or VCR. An output of the video demodulator is fed into one or more audio subcarrier demodulator circuits. These are actually FM receivers that select the subcarrier frequency and demodulate it into audio. The most popular subcarrier frequency for program audio (the audio belonging to the picture) is 6.8MHz. Some transponders use additional audio subcarriers to transmit other services such as background music, slow scan, news, etc. The output of this circuit could be hooked directly to an audio amplifier or hi fi.

Figure 22 is a simplified block diagram of a dual conversion receiver for use with an LNC. In this example, the input is a 500MHz-wide signal between 270 and 770MHz. A frequency-synthesized second local oscillator selects the transponder and converts the frequency to 230MHz. (Remember the first oscillator and mixer is at the LNC). This 230MHz IF is fed into a demodulator and clamp the same way as the first example.

Figure 23 shows a single conversion scheme. The receiver sends a tuning voltage to the LNC and the voltage determines the local oscillator frequency and therefore the received transponder. The output of the LNC is the IF frequency of the receiver. This signal is fed into the IF filter and amplifier and the rest is the same as the first two examples. The obvious advantage of this configuration is simplicity and low cost. This configuration is not presently used for commercial applications.

Two of the most important receiver specifications are IF bandpass and video threshold. The shape of the bandpass is important to the picture clarity and fidelity. If the bandpass is too narrow, the picture will lack definition. The

Figure 18 (top). A feed assembly with an attached amplifier.

Figure 19. Noise figures and corresponding noise temperatures.

Figure 20 (left). An OMT and two LNAs. Notice that the LNAs are mounted at 90° angles to each other.

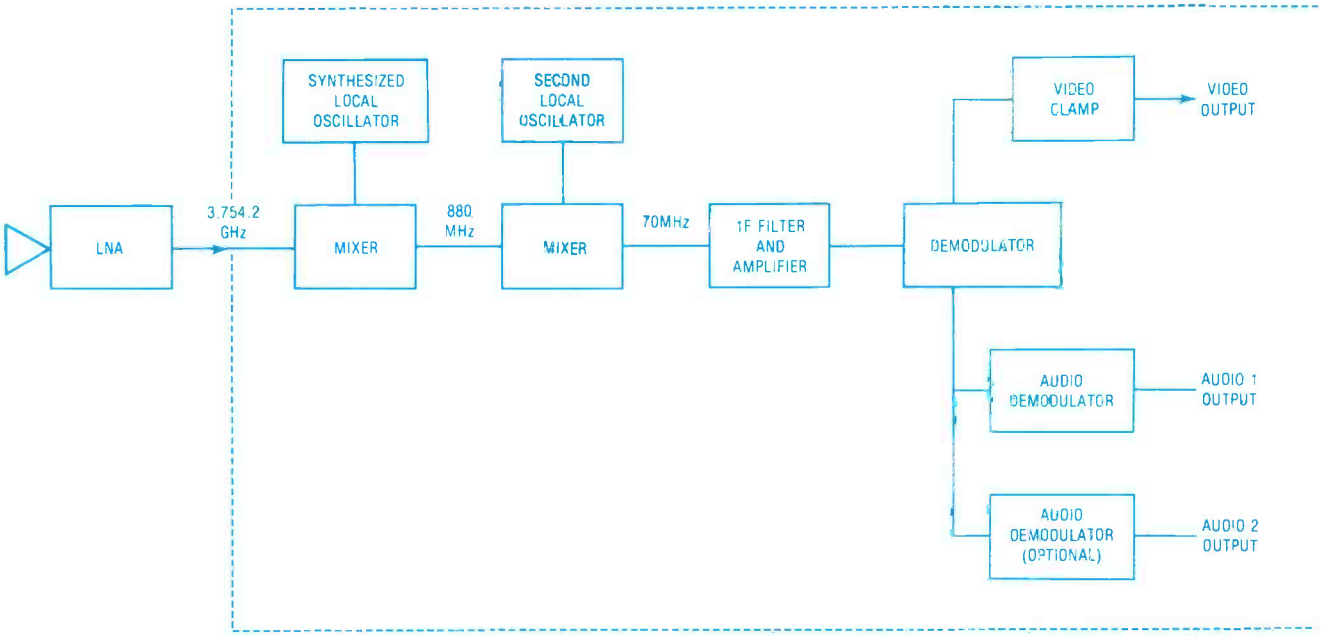


Figure 21. A dual conversion block diagram.

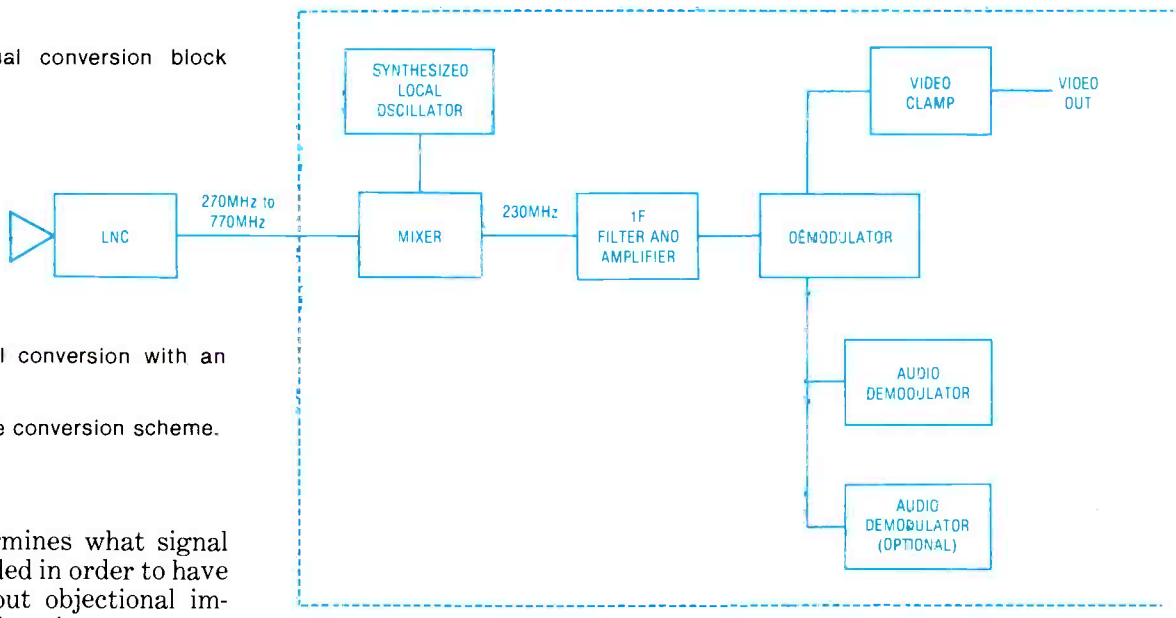


Figure 22. A dual conversion with an LNC.

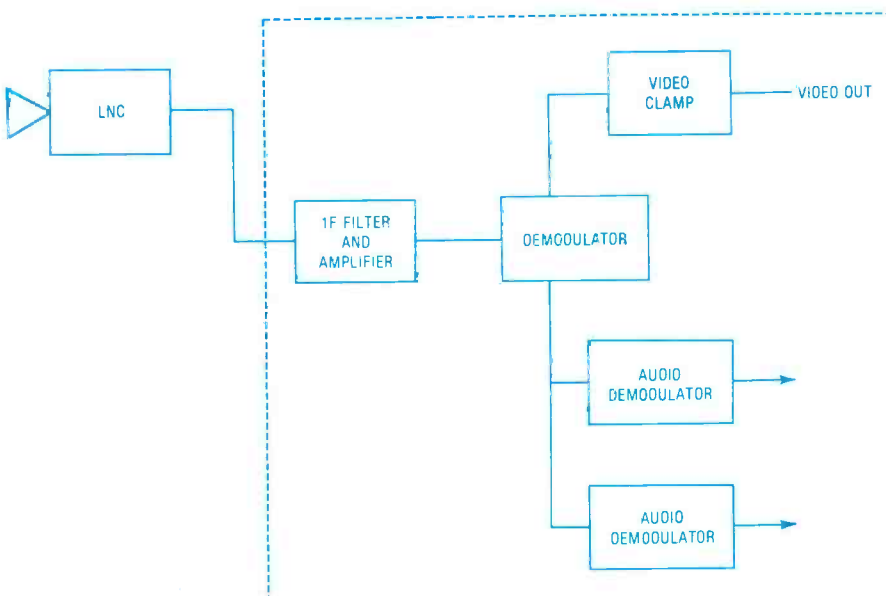


Figure 23. A single conversion scheme.

threshold determines what signal strength is needed in order to have a picture without objectional impulse noise. This noise appears as snow on the screen. This is important to the backyard earth station owner because the lower threshold the receiver has, the smaller the antenna needs to be.

The modulator

The last block in Figure 7 is the modulator. Notice that the receiver outputs mentioned above cannot be hooked up to a common TV set. The modulator takes the basic audio and video from the receiver and converts them to the TV format. The output is usually in the TV VHF band with channels 3 or 4 most common. The modulator in a video cassette recorder (VCR) could be used.

ES&T

How to get maximum estate benefits from your business

By David E. Birkhaeuser, estate planning specialist, Massachusetts Mutual Life Insurance Company.

If you own your own electronic servicing business, passing it on to your heirs is the greatest legacy you can give them. Right?

Maybe.

Owners and partners of electronic servicing firms have several special problems to consider in making their estate plans, but they are not impossible to solve. However, the problems could end up producing nothing but headaches for your heirs if you don't face them and update your estate plans at least every two years.

The first question you must ask yourself is whether your family really has what it takes to manage the business. Let's face it, if no one is interested in electronics, it might be a mistake to leave it to them. If you decide to sell your business, there are still ways to capitalize on it and leave a sizable estate to your heirs.

Buy-sell agreements

What you need to consider is a buy-sell agreement, an arrangement whereby somebody else, or the business itself, will buy out your interest at a specified price when you die.

There are two types of buy-sell agreements. The first is called a *cross-purchase* agreement under which surviving partners buy the decreased owner's share. Frequently these agreements are funded with life insurance. Each of the partners holds a policy on the life of the others. When one dies, the proceeds are used to buy his part of the business.

There are advantages and disadvantages to cross-purchase agreements. On the positive side, they are the most beneficial to the estate of the deceased because proceeds are taxed at the more favorable capital gains rate. On the negative side, administration can become clumsy and require a number of policies if there are more than a few partners. Also, premiums are a personal and not a business expense.

The second type of buy-sell agreement is a *stock redemption* or *stock retirement* plan. Under this plan, the business itself agrees to buy the deceased partner's interest. Life insurance also is the principal means of funding a stock retirement plan.

This sort of buy-sell agreement is the most popular because the business rather than the individual pays the premiums. It also has advantages for the business, which carries the policy on its books as an asset and has the cash value of the policy available for its use.

In general, buy-sell agreements, funded with life insurance, offer several advantages. First, they guarantee your business will be sold at a fair price and that your estate will have cash on hand to pay estate taxes and expenses. A buy-sell agreement also gives the owner a major voice in deciding who will run the shop after his death.

By far, the most important advantage of a buy-sell agreement is that it sets an estate tax value for the business. The price of a publicly traded company can be easily established just by calling a broker or looking in the newspaper for the latest stock quote. In the case of an electronic servicing business, a properly drawn buy-sell agreement performs the same function and precludes the Internal Revenue Service from placing a higher value on the business after the owner's death.

Will your business survive?

A buy-sell agreement is a high priority if you are selling your business, but there are other priorities if you decide to will it to your family. Primarily, you must be certain it will be able to survive your death. Profits of an electronic servicing firm frequently plunge when the owner dies. Long-time customers often go elsewhere, and suppliers and banks may be reluctant to extend credit.

There are two ways this problem can be faced. Either a sinking fund can be set up or, more commonly, a life insurance policy can be taken out on the key employee. Either one can be used to cushion the economic blow of a death and keep your shop above water until the new management proves itself.

Also, future management must be planned for. If a member of your family needs a few more years seasoning before taking over, a capable manager must be recruited and induced to stay with the owner. A number of noncash incentives can serve to tie him to the business. From the tax point of view, they offer advantages to the key employee, and for the owner, they come at a reasonable cost.

Fringe benefits

Two fringe benefits that have been increasing in popularity are split-dollar insurance and deferred compensation plans. Under split-dollar, the owner and the key employee split the premiums on a life insurance policy. It is truly a no-lose situation for either side.

Under a deferred compensation agreement, the business agrees to provide additional income to the key employee when he or she retires. Normally, that will mean it is taxed in a lower bracket. The safest way to fund a deferred compensation agreement is through a life insurance policy, which will guarantee that the business can meet its commitment to the employee.

The problems associated with an interest in an electronic servicing business are not insurmountable. However, every owner should consider his personal situation and enlist the services of an estate planning team – lawyers, accountant, life insurance agent and banker – so that the retention or disposition of his business is properly handled.

ES&T

NEW PRODUCTS

ECL adapter

Fluke Automated Systems announces a new ECL adapter for its 3050A digital/analog functional test system. This device will permit the 3050A to achieve a total ECL capability.

Using zero-insertion-force connectors, Fluke's new adapter is attached between the test system and the user's adapters. The adapter will be compatible with 3050A functions such as pattern generation, 2-k stored patterns, automated diagnostics for either comparison testing or single-board signature testing.

The adapter has a modular design with a minimum configuration of 64 bidirectional pins and can easily be expanded according to the user's need.

Circle (21) on Reply Card

ECL logic probe

The LP-4, a full-featured probe capable of handling the high speeds and narrow threshold differentials of emitter coupled logic has been introduced by *Global Specialties Corporation.*

The LP-4 detects and indicates

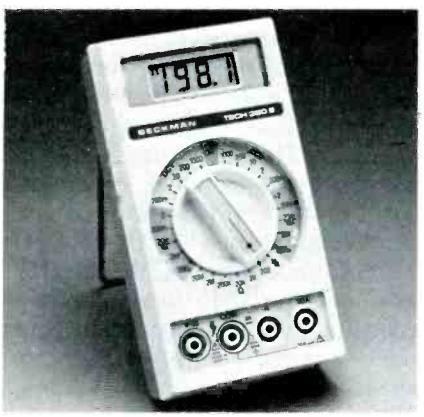
valid ECL logic levels using LED indicators for HI (logic 1) and LO (logic 0) levels. A third LED labeled PULSE, indicates the occurrence of single pulses as short as 3ns in duration and of pulse trains with repetition rates up to 100MHz minimum (150MHz typical at 50% duty cycle). With the PULSE LED on, the HI or LO LEDs indicate positive or negative polarity.

The LP-4 features a 2-position switch for PULSE of MEMORY (latch) mode selection. When PULSE has been selected, the PULSE indicator marks the occurrence of single pulses with a 0.3-second (stretched) flash of light. With the presence of a pulse train, it will flash continuously at a rate of approximately 3Hz. When MEMORY has been selected, a single one-shot pulse will be stored, and the PULSE LED will remain on until it is reset by toggling the switch.

Circle (20) on Reply Card

Digital multimeters

Beckman Instruments Inc. has expanded its line of digital multimeters for technicians, service representatives and hobbyists



to include a new portable that gets your attention by sound when continuity is detected.

The attention-getting DMM is called the TECH 320B digital multimeter and has both audible and visual indicators. When it's not possible to see the large area LCD, the meter will alert the user when continuity is detected by a single, loud "beep" tone. Continuity is also visually displayed (in less than 1/10 of a second) by the appearance of an Ω in the upper left corner of the LCD.

Like other Beckman portable DMMs, the TECH 320B features a single center selector switch, 0.1%

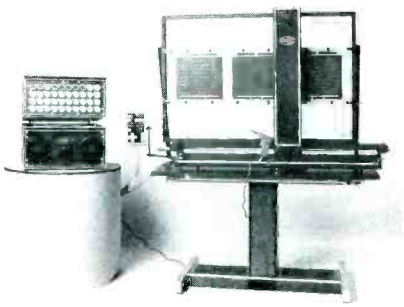
basic Vdc accuracy, 10 ampere ac/dc current ranges, 2000-hour battery life from a standard 9V battery, semiconductor test function and overload protection on all ranges.

Beckman's TECH 320B DMM has 29 ranges and is protected against overload conditions that result from the measurement of unknown signals or from operator error. Voltage ranges are protected to 1500Vdc or 1000Vrms ac. All resistance ranges are protected to 500Vrms and current ranges are 2A/250V fuse protected—a spare fuse is included. The 10A ranges are rated up to 20A for 30 seconds.

Circle (22) on Reply Card

Wire wrapping system

The *OK Machine and Tool Corp.'s* SW-102 is a revolutionary new semi-automatic wire wrapping system that offers full industrial features and a 40"x30" wiring area. The SW-102 employs state-of-the-art microprocessor control to achieve optimum performance, flexibility and reliability. In addition to the 40"x30" wiring area, the system features 10ips traverse speed, high resolution stepper-motor design with .0025-inch increment, full operator display complement (including sequence number, X position, Y position, T1/T2 status, bin number, plus pin number and routing direction), and a rugged 40-tube wire bin. The system is further equipped with a paper tape transport that contains its own microprocessor and buffer to ensure fast, accurate data transfer as well as smooth tape handling.



The SW-102 offers software flexibility that can read tapes in either ASCII or EIA code, prepared either for absolute or incremental positioning. The microprocessor can also be reprogrammed to read tapes in the format of any wire wrapping machine manufacturer, thereby eliminating the problem of software compatibility with existing equipment. Modular design ensures maximum utility as well as extreme ease of servicing.

Circle (23) on Reply Card

PCM cassette deck

JVC (Victor Company of Japan Ltd.) has developed a PCM cassette deck capable of one-hour PCM digital recording or playback. This system uses the high density (46.3k BPI) recording technique. The recording format is also designed to meet the mass production requirements of prerecorded tapes. With the advent of this new PCM cassette deck, it is possible to make HiFi recordings of low distortion and wide dynamic range on cassette tapes.

The PCM system, which records audio material on a magnetic tape or disc by converting analog audio signals to digital codes of either "1" or "0", has been attracting wide attention as an ideal HiFi system that produces minimum noise and distortion that is free from wow and flutter.

Circle (24) on Reply Card

Dish-positioning actuator

Burr Engineering has developed a new actuator to position TV dishes to exact satellite locations.

Physical movement is achieved by either an acme screw or ball screw for infinite adjustment. Although the actuator operates on 12V power, it can also be adapted to 110V power.

Actuation is accomplished by automatic positioning from a control unit that locates satellite positions for TV reception or relaying signals. For end-of-travel protection, limit switches are incorporated in the power head. Without motor operation, hand cranking is possible.

The unit includes mounting hardware for attachment to satellite dish.

Circle (25) on Reply Card

Channel processor

Blonder-Tongue Laboratories Inc. has announced that its Dynamatic no. 4455 CATV channel processor is now available for superband frequencies J-W. The Dynamatic is also used for VHF channels 2-13; A-1, A-2; midband A-I; ch. D inverted; IF and FM.

The Dynamatic is designed to amplify and stabilize the level of a single channel in CATV headend systems. The combination of a low-noise, high-gain amplifier with high output capability and a wide AGC window assures a large dynamic range providing a stable, quality signal free of distortion and intermodulation products.

A front-panel, manual-gain control facilitates proof of performance testing without altering output level settings. The ampli-

fier is equipped with an ON/OFF switch, pilot lamp and an LED indicator that shows the presence of a usable input signal.

The Dynamatic consists of three modular sections: a channelized FET input amplifier with variable gain for AGC (automatic gain control); a main amplifier with four broadband RF stages, power supply and AGC control circuitry; and a channelized output module consisting of a directional filter diplexer to enable backmatched mixing of alternate channels in a system. All modules are easily removed for servicing.

Circle (26) on Reply Card

PCB repair kit

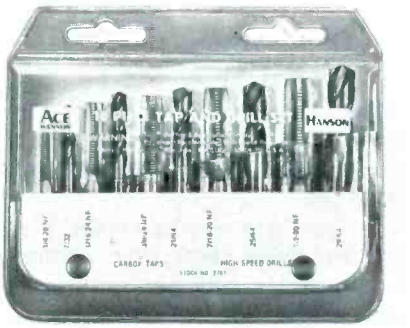
The CIR-KIT selector pack from *Pace Inc.* is a self-contained repair kit for the field repair or replacement of lifted, damaged or missing pads and tracks on printed circuit boards.

With CIR-KIT, virtually anyone can quickly and easily repair a damaged run or pad on a PCB, eliminating the need for discarding the board or having to contend with long downtimes while the board is removed for repair at the shop. CIR-KIT includes a selection of pre-tinned and scored eyelets, several Trak-Pads, which are specially prepared and pre-tinned sheets of various sized replacement pads and tracks, an abrasive stick for cleaning both the work area and the Trak-Pads to be used, plus the necessary tools and accessories for cold setting the eyelets. All that is required by the user is a soldering iron and solder.

Circle (28) on Reply Card

Tap and drill set

A new series of 10-piece tap and drill pouches for home, commercial and industrial use is being introduced by *Henry L. Hanson Inc.*



The Ace Hanson 10-piece tap and drill pouches each feature five taps plus five high speed steel drills. Offered in four different sets to satisfy do-it-yourselfers and professionals, the vinyl pouches can be pegboard mounted and have a tap drill chart on the back.

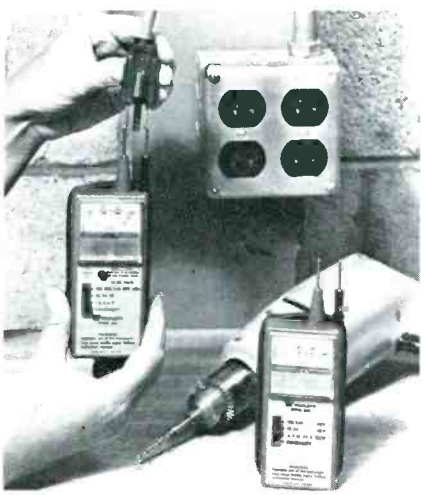
The pouches come in ¼-inch to ½-inch NC and NF sizes with carbon taps and matching high speed steel drills. Industrial sets come in the same sizes and feature precision-rolled, high speed steel taps with high speed steel drills.

Circle (29) on Reply Card

Voltage and continuity testers

The palm-size models 202 and 203 ac/dc voltage and continuity testers just introduced by *Triplett Corp.* provide basic voltage and continuity testing with burn-out and overload protection. The portable testers are ideal for general maintenance or home electrical usage and may be operated on one 1.5V battery.

The continuity function may be used to obtain an approximate cir-



cuit resistance reading. The meter deflection is merely referenced to an auxiliary chart to estimate the resistance of the circuit.

Voltage ranges are model 202: 12, 24, 120, 240Vac, 1.5, 6, 9, 12, 22.5Vdc and model 203: 1.5–480Vac or Vdc. Continuity ranges are model 202: 0–150,000 Ω (appox. 10,000 Ω at half scale) and model 203: 0–100,000Ω (approx. 7000 Ω at half scale). On the model 202, overload protection is automatic on all ranges up to 250V. Model 203 overload protection is automatic on all ranges up to 500V. Overload protection on both models is internally designed to eliminate nuisance fuse blows. No fuse changes are needed.

Circle (32) on Reply Card

Connectors, adapters, cables

Marshall Electronics Inc. has introduced a complete line of 'F'59

push-on connectors, adapters and pre-assembled cables.

The line is in answer to the video users' request for a more convenient method of interconnecting VHF/UHF signals than the standard screw-type connector that has been used for the past 20 years.

The new push-on series solves the inconvenience problem of these standard screw-type connectors and is available in three types.

First is a push-on cable available in 3-, 6- and 12-foot lengths. The cable is flexible and is 100% shielded against outside interference. The cable is designed to give the finest possible low loss, high definition picture.

Second is a push-on adapter that converts existing screw-type cables to the push-on type. The adapter simply screws on to the existing cable, converting it to a push-on type with a non-bendable center pin.

The last type is for those who want to make their own cables. The connector requires no crimping or soldering. It twists directly on to the RG/59 cable and has the holding power equal to premade cables. All that is required is that the cable is stripped so that a ¼ inch of shield is exposed along with the proper length of center conductor. The connector is then twisted directly on to the cable until the center conductor is in the proper position.

Circle (33) on Reply Card

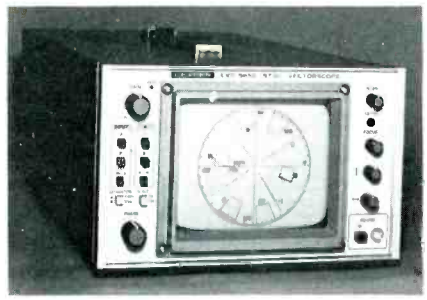
Vectorscope

Leader Instruments Corp. recently introduced the model 5850 vectorscope with CRT-generated targets.

Until now, video engineers had to cope with centering the NTSC vectors in target boxes that were engraved on the face of the oscilloscope. This often meant squinting at the face of the scope in a dimly lit control room, or taking attention away from other equipment to get closer to the vectorscope. The 5850 changes that. The phase-amplitude targets are generated by the CRT so that they are illuminated and are as easy to see as the vector points themselves.

Other advantages are also present because of the CRT-generated targets. Because the target boxes and the vectors are both produced electronically, there is no error induced by CRT aging. And because the targets can easily be seen, even in a dimly lit control room, a simple coaxial switching system permits one vectorscope to be used remotely to monitor several video sources.

Phase and amplitude adjustments are made more accurate by the illuminated inner target display, which represents error limits of +/–2.5° and +/–2.5 IRE units. Two loop-through inputs are included that can be selected for display by front-panel push-



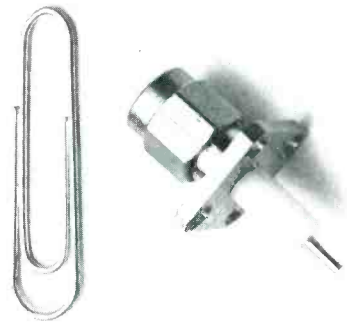
buttons. A test circle pattern is also selectable. The phase reference is chosen from either of the two composite video inputs, and one of these can be switched to phase lock to a subcarrier input. Another front panel push-button switch selects either 100% or 75% saturation levels. A gain control permits continuous adjustment as well as a detented calibrated position and a phase control allows you to rotate the display through a 360° circle.

Circle (31) on Reply Card.

Panel receptacle

A male panel receptacle with a passivated steel shell has been introduced by *ITT Pomona Electronics.*

Model 4808 features a gold-plated center conductor, Teflon insulation and 50Ω impedance. The



panel receptacle meets the specifications of MIL-C-39012.

Circle (34) on Reply Card

Portable gaussmeter

A new general-purpose portable Hall-effect gaussmeter for measuring dc and ac (RMS) magnetic fields is being introduced by *Walker Scientific Inc.*

The Walker MG-5D portable Hall-effect gaussmeter provides dc and ac field readings from ± 100mG to ± 19.99kG with true

RMS readings from 5Hz to 20kHz. Featuring three full-scale bipolar ranges of ± 100.0G, ± 1000G, and ± 10.00kG with 100% over-range and 0.05% resolution, it displays measured values on a 3½-digit ± 0.05% bipolar LCD meter.

Operating on ac or battery power, the 2.25"x8.5"x9.25" Walker MG-5D can be furnished with a wide selection of precalibrated, interchangeable transverse and axial Hall probes (some

capable of extending field readings to 150.0kG). An analog output is provided for external monitoring.

Circle (36) on Reply Card

Digital directional wattmeters

The *Bird Electronic Corp.* model 4391 RF Power Analyst digital directional wattmeters measure peak pulse power and peak envelope power (PEP), in addition to CW power during normal equipment operations. Designed for pulsed RF systems such as avionics surveillance, collision avoidance, navigation, radar, command control communications (C^3), telemetry, etc., they need no attenuators, directional couplers or charts.

Based on the Thruline principle and using the same plug-in elements for frequency and power level selection, model 4391 reads

incident and reflected CW power in watts or in dBm, incident and reflected pulse power in watts, calculates VSWR, dB return loss and percent modulation, remembers maximum and minimum parameter levels during equipment adjustment and overranges at least 20% beyond nominal full scale.

Circle (37) on Reply Card

Microcomputer

A new model microcomputer, the Z-90, was introduced by *Zenith Data Systems* at Info '81.

The Z-90 is similar to the Z-89, which has been on the market for more than two years, but has more diskette storage and comes with more memory standard.

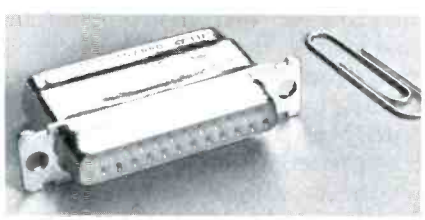
"Advances in diskette storage techniques have permitted us to design a new microcomputer with much higher capacity and at very competitive prices," said Robert K. Reid, director of sales and marketing.

The Z-90 adds a double-density disk controller card, which increases storage available on 5.25-inch diskettes. The Z-90 also comes with a full complement of 64K bytes RAM, instead of 48K bytes.

Circle (30) on Reply Card.

Monolithic filter adapter

A pin/socket filter adapter for D-sub miniature has been introduced by *ITT Cannon.*



Using a monolithic capacitor substrate, the innovative filter adapter construction provides economical RFI/EMI protection with no equipment changes necessary.

The performance of the monolithic filter adapter is designed to meet FCC Docket 20780 requirements.

Circle (35) on Reply Card

ES&T

NEW LITERATURE

A special 8-page catalog AC-981 introduces **Alcoswitch's** Command Series push-button family. This catalog lists specifications, ratings and prices for lighted push-button switches and pilot lights, and includes unlighted mushroom head, selector and keylock models. Hundreds of practical combinations of lens colors, lamp voltages, contacts and functions provide designers with solutions to many switching problems.

Circle (45) on Reply Card

Edsyn Inc. has released their new SECRET Soldering Products Manual.

This manual (Form 325) contains hundreds of detailed illustrations and photographs that highlight Edsyn's complete product line of over 250 items. Included are sections containing portable and vacuum powered desoldering tools, soldering tools and accessories, soldering tool holders, portable special purpose hand tools, professional kits, plus many additional photographs and copy inserts showing various product applications. Every item is easy to find by looking through the appropriate product section or the easy-to-read alpha-numerical index.

Circle (49) on Reply Card

A new application note is now available from **Fotec Inc.,** that offers practical advice on testing and characterizing fiber-optic communications systems. Unlike most fiber-optic measurement articles, which concentrate on testing fibers and cables, this application note also covers testing fiber-optic system transmitters, receivers, repeaters, couplers and connectors as well as complete communications systems.

Topics covered include measuring the amount of power coupled into the fiber by the system source, the losses in the fibers, couplers and connectors, and the sensitivity of the optical receivers. Sources of errors in making these measurements are discussed as well as hints on troubleshooting complete systems. All techniques described are appropriate for field service as well as laboratory applications.

Circle (46) on Reply Card

Weston Instruments, a manufacturer of test instrumentation and panel meters, announces a new brochure detailing the newest Roadrunner, a hand-held audible/digital multimeter. Designated the Roadrunner II, it features all of the standard facilities characteristic of this meter family: measurements of voltage to 1000Vdc and 750Vac; current to 2000mA ac and dc; resistance to 20MΩ. An audible test function immediately indicates voltages or resistances above or below precise thresholds.

This model 6120 adds direct thermocouple measurement of temperature from 0° to 300°C; peak hold function for capture of transient signal measurements of peak dc and ac voltages and currents down to 50ms; and logic-probe testing, for dynamic monitoring, test and troubleshooting of microcomputer devices, peripherals, and virtually any stand-alone digital I/O device.

The brochure illustrates and describes the instrument and its field-test capabilities, besides providing complete technical specifications of its operating modes and ranges.

Circle (47) on Reply Card

RCA Distributor and Special Products Division has announced two publications designed to aid service dealers in servicing RCA VCRs, cameras, and VideoDisc players.

The new 16-page illustrated catalog of RCA tools, lubricants and service aids for video instruments (Form 1F6857) includes tools, gauges, jigs, test tapes and discs, and other service aids designed for servicing of RCA video instruments. A number of these tools also are useful in servicing instruments from other manufacturers.

RCA also updated its 12-page catalog of video instrument accessories (Form 1F5876 Rev. 9/81). This catalog illustrates and cross references a variety of cables, remote controls, batteries, lenses, caps and hoods, and other accessories for VCRs, cameras and VideoDisc players.

Circle (51) on Reply Card

Beckman Instruments Inc. has published a pamphlet on their Hardhat DMM, the HD-100.

The three-fold, four-color pamphlet highlights topics from Beckman's exclusive Insta-Ohms continuity indicator to its single selector switch. A complete list of

specifications for the HD-100 is also included.

Circle (52) on Reply Card

Global Specialties Corp. has announced the availability of their

4-page brochure detailing the company's line of portable, compact, inexpensive, logic-state-oriented test equipment.

The 4-color brochure describes Global's logic probes, pulsers, monitors and complete logic analysis kits. Full product descriptions and specifications are included in this latest publication along with information on the company's new LM-4 Logic Monitor and LP-4 ECL Logic Probe.

Circle (53) on Reply Card

Short-form Catalog C-720 on disc and "doorknob" ceramic capacitors has just been released by the **Sprague Products Co.**, Distributors' Division of the Sprague Electric Company.

The new catalog lists 277 ratings, the most popular ratings in the market. Also included are salient performance characteristics for general application, temperature-stable, NPO, high capacitance reduced titanate, and a-c rated disc capacitors, as well as high-voltage doorknob types.

Circle (48) on Reply Card

A new manual from **Applied Micro Circuits Corp.** shows how logic and system designers can implement logic functions on monolithic integrated circuits using AMCC's Quickchip macro approach to array design.

The Q700 high speed (.9ns per equivalent gate) logic array series has been designed for easy logic implementation into silicon. Procedures and ground rules are provided to interconnect predesigned logic elements (macros) such as gates, flip-flops and multiplexers. The Q700 series devices can accommodate up to 1000 gates with commercial or military operation. Standard TTL and/or ECL input/output configurations are available using the I/Q macros.

Because of the continuous updating of macro elements and simulation information, the manual is made available under a registered subscription basis for $300 (first year). This fee is credited to customers with their first Q700 Quickchip order.

Circle (50) on Reply Card

Marshall Electronics has announced their new 1981-82 video catalog, featuring an expanded

line of home and professional video accessories.

The line includes a series of installation supplies designed to simplify the installation of video equipment.

The catalog features a complete line of switching devices for most any requirement.

Circle (54) on Reply Card

ES&T

THE MARKETPLACE

Advertising rates in the Classified Section are 50 cents per word, each insertion, and must be accompanied by cash to insure publication.

Each initial or abbreviation counts a full word.

Minimum classified charge $10.00.

For ads on which replies are sent to us for forwarding (blind ads), there is an additional charge of $3.00 per insertion to cover department number, processing of replies, and mailing costs.

Classified columns are not open to advertising of any products regularly produced by manufacturers unless used and no longer owned by the manufacturer or distributor.

For Sale

Circle (10) on Reply Card

AUTOMOBILE RADIO and tape replacement parts. Delco, Chrysler, Philco-Ford, Motorla, Panasonic and many others. Large inventory. Laran Electronics, Inc., 3768 Boston Road, Bronx, NY 10469. (212) 881-9600, out of New York State, (808) 223-8314. 5-79-tf

TV & RADIO TUBES, 36 cents EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92104. 8-76-tf

ELECTRONIC SURPLUS: CLOSEOUTS, LIQUIDATIONS! Parts, equipment stereo, industrial, educational. Amazing values! Fascinating items unavailable in stores or catalogs anywhere. Unusual FREE catalog. ETCO-011, Box 762, Plattsburgh, N.Y. 12901. 6-78-tf

SCRAMBLED TELEVISION, encoding/decoding. New book. Theory/circuits. $9.95 plus $1 shipping. Workshop, Box 393ES, Dept. E, Bethpage, N.Y. 11714. 7-80-tf

PRINTED CIRCUIT boards from your sketch or artwork. Affordable prices. Also fun kit projects. Free details. DANOCINTHS INC., Dept. ES, Box 261, Westland, MI 48185. 5-81-tfn

TUBES FOR TV AND RADIO – 35¢ ea. Washington TV Service, 1330 E. Florence Ave., Los Angeles, CA 90001. 10-81-5t

PICTURE TUBE REBUILDING EQUIPMENT capable of producing four high quality tubes per day (WILL TRAIN TO OPERATE). Call or Write Atoll Television, 6425 Irving Park, Chicago, Illinois 60634, ph. 312-545-6667. 10-81-6t

INDIVIDUAL PHOTOFACT FOLDERS under 1100. Postpaid $3.00. Loeb, 414 Chestnut Lane, East Meadow, NY, 11554. 11-81-3t

FOR SALE (Cont.)

B&K TV ANALYST 1077-B $350.00, **B&K Tube Tester** 747-B $200.00. Free $50.00 worth of semiconductors with purchase. Gordon Gray, 16 Sheffield St., Pepperell, MA 01463. 1-82-1t

SELLING OUT: Sams Photofacts 950 thru 1409; 10 consecutive $3.25 each, 25 consecutive $3.00 each, 50 consecutive $2.75 each, 100 consecutive $2.25 each, all for $2.00 each. RCA Factory Service Manuals, CTC22 through CTC76, $95.00. **Heath** IG-5257 Sweep Generator, new cost $239.95, excellent, sell $119.95. **RCA** XL-100 module kit, unusued, new cost $498, sell $225.00. **New Thordarson** FLY308, 312 $15 ea. David L. Smith, Rt. 2, Box 698, Rustburg, VA 24588, 804-821-2068 after 6 p.m. except weekends. 1-82-1t

RADIO-TV TUBES INCLUDING ANTIQUES! Many tubes thought to be obsolete are still being manufactured. Write for free discount price sheet of over 1,800 types. Electronic Parts Co., 1015 S. Escondido Blvd., Escondido, CAL 92025, (714) 741-2300. 1-82-6t

Business Opportunity

TV TECHNICIAN! Increase your income up to $60,000 yearly. Rent-lease-sell TVs new-used, even from comfort of your home. Basic Preliminaries $4.00. Perrys TV Systems, 1467 Hwy. 90 West, Milton, FL 32570, 904-994-0068. 12-81-tf

COMPUTERIZE YOUR ENTIRE TV OPERATION. GL-AP-AR-INV. Tubes – Parts – Customer – Vendor & TV rental files-programs. Start small & add to later. For Apple TRS80-NEC-Heath-Zenith. Free details. Perrys Computer Systems, 1467 Hwy 90 West, Milton, FL 32570. 904-994-0068. 11-81-tf

FLORIDA'S WEST COAST: Small T.V. Service Business attached to home; plus separate rental house. Have CERTIFIED APPRAISAL. Ph. 1-813-541-2039 or write: Owner, 7744 - 46 Ave. North, St. Petersburg, Fla. 33709. 1-82-tfn

Wanted

WANTED: Will pay cash for Motorola Mocom 10 2-way radios. J.N.E. Sales & Service, 219-398-1650. 1-82-1t

NEEDED – BATTERY PACK (12B012) Nicad's for Melcor calculator MOD SC-635. Robert D. Evans, 9468 Halls Ferry Rd., Jennings, Mo. 63136. 1-82-1t

Help Wanted

TV and 2-way Technicians wanted. $15K to $22K per year. Benefits include employee stock purchase plan, In the largest Retail Service Center in Northwest Kansas. Friendly community, good schools, short drive to the Rockies. Equal Opportunity Employer. Miller's Electronics Inc., Goodland, KS 67735. 913-899-2386. 10-81-tfn

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ECG 526A	977-Z9526-A
ECG 528	977-41
ECG 529	977-Z9529
ECG 530	977-Z9530
ECG 531	977-Z9531
ECG 532	977-Z9532
ECG 533	977-Z9533
ECG 534	977-Z9534
ECG 535	977-Z9535
ECG 536A	977-Z9536-A
ECG 537	977-Z9537
ECG 538	977-Z9538
ECG 539	977-Z9539

GE 521	977-Z9526-A
GE 522	977-Z9536-A
GE 523	977-Z9522
GE 524	977-Z9531
GE 525	977-Z9532
GE 526	977-Z9533
GE 527	977-Z9500-A
GE 528	977-36
GE 529	977-Z9529
GE 534	977-Z9534
GE 535	977-Z9535
GE 536	977-Z9537
GE 537	977-Z9538
GE 538	977-Z9539
GE 539	800-791
GE 540	977-Z9530

N2A	977-Z9529
N2A-1	977-Z9529
N2A-2	977-Z9529

SK 3301	977-Z9531
SK 3302	977-Z9533
SK 3303	977-Z9522
SK 3304	977-Z9500-A
SK 3305	977-Z9534
SK 3306	977-36
SK 3307	977-Z9529
SK 3308	977-Z9526-A

14B348-1	977-36
14B348-2	977-36
14B348-3	977-36
14B348-4	977-36
14B348-5	977-36

28-32-0X	977-Z9500-A
28-35-01	977-46

32-29778-2	977-Z9500-A
32-29778-3	977-Z9500-A
32-33057-2	977-Z9522

32-33057-3	977-Z9500-A
32-33057-4	977-Z9500-A
32-33057-5	977-Z9500-A
32-33094-1	977-Z9522
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32-33094-4	977-Z9522
32-33094-5	977-Z9522
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32-35894-4	977-Z9522
32-35894-5	977-Z9500-A
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32-35894-7	977-Z952
32-39091-1	977-36
32-39091-2	977-36
32-39091-3	977-Z952
32-39091-4	977-36
32-39091-5	977-36
32-39091-6	977-36
32-39091-7	977-Z9526-A
32-39091-8	977-Z9526-A
32-39091-9	977-36
32-39704-1	977-Z9522
32-39704-2	977-Z9522

66F-159-1	977-Z9522
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66F-159-3	
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	977-36

76-14327-1	
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86-127-3	

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1464607-10	977-Z9533
1464984-1	977-Z9532
1464984-2	977-Z9532
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1466860-2	977-Z9537
1466865-1	977-Z9532

1826065-1	977-Z9532
1826065-2	977-Z9532
1826065-3	977-Z9531

S-88569	800-791
S-88593	800-791
S-91731	800-791

212-102	800-791
212-103	800-791
212-104	800-791
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212-106	800-791
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212-141-02	977-36
212-141-02	977-36
212-141-03	977-37
212-142	977-46
212-142	977-38
212-142-02	977-46
212-143	977-40
212-145	977-41
212-145-01	977-41
212-145-01	977-42
212-146	977-41
212-146-01	977-41
212-146-01	977-42
212-147	977-43
212-149	977-45
977-42	977-41

57-90	977-Z9530
57-98	977-Z9530

66F-054-3	977-Z9500-A
66F-054-4	977-Z9500-A
66F-112-1	977-Z9522
66F-112-2	977-Z9522
66F-181-1	977-Z9522

93D96-2	977-Z9500-A
93D96-3	977-Z9500-A
93D99-2	977-Z9538
93D99-3	977-Z9538
93D99-4	977-Z9538
93D99-5	977-Z9539
93D99-6	977-Z9539
93D99-7	977-Z9539

800-000-025	977-Z9500-A

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146364-1	977-Z9536-A
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Now in stock at your Zenith distributor's — a full line of universal triplers.

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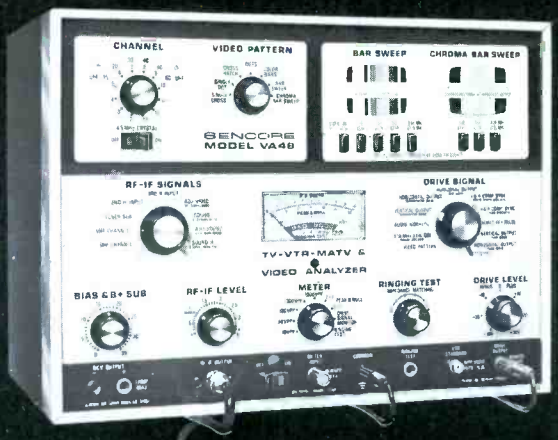
Circle (2) on Reply Card

CUT YOUR TV-VCR SERVICE TIME IN HALF

WITH SENCORE'S VA48 VIDEO ANALYZER



double PATENTED

$1,395

Used by 22,000 techs

The patented Bar Sweep patterns now appear on all Sams TV and VCR Photofact schematics

Cut your service time in half
You can cut your service time in half. It's a fact. We surveyed 1,500 VA48 owners. The results showed that the average tech cut his service time by 54% using the VA48 and the signal substitution method of troubleshooting.

What is signal substitution?
In a nutshell, signal substitution lets you inject known good signals from the VA48 into any stage of the TV or VCR. (Normally you start somewhere in the middle, "divide and conquer.") If you get a good picture on the screen, you know everything is working from that point forward. You then back up stage by stage, until the problem develops on the screen (or speaker). Once the problem reappears, you know you are injecting into the defective stage.

It's that simple and only the VA48 provides all the signals necessary to inject from antenna to CRT so you can cut your service time in half (or double your output for the same time on the job.) This increased productivity is why the VA48 has become the industry servicing standard for TVs and VCRs.

The VA48 is the industry standard
Over 22,000 techs nationwide now use the VA48. The patented Bar Sweep pattern even appears on Sams Photofact schematics. Isn't it time you cut your service time in half?

Here's our offer . . .

☐ **YES,** I'd like to cut my service time in half. Please mail me complete info, and put me on your mail list.
☐ **YES,** I'd like more information. Please have a pt one sales engineer call me.
☐ **YES,** I'm ready to order. Contact me immediately.

Name _____
Company _____
Address _____
City _____ State _____
Zip _____ Phone ( ) _____

Best time to call: ☐ AM ☐ PM ☐ Evening

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3200 Sencore Drive, Sioux Falls, SD 57107 (605) 339-0100
TWX: 910-660-0300

30-DAY MONEY-BACK GUARANTEE

Use the VA48 for 30 days. If you find that at the end of 30 days you have not cut your service time in half, you can return your VA48 to Sencore for a full refund.