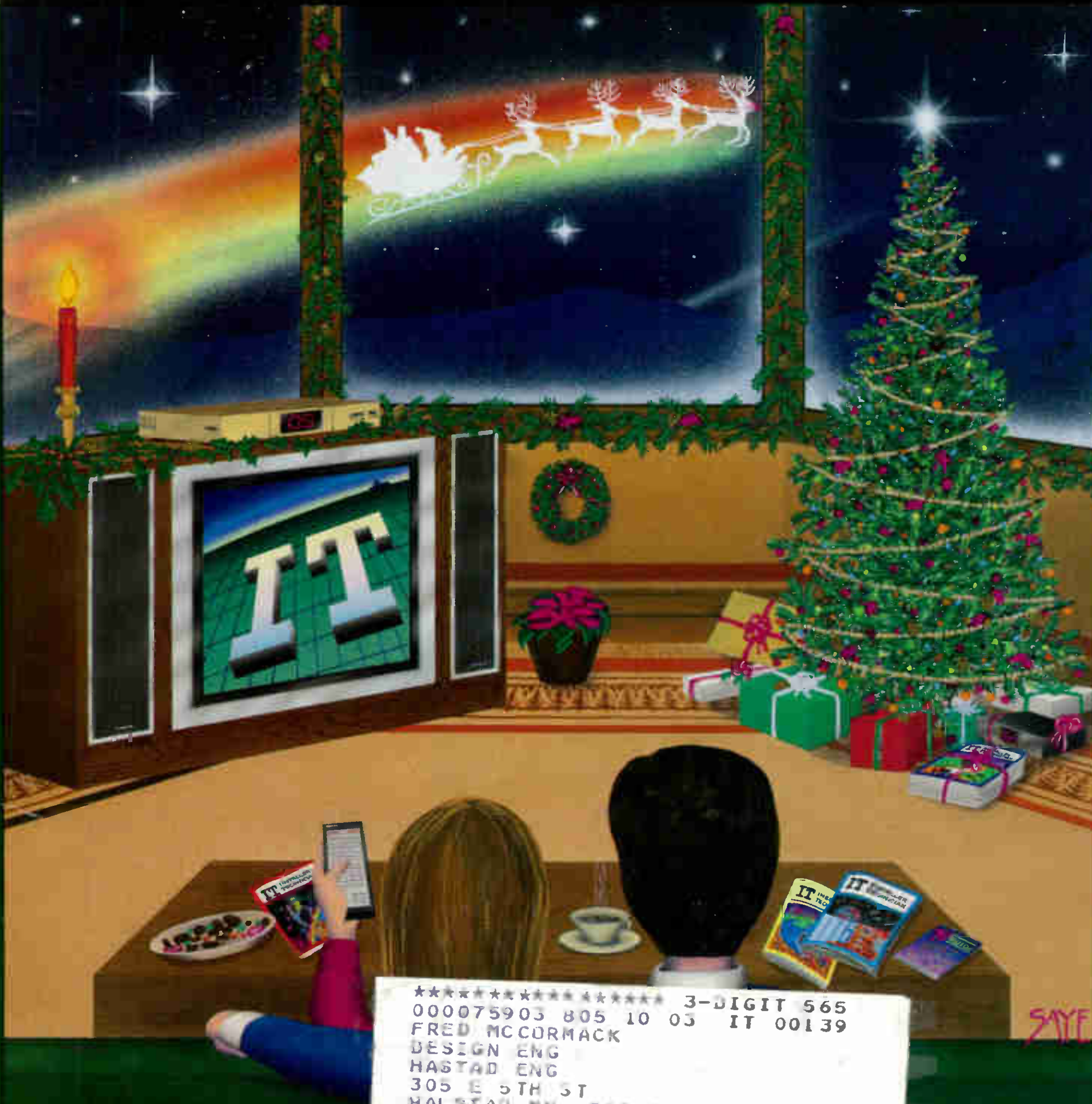
December 1988

Interfacing with consumer electronics

IT INSTALLER TECHNICIAN

The cable magazine for installers and technicians.

Formerly CATJ, Cable Tech.



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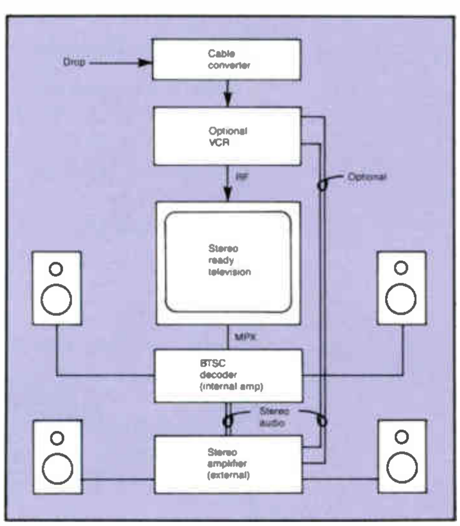

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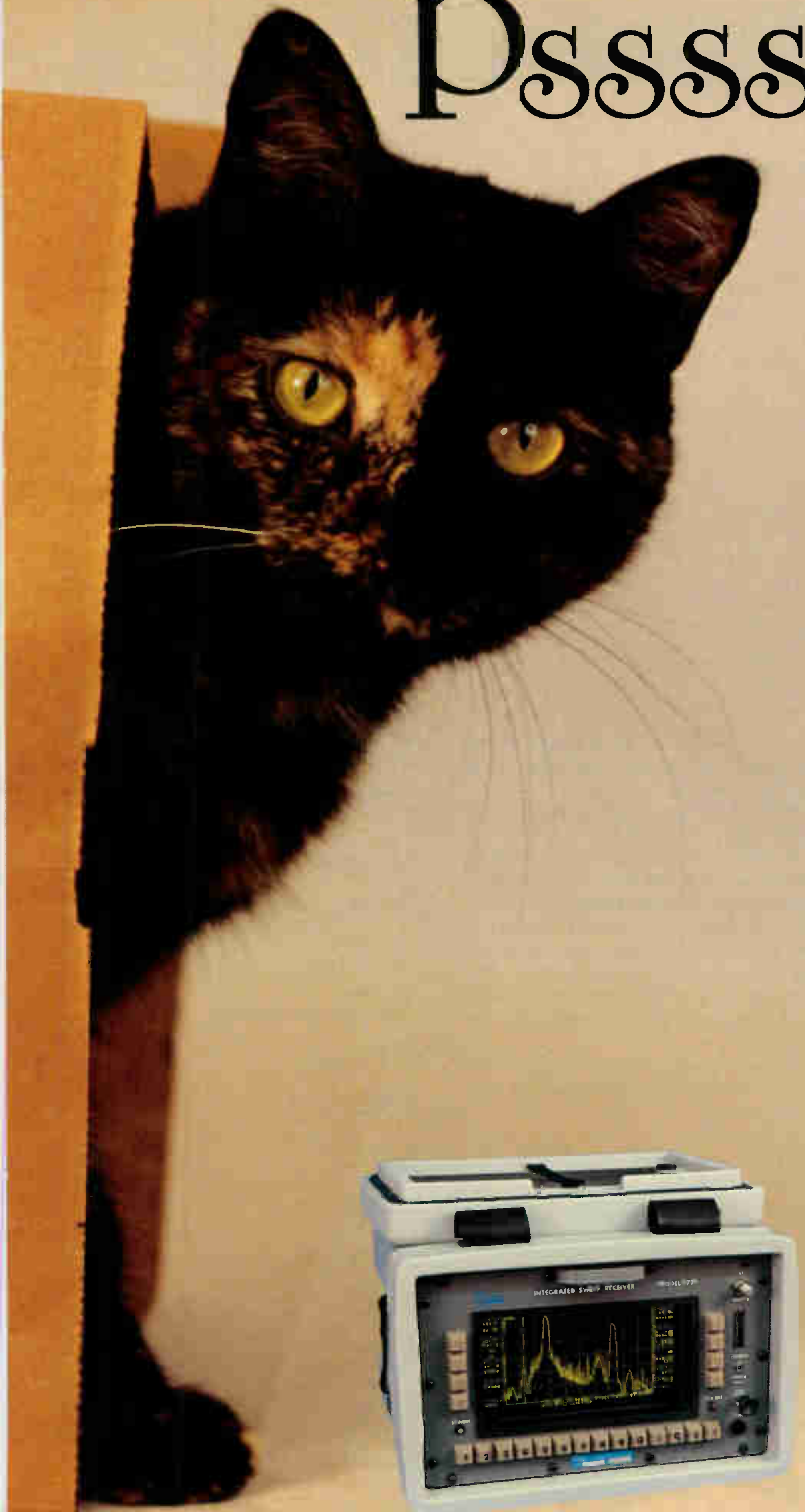

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Reader Service Number 3.

INSTALLER TECHNICIAN

News you can use

Since you're scurrying around department stores this holiday season trying to match the right gift to the right relative—and too busy to read this—let me just clue you in on a few important things you really should be aware of:

- The Society of Cable Television Engineers will announce its new insurance benefits program for SCTE members during a press conference at the Western Show. The program will allow the Society to offer reduced rates of insurance coverage. By the way, this is just another of the dozens of reasons for you to join the SCTE. (What are you waiting for? Christmas?)
- The National Cable Television Association is presenting a series of free regional seminars focusing on signal leakage and cable system compliance with the FCC's cumulative leakage index requirements. Each 1½-day seminar is designed to explain regulations of the Federal Communications Commission and how to comply with them. (For more information, read "News" on page 8.)
- Cable Security Systems Inc. and Power Guard Inc. announced the move of their sales and customer service departments to a newly constructed office facility at 506 Walker St. in Opelika, Ala. Their new mailing address is P.O. Box 2796, Opelika, Ala. 36801. Phone numbers are (205) 742-0050 or (800) 288-1506 (Cable Security Systems), and (205) 742-0055 or (800) 288-1507 (Power Guard).

What's new

With this issue, we've made a few additions and changes in our masthead. First, Marty Laven was named vice president of sales and marketing. Marty brings a 10-year publishing and marketing communications background to our company. Prior to joining us he was communications director for United Way of Broward County, Fla. Some of you may remember him from his many years of experience in the cable industry in the late '70s and early '80s.

Other changes include: Neil Anderson, previously an account executive, was promoted to national sales manager; Marie Beert was promoted to marketing administrative assistant; and Shelley Bolin, formerly editorial assistant, was promoted to assistant editor. Danielle Kelley is our new receptionist.

We're working for you, and dedicated to the cable TV industry.

Finally, I'd like to leave you with a little holiday cheer in the form of a cartoon. It was drawn by Norman Ellison, installer for Viacom Cablevision in San Francisco, and sent to us by Victor Ross, assistant supervisor of apartment installation. (The inscription was taken from the book *Peak Performers* by Charles Garfield.) Thanks, guys.

So, until we meet again—Happy Hanukkah, Merry Christmas and Happy New Year!

Paul R. Levine

Office: Communications Technology Publications Corp., 12200 E. Briarwood Ave., Suite 250, Englewood, Colo. 80112, (303) 792-0023. **Mailing Address:** P.O. Box 3208, Englewood, Colo. 80155.

Advisory Board

News

NCTI keeps up with the changes

DENVER—The National Cable Television Institute released its newly revised Installer Course for industry technical personnel. The course is designed to teach entry-level cable installers the proper procedures for performing aerial, underground and interior drop cable installations.

The 22-lesson course was updated to take into account significant changes in installation practices, the National Electrical Code, the number of active channels, converters, coaxial drop cable, F connectors, passives, TV sets, VCRs, test equipment, installation materials and tools. With these revisions, this course will help in training new installers and preparing those interested in SCTE installer certification.

The course begins with a six-lesson overview of the CATV system, covering topics such as signal sources, processing and distribution, and subscriber services. From there lessons cover tools, safety practices, emergency first aid, customer relations, converters and decoders, TV set tuning, etc. Some of the new information concerns VCR cabling and tuning, impulse pay-per-view, BTSC stereo and security tools.

Among the most popular of NCTI's courses, more than 6,300 cable technical professionals have graduated from the course since its inception in 1968. More than 1,200 students are currently enrolled in the program.

NCTA sponsors series of leakage seminars

WASHINGTON, D.C.—The National Cable Television Association is currently presenting a series of free regional seminars focusing on signal leakage and cable system compliance with the Federal Communications Commission's cumulative leakage index (CLI) requirements. Each 1½ day seminar is designed to explain FCC regulations and advise cable operators on how best to comply. The first seminar was held Nov. 29-30 at the Airport Hilton in Kansas City, Mo.

Some of the topics being addressed in the seminar are the history of signal leakage, the evolution of the current rules and the economic and technical implications of complying with the rules. A special emphasis is placed on programs and techniques proven successful in meeting CLI requirements and reducing leakage. Vendors with equipment or services relating to leakage were invited to present their wares and to field questions.

Forthcoming seminars include Jan. 7-8 at the Airport Hilton in Seattle; Jan. 24-25 at the Hilton in Albuquerque, N.M.; and Feb. 14-15 at the Airport Hilton in Atlanta. Philadelphia is planning to host a seminar in late February. For more information, contact the NCTA Science and Technology Department, (202) 775-3637.

SCTE to offer insurance program

EXTON, Pa.—The Society of Cable Television Engineers announced that a new insurance benefits program will be available to members. The SCTE recently formed a relationship with Smith-Sternau Organization Inc., an insurance broker that represents a large number of engineering associations.

To those wishing to take advantage of this opportunity, this "group trust" program will allow the SCTE to offer reduced rates of insurance coverage. Scheduled to be introduced next year will be major medical, excess major medical, term life, hospital indemnity and high-limit accident. Members can apply for one or any combination of plans to suit their requirements.

The SCTE will hold a press conference about the program at this month's Western Show in Anaheim, Calif.

New insurance program to benefit members

The Society of Cable Television Engineers recently announced that an insurance benefits program will soon be available to its members. The Society has forged a relationship with Smith-Sternau Organization Inc., an insurance broker that represents a large number of engineering associations.

By participating in a "group trust" program of insurance coverage, the Society will be able to offer reduced rates to members wishing to take advantage of this opportunity. This new insurance benefits program represents the latest in a long line of services to the Society's membership.

The insurance programs to be introduced in 1989 will be major medical, excess major medical, term life, hospital indemnity and high-limit accident. Members may apply for one or any combination of plans to suit their individual requirements. The available plans are based around a member's principal insurance coverage or a portion of the available plan can be selected to supplement what a member may presently have.

Plans for '88 Western Show announced

The Society will be very active at the Western Cable Show, to be held Dec. 7-9 in Anaheim, Calif. The SCTE Interface Recommended Practices Committee, as well as its three subcommittees, will meet Dec. 6. The National Board of Directors' Executive Committee also will meet in conjunction with the show and SCTE will hold a press conference to announce the new insurance benefits program.

SCTE's plans for participation at the 1988 Western Show also include the sponsorship of seven technical panels. The panels scheduled for the show are as follows:

Wednesday, Dec. 7

- "FCC," with Bill Riker (moderator), SCTE; Wendell Bailey, NCTA; John Wong, FCC; and Brian James, NCTA.
- "Signal leakage," with Robert Dickinson (moderator), Dovetail Systems; John Wong, FCC Media Branch; Roy Ehman, Jones Intercable; Steve Raimondi, UA Cablesystems; and Chris Duros, Cable Trak Inc.

Thursday, Dec. 8

- "Fiber in cable: A view of the possibilities," with Joe Van Loan (moderator), consultant; Frank Little, Scientific-Atlanta; Brent Bayon, Viacom Cable; Jim Chiddix, ATC; and Jim Hood, Catel.
- "Fiber transmission systems: Exploration of system architectures" with Jim Chiddix (moderator), ATC; Dave Large, Raynet Corp.; David Fellows, Scientific-Atlanta; Dave Robinson, General Instrument; and John Holobinko, American Lightwave Systems.
- "High definition—Moving toward reality" with Ted Hartson (moderator), Post-Newsweek Cable; Wayne Luplow, Zenith Electronics Corp.; Dr. James Carnes, David Sarnoff Research Center; Yves Faroudja, Faroudja Laboratories; and Arpad Toth, Philips Laboratories.
- "HDTV roundtable" with Ted Hartson (moderator), Post-Newsweek Cable; Gregory DePriest, Association of Maximum Service Telecasters; Brenda Fox, NCTA; Vito Brugliera, Zenith Electronics Corp.; Lex Felker, FCC; Rupert Stow, CBS; and Larry Irving, Office of Telecommunication.

Friday, Dec. 9

- "Consumer Electronics Interface Report" with Walt Ciciora Ph.D. (moderator), ATC; Joe Van Loan, consultant; Tom Mock, EIA; Joe Stern, consultant; and Anthony Radice, General Instrument.

SCTE endorses NCTA signal leakage seminars

The Society recommends that cable system technical personnel attend one of the National Cable Television Association's seminars on signal leakage. These seminars will explain the FCC rules and regulations for signal leakage and how to cope with them on a day-to-day basis. Special emphasis will be placed on the programs and techniques that have proven successful in meeting CLI requirements and reducing signal leakage.

The following seminars were scheduled for 1989 at press time: Jan. 7-8 at the Airport Hilton, Seattle, Wash.; Jan. 24-25 at the Hilton Hotel, Albuquerque, N.M.; and Feb. 14-15 at the Airport Hilton, Atlanta. There is no charge for attendance at these seminars.

Bring your manager to an SCTE meeting

The National SCTE Board of Directors recently discussed a method of dealing with a problem that many of the Society's local chapters and meeting groups seem to encounter: getting managers to support sending employees to local SCTE meetings. This problem frequently is caused by a lack of knowledge or understanding of the benefit local groups provide to cable systems and their managers by offering low-cost technical training.

A possible solution to this problem is to hold a "bring your manager day" at least once each year to which you would invite local managers for the purpose of letting them see just what happens at a group meeting.

A "bring your manager day" should begin with a brief business meeting in the morning, followed by a series of informative topics that also are of interest to system managers. Suggestions for topics include "Where do we stand with fiber optics in today's cable system," "Where cable systems should be with BTSC stereo," "What's happening with HDTV" and "Local ad insertion systems—What is available and what they can do for your cable system." There always will be topics of this nature that are of interest to system managers, just remember to keep them reasonably non-technical in nature but informative from an operations point-of-view.

Be sure to reserve some time for a presentation on SCTE and what it is doing for the cable industry nationwide, as well as what the local chapter or meeting group is providing to benefit the area's technicians and installers. Devote some time in this presentation to covering how the education of these people results in better service, fewer outages, lower operating costs and happier customers. Follow this with a schedule of the training programs the group will present in the next six months, as well as a review of what the group has accomplished over the past year.

SCTE Chapters and Meeting Groups

As a service to SCTE members, the following is an up-to-date listing of the Society chapters and meeting groups, with each group's contact person and phone number. Members should take this opportunity to join a local group.

Appalachian Mid-Atlantic Chapter
Contact: Ron Mountain, (717) 684-2878
Cactus Chapter
Contact: Harold Mackey, (602) 866-0072
Cascade Range Chapter
Contact: Norrie Bush, (206) 254-3228
Central Illinois Chapter
Contact: Tony Lasher, (217) 784-5518
Central Indiana Chapter
Contact: Steve Murray, (317) 788-5968; or Joe Shanks, (317) 649-0407
Chattahoochee Chapter
Contact: Richard Amell, (404) 394-8837
Delaware Valley Chapter
Contact: Diana Riley, (717) 764-1436
Florida Chapter
Contact: Dick Kirn, (813) 924-8541
Gateway Chapter
Contact: Darrell Diel, (314) 576-4446
Golden Gate Chapter
Contact: Tom Elliott, (408) 727-3900
Great Lakes Chapter
Contact: Daniel Leith, (313) 549-8288
Greater Chicago Chapter
Contact: William Gutknecht, (312) 438-4200
Heart of America Chapter
Contact: Wendell Woody, (816) 474-4289
Hudson Valley Chapter
Contact: Wayne Davis, (518) 587-7993; or Bob Price, (518) 382-8000
Iowa Heartland Chapter
Contact: Dan Passick, (515) 266-2979
Miss/Lou Chapter
Contact: Rick Jubeck, (601) 992-3377
New England Chapter
Contact: Bill Riley, (617) 472-1231
North Central Texas Chapter
Contact: Vern Kahler, (817) 265-7766
North Country Chapter
Contact: Douglas Ceballos, (612) 522-5200
North Jersey Chapter
Contact: Art Muschler, (201) 672-1397
Ohio Valley Chapter
Contact: Robert Heim, (419) 627-0800
Oklahoma Chapter
Contact: Gary Beikman, (405) 842-2405
Old Dominion Chapter
Contact: Margaret Harvey, (703) 238-3400
Piedmont Chapter
Contact: James Kuhns, (704) 873-3280
Razorback Chapter
Contact: Jim Dickerson, (501) 777-4684
Rocky Mountain Chapter
Contact: Steve Johnson, (303) 799-1200
Tip-O-Tex Chapter
Contact: Arnold Cisneros, (512) 425-7880
West Texas Chapter
Contact: Jerry Whitehead, (915) 655-8911
Central California Meeting Group
Contact: Andrew Valles, (209) 453-7791; or Dick Jackson, (209) 384-2626
Chaparral Meeting Group
Contact: Michael Gormally, (505) 761-6200
Chesapeake Meeting Group
Contact: Thomas Gorman, (301) 252-1012
Dairyland Meeting Group
Contact: Jeff Spence, (414) 738-3180
Dixie Meeting Group
Contact: Greg Harden, (205) 582-6333
Inland Empire Meeting Group
Contact: Michael Lajko, (208) 263-4070
Michiana Meeting Group
Contact: Thomas White, (219) 259-8015
Midlands Cable Training Association
Contact: John Page, (712) 323-0420
Mt. Rainier Meeting Group
Contact: Bill Donaldson, (206) 742-5811
Palmetto Meeting Group
Contact: Rick Barnett, (803) 747-1403
Southeast Texas Meeting Group
Contact: Harold Null Jr., (713) 645-3738
Southern California Meeting Group
Contact: Tom Colegrove, (805) 251-8054
Tennessee Meeting Group
Contact: Joe Acker, (205) 932-7264
Upstate New York Meeting Group
Contact: Ed Pickett, (716) 325-1111
Utah Meeting Group
Contact: Roger Peterson, (801) 486-3036.
Wyoming Meeting Group
Contact: Jim Niswender, (307) 324-2286 ■

The right way for installers to figure out what's wrong.

The best time to discover a subscriber installation problem is at hook-up. *Before* you have to make an expensive service call.

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For instant troubleshooting.

If an installer discovers a problem, he can track it down simply by retracing his steps. Testing every point from the TV to the tap. Until he finds it.

An LCD display gives the *exact* signal level (without dummy lights or needles to read.) At *three* frequencies, not just two. Frequencies *you* set, not the factory.

MicroSAM has programmable band ranges up to 550 MHz. At ± 1 dB accuracy, with 0.1 dB resolution.

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MicroSAM gets rid of the guesswork. So you get it right the first time.

Call Wavetek at 1-800-622-5515 (in Indiana call 317-788-5965) for more information and the name of the nearest MicroSAM distributor.

See us at the Western Show, Booth 626.
Reader Service Number 7.

WAVETEK®

The Qualified Installer Program: Between the lines

By Pam King
Technical Training Coordinator, Jones Intercable Inc.

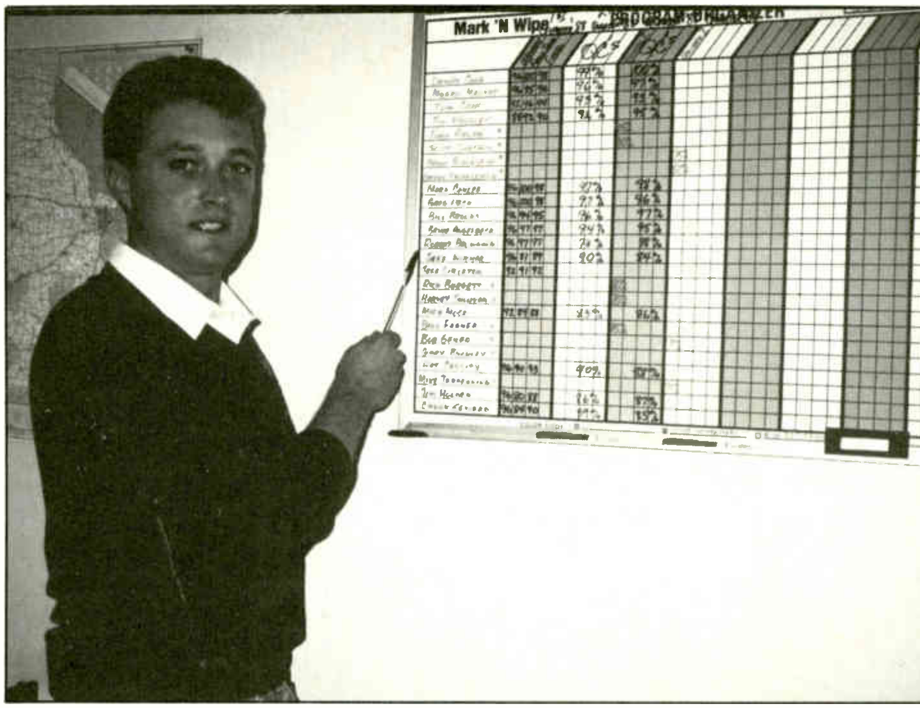
The Qualified Installer Program (QIP), a customized version of the Performance Plus installer program, was developed to present installation guidelines for Jones International's full-time installers, contract installers and technicians who work with drops. The QIP manual sets performance standards every installer is expected to meet.

The elements of the program include:

- The QIP manual, which is similar in size to a driver's manual
- A videotape
- A series of meetings to review the program with installers
- Written and field skill evaluation
- Quarterly progress reviews
- Waiver procedure for system-specific variations to the program
- A leader's guide to assist the QIP facilitator in presenting the program

You might have heard all this before. Descriptions of the Qualified Installer Program were included in both *Communications Technology* and *Installer/Technician* over the past year. A paper was written for the National Cable Television Association and numerous workshops conducted for the Society of Cable Television Engineers meetings on the QIP and related installer topics. There was a lot of speculation and preliminary calculation on how this program might impact our systems in terms of reduced service calls. So what can we tell you that you haven't heard before? Simply that the program is working; we are witnessing a decline in our drop-related service calls.

We knew from the beginning the success of this program relies primarily on careful performance monitoring, as well as closing the feedback loop between system managers, chief engineers and installers. However, there was a very important ingredient missing from our carefully prepared plans: How do you take a two-dimensional program on paper and turn it into a three-dimensional living, working, successful program? You need a person who understands installations, is enthusiastic about the program and able to manage all its elements. This person must be able to "read between the lines" and translate the material for the installers. The only person who can do this is the system QIP facilitator or installation manager. The associates in our Independence, Mo. system lead the way to show us how.



Bill George examines QC scores on the QIP compliance tracking board.

Customize the program

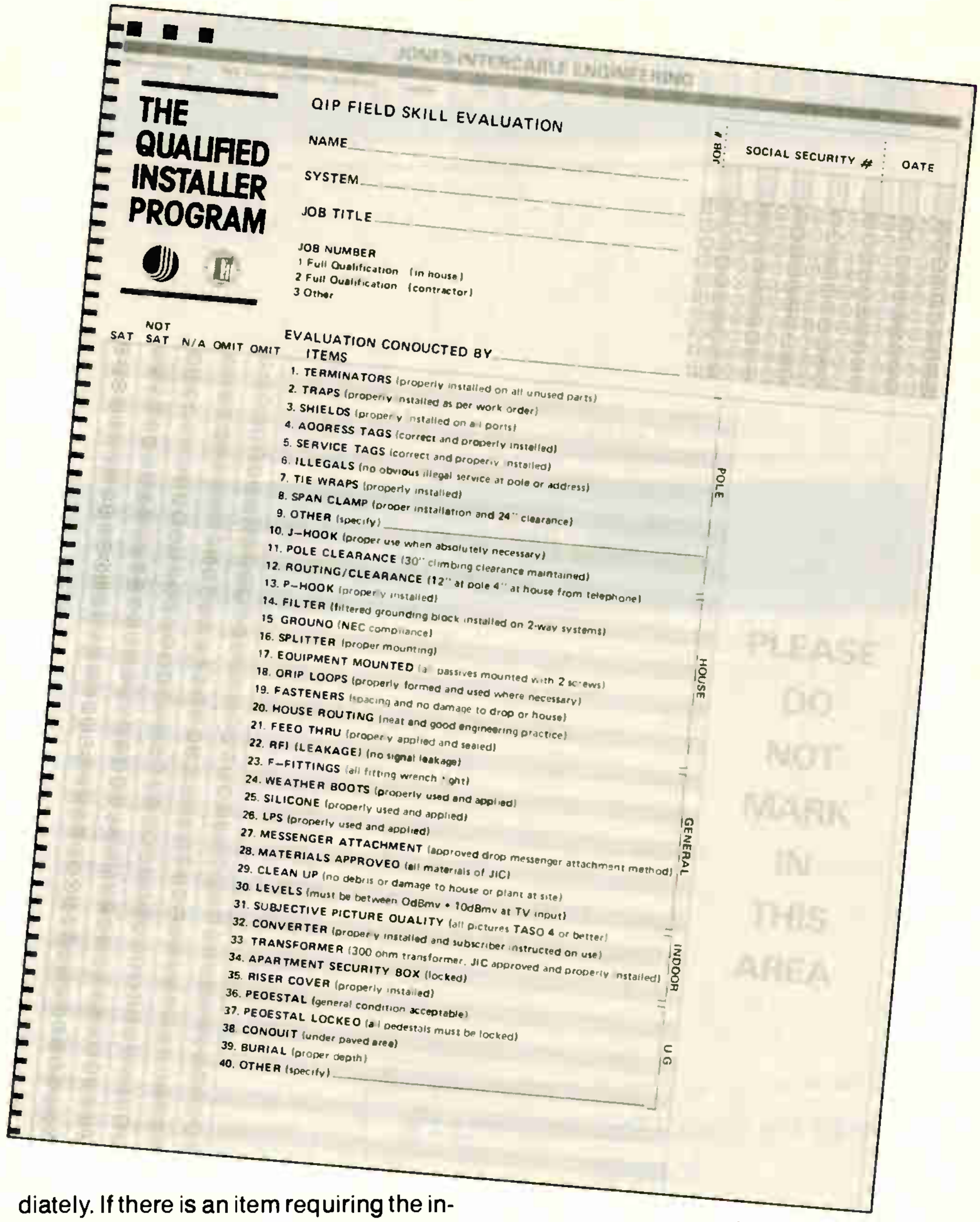
Bill George, installation manager in Independence, is responsible for managing the Qualified Installer Program. When he first launched the program in his system 10 months ago, he used the leader's guide as well as all the other elements of the program supplied to him by the corporate office. He had to—it was a new program and this was the only way to decipher what the corporate office wanted. From the start, he began customizing the program to meet his system's needs. For example, he noticed that the initial four, two-and-one half hour meetings as described in the leader's guide were just too long. It was difficult to keep the installer's attention for that long, especially the contractors. They had installs to do and were not getting paid to sit in a classroom. (The installation contract company, Four-K Cable Service, now pays the new hires while in training.) So Bill revised the format; instead of four, two-and-one-half hour classroom sessions, he now conducts approximately 15 to 20 one-half hour sessions. Note that the total training time is still about 10 hours. He is able to hold the interest of the installers and retention of the material studied is higher. Plus, these meetings are not limited to new hires; special meetings using a similar format are called for existing installers periodically or as the need arises.

"Tracking and follow-up are critical to the success of any training program, but are especially important when the work is done away from the office..."

Recreating situations the installers may encounter in the field reinforces learning. On a recent visit to the Indepedence system I had the opportunity to videotape a meeting about troubleshooting the drop. Bill made four jumpers, all with a different problem. A television was set up in the front of the conference room. Bill then asked individual installers to troubleshoot the jumpers and situations where these problems may appear in the field were discussed as the installers looked for them. The installers also were asked to refer back to the chapter on troubleshooting in the QIP manual. Bill gave examples to further explain the material in the manual and added personal experiences and examples not included in the manual. The high interest level among the installers indicated the success of this approach.

The most important test was still to come: Did the installations being performed reflect the material learned in the classroom and the high-quality installations Jones Intercable demands? Tracking and follow-up are critical to the success of any training program, but are especially important when the work is done away from the office as is the case with installations. The field skill evaluation form is used to qualify the installers as well as a check sheet for each individual install.

Bill and I left the office equipped with copies of field evaluation sheets (see the accompanying sample) for the quality checks (QCs), a few randomly selected work orders and the video camera. (We have been using video more often at Jones Intercable as a means of documenting programs as well as a training tool. You'll hear more about this in the future.)



The first job was a new underground installation. As Bill reviewed the workmanship, he was hard pressed to find anything wrong. He did find the lock hasp the installer carelessly left on the ground by the pedestal. This caused the installer to receive a QC compliance of 98 percent (85 percent is passing). Before leaving the site Bill reviewed the QC sheet in its entirety, checked for signal leakage and verified that proper signal levels were achieved.

The second job was not quite as good, with 90 percent compliance. The installer had scraped away paint from the power conduit for the attachment of the grounding clamp but not quite enough paint was scraped (– 6 points). Also, the riser guard from the ground to the house box was missing (–4 points). These items may not have been so critical in the past, but they are all part of a quality job.

Logging the results

Back in the office, the results of the QCs are logged in the quality assurance (QA) log book and copies are made (one for the installer and one for the installer's files). At the end of the day the installers look for these sheets, which are folded closed and pinned to the bulletin board. This way they know what needs to be corrected immediately. If there is an item requiring the installer to go back and repair, this is noted in the book. The installer reports back to Bill when the job is complete. Files that include copies of all the field evaluations and written exams are maintained on all installers. These files also are available to the contract supervisor.

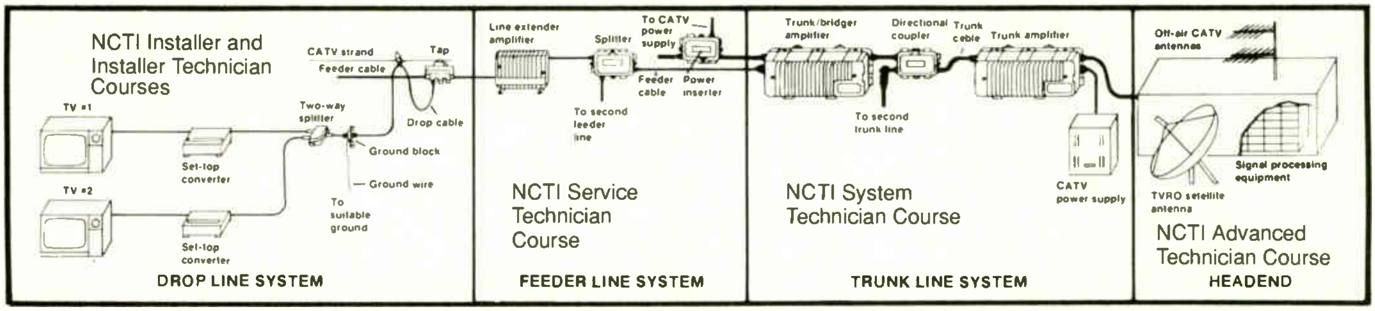
Tracking doesn't end with the QA log book and individual files. The QC compliance percentage for all the installers, both in house and contractor, are posted by quarter on a tracking board on the wall. This board also indicates which installers achieved their full qualification. The installers take note of how their scores compare with other installers, creating some healthy competition.

The installer is an important, but often neglected, cornerstone in our industry. The installer has a critical job, being the only company representative to the majority of the customers. The installer also is responsible for the technical integrity of each installation performed. The Qualified Installer Program has made a quantum leap in setting standards in this direction.

There are numerous components that contribute to the success of the program, including cooperation from the installation contractor and support from the general manager and chief engineer. But the real key to the success of this progam is the enthusiasm, dedication and the ability to "read between the lines" of the installation manager. ■

The author wishes to thank: General Manager Doug Johnson, Chief Engineer Nathan Brewster, Installation Manager Bill George and the installers of Independence, Mo., for their input and assistance with this article.

From Headend to Drop



NCTI is the industry's technical training source

Where is your technical training need?

At the installer level? Continuing education for your Chief Tech? Technical insight for your Customer Service Reps? No matter what level of technical training your operation needs, NCTI has courses to offer.

For more than 20 years NCTI has been providing the technical training cable industry professionals need to ensure engineering excellence. Why has NCTI become the industry's technical training source?

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NCTI lessons have been undergoing an intensive updating process. Material is carefully screened and changed to reflect the rapid advancement in technology and techniques.

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From F-connectors to satellite receivers, from modulators to set-top converters, NCTI covers the full range of cable industry technical issues.

Self Paced

NCTI's courses are designed to allow students to progress at their own pace, and to study when and where they are most comfortable. As a result, NCTI student complete a far greater proportion of courses than most like training programs.

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NCTI takes the pain out of your technical training. We make it simple to enroll students and monitor their progress. Each time a student submits an exam, a grade report is promptly returned. And, each quarter management receives a Progress Report showing the status of each student in their system.

Our goal is to provide the industry's best training materials and to produce qualified technicians and engineers equipped to construct and operate first class cable television systems.

To learn how you can put NCTI training to work in your system, or how to enroll, call us at (303) 761-8554, or return the coupon. **Do it today!**

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IT 12/88

Reader Service Number 8.

Installation with the extras

By David B. Sinclair
Technical Instructor, Henkels & McCoy

A house installation should be done in a neat and efficient manner and the installer should have the proper tools and equipment. The tools required should be the only ones in your belt, so you do not waste time searching through tools you don't need.

The type of installation to be performed is a single-unit house with two televisions and one VCR. The house is a ranch style with a basement (Figure 1). The first step is to verify the work order with the customer, then look over the entire job starting with the tap. An install should be done so that the drop cable follows the other utilities into the house but this is not always possible. Set the cable caddy at the house to pull the cable from the house to the tap.

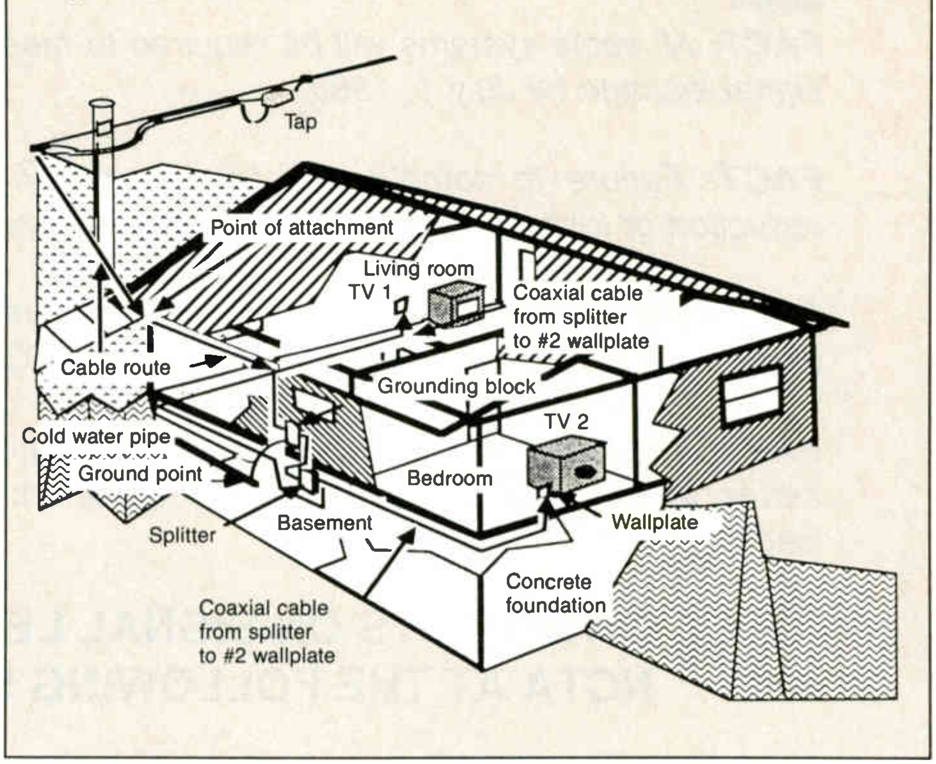
It is faster to attach the F fitting to the cable before taking the end of the drop wire up to the pole; in fact, it is always easier to perform as much work as possible on the ground. If you are using messenger drop cable, peel back enough messenger to make a large drip loop. Wrap the messenger around the span clamp at least twice, then around the cable at least six to eight times. Attach the span clamp to the strand and screw the F fitting into the tap port. Hand tighten it, then, using a 7/16 wrench, tighten it one-eighth of a turn. Next add the address or identification tag to the drop cable. An organized installer should only have to climb the pole once to perform an install at the tap.

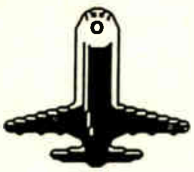
The next attachment is at the house. Attach a house hook or P hook at the eaves or large board to obtain all aerial clearance for streets, driveways and alleyways designated by the National Electric Code. The cable should be raised and pulled snug but not tight. Then strip back the messenger and wrap it at least twice around the house hook and six to eight times around both messenger and drop cable to prevent them from separating. The messenger wire should be stripped away from the house hook to the ground block.

Converter installation

The next phase of the installation is the converter system (Figure 2). Plug the converter into the AC outlet, then plug the television set into the back of the converter. Connect an F fitting to the end of the drop, making sure there are no braids pro-

Figure 1





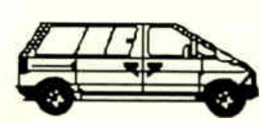
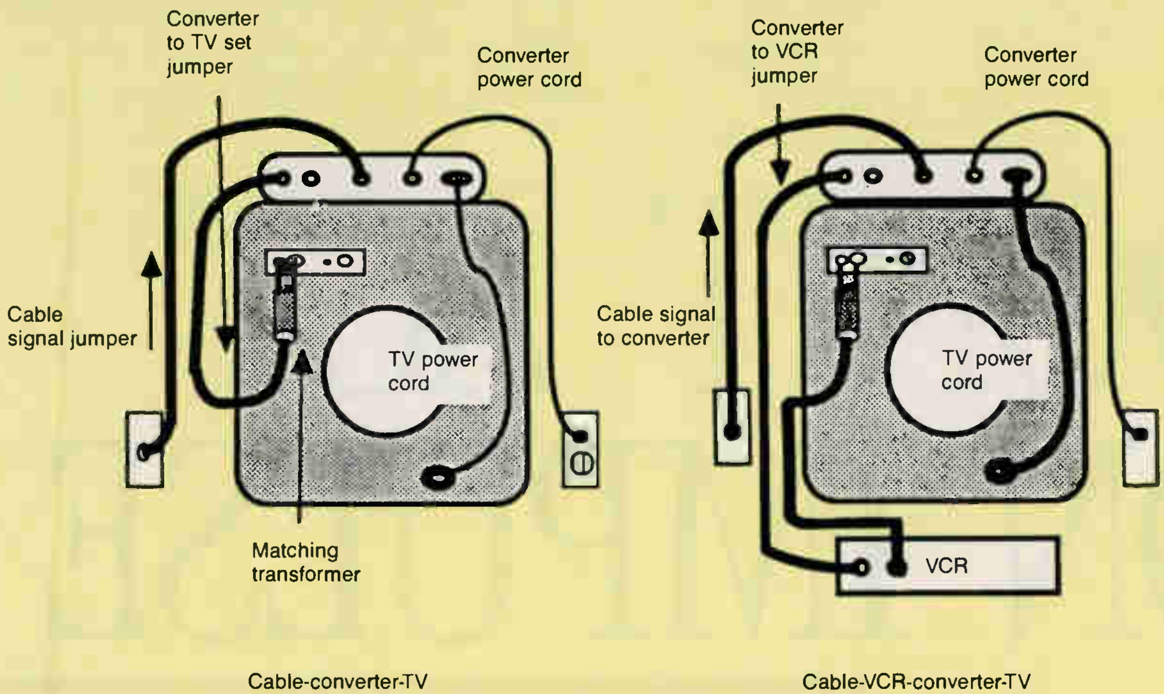


Figure 2



truding past the crimp ring to prevent injury to the customer. Install the cable to the input side of the converter and make a jumper for the output of the converter to the 75 ohm jack on the back of the television set. If a 75 ohm jack is not available, install a matching transformer to the 300 ohm-VHF terminals and disconnect all outside antenna wires. The television has to be set to the output channel of the converter and fine tuned for best picture quality. Some systems will require you to record RF levels on certain cable channels on your work order. Check all cable channels available to the customer and note any picture problems.

The installation of the second set will be in the living room. On the outside wall of the living room, mount the splitter. Drill a hole behind the television to the outside so that it slopes downward and out. Set your cable reel in the living room and pull the cable out to the splitter, then connect the cable to the output of the splitter, making sure a service loop or drip loop is installed at the splitter. Install a plastic feed-through bushing for the outside hole and use sealant to keep moisture out. Proceed with the inside cable wiring; where the cable enters the living room, cut it and install the F fitting. Next connect the F fitting to the wall plate with an F-81 barrel and mount the wall plate with a small pocket level.

The final wiring step is to make a jumper that reaches the converter; leave enough

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cable so the customer can move things to clean without pulling on the cable. This will prevent unnecessary service calls from the cable being pulled and stretched out of the F fitting. Connect the cable from the wall plate to the input side of the converter box and install a jumper from the output of the converter box to the input side of the VCR. You also will need to make another jumper to go from the output of the VCR to the antenna connection on the back of the television set.

The PPV option

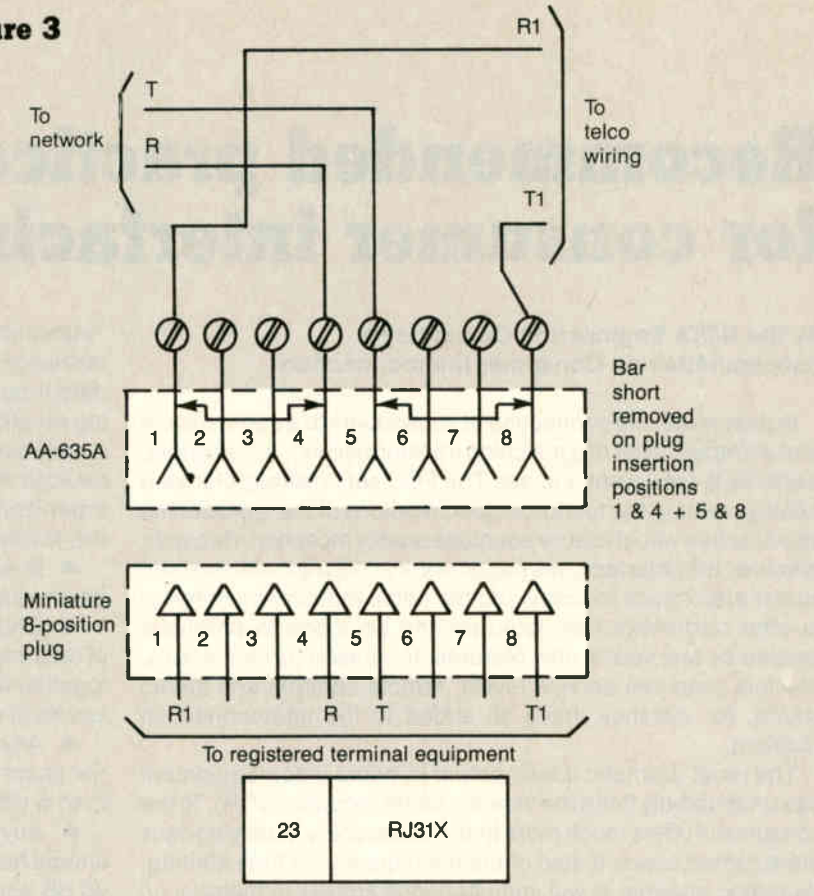
The option of pay-per-view also is available in the newer cable systems. The phone loop is connected to the converter by modular plugs, as in your home telephone. The customer can request a movie through the converter, which incorporates an automatic dialer. This will access the billing system and turn on the designated movie. In order to do this, the phone company requests that an RJ31X jack be installed. The phone wire should be installed from the main telephone junctions as follows: The tip is a green wire that is attached to the T1 terminal; the red ringer wire is attached to the R1 terminal. The next wire will have a male connector on each end and will come from the RJ31X jack to the phone plug on the back of the converter. This installation will enable the telephone system to be isolated if the phone wire is unplugged from the converter accidentally. A bar will short across the module jack automatically if there is no continuity (Figure 3).

To fine tune the set, turn on the power for the VCR and television set. Now set the VCR channel with the converter output channel. If the converter has Ch. 4 for output, turn the VCR to Ch. 4 input, then match the television set to Ch. 4. Fine tune to this channel until the cable channels are clear of distortions. You may have to adjust the color by first removing all the color and adjusting the brightness and contrast. Then add the color slowly and adjust the tints and hues. A color bar is the best way to adjust the TV color.

You should take signal readings at this time if required by the system and also note all serial numbers from the converter boxes that were installed. The customer will need to be shown how to use the cable with the VCR. Some customers have more knowledge than others, so be patient. Have the customers operate the cable for you.

Remember, to perform a neat, efficient install you must be organized and equipped with the proper materials and use common sense. ■

Figure 3



Recommended practices for consumer interfacing

By the NCTA Engineering Committee's
Subcommittee on Consumer Interconnection

In past years, the connection of subscribers to a cable system was a simple matter of a matching transformer and, occasionally, a splitter to feed a second set. The FCC set up straightforward rules governing the technical specifications of the signal at the interface that would assure adequate quality reception. Recently, however, this interface has become very complex with the consumer electronics industry and the cable industry each trying to offer customers new features and solutions to problems caused by last year's new features. Increased tuning ranges, multiple premium service levels, remote controls and stereo sound, for instance, have all added to the interconnection problem.

The most dramatic development in home video equipment has undoubtedly been the videocassette recorder (VCR). To the consumer it offers much more than the capability of playing back prerecorded tapes. It also offers the capacity for time shifting, recording material at will, simultaneous access to material on different channels and numerous special effects that can be applied to recorded material, including "zapping" of commercials. Not only the cable industry, but the broadcasters and movie theaters have been drastically affected by its widespread market acceptance.

Of all the new consumer electronics developments, the VCR presents the greatest challenge to the cable television technical community. Most VCRs contain their own tuners, VHF modulators and a means of time-programming to allow unattended recording of a series of events on different channels. Connection to a cable system in such a way as to not lose any of these features is not simple!

FCC technical standards

A major part of the FCC's technical rules for cable television (Part 76, Subpart K) are related to specifying characteristics of the signal presented to the consumer's television set. The principal ones that concern us here are:

- The signal level (75 ohm) shall be a minimum of 0 dBmV but below "overload" level.
- The signal level of adjacent channels shall be within 3 dB and all channels shall be within 12 dB.
- The visual carrier-to-noise ratio shall be greater than 36 dB.
- The level of intermodulation products shall be at least 46 dB below visual carrier level.
- The leakage of cable signals shall be less than 15 μV/meter as measured at 100 feet and, in the range from 54 to 216 MHz, shall be less than 20 μV/meter as measured at 10 feet.

Note that although these requirements (except for signal leakage) apply only to broadcast signals and are no longer enforceable at the federal level, they still have a sound technical basis.

These rules were promulgated in a much simpler time when "subscriber terminal equipment" meant one, or perhaps two, television sets whose tuning ranges were limited to the standard broadcast channel allocations. In recognition of a changing situation, the EIA/NCTA Joint Engineering Committee drafted a proposed CATV RF specification for television receiving devices that is currently in the approval process by the parent organizations. This standard would augment the FCC rules to the following degree:

- In order to prevent front-end receiver overload, the maximum video carrier level should be limited to +20 dBmV.
- Channels using the same frequencies on different cables of dual cable systems should have the RF carriers phase locked together to reduce the visual effects of co-channel interference. Levels of equivalent channels should be matched within 5 dB.
- Any video equipment designed to loop-through the RF carrier (such as a VCR's bypass mode) should have a loss of less than 5 dB.
- Any RF selection switches contained in video equipment should have an isolation of at least 70 dB through 216 MHz and 60 dB above that.
- Any video equipment with an RF input port should meet the requirements of Part 76 with respect to the reradiation of cable signals and should further have an invisible level of picture degradation when operated in external fields of up to 1 volt per meter from local VHF television stations.
- In recognition of the splitting losses required for multiple terminal equipment, cable systems are advised that in future designs, levels of at least +5 dBmV should be provided at the first terminal equipment connection point.

Although these latter requirements do not have the force of law even if accepted by the organizations involved, they are a fair representation of the performance levels that will be required in today's complex home video environment.

A simple off-air connection of a VCR and TV set is shown in the accompanying figure. This connection allows for simultaneous multichannel access, timed recording of events on different channels and tape playback, all without any switching of cables. More elaborate installations may allow for tape-to-tape copying, FM receiver interconnections, external sound amplification or additional video sources.

The ideal solution would allow the greater programming selection of cable without adding cost, picture degradation or operating complexity and without loss of features or an increase in signal leakage. Before considering overall solutions, individual component requirements will be examined.

Component requirements

In a typical non-cable installation, the output modulator of the VCR is set to a channel that is not used by a broadcast station. Since that removes any possible co-channel interference situations, switch isolation does not have to be particularly high. A typical cable connection, on the other hand, will very likely have a cable channel, the converter output and the VCR output all

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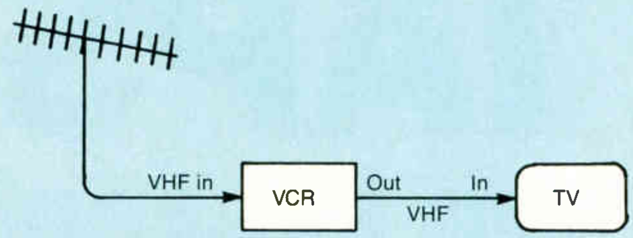
Off-air connection of a VCR and TV



on the same channel, usually Ch. 3 or 4. Furthermore, none of these sources are locked together. Under those situations, it is necessary to assure that the ratio of desired to undesired video carriers be at least 65 dB at the input port of any demodulating device. Since the levels of the various sources will typically be within a 10 dB window, a conservative specification for an RF selection switch's on-off insertion loss ratio would be 75 dB at frequencies at or below Ch. 4. Should one of the input sources be an external antenna, the variation in expected signal ranges would be higher and the suggested specification is 80 dB through 216 MHz, which is still below the specified performance of A/B switches used by the cable industry today. At other frequencies, generally the only co-channel situation occurs when selecting cables in a multi-cable system. If the opposing channels are phase-locked together an on-off ratio of 60-70 dB is adequate to assure non-degraded reception and to preserve the A/B isolation of the distribution system.

Although practices vary, many cable systems have been designed to deliver signal levels in the 0 to +3 dBmV range since that is adequate for simple television connection and higher levels add to the cost of plant construction and increase amplifier cascades.

Assuming a noise-free transmission network, the maximum attainable equivalent video carrier-to-noise ratio is:

$$C/N = 59 - NF + level$$

where:

C/N	=	ratio of a noise-free incoming video carrier to the sum of thermal and internal noise sources measured in a 4 MHz bandwidth
NF	=	terminal equipment noise figure in dB
level	=	carrier level at the input terminals in dBmV

Thus, if a converter has a noise figure of 11 dB and is driven with a 0 dBmV signal, the maximum attainable C/N is 48 dB. The noise of the signal processing equipment and transmission system will combine with this noise to determine the final video signal-to-noise ratio. If the terminal signal level is below 0 dBmV, the maximum attainable noise performance will vary accordingly and the converter will play an increasingly large part in determining overall noise level. Aside from FCC requirements, 0 dBmV was chosen as a compromise such that in general subscriber terminal equipment is not the dominant factor in total noise contribution.

In addition to the detrimental viewing effects of excess noise, low signal levels may interfere with proper operation of addressable devices and operation of teletext decoders and similar equipment. Typically, such equipment is specified for proper operation down to 0 dBmV only.

Thus, switching and splitting networks that result in more than

Reader Service Number 15.

minimal losses to the signal paths can result in noisy pictures at least and possibly improper operation of such devices as addressable descramblers. How much loss is too much will depend on drop levels in any given system.

To the extent that losses cannot be minimized by innovative circuit design, they may be overcome by amplifiers placed in some of the input or output ports of the switching network or, in some cases, by selectively changing customer tap levels or replacing RG-59 drop cable with RG-6.

Any subscriber interconnection network should meet the requirements set forth in the proposed EIA/NCTA guidelines. Under current FCC regulations, cable operators have responsibility for total leakage of cable signal from their franchise areas even though some of the leaking equipment may be subscriber-owned. These requirements are detailed in FCC rule paragraph 76.611 as amended Oct. 26, 1984, and are commonly known as composite (or cumulative) leakage index or CLI.

In discrete-component arrangements of splitters and A/B switches, the major contributor to leakage is liable to be the quality of F connector installation and the tightness of the fittings. Such factors should be considered if the operator chooses to let the subscriber take the major responsibility for installation of networks.

Packaged networks generally have fewer external connections, but have the added requirement of total shielding over the switching components. While federal rules regarding the signal leakage requirements for various classifications of subscriber terminal equipment are currently under review, some currently available networks are rather poorly shielded.

In any case, operators should educate both customers and installers as to the importance of good connections. Aside from external leakage and ingress considerations, poor shielding and leaky cables will detract from the isolation of non-selected RF sources and cause co-channel interference.

Security factors

Much of the dissatisfaction with the connection options offered to customers by cable systems is related to converter/descramblers. They are used to convert a spectrum of input channels to a common output channel and to descramble selected premium services. The problem is they only deliver a single channel at a time so that recording one channel while watching another is impossible, particularly if both channels are scrambled.

Some of the solutions that are being considered address this issue by using multiple descramblers to simultaneously deliver all subscribed services. While this may offer subscriber convenience the operator should evaluate potential revenue losses due to:

1) Second descramblers offered at reduced rates being transported to other subscribers' homes as primary units.
2) "Backyard" interconnects with multiple descrambled services delivered to non-subscriber's homes or apartments by coaxial cable.
3) The cost associated with more elaborate descrambling hardware. ■

Reprinted with permission from "Connecting Cable Systems to Subscribers' TVs and VCRs—Guidelines for the Cable Television Industry" (1987) by the NCTA.

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Reader Service Number 17.

Transmitting video by light

This is the fourth and final installment of a series on optical fiber.

By Scott A. Esty
Market Development Supervisor
Telecommunications Products Division, Corning Glass Works

Some common references to optical fiber as a "light pipe" have led some new to optical transmission to assume that light signals are transmitted along a hollow core in the fiber. Actually, optical fibers are solid glass strands with a unique structural design. An ultra-pure central core glass is enclosed in another glass with a slightly different composition. The logic behind this will be explained after a historical digression and brief physics lesson.

As we began to explain in "From the Manufacturer's Side" in October, optical fiber transmits light by engaging a natural law of physics known as the principle of "total internal reflection." This physics principle was first demonstrated by a British scientist named John Tyndall in the mid-1800s. He demonstrated a way to confine light and actually bend it around corners. His experiment reflected light out through a hole in the side of a bucket of water. He was able to demonstrate how the light was confined to the curved stream of water, actually redirecting the path of light. Total internal reflection is even more efficient than mirrored reflection, reflecting more than 99.9 percent of the light.

The physical property of a transparent material that results in total internal reflection has been quantified as its refractive index (n). It is defined as the ratio of the speed of light in a vacuum to the speed of light in that specific material:

$$n = \frac{c_{vacuum}}{c_{material}}$$

where:
c_{vacuum} = the speed of light in the vacuum
$c_{material}$ = the speed of light in that material

Light travels fastest through a vacuum, but as it starts to travel through denser materials, it actually slows down a little. Each transparent material has its own unique refractive index value.

Associated with the index of refraction is a corresponding critical angle of incidence. The reference plane for this angle of incidence is the surface of the material in which the light is traveling, if the bordering substance has a different refractive index. If the rays of light strike this interface at an angle smaller than the critical angle of incidence, almost 100 percent of the light is reflected back into the medium.

All of us have experienced this phenomenon when swimming underwater. Water has a refractive index 43 percent higher than air. In order to see up through the surface of the water above you, your line of sight would need to cross the water surface at an angle greater than 49 degrees. Any smaller angle would reflect your line of sight back into the water. Similarly, light rays traveling parallel in a strand of glass would have a very difficult time escaping from that strand as long as their angle of incidence remained small.

There are two key requirements that originally were recognized for making such a glass path that would transmit light for communications purposes. The first was to make a glass sufficiently clear that enough of the initial light power, about 1 percent, could be detected after 1 kilometer (0.6 mile). This was recognized as the required minimum distance that would make optical communications over glass fibers cost-effective. The greater problem was designing a refractive index structure that would sustain the transmitted signal definition over the required distance.

To confine the light within the interior of the fiber, the glass fiber design actually consists of a core glass with one refractive index and a concentric cladding, or outer, glass with a lower index of refraction. Corning scientists included a dopant in the core glass to raise its refractive index above that of the cladding glass. The core/clad interface also must be perfectly smooth and round in order to eliminate any possible inconsistencies that could bounce the light out of the core.

Figure 1 shows how the principle of total internal reflection applies to optical-fiber operation. The refractive index of the core glass (n_2) is higher than that of the cladding glass (n_1). Due to this difference in indices of refraction of the two materials, n_2 being greater than n_1, the light entering the core at an angle less than or equal to θ (theta) will be reflected back into the core at the core/cladding interface. These rays of light will then be guided to the other end of the fiber as they are reflected or bounced along within the core. In contrast, rays of light entering the core at an angle larger than θ will be refracted into the cladding and lost out of the fiber.

Fiber types

Over the years, two general types of fiber have emerged to meet specific end-use application requirements—multimode fibers and single-mode fibers (Figure 2). Although potentially counterintuitive (since "multi" usually is better) the single-mode fiber offers the higher information-carrying capability over the longest distances. Consequently, single-mode fiber probably will be the fiber of choice for most cable operators. However, multimode fiber also may be encountered, so a brief description about the general differences between the two fiber types is in order.

In the lingo of optical terminology the word *mode* can be thought of as a ray of light. In multimode fiber, many modes or rays are transmitted. Multimode fiber's larger core (50 to 100 microns in diameter) captures hundreds of rays from the light source, each entering the core at one of many different angles. Some of these rays are shed by the fiber.

Of the rays that are captured by the core, some travel a direct path parallel to the length of the fiber; other rays enter at a steeper angle, traveling a longer circuitous route from edge to edge of the core as they travel down the fiber. Consequently, some part of the light pulse entering the fiber reaches the farther end sooner than other parts of the same light pulse. This results in *pulse broadening*, which limits the speed, or spacing, with which pulses can be introduced into the fiber. Consequently, this phenomenon limits the information-carrying capability of multimode fiber.

Single-mode fiber overcomes this shortfall of multimode fiber since only one mode of light can travel in the core. Compared to multimode fibers, single-mode fibers have a much smaller physical core size, typically less than 10 microns in diameter. The cladding diameter, however, remains at the de facto standard of 125 microns for purposes of connecting and splicing. With only one mode it is easier to maintain the discreteness of

Figure 1: Principle of total internal reflection for optical fibers

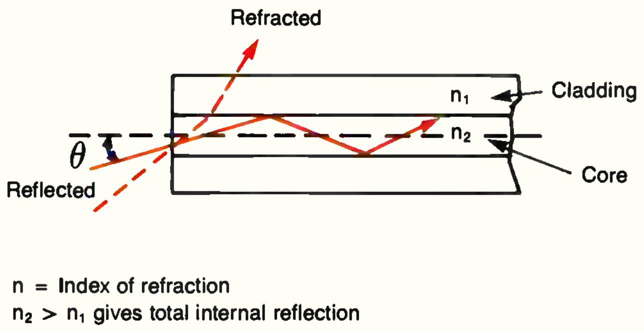
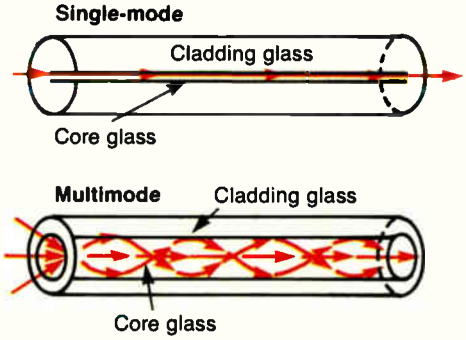


Figure 2: Two basic types of optical fiber



A mode is analogous to a ray of light

each light pulse. The light pulses can be packed much more closely together in time, hence increasing the signal content.

Since multimode fiber has a significantly larger core, it is easier to splice and connectorize and more easily captures light from a lower-cost light emitting diode (LED). Consequently, multimode fibers have become the fiber of choice for systems that have many ends and joints and where distance or capacity is not a driving factor.

In contrast, single-mode fiber has become a standard for longer-distance, high-bandwidth systems where superior system performance is required. In these systems, splicing requires greater care and higher-cost lasers are required to launch enough light power into the fiber.

Single-mode fiber has revolutionized the wiring of America. Today, more than 5 million miles of single-mode fiber stretch from coast to coast terminating optical paths with nearly unlimited capacity within a few miles of 80 percent of our population.

Design parameters

In working with single-mode fiber, there are four important optical performance parameters: attenuation, dispersion, cutoff wavelength and mode-field diameter.

Attenuation quantifies the loss in light power, or decrease of signal strength, as the light signals travel through a fiber. Optical attenuation measurement, or light power loss, is represented as the logarithm of the ratio of the output power to the input power in a defined system. The resulting unit is a dimensionless ratio known as a decibel (dB). The defining equation is:

$$\text{dB optical} = -10\log_{10} \frac{\text{optical power output}}{\text{optical power input}}$$

In the fiber-optic world, the minus sign in the -10 factor is used by convention to avoid negative numbers in attenuation measurements. Coaxial attenuation values leave the negative value to represent loss. Attenuation is measured as a logarithmic value to make it easier to manipulate as an additive value for loss budget calculations.

Figure 3 illustrates the tremendous progress that has been made in reducing optical-fiber attenuation. As recently as 1969, only 1 percent of the light power launched into a fiber was detectable after 20 meters or 60 yards. In 1970, Corning demonstrated the commercial feasibility of optical fiber transmission by achieving less than a 20 dB per kilometer fiber (1 percent of the light power was retained after a kilometer). Today, we are able to transmit 1 percent of the light power 91 km (55 miles).

Today's fiber attenuation is so low that if the ocean were as clear as an optical fiber, you easily could see its deepest points from a boat. Some comparisons with common glass illustrate the clarity of fiber. A 1¼ inch pane of ordinary window glass cuts light power strength by 50 percent. Even the highest quality optical glass, from which lenses are made, decreases the light intensity by 50 percent after traveling just 10 feet. In contrast, more than eight miles of optical fiber are required to reduce the signal strength by 50 percent (3 dB).

Light power is attenuated both by intrinsic and extrinsic factors. Intrinsic factors, such as absorption and scattering, are inherent to the raw materials used to manufacture the fibers. Extrinsic factors include cable manufacturing, environmental effects and physical bending. Macrobending and microbending are two different bending phenomena that can cause attenuation.

Intrinsic absorption is caused by the molecular structure of the material. Impurities such as metal ions and OH ions absorb light at particular wavelengths, resulting in higher attenuation at those wavelengths. Also, atomic defects in the form of unwanted oxide elements in the glass composition will absorb light.

Two different types of scattering affect fiber attenuation. Intrinsic scattering, technically known as Rayleigh scattering, defines the theoretical lower limit for fiber attenuation due to the silica-based materials used in glassmaking. Also, other non-homogeneities in the glass structure can cause additional scattering. Optical fiber manufacturers are very close to the lowest attenuations that theoretically can be obtained in silica-based fibers, making these types of attenuation causes relatively rare.

The extrinsic factor called macrobending induces attenuation as the result of how fiber is used; specifically, it is associated with large-scale bends in a loop or around a corner. Permissible curvatures around corners, for instance, depend on the diameter of the fiber and/or the fiber cable. When the fiber is bent tightly, part of the power at the bend is no longer guided but is radiated out of the fiber.

The other type of extrinsic attenuation inducement is the result of microbending. Microbending loss, as the name implies, is caused by small-scale microscopic axial distortions along the fiber length. These bends are much smaller than can be seen by the unassisted eye and are caused primarily by fiber jacketing, cabling and environmental effects. Microbending, if present, most often is induced by temperatures below −40° C because cabling materials have slightly different coefficients of thermal expansion than the fiber. The different rates of contraction/expansion only become significant at these extremely cold temperatures. →

Figure 3: Advances in fiber-optic technology

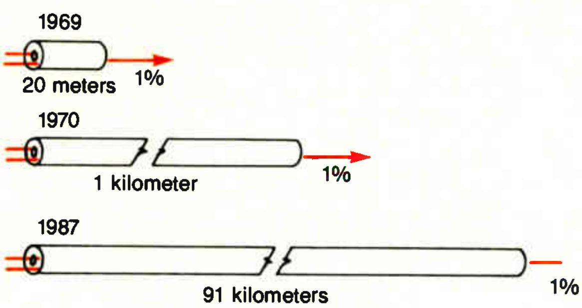
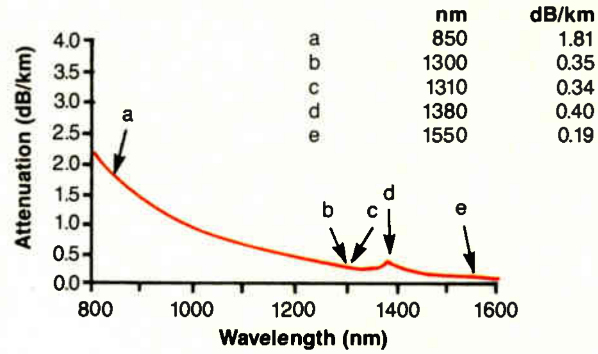


Figure 4: Spectral attenuation of a typical SMF-28 single-mode fiber



Attenuation also is wavelength dependent. Figure 4 illustrates a typical spectral attenuation curve for Corning's single-mode fiber, SMF-28. The curve plots attenuation in dB per kilometer on the vertical axis vs. wavelength from 800 nm to 1600 nm on the horizontal axis. The table in the upper right-hand corner of Figure 4 lists typical attenuation values in dB per kilometer for a few specific wavelengths generally associated with single-mode fiber performance. The low points on the curve are known as windows of operation for the fiber and are labeled by the wavelengths of light at those points.

Dispersion is the second key single-mode fiber performance parameter, causing a pulse of light to broaden as it travels through a fiber. Consequently, optical fibers are manufactured to have zero total dispersion at a specific operating wavelength of light, typically at 1310 nm or 1550 nm.

The units of dispersion are:

$$\frac{\text{picoseconds}}{\text{nanometers} \times \text{kilometer}} \quad \text{or} \quad \frac{\text{ps}}{\text{(nm) (km)}}$$

Picoseconds represent the time-measured increase in the pulse width. The nanometer component is the spectral width of the typical light sources, which transmit several colors, or wavelengths of light. Each color of light travels at its own specific speed. The kilometer units represent the fact that the effect is length dependent.

Figure 5 shows the combined effect of attenuation and dispersion on discrete pulses of light as they are transmitted through a fiber. Both attenuation and dispersion measurements are a function of fiber length, so attenuation decreases the signal strength or amplitude with length. Also, pulse width increases as a function of length, therefore, the pulses that initially were discretely separated in time will, at some time and/or distance, start to overlap. When this happens, it becomes more difficult to differentiate between the specific pulses and transmission quality is compromised.

The third key design parameter is *cutoff wavelength*, which defines the wavelength at which the fiber begins to operate single-moded. Only one ray of light at wavelengths above this level can propagate in single-mode optical fiber. This wavelength is specified and measured in nanometers; a typical single-mode fiber cutoff wavelength is around 1220 to 1260 nm. Above that, all higher-order modes are cut off or quickly attenuated.

The fourth key single-mode fiber parameter is *mode-field diameter*, or the specified diameter of the spot of light transmitted through a single-mode fiber. For single-mode fiber, the physical core diameter actually is smaller than the mode-field diameter. This difference arises from the fact that part of the light is traveling in the cladding since the wavelength is too large to be confined by the core. Therefore, in single-mode fiber the mode-field diameter, rather than core diameter, is the functional specified parameter affecting jointing, splicing and connectorizing.

Signal modulation

It is one thing to get the light from one end of the fiber to the other. It is quite another to encode the light signal with the message we want to transmit. In using light as a messenger to carry our video programming the video sound and/or data are electronically encoded in a representative waveform that is transmitted over the fiber by modulating the light source (Figure 6). The light variations are formatted in one of three general ways to represent the signal: amplitude modulation (AM), frequency modulation (FM) and digital.

AM is the simplest, most direct format. The signal is transmitted by amplitude modulation of the laser's or LED's light output. Here, the intensity or brightness of the light source is varied in time to define the waveform. This the the closest parallel technology to CATV modulation in coaxial cable, requiring minimal signal processing or conversion at interfaces between the two media.

However, generating laser signals for AM transmission of the full CATV channel spectrum requires more development work at this time. Specifically, we need to control the laser's linearity because, in AM transmission, there must be a linear relationship between the current driving the laser and the light power intensity of the laser's optical output. Each laser has only a narrowly defined range where the current to light power relationship is linear and some lasers are more linear than others.

Temperature also can shift the bias point on the laser response curve into the non-linear extremes, distorting an AM signal. Nonlinearity also will introduce intermodulation products (cross-mod and composite triple beat—CTB). One method used to stabilize a laser's optical power output involves controlling its temperature with an automatic thermal electrical cooler, but recent advances are limiting the need for this precaution for digital systems. As analog systems become more common, research efforts also will address AM laser performance issues.

Another limiting factor for AM systems is the power budget. Since the receiver is required to read fluctuating power levels, there must be enough light power to energize the detector. Consequently, the end-to-end power budget between present AM laser output power and typical receiver sensitivities is limited to 6 to 8 dB.

Another analog transmission format is frequency modulation

Figure 5: Signal change with distance

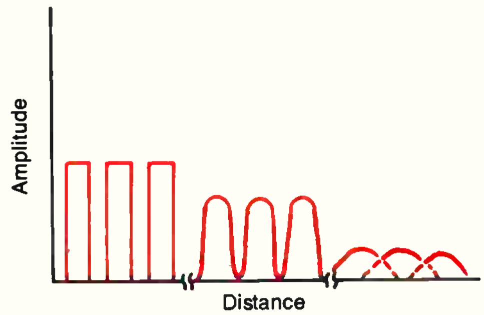
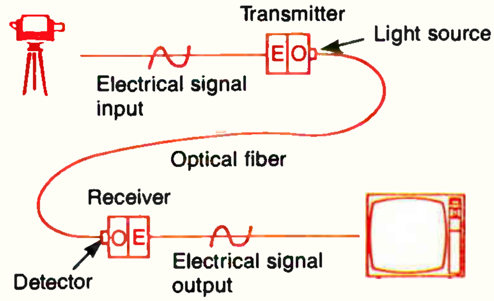


Figure 6: Optical system elements



(FM). Here, the laser operates, or pulses in time with the frequency of the signal, to define the representative waveform. The pulses of light can be thought of as on/off cycles, but in reality the laser is cycling from "on" to a "brighter on." The detector is only seeking to identify pulses of light and their duration, not their relative intensities. Thus, FM systems typically have a larger power budget.

The last broad category of transmission technology is digital. This requires more signal processing procedures, but the resulting transmission stream can be precise with quality like that of a compact audio-disc player.

For digital transmission the original analog signal is segmented in microsecond increments of time, and the waveform measurement in each time slot is encoded as a digital word consisting of a binary series of 1s and 0s. These 1s and 0s can be transmitted as either a "pulse" or "no pulse" of light in each defined time slot.

Optical fiber can use each of these different transmission technologies equally well. However, since consumer sets are analog today, digital technologies would be expensive to implement now. In the future, upgrades of existing AM or FM systems can be accomplished simply by changing end electronics; the fiber itself will last through several generations of electronics.

CATV system operators were among the first fiber pioneers and some of the earliest optical systems were built by cable companies in the late 1970s. For more than 10 years now, optical fiber has been establishing a firm track record as a reliable, cost-effective medium for supertrunk applications. Today, fiber supertrunks are an accepted standard.

As fiber moves beyond strict supertrunk applications, many more of you will have the opportunity to work with it. Several system operators are looking at systems with fiber trunks, fiber feeders and even fiber drops. The first all-fiber system may be sooner than you think. ■

Figure 1: Series ohmmeter

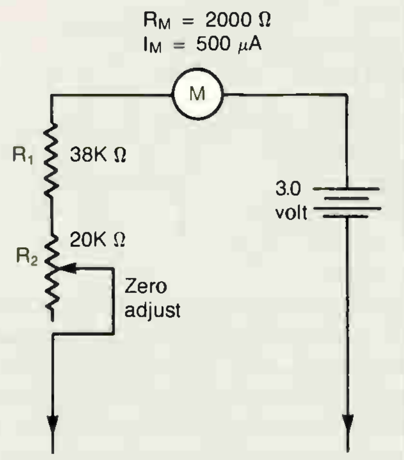
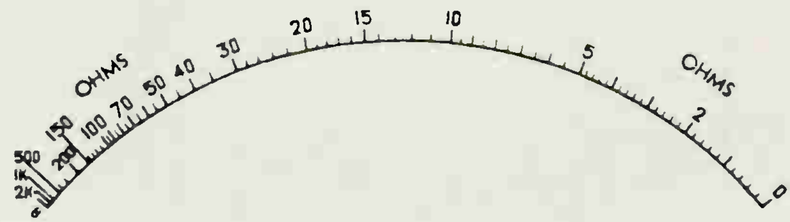


Figure 2: Ohmmeter scale



Basic electronics theory

This is Part VIII of a series about basic electrical and electronic principles, designed for the individual with little or no training in either electricity or electronics.

By Kenneth T. Deschler
Cable Correspondence Courses

This month we will continue with our study of basic measuring instruments. In this lesson we will cover the theory of operation of the ohmmeter, wattmeter and the multimeter. In addition, we will learn the proper method of reading meter scales.

Ohmmeter

An *ohmmeter* is designed to measure resistance (opposition to current flow). Figure 1 shows the schematic diagram of a simple *series* ohmmeter with the ability to measure from zero ohms to approximately 500K (500,000) ohms of resistance.

To understand how this circuit operates, let us start by using Ohm's law to find its maximum resistance.

$$
\begin{aligned}
R_T &= R_m + R_1 + R_2 \\
&= 2\text{ K} + 38\text{K} + 20\text{K} \\
&= 60\text{K ohm}
\end{aligned}
$$

Therefore with three volts applied, we can obtain the 50 microamperes of current necessary for full scale deflection.

$$
\begin{aligned}
I_T &= E_T/R_T \\
&= 3/60 \times 10^3 \\
&= 50 \times 10^{-6}
\end{aligned}
$$

Figure 3: Multiranged ohmmeter circuit

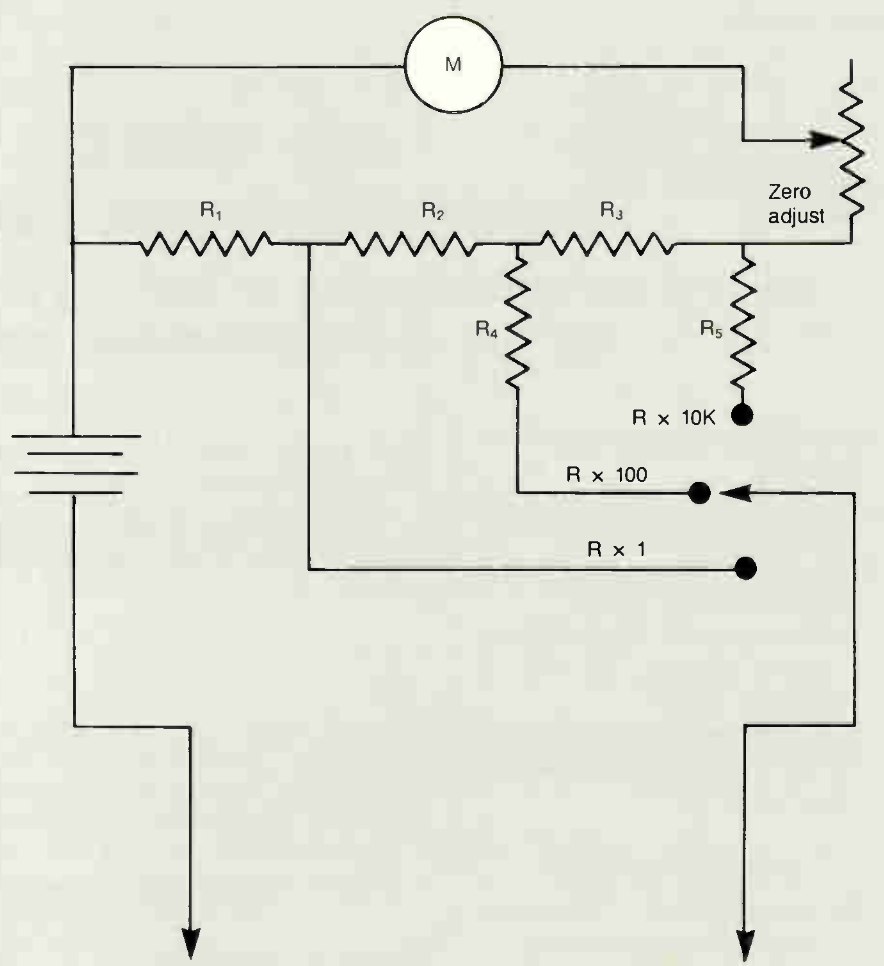


Figure 2 shows a typical ohmmeter scale. Notice that zero resistance is on the right and Infinity ( ), maximum resistance, is shown on the left.

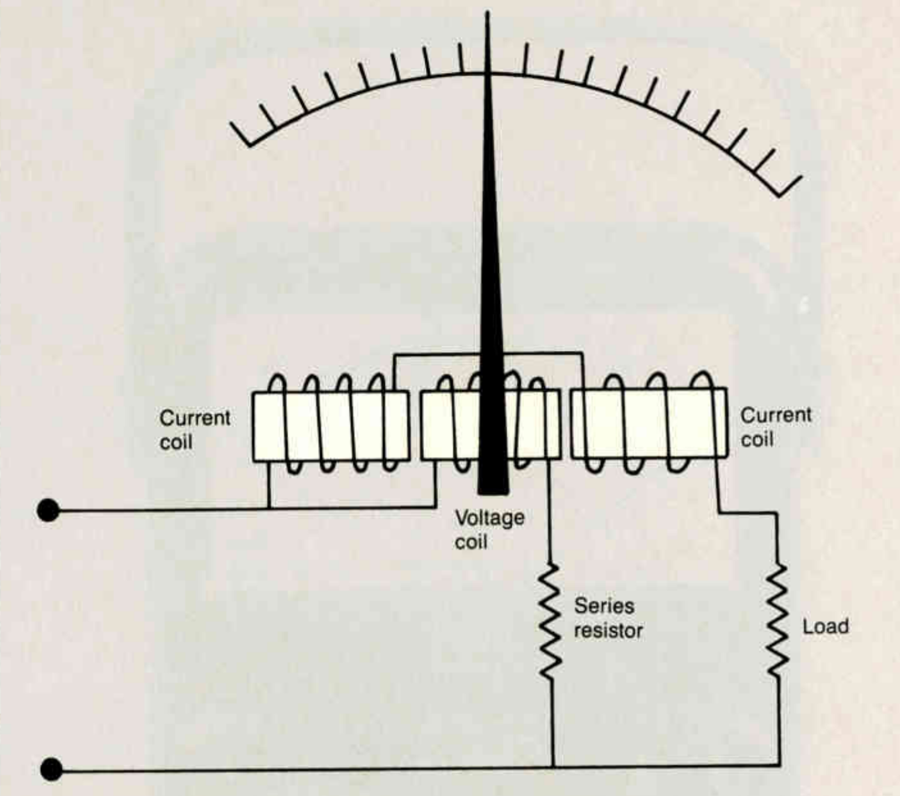
To set up an ohmmeter for use we must first touch the two meter leads together and adjust the zero adjust control (R_2) until the meter needle is directly over the zero ohms graduation on the scale. Once set up, the value of an unknown resistor may be found by placing the meter leads on each side of the resistor and reading its value on the scale. The purpose of the zero adjust control is to compensate for an aging battery. By again using Ohm's law we can determine how low the battery voltage can drop before replacement of the battery becomes necessary.

$$E_{batt} = (I_m)(R_m + R_1)$$
$$= (50 \times 10^{-6})(2 \times 10^3 + 38 \times 10^3)$$
$$= (50 \times 10^{-6})(40 \times 10^3)$$
$$= 2.0 \text{ volts}$$

Remember: R_2 will equal zero ohms when the battery is low.

Let us now look at a multiranged ohmmeter circuit. Figure 3 shows a circuit that provides three ranges for measuring resistance. The designations R × 1, R × 100 and R × 10,000 mean that the reading taken is to be multiplied by 1, 100 or 10,000 respectively. Ohmmeters should never be used in a circuit having power applied and should always be zeroed whenever ohmmeter ranges are changed.

Figure 4: Wattmeter



Wattmeter

Ohm's law states that P = I × E. Therefore, if we have an instrument that will measure both voltage and current at the same time, the power used in a circuit can be measured directly. The *wattmeter* is just such an instrument. Wattmeters contain two types of coils: one type is used for measuring circuit current and the other for measuring circuit voltage. Figure 4 is the schematic diagram of a wattmeter.

Wattmeters are placed in series with the load. When the load current flows through the two current coils, an electromagnetic field is generated that reacts with the field of the voltage coil causing it to rotate on its pivots. By attaching a pointer to this coil, a direct reading of the power drawn by the load is found. Special types of voltmeters, ammeters and wattmeters will be covered in forthcoming lessons when dealing with radio frequency (RF) circuits.

Multimeter

A *multimeter* is a combination of a multiranged ammeter, voltmeter and ohmmeter in one case. A typical multimeter is shown in Figure 5. The multimeter shown has three controls:

1) A function switch with the following positions: +DC (used for DC voltage and current as well as resistance measurements), −DC (used for negative DC voltage measurements) and AC (used only with AC voltage).
2) A range switch with the following ranges: DC ammeter (50 μA, 10 mA, 100 mA, 500 mA and 10 A), AC and DC voltmeter (250 mV, 1 V, 2.5 V, 10 V, 50 V, 250 V, 500 V, 1000 V) and ohmmeter (R × 1, R × 100, R × 10,000).
3) A zero ohms adjust.

To operate this multimeter we first select either +DC, −DC or AC. Next we select the voltage, current or resistance range we wish to measure. We should then insert the red lead into the positive jack and the black lead into the common jack. Once these steps have been completed we are ready to make our measurement. To use a voltage or current range not available on the range switch we simply remove the red lead from the positive jack and insert it into the proper jack for that range. These jacks are located above and below the range switch.

Rules for using multimeters

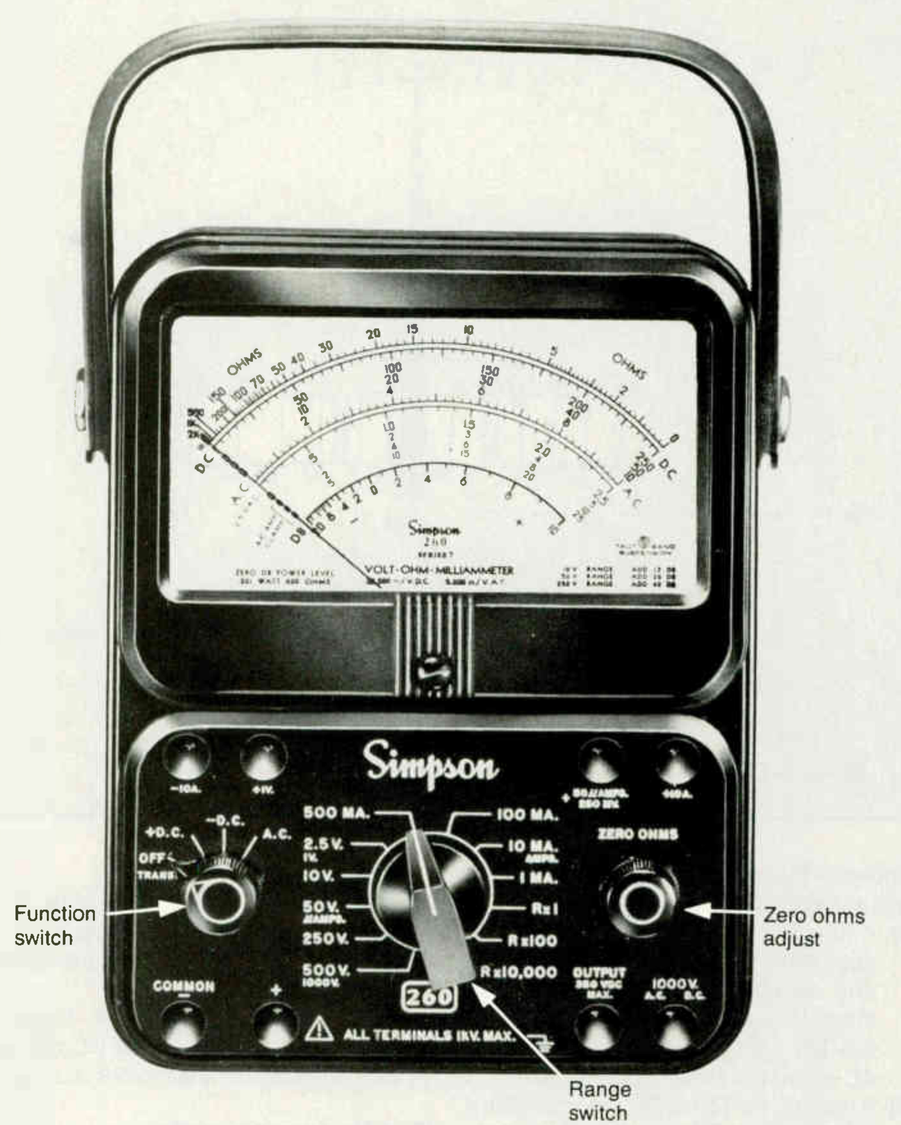
1) Never try to read a quantity higher than the maximum range value.
2) Always go to the highest range and work down if the value is not known.
3) Always zero the meter when using it as an ohmmeter.
4) Always leave a meter in the "transit" position and on the highest DC voltage range when the multimeter is stored.

Reading meter scales

Figure 6 is a representation of the scale used on the Simpson Electric Co. Model 260 multimeter. As shown, it has an ohmmeter scale, a scale used for DC current and voltage, a scale used for AC voltages, scales used when an AC ampere clamp-type probe is used and a scale for measuring decibel (dB) units. The scale marked 2.5 VAC is used only when measuring up to 2.5 volts alternating current. The numbers between the DC and AC scale define the major graduations. The numbers 0 to 250 are used whenever readings are taken on the 250 mV, 2.5 V or 250 V ranges. The 0 to 50 numbers are used for the 50 μA, 50 V, 500 mA and 500 V ranges. The 0 to 10 numbers are used for the 1 V, 10 mA, 10 V, 10 A, 100 mA and 1000 V ranges.

Let us look at Figure 6 and determine the readings when the meter pointer is at position A. →

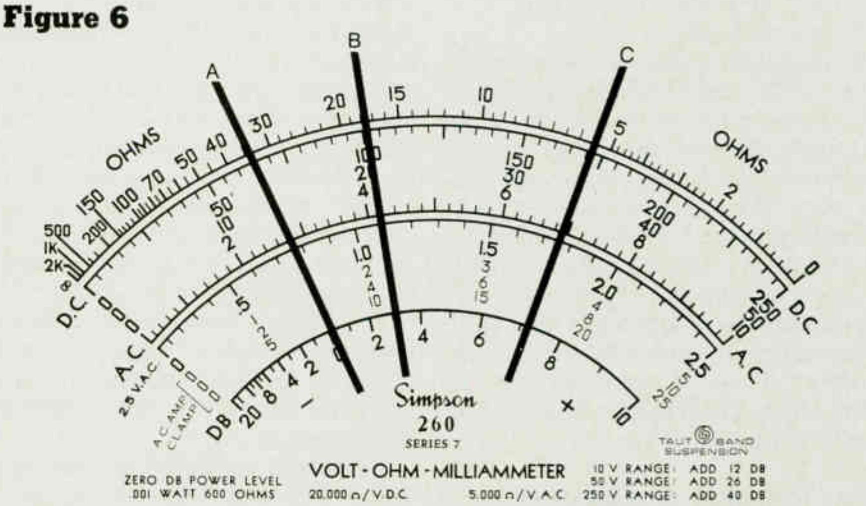
Figure 5: Typical ohmmeter



"Ohmmeters should never be used in a circuit having power applied and should always be zeroed whenever ohmmeter ranges are changed."

Range	Reading
R × 1	35 ohms
R × 100	3500 ohms
R × 10,000	350,000 ohms
50 μA DC	12.8 μA
10 mA DC	2.58 mA
100 mA DC	25.8 mA
500 mA DC	128 mA
10 A DC	2.58 A
250 mV DC	64 mV
1 VDC	0.258 V
2.5 VDC	0.64 V
10 VDC	2.58 V
50 VDC	12.8 V
250 VDC	64 V
500 VDC	128 V
1000 VDC	258 V
250 mV AC	67 mV
1 VAC	0.27 V
2.5 VAC (special scale)	0.75 V
10 VAC	2.7 V
50 VAC	13.5 V
250 VAC	67 V
500 VAC	135 V
1000 VAC	270 V
AC clamp (5 A)	1.5 A
AC clamp (10 A)	3 A
AC clamp (25 A)	7.5 A
Decibel	−0.1 dB

Figure 6



Check yourself

1) What is the reading on the 50 VAC range if the needle is at position C?
2) What is the reading on the R × 100 range if the needle is at position B?
3) What is the purpose of the current coil in a wattmeter?
4) What is the combination of an ohmmeter, ammeter and voltmeter in one case called?

Next month we will cover inductors, transformers and inductive circuits. ■

Thanks to David Brown of Simpson Electric Co. for his help on this article.

Answers
1) 34.5 VAC
2) 1800 ohms
3) To deflect the voltage coil by its field.
4) Multimeter

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C229868	OUTPUT CONV. 6350 CH-10
C229870	OUTPUT CONV. 6350 CH-12
C229871	OUTPUT CONV. 6350 CH-13
C229872	OUTPUT CONV. 6350 CH-A
C229873	OUTPUT CONV. 6350 CH-B
C229874	OUTPUT CONV. 6350 CH-C
C229875	OUTPUT CONV. 6350 CH-D
C229876	OUTPUT CONV. 6350 CH-E
C229877	OUTPUT CONV. 6350 CH-F
C229878	OUTPUT CONV. 6350 CH-G
C229882	OUTPUT CONV. 6350 CH-K
C229884	OUTPUT CONV. 6350 CH-M
C229888	OUTPUT CONV. 6350 CH-Q
C229890	OUTPUT CONV. 6350 CH-S
C230250	SPECTRUM INVRT. 6350
C274780	LO REF. LOOP THRU 6350
C342690	AUDIO MOD. 6350
C345153	OUTPUT CONV. 6350 CH-A+
XRPG-3	PILOT CARRIER GENERATOR
122006-02	POWER SUPPLY TRUNK AMP
142000-01	BRIDGER AMP T4XX
142014-02	BRIDGER AMP
300199-01	POWER SUPPLY T4XX
E-417E	LINE EXTENDER
E-417H	HOUSING FOR E-417E
T400H	HOUSING W/PS T4XX
T400HB	HOUSING BER T4XX
T421-002	TRUNK AMP
T470-002	TRUNK AMP
T470-003	TRUNK AMP
T470-030	TRUNK AMP
T470-051	TRUNK AMP
T470-052	TRUNK AMP
T500H	HOUSING W/XF T5XX
T507-030	TRUNK AMP
JLE-300	LINE EXTENDER 300 MHZ NH
JLE-300H	HOUSING FOR JLE 300
JLE-7400-2W	LINE EXTENDER 400 MHZ
JLE-7450-2W	LINE EXTENDER 450 MHZ
JLH	HOUSING FOR J SERIES L.E.
RCG-115N	RETURN CARRIER GENERATOR
SAM	AUTO SLOPE MOD.
SAM-PT	AUTOMATIC MODULE
SAM-PT-300	AUTOMATIC MOD. 300 MHZ NH
SAS-300	AUTO SLOPE AMP 300MEG
SAS-S	AUTO SLOPE AMP
SAS-S-300	AUTO SLOPE AMP 300 MHZ NH
SBM-300	BRIDGER MAN. 300 MHZ NH
SBM-P	BRIDGER MODULE
SBM-S	BRIDGER MODULE
SCD	TRUNK CHASSIE
SCD-2W	CHASSIE FOR TRUNK AMP
SCD-2W-300	TRUNK AMP 300 MHZ NH
SCD-2W-300H	HOUSING FOR SCD-2W-300
SCD-2W-R115	TRUNK CHASSIE W/RFC-115
SCD-2W-T108	TRUNK CHASSIE W/TRA-108M
SCD-2W-T30	TRUNK CHASSIE W/TRA-30M
SCD-2WD	CHASSIE FOR TRUNK AMP
SCD-2WE	BASEPLATE CHASSIS
SCL	TRUNK CHASSIE
SCL-2W	CHASSIE FOR TRUNK AMP
SCL-2WD	TRUNK CHASSIE

Item Number	Description
SDH-P	DISTRIBUTION MOD.
SDHP-300	DIST. AMP 300 MHZ NH
SJAS-400	TRUNK AMP 400 MHZ NH
SJBM-300	BRIDGER MODULE 300 MHZ
SJBM-301	BRIDGER MAN. 300 MHZ NH
SJBM-400	BRIDGER MAN. 400 MHZ NH
SJBM-450	BRIDGER MANUAL 450 MHZ NH
SJDL-301	DIST. AMP 301 MHZ NH
SJDL-400	DIST. AMP 400 MHZ NH
SJDL-405	DIST. MOD.
SJDL-450	DIST. AMP 450 MHZ NH
SJM-400	TRUNK AMP 400 MHZ NH
SJMM-300	MANUAL MODULE 300 MHZ NH
SJMM-301	MANUAL MODULE 301 MEG
SJMM-400	MANUAL MODULE 400 MHZ NH
SJMM-450	MANUAL MOD. P/P 450 MHZ NH
SJSP-60	POWER PACK 60V
SJSW-30	POWER PACK
SJSW-60	POWER PACK 60V
SLE-2P	LINE EXTENDER
SLE-300	LINE EXTENDER
SLE-300-2W	LINE EXTENDER 300 MHZ NH
SLE-300A-2W	LINE EXTENDER 300 MEG
SLE-300H	HOUSING FOR SLE-300
SLH-2	STARLINE L.E. HOUSING
SLR-300-2W	LINE EXTENDER
SMM	MANUAL MOD.
SMM-P	MANUAL MOD. NH
SMM-PT	MANUAL MODULE
SMM-S	MANUAL MODULE
SMMS-300	MANUAL MOD. 300 MHZ NH
SPCM-30	POWER CONTROL MOD 30V
SPCM-60	POWER CONTROL MOD 60V
SPP	POWER PACK
SPP-30	POWER PACK
SPP-60	POWER PACK 60V
SPP-S-30	POWER PACK
SPP-S-60	POWER PACK 60V
SPS-12	POWER SUPPLY 12V
SPS-30	POWER SUPPLY 30V
SPS-30B	POWER SUPPLY 30V
STH-7	STARLINE TRUNK HOUSING
STH-7B	HOUSING BER
TRA-108A	RETURN AMP
5-D440	DISTRIBUTION AMP 440 MHZ
5-T330	TRUNK AMP 330 MHZ
5CC-440	COMPLETE CONTROL 440 MHZ
5LE-440/30	LINE EXT. 440 MHZ 30V
5LE-440/60	LINE EXT. 440 MHZ 60V
MX-504H	HOUSING FOR MX-504
CEPS-3	POWER SUPPLY (CASCADE)
234430	TRUNK I/T FORWARD NH
CTN-1200	POWER SUPPLY
KCMG	MANUAL GAIN BRIDGER
PCAB-1	TRUNK AGC BRIDGER
PCAD-1D	BRIDGER TRUNK AGC NH
PCAD-1H	HOUSING FOR PCAD-1D
PCM-4	TRUNK AMP NH
PCM-4H	HOUSING FOR PCM-4
PCMB-2	TRUNK AMP NH
PCMB-2H	HOUSING FOR PCMB-2
PCRA	RETURN AMP

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TFAV	TRUNK AMP AGC	FFT4-20F	TAP 4W 20DB
TFM	TRUNK AMP MGC	FFT4-23	TAP 4W 23DB
TFPS	POWER SUPPLY	FFT4-23D	TAP 4W 23DB
TH	HOUSING FOR T SERIES L.E.	FFT4-23F	TAP 4W 23DB
XH	HOUSING FOR X SERIES L.E.	FFT4-23H	TAP 4W 23DB
XR2A	FORWARD AGC MOD.	FFT4-26	TAP 4W 26DB
XR2B	BRIDGER INTERMEDIATE	FFT4-26D	TAP 4W 26DB
XR2B-2	BRIDGER 2 OUTPUT	FFT4-29	TAP 4W 29DB
XR2B-4	BRIDGER 4 OUTPUT	FFT4-29D	TAP 4W 29DB
XR2DA	DIST AMP HYBRID AGC	FFT4-32D	TAP 4W 32DB
XR2DM	DIST AMP HYBRID MGC	FFT4-7T	TAP 4W 7DB
XR2F-1	INPUT MOD.	FFT4-7TD	TAP 4W 7DB
XR2F-13	INPUT MOD.	FFT8-4D	TAP 8W 4DB
XR2F-14	OUTPUT MOD.	SHS-2	HYBRID SPLITTER
XR2F-19	OUTPUT MOD.	SO-2	FEEDER MAKER
XR2F-3/110	INPUT MOD.	SO-4	FEEDER MAKER 4DB
XR2F-4	INPUT MOD.	SPJ-2	POWER COMBINER
XR2F-5	OUTPUT MOD.	SPJ-3C	DIRECTIONAL COUPLER 3DB
XR2F-7/110	OUTPUT MOD.	SPX-0.5	PAD 0.5 DB
XR2F-8	OUTPUT MOD.	SPX-00	PAD 00 DB
XR2HA	LINE AMP HYBRID HRC	SPX-01	PAD 01 DB
XR2HM	LINE AMP HYBRID HRC	SPX-02	PAD 02 DB
XR2LA-PS	POWER SUPPLY	SPX-03	PAD 03 DB
XR2LAF-1	POWER INPUT MOD.	SPX-06	PAD 06 DB
XR2LAF-2	POWER INPUT MOD.	SPX-09	PAD 09 DB
XR2LAF-3	POWER OUTPUT MOD.	SPX-1.5	PAD 1.5 DB
XR2LAF-4	POWER OUTPUT MOD.	SPX-12	PAD 12 DB
XR2LARA	REVERSE AMP MOD.	SSP-12	POWER INSERTER
XR2LS-3	LINE EXT.	STC-12	DIRECTIONAL COUPLER
XR2M	FORWARD MGC MOD.	STC-12C	DIRECTIONAL COUPLER 12DB
XR2PS	POWER SUPPLY	STC-16	DIRECTIONAL COUPLER
XR2RHA110	REVERSE AGC MOD.	STC-3	DIRECTIONAL COUPLER
XR2SPH	HOUSING FOR XR2SP	STC-3B	DATA LINE
XRBI	INTERMEDIATE BRIDGER	STC-3C	DATA LINE
XRCE-3	LINE EXT.	STC-3D	DIRECTIONAL COUPLER 3DB
XRCE-6	LINE EXT.	STC-8	DIRECTIONAL COUPLER
XRDC-16	LINE EXT.	STC-8B	DIRECTIONAL COUPLER 8DB
XRDC-8	LINE EXT.	STC-8C	DIRECTIONAL COUPLER 8DB
XRLA	LINE EXT.	STC-8D	DIRECTIONAL COUPLER 8DB
XRLS-2	LINE EXT.	DCW-06DB	MINITAP 06 DB
XRLS-3	LINE EXT.	DCW-09DB	MINITAP 09 DB
XRPR	POWER SUPPLY	DCW-12DB	MINITAP 12 DB
XRRP	LINE EXT.	DCW-16DB	MINITAP 16 DB
XRSP	LINE EXT.	DCW-20DB	MINITAP 20 DB
N4-S5	TRAP CH. 5	2-14BW	TAP
BPF-B	BAND PASS FILTER CH. 8	2-17BW	TAP
BADC	B.A. DIRECTIONAL COUPLER	2-20BW	TAP
BAEQ-12-1	B.A. EQUALIZER	2-23BW	TAP
BAEQ-3-3	B.A. EQUALIZER	2-26BW	TAP
BAEQ-8-1	B.A. EQUALIZER	4-08BW	TAP
BASP	B.A. SPLITTER	4-14BW	TAP
CSA-300-3	EQUALIZER T4XX	4-26BW	TAP
DISP-3	DISTRIBUTION SPLITTER 3-3	4-32BW	TAP
EQ-450/13	EQUALIZER 450 MHZ 13DB	8-17BW	TAP
EQ-450/15	EQUALIZER 450 MHZ 15DB	8-20BW	TAP
EQ-450/8	EQUALIZER 450 MHZ 8DB	8-26BW	TAP
EQA-1A	EQUALIZER T4XX	8-29BW	TAP
EQA-220-2	EQUALIZER T4XX	8-32BW	TAP
EQA-220-4	EQUALIZER T4XX	EQ-04DB	EQUALIZER 450MHZ
EQA-220-6	EQUALIZER T4XX	EQ-08/250	EQUALIZER
EQS-0	EQUALIZER LAN 0DB	EQ-08/300	EQUALIZER
EQS-186-4	EQUALIZER LAN 4DB	EQ-08DB	EQUALIZER 450 MHZ
EQT-450/10	EQUALIZER 450 MHZ 10DB	EQ-12/300	EQUALIZER
PB-0	PAD 0DB	EQ-15DB	EQUALIZER 450MHZ
PB-1	PAD 1DB	EQ-16DB	EQUALIZER 450MHZ
PB-2	PAD 2DB	EQ-18DB	EQUALIZER 450MHZ
PB-5	PAD 5DB	PCSPL-1	SPLITTER
PB-6	PAD 6DB	PCSPL-2	SPLITTER
PPLUG	POWER PLUG T4XX	PCSPL-3	SPLITTER
DS-200	SPLITTER 2-WAY 3.5 DB	PD-0	PLUG-IN PAD 0DB
DS-300	SPLITTER 3-WAY 5.5 DB	PD-3	PLUG-IN PAD 3DB
DS-3EL	SPLITTER 3-WAY 5.5 DB	PD-6	PLUG-IN PAD 6DB
DS-400	SPLITTER 4-WAY 6.5 DB	PD-9	PLUG-IN PAD 9DB
DS-4GB	SPLITTER 4-WAY 6.5 DB	PPLUG	POWER PLUG
DS-800	SPLITTER 8-WAY 11DB	T4BDC-8	PLUG-IN PAD
FFT4-10D	TAP 4W 10DB	T4BDL-12	PLUG-IN PAD
FFT4-10F	TAP 4W 10DB	T4SPL	PLUG-IN PAD
FFT4-14	TAP 4W 14DB	VEQ-08/300	EQUALIZER
FFT4-14D	TAP 4W 14DB	VEQ-12/250	EQUALIZER
FFT4-14F	TAP 4W 14DB	VEQ-12/300	EQUALIZER
FFT4-17	TAP 4W 17DB	XR2-13	TAP 4WAY 13DB

Reader Service Number 19.

How to interface VCRs and cable TV

By James Sandgathe
System Auditor, Tele-Communications Inc.

How many times have we heard our customers ask for help in connecting their VCRs to the cable system? The advent of VCRs has resulted in confusion as to the most viable way to connect the subscriber's equipment to the system. Giving the customer the proper information will not only reduce your service calls but also give the customer a better impression of the company. In this report I will discuss several ways to interface the VCR with cable. It should be noted that there are numerous additional ways to connect this equipment that are not going to be covered here as the comprehensive treatment of this subject would simply require too much space and introduce too much complexity. This brief effort will explain several specific approaches that encompass the majority of installations.

Single converter, addressable or non-

Figure 1: VCR hookup with a single converter

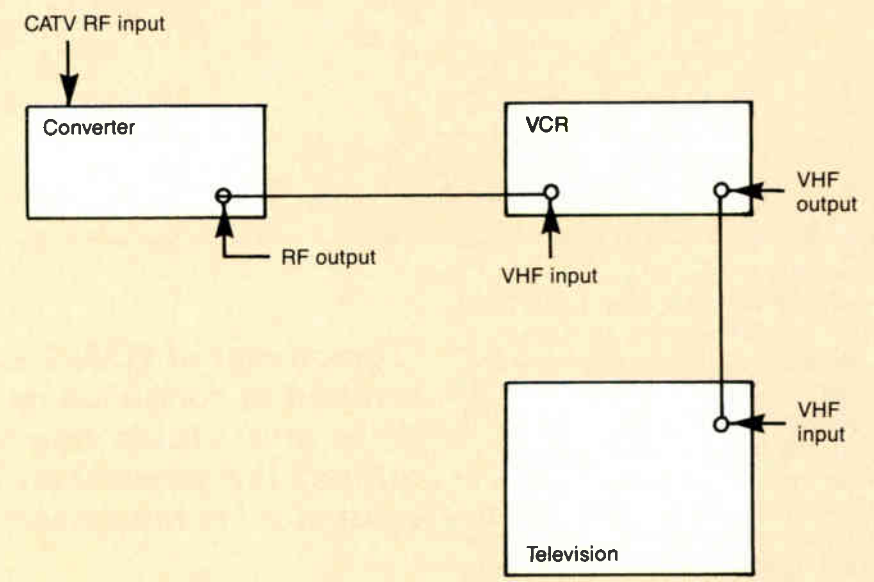
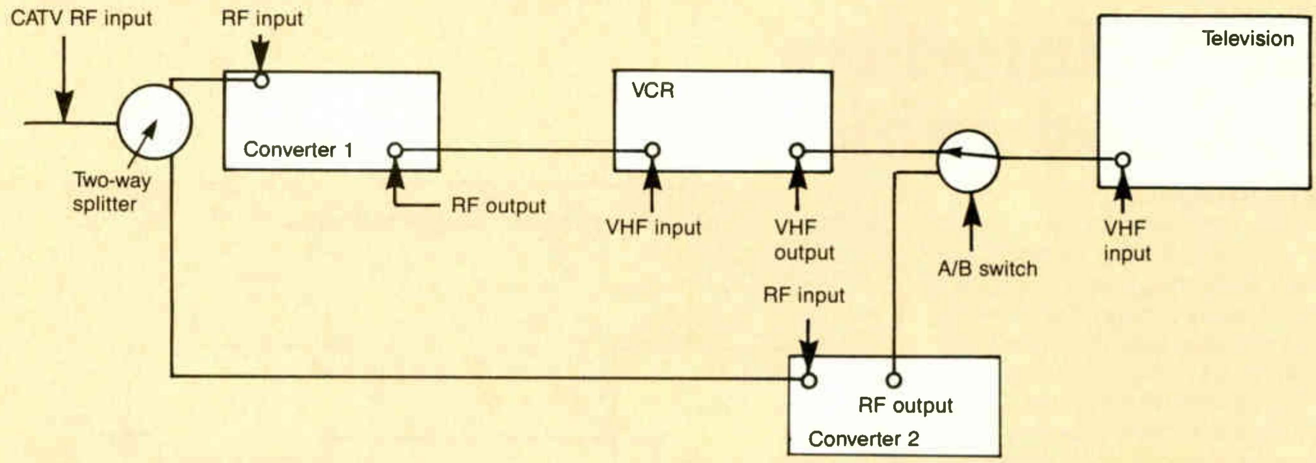


Figure 2: VCR hookup with two converters



addressable (Figure 1):

1) Connect the cable drop to the input port on the converter.
2) Connect the RF output from the converter to the VHF input on the VCR.
3) Connect the VHF output of the VCR to the VHF input on the TV set.

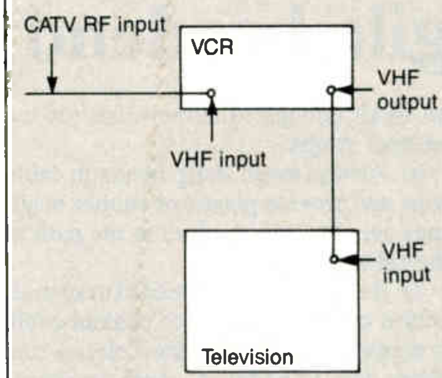
With this hookup you can watch or record an authorized channel. What you cannot do is record one channel and watch a different channel at the same time.

"The advent of VCRs has resulted in confusion as to the most viable way to connect the subscriber's equipment to the system."

Two converters, addressable or non-addressable (Figure 2):

1) Connect the drop to the input port on the converter.
2) Connect the RF output of the first converter to the VHF input of the VCR.
3) Connect the VHF output of the VCR to one input on the A/B switch.
4) Connect the RF output of the second converter to the second input on the A/B switch.
5) Connect the switch output to the VHF

Figure 3: Cable-ready VCR hookup



input on the television receiver.

Remember, the VCR must always be tuned to the same channel as the converter output (usually Ch. 3).

Cable ready VCRs (Figure 3):

1) Connect the drop to the VHF input on the VCR.
2) Connect the VHF output of the VCR to the VHF input of the television receiver.

When dealing with cable ready VCRs you must ascertain that the unit can tune the entire band of frequencies carried by the cable system. Also, on the VCR there will normally be a switch that is labeled "CATV/Normal." This switch must be in the "CATV" position when using this method. Remember to select either Ch. 3 or 4 on the TV receiver in order to match the output of the VCR.

With this method you will be able to receive all the channels the VCR is capable of tuning. If the cable system uses channel scrambling for security this procedure will preclude the reception of any premium channels. In the event the system uses traps for security, this would be the preferred hookup since all authorized channels would be receivable by either the television or the VCR. Also, in the event that the VCR is cable-ready and the television is not, the VCR can be used as a tuner for the TV set. Another matter to be considered is the frequency plan used by the system (HRC, IRC or standard). The VCR must be able to accept and tune the frequency plan the system transmits.

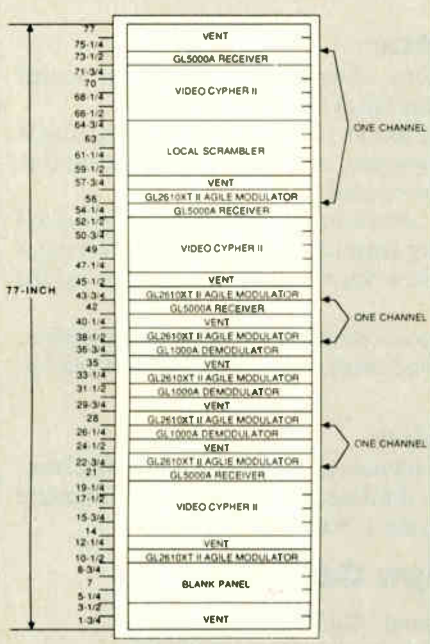
Constraints exist due to the limitations of the subscriber equipment as well as the security technology used by the system. Within these constraints, and consistent with the policies of the company, it is up to the installer to provide the subscriber with the configuration that is most suitable for enjoyment of cable service. ■

Installation of a frequency agile headend

By Karl Witbeck
Applications Engineer
And John Coiro
Vice President, Sales, ISS Engineering

ISS Engineering equipment is designed for ease of installation into a new or existing headend. However, proper planning and preparation must be given prior to the actual installation. This often means simply assuring an adequate supply of quad shielded cable, quality "F" fittings, a good set of hex crimpers and the elusive 10-32 rack screws (of which every job seems to be three or four short of enough!). The next consideration will be the combiner or a combining network using high quality directional couplers available from various manufacturers. The key words *high quality* cannot be stressed enough in relation to the installation of a headend. Regardless of the care, superior construction and materials used in the system, the limiting factor is the quality of the headend. The savings of a relatively few dollars in materials for the headend can degrade the picture quality throughout the entire system. But, if you have quality leaving the headend, then and only then will the system have the opportunity to deliver a qualitative signal.

Figure 1: Headend rack layout



When racking the equipment, consideration should be given at the initial stage of headend planning. The common temptation is to put 100 pounds of equipment in a 10-pound box. (We have heard stories of 1,000 pounds put into a 5-pound box!) When planning a rack layout, equipment should be spaced with vent panels so that convection cooling can take place. We highly recommend this be considered in the rack layout. Using a standard rack layout form for a rack with 19-inch rack rail spacing, equipment can be penciled in to determine the amount of space needed and the number of racks required. Also, it is recommended to leave some space for future expansion.

Figure 1 shows a headend rack layout in a 77-inch rack. Note that the entire rack is filled and vents are used above the modulators. When a rack of this size is installed, the location should be equipped with air conditioning or ventilation of sufficient size.

It is important to give attention to the routing of cables to avoid the spaghetti factory look. There is nothing worse than getting lost in a cable jungle. There are a few basic rules to follow when cabling a headend (see Figure 2):

1) Incoming and outgoing cables should be harnessed separately and, in most cases, should be routed to opposite sides of the rack.

2) Leave a 2-foot service loop on cables going to and from individual pieces of equipment for future removal for service, troubleshooting or relocation.

3) Audio, video and RF cables should be harnessed separately and preferably run in separate conduit or tray to and from the rack. This is especially true when using subchannels (or T-channels).

4) Ty-wrap all cable harnesses to harness straps bolted to the sides of the rack. The straps are $^1/_8$-inch by $1^1/_4$-inch angle metal stock run the full height of the rack. They are available at most hardware stores.

5) All distribution equipment such as splitters, combiners and taps that are not directly rack-mountable should be bolted to a piece of ½-inch plywood (preferably painted black) fastened to the inner sides of the rack. The strips of plywood should be small enough to allow room for the harness straps.

6) Always avoid sharp bends in cable runs and provide plastic or rubber bushings over any metal edges in the path of the cable harness.

7) It is always recommended to keep all cables off the floor. Once coaxial cable is stepped on, it damages the dielectric and alters the impedance characteristics.

Channel processors utilizing the ISS Magnum Series afford the system an "any channel in/any channel out" format through the use of a demod/remod process. To set up the demodulator portion of the Magnum Series processor the only requirements are the known signal level of the desired channel, and attenuators to allow the signal to be padded slightly below the maximum input of the demodulator's specification (maximum of +20 dBmV, minimum of −10 dBmV). Always attenuate at the input of the demod section, using a male/female-type attenuator available from any number of manufacturers. Once the proper input channel is selected and levels are established, you must decide *who* is going to be in the headend and the probability of an inadvertent channel change on the processor. The demodulator (GL-1000A) has front panel switches as a feature, to facilitate the ease of channel change. In light of this, the ease of inadvertent change is also always present. To correct this situation there is a non-volatile "lockout" memory incorporated into the GL-1000A. You simply add the desired channel into memory, thereby locking out all others. Then an accidental brushup against the channel selection switch or the best efforts of helpful, but unauthorized, persons cannot force a channel change until you specifically add other channels to the memory.

In the setup of the processor's modulator portion, the same considerations are present for output level and aural carrier level (typically 15 dB below video); however, the major difference is in areas where the off-air signal is transmitted offset due to proximity to another signal on the same channel (or a desired offset where on-channel processing takes place, in lieu of "phaselock"). This feature causes the tuner of the cable converter to seek out the strongest signal present with the AFT (automatic fine tuning) window and lock onto it instead of the weaker undesired signal. To achieve the same offset in the system, the technician only needs to access the front panel offset switch and apply the same (or greater) degree of offset (i.e., 12.5 or 25 kHz). This is a detent-type recessed screw adjustment from the front panel and requires no special equipment or tools to perform. However, as a matter of good practice, it is always advisable to use a frequency counter to verify and note the measured offset frequency on this and any change or new installation of headend equipment.

Although the ISS Engineering series of modulators all have front panel LED indicators for overmodulation, it is suggested that at the time of installation (and on a periodic basis as a good engineering practice with all headend equipment from any manufacturer) a spectrum analyzer be used to adjust the depth of modulation to 87.5 percent according to the operating instructions of the analyzer. The LEDs serve as a "quick" method when you do not have an analyzer readily available or a quick check to ensure you are not overmodulating. To set modulation using the LEDs, simply insert an alignment tool into the modulation adjustment on the front panel and rotate the adjustment clockwise until the LED is illuminated. Then slowly rotate the adjustment in a counterclockwise direction until the LED just extinguishes and stays off. If there is a "flicker" in the LED, the unit is still overmodulating.

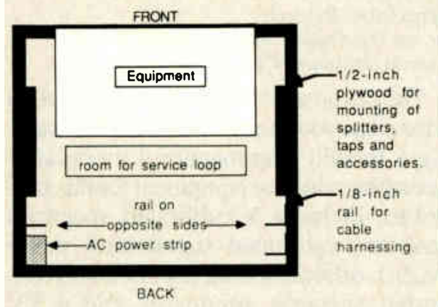
Demodulating a "sub-channel" signal is just as easily accomplished with the GL-1000A. To access the subchannel spectrum on demodulators with the T-channel option, an F-to-F jumper is connected between the "midband out" port and the "A input," select "A input" on the front panel and connect the incoming T-channel source to the connector marked "T CH" and tune the appropriate channel desired. The channel selector will show Channel 14 corresponding to T7 and T14 represented as Channel 21, inclusive.

Satellite-delivered channels are as simple to install as off-air, assuming that proper dish alignment has been achieved and an adequate interference-free signal is present. Powering of the LNA or LNB has often caused the most confusion regardless of the receiver manufacturer. With the GL-5000A, each input from the LNB has a powered output. As a matter of good practice, we recommend that each receiver's LNB fuse (located on the rear panel) be removed and stored for future use. Only one receiver per polarity should have a fuse left in it to power the LNB. The confusion as to if a splitter has more than one power passing leg and which receiver provides power, has caused many a blown fuse, frayed nerves and headaches. By removing *all but one* fuse, the problems quickly vanish.

The GL-5000A satellite receiver takes into consideration a multitude of available signal conditions (−60 to −20 dBm/carrier) and provides a switchable attenuator on the input to accommodate for your local area. The receiver is shipped with the attenuator switched "in," providing an attenuated signal at the input of the tuner for all uses except in the extremely low signal areas. In these areas the attenuation may be switched out to provide an extended range of acceptable signal. The appearance of "sparkies" is the first visual indication of a low signal level, requiring the attenuator to be switched back in and/or additional power passing attenuators be added at the input to the receiver starting with 3 dB and increasing in 3 dB steps until the attenuation is sufficient. It is important that the attenuation is placed at the receiver, as power varies from transponder to transponder and attenuating at the signal splitter of LNB might cause lower than acceptable levels to the rest of the receivers on that polarity and create more work for you to switch out attenuation on those other receivers.

The modulator setup for use of a satellite-delivered channel is the same for a processor with the following exceptions. Closely follow the VideoCipher (VC) installation and authorization process. Once the sync light on the VC is illuminated and a clear picture available, install the modulator as before. If a BTSC stereo encoder is to be used, the pre-emphasis selector on the rear panel of the ISS modulators must be set to the "off" position to allow for the stereo signal to properly pass to the system. If the signal is not encoded with a BTSC encoder the selector must be left in the "on" position to provide the necessary pre-emphasis. The modulator can be reconfigured as required for stereo with the simple switch selection.

Figure 2: Top view of rack layout

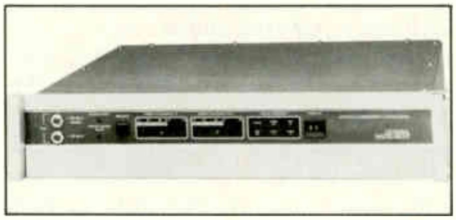


An important note to modulator setup is an unfounded rumor in the industry that the only "legal" offset is "positive." Numerous inquiries have been made to the FCC's (Cable Compliance) office in Washington, D.C., and all have received the same answer: Offset—there is no required or desired direction, positive or negative, as long as the specified channel is offset by the required amount (12.5 to 25 kHz) and the FCC is advised of this action as is required. It is even "legal" to mix positive and negative offsets in the same system, as long as you fulfill your requirements to notify the FCC.

The myths of carrier-to-noise (C/N) are dispelled by a simple addition of logic. In a traditional fixed-channel modulator, a bandpass filter is located immediately before the output connector. With the ISS series of modulators the bandpass filter is located *after* the output connector. When ordering your channels, designate a channel for each Series II modulator (no charge with the Series II). This is a non-permanent filter that may be removed and changed as your channel lineup changes, affording you complete agility and a C/N of up to 90 dB per channel. If a replacement filter is required, a nominal charge of less than $30 is the total ISS cost. If an emergency change is required and a filter is not immediately available, there is no serious degradation in operating several modulators without filters (we recommend no more than four) until new ones can be obtained. ■

Configuration and operational setup of a Jerrold Commander 5 modulator

By Bill Beck
Applications Engineer
Jerrold Distribution Systems Division
General Instrument Corp.



The purpose of this article is to explain what steps you should follow when installing a Jerrold Commander 5 modulator. Recommended test equipment for this procedure includes a calibrated spectrum analyzer, calibrated signal level meter (SLM), calibrated frequency counter, calibrated variable attenuator and a TV receiver with converted PMG-61F plug-in adaptor.

Commander 5 provides such standard features as 86-channel agility; IF AGC (automatic gain control); IF switching; FCC-compliant frequencies; BTSC stereo compatibility; front panel test points; front panel adjustments for depth-of-modulation, RF level and sound deviation; front panel status indicators; and scrambling compatibility.

In addition, an available option package, Model MOB, offers audio-follow-video switching, additional IF switching, composite video insertion, video AGC and audio AGC. Figure 1 shows a functional block diagram.

Modulator configuration

Prior to installation, you must decide what modulator operating characteristics you will need. After removing the Commander 5 from the carton and placing it on the test bench, install the coax jumpers (supplied with the modulator) between the F connectors labeled for sound IF in and out and picture IF in and out, then remove the 13 Phillips-head screws in the sheet metal lid and the cover.

Figure 2 offers a "decision tree" or flow chart to guide in the configuration process. Essentially, the decision tree asks a series of questions concerning video input and other relevant matters. All factory-set selections are shown. Jumpers and switches for these functional selections are located on the baseband-to-IF board and

Figure 1

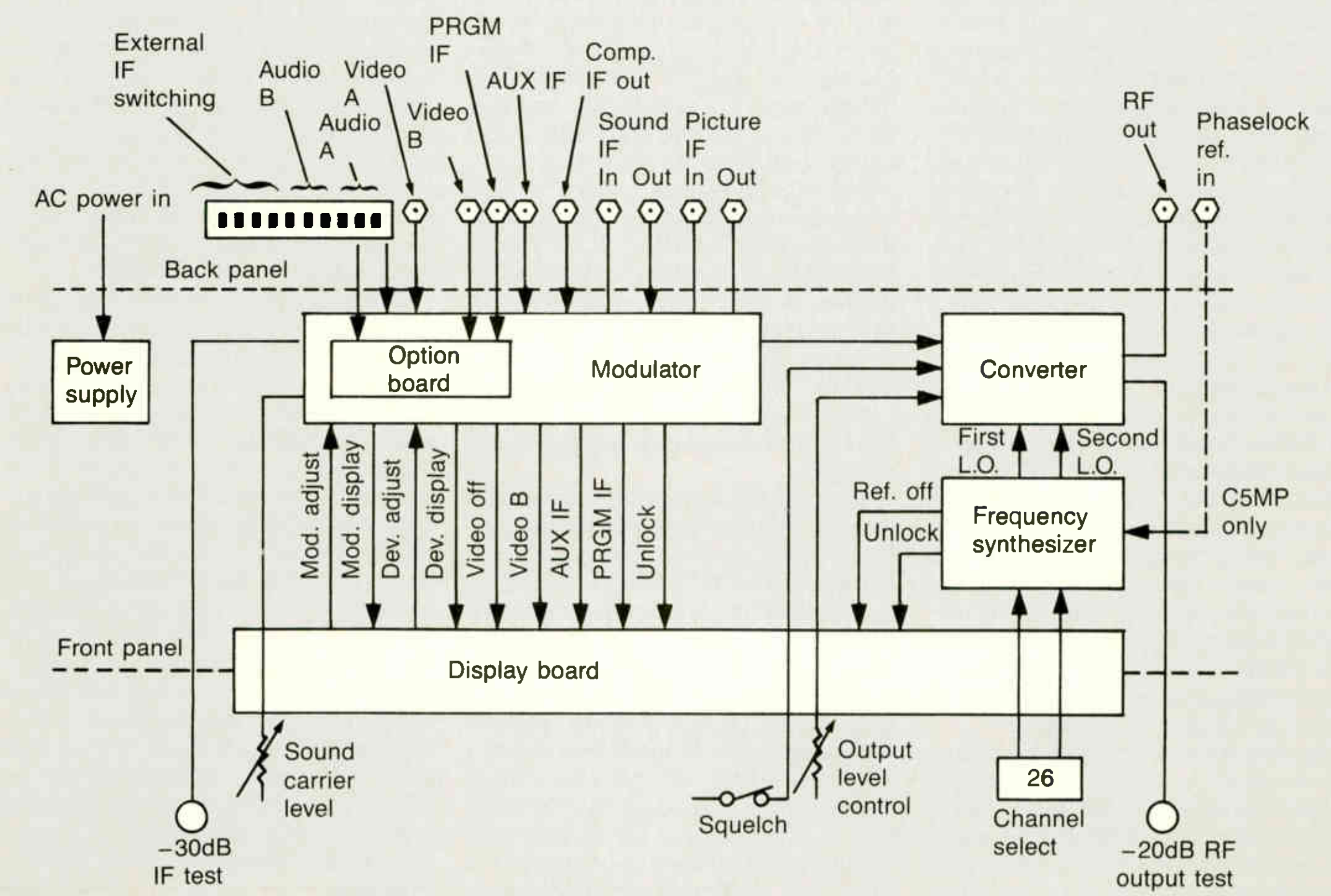
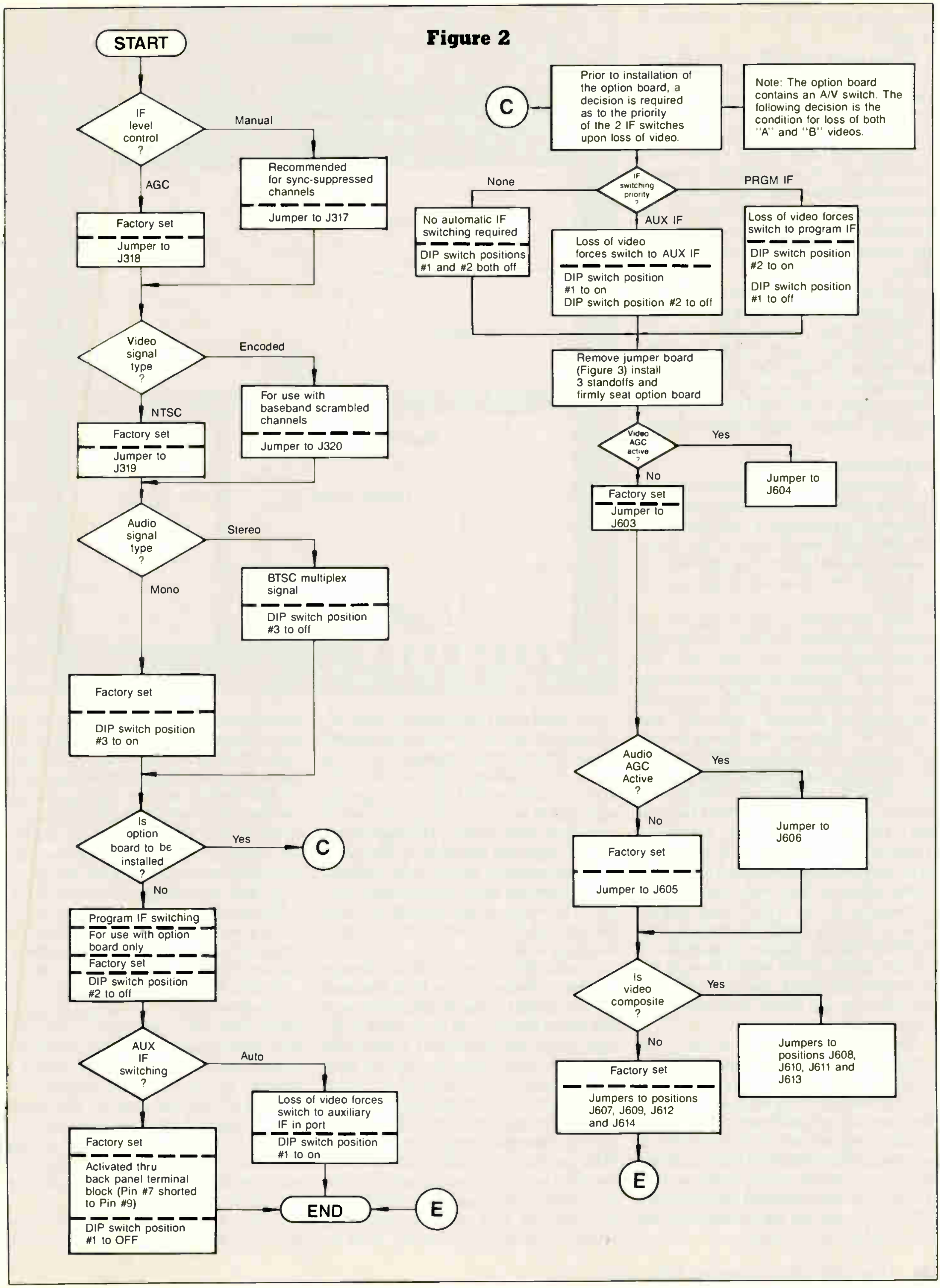


Figure 2


START
IF level control ?
Manual
AGC
Recommended for sync-suppressed channels
Jumper to J317
Factory set
Jumper to J318
Video signal type ?
Encoded
NTSC
For use with baseband scrambled channels
Jumper to J320
Factory set
Jumper to J319
Audio signal type ?
Stereo
Mono
BTSC multiplex signal
DIP switch position #3 to off
Factory set
DIP switch position #3 to on
Is option board to be installed ?
Yes
No
C
Program IF switching
For use with option board only
Factory set
DIP switch position #2 to off
AUX IF switching ?
Auto
Loss of video forces switch to auxiliary IF in port
DIP switch position #1 to on
Factory set
Activated thru back panel terminal block (Pin #7 shorted to Pin #9)
DIP switch position #1 to OFF
END
E
C
Prior to installation of the option board, a decision is required as to the priority of the 2 IF switches upon loss of video.
Note: The option board contains an A/V switch. The following decision is the condition for loss of both "A" and "B" videos.
IF switching priority ?
None
PRGM IF
AUX IF
No automatic IF switching required
DIP switch positions #1 and #2 both off
Loss of video forces switch to AUX IF
DIP switch position #1 to on
DIP switch position #2 to off
Loss of video forces switch to program IF
DIP switch position #2 to on
DIP switch position #1 to off
Remove jumper board (Figure 3) install 3 standoffs and firmly seat option board
Video AGC active ?
Yes
No
Jumper to J604
Factory set
Jumper to J603
Audio AGC Active ?
Yes
No
Jumper to J606
Factory set
Jumper to J605
Is video composite ?
Yes
No
Jumpers to positions J608, J610, J611 and J613
Factory set
Jumpers to positions J607, J609, J612 and J614
E

the option board as shown in Figures 3, 4 and 5.

When using an MOB (option board), Commander 5 provides three different switches (audio/video, program IF and auxiliary IF). You must decide the automatic operation priorities. Commander 5 is designed so that loss of video A will revert to video B automatically; however, loss of both videos requires you to choose between program IF and auxiliary IF. You can force any of the switches by shorting the following pins on the back terminal block:

1) Pin 8 to Pin 7 (GND) video A to video B
2) Pin 9 to Pin 7—auxiliary IF connected
3) Pin 10 to Pin 7—program IF connected

In shorting the pins, Pin 9 always has the highest priority. The status of any of the switches is shown on the front panel. For example, if the video on "A" port is lost, the "video B" annunciator will light.

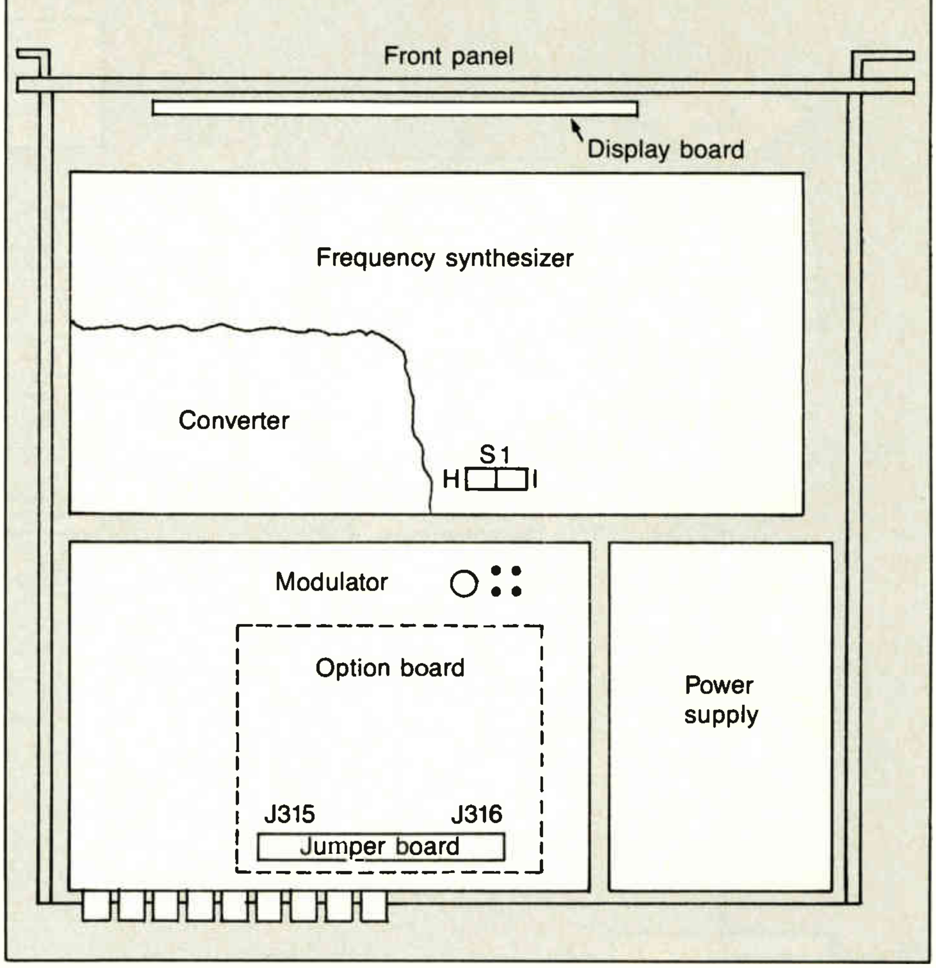
Preliminary checkout

Commander 5 features must be configured for your individual system use. The following is a process of configurations, the checks for out-of-the-box, the operational setup and preventive maintenance schedule for ensuring high-quality pictures.

With the Commander 5 on the test bench, connect the modulator to a 110 VAC outlet and power "on" the unit. The "video off" light on the front panel should be lit (unit without an MOB). If an MOB was installed, both the "video off" and "video B" lights are on. Using a small wire jumper (22 gauge) short Pin 9 to Pin 7 on the back panel terminal block and note the "AUX IF" indicator. If an MOB is installed, also short Pin 10 to Pin 7 and note the "PRGM IF" indicator. Connect a video source to the video A F-connector. If the unit has been configured for normal video, adhere to the 1 volt, peak-to-peak convention for an NTSC video signal. With an SLM or spectrum analyzer, and the PMG-61F test adaptor, measure the IF picture carrier (45.75 MHz) through the front panel test point. The test point is 30 dB down, so a 0 dBmV level should be present at this point.

The picture IF is factory set for a +30 dBmV; however, if the measure is different from this specification, adjust the picture IF level with R301 (as noted in Figure 4). Replace and secure the cover with the 13 Phillips-head screws. If the modulator is configured for a baseband audio or stereo source, connect the audio source to Pins 1, 2 and 3 on the back panel terminal block (Pin 2 is ground, the source should be 600 ohms balanced at 0 dBm).

Figure 3



The front panel indication of depth-of-modulation and sound deviation should show several LED segments lit. The depth-of-modulation indicator is a 20-segment display. The first 10 segments represent 8 percent each and the last 10 segments 2 percent each. The segment beneath 87.5 percent should be lit. The sound deviation indicator should show a lighting of segments that varies with the audio content. The sound deviation circuit is a peak detector and responds instantly to a changing volume.

Connect the spectrum analyzer through a variable attenuator to the RF output port of Commander 5. Set the attenuator such that the analyzer is not overloaded at the input (30-50 dB attenuation). Observe the RF output and adjust through its level range (should be adjustable from +45 to +63 dBmV). Use the thumbwheel channel selector and check the RF output at various channels through the 50 to 550 MHz passband. (A 2 dB variation across the entire band may be expected.) In addition, push the front panel squelch button and note the loss of RF output. The squelch control is a momentary 70 dB attenuator and should eliminate the RF output completely. The squelch control will assist in headend troubleshooting without removing power from the modulator. If the IF AGC feature was selected as part of the configuration, install a variable attenuator in the picture IF loop. Set the attenuator for −6 dB of signal and note on the spectrum analyzer or SLM that the RF output level does not change more than .5 dB.

Remove the attenuator from the picture IF loop with the spectrum analyzer still connected, fine-tune the spectrum analyzer and set it for zero frequency scan.

Ensure that the spectrum analyzer is in its greatest resolution setting (at least 1 MHz). Select the linear mode of the spectrum analyzer and temporarily remove the signal connection. This should supply a baseline of the trace that matches the baseline of the scope graticule. Reconnect the RF signal to the spectrum analyzer. The sync of the video will be positive going (or inverted). Adjust the analyzer gain such that the top of the sync matches the top line of the scope graticule.

In this situation, the depth-of-modulation of video signal should be seven full graticules (or 87.5 percent) and corroborate the Commander 5's depth-of-modulator display. As always, when dealing with video, make sure that the spectrum analyzer is not being fed an unterminated or double terminated line. Return the spectrum analyzer to a frequency swept mode (perhaps 1, 2 or 5 MHz per division) and set the RF level so that the spectrum analyzer shows its greatest dynamic range (greatest separation between the peak of the signal and the noise floor). Remove the video and audio sources so the spectrum analyzer shows just two CW (continuous wave) carriers. Observe the surrounding passband for spurs or beats. All spurious beats should be 60 dB below the picture carrier when the level of the picture carrier is 58 dBmV. At the same time, review the passband to see that Commander 5 is not excessively noisy. Carrier-to-noise ratio, in dB, should be in the high 60s. Consult the operating manual of your spectrum analyzer for the proper meter settings and correction factor. (There is some difference between makers and models.)

Remove the spectrum analyzer from the RF output. Disconnect the video and audio sources from Commander 5. Connect a frequency counter to the RF output through the variable attenuator. It may be necessary with some counters to remove the sound carrier to obtain a stable reading. If so, temporarily interrupt the sound IF path. Read the carrier frequency directly from the counter. All channels should show the +12.5 kHz shift within a ±5 kHz tolerance.

This feature makes Commander 5 compliant with the new FCC rules with all channels but A-1, A-2 and 42 (or FF). These three channels fall into the air navigation band and require a 25 kHz offset. Commander 5 requires a factory modification for those particular frequencies. Remove the variable pad and counter from the Commander 5. As stated earlier, the previous discussion is meant to check out the operational characteristics of the Commander 5's configuration and performance prior to installing it into the rack.

Operational setup

The installation manual accompanying each Commander 5 provides wiring diagrams for different applications. Select the appropriate diagram and install the Commander 5 in its rack position. Prior to making the system connection, power up the modulator for a 24-hour period.

After the burn-in period, select the appropriate output channel and make the input and output connections into the system. Check the IF picture carrier for a 0 dBmV level at the front panel test point with the PMG-61F adaptor and signal level meter. Tune the signal level meter to 41.25 MHz and adjust the sound carrier to −15 dBmV. Connect the signal level meter or spectrum analyzer to the combined head-end test point and adjust the RF output

Figure 4

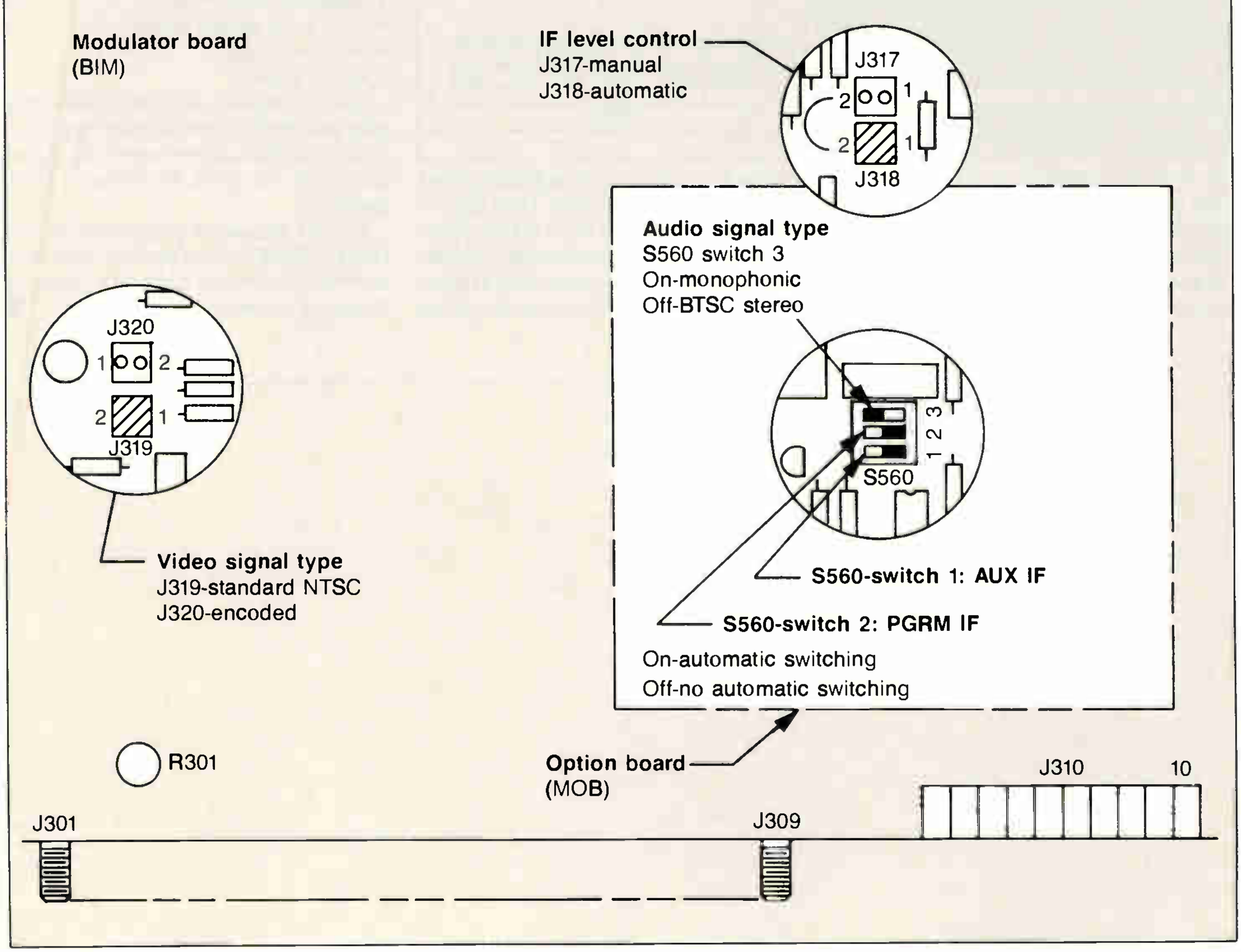
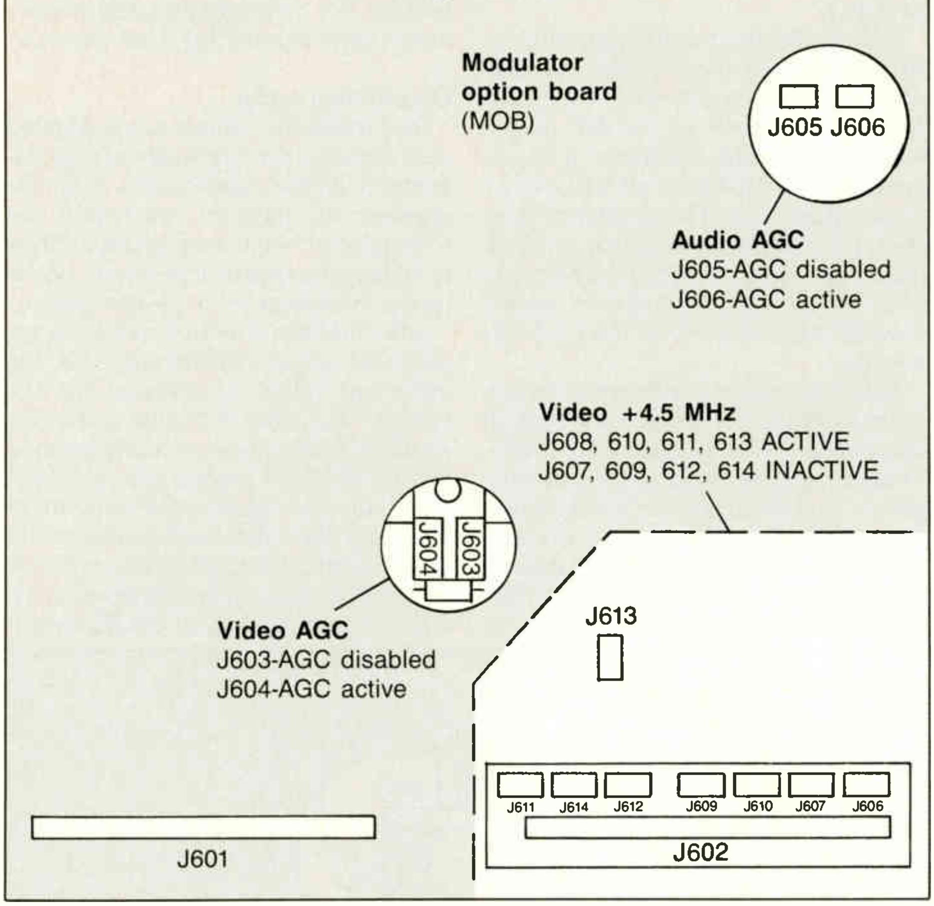


Figure 5



level of the modulator to a level conforming with your system insertion level. Remove the meter or spectrum analyzer and connect the TV receiver and converter, if necessary, to the headend combined test point. Adjust the front panel depth-of-modulation control so the indicator shows an 87.5 percent deflection. Tune the TV receiver or converter to an off-air channel, then back to the Commander 5's channel and match the volume or loudness between the two with the sound deviation control. Check the picture for clarity and note the time and date of installation, the IF and RF test point levels and any of the configurations or switching functions selected. (Note: A diagram showing wiring connections should be present in the headend.)

At this point the Commander 5 is operational in your system.

Maintenance tests

The following tests should be implemented to ensure proper maintenance of Commander 5. The greater the preventive measures taken, the less downtime or poor picture quality a system will sustain.

- Picture quality: daily, each morning
- Depth-of-modulation: daily, each morning (front panel indicator)
- Sound deviation: daily, each morning (front panel indicator)
- Audio/video input levels: weekly
- Picture and sound IF levels: weekly
- Picture and sound RF levels: weekly
- Switching functions: monthly
- RF frequency: monthly
- Spurious beats: yearly
- Carrier-to-noise: yearly
- Flatness: yearly
- Hum: yearly

It is also recommended that you develop a log that incorporates these testing periods and that a certain day or time of day in each period be set aside to perform maintenance.

Jerrold maintains a 24-hour hotline (1-800-JERROLD) to provide field engineering assistance to customers requiring technical assistance. ■

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December 1988

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As we approach the beginning of our sixth year of publishing, it's important to remember that we are here today because of our dedication to our readers—and to the cable TV industry. And in the coming months, you'll be reading more about just how we're working for you, as well as getting to know the people of CT Publications, such as those below.

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BTSC stereo in the home

By Steve Fox
Marketing Manager, Wegener Communications

BTSC stereo transmission allows stereo audio to be delivered with video on a television channel. Both cable systems and off-air television stations use essentially identical encoding systems to generate stereo, so the equipment used by the subscriber to receive and decode BTSC stereo audio is the same in either case.

Very briefly, the process for encoding stereo onto the video channel at the headend involves baseband stereo audio (wider in bandwidth and higher in deviation than conventional monaural audio) which is input to the TV modulator in place of the monaural signal, combined with baseband video and delivered to the subscriber on a specific television channel. The stereo signal is structured so that a conventional monaural television will process only monaural audio and ignore the additional stereo portion of the audio signal, while a stereo television will process the entire audio signal and deliver a higher quality, more pleasing stereo output.

As BTSC becomes more prevalent, some cable systems and MSOs are considering providing BTSC decoding components to their subscribers. These additional components may be rented just as a converter is rented or may be sold outright. BTSC component installation may, therefore, be required or offered at a fee to some of your subscribers. In other words, you may soon be called upon to install BTSC systems in your subscribers' homes.

As with any installation, prior planning will save time and help ensure proper system performance. First, identify the components to be used in the installation. The subscriber may have all of the equipment needed for stereo reception or you may need to add equipment to complete the system. There are several ways a stereo system can be put together, each depending on the actual subscriber equipment involved.

Second, determine component placement. You will want to discuss this with the subscriber to ensure that all of the components used are conveniently located.

Figure 1: Stereo television

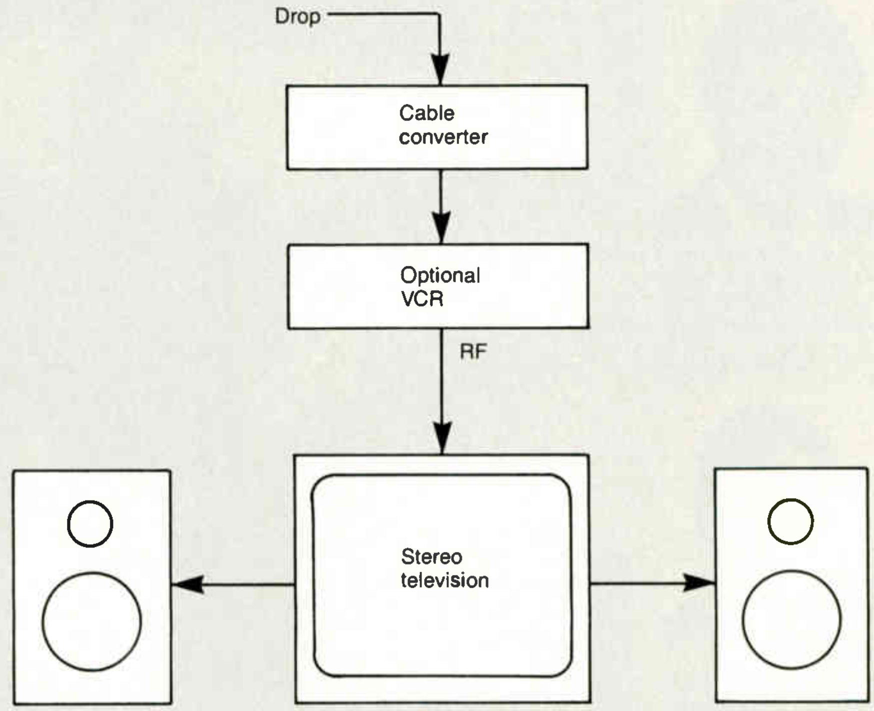
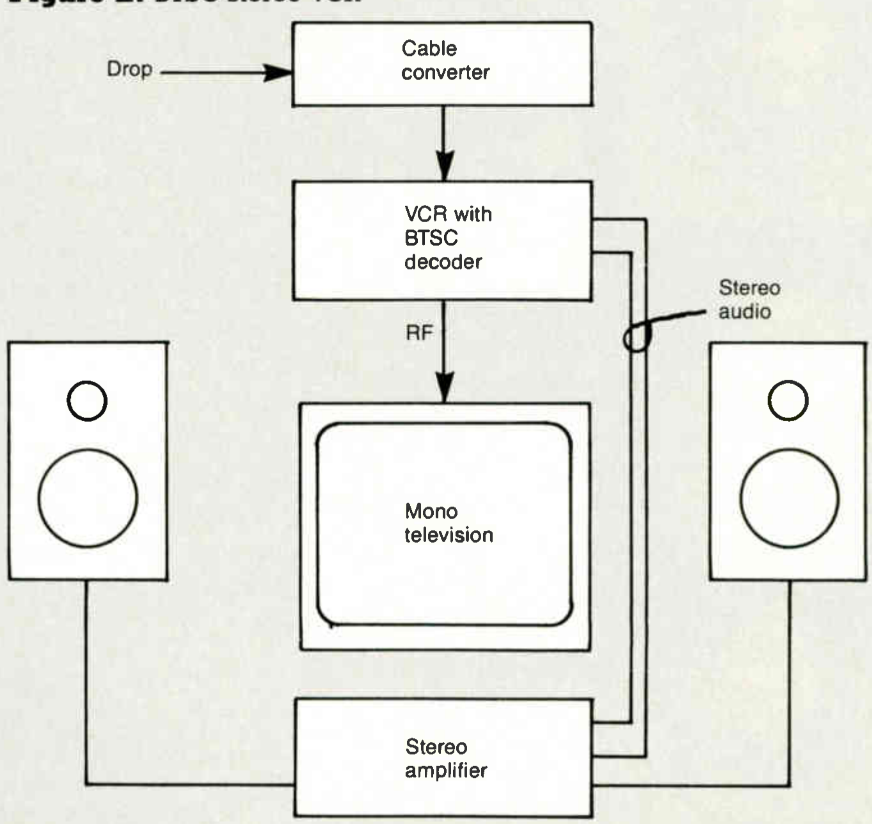


Figure 2: BTSC stereo VCR



You may need to make a long wire run if the stereo amplifier is not located close to the television or if the existing cable converter needs to be relocated. Of course, make sure you know what each component in the system is supposed to do, how they will interface with each other and how the completed system is to operate.

Other questions to keep in mind while planning the installation include: Are multiple television outlets involved? Are splitters or RF amplifiers needed? Does the subscriber want to relocate his existing equipment prior to installation of the BTSC components?

BTSC stereo components

As stated earlier, one variable found in each particular installation will be the actual components used to decode the stereo. The subscriber will have some equipment and you may need to add or recommend additional components to complete the system. One of three components will be used to perform the actual decoding of the BTSC signal: a stereo or "stereo ready" television, a VCR with a built-in BTSC stereo decoder or an outboard stereo decoder.

Figure 1 shows the most basic configuration. In this example, the output of the converter is connected directly to a stereo television. This television contains all of the circuitry necessary to decode the stereo signal and almost always will include stereo speakers. Some stereo televisions also will provide an output for optional external, higher quality speakers. The VCR in this example also is optional. Converter, VCR (if used) and stereo TV RF connectors will be type F.

In Figure 2, a VCR with a built-in BTSC decoder is used with a monaural television. Keep in mind that the decoder is an extra cost feature of the VCR and many VCRs do not incorporate BTSC capability. Also keep in mind that a BTSC decoder is not the same thing as a Dolby decoder or the high fidelity capability found in some VCRs. The converter is connected through the VCR to the television, with the VCR providing left and right audio outputs that connect to the auxiliary inputs of the subscriber's stereo amplifier. In this and all other examples where a monaural television and external BTSC decoder are used, turn the volume down on the television and up on the amplifier or decoder when listening to stereo broadcasts. The television will reproduce only the original monaural portion of the audio. Cable converter and VCR RF connections are type F; the television may have screw terminal inputs to the tuner that require a 75 ohm type F to 300 ohm twin lead adapter. The interface between the VCR and stereo amplifier will be RCA jacks.

"As BTSC becomes more prevalent, some cable systems and MSOs are considering providing BTSC decoding components to their subscribers."

Some televisions are "stereo ready" or "stereo capable" as opposed to being stereo televisions. This usually means that the television has RF BTSC decoding circuitry only and requires an external or outboard stereo decoder to complete the process. In Figure 3, the converter is connected to the stereo ready television through an optional VCR. The television provides a multiplexed (mpx) audio output to the decoder. The decoder outputs left and right audio to the subscriber's stereo amplifier and speakers. Some outboard decoders include an internal stereo amplifier while others don't. If an amplifier is included, the speakers may be connected directly to the BTSC decoder and a separate stereo amplifier is not required. This feature is especially appropriate if the subscriber's television and stereo system are not located close to each other or if the subscriber doesn't have a stereo system. The converter, VCR (if used) and television will have type F connectors. Multiplexed audio and amplifier connections will be made through RCA jacks.

In Figure 4, an outboard BTSC decoder is used with a monaural television to obtain stereo. The converter interfaces with the stereo decoder, which then provides monaural audio and video to the television; left and right audio outputs to the external stereo amplifier and speakers provide stereo sound. Again, the decoder may include its own amplifier, eliminating the need for an external amplifier and speakers. RF connections between the converter, decoder and television are type

Figure 3: Stereo ready television

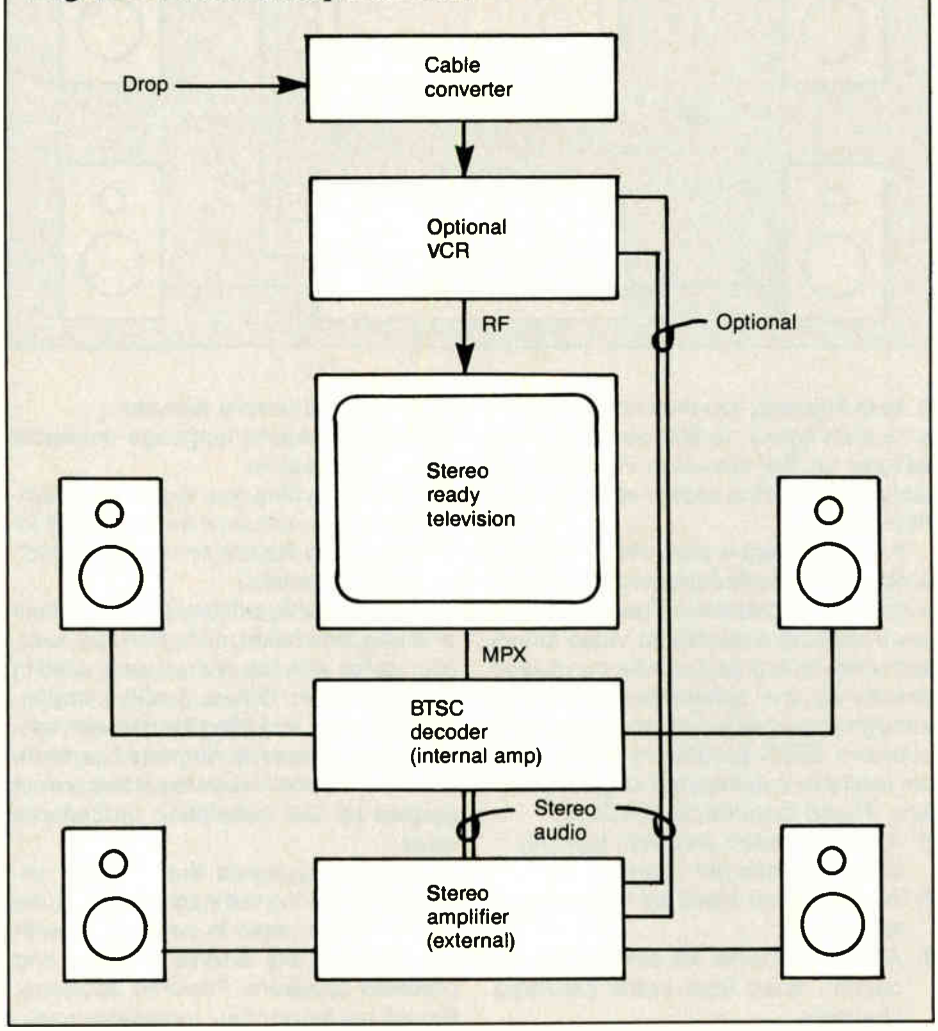
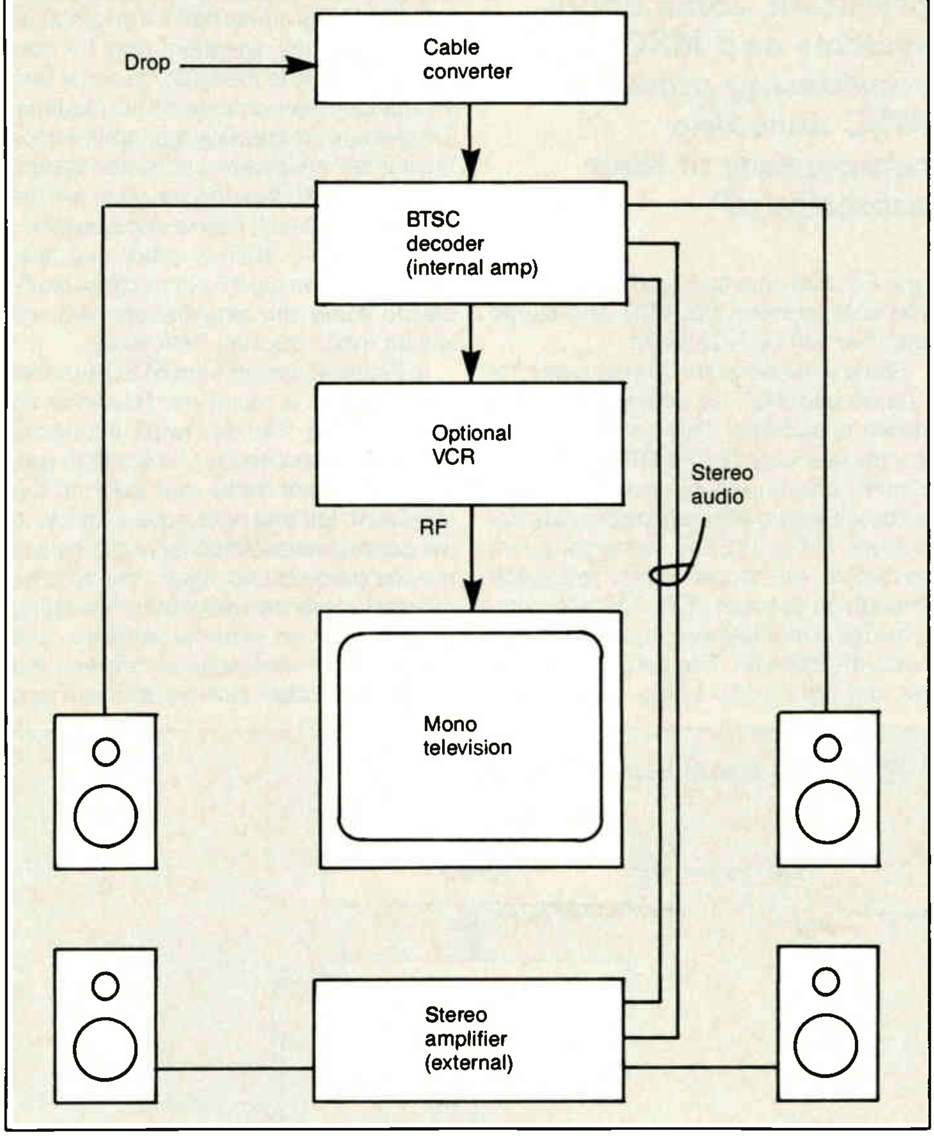


Figure 4: Outboard BTSC decoder



F. As in Figure 2, you may need to install a 75 ohm type F to 300 ohm twin lead adapter on the television RF input. All audio connections except speakers use RCA jacks.

If a component is provided to the subscriber by the cable company, it will be the outboard BTSC decoder. These decoders are becoming available in video stores and other outlets and can be purchased directly by the subscriber as well as through some cable companies. Several outboard BTSC decoder manufacturers are available and features vary considerably. These features may include:

1) A built-in stereo amplifier, typically about 10 watts per channel
2) A multiplexed input for stereo ready televisions
3) A slide rule tuner for direct off-air reception apart from cable delivered channels.
4) Hand-held remote features
5) SAP, or second language monaural audio reception
6) A stereo synthesizer to produce "synthetic" stereo from monaural audio inputs. (This feature provides "stereo" on all channels.)

Quality, usually exhibited by the amount of stereo separation, distortion and buzz, also varies with the components used in the installation. Unless quality components are used, including the decoder, television and converter, degraded performance characteristics can result that are not caused by the installation procedures used.

Other components that may be encountered during the installation include an RF switch, used in conjunction with multiple outlets and/or a VCR, and powered speakers. Powered speakers, though not found often, include an amplifier built into the speaker enclosures with volume, tone and balance controls located at the front of one of the speakers. This feature will be appreciated in installations where an external amplifier is either not present or not conveniently located.

Another consideration is the converter itself. Not all converters are compatible with BTSC; if not, you shouldn't be asked to perform a subscriber installation. Generally, an RF converter will pass the BTSC signal intact without a problem. Most older baseband converters will not pass the entire BTSC signal, however, and cannot be used. Many newer baseband converters do work well with BTSC, thanks to the efforts of the converter manufacturers. Usually, to get any BTSC-compatible baseband converter to pass the stereo portion of its output to the television or outboard decoder, the volume control on the converter must be set to maximum. Volume can then be controlled by the stereo amplifier used in the system.

Be a pro

When installing the system, do a professional job. You are representing your company as an installer and as a salesman for the cable channels. Minimize the length of wires and cables used. In your pre-installation discussions with the subscriber, find out if any components might be moved in the future (i.e., is the television on a moveable stand) and make allowances. Bind and hide wires and cables to improve the appearance of the installation.

Test equipment is expensive and chances are you won't have any with you to quantitatively measure stereo performance. Check video and RF levels as you would in any installation, then subjectively check stereo performance by listening to the audio on several stereo channels. You will be hearing exactly what the subscriber hears, so listen carefully for stereo quality and any buzz or other undesired noises. The stereo should be clean and clear. Use both headphones and speakers when conducting these tests and use the amplifier balance control in your evaluation of stereo level and separation on both audio channels.

Also make sure you document the installation. Remember that you may encounter a number of equipment configurations, therefore a well-drawn block diagram will help if problems arise later and also will help with future installations. Keep a copy for your files and provide a second copy to the subscriber. Last, make sure the subscriber knows how to operate the system and is comfortable with it. ■

Test equipment for signal analysis

By Greg Lemon
Sales representative, Midwest CATV

You've been promoted to line tech. Will the test equipment you work with change? You bet it will. The minor signal analysis performed to this point has probably been of the "go, no go" type. Now you will have to know more about the signals in your cable plant and how to monitor them. The additional testing required will mean different test equipment, along with a more complete understanding of signal analysis.

In the measurement of signal parameters, you must understand what will provide the most useful information about the signal being examined. In CATV, both network analysis and signal analysis are useful. Network analysis lends itself more readily to the quality control, repair and alignment/calibration aspect of each separate piece of equipment or cable because it is concerned with how a circuit affects a known signal. Signal analysis is concerned with measuring a signal and defining it by frequency, amplitude and noise.

The first field strength meter that may have been a part of your past installation work was probably a one- or two-channel selectable device providing only a pass or fail indication. Some meters may provide an amplitude readout on a meter movement within a limited range and channel selection; other installer meters can be field-tuned over a very wide RF bandwidth. These meters are all frequency selective voltmeters and may be referred to as field strength meters, signal level meters or level meters. Newer meters available have multiple channel selection and a readout in dBmV.

What each of these meters has in common is they are all voltmeters that have been made frequency selective. This selectivity is accomplished in one of three ways: 1) a fixed bandpass filter preceding the voltmeter and display, 2) a tunable bandpass filter preceding the voltmeter and display and 3) a tunable oscillator providing a fixed intermediate frequency to be detected and displayed.

Test accuracy

The more sophisticated a signal level meter is, the more tests it can perform, but the primary information provided is signal amplitude. Measurement accuracy depends on the meter's quality and how well it is cared for. Equally important is the use of a known reference source. This could be a built-in calibrated output, a calibrated signal generator or a calibrated system test point. Some signal level meters also are able to perform tests such as hum and carrier-to-noise.

Hum modulation, the low frequency modulation of a carrier, may be caused by a failing or defective power supply or a corroded connection in any part of the cable plant that is an AC power path. Because hum modulation affects all RF carriers in the system to the same degree, only one unmodulated carrier is needed for testing.

"Because all signal level meters are different, the manufacturers' suggested testing procedures must always be followed."

Carrier-to-noise (C/N) testing is a comparison of the desired carrier level and the noise power added by the amplifiers. Normally the C/N ratio is referenced to a 4 MHz bandwidth with several correction factors subtracted that compensate for instrumentation errors. Because all signal level meters are different, the manufacturers' suggested testing procedures must always be followed.

Some signal level meters provide vertical and horizontal outputs to drive an oscilloscope for an amplitude vs. frequency output display. Also, some meters have a built-in cathode ray tube (CRT) that provides a black and white picture display of any channel tuned because a proper RF carrier amplitude does not ensure a quality picture.

The oscilloscope mentioned earlier is a device that provides an amplitude vs. time display on a CRT. All input signals are displayed at the same time, the vertical input determining the amplitude and the horizontal input determining time. Because the oscilloscope is a visual display device, the accuracy of amplitude or frequency measurements are determined by the user's eyesight. This lack of analog or digital readout allows for considerable error and should only be used for reference and comparison.

Another piece of test equipment that will be encountered is the AC voltmeter, used to measure the RMS (root mean square) voltage of an AC power source. However, it is not frequency selective and combines all power in its sampling bandwidth. This device normally has DC voltage measurement capability and is used through the cable plant to determine the amplitude of AC voltage at location. The DC voltage portion of the meter is used to monitor the B+ supply voltage in the line amplifiers' power supplies.

The piece of equipment that is extremely important to maintaining the headend is the frequency counter. Its principle of operation is quite simple—it samples the input signal. That is, it counts the number of cycles during a specific time and displays a readout in frequency. This device can only measure the frequency of one carrier at a time and the carrier cannot be modulated. The frequency counter is normally used in the headend to maintain frequency accuracy because that is what is established. Remember, the system amplifiers should only affect the level of amplitude of the RF carriers and not their frequency.

Another general purpose piece of test equipment is the spectrum analyzer. Although this may sound like a very complicated test unit, it is a continuously tuned voltmeter with a CRT display for an output. Again, we have a display that is amplitude vs. frequency. By being continuously updated with new information, the display provides an instant look at changes in level, noise, sidebands and interference. The CRT display shows all signal information in the bandwidth of interest. ■

Bibliography

Technical Handbook for CATV Systems, by Ken Simmons, Jerrold Publications, No. 436-001-01, Jerrold Electronics Corp., 1983.

Cable Television System Measurements Handbook, Hewlett-Packard Co., 1977.

Testing Broadband LAN Performance, Wavetek RF Products.

Training through the years

By Byron K. Leech
President, National Cable Television Institute

Every year, seeing my calendar turn to the month of December leaves me with the same thought: Where did the year go? 1988 has been a terrific year for us at NCTI. We've seen the number of students enrolled in our courses increase by nearly 40 percent over 1987. And we've felt a renewed appreciation in the industry for the importance of a well-trained technical staff.

Another event occurred recently that also made me stop and wonder where the time has gone. Tele-Communications Inc. (TCI) and NCTI once again renewed their training relationship that began back in 1970. That means NCTI has been training technical personnel for 18 years. Eighteen years! Where has the time gone? During that time period TCI has grown to be the industry's largest multiple system operator and has become an industry leader in every respect.

NCTI also has undergone some changes during that time period. In 1970 we were a fledgling company striving to provide quality technical training to as many industry professionals as we could find. We've now grown into the largest independent study school specializing in cable TV technology. We've trained more than 27,000 industry professionals. That's a lot of installers, techs, chief techs, customer service reps and the myriad of other titles that make up this industry. That's almost as overwhelming as realizing it's already December and yet another year has gone by.

Decades of change

In reflecting on the passage of time he's seen in his 30-year-plus career in cable, Dave Willis, TCI's director of engineering, once had this to say:

"The changes that have occurred in the three decades in which I've been involved in cable have been stunning. At cable's inception, virtually all signals were off-air and were frequently received from very distant transmitter locations. In many instances, the systems were capable of distributing only low-band signals.

"The 12-channel system followed swiftly as the number of available broadcast signals increased. With the advent of the transistor, cable systems entered the first phase of maturity. I remember vividly the trials and tribulations of tube amplifiers and solid dielectric 11/u and K14 coax cables. In many rural areas, open parallel lines were used for both transportation and distribution of TV signals. Homemade subscriber tap boxes using isolating capacitors and resistors were widely used in those initial systems. Single channel reception was achieved using AGC strip amplifiers and converters. Adjacent channel carriage was a rarity.

"Now, of course, is the time to prepare for tomorrow and training is a part of that preparation."

"Compare this scenario with the modern cable system and you can only be shocked by the rate of change in this industry. Many of today's cable TV systems routinely deliver television channels in quantity and quality that would have been beyond belief not too many years ago. There are numerous reasons for this rapid development of cable. Developmental work on amplifiers has been dramatic. Improved cables, connectors and construction skills and methods have also contributed significantly. Another factor to be considered is

(Continued on page 58)

Decibels (Part 7)

By Ron Hranac
Jones Intercable Inc.

Decibels can be used to express a great variety of signal level measurements. Some common ones that you may see used in cable television include dBμV, dBmV and dBV. Each has its own 0 dB reference, which allows the use of the decibel in these forms to represent absolute levels, expressed as ratios to their respective references. Table 1 summarizes the 0 dB references for each of these expressions and Table 2 provides conversion factors between them across a 75 ohm impedance. Table 3 converts between the expressions from −20 to +20 dBmV. Examples are on the next page.

Table 1

0 dBμV = 1 microvolt across reference impedance
0 dBmV = 1 millivolt across reference impedance
0 dBV = 1 volt across reference impedance

Table 2

dBμV − 60 = dBmV	dBmV + 60 = dBμV	dBV + 120 = dBμV
dBμV − 120 = dBV	dBmV − 60 = dBV	dBV + 60 = dBmV

Table 3

dBmV	dBμV	dBV	dBmV	dBμV	dBV
−20	+40	−80	+ 1	+61	−59
−19	+41	−79	+ 2	+62	−58
−18	+42	−78	+ 3	+63	−57
−17	+43	−77	+ 4	+64	−56
−16	+44	−76	+ 5	+65	−55
−15	+45	−75	+ 6	+66	−54
−14	+46	−74	+ 7	+67	−53
−13	+47	−73	+ 8	+68	−52
−12	+48	−72	+ 9	+69	−51
−11	+49	−71	+10	+70	−50
−10	+50	−70	+11	+71	−49
− 9	+51	−69	+12	+72	−48
− 8	+52	−68	+13	+73	−47
− 7	+53	−67	+14	+74	−46
− 6	+54	−66	+15	+75	−45
− 5	+55	−65	+16	+76	−44
− 4	+56	−64	+17	+77	−43
− 3	+57	−63	+18	+78	−42
− 2	+58	−62	+19	+79	−41
− 1	+59	−61	+20	+80	−40
0	+60	−60			

Problem
The output of a headend processor is +55 dBmV. What is that signal level in dBμV?

Solution
Use the formula

$$\text{dBmV} + 60 = \text{dB}\mu\text{V}$$
$$55 + 60 = +115\ \text{dB}\mu\text{V}$$

Problem
What is that processor's output in dBV?

Solution
Use the formula

$$\text{dBmV} - 60 = \text{dBV}$$
$$55 - 60 = -5\ \text{dBV}$$

Problem
While performing signal leakage measurements, you find a leak at a level of +18 dBμV. What is that level in dBmV?

Solution
Use the formula

$$\text{dB}\mu\text{V} - 60 = \text{dBmV}$$
$$18 - 60 = -42\ \text{dBmV}$$

Problem
The output of a line extender is −12 dBV. What is that signal level in millivolts?

Solution
First convert the line extender's output to dBmV using the formula

$$\text{dBV} + 60 = \text{dBmV}$$
$$-12 + 60 = +48\ \text{dBmV}$$

Then convert dBmV to millivolts (see the August 1988 "Installer's Tech Book") using the formula

$$\text{Millivolts} = 10^{\frac{\text{dBmV}}{20}}$$
$$= 10^{\frac{+48}{20}}$$
$$= 10^{(2.4)}$$
$$= 251.19\ \text{mV}$$

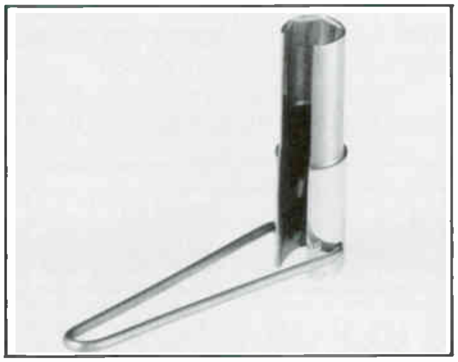
Products

Battery tester

Performance Cable TV Products' universal battery tester enables users to determine the condition of deep cycle, high capacity storage batteries used in uninterruptible computer power supplies, inverters and CATV standby power supplies.

The hand-held tester contains LED indicators that show the condition of a battery while subjected to a 96 ampere electronic load for 10 seconds. Other LED indicators show when the tester is connected to an excessive voltage or leads are reversed.

For more details, contact Performance Cable TV Products, 1770 Macland Rd., Dallas, Ga. 30132, (404) 443-2788; or circle #132 on the reader service card.



Security wrench

Available from Budco, its universal security wrench is designed for work on the secured coaxial cable connectors used in the CATV industry. It fits most security cups and can be used on F-series and CF-type coaxial connectors or F-series terminators. Made of case-hardened, drop-forged high-alloy steel, the wrench is guaranteed not to split or spread and comes with a one-year replacement warranty, according to the company.

For further details, contact Budco, P.O. Box 3065, Tulsa, Okla. 74101-3065, (918) 252-3420; or circle #131 on the reader service card.

Leakage detector

The Sniffer Jr. from ComSonics is a hand-held device that offers leakage detection at the drop on a "go, no go" basis. From the subscriber tap to the customer's TV set, the device's sensitivity and crystal controlled tuning permits signal leakage integrity inspection of drop installations, according to the company. It is available at Chs. C, D and G.

For additional information, contact ComSonics, P.O. Box 1106, Harrisonburg, Va. 22801, (800) 336-9681; or circle #129 on the reader service card. ■

Ad Index

From the NCTI
(Continued from page 54)

the improvement in the skill and knowledge of the huge technical work force maintaining these cable systems on a day-to-day basis. It's safe to say that more of these technicians have received training from NCTI than from any other source."

In turning his sights to the future Dave said, "Even with all this advancement, cable is still very much in its developmental stages. Given the past, there appears to be no concept that can be ruled out of the future of cable television. Simply being a part of cable television development is fulfilling and rewarding.

"Now, of course, is the time to prepare for tomorrow and training is a part of that preparation. It is the goal and intent of TCI to play a major part in the future of cable television and it is clearly recognized by TCI that well-trained competent personnel constitute a key ingredient of the successful cable television company.

"TCI has long encouraged our employees to avail themselves of the courses offered by NCTI. It is, in fact, a condition of employment that all new entry-level field personnel complete the Installer Course that is offered by NCTI.

"Periodically I survey the management of our field operations requesting them to evaluate for me the effectiveness of this training. Negative responses have never been received. TCI management has always been supportive of these efforts and Executive Vice President J.C. Sparkman has been particularly instrumental in our overall training efforts."

Somehow I don't think we could have said it any better. As we head into a new year and continue to build the future of the cable industry, we at NCTI want to take a moment to thank TCI for its continuing support and genuine commitment to a well-trained, highly professional technical work force. And, for the coming year, we want to wish you an ample dose of the kind of prosperity we've enjoyed in 1988. ■

Business Directory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CATV Converter Repair Parts and Supplies.
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Reader Service Number 31.