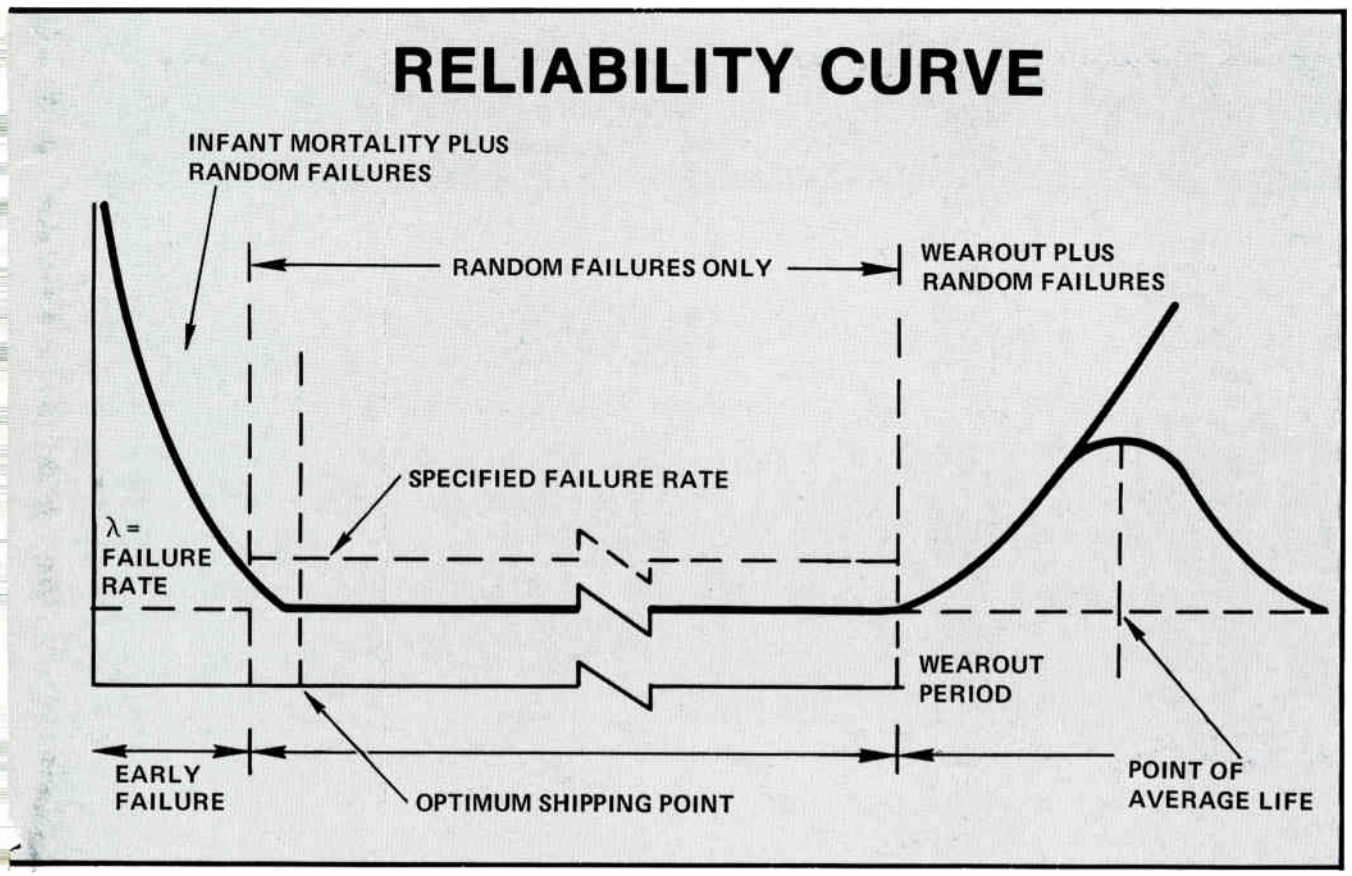
communications/engineering digest

reporting the technologies of broadband communications



may, 1977
vol. 3, no. 5

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may, 1977
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communications/engineering digest

FEATURES

DEPARTMENTS

COVER: Concerned about system reliability? This month's cover depicts the typical condition of operational reliability for RF integrated circuits. See page 24.

communications/engineering digest is published monthly for the Society of Cable Television Engineers by Titsch Publishing, Incorporated, 1139 Delaware Plaza, Suite 200, P.O. Box 4305, Denver, CO 80204 • May 1977 Subscription cost is $12 per year U.S. and possessions, $15 Canada and Mexico, $17 foreign $1 single copy. Controlled circulation postage paid at Denver, Colorado


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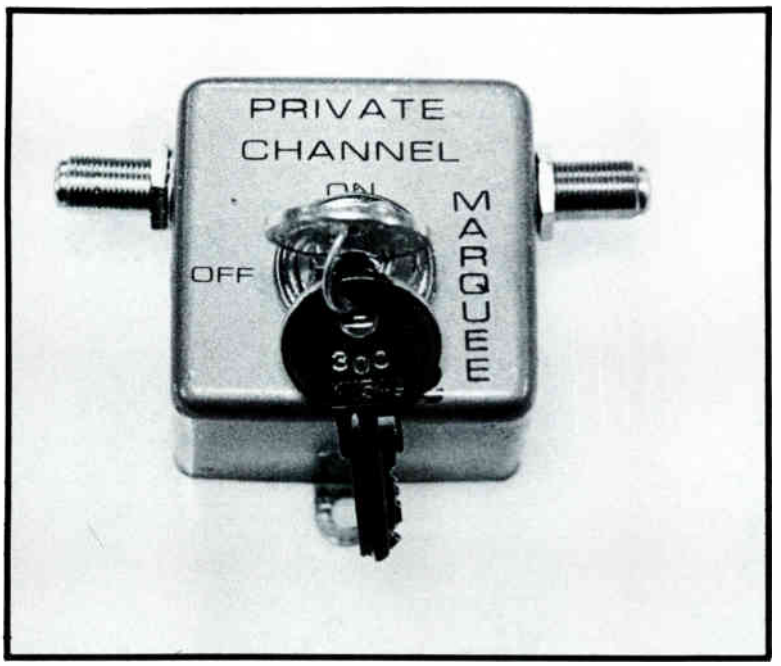

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Technical News at a Glance

. . . *The House Communications Subcommittee is reviewing* **"Options for Cable Television Regulation"** *prepared by the staff* **for** *the Communications Act rewrite. Options listed in the memorandum lean toward a* **"separations"** *policy and hint at adapting the* **telephone system** *for possible delivery of programming and other services.*

. . . **The Canadian Cable Television Association** *will hold its* **20th Annual Convention May 23 - 26, in Calgary, Alberta.** *Along with several technical sessions, time will be devoted to examining pay television and the industry's responsibilities to the consumer.*

. . . **The Society of Cable Television Engineers** *is embarking on a year-long* **reorganization study.** *Bob Bilodeau, president of the society, says that now that SCTE is entering its tenth year, it is important that it examine the goals and organization and membership requirements. The project is expected to be completed by April of next year.*

. . . **Elected to the NCTA Board of Directors** *during the association's annual convention in Chicago last month were:* **Doug Dittrick,** *Viacom;* **Jerry Greene,** *Classic Cable Systems;* **John Gwin,** *Cox;* **Ken Gunter,** *UA-Columbia;* **Jim Ackerman,** *Becker Communications; and* **Richard Loftus,** *AmVideo Corp. Elected as Associate Director was* **Rod Hansen,** *CableData; Alternate Associate Directors elected were* **Judith Baer,** *Communications Engineering Services and* **Frank Drendel,** *Comm/Scope.*

. . . *FCC Chairman Richard E. Wiley announced in Chicago last month that the Commission is beginning* **a major inquiry into the economic relationship between cable television and the rest of the communications establishment.**

. . . **Among those receiving awards at the NCTA convention** *in Chicago were:* **Tom Gilchrist,** *director of the Florida CATV Association, "Outstanding Contributions to State and Regional Activity;"* **Bud Hostetter,** *"Outstanding Committee Chairman;"* **Bob Hughes, Russ Karp, George Morrel** *and* **John Walson,** *"President's Award for Meritorious Service;"* **Sam Haddock,** *"The Larry Boggs Award;"* **Dick Jackson,** *"The Robert H. Beisswenger Award;"* **Alex Best, Jim Stilwell,** *"Outstanding Engineering Achievement Awards;"* **Frank Bias,** *"SCTE Man of the Year."*

. . . **The New Jersey Public Utilities Commission** *reports that more than half of the state has cable television systems operating or franchising process underway. There are now* **275,000 subscribers in New Jersey on 5,787 miles of plant.**

. . . **Powervision,** *a recently organized California corporation, has* **aquired the rights from Gulton Industries** *to manufacture and market Gulton's standby power supplies.*

. . . *Although* **Charles Ferris,** *aide to Speaker of the House "Tip" O'Neill, is still rumored as the White House's top choice to succeed Richard Wiley as FCC Chairman,* **reports indicate support for his nomination might be dwindling.** *Consideration is reportedly being given to naming a Black to the job. Or, another possibility, Wiley could be reappointed.*

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SCTE is a non-profit membership organization incorporated in the State of New Jersey. Dues for Senior Member and Member Grade are $20.00 per year; Associate Member is $15.00 per year; Student Member is $6.00 per year. Sustaining Memberships are available for a minimum of $100.00 per year. All but $6.00 of dues are tax deductible.

You will receive your membership application in the return mail. Do not enclose payment with this application.

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scte comments

Judith Baer, Executive Director

New Adventure

Well, here we go on a new adventure—SCTE is heading into its tenth year, and it's time to take the next step. That step, suggested by SCTE's board of directors during the 1977 Annual Membership meeting, is to carefully study where we are, what we are, where we want to go, what we want to be and most importantly, how we're going to get there.

Somebody said that you've got to learn how to walk before you can fly. Portions of SCTE's organization are still crawling, some are standing up once in a while and falling back down, many are walking tall and a couple are about to take off with a giant leap—they're actually starting to fly.

What's got to be assured is that everyone gets the support necessary to boost them into the next phase, whichever one it is. That comes from the board of directors, staff and SCTE membership all working together.

Over the next few weeks SCTE will be forming a "re-organization study group," comprised of members and non-members, representatives of most every CATV industry group, educators, suppliers, FCC people, etc., etc., The first meeting of this group is tentatively scheduled for late June and at that time, a schedule will be developed to produce a comprehensive report, to you, the members of SCTE. The entire study is scheduled for completion by April 1978.

SCTE Calls Organization Study Meeting

Robert Bilodeau, president of the Society of Cable Television Engineers has announced that the first in a series of meetings to study SCTE's functions, future and structure, will be held Wednesday, June 22, 1977, at the Mayflower Hotel in Washington, D.C.

Forty SCTE members, officers and representatives of the Community Antenna Television Association, the National Cable Television Association, the Institute of Electrical and Electronics Engineers, the Federal Communications Commission, C-TAM, industry suppliers and others concerned with cable television engineering will meet on this date. The purposes of this first event include clarification of points to address throughout the study, committee and task assignments, structures and schedules.

It's a giant task that some very concerned and involved SCTE members are taking on, and it's to the benefit of the entire organization.

Sound like just "another committee?" Well, it's *not* just another committee at all. Frankly, there's never been anything quite like it in the CATV industry, and the fallout in communications, improved relationships, member benefits general goodwill is going to take SCTE far down the road to success.

We welcome your remarks and invite your participation. You're a part of SCTE, and you're welcome to become a part of this study. Drop us a line at the SCTE Washington office, express yourself, and we'll bet that we can find something for you to do. □

CCTA **canadian column**

Ken Hancock, Director Engineering

Rewards or Rainbows

As this column is written, during the last week of April, most of us are well on the way to recovery from the effects of the NCTA Chicago convention, and are getting into a contemplative mood and evaluating all that we learned and saw. As a Canadian I was, as always, very impressed with the smooth organization, the vast number of activities to suit all interests, and by the bustling enthusiastic trade show.

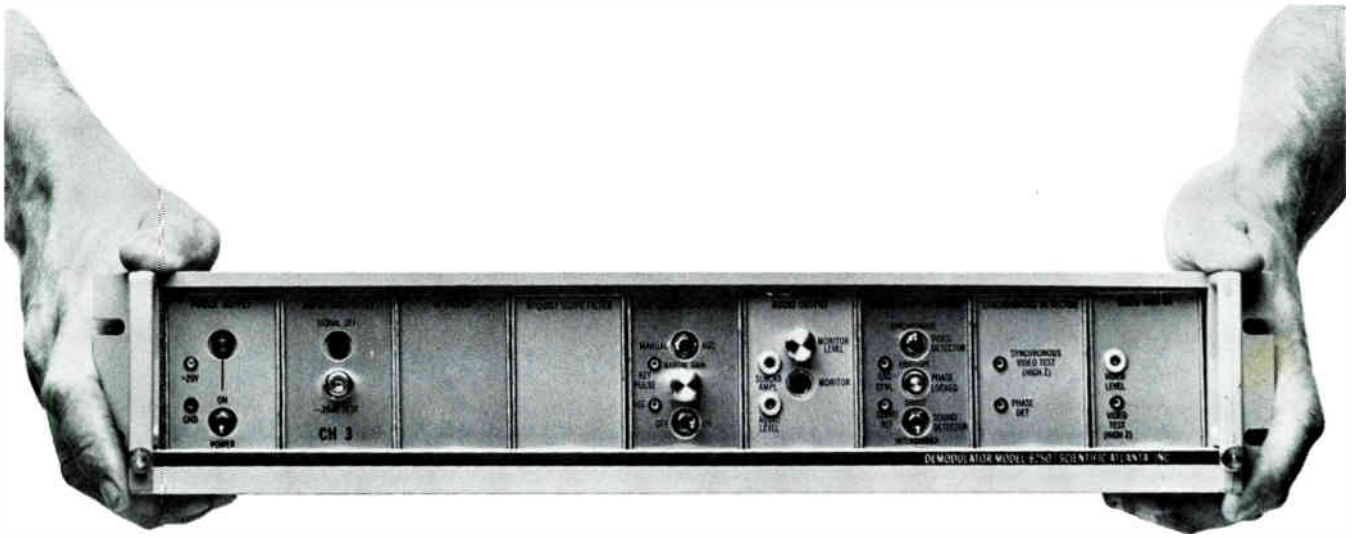
One of the significant features was the new emphasis on fiber optics, and this is the subject of "Canadian Column" this month. For many of us, fiber optics is something that we have been talking about and advocating for three or four years, slowly seeing the day where this technology will become a reality in the cable television industry getting closer and closer. The Chicago convention indicates that it is now just around the corner, if not already here. Four companies had fiber optics demonstrations of greater or lesser sophistication, and in addition there was an interesting, if controversial, paper given on "System Analysis and Design of an Optical Fiber System for CATV Applications."

In Canada also, there has been considerable work carried out on fiber optics communications by the government at the Communications Research Center in Ottawa; by the telephone industry at the Bell Northern Research Laboratories; and by private industry such as Canada Wire and Cable. As early as 1973, a definitive paper, complete with demonstration, on fiber optics communications for the cable television industry was presented at the CCTA convention. Papers on fiber optics have been given at each CCTA convention since that date, and at this year's convention, which will be held from the 22nd to the 26th of May in Calgary, Alberta, there will be several demonstrations, papers and a panel discussion on this concept.

The promised advantage of fiber optics appears perhaps to be something like "snake oil"—it will cure everything. And this perhaps is the current danger. Most certainly, fiber optic technology holds the promise of far greater information carrying capacity, of significantly lower attenuation and the definite possibility of a less expensive method of distribution, than coaxial cable. In addition to this, at one fell swoop we overcome the problems of radiation and ingress. There is now little doubt that these rewards will be ours, the only question is when. This is where the rainbow part of the title comes in, and as all readers will know, a rainbow is an optical phenomenon, but the pot of gold at the end of it is still to be found.

Fiber optics is still a very new and developing technology. If handled the right way, it can provide a massive step forward to the cable television industry. However, as with many new technologies there can be a very definite danger of premature "over-sell" delaying timely application of fiber optics. It is essential that initial applications be within the true bounds of the state of the art at that particular time. By state of the art should be included not only the technical factors, but very obviously the economic factors, and just as importantly marketing factors.

All staff members at CCTA join me in hoping that we will meet you at our Calgary convention between the 22nd and 26th of May. See you all there.□



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news

Options Lean to Separations; Technical Standards a Must

WASHINGTON, D.C.—Members of the House communications subcommittee, anticipating rewrite of the Communications Act of 1934, are reviewing a memorandum on "options for cable television regulation" prepared for them by Karen Possner of the subcommittee staff. One way to achieve a high level of technial quality, the memorandum suggests, is through the development of leased channels.

Although the papers are meant to outline the history, present status and possible alternatives for regulating the industry, the portion dealing with cable television appears to have concluded that cable is a "hybrid" which might well lend itself to being regulated akin to a common carrier with control of the programming separated from the distribution system.

The "broker option," as it is called, sees one entity applying for a cable franchise, leasing his capacity from another entity, and then reselling the capacity to programmers on a first-come first serve, non discriminatory basis.

"In this way," the memorandum stated, "he would be acting much like a 'value-added carrier,' in that the resale value of the channel would be increased by the product supplied by the programmer."

Two advantages of such an arrangement were outlined for the congressmen. The most "interesting" to say the least is the suggestion that, if cable is unable to obtain sufficient capital, AT&T and the 1,600 independent telephone companies already reaching 95 percent of American homes could be turned to for distribution.

"With developing technologies, such as fiber optics, telephone companies might be induced to install increased capacity if they knew that that capacity could be put to some revenue-producing use beyond standard telephone service."

"Additional incentives could accrue if phone companies could be assured that such an application on increased capacity would indeed be feasible. And by prohibiting any kinds of competitive service, the political dangers of unfair pricing and other anti-competitive practices could be substantially diminished."

Though falling short of a complete endorsement of such a common carrier approach, the memorandum recommended a "proper environment for such experimentation." Whatever, regulatory determination is made, however, it was suggested that at the very minimum of federal regulation, a national delineation of technical and interconnection standards would have to be made.

Copies of the memorandum, "Options for Cable Television Regulation," may be obtained from Universal Information Ltd., 1523 O St. N.W., Washington, D.C. 20005. The cost is $5. Payment must accompany the order.

SCTE Proposes Re-Organization Study Group

WASHINGTON, D.C.—Robert Bilodeau, president of the Society of Cable Television Engineers, has called for formation of a "Re-Organization Study Group" comprised of SCTE members and associated industry personnel. Bilodeau made the announcement

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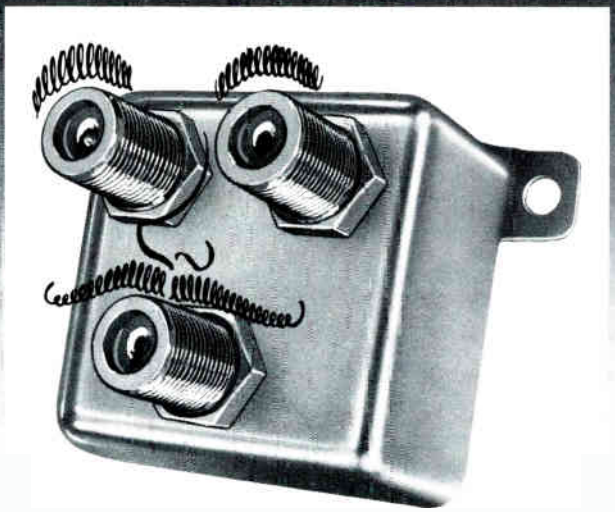

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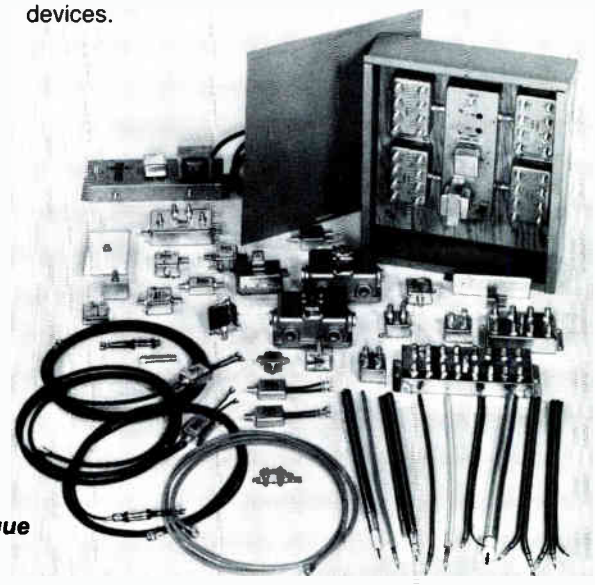

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during SCTE's Ninth Annual Membership Meeting, April 17 in Chicago, IL.

"We're entering our tenth year," said Bilodeau, "and it is important that we examine our goals, our organization, our membership requirements and our requirements."

Judith Baer, executive director of SCTE, offered an in-depth proposal to the membership, outlining various topics suggested for study. Included are SCTE's interface with other industry groups; associate member involvement in SCTE's organization; professional and senior member development; engineering management development; chapter organization; long term planning and goals; by-laws revision; ways and means, budgets; overall organizational format; individual membership development; recruiting SCTE members; nominating committees; and SCTE national headquarters responsibility.

Both Baer and Bilodeau stressed the importance of including various industry groups in the study group. Representatives of the National Cable Television Association, the Community Antenna Television Association, IEEE Broadcast, Cable and Consumer Electronics Society, FCC, cable industry multiple and independent system owners and operators, publications specialists, representatives of Canadian and foreign SCTE groups and the Society of Broadcast Engineers will be invited to participate in the study.

"This is a critical time for SCTE and it is important that the organization live up to its members' expectations," said Bilodeau. "I think that this study can be accomplished with a minimum of expense, and that it can be completed for presentation to the general membership by April, 1978."

Canadian Convention Has Much To Offer

OTTAWA - The 20th Annual Convention of the Canadian Cable Television Association scheduled for the Calgary Convention Centre, May 23-26, promises to not duck away from the tough issues says the association's president, Michael Hind-Smith.

"We tackle such matters as public expectations for the extension of services to unserved areas. We take a hard look at cable's community channel and how it meets public needs. We grapple with the social dividend we shall be required to yield in order to deliver Canada's newest dimension of broadcasting—pay television," Hind-Smith says.

And for the final session the association plans to take a closer look at the consumer at how his interests are reflected and protected. To this end, the association has invited the public of Calgary to participate both at the convention hall and through the community channel.

CCTA has proudly proclaimed "The New Majority" as the convention theme for 1977. Sometime during 1977, as Hind-Smith explains, Canada will becomes the first country in the world to have a majority of its citizens on cable.

The association is departing from earlier convention formats and has arranged special sessions to concentrate on business, technical and programming considerations.

Hind-Smith is also very pleased with the "high quality of the original technical papers that will be presented at the Convention." Included in the technical program are:

Conceptual Design of a Switched Television Distribution System Using Optical Fibre Waveguides; Television Interference from Power Lines; Viewer Tests Using Tape Recorded Stimulus Pictures and Simulated Interference; New Experimental Services of the Co-Axial Cable Information System; A preview of the Advanced Canadian Cordless Converter Design; Improving System Design; A Cure for Differential Fading in Colour TV Signals; The Importance of Maintaining Test Equipment; and Setting and Maintaining Modulation Levels.

Chapter Organizing In Rocky Mountains

DENVER, CO—Robert Bilodeau, vice president of engineering at Suburban Cablevision in East Orange, NJ, and president of the Society of Cable Television Engineers, has announced a new SCTE chapter being organized in the Rocky Mountain states. The organizational effort is being coordinated by Judith Scharf, design engineer and SCTE member at TCI in Denver, Colorado.

"Scharf has found that SCTE has many members in the Rocky Mountain states," says Bilodeau. "We've recruited her to begin developing programming for chapter meetings to better serve the technicians and engineers in that area, and I know she'll do well."

Scharf, highlighted in the October 1976 edition of *Communications/ Engineering digest*, has been with Tele-Communications, Inc. for seven years, starting as a part-time draftsman and eventually moving into her current position as design engineer.

"More activity from SCTE is needed in the Rocky Mountain area," says Mrs. Scharf. "I'm excited about getting more involved in the Society's programs. I'd be pleased to hear from other SCTE members. They may call me at (303) 771-8200."

SCTE Announces Summer Meetings

WASHINGTON, D.C.—Five Chapters of the Society of Cable Television Engineers have announced meetings during the 1977 summer months and invite SCTE members and others to attend. Some Chapter meetings will be held in cooperation with regional or state CATV associations, the others will be hosted independently.

On May 20, the SCTE Southeastern Chapter will host a "hands-on" session on CATV test equipment at Scientific-Atlanta in Atlanta, GA. The Southeastern Chapter includes North and South Carolina, Georgia, Alabama and Florida. Contact Guy Lee at Georgia Cable-

vision, president, at (404) 892-2288.

Wednesday, May 25, the Mid-Atlantic/Appalachia Chapter will feature "Making Use of What You Have," a session on amplifier update and testing existing equipment on hand. The meeting will be held in Carlisle, PA at 9:30 a.m. Contact Jim Grabenstein, Potomac TV Cable, (301) 722-6540.

On June 16-17, the New York SCTE members are invited to take part in the Third Annual Technical Seminar hosted by the New York State Commission on Cable Television and the NY State CATV Association in Albany, NY. The program will feature two days of full programs and papers. Contact Bob Levy, NYSCCT, (518) 474-4992.

Ralph Haimowitz of Indian River Cable will be looking for SCTE members to join him during the Florida State CATV Association Meeting, June 26-28 at the Breakers in Palm Beach, FL. Haimowitz can be contacted at (305) 589-3846 for information.

And, finally, in this first round of SCTE meeting announcements for the 1977 summer months, the Southeastern SCTE Chapter will stage extensive technical sessions and meet during the 17th Annual Southern Cable Television Association convention in Atlanta on August 21-24. Guy Lee of Georgia Cablevision should be contacted for details at (404) 892-2288.

Information on membership may be requested in writing to SCTE, 1523 O Street Northwest, Washington, D.C. 20005.

SCTE Mid-Atlantic/ Appalachia Elects New Officers

WASHINGTON, D.C.—The Society of Cable Television Engineers' Mid-Atlantic/Appalachian Chapter, covering the Maryland-Delaware, Pennsylvania, Virginia and Washington, D.C. areas, has elected officers for the 1977-78 membership year.

James Grabenstein of Potomac Valley TV Cable in Cumberland, Maryland, will serve as the Chapter's chairman; Lew Strock of Antietam Cable TV in Hagerstown, Maryland, has been elected vice chairman; Pete Edwards of Rollins Cablevision in Wilmington, Delaware, will serve as secretary-treasurer.

In a letter to all CATV system technical personnel and managers in the middle Atlantic states, Grabenstein thanked John Cascioli and the Maryland-Delaware CATV Association, "for the cooperation in having technical meetings in our area since the local champter of SCTE has been formed." Grabenstein also said, "I sincerely thank all the members who have actively participated in the past year, and hope you will continue to do so." The Mid-Atlantic/Appalachian Chapter of SCTE has held twelve consecutive monthly meetings, each one on the last Wednesday of the month. Average attendance at the meetings, according to Grabenstein is 30 technicians and engineers from the area, "with guests dropping in from all over." The Chapter hosted more than 100 during its January meeting, featuring FCC Field Enforcement Bureau personnel, Glenn Chambers of ATC on "Proof of Performance," and various other speakers and participants.

The Chapter has scheduled its May meeting in Carlisle, Pennsylvania, on Wednesday, May 25. The topic will be "Making Use of What You Have," and will encompass updating and testing of existing in-plant equipment to meet current standards.

For information, contact James Grabenstein, Potomac TV Cable, (301) 722-6540.□

It happened every time I did a "measurement by comparison" check on the Test Bench. I'd hook together the most expensive gear in the lab, put the display on a scope, and there it'd be... tilt, notches and lumps! Generally about .5 to 1 dB worth.

Then I learned that Wavetek has put together a complete system for making measurements by comparison. It costs less than $1,250, plus another $545 for the 12" scope. But the best news is that Wavetek's system lets me eliminate enough RF tilt to get a correlation of 0.1 dB.

If you're interested, you really should call collect, write, or circle the reader service number, but I can tell you this much: The system has two parts, a Model 1067 Sweeper and a Model 1075 Comparator. The sweeper goes from 1 to 400 MHz with flatness better than 0.25 dB, and RF output calibrated from +57 to −13 dBmV. The comparator accepts power and timing signals from the sweeper so the known and unknown ports are always phased properly. Controls to adjust tilt for Channel A and tilt plus gain for Channel B compensate for most loss and tilt errors of the test bench cables and terminations. (That's the part I like.) There is also a function to introduce "tilt loss" and "flat loss" to simulate cable.

To sum it up, next time you're running into problems with tilt, notches and lumps... I'd lean towards Wavetek.

WAVETEK Indiana Incorporated, 66 North First Ave., Beech Grove, Indiana, P.O. Box 190, Beech Grove, Indiana 46107, Tel. (317) 783-3221, TWX 810-341-3226.

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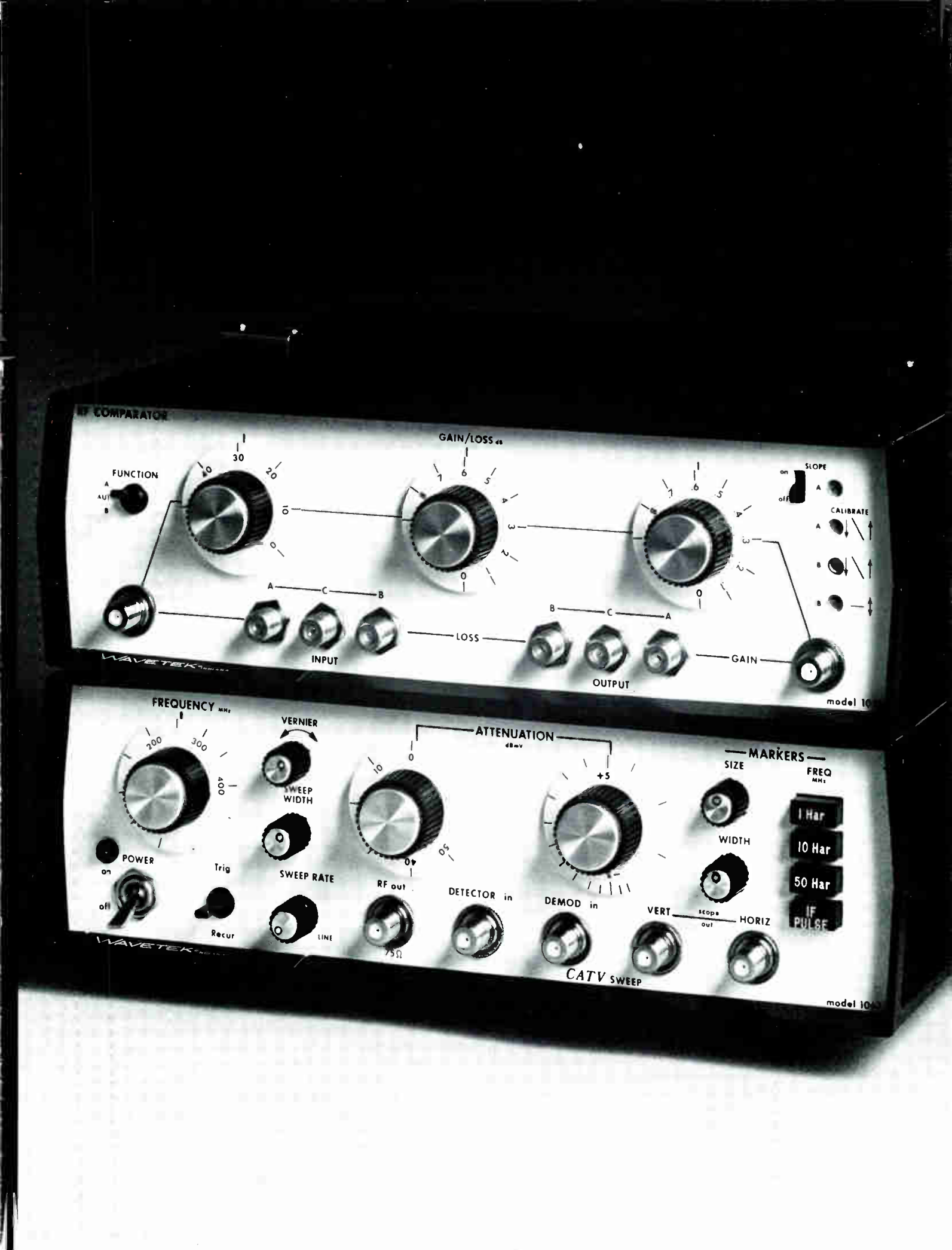
"Tilt drove me half crazy until I discovered Wavetek's new CATV sweep system."

Harvey Smith, CATV technician

Before

After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FUNCTION
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GAIN/LOSS dB
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SIZE
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1 Har
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scope out
HORIZ
CATV SWEEP
WAVETEK
model 10

CATV 77: The Choice of 12 Million Families

Technically speaking, the 26th Annual NCTA show offered a variety of new or improved products for the cable operator. Talk of fiber optics and new entries in the receive only earth station dominated most discussions. A total of five companies were actively pursuing the uses of optical fiber.

Something different this year, the technical sessions were keynoted by an "outsider." Robert Goralski, though having spent most of his career in television, is not an engineer. But as director of public relations for the Gulf Oil Corporation in Washington, he presented the audience with a little different slant on things which was well received by the early morning crowd.

Goralski spoke of the expanding world of communications and cautioned that "the more successful you are, the more interested in your activities Washington becomes." And, he stressed the importance of educating everyone you come in contact with about who you are and what you are trying to accomplish.

Goralski also said it is important for television to provide a look at problems before they become crises, even though its statements are often oversimplified. And, he added that one of the cable industry's problems will be its success. A regulatory vacuum will be noticed which, he said, will be difficult to keep the government "demagogues" out of.

The technical sessions of the show covered many new techniques in cable. The Advanced Techniques sessions included a discussion of feedforward, by Bert L. Henscheid, *Theta-Com.* Carl Johnson of *Jerrold* discussed the uses of a ring modulator and a diode detector for testing the modulator and demodulator. Simple technique of diff-gain and diff-phase were also covered.

Bob Dickinson, *E-Com,* presented Ron Simons' paper on the Teleprompter optical fiber link used for single channel carriage in New York.

I. Switzer discussed the use of automatic VIR correction on long haul microwave systems used in Canada. He uses an automatic measuring system to continuously monitor the system.

Archer Taylor presented a report on his study of TV picture impairments, funded by the National Science Foundation in cooperation with Robert Welch, University of Missouri.

The Protection From Theft of Service

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Facing page: Engineers and technicians mixed it up with all segments of the industry during the annual Engineers' Reception and awards ceremony. Above: 1) Bert Henscheid explains feedforward application techniques; 2) Archer Taylor, Malarkey, Taylor & Assoc. reporting on research into the human reaction to picture impairment; 3) SCTE's Steve Dordoufis, Bob Bilodeau and Glen Chambers (seated) presenting Frank Bias with the society's "Man of the Year" award; 4) sociologist Rod Welch, University of Missouri, relating his findings in the picture impairment study; 5) Wavetek's Bob Welsh running some "proofs"; and, 6) Dr. Frank Dabby breaking down systems analysis and design for an optical fiber system.

panel was headed by Ron Simons of *Teleprompter*, Dan Pike, *United Cable*, Joe Stern, and Graham Stubbs, *Oak Industries*, discussed possible solutions to the increasing problems of illegals.

The Advanced Techniques II sessions, headed by Joe Stern, featured a standing room only crowd to hear Dr. Frank Dabby, *Times Wire*, discuss their new 12 channel laser launched optical fiber link. Dr. Dabby presented a lot of equations that I couldn't understand (and he admitted he couldn't either). Also included were some blue sky predictions about performance, capability, and deliveries. Little was discussed concerning the actual laser technology.

Mike Ellis, *International Cable Communications*, discussed a low frequency (125-250 kHz) bi-directional approach to two-way cable. In spite of objections from the audience as to performance, the system is rumored to work well. We suspect that, considering the power levels used (5 volt signals), the signals are actually being transmitted back to the headend.

John Leslie of *Catel* discussed the merits of using FM modulation for long haul coax transmission of video. He also succeeded in embarrassing a certain magazine editor by mentioning his name no less than three times during the course of the talk . . . FM does work!

A unique hands on session was chaired by Ken Walker, *Magic Valley Cablevision*, Twin Falls, Idaho. Similar to the CATA mini-COS seminars of the past year, *Mid-State*, *Wavetek* and *Texscan* showed actual proof of performance tests on a cable system. Everyone who attended enjoyed the lectures.

A technical session on small earth stations included discussions on

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Above: 1) SCTE yo-yos were in evidence everywhere; 2) Catel's TM-2400 modulator; 3) Nick Wirth, Caywood Cooley and Jim Lahey at the Engineers' Reception; 4) Alex Best and FCC chairman Dick Wiley; 5) Peca's tech-recovery unit; 6) Scientific-Atlanta's fiber optics demo; facing page; 7) Cerro's super balanced matching transformer; 8) Neal Owens and the heart of Microtime's signal processor; 9) Jerrold's cordless converter; 10) Gulf's Bob Goralski and SCTE president Bob Bilodeau, Suburban Cablevision; 11) Tomco's PT-1000 program timer/switcher; and, 12) Jim Stilwell receiving his NCTA engineering award from Chairman Wiley.

coordination of sites, smaller terminals, picture impairment, and a 1999 look at cable TV. Featured speakers included: Jack Golin—*ITT*, Jim Hart—*Scientific Atlanta*, David Reiser—*Microdyne*, Carl Van Hecke—*Andrews*, and Dan Yost—*Compucon*.

To complete coverage of the technical talks, of notable interest was a signal-to-noise test designed by Bob Tenton of HBO. By transmitting a special test signal, the user can, with a simple waveform monitor, measure the signal-to-noise ratio of a satellite link or CATV system.

And finally, Bob Powers of the FCC's Cable Bureau discussed the signal leakage problem and the impending legislation that will be taking place. He summarized the implications of leakage on various phases of aviation equipment and gave the audience a good idea of what has to be done to solve the problem.

Times Fiber Communications, Inc. showed the first true breakthrough, 12 channels simultaneously on one fiber using an improved laser launcher. Dr. Frank Dabby of *Times* said, "Technological breakthroughs in laser configuration now make it possible to discuss Fiber Optic analog TV signal transportation systems with at least 12 channel capability."

Most cable people were treating earth stations with the same casualness as they would in choosing a new amplifier. While the newness has worn off, at least one more manufacturer *(Farinon)* has entered this seemingly saturated market bringing to 13 (count them) the number of manufacturers offering earth terminals. *Hughes* closed a sale for 18 4.5 meter terminals to Teleprompter during the show, but most other terminal suppliers described business as slow.

There were more than enough new products introduced at the show. T.E.S.T., for instance, announced a new compact MDS receiver with a simplified, highly rugged antenna using a styrofoam type cone molded over the elements. This

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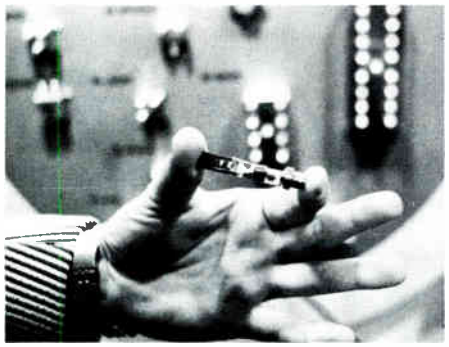

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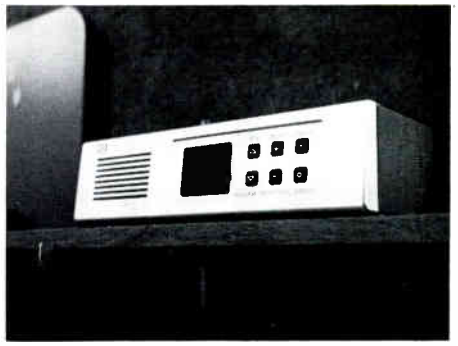

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antenna/receiver combination will be a welcome addition to the MDS user wishing to serve motel and high-rise complexes.

Microtime unveiled its new "PLUS" 1500 video picture corrector. This unit corrects most of the problems encountered when using smaller VTR's for local origination and pay channel applications. *Jerrold* showed a cordless 36 channel converter. Channels are selected on a small calculator style keyboard and the channel number appears in a L.E.D. display on the main receiver-converter. In addition, *Jerrold* offered the Starpack, an outdoor descrambler that can be mounted on the pole or strand. *Jerrold* plans to offer midband and multichannel units soon.

Signal Transmission Technology, a new division of *Tomco,* showed its first product entry, the TVSP-1. This unit lets you put high quality TV sound on the FM portion of your cable system. The unit accepts I.F. sound directly from most signal processors. A stereo synthesizer is also planned in the near future. *Tomco* showed the PT-1000 program timer/switcher. By using the current clock and microprocessor technology of today, Tom Olson has produced a programmable non-duplication switcher, an improvement over the older electro-mechanical units.

An interesting way to fill an extra channel was demonstrated by *TSC Labs.* They can supply a complete radar set for local weather displays. The display has a map overlay and weather conditions show up in various colors. The price of over $30,000 is somewhat restrictive, but in some parts of the midwest, especially in the tornado belts . . . who knows?

PECA displayed two new additions to its family. The first was Ken Simons, one of the technical leaders in cable, and the other was a small simultaneous sweep receiver for use with a storage oscilloscope. The sweep receiver is battery powered and compact enough to be carried up a pole or into other less accessible locations.

The 26th Annual Show is difficult to summarize. While there were some technical breakthroughs in the area of Fiber Optics, business for the most part was —as usual. Many cable operators now take the attitude of waiting until something is proven before buying. In some ways this will mean that the industry will be less exciting, but on the other hand, stability seems to make the banks happy. The prognosis for next year is growth and conventional techniques.

Cliff Schrock
Technical Editor

Reliability Considerations In Design And Use Of RF Integrated Circuits

By James Humphrey & George Luettgenau,
TRW Semiconductors

Requiring an absorption of military and aerospace technology, reliability considerations are becoming increasingly important in the operation of CATV systems. Market surveys show a large number of MSO's and consultants consider reliability as a major factor in equipment selection and in the profitability of their systems.

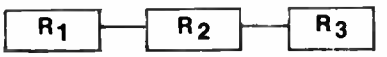
The term reliability is related to the probability that an item will perform a defined task satisfactorily for a specified length of time when used for the purpose intended and under conditions for which it was designed to operate. It is represented by the following equation:

$$R = e^{t/m} = e^{-\lambda t}$$

where **R** is the reliability or probability of success: t is the mission time in hours; and m represents the mean time between failures **(MTFB)** in hours. It can also be explained as the number of hours divided by the failures. λ is the failure rate which is equal to $\frac{1}{\text{MTBF}}$ which in turn is $\frac{\text{failures.}}{\text{hours}}$

SYSTEM RELIABILITY

When components are in series, failure of any one of the components will result in failure of the system.



Following from this, the equation for system reliability is $R_{system} = R_1 \times R_2 \times R_3 \times \text{---} R_N$.

The failure rate, therefore, is $\lambda_{system} = \lambda_1 + \lambda_2 + \lambda_3 + \text{---} \lambda_N$

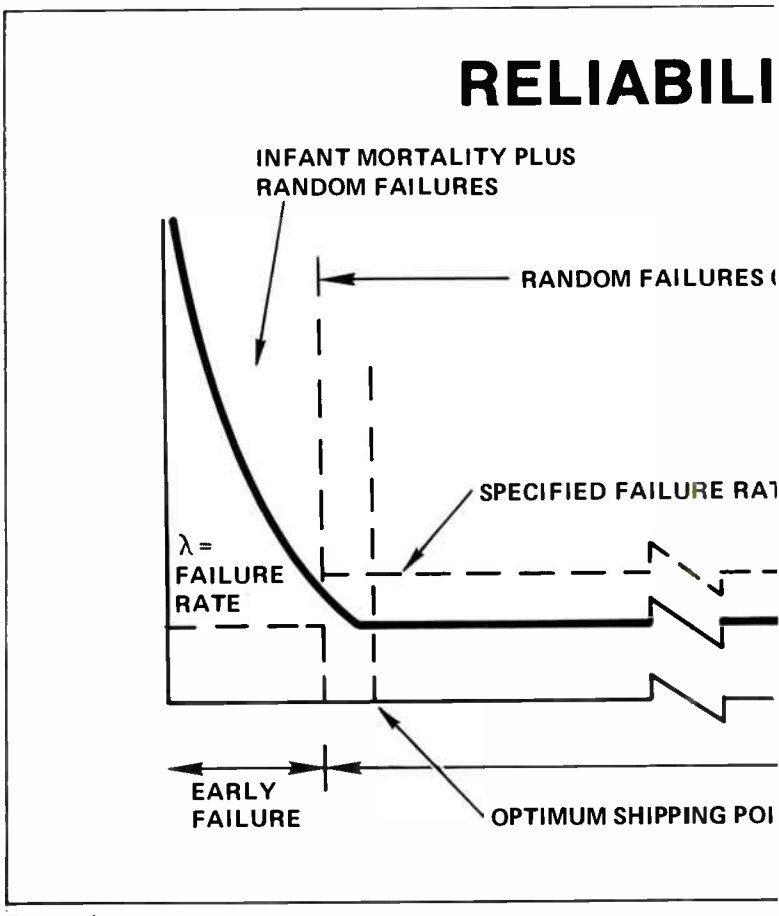
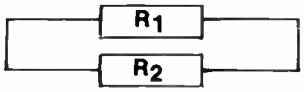


Figure 1

When the same components are in parallel (redundancy) neglecting, for simplicity, the decision-making device, the switch-over function and the fail safe requirements are:



The reliability equation for this situation is $R_{system} = R_1 + R_2 - (R_1R_2)$.

Figure 1 represents the typical condition of operational reliability.

Reliability Prediction Algorithim

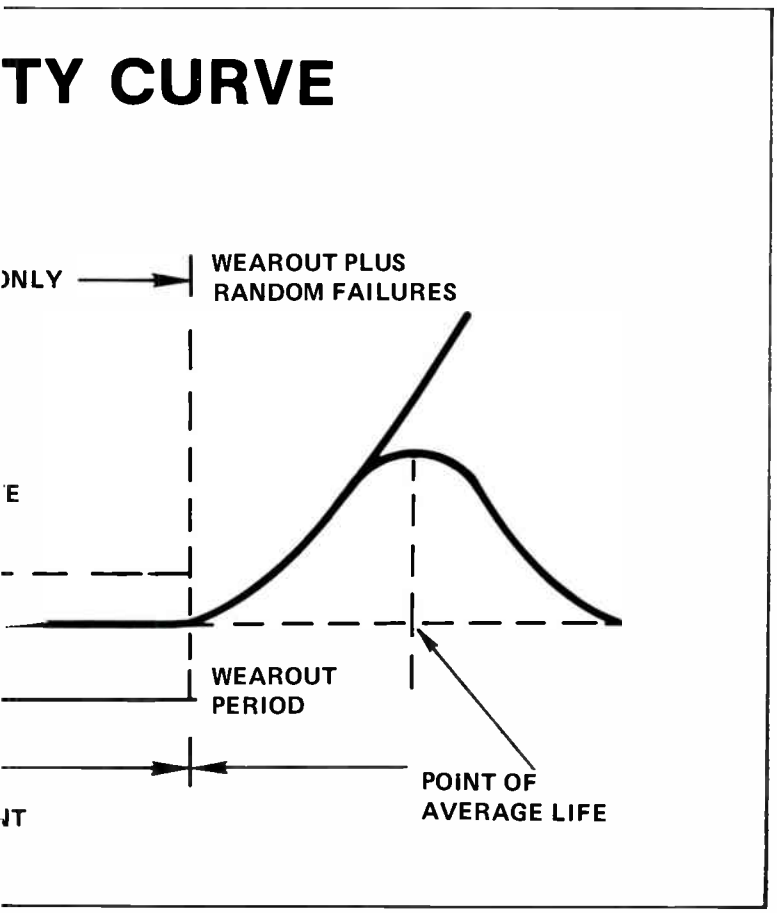
The military has done extensive studies in the area of reliability. One very useful military document is Military Handbook 217B, *Reliability Prediction of Electronic Equipment.* The study shows how to develop failure rate predictions by the use of mathematical models based on years of data collection by military agencies.

One of the models developed in the handbook is the Part Failure Rate Model λ_p. It is expressed in the equation.

$$\lambda_p = \lambda_b (\pi_T \times \pi_E \times \pi_Q \times \pi_F \times \pi_M).$$

λ_p is equivalent to the part failures in failure per 10^6 hours and λ_b is the base failure rate. The temperature adjustment factor is designated by π_T while the environmental adjustment factor is represented by π_E. The adjustment factor for circuit function is expressed by π_F. This includes 0.8 for digital hybrids; 1.0 for linear hybrids and 1.1 for combination hybrids. π_M is the adjustment factor for maturity of the product.

Another model developed by the military is the Base Failure rate Model λ_b as expressed by the following:



$$\lambda_b = \lambda_s + A_s\lambda_c + R_T N_{RT} \quad \text{(Substrate contribution)}$$

$$+ \Sigma\lambda_{DC} N_{DC} \quad \text{(Attached components contributions)}$$

$$+ \lambda_{PF}\pi_{PF} \quad \text{(Package contributions)}$$

In this equation, λ_b is the base failure rate in failures per 10^6 hours and λ_s is the failure rate contributions due to the substrate and film processing. A_s λ_c is the failure rate contributions due to network complexity and substrate area which includes:

a) Number of lead terminations
b) Number of film resistors
c) Number of discrete chip devices
d) Type of film (thin versus thick)

$\Sigma\lambda_{RT}N_{RT}$ equals the sum of the failure rates for each resistor as a function of the required resistance tolerance. $\Sigma\lambda_{DC}$ DC represents the sum of the attached device failure rates for semiconductors and capacitors. The hybrid package failure adjusted to include material and style is expressed by $\lambda_{PF}\pi_{PF}$.

PHYSICS OF CONSTRUCTION

Following the enumeration and identification of symbols used in reliability algorithms, an understanding of the major microelectronic components with respect to their reliability contributions is in order.

Transistors

The transistor die is the heart of the hybrid amplifier. With four to eight devices per circuit, the transistor determines performance and is most critical to proper circuit operation.

During the last few years there have been major advances in the performance of linear broadband transistors. But, often efforts to improve one characteristic have adverse effects on other desirable features. For instance, distortion may be bettered by thinning the epitaxial collector region. This, however, leads to sensitivity to voltage transients and other abnormal operating conditions. Therefore, devices with outstanding performance in one area are prone to weakness in others. Computer-aided device design coupled with volume production and tight process controls have resulted in transistors in which all essential features are in proper balance.

High f_t is generally recognized as an important factor in achieving wide bandwidth and uniform distortion characteristics. Gigahertz transistors, which are now being used, have very delicate patterns involving micron and submicron tolerances. The also occupy sizable areas on the silicon wafer, since watt-sized powers have to be handled. It is only realistic to expect that all parts of the overall transistor structure are not perfectly alike, but rather resemble the parallel configuration of many, slightly differing, small devices.

Emitter Balancing Resistors

It is also apparent that the entire transistor geometry cannot be tightly thermally coupled within itself, therefore giving rise to the possibility of small sub-areas of the transistor assuming different values of temperature than others. This possible problem can be combated effectively by adding emitter balancing resistors to the device (Figure 2). Ideally each emitter-site or

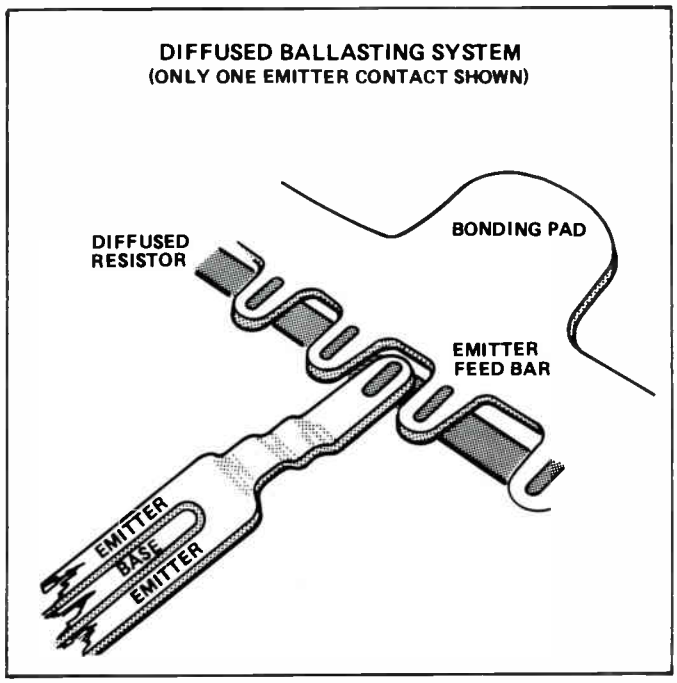


Figure 2

finger should have its own resistor. This goal is easily realized in interdigitated structures. Film or diffused monolithic resistors may be used. From a process and reliability point of view, diffused resistors are preferred because they avoid the silicon-oxide barrier which has a very high thermal resistance.

Metal Migration

Some time ago a serious failure mechanism associated with GHz transistors was discovered. The metallization stripes of such devices, as mentioned earlier, are only a few microns wide. The metal thickness is, because of fabrication limitations. of similar dimensions. Consequently, the current density in these stripes is quite high—often reading hundreds of thousands of amperes per cm^2 of cross-section. Under these circumstances, metal migration may occur. With such large numbers of electrons flowing in such crowded space, the probability of collisions with thermally activated metal ions is great. The ions are propelled in the direction of electron current flow causing, in the long run, the metal to move, forming hillocks, whiskers and voids. The lifetime of a transistor is a function of three things: the current density, the temperature, and the type and consistency of metallization.

Not much leeway exists in reducing the current density (unless F_t is sacrificed). Changing from aluminum to gold extends the life at least by an order of magnitude. At high temperatures the difference is even more pronounced. At 150°C, the time to metal failure for gold metalization microwave transistors is in excess to 10^6 hours=114 years.

While the number is quite comforting, one is not at liberty to treat the subject of transistor chip heatsinking too lightly. A proven method for removing heat while at the same time obtaining a solid mechanical mount, has been to employ a heatspreader between the silicon chip and the IC substrate. Automatic mounting stations are used to *eutectic collect* mount the chip to indexed leadframes. Tight control of pressure and scrub sequence result in defect-free attachment. Although one may employ other methods of heatsinking, e.g. beryllium oxide substrates for part of the circuit, the added mechanical complexity and the reduced freedom of optimal circuit layout presently outweigh the minor advantages resulting from a reduction in transistor temperature.

Interconnects

One of the most important parts of hybrid circuits is the interconnect system. The ability to reduce the number, control the quality, and test them by screening complete functions, is one of the major advantages of hybrid circuits over more conventional approaches. Constant improvement in the mechanical and metallurgical systems have drastically improved reliability. An analysis of the schematic of the standard 33dB Hybrid Amplifier will illustrate the point. (Figure 3)

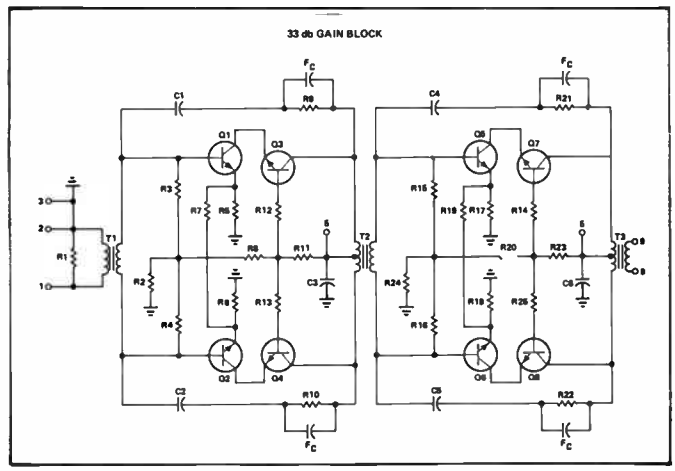


Figure 3

Comparing hybrid versus discrete techniques, one can show the following:

1. For each transistor used, a minimum of three interconnects corresponding to the solder joints at the PC board are eliminated.

2. For each capacitor used, a minimum of two interconnects are eliminated.

3. For each film resistor used, a minimum of four interconnects are eliminated corresponding to the connection to the resistor body and the connection to the PC board.

4. Transformer interconnects will be the same for hybrid or discrete.

Thus, the increase in interconnects in building 33dB of gain in discrete form over the same circuit in hybrid form is:

Add due to transistor =24

Add due to chip capacitors =12

Add due to resistors =100

Add due to transformer =0

Less due to hybrid jumpers =-4

Less due to active pins =-5

127 Additional interconnects per 33dB function

MIL Handbook 217B also discusses the reduction in reliability of printed circuit boards as a direct multiple of the holes required. Eighty-one additional holes are involved in making one discrete amplifier.

Having the interconnects made early in the manufacturing sequence, before the subsequent series of tests and inspections, has beneficial influence on end equipment reliability. The

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complete functional system, including interconnects, is tested, screened and Q.C. sampled many times before it even meets up with the PC board in the manufacturers' subsystem.

Component Mount

The transistor heatspreader, chip capacitors and pin connections are soldered to the metallization pattern on the substrate surface as shown in Figure 4. This process is completed in a tightly controlled solder reflow furnace.

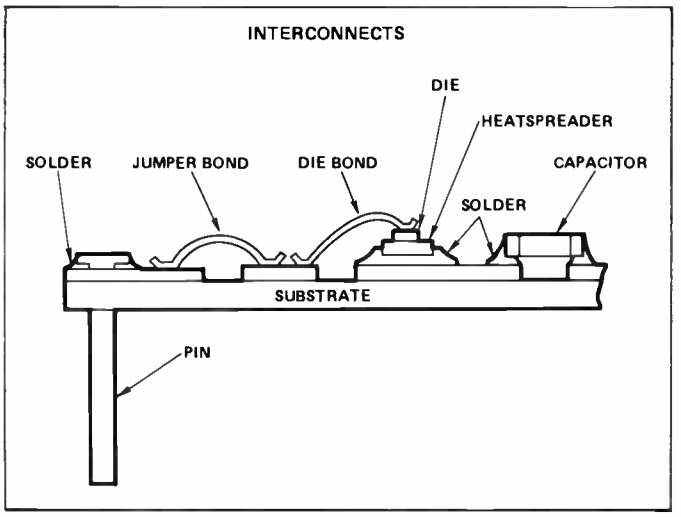

Figure 4

Due to the fact that the units are processed in an inert atmosphere and thoroughly cleaned and inspected early in the production process, workmanship problems are greatly reduced.

Bonds

Wire bonding was a major reliability issue for years. Aluminum has been one of the most widely used bonding systems in the hybrid industry for many years. The main reason is that ultrasonic aluminum systems bond at room temperature and, hence, do not interfere with other hybrid assembly processes.

Gold thermal compression ball bonding has been a reliable standard process in the semiconductor industry for years. However, the requirement for 300°C bonding temperatures has kept this technique out of most hybrids. The recent changeover to all gold hybrids prompted the development of a compatible low temperature gold wire bonding system which by far out-performs aluminum.

The gold bonding provides compatibility with the gold die and substrate while, at the same time, it demonstrates strength with time and temperature. Aluminum bonding, on the other hand, degrades with time and temperature. Gold bonding, although it is ore expensive, is more malleable than aluminum and is not subject to cracking. It also allows for an easier to control process. An intermetallic formation with gold and Kirkendall voiding are two other disadvantages of aluminum bonding. Figure 5 and 6 illustrate the better strength characteristic of gold over aluminum bonding.

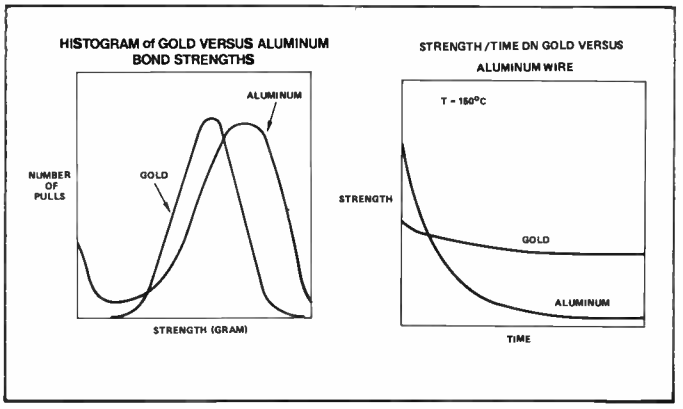

Figure 5

Figure 6

RELIABILITY ADJUSTMENT FACTORS

The reliability adjustment factors relate to the external influences on hybrid circuit reliability.

Temperature Adjustment Factor π_T

Operating temperature is one of the most important factors in reliability. As can be seen by the curve shown in Figure 7, great reliability improvements can be obtained by lowering the case temperature. This curve shows that a hybrid circuit, operating at a case temperature of 100°C, has four times the failure rate as the same curcuit run at 50°C.

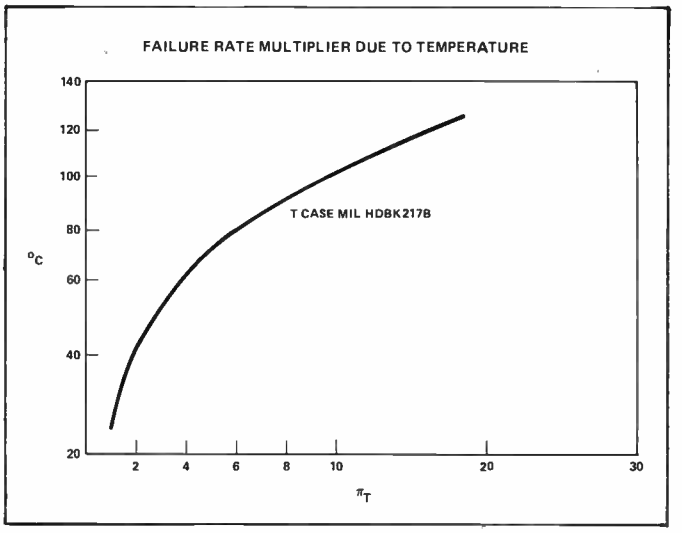

Figure 7

Environmental Adjustment Factor π_E

This adjustment factor is based on the service environmental conditions that the part will be exposed to during operation. Some conditions are listed in Figure 8. The question is where does CATV fit into this list. Mechanical and thermal casting designs are extremely important in protecting the RF IC from the external environment conditions. Still, wide variations in system placement introduce a swing factor for environmental effects, which will cause π_E for CATV to fall between 1.0 and 5.0. The

π_E, ENVIRONMENTAL FACTOR BASED ON ENVIRONMENTAL SERVICE CONDITION

PER MIL HNDK217B

ENVIRONMENT	SYMBOL	π_e
GROUND, BENIGN	G_B	0.2
SPACE FLIGHT	S_F	0.2
GROUND FIXED	G_F	1.0
AIRBORNE, INHABITED	A_I	4.0
NAVAL, SHELTERED	N_S	4.0
GROUND, MOBILE	G_M	4.0
NAVAL, UNSHELTERED	N_U	5.0
AIRBORNE, UNINHABITED	A_U	6.0
MISSILE, LAUNCH	M_L	10.0

Figure 8

user must strive to keep the components at close to laboratory zero as possible.

Maturity Adjustment Factor π_M

The failure rate predicted by this mechanical model can be expected to increase by a factor of (π_M = **10)** under any one of the following conditions:

a) New device in initial production.

b) Where major changes in design or processes have occurred.

c) Where there has been an extended interruption in production or a change in line personnel (radical expansion).

The factor of 10 can be expected to apply until conditions and controls have stabilized. This period can extend for as much as six months of continuous production. This maturity factor is extremely important. The industry has used over 400,000 CATV modules since the first module was shipped in 1970. Since that time the IC has constantly been improved and refined. Optimum reliability is an evolutionary process depending on time, volume, defect analysis and feedback to fine tune the product and eliminate defects.

Quality Adjustment Factor π_Q

This is the adjustment factor based on the quality grade of the product. This factor modifies the reliability levels by the different quality levels specified in MIL STD 883, "Test Methods and Procedures for Microelectronics." These levels take into account different screening levels, qualification levels and quality conformance inspection requirements for the specified class.

	π_Q
MIL STD 883 Class A	0.5
MIL STD 883 Class B	1.0
Vendor Equivalent Class B	5.0
MIL STD 883 Class C	30.0
Commercial with Screening	50.0
Commercial (Nor Screening)	75.0

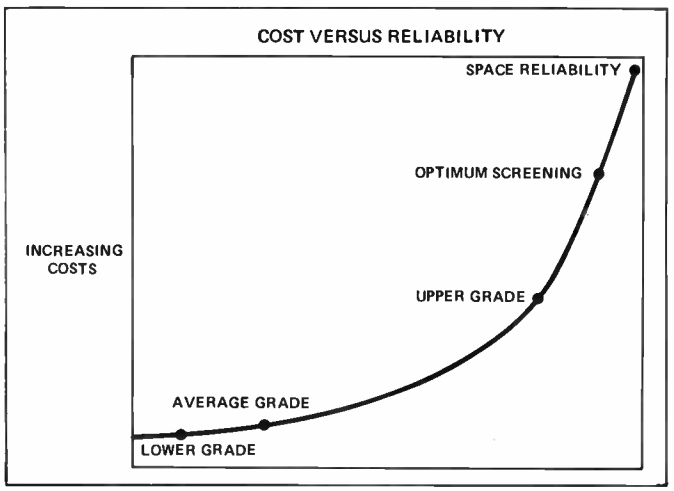

Figure 9

A study of the MIL STD 883 Quality Requirements allow a very important discussion of cost versus reliability. As could be expected the test, manpower, equipment, time and paperwork go up rapidly as the MIL STD Grade is increased. A relative plot of this relationship is shown in Figure 9 . Many of the MIL Standard Military requirements seem unimportant in influencing CATV reliability. However, the cost versus reliability curve is real and equipment supplier can make choices as to the type of reliability he is willing to pay for.

EQUIPMENT

It takes a massive capital investment in order to meet the manufacturing requirements for the CATV industry. The volume, quality and performance standards required have caused suppliers to constantly reinvest for the future. Many of the invested dollars are for equipments for which the return on investment is subjective.

Scanning Electron Microscope

This instrument allows very high magnification of surface conditions not available with optical methods. Magnifications up to 100,000 times are possible with the SEM.

Dispersive X-Ray Analysis

This capability, which is a feature of the SEM, allows us to make a microprobe to determine the chemical composition of a sample. This is accomplished by detection of secondary emission x-rays which possess characteristic energies. The relative quantity and location of elements may then be displayed on the CRT.

Variable Frequency Vibration

This is a destructive test which is performed for the purpose of determining the effect on component parts of vibration in the specified frequency range.

X-Ray

This is a very valuable tool for detecting voids in solder or eutectic bonds.

Infrared Microscopy

The ability to examine a circuit thermally under operating conditions is absolutely necessary when designing a new product or testing a new process. The infrared microscanner is used for evaluation of new products from the standpoint of thermal resistance and operating temperature. Resolution of 0.0005 inch can be achieved.

In summary, relability can be improved by adding quality cost to the module process. This increased cost may easily be returned due to the lower failure rate. Contributing to this increased reliability is the monometallic system, including the gold die metallization and the gold wire bonding. The hybrid circuits also offer massive reliability leverage due to the reduction of interconnects; the ability to control quality by screening and the large volume of complex standard functions are easier to control.

REFERENCES

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critique/letters

Dear Editors:

Although I am in complete agreement with Cliff Schrock's rebuttal to FAA's position on the threat of interference, I believe that this whole situation can be turned around to the benefit of the entire communications industry.

The threat of serious harm from electromagnetic interference is not unique to either aviation or cable television. Consider how cardiac pacemakers, medical telemetry, or the dispatching of public safety forces can be thwarted by spurious radiation from any of thousands of devices.

With increasing use of the spectrum, the day is rapidly approaching when every device that either radiates or is susceptible to radiation must adhere to rigorous technical standards. The task is technically, legally and politically formidable. It is understandable that Congress and the FCC have managed to dodge it so far.

The electromagnetic spectrum is a natural resource, and like other resources it is limited. We can only squeeze so many signals into the available spectrum space. Cable television, has the capability of conserving more megahertz of spectrum than any other development. If cable systems avoid aviation frequencies, we are only dodging the issue. The solution must be technical.

If the FAA has done nothing else, it has alerted the public and Congress to the fact that interference can be more than simply an annoyance.

John E. Cunningham
Cleveland Institute of Electronics

President Jimmy Carter
The White House
1600 Pennsylvania Ave.
Washington, D.C. 20500

Dear Mr. President:

In this country of plenty of ours, we have approximately 13½ million citizens who are totally or partially deaf and can absorb only a fraction of the news and entertainment available on television.

The technology is now available for the networks to transmit, "piggy back," digital information which could be converted (with a set-top converter) to a visual captioned "crawl" on the bottom of the television set, enabling the deaf to "see" the spoken words.

I am enclosing a copy of an article, with permission of the publisher, in the February 1977 issue of *Communications/Engineering digest* by Mr. Cliff Schrock which outlines various methods of accomplishing this task.

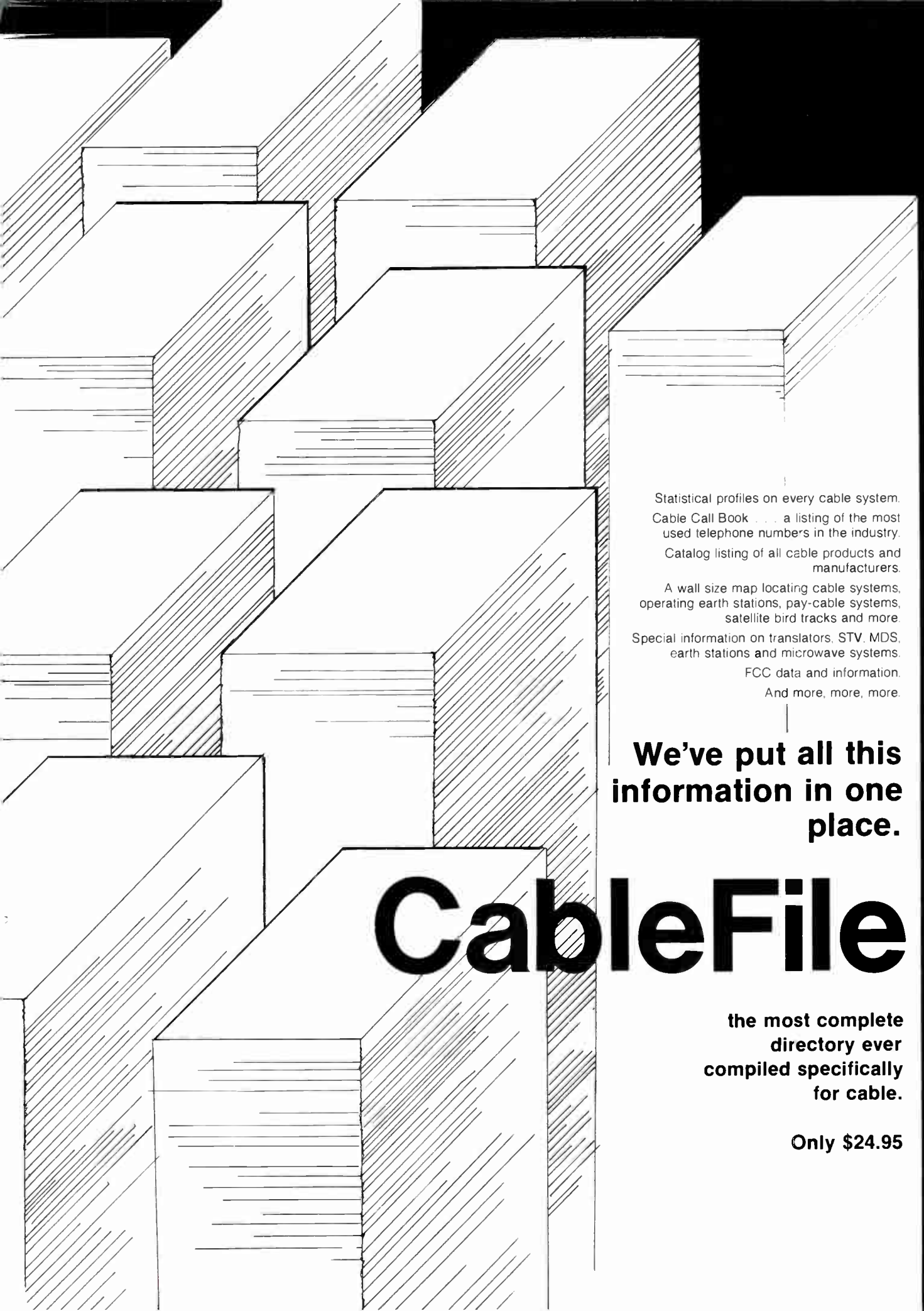
With your personal efforts, at this time, to increase our nation's and our world's sensitivity to human rights, we would be doing the deaf citizens of our country a terrible injustice if a serious attempt is not made at coming up with some type of program during the forthcoming May 23-May 27 meeting of the White House Conference on Handicapped Individuals.

A sad commentary on this problem is that, I, along with several million American citizens would not be aware of the problems of the deaf unless we are personally affected. My "exposure" to the problem is through my brother Kenneth Broussard of Orange, Texas, who is deaf and further handicapped by a spinal cord injury which left him a quadriplegic.

The reluctance of the major networks becoming involved in such a program could be overcome by their advertisers who could be made aware of their products' commercials reaching (totally) an additional audience of 13½ million people.

I am aware of the problem, yet painfully aware of the fact that I have no solution. Please help us find an answer.

Calvin D. Broussard
UA-Columbia
Fort Smith, AR



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