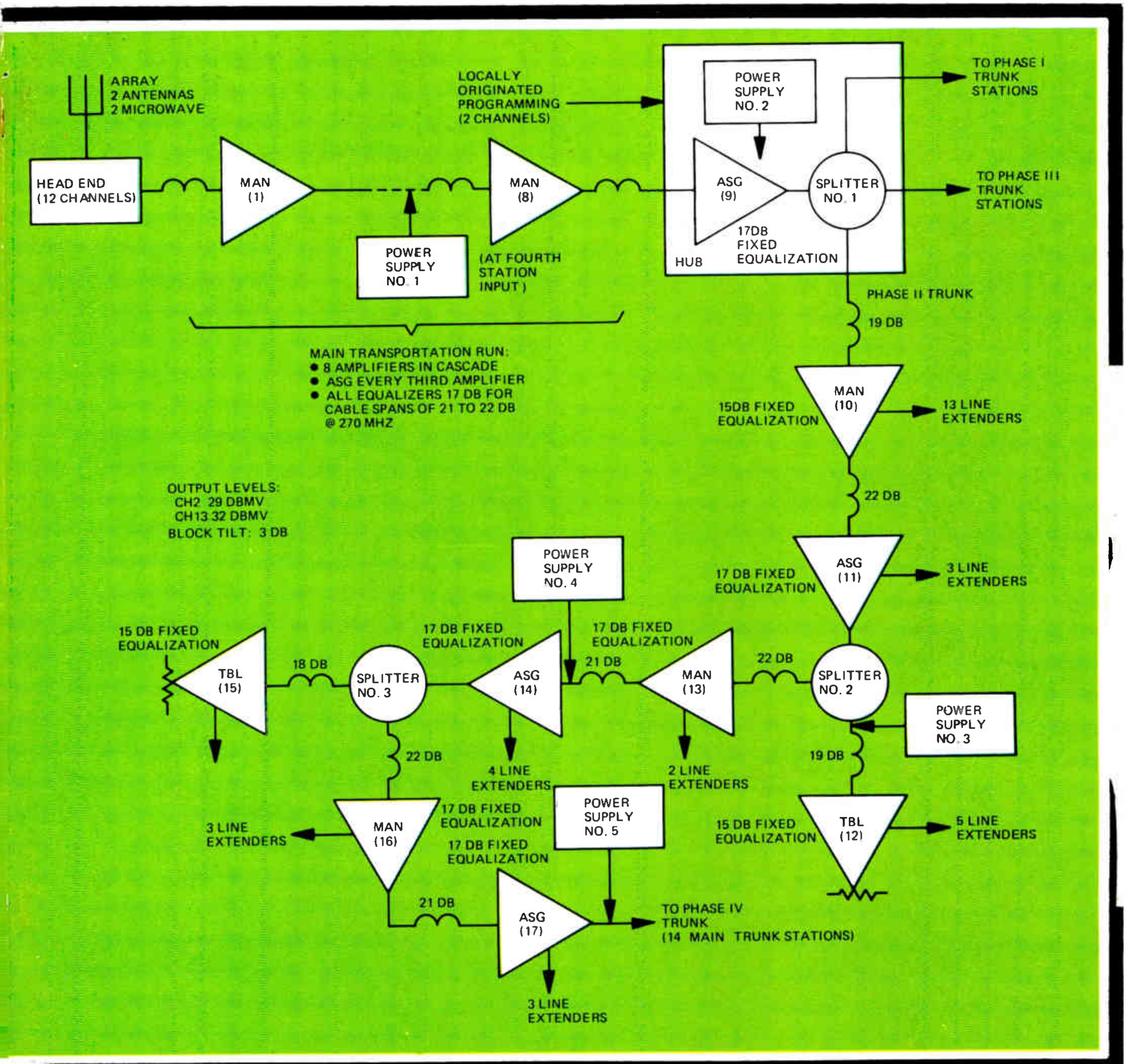
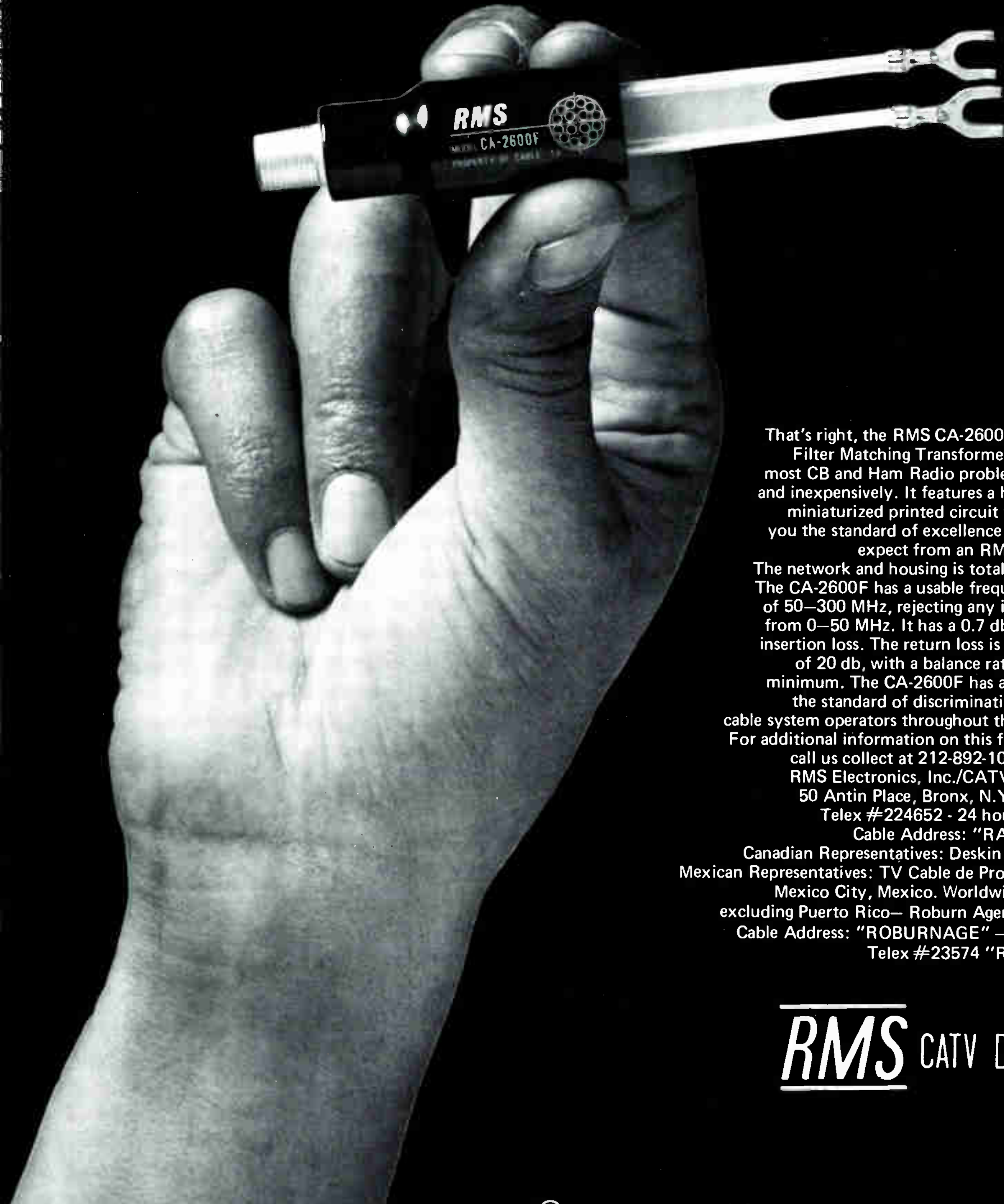
communications/engineering digest

reporting the technologies of broadband communications



june, 1977
volume 3, no. 6

The proven way to eliminate CB and ham radio interference



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RMS CATV DIVISION

june, 1977
volume 3, no. 6

communications/engineering digest

FEATURES

DEPARTMENTS

COVER: This month's cover depicts what is referred to as the "typical trunk section" of the Wilson, North Carolina, system which is featured on page 20 in an article by A. Lochanko of AEL entitled "Reliable Design for Field Installation and Tests."

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Canadians Ponder Their Future

"Oh, Canada!" To a foreigner the powerful opening phrase of our Northern neighbor's national anthem at once expresses exhilaration and perhaps desperation. For indeed that vast country has much to be proud and thankful for. But all the same time, behind those well set jaws of the Western Canadians and the carefree manor of the French speaking, there appears to be grave concern for the future of the land and most certainly communications which is to play a vital role in whatever happens.

To a visitor who knows Canada best from album after album of Gordon Lightfoot ballads there is a sense of amazement as to how the country's Nationalism compounded by its multi-lingual, multi-cultural, provincial sectionalism pervades every aspect of business and personal endeavor there. The development of Canadian cable television does not escape it in the least.

But, maybe the situation is more universal than it appears. We're rewriting the Communications Act; they have Bill C-43. They're concerned about American imports of hardware and programming; we are concerned about Japanese hardware. They thirsting for pay-TV answers; though we've been at it a while, so are we. Instead of Federal-State jurisdictional battles, theirs are Federal-Provincial. And as already mentioned, its confused even further by multi-culturalism.

Despite the situation it was heartening to witness how very directly the Canadian cable industry deals with its problems without the webs of political intrigue in evidence south of the border. It may be naive,

Ken Hancock's regular "Canadian Column" will return next month

but it seemed the Canadians say the same thing in the back rooms as they do at the podiums—whether it has to do with urban subsidization of rural extensions, ownership of plant, pay-TV, cut offs for rule exemptions, or whatever.

This self-imposed sense of patriotic responsibility will be taking on an even greater significance now that cable television is being purchased in more than half the homes in Canada. "With that success comes more responsiblility," it was echoed by every major speaker at the 20th annual convention. Part of fullfilling that responsibility it seems, is developing a concensus about what cable television is in Canada.

CCTA Chairman Phil Lind said that without question, the most challeng-

(Continued on page 16.)

SCTE comments

Judith Baer, Executive Director

Giving - and Taking!

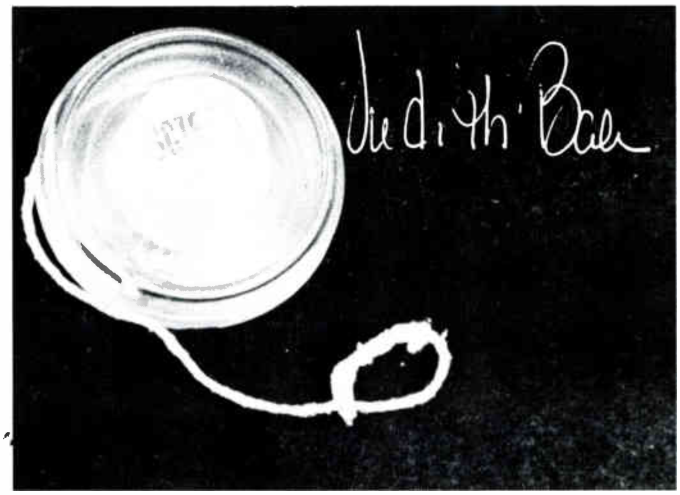
SCTE made quite a name for itself in Chicago. And now, in Calgary! We've managed to open up lines of communications, get management's attention and make a lot of friends. After moving into Calgary and the Canadian Cable Television Association meeting last month, we'll head for Oklahoma and the CATA Second Annual CCOS meeting in mid-July. In August it's back to Atlanta and the 17th Annual Southern Cable Television Association meeting on the 21st. SCTE will be staging "yoyo clinics" during each of these events. SCTE has found that giving means getting—and there's absolutely nothing wrong with that, so long as everybody wins.

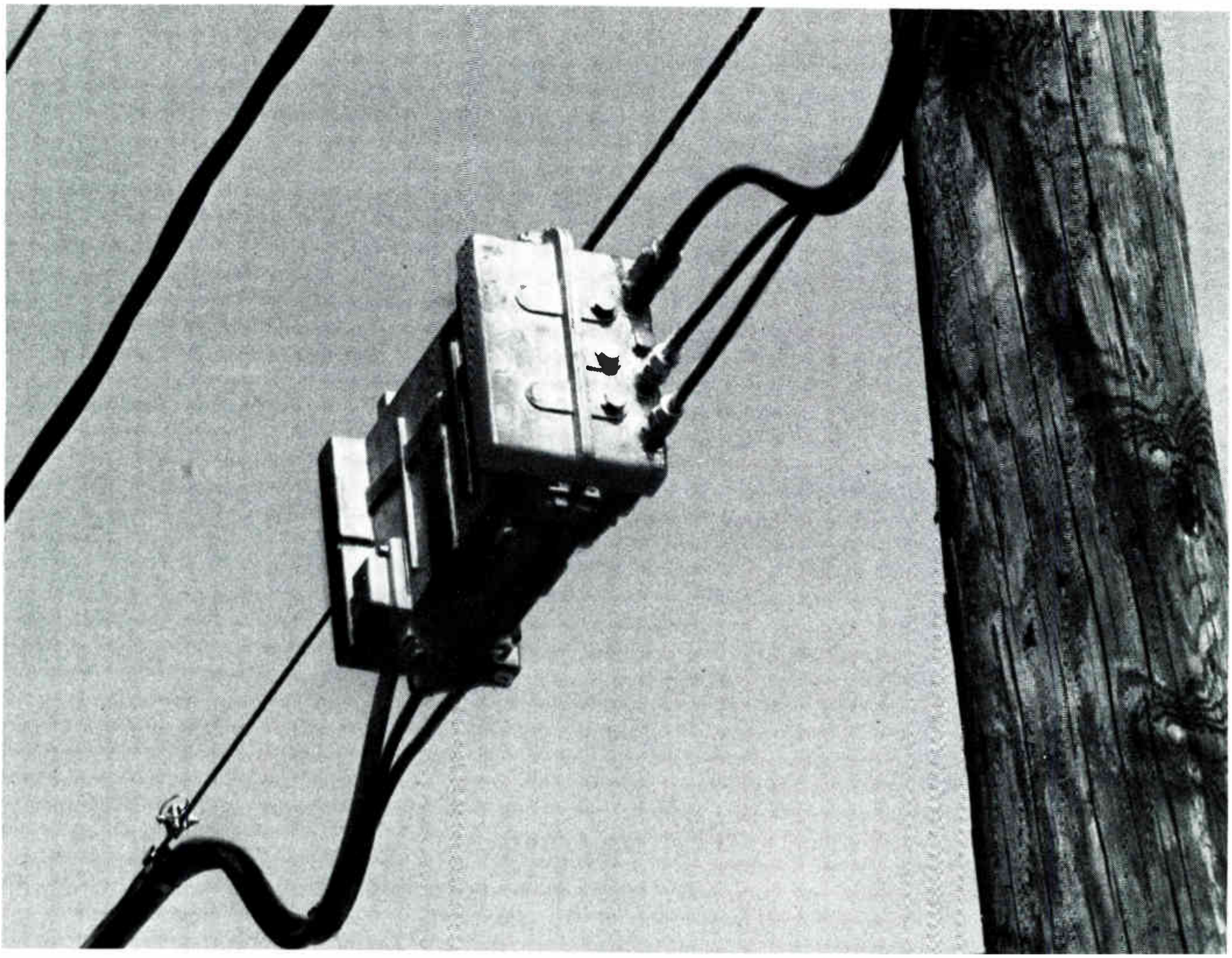
Some SCTE members give a lot to this organization. They take a great deal of responsibility, add to their already hectic workloads, and get a great deal done. Others, as in human nature, find it is easier to simply sit back and let everyone else do the work. Some complain, others just remain invisible and provide no input whatsoever. Again, that seems to be the nature of humans, it is not just a weakness in "technical" people.

Some organizations also find it fair to give support to SCTE, while others totally ignore our existence. SCTE provides programming, publicity, support, exposure and mileage to most every cable television industry group, and to some outsiders as well. SCTE feels this is important to do since we've found it is impossible to set yourself aside and continue to grow. With no fresh inputs, we all get stale and very, very boring. Besides, what is to be achieved by ignoring people? It is certainly no way to make, or keep friends and supporters.

To those members who've worked so hard to help SCTE grow and flourish, thank you. To those members who do nothing, that's okay—but you'll get more if you do more. To those members who only complain and offer not one whit of support, if your criticism is well founded, thank you for it because we'll learn from it. To the organizations that have supported us and worked toward our common goals with us, thank you. To those groups that continue to ignore SCTE's presence, you know who you are, and we'll get to you yet!

Meanwhile, SCTE will continue to give, and some will continue only to take.





SCTE

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How Long?

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Company Name/School Dept./Division

Company Street Address City State Zip

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☐ Other: ________

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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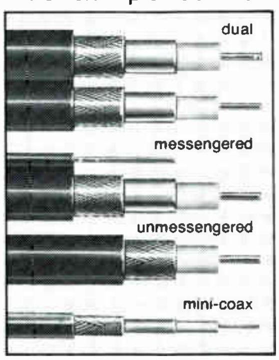

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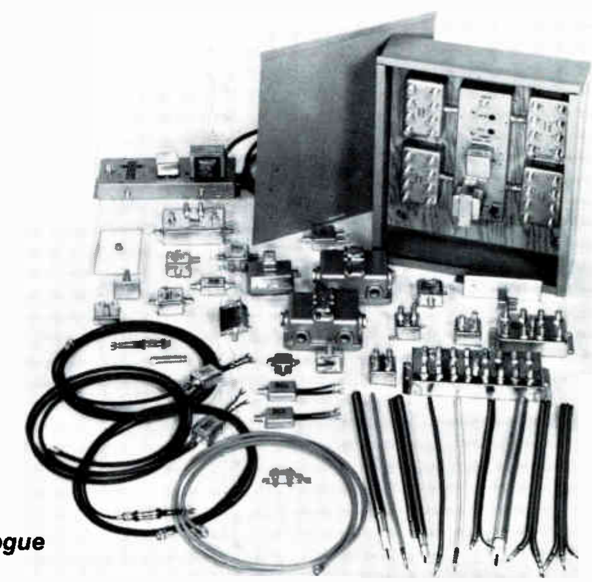

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Technical News at a Glance

. . . *A six-member group of operators and a manufacturer have formed a consortium in Canada to be known as* **BCN Fibre Optics Ltd.** *to conduct a test of fiber optics technology beginning with an* **eight kilometer test of trunk in London Ontario.** *The trunk will be running side by side with existing conventional trunk. The test link will carry 14 TV channels and 12 channels of stereo FM.*

. . . *The* **Office of Telecommunications Policy's** *Intra-agency Committee on Rural Communications met last month to "identify, evaluate and document the major regulatory and institutional barriers to the* **improvement of communications services in rural areas."** *The committee, which was established in April by OTP director William J. Thaler, must produce a draft report of its findings to Congress by August 31.*

. . . *Congressmen* **Timothy Wirth (D-CO)** *and* **James Broyhill (R-NC)** *introduced* **a pole attachment bill** *on May 25, one week after Senator Ernest Hollings introduced similar legislation, with the support of 17 co-sponsors. The bill, which differs from the Senate's version by* **excluding forfeiture,** *reflects the agreement reached by NCTA and NARUC.*

. . . **Community Antenna Television Association president Klye Moore** *has called on the* **Federal Communications Commission to reconsider microwave regulations as they apply to rural areas.** *Moore informed the Commission that CATA plans to file a request for rulemaking in that regard. Moore said, "CATA believes a whole, fresh, new look at the microwave rules are in order."*

. . . **NCTA has announced the 1977-78 chairmen of 18 committees.** *The committees and chairmen are: Associates,* **Irving Faye;** *Blue-Ribbon,* **Bob Hughes;** *Communications Act Rewrite,* **Ralph Baruch;** *Deregulation,* **John Gwin;** *Equal Employment,* **J. Richard Munro;** *Elections/Bylaws,* **Polly Dunn;** *Financial Affairs,* **Ken Gorman;** *Government Relations/Cablepac,* **Doug Dittrick;** *Independent Operators Board,* **Mel Gilbert;** *Long-Range Planning,* **Monroe Rifkin;** *Membership,* **John Saemon;** *Pay-cable,* **Gene Schneider;** *Public Affairs/Information,* **Richard Loftus;** *Rural Telecommunications,* **Aaron Fleischman;** *Satellite,* **Bill Bresnan;** *State/Local Regulations,* **Bill Strange;** *Utility Relations,* **Bud Hostetter.**

. . . *Broadband Communications head* **Irving Kahn has chastised Ma Bell** *as no "High Priestess" in a speech before the Electronic Industries meeting in Hyannis Port, Massachusetts. Kahn also took exception to* **extensive lobbying costs by AT&T** *to bring about monopoly power overall communications.*

. . . *The* **Motion Picture Association of America** *has filed for a declaratory ruling with the FCC saying that* **network practices violate the financial interest rule.** *MPAA president* **Jack Valenti** *pictured the three commercial networks as "anti-competitive monopsony . . . swollen with profits."*

news

CATA Seeks Changes In Microwave Rules

WASHINGTON, D.C.—During a Federal Communications Commission "En Banc" meeting last month, Community Antenna Television Association President Kyle Moore called on the Commission to reconsider microwave regulations as they apply to rural areas. Moore informed the Commission that CATA plans to file a request for rulemaking late this summer which would authorize Rural CATV Relays on a shared, non-interference basis.

Moore told the Commission that a 20 milliwatt microwave transmitter and receiver should cost $108 per channel and serve rural areas with as few as 10 homes. But under present FCC microwave rules, the same unit costs $2400 per channel, a price economically infeasible for the small cable operators.

"In other words, where with the 108-dollar unit I could afford to serve settlements with as few as 10 homes, now with a 2400-dollar unit I am restricted to settlements or communities of approximately 150 homes, "More of approximately 150 homes," Moore said. "This is a most significant 15 to 1 ratio."

The existing microwave regulations were largely drawn up during the 1950's, according to Moore. "CATA believes a whole fresh, new look at the microwave rules and regulations is in order," he added.

"We believe that if the present day rules that restrict the advance of technology were re-appraised, and if the rules were not merely relaxed but totally rewritten from the ground up, that the Commission's 1952 dream of quality television for all Americans would move several steps closer to realization."

Canadian Fiber Optics Test Announced

CALGARY, ALTA.—In a move designed "to return Canada to preeminence" in the field of cable television technology, five members of the Canada Canadian Cable Television Association and an associate member have formed a consortium to research and develop the uses for fiber optics within the industry.

The consortium, which includes Premier Cablevision of Vancouver; Canadian Cablesystems of Toronto; National Cablevision of Montreal; Rogers Cable TV of Toronto; Cable TV of Montreal and Canada Wire and Cable of Toronto, are incorporating a new company, BCN Fibre Optics Ltd., Canada's Federal Department of Communications is also expected to participate in that $1.5 million test.

The test is being termed an "open project" with the results to be made available to the cable industry in Canada. As presently conceived the link will have the capacity to carry 14 TV channels and 12 FM stereo signals over a distance of eight kilometers "with studio quality."

It will be carried out in London, Ontario, and will allow technicians direct comparison to a conventional system over the same distance carrying the same signals according to planners.

Moreover, the Canadians appear to be particularly excited about the project because of plans to use digital transmission. The use of digital technology will preclude the need for amplifiers in line at regular intervals through the system as is necessary with analog transmission. It is hoped that the digital repeaters will prove their worth in lessening signal degradation.

One of the main goals of the consortium, in addition to eventually being able to reduce costs through fiber optic technology and improving picture signal quality, is to be able to more practically extend cable television service to outlying communities. It is generally conceded that microwave spectrum is becoming a scarce resource in Canada and alternatives are being sought to expand distribution capabilities.

Members of the consortium made it clear in Calagary, during the CCTA's 20th annual Convention, that they have thoroughly researched the rapid developments in fiber optics in the United States, and have opted for reasons in addition to Nationalism to explore the new technology's potential domestically.

Firm agreements with Canada Wire and Cable are still being worked out, but officials indicated that in the event Canadian manufacturers and distributors are unable to meet the BCN's standards, the consortium is prepared to look outside of the country.

The announcement of the groups plans was met with a great deal of fanfare locally and also rated coverage on CBC television and in newspapers throughout the country.

SCTE Records Banner Month in Membership Sign-Ups

WASHINGTON, D.C.—Robert Bilodeau, president of the Society of Cable Television Engineers, has announced that membership during May reached record numbers. "It's the greatest single month of membership, new and renewals, Sustaining Memberships and the affiliation of 56 SCTE members from Canada."

Comm/Scope Corporation, Times Wire & Cable Company and Sadelco joined SCTE as Sustaining Members during May. "A Sustaining Membership is a corporate entity who chooses to support the goals of SCTE with an annual dues minimum of $100," says Bilodeau. "Sustaining Members may be either cable operating companies or suppliers to the industry."

More than 50 SCTE members signed up during the first three weeks of May, with most submitting their dues with their applicatons. The affiliation of the Canadian members comes from the

Toronto, Ontario area of Canada. "We're pleased to have this continued good relationship with the cable television engineers and technicians in Canada," Bilodeau said. "And, we're seeing increasing participation throughout the United States as our members form chapters and program local meetings," he continued. "Recently, chapters have been formed in the Southeast, the Upstate New York Chapter is becoming quite active, and inquiries are coming in from New England, Colorado, Kansas and Florida."

Under SCTE's national structure, membership concentrated in any area of the nation may start a chapter to serve its members. The chapter is formed under the SCTE national by-laws, local officers are elected and programming is set up through the chapter.

Communications Act Rewrite Options Papers Available

WASHINGTON, D.C.—Copies of the Options papers prepared by the staff of the House Subcommittee on Communications for use during rewrite of the Communications Act of 1934 are immediately available for shipment.

The complete set of 8 volumnes may be purchased for $68. Individual subjects may be purchased at listed prices: OP-1 Broadcasting, $18; OP-2 Public Broadcasting, $10; OP-3 Cable Television, $10; OP-4 Domestic Common Carrier, $10; OP-5 International Common Carrier, $10; OP-6 Safety, Special and Mobile Communications, $10; OP-7 Privacy, $10; OP-8 Spectrum Resource, $10.

A mix of any 6 volumes except Broadcasting may be purchased for $55; any 5 except Broadcast are $48. Payment to Universal Information, Ltd., 1523 O Street NW, Washington, D.C. 20005, must be included. A $5 billing charge will be added to orders that are not pre-paid.

C-TAM Schedules Hollywood Conference

The Cable Teievision Administration and Marketing Society, Inc., (C-TAM) will hold a three day conference in Hollywood at the Century Plaza on July 25, 26 and 27th. It's a first-time industry exchange of marketing ideas between the motion picture industry and the pay-cable exhibitors.

The "C-TAM Goes to Hollywood" meeting will provide the group which buys, books and markets pay-cable television a first time opportunity to exchange ideas with the top creative marketing people within the motion picture industry.

Speakers for the motion picture industry who will tell the cable marketers, How the Movies Sell Movies, include: Tom Wertheimer, vice president of MCA; Gordon Weaver, marketing vice president of Paramount Pictures; Fred Goldberg, senior vice president of United Artists; MCA marketing specialist, Willette Klausner, and more.

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PROGRAM

Thursday, June 16

8:00 AM	REGISTRATION
9:00 AM	TECHNIQUES OF CABLE FM — Dick Old, Sales Manager, CATV Division, Catel, Mountain View, CA
10:00 AM	COFFEE BREAK — Time to meet fellow techs
10:30 AM	STRIP AMPLIFIER HEADENDS — Dwight Staechler, System Engineer of Blonder Tongue Labs, New Jersey
11:30 AM	HETERODYNE HEADENDS — Alex Best of Scientific Atlanta, Atlanta, GA
12:30 PM	LUNCHEON — Bob Kelly, Chairman, new York State Commission on Cable Television
2:00 PM	LOCAL DISTRIBUTION MICROWAVE — Abe Sonnenschein, Manager of AML, icrowave, Torrance, CA
3:00 PM	COFFEE BREAK — Time to meet fellow techs
3:30 PM	FCC ENFORCEMENT — Cecil Ellington, CATV Specialist, FCC, Arlington, VA (Slide Presentation)
4:00 PM	SPECTRUM ANALYSIS (VTR Presentation) — Ken Foster, Chief of Telecommunications, New York State Commission on Cable Televsion
6:30 PM	COCKTAIL PARTY — Music by Roslyn Balch, Radio-TV Entertainer
7:30 PM	FORMAL DINNER — Peter Gilbert, President of International Cable of Buffalo, guest speaker
9:00 PM	TOUR OF NEW YORK NETWORK OPERATIONS CENTER — A. E. Smith, State Office Building, Joseph Doherty and Ira Singer, hosts

Friday, June 17

8:30 AM	REGISTRATION — NEW YORK STATE CABLE TELEVISION ASSOCIATION
9:00 AM	SATELLITE TRANSMISSIONOF CATV — Bob Tenten, Chief Engineer, HBO, New York City
10:00 AM	COFFEE BREAK — Time to meet fellow techs
10:30 AM	DATA TRANSMISSION — Bob Dickinson, President of E-Com Corp., Berkeley Heights, NJ
11:30 AM	FIBER OPTICS APPLICATIONS — Bell Telephone Laboratories, Holmdel, NJ
12:30 PM	LUNCHEON — Tony Esposito, Executive Director, new York State Cable Television Association

CCTA Report

(Continued from page 4.)

ing problem facing the cable business is to decide for itself what exactly it is and what it wants to become.

"Cable television has thus far defied definition and this has some serious consequences," Lind said. "For one thing, the legislators reflect this confusion in their legislation."

Lind asked if the industry was content to remain a passive carrier of broadcasting signals or should it expand its role to include some common carrier functions. Should the industry become a programming entitity?

Further, he questioned whether its good enough to hide behind the "uncommon carrier" definition. "We must begin the task of clearly articulating where we want to be in the years ahead," he said, "This is going to be a most difficult task, for it means isolating all the possibilities, selecting some, and then spending time and resources to develop them to the point of presentation to the regulatory agencies and the public."

Canadian Radio-Television and Telecommunications Commission Chairman Harry Boyle's concerns are much the same, perhaps with a twist. Boyle addressed the convention and said that there is very little to be gained by an exhaustive search for the correct theoretical description of what cable television is and is not.

"What is more important," he said, "is the perception of the regulator, derived from statutory authority, as to the nature of the undertaking that is to be regulated."

As for the industry, he placed the importance on its perception of "the scope and limits of its responsibilities." And, he quickly added, "The Commission has never deviated from an essential interpretation that cable is an integral part of the broadcasting system."

He said, "the Commission has not treated cable as a traditional carrier imposing rates of return, tariff filings, and cost allocations on cable opeations. Quite the contrary is true."

CCTA Chairman Michael Hind-Smith likewise stressed the importance of the industry's relationship with broadcasting. In his annual report he chose the word "interface" to apply to what he said was substantial progress in improved relationships with broadcasters.

Seeking even better cooperation, Hind-Smith called for higher exemptions for program substitution

CRTC Chairman Harry Boyle collects himself after addressing the convention. In background are convention chairman Jack Davis and vice chairman Noel Bambrough.

Proceedings of the 20th Annual CCTA Convention were cablecast on two channels in French and English.

obligations, restoration of local FM signals for background audio, and further discussion of cable's future as an advertising medium.

But, generating as much excitement as anything, was the announcement of BCN and the fiber optics experiment. (See page 14.) It has such strong appeal to the Canadian psyche. They have felt for years that they have been preeminent in cable television; but, that perhaps, recently, they have let that leadership slip away.

The opportunity is there once again to regain that status they feel they have lost. They are collectively pleased to be taking the initiative, even if they can't accomplish their goals entirely with their own resources.

But, as CRTC's Boyle said, "We do not have the luxury of holding up technology while we study what to do with it." Most Canadians at the covention seemed to agree.

And they must decide whether or not they agree with Boyle when he says " . . . we use the comfort of old habits to protect us from exploring the potential of new technology."

"We cling," he said, "to the common carrier mythology that there is no relationship between content and means of distribution of communications. The truth is, we are in the grip of increasing communications technology that will shape content and influence our lives."□

—Pat Gushman, Editor

Technical session on extension of services explored microwave, satellites and fiber optics.

E.R. Jarmain, chairman, Cablesystems Engineering Limited, is interviewed by a television reporter following the announcement of the formation of BCN, Ltd., and the entity's plans for testing fiber optics.

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.

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Harvey Smith, CATV technician

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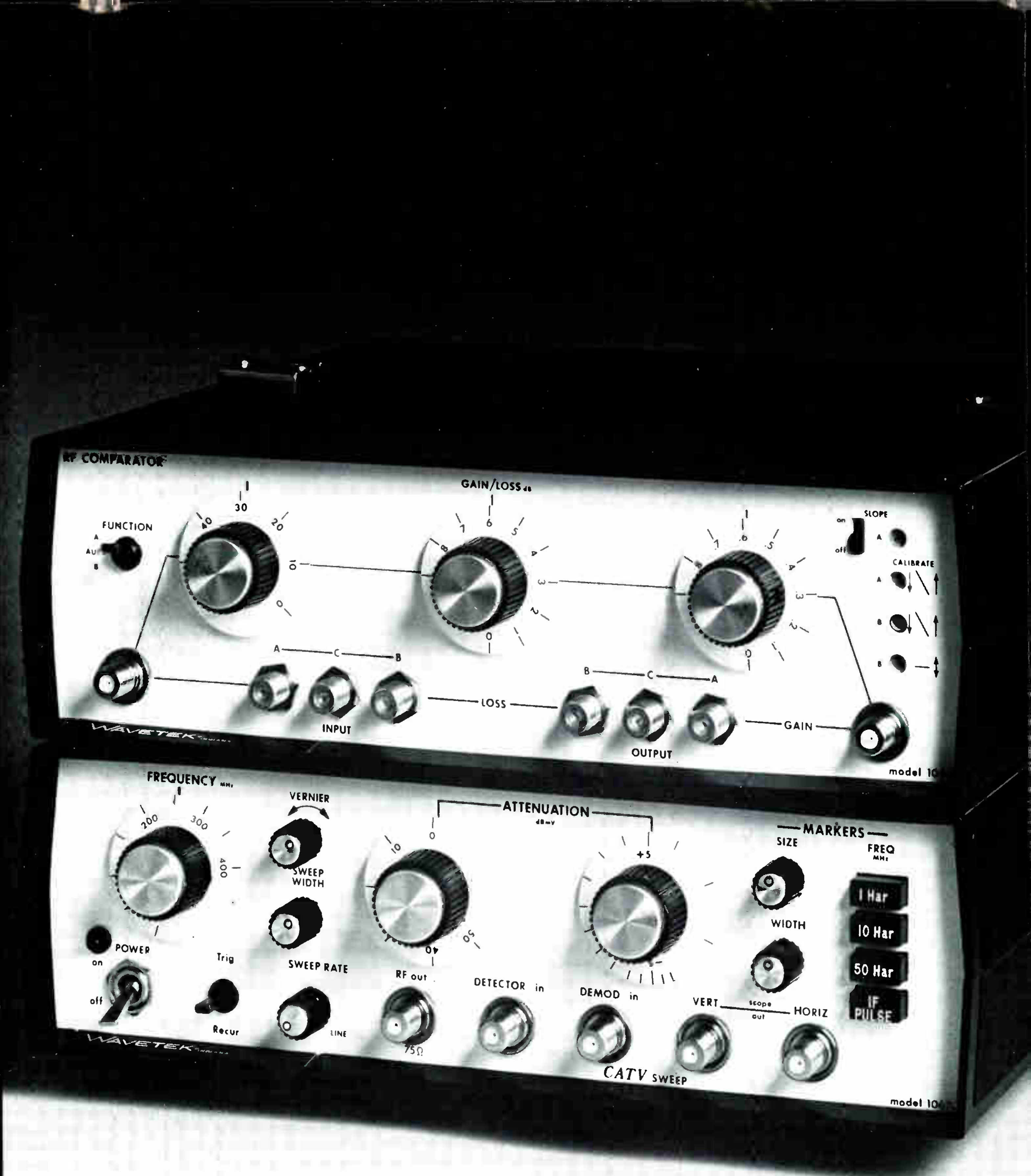
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CATV SWEEP

Reliable Design for Field Installation and Tests

Part I

A. Lochanko
American Electronic Laboratories, Inc. (AEL),
Lansdale, PA

Today's economics require a CATV system to provide more than just low initial cost. The system must be highly reliable, deliver high picture quality, and ensure low maintenance costs. Also, adequate margins must be provided, through conservative design and specifications at all levels, to allow for an increase in channels carried, alignment errors, test equipment miscalibration, and system expansion.

AEL has recently installed a high-reliability low-maintenance CATV system in Wilson, North Carolina. The system is a single-cable sub-split type having a total cable length of 116 miles. It incorporates 80 bi-directional trunk stations and 300 line extender stations. Currently, over 4,000 well satisfied subscribers are served by the system which is intended to serve up to 7,000 subscribers.

Since being installed, the system has provided outstanding performance in all critical parameters such as:

- Transmission response flatness
- Distortion levels
- Signal-to-noise ratio
- Hum modulation
- Stability with temperature variations.

The service record has shown that the system is highly reliable, is easy to maintain, and is stable under extremes of temperature and humidity variations, which have been very severe this year.

The following paragraphs present the basic concepts considered in the design of the hardware and the system. Also covered are the results of post-installation performance tests. The concepts presented will provide useful background information to system designers, field personnel, and system owners.

System Design Concepts

The refinement of a CATV system is determined primarily by the requirements of picture quality and the need of stable, reliable performance under changing environmental conditions.

Among the major electrical parameters determining picture quality are the level of distortion products in the system, the overall signal-to-noise ratio, flatness of transmission response in a given channel, ghosting due to reflections (mismatches), and group delay.

Part of the Wilson, North Carolina, system is shown in Figure 1. The cable network consists of 0.750 in., Parameter 1 cables for the trunk spans and 0.500 in. Parameter 1 cables for the feeders. The RG-59/U cables (foam polethylene) are used for the tap-to-customer spans. Knowing the cable types used, transmission frequencies, and the ambient temperature, the cable losses are easily determined. Typical cable losses of 68° F are:

Cable Type	Cable Length (ft.)	Loss at 270 MHz (dB)	Loss at 50 MHz (dB)
RG-59/U Foam polyethylene	100	4.15	1.73
0.500 in. Parameter-1	1490	21	8.3
0.750 in. Parameter-1	2120	21	8.2

The loss values vary by approximately 1.1 percent for each 10° F change in ambient temperature.

The cable spans on Figure 1 are 21 to 22 dB at 270 MHz; these cable spans take into consideration final achievable performance results with minimum hardware used in the system.

System optimization requires evaluation of noise and distortion parameters; these parameters determine the number and types of amplifiers in the cascade, system cable spans, and optimum operating levels, as shown in the Appendix.

On the average, a typical TV channel signal delivered to a subscriber in the Wilson, North Carolina, system has the following characteristics: level from 3 to 6 dBmV, depending upon the customer's location in the local distribution system; cross modulation distortion level better than -56 dB; composite intermodulation levels better than -65 dB; flatness variation over a video channel better than 0.06 dB; gain variation to 0.5 dB maximum; slope variation +0.25 dB. For a TV picture of excellent quality (no perceptible "snow"), the signal-to-noise ratio must be at least 45 dB. Tests on the Wilson system have shown the signal-to-noise ratio to be 46 dB. Refer to the Appendix for derivations of the above parameters.

Refer again to Figure 1. Twelve-channel air link television signals are received by the antenna array, processed at the headend and sent over the main transportation run to the hub. The main transportation cable runs are 2100 to 2220 ft. in length and represent cable losses of 21 to 22 dB at 270 MHz per run. The signal flow from the hub can be easily traced.

The system design specifications were achieved by employing an ASG (Automatic Slope Gain) station at every third trunk location. This limited use of the ASG stations is achieved by careful design of the automatic control circuitry resulting in a station that tracks cable with extremely good correlation over a wide temperature range as shall be shown. Good temperature compensation ensures stable performance.

The ASG uses Ch. 5 and Ch. 12 for the control carriers without any appreciable effects caused by sync or other modulation. This is achieved by employing the true peak detector combined with sync filtering in the detector circuits. Temperature stability of the control module is achieved by using temperature-stable capacitors in the tuned circuits. Also, other temperature compensating devices are used in the detectors to stabilize drift due to the diodes and the operational amplifier. The temperature stability of the circuits is ensured through proper compensation techniques. The time constants of the ASG circuits are such that short time variations in the signal do not noticeably affect the gain or slope of the system. Only the long-term variations, such as temperature effects, will cause the ASG circuits to respond; however, the detector design minimizes recovery time from large amplitude transients. The adjacent channel's interference to the control carrier has been minimized by using stable, highly-selective circuits and filters in the control modules.

The function of the ASG module is to compensate for effects of long term temperature variations of cable; it accomplishes this function in conjunction with the gain and slope circuits in the trunk module. The pin diode slope and gain circuits are designed to ensure excellent cable tracking for 10 dB of cable variation. This is accomplished by ensuring that these circuits, as well as all others, maintain at least 18 dB of input and ouptut return loss. As a result, there is a minimum of deterioration in tracking characteristics over the entire adjustment range.

To compensate for cable characteristics, each station uses fixed equalization 3 to 5 dB less than the cable being compensated. The additional equalization is provided by the slope control circuits manually or automatically.

To maximize station cascadability, it is essential that the amplifier module have as large a noise and distortion performance window as possible. The Mark IV station trunk

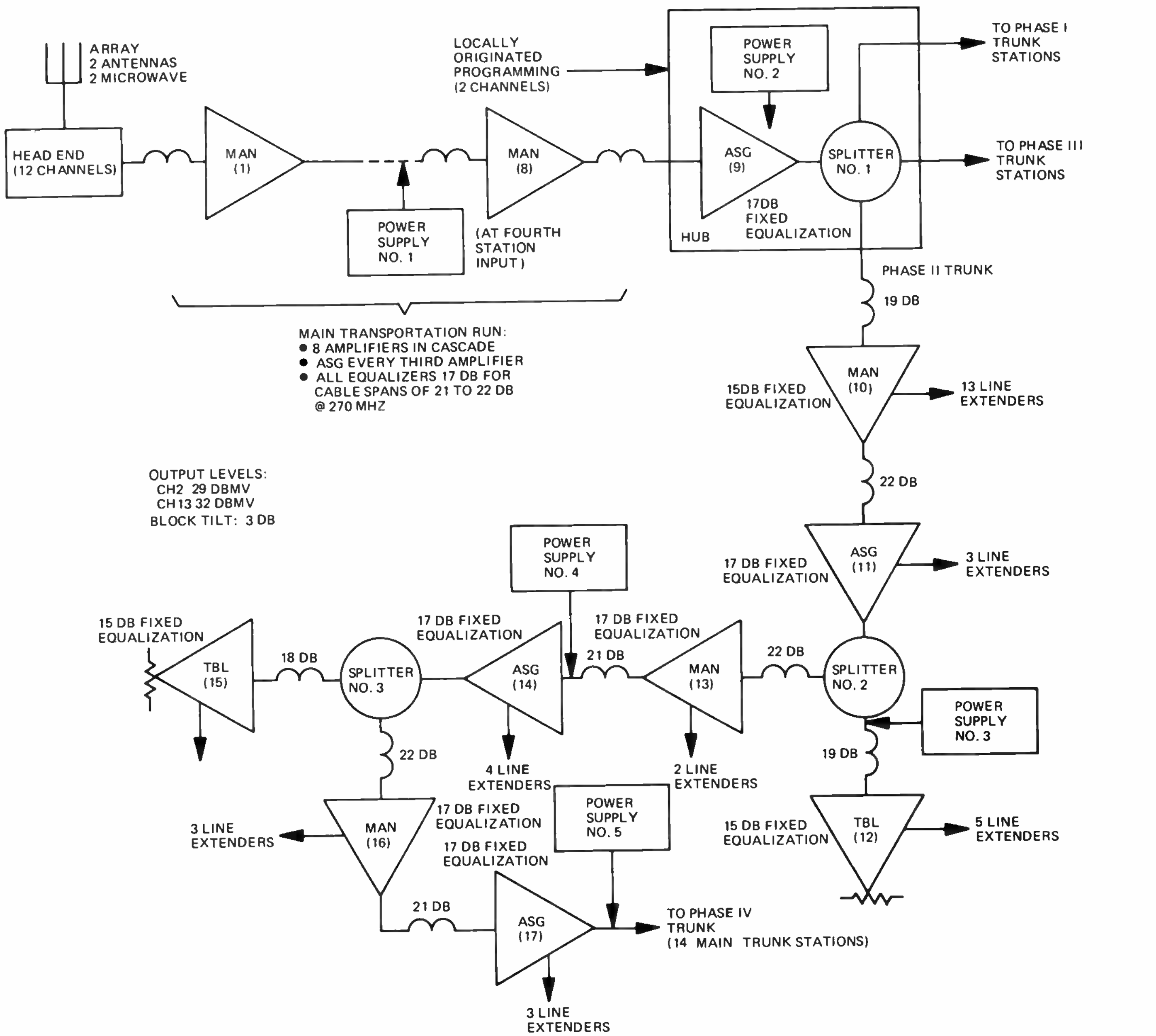

Figure 1. Typical Trunk Section of Wilson, North Carolina System

module has achieved this by using a pin diode gain control attenuator at the amplifier's input. To accomplish this, two critical performance parameters must be optimized; namely, insertion loss and return loss.

The amount of insertion loss in this circuit is directly additive to the noise figure of the input hybrid in determining the overall noise figure of the module. In recognition of this requirement, the insertion loss of this pin diode circuit has been maintained at 0.5 dB. This slight compromise in noise figure is overshadowed by the improvement in distortion performance when compared to a circuit that would place the pin diodes after the input hybrid wherein, with higher levels present, the diodes would add significantly to the station's distortion.

The attenuator's second design parameter, return loss, is equally important since it directly affects response flatness, cable power is accomplished at each station and is also discussed below.

The block diagram of Figure 1 demonstrates the manner in which any similar system can be developed by using high-quality versatile stations. Figure 2 shows local signal distribution in the Wilson system from a typical trunk station to the TV set. Local distribution from the ASG station No. 14 (on Figure 1) is typical of the entire system.

Local distribution in this area is accomplished using 0.500 in. Parameter 1 coaxial cable and four AEL CVT-5E line extender stations. Signal input to the line extenders is 19 +2 dBmV; output levels are approximately 42 dBmV for high band signals and 39 dBmV for the low band. Signal taps to the subscribers are represented by the small rectangles. Distribution to the subscribers is accomplished by RG-59/U cable; tap loss for

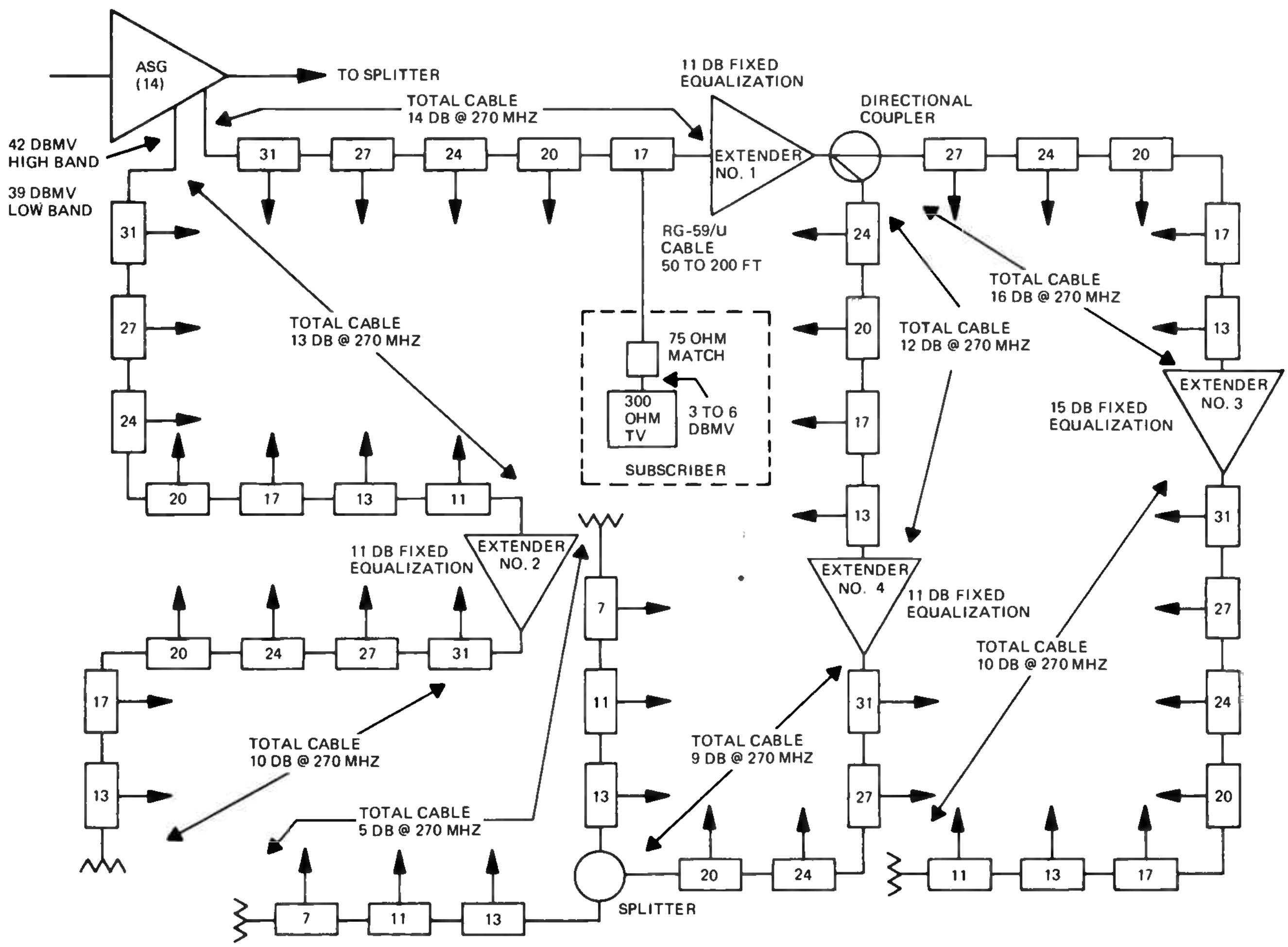

Figure 2. Wilson, North Carolina, CATV System (Local Distribution from Trunk Station No. 14)

tracking performance, the characteristics of the station's input diplexing filter, and the return loss of the entire station. Observe that, as a result of locating the pin attenuator at the input, the station exhibits a constant carrier to noise. This simplifies carrier to noise calculations for temperature variations. Even more stringent controls on return loss are established for cascaded building blocks within the station in order to hold the very flat response which will be discussed later.

The AC power is inserted into the cable runs by corresponding AC power supplies as shown in Figure 1. Programming of the AC each subscriber circuit is noted in the rectangles. Other aspects of the distribution are marked on Figure 2 (equalization, cable spans, etc.).

The CVT-5E extender stations with their low distortion and adequately flat transmission response will permit expansion of the distribution system as system expansion becomes necessary. The low distortion is achieved by using high-quality hybrid devices in the amplifiers.

The packaging approach in the CVT-5E station allows good thermal paths for the active devices in the station. This results in a relatively low temperature rise within the housing and subsequently high reliability.

Trunk Station Design Concepts

The station's design features greatly affect the system's performance. To ensure high-quality station performance, the pin diode slope circuit and its control circuitry must precisely track cable slope while maintaining an excellent match to surrounding circuits.

Several aspects of the Mark IV stations design are considered; namely, the rf signal paths, base plate, passive devices, rf modules, power supply, protection circuits, and packaging principles.

The rf signal flow paths are presented in Figure 3, "Mark IV Functional Block Diagram," and are self-explanatory: they represent a two-way station with signals from the Trunk Input to the Trunk Output port and also to the feeder cables (54 to 300 MHz); the return path (5 to 32 MHz) is from the Trunk Output port to the Trunk Input port; also from the Feeder Cables to the Trunk Input port. The station may have either Manual or ASG control of gain and slope.

In the Wilson system, the return path of 5 to 32 MHz capability is not used at the present time, but it is an integral part of the installed and tested equipment. Plug-in untuned modules will complete the upstream path with only level setting required.

In addition to wide design margins for electrical parameters, all station modules must be considered in terms of mechanical design criteria. Factors to be considered, in addition to the temperature rise contribution of each module are: ease of handling, ease of adjustment, plus ease and economy of repair.

The temperature rise contribution of each module is minimized by substantial heat sinking of components within the module and by careful attention to the design of the mechanical interface of the module with the station housing. Good mechanical interfaces ensure that heat generated by each module will be rapidly conducted to the station housing and then to the surrounding air. Low temperature gradients within the housing preclude the detrimental effects of local hot spots on electronic components.

The Mark IV station contains the base plate, power supply, and all signal modules within a cast aluminum housing designed to provide a low packaging density environment. This environment ensures that temperature changes within the housing are relatively moderate and provide good electrical stability and freedom from failures related to thermal effects. The hottest area temperature within the housing (heat sinks) is 84°C maximum at 60°C still air ambient test.

All station modules are considered in terms of mechanical design criteria; temperature rise within modules is minimized by adequate heat sinking within the module and from the module to the housing areas from which heat conduction to the surrounding air is good.

The base plate contains all passive devices such as: diplexers for two-way operation, directional couplers, splitters, plug-in fixed attenuators, plug-in fixed equalizers, fusing, surge protection devices, and ports for plug-in modules.

Overall rf signal flow has been planned to guarantee logical signal flow resulting in ease of field installation, structural isolation of the high level bridger output from the trunk input, and structural isolation of all upstream-from-downstream signals.

Feeder maker modules are of such a design that they effectively do nothing to the signal other than split it, which is, in fact, their sole function.

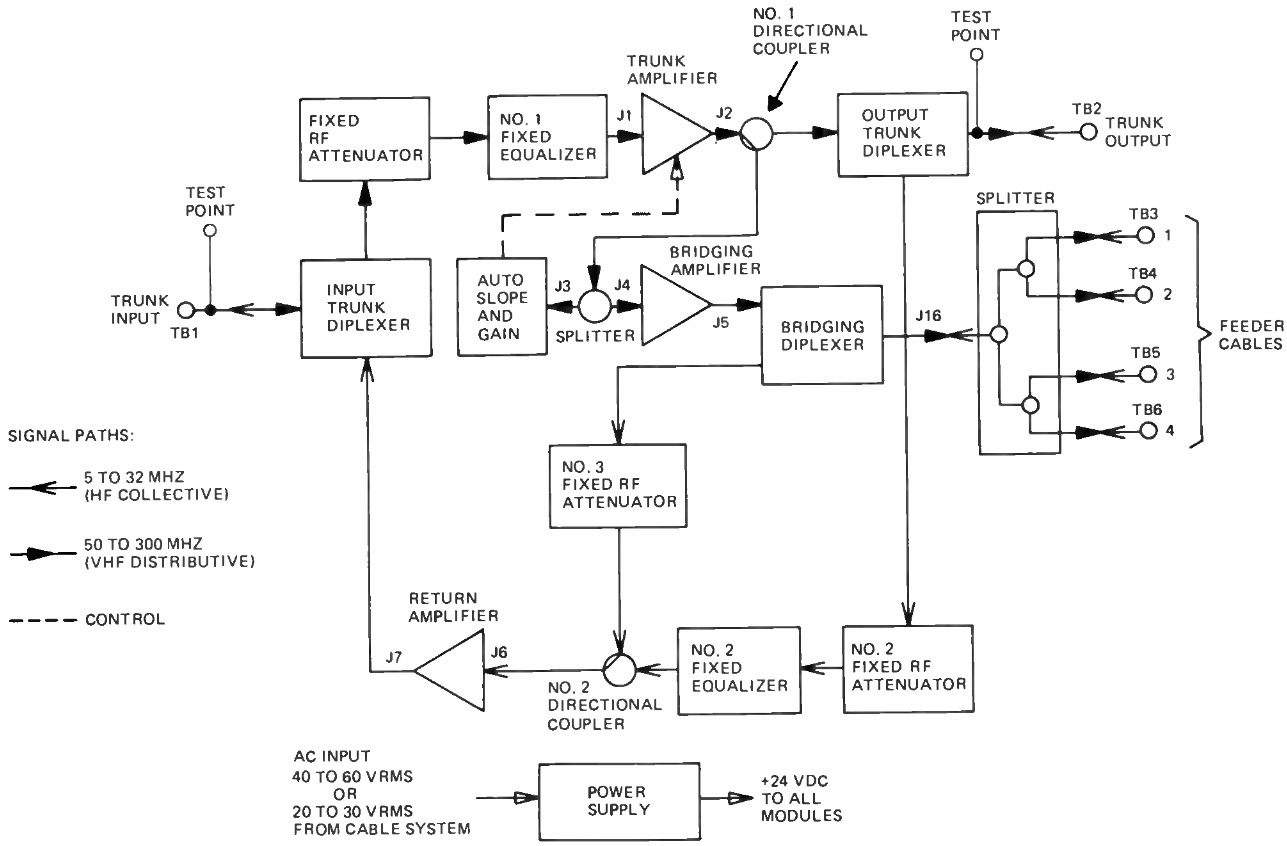

Figure 3. Mark IV Station Block Schematic

The reliability and efficiency of the station's power supply deserves extensive treatment. The station is not only dependent on the power supply's performance, but also on its location in the cascade; the inability of the power supply to function properly can result in a catastrophic system failure.

The power supply is an area of major concern for the station designer as it contains most of the heavy current circuit elements and, therefore, is the major site of heat generation and the major contributor for circuit element failures related to thermal effects. Good efficiency combined with low packaging density and adequate heat sinking to the housing surfaces ensure markedly reduced failure probability of all elements comprising the station.

This approach to power supply design suggests the selection of conventional series regulators rather than switching-type regulators. Switching-type regulators provide good efficiency with low dissipation (necessary for high-density packaging designs) for a wide range of AC input voltages in the system. The switching-type regulators, however, are more subject to damage than the series-type when subjected to the transients frequency encountered in operational systems. Transient safeguards for switching-type regulators are very often designed to handle the worst case of a given geographical or local area of installation. The transients that must be considered (for any type of the voltage regulator) include power line turn-on or turn-off induced surges, induction due to adjacent power lines with abrupt load changes, and lightning strikes.

The quality of the station's grounding system, both within the housing and at the local site (earth ground return) can not be overstressed. All module grounds must converge into a common station ground. According to regulations, all ground returns from the cable and wire systems on a utility pole (telephone, CATV, power lines of low and high voltage) must have common conductor to ground (earth); this conductor presents a major problem when its impedance is high. Also, the ground impedance from the return conductor to earth may contribute to the common high impedance path; soil type, presence of moisture and the return conductor surface area in soil determined quality of the earth ground. For good reliability, all local grounds should utilize heavy conductors and provide adequate and reliable contact with a good earth ground. The transients mentioned above may also damage any module in the station as well as the power supply.

In most power supply designs, the series-path power transistors and associated components are the first circuit elements to be damaged by heavy transients. The series-path transistors of a switching-type regulator are, however, more susceptible to transient damage. Since switching operation occurs at about 20 kHz and the transients apt to cause transistor damage are of a millisecond (or less) duration, heavy transients imposed on switching-type regulators during the off period (when input impedance is high) are likely to damage the device. Improvements in the area of transient protection for transistors operating in this manner will be necessary before switching regulators can operate with the same immunity to transients as series pass regulators.

The trapezoidal waveform AC input voltage, of either 40 or 60 Vrms or 20 to 30 Vrms, is taken directly from the cable system. System DC voltage is isolated in the station by an input transformer which has multiple primary winding taps. One of the taps is selected during installation to match the individual station's AC voltage. The six taps provided on the transformer provide an effective and inexpensive way to maintain high efficiency (70 percent). The voltage drop in the series-path transistor of the regulator is kept to a minimum, and the temperature rise within the housing is minimized, assuring higher reliability and stable performance of all modules within the housing.

Standard features of this supply include input and output overvoltage protection as well as short circuit protection. When the power supply senses an over-voltage condition, a crowbar circuit fires, thus opening a fuse and thereby protecting the station from damage due to prolonged over-voltages. The short circuit protection is of such a nature as to protect the power supply from damage. Resumption of normal power supply operation occurs after the short has been removed. Both the chokes and the copper paths of the trunk power passing circuit are capable of carrying the full current output capability of the 60-volt squarewave power supply.

To be able to establish which tap to use at a given cascade station a conveniently located DC test point is provided in the station's power supply. This test point will show the DC voltage in the voltage regulator before regulation. This voltage value is primarily a function of the AC rms value of the trapezoidal voltage applied to the isolation transformer's primary. A regular DC voltmeter can be used to select the tap for lowest heat dissipation in the series path transistor. The rms value of trapezoidal voltages measured in the field is speculative at best.

AC power programming flexibility is achieved by the incorporation of an additional fuse circuit; this fuse allows independent powering of the trunk from the distribution ports, or it permits the trunk and distribution lines to be tied together for powering purposes. Protection from the surge voltages is achieved by using ruggedized, fast-firing surge protectors at each port of the station.

With a primary design objective for the trunk station being the minimization of performance degradation for the broadband, extremely flat, low distortion hybrids, it is necessary that all circuitry in the station be flat, have good return loss, and minimize loss and distortion. As seen earlier in this article, not only is the design of the circuit important but also the circuit's location is important in determining the station's performance. Maintaining at least an 18 dB return loss not only ensures a minimum deterioration in flatness of the hybrids but also limits the number of controls necessary to optimize that flatness. As a result of all these considerations, the number of "pooch" adjustments in the trunk and bridger modules has been held to two. These two controls take corrective action at the extreme ends of the bandpass only, not in the middle of the band.

Appendix

For the purpose of this document we will assume that all cascaded amplifiers are identical, have similar performance characteristics, and are separated by identical cable lengths each of which has a loss equal to an amplifier gain. From this, two basic quantities may be obtained: noise and distortion; these characteristics determine the quality of the resultant TV picture and the final length of the system.

a. Noise Relationships

The noise output of a single amplifier with a terminated input is

$$N_1 = 59 + G_1 + F_1 \text{ (dBmV)} \qquad (1)$$

where,

G_1 = operating gain of amplifier in dB

F_1 = noise figure of amplifier corresponding to G_1 gain (in dB).

For further information, see card on page 28.

The lowest allowable signal output is:

$$S_{min(1)} = N_1 + R_{min} = -59 + G_1 + F_1 + R_{min}\ (dBmV) \quad (2)$$

where,

R_{min} = lowest acceptable signal-to-noise ratio (S/N) in dB. See Table 1.

Table 1. Acceptable Signal-to-Noise Ratio (S/N) Levels

TASO Picture Rating	S/N
1. Excellent (no perceptible snow)	45 dB
2. Fine (snow just perceptible)	35 dB
3. Passable (snow definitely perceptible but not objectionable)	29 dB
4. Marginal (snow somewhat objectionable)	25 dB

The system noise figure is determined as:

$$F_m = F_1 + C\ (dB) \quad (3)$$

where,

C = 10 log m (cascade factor)

m = number of amplifiers in cascade.

The noise output of the last amplifier is:

$$N_m = N_1 + C = -59 + G_1 + F_1 + C\ (dBmV). \quad (4)$$

Therefore, the lowest allowable signal output from the last amplifier is:

$$S_{min(m)} = N_m + R_{min} = -59 + G_1 + F_1 + C + R_{min} = S_{min(1)} + C = S_{min(1)} + 10 \log m\ (dBmV). \quad (5)$$

b. Cross Modulation Relationships

$$XM_m = XM_1 + 2C \quad (6)$$

where,

XM_m = system cross modulation
XM_1 = cross modulation of one amplifier
C = 10 log m (as shown in equation 3).

To determine the system maximum output, with system cross modulation expressed as XM_{max}, use the relationship:

$$S_{max(m)} = S_{max(1)} - 10 \log m = S_{max(1)} - C \quad (7)$$

where,

m = number of amplifiers in cascade

$S_{max(1)}$ = output in dBmV from one amplifier where cross modulation SM_{max} is on the worst channel with the other channels measured at the operating gain.

The system cross modulation $XM_m = XM_1 + 2C = SM_1 + 20$ log m.

c. System Noise and Cross Modulation Effect

To relate noise and cross modulation on system length, the term tolerance (TS) will be used as the allowable variation in level that does not produce objectionalbe picture degradation. This is expressed as the difference in dB between the lowest permissible output (determined by noise) and the highest permissible level (determined by cross modulation).

For a single amplifier this is expressed as:

$$T_{(1)} = S_{max(1)} - S_{min(1)} = S_{max(1)} + 59 - G\ - F_1 - R_{min}\ (dB) \quad (8)$$

where,

$S_{max(1)}$ as in (7).

For a cascaded system, the system maximum output is expressed as:

$$S_{max} = S_{max(1)} - C; \quad (9a)$$

system minimum output is expressed as:

$$S_{min} = -59 + G_1 + F_1 + C + R_{min}; \quad (9b)$$

and system tolerance is expressed as:

$$T_S = S_{max(m)} - S_{min(m)} = S_{max(1)} + 59 - G_1 - F_1 - R_{min} - 2C = T_{(1)} - 2C\ (dB). \quad (9c)$$

d. Maximum Number of Amplifiers

From equations 8 through 9c we may derive the value of tolerance equal to zero as:

$$T_1 = 2C;\ T_1 - 2C = 0 \quad (10)$$

With the value of T_S equal to zero for the maximum number of cascaded amplifiers, the tolerance of a single amplifier approaches the value 2C. During the state of zero tolerance only one operating level is posible.

e. Optimum System Operating Level

The optimum system operating level is defined as the operating level that is halfway between the maximum and minimum output (i.e., this is the midpoint between the level at which cross modulation becomes objectionable and the level at which noise becomes intolerable).

From equation 7 we have the formula:

$$S_{max(m)} = S_{max(1)} - C$$

where,

$2C = T_{(1)}$ for zero tolerance.

Therefore,

$$S_{max(m)} = S_{max(1)} - \frac{T_{(1)}}{2} \quad (11)$$

In order to find the optimum operating level for each amplifier in a cascaded chain, subtract one half the single amplifier tolerance from the single amplifier maximum output. At zero tolerance:

$$S_{min(m)} = S_{min(1)} + \frac{T_{(1)}}{2} \quad (12)$$

f. Triple Beat Distortions, Second Order Distortion

The occurrence of composite triple beat distortion is due to the third order distortion in the active devices of the system. The visible threshold level of the triple beat distortion is 46 dB below the peak carrier with 30 channels. However, AEL amplifier performance specifications far exceed these requirements and perform exceptionally well for this criterion.

The second order distortion levels also are very low (-68 dB or better). ☐

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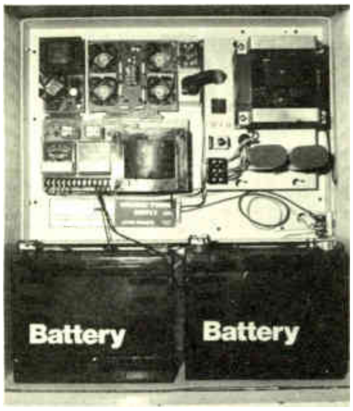

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Survey Reveals Heavy Spending On Test Gear

Sophisticated data communications networks require an ever-increasing range of telecommunications test equipment, according to a new study from International Resource Development Inc., a market research firm. Based upon an in-depth survey of more than seventy major users, the study points to the development of new domestic and international satellite systems, and the growing demand worldwide for improved telecommunications, as reasons for the "skyrocketing" growth in the test equipment market.

The 185-page report entitled "Telecommunications Test Equipment" says that worldwide shipments of telcom test gear this year will exceed $1 billion, and the market will pass the $2 billion mark by 1982. Communications common carriers are the largest users of test equipment, according to IRD, but there has been a rapid increase in the use of test gear by communications users, particularly the "Fortune 1,000" type of large companies, many of whom have their own extensive data communications networks.

Not a single communications user interviewed expected to reduce spending on telecommunications equipment during the next few years; all expected to be spending at least as much next year; and some users planned to increase their expenditures by "several hundred percent". On the basis of the survey, IRD expects most telecom market sectors to expand by at least 15% per year, with some sharply higher increases in certain categories, such as tech control gear in data communications systems.

The spread of domestic and international communications satellite networks will also bring with it extensive test equipment needs, the report says. IRD predicts a strong upsurge in telecommunications usage to result from new communications offerings from such suppliers as IBM-backed Satellite Business Systems.

As the use of test equipment has widened, according to IRD, the manufacturers have responded to a market demand for better "human engineering" of the equipment, with more automatic features and digital readouts. At the same time, the use of microprocessors and Large Scale Integration (LSI) has resulted in smaller and more portable equipment.

The IRD report analyzes the operations of more than one hundred suppliers of telecommunications test equipment, with estimates of each supplier's market share in each market subsegment. IRD points to the very attractive profit margins as evidence that users are more concerned about quality and performance than about price. The report points out that it is still possible for a small company to enter the test equipment market and expand rapidly.

Documenting its market estimates by a supplier-by-supplier revenue breakdown, coupled with the results of the user survey, IRD estimates the present size of the telecommunications market to exceed $1 billion worldwide, with spending of about $600 million in the U.S. in 1977. The report includes ten-year market projections for the U.S., Western Europe and Japan, and discusses the reasons for geographical differences in the growth of each market segment. □

Testing Video Signal to Noise Ratio Using a Modified Staircase Waveform

By Robert C. Tenton, Home Box Office

While there are several measurement techniques that are used for measuring video signal to noise ratio, they generally require specialized test equipment. Broadband RMS voltmeters have been used to measure the noise level of a system in the absence of a test signal.

Rhode and Schwarz produces a video noise meter that measures the noise on a flat field waveform but it is not common in the CATV field. Tektronix has an instrument which strips the noise from part of a line of video (Figure 1). Calibrated noise from this instrument is then inserted by the operator until the noise inserted appears on an oscilloscope to be equal to the noise on the signal (Figures 2 and 3). Lenco manufactures a device which uses a tangential noise measurement technique. This measurement is made by displacing the waveform vertically by a variable voltage; the traces are then brought together until the dark band observed between the two waveforms disappears (Figures 4 and 5). The displacement voltage which is directly related to S/N ratio, is measured by a logarithmic digital voltmeter in the instrument which displays the S/N ratio directly in dB.

Another approach (described in the NTC Report Number 7) uses an oscilloscope and low pass and weighting filters. The technique requires estimation of the quasi-peak-to-peak amplitude of the noise at blanking level; quasi-peak-to-peak being defined as "the average level [of the noise] ignoring large occasional spikes of noise." The measured voltage is converted to the video S/N ratio by referring to a graph.

Methods which require only a TV set would be ideal, but at this time there does not appear to be an accurate way to do this, although several approaches were investigated. The next approach was to rely on a wideband (10 MHz) general purpose oscilloscope with low pass and weighting filters.

Measurement Technique

In order to make a satisfactory S/N measurement, a low pass filter is required to remove noise energy which may be present above the desired video bandwidth. In addition, a CCIR Weighting Filter is used to "shape" the noise over the frequency band to correspond to the response of the human eye. It should be noted that all S/N measuring techniques use these filters to obtain a weighted S/N ratio. The oscilloscope used in the measurement

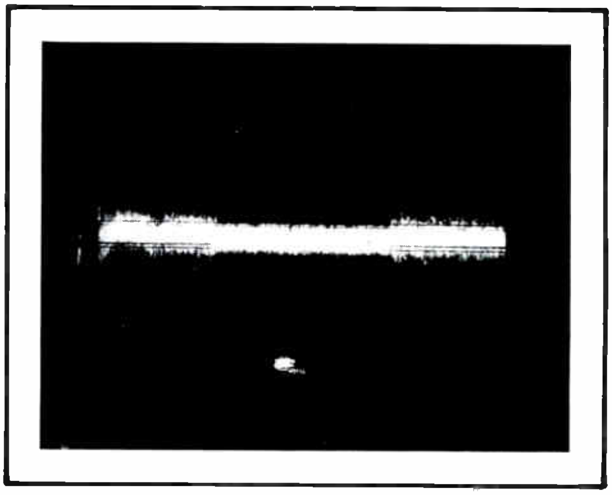


Figure 2

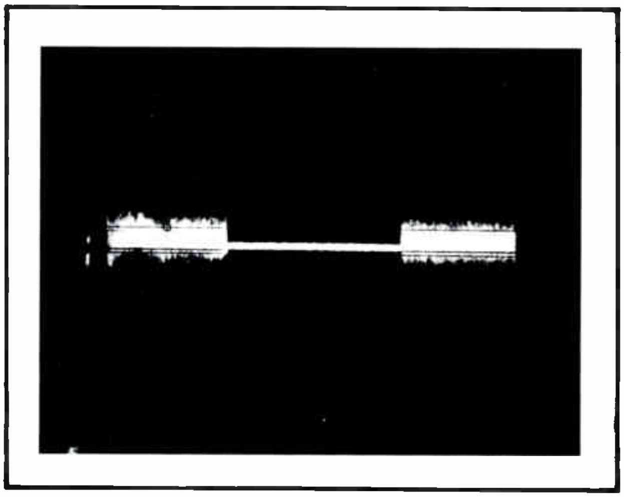


Figure 1

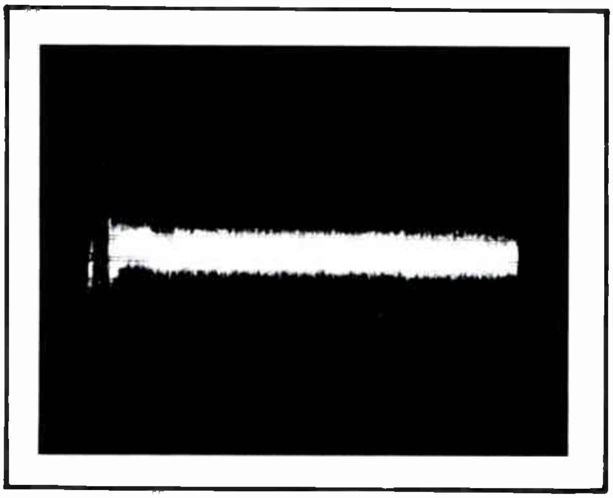


Figure 3

should have a bandwidth which is flat in the area of interest which means that it should have about a 5 MHz to 10 MHz bandwidth. Sensitivity should be about 20 mv/division minimum, and DC coupling is desirable although not necessary.

The S/N ratio measurement is made by setting the horizontal sweep to display one field of the test waveform. If the scope sweep has a vernier control, the display can be adjusted to have each of the 10 groups of steps fill one horizontal division; therefore each horizontal division will correspond to a specific S/N ratio. The S/N of the system corresponds to the last step which is completely filled by noise of uniform brightness.

The next step(s) which corresponds to a lower S/N ratio(s) will have a dark space (or "banding") between them. If banding appears between all steps, the S/N ratio is 57 dB or better; if the spaces between first steps are filled with noise, the S/N ratio is 56 dB. If the first and second steps are filled, then the S/N ratio is 55 dB and so on down to the last step. If the tenth step is filled, then the S/N ratio is 47 dB or worse.

Figures 8 through 11 show S/N ratios corresponding to 55 dB, 52 dB, 49 dB, and 48 dB respectively. The oscilloscope should be set up for "normal" brightness and focus although the measurement is not very sensitive to these variables.

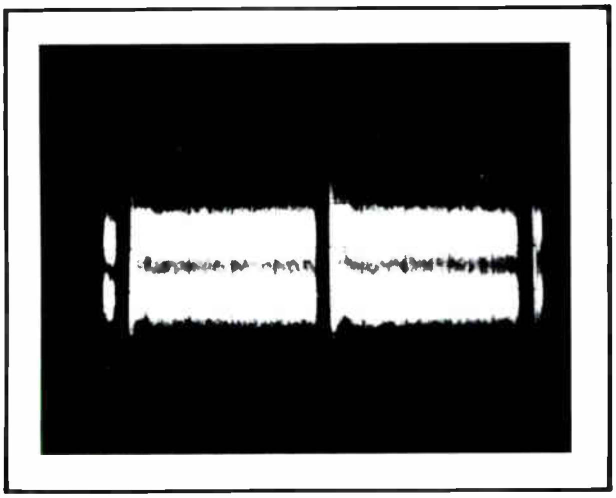


Figure 4

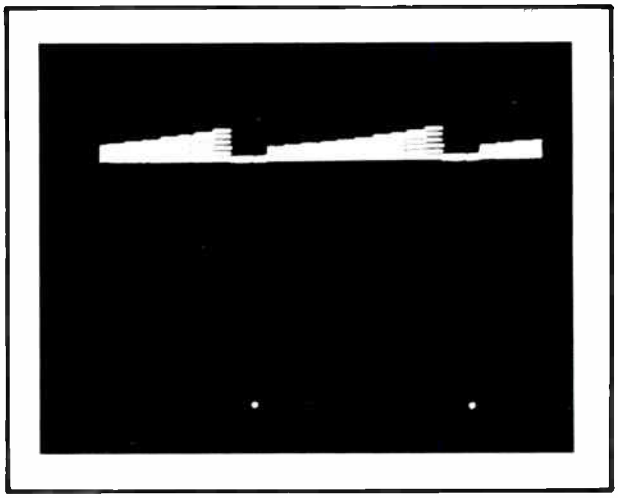


Figure 6

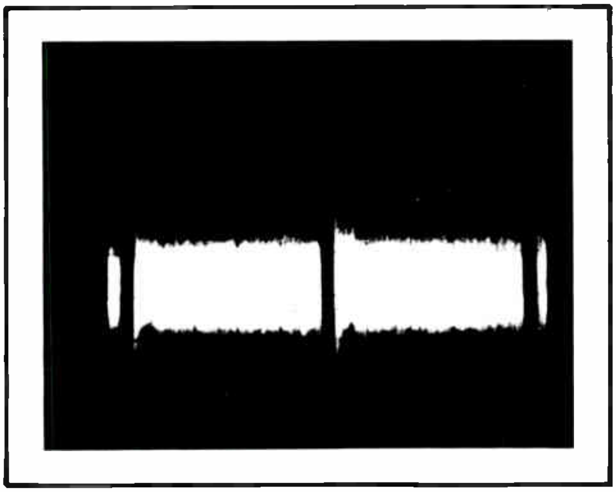


Figure 5

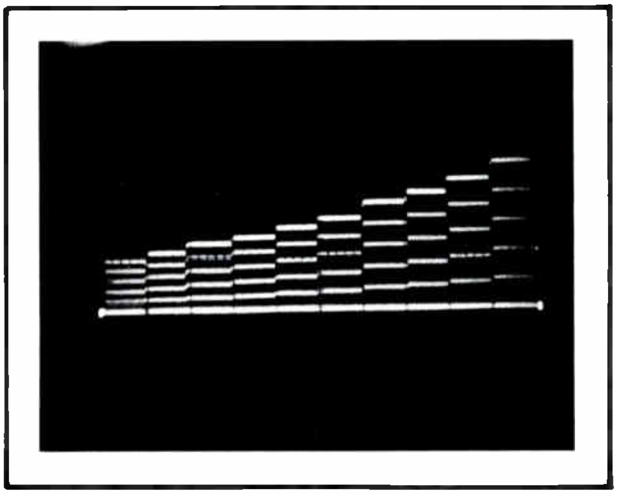


Figure 7

Proposed Method

If a full field 10 step staircase test signal is viewed on an oscilloscope such that a full field is displayed, the trace appears as 10 horizontal lines of equal spacing. if noise is added to the waveform as in a transmission system, the space between the horizontal lines will be filled in just as in the tangential method. Of course, the steps in the standard 10 step staircase are too widely separated for the S/N ratios which are generally encountered.

The generator can be modified to produce steps with closer spacing, but a staircase with equally spaced steps would be useful to measure only one specific S/N ratio. If, however, the spacing between steps is changed every 1.4 msec across a video field (Figures 6 and 7), then 10 S/N ratios could be measured. In this case 1 dB increments were chosen and adjusted to cover the range of 47 dB to 56 dB S/N ratio.

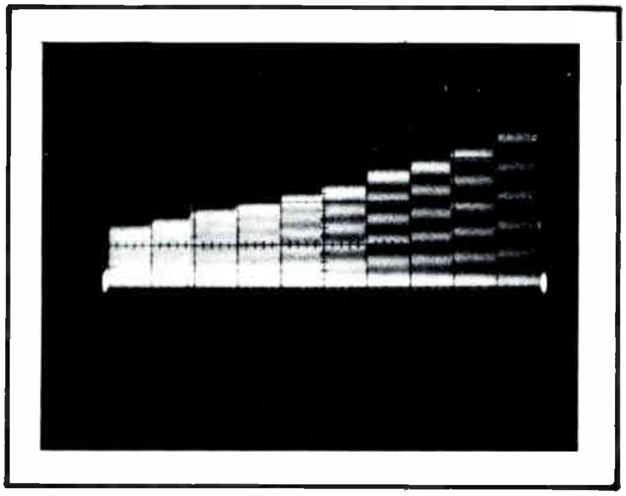


Figure 8

Accuracy and Resolution

The accuracy of the technique is dependent on the accuracy of the level of the test signal going into the system to be tested as well as the accuracy of the level between the steps. Resolution appears to be about 1 dB. The measurement accuracy does not depend on the accuracy of levels at the receive end nor does it require a calibrated oscilloscope.

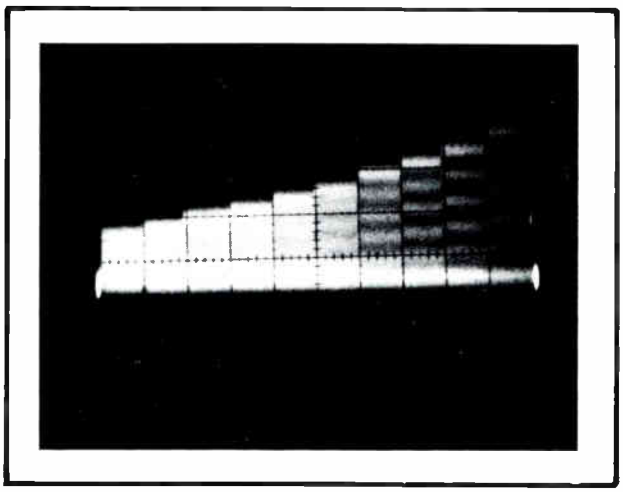


Figure 9

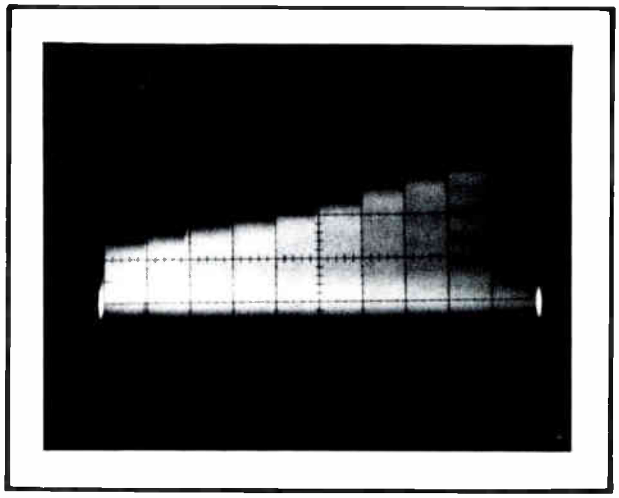


Figure 10

Field Tests

While this technique has been tested in a lab environment, further tests will be conducted to determine whether any difficulties occur in a field environment.

Applications

The primary application for which the S/N measurement technique was developed is satellite earth stations. Other applications include microwave transmission systems or possibly the cable system itself. The test signal could also be recorded at the beginning of a videotape so that the overall record-playback S/N ratio can be monitored. The test waveform can be set up to accommodate whatever range of S/N ratios that might be required for a given application.

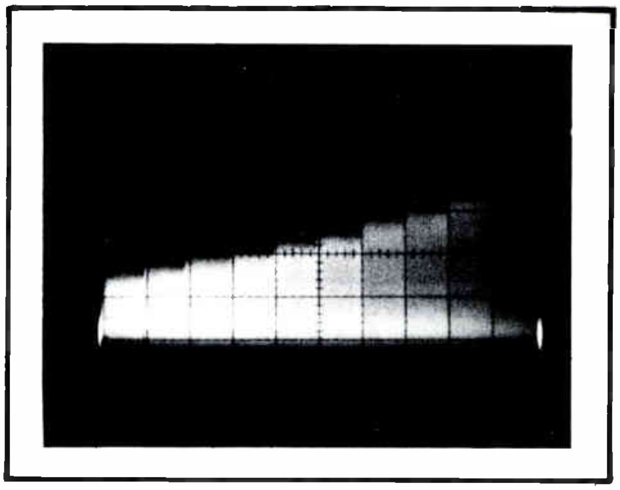
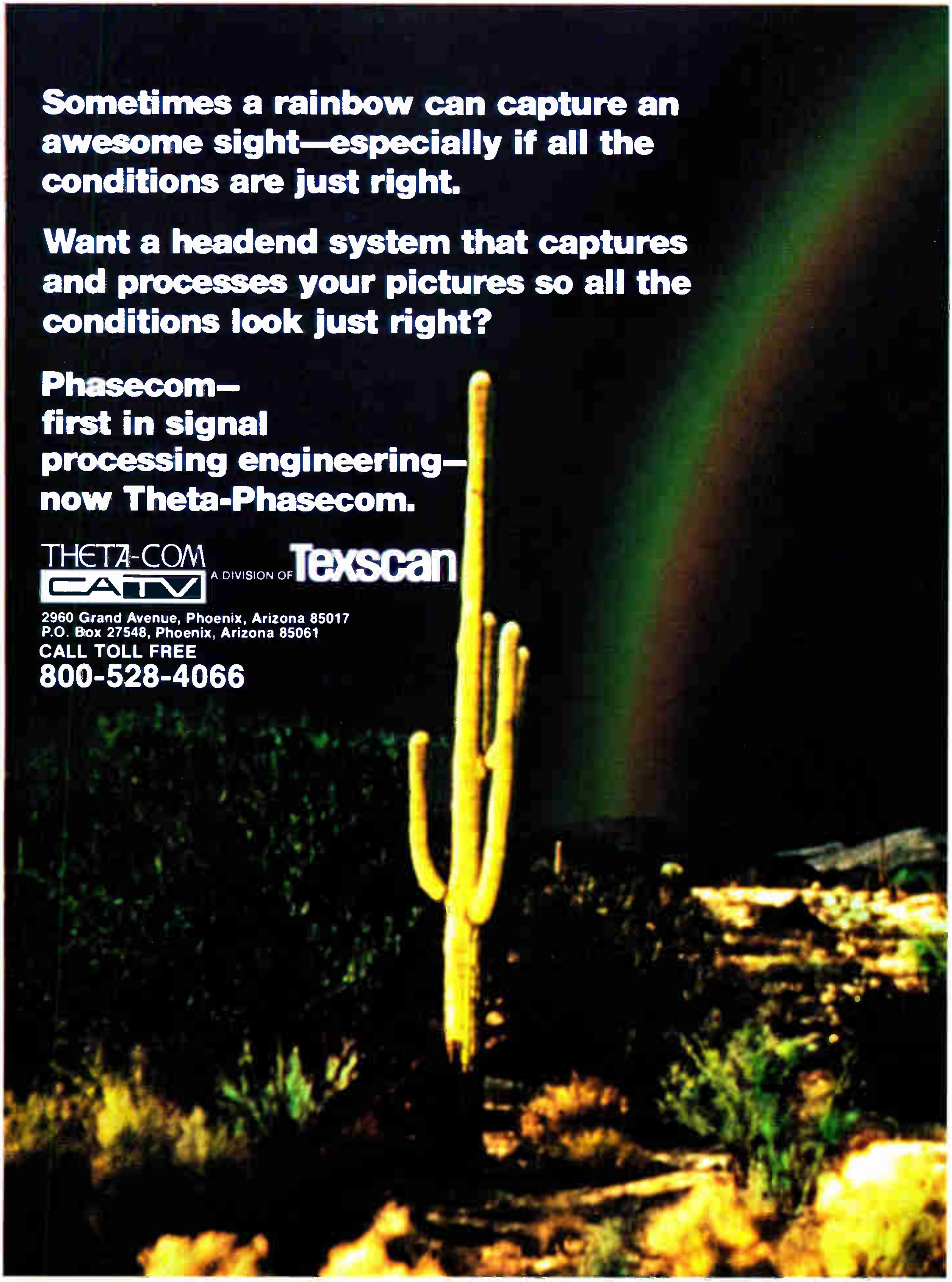


Figure 11

Acknowledgement

A special note of thanks is due to Jim Demetrius for his invaluable assistance in the construction, testing and criticisms of this technique.☐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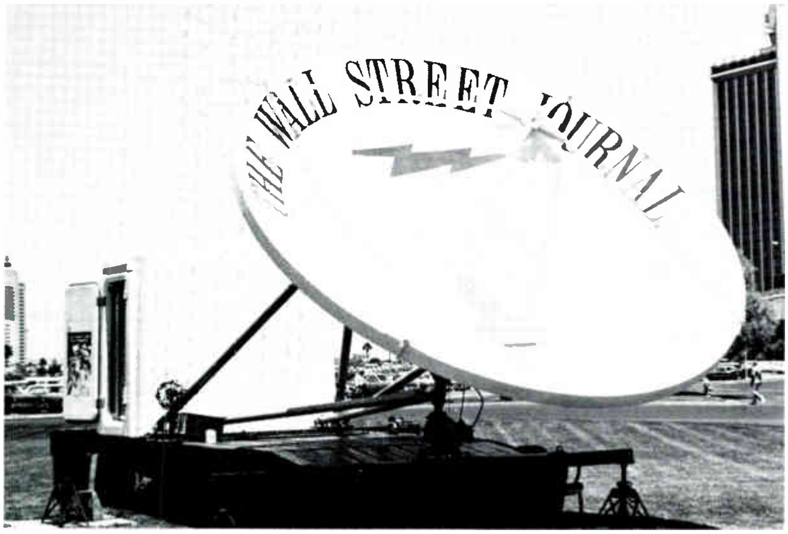

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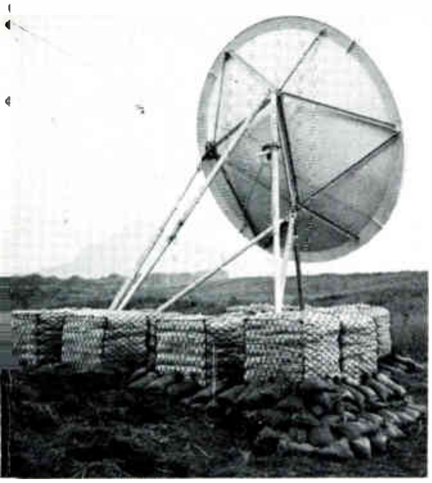

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