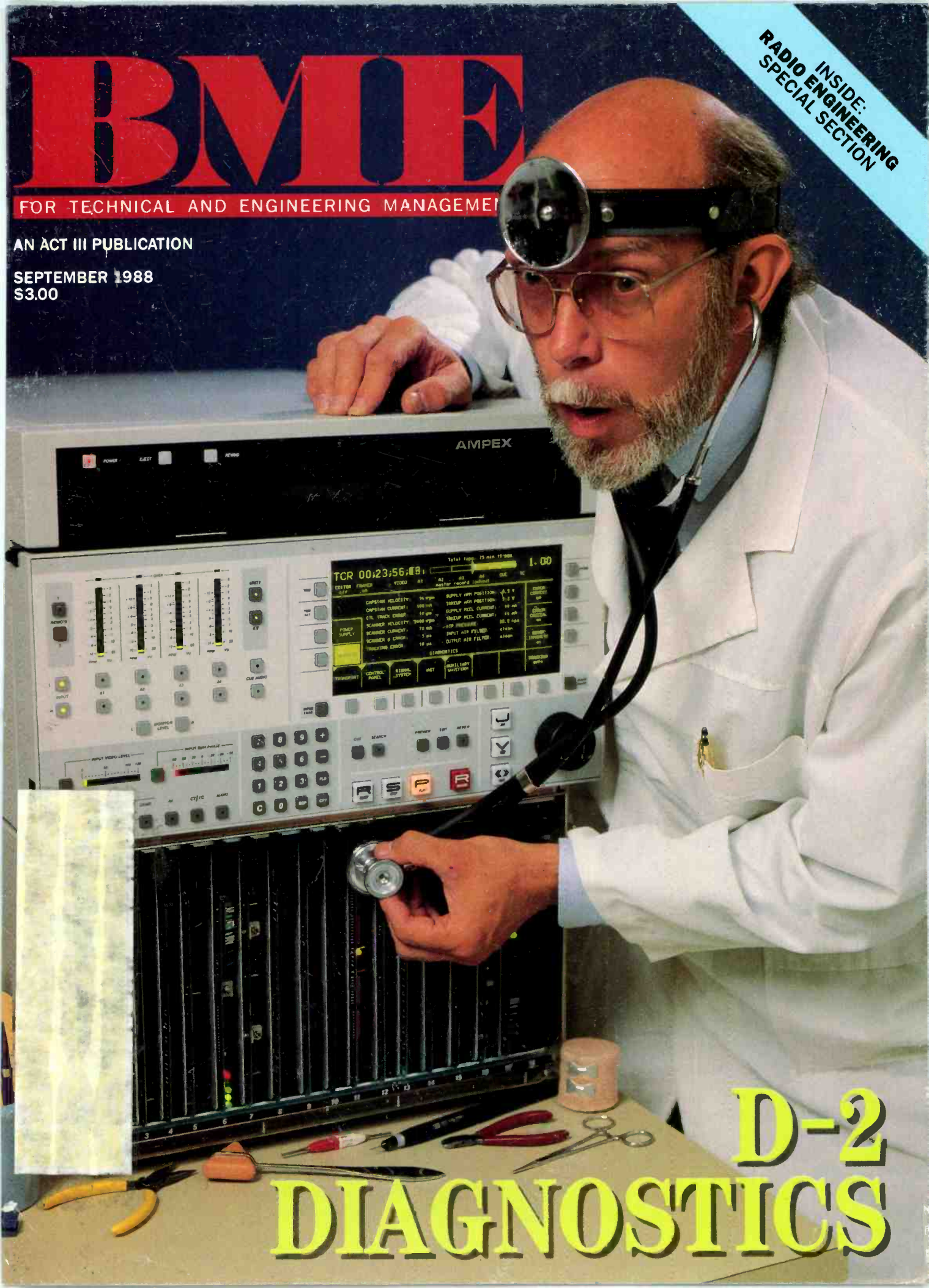
BME
FOR TECHNICAL AND ENGINEERING MANAGEMEI
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SEPTEMBER 1988
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RADIO ENGINEERING
SPECIAL SECTION
AMPEX
D-2
DIAGNOSTICS

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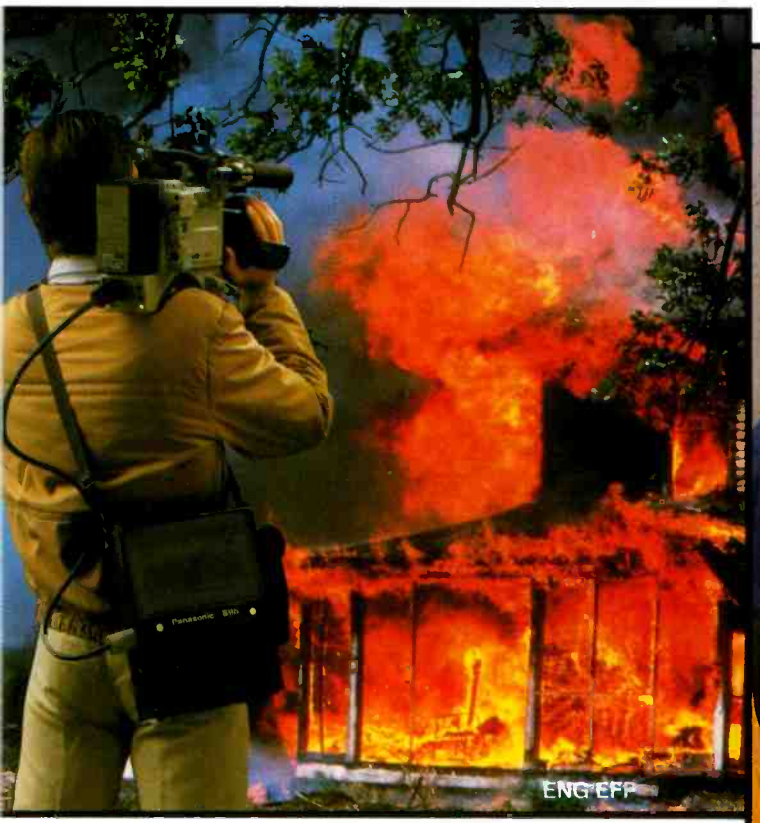

The SVHS format behind the Panasonic® Pro Series will change the way you look at half-inch recording systems. Because it delivers over 400 lines of horizontal resolution. At an affordable cost. So you can get a sharper image even as you sharpen your pencil.

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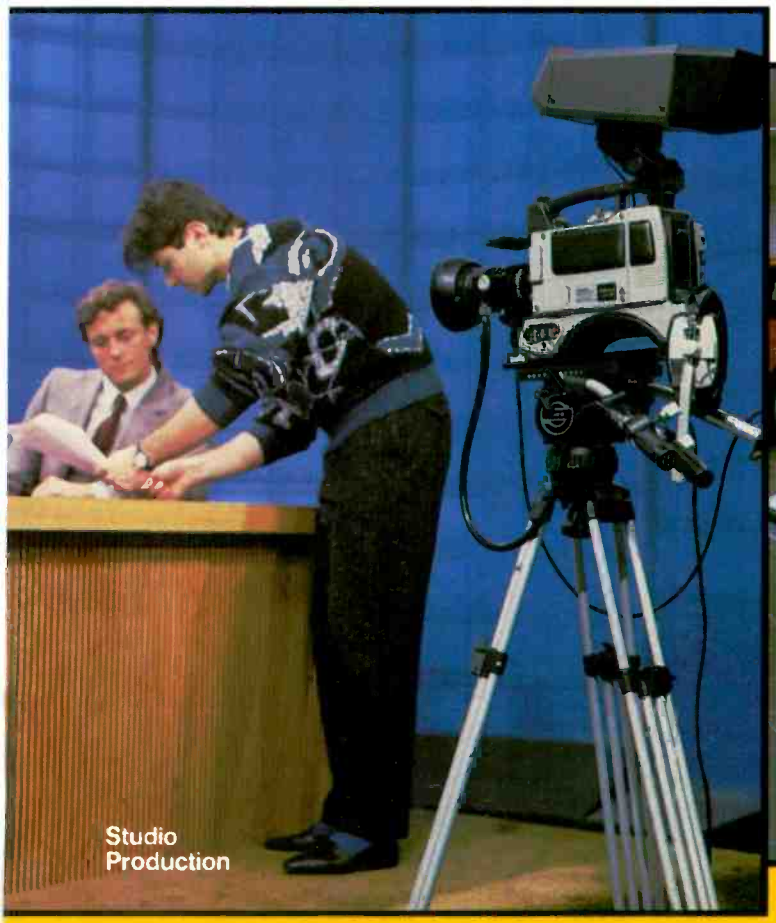
even as you sharpen your pencil.



Whether it be a small or large operation.

For video network applications, the Pro Series produces high quality images on both large projection systems and small screen monitors. With features like auto repeat playback for unsupervised presentations. And the system is upwardly compatible with standard VHS. So you can continue to use your existing library of recordings without any type of conversion.

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For more information, call Panasonic Industrial Company at 1-800-553-7222. Or contact your local Panasonic Professional/Industrial Video dealer.

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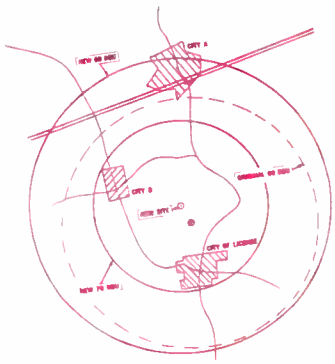
SEPTEMBER 1988
VOL. 24, NO. 9

On the cover:
"D-2 Diagnostics;" photo by Hudson Edwards, staff photographer Ampex Corp.



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Radio Engineering Section

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Digital Timetable

Features

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Unlike other consoles that try to be all things for all applications, the new Mix Trak 90 modular console from Broadcast Electronics is strictly designed for on-air use!

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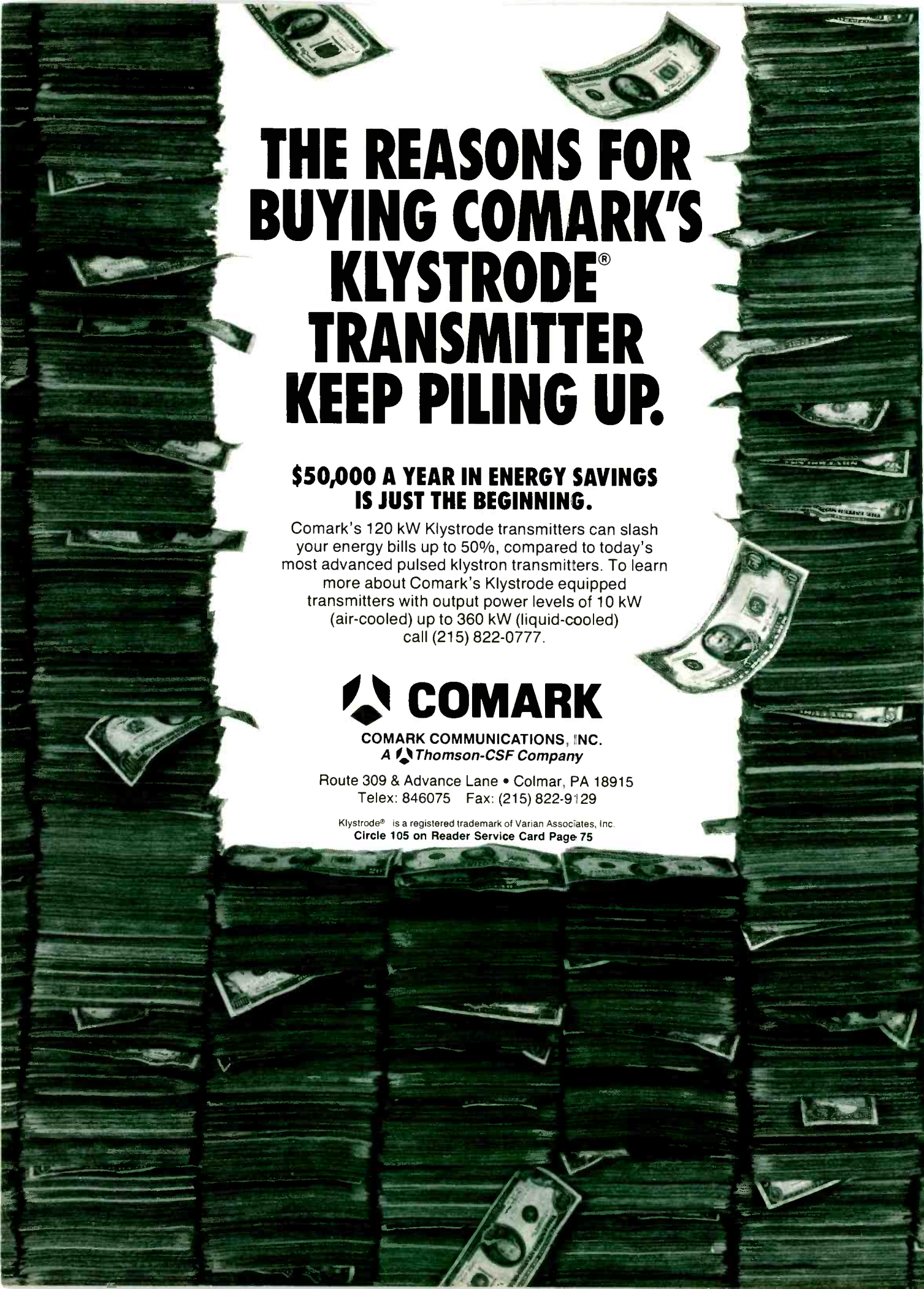

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VIEWPOINT

Technological changes are challenging our industry and causing us to rethink old ways.

Technology can solve an array of problems, as we all know, but often it brings about a new set of problems while solving the old ones. New technologies, furthermore, may displace older and more familiar ones. For the engineer responsible for keeping a broadcast station up to spec, it can be disconcerting when a new and presumably better technology throws a monkey wrench into established procedures. Suddenly, the familiar pattern on the waveform monitor is changed, or meaningless, or not there at all.

This month, *BME* looks at some of the technological changes that are challenging our industry and causing us to rethink old ways of doing things. The advent of digital video recording has already made a big impact on teleproduction facilities, and is poised for its inevitable, gradual entrance into the television station as well. Unlike analog recording formats, the digital video signal is an abstract stream of data with few or no meaningful characteristics on conventional test equipment. One means of extracting useful diagnostic information out of the composite digital signal is described in this month's feature on D-2 diagnostics.

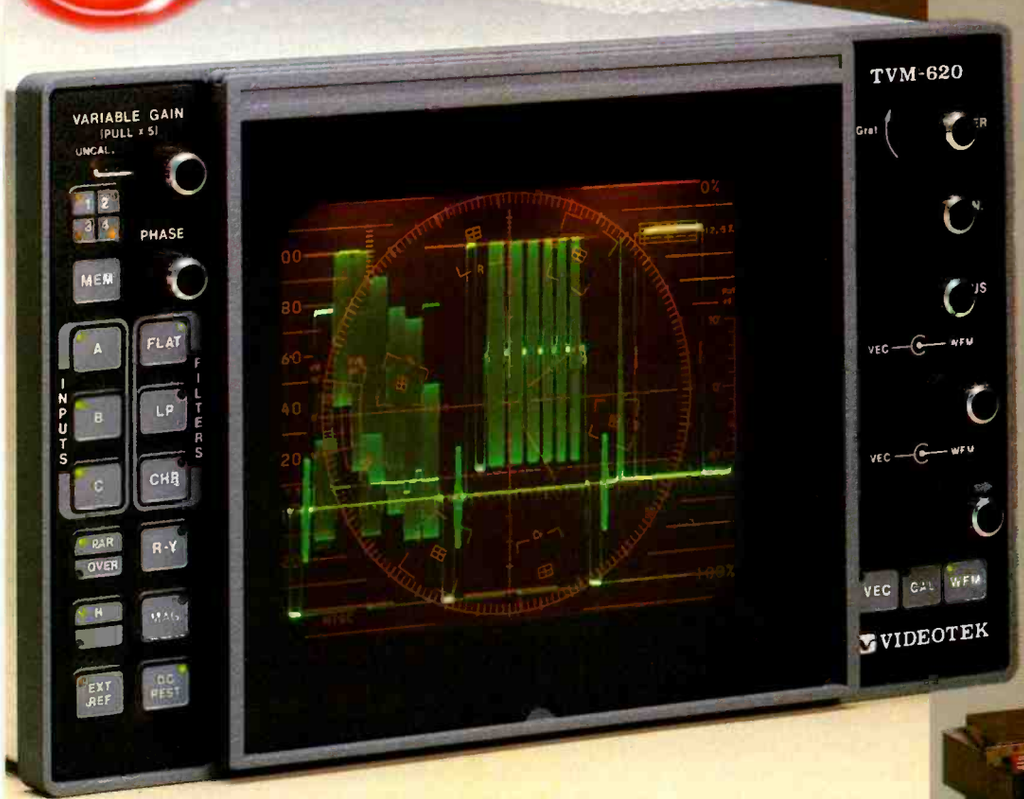
The rate of technological change is another bone of contention, with some users—especially on the teleproduction end—champing at the bit in impatience and others feeling rushed into premature decisions. This summer, a panel of industry experts, gathered at the first annual convention of the International Teleproduction Society, attempted to determine whether the movement to digital video is progressing at a rate beneficial to all concerned. Their comments are excerpted in "The Digital Timetable" in this issue.

Radio broadcasters often feel overshadowed by their showy sibling, television—even though U.S. radio stations outnumber television outlets 10 to one. When we recently asked a sizable sample of our readership how we could serve them better, radio engineers spoke out loud and clear demanding expanded coverage of their unique industry.

It's my great pleasure, therefore, to introduce *BME*'s new Radio Engineering section, which debuts in this issue. This radio-only section, dedicated to the needs of radio engineers, will appear every month. Our premier edition, which coincides with the NAB's Radio '88 convention, features a technical piece on synchronous AM noise in FM transmitters, along with an update on NRSC standards work. The new section is ably coordinated by *BME* senior editor Beth Jacques, and the coming months will bring a multitude of useful technical pieces. We're delighted to offer this section as a service to our radio readers. ■

Eva J. Blinder
Editor

Triple Play



Videotek's new combo monitor gives you more inputs, more output and more memory for less money.

Only Videotek's TVM-620 waveform monitor/vectorscope gives you three selectable inputs for multiple viewing combinations, a roster of other winning features *and* the economy of a two-in-one unit.

Parade or overlay modes let you view any combination of up to three inputs simultaneously with one touch of our new membrane control panel. And ours is the only combo monitor that currently offers user-defined, one-button memory recall.

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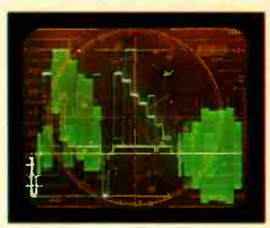
Engineers look to Videotek for thoughtfully-designed equipment that's built to be reliable and priced to be in your ballpark. See your Videotek dealer today about the TVM-620 plus our full line-up of test equipment.



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FEEDBACK

Smoke Out

In the June 1988 issue of *BME*, I noticed a comment made by Lindy Williams in the "New Ideas in Technology" section on Radio/Audio Studios ("Radio/Audio Studios: A Digital Future?" p. 70) pertaining to cigarette smoke in control rooms and near equipment.

Anyone who allows smoking around expensive electronic equipment, and especially around other human beings, is indeed a fool. The smokers should be sent outdoors. This observation is for us, unfortunately, based on experience.

David Fusco, president
Music Unlimited

Small-Market Blues

I have read *BME* since its inception. I thought the "Great Idea Notebook" feature ran a few years back was one of the finest things ever published. But, somewhere along the way, I feel both radio and small-market stations have been lost sight of. In *BME*'s May issue, only 21 out of 90 pages had anything to do with radio. I know that it is difficult to cover, with equity, the many exploding technologies that broadcasting now embraces, but this letter has been stirring for a long time now.

What brought the pot to a boil for me was Sim Kolliner's editorial ("Image, Stereotypes, and the Broadcast Engineer"). The world of broadcasting he describes bears absolutely no resemblance to anything I now do, nor, indeed, anything I have ever done as a CE since 1962.

I hope this plea is constructive—because what you do you, you do very well.

I suppose I remember those early years when I sat here with a grid-modulated W.E. transmitter and a shunt-fed antenna, poring over ev-

ery trade magazine for any help I could get.

I've certainly, since then, gotten a lot of help from *BME*, and I thank you for it. You might consider a few articles on radio basics and small-market stations.

John Gaboury, CE
KEZC-AM/KJOK-FM

As we talk to our readers—radio and television engineering management in markets of every size—we're impressed with the diversity of what people want to hear about. As a rule of thumb, large-market stations with budgets want to hear about the hottest new equipment. Medium and small markets want to know how other stations solve technical problems. Everyone wants a pass at issues, news and the technology behind the solutions and the new equipment. Everyone is very curious about what everyone else is doing. What's constant is the level of expertise and the commitment to broadcasting, whether the engineer holds a Class 1 license, technical degrees or a bootstrap badge of courage and creativity by way of keeping a Mom-and-Pop on-air in the worst storm to hit Shiloh since 1865. With this in mind, the September issue of BME *introduces* ***"Radio Engineering,"*** *a new monthly section that will focus on radio issues, news, new products and technical articles, which we hope you will find interesting, timely and useful. We also plan to look at some outstanding station technical profiles and some great technical ideas. Please let us know what you'd like to read in this section and we'll do our best to accomodate you. What "radio basics," for instance, would you like to see?—Ed.*

Fixing a Bug

Here are some modifications for the AFPADS.BAS program in the July issue of *BME* ("Audio Pads and Attenuators," p. 76). Ron Balonis sends the following clarification: *The loss (in decibels) for an attenuator or pad is a decrease in the power, voltage, or current at the output as compared to the input power, voltage, or current. In broadcast audio work, pad loss ususally refers to a decrease in the voltage or current, a loss in* level. *Due to some last-minute editing, I made two program changes that set AFPADS.BAS so that it calculated pads based on a* power, *not level, loss situation.*

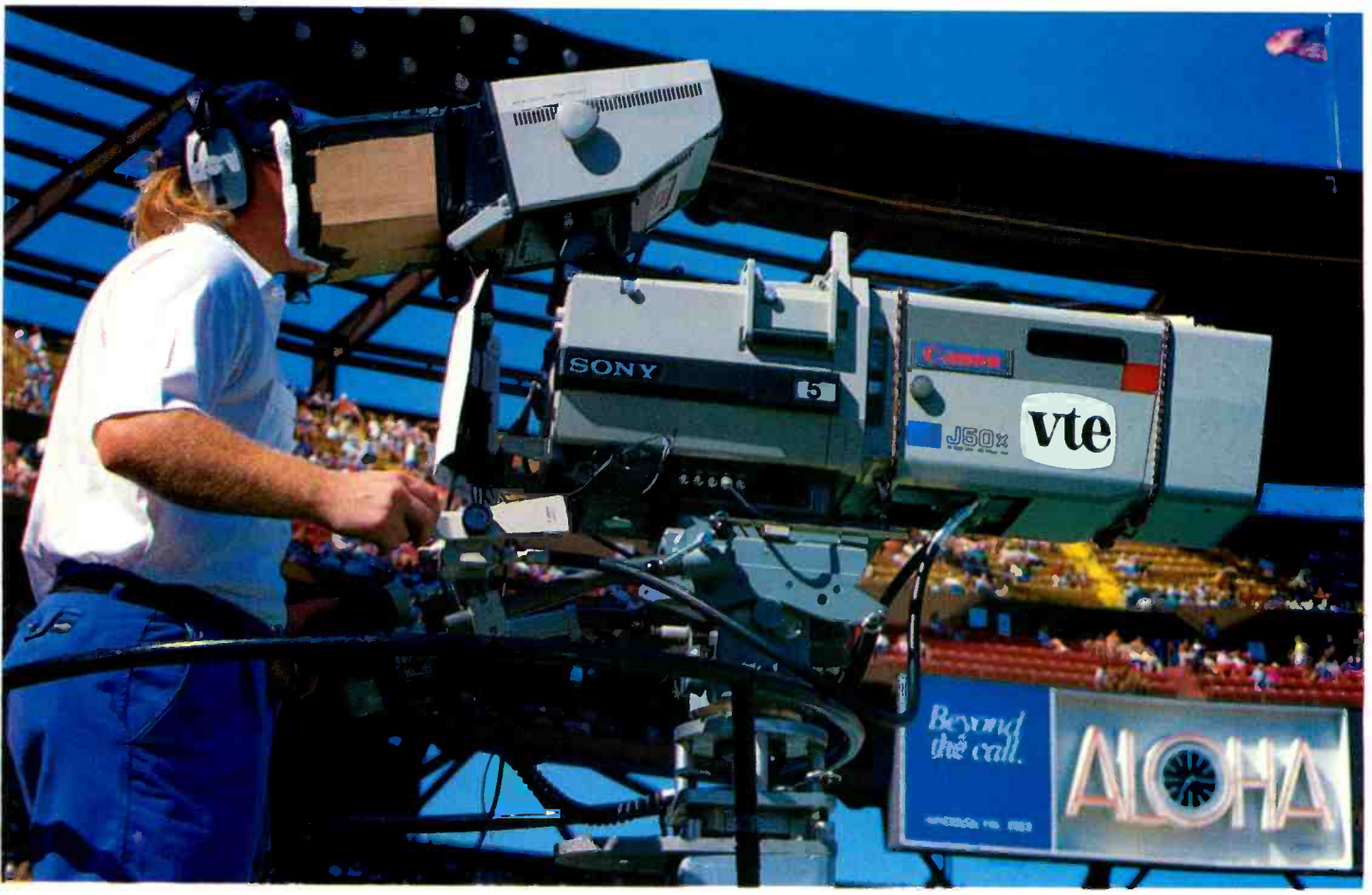
To fix the program, change lines 175 and 205 to read:

```
175 LMIN=20*LOG(KMIN)/LOG(10): PRINT
205 K=EXP(LOSS*LOG(10)/20):'-----FIRST FIND K
```

To modify the program to allow you to select the type of pad loss, add lines 157 and 158 and edit lines 15, 175, and 205 as follows:

```
15 RESTORE:DIM OHMS(24):DB=20:'--E & I
157 INPUT "LOSS/ATTEN. -E,I, or P- ";DB$
158 IF DB$="P" OR DB$="p" THEN DB=10
175 LMIN=DB*LOG(KMIN)/LOG(10): PRINT
205 K=EXP(LOSS*LOG(10)/DB):'-----FIRST FIND K
```

Do you have any questions, comments, or criticisms concerning what you read in BME*? Any bulletins or issues you want to open up to other engineering management readers? Our letter column, Feedback, is your forum. Write to: Feedback—BME Magazine, 295 Madison Avenue, 19th Floor, New York, NY 10017.*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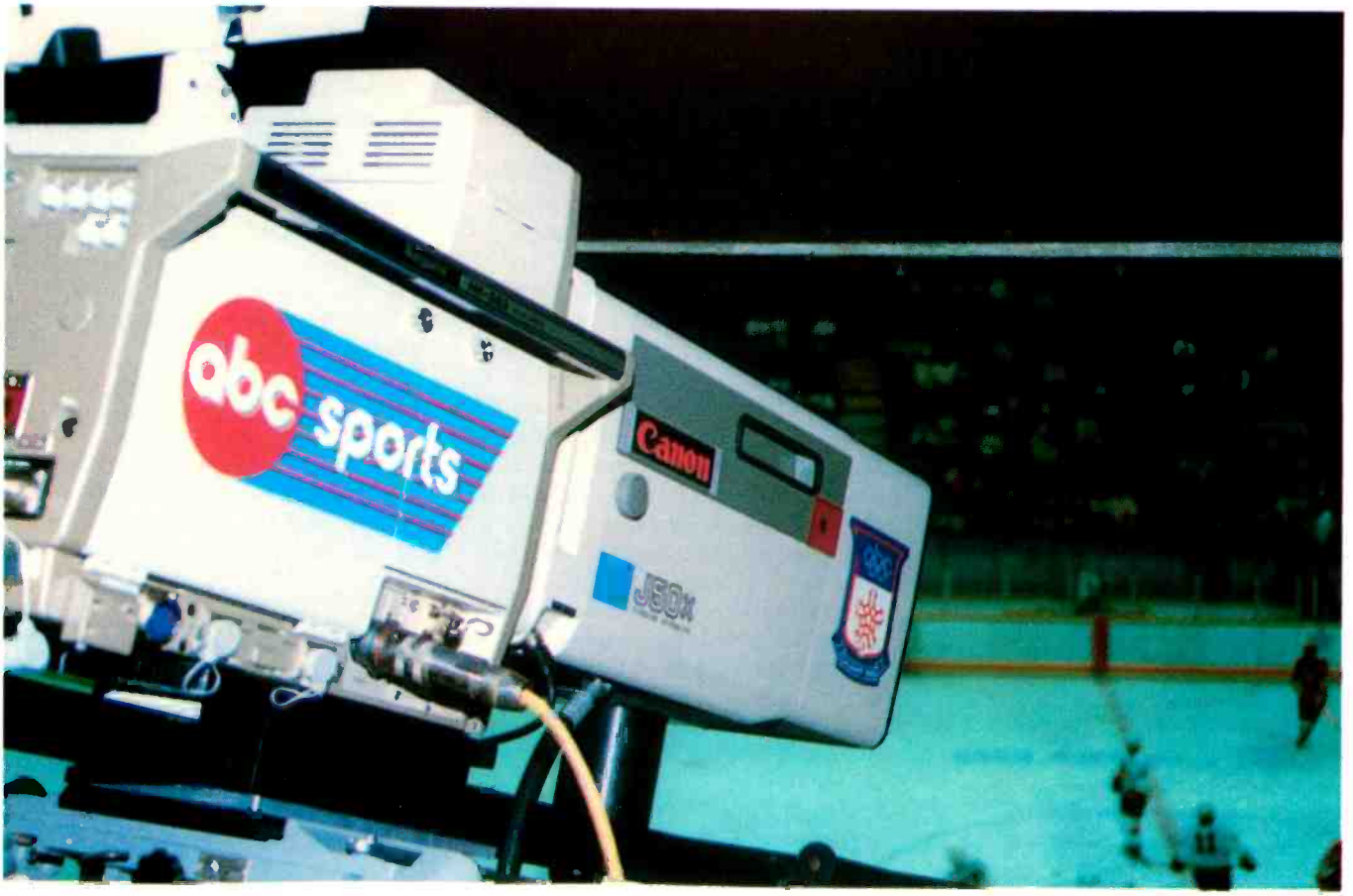
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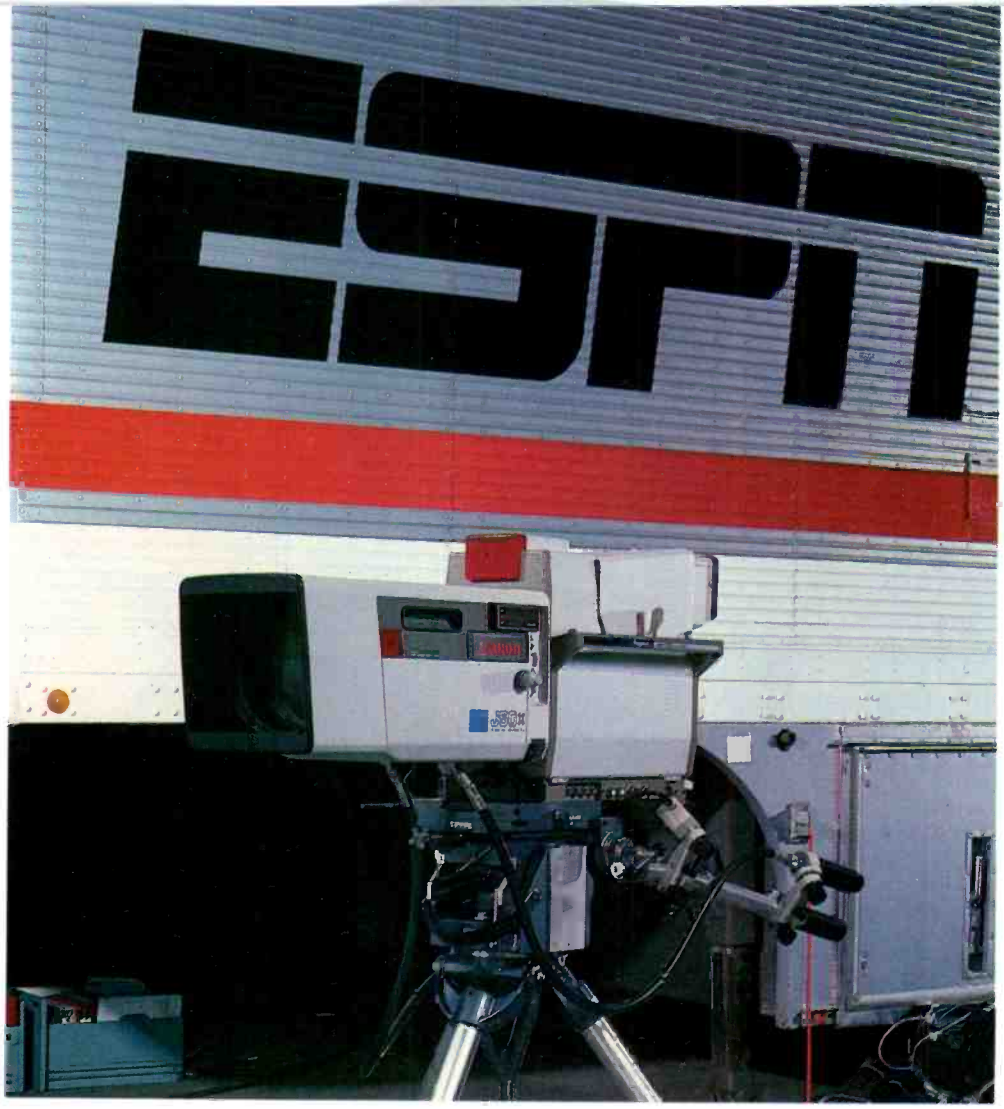

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Canon answers the demanding requirements of electronic field production with the sensational new J50X9.5BIE. The perfect lens for outdoor events like the Super Bowl and the Calgary Olympics where the J50X was put into action. Featuring a 50X zoom ratio, f1.4 maximum aperture, and an effective focal length of 9.5 to 950mm, thanks to its built-in 1.5X and 2X extenders. Any way you look at it, the J50X9.5 gives you incredible reach. Yet, it's great indoors too, with a minimum object distance of 7.2 feet and macrofocusing to 20 inches. Plus the usual high M.T.F., minimized distortion and chromatic aberration you've come to expect from Canon broadcast lenses.

An optional rotary shutter provides a choice of 1/1,000th, 1/500th and 1/250th sec. high shutter speeds and will interface with most major manufacturer's cameras.

The J50X9.5BIE is designed for outstanding performance on both 2/3" tube and CCD cameras. And with a weight of just 36 lbs., these credentials are even more impressive. Simply stated, the J50X represents the most advanced design in optical technology available to the broadcast industry today. There is no better lens to meet the tough professional standards of electronic field production. So the next time you need a broadcast lens with the reach of a 50X zoom and unsurpassed optical quality, choose Canon. Because no other lens measures up.

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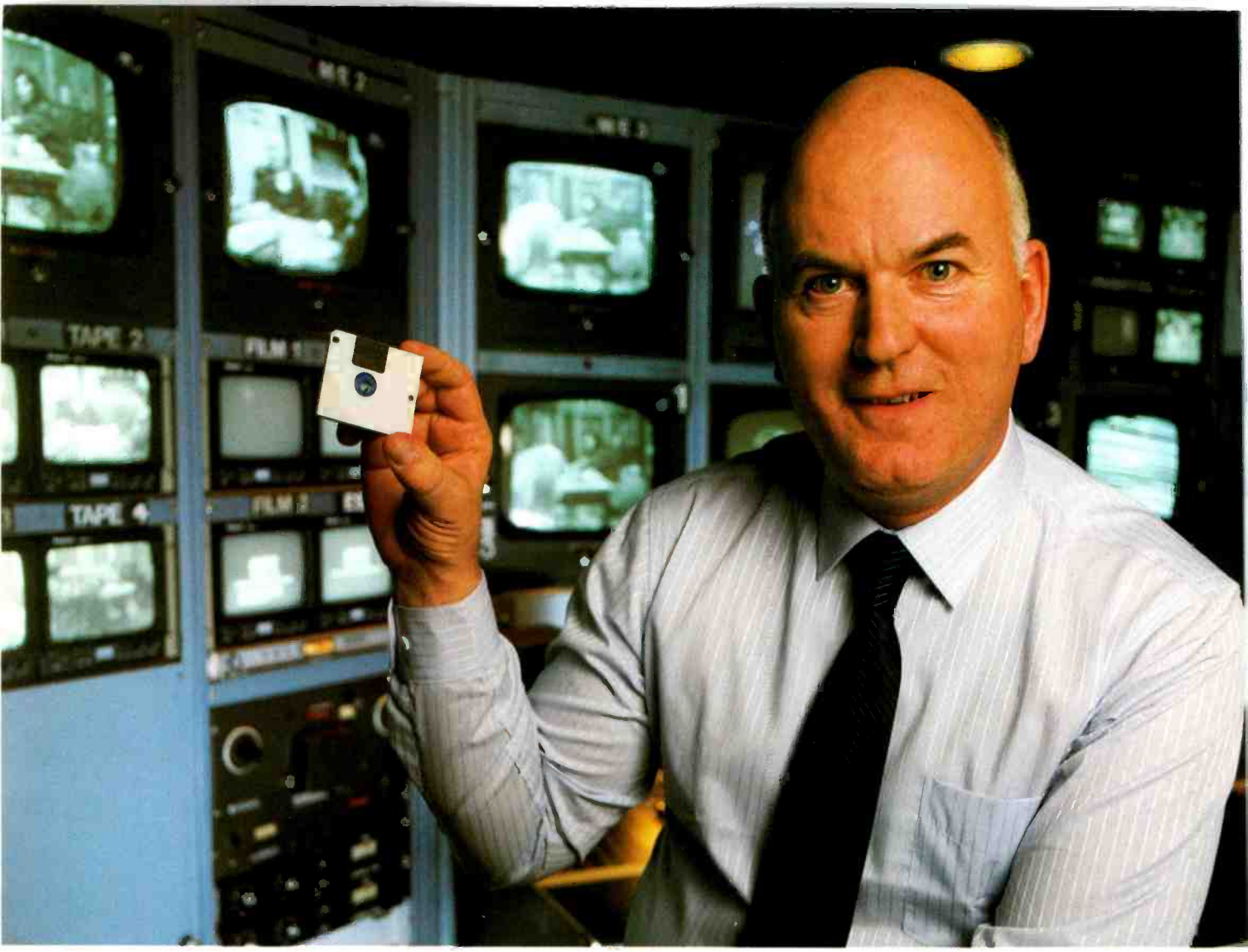

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UPDATE

FCC Proposal on FM Directional Antennas...BTS/Alias Pact in Atlanta...Faroudja Starts ATV/R&D...Waveframe Announces New Top Management...Dynatech Buys ALTA Group

FCC Proposal on FM Directional Antennas

Following "generally supportive" comments on an initial Notice of Inquiry on FM directional antennas in the summer of 1987, the FCC has released the text of a Notice of Proposed Rulemaking (MM Docket No. 87-121). The comment deadline was extended to the first week in August.

Implementation may spur increased use of FM directional antennas in FM broadcasting, leading, some fear, to "the AM-ization" of the FM band. A further proposal in the same rulemaking, termed "troubling" by the NAB, allows FM stations to accept FM interference.

As it stands, the rulemaking proposes use of FM directional antennas to permit "increased flexibility" for FM licensees choosing transmitter sites.

The rulemaking contains several additional proposals. These include specification of a uniform protected contour of 1 mV/m for all classes of station, including class B1 and B facilities. Class B1 facilities are now protected to the 0.7 mV/m contour; Class B facilities are protected to the 0.5 mV/m contour.

In addition, the Commission has filed a first-time proposal to protect FM commercial stations on a contour-to-contour basis.

Under the new proposal, a nondirectional FM station could change tower location and move, for example, physically closer to a co-chanel FM station. The station that moved would have to use a directional FM antenna to reduce radiation to the extent that the co-channel station's protected contour remained protected. After the station moved, it would itself be protected only to the extent of its own protected contour.

The NAB therefore contends the new potential for "shoehorning" plus the allocations regime proposed together in the March 30 rulemaking could lead to serious congestion of the FM band in many markets.

The new rulemaking also proposes allowing FM stations to accept FM interference. One consequence is that FM stations electing to increase power and upgrade facility classification would extend coverage but receive greater interference.

BTS announced a hardware and software marketing agreement with Alias at SIGGRAPH.

SIGGRAPH Sets Scene for BTS-Alias Pact

Last month's 1988 SIGGRAPH show in Atlanta showcased not only the very latest in computer graphics technology. Some of the biggest news coming out of the annual convention involved business deals and joint ventures between major players in the graphics field.

Alias Research and Broadcast Television Systems (BTS) announced a joint marketing agreement that will provide Alias with a more powerful rendering platform and BTS with access to the popular Alias software package. The agreement calls for BTS to provide Alias with its new EPIC and Pixelerator hardware platforms, which will be sold by Alias into the industrial design, scientific visualization and automotive markets. In turn, BTS will assume exclusive worldwide marketing and distribution responsibilities for all Alias products in the video teleproduction and broadcast markets. Alias also announced the release of version 2.4 of its Alias/2 software, which provides a number of design tool enhancements.

Wavefront Technologies announced several agreements that will make its software available on additional

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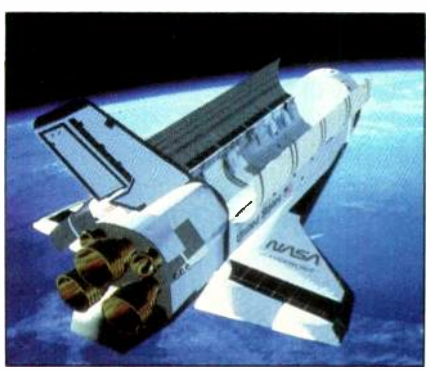
UPDATE

hardware platforms. The new platforms include the Hewlett-Packard 9000 Series, 300 and 800 workstations; the Stellar GS1000 Graphics supercomputer; and the Textronic 4330 Series 3D graphics workstations. Wavefront also unveiled its new version 2.8 software, scheduled for September 1 release. This software, which runs on all newly announced computers, introduces 16 new or enhanced features in the Model, Preview and Image modules.

Two developments in high-end video paint systems were on display at SIGGRAPH. Abekas Video Systems demonstrated a new interface between its A60 digital disk recorder and the Quantel Paintbox. The new Touch Up software from Abekas integrates with the Paintbox menu system to provide control of the A60 for image touchup and rotoscoping. The interface is transparent to the operator, bringing up the A60 control menu when external video is selected. Abekas also provides a plug-in interface board to allow the Paintbox to accept the CCIR 601 digital output from the A60.

A high-end video paint system popular in Europe made its U.S. debut at the show. The Matisse paint system, demonstrated by Spaceward Microsystems of London, England, is a full 32-bit video graphics system for the creation of high-quality still video images. The company is currently determining its U.S. distribution strategy and expects the product to be available in the U.S. soon.

Other hot news at the show was the rapid development of still image systems. Both Kodak and Sony introduced new systems designed to capture, transmit and print still video images from computer graphics systems. The Kodak SV6500 color video printer can capture images from composite video, RGB video and digital sources. Sony's UP-5000 color video printer accepts composite, RGB, Betacam and S-Video inputs. Both use thermal transfer printing techniques that provide 256 levels of R, G and B for over 16 million possible colors. In addition, both companies showed still image transmission systems that allow full-bandwidth still video images to be transmitted over standard telephone lines in a matter of minutes.



Wavefront Technologies unveiled its new version 2.8 software package.

Yves Faroudja at the 128th SMPTE.

Faroudja Starts ATV R&D Operation

Faroudja Laboratories, which holds a portfolio of more than 20 key patents in the video processing field, has set up a separate R&D company to develop its SuperNTSC advanced TV (ATV) system. Called Faroudja Research Enterprises, Inc. (FRE), the new company will be based in Sunnyvale, CA.

Both ABC and cable operator TCI encouraged Faroudja to set up a fully equipped research facility to develop a full system employing SuperNTSC components, according to the company. In addition, ABC and TCI are considering funding the operation, industry sources say. TCI is currently testing SuperNTSC on one of its cable systems in Sunnyvale.

FRE's goal is to produce "a completely compatible SuperNTSC system that meets the performance characteristics outlined in the FCC Advisory Committee on Advanced TV Systems," according to president Yves Faroudja. Faroudja also said FRE was established because of strong industry response to recent SuperNTSC demonstrations at the NAB, NCTA and ITS. The facility will be staffed with 10 engineers and technicians.

Faroudja Laboratories has proposed SuperNTSC to the ATS Committee as a future standard for an advanced television system for use in public broadcasting in the United States. FRE development will be independent of Faroudja Laboratories' regular commercial work, the company says.

In addition, ABC engineering executives have examined the SuperNTSC system and provided technical guidance, test materials and other support to extend the system into the broad-

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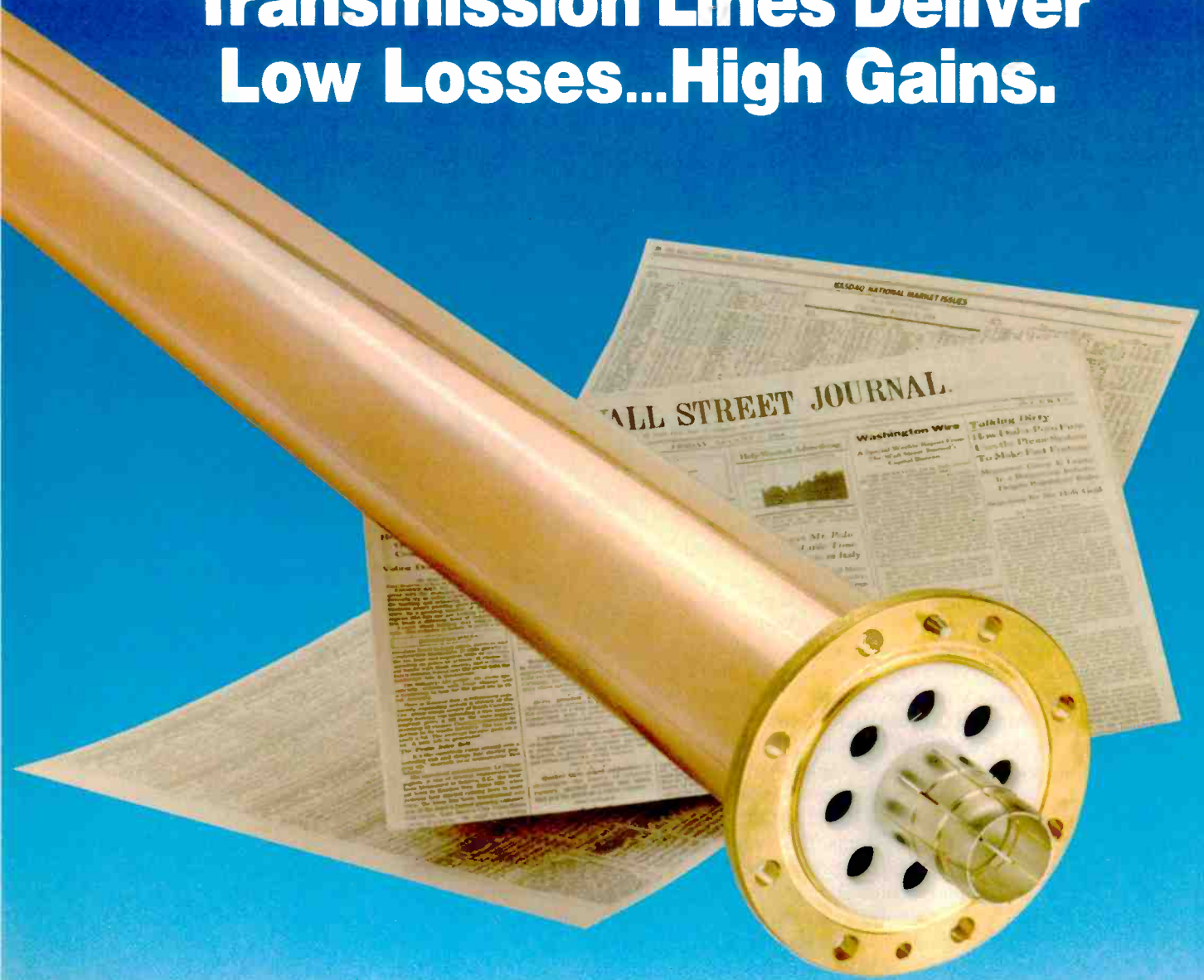

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cast environment, according to Faroudja. ABC has taken an active role in ATV development; it has provided funds to the Sarnoff/NBC Advanced Compatible TV (ACTV) system and to the MIT system and is a member of the NAB Advanced TV Test Center. Both the NAB test center and the cable industry's Cable Labs were formed recently to evaluate some 19 separate ATV systems currently under proposal.

In related news, both the House Telecommunications Subcommittee and the Association of Maximum Service Telecasters have scheduled hearings and meetings on high definition television (HDTV) in Washington, DC, Wednesday, September 7. Zenith Electronics Corp., a new entry in ATV development, is scheduled to appear at both meetings to explain its advanced TV transmission system. Zenith has filed a letter of intent to begin testing with the FCC's Advanced Television System advisory committee but has not announced details of compatibility with NTSC.

Waveframe Announces New Top Management

Boulder, CO-based WaveFrame Corp., which designs and manufactures digital audio workstations for the film, television and audio production industries, has apointed James S. Mays president and chief executive officer. At the same time Steven Krampf has been named senior vice president of sales and marketing. The move follows the departure of former president Glenn T. Edens early this summer.

A private investor in initial WaveFrame financing, Mays was most recently vice president of manufacturing and business development and acting vice president of engineering for office automation corporation NBI, Inc. A BSE graduate of Princeton University, Mays was also acting chief executive officer of Integrated Solutions, Inc., an NBI subsidiary that produces Unix-based minicomputers.

"WaveFrame represents a rare opportunity for me to work with a company that is well-funded and well-supported by investors and which enjoys a clear technological lead," Mays said.

Krampf was the senior product manager for the recording systems division of Ampex. A co-founder of Entrack Corporation, a start-up company which developed a disk-based audio workstation for audio post-production applications Krampf was also formerly vice president of sales and marketing at Otari Corporation.

The WaveFrame AudioFrame workstation is now out of the beta site mode and has been used in the production of several major motion pictures and television programs since its introduction in 1987. ■

Dynatech Buys ALTA Group

The ALTA Group, which manufactures and markets video production and signal processing equipment for the television industry, has been acquired by Dynatech Corp., Burlington, MA. ALTA joins Dynatech's communications product group which inludes Utah Scientific, ColorGraphics, Dynatech NewStar, Quanta Corp., VTA, Calaway Engineering and New England Technologies.

"We are especially pleased about this marriage because the ALTA Group provides equipment which is strong in the corporate and industrial market, the area we feel has the strongest potential for growth," said Terry Kelly, corporate vice president of Dynatech and cofounder of Colorgraphics. Citing ALTA's reputation for combining high technological quality and affordability, he stated that joining forces with Dynatech will also enable the ALTA Group to more effectively market its PAL-format equipment outside the U.S.

Founded three years ago, the ALTA Group will continue to be based in San Jose, CA, according to vice president of sales and marketing Frank Alioto. The ALTA Group was purchased not only for its existing product line of moderately priced TBC, frame synchronization and digital equipment, but also for a range of new products targeted at broadcast stations, he said. These include the recently introduced Centarus still-store device and the Pictoris video compression/digital effects unit.

"We're particularly pleased to be part of a quality company like Dynatech,"said ALTA Group president Wayne Lee, adding that Dynatech support of the incumbent management team and the enhanced international marketing ability were two important factors in the acquisition.

Dynatech Corp. supplies electronic products and systems worldwide through 60 subsidiaries in North America, Europe and Asia. Dynatech posted sales of $368 million for fiscal 1988. Annual sales for the ALTA Group are approximately $6 million.

ALTA Group founders Michael Tallent, Wayne Lee, Ronald Long and Frank Alioto (L-R). Tallent received an Engineering Emmy in 1974 for the development of the CVS500 digital time-base corrector and the subsequent application of digital technology to commercial television.

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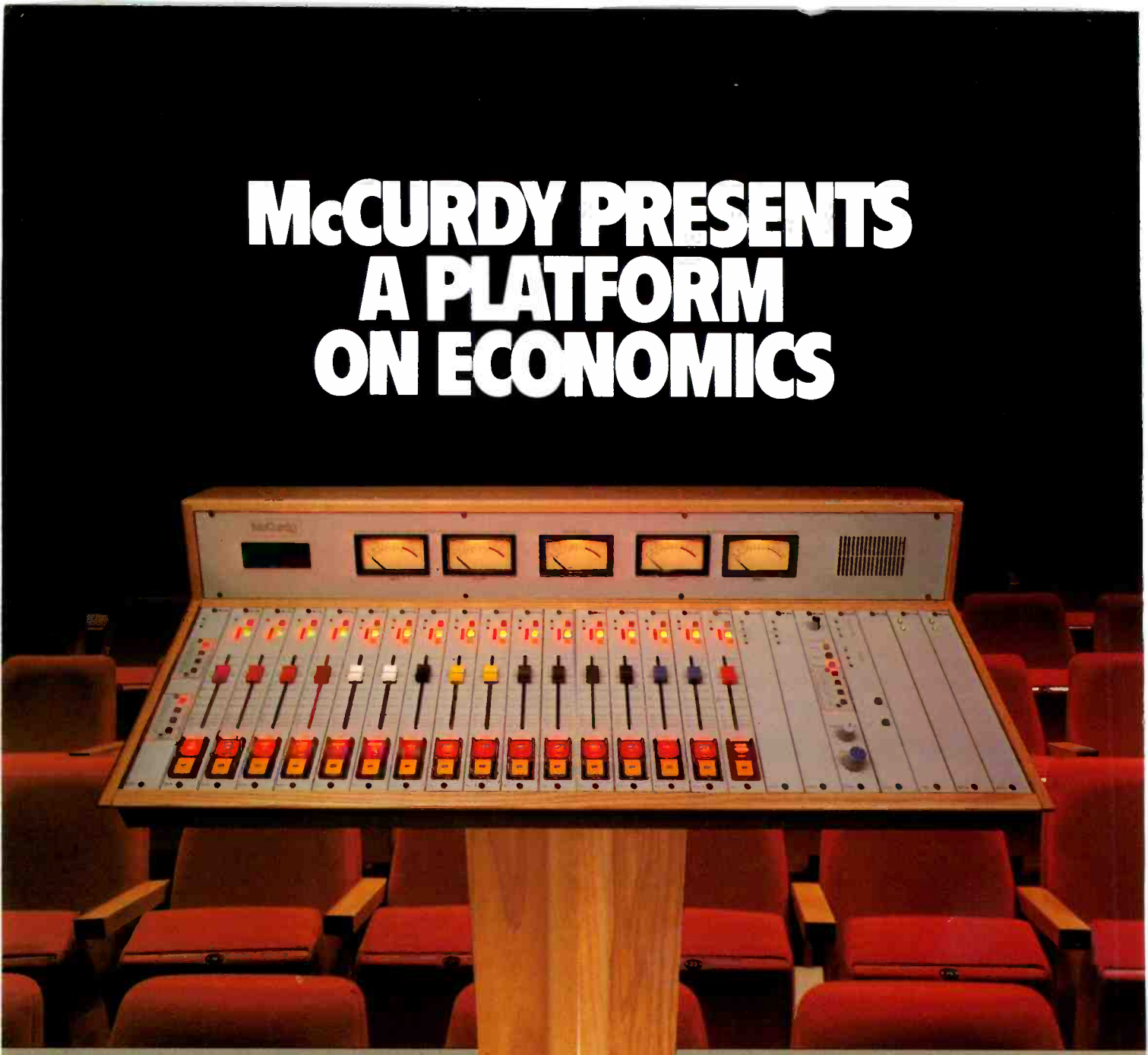

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CROSSTALK
AN ENGINEERING MANAGEMENT JOURNAL

FM/FM Simulcast Strengthens Contour...Broadcasters On-Line...Instant Remote Truck

FM/FM Simulcast Strengthens Contour

Independent Chicago based music station WNIB (97.1 FM) had a problem. In the mid-70s, the station was only rated 5000 W and was unable to oppose the transmitter relocation of a small-market, first-adjacency FMer, WKZN. Now in a short-spaced situation, WNIB was blocked from a future extension of signal to its prime demographic, the classical-music-hungry audiences of North Shore suburban Chicago.

To make matters worse, in 1975 WNIB moved its transmitter to an antenna height of 1190 HAAT but still had to broadcast at the equivalent of 5000 W to eliminate interference to its northern neighbor. When WNIB directionalized its antenna in 1981 and increased ERP to 33,000 W west, south and east, it was still limited to 5000 W to the north.

The resulting stand-off—WNIB couldn't reach classic music buffs in Chicago's northern suburbs and WKZN couldn't get enough signal into metro Chicago or Milwaukee, WI—prefigured the American infatuation with mergers and acquisitions. WNIB purchased WKZN in 1983, renamed it WNIZ and began the country's first FM-FM simulcast.

The result of this unusual situation? In May 1984, WNIB was able to increase power to 50,000 W, generating a 50 percent increase in power west, south and east and almost 1000 percent more power to the north. WNIZ is currently transmitting 10,000 W at 500 HAAT, which is gradually being upgraded to 50,000 W omnidirectionally.

WNIB is now heard clearly in northern areas where it had previously suffered interference.

WNIB coverage area, 1981 to 1984.

Increased coverage since 1984 merger.

Because the stations are first adjacent rather than co-channel, listeners in the overlap area can tune the stronger signal with a directional antenna. Since the programming is the same, listeners report "drift" is not as objectionable travelling through the area and drivers also simply take the stronger signal. The setup also differs from FM translators, which cover a "hole" in an area, or FM boosters, where sync equipment is needed to align timings to eliminate multipath. The FM-FM simulcast originates with programming from WNIB's studio in Chicago, which is sent by telco facilities to the WNIB transmitter on the Amoco Standard Oil Building. This signal is broadcast at 97.1 MHz and picked up at the WNIZ studio in Zion, IL, via a custom Scala log-periodic receiving antenna 40 feet above ground level and a McIntosh model MR 80 receiver. A Marti 900 MHz STL relays the WNIB signal to the transmitter site at Kenosha County, WI, where it is broadcast as WNIZ at 96.9 MHz using a 10.1 ratio directional antenna with 50,000 W to the north and 5000 W to the south.

Broadcasters On-Line

Last month's Tech Watch column bemoaned the lack of a nationwide, dedicated computer network for broadcast engineers. One promising development on that front is the steady growth of A/V Sync, the electronic bulletin board system (BBS) operated in Atlanta, GA, by Bill Tullis.

MULTI-FORMAT INTEGRATION

JVC DISPELS THE RUMORS OF FORMAT WARS

The video world is alive with talk about formats, old and new. Editors write about "the new age of video". Trade show attendees pack the booths to see the newest formats.

It makes great conversation. But it's making the people who buy and use video equipment uneasy, and confused.

The trouble is that all the formats—3/4-in., S-VHS, and MII are being perceived as little islands unto themselves, with no connecting bridges, and no transitions.

It's time someone told the real story about multi-format integration, because the truth is that these formats can work together. They can be complimentary, not confusing. And they can offer more than the individual parts alone can provide.

How can this be? It takes a commitment to create a bridge between formats, so that the production suite is a place of harmony. Not hostility.

JVC has made that commitment. Our 3/4-in., S-VHS, and MII products work together. They will also work well with equipment from other manufacturers. The result is a production suite that links yesterday's technology with today's innovations, and today's innovations with tomorrow's technology.

It didn't happen by accident. We planned for it. Rather than beat our chests about the "exclusivity" of our formats, we committed our company to products that ease the transition from MII to S-VHS to 3/4-in. to VHS. And even to 1-in.

Imagine the benefits: The field production crew brings S-VHS footage to the production suite, where it is edited in the most desirable manner—at the component level. The material can be integrated with existing libraries of 3/4 in., VHS, or *any* other tape, and it can be alternately monitored in component form, or in any format, on a single monitor. The end result can be S-VHS, 3/4-in., MII, 1-in. or VHS.

So much for exclusivity.

And so much for the belief that a multi-format world must also be confusing and expensive. While our competition is boasting the benefits of one format over the other, JVC is integrating the benefits and applications of *all* the formats to make life easier, less confusing, and less expensive.

Let JVC show you that there really is such a thing as multi-format integration, and how it can make your production suite complimentary—not confusing.

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ALWAYS A STEP AHEAD...
TO KEEP YOU A STEP AHEAD.

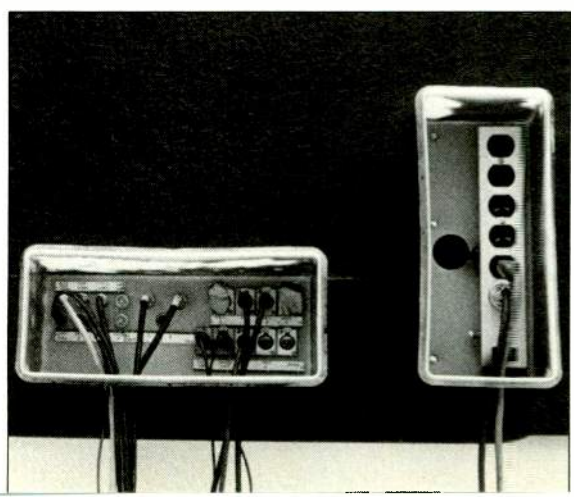
Tullis, who by day is audio manager at Turner Broadcasting System, started A/V Sync about a year ago as an information clearinghouse for people in radio, television, sound reinforcement, broadcasting, and related areas. Once registered, a caller can access conferences dedicated to sound, recording and acoustics; video, graphics and film; audio-for-video and MIDI; production; and RF, FCC, HAM and conventions.

File and program offerings are extensive. The film, video and graphics conference, for instance, contains file directories for techniques, fixes, engineering; software and related documents; editing systems; products and services/resumes; and papers and text files. Conference file lists and new uploads are kept in yet another directory. A recent addition to A/V Sync's offerings are the BASIC programs from *BME*'s monthly Compute column.

"We never knowingly post anything that isn't shareware or public domain," Tullis asserts. "We will post demos if they're good or interesting enough."

While the message bases are open to anyone who logs onto the system and completes a brief registration questionnaire, file access is limited to paying subscribers. Potential users can pay a trial rate for six months of limited downloads or can subscribe at the full price for full priviledges.

Interested? Set your modem parameters to eight data bits, one stop bit and null parity and your transmission rate to 1200 or 2400 bps, and dial 1-404-320-6202 for a tour of A/V Sync.



Custom-built connector panels, weather-proofed with Tupperware, fit into a window frame.

WTAT's staff combined comfort and engineering efficiency in this mobile home-turned-production truck.

Instant Remote Truck

The next time your creative services director suggests a Tupperware party, don't laugh. WTAT-TV, the Charleston, SC, independent, covered a 17-day arts festival with a converted motorhome, seven people and two Tupperware bread boxes.

WTAT's production schedule for the Spoleto Festival, a city-wide amalgram of theater, dance, music and art, called for two half-hour shows to be taped live each day—a total of 34 shows, each produced at a different location. To accomplish this, the station rented a 30-foot Coachman motorhome and removed the sofa to make room for the production equipment.

The station does have a small remote van, but according to chief engineer Morris Pollock, "The workload and comfort was a consideration. Our van has no externally mounted airconditioning, but the motorhome had that and a generator."

The station's engineering staff custom-built an exterior connector panel and installed it in the frame of one of the motorhome's sliding windows. This panel contained all necessary audio, video and power connections and was completely weatherproofed with the Tupperware bread boxes.

Pollock notes, "With the connector panel, it was easy for the creative services people to operate the truck without an engineer."

Besides the cost of renting the motohome itself and constructing the connector panel, the station's only expense was a rented cellular telephone so the creative services staff could contact engineering if anything went wrong.

"There were virtually no problems," Pollock says. "We were never called out there. Technically, it went real smooth."■

ICEBERG . . . *A thick mass of floating ice*

Webster Illustrated Contemporary Dictionary

The dictionary doesn't mention that *most* of the thick mass of ice is *under* the water. Ads and photos of "floating" or recessed audio consoles don't mention that *most* of the console is *under* the tabletop. For example, console "B" is recessed 6-9/16 inches; console "A" is recessed 6-1/2 inches; and some manufacturers brochures don't even list the under-the-table dimensions of their "kneebreakers".

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Cookin' With GaAs

By Eva J. Blinder

What's faster than a speeding semi-conductor? More powerful than a silicon chip? You guessed it—gallium arsenide, the latest wonder material for integrated circuits. GaAs is gaining increased attention in the computer world for its advantages over silicon: faster speed, lower power consumption, greater radiation hardness and broader operating temperature range. In fact, gallium arsenide has so many sterling qualities—led by its blazing speed—that IC users in a number of fields, including supercomputing, the military, and manufacturing, are champing at the bit in their eagerness.

So why isn't the world cooking with GaAs? Like other leading-edge chip manufacturing technologies, GaAs poses certain intrinsic problems that must be overcome before GaAs chips can be manufactured cheaply enough to be practical for widespread use. Its advantages, however, make it so attractive that development work is continuing apace.

It is the switching times of an IC's internal circuits that limit its optimum available speed. The molecular structure of gallium arsenide has faster electron mobilities than silicon, allowing GaAs circuits to operate almost six times faster. Device speeds up to 60 GHz are considered possible, compared to a limit of about 4 GHz for silicon. At the same time, gallium arsenide devices draw considerably less power than comparable silicon devices.

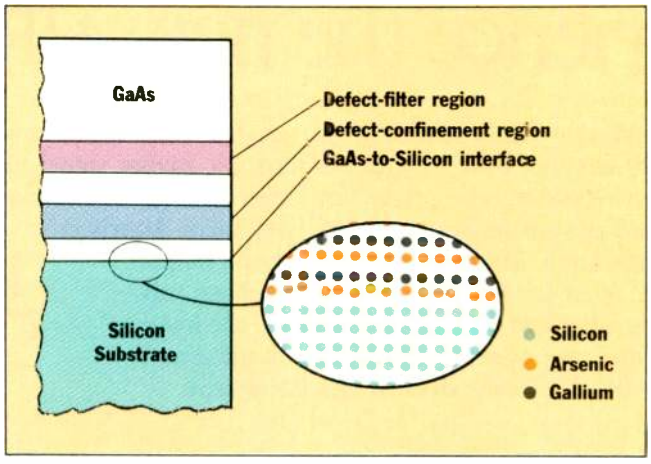
IC design itself may be simplified with gallium arsenide. GaAs has an energy bandgap of 1.1 eV, compared to silicon's 1.4 eV bandgap. The larger bandgap of GaAs means that gallium arsenide can operate under a wider temperature range. It also means a lower parasitic capacitance, reducing the number of masks called for in the chip manufacturing process.

An advantage of particular interest to the defense and space industries is the "radiation hardness," or resistance to radiation, of GaAs. A GaAs device can tolerate a rad total dose of 107 to 108.

Until recently, manufacturing ICs on a GaAs substrate has been difficult and expensive. The past 18 months, however, have seen advances in manufacturing technology that may soon make GaAs ICs affordable and widespread. It is now possible to manufacture GaAs wafers in a relatively cost-effective manner and make them into stable, tightly controlled ICs.

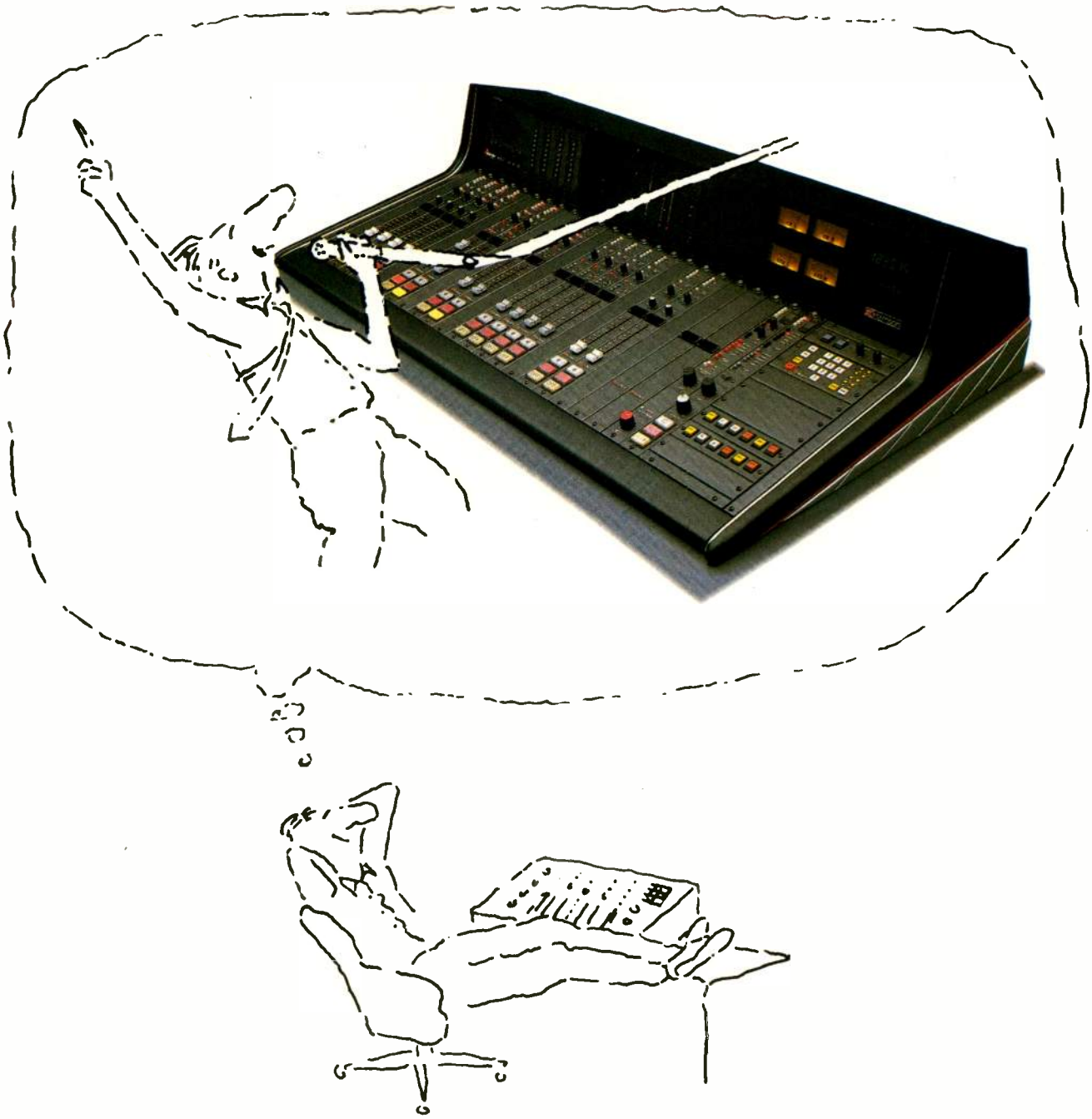
Some of the difficulties posed by gallium arsenide arise from its dual-element nature. Unlike silicon, which is a single element, the gallium arsenide molecule is composed of two elements, gallium and arsenic, each with its own physical characteristics.

Reliably growing gallium arsenide wafers was the initial roadblock limiting development of GaAs chips. The recent development of a crystal-growing technique, liquid-encapsulated Czochralski (LEC), has enabled manufacturers to grow gallium arsenide wafers in a more cost-effective manner. The wafers produced by the LEC technique are stable and consistent, although they are small in size, reaching diameters of only two or three inches. (Silicon wafers may reach six inches in diameter.)



Poor match between gallium arsenide and silicon can result in chip defects.

Blinder is the editor of BME.



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Turning the wafers into usable chips is another problem. Because of the molecular differences between gallium arsenide and silicon, the impurity diffusion processes used in manufacturing silicon wafers do not transfer well to gallium arsenide production. Practical production of gallium arsenide wafers received a boost in 1985 when Varian Associates developed an ion implanter designed especially for use with gallium arsenide wafers. Another important development was direct-step-on-wafer photolithography, a technique that brought the line width of GaAs circuits down to 0.5 to 1.0 micrometer.

Gallium arsenide wafers are brittle, making handling difficult. To address this obstacle, some manufacturers have developed automated cassette-handling equipment to prevent wafer breakage during processing.

One promising development has been the development of GaAs-on-silicon wafers, which combine the speed of gallium arsenide with the processing ease of silicon. Because silicon is sturdier than gallium arsenide and is easily grown into larger wafers, using it as a substrate for GaAs seems like a natural idea. The use of a silicon substrate allows economies of scale not possible with GaAs alone. Some manufacturers have already started shipping GaAs-on-silicon wafers as large as four inches in diameter.

Even this seemingly fortuitous combination has its own set of problems, however. Differences in the atomic lattice dimensions of silicon and GaAs molecules make the interface between the two substances tricky. This can result in interface dislocations, defects that can propagate themselves into the GaAs layer itself through a process known as "threading," causing degradation in the actual circuitry.

One technique to compensate for this is the insertion of a "defect confinement" region on the chip, separating the GaAs from the silicon substrate. Work is still continuing on the GaAs-silicon combination. One promising development is the ability to selectively grow GaAs on portions of a silicon wafer; this opens the door to combined silicon-GaAs devices that could use the strengths of each substance.

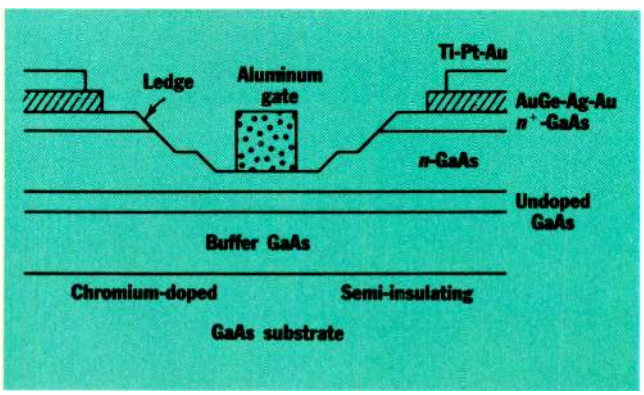
One promising development has been the development of GaAs-on-silicon wafers, which combine the speed of gallium arsenide with the processing ease of silicon.

So far, gallium arsenide has been used primarily for MESFET, or metal Schottky field effect transistor, structures. Although MOSFET (metal oxide semiconductor field effect transistor) structuring is considered more desirable, efforts to make GaAs MOSFETs have been unsuccessful because of the difficulty of growing stable oxides on GaAs. Silicon, on the other hand, provides a good base for growing oxides. The defects caused by threading form another stumbling block to the use of GaAs-on-silicon ICs; while MESFETs are relatively resistant to these defects, devices such as laser diodes are very sensitive to them. Researchers are reporting some success in building GaAs-on-silicon laser diodes, but serious problems remain to be solved before the devices are ready for commercial use.

Once manufacturing problems are overcome, users can expect to see GaAs chips in all sorts of equipment. The eagerness to adopt GaAs technology is greatest in industries where high-speed calculations currently tax the abilities of silicon; weather forecasting and computer graphics are two obvious broadcast-related applications.

The faster speed of GaAs chips could, for example, greatly reduce the number of chips needed by parallel processing supercomputers. These computers use large numbers of processors operating in tandem to break through the limitations of single, silicon-based chips. By incorporating speedy GaAs-based chips instead, the number of chips needed could be reduced, thereby reducing the complexity of the machine.

The obstacles to widespread adoption of GaAs technology are formidable, but are beginning to fall thanks to intensive research and development work. GaAs FETs are already beginning to appear in the broadcast plant. Their presence will grow rapidly in just a few years, bringing increased efficiency to broadcast plant operations. ■



Gallium arsenide power FET.

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D-2 DIAGNOSTICS

Troubleshooting a digital VTR poses problems unknown in the analog domain. Sophisticated signature analysis techniques provide an accurate, simplified solution for the VPR-300 D-2 DVTR.

BY FRASER MORRISON

When something goes wrong with a Type C one-inch VTR, experienced broadcast engineers usually know where to look to find the problem's source. Established procedures and years of familiarity with analog video make most troubleshooting a straightforward process.

Digital recording of the television signal, with its superior signal quality and multigeneration performance, eliminates many of the problems associated with analog recording. At the same time, however, it creates a new set of problems as far as troubleshooting is concerned. For example, almost all functions of the analog recorder occur in real time, allowing the engineer to hook up an oscilloscope and check the waveform. In the digital recorder, on the other hand, the data stream is shuffled into a new form by the recording electronics and becomes virtually unrecognizable by any equivalent analog-type measuring device. The data stream moves and changes at extremely high speeds, further complicating any attempt to measure it by conventional, real-time methods. Even with the help of a logic analyzer, the complex digital waveforms that can be observed do not resemble anything familiar from analog video.

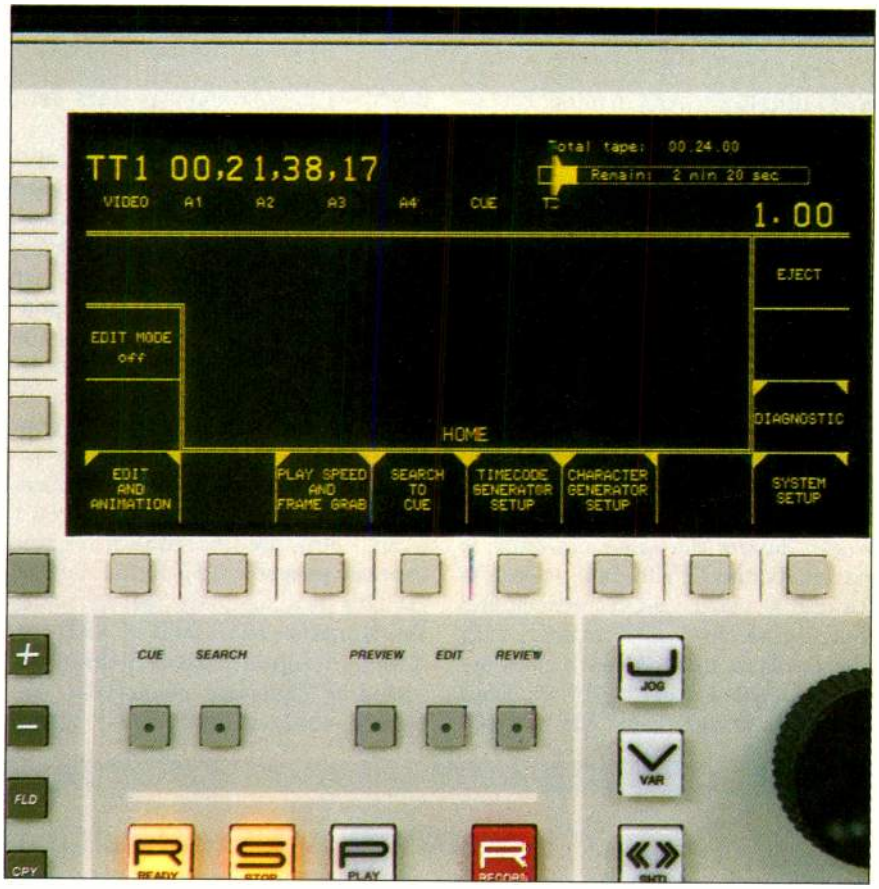
Furthermore, the highly complex electronics of a digital VTR make specific fault location much more difficult. In the VPR-300, much of the analog circuitry has been replaced by large-scale integrated circuits, greatly reducing the number of accessible test points. Combined with the greater complexity of the digital data, the heavy use of LSIs increases the difficulty of troubleshooting. In addition, many of the ICs used in the DVTR are custom and proprietary, making them almost impossible to diagnose. Without some accurate onboard diagnostics capability for the signal system, the only alternative for troubleshooting would be time-consuming board and IC swapping. Even if sufficient time and spare parts were available, this method is inefficient at best and inaccurate at worst, since the internal error correction of the DVTR

sometimes can mask errors arising from a bad or missing IC.

It was for these reasons that Ampex decided to incorporate a sophisticated signature analysis scheme into the VPR-300 D-2 composite digital video tape recorder. To our knowledge, this is the first time that such a capability has been incorporated into the internal electronics of a piece of broadcast equipment. On-board signature analysis allows the VPR-300 to offer a comprehensive, internal diagnostic tool that greatly streamlines and simplifies the process of circuit board fault detection.

Signature analysis is only one of the diagnostic tools provided in the VPR-300. In addition to the signature analysis, which permits rapid fault isolation in the electronic circuitry, the recorder incorporates real-time diagnostics for such basic system parameters as power supply voltages, motor currents, and tension arm positions. These real-time diagnostics are very similar to, although more comprehensive than, those offered in the VPR-3 one-inch Type C VTR. The parameters they measure have well-defined norms or limits, and the current value is easily monitored by the system to alert the operator of any nonstandard conditions.

For analyzing the status of the digital data stream, however, such real-time diagnostics are insufficient. It is here that signature analysis comes into play. In its most basic form, signature analysis involves extracting a unique data pattern or "signature" from the data stream in such a way that the signature will be unique and repeatable at a given sample point. These signatures have no objective "meaning," but are arbitrary four-bit hexadecimal numbers determined by applying a pseudo random number generator algorithm to the binary data stream. By determining the correct signatures for different points in the signal path and storing these in the DVTR's on-board computer, the stored signatures can be compared with the actual signatures for system diagnosis and fault isolation. Any repeatable data that is synchronized to a clock may be tested using signature analysis. In essence, signature analysis creates an ordered, instantly retrievable representation of the highly complex and variable data stream operating in the machine.



The VPR-300's menu screen is the primary user interface for the recorder's internal diagnostics. By punching the appropriate button, the user accesses the diagnostic routine and reviews its results.

In practice, the advantages of the DVTR's built-in signature analysis are readily apparent. If a problem is noted, the engineer simply calls up the diagnostics menu on the VPR-300's data display and punches a few buttons. The signature analysis circuitry checks each circuit board in succession until it locates the source of the fault, a process that takes only a few seconds. The faulty board can then be exchanged with a working board and later replaced or repaired.

Any signature analysis scheme relies on accurate identification of the appropriate signatures. For the signatures to be useful in fault isolation and diagnosis, they must be unique at each measuring point. The method for creating the signatures was devel-

oped with these needs in mind. Essentially, creating a useful signature requires that the data stream to be tested must be delimited so that it has a recognizable beginning and end. Further, it must be subject to a synchronizing clock and possibly a qualifier, which reduces the actual number of data bits that must be processed, saving analysis time.

The algorithm chosen gives an accuracy better than one in 65,536, independent of the data stream length or clocking frequency, so the chances of two different data streams of finite length having the same signature is extremely small. The data stream is fed into an *exclusive OR* network and then into an array of 16 registers with four feedback lines. At each clock cycle, the contents of the 16 flip-flops change as the *exclusive OR* network combines previous and present data to ensure a unique signature.

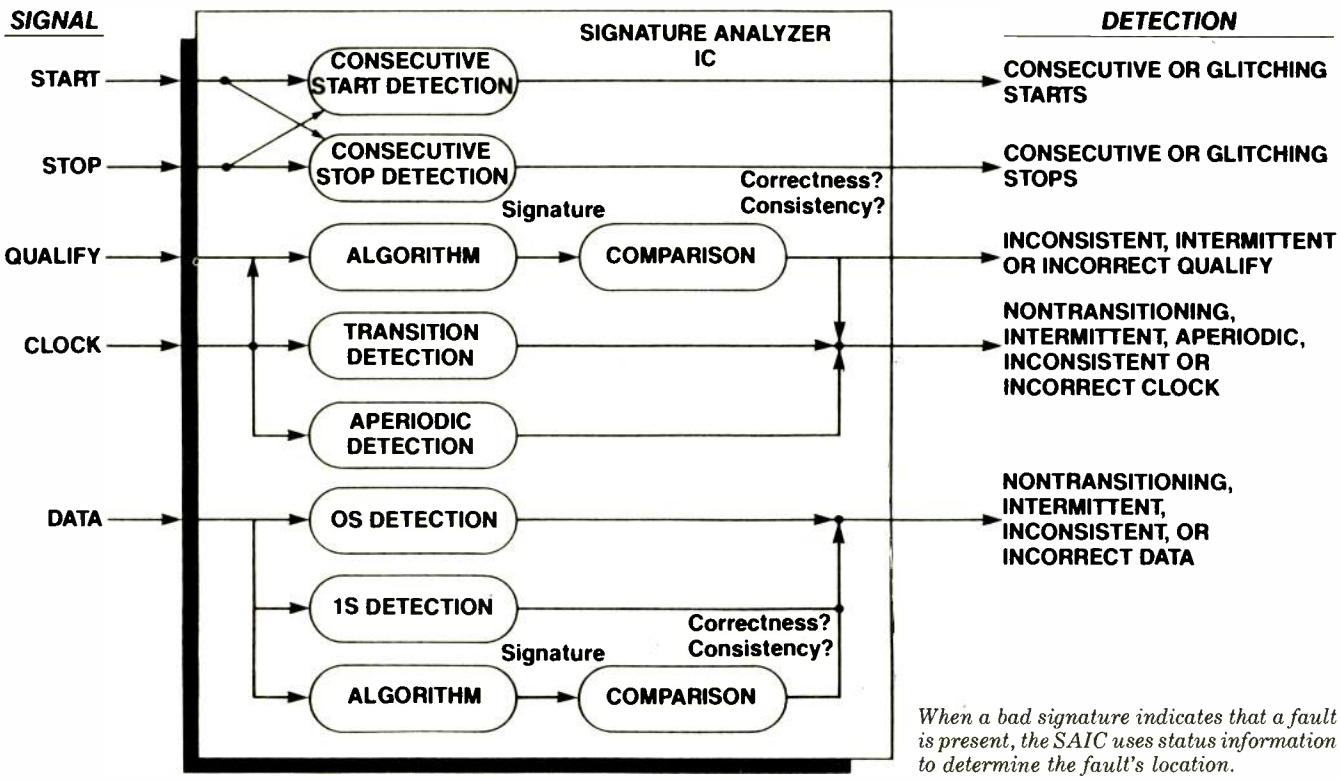
Once the signature is created, fault analysis becomes a straightforward process of comparing the signature found at a particular address to the prestored benchmark signature for that address. If the measured signature agrees with that stored in the computer, any perceived fault must occur farther along in the data path.

Actual implementation of signature analysis in the VPR-300 is accomplished by an on-board Application Specific Integrated Circuit (ASIC) developed by Ampex for this express purpose. Controlled by the DVTR's own sophisticated processor, this signature analysis IC (SAIC) performs all signal system diagnostics, including signature generation, signature analysis and nodal status analysis. It is capabable both of identifying a correct signature and determining the repeatablility or stability of that signature—the two goals of signature analysis.

Two primary interfaces on the SAIC permit it to perform its functions. First is the interface to the circuit board under test, which includes connections for data, clock, start, stop and qualifier. The 16 direct data inputs of this interface are internally multiplexed. In addition, this interface has three auxiliary multiplexer lines that permit expansion of the other connections.

The second interface is the computer bus interface, for control of the SAIC's operation and communication. The computer can specify setups, mode selections and read selections, and also selects the type of analysis

Signature Analyzer Fault Isolation



When a bad signature indicates that a fault is present, the SAIC uses status information to determine the fault's location.

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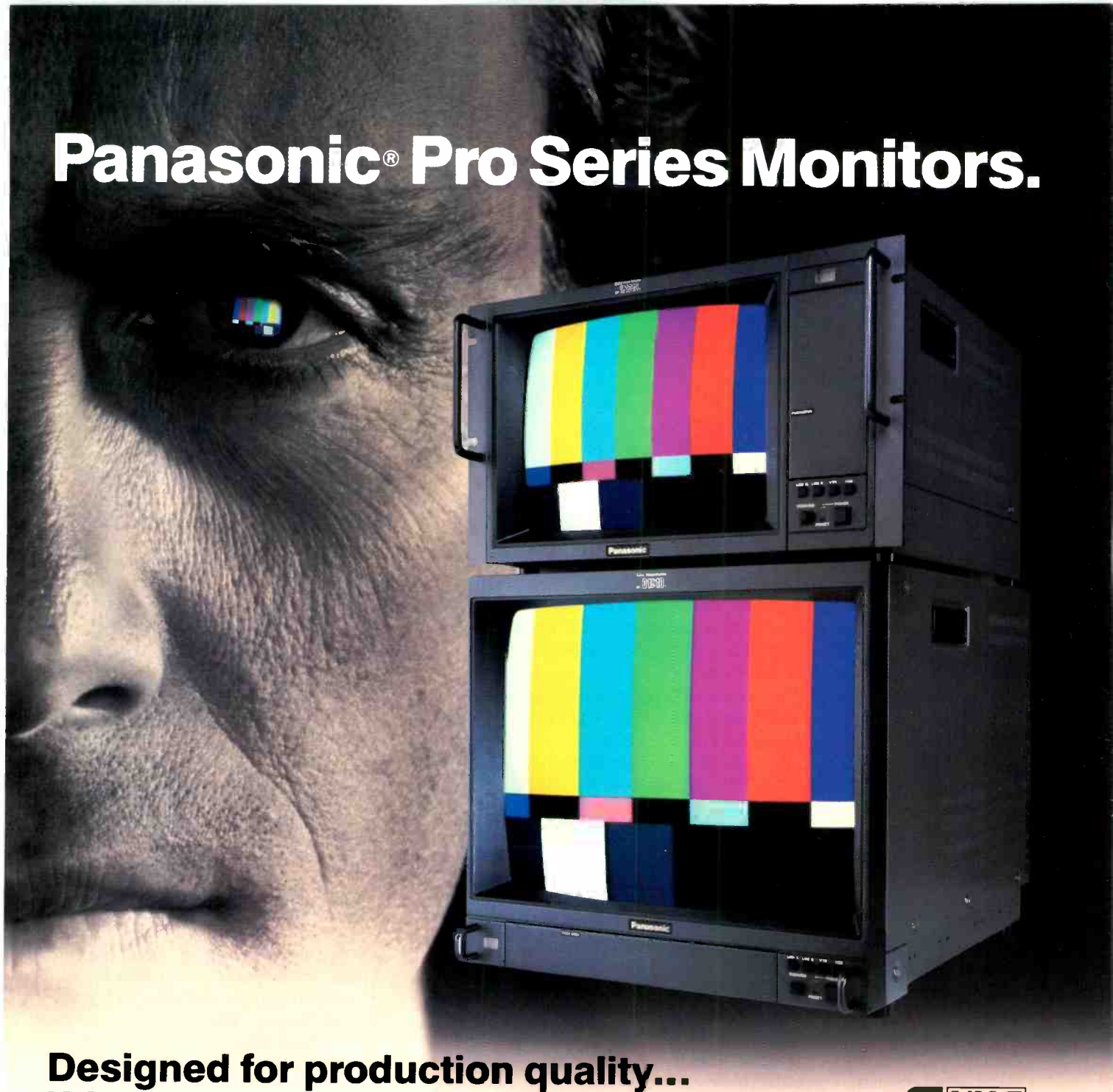

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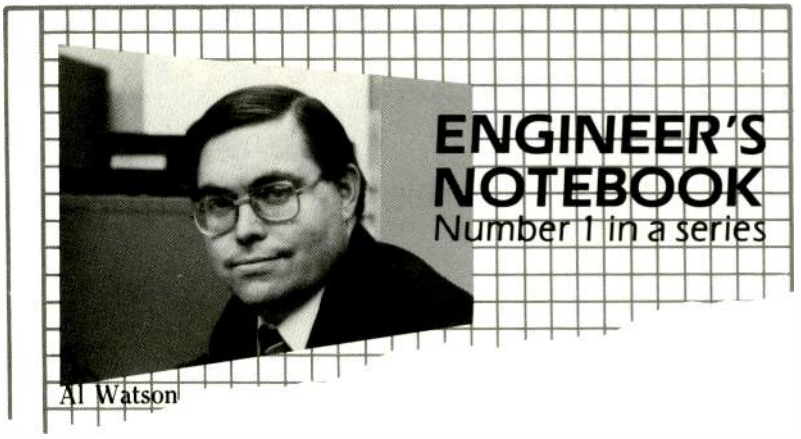

N/DYM™ Technology Comes to Broadcast Microphones

By Alan Watson, Director of Engineering
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Those familiar with the benefits enjoyed by musicians through the new neodymium-magnet microphones have no doubt predicted that the new technology would soon be available in broadcast microphones. And now, with the advent of the Electro-Voice RE45N/D hand-held shotgun microphone, the prediction has come true.

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the SAIC will perform.

The SAIC is capable of generating a number of additional types of diagnostic information along with signature analysis. For example, it can signaturize the clock that is applied to the data stream. This permits the SAIC to determine if an inconsistent or incorrect signature it receives results from a malfunctioning clock interval or bad-quality information rather than from bad data.

The SAIC (signature analysis integrated circuit) is capable of generating a number of additional types of diagnostic information along with signature analysis.

In addition, the SAIC can detect circuit malfunctions (indicated by extraneous start or stop signals) or nontransitioning clock signals. Some immediate status information is supplied by the SAIC's ability to detect nontransitioning data, a fairly common symptom of digital circuitry failure.

The VPR-300 SAIC implementation provides three testing modes, Diagnostic, Semi-diagnostic and Learn. It can test each of the several hundred data nodes in series, which takes about 90 seconds for the entire DVTR, or using a quicker, parallel scheme in which all input data nodes are analyzed simultaneously. Parallel testing is completed in about one-sixteenth the time of individual testing.

The Diagnostic mode, which runs automatically on power up and may be invoked at any time from the DVTR control panel, uses the SAIC's parallel mode for speed and efficiency.

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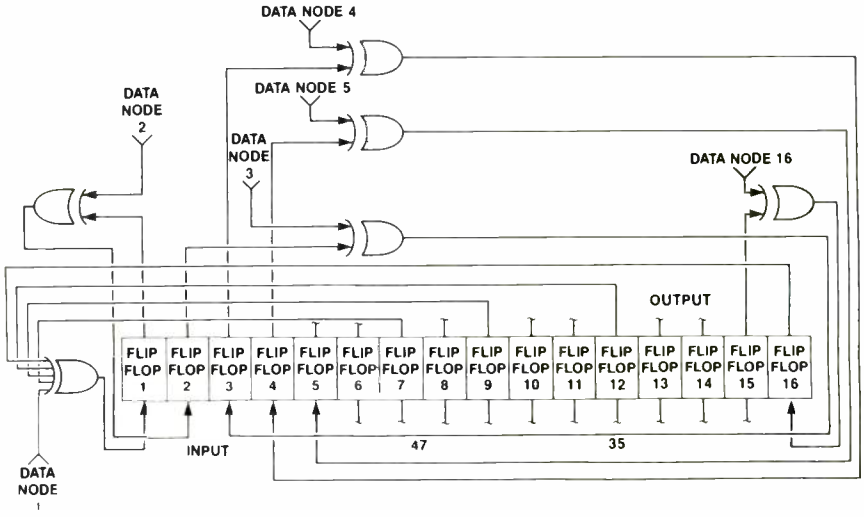
The machine does not have to be taken off-line to be checked. Diagnostic mode will indicate if a fault is present, but will not isolate the faulty node. If Diagnostic mode returns a bad signature, the next step is to employ Semi-diagnostic mode, which permits the user to access any of the hard-wired nodes in the system and to run various forms of serial analysis to isolate the fault. The entire process is performed from the VPR-300's front panel.

Learn mode allows the setups, signatures, and test procedures to be stored in the processor's memory for use during Diagnostic and Semi-diagnostic modes; this information is created in the factory.

Certain limitations and tradeoffs inherent in signature analysis had to

Signature Analyzer Parallel Algorithm



A unique form of parellel analysis allows the SAIC to analyze all data nodes simultaneously. While this method is faster, it will not isolate the problematic node.

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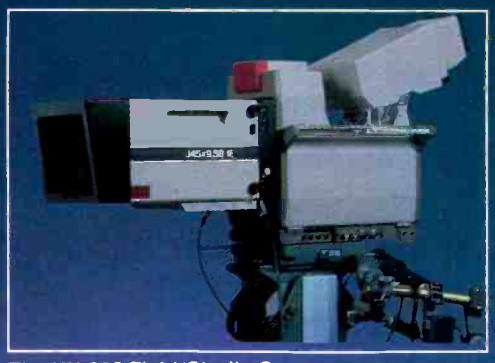

The HK-323 Field/Studio Camera

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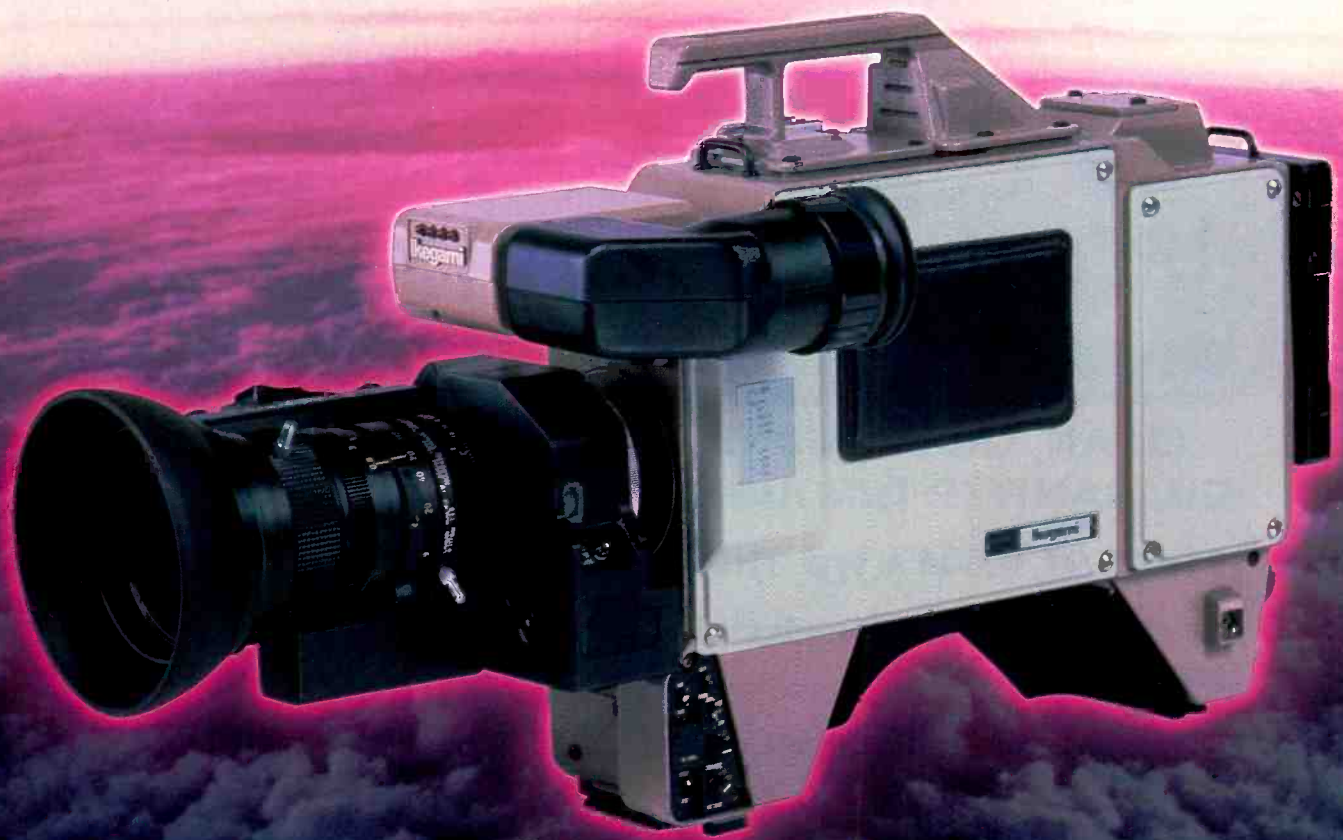

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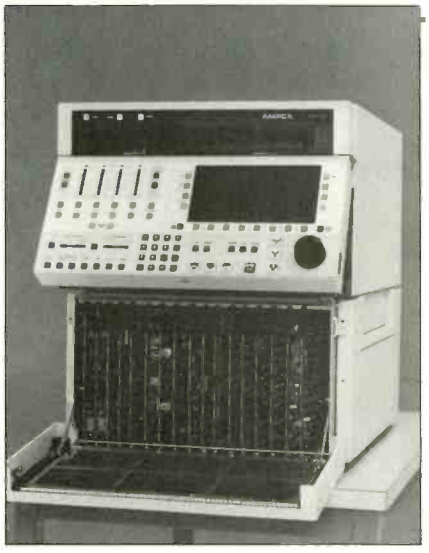
be taken into consideration during design of the DVTR's diagnostics. As previously stated, successful signature analysis depends upon repeatable pattern generation. For maximum efficiency, the digital pattern generator should be placed immediately following A-to-D signal conversion at the front end of the system, thereby allowing the signal to be traced from its origin in digital form through the remainder of the signal path. The patterns are manipulated and changed throughout the signal path.

Ideally, the diagnostics should be able to examine every data node that creates a unique and repeatable signature. Another consideration is that various parts of the processing circuitry operate at different frequencies. To provide accurate testing, therefore, either the pattern generator must operate at the slowest frequency of the node to be tested, or additional pattern generators operating at the slower speeds must be added.

State changes must be achieved for all nodes associated with a given pattern generator; semi-global generators may not cause all test nodes to transition, resulting in spurious errors. Another problem is that in some cases processing circuitry may unsettle the generator's effective periodicity, making additional generators



Signature analysis easily isolates faults down to the circuit board level.

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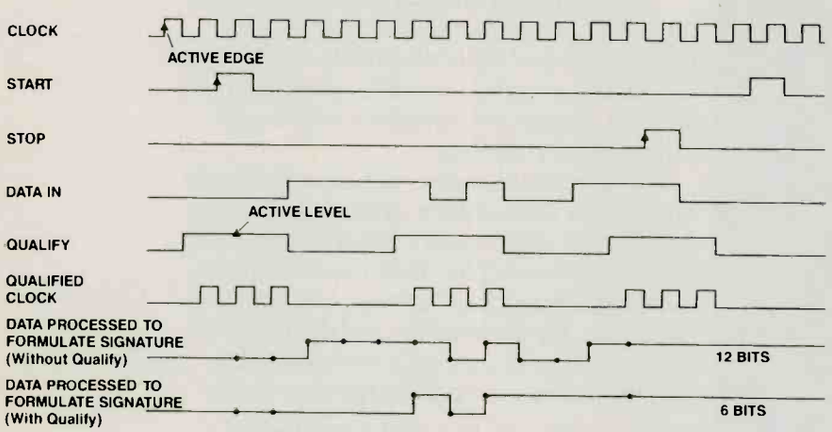
Signature Analysis Timing Diagram



NOTE: ALL ACTIVE EDGES AND LEVELS ARE POSITIVE ACTIVE

To generate a signature, the data stream must be delimited using the Start and Stop signals. The Clock signal clocks the data into the algorithm registers.

necessary to re-enlist this repeatability to other board components.

The main objective for Ampex engineers, therefore, was to select a pattern that could be propagated successfully downstream from its origin at the system's front end, causing state changes in all the circuitry. It was also desirable to limit the size and complexity of the diagnostic system, although this was a secondary consideration. The compromise solution uses several pattern generators for different circuit "territories" based on operating frequency. For example, split field color bars or a frequency sweep signal are typical test patterns for video processing circuitry. For the much slower frequencies found in the audio processing circuitry,the pattern frequencies are 1000 times slower.

By streamlining and simplifying the troubleshooting of such a complex piece of electronics, on-board signature analysis provides the best solution for both day-to-day system checkups and fault location. While signature analysis may seem, at first glance, an intangible, "black box" approach to system diagnostics, in actuality it allows the engineer to probe the circuitry to the depth he deems appropriate. Signature analysis eliminates the tedious and sometimes misleading process of determining where the actual error lies. ■

Fraser Morrison is senior staff engineer for Ampex Corp.'s Recording Systems Division.

For Further Information

on signature analysis, see:

Herz, William S., "Diagnostics for a Composite Digital Videotape Recorder," *SMPTE Journal*, October 1988.

Hewlett-Packard Application Note 222-2, "Application Articles on Signature Analysis."

No one would argue that in recent years the broadcast industry has experienced dramatic changes. Stations have traded at unprecedented figures, increasing the debt load, while demands on quality and production values have skyrocketed. This, in turn, put pressure on station broadcast equipment to perform more cost effectively while maintaining one-inch type quality.

As part of this change, Panasonic Broadcast Systems Company (PBSC) has grown, from its inception two years ago, to take its place among the leaders in supplying broadcast quality production and post-production equipment to the video marketplace.

Such growth is the beginning of a long-term plan. Panasonic Broadcast has instituted a sales representative and field service engineer program unique to the video hardware industry. Offering six service locations throughout the United States with fully trained people and stocked with parts, Panasonic Broadcast provides the video user with one of the most economical, highest quality product line available anywhere in the world.

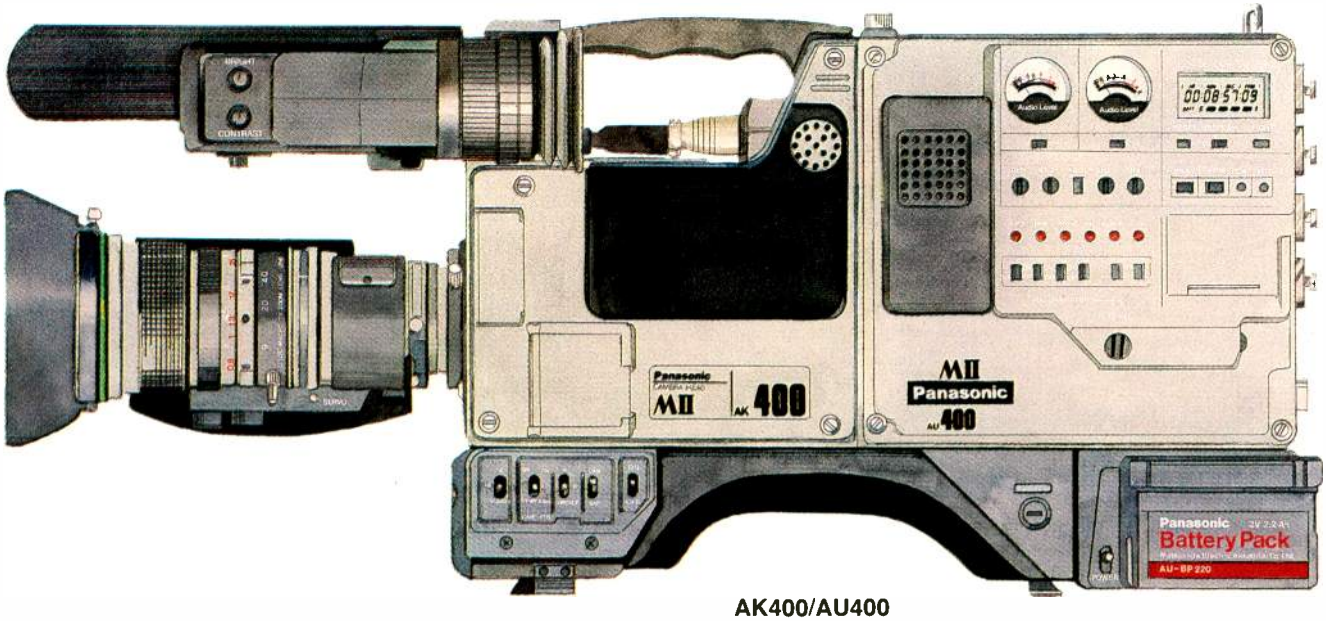
Equipment is not, however, the whole story. Special people working for and from a special industry are the foundation of Panasonic Broadcast. The company's hiring of recognized video professionals is the backbone of its success. The sales representative program, recently strengthened and expanded, makes it easier to get MII equipment than ever before. Total company employment is expected to grow to more than 100 this year, which guarantees support long after the purchase is made. As the full line of MII's versatile products grows, communications can achieve a higher level of production quality.

Stan Basara, Panasonic Broadcast's president and chief operating officer, states the company's charter concisely: "We wanted to bring to the video marketplace a quality product in terms of both hardware fit and finish, technical video performance and quality after sales support. In addition, there is cost effectiveness: comparable to one-inch quality at half the price."

"We wanted to bring to the video marketplace a quality product."

The company has come through on that promise by providing a full range of products.

From one end of the spectrum, through and including the playback decks, the record/play units, the portables and the camera-dockable recorder, the full line of MII product reaches its pinnacle with the AU-660PE. As noted by Basara, "This is a high performance VTR with enhanced editing capability configured to answer the sophisticated operational needs of larger teleproduction facilities. We feel it represents our continuing commitment to high quality in a cost effective package, designed to meet the demands of our customers." The MII product line is constantly being expanded to meet market needs in order to offer viable alternatives to customers. It



AK400/AU400

AU-660 PE

should be noted that the MII family of products includes the AK-400 frame interline transfer CCD camera that accepts the AU-400 dockable recorder. Even given the high quality and reasonable pricing, today's video professional needs more.

"What else is there? The backing of one of the world's largest corporations."

Quality, cost, systems, what else is there? The backing of one of the world's largest corporations.

A History of Innovation

Though Panasonic Broadcast was born only two years ago, it draws on the 60 year history of quality electronics products fostered by its parent, Matsushita Electric Industrial Company Ltd. Matsushita's manufacturing, research and development prowess is renowned throughout the world for its vision and depth. And its use and purveyance of advanced technologies is well documented. The parent company was founded in 1918. It came to the United States in 1959, the same year as Alaska and Hawaii became states, and now applies resources unmatched in the video hardware industry.

Therefore, the criteria for establishing a new company under such an auspicious parent needed to be substantial. Also, targeting the video hardware industry which has a professional and demanding clientele, required that the new company, Panasonic Broadcast Systems, be able to deliver the goods. Thus, as Jerry Spencer, Panasonic Broadcast's marketing manager, said, "The company's reason for existence: to serve the professional video marketplace with quality products, offering the best performance at the most cost efficient level."

This would not be possible without the support of one of the largest electronics corporations. Matsushita, worldwide, offers the name brands of Panasonic, Quasar, Technics, Ramsa and National. It has 48 manufacturing facilities, worldwide, with 37 sales organizations in 35

"Matsushita is a $38.5 billion company spending over $2 billion per year in research and development."

countries. Matsushita is a $39 billion company spending over $2 billion per year in research and development. It boasts an army of more than 21,000 engineers and employs in excess of 170,000 people worldwide. In the United States, its sales have reached the $4.3 billion level, and there are 9,000 U.S. employees.

WPRI Converts To MII

The story about WPRI, a Knight-Ridder owned ABC affiliate in East Providence, Rhode Island, is progressing in stages. In 1987, the station had budgeted for a single one-inch machine.

It was at that time that Steven Davis, director of operations, went to NAB and saw the MII demonstration. It didn't take long for him to conclude that he could get a few AU-650s for the price of a single Type C machine. The MII's durable cassette system with 90 minute record capability in addition to quality analogous to one-inch were influential in his decision. So he bought three machines.

That was stage one. The second part of the story deals with performance. "Originally, we bought the machines based on price," remembers Davis. "But we found the machines have phenomenal reliability, absolutely no problems. In fact, we have experienced 3,100 hours on one upper head drum with no ill effects. We are completely sold on the superiority of the MII transport."

That's why, when Davis converted news over to the MII format, it was a planned acquisition based on a solid track record. Their successful experience and the machine's reliability served as the springboard for additional MII purchases. The field edit package was added to the station's roster of equipment after a trouble-free six month trial period. "This allows us," Davis said, "to provide our own editing facilities wherever we go. So format compatibility is never a problem."

The third stage of this series is that new AU-500 portable recorders will be added this year for edit playback while the AU-550 field edit recorders will be bought to serve as edit source decks.

It looks like this story will continue for some time to come.

KPNX Makes News With MII

In early 1988, KPNX chief engineer Leon Anglin began to replace his existing Betacam gear with Panasonic's MII equipment. The reason for the NBC affiliate's switch: the format itself.

"The format gives the news department capabilities it never had before," states Anglin, "giving us the quality and the versatility of the 90 minute cassette. With our time delay of network feeds and the way we master our news reels, those were essential qualities provided only by MII."

The Phoenix, Arizona station masters all of its news stories onto 90 minute "reels" and neither ¾" nor Betacam was able to handle that length. MII's variable cassette size allows the station to accommodate their method of archiving news stories. As for playback, four AU-620 studio players and an AU-650 recorder are used.

The use of MII goes beyond the confines of the station's walls and into the field for ENG. The satellite news vehicle is also equipped with Panasonic Broadcast's AU-650, while in field situations the station has also used the AU-550 field editing package. Since both recorders offer 90 minute record capability, they can easily cover news conferences and lengthy field reports without concern about tape length.

Much of the network programming is delayed, because of the time zone situation in Phoenix. "Here too," says Anglin, "the longer recording ability of the MII format was beneficial since we have an automated facility utilizing the software and system design from Time Logic and NTC. All this directly interfaces through the RS-422 port of our AU-650s. This is also beneficial in the area of backup equipment, since any MII deck can be brought on line for backup in our automated system due to the 422 port capability."

The NBC affiliate also runs a post-production suite geared mainly toward station needs. When the schedule permits, however, the facility is booked with outside clients. There is an ever increasing demand for the MII format from these clients so post production is also outfitted with AU-650s.

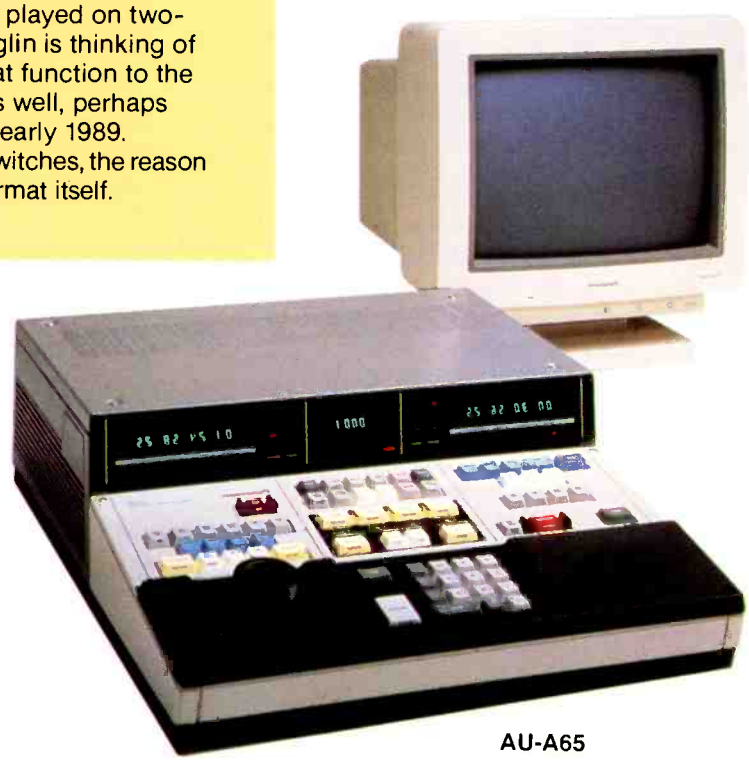
Rounding out the plant, syndicated programs are also played back on the MII machines. Commercials, the lone hold-out department, are currently played on two-inch, but Anglin is thinking of switching that function to the MII format as well, perhaps sometime in early 1989.

When he switches, the reason will be the format itself.

Now the question arises: "How does that benefit the video professional?" The answer is vertical integration. All of the products and innovations developed through the Matsushita Electronic Components division (or any other sector of the company) is first offered to companies owned by Matsushita. In this way Panasonic Broadcast can take advantage of one of the world's most creative and largest suppliers of electronic components. The AK-400 CCD camera, for example, uses the frame interline charge coupled devices (CCD's) designed by Matsushita. In another example, as one of the world's largest supplier of robotics, Panasonic Broadcasts' customers requiring video cart machines benefit from that arm of the business. And the list goes on.

Perhaps, most important is that the parent company's president, Akio Tanii and its senior managing director, Tsuzo Murase, rose through Matsushita's video side of the company. Thus, they are strongly committed to Panasonic Broadcast Systems' success, creating a sense of productivity in this field that is critical to its longevity.

The company philosophy of creating products that are useful to and, indeed, serve to benefit the quality of life of the end user carries through from the parent company. This is seen in the extreme care and precision in every aspect of Pana-



AU-A65

AU-500

sonic Broadcast's hardware. From the tape transport to the system configuration; from the choice of format (capitalizing on Matsushita's vast experience in half-inch VHS) to engineering, parts and service support, the mark of quality is evident.

MII's Support Network

Down the halls of video facilities can be heard the echo of, "So you sold me on the equipment and the great company, but now you disappear, leaving me to figure out how it works and where I'm going to get service, right?" Wrong. Panasonic Broadcast has a unique and thorough after-sales support network.

Trevor Smith, national service manager, states the case well, "Our philosophy in service is that sales brings a customer into the MII fold, while the quality of the product and our service insure long term satisfaction. We don't believe in walking away after a sale, we'll be there 24 hours a day after that." Parts availability, parts supply, service and rapid phone access to service personnel are the key elements in this type of support.

The details of how this works are impressive. Six regional service centers that stock parts. Each service engineer at every site is available by phone or to come to the site. He can always be located by beeper if necessary. If the customer prefers to talk with headquarters there is an 800 number that is active 24 hours a day. No matter how the customer wants his service handled, Panasonic Broadcast is already set up to do it that way. Of the six service centers, the Northeast is handled by headquarters in Secaucus, NJ; the Southeast center is in Atlanta, GA; the Southwest in Dallas/Fort Worth, TX; the Midwest in Chicago, IL;

"Panasonic Broadcast can take advantage of one of the world's largest suppliers of electronic components."

and the West in Los Angeles, CA. The Los Angeles and Dallas/Fort Worth facilities are expanding to meet the increase in sales, staying ahead of the customer's needs. A new facility is being opened in the Washington, D.C. area as well.

NBC to Seoul: MII's The Ticket

Perhaps the most prestigious and logistically challenging video programming event is the Olympics. This year's games will be held in September in Seoul, Korea and will be covered by NBC. After securing the rights and negotiating all the terms, the network then faced the hard part: how to handle video production. Full blown production facilities, stocked exclusively with Panasonic Broadcast's MII production and post-production gear will be on hand to meet the challenge. Every event will be recorded and edited on MII video equipment.

NBC will provide approximately 180 hours of programming during the course of the Olympic Games. The network plans to use 7,500 MII cassettes for this purpose, with an additional 5,000 pieces allocated to NBC News.

Exclusive of what the news department is doing, NBC Sports will use a host of recording, editing, processing and effects systems to help bring the games to the world. The facility used to produce such an impressive schedule of events must, in itself, be quite impressive. And it is. The four large edit rooms will contain seven MII VTRs working with a composite switcher, with all seven VTRs being able to record from the venues and also able to feed out of the edit room. The network views MII's component editing as the superior method for producing quality video because the facility can eliminate NTSC short falls, such as dot crawl, cross color, which are inherent in NTSC encoding.

In addition, there are 11 smaller edit rooms employing either three or four VTRs each that will serve as the primary recording points for venue feeds. These rooms will also use component switchers. Principal playback machines will be located within NBC's Tape Central which contains 14 MII VTRs.

In the field, NBC crews will have 10 handheld camcorders with MII AU-400 recorders. The base for most venues will be handled by mobile units with both field recorders and edit recorders. Track and gymnastic event venues will be equipped with MII studio VTRs.

Often, with the dazzle of an international event being recorded on state of the art video gear, the audio portion is often neglected. NBC's history of leading the way in stereo will put the audio capabilities of MII to good use in Seoul. Channels one and two, recorded on the longitudinal tracks, will be the stereo audio feed coming from the venue. Channels three and four, recorded on the FM configuration, will allow later editing to accommodate different announcements and to adjust for sound continuity.

From September 15 until October 4, the Olympics and NBC will provide a caliber of entertainment that is rare in broadcast history. To prepare for the Olympic challenge, durability, performance and support were necessary. That part was provided by Panasonic Broadcast Systems.

"As a further gesture towards our customers," explains Smith, "we are prepared to loan boards and equipment until original equipment is completely repaired, and meets specifications. We are able to do this because every region is equipped with parts for immediate response to customer requests."

Spare parts and boards can be shipped to the customer on a 24-hour basis. Panasonic Broadcast is also committed to getting an engineer on site at the customer's facility within 24 hours. In order to accomplish this, the company has 13 field service engineers backed up by a complete support group in each region and at headquarters. Yet, the service and quality of product provided by the company goes even further; back to the reason for the company's existence.

"The same classes are offered for the end-user as those used to train the company's service engineers."

This philosophy continues with training. Bill Bakonyi, national manager for technical training and publications says the customers place great value on training and information, saying, "People need to be informed. That is as much a part of our company as anything else. We must, and do, provide that kind of support." To demonstrate the sheer depth of training offered by the company, the same classes are offered for the end-user as those used to train the company's own service engineers. This provides an advanced level of training to the video professional which users say is the best in the industry.

"Service manuals offer the customer what he really wants to know, as opposed to whatever the company wants to tell him."

Bakonyi adds, "Now that the industry has decided that MII will deliver on a par with anything that's out there, they want to know what the company will do for them. What we do is unparalleled. We provide thorough classes all over the country in both operations and technical service. And, perhaps most important of all, we provide excellent service manuals offering the customer what he has asked for, what he wants to know, as opposed to whatever the company wants to tell him."

Regarding the manuals, current equipment users have given rave reviews on all aspects of the documentation. The layout is user-friendly, allowing technicians to look at all related boards and schematics together. It is not necessary to flip back and forth through the manual in order to find related information. Another advantage has been the technical descriptions of any element in the system, providing a concise, clear description of what the component is and what it does. Best of all, it's written in plain, accurate English.

In all training sessions, which take place regularly and can be scheduled separately at the customer's site, there is an open attitude, a willingness to show the students anything. Because, as Bakonyi says, "We are proud of the product and the design and the company philosophy that made it work. We are happy to show the product to anybody. We also try to build in a high degree of comfort with the products and training because that becomes important given the high performance of the machines."

After purchasing and being trained on the theory, adjustment and repair of the equipment, the customer can still expect Panasonic Broadcast to support the product. After-sales service is the name of the game, and the extensive network organized on a national basis provides that to the customer.

AU-A50

AU-550

AU-MX50

Corporate Product Philosophy

A truly unusual characteristic of the company philosophy extends beyond support and service and reaches to the core of all product design and implementation: attention to detail. This allows a broader perspective as well, spreading to compatibility with other equipment in the marketplace. Product review groups at Panasonic Broadcast Systems study how the product is being used and what can be done to improve it. This insured that MII VTR's will interface with equipment manufactured by others. Software changes, for example, are diligently researched and solved by interfacing the customer with other manufacturers.

"Sales brings a customer into the MII fold, while the quality of the product and our service insure long term satisfaction."

There is a host of equipment manufacturers with whom Panasonic equipment can interface. Among them are: Alamar, Ampex, Asaca/Shibasoku, CMX, Cipher Digital, EECO/Convergence, Grass Valley Group, Ikegami, Lake Systems, Lexicon, M&R Data Services, Merlin Engineering, Odetics, Sony, Time Logic, and Utah Scientific. Obviously systems interface and product support are fundamental to the Panasonic Broadcast way of doing business. This dedication extends from the large system interface down to the smallest detail in every machine, resulting in a direct cost benefit to MII users.

"A complete system, a complete company, a universe of elements..."

This philosophy includes the choice of the cassette based half-inch format itself, as well as its reduced tape consumption reduction, all of which carries through into extended recording time. The factors of linear tape speed and the amount of tape used yields a 70% reduction in tape consumption.

Integrity of the elements is also central to this philosophy of quality. For example, the use of single piece, cast aluminum tape transports in the MII equipment instead of three-piece sheet metal assemblies assures durability, as well as consistently meeting critical specifications. Stainless steel ball bearing tape guides with ceramic edges, cassette based metal particle tape instead of metal oxide as well as amorphous video heads are some of the extra measures taken at Panasonic. This ensures that the customer gets smoother tape handling, longer head wear and more passes of the tape. These benefits the customer can take to the bank... and effectively does, due to lower operational costs.

All in all the philosophy tells the video professional that when they buy MII they are buying people who support them, products that produce for them and a philosophy that looks to the long term. A complete system, a complete company, a universe of elements all converging to bring the highest performing product to the video marketplace.

WRAL Puts MII Through Its Paces

From the time WRAL converted its operation to the MII format in 1987, to its trip to China in the summer of 1988, the CBS affiliate has continued to push the format to the limit.

"We have found," reveals the Raleigh, North Carolina station's chief engineer, Wilbur Brann, "superior quality and durability. We sent some people to China for a period of three weeks. They went through previously unexplored territory. During that entire time, under conditions of stress, the crew did not experience one failure. And they got beautiful pictures."

These are unusual circumstances for a local station to acquire a story, but WRAL is an unusual station. WRAL is perennially dominant in its market, as well as being selected as one of the 25 best stations in the country. This recognition can be attributed, in part, to its dedication to extensive news coverage. To maintain this kind of reputation, the station needs to rely on equipment employing advanced technology.

The station maintains three vans used for EFP, with AU-650 studio VTRs in each. The one satellite news vehicle (SNV) the station owns is also equipped with AU-650s. Brann said they take the AU-550 field edit package wherever they go, as they did to the recent Democratic National Convention.

The station purchased the M.A.R.C. II automated cart machine to air commercials in addition to recorded satellite and syndicated programming. The M.A.R.C. II was favored, since one of its invaluable assets is its ability to record within the machine while controlling external recorders. In addition, the cart machine is airing the station's programming and network feed.

But this is not really the limit, the station may buy another SNV and then...

A Selected MII User List

Teleproduction

AME, Burbank, CA
ASV Corp., Norcross, GA
Compact Video Services, Burbank, CA
ESPI Video, Dallas, TX
Unitel Video, Los Angeles, CA
Video Techniques
Windstar Studios, Colorado Springs, CO

Stations

KCNC, Denver, CO
KEYC, Mankato, MN
KGSW, Albuquerque, NM
KHQ, Spokane, WA
KJRH, Tulsa, OK
KMOT, Minot, ND
KOKI, Tulsa, OK
KPLR, St. Louis
KPNX, Phoenix, AZ
KTHI, Fargo, ND
KTSM, El Paso, TX
KVOA, Tucson, AZ
KXXV, Waco, TX
WBRE, Wilkes-Barre, PA
WDSU, New Orleans, LA
WFTS, Tampa, FL
WGEM, Quincey, IL
WHAG, Hagerstown, MD
WHIZ, Zainsville, OH
WHO, Des Moines, IA
WICD, Champain, IL
WJAC, Johnstown, PA
WJKS, Jacksonville, FL
WKJG, Ft. Wayne
WPRI, E. Providence, RI
WPSD, Paducah, KY
WPTF, Raleigh, NC
WPTV, West Palm Beach, FL
WRAL, Raleigh, NC
WROC, Rochester, NY
WSBT, Southbend,
WSTM, Syracuse, NY
WTVO, Rockford, IL
WWNY, Watertown, NY
WXFL, Tampa, FL
WXYZ, Southfield, MI

Stan Basara, Panasonic Broadcast Systems Company.

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THE DIGITAL TIMETABLE:

TOO MUCH, TOO SOON?

Is the transition to digital video happenning at a pace advantageous to stations and facilities? At the recent ITS Convention, a panel of experts considered this question.

With the marketing of practical digital VTRs, the surge to digital video has moved into a new stage at television stations and teleproduction facilities around the country. The all-digital studio, until recently the province of only a few high-end post houses, is close to being a practical reality for broadcast facilities.

But is the all-digital studio a worthwhile goal for the industry? What are its drawbacks, in terms of both implementation and product availability? Is the digital timetable proceeding too slowly—or too fast?

At the first annual convention of the International Teleproduction Society, which convened recently in Los Angeles, a distinguished panel met to consider these questions. Their comments, excerpted here, shed some interesting light on the status of digital video in today's—and tomorrow's—television studios.

Joining the panel were: Richard Daly, vice president for product development at ColorGraphics; Marcos Obadia, vice president and chief engineer of Limelight Video in Miami; Phil Bennett, co-founder and vice president of Abekas Video Systems; Peter Dare, vice president of product operations for Sony Corp.; John Conrad, chief engineer of Video Tape Associates in Atlanta; and David Fibush, engineering section manager in the Recording Systems Division of Ampex Corp., in charge of small format recorder development. Both Fibush and Dare serve on the SMPTE's Committee on Television Recording and Reproduction Technology, which Fibush chairs. Eva Blinder of *BME* Magazine moderated the discussion.

"I think in the long term, the parallel issue will disappear from the scene."—Dare

BME: Right now we have two commercially available digital tape recording standards, D-1 component and D-2 composite. Are the methods that are available for coding between the two formats adequate?

BENNETT: Of course, with the emergence of these two standards, the same old problems of getting from component to composite are going to continue to happen. The real problem is not so much going from D-1 to D-2, which inherently degrades the pictures by converting them to the NTSC standard that we all know and love. Everybody knows what that loss is and will accept it. The real problem is going to from D-2 to D-1. You won't end up with something that looks like a D-1 master. However, there are a lot of things that can be done to improve that situation. And strangely enough, many of those are coming out of the consumer field.

DALY: Because of the international character of D-1 and the NTSC world, you not only have the problem of converting from component to composite, but you have the problem of going from 13.5 MHz to 14 MHz. It's quite feasible technically, but its not going to be a cheap process. What I suspect is going to happen is that the D-1 is going to be converted to a high bandwidth analog signal internally and then resampled to D-2. I suspect that some people are going to find that that's the cheapest way to convert

DIGITAL TIMETABLE:

"I think that we are just being technology-hungry for technology's sake."—Dare

from one format to another. It would be completely hidden inside the device.

FIBUSH: When you convert from D-1, which basically has wideband chroma signals, to D-2, which is an NTSC composite signal, if it's going to go over an antenna, which a lot of these signals eventually will, there is a little problem about the FCC rules. I'm not sure how this going to get resolved, but you're not putting out I and Q bandwidths that are correct. This is one of the topics that's being considered, among others, at one of the SMPTE working groups.

BENNETT: As a practical matter, I think, most people haven't been paying too much attention to that; and that undoubtedly is causing some problems. I would have to say that filtering for a correct IQ bandwidth isn't going to be a major problem in the transcoder. Similarly, on the sample rate conversion issue, I think we're already seeing in the post-production business the problems of going from D-1 film transfers to one-inch C. There are often control issues in terms of exactly how we filter to get from the current D-1 to the current analog implementation. I think there is going to be a strong pressure from the users on this.

DARE: We have shown digital conversion in both directions, D-1 to D-2 and D-2 to D-1, and converting the bit rate is certainly a problem. We do it at about 470 MHz; there are some magic numbers related to CCIR 601 and the NTSC systems. There are some very fortuitous numbers; it was not planned that way, I am sure. But the conversion can be done in the digital domain and quite frankly, it's not all that expensive.

CONRAD: We've committed ourselves to the D-2 format in our plant mostly because of the architecture of our plant. If we tried to implement D-1, we would have almost a complete plant reengineering to do. I think Phil Bennett was somewhat right when he said that cost is the determining factor on D-2's taking off. But I would change that to say, the dollars. We would have paid more for the machines if they cost more. The real thing for us is the dollar the client is going to spend. We can implement the D-2 format and give our clients a complete loss of one-inch tape generation

"Converting between D-1 and D-2 is quite feasible technically, but it's not going to be cheap."—Daly

"Users have got to stand up and say what they need."—Fibush

loss as soon as those machines are delivered. It makes a whole lot of sense for the market we are trying to serve.

BME: What's the status of the SMPTE standardization work on interface standards? Is there a standard yet for D-2?

FIBUSH: I don't think there is any dissention among the troops on the D-1 parallel interface. In terms of D-1 or component serial, there is an interface that is agreed upon. But there is a lot of concern as to whether or not eight bits is enough. And there is concern as to whether or not that's really the most effective way to do the transmission. In composite, there is a conflict going on at the moment. But there is among the manufacturers an agreed-upon parallel connection between equipments. There's some concern that it looks too much like what's intended to fit in an analog environment and should look more like what is intended to fit into, let's say, the D-1 environment. Some of the issues have to do with what goes in the horizontal blanking interval. Do you put sync and burst in there or do you put ancillary data? The equipment that

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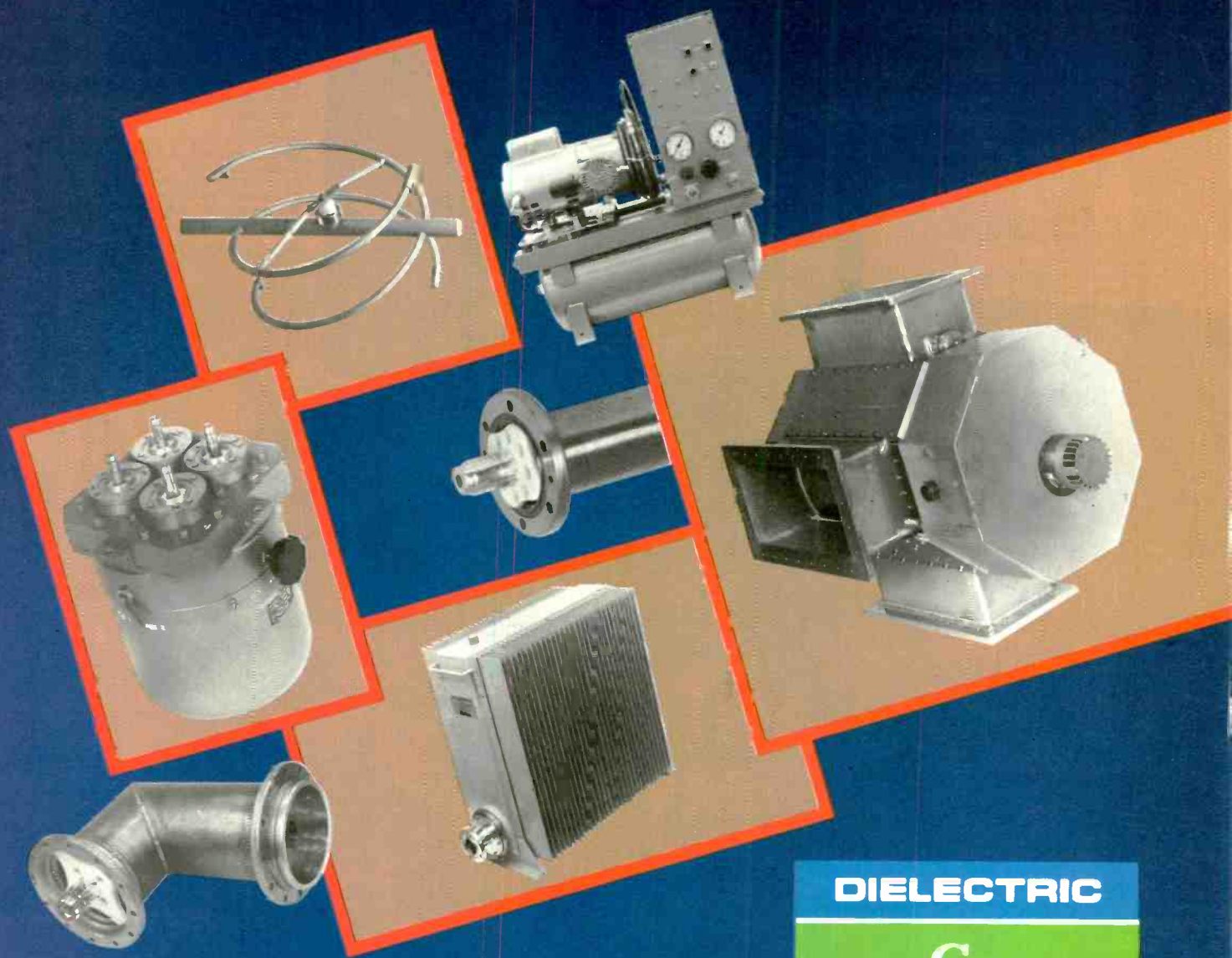

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DIGITAL TIMETABLE:

"The arrival of the 4:2:2 standard to us was just a different way of shaking digital in and out."—Bennett

exists in the field today puts digitized sync in there because that's what most easily fits into today's environment.

DARE: I think in the long term, the parallel issue will disappear from the scene. The connector is a D-25 pin connector. The cable is a flat ribbon cable that has limited ability to run long lengths; and I think some of you have experienced the fact that the connector falls out as well. That's also a controversial issue. I mean, you think we can't decide on the data rate; we can't even decide on the screw size.

To get back to the more serious issue, parallel transmission of either composite or component is very expensive to implement. I believe that the more practical implementation is the serial implementation. As Dave said, that's a contentious matter. But I think from the user's point of view, the serial approach is a better approach.

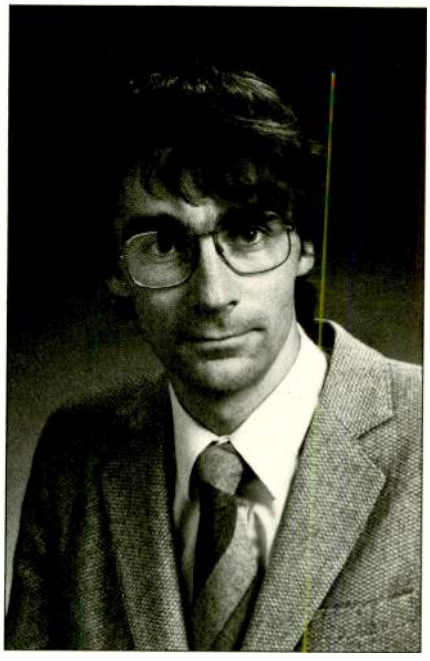
BME: What about the all-digital plant? Do we really need it? When will it be cost-effective?

CONRAD: I think to a man, everybody would look forward to a completely digital plant, mostly because of the capability of seeing the same thing over and over again; no generation loss, no changes or anything like that. A completely digital plant is feasible now. But you have to do an awful lot of original development yourself. It's a nice thing to work towards, but I'm still planning on loading up one-inch machines for 10 or 15 years to come.

OBADIA: An all-digital plant, whether it's in component or in composite, incurs an incredible cost. I think that nobody yet has really given serious thought about the cost of putting in an all-digital composite plant. Definitely for D-1 it's an expensive proposition, but there are a great deal of advantages.

DALY: In terms of cost, the good news is that to have a digital paint system is probably cheaper than what you're used to in the past. These systems have always been digital. The arrival of the 4:2:2 standard to us was just a different way of shaking digital in and out. Paint animation systems are not going to suddenly go up in price because they're all digital.

DARE: Going to an all-digital plant only makes sense when you can do it cheaper, when you can do it better, and when it saves you money. Unless it does those things, I think that we are just being technology-hungry for technology's sake. We've been focusing this morning on how we do it with the video. Doing an all all-digital audio plant carries with it similar complexities. And the question has to be asked, if we have a 20-bit audio system with the capabilities of 135 dB of signal-to-noise, with a bandwidth to 20 kHz, what is the cost- benefit ratio when the delivery system is a 65 dB signal-to-noise system with 15 or maybe 12 kHz? I'm not suggesting for one minute that we downgrade them, but there is a cost for going for these very high parameters and high performance.



"I think the users are going to find out for themselves that eight-bit composite is pretty granular."—Bennett

The other issue that I would like to address is the perception in the industry that because we have a digital VTR and some other digital boxes, that we can go through these processes infinitely. In some instances we can, but if the picture is being processed, the VTR doesn't degrade the picture, but rather the effects device degrades the picture. So, the responsibility of maintaining the picture quality moves from the VTR manufacturer to the picture processor manufacturer. And the analog world wasn't quite that way. The VTR screwed it up so badly that we could pass through some of the processing equipment without you noticing it going downhill. Phil, what do you say?

BENNETT: I can't resist having a go at that. I think the users are going to find out for themselves. Eight-bit composite is pretty granular. In some instances it can actually look worse than C format with a nine-bit time base corrector. And that's the way its supposed to be, because that's what you're paying for. By staying away from a greater system you could possibly build, it becomes commercially viable and I think that's why that D-2 format is going to be so successful. But there is certainly going to be cases where you can see that you're looking through that digital window. There is always going to be degrada-

DIGITAL TIMETABLE:

"If we tried to implement D-1, we would have almost a complete plant reengineering to do."
—Conrad

tion. The effects machine in D-2 is of course is going to have decoding problems just the same way as they always have. In D-1, effects machines produce much less degradation. At the same time, the component effects machine should be built to a much higher performance level than a composite effects machines, simply because of the two different market bases that it appears that they are going to be targeted at.

Nobody has been addressing that yet. People regard an effects machines as an effects machine and it doesn't make any difference whether you want to use it in a composite environment or a component environment. I think we're going to see a bit of a split in the business, particularly with graphics devices that may be 4:4:4:4. People probably will have some requirements for very high end and maybe that means all the equipment in that environment should be very high end. People are also going to have a requirement for D-2 equipment; maybe all that D-2 equipment should be compatible with not just that D-2 standard but that D-2 quality expectation, and be priced accordingly. I think its more than just two different tape formats; we're really talking about two different business philosophies.

BME: What pieces are missing from the all-digital plant, and what's in the development pipeline?

OBADIA: For the last year and a half we've been working in our facility with a D-1 format and manual patching. Finally now we've taken delivery of the first 601 routing switcher, and it's made life a lot easier. Now we're waiting for the digital audio routing switcher to become available. Digital effects devices are available now, but digital production switchers are still on the development table.

FIBUSH: I think one piece that is fairly obviously missing is the acquisition recording VTR. And one of these days that needs to be digital. It happens to be one of the things that the SMPTE is investigating again. In terms of what we call small format digital, we're just in the study group phase, but we have written a requirements document.

OBADIA: If we're going to try to agree on a small format recording standard, is it going to be component or composite? One of the things that we have experienced using component digital mastering is that it is very important to keep the matrixing process down to one time and only one time.

DARE: At least from my knowledge of the group discussion so far, there have been no decisions reached. I think we also have to be careful that we shouldn't introduce another format for the sake of some technology. We need a good reason to change the acquisition format. One could argue that the acquisition format should indeed be better than the studio format, because you want all of the data coming back. It's a poor argument in some respects, but it's worth consideration; and yes, you're absolutely right that ITS members don't want the same quality as some network news; they want better quality.

FIBUSH: I agree that the acquisition format has got to be component. On the other hand, we understand there is some work going on on a small format digital that happens to be composite in one of the companies; it doesn't happen to be Ampex. Users have got to stand up and say what they need; if you just get the manufacturers together, they have their own ideas. ■

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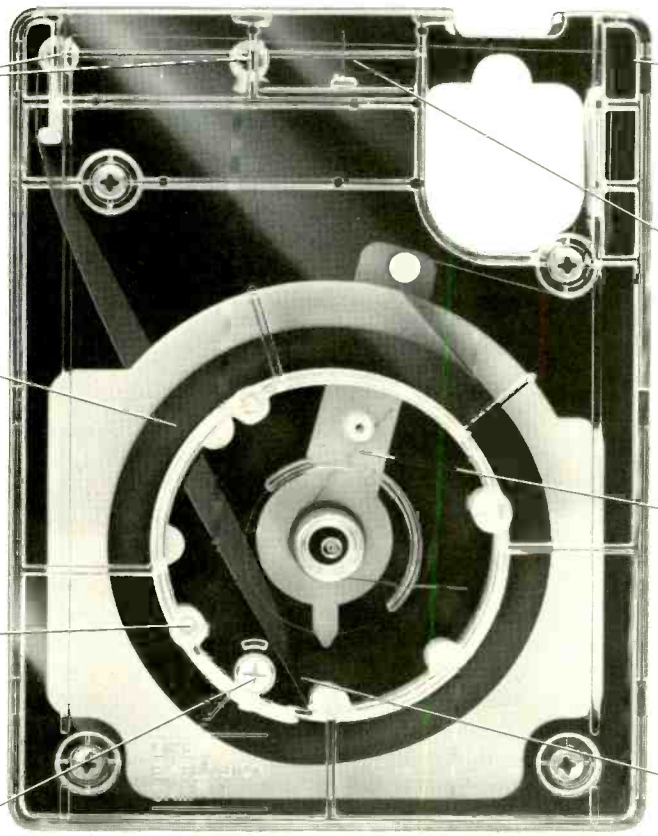

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3M

THE LETTER OF THE LAW: PCB COMPLIANCE

The EPA's PCB compliance directive is in effect now. Is your station up-to-date?

Although most broadcasters are now aware that the Environmental Protection Agency is currently implementing its 1985 directive on the use and disposal of allegedly hazardous PCB material, industry sources say there is still "lots" of PCB equipment in operation in the field.

The EPA directive follows the Congressionally enacted Toxic Substances Control Act (TSCA) of 1976. This statute encompasses the manufacture and use of polychlorinated biphenyls (PCB), which functioned as a dielectric fluid in most pre-1980 radio and TV transmitter power transformers and high-voltage capacitors. PCBs were most commonly used as insulating oil in oil-filled capacitors and as heat-transfer fluids.

"This rule became effective in December 1985 and it's important that broadcasters make a good faith effort to get into compliance," says Ralph Justus, the NAB's director of engineering regulatory and international affairs. Although most EPA actions to date have involved utility companies, accident-related incidents involving noncompliant broadcasters have also been the subject of various legal actions.

"If noncompliance comes to the EPA's attention, it will be prosecuted," Justus says, citing a recent case where a station shouldered a cleanup bill of a quarter million dollars. In addition to the costs of a mandatory cleanup, the EPA can set fines of $25,000 per day per violation. Noncompliance or illegal activity can also summon up punitive action including jail sentences and public apologies published in full-page newspapers advertisements.

To get legal, broadcasters must immediately label equipment, conduct inspections, prevent leaks, maintain quarterly logging procedures and have begun a PCB disposal program, according to Justus. The owner of the PCB equipment is responsible for it, whether he is familiar with the rules or not, and so transfer of title of PCB equipment pursuant to disposal is an especially tricky area.

PCB legislation and the attendant transfer of title issue also affects the used transmitter market, according to Greg Best, director of TV product development for Harris Broadcasting. Transmitters up to 40 years old have often changed hands for use as standby equipment. Prospective purchasers and current owners of pre-1979 transmitters and all very old pieces of equipment are therefore advised to have them carefully checked for compliance and title. Note, too, that it is illegal to export PCB transformers and capacitors without an EPA exemption.

The EPA rules define procedures that must be followed regarding the marking of PCB items, leaks, disposal, storage for disposal and record keeping. PCB items include transformers, capacitors, switches or any container of PCBs. As in the title issue mentioned above, an owner of any item containing PCBs is responsible for it, whether or not he or she is familiar with the TSCA rules and regulations.

According to the EPA, the toxic effects of PCBs include the development of chloracne and the possible alteration of reproduction processes in mammals. Worse, burning PCBs produces byproducts such as polycholorinated dibensodioxin/dibenzofurans, which are more toxic than PCBs themselves. Occupants of commercial buildings who could breath smoke following a fire are considered to be at risk, and buildings have been closed after a PCB fire because of lingering contamination.

The EPA defines a "small capacitor" as generally less than 100 cubic

BY BETH JACQUES

inches in size and containing less than three pounds of dielectric fluid. A "large capacitor," according to EPA definition, is larger than 200 cubic inches and contains more than three pounds of dielectric fluid.

A "PCB transformer" is defined as any transformer that contains 500 parts per million (ppm) PCB or greater. A PCB transformer can be converted to a "PCB contaminated transformer" (50-500 ppm) or a "non-PCB transformer" (less than 50 ppm) by being properly drained, refilled and tested.

The EPA further defines "disposal" as intentionally or accidentally discarding PCB items. This includes spills, leaks, uncontrolled discharge, transporting, destroying, decontaminating or confining PCBs. Disposal procedures for large transformers include flushing them, burning the PCB oil and the flushing fluid and burying the case in a hazardous waste landfill or dumping site.

Marking PCB items is a key component of compliance. Each piece of PCB-containing equipment must be marked with a legally mandated label; see sidebar for label sources.

There are very strict rules for the disposal of PCBs, and the procedure must be carried out only by a company licensed for PCB disposal. A cleanup of any released PCBs or leaks must start as soon as possible, but in no case later than 48 hours after the incident. PCB capacitors and transformers must be removed and disposed of by an authorized agent, and it is illegal to scrap a transmitter with its associated PCB capacitors and/or transformers.

It is worth stressing again that unless a broadcaster ensures that title of PCB equipment he is having disposed is legally transferred, he remains responsible for it. This is particularly important to note when dealing with some independent agents or contractors who may agree to take title but are in fact not sufficiently financed or legally empowered to do so.

Inspection is another important part of compliance. Broadcasters must visually inspect for leakage every PCB transformer in use or stored every three months, and keep a record. Stations also must keep a log identifying all items containing PCBs, including spare parts like large capacitors, transformers, regulators and dummy loads, and make them available to the EPA on request. An annual inspection is also required, and records of inspection and maintenance must be kept for three years after disposal.

Finally, reporting requirements are also strict. Stations that own PCB transformers must register them with their local fire departments. If a PCB transformer is involved in a fire, the owner must report the incident immediately to the U.S. Coast Guard National Spill Response Center (telephone 800 424-8002; 426-2675 in Washington, DC).

Since some broadcasters also own their own power transformers, they should be completely familiar with potential dangers and EPA requirements. Some stations also operate transmitters in conjunction with power transformers owned by the local utility company; this and other questions pertaining to utility-owned transformers should be discussed with the utility.

Working with other stations in a local area to organize a group PCB disposal program can save money, according to an NAB conference report by H. Carr Stalnaker of KEZQ-FM, Jacksonville, AK. Determining whether PCBs are actually present in a transmitter is the first step, and it is more difficult than it appears, because different suppliers may have been used to supply the transmitter manufacturer during the model life of the equipment.

Charges for PCB disposal are broken out into transportation and elimination categories. By organizing a local area PCB disposal project, Stalnaker suggests, stations can negotiate as a group with a reputable hazardous waste disposal firm, pool labor costs and arrange for regular "milk run" pickups.

Stations with further questions should contact their closest EPA Regional Office or EPA headquarters, Washington, DC (800 424-9065 or 202-554-1404). ■

Jaques is senior editor of BME.

National PCB Disposal Companies

General Electric: (800) 626-2001, ext. 25
Westinghouse Electric: (412) 937-7140
Ensco: (501) 223-4160
Chemical Waste Management, Inc.: (312) 218-1500

PCB Label Suppliers

Seton Name Plate Corporation: (203) 448-8059
Brady Signmark Div.: (414) 961-2233 or (301) 779-6569
Labelmaster: (800) 621-5808

Identification of PCB Items

ASKAREL is the generic name for PCB fluids and systems. Products containing PCBs have different trade names, including:

Apirolio	Diaclor	Inclor	Pyralene
Asbestol	DK	Inerteen	Pyranol
Askarel	Dykanol	Kanechlor	Pyroclor
Aroclor B	EED-18	No-Flamol	Sal-T-Kuhl
Chlorestol	Elemex	Non-Flammable Liquid	Santotherm FR
Chlophen	Eucarel	Phenoclor	Santovac 1 & 2
Chlorinol	Fenclor	Pydraul	Solvol
Clorphon	Hyvol		Therminal

ENGINEERING SESSIONS

Thursday, September 22
Morning Session
(Main Lecture Hall, third level)

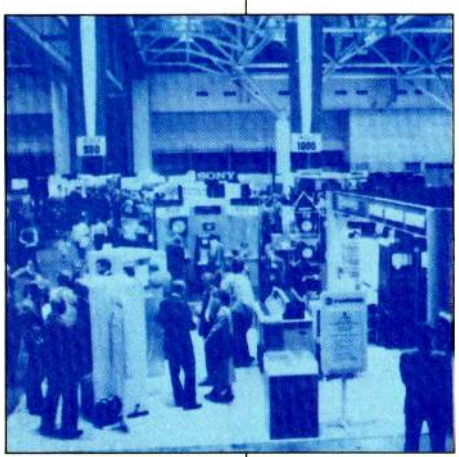
10:00 a.m.
Conference Opening and Welcome
10:20 a.m.
Facts About FAX: Digital Data FM SCA Systems
Harold Walker, Pegasus Data Systems
11:00 a.m.
Protecting Against Power Disturbances
Oral Evans, Control Concepts Corp.
11:30 a.m.
The Computer's Place in Broadcast Engineering
Russell Brown, KTSF-TV
12:00 p.m.
The Application of Microcomputers to the Directional Antenna

Afternoon Session
1:30 p.m.
NAB Project Update
Michael Rau, NAB
2:00 p.m.
Using the Expanded AM Band (1605-1705 kHz)
D.R. Forde, Communications Authority of Canada
2:30 p.m.
Engineering Education for the Broadcast Engineer
Panel Discussion
4:00 p.m.
SBE National Membership Meeting
(Main Lecture Hall)

Night Owl Session
(Mezzanine Level)
7:00 p.m.
Audio Processing and the NRSC
Panel Discussion

Friday, September 23
Early Bird Session: Television

8:00 a.m.
Strategies for Implementing D-1 and D-2 Recorder Formats
Curtis Chan, Centro Corp.
8:30 a.m.
ACTV Progress Report
James Carnes, Sarnoff Research Center
9:00 a.m.
Advances in Fiber Optics for TV
Bob Griffiths, Ph.D., Telemet
9:30 a.m.
Measuring Synchronous AM Noise in TV Transmitters
Geoffrey Mendenhall, P.E., Broadcast Electronics
10:00 a.m.
Exhibit Hall Opens
1:00 p.m.
SBE Certification Exam, Radio
(Meeting Room G, third level).EC



Afternoon Session: Television
(Main Lecture Hall)
1:00 p.m.
Teleproduction Intercommunication: Wired and Wireless
Bob Tourkow, Clear-Com Systems
1:30 p.m.
Microprocessor Control of Switchless Combiners, Switching Combiners and RF Systems
2:00 p.m.
Protecting Your Station: Security Technology
Gerry Kaufhold, Consulting Engineer, Linear Corp.
2:30 p.m.
Techniques in Narrowband Remote Pickup
Barry Victor, The Victor Group
3:00 p.m.
A Spectral Tool Box for the TV Transmitter Engineer
Christopher E. Traficante, Townsend Broadcast Systems
3:30 p.m.
Low-Cost Transmission Line Maintenance Using a High-Power Pulse Reflectometer
John P. Bisset, Delta Electronics

Night Owl Session
(Mezzanine level)
7:00 p.m.
Management for Engineers

Saturday, September 24
Early Bird Session: Radio
(Main Lecture Hall)
8:00 a.m.
FM Directional Antennas: Boon or Bane for Commercial Stations?
8:30 a.m.
Visualizing Antenna Fields
Ron Nott, Cortana Corp.
9:00 a.m.
FM Licensing Update
Robert Greenberg, FCC
9:30 a.m.
Avoiding Problems with DA Proofs
John Sadler, FCC
1:00 p.m.
SBE Certification Exam, TV
(Meeting Room G, third level)

Afternoon Session: Radio
1:00 p.m.
Digital AM Technology
Ron Frillman, Harris Corp.
2:00 p.m.
On-Frequency Retransmission of FM Signals
Kinley Jones, Omega International
2:30 p.m.
The State of Contract Radio Engineering
Panel Discussion

Night Owl Session
(Mezzanine Level)
7:00 p.m.
Care and Feeding of Directional Antennas

SBE BRINGS THE ROCKIES DOWN TO EARTH

Engineering skill sessions, regulatory topics, and upcoming technology will dominate this fall's show.

The rarified air of Denver, nestled among the Rocky Mountains, will be host to some down-to-earth engineering exchanges this September 22-25 as the Society of Broadcast Engineers convenes for its third annual convention.

The full schedule of engineering sessions has been planned to reinforce and broaden the professional skills of the attendees. Topics range from actual how-to workshops on all aspects of engineering to discussions of time management and personnel issues. A heavy dose of FCC and regulatory topics will also be included, recognizing such important questions as the future of the broadcast spectrum and safety issues for engineers. The sessions make up "a three-day briefing session for the working engineer," according to Andy Butler, executive secretary of the SBE and director of engineering at WFAN-AM, New York.

At press time, preregistration for the conference was running approximately 10 percent ahead of last year, and Butler predicts attendence will top 2000. Nearly 200 exhibitors had signed up by press time. The success of the show has prompted SBE to bring in an outside contractor, Eddie Barker Associates, to service the exhibits, leaving the society free to spend more time developing the sessions. In addition, this year for the first time attendees will receive a show daily to keep them abreast of the program and exhibits.

A special feature of the SBE convention is the Night Owl sessions that will convene each evening at 7:30. In contrast with the more formal daytime sessions, the Night Owl workshops tend to be freewheeling learning and sharing experiences. The sessions will be run by Don Bouschert, chairman of the popular Broadcasters' Clinics sponsored annually by the University of Wisconsin Extension in Madison. ■

SBE EXHIBITORS

Abekas Video Systems 410-410A
ADC Telecommunications, Inc. 615
Advanced Micro-Dynamics, Inc. 106
Allied Broadcast Equipment 423
Allied Tower Co., Inc. 601
Alpha Audio 671
Alpha Wire & Cable 261
ALTA Group, Inc. 229
Altronic Research, Inc 512-514
Amperex Electronic Corp. 370
Ampex Corp. 124-130
Andrew Corp. 640
Arcor Wire & Cable 311
Arrakis Systems, Inc. 622
ATI-Audio Technologies, Inc. 352A-354
Audio Precision, Inc. 211A
Audiopak, Inc. 433
Autogram Corp. 237
Bogner Broadcast Equipment 108
Bradley Broadcast Sales–225
Broadcast Audio Corp. 452A
Broadcast Communications Systems 116
Broadcast Electronics, Inc. 202
Broadcast Financial Management 654
Broadcast Rentals & Sales 374
Broadcasters General Store, Inc. 236
BSW Broadcast Supply West 411-411A
BTS 315-317
Canon USA, Inc. 129
Chastronics 551
Circuit Research Labs, Inc. 333-335
Colorado Video, Inc. 415
Comprehensive Video Supply 435
Compusonics 553A
Computer Interface Corp. 456
Comrex Corp. 450
Conrac Display Products Group 367
Continental Electronics 655
Control Concepts Corp. 316
Cortana Corp. 360-362
Crouse-Kimzey Co. 241
Current Technology 430-432
Dataworld 211
Davilyn Corp. 413
Delta Electronics, Inc.510-510A
Di-Tech 609
Dielectric 550
DSC Digital Services Corp. 356
Victor Duncan, Inc. 579-581
Dyna-Com, Inc. 637
Eastman Kodak Co. 244
Echolab, Inc. 143
Econco Broadcast Service 536
EEV, Inc. 320
EG&G, Inc. 617-619
Electro-Voice 605
Electronics Research, Inc. 464
Fidelipac Corp. 218
Flash Technology Corp. 233
Fuji Photo Film USA, Inc. 412
Fujinon, Inc. 414
G&M Power Products, Inc. 621
Garner Industries 516
Gentner Electronics Corp. 326
Graham-Patten Systems, Inc. 355
Grass Valley Group 302
Gray Communications Consultants 434
Harris Corp. 351
Harrison Systems, Inc. 217
Karl Heitz, Inc. 110
Hitachi Denshi America 136-140
HM Electronics, Inc. 547
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Howe Technologies Corp. 568
Hughey & Phillips, Inc. 571
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International Tapetronics 3M 330
ITS Corp. 520
Jampro Antennas, Inc. 337
Kintronic Labs, Inc. 321
Laird Telemedia, Inc. 549
LDL Communications, Inc. 378
Leitch 329-331
Lighting Services, Inc.625-633
Lightning Eliminators & Consultants 575
Lowel-Light Manufacturing, Inc. 429
LPB, Inc. 468
LTM Corp. of America 569
Lyncole XIT Grounding 239
M A-Com Mac, Inc. 311A
Marti Electronics 310
McCurdy Radio Industries 646
Microtime, Inc. 134
Microwave Radio Corp. 421
Midwest Communcations Corp. 616
Miller Fluid Heads (USA), Inc. 431
Modulation Sciences, Inc. 118
Moseley Associates, Inc. 120
Motorola AM Stereo 420
Nalpak Video Sales, Inc. 235
National Association of Broadcasters 652A
National Video Consoles 363
NPR Satellite Services 372
O'Connor Engineering Labs 532-534
Odetics–610
Omega International 554
Omicron Video 132
Orion Research, Inc. 125-127
Otari Corp. 634
Pacific Radio Electronics, Inc. 270
Pacific Recorders & Engineering 628
Panasonic Industrial Co. 544
PCO, Inc. 232
Pinnacle Systems 437
Potomac Instruments 417-419
QEI Corp. 322
R Scan Corp. 369
Radio Design Labs 123
Radio Resources 416
Radio Systems, Inc. 583
RAM Broadcast Systems 644
RF Specialties Group 219
RF Technology, Inc. 221
Rohde & Schwarz, Inc. 223
Rohn 240
Roscor Corp. 376
Sachtler 228
Scala Electronic Corp. 371
Schneider Corp. of America 319
Shively Labs 222
Shure 440
Sigma Electronics, Inc.555
Sony Corp. of America 402
Sound Technology 131
Studer Revox America 344
Tamron Industries, Inc.418
Tascam 231
Tecra Tool Industries 243
Tektronix, Inc. 213 215
Telescript, Inc. 545
Teletech, Inc. 313
Television Technology Corp. 210
TFT, Inc. 102-104
TIC General 528-530
Townsend Broadcast Systems, Inc. 227
TWR Lighting, Inc. 271
Utah Scientific, Inc. 338
Utility Tower Co. 641
Video Accessory Corp. 114
Video Services Unlimited 635
Videomedia 611
Videotek, Inc. 253A
Vinten 334-336
Ward-Beck 310A-314
Waxman Industrial Network 460
Wheatstone Corp. 428
Wolf Coach, Inc. 639

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It has 32kHz, 44.1kHz, and 48.0kHz sampling rates plus 3 separate digital input/output interfaces (AES/EBU, SDIF-2 and S/P DIF). Features that make the PCM-2500 a natural for direct interface to CD mastering systems and a variety of digital studio equipment.

Consistently superior sound quality is ensured by newly developed Sony digital LSIs including independent A/D and D/A converters for both audio channels (left and right). And the D/A section employs 4x oversampling digital filters.

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For an ear-opening demonstration of the new PCM-2500, see your Sony Professional Audio representative or call Sony at 800-635-SONY.

SONY.

Professional Audio

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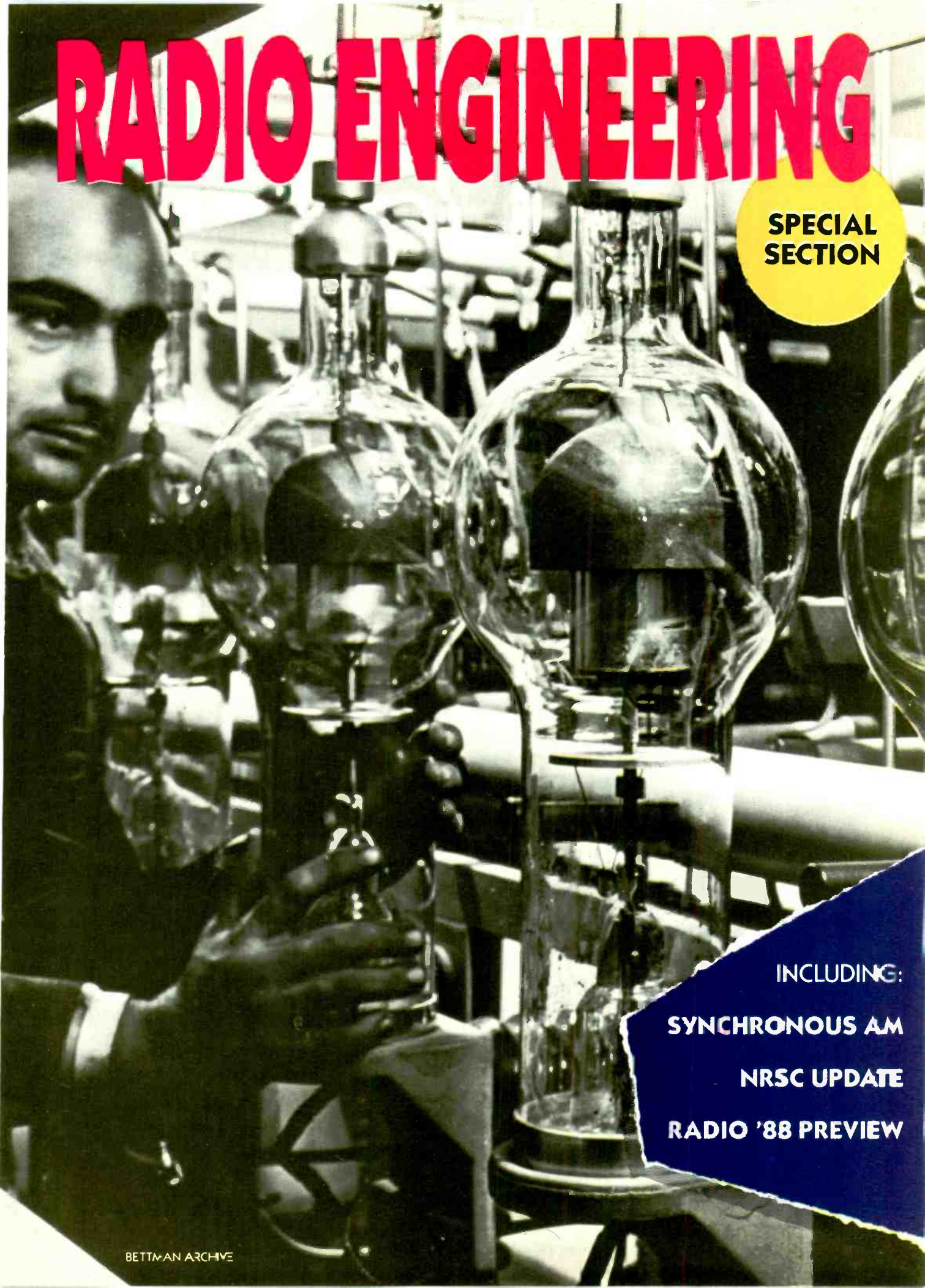
RADIO ENGINEERING

SPECIAL SECTION



INCLUDING:

SYNCHRONOUS AM

NRSC UPDATE

RADIO '88 PREVIEW

BETTMAN ARCHIVE

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Photographed at On Tape Productions, San Francisco, CA.

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RADIO NEWS

FCC Plans to Create New Class 3 FMs

The FCC has requested comments on a proposal creating a new Class C3 FM service with a maximum power of 25 kW and antenna height above average terrain of 328 feet. The new class would be allocated in zone II, which covers most of the continental U.S. except densely settled areas in the east, northeast and portions of California. The new class would serve as an intermediate step between Class A and Class C2, and the Commission estimates that up to 300 of the current 2040 Class A stations could upgrade to C3 status.

At the same time, the FCC proposed doubling the maximum power of Class A FM stations from 3 kW to 6 kW to allow the "least powerful and most numerous" class of station to increase coverage and provide a stronger signal within existing coverage areas. The NAB has recommended that improvements should only be authorized for Class As that can meet increased separation distance requirements. The proposal follows a 1987 petition from the New Jersey Class A FM Broadcasters Association.

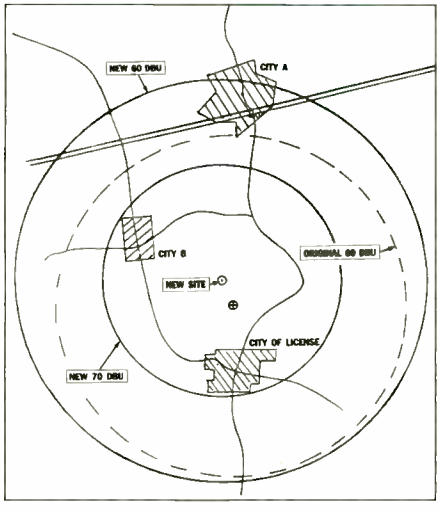
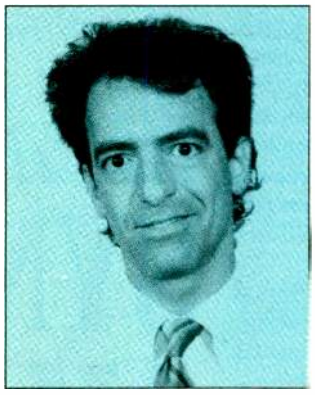


Exhibit E-2-B: Petition for Rulemaking: Coverage Relief for Class A FM Broadcast Stations. Clear Channel Communications of San Antonio, TX, developed this contour map showing typical coverage gains for a Class A FM station in a rural area where relocation of antenna and equipment is unrestricted by assignment.

"If nothing else, Clear Channel and the New Jersey Class A Broadcasters Association have made a valiant attempt to increase the value of low-power properties," said John Furr, technical director of Clear Channel Communications, whose engineering statement supports the New Jersey petition. "We think it's significant that the FCC is considering this petition, especially since we were initially advised the implications were too far-reaching."



Pizzi Named Contributing Editor

Skip Pizzi, currently the training coordinator for National Public Radio's Engineering Department, Washington, DC, has been named contributing editor for *BME*. A specialist on digital audio technology, Pizzi will develop technical articles on radio and audio engineering.

Pizzi holds a BA in Fine Arts from Georgetown University. He has worked in music, theater, sound reinforcement, sound design, studio recording and local and network radio engineering, most recently as a mix engineer and technical director for award-winning NPR programs. Pizzi is the current chair of the District of Columbia chapter of the AES.

AES 85th Convention to Los Angeles

The 85th Audio Engineering Society convention will be held November 3 through 6 in Los Angeles, CA. The North American convention will feature exhibitions at the Los Angeles Convention Center and papers and additional demonstrations at the Los Angeles Hilton Hotel.

The convention will celebrate "A Century of Technology in the Service of Artistry"—a theme designed to emphasize the interdependency between the creative and technological domains of the audio industry, according to convention chairman Dr. Marshall Buck. Papers chairman is Eric Benjamin and workshops chairman is Don McCroskey.

Nine technical sessions include digital signal processing, analog circuitry and a technical council tutorial.

The 1988 Technical Excellence and Creativity (TEC) Awards ceremony will also be held November 3 in Los Angeles. Funds raised by the awards support scholarship programs in audio education and charitable organizations for deafness and hearing disabilities. ■

MEASURING SYNCHRONOUS AM IN FM TRANSMITTERS

Incidental AM modulation is hotly debated by FM and TV stereo engineers. Here are some causes of synchronous AM noise and practical ways to optimize transmitter tuning.

Modulation of limited bandwidth systems is the major explanation for synchronous AM noise, one of the hottest topics today in the FM broadcast engineering community.

It is important to understand the value of synchronous AM measurements in evaluating the transmission system as well as in selecting test equipment, setting up the system and interpreting results. This is especially important because incorrect results can be generated if inappropriate test equipment and measuring procedures are used.

The perfect FM transmitter would have an absolutely constant output, regardless of FM modulation or power supply variations. In practice, there is always some residual amplitude modulation of the FM or TV Aural transmitter output. The two types of AM modulation that are of interest to the broadcast engineer are *asynchronous AM modulation*, which is measured without FM modulation and is primarily related to power supply ripple or filament supply imbalance, and *synchronous AM*, which is a measure of the amount of incidental amplitude modulation introduced onto the carrier by FM modulation.

The synchronous AM measurement is very useful for determining the proper tuning of the transmitter. Since all transmitters have limited bandwidth, there will be a slight drop-off in power output as the carrier frequency is swept to either side of the center frequency. This slight change in RF output level follows the waveform of the signal being applied to the FM modulator causing AM modulation in synchronization with the FM modulation. The concept is similar to the slope detection of FM by an AM detector used with a tuned circuit.

Measurement of synchronous AM gives the station engineer an idea of overall system bandwidth and whether the passband is positioned correctly. Tuning for minimum synchronous AM will assure that the transmitter passband is properly centered on the FM channel.

The higher-order FM sidebands will be slightly attenuated in amplitude and shifted in phase as they pass through the final amplifier stage. These alterations in the sideband structure introduced by the amplifier passband result in distortion after FM demodulation at the receiver. The amount of distortion is dependent on available bandwidth versus the modulation index being transmitted. For a given bandwidth limitation, the distortion usually can be minimized by centering the passband of the amplifier around the signal being transmitted. Tuning an amplifier for minimum plate current does not necessarily result in a centered passband.

To date, there has been confusion about the relationship between multipath distortion ("picket fencing" or "chopping") and synchronous AM.

Multipath is caused by differential path lengths of directly propagated and reflected signals arriving at the receiver with different time delays. It is not caused inside the transmitter by synchronous AM.

Multipath distortion causes amplitude variations in the received signal due to the constructive and destructive interference of the vector sum of the signals arriving at the receiving antenna. Synchronous as well as asynchronous AM generated in the transmission system will add to the AM caused by multipath, so large amounts of synchronous AM could, therefore, further degrade the signal

when added to path-induced multipath distortion.

Eliminating synchronous AM will not eliminate areas of multipath distortion, but it can provide marginal improvement by not adding this AM component.

Synchronous AM of -40 dB or more below equivalent 100% AM is considered acceptable. Higher levels of synchronous AM will cause increased "chopping" of the signal at the receiver near limiting threshold under weak signal "fringe area" conditions and can also exacerbate multipath problems. There is not much advantage to reducing synchronous AM below -45 dB if multipath distortion is significant because the additional signal level variations at the FM receiver limiter caused by the synchronous AM components are insignificant when compared to the signal level variations caused by multipath.

Excessive synchronous AM is also an indirect indication of passband-induced distortion problems that degrade stereo performance and SCA crosstalk.

Many older multi-tube transmitter designs presently in use will have as much as six percent (-30 dB) synchronous AM when simply tuned for best power output and efficiency even though the asynchronous AM (without modulation) may be better than -50 dB. Some newer single-tube transmitters can be adjusted for 50 dB or more suppression of synchronous AM.

The synchronous AM level of virtually any FM transmitter can be improved by proper tuning techniques. An approximation to the overall system bandwidth can be related to synchronous AM as shown in Table 1.

All optimization should be done with any automatic power control (APC) system disabled so that the APC will not chase the adjustment in an attempt to keep the output power constant. The transmitter should be connected to the normal antenna system rather than to a dummy load. This is because the resistance and reactance of the antenna will be different from the dummy load and the optimum tuning point of the transmitter will shift between the two different loads. Tuning sequence is:

1. Initial Tuning And Loading. The transmitter is first tuned for normal output power and proper efficiency according to the manufacturer's instruction manual. The meter readings should closely agree with those listed on the manufacturer's final test data sheet if the transmitter is being operated at the same frequency and power level into an acceptable load.

TABLE 1:
APPROXIMATE SYSTEM BANDWIDTH AS RELATED TO SYNCHRONOUS AM

SYNCHRONOUS AM *(below equivalent 100% AM) (with +/- 75kHz @ 400 Hz FM)*	APPROXIMATE TRANSMITTER BANDWIDTH (-3dB)	RF LEVEL RECEIVER LIMITER VARIATION AT	
		(%)	(dB)
-30 dB	410 kHz	6.32%	0.57 dB
-35 dB	550 kHz	3.54%	0.31 dB
-40 dB	730 kHz	2.00%	0.18 dB
-45 dB	1.00 MHz	1.12%	0.10 dB
-50 dB	1.34 MHz	0.64%	0.06 dB
-55 dB	1.82 MHz	0.36%	0.03 dB
-60 dB	2.46 MHz	0.20%	0.02 dB

2. Input Tuning And Matching. The input tuning control should first be adjusted for maximum grid current and then fine-tuned interactively with the input matching control for minimum reflected power to the driver stage. Note that the point of maximum grid current may not coincide with the minimum reflected power to a solid state driver. This is because a solid state driver may actually output more power at certain complex load impedances than into a 50 ohm resistive load. The main objective during input tuning is to obtain adequate grid current while providing a good match (minimum reflected power) to the coaxial transmission line from the driver.

3. Output Tuning. The output tuning control adjusts the resonant frequency of the output circuit to match the carrier frequency. As resonance is reached, the plate current will drop while both the output power and screen current rise together. Under heavily loaded conditions this "dip" in plate current is not very pronounced,

BY GEOFFREY N. MENDENHALL

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so tuning for a "peak" in screen current is often a more sensitive indicator of resonance.

Amplifiers utilizing a folded halfwave cavity will display little interaction between output tuning and output loading because the output coupling loop is located at the RF voltage null point on the resonant line. Quarterwave cavities will require interactive adjustment of output tuning and output loading controls since changes in loading will also affect the frequency of the resonant line.

4. Output Loading. There is a delicate balance between screen voltage and output loading for amplifiers utilizing a tetrode tube. Generally, there is one combination of screen voltage and output loading where peak efficiency occurs. At a given screen voltage, increasing the amplifier loading will result in a decrease in screen current, while a decrease in loading will result in an increase in screen current.

As the screen voltage is increased to get more output power, the loading must also be increased to prevent the screen current from reaching excessive levels. Further increases in screen voltage without increased loading will result in a screen overload without an increase in output power.

5. Automatic Power Control Headroom. Automatic power control (APC) feedback systems are utilized in many transmitters to regulate the power output around a predetermined setpoint with variations in ac line voltage or changes in other operating parameters. Most modern FM broadcast transmitters utilize a high gain tetrode as the final amplifier stage with adjustment of the screen voltage providing fine adjustment of the output.

For each power output level there is one unique combination of screen voltage and output loading that will provide peak operating efficiency.

In addition, if the screen voltage is raised without sufficient loading, a screen current overload will occur before the upward adjustment in power output is obtained. To avoid this problem, it is a good idea to tune the transmitter with slightly heavier loading than necessary to achieve the desired power output level in order to allow for about five percent headroom in adjustment range. The output loading can be adjusted for a "peak" in output power of five percent over the desired level and then the screen voltage can be reduced enough to return to the desired level. This procedure will allow headroom for an APC system controlling screen voltage and will result in about a one percent compromise in efficiency, but it will assure the ability to increase power output up to five percent without encountering a screen overload.

After the correct loading point has been set, FM modulate 100 percent (±75 kHz) at 400 Hz and fine-adjust the transmitter's input tuning and output tuning controls for minimum 400 Hz AM modulation as detected by a wideband envelope detector (diode and line probe). The input matching and output loading controls should need no further adjustment.

It is helpful to display the demodulated output from the AM detector on an oscilloscope while making this adjustment. The output of the AM envelope detector should be connected to the vertical input (Y input) of the scope while the sweep is triggered by a sample of the 400 Hz audio tone fed to the external trigger input. This is called the "AM waveform" measurement. Note that as the minimum point of synchronous AM is reached, the demodulated output from the AM detector will double in frequency from 400 Hz to 800 Hz because the fall-off in output power is symmetrical aroundthe center frequency, causing the amplitude variations to go through two complete cycles for every one FM sweep cycle. (See Figure 1.)

The advantages of observing the demodulated AM waveform versus time is that the frequency doubling effect is

Figure 1: *Synchronous waveforms and calculations.*

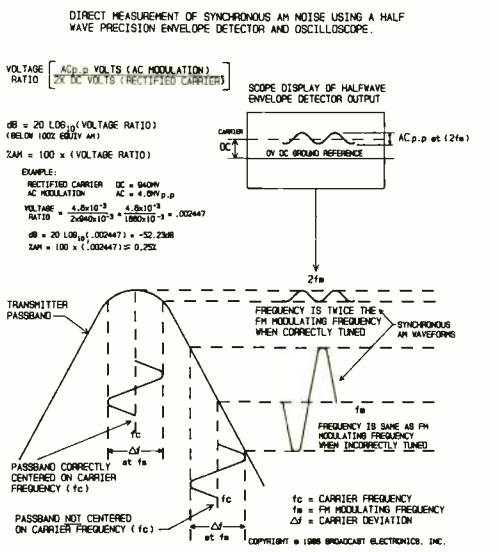
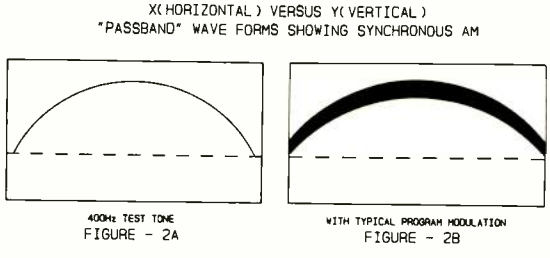


Figure 2: *x versus y "passband" waveforms.*



a sensitive, clear indication of the symmetrical tuning point and the actual level of the AM noise below equivalent 100 percent AM modulation can be calculated from the waveform's ac and dc components. The disadvantage of this measurement technique is that it cannot be performed with normal program audio present. If it is necessary to touch up the transmitter tuning with normal program audio present, an X - Y display of demodulated AM on the vertical axis (Y input) versus the audio input to the FM exciter on the horizontal (X input) axis will provide a representation of the transmitter's passband, as shown in Figures 2A and 2B. This is called the "passband" measurement. Figure 2A shows the relative amplitude of the transmitter's output power versus deviation from the center frequency with single tone 400 Hz modulation. Figure 2B shows the same information except that complex program modulation is present.

When making the passband measurement on stereo multiplex transmissions, best results will be obtained if the horizontal input of the scope is driven by a sample of the composite baseband being fed to the FM modulator rather than L+R program audio. A sample of the composite baseband being fed to the FM modulator can be conveniently obtained from the front panel composite test jack provided on some FM exciters.

Figure 3: *Block diagram for synchronous AM measurements calculating AM noise directly from the demodulated AM waveform.*

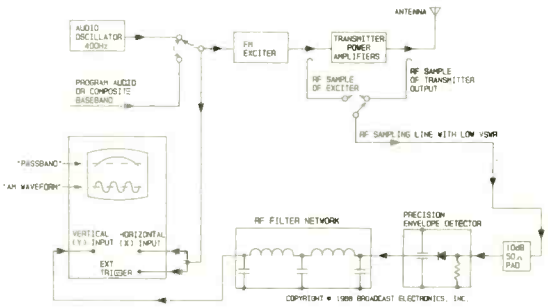


Figure 3 illustrates a typical test equipment setup and shows a block diagram of the required test equipment for making synchronous AM waveform measurements. A precision envelope detector with high return loss (low input VSWR) is used so that accurate synchronous AM waveforms can be observed while tuning the FM transmitter. Both the AM waveform and passband measurements can be made depending on whether the scope is in the triggered sweep mode or the X-Y mode. Composite baseband can also be routed into the test setup so that fine tuning can be done with normal programming being broadcast. It should be possible to minimize syn-

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chronous AM while maintaining output power and sacrificing little efficiency in a properly designed power amplifier. Deemphasis should *not* be used after the precision envelope detector, since the additional phase shift to the demodulated AM (Y-axis) caused by deemphasis would not be equal to the phase shift of the composite baseband fed to the X-axis.

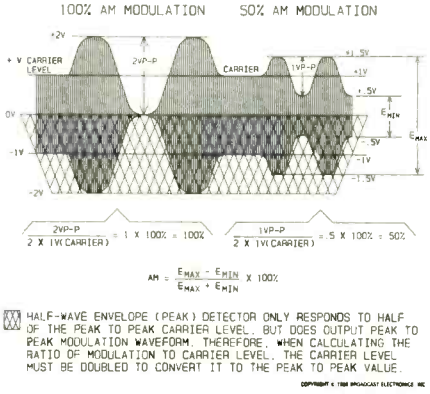
Most FM demodulators cannot be relied upon to make accurate synchronous AM noise measurements so it is a good idea to crosscheck the demodulator reading directly against the demodulated output of a precision envelope detector.

This can be done by first measuring the dc component of the waveform with a voltmeter or by dc coupling the scope input. The scope is then ac coupled and the input sensitivity is increased until an accurate peak-to-peak measurement of the ac modulation component can be made. The peak-to-peak ac voltage is then divided by twice the dc component to obtain the "voltage ratio." Twenty times the log (base 10) of the voltage ratio is the actual AM noise level in dB below equivalent 100 percent AM modulation.

Multiplying the voltage ratio by 100 yields the percent of AM modulation. (See Figures 1 and 4.)

Figure 4 shows how the percentage of AM modulation can be calculated

Figure 4: *AM modulation calculations.*



HALF-WAVE ENVELOPE (PEAK) DETECTOR ONLY RESPONDS TO HALF OF THE PEAK TO PEAK CARRIER LEVEL, BUT DOES OUTPUT PEAK TO PEAK MODULATION WAVEFORM. THEREFORE, WHEN CALCULATING THE RATIO OF MODULATION TO CARRIER LEVEL, THE CARRIER LEVEL MUST BE DOUBLED TO CONVERT IT TO THE PEAK TO PEAK VALUE.

by directly observing the RF envelope or by the use of the demodulated waveform from a precision half-wave (peak) envelope detector. Note that the peak detected value of the carrier must be doubled to convert it to the peak-to-peak value of the carrier. The ratio of the peak-to-peak modulation component to the peak-to-peak carrier is then used to calculate the percentage of AM modulation.

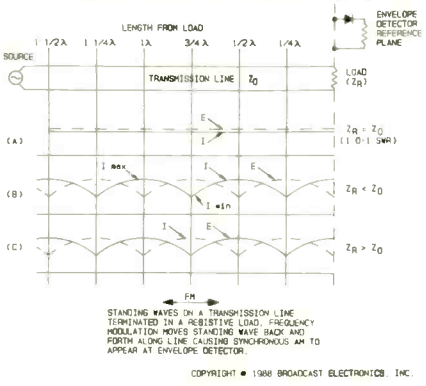
When making these measurements, it is important to take care that the test setup does not introduce synchronous AM and give erroneous readings, which would cause the operator to mistune the transmitter to compensate for errors in the measuring equipment.

For example, the input impedance of the envelope detector must provide a nearly perfect impedance match so that there is a very low VSWR on the sampling transmission line. Any significant VSWR on the sampling line will produce synchronous AM at the detector because the position of the voltage peak caused by the standing wave moves along this line with FM modulation.

Figure 5 illustrates the effect of the standing wave ratio on the RF voltage presented to the envelope detector. As the sampling line length is increased, the amount of erroneous AM caused by a given standing wave ratio also increases because each additional quarter wavelength causes more movement of the standing wave with FM modulation.

Unfortunately, the AM detectors

Figure 5: *Effect of sampling line SWR on synchronous AM measurements.*



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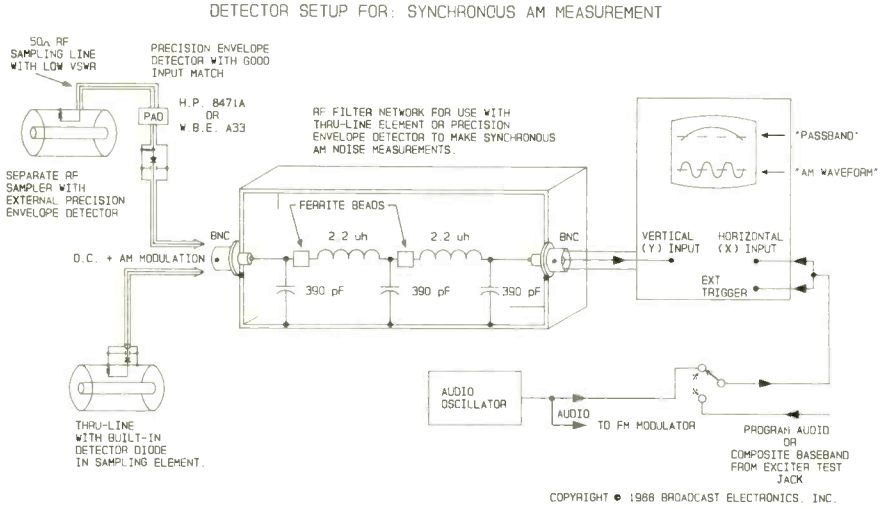
supplied with most modulation monitors do not provide a sufficiently accurate match to be useful for this measurement. Precision envelope detectors are available from Wide Band Engineering and Hewlett Packard that provide a 30 dB return loss (1.06:1 VSWR) to the sampling line when combined with a 10 dB, 50 ohm resistive pad.

A thru-line type of directional coupler normally used to drive the wattmeter movement has an envelope detector diode built into the sampling element. It provides a dc component to which the meter movement responds as well as a demodulated AM noise component to which the meter movement does not respond.

Feeding the thru-line element output to an oscilloscope instead of to the wattmeter movement now allows the synchronous waveform to be measured accurately. This approach eliminates the errors due to VSWR on the sampling line, since the detector is located at the sampling point.

Figure 6 shows how to use a thru-line coupler for making synchronous AM measurements. The manufac-

Figure 6: *Detector setup for synchronous AM measurement.*



turer of the thru-line coupler can supply the special connectors and/or cables to connect its output to the oscilloscope. Care must be taken to avoid hum pickup from ac ground loops while making these low level measurements.

Both the thru-line element detector and the precision envelope detectors have some residual RF on their dc output, so an RF filter network should be placed between the detector and the input oscilloscope. Figure 6 shows a suggested configuration for this filter, which can be constructed easily in a small shielded enclosure.

Broadcast Electronics has recently developed a built-in precision envelope detector that will be added to the Automatic Power Control (APC) system used in the "A" series of FM broadcast transmitters. A calibrated front-panel AM noise test jack will allow observation of the synchronous AM waveforms or direct measurement of the synchronous AM noise level on a standard audio voltmeter.

VHF amplifiers often exhibit a somewhat unusual characteristic when tuning for maximum efficiency. The highest efficiency operating point does not exactly coincide with the lowest plate current because the power output continues to rise for a while on the inductive side of resonance coming out of the dip in plate current. If the amplifier is tuned exactly to resonance, the plate load impedance will be purely resistive and the load line will be linear. As the output circuit is tuned to the inductive side of resonance, the plate load impedance becomes complex and the load line becomes elliptical instead of linear since the plate current and plate voltage are no longer in phase. Apparently best efficiency occurs when the phase of the instantaneous plate voltage slightly leads the plate current. ■

Sources of Precision Envelope Detectors

Wide Band Engineering, Inc., P.O. Box 21652, 1838 E. University Dr., Phoenix, AZ 85036.
Hewlett Packard, Inc., 1820 Embarcadero Rd., Palo Alto, CA 94303-3308.
THRULINE is a registered trademark of Bird Electronic Corp., 30303 Aurora Rd., Solon, OH 44139.

Thanks to Ed Anthony, Jay Linderer and Mukunda Shresthah.

Geoffrey N. Mendenhall, PE, is vice president of engineering for Broadcast Electronics, Inc., Quincy, IL. He holds a BEE degree from Georgia Institute of Technology and three U.S. patents.

NRSC UPDATE

Converting to NRSC is one important route to AM improvement. Here's where the issue stands right now.

BY STANLEY SALEK

Improved AM sound coupled with protection of station separation is a goal American broadcasters have worked toward since the formation of the NRSC (National Radio Systems Committee) in 1980.

Those goals are now one step closer to reality following a new FCC rulemaking. At the Commission's general meeting July 20, the FCC proposed adoption of standards which include those developed by the NRSC in order to improve the technical quality of AM radio.

The first NRSC audio standard (NRSC 1) limits audio frequency to 10 kHz to help reduce adjacent-channel interference. It also will standardize station use of audio preemphasis (boost) and a corresponding deemphasis curve in consumer AM receivers. The rulemaking follows a petition filed by the NAB in late 1987 asking the FCC to make NRSC 1 mandatory and implemented as of January 1, 1990. The NAB petition states that maximum benefit and reduced interference will only be achieved if all stations comply.

At the same meeting, the FCC also requested comments on the second NRSC standard (NRSC 2, or "RF Mask"), which limits radio frequency emissions. NRSC 2 is designed to facilitate reduction of RF splatter outside the ±10 kHz limit.

The NRSC standards were developed jointly by the NAB and the EIA (Electronic Industries Association), which represents the interests of home receiver manufacturers. They undertook development of the standards as a joint project in 1985 and completed a preemphasis standard recommendation in the middle of 1986. This standard provides high-frequency boost to narrow-bandwidth ratios and allows wideband receivers to follow standard deemphasis.

The committee also completed a bandwidth limiting standard (10 kHz) in late 1986. This standard was designed to protect second-adjacent channels from interference and utilized a lowpass filter placed just before the transmitter audio input.

The complete NRSC 1 audio standard was submitted for ANSI standardization and released January 10, 1987 as a voluntary standard. Fully compatible with stereo systems, NRSC 1 is installed via audio processor modification.

Voluntary compliance is underway, and over 800 American AM stations have reported voluntary conversion to NRSC 1 as of July 7, 1988. Stations have also reported improvement with existing radio receivers, including reduced intermodulation distortion, better performance into narrow antenna systems, reduced interference and newly receivable stations.

The final standard for NRSC 2 ("RF Mask") was released June 1, 1988. Allowing measurement of transmitter RF performance, RF Mask sets guidelines for maximum occupied RF bandwidth under program conditions, pulsed noise conditions and stereophonic conditions. Measurement techniques are achieved via spectrum analyzers and "splatter monitor" devices, which are currently being manufactured. NRSC 1 is required for NRSC 2 compliance and measurement; taken together, the NRSC standard acts as a complete system.

Similar improvement is envisioned for FM technical quality, and the next steps may include the formation of an NRSC FM group. ■

Salek is staff engineer for the NAB.

NAB Applies for Experimental AM

As part of the NAB's program to support AM improvement, the association has filed an application with the FCC to operate an experimental AM radio station in Beltsville, MD.

The experimental station will test whether new antenna designs achieve separate control over skywave and groundwave signals. The NAB plans to operate the station for two years. The facility will operate on the 1660 frequency and use power up to 5 kW.

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Motorola AM Stereo 212-216
Music Director Prog. Services 401
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Engineering topics, technical seminars and informal discussion of the unprecedented number of recent technology rulemakings proposed by the FCC will dominate the NAB Radio Convention, Radio '88. The conference runs from September 14 to September 17 in Washington, D.C.

Radio '88 will include the NAB's AM Directional Antenna Seminar, described as the only comprehensive AM directional antenna program in the United States. Programmed by Carl Smith of Smith Electronics Inc., the special seminar begins September 13.

Other Radio '88 offerings will include a day-long workshop examining the digital radio station and a half-day presentation of the NAB's RF Radiation Compliance seminar. The digital radio station workshop will cover sampled-data theory, digital audio storage, digital AM and FM modulation and transmission techniques and CD/DAT technology. In addition to a Q & A session with engineers who have converted to digital technologies and a presentation on digital audio interconnection, the seminar includes expanded sessions on all-digital editing, production and effects generation.

The NAB RF Radiation Regulation Compliance seminar is a hands-on session covering compliance evaluation and a practical explanation of FCC regulations. Engineers can each assess his or her particular station with experts in FCC RF radiation regulation, facility design and modification, RF radiation measurement and legal aspects of radiation regulation compliance.

Radio '88 will also feature five special technical panels for radio engineers. An FCC Engineers' Forum will provide an open interchange among station engineers and FCC branch engineering staffers. Two panels of special interest consider the causes and cures of interference and FM directional antennas, the subject of a recent controversial FCC proposal. Other panels examine PCs for engineering applications and an update on the EBS.

Radio '88 will also host eight special presentations about AM and FM improvement. Key sessions include a National Radio Systems Committee (NRSC) update on AM improvement, which was also the subject of a recent FCC rulemaking, a report on the reduced skywave antenna project and the first public presentation of a series of psychoacoustic tests evaluating tolerance of AM interference. Over 140 exhibitors will display their wares in the Radio '88 Exhibit Hall at the Washington Convention Center. In addition, a two-hour "spotlight" Computer Fair will be held September 17 to showcase broadcast-related hardware and software.

On the "talent" front, newscaster Paul Harvey will take the mic to host the Radio Award Luncheon Friday, September 16 where Ben Hoberman, former president of ABC Radio, will receive the 1988 NAB Radio Award. Radio '88's opening ceremony will spotlight 10 radio stations during the second annual Crystal Radio Awards presentation September 15. ■

RADIO '88 ENGINEERING SESSIONS

This schedule highlights events of special interest to engineering and technical staff. For a complete list of sessions and workshops, consult the full NAB schedule at Radio '88

Tuesday, September 13
12:00 p.m.-6:00 p.m.
Directional Antenna Seminar

Wednesday, September 14
8:00 a.m.-6.30 p.m.
Directional Antenna Seminar
2:00-5:00 p.m.
Radio Station Tours./
NAB Science & Tech Offices
6:00-8.00 p.m.
Welcome Reception
8:00 p.m.-Midnight
Hospitality Suites

Thursday, September 15
8:30 a.m.-4 p.m.
Digital Radio Station Seminar
9:15-11:15 a.m.
Crystal Radio Awards
11:00 a.m.-6 p.m.
Exhibits Open
4:00-6:00 p.m.
Exhibit Hall Reception
5:00 p.m.-6:15 p.m.
Interference: Its Causes and Cures
6:00 p.m.-Midnight
Hospitality Suites

Friday, September 16
8:00 a.m.-1:00 p.m.
RF Radiation Regulation
Compliance Seminar
11:00 a.m.-6:00 p.m.
Exhibits Open
12:30-2:15 p.m.
Radio Award Luncheon
2:45-4:00 p.m.
FM Improvement
4:00 p.m.-Midnight
Hospitality Suites

Saturday, September 17
9:45-11:00 a.m.
AM Technical Improvement, Part I
10:00 a.m.-12 noon
Computer Fair
11:00 a.m.-6:00 p.m.
Exhibits Open
11:15 a.m.-12:30 p.m.
AM Technical Improvement,
Part II
12:45-2:00 p.m.
FM Directional Antennas
2:15-3:30 p.m.
PCs for Engineering Applications
2:15-3:30 p.m.
EBS: What's Old, What's
New, What's Changing
3:45-5:00 p.m.
FCC Engineers Forum
7:00 p.m.
Closing Party

Calculate Intermodulation Products

By Ronald F. Balonis

There must be a law for it: "In time, just about everything gets more complex." It's especially true in engineering these days, where just about everything contributes to the growing complexity of the job and the profession. For example, the increasing number, for all services, of cosited and colocated transmitters increases the potential for and the problems of interference by intermodulation products.

In the old days, IM (intermodulation) interference was a rare engineering problem that few ever had reason or opportunity to solve. But today it faces just about every engineer involved in putting in a new transmitter or maintaining or replacing an old one.

The first step in solving an "intermodulaton" interference problem is to determine its probable sources by using the frequencies of the suspect transmitters to compute the IM products (new frequencies) they can generate. Even though the mathematical relationships are simple—the sums and differences for the harmonics—the procedure becomes increasingly complex with the increasing order (harmonic relationships) of the products.

It's something that's better done, more accurately too, by a computer. And that gives us the topic and the program for this month's column. Given two frequencies, INTERMOD.BAS calculates the second-, third-, and fifth-order products that the two frequencies can generate by intermodulation (mixing) of their fundamentals and harmonics.

Intermodulation products are actually RF distortion products. They're the new frequencies generated when the harmonics of strong RF signals mix with each other in some kind of nonlinear device or circuit. They become, and they create, interference when they coincide with the a desired signal or when they exceed the emission limits for the service.

Two frequencies, F1 and F2, will produce many intermodulation products. The empirical formula is (mF1 +/- nF2) with m and n being the harmonic multiples. Generally the most troublesome intermodulation products (frequencies) are the low-order ones; when $n + m$ equals a low odd number the products will lie close to either F1 or F2 and will be "in-band," so to speak. Therefore, to keep it as simple as possible, INTERMOD.BAS calculates only the normally troublesome products—the second-order ones, F1 + F2 and F1 - F2; the third-order ones, 2F1 + F2, 2F1 - F2, F2 + 2F2, and F2 - 2F2; and fifth-order ones, F1 + 4F2, F1 - 4F2, 2F1 + 3F2, 2F1 - 3F2, 3F1 + 2F2, 3F1 - 2F2, 4F1 + F2, and 4F1 - F2.

Intermodulation products can be generated whenever RF signals are applied to a nonlinear device. An overloaded receiver, for example, can be a source of intermodulation. A receiver's front-end can exhibit nonlinearity at relatively low input voltage levels, and even though the IM products generated will be low in amplitude, perhaps affecting only the receiver, they can be radiated by its antenna to other nearby receivers.

Intermodulation products can also be generated in and by transmitters when strong signals, present on the antenna, are coupled to its final stage to mix with the fundamental and its harmonics.

```
        -- INTERMODULATION PRODUCTS --

FREQUENCIES <F1/F2>: 1240/1340


ORDER   -- PRODUCTS --------->
       [1F1-1F2][1F1+1F2]
2ND =      100      2580

       [1F1-2F2][1F1+2F2][2F1-1F2][2F1+1F2]
3RD =     1140     3820     1440     3920

       [1F1-4F2][1F1+4F2][2F1-3F2][2F1+3F2]
5TH =     3620     6300     1040     6400

       [3F1-1F2][3F1+1F2][4F1-1F2][4F1+1F2]
          1540     6500     4120     6600 ?
```

Figure 1: *demo screen for INTERMOD.BAS.*

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```
0 'INTERMOD.BAS -INTERMODULATION PRODUCTS-
5 'BY RONALD F. BALONIS      MAY 3, 1988
10 DIM IM(14),IDX(14):NUMB$=" ########"
20 TLE$="-- INTERMODULATION PRODUCTS --"
50 CLS:PRINT TAB(25);TLE$:PRINT
80 '
90 '----------ENTER THE TWO FREQUENCIES
100 LINE INPUT "FREQUENCIES <F1/F2>: ";F0$
105 IF F0$="" THEN STOP:'-----OR SYSTEM
110  J=INSTR(F0$,"/")
115  IF J=0 THEN 100:'--------TRY AGAIN
120   F1=VAL(RIGHT$(F0$,J-1))
125   F2=VAL(LEFT$ (F0$,J+1))
130   IF F1*F2=<0 THEN RUN 0:'--RESTART
135   I=INSTR(RIGHT$(F0$,J-1),".")
140   IF I>8 OR J>8 THEN RUN 0
145    IF I>0 THEN MID$(NUMB$,I+10-J)="."
148 '
150 '--COMPUTE 2ND, 3RD, & 5TH PRODUCTS
160 FOR M=1 TO 4:'------  (mF1 +/- nF2)
165  FOR N=-4 TO 4:'-------PLUS & MINUS
170   IF N=0 THEN 185 ELSE P=M+ABS(N)
175   IF P=2 OR P=3 OR P=5 THEN 180 ELSE 185
180    K=K+1:IM(K)=ABS(M*F1+N*F2):IDX(K)=P
185  NEXT N
190 NEXT M:PRINT:PRINT
195 PRINT "ORDER  -- PRODUCTS --------->"
200 '
290 '--DISPLAY 2ND, 3RD, & 5TH PRODUCTS
300 PRINT "       [1F1-1F2][1F1+1F2]"
305 PRINT "2ND =";
310 FOR J=1 TO 14
315  IF IDX(J)=2 THEN GOSUB 400
320 NEXT J: PRINT:PRINT
325 '
330 PRINT "       [1F1-2F2][1F1+2F2]";
335 PRINT "[2F1-1F2][2F1+1F2]"
340 PRINT "3RD =";
345 FOR J=1 TO 14
350  IF IDX(J)=3 THEN GOSUB 400
355 NEXT J:PRINT:PRINT
360 '
365 PRINT "       [1F1-4F2][1F1+4F2]";
370 PRINT "[2F1-3F2][2F1+3F2][3F1-1F2]";
375 PRINT "[3F1+1F2][4F1-1F2][4F1+1F2]"
380 PRINT "5TH =";
385 FOR J=1 TO 14
390  IF IDX(J)=5 THEN GOSUB 400
395 NEXT J:INPUT " ";X:RUN 0:'--RESTART
400 '
405 PRINT USING NUMB$;IM(J);:RETURN
410 '----------END OF PROGRAM----------
```

Figure 2: *program listing for INTERMOD.BAS, a intermodulation product calculation scheme.*

Given the right conditions—a strong enough RF signal and a nonlinear device of some sort—intermodulation products can and do occur most everywhere.

The demo example illustrates, a common intermodulation problem on the AM band for some radio markets. The basic conditions for its occurrence are two stations, such as local channels 1240 and 1340, that are spaced a mile or so apart: The third-order products of F1 - 2F2 and 2F1 - F2 of the stations fall in-band close to F1 and F2. The modulation of F1 on F1 - 2F2 and the modulation of F2 on 2F1 - F2 usually indicates that the "mix" occurs in each station's transmitter.

And there's the familiar cases of the IF intermodulation product problems in the TV and FM services. For TV Channel 6 and FM Channel 253 assignments, it's the IF relationship between Channel 6 audio at 87.75 mHz and the FM Channel 253 audio at 98.5 mHz. And for FM, it's assignments separated by 10.6 or 10.7 mHz. The problems for both result from the IF-related intermodulation product that a nearby receiver can generate. And, the primary method of solving, or preventing it, is by the separation distances in the allocation rules, but a lot depends on the receiver.

The program works as follows: After the usual initialization statements, the LINE INPUT statement in line 100 prompts for input of the two frequencies separated by a / (slash). The / enables the RIGHT$ and LEFT$ functions to assign the values to F1 and F2. If the / is missing, if one of the values is 0, or if the entered frequency is more than seven characters long (including the decimal point), the program restarts on the error. A null enter ends the program.

Lines 150-190 compute the intermodulation products for the two frequencies, F1 and F2. To compute all the products, the formula is coded as a double loop, M from 1 to 4 and N from -4 to 4. The product order is the sum of the absolute values of M and N. Line 175 steers the loop so that only the second, the third, and the fifth are calculated.

Lines 300-395 display the products using a simple loop to print them—lines 300-320 for the second, lines 330-355 for the third, and lines 365-395 for the fifth.

Once again, this program was written for and runs on an IBM-compatible PC using GWBASIC and MS-DOS. Since it is coded in near-generic BASIC, it should work on many others, too.

Tracing intermodulation interference requires a combination of intuitive, forensic, and pure detective skills. INTERMOD.BAS only computes the products of the suspect frequencies taken two at a time. Finding the offending equipment—transmitter or receiver—is up to you. Look first where the fields are strong. It may just take a little trial and error—some one-at-a-time connecting and reconnecting or turning on and off.

The final step is fixing the problem. It is always best to solve an IM problem at its source, if at all possible. If the mixing is occurring in a receiver, trap out one of the frequencies at the receiver. If it is occurring in a transmitter, insert a low-pass filter in the line to the antenna. If the nonlinear device producing the IM products cannot be found, the troublesome product can still be eliminated at the receiver. ■

Balonis is chief engineer at WILK-AM, Wilkes-Barre, PA.

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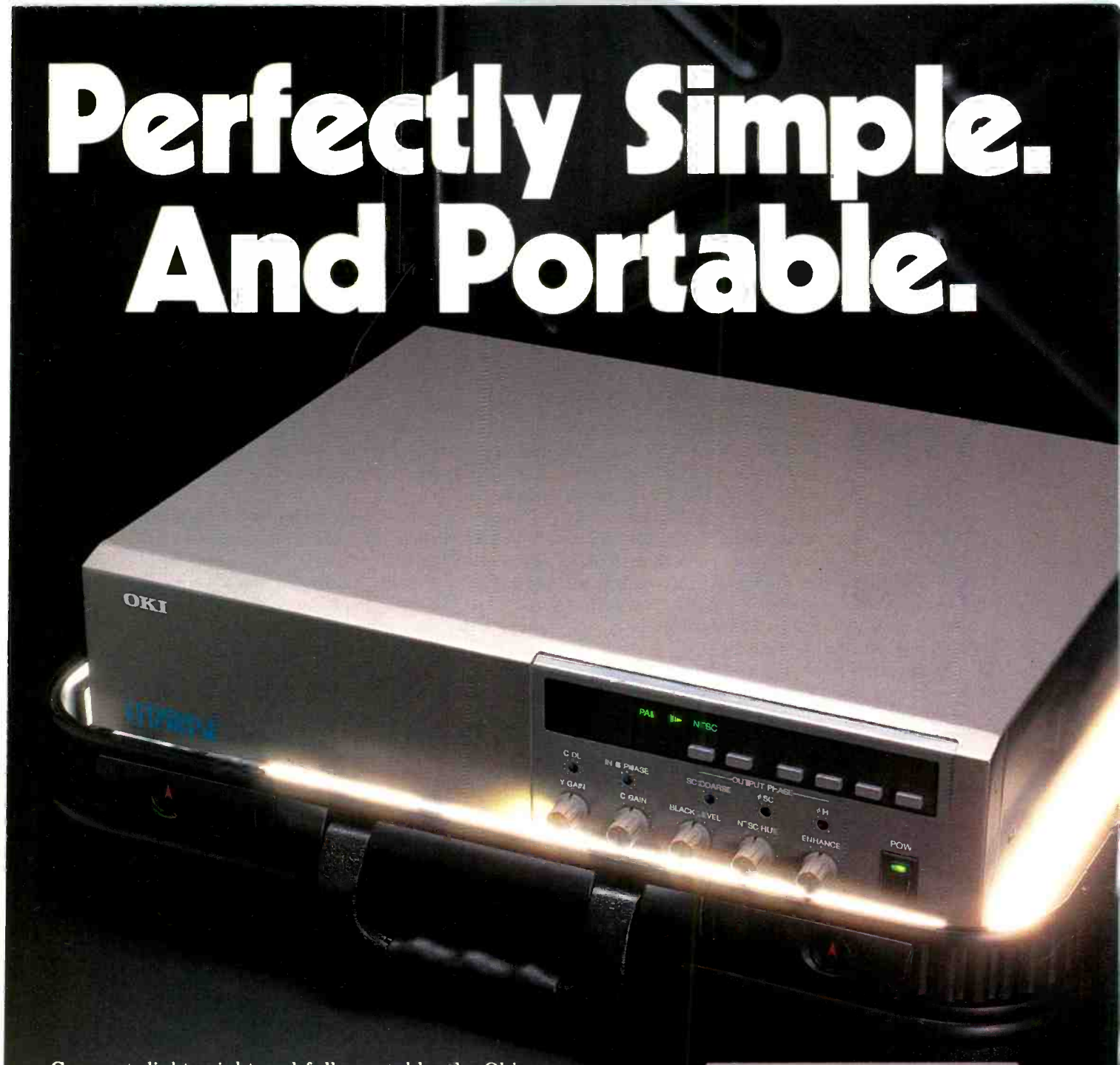

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Qualifying for Construction Permits

By Harry Cole

Engineers who are entrepreneurially minded, or who work for companies that like to try to acquire construction permits through the application process (rather than by buying either construction permits or the licenses of operating stations), occasionally find themselves called upon to assist in the preparation of construction permit applications.

While such assistance could normally entail preparation of the technical engineering portions of the application, it might also involve work in connection with the certifications relative to financial qualifications and site availability. Because of the possibility of such involvement, we thought it might be a good idea to review certain aspects of these two largely nontechnical areas.

The FCC requires that each applicant for a construction permit be, among other things, financially qualified. That means that the applicant must have available to it sufficient funds to construct its proposed station and operate it for a period of three months without revenues.

In other words, the applicant must first figure out how much money it will take to do the job (i.e., construct and operate the station) and assure the availability of at least that amount of funding.

This task often involves someone with engineering expertise because it requires familiarity with the nature and amount of equipment to be purchased and the approximate costs of such equipment.

If you are asked for assistance for such a project, you should first discuss the matter with the applicant's consulting engineer, or whoever else is preparing the technical portion of the application. Make sure you understand precisely what is going to be proposed in the way of transmission equipment. While the application form tends not to request explicit information about transmitter and antenna specifications, some consultants choose to include some such information in their portion of the application. Make sure to base your cost projections on an equipment list that is consistent with all aspects of the technical proposal in the application.

Once you understand what equipment is going to be referenced in the application, and thus what equipment you will definitely have to include in your cost projections, you should prepare a rough list of all the equipment you expect to need in order to get the station up and running. In addition to the transmitter, this would normally include antenna and antenna line, at least a rudimentary amount of studio equipment, office furniture and equipment, auxiliary power generators and possibly some STL hardware, depending on how you intend to get the signal to the transmitter.

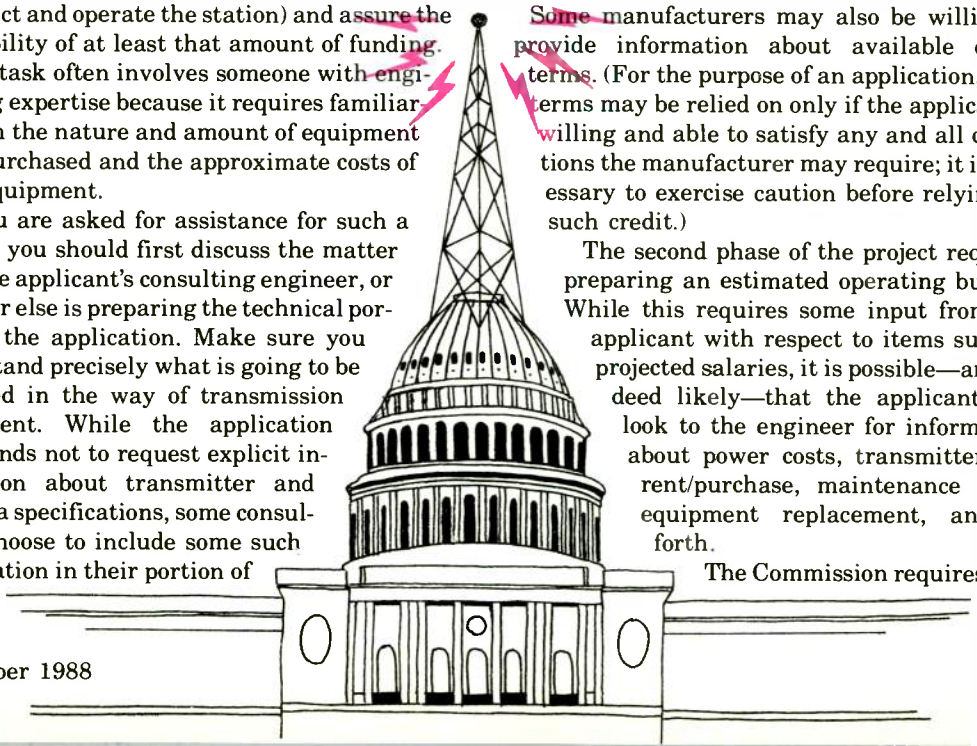
Cole is a partner in Bechtel & Cole, a Washington, DC-based law firm.

Next, get equipment cost estimates on each of the listed items. Manufacturers are usually happy to help out at this stage because they view this as a potential sale if the application is successful.

Some manufacturers may also be willing to provide information about available credit terms. (For the purpose of an application, such terms may be relied on only if the applicant is willing and able to satisfy any and all conditions the manufacturer may require; it is necessary to exercise caution before relying on such credit.)

The second phase of the project requires preparing an estimated operating budget. While this requires some input from the applicant with respect to items such as projected salaries, it is possible—and indeed likely—that the applicant will look to the engineer for information about power costs, transmitter site rent/purchase, maintenance costs, equipment replacement, and so forth.

The Commission requires that



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each applicant be prepared to meet three months' worth of operating costs. It is probably easiest to put together a monthly budget and multiply it by three to determine the amount of operating expense that will have to be financed. It is not absolutely necessary that each budgeted estimate be supported by written estimates from suppliers. Normally, estimates made on the basis of experience and familiarity with the proposal and with the proposed community of license will suffice.

Once the three-month operating budget and the equipment budget have been prepared, the final step is to add the two together to generate a bottom-line number that will represent the "funds required" to construct and operate for three months. The applicant will then have to assure that sufficient funds are available to it from qualified, committed sources to meet that "funds required" amount.

In order to keep equipment costs down, note that you may be able to find used equipment or even lease equipment packages. These approaches can cut equipment costs dramatically, but be sure to get documentation of their availability before relying on them. Also, bear in mind that the FCC does not normally give special consideration to applicants proposing state-of-the-art equipment. It is therefore not essential that your projections include only top-of-the-line gear or attractive but nonessential items such as high-tech news vans and elaborate studio or production equipment.

When certifying site availability, the FCC requires that each applicant take steps to assure that its proposed transmitter site will be available to it for such use. Again, tying this assurance down can often fall onto the engineer's shoulders.

As in the financial qualification preparation discussed above, your first step is to ensure that you and the consultant preparing the technical portion of the application understand and agree on the precise site that will be proposed. Once the site is determined, the site owner should be identified. If the owner is not immediately obvious, ownership can usually be tracked down by reviewing local land records or consulting with local real estate agents. Next, contact the site owner or its agent directly.

If the applicant wishes to purchase the property, determine from the owner or agent that the property is in fact for sale and how much it would cost to purchase it. If you are not in a position to purchase the land immediately, it is helpful to obtain an option to purchase it down the line.

Virtually all terms of an option to purchase are subject to negotiation. In addition to keeping the price reasonable, your primary interest in such a negotiation is to generate a document which demonstrates solid assurance that if and when the construction permit application is granted, the transmitter site will be available to the applicant. At a minimum, you should get a letter or some other document reflecting your contacts with the owner and the owner's willingness

to sell the property.

If the applicant merely wishes to rent the property, you must approach the situation slightly differently. First, be sure to explain that you or your employer would like to specify in an application to be filed with the Federal Communications Commission that the proposed transmitter is going to be located on the site in question. Ask the owner if the site would be available for such a proposed use and for an estimate of the rent that would be charged. The owner's willingness to make the property available for this purpose should be presented in writing.

Site availability is the subject of increasing litigation at the Commission. That means that any certification of site availability is likely, if not certain, to be examined thoroughly by competing applicants and possibly by an administrative law judge. For this reason it is important to *document* the basis of any such certification.

In order to keep equipment costs down, note that you may be able to find used equipment or even lease equipment packages.

Finally, any time you find yourself involved in the preparation of an application to be filed with the Commission, you should be prepared to share your efforts with the applicant's communications counsel. You are all involved in a common effort to prepare and file the best possible application, and you should work together to make sure that all conceivable snags in the effort have been identified and avoided.

Telephone Broadcast—The Rule Remains the Same—In case anyone suggests to you that it is all right to broadcast or tape for broadcast telephone conversations *before* the other party to the conversation has specifically consented to such broadcast or taping, you should be aware that such conduct is *not* all right. In fact, it is a violation of the FCC's rules, as the Commission confirmed last July.

It has ,long been a requirement that station licensees must inform callers of the licensees' intent to record the call for later broadcast or to broadcast the call live. A number of petitioners had proposed that the FCC revise or abandon that requirement.

As the FCC sees it, the broadcast of an individual's telephone conversation "carries the potential for a...serious loss of privacy." The prior notice requirement is a reasonable measure designed to protect against such losses. ■

EQUIPMENT

New Features for the Prodigy...Avcom Spectrum Analyzer...Patch Panels from Switchcraft...Acoustics Systems' Voiceover Booths...and More New Products

Videotek Adds Feature to Prodigy

A user-programmable downstream keyer is a new standard feature of Prodigy, Videotek's production and post-production switcher. Along with external key-cut and key-fill capabilities, the downstream keyer allows an operator to key in and out transitions of 0 to 999 frames.

Reader Service #200

Avcom Debuts Portable Spectrum Analyzer

The PSA-37D is Avcom's new portable spectrum analyzer with digital frequency readout. Frequency coverage is from less than ten to over 1750 MHz and from 3.7 to 4.2 GHz in five bands. The digital frequency readout is shown in MHz on a front-panel LCD display, enabling quicker identification of such problems as terrestrial interference.

Included features are a built-in DC block with +18 VDC for powering LNA's and BDC's, calibrated signal-strength amplitude display, selectable vertical sensitivity of either 2dB or 10dB/DIV and an internal battery with charger.

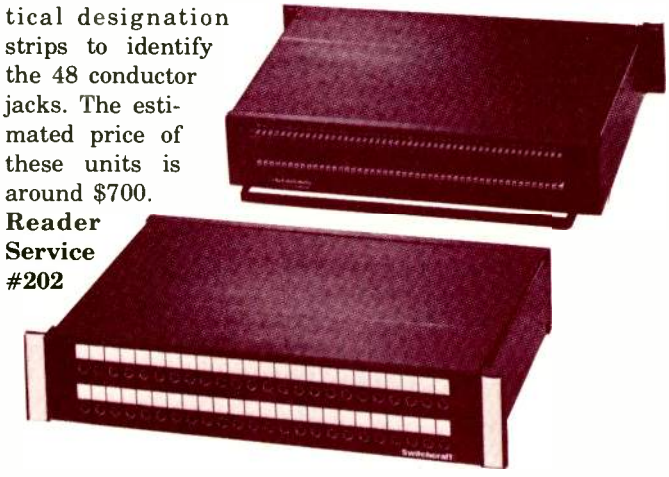
Reader Service #201

Switchcraft's New Audio Patch Panel

The new audio patch panels from Switchcraft will be available in September. Available in several configurations, they are fully shielded, ready for 19-inch rack mounting and are delivered fully assembled. Insulation Displacement Connectors inside and outside, enabling easy terminations, are options for the rear panel of the units only. All circuits are clearly identified.

Each patch panel has two large horizontal and two vertical designation strips to identify the 48 conductor jacks. The estimated price of these units is around $700.

Reader Service #202



Pre-Fab Voiceover Booths from Acoustic Systems

Acoustic Systems introduces its BB Model line of prefabricated acoustic enclosures in ten sizes ranging from three-foot/eight-inch (outside width) by three-foot/eight-inch (outside length) to eight-foot/eight-inch by eight/eight with a standard inside height of seven inches. They are constructed with four-inch thick panels, having an STC rating of 45, and can be assembled and taken

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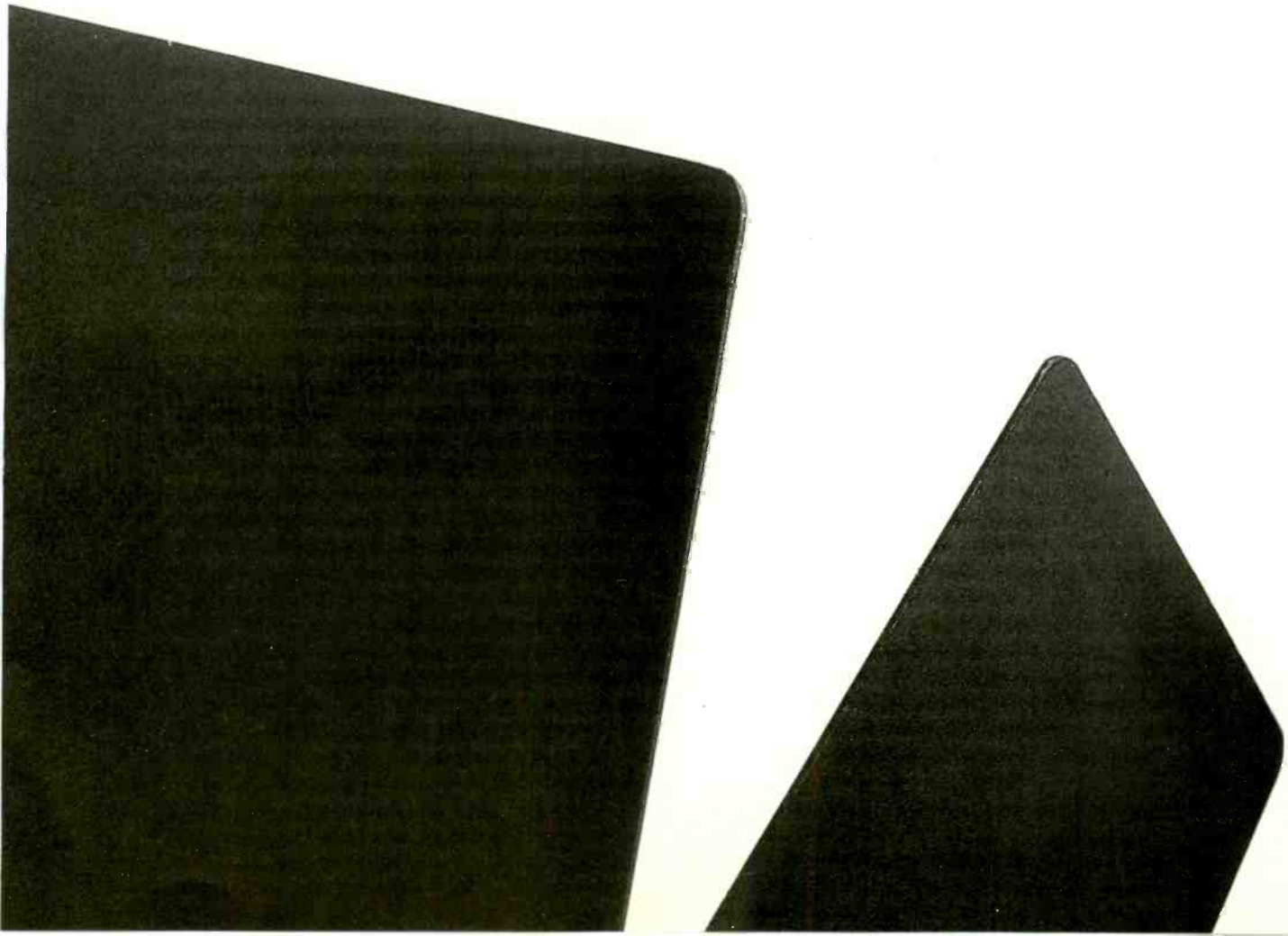

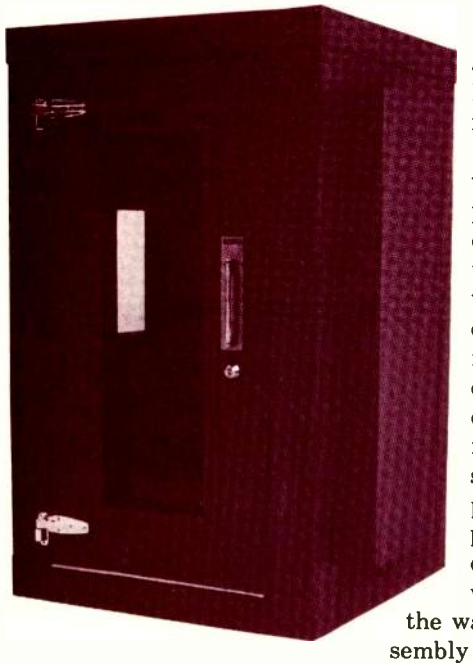

apart without loss of acoustic integrity.

Standard features include prewired duplex outlets, silenced ventilation system, prewired incandescent lighting, a recessed conduit run for cable management, durable splatter coat platinum enamel paint finish and double-glazed windows in both the wall and door. Assembly takes less than 16 hours with a two-person crew and electrical service is possible with a standard 12 ft. cord plugged into a 110 volt outlet.

Reader Service #203

Evertz Time-Code Reader/EDL Lister

The Model 623 with serial I/O is a microcontroller-based module with full-speed LTC, LTC translator/phase restorer and an RS-232 serial interface. A decoded, regenerated play speed LTC output is provided, which allows outcoming code to be properly synched to video while incoming code remains intact at normal speed.

Model 623's sophisticated high-speed reader reliably recovers LTC over the full shuttle and wind speed range of most VTRs.

A companion product to Evertz' new Model 623 Time-Code Reader, the 623-EDL software detects breaks in the VITC or LTC time code and can generate an Edit Decision List on the RS-232 output by substituting an edit decision list mode for the continuous broadcast mode. It can detect edit points with continuous code of at least 12 readable frames durations, and it compensates for time code dropouts or reading errors. The 623 modules can be intergrated into existing EV BLOC rack frames.

Reader Service #204

Broadcast Video Systems Has Digiview

The new Digiview PC add-in T&M unit, manufactured by Viewtronics, Ltd., and distributed by Broadcast Video Systems, is a unique instrument for measuring and checking parallel digital signals sampled according to CCIR 601 recommendations.

Designed to aid setup of analog-to-digital conversion equipment and testing digital processing systems, the Digiview card and software feature error detection routines and a numerical comparison scheme.

Reader Service #205

Cine 60 Universal Batteries Go Portable

Cine 60 triple voltage portable universal batteries power most ENG/EFP cameras, VTRs, TV monitors, low voltage and 30V lights, BetaCam-type camcorders, instrumentation systems, microwave equipment, test instruments and camera prompters. Both 13.2V and 14.4V are available at the same time via 5-pin XLR battery output connectors, enabling simultaneous power for a 13.2V system such as a BetaCam and a 14.4V light without an adapter. The battery can also provide 30V power. Cine 60's triple voltage portable universal batteries replace on-camera batteries, BP-90, NP-1 and all other 12, 13.2 and 143.4V battery systems. They are available in belt or battery packs in standard and fast charge modes.

Reader Service #206

New Whip Antenna from Valcom

The Valcom Model V-33070-CL2 is a heavy-duty, coil-loaded 74-foot whip antenna designed for maritime and aviation broadcasting

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applications. It was originally manufactured to meet Canadian Department of Transport specifications.

Features include a 2 kW below 1.5 MHz/5 kW above 1.5 MHz power rating and a frequncy range of 100 kHz to 30 MHz with a tuner.

Reader Service #207

dbx Enhances RTA-1

New software for the dbx RTA-1 real-time analysis system includes enhanced room-response curve capabilities, improved microphone calibration capabilities and customized printout. Room response curve analysis now provides 15- and 30-second averaging for faster response to changing conditions and quicker equalization. Statistical analysis increases rejection of spurious noise.

Mic calibration now features direct readout of dB SPL; information can be stored for up to ten mics. In addition, a one to 42-character banner appearing at the top of the printout can now be entered. dbx has reduced the price of the RTA-1 from $6950 to $4500.

Reader Service #208

Bruel & Kjaer Unveils New Mic

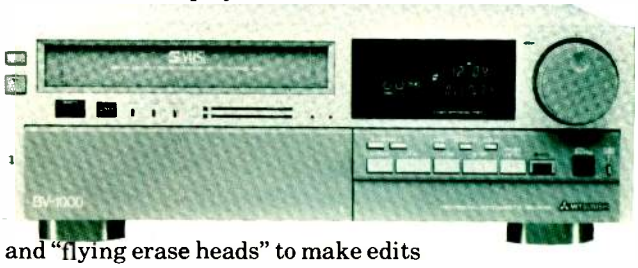
Bruel & Kjaer has launched the type 4011 prepolarized condenser-microphone with cardioid directional characteristics. It combines flat on-axis frequency response with a uniformly smooth off-axis phase and frequency response. It employs a new B&K diaphragm and a P48 independent phantom-powered transformerless preamplifier.

The 4011 is calibrated for a frequency response of 40Hz to 20kHz at 30 cm and can handle 158 SPL before clipping. It also uses a 0/-20 dB attenuator, user-selectable by a switch recessed in the XLR connector.

Reader Service #209

Mitsubishi's First Pro VCR

Mitsubishi launches its first "professional" videocassette recorder. The S-VHS-format BV-1000 offers high-resolution editing and special effects capabilities. The unit employs an edit window



and "flying erase heads" to make edits within +/- 2 frames accuracy. Other features include a jog shuttle, which enables still frame, variable search, variable slow motion and frame-by-frame advance, and a 1.4 mHz 8-bit digital memory. Effects include nine to 100 split screens, freeze frame, strobe and multi-strobe, variable speed-scan and window size and insert edit, fine edit and audio dubbing.

The BV-1000 also features high-speed position and index search capability and high fidelity/MTS sound. The unit is rack-mountable and is equipped with a full-function wireless remote control.

Reader Service #210

Circuit Studios Ups Velocity 3D System

Circuit Studios' Version 2.2 Velocity 3D modeling and video animation system is a configurable package which provides realtime solid-shaded modeling, animation and rendering via the Megatek 911S graphics engine. New features include the Tomographic 3D modeling package which creates complex asymetrical objects using cross-sectional technique; enhanced reflec-

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tions including Speed Chrome, which is similar to elevation mapping, and 3D Environmental Mapping for ray-traced effects. Velocity can now record interactive, anti-aliased output to videotape frame-by-frame at less than 1 second per frame. Sun 386i Velocity is a new configuration which uses a Sun workstation as a front end. Prices start at $48,000 for a complete system; a typical configuration with options is $70,000.
Reader Service #211

Nova Announces Inverter

Nova has announced a solid state 250KVA sine wave inverter for mobile, industrial and telecommunications applications. The model 2560-12 uses pulse-width modulation and operates from a battery or generator over an input range regulated for voltage and frequency of 11-16 VDC. It produces 120 VAC at 60 Hz with a low-distortion sine wave output.

It is intended for applications where AC power is unavailable or for use in tandem with existing battery supplies to provide uninterrupted power to critical loads. Uses include powering process control instrumentation, data acquisition equipment, SCDA systems, computers and emergency lighting. Output voltage regulation is plus/minus 1 percent from no load to full load; frequency regulation is plus/minus .5 percent. It can supply loads with a power factor of 0.7 lead to 0.7 lag. Weight is 37 lbs. Suggested retail price is $1105.
Reader Service #212

Schlumberger's New Workstation

The SI 1220 is a fully integrated workstation for dynamic signal analysis. It can perform FFT analysis, sine swept frequency, logarithmic frequency and octave analyses. Coupled with an optional generator it can stimulate passive devices in frequency and time domains using ten preprogrammed or user-programmed waveforms.

The SI 1220 comes in two or four-channel configurations and can analyze four channels to 50 kHz with 500 line resolution. With built-in pre-amp and ICP supplies for all channels, the interfaceable workstation connects directly with transducers. The 1220's data-processing features include 3-D and greyscale waterfall displays, a 1M sample memory, a large CRT capable of displaying up to four results and a menu system with HELP pages. Delivery time is 12 weeks. Suggested retail price is $18,250.
Reader Service #213

Video Associates Labs Intros Card

VAL's new MicroKey/Mark 10 is a modular board for interactive NTSC/PAL video development and delivery. The card is claimed to be the first plug-in modular board which easily consolidates an IBM PC, Model 30 or IBM-compatible bus card in one slot. It provides standard EGA graphics with a 16 out of 4,096 palette and an available graphics overlay of videodisc/videotape. A videodisc control module is standard.

Optional modules available within the single slot environment include fade and analog RGB multi-standard monitor support. No additional graphics card or extra ports are required for videodisc control. Suggested list price is $1295.
Reader Service #214

Lyon Lamb Announces Real Time Interlace Converter

The Lyon Lamb ILC interlace converter uses high-speed sampling and digital conversion of sam-

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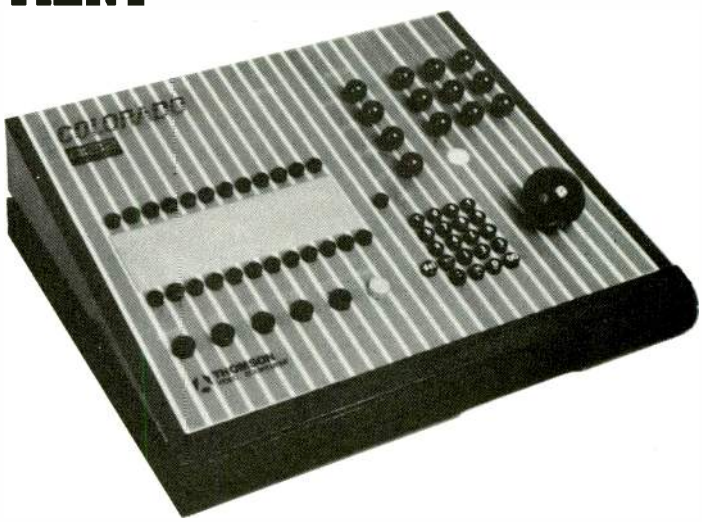

ples to analog RGB to convert high-resolution computer graphics from 60-70Hz non-interlace displays to high-resolution 30Hz interlace format RGB in real time. The ILC interfaces to a wide range of non-interlace graphics systems as input, and to all 30Hz display devices for output, including multisync monitors and large screen projection systems.
Reader Service #215

NEC Bows ENG Camera

The SP-30 is NEC's new high-resolution, low-light sensitive multi-use ENG camera. Using the CCD sensors already employed in the NEC EP-3 studio camera, the SP-30 also offers auto functions, monitoring, and controlled adjustments. Other features include f/6.2 sensitivity at 2000 lux, horizontal resolution of 700 TV lines, S/N ration of 60 dB and a built-in electronic shutter with seven speeds from 1/60-1/5000th of a second.

The SP-30 lenses are interchangeable with the SP-3A ENG lenses, and it is compatible with all SP-3A adapters and accessories. The SP-30 camera may be used as a standalone with cable connection through the NTSC adapter to a VCR, combined directly with the Beta SP format camcorder or through an MII adapter to MII recorders. It can also be genlocked to an onboard VTR and can generate its own NTSC signal from within the camera head. Suggested retail price is $25,000.
Reader Service #216

Telepak Bows New Recorder Bag

Telepak has added a recorder bag for the Panasonic 7400 to its range of custom-designed packs and covers. Featuring a lifetime guarantee, the 7400 Recorder Pak is made from a durable water and stain-repellent nylon fabric and extensive padding. Suggested list price is $175. The 7400 Recorder Pak is available now.
Reader Service #217

Digital Color Corrector from Thomson

The Colorado is Thomson Video Equipment's new fully digital color corrector. In addition to color correction and grading, it can be used for mastering, post-production effects and general manipulation. It also offers time code and memory capability. The Colorado operates on masters, gains, gammas and saturation RGB. It is compatible with other Thomson 4:2:2 digital studio component equipment.
Reader Service #218

Shure Debuts Gooseneck Mike

Shure has introduced the model SM 99 miniature condenser microphone for gooseneck mount applications. Designed for sound reinforcement applications requiring wide frequency response, the system features a one centimeter precision condenser element and on-board preamplifier with a supercardioid polar pattern.

The unit is fitted with a pop filter suitable for speech and music. The mic features wide dynamic range, low distortion and RF protection. Suggested retail price is $240.
Reader Service #219

Radiation Systems Introduces Uplink

Radiation Systems Inc. has introduced the 240AT self-contained air transportable satellite uplink trailer system. Featuring a 240KV 2.4-meter antenna with a trailer requiring a standard Class 3 towing hitch, the 240AT Ku-band satellite uplink can go over-the-road or, via trailer, air shipped overnight by conventional carrier. Radiation Systems designs, manufactures and installs a broad range of antenna systems for applications including satellite earth stations.
Reader Service #220

Lighting Control from Electronics Diversified

The new Omega lighting control console from Electronics Diversified provides 72 channels to control up to 960 dimmers with 900 full-size cues, proportional soft patch with programmable non-dims and ten individual dimmer curves assignable to any dimmer. This manual or memory console also features auto linking and multiple step cues, two simultaneous operating special effects, and 72 overlapping, pile-on submasters with individual timers. A 3.5-inch disk drives stores recorded information. The console supports AMX-192, DMX-512, Colortran and Fiber-Link protocol.
Reader Service #221

Heitz Adds to Gitzo Line

Karl Heitz has announced four additions to the Gitzo line of camera support equipment. These include two giant monopods—a four-section unit rising to eight feet and a six-section model with a maximum height of 12 feet. The others are the Inter Pro Studex tripod, a lightweight, heavy-duty unit for cameras up to 30 pounds, and a new tilt attachment for the Gitzo 480, 580 and 680 fluid heads. These provide over 90 degrees front and rear tilt.
Reader Service #222

BUSINESS BRIEFS

A flurry of sales and installations were recently reported by **Panasonic Broadcast Systems**. Raleigh, NC's **WRAL-TV** has reportedly become the first station in the world to use Panasonic's M.A.R.C. II automation system in actual on-air operations...The Christian Broadcasting Network **(CBN)** has logged an order for a new 1200-cassette M.A.R.C. II, as well as orders for MII AU-650 studio VTRs and AU-620 studio players. The equipment will be delivered in late 1988 when the network begins conversion from one-inch to MII... **WSBT-TV**, South Bend, IN's CBS affiliate, and the nation's oldest UHF station, has purchased a 475-cassette M.A.R.C. II. According to WSBT CE Robert Bell, "One of the reasons we picked the Panasonic cart machine is because it can be used with standard AU-650s. Most cart manufacturers require special VTRs for their systems."...Knight-Ridder station, **WPRI-TV**, Providence, RI, a previous convert to MII for recording and playback of satellite programming, now plans to convert its entire ENG/EFP operation to the half-inch format. Equipment purchased for the change includes AU-650 studio VTRs, AU-500 portable VTRs, AU-550 field edit recorders, AU-400 cameras, AK-400 CCD cameras, and AU-630 playback VTRs...NBC affiliate **KTSM-TV**, El Paso, TX, is planning a conversion to MII to the tune of $1 million...**Rainbow Network** Communications, Floral Park, NY, too, has just purchased MII playback equipment.

Fidelipac Corp. is offering a bit of purchasing incentive for internationally minded customers. Purchasers of a one-recorder/three reproducer Dynamax cart machine package between July 1 and December 31 will qualify for a free five-day trip to the **European AES** in Hamburg, Germany. According to VP-marketing Art Constantine, "We've done extremely well in the export market, and, in considering several promotional possibilities, we said 'Why not show our customers how we do business overseas and give them an opportunity to learn about broadcasting outside the U.S.' "...Recent installations of **Neve** V series consoles include North Hollywood's Devonshire Studios and New York's **Chung King House of Metal**...**NCGA** has announced a call for entries for its fourth annual International Computer Animation Competition; 1-800-225-NCGA for more information

Jeff Blackden has been named VP-manufacturing at **Pinnacle Systems**...Murray Shields is **Auditronics**' new director of sales... **Switchcraft** has tapped Richard E. Livengood as its new component division plant manager...**Vinten Equipment, Inc.,** has appointed Robert Getchell marketing development engineer for the company's Microswift line. ■

A New England Digital Synclavier digital audio system now graces the studios of Gannett affiliate KIIS-FM in Los Angeles. Slated for double duty with both on-air and production chores, the machine was put to use almost immediately by (left to right) Paul Donahue, Gannett director of engineering; Jonas Olmstead, NED digital product manager; and Mark Driscoll, KIIS-FM production manager, to produce on-air promo announcements.

Another recent installation of NED equipment includes the purchase of a "tapeless" studio package (a Synclavier and Direct-to-Disk recorder) by Ambassador Television, Pasadena, CA.

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Station Trading: A Fatal Dose?

By Andy Butler

The following sounds like a tirade, but it really isn't. It is simply a passionate plea to save an old friend. I have spent 25 years serving an industry that I love. That industry is headed down a dangerous road. I hope we see the cliff before it is too late to avoid taking the plunge.

Station trading is an opiate. It seems as innocent as marijuana, but it is as addictive as cocaine and as debilitating as heroin. Those are strong words, but I've seen both sicknesses in action, and the results are distressingly the same.

Since the FCC suspended the three-year holding role, there has been an explosion in station prices fueled by an enormous rush to acquire as many of these limited franchises as possible before they are priced completely out of reason. Many of these acquisitions are financed by highly complicated leveraging arrangements that require enormous amounts of time to negotiate and consummate. Since the final outcome of this deal-making can have a major impact on their personal wealth, it is understandable that many CEOs of major broadcast groups spend a majority of their time concentrating on these efforts.

While this practice is proper, the "trickle-down" effect can be disastrous. People are people, and company culture is just people at work, so whatever is most important to the top manager in a company becomes priority to those working for them. They quickly realize that the people who are achieving positive visibility are those who are helping handle the myriad details that each acquisition or disposal includes. As the number of deals increases and they become more complicated, the web expands. Station-level management becomes involved as station managers win praise for helping with pre-acquisition surveys and planning for operational takeovers. Program management becomes involved in evaluating the new markets and advising the group programmer on strategies and alternatives. Promotion directors are planning TV buys and designing logos for other markets. Engineering managers find themselves called upon to evaluate the technical strengths and weaknesses of potential acquisitions. Those who are concentrating on their own stations start to feel left out and unimportant.

The pressure on broadcasting is tremendous. New technologies are giving people attractive alternatives to traditional broadcast offerings. Responding to this challenge takes tremendous drive and innovative thinking. Unfortunately, more and more of broadcasting's "best and brightest" are devoting the prime energies of themselves and their best people to acquiring and trading. Operating properties isn't as glamorous or profitable as buying and selling them, but it must be done. No matter how clever a trader you become, you can't achieve long-term profitability if the properties aren't sound operating entities. With this in mind, a heartfelt plea to those in charge: It's getting pretty scary down here where the work gets done. We need your drive and innovation in the boiler room. Hope you can join us before the fire goes out! ■

Butler is director of engineering at WFAN-AM, New York City. He also serves as executive director of the Society of Broadcast Engineers.

More and more of broadcasting's "best and brightest" are devoting their prime energies to acquiring and trading.

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For those interested in more advanced techniques, the SP-6 employs a powerful talent monitor section designed to rapidly call up live mic and track combinations, making difficult punch-ins a breeze. Standard SP-6 input channel equalizers are more comprehensive than those supplied as optional items on competing products, allowing much greater creative freedom. Input channel auxiliary send sections are designed to be the most versatile in the industry, providing 4 different auxiliary buses to allow digital delay, reverb, talent foldback, and mix-minus feeds. Stereo input channels can provide either mono or stereo effects sends. Even more, the SP-6 has 4 auxiliary effects return inputs that allow effects to be recorded onto the multitrack or sent to the monitor buses.

The SP-6 provides independent headphone, control room and studio monitor feeds, as well as stereo cue/solo. Control room and studio mute and tally functions are independently dipswitch selectable on individual input channels. Additional studio modules may be ordered to accommodate larger, multi-studio installations. The SP-6 may be configured with any combination of mono and stereo input modules, in mainframe sizes ranging from 16 to 32 or more inputs. The console is available in either an 8-track production format or a 4 stereo subgroup TV master control configuration. So why not profit from Wheatstone's experience and reputation? Call us today and learn more.

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