SEPTEMBER 1987 $3.00

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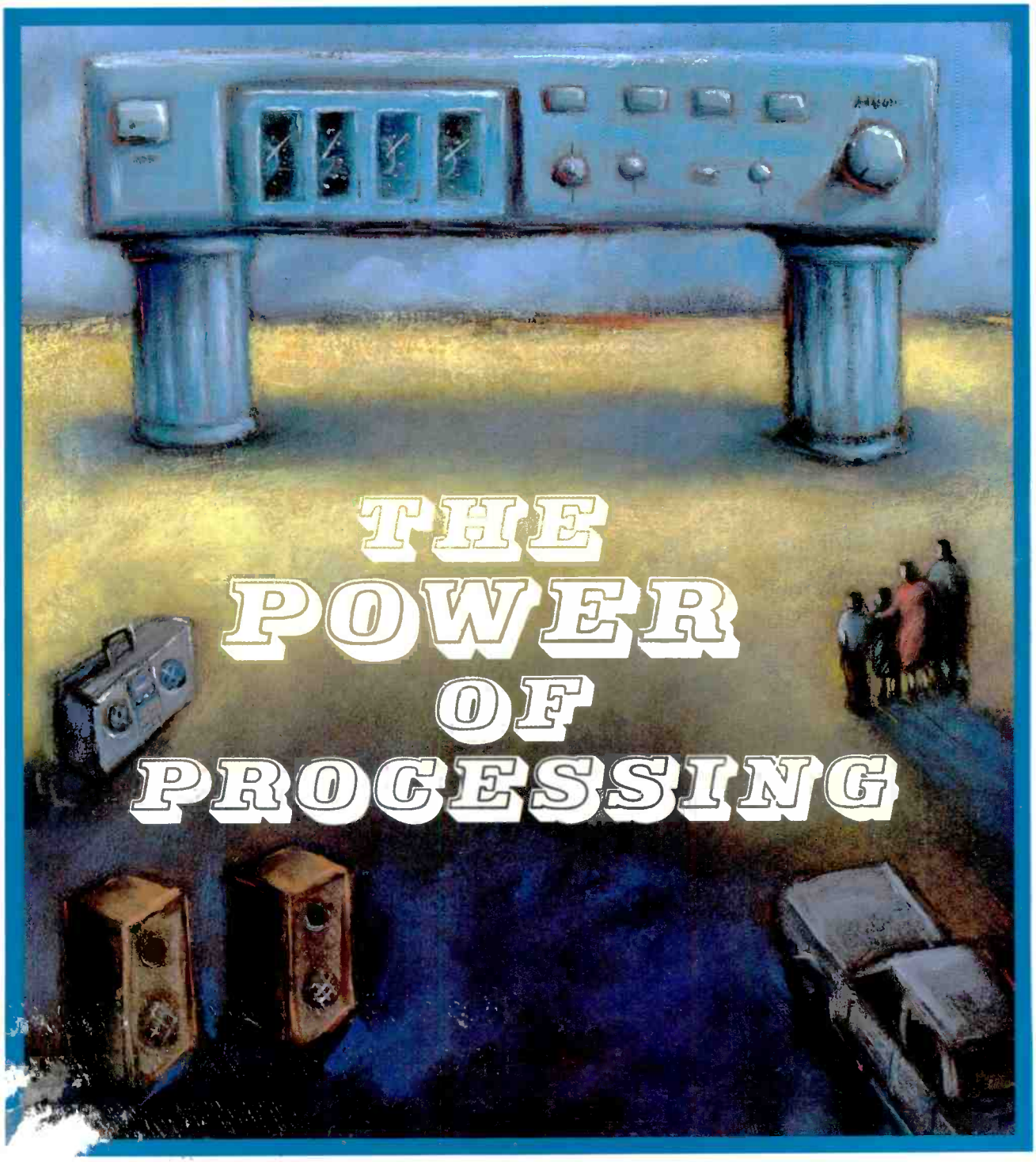
BROADCAST MANAGEMENT/ENGINEERING



Also in this issue:

- Microphone Techniques for MTS
- Time Base Correctors
- Psychoacoustics
- GM/CE Relationships

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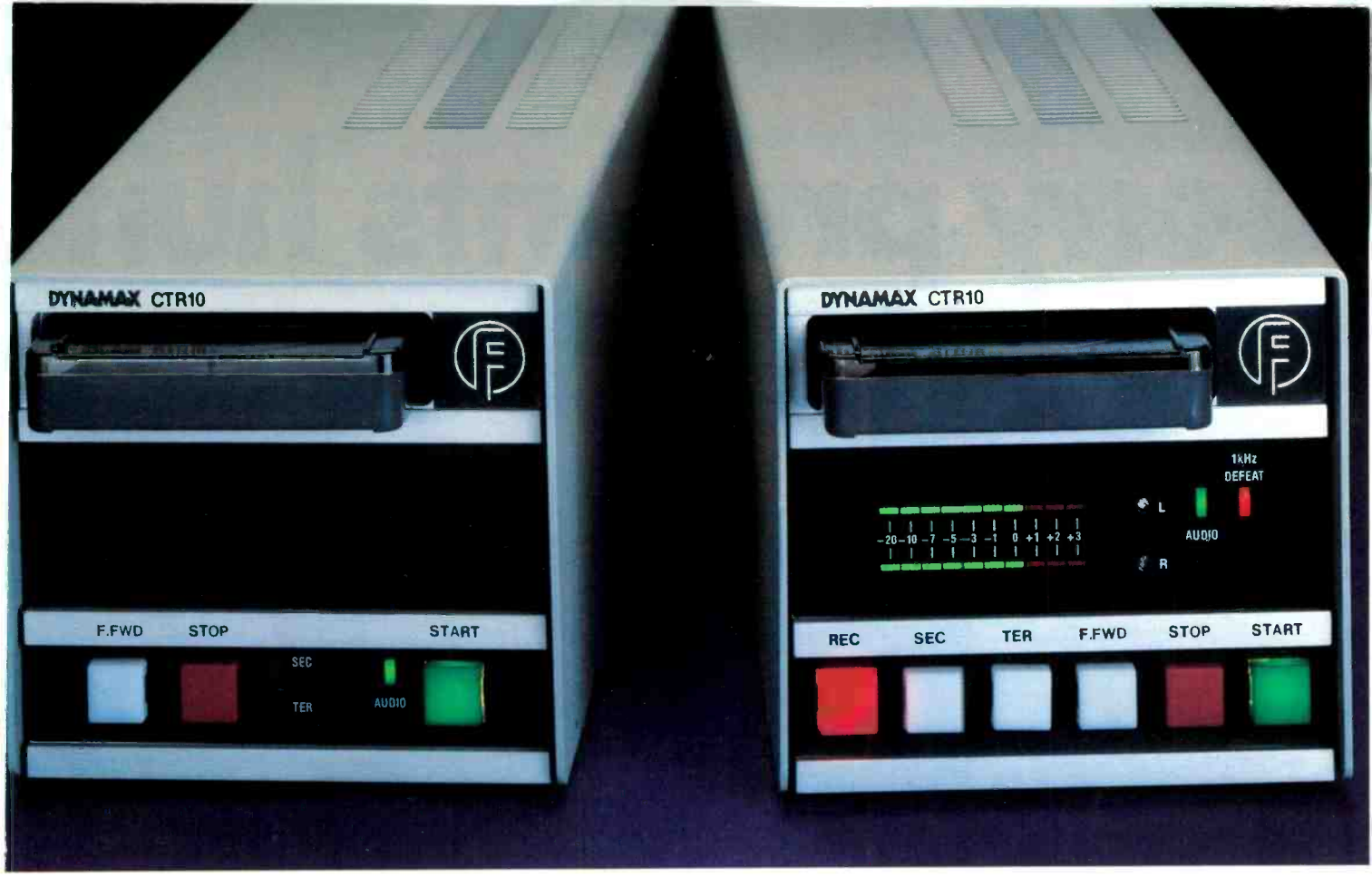

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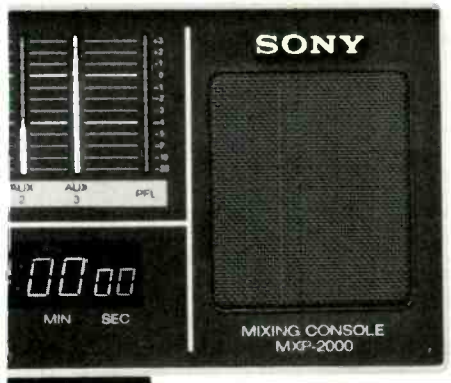

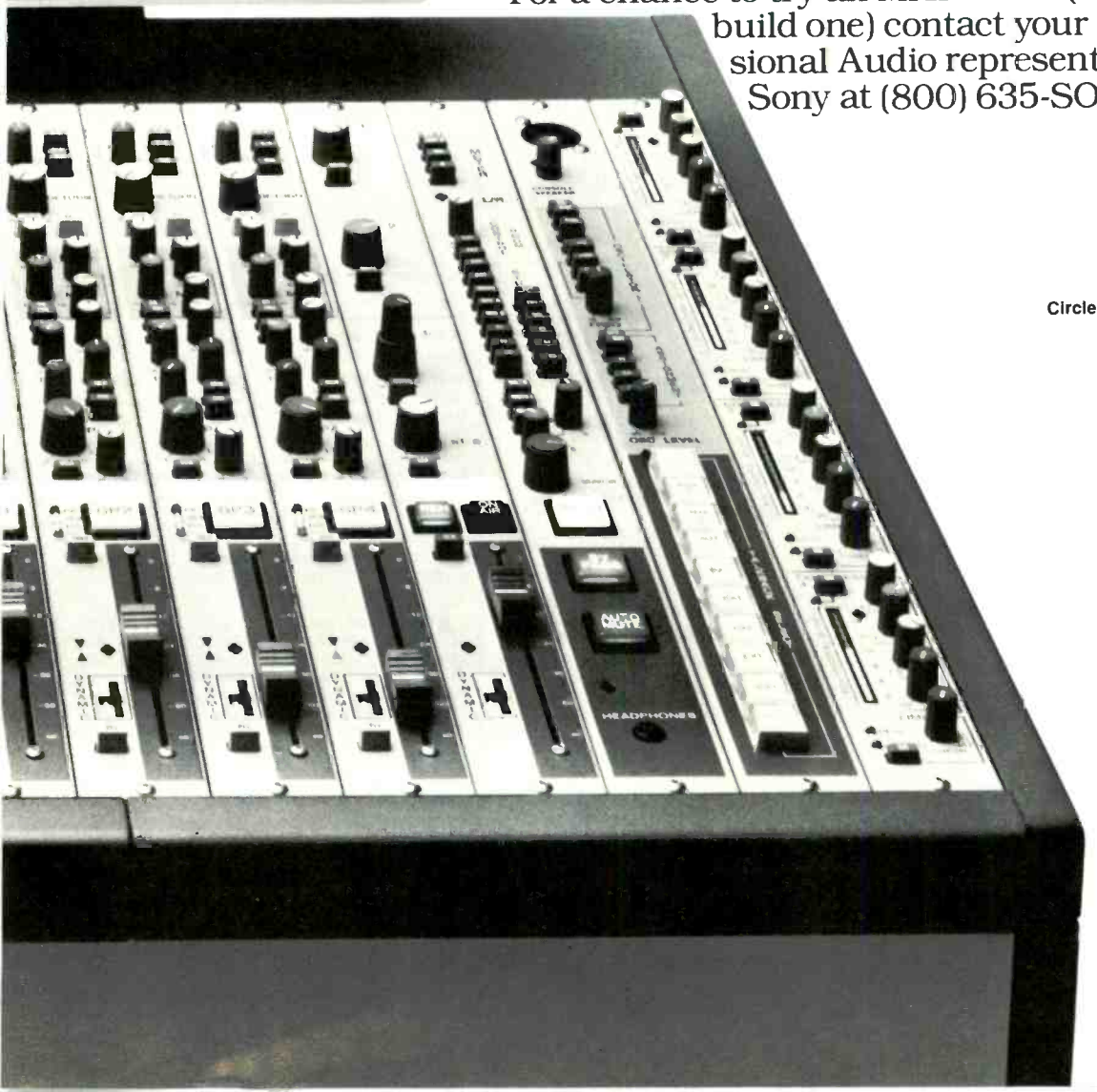

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Professional Audio

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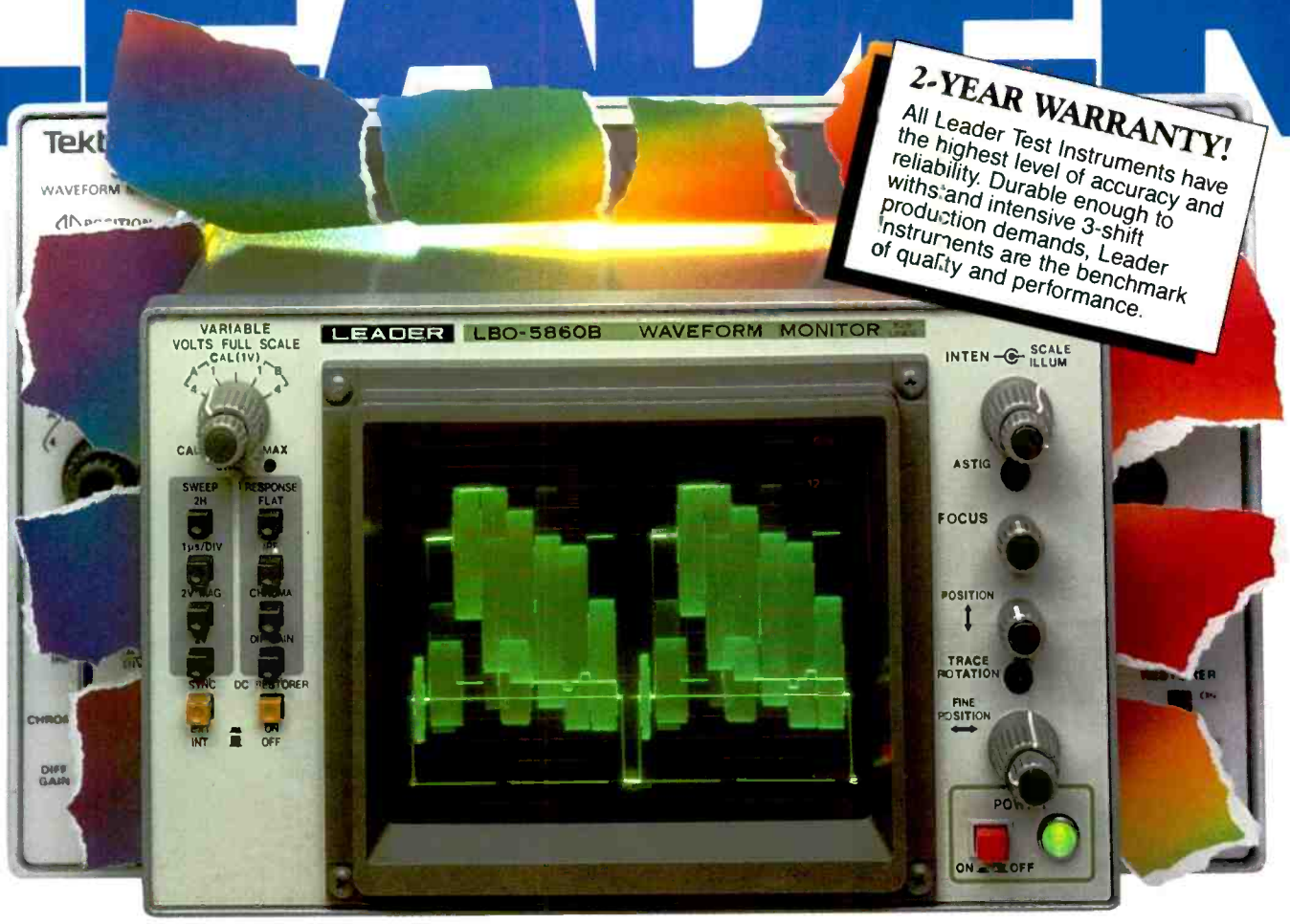

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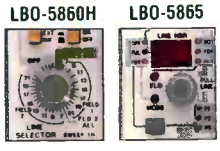

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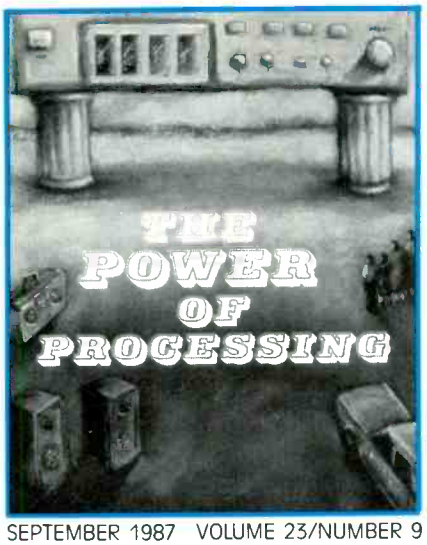

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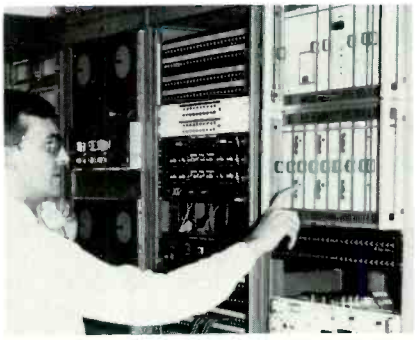
SEPTEMBER 1987 VOLUME 23/NUMBER 9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Features

Cover:

This original oil painting was done by New York-based illustrator Steve Dininno. It graphically depicts how audio processors are employed by radio stations to appeal to a wide spectrum of users.

Departments

AM Stereo Revisited (Again)

"The industry is prepared to rise from the fear and uncertainty that has plagued it for the last several years."

With the recent follow-up report issued by the National Telecommunications and Information Administration on its February study on AM stereo, that technology is being brought under scrutiny once again. Two proclamations of note came out of the second report. The NTIA's determination that there is not degradation of sound in multisystem radios compared with single-system AM receivers was qualified by the statement that implementation of multisystem technology was not feasible due to the dominance of Motorola's C-Quam system in the marketplace and the lack of support for multisystem units by manufacturers.

The more cogent statement in the recent report, however, concerns the NTIA's recommendation that the FCC protect the C-Quam pilot tone from interference. In our opinion this is the right move. Such protection would provide the needed impetus to the sagging AM marketplace. Having already lived under the intolerable burden of confusion, AM broadcasters need a strong, positive force to renew their vigor. A bold gesture by the FCC in protecting the C-Quam pilot tone would surely serve notice to AMers that the industry is prepared to rise from the fear and uncertainty that has plagued it for the last several years.

Importantly, this would only be a protection and not new regulatory red tape. Thus, there would be no interference with those broadcasters who have chosen the Kahn AM stereo system or those still free to chose it. It would, like the EIA's MTS protection, only give the industry the comfort of protection rather than dictating to it a certain technology. Such a move by the FCC, it would appear, is as close as we are likely to get to a solution, and is certainly as close as we will ever get to satisfying all concerned parties.

Go ahead FCC, pass the protection.

Tim Wetmore

Tim Wetmore
Editor

SURVIVAL RADIO

It really *is* a jungle out there. And in that jungle, Otari's MTR-10 audio machine gives you the ammunition you need to stay alive—like three speeds, microprocessor control, a built-in cue speaker, and an optional ten-memory autolocator.

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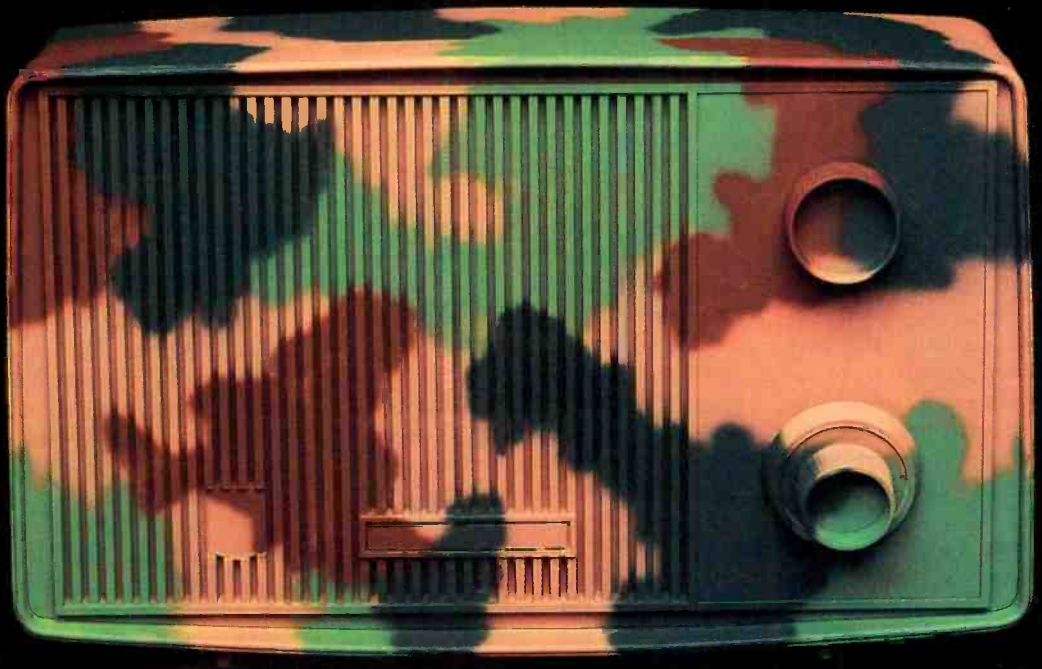

Fairness Battle Lines Formed

NAB president Edward O. Fritts has issued a statement saying that his organization will work to help President Reagan sustain his June 20 veto of the fairness doctrine. A Congressional battle on the issue is shaping up as this issue goes to press.

"The President believes as we believe that the fairness doctrine is unconstitutional and impinges on the First Amendment rights of broadcasters," Fritts says. "Our preliminary count is that a veto is sustainable and we will work hard to help the President sustain his veto. Broadcasters believe in fairness and will report fairly whether there is a fairness doctrine or not. The question is whether we should have government telling our news departments how to operate."

One group opposing the FCC's August 4 abolition of the fairness doctrine is the Syracuse Peace Council. They have filed a petition with the U.S. Court of Appeals in New York to have the doctrine reinstated, and argue that the FCC acted beyond its authority in repealing the doctrine. The group maintains that the doctrine was law, and not FCC policy, and that the commission does not have the authority to declare it unconstitutional.

The new CNN Newsroom at Atlanta's just-completed $30 million CNN Center became operational at 6 a.m. (EST) July 13. Occupying 20,000 square feet of space and employing 120 people, the CNN Newsroom is outfitted with a specially designed Basys newsroom computer system with capacity for more than 500 terminals. In keeping with CNN tradition, a window at the front of the newsroom adjoins the CNN news set, giving audiences at home a view of newsmaking operations. Directly behind the window are three writer's pods, one for each eight-hour shift. Behind the pods is the supervising producer's desk, national and international assignment desks, and—in the lower right of this picture—the satellite newsgathering/CNN Newsbeam coordination desk. The computer graphics area is visible in the upper right. CNN is received in 42 million homes, serves 175 broadcast television stations, and is carried on nearly every CATV system in North America.

FCC Raids Pirate Radio Ship

In a move to protest what they saw as the "stagnant" state of rock programming on New York City radio, a group of self-described radio enthusiasts launched a seafaring pirate radio operation off the shore of Long Island late last July.

Housed in a rusting 170-foot freighter outfitted with five transmitters—including a 110-foot radio tower—the station, dubbed Radio NewYork International (RNI), began broadcasting on July 23. Two days later, two FCC agents along with officers from the Customs Service and Immigration and Naturalization Service boarded the Honduran-registered ship and issued a warning to the station's personnel that they were apparently violating Federal rules by broadcasting without a license.

RNI claimed, however, that they were in international waters outside the three-mile territorial limit (and thus, outside the FCC's jurisdiction), and they resumed their rock and oldies broadcasts on unassigned frequencies on the AM, FM, and shortwave bands the following evening.

"It's like sending up a flare that something is wrong in the radio media in New York that people would go this far to try and bring an alternative voice to the air," RNI's 30-year-old operations manager Randi Steele told the *New York Post*.

At dawn on July 27, the FCC returned in the company of Coast Guardsmen who arrested the station's chief engineer, Alan Weiner, and disc jockey Ivan Rothstein. The two men were arraigned later that day in Federal District Court in Brooklyn on charges of conspiracy to impede the FCC and operating a broadcast station off the shore of the U.S. Both were released on their own recognizance after promising to cease the broadcasts.

Weiner, of Monticello, Maine, has had run-ins with the FCC prior to RNI. In 1971, Federal agents broke up his pirate radio station, WSEX, in Yonkers, New York; two years ago his radio license in Maine was revoked for broadcasting on unassigned frequencies.

An FCC spokeswoman noted that although the ship was flying the Honduran flag, RNI violated an international treaty that forbids broadcast operations aboard

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ships. She added that the Honduran government was notified before the ship was seized.

If convicted, Weiner and Rothstein could face maximum prison terms of five years and $250,000 fines. A hearing has been set for August 27.

SMPTE to USSR

Three officials of the Society of Motion Picture and Television Engineers (SMPTE) have recently returned from a nine-day technical demonstration tour of the USSR for the purpose of exchanging information and ideas with their Soviet counterparts.

SMPTE president M. Carlos Kennedy, editorial vice president Howard T. La Zare, and society engineering director of motion pictures Edmund M. Digiulio made the trip at the expressed invitation of S. A. Solomatin, deputy chairman of Goskino, state committee on cinematography.

The SMPTE delegation visited Soviet motion-picture research institutes, labs, television and film studios, and manufacturing facilities in Moscow, Kiev, and Leningrad. They also participated in technical discussions of the Goskino.

Among the observations the group made on the trip was that the USSR feeds television programming via satellite to the country's five time zones. M. Carlos Kennedy stated that "Our hosts in the Soviet Union displayed a great deal of openness, sincerity, and friendliness. They were respectful and totally open-minded to our ideas."

Help for Haitians

The following is an edited appeal received by this magazine from Thomas F. Korn, district governor's aide of the World Community Services Committee and of the Marshfield, WI, Rotary Club. Mr. Korn writes:

"For the past three years our Rotary Club has been involved in a number of projects to help schools and hospitals in and near Cap-Haitien, Haiti. They badly need a 5 kW or larger, 120 volt AC (60 Hz) automatic electric generator, either gasoline or diesel driven. They need it for a children's clinic to pump water and to power microscopes and other electronic devices. Also badly needed is a low-power (maximum 250 watts, preferably less) FM broadcast transmitter, antenna, and studio equipment. Haitians have radios but need to be taught to boil their water, cook their vegetables, and wash their hands. The University Roi there will operate the station. Neither of these items need be new, but they should be in reasonably reliable operating condition. One of your readers might have this equipment going to waste somewhere and it could be saving lives right now. Naturally we are hoping an altruistic reader will make a gift of these items."

Mr. Korn can be contacted by writing to the Marshfield Rotary Club, P.O. Box 928, Marshfield, WI 54449.

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Traffic, Lint, and Clean Beaches

Innovative promotions are nothing new to radio, but some recent ideas again prove that the imagination of radio people is limitless.

One promotion is making life easier for distressed motorists on Phoenix's Black Canyon and Superstition freeways during morning and evening rush hours. For several months, a special Chevy van operated by local KOY AM and FM has provided free roadside service to troubled cars and drivers.

The KOY/Courtesy Chevrolet van is outfitted to provide gas, fix flats, jump batteries, or call a tow. In addition, KOY's woman in the van, Julie Lyle, provides listeners with a "worm's eye view" of the traffic situation.

Lint is even more abundant than disabled cars, prompting WKRI in West Warwick, RI, to conduct a lint-a-thon. Morning personalities Donna Wagoner and Al DeStefano urged listeners to send in the fuzzy stuff, which WKRI then sent by the bale to a California artist who sculpts it.

The stunt was inspired by a story on the AP wire feature "Where There's Life," by AP national writer Ira Dreyfuss. AP member stations frequently turn the feature's offbeat stories into promotions and contests that enjoy enthusiastic listener response.

Response to the problem of littered Los Angeles County beaches recently consisted of a donation of 6,000 trash barrels by area station KTVW-FM, known as the Wave. The barrels will be spotted along a 31-mile stretch of coastline, and will sport the Wave logo. A station spokesperson said the program is a "giving back" to the community, which has strongly supported the seven-month-old Wave.

TV News Expands

Twice as many network television affiliates increased their evening local news programming during 1986 as decreased it, according to a new study by the Television Information Office (TIO).

The study also shows that 249 stations now broadcast one hour or more of local news between 4 p.m. and 7 p.m., an increase of 13 stations in one year. Other statistics find that 37 affiliates increased local news programming between May 1986 and May 1987, while 18 reduced it, and 19 stations doubled their local news programming from 30 to 60 minutes.

The survey is based on A.C. Nielsen data from all 214 reportable Nielsen markets, covering 638 affiliates. "Americans get most of their news from television," said TIO director Robert Mulholland. "The study indicates stations are aware of, and responding to, their viewers' news needs."

RKO Licenses Revoked

In a 75-page decision delivered on August 11, FCC Administrative

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Law Judge Edward Kuhlmann ruled that RKO General "is unqualified to continue as a broadcast licensee."

Upon denying the company's renewal application for KHJ-TV in Los Angeles, Kuhlmann called for revoking RKO's licenses on its 13 other broadcast properties.

Kuhlmann accused the company of repeatedly lying to the FCC, falsifying documents, overcharging advertisers, and defrauding affiliates. He added that "no case ever before decided by this Commission presents dishonesty comparable to RKO's. There is not a single case of fraudulent business practices investigated and reviewed by this Commission which exhibits as many practices affecting as many advertisers over as many years."

The decision charges that RKO purposely submitted at least 30 false financial reports to the FCC from 1971 to 1975 that distorted barter and trade revenues for each station by as much as $400,000. In 1977, RKO estimated these errors to total $3.8 million, but Kuhlmann maintains that the true amount remains unknown because the company lacks documentation for many of the transactions.

Kuhlmann further noted that between 1979 and 1985, the RKO radio networks, under then president Thomas Burchill (now president of the Lifetime cable channel), practiced "unethical and dishonest business activities" that resulted in an estimated $5 million overcharge to advertisers.

He also charged company executives with attempting to cover up the destruction of an internal audit that found RKO to be in a "perilous position" with the FCC, IRS, and SEC—as well as misleading the Commission about an IRS probe into the company's business transactions.

RKO's president Pat Servodidio claims that Kuhlmann "refused to give weight to the extraordinary commitment and achievements of our stations to their mandate of public community service."

In addition to KHJ-TV, RKO's properties include: KHJ-AM, KRTH-FM (Los Angeles); WOR-AM, WRKS-FM (New York); WHBQ-TV, WHBQ-AM (Memphis); WRKO-AM, WROR-FM (Boston); KRFC-AM (San Francisco); WGMS-FM (Washington, D.C.); WGMS-AM (Bethesda); WFYR-FM (Chicago); WAXY-FM (Fort Lauderdale).

RKO has 30 days to appeal the decision, which is expected to go before the FCC Review Board before being voted on by the entire Commission. The company will retain all of its licenses until all appeals are exhausted.

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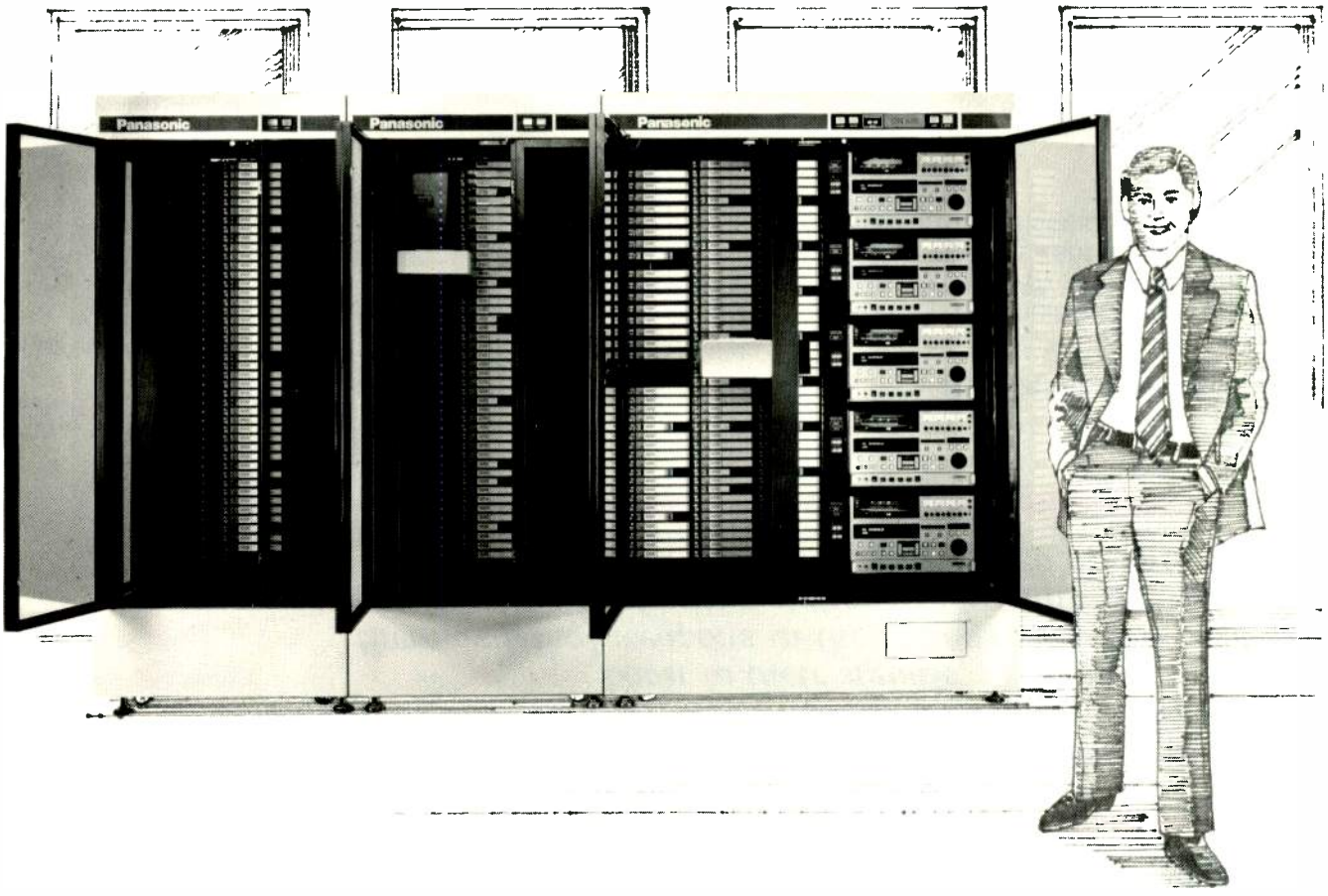

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THE POWER OF PROCESSING

Audio processors are standard fare in radio. Some broadcasters employ these devices to provide a healthy boost to their signals, while others see them as lethal weapons in the ratings war. How can processors help—or hurt—your station, and what's loudness got to do with it?

By Steven Schwartz

WLVE's chief engineer Roy Pressman stands by his Optimod 8100A, which is kept as a backup system for the station's processing chain.

Asking station engineers about their choice of processing gear can be like requesting Stealth bomber blueprints from the Pentagon. Most decline to get into specifics; some will only discuss a single component in their system. A few won't talk about it at all. The top secret status accorded most radio stations' audio processors is understandable, however, given the competitive nature of the business (where almost any advantage over "the guys down the road" is a closely guarded asset).

As the last link in the audio chain before transmission, processing plays a crucial role in the way a station presents itself to its listeners. Although each station strives for a unique balance of hardware and applied technique, most rely on three basic processor functions: compression/expansion, adding less effective gain for larger signals and more for smaller ones, respectively; limiting, which maintains consistency in the signal by keeping the output within selected parameters; and clipping, which increases signal density by chopping down peaks to a predetermined value. In addition to boosting the modulation level, combinations of these three processes can be used to significantly enhance broadcast material by adding differing amounts of loudness, brightness, and distortion. Hence, many stations credit their processor selection with providing a particular sound quality that distinguishes them from the competition.

Just how much processing is used depends on a station's format as well as its program and source materials; some may opt not to use it at all. Many classical music broadcasters, for instance, share the opinion that audio processing adds unwanted coloration to the music and are thus willing to sacrifice the added loudness for a purer signal. Conversely, most other commercial broadcasters—particularly those with rock 'n' roll formats—apply these black boxes as heavy artillery in the battle for dominance on the dial.

This is nothing new, of course. The concept of competitive loudness has been around since the early 1960s, when programmers first hit upon the notion that increased modulation levels yielded higher cumes. The legacy of that theory continues on today in the form of so-called loudness wars among FMer's in some highly competitive markets—although it is generally acknowledged that there isn't all that much bandwidth left for significant increases in modulation. Ironically, it was a very similar situation that many feel was a major factor in the decimation of the AM band.

That fact, as well as the popular impact of the compact disk, is causing some FM broadcasters to re-examine their processing priorities. At least that's the opinion of the major processor manufacturers, such as Texar's president Glen Clark, who sees the FM market "steering away from the loudness-at-all-costs philosophy to loudness without the expense to quality."

Clark maintains that was one of the reasons behind the 1981 introduction of Texar's Audio Prism, a discriminate audio processor with digital control of its compression/expansion functions. "The traditional analog processor will expand and compress," he explains. "When it stops compressing it starts expanding. Such continual gain reversals in analog processing is one of the leading causes of grunge and listener fatigue. The digitally-controlled processor, on the other hand, will expand, compress, and—when necessary—do nothing. The Audio Prism changes the gain only when the situation requires it. All those extra gain reversals don't contribute to the loudness; they only contribute to the grunge factor."

Loud and clean

The concept of digital control is apparently one that appeals to broadcasters. In New York City alone, Clark estimates that there are 22 Audio Prisms either on or feeding the antenna atop the Empire State Building. Two of those belong to WNEW-FM, a Metromedia station featuring a contemporary/classic rock format. In fact, the Audio Prisms were the only processors in the station that chief engineer Fred Moore would specifically mention.

"We've had our Texars for approximately three years," he notes. "The thing that I like best about them is that it's hard to make a Texar sound bad. I think that's one of the features that has made them so popular. They've also been extremely reliable; we've had virtually no down time on either one."

While he would not go into detail about the WNEW's processing chain, Moore emphasized that he does not use any equalization on the station's on-air McCurdy 8000 Series console. Mic processing is also left out of the picture. Rather, he points out his preference for Sennheiser's MD421 microphone, which has a roll-off control for range adjustments that can satisfy most situations where processing would have otherwise been required.

"We don't have any real black boxes hidden away anywhere," he says. "We try to do what we do with good sound engineering techniques. And that produces what we want in terms of audio here."

Nevertheless, Clark states that the Audio Prism is most commonly used by FM broadcasters in conjunction with Orban's Optimod 8100 and, depending on the situation, a quality clipping device. Moore remains firm. "I've used it with and without Optimods, as well as other transmitter devices," he says.

Despite the station's claim of having the world's largest record collection, Moore has seen a rapid increase in the number of CDs played on the air in recent

months. Still, he maintains that the station rarely changes the settings on its processors (aside from an occasional fine tuning) and never adjusts it for different audio sources. When he does tweak the processing, he will spend weeks listening to it on a myriad of sources. The final decision will usually rest on a high-quality receiver/speaker system—the rationale being, "if it sounds good on that, it should sound good on the others." Moore adds: "We try to be as consistent as possible. If you listened to WNEW last year and you listen again a year from now, you will hear a station that sounds very much the same. We don't make willy-nilly changes."

Although he insists that WNEW does not "tailor" its sound to cater to any particular segment of its listening audience, Moore admits that it is a common approach to programming in the New York area. He notes that ten years ago WPLJ (one of WNEW's major competitors) had a "tinny" sound that was designed to provide maximum loudness to listeners with transistor radios. Today, portable and personal stereo systems, car radios, clock radios—as well as hi-fi equipment in the home—are all potential vehicles for special processing treatment.

"You try to be aware of what that audience wants to hear," says Andy Butler, director of engineering for Emmis Broadcasting's New York stations WQHT-FM and WFAN-AM. "It is subjective to a certain extent, but you have to do it. For example, WQHT features an urban dance format aimed primarily at 18 to 24 year olds, male and female—primarily female. Consequently, we don't see our average audience listening on a home stereo system, at least it's not as likely as it would be with a rock audience. They're more likely to be listening on a portable stereo unit, a table radio, or a car radio. So, you have to be aware of how you sound on that type of receiver. It generally calls for a full, fat low end. And, to maintain definition against that fat bottom, it also requires pretty healthy presence equalization."

Terry Grieger, chief of engineering for Emmis Broadcasting, in the "wire room" at New York's WQHT/WFAN. To his left is the station's backup processing chain consisting of (from bottom) a pair of Orban Optimods, two Audio Prisms, an Eventide Digital Delay, and a CRL Spectral Energy Processor system.

Butler notes that since there is not a lot of contemporary dance music available on CD, the station relies solely on carts for its source material. ITC Series 99 cart machines handle the recording chores, while a combination of 99s and Delta decks are used for playback. The station's on-air studio is also equipped with an Auditronics 200 Series console, which is fed into a custom-built processor.

The processor's design allows the station to have all its various functions—compression, limiting, spectral tailoring, and stereo generation—contained within a single box. The approach affords easier control of the various processing parameters, and, according to Butler, actually makes the station sound better. He adds that the decision to originally go with a custom-made processor arose out of the specialized nature of the station's format. "We needed to go with somebody who was willing to work with the company in developing something that would meet our needs," he says. "We looked at a number of different processors, but we couldn't find anything that was commercially available that could have been altered to do what we wanted it to do for anywhere near a reasonable amount of money or labor."

The company also uses a custom processor on WFAN-AM, the nation's first all-sports talk radio station which made its on-air debut last July 1st. Here again, the decision to use an original processor design was based on the nature of the program material.

"A lot of AM processors have a rough time dealing with all-talk formats," Butler says. "They tend to be designed to concentrate more on music than voice. Besides the fact that the bandwidth is narrower, I personally feel it's a lot more difficult to achieve competitive loudness and density with voice programming—especially over a telephone—than with music. The waveforms are much more complex, insofar as the amount of transients and asymmetry involved. Call-in programs are really tough. Trying to maintain competitive density when you have a narrow band centered at 2200 Hz and significant signal loss is not easy."

Stretching the limits

Needless to say, the AM band has had its share of problems over the last decade—overcrowding, overmodulation, the battle between stereo formats, and an average bandwidth of just over 3 kHz on most receivers, to name a few. Finally, there's some good news: the voluntary NRSC (National Radio Systems Committee) standard approved last January. Sponsored by the NAB and the Electronic Industries Association (EIA) and made up of representatives from the major broadcast groups, receiver manufacturers, and broadcast equipment manufacturers, the NRSC's goal was to find a frequency response standard for transmitting and receiving AM signals that could be agreed upon by both broadcasters

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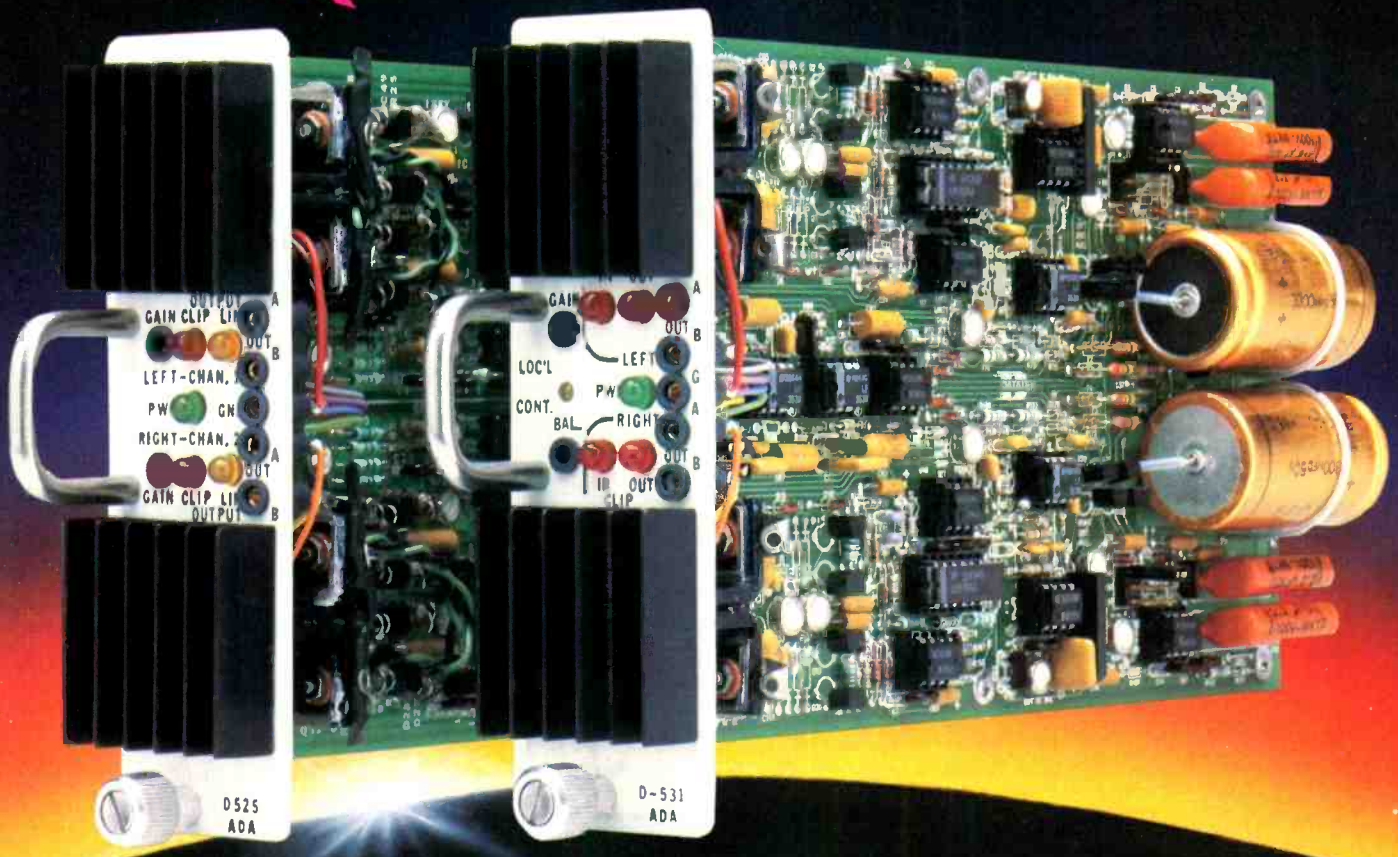

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and receiver manufacturers.

The compromise worked out calls for stations to use a modified 75 μs preemphasis curve in conjunction with a 10 kHz filter. So far, the 10 kHz filter has generated more than its share of concern within the industry, with opponents claiming that a 15 kHz filter should have been selected to achieve parity with FM. Those in favor of the NRSC's choice argue that the implementation of a true 15 kHz filter would have involved a most unfeasible requirement—reallocating the entire AM band.

One of the more outspoken critics of the standard is the Mike Dorrough of Dorrough Electronics (and the inventor of the discriminate audio processor), who sees the 75 μs preemphasis as "too demanding a curve that will change the timing of the harmonics" and perceives the 10 kHz filter as being "nonmusical." Nevertheless, the three processor manufacturers who participated in the NRSC—Orban, Texar, and CRL—are confident that the standard is workable.

"We gave a lot of thought to the curve. The NRSC filter is not a trivial engineering problem," says Glen Clark. "If you approach it with conventional methods—that is, pulling out the filter cookbook and taking it from there—then those accusations are correct. But I know that two of the manufacturers, including Texar, have already solved the problem, and we're quite pleased with the musical sound of it. But it wasn't easy. You have to be prepared to spend two months in the lab and to do some inventive techniques."

All three companies introduced new NRSC-compliant processing gear at this year's NAB convention, as well as economical retrofit kits and upgrades for older processors currently in use. "We've already converted 200 stations over to the standard," notes CRL's sales manager Bob Richards. "And I have another 500 postcards in my drawer from stations that have pledged to covert to the NRSC. We expect it to really turn things around."

Processing progress

Although it is extremely significant, the NRSC standard is not the only new development in processing these days. Orban's marketing and sales manager Howard Mullinack states that his company is currently pursuing two new areas of interest. The first is mic processing, as evidenced by the unveiling of the 787A programmable mic processor at NAB. Slated for shipping later this fall, the 787A features three-band parametric equalization, a compressor section, and a full-function de-esser to control excessive sibilance. Mullinack points out that whereas most announcers like to have their own mic processing setups, they can't always be trusted to reset the controls. Consequently, the major feature of this new unit is its 32 programmable presets with built-in security codes to prevent tampering.

The company is also looking into various ways of enhancing stereo imaging, which would be aimed primarily at CHR (contemporary hit radio) stations looking for a more impressive sound in the car. Mullinack notes that while progress is being made, there are still multipath problems to overcome, as well as an undesirable sacrifice of the mono (L + R) signal that results from the increasing of the L-R level.

Although "digital" continues to be a potent buzzword in the processing community, all of the major manufacturers predict that the digital processor (i.e., one that performs all of its processing chores in the digital domain) is still several years down the road. The general consensus is that the current cost of the technology is still too high to offer a significant improvement over analog processors.

Consequently, Texar's Clark takes a more cautious outlook on the future, maintaining that "it's going to be a game of inches from here on.

"When you think about the theoretical limits and you realize where we are right now, you see that Orban, CRL, and Texar are all playing with the same laws of physics. And, when you realize that we're all working within the same limitations, you then realize that there just isn't that much more that any of them can do as far as the quantum leap is concerned."

Instead, he suggests that "cleanness" is the big news in the major markets. "Make sure you've got a clean exciter. Clean up the studios, get rid of your turntables

Zeeco Corp.'s WQIO-FM, Mount Vernon, OH, became the first American broadcasters to use DAT on the air. The station is using five Sony DTC-1000 ES decks.

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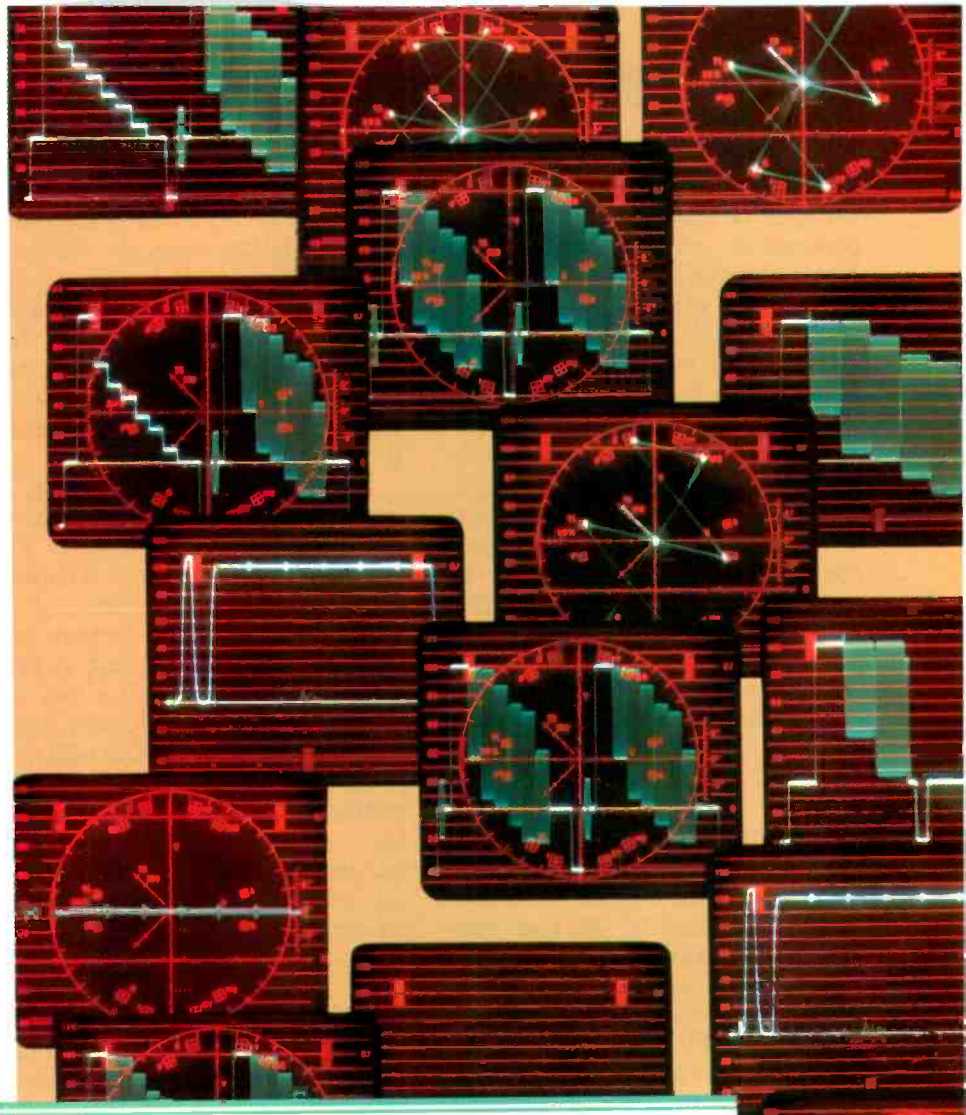

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and cart machines—go with digital tape or CDs. I think that the processing situation is pretty static and the limiting factors are some place other than with the processors. By that, I mean the exciters in the studio or the source material."

CRL's Bob Richards, meanwhile, looks to the CD to provide the momentum for his company, and notes the recent introduction of two new "digital-friendly" processors specifically tailored to compliment the high dynamic range of the CD. "We feel these products offer the lowest distortion of any product we've ever built," he says. "They've both been designed using the compact disk as source material in our lab."

The line consists of the new Stereo Gain Controller, a dual-band AGC with 9 dB of gain reduction and .15 percent of IM and harmonic distortion, and the SMP-850 limiter, a transfer function limiter that was originally developed for the TV market, featuring three-band limiting for true high frequency reproduction without causing depression of the midrange.

"Traditionally, music that was broadcast over the radio with processing usually sounded better than what the consumers played themselves at home," he says. "But with the compact disk that's changing; CDs sound better than the radio. So, from a processing point of view the question is: how do you broadcast that improved sound without degradation?"

Back in the trenches

Roy Pressman, chief engineer at Miami's WLVE-FM, takes issue with the first part of Richards' observation.

"I don't agree with that simply because of the number of active stages that you have to go through to get to the end user's radio," he says. "I think it's almost an impossibility for it to sound any better than the record. When you play a record, you're going to be dealing with optimal signal-to-noise, minimum distortion, minimal phase shift, and I just don't think there's any way, at this point, to be competitive and have it sound better than the record. I think some people may have the misconception that just because there's a little AGC on there that it may sound better to them, but to my ears, the record is always what we're trying to get the radio to sound like."

Nevertheless, Pressman is quick to acknowledge the superior audio performance of the CD. The flagship station for Gilmore Broadcasting, WLVE features an adult contemporary format and was the first in its market to play a compact disk over the air; the digital sound source now comprises 80 percent of the station's programming. The station's commitment to quality audio is further evidenced by its choice of hardware, which includes an a digital STL and a state-of-the-art on-air studio highlighted by a Pacific Recorders & Engineering BMX III-22 audio console, three Philips LHH 2000 CD players, six ITC Series 99 cart decks with dbx noise reduction, and JBL 4411 speakers.

For processing the console output, the station relies on custom-built triband AGC and FM limiter components, as well as a commercial stereo generator with some built-in composite clipping (an Orban Optimod 8100A is kept on hand as a backup processor). The on-air studio also includes three ADR mic processors used in conjunction with the station's selection of Neumann U87, U889, and TLM microphones.

Despite the station's array of processing gear, Pressman practices caution in applying it to the signal: "I think the best compromise is to use everything in moderation—a moderate amount of compression and limiting and enough clipping so that you're competitively loud—rather than just going for broke with an awful lot of everything. There's also a detrimental effect when there's too much processing. A CD will usually sound a lot louder than an LP or a cart because all the dynamics and transients are there. It punches through a lot better.

"It all boils down to one thing," he explains. "That is, as long as you're as competitively loud with your competitor, you're fine. If you're the lowest thing on the dial, there's a possibility that your listeners will not hear you. But there has never been a study conducted that I know about that says because a station is louder it gets better ratings. It's kind of a shame, too, because if you ever take a CD and play it directly into the exciter without any processing at all—other than some preemphasis, obviously—and listen to it back on a good stereo, you wouldn't believe how good it sounds. It's simply amazing. Unfortunately, the volume of everything else on the dial just buries it."

Although the CD seems destined to be a permanent fixture on the broadcast landscape, many programmers are now looking once again to the Far East in anticipation of the arrival of digital audio tape (DAT) recorders, which offer the same high-end specifications as the digital disk packed into a downsized cassette with up to two hour's worth of playback/recording time.

For Zeeco Corporation's WQIO-FM in Mount Vernon, OH, the future has already arrived. When the station commenced broadcasting last June 29, it also became one of the first American broadcasters to use the DAT format on the air. WQIO presently has five Sony DTC-1000ES decks, which, according to chief engineer Rick Cruz, provide the station with 60 percent of its programming (15 percent is reserved for CDs, while the remaining 25 percent is handled by ITC Delta cart machines).

Although Cruz says that he signed a nondisclosure contract and is bound by it not to reveal any of the components in the processing chain, he notes that the station currently uses seven different processors in its system. "I should emphasize that we do not overprocess our signal," he says. "We have such control over our parameters that we can virtually cross our lows, mids, and highs over to any frequency we desire."

He admits, however, that when the station first started using the processing with its DAT and CD sources, they experienced a lot of splash on the high end. This was ultimately eliminated via a crossover/EQ combination used in conjunction with the limiter/compressors. Cruz adds that a "couple of units in the limiter/compressor category" also had to be modified simply because they were acting too much like a machine. "When the music came to a quiet passage you could just hear the compression kick in, even when we had the compression settings turned all the way down," he explains.

The station keeps two DAT machines in its production suite and another two in the on-air studio which are fed into a 12-channel Logitek Perfectionist console; the fifth DTC-1000ES deck is kept as a backup unit in the event that one of the other machines breaks down. WQIO also intends to become the first station in the U.S. to give away a DAT recorder to one of it listeners during the week of September 17th as part of a local promotion campaign with Coca-Cola and McDonald's.

Cruz mentions that the DAT machines have an approximately 5 dB louder output than some of the station's other source machines. However, the difference was sometimes masked by some of the processing circuits designed to enhance stereo reproduction or stereo tracking. "It just sounded like it was being processed too much," he says. "And that's not what we wanted—especially with the DAT technology. We wanted people to notice the difference between a Delta Scotch cart and a digital tape."

Obviously, the importance of high-quality source material and machines cannot be overlooked in any discussion about audio processing. Thus, WLVE's Roy Pressmen offers this bit of advice for stations looking to overhaul their processing gear: "The conclusion that I've drawn over the years is that the most critical thing to a station's success is program and source material. This is where a lot of stations run into problems. They run out and buy everything they can find, do everything they can to beat the guy down the road. The problem is they may not have a good tape transfer system, they may have lousy turntables and old carts. It comes down to the universal law—garbage in, garbage out. And if they're using this stuff while the competition is using CDs, they still stand to lose because the audio signal going into those audio processors has got to be perfect.

"It's really easy to go out and buy a new piece of processing gear. But tell someone they have to recart 800 songs and see what kind of reaction you get. You know, you can shine the paint on that car all you want, but if the engine is out of tune, you're not going to beat the other guy." **BM/E**

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Microphone Techniques for MTS

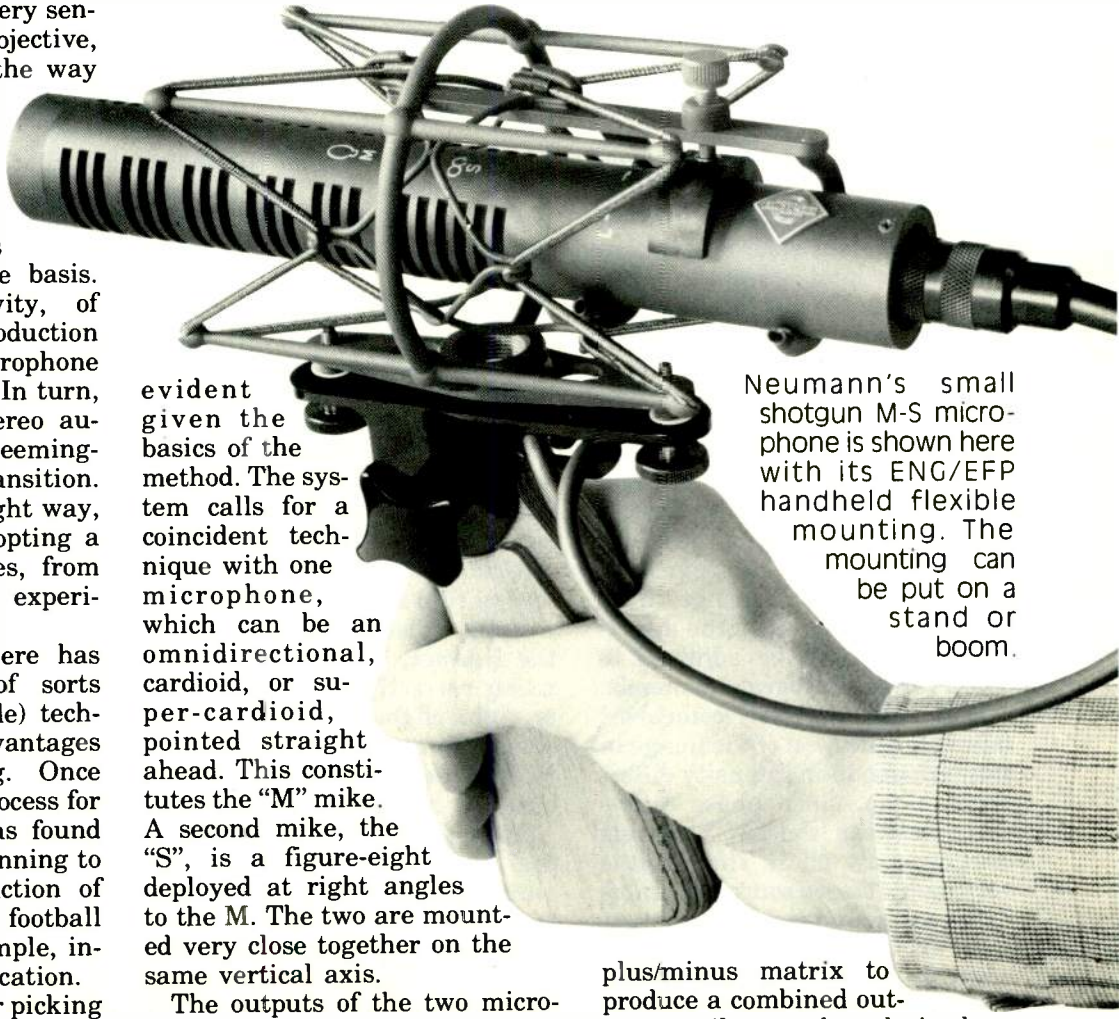
In the last few years, television audio production capabilities have improved due to the demands of Multichannel Television Sound. In keeping with this development, microphone techniques are evolving as standards are being set.

By Robin Lanier

The human ear is a very sensitive, but quite subjective, instrument. Since the way we hear recorded material is based, to a great degree, on the placement of microphones in recording an event, the resultant stereo sound is analyzed on a subjective basis. Such built-in subjectivity, of course, leads the audio production people to approach microphone use in a variety of ways. In turn, this condition causes stereo audio production to be in a seemingly perpetual state of transition. There is, therefore, no right way, and broadcasters are adopting a wide range of techniques, from standard procedures to experimental tactics.

Recently, however, there has been a consolidation of sorts around the M-S (mid-side) technique due to its many advantages for stereo broadcasting. Once thought of as a special process for music recording, M-S has found new territory and is beginning to take hold in the production of sports telecasts. HBO's football pickup strategy, for example, incorporates the M-S application.

The M-S advantages for picking up sound at such venues becomes evident given the basics of the method. The system calls for a coincident technique with one microphone, which can be an omnidirectional, cardioid, or super-cardioid, pointed straight ahead. This constitutes the "M" mike. A second mike, the "S", is a figure-eight deployed at right angles to the M. The two are mounted very close together on the same vertical axis.



Neumann's small shotgun M-S microphone is shown here with its ENG/EFP handheld flexible mounting. The mounting can be put on a stand or boom.

The outputs of the two microphones are then sent through a plus/minus matrix to produce a combined output, similar to that derived

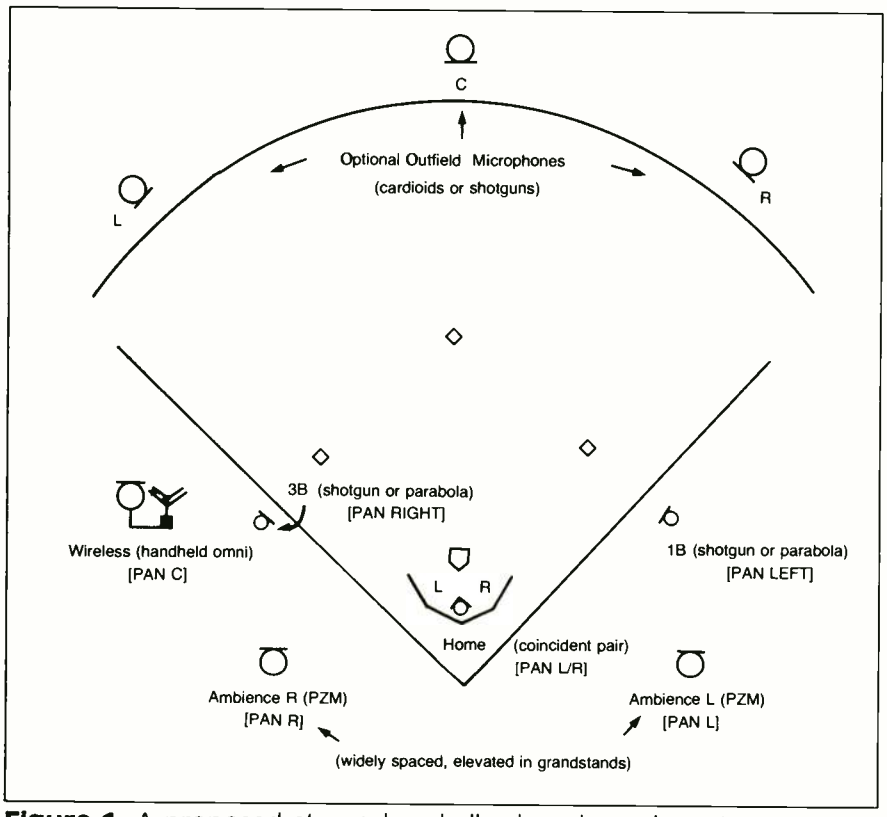


Figure 1: A proposed stereo baseball microphone layout.

from an X-Y microphone combination. Sounds originating on the left are localized to the left side, and right-side originating sounds are localized to the right. The M+S in the matrix comprises the left side, while the M−S makes up the right.

An additional feature of the M-S technique allows some fine control of the sound image. By adjusting the ratio between the amplitude of the two outputs, the stereo reception angle and the width of the stereo image can be manipulated over a wide range, from narrow to broad. Also, the direct-reverb ratio can be adjusted to suit a range of program demands.

With the use of coincident mikes, localization of the image in stereo depends on intensity differences alone, since phase differences between the two channels are extremely small. The result is very stable stereo source locations (left, center, and right). The treatment of ambient sound is thus quite realistic. Ambience from all directions is in phase in the two channels, but its directions are correctly reproduced, providing an even spread from left to right, producing a sound free of false coloration.

M-S applications

Of primary concern in sports pickups, like baseball or HBO's football telecasts, is the ability of M-S to put both the announcer and the events in front of the camera, squarely in the center of the sound image. Of course, this positioning has been found to be critical both to stereo television and to film in order to avoid disturbing "dislocation" effects on the listener. With the main elements correctly in the center, left or right of the sound image, the events obtain a strong feeling of reality. (See Figure 1 for proposed baseball microphone placement).

Such an effect is enhanced by the ambient crowd noises that seem to surround the listener as if he were in the stands. It is this combination of effects that has long made stereo sound in sports television popular in Japan, and it is now beginning to do the same here.

There has been concern expressed about stereo television for those viewers who are still restricted to receiving mono sound. Here again, the M-S technique scores. MTS, of course, gets its mono by adding left and right channels together. If the pickup method employs M-S miking, that means M+S is added to M−S, and the S, or side, mike output simply cancels out. The straight pickup from the M mike is the perfect mono.

In addition, with this M-S mono configuration, the ratio of reverb to direct sound is reduced (reverb is largely in the S channel). This is fortunate since listeners are often disturbed by high reverb in mono sound since it confuses their perception of the material. While, on the other hand, reverb in stereo is acceptable, often desirable, because the hearing system gets double cues and can zero in on the program material.

The effectiveness of M-S seems evident from the information presented. The industry, as noted earlier, is still in a transition stage, however, since there are many engineers who were "raised" on multiple microphone techniques for picking up large crowds. Many of them continue to use that method of feeding stereo television. Even with their high skill level, it takes careful readjustment, mike shifting, and amplitude balancing to get a good sound. This is further complicated by the necessity for getting a good mono sound, requiring further adjustment. So the ease of use would seem to be an advantage.

Complaints persist, however, regarding the M-S technique. The subjectivity alluded to earlier plays a part in perceptions of M-S not yielding a strong stereo. It's possible that those who are used to multiple microphone stereo, with its large phase differences,

About the Author:
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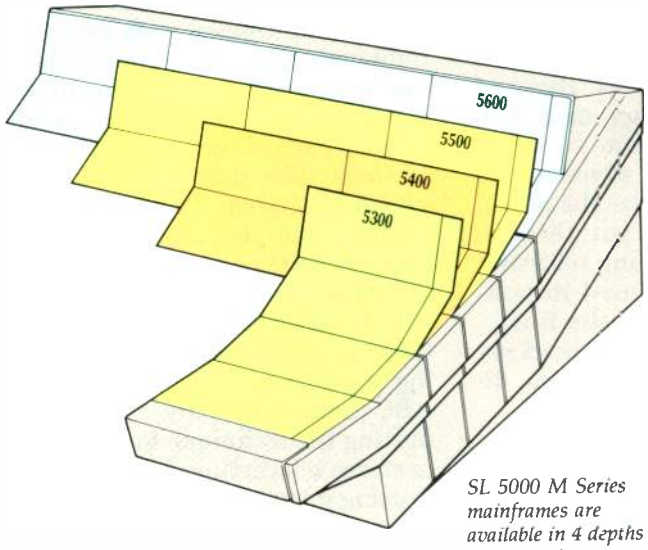

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are conditioned to the inherent wide, reverberant kind of stereo produced by multiple miking. There is less stability of localization in this method than occurs with coincident miking (localization tends to be especially poor in the center).

Advanced hybrid methods

In popular music, multiple mikes will probably always be used since the objective is not to get the most natural sound, but to achieve an unnatural emphasis on part of the sound. The method is also very attractive when large musical ensembles—opera, symphony, chorus—must be picked up. It is tempting to be able to stick a mike in front of some element that is weak.

It is possible, however, to combine M-S with multiple mikes in an advanced stereo pickup technique. This hybrid method was used by CBS during its coverage of the last Super Bowl game. The manner of deployment included a number of M-S assemblies at different locations to assure pickup of scattered events throughout the stadium. An elaborate mixing system allowed the emphasis to shift as needed.

Further combining the attributes of each system, CBS added a third, separate channel by combining the two accounts of the ambience. The three channels were then encoded into Dolby stereo, which allowed them to be broadcast over two MTS channels. Viewers with Dolby decoders could create a third playback channel with additional speakers at the rear for a "surround sound" effect. The third channel had no affect on receivers without the decoder; mono and stereo were handled as in normal MTS, but listeners with decoders could get an even stronger sense of being in the stadium.

In keeping with the evolving nature of stereo television, then, M-S demonstrates the potential for a variety of future developments. This is due, in part, to its great flexibility in standard procedure as in its use for movie sound and videotaped programs.

For example, Jerry Bruck, president of Posthorn Recording in New York, and an independent recording engineer, was consultant for sound recording in the motion picture *Fame*. The movie depended heavily on excellent projection of music, an element of the picture that later received critical acclaim. Bruck used M-S techniques throughout. In doing so, however, he took advantage of the system's flexibility: the M and S signals were not put through the matrix before being recorded, but the matrix was used in post-production to produce the final.

As with broadcast programs, dialog and many single events must be strongly centered in film, and Bruck could do this instantly, as required, by closing the stereo angle to a tight focus. On the other hand, when a large musical group performed, or there was a crowd scene, the stereo perspective could be opened wide. The stunning result was that the picture gained tremendous power in presentation. Bruck has used M-S for sound recording in many other assignments, including a video produced for release to television of Vladimir Horowitz.

The music connection

Another New York independent, Bob Katz, has used M-S as the preferred pickup technique on many assignments, one of which was for a recent video special. The piece was a history of jazz called *Trumpeting* with the trumpeter Wynton Marsalis as star and host. The program included both recorded and live segments, incorporating a number of mono sources of historical jazz.

By recording the M and S signals separately and setting the stereo perspective in post-production, Katz was able to match the spread to the highly variable conditions encountered with the different source material. He could get excellent stereo with just the right spread in live segments, but was able to reduce the spread to match the ambience and general effect of each of the recorded mono portions. The sources, of course, varied to a great extent in their quality, and the use of M-S allowed Katz to produce a more unified type of sound.

Independent engineers and CBS are not the only ones exploiting the possibilities of M-S. Both ABC and, especially, NBC are putting the technique to some use in stereo telecasting. PBS, as well, is using it extensively to feed television affiliates via the organization's satellite network. If current trends continue, it seems fairly sure that M-S will be the predominant mike technique for stereo broadcasting of live material in the future. As the technique finds its way into more recording situa-

The RSM 190 microphone system from Neumann includes a short shotgun assembly with the two mikes inside the housing, as well as a small, easily portable matrix.

tions, it will reach broadcasters second hand as finished program material.

Some additional attractions of M-S should be noted. A critical advantage is that, unlike X-Y stereo miking systems, the main sound does not come in off-axis to the microphones. Since microphones tend to add false color to off-axis sound, a system that greatly reduces off-axis pickup has an advantage in fidelity.

An important characteristic of the stereo effect in M-S is that it does not diminish when the sound sources are far away from the mike. In phase-difference oriented separate miking, events very close to the mike tend to have exaggerated separation, while those far off tend to lose any sense of separation.

Further, there is a great physical advantage in the fact that a single mike assembly, which can be mounted on a single stand or boom, is a complete stereo mike system. One assembly is a lot easier to handle than two, not only to carry to the appropriate spot, but also to set up for the right sound balance. One disadvantage to be noted in the M-S system is the presence of an additional unit, the matrix. Yet, the matrix can be left behind and employed during post-production.

The equipment connection

Those interested in stereo production and the M-S technique quite naturally wonder what equipment is available. Any two high-grade mikes, one of which is a figure-eight, can be assembled into an M-S pair. They must be quite close together, so small size is an advantage. There are, in addition, a number of manufacturers making complete pairs, with mountings especially designed to hold the two mikes extremely close and lined up vertically. It is probably better in most cases to buy an assembled pair than to use a homemade mounting, which would require expert work on a machine tool to obtain the mounting required.

Prepared microphone pairs are offered by, among others, AKG, Schoeps, Neumann, Sanken, and, most recently, by Fostex. It seems likely that as the popularity of M-S spreads there will be more ready pairs on the market. Still, those now available are of a very high quality, reflected, of course, in their prices.

Acquiring the microphone

This matrix for M-S, made by Audio Engineering Associates, can be used to feed the M and S signals directly to tape. It can also produce the left and right active channels.

pairs, then, is straightforward. The matrix, on the other hand, may prove more difficult to come by. There is a matrix with an excellent reputation, the MS-38, made by Audio Engineering Associates of Pasadena, CA. Wesley Dooley, a principal of that company, and his associate Ronald Streicher have been important ambassadors for the M-S technique. Their 1982 paper on the topic for the Audio Engineering Society (AES) was an intensive treatise and has become the standard background source.

Another AES paper ("Stereo Microphone Techniques for Broadcast"—AES pre-print #2146), this one prepared by Skip Pizzi of National Public Radio, describes M-S applications in considerable detail and includes the schematic of a "homemade" matrix (see Figure 2). His main conclusion: M-S is the best technique available, with the enhancement of additional M-S mikes when necessary to fill holes

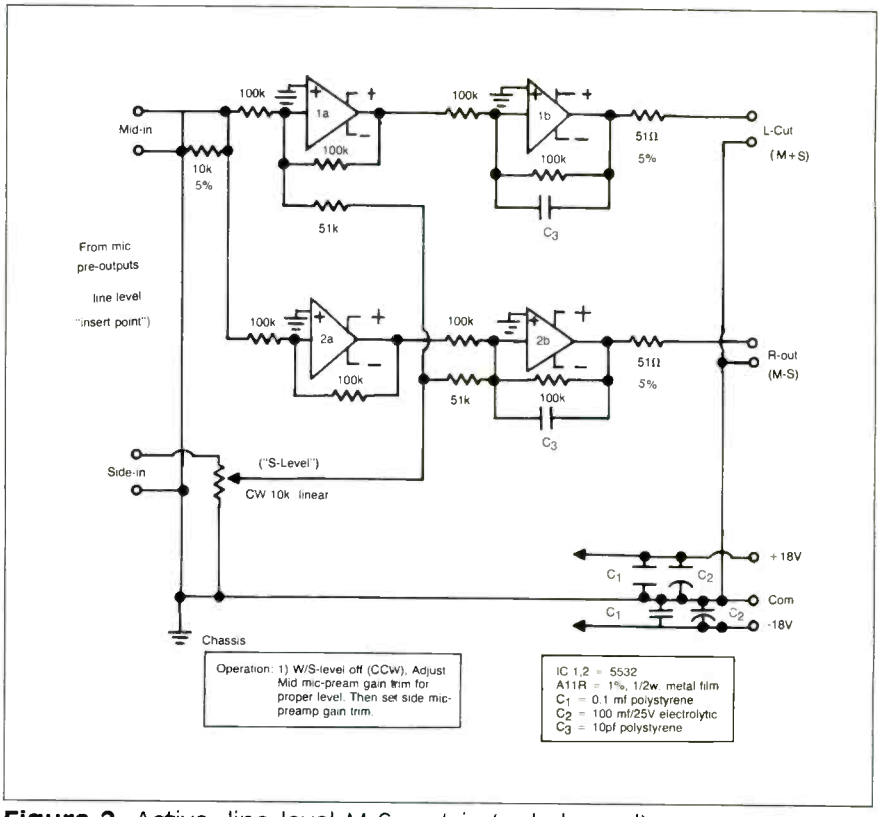


Figure 2: Active, line-level M-S matrix (unbalanced).

or strengthen the ambience, for broadcasting or recording large musical groups.

Exploiting the flexibility of M-S with a new system, the RSM 190, is Neumann (distributed by Gotham Audio in New York). Describing the new mike pair: the M is a short, shotgun design, and the S mike is a figure-eight as required. Neumann is targeting its device at the studio and location applications in which M-S has proved itself as well as, surprisingly, the ENG/EFP markets. The system includes a portable matrix, so that the stereo perspective and the direct-reverb ratio can be set over a wide range on the job. For a location shot that has high noise or excessive ambience, the S mike output relative to the M mike can be sharply reduced, with the shotgun providing a long reach. When a wide stereo image is wanted, that is, of course, instantly available. The system switching allows the M and S outputs to be recorded without going through the matrix so that perspective can be adjusted in post-production, if desired.

The system takes advantage of the compactness and adjustability of M-S to provide an easily obtained field stereo under extreme conditions. Engineers who have made preliminary use of the RSM 190 at airports, in street scenes, inside a large market, and in other typical difficult locations have given it positive reviews.

Audio Engineering Associates also makes a unit, the MS-380, that combines the matrix with two high-quality mike preamps as well as very flexible switching and connection systems. The total effect is to make M-S useable, not only in broadcasting, but in recording, motion picture sound, and sound reinforcement.

Another complete M-S system recently on the market is from the Fostex Corp., and is interesting for its own reasons. It is considerably less expensive than most of the other systems mentioned, in line with the well-known effort of Fostex to widen the market for broadcast equipment. The microphones use the ribbon magnetic system that Fostex has been marketing in its separate microphone units. The diaphragms are thin plastic with a kind of printed circuit "coil" on each . This provides many of the excellent qualities of the ribbon mike, while providing much higher inductance and output in the "coil."

In the Fostex system, the M mike is a cardioid, and the S a figure-eight. A matrix is part of the system. The appearance of this system can be regarded as evidence that M-S microphone techniques are here to stay. Professionals in broadcast and recording, as well as the small studios have found its flexibility and accuracy to be the solution to the missing link in the evolution of stereo sound. **BM/E**

PSYCHO-ACOUSTICS:

The Science of Sound Perception

Part IV

Combination Tones and Harmony

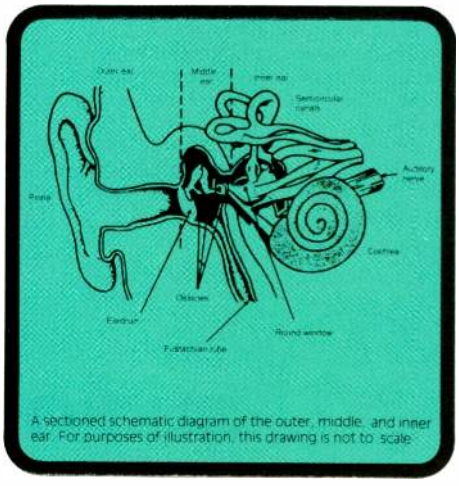
Paul B. Christensen, Chief Engineer
WIVY-FM, Jacksonville, FL

In wrapping up this series, we will focus our discussion on the various effects that can occur when two or more tones reach each other simultaneously. We will discuss: two tones with the same frequency, and then proceed to two pure tones of different frequency, and, finally, complex tones and chords.

Linear combination

A linear system is one in which doubling the driving force doubles the response. If two driving forces are applied to a linear system simultaneously the response will be the sum of the responses to the driving forces individually (i.e., the response of the system to one driving force is not affected by the presence of the second one).

The terms *linear* or *linearity* are often applied to audio and radio frequency amplifier systems. A loudspeaker with a linear response, for example, will reproduce the sound of a flute and at the same time, and quite independently, will reproduce a piano sound when presented with driving forces characteristic of each instrument. If the loudspeaker were not completely linear in its response, one signal would influence the other. This effect is known as intermodulation distortion. In order for a loudspeaker to radiate a pure tone, its cone moves in and out with a motion that is essentially *simple harmonic motion*. How does a loudspeaker cone move when two tones are radiated? If its response is linear, its motion at any time will be the linear addition of two simple harmonic motions.



A sectioned schematic diagram of the outer, middle, and inner ear. For purposes of illustration, this drawing is not to scale.

Pure tones with slightly different frequencies: beats

A pure tone is a sound wave with one frequency. The superposition (combination) of two pure tones proceeds in the same way as the superposition of two simple harmonic motions. If the tones have the same frequency, the resultant amplitude will be somewhere betweeen $x+y$ and x-y (or y-x, if y is greater than x), depending on their phase difference. We usually refer to a pure tone as a *sine wave*.

If two pure tones have slightly

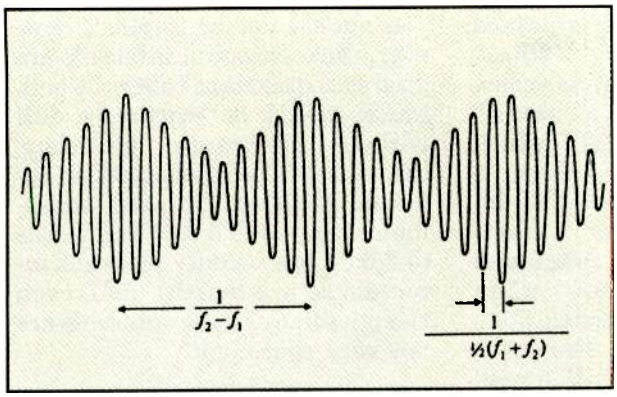


Figure 1: Waveform with beats due to pure tones with frequences f_1 and $f_2 = f_1 + df$.

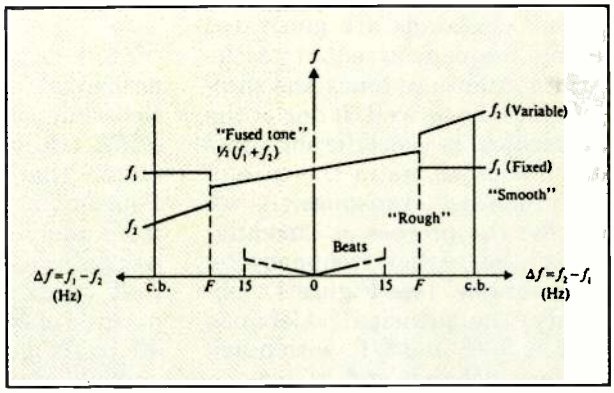


Figure 2: Representation of frequencies heard when pure tones of frequencies f_1 and f_2 are combined.

different frequencies, f_1, and $f_1 + df$, the phase difference 0_y-0_x changes continuously with time, and so the amplitude of the combined tones change also. The amplitude of the resultant varies between $x+y$ and x-y at a frequency, df. These slow periodic variations in amplitude at frequency df are termed *beats*. If the amplitudes x and y are equal, the resultant amplitude varies between $2x$ and zero.

In the case of two pure tones of slightly different frequency, linear superposition detected by our ears leads to a sensation of audible beats at the *difference frequency*, df. These beats are heard as a pulsation in the loudness of a tone at the average frequency $f = \frac{1}{2}(f_1 + f_2)$. An example of beats is shown in Figure 1.

As long as the frequency difference, df, is less than approximately 10 Hz, the beats are easily heard. When df exceeds about 16 Hz, the beat disappears and takes on a roughness. As df increases still further, a point is reached at which the "fused" tone at the average frequency gives way to two tones, still with roughness. The respective resonance regions along the basilar membrane are now separated sufficiently to give two distinct pitch signals, but the excitation corresponding to the two pitches still overlaps to give an effect of roughness. When df exceeds the width of the critical band (see "Psychoacoustics—Part III: Loudness, Sound Pressure, and Power," *BM/E*, April 1987, p.49), the roughness disappears and the two tones begin to blend (see Figure 2).

The limit of pitch discrimination or "fusion frequency," the point at which the single fused tone changes to two tones, varies with the center frequency in a manner somewhat like the critical band. It varies from about a semitone at 400 Hz to more than a whole tone (below 250 Hz and above 3500 Hz), but is always less than the critical bandwidth. At the same time, it is five to 30 times greater than the just-noticable difference (jnd) for frequency.

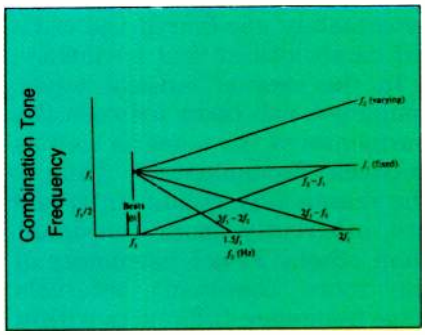


Figure 3: Most influential combination tones for a two-tone presentation consisting of one fixed frequency f_1 and one of variable frequency f_2.

Beats can also be heard when tones of slightly different frequencies are presented separately to our two ears; these are termed *binaural beats*. These are quite difficult to detect and are best heard with f_1 around 400 Hz and df in the range of 7 to 18 Hz. When df is less than 5 Hz, the beat changes to a *rotating tone*, a tone that seems to move around the inside of the head.

Combination tones

When two tones are sounded together, a third lower tone is frequently heard. This undertone is usually called a *difference tone* or *Tartini tone*, named after the Italian violinist Tartini who discovered it around 1715. If the two tones have frequencies f_1 and f_2, the difference tone, which is the most common example of a combination tone, occurs at a frequency f_1-f_2 or f_2-f_1.

Other combination tones that can be heard have frequencies given by $2f_1$-f_2 and $3f_1$-$2f_2$. The $2f_1$-f_2 tone, called the cubic difference tone, may be detected at stimulus levels as low as 15 dB, but is heard only in a limited frequency range below f_1. Another member of this class of combination tone that can be detected, although with some difficulty, is $4f_1$-$3f_2$. It is interesting to note that these combinations are the same frequency groups that manifest as *intermodulation distortion*.

Various combination tones are shown in Figure 3. This graph is somewhat an extension of Figure 2, for which the covered difference $df = f_2$-f_1 was small.

Modulation of one tone by another

Closely related to combination tones is *amplitude modulation*, a term most of us are familiar with. To briefly review, when vibrations occur at two different frequencies in a nonlinear system,

various sidebands are generated having frequencies equal to the various difference tones and summation tones as well. If one of the frequencies is considerably less than the other, as in the case of AM broadcast transmission, we describe the process as "modulation of the higher frequency by the lower one" (see Figure 4). Obviously, the principal sidebands occur at f_2+f_1 and f_2-f_1, with much smaller sidebands at f_2-2f_1, etc. In the case of pure tones, they are not usually heard as separate tones but as components of a complex tone.

Consonance and dissonance

The ancient Greek mathemetician Pythagorus is considered the discoverer of the fact that the tones produced by a string vibrating in two parts with simple length ratios sound harmonious. These ratios are commonly known as the "perfect" intervals of music, which are considered to have the greatest consonance. In 1638, Galileo reported: "agreeable consonances are pairs of tones which strike the ear with a certain regularity; this regularity consists in the fact that the pulses delivered by two tones in the same time, shall be commensurable in number, so as not to keep the eardrum in perpetual torment, bending in two different directions in order to yield to the ever-discordant impulses." The most consonant music intervals are largely considered to be the following:

2:1 Octave (C/C)
3:2 Perfect Fifth (G/C)
4:3 Perfect Fourth (F/C)
5:3 Major Sixth (A/C)
5:4 Major Third (E/C)
8:5 Minor Sixth (A'/C)
6:5 Minor Third (E'/C)

In 1877, Helmholtz explained consonance by referring to Ohm's acoustical law (see "Psychoacoustics—Part III: Pitch and Timbre," *BM/E*, July 1987, p.29), which stated that the ear performs a Fourier analysis of sound, dividing a complex sound into various partials. Helmholtz concluded that dissonance occurs when partials of two tones produce 30 to 40 beats per second. The more partials of one tone coincide with partials of another tone, the less chance of beats will occur in this range that produce roughness. This explains why simple ratios define the most consonant intervals.

Recent studies have revealed that in the case of two pure tones, the frequency differences, which determine consonance and dissonance vary with frequency:

1. If the frequency difference between two pure tones is greater than the critical band, they sound consonant. If it is less than the critical band, they sound dissonant.
2. The frequency difference that gives maximum dissonance is approximately one-fourth the critical bandwidth at that frequency.

In the case of musical tones, roughness can occur between the harmonics of the tones as well as between fundamentals. This is the reason why certain intervals are inherently more consonant than others. Fewer harmonics of the more consonant intervals have frequency differences within the roughness range.

Figure 5 shows the expected dissonance between two tones, each having six harmonics, making the assumption that dissonance between various harmonics are additive.

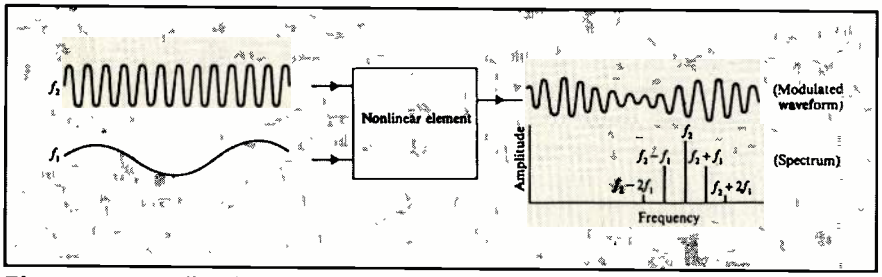


Figure 4: Amplitude modulation of one vibration by another in a nonlinear element.

It should not be implied, however, that consonant intervals are good and dissonant intervals bad. Music would be extremely dull without dissonance; musicians can make a concise distinction between pleasantness and consonance. Sixths (5:3,8:5) and thirds (5:4,6:5), are usually pleasant intervals as are fourths (5:4), even though some of these intervals are not very consonant.

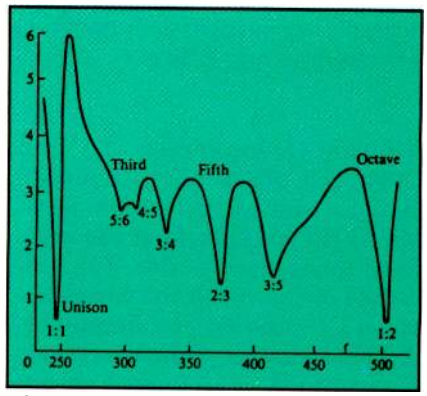


Figure 5: Dissonance expected from tone A with f=250 HZ and tone B with varying frequency.

The effect of phase on timbre

Even though Helmholtz felt the influence of phase between harmonics to be very small, he did realize exceptions in the case of "musical" sounds. Experiments by R. Konig using siren discs, indicated that timbre has some dependence on phase. Using an electronic function generator, J. Licklider noted that changing the phase of a high-frequency component has more effect on timbre than changing the phase of a low-frequency component.

In 1970, R. Plomp summarized the most important results of his experiments conducted with H. Steeken on phase and timbre:

1. The maximum effect of phase on timbre is the difference between a complex tone in which the harmonics are in phase and one in which alternate harmonics differ in phase by 90 degrees.
2. The effect of lowering each successive harmonic by 2 dB is greater than the maximum phase effect described above.
3. The effect of phase on timbre appears to be independent of the sound pressure level and

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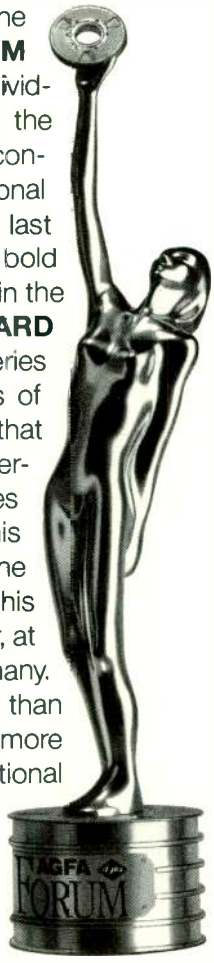

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spectrum.

Figure 6 shows how changes in the relative phases of the components can change a waveform. The components in this case, are harmonics 5 to 10 of a 200 Hz fundamental, and pronounced peaks result when they are all in phase. These peaks contribute a sense of harshness to the sound.

The mechanism for phase perception is not clearly understood at this time. J. Goldstein constructed a theory that explains certain experiments on phase perception on the basis of the ear's limited frequency resolution. When two or more spectral components lie within a critical band, the ear is not able to resolve them, so it finds clues from the time envelope.

Whereas the effect of phase on timbre is small for steady tones, the ear is very sensitive to *changes* in phase, especially if it takes place at a regular rate. This phenomenon is known as *second-order beats*.

Beats of mistuned consonances

Many researchers, including Helmholtz and Plomp have discussed the pheomenon of second-order beats. They are described as variations in timbre, changes in loudness of one or both constituent tones, and they are quite prominent even at low sound levels. Second-order beats between mistuned consonances can be heard up to about 1500 Hz, depending on the sound level.

In the case of a mistuned octave, envelope changes as large as 13 percent occur that correspond to variations in sound level of approximately 1.5 dB, too small to account for the prominent beats that are heard. Presumably, the beats of mistuned consonances are related to periodic vibrations of the waveform. With the philosophy of modern auditory theory, it would appear that the beats are due to the periodicity of nerve impulses. Nerve impulses are generated when the displacement of the basilar membrane passes a certain critical value, and therefore, slow variations in the time pattern of the impulses.

Beats of mistuned consonances have been used by piano tuners to tune fifths and fourths on the piano.

When the two interacting tones include harmonics, ordinary first-order beats can occur between various harmonics.

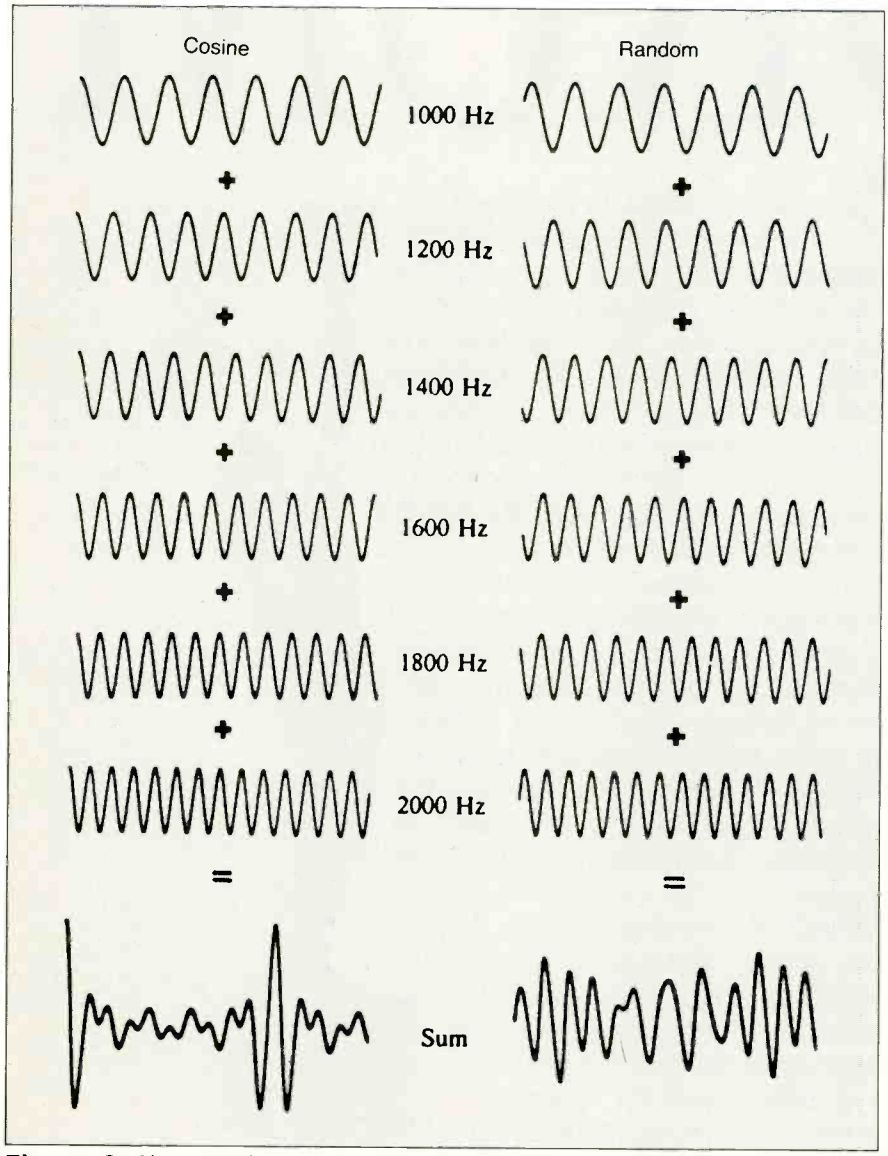

Figure 6: Changes in relative phases of components can change the waveform itself.

Autocorrelation and cross-correlation

The foundation of the physical and psychological interpretations of sound rests in the nervous system. The basic building block of the nervous system is the *neuron* or nerve cell, which transmits and processes neural impulses. The neuron has receptors called *dendrites*, which receive information and *axons*, which transmit information to other neurons. The "schematic" among our more than six billion neurons, which determines which neurons receive pulses from which others, is the key to human intelligence. Even though much of this scheme is fixed in the cerebral cortex, the interconnecting of neurons is the result of repeated stimulation patterns, which leads to *learning*.

It is possible to attach small electrodes to nerve fibers and observe the rate of neural impulses. Some neurons generate pulses spontaneously at a certain rate that can be either increased or decreased in accordance with the

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pulses received from other neurons.

A given auditory nerve fiber carries two types of data:

1. The fact that the nerve is firing at all indicates that the basilar membrane has been excited at a particular place (place theory).
2. The time distribution of impulses carries data on the repetition rate (periodicity theory), and possibly on the vibration pattern itself; this is true only for lower frequencies.

Two important nervous system processing functions are autocorrelation and cross-correlation. *Autocorrelation* is the comparison of a pulse train with previous pulse trains in order to pick out repetitive features. *Cross-correlation* is described as a comparison between signals on two different nerve fibers. This could account for the localization of sound at low frequencies by measuring the time delay between signals from our two ears.

Cerebral dominance

Information from our left ear passes to the right side of the brain and information from the right ear to the left side. This is consistent with the bilateral symmetry exhibited in nearly all our sensory and motor functions. Of course, there are pathways from the left ear to left cortex and very strong ties between the right and left cortexes, so that both sides of the brain receive processed information from both ears.

Clinical evidence has shown that the dominant hemisphere for the brain (left cortex) for 98 percent of the population is specialized for speech processing and the minor hemisphere for nonlinguistic functions.

Recognition of melodies requires the use of both hemispheres. It has been discovered that musically experienced listeners recognize melodies better in their right ear than the left, while the reverse is true for nonmusicians. Patients with severe traumatic speech impediments are sometimes able to sing a song that had been learned before the trauma occurred, even though they could not speak the same words.

Trust your ears

"Nature," said the ancient Greek philosopher Zeno, "has given man one tongue, but two ears, that we might hear twice as much as we speak." Most of us take for granted the unique auditory abilities that we possess and many of us could benefit from this advice.

The final judgement as to whether or not sound reproduction is high-fidelity must be conducted by the trained ear itself. We say "trained" ear because we intend to judge sound by what we are accustomed to hearing. A listener who regularly hears good music in a concert hall will detect shortcomings in a sound reproducing system that elude a person who listens mostly to reproduced sound. Most of us in the broadcast industry have so tuned our ears to omnipresent stereophonic sound in small studios, that live performances sound strange to us.

In 1969, H. Olson emphasized the physiological and psychological aspects of sound reproduction, which he divided in two parts: the *sensorial process* the *synthetic emotional process*. Both are subject to musical training, especially the emotional process. The emotional process depends on current tastes in music.

Efforts to reproduce the spacial character of the sound and to provide ambience in the listening area have led to stereophonic, quadraphonic, and other multichannel techniques for sound reproduction. Obstacles have prevented quadraphonic sound from becoming a factor in the high fidelity industry, but indicators still reflect increasing interest in multichannel sound. **BM/E**

Editor's note: This concludes our series on psychoacoustics. We hope it has been informative as we strive to provide information on all aspects of the broadcaster's experience. Please let us hear from you on this and other (future) series.

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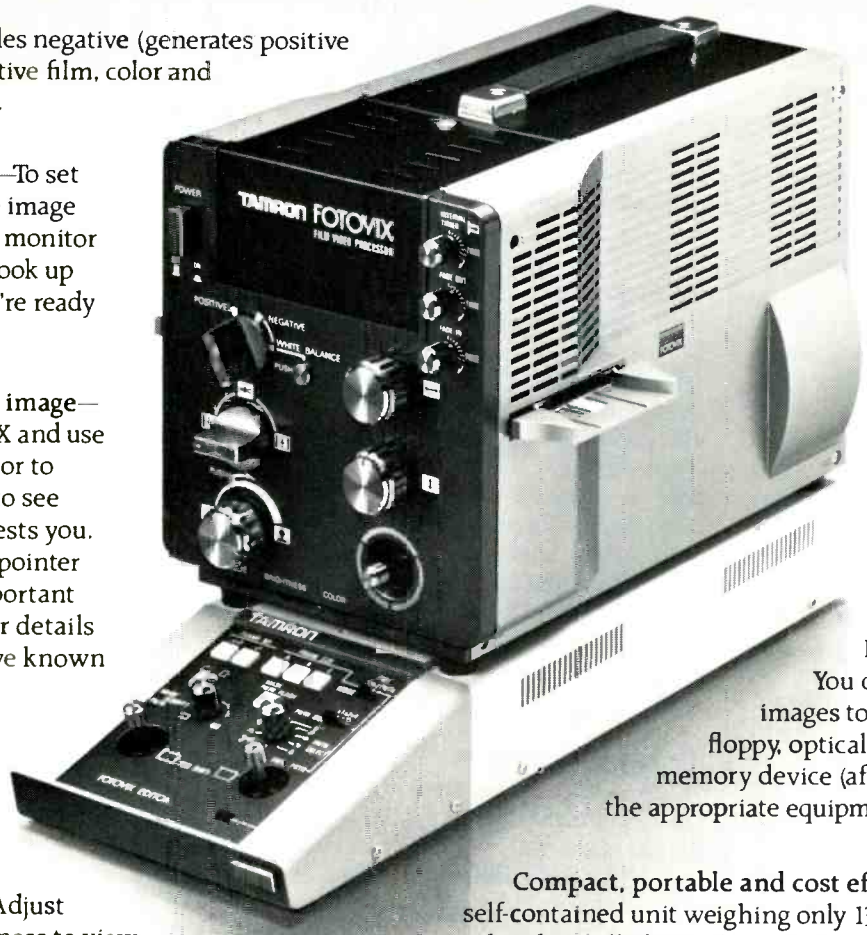

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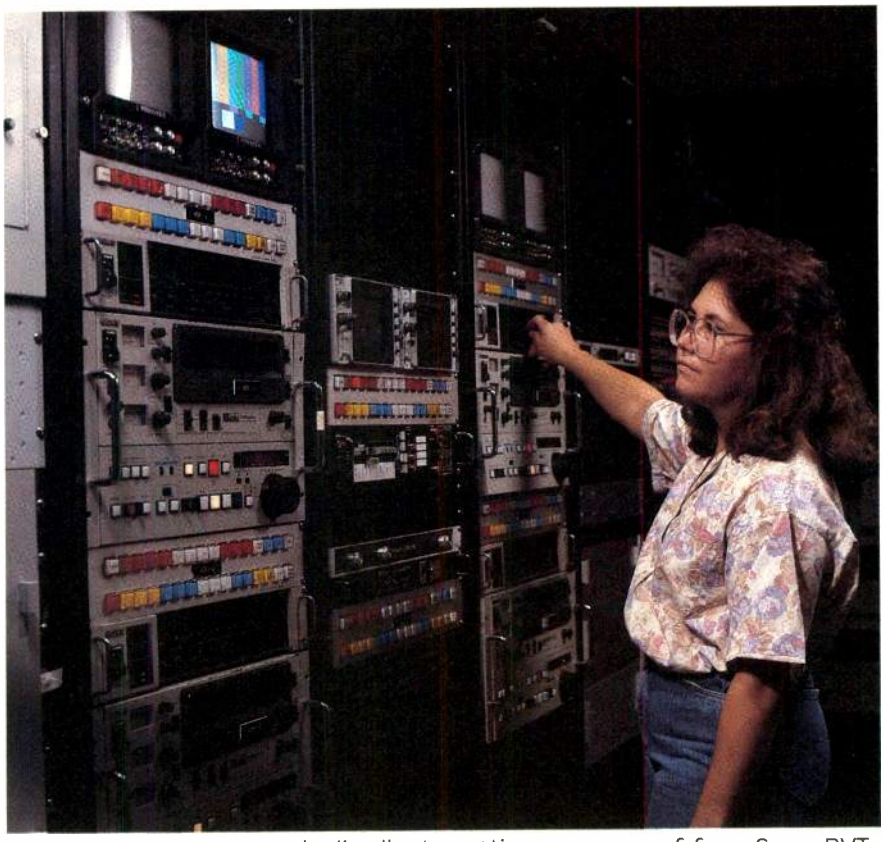
Some A, B, C's on TBC's and Frame Syncs



Editel Chicago's Mary Frisoli adjusts settings on one of four Sony BVT 800 time base correctors matched to BVU 800 VCRs in the interformat suite.

Perhaps the most critical aspect of video processing lies in keeping the video signal in proper shape throughout the plant. Video from tape and outside sources are two areas needing specific treatment.

By Brian McKernan

The maxim that timing is everything is especially true in the case of video signals. A complex serial stream of analog data, video is comprised not only of several basic picture parameters, but also of horizontal, vertical, and color timing information. The time base of the video signal requires ultra precision for accurate processing, and for display at a scanning rate of more than 15,000 lines each second.

Throughout the history of television there has been a continual quest for timing accuracy and the elimination of synchronization artifacts. As television technology evolved, solutions to various timing problems included the synchronizing of cameras, the development of vertical interval switching, and of genlock.

Two of the most significant developments in television in the past decade have been the introduction of small-format VTRs and the growth in use of terrestrial and satellite microwave. These technologies create their own problems of time base instability, however, and video output from them must be processed to maintain RS-170 standards within the video plant.

Such processing is performed by time base correctors (TBCs) and frame synchronizers, a category of products that are among today's

most important "black boxes." Common to TV stations and teleproduction houses for over a decade, both TBCs and frame synchronizers continue to improve yearly with increasing numbers of features, decreasing cost, and in some cases integration into single, multifunction units.

Time base correctors and frame synchronizers are both designed to stabilize and synchronize video signals, but they differ in function. Time base correctors handle small, rapid instabilities inherent in the videotape recording and playback process. Frame synchronizers remove slow, drifting errors of transmission delay in stable video from outside sources, and then sync that video to the local house sync source, permitting clean transitions to and from in-house video.

The trouble with tape

Maintaining stability in any plant where video production is done means, of course, locking all equipment (including TBCs and frame synchronizers) to a master sync pulse generator. Pumping out black burst, the master sync source genlocks, times, and phases all video-processing equipment together so that synchronization artifacts—jitter, bumps, rolls, shifts, and color distortions—do not occur during switches, edits, and mixes between VTRs, cameras, or other video sources.

The weak link, however, is the VTR/VCR. There the virtual perfection of timing integrity is lost because of the mechanical recording/playback process. Even the best VTRs and tape are not immune to these problems. Changes in temperature, humidity, drag, and tension can alter the physical size or shape of a tape between the time of recording and playback. A variation as small as only one thousandth of an inch in tape size or shape can be seen on a monitor as picture distortion. Time base error is also created by the VTR, and can be caused by the size, shape, and condition of the tape path, and by mechanical or electrical gyrations in the tape transport.

There are few television or teleproduction professionals who haven't seen, on at least one occasion, what time base error looks like in a displayed picture. It shows up as geometric distortion in playback, appearing as image bending or fluttering most noticeable at the top of vertical lines, and also as picture tearing, color breakup, and phase shifts. If not corrected, such problems multiply when tapes are duplicated. Time base error greatly limits the utility of video equipment; time base incorrect video cannot be edited or mixed with other video, correct or otherwise. Video must also be time base correct to meet the FCC-mandated tolerances of television transmitters.

TBCs to the rescue

Time base correction is nearly as old as the VTR itself. Ampex introduced electromechanical servomechanisms and voltage-variable video delay lines for time base correction as part of their evolution of quadruplex machines. Early one-inch VTRs were originally time base corrected with analog techniques similar to those invented for quad.

The lesser mechanical tolerances of still smaller format helical scan VTRs introduced new problems of time base instability. Half- and ¾-inch VTRs were suitable for industrial use, but not for broadcast. In the early 1970s, television news departments saw the potential use of small formats for ENG. Before that was to occur a solution was needed to make the smaller VTRs meet broadcast standards.

Working on such a solution at that time were companies such as Consolidated Video Systems (CVS) and the ADDA Corporation. Harris Video Systems' Ron Frillman, an original member of the CVS research team, recalls the challenge they confronted:

"With the early U-matics, we were faced with machines that, instead of having a capstan servo

Outside video sources at WBNS-TV are synched soon after they enter the building. Dan Black, maintenance technician, surveys the station's Microtime and Harris frame synchronizers.

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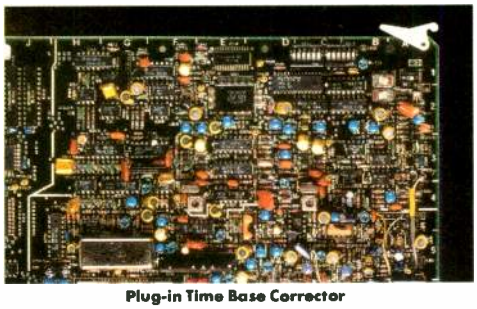
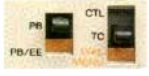


Plug-in Time Base Corrector

TBC Remote Control



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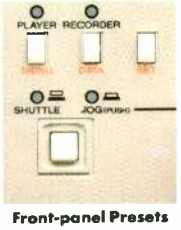

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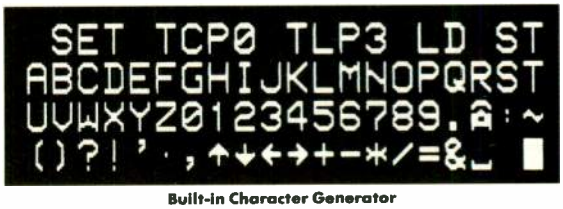

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motor, had one motor in the system with drive belts going off to power all the other parts. The only constants we could count on from a picture coming off such a machine were horizontal sync, because it relates to the speed of the head drum, and burst, which is always on the back porch of the signal. So we designed a clocking frequency derived from burst, which is today a Harris patent." CVS is today part of Harris Video Systems.

"The next trick was the need for more than one line of memory. An analog delay line was only good for one line—plus or minus half a line—and there was too much error in the cheaper VTRs. You had to go to digital to get any kind of memory capacity, so CVS developed a converter for analog to digital. We had three lines of memory in the original box. The nice thing about digital is if you have greater than a line of video error you can afford to cut it off and throw it away."

Live from space

The development of the frame synchronizer was also ongoing during this time period, at CVS, NEC, and other companies.

"Synchronizers were a fallout from TBC research," explains Frillman. "Same technique, except you needed to handle a large, slow, drifting error. We originally designed the synchronizer for NASA's live video from manned lunar missions. That microwave signal being beamed back to earth had a large and slow drift to it. No TBC had a large enough window to handle it. So we built sufficient memory so that we could write in a field, and constantly refresh the memory so that it would never run out.

"If that slow-drifting signal were fed [unsynchronized], all the television transmitters in the world reading it would have gone out of lock. TV transmitter tolerances are very unforgiving. In order for the world to see the men walking on the moon we had to give them a stable signal. Very few people know that the historic live video from the moon was processed on a CVS frame synchronizer."

Editor Chris Hengeveld at the controls of a Fortel Y-688 TBC in an interformat suite at National Video, in New York.

Bits and windows

Time base corrector and frame synchronizer technology has benefitted from the growth of the computer industry, which is the impetus behind the development and decreasing cost of A to D chips. Most digital TBCs and syncs on the market are 8-bit systems because of the wide availability of 8-bit A to D converters.

The memory capacity that a TBC or frame synchronizer has for holding video signals needing correction is known as its window. The window specifies the maximum timing error that can be corrected. In a TBC, a 16-line window will permit correction of timing errors of up to plus or minus 8 lines, which is usually adequate for timing errors encountered in typical applications. Advanced sync must, however, be fed back to the VTR to control its output so it falls within the window.

TBCs described as having an infinite window can store a complete frame of video in memory, enabling correction of any amount of timing error. Advanced sync, therefore, is unnecessary with infinite window TBCs, which can be used with machines that cannot accept advanced sync, such as VHS and Beta. Infinite window design also permits capture of a complete field or frame for freezing, a popular feature.

Frame synchronizers also store a complete frame of memory, but differ from TBCs in that they can hot switch in the event of signal loss, freezing on the last good frame until video is restored. Additionally, the bandwidth that a frame synchronizer can handle is usually greater than that of a TBC. Such capabilities vary, however, depending on the manufacturer, model, and price. Many combination TBC/frame synchronizers are on the market today, with more introduced every year.

The buyer has a wealth of choices today among TBC and frame synchronizer products, and companies offering them include Alta, Ampex, Apert-Herzog, Crosspoint Latch, For-A, Fortel, GML, Harris, Hotronics, Grunder, Leitch, Lenco, Microtime, NEC, Nova, Panasonic, Prime Image, Quantel, Scientific Atlanta Digital Video Systems, Shintron, Sony, Tektronix, and Toshiba.

Simply stated, the typical design of both TBCs and frame syn-

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chronizers involves conversion of input analog video to digital form, and then the storage of that information just long enough to output it—converted back to analog—so that the video is synchronous to the master house sync source.

TBCs use a sampling frequency of four times the color subcarrier, or 14.32 MHz. Each sample is then converted to an 8-bit binary word, which yields 256 levels of resolution for each cycle of 14.32 MHz.

Sync and burst, occurring in the blanking portion of the signal, are deleted in the time base correction process. Prior to output the video is passed through a processing amplifier, which adds new sync and burst, correcting for errors of timing, color, and phase. A clean, time base correct signal is the end product.

Nipped in the bud

Satellite and ENG microwave use in broadcasting has made the frame synchronizer a vital tool in the modern television station. A good example of this situation is illustrated by WBNS-TV, the CBS affiliate in Columbus, OH. The station operates an SNV, two ENG trucks, three portable ENG units, an ENG helicopter, and also takes feeds from six satellite antennas.

"With all of this microwave coming in we try to make our station synchronous as far upstream as possible," explains maintenance technician Dan Black. "You cannot afford to genlock to an outside source any more, because of the roll a hot switch causes on the air, and the glitch it creates in the house reference. A separate synch system for production or master control is one solution, but it just adds another level of complexity.

"Because those outside signals have to be synchronous to the house standard, we synch them as soon as they come into the building," Black says. "There's one DA just for monitoring the raw network signal, and from there it goes right into a frame synchronizer. Then it's synchronous for the whole plant. We do the same thing for other satellite feeds and for all the ENG. By the way, we always have provisions for monitoring the signals before they go into the syncs. That lets us isolate problems.

"It's rare when you're not doing something with the incoming signals—perhaps passing them through a keyer or on to master control directly—and by synching them right where they come in we only have to sync them once. Then we can patch them around and not worry about it. We can treat that video as if it was the output of a camera or tape machine.

"We have ten synchronizers in all, and they all have proc amps built in, so the incoming video is also cleaned up. We have four Harris 690s, four Microtime S-130s, and two Microtime S-230 combination frame sync/TBCs. The S-230 is handy for when field equipment is running off frequency, and for the surprising number of instances where satellite feeds originate from non-time base corrected VCRs. The S-230 senses the type of signal coming into it and automatically time base corrects unphased color."

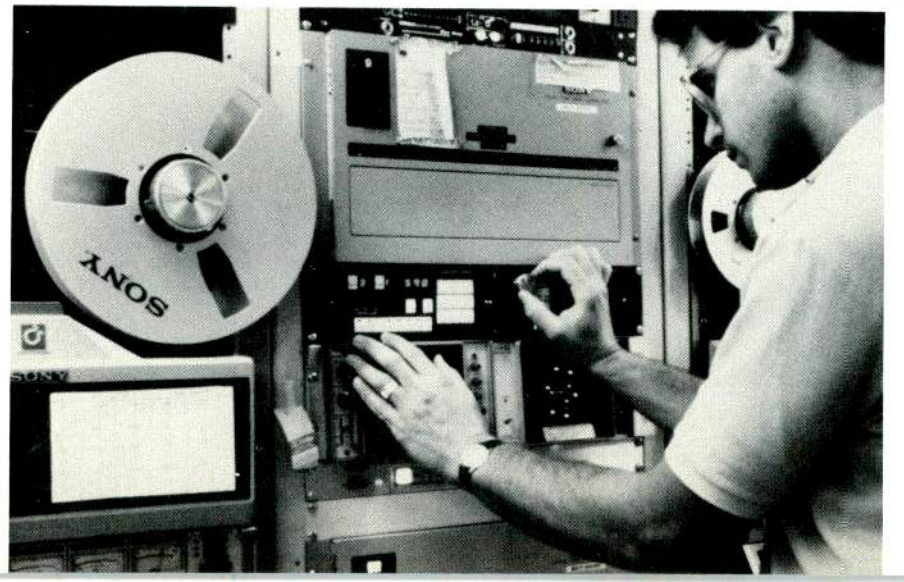
U-matic utility

Time base correction is required for all video processing formats employed by VTRs, and there are TBCs designed to handle each type. These include: the direct color composite recording process of one-inch Type C; the heterodyne—or color-under—process of U-matic; and the component Y, R-Y, B-Y signals of Beta and M-II. A further variation is dub processing, which uses the wider bandwidth of the unencoded luma/chroma output on U-matic machines. With dub processing, TBCs can retrieve higher quality signals than are normally possible from the composite output of a U-matic VCR.

"Three-quarter-inch is a very popular format that continues to get better," observes Herb Ohlandt, vice president and director of engineering at National Video, in New York. "Two of our seven edit suites are interformat suites. Both regularly use two or three Sony BVU 800 series machines in addition to two BVW 40s. We're most interested in the highest quality for our ¾-inch customers, who are just as important to us as our one-inch customers.

"We studied several models of TBC, and chose the Fortel Y-688 and Turbo 2 for their component dub feature and ability to handle weak to poor tapes, which is crucial for us. They're super. We also like the Turbo's quietness of picture, frequency response, and chroma noise."

The Fortel Turbo 2 is compatible with both ¾-inch dub and half-inch component formats, part of a trend in which TBC architec-



The Zaxcom multiple time base corrector remote control system installed at New York's Broadway Video includes control panels in the machine room (seen here) and in the edit suites.

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tures are designed to process more than one VTR signal format. This flexibility is matched by a trend in which TBCs are not only combined with frame synchronizers in the same box, but also in which such extra features are offered as drop out compensation, noise reduction, frame/field freeze, and the ability to produce recognizable pictures in dynamic tracking and high-speed shuttle VTR modes.

TBC FX

Another significant feature of the newer TBCs is the ability to alter the sequence in which the digital codes of picture information are read from memory, and thereby generate special effects. For-A, Crosspoint Latch, and Prime Image are three manufacturers offering TBCs with effects. For the user, this can be an economical alternative to more expensive digital video effects systems—or even a way to extend their capabilities.

"We have the Prime Image TBC-Sync Plus, as well as a Digital Services Corporation Eclipse video effects unit," explains Bob Chesney, president of Chesney Productions, in Newport Beach, CA. The company produces *Windows on Wall Street*, which is shown on the Financial News Network, and they also produce 90-minute instructional videos aimed at the business market.

"We use most of the TBC-Sync Plus effects, such as mosaic, posterization, sepia, and freeze frame, and even though we have those same effects on the Eclipse, doing them on the Prime Image lets us free up the Eclipse for other things. You can even combine effects on the TBC-Sync Plus, and that's ironic because you can't do that on our Eclipse. We also use the TBC-Sync Plus freeze frame and freeze field as a quick still store."

A pioneer in using TBC technology for more than time base correction is The Alta Group, which makes three products—Cygnus, Pyxis, and Centaurus—that collectively offer quality digital effects, A/B roll editing, and still storage at prices geared to the low-end producer.

Crossing boundaries

Yet another TBC-related special effect common today is the disappearing act, especially where half-inch component formats are concerned. Compactness is one of the key features of Beta, Beta SP, and M-II, and in keeping with this, TBCs for these VCRs are being designed as integral plug-in boards that vanish inside the housing of the tape machine itself.

This is partially a consequence of the compressed time-division multiplexed signal processing of component formats, which eliminates some of the jitter needing correction. Users acknowledge they have little need for outboard TBCs with half-inch component VCRs unless they're transmitting direct from small field units. Integral TBCs have the advantage of being specifically designed for the VCR they're part of, and they save space. Sony, Panasonic, Ampex, BTS, and JVC all offer integral TBCs for their half-inch VCRs, and Sony has even introduced one for its BVU-950 U-matic SP machine.

Despite the tendency toward integral TBCs, manufacturers are aware of the value of flexibility in their equipment, and a TBC that can bridge several different worlds is a hedge against a future that some feel may see one format win out over another. One such product is Microtime's T-220 Format Interchange TBC, which is designed with the capacity to input and output composite, dub, and component simultaneously. A universal TBC that can process all of these signals essentially makes it a system transcoder.

TBCs for type C

In the world of one-inch, time base correction has also gone the way of the system approach, with both plug-in cards and outboard units designed specifically for given VTRs. One reason users frequently cite for going the integral route is satisfaction with having a TBC perfectly suited for the specialized tricks of Type C.

"We're done purchasing TBCs as standalones," comments Scott Jacobs, president of IPA, The Editing House, in Chicago. "We're building a new edit suite that includes three Sony BVH-3000s, which have slow-motion capability. We chose the top-of-the-line plug-in Sony TBCs for them because it makes the slow-mo look terrific."

At nearby Editel Chicago, chief engineer Mark Adler agrees with Jacobs that it's best to go with same-manufacturer TBCs when it comes to one-inch. Editel Chicago's newer Ampex and Sony VTRs are outfitted with matching TBCs. One of these models in particular, the Ampex TBC 6, is not only designed for such special functions as rendering clear pictures in the variable-speed and shuttle modes of Ampex one-inch, but it can also be used with U-matic VCRs. Both the Ampex TBC 6 and the TBC 40 have heterodyne processing built in, which is handy for those blocks of time when the one-inch is idle and the U-matic is in use, or when dubbing up from that format to one-inch.

Remote control

Television stations, and—especially—post-production facilities, for whom time base correction is crucial because of its necessity in editing, vary when it comes to placement of TBCs. At New York's National Video, one-inch VTRs and TBCs are co-located and both are the responsibility of the playback person.

"We don't remote-control our TBCs; that would give the editor something new to do, and editors are busy enough as it is with such equipment as the Abekas, ADO, and Kaleidoscope," says National's Ohlandt. "On the other hand, in our interformat suites the editor does playback himself, he's a one-man band, and it's cheaper that way." Fortel Y-688 and Turbo 2 TBCs are mounted directly beneath the U-matics at National Video's two interformat suites.

"We remote all our TBCs," explains IPA The Editing House's

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Jacobs, "and each of our editing rooms is equipped with a Zaxcom Video TBC control system. It's a very smart little remote control that allows you to preset parameters for each different tape. We just installed a Zaxcom multiple TBC control system, which controls eight TBCs.

"With our one-inch machines we used to have to reset the TBC every time we changed reels, and if you put the same tape back up later, you'd have to reset for it again. But with the Zaxcom you just press the button for, say, VPR3 and setup position four, and you're back in business. We're very concerned about cutting the editing time for the client, and if you can cut an hour off an editing session by being able to automatically set up machines, then you're also saving that client some money," Jacobs says.

Future generations

A major new processing product for one-inch Type C video attracting much attention lately is one in which time base correction is only part of the picture. "We're mulling over getting an Ampex Zeus," says Editel Chicago's Adler. "We like it because of its ability to handle Varispeed; you can shrink a 32-second spot to 30 seconds and Zeus will do a great job of getting rid of the artifacts that normally occur in such a procedure."

Described as an advanced video processor, Zeus features 9-bit sampling and totally digital velocity compensation, which greatly enhances the multigenerational performance of Type C. Twenty-third generation NTSC video produced on Zeus has been demonstrated with virtually no picture degradation.

Zeus' other features include multigeneration setup mode to show what initial setup levels will look like in ten generations to optimize adjustments; a decode mode to correct for non-color-framed edits and to allow edits to be made every two—instead of four—NTSC fields; full bandwidth frame store; serial remote control capability; ability to handle heterodyne VCRs on a second input; and compatibility with older Ampex VTRs, such as the VPR2 and VPR2B.

The development of the Zeus advanced video processor has been attributed by some as one-inch Type C's response to the gradual encroachment of digital video recording technologies, which are free of the multigenerational degradation of analog formats. Ironically, however, it's digital technology—including TBCs and frame synchronizers—that is today optimizing the quality and flexibility of analog video. In broadcast, at least, it will be an NTSC world for quite some time to come, and the good news is that today's video processing products offer a wide array of choices that just keep on getting better.BM/E


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Satellite Protection Systems

Bonneville Satellite maintains satellite network systems through intelligent technical planning and use of uninterruptable power systems.

Denise Fowler checks information at the Los Angeles technical operations center of Bonneville Satellite Corp.

Los Angeles may be recognized as the home of many television and film stars, but different types of stars play a vital role in the operations of a telecommunications company with one of its technical operations centers there. This firm, which utilizes satellites revolving thousands of miles above the earth to relay and transmit broadcasting signals across the United States, includes as one of its major clients Cable News Network (CNN). Because CNN frequently broadcasts live programming, the slightest power problem, not to mention blackout, would cause an embarrassing interruption for millions of its viewers.

Consequently, the telecommu-

nications company selected its first uninterruptable power system (UPS) to provide not only the power conditioning capabilities of the line conditioners used at other company sites, but also no-break power in the event of a blackout.

Headquartered in Salt Lake City, the company is Bonneville Satellite Corp., and it also operates technical operations centers (TOCs) in San Diego, Salt Lake City, and Washington, DC.

Bonneville Satellite Corp. was founded in 1978 as a part of Bonneville International Corp., which comprises a group of AM, FM, and television stations, as well as a production company for television programming and advertising.

"We were founded because there was a need for the delivery of network programs from one point to another via microwave or satellite uplink," explains Ray Hutchinson, Los Angeles area manager. "Much like common carriers in other businesses, we don't build or create anything, we have responsibility for transporting somebody else's products and distributing them."

Because Bonneville is entrusted by its clients to transmit these signals clearly and quickly, the firm cannot afford to lose a signal for even the briefest moment of time due to a power problem.

Bonneville's list of clients is indeed impressive, ranging from news and scheduled daily programs to sports, entertainment, and special events. Besides CNN's Los Angeles news bureau, current clients include Hospital Satellite Network, the CBS West Coast regional news, ABC Sports, ESPN, the NCAA, and a variety of professional baseball, basketball, and hockey teams. Bonneville also has handled transmission of such prestigious events as the 1984 Summer Olympics in Los Angeles and the Academy Awards.

Los Angeles operations

While each of Bonnevile's five TOCs has different capabilities to meet a broad range of client requirements, the Los Angeles TOC is one of the most complete. Located in an office building on famed Sunset Blvd., the Center features a studio complete with a stage; two cameras and lighting; teleconference facilities; videotape editing machines; a conference room with a large-screen projection system for video conferences; and a rooftop view that clearly identifies the well-known "HOLLYWOOD" sign or the Los Angeles skyline for use as broadcasting backgrounds.

Bonneville transmits both live and taped programs for distribution to radio, television, cable systems, or closed-circuit audiences, and also can provide signal pickup, coordination, cameras and crew, remote vans, switching equipment, videotape, and a production staff trained in broadcasting operations. Transmissions originating from Southern California generally are sent south via several microwave relay sites to Bonneville's San Diego satellite uplinks. These twin 10-meter Scientific-Atlanta uplinks, which also are utilized at Bonneville's Salt Lake City and Washington TOCs, have the capability of transmitting both horizontally and vertically polarized signals to a satellite.

In the case of CNN transmissions, the telecommunications process differs slightly from the other Bonneville clients because it involves a relay site specifically dedicated to CNN.

This relay site is located at Saddle Peak, situated at the top of the canyons in Malibu, a relatively isolated suburb of Los Angeles approximately 20 miles from Bonneville's downtown TOC. CNN's crew covers southern California

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Digital Delay	☐	☐	☐
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VIDEO PROCESSING			
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TRANSMISSION/ TV OPERATIONS			
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RADIO OPERATIONS			
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2. To what extent does audio processing influence your business?

☐ Very Important ☐ Somewhat Important ☐ Not Important

3. What areas of audio/video processing are of greatest concern to you at this time?

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4. If TV Station—do you plan to convert to Stereo within the next:

☐ 6 months ☐ 12 months ☐ No plan

5. What best describes your organization?

☐ TV station ☐ Radio network ☐ Other (specify) _____
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6. What is your function?

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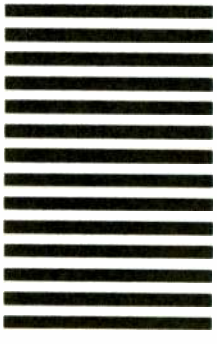

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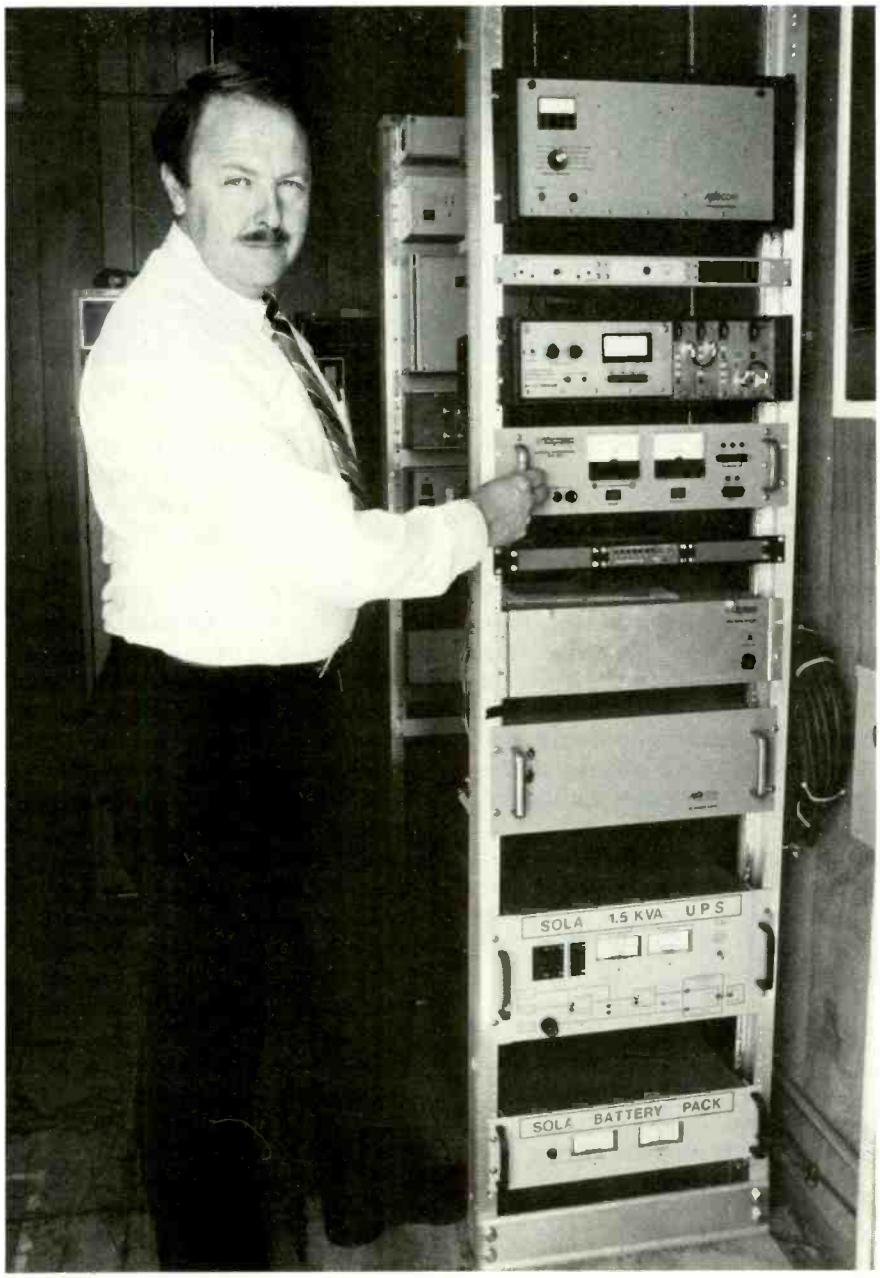
stories with its own news truck equipped with microwave equipment, and the transmission is sent via microwave to Saddle Peak. At Saddle Peak, the signal is recieved by a MA/COM receiver and sent via a MA/COM controller and antenna system to the Los Angeles TOC. The transmission then could be routed locally to another carrier or sent to San Diego, up to the satellite, and down to CNN's headquarters in Atlanta.

Once the signal reaches the San Diego uplink, it is converted to a frequency of 6 GHz and beamed by an MCL 3.35 kW high-power amplifier to one of the satellites on which Bonneville leases transponders. There, the signal is converted by the transponder to a frequency of 4 GHz and transmitted to one or more downlinks at whatever location or locations the client desires. No matter how the signal is routed to the satellite, the entire process takes less than one-half second from the time of the initial transmission from the mobile unit is made to its being received at the downlink.

UPS safeguards CNN broadcasts

When CNN's Los Angeles news bureau became a Bonneville client during the summer of 1985, its contract with Bonneville required that an uninterruptable power system protect the equipment at Saddle Peak. "CNN wanted to be assured we would have power for their live transmissions in the event of an outage," says Hutchinson. "If CNN were broadcasting live and a power failure occurred, it would be disastrous. We simply cannot afford any power failures at all."

Another reason for purchase of the UPS relates to the location of the relay site at Saddle Peak and the fact that if a power outage occurred, nobody would be on hand to immediately rectify the situation before an emergency generator kicked in. This generator, a 20 kW model located inside the main building on the site and connected to a transfer panel, is linked to other buildings in the same com-



Hutchinson points out the Sola 1.5 kVA UPS installed at the relay site.

Bonneville's TOC in Los Angeles includes a fully equipped studio.

pound in which Boneville leases space.

The generator is powered by propane, and has the ability to run nearly indefinitely. However, the unit takes up to 10 seconds to provide power, an unnacceptable delay when CNN is broadcasting live programming. In the event of a power failure, even with the generator operating properly, the transmitter at Saddle Peak or the reciever at Bonneville's Los Angeles TOC could still take up to 30 seconds to recover, an eternity in the world of radio and television broadcasting, notes Hutchinson.

To prevent these potential problems, Gary Horrocks, director of engineering for Bonneville, purchased a 1.5 kVA rack-mounted UPS manufactured by Sola, a unit of General Signal. Horrocks knew he would need an on-line UPS rather than an off-line standby power source (SPS) because the latter's four- to 10-millisecond delay in switching from AC line power to battery inverter power in the event of a blackout would be unacceptable for the microwave equipment at Saddle Peak.

The 1.5 kVA UPS operates continuously during normal line-power conditions to provide voltage regulation plus isolation from noise and transients. During normal power conditions, commercial AC power is delivered to the unit's rectifier/charger, where it is converted to DC to charge the battery and power the inverter. This transistor-switching, multiple-pulse width inverter converts the DC power to regulated, noise-free AC, which powers the load. It holds output voltage to within ±2 percent despite line voltage flucuations ranging from +10 to −15 percent.

Any drop in the AC line power causes the rectifier/charger's DC output to decrease, but the battery automatically compensates and continues to supply DC power to the inverter for up to 10 minutes. The battery also serves as a shock absorber for any AC line disturbances and helps to isolate the DC inverter from these disturbances.

The UPS, which is only 8¾ inches high with a separate 5¼-inch battery pack, has two meters that show output voltage and current, and also features a primary AC breaker, battery breaker, and bypass fuse. Red, amber, and green LED indicators arranged in a power flow diagram continuously display the status of the system, and an audible alarm sounds if any fault conditions occur. The

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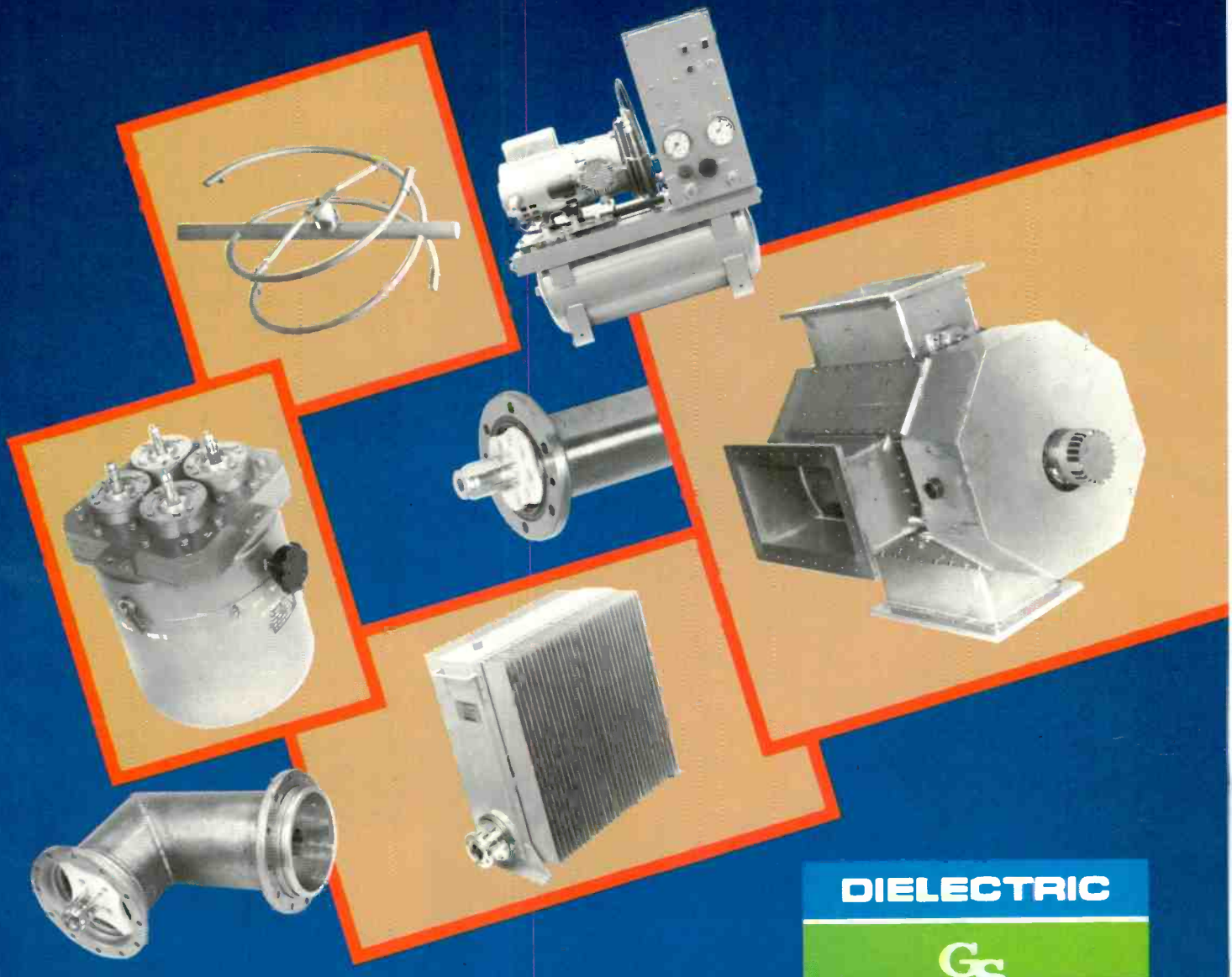

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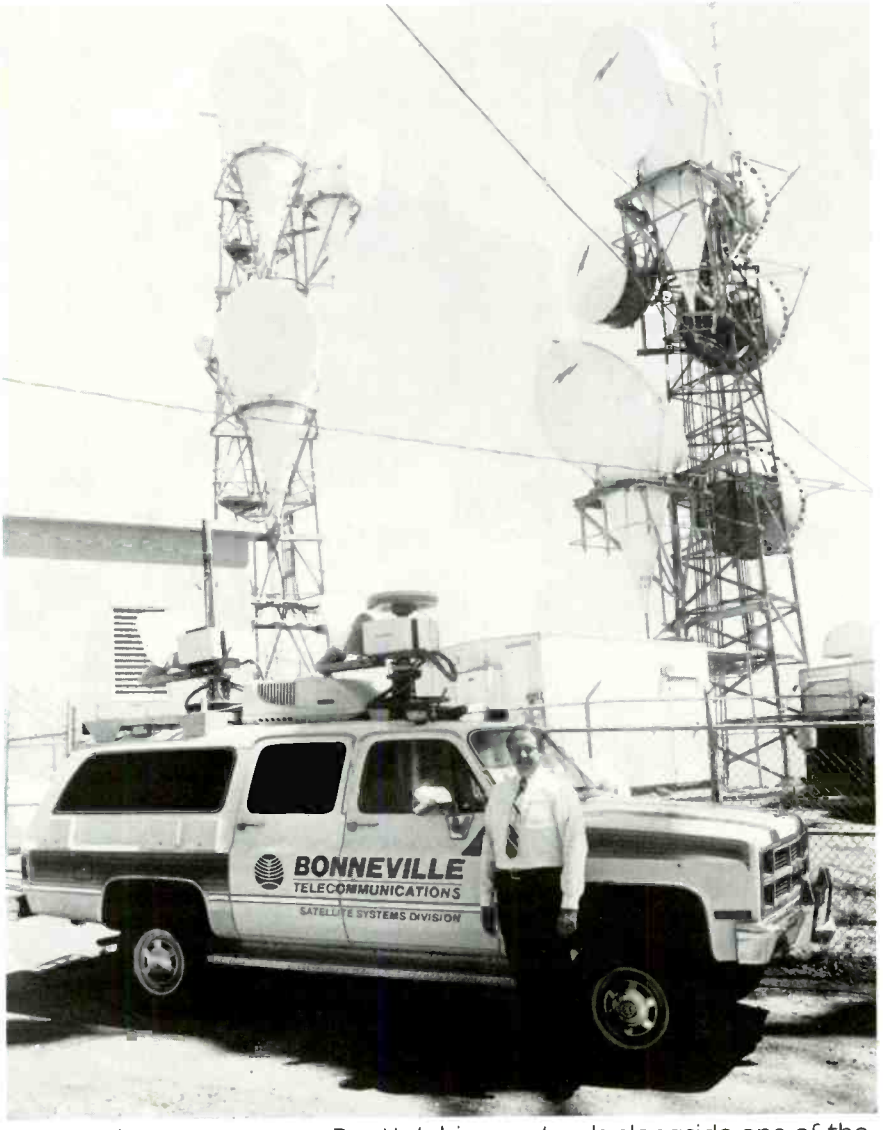
battery pack is a sealed, 48-cell lead/acid unit that requires no maintenance.

This particular Sola model was selected, says Horrocks, because of its regulation features, meters, and rack mount capabilities. Due to the amount of the equipment required to fit into the six- by eight-foot building Bonneville leases at Saddle Peak, the rack mounting capability was an important consideration. "We had a lot of confidence in Sola products as a result of Bonneville's experience with Sola line conditioners at the Salt Lake City TOC," says Horrocks, and the 1.5 kVA model was specified after he calculated that the equipment at Saddle Peak draws about 750 watts, enough power to safely provide for future upgrading of equipment at Saddle Peak.

Because the power in Los Angeles is generally very stable, Bonneville has not experienced any power problems at Saddle Peak during the time the UPS has been installed there. However, the cost of the UPS is minimal when weighed against the cost of a power problem that could affect service to CNN and harm Bonneville's excellent reputation. In fact, points out Horrocks, the unit's presence at Saddle Peak is so reassuring that he is considering adding additional UPS models at other sites. **BM/E**



Los Angeles area manager Ray Hutchinson stands alongside one of the campany's mobile vans at a microwave relay point for CNN, located at the top of the canyons at Malibu—Saddle Peak.

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Undeclared War?: The GM and CE Relationship

Operating today's radio station is a complex task of balancing the financial and programming concerns of the general manager and the technical and operational duties of the chief engineer. Is there a common ground on which to build a working professional relationship?

By Tim Wetmore

Oil and water don't mix. The chemical characteristics of each is so different from the other that they repel each other, unable to accomplish a blending of the attributes that each element might bring to the combined result. Are we talking about the chief and the GM in the same way?

There are those who maintain this is a good analogy for the fundamental differences between the two disciplines, the two most critical guiding forces for any station. The reasoning for this position: the general manager usually grows up through the sales organization and is revenue/cost oriented. He is trained throughout his career to think that without sales there would be no station and this becomes his essential operating philosophy when he graduates into the ranks of general manager.

The chief engineer, on the other hand, is schooled in the technical nature of the station and is hardware/performance oriented. He is trained to think that the best quality plant, equipment, and personnel are required to get a quality signal on the air and keep it there. He is told that without the signal carrying the programs to the audience there would be nothing to sell.

This, quite naturally, sets up a confrontational basis for working together right from the beginning of one's career. Along with the thorough training in the basics of one's profession, future chiefs and GMs seem also to be receiving a solid grounding in suspicion. As the respective career paths begin to converge, the problems really begin to show up. It's difficult to create a harmonious atmosphere in which to work when the only occasions for discussion revolve around failed equipment and spending money. Instead it would seem necessary to build a foundation of trust and common interest. But how likely is this? Is it even possible?

The answer, of course, is that it is possible. The way to do it is through better communication. Though this is an over used and misused term, it nevertheless applies here. And what most needs to be communicated are the common goals of the station, the manager, and the chief. On top of this there is the matter of how to go about achieving these goals.

Perhaps a beginning point is to determine what each party is attempting to do. From this point it may be possible to determine where the paths will converge, thus arriving at the common ground so desperately sought. It should be kept in mind through the discussion that market size may be an important factor in relationships. If it is a large market and a healthy station, obviously the GM is more likely to provide a larger budget with which the chief can operate.

The manager, then, is trying to optimize the efficiency of the station and thus increase profitability. In light of this, the manager is usually looking to do two things, one of which is further his career. The other is to lower costs while increasing revenue. The engineer enters this picture in a negative manner, as an expense to the station, especially in small operations where you have a one- or

two-man engineering shop. The engineer, on the other hand is also trying to further his career and is trying to build a good sound for the station. He often sees the manager as a stumbling block in both regards since the manager won't give him the money he feels he needs to keep operating the physical plant in a professional manner.

Lines of communication

Barry Mishkind, the chief engineer and VP of operations at KKPW/KFXX, an AM/FM combo in Tucson, AZ, has previously encountered the obstacles separating the two disciplines. "What's needed most is to develop a proper budget, and I stress proper, realizing the limits of what can be spent. You must understand cash flow and the professional engineer should be able to work within the constraints of a properly prepared budget. Yet the managers need to rethink their positions on engineering as simply another expense. They need to commit to a certain level of performance, and that shows up in the properly prepared budget."

Again, communication would seem to be the basis for each understanding the plight of the other and coming up with a "properly" prepared budget. Compromise is a word that fits in here and is a common denominator to all successful professionals in all disciplines. It has a negative connotation, but for all that, it is the glue that binds almost every agreement. Each side wants to see evidence that the other is willing to give a little (sometimes a lot) in their direction.

As Mishkind relates, "There is a need for communication and agreement on common goals that will fulfill the goals of the station. Together the chief engineer and general manager should be able to sit down and prioritize the top five requirements. One way to keep the communication open is to let the manager know about the positive side of engineering. Don't let the communication channel lapse until something goes wrong and you are forced to sit down with the manager. The topic is always negative with this approach. If you let the manager know about positive performances, that gives a different slant to the relationship."

Naturally, each market, not to mention every individual and every station, has its unique characteristics. According to Mishkind, "Of course, there is a distinct difference between small and large markets. The problem is worse in small to small/medium markets where reverse pressures of deregulation provide no incentive to have the best plant. Also in the smaller markets there is either no or very little competition, in addition to which many small operations refuse to acknowledge that they are part of a larger radio community with its attendant standards."

"The manager, then, is trying to optimize the efficiency of the station and thus increase profitability."

Further, technology itself impacts the decision making process. With many of the products in the technical plant having reached a very high level of performance, perhaps even the pinnacle of practical application, the old saying of spending money now to save money later holds true. It is Mishkind's contention that, "certain facets of the engineering sphere have stabilized. Processing may have reached its peak in terms of being clean and loud. It is also evident that the quality of transmitters is reaching its peak. Now that the level of the technical state of the art is so high, there is a level that most stations can aspire to if they will only commit a reasonable part of their engineering budget to the technology. Of course, in the long run this saves them money on maintenance and replacement parts."

Lines of definition

Andy Butler, director of engineering for Emmis Broadcasting's WFAN/WQHT, an AM/FM combo in New York, sees the problem as a shift in the industry, a shift so dramatic in nature that the normal definitions of who does what have been upset. The old rules don't seem to apply anymore, and that leaves both general managers and chief engineers searching for a clear explanation of their boundaries within the context of the "new" industry.

"The relationship between the general manager and the chief engineer has deteriorated by the situation in engineering when, in the past 30 years, the industry redefined the engineering function. Formerly the task involved design, engineering, construction, and maintanence, whereas now a lot of people cannot define what engineering is within the context of the modern station. This includes engineers. I feel if we can't define the profession for ourselves then we should not hold any grudge against the other branches of management."

It is important to note, however, that the burden of defining one's position and the communicating of problems should not be left to engineering alone. As Butler points out, "There are a lot of things at work here and it varies by station. Depending on the structure, the responsibilities may change. It now seems that the engineer is a single person operating in a station environment with no support group around him, like an engineering department, and he thus becomes defensive and reactionary. This is a fault of his isolation and generally poor realization of his value by others in the station environment, rather than being something entirely of his own making."

There are those who also claim that the engineering function in the station is going through a maturation process as the industry goes through its changes. This school contends that good engineers were driven out of the pro-

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fession by the treatment, pressure, and low pay. "Still," allows Butler, "there are many very good people left, out of love for the profession, and we must make the industry understand why it really needs us and how engineering itself nurtures the industry."

Lines of education

Then, of course, there is the process of the engineer educating the manager in the value of engineering to the station. This may seem to put all of the burden on the engineer, but in the harsh reality of today's industry, the engineer is most vulnerable and must fight for his survival. This is not to suggest, however, that there is no responsibility on the part of the general manager.

Mike Harris, general manager at the Poughkeepsie, NY AM/FM combination WELK/WPDH made the necessary leap in order to have open lines of communication with his chief engineer. He took it upon himself to learn as much as possible about the technical side of the radio station so that an open dialog, based on understanding and respect, could take place. "I wanted to be able to have an intelligent conversation with the chief engineer and to be able to understand what he does, what his concerns are. Thus, I believe, our relationship is very good. It's obvious that the more you know about all aspects of a station operation, the better you can run the station."

Harris seems to have overcome the lack of common background with his chief by educating himself, by taking the time and effort to teach himself and to seek out the advice of the engineer until he felt comfortable with the technology. Beyond respect, this generates a kind of synergy on which all facets of the operation can feed. "We feel," continues Harris, "that programming, engineering, and sales are all equally important elements of a successful operation. We have recently updated many pieces of expensive equipment because we understand that the technical side is an integral part of our success and not just an expense. We are aware that in many small markets, stations are putting the engineering department on contract so that they do only the absolute minimum amount required to stay on the air and no more." This obviously relegates engineering to inferior status, relegates it in fact to not being part of the operation. Engineering is then just an outside functionary, and this almost completely eliminates any rapport or understanding a GM/CE relationship might generate.

Similarly, in understanding the manager, the engineer must employ some of the skills the general manager has already learned, namely salesmanship. The engineer must make the GM understand, must be able to define for him, the value of the engineer in terms of the priorities of the general manager. Due to deregulation fully-staffed engineering departments are no longer required. Butler tersely explains, "The days are gone when engineering exists because it has to. You no longer have to maintain a certain complement of engineering, you now only have to make the station operate within legal minimums."

When the FCC requirements went out of existence, the engineer was left to prove his worth because there is no longer a regulation that mandates his presence. There is no inherent worth, so it must be demonstrated within the new context of how the modern station operates that the engineering people fit in with management plans and, indeed, are part of management.

"Technology itself impacts the decision making process."

Returning to the issue of communication, then, what will force the hand of the GM to assume his half of the responsibility and make his gesture toward the engineer. Soon enough each side will learn the real value of the other. In the process there will be conflict. Strangely enough, many of the actions on both sides of the conflict may have caused the current dilemma.

Having pushed many engineers out of the industry, management is now faced with learning that good engineering talent is getting to be rare. Now if a good, conscientious broadcaster wants a competitive, highly motivated chief, he will have to steal him from somebody else because of the dearth created at the entry level by management. Consequently, the manager will have to pay more to attract people and get to the level where he can cycle people back into business from the places to which they fled earlier. Also, new talent will have to be brought into the business.

All types of management, both sales and engineering types, may want to consider making contributions to programs, starting intern training for broadcast engineers, or funding courses for training of new talent. "It should now be considered a necessary cost of doing business if you are going to get the talent and survive in today's competitive broadcast world," claims Butler.

Likewise, engineers will have to realize there is a necessary change in the skills required of them. Management skills such as budgeting and revenue generation will become second nature to the surviving engineers of the future. Businesslike attitudes, conduct, and responsibilities will also be required if the engineers of today want to become the engineering managers of tomorrow.

Perhaps it's ironic that one of the things that drove engineers out and hardened their perspective was how the modern, efficient, automated plant (which they designed and nurtured) replaced many functions formerly executed by the engineer. Ironic too, is the way in which management, once happy to eliminate the expense represented by engineering, now goes begging for quality engineering talent. **BM/E**

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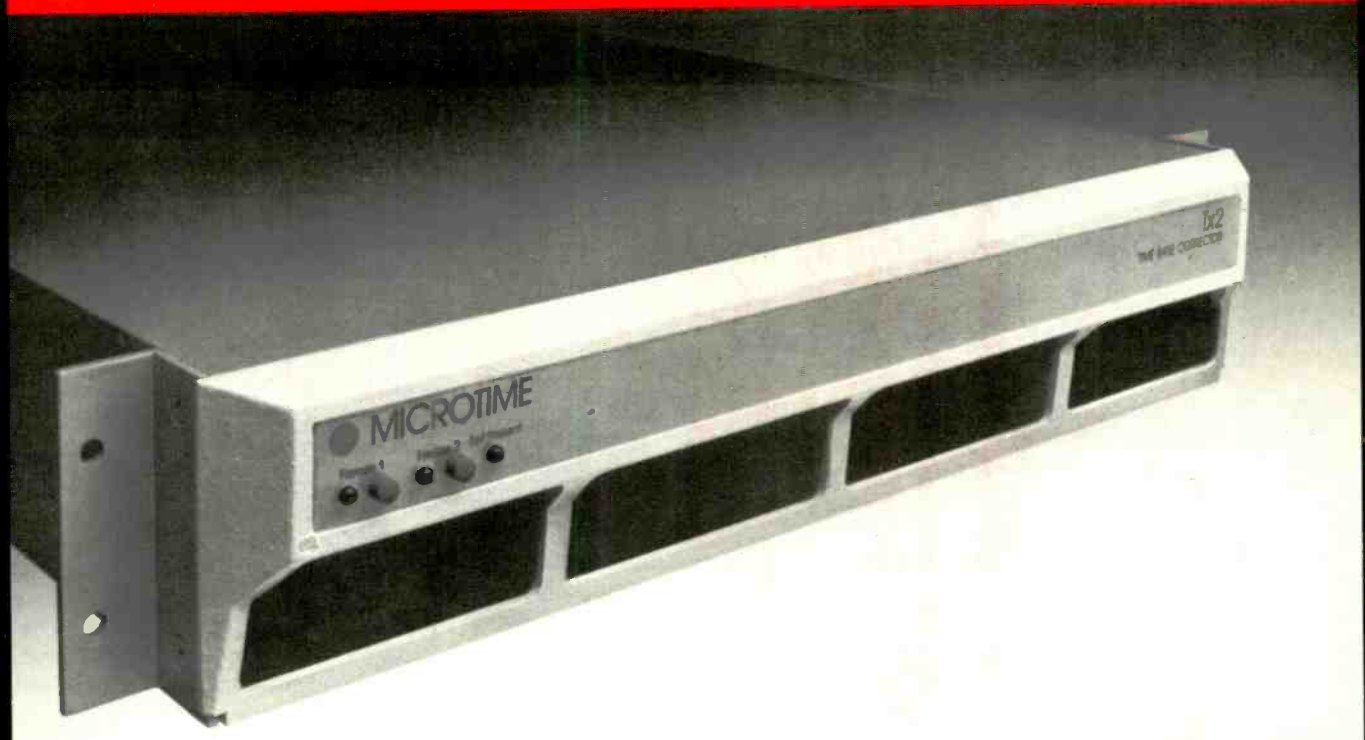
Tx2 Not Just Another TBC



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RADIO 87

Anaheim, California Sept. 9–12

This year's gathering in Anaheim promises "Engineering Plus" . . . and more.

By Steven Schwartz

Following the course set by last year's NAB Radio Convention, engineering topics are expected to dominate the technical sessions and seminars at the upcoming Radio '87 conference. The show will run September 9 to 12 in Anaheim and will be held in conjunction with NAB's popular Directional Antenna Seminar, which begins on September 8. Organized by noted antenna expert Carl Smith of Smith Electronics, this year's DA seminar will cover the theoretical aspects of directional antennas, as well as the latest updates on feeder and monitoring systems, operation, adjustment, maintenance, and applicable FCC rulings.

Other engineering highlights include a four-hour seminar on the NRSC standard, scheduled for September 11, with experts from the Committee who will examine the history of the standard and the reasons behind its adoption. The NRSC will also discuss its new "RF mask" technology designed to cut down spurious AM emissions. The RF Radiation Regulation Compliance Seminar on September 12 should also be of special interest to engineers. The seminar will feature presentations by six speakers who have had considerable experience in dealing with FCC regulations and will provide attendees with information needed to conduct their own on-premise evaluations to comply with the FCC code.

Radio '87 officially begins on Thursday, September 10, with Radio America, an audio-visual salute to American radio stations highlighted by the presentation of a new series of awards, The Crystal Radio Awards for Excellence in Local Achievement. Last year's Radio Award winner Gary Owens will host the festivities and present the awards to ten stations with outstanding records of local identification.

More than 130 companies will be on hand in the "Celebration of Radio" Exhibit Hall, displaying the latest in radio hardware, software, and services. Likewise, there will be no shortage of workshops and sessions for radio management, programming, and sales personnel. Nearly 80 events are scheduled, covering a wide selection of topics—including Negotiating Skills, New Cart Machine Technology, How to Wring Hi-Fi from Ma's Bell, Show Prep, Programming Music for Diverse Audiences, New FM Technology, Future Trends in Computerization, and an FCC Town Meeting with members of the Commission.

Keeping with tradition, a number of familiar names and celebrities will also be in attendance. Rock 'n' roll personality Dick Clark will emcee the Radio Award luncheon on Friday, which will also feature an address by the 1987 Radio Award Recipient, veteran CBS News correspondent Douglas Edwards. You can also find Mutual's popular talk show host Larry King moderating a panel of well-known radio columnists as they discuss trends in radio programming in a special session titled "What's Hot—What's Not" on Saturday morning. Lastly, the show will end on a high note Sunday evening when the popular country-rock group Alabama performs at the Farewell Gala Dinner Celebration at the Hilton. **BM/E**

Radio '87 Agenda

The following schedule highlights some of the events at Radio '87. For a complete list of sessions and workshops consult the NAB schedule at the show.

Tuesday, September 8
2:00-7:00 p.m. Engineers' Registration
5:00-9:00 p.m. Directional Antenna Seminar

Wednesday, September 9
7:30 a.m.-12:00 p.m. Directional Antenna Seminar (cont.)
12:00-8:00 p.m. Registration
1:00-5:00 p.m. Directional Antenna Seminar (cont.)
6:00-8:00 p.m. Welcome Reception
8:00-midnight Hospitality Suites Open

Thursday, September 10
7:30 a.m.-5:00 p.m. Registration
7:30 a.m.-12:00 p.m. Directional Antenna Seminar (cont.)
9:00 a.m.-10:30 a.m. Radio America & Opening Session
10:15 a.m.-6:00 p.m. Exhibits Open
11:15 a.m.-12:30 p.m. Negotiating Skills
Ratings & Research Update
Future Trends in Computerization
A Manger's Guide to "People Law"
—Employees' & Stations' Rights & Wrongs

Radio '87 Exhibitors

Accu-Weather
The Ad Team
Advanced Broadcast Mgmt., Inc.
Aircraft Music Library
Alden Elec./Zephyr Info. Svcs.
All Star Radio
AM Media Consultants
American Image Productions
American Medical Assn.
Aribtron Ratings Co.,
Associated Press Broadcast Svcs.
ATI—Audio Technologies, Inc.
Automated Business Concepts
Barrett Associates, Inc.
BMI
BPME Broadcast Audio Corp.
Broadcast Electronics, Inc.
Broadcast Supply West
Cablewave Systems, Div. Celwave
Cal Switch CBSI/Custom Business Sys., Inc.
Century 21 Programming, Inc.
Charles Michelson Inc.
Clayton Webster Corp.
CMI
CNA Insurance
Columbine Systems, Inc.
Communication Graphics, Inc.
Compusonics
Concept Productions
Continental Electronics
CRN International
Datacount Inc.
Dataworld
Decision Data Systems
Dielectric Communications
Drake-Chenault Radio Consultants
Eventide, Inc.
Federal Emergency Mgmt. Agency
Fidelipac
Film House, Inc.
Fireworks by Grucci, Inc.
FirstCom Broadcast Svcs.
Gentner Engineering
Giant Boom Box
HLC
Harris Corp.
Harte-Hanks Broadcast Dir. Mktg.
Hazel's Fantasy Factory
Holaday Industries, Inc.
Howe Audio Productions, Inc.
IDB Communications Group, Inc.
IGM Communications
International Tapetronics/3M
Jefferson-Pilot Data Svcs.
Jim West Co.
Kalamusic
Kavouras, Inc.
Keepers
LDL Communications, Inc.
LeaseAmerica Corp.
LPB Inc.
Media General Broadcast Svcs.
Media Touch Systems, Inc.
Metro Traffic Control
Modulation Sciences Inc.
Motorola Inc. AM Stereo
Multi Ad Svcs.
Music Director Programming Svce.
NAB Public Svce.
NAB/Science
National Humanities Ctr.
Nautel
NPR Satellite Svcs.
Programming Plus
Radio Advertising Bureau, Inc.
Radio Computing Svcs.
RadioMail
Register Data Systems
Riviera Broadcast Leasing
RSN Promotions Inc.
Sacred Heart Program, Inc.
Satellite Music Network
Scarborough Research
Schafer International
Shively Labs
Shure Brothers, Inc.
Spanish Coast to Coast
Specialized Business Systems
Starmagic Radio
Strata Marketing
Systemation
Tapscan, Inc.
Telacast, Inc.
Tennaplex Systems Ltd.
TM Communications, Inc.
TTC/Wilkinson Radio
2B System Corp.
United States Advertising Svce.
United Video, Inc.
U.S. Air Force
U.S. Army Reserve
U.S. Tape & Label
Weather Services Corp.
Western Towers
WFMT/Beethoven Satellite Net.
Wheatstone Corp.
WNTR Radio
Zambelli Internationale Firew.

Radio's Newest Formats
AM Success Stories
12:15-1:45 p.m. Exhibit Hall Lunch
1:45-3:00 p.m. Town Meeting with FCC Staff
RF Maintenance for AM/FM
Bullpen for Program Directors
Power Marketing for the '90s
3:15-4:30 p.m. Audio Processing for AM & FM
The Amazing Invisible Market, 35-64
Search for Executive Excellence
4:45-6:00 p.m. Cart Machine Technology
Removing Electrical Interference
6:00-midnight Hospitality Suites Open

Friday, September 11

7:30 a.m.-5:00 p.m. Registration
8:00 a.m.-12:15 p.m. NRSC Seminar
9:00-10:15 a.m. RAB General Session
New & Improved Radio Stations—
A Guide to FCC Radio Allocations Opportunities
Program Sources
Show Prep
9:00 a.m. Exhibits Open
10:00 -11:00 a.m. Exhibit Hall Coffee Break
11:00 a.m.-12:15 p.m. SRA Session
Programming Music for Diverse Audiences
How to Make $100 Million in Broadcasting
12:30-2:15 p.m. Radio Award Luncheon
2:45-4:00 p.m. Using AM Synchronous Transmitters
How to Wring Hi-Fi from Ma's Bell
4:00-6:00 p.m. Syndication Show & Reception
4:00-midnight Hospitality Suites Open

Saturday, September 12

7:30-10:15 a.m. RF Seminar
7:30 a.m.-noon Registration
9:00 a.m. Exhibits Open
9:00-10:15 a.m. Government Relations Sessions
What's Hot, What's Not: The Press Looks at Radio
How to Produce Your Radio Station
10:15-11:15 a.m. Exhibit Hall Brunch
11:15 a.m.-12:30 p.m. Effective Public Service Promotions
Programming for Small Markets
Producing Promotional Radio Material
11:15 a.m.-2:00 p.m. RF Seminar (cont.)
1:00-2:15 p.m. Emerging Hot New Sales Categories
AM Quality: Does It Matter?
2:30 p.m.-3:45 p.m. Writing/Speaking Workshop for Engineers
Power Radio—Radio News & Information
4:00-5:15 p.m. Research that Matters
New FM Technology
Maintaining Towers: The Lowdown on the Highup Connection
6:30 p.m. Farewell Dinner with Alabama

Comparative Renewal

By Harry Cole, Bechtel & Cole, FCC Counsel

Those of you who follow the intricate ballet of the Federal legislative process have probably been noticing the recent increase in discussions of the "comparative renewal" process. These discussions have been cropping up in the trade press in connection with several proposed amendments to the Communications Act of 1934 that are presently under consideration in the House and Senate.

The Communications Act, as interpreted by the 1945 Supreme Court in the case of *Ashbacker Broadcasting Corp. v. FCC*, requires that the Commission give reasonably equal consideration to applications that seek the right to utilize a particular frequency. Thus, where two or more applicants both apply for the same FM channel in the same town, the FCC must hold a comparative hearing before it can award the license to either applicant. By the same reasoning, each time an existing licensee files a renewal application, it is in effect asking for authorization to use, or to continue to use, its channel. Under the *Ashbacker* doctrine, the Commission must therefore provide others who might want to use that channel a reasonable opportunity to apply for it. When such applications are filed, they are entitled to a comparative hearing along with the renewal application—hence the term "comparative renewal."

The comparative renewal process has not been easy to implement by any means. However, the Commission—whether rightly or wrongly—has historically been extremely sensitive to the problems of incumbents caught in the comparative renewal process. In fact, in recent memory only two cases come to mind in which an incumbent lost its license as a result of that process, and one of those cases (Simon Geller) has since been reversed.

The way the Commission has usually placed its thumb on the scale of the comparative renewal process is the device of "renewal expectancy." This is an approach by which the FCC attempts to convert a comparsion of apples and oranges (*i.e.*, a comparison of the incumbent's actual past programming with the challenger's proposed future programming) to a comparison of more equivalent factors. Also, it is intended both to assure that existing licensees are rewarded for subtantial past performance and to prevent, or at least reduce the risk of, any massive instability in the ownership of broadcast licenses.

The difficulty, of course, has come in defining exactly what level of "solid" or "substantial" performance is to be sufficient to warrant the grant of a renewal expectancy. The Commission has been unable to articulate any hard and fast standard along these lines, despite the fact that it has had a rulemaking proceeding underway for some six years to explore precisely that question. Instead, the FCC has historically muddled from one case to the next, reviewing the particular facts and circumstances of each case and, in virtually every one, concluding that a renewal expectancy was warranted.

If past is prologue, then, broadcasters have little to fear from the comparative renewal process. The FCC's demonstrated reluctance to take away licenses has, if anything, become more pronounced in recent years. The odds of losing a license in this kind of proceeding are thus extremely small.

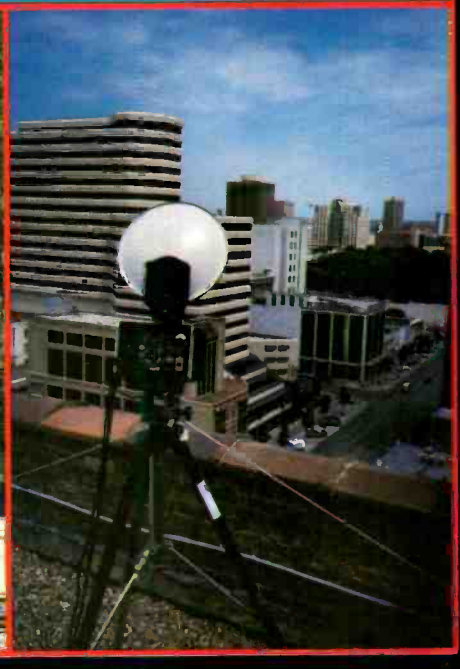
Why the fuss?

Why, then, are industry representatives making such a big fuss about changing the Communications Act to eliminate the comparative renewal process? It appears that, notwithstanding the odds in favor of incumbent renewal applicants, there is a feeling in some segments of the industry that an even greater degree of certainty is desirable; that licenses should not be subject to risk of loss in any but the most egregious cases.

The comparative renewal process, however, has been in place for more than 50 years, and there was clearly some reason for Congress to adopt it in the first place and to refuse to change it since. That reason, of course, is Congress' (and the courts') perception that the risk of a potential challenge will prod broadcasters into providing their audiences with substantial programming. This, in turn, goes back to the fundamental theory that the airwaves are a national asset belonging to "the people" and licensees based on the licensees' promises to provide substantial service. Congress is just interested in maintaining some leverage over broadcasters. If the process is eliminated, Congress will substitute some alternate means of accomplishing the same legislative goal.

And that is where broadcasters seem to come up short in their efforts to abolish the comparative

ENG



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renewal process. As of this writing it appears that the industry's lobbying effort is disintegrating over the question of what alternative provision(s) might be acceptable in return for the abolition of the current process. An obvious choice would be the inclusion, in the Communications Act, of specific programming performance criteria, which, if satisfied, would guarantee renewal. But such a provision would require each licensee to maintain detailed records of its programming in order to be able to demonstrate that it had complied with the statutory criteria. Also, it would require that the Commission involve itself in the review of programming to the extent that the FCC would have to doublecheck each licensee's program showing to satisfy itself that the criteria had been met.

Before you start to bemoan your continued existence in an industry plagued by the comparative renewal process, you may wish to stop and reflect a bit. As things stand, incumbent licensees already enjoy a substantial advantage in any comparative renewal proceeding since the FCC clearly prefers not to take licenses away. It thus remains for the licensee only to be able to satisfy the Commission that the station's past performance has been reasonably strong: that it aired, at times reasonably calculated to attract an audience, substantial nonentertainment programming directed to the peculiar problems and needs of the station's audience.

Keeping good book

Most broadcasters probably already provide programming sufficient to meet that standard. To the extent that a licensee does so, it is almost home free. The only remaining problem would be the ability to document that programming. With the elimination of the FCC's program log requirements, it is possible that many stations do not keep the kind of detailed program records that they used to. That could present a problem down the line because, in a comparative renewal proceeding, the Commission will be looking for hard evidence of the station's performance. Simply to offer vague general descriptions of program content and scheduling is unlikely to be persuasive. As you may recall, the Commission (at the prodding of the Court of Appeals) has dealt with this somewhat in connection with the obligation to maintain quarterly "issues/programs" lists setting forth in reasonable detail each station's issue-related programming. Again, though, the "issues/programs" list obligation is not one which is enforced stringently or frequently by the Commission, and it could be easy to neglect it until it is too late. To the extent that maintaining programming records is viewed as an inconvenience (or worse), it should be tolerated in much the same way that the cost of insurance is tolerated.

All of this is not to say that the comparative renewal process does not entail some continuing downside for incumbent licensees. Even if you

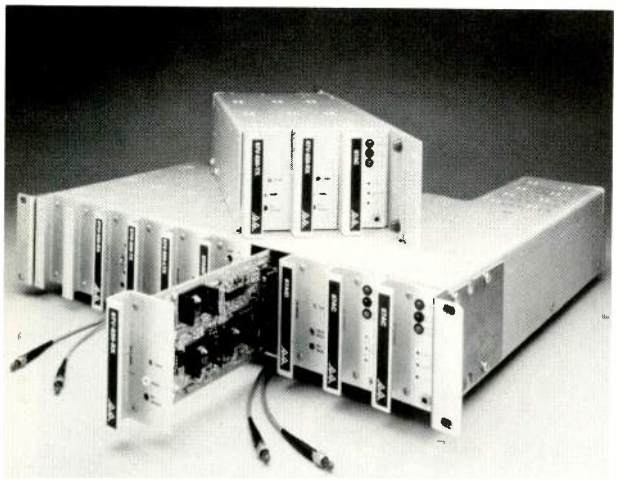
have the best programming in the world, if a competing application is filed against your renewal you will still have to pay the litigation costs of defending your license. Those costs would not be insubstantial. Of course, you are permitted to continue to operate the station while the proceeding grinds on, but it would still represent a significant drain on your finances. You could cut things short by offering to settle the proceeding (usually by paying the challenger cash for dismissing its application). This smacks of paying ransom money and is, therefore, not wholly palatable, even though at times it appears to be the only way to take care of things.

Unfortunately, there is no effective way to prevent a comparative renewal challenge by a challenger interested primarily in settling out for cash. The law forbids the filing of applications for the purpose of achieving such a settlement, but it is invariably difficult, if not impossible, to prove with any precision what an applicant's real motives for filing might have been. Responsible broadcasters can take some comfort in the knowledge that they are not likely to be the target of a renewal challenge simply because the challenger will know that its challenge is likely to be successful if pressed through the FCC. The residual risk that a challenger might nevertheless file a doomed-from-the-start application is just one more risk which is inherent in the licensing system.

Proof in the programming

The bottomline here is that broadcasters probably do not need to fear a comparative renewal challenge as long as they are providing solid, issue-responsive programming and can prove it. Further, the better a licensee's programming performance, the less likely it is that the licensee will be the subject of a competing application to begin with. It could easily be argued that this is not a particularly difficult system with which to live. The alternative—*i.e.*, complete freedom from the threat of a comparative renewal proceeding—may be cosmetically appealing. But the practical realities of the legislative process dictate that such freedom would almost certainly involve some trade-offs, including substantially greater governmental involvement in the day-to-day programming decisions of licenses. After all, if Congress wishes to assure substantial broadcast performance and if licensees are unwilling to live with the comparative renewal approach, which in effect allows licensees to regulate their own programming, Congress will have to take other steps to get what it wants. The question reduces to whether the industry is happier with the devil it knows, or the devil it doesn't know.

If you have any questions about the comparative renewal process (and steps you can take to minimize the risks of that process), you should contact your communications counsel. **BM/E**



GVG Unveils Video/Audio Fiber System

New from The Grass Valley Group is a low-cost fiber optic transmission system designed for the distribution of audio and video signals. The Series 87 EZ-LINK features both LED and laser transmitters for distribution up to 8 kilometers. Other features include an FM square wave carrier to eliminate distortion due to nonlinearity, S/N performance of 60 dB, 10 MHz frequency response, and NTSC and PAL baseband compatibility.

The system can be configured in an eight-module rack-mount tray or in a flexible two-module wall-mount unit.

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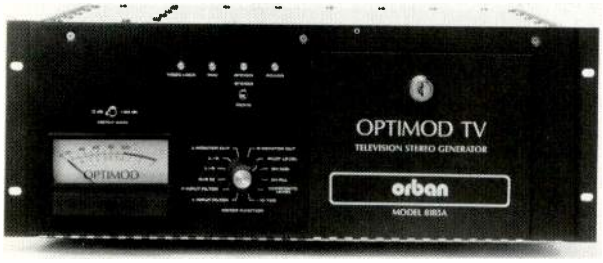

New-Generation Optimod from Orban

Improvements based on 2.5 years of user suggestions for the original Orban 8182A/SG TV stereo generator highlight the features of the new 8185A generator. New capabilities include a digital baseband encoder, left and right inputs for audio processing, built-in calibration tone for Bessel null testing, improved peak-indicating metering, group delay equalization, and optimized noise-reduction circuitry.

In addition the 8185A can work in conjunction with any audio processor, not just the Orban 8182A, as was the case with the 8182/A.

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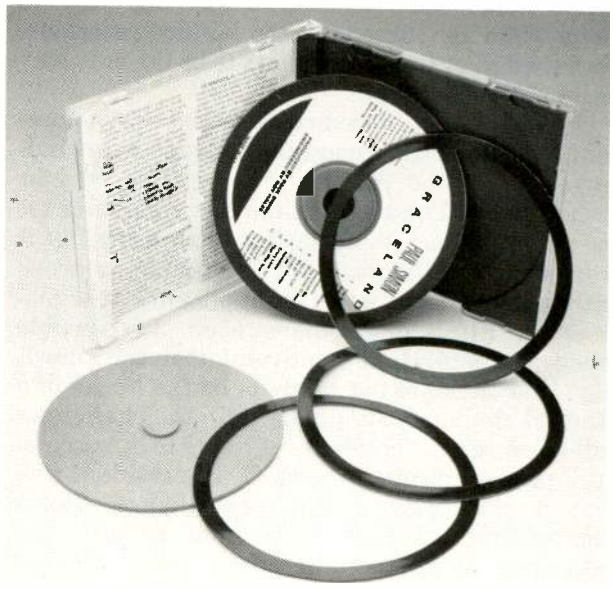

CD Rings from Sims

Sims Vibration Dynamics has introduced a simple but effective device for reducing surface flutter of CDs—The CD Ring. Each ring is made of a rubber-like compound and attaches easily to the back side of a CD. Centrifugal force during the turntable rotation "pulls" at the ring and flattens out the disc, allowing the laser to read more bits of information. According to the company, helium neon laser tests revealed that the laser head tracks 30 percent better with the rings. Retail price is $19.95 for a pack of 15 rings.

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Adams-Smith Boots Audio Edit Control Software

Adams-Smith has announced the availability of a new software package that allows all audio transport functions, including record-in and record-out, to be controlled from a CMX-style video editor.

The software, sold as an option for the company's Model 2600 SI serial interface module, allows the module to be joined in tandem with an Adams-Smith SY tape synchronizer unit. This combination affords complete control of synch, cueing, and frame-accurate punch-in and -out of the audio transport from the video editor's keyboard.

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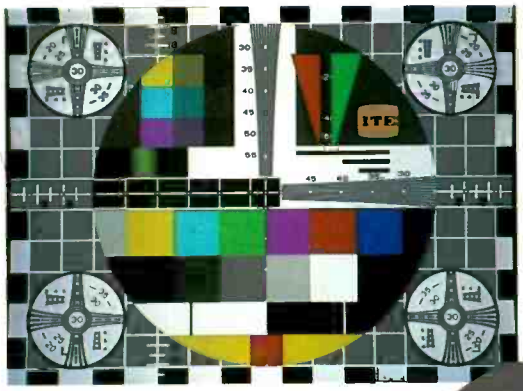

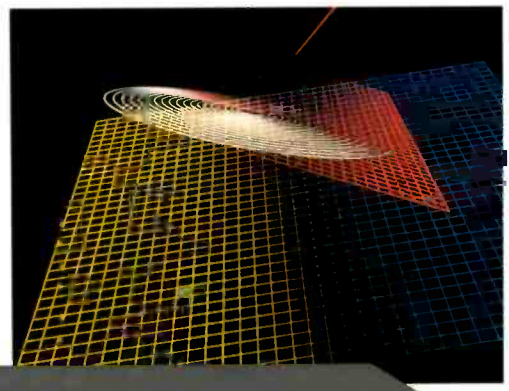

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Now available from Eckel Industries are textured functional panels (TFPs), which provide a convenient cost-effective method for muffling unwanted noise and upgrading the acoustic environment in the workplace, broadcast facility, or studio.

The TFP design incorporates a functional approach to noise control. Only a section of a wall or ceiling needs to be treated with a panel to achieve suitable levels of quiet. The panels' modular design also provides an unobtrusive and attractive decoration method. Sound absorption coefficients for the panels are .95 to .99+ over the 500 to 2000 Hz range.

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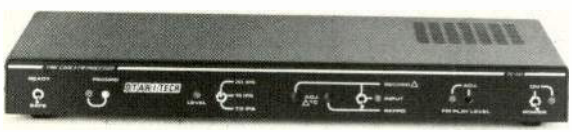

Otari Intros New Tech Line

Otari Corp. has announced the creation of a new product line—Otaritech—targeted at the broadcast and recording markets. The premiere product of the line, the TC-50 center-channel time-code/FM processor is an inexpensive method of adding time code capabilities to an audio tape machine. The unit retrofits to Otari two-track machines like the BII, MKIII-2, and MX-5050, and allows ¼-inch two-tracks to be synched to a videotape or film machine with stereo audio.

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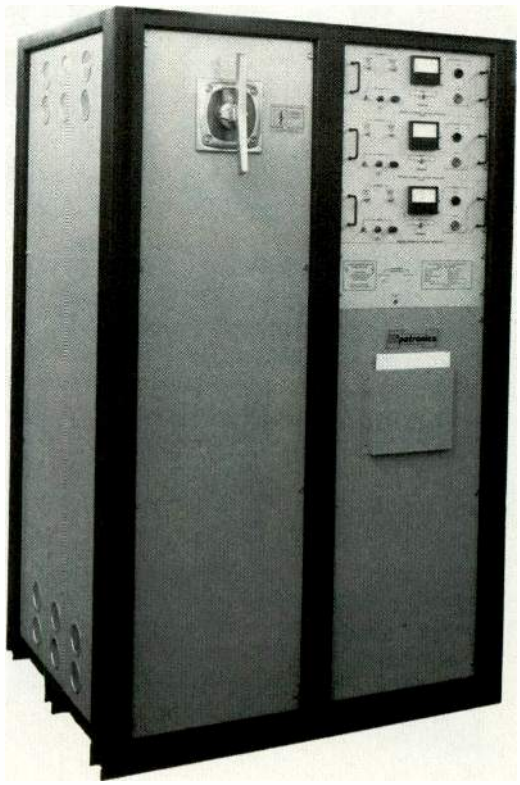

Hipotronics Debuts Voltage Regulator Option

Hipotronics, Inc., is now providing optional individual output phase control to within ± 1 percent on the Peschel automatic voltage regulator (PAVR) unit. The regulator utilizes the patented Peschel variable transformer and is available in medium- to high-power models for a variety of broadcast and video applications.

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Microtime TBC Adds Beta Compatibility

Now users of BVW series VTRs can use the Microtime T-220 to time base correct the component output of VTRs that do not have a built-in TBC. All current BVW-20, -25, and -35 VTRs have Y, R-Y, B-Y outputs that are directly compatible with the T-220.

Standard features of the TBC include wideband component video processing, interpolated freeze, synchronizing, DOC, Vari-Trak, high-speed search to ±40x, and component and composite outputs.

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If you're into page turns, don't turn this page.

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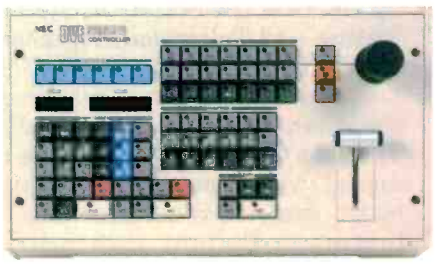

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After a two-year absence from the broadcast marketplace, the once-bankrupt **McMartin Industries** is being resurrected by Pollution Research Control Corp. The new management has assumed ownership of all assets and product lines, including the Super S technology. Company representatives have also reported that many of the past employees are back at their old jobs.

It was announced at a joint SIGGRAPH press conference that **Cubicomp Corp.** has signed a letter of intent to purchase the product line and assets of **Vertigo Systems International, Inc.**, manufacturers of the V-2000 family of 3-D animation Systems. Cubicomp president Harry M. Taxin listed the fusing both of the companies' product lines as well as its engineering and creative staffs as key advantages of the acquisition, and added that "by combining the experience of our two companies, we are offering the industry a line of systems that is unprecedented in its breadth and creative potential." All this on top of the news of yet another revision of the sales agreement between Cubicomp and **Ampex** concerning the PictureMaker. Ampex's sales force will now provide a broad base of prospects for the 3-D system to be turned over to Cubicomp's specialized sales team. Previously, the companies shared the marketing of the PictureMaker.

Another **Ampex** *agreement, this one a pack-out bundling program with* **Studer-Revox**, has been expanded to include the new ¼-inch Studer A807 analog recoder. Every ¼-, half-, and one-inch A80 and A800 family recorder now comes bundled with a reel of Ampex Grand Master 456 tape.

Panasonic Broadcast Systems Co., the recently formed wing of Matsushita that handles sales and support of the company's M-II products, is undergoing an internal restructuring program to enhance the momentum of the product line. Essentially, the reorganization divides the company into four major divisions: sales; marketing, planning, and administration; product development, engineering, and service; and finance. All divisions will report directly to Stan Basara, Panasonic Broadcast Systems president and CEO.

Ten companies, eight U.S. firms and one firm each from Japan and the U.K., have become sustaining members of the Society of Motion Picture and Television Engineers (**SMPTE**). According to SMPTE Sustaining Members Committee chairman Edmund M. DiGiulio, The Alta Group, manufacturers of digital video production equipment; cassette duplicator manufacturers Dwight Cavendish; Christie Electric Corp., a power-related product supplier; camera accessory company Geocam Corp.; Montage Group, Ltd., manufacturers of a random access editor; and North American Philips Lighting Corp. are among the ten new members who, along with 240 other firms, provide financial support for the varied programs and objectives of the SMPTE.

Back to school: A variety of publications, from handbooks to product catalogs, have become available in recent months. Production facility professionals will be interested in getting a look at the new expanded version of the *I.T.S. (International Teleproduction Society) Handbook of Recommendations and Procedures.* This 350-page volume, edited by Doug Weiss of the D.C.-based **Andre Perry Group**, attempts to standardize operating practices industry-wide. According to Weiss, "The handbook is a tool designed

A unique stock graphics library service is now being offered to television stations and production facilities from Flightspeed Graphics of Santa Clara, CA. The Stillstock-1 service, demonstrated at the BPME/BDA convention in Atlanta, is a tape library of 300 numbered and timecoded stock-house quality images of sunsets, scenic views, cities, sports, and more. Steve Matson, paintbox artist for Positive Video in San Carlos, CA, has used the Stillstock-1 images in conjunction with his own electronic paint system to produce high-quality graphics. The image pictured was photographed directly off a 13-inch RGB monitor from an original image mastered onto one-inch videotape. "The quality of the images," says Matson, "along with the ease of locating the specific image I'm looking for, saves me a lot of time and allows me to concentrate on creating the graphic rather than searching for the image." Available in any tape format, Stillstock-1 retails for $1200, or about $4 per image.

for use by I.T.S. members and their clients . . . it helps clients make their way through the video maze, establishes uniform standards for incoming personnel, standardizes industry procedures, and expedites the movement of tapes between facilities." The handbook will be distributed free to Society members. Additional copies can be obtained through the International Teleproduction Society, Suite 21E, 990 Avenue of the Americas, New York, NY 10018; (212) 629-3266.

A new publication from audio equipment manufacturer **Tascam**, *Understanding Synchronization*, explores one of the hottest yet most misunderstood topics in pro audio—synchronized recording. The book attempts to serve as a concise reference for time-code oriented production, which grows as video and audio recording continue to merge. For a free copy, write to Understanding Synchronization, Tascam, 7733 Telegraph Rd., Montebello, CA 90640.

Focal Press, publishers of technical books for video, broadcasting, and cinematography professionals, has just issued its Fall 1987 catalog, replete with book descriptions and pricing information. New titles include publications on radio and television programming, documentary direction, and television news technique. Contact Kevin Kopp, Focal Press, 80 Montvale Ave., Stoneham, MA 02180; (617) 438-8464.

Four recent equipment catalogs: **Rohde & Schwarz—Polarad's** Instrumentation Catalog features specs grouped by application for easy reference . . . **Winsted's** latest product listing features new editing consoles, tape storage systems, A/V carts, and Beta "TapeCube" units . . . The new mini-catalog from **For-A** details its entire line of pro video products . . . And **Multiplier's** "Batteries for Communications" catalog showcases over 400 power-related products, with 65 new units added this year. Consult *BM/E*'s August issue ("The Source") for addresses and phone numbers.

Microwave Techniques, manufacturer of high-power microwave equipment, has become a wholly-owned subsidiary of **Howell Laboratories**. The two Maine firms will join product lines in the broadcast coaxial and waveguide fields. **Shively Labs**, FM antenna manufacturer, is another broadcast-oriented division of Howell.

Satellite Information Systems Company (Siscom) has executed a newsroom software development contract with **NBC News**. The three-phase agreement includes development, evaluation, and licensing of the specialized software . . . A leasing program for the K40 character generator was announced recently by Philip K. Edwards, president of **Knox Video**. According to Edwards, the 58-key, 2.5-font machine will be available for one- to five-year terms.

Movers: **Agfa-Gevaert** recently opened a new U.S. office: 100 Challenger Road, Ridgefield Park, NJ . . . Also in Jersey, **CMX Corp.** has relocated its East Coast sales office to 2460 Lemoine Ave., 3rd floor, Fort Lee, NJ 07024 . . . **Pinnacle Systems, Inc.'s** new office: 2380 Walsh Ave., Santa Clara, CA 95051 . . . Corporate HQ for **Sennheiser Electronics** has moved from Manhattan to 6 Old Vista Rd., Old Lyme, CN . . . **Winsted** has moved its offices and warehouse facilities to 10901 Hampshire Ave. South, Minneapolis, MN 55438.

And shakers: Wulf Gray is the new chairman of **Amber Technology**. Previously Gray was associated with Simon Gray, Inc., which was bought by Rank Industries, Australia . . . Charles A. Steinberg succeeds the retiring Arthur H. Hausman as **Ampex** chairman of the board. Steinberg had been president and CEO of the company; Max Mitchell will take over those duties . . . Kenneth Simmons moves up from VP and GM to president of **Colorgraphics Systems**.

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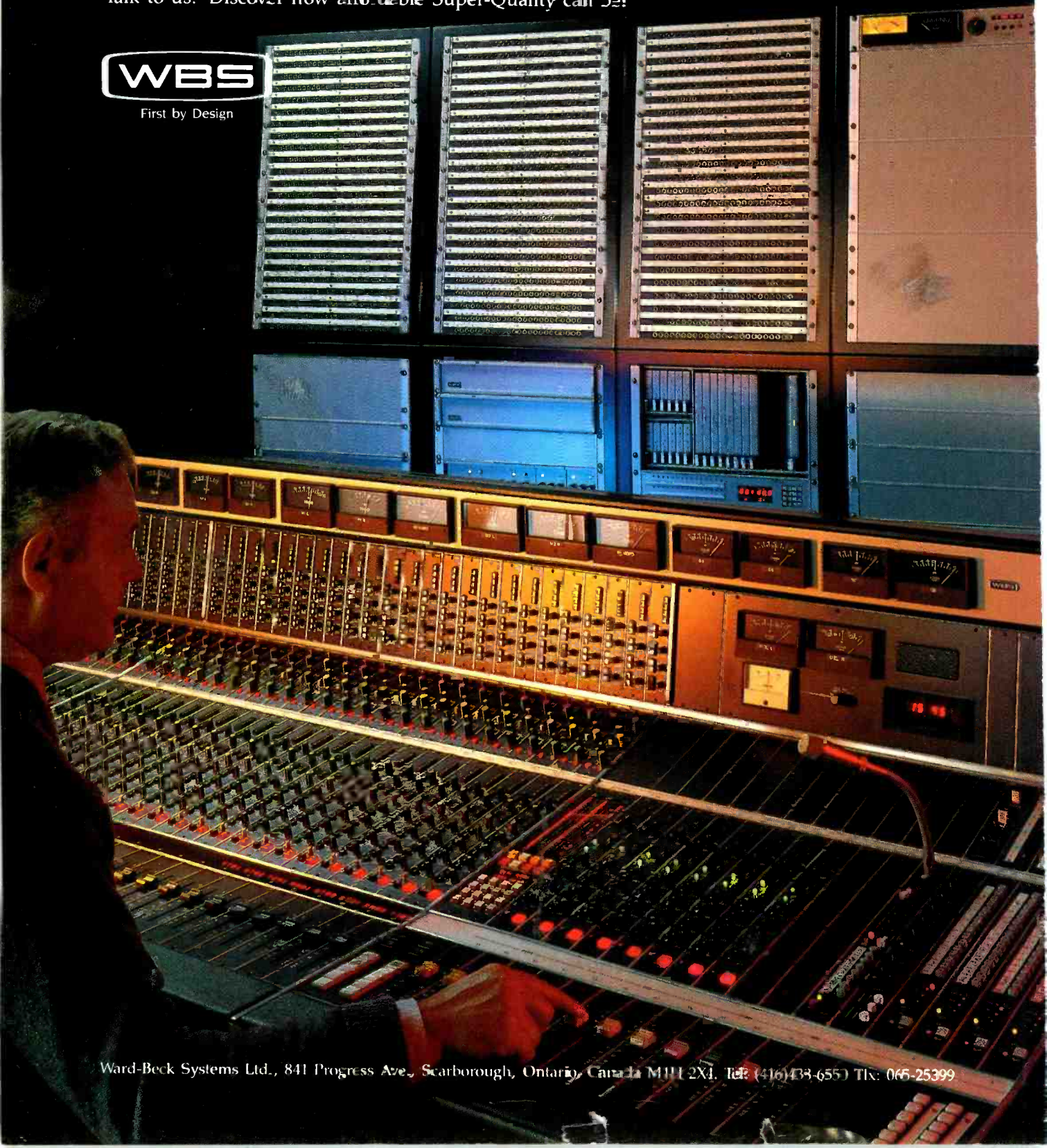

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