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August 1993/$4.50

Audio technology update

- Digital audio effects
- Digital audio workstations
- DAB: Radio's rising star
- Noise control for engineers

Also featured

- Radio in Transition: Remote-control systems
- Inside character generators

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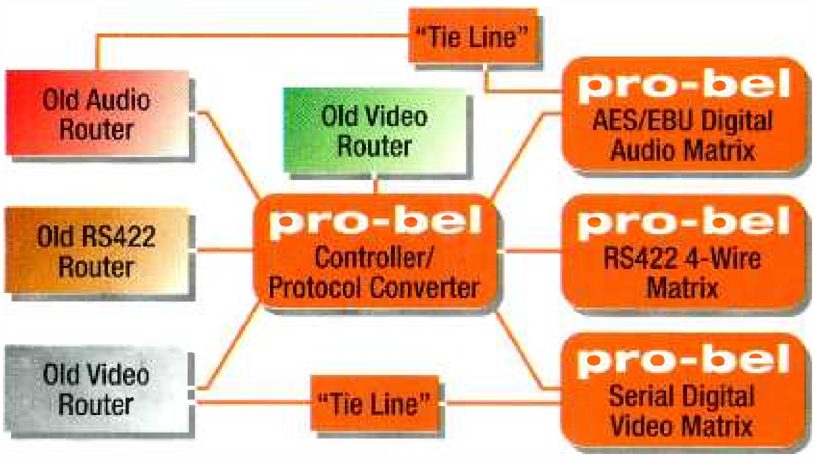

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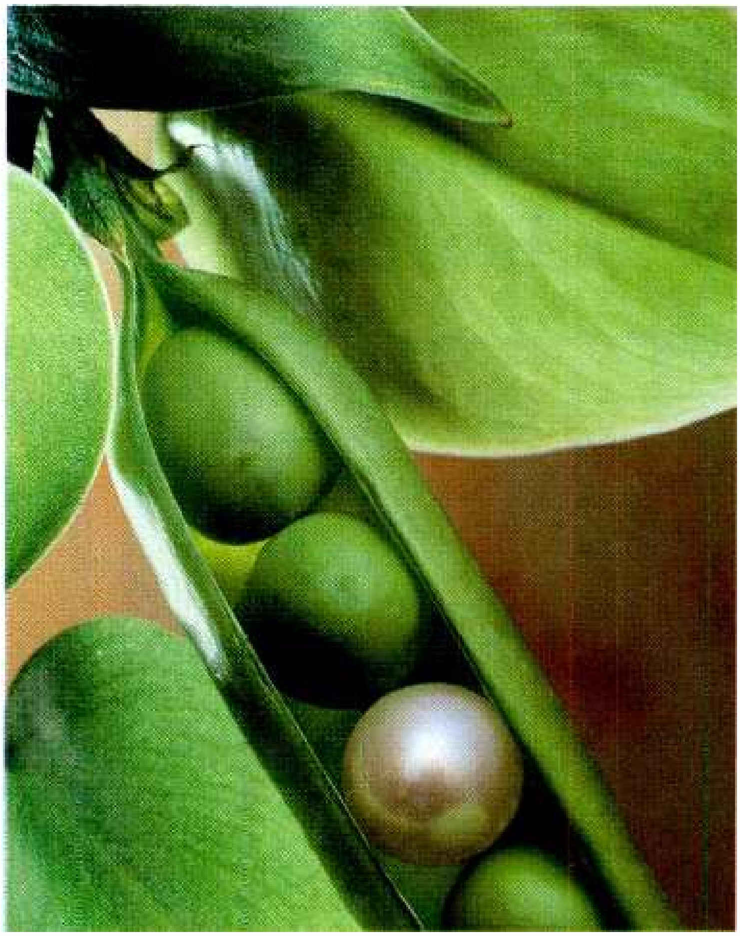

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AUDIO TECHNOLOGY UPDATE:
Producing audio programming used to be a time-consuming and laborious task. Careful optimization of the recorders, precise razor blade editing and seat-of-the-pants mixing used to be standard practice. Today, digital storage and editing make the process not only much easier, but the final product is of higher quality.

THIS MONTH...

OTHER FEATURES:

DEPARTMENTS:

ON THE COVER:

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News

By Dawn Hightower, senior associate editor

95th AES addresses audio in multimedia

The 95th AES Convention will be held in New York, Oct. 7-10 at the Jacob Javits Convention Center. The theme is "Audio in the Age of Multimedia." Many of the technical papers, workshops and seminars will address this growing technology trend.

Several technical sessions will be dedicated to surround sound sweetening for HDTV, optimum rear loudspeaker height, and multichannel sound reproduction.

Multimedia papers will deal with synchronization in a multimedia application, future human interfaces for computer-controlled sound systems, as well as a discussion of a new talking history atlas.

The SBE announces national convention and NEWSTECH '93

The annual SBE Convention and Engineering Conference will be held at the Miami Beach Convention Center Sept. 29 through Oct. 2.

The Ennes Engineering Workshops will be held on Sept. 29. There will be a half day and a full day session. They are designed to provide maintenance and operation instruction on key equipment.

The three days of seminars will begin on Sept. 30 and will cover digital video, digital radio, new technology for television and radio, technical tips and FCC regulations.

On Sept. 29 at 2 p.m., the NEWSTECH trade show will open for the first time. It is the combined trade show of SBE and RTNDA. Exhibits will be open daily from Sept. 29 through Oct. 1.

For more information, call the SBE national office at 317-253-0122.

Ross Perot keynotes NAB Radio Show

The National Association of Broadcasters' annual Radio Convention will be held at the Dallas Convention Center, Sept. 8-11. Ross Perot will deliver the keynote address on Sept. 9.

The Radio Show will have more than 50 sessions covering all facets of radio operation, including management/operations, programming, sales/marketing and technology management.

The convention will close on Sept. 11 with the Marconi Radio Awards honoring the best and brightest radio personalities, stations and formats.

For information on the NAB Radio Show, call the NAB Radio Department at 202-429-5420. To register, call 800-342-2460 or 202-775-4972, or fax 202-775-2146.

Sony announces MD Data standards for PC data storage

Sony has announced the development of standards for MD Data, a compact data storage medium offering high data storage capacity for PC applications.

The MD Data standard has been developed to meet the computer industry's growing need for storage media capable of handling large amounts of data. The standard is based on specifications established for the MiniDisc personal audio system. Sony will offer the MD Data standard to computer and other manufacturers to generate industry support.

In addition to the cost-effectiveness and user-friendliness of floppy disks, MD Data will provide compact, portable size (68mmx72mmx5mm); 140MB memory capacity; a data transfer rate of 150kB per second; and a single drive mechanism that can accept three different disk types.

Stations opt for retransmission consent with cable systems

More than 80% of TV stations and 90% of TV affiliates (ABC, CBS, Fox and NBC) have chosen to negotiate for retransmission consent with at least one cable system in their local TV market or area of dominant influence (ADI). The figures came from a survey of commercial broadcast stations by the National Association of Broadcasters (NAB).

Local TV stations typically serve markets with many local cable systems, in some cases as many as 200 or more. This means separate negotiations must take place between each TV station and often dozens of local cable systems for cable carriage.

The survey also reports that of those stations opting for retransmission consent, 25.1% have opted for retransmission consent with every cable system within their ADI. In other instances, a local TV station may seek retransmission consent deals with some local cable systems and opt for must-carry status with others. ■

BROADCAST engineering

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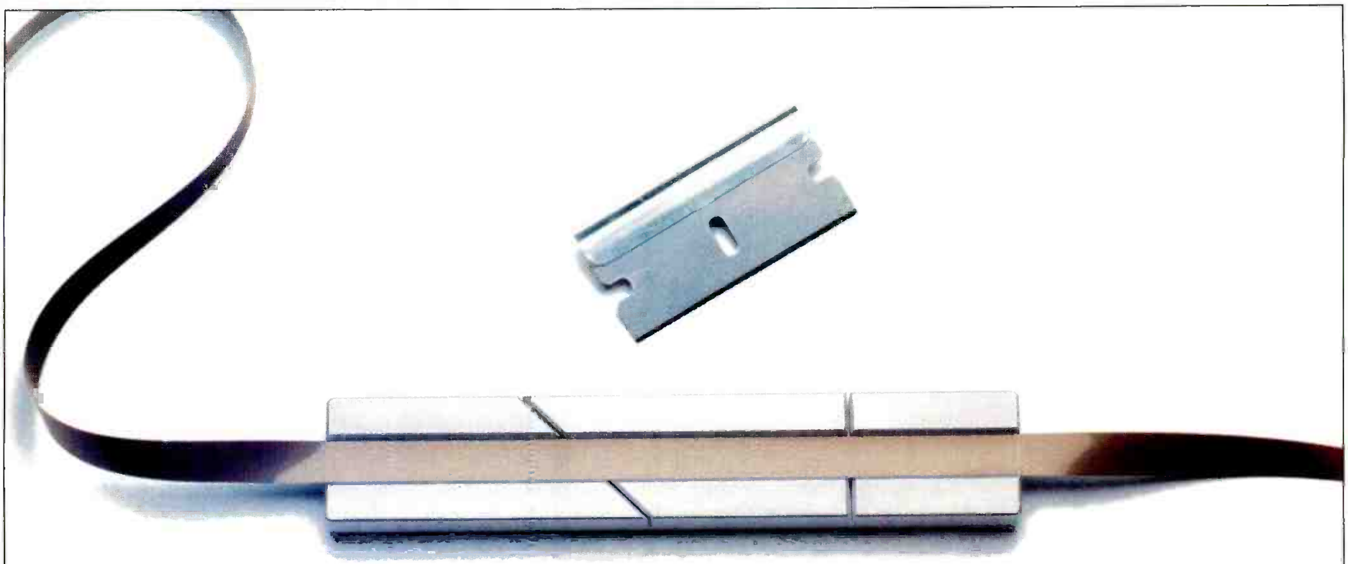

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Editorial

Serving the public: just part of the job

During the first few weeks in July, I, along with millions of other viewers, watched in sadness and horror as rain-swollen rivers in our Midland crept higher and higher. Finally, despite man's best efforts, the rivers and creeks crested their banks and swept across farmland as well as city streets. The casualties of this climatic nightmare were the people, their homes and businesses.

As the news cameras rolled, we saw farmers weeping at the sight of their land overrun by water, their crops ruined, buildings and equipment damaged or destroyed. We saw families moving what few possessions they could carry into boats as rescuers ferried them to higher ground. Dramatic videotape showed downtown city businesses submerged in water, with only the roofs or awnings of stores visible above the muddy, raging water.

The sources for this dramatic flood coverage were over-the-air broadcasters. The story was told on the radio and on television. This coverage reminded me of how important the American Broadcaster is to our nation.

One Friday, during the torrential rainstorms, three tornadoes were spotted within five miles of my home in a span of only 30 minutes. Although I never saw them, I knew they were there because the local radio station had stopped commercial programming to cover the storm. They kept me informed so I could protect my family.

When I wanted to know how the weather front was developing and what to expect, I tuned to my local TV stations. I saw live coverage provided by trained meteorologists using sophisticated radar and graphics systems.

Broadcasting is based on an important premise: The simplest and most reliable way to get information from the source to the receiver is through the air. Broadcasting works in all kinds of weather, doesn't require a coax or fiber cable, or telephone poles or power for line amplifiers. Broadcasting works when the home is without power. It is portable and can go to the basement with you when tornadoes are spotted or to higher ground when flood waters are rising, to continue providing immediate, up-to-date weather information. When the public needs information most, they turn to their local broadcaster.

Broadcasters have always taken the safety of their audiences seriously. Stations spend large amounts of money building backup sites, installing emergency generators, providing mobile vehicles and trained staff to cover weather-related events. Broadcasters don't sell commercials around the next ice storm or hurricane. They provide this high level of service because it's the nature of the job.

For those who consider broadcasting to be on its last leg, consider this: When you need information to help you survive the next hurricane, tornado, ice storm or flood, who will be there to inform you? You can bet it will be your local radio and TV stations.

American radio and TV broadcasters deserve to be congratulated for the top-notch service they provide. Providing public service is something they do; it's just part of the job.

Brad Dick, editor

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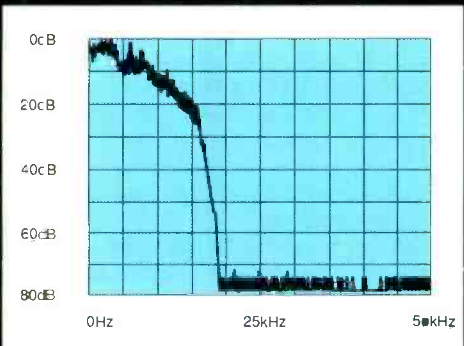

Power spectral density at the 4000's output using "maximum peak hold" measurement. (5kHz/div. horizontal; 10dB/div. vertical)

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The 4000 provides transparent limiting with any source. Blind tests confirm that the sound of the Orban Transmission Limiter 4000 is virtually indistinguishable from the original source when driven as much as 15dB into limiting—even to trained listeners. Try it for yourself and hear what your facility can deliver when it is protected, not just restricted.

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The Transmission Limiter 4000 is one of a family of reliable, quality Orban products designed for demanding broadcast applications. Call your local Orban dealer for a hands-on demonstration of the Orban Transmission Limiter 4000—another breakthrough product from the leaders in broadcast audio processing.

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Circle (7) on Reply Card

FCC Update

FCC defers cable rate regulations

By Harry C. Martin and Andrew S. Kersting

The FCC has deferred implementation of its cable service rate regulations until Oct. 1. The deferral applies to all regulations. The commission will not accept certifications by local franchising authorities to regulate the basic service tier. The commission also will not permit complaints invoking its regulatory oversight over cable programming rates, prior to Oct. 1.

The freeze also has been extended on regulated cable rates until Nov. 15. In its *Rate Freeze Order*, the FCC previously froze cable rates (excluding premium channels and pay-per-view services) until Aug. 3. The FCC was concerned that cable operators could raise rates during the period between adoption of its rules, and the time local franchising authorities established regulation of the basic service tier and consumers filed complaints concerning cable programming rates. The freeze extension is to protect consumers during the deferred implementation period of the cable rate regulations.

The agency will entertain petitions for emergency relief from cable operators who make detailed showings that the freeze would impose severe economic hardships or threaten continued cable service.

Station fined $50,000 for operating above maximum ERP

CyberTel Corporation was issued a $50,000 fine for operating an Illinois land mobile base station above its effective radiated power (ERP) limits.

FCC rules permit base stations to operate with a maximum ERP of 500W. CyberTel was operating with an ERP of 976W.

In response to the violation notice, CyberTel claimed the excess ERP resulted from an inadvertent error in setting the transmitter output power by the contractor hired to install the equipment. According to CyberTel, the error was due to confusion created by two relocations of its facilities over a short period of time. CyberTel claimed one set of engineering specifications existed for its original site, another set existed for the site operated under special temporary authority, and a third set existed for its new site.

Martin and Kersting are attorneys with Reddy, Begley & Martin, Washington, DC.

The FCC's rules noted that licensees are liable for the acts of contractors and remain responsible for the quality of maintenance, compliance with all FCC rules, and of the general instruction given to contractors. After CyberTel continued operation in excess of the maximum ERP, the commission determined that CyberTel's unauthorized operation constituted willful and repeated conduct. The base fine for exceeding ERP power limits is $50,000.

The FCC has deferred implementation of its cable service rate regulations until Oct. 1.

Home shopping stations qualify for must-carry status

The FCC has determined that stations predominantly used for the transmission of sales presentations or program-length commercials (home shopping stations) operate in the public interest and qualify as local commercial TV stations for purposes of cable carriage. The FCC based its finding on criteria in the 1992 Cable Act:

1. The success of the home shopping format demonstrates that such stations have significant viewership;
2. The existing renewal system adequately accommodates competing demands for spectrum now used by home shopping stations and;
3. Home shopping stations play an important role in providing competition to nonbroadcast services supplying similar programming.

Home shopping stations made their initial must-carry/retransmission consent elections and notified cable operators of their preferred channel positions this month.

Blanketing interference claim denied

The FCC affirmed an action by its staff denying a complaint filed by a Framingham, MA, FM station. It alleged that a Boston FM violated the blanketing interference rules when it modified its facilities.

The Framingham licensee alleged that the Boston facility was causing blanketing interference to reception of the Framingham signal in the immediate area of its transmitting facility. Blanketing interference occurs when an FM station's signal strength is so strong that it causes receivers near the transmitting antenna to be partially or completely blocked from receiving signals from other broadcast stations. The commission's rules require licensees to satisfy all complaints of blanketing interference received by the station within a 1-year period. The rule is designed to protect FM radio listeners and TV viewers, but not other broadcasters.

The commission affirmed the staff's determination that the interference alleged by the Framingham licensee was not blanketing but, rather, receiver-induced third-order intermodulation effect (RITOIE). (For more information on RITOIE, see "FM Intermodulation Effects: A Case Study," in the December 1991 issue.)

RITOIE occurs when strong signals from two stations interact within a receiver to generate a signal on a third frequency. No listener or viewer complaints occurred following the move of the Boston station's facilities. Therefore, the FCC concluded that the petitioner was not protected from the alleged RITOIE interference under the provisions of the rules, because there were no complaints within the definition for the Boston operator to satisfy. ■

Renewal and filing due dates

Annual ownership reports (or certifications) are due Oct. 1 for all radio and TV stations licensed to communities in: Alaska, Florida, Guam, Hawaii, Iowa, Missouri, Oregon, Puerto Rico, Samoa, the Virgin Islands and Washington. TV stations in the following states and territories must file their renewals by Oct. 1: Alaska, Guam, Hawaii, Oregon, Samoa and Washington. Iowa and South Dakota LPTVs and TV translators also must file their renewals by Oct. 1. In addition, issues/program lists for the July-September quarter must be placed in the public file of all commercial broadcast stations by Oct 10.

EVER WONDER WHAT THE OTHER 282 BUTTONS ON YOUR SWITCHER ARE FOR?

Big panels look impressive. But, in fact, most switchers used in Post-Production today are actually hold-overs from the days of live television, when you needed lots of inputs to handle all the sources.

Digital Post-Production environments, however, typically require only a few inputs. And you really don't need to pay for more than that.

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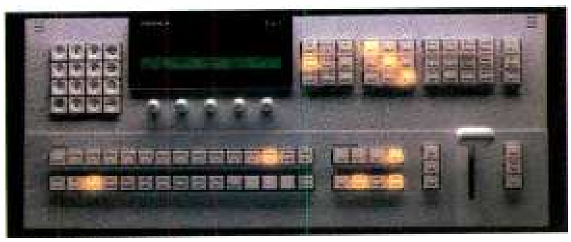

The DCT 700s gives you big-switcher performance in a small package. It gives you the freedom to be more creative...and the power to be more competitive.

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Part 8

Strictly TV

Strictly HDTV

Compression

Curtis Chan

In recent speeches, Apple Computer Chairman John Sculley has urged broadcasters to embrace digital technology by considering dynamic channel management. This concept in theory uses digital compression to partition a standard 6MHz TV channel into an intelligent datastream of multimedia services. This month we will focus on digital compression techniques.

Why digital compression?

When dealing with analog signals, artifacts are cumulative. As they accumulate, individual artifacts become increasingly difficult to discern from the video signal.

In digital, the ability to regenerate the digital pulse train makes signals more resistant to circuit limitations and transmission impairments. For image compression, the process of removing redundant information is most effective in the digital domain. Digital technology and compression could expedite transmission, storage and processing of multiple signals that could be crucial to the future of broadcasting.

Source coding

A major objective for source (compression) coding of video or audio is to represent the original signal with as few bits as possible, while preserving the quality level and intelligibility required for the given application. Source coding can be classified into lossless and lossy coding.

Regarding video, lossless (entropy) coding is based on statistical prediction of properties of an image. The compression ratio is governed by image content. Lossy coding exploits the properties of the human visual system and codes only the information that can be subjectively seen. Optimal source coding combines the two methods through a variety of techniques.

Before coding, the video usually is converted to YUV. The advantage is that most of the high-frequency components are concentrated in the Y component, allowing undersampling of U and V without seriously affecting the high-frequency details of the image.

Chan is principal of Chan and Associates, a marketing consulting service for audio, broadcast and post-production, Fullerton, CA.

Intraframe and interframe coding

Video compression methods can be intraframe or interframe. Intraframe codes each frame based on the information from that frame only, removing only the spatial redundancy within the frame. Intraframe approaches include predictive coding, transform coding and vector quantization.

Interframe coding removes the temporal (time) and spatial (position) redundancy between pictures. This method requires temporal reduction of the current and the next predicted frame. Motion prediction and compensation is needed, necessitating the need for a frame memory. Interframe coding is used in the proposed HDTV systems because intraframe coding alone can't achieve some of the compression ratios needed.

Digital technology and compression could expedite transmission, storage and processing of multiple signals.

Motion prediction/compensation

Motion prediction and compensation provides information for interframe coding. In television, sequences of frames have a high degree of correlation (redundancy), thus motion prediction and compensation is used to predict the difference between the current frame and the estimated current (next) frame.

One motion prediction method is block matching. Block matching used in the HDTV proposals involves the consideration of a small region in an image frame and searching for the displacement that produces the best match among possible regions in an adjacent frame.

Transform and predictive coding

The various algorithms used to reduce the bit rate of the video signals can be divided into two classes: time domain coding and transform domain coding. In time domain coding, a differential pulse code modulation (DPCM) loop predicts the value for a digital sample based on the past history of the encoded signal.

In transform coding, experience indicates that bandwidth reduction is sometimes easier if the signal is first subjected to a linear transformation prior to prediction and quantization. The transform coefficients (matrix coefficients) are then coded. These methods try to reduce the correlation among image pixel intensities and reduce the need to repeatedly code redundant information. An example of this is Discrete Cosine Transform (DCT).

Another method is predictive or waveform coding. This is more simplistic than transform coding and at low compression ratios, the bit-rate reduction capabilities are comparable to transform coding. One widely used method is DPCM, in which a prediction of the current pixel intensity is obtained from more than one previously coded pixel intensity.

Quantization and entropy coding

The process of assigning a specific continuous scalar (magnitude with no direction) quantity to one of several discrete levels is called quantization. Scalar quantization is when each scalar is quantized separately and provides a simple method for on-line dynamic lossy compression. If two or more scalars are quantized jointly, the method is called vector quantization.

Entropy coding assumes that certain image values appear more frequently than others. Shorter code words are assigned to those values occurring more frequently. The entropy is the lowest possible average bit rate required in coding a message. An example is Huffman coding.

Concluding thoughts

Given a fixed total data rate, data allocation becomes the trade-off between emphasizing picture resolution or transmission robustness. Depending on the requirements of the compression scheme and resultant picture quality, images can be encoded either in an interframe and/or intraframe manner.

Finally, through source-coding schemes, redundancy in the spatial and temporal domain can be significantly reduced while holding the quality level and intelligibility high for a given application. ■

New DA rules proposed

By John Battison, P.E.

This past June, the FCC issued a Notice of Inquiry (NOI) into the rules regarding AM directional antenna performance and specifications. This long overdue NOI should provide some essential guidance in the new world of computer-operated systems and, in many cases, non-human supervision.

The original rules and the long-gone *Standards of Good Engineering Practice* (now incorporated into the rules) were products of the 1930s. The current rules concerning DAs were mostly written in 1939, so an update is clearly in order.

The FCC study originated with a petition filed by several of the top broadcast consulting engineering firms. Only a few of the professional engineers participating in today's filing were alive when the current rules were prepared, but most of them probably had a hand in writing the 1939 rules. It is fitting that they should spearhead the move into a new era.

This inquiry will lead to the issuance of a Notice of Proposed Rule Making (NPRM). Input from interested parties to the current NOI is welcome, and will be encouraged again when the NPRM is issued. The commission listed 18 separate rules that are pertinent to this inquiry. The NOI's scope is not limited to these rules, however, and interested engineers are at liberty to raise other related issues that they feel require examination. If you have had problems with some FCC requirements for AM DAs, or feel that there is a better way to make certain measurements or calculations, now is the time to speak up.

A different world

A great many of the directional antenna systems designed and installed from 1939 through approximately 1965 were located in wide open spaces, far from towns and other developed areas. It was unusual to find power and telephone lines immediately adjacent to the array. Buildings and other potential reradiators were not normally close by. Over the years, however, these problems have been introduced and now require solutions.

Battison, *BE's* consultant on antennas and radiation, owns John H. Battison and Associates, a consulting engineering company in Loudonville, near Columbus, OH.

The rules in question have been amended many times, usually as a quick fix. This has resulted in rules that work, but they fail to provide the technical guidance and regulation that is required.

Today, there is another problem to contend with that we did not have in 1939 — the EPA and its regulations, which many find illogical and nonsensical. It is probably beyond the scope of the current NOI to cover EPA-related issues, but it wouldn't hurt if some filings included such concerns within their comments.

The current rules concerning DAs were mostly written in 1939, so an update is clearly in order.

Previous changes

A few years ago, the FCC adopted sweeping changes in the AM rules. These were designed to facilitate the introduction of the extra 100kHz at the top of the broadcast band (the so-called *expanded band*), and to reduce co-channel and adjacent-channel interference.

The rule changes reduced the amount of interference allowed. In many cases, this has required re-engineering of arrays and has put a crimp in new applications.

Every RF engineer knows of at least one case where a directional pattern was designed to provide interference-free service, but that satisfactory operation was extremely hard to obtain. Typically, the required minima and CP-directed maximum radiation on various radials could not be achieved.

Why did that perfect theoretical array prove to be so hard to tune? Probably because the power company put up a high line close to the site, or a tall building went up, or perhaps a cellular phone tower went up and the FCC missed its adjacency to the new DA site. Maybe a gravel pit went in close by, and its tall derricks going up and down at random intervals produced changing minima. Or, perhaps just reradiation from an unsuspected wire cattle fence was enough to spoil the pattern.

In the past, such occurrences were accepted as part of the hazards, and all possible steps were taken to avoid them. The rules also provide a small latitude in extreme cases. The long-defunct MEOV (maximum expected operating value) was a lifesaver to many consulting engineers. Today the *standard pattern* is supposed to cover all eventualities. If all else fails, there is the *augmented pattern*, but this is truly a last resort.

The NPRM will seek a method of anticipating some of these problems, and also try to find better ways of calculating directional patterns. New antenna designs also may be explored. Vertical radiation is one of the major obstacles in the design of DAs. This has become doubly important today with the end of daytime-only operation.

Your comments sought

The FCC is asking interested engineers to consider the current rules referring to DAs along with any others that are considered relevant. The commission also has established a set of general criteria outlining the scope of the NOI that may extend beyond these rules. These criteria include the following issues:

A) Instrumentation requirements, documentation, frequency of measurement and calibration, parameter limits and measuring points.

B) Measuring protocol in the field, distances, parameters and repeatability.

C) Theoretical vs. measured parameters, resolution of differences, precedence of theoretical over measured.

D) Effects of various structures in the vicinity of the array. Can effect be calculated, or must measurements be made? Should new measurements/calculations be made when local conditions change?

The aim of the NOI is to weed out unnecessary measurements and rules, and to eliminate those that impose an unnecessary financial burden on licensees. Reply comments are due by Sept. 7, 1993. Refer to Docket No. MM 93-177. Further information can be obtained from Joe Johnson at the FCC, at 202-632-9660. ■

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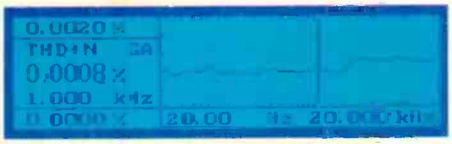

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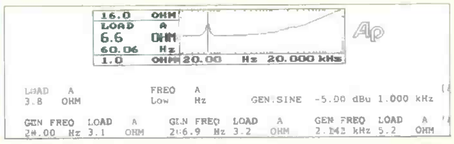

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Part 3

Management for Engineers

The thinking worker

Participative management

By Judith E.A. Perkinson

The owner of a small business was tired of the unrest and back-biting between his staff. He was even more tired of having to make every decision and handle every problem. He had taken management classes and tried to apply the techniques at work, but felt that his staff just didn't care and was unwilling to work with him.

This man had no idea how to implement a working participative system. He did not have the nuts and bolts necessary to put those ideas to work.

Key elements

Communication and structure are two critical elements that must exist in order to provide a system that encourages the thinking worker. They also provide a system in which a manager can tap into the resources of thinking workers.

Communication

Communication must be a 2-way street. Unfortunately, most of us are products of the autocratic management system.

Traditional autocratic management systems are founded on one-way communication: The supervisor tells the subordinate what to do, and the subordinate performs the duty without question. As management techniques evolved, subordinates were allowed to ask clarification questions to ensure they understood the request. However, these questions did not include any input from the employee.

An effective participative work environment relies on mutual communication. A good manager can make this happen.

Seeking input is the first step

In Part 1 of this series, we talked about giving workers permission to think. Part of that process involves managers asking for input. It may be as simple as asking an employee what he thinks should be done when a problem is presented to him. The first step is to communicate to the employee that you are interested in his input. Ways to make that happen include:

1. Encourage employees to offer suggestions or solutions when they come to you with problems.
2. Bring your staff together to provide information when a problem occurs.
3. Ask your employees for suggestions when you identify a problem.
4. Establish problem-solving and work improvement teams.

Remember, if your employees do not know you are willing to listen, they will be less likely to tell you their ideas.

Perkinson is a senior member of the Calumet Group Inc., Hammond, IN.

Listening: the lost art

In order for communication to be complete, listening must take place. As a manager, the key to productive listening is to listen to what is said, not just to what you want to hear. Make a serious effort to *listen* to your employees:

- *Stop and listen.* Take time to hear what your employees say. Listening to your subordinates should not be an imposition on your busy schedule, it should be part of your management responsibilities.
- *Concentrate.* Concentrate on hearing what people are saying. Don't second guess. Don't assume you understand.
- *Feedback.* Confirm the information you are hearing. Don't leave communication to your interpretation.

Systems

Many managers believe that they have a 2-way communication system established with their workforce. In reality, many of these systems are accidental or casual communication systems:

"I have an open door."

An open door policy can be good because it encourages staff to approach the manager with problems, ideas and suggestions. However, it does not go far enough. This policy requires the employee to come to the manager. Sometimes, an employee may not feel comfortable approaching his boss. So, you should be willing to take the initiative. Don't depend upon the employee to take the responsibility of approaching you.

"We have all kinds of committees working on problems."

There is an old saying about corporate America, "If you want to kill an idea, assign it to a committee." A committee cannot work until there is a structure that makes it work. Two common mistakes made with committees include:

- *Lack of structure.*

Often, ideas, suggestions and problems are assigned to a committee, but the committee generally has a vague purpose, with no time frame and no working structure.

Committees should have a specific purpose, with a time frame and access to the resources to accomplish the task.

- *Responsibility not opportunity.*

Once the committee has a clear direction and purpose it is common for members to add this responsibility to an already busy schedule.

If your are serious about making a committee work, then make it an opportunity not a burden.

Institutionalizing 2-way communication

Take the accident out of communication. Three key elements are necessary to institutionalize 2-way communication.

1. Predictable opportunity. Reserve a time for initiating communication and encourage employees to use it.

2. Feedback on results. The office suggestion box has become a joke, because managers don't bother to let employees know what happened with the suggestions. If you ask for input let your employees know what you did with the input. Even if you do not use the idea, let it be known.

3. Develop the necessary skills. One of the most damaging mistakes a manager can make is to assume that their employees know how to problem solve.

Next month, we will look at developing skills for a participative workforce. ■

Any management questions?

This is a chance for you to voice your management concerns and have them addressed in upcoming columns.

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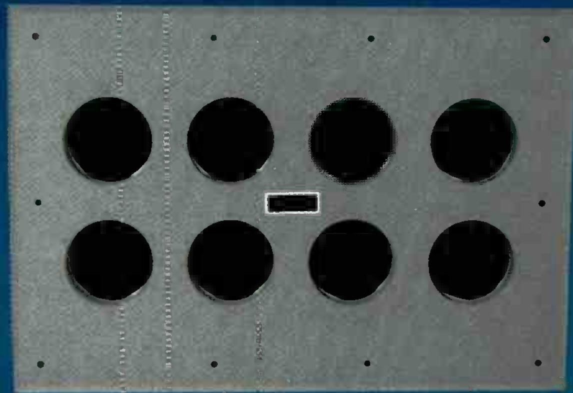

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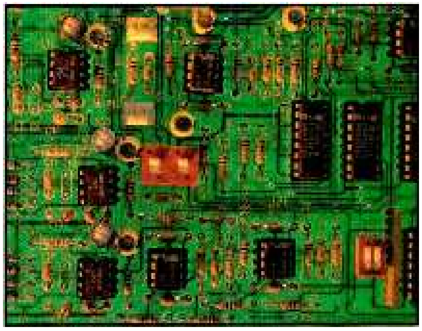
Part 2

Circuits



Serial communications

RS-422 and RS-485

By Rodney W. DeMay

Last month, we covered the basics of RS-232, an unbalanced data transmission system. This month, we will cover two standards for balanced systems, RS-422 and RS-485. These systems have a generator (usually referred to as a driver or transmitter) and a receiver.

Balanced line drivers

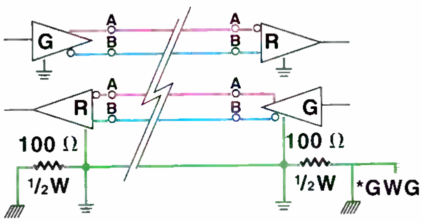
In a balanced differential system, the voltage produced by the driver appears across a pair of output terminals, A and B. The balanced line driver produces a voltage from ±2V to ±6V. When the voltage of the A terminal with respect to the B terminal is negative, the line is in a binary 1 (MARK or OFF) state. If it is positive, then the line is in a binary 0 (SPACE or ON) state. A signal ground connection is necessary to keep the common mode voltage at the receiver within the required -7V to +7V range. Circuits can operate without signal ground, but may not be reliable.

A balanced line driver also can have an enable signal that connects the driver to its output terminals. When not enabled, the driver is basically disconnected from the transmission line. An RS-485 driver must have the enable control signal. An RS-422 driver may have this signal, but it is not always required. The disconnected or disabled condition is usually referred to as the *tristate* condition. If two or more drivers are enabled on the same transmission line, the state of the signal will be unknown. Although it will not damage the drivers, it should be avoided.

Balanced line receivers

A balanced differential line receiver senses the voltage state of the transmission line across two signal input lines, A and B. If the differential input voltage is greater than +200mV, the receiver will have a specific logic state on its output terminal. By reversing the input voltage to -200mV, you create the opposite logic state on the receiver's output terminal. The 200mV to 6V range is required to allow for attenuation on the transmission line. A receiver may have an enable signal, but it is not required.

DeMay is an R&D engineer for B & B Electronics, Ottawa, IL.



*GREEN WIRE GROUND

Figure 1. *Typical 4-wire connection of a simple RS-422/485 system. Note 1/2W, 100Ω resistor between signal and chassis ground.*

RS-422

With RS-422, up to 10 receivers can be connected to a single driver. The device that broadcasts the message is the master, other devices are slaves.

Figure 1 shows a typical RS-422 master/slave connection using TD and RD. Adding more slaves to the system complicates the data flow. Without an enable signal, only one driver per transmission line is allowed, and the data flow is usually limited to one direction—from the master to the slaves. The slaves will be listen-only devices. With software, it is possible to assign each slave an address. The addressing scheme and software protocol varies with systems.

RS-485

The RS-485 standard expands the range of the common mode voltage to a range of +12V to -7V. Some RS-422 drivers, even with tristate capability, cannot withstand this voltage range.

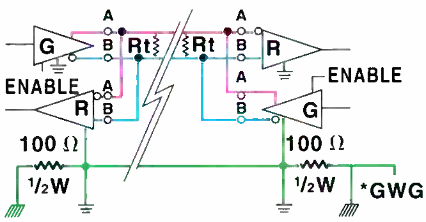


Figure 2. *Two-wire connection between RS-485 devices. Terminating resistors are determined by the system designer, but should not be less than 90Ω.*

With RS-485, there are basically two methods of connecting devices. One is a 4-wire mode, which is identical to the RS-422 connection shown in Figure 1. In a 4-wire network, one node is the master node and all others are slaves.

RS-485 systems also can be connected in 2-wire mode. Figure 2 shows a typical 2-wire network. As many as 32 driver/receiver pairs can share a 2-wire party line network. Because only one device can drive the line at a time, a device must tristate (disable) its driver when it is not transmitting data. The master device determines which device has control of the transmission line. A slave driver is tristated until the master sends a matching address. The slave then enables its driver until the data transmission is complete. After the data transmission, the driver returns to its disabled state.

Transmission line termination

Some systems require a termination resistor to eliminate problems caused by environmental noise, reflections and high data rates. Both standards leave the selection of these resistors up to the system designer. When selecting a termination resistor, the cable type and length, number of nodes and data rate are some factors that require consideration. The resistor should not be less than 90Ω. If a line is driven by a transmitter that is never tristated or disconnected from the line, a termination resistor is not required. The driver provides a low internal impedance that terminates the line at that end. In a multipoint RS-485 system, a commonly used method is to employ a termination resistor at both ends of the line, but not at drop points in the middle of the line.

By now, you should be familiar with the basics of RS-422 and RS-485 interfacing. However, several other important aspects need to be considered (cable selection and ground techniques). If you are considering installing an RS-422/485 multipoint system, obtain the application note for further information.

➡ *For the application note covering these topics, circle (302) on the Reply Card.* ■

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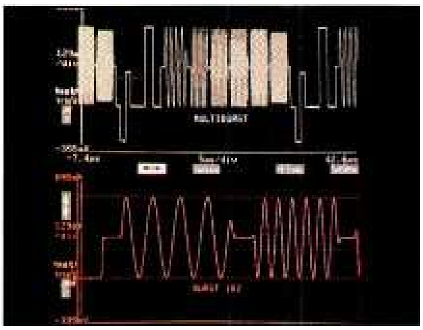
Part 6

Troubleshooting



Care and feeding of coaxial transmission lines

Electrical measurements

By Dean W. Sargent

After documenting and inspecting your system, it's important to know what the system looks like electrically. This will serve as a reference for future measurements. These measurements must be done correctly and provide meaningful information.

The measurement system

In order to get the maximum information about your system you'll need to measure magnitude and phase parameters. This is done with a manual or an automatic network analyzer. The manual analyzer displays information on a CRT or numeric readout. The automatic analyzer displays information on a CRT, but also allows the data to be plotted, printed or stored to a disk for later plotting.

You need to impedance match any transitions used to "get into" the system, and match any terminations used to terminate the measured device. It's important to know what your system measures, not what it looks like modified by any unmatched transitions used in the test setup.

Begin by installing your input transition on one end of a *reference line* and a termination on the other end. This reference line should be a length of standard transmission line with no insulators on the inner to affect its impedance.

Using the network analyzer

The network analyzer is then connected to this system. Adjust the matching devices on the transitions and termination for a match.

In the measurement setup a directional coupler is used in conjunction with the network analyzer. This will provide the reference magnitude and phase for comparing with the reflected power. Results are then displayed on the instrument. If an automatic analyzer is used, it can automatically calibrate the analyzer/directional coupler. This is done by installing first a calibrated short, then open and finally a termination on the directional coupler.

The analyzer stores the characteristics of these devices and can correct the measured data accordingly. This allows it to remove the effects from the instrument and directional coupler from the measurement. By using this method, transition-matching devices are adjusted to match the transitions. If a manual instrument is used, these matching devices also will have to consider the effects of the directional coupler in addition to the transition. Because of the position of the coupler and the transition, it may not be possible to get as good a match on the combination as would be possible on just the transition.

Three basic measurements should be made on the transmission line/antenna system.

When this calibration method is used, it's important that the entire configuration setup characteristics be stored in the instrument.

Making basic measurements

Three basic measurements should be made on the transmission line/antenna system: 1) measure the transmission line alone with a termination at the antenna point, matched at your frequency; 2) measure the antenna without the transmission line, and; 3) measure the transmission line and antenna together.

The measurement of the transmission line will be different than the antenna and the transmission line and antenna.

Because the transmission line is long, there will be numerous places where discontinuities can occur. If this were plotted on a Smith Chart, you'd see many circles, one on top of the other. The largest circle would show the maximum VSWR value. If the circles were off center, they would indicate an input mismatch and by how much.

Although there is some information that can be used from this type of plot, it's probably better to plot it in VSWR vs. frequency. If the system's magnitude and phase data are stored on a disk it becomes a simple matter to later plot the results.

Another useful measurement used in conjunction with the VSWR plot of the transmission line is a TDR plot. If a TDR measurement is to be of any value, it must have good enough resolution to display every bullet and preferably every insulator. This requires the TDR to send an extremely narrow pulse through the line. The narrower the pulse, the more energy at higher frequencies are in the pulse.

If components in the system are "narrowbanding," such as optimized elbows or an antenna, energy that was out of the channel will show up as a discontinuity. Because coax has a cutoff frequency, you should not sweep higher than the point for the size of your line. Stay below this cutoff point or the results will be inaccurate.

If the VSWR measurement is good, the TDR measurement is of little value. If, however, the VSWR measurement results are poor, the TDR can help you find the offending component or components. The VSWR and the TDR measurements should be made with the line terminated, not with the antenna connected. The termination was matched to the frequency and any of the components that are matched also will be narrowband. The results should be obvious. The antenna won't tell you where the end of the line is, but the termination will.

Once the transmission line is measured and stored on disk, it's now time to see what the antenna looks like. Now the transmission line can be calibrated out of the results.

Because you're looking at your antenna, you'll want to see its impedance as well as the VSWR. This measurement can be plotted in the Smith Chart format.

Now that you have the data from both the transmission line and the antenna, you need to see them together. To do this, you have to go back to the original calibration when the instrument and directional coupler were calibrated out, and you'll see the line with the antenna. This measurement represents what your transmitter sees, and will be plotted like the transmission line with a termination.

Measured data must be displayed in a manner that will be of the most value. ■

Sargent is president of D.W. Sargent Broadcast Service Inc., Cherry Hill, NJ.

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Image resizing and display

By Curtis Chan

Graphics and video windows are becoming priority design issues in everything from computers to advanced digital television. High-quality window resizing is fast becoming a requirement. The amount of circuitry required to implement simple algorithms is considerably less than that required to implement the more complex algorithms. With limited system real-estate available, the challenge is to find the balance between simple and complex algorithms.

A resizing solution

A new chip (Genesis gm865X1) from Genesis Microchip Inc., Markham, Ontario, Canada, has been developed that addresses the problem. The chips use a patented algorithm developed by NorthShore Labs Inc., Princeton, NJ. They are targeted for markets between workstations and high-end PCs and are compatible with MPEG, JPEG and Px64 compression standards.

The 68-pin CMOS PLCC chip provides on-chip memory for digital filtering and advanced interpolation. It is capable of real time resizing and has up to 65 taps for filtering, using 9-bit coefficients. The taps can be used in any combination, and with four user-defined parameters, image-size can change in increments of 1 pixel and/or 1 line. Aliasing is minimized, and maximum high-frequency content is retained by selecting the optimum filter for a selected window size or display resolution.

What you see is what you get

Communications theory helps in understanding how the chip functions. During image reduction, artifacts appear because the output bandwidth is smaller than the input bandwidth. The information causing aliasing resides in the part of the signal's baseband above the output image's Nyquist frequency. A 10% image reduction means 10% of the input signal's spatial frequency must be eliminated. The challenge is to fractionally bandlimit the target image's signal independently in both directions, cutting off all baseband above the Nyquist frequency. Simply put, it means finding the right 10%. The algorithm accomplishes this by applying advanced interpolation techniques, selecting the number of taps required and calculating the correct coefficient for each tap. Another advantage of the architecture is the ability to segment the image that is to be resized. The segments can be sent to different chips and seamlessly reconstructed.

Image magnification poses a challenge in the ability to moderate image distortion. The Genesis chip addresses this issue by applying a slightly peaked filter to sharpen the resized image.

Chan is principal of Chan & Associates, a marketing consulting service for audio, video and post-production, Fullerton, CA.

Mirrors on a chip

Texas Instruments has announced a new screen display technology that uses microscopic mirrors mounted in a RAM array to form an image. Although just a technology showing, the prototypes can already handle NTSC and PAL images with HDTV on the horizon. Present prototypes can handle 640x480 or 768x576 pixel images. In one experiment, an NTSC image was projected onto a 60-inch screen at a distance of 12 feet with a reported 50:1 contrast ratio. Claimed advantages include flicker-free operation, better color convergence, more lifelike colors and less visual noise.

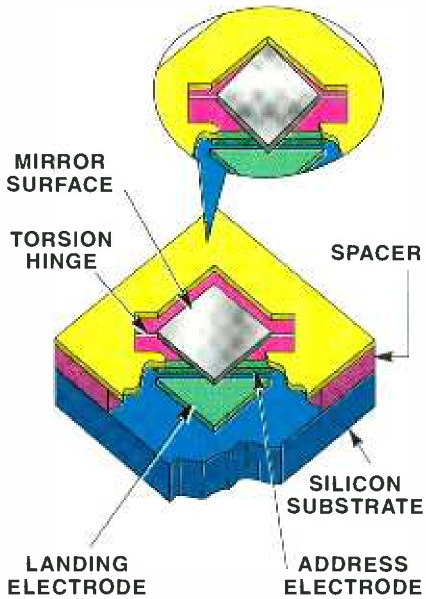

Figure 1. Detail of TI DMD chip showing micromirror mounted above a single RAM location. Mirror tilts in response to the data stored in RAM.

The technology uses a digital micromirror device (DMD), which is a modified random-access memory chip. The DMD is laid out as an array of storage cells. A reflective aluminum alloy square is suspended two microns above each cell. Because the reflector is so close to the storage cell, it is sensitive to the electric charge in the cell. The mirror twists, depending upon the state (0 or 1) of the cell. To turn the array into a display device, light is beamed across the array's surface. The light reflects in one direction or another, depending upon whether the array is given a 1 or 0 state. The result is a pattern of light or dark pixels. To make it viewable, a lens is placed along one of the light paths.

From gray scale to color

For color displays, red, green and blue light sources are fired briefly in sequence. In operation, the DMD is loaded with the desired bit pattern prior to a color flash. As the flash rate increases, the observer's eyes merge them into a continuous image. The intensity of the image is achieved by varying the time that each pixel (reflective micromirror) is on. A short fraction of the color interval for dim values and larger fractions for higher brightness.

Cost is the key

A DMD chip has the same basic cost structure as RAM. However, because of the additional steps needed to grow the mirror structures, it's about twice as expensive at any given level of production. Before the DMD makes its entrance into the broadcasting arena, expect TI to hone its manufacturing skills first in areas that are not as sensitive to price, such as aircraft cockpit displays and medical and industrial imaging. ■

SHED A FEW UNWANTED POUNDS

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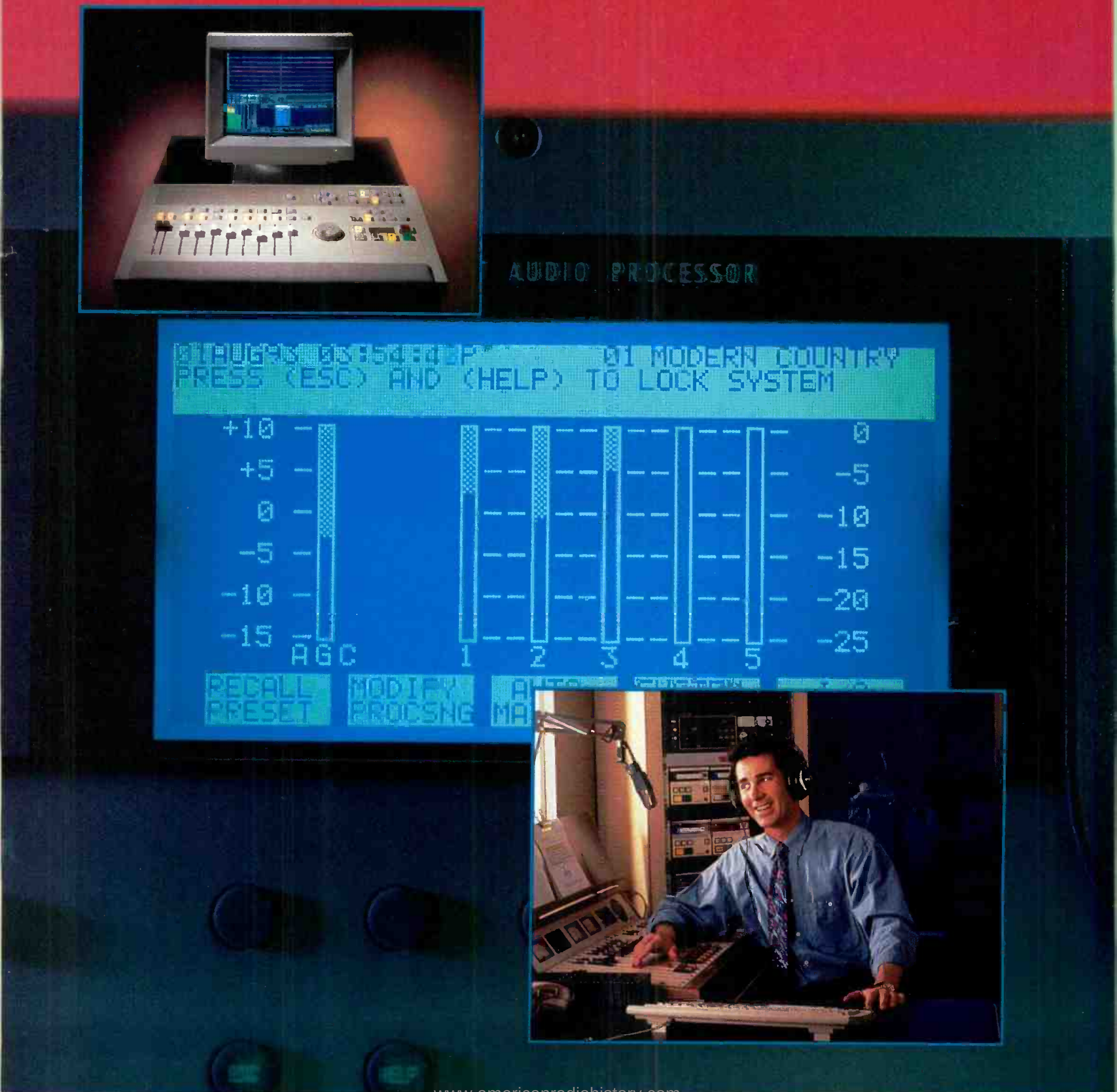
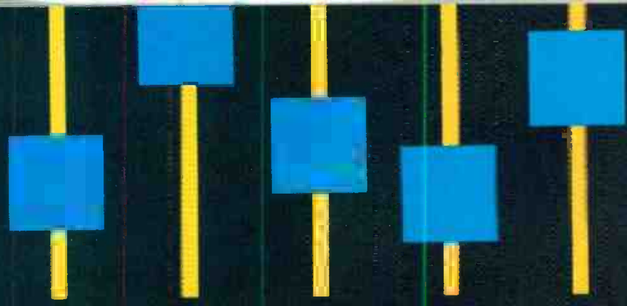
*The GY-X2U weight is 13 pounds not including lens and battery.

Audio technology update

Consumers are familiar with the high quality available from digital audio — and broadcasters must meet that expectation with equally superior sound.





It wasn't long ago that audio was synonymous with analog. Analog signals used to be stored on tape or LPs. Now, digital audio is stored on tape or CDs. Thanks to the CD, consumers see "digital audio" as the key phrase identifying the highest quality audio signals. In fact, the advent of the CD player probably did more to push forward the acceptance of digital audio and set the standard by which other audio signals are measured than any other audio innovation.

Because the consumer readily identifies digital with a superior product, broadcasters and program producers need to meet that expectation with their products and programs or risk losing market share. Fortunately, finding solutions to this challenge isn't difficult. With the wide range of digital hardware products available, the difficulty is often in choosing the correct product for a particular application.

This month's issue looks closely at several important audio topics, with an emphasis on the advantages provided by digital technology. Once an audio signal is converted into its digital equivalent, almost magical transformations are possible. In "Digital Audio Effects," the author reviews many of the tools available in audio processing and effects.

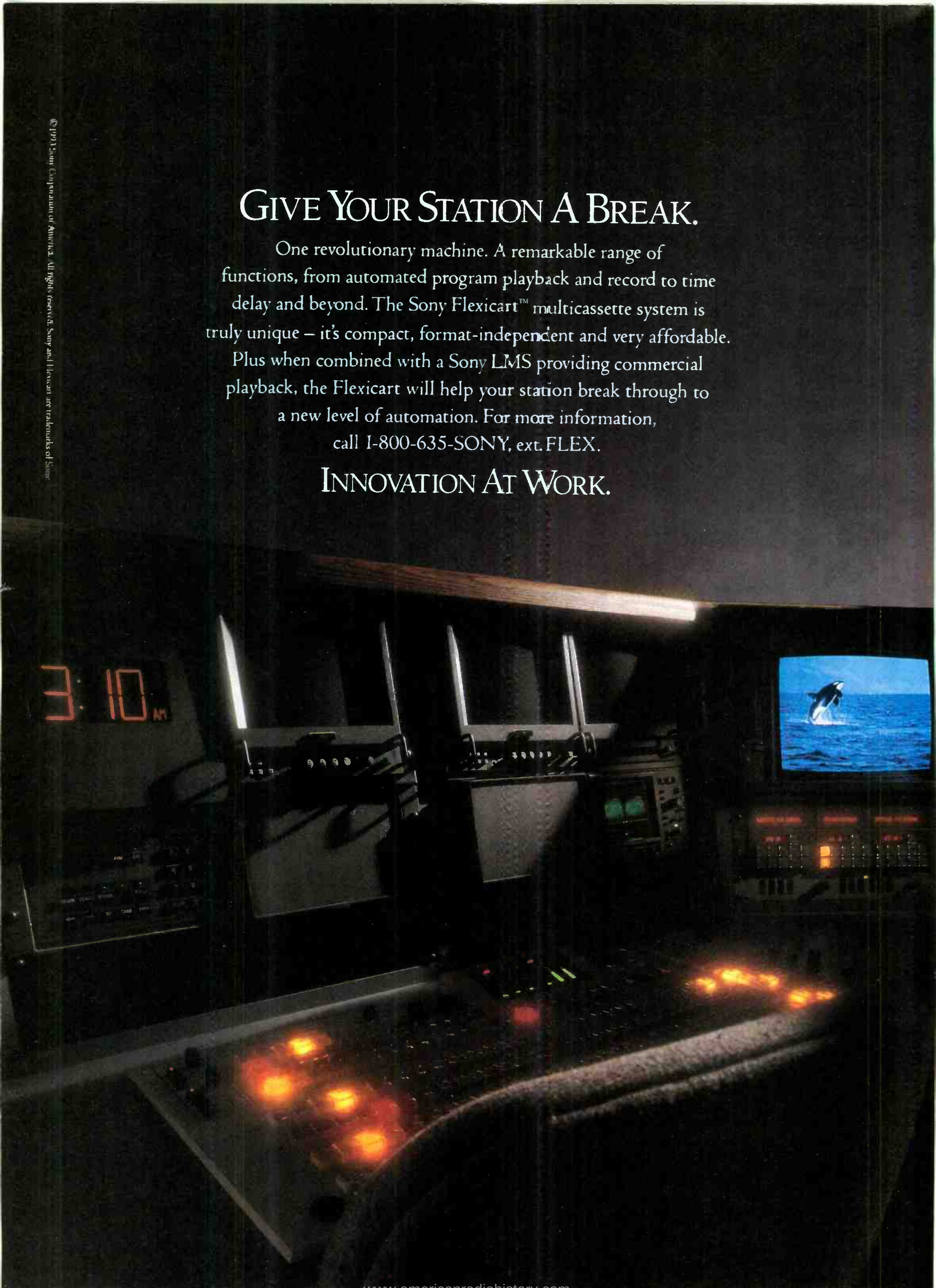
Continuing *BE's* tradition of exhaustive coverage of leading-edge issues, technical editor Skip Pizzi provides the industry's best coverage on digital audio workstations. In his feature, "Digital Audio Workstations," you'll learn about the latest available features and how to select a unit that is best suited to your particular application. Because purchasing a DAW is a significant investment, the article also includes a complete list of DAW manufacturers, their products and a summary of features.

One of radio broadcasters newest challenges — digital audio broadcasting (DAB) — is looming on the horizon. Radio station managers and engineers must understand how their facilities will be affected by this new technology. "DAB: Radio's Rising Star" details the proponents, their systems and projected implementation costs. Begin learning how you can plan for your station's digital future.

Although digital audio can solve many problems, there is always the need to provide a good acoustic environment for audio recording and broadcasting. "Acoustic Noise Control for Broadcasters" provides readers with basic guidelines on proper studio acoustics. Don't let a minor shortcut by your builder damage the final performance of your new studios. Know what to look for in the beginning.

Brad Dick

Brad Dick, editor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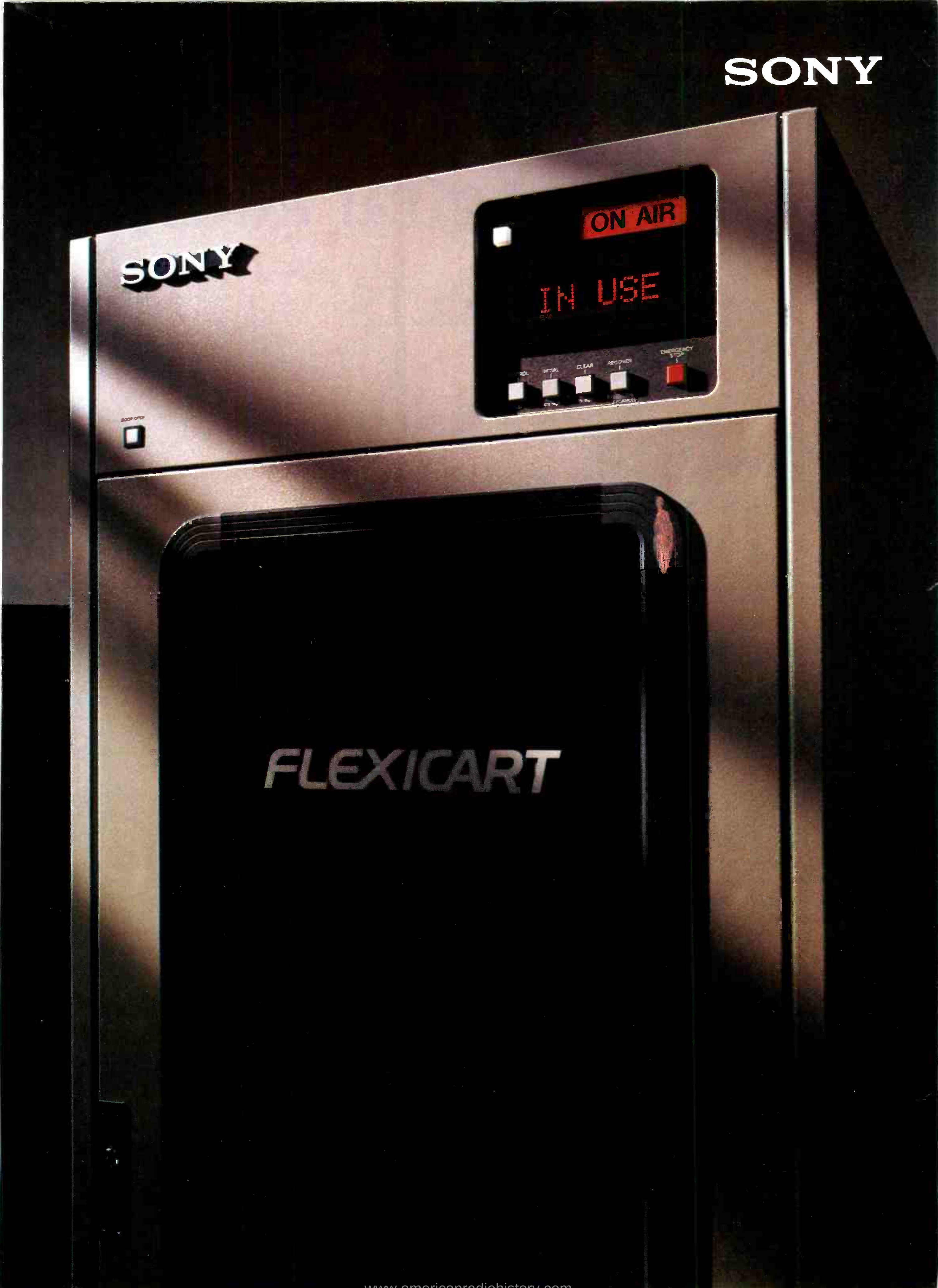
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Digital audio effects

Audio processing power gets stronger and more accessible.

By Curtis Chan

The Bottom Line

Audio production has changed dramatically since the early days of broadcasting. Today's software-driven digital signal processing (DSP) allows nearly infinite manipulation of sound in real time. New integrated platforms are making such processing even more affordable. Digital technologies are now starting to challenge the last analog area of dominance — the mixing console. Broadcasters and post facilities will all benefit from these developments by finding new equipment with improved features, versatility, performance and price.

Chan is a principal of Chan & Associates, a marketing consulting service for audio, video and post-production, Fullerton, CA.

The power of digital audio systems for signal manipulation rests in a technology that is generically called *digital signal processing* (DSP). To put it in its most basic form, DSP is defined as a process by which an analog (continuous) signal can be represented by its approximate digital equivalent (discrete instantaneous values uniformly spaced in time), and subsequently manipulated and output in a predefined manner. Recent advances in theory and application of DSP can be attributed to the developmental boom in VLSI circuits, as well as to the proliferation of the general-purpose computer.

These performance enhancements include increased throughput rates, reduced circuit complexity, heightened reliability and greater yields.

Although it is not the objective of this article to discuss DSP theory in detail, it is worthwhile to examine one of the primary building blocks of DSP — the *digital filter* and its relationship to the manipulation of sound.

It's all in the filter

A digital filter is simply a formula (or *algorithm*) for changing a bitstream's characteristics in a defined manner. Any audio processing function can be performed by digital filters implemented within a DSP system. (See Figure 1.) So in DSP terms, a filter is more than just a frequency rolloff. When implemented properly, a digital filter can arbitrarily reshape the nature of a sound in the amplitude, frequency and/or time domains.

The major advantages of digital filters are good numerical accuracy, programmability, stability in the presence of changing environmental conditions, suitability for multiplexing, and convenience for processing data that is directly available in binary form. Some of their disadvantages are relatively high per-unit costs, frequency limitations imposed by the speed of the digital hardware, and the necessity for a significant amount of clocking and control circuitry to sequence their binary operations properly.

Within certain limits (which continue to be pushed outward), it is easy to see how any kind of audio processing function can be performed through the arrangement of DSP devices, and how the resulting processing is wide-ranging, powerful and easily reconfigurable through software control. The crucial question is whether DSP architecture is significantly advantageous over equivalent analog circuitry in terms of processing power or cost-effectiveness.

DSPs galore

The basic DSP platforms used for audio come in 16-, 24- and 32-bit resolutions. Most applications use 24- or 32-bit designs. The 24-bit types of fixed-point DSPs can process typical 16-bit audio data without overflow errors that occur when using 16-bit DSPs. Performance peaks at 140 million operations per second (MOPS) at 40MHz, allowing up to seven operations in 50ns. Higher-order DSPs offer 32-bit precision, some of which incorporate floating-point operation for wider operating range. These platforms are used extensively in multimedia environments that can sup-

Advanced wireless intercom system

Vega Q600

- **Rugged, reliable, metal beltpack remotes**
- **Hybrid UHF/VHF operation to conserve scarce VHF frequencies**
- **Inexpensive VHF monitor receivers to lower system costs**
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- **Up to six beltpacks per master station**
- **Designed specifically for broadcast and production**
- **Directly compatible with all standard wired intercoms**
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In the studio or on the set, Vega's wireless intercom systems are the choice of professionals who demand ruggedness, reliability, broadcast-quality audio, and a full set of professional features. Designed from the ground up for broadcast and production work, the Q600 UHF/VHF system provides all the functions and technical capabilities required for these demanding applications.

The Q600 system provides continuous, full-duplex, hands-off communications between up to six people plus an unlimited number of "listen-only" users.

The QTR-600 beltpack remotes are extremely easy to use and provide operation similar to that of hard-wired intercom beltpacks. They are compatible with popular dynamic or electret headsets, such as Beyer, Clear-Com, and Telex. The cases are welded aircraft aluminum alloy with a high-impact, molded Cycolac (ABS) control panel that will withstand the roughest use.

One QX-600 master station supports up to six QTR-600 remotes with "hands-free" two-way communications, and an unlimited number of PL-2 receivers for listen-only users. Circuitry is provided to interface external line audio with the system or to link two QX-600s into a 12-user system. The master station is directly compatible with all standard wired intercom systems such as Clear-Com, RTS, ROH, Telex, and many others via internal programming switches. A local headset position and extensive control, adjustment, and monitoring provisions are also included.

The PL-2 VHF mini-receiver provides a high-performance, low-cost solution to providing one-way "listen-only" communications. Very often, individuals need to receive instructions but are not required to speak. Using PL-2 receivers for this application avoids the expense of additional full two-way remotes and can significantly lower the cost of a typical system. The PL-2 is fully compatible with the Q600 system and is designed to provide reliable communications in the most demanding RF environments.

When the job demands hands-free, full-duplex operations in the most demanding environment, go with the Vega Q600, the system recommended by professionals worldwide.

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port graphic, audio and communication functions. Typically, they can perform up to 200MOPS at 40MHz, with up to 10 simultaneous operations.

Such operating capacities would seem to be more than adequate until you consider the manipulation of up to 72 channels of digital audio, real time effects processing (equalization, compression/expansion, reverb, gating), internal housekeeping and control logistics, timing, and interfacing to the outside world, which constitute just the basics of what a modern digital console is required to do. Thus, the fully digital mixing console defines the epitome of DSP design today.

A variety of DSPs exist that fit almost all price and application requirements. Some of the areas of interest to broadcasters include reverbs, effects processors, noise eliminators, sampling systems and mixing consoles. Although broadcast applications have been ongoing in some of these areas for several years (see "Digital Audio Production Tools," July 1992), audio mixing in the digital domain has been given serious consideration only recently. This is due in part to the increased use of digital audio recording in the audio and video post-production environments. It also stems from greatly improved cost-effectiveness of late in digital mixing hardware.

Recent developments in digital mixing

The first digital audio mixers appeared in the mid-1980s. However, their generally prohibitive costs and marginally improved capabilities over state-of-the-art analog designs kept them from achieving widespread acceptance. More recently, advancements in digital signal processing technology have allowed significant gains to be made in the performance/price ratio of digital mixers, along with improved capabilities, intelligent user-interfaces, integrated processing and overall versatility.

With today's DSP and computer technology, digital mixers can be tailored for each application, in essence creating a virtual console approach. Modular and expandable hardware configurations allow systems to accommodate facility growth and maximize affordability.

A few manufacturers have taken a hybrid approach, whereby selected models of existing analog consoles can be retrofitted with external hardware that applies digital control as well as partial audio path replacement with DSP. This can provide digital control, quality and functionality at a lower cost than a full console replacement would require, while retaining the familiarity of existing control surfaces.

As detailed earlier, current DSP platforms allow many audio processing functions to be handled by a single chip. In a digital mixer environment with multiple DSPs

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The first quiet multichannel UHF wireless.

Fact: Due to problems inherent to UHF technology, like phase noise and residual frequency modulation, UHF wireless systems tend to be noisy.

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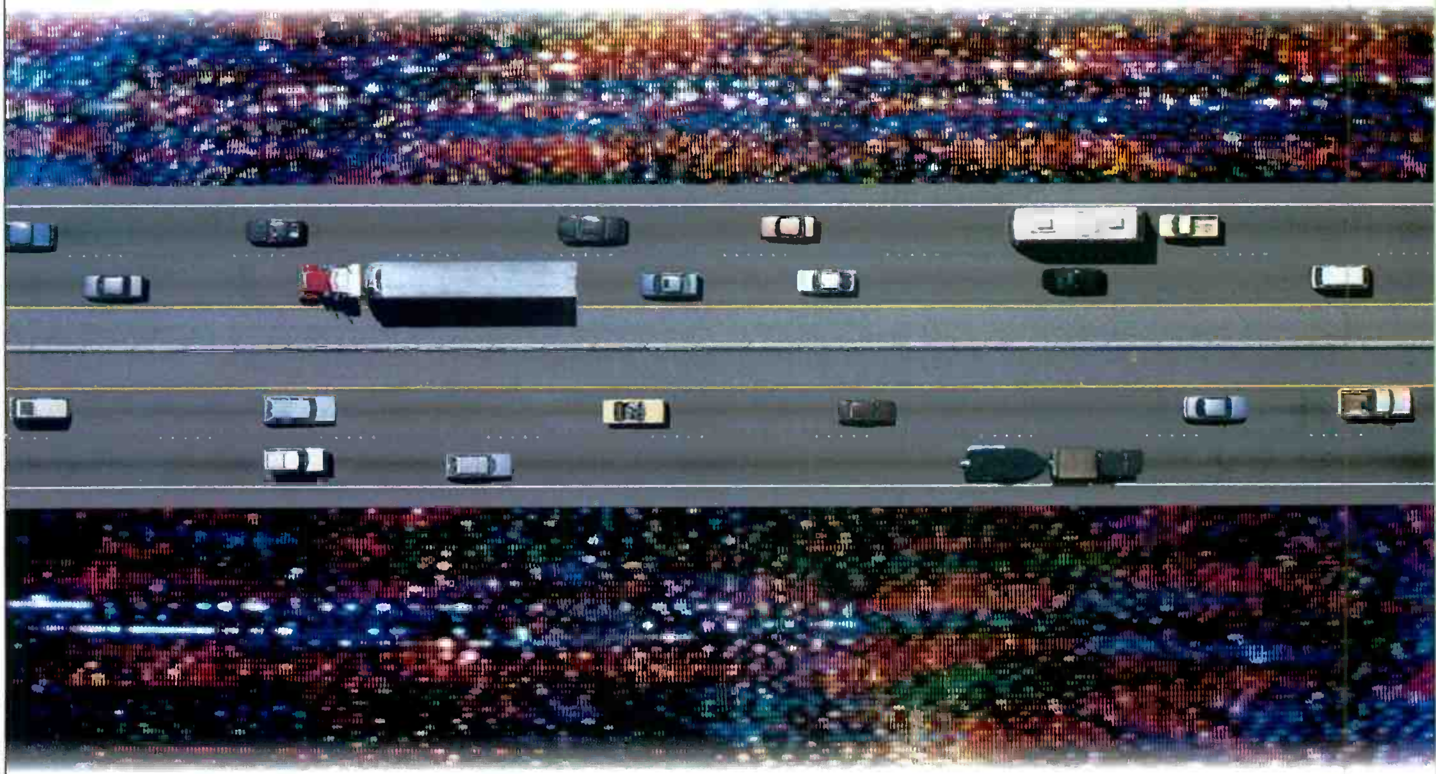

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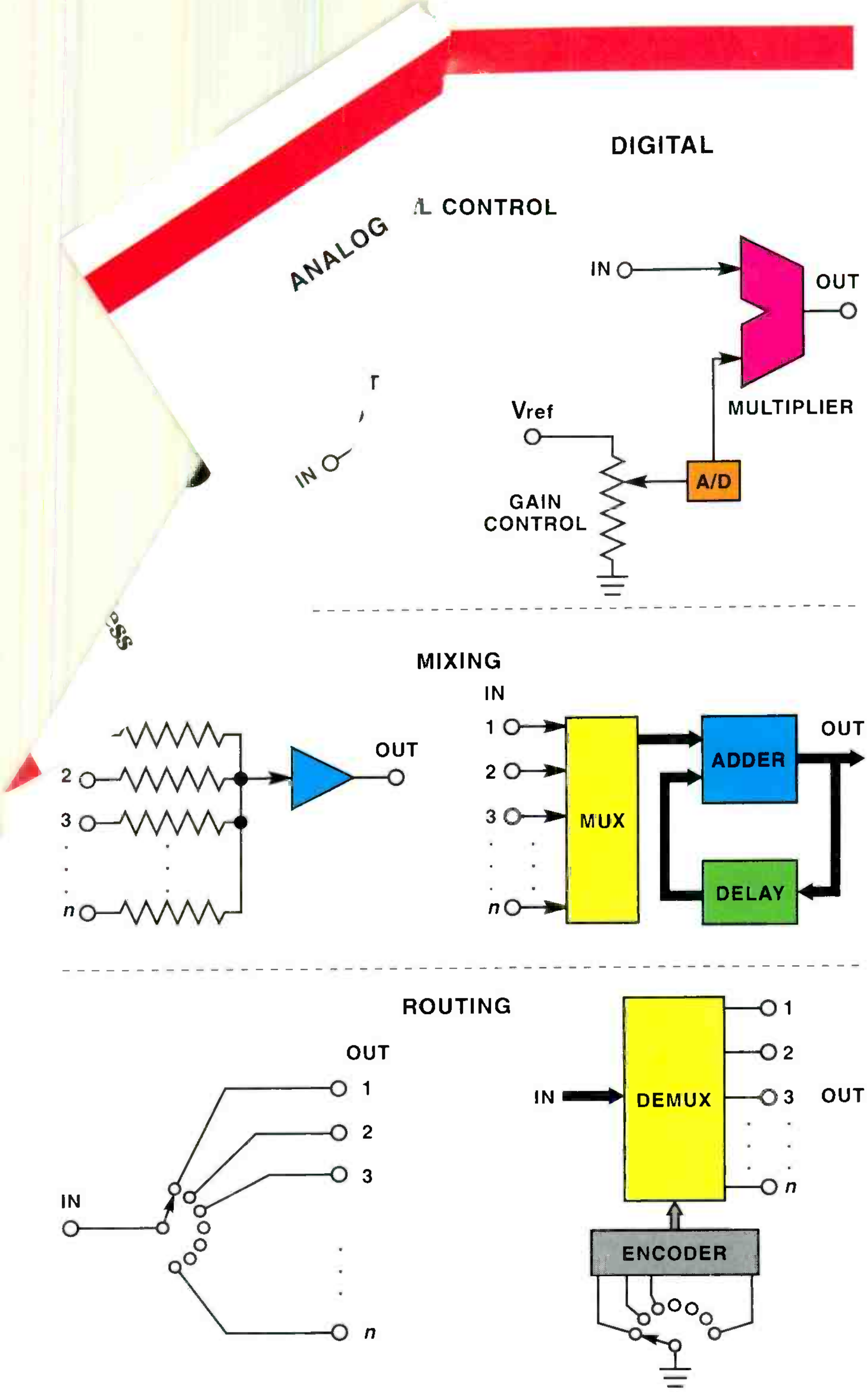

Figure 1. A few basic audio processing tasks in their digital and analog forms. (From Advanced Digital Audio, *Ken C. Pohlmann, editor.)*

running in tandem, on-board digital effects are added to the level control, panning and routing features expected on any console, along with the potential for automation of some or all parameters.

Furthermore, many digital consoles allow analog and digital inputs and outputs (I/O). Analog signals are sent through an analog-to-digital conversion (ADC) block prior to DSP operations and output through a digital-to-analog conversion (DAC) block for recording (if required) or for monitoring. Similarly, digital input signals are sent directly to the DSP block, and either output directly in digital form or re-routed to the DAC block for analog output. (See Figure 2.)

Integrating digital mixers in the studio

Digital mixing consoles must not only deal with timing and control of signals internally, but also allow for easy interface

Continued on page 82

Digital au workstation

The workstation world is becoming a friendlier and l expensive place.

By Skip Pizzi, technical editor

The Bottom Line

The digital audio workstation (DAW) has moved from a hothouse plant to a staple crop in the audio industry. The collective experiences of DAW designers and users are paying off as systems become less expensive, more powerful and easier to use. Most important to the broadcaster is the trend toward greater DAW integration with the rest of a facility and its operations. One by one, the downsides of DAWs are being dealt with, making them ideal platforms for an increasing amount of broadcast production.

Perhaps no single issue challenges broadcast technologists today more than the move from conventional production styles to the use of digital, non-linear workstations. Questions of cost/benefits are clouded by "compared to what" complications, while productivity analyses are mired in worries about user-friendliness and operator training. It is anything but an empirical decision, mixing many qualitative and quantitative matters.

In particular, the stark hardware differences between digital audio workstations (DAWs) and their predecessor technologies are so profound that they quickly drive broadcasters wide of their comfort zone. It is only with extended and repeated exposure to these devices that industry veterans have begun to seriously consider DAWs in their facilities.

To aid in that examination, the following is a quick look at some of the parameters that should be explored by prospective workstation purchasers, along with some information about the areas that are currently undergoing development in the DAW industry.

Doing your homework

The best place to start your evaluation is not with the products, but with your facility's process. What is it that you do, and what are the limiting factors to doing it better, faster or cheaper? The answers to these questions will tell you if a workstation might help. If the answers show that your growth is limited by current hardware, the costs of operations, insufficient production time or lack of space, consider the DAW solution.

Next, fine-tune your analysis with an idea of what specific uses you might have for a DAW. Many different systems are available, and no two are alike, either in exactly what they can do or in how they do it. Emphasis is on the latter, which is why operations staff input and hands-on demonstrations are particularly important — but those come later. Some narrowing of the field is important first.

For many, this prospect seems akin to someone who has spent his entire life in the desert going shopping for a boat. The marketplace is so foreign to such an observer that subtle nuances and specific applicational advantages of individual devices might go completely undetected. Nevertheless, after a bit of study, it becomes apparent that DAWs are just new tools — tools that may be worthwhile not because they are new, but because they are better. This is the fundamental criterion by which a DAW should be judged: Can it make the work of this facility improve in terms of quality, cost-effectiveness, speed or flexibility? Can it help satisfy the client? Can it make the staff more productive and/or creative? Can it help this business do its job better and prosper?

The "Workstations at a Glance" table on p. 38 is designed to provide a cursory overview of the major workstations currently available. Only a few items among the many details of these systems are listed, but they have been specifically chosen to help make some broad judgments on which DAWs might be most worthy of further examination for a particular application. (A more complete examination could easily fill the space taken by this table for each workstation.) For example, the number of channels offered by a system and its strengths in certain operational areas should help in your first cut. Reply Card numbers can help supply you with more information.

Checking with manufacturers for prices also should be an early step to save you from evaluating any systems that are out of your budget. Many of these systems are quite modular in design, allowing the user to configure them to specific needs and budgets. It is best to have some basic functional requirements ready when you begin price checking. The capacities listed in the table are generally the maximum possible for each system, so check for the availability of smaller (i.e., lower-priced) configurations if your situation allows (or demands). See "The Table Explained," p. 38, for more details on interpreting these values.

What to look for

One way to get a handle on the spectrum of possibilities, as well as various systems' strengths and weaknesses, is to see how different products handle the same functions. For example, some systems use proprietary computer platforms while others use popular desktop models. (Systems running on IBM and compatibles, Macintosh, Atari or Amiga are all available.) Among the desktop DAWs, some use the computer's microprocessor as a host, while others simply use the computer as a control and display device, with actual audio processing taking place in proprietary peripherals. Naturally, these variations affect system costs, capabilities and operating speeds.

Another area of difference is the variety of user-interface styles. Displays range from small LCD screens on rack-mounted panels to high-resolution color video on large monitors. Control options exhibit an even wider spectrum of possibilities, including the standard computer keyboard and mouse, touchscreens, tablets and proprietary surfaces, the latter incorporating hard keys, soft keys, assignable faders/knobs, transport controls emulating tape decks or other conventional devices, and even motorized faders.

Also compare how editing and mixing are handled. Most edits are considered crossfades by digital systems. Some systems crossfade in real time between two separate audio data files (or *tracks*), while others write a new crossfade file and insert that at the edit point during playback (the so-called *non-real time* approach). Although editing may take a bit longer with the latter method, real time editing requires twice as many audio tracks to be managed simultaneously because two tracks are active for every channel crossfaded. Again, this can affect system cost. Mixing is similarly handled along these disparate lines — some systems manage real time mixing of multiple tracks (*dynamic* mixing) while others rewrite data into new *mix files* first, then play those files back (*static* mixing).

Additional variables to consider in DAW mixing include whether the mixing is performed in the digital or analog domain, whether automated mixing is included and, if so, whether the automation is of the snapshot or dynamic type, and which parameters, (faders, EQ, panning, sends, routing, etc.) are stored.

A basic decision that is driven by your facility's needs is the number of inputs, outputs, tracks and channels you require in a DAW.

Find out how the system handles audio storage. Access time constraints of disk drives limit the number of simultaneous tracks that can be managed on a single drive. Many multitrack systems use parallel disk structures, by which separate groups of tracks are handled by separate drives (typically four tracks to a drive). Most of these systems require proprietary disk drive/control units. (See Table 1.) In actual broadcast productions, the amount of recording time required on some tracks (e.g., narration) is much greater than that required by others (e.g., sound effects). In such cases of disproportional track-time distribution, some parallel disk systems allow more efficient use of total drive capacity than others. A related matter concerns maximum recording time of the system. Some DAWs define a fixed upper limit, while others do not.

A basic decision that is driven by your facility's needs is the number of *inputs, outputs, tracks* and *channels* you require in a DAW. Unlike conventional multitrack systems, quantities of those four parameters are not inextricably linked in DAWs. In other words, it is common to find what is called a 16-channel DAW system (i.e., 16 simultaneous channels available during playback) with four audio inputs, eight audio outputs and 256 tracks. This means that up to 256 separate audio files (sometimes called *virtual tracks*) can be maintained, but only 16 of them can be played back at any one time. (A system's simultaneous playback capability is sometimes referred to as its number of *real tracks*). Internal mixing or routing would be required on this DAW to reduce the number of simultaneous audio output channels to eight or fewer. The unit also would be limited to recording four or fewer channels at a time.

For broadcast production, this disengagement of inputs and operating channels/tracks is handy, because most productions' audio elements are assembled to a multitrack storage medium serially (one or two at a time). Contrast this to music-recording applications, where many tracks — and therefore audio inputs — are required in parallel (all at once). The number of channels on a DAW also need not be matched by an identical number of outputs for most broadcast production applications, if adequate internal mixing features are provided. Space requirements and cost are both potentially reduced by these configurabilities.

Internal channels or tracks can be maximized to what production projects actually require, without necessarily increasing the hardware's input and output (I/O) porting correspondingly. (The number of simultaneously available internal channels on a DAW is defined by the read/write speeds of the disk drives and data interfaces/buses.)

Note that the number of simultaneous internal channels available during recording may be less than the number available during playback on some systems. The latter number (i.e., channels available for mixdown) is typically more important for broadcast-style production.

Examine a system's upgradability in this context. Although the attribute of upgrading is routinely touted in computer-based systems, such flexibility can only go so far in DAWs. Most systems offer software revisions that can add features and perhaps some speed. Yet, hardware limits will be reached at some point in every system, beyond which no further upgrades are possible.

To counteract this problem, a growing number of DAWs allow modular hardware upgrades that provide additional operating channels and I/Os, and some offer optional audio processing modules as field-installable hardware/software packages.

Audio processing is an area of divergence among DAWs. Even though all systems offer editing, and a large number offer mixing in some form, the audio processing complements found on DAWs can range from non-existent to extensive. Let your situation dictate what you need in this area. The possibilities include equalization, dynamic-range control, reverberation and other time-domain effects, pitch-shifting, time compression/expansion, sampling-rate conversion and file-format conversion. Systems that do not include numerous internal audio-processing features generally provide sends for external application of these techniques.

Interfacing

As the workstation becomes the new heart of the production room and simultaneously integrates the functions of what were previously separate devices, it must be interconnected into a variety of domains.

First is audio, where I/O exists in analog and digital (typically AES/EBU format)

Continued on page 41

Networking for digital audio workstations

By Gary Hall

Broadcast and production engineers are becoming accustomed to the speed and flexibility of random-access audio systems. But today's systems are isolationist, requiring that material be loaded and unloaded at or near real time. Local area networks (LANs) for computers provide a model for the next logical step in digital audio systems' evolution.

Networking has already transformed business, linking desktop PCs into powerful systems. In many environments, the office LAN has become indispensable. Audio workstations also can be linked into high-speed networks, in which storage, processing, source materials and work output are shared and available to all. But there are substantial differences between the needs of business networking and those of media, such as audio or video.

The demands of audio

Business LANs are designed to handle users who peck at keyboards and occasionally transfer files or messages. To provide the same transparency of access, networks for a continuous medium, such as audio, must meet some special criteria.

The first issue concerns bandwidth. Digital audio is a dense medium, and practical network applications demand numerous channels simultaneously and in real time. Analysis indicates the need to support work groups of anywhere from two to 75 stations, with a range of four to 100 total audio channels on the network. Table 1 shows some network capacity estimates for a few typical industry environments.

Continued on page 42

Hall is technical support manager for Sonic Solutions, San Rafael, CA.

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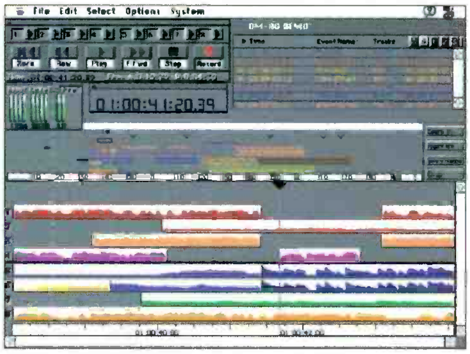


Optional DM-80-S Multitrack Manager control for the Macintosh®— easy to learn, fast to use.

the Word.

Problem is, many DAWs just can't give you all of these things.

Here's why:

Problem: Some systems use a single computer for graphic user interface *and* for audio information processing. This slows the whole system down, and makes you wait.

The Answer: A workstation that separates the hardware "engine" from the user interface computer. This way, audio information processing is not slowed down by the user interface, and the interface computer operates without the load of additional tasks. And you save time and money.

Problem: A system crash in the middle of a complicated project could cost you as much in time lost as some of the less professional DAWs are worth. You should expect reliability you can count on from your DAW, and get it.

The Answer: First, call around. Check the reputation of DAWs. We have DM-80s working every day all over the world in high volume production environments. Our customers will tell you they're reliable.

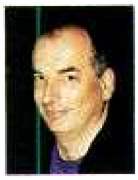
Problem: Some systems don't give you a user interface that's familiar and easy-to-use.

The Answer: Buy a DAW that lets you choose either a dedicated hardware remote that gives you familiar tape recorder controls, or computer software control that is simple to understand and easy to operate.

Problem: Some DAWs are the weakest link in the audio chain. The DAW you buy should deliver sonics as good or better than any piece of audio equipment you own.

The Answer: Choose a DAW from a company that knows professional audio, not just a company that knows computers. But most of all, ask audio professionals who own one.

We believe you'll find all these answers and more in the Roland DM-80 Digital Audio Workstation. Call us at (213) 685-5141, ext. 337, or FAX (213) 722-0911 for a brochure. Or better yet, schedule a demo. You're going to like what you hear.



"The thing is just impossible to screw up! The DM-80's non-destructive editing is the only way to go—revisions are extremely easy, and very quick."

— David Esch
Director of Commercial Production
WPNT Chicago

"Edits fast, sounds great, and doesn't break. The DM-80's multilayering capabilities and simultaneous recording on all tracks gives us the flexibility to do whatever we want."

— Joel Valentine
President
21st Century Sound Design, Hollywood
(*"Northern Exposure"*)

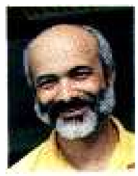
the Word on the street.

"The first DM-80 paid for itself in two months, so we bought a second one... I like the editing ease—no waiting. It's my 'word processor' for audio."

— Michael Stanton
Composer/Arranger
Audio Productions, Inc., Nashville

"The DM-80 is our secret weapon! It's a very enabling technology."

— Maz & Kilgore
Grammy nominated Producers
New York



"What goes in... comes out! And the sound is wonderful. Easy editing, plus easy sync to video lets me concentrate on the creative aspects of the production."

— Richard Freitas
Emmy Award nominated audio producer
The Dovetail Group, Connecticut

"Operational speed and ease of editing make the DM-80 the greatest thing since sliced bread! We use it for all our production."

— Vincent Fumo
Senior Editor
Independence Blue Cross, Philadelphia

"The DM-80's power and speed allow me to complete a half-hour television documentary every week. As an investment, the DM-80 has proven to be a very smart choice."

—Jim Heffernan
Emmy Award winning Sound Designer/Producer
Videosmith, Inc., Philadelphia
(*"1st Flights With Neil Armstrong"*)

Roland®
ProAudioVideo

Circle (21) on Reply Card

WORKSTATIONS AT A GLANCE

MFR	SYSTEM	#CH	EDT	DSP	MIX	NET	MC	MED	TC	CMNT	PLTFM	RS#
Akai	•DD1000	2/4	+	+	/		/	MO	+	1,2	Prop	320
AKG	•DSE 7000	2/8	+		+		/	RAM	O	3,5	386	321
AMS Neve	•AudioFile Optica	2/4	+	/			+	MO	+		Prop	322
	•AudioFile Spectra	8/24	+	/	+		+	PHD	+	4	Prop	
Augan	•408 OMX	4/8	+	/	/		+	MO	+	5	Prop	323
Avid Technology	•AudioVision	8/8	+	+	/	/	+	HD	+	6,7,8	Mac Quadra	324
CEDAR Audio	•CEDAR Prod. System	2/4	/	+	/			PHD	/	5,6,17	386	325
D2D Systems	•D2D Edit	4/8	+	+	/	/		HD	/		Atari Falcon	326
Digidesign	•Audiomedia II	2/4	/	/				HD	/	8	Mac II	327
	•Pro Tools 2.0	16/16	+	+	+	/		HD	O	6,8	Mac	
	•Session 8	8/8	/	/	+			HD	O	4	386SX	
	•Sound Tools II	2/4	+	+	/	/	/	HD	O	6,8	Mac II	
Digital Audio Labs	•The CardD	2/2	/	/	/			HD	O		386	328
Digital Audio Research	•Sabre	4/8	+	/		/	+	PHD	+	9	Prop	329
	•SoundStation Delta	8/16	+	/	+	/		PHD	+	9	Prop	
	•SoundStation Sigma	8/16	+	+	+	/	+	PHD	+	9	Prop	
Digital F/X	•Digital Master EX	4/4	+	/	/			HD	+		Atari ST	330
	•WaveFrame 401	8/8	+	/	+		/	HD	+	4,10	486/33	
Doremi Labs	•DAWN II	48/48	+	/	+	/	+	PHD	+	4	MacII w/ Sys7	331
Fairlight ESP	•Fairlight MFX-2	2/16	+	/	/		+	HD	+		Prop	332
Future Editing-Equipment Design	•Audio Solutions	2/4	+		/		+	MO	+	4	Prop	333
Korg	•SoundLink	8/8	/	+	+		/	PHD	+	3,11	Prop	334
Lexicon	•Opus	8/8	+	+	+	/	/	PHD	+	3,12	Prop	335
Micro Technology Unlimited	•MicroSound	4/≥4	+	/	+	/		HD	O	6,10	386	336
Otari	•ProDisk PD-464	64/64	+		+		/	PHD	+	13	MacII	337
Pacific Recorders & Engineering	•ADX	32/32	+	+	+	/	+	HD	+	18	MacII	338
Roland	•DM-80	8/8	/	/	+			HD	O	1,3	Prop	339
SADiE	•SADiE Disk Editor	2/8	+		/			HD	+	10	486	340
Sonic Solutions	•Sonic Quattro	64/192	+	+	+	+	/	PHD	+	4,6,14	MacII	341
	•Sonic Station II	64/192	+	/	/	+	/	PHD	+	4,6,14	MacII	
Spectral Synthesis	•Audio Engine	24/24	+	+	+	/	/	PHD	O	4,10	486/33	342
SSL	•ScreenSound	8/8	+	/	+	+	+	PHD	/		Prop	343
	•Scenaria	24/24	+	/	+	+	/	PHD	/	3,7	Prop	
	•OmniMix	24/24	+	+	+	+	/	PHD	/	3,7,15	Prop	
Studer Editech	•Dyaxis Lite	2/2	+		/	/		HD	+		Mac	344
	•Dyaxis I	2/2	+	+	/	/	/	HD	+		MacII	
	•Dyaxis II	24/48	+	+	+		+	PHD	+	16	MacIIci	
Sunrize Industries	•Studio 16/AD516	6/24	/	/	/	/		HD	/		Amiga 2000	345
Synclavier Company	•Synclavier Tapeless Studio	32/32	+	+	/		+	PHD	+	4	MacII	346
Turtle Beach Systems	•56k Digital Recording System	2/2	/	/	/			HD	+	17	286/12	347

THE TABLE EXPLAINED

#CH - Number of channels. The data is expressed in two values. The first is the maximum number of audio inputs ***or*** simultaneous channels supported in record mode, whichever is smaller. (This determines how many channels can be recorded at once.) The second value (following

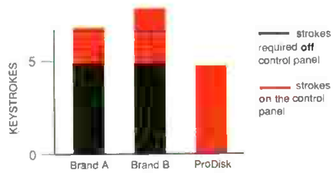
FAMILIAR TERRITORY... WELCOME HOME!

The most powerful digital audio workstation is now also the easiest to use with the introduction of our new Hardware Control Panel.

The CB-158 control panel is designed to work specifically with the ProDisk 464 and its easy-to-use GUIDE editing screen -- this combination gives you the speed you need to save time, and money.

This new control panel places all recording and editing functions on dedicated keys, greatly simplifying the editing process and dramatically reducing the learning curve. And it provides machine control of up to 4 external video or audio decks!

Call Otari at (415) 341-5900 for more information about the easiest to use DAW on earth!



Otari's ProDisk 464 is fast and easy to use. Here's proof: To record a file and trim head and tail,* it requires fewer total keystrokes. Even more significantly, ProDisk lets you work totally on the control panel while its two competitors force you to supplement with either keyboard or mouse.

*Comparison of many other functions show similar keystroke savings.

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United Kingdom
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Otari Deutschland GmbH
Sales and Marketing Europe
(Germany) 49/2159-50861
Fax: (Germany) 49/2159-1778

Otari Singapore Pte., Ltd.
(65) 284-7211
Fax: (65) 284-4727

Otari Corporation
Foster City, CA
(415) 341-5900
Fax: (415) 341-7200

Otari N.E. Sales
N.Y., N.Y.
(212) 297-6109
Fax (212) 986-1952

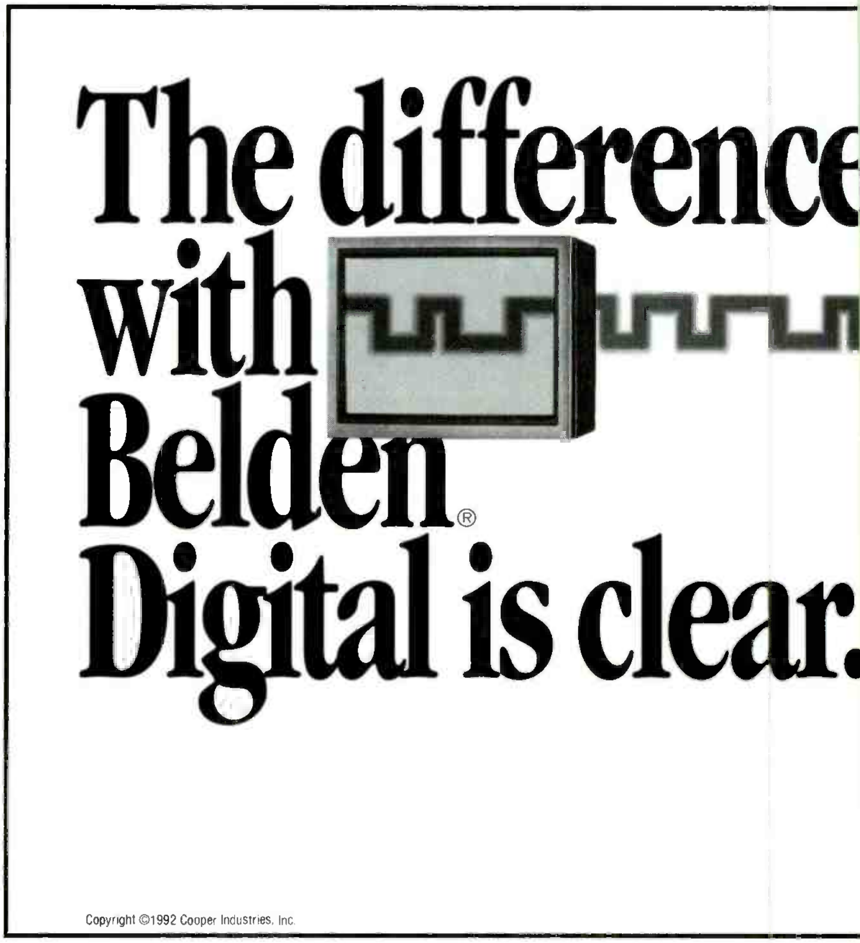
the /) refers to the maximum number of simultaneous channels supported in ***playback*** mode. (This is equivalent to the number of "real" tracks or internal audio channels in the system for routing or mixdown operations. It is perhaps the most significant single number for comparison of systems' channel capacity in broadcast production. The number of actual audio ***outputs*** available in the system may differ from this value.)
EDT - Editing. Systems with some editing capability are listed with a (/). Systems with significant editing capability receive a (+).
DSP - Digital Signal Processing, referring here to audio processing capability, such as equalization, gain reduction, reverberation, time compression, sample rate or format conversion, pitch shifting and other special effects. Systems with some capacity are listed with a (/), while systems with significant capacity receive a (+).
MIX - Mixing. Systems with some mixing capacity are listed with a (/), while systems with significant real time, dynamic mixing capacity receive a (+).
NET - Networking, referring to data bus interconnection between multiple workstations of the same type. Systems with some networking ability are listed with a (/), while systems with significant networking capacity receive a (+).
MC - Machine Control, referring to the workstation's ability to control or be controlled by external devices, such as VTRs, video editors, CD recorders and audiotape recorders. Limited machine control is listed as (/), while higher capacities are noted (+).
MED - Media, referring to the system's ***primary*** storage media (other media types can often be substituted). HD = hard-drive, MO = magneto-optical, PHD = proprietary hard drive (user cannot add off-the-shelf drives), RAM = random access memory.
TC - Time Code, referring to the system's ability to read and/or generate time codes, the number of codes recognized, and how the system can respond to them (i.e., trigger or chase-lock). Systems with some capacity are listed with a (/), More versatile systems receive a (+), and systems where time-code functions are optional are noted with (O).
CMNT - Comments. See list below.
PLTFRM - Platform, referring to the host computer associated with the system, if any. Platforms listed are the ***minimum*** required, as specified by workstation manufacturers. Systems that do not use a standard desktop computer are listed as "Prop" (proprietary platform).
RS# - Reader Service Number. Circle on Reply Card for more information from manufacturer.

COMMENTS:
1) Optional *Macintosh* control software offered.
2) Up to 14 units can be ganged together for multitrack-like operation.
3) Hard fader control surface as standard equipment.
4) Hard fader control surface as optional equipment.
5) Background uploading offered.
6) Offers optional noise-reduction or restoration software.
7) Includes synchronized random access video.
8) Third-party software available.
9) Foreign language dubbing-assistance software offered.
10) Display operates under *Microsoft Windows*.
11) Integral 16-track MIDI sequencer as standard equipment.
12) Lower-cost *Opus/e* includes console without hard fader control.
13) Removable hard disk as standard primary media.
14) Supports 20-bit audio resolution and optional CD-mastering soft/hardware.
15) Includes specialized busing, panning and processing for surround sound.
16) Optional *Dolby AC-2* data reduction offered.
17) Does not include A/D or D/A converters. I/O is AES/EBU or SPDIF only.
18) Combines Doremi Labs *DAWN II* with proprietary control hardware.

RULES FOR INCLUSION IN THIS LISTING:
1) Only systems whose primary application is ***production*** are listed. This means that "cart replacement" or automation systems are not included, even though they might incorporate some digital editing capabilities. Also not included are digital audio cards providing A/D and D/A conversion and/or data compression only, or those designed for multimedia/computer-game applications. Pure third-party software offerings also are not listed, nor are hardware systems that operate purely as MIDI-based sampler/sequencer peripherals. Finally, systems designed for use with the recently discontinued *NeXT* computer as a host platform are not included in this listing.
2) The systems must be available for delivery as of mid-July 93.
3) They must be readily available in the USA.

SOURCES:
The Tapeless Directory, 3rd edition, by Yasmin Hashmi and Stella Plumbridge; manufacturers' literature and comments; user comments; product demonstrations.

❑



Continued from page 34
varieties. Check a system's quantities of each form (digital vs. analog) — they will not always match. In fact, a few systems do not include any analog I/O as standard equipment.

Next comes synchronization, where DAWs can be versatile. External word-clock synchronization is offered on some units, allowing the DAW to be slaved to a house digital audio sync (or *audio black* as it is called in some video post environments). SMPTE or VITC generation and/or synchronization is offered on many systems, either as standard equipment or as an option, allowing a DAW to serve as master reference or slave to a VTR.

Prospective purchasers should check which frame rates are supported and how wide a speed-variation range in time-code reference signals can be tolerated. Some systems offer only trigger-locking to reference signals, while others provide chase lock. Several DAWs also reference to and/ or generate MIDI time code (MTC).

An emerging area of interface for workstations is that of *machine control*. Many systems can control or be controlled by external devices, typically VTRs and ATRs. A few models offer CD-recorder control interfaces. Automated/assistive software is included in some systems for VTR-looping and other automated dialog replacement (ADR) functions. Most DAWs with machine control offer it via RS-422 serial interface (often in the Sony 9-pin protocol). MIDI also is featured on a few systems for external device control, and some systems allow MIDI sequencer programs to be run compatibly on the host computer alongside the DAW software.

A special case of machine control offered by several DAW systems is *edit-decision list (EDL) autoconforming*, whereby a video editing system's EDL can be imported (typically via floppy disk), and the DAW can then control and record audio from external VTRs based on the list's time-code addresses. Various editing systems' EDL protocols are supported by different autoconforming DAWs. A further refinement offered by a few systems is *VTR emulation*, where the DAW substitutes itself for the VTR's audio tracks and is directly controlled by the video editor in an on-line arrangement.

Finally, a few systems offer the most recent introduction to the workstation interface-option matrix: *networking*, whereby multiple workstations of a given variety can be interconnected via a high-speed data bus. (See the related article, "Networking for Digital Audio Workstations," on p. 34.)

Miscellaneous features

Several other items are worth examining among DAWs. Check the *backup/archiving* function, in terms of media used and transfer speeds. The latter ranges from real time to five times faster than real time among today's systems. Furthermore, evaluate what data is archived. Is just the audio data stored, or are edit cues and automated mixing/DSP data also retained?

In addition, find out whether the archiving can be done "in the background" while other operations are taking place. Some systems also may allow data to be input (uploaded) to the workstation as a background function. Such multitasking may or may not have a significant effect on the speed of foreground operations.

Finally, note that a few systems offer data reduction (compression) for reducing the disk storage space required. Many include library features for storage management of frequently required materials. Some of these libraries include powerful, database-like searching features.

What's next?

These processes that have been listed should be only the beginning of your evaluation. With such a range of functions and user-interfaces to examine, DAWs are clearly not something you purchase via mail-order. Talk to other users, and try candidate devices out for extended periods in your facility, if possible.

Radio stations also should observe the growing overlap in function between DAWs and digital automation systems. As workstations add lengthier playlist capabilities and networking functions, and digital automation systems add editing and other audio production features, the two product types seem to be approaching the same place from different directions. (See "Radio in Transition: Program Automation Systems", July 1993.) Eventually, an entire station may be based on an audio/data LAN, with nodes that include an automation-like terminal and software in master control, a DAW-style system in the production room and a text/audio workstation in the newsroom, all sharing common networked storage.

This environment may be a long time coming, however. In the meantime, the output of a production facility and its staff may be greatly enhanced by the non-linear, integrated processes of digital audio workstations.

For further comparative information on DAWs, see "The Tapeless Directory, 3rd edition" by Yasmin Hashmi and Stella Plumbridge, available from SYPHA, 216a Gipsy Road, London SE27 9RB, UK. ■

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Most LANs operate at rates between 200kbit/s and 10Mbit/s. At the high end of this range, a few channels of CD-quality digital audio can be supported, provided that the net can operate at near-100% efficiency. (As explained later, this is seldom the case.)

The *fiber distributed data interface* (FDDI) is a high-speed networking standard used in the computer and telco worlds, but it is now finding applications in the audio industry. FDDI and its twisted-pair derivatives provide raw bandwidth of 100Mbit/s. In its fiber-optic implementation, FDDI also is noise-immune and supports extremely long cable runs — up to 2km between terminals and up to 200km on a single ring network.

Data reduction (compression) can effectively multiply bandwidth by increasing the number of channels that may be carried simultaneously on an audio network. Yet, much remains to be done on standardizing the treatment of data-reduced audio. Current reduction algorithms deliver impressive performance, but subsequent audio processing or repeated application of data reduction can increase degradation unacceptably. Therefore, this is not an optimal solution to the bandwidth problem in networks used by the audio production community, where unreduced digital audio signals are preferred.

Network architecture

Business LANs deal in transactions that are not especially time-critical. When traffic is high, transmissions can be deferred. The worst that the user experiences is slow down (clogging) of the network. Digital audio applications require continuous data at a fixed rate. Once a transfer has started, no interruptions can be tolerated, and a digital audio network must be able to guarantee delivery of data.

In a LAN or a digital audio network, terminals or workstations (nodes) are linked by a single electrical or optical connection shared by all devices. A method must be provided for each node to transmit and receive messages and commands. The key to data continuity is the protocol regulating how stations share the network. Two common schemes for controlling network access are *collision detection* and *token passing*.

In collision-detect protocols, individual stations transmit as needed, with minimal regard for stations already using the net. If a message collides with a message from another node, all parties cease transmission, then each again attempts to gain access to the net. Collision detection is reasonably efficient for moderate traffic levels, but efficiency drops markedly when the rate of collision rises. Analysis shows that collision-detect protocols can

Continued on page 84

Do you remember what you were doing on June 17, 1993 at 12:31 ?

DAB: Radio's rising star

Nothing worth having comes easily.

By Skip Pizzi, technical editor

The Bottom Line

As the reality of digital radio broadcasting approaches, activity toward standardization has accelerated. But the path to this goal is anything but straight and level. The stakes are high and not everyone will get a piece of the action. Among the primary players are today's radio stations, which will have to convert and compete in a digital world. Between now and 1995, the die will be cast for the future of radio.

The road toward digital radio broadcasting (or DAB) has been a bumpy one of late. Positive and negative developments have taken place. Although the net movement has been generally progressive, numerous critical questions still remain unanswered. As a result, many developmental time frames and projections have been revised with later target dates.

In the United States, progress has been predictable and mildly productive, but with an increase in political and commercial entanglements, as the reality of digital radio technology looms ever closer.

In Canada, DAB is relatively on plan for continuing development and eventual deployment of its L-band Eureka 147 system. Mexico is seriously considering following the Canadian approach. In Europe, on the other hand, some unexpected and remarkably destabilizing developments have derailed progress and made the digital radio situation far less certain than previously thought. Meanwhile, on several technical fronts, important testing and system evaluations are taking place.

Current testing

Canadian tests of the Eureka 147 DAB format have recently focused on *single-frequency network* (SFN) applications at L-band (1,500MHz). This attribute allows the same frequency to be used in adjacent markets for broadcast of the same programs without harmful interference in overlap zones under some limits. (On a smaller scale, it allows coverage within a single market to be achieved with multiple low-power co-channel transmitters.) It is those limits of SFN application that the Canadian tests are exploring, with largely successful results. (See "re: Radio," June 1993.)

The Canadian plan calls for six CD-quality stereo channels to be multiplexed into a 1.5MHz channel, using ISO/MPEG Layer II (formerly MUSICAM) data reduction. The 1,452-1,492MHz band will be used, with some portions dedicated to terrestrial service and others set aside for direct broadcast satellite radio (DBS-R) transmissions.

In the United States, the Electronic Industries Association (EIA) and the National Radio Systems Committee (NRSC) are moving toward comparative testing of proposed digital radio broadcast formats. This process has been delayed by political struggles within the test committee, and between the committee and system proponents, but such tests are expected to begin by early 1994. The range of format types that will be evaluated also has made design of the testing procedures complex. Three separate methodologies will be included: *in-band/on-channel* (IBOC), *in-band interstitial* (IBI, also referred to as *in-band adjacent*) and *new band* (NB). Further complicating matters is a political compromise reached earlier this year, under which the NRSC's DAB subcommittee will test IBOC formats, and EIA's Digital Audio Radio (DAR) subcommittee will handle the rest of the format proposals. (See Table 1.) In practice, however, essentially the same testing personnel, equipment and facilities will be used for all EIA and NRSC testing.

Both subcommittees will conduct ob-

jective system tests at NASA's Lewis Research Center in Cleveland. The committees are currently negotiating with Canada's Communications Research Centre (CRC) in Ottawa for subjective analysis of the formats' performance. (Audio recordings for subjective analysis will be made during the objective tests at Lewis.) Systems will be evaluated on their overall signal quality and on their performance under a variety of impairment conditions.

Because of the variety of delivery methods among the candidate systems, final output of the EIA/NRSC process (expected in late 1994) may include multiple format recommendations. It will then be up to the FCC to take further action toward standardization and authorization of a digital radio system.

Presently, the EIA is conducting VHF channel characterization tests, collecting data to be used for the in-band formats' testing at Lewis Research Center.

A preview of testing for the NASA/VOA format was conducted at the Jet Propulsion Laboratory (JPL) in Pasadena, CA, on June 17, with impressive results. An S-band transmission (at 2,050MHz) from a geostationary satellite successfully fed 20kHz stereo audio at 256kbit/s (using ISO/MPEG Layer II) to a fixed receiver. Most notable were the DBS-R receiver's use of only a single omnidirectional (short whip) antenna, and its reasonable performance indoors. Furthermore, the satellite used only a 7W transmitter in a 2° spot beam (equivalent to 46.4dBW, approximately 10dB less than what other DBS-R proponents have projected in their link budgets), and the satellite's placement at 62°W gave it an elevation of only 20° at the receive site in Pasadena.

On the international scene, the CCIR (renamed the Radiocommunication Sector [RS]by its parent organ, the International Telecommunications Union) continues its research and plans to finalize its digital radio format standard by late 1994. This favorable convergence of the ITU/RS and EIA/NRSC final reporting dates may create unity in their recommendations.

Eureka reconsidered

Earlier this year, progress toward the establishment of a Eureka 147/DAB format in Europe was dealt a potentially major setback in its home turf. The German radio network ARD declared that it was putting a halt to all plans and projects to implement Eureka 147 until at least 1997, when the matter will be re-evaluated.

The reasons cited by ARD were primarily financial. Although the severe and worsening German recession has cut ARD's government funding, some observers have speculated that money was only part of the story. ARD's analysis of current German spectrum planning for Eureka 147 terrestrial implementation indicated that not all of ARD's current channels might be duplicated by new digital channels in every area now served. The multichannel nature of Eureka 147 transmissions also would mean that ARD's competition (including private commercial stations) could attain equivalent coverage to ARD's signal(s) in a given area, which might imply improved conditions for some competitors. ARD, therefore, may have seen the coming of Eureka 147 as a difficult expenditure during tight times,

and a process that might reduce their service potential while increasing their competition's position. If this analysis is accurate, it seems that the network had no other sensible choice.

Speculation also persists that ARD (and others in Europe) are buying time to wait for U.S. test results of in-band systems. Current plans in other European countries still call for the Eureka 147 format, but unity across the continent regarding DAB largely ends there. Earlier hopes for a common pan-European terrestrial spectrum allocation for digital radio have been scrapped, as France proceeds toward an L-band system (similar to the Canadian plan). Other countries are considering disparate groupings of channels in the upper FM or the VHF and UHF-TV bands. In some cases, these countries plan such moves as only interim or "parking" allocations, with subsequent plans for an eventual common L-band DAB implementation after 2007.

Movement toward DBS delivery of digital radio in Europe is inactive at present. This is attributed to a growing sense that the small, densely populated, multilingual and financially strapped countries are not appropriate venues for a DBS-R system, and that terrestrial distribution makes more technical and economic sense.

Taken as a whole, the current digital radio situation in Europe is divergent. ARD's action seems destined to increase this trend, and the results of current U.S. format tests will undoubtably have their impact, leading to a period of further and perhaps protracted debate. This could thwart any real progress in Europe for the next few years. An expected World Administrative Radio Conference (WARC) meeting on international DAB frequency coordination in 1998 (or sooner) holds perhaps the best hope for possible resolution of growing European digital radio differences.

The current climate at the FCC may have turned against early DBS-R authorization, such that DBS-R will not be established before terrestrial digital radio service is standardized.

Other U.S. developments

On the U.S. domestic DBS-R front, a few quiet movements have taken place. The original field of six applicants (see "re: Radio," March 1993) has been narrowed to four, with two players dropping out or merging with other applicants. Meanwhile, several FCC commissioners seem to have taken heed of calls from the NAB and elsewhere that establishment of the S-band DBS-R service would be harmful to the public interest served by terrestrial radio. Veteran FCC-watchers speculate that the current climate at the FCC may have turned against early DBS-R authorization, such that DBS-R will not be established before terrestrial DAB service is standardized.

On this point, Canada's approach is noteworthy: Although terrestrial and DBS-R services will share a common band and receiver there, terrestrial stations will have a head start, with no DBS-R services allowed until after 2001.

Regarding U.S. terrestrial DAB service, some cost estimates have been developed for radio station conversion. Depending on the format, best-case conversion cost estimates for currently proposed formats range from $45,000 to $60,000 for FM stations, and from $20,000 to $70,000 for AM stations. (See Table 1.) The worst-case estimate for any format at any station is under $100,000. These estimates cover RF-system capital conversion costs. They do not include related studio upgrades or possible increased operating costs that

FORMAT	PROPONENT	METHOD	BROADCASTER COST ($k) AM STATIONS	FM STATIONS	REL. RCVR. COSTS	REL. GOV'T. COSTS
Acorn AM	USA Digital	IBOC-AM	$ 20-60+	$ N/A	High	Low
Acorn FM	USA Digital	IBOC-FM	N/A	60-65+	High	Low
Amati	Amati/AT&T	IBI/IBOC	70-75+	55-75+	Med	Low/Med
AT&T	AT&T/Bell Labs	IBI	70-75+	55-75+	Med	Med
Eureka 147	Thomson (TCE)	NB (L-band)	45-95+	45-95+	Low/Med	High
NASA/VOA	NASA/VOA	NB (S-band)	(DBS-only)		Low/Med	Low

Table 1. *Proposed digital radio formats under consideration in the EIA/NRSC testing program. Conversion costs and relative receiver pricings are based on estimates from other manufacturers, and are not provided by the proponents. Relative governmental costs reflect the varying regulatory burdens for establishing each format. Note that Amati/AT&T system has been proposed as either an IBI or IBOC format, but with reduced capability in its IBOC form. (KEY: IBOC=in-band/on-channel, IBI=in-band interstitial, NB=new band, TCE=Thomson Consumer Electronics.)*

DAB may engender.

Other financial considerations in the DAB transition involve receiver pricing and governmental costs of regulation. Current proposals produce a wide range of projected results, as shown in Table 1.

A final analysis by U.S. broadcasters can only come if and when a standard format is established and authorized by the FCC. Until then, examining the potential financial *benefits* of digital radio service seems worthwhile. This must take place before a standard format is set, because the standard may set hard limits on future service offerings. For example, will qualitative enhancement of existing audio service prove acceptable, or should the potential for a quantitative enhancement to the number of audio services provided by a licensee also be included? Are aural services the only type that will be broadcast, or are there ancillary markets to be served by datacasting? Can DBS-R and terrestrial services exist together? How good does a system's mobile performance have to be? The list of questions goes on. The answers will substantially define the future of the world's radio broadcast service. ■

Examining the financial benefits of DAB seems worthwhile.

Acoustic noise control for broadcasters

Silence is golden, and gold is hard earned.

By Eric Neil Angevine, P.E.

The Bottom Line

In much of today's new construction, lightweight materials and modern methods produce buildings with surfaces so thin that it's easy to hear through the walls. Quiet studios are getting harder to come by, especially in increasingly noise-polluted urban areas. Concurrently, audiences may be increasing their awareness of unwanted noise through improved reproduction systems, quieter cars and listening rooms, and growth of headphone listening. Broadcasters should therefore become familiar with the basics of noise control.

Angevine is associate professor of architecture at Oklahoma State University in Stillwater, OK.

Sound that interacts with a surface must be either reflected, absorbed by the surface or transmitted through the surface. It is this latter element, sound *transmission*, that is addressed in this article.

The amplitude of a sound pressure wave is the most influential factor to subjective human assessment of a sound's loudness. The differential pressures in sound disturbances involved are extremely small compared to atmospheric pressure, but they nevertheless can vary over a wide range. For this reason, a *logarithmic scale* has been developed, which corresponds closely to human reactions to sound amplitudes. The decibel (dB) is the basic unit of *sound pressure level* (SPL). Table 1 summarizes the physical sound pressures (in newtons per square meter) and corresponding SPLs (in dB) of some common sounds.

Spectral issues

A sound wave typically includes components of sound at many frequencies simultaneously. When considering sound transmission, the frequency content of a sound under analysis should be known. For reasons of simplicity, it is common practice to present such spectral sound level data at a series of standard frequencies, which are the center frequencies for a series of consecutive octaves.

Many schemes have been developed to provide a single number that represents an approximation or average of the sound level at all frequencies. The combined total or "linear" sound pressure level provides a particularly poor estimation of the subjective loudness of sounds containing significant energy at low frequencies, however. For this reason, an electronic network is used to modify or weight sound measured by a sound level meter to correspond more closely to the subjective response of human hearing. The most commonly used weighting network follows the *A-weighting curve* shown in Figure 1.

Transmission through barriers

Some of the sound energy that enters a solid material will be transmitted through the material and reradiated as noise from vibration of the material's opposite side. Much of the incident sound energy will be absorbed by the internal damping of the material, reducing the sound level that will be observed on the other side.

The sound transmission loss (TL) is a rating of how much the sound pressure level will be reduced in passing through such a barrier. It is independent of the absolute incident sound level. In general, TL obeys the so-called mass law:

$$TL = 20\log w - 20\log f - 33dB$$

where TL is the loss at frequency of interest (f), and w is the surface weight of the barrier in pounds per square foot of surface area (not the density). The mass law therefore predicts a 6dB increase in the sound transmission loss for each doubling of the mass of the barrier. The second term indicates that all materials will have a greater sound transmission loss at high

frequencies, increasing 6dB per octave (doubling of frequency).

The mass law shows that materials providing good sound barriers are solid and heavy, while those that are sound absorptive are porous and usually lightweight. It is a common misconception that sound-absorptive materials placed on the surface of a wall will increase the TL through that wall. Unfortunately, many have learned the fallacy of this belief the hard way.

Noise control assessments

In order to decide how much sound transmission loss is required of a facility's interior and exterior walls, it is first necessary to establish the expected sound pressure level outside of an acoustically critical enclosure and the desired background sound level within such a space.

Several guidelines exist for rating background noise levels. The most common, and least accurate, is to limit the A-weighted sound pressure level. A-weighted measurements can be provided by a simple sound level meter, but they include no information about the occupied frequency spectrum of the sound being measured — for example, whether it is predominantly rumbly (low frequency), hissy (high frequency), or comprised of a single or a few individual pure tones.

It is more desirable to rate the background noise spectrum measured in octave bands. The most common method of rating noise spectra is the *Noise Criteria* (NC) curve set. Sound pressure levels measured in eight octave bands (centered from 63Hz to 8kHz) are plotted against these curves, which are based on human hearing's spectral sensitivity at various loudness levels (specified in 5dB increments). The NC-rating of the space is selected as the lowest curve not penetrated by the measured noise in any octave band.

TYPICAL SOUND	SPL (dB)	ACOUSTIC PRESS. (N/m^2)
Threshold of hearing (young person at 1,000Hz)	0	0.00002
Broadcast studio (background noise)	20	0.0002
Whisper Nighttime noise level (quiet residential area)	40	0.002
Conversation at 3 feet	60	0.02
Noisy cafeteria Quiet factory	80	0.2
Car horn at 10 feet Noisy factory	100	2.0
Rock band with amplification Jet engine at 500 feet	120	20
Instantaneous damage to hearing	140	200

Table 1. *Acoustic sound pressure and sound pressure levels (SPL) of some common sounds.*

Background sound levels of NC-20 or lower typically are specified for studio spaces. An NC-20 condition means that no room noise in any band appears louder to human listeners than 20dB above the threshold of hearing in that band.

Isolation

As described previously, doubling the mass of a simple barrier will produce only a 6dB increase in sound transmission loss. Thus, it is impractical to improve a simple barrier only by increasing its mass.

On the other hand, two corridor walls each having a sound transmission loss of 30dB should ideally be able to reduce the sound transmission between two rooms on opposite sides of the corridor by approximately 60dB. Following this logic, it should be possible to design a single composite wall whose sound transmission loss is equal to the sum of its component parts. To do this effectively, it is necessary that the various components be independently supported.

Composite walls

While two sheets of gypsum board attached to wood studs (a simple barrier) will have a sound transmission loss only 6dB greater than that of either one alone, the same two sheets of gypsum board can provide nearly twice the TL of a single sheet if they are isolated by resilient lightweight metal channel studs or resilient furring channels.

In designing and building such composite walls, it is most important to minimize the structural contacts between the layers of sound barrier materials. Ideally, the individual layers will not touch each other and will be supported in common only at the edges, but this is not always practical.

When composite constructions cannot provide adequate sound transmission loss, the use of an air buffer, such as a corridor, storage room or any unoccupied air space between two massive barriers, will allow the designer to place an effective, true double wall around an acoustically critical area. (See "Exposing Acoustical Myths," March 1992.)

STC ratings

Many engineers dislike the concept of dealing with sound transmission loss as a function of frequency. It is particularly pointless when single-figure metrics, such as the A-weighted sound pressure level and NC ratings, are being used. The *sound transmission class* (STC) rating is a single-figure value that approximates the sound transmission loss. A note of caution should be made about the indiscriminate use of STC ratings, however.

The determination of STC evaluates the sound transmission loss of a material or construction only at frequencies between 125Hz and 4,000Hz. STC was developed primarily as a tool for evaluating the sound transmission of speech, and it is not valid for noise sources with frequency spectra that extend beyond those limits. It therefore may not accurately estimate TL for sound from mechanical equipment, motor vehicles or even music containing a significant amount of low-frequency sound.

Sound leaks

To provide a high TL, an enclosure must not only be substantial, but also must completely separate the two spaces. This includes floor, ceiling and wall surfaces, as well as doors and windows and the junctions between all these components. Doors and windows seldom provide a sound transmission loss as great as that of the walls in which they are installed. For this reason, the area allocated to doors and windows should be kept to a minimum even when expensive sound-rated doors and windows are used. In general, if windows and doors are of good quality and are installed carefully, their effect will not be serious if they are kept at minimum size and number.

The total TL of an enclosure system is ultimately limited by the quality of con-

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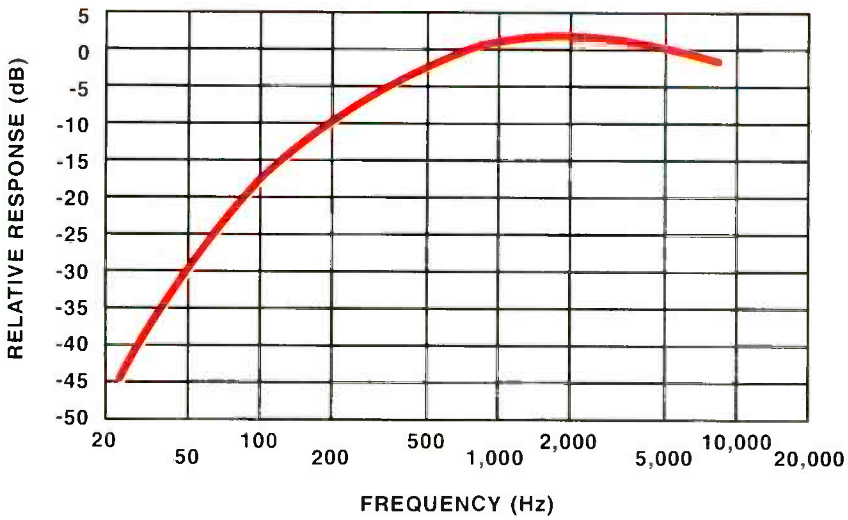


Figure 1. *Frequency response of the A-weighting network used in sound level measurement.*

struction and the sound that enters through construction cracks, weaknesses in materials or small openings. A wall with openings equal to as much as 1% of its total area can provide no better TL than 20dB. To attain a TL of 60dB, a wall must not only be designed for such performance, but also built with openings limited to one ten-thousandth of one percent (a factor of 0.000001) of its wall area. This is equivalent to a 1/32-inch crack beneath an otherwise perfect 3-foot wide door in a wall 320 feet long and 25 feet high.

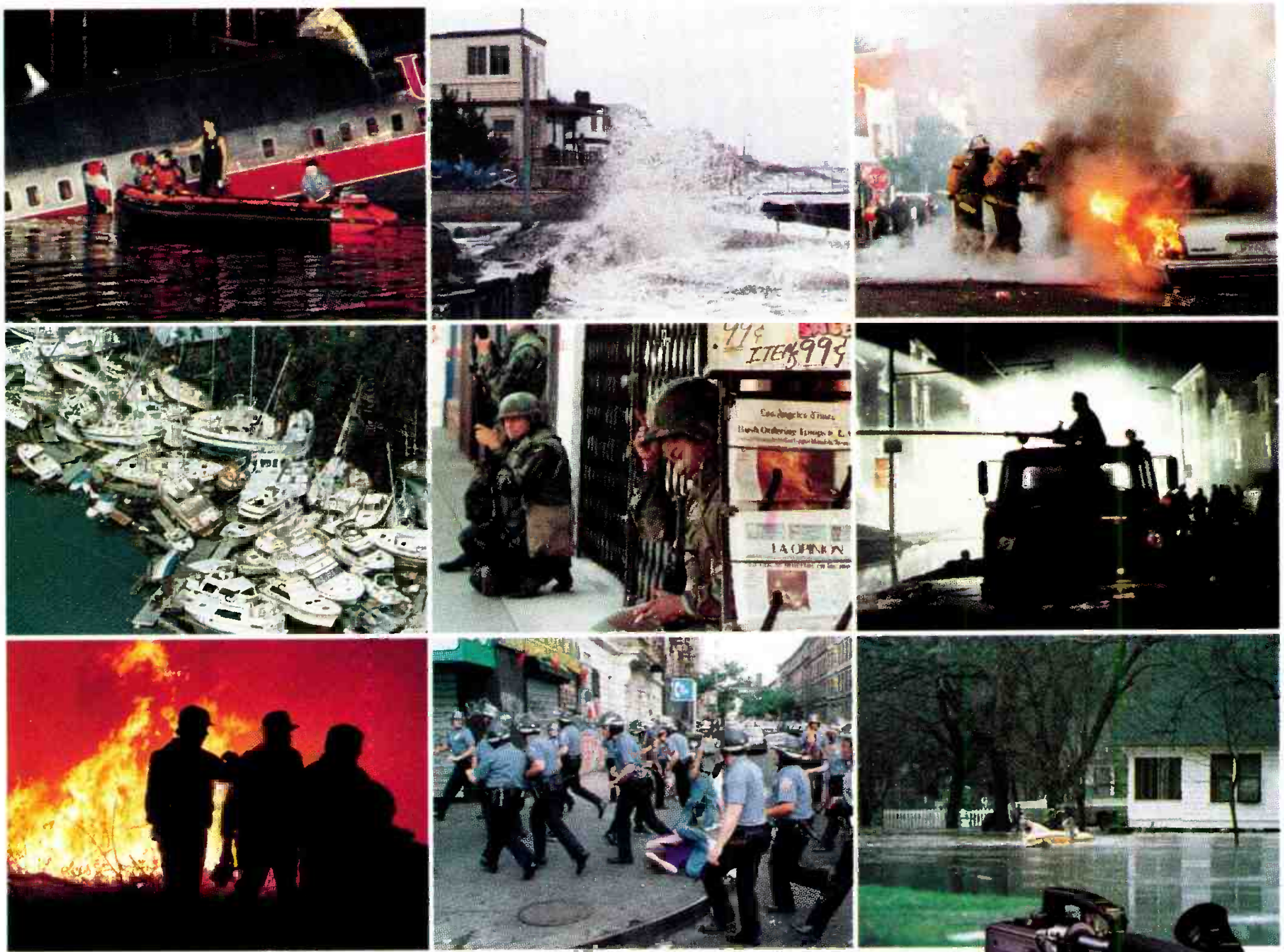
Such a statistic emphasizes the need for all doors and windows to seal completely when closed. The use of adjustable seals and double-acting hinges is almost essential if adequate sound insulation is to be maintained. In general, the use of fixed seals with thresholds and jambs is preferred to the use of drop seals, because mechanical seals require regular maintenance to keep them working effectively.

An effective way to maintain high TL at studio doors is to implement the intervening airspace concept described earlier through the use of a *sound lock* — a small vestibule with a well-sealed door on each end. This also helps to maintain partial isolation even during periods of access, as long as one door can remain closed while the other is opened.

Mechanical equipment noise

It is normally possible to minimize noise from mechanical equipment by locating it far away from acoustically critical spaces. However, piping and ductwork for heating and air-conditioning studio spaces can still transmit sound into acoustical spaces. Because a duct can act as a plane-wave tube between two rooms, it can transmit noise of fans and other equipment over long distances. It also can transmit sound between adjacent spaces connected by a common duct.

To minimize the transmission of airborne sound through ducts, all ducts leading to or from studio spaces should be acoustically lined with sound-absorptive duct liner material. Elbows and turns further reduce sound transmission through



ducts, but their use also can create more noise from turbulence or excessive pressure drops in the airstream. To counteract this, it often is necessary to install sound traps (mufflers) in ducts serving acoustically critical spaces.

The moving airstream also can generate noise simply from the velocity potential of its movement. Aerodynamic noise is roughly proportional to the fifth power of the airstream's *linear velocity* (quoted in feet per minute — not to be confused with the more commonly cited *volume airflow*, which is quoted in *cubic* feet per minute). Thus even a small increase in linear velocity will result in a significant increase in noise. A significant component of airflow noise is generated at the outlet and return registers. An appropriate choice of diffuser grating for these registers can reduce the airflow noise produced in the room.

One way to achieve a desired volume of air exchange in a room with a minimum of airflow noise is to use the largest diameter ducting that is practical. This allows a sufficient volume of air to flow through a duct over a given unit of time, while the air column proceeds through the ducts at relatively slow velocity.

Noise control in air-conditioning systems is an exact science, but one that is often misunderstood by a non-specialist. It is an area where expert advice is highly recommended.

No matter how well a studio may be insulated, it must have good internal acoustics and isolation.

Structure-borne sound

Any source of mechanical vibration within the building can create sympathetic vibration in the structure, which will ultimately be radiated elsewhere in the building as audible noise. When problems of structure-borne sound cannot be overcome by isolating the source of vibration, elaborate constructions are usually required to insulate studios and other critical areas. Again, professional specialists are called for in solving such problems, but broadcasters should be aware of the potential problem created by any equipment or environmental sources that might transmit vibration to the structure.

This also applies to sources of mechanical vibration within the acoustical space itself. No matter how well a studio may be insulated from its surroundings, it must also have good internal acoustics and isolation. (See "Acoustics for Broadcast Engineers," May 1992.) Sound created within the space must be controlled to prevent unwanted reverberation and transmission, while still allowing reasonable sound levels to be generated in the space.

Conclusion

This article has discussed a few major points on noise control — an area of critical importance in broadcast studios. Although such a discussion is intended to assist the broadcast engineer in identifying areas of concern, it should not be used as a substitute for expert professional advice.

The field of architectural acoustics is growing rapidly, and there are numerous consultants with years of education and experience who can assist you in the design or renovation of any studio project.

➡ *For more information on acoustic noise control, circle (300) on Reply Card.* ■

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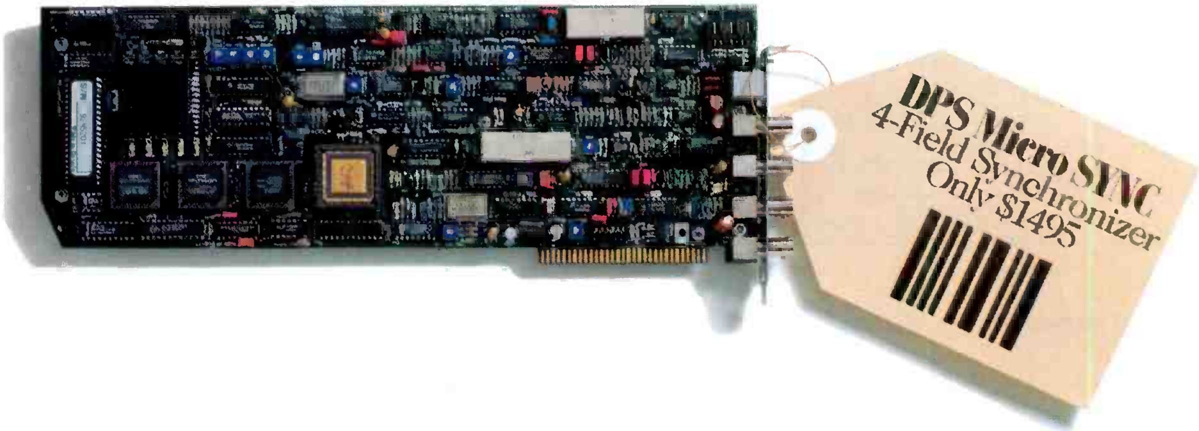

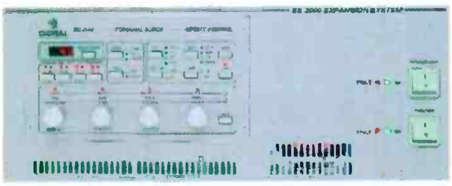
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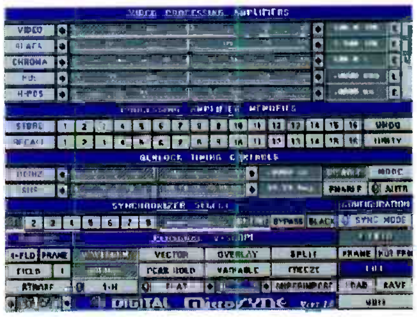

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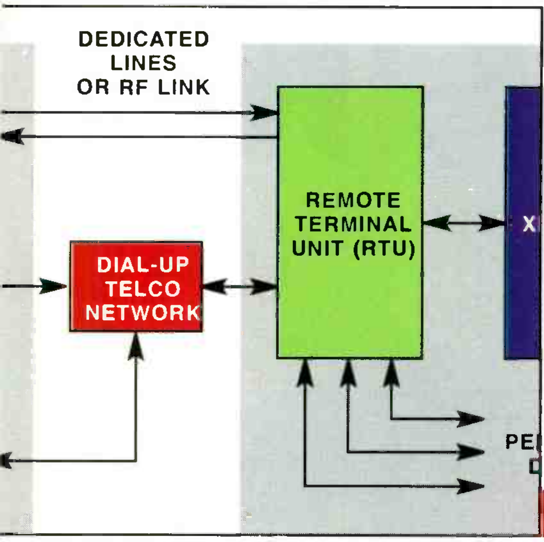
Radio in transition

Transmitter remote-control systems



Transmitter remote control is an unheralded yet valuable part of most radio operations.

By Jamal Hamdani

The Bottom Line

Remote-control systems let broadcasters have their cake and eat it too. They allow a station to cover its service area well from an often inhospitable transmitter location, while its staff works in a comfortable and easily accessible facility. Only occasional visits to the transmission site are required, and between visits, the remote control keeps watch over the valuable equipment. Operational efficiency and protection of investment are well-served by remote-control systems, and their capacities continue to expand. ***S***

Transmitter remote-control systems are increasingly used today to monitor and control broadcast facilities. When properly designed and implemented, they provide a quick return on investment, for the following reasons.

Remote-control systems provide an accurate, reliable and proven method of controlling equipment at a location distant from a studio (or other control point). With remote control, a broadcast facility also can monitor the status and performance of its distant equipment. Corrective measures can be ordered when necessary, and their execution confirmed. Changing frequency, program input, transmitter or antenna switching and trimming of power and frequency are some of the functions that are possible with remote control. Downtime and technician travel time are minimized, and a station can remain confident that its equipment investment is performing to its maximum value.

More recent "smart" remote-control systems can continually optimize equipment performance, thereby increasing equipment life, reducing operating costs and guaranteeing maximized performance at all times, without increasing operational burdens. These systems also can provide immediate and automatic record keeping. In addition, governments and national broadcasting organizations have found that broadcast remote-control systems provide invaluable reassurance during emergencies, and can offer security management as well.

A review of the basics

The configuration of a basic broadcast transmitter remote-control system has remained unchanged for the last three decades. What has changed are the user interfaces and the access paths employed. (See Figure 1.)

Remote-control systems provide an accurate, reliable and proven method of controlling equipment at a location distant from a studio

The standard setup uses a *transmitter unit* (or *remote terminal*) interfaced to the transmitter and perhaps other peripheral equipment at the distant site. The transmitter unit provides command on/off capability (typically through relays), telemetry readings from the transmitter and status readings to monitor other on/off conditions at the site.

A *studio unit* (or *control terminal*) con-

Hamdani is executive vice president and chief operating officer for Moseley Associates, Santa Barbara, CA.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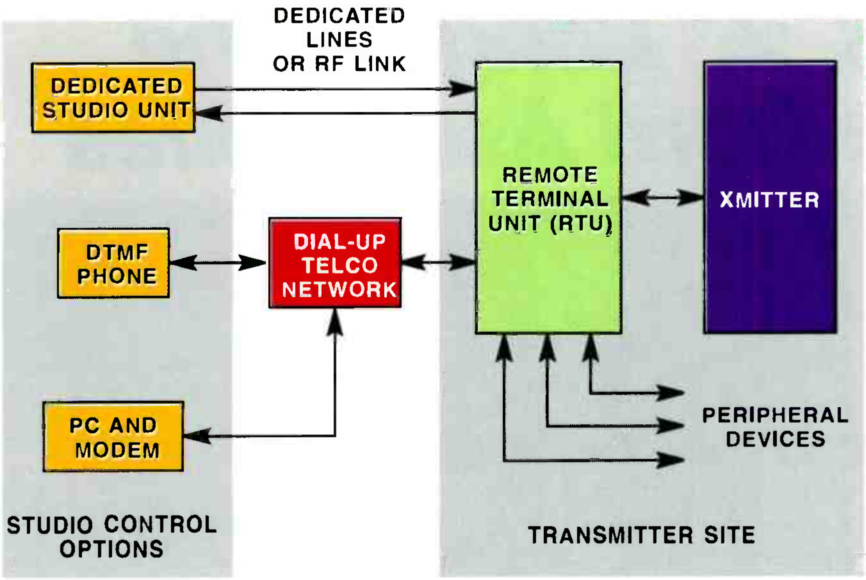

Figure 1. *Today's remote-control systems provide a number of user-interface and access-path options to the transmitter site.*

nects to the transmitter unit over phone lines or via a microwave RF link. The studio unit sends commands to the transmitter unit from the control point (typically a broadcast studio), and monitors and displays the telemetry sent back by the transmitter unit.

Like most broadcast equipment, this type of control system has evolved from tube versions in the 1950s, to basic discrete transistor circuits in the 1960s, to TTL systems in the 1970s, to present-day microprocessor-based systems.

The obvious advantage of keeping a dedicated system in place, especially with a full-time air staff, is the simplicity of training an operator to monitor the transmitter site. Because of the tremendous investment in capital equipment at the distant and generally unattended transmitter site, many stations still prefer to monitor and control their sites with such a dedicated system.

Dial-up control

Within the past few years, the definition of the *studio unit* has changed somewhat. This followed the introduction of the first voice-response remote-control systems. These systems allow operators to use a DTMF keypad (a touch-tone phone) to gain access to the remote terminal unit (under password protection) via standard dial-up phone lines. A synthesized voice reports telemetry parameters back down the phone line to the caller, allowing the user to interactively control the transmitter. A standard telephone replaces the studio unit, requiring only the transmitter unit interfaced to a dial-up phone line at the transmission site. The dedicated telco line or RF path is no longer required.

Dial-up applications were first adopted by radio stations looking for a way to run unattended automation formats.

Dial-up applications were first adopted by radio stations looking for a way to run unattended automation formats. These systems soon became popular with radio stations in general, even though the units were originally being used in a manner that was in potential defiance of FCC regulations regarding transmitter fail-safe operation. The commission subsequently changed its remote-control rules to accommodate the technology. The current rules simply state that: 1) A station is responsible for broadcasting under the parameters of its license; 2) Positive control of the transmitter must be retained; and 3) A station must be able to initiate its Emergency Broadcast System responsibilities.

PC control

On the heels of dial-up/voice-control systems, a succeeding generation of remote-control devices added an RS-232 port to the remote terminal and the studio unit. Users of such systems can interrogate a site via personal computer and modem (again on a dial-up phone line) using a software package provided by the remote-control system manufacturer. In this case, the PC and modem effectively replace the studio unit.

An important benefit of dial-up systems is the ability to access the system from almost anywhere.

An important benefit provided by any dial-up system is the ability for authorized users to access the system from locations other than the studio or transmitter site. For the voice-type systems, this includes any place with a telephone. For the PC-based systems, the control point can be any PC and modem hooked up to a phone line and running the appropriate software. Today, PC-based systems increasingly appear to be the method of choice for remote-control operations.

Automatic and built-in systems

The powerful processing capabilities of the PC have given modern remote-control systems *smart operator* capability. Automatic control allows for complex antenna array switching, power trimming and program selection. On some systems, PC-based software packages are capable of recalibrating the remote terminal unit without an engineer visiting the transmitter location. In addition, modern transmitter units — typically referred to as *remote transmitter units* (RTUs) — are capable of time-of-day and event-driven command activation.

An increasing number of transmitter manufacturers are integrating remote-control systems into their equipment. Taking advantage of the microprocessor that is already included in the transmitter, the manufacturer also can program automatic control features and interfaces. In some cases, graphic displays are provided, which can be helpful to an engineer evaluating a problem or looking for assistance during a facility emergency.

Most of these systems have an RS-232 port so that a PC at the control point (studio) can directly connect to the transmitter via modems. Some systems even provide limited capability to connect external equipment at the site. Despite the obvious benefits of an integrated so-

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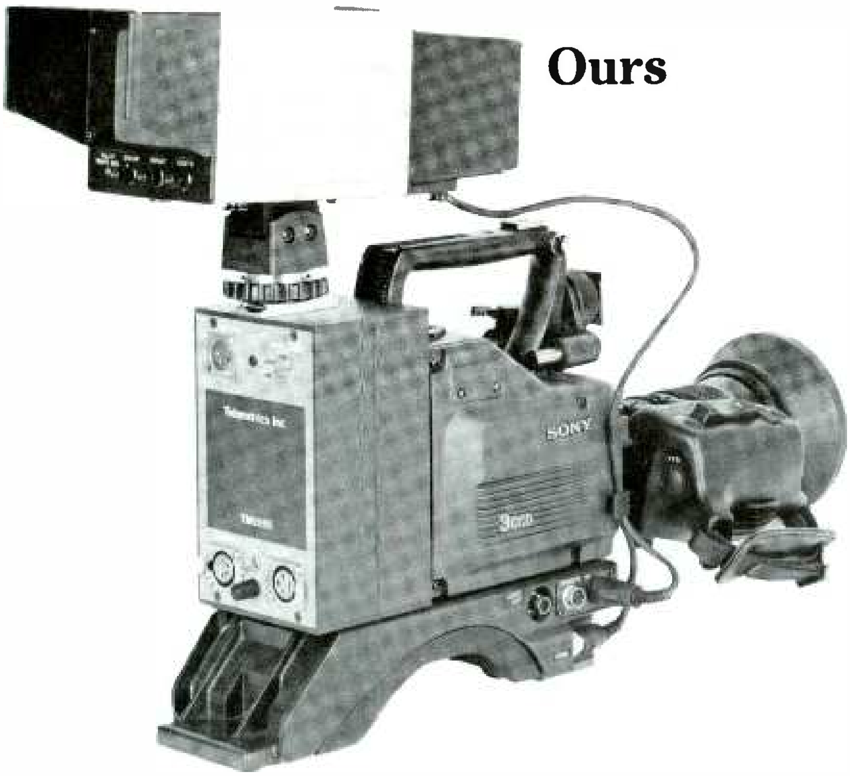

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lution, these built-in remote controls require engineers and operators to master each transmitter's individual system, because no two such systems are the same. For a multitransmitter site, this can be rather cumbersome.

Multisite/network control

Large statewide and nationwide networks require multisite remote-control systems. Invariably, PCs are used for controlling these remote terminals from the network master control location(s). The RTUs for such systems must be capable of multiline communications and control by multiple terminals. Typical network topologies allow for a mixture of leased-line, microwave and dial-up circuits between the various RTUs and the master and alternate control sites.

The power and flexibility of the system's control software to manage communications, display, logging and control is the key to the success of multisite networks.

Control software and new directions

Most control software programs consist of a main control program, a customized screen generation program, a logging module and a smart-routine program. Users can design custom screens to display information from the remote terminal(s). More comprehensive packages allow for alarm overlays, hot keys, log file viewing, remote setup, automatic control, pan and zoom, and operator prompting/messaging. Hierarchical passwords ensure security and logging of all operations.

Large statewide and nationwide networks require multisite remote-control systems.

Although dial-up systems remain popular, the increasing use of full-duplex digital studio-to-transmitter links (DSTLs) may stimulate a return to dedicated paths for remote control, using auxiliary data channels provided by most DSTL systems. Dial-up systems remain a sensible backup in such cases. (See next month's "Radio in Transition" for more on DSTLs.)

Future systems will likely continue the trend toward increased adaptive control and expanded peripheral capacity. Microprocessor or PC-based systems purchased today may accommodate many of these improvements through software or firmware updates, thus allowing broadcasters to benefit from this progress while preserving their recent capital investments.

With this in mind, broadcasters can continually sharpen the watchful eye they keep on their valuable yet unstaffed transmission facilities, the proper operation of which is so critical to delivery of their product.

➡ *For more information on remote-control systems, circle (308) on Reply Card. See also Transmitter Remote Control, Telemetry, pg. 22 of the BE Buyers Guide.* ■

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Inside character generators

Character generation is only the beginning.

By Steve Epstein, technical editor

The Bottom Line

Today, character generation no longer requires dedicated systems. Powerful graphic systems with character generator capability are becoming commonplace. Despite this, stand-alone systems, whether dedicated or desktop, still exist and are more powerful than ever. In today's economy, facilities need to squeeze the most from each piece of equipment. The right character generator can add enormous power and flexibility to graphics capability.

Since their introduction in the early 1970s, character generators (CGs) have come a long way. Not only can today's units generate characters, they also can produce more than 16 million colors and animate text and graphics in three dimensions. Configurations include dedicated systems and desktop solutions built around the PC, Mac and Amiga. In addition, character generators are included in sophisticated graphics systems, such as paint and weather graphics units. This article looks at today's character generators, including new features, connectivity and user interfaces.

Dedicated systems

Many of today's dedicated systems offer the flexibility of dual channels for either single or dual users. Systems include dual encoders, with each channel having fully independent, full color, anti-aliased outputs with a full bandwidth key channel. An optional second keyboard allows two users to access one channel each. Another option allows for an internal third channel so that one of the two users has access to a full 2-channel system.

Most systems have multiple microprocessors, and many are based on the Motorola 68000 family. Internal RAM from 8Mbytes to 16Mbytes is common among dedicated mid- to high-end systems. Optional memory expansion is available up to 160Mbytes on some systems. Depending on the system architecture, memory is accessed through several means. Some units store information in a standard RAM configuration, while other access frame buffers and data pipelines.

In addition to online RAM storage, systems provide internal drives as large as 240Mbytes. Nearly unlimited additional storage is provided through SCSI ports that can support one or more external drives, available with both fixed and removable media in magnetic and optical formats. Many systems also provide 3.5-inch floppy drives for storage of operator setups, backup of system settings and storage of client-specific information.

Many of today's dedicated systems offer the flexibility of dual channels with either single or dual users.

Serial interface ports are common with RS-232, RS-422 and Ethernet supported. In addition, many units are capable of networking with other systems. Some can network only with systems made by the same manufacturer, although many can interface with PCs, Macs and/or SGI platforms. Be aware that many require optional software to complete the interface. GPI inputs used for remote-event triggering are nearly universal, and some units have programmable GPI outputs that can be used to trigger other devices directly from the CG.

Most of today's units are available in NTSC and PAL versions, with composite, component and digital inputs and outputs. HDTV is supported as an option, with at least one system capable of outputting in a 16:9 widescreen format.

Desktop systems

Computers and character generators are naturally related with similar input, output and storage functions. Computers can easily be adapted for the presentation and graphics functions of character generators. Numerous computer typefaces are available, largely because of the desktop publishing explosion of the 1980s. The ability to display these typefaces, combined with today's video I/O cards, have made computer platforms with quality software into extremely capable CGs.

Currently, desktop CGs are not quite as fast as dedicated systems. CGs, especially those used for live events, such as news and sports, need to be capable of quick information access and updating. Many desktop CGs are not fast enough for these applications. Most desktop systems are single channel and capable of providing high-quality character generation in environments that are not time sensitive. Newer systems are being optimized for speed and soon will be capable of operating fast enough for use in many live situations.

Text

Systems today offer users an almost unlimited number of typefaces. Not only are typefaces offered by the manufacturer, but numerous third-party fonts also are available, such as Adobe, Bitstream and Postscript. Fonts are available in *bit-mapped* and *vector-scalable* versions. Bit-mapped fonts come in various font sizes, while vector-scalable fonts are sets of geometric curves that can be scaled to any size. In addition, software allows users to create their own typefaces, either from scratch or by modifying existing fonts.

Systems today offer users an almost unlimited number of typefaces.

Additional fonts can be purchased through various means. One manufacturer will send fonts by modem directly into the system. Another ships 300 standard fonts on the hard drive of each system. Access to a limited number of these fonts is standard; passwords control access to the rest. If new fonts are needed, contact the manufacturer with a purchase order in hand and they will give you the password. The password allows you to access the previously unavailable font on the system hard drive.

Most systems offer full-color 32-bit resolution with an 8-bit key channel. Characters can be generated in any color or a gradient of colors. Edge attributes include color, size and position, and these can be set independent of the character attributes. Other features include metallic shading of characters, bevelling, chiseling and transparency. Some units even offer 3-D font generation. Characters can be animated along straight or curved paths, as individual characters or groups.

Graphics

Although camera capture in CGs has been available for some time, today's systems have the added capability of sizing and shaping captured elements. Images are captured in full color and in real time, and can be saved as characters in a font or as named images stored direct to disk. Once captured, many systems allow images to be retouched. Professional paint and drawing tools feature various brush styles and image processing functions. Many systems support drawing tablets and/or a mouse.

Camera-captured information, graphics and internally generated patterns can be mapped onto the body or edge of text. Some systems allow users to create 3-D objects, and then map text and graphics onto the object.

Interfacing

In addition to multiple keyboards and serial communications capabilities, character generators with some additional software can interface directly with computers. Interfacing directly with spreadsheet/database software adds considerable functionality. Last year's presidential election and Olympic coverage made use of this type of interface.

A number of tally boards were designed for coverage of the election. Several consisted of candidate head shots, names, state symbols, current vote total and a page header. An external computer was interfaced with the election wire services, and it maintained a candidate database. As needed, the system would retrieve all of the required images, icons and text. These elements then were animated individually to create the final composite image. The system allowed real time, up-to-the-minute data to be reported throughout the coverage. A similar setup was used for Olympic coverage — scores were entered, tallied and then animated onto the screen.

Camera-captured information, graphics and internally generated patterns can be mapped onto the body or edge of text.

Other development areas

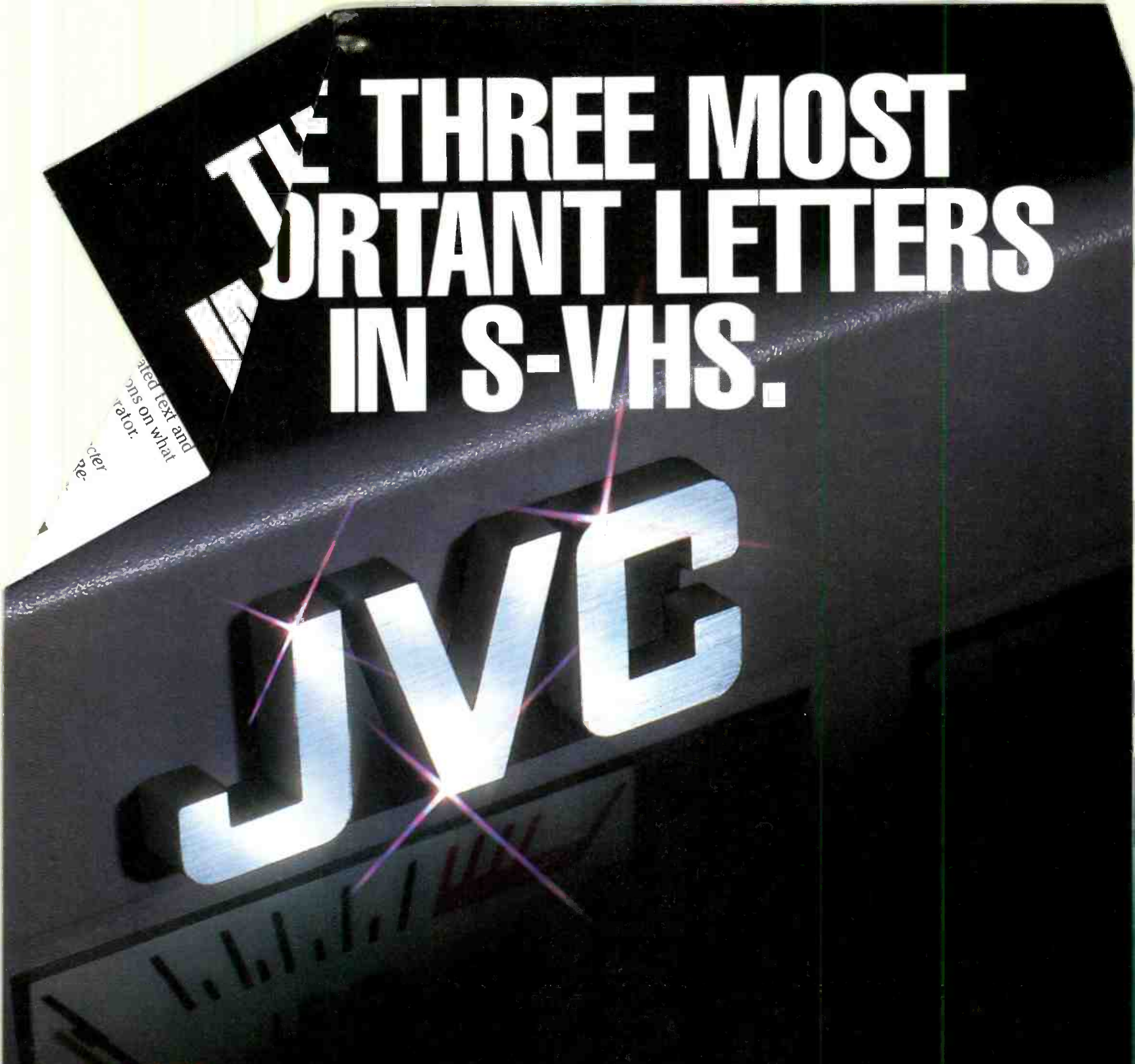
Character generators also are being developed for other areas of use. One dedicated system has the added capability to interface with popular computer graphics software, allowing file transfers in both directions. One of the biggest advantages of such an approach is the ability to use common elements in print and TV ad campaigns.

Another area of development is small logo and text keyers being used by networks and affiliates for identification, trailers and weather information. These small keyers are capable of importing and storing stills, text and graphics created on larger systems. Furthermore, these small keyers allow master control to key sophisticated graphics without tying up production equipment. In addition, an addressable second channel for these devices will allow networks to communicate in closed-circuit with affiliates. Text can be displayed on dedicated monitors in master control.

An offshoot of computer and CG technology involves the on-air program guide that is common on cable and satellite systems. New versions are becoming available that use PCs for storage and user interface. Single board generators combined with an additional keyer (if necessary) can be addressed through modems and used to feed information channels. Up to four independent CGs and two keyers can be installed in a standard PC.

Conclusion

Although at first glance it may seem that today's character generators are just more of the same, these systems truly have evolved over the last few years. Whereas many anti-aliased fonts have been around for awhile and system speed and storage have been on the increase, so has the demand for space. The real



JVC PROFESSIONAL

More and more of today's video professionals have come to recognize S-VHS as the format for the 90's and beyond. And now more than ever, the name they look to for the most comprehensive and advanced line of S-VHS equipment is JVC. As the inventor of the S-VHS format, JVC has designed a system that will appeal to every area of the broadcast and industrial video community - from acquisition to post production and duplication. And the future of S-VHS looks even brighter, with JVC's introduction of a myriad of new and innovative products. For more information on the full line of JVC S-VHS equipment visit your nearest JVC dealer or call us at 1-800-JVC-5825.

- **World's first Variable Tracking S-VHS Player with slow motion. The BR-S525.**
- **Lowest light 3-chip camera. The 2-Lux KY27.**
- **Lightest docking S-VHS portable. The BR-S422.**
- **First full-size 3-chip S-VHS camcorder. The X2.**
- **The world's only 3-chip S-VHS-C camcorder. The X1.**
- **First S-VHS editor with on-board controller and plug-in TBC. The BR-S822.**

Circle (47) on Reply Card

Full-scree... acter gener... background ... including layer... courtesy of Quan...

a high-end char- ...captured, ...atures

evolution has tak... realm of functional... chitectures now all... and out of systems. Fi... users take advantage ... from different equipmen... them to produce sophistic... graphics images and animat... was once just a character gen...

➡ *For more information on chara... generators, circle (309) on the ... ply Card. See also character genera... tors and titlers on pg. 13 of the BE... Buyers Guide.*

Character generator buyer's guide

By Steve Kilisky

When shopping for a new character generator, you must first determine a budget. Once the fiscal guidelines are established, ask some tough questions to get the most for your money. Evaluate how the CG is to be used before reading spec sheets and seeing demos. Numerous feature sets and human interface philosophies are available, even within a single price range. Primary concerns should be dictated by current and future needs. In addition, consider the following list of items when evaluating character generators. Tailor the list to suit the needs of your staff and facility.

Specifications

During demos, verify how much of what you're seeing is standard and what is optional. Ask questions about the following:

- *Hard drives:* Look at how many and what size drives the system can support. What is standard? What is available and from whom — manufacturer and/or third-party suppliers? Look also at the system requirements. How much is needed to store a font, page or graphic?
- *Memory:* Like hard drives, look at expansion capability as well as reasons why expansion may be needed.
- *I/O:* What inputs and outputs are standard? What options are available? Can the unit be gen-locked? Is there an internal keyer? What types of serial or parallel remote capabilities are available?

Animation

Look at the unit's animation capabilities and consider the following items:

- How much animation is standard? What options are available?
- Is the animation object-oriented or limited to rows or pages?
- Does the unit support keyframes? How many? Can they be set, stored and updated easily and quickly?
- Can object color and transparency be animated?

Options

In addition to options listed previously, check into the following areas and balance the long-term cost of standard vs. optional features:

- *Typefaces:* How many and which are standard? What is the cost of additional fonts? How many are available? Can they be purchased from third-party vendors?
- *Software:* What is the cost of updates? How easy are they to install? What additional features are available?
- *Interfaces:* Can the system be interfaced to other computers, such as the newsroom computer, production editor or switcher? Does it require additional hardware, software or both?

Background generators

Look carefully at the sophistication of the background generator including capabilities such as:

- Can backgrounds be rotated? In all three dimensions?
- How many colors are available simultaneously?
- Can backgrounds be layered? what is the maximum number of layers?
- Does the background have to be full screen or can banners be drawn?
- Can banners be positioned? Animated? Maximum per screen?

Text placement and manipulation

How systems handle text will determine to some extent how flexible they are. Consider the following:

- Is the system row-based or capable of free-form text placement?
- Are there limits on the number of rows, characters, layers or colors?
- What are the available character attributes? Are they easy to manipulate?
- Can you type on any angle, curves, rotate individual characters?
- Are light sources available? Can they be located?
- Can characters be texture mapped?

Ease of use

Like any equipment, a character generator's user-friendliness will often determine overall use. Have one of your operators sit down and try out the demo equipment. Check for the following:

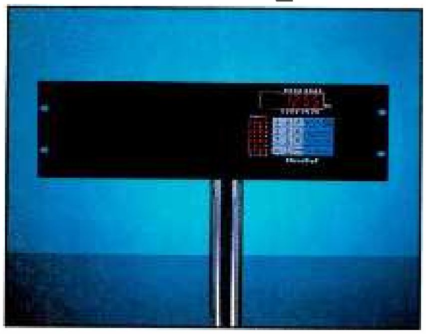
- Is it easy to learn?
- Are there complex menus or dedicated hard keys? Generally, the more hard keys the better.
- Can changes/corrections be made quickly and easily?
- Is text resizing quick or do fonts have to be re-rendered?
- Are typefaces on-line or do they need to be pre-rendered. How much time is required?

After sale support

Ask questions about support after the sale. How long is the warranty period, and what is covered? Is 24-hour support available? What kind of spare parts are recommended? Is there a board exchange program. If so, what does it cost? Find out what kind of training is available for operators as well as technicians, how much it costs and how much is included with the sale. Finally, get a list of references and check with other users to see how well they like the unit, and how well it has lived up to expectations. ❑

Kilisky is a product manager for Abekas, Redwood City, CA.

Field Report



ChronTrol XT timer

By Chriss Scherer

Some comedians will tell you that timing is everything. The same is true in broadcasting. Exact and accurate timing of events is critical. ChronTrol XT timers are accurate-to-the-second controllers that can automatically begin recording a feed, change an antenna pattern, or even start sources for or from a network feed.

Overview

The ChronTrol XT series timers are available in several configurations, with options of 2, 4, 8, 12 or 16 relays (referred to as circuits); 20 or 40 program areas; and 8 or 16 inputs for external triggering of programs or circuits. The unit tested was fully loaded with 16 circuits, 40 programs and 16 inputs.

The timer is built on a 3-rack-unit panel (table-top and wall-mount versions also are available), with a 24-button keypad, 6-digit LED display and indicators for the status of the relays. The switches are dome-type bubble switches, and each keystroke produces a beep to confirm an entry. The red LED display is 0.56-inches high. During normal operation it shows the time in hours and minutes. Seconds can be displayed if desired.

On the back of the unit, the relays are mounted on the right, and the circuit board is on the left. The single circuit board is compact and mounted with the components facing the panel (traces outward). The board is mounted near the front panel, and a metal cover wraps over it and the power supply transformer. The unit does not include a power cord.

Most of these timers are built for industrial applications, and a permanent installation of direct hard wiring is normal. The manual recommends installation directly to a conduit box by a qualified electrician. The transformer leads extend approximately 15 inches from the strain relief, enough length to attach a plug. In any event, make sure the installation meets local codes.

The circuit board

The components are soldered in place rather than socketed. There is a connection for a 9V battery for backup power to maintain time and programs. An alkaline battery is recommended, which can maintain the memory for 14 days if necessary.

Also on the circuit board is the connection for the external inputs. This is a 20-position, dual row, box header. It is not the easiest connector to work with, because it is designed for ribbon cables. A DB connector would be preferred, although a jumper could be made to a terminal or punch block for easier connection. The external inputs are activated by switching them to the common pin, via a dry contact or open collector. Because there are up to 16 contact positions and only four common positions, an external interface may be necessary if the inputs are being triggered by different sources.

Two modular connectors are provided for serial communication. One provides RS-232C data for connection to a computer or modem. The other can be used to daisy chain multiple units together. With RS-232C, it is possible to download program data to a computer or other device, and upload it later. If a complex set of programs is being used, this would be ideal for a memory backup system. It also is possible to access the XT timer through a modem on a telephone line. An on-board modem is optional, which can be set to dial out at a specific time.

The relays are all SPDT dry contact switches. The coils are 15VDC and are custom-manufactured for ChronTrol. The connections to the relays are made with quick-disconnect-style connectors. The relays are clearly labeled with their circuit assignments.

The program

The timer derives its time base from the 60Hz line frequency. Resetting the time is extremely simple and can be manually adjusted as needed. In addition, the keyboard can be locked-out if desired. A lock-out code of up to four digits can be entered. The keyboard will stay in its locked or unlocked mode until changed, or until the power is interrupted. When power is restored after an interruption, the keyboard will be locked (if a lock code is set).

No "back door" to the lock code exists. If a code is entered and then forgotten, the unit must be powered down with the battery removed. When the unit is powered up again, the lock code will be cleared, and so will all of your programs.

The way the timer handles programs is where it really shines. Programs can oper-

Performance at a glance:

- *Event programming up to one year in advance*
- *RS-232C interface capability for multiple control and up- and downloading of program data*
- *Programs can automatically adjust for daylight-saving time and holidays*
- *Up to 40 programs, 16 inputs, 16 circuits*
- *Specific timing to the second*
- *Easy-to-read display*
- *Compact size in a rack-mount package*

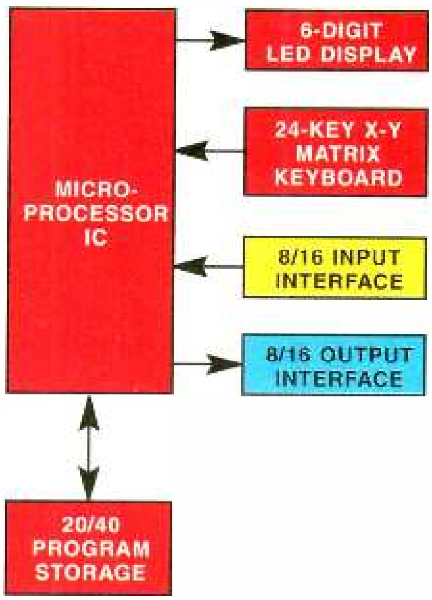


Figure 1. *Functional block diagram of the XT timer, showing relationship between various modules.*

Scherer is an engineer at WRMR-AM/WDOK-FM, Cleveland.

ate individually to operate the relays, or they can work with other programs for more complex timing operations. While entering a program, the actual program location can be set manually, or the timer can give you the next available slot.

Specific programs, inputs or the keyboard can control the circuits. Programs can control other programs, and inputs can be used to control programs, circuits or other inputs. This is not as difficult as it may sound. A flow chart helps when entering programs. The manual also explains it in words, but it is not as clear in this form. The flow chart gives a better illustration of setting programs. A quick-reference guide facilitates the programming process.

Two types of programs are possible: interval and on/off. The on/off programs are fixed based on a time of day, while the interval programs are floating on a timed interval of days, hours, minutes and seconds. Interval programs must always be cued from a trigger, either an external input, another program or the keyboard. Any program can be set up to 365 days in advance. They can run on specific days of the week or skip specific days. There also is a provision for a holiday list. This allows the XT to run programs only on holidays or to skip them on holidays. Another function automatically allows for daylight-saving time.

After programs are entered, the display can be set to show a countdown to any specific event. The time can be displayed in hours, minutes and seconds. Once the event occurs, the timer will show a countdown to the next scheduled event, if any. When a circuit is activated, the minimum cycle time (on then off, or vice-versa) is one second. If a momentary closure is required, setting the relay for this duration should suffice.

Most of these timers are built for industrial applications, and a permanent installation of direct hard wiring is normal.

Time's up

Twelve examples of programs are given and how they can interreact with each other. The manual does not include a schematic or circuit board layout, but ChronTrol provided one upon request. One section details the program review sequence that is useful.

Basic timers start at $389 with two circuits and 20 program areas. The fully loaded model, with 16 circuits, 40 programs and 16 inputs, sells for $1,379.

The XT timer actually is easy to program once the protocol is understood. The ability to go in and review specific programs and other parameters also is helpful.

If you need to time control devices in your station operation, the ChronTrol XT may be the solution. It can control up to 16 separate devices and can accommodate daily or weekly schedules, with or without holidays. With many versions available, it is easy to get the right unit for the right job.

Editors note: Field reports are an exclusive *BE* feature for broadcasters. Each report is prepared by the staff of a broadcast station, production facility or consulting company. These reports are performed by the industry and for the industry. Manufacturer's support is limited to providing loan equipment and aiding the author if requested.
It is the responsibility of *Broadcast Engineering* to publish the results of any device tested, positive or negative. No report should be considered an endorsement or disapproval by *Broadcast Engineering* magazine.

➡ *For more information on the ChronTrol XT timer, circle (310) on the Reply Card.* ■

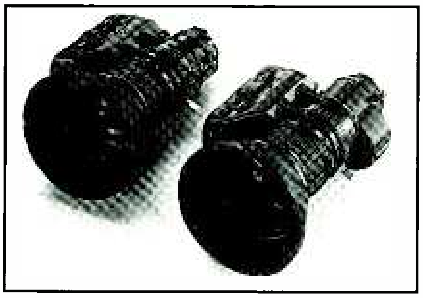
New Products

Hand-held lenses

By Fujinon

• **A16X9RM:** for $^{2}/_{3}$-inch cameras; uses Aspheric Technology; lightweight; has widest angle and closest MOD of any economical lens.

• **S16X6.7RM:** for $^{1}/_{2}$-inch cameras; includes same features as A16X9RM.



Circle (350) on Reply Card

Emergency alerting system

By TFT

• **EIS 911:** economical way to meet FCC EBS requirements; in-band system uses robust broadcast and cablecast frequencies to send messages; transmits signal that is up to 100 times stronger than RDS; uses BPSK in an 850ms-long burst with reliable Reed-Solomon forward error correction.

Circle (351) on Reply Card

Routing switcher

By Pro-Bel

• **TS16 series:** full line of 16x4 routing switchers; series includes analog video, mono or stereo audio, serial digital video, and AES/EBU audio variations — each housed in a self-contained 1-rack unit frame; multilevel operation involving any combination of signal formats can be achieved by linking frames via an RS-485 interface; video router provides 30MHz bandwidth; serial digital video router accommodates data rates between 140-360Mbits; AES/EBU audio router accepts signals with sample rates in the 32-54kHz range.

Circle (352) on Reply Card

Multiformat modular switcher

By Pro-Bel

• **TM24 series:** encompasses analog video, audio, serial digital video and AES/EBU audio formats; offers flexibility to mix any combination of switcher levels within a standard 3-rack unit frame; provides initial matrix sizes of 24x6 for video and 24x12 for audio; expands to 24x24 by addition of plug-in modules; analog video router has 30MHz bandwidth; serial digital video compatible with all digital video signal formats, providing operation with data rates between 140-360Mbits; AES/EBU digital audio is fully compatible with asynchronous digital audio signals at sample rates between 32-54kHz.

Circle (353) on Reply Card

AES/EBU digital audio router

By Pro-Bel

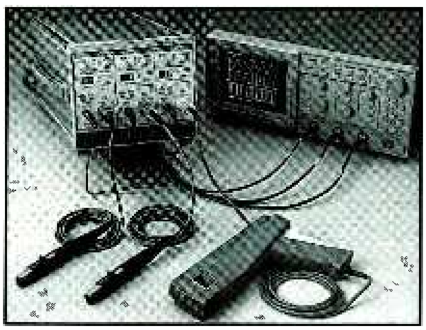
• **MADI (multiplexed audio digital interface):** uses the AES-10 MADI standard; uses compact transcoder frames to simultaneously encode and decode multiple channels of digital audio into and from the multiplexed MADI signal; signal can be carried either on coaxial cable or optical fiber, accommodating up to 56 mono channels per transcoder.

Circle (354) on Reply Card

Programmable current probe amp

By Tektronix

• **AM5030:** first stand-alone programmable current probe amplifier; improves productivity and signal measurement accuracy in the GPIB benchtop, or rack-mounted design and evaluation lab environments; GPIB version of industry standard AM503A; the only wideband programmable DC current probe amplifier for use with oscilloscopes; offers DC-50MHz bandwidth and plugs into TM5000 power modules.



Circle (356) on Reply Card

Antennas

By NSI

• **LO series:** omnidirectional antennas; operate over 10% bandwidths of frequencies between 1.7-2.7GHz; available in 2dB and 5.5dB gain versions; feature an integral radome; available with a type N or SMA connector.

• **LP series:** patch antennas; operate at 1.85-1.99GHz and 2.4-2.485GHz; feature integral radome; available with a type N or SMA connector.

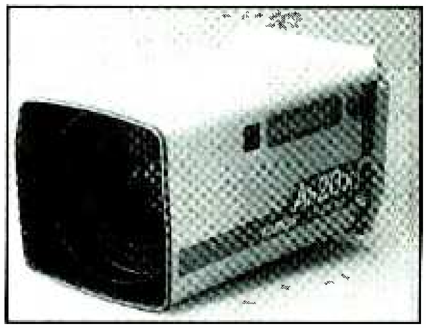
• **DC series:** broadband cavity back dipole antennas; operate over 25% bandwidths of frequencies between 1.7-2.7GHz; available in single linear, dual linear, single circular and dual circular polarized versions.

Circle (355) on Reply Card

Studio production lenses

By Fujinon

• **Ah20X8ESM and Sh20X6.2ESM:** for $^{2}/_{3}$-inch and $^{1}/_{2}$-inch cameras; feature close MOD and fast maximum aperture; include Electron Beam Coatings (EBC), which provide solid control over ghosting and flare; other standard features include LED display of focal length and aperture, along with an LED on the lens housing that shows extender and pattern projector position.



Circle (360) on Reply Card

Software applications directory

By Chyron

• **CODI software applications directory:** free to all interested parties; lists current CODI software packages available from third-party vendors; to obtain a copy, write or call Nancy Roback c/o CODI, Chyron Graphics Corporation, 265 Spagnoli Road, Melville, NY 11747; phone 516-845-2026; fax 516-845-3895.

Circle (357) on Reply Card

Backup system

By Otari

• **BackUp Station:** low-cost solution to backing up and restoring files for digital audio workstations; consists of a storage unit chassis that can hold up to five of Otari's removable disk drives, along with an Exabyte model 8500 8mm tape drive; system controlled by any model Macintosh computer from a Classic II up.

Circle (358) on Reply Card

M/S stereo microphone system

By AKG Acoustics

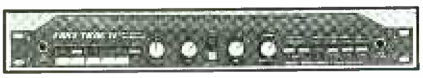
• **C522/MS:** dedicated M/S stereo microphone and matrix box designed for location production of television, film and music; ideal for EFP, ENG and SNG applications; rechargeable; outputs independent M/S signals that can be discreetly recorded and then combined to XY in post-production; features optional battery-powered UM52 matrix box for use in the field to monitor the mid or XY signal through headphones.

Circle (359) on Reply Card

Audio workstation

By Henry Engineering

• **Fast Trac II:** voice-over audio workstation; functions as a stereo switcher, audio mixer, utility dubbing center, voice-over recording system, compact production facility or as the "control head" of a multitrack digital editing workstation; incorporates all the functions of a typical audio mixing console.

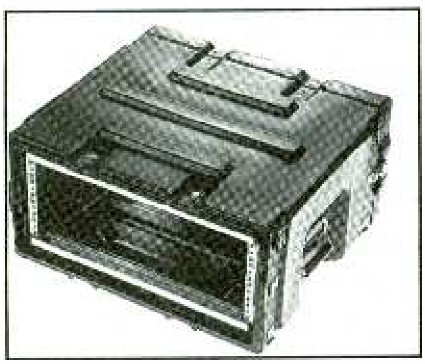


Circle (361) on Reply Card

Rack cases

By Hardigg

• **ProRack:** line of inexpensive, non-shock-mounted, rotationally molded, EIA standard 19-inch rack cases; lighter than conventional wood cases; stackable; include fully recessed hardware, single one-piece molded shell and conic-fit frame.



Circle (364) on Reply Card

Digital elevation data

By SoftWright

• **Terrain Analysis Package (TAP):** provides digital elevation data for all the provinces and territories of Canada and the United States; for extensive modeling of RF coverage studies for land mobile, cellular, paging, broadcasting and microwave radio systems; PC-based; can be used to design or evaluate existing or proposed transmitter sites and hardware configurations prior to actual construction.

Circle (363) on Reply Card

Converters

By Alpha Image

• **Alpha 312:** provides high-quality 10-bit RGB/YUV to serial digital conversion.

• **Alpha 322:** offers 10-bit serial digital to RGB/YUV conversion.

• **Alpha 362P:** dual encoder card; offers two broadcast-quality serial digital component to PAL encoders on a single card.

Circle (362) on Reply Card

Hand-held microphone transmitters

By Telex

• **HT-200:** includes an easily accessible battery compartment and an antenna integral to the unit, which prevents hand interference; all switches and controls mounted at base of the unit; uses standard 9V alkaline or NiCad battery; four condenser or dynamic head configurations available.

Circle (365) on Reply Card

Wireless receiver

By Telex

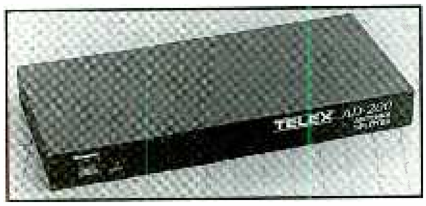
• **FMR-200:** single-channel true diversity VHF receiver; includes High-Q front end for superior out-of-band signal rejection, and a full linear phase IF, consisting of three matched high-quality ceramic filters and a 4-pole discrete toroid filter.

Circle (366) on Reply Card

Antenna splitter

By Telex

• **AD-200:** amplified broadband antenna splitter; makes it possible to operate up to four wireless diversity microphone receivers using only two antennas; features a newly designed High-Q front-end filter design and low noise amplifiers; includes eight 2-inch coax antenna cables; covers 150-235MHz frequency range.



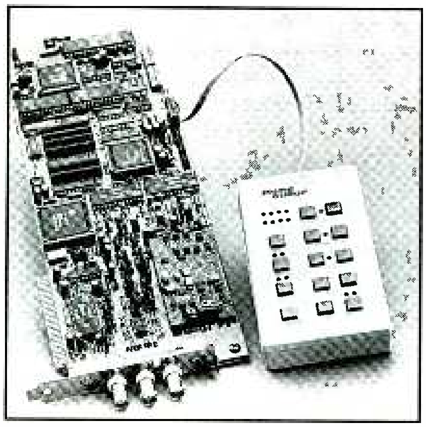
Circle (367) on Reply Card

Digital standards converter board

By Prime Image

• **STD Con/PCB:** plug-in board for PC

operation can be used with IBM, Amiga or any compatibles that incorporate an AT bus; offers complete world TV standards conversion, including NTSC, PAL, PAL-M, SECAM, PAL-N and NTSC 4.43 inputs; and NTSC, PAL, PAL-M, PAL-N AND NTSC 4.43 outputs; incorporates on-board time base corrector/synchronizer in addition to its standards converter components; accepts synchronous or non-synchronous inputs, with transcoding of composite or Y/C into Y/C or composite out.



Circle (368) on Reply Card

Filters

By Matthey Electronics

• **Satellite filters:** suitable for use in SNG video upconverter equipment and professional satellite receivers; centered on 70MHz; incorporate amplitude and group delay shaping characteristics defined by Eutelsat and Intelsat specifications for full and half transponder use.

Circle (369) on Reply Card

Digital audio edit mixer

By Philip Drake Electronics

• **DMX 1000:** compact digital audio mixer; input side includes 20 digital or analog sources, which can be increased with addition of a router interface; output side features four mix buses, four monitor buses and two effects send buses; provides powerful edit interface, using ESAM II protocol; other features include 7-frame delay, time line editing of 20 different events within one edit, comprehensive EQ on each channel.

Circle (370) on Reply Card

Digital communication system

By Philip Drake Electronics

• **DCS3000:** uses single 75Ω coaxial cable for interconnection between each control panel; digital routing matrix gives a full 10kHz audio bandwidth throughout the system; external audio equipment interfaced via 16-bit A-to-D and D-to-A converters housed within 128x128 matrix in 9U.

Circle (371) on Reply Card

Racks

By Zero Stantron

• **Duplicator racks:** pull-out shelves for easy access to duplicating units; strong enough to hold multiple duplicating units; feature pre-tapped rails for panel mounting and fan trays.

Circle (372) on Reply Card

Digital editing package

By ColorGraphics

• **E-Max:** on-line digital editing package for the DP/MAX video workstation; imports and exports the leading EDL formats; can create linear and non-linear auto assemblies.

Circle (373) on Reply Card

Disc recorder

By ColorGraphics

• **DP/Mosaic-C:** delivers six minutes of record time on standard disk drives; recording time is accomplished with 4:1 compression; offers digital video inputs and outputs along with RS-422 control; optional component analog.

Circle (374) on Reply Card

Routing switcher

By Dynatech Video Group

• **DYNA-128:** serial digital routing switcher; 128x128 matrix system occupies only 12 rack units of space; offers reclocking on input and output; provides cable equalization for up to 1,000 feet of cable; provides for software-selectable equalization for NTSC and PAL composite serial digital and component serial digital; features a real time control system.

Circle (375) on Reply Card

Character/graphics generator

By Quanta

• **SIGNA:** mid-range, anti-aliased text and graphics system; includes on-line dynamic sizing, disk-loadable operating system software, 5ns resolution, 16 levels of anti-aliasing; 256 levels of transparency, smooth color spreads, 10 master typefaces, over 100 fonts on-line, 32-bit CPU, 52MB hard disk and a built-in sync generator.

Circle (376) on Reply Card

Video board

By Quanta

• **PAL/NTSC switchable video board:** for the DELTA text and image generator; includes jumper-selectable YUV or RGB operator, output gain adjustment on YUV and RGB, separate fade mode for alpha channel and improved linearity of downstream keyer.

Circle (377) on Reply Card

Master control switcher

By Utah Scientific

• **MC-601:** serial component digital master control switcher; fully compatible with Utah's Total Automation System (TAS); can operate as a digital level together with an analog level or as a digital level only.

Circle (378) on Reply Card

Converters/encoders

By Alpha Image

• **Alpha 312 converter:** provides 10-bit RGB/YUV to serial digital conversion; uses half the rack space of the previous generation of converters.

• **Alpha 322 converter:** offers 10-bit serial digital to RGB/YUV conversion.

• **Alpha 362 dual encoder:** offers two broadcast-quality serial digital component to PAL encoders on a single card.
Circle (379) on Reply Card

Logo display system
By Quanta
• **T-A-G-S:** logo display unit for tagging station IDs, network affiliation or other graphics; operates as a single 2RU stand-alone device capable of receiving (via RS-232), storing and displaying up to 30 Delta-created logos or graphics; all logos are 32-bit, anti-aliased images.
Circle (380) on Reply Card

Editing system
By Digiteyes
• **Shotlister:** interfaces to almost any videotape editing system; automatically identifies the reel number of each tape; can read or make 17 formats of EDL.
Circle (381) on Reply Card

High-power amplifier
By MCL
• **M/N 30030:** 2,250W X-band traveling wave tube HPA; dual-drawer rack-mountable unit; comprised of the M/N 15417 TWTA drawer and the M/N 15418 HVPA (high-voltage power supply) drawer; operates with a 7.9-8.4GHz frequency range; designed for use in fixed, transportable and ship-board satellite communications applications.
Circle (382) on Reply Card

Ferric duplicator tape
By BASF
• **FERRO:** similar to BASF 619i/919i in high- and low-frequency output, distortion and S/N ratio and bias noise; shipped in Monobox packaging; uses a tensilized base film; available in C-60 and C-90 lengths.
Circle (383) on Reply Card

Training video
By Alesis
• **ADAT digital multitrack recording system video:** designed to help end-users convert their analog studios into digital format; covers the ADAT recording system as well as the BRC master remote control.

Circle (384) on Reply Card

Brochure
By Alesis
• **1993 product brochure:** updated full-line product brochure; features all Alesis products, including the X2 recording console, Quadrasynth 64 voice 76 key master keyboard, and AI-1 ADAT to AES/EBU and S/PDIF digital interface; features full color photos and detailed specifications for entire line of drum machines, rack-mountable reverbs, limiters, power amps and equalizers; 27-inches in length; folds to fit mailing envelope, file or coat pocket.
Circle (385) on Reply Card

Digital standards converter
By Video International Development
• **DTC 1004:** for one-way conversion of TV broadcast standards; features motion-adaptive 4-field/4-line interpolation and motion-adaptive digital noise reduction, and full proc amp controls.
Circle (386) on Reply Card

Satellite receiver
By Advent
• **AVR 2950:** designed for professional FM satellite TV applications; fully compliant; up- and down-gradeable.
Circle (387) on Reply Card

Satellite earth terminals
By Advent
• **NewSwift:** comprises a high-efficiency, offset fed antenna with low sidelobe performance; lightweight; can be transported using a station wagon, minivan or 4-wheel drive vehicle; easily deployed and operated single-handed.
• **Nomad:** self-contained, compact and economical satellite earth terminal with integral roof-mount antenna; cabin-based; transmits and receives video and/or data communications in the C, Ku and Ka frequency bands.
• **Migra:** trailer-based satellite earth terminals designed for mobile, semi-permanent and permanent applications; exceptionally lightweight; designed for rapid deployment by road, air, rail or sea.
Circle (388) on Reply Card

Rack case
By Alesis
• **Master studio rack case:** includes heavy-duty 2-inch screw-on casters for easy mobility in the studio; 32 inches high; features slant-front for easy access while seated at the console; includes zippered accessories pouch and standard rack screws; three accessory compartments available separately: 1) 5-space, rack-mountable VHS tape shelf that accommodates up to 14 VHS tapes; 2) 4-space, rack-mountable locking security cover constructed of solid steel; 3) 4-space, rack-mountable rack vault.
Circle (389) on Reply Card

Time base corrector
By Ikon Video
• **Time Base One:** includes infinite window memory, full frame or field freeze, dual-switch selectable inputs, 5.5MHz bandwidth, and composite and Y/C input and output with full transcoding; features an internal blackburst generator with BNC output and gen-lock input.
Circle (391) on Reply Card ■

Circle (53) on Reply Card

Industry Briefs

BUSINESS SCENE

Quantel, Darien, CT, has sold a Henry concurrent editor system to HBO Studio Productions, New York. In addition, HBO has purchased two Paintbox V8 systems and three Picturebox still-stores linked by Picturenet ethernet-based networking.

Also, Realtime Video, San Francisco, used Henry to complete a 5-minute special effects adventure sequence for Midland Productions and the MGM Grand Hotel & Theme Park in Las Vegas. Realtime used Henry to create a 30-second Cerebral Palsy Foundation PSA for Levi Strauss as well.

ImMIX, Grass Valley, CA, has begun shipping its VideoCube digital video post-production workstation to customers throughout the United States and Canada.

Philip Drake Electronics, Herts, England, has received orders for its new generation digital Intercom/Talkback system from the following companies: Dewe Studios, Germany; Channel 4, United Kingdom; Polish TV, Poland; VMTV, United Kingdom; European Parliament, Belgium; Pro Vision, United Kingdom; ERTU Broadcast Center, Egypt; Telecine, United Kingdom; and BRTN Radio, Belgium.

In addition, Drake has received a significant order for audio distribution amplifiers from Wharf Cable, Hong Kong. Drake also has won an order for its fully digital intercom system, DCS3000, to be supplied to Sony Broadcast Corporation of America for DirecTv, North America's first high-power direct broadcast satellite entertainment distribution system.

Canon, has delivered six 55X Super Telephoto Field lenses to WLVT-TV/39, Bethlehem, PA. Also, WSCH-TV, Portland, ME, has bought three PJ45X9.5 BIE lenses.

Odetics, Anaheim, CA, has sold three TCS90 cart machines to PBS, Alexandria, VA. TVI, Portugal, also has purchased a TCS90 cart machine.

Panasonic, Secaucus, NJ, has sold two additional AJ-D350 (one NTSC, one PAL) and one AJ-D340 (NTSC) D-3 studio VTRs to PDR Productions, New York.

In addition, Beverly Hills Video Group, Los Angeles, has purchased a pair of AJ-D350 D-3 format studio VTRs. Broadway Video, New York, also has taken delivery of an AJ-D350 D-3 format studio VTR. New York-based Creative Ways has purchased two AJ-D350 D-3 half-inch composite digital studio VTRs as well.

Sony, Montvale, NJ, has delivered HSP-800 Sprinter high-speed video duplicators and SVO-960 real time VHS duplicating VTRs to Technicolor Video Services, Camarillo, CA. This is the second purchase of Sony equipment that Technicolor has made within the last three months.

Also, NEP Supershooters, Pittsburgh, has purchased 24 BVP-series cameras. NEP also is upgrading its fleet of location trailers with an initial purchase of 16 BVP-375 and eight BVP-90 cameras.

Twentieth Century Fox and Sony Electronics are working together by using the newest digital data recording technology to preserve the world's oldest and most comprehensive collection of news films, the Fox Movietone Newsreel Library.

In the first application of its kind, Fox has purchased four Sony DIR-1000 series digital data recorders to use with a digital progressive scanning system that enables Fox to digitally restore and archive more than 10,000 hours of deteriorating, irreplaceable black-and-white newsreel footage of historic events dating back to 1919.

Pioneer New Media Technologies, Upper Saddle River, NJ, has sold 10 CD Autochangers in the United States, England, France and Japan through its system integrator, Radio Computing Services, Scarsdale, NY.

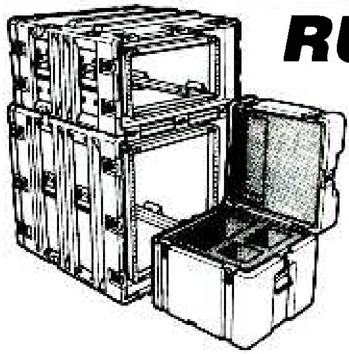
Dolby, San Francisco, has delivered three DSTL systems to WESGO, a 9-station independent Australian radio network.

BTS, Simi Valley, CA, has been selected by CBS Radio to provide the central routing switcher for the CBS Radio Washington News Bureau in Washington, DC.

In addition, Hollywood Digital, Hollywood, has selected two DCR-500 and three DCR-300 D-1 digital VTRs as its primary recording systems for editing, storage and tape transfers. Also, WOFL-TV, Orlando, FL, has acquired a Prizm Video WorkStation digital effects system.

Furthermore, BTS has sold an FDL-90 CCD telecine to GTN, Detroit. TCI, Des Moines, has purchased LDK-91SR CCD camera systems from BTS as well.

Avid Technology, Tewksbury, MA, has delivered and installed digital production equipment to Fox News, a division of Fox.



Fox acquired several Media Composer digital non-linear editing systems and two Media Recorder digitizing stations.

Ampex, Redwood City, CA, has been selected by Sunset Post, Los Angeles, to supply a DCT system, which will serve as the foundation for the facility's transfer to all-digital editing and telecine film-to-tape transfer. WTTW-TV, Chicago, also has purchased an entire DCT digital component post-production system.

Charlex, New York, has installed three DCT 700d tape drives.

In addition, Ampex has sold two DCT 700d tape drives to Tele-Cine Limited, London. Picture Company, Dublin, Ireland, also has installed a DCT edit suite.

Abekas, Redwood City, CA, has sold an 8-layer A84 digital layering switcher to Interface Video, Washington, DC.

Solid State Logic, Oxford, England, has received an order from Bayerischer Rundfink, Munich, Germany, for an SL4000 G series Master Studio System.

Also, Japan-based NHK, Sanwa Video, Omnibus, YTV and Imagica have all purchased Scenaria systems.

Vega, El Monte, CA, supplied 20 R-42A PRO PLUS VHF wireless receivers and companion 77/DIII transmitters to the Royal Shakespeare Company, Washington, DC.

Furthermore, WESH-TV, Orlando, FL, used Vega wireless IFB systems and 600-series PRO PLUS UHF wireless microphone systems in an "electronic town meeting."

Electro-Voice, Buchanan, MI, has installed a DeltaMax DML-1122A and DML-2181A system at "Wild Bill's" showroom at the Excalibur Hotel and Casino, Las Vegas.

In addition, Waterside Park, a new 12,000-seat baseball stadium in Norfolk, VA, has installed three MH6040C Manifold Technology coaxial horn/driver systems.

Alesis, Los Angeles, has opened 16 regional service centers throughout the continental United States. The following service centers are open and ready for business: DBM Technical Service, New York; Ron's Keyboard Service, Tacoma, WA; Advanced Musical Electronics, Los Angeles; Entertainment Support, Riviera Beach, FL; Mid-Town Instrument Repair, Chicago; Good Guys, St. Paul, MN; Maximum Audio, Hayward, CA; Secret Service, Cincinatti; Logical Audio, Tucker, GA; Studio Supply, Dallas; Electronic Innovation, Warren, MI; AVC Service Center, Nashville, TN; Antech Labs, St. Louis; Prototypes, Kensington, MD; Alactronics, Wellesley, MA; and Klay Anderson, Salt Lake City.

Video Design Pro (VDP), Las Cruces, NM, has been certified by Autodesk as a Unique Application Reseller—one of only 30 in the world. This status recognizes VDP's integration and linking of AutoCAD into its communication systems design software, and its quality of support for both its own products (VidCAD and CableDOC) and AutoCAD.

Winsted, Minneapolis, has appointed F.M. Valenti as its sales representative for Connecticut, New Jersey and New York. Multimedia Marketing, Santa Clara, CA, has been chosen to represent Winsted in northern California, Nevada, Oregon and Washington. Daniels Marketing, Mission Viejo, CA, will represent Winsted in southern California and Arizona.

Philip Drake Electronics has established a base in California from which its DCS3000 fully digital intercom system will be marketed and supported.

NewTek, Topeka, KS, has begun shipping the new Video Toaster 4000 software and hardware to its authorized dealer network.

Grass Valley Group, Grass Valley, CA, has announced a major restructuring plan designed to improve overall productivity and profitability. The plan provides for the consolidation of marketing, engineering and manufacturing operations with a consequent reduction in management levels aimed at improving internal communications and responsiveness.

Tektronix, Beaverton, OR, has signed Mega Hertz, Englewood, CO, and CSI, Seattle, as its newest representatives to the cable marketplace. Mega Hertz will market Tektronix's current and future cable TV product line to customers in Arizona, Colorado, Iowa, Kansas, Missouri, New Mexico, Utah and Wyoming. CSI will cover Idaho, Montana, Oregon and Washington.

Ampex, Redwood City, CA, has implemented a worldwide tape sales organization that will enable it to better meet the needs of its global customer base with a faster response time and a broader range of magnetic media products. The newly formed units, Ampex Media International and Ampex Media Europa, are legal entities and were fully operational as of July 1. ■

Show of Shows update

EEV

UHF TV power products: improved versions of the high-efficiency IOT7340R 40kW air-cooled and IOT7360 60kW water-cooled inductive output tubes; KSC3371 ESC klystrons.
Leddicon camera tubes: 2/3", 1", 30mm types for studio, EFP and ENG cameras.
Power tetrodes: 4CX series for AM/FM transmitters; 5kW, 15kW, 35kW power levels; improved mesh filament for longer life and reduced noise.

Fujinon

HR40x15 ES: HDTV production lens for 1-inch cameras; longest HDTV lens available. Others include:
A8.5x5.5EVM, S8.5x4.2EVM
A15x8EVM
A16x9RM/ERM
Ah66x9.5ESM, Sh66x7.3ESM
Ah24x7ESM
Ah20x8ESM, Sh20x6.2ESM

Pioneer New Media Technologies

VDR-V1000A: Random access broadcast video disc recorder providing instant access to any frame on a 32-minute capacity magneto optical disc; features include real time non-linear play, component recording format, full-frame TBC, built-in SMPTE time-code generator, non-contact media, 2 channels PCM audio, 3 operator presets and more.
VDP-V1100A: as above, except player only.
TD-001: PC-based time delay package combined with a VDR-V1000A facilitates flexible delays varying from one second to 32 minutes.

Roland Corporation U.S.

RAP-10 Audio Producer: sound card and Audio Toolworks software; provides desktop digital audio workstation capability for use in a PC-compatible computer.

Sierra Automated Systems

32000C: studio communications system; up to 32 users within one 3RU frame.
Control panels: IFB control panels for SAS 32000 series communication system. ■


"You Find A Winning Game Plan To Increase Copier Productivity And Reduce Operating Expenses, You Go For It."
Chuck Daly
Championship Coach
Business is like sports.
To win, you've got to make sure your team is performing to the maximum. That's why Sharp has developed a Winning Game Plan for copiers.
This booklet can help you find the right Sharp Copier that's going to give you a big jump in productivity and reduce operating expenses.
Copiers like Sharp's SD-3075 high-volume duplicating system–a phenomenal player that gets the job done at 75 copies-per-minute. It has every advanced feature as standard. It collates, staples, handles 2-sided copies, report covers, inserts and computer fanfolds.
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We guarantee it: with performance like this, there's no way you're not going to come out ahead.
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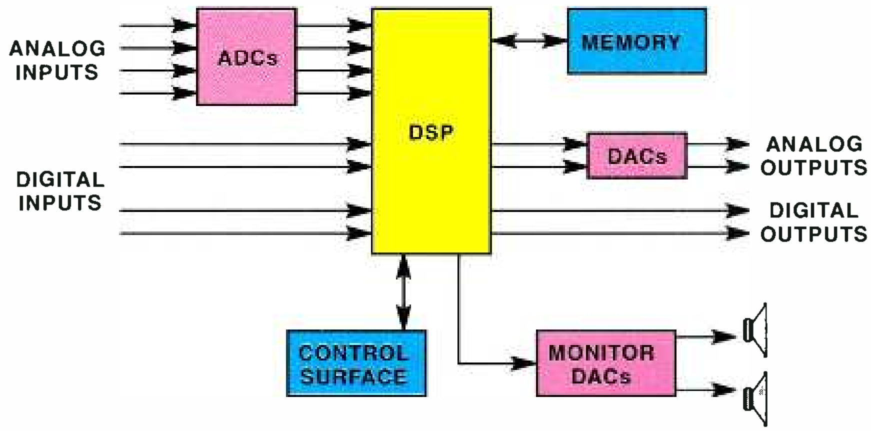

Figure 2. *Basic block diagram of a digital audio mixing system.*

Continued from page 31
to the outside world. In several respects, this is a more complex task than the equivalent interface of an analog mixer.

Three components of audio signals must be conditioned: timing (absolute or relative), frequency (sampling frequency) and phase. This means that digital mixers must be phase and frequency synchronous with their input signals. These input sources also must be time-synchronous to the sample or subsample. SMPTE time code is the most widely used reference for time-sharing events and synchronizing streams of audio. However, the use of conventional code is difficult in some applications of digital audio primarily because of the non-integer relationship between most audio sampling rates and NTSC video frame rates. Remember that frequency sync doesn't guarantee time sync and that time sync at any given point doesn't guarantee frequency sync throughout. Thus, the following observations about digital systems apply:

- A system that provides time synchronization only at any specified point is called a *triggered system.*
- A system that provides frequency sync only is considered one that can be *synchronized.*
- A system that can provide both continuous time and frequency synchronization simultaneously is capable of *resolving.*

A digital console first has to contend with frequency synchronization. A video source or AES-11 Digital Audio Reference Signal is usually preferred for this digital "house sync" signal because of its tight jitter/accuracy specs. The AES3-1985/1992 Recommended Practices specifies a high level of frequency accuracy that digital console manufacturers try to meet.

Unfortunately, the console may be called upon to digitally interface with signals from some digital recorders and outboard audio processors that don't meet this specification. The only way to solve integrity problems with digital I/Os is to choose a master reference with good frequency accuracy and stability to which all sources can be reliably referenced.

The primary physical difference between analog and digital mixers is the latter's ability to act as a virtual console.

A separate matter is phase synchronicity. This dictates that all components in a production system must be phase-locked (i.e., all devices' events happen at the same time). This includes sample edges, channel-status block edges and video sync edges. All of this seems fairly straightforward until you remember the non-integer time-code/sampling relationships mentioned earlier. For example, there are 1,471.47 samples per NTSC (29.97 f/s) video frame at 44.1kHz, or 1,601.60 samples per NTSC frame at 48kHz. This means that the sample edges only align every 10 frames at 44.1kHz or only once every 100 frames at 48kHz. Thus, sample accuracy dictates which particular sound sample lines up with the first video edge. At 20kHz, this condition might lead to a 90° phase shift between machines.

A more serious problem is the Channel Status (CS) sub-block boundary used in the AES/EBU professional digital audio interface and IEC 958 Type II (the consumer digital audio standard). Each CS block runs for 192 samples. If two different but sample-synchronous signals are being mixed, assigning certain information to the mixed output is difficult if the blocks were not CS-phase synchronous when they were input. Therefore, manufacturers choose a point where the video sync used for time-code phase accuracy and the sample clock used for audio phase accuracy are tied together absolutely.

Conclusion

Increasingly mature DSP applications hold great promise for the broadcast production community. Increased cost-effectiveness and processing capacities have provided numerous facile and inexpensive audio devices.

Affordable digital audio mixing platforms could mean the end of analog-to-digital transition in the audio production world.

Affordable digital audio mixing platforms could mean the end of analog-to-digital transition in the audio production world. The digital mixing platform is the ultimate and most central link in the audio production chain. Once this migration is complete, the digital whole will be greater than the sum of its parts, and broadcasters will reap the benefits of a digital system's increased production power.

➡ *For more information about digital audio processing, circle (301) on Reply Card.*

APPLICATION	NUMBER OF STATIONS	CHANNELS PER STATION
Music Production	1-3	4-48
Radio Production	2-5	4-16
Radio, On-Air	2-20	4-8
Radio, News	2-75	4-8

***Table 1.** Estimated requirements for audio data networks in various applications. (Source: Sonic Solutions)*

Continued from page 42

achieve approximately 37% overall efficiency, but in the short term, the data rate can fall to zero. This would be deadly in media applications.

In *token ring* networks, each node has two ports — an input and an output. The output of one node connects to the input of the next, with the final output connecting back to the first to form a ring. A special bit-pattern, called the *token*, is used to signal which node has the floor. Only one node can hold the token at a time. The node holding the token has an allotted time to speak before the token is passed to the next station. The token proceeds at high speed around the ring, so there is never a danger of collision, and available bandwidth is shared efficiently.

Local vs. central sound storage

There are two common approaches to configuring storage in networked systems. Many networks are arranged around one or more file servers in which data and programs are stored. This topology is favored in many business applications. An alternative is the distributed network, where network terminals operate as effective peers. Each station is equipped with local storage, and any station can function as both server and client.

Digital audio networks emphasize a distributed approach for two reasons. First, usage patterns and lifespans of audio data files are different than most business data. Production materials are in use for several days or, at most, weeks. Second, the data bandwidth capacity in a high-speed network favors distributed storage. A 100Mbit/s network has much higher bandwidth than commonly used hard disk drives. Storing library materials on a single server in such a network makes overloading at the disk interface likely. By distributing storage, clogging is avoided and more efficient use is made of the higher bandwidth.

Finally, just as in the business domain, network management is a critical component to successful application of these systems. In a distributed storage environment, the network manager must supervise the status of each station's drive and continually archive files that are no longer needed.

Digital audio networks will become a critical part of future production and broadcast facilities, allowing the full power of non-linear production systems to be experienced by users.

➡ *For more information on networks for digital audio workstations, circle (311) on Reply Card.* ❑

Professional Services

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FOR SALE

TELEVISION TRANSMITTER (USED) FOR SALE: GE model TT530C (1968) operating on CH 5 with 22 KW TPO complete with Vestigial Sideband Filter. Make offer. Steve Arnold c/o Calif. Ore. Broadcasting, 125 S. Fir St., Medford, OR 97501 or call 503-773-4033.

DE VENTA, ALGUNOS TTC UST-106A 100W TELEVISIÓN TRANSLADORES USADOS. $6,000.00USD TAL COMO ESTÁ O $7,500.00USD EN SU PROPIO CANAL. 1-800-882-1099 RON BARNES.

USED SATELLITE EARTH STATION FOR SALE! • 6.1 meter, 2-port Antenna • Environmentally controlled Shelter • C Band • 110 Partial Motion • Up/Down Converter • All amplifiers. Call Bill Bullock (415) 616-3401.

FOR SALE Panasonic DM7010 MII Camera/VCR Dockable System. Three 2/3" CCD's, 750 Lines, 62db S/N, Digital Processing. New/Full Warranty. $13,000 ($24,000 Retail). Many Other Models Available. (800) 233-2430.

SCSRT I SCA card with excellent crosstalk rejection, $20.00. Superradio III with advanced IF filter for even better selectivity, plus SCA, $95.00. Performance guaranteed. 1-800-944-0630.

SONY I INCH BVH-2000, 1100A w/Warantee. Betacam, Cameras, TBCs, Decks, Monitors, or call for replacement parts. Refurbished slant guide assemblies—$150. We buy clean, late-model equipment. (609) 786-1709. (215) 836-7669.

U47's and other NEUMANN Tube or Fet mics for sale. Reinhard Klippel, Witzlebenstr. 39, D-14057 Berlin. Tel. 030-322-4268, Fax: 030-322-1939. Written offers preferred.

Circle (65) on Reply Card

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FOR SALE

TRAINING

FCC GENERAL CLASS LICENSE. Cassette recorded lessons with seminars in Washington, Newark, Philadelphia. Bob Johnson Telecommunications, Phone (213) 379-4461

EQUIPMENT WANTED

WANTED: USED VIDEO EQUIPMENT. Systems or components. PRO VIDEO & FILM EQUIPMENT GROUP: the largest USED equipment dealer in the U.S.A. (214) 869-0011.

HELP WANTED

TV MAINTENANCE ENGINEER opening in Upstate New York. Large facility loaded with state-of-the-art equipment. Must be capable of troubleshooting studio equipment to the component level. Experience in maintaining digital and microprocessor-based equipment required. UHF experience a plus. Send resume to: WXXI Human Resources, PO Box 21, Rochester, NY 14601. EOE.

ELECTRONICS FIELD/SHOP ENGINEER. Swiderski Electronics, Inc. located in the Chicagoland area, is looking for an Electronics Field/Shop Service Engineer with a min. of 2 years exp. Individual to work with Broadcast/Industrial 1/2", 3/4" & 1" VTR's and related equipment. Full time position. Full company benefits. Send resume & salary history to: Human Resources Dept., 1200 Greenleaf Ave., Elk Grove Village, IL 60007. Fax resume to: (708) 364-5019.

BROADCAST RECORDING TECHNICIANS. National Public Radio currently has openings in the Audio Engineering Division for Broadcast/Recording Technicians. Candidates must have live on-air production multi-machine mixing and intensive remote experience. NPR technicians must work shifts throughout the broadcast week (24 hours, seven days) and travel as needed. Experience with all analog broadcast and high quality recording equipment is essential. Familiarity with digital editing, multi-track recording is desirable. Applicants must be dependable. To apply send cover letter and resume to: NPR, 2025 M. Street NW, Washington, D.C. 20036. ATTN: Dept 541. NPR is an Equal Opportunity Employer.

TV TECHNICIAN Major metropolitan Northeast station has an opening for a technician with extensive studio camera experience. Individual must possess a minimum of 5 years experience in all phases of studio and control room television production. Send resume (NO CALLS) to Irwin Ross, Director of Engineering, WPVI-TV, 4100 City Avenue, Suite 800, Philadelphia, PA 19131. EOE

UHF TRANSMITTER ENGINEER. KADY-TV, an independent television station is looking for a transmitter engineer with a strong engineering background and 5 years of microwave and UHF transmitter experience. Experience with Comark and RCA transmitters desirable. Knowledge of FCC rules a must. FCC General Class License a plus. Send resume and salary history to: Human Resources, KADY-TV, 663 Maulhardt Avenue, Oxnard, CA 93030. Fax (805) 485-6057. EOE/M-F.

RADIO CHIEF ENGINEER TOP 20 ADI Needed immediately. Our chief must be a hands-on, take charge engineer. This is not an entry level position. You will be responsible for a small staff, all studios and general building facilities. New state of the art studios on line. AM directional experience mandatory. Major corporate ownership. GREAT benefits! RUSH confidential resume to: Dept. 738, c/o Broadcast Engineering, P.O Box 12901, Overland Park, KS 66212-2901. An Equal Opportunity Employer, M/F.

CHIEF ENGINEER: UHF independent is looking for hands-on chief. Successful applicant should have maintenance experience on both studio and UHF transmitter equipment. Minimum three years supervisory experience as either chief or assistant chief required. Must possess good communication skills and be computer literate. Great opportunity with a young, growing independent station in a very desirable location. Send resume to: General Manager, KTVD-TV, 11203 East Peakview Avenue, Englewood, Colorado 80111. EOE/M/F.

WANTED: CHIEF ENGINEER of Radio Networks, successful candidates will have significant experience in satellite systems as well as studio and remote equipment. Outstanding management and customer relations skills also required. Resume and cover letter to: Dept. 736, c/o Broadcast Engineering, P O Box 12901, Overland Park, KS 66212-2901.

Classified

HELP WANTED

TRANSMITTER/STUDIO ENGINEER needed for top 50 market UHF-TV station. SBE Certification desirable. Experience maintaining UHF full power transmitters required. Knowledge of Type "C", Betacam SP, and U-Matic videotape maintenance also desired. Full time position. EOE. If interested please send (or Fax [804] 399-3303) resume to WGNT-TV Channel 27, Attention: George Randell, 1318 Spratley Street, Portsmouth, VA 23704.

MANAGER OF ENGINEERING SERVICES. NPR has an immediate opening for manager of the seven person audio maintenance unit. This position involves full day to day responsibility for the network's ten headquarters facilities, as well as audio equipment at remote feed locations and news bureaus. Candidates should be equally at home troubleshooting to the component level of modern broadcast audio equipment, supervising a highly competent professional staff, and participating as an active member of the engineering management team. Job One, of course, is maintaining the highest professional standards of technical quality throughout the NPR production and on-air facilities. Candidates should possess a BSEE or equivalent and/or ten years progressive experience in broadcast audio maintenance. Applicants should possess superior written and oral communications skills, a demonstrated proficiency in managing an engineering team, and a preoccupation with achieving results. Competitive salary and benefits. NPR is currently engaged in an ambitious relocation of its headquarters facilities in Washington, D.C. This position will remain open until filled. Send resume and letter of interest to, NPR, 2025 M. Street NW, Washington, D.C. 20036. ATTN: Dept. 113. NPR is an Equal Opportunity Employer.

STUDIO BROADCAST ENGINEERS needed on the Gulf Coast of sunny Florida. Component level experience in Analog/Digital switchers, Betacam, 1", and D2 VTR's, CCD cameras, Robotics, Graphics Generators, and Editors. 4-6 years studio experience, FCC or SBE certification. EEO Employer. Send resume with salary history to HSN, Attn: Tim Snyder, Human Resources Rep., P.O. Box 9090, Clearwater, FL 34618-9090

WPIX **2010 CALLS........**

New York's leading independent station, is building the station of the future.

We are looking for a **project supervisor** to join our design group. The **WPIX** project management team will join with one of this country's hottest systems integration and design crews: Sony's SID Group.

We are looking for a dynamic, experienced broadcasting engineer who can make things happen quickly through experience and vision.

This may be a long term opportunity for a person who is up to a fast track project.

Resumes may be faxed to **(212) 697-6095** or mail to: **WPIX, Inc.**

220 East 42nd Street, New York, NY 10017
Employment S
WPIX is an Equal Opportunity Employer
A Tribute Broadcasting Station

POST PRODUCTION ENGINEER

Excellent opportunity for an experienced engineer at our Digital-oriented facility in sunny South Florida. Top notch equipment that needs another top notch engineer. Good attitude and self-starter a must, Rank experience a plus. NO PHONE CALLS PLEASE. FAX OR SEND RESUME TO:

CHIEF ENGINEER, EDEFX GROUP
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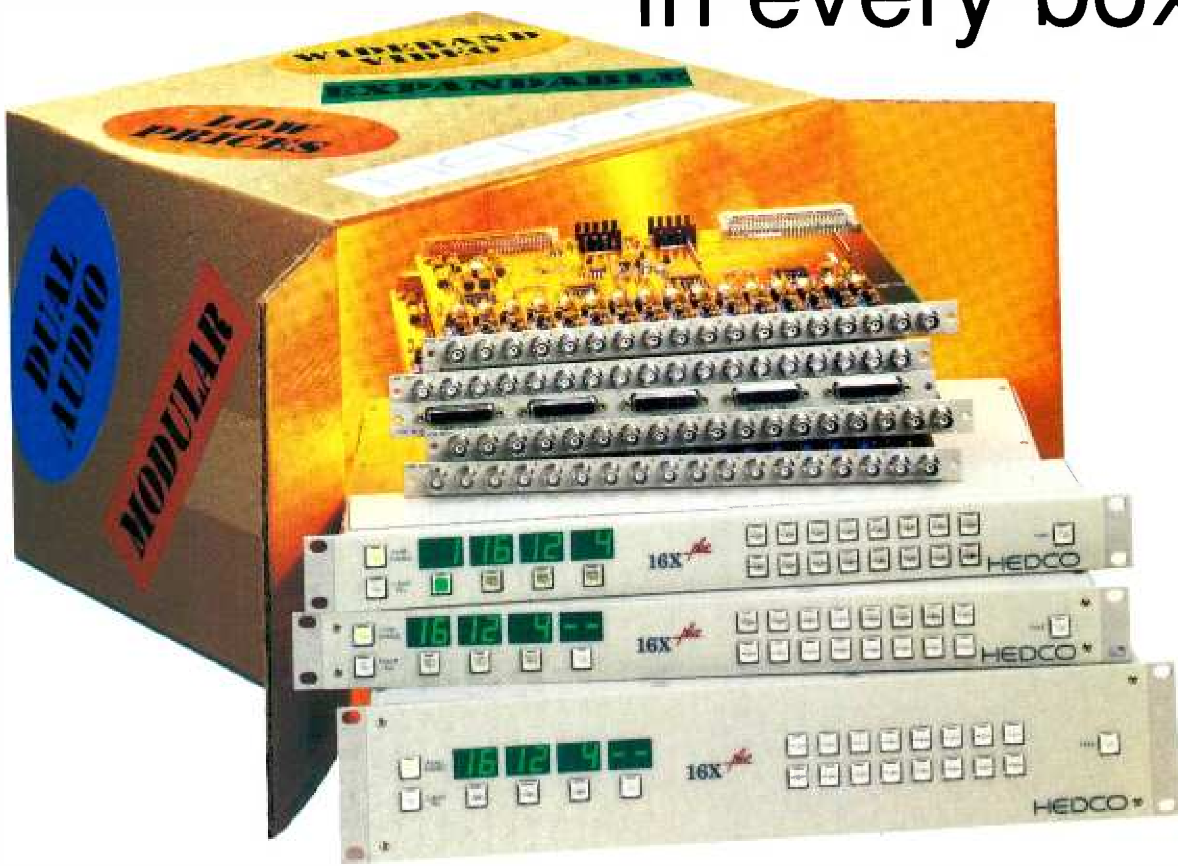

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