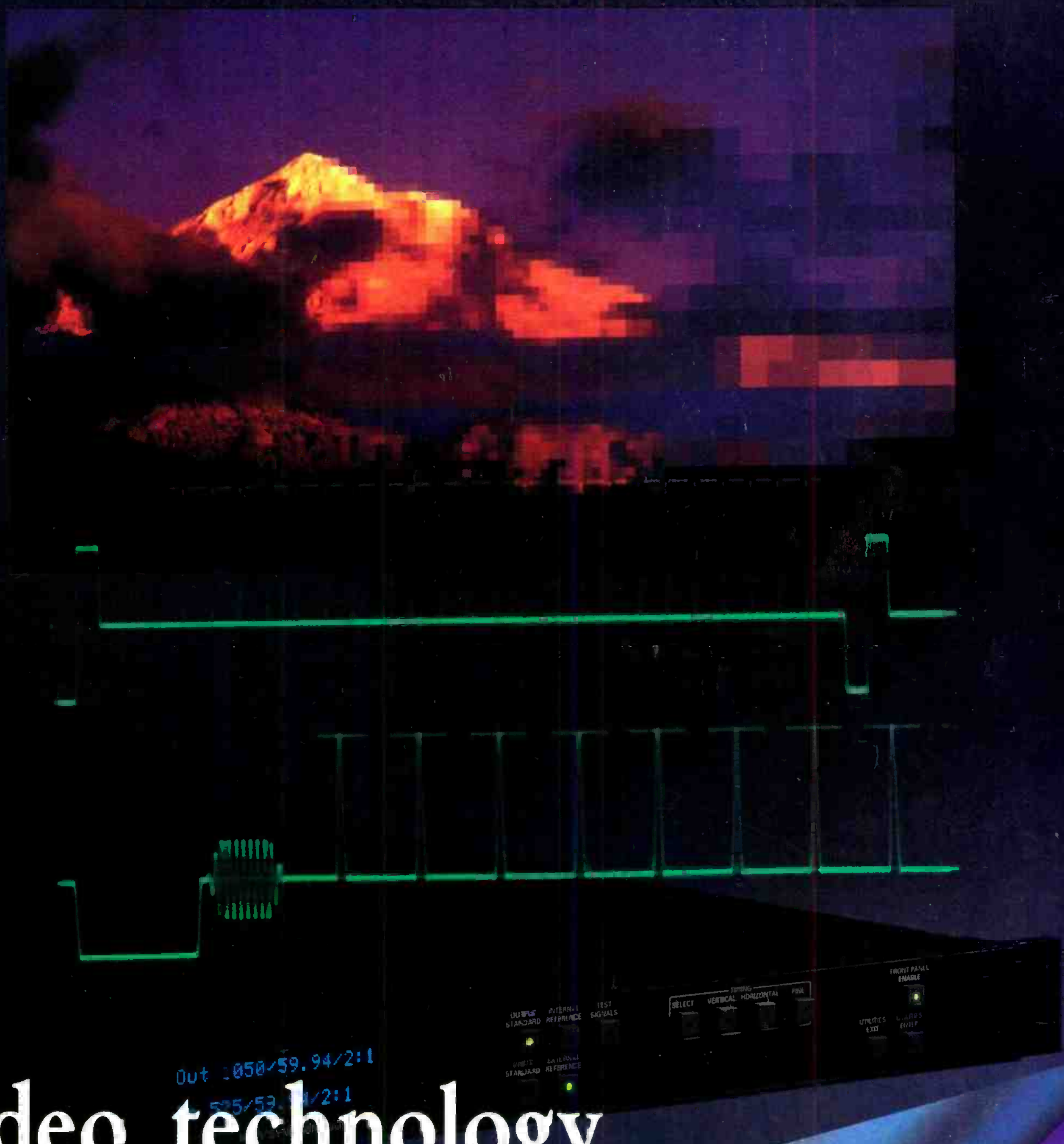
BROADCAST engineering®

AN INTERTEC PUBLICATION

August 1991/$4.50



Video technology update

Digital audio workstations p. 56

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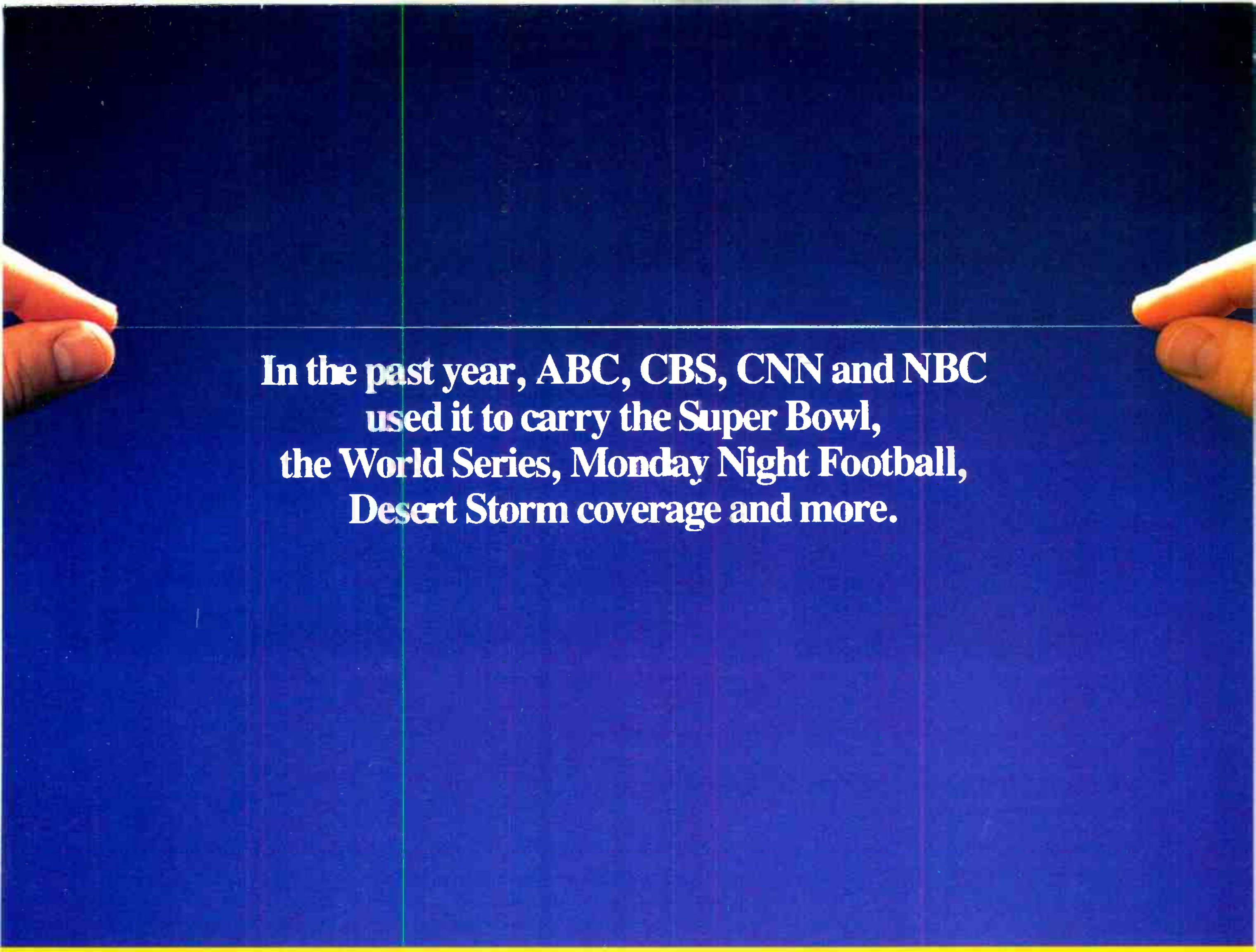

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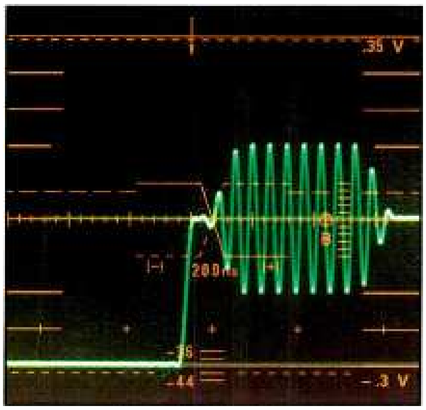

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VIDEO TECHNOLOGY UPDATE:

Video technology is moving in fast forward, and engineers must run to keep up. With HDTV around the corner and computers entering the professional video arena, today's engineers face a bewildering array of technological challenges. This month, we will report on the important issues and challenges you'll face with tomorrow's video systems.

FEATURES:

OTHER FEATURES:

DEPARTMENTS

ON THE COVER

Today's video facilities will soon handle HDTV signals. The integration process of HDTV into NTSC is symbolized by the HDTV synchronization signals and the pixel image in a 16:9 format. Cover credit: Kim Bracken, *BE* graphic designer. Design by Tektronix.

SERIAL DIGITAL

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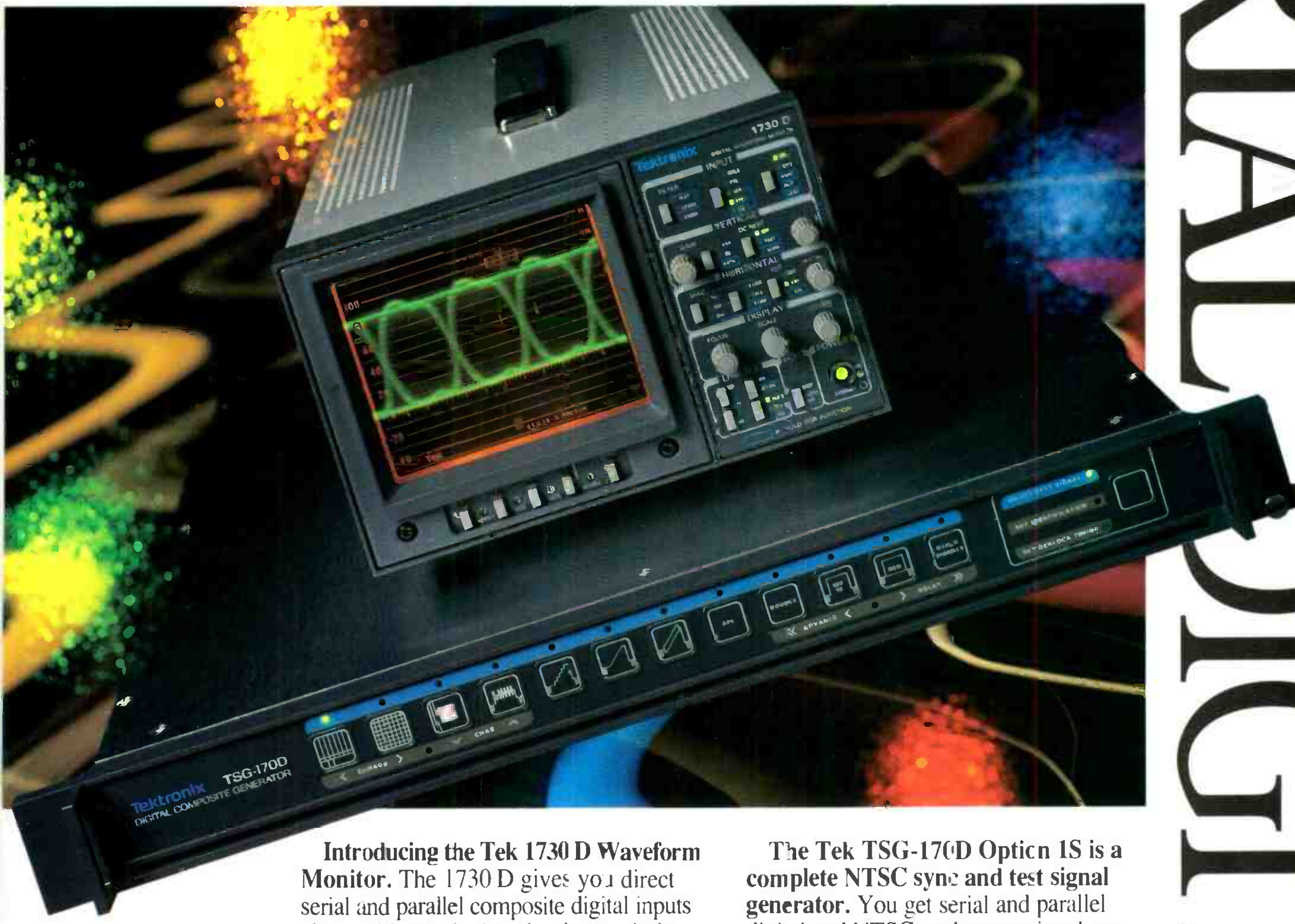

Introducing the Tek 1730 D Waveform Monitor. The 1730 D gives you direct serial and parallel composite digital inputs along with standard analog inputs, independently or simultaneously, for NTSC applications. All in a compact, familiar package that fits in half a rack.

The 1730 D's unique eye pattern display of the 143 MB/s NTSC serial digital signal makes it easy to check transmission path integrity. And the high return loss of its loop-through serial digital inputs permits observation in the same cable that reaches destination equipment.

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The 1730 D is a versatile tool you can use as a system monitor for new digital recorders and telecines. And for maintenance it provides a precision point of reference for evaluating DACs and filters in production equipment.

The Tek TSG-170D Option 1S is a complete NTSC sync and test signal generator. You get serial and parallel digital and NTSC analog test signal outputs, AES/EBU serial and parallel digital and analog audio tone outputs, and RS-170A black burst outputs for master SPG applications. Plus 12-character identification, tape leader countdown and digital genlock with output timing offset.

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News

By Dawn Hightower, senior associate editor

The ATV testing calendar has been released

The "Test Sequence & Calendar" has been released by the FCC Advisory Committee. It contains the testing dates for the six advanced TV (ATV) transmission systems under consideration by the FCC Advisory Committee and scheduled for laboratory testing at the Advanced Television Test Center (ATTC).

The calendar replaces the one released earlier this year, (1/8/91) in light of the recent advent of several "all-digital" systems, and the resulting changes in test plans and the completion of testing facilities.

The testing reflected on this calendar will be conducted at the test center's facilities in Alexandria, VA, by ATTC and Cable Television Laboratories. Additional testing will be conducted on a related schedule at the Advanced Television Evaluation Laboratory in Canada.

NAB urges inclusion of must carry/retransmission option

The NAB and CEO Edward O. Fritts called the must carry/retransmission consent provision contained in the Senate cable bill a "win-win" situation for the public and urged that any House cable legislation include the option.

In testimony before the House Telecommunications Subcommittee, Fritts said that by providing must carry rules, the public is guaranteed access to broadcast signals. By allowing broadcasters to control their own signal, Congress will put them on a more equal economic footing with cable.

Fritts called retransmission consent the key to avoiding "a nation of information 'haves' and 'have nots' " and noted that although broadcasters are denied the ability to retransmit another broadcast signal without permission, cable can do so "with impunity."

Countering cable industry claims that a negotiation between broadcaster and cable operator would increase cable rates, Fritts stated that "the FCC can be given authority, as it is under the Senate bill, to keep rates reasonable for consumers." He also said that the concept of retransmission consent "does not require that money change hands," noting that the compensation to the broadcaster could include "promotional considerations, additional changes to program or other agreed-upon terms."

Ennes Foundation receives donation

The SBE Ennes Foundation has received a $1,000 donation from Intertec Publishing, Overland Park, KS. The money will be used to support educational programs.

The foundation was formed in 1986 by the society in memory of Harold E. Ennes. It helps the SBE provide educational programs and training materials for broadcast engineers.

Regulators asked to assure spectrum

The National Association of Broadcasters (NAB) will support an effort to get the Federal Communications Commission (FCC) to clarify rules that could undermine the ability of TV stations to send their video signals from remote news sites back to studios.

In comments supporting a petition by Microwave Radio, NAB said a clarification is needed because the federal agency has narrowed its rules to limit broadcast access to airwaves used predominantly by private radio users. In the past, both groups shared a portion of the airwaves in the 23GHz band.

Concerned about the impact on newsgathering operations and studio-to-transmitter links (STLs), broadcasters need the FCC ruling to avoid being displaced from the 23GHz band. The use of alternative spectrum would be impractical because it is already congested.

NAB has asked the FCC to amend its rules to grant continued access to the 23GHz band. Left uncorrected, the FCC's new rules "would be disastrous to broadcaster operations," affecting TV newsgathering between remote sites and TV studios.

SBE approves convention dates

The board of directors of the Society of Broadcast Engineers (SBE) has approved the following dates for the annual SBE convention: Oct. 2-5, 1991, Houston; Oct. 14-17, 1992, San Jose, CA; and Oct. 13-16, 1993, Richmond, VA.

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BROADCAST ENGINEERING is edited for corporate management, engineers/technicians and other station management personnel at commercial and educational radio and TV stations, teleproduction studios, recording studios, CATV and CCTV facilities and government agencies. Qualified persons include consulting engineers and dealer/distributors of broadcast equipment.

BROADCAST ENGINEERING is published monthly (except in the fall, when three issues are published) and mailed free to qualified persons within the United States and Canada in occupations described above. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address changes to Broadcast Engineering, P.O. Box 12960, Overland Park, KS 66212.

SUBSCRIPTIONS: Non-qualified persons may subscribe at the following rates: United States and Canada; one year, $50.00. Qualified and non-qualified persons in all other countries: one year, $60.00 (surface mail); $115.00 (air mail).

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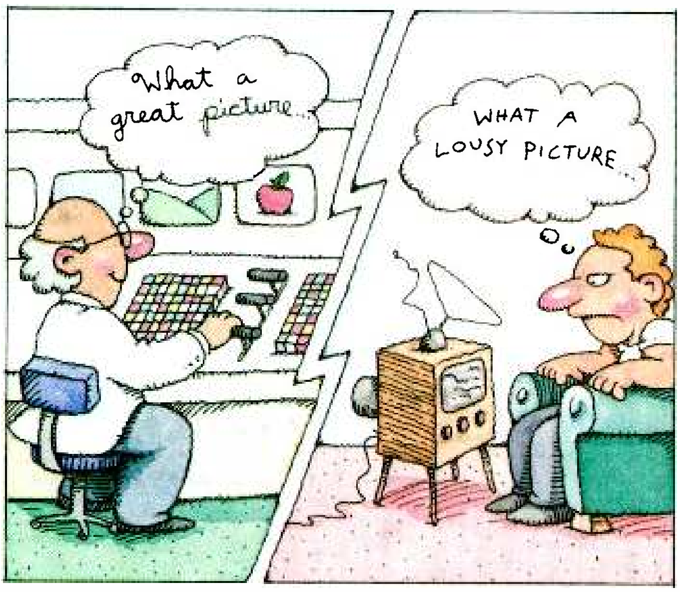
It's already good enough

The latest technology battle lines were drawn in June at the Montreux ITS convention. Three giants in the videotape recorder business released snippets of information about their soon-to-be-available videotape formats. Although little concrete information was presented, it appears that the next generation of digital video recording formats is just around the corner.

The rush to provide broadcasters and production houses with another choice in recording formats has caught professionals by surprise. The first reaction I heard to the announcements was, "Oh, no, not another format." This sentiment was echoed by many throughout the show.



Although new technology is often greeted with open arms, that has not always been the case with videotape formats. Let's look at why.

Cost is usually the answer. Probably no other piece of production equipment impacts so many factors within a facility. If you have a large investment in one, two or three different (and incompatible) videotape formats, the idea of adding a second, third or forth isn't something you look forward to.

First of all, you need to consider the cost of the new recorders. Second, the needed support equipment for new component or digital formats can be equally expensive. Third, the technical department is faced with supporting yet another technology. Purchasing tape is the last hurdle to implementing a new format. At today's prices, equipping a facility with perhaps hundreds of hours of new video recording tape is not an inexpensive proposition. With all these drawbacks, it's easy to see why users might not be particularly enthusiastic about the introduction of another videotape format.

Timing was another question that ran through many of the convention attendees' minds. Why another format now? Why the surprise announcements from three companies simultaneously? The D-1 format has yet to become a common sight in most broadcast and post facilities. The D-2 format has become popular, but far less so than the Betacam, Betacam SP and MII formats. Furthermore, the newest format, D-3, has yet to see full-scale production.

So why the ballyhoo about the possibility of up to three more formats? This situation has many industry professionals scratching their heads. The new formats will likely provide additional benefits, but will those benefits offset the cost of converting to them?

Improvement for improvement's sake is not a sufficient reason to adopt new technology. However, the realists will recognize that most of what broadcasters broadcast and what producers produce is already sufficient in the eyes of the consumer. We ought to be asking ourselves if further improvements in the source signals will even be noticeable to the viewers. Or will the advantages of new digital videotape formats be lost on the 20- or 25-inch TV screens by the time the image has traveled through 30 miles of cable or been bounced off several large buildings?

Those of us who produce and transmit entertainment programming have always embraced new technology. We strive to give our audiences better quality. It's been our goal to seek the best, and when new ideas are introduced, we endeavor to implement them as soon as possible.

In this case, however, have we put the cart before the horse? Will our audiences appreciate (pay for) any improvement in image quality (assuming they can even see it)?

We may have reached a crucial point in communication technology. Further improvements at the source may not be recognized by the audience because the receive process has become the limiting factor. It's analogous to AM stereo. The quality is there, but who cares? Will the same thing happen with transmitted video?

Maybe it's time to concentrate on the delivery process. What we really need is a quantum leap in receiver and delivery technology. Until that happens, our viewers may tell us that it's already good enough.

Brad Dick

Brad Dick, editor

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Main studio rule tightened

By Harry C. Martin

In a decision released in June, the FCC interpreted its broadcast station studio rule (Section 73.1125) to require the presence of at least one full-time manager and one full-time staff person at the main studio during normal business hours. The commission's staff advises that this requirement can be met through a combination of full- and part-time managers and staff members, as long as there is management *and* staff present at the studio on a full-time basis during normal business hours.

The new decision is the first the agency has issued on this subject since 1987, when the main studio rule was amended to require a "meaningful management and staff presence" at main studio facilities. As a result, many radio stations, including those that have leased portions of their broadcast day pursuant to time-brokerage agreements, may not comply with the commission's interpretation of the studio rule. Also vulnerable will be FM stations that have located "auxiliary" studios outside their 3.16mV/m contours while maintaining only outpost main studio facilities (employing, for instance, a part-time employee and an answering service) within their communities of license.

Reconsideration of the new decision will probably be sought. In the meantime, the requirement that at least one manager and one staff person be present at the main studio during normal business hours will be the applicable legal standard.

FCC redefines "effective competition" for cable

The commission has redefined "effective competition" to allow local franchising authorities to regulate basic cable service rates. Under the Cable TV Act of 1984, municipal rate regulation is prohibited in cable communities where there is effective competition to the local cable TV system. Effective competition has been defined, up until now, as the availability of three or more over-the-air TV signals in the cable community.

Under the agency's new definition, effective competition exists only if:

- Six unduplicated over-the-air TV signals are available in the entire cable community.
- An independently owned, competing multichannel video delivery service (for example, SMATV, MMDS or a second cable service) is available to 50% of the homes passed by the incumbent cable system, and subscribed to by at least 10% of the homes passed.

In the absence of effective competition as defined, a franchising authority has the discretion to regulate the rates charged for basic cable services. For those cable systems whose basic service rates are regulated by their franchising authorities, the FCC will require that in setting or approving rates, franchising authorities allow cable operators to earn a fair return on investment. The Cable Act provides for a 5% automatic annual increase in subscriber rates for basic tier service. The commission's new rate-setting standard takes into account, in addition to a reasonable profit, cost factors, such as programming, customer service, labor costs and debt service.

The FCC also is seeking comments on whether the elimination of must-carry obligations by cable systems is undermining effective competition, and if so, whether some form of must-carry should be reimposed.

FCC modifies TV "satellite" standards

The commission has revised its policies and rules governing TV "satellite" stations. Satellite stations are full-power TV facilities that rebroadcast all or part of the programming of a parent station that is commonly owned.

Specifically, the FCC has revised its case-by-case approach of considering TV satellite requests by adopting a "rebuttable presumption" favoring applications that can satisfy the following three public interest criteria:

1. There is no city-grade overlap between the parent and the satellite.
2. The proposed satellite would provide service to an underserved area.
3. No alternative operator is ready and able to construct or to purchase and operate the satellite as a full-service station.

Applicants who fail to meet the 3-part test may still obtain approval if they can show that other compelling reasons warrant a grant of their applications.

The commission also abolished the 5% cap on the amount of local programming that a TV satellite licensee may originate.

FCC studies EBS technology

The commission is seeking information on technical improvements to the Emergency Broadcast System (EBS). The agency's goal is to implement a system of receivers that are activated only for emergencies of a certain type or in a certain area.

Specifically, the FCC wants to know (1) whether there is a need for an updated automatic alerting system, and if so, what type of equipment is most appropriate for this application; and (2) if there are applications of technology that could reduce new burdens on licensees in connection with current EBS rules.

Two basic alternative technical systems currently are possible. One would use the inband audio to convey the alerting information, as in the present 2-tone alerting system. The other would use non-audio band signaling systems, such as an FM subcarrier.

Automatic activation of EBS stations is possible with the new technology. It would mean that a broadcast station could be switched from its normal programming to EBS transmissions by an external authority. This could add a major feature to EBS, but it also poses legal and policy issues. An automatic activation system would appear to be illegal absent amendments to the Communications Act, which generally require that stations be operated and controlled by a licensed duty operator.

To implement the suggested changes, the commission could either select a specific alerting system in a rulemaking and mandate its universal use by a certain date, or, alternatively, select a preferred system and encourage rather than mandate its implementation by broadcasters and emergency planning services. Comments are being solicited on all of these issues.

Martin is a partner with the legal firm of Reddy, Begley & Martin, Washington, DC.

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Clip those peaks

By Andrew Suk

Since the advent of television, engineers have advised talent not to wear white shirts. Regardless, video engineers often settle into the camera control position and find images of smiling newscasters wearing shirts and blouses as reflective as front-surfaced mirrors. If the talent has a tan, engineers have only two choices: the newscaster can wear a white shirt and have no discernible face, or have good-looking skin and clothes that look like they're going to burst into flames. This problem is due to the contrast ratio of the two colors.

Contrast ratio is a little understood but easily recognized anomaly of pick-up devices. Video cameras are limited not only by the amount of light required, but also by the ratio of maximum-to-minimum brightness. This article should help clear some of the confusion concerning acceptable video levels.

"It isn't white, it's beige"

One common problem concerns setting video clips. There is also confusion about how to handle video peaks and chroma excursions beyond 100IRE. All of this gets back to why video engineers often find themselves dictating fashion parameters to on-camera talent.

In the first place, FCC specifications are transmission standards, not studio laws or regulations. Anything goes in the studio, but once the signal hits the transmitter, it has to be correct. If it isn't, it may cause degraded signals and interference that can result in degraded video and possibly, fines.

The FCC expresses the specification for peak white as a percentage of the full carrier: (0.125 +0.025)C, where C = peak carrier amplitude. This is commonly referred to as 12.5%. With proper depth of modulation, this roughly translates into 100IRE ±4IRE. This specification is for luminance only. It specifically excludes the chrominance signal.

The approved specification for studio equipment is RS-170. This contains amplitude and timing parameters for the NTSC system. The RS-170 standard calls for a "program operating level white" of 100IRE +0, −2IRE. Exceeding the studio specifications may not noticeably degrade the picture on the studio monitors. However, transmitting luminance signals greater than 100IRE can result in visual distortion. It could also interfere with the audio signal, causing an objectionable sync buzz. For this reason, automatic signal processing is used to properly set the video levels before they are transmitted. This may also distort the original image, but that's the trade-off to exceeding FCC regulations.

Highlights vs. hot shots

Cameras have peak limiters or clipping circuits that limit the peak excursions to an acceptable level, usually less than 105IRE. Additional clipping will normally secure a maximum peak white amplitude of 100IRE.

Exceeding the studio specifications may not noticeably degrade the picture on the studio monitors. However, transmitting luminance signals greater than 100IRE can result in visual distortion.

A bright sky or lamps (and possibly talent's clothing) may exceed this peak white level. Occasional highlight overshoot — the glint off a chrome bumper or the bright reflections off eyeglass frames — will produce spikes greater than 120IRE. Clipping these highlight peaks should not noticeably degrade the picture. However, clipping a large peak white area will remove picture detail from the bright portions.

The difficulty for the video engineer comes in determining what is an acceptable highlight and what is peak white. This really isn't subjective, as some of the great production vs. engineering battles have made it. Simply put, highlights should be the exception, not the rule. Camera zebra bars set to the proper level, or the 100IRE line on a waveform monitor, are the best tools for establishing white levels. You must prevent any luminance from exceeding that level. (See "Strictly TV," January — March 1991, for a further discussion of this topic.)

Overshoots can come not only from highlights, but also from excessive image enhancement. If this occurs on a studio camera, and the video clip is improperly set, the problem could show up as a sync buzz on one camera only. This would create an interesting troubleshooting problem for the transmitter engineer.

This discussion has referenced the luminance signal only. High-frequency chrominance components can often reach 120IRE. Soft clips will clip the luminance component only. Typically, this is set to 100IRE. Hard clips limit luminance and chrominance. This level is set approximately 10IRE above the soft clip level. It is common practice to transmit up to 110IRE of chroma. In fact, many test signals include chroma components up to this level.

Studio operators tend to think in terms of the composite video waveform. At the transmitter, the color signal is handled separately as a chrominance subcarrier. All FCC measurements are made with an IEEE filter, except when measuring chrominance components. The 12.5% FCC specification refers to luminance only; chroma can and will exceed this level.

Communicate

After setting clip levels and checking all the technical parameters of the cameras and support gear, it's time for the most important preventive maintenance step: You must talk to the people involved. Take the time to show the talent what they look like with nice tans and beige blouses. Explain to them in non-engineering terms why a signal that looks good on the studio monitor might look quite different by the time it reaches the home set. Some genuine one-on-one discussion may go a long way toward improving your facility's video.

Suk is director of engineering, Cordillera Communications, and chief engineer of KIVI-TV Nampa, ID.

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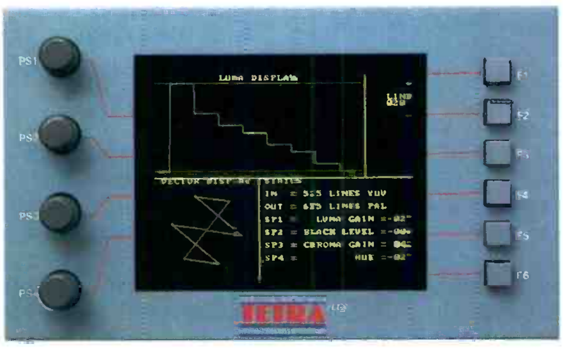

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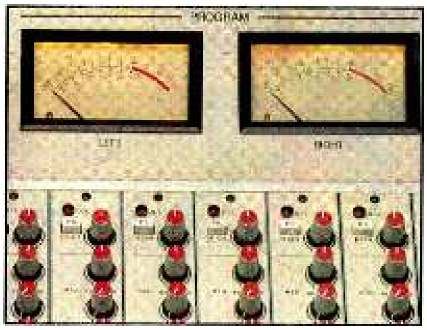

The case of the drifting DA

By John Battison, P.E.

One of the most interesting papers presented at last spring's NAB Engineering Conference was "Report on a Drifting AM Directional Array." Because it was so worthwhile and did not appear in the *Proceedings* of the conference, I obtained permission from the author, Douglas L. Barton, owner and chief engineer at KMTI, Manti, UT, to paraphrase it here. (This story may sound familiar to other AM engineers who have been around awhile.)

During the adjustment of KMTI's brand new DA-2 2-tower array last summer, some strange symptoms were observed.

For a period of approximately 30 seconds after the application of 900W to the night common point, the indicated phase angle slowly drifted around 5° and the current ratio varied about 5%. After this, the array became stable.

A similar phenomenon was observed with 10kW at the day common point, but the duration of the drift period was only about 15 seconds.

This drift was observed throughout the whole system. Even the VSWR meter on the new transmitter showed the effect. When the drifting ended, the common point measured 50Ω on the operating in-line bridge (OIB). But when measuring with the transmitter off using a receiver-generator and an OIB, the common point impedance measured 60Ω + j20. Apparently, the low output power of the receiver-generator was not sufficient to shift the array.

All components were checked. There was no heating; the coax and transmitter checked out; and the antenna base insulators and chokes were all right. Uncovering the ground system showed it to be properly installed and brazed. Changes in ground water level had no effect. According to Barton, *everything* was checked and found to be correct.

Measurements made of each tower in a non-DA mode showed a change in impedance during the drifting interval. The symptoms resembled a capacitor changing value as it charged; but changing capacitors were ruled out.

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

As part of the detective work, a dummy antenna was made. It consisted of several branches of 12-gauge wire fanned out about six inches above the ground, 50 feet from the tower base. A good match at the ATU was produced, and the same drifting effect was obtained with both towers floating.

The soil at the swampy site was wet, black and mucky. In order to measure its resistance, two electrodes were inserted approximately 12 inches into the soil. Measuring the current with various voltages applied through a Variac indicated that the resistance varied across an interval of time, the duration of which depended on the voltage applied. The soil was causing the phenomenon. Presumably, the changing currents changed the DA's ratio as well as the phase.

Because this research was conducted last summer, the array has continued to exhibit the drift with absolute uniformity through the fall, winter (a severe one) and spring. The drift periods' durations are so regular that, according to Barton, "you could set your watch by them." (For further information, he can be reached at 801-835-7301.)

This kind of problem has probably faced most of us at one time. However, it has been my experience that the drift usually continues for longer periods, and often never seems to finish or stabilize itself. In these cases, the engineer has a long road to follow to find the trouble.

A similar difficulty can arise in arrays with a negative tower, in which that tower swings from negative to positive and back. To correct this problem, the negative tower can be "anchored" by connecting a resistor across its base to stabilize it and iron out the swings.

LPTV antennas on AM towers

Another AM transmission site issue involves the mounting of low-power TV (LPTV) antennas on AM towers. LPTV stations continue to proliferate, and the latest LPTV window, which closed at the end of April, resulted in many new filings. LPTV operators seem to be attracted to FM and TV towers or existing buildings for their antenna sites. AM towers, unless grounded and shunt-fed, generally pose a problem for LPTV. In fact, for any service that needs to get across the base insulator, it is wise to avoid the series-fed AM tower.

Recently, one of the few suppliers of Isocouplers and similar devices to cross the AM base insulator announced a line of low-power isolators suitable for LPTV. Renting space on an AM tower to an LPTV station could result in additional revenue, and this can be especially attractive if the rental contract includes the cost of the isolating equipment.

It behooves a station engineer who is asked by management about the idea of renting to an LPTV to include the cost of crossing the base insulator. Also, allow for the possibility of additional renters, as more companies become interested in using towers.

This brings us to the folded unipole. Sometimes a need — or a possibility — arises for changing to a folded unipole. Don't sell the idea short. Once you've grounded the tower, there is almost no limit to what you can hang on it, and thus bring in rent. If you are non-DA, the change could hardly be simpler. If you have a DA, it is not that much more difficult.

AM towers, unless grounded and shunt-fed, generally pose a problem for LPTV.

On the other hand, a new tower at the old AM transmitter site might also be built for LPTV or other expansion purposes. You may recall such a case that was described in the March and April installments of this column. Winter weather had stalled the project, but I am happy to report that it is now complete. The story of the new tower's detuning will be concluded in next month's column.

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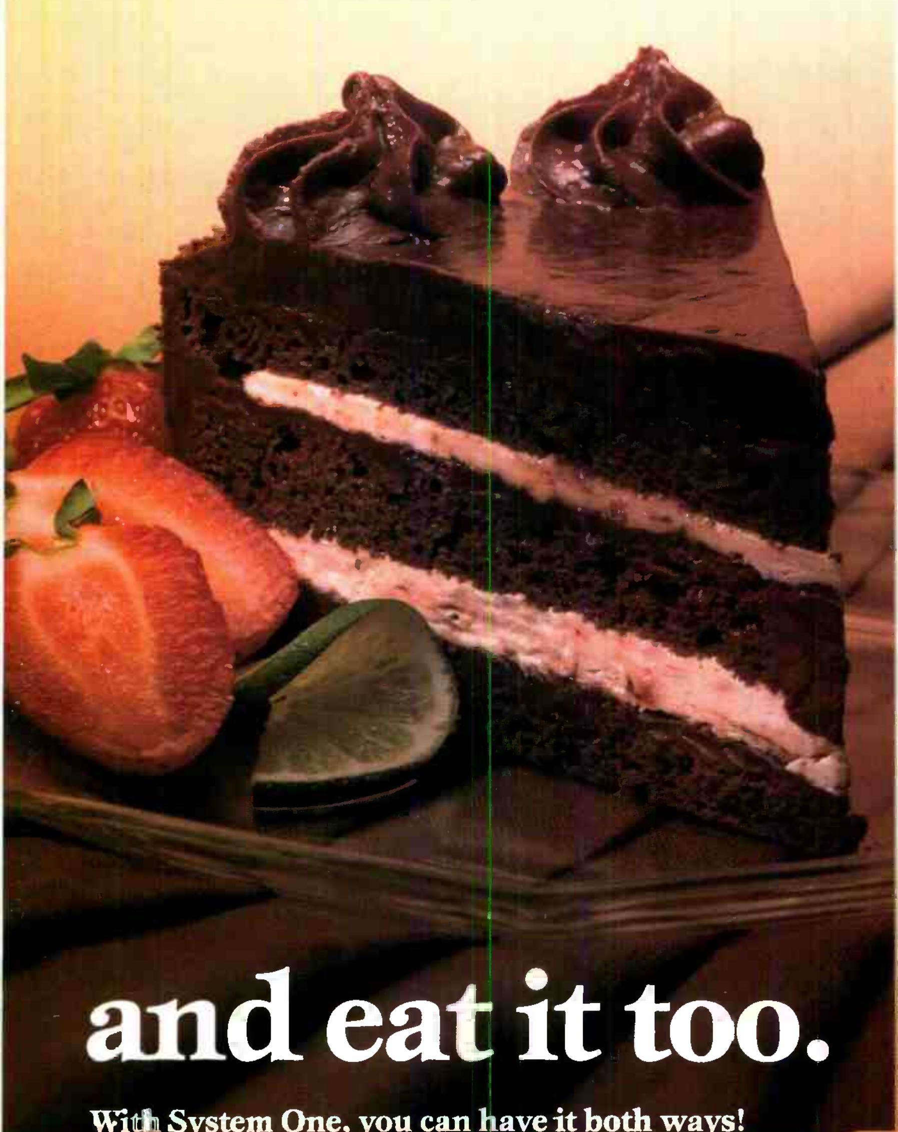

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SBE working to save 2GHz auxiliary band

By Bob Van Buhler

The SBE was contacted by the Federal Communications Commission (FCC) in late March and asked to supply certain data about the 2GHz microwave band. In the same communication, SBE was asked to have coordinators determine where existing 2GHz mobile auxiliary stations could be relocated if that band were reallocated to another radio service.

The society declined to request this speculative information from the coordinators, informing the commission that any reallocation of the 2GHz band would be "vigorously opposed" by the society. SBE also stated that other bands could not be substituted for it because of the high investment in equipment already in place. Furthermore, in many metropolitan areas, the band is already saturated with mobile ENG and shared non-broadcast uses.

In keeping with SBE's commitment to accurate auxiliary services information, the society offered to cross-check the accuracy of the FCC's database information against local coordinators' information. The commission failed to respond to the offer.

Christopher D. Imlay, SBE's Washington attorney, reaffirmed that SBE remains committed to protecting the 2GHz band from any reallocation, and "will utilize all resources at its disposal" to assure continued use of the band for TV auxiliary purposes.

Members to be surveyed

Information concerning SBE members' involvement in contract technical services is being requested. Vice president Richard Farquhar is heading the survey.

Recent studies have shown that an increasing number of engineers perform contractual services instead of working for a single station. It is estimated that one-sixth to one-third of SBE's membership is involved in contract engineering. The society would like to develop new services for the increasing number of SBE members performing this type of work.

The independent contract engineer is also often at a disadvantage in the area of career training opportunities. The Ennes workshops at the Houston SBE Convention will feature a specially designed program to address this problem. The workshop, "How to Become a Consultant," will feature an attorney, an accountant and two working contract engineers. These experts will provide solutions to the problems encountered in operating a personal technical consulting business. Workshop attendees will learn how to contract their services correctly, how to determine fees, how to collect, and how to determine what insurance and financial commitments are needed.

New Ennes workshops planned

TV automation is now a fact of life for many stations. Alamar will present a workshop at the Ennes sessions, designed to lead broadcast engineers through the technology and to provide sound information on the design, installation, maintenance and operation of TV automation equipment.

As fiber-optic technology becomes less expensive, more facilities are looking for ways to use this high-quality transmission method. ADC will host a workshop on how to use, maintain and purchase fiber-optic systems for a video facility. From replacement for STLs to reducing cable trough crowding, fiber may be the answer to some of your problems. Attend this session and see for yourself.

A special session on newsroom automation is being conducted by Dynatech Newstar. The session is designed to show you how to evaluate, select, operate and maintain a modern newsroom computer system.

One free additional admission pass to the workshop will be provided to each Ennes attendee. The pass may be used by your station's news director to attend the session. Join your news director in this important workshop.

Dielectric Corporation will present a comprehensive workshop on RF transmission systems, from the transmitter to the antenna. Engineers will learn how to design, specify, order and install the pieces in an RF transmission system.

Furthermore, a valuable hands-on video measurements workshop will be run by Tektronix. The session will teach the attendees how to perform quick and accurate measurements on audio and video signals. Therefore, audio and video monitors will be provided to each participant for use during the workshop. Because seating is limited, early registration is recommended.

A firm grounding in the principles of RF are a necessity to the broadcast engineer. Harris Allied Corporation will conduct an intensive full-day workshop that emphasizes RF circuit theory. The session will provide important, yet often missed, training in the area of RF systems operation and design. The workshop is based on the 2-semester course taught at Woods Community College, Quincy, IL.

Don Markley's popular RF seminar will be held again this year. Markley, a consulting engineer, will reveal some of his tricks of the trade during the session. Don't miss this rewarding (and entertaining) workshop.

Digital broadcasting looms large in the near future, promising rewards for the well-prepared engineer. Many engineers and station managers make the mistake of viewing this technology as something in the distant future, rather than a near-term opportunity.

To address this coming revolution, *Broadcast Engineering* is sponsoring a workshop outlining the steps your station can take to ensure a place at the starting gate of this important technology. Technical options, predicted costs and time frames will be discussed.

As with the newsroom automation workshop, one additional free admission pass will be available to each registered attendee. The pass may be used by your station manager.

Dick Cupka will return to the Ennes workshops to share his skills on engineering management. Learn how to be an effective manager whether you have a staff of one or 100. Learning these skills may help you perform your job better and increase your chances for advancement.

The Ennes workshops will be held in Houston on Oct. 3, the day before the SBE Convention. Remember to register in advance, because seating is limited. See your convention registration documents for more information.

Van Buhler is manager of engineering at KNIX-FM/KCWW-AM, Phoenix.

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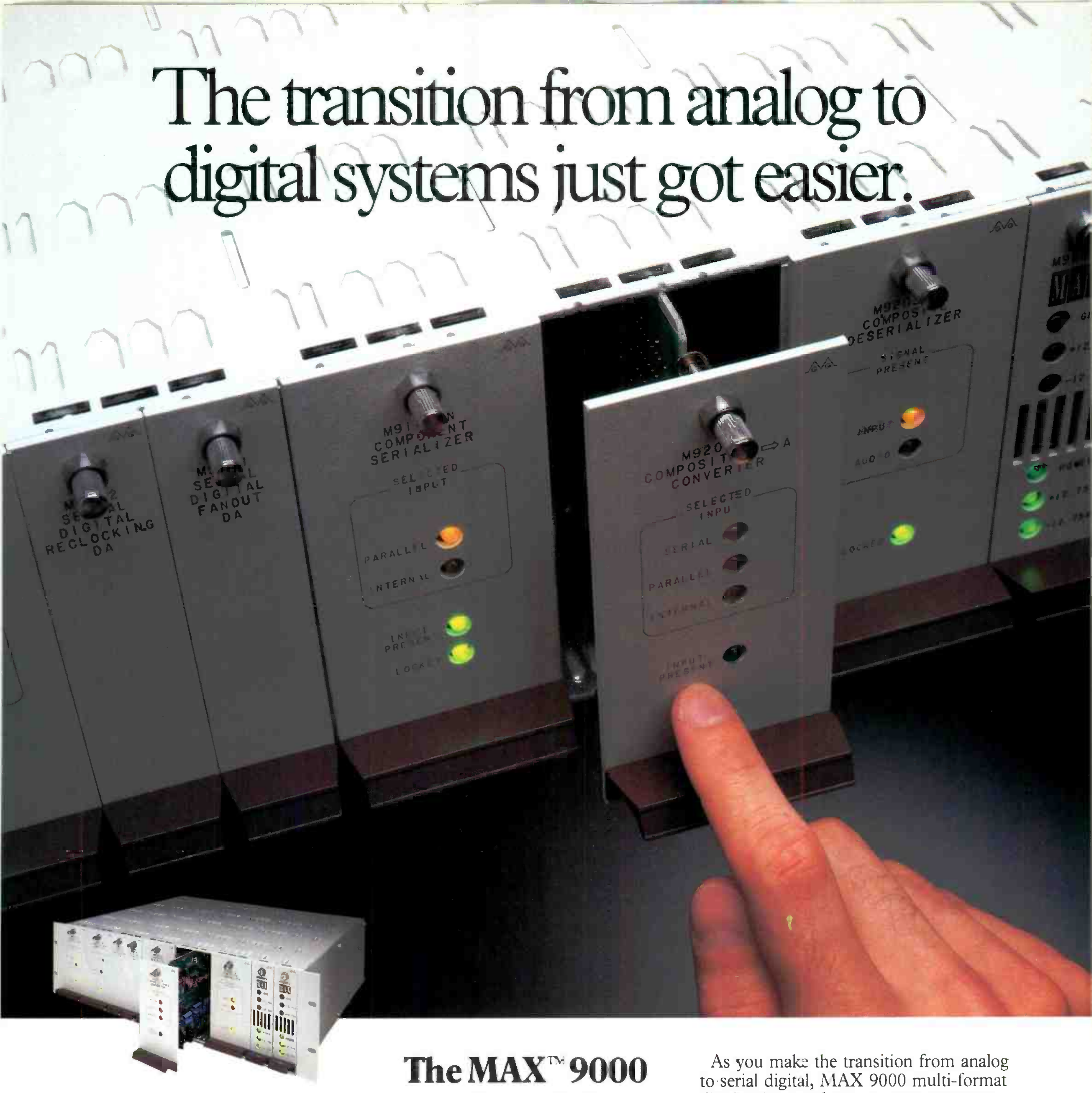

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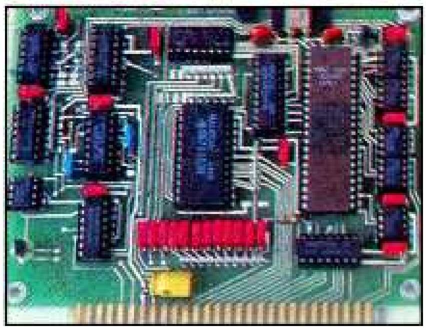


Building with microcontrollers

Wrapping up microcontrollers

By Gerry Kaufhold II

Last month's column prepared you to connect a Z-8-based microcontroller to a videotape machine. This month, the circuitry will be completed, and the 12 steps of microcontroller-based design will be concluded. (See "Circuits," October 1990.) Three tasks remain: The electrical interface between the Z-8 and the remote-control connector must be described, the interface must be protected against electrostatic discharge (ESD), and the entire circuit must be housed to prevent spurious electrical radiation.

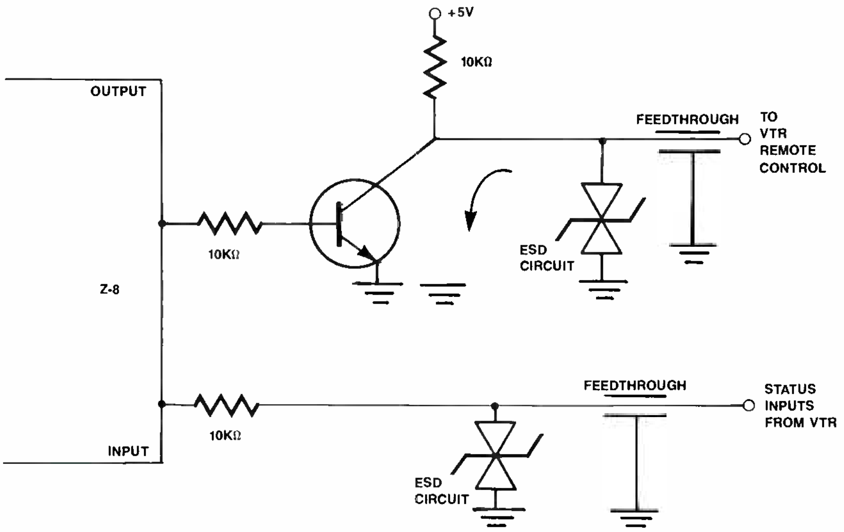


Figure 1. *The electrical interface between the Z-8 and VTR remote cable. Notice electrostatic discharge (ESD) devices to protect the circuitry, and the feedthroughs to prevent creating electrical disturbances in other devices.*

Driving relay closures

Figure 1 shows the electrical interface between a Z-8 output pin and a relay closure on the remote-control connector. The transistor is wired as a common-emitter amplifier, and the circuit is inverting. Forward-biasing the base-emitter junction turns the transistor on, forcing the collector voltage low.

The Z-8 data sheet states that the output high voltage (V-oh) will be a minimum of 2.4V. It is capable of sourcing 250μA. The output low voltage (V-ol) will be less than 0.4V. When driving low, the Z-8 output pin will sink up to 2mADC.

In this design, NPN transistors drive the signal lines from the Z-8 to the remote-control cable. PNP transistors will probably fail to adequately cut off because of the relatively low value of V-oh (2.4V).

The Z-8 can source only 250μA per pin. Therefore, use a transistor with a high gain, preferably one with a current amplification factor (beta) of more than 200.

Connect the transistor base to the Z-8 I/O pins through a 10kΩ resistor. When the Z-8 output goes high, the output voltage raises to 2.4V. Remember that the base-emitter drop of an NPN silicon transistor is 0.7V. Therefore, the resistor must drop 1.7V (2.4V - 0.7V). You must current-limit the output pin of the Z-8 to prevent an overload.

When the Z-8 output goes low, the voltage on the I/O pin drops to less than 0.4V. This should reverse-bias the NPN base-emitter junction, cutting off the transistor.

Remembering the logic

When the Z-8's I/O pin goes high, the transistor will turn on. Current flows through the collector-emitter junction to the ground. This drives the relay-closure pin on the videotape machine low.

Select an NPN transistor that can sink the full relay current with approximately 100μA driving its base. If the relay current is 20mA, then the current gain of the transistor must be 200. Note that many of today's videotape machines can be driven by non-relay remote controls, which further ensures your success.

The control program receives commands from the PC, and translates them into 1s or 0s on the Z-8's output pins. The program must drive each relay closure high to drive the power transistor low. However, the program must read inputs from the tape deck directly, without inversion.

ESD

You cannot predict the electrical environment in the vicinity of the remote control. Therefore, there must be protection against electrostatic discharge (ESD), which is static shock.

RFI

The remote-control project must not cause malfunctions of other station equipment. A good design will provide the entire Z-8 microcontroller board an adequate ground plane. This reduces radio-frequency interference (RFI) and electromagnetic interference (EMI).

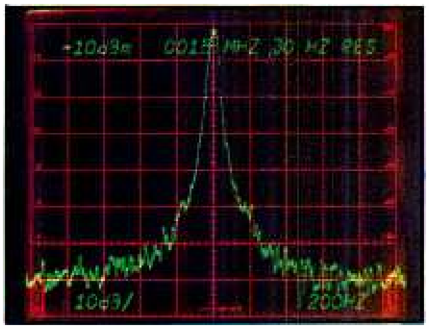
In addition to providing a good ground plane on the printed circuit board, designers can prevent spurious radiation by packaging the entire printed circuit board inside a mu-metal box.

Another RFI suppression technique is to use capacitively coupled feedthrough terminals to connect the circuit to the outside world. It takes a few extra steps to drill the necessary holes and solder the connections, but the protection is worth the effort.

Talk it up

Explain the project to the operators as soon as it's completed. Tell them how it works, where it is located and what to do if it fails. Most problems usually occur in the first week of operation. After that, it is probably safe to leave your new microcontroller on-line. Check it regularly as part of a routine preventive maintenance program.

Kaufhold is an electronics industry analyst based in Tempe, AZ.



DAT maintenance

Spare parts

By Richard Maddox

The primary replacement item on a DAT recorder is the head assembly. The replacement interval for DAT heads depends on the manufacturer and model, with an average lifespan of approximately 1,000 hours.

Based on my experiences, it's a good idea to order replacement head drums well in advance. Back orders and low stock levels are common. Apparently, head drum assemblies are not easy to build. One manufacturer told me that in a *good* month, it will get 20 head drums into the United States. Your best protection is to always keep one in stock for each model of machine you have.

Pinch rollers are another commonly replaced item subject to occasional shortages. Most delays on DAT parts are due to the long lead times between order and delivery, because all DAT parts come from Japan. Most manufacturers only receive one shipment of spare parts per month, so if you order a part, it could take up to 45 to 60 days to receive it.

Used DATs?

If you replaced all the parts listed under manufacturers' maintenance schedules at the 5,000 hour mark, you could spend $400 to $500 in parts, which is virtually the cost of a new transport assembly.

Buying a used DAT machine is a "buyer beware" situation. Check any prospective purchase for mechanical abuse and head wear, and see if it still meets specifications. Check compatibility with other decks for playback and record.

You can also check the elapsed time indicator. But, like a car's odometer, it's easy to either disconnect the indicator or reverse the connections to run the 5,000-hour mercury indicator back toward zero hours.

The best indicators of visible wear are the elevator assembly, the cassette tray and the function buttons (especially play, stop and eject). If the machine has had a head change, you can assume that it is probably at least halfway to major overhaul time (5,000 hours).

Maddox is technical manager at Media Management Associates, Lynnwood, WA.

If the head drum is worn (indicated by high error rates and poor recordings), a new drum and alignments will cost anywhere from $150 to $300 (depending on whether you perform the labor or send the unit out). That price range only applies to 2-head units — expect to double those figures for 4-head machines.

Stocking spare parts

Table 1 lists the common parts that will need replacing over the life of the machine, and the major boards and subassemblies that will help in troubleshooting electronic problems.

PART	APPROXIMATE PRICE
Head drum assembly (2-head)	$150
Head drum assembly (4-head)	300
Pinch roller	15
Capstan assembly	125
Reel table assembly	175
Brake bands or pads	<10
S1/T1 guide assembly	<10
Main logic PCB	200
Main servo control PCB	200
RF amplifier module	75

***Table 1.** Recommended basic spare parts list for facilities with multiple DAT machines.*

At a minimum, the head drum(s) and pinch roller(s) should be in-stock items. The need for the other items is a function of how reliant you are on your DAT machine every day.

The capstan and reel table assemblies typically are replaced at the 5,000 hour level. However, like all mechanical assemblies, they can fail at any time. They are also handy for substitution troubleshooting, because neither one requires a lot of adjustment upon replacement.

Brake pads, either felt or rubber, will wear sooner than the tension bands. Brake pads seem to need replacing after approximately 1,000 to 1,500 hours, with tension bands lasting up to 3,000 hours.

The guide assemblies are not a normal replacement item, but I have come across a few that got bound up (most likely because of the set screw scarring the inner shaft), making adjustment impossible. Having one in stock meant an easy repair instead of setting the machine on the shelf and waiting a week or two for a replacement to arrive.

A set of main logic and servo boards for each model of machine you have is a great aid in electronic troubleshooting, albeit an expensive one. Without them, you're left with having to swap boards between machines, or return the machine to the factory service center for repair. I don't know of any manufacturer that will just repair the boards for you, or that give you any credit on the "cores" when you need to buy a new one.

The RF module seems to be the most frequent source of electronic failure, and because it is not something that can be easily repaired in the field, a replacement is certainly useful.

Conclusion

Over the past few years, I've worked extensively on several manufacturer's DAT machines, and I've found their electronics to perform on a par with other pro and consumer electronic products, exhibiting a failure rate well below 1%.

The transports are precision-tooled designs that must stand up to normal wear and tear without exceeding tolerances. Their parts will wear out, making the transport where most DAT problems and failures occur.

Fortunately, DAT machines are fairly easy to service with basic hand tools, a DMM and a good oscilloscope, as long as you also have the manufacturer's service manual and test tapes at hand.

Finally, let me recommend a recently published book for your further study, *RDAT*, by John Watkinson, published by Focal Press. It's an up-to-date, clear and comprehensive volume on the workings of DAT recording.

Part 4

Management for engineers

Time management

Overcoming procrastination

By Judith E.A. Perkinson

I read an article in a magazine a few months ago about procrastination that made me mad. When I first picked up the article, I thought it would tell me how to avoid procrastination. Instead, I read about how terrible it was that people procrastinated, and it stopped short of offering any hints on avoiding procrastination pitfalls.

Like many people, I procrastinate. This is normally followed by intense guilt and a vow never to postpone anything again. After reading the article, I began a collection of anti-procrastination techniques. What follows is an anthology of ideas that were collected from people who have used these methods to avoid procrastination. They are not theories or projections, but real solutions that have worked. Not all of the techniques will work for everyone, but some of these ideas may help you overcome your own problems with procrastination. By the way, one of these suggestions actually helped me stop putting off writing this article.

The time to do it is when you think of it

If you learn nothing else from this article, be sure to memorize this: *The time to do it is when you think of it.* The basis of all procrastination is the promise to do something in the future.

Many events help jog our memories. It can be the sight of an item out of place, a comment from someone that triggers a thought, or even a sudden remembrance of something you were going to do. When you have a memory jog about a certain task, don't put it off, just do it.

This philosophy may not always work, however. Effective time management does not encourage you to run around like a chicken with its head cut off just because you remembered something. But taking the extra minute to do a task now pays off in major time savings in the future.

So make that phone call, adjust that piece of equipment, stick that report in the right file before it gets lost, and put spare parts in their proper places. Sometimes it takes longer to develop a "to do" list than it does to perform the task.

Learning to do this is easier than you think. Next time you have your memory jogged about something you need to accomplish, try doing it.

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

The organized mess

Many procrastinators have messy desks. Not all messes are bad, however, and not all messy desks mean that the owner is disorganized. I am not talking about neatness, but about organization. Here is where people will assure you that if they cleaned their desks, they would never be able to find a thing. That may be true, but more often, an untidy desk means that the owner cannot find anything either.

Personally, I am a reformed messy desk owner. When I began to use 3-ring notebooks faithfully, I eliminated about 60% of the clutter on my desk. It was a short step from that to a clean desk. My problem was that I did not have a system for handling paperwork. I spent many years pretending that I knew where everything was in my messy office. Now I do know where things are. It is easier to work on a clean desk, and I am not ashamed to have people come into my office.

The key to managing my messy desk was handling paper flow. See the related article in the June "Management for Engineers" column. It deals with how to organize your paperwork and should help you sort through some of the mess.

Tackle the task you don't want to do

Tackling that task you don't want to perform is hard to do. And that is the heart of procrastination — forcing yourself to just do it. We do not want to perform these tasks for many reasons. Some of the common ones include:

- A missing piece of information or equipment.
- You don't feel comfortable with your skills.
- The task is too challenging.
- The task is too boring.
- You don't like to do that particular activity.
- You think it is unnecessary or not worth your effort.

Often, you waste more time by delaying or deliberating the task than it would actually take to do it. The task becomes a burden, and you make excuses for not finishing it, which can put you further behind. Eventually, you could damage your reputation or, at best, diminish your effectiveness. The task is not worth the price you pay for your procrastination.

There are no easy answers to procrastination. It helps if you set up a reward for completing the task, or if you schedule dedicated time to do it. But in the end, the only real solution is to perform the job.

Schedule an anti-procrastination time

Sometimes the only way to dig out from under your promises and good intentions is to schedule a morning or afternoon that you commit to anti-procrastination activities. This is the time to take care of tasks that have been hanging over your head, left over on your "to do" list or sitting on your desk.

As you approach the set aside time for these activities, you may find many reasons to spend this time doing more important activities. But that is what procrastination is all about. Be brave, resist the urge and plunge into those tasks that have been put off. At the end of your scheduled anti-procrastination time, you will be caught up in your tasks, and you will feel like a load has been lifted off of your shoulders.

The hardest part is getting started. The best part is having done it.

Anti-procrastination continues

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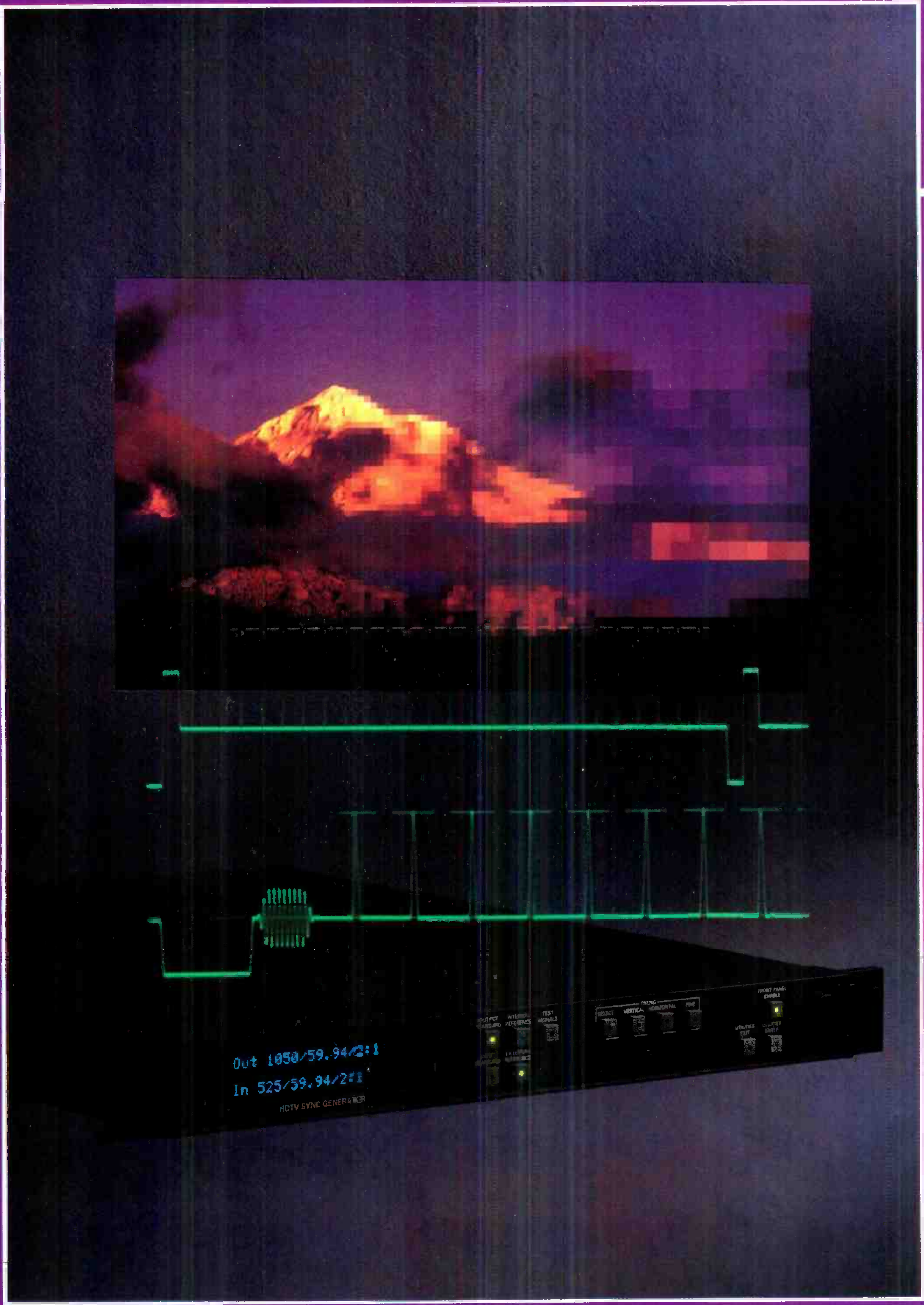

Out 1050/59.94/2:1
In 525/59.94/2:1
HDTV SYNC GENERATOR

Video technology update

HDTV may be just around the corner.

An event occurred last month that could change the face of video technology forever. The Advanced Television Test Center (ATTC), where the proposed high-definition TV (HDTV) systems are analyzed in an effort to find the best one, opened for business.

On July 12, the ATTC began evaluating the first of six proposed U.S. HDTV transmission systems. The work will last approximately 12 months — long enough to provide an update by this time next year. The ATTC trials will be followed by field trials and the eventual adoption of a U.S. HDTV standard.

Accordingly, we placed special emphasis on HDTV in this month's video technology update package, which also contains articles about HDTV, the integration of HDTV and NTSC, and the integration of PC video and NTSC.

Even with all this effort, many broadcast and production engineers wonder just how HDTV may affect their facilities. When will new equipment be needed? How much will the conversion cost? Some even wonder if HDTV will ever be carried by terrestrial broadcasters. The questions are easy, but the answers are difficult.

In this month's issue, we will take a close look at HDTV from several perspectives. First, we will review the six proposed systems and their technical parameters. The article, "Comparing the Options in HDTV," provides a thorough background on the new HDTV and ACTV transmission systems.

Many believe that HDTV will be incorporated into TV facilities much like color was — one step at a time. The experts say that networks will be the first to deliver HD signals. Local affiliates will simply pass through the video signals. Later, as equipment costs decrease and familiarity with the technology increases, stations will begin inserting their own HD productions. This is when the real changes commence. How will your facility implement the changes? "Integrating HDTV into NTSC" reviews the important implications to consider when planning for the changes.

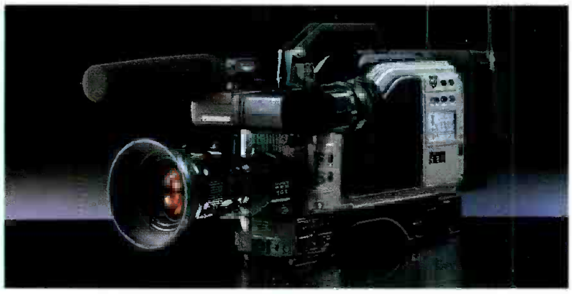
Today's engineering managers must design and purchase facilities that will permit evolution into the HDTV arena. After all, managers want to be sure that financial and technical decisions made now are compatible with what develops tomorrow. If you need help in making today's decisions for tomorrow's technology, this issue of *Broadcast Engineering* will be of great use. Your facility's future begins now.

Rick Lehtinen

Rick Lehtinen, technical editor

DIGITAL PR
START T

The purists say if you're serious about getting the best out of digital video recording, you ought to be digital from camera pick-up to duplication master. But that hasn't always been practical or possible, until now.



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The system's entirely new editing technique generates a guardband at the IN and OUT points, eliminating crosstalk interference between tracks and maximizing interchange reliability. A new amorphous head design has increased sensitivity dramatically. Search speeds up to 100X normal, with picture, are practical.

ODUCTION:
O FINISH.

The digital quality is superb. A new 8-14 channel coding system provides a packing density 2.5 times greater than that achieved in D2 recording systems. A new error correction format is three times more powerful than the approach used in D2 systems. Panasonic's Half-Inch Composite Digital format offers the convenience and economy of working with half-inch metal particle videotape cassettes, while providing quality that outperforms larger, more costly digital video recording systems.

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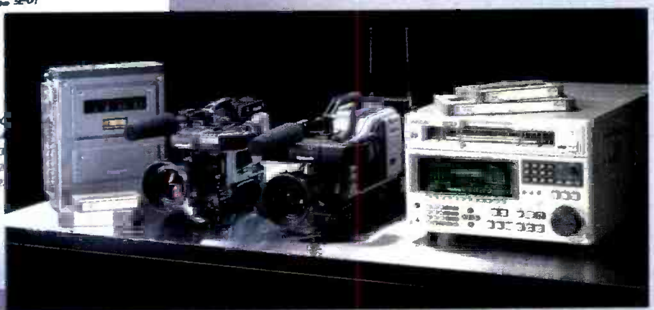

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Comparing the options in HDTV

HDTV system tests are under way.

By Rick Lehtinen, technical editor

High-definition television (HDTV) is being touted as one of the major developments of this decade. It promises to offer movie theater-quality images, with sound that matches a digital compact disc.

However, HDTV also presents some of the more troubling technological puzzles to face the broadcast industry in 50 years. Should systems be analog or digital? Which system is best? How will the systems be chosen? What will it take to get HDTV on the air at the local affiliate level?

This article will examine the HDTV issue, and offer some answers to these questions.

Meeting the players

Understanding the nomenclature is basic to understanding the HDTV process. We will begin with a short synopsis of HDTV technology.

HDTV is different things to different people. For Europeans, it is the result of a multinational project called Eureka 95. For the Japanese, it is a series of transmission formats based on the Multiple Sub-Nyquist Sampling Encoding (MUSE) video-compression system. For the United States and Canada, HDTV has yet to be pinned down. Extensive tests are under way to determine what form HDTV will take.

At one point, the FCC advisory board had before it more than 20 proposed systems. Today, there are six. The list diminished as several proponents merged their proposals. Others dropped out of the running. One former contender, Faroudja Labs, has announced that its work is complete. The company has withdrawn from the testing procedure, and is putting its technological demonstration on the road instead, visiting various cities around the country.

Of the six remaining systems, only one has a sole proprietor. NHK, the Japanese Broadcasting Company, is proposing Narrow MUSE, which is often considered an analog system.

HDTV presents some of the more troubling technological puzzles to face the broadcast industry in 50 years.

A consortium composed of Zenith Electronics and AT&T is proposing a digital system called Digital Spectrum Compatible-HDTV (DSC-HDTV).

Two proponents are putting forth the four remaining systems. The American Television Alliance (Massachusetts Institute of Technology and General Instruments) is proposing two all-digital systems, the ATVA Progressive and ATVA Interlaced (also called DigiCipher). The Advanced Television Research Consortium (NBC, the David Sarnoff Research Center, Philips and Thomson) is proposing Advanced Compatible Television (ACTV), an NTSC enhancement system, and Advanced Digital Television (ADTV), a digital HDTV system. (See Table 1.)

Driving two systems to market may be more than public spirited — it's a form of hedging a bet. Proponents with two systems double their chances of winning potential royalties of hundreds of millions of dollars if their system is selected.

Playing by the numbers

Describing proposed HDTV transmission systems is a numbers game.

The basic parameters of each system can be described in terms of a line rate, a frame rate, and whether the system uses progressive scanning or uses interlace. Today's NTSC operates at 525 lines per frame, 59.94 frames per second (changed from 60 frames per second years ago to accommodate the introduction of color), and a 2:1 interlace. In HDTV language, that's 525/59.94/2:1.

By comparison, Narrow MUSE operates at 1125/60/2:1. The ATVA Interlaced system works at 1050/59.94/2:1, while ATVA Progressive runs at 787.5/59.94/1:1. DSC-HDTV operates at 787.5/59.94/1:1. ADTV uses 1050/59.94/2:1, while ACTV uses 525/59.94/1:1.

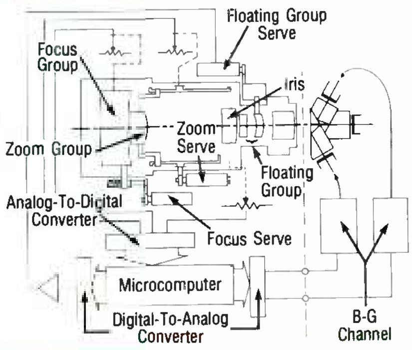
The choice of these numbers determines the apparent image quality of the system, and also influences the system's ability to integrate into an NTSC facility. The 1125/60 of Narrow MUSE has great compatibility with the 1125/60 production standard, but the line and frame rates require elaborate conversion equipment for NTSC conversion. (See the related article, "Integrating HDTV into NTSC," p. 38.) On the other hand, the 1050/59.94/2:1 signals, direct multiples of NTSC, may lack

OUTLOOK ON OPTICS

HDTV REDEFINES LENS PERFORMANCE

HDTV has probably done more to advance the state of broadcast lens technology than any other breakthrough. Many achievements are already being transferred to today's broadcast lenses.

HDTV lenses must be optically, mechanically, and electrically superior in every way. They must have the highest obtainable resolution and dynamic range, and flare must be reduced to unprecedented levels. Maximum aperture and light transmission must be high, and coma, field curvature, shading, and distortion must be extremely low.



All this must be achieved in a small, lightweight package familiar in feel to both cine and video camera operators. The need for such high performance often requires a fresh approach to solving a familiar problem such as chromatic aberration, with the use of new materials and highly refined versions of existing ones.

Compounds such as crystalline fluorite are being used to produce HDTV lens elements with low dispersion and a very high refractive index. New lens coating methods are employed that reduce flare more completely than ever.

The Floating Group

Control of chromatic aberration, distortion, field curvature, and shading is also much more difficult in HDTV lenses, especially those with large zoom ratios. To satisfy the stringent requirements in each of these areas, Fujinon developed a lens assembly called a "floating group" that provides real-time error compensation.

The floating group is a motorized lens system mounted behind the iris of the lens. The microprocessor-controlled system monitors zoom, focus, and iris position. The data is compared with stored values of field curvature, registration, and shading, and instructions are sent to the camera where corrections are made. The floating group method also delivers a dramatic reduction in lens size and weight.

Fujinon is a pioneer in HDTV lens technology and is committed to the development of next-generation broadcast equipment, as well as to continuing support for all its products, no matter how many years they have been in service.

For more information about HDTV lenses or any of Fujinon's broadcast products, contact Fujinon at (201) 633-5600, or write Fujinon, 10 High Point Dr., Wayne, New Jersey 07470.

Many of the advances being made in HDTV research are already being transferred to today's broadcast lenses.

Floating group motorized lens system

FUJINON

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FCC ADVISORY COMMITTEE ON ADVANCED TV SERVICE TEST SEQUENCE AND CALENDAR						
		Move in (10 days)	Laboratory Test Period		Move out (5 days)		
	Period	Interface Check	Start Testing	End Testing	ATV System Proponent	Scanning Format
1991	1	July 8	July 12	September 3	ACTV: Advanced Compatible Television David Sarnoff Research Center/ATRC	525/59.94, 1:1
	2	September 4	September 10	October 24	Narrow MUSE NHK, Japan Broadcasting Corporation	1125/60, 2:1
	3	November 8	November 14	January 7	ATVA Interlaced System (DigiCipher) General Instrument Corporation/ATVA	1050/59.94, 2:1
1992	4	January 8	January 14	March 2	DSC-HDTV: Digital Spectrum Compatible HDTV Zenith Electronics Corporation/AT&T	787.5/59.94, 1:1
	5	March 3	March 9	April 22	ADTV: Advanced Digital Television N.A. Philips Consumer Electronics Co./ATRC	1050/59.94, 2:1
	6	April 23	April 29	June 15	ATVA Progressive System Massachusetts Institute of Technology/ATVA	787.5/59.94, 1:1

ATRC = Advanced Television Research Consortium (NBC, Philips, Sarnoff, Thomson)
ATVA = American Television Alliance (General Instrument, MIT)

Table 1. *The ATTC test sequence and some system parameters for the six proposed U.S. HDTV systems.*

some of the resolution of higher-frequency systems. (The testing will help determine in what situations, if any, this could be an issue.)

One of the few parameters the system proponents agree on is aspect ratio. It's 16:9, compared with NTSC's 4:3.

Sharing time

Perhaps a thornier issue than upward and downward compatibility with NTSC is the question of how to serve new HDTV viewers and existing NTSC viewers. The FCC has ruled that any new HDTV service must be compatible with existing receivers. It is doubtful that any new spectrum will be allocated for terrestrial HDTV transmission.

The FCC seems fixed in its determination to nail down the HDTV transmission format before considering the possibility of an interim EDTV format.

One answer is to simulcast. A simulcast system is one in which the HDTV service is broadcast along with the existing NTSC service. Simulcasting is different from some earlier HDTV proposals that sought to broadcast merely augmentation signals. Proponents once hoped that an NTSC service, coupled with an augmentation signal, could serve as an HDTV system. These proposals were later discarded.

A third answer is enhanced-definition television (EDTV) and improved-definition television (IDTV). These offer part, but not all, of the benefits of HDTV. The current EDTV proposal would offer partial HDTV advantages on a wide-screen television, and still provide service to regular sets.

Digital shift

The preponderance of digital HDTV systems is a relatively new —and widely welcomed — development. The move to HDTV digital started on June 1, 1990, the cutoff day for system applications. General Instruments, San Jose, CA, announced it would enter its DigiCipher encoding system, originally designed for cable and DBS, as a terrestrial HDTV system. Other proponents rapidly followed suit.

The technologies behind many of the digital HDTV systems originated in the teleconferencing arena. They came to the forefront during FCC discussions because they helped a fundamental puzzle of HDTV — how to fit more signal down the same bandwidth.

Another potential advantage of digital HDTV is better coverage. Stations can use pulse modulation and digital error-correction codes to fill the station's contour, including the fringe area. It may also enable use of lower-powered transmitters. This makes the service less likely to interfere with the existing TV service.

Digital may increase the commonality between competing HDTV systems. There has been some discussion of making reprogrammable digital HDTV systems and transmitters with switchable formats.

Finally, as we shall see later, U.S. interest in an all-digital HDTV system may help the country recapture a sizable chunk of the domestic and international TV receiver market. This was an advantage that slipped away long ago.

The three tests

One of the characteristics differentiating TV systems is the ability to reproduce fine details. This ability is determined by several factors, such as the number of scanning lines, the frame rate and, to a lesser extent, the frequency response of the signal-processing circuitry. In digital systems, the methods used to compress the signal into a spectrum-compatible package also can affect system quality.

The Advanced Television Test Center (ATTC) was established to provide a fair and reliable evaluation of each proposed HDTV system. The $15 million facility sits in Alexandria, VA, approximately one mile south of Washington's National Airport. Built with contributions from the participating companies, the lab has the task of screening the six slotted HDTV systems. It will take a little more than a year.

The ATTC's charter is to provide a technical evaluation of the capabilities of each proposed system. In addition to these objective evaluations, the lab will record video- and audiotapes of the systems' out-

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puts. These images will undergo subjective evaluation at two separate facilities. Videotapes will go to the Advanced Television Evaluation Laboratory, at the Communications Research Centre in Ottawa, Canada; audiotapes will go to Westinghouse Science and Technology Center in Pittsburgh.

The lab tests will be followed by field tests, after which the FCC Advisory Committee will recommend a system to the FCC. It is anticipated that the recommended system will become the U.S. HDTV terrestrial transmission system. The commission wishes to make a standards decision by June 1993.

The FCC advisory panel consists of 256 industry representatives drawn from broadcast networks, the production community, studios, equipment manufacturers, telephone companies and others, from the professional and consumer sides of the industry. Empaneled in 1987, the group advises the commission on HDTV matters. It also determined which of the HDTV proponents advanced to the testing phase.

As many as 500 volunteers work on the various subcommittees and working parties established by the advisory committee. These workers evaluate systems, support testing work and do critical analysis of the legal, economic and social issues that are also part of the standards-setting activity. This work involves all sectors of the communication and TV communities.

The entire process is a public proceeding carried out by the FCC and chaired by Richard Wiley, former FCC chairman.

Who's on first?

Table 1 shows that the first system to be tested is ACTV. This system moved into the ATTC for installation and interface testing on June 25. System evaluation began on July 12. Each proponent receives 10 days to move into the center and set up. Four days of interface testing then follow. During this time, the proponent sees to it that the test setup works well with its equipment. Manufacturers are excluded from the lab while the testing is under way, although they are kept apprised of the progress.

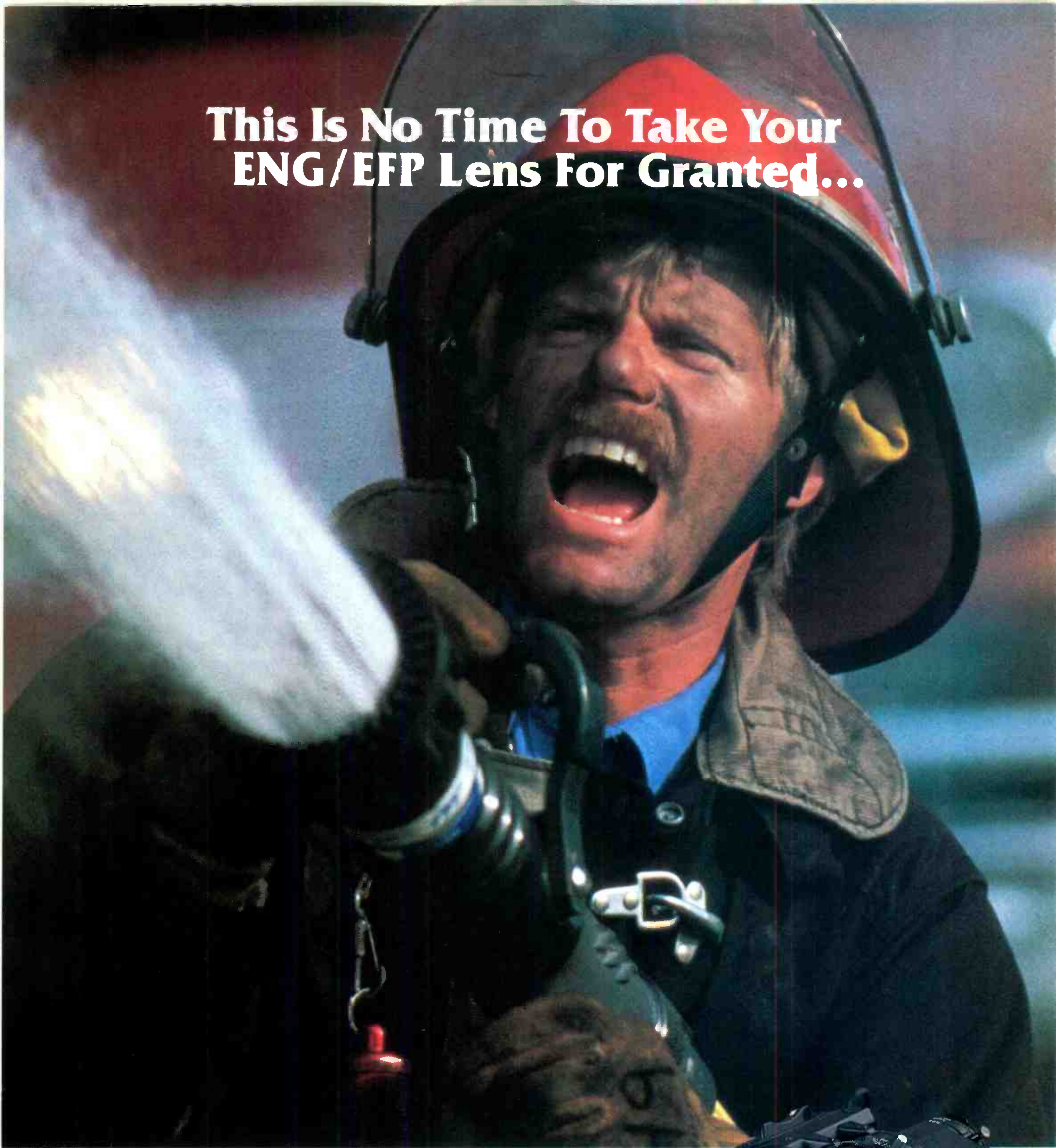
The ACTV system produces enhanced NTSC. It claims to be compatible with existing TV sets, but its full value will only be apparent on wide-screen televisions. The other five systems are simulcast HDTV systems.

Digital HD
(The SECAM scenario)

In some ways, the choice of a U.S. HDTV standard resembles the process by which France ended up with SECAM. The French, sensing there was money to be made manufacturing TV receivers, resisted joining the rest of Europe with PAL, or the United States and Japan with NTSC. This dogmatic position may have proved to be their own undoing. SECAM is so difficult to edit that most facilities edit in PAL and then standards convert it. As to the TV sales, they didn't materialize as hoped. Asian-built tri-format televisions and VTRs stole a large part of the market.

Is the United States heading down a similar path? Japanese HDTV is up and running, although sets are costly (up to $12,000).[1] The European system is also rolling along on schedule. Why should the United States try to reinvent the wheel? Is there some striking difference that may save the United States from ending up with a high-definition SECAM? Yes. U.S. systems are digital. This has the potential to leapfrog the competition.

The advanced nature of the current U.S. HDTV proposals is not overlooked by foreigners. Recent reports from Japan indicate a growing uneasiness among its HDTV community. Seeing that digital HDTV will be available much sooner than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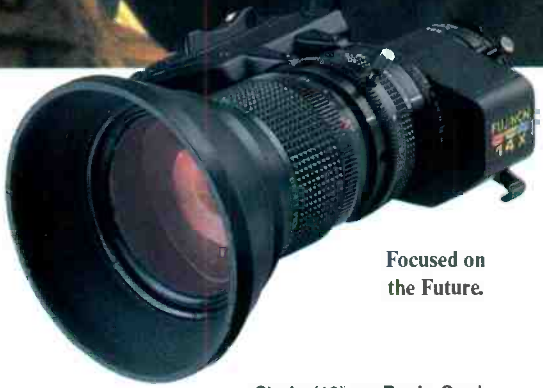
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14X

they had predicted, the Japanese now realize that their HDTV system is based on comparatively old technology. This could create new opportunities for American companies. Adoption of newer American technology could restore our leadership in HDTV, and perhaps lead to the adoption of the U.S. system in other countries.

Europeans also have begun to second-guess themselves. The Eureka standard will be stop-gapped by implementation of an intermediate standard, called D-2 MAC. However, the digital HDTV proposals might well be technically superior and available at nearly the same time. Therefore, Europe could find itself committed to one TV standard, while a better one is just around the corner.[2]

Others wonder if the choice of any standard will matter at all. It won't take long for the big overseas set manufacturers to develop the know-how to make them. In many cases, they may be hired to build them.

Stepping stones

Will the world go to HDTV all at once? Not likely. Instead, look for a gradual easing in of HDTV technology. This will be facilitated by the adoption of interim standards. In Europe, the interim path to Eureka 95 is the Duo-binary Multiplexed Analog Component system (D2-MAC). This 4:3 aspect ratio system has 50% more information content than PAL, and carries from two to eight audio channels.

In the United States, the FCC seems determined to nail down the HDTV transmission format before considering the possibility of an interim EDTV format (even though the ACTV system is under test.) For the Japanese, one of the MUSE variants can fill the interim standard requirement.

There is another possible scenario that is picking up steam. Networks would deliver HDTV to the affiliates, who would then add local-origination material, produced not in HDTV, but in line-doubled 525-line NTSC or some other synthesized HDTV format. This parallels the early days of TV stereo, when most stereo programming was merely mono sound reprocessed to occupy the left and right channels.

Displays

The high cost of HDTV receivers threatens to slow market penetration. Studies indicate that on consumer sets with screens 25 inches or smaller, there is no discernible quality difference between HDTV and NTSC. Currently, 95% of all televisions are 25 inches or smaller. In other words, there is not much evidence that the public at large will demand to see HDTV viewed on small screens.[3]

This is a sensitive issue. Some sources indicate that at least two manufacturers, Philips and Thomson (which markets under the GE and RCA labels), have their advanced compatible televisions ready and waiting. Presumably, it is a short step from there to a full HDTV receiver. At some point, however, the industry must ask how much more the public will pay for a television that offers little discernible improvements.

One answer may lie in increasing the display size. CRT projectors have improved continuously in recent years, driven in part by the need for large alphanumeric and computer graphic displays. The HDTV capability of such systems is a moot point. Many computer workstations have far more rigorous display requirements than HDTV.

Active matrix liquid crystal displays are another strong contender for the display of the future. They have the advantage of being flat, and they consume little power. Active matrix LCDs are also the subject of tremendous investment by the Japanese. One study recently determined that

Continued on page 36

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AT AMPEX, we believe that the best way to move into the digital future is by leveraging your current investment in analog.

The fact is, while digital technology may be revolutionary, the market for it will be evolutionary. The economics simply don't support all-digital environments for the vast majority of work being done today. Clients aren't willing to pay more money for a routine effect just because it's done on a flashy new system.

It's also a fact, however, that the digital day is coming. The image clarity and purity, the creative flexibility and opportunities, and the multi-generational capabilities are significant advantages that the market will increasingly demand.

But we think you can move into this future in stages, from composite analog to composite digital to component digital, moving as the market builds and the technologies mature (and become less costly).

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Continued from page 32

10 Japanese companies are spending approximately $3.5 billion in the current 5-year period to develop and manufacture displays of this type.[4]

Other emerging display technologies include AC and DC plasma, AC and DC electroluminescence, modulated crystals and even laser-based systems.

How soon? How much?

Now that testing is under way, the end may not be in sight, but at least the path is defined. Two recent studies suggest that the first reception and retransmission of HDTV signals could occur within 18 months after a standard is set. These pathfinding stations would be fully HDTV capable within five years. Smaller stations would acquire their first HDTV capabilities within seven years after the standard is set. It could take approximately 15 years to completely convert every station to HDTV.

But at what price? Early predictions of the HDTV price tag have scared off even the most adventurous. However, second guesses have HDTV coming in much more reasonably. Twelve million dollars is the worst-case estimate, and that can be spread over several years of a phased-in approach.

One question is, can we afford it? Another is, do we have any choice? As display technology rises to meet HDTV's availability, the time may come when stations may not have a choice. It's been predicted that most TV stations will have at least some HDTV capability within 10 years. If so, then the time to make serious planning decisions is a lot closer than we think.

Acknowledgments: The author wishes to thank Robert Di Iorio, MIT; Peter Fannon, ATTC; Frank McLanis, Ampro; and Steve Talley, Magni Systems for their help in the preparation of this article.

Assistance with the audio article was provided by Jane Frock, NAB; Scott Keneman, David Sarnoff Research Center; Dr. Keiichi Kubota, NHK; Dr. Jae Lim, MIT; Pamela Shearmur, ATTC; John Taylor, Zenith Electronics; Mike Walker, General Instruments; and Ed Williams, ATTC.

Footnotes

1. "La Stratégie Européene pour la Télévision Haute Définition Devrait tre Réorientée." Le Monde, Feb. 12, 1991.
2. *San Diego Business Journal.* Feb. 25, 1991, p. 27.
3. *Electronic Media.* Sept. 24, 1990, p. 58.
4. *EE Times.* March 1990.

Is anyone listening to HDTV?

By Skip Pizzi, technical editor

Audio configurations in some of the U.S. ATV transmission proposals are still being tweaked.

When HDTV transmission formats were first discussed in the mid-80s, audio was a bit of an afterthought — just as it had traditionally been in the TV industry. Since that time, however, multichannel TV sound (MTS) and hi-fi stereo VCRs and videodisc players have raised the audience's awareness of quality audio-for-video.

MTS and stereo home video also brought the possibility of recovering the matrixed surround-sound signals that are encoded into most cinematic releases' soundtracks. This allowed the surround-equipped home viewer an unprecedented ability to create a large, multichannel sound-field, rivaling a theatrical sonic experience. Entertainment and sports programs produced strictly for television soon followed suit.

"Surround" systems

A high-definition TV system must include "high-definition audio." Today, that means some sort of "surround-sound" system. These systems use a matrixing approach similar to that employed by stereo optical film soundtracks, to encode four channels of audio (left, center, right and surround) into the two main channels of BTSC audio. However, not everything about a matrixed surround system is sublime. Decoding is not always perfect, separation between some pairs of channels is limited and the relatively low level of the surround channel makes it somewhat noisy.

Even with these flaws, a matrixed surround system can provide spectacular sound to accompany video program-

Continued on page 74

FORMAT	NO. OF CH.	BAND-WIDTH	D/A VID	D/A AUD	CODING SCHEME	DATA RATE	TRANSMISSION METHOD
ACTV	2	20kHz	A	D+A	ISO[2]	256kbit/s	QPSK subcar.
ADTV	4	20kHz	D	D	ISO[2]	512kbit/s	mpx[3]
ATVA	4	20kHz	D	D	prop.	512kbit/s	mpx[3]
DigiCipher	4	15kHz	D	D	VC-II[4]	1.76Mbit/s[5]	mpx[3]
DSC-HDTV	4	20kHz	D	D	prop.	500kbit/s	mpx[3]
Narrow MUSE	4	15kHz	A	D	NI-DPCM[6]	1.35Mbit/s[7]	in VBI

Footnotes

1. ACTV is an on-channel NTSC-compatible system, so standard BTSC analog audio is provided along with a digital audio channel for ACTV-equipped receivers. Specifications quoted refer to the digital audio service.
2. Pending selection/establishment of standard audio data-compression algorithm by ISO.
3. Audio data is multiplexed with video data, and transmitted in a single datastream.
4. Similar to VideoCipherII audio, using 15-to-10 bit instantaneous μ-law compression, with high-frequency emphasis. Subject to change before final certification.
5. Likely to be reduced before final certification.
6. Near-instantaneous differential PCM companding (15-to-8 bit).
7. Includes 128kbit/s auxiliary data channel.

***Table 1.** Comparison of systems used for main program audio by U.S. ATV transmission standard proponents (as presently specified). Parameters displayed indicate number of audio channels available, audio bandwidth of each channel, whether a digital or analog system is used for video and for audio, the coding/compression scheme employed, the total data rate used for audio (including error-correction overhead), and the method of transmission for audio channels. "Prop." indicates undisclosed proprietary methods involved.*

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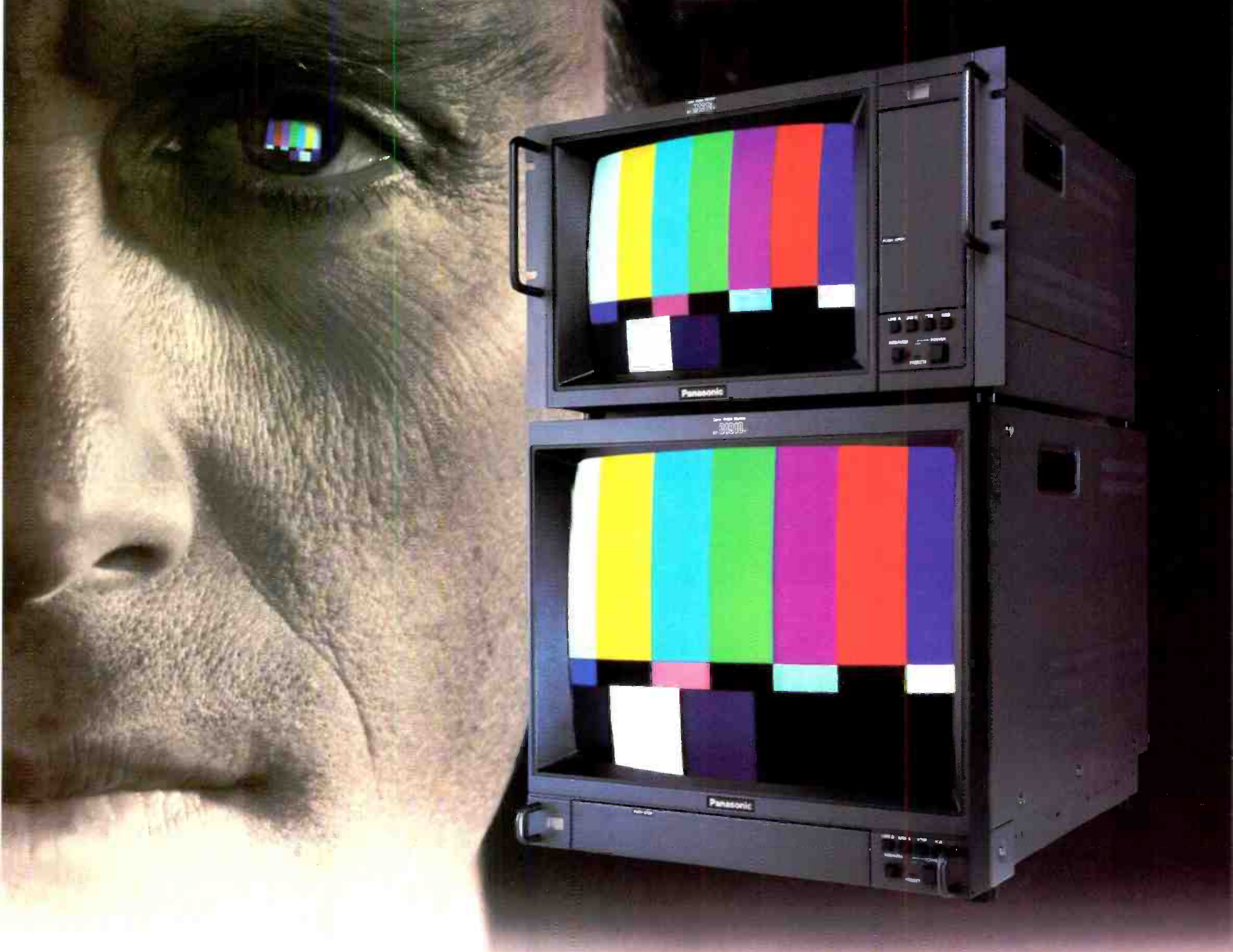

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Integrating HDTV into NTSC

Timing considerations for the hybrid NTSC/HDTV facility.

By Mike Overton

The introduction of HDTV signals into TV stations and production facilities will resemble the process that was used when color was first instigated. The process will be gradual, with the first stage consisting of passing along HDTV network signals. Then, as the cost of HDTV production equipment declines, studios will be equipped with the new hardware. The process will be evolutionary, not revolutionary.

Careful planning will be required in order to effectively and simultaneously handle two quite different video standards. Perhaps the most critical aspect of this process will be equipment synchronization and timing.

Getting started

HDTV production can be initiated in a variety of ways. First, a facility could start from scratch and build a new HDTV plant. For most broadcasters, however, the practical approach will be to phase into HDTV production. Early HDTV production will probably use an isolated island of HDTV equipment. Then, as HDTV operations increase, facilities will likely interconnect the HDTV and NTSC production areas. Obviously, HDTV feeds will be down-converted for NTSC distribution. It is also likely that much of NTSC programming, especially archive material, will find its way into HDTV formats.

Overton is an engineer for Television Processing, Tektronix, Beaverton, OR.

Several suggestions have been made to make today's 525-line video more compatible with HDTV. Interim formats of wide-screen 16:9 aspect ratio NTSC and component video have been proposed. These formats are intended to allow continued use of the current plant while gaining the benefits of the wider aspect ratio. When the wide-screen formats up-convert to HDTV, the aspect ratios will match. Hybrid operations will probably continue for a long time.

All of the proposed HDTV systems for the U.S. market make some concession to the NTSC raster. The 1125 uses the 59.94 frame rate, while the 787.5- and 1050-based systems go one step further by having horizontal rates that are integer multiples of the NTSC rate. These simple relationships will streamline both format conversions and the design of the master sync system. (See "Is Anyone Listening to HDTV?" p. 36.)

Living with two or more standards

Many years down the road, NTSC video will be retired and most production will be in HDTV. In the interim, however, down-conversion of HDTV to NTSC and up-conversion of NTSC to HDTV will be commonplace. Figure 1 shows some of the possible routings of video and synchronization signals for such a hybrid plant.

To simplify the rate conversions needed to go from NTSC to HDTV, the HDTV system raster parameters should be carefully chosen. A simple relationship between HDTV and NTSC rasters will also make multistandard equipment more practical for the broadcaster and consumer.

Stability requirements

The HDTV system could lock to the NTSC system, or the NTSC system could lock to the HDTV system. Which makes the most sense? The hybrid facility illustrated in Figure 1 takes into consideration the different time base stability requirements of NTSC and HDTV. Notice that there are two types of synchronizing signals.

You may think the HDTV system, with its higher resolution, would require better time base stability than NTSC. Surprisingly, HDTV and NTSC have similar susceptibility to timing errors. This is because all HDTV production systems are component based, and component TV systems are more tolerant of timing errors than composite systems.

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Sync waveforms...new and old

The familiar NTSC waveform shown in Figure 2(a) has an abundance of timing information. Typical gen-lock circuitry uses the leading edge of sync as a coarse reference, and then uses approximately six cycles of burst for a fine reference. This allows such products to achieve gen-lock with jitter of a few hundred picoseconds or less. Other gen-lock circuits, especially in monochrome systems, use only the falling edge of sync. Working with only a 140ns rise time sync pulse, jitter might be 10ns or so. This is barely adequate for NTSC systems.

Most HDTV signals use a tri-level sync as shown in Figure 2(b). Tri-level sync has several advantages. Perhaps the most recognized advantage is that the sense threshold on the rising edge of sync is at blanking level. This makes it less sensitive to sync amplitude variations. However, conventional sync-lock circuitry typically samples the amplitude of sync to adapt the sense threshold, effectively obtaining tri-level sync's independence to amplitude variations. The real advantage of HDTV tri-level sync is that the critical rising edge has twice the amplitude and about half the rise time — or about four times the slew rate — of NTSC sync. Correspondingly, a tri-level sync-lock yields four times the stability of an NTSC sync-lock.

Although the HDTV sync-lock will be far more stable than the NTSC sync-lock, and could lock the NTSC equipment, an even better reference exists. The NTSC subcarrier phase is approximately 10 times as critical as NTSC sync timing, and two times as critical as HDTV timing. This makes modern NTSC sync generators, with their 100ps burst-lock stability, an excellent choice for synchronizing NTSC equipment.

Noise is also a consideration. HDTV signals have wide bandwidth. Even clean stu-

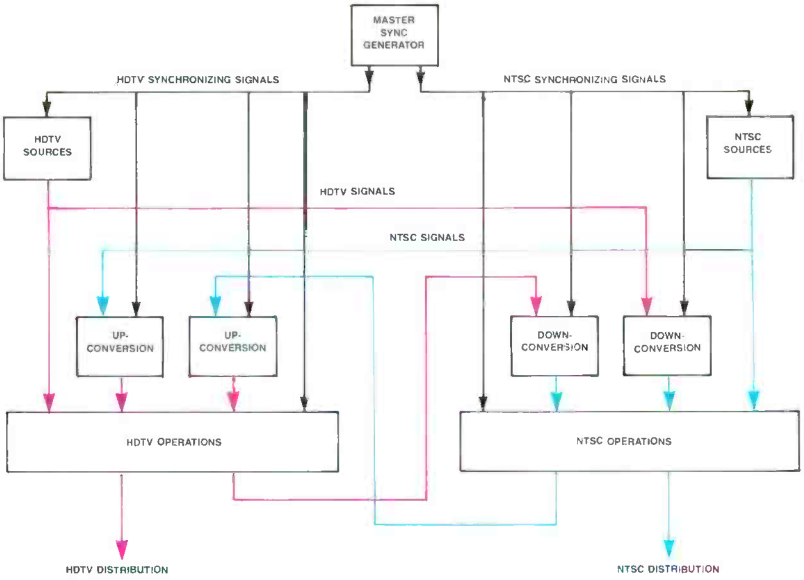

Figure 1. *Transitional TV plants will probably have NTSC and one or more HDTV formats. There may even be interim wide-screen NTSC or wide-screen 525-line component formats.*

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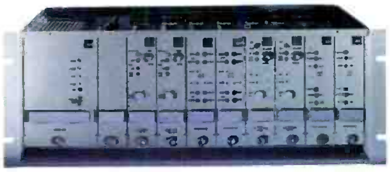

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dio signals will have more noise than the narrow bandwidth NTSC signals to which you may be accustomed. Although some sync-lock and gen-lock circuits have better noise immunity than others, noise will almost invariably introduce — or at least increase — jitter. Because HDTV signals do not have the stability offered by a timing burst, there is a strong case for keeping NTSC signals referenced to an NTSC sync generator for optimum stability.

The master sync source shown in Figure 1 could be either a multistandard generator or an NTSC master sync generator with an HDTV sync generator slave. Because many NTSC plants already have the NTSC master sync generator, the latter approach may be attractive. A flexible HDTV sync generator that can supply a variety of HDTV output formats while locked to an NTSC or HDTV input would also meet a facility's evolving requirements. Such flexibility would ensure that investments in experimental HDTV equipment today will still be useful after the standards issues have been settled.

Figure 2(a).

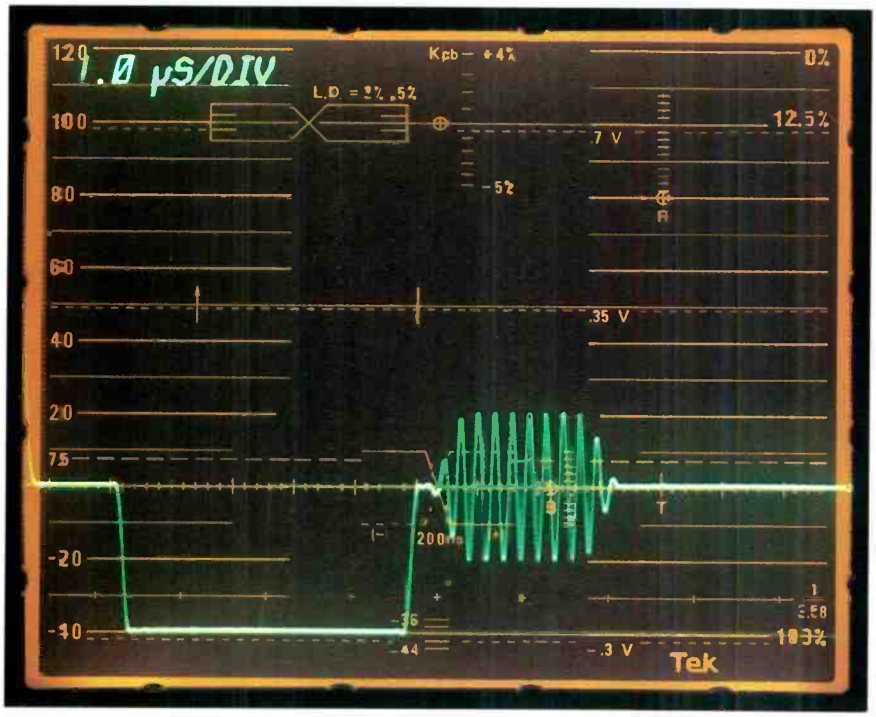

Figure 2(b).

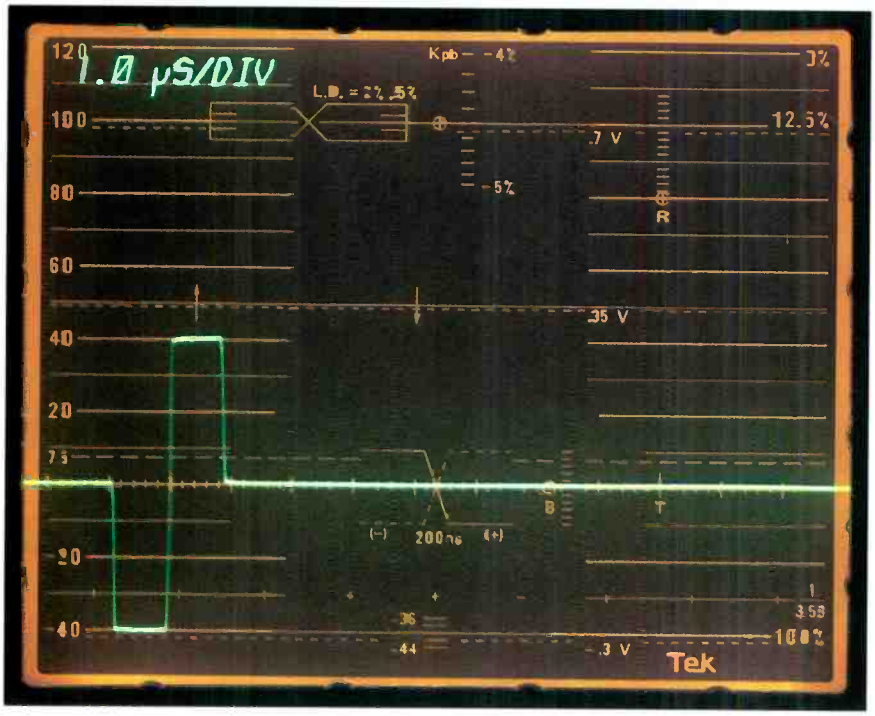

Figure 2. The familiar NTSC sync and burst waveform shown in 2(a) has precise timing information in the burst. The tri-level HDTV sync waveform shown in 2(b) has better slew rate and amplitude than NTSC sync, but still is not as precise as the NTSC signal with color burst.

For most broadcasters, the practical approach will be to phase into HDTV production.

Checking sync stability

Every piece of equipment that processes the HDTV signal needs to have a high degree of stability. The question becomes how to measure jitter of only a few hundred picoseconds? Seeing 100ps of sync jitter on a scope can be difficult.

One tool is the bowtie signal for HDTV. Originally designed for 525-line and 625-line component video testing, the HDTV bowtie has higher frequency burst packets (5.000MHz and 5.002MHz) and higher resolution markers (1ns). Like the original bowtie, the packets are phase matched at the center of the line. The 5.000MHz sine wave packet is fed to the green (or luminance) channel, and the 5.002MHz packet to the blue and red (or color-difference) channels. When the packets are subtracted, the bowtie pattern in Figure 3(a) is displayed.

The position of the null gives a sensitive measurement of relative timing. If channel timing is correct, the bowtie pattern has a sharp null at its center. If the timing is incorrect, the null shifts off center, as shown in Figure 3(b), to indicate lead or lag. Counting the on-screen timing markers shows the amount of timing error.

In the case of jitter, the null remains in the center of the bowtie. However, the null spreads out according to the amount of jitter present. The bowtie works best in low-noise situations.

Color framing in components?

Whether there will be a need for color framing on the component video HDTV signal is a source of industry debate. After all, there are only two fields, and there is not supposed to be any subcarrier in

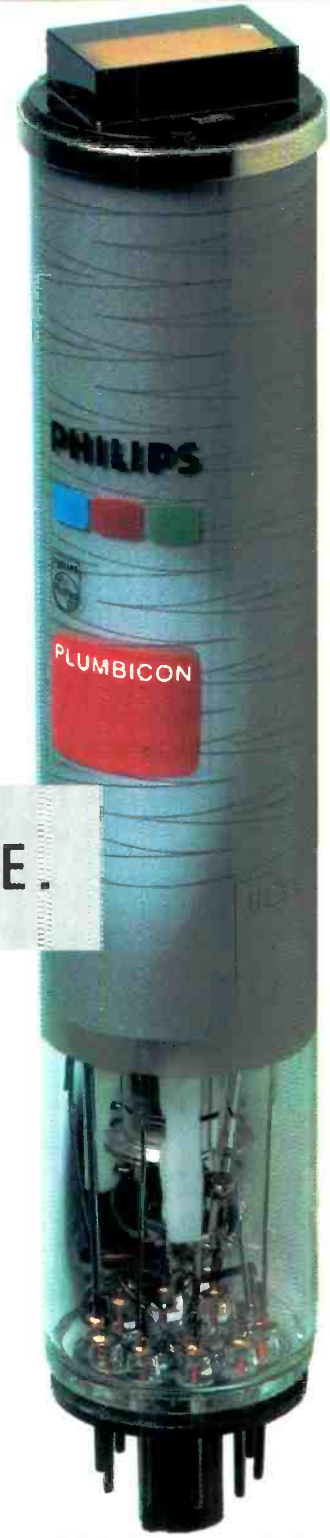

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Figure 3(a).

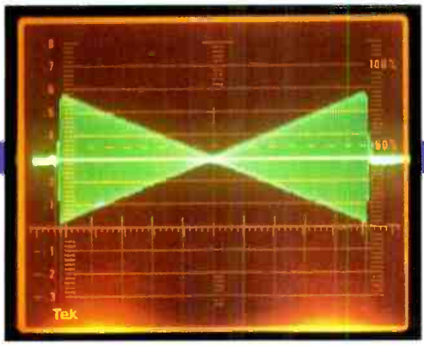

Figure 3(b).

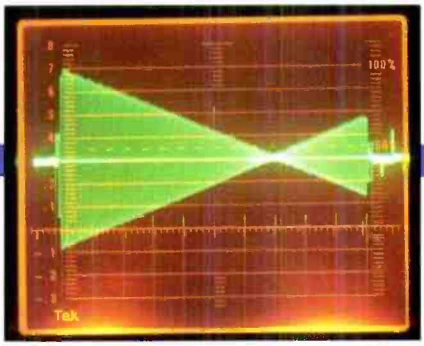

Figure 3. *The bowtie test signal, originally developed for 525-line component measurements, has been updated for HDTV timing measurements; (a) shows the bowtie with a perfect interchannel timing match; (b) shows a waveform in which the null has moved to the right, indicating a delay error in the color-difference channel relative to the luminance channel.*

component video. However, experience with established technologies shows that when a composite signal is decoded and processed through component equipment, a small amount of residual subcarrier typically remains in the luminance channel.

Many fear that if the HDTV equipment does not observe the color frame sequence, this residual subcarrier will not add together properly with the new color subcarrier when the signal is re-encoded.

It is not clear how much of a problem this will be if an NTSC signal is up-converted to HDTV, and then later re-encoded. However, it may be a good idea to have a color frame flag on the HDTV sync waveform, just in case. This is easily done if the sync generator maintains color framing at the slowest frame rate in the system — in this case, the NTSC 4-field color frame rate.

Standards committees are currently debating the issue of adding a digital flag carrying frame start information to the HDTV vertical interval. It is hoped that such a step will not be necessary. Tracking a color frame through component processing would greatly increase the complexity of HDTV and today's 525-line systems.

Ready for the first step?

Interest in HDTV is continually growing, undoubtedly spurred by the increasing availability of production equipment. With FCC testing about to begin, HDTV broadcasting in the United States is on the horizon. Although a few cutting-edge commercial facilities are experimenting with HDTV production before the standards issues are sorted, most broadcasters will not be working with wide-screen television until a transmission standard is chosen.

Early ventures into HDTV will probably involve mixed-format plants with down-conversions to NTSC and up-conversions to HDTV. With the production, conversion and synchronization equipment available today, those broadcasters who wish to can begin pioneering work in HDTV programming and distribution. However, it is imperative to plan the systems carefully to meet the stringent synchronization requirements of this mixed environment.

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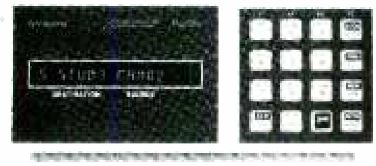

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Converting PC video to NTSC

Crossing the bridge between personal computer video and NTSC.

By Paul McGoldrick

Personal computers are poised to become familiar fixtures in the video production business. By using PCs, facilities can perform on- and off-line editing, graphic design, storyboarding and a host of other applications. In certain situations, PCs can even function directly as video sources. However, before PCs can become as common in the video environment as countertop appliances are in the kitchen, users must understand a few basics. This article maps out some of the issues involved in creating computer-generated video signals.

Video is video is video?

Why do people have such a difficult time agreeing on what "video" means? Defining terms is the first hurdle in using PCs as video sources. To the broadcast engineer, *video* means a specific composite or component signal, the timings and amplitudes of which are spelled out in standards documents (RS-170A, CCIR 601, RP-125 and so on). On the other hand, in the computer environment, *video* refers to the PC's visual output. These signals also conform to fairly well-defined standards. Unfortunately, these two definitions of video have little to do with each other. The only factor these signals have in common is that they electronically describe pictures. For the most part, the similarity ends there.

McGoldrick is director of international sales for Magni Systems, Beaverton, OR.

Color is a key determinant of computer "video" capability. As PCs evolved, their displays increased in power from monochromatic to 16 colors to 256 colors. Today, at the top end, computers have palettes offering more than 16 million colors. Likewise, the resolution or fineness of those images has improved dramatically. Pixel resolutions in today's advanced computer graphic standards approach those that you are accustomed to hearing for high-definition television (HDTV). These resolutions are often less-than-immediately compatible with NTSC.

Many computer images scan sequentially from top to bottom, line by line, rather than interlaced as in broadcast video. This is particularly important when considering some of the conversion limitations that hardware alone cannot solve.

Finally, some computer video standards are valid for only one brand — in some cases, only one model — of computer. This is completely foreign to the video arena, where manufacturers strive to maintain compatibility.

Electing a platform

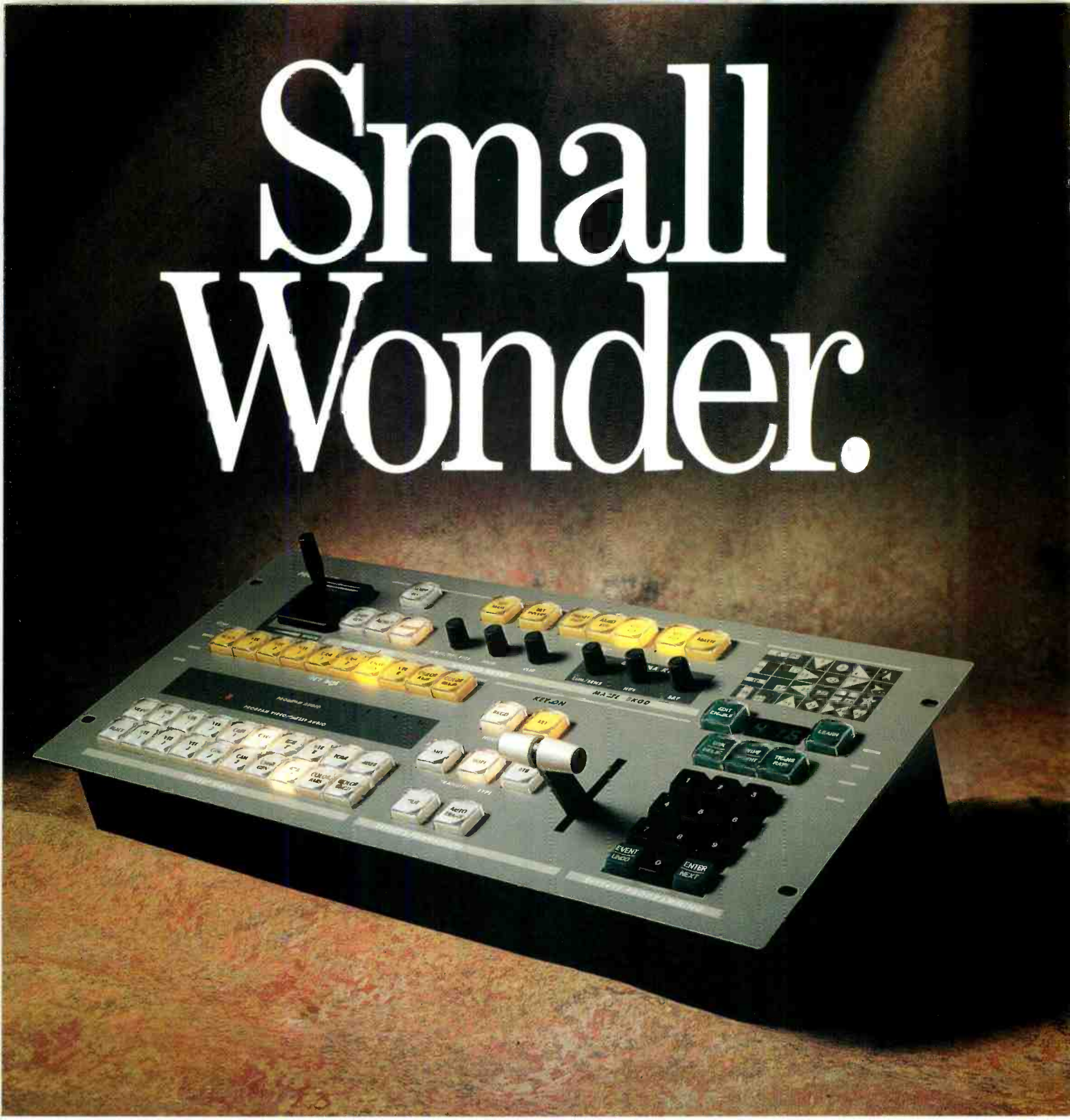
Picking a computer platform involves more than deciding on a collection of hardware. It's like voting for political candidates — along with the people come their stands on various issues.

Choosing a platform means making decisions concerning how operators will work with the computer (through a keyboard or a mouse). It is deciding which software packages will be available to your facility. Ultimately, it determines what other parts of the facility, and the parts of the industry at large, with which your system will be compatible. Picking a platform even chooses your allies. It tells the world who you back in the lively exchanges between the IBM, Macintosh and Amiga worlds.

In many ways, the major platforms' suitability for today's video is more or less even. IBM-type PCs now offer user interfaces that are far friendlier than DOS. The design ease of the Macintosh has made it a natural for graphics professionals, and consequently for video. Amigas are video-ready in terms of their aspect ratios. Amigas have also developed a loyal following, helped along by the Video Toaster's debut. All three platforms have a broad range of video hardware solutions and software options available. Be prepared to do substantial groundwork before determining which platform will ultimately serve you best.

Format options

If your facility has already committed to a video format or formats, integrating PC-based video into the system is primarily a question of how direct the connection between the PC and its destination can be. If the bulk of your facility's signal processing is in NTSC, it is fairly easy to introduce PC-generated graphics at any point up to the transmitter. On the other hand, if most of the production work is in a component or digital format, you must



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determine where PC-originated material enters the production process. This will, in part, determine the hardware options.

For most broadcasters, composite NTSC and PAL still prevail for transmission. Different component (Beta, MII and so on) and digital (D-1, D-2) standards are widely used for production. The various "S" video formats, such as S-VHS and Hi-8, are also gaining in popularity.

In many ways, the major platforms' suitability for today's video is more or less even.

The widest range of PC-video conversion hardware is available for NTSC/PAL and the S-video formats. This equipment ranges from circuit board level — commonly and inaccurately referred to as "gen-locks" by the computer world — to stand-alone scan converters. As you move from common, mass-market computers into systems that are newer or were designed for more technically sophisticated users, the options for PC conversion diminish to stand-alone units.

Scan conversion

The most flexible and highest-quality PC-to-video conversions use scan conversion. The technology itself is fairly straightforward. (See Figure 1.) The finest scan converters are stand-alone systems that can process nearly any computer-generated format into one of several video output formats. Also, they often offer a series of video controls resembling those of a proc-amp.

Scan conversion technology has been available for some time — well before the "desktop video" revolution. The flourishing interest in desktop video has led some manufacturers to re-examine the technology in terms of operation and objective. The cost of memory has been reduced significantly over recent years. This allows creation of scan conversion systems in low-cost board-type configurations. However, when converting from a non-standard graphics resolution, use of a high-end scan converter may still be a requirement.

The gen-lock

In computer parlance, the word "gen-lock" seems to entail locking and keying. Usually the output of a gen-lock is a video signal with the computer text or graphics keyed over it. Thus, in the computer domain, the video signal passes through the computer on the way to its destination.

In a broadcast sense, a gen-lock is a device that produces a stable, time-able video output from a computer. This output feeds a switcher or other video equipment. The timing/phasing capability comes either from controls on the device itself, or from adjusting the reference video.

Gen-lock devices usually take the form of a graphics card with plug-in modules, or as separate cards that connect to the graphics card. The dividing line is whether the images are created at the graphics card scan rates or at the NTSC rates.

The gen-lock circuitry usually connects to the graphics card inside the computer. The gen-lock section converts reference video into H & V drive for the graphics circuitry. Alternatively, users can run the output of a free-running graphics generator into a frame buffer or time base corrector (TBC). The TBC then locks to the external reference.

Audio has not been overlooked. Some manufacturers have made products that provide digital audio sampling, editing, data compression and storage. The compressed audio files are tagged to a given still-frame image using a system of file extensions. This would make it theoretically possible to store several station IDs along with jingles and tag lines on a computer, and to archive the images on small floppy disks.

The VGA converter

Some graphics cards have composite or S-video outputs. These can be gen-locked by running them through a frame synchronizer or TBC. However, at this level it becomes important to put more trust in a reliable waveform monitor and vectorscope than in the manufacturer's claims for a product's performance.

"Broadcast quality"

It is difficult for the computer layperson to understand what is meant by "broadcast quality." This is understandable. It is easy to claim a given product is of broadcast quality, but far less easy to prove it. As a result, the term may be overused.

The original RS-170A drawing defines amplitudes of horizontal and vertical sync, and of the picture. It also defines setup, sync widths, the full train of sync pulses, and the amplitude of burst (including the correct number of burst cycles and where they are supposed to be). A signal with these essentials is the only one that can claim true, rather than near, broadcast quality.

It is easy to claim a given product is of broadcast quality, but far less easy to prove it. As a result, the term may be overused.

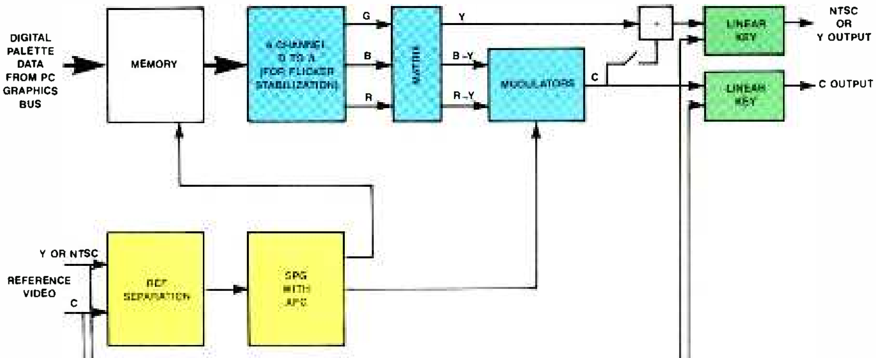

Figure 1. A block diagram of a basic broadcast standard converter. The sync pulse generator (SPG) section provides a stable reference when free-running, or else synchronizes it to external reference video.

What the user considers acceptable, however, may not be quite so demanding. Below "broadcast," several degrees of quality may be usable. Some products allow users to record signals that are of home video quality. At the lowest level, there are converters that give acceptable pictures directly to that most forgiving piece of equipment — the picture monitor.

Converting a high-resolution graphics signal will always lose some of the quality. The main deterioration will be in resolution, simply because of the limitations of composite video. For example, a 640×480 graphics display has pixel widths of approximately 36ns (with a 28MHz clock), while the converted resolution in NTSC will be approximately 80ns.

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Circle (34) on Reply Card

Digital audio workstations diversify

"Divide and conquer" is the motto in today's workstation world.

By Skip Pizzi, technical editor

Despite the shakeout that most industry observers expected by now, the digital audio workstation (DAW) marketplace has continued to grow. This growth has been more divergent than convergent, however, as different manufacturers have targeted distinct areas within the audio production industry to move toward. As a result, products have become more specifically oriented toward certain tasks, providing multiple advantages to the manufacturer and user. These devices have become so divergent that it may soon be inappropriate to refer to them under the single banner of "digital audio workstation." For the prospective buyer, this is mostly good news, but it makes the purchasing *choice* all the more important.

Narrowing focus

The market-breakdown categories that have appeared for the workstation marketplace so far seem to be along the lines of musician (performer/composer), large-scale music recording, video post-production, film post and radio production. Most manufacturers have focused on one of these, although a few continue to pursue a more diversified approach.

The benefit to the user in this specificity follows a corollary of the classic information theory: The less a device can do, the easier it is to operate. Conversely, the more flexible a device is, the more difficult it will be to make it perform any one of its operations. This is not to imply that these devices are limited in their abilities. In fact, flexibility is perhaps their greatest asset. But with increased flexibility often comes decreased user-friendliness and/or slower speed of operation, and manufacturers are now working with this trade-off. By reducing flexibility to only those operations required by a specific class of user, operational friendliness and speed can be increased.

What is a workstation?

The fast, random-access nature of hard disk recording is exploited in practically all workstation designs. Non-destructive editing is accomplished simply by changing playback address commands. Audio is typically not "lost" when it is edited, rather instructions are given to simply *not read* that data. This is the founding premise of DAW operation. However, technology has come a long way from there.

The question of what constitutes a DAW is increasingly hard to answer. Not all workstations are created equal. (Although this was true in their earliest days, the spectrum of possibilities continues to widen.) The most basic devices are designed as hard disk recorders and editors, typically handling only mono or stereo audio. The next level up involves multitrack capability, which allows editing plus some type of rudimentary mixing, usually with a "virtual" console representation on screen. Further up the ladder comes extensive virtual mixing capabilities, generally with more tracks, and digital signal processing (DSP) added for wide-ranging equalization, gain reduction and reverberation effects. Finally, a "hard" mixing console is added, putting traditional faders and knobs into the user's hands, combined with the workstation's typical QWERTY keyboard and mouse control surfaces.

Another basic distinction among DAWs is whether they use a proprietary computer platform, or are designed as peripheral hardware and software packages to run on popular desktop computers. (Some systems split the difference by operating on proprietary platforms, while using a desktop computer for control and display only.)

Fully desktop-resident systems are the least expensive. However, with this economy comes certain drawbacks. Desktop computers were designed to handle the data throughput needs of word processing, accounting and graphics applications. Even the most data-intensive of these programs does not come close to the massive data throughput required for digital audio recording and production. Although 1Mbit is a significant amount of data for text work, it's hardly more than a single second's worth of quality digital audio data. Therefore, digital audio applications are worlds apart from office automation tasks in their data requirements, both in active memory (RAM) and storage (hard disks) needs. Data bus-width demands are also quite high for audio, with the host computer's CPU type and its operating speed having further critical impact.

Earlier desktop-based workstations suffered from slow operation, but this has improved in more recent designs. However, there was (and is) no lack of flexibility or features among most of these systems, making them the most popular product area in the DAW marketplace at present. The platforms are also being adapted for

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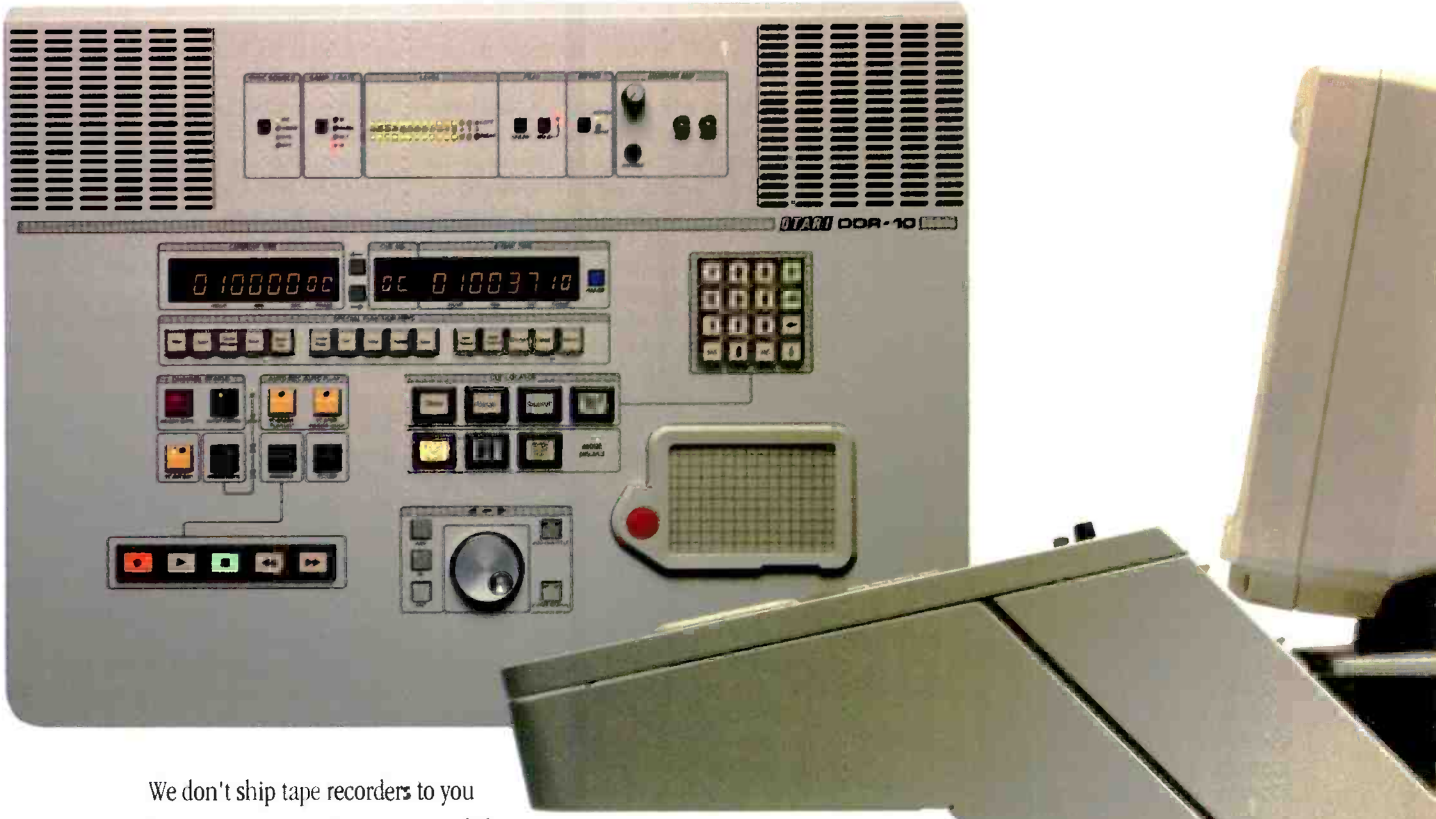

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these needs as manufacturers respond to this application of their devices. One popular computer manufacturer recently announced its latest system, which will accommodate up to 128Mbytes of RAM. (Typical desktop computers today rarely have more than 8Mbytes).

Meanwhile, the traditional "heavy hitters" of the DAW industry continue their proprietary platform approach, arguing that speed and capabilities are greatly expanded when the computational system is designed and optimized from the ground up for digital audio application.

Divergence in approach

Several parts of the audio and broadcast industries have welcomed the workstation, most notably the audio-for-video and audio-for-film markets. Increased productivity and accommodation of last-minute changes seem to be primary among the advantages DAWs have brought to these communities. However, like word processors or other computer applications, each manufacturer's product achieves essentially the same operations in vastly different ways. This means operator training will be significant to any DAW's success in a facility, and that all training is specific to a single device. Because no one system has garnered predominant market share, the industry lacks true references or standards as yet.

Initially, the most striking difference between systems is their display of data on screen. This can vary from primitive-looking monochrome ASCII text on a black background, to vibrantly colorful 3-D cartoon consoles with knobs that turn and faders that move in real time. Even with the one display feature shared by most DAWs, in which visual tracks of audio scroll past a fixed cursor mark (or "now line") on the screen, the industry has not come to terms with which way the tracks should move. Some pull them left-to-right, others go right-to-left and one runs down-to-up. Although none seems inherently better, the adjustment for an operator moving between systems for this and many other varying display parameters could be significant.

Such diversity could be written off as a matter of style or competitive advantage. Furthermore, users' preferences can be considered simply a matter of what they are familiar with, or based upon the device on which they first learned (just as cut-and-splice audio editors often fanatically prefer one type of tape deck for their editing). But these differences become a major problem in the area of compatibility between products. With more DAWs populating the industry's facilities, it has become common for a project to be started on one type of workstation and finished on another. (A digital multitrack tape recorder may also be involved.) As yet, no common file interchange standard exists for DAWs, although work toward this end is currently under way.

When — or even whether — this standard protocol will be completed and supported remains an open question. Because no manufacturer wants to appear to be adopting a "lowest-common-denominator" approach for the standard, progress here has been slow. The enormous differences between systems hasn't helped either. Just how far apart the players actually are was shown during the first meetings of the current semiofficial DAW standards committee (the *AES Subworking Group on Operational Requirements for Professional Disk Recording*). Arguments raged simply over the differing nomenclature used by various manufacturers for the same processes. The committee took this problem on as a necessary first task, and standardized terminology has now been hammered out. This is a considerable achievement, but mere child's play compared to its next mandate. The committee's work is now aimed toward arriving at a media-independent DAW file interchange standard that is easy to implement, includes picture synchronization data and allows for manufacturer-specific "extensions" to be included.

On the plus side, this same increased diversity toward specific market sectors has brought users the benefits of applications tailored to their individual needs. For example, a workstation that offers software facilitating foreign language dialogue dubbing is of great value to the film post-production industry, while one that implements real-time time compression is useful to the video-post world. Any of several DAWs that support MIDI would be useful for a musician or radio station, whereas a SMPTE-supporting device makes more sense for a TV facility.

Other new directions include a "miniworkstation" based on a magneto-optical recorder, with a small LCD window for display (an outboard video monitor display is optional). This unit actually makes field recordings "direct-to-workstation" a viable option. On the other end of the spectrum is a large, multi-user networked system, with stations that all share a common mass-storage sound library (for sound effects). Up to 7× real time file transfer is currently possible from the central storage to individual stations.

Flexibility and quality

As development progresses and applications expand, other DAW attributes that were once considered acceptable are now being scrutinized for possible improvement. The "onion-skin" analogy is apt here — just as one element is improved, or a problem peeled away, another unforeseen layer of the system becomes the new limiting factor.

Removable media is presently one such issue. In broadcast production, the advantages provided by being able to remove files from a production session and move them to another facility (or come back to the same one a few days later to continue or rework a new version) are considerable. In the past, however, the inherent removability of optical drives had been eschewed by workstation manufacturers in favor of the faster access time (and lower cost) of magnetic hard disks. Removable magnetic disks are available, but their limited capacity makes them inappropriate for most digital audio applications. Now, a growing number of DAW makers are addressing this dilemma by implementing a removable magneto-optical disk (MOD) storage system. Most implementations adhere to the current ISO standard for such disks, using erasable, double-sided $5^1/_4$-inch media with 650Mbyte capacity.

Another area of increased interest involves audio quality. Because the audio acrobatics that workstations perform have become less of a novelty, the pure sonic quality of these devices has been revisited. Is audio quality being traded for flexibility and speed? The primary object of attention here is the analog-to-digital converter. Newer systems implement 18-bit, 64×-oversampled sigma-delta converters (and the latest DSP chips) to optimize audio quality at the initial conversion stage, and maintain it throughout the system. (See the related article, "Hard Disk Recording for Broadcast Use," p. 60.) Data-compression systems are not yet found on many workstations, but they are sure to appear. These will be of concern for their affect upon audio quality as well.

Most DAW manufacturers do not intend to use data compression to squeeze more audio onto their storage media (although this would be a possibility). If economically feasible, it makes sense to keep digital audio at the highest resolution possible throughout the production process. After a project's completion, however, the compression may be applied for transmission or storage/mastering to one of several upcoming consumer distribution media that will use data compression (CD-I, DCC and MD [minidisc] formats). It might be handy to have several popular compression algorithms on-board (simple enough with resident DSP chips), just for monitoring or audition purposes. This way, a producer could hear how a completed project will sound when passed through such a system on its way to the end-user.

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Hard disk recording for broadcast use

By Robert Bird

Unlike conventional recording studios and post-production facilities, AM and FM broadcasters need to initiate the replay of sound sources in a virtually ever-changing sequence. In essence, flexible radio programming relies upon this ability to accurately trigger the real time or automated playback of literally thousands of music cuts, commercials, jingles, station IDs, news cuts and PSAs, any of which might need to be replayed in a presequenced order or accessed randomly throughout the broadcast day.

This is why an increasing number of broadcasters are evaluating the potential of hard disk-based, random-access systems for local and satellite-delivered programming. The flexible programming and instant-start playback offered by disk-based systems provide many advantages for broadcast use.

Hard disk formats: fast access and editing flexibility

Although computer-controlled CD jukeboxes and DAT players are possibly more suitable for the programmed replay of longer cuts, hard disk systems offer a unique combination of sample-accurate editing and instant access to any sound file.

Digital audio files can be stored on conventional hard drives and instantly accessed in random sequence. Each discrete element can be assigned an easy-to-understand alphanumeric label, and the controlling software set up to extract information from a companion database that lists useful details, such as running time, playout dates (for time-critical material), scheduling data and other information for the on-air talent or operator.

Hard disk editing is "non-destructive" — it simply involves the tagging of new stop/start points for each sound element. File data is neither permanently changed, nor re-recorded to disk. Hard disk systems allow play lists and sound files to be freely modified according to programming requirements.

Bird is product manager for Antex Electronics Corporation, Gardena, CA.

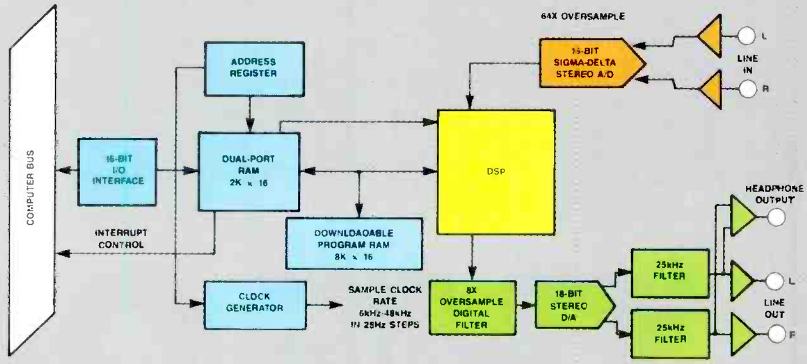

Figure 1. Block diagram of a typical desktop computer peripheral card allowing storage of high-quality digital audio on the computer's hard disk. Editing and signal processing may also be provided on board.

Analog-to-digital conversion

A typical system for digitizing mono or stereo sound sources and vectoring them to a hard disk for storage and replay is shown in Figure 1. Circuits such as these can be placed on boards that are plug-in compatible with popular desktop computer systems. Control of all record and replay functions is then possible via the host computer's standard commands, which are available in a variety of familiar programming languages.

In many such systems, the analog signal can be digitized at user-selectable sampling frequency and resolution, then stored to and replayed from hard disk. For broadcast use, the sampling rate is usually set to 32kHz or 44.1kHz (the latter offers direct digital I/O from CD and DAT players). Lower sampling rates are reserved for news or voice-only applications. To ensure an adequate dynamic range, 16-bit resolution is standard.

Newer generation A-to-D converters incorporate 1-bit sigma-delta techniques, typically providing 64× oversampling, which ensure true 16-bit resolution and enhanced converter linearity through the passband, especially for low-level signals. Meanwhile, 18-bit DACs with 8× oversampling or higher are being used for improved precision in recovering data from hard disk.

Data-compression coders that allow two, four or even eight times as much information to be stored to hard disk without significant audible degradation are also being explored.

Regarding storage capacity on hard disk systems, maximum record time can be calculated from the following formula:

$$R = \frac{133.333 \times M \times D}{(F \times B \times C)}$$

Where:

- R = record time (min)
- M = hard disk capacity (Mbytes)
- D = data-compression factor, if any (comp. ratio = D:1)
- F = sampling frequency (kHz)
- B = resolution (bits)
- C = number of audio channels

For example, a 320Mbyte hard disk will hold approximately 30.23 minutes of stereo, 16-bit, non-compressed (D=1) digital audio sampled at 44.1kHz; a 4:1 compression system would increase that disk's capacity to a little more than two hours of stereo audio.

by some of the larger and longer-standing DAW manufacturers. These companies now have a considerable client base in the market, and a few are moving to an open-architecture scheme. Although this approach used to be considered a bit risky in such a competitively saturated marketplace, it may now be an advantage because it will allow third-party software developers to enhance the flexibility (and perhaps the popularity) of a particular DAW, at no cost to the workstation manufacturer. Wide availability of third-party software also helps convince the industry that a particular platform is gaining market share.

Other recent trends in workstation design show an increase in the number of output channels, a wider support of digital audio interface standards and control protocols, more real time and synchronizer-locked (or otherwise automatable) DSP functions, and faster backup times. (At present, 4× real time backup is considered fast, with 8× under development. Backup media used by various manufacturers include DAT [data and audio formats], 8mm videocassettes and computer-type backup cassettes.)

Right for radio?

The acceptance of workstations into the film, TV and music post-production industries is testimony to their usefulness there. However, with one significant exception, DAW manufacturers have not specifically targeted the radio production marketplace. Not surprisingly, workstations' penetration into radio has been small. Yet,

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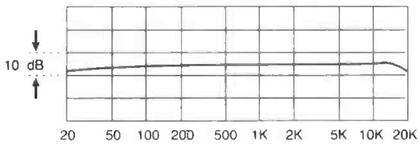

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this is more of a "compared to what" issue than a marketing problem. Workstations are a big step forward when placed into an existing multitrack environment, especially one where synchronization to visual material is involved. When viewed from an asynchronous, *multimachine, multisource* production perspective — such as that used in most radio production facilities — a workstation's advantages are less obvious.

In a traditionally non-multitrack environment, a workstation's speed is at least partially erased by the need for real time uploading and downloading of all material before editing or production can commence. (In a post-production environment employing multitrack tape, this process is already part of standard operation, so a workstation's essentially equivalent requirement is not seen as a disadvantage.)

Use of a workstation in a previously non-multitrack operation can actually cause simple projects to take *longer* to complete. However, at many stations, a small (4- or 8-track) multitrack recorder is often used for spot production, so a small capacity, fast-operating workstation would fit in nicely in terms of operations and budget. At other stations, however, where

A buyer's guide to DAWs

By Skip Pizzi, technical editor

Before first-time workstation buyers can arrive at the answers they want, they need to know what questions to ask. Here are a few questions for yourself and your staff (with some sample answers to get you going):

- *Why do we want a workstation?* (To increase productivity, to expand capability, to keep a competitive edge.)
- *What kind of projects will we use a workstation for?* (Radio spots, TV spots, long-form audio, long-form video, film projects.)
- *Who will operate it?* (Only one or two key people, a staff of dedicated editor/technicians, DJ/board-ops.)
- *Who will train those operators?* (A key staff person, a manufacturer's representative, a dealer representative, a consulting third party.)
- *What other equipment will be used with the workstation?* (Analog tape decks, CD players, DAT decks, multitrack decks, outboard mixer(s), SMPTE-locked ATRs, VTRs, video edit controller, house sync, VITC, film dubbers, outboard processing gear, MIDI-equipped hardware, samplers, other workstations or hard disk recorders, other computers or automation controllers.)

Comparison shopping

Once these questions are fully answered, you will know something about the parameters of what you're looking for. Take that information and go shopping, asking the appropriate questions from the following list (and others that you might add — this is certainly not an exhaustive list). Even though one of the prime advantages of a workstation is its expandability, take note of any answers to your current needs that are qualified with, "That upgrade will be available soon." As you proceed, be sure to obtain clear answers on what's included in the base price, and what each option costs.

Regarding hardware:

- *How many "tracks" does the standard unit come with? How many more are optionally available?*
- *Does the system use another manufacturer's computer platform, or is it a self-contained, proprietary device?*
- *If another manufacturer's computer is used, what functions does the system*

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a multitrack tradition is not already in place, acceptance of the workstation is likely to be slow.

Another more practical obstacle to the entrance of workstations into the radio production studio is the uniquely fragmented nature of work in that environment. Unlike other production situations, a radio station's production studio may see parts of several different projects (each with a different combo operator) in rapid succession. For example, a typical morning might include voice tracks cut for a production that will take place next week; mixing of a few spots, using elements recorded last week; some production music dubbing for a spot to be produced tomorrow; editing and processing of a news actuality to be inserted into a spot later in the day; and preproduction for a long-form weekend show that will be mixed three days later. Uploading of materials into the workstation takes a lot of time, and the system's hard disk storage capacity may not be enough to hold all in-progress projects' materials between sessions.

Removable media helps with this problem, because each project's producer can carry materials in and out of the studio on disk. Hard disk capacity on the DAW

use it for? (Audio operations and storage, operations only, control and display only.)

- *How many analog audio inputs and outputs are fitted?*
- *How many audio channels can be recorded simultaneously?*
- *How many channel outputs are available simultaneously?*
- *What DIO formats are supported?* (AES/EBU, S/PDIF, SDIF-2, PD, MADI, Yamaha.)
- *How many channels of DIO are simultaneously available?*
- *What are the primary storage media used by the system?* (RAM, hard disk, MOD.)
- *Are the media fixed or removable?*
- *What are the backup media used by the system?*
- *At what speed is data written to backup media?*
- *What are the standard and maximum recording times available?*
- *What sampling rates are supported?* (48, 44.1, 44.056, 32kHz.)
- *Is sampling rate or digital format conversion offered?*
- *What control interface standards are supported?* (ES-bus, MIDI, Sony/Ampex "9-pin," RS-232, RS-422.)
- *What auxiliary data bus ports are provided?* (SCSI, Ethernet.)
- *What synchronization standards are supported?* (SMPTE/EBU, VITC, MIDI-TC.)

Regarding operations:

- *How many files can be played back simultaneously?*
- *Can sound files be mixed internally?*
- *How many channels/files can be mixed at one time?*
- *Can sound files be modified?* (EQ, dynamics, delay/reverb and so on.)
- *Is time compression available?*
- *What control surfaces are used by the system?* (QWERTY keyboard, mouse, dedicated buttons, soft keys, touchscreen, jog wheel, "hard" mixing console.)
- *Is networking of multiple stations possible?*
- *Is third-party software available? If so, from whom, and what is offered?*

Regarding reliability:

- *How many systems are currently in operation?*
- *How will service and support be provided?*
- *How many times has software been updated? When is the next version release anticipated?*
- *Can we have a list of references?*

During demonstration:

- *How intuitive, flexible and user-*

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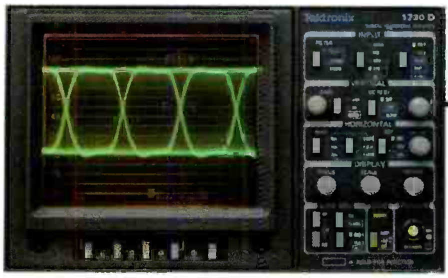

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friendly are the editing, mixing and sound-modifying functions?

- *How appropriate is the system's design and complement of features for our needs?*
- *How easy will the system be for our operators to learn?*
- *How useful is the display, and how easy is it on the eye?*
- *How are audio levels displayed?*
- *How does the system perform and sound when "scrubbing" an audio track?*
- *How does the system perform in synchronization with other devices?*
- *How many keystrokes are required for our most common requirements?*
- *How fast does the system carry out operations?*
- *How easy is it to inadvertently lose data?*
- *How fast does the system boot up?*

Narrowing the choices

Assuming you've gotten a handle on the whole field of players, the first cut should be relatively easy, based on matching the answers to the two sets of previous questions. Nevertheless, expect to find several that seem to roughly fit your bill. Those are the units to evaluate thoroughly at your facility, with your typical materials, on some common (and a few uncommon) projects.

No two systems are alike, and the compromises will be hair-raising. It's likely you'll love one aspect of Product A, but hate something else, while having the exact opposite reaction to those same functions on Product B. When you face seemingly zero-sum on the strength/weakness scale, small details, such as *cost*, can provide an ameliorating affect to the dilemma. Of course, a system that's way out of your price range should be ruled out early on, but once a realistic competition has been joined, price can act as a tie-breaker.

Finally, don't be "paralyzed by progress." Tomorrow's systems will probably be better and do more for less than today's systems. That comes with the territory, and using that as an excuse to wait will only put your facility further behind the curve. Consider what the appropriate hardware will cost compared to what you currently have, and how it will affect your cost of operations *today*. If the numbers seem advantageous, talk to other current users and see whether your projections are borne out in their experience.

Remember, too, that future improvements are offered for practically all computer-based hardware, especially when open architecture is involved. With all of this in hand, you can confidently decide on whether a workstation will move you toward the improved and more cost-effective output you desire.

References

For further information about specific workstations and manufacturers:

Jacobson, Linda. "Re:Sources." R•E•P, March 1991.

Joseph, Mike and Schwartz, Rick. "Reality Check." R•E•P, March 1991.

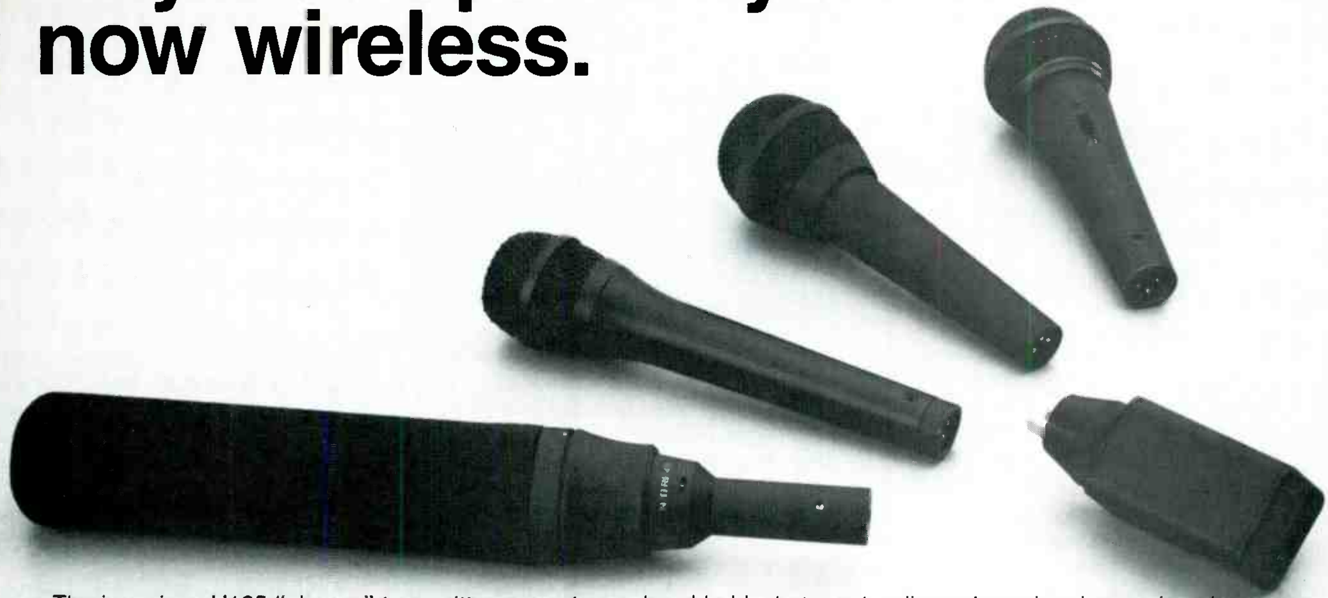
need not be excessively large, and upload/download operations can even take place off-line at a dubbing station outside of the control room, saving studio time.

Another solution to the upload/download dilemma has been implemented by one national daily news source. In this facility, incoming feeds (from satellite or telco line) are recorded directly to a workstation's disk as they are received. Editing and production of this material can begin at the workstation immediately after the feed is completed, and pieces are often aired live to the network directly from the workstation. (Field-acquired material recorded on portable cassette or DAT must still be uploaded to the workstation in real time, however.)

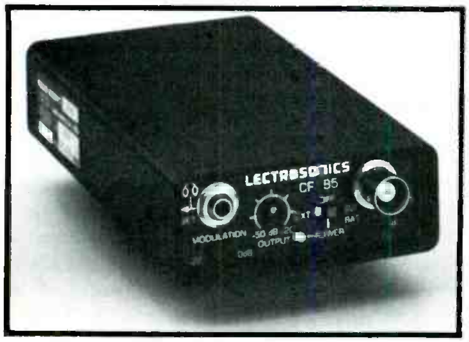
A final difference for radio stations is the nearly universal use of *combo operation*

Continued on page 72

Any microphone you own is now wireless.



The ingenious H185 "plug-on" transmitter converts any hand-held, shotgun, lavalier or boundary layer microphone with an XLR connector to wireless operation. Constructed of durable machined aluminum, the H185 is built to thrive in the tough world of broadcast. Shock-mounted crystals minimize breakage caused by dropping or careless handling. A self-adjusting battery compartment accepts any alkaline battery. A precision, spring-loaded microphone coupler assures a secure, noise-free fit with any XLR jack. Build-in LEDs provide accurate audio level monitoring and battery status information.



For television ENG . . .

The compact CR185 receiver was designed for "on-camera" use, and is the perfect match for the H185 for ENG and EFP work. Narrow band filtering, high sensitivity and high intermod rejection make the CR185 receiver the best in its class. Audio output is balanced via a rear panel XLR jack. The CR185 operates from an alkaline 9 Volt battery or external 12V DC with either polarity. This is the receiver that will keep working when the others fail.

For radio station remotes . . .

Two standard sized receivers are available for use with the H185 in the studio or in remote locations. The R185 receiver combines a "bullet proof" front-end with narrow band crystal filtering and ultra-stable oscillators for unmatched sensitivity, selectivity and stability. The DR185 is a dual receiver diversity design utilizing two R185 receivers in a maximal ratio combining configuration for the most effective reduction of drop-outs available. These receivers operate from 110V AC or 12V DC and will perform reliably in the most difficult RF environments.

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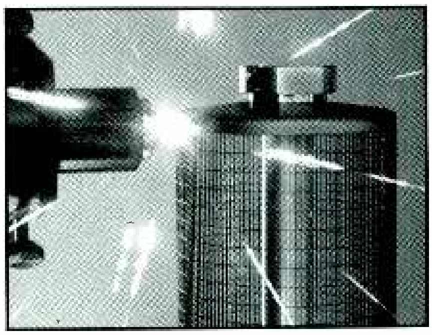


D-3: The 1/2-inch digital format

By Phil Livingston

The 1/2-inch digital composite format, now designated *D-3* by SMPTE, provides high-quality digital video and digital audio recording for use in all applications, from production and field shooting to the final edit.

The D-3 format offers several electronic, mechanical and technological advantages. Technical advancements, developed by NHK (the Japan Broadcasting Corporation), include an advanced 8-14 modulation coding system; an enhanced error-correction system; a robust digital audio system; rotary erase heads to create edit point guardbands; and a highly stable, low-tension, low-friction, low-writing speed transport.

Digital techniques

The composite digital video signal is sampled at 4fsc (14.3MHz), "over quantized" at nine bits and processed in eight bits. This makes the VTR plug and signal compatible with D-2 and other 4fsc production devices without translation or ancillary equipment. Dual channels are azimuth recorded by head pairs at the rate of six helical tracks per field. The AES/EBU PCM audio signal is sampled at 48kHz for each of the four independently editable audio channels, quantized at 20 bits and recorded at both ends of the helical track, writing two sectors at either edge of the tape. Furthermore, there are three longitudinal tracks for cue, control and time code. (See Figure 1.)

Before recording, the original signal must be digitized. This helps prevent the multigenerational degradation of some analog formats. However, once in the digital domain, operations that are not feasible in the analog world can be performed. For example, data shuffling, which distributes the minute picture elements pseudorandomly across the tape, and exact mathematical error correction, using Reed-Solomon coding, simply cannot be done in the analog domain.

Meet me at 8-14

In digital recording, several channel coding schemes (transformation methods) have been tried for digital video recording over the years. In the absence of the traditional FM carrier, the bitstream of digits representing the video and audio information must be manipulated so that it can be successfully written to and recovered from the tape.

D-3's 8-14 code modulation system is a significant development. It translates the 8-bit number into a selected equivalent 14-bit number. The 14-bit words have been carefully selected so that 8-14 modulation coding is DC free. The required spectrum is 28MHz, compared to 32MHz for D-2.

In digital video, the original signal is not preserved. Instead, it is sampled at points and converted to a series of digital values — the 8-bit digital "words." The series of 8-bit words are processed, transformed to a series of 14-bit words, serialized and recorded. At playback, when the 14-bit number or word is recovered from the tape, it is immediately converted to the original 8-bit value. Both of these conversions are done with *look-up tables* and are non-arithmetic. This prevents error propagation.

The look-up table quickly supplies the equivalent value from a group restricted to only 3% of all the possible 14-bit numbers (more than 16,000). By not allowing any word with fewer than two identical digits in any string, nor allowing any string longer than seven identical digits, approximately 550 numbers are carefully selected to ensure that the high- and low-frequency requirements of recording are satisfied. (See Figure 2.)

The effect of mistracking on playback signal recovery is one factor that concerns designers. The 8-14 algorithm bit error rate for a given mistracking error (in equal pitch tracks) is slightly better than Miller Squared Coding (used for D-2), and much better than serialized or randomized non-return to zero. (S-NRZ is used for D-1.) Compared to Miller Squared, the 8-14 coding scheme allows 14% greater recording density.

Two factors contribute to this improvement. First, in D-3 (as in D-2), there are three helical track pairs across the tape for each NTSC video field (four for PAL). The same heads read or write audio and video. Unlike the one-third field sectors of D-2, the video and audio data is distributed across the entire six tracks. Second, as in D-2, Reed-Solomon error-correction codes are generated at two points in the digital signal processing, forming an outer and inner error-correction code. However, unlike D-2, both of these are 8-byte product codes. This increases the correction capability.

D-3's error-correction system is effective for random errors to burst errors of almost 7,000 bytes in length. This makes the format robust and resilient to degradation, even under non-ideal conditions.

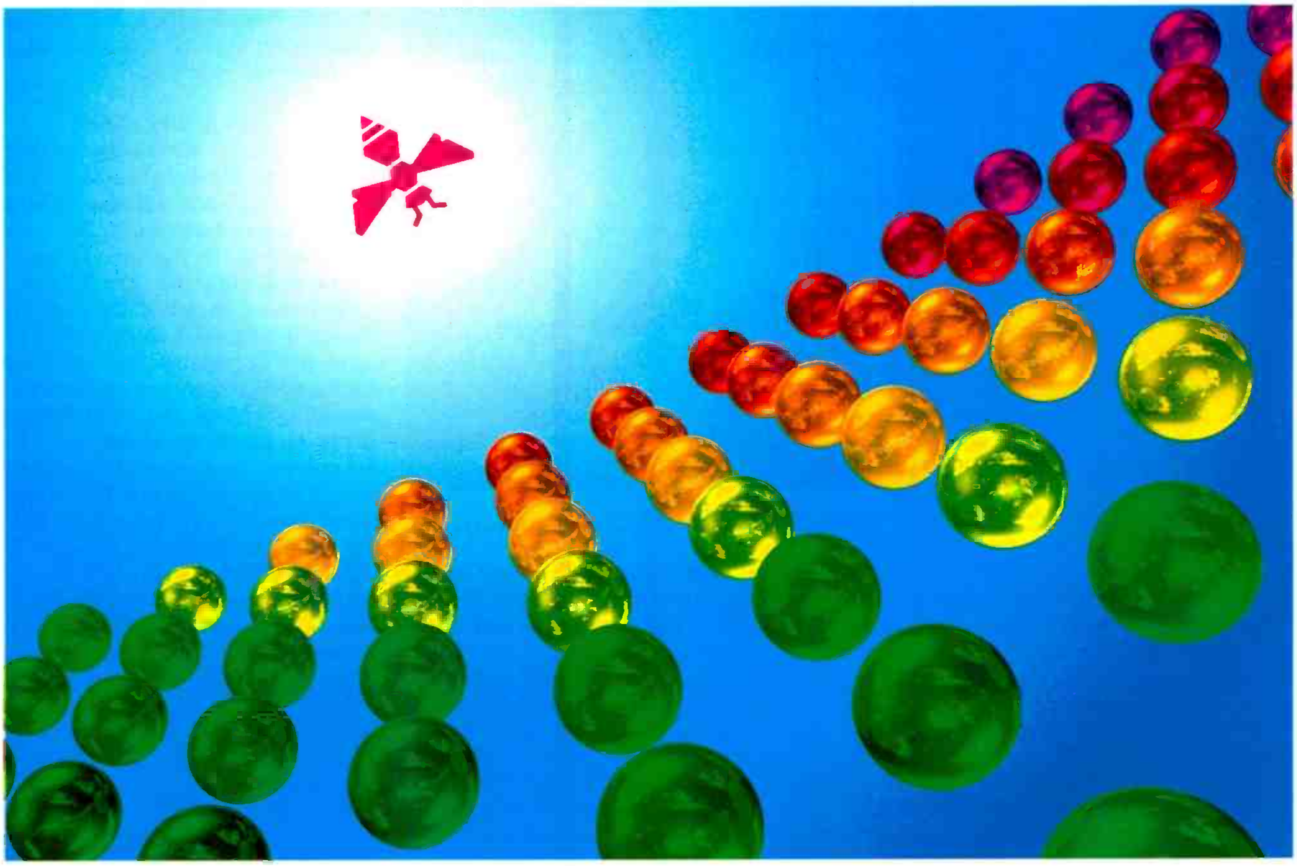
D-3 features guardbandless azimuth recording, except during editing. Unlike the D-1 and D-2 formats, 1/2-inch digital has a flying erase head. It erases previously recorded material and is closely followed by the record head, which writes the new material. In contrast, D-2 format editing simply records on top of the previously recorded material. Because the track is being recorded over by a track of the same azimuth, it may not be fully erased and, to some extent, may still remain intact. This is the so-called *same azimuth incomplete erase* problem.

The D-3 rotary erase head also creates a "guardband" between old and new material at the in and out points for clean edits. These guardbands help alleviate the potential for increased bit error rates (caused by mistracking) at those in and out points.

Because the 1/2-inch digital VTR's tape transport has only one stationary post and small friction angles, increases in load — because of tape-post friction — are kept to a minimum. It does not require air or ultrasonic guides. This allows D-3 to have approximately one-fourth the tape tension of D-2 (30g vs. 130g).

Paying careful attention to the aerodynamics of the head interface permits this low tape tension to provide sufficient head-to-tape contact. The reduced tape tension should result in longer video head and tape life, because there is less head and tape abrasion. It also increases interchangeability. Tape tension affects interchange because greater tension causes more deformation of the tape by the moving head. That greater deformation is more difficult to replicate exactly at playback.

Livingston is assistant general manager, Panasonic Communications & Systems, Secaucus, NJ.



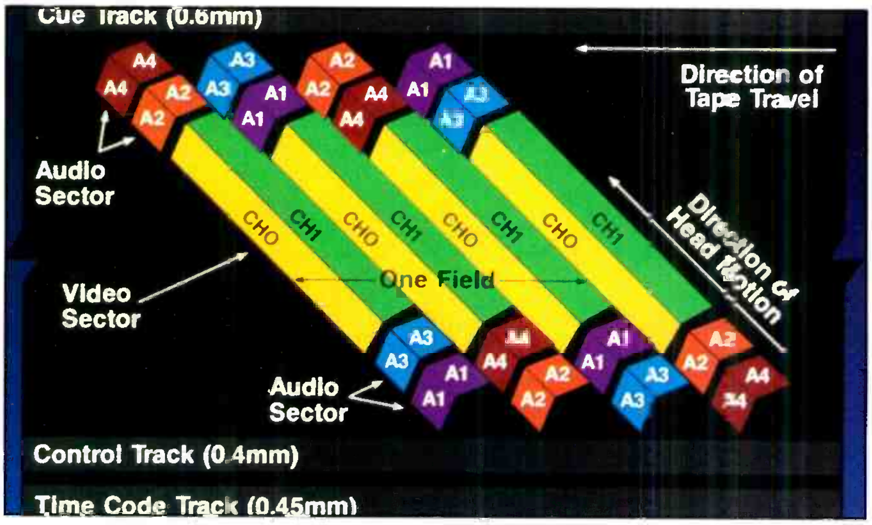


Figure 1. The location of various tape tracks on D-3's ½-inch tape.

Why ½-inch?

The popular component analog MII and Betacam formats have made users aware of the convenience and economy of ½-inch cassettes. The implications of smaller tape include lower tape costs, lower reel and servo power consumption, and more portable equipment.

Lower writing speed means a smaller head drum cylinder diameter (D-3's 76mm vs. D-2's 96mm). It also results in extended life for both tapes and the new superstructured nitride film head (because wear is related to writing speed), and lower power consumption.

One of the primary goals of the ½-inch digital format was to increase packing density so that cassette size could be reduced. The smaller cylinder makes possible a 1-piece camera/recorder and a truly portable VTR. For use and storage, ½-inch digital tape costs are reduced when compared to the other digital formats. The ½-inch format offers 2.36 times the packing density of D-2 and five times the packing density of D-1.

CD-quality sound

For audio, D-3 offers superb CD- (compact disc) quality digital audio. Each of the four independently editable PCM audio channels are recorded with 20-bit accuracy, extending the dynamic range of the digital audio to more than 100dB.

Because of human aural acuity, audio signals have greater susceptibility to perception of degradation than video signals. Digital audio requires an extremely robust recording scheme. D-3 ½-inch improves digital audio recording by:

- increasing the error-reduction correction power of the outer code by making the check product eight bytes long, equal to the audio databytes (D-2 has only 4-byte outer error correction).
- improving burst error correction by increasing the dimension of the inner Reed-Solomon product code to cover one field.
- distributing the adjacent audio sectors to be recorded by head pairs in the direction of the track pitch. Samples of the same audio channels are located in adjacent audio sectors.
- using sector shuffling to distribute audio channel sectors to the opposite edges

of the tape, which is a more effective compensation for longitudinal tape dropouts.

The edit-point guardband recording method also reduces interference factors originating from single audio channel editing. Audio edits can be cuts, "V" fade or cross fade. The fade duration is selectable from 5ms to 100ms. This attenuates audio edit disturbances to the point that you can edit in mid-word if desired.

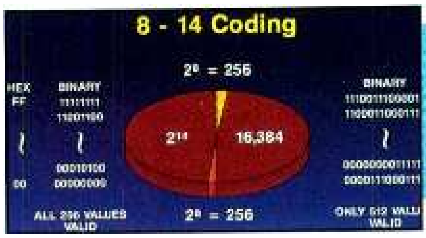


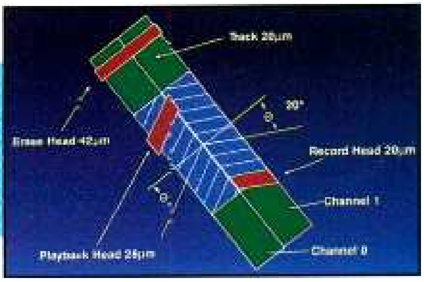
Figure 2. The D-3 8-14 coding algorithm works by assigning each 8-bit word of the record signal to one of a selected group of 14-bit words. The 14-bit words are chosen to facilitate error correction and minimize DC on recordings.

Other improvements

Other major developments offered by ½-inch digital:

- For post-production, D-3's independent play heads on AT piezo-elements allow rapid single machine layering of video effects by using the pre-read or read-before-write self-edit function.
- Use of a 2-line vertical shift and 2-sample horizontal shift during recording provides stable, viewable color pictures in shuttle at up to 100X playback. D-2 uses a 4-line vertical shift recording method, which results in vertical bounce that can degrade shuttle playback.
- Simplified operation and service by a menu-driven system for feature selection, maintenance and diagnostics are possible. Vital machine status and functions can be quickly and easily accessed through the front panel.
- Audio-in-jog feature allows editors to select edit points using audio cues — just as they do now with analog VTRs.
- Program compression allows up to 15% variation longer or shorter than real time for programs and post-production, selectable in 0.1% increments.

Figure 3. D-3 uses a 2-channel azimuth recording system and a 20° track pitch.



The ½-inch D-3 format allows the TV community to apply digital video recording beneficially and economically. Engineers looking at such parameters as signal-to-noise ratio, differential phase and differential gain will find that the performance of D-3 compares favorably with D-2. It offers a low purchase price and operating cost, smaller physical size and a more robust interchange — despite the smaller size — than other digital formats.

Editor's note: See "Applied Technology: The D-1 and D-2 Formats," by Carl Bentz and Rick Lehtinen, *Broadcast Engineering*, August 1991, p. 76, for a thorough review of the D-1 and D-2 formats.

Continued from page 66

in the production suite. Unlike the dedicated technician/engineer operator used in the music and teleproduction fields, a radio station's production studio will have operators of widely divergent skill levels. When a workstation is installed, transition and operator training may be a problem, with learning-curve and "technophobic" issues likely to arise. Often, the workstation becomes the province of only one or two enthusiasts, with the remainder of the staff preferring traditional methods. The more complex or cumbersome the system, the more prevalent this problem will be.

This is not to say that a radio station cannot benefit from the use of a DAW. Rather, the specific product choice and the process of its implementation and transition should be thoroughly explored. Consider also the merging of technologies — some of the more sophisticated computer-based program automation systems equipped with hard disk recording include editing capabilities similar to those of low-end workstations. Perhaps this is the direction from which a radio station may best enter the digital audio production world.

Some advice

Because a typical workstation will replace a multitrack recorder, console, mastering deck and more, it has never been easier to make a major purchasing error with a single stroke of the pen. Out of the score or so of serious DAW manufacturers, identify those whose products are the most applicable to your work. Then, study them each in detail. A little tire-kicking will not suffice; arrange for detailed demonstrations and extended trials at your facility. Only after this will you be equipped to make the proper choice, and cruise comfortably into the new world of multitrack audio production.

References

Elswick, E. William. "Standardization of Digital Audio File Interchange — A Progress Report." *Proceedings* of the AES 9th International Conference, Detroit, Feb. 1991.

Schwartz, Rick. "Taking it Tapeless." *R•E•P*, March 1991.

Jacobson, Linda and Hurtig, Brent. "Tapeless Technology." *R•E•P*, March 1991.

Acknowledgments: Thanks to Dar Maxwell of Monitoradio, Boston and the Society of Professional Audio Recording Services (SPARS), for their contributions to this article.

Broadcast Engineering defines a digital audio workstation as any currently available device that records and stores digital audio, provides extensive editing capabilities, and performs one or more of the following functions:

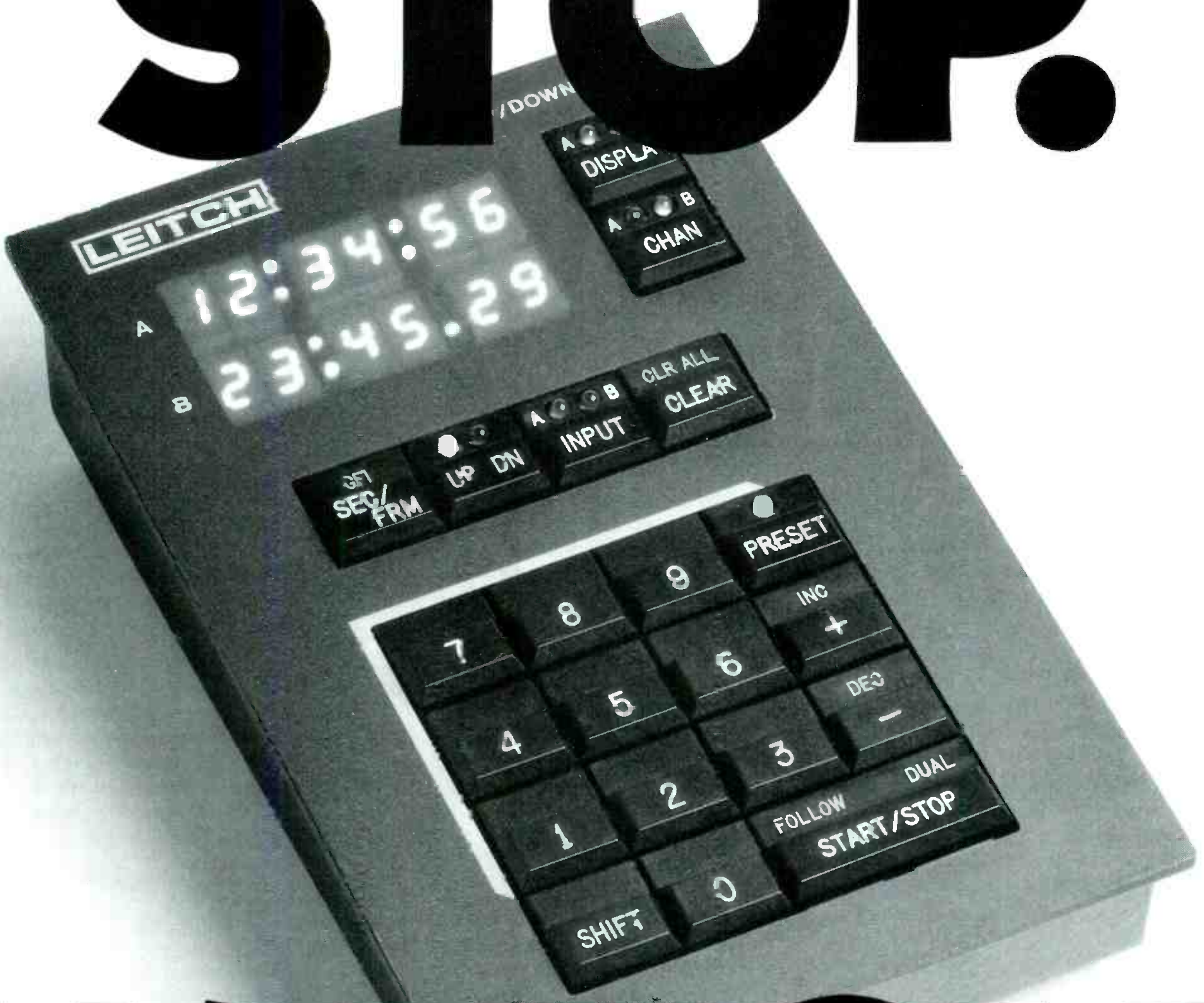
- Emulate a multitrack recorder.
- Modify audio using digital signal processing.
- Provide audio mixing capability.

The following companies provide equipment meeting the above criteria:

Company	Reader service number
AKAI Professional/IMC	322
AKG Acoustics	323
AMS Industries/Neve	324
Digidesign	325
Digital Audio Research	326
Doremi Labs	327
Fairlight ESP	328
Hybrid Arts	329
Lexicon	330
Micro Technology Unlimited	331
New England Digital	332
Otari	333
Roland	334
Solid State Logic	335
Sonic Solutions	336
Studer Editech	337
Symetrix	338
Turtle Beach	339
Waveframe	340

Additional information on digital workstations is available from these manufacturers. Circle the desired reader service number on the *BE* action card on p. 89 of this issue.

STOP.



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Continued from page 36

ming via MTS. This type of TV sound defines the current state of consumer audio-for-video art and sets the stage for improvements by the next-generation system.

Discrete multichannel systems

The compromises associated with matrixed surround systems have been tolerated only because they allow multiple audio channels to work in an existing 2-channel format. When designing a new TV transmission format from scratch, *discrete* multichannel audio is preferred, because it provides the capacity for surround sound without the need for matrixing.

Various proposals within the advanced TV audio industry have called for four, five, six and eight channels of main program audio, with one or two second audio program (SAP) channels, all discretely carried on the ATV standard transmission signal. (A mono SAP channel is available in today's BTSC format, used for second-language and visually impaired audio tracks. However, it is not widely implemented as yet in the United States.) Regarding physical layout, most discussions place three speakers across the front (L, C, R), and call for two separate surround channels (L, R). The most extreme example to date puts four speakers across the front and four across the back. Some of these proposals distinguish between "home" and "theater" systems, with the latter arrangements intended for electronic cinema applications. The inclusion of additional subchannels for teletext and other ancillary services has also been discussed.

Multichannel systems should be capable of "folding down" compatibly to smaller system (2-speaker stereo and mono) reproduction. However, some proposals even call for an adaptive reaction in the home system to the "layout" of channels used by a particular program. Such a "smart" decoder using soft-configurable channel arrangement precludes the obsoleting of receiver hardware if a new surround format comes into vogue.

Data compression

In such an environment, it's not surprising that exact audio configurations in some of the six current U.S. ATV transmission proposals (now undergoing testing at the Advanced Television Test Center) are still being tweaked. Beyond the issues of surround formats, this hedging results from the recent and rapidly paced development in digital audio compression technology. (All proponents' audio formats now call for some kind of digital audio service, even if the video is analog.) At least one system has proposed a number of alternate schemes for audio, delaying a final decision until later. Others are making hurried final adjustments as this is written. See Table 1 for how things stood for audio among the U.S. ATV proponents at press time.

Regarding data compression, multichannel systems offer another synergy that is being explored for cinematic and ATV applications. The multiple channels to be used for main audio program will typically carry a significant amount of common information, and will rarely carry completely distinct audio in any one channel for any great length of time. The latest data-compression algorithms analyze this commonality and use it to further reduce the data rate required. (For more on data compression, see "Digital Radio Update," July 1991, and "Remotes Revisited," January 1991.) Major developments in audio data compression have taken place while ATV delivery formats have been in the pipeline, so the proponents' recent scrambling to incorporate them is understandable.

ATV audio format testing

The ATTC began testing the six formats proposed for U.S. ATV transmission last month. In the area of audio, its tests are examining SNR, dynamic range, distortion, frequency response, headroom vs. frequency, RF bandwidth (in systems using separate audio carrier[s]) and audio/video delay. For the one remaining system with downward compatibility to NTSC (ACTV), degradation to BTSC audio and VBI data will also be examined. Furthermore, subjective listening tests will be conducted for all systems under ATTC supervision at the Westinghouse Science and Technology Center in Pittsburgh. All tests are scheduled to be completed by mid-1992.

Meanwhile, separate sets of current and upcoming tests will attempt to identify standard audio data-compression algorithms, conducted by each of the following: the International Standards Organization (ISO), the Consultative Committee on International Telephony and Telegraphy (CCITT) and the International Radio Consultative Committee (CCIR). A resulting standard compression methodology might be implemented in the eventual U.S. ATV transmission system.

References

Keller, Thomas B. "Proposal for Advanced HDTV Audio." 1991 HDTV World Conference Proceedings.

Meares, D.J. "High-Definition Sound for High-Definition Television." Proceedings of the AES 9th International Conference.

Theile, Günther. "HDTV Sound Systems: How Many Channels?" Proceedings of the AES 9th International Conference.

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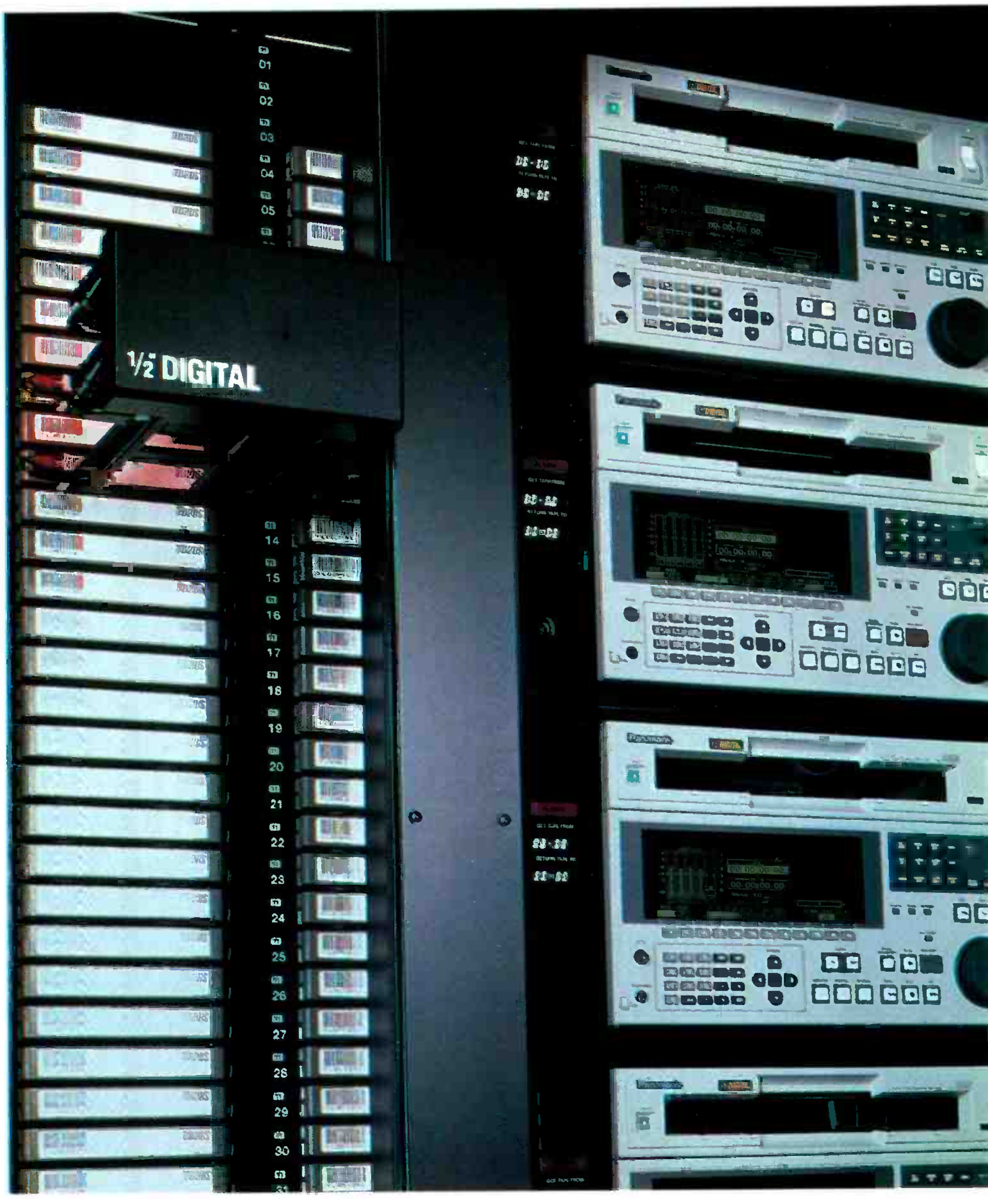

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Basys and GVG sign cooperative agreement

Basys, Yonkers, NY, and *Grass Valley Group (GVG)*, Grass Valley, CA, have announced a worldwide development and marketing undertaking aimed at making the sophistication of full automation practical and cost-effective for all elements of the TV industry.

Alpha Image joins Dynatech Broadcast Group

Alpha Image, the UK-based manufacturer of digital video products, has been acquired by *Dynatech*, Burlington, MA.

ITS gives special Monitor Awards to Abekas and Sony

The International Teleproduction Society (ITS), has awarded a special Monitor Award for excellence in engineering achievement to *Abekas*, Redwood City, CA, and *Sony Corporation of America*, Teaneck, NJ. Abekas received the award for the Abekas A84, a multilayer component digital post-production switcher with optional embedded digital disk cache recorders. Sony received the award for the Sony serial digital interface chip set, which is composed of five devices that provide capability for a simple, reliable interconnection system for equipment requiring digital video and audio inputs and outputs.

Microwave Radio Corporation relocates headquarters

Microwave Radio Corporation has moved its headquarters from Lowell, MA, to Chelmsford, MA. The address is 20 Alpha Road, Chelmsford, MA 01824; telephone 508-250-1110; fax 508-256-5215.

Astre Systems signs agreement with sales rep firms

Astre Systems, Modesto, CA, has signed an agreement with two sales representative firms: Triad, Littleton, CO, and J & L Associates, Colorado Springs, CO.

AMS goes direct with sales and support

AMS, Bethel, CT, has announced the direct marketing and sales in North America of its SoundField Mk IV and ST-250 stereo microphones, along with its digital signal processors. Customers and potential customers may call 1-800-258-0AMS for information on AMS digital products and microphones.

Quantel relocates headquarters

Quantel has relocated its headquarters to Darien, CT. The address is 85 Old Kings Hwy. North, Darien, CT 06820; telephone 203-656-3100; fax 203-656-3459.

CEL Electronics changes trading name

CEL Electronics, Saffron Walden, England, has changed its trading name to CEL Broadcast.

Dynatech ColorGraphics forms DP users group

Dynatech ColorGraphics, Baltimore, has formed a DP users group. The next users group meeting is scheduled for later this summer in Madison, WI. For more information, contact Doug Hinahara, 608-274-5786; Hans Pigorsch, 608-274-4000; Nick Dager 212-228-4154; or Emilia Harrison, 011-31-0-3240-11866.

People

Dobrimir Borovecki has been appointed customer support manager for TSM, Valley Cottage, NY.

Jesse Blount Jr. has been named vice president, sales and marketing, for Dynair Electronics, San Diego. He is responsible for all corporate marketing and sales activities, including marketing plan development, product management, sales management and advertising.

Bill Thompson has been named audio products marketing manager for the Tektronix TV division, Beaverton, OR. He is responsible for developing and implementing a market strategy for the division's audio products.

David H. Davies has been appointed vice president, development engineering, for Ampex, Redwood City, CA. He is responsible for product and process development programs at the company's headquarters and at the Opelika, AL, manufacturing facility.

George Palmer and **Trevor Smith** have been appointed to positions with BTS, Salt Lake City. Palmer is product sales support specialist for cameras in the western United States. Smith is manager of customer service for the United States, Canada and Latin America.

Tony Balboa has been appointed sales representative for Lexicon, Waltham, MA. He is responsible for sales in the Southern California region.

Thomas M. Spain has been named national sales manager for Studer Revox, Nashville, TN. He is responsible for U.S. sales activities of the company's professional and consumer product lines.

James McFarland has been named vice president, corporate development, for Telex, Minneapolis. He is responsible for the company's corporate development, strategic planning and acquisition activities.

Curt A. Rawley has been promoted to president and chief operating officer for Avid Technology, Burlington, MA. He is responsible for overseeing daily business operations of the company.

Art Silver, a 32-year veteran of radio broadcasting and long-time district sales manager for Harris Allied Broadcast Equipment, died June 13, 1991 at his home in Waterbury, CT, of cancer. He was 55.

Silver was a senior certified member of SBE and held memberships in the Audio Engineering Society (AES) and IEEE.

His survivors include his wife, Melida, and two sons, Mitchell and Michael.

The New Jersey Broadcasters Association has established the Art Silver Scholarship Fund in his honor. Contributions may be sent to the association at 9 Davison Ave., Jamesburg, NJ 08831.

Miles Thomas, Jill Jameson, Joel Evan Quirt and **John "J" Clark** have been appointed to positions with IDB Communications Group, Los Angeles. Thomas is director of audio services. He is responsible for providing technical support to the company's audio sales and marketing staff. Jameson is audio sales manager. Quirt has been promoted to audio control manager, and Clark is the audio transmission supervisor.

New products

Hand-held communications

By ACE Comm./Monitor Division

• **AR1000XC:** compact, hand-held receiver tunes 500kHz through 1.3GHz with 1,000-channel programmable memory; reception of AM, shortwave, public service bands; AM, narrow FM, FM broadcast and TV aural modes may be selected at any frequency setting; LCD panel shows 21 prompts to assist in receiver use.

Circle (351) on Reply Card

Multistandard kits

By Ampex

• **D-2 output conversions:** adapter kits for D-2 format studio VTRs permit output signals in NTSC or PAL signal standards; kits include seven replacement boards and new record/play heads; conversion can be accomplished by the customer.

Circle (354) on Reply Card

Networking reference

By AMP.

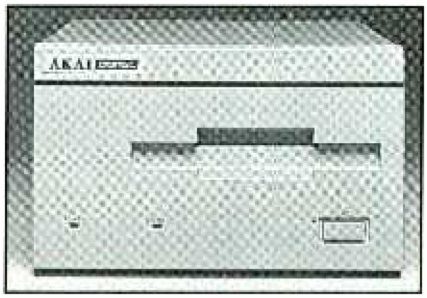
• **NETCONNECT catalog:** for open wiring systems using twisted-pair, coaxial and fiber-optic conductors in various types of computer networks; 176-page book includes extensive glossary, network applications information and power wiring systems; networks include Ethernet, Thinnet Tap and other systems.

Circle (353) on Reply Card

Mass storage device

By AKAI Professional

• **S501-II disk drive:** magneto-optical technology stores 650Mbytes of digital audio data on Sony MO disk cartridge; expands DD1000 recorder with 30 minutes of storage time per disk drive using 44.1kHz sampling; three drives can be used with one DD1000 unit.



Circle (352) on Reply Card

Retrofit modules

By api audio products

• **550s EQ, 212s pre-amp:** modules designed for plug-in installation in Sony MXP-3000 audio mixer; EQ unit has unbalanced inputs/outputs to match the console and features "Proportional-Q" filtering; both modules have discrete device stages for quiet amplification.

Circle (355) on Reply Card

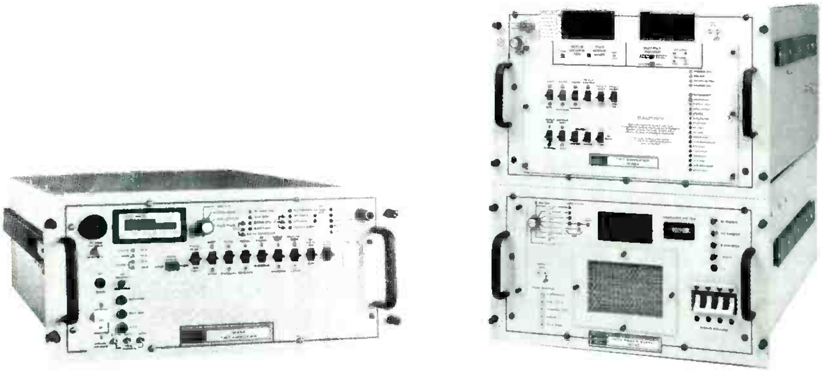
Audio distribution

By Siemens AG sterreich

• **Compact router:** SMD design uses Crossmatic D modules for 32 to 64 inputs with 32 to 64 outputs; analog modules have switching times of 100s to 3ms, depending upon type; configures for parallel level operation with automated control from PCs or host DIRI rack interface. Also available, all digital router with complete A/D-D/A, sampling rate and format conversions; AES/EBU, SPDIF and DS1 connections; Crossmatic D control concept; space-division multiplexing is usable for analog and digital audio signals.

Circle (384) on Reply Card

12 Reasons To Specify MCL C-Band, Ku-Band and DBS High Power TWT Amplifier Systems.



1 Designed specifically for satellite earth station use in video, voice and digital communications applications, MCL High Power TWT Amplifier Systems are recognized worldwide for meeting the most demanding signal purity and reliability requirements. **2** TWT Amplifiers range from 50 to 3,000 + watts. **3** Commonality in design and operation provides module interchangeability, and minimizes maintenance and repair downtime. **4** Designed to operate under extreme environmental conditions, and in unattended remote areas. **5** Single Drawer Amplifiers (50-300W Ku-, 75-125W C-Band). **6** Double Drawer Amplifiers (300 to 750W C-, Ku-Band and DBS). **7** Single Cabinet Amplifiers (2.5KW-Ku, 3KW C-Band). **8** TWT Tube Protection. **9** Amplifier Performance Readout/Control. **10** High Voltage Component Protection. **11** "Remote" Capability (computer interface, also). **12** MCL's design, manufacturing and quality control processes ensure the highest quality satellite communications amplifiers and allied equipment available on the market today. All at competitive prices.

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Circle (62) on Reply Card

Components catalog

By ARS Electronics

• **1991 Product Selection Guide:** distributor catalog includes various audio connectors, patching equipment; new and rebuilt RF power tubes; ICs, transistors, audio power and other vacuum tubes; microphones, speakers.

Circle (357) on Reply Card

Low-noise amplifier

By Audio Intervisual Design

• **Avalon M2 mic pre-amp:** discrete circuit design with increased high-level headroom, low noise to −126dB EIN; symmetrical class A stages based on Avalon 2022 thermally conductive hybrid cell; 48V internal phantom powering.

Circle (358) on Reply Card

Product data sheet

By Bud Industries

• **Rack/enclosure brochure:** describes numerous relay racks to plastic utility cases added to the line; includes standard 19-inch racks, 24-inch enclosures and a range of accessories, including locking casters and slide mounts.

Circle (359) on Reply Card

Power regulation

By Furman Sound

• **Models AR-117, AR-PRO:** line voltage regulators for electronics equipment; AR-117 for 117VAC to 15A current drain, corrects for input voltages from 99-129V; AR-PRO unit offers 30A current capability to 14 outlets at 120VAC from an 88-240V input range; does not use ferro-resonant transformer design.

Circle (365) on Reply Card

Professional mixer

By Cooper Sound Systems

• **CS 106+1:** 6-input stereo audio mixer with module contains M/S decoder feeding a seventh channel; three main output channels drive +4dBm balanced XLR output connectors; Tuchel outputs available for use with Nagra recorders; P&G slider attenuators; PPM or VU analog metering; 16 pounds.

Circle (360) on Reply Card

Communications headsets

By David Clark Company

• **Model H7042:** noise-attenuating headset fits under safety head-wear; foam-filled ear seals protect wearer's hearing; low-impedance unit combines with U3818 module to connect to series 3800 intercom; microphone designed to reduce ambient noise in sound fields to 125dB; also usable with 2-way portable radios.

Circle (361) on Reply Card

Connector assistance

By Jensen Tools

• **BNC removal tools:** simplifies removal of BNC connectors from hard-to-reach or high-density panels; available with 4-, 8- and 12-inch reach, plastic handle.

Circle (369) on Reply Card

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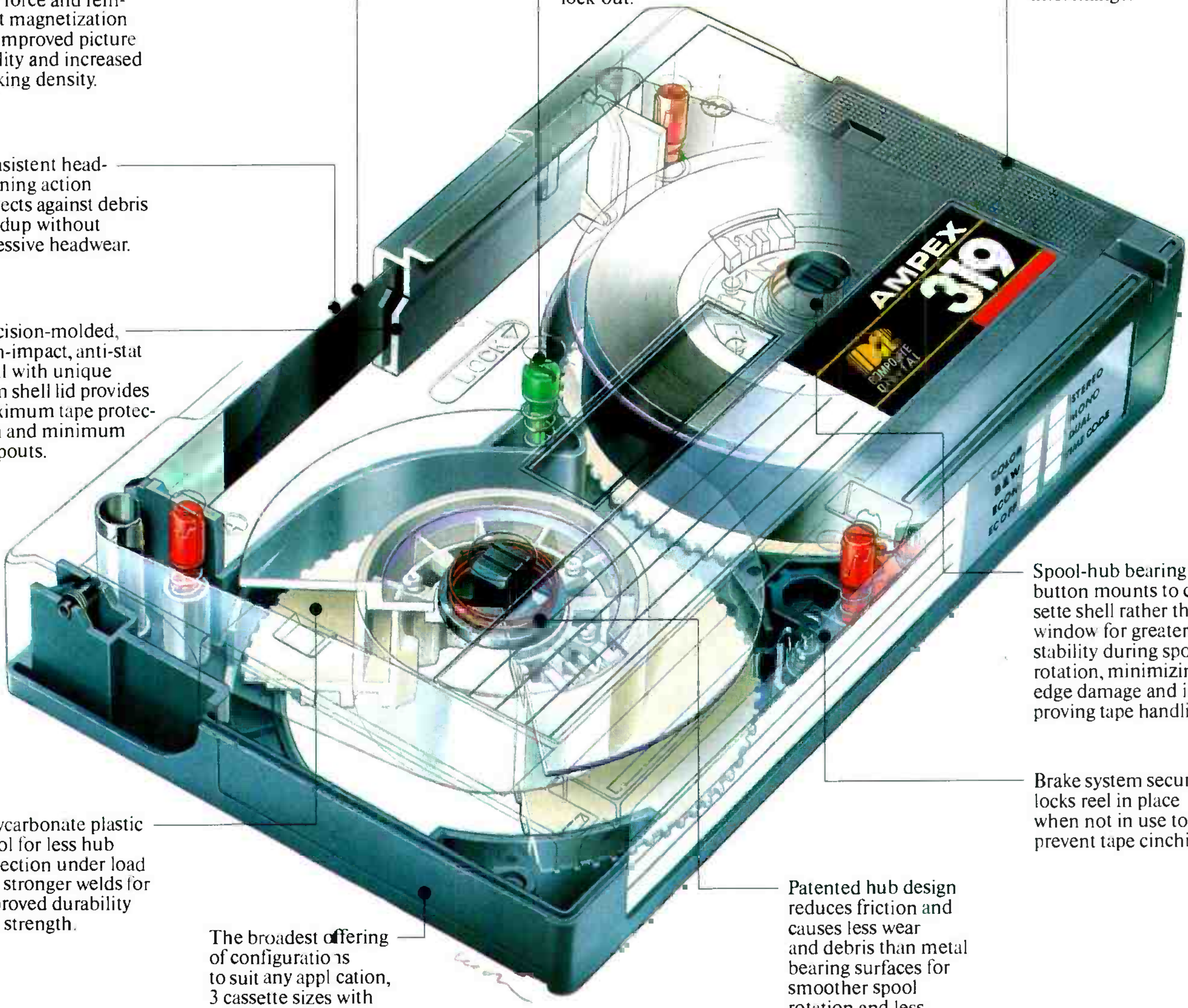

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Circle (65) on Reply Card

Transmitter components

By Power Electronic Components

• **VECO vacuum capacitors:** direct substitute units for Dolinko & Wilkins high-voltage glass capacitors that are no longer available; units range from 6-1,000pF capacitance in several voltage levels from 7.5kV to 32kV peak; made from oxygen-free, high-conductivity copper and Pyrex glass.

Circle (378) on Reply Card

Enhanced wireless system

By Nady Systems

• **Model AD-4:** amplified antenna distribution system; dual-antenna unit feeds four diversity or eight non-diversity wireless receivers; cascade outputs can be used to drive additional AD-4 units for operation of many diversity receivers from the two antennas; cabling and telescoping antennas with BNC adapters included.

Circle (374) on Reply Card

Video filters

By ARCO Electronics

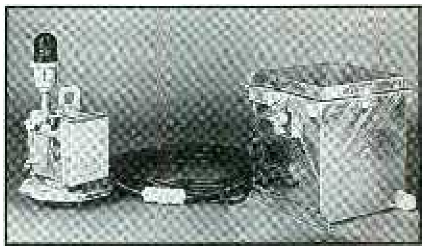
• **LP series:** low-pass filters for CCIR 601, NTSC or PAL video signal conditioning; a typical unit is the 5.75MHz filter for standard studio (4.2.2) frequencies, which exhibits 40dB attenuation at 8MHz.

Circle (356) on Reply Card

Obstruction lighting

By Hughey & Phillips

• **Models OB-30, OB-28:** rugged, vandal-resistant obstruction lights for "under-construction" applications; OB-30 includes an L-810 steady burn lamp with controls, lifting eye, 200-foot 10/2 cable; OB-28 uses a non-FAA flashing Xenon strobe; both feature battery operation with automatic 3-stage charger unit; suitable for permanent use in remote sites.



Circle (368) on Reply Card

Software upgrade

By Dynatech ColorGraphics

• **DP version 6.0:** gives increased power to DP digital production systems in applications, such as paint, matting, shaping and animation; expands capabilities of Workbench system; enhanced shape tools, polygon shape selections; increased control over areas to be painted; improved key frame render attribute editing.

Circle (362) on Reply Card

Level, phase monitoring

By Fieldwood Systems/Muncy Associates

• **SDP-1 stereo display processor:** enables the staff to monitor level and phase status of stereo audio signals with up to six standard VU meters, or with distinctive displays on an X–Y CRT monitor or general purpose oscilloscope; 2-color in-phase and out-of-phase-signal (OOPS) lamps on front panel.

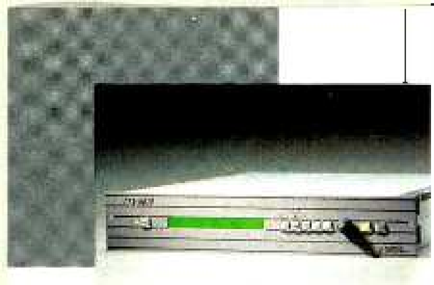
Circle (363) on Reply Card

Signal processing

By Gotham Technology

• **FFT software module:** creates a 3-D display, plotting frequency, time and amplitude to show audio spectrum events; exhibits dynamic range to 180dB; capture data on disk for later analysis; VGA graphics card in an AT-type machine suggested.

Circle (366) on Reply Card



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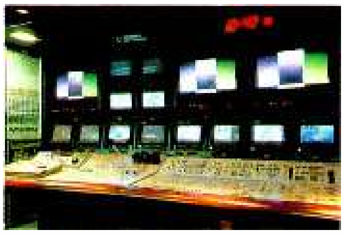

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Power supply component

By Motorola/Media Relations MD 56-102

• **MJE-/MJF-18004:** power transistor rated at 5A and 1kV V_{CEO}; Switchmode series suited for 220V off-line switching power supplies from 30-100W at 40-70kHz switching frequencies; available in TO-220 and isolated TO-220-style packages.

Circle (373) on Reply Card

Product catalog

By Panduit Electrical Group

• **Bulletin E-PWC-2:** illustrates the full line of P-CONN screw-on nut-style wire connectors; available for No. 12-No. 20AWG conductors in four standard colors.

Circle (377) on Reply Card

Video test source

By Network Technologies

• **MONTEST-AD24:** video generator simulates 24 different computer video formats covering horizontal scan rates from 15.7-89.3kHz; designed for alignment of monitors using analog, TTL or ECL inputs; color bars, cross-hatch, full raster and window patterns.

Circle (375) on Reply Card

Product literature

By PACE

• **Brochures:** describe ST 50, MBT 201, MBT 250 soldering systems; IR-70 high-capacity iron; upgrade features for SMT/through-hold applications; options include ThermoTweez handpiece for component removal without damage; MBT 250 includes special tip and temperature selection, auto tip temperature offset compensation.

Circle (376) on Reply Card

Impedance interface

By FSR

• **TAI module:** compact unit includes RCA input connectors, terminal strip outputs as an interface between stereo audio from tape decks, CD players and other equipment to the +4dBm standard professional signal level; outputs are balanced 600Ω with transformer coupling; configures as left and right or mixed output.

Circle (364) on Reply Card

Wireless IFB

By R.F. Neulink/R.F. Industries

• **IFB transmitter device:** for field cuing, ENG truck and helicopter operations; available for VHF and UHF frequencies.

Circle (379) on Reply Card

FM combiner

By SIRA Sistemi Radio

• **Series UC/FM/LB:** filters for 87.5-108MHz installation combining multiple channels; channel isolation greater than 32dB with VSWR rating less than or equal to 1.05; models available for 1kW through 25kW.

Circle (385) on Reply Card

Professional services

Preview

September...

AUDIO-VIDEO CONTROL SYSTEMS

- **Interfacing Small-Format Editing Systems**

As technology reduces the size and cost of cameras and recorders, engineers must find ways to interface the new equipment into fast-paced editing suites. The article looks at the requirements of the new small-format equipment, and how the new hardware can be interfaced in edit and post suites.

- **Routing Digital TV Signals**

Digital TV signals represent new challenges to control and routing systems. Switching and distribution of these complex waveforms requires special equipment and careful planning to avoid expensive mistakes. The article looks at some of the new technology that makes the process easier.

- **Interfacing Multiple Control Systems**

Automation comes to life as video and audio equipment relies on one of two common standards: SMPTE and MIDI. The problem is when one standard must talk to the other. The article takes the mystery out of connecting what sometimes appears to be incompatible devices.

October...

PROFITABLE TECHNICAL MANAGEMENT

- **11th Annual Salary Survey: My Share**

Broadcast and post-production operations have never been so complex. The technical personnel required to operate these facilities are highly skilled and valuable. The salary survey looks at compensation programs by radio and television in three different categories.

- **Engineers — Part of the Profit Team**

Engineers should be part of the management team within a station. One key is to show the manager that you understand the need to be profitable. Another is to demonstrate creativity in helping the station make money. The article looks at ways engineers can become part of the station's profit team.

- **Competing for Your Job**

If you had to interview for your job today, would you qualify? That's an important issue many people forget as they become "comfortable" in their surroundings. The article prods the reader to re-examine how important their skills are to the station or production manager.

Classified

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LEADING COMPANY in industry of long form advertising seeks video engineer experienced in installation, maintenance and repair of complete studio and post production facility with 3/4", beta-SP and 1" equipment. Immediate opening. Salary dependent on experience. Call or write John Prechtel, Hawthorne Communications, Inc., P.O. Box 1366, Fairfield, Iowa 52556, 515-472-3800. 8-91-1t

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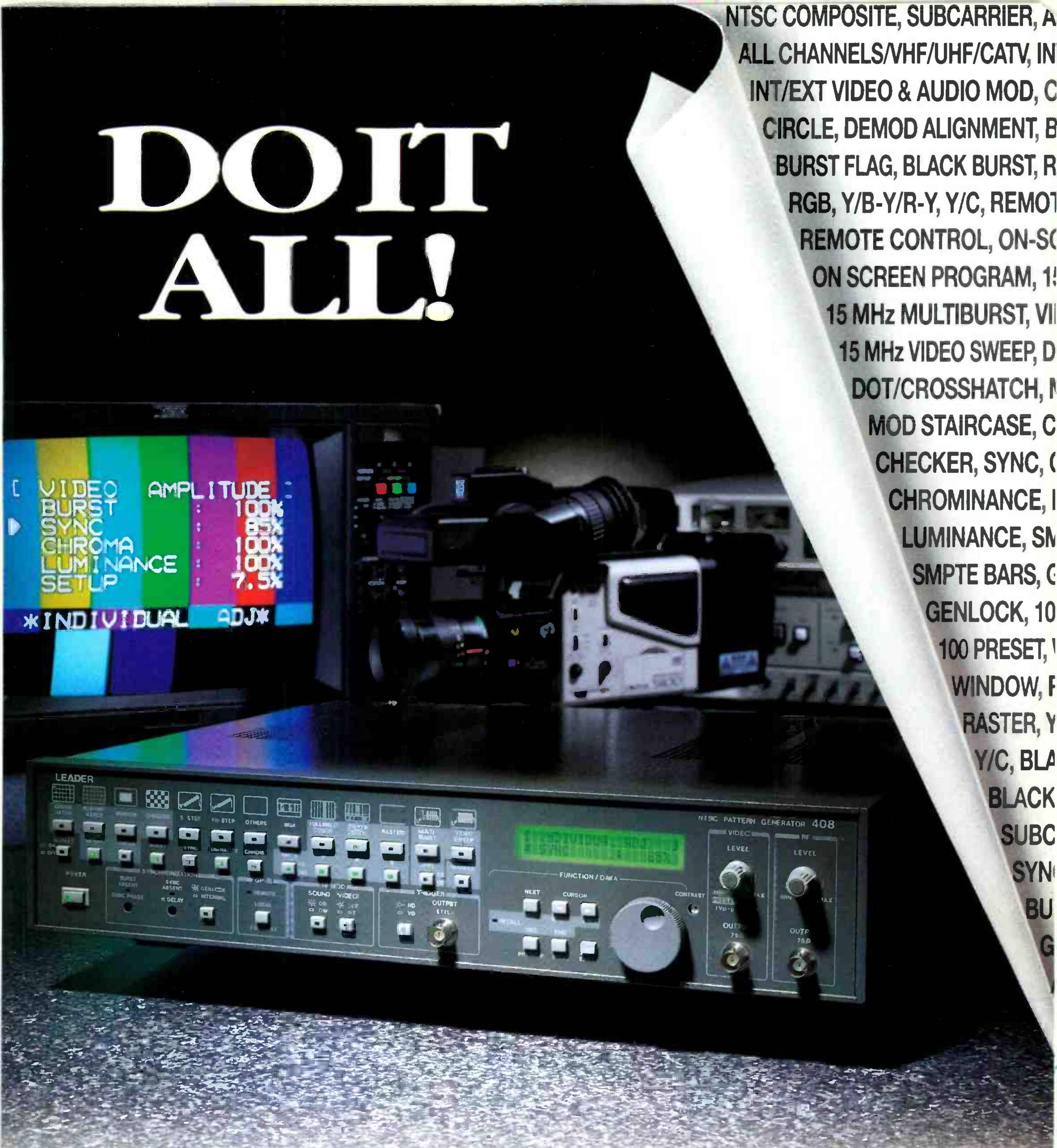

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