BROADCAST® ENGINEERING

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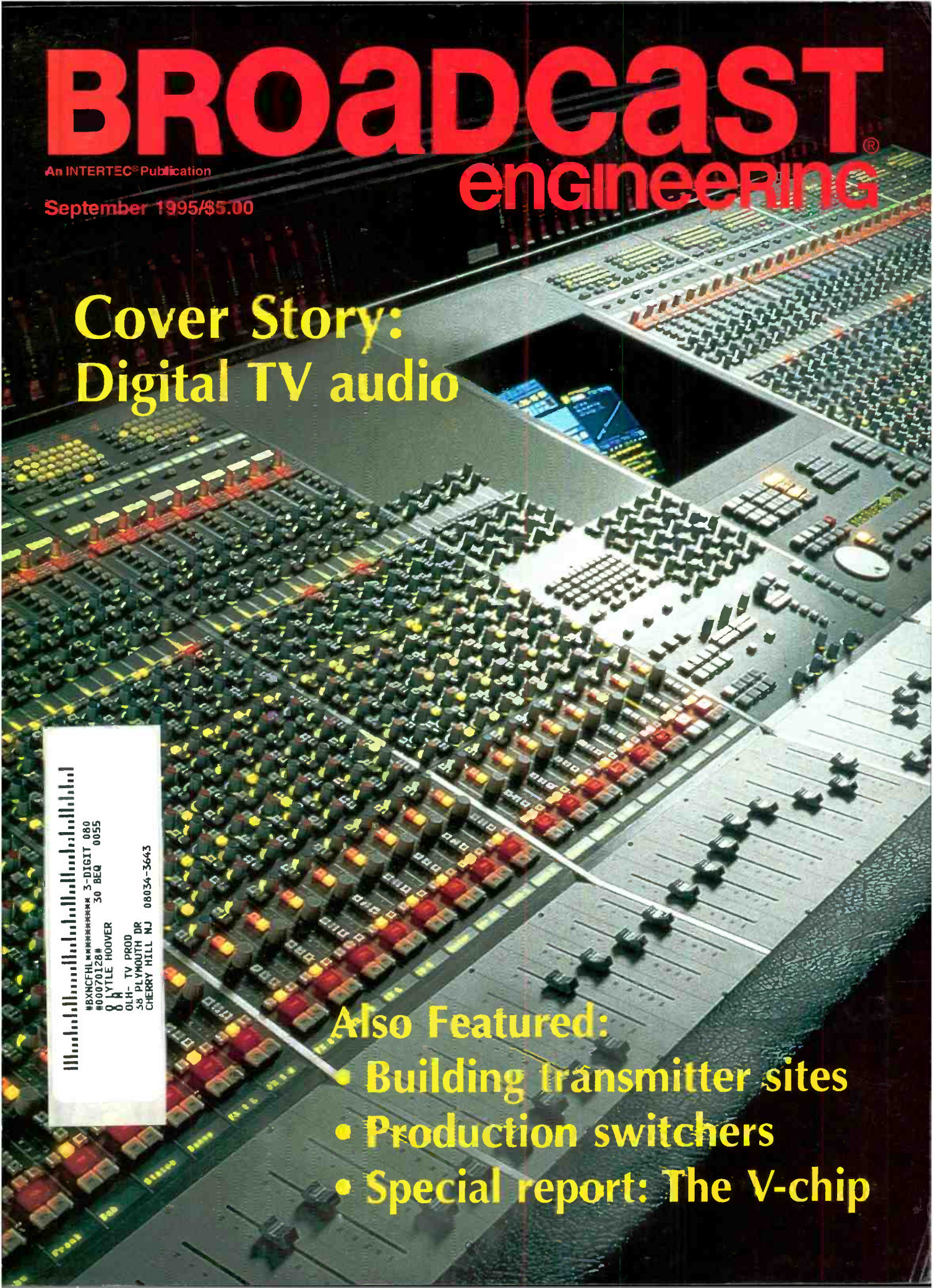

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- Production switchers
- Special report: The V-chip

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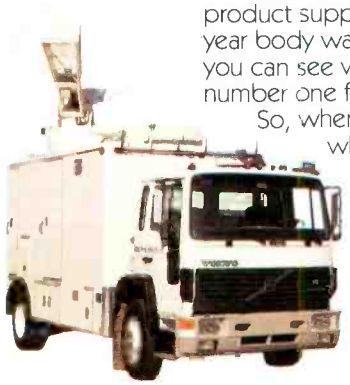

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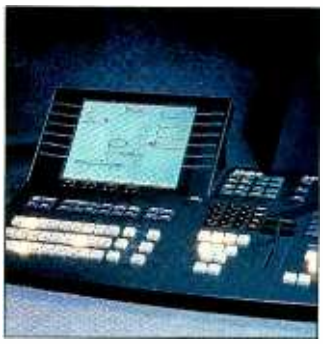
THIS MONTH...



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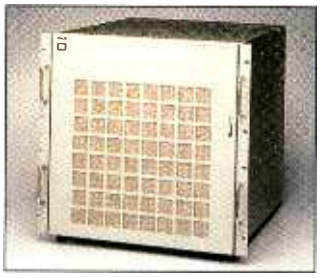

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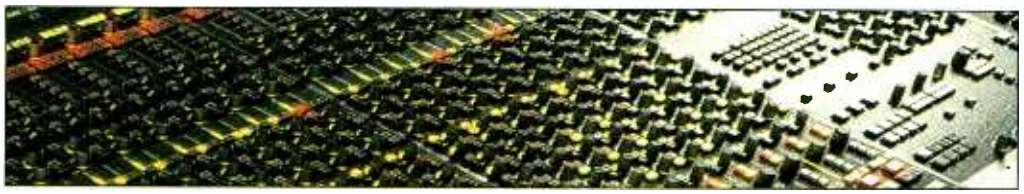
COLUMNS:



ON THE COVER: Mixing audio for video production has come a long way since the days of the RCA and Gates rotary mixers. On the cover is the Axiom digital production system from Solid State Logic, providing fully digital and automated mixing for high-end broadcast and post applications. Photography courtesy of Solid State Logic.

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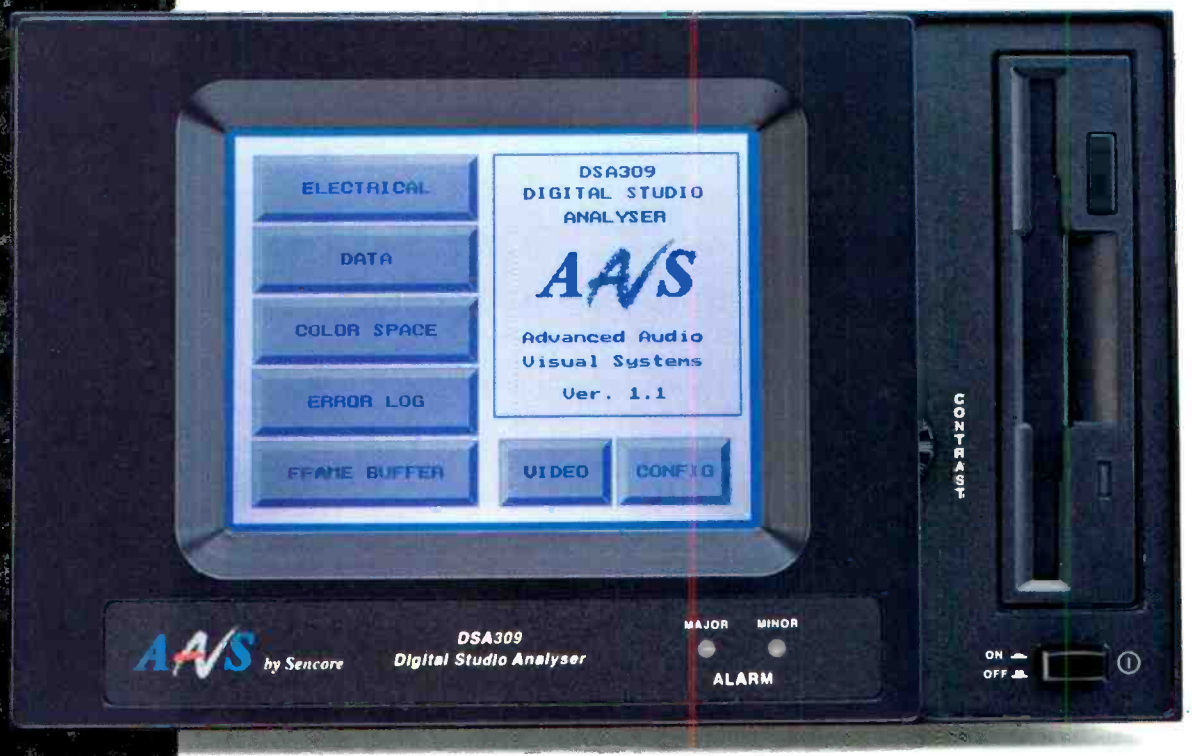

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By Art Brodsky

The V-chip moves toward reality

There is no more seductive item on Capitol Hill today than the *V-chip*. (The name is derived from "violence chip," which is a blanket term applied to selective signal-blocking technology in consumer TV sets.) After all, what could look better to a grass-roots politician than a simple, cheap, high-tech answer to the high-visibility problem of violence on television? Not much, apparently.

In the Senate (where it is called the *C-chip*, for "choice chip"), not even the opposition of the Republican leadership, including majority leader Bob Dole (R-KS), could stop members from passing the measure by a 73-26 vote in June. Republican leadership in the House of Representatives also opposed it, but the V-chip concept, which originated in the House with Rep. Edward Markey (D-MA), still passed by a 224-199 vote in August. President Clinton has endorsed the V-chip concept, as well. Barring a veto of the telecommunications bill (which is possible, but for reasons other than the V-chip), the technology could become a reality — and a requirement — for TV set makers in the next couple of years.

More than meets the eye

As with many telecommunications issues, this one isn't as simple as it looks. The issues surrounding the V-chip are surprisingly complex and tangled on a number of different levels. The congressional votes themselves are apt symbols of this. For example, in the Senate, the V-chip was losing until a couple of key senators had second thoughts and the tide turned. On the House side, it took two tries to pass the V-chip, the second one coming on a procedural motion that rarely, if ever, is approved.

These political convolutions are mirrored in the chip's technical and legal ramifications. On the technical level, the concept of the V-chip comes from its ancestor, the closed-captioning decoder (another item that Rep. Markey helped approve). Like its predecessor, the V-chip also would read and respond to data transmitted in a video signal's vertical blanking interval (VBI). With a simple remote-control device, parents would have the opportunity to block out programs by category of rating (using rating data sent by the broadcaster in the VBI), or simply by time period or by channel.

Markey and others contend that the chip is cheap, adding no more than about $1 to a TV set, but providing parents with the defenses needed to take control of the programming delivered into the home. According to Markey and other supporters, the electronics industry has developed standards for the V-chip's use, and these systems have been tested successfully in Canada.

The TV set manufacturers represented by the Electronic Industries Association (EIA) disagree. They contend that the chip could add as much as $72 to some low-end TV sets ($20 to $50 for additional memory capability and another $10 or more for channel-blocking capability). Considering that the average 13-inch TV set sells for $135, an additional $72 could increase the cost of the set by about 50%, EIA argues. Meanwhile, EIA is working on standards for the VBI program-blocking data, but it said the industry isn't ready to meet the ambitious schedules that the legislators want to impose.

Unfortunately for EIA, it had little credibility in the congressional debate with the V-chip's friends. Rep. Markey and other chip proponents are fond of citing industry estimates of $25 or more that the closed-captioning chip would cost when it was introduced about five years ago. Now, the cost is negligible, and Markey, who proposed the V-chip concept in 1993, argues that the same situation will occur again.

The four major TV networks are looking into alternatives that would allow parents to block out shows by a time block, much like programming a VCR, and using technology that could be brought to market more quickly than the V-chip. But the so-far victorious V-chip cadre has won the day by arguing that in the 500-channel universe, it would be impossible for parents to block out programming on a time-slot or individual-program basis. Broadcasters countered with the question of logistics — how could the thousands of hours of TV shows be rated, especially when some programs are completed just before air time? Other V-chip opponents, such as Rep. Tom Coburn (R-OK), added that the V-chip would lock the TV industry into one technology, rather than giving parents a choice.

Beyond the technological issues, there are philosophical and legal ones. Opponents of the V-chip argue that it would violate the First Amendment because the government would be required to either set up the ratings or set up a commission to rate programming. Many V-chip opponents don't like any government involvement, and during the congressional debate, opponents raised the specter of a Federal Censorship Commission with an "army of bureaucrats" who would be spending taxpayer dollars to rate programs. Washington attorney Robert Corn-Revere, writing a policy analysis for The Cato Institute (a Washington, DC, think tank), summarized the issue: "The heart of the debate is whether the Constitution permits the government to impose a ratings system for television programming. It does not."

Broadcasters agreed, and using the Senate's terminology, have renamed the C-chip as the "censor chip." This was best illustrated when Rep. Dan Frisa (R-NY) spoke against the bill in the House with a mocked-up bag of "Censor Chips" in his hand. The networks argued that the chip could hurt ratings if parents blocked out all programs within a certain category without actually checking out individual shows.

Final decision still pending

The end result will depend on subsequent legislative and executive action, because the House and Senate bills hold some differences regarding the V-chip. To tailor his V-chip bill to the House, Rep. Markey made it as voluntary as possible and included minimal government involvement. It allows the industry one year to come up with a voluntary standard ratings scheme. If it fails to do so, the government would appoint members of a commission from the industry and the public to set up a ratings system, but the industry still would be under no obligation to use it. Under the Senate bill, however, the ratings standard could become mandatory, depending on industry action. These and other differences will be ironed out in a House-Senate conference, expected soon.

Because this discussion is taking place in Washington, politics will continue to play an inevitable role. On the surface, it looks like an easy vote for parental control of TV programming, which, as all politicians know, is the wellspring of all sorts of evil and viciousness. Lined up against the parents are some pretty powerful opponents, however: the big TV networks and the rest of the broadcast industry. They offered substitutes for the V-chip in the Senate and the House, including a resolution calling for the broadcast industry to do something to solve the problem (in the Senate), and a $2 million contribution to a new fund to come up with new technologies (in the House).

The strategy almost worked. In the House, on Aug. 4, the new technologies fund was contained in an amendment by Rep. Coburn, and it actually won the day, 222-201. It gave House members a vote that supported the spirit of parental control, but without the specific language of the V-chip, thereby assuaging broadcasters. But Rep. Markey, through a clever parliamentary device, forced a second vote on the V-chip issue per se. As

Continued on page 81

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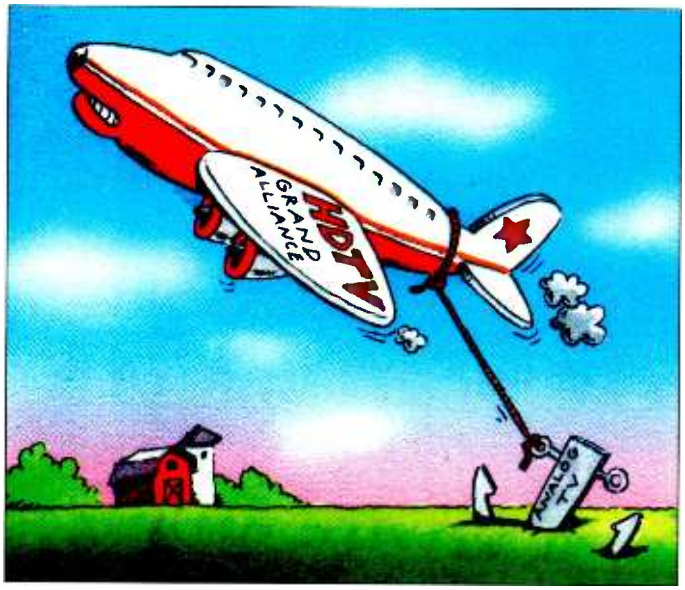
EDITORIAL

ATV: Anchor around our necks?

At the August meeting of the IEEE, Dr. Donald A. Norman, vice president of Apple Computer's Advanced Technology Group, trashed the Grand Alliance's proposed ATV system. At the meeting, Norman said the "Grand Alliance" industry consortium would take the nation "into the future with a jaunty air and *an anchor around our necks*." (Emphasis added.)

Norman presented his vision of the future where teenagers use their family's giant-screen televisions to shift between watching rock-concert broadcasts and doing homework on the WWW. I'll bet this guy doesn't have any kids!

I know from firsthand experience that my teenagers aren't going to use a "home theater" to research anything. It's an entertainment center, not a library! When it comes to doing homework, they (or I) don't need a 10-foot screen. A 15-inch monitor works just fine, thank you. I can browse the Web until I drop, and seeing it on a 10-foot screen won't make it any faster, better, cheaper or improve my kids' grades.



Sorry Norman, but your viewpoint reflects only the world of computer geeks. You guys think the world revolves around a computer (notice I didn't say TV) screen. You seem to believe that the human interface to the entire world ought to be a computer coupled to a wall-sized display.

In Norman's speech before the IEEE, he used the following "real world" example of how the home-entertainment system should work. The father asks his daughter Jane, who is watching a rock concert on their Theater Vision in the family room, if her paper on the Mona Lisa is finished. Of course it isn't, so the father picks up the "control slate" and switches the television to the WWW. He enters "Mona Lisa" on the slate and the web browser helps them locate the Louvre Museum in Paris.

The dutiful daughter cuts and pastes relevant passages from the Louvre information (all automatically marked as to their source) until she has created her paper. By now, the rock concert must have slipped her mind because she (according to Norman) decides to Web browse to view the "Gates Da Vinci" art collection. To top off her homework assignment, she voluntarily selects and then watches a short film from the National Public Television archives. Then she skips off to Florence via the WWW to watch more videos, paintings and text.

Two hours later Jane has completed her paper, and, according to Norman, "the entire family has traveled, learned and worked together." Give me a break. What planet did this family come from — *Mars?* That's not reality — it's fantasy.

Norman, and many from the computer industry, seem to have an innate desire to reinvent the world every few years. He talks about NTSC's age as though it was discovered during the Jurassic period.

If you want to compare lifetimes, what about the Lisa computer, Norman? How long did it last? Two years, maybe three? What about the Pentium, any bugs there? Compare those two glaring computer-industry goofs to how long NTSC has served us well. NTSC has been around for more than 45 years, so stick that in your floppy drives, you computer geeks.

The American public deserves better than to be told by a selfish industry that the Grand Alliance system represents an anchor around our necks in terms of performance or potential growth. Until the computer industry can prove they can build something that works half as well as NTSC has and will at least outlast my kids' tennis shoes, I'll support the broadcast industry's viewpoint. The Grand Alliance system offers both broadcaster and viewer many exciting opportunities, so let's give it a chance.

Brad Dick

Brad Dick, editor

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By Harry C. Martin and Andrew S. Kersting

Advanced TV systems

The FCC has issued a Notice of Proposed Rulemaking (NPRM) inviting comment on topics affected by the transition to digital broadcasting. The NPRM also is revisiting decisions made in a 1992 order when it was not apparent that digital technology would permit multiple program streams to be delivered using a single 6MHz channel.

The NPRM recognizes the evolution of digital technology and advances made in the development of a standard for digital video broadcasting, including high-definition television (HDTV).

The NPRM identified four goals that are intended to guide the rulemaking process:

- To preserve the nation's free, universal broadcast service;
- To foster an expeditious and orderly transition to digital technology that will allow the public to receive the benefits of digital television, including HDTV;
- To eventually recover spectrum in contiguous blocks from coast-to-coast for new undefined services; and
- To ensure that the spectrum will be used to best serve the public interest.

The commission reaffirmed its earlier decision that current broadcast licensees be granted initial eligibility to shift from existing analog broadcast technology to digital service. In a departure from its previous decisions, the FCC noted that broadcasters would be allowed greater flexibility in responding to market demand by transmitting a mix of HDTV, standard definition television (SDTV) and other services.

The FCC also requested comment on other issues, including the following:

- What limits should there be on the use of the ATV channel, and whether there should be a minimum requirement for HDTV transmissions?
- How should broadcasters' public interest obligations be affected by the shift to digital broadcasting?
- How should the end of the transition period be determined? Are there ways to shorten the transition that would preserve the interests of broadcasters and consumers?
- Should a simulcast requirement be imposed upon licensees?
- What steps should be taken to optimize recovery of spectrum?
- Should small-market stations receive special consideration?
- Can the special needs of noncommercial licensees be accommodated?
- Should mandatory receiver standards be adopted?
- How are existing laws, such as must-carry, affected by the transition to digital?

The commission also released a Notice of Inquiry (NOI) concerning how to best allocate future uses of recovered spectrum. The NOI is expected to be followed by two additional proceedings later this year after receipt of a recommended standard from the FCC's Advisory Committee on Advanced Television Services, which is expected this November. One item will seek comment on the issues relevant to the endorsement of that standard. The other item will study issues related to the allotment and assignment of channels during the transition period. Both items will be followed by a final report and order sometime next year, which will launch the Advanced Television System. ■

FCC revises EBS test script

The FCC has released a public notice announcing the adoption of a revised test script for EBS tests. The revised script is intended to allow broadcasters to perform a weekly EBS test in 30 seconds when used in conjunction with the new 8-second EBS alerting tone.

In order to perform the test in 30 seconds, the FCC recommends the following procedure: 1) Discontinue normal programming; 2) Broadcast this announcement: "The following is a test of the Emergency Broadcast System;" 3) Transmit the attention signal for eight seconds, as specified in Section 11.32 of the EAS rules; 4) Broadcast this announcement: "This station is testing its Emergency Broadcast System equipment. The EBS will soon be replaced with the Emergency Alert System. The EAS will provide timely emergency warnings. This station serves the (insert EBS/EAS local area name) area. This concludes this Emergency Broadcast System test;" 5) Resume regular programming.

Remember that all weekly EBS tests conducted by your station must be logged in your official station's log as should tests received from the station that you are monitoring.

For questions about the EAS, contact the EAS staff in the FCC Compliance and Information Bureau at (202)418-1220.

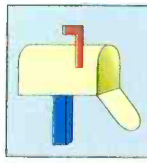
DATELINE: Oct. 1

Commercial TV stations in the following states and territories must file their annual ownership reports or ownership certifications by Oct. 1: Alaska, Florida, Guam, Hawaii, Iowa, Missouri, Oregon, Puerto Rico, Virgin Islands and Washington. Also, stations must place their third quarter listings of community issues and responsive programming in their public files on or before Oct. 1.

AM radio	4,907	FM translators & boosters	2,398
FM radio	5,233	UHF translators	2,539
FM educational	1,779	VHF translators	2,267
Total	11,919	**Total**	7,204
UHF commercial TV	617	UHF low-power TV	1,133
VHF commercial TV	559	VHF low-power TV	550
UHF educational TV	240	**Total**	1,683
VHF educational TV	123		
Total	1,539		

Table 1. Totals for broadcast stations licensed as of June 30, 1995.

Harry C. Martin and Andrew S. Kersting are attorneys with Fletcher, Heald & Hildreth, P.L.C., Rossyln, VA.



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Circle (19) on Reply Card

EAS update

The network web of EAS

By Paul Montoya

Last month we looked at the history of emergency alerting. Now it's time to explore how each part is important to the overall operation. The key components are coding of messages, a network "web" to disseminate information, and plans as to how the coding and "web" will work.

Why a web is necessary

The EBS operated on a modified "daisy-chain" system. It was modified in that an operational area could function with one station disseminating information to all or most of the stations within a market directly. This provided no redundancy, however. The problem was often exacerbated in cases where four or five relays were required to pass information from a central location to a distant alerting station.

Terrain was often a problem, but more often it was a misinterpretation of what a station was to do with a message passed on to it.

The web system answer

The web system addresses these problems by getting information to the station needing to broadcast the message as directly as possible, and providing an alternate or redundant path. Sometimes, getting the information to the broadcaster directly means bypassing the primary or disseminating station.

A good example of this is NOAA Weather Radio. Stations can monitor NOAA Weather Radio on VHF radio. Other examples include communities that use UHF repeater frequencies, statewide satellite broadcast news distribution or broadcast frequency coordination/emergency alerting via RPU frequencies. No longer is there the need to wait for the relaying station to get to a commercial break to relay information. This can take the average message-dissemination time from six or nine minutes down to less than 30 seconds.

Other means of disseminating information besides broadcast channels also aid many states that have terrain or size obstacles. Large states can rely on satellite for information distribution. States that have terrain obstacles can use microwave or satellite to relay signals.

Redundancy in the web

A level of redundancy is built into the web. As an example, should the Weather Service generate an alert, it could go out via NOAA Weather Radio; or be simultaneously placed on a broadcast RPU channel located on a tall building or hilltop; or be placed on the statewide microwave system. The primary broadcast station also may rebroadcast the information. If all paths function well, the message could be received from four different sources.

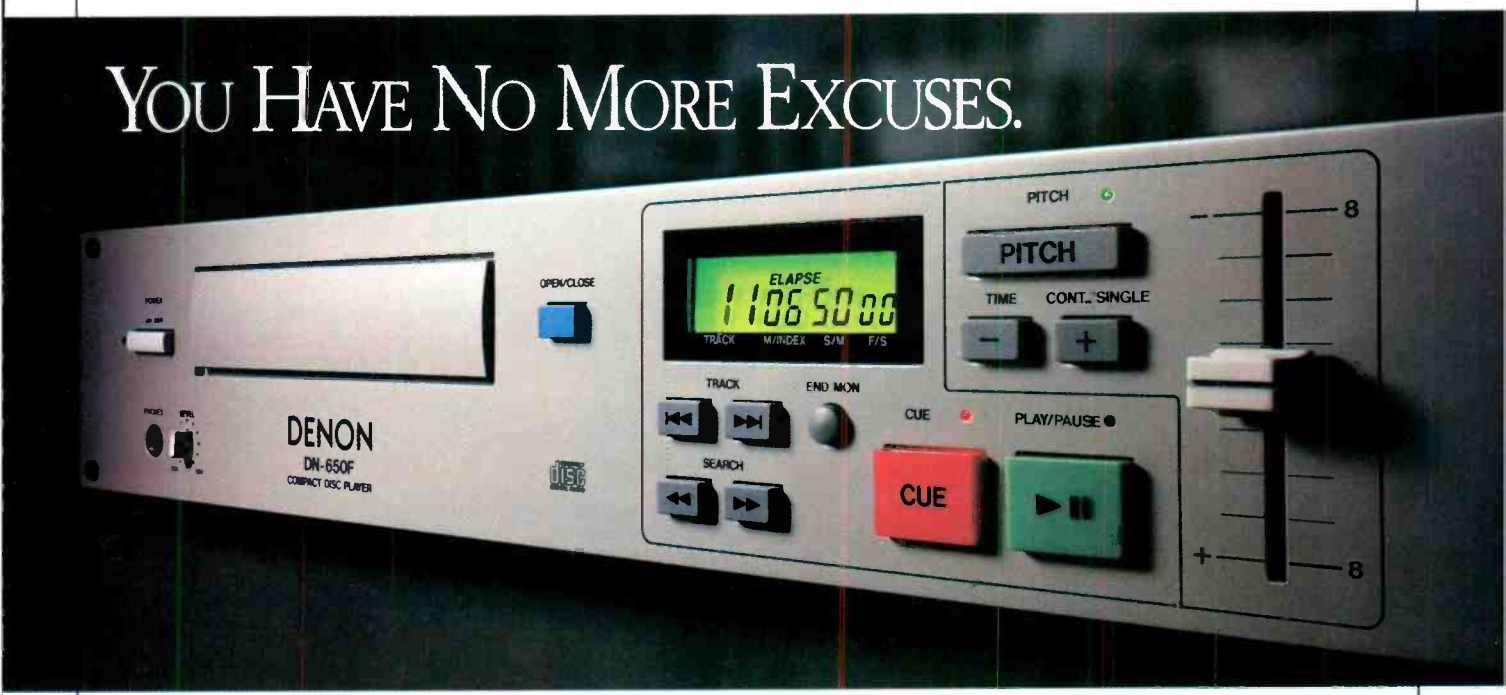
Input considerations

Hardware configurations are important in planning your system. Some manufacturers may provide "receivers" internal to the unit while others may provide audio or data input ports and leave it up to you or a third-party vendor to provide the receiver.

John Hart of Lakewood, CO, has begun the "first public worldwide emergency communication center," called E-COMM. Its purpose is to link amateur radio operators worldwide within the Internet. Even more creative distribution systems will evolve and we should be prepared to accept their signals. ■

Paul Montoya is president of Broadcast Services of Colorado, a contract engineering firm in Lakewood, CO.

You used to have excuses for using a consumer CD player. Perhaps you wanted audiophile sound quality, but then you had to put up with pre-historic user controls. Maybe you wanted an inexpensive player, but then you were saddled with awkward operation, marginal reliability and even worse sound.



The DN-650F Professional CD Player changes everything. Denon has combined their legendary audiophile sound quality with powerful features developed specifically for studio and broadcast applications. Industry-proven professional controls include true instant start, auto cue-to-music, index search and a full complement of professional input/outputs, such as balanced and unbalanced audio, digital out, and a GPI interface. In addition, you can format these features for your specific applications.

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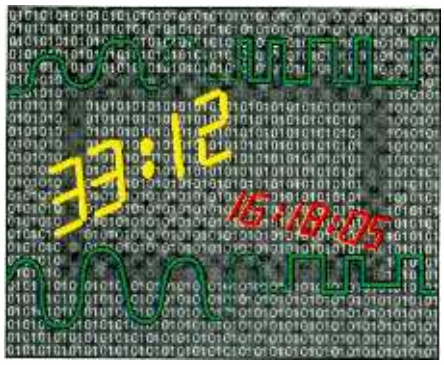
Circle (15) on Reply Card

By Steve Epstein, technical editor



Digital basics, part 2

In last month's column, we discussed the fundamentals of digital. This month we'll look at digital video signals, along with the cables and connectors used for digital video. In the early days of digital video, equipment was interconnected using a parallel transmission scheme. Twelve twisted pairs along with 25-pin "D" connectors were the standard interconnect. Ten of the twisted pairs were used for data, the eleventh was a 27MHz clock and the twelfth pair was used for system grounds. Cables were terminated with 110Ω. Parallel transport worked well, however, cable lengths are limited and assembling the connectors is time consuming. The parallel interface is still in use today, however, a serial interface using a single coax has found much wider acceptance.

Serial digital signals

Initial recommendations for serial interconnects were referenced to the standard cable used for analog, Belden 8281. At the time, 50Ω BNC connectors were standard throughout the industry. This connector/cable mismatch has negligible affect on analog video signals. Unfortunately, it creates problems at the higher frequencies used for serial digital transport. These problems include attenuation and reflections. Although the use of a single connector will not cause major problems, good engineering practice attempts to avoid this type of mismatch whenever possible.

Current recomendations call for equipment chassis connectors to provide a 75Ω connection. This can be accomplished using 75Ω connectors or 50Ω connectors made electrically equivalent to 75Ω with the proper circuitry within the device. Many manufacturers have chosen the latter because the 50Ω connectors are slightly stronger mechanically. SMPTE recommendations specify that which ever connectors are used, they should provide good electrical contact and not be damaged by or cause damage to BNC connectors currently in use. For cabling, if existing cables have good 50Ω connectors there is no need to replace them. However, if connectors need to be replaced, or for new installations, the use of 75Ω connectors is recommended.

Early recommendations called for maximum cable lengths of 300m (1,000 feet). Today, however, newer cables and connectors exist that were designed with digital video in mind. Patch panels and 75Ω BNC connectors are now commonplace. These improvements have added to the robustness of the digital video interconnection. However, they have not eliminated the real-world problems of frequency rolloff, attenuation and noise associated with moving signals from point to point over copper wire. Cables attenuate signals in a predictable fashion, therefore, equalization can be applied at the receiver end to "normalize" the signal.

Bit-error rates can increase from acceptable to unacceptable levels with the addition of only 20 meters (60 feet) of cable.

The 270Mb/s serial digital signal has no separate clock signal, requiring the clock to be recovered from the signal itself. This can only be done if transitions occur regularly. To ensure regular transitions, a non-return to zero inverted (NRZI) scrambling scheme is used. NRZI scrambling maximizes transitions and thereby enhances clock recovery. (For more information, see "Measuring Serial Digital Signals," November 1994.) Both signal attenuation and jitter will affect clock recovery. Without a solid clock, signal recovery is impossible.

Maximum recommended cable lengths have increased with the newer cables and connectors. However, many engineers fail to realize that these maximum lengths are for a single cable with no intermediate connections or patch points. Each connection increases signal degradation and reduces the maximum permissible length. Figure 1 illustrates typical bit-error rates found as cable length increases. The "digital cliff," as it is referred to, is the point where the number of errors increases quickly making signal recovery impossible, or at best, unpredictable. Bit-error rates can increase from acceptable to unacceptable levels with the addition of only 20 meters (60 feet) of cable, or by the degradation of a connector or patch point.

Normally the "cliff" occurs when cables reach lengths of about 300 to 350 meters in a "clean" installation. If care is taken throughout the installation, additional lengths are possible, and conversely, a poor installation will be unable to attain these lengths. Some of the particulars of a clean installation include cable-bend radius, connector installation and the tension of wire ties on cables with low crush resistance. When planning a major installation, check with the cable manufacturer and obtain their recommendations for the cable types being considered to ensure proper installation.

The accepted test for determining the system's proximity to the cliff is to add cable to a working connection. Normally, 50 meters (150 feet) is added to verify that and proper operation is maintained. If the connection fails, the connection is near the edge of the cliff, and any future degradation of the signal path could make signal recovery difficult. At first glance, it may appear that this test need only be performed when the system is first assembled. However, this is a maintenance item that needs to be addressed periodically to verify that the cliff remains a safe distance away as the system ages.

During the initial installation, signal level and jitter measurements should also be taken and recorded. These measurements can later be used as a reference to determine if and where any degradation has occurred along the signal path. To ensure a reliable and properly functioning digital system, particular attention must be paid to the quality of the digital signal. In this manner, as the digital cliff is approached, corrections can be made to prevent sudden failure.

Error detection and handling

Adding cable to a connection is a time-consuming process that can only be done when the connection is not in use. Additionally, a typical facility may have thousands of connections that would need to be tested periodically. Needless to say, a better method is needed to verify the integrity of signal paths throughout a facility. SMPTE RP 165 addresses this by recommending the use of error-detection checkwords and flags within the serial digital bitstream.

Error detection and handling (EDH) is

accomplished by embedding information at the transmitter end of a cable that allows the receiver to determine if any errors occurred between the transmitter and receiver. In addition, errors can be reported that occur upstream of a particular transmitter/receiver pair. This allows a single monitoring point at or near the end of the signal path to verify whether the entire path is functioning properly.

According to SMPTE 165, a cyclic redundancy check (CRC) is calculated for each video field. For those unfamiliar with CRCs, they are checksums calculated with a specific formula that provide assurances that both the value and position of bits in a datastream are correct. CRCs are calculated for the full video field, the active video region and ancillary data packets. Once calculated, the CRCs are added to the bitstream. At the receiver, the CRCs are recalculated and checked against the CRCs calculated at the transmitter. If the CRCs match, it is assumed that no errors occurred. Non-matching CRCs indicate errors.

Basically, two types of video equipment exist — equipment that modifies the video signal, such as production switchers, and equipment that does not modify the signal, such as distribution amplifiers. Equipment that modifies the signal must recalculate the CRC before the signal leaves the unit. If this is not done, a CRC error will be generated when the modified signal is received.

A total of 15 error flags are used to identify the type and location of errors. Each flag is

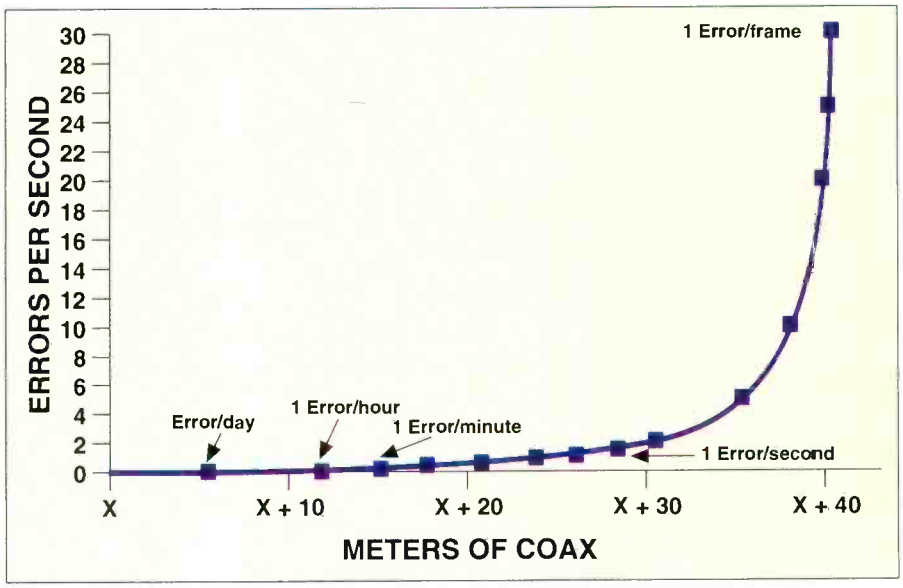
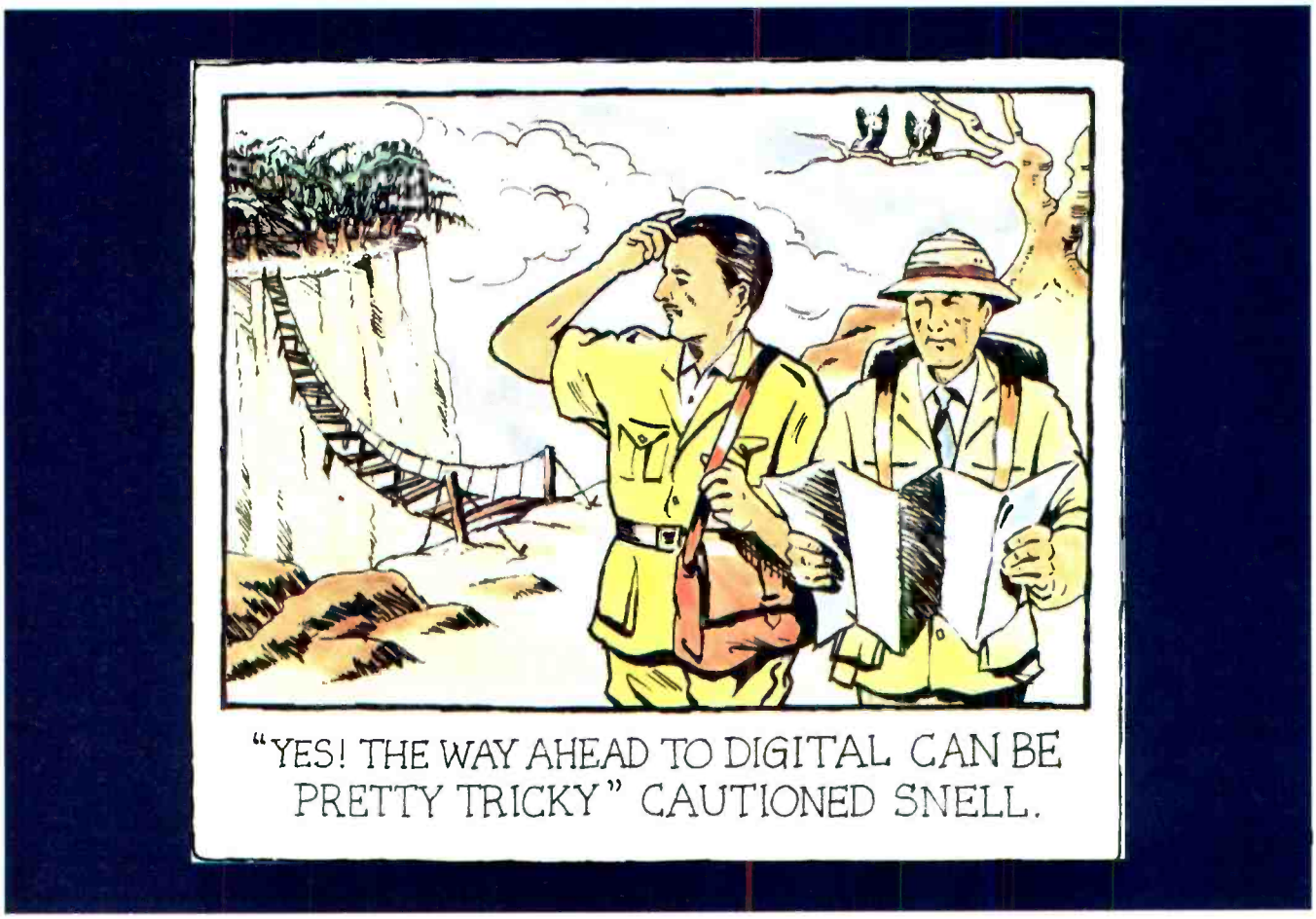


Figure 1. As cable length increases, bit-errors remain near zero. However, at a point the number of errors increases exponentially. In a typical installation, this occurs around 300 to 350 meters.



set or cleared on a field-by-field basis. Five flags are used for each of three areas. The five flags are: *edh* (error detected here), *eda* (error detected already), *idh* (internal device error detected here), *ida* (internal device error detected already), and *ues* (unknown error status). The three areas checked are the active picture area, the full field and the ancillary data. With these error codes, if an error is detected in one area, the edh flag will be set. If every other connection works properly, the edh flag will be cleared, but the eda flag will remain set throughout the rest of the signal path, allowing the error to be detected and displayed by EDH monitoring equipment located downstream.

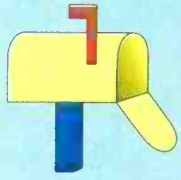
Flag descriptions

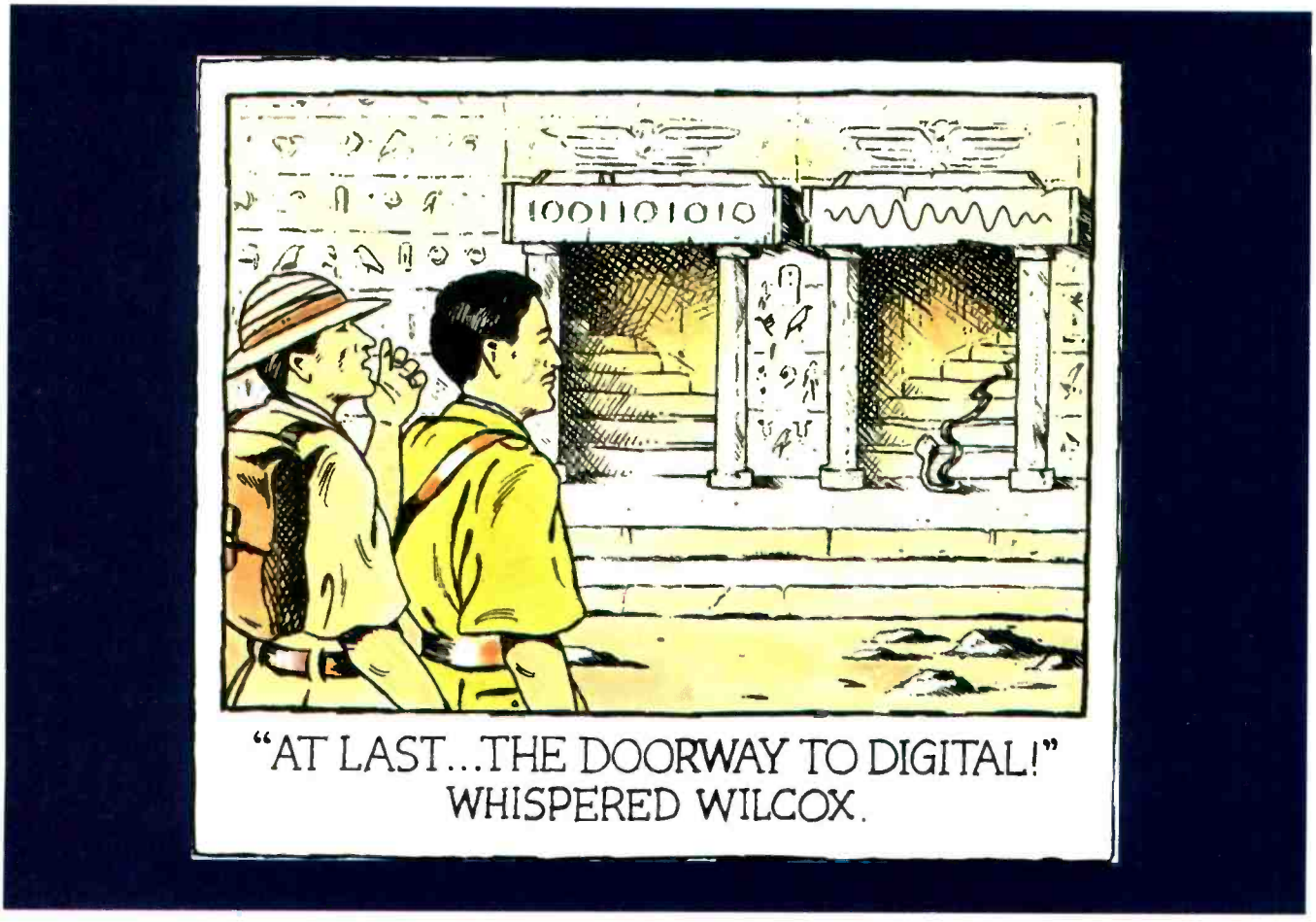
In most digital systems (SMPTE RP 165 included), the terms clear and set reference the value of a flag. If a flag is set, its value is one, if a flag is cleared, its value is zero.

The 15 available flags are used in the following manner. The edh flag for the active picture is set if the CRC calculated at the receiver is different from the active picture CRC sent by the transmitter. The full field edh flag is set in the same manner. For ancillary data, if the checksum for the ancillary data packets does not match the calculated checksum, then the edh flag for ancillary data is set. For all three areas, the eda flag will be set if the edh flag has been set by a previous device. If the received CRC is correct (indicating no errors in the most recent transmission), the edh flag will be cleared. The idh flag is set by devices that are capable of detecting that internal errors have occurred. Like the edh/eda flags, the idh/ida flags are cleared and set by devices down the line to ensure that errors are reported. Finally, the ues flag is set if a signal is received from a device that does not support EDH.

EDH monitoring devices can be used to read and display any errors in the system. However, because many devices currently in use do not support EDH, care must be taken when troubleshooting system errors to avoid a misdiagnosis. As EDH becomes more widely accepted, the automatic in-service signal quality monitoring it provides will allow maintenance personnel to detect problem areas before they reach the point of failure. Several devices are currently available that provide EDH monitoring and additional devices will be available in the near future. ■

Acknowledgment: This article was prepared with materials supplied by Michel Proulx, Leitch Incorporated and Synergistic Technologies, Incorporated.





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By Curtis Chan

Hiring for success

In today's competitive broadcasting environment, hiring the right mix of technical and operational talent is crucial to the long-term success of a company. Most managers, having been brought up through the ranks, have had little or no opportunity to be trained in the fine art of interviewing. For that matter, interviewees going through the interview gauntlet can be a daunting experience. The following guide will outline some pointers for the interviewer. There are also some tools for the interviewee to make his or her job less stressful.

First, today's anti-discrimination laws make it easier for potential candidates to seek litigation with probable cause. As a result, employers should think twice about delving into a candidate's personal life. Because of these laws, there are some basic do's and don'ts — so let's discuss them first.

Know the basics

Managers beware -- the off-the-cuff questions you ask during an interview could give you a free ride to court. The basic rules of thumb are: If it's not strictly job related, don't ask the question. Don't be smug and indirectly solicit information you know to be in violation, and if in doubt, don't ask.

Questionable areas to avoid are marital/family status, age, health/disability, national origin and criminal records. Asking about an applicant's spouse, marriage status and children is strictly taboo. Also, asking whether a female candidate prefers Ms., Mrs. or Miss is also a no-no. The interviewer can also be accused of discriminating by volunteering information about his or her own family. Age, date of birth and elementary or high school dates of attendance are also questions that shouldn't be asked. However, asking for dates of college or graduate school are okay because many applicants complete higher education at different times. General health and disability questions are also illegal under the Americans with Disabilities Act. As to national origin, you can ask for languages the applicant reads, writes and speaks, but shouldn't ask how proficiency in the language was gained. Last, the question, "Have you ever been arrested?" is not permissible in most states. But, you can ask if he or she has been convicted of a felony.

Checking references

Not being able to ask pertinent questions is but one of the limitations that employers face. Another area to be concerned about is reference checking. Checking or giving references isn't as easy as it once was. In an effort to avoid lawsuits from disgruntled former personnel, you may wish to only divulge the dates of employment worked at your site. On the other hand, many previous employers will provide good references for your prospect simply because they fear a lawsuit.

It's a fact...

Bad hiring decisions hurt the bottom line: Studies have shown that replacing an employee can cost up to 150% of that worker's annual compensation.

Cutting through the maze

So, how do you cut through the maze of résumés, glowing references and "star-quality" personalities to hire the best person for the job? First, develop a list of qualifying skills, education, character traits, interpersonal communication skills, responsibilities and job experiences that reflect the nature of the position.

Second, screen all the résumés that best fit your criteria. It's best to narrow the field further by conducting an initial screening over the phone. After you've narrowed the list, arrange for an interview with yourself and several others in your department. Depending upon the level of the position, it might be wise for the applicants to meet your superiors as well as other managers that they may work with (limit it to five).

In many cases, these other interviewers may spot something that you might overlook. During the interviewing process, don't give away too many clues about the kind of person that you're looking for or else the candidates will fashion their answers accordingly. Instead, ask open-ended questions and make sure that you give them plenty of opportunity to ask questions as well. Throughout the interview, look for responses that reveal traits that are critical for success. In the end, you want a person that is going to perform at or above expectations when under pressure.

Asking the right questions

Validate the authenticity of the applicant's résumé. Ask a question in different ways and then ask the second and third question for details. For instance, your applicant might claim that he was the chief engineer for a big unknown station and carried total fiduciary responsibility. It sounds impressive until you find out that he was the entire engineering department and was responsible for a budget the size of one of the line items on your budget.

Also, ask questions on how the applicant solved difficult problems, both technical and people related. In a large network or station, the applicant is going to come face to face with issues related to people and politics.

Another question you can ask is what the applicant's greatest failure was and how he dealt with it. Remember, if an applicant can share real failure, most likely, he will probably have a well-rounded integrity level.

The last two points center on money and gut feelings. In the first case, look for applicants that understand that compensation is a result of perceived responsibilities and positional stature. A smart applicant will relate financial compensation to the escalation of responsibilities and will try to negotiate more responsibilities for the given job function. As a consequence, financial compensation may also be negotiated.

For the interviewee, percentages sound better than dollar amounts, and company perks can account for a substantial share of the overall compensation package. If you can't get the amount you seek initially, try asking for an earlier review. For the manager, if you find the right applicant, look for creative solutions instead of sticking to salary guidelines.

It's more than just gut instinct

Be wary of trusting your gut too much without quantitative research to back it up. Many managers are tempted to hire the person they seem to get along with best, even if they're smart enough to realize that they should hire people that complement their weaknesses. Interviewing is an art and an analytical tool. By knowing the basics, developing your list of qualifications and asking the right questions, you can successfully hire the right person for the job. ■

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

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CompuServe: 74672,3124
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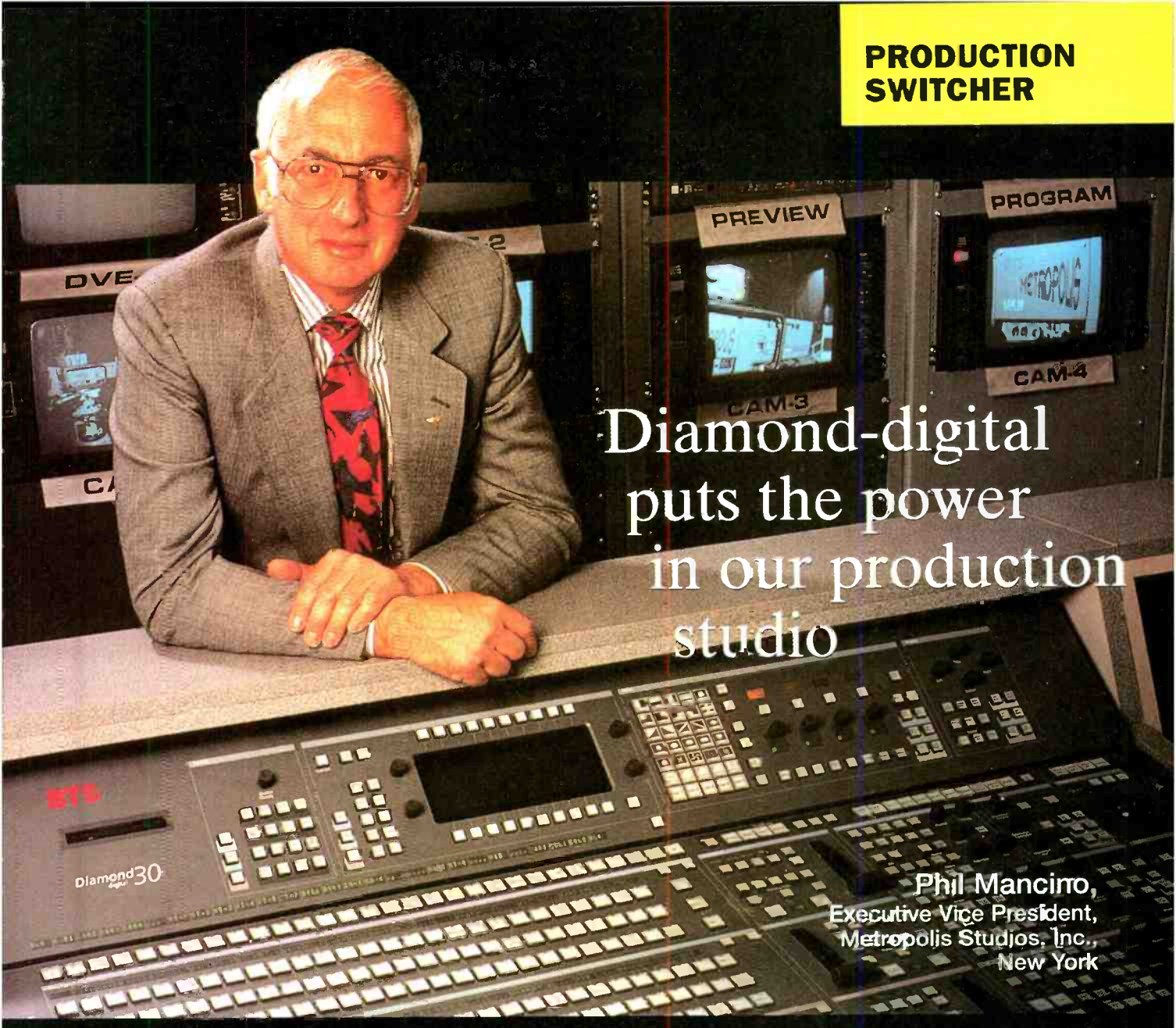
PRODUCTION SWITCHER



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Shown: The BTS Diamond-digital DD 30. Photographed at Metropolis Studios, New York N.Y., an all-digital video production facility.

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By Bennett Liles

Truck safety

The most important issue in broadcasting is also its least exciting subject — that is, until an ENG crew sent out to get a story *becomes* the story or a big truck hired to shoot a scene *causes* one.

For big trucks and small, safe operation is built on common sense. But common sense sometimes retreats under pressure, and otherwise careful people let something slide in order to get the story or make the show on time. When that sense of urgency sets in, alarm bells should go off in a wise operator's head. ENG vans, SNG (uplink) trucks and production rigs each have their own safety challenges, in addition to the general safety tips that apply to all of them.

Getting there

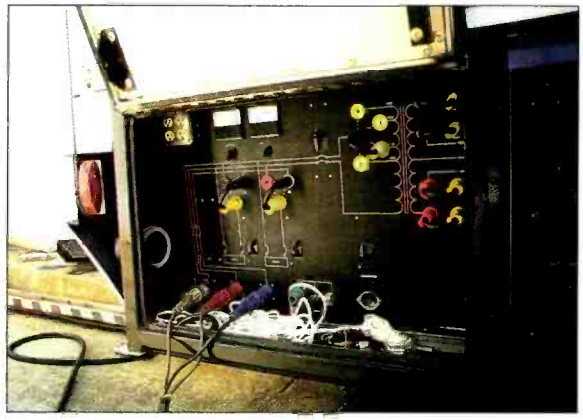
Although no larger than many other vehicles on the road, ENG vans are almost always in a big hurry. Their usual domain is downtown, where there are plenty of *mast-snaggers*. Rule number one for operators is to be aware of the truck's height with mast down *and* with mast up. Height figures should be big and clear and located where the driver cannot fail to see them. Know your truck.

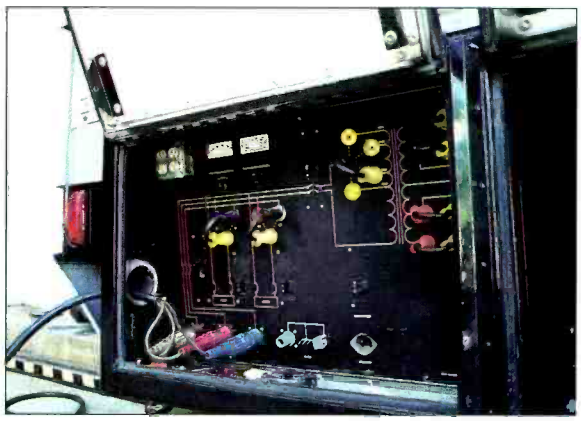
Although disadvantaged with larger size, SNG and production rigs usually have time to scope out their routes, which is a *must* for such vehicles. A liaison with local freight truckers is also good; they know all the squeeze points between cities. Check thoroughly for low overpasses and plan to stay on interstates and main roads, if possible. If another, smaller vehicle is also on the trip, send it ahead by at least a few blocks and communicate with it by CB or hand-held walkie-talkie. Three essentials for any truck are a first-aid kit, a fire extinguisher and a recent map. Know your route.

Driver training is paramount and in driver licensing, 26,000 pounds is the magic number for gross vehicle weight. Above this weight, a *commercial operator* (or *driver's) license* (CDL) is required — the same license needed by the freight haulers. Although not all regulations for freight haulers apply to remote truck drivers, CDL requirements are the same for private carriers (like remote trucks) and carriers-for-hire. States have the responsibility for testing drivers for CDLs under guidelines from the Federal Highway Administration and the tests involve a medical exam and demonstration of skill and knowledge. Applicants must pass 80% of the questions. The specific skills required are listed in section 383.113 of the Federal Motor Carrier Safety Regulations, available from your state's Department of Transportation (DOT). A special test section is required for drivers of vehicles equipped with air brakes. Employers of improperly licensed drivers are subject to federal fines of up to $5,000. The blood alcohol concentration limit (BAC) for CDLs is .004, but *any* positive BAC will result in being put out of service for 24 hours and a note on the driver's record. CDL drivers are also required to have at least eight hours of rest after every 10 hours behind the wheel. This and other driver rules are found in Part 395 of the Federal Motor Carrier Safety Regulations also available from DOT. Know the law.

Production rigs and SNG trucks usually fall into *Category A* of these regulations, unless the cabs are towing units of less than 10,000 pounds, in which case, they are under *Category B*. If a CDL operator is required, logs must be kept. These will be scrutinized by DOT if there is an accident. If more than 26,000 pounds, the truck must submit to DOT weighing at all weigh stations. Experienced operators warn that tires, lights and reflectors are favorite items for DOT inspectors. Carry spare lamps for all lights on the vehicle, including headlights. DOT can stop, hold and fine any truck for violations. Some states are worse about this than others and many operators warn, "Never go through Virginia with full tanks." By the summer of 1996, many of the differing state regulations will be unified under the Intermodal Surface Transportation Efficiency Act (ISTEA), sometimes referred to by DOT officials as "ice tea." One good source of information on truck regulations is J.J. Keller & Associates, Neenah, WI (800-558-5011). Keller sells "compliance tools" and publishes regulations books.

The weighing and paperwork involved with the big rigs will cause delays, so allow plenty of time to reach your destination. Don't be forced into hurrying. Good man-





At top, this production truck's power bay has been hastily hooked up to mains incorrectly. Center photo shows the proper hook up, routing cables through duct on left side of power bay. This allows the power bay door to be completely shut (bottom photo), providing increased safety and security.

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Safety awareness for ENG/SNG operators

By Peter Zawistowski

Broadcasters, like most people, have a great respect for life. But often, remote vehicle operators place their lives in needless danger. Microwave masts coming into contact with overhead power lines, lightning strikes, dubious AC-power configurations and runaway vehicles are some common areas of concern.

At many facilities, experienced field personnel pass along safety techniques to other operators. What is being done at your facility to train new staff on safety issues? Does your station have a formal training program or safety guidelines for remote productions? Has the truck operator ever seen the manufacturer's operations manual? Simple as it sounds, playing it safe is the best policy.

You're either safe or you're out

Lightning kills or injures more than 1,000 people annually in the United States. Most of these people are in the vicinity of the strike and not struck by the lightning directly. Many operators feel that they earn a badge of courage by staying on the air during storms. This poses a hazard not only for the truck operator but the crew, talent and bystanders. You can't count on the time difference between lightning and the sound of thunder (five seconds is approximately one mile of distance) for estimating a safe distance. Remember, the distance is horizontal and vertical. The lightning could be directly above you, a mile or so high.

Mast safety is another perennial concern. How many times have you raised the mast without a 100% clear view of what's overhead? Especially at night, even with a mast with spotlights, you cannot be sure about overhead clearances. An ENG crew with its truck squarely on the ground, jacks down, leveled and with wheel chocks cannot be certain that the mast will not sway into danger. How many times have you sent back storm footage of live power lines dancing in the street? Are you really sure that overhead line will not touch the mast in high wind? Some power companies offer videotapes or training to those who work near power lines. During winter, operators should also be aware of falling ice. Masts purged of air, but refusing to come down all the way due to an ice-layer buildup, may give a false indication that the mast is retracted when it is still at least partially deployed.

A safety quiz

Are fire extinguishers standard equipment in the truck? Are they easy to reach? What types of fires will they work on and are they recharged and up-to-date? Think about your first-aid kits. Include burn cream for those who handle hot lights or wind up their cables too fast, as well as treatments for all types of cuts and bruises.

Proper stowing of equipment in vehicles is another important issue. Is everything safely secured, even in the case of unexpected maneuvers? On the smaller ENG vehicles are there backstops to prevent cameras, tripods and other equipment from jettisoning forward into the driver's area? Is seating in the van safety-rated and equipped with seat belts?

Regarding AC power, are outside breakers GFI rated? After connecting to "shore power," can the voltage be displayed on a meter before turning on the main circuit breakers? Does everyone involved know how to turn off the main power if a problem occurs? Is all the equipment being used properly grounded and UL approved?

Three other rules: 1) Keep all loose clothing, neckties and ponytails away from operating generators. (The cooling fan and related spinning belts will have no mercy on those who intrude without caution.) 2) If you don't know if something is temperature-hot, assume it is. 3) If you don't know if something is power-hot, assume it is.

Glowing in the wind

RF energy is a concern to all SNV operators, but disregarded by many ENG operators. The roof area on an SNV is never a spot for camera use. The satellite dish on top of SNVs can emit hazardous amounts of RF energy. The area behind and next to the antenna may also have hazardous emissions as well as a potential for harm from mechanical motion if the antenna is repositioned — either on purpose or by accident. ENG microwave systems may also emit hazardous amounts of RF energy that you won't immediately notice.

Most manufacturers are testing their vehicles for carbon monoxide (CO). Many are equipping their ENG vehicles with outside-the-vehicle mast operation only. When the mast is not stored, do all warning lights on dashboards, equipment racks and on the I/O panel indicate properly? All the safety lights, spots and warning horns are ineffective if the safety system isn't tested regularly or if it is bypassed because of a broken or missing part. Most manufacturers will offer training on their vehicles, but who receives this training? Who will disseminate this information to all the truck operators? Who will train the new operator and issue this vital information?

Review your station's safety guidelines. Help establish a safety program for new and experienced operators. Always look up, chock your wheels and keep one hand in your pocket. ■

Peter Zawistowski is senior engineer at Target Enterprises, North Reading, MA.

Editor's note: The author is interested in your comments and training resource suggestions on establishing a Certified Operator course for ENG and SNV operators. See the numbers in the box on p. 22 to send comments to *BE* editors.

Thanks to Lisa Robinson of Frontline, Mark Leonard of Wolf Coach and Ted Kendricks of ENG Mobile Systems for their input to this article.

agement will always give the final authority to the operator on the scene, for *all* trucks. ENG operators don't require CDLs, but vehicle insurance may be cheaper if the operators have been certified through a training course. American Family Life Assurance Corporation. (AFLAC) of Columbus, GA, owns several broadcast stations, and the company offers such a course to the employees of its broadcast division. It has also produced a comprehensive manual on ENG safety.

On the job

Once the truck is parked and the engine is turned off, the issue of security becomes foremost. On the big rigs and SNG trucks, the cab is the main area that is vulnerable to unauthorized entry, but ENG trucks can be entered in a number of spots. It is surprising how often ENG trucks are left unlocked and unattended at the site of a big story. Here again, haste is often the culprit.

Use a well-known and reputable security company for remote trucks. Other remote truck owners are good sources of recommendations for security firms. Be sure to establish an appropriate security plan with the company you select. Include a policy that ensures your truck operator will retain authority to change the security plan if there are any problems while a guard is on duty.

Some thieves specialize in remote trucks and walkie-talkies are almost always a prime target. For remote trucks, security is not only an after-dark problem. Rowdy sports fans and rioting crowds have been known to injure

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remote crews or damage vehicles. Whether it's lightning or a nasty crowd, if the operators say it's too dangerous to stay, they should have the final call on it, with no fear of penalty.

The big trucks should always have a licensed electrician perform the power connection, not the local "generator guy." In most cities the rule is: no electrician, no power. Local fire inspectors *will* shut you down if no electrician is on hand. Entertainment cable is also required for high-current (big truck) loads. Unlike the traditional welding cable, entertainment cable has insulation graded for 220V, high-amp service. The truck's power leads must be shut away from unauthorized access while connected. The terminals should be cleaned and tightened frequently because the continual jolting and vibration they experience on the road tends to shake some connector types dangerously loose, and arcing can occur when power is applied. Camlocks are the most reliable.

Grounding is a subject worthy of volumes. Ground loops and audio hum are the usual reasons for disconnecting the power ground in the heat of battle, just before or during a show. Some operators have even made ground connectors that have no actual connection inside but *look* like the real thing just to get past the local fire department. If possible, it's always safer to lift the ground on individual mic lines instead of pulling the power ground. It's also good practice to run truck power to *all* users who are connected to the truck by audio or coax lines.

Three-phase power should involve five lines; three hot lines, a neutral and ground. If the truck has an internal power transformer aboard, it can supply neutral, in which case, four lines connect to the mains supply. On trucks with internal power transformers, as most are nowadays, ground loops are less common.

In the ENG world, the antenna mast is a favorite for horror stories about truck safety. There have even been fatalities when masts have been raised into or driven through power lines. Some ENG trucks have an interlock that will not permit the ignition to be started or the truck to be put in gear when the mast is up. This has, in some cases, caused problems with the vehicle warranty. Another method, though it doesn't physically prevent the mast from being raised into trouble, sounds a deafening klaxon in the driver's ear the moment the ignition is started with the mast up. Another scheme has a spring driven key in the bumper that has to be held by a second person, outside the truck, when the truck location has to be "bumped" for a better microwave shot.

The air seals in ENG truck masts have been known to wear out. If such a mast is overpressurized, its top section can be launched like a rocket, taking the antenna with it, on a ride that inevitably includes a painful and expensive landing. Wolf Coach in Boston and TV Engineering Corporation in St. Louis have built many an ENG van, and they are a good source of safety information on these vehicles.

Know your truck, know your route and know the law. For broadcast trucks, safety gremlins of all types are waiting out there, and haste can often waste you. Whether it's dealing with power, thieves or the road itself, you issue them all an engraved invitation to bother you when you're in a hurry. ■

Bennett Liles is an audio engineer at Georgia Public TV, Atlanta.

For more information on remote vehicles, circle (102) on Reply Card. See also, "Vehicles, Production, ENG/SNV," p. 96 of the BE Buyers Guide.

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Circle (17) on Reply Card

By T.C. Hall

Internet access software

One year ago this month, the long-awaited Internet In a Box (IBox) from SPRY was released, and finally the high barriers to Net access crashed down and the masses were allowed to rush in. IBox proved to the world that getting on the Net did not take a background in UNIX programming or a working knowledge of an alphabet soup of acronyms like TCP/IP, PPP or POP. SPRY promised "instant access," and though its definition of "instant" meant about 15 minutes from out of box to Web browsing, the IBox experience represented a significant user paradigm shift for the experience of actually getting on the Net.

Internet access suddenly became easy

A year later, SPRY was gone (it is now CompuServe's Internet Division thanks to a $100 million buyout), but the definition it established for a proper consumer Internet access product remains. To be considered successful, a vendor needs to supply all the basic tools (Web browser, Gopher, FTP, newsreader, telnet) with some brain-dead automated Internet access process.

Where is the market now? The greatest flexibility in products and platforms is still afforded by hooking up with a local service provider giving SLIP or PPP access for a monthly fee. The trick is finding the right Internet provider with the tools and the ease-of-access to get what you desire from the Net.

This month we will look at Macintosh- and Windows-based all-in-one Internet access packages. As you might guess, the selection of Mac products reflects the 10% (or so) market share that Apple enjoys, but I have managed to put together two Mac options and two Windows options. For the record, the packages were evaluated on an IBM PC 720 and a Power Mac 601/66. Both machines were using 14.4 modems.

Windows products

• *IBox 2.0:* The granddaddy of Internet access tools is still easy to install and manipulate. A year ago, as a Windows newbie, I installed a beta of IBox on an IBM Thinkpad in a matter of minutes while reclining in bed. The products evolution has matured to include some neat new features (a new search mechanism with Internet Wizard and direct access to CompuServe's WINCIM), but the basic ease-to-Net has not changed. You can still get instant access through CompuServe's network (the actual wires, not the on-line service). It takes a few minutes while your computer talks to a remote server, or you can pick up your phone and call one of the service providers SPRY includes in its manuals.

The knock on IBox is its browser because it still is not as fast as Netscape's Navigator. But overall, the suite of Internet tools you get is hard to beat. SPRY's Network file manager is still the best integration of Windows file manager and a file transfer protocol (FTP) client, allowing incredibly easy drag-and-drop transfer of files. The newsreader comes pre-loaded with specific topic groups, and IBox makes it easy to create your own groups. All in all, SPRY is still doing a great job of holding the hand of the Net novice. My advice for Windows people is to get IBox and then download Netscape to use as your browser.

• *Netscape Personal Edition:* After giving away its browser for almost a year, Netscape is ready to get some revenue from the market share it has built. Some reports say Netscape has more than 70% of the browser market, which is easy to believe because their "Navigator" is by far the quickest tool out there to surf the Web. Netscape is now trying to get into the retail channel, and the Personal Edition is its first product to hit the shelves. The problem with this product is certainly not the browser or the instant connection (a nice selection of options that gets you up quickly), but the package it delivers. The only tools Netscape gives you is Eudora and Navigator. Netscape will tell you that's all you need, but although a Web browser can do a lot, it still lacks some basic functions. Navigator still can't do telnet (which some people will want to do once they get a little Net savvy), and using it for newsgroups will be extremely s-l-o-w. Also, although Netscape can download using FTP, it does not let you put through a file using FTP. This one-way transfer will become frustrating for users as their knowledge matures.

Mac products

• *Internet Starter Kit:* The Internet Starter Kit (ISK) is actually older than IBox, but it can't really be considered in the same league because it is actually a book that comes with repackaged shareware. ISK gives you the software to set-up an Internet connection with MacPPP and MacSLIP along with the applications to get you surfing with turbo Gopher, Fetch (FTP) and MacWeb (Web browser). A downside is that it does not supply a newsreader. The tools are mostly there, but it takes some doing to actually get up and running. ISK tries to walk you through the process, but be prepared for the frustration that IBox originally tried to solve with an instant connection. When I used ISK, I had to spend a few days with a provider getting all the numbers in place. You also have to watch out for MacPPP and MacSLIP; due to their shareware status, they are not stable. Still, if you are looking for an easily acquired package that will point you in the right direction, then the Internet Starter Kit will work fine.

• *The Whole Works:* On the surface, the WELL Whole Works (WW) is not much different than ISK. There are, however, three major differences. One is that the WW gives you Netscape's browser that is head and shoulders above MacWeb. The second difference is that WW gives you better direction to getting a Net connection. The third is that the Well is, well, The WELL. As a 10-year pioneer in the on-line services business, the Well has created an aura that is special. The Whole Works lets you experience this as the package also provides the software to the WELL's renowned on-line community. Besides Netscape, the other tools are Turbo gopher, Fetch, MacPPP, Eudora (E-mail), and Natius (a newsreader).

The other option is to take the plunge with an on-line service. Prodigy, CompuServe and America On-Line (AOL) all offer Web and general Internet access for Windows users, but only AOL has a Mac offering. The on-line services are also easy and deserve attention. But that's a different column. ■

T.C. Hall is a senior account executive at Niehaus Ryan Haller, a high-technology public relations firm in South San Francisco.

Macintosh- and Windows-based all-in-one Internet access packages

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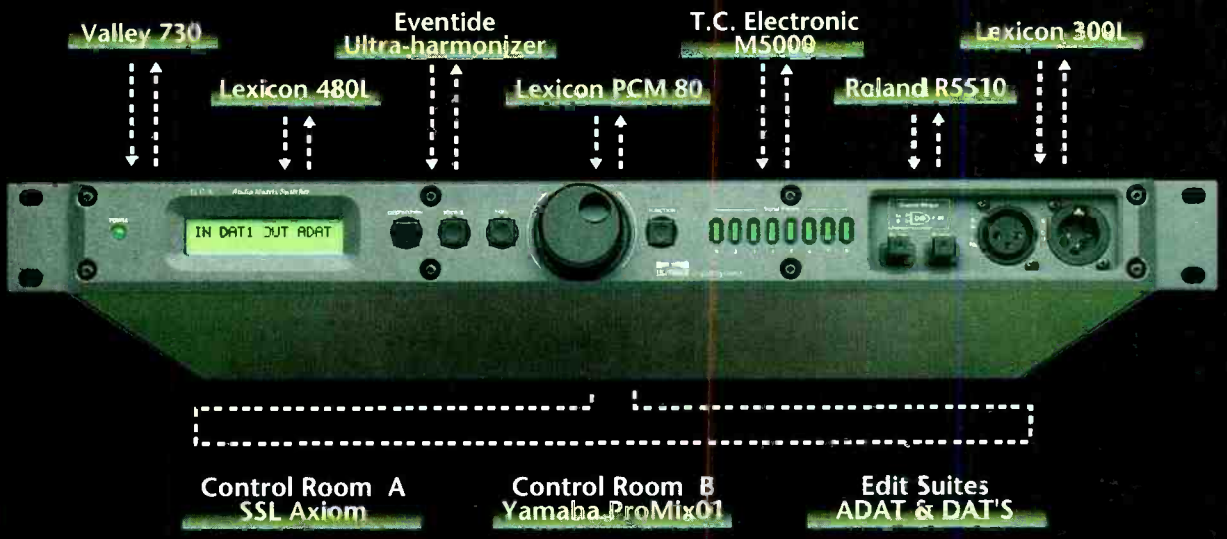

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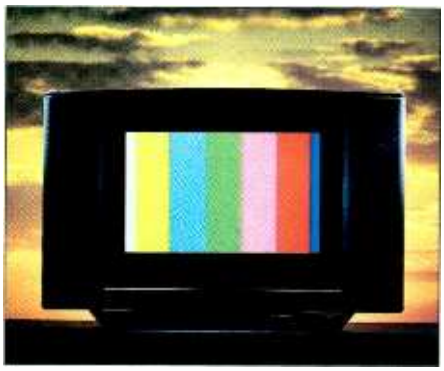
By Louis Libin

Interpreting your new advanced TV coverage



In this column, we've discussed how stations can begin planning for ATV implementation. We've touched on the factors that the FCC will use to make the final ATV channel determination – your new ATV assignment. Shortly, the commission will officially adopt a standard for a new advanced TV broadcast service. To begin the implementation phase, the commission will assign each of the approximately 1,700 TV stations a new channel. The ATV channel will be paired with the current NTSC channel and most of the new ATV assignments will be in the UHF band. The question I will address in this column is: Will your current viewing audience be able to receive the new ATV signal?

Laboratory and field tests have confirmed that ATV can outperform NTSC transmission. ATV can deliver HDTV-quality pictures into the fringe areas of NTSC with lower transmitter power. But how can you, the chief engineer, assure the station manager that the new channel assigned to your station is sufficient to provide good ATV coverage of the station's service area?

How to interpret the new coverage

Interpreting ATV coverage is different than interpreting NTSC. Broadcasters need to evaluate how NTSC stations could impact the ATV channel. All local ATV channels must be thrown into the equation because they may impact either or both of the ATV and NTSC coverages. What, if any, new interference will there be into the NTSC service area? The existing service area of NTSC stations is the baseline against which ATV assignments are assessed. The NTSC service area is defined as the area within the predicted Grade B contour reduced by areas where interference caused by other NTSC stations exceeds the *slightly annoying level* as determined by tests at ATTC.

Interference levels

The interference level is expressed as a desired-to-undesired (D/U) ratio of predicted signal strengths. An acceptable, or permitted, level of an undesired signal is a signal strength that is less than or equal to the signal strength of the desired signal by a specified D/U ratio measured in decibels. That is, the strength of the desired signal must exceed the strength of the undesired signal plus the D/U ratio as measured at the receiver terminals. In this sense, the D/U ratio may be viewed as the threshold for the onset of unacceptable interference from that signal.

Laboratory and field tests have confirmed that ATV can outperform NTSC transmission.

Measuring signal strengths

A D/U ratio compares the signal strengths of the desired signal and an undesired interfering signal at a given location. The signal strengths are measured or derived according to a criteria of location and time availability. For instance, the desired ATV signal is determined according to a 50/90 rule and, except for close interferers, the undesired ATV or NTSC signal strength is determined according to a 50/10 rule. That is, the desired signal is to be available at 50% of locations for 90% of the time, and the undesired signal is available at 50% of locations for no more than 10% of the time.

A larger D/U ratio signifies a more stringent interference rejection criterion. There are individual D/U ratio parameters for each type of interference. The types of interference considered include co-channel, adjacent channels and taboo channels for all combinations of ATV and NTSC signals as the desired and undesired stations. For instance, the D/U value for NTSC-to-NTSC co-channel interference is 28dB with normal frequency offset.

ATV service area

The most critical parameter of an ATV allotment plan is the separation distance between a new ATV transmitter and an existing co-channel NTSC transmitter. An ATV transmitter power level that would support an ATV coverage area comparable to the existing NTSC Grade B contour could create interference within the service areas of other NTSC stations. This would occur when the co-channel separation parameter is set to the largest distance that will permit all existing NTSC stations to be paired with ATV channels. The goal is to assign the ATV channels in such a way that any ATV interference into NTSC falls mostly in areas already lost to NTSC interference. Any reduction of NTSC service areas is termed *new interference*. An ATV transmit antenna is assumed to be at the same location and height and to have the same directional pattern as the antenna of the paired NTSC station. The noise-limited contour of an ATV station is where the predicted signal strength, in the absence of interference, is just sufficient for errors in the received signal to not exceed the threshold of visibility.

The Advisory Committee has determined this threshold as a digital signal bit error rate of 3×10^{-6}. This bit error rate is achieved at a signal-to-noise ratio of 14.9dB. The ATV service area is the area within the noise-limited contour reduced by the areas where interference from ATV or NTSC stations is above this threshold of visibility.

ATV signal strengths

ATV reception requires a certain minimum signal strength. It is a digital system, which means that the picture and sound information is encoded into a datastream of binary numbers. So long as there is sufficient signal strength for the decoder to decode digital data, a perfect picture will result. If the signal strength falls below that level, the system crashes and no reception is possible. There is no gradual deterioration of picture quality with increasing distance from the transmitter as with NTSC television. Thus, there are no grades of coverage; it is all or nothing.

The propagation disparities between the different channel groups is easily seen. Channels 2-6 require signal strengths in the 20-30 microvolt per meter (uV/m) range. For channels 7-13, the requirement is around 60uV/m, and for UHF it varies from 120 to 200uV/m.

The ATV channels can be assigned so that the new service areas closely replicate the existing NTSC service areas. Generating a good assignment table is a lengthy and complex process, but one that is nearing completion. Terrain mapping data can be used to predict signal propagation, coverage and interference. Most important, the higher power of UHF stations can be used to a station's advantage to provide robust signals in urban areas. ■

Louis Libin is the director of technology at NBC, New York.

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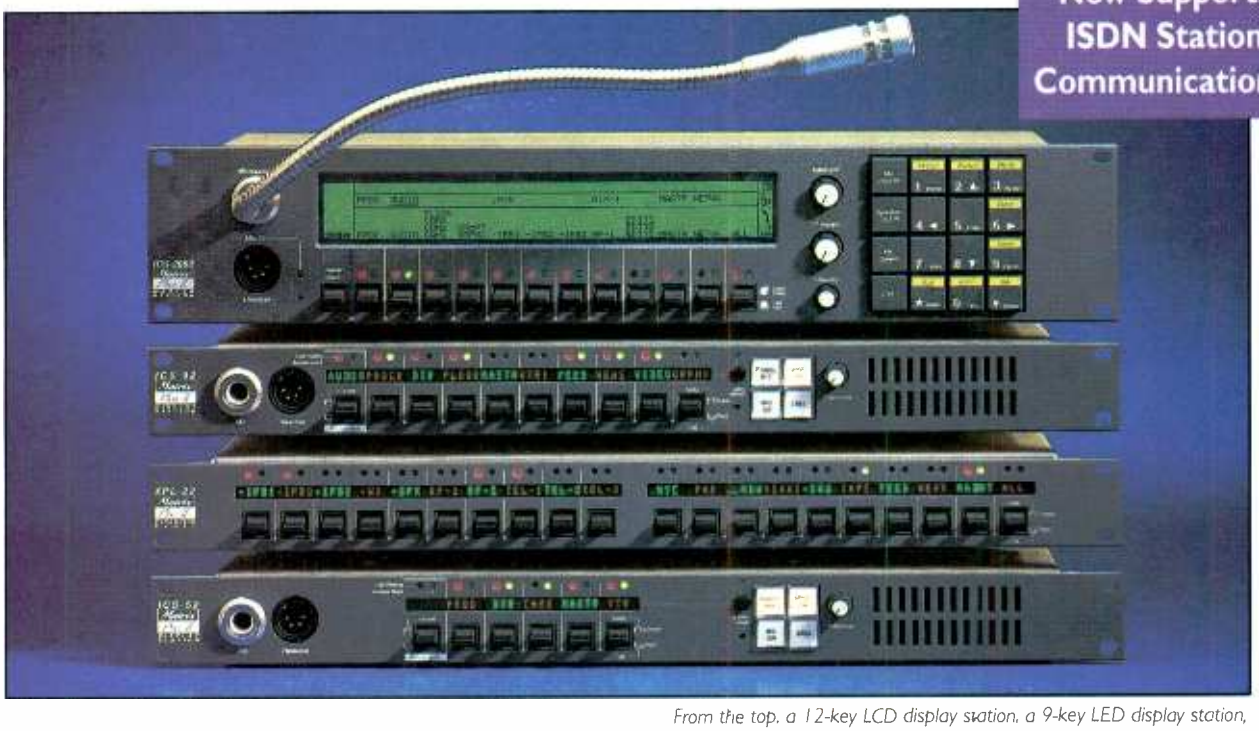

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By Skip Pizzi, technical editor

A digital TV audio primer

Digital audio is becoming a way of life for broadcasters.

The Bottom Line:

As both the video and audio components of TV broadcasting become digitized, it is a good time for broadcasters who never felt fully competent with audio to ratchet themselves up to speed. Many consumers already expect CD-quality sound, and all the new storage and transmission formats in broadcasters' future will include it. Study hard — you may find that it's familiar territory. $

Above photo: The CCS Pace, a networked audio workstation designed for high-end news production, is shown in use at CBS, Washington, DC.

Lately, it seems that the words "digital" and "audio" are seen together as often as a couple of newlyweds, and their honeymoon doesn't show signs of ending anytime soon.

This trend may make broadcasters who gravitate toward video feel more comfortable than they did with analog audio systems. That's because digital audio is more like video than analog audio, particularly in terms of bandwidth, termination and synchronization. Like video, digital audio is a frame-based signal rather than a continuous one like its analog predecessor. This similarity also produces numerous synergies for digital audio in the emerging serial digital video world.

Digital audio basics

All audio signals ultimately originate at a microphone, which remains an analog device at present. Ideally, however, the microphone's output is converted as quickly as possible to a digital signal. This typically occurs at the output of the microphone pre-amp (also still analog), which amplifies the relatively weak signal emanating from the microphone (typically a few millivolts) to *line level* (around 1V).

The digital audio signal is then generated by an *analog-to-digital converter* (ADC), which samples and quantizes the audio signal coming from the microphone pre-amp. Based on the well-known *Nyquist Theorem*, the sampling rate of this converter must be at least two times the highest frequency to be sampled. Because the audible bandwidth (for humans) is considered to extend to about 20kHz, digital audio sampling must occur at around a 40kHz rate if high-fidelity audio is to be reproduced.

Three "standard" digital audio sampling rates have developed around this value. The most common is 44.1kHz, the sampling rate used in the compact disc (CD) format. In the professional audio world, a 48kHz standard sampling rate is used for most digital audio recording. For less-demanding applications, a 32kHz standard also exists, which is supported by some professional and consumer recording equipment. It is typically employed for extending storage capacities where a 15kHz audio bandwidth is adequate (such as for speech or non-critical music recordings).

Quantization of the data acquired at each of these sampling points is usually stored with 16-bit precision (again based on the CD format), although a few devices offer 18- or 20-bit digital audio resolution (such as some DVTRs). Some digital signal-processing equipment and mixing consoles operate with 24-bit paths.

The discrete values of these quantized samples are encoded with various forms of forward error correction (FEC) and then modulated in an appropriate form for storage or transmission in the digital domain. Most often, *Reed-Solomon coding* and *pulse-code modulation* (PCM) are used for these purposes. Because the receiver or playback device need only detect the presence or absence of these coded pulses, the signal is rendered immune to most artifacts inherent in the medium. Most noise and distortions of the medium, which would be irreversibly added to an analog signal, are ignored by the digital process. This is the primary advantage of digital audio technology.

Eventually, the digital audio signal is reconverted and filtered to a continuous analog voltage by the *digital-to-analog converter* (DAC). The DAC and the ADC are the limiting factors to the aural quality of a linear (i.e., "uncompressed" — more on this later) digital audio system.

In any digital sampling system, the amount of data produced by the ADC is critical to the system's storage and transmission-bandwidth requirements. This *data rate* (in bits per second) is determined by multiplying the sampling frequency (in Hertz) by the resolution (in bits). Therefore, the typical 16-bit, 48kHz-sampled digital audio converter operates at a 768kb/s output data rate per audio channel. If multiple audio channels are involved, as is often the case with audio, the digital signal is usually formatted as a single, multiplexed datastream that includes all channels' data. The total data rate of this multiplexed signal is the single-channel data rate times the num-

ber of channels involved. Therefore, a typical stereo (2-channel) digital audio converter produces a 1.536Mb/s data rate. This value (abbreviated to 1.5Mb/s) has become a standard metric in the digital audio world for "CD-quality" digital stereo audio transmission. A related benchmark for stereo, CD-quality digital audio storage requirements is 10MB/minute. (These values are often referred to as "raw" data rates, because they do not include the system- or format-specific overhead added for FEC and headers.)

RESOLUTION (bits/sample)	COMP. RATIO	DATA RATES (kb/s), PER CHANNEL		
		f_s=48kHz	f_s=44.1kHz	f_s=32kHz
16	1:1	768	705.6	512
8	2:1	384	352.8	256
4	4:1	192	176	128
3	5.3:1	144	132.3	96
2.67	6:1	128	117.7	85.4
2	8:1	96	88.2	64
1.45	11:1	69.6	64	46.4
1.33	12:1	64	58.8	42.6

Table 1. Digital audio data rates produced by various sampling frequencies and resolution levels. Values shown are for a single (mono) audio channel. Audio bandwidth is approximately one-half of fs.

Serial digital audio distribution

The standard method for professional digital audio signal transport throughout the production facility is the *AES/EBU* format. (The name comes from two industry organizations, the Audio Engineering Society and the European Broadcasting Union, who jointly developed the standard.) It combines two audio channels into a single signal, using alternating left- and right-channel subframes, each with up to 24-bit audio resolution. It is self-synchronizing and includes auxiliary bits for error checking and user data.

AES/EBU can travel on twisted-pair cables, but path lengths are limited and 110Ω cable and terminations are specified, because of the signal's 3MHz nominal bandwidth. Its standard connector is the XLR-3, and the signal is electrically identical to RS-422.

Several manufacturers offer AES/EBU switchers in small (8x8 and the like) stand-alone devices or large, facility-wide routing systems. In the latter case, these routers are usually designed as hybrid devices, using separate analog and digital matrices, with tie lines between them. As the facility migrates from analog to digital, the relative size of the two matrices can change accordingly. (See "Getting There: Format Conversion," August 1995.)

Advantages of integration

While AES/EBU replaces traditional analog audio routing, two other methods of routing digital audio are also emerging. The first places digital audio signals into the serial digital video (SMPTE 259M) signal in a process known as *embedding*. This allows a single serial digital signal to carry the entire TV program — multichannel audio, video and ancillary data — on a single cable and via a single signal path through the facility. Multiplexing and demultiplexing equipment assembles and disassembles the components of the serial digital TV signal. (See "Transition to Digital," July 1995.)

The second new approach to digital audio routing occurs between computer-based production devices, such as digital audio workstations (DAWs). The non-linear storage systems used by these devices allow the transfer of audio data in the form of data files rather than as real-time audio signals. Such *file-based* or *asynchronous* transfers are becoming popular in the DAW environment, both via LAN within a facility or between facilities, using dedicated or dial-up transmission paths of nearly any available bandwidth. A primary advantage of file-based transfer is its ability to accommodate a wide range of transmission bandwidths. A narrowband path does not affect the audio quality of the program — it only makes the transfer take longer. (See "Digital Audio Workstations," August 1995.)

Digital audio is more like video than analog audio.

There are many places in the facility where it is still desirable to maintain separate, real-time audio, video and ancillary data paths. This is why the multilevel analog/digital audio routing systems mentioned earlier will remain popular even as embedded audio and file-based LAN transfers proliferate.

Another venue for integration is within the DAW platform, where feature sets continue to grow. In the broadcast environment, this handy trend incorporates text, audio and video, thus allowing more production to take place on a single workstation and generating a single multimedia archive file.

Audio data compression

Although the data rates and storage needs of digital audio seem paltry by digital video standards, reductions of these requirements through *audio data compression* (or *bit-rate reduction*) systems can still help to significantly improve cost-effectiveness and productivity in the digital facility. Human perception of sound is not as forgiving as the human visual sense, so lossy compression algorithms that exploit such sensory weaknesses (so-called *perceptual coders*) can only reduce data requirements by a moderate amount. Reduction factors of 4:1 to 6:1 are common, and up to 12:1 is occasionally possible. Resulting data rates are shown in Table 1. (See "Audio Data Compression 101," September 1994.)

A concern with higher data compression ratios is how robust the signal will be if it encounters multiple generations of encoding and decoding. For this reason, lower ratios are recommended for transmissions involved in the production of programs and their distribution to network affiliates and headends. More aggressive compression can be applied at the final transmission stage (after which it is unlikely that subsequent data compression will be applied).

On the broadcast production side, the use of data compression is not yet widespread. With today's algorithms, however, high fidelity can be maintained while storage requirements are cut by 80% or more. Equally important is the increased traffic that a LAN of given speed can carry when each audio signal traveling through it is reduced to a fifth of its original bandwidth. For some applications, these advantages will justify the hardware/software cost and qualitative risks of audio data compression, so its use may become widespread in production and transmission systems.

Multichannel delivery

As the age of digital TV program delivery approaches, broadcasters consider improvements in the quality and quantity of their audio and video signals. For audio, quality can be no less than CD-equivalent, and quantity must accommodate the multiple channels of home-theater surround sound.

A good example of this is the Dolby AC-3 system that has been identified for use in the Grand Alliance ATV transmission format. It is a 5.1 channel system. This means that it carries five full bandwidth audio channels

Continued on page 87

Here's How Cable Operators

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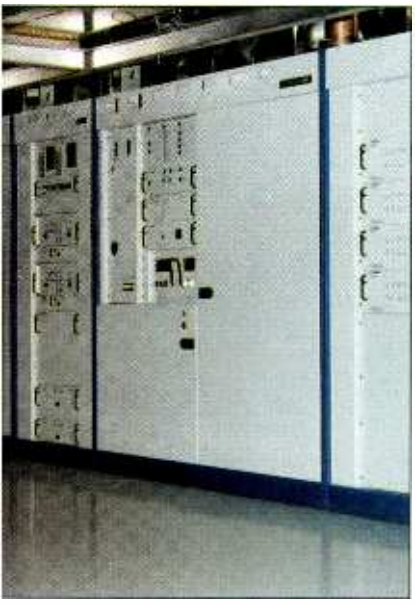
Circle (9) on Reply Card

Building a transmitter site

By Donald L. Markley



Courtesy of Comark

Know the basics before building your transmitter site.

The Bottom Line:

Building a facility for a new transmitter is a lot like getting married. If you don't put a lot of thought into what you do, you will live with your mistakes for a long time. What may at first seem like little glitches you can live with will become a constant source of irritation and expense. Before diving into the task of constructing your transmitter site, think the whole thing through carefully. $

For the purpose of this article, let's assume that you have a construction permit for the new site and the appropriate zoning to construct the necessary structures. Your next step should be to go to the local authorities to determine exactly what documentation is needed to obtain the necessary building permits. This will vary widely depending on your area and can include such things as planning for hurricanes or earthquakes. Luckily, these two things do not commonly occur in the same location. In any case, you may need the services of a professional architect to assist you in the fine points of building design and to prepare the necessary documentation.

Electrical service

Some things are common to all sites regardless of the type of facility or size. The first is the availability of acceptable electrical service. For small transmitting facilities, single-phase power may be adequate. If the proposed facility is this type, you need only look into reliability. For larger facilities, 3-phase power will be required. All transmitting facilities requiring 3-phase power should only be served from either a "wye" or a "closed delta" system. It is not uncommon to have a utility company argue that a system called "open delta" will work just as well. It won't. No two ways about it.

Open delta systems may be fine for grain dryers or some simple motor loads, but the transients involved and the voltage variation across the open phase is not acceptable when the load is a high-voltage power supply. Many manufacturers are serious enough about this problem that your equipment warranty is void if you connect to an open delta system. Harris Inc. offers an information packet on this subject. See the Reader Service Number at the end of this article to obtain a copy.

Another problem is determining the actual service required. For large systems requiring voltages greater than 240V, you will have to provide your own transformer for 120/240V loads. The utility company normally will only provide one type of service. Therefore, if you need 440V 3-phase power, you will need to have a step-down transformer for smaller loads. Your electrical contractor can normally handle this with no problem if you provide him with the magnitude of the low-voltage load. Remember, if you have the higher-voltage 3-phase service available, the heating and air-conditioning loads can be placed on that service and do not need to come from the transformer.

Standby power

The power company should be able to give you a record of power outages for the line that will be serving your site. A good backup to that data is to talk to the neighbors. A judgment call needs to be made at this point as to what amount of downtime will be acceptable from the new site. If you are at the end of a rural line, which is often down for a few hours every month or so, standby power may well be in order. This is especially true if your station is in a major market and is faced with the competition that such markets offer. The design of a good standby facility is more than adequate for an article by itself and beyond the scope of this article. However, a few main points should help take the aspiring station builder in the right direction.

First, contact a reputable dealer that is nearby. Your choice of equipment brand may be dictated by the availability of service and parts. Also, a good dealer can help you greatly in designing your standby facility. After determining the required load for the facility, it will be necessary to determine the desired fuel. The choices are propane, gasoline, natural gas or diesel. All have advantages and disadvantages that will often be addressed by local regulations concerning storage. You should definitely have sufficient fuel storage to last a couple of days with the idea that you can bring in more fuel if necessary. That point needs to be modified somewhat if you have an extremely isolated site or if access is limited in bad weather. The EPA

Continued on page 36

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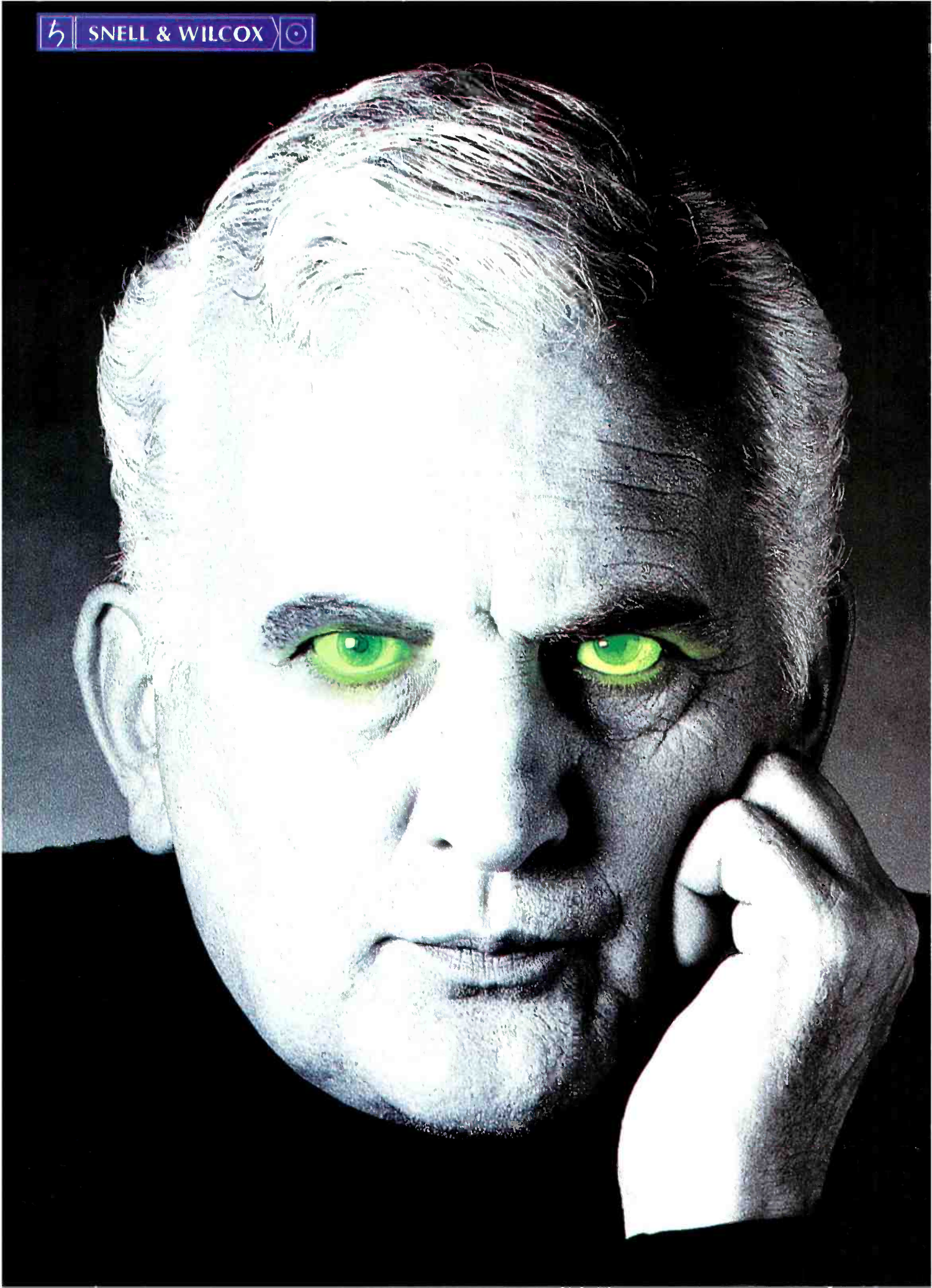

SNELL & WILCOX

Continued from page 32

has some tough requirements for fuel storage. Your dealer can guide you through this maze.

Unless the project is for a major facility, such as multiple TV stations, don't worry about peak-load sharing. The only needs are to get the transmitting equipment back into operation, keep the tower lights on and maintain minimal environmental control. For most facilities, it will be most economical to let the entire facility switch to the standby power equipment rather than stand the expense of equipment that will switch off non-essential loads.

KLDH-TV transmitter site September 1984. Setting bottom 150-foot section of replacement 1,439-foot tower. Note standby 400-foot tower in background. Tower crew is placing bottom triangle section on main pin on base plate.

Standby generator control systems are readily available that will allow delays in the system operation. First, do not start the generator immediately upon power interruption. A substation circuit breaker resetting will cause minimal program interruption and usually is not a good reason to start the whole facility into operation. If the power goes off for a reasonable period of time, 30 seconds for example, let the generator start. An additional reason for starting up the facility would be for an unacceptable reduction of voltage as in the dreaded "brownout." The power-line sensor should also recognize the loss of a single phase, a situation that can cause significant motor damage in blowers without actually shutting down the transmitter.

Another major delay should be used to determine when the system is switched back to the power lines. Do not switch immediately upon return of commercial power. In storms or during repairs, power often returns for only a few seconds and goes off again when circuit breakers sense that an overload condition still exists. Keep the generator running until it is definite that the primary power is back to stay. Then, let the generator run for some time to cool down after the load is switched back to the main service.

Concerning cables

Buried cable requires special treatment to enter the building. When the foundation is poured, have conduit elbows installed to route cables from the outside up into the cable trenches or to a vertical run along the outside wall. The elbows should be of large radius to permit cables to be pulled in easily. Then, the elbows should be carefully sealed to exclude rodents and snakes. These creatures like to crawl and slither into building openings a few inches below ground where they can get into a nice warm building. In addition to causing damage to equipment, nothing adds gray hair to an engineer's head like coming face-to-face with a snake in the bottom of a transmitter.

Nothing adds gray hair to an engineer's head like coming face-to-face with a snake in the bottom of a transmitter.

On the subject of cables, a simple trench in the floor will greatly aid in the equipment installation while maintaining a degree of neatness. The trench can easily be formed by the contractor at no significant cost. Have the trench formed with a lip on each side sufficient to hold a 2" x 12" plank. The planks can be cut to the necessary lengths and dropped into the trench resting on the lip. A 1-inch plank is not recommended. If used, it can be safely assumed that something heavy will eventually go through and cause damage to the most critical wire in the facility. When painted, the planks make a serviceable and easily removable cover over your wiring.

Building design

For a simple site, a building contractor can usually do the necessary design work for the building. For larger multiple room buildings, an architect is highly recommended. One thing that must be pointed out to the contractor or architect is that the building must be capable of withstanding falling ice. For short towers, at least two inches of wood will provide sufficient protection. In heavy-ice areas or near tall towers, more significant protection is required. Some stations construct a framework over the roof covered with either a steel grid or heavy wood, such as old railroad ties. It is also advisable to extend the ice shield to cover a parking area to provide protection to staff cars. If the tower is loading up with ice, it is highly likely that someone will be at the site to deal with the transmitter.

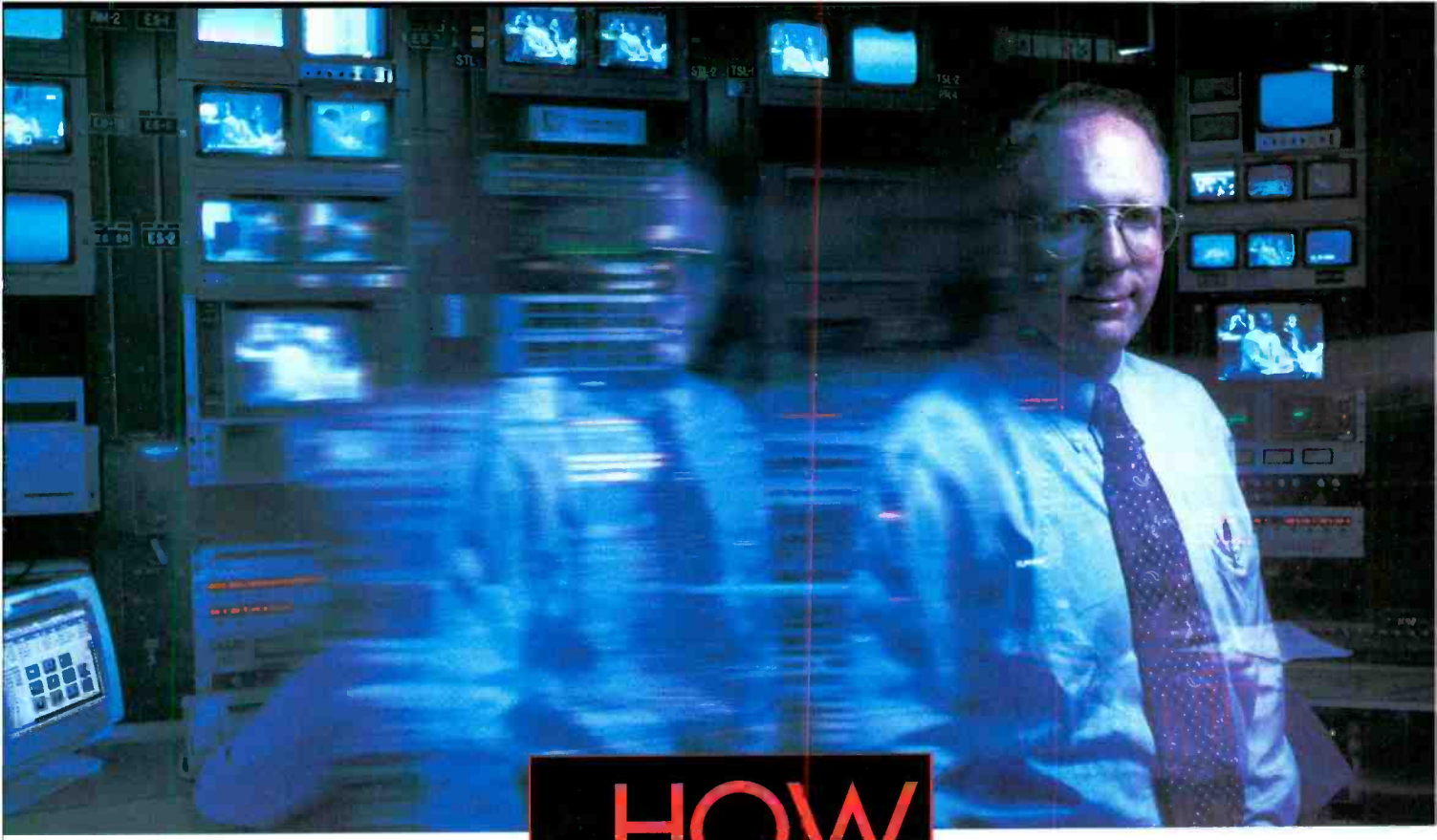
Water is not normally a problem at small sites. A good floor drain that simply runs outside of the building is helpful when washing the floor. Again, cover the drain with an appropriate screen to keep out undesired critters. The necessary sanitary needs are usually ignored at small sites. For larger sites that often have people present, a small rest room can be a blessing. If you are lucky, you will be able to connect to city water and sewer. Otherwise, a well can usually be drilled for a water source and a septic system can be installed. Again, some tests may be necessary for the septic field. Those tests can be conducted by a local civil engineering firm and provided to the authorities for a building permit.

Cosmetics and security

It is strongly recommended that the floor be sealed and that the walls be painted. The floor can be treated with any number of good, commercially available materials that will eliminate dust. Those materials will also leave a smooth, hard surface that can be mopped. The better materials are smooth enough to receive a coat of wax. In addition to making the place look better, the floor coating and wall painting will greatly reduce dust inside the building. The outside walls can be painted if you desire.

A major point to remember is that the site will probably be unmanned the majority of the time. Therefore, make everything rugged to withstand attempts at forced entry. You cannot prevent a dedicated attempt to get to your equipment, but you can deter casual vandals. Do not install windows in the building and use a heavy steel door with a strong dead-bolt lock. The door should be large to ease the problem of bringing in equipment. A good security system connected to a local

Continued on page 44



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A: *Carefully.*

Q: Right. So did you choose the Louth ADC-100 automation system to bridge to disk or give you future flexibility?

A: *Yes.*

Q: Meaning you liked Louth's ability to control all types of different devices?

A: *Yes.*

Q: And you weren't worried about any problems with proprietary automation software or choosing any disk vendor you wanted?

A: *No.*

Q: So if you were to give advice on how to make the transition to disk, without worrying about where your station goes in the future, what would it be?

A: *Louth.*

Q: And what about the multi-casting environment?

A: *Louth.*

Q: Of course, you'd still need a media management and traffic interface system to tie it together. Any final words of advice?

A: *Louth.*

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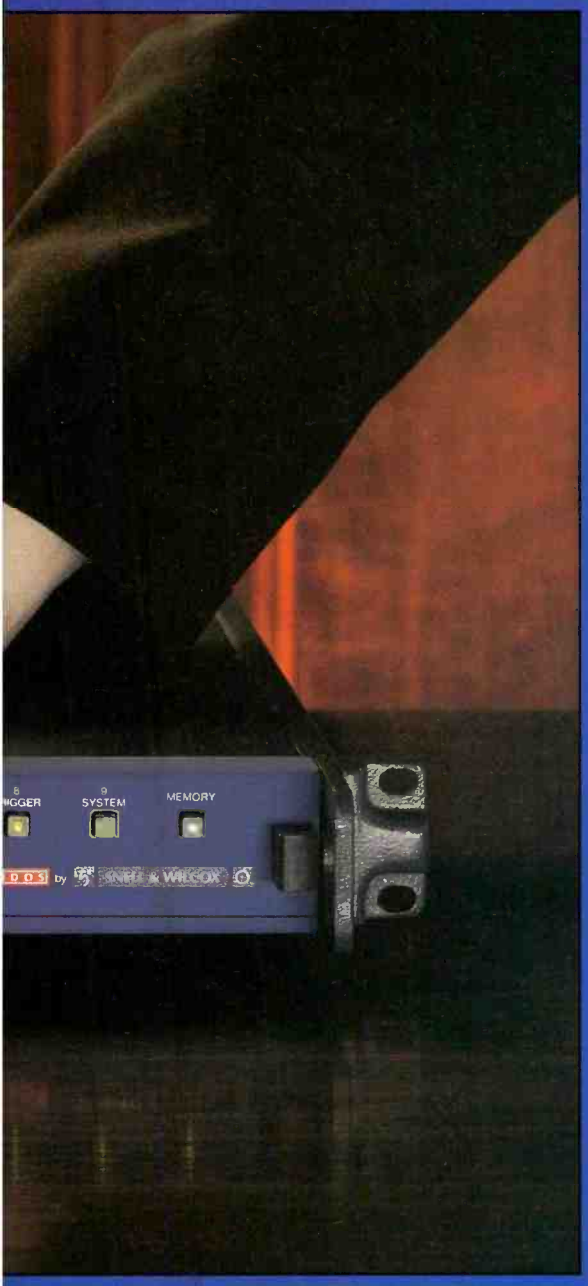

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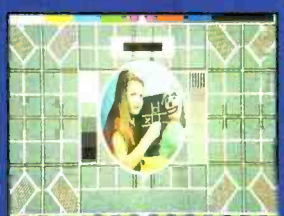

16:9 Widescreen Version of BBC Test Chart "F"

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Circle (31) on Reply Card

Connecting 3-phase power sources

By Steve Epstein, technical editor

In single-phase power systems, the power (VxI) is pulsating. The power curve goes through zero twice each cycle. If the *power factor* (ratio of the load resistance to the load impedance) of the load is less than unity, part of the power curve is negative. This represents power being returned to the source. In resistive circuits, such as those producing light and heat, this is no problem. In reactive circuits, however, it can present significant design problems. Properly connected 3-phase power supplies provide a less-pulsating power pattern. In addition, the three wires of a 3-phase source can supply 173% more power than the two wires of a single-phase source. Three-phase systems have three sources of power separated by a constant time interval. They are generated using a 3-phase generator in which the windings are separated by 120°.

A balanced delta-connected load is defined as three equal resistances or impedances connected in a closed-delta formation. A balanced delta-connected load and 3-phase supply is shown in Figure 1. Delta connections of this type work best when the three loads are balanced, such as in 3-phase motor circuits. However, when the loads are not or cannot be balanced, a wye connection may be used. Wye connections use four wires, three phases and a neutral. In a wye connection, the voltage between any two lines is equal to the vector sum of the two phases ($E_L=E_P\sqrt{3}$). A wye source properly connected to a wye load is shown in Figure 2. In a wye connection, the amount of current flowing in the neutral wire is equal to the vector sum of the currents flowing in each of the three phases. Therefore, if the loads are identical, the current in the neutral wire is zero.

Many times it becomes necessary to transform a 3-phase source voltage to a lower (or higher) 3-phase voltage. This can be done with a 3-phase transformer with a 3-legged core. The disadvantage of this method is the entire transformer must be replaced if a winding fails. Because of this, three separate single-phase transformers are often used instead. The primaries of the transformers may be connected in wye or delta, similarly, the secondaries can also be connected in a wye or delta. If the loads are balanced, any combination is permissible, however, harmonics in the magnetic circuits make the wye-wye connection undesirable in all but high-voltage applications.

An advantage of the delta-to-delta connection is that the system will operate with only two transformers. (See Figure 3.) When operating with only two transformers, this arrangement is referred to as *open delta*. In essence, a closed delta with a failed transformer, will operate in an open-delta configuration once the failed transformer is removed. This arrangement is normally only recommended for use in emergency or temporary conditions. One disadvantage of this method is all of the power is supplied by two rather than three coils and, therefore, larger coils are needed to carry the load safely. Two transformers in an open-delta configuration can only supply 57.7% of the power supplied by three comparably sized transformers operating in a closed delta. As noted in the main article "Building a Transmitter Site," this configuration has other problems and is not recommended for use with broadcast transformers. ■

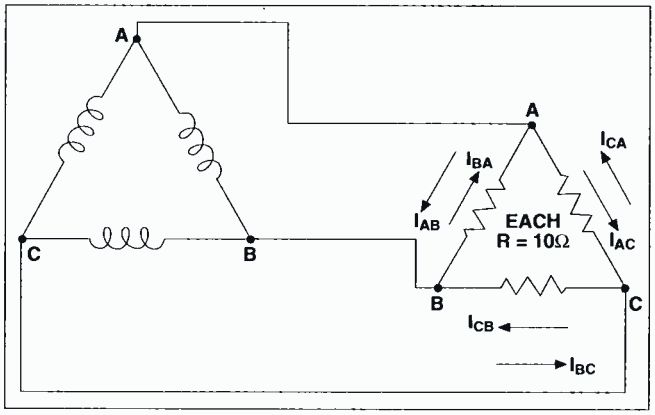

Figure 1. A balanced load connected to a delta supply in a delta configuration.

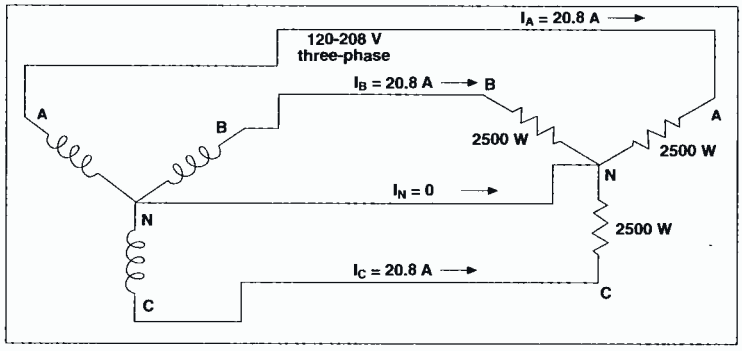

Figure 2. A wye-connected source and load using a neutral wire. The neutral wire carries current that results from any imbalance in the loads.

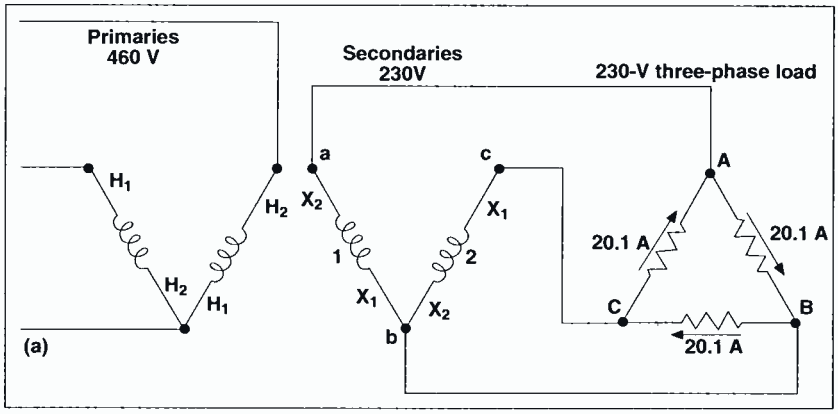

Figure 3. Transformers connected in open-delta system supplying a balanced 3-phase resistive load. This arrangement is not recommended for use in broadcast transmitters.

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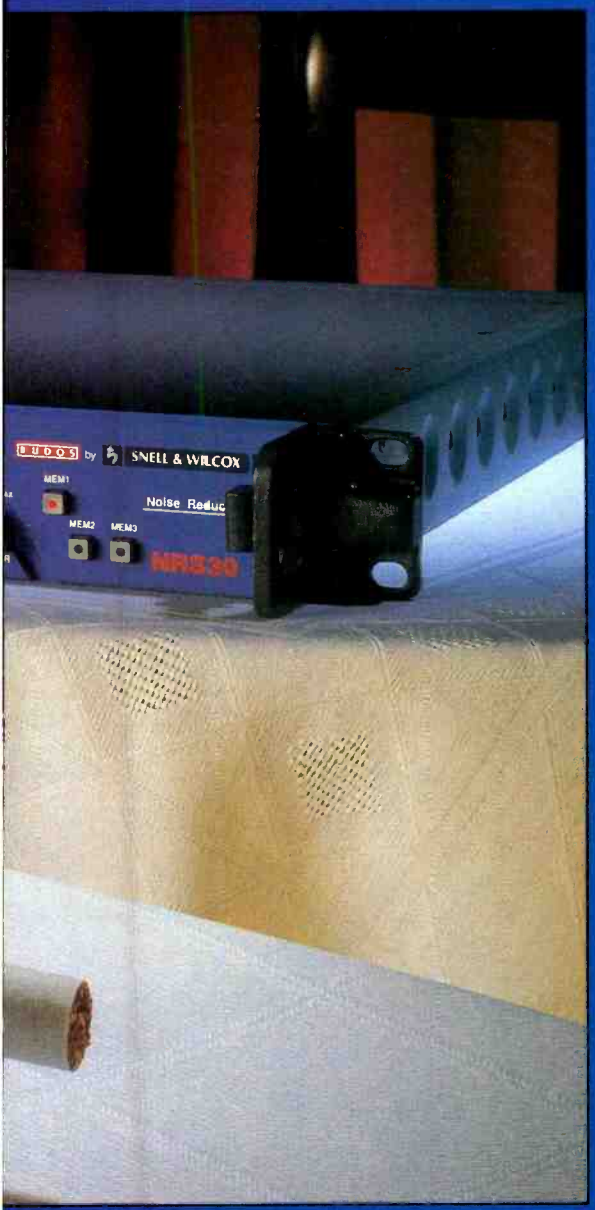

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Continued from page 36

service will at least warn you that your equipment is about to disappear. If you are lucky, the notice that a security system is in place will also discourage some of the curious.

A good fence around the tower(s) is highly recommended. A fence is required by the FCC rules and it is advisable to go beyond the simple commission requirements and build something that will keep amateur tower climbers out. An 8-inch chain-link fence topped with either barbed or razor wire is normally sufficient. Like the case with building security, you cannot keep the determined trespasser out. But, you can make access sufficiently difficult to discourage those who want to climb your tower.

Also, remember to adequately post the site with RF hazard signs. These signs should be on all sides of the fence around the tower and on the building.

Air handlers

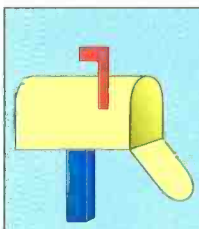
Finally, give careful thought to the air-handling system for the building. The two greatest enemies of modern equipment are dirt and heat, especially when combined. The failure rate of equipment is greatly increased when dirt on components prevents normal cooling and/or when adequate ventilation is not provided to prevent heat build-up. The most desirable system is total heating and air conditioning with electrostatic filtering of all incoming air. Most small systems will work adequately by circulating outside air through the building. A wall-mounted air conditioner and small space heater are advisable for those periods when maintenance is being performed.

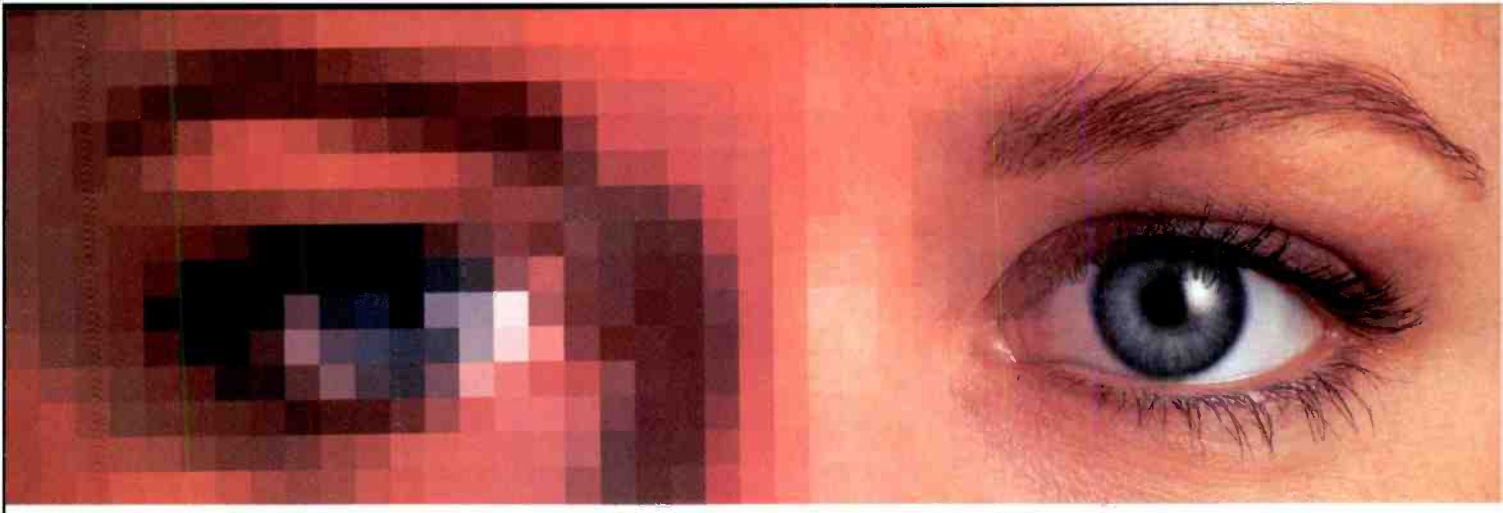
In any case, use an input fan and filter system to maintain positive pressure inside the building with clean air. The filters must be changed regularly to achieve the desired results. Positive pressure results in all air leaks in the building being filtered air going out as opposed to dirty air coming in. A heating/cooling contractor can design a "modulated" system that will control louvers on the input, output and transmitter exhaust duct. This will adjust the air flow to use the transmitter heat during cool or cold weather. Basically, the transmitter air will stay in the building during extremely cold weather. During hot weather, the transmitter should exhaust directly with the louvers on the building input and output being wide open.

After all is said and done

Even after considering all of the points that have been discussed, you can plan on running into some site-specific problems at the whim of your local building officials. For example, a station in Oklahoma City recently had a fight over a requirement for a paved road and six paved parking spaces with one designated for handicapped. This was for a simple non-manned AM site. Although reason did win out in this instance, don't be surprised if you are faced with similar non-applicable regulations. ■

Donald L. Markley is president of Markley and Associates, Peoria, IL.





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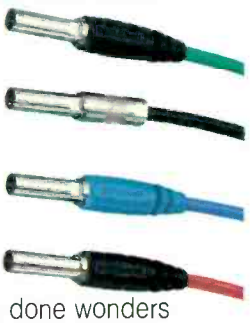

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Color correction in production switchers

By David M. H. Workman

Digital technology has dramatically enhanced production switcher capabilities.

The Bottom Line:

Like all high-tech products, video production switchers have taken a quantum leap in features and performance in the last decade. Today's production switchers are smaller, possess additional features, consume less power and are less expensive than earlier systems. The addition of internal color correction to production switchers is a good example of this metamorphosis. $

The transition from analog to digital video processing is responsible for the new-found power in production switchers, but this same change also has affected the way switchers are evaluated and purchased. Standard performance measurements that were used on analog products have little meaning in the digital world, and even the new digital specifications are not much help. For the most part, digital either works or it doesn't. Consequently, digital production switcher purchase decisions are often based on more subjective issues, such as chroma-key quality, user interface, manufacturer reputation and (often most important) price vs. performance.

One helpful feature that digital processing makes possible on production switchers is integrated color correction. Whether used for truly corrective purposes or for adding color enhancement and effects, color correctors are a welcome addition to any production suite.

Not all color correctors are created equal, however, and there is a big difference between real color correctors and simple proc amp controls. Proc amps will usually provide *chrominance saturation*, *luminance gain control* and occasionally *hue rotation*, but usually do not provide *gamma correction* or *black/white balance*.

On the other hand, a well-designed color corrector will have three processing blocks — one for each Y, R-Y and B-Y (or RGB) color component. Each processing block provides a number of adjustments: *gain*, *offset*, *gamma*, *knee*, *black clip* and *white clip* primary controls, often with *solarization* and *invert gain* thrown in for good measure.

Even though the native CCIR 601 component digital video coming into the switcher is in a Y/R-Y/B-Y format, most people are more comfortable with RGB controls for color correction. There are two ways to provide RGB controls on 601 formatted video. The simple approach uses software look-up tables to emulate RGB controls in the user interface, while actually controlling the Y, R-Y and B-Y color components. The more desirable method, however, actually transcodes the video to true RGB color space.

Color correctors are a welcome addition to any production suite.

The latter is preferable because RGB components are completely independent and non-interactive, while the actual color space of the software emulation approach (Y/R-Y/B-Y) is interactive. By transcoding the video to RGB format before correction, you avoid the problem of the red controls affecting the green and blue components, for example.

Transcoding techniques

To maintain signal integrity during the transcoding process, it's good practice to upsample the 4:2:2 video to 4:4:4 bandwidths before transcoding. This ensures that each RGB color component has the same bandwidth characteristics through the color-correction process. Remember that red,

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green and blue color signals have equal bandwidths, but R-Y and B-Y have half the bandwidth of Y (luminance). Because the Y component makes up the majority of the green color component during the transcoding process, the green path would have more precision than red and blue if the R-Y and B-Y were not upsampled.

If the switcher supports 4:4:4 chroma-keying, the video coming into the color corrector may already be a 4:4:4 video signal. In this case, the upsampling is simply bypassed and the 4:4:4 bandwidth video is directly transcoded to RGB. In either case, after correction the RGB video needs to be properly re-transcoded, downsampled and filtered back to a 4:2:2 video output signal. At this point, a proc amp circuit on the output can provide saturation, hue and overall picture gain and offset, plus a few extras like luma tinting and overall color tinting.

There is one more advantage of working with RGB video. Because the volume of RGB color space fits inside the volume of Y/R-Y/B-Y color space, you will almost always be Y/R-Y/B-Y color legal when making RGB adjustments. Figure 1 shows a Y/R-Y/B-Y and an RGB color cube, and Figure 2 shows the two spaces overlaid. You can see that level transitions out of the normal RGB space will still be inside Y/R-Y/B-Y color space.

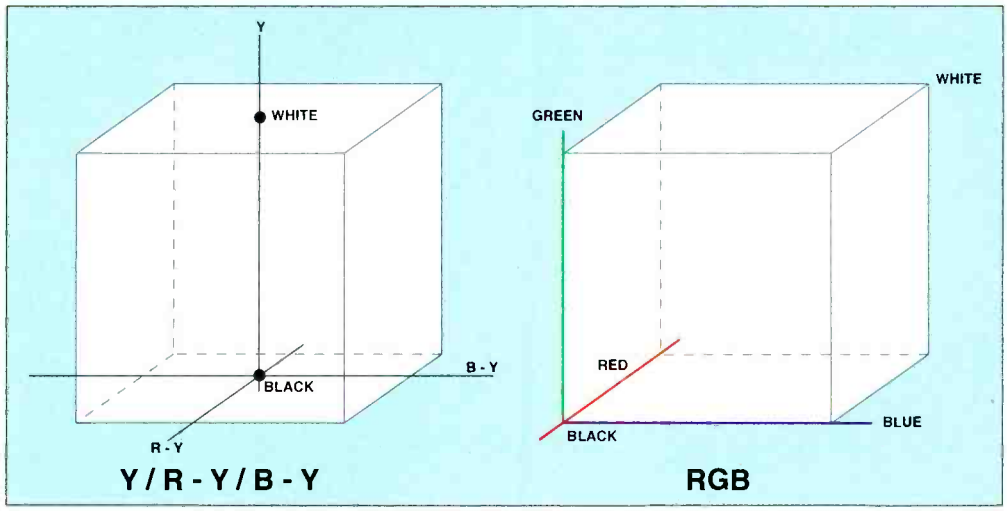

Figure 1. Conceptual diagram of two different component-video formats' color space.

Implementing color correction on switchers

Now consider how many color correctors should be included on a switcher, and how they should be controlled. At first glance, it would appear advantageous to have a color corrector for every input on the switcher. For most "single M/E" component digital production switchers available today, this would mean 16 independent color correctors. With good software control, however, greater functionality can be achieved at a much lower cost by reducing this high hardware requirement to only seven color correctors. This approach places color correctors at the output of each major switcher bus: key one fill, key two fill, downstream key fill, M/E background A, M/E background B, program and preset.

There are three different methods for controlling the color correctors. The first is *source-based operation*, which gives the same functionality as having a color corrector on every input. As you select a given crosspoint on any bus in the switcher, it will recall the *source memory* for that crosspoint. As you adjust any color corrector, any other bus that has that same source called up will be updated in real time with the same adjustments.

A second approach is *bus-based operation*. In this case, you essentially turn off the source memory, and all the sources on a given bus share the same set of parameters. This mode allows easy copying of source-memory settings from one source to another, and it provides a quick way to mix or wipe between a color-corrected and a non-color-corrected version of the same source.

The third mode is a hybrid of the two: *source-by-bus operation*. Under this method, each bus has its own independent set of source memories, which are not (necessarily) shared from bus to bus. This is a powerful operating mode for tough productions where you are recalling different sources on different buses, and they all need to have different settings. It may not be used very often, but when you need it, it's vital.

Early component digital production switchers had fairly rudimentary color correction, but they nevertheless became a popular item. Now color correction on the switcher has become an essential tool. Producers, directors and editors have come to rely heavily on color correction in the post-production environment, an area where it was unheard of just a few years ago. ■

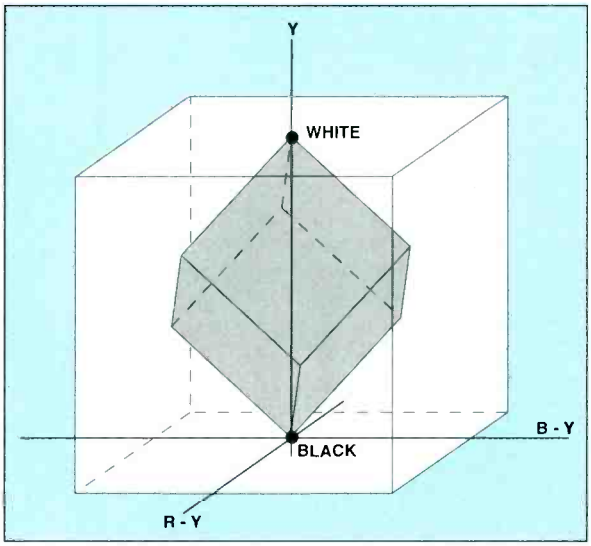

Figure 2. Superpositioning of RGB and Y/R-Y/B-Y color spaces shows that RGB's fits completely within Y/R-Y/B-Y's. This ensures that color correction performed in the RGB domain will remain CCIR 601-legal.

David M. H. Workman is product manager, Abekas Video Systems, Redwood City, CA.

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Data broadcasting: Low-cost alternative gets into high gear

Data broadcasting provides opportunities for broadcasters to compete with telcos and cable by using their existing low-cost pathways on the information superhighway.

As broadcasters evaluate new revenue opportunities — while facing competition from cable, telcos and on-line services — delivering data on the TV signal is attracting more attention. A growing number of companies — including the trio discussed in this column — are focused on delivering broadcasters to the world of data broadcasting.

En Technology, Applied Micro Technology (AMT) and WavePhore — representing different parts of the country, with varying backgrounds, industry experience and approaches — reflect the range of activity in the data broadcasting field. En Technology is a New Hampshire-based start-up, planning a fall launch of a high-speed data delivery system for consumers via the vertical blanking interval (VBI). AMT, a 22-year-old company in Kansas, is developing new, higher-speed VBI-based systems for its information broker customers serving commercial customers. And Arizona's WavePhore, a 4-year-old company formed to offer multimedia datacasting services, is tapping the video baseband, initially for commercial customers, to deliver data at even faster rates.

What all three have in common is providing broadcasters with relatively low-cost technologies that will let them become new media players and competitors. In addition, all three are profiting from the proliferation of PCs: Their systems deliver digital data for downloading and display on computers. Through their respective efforts, broadcasters don't have to wait for a digital broadcasting transmission standard to become digital data broadcasters.

Expanding VBI data delivery

AMT, in Kansas City, is an electronics development and manufacturing company that started out developing technology for the FM subcarrier. Today, in addition to providing equipment for the largest SCA FM radio network in the United States, AMT designs and markets VBI-based systems for information broker customers. This includes companies such as Bonneville Market Information (Salt Lake City) and Data Transmission Network (Omaha, NE). AMT's turnkey data transmission and reception system is often found delivering encrypted stock and commodity information to PCs on Wall Street.

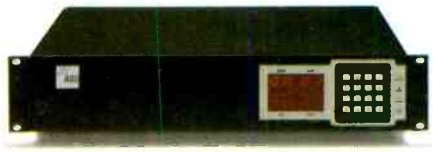
AMT's model 480 is one of the first multiline VBI receivers that allows reliable, high-speed data delivery. Using up to five VBI lines, the 480 can receive up to 67.2kb/s. Currently, many of AMT's inserters are used to distribute data on superstations such as WGN and TBS. But the company has its sights set on encouraging more local stations to get into the data broadcasting business.

Company director of sales and marketing, Steve Dery, reports "In the past six months, we have seen a tremendous interest in the VBI, particularly from [information broker] customers who recognize it as a great, viable source for getting good, reliable data out very quickly." However, Dery says the challenge is to convince local and national broadcasters that there is a revenue source and it is currently a lost revenue.

Dery also mentioned — but could not divulge specifics on — customers using AMT's VBI products for consumer-targeted data

Above photo: With En Technology's system, codenamed Malachi, stations can send data to board-equipped computers. Malachi offers some promotional opportunities for broadcasters, such as its instant message or on-screen alerts carrying their call letters and logo.

By Marjorie Costello



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delivery. These include customers who are either currently or planning to offer sports information, games for interactive television and Internet information.

Riding a new data wave

At WavePhore the future of data broadcasting lies inside the video signal, specifically using a section of the vestigial sideband. Company chief operating officer Glenn Williamson explains that, "VBI data broadcasting is limited to 150kb/s, using all lines. That puts the average transmission, which uses four lines, at a maximum rate of 30 to 40kb/s."

For the Tempe-based company's trademarked Multimedia Datacasting service, faster data rates are required compared to rates available via the VBI, although the company is also in the VBI business. It acquired Montreal-based Bleumont Telecom during the past year and is operating a VBI data network for the Canadian Broadcasting Corporation (CBC). The CBC network transmits financial, travel, real estate and other information.

As Williamson continues, "The VBI is a technology that's been around 20 years. It's adequate for certain types of data, but today, with the size of data files that must be moved around for a PC — with graphics, pictures, multimedia — a higher throughput is required. This is where the VBI hits a wall. Its throughput capacity is not fast enough to deal with the files," asserts Williamson.

WavePhore's digital data technology, called TVT1, transmits in-band at 384kb/s, and when adding available VBI lines, "We can do over 500 [kb/s]," claims Williamson.

WavePhore's technology, however, can't be commercially deployed in the United States because the company is awaiting FCC approval. The company applied for a rulemaking change two years ago and its filing continues to make its way through all the required stages.

Meanwhile, WavePhore has signed agreements to launch datacasting networks using TVT1 technology in Canada and Russia and other former Soviet republics.

According to Williamson, once WavePhore gets the FCC's green light, "We are ready to roll and put [our technology] in the marketplace and set up a network." WavePhore foresees its initial customers to be commercial establishments, who will want to distribute financial data and news.

The potential for data broadcasting systems — for commercial and consumer applications — was underlined when Intel made a major commitment to WavePhore this past May. The chip-making company signed a product licensing agreement to feature WavePhore technology in future PC-related products. It also purchased a sizable number of shares of the publicly traded WavePhore.

As Williamson predicts, "As more computers come out that are data-broadcasting ready — like having a modem card in your PC but now picking the data off the RF — you are going to reach a critical mass and more people are going to want to become involved." But Williamson admits that even with the most innovative technology, it's difficult to change the mindset of broadcasters regarding their business model for making money. "Broadcasters own the best real estate in the RF frequencies. They have so much available to them," notes Williamson. However, he goes on to explain that even if broadcasters are presented, "With an enabling technology to get them into digital data broadcasting, they remain so caught up with the existing norms, like selling advertising."

En Technology's Malachi uses the TV signal to send encrypted, digital, consumer-oriented information to home PCs equipped with its proprietary chipset.

More forward-thinking broadcast operations, on the other hand, says Williamson, recognize that cable and telcos are also vying to get into the data business. However, their cost of entry will be significantly higher, because of enormous expenses associated with cable and fiber-optic deployment. Williamson observes that broadcasters getting into data delivery changes the whole paradigm because technology [like WavePhore's] lets broadcasters transmit data faster to more people than the telephone companies at next to no cost.

Concludes Williamson, "If broadcasters can enter the computer age, then they will find themselves in a much stronger position. Right now cable and telcos are fearful of waking the sleeping [broadcast] giant."

Data goes home

While current data broadcasting networks are primarily geared toward serving commercial customers, who often work on Wall Street, En Technology's planned system is targeted at folks living on main street. Slated for launch this fall, En Technology's system — code-named Malachi — was originally developed as a speedy and cost-effective way to send computer software. No wonder, En Technology, in Keene, NH, is a spin-off of computer mail-order power PC Connection/MacConnection.

En Technology, formed in late 1994, showed its technology during the 1995 NAB. Since that time, founders Patricia Gallup, David Hall and their staff have given hundreds of demonstrations to broadcasters, cable people, computer makers and people they like to call "content providers."

Malachi uses the TV signal to send encrypted, digital, consumer-oriented information to home PCs equipped with its proprietary chipset. The speed of the transmission varies, depending on whether the information is piggybacking on the VBI or taking up an entire TV channel.

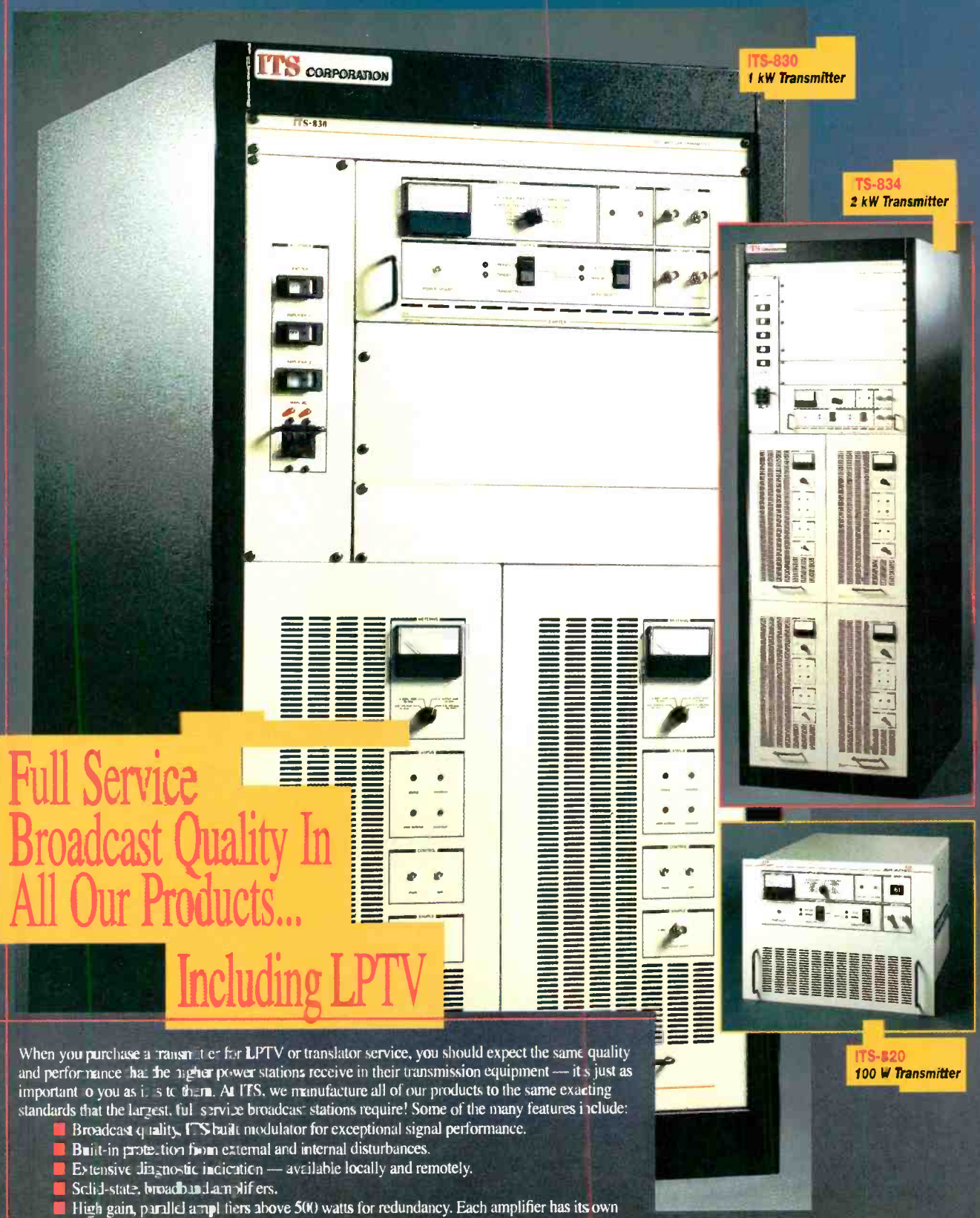
Computers equipped with the $99 Malachi board can download large amounts of data quickly, after the signal is tuned through a television. Mac users can connect an external box with the Malachi chipset. Although not as fast as many current or planned commercial data systems, En Technology's system is significantly faster than its current consumer competition, the PC modem. Sending a 3MB file using En Technology's VBI-based approach takes four minutes and only 15 seconds using a full TV channel — as compared to up to an hour with even a speedy conventional modem.

The computer is linked to the television or VCR through a wire. Company president Patricia Gallup comments that increasingly, "Computers and TVs are moving into the same space in the house." The data can also be recorded on a VCR for later transfer to the home PC's hard drive.

Although delivering computer software was the original impetus behind the technology, Malachi is being promoted as a way for broadcasters to transmit everything from news, weather and sports information to brochures, magazines and catalogs. While some data will be free, other information — particularly computer software — can be accessed once the consumer calls in with a credit card and receives an unlocking code.

En Technology's founders are no strangers to the broadcasting world. Company chairman, David Hall, ran his family's specialty audio company, Audio Accessories, before starting PC Connection with Gallup in 1982. Audio Accessories continues to make high-quality patch panels for broadcast operations, such as Opryland Productions, the major broadcast networks and CNN — among others. In addition, the two own PCTV, PC Connection's TV production arm, that produces a growing schedule of computer-oriented shows running on PBS and cable. The company also recently signed a deal to produce Microsoft's TV show.

According to Gallup, at NAB, "We received a really positive response from broadcasters. With all the talk about the information highway, the broadcasters are the ones who have been left out of the loop — particularly the local broadcasters." She and Hall point out that broadcasters, like ABC and



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NBC, are already supplying digital content about their shows to on-line services like America Online and could easily repackage it for En Technology's service.

But the benefits don't stop there. As Gallup relates, "People are watching their TVs and then going to their PCs for that [digital] information. So, what better way to address that market than to actually send data at the time they are watching the shows? And there are no on-line services and no tied up phone lines." As a result, En Technology suggests that its technology is a way for broadcasters to use the PC to draw viewers back to their TV stations and programs.

One of the system's features, offering some intriguing promotional opportunities for broadcasters, is its instant message or on-screen alerts. Stations can send messages to board-equipped computers carrying their call letters and logo. For example, the alerts could announce that a certain show is coming on or flash a news headline. If a board owner doesn't exercise the message-blocking option, these alerts would be displayed even if the computer was running a word-processing program: Malachi is always operating in the background.

As mentioned earlier, stations can also use an entire channel to transmit more data at faster rates. This is most likely to occur during low-revenue-producing time segments or when the channel is ordinarily off the air. When using the full channel, a station could feature a talking head host in the live picture — at the top — announcing, for example, the imminent transmission of a computer program or publication. At the bottom of the screen, there would be "snow," indicating that data is being transmitted.

Stations can participate by either passing through the data from a network or by originating their own. A local news show could carry detailed news or sports information. NBC could transmit star photos and bios along with *Seinfeld* broadcasts.

To originate material, the broadcaster would have to install En Technology's computer board, software and inserter, and provide a dedicated PC. Slated to be available on a lease basis, the easy-to-install system has been tested successfully at stations throughout the country, says En Technology's founders. Although he was not ready to provide specific rates, Hall said it would be so low it probably wouldn't even have to hit the purchasing department.

Broadcasters could also collaborate with sponsors. One example, as cited by Hall, could involve an advertiser like Coke working with a broadcast network during the Olympics to distribute a daily multimedia brochure about events and athletes. As participants, stations could also sell En Technology's board, receiving a share of the ongoing download revenues generated by each piece they sell. Royalties will be tracked through the board's identification number. Explains Gallup, "The more broadcasters generate on their own, the more money they could make."

Stations could promote the board and service on the air, while using PC Connection for fulfillment. The boards will also be sold this fall through leading computer and retail chains, who also receive royalties, as well as by PC Connection.

A second board, that could arrive as early as Christmas, will feature a built-in TV tuner. En Technology is also speaking with computer makers about including its chipset during 1996 on system motherboards.

With televisions in virtually every home and household PC penetration approaching 40%, it appears that the marriage of the television and computer is inevitable.

The first show featuring data for decoding by En Technology's board will be transmitted with PCTV's *Computer Chronicles* and *PC Superstore*. In addition to working with stations and networks to start offering their own content, En Technology is also developing a National Data Network. Using the VBI, the network would send information throughout the day, unrelated to the program on the air at the time.

With televisions in virtually every home and household PC penetration approaching 40%, it appears that the marriage of the television and computer is inevitable. And for TV stations, this could provide a strong incentive to become data broadcasters by offering new revenue sources, while forging new links with audiences. Data broadcasting would also provide broadcasters with a way to compete with telcos, cable and even the Digital Satellite System (DSS), by using their existing low-cost pathways on the information superhighway. ■

Marjorie Costello is a broadcast and video industry consultant and *Broadcast Engineering* contributing editor based in New York.

For more information on data broadcasting, circle the following numbers on the Reply Card:
En Technology (103)
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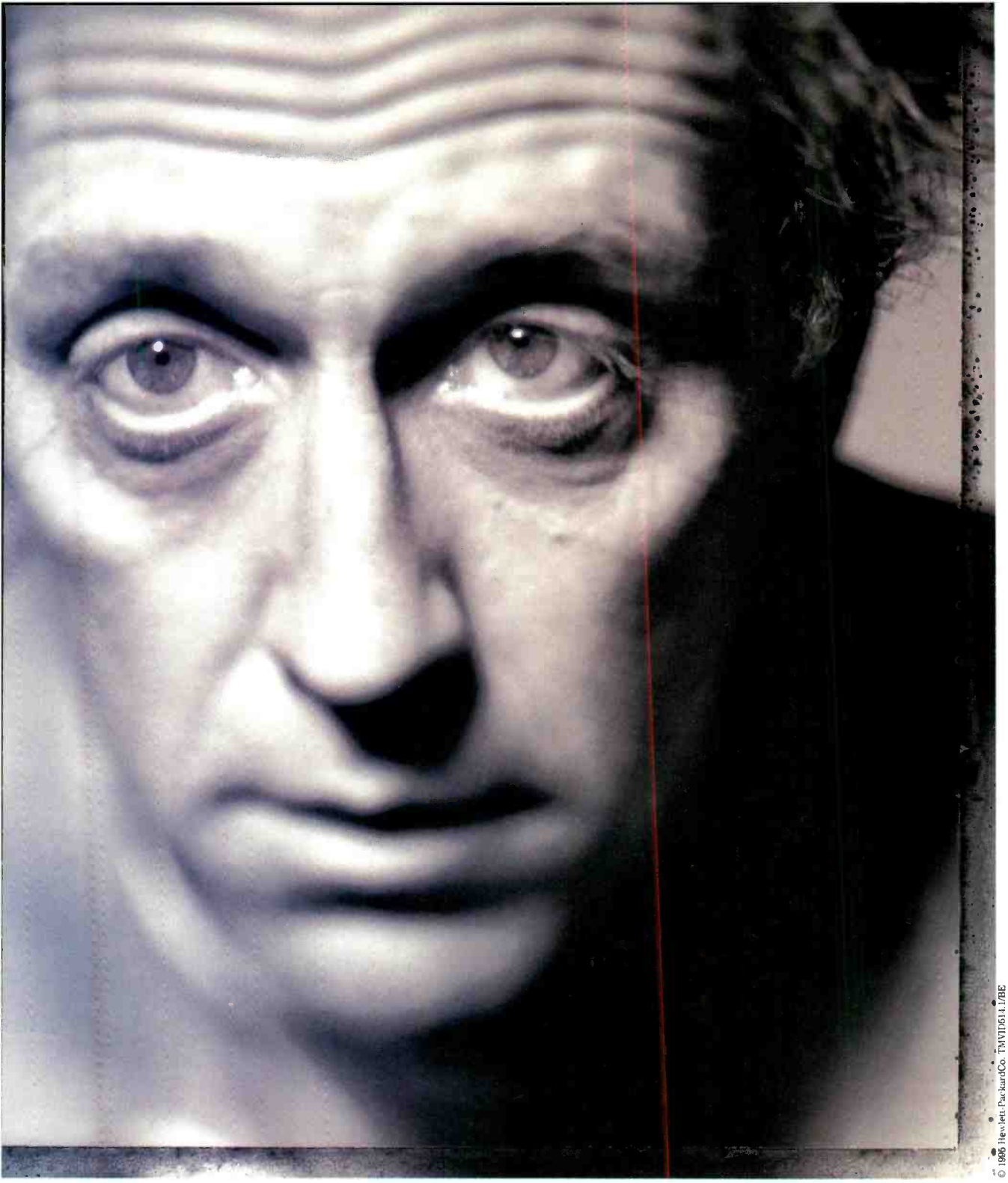

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By John Crooks

Tower maintenance secrets revealed, part 2

The inspection and maintenance of the tower structure, shelter and related attachments are important. The basic areas of inspection will be touched upon, and although they are not all-inclusive of all inspection points, they form a good guideline for developing your own technical specifications.

The tower site

The tower site is important for issues of liability as well as for continued system performance. The driveway and surrounding areas need to be maintained to allow vehicle access. Also, look for drainage problems. If the area shows signs of erosion or silt collection, the site may collect water that could enter the building and cause equipment damage.

Proper fencing must always be maintained for issues of liability. Site owners are regularly found liable in injury cases involving unwanted persons entering sites where fencing has not been maintained.

Transmission line bridge

The transmission line bridge is designed to provide a means of mounting transmission lines between the shelter and the support structure. It also protects the transmission lines from falling ice. In order for the bridge to be effective, it must be able to support its own weight, plus the weight of the lines, plus any ice- and wind-loading that may be placed upon it. In addition, it must withstand the force of falling ice while completely covering all lines mounted under its surface area. The transmission line bridge must also be properly grounded. Usually, this is accomplished through exothermic welding of grounding leads to the support pipes.

Transmission lines should be supported at proper intervals in accordance with the manufacturer's recommendations. They should never be fully supported by means other than support pipes. If the lines are mounted to the tower and the building, the bridge can be damaged by tower and building movement.

Tower and site grounding

It is a sure thing that nearly everyone has a different opinion on what an ideal grounding system entails. At a minimum, EIA specifications should be fully met. No matter what the design, resistance measurements should be taken with a ground system resistance tester to determine system performance.

The connection integrity will have a profound affect on system performance. Exothermic connections will perform at a higher level for a longer period of time than will mechanical connections. All accessible connections should be visually checked.

Every tower should have a lightning rod that extends beyond the tallest object on the tower. A lightning rod that is not the tallest object on the tower, either by design or by lightning strike deterioration, is not doing any good. Large metal objects within six feet of any other grounded object should also be grounded to the station's system.

Anchors and foundations

The relative alignment of anchors to tower is something that is not easily adjusted after tower construction. However, these items can be checked for compliance using a transit and an inclinometer.

Distortion to anchors can be caused by several forces, including impacts by such objects as tractors. This is not uncommon in farm areas where anchors are not well protected. Any distortion should be reported and, ideally, reviewed by a structural engineer.

Anchor deterioration has been the cause of many tower structure failures. It is often caused by cathodic action, and as a result, cathodic protection systems are becoming more commonplace.

Exposed concrete should be inspected closely for the affects of weather. Small cracks in concrete can increase greatly in size due to water freezing and thawing in them. Sometimes the result of poor conditions during concrete placement becomes evident on the surface of the concrete. For example, spalling and chipping can indicate that freezing conditions occurred during concrete placement.

Guy wires

The surface condition of guy wires should be noted, and any deterioration of the surface of the wires, such as pitting, is cause for immediate replacement. If vibration dampers are present, their condition should also be noted. Though not usually cause for immediate alarm, a poor condition should be remedied as quickly as is practical.

It is not unusual to find rusty guy attachment hardware, such as Preforms, thimbles, shackles and turnbuckles. Most surface rust can easily be remedied by wire brushing and cold galvanizing, but if serious deterioration has occurred, the hardware should be replaced immediately.

Guy strain insulators are typically used on AM- or FM-insulated towers and are typically found at the tower and anchor ends of guy wires. The insulators should be inspected for cracks and for deterioration of the protective surface coating. Strain insulators with deteriorated surface protection will appear "fibrous," whereas a fully protected insulator will be smooth and slick.

Turnbuckle safeties are designed to prevent turnbuckles from "turning out." Because the absence or incorrect installation of safeties can spell trouble for a structure, they are a high-priority item for inspection.

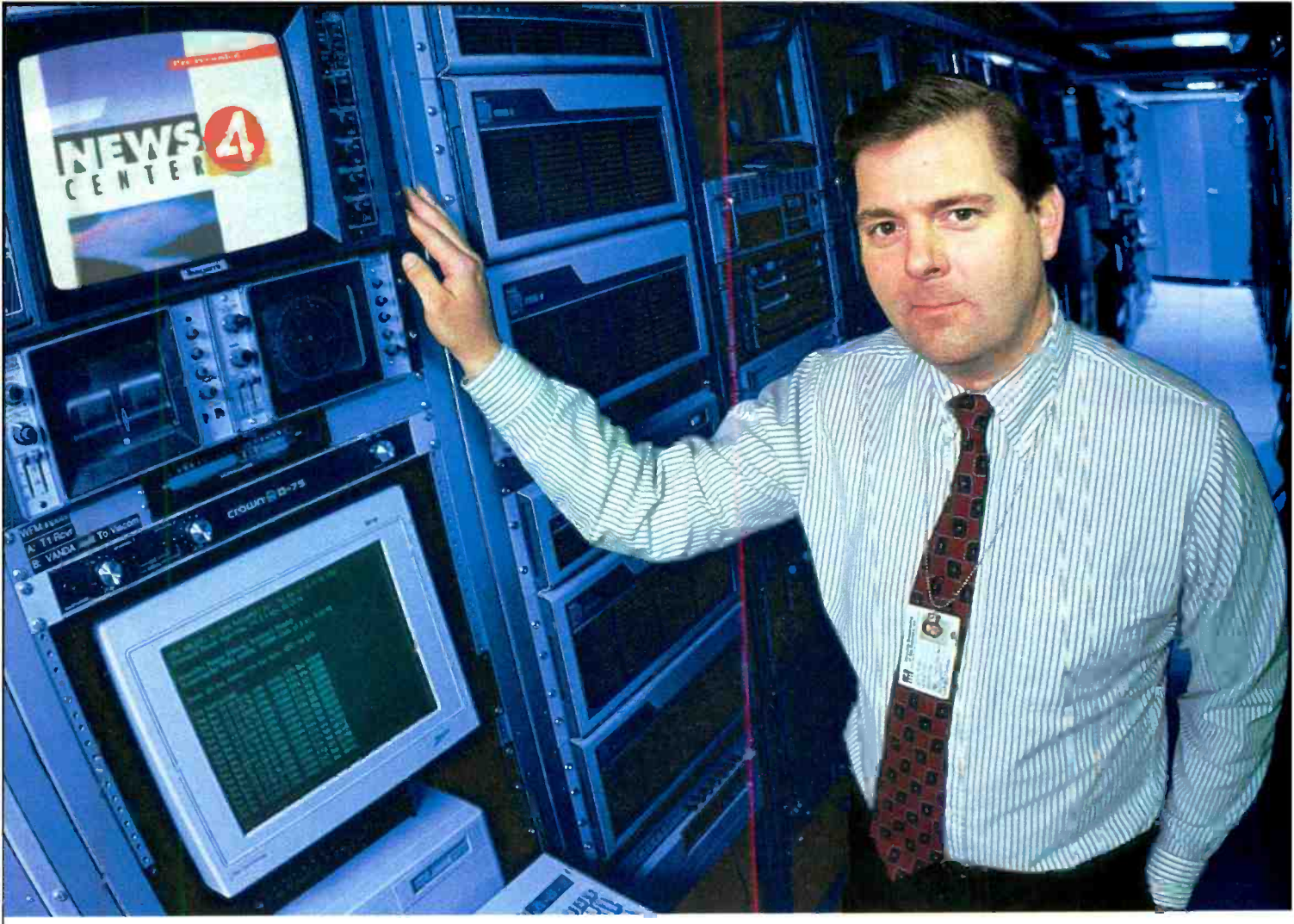
All guyed towers with Preforms or grounding attachments should have some form of ice protection. If not protected, grounding can be destroyed and Preforms can be completely unraveled.

An example of how not to do things. One small ice bridge is used to protect one transmission line. The remaining lines are unsupported and unprotected between the tower and building.

Alignment and tension tests

Tower alignment should be checked with transits. The transits should be placed at locations 90 degrees apart. Some specifications require tower alignment within 1/8-inch of plumb for the entire structure, but EIA standards are more lenient. Pick a standard and stay with it.

Guy wire tensions are checked by one of four means: dynamometer, shunt-type meter, sag method or hydraulic tension gear. The indications for the use of each are preferential as well as mechanical. For example, few dynamometers are made that



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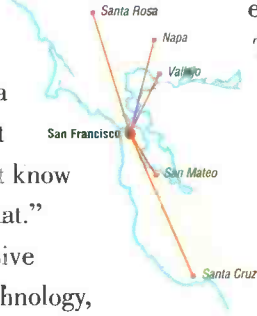

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will read the tension of a guy wire at 72,000 pounds of tension. Usually, these measurements are taken using the sag method or hydraulic tension gear. In any case, several points should be noted:

- Manufacturers' specifications should be followed for guy wire tension requirements at various temperatures.
- Guy wire tension readings should be taken at all three anchors due to tension differences between wires.
- If a given guy wire's tension is excessive or too loose while the tower is still straight, the cause should be determined and corrected.
- Accurate records should be kept of all tension readings. Each guy wire orientation and level must be marked in conjunction with its tension reading.

Lighting system

The first requirement for the lighting system is a record that identifies the manufacturer and model number. In the event of a system failure, this will assist in locating parts suppliers. The lighting system should also be inspected for FAA compliance. Any non-compliance issue must be remedied immediately.

Inspection of the beacons would include cable condition, glass and seal condition, etc. Conduit inspection would include placement of junction boxes, tightness of connections, strain relief in boxes, wire connections, cover screw condition, etc.

While on the site, the lighting system should be checked for proper function. This would include flasher operation and a flashes-per-minute record. The photocell operation should also be checked for proper operation by covering it with an object that would simulate dusk conditions.

Lastly, ice protection is a must for lighting that is under the risk of damage due to falling ice. At a minimum, ice shields should be installed over all beacons.

Painting and obstruction marking

The FCC is not in compliance with FAA regulations. The paint luminosity or brightness must be checked with an FAA paint color chart. The chart shows upper and lower limits of color and luminosity tolerated by the federal regulations. Remember, the naked eye is not a substitute for a color chart.

Paint adhesion will affect how long the tower paint will adequately adhere to the tower surface. Temperature and weather conditions at the time of paint application, as well as surface preparation, all affect the long-term adhesion of the paint. A badly peeling tower should be scraped and repainted immediately, or an alternative must be implemented to comply with the FAA regulations.

Paint bands should be measured and paint band lengths up to 700 feet must be 1/7 the height of the tower. That is to say that a tower that is 700 feet tall would have seven paint bands of 100 feet each.

This broadcast line was struck by lightning. The coax was destroyed — even the outside plastic jacket of the coax was melted. The black, charred piece next to the elbow is a melted bullet.

Tower structure

Several structural-type items need to be checked. All connections that are bolt-type attachments should be spot checked for tightness and welds should be spot checked for cracks. This is especially important at high-stress points, such as torque arms and guy pull-offs.

If any unusual conditions, such as adverse weather, have affected the tower, special attention should be given to structural concerns. Heavy storms may warrant a complete tower inspection.

Checking for corrosion varies in degrees of difficulty. It is more difficult to inspect the inside of a pipe-leg tower than it is the outside of a solid-leg tower. The tower should be galvanized and if it has pipe legs, make sure the drain holes are open. Consider having ultrasound testing done on the members of older towers. Any problem areas should be repaired immediately by wire brushing and cold galvanizing.

Transmission lines and antennas

Transmission lines and antennas are the heart of any communications system and they are also some of the most delicate parts. The physical condition of *each* line and antenna must be inspected closely for visible damage.

The antenna and line mounting, such as wire ties or stainless steel strapping, can cause major damage to transmission lines. To reduce the potential for damage, loose or missing hanger or bracket hardware should be tightened or replaced immediately.

All connections between antennas and lines should also be inspected for correct weatherproofing and structural integrity. Weatherproofing that has deteriorated should be immediately replaced or repaired.

At a minimum, transmission line ground kits should be placed on the lines at the top of the run, at the bottom of the run and wherever the distance between kits exceeds 200 feet. Ground-kit installation is critical — an incorrectly installed ground kit is as bad as no ground kit. Prior to connection of the kit, all ground connection surfaces on the tower should be cleaned. Also, check to make sure that all ground wires run in a downward direction with a minimum of slack in the wire.

A bus bar should be installed at the exterior building wall for the connection of the ground kits at that location and an antioxidant compound should be used at all mechanical connections.

Inspection photographs

A complete set of photographs should be taken with every inspection. "Complete" will need to be defined. It can mean a photograph of every item found wrong. It can also be a series of photographs for every major category that is inspected. Each photograph will serve as a graphic representation of the subject at hand. Every inspection report should include a photograph log that includes a written description of each photo.

Antenna and line inventory

A complete antenna and transmission line inventory should be developed. Each subsequent inspection should include a verification of the inventory. This will help keep track of new and abandoned tower loading and it will also assist in a tower re-analysis in the event that space is allocated to renters on the tower. ■

Anchor alignment

Most tower manufacturers adhere to the following alignment specifications as they pertain to anchor alignment:

- Anchor head plumb: +/- 2 degrees
- Alignment with tower leg: +/- 0.5 degrees
- Angle of departure: +/- 1.5 degrees
- Orientation: +/- 1.5 degrees

John Crooks is the vice president and instructor at the tower technology school for Broadcast Communications, New Glarus, WI.

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By Bill Thompson

Tektronix 764 digital audio monitor

TV audiences have never been more sophisticated or more demanding when it comes to audio quality. The advent of CD and LD players, digital direct-to-home satellite and cable services — along with the ever-improving cinema, automotive and airline entertainment systems — have all directly contributed to heightened listener awareness.

As a result, broadcasters are responding to their customers by introducing ever-increasing numbers of digital components into their audio facilities. To keep pace with this trend, Tektronix has introduced the 764 digital audio monitor, an advanced instrument used to analyze and manage these new digital audio signal paths.

Capabilities

At first glance, the 764 monitor resembles a number of conventional analog audio monitors. It uses bar graphs to represent audio signal levels, along with an X-Y scope to display the phase relationships of audio signal pairs. The unit presents itself in a familiar half-rack form and has simple controls that allude to the analog audio monitors historically used by creative and technical people.

This is where the similarities end, however. The digital audio monitor is a digital instrument, one that supports traditional audio monitoring tasks as well as the complex new ones associated with digital audio signals.

Signal level display

One of the 764's primary assignments is signal-level monitoring. This task is critical for equipment lineup and operational measurements. Although the level display appears somewhat pedestrian, it includes some versatile programmability. Digital circuitry allows accurate monitoring of reference and peak program levels, along with adjustments of range and resolution and selection of different dynamic response characteristics. Additionally, sum (L+R) and difference (L-R) display can be substituted for the standard L/R mode.

The digital design of the unit increases the accuracy of its signal level display in two respects. First, the monitor is free from the drift and aging characteristics normally associated with analog circuitry. Second, because interpolation is used on the sampled signal, the measurement response lacks comb-filter ripples at submultiples of the sample rate.

For monitoring *digital full-scale* and *digital silence* samples (i.e., *clipping* and *muting*) of audio data, built-in detectors are used. When clips and mutes occur, the monitor alerts the operator through on-screen warning messages. (See Figure 1.) The variable thresholds of these detectors permit users to ignore, for example, single clipped or muted samples and only alarm on those exceeding the length specified.

Phase display

The phase monitoring capabilities of the monitor exceed those of conventional instruments in several important ways. For example, signal pairing choices can include any combination of signals from either of two AES/EBU digital audio signals. Choices of X-Y or *Soundstage* (shown in Figure 1) axes are user-selectable from the monitor's menu, while automatic gain control adjusts displayed indications for easy interpretation.

Typically, the usefulness of any graphical phase display diminishes when signal level decreases and when audio passages employ sophisticated effects. Therefore, a numerical phase-correlation meter is included on the monitor (just below the graphical phase display), providing accurate phase monitoring under a wide range of circumstances. For detection of relative polarity problems between channels, either the correlation meter or phase display can be observed.

Session screen

The pace in master control, machine and audio-sweetening rooms can become rather frantic at times, and an engineer may occasionally miss the error messages or flags flashed on the 764 monitor's display. To keep track of error indications, the instrument is equipped with a logging/reporting capability called the *session screen*, shown in Figure 2. It tracks and displays the accumulated occurrences of events like clips and mutes, maximum signal level and a variety of signal errors.

This allows an engineer to view session results and verify the technical integrity of audio passages or the audio equipment itself. If hard copies of findings are required for quality-control notes, client reports or

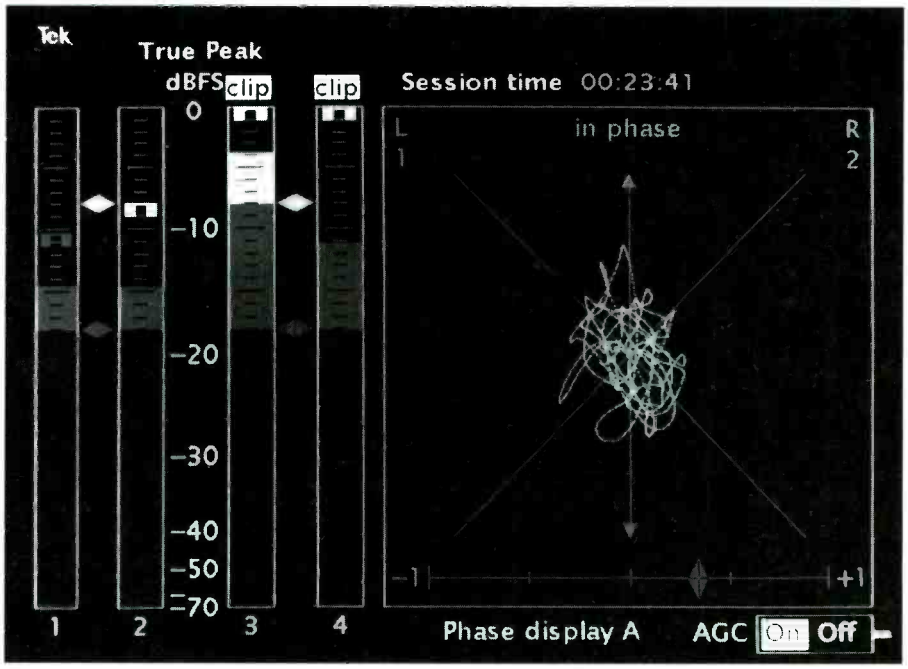

Figure 1. The four level bars at left represent two stereo AES channels. Signal clipping and muting flags are displayed as in-bar messages. The graphical phase display presents a Lissajous pattern of channel phase relationship, while the correlation meter below it augments this capability. (The "Soundstage" display shown here rotates the traditional X-Y display counterclockwise by 45 degrees, so that the in-phase axis is vertical rather than diagonal.)

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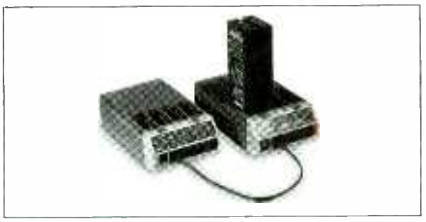

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maintenance records, session results can be output to an external printer via the monitor's RS-232 port. A more detailed logging format provides time-stamped reports derived from periodic logging of audio characteristics and error-driven events. In this operating mode, LTC, VITC or running-time data helps locate the exact time that specific events occurred. For flexibility, the session screen continues to operate in the background even when hidden behind the primary level/phase display. When session summary results are needed, the display can be brought back to the foreground.

Error detection

System and interface errors can produce subtle or serious audible defects in program material. The 764 monitor can detect them, display a warning message and log the occurrence in the session screen summary.

This capability alerts the user to a variety of electrical or transmission link problems, including unlocking of the unit to an incoming signal, bi-phase coding violations, parity errors, cyclic redundancy checking (CRC) errors, low confidence due to marginal input signal level, improper validity bit settings and ambiguous left/right sample pairings.

Channel status/user data displays

A vital secondary feature of the 764 monitor lets engineers view contents of the *channel status* and *user data* blocks residing in the digital audio datastream. This capability assists users in troubleshooting equipment compatibility by helping identify whether the blocks contain appropriate or required data.

The monitor's ability to save multiple setups is an attractive feature.

The monitor provides several different representations of this information, including English language decoding of channel status blocks. An *adaptive cursor* that highlights groups of related bits can be positioned over specific data block fields of interest. User data blocks are supported in a similar manner.

Broadcast facility applications

The monitor is tailored for quick installation and ease of use. Its passive loop-through digital inputs are compatible with balanced AES and unbalanced coaxial cable digital audio signals. Because it is designed to be inserted in-line with signals of interest, the monitor is simply daisy-chained to downstream devices, just as vectorscopes and waveform monitors are typically installed.

All the monitor's functions are called up through simple front-panel menu selections that include detailed help screens. For users wanting a big picture when monitoring signal activity, an external display can be connected through the VGA output port at the back of the unit. A front-panel headphone jack is also provided.

In master control rooms, the 764 monitor is ideal for verifying final-level and phase characteristics, either on its own screen or via the external VGA display. By observing the phase display, phase correlation meter and L+R/L-R bars, any mono-compatibility problem can quickly be identified. Using the instrument's extremely accurate level measurement capability combined with either VU, PPM or True Peak ballistics readings, a precise determination of the audio material's characteristics being supplied to the transmitter can be made.

Where AES routers are used, the monitor can be connected in-line with router inputs, outputs or both. These configurations are helpful in identifying specific audio signals

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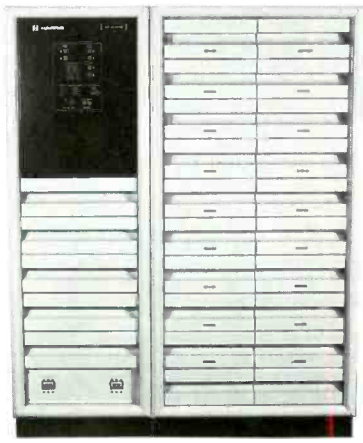

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through headphones, and for determining equipment sample rate and synchronization with house AES timing sources. The instrument is also useful for locating polarity and phase problems, along with verifying router configurations.

In post-production facilities, the 764's ease of use lets creative people put their energies into projects instead of into monitoring tasks. The unit can be set up to perform a session screen (i.e., logging data in background mode) while level and phase indications are displayed in the foreground. Once the project is completed, the report generated by the session screen can be bundled along with the client's material as a quality-control certificate.

Because audio post-production facilities are often shared by more than one engineer, the monitor's ability to save multiple setups is an attractive feature. Each engineer can configure the instrument for a particular project, and recall the setup at any time.

The benefits of having an instrument that monitors audio signals in the digital domain are numerous. Procedures that involved guessing at calibrations or attempting to compensate for component drift are eliminated. Furthermore, the digital-to-analog converters, buffers and other homebrew devices once used to smooth out system interconnections are no longer necessary. Programmable instruments like the Tektronix 764 digital audio monitor help manage conventional — as well as emerging — digital audio requirements. Ultimately, the device allows broadcasters to deliver higher quality audio while simplifying day-to-day operations. ■

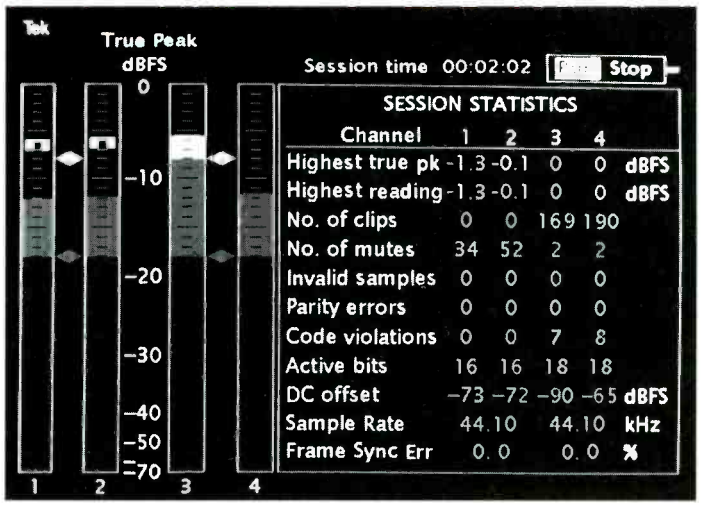

Figure 2. Signal characteristics are accumulated and displayed on the session screen, along with continuing indications of signal level.

Bill Thompson is audio product manager for Tektronix, Beaverton, OR.

For more information on the Tektronix 764 digital audio monitor, circle (107) on Reply Card.

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By J. Carl Cooper

Second-generation audio-to-video synchronization

A new generation of correction systems for audio-to-video synchronization errors has been developed for the TV broadcast industry. These products employ new techniques to solve a problem that has plagued the industry since its inception. However, recent production technology has opened even more opportunities for A-V sync problems.

Before describing the workings of this new hardware, it will be helpful to review the basic causes and effects of A-V sync problems including the results of some recent perceptual research.

Viewer perception problems

The most obvious result of audio-to-video mismatch is visible *lip-sync* error. This problem can and does occur in today's systems through a variety of means. The mistiming of audio and video always causes a subconscious degradation of a program's entertainment quality for the audience. This is particularly true when the audio is advanced with respect to the video. In natural environments, people are used to hearing audio slightly delayed with respect to video due to the slower propagation speed of sound vs. light. In today's TV systems, however, it is the *video* that is often delayed causing the sound to arrive before the corresponding visual image.

Beyond seeming unnatural, a TV program with such advanced audio (or delayed video) is believed to place the audience under subconscious stress. Psychological tests conducted at Stanford University have demonstrated that viewers who watched TV commercials with video lagging behind the audio responded to the people in the commercials more negatively (e.g., "less interesting, more unpleasant, less influential, more agitated, less successful") than the same commercials played with the audio in sync with the video. It was also discovered that this effect takes place with relatively small audio advances in which the actual identification of a lip-sync problem was detected by few viewers.

In addition to the negative perception of the commercials in the presence of advanced audio, there was also evidence that test subjects' memory of the negative aspects of the commercial were retained longer in these cases. This presents the worst possible scenario to the advertiser: The viewer perceives the out-of-sync commercial in a bad light and remembers this negative appraisal longer than a commercial that is properly presented. Such problems can cause significant concern for TV advertisers.

CCD camera-generated vision delays

A-V sync errors are becoming more troublesome as TV technology progresses. The growing use of cameras with CCD sensors is one source of the problem. All CCD sensors have an inherent visual delay mechanism. The exact visual delay varies with the sensor type.

The inclusion of digital framestore-based image processing in newer CCD cameras exacerbates the problem, commonly creating video delays of up to four fields.

Variable temporal resolution in the CCD

Variable shutter speeds on CCD cameras also play a role in their temporal sampling of the image. At maximum exposure — a 1-frame shutter speed — the image is integrated over the entire frame, tending to blur any motion in the image and making it difficult for the viewer to distinguish precise events, such as lip movement. This blurring was normal with tube-based cameras, which are continuously exposed to light.

With the fast shutter speeds of CCDs, the image is integrated over a relatively short time — for example, 100ms for a $^{1}/_{10,000}$ of a second exposure. The shorter exposure time gives brighter and less-blurred moving edges. This can result in a dramatic improvement of the viewer's ability to perceive detailed motion. Unfortunately, this improved perception also applies to the undesirable temporal artifacts of the signal. The CCD camera's effect on improved motion-perception makes any audio-to-image mismatch easier for the viewer to (consciously or subconsciously) detect.

Video-processing delays

Video signals are often passed through special-effects generators, color correctors, noise reducers, frame synchronizers and a variety of other editing and image-processing functions. As RAM costs continue to decline, these devices have increased in complexity, and many now incorporate frame-based processing functions that add delays that are frequently switched in and out of the signal path.

This presents a different problem from earlier days when video delays drifted slowly due to differing sync-generator phases. The video delay in many of today's systems can take *instantaneous* jumps of one or

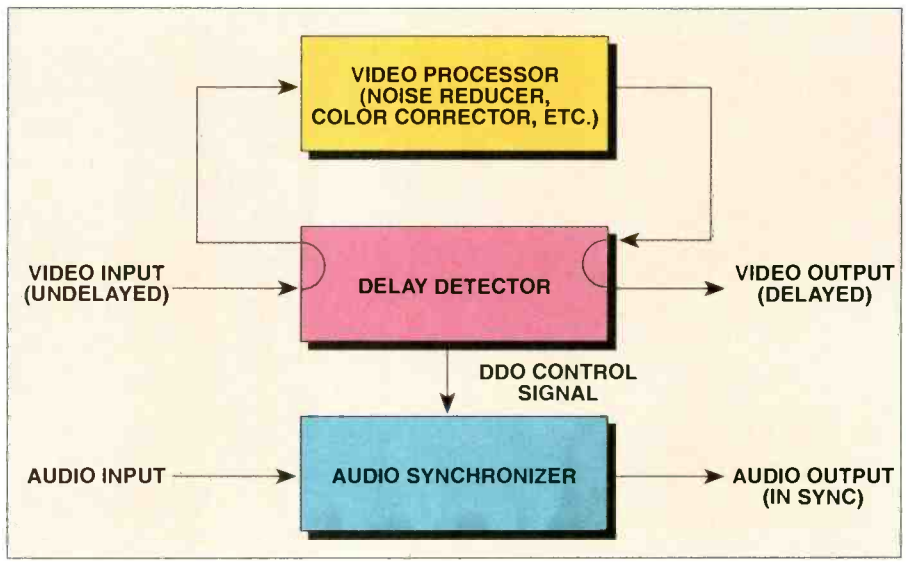

Figure 1. A delay detector (such as the Pixel Instruments DD2100) continuously measures the video delay caused by a video-processing device. The measured delay is sent as a digital delay output (DDO) control signal to a companion audio synchronizer (such as the Pixel Instruments AD2100 or AD3100), allowing it to continuously adjust its delay to keep audio in sync with video.

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more frames as editors and other operators select different processing modes. This situation is especially true of many current noise-reduction and color-correction products in which extra frames of delay are added for each additional selected function. Such quick changes in delay time pose special challenges for audio synchronizers that must keep up with these relatively large and sudden variations in video delay.

Setting performance standards

Several committees have set standards or guidelines for A-V sync errors. For example, the Radiocommunications Sector of the International Telecommunications Union (ITU) specifies a tolerance of *+1, -2 fields* throughout a system. The "+" and "-" refer to the audio compared to the video (e.g., +1 field means the audio is one field ahead of the video). The ITU bases these recommendations on its subjective studies that indicate errors of greater than +20ms or -40ms are detectable and errors of +40ms and -160ms are subjectively annoying. (Again, "+" and "-" refer to sound's arrival time with respect to video.)

The ITU's recommendations further specify that these tolerances should be held absolute and not cumulative through a system, because signals can enter and exit a system at various places. In other words, these tolerances are not the net A-V sync effect on a signal passed through an entire facility, but instead are the tolerances observed at every point throughout the facility. An ITU draft recommendation calls for a *partitioning of tolerances* throughout a facility as shown in Table 1.

EIA/TIA-250-C standards call for a similar +25ms to -40ms specification for transmission facilities (end-to-end). Given the inherent video delays in CCD cameras, little additional delay can be tolerated in the rest of the system.

Measuring the video delay

TV facilities need to be designed with audio synchronization in mind. It is impractical to remove the offending video delays. The only remaining solution is to ensure that the program audio receives the same delay as its associated video.

Part of the solution required to satisfy the ITU recommendations involves measuring the video delay at each significant delaying device so that a corresponding audio delay can be inserted at that point. Several video synchronizer manufacturers provide a *digital delay output* (DDO) that indicates a current video delay-value for use by a companion audio synchronizer. Alternatively, video delay detectors are available for devices that do not provide DDO signals. The audio synchronizer receives the DDO signal and automatically delays the audio signal by a corresponding amount.

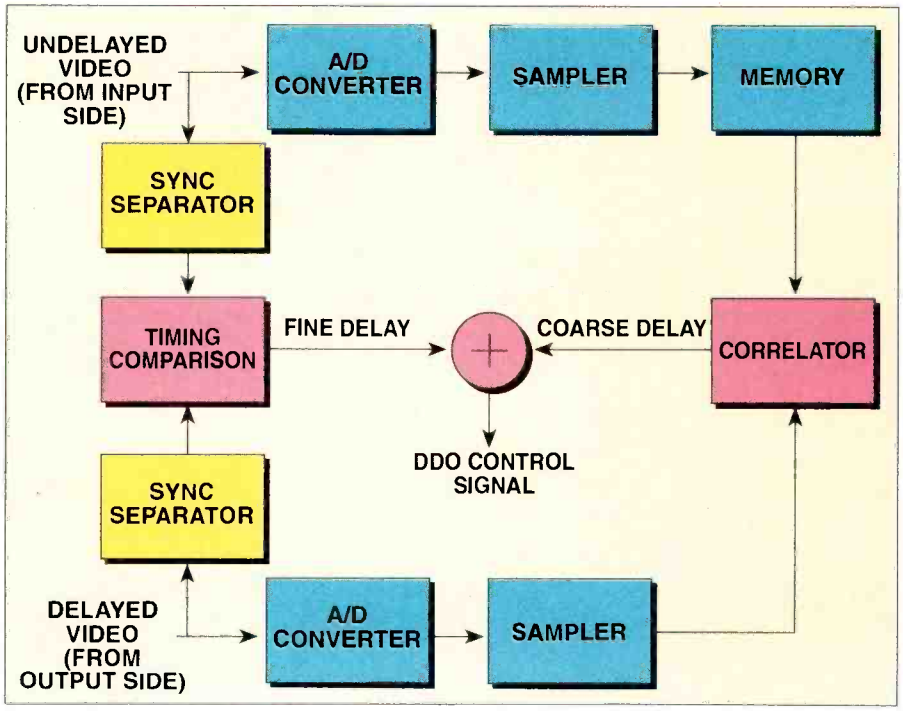


Figure 2. Basic block diagram of the Pixel Instruments DD2100 delay detector.

Delay detectors for video devices without DDOs operate as follows: The detector has two video inputs. One is fed by tapping the video signal just as it enters the device in question, and the other is fed by the device's output. (See Figure 1.) The delay detector stores a given video frame from the upstream input and then compares all the frames coming out of the device to the stored frame. By counting the number of frames that pass until the stored frame is output, the video delay through the device is determined. Comparing the phase of the device's input and output vertical sync signals allows the delay to be measured with subframe precision. (See Figure 2.)

These detectors are easy to add to an existing system requiring only that input and output video be looped through their inputs. They provide a DDO signal that can be used by an audio synchronizer to make appropriate corrections.

The second-generation audio synchronizer

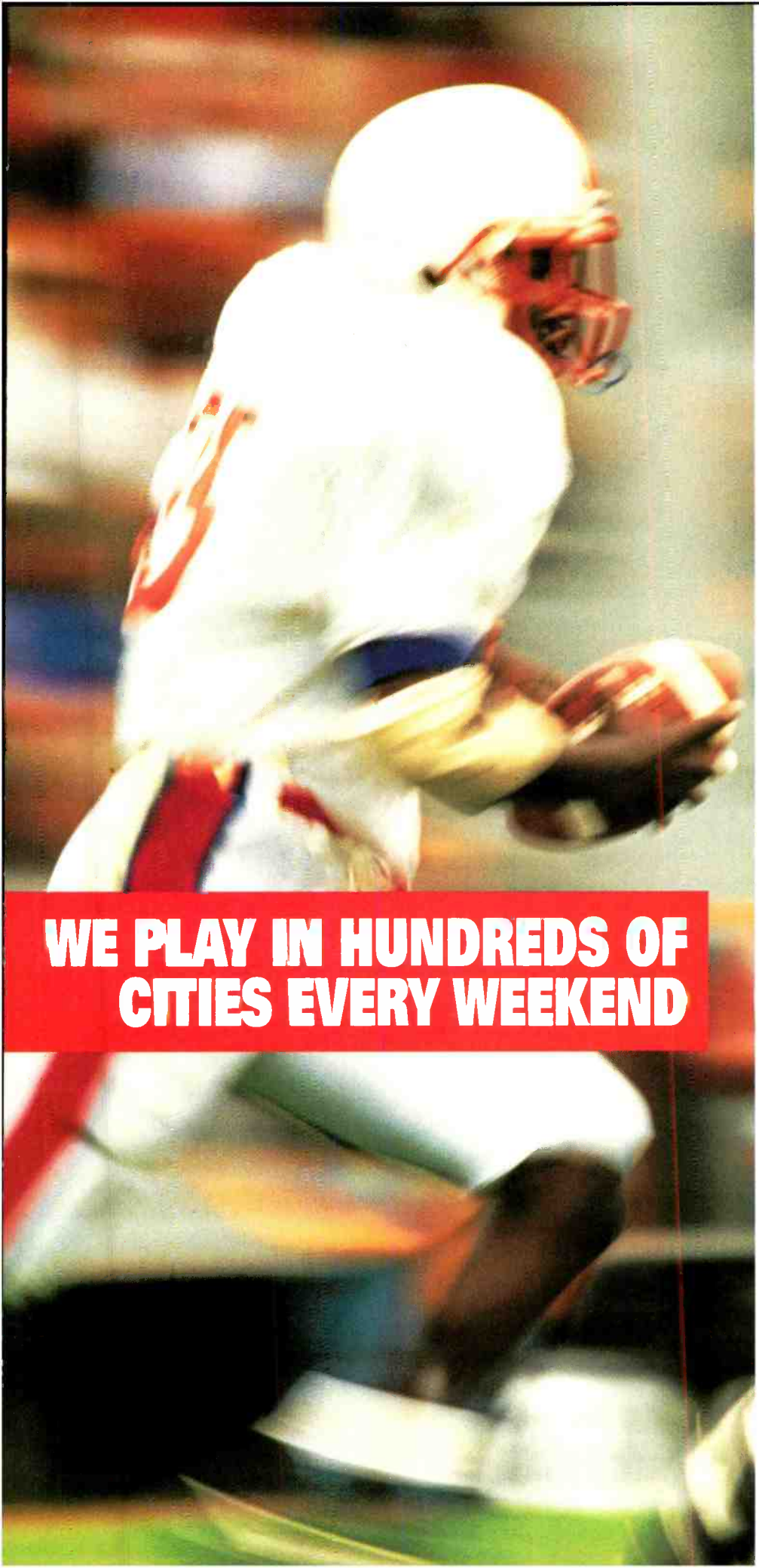
All currently viable solutions to the A-V sync problem use adjustable audio delays at some point in the system to delay the audio to match the delayed video. Because current video processing can create large and abrupt video delay changes, today's audio synchronizers are challenged by having to make dynamic delay adjustments that are imperceptible to the audience.

Older audio delays often worked by dropping or repeating audio samples and relied on slowly changing video delays to operate properly. The occasional sample manipulation that these devices performed usually went by unnoticed. However, when faced with instant delay jumps of a frame or more, these devices require several seconds or even minutes to attain the new delay values with the sample manipulation, often creating noticeable distortion during the entire adjustment period. This causes the audio to be out of sync and noticeably degraded for an extended time. In systems where large jumps in delay are frequently made, this produces unacceptable performance.

An additional problem that has become more important is the effect of such sample manipulation on audio outputs that remain in the digital domain (typically using the AES/EBU interconnection standard).

Therefore, in order to overcome the audible problems inherent with sample manipulation and to preserve the integrity of AES/EBU digital audio, it's necessary to have 1:1 correspondence between input and output samples in the audio synchronizer.

This implies that the audio delay memory must store every incoming audio sample and retrieve every stored audio sample only once. In order to accomplish this, the memory must have completely decoupled and asynchronous storage (*write*) and retrieval (*read*) functions. By varying the read rate with respect to the write rate, the delay time can be controlled either decreasing delay by causing the retrieval to catch



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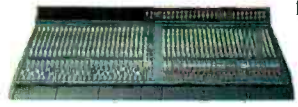

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+10ms	-30ms	Production/presentation sector
+10ms	-10ms	Distribution/transmission sector
+2ms	-2ms	Per codec (within sectors)

Table 1. Partitioning of tolerances for audio-to-video synchronization errors as proposed by the ITU. (Source: ITU Doc. 11A/47-E, October 1993.)

up with the storing or increasing delay by having the retrieval lag behind the storing. In digital audio systems, this must be performed with the independent requirement of maintaining the word-clock rate at the correct frequency.

Varying the read rate with respect to the write rate can create an audible pitch-change artifact, and it also requires reclocking to maintain the proper clock rate for AES/EBU output.

The only comprehensive solution is the inclusion of an integrated pitch-correction circuit in the synchronizer.

One way to make the pitch change indistinguishable to the viewer is to limit the differential rate between write and read rates, thus keeping the audio pitch change extremely small. Unfortunately, this results in making the amount of time required to change delay settings correspondingly large.

Another possible approach involves an adaptive process, whereby the frequency and level of the audio signal is taken into account. Larger read/write rate ratios can be tolerated if little or no high-frequency audio is present or if there are periods of silence. This does not provide a consistently significant improvement, however, and frequently is of no advantage for any program material having a musical background.

The only viable, comprehensive solution is the inclusion of an integrated *pitch-correction* circuit in the audio synchronizer. With such pitch correction, it is possible for the synchronizer to make rapid audio delay changes and maintain proper digital output word-clock rate while the pitch-correction circuit adaptively reduces any corresponding audio pitch artifacts to a level that will be unnoticed by the audience. Given current digital signal processing (DSP) technology, this functionality is possible and affordable.

One commercial product that incorporates pitch correction is the AD-3100 manufactured by Pixel Instruments. This device has selectable analog and AES/EBU digital inputs along with simultaneous analog and digital outputs. It receives a DDO signal from a video device and adjusts the read rate of the internal memory to increase or decrease the delay while at the same time providing DSP pitch correction to maintain proper pitch and output sample rate. In this device, multiframe delay changes can be made in a matter of milliseconds without introducing noticeable audio artifacts or losing A-V or digital synchronization. ■

J. Carl Cooper is director of engineering at Pixel Instruments, Los Gatos, CA.

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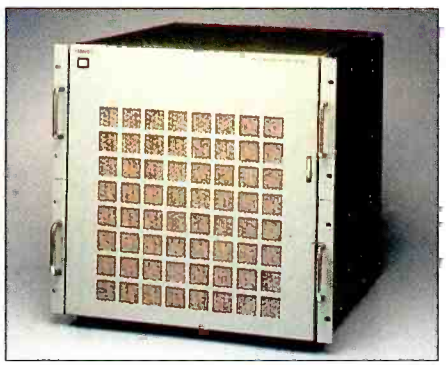
By Jerry Berger



Emerging technologies

The broadcast and cable marketplace has long speculated that some videotape-based transmission technologies are nearing the end of their life cycle. However, the introduction of a practical, tapeless technology that offers the equivalent in multichannel playout, storage capacity, choice of quality levels and cost efficiency has been slow in coming.

The allure of the recent introduction of disk-based video file servers is their ability to meet the operational requirements of multichannel playout, instant random access to prerecorded material and lower maintenance costs. However, for applications such as archiving or long-form recording and playback, tape-based recording media is clearly the economic winner — now and for the foreseeable future. Therefore, the choice of a video file server over established videotape technology must be application specific.

In the applications of commercial ad insertion or program playback, whether in a video on demand (VOD), near video on demand (NVOD) or scheduled playback mode, there are five parameters that broadly determine the feasibility of a system:

1. Quality. The first consideration is the minimum acceptable signal quality. This quality selection needs to take into account today's requirements as well as future expectations. It is wise to select a quality level that will provide plenty of headroom to support the advent of new services. Broadly defined, you should determine which of the existing videotape formats the minimum quality level should be equal to.

2. Storage media. The second consideration deals with the amount of on-line library storage the system must archive and manage as well as the time required to access that material. The measurement of storage may be expressed either in the amount of programs and commercials in the system or in hours and minutes of recordings in the library. Access time requirements for commercial insertion and VOD program playback are usually measured in seconds to air.

Above photo: MPEG-2 encoder system for VideoStore.

3. Fault tolerance. The third consideration is the requirement for a high degree of reliability within the transmission system. Depending on the potential loss caused by an outage, the request for a fail-safe operation can quickly grow into a requirement for total system redundancy. Because of the excessive costs associated with complete redundancy, a compromise that allows for a bypass of any single point of failure in the system is desired. This "no single point of failure implementation" should be joined with excellent remote system diagnostics to maintain reliability in often unattended operations.

4. Future proof. The fourth consideration deals with the modularity, expandability and interoperability of the total system. Concerns for future cost-effective storage and channel capacity expansion must be met head-on as new and exciting programming opportunities present themselves to the program providers. Also, the ability to integrate with a multitude of traffic, automation and wide area network (WAN) video distribution systems is a must.

5. Cost. The final consideration is total system cost. This cost is calculated inclusive of the quantity of storage media at the quality level previously defined, as well as the cost associated for the amount of human intervention required to maintain the operation.

In addition to these five primary considerations, numerous additional requirements form the detail of the system architecture and subsequently the selection of the system best suited for the application. Some examples are:

- An efficient procedure to record and monitor the new material filed into the system and management of the library database.
- The ability to provide hierarchical near-line storage.
- The physical transportability of video material from one area to another.

Cable systems, telcos, direct broadcast satellite (DBS) and broadcasters are all vying for the same advertising dollars, as well as being constrained by limited capital dollars. They are further being challenged to expand their businesses by adding programming services without investing in sizable amounts of new equipment or personnel.

Current tapeless technology resolves many of these issues such as the ability to have instant random access to video without regard to VTR or cart machine cycle time; the ability to perform any combination of playback, record or off-line archiving on multiple channels simultaneously; and the promise of reduced maintenance costs. All of these offer a solution to the changes currently under way in the industry. In addition, with the video images of MPEG-2 compression algorithms quickly approaching broadcast quality, the options are expanding rapidly.

What are the applications for these new tapeless technologies and what are the real solutions for the program distributor? Sony believes that these new technologies, when specifically applied to operational tasks that they are optimized for, create the levels of cost-effective solutions that, until recently, were unattainable by current product offerings. For many short-form transmission applications, the use of disk storage makes sense, primarily because of the advantages of quick and random access for simultaneous multichannel transmission.

The market requirement for multiple output channels is growing in the United States and abroad. While broadcasters are discovering the need for second or third channels, cable systems generally provide from 30 to 50 channels, DBS is promising hundreds of channels and the telcos are preparing to explode even more programming services on the marketplace. Current multicassette technology provides effective library management of a single-channel direct-to-air transmission. To effectively handle additional asynchronous output channels, however, the automation system either has to pre-compile material for later replay or additional VTRs must be brought into the automation system.

Sony believes that a marriage of the new tapeless technologies and tape-based systems offers the user the best cost vs. performance ratio in achieving true library management and on-air reliability. Recent advances in the employment of data recorders will provide a cost-effective alternative to traditional videotape cassettes for large amounts of hierarchical storage. Sony has taken all these requirements into account when designing the VideoStore multichannel video file server.

The VideoStore system

Based on RAID-3 technology, the VideoStore combines instant random access to all stored data, large storage capacity and high-quality MPEG-2 (MP@ML main profile, main level) compressed video in an integrated, fault-tolerant, multichannel video transmission system. The system architecture contains a cost-effective and centralized design. This way, any media may play to any output at any time and be revised up to the last second prior to air.

- *Media Control Unit* (MCU): Contains all the control electronics, CPU, as well as communications and bus architecture for the VideoStore system. Up to 12 independent and discrete output channels per MCU may be installed. Multiple units may be linked to-

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gether with an optional clip exchange board resulting in effortless library management of multiple VideoStore systems. Clips only need to be encoded once and the clip exchange option facilitates the distribution of the encoded data to/from multiple MCUs. Redundant low-volume fans and power supplies are installed to minimize single points of failure. The MCU provides the benefits of Sony's RAID 3 predictive maintenance™, hot swappability and non-disruptive faulting even though there are no hard-disk drives (HDD) in this unit. The MCU supports remote VideoStore systems diagnosis through a dedicated RS-232C port.

• *Media Unit:* Can be easily and economically expanded to accommodate up to seven units for added storage capacity. Each unit is comprised of six high-performance hard-disk drives in a 5+1 RAID 3 configuration. Each HDD stores 2.1GB of information, effecting a storage capacity of 4.5 hours per unit (equal to more than 520 30-second commercials). A system equipped with seven Media Units can, therefore, provide instantaneous access to more than 30 hours of full-motion video information of approximately 3,700 30-secnd commercials. Off-the-shelf drives can easily be interchanged as hard-disk storage technology evolves, thereby increasing storage capacity exponentially. In addition to the features of predictive maintenance, non-disruptive faulting and hot swappability of most all internal components as in the Media Control Unit, the Media Unit also provides for automatic data rebuild for any lost HDD in the VideoStore system upon insertion of a replacement drive.

• *MPEG-2 decoder boards:* Sony's VideoStore can be configured with a 2-channel video output board designed for vertical switching applications, such as in cable commercial insertion. In addition, a single-channel genlockable board has been designed for more sophisticated integration into broadcast master control environments. Both decoder boards have analog composite or component outputs allowing for easy integration into existing facilities.

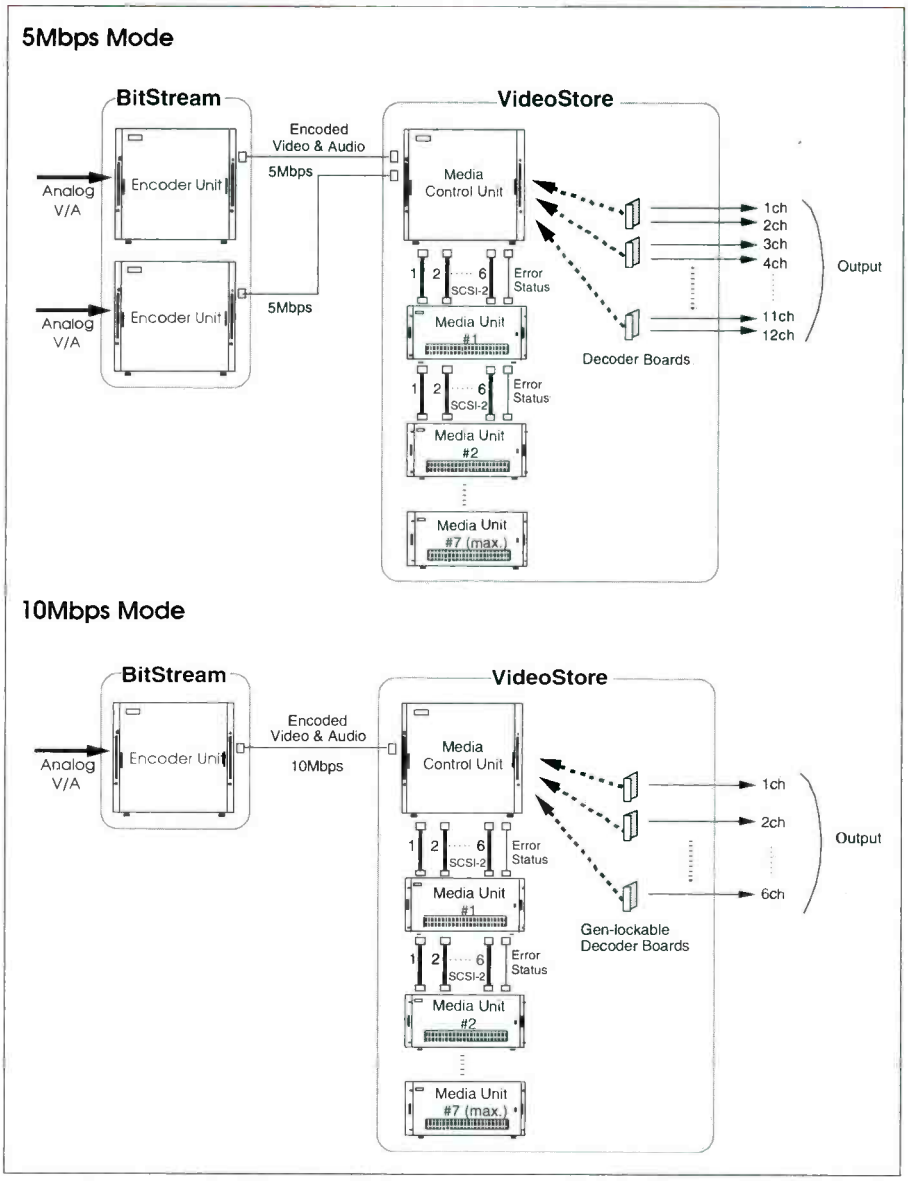

Figure 1. Basic setup of the BitStream and VideoStore units for multiple channel outputs. Each Media Unit provides a storage capacity of 4.5 hours.

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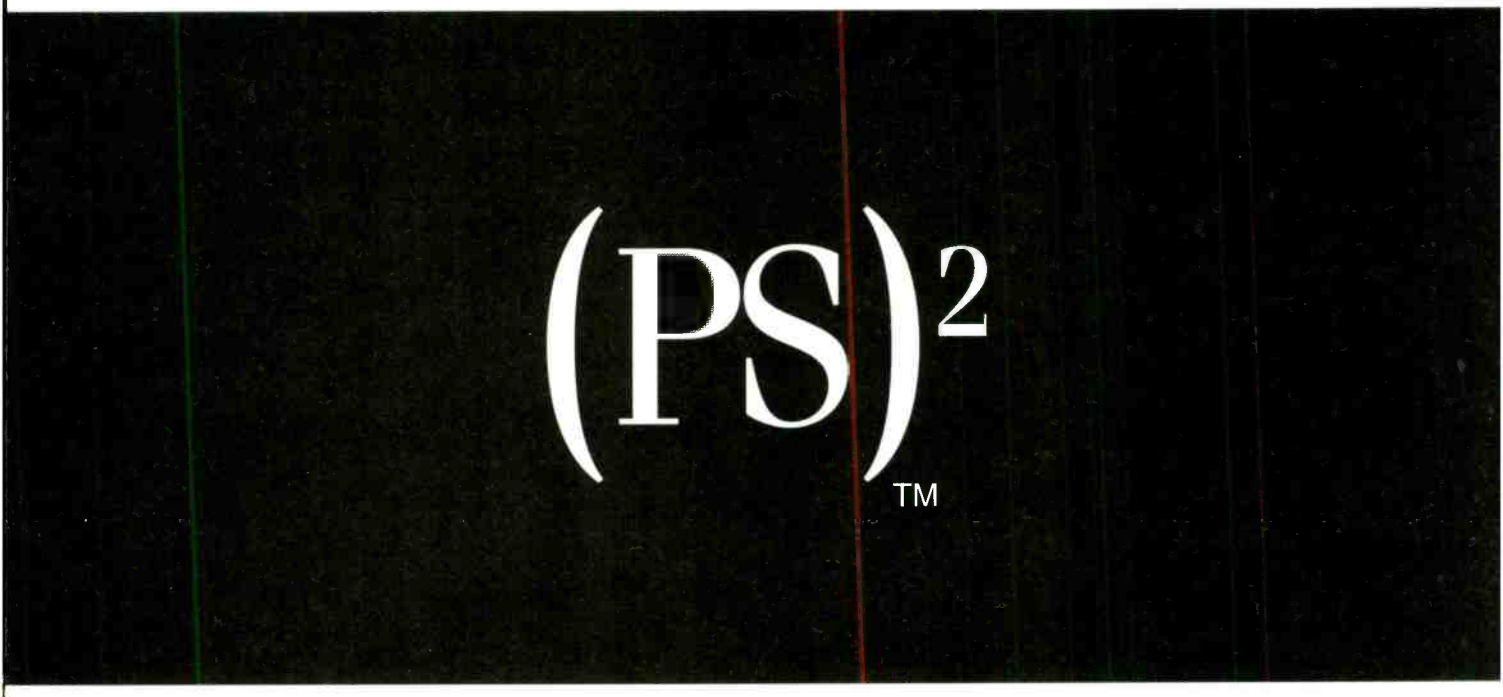

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• *Wide area network interface:* The BitStream/VideoStore supports interfaces to various wide area networks with the capability to distribute an encoded MPEG-2 bitstream to multiple wide area VideoStore systems.

The VideoStore's four levels of fault tolerance are:

1. Predictive maintenance provides the ability to alert the user of potential component failures prior to the failure occurring.
2. The ability to suffer multiple single points of failure and continue to perform without any impact to performance.
3. Hot swappability of the Media Units' RAID hard-disk drives and power supplies and most of the Media Control Units' components.
4. Automatic data reconstruction upon replacement of a failed hard-disk drive.

BitStream system standard features

• *User selectable 5 or 10Mbps MPEG-2:* The BitStream offers the user real-time MPEG-2 (MP@ML) encoding with a choice of software or hardware control of the desired compressed bit rate.

• *Motion estimation/compensation:* The BitStream includes a wide window of base motion vector range (H: 48 pixels/ V: 32 lines) for excellent encoding performance of fast-moving video images at low bit rates.

• *Embedded clip verification:* The BitStream embeds the clip ID number into each encoded spot. This number is subsequently read on playout to verify that the correct clip actually aired. This information is then reported to the application control software for logging traffic verification.

• *Built-in frame synchronizer:* The BitStream ensures direct compatibility with a wide variety of non-synchronous video input sources such as incoming satellite feeds. Additionally, 3/4-inch U-matic and S-VHS tapes may be encoded without the need for a time base corrector.

• *Built-in VTR machine control:* The BitStream includes RS-422A VTR machine control that can be used to control the frame-accurate playback and cuing of your source VTR during the encoding process.

• *Built-in single-channel analog composite and component decoder board:* The BitStream offers the user the ability to monitor and review the encoded clip without having to allocate a playout channel on the file server.

• *Built-in audio multiplexer:* The input audio is multiplexed with the input video and coded as MPEG-1 audio layer 2 (Musicam format).

• *Analog composite input:* One input with one loopthrough connector.

• *Analog component input:* One dub connector and three BNC connectors for Y, R-Y and B-Y.

• *S-Video Input:* One S-Video input.

• *Maintenance status information through application software:* All components of the BitStream are constantly monitored for fault conditions.

• *Dedicated remote diagnostics RS-232C port:* The BitStream may be remotely or locally accessed while the system is in use for system diagnostics down to the board level. Even more detailed investigation is possible by taking the system off-line. This dedicated port bypasses the application control software level.

• *RS-422A/232C switchable control interface:* All major automation suppliers have announced their interface compatibility to the VideoStore system.

• *SCSI 2 fast output (to library media unit and tape streamer):* (8-bit, 5MHz).

BitStream system options

• *2-channel audio input* — two balanced XLR and two unbalanced RCA audio connectors.

• *4-channel audio input* — four balanced XLR and four unbalanced RCA audio connectors.

• *Closed-captioning support* — vertical interval closed-captioning data compatibility; the closed-caption data is preserved within the MPEG-2 datastream and re-inserted during

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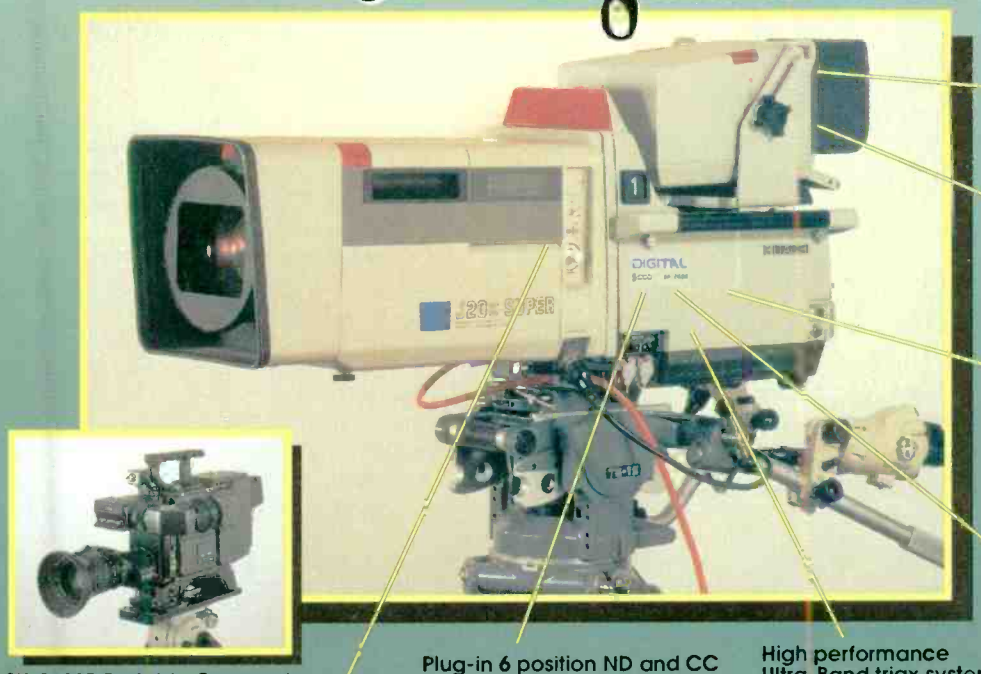

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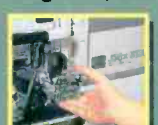

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the decoding process.

• *ME expansion chipset* — this 200% expansion option provides for the best possible picture quality when encoding video with fast horizontal motion sequences.

• *SDI (serial digital interface) input* — the SDI input substitutes for the analog input board.

Standard VideoStore system features

• *Bitstream input* — direct connection from the bitstream encoder.

• *Up to 12 video/ 24 audio output channels:* at 5Mbps with 2-channel decoder boards; up to six video/24 audio output channels with single-channel decoder boards; both boards may be intermixed within the system when operating at 5Mbps.

• *One second access time to any playlisted clip* — between 2-3 seconds access time for non-scheduled VOD-type applications.

• *Picture-to-picture clip playback without black between* — the MPEG-2 datastream is actually switched cleanly and randomly between clips.

• *+/-1 frame playback accuracy* — the playout picture is frame accurate to its original encoded SOM and duration.

• *RAID 3 hot swappable components* — mostly all components are hot swappable within the system.

• *Predictive maintenance status information through application software* — all components of the VideoStore are constantly monitored for fault conditions.

• *Dedicated remote diagnostics RS-232C port* — the VideoStore may be remotely or locally accessed while the system is in use for system diagnostics down to the board level; even more detailed investigation is possible by taking the system off-line; dedicated port bypasses the application control software level.

• *RS-422A/232C switchable control interface* — all major automation suppliers have announced their interface compatibility to the VideoStore system.

VideoStore system options

• *Wide area network interface* — VideoStore is network independent. The network option provides for an MPEG-2 encoded bitstream over Ethernet (TCP/IP) allowing for a variety of customer-installed WAN topologies.

• *Clip exchange board* — provides for simultaneous 2-channel loading to dual inputs (at 5Mbps) and single-pass encoding to multiple VideoStores for larger than 12-output channel systems; required for data tape streamer.

• *Multiple GPIs* — four GPIs associated with each output channel.

• *Redundant power supply* — when the redundant power supply is installed, both operate at 30% load; supplies are hot swappable.

• *Gen-lock video/4-channel audio decoder board* — up to six single-channel gen-lockable (RS-170A) boards may be installed in the media control unit; supports either 5Mbps or 10Mbps; supports closed-captioning and embedded clip verification data.

• *2-channel video decoder board* — up to six 2-channel input referenced vertically timed boards may be installed in the media control unit; supports 5Mbps only; supports closed-captioning and embedded clip verification data.

• *2.1 or 4.2GB HDDs* — one inch by three inch form factor, 7,200 RPM, multiple manufacturers.

• *Sony data tape streamer (8mm cassette size)* — provides for data tape backup, near-line archival storage, transportable media and faster than real-time recording and VideoStore loading. ■

Jerry Berger is manager, video file server technology, Business and Professional Products Group, Sony Electronics, Inc., Montvale, NJ.

News Special Report continued from page 4

Markey put it, the "forces of self-preservation" then won out with no member of Congress wanting to be seen as voting *against* curbing TV violence. Thus, the V-chip survived its closest call, and made its way into both houses' telecommunications reform packages, virtually guaranteeing its inclusion in the final bill.

The proposed regulations still face a procedural gauntlet before they become law — conference committee revisions, conference acceptance votes in both houses, a possible veto, and a veto-override or further negotiations with the White House. But it now seems likely that the broadcast and consumer electronics industries will face a phased movement toward some type of parental TV-control technology in the near future.

Art Brodsky is senior editor of *Communications Daily* in Washington, DC.

News

SCTE premieres training seminars

The Society of Telecommunications Engineers (SCTE) has announced two seminars, "Introduction to Telephony" and "Introduction to Fiber Optics," which will be offered at various locations across the United States on a varying schedule.

"Introduction to Telephony" is a 2-day seminar for technical personnel who want a basic knowledge of telephone system operations, telephone networks and customer equipment with the various interconnect and service options. The seminar also is beneficial to non-technical personnel who need a general understanding of telephony basics.

Everyone attending the seminar receives a Certificate of Attendance. Those who pass the exam receive a Certificate of Achievement. The registration fee is $195 for SCTE members.

"Introduction to Fiber Optics" is a 3-day seminar designed for industry personnel who desire a general understanding of fiber optics, fiber-optic systems and fiber-optic test equipment. Attendees will benefit from the hands-on demonstrations of mechanical and fusion splicing that will be included in the seminar. The registration fee for SCTE members is $240.

The seminars will be presented back-to-back in October, with "Introduction to Telephony" set for Oct. 16-17 and "Introduction to Fiber Optics" set for Oct. 18-20 at the Holiday Inn West in Fort Lauderdale, FL.

For more information on future dates and locations, contact SCTE national headquarters at (610)323-6888.

The SBE announces award winners

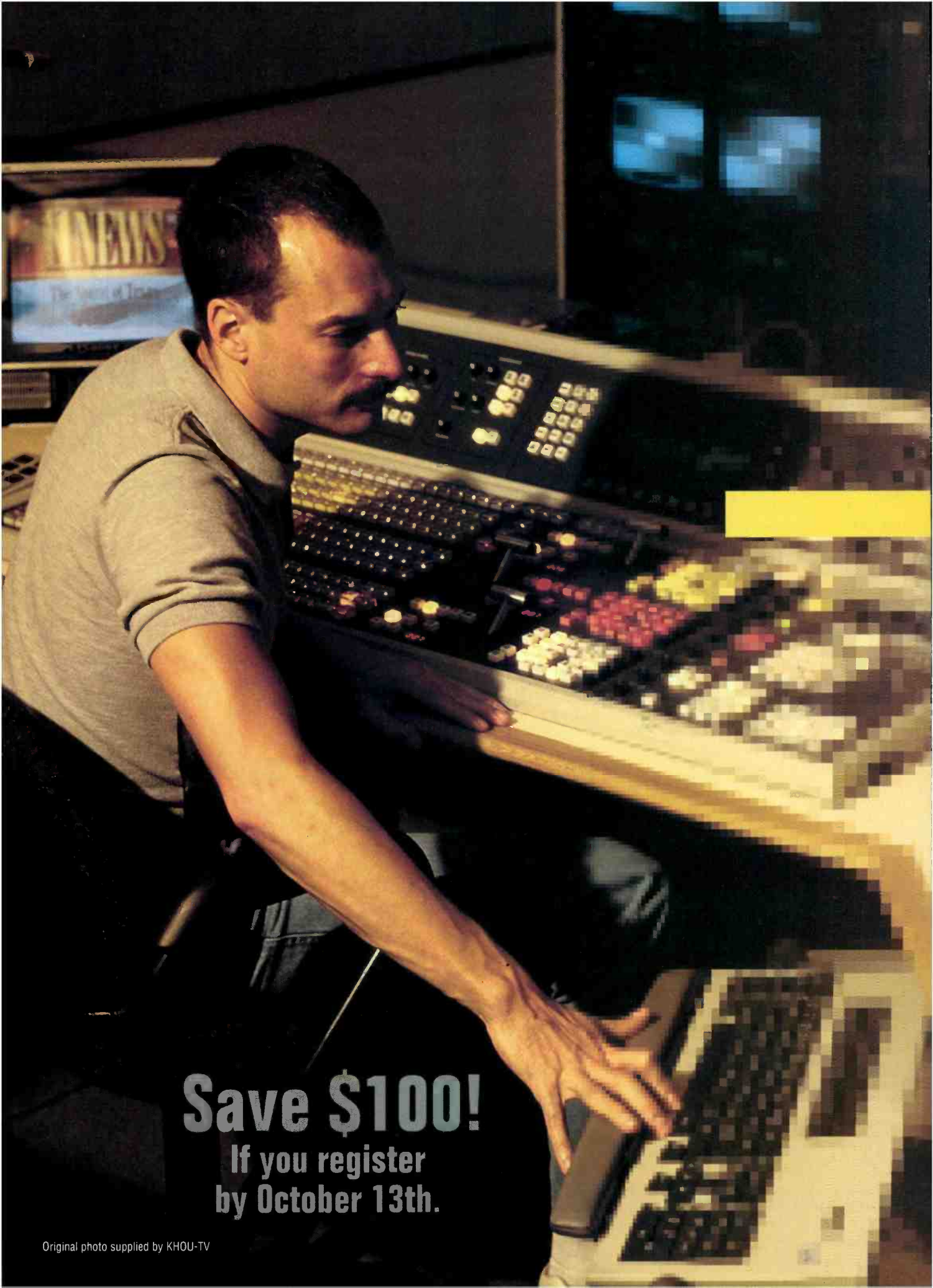
The Society of Broadcast Engineers (SBE) has announced the recipients of its 1994 individual awards. The awards were presented during the society's annual Engineering Conference and World Media Expo, Sept. 9, in New Orleans.

Life Time Achievement Awards were presented to James C Wulliman of Green Valley, AZ, and Benjamin Wolfe of Baltimore MD. Both men are Charter and Fellow members of the SBE and were instrumental in founding the society's certification program in the early 1970s.

Ed Roos of West Palm Beach, FL, an engineering manager at WPTV-TV, has been named a Fellow of the society. He is a Charter member, founder of SBE Chapter 88 and a former 2-term SBE national board member.

Donald Wilkinsin, vice president/director of engineering of Fisher Broadcasting in Seattle, WA, received the SBE's Broadcast Engineer of the Year Award.

Douglas Garlinger received the Educator of the Year Award. He is a member of the SBE Certification Committee and is co-author of the SBE Television Operator's Course. He is director of engineering for the LeSEA Broadcasting corporation.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Circle (58) on Reply Card

By Tony Delp

Hitachi digital triax

In 1990, Hitachi recognized two indicators of what future cameras would be: 1) The broadcast industry was rapidly changing to all-digital video equipment except cameras; 2) Discussions of a future broadcast replacement for the aging NTSC system indicated a digital-based standard. In response, Hitachi development has concentrated on taking broadcast cameras into the digital age.

The first stage of this development was to eliminate analog video processing in the camera head. Processing circuits include gamma, detail, skin-tone detail, aperture, masking and knee. These circuits can be the most difficult part of a camera system. Even minor differences between the RGB channels can produce noticeable errors in the output video.

In 1994, the SK-2600 camera series was introduced with RGB digital processing using a single LSI device. This camera set standards in stability, performance and control. Analog transmission, however, was required between the camera head and the camera control unit. The use of analog transmission with its inherent artifacts, such as phase distortion, loss of resolution, group delay and added noise, created a less-than-transparent transmission medium for this high-performance camera. Analog transmission requires a D/A conversion at the camera head for transmission, followed by an A/D at the CCU to provide a digital output.

In 1995, Hitachi introduced two digital transmission alternatives — digital triaxial and digital optic-fiber transmission. These systems eliminate analog transmission artifacts and will set benchmarks in transmission fidelity. Now the CCU output is identical to the camera head output. Also eliminated was the need for multiple D/A and A/D conversions. The camera system is digital from the output of the CCD pre-amplifiers to the output of the CCU. This assures distortion- and noise-free digital operation. The digital triax system is ideal for use in studio applications where modest cable lengths are the norm. Digital optical fiber is provided for applications requiring extreme cable lengths (up to 10,000 meters). Other than the cable length and type of cable used, the digital triax and digital optical-fiber systems are virtually identical in performance and operation.

Hitachi's digital transmission system over standard triax cable provides the first practical fully digital camera system. Triax camera cable is the standard in studio and field cameras and is readily available, low in cost and easy to service. For the many facilities already prewired with triax, digital cameras can simply be connected to existing camera cables.

Designing digital triaxial transmission proved fairly difficult. One of the reasons was the requirement for bidirectional operation. Several patents are pending on the technologies developed in achieving this bidirectional capability and in solving the many other problems associated with digital transmission design.

In operation, serial digital component (Y, R-Y, B-Y) is transmitted from the camera head to the CCU with 10-bit accuracy. The system provides a wideband Y signal, flat to 10.5MHz along with reduced bandwidths for the R-Y and B-Y signals (3.5MHz). The Y video signal bandwidth of 10.5MHz may seem unremarkable when compared to the specifications of analog triax systems. However, digital transmission provides a higher response at the cutoff frequency than analog. (See Figure 1.)

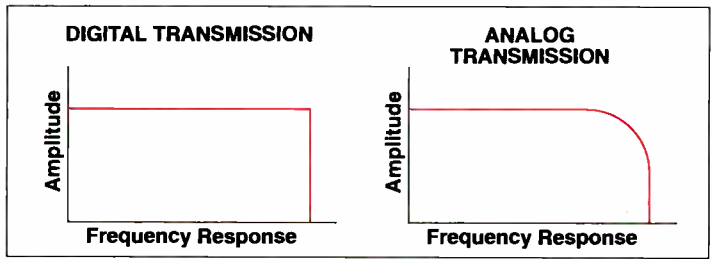

Figure 1. Digital transmission systems generally have a sharp cutoff at the cutoff frequency, whereas analog systems have a gradual rolloff of frequencies near the cutoff frequency. This allows the digital system to have a higher response at the cutoff frequency than an analog system.

Basic analog transmission design normally includes a gradual rolloff in response as frequency increases. Typically, the response is reduced by several decibels at the cutoff frequency. Without some rolloff, analog transmission produces objectionable ringing and overshoots. Digital transmission has no such limitation and has an extremely sharp cutoff with a virtually flat response up to the cutoff frequency. With a higher response at the cutoff frequency, digital systems generally have superior response when compared to analog systems of a similar bandwidth.

Early in the development of the digital camera system, careful consideration was given for the clock frequencies to be used for digital processing and transmission. It was determined that using the CCD's pixel readout clock rate for A/D conversion, digital processing and digital transmission provided the best performance. In the SK-2600, this clock rate is 21.5MHz. This design provides optimum signal transfer. It also eliminates the possible generation of beat frequencies due to multiple clock rates, which can introduce noise into the video signal. The transmission rate is expressed in megabits per second (Mb/s) and for the SK-2600 is 360Mb/s from the camera head to the CCU. The transmission rate from the CCU to the camera head is 60Mb/s. JPEG is used to reduce the overall bit rate, and time domain multiplexing is used to accomplish bidirectional transmission. With the use of automatic cable equalization to offset cable losses, cable lengths of 350 meters of triaxial cable (Belden 9232) are possible. Included in the digital transmission from the camera head to the CCU are component video (Y, R-Y, B-Y), control data, intercom and two high-performance audio signals from the built-in microphone inputs. The CCU digitally transmits to the camera head control data, viewfinder returns, intercom, program audio, gen-lock and teleprompter video.

At the CCU, the digital video signals are converted to serial digital component or composite using a single digital filter with time-variant tap coefficients. This filter prevents conversion loss and maintains the transparency of the digital system. Simultaneous analog outputs of RGB or Y, R-Y, B-Y and NTSC are also provided. Optional digital inputs are available for the teleprompter and viewfinder returns.

Digital triaxial transmission marks the beginning of a new era for video cameras. The fully digital video camera can now join the digital chain of recording, post-production and transmission systems already in daily use. ■

Tony Delp is the product manager-cameras for Hitachi Denshi America, Woodbury, NY.

For more information on the Hitachi digital triax system, circle (108) on Reply Card

INDUSTRY BRIEFS

BUSINESS

Global Access Telecommunications, Boston, has been awarded a multimillion dollar contract by Group W Videoservices. Under terms of the contract, Global Access will become the exclusive provider of satellite time for Group W Videoservices syndicated programming.

Dielectric Communications, Raymond, ME, has been awarded two antenna system projects by Hearst Broadcasting, as well as three antenna system projects by Meredith Corporation.

In addition, the company will supply and install new transmission line in four TV stations for Mississippi Educational Television.

Also, Dielectric has announced the company's ISO 9001 certification.

A.F. Associates, Northvale, NJ, and Electrogig, San Francisco, CA, have joined forces to provide integration of Electrogig's Reality Tracking product into a broadcast and post-production system to create virtual set studios.

Videomedia, San Jose, CA, and Strassner Editing Systems, North Hollywood, CA, have merged into one company. Videomedia is the surviving entity of the merger.

Sony Electronics, Montvale, NJ, has announced the purchase of an MXP-728 broadcast audio console by Liberty Sports Communications, Houston, TX.

Also, the company's Digital Betacam format recording media has been selected for the Home and Garden Television Network (HGTV), by the E.W. Scripps Company.

Recognition Concepts, Inc. (RCI), Carson City, NV, has shipped its first HDTV disk recorders to use 4:2:2 tape backup to Keisoku Giken Co., Japan, and Korean Broadcasting System (KBS), Korea. RCI will deliver a third HD disk recorder equipped with D-1 backup and an FDDI network connection to Sony Pictures, Culver City, CA.

Chyron Corporation's MWW Group, Melville, NY, has signed a definitive agreement to purchase 64,414,732 shares of Chyron Corporation common stock from Pesa Inc. and Sepa Technologies Ltd. Co. for consideration of approximately $32 million.

Chyron has also announced the sale of four iNFiNit!, two MAX!> and four MAXINE! graphic systems to cable company Telecommunications Inc. (TCI).

In celebration of the 60th anniversary of the Eimac product line, Varian, Palo Alto, CA, has announced the winner of its "Oldest Tube" contest. The KFI (AM) radio tube, gave 87,242 hours of service.

Radamec EPO, Northvale, NJ, has announced the order of customized robotic equipment by NHK, Japan, for a studio that NHK has devoted to educational programs.

East ~ West Communications, Singapore, has been established by Jim James, former marketing manager of AMS Neve plc. The new marketing agency was created to meet the needs of professional audio, video and multimedia manufacturers that are trying to communicate with their existing and potential customers in the Asia-Pacific region.

Orion Atlantic, Rockville, MD, and Viacom Inc., New York, have signed long-term contracts for transponder capacity on the Orion 1 satellite. Orion will provide full-time contribution feeds for international programming, including MTV Europe and VH1.

Also, Orion Atlantic provided satellite transmissions for the French Open May 29 through June 11. The all-Ku-band transmissions were seen simultaneously in Europe and North America by using the beam combining features of the Orion 1 satellite.

Digital Equipment Corporation, Tarrytown, NY, has announced that it is pursuing a 3-tiered strategy for its Digital Media Studio to become the industry-leading provider of the critical resources required to design, develop and release interactive applications for distribution over multiple broadband networks.

Also, Digital Equipment has introduced The AlphaStudio Broadcast System, an all-new, digital-based, broadcast video solution.

Media Touch Systems, Inc. has moved to 15 Ermer Rd., Salem, NH 03079; phone 603-893-5104; fax 603-893-6390.

EVS Broadcast Equipment S.A., Belgium, has been selected by Panasonic for the slow-motion replays of the 1996 Summer Olympic Games. The company has also adapted its digital disk recorder LSM (Live Slow Motion) to make it fully compatible with the new Panasonic camera.

Advanced Audio Visual Systems (AAVS), Sioux Falls, SD, has just completed the sale of five S310 digital video analyzers to Sony.

Hitachi Denshi America, Ltd., Woodbury, NY, has announced the purchase of three of the company's SK-2600 digital cameras and digital triax, along with three Canon 55:1 lenses to Philadelphia-based pay-TV service SportsChannel PRISM Associates.

Avid, Los Angeles, has announced the upgrading of five of its Media Composer 4000 series systems to Media Composer 8000 systems by FilmCore, Hollywood.

Da Vinci, a member of the Dynatech Video

Group, has announced that Henninger Baltimore, a division of Henninger Media Services, has purchased a Renaissance 8:8:8 digital color corrector for its new facility in Baltimore.

BTS Broadcast Television Systems GmbH, Germany, has announced the order of a 7-channel Media Pool video server, two digital vision mixers and digital routing equipment by SIS (Satellite Information Services), United Kingdom.

Videotek, Pottstown, PA, is expanding its research and development activities to Beaverton, OR. The Pottstown headquarters engineering group will continue to develop instruments and devices for analog and digital video users. The Beaverton engineering center will focus on emerging markets.

Thomson Broadcast has announced the sale of 10 cameras to Avesco Group Company, Creative Technology, for its new widescreen digital OB truck.

Comark, Colmar, PA, has introduced its $(PS)^2$, a technology the company has recently applied to IOT transmitters.

The International Television Association (ITVA) has awarded its Advanced Technology Support Award for 1995 to Videssence, Inc. for the company's SRGB lighting products.

PEOPLE

Bruce Peterson has been named director of marketing for the audio division of Crown International, Elkhart, IN.

Paul Rivens has been named sales support engineer for the intercom business segments of the Pro Sound and Entertainment group of Telex Communications, Inc., Minneapolis, MN.

Mark B. Terry has been appointed president of JBL Professional, Hertfordshire, UK.

Mike Wolschon has been named marketing manager for storage and retrieval products for BTS Broadcast Television Systems, Inc., Simi Valley, CA.

Also, Thomas M. Calabro has been appointed chief marketing strategist, camera line, at BTS. ■

Continued from page 29

(left, right, center, left-surround, right-surround) and one reduced-bandwidth channel to feed low-frequency information to a subwoofer. (The subwoofer channel carries only about one-tenth the bandwidth of the full-fidelity channels, hence its "0.1 channel" nomenclature.)

These six discrete audio channels are digitized, compressed and multiplexed into a single 384kb/s signal by the AC-3 system. Without data compression, this surround-sound digital audio would require about 4Mb/s of transmission bandwidth. This also implies that storage of AC-3 digital audio requires less than 3MB/minute, while in its uncompressed form, the same audio would require more than 25MB/minute.

Although the multiple channels in a surround-sound mix are destined for separate loudspeakers, there is often a good deal of similar audio material shared by the individual channels. (This also occurs in stereo programs, where much of the audio is common to left and right channels, creating the so-called *phantom center* image.) The AC-3 system (as well as other algorithms) gains some of its coding efficiency from exploiting this commonality between audio channels.

Conceptually speaking, if the same audio appears in several channels simultaneously, it need not be encoded separately for each channel, but simply encoded once and "copied" to the other channels during playback. The algorithm performs this *joint coding* process without compromising the audible quality of any channel, and without losing any separation between the channels. Because it acts as a discrete 5.1 channel system, AC-3 also avoids the motion artifacts and panning limitations that plague the current Dolby Surround (4-2-4 channel matrix) system.

Future production and transmission systems will have to accommodate the 5.1-channel and AC-3 format signals of future TV programs. This includes storage systems, routers, mixers, switchers, processors and transmission equipment.

The integration, spectrum efficiency and quality of digital audio should be welcomed by the providers and consumers of tomorrow's TV programs. The transition to digital audio also should make for a happy marriage with digital video. Like any relationship, it may have its rocky moments, but this compressed couple is poised to create a big, happy family of successful broadcasters and satisfied audiences. ■

For more information on digital audio equipment, circle (110) on Reply Card.

Internet: be@intertec.com
CompuServe: 74672,3124
FAXback: 913-967-1905

NEW PRODUCTS

Component production switcher
Abekas

• ASWR8100: a digital production switcher featuring an internal SCSI hard drive that allows users a new option for saving effects created on the 8100's TimeFrame effects editor; both the hard drive and the floppy drive can store video stills as well as keys and masks from an internal framestore in either YUV format or an industry standard RGB TIFF file; the 8100 also features a 10-bit component analog input module that accepts YUV or RGB formats and supports 4:4:4 chroma-keying directly from an RGB camera source; the 16 inputs can be a mix of serial or parallel digital, RGB or YUV component analog or the third new option, analog NTSC or PAL composite; seven independent reTouch color correctors operate in RGB or YUV color space with gain, offset and gamma control for each color component.

Circle (350) on Reply Card

Rack-mount SCSI switch
Applied Concepts

• Rack-mount SCSI switch product line: six models available for single-ended, differential, narrow (8-bit) and wide (16-bit) SCSI versions for providing electronic switching of six independent SCSI ports in any combination; the SCSI switch is a 4x2 electronic crosspoint switch that offers full transparent selection of up to 32 SCSI devices between two separate computer systems; the SCSI switch can be controlled locally, from the front panel or via the remote RS-232 interface.

Circle (359) on Reply Card

A/D transcoder

Videotek

• **TAD-101:** a component analog to digital transcoder with EDH designed to provide maximum flexibility; accepts the full assortment of component analog formats for both 525/60 and 625/50 systems and transcoding to 10-bit digital component video; both parallel and serial digital component video outputs are provided; error detection and handling data is added to the signal to facilitate the use of EDH checking devices throughout the digital path; the design of the TAD-101 employs advanced technology and meets or exceeds SMPTE 259M and ITU-R BT.601/656 standards.

Circle (352) on Reply Card

Catalog

Kings Electronics

• Broadcast Video Products catalog: 56-page catalog featuring broadcast video connectors and jackfields; Kings Electronics offers a complete line of products from the well-known crimp BNC connector to self normalizing video jacks in front load modular and solid panels; products are available in standard or miniature sizes; catalog also features cabling procedures, part number index and a glossary of terms.

Circle (354) on Reply Card

Transmitter

Itelco

• **T614K & T634K transmitters:** the T614K (10kW) and the T634K (20kW) have been added to the I.O.T. common-mode amplification product line; these products extend the energy conservation and cost savings to the medium-power transmitters.

Circle (355) on Reply Card

V-UHF TV transposers

Teko Telecom

• **5/10W modular V-UHF TV transposers:** BLM-type TV transposer with 5/10W RF output power designed to receive all TV channels in band I, III, IV and V (including channel C in band II) and transmit them in bands III VHF and IV/V UHF; this flexibility has been obtained by splitting the transposer into eight plug-in modules housed in a 19-inch 3SU subrack; each module can be replaced with an equal one without changing the overall technical characteristics; in the UHF band, this equipment can use its built-in linearity precorrector, along with an external (FU02) notch filter to operate at 10W output power.

Circle (353) on Reply Card

Interface and signal monitoring package

Snell & Wilcox

• Kudos IQ: a compact 1-rack unit packed with high-quality technology; Kudos IQ incorporates

a wide range of digital interface and signal monitoring products that do not compromise on performance despite their low power consumption and small size; these products include a digital test pattern generator, 3-channel digital-to-analog converter, 3-channel monitoring encoder, digital error-detection system, digital video-monitoring system, 3-channel analog-to-digital converter, 3-channel decoder/ADC, and 3-channel line-comb decoder.

Circle (356) on Reply Card

Modular SRGB lighting fixtures

Videssence

• Modular fixtures: "concept" lights available in two output levels; Modular-78 and Modular-110 are linear and compact so that they can be used with low lighting grids or in rooms where the fixture must underhang a low ceiling; a unique dovetail track interlock is the key feature of the Modular fixture body and allows up to four fixtures to be ganged together on a single yoke; the unit is self-contained and the fixture is equipped with a Softspot Linelens, that condenses and focuses the illumination into a powerful directional field.

Circle (362) on Reply Card

Publication on electrical power quality

Dranetz Technologies Inc.

• PQ Today: a quarterly full-color tabloid that is published jointly by Dranetz Technologies Inc. and Kreiss Johnson Technologies Inc.; the publication is for those who deal with power-related problems or those who have responsibility for maintaining facility electrical systems; topics focus on issues related to electrical power quality including technical, educational and general interest in addition to case studies.

Circle (358) on Reply Card

Digital test instrument
Videotek

• **VTM-100D:** a digital test instrument for 601 digital that displays waveform and vector information on a picture monitor; the A and B inputs each accept either 525/60 and 625/50 serial digital component video signals at 270Mb/s; the easy-to-use screen menus provide access to all display settings and the display modes, magnification, alarms, and formats can each be configured to the user's exact needs; key features include the flexibility to display the signals alone, as a key or mix with video picture, plus half-screen and quarter-screen overlays; errors in the video signal detected by the VTM-100D are reported as alarms and are also accumulated so that occasional hits can be tracked over time.

Circle (360) on Reply Card

Product info on disk
IC Master

• **IC Master CD-ROM PLUS:** IC Master database on a single compact disk; disk contains product and vendor information published in the IC Master catalog featuring product and design information on 108,000 integrated circuits with more than 20,000 new device listings; Windows and DOS format are on the same disk; CD-ROM PLUS search capabilities permit device selection by a flexible category search as well as keyword search; parts can be selected by multiple criteria or by description.

Circle (357) on Reply Card

Component production switcher
ECHOlab Inc.

• **MVS6:** a component version of ECHOlab's modular video switcher series; the two mix-effects MVS6-3W switcher provides five keyers with up to five layers of linear keys; any combination of mix, wipe or key can be used simultaneously; the MVS system's switching matrix coupled with simplified timing of all key and bus inputs permits using any cut and fill anywhere on the switcher; it also eliminates the need for external timing and allows operators to easily change priorities and routines on the fly.

Circle (351) on Reply Card

Tripod
OConnor Engineering Labs

• **25L tripod:** 7-pound tripod made from lightweight carbon fiber; the height range is 15 to 66 inches and the tripod comes equipped with a 100mm ball-top casting, mid-leg (removable) spreader, and spike guards.

Circle (375) on Reply Card

Monitors
Sony

• BVM series: monitors designed to provide the highest resolution with the ability to reproduce precise color; available in a stand-alone style or a divided type with separate display and control unit; some of the features include auto-alignment system for monitor setting, IC memory card for easy set-up and Sony Interactive Status Reporting (ISR) system for remote diagnosis; the highest-grade monitor in the BVM series provides more than 1,000 TV lines; the BVM series accepts both 4:3 and 16:9 aspect ratio signals.

Circle (363) on Reply Card

Digital broadcast video system
Digital Equipment Corporation

• AlphaStudio: a completely digital broadcast video system based on 64-bit Alpha technology that integrates high capacity and high-performance storage with high-performance computing for powerful full-motion digital imaging; AlphaStudio allows record and play direct to and from disks with or without the option of compression in multiple video streams; the system supports an open system building-block style of hardware and software architecture with standard computer, storage, network, video and software components.

Circle (364) on Reply Card

Intermod filter system
Dielectric

• Elliptic function balanced intermod filter system: system designed to permit the use of common amplification NTSC or CCIR TV service with UHF transmitters; the intermod filter is used when visual and aural signals are multiplexed at low level and amplified in the same transmitter; while traditional harmonic filters are still necessary, the amplification of these combined signals creates some additional products that, if left unattenuated, would interfere with other channels in the spectrum.

Circle (365) on Reply Card

Continued on page 96

The GALLERY

TASCAM

DA-88 Multi-Track Recorder

The first thing you notice about the eight channel DA-88 is the size of the cassette - it's a small Hi-8mm video cassette. You'll also notice the recording time - up to 120 minutes. These are just two of the advantages of the DA-88's innovative use of 8mm technology.

- Intrinsic to the 8mm video format is the Automatic Track Finding (ATF) control system. This approach records the tracking control information, along with the program material, using the helical scan (video) head. Competing S-VHS based system record the tracking data with a linear recording head, independent of the program data. The S-VHS tape must be run at a higher speed (thereby delivering shorter recording time) to deliver control track reliability, and requires some form of automatic or manual tracking adjustment. Synchronization and tracking must be adjusted, either automatically or manually (just like on your home vcr) as the machine ages, or if the tape is played back on another machine.
- On the other hand, the ATF system ensures that there will be no tracking errors or loss of synchronization. The DA-88 doesn't even have (or need) a tracking adjustment. All eight tracks of audio are perfectly synchronized. What's more, this system guarantees perfect tracking and synchronization between all audio tracks on all cascaded decks - whether you have one deck or sixteen (up to 128 tracks!).
- Incoming audio is digitized by the on-board 16-bit D/A at either 44.1 or 48KHz (user selectable). The frequency response is flat from 20Hz to 20KHz while the dynamic range exceeds 92dB. As you would expect from a CD-quality recorder, the wow and flutter is unmeasurable.
- One of the best features of the DA-88 is the ability to execute seamless Punch-ins and Punch- outs. This feature offers programmable digital crossfades, as well as the ability to insert new material accurately into tight spots. You can even delay individual tracks, whether you want to generate special effects or compensate for poor timing. All of this can be performed easily on a deck that is simple and intuitive to use.

OPTIONS

- **RC-808** – Single Unit Remote Control
- **RC-848** – System Remote Control
- **MU-8824** – 24-Channel Meter Unit
- **SY-88** – Complete SMPTE/EBU Chase Synchronizing and MIDI Machine Control interface

Fostex

RD-8 Multi-Track Recorder

This digital multitrack recorder is designed specifically for the audio professional. Fostex has long been a leader in synchronization, and the RD-8 redefines that commitment. With its built-in SMPTE / EBU reader/generator, the RD-8 can stripe, read and jam sync time code - even convert to MIDI time code in a sync environment the RD-8 can be either Master or Slave. In a MIDI environment it will integrate seamlessly into the most complex project studio, allowing you complete transport control from within your MMC (MIDI Machine Control) compatible sequencer.

- Full transport control is available via the unit's industry-standard RS-422 port, providing full control right from your video bay. The RD-8 records at either 44.1 or 48KHz and will perform Pull-Up and Pull-Down functions for film/video transfers. The Track Slip feature helps maintain perfect sound-to-picture sync and the 8-Channel Optical Digital Interface keeps you in the digital domain.
- All of this contributes to the superb sound quality of the RD-8. The audio itself is processed by 16-bit digital-to-analog (D/A's) converters at either 44.1 or 48KHz (user selectable) sampling rates, with 64X oversampling. Playback is accomplished with 18 bit analog-to-digital (A/D's) and 64X oversampling, thus delivering CD-quality audio.
- The S-VHS transport in the RD-8 was selected because of its proven reliability, rugged construction and superb tape handling capabilities. Eight tracks on S-VHS tape allow much wider track widths than is possible on other digital tape recording formats.
- With its LCD and 10-digit display panel, the RD-8 is remarkably easy to control. You can readily access 100 locate points, and cross-fade time is fully controllable in machine to machine editing. Table of Contents data can be recorded on tape. When the next session begins, whether on your RD-8 or another, you just load the set up information from your tape and begin working. Since the RD-8 is fully AOAT compliant, your machine can play tapes made on other compatible machines, and can be controlled by other manufacturers ADAT controllers. Your tapes will also be playable on any other ADAT deck.
- In addition to familiar transport controls, there are a number of logical, user friendly features. This is the only unit in its class with an on-board, back-lit variable contrast LCD display. It provides all of the information you'll need to keep track of offsets, punch points, generator functions and other pertinent data. Three function keys, combined with HOME, NEXT and UP/DOWN buttons, enable you to navigate the edit menus effortlessly. If you need to have access to the front panel controls, the optional model 8312 remote control gives you remote command of the most common functions.

SENNHEISER

RF SERIES CONDENSER MICROPHONES

Unlike traditional condenser microphones, the capacitive transducer in Sennheiser condenser microphones is part of a tuned RF-discriminator circuit. Its output is a relatively low impedance audio signal which allows further processing by conventional bi-polar low noise solid state circuits. Sennheiser microphones achieve a balanced floating output without the need for audio transformers, and insures a fast, distortion-free response to audio transients over an extended frequency range. The RF-design yields exceptionally low noise levels and is virtually immune to humidity and moisture. The comparatively low RF-voltage across the elements of the transducer also eliminates arcing and DC-bias creeping currents. Sennheiser employs RF-technology to control residual microphone noise. Optimizing the transducer's acoustic impedance results in a further improvement in low noise performance. Sennheiser studio condenser microphones operating according to this RF-principle have proven their superior ruggedness and reliability in the past decades under every conceivable environmental condition.

MKH 20 P48U3 Omnidirectional

Low distortion push-pull element, transformerless RF condenser, flat frequency response, diffuse/near-field response switch (6 dB boost at 10 KHz), switchable 10 dB pad to prevent overmodulation. Handles 142 dB SPL. High output level, ideal for concert, Mid-Side (M-S), acoustic strings, brass and wind instrument recording.

MKH 40 P48U3 Cardioid

Highly versatile, low distortion push-pull element, transformerless RF condenser, high output level, transparent response, switchable proximity equalization (-4 dB at 50 Hz) and pre-attenuation of 10 dB to prevent overmodulation. In vocal applications excellent results have been achieved with the use of a pop screen. Recommended for most situations, including digital recording, overdubbing vocals, percussive sound, acoustic guitars, piano, brass and string instruments, Mid-Side (M-S) stereo, and conventional X-Y stereo.

MKH 60 P48U3 (Short Shotgun)

Short interference tube RF condenser, lightweight metal alloy, transformerless, low noise, symmetrical capsule design, smooth off-axis frequency response, switchable low cut filter (-5 dB at 100 Hz), high frequency boost (+5 dB at 10 KHz) and 10 dB attenuation. Handles extremely high SPL (135 dB), ideal for broadcasting, film, video, sports recording, interviewing in crowded or noisy environments. Excellent for studio voiceovers.

MKH 70 P48U3 (Shotgun)

Extremely lightweight RF condenser, rugged, long shotgun, low distortion push-pull element, transformerless, low noise, switchable presence (+5 dB at 10 KHz), low cut filter (-5 dB at 50 Hz), and 10 dB preattenuation. Handles 133 dB/SPL with excellent sensitivity and high output level. Ideal for video/film studios, theater, sporting events, and nature recordings.

MKH 416 P48U3 Supercardioid/Lobe (Shotgun)

Transformerless, RF condenser designed as a combination of pressure gradient and interference tube microphones. Very good feedback rejection, low proximity effect, 128 dB/SPL. Rugged and resistant to changing climate conditions. Ideal for boom, fishpole, and camera mountings. A long-distance microphone for video, film, and studio recording. Excellent for interviewing for reporters, podium or lecture microphone.

MKH 816 P48U3 Ultra-directional Lobe (Shotgun)

Narrow-beam pattern, transformerless RF condenser microphone. Handles 124 dB/SPL and has high output voltage. Perfect for crowded news conference, movie sets, TV stages, sporting events and nature recording.

CHYRON Graphics

PC-CODI TEXT and GRAPHICS GENERATOR

A PC-compatible (ISA bus) board, the PC-CODI incorporates a broadcast quality encoder and wide bandwidth linear keyer to provide highest quality realtime, video character generation and graphics display. Used individually or configured with multiple boards, it is a complete and affordable solution for information displays, broadcast, video production or multi-media applications.

- Standard PC/AT ISA bus interface: 2/3 length form factor
- Fully-antialiased displays
- Less than 10nsec. effective pixel resolution
- 16.7 million color selections
- Fast, realtime operations
- Character, Logo and PCX Image transparency
- Display and non-display buffers
- Bitstream typeface library selection
- Variable edges: border, drop shadow and offset
- Variable flush
- Full position and justify control of character & row
- User definable intercharacter spacing (squeeze & expand)
- Multiple roll/crawl speeds
- Automatic character kerning
- User definable tab/template fields
- Shaded backgrounds of variable sizes and transparency
- User definable read effects playback; wipes, pushes, fades
- High quality composite & S-video (Y/C) encoder
- Integral composite and S-video linear keyer
- NTSC or PAL sync generator with genlck
- Module switchable NTSC or PAL operation
- Software controlled video timing
- Board addressability for multi-channel applications
- Auto display sequencing
- Local message/page memory
- Preview output with safe-title/cursor/menu overlay
- Composite & S-video input with auto-genlock select

SONY COLOR MONITORS

PVM-1350 13˝ Presentation Monitor

- Employs a P-22 phosphor fine pitch CRT to deliver stunning horizontal resolution of 450 horizontal lines.
- Equipped with beam current feedback circuit which eliminates white balance drift for long term stability of color balance.
- Has analog RGB, S-video and two composite video (BNC) inputs as well as 4 audio inputs.
- Automatic Chroma/Phase setup mode facilitates the complex, delicate procedure of monitor adjustment. Using broadcast standard color bars as a reference, this function automatically calibrates chroma and phase.
- Chroma/Phase adjustments can also be easily performed with the monochrome Blue Only display. In Blue Only mode video noise can be precisely evaluated.
- Factory set to broadcast standard 6500K color temperature
- Provides an on-screen menu to facilitate adjustment/operation on the monitor. The on-screen menu display can be selected in English, French, German, Spanish or Italian.
- On power up, automatic degaussing is performed. There is also a manual degauss switch to demagnetize the screen.
- Sub control mode allows fine adjustments to be made on the knob control for contrast, brightness, chroma and phase. The desired level can be set to the click position at the center allowing for multi-

PVM-1351Q 13˝ Production Monitor

Has all the features of the PVM-1350 *PLUS*:

- Is also a multisystem monitor. It accepts NTSC, PAL and NTSC video signals. NTSC 4.43 can also be reproduced.
- Equipped with a SMPTE 259M Serial Digital Interface. By inserting the optional serial digital interface kit BKM-101C for video and the BKM-102 for audio the PVM-1351Q can accept SMPTE 259M component serial digital signals.
- Equipped with RS-422 serial interface. With optional BKM-103 serial remote control kit all of the monitor's functions can be remotely controlled with greater confidence and precision.
- Equipped with input terminals such as component (Y/R-Y/B-Y), analog RGB, S-video, 2 composite video (BNC) and 4 audio terminals for complete flexibility.
- Aspect ratio is switchable between 4:3 and 16:9 simply by pressing a button.
- Underscan and H/V delay capability. With underscan, entire active picture area is displayed. Allows you to view entire image and check the picture edges. H/V delay allows viewing of the blanking area and sync/burst timing by displaying the horizontal and vertical intervals in the center of the screen.
- Color temperature switchable between 6500K/9300K/User preset. 6500K is factory preset. 9300K is for a more pleasing picture. User preset is 3200K to 10,000K.

PVM-1354Q/PVM-1954Q 13˝ and 19˝ Production Monitors

All the features of the PVM-1351Q *PLUS*:

- SMPTE C standard phosphor CRT is incorporated in the PVM-1354Q/1954Q. SMPTE C phosphors permit the most critical evaluation of any color subject. Provides over 600 lines of horizontal resolution.
- The PVM-1354Q mounts into a 19-inch EIA standard rack with the optional MB-502B rack mount bracket and SLR-102 slide rail kit same as PVM-1351Q. The PVM-1954Q mounts into a 19-inch EIA rack with the optional SLR-103 slide rail kit.

SHURE

FP32A PORTABLE STEREO MIXER

This small and rugged portable mixer is well equipped to handle the demands of EFP, ENG, live music recording or any other situation that requires a low noise high performance mixer.

- High quality-low noise electronics, perfect for digital recording and transmission
- Three balanced inputs, two balanced outputs plus tape out and monitor
- Supports all types of condenser mics with internal phantom supply
- Inputs can be switched between mic and line level
- Each channel has own pan pot
- Each channel has illuminated meter and peak indicator
- Two units can be cascaded to provide six input channels
- Internal 1KHz oscillator for record and send level calibration
- Internal (2x9V alkaline batteries) or external power
- Switchable low cut filters

MACKIE

MicroSeries 1202 12-Channel Ultra-Compact Mic/Line Mixer

Usually the performance and durability of smaller mixers drops in direct proportion to their price, making lower cost models unacceptable for serious recording and sound reinforcement. Fortunately, Mackie's fanatical approach to pro sound engineering has resulted in the Micro Series 1202, an affordable small mixer with studio specifications and rugged construction. The Micro Series 1202 is a no-compromise, professional quality ultra-compact mixer designed for non-stop 24 hour-a-day professional duty in broadcast studios, permanent PA applications and editing suites where nothing must ever go wrong. So no matter what your application, the Micro Series 1202 is ideal. If price is the prime consideration or you simply want the best possible mixer in the least amount of space, there is only one choice.

CR-1604 16-Channel Audio Mixer

In less than three years, the Mackie CR-1604 has become the industry standard for compact 16-channel mixers. It is the hands-down choice for major touring groups and studio session players, as well as for broadcast, sound contracting and recording studio users. For them the CR-1604 offers features, specs, and day-in-day-out reliability that rival far larger boards. Its remarkable features include 24 usable line inputs with special headroom/ultra-low noise Unityplus circuitry, seven AUX sends, 3-band equalization, constant power pan controls, 10-segment LED output metering, discrete front end phantom-powered mic inputs and much more.

TASCAM

M-2600 Series 16/24/32 Channel Eight Channel Mixers

LOW NOISE CIRCUITRY

- Combining completely redesigned, low noise circuitry with Absolute Sound Transparency™ the M-2600 delivers high-quality extremely clean sound. No matter how many times your signal goes through the M-2600, it won't be colored or altered. The signal remains as close to the original as possible. The only coloring you hear is what you add with creative EQ and your outboard signal processing gear.
- Double reinforced grounding system eliminates any hum. World-class power supply provides higher voltage output for better headroom and higher S/N ratio.

THE BEST AUX SECTION IN THE BUSINESS

The most versatile AUX section in its class, rivaling expensive high-end consoles. 8 sends total, 2 in stereo. Send signal in stereo or mono, pre- or post-fader. Available all at once. Return signal through any of 6 stereo paths.

Continued from page 92

Custom panels
Gepco International

• Custom panels: panels custom-built to specification; panels are fabricated in 1/16-inch and 1/8-inch aluminum, anodized or laminate, in a variety of colors; laminate finishes can be color-filled for function identification and all engraving is done on computerized CAD/CAM equipment; graphics for plastic finishes can be silk-screened or photographed.

Circle (366) on Reply Card

Real-time video distribution platforms
FutureTel

• MPEGTHERE & MPEGANYWARE: integrated hardware and software platforms that make distribution of live video over wide area networks possible; MPEGTHERE supports point-to-point distribution of real-time video over T1 lines, while MPEGANYWARE enables simultaneous multicast of real-time video over multiple T1 lines; both systems are based on FutureTel's state-of-the-art MPEG-1 encoding technology and T1 technologies enabling the real-time compression and distribution of any standard NTSC or PAL signal; as the video is encoded, the video stream is automatically sent to remote sites where it is decoded and played back in real time ensuring audio and video synchronization; applications include cable head-end distribution, distance learning, ad insertion and remote screening.

Circle (367) on Reply Card

Digital video recorder
Fast Forward Video

• Bandit: latest version of Bandit includes 2+ channels of CD-quality audio and functions as a complete Betacam SP replacement deck; other new features include full RS-422 machine control, externally controlled gen-lock, a choice of non-linear software packages, and a new chassis design that can be used as a desktop tower or rack mount; Bandit also features component input/output, CCIR-601 internal resolution and 20 minutes of storage.

Circle (368) on Reply Card

Lavaliere mic
Sennheiser Electronic Corporation

• MKE2: a smaller version of MKE2 that is easier to hide, more linear in high-end response and more immune to sweat; the end cap is removed and supplied as an accessory so that sweat is prevented from being drawn into the capsule; the anodized shell of the capsule retains the exact sonic quality of the original design with the added benefit of providing a 1dB flatter response above 10kHz without the cap.

Circle (369) on Reply Card

PROFESSIONAL SERVICES

CLASSIFIED

FOR SALE

Circle (102) on Reply Card

Circle (100) on Reply Card

CLASSIFIED

FOR SALE

Want more information on advertised products?

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EQUIPMENT WANTED

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

WANTED: For RCA TM-21 color monitor flyback #214870 and power transformer #213987 or entire monitor. J. Ballard (212) 664-3033.

TRAINING

FCC GENERAL CLASS LICENSE. Cassette recorded lessons for home study. Our 30th year preparing radio technicians for the license. Bob Johnson Telecommunications. Phone (310) 379-4461.

Classified Advertising Rates

Advertising rates in **Broadcast Engineering** Classified Section are $119.00 per column inch, per insertion, with frequency discounts available. There is a one inch minimum and ten inches maximum.

Ads may also be purchased By-The-Word for $1.75 per word, per insertion. Initials and abbreviations count as full words. Minimum charge is $40 per insertion.

Blind box ads (replies sent to **Broadcast Engineering** for forwarding) are an additional $40.00. Reader Service Numbers are available for $50.00 per insertion. Ads 4 inches or larger receive a Reader Service Number free.

Spot color, determined by **Broadcast Engineering**, is available at $95.00 per insertion.

No agency discounts are allowed for classified advertising.

Call Matt Tusken
Classified Sales Manager
at 800-896-9939 to reserve your classified ad!

CLASSIFIED

HELP WANTED

MAINTENANCE ENGINEER Black Entertainment Television Inc. Ability to troubleshoot to the component level production switchers, digital video effects systems, routing switchers, vtr's character generators, cameras, editing systems and audio equipment. This will include system interfacing to computers and compatible components, equipment installation for studio and remote productions. Must be knowledgeable of system timing theory, broadcast specifications, and electronics course study. Ability to perform fiber switches and satellite downlink. Must have 3 years experience. BET, Corporate Human Resources, 1905-E 9th Street, N.E., Washington, D.C. 20018.

TV CHIEF ENGINEER Do you like to climb, hike and play in the snow? Then we have a job for you! Alaska station group is looking for a Chief Engineer. This is a hands-on maintenance intensive position. Must have strong studio/RF transmitter skills. If you dream of living and working in the last frontier then send your resume to: Mark Chassman, General Manager, Alaska Broadcasting Network, 2700 E. Tudor Rd., Anchorage, AK 99507. ABN is EOE.

SALES ENGINEERING/SUPPORT - Quantel is seeking Product Managers and Assistant Product Managers for its Product Support Department based in Connecticut. It is preferable that the successful candidate have engineering experience in the Broadcast and Post Production industry. Please forward resume and salary requirement to Vice President Product Support, Quantel, 85 Old Kings Highway North, Darien, CT 06820 or fax to 203-656-3459.

STUDIO MAINTENANCE ENGINEER This position involves equipment maintenance to the component level on all types of studio equipment. MII VTR experience is helpful. Successful candidate will be part of a major expansion and rebuild. Excellent pay and benefits. Send resume to KPLR-TV, Attn: Dept. EF, 4935 Lindell Boulevard, St. Louis, MO 63108. EEO Employer. No calls please.

TELECOMMUNICATIONS ELECTRONICS Rapidly growing, entrepreneurial satellite communications company which operates transportable uplink units in the southeast, southwest and midwest seeks a bright, meticulous, self-starting, energetic person to serve as chief engineer. Responsibilities include maintenance and repair of equipment as well as design, fabrication and integration of communication systems. Experience with RF and microwave equipment and broadcast video and audio equipment is essential as is the ability to diagnose and perform maintenance down to the component level. Some knowledge of data systems/equipment desirable, but not essential. Excellent salary and benefits to the right person. We demand a great deal, but offer tremendous responsibility and rewards. Please mail resume to J. David Honeycutt, 1342 Knollhaven, Baton Rouge, LA 70810.

CHIEF ENGINEER: KCAU-TV in Sioux City, IA is seeking a Chief Engineer. Qualified applicants must have strong broadcasting background and at least two years of management or supervisory experience. This position requires complete knowledge of satellite systems, transmitters, computers, control room and studio equipment. SBE Certification or FCC General Class License preferred. Send resume to Kim Cleaver, General Manager, KCAU-TV, 625 Douglas, Sioux City, IA 51101, or fax (712) 277-3733. EOE.

STUDIO MAINTENANCE ENGINEER Waterman Broadcasting has opening for experienced Maintenance Engineer. Computer and digital experience needed. Experience with BTS router, Pinnacle Flashfile, Avid Digital Airplay, Odetics Airplay, Grass Valley 300 Switcher and 700 DVE or equivalent needed. Prefer SBE member with FCC license. Waterman Broadcasting is an equal opportunity employer in SUNNY south Florida. Send resume to Wayne Phillips, P.O. Box 7578, Fort Myers, FL 33911 or call 941-939-6299.

NATIONAL PUBLIC RADIO is seeking key information technology professionals to move the network into the information future.

#244 Director, Information Services: NPR seeks a Director to provide leadership & direction to the Information Services staff in planning, procurement, resource mgt., communications & training. Candidate will represent NPR in national & regional forums as its technology expert; participate in key work group & will work with sr. mgt. in development & implementation of NPR's strategic information services network & content plans. Bachelor's degree required. Must have demonstrated leadership & experience in managing information services. Experience in microcomputing hardware & software design, integration, implementation & maintenance required & familiarity with a broad range of programming systems & languages, dbase mgt. & appls.

#714 Network/Systems Administrator: NPR seeks an energetic, self-motivated, and detail oriented network & software support professional. Responsible for providing 24-hour on-call, technical & administrative support. Duties include monitoring, tracking & reporting system indicators. Provides system & technical support for VAX VMS, workstations & servers (DOS, WFW, Mac, WinNT, UNIX). Researches new systems, & components. Requires BS degree in Computer Science with years of emphasis on network & systems design & troubleshooting preferred. 3 yrs. network/systems administration to include responsibility for a multiplatform system. Proficient in Windows, MS Office Tools & MS Project. Able to work in a fast paced environment.

#743 Coordinator, New Media Services: NPR seeks a dynamic, creative, deadline oriented leader to design, develop & implement NPR's on-line image including areas for File Transfer Protocol (FTP), Gopher, World Wide Web (WWW) & other emerging technologies on the Internet & National Information Infrastructure (NII). Oversees the development efforts of Gopher, FTP & WWW for use by our member stations, & researches & recommends new technologies for use by NPR. BS degree required & working knowledge of NPR & online computer information services. 2 yrs. experience with various computer operating systems, including UNIX, Mac & IBM. Fluent in PC Hypertext Mark-up Language (HTML), FTP site management, Gopher. Audio quality standards, audio editing & digital audio skills required. Experience in designing & executing business plans for new products & services helpful.

All positions offer a competitive salary, excellent benefits, and an informal professional working environment. Send resume and cover letter referencing job number/title to: National Public Radio, Dept. of Human Resources, 635 Massachusetts Ave. NW, Washington, DC 20001-3753. NPR is an Equal Opportunity Employer.

ATLANTA CHIEF ENGINEER Trinity Broadcasting station in the Atlanta area. Experienced in maintenance of UHF transmitter, studio systems as well as personnel supervision and training. SBE certification a plus. Send resumes to Ben Miller, Mail P.O. Box C-11949, Santa Ana, CA 92711; E-mail: BMILLER614@AOL.COM; Fax: 714/665-2101. M/F EOE.

StarTech CORPORATION

KEY MEMBER
IN A DYNAMIC OPPORTUNITY
Full responsibility for
video, voice, and data networks

Star Tech Corporation, Boston, MA, operates a transaction processing network and pay-per-view movies for mid-size and smaller hotels, motels, and resorts. **Star Tech Cinema** is delivered by cable TV from digital video file servers and soon will be upgraded to digital transmission on via DBS.

We need a broadcast/network engineer to join the founding team with broad responsibility for network and systems operations and design and to actively assist in the launch on DBS.

Experience with digital video, satellite and cable TV, and telecommunications and data networks are essential, and knowledge of voice response, real-time transaction processing, and DEC VMS would all be valuable. But mostly, this person will be both a clear thinker and a self-starter and will be keenly interested in the demands and challenge of this early stage opportunity.

P.O. Box 358
Watertown, MA 02272
617-926-5577, Fax 926-5977

CALIFORNIA GROUP OWNER has an immediate need for Director of Engineering of (5) television stations. Applicants should possess a degree in electronics, SBE certification of Senior Broadcast Engineer and an FCC general class license. A minimum of 5 years experience as a Chief Engineer and have hands on knowledge of UHF high-powered transmitters, microwave systems and studio equipment. Salary commensurate upon experience, plus benefits and company issued vehicle. Send resumes to Personnel Department, P. O. Box 4159, Modesto, CA 95352. EOE.

AGGRESSIVE EASTERN U.S. TOP 60 affiliate seeks the right person to assume Assistant Chief Engineer responsibilities. Hands on repair and maintenance with multiple formats, studio & ENG equipment and problem solving abilities needed. Experience with high power UHF a plus. If you are a mature self-starter with at least two years experience, and a FCC General Class License or SBE Certification, please forward your resume and salary requirements to: Classified Ad Coordinator, Broadcast Engineering, Dept. 767, 9800 Metcalf, Overland Park, KS 66212-2215. EEO.

ASSISTANT CHIEF ENGINEER WYES-TV has an immediate opening for the position of assistant chief engineer. The team player selected must have good people skills in order to perform managerial tasks as well as interface effectively stationwide. Technical requirements include five years minimum broadcast tv maintenance experience, FCC general class license or SBE certification, component level troubleshooting, computer literacy with networking experience. Send resume with salary requirements to: Personnel Office, WYES-TV, P.O. Box 24026, New Orleans, LA 70184-4026. No telephone calls please! WYES-TV is an equal opportunity employer.

CLASSIFIED

HELP WANTED

STATION MANAGER

with television engineering background needed immediately for KSKN-TV in Spokane, Washington. Individual responsible to operating full power, 24-hour, UHF home shopping network station. Must be experienced in transmitter, studio, and microwave maintenance. Knowledge of FCC regulations and compliance mandatory. Management experience a plus but not required. Good people and community relations skills necessary. FCC license required. Send resume to KSKN-TV, Inc., Corporate Office, 408 Paseo Companeros, Chico, CA 95928. KSKN-TV is an equal opportunity employer.

MAINTENANCE ENGINEER Dominant NBC in the beautiful Appalachian Mountains. Excellent local public education system and quality of life with low crime rate and great fishing, hunting, boating and other outdoor activities. Experienced, with maintenance, repair, and operation with state of the art equipment throughout. Should possess basic knowledge of VHF transmitters and be skilled in computer operations including networks using Microsoft NT server. College degree preferred. Resumes before September 15 to Judy Baker, WCYB-TV, 101 Lee Street, Bristol, VA 24201. No phone calls. EOE/M/F/H/V.

Invest your advertising dollars where your prospects invest their time...

BROADCAST engineering

Video Service/Maintenance Technician

Swiderski Electronics, Inc. a leader in the Audio/Video/Telecommunications field, has an immediate opening for a qualified Audio/Video Service/Maintenance Technician. 2 yrs. exp. Position works with Broadcast/Industrial 1/2', 3/4' and 1' VTR's & related equipt.

Send resume & salary history to:
H/R Dept., 1200 Greenleaf Ave.
Elk Grove Village, IL 60007
Fax resume (708) 364-5019

TURNER ENTERTAINMENT NETWORKS

TELEVISION ENGINEERS

Turner Broadcasting System, the leading News, Sports, and Entertainment system in satellite communications, has career opportunities for engineers with **broadcast maintenance** experience. These positions demand an extensive background in television engineering and at least two years of training in electronics technology. Turner Broadcasting System offers an excellent benefit and compensation program.

Send resumes to:
Mr. Jim Brown, Corp. Engineering
Turner Broadcasting System, Inc.
One CNN Center
P.O. Box 105366
Atlanta, GA 30348-5366
(404) 827-1638 office
(404) 827-1835 fax

TBS is an equal opportunity employer

Acentech

Senior Video Consultant

Boston area acoustics/audiovisual consulting firm with 45 year history seeks senior level video/audiovisual system designer. Experience and interest should include videoconferencing, video production and high-end audiovisual facilities. Computer/CAD literacy is required; good communication skills are essential. The successful applicant will be involved in major projects nationwide.

Direct all resumes to:

Personnel Manager
Acentech Incorporated
125 CambridgePark Drive
Cambridge, Massachusetts 02140
Fax: 617-499-8074

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Fax 717-654-5765 • Phone 717-655-7143

SERVICES

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In all formats NTSC, PAL, SECAM.

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Circle (101) on Reply Card

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- FAST IN / OUT SHIPPING

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SERVICE COMPUTER AND BROADCAST picture monitors vcrs cameras switchers and much more. Installation and design of entire broadcast studios. You buy the equipment we install. Call Pathway Electronics (216) 654-3392.

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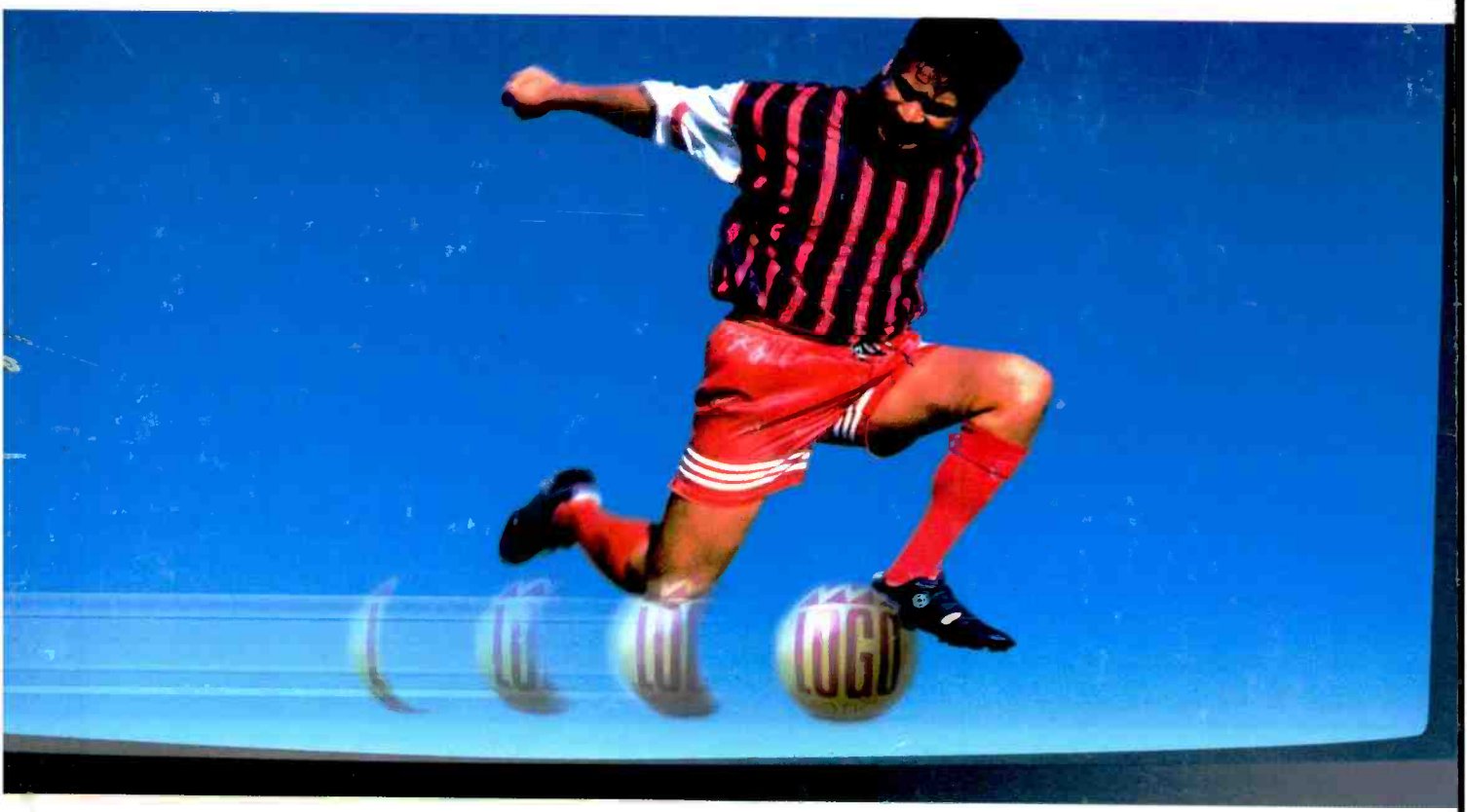

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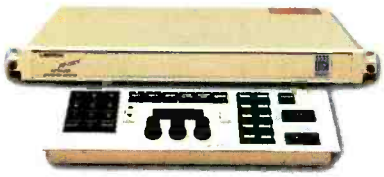

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