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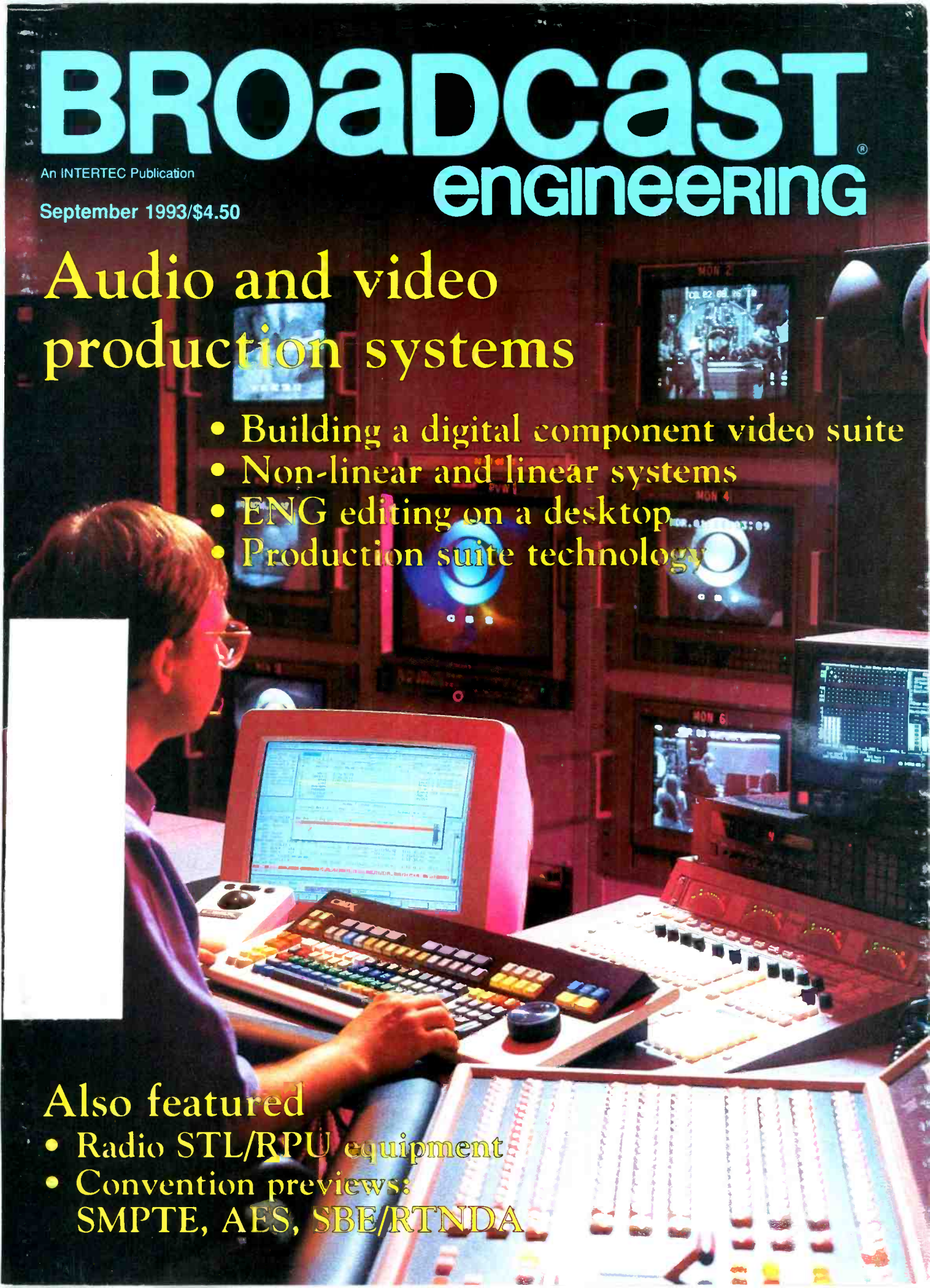

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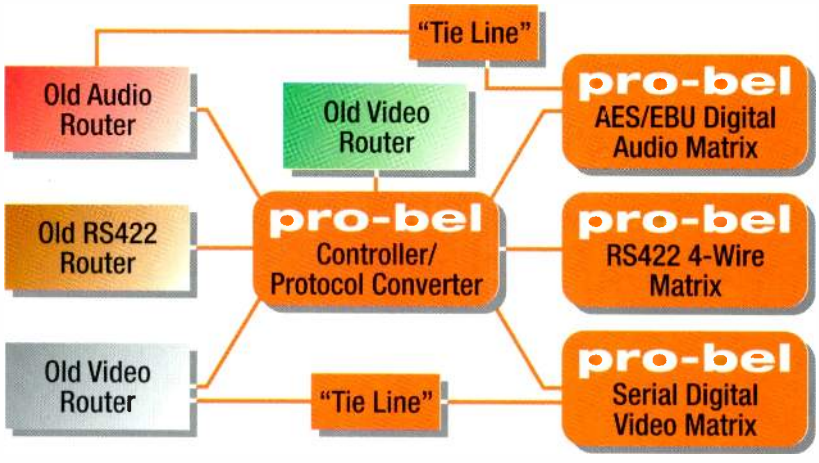

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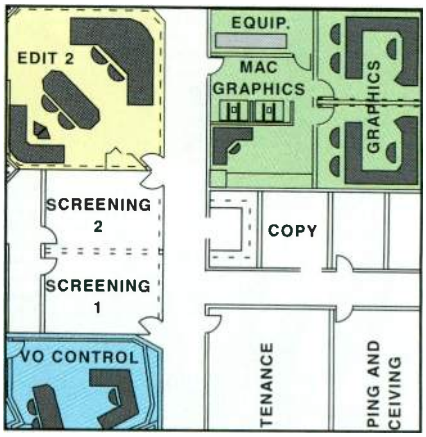

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AUDIO AND VIDEO PRODUCTION SYSTEMS:

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The CMX Omni 1000E in use in an all-digital suite at CBS Television City, Hollywood. CMX, a division of Chyron Corporation, is a member of the PESA Chyron Group. (Photo By Douglas Schwartz. Design by Stephanie Chiles.)

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News

By Dawn Hightower, senior associate editor

RTNDA, SBE, SMPTE, NAB announce joint exhibit

The Radio-Television News Directors Association (RTNDA), the Society of Broadcast Engineers (SBE), the Society of Motion Picture and Television Engineers (SMPTE) and the National Association of Broadcasters (NAB) have announced a joint exhibit. It will be held Oct. 12-15, 1994, at the Los Angeles Convention Center, Los Angeles.

Under the new agreement, the annual conferences for RTNDA, SBE, SMPTE and the NAB Radio Show will be conducted as separate and independent events, which will be scheduled concurrently. However, the organizations will hold one combined exhibition.

The agreement for a joint exhibition is for eight years, and NAB will manage it.

1994 SMPTE call for papers

The 1994 SMPTE Advanced Television and Electronic Imaging Conference will take place Feb. 4-5 at the downtown Marriott, Chicago. A call for papers has been announced. Subjects to be covered include HDTV, multimedia applications, integrated imaging, video compression, image compositing, advanced digital formats and electronic imaging.

Authors interested in presenting papers must submit their name, company affiliation, address, telephone number and a 500-word synopsis to Marilyn Waldman at SMPTE headquarters, 595 W. Hartsdale Ave., White Plains, NY 10607; telephone 914-761-1100; fax 914-761-3115.

SMPTE engineering committees on-line

The SMPTE Engineering Electronic Communications (SEEC) system has opened as a private area on CompuServe. SEEC offers users access via computers to calendars of SMPTE engineering meetings and other activities. A general engineering committee bulletin board, library and message sections are accessible only to individual committees and their subcommittees.

The technology committee libraries will hold drafts of SMPTE standards, recommended practices and engineering guidelines, which can be downloaded by members. Comments on these drafts can be uploaded to the corresponding technology committee message section, where the comments can be read by the members and considered for incorporation.

SEEC will not be visible or accessible to regular CompuServe users. To access SEEC, users must sign up with the engineering department at SMPTE headquarters. There are no extra charges for accessing SEEC. Normal CompuServe features are available through the SEEC menus.

The SEEC system, which is a supplement to face-to-face engineering committee meetings, will be available for viewing in the registration area at the 135th SMPTE Technical Conference and Equipment Exhibit, Oct. 29 through Nov. 2 at the Los Angeles Convention Center, Los Angeles.

During the conference, a number of engineering committee meetings also will take place. For further details, contact the engineering department at SMPTE headquarters, 595 W. Hartsdale Ave., White Plains, NY 10607; telephone 914-761-1100; fax 914-761-3115 or through CompuServe mail to 71362,23.

GIC to supply digital compression to PRIMESTAR

General Instrument Corporation (GIC) has formed an agreement with PRIMESTAR to provide the direct broadcast satellite (DBS) service with GI's DigiCipher digital compression technology. The agreement will allow PRIMESTAR to expand its service offerings to at least 70 channels by mid-1994.

PRIMESTAR will exchange its current analog system for DigiCipher digital equipment and support system. Launched in November 1990, PRIMESTAR delivers 24-hour-a-day entertainment and information.

FM subcarrier study group formed

The National Radio Systems Committee (NRSC), co-sponsored by the National Association of Broadcasters and the Electronic Industries Association, has formed a study group to investigate high-speed FM subcarrier technologies.

The NRSC is inviting individuals or companies that have proven and tested subcarrier technologies, which are compatible with the 57kHz RBDS subcarrier, to participate in the activities.

Additionally, any individual or company with a business interest in FM subcarrier technology is invited to participate. ■

BROADCAST engineering

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

BROADCAST ENGINEERING (ISSN 0007-1994) is published monthly (plus three special issues) and mailed free to qualified persons within the United States and Canada in occupations described above. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address changes to Broadcast Engineering, P.O. Box 12960, Overland Park, KS 66282-2960.

SUBSCRIPTIONS: Non-qualified persons may subscribe at the following rates: United States and Canada; one year, $50.00. Qualified and non-qualified persons in all other countries; one year, $60.00 (surface mail); $115.00 (air mail). Subscription information: P.O. Box 12937, Overland Park, KS 66282-2937.

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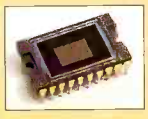

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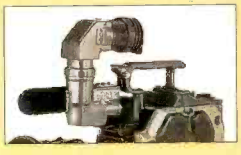

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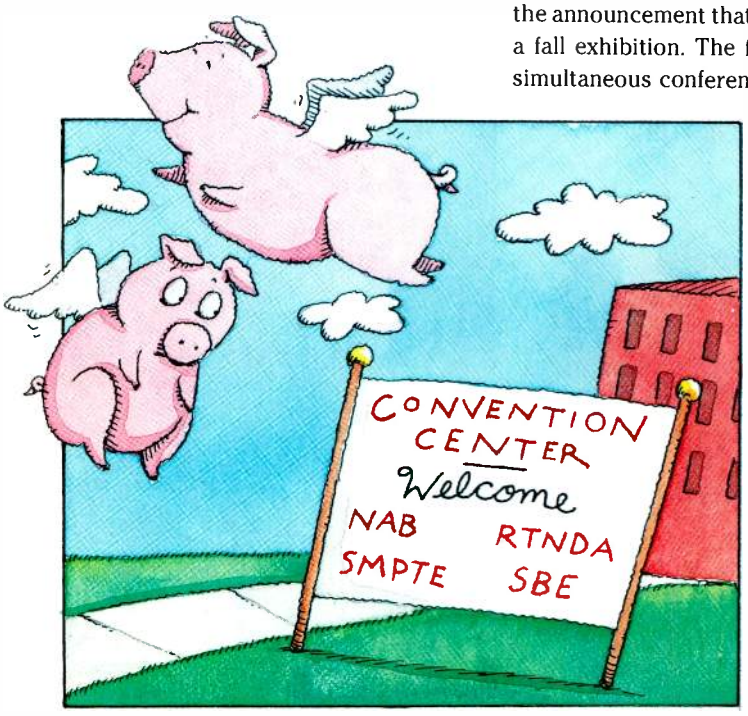
Editorial

When pigs can fly



The impossible seldom happens, but I've witnessed an example. I'm talking about the announcement that NAB, SBE, RTNDA and SMPTE have agreed to jointly sponsor a fall exhibition. The four associations will share a common exhibition and hold simultaneous conferences, beginning in Los Angeles, Oct. 12-15, 1994.

This an excellent idea, one that *Broadcast Engineering* magazine proposed two years ago in December 1991. At that time, I called for this industry's associations to join forces and reduce the number of fall shows. I'm glad to see someone was listening.

As our industry begins to climb from the depths of a recession, it's exciting to see these organizations come together for everyone's benefit. The exhibitors will profit from higher attendance and potential new customers. Some exhibitors will even be able to eliminate the costs of three of the shows they used to attend.

Attendees will see new products, companies and technology that otherwise might be missed. They will be exposed to allied areas of the industry, and gain new knowledge and a broader perspective. It's hard to see how anyone will lose in this arrangement.

But the battle hasn't been won yet. Members of SBE, RTNDA, SMPTE and the NAB should demand that their organizations continue to operate the event in the best interest of their members. It's easy to lose sight of the goal of serving the members when focused only on the profits of the event. When that happens, exhibitors get gouged and the attendees get cheated.

The leaders of each organization should be congratulated for their efforts. Undoubtedly, it must have been a difficult process. Thank you for putting your members and exhibitors ahead of territorial and historic prejudices. Let's all hope the synergy from the four groups will produce not only a better event, but also help stimulate our industry to even higher growth.

It's sometimes said the impossible happens only when pigs learn to fly. What's that I see overhead?

Brad Dick

Brad Dick,
Editor

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Circle (7) on Reply Card

FCC Update

FCC studies AM directional antenna performance

By Harry C. Martin and Andrew S. Kersting

The FCC is inquiring into the policies and rules concerning the performance verification of AM directional antenna systems. The agency will review the regulations concerning AM directional antenna performance verification; determine whether the regulations are effective in controlling interstation interference, particularly at night; and consider adopting alternative regulatory provisions made possible by advances in antenna analysis methods and instrumentation technology.

The inquiry will identify portions of the rules with regard to AM directional arrays that should be modified or deleted. The goal is to form a set of rules to ensure that array evaluations are done thoroughly and accurately, and to the satisfaction of existing interference criteria. The FCC also would like to eliminate redundant, outmoded or unnecessary rules, as well as rules that impose a burden on licensees.

Revised service and technical rules for FM translator stations

The FCC has affirmed and clarified its FM translator rules on ownership and financial support for translators, the definition of "major change" in translator coverage areas, maximum power output and interference criteria. The agency also adopted minor amendments to its grandfathering criteria and its rules dealing with the technical aspects of local program origination.

The FCC clarified that "other-area" translators, whose ownership and financial support relationships with a primary station are temporarily "grandfathered," will not be required to comply with the service rules for the rest of the 3-year period, which will end June 1, 1994, if the translator changes its primary station. Waivers barring financial support of translators by distant stations will be considered after June 1, 1994, if the translator can show it will have to suspend operations if its distant-station support was discontinued.

The FCC also amended the grandfathering provision concerning the technical rules by specifying that FM translators authorized prior to the effective date of the rules must comply with the full scope of the technical requirements when they implement a "major change" modification or if they cause interference. FM translators seeking "minor changes" may continue to operate without complying with the technical rules as long as they satisfy the standards for actual interference. Translators proposing modifications that would not change or increase the 1mV/m coverage area by more than 10% are not subject to the "major change" review process.

The FCC also added a provision to its rules permitting acceptance of FM translator applications that are accompanied by written agreements with all relevant TV Channel 6 broadcast station licensees or permittees.

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

Rules modified between FM applications and rulemaking

The FCC has modified the rule that protects various types of FM applications from conflicting rulemaking petitions. The rules were amended so that applications for new FM stations or major changes filed during a filing window are protected from rulemaking petitions at the close of the filing window. FM applications are entitled to cut-off protection from conflicting rulemaking petitions at the same time they receive protection from other mutually exclusive applications. Other FM applications are protected as of the date filed.

As a result of the rule change, a timely counterproposal may be unacceptable if it conflicts with a previously filed FM application. The FCC will consider such counterproposals if they are amended to protect the transmitter site of the previously filed FM application within 15 days after the application appears on public notice. The proponent must demonstrate it did not know of the pendency of the conflicting FM application at the time it filed its counterproposal.

FM channel and class modifications permitted by application

The FCC has amended its rules to permit FM licensees and permittees to request, by application, upgrades on adjacent and co-channels, modifications to adjacent channels of the same class, and downgrades to adjacent channels.

Under the old rules, licensees and permittees were required to request these changes through a 2-step process. The new rules eliminate the rulemaking step in circumstances where it would substantially duplicate the application process. Now it permits a licensee or permittee to seek modification by application alone. Applicants who apply for a station modification under the one-step process must specify a site that complies with all application criteria, and demonstrates the existence of an available site that meets the allotment standards.

Non-type approved aural STL/ICR transmitters for backup service

The commission is proposing to allow stations to use non-type approved transmitters for aural STL/ICR service on a backup basis for up to 720 hours per year. The commission defined "backup" as the "temporary use necessary to restore and maintain regular service because the primary transmitter unit has failed or requires servicing."

The use of non-approved equipment would be restricted to situations where there would be no impediment to new aural auxiliary stations. Any licensee or permittee desiring to use unapproved equipment for more than 720 hours per year would be required to obtain advance commission approval. ■

Date line

On Oct. 1, 1993, annual ownership reports (or ownership certifications) are due for all radio and TV stations licensed to communities in the following states and territories: Alaska, Florida, Guam, Hawaii, Iowa, Missouri, Oregon, Puerto Rico, Samoa, Virgin Islands and Washington. TV stations in the following states and territories must file their renewals by Oct. 1, 1993: Alaska, Guam, Hawaii, Oregon, Samoa and Washington. Iowa and South Dakota LPTVs and TV translators also must file their renewals by Oct. 1, 1993. In addition, issues/program lists for the July-September quarter must be placed in the public file of all broadcast stations by Oct. 10, 1993.

EVER WONDER WHAT HAPPENS TO THE OTHER LAYERS WHEN YOU HAVE TO CHANGE THE 15TH?

Real-time disk recorders were revolutionary when they were introduced. They allowed you, for the first time, to produce multilayered video without picture degradation. And since then, they've spawned a new generation of non-linear real-time editing recorders of great power.

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The DCT 700d gives you all the creative freedom of a transparent multilayering environment combined with the speed, flexibility, and efficiency of a sophisticated editing tape drive. So when the drive is done with that complex commercial, you can put it to work editing that long documentary. That just can't be done with any other component system currently available, due to the limitations of high cost, high maintenance, and low editability.

In fact, the DCT 700d is simply the best digital editing tape drive in the world. We say that because it is built on the technical foundation of the best *analog* editing tape recorder ever made, the Ampex VPR-3, and the best video signal system, the Ampex Zeus. VPR-3/Zeus is the fastest, gentlest, most accurate, most transparent system ever designed for the analog environment–which may explain why you'll see them in almost every premier post-production house in the world. It truly set the analog recording standard. And now the DCT 700d Tape Drive sets the *digital* recording standard.

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The DCT 700d, however, is only part of the story.

DCT from Ampex is actually a *system.* A system conceived and optimized for post production in the digital component environment. And the first complete digital component system available from one manufacturer. In addition to the DCT 700d drive, it includes new tape cartridges, a new production switcher, new computerized edit controllers, ADO® digital special effects, and interconnect equipment.

It is a compact, sophisticated, practical digital component system that unlocks a whole new world of creative–and competitive–possibilities.

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DCT is the digital component system from Ampex, the company that has been creating video solutions longer than anyone in the world. The company that has been the leader in applying technical innovation to solve practical problems.

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Part 9

Strictly TV

Strictly HDTV

Single system compromise

By Curtis Chan

Several months ago, the FCC HDTV advisory committee got its first official look at the Grand Alliance's proposed system. The committee dropped further consideration of the four proposed systems to concentrate on a single unified system. If all goes well, a finished prototype may be ready for testing by May 1994, with a possible recommendation submission by the summer. As this goes to press, the committee will have decided if the alliance gets the go ahead with the prototype.

In either case, the committee pressed the alliance in the June 30 and July 1 meeting to adopt a 1,080 active line screen, not including the vertical blanking interval. Also, the committee recommended using 1,920 pixels across the screen, because the 1,080 x 1,920 screen would be compatible with some of the proposed HDTV systems overseas. This move reduces another obstacle in the development of an international standard.

What is left to do?

The committee also formed five working groups: scanning format, data transportation, transmission, audio and one to assess the impact on broadcasters and consumers. The final dates for working group submission was Aug. 31 for the audio and data transport systems and Sept. 15 for the scanning format group. Nov. 30 is the target date for the over-the-air transmission group. Work on the compression issue is to be submitted on Sept. 30.

When in doubt, compromise

During the transition toward the Grand Alliance, the computer industry had been lobbying aggressively for progressive scan. The most significant compromise is the alliance's commitment to develop a system that incorporates both progressive and interlaced scanning. The goal is to address the interoperability of HDTV with computers, telecommunications and other media formats, such as imaging, institutional and defense. The compromise calls for six scanning formats, one interlaced and five progressive. The system will be able to provide 787.5-line progressive scan at 24fps, 30fps and 60fps, and progressive 1,050 line at 24fps and 30fps. Because the 6MHz bandwidth and current compression technology prohibit 60fps, 1,050-line progressive transmission, a 1,050-line interlace format will be supported initially.

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

Compromise raises doubts

Unfortunately, even the best of intentions often result in debate. Initially, the goal for every television was to be able to receive both the progressive and interlaced formats, and to be able to convert the format to whatever display mode exists in the particular receiver. The proposal also stated that transmission of film material is to be in a progressive scan format and that the alliance will work toward eliminating interlaced scanning from the transmission path in the future.

A finished prototype may be ready for testing by May 1994.

This compromise did not bode well with some of the proponents. Jae Lim, M.I.T.'s professor of electrical engineering and director of the institute's advanced TV research program, is behind the Grand Alliance, but did not agree with the scan format issue from a technical point-of-view. He felt that interlaced scan abided by the 20-80 rule — 20% of the plan causes 80% of the problem. He added that 1,050 interlace format was a mistake and should be eliminated. Lim pointed out that the M.I.T./G.I. contingency proposed five progressive scan transmission formats. By adding interlaced scan, all sets must accommodate it, which is an added expense with no apparent benefit. By eliminating interlace scan, the cost of a set could drop two or three hundred dollars, concluded Lim.

Apple Computer senior scientist, media architecture, Michael Liebhold, also agreed with Lim and said the progressive scanning display is a step forward and an interlaced system is a step backward. He understood broadcasters concern for the cost of progressive, but the computer industry suggestion is to go right for the progressive display, which will take care of much of the cost early on.

During the discussions, however, others argued that the interlace option was the fastest and cheapest way to get the system off the ground.

G.I.'s vice president of HDTV business development Dr. Robert Rast agreed that the standard has to be 1,050-line progressive scan, but stated that it was not possible yet. For example, film could be sent at 1,050 progressive, but live video would require switching to 787 lines at 60fps.

AT&T's vice president of video technology and infrastructure Robert Graves concurred with Rast and said that the principle of the alliance is to move to all progressive scanning with 1,000 lines. Currently, progressive has the capacity of 787 lines. We need 1,000-line 60fps in a 6MHz TV channel. One way to achieve this is to include interlace scanning. Graves pointed out that some people think interlaced with 1,050 lines gives better spatial resolution, but progressive gives better temporal resolution. He believes that 787 progressive is the answer. Rast concluded that the scheme would give broadcasters a choice for transmission.

In the end

At the conclusion of the meetings, three issues appeared to be resolved: the use of square pixels, decoupling of the transmission and display components of the ATV system, and the packetization of the data and header descriptors.

As you might have guessed, square pixels (computer imaging industry de facto standard) provide a common image representation that enhances interoperability among all imaging systems. Decoupling is supported through the use of a frame buffer in the receiver, which can then decode any of the six proposed formats and process the imagery for the best presentation on an interlaced or progressive scan display. Finally, the identification of the transmission format and the encoded data is facilitated through the use of packet headers and descriptors. ■

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Circle (9) on Reply Card

EIA's multipath testing for in-band DAB

By Robert D. Culver, P.E.

In 1992, the Electronics Industries Association (EIA) established its Digital Audio Radio (DAR) subcommittee with the intent of recommending a standard digital radio broadcasting system to the FCC. The testing process is under way, operating as a joint project with the National Radio Systems Committee (NRSC).

The EIA/NRSC testing of proposed DAB formats will occur in multiple stages. The first round will take place in a controlled laboratory environment. For this simulation, a representation of the channel conditions likely to be encountered in the frequency band(s) to be used is required, primarily to characterize typical fading characteristics caused by multipath. For the testing of in-band FM formats, this channel fading data is required for the VHF band.

As a preliminary step to its format testing, EIA undertook the development of reliable and comprehensive VHF channel characterization data through field measurement. Pilot tests were carried out in June at the ATV test site in Charlotte, NC.

The test's transmission system

The test signal used consists of a series of 255 pulses generated repeatedly at a rate of 2MHz. The high/low nature of the 255 pulses follows a random sequence, but the sequence is the same every time. Therefore, the test signal is referred to as *pseudo-random* in nature. The pulse string is long enough to allow more than 40dB of level resolution, yet short enough to assure identification and capture of one complete string in a relatively short time.

The 2MHz pulse rate modulates a wideband (TV) transmitter with relatively simple QPSK modulation. The output is filtered to a 4MHz-wide, Gaussian-distributed noise signal. The test signal is transmitted with a center frequency of 85MHz, the center of the TV Channel 6 authorization for the ATV test being conducted by PBS in Charlotte. The frequency's proximity to the lower end of the FM band makes it appropriate for in-band tests.

Culver is a consulting engineer at Lohnes and Culver, Laurel, MD, and president of the Association of Federal Communications Consulting Engineers (AFCCE).

For the Charlotte tests, a 10kW average ERP was used from a panel antenna at 143m (470 feet) above ground level (AGL). This generated a circularly polarized signal over a half-circle area. For a subesquent round of tests in Seattle, lower transmission power (7.6kW ERP) and a tighter antenna pattern were used to protect a Channel 6 operation in Victoria, BC.

The Charlotte tests showed that interference to the test receiver was a significant concern. Adjustments to the system design were made to accommodate this requirement in the Seattle tests.

Receiver system

The test signals are received by a specially built "reference" antenna that receives horizontally and vertically transmitted components, but outputs them separately and independently. The two outputs are fed via low-gain, low-noise RF amplifiers to the receiver. Each RF amp can be turned on or off remotely by the test computer. The system travels in a minivan. The antenna is mounted on the roof such that its center is approximately 3m above ground level.

To assure that samples are taken often enough to accurately describe the channel effects along a path and over area, the measurement interval is set to $^1/_{10}$ wavelength or 0.35m. The sample interval is controlled by a shaft encoder attached to the drive train of the van. Data can be collected at up to 88km/h (50mph), but slower speeds make data collection easier for the crew in the van. At easily identified landmarks, the crew notes the location, time and data file number being recorded.

The receiver digitizes the received test signal's RF voltage to 8-bit precision at twice the transmitted pulse rate. Both the horizontal and vertical polarized signals are received and recorded. This is accomplished by the computer's switching of power to the RF amplifiers. The short transition time between amplifiers limits the distance between horizontal and vertical samples to less than 0.01 wavelengths at the maximum data-collection speed of 88km/h. Thus, the H and V samples are collected at nearly the same location.

At each sample point, enough data is collected so that three full 255-pulse series are received. This ensures a high probability of at least one full series being available for analysis. Including all such overhead, about 6kbytes of data are collected at each sample point. This equates to 17Mbytes of data per kilometer of test path.

Approximately 17Mbytes of data is collected per kilometer of test path.

Onboard the van is an RF spectrum analyzer, the output of which is continuously recorded by a VCR. A microphone in the van feeds the audio track of the VCR. It allows verbal slating of landmarks to describe path positions. Van equipment is powered by a 12VDC to 110VAC inverter.

Data analysis

With a fast 80486-based PC, data analysis requires more than 15 seconds per sample point. This amounts to nearly 12 hours of PC-processing time per kilometer of test path.

The data will yield the reflection time and magnitude relative to the direct signal with high precision. From that information, the frequency response of the channel can be calculated to yield the RF fading characteristics. It is anticipated that time-delay, frequency fade-depth, width and change, and recurrence with position will each be well-determined. For comparison, the spectrum analyzer video recordings also will be available.

The spectrum analyzer is limited to approximately three updates per second, so when the van is moving slowly, the changing character of the channel over its full 4MHz width can be easily seen. This visual representation of the channel is a powerful demonstration tool for frequency-selective multipath fading.

Final results of these tests will first be used by the EIA/NRSC test labs for programming simulation models of proposed in-band formats. Test data also will be made available to the industry at large during the IEEE Broadcast Symposium in September 1993 and thereafter. ■

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Part 4

Management for Engineers

The thinking worker

Team problem-solving skills

By Judith E.A. Perkinson

If managers want to have successful problem-solving teams, then they must train their employees in group problem-solving skills. Unfortunately, teamwork and problem-solving skills are not commonplace abilities in an engineering department. Today, the smart manager does not ask employees to function without the proper training.

Problem-solving team training should not be disregarded. Thousands of resources are available that can help you train your staff. Many community colleges, consulting firms and individual contractors offer team building and group problem-solving development. Ask around your station. There may be someone already employed who has been through some type of problem-solving training and can recommend a resource. That person also may be capable of doing the training for you.

The training program should teach the basic skills needed for effective participation in problem-solving teams. These skills should include:

1. Group handling skills
2. Communication skills
3. Brainstorming
4. Problem identification
5. Data collection
6. Data analysis
7. A structured problem-solving method

Training does not have be time consuming or expensive. However, it needs to be done, or the time and effort put into the problem-solving process could easily be wasted. Not only is this costly, but it also is frustrating and can have a negative effect on the department's morale.

Develop the future

The thinking worker does not stop with the development of problem-solving teams. Thinking workers need to be able to use these problem-solving skills when working independently. For decades, workforces have been trained in technical skills using equipment-based learning. This method held to the idea that workers' understanding needed to be limited to their immediate responsibilities. Work was compartmentalized and workers were taught only what they needed to know to complete the task at hand. It was up to the manager to have the big picture. The result has been described as putting arms and legs on machines. The boss was the only one allowed to think. The workers simply fulfilled individual duties.

If managers want to have successful problem-solving teams, they need to train employees in group problem-solving skills.

This attitude is much too expensive to continue in our current explosion of technology. In order to develop and maintain a thinking workforce, the approach to training technology must change. The answer has been the development of "process-based learning."

Understanding process-based learning

Process-based learning divides the training curriculum into three critical areas, and then uses these areas to construct the learning experience. The three components contribute to the worker's ability to understand the entire process, to know why he is doing what he is doing, and to be able to respond when the process is not functioning as it should.

• *Principles and theory.*
Workers are introduced to the basic principles and theory that make the process work. The purpose is not to make the person an expert in the design theory, but rather to allow the worker to see what the entire process is designed to accomplish and what body of knowledge or understanding makes the process work. This gives the worker a context in which to function.

• *Application.*
This piece is the "how do we do it?" aspect of the training. It is similar to more traditional equipment-based training. This not only explains the specific operations in the job, but it also helps the worker understand the kind of impact he has on the process.

• *Problem recognition, identification and reaction.*
Nothing is perfect. A thinking worker must be able to respond when the process is not functioning as it should. In order to make this possible, the worker must be able to recognize that something is not right. Training should teach workers to recognize the warning signs of a potential problem.

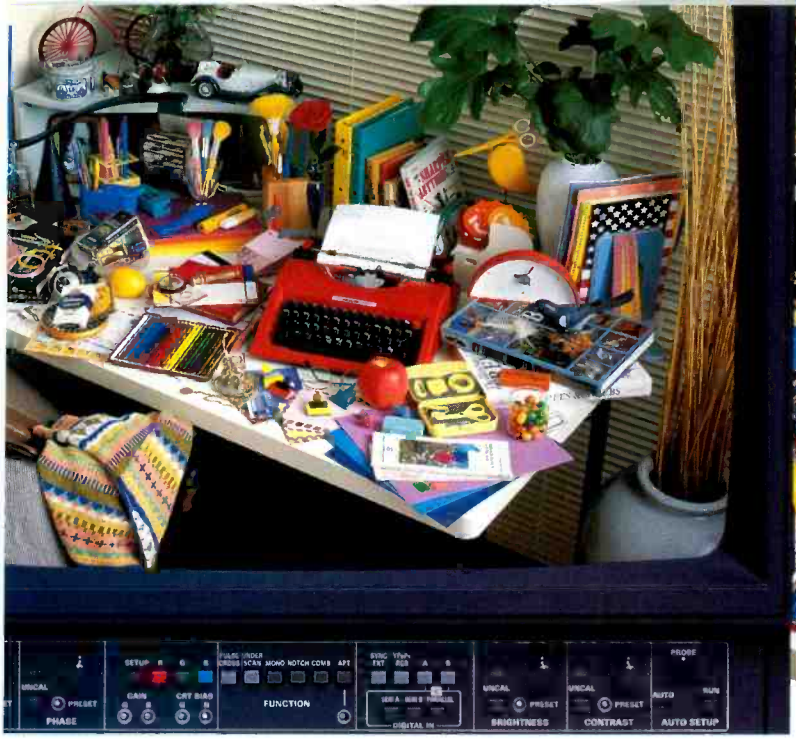
Because many problems may be similar, employees must be able to identify the real problem. To accomplish this, training must teach the workers to sort, analyze and identify. Finally, once the problem is identified, the employee must know how to react to the problem.

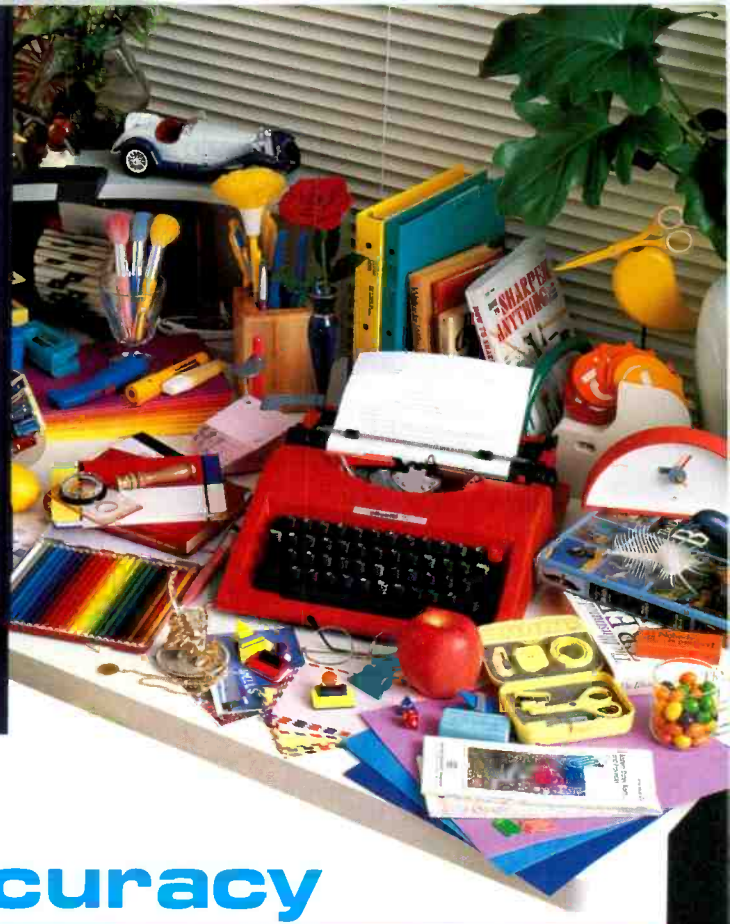
These three elements need to be implemented into any skill-building program. The process can begin with the next new piece of equipment. Once incorporated into your basic training approach, you will see major changes in your employees' ability to respond, troubleshoot and, most of all, think.

The reward is thinking workers

The topics discussed in this series of articles are not simple. For most people, these techniques represent a change in management style and function. These changes will not work if you cling to an autocratic style of management. If you are tired of carrying so much responsibility, and if you want to get the most from your workforce, then give serious consideration to the development of thinking workers. If you are ready to adapt your management style and open yourself to the possibility of thinking workers, you will enjoy a participative and more productive workforce. It may not be easy, but it is well worth the effort. ■

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





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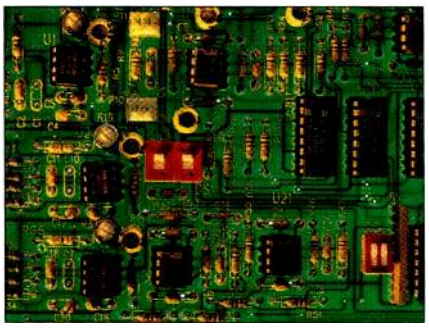
Part 3

Circuits

Serial communications

Connecting one standard to another

By Rodney W. DeMay



This is the conclusion of the series on serial communications. Parts 1 and 2 covered the basics of RS-232, RS-422 and RS-485. Although software and cabling changes are sometimes required, these standards make it possible to connect two compatible devices. When all the devices in a system follow the same standard, these standards are sufficient.

Almost every PC and laptop computer has an RS-232 serial port, as do modems and serial printers. Most people know they can connect their PC to a modem. But what about the various control devices and addressable peripherals that use RS-422/485? How can you communicate to these devices using your PC's RS-232 port? To connect an RS-232 device to an RS-422/485 device, the electrical requirements must be met for each device. The single line (unbalanced) transmission of RS-232 signals must be converted to signals transmitted on a pair of lines (balanced). The opposite conversion is required for the RS-422/485 signals.

Conversion

Several options exist for connecting these different devices. First, some newer serial ports can be configured as RS-232, RS-422/485. Another is inserting a circuit between RS-232 and RS-422/485 equipment. The circuit performs the conversion mentioned earlier.

Several manufacturers make RS-232 to RS-422/485 converters. A basic converter consists of two transceivers. One transceiver converts RS-232 signals to TTL signals and vice versa. The other transceiver handles the RS-422/485 side.

Driver control

An additional consideration that applies to RS-232 to RS-485 converters deals with the enabling and disabling of the driver on the RS-485 side of the converter. As discussed last month, RS-485 drivers must be disconnected from the transmission line when not transmitting. When converting from RS-232 to RS-485, there are basically two methods of controlling the driver: *RTS control* and *send data (SD) control*. RTS control is the most common method. (See Figure 1.) When the RTS signal is active, the driver is enabled. It's important that the RTS signal is active before data is sent. RTS must remain active until all of the data (including the final stop bit) has been sent. When a device is not sending data, the driver must be disabled. Software controls the timing by which the driver is enabled and disabled. In addition, the receiver can be disabled whenever the transmitter is enabled to prevent data from being echoed.

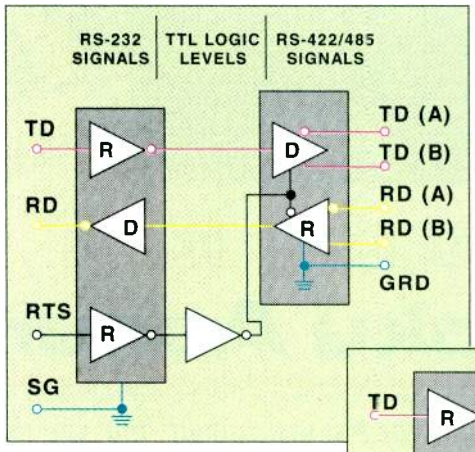


Figure 1 (left). *Typical connections used to adapt RS-232 and RS-422/485 signals. RTS control is used to enable/disable the RS-485 driver (if required).*

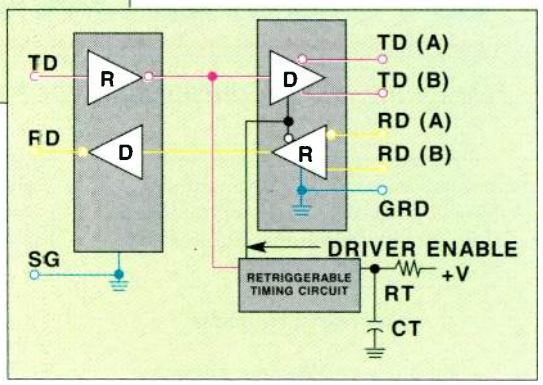


Figure 2 (bottom). *Connections for adapting RS-232 to RS-422/485 using SD (send data) control of the RS-485 driver. RT and CT determine time out of driver enable signal.*

An RS-232 to RS-485 converter using SD control to enable the driver contains a timing circuit triggered by the data signal. The leading edge of the start bit triggers the timing circuit, which enables the driver for a short interval. Each additional data transition resets (extends) the interval. If there are no transitions, the circuit times out and disables the driver. The duration of the time out is critical. If it's too short, parts of each character can be missed. If it's too long, another driver may try to transmit data and a collision will occur. The duration of the time out is determined by an RC network. (See Figure 2.) When setting the time out, both data rate and turnaround time of the system must be considered. A commonly used value is the transmission time of one character.

Other concerns

Several topics also require consideration, but are beyond the scope of this article. For example, voltage spikes and ground loops can develop in communication lines when equipment is located in different buildings, industrial locations and other harsh environments. Adding surge suppressors and optical isolators can help protect equipment from these conditions. The cost of adding this protection is usually minimal, compared to the cost of replacing or repairing the equipment incompatibilities.

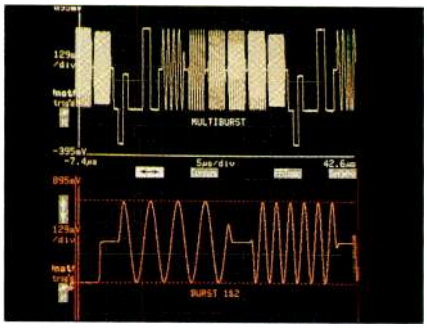
Several incapabilities can arise while trying to connect to similar devices. Even more complications can occur when connecting an RS-232 device to an RS-422/485 device. With a little knowledge of the basics of the three standards, you should be able to work your way through these problems.

➡ *For more information, circle (302) on Reply Card.* ■

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

Part 7

Troubleshooting



Care and feeding of coaxial transmission lines

Multiple station systems

By Dean W. Sargent

Parts 1-6 have discussed the general usage of rigid coax in a single station environment. This month, we will discuss multiple station systems, which have their own unique requirements. The average power will be higher, so we will address another parameter — peak power.

Peak power

Peak power in an FM system is the power developed when all the individual station powers are in phase. If the stations are all operating at the same power, we can say:

$$Ppk = n^2 * p$$

with *n* being the number of transmitters, *p* being the power of each transmitter and *Ppk* being the resultant peak power. If the power of each station is different, the voltage in the line is calculated for each transmitter by taking the square root of p*r, where *p* is the transmitter power in watts and *r* is the line impedance in ohms. Add these voltages for all stations to get the total in-phase voltage. To get the peak power, square this voltage and divide by the line impedance in ohms.

Peak power rating

The peak power rating of a transmission line is limited by voltage breakdown between the inner and outer conductors. Voltage breakdown is independent of frequency, but varies with the pressure in the line and type of atmosphere. This peak power rating can be increased by increasing the pressure in the line. An increase in peak power of 1.9 times can be made by increasing the pressure from 0PSI to 10PSI, and approximately 2.3 times by going to 15PSI. Do not go any further than necessary, and never exceed 30PSI.

If you use pressurization to increase the power rating of a transmission line, install a monitoring and control system to drop the transmitter powers to a safe level in the event of a loss of pressure.

This rating is probably the most difficult one for a manufacturer to specify because you are dealing with a voltage gradient that the line will withstand. This maximum voltage gradient occurs at the inner conductor surface in a coax line. Because breakdown is a variable phenomenon that occurs at widely different values, depending on dust or dirt particles, moisture and scratches on the surface of the inner conductor and dirty insulators, a calculation of the breakdown gradient cannot be used.

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

Safety factor

The rating for peak power for the same size cable from one manufacturer to another can vary. The best option is to ask the manufacturer what the safety factor is and compare them. If the cable is heliax or some other semiflex cable, the safety factor used by the manufacturer may get used up when the cables are dressed (bent). In the bending of the cable, the inner conductor can migrate away from center or the outer conductor will "ripple" at the inside of the bend. Remember that peak power ratings, like average power ratings, must be lowered for VSWR.

Some heliax-type cables use foam dielectric instead of air. These cables have a greater dielectric strength for similar sizes and may have a higher peak power rating. This usually cannot be realized because the connectors used with the cable have air spaces that get us back where we started. Cables of the same size should be rated the same for peak power, unless special connectors are used that will handle the same peak power as the cable.

The normal design criteria for multistation antenna systems is to use a 2-to-1 safety factor for all coax in the system. If your calculations for peak power of all transmitters calculates out to a peak power of 100kW, multiply it by 2 and pick a line that can handle 200kW. This may be conservative, but you will not lose your line.

Sizing the cable

The selection of transmission line size will be based on the peak power rating. This will depend on the number of stations in your system. You may get requests from other stations to go on the system later and if the cables are not sized large enough, you will not be able to add to the system.

If you are using heliax-type cable, its installation is extremely important. The cable should be hoisted using cable grips at intervals not to exceed what the manufacturer specifies. The hoisting cable also should be attached so it is lifting only that much cable. If it is not done correctly, the cable will be stretched. The grips used to hoist the cable should be used to support the cable vertically. A good way to mount the grips is by using a turnbuckle so each section of the vertical run can be supported, and the turnbuckle can be used to adjust it. The cable should then be strapped to the structure to prevent any lateral movement. Do not tighten these wraps so that they distort the cable or cut into the covering. Also, do not use the wrap to support the cable vertically, only laterally.

All semiflex coax cables have a minimum bending radius, which is published in the manufacturer's literature and must be adhered to. The most likely place for the bending radius to be exceeded is at the base of the tower when it is being installed.

Extreme care must be exercised when feeding the cable into the tower to take it from horizontal to vertical. If the cable gets kinked, the section must be removed and the cable spliced together. Each manufacturer makes splice connectors, or you can install a flange connector on each piece of cable and use an inner connector to effect the repair.

If you are using rigid transmission line in your system, the length of each section of line must be 17½ feet. This is to prevent a high VSWR from developing at certain frequencies in the FM band because of flange build up. The length of each section also should not be an even number of one-fourth lambda at any frequency. If you have other frequencies, calculate what length is necessary and order accordingly.

Preparation keeps your system safe

The precautions discussed in Parts 1-6 apply to multistation systems and take on more importance because of the elevated powers. The more stations on a system, the more opportunities for problems. A well-designed transmission line system will provide years of reliable service.

➡ *For more information on transmission lines, circle (303) on Reply Card.* ■

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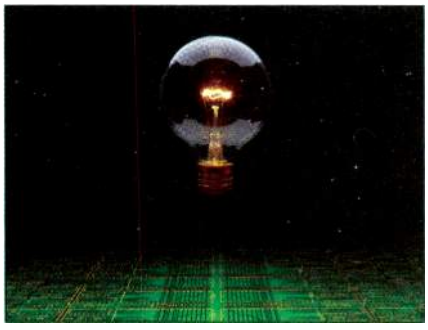
Technology News

Video compression



By Curtis Chan

Almost every form of today's visual communication media uses some type of compression. It is crucial to such applications as video teleconferencing, video telephones and digital HDTV. Hoping to capitalize on these emerging markets, vendors are developing dedicated and programmable chip architectures.

Merging computers and television

Video compression addresses the need to encode and decode a full-frame video image (approximately 1Mbyte) at standard scan rates. Progress has been made in several different areas, including the multimedia PCs/Macs using CD-ROM technology, the new generation of broadcast VTRs and even telco distribution. Signal differences between video and computer images have led to a generation of scan converters and interfaces. However, as time goes on, video and computer imaging technologies are growing closer.

The trend is well on its way with cable and regional phone companies offering video-on-demand in some markets. Continuing progress in video compression will enable broader future applications. In addition, LANs will become major players in the transmission of video, text and audio as compression technology advances.

Multiple players, multiple standards

Market potential for compression chip sets is staggering. A year ago, only a handful of companies, including C-Cube Microsystems, LSI Logic, and Intel, had image-compression ICs. Today, the list has more than doubled with AT&T Microelectronics, AMD, Integrated Information Technology, IT and SGS-Thomson Microelectronics among the players. Several Japanese companies also have announced their intentions to enter the market.

At present, the chips fall into three categories: JPEG, MPEG and P*64. P*64 is an International Committee for Telephone and Telegraph (CCITT) standard for video-based telecommunications.

These algorithms all use discrete cosine transformation (DCT), a DSP technique that compresses video at ratios from 20:1 to 200:1, depending on the use of either lossless or lossy compression.

JPEG was developed for capturing individual still frames. It uses an intraframe compression technique that treats each image as a distinct entity. JPEG is a symmetrical algorithm (same amount of computing power to compress and decompress) that eliminates spatial redundancies, thus reducing image data at ratios up to 50:1.

In contrast, MPEG was developed for full-motion images and eliminates spatial and temporal redundancies. MPEG1 uses interframe compression and achieves up to 50:1 reduction by storing only the differences between successive frames. MPEG1 also includes audio compression specifications for ratios to 10:1. Unlike JPEG, MPEG is asymmetrical, requiring more computational power to compress than to decompress. The results are impressive: A non-compressed video image of 25Mbyte/s (640x480/24bits/30fps) can be reduced to approximately 550kbytes/s.

The third entrant in the game is CCITT's H.261, more commonly known as P*64. This algorithm provides fast processing for demanding applications, such as video telecommunications, for on-the-fly video compression. Because such applications are not usually motion intensive, limited motion-search-and-estimation strategies are used to achieve higher compression ratios that range from 100:1 to more than 2,000:1.

Different strokes

Like standards, the implementation methodologies and their respective beliefs also vary. For example, C-Cube's CL450 decoder is programmable and works on downloadable microcode resident in external DRAM. The microcode controls the device and governs which algorithms are used.

IIT's approach is in developing a hardware platform tuned to run compression software. IIT believes present software solutions are too slow, and hardware codecs are too inflexible and expensive. The result of their efforts is a pair of chips dubbed the Vision Processor and the Vision Controller. Programmable architecture allows a codec to be built around all three compression standards and fit in an area of three square inches.

TI disagrees with the one-size-fits-all approach, and has taken a 2-pronged approach to video compression. One is programmable to provide flexibility and upgradeability. The other is dedicated, trading flexibility for low cost, low power and minimum real estate. TI provides software task libraries to implement JPEG imaging, MPEG audio coding and other multimedia compression functions. To this end, TI is developing a parallel architecture DSP targeted at video applications. The company has announced an agreement with C-Cube involving technology transfers from C-Cube into TI for MPEG video decoders and JPEG codecs. C-Cube in turn gets TI's MPEG audio technology.

Intel has taken another stance. Along with the less-than-successful DVI compression scheme, Intel has developed the Indeo Video Technology software solution that allows video on the latest generation of PCs. The key to Indeo is its scalability, which adapts the image to hardware performance without any changes to the software or the video file. The quality of the image also is scalable and improves as system performance increases.

Media Vision's new Captain Crunch video compression technology offers real time compression/decompression and picture quality equal to or better than MPEG1 at one-tenth the price of MPEG or DVI. Rather than waiting for the standards committees to make everyone happy, Media Vision is filling market needs where it makes sense to do so. The chips can handle 320x240 pixels at 30fps with 24-bit color accuracy. Later this year, Media Vision plans to offer a new chip set priced around $50.

No matter what system is used, video compression is still in its infancy and has a long way to go to meet the demands of broadcasting. However, as in any evolving market with a high revenue potential, dramatic improvements are right around the corner. ■

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

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JVC. The three most important letters in S-VHS.

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Audio and video production systems

With careful planning and installation, your production suite can be a showcase of capability.

Today's production equipment is a dream to operate and install, compared to that of only a few years ago. Couple these advantages with the resulting improved image and audio quality, and users find themselves in production nirvana.

As post houses and broadcasters seek to reach this goal, engineers and technical managers face a bewildering choice of options. Component or composite, digital or analog, where to use serial are all significant and quality-determining issues.

Often, a facility's first application of digital component video technology is in a production suite. The features and capabilities of such installations are many. However, the choices that must be made along the path to get there are great. Success only comes through careful planning and installation. This is no place to make an expensive mistake.

"Building a Digital Component Video Suite" and "Production Suite Technology" provide guidance on how to build your first digital suite, or improve the one you may already have. Learn from two experts how your suite can be a showcase of capability.

A continuing hot topic is that of editing systems. Whether to use a linear or non-linear approach is often the first issue that must be decided. Two of this month's articles give detailed insight into the advantages of each approach. "Non-linear Editing Systems" and "Linear Editing Systems: A Perspective" provide a look at some of the important issues in each method. After reading these articles, you'll have a better idea of which solution is best for your editing rooms.

Digital News Gathering is new on the editing scene. This non-linear process provides newsrooms with the ability to quickly edit material into news clips for late-breaking stories.

Answers to your questions on the latest production room technology are just ahead. Learn how post and broadcast facilities can successfully implement serial and digital technology into their operations. Don't wait for your competitor to capture that next client. Read on!

- "Building a Digital Component Video Suite" ..... page 26
- "Non-linear Editing Systems" 36
- "Linear Editing Systems: A Perspective" 44
- "Digital News Gathering on a Desktop" 50
- "Production Suite Technology" 58

Brad Dick

Brad Dick, editor

Why not get everything professional Digital Audio Workstations have to offer?
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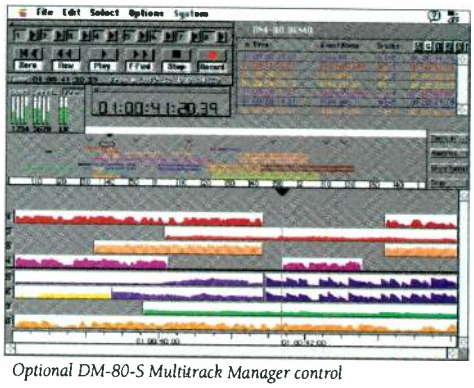

Optional DM-80-S Multitrack Manager control for the Macintosh®— easy to learn, fast to use.

the Word.

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

Here's why:

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

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

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

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

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

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

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

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

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

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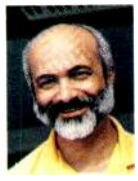

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Building a digital component video suite

Today's technology makes it easier than ever.

By Curtis Chan

The Bottom Line

Digital component video eliminates many of the problems associated with traditional analog composite systems. Converting a facility to component digital is no simple task. However, the long-term rewards may justify the expense. The flexibility of today's equipment makes the conversion process much simpler and more cost-effective than ever before.

$

From corporate audio/video (A/V) houses to high-end video boutiques, analog and digital video component technology has arrived and is offering tremendous performance/price benefits to users. This article will discuss the current state of component technology and what it can do in terms of increased productivity and profitability.

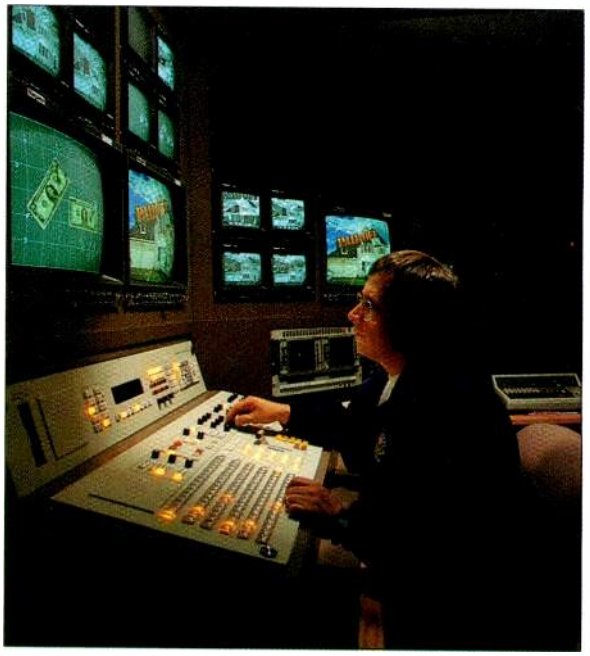
Benefits galore

Component technology offers several benefits. Problems associated with composite video, such as cross-color or cross-luminance artifacts, are eliminated. Further benefits are gained if component is used for field acquisition. Add to this the fact that most computer, paint and DVE graphics stations also operate in the component domain, and you have the basis of a pristine image environment. Follow with digital video, where multigeneration performance is identical from stage to stage. Switching between 525- and 625-line operation in digital component permits one system to serve multiple standards. Finally, companies are offering integrated system solutions at various price points, including everything from the video deck and interconnect equipment to the edit controller. This approach allows small operations to buy into the component format early on and provides a migration path to

Continued on page 29

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

Author's note: Special thanks to Sony, Panasonic, Ampex, N-Vision and Graham Patten for their help with this article.



Component suite used for corporate video production. (Photo courtesy of Grass Valley Group.)

Advanced wireless intercom system

Vega Q600

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- **Inexpensive VHF monitor receivers to lower system costs**
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- **Up to six beltpacks per master station**
- **Designed specifically for broadcast and production**
- **Directly compatible with all standard wired intercoms**
- **Many advanced circuit and system design features**

In the studio or on the set, Vega's wireless intercom systems are the choice of professionals who demand ruggedness, reliability, broadcast-quality audio, and a full set of professional features. Designed from the ground up for broadcast and production work, the Q600 UHF/VHF system provides all the functions and technical capabilities required for these demanding applications.

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

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

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

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

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

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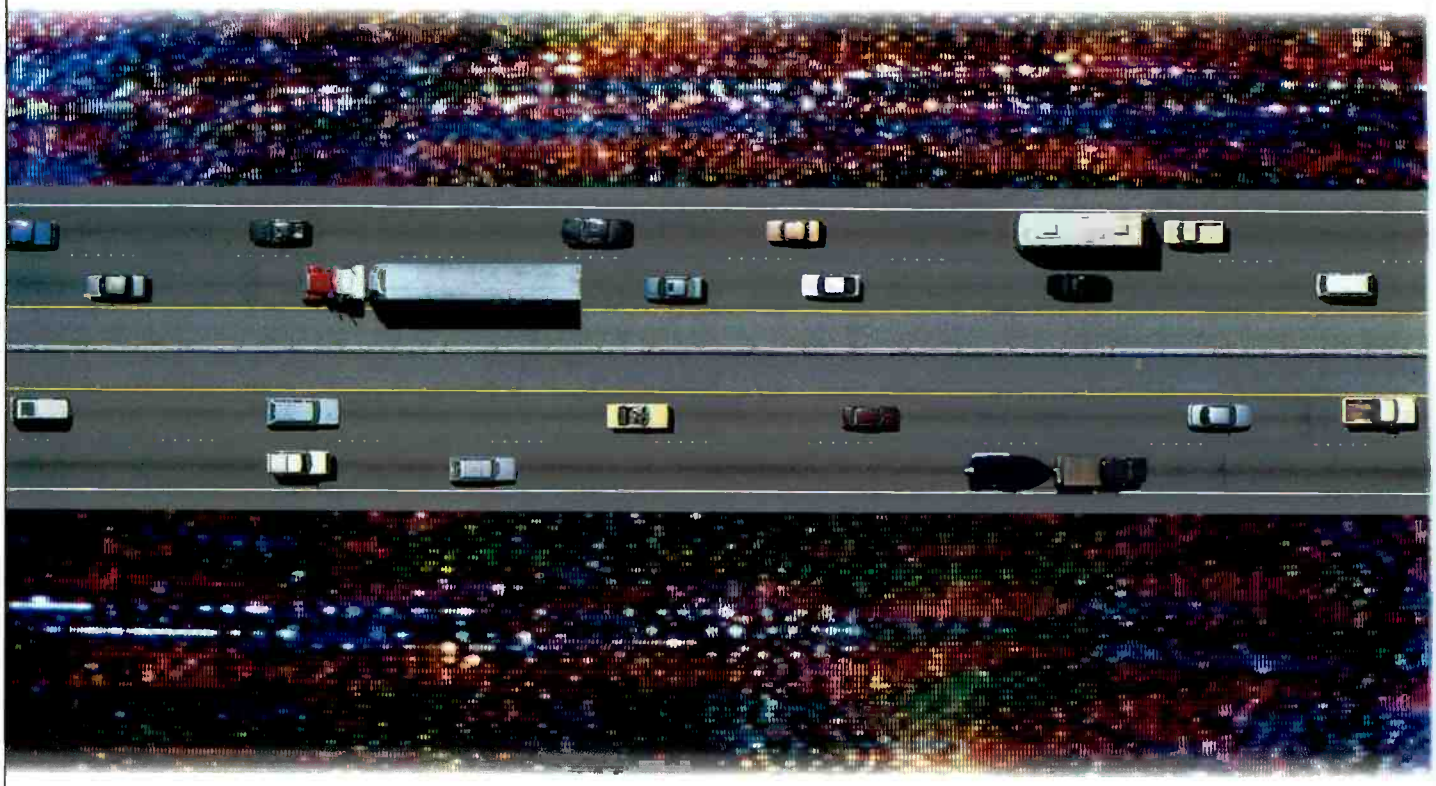

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Continued from page 26
the future. Let's take a closer look at the technology and the technical considerations needed to build a component suite that not only gives optimal performance today, but also allows system growth tomorrow.

The equipment

Assuming that you've decided to jump into component, the next choice is the equipment. The following are some of the options available:

• *Tape formats.* Small start-ups, such as event videographers, local TV news or corporate A/V houses, might consider S-VHS or Hi8. Several companies supply the appropriate decks for field acquisition or editing. Both formats offer significant performance gains over low-end composite and both are economical to own. Better yet, when mated to a mid-level DVE and switcher combination, the results can be impressive. Many companies offer complete system packages for both formats.

Professional formats, such as Betacam (SP) and MII, have dropped in price over the last few years and provide a bridge to the next level of performance. These formats give outstanding value to pro and corporate users or as an off-line system for a high-end post house. Specifically designed for analog and hybrid environments, some of the decks offer full digital interfaces, including serial digital I/Os for video and AES/EBU digital audio I/Os. Performance of these formats is comparable for most tasks, and reliability and ruggedness have been built in. Both formats have withstood the test of time. Complete system packages are available in the two formats with multiple variations in switcher, editor, DVE, router and audio options.

For state-of-the-art, Sony and BTS have D-1 machines. In addition, there is the Ampex DCT, and coming soon are Sony's Digital Betacam and Panasonic's D-5. D-1 technology has evolved to the point that complete integrated systems can now be purchased. Most newer-generation machines are half the weight and consume one-third the power of the original machines, with equally impressive performance gains. More important, a D-1 VTR can be purchased for the price of a high-end type-C machine.

Furthermore, Panasonic's 16:9 capable D-5 format promises to deliver pristine audio/video quality at a competitive price. The result is a DVTR with a recorded footprint and track pattern similar to the D-3 format. The D-5 recorders will offer full 10-bit recording of the digital component video signal, fully conforming with the revised CCIR-601 and CCIR-656 standards that are now specified to 10-bit resolution. The critical head-to-tape interface control system developed for D-3 requires only minor changes in the D-5 recorder, because the scanner rotation speed is the same for both formats. The only changes are increased linear tape speed, redesigned head assemblies and higher levels of VLSI for data processing. The DVTR will automatically select the correct linear tape speed for D-3 playback. In addition, digital sample rate conversion and decoding will allow both composite and component signals to be output.

Although current and future plans of

Strategy for interconnecting audio

One of the key areas of integrating a successful component environment is getting the audio implementation right. Here are a few helpful hints.

1. Choose a common facility standard for interconnect, such as the AES3 standard.
2. Choose an electrical interface, such as coax or twisted pair. Look at labor costs, cable costs, cable distance, XLR to BNC adapters, output signal fan out and EMI effects. Consider both the long- and short-term effects as you make this decision.
3. Carefully choose a cable type and consider impedance, cost per foot, cross section diameter and ease of preparation.
4. Plan on conversion equipment for signal formats different from the facility standard. Also plan for multichannel interconnects between devices, such as DVTRs, multitracks and digital audio mixers.
5. Synchronize the facility to allow direct digital transfers across dissimilar format machines.
6. Consider a small asynchronous router as a preselector to the synchronous router for resource sharing to process wild inputs. Sample rate convert wild inputs to the plant master time base.
7. Define an in-house full-scale digital audio reference level and stick to it.

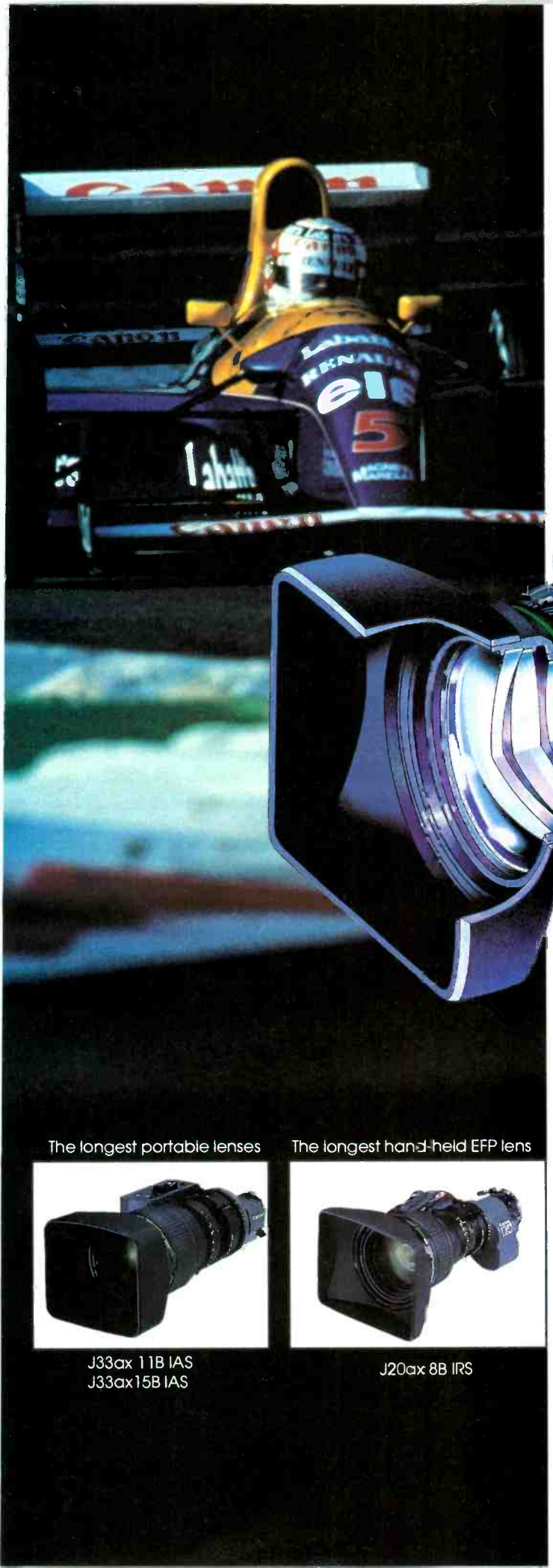
production and transmission are still based on a 4:3 aspect ratio, considerable momentum is gaining on the establishment of a 16:9 aspect ratio for future extended definition television (EDTV). The D-5 format has taken this into account by offering both options. In the 10-bit mode, it will be suitable for all applications in digital component 4:3 aspect ratio TV systems, and also digital component 16:9 TV systems that are configured for 13.5MHz digital sampling rate.

On the other hand, by providing full playback capability, Digital Betacam gives Sony a strong technology bridge for users that have already committed to Betacam (SP) and amassed a large tape library. Additionally, Digital Betacam can record a 10-bit CCIR-601 signal, making its signal compatible to D-1. Finally, DCT is being portrayed as the ultimate post-production VTR, capable of not only high-quality audio/video, but also touting the fastest drive electronics in the industry. Whichever is chosen, manufacturers have built up an arsenal of peripherals and interconnect equipment that allows multiple configurations and performance levels.

• *Edit controllers.* The editor is at the heart of every editing system. If properly designed, it delivers a design synergy that makes for seamless coordination of the entire post system and results in efficient translation of creative vision into reality.

On the low end, edit controllers have benefited from technology passed down from high-end cousins. Most include serial and parallel interfaces. EDLs can be quickly entered and rehearsed. Some units can learn complex linear and non-linear 2-D and 3-D digital video effects, wipes, mattes and dissolves. With the appropriate audio mixer, editors also can perform split audio edits along with left/right crossfades. Precise transport control, including high-speed and slow-motion effects, are standard on most systems along with the capability to control multiple VTRs.

Moving upward in price and performance, many features are available to complement the component suite. High-end editors provide a rich set of interactive communication cues to the editor. These include full status reporting of all peripherals, including switcher, DVE, color corrector, VTRs and audio mixer. Some editors have the flexibility to run the edit session from the switcher. High-end editors also handle the D-1 format's four channels of audio with independent split in-points for all four channels. Finally, high-end editors adapt to your operating style with a choice of a QWERTY keyboard or a dedicated key-per-function keyboard along with the ability to store user-defined macros.



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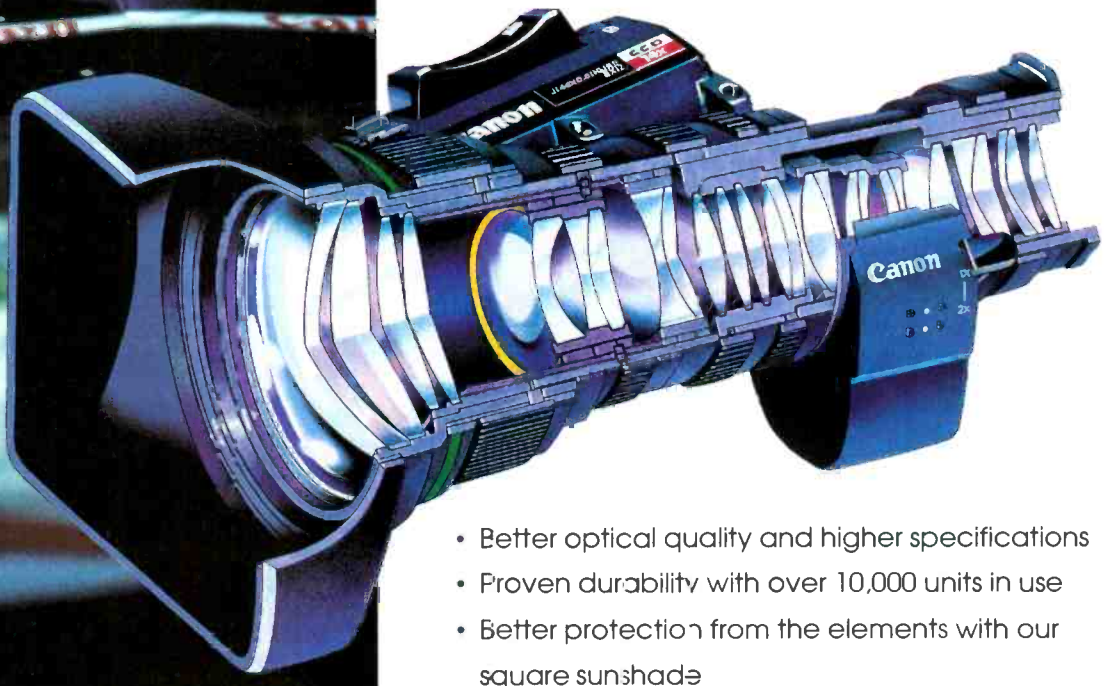

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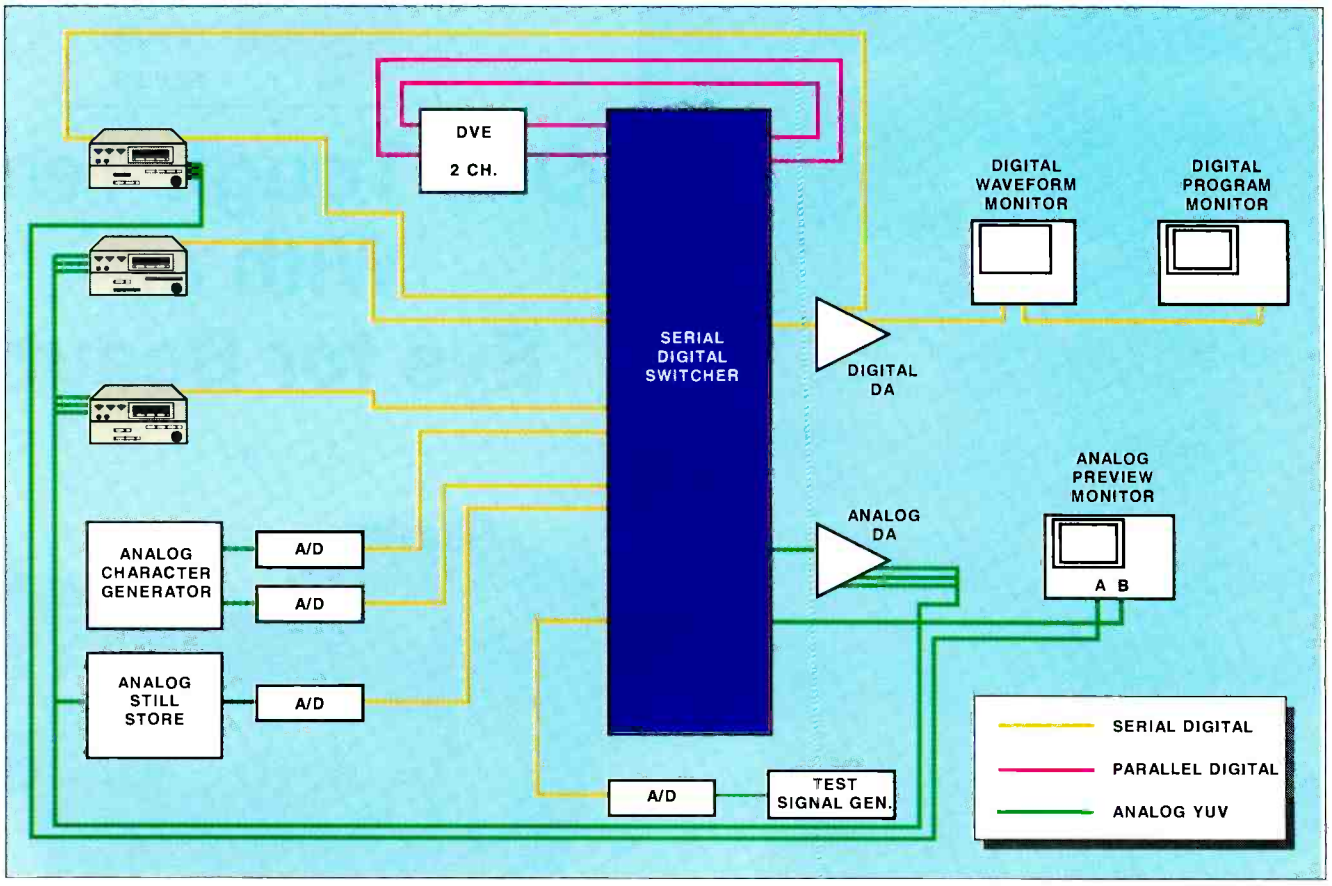


Figure 1. *Block diagram of a component facility using both analog and digital equipment. Switcher is serial digital with parallel digital I/O for the DVE. Analog YUV outputs are provided for program and preview.*

• *Video switchers.* With the advent of digital component technology, complemented with improvements in DSP, ASIC and software coding, present day switcher technologies have branched away from the evolutionary tree. Improvement areas are focused mainly in the mid- to high-end digital switcher markets. By executing mixes, keys and wipes in the component digital domain, images are stable and transparent, and mattes are free from noise. Likewise, digital setups are drift-free and repeatable. Keys are clean and sharp without exhibiting the artifacts associated with NTSC.

User interfaces play a critical role in switcher performance. For example, several new digital component switchers have opted to hide the switcher's newfound power behind an analog switcher facade. This is an easier transition for operators brought up on more traditional analog-based equipment. Benefits include faster ramp-up time, improved productivity and higher signal quality.

Intelligent interfaces include assignment of hard keys with their associated path of processing or through the use of software macros and assignable soft keys. For example, many digital switchers offer full programming of peripheral devices, such as digital disk cache recorders, digital special effects and still-stores, directly from soft key-based graphical display interfaces. This feature almost eliminates the need for multiple control panels in the edit suite.

Another revolution that has occurred because of component digital technology is the realization of a compositing switcher vs. the traditional M/E architecture. Conventional M/E type switchers have three major elements: M/E modules, a program/preset bus and a downstream keyer. M/Es typically have dedicated background buses for A and B video and one or more dedicated keyers. Some of the newer switchers have two separate M/E banks. The output of either bank can be re-entered as a foreground or background input to the other, allowing control of multiple layers of video.

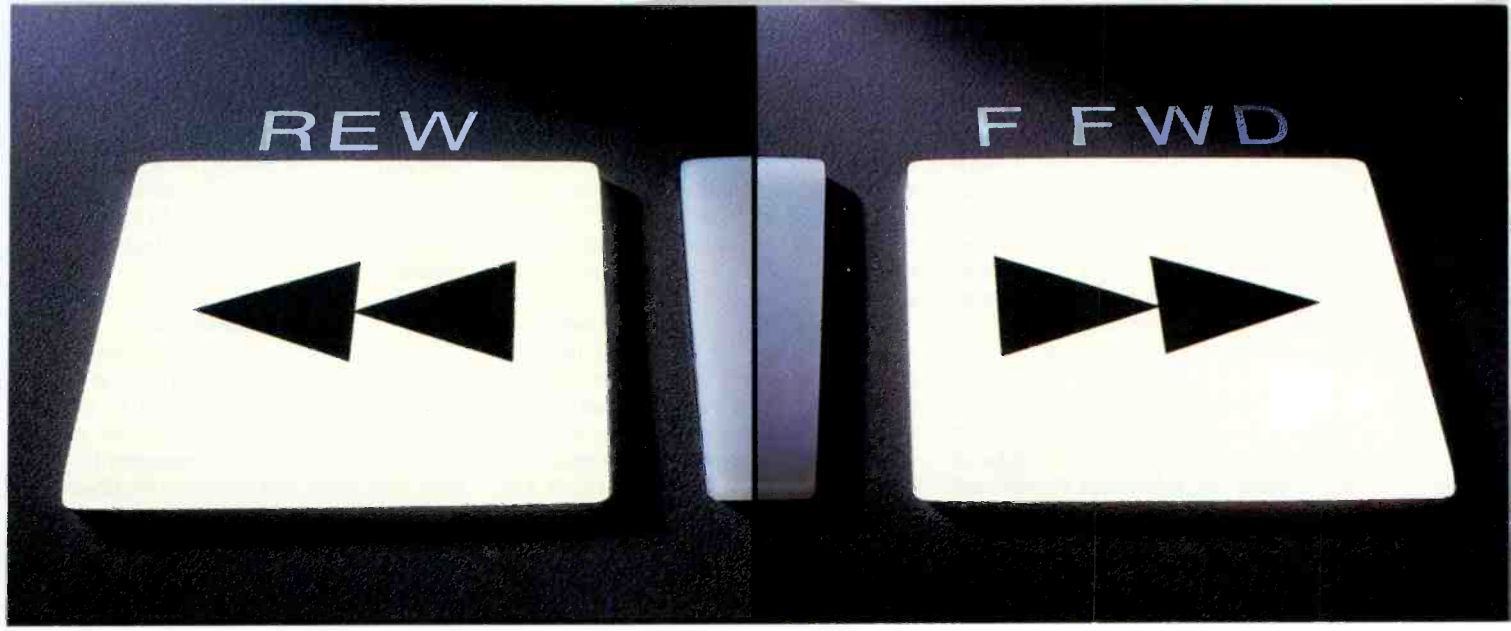
The same analogy is applied to compositing switchers. In these switchers, effects are created in layers. Layers can be defined as either backgrounds or keys and are stacked in order of priority to create the final composite.

The benefits of a compositing component-based switcher are many. Because the switcher treats each layer as a full background image or key, any combination of key and background elements becomes available to the operator in any desired image priority. Layers can be cut, mixed or wiped into or out of the video composite individually or in combination with other layers. It also is easy to apply traditional attributes to each layer. In doing so, each layer has an independent, user-assignable linear or non-linear wipe and mix transition profile, transition rate and offset time. Because each layer is independently controllable, arbitrary image priority can be accomplished easily. Best of all, the final image quality is pristine because the internal processing is done in the component digital domain.

Serial digital I/O and monitoring

The availability of a serial digital distribution standard has helped to significantly establish digital technology into the post and broadcast arenas. No longer hindered by bulky parallel cables, the use of serializers and deserializers allows for simple BNC hookups. Today's serializers/deserializers also incorporate equalization and buffering for long feeds. Instead of using multiple cables to route and distribute either analog component or digital component and AES/EBU, a single fiber or coax feed is used.

Either 8281-type coax or the newer 1505A can be used. The latter can handle up to 370Mbits/s on a much smaller radi-



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us form factor. Even better, if everything is kept in the digital component and serialized audio domain until the signal must get to the outside world, timing problems are eliminated. (See Figure 1.) If A/Ds are installed directly onto machine outputs, all signals would be digital until returned to a recorder via a D/A converter.

Multilevel routing

Despite the advantages of working in the component realm, users are still faced with routing the myriad of signals and signal types present in a large facility. Routing analog and/or digital component, analog or digital audio, machine control and time-code signals requires an extremely flexible routing system. Different levels of routing can accommodate complicated digital domain effects, yet provide flexibility in the analog domain. The routing switcher control system should provide some level of transparency.

One method is to route resources to designated locations from a central machine room with a sophisticated management system. Taking the example of mixed signals, the user would need a digital video framestore(s) for the component digital signals, an analog video framestore, a time-code framestore, a data framestore, an AES/EBU 4-channel digital audio matrix and an appropriate matrix for 525/625 reference switching. At this point, the entire system can switch instantly between 525 and 625 signals.

To handle TBC needs, a remote-controlled TBC can be integrated into the router. As a result, when a VTR is assigned to an edit bay through the routing system, the video is automatically assigned and the AES channels are automatically selected. The RS-422 control signal and time-code connections also are routed when source selection is made. The related TBC remote system automatically assigns the corresponding control points for each VTR assigned. The benefit is that almost any audio and video signal can be switched on the router and the related timing and control signals transferred accordingly.

Another dilemma is signal monitoring in a digital component environment. You can purchase all new monitors with digital inputs, but that can get expensive. Another approach for simple control room monitoring is to feed a separate analog router with the video and time-code outputs of VTRs to provide access to tape playback monitoring. At some point, however, a quality control point with complete digital monitoring should be established in order for digital signals to be verified.

The final analysis

In a component (digital) environment, all video processing takes place in the component domain. Compared to composite video, component systems give you greater color detail. Component systems also allow edit points to be chosen anywhere on the tape, free from the limitation of color framing. Systems maintain precise timing, without constant tweaking for SC-phase. For all of these reasons and more, component video is becoming the choice for many professionals.

➡ *For more information on component video equipment, circle (305) on Reply Card. See also the Video section, pps. 12-16 of the BE Buyers Guide.* ■

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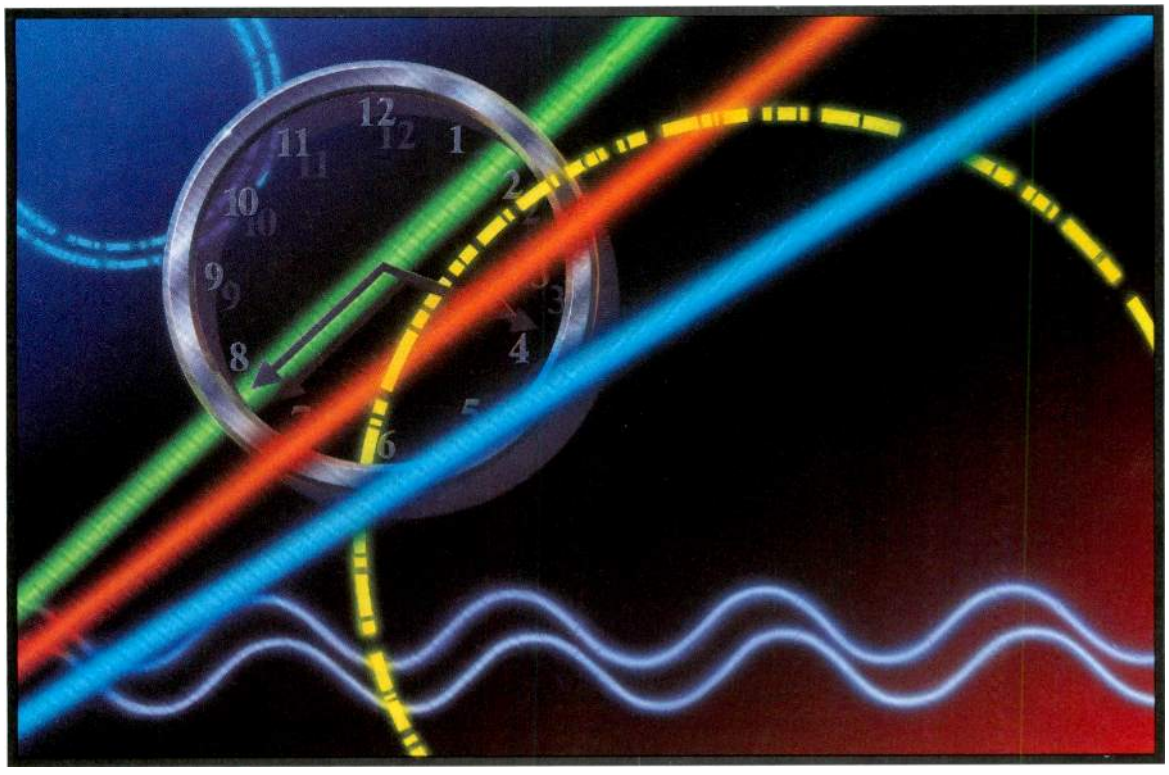

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Non-linear editing systems

Quality goes up as cost goes down.

By Maureen McConnell

The Bottom Line

The quality, speed and flexibility of non-linear systems have increased as compression chip sets and large disk drives have improved performance. As performance increases and prices decrease, these systems are gaining wider acceptance throughout the broadcast and post-production industries.

Non-linear editing systems digitize and store analog footage providing random access from digital storage. Despite the high cost, specialized off-line applications have used non-linear editing systems for years. Today, these systems have on-line quality output and user-friendly interfaces. Recently, prices have decreased, making non-linear video editing cost-effective for an even wider range of applications.

Compression

The concept of having random access to video information from digital storage in real time may be ideal. However, it is not a simple task. Full-motion video is made up of 30 still images (30 frames/60 fields interlaced) per second. With 24-bit color and resolution of 720 x 484 pixels (NTSC), approximately 700kbytes of memory per video frame are required. For the video to be seen in real time, systems have to transfer 21Mbytes (700kbytes x 30 frames) of video information per second, a difficult feat for today's computers. At 21Mbytes per second, the amount of storage required for even a short production is phenomenal.

Compression technology makes digital video editing possible. It is used to squeeze video into a manageable size for transfer and storage. Compression is at the heart of almost every non-linear editing system on the market today. Various compression methods include motion JPEG (Joint Photographic Experts Group), MPEG (Moving Picture Experts Group), DVI (Digital Video Interactive) and Wavelet.

- *Motion JPEG* is the most widely used compression technique for video editing. It was originally developed for encoding still images. Because video is actually a series of 30 still images per second, JPEG can be used to digitize each frame, then play back these frames simulating full-motion video, hence the term motion JPEG.

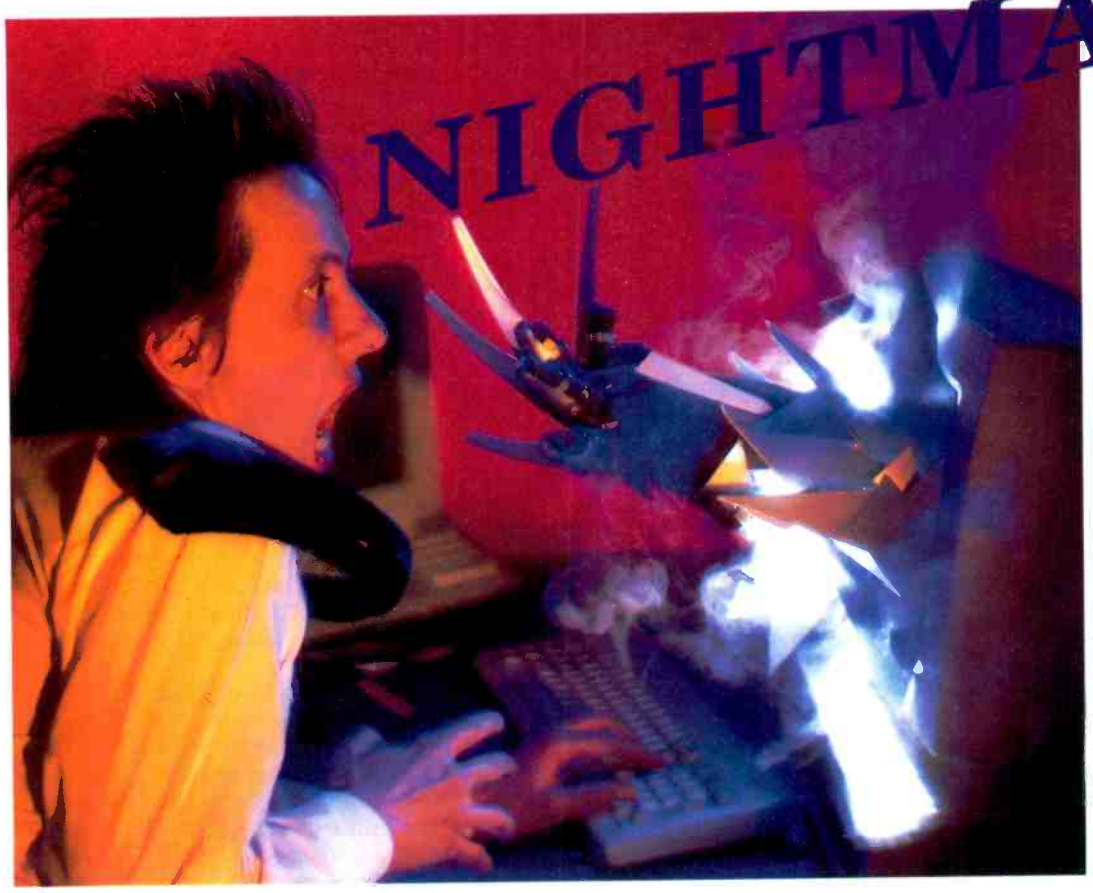
JPEG compression is symmetrical (compression and decompression take the same amount of time). The human eye typically notices luminance more than color (chrominance) detail, therefore color information is compressed at a lower bandwidth without any apparent degradation of the picture. JPEG works in the frequency domain and uses discrete cosine transform (DCT).

Each frame is broken down into pixel blocks, DCT is applied to each block, and redundant or high-frequency information is eliminated. The remaining data is then quantified and compressed using Huffman encoding. JPEG uses intraframe (non-temporal) encoding, saving image information for each frame independently. This provides random access to each frame of video, in real time, making JPEG a good solution for frame-accurate video editing systems.

Lossy compression is used for non-linear editing, with compression ratios ranging from 2:1 up to 100:1. Many systems allow the use of variable compression ratios. JPEG does not have a built-in solution for digitizing audio. However, systems typically use a separate board to

McConnell is marketing assistant of the Video Products Group, Matrox Electronic Systems, Dorval, Quebec, Canada.

CHOOSING THE RIGHT COMPUTER BASED AUDIO EDITOR CAN BE A NIGHTMARE



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Screen shot of the cuts editor of a non-linear system, showing video and control panels used for editing.

Screen shot of video and menus available on a non-linear editor. Time line provides an overview of project. (Photo courtesy of TouchVision.)

digitize the audio portions and then interleave the digital audio with the digital video.

• *MPEG* is often used in multimedia applications, and provides compression ratios as high as 200:1. Reasonable image quality is maintained at ratios up to 100:1. MPEG is asymmetrical (compression takes longer then decompression), and compression typically is done on a different system. MPEG also uses DCT/Huffman encoding. However, unlike JPEG, it uses intraframe and interframe coding. MPEG eliminates the redundant information between frames over time (temporal redundancy) and encodes only the differences (incremental encoding). As a result, each frame is not saved as a single element; to reconstruct a single frame, MPEG must have information from previous frames. This does not permit the instant random access expected of non-linear systems. Because of the lack of true random access and because affordable real time MPEG encoders are not available, it is inappropriate for non-linear editing.

• *DVI* is a proprietary standard consisting of two modules: production level video (PLV) and real time video (RTV). PLV is comparable to MPEG and also is asymmetrical. It benefits from variable compression ratios that can go relatively high and still maintain good image quality. Compression costs, however, are quite high, and footage typically must be sent out to a service bureau.

RTV imitates PLV — it uses lower resolution images (352 x 220), which allow real time compression. It has been used for non-linear editing, but it is being phased out because JPEG provides better quality.

• *Wavelet technology,* like JPEG, saves each frame individually. However, it differs from JPEG in that it quantifies information for each frame as a single unit, instead of dividing the image into pixel blocks. The artifacts typically found in Wavelet differ from the blocky effects sometimes seen in JPEG when high compression ratios are used. Wavelet suffers from some noticeable image degradation around the edges of objects, which introduce artifacts into details.

Video output quality

One important question regarding non-linear video editing is video output quality. Four factors are evaluated to determine image quality: compression ratios, data transfer rates, q-factors (quantization factors) and the number of frames/fields per second.

The compression ratio used is directly related to the data transfer rate achievable by the system. For instance, transferring 21Mbytes (one second of video) at a transfer rate of 2Mbytes/s requires a compression ratio of at least 10:1.

Q-factors also can be applied to determine video output quality. Q-factors range between 1 and 255. High q-factors result in high compression, and low q-factors result in low compression. A fixed q-factor can be selected based on the transfer rate of a particular system. The q-factor is applied to compress each frame so that its compressed size will not surpass the transfer rate limit. One drawback is that the q-factor selected is based on the most complex frame. Simple frames are compressed at the same q-factor as complex frames (which require higher q-factors). The result is lower quality output for simple frames than could potentially be achieved. To avoid this problem, dynamic q-factors are used. This method starts with a predetermined q-factor, which is changed by the system on a field-by-field basis, depending on the data. This ensures the best quality possible for each frame and provides better overall output quality. It also ensures a stable transfer rate throughout the production and predictable storage space.

Another measure of final output quality is the number of frames transferred per second. Various frame rates can be achieved, ranging from as low as eight frames per second to 30 frames (60 fields) per second. For simple off-line work, a low frame rate may suffice. At 15 frames per second, only half the storage is required, and quality is reasonable for off-line editing. Systems used for high-quality on-line editing require full-frame rate to achieve a stable image. Often, systems offering 30 frames per second do not provide the full 60 fields. Instead, they provide only 30 fields that are doubled to achieve 60, resulting in subtle motion artifacts.

Audio

Important non-linear editing audio features to consider are the number of input/output tracks and the number of internal tracks. Multitrack digital audio editing and the ability to perform software-controlled equalization also should be considered. In addition, carefully evaluate glitch-free editing and the final output quality.

Storage

Although compression can reduce the size of digital video considerably, the amount of storage required is still quite high. Storage can be split into two categories: primary and secondary. Primary storage is used for accessing digital video and/or audio frequently. Secondary storage is used to store digital video/audio that will be accessed less often, for instance when working on more than one project, or for saving productions for later use.

For quick, easy access to digital files, SCSI hard drives (fixed or removable) are good solutions for primary storage. At about $1,000 per gigabyte, they are fairly inexpensive. They have transfer rates of up to 4Mbytes/s. Single disk drives come in sizes of up to 3.5Gbytes, providing approximately 30 minutes of near-Betacam quality digitized video or approximately 120 minutes of VHS quality. Up to three SCSI adapters can be used in one system, providing control for multiple storage media. Each SCSI adapter allows a mix of up to seven storage devices.

Magneto-optical or phase change optical drives provide an ideal solution for preview quality work and for secondary storage. Their big advantage is the use of removable diskettes. Projects can be changed as quickly as inserting a new diskette. They will store about 34 minutes per gigabyte and are inexpensive (approximately $100 per gigabyte). Storage levels range from 650Mbytes to 1.3Gbytes per diskette, with transfer rates of approximately 0.5Mbytes per second. Other solutions for secondary storage include removable hard disks and tape backups.

Continued on page 43

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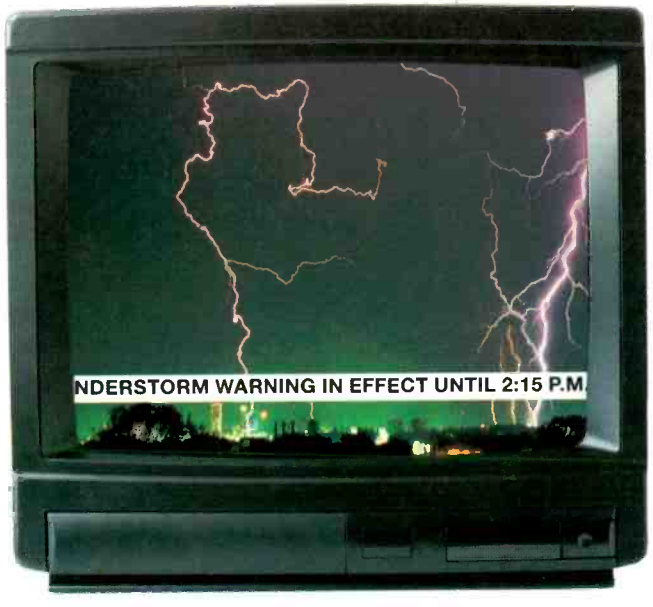

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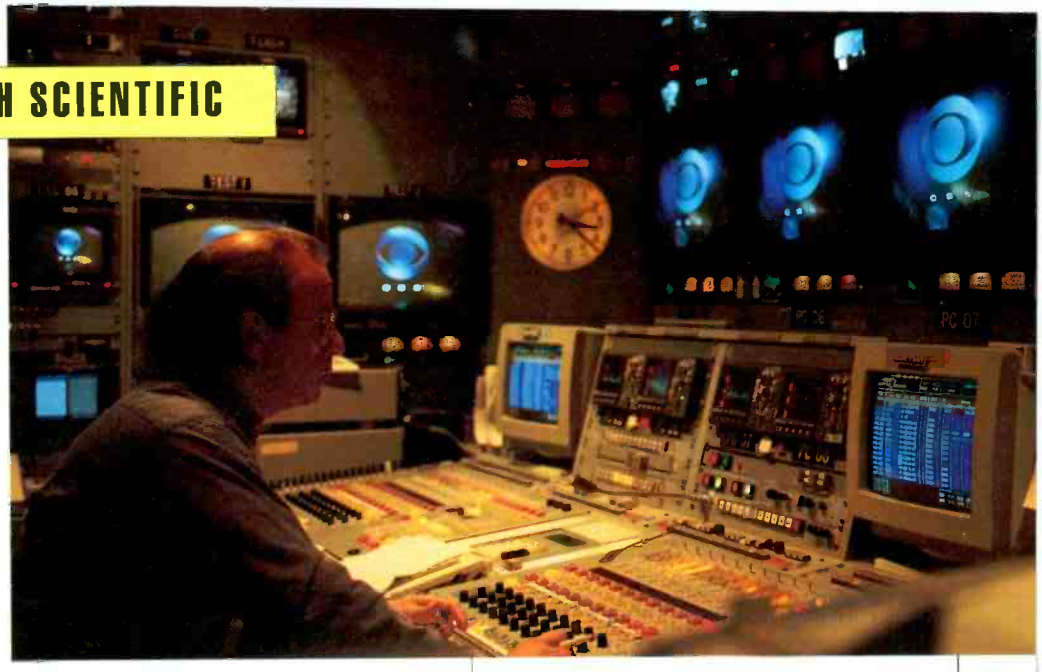

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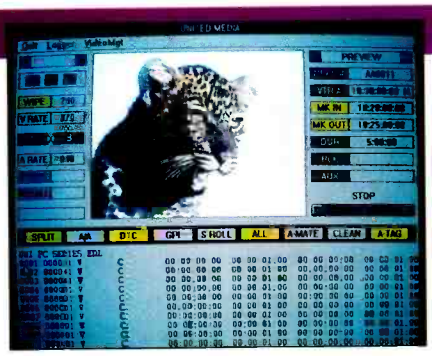
Graphic user interfaces

Graphic user interfaces (GUIs) provide the man/machine connection. Time line interfaces provide the ability to recut or modify portions of the edit master easily. Use of intuitive graphic interfaces, such as VTR-like controls to locate segments of raw footage and picture icons to represent the elements, makes identifying and cataloging video, audio, graphic and title segments simple. Systems using direct keyboard functions in conjunction with a mouse can improve editing speed. Availability of CMX keyboard mapping brings the learning curve to near zero.

Effects and transitions

Many non-linear systems offer little in the way of effects. Often computed in software, effects generation can be a time-consuming process. Sometimes EDLs are moved to an on-line system, and the original source tapes are used to produce the final master. Usually, only the simplest special effects become part of the EDL; complex effects must be created and tuned in the more expensive on-line environment. If simple cuts are not sufficient, one solution is an editing system that offers a hardware-based video effects engine with the capabilities of an on-line edit suite. On-board digital video mixers have the ability to process effects and transitions in real time. Previews and modifications can be executed simply and quickly, enhancing productivity.

When considering systems that provide effects and transitions, determine the number and complexity of effects available. Typical transitions include dissolves, wipes and tiles. Typical DVEs include 2-D movements, scaling of video or graphics and effects, such as mosaic, strobe and posterization. Three-dimensional effects include warps, skew, perspective, rotation and page turns. Other features to look for include multilayer compositing (several independent layers of video, graphics and titles occurring at the same time) and keying (alpha, chroma and luminance keying).



Screen shot of a video editor capable of linear and non-linear editing. The display also shows machine and EDL information. (Photo courtesy of United Media.)

Advantages and disadvantages

One of the main benefits of non-linear editing is the time savings inherent in disk-based random access to video segments. With non-linear, there is no waiting for tapes to spool to preview a segment. Another benefit of non-linear editing is the overall cost. If the quality of the digital video playback from hard disk is good enough for the specified application, then only one VTR is required, first to play the original footage for digitization and then to record the final output. Multiple playback decks are not required, which results in cost savings. The downside, however, is the amount of storage required for saving the digitized video and audio. The cost of these storage devices can easily exceed that of the VTR's. To keep costs of storage to a minimum, systems that support low-cost SCSI drives and removable media are good choices, as are systems that offer selectable levels of video quality.

The ideal non-linear system is one that offers a choice of mastering the final tape from either hard disk or high-quality videotape originals. When broadcast-quality output is a must or complex effects are required, such a system eliminates the need to use two separate systems (one for producing the EDL in non-linear mode, the other being the expensive on-line suite to create the master). The major benefit of such a system is that all of the edits and special effects can be created, previewed and adjusted in the quick non-linear editing mode, and then the same system can automatically edit the final master from original source tapes, ultimately saving time and expense.

➡ *For more information on non-linear editing systems, circle (306) on Reply Card. See also the Video section pps. 12-16 of the BE Buyers Guide.* ■

Selecting a non-linear editor

When it comes time to purchase a non-linear editor, evaluate the following aspects carefully.

Output quality

Output quality is one of the most important issues to evaluate before purchase. Depending on needs, various output quality levels could be required.

- Will required output quality change for each project? What range of quality is needed?
- How will the system be used — on-line, off-line or both?
- What is the output? 30 frames/30 fields, 30 frames/60 fields? What is really needed?
- In addition to disk-based editing, will tape-to-tape editing be needed?

Storage

Spending money for storage media is unavoidable. The right mix of primary and secondary storage should be based on overall editing patterns. For instance, one user may work on several different productions at once, whereas another may only work on one project at a time. To manage multiple projects, removable media can be used to switch from one project to another. Systems that support several storage options offer the most flexibility.

Look at project length and overall quality required to determine total needs. In addition, consider transfer speeds and compression ratios when considering primary and secondary storage devices.

Audio

As part of the production process, audio must be considered.

- What level of quality is required? CD? DAT?
- How many internal tracks are needed?
- Is multitrack editing needed?
- Is software equalization required?
- How many simultaneous output tracks are needed?

Effects and transitions

The type of effects and transitions vary from production to production. Systems with hardware-based digital video mixers generally are faster than those that compute effects in software only.

Determine current and future production needs, what video effects are needed and how long it takes the system to generate them.

User interface

The editing software integrates and controls all the hardware and software resources of the editing system. Time lines, graphical interfaces, direct keyboard functions and CMX-type keyboard mapping are just a few of the features that can make video editing simpler and quicker. A hands-on trial is important and will ensure the system is compatible with the user's editing style.

Linear editing systems: A perspective

Will the old 'in' and 'out' ever be the same?

By Norman H. Strassner

The Bottom Line

If you read the trade presses, it may appear that linear editing is dead and non-linear editing is alive, doing well and definitely here to stay. This point-of-view is terrifying to the thousands of producers, post facilities and independent editor/small system owners who are sitting on tens of millions of dollars worth of linear video gear. Non-linear is sexy, up-to-the-minute and looking to the future. Linear is bland, rusting and passé.

Users of linear are told the systems are dinosaurs and they should convert immediately. This advice may be neither realistic nor practical.

$

It is inevitable and exciting that developments in non-linear editing are progressing at a rapid pace. Companies continue to sell linear editing systems, but they also are working hard on developing non-linear systems. The time will come when linear systems will not be able to keep up with the advantages and abilities of non-linear. However, that future is still several years away. The number of linear editing systems sold will diminish, but the market will not suddenly disappear. It will, as General MacArthur said, "just fade away."

Many post-production professionals are still using linear editing equipment and facilities, and will continue to do so for quite some time. Linear has had a long and dependable life, and equipment manufacturers have been (and still are) making high-quality videotape hardware. In fact, linear editing controllers are still being sold to people who are using the old Sony

A linear editing suite at International Post, Northvale, NJ. (Photo courtesy of A.F. Associates.)

Strassner is the owner of Strassner Editing Systems, Los Angeles.

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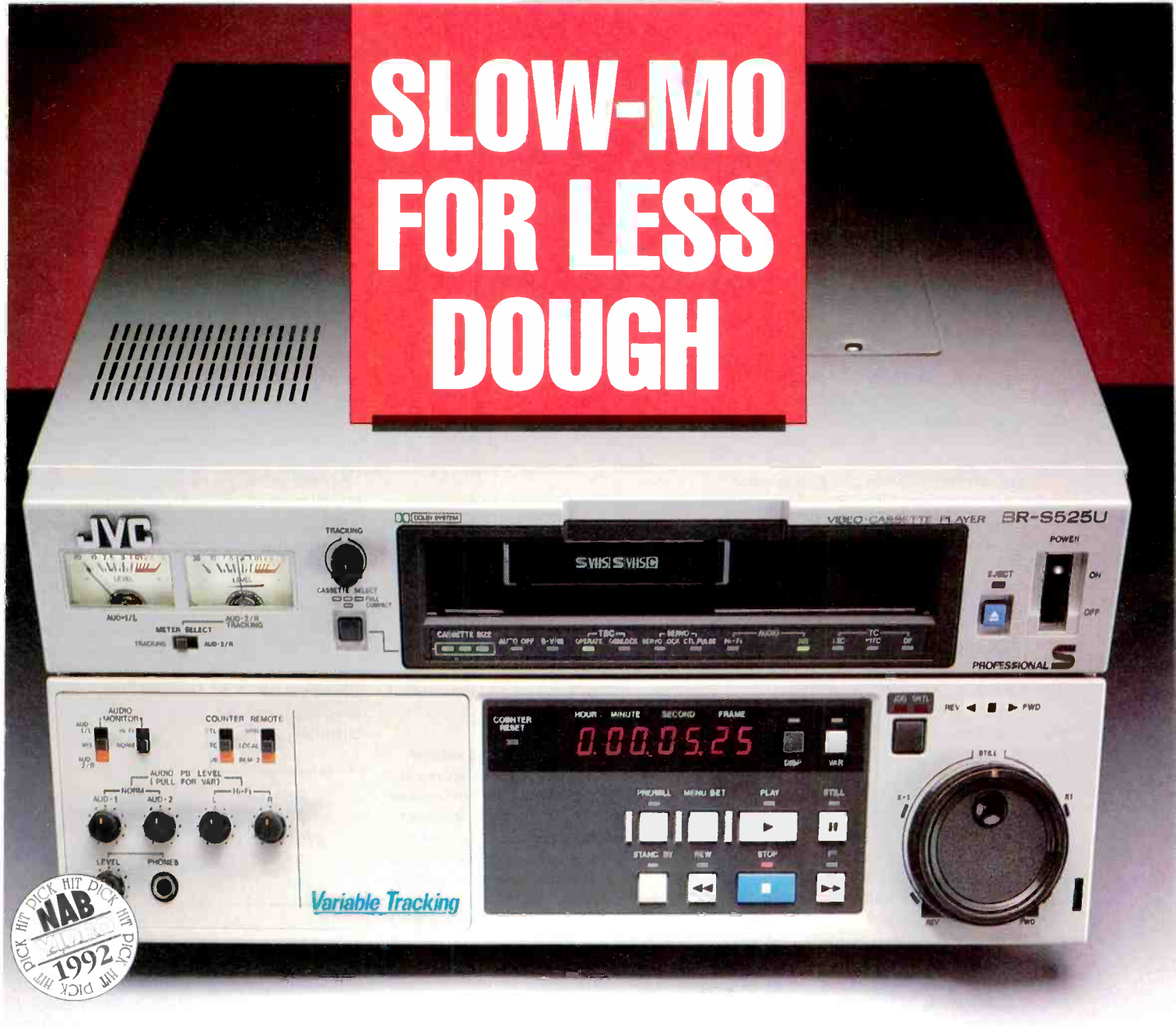

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"Type 5" 3/4-inch VTRs (5800s, 5850s), which have not been manufactured for many years and have been reconditioned more times than the original Star Trek series has been rerun.

Traditional linear editing has numerous advantages. A well-tuned linear editing system can turn out a quality product quickly and efficiently. There is no need for real time transfers to digital media or the prerequisite disk formatting. In addition, the end product can usually be sent directly to air. Until digital audio/video field acquisition comes into common use, the source media coming back from the field will be videotape or film (which is easily transferred to tape).

Today, during live news and sports coverage, field tapes or still reels continue to be dropped in immediately for air just minutes after editing. This feat, for the moment, cannot be duplicated in the non-linear realm.

A beginning, a middle and an end

Consider the following: Non-linear is how we think. Linear is how we live.

We think and create in a non-linear virtual manner where any thought can be moved around instantaneously to develop a mental model. Taking that model and creating its substance in the real world usually requires the physical building of the model into a finished, tangible product. The material built through the post-production process is, in most cases, no different from building a house, a car or planning a financial strategy. Stories have a beginning, a middle and an end. It is no accident that we live with the duality of being able to think about a linear physical reality in a random-access/non-linear manner. The doing requires us to step back from the thinking and address logical sequences, without which common understanding is virtually impossible. Non-linear editing tries to remove the stepping back process and develop the mental processes into the best way to produce a physical result from a train of thought. Is this the best way? Or is it an attempt to take human mental ability and wrongly apply it to real world actions?

Time will tell

While the clock is ticking, we are experimenting with new ideas in digital. One of the results is that many post-production bays have been turned into a kind of virtual reality experimentation chamber.

In order to participate, companies must spend from $60,000 to $120,000 or more on equipment that may be obsolete well before it is paid off. Is the finished product any better than it would have been if the same material had been paper cut and edited as a linear sequence of events? Maybe.

It is not time to throw out the baby with the bath water. The importance of non-linear technologies applied to certain types of television and film post-production is a given, and its long-term involvement in the process is assured. The death of linear editing techniques, however, is greatly exaggerated.

The number of linear editing systems sold will diminish, but the market will not suddenly disappear.

The promotion of non-linear editing products has created the "non-linear snob." They talk non-linear speak. They laugh at you for considering the purchase of a linear editor and tell you it is foolish to invest in old technology. Then they return to their own editing facilities where five to 15 on-line linear editing bays are always booked and making lots of money.

When an editor is not an editor

There was a time when it was necessary and appropriate that an artist be familiar with his or her tools. Editors needed to know how to clean video/audio tape heads, what video sync is and what it is used for, how to read a waveform monitor/vectorscope, etc.

Today, anyone who can visualize how to put picture A and picture B together and push all the right buttons can call himself an editor. And, he will do it for minimum wage because the industry has decided that as long as there are not any flash frames, the public does not really know a good edit from a bad one.

This may be progress. However, to be politically correct, we need to call some of these people "editorially challenged."

QWERTY or not QWERTY

Programming a useful and easy-to-use editing system is no different from producing a story that is easy to understand and enjoyable to experience. Editors (the people) must be able to edit with fluidity of thought and action. Toward that end, editing systems must be developed that respect the law of conservation of mental energy. The human mind can only concentrate on a limited number of tasks before distributed levels of concentration begin to detract from the process.

One of the biggest disadvantages to mouse-driven editing systems is the division of attention required. The point of editing is to make the story flow and look good. Keyboard-driven edit controllers can be operated blind by any competent editor/typist, allowing full attention to be paid to the program monitor where the creative work is focused. Mouse-driven software requires the operator to continually glance at the status monitor, correctly place the cursor and pull down menus. It increases the time needed to perform an edit and distracts from the almost mystical connection between one frame of video and the next. The best editors are those who see the finished product as a seamless flow of pictures, sound and story. The best edits are those that are so much a part of the story as to be unnoticed. The infamous shower scene in *Psycho* is an example of where 88 cuts flowed into one riveting whole.

For at least two decades there have been two distinct physical models for the linear editing interface-dedicated custom-editing control consoles and the QWERTY keyboard system. Dedicated editing controllers have been the systems of choice for small and mid-sized facilities because they are inexpensive and easy to operate. For the big jobs, QWERTY systems have no equal. They are more flexible and powerful and offer a much more sophisticated level of editing options. They also have more buttons.

Non-linear is how we think. Linear is how we live.

One major asset of QWERTY systems lies in the ability to easily and quickly comment a given edit. The standard CMX EDL format is essentially a fixed field database record with a lot of meaningless numbers. The ability to notate and describe an edit is what QWERTY editing is all about. It is one of the primary reasons for the proliferation of new QWERTY-based systems. Several non-QWERTY systems had commenting capabilities, but the process was time consuming and complicated so the feature went mostly unused.

Over the last few years, the trend has been to provide high-end QWERTY-type editing controllers that eliminate much of the techno-nonsense from the edit bay, and provide additional features previously unavailable on traditional, dedicated QWERTY systems.

Original QWERTY systems used the PDP-11 computer chip, developed in the late 1960s, as the processor for its machine control software. Surprisingly, in the era of the Intel 80486, Pentium and Motorola 68k microprocessors, manufacturers are still using this technology for many high-end editing systems. The PDP-11, with its original RAM availability of 8kbyte, may have been well-suited for the

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simple tasks of moving machinery (including early VTRs) around, but is ill-suited for today's requirements of flexibility and performance. Its operating system, RT11, has not been appreciably updated since the 1970s. Meanwhile, a whole class of computers has grown up with more power and flexibility at a lower cost.

The death of linear editing techniques is greatly exaggerated.

Many of today's most popular editing controllers are based upon either the IBM-PC platform or the Mac. Although the PDP-11 has shown its capability for the reliable control of mechanical devices, nobody at Microsoft has rushed into the market with Windows for RT11. The closest thing RT11 has to a pull-down menu is taking the manual off the shelf.

PCs and Mac-based editing controllers provide the user with unprecedented flexibility. Edit one minute, word process a letter the next, then print out a complete bill. If your computer fails, borrow one or go to the local computer store and buy a part off-the-shelf instead of waiting for the factory to deliver that proprietary part from the factory.

How many microprocessors does it take...

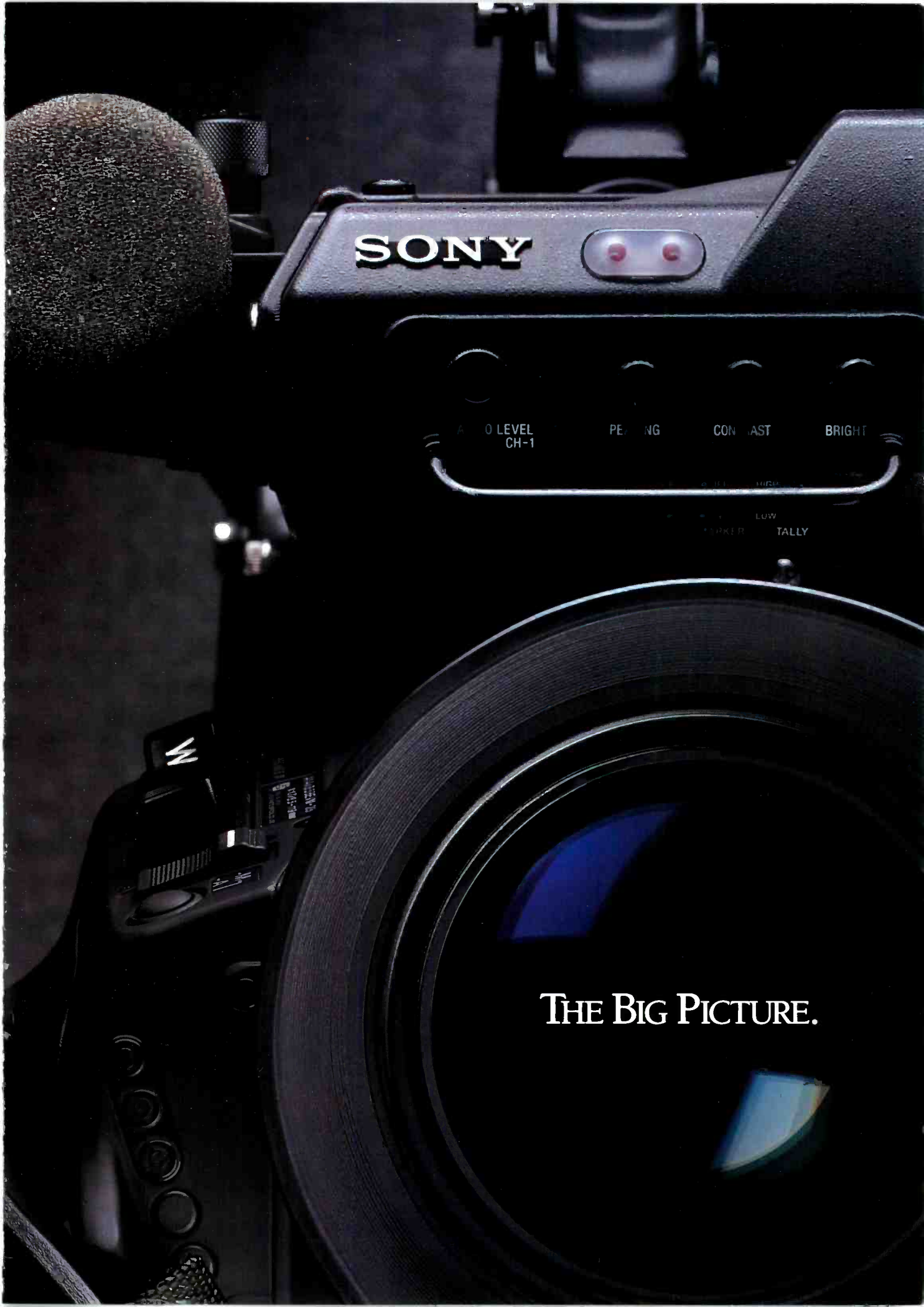
The next big issue in linear editing is machine control, which generally comes in two flavors: *proprietary single-use dedicated hardware* and *open-architecture multiple use hardware*. Just ask the manufacturers how much software is available for their hardware from third-party vendors. In general, the more programmers writing software for a specific hardware technology, the better. This also increases the return on your hardware investment if you decide to sell later. With some systems, you can actually sell the pieces separately and selectively and have a better return on investment.

Systems that use a single microprocessor, no matter what kind or how fast, must rely on wholly time-linear software procedures. This means that the more real time tasks the computer must control, the less able it becomes to process the information it receives. This process is commonly (but sometimes erroneously) referred to as direct machine control. The software communicates with the physical VTRs and other peripheral devices via a "dumb" RS-422 serial interface.

Developments in distributed processing techniques and local area networks have produced new breeds of *intelligent distributed processing*. Intelligent distributed processing allows complicated tasks (VTR and switcher control, special effects device operations, etc.) to be transferred from a main controller (variously called a transmitter, host or server) to a local controller (receiver, node or workstation) and downloaded to make the task the sole responsibility of the local controller to execute. In this way, the host can act like an air traffic controller, giving occasional orders to all the airplanes coming in and going out, instead of trying to fly them all himself.

The ducks can line themselves up

Living somewhere in the cyberspace of electro never-never land is the editing soft-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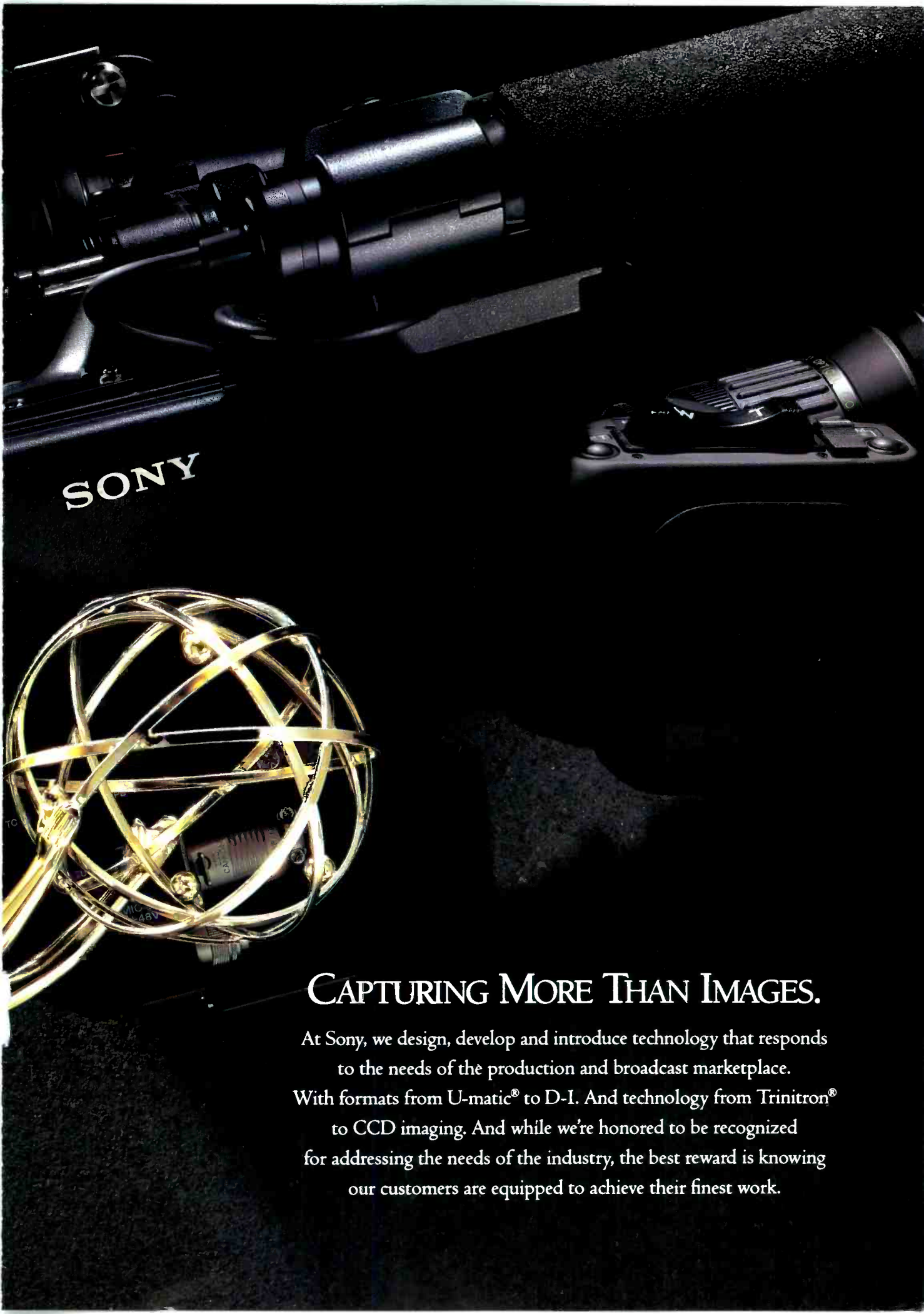

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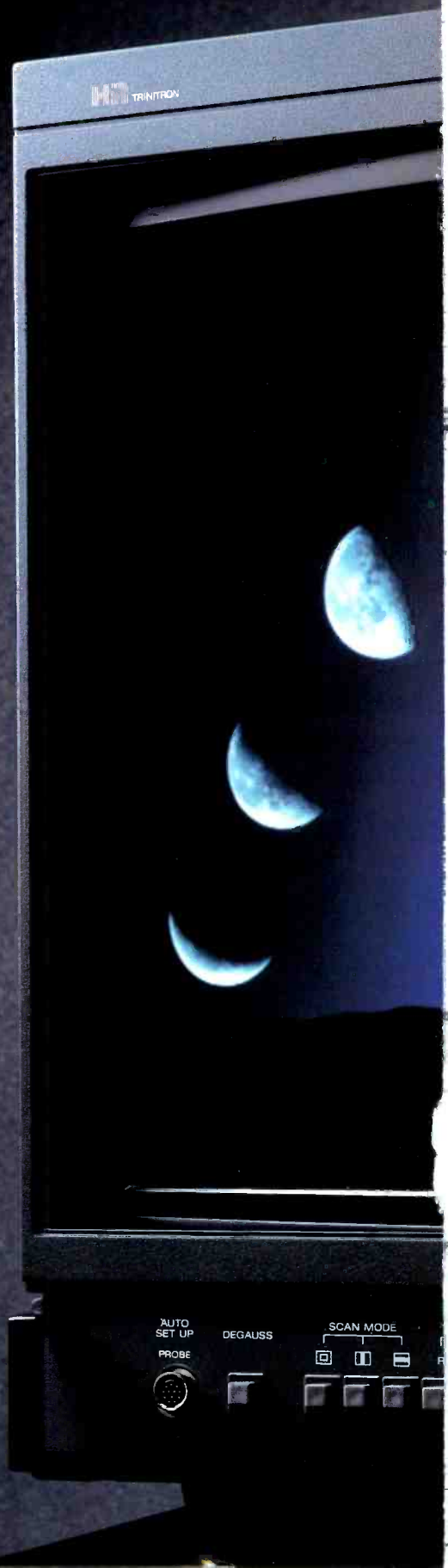

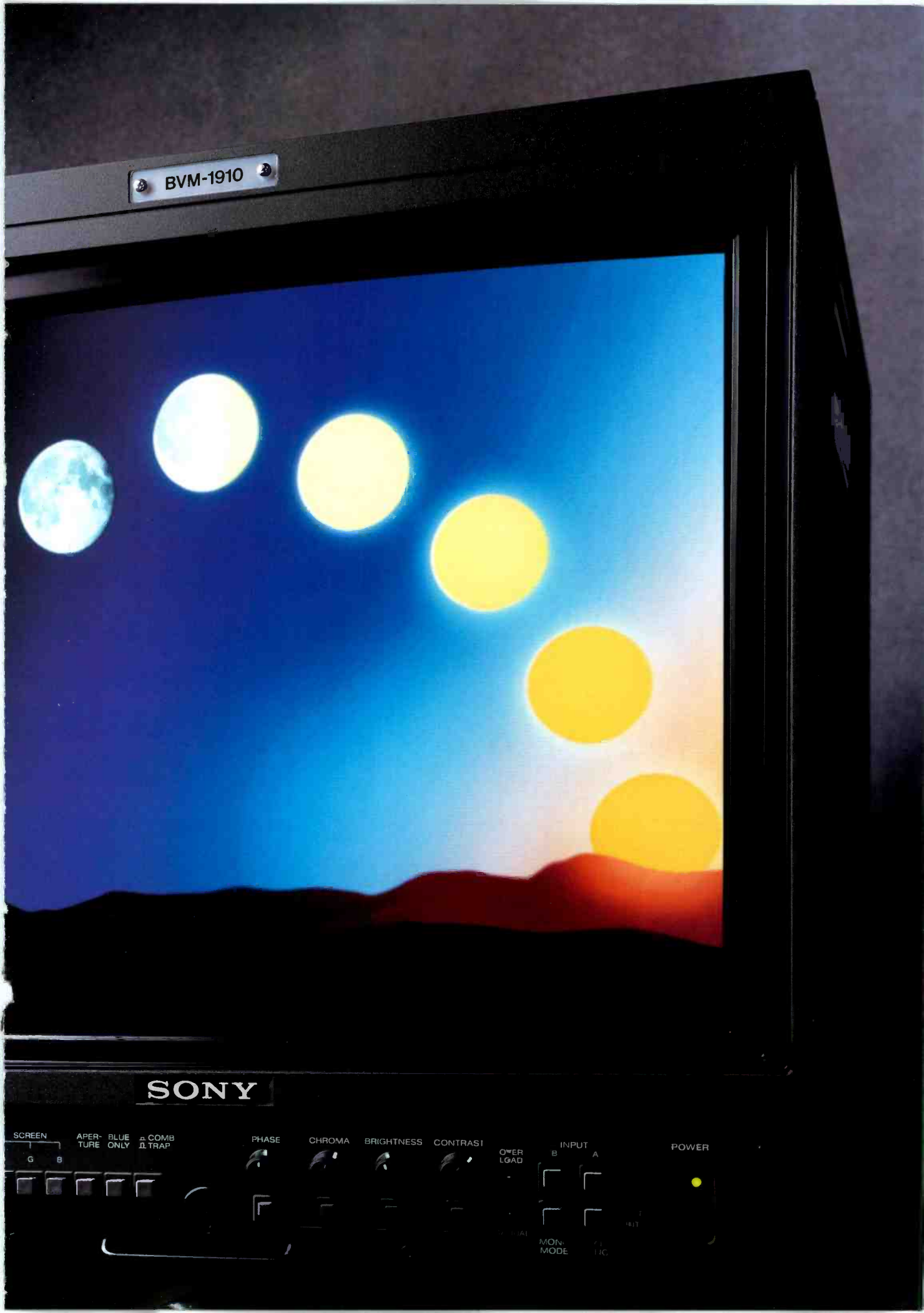
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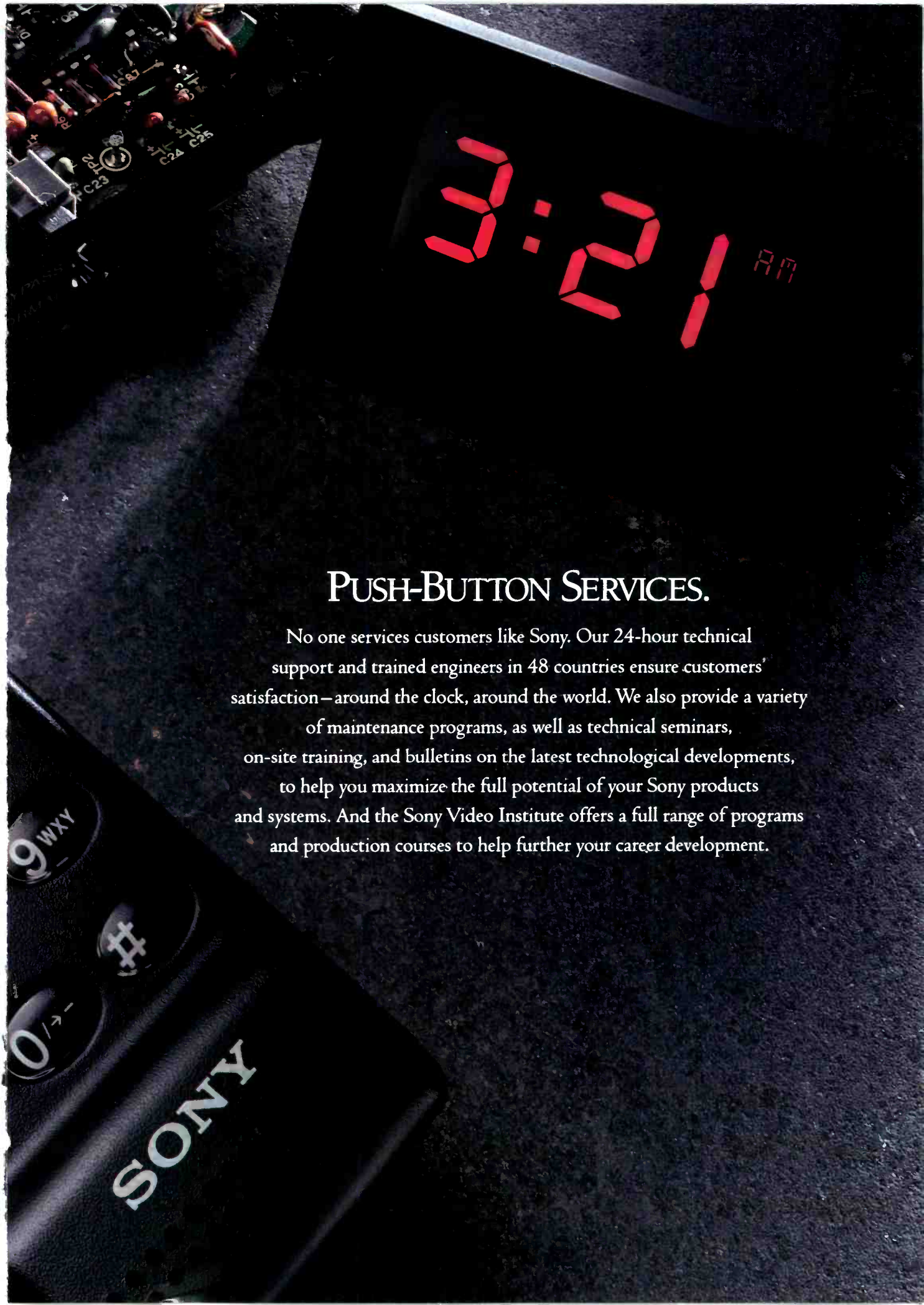

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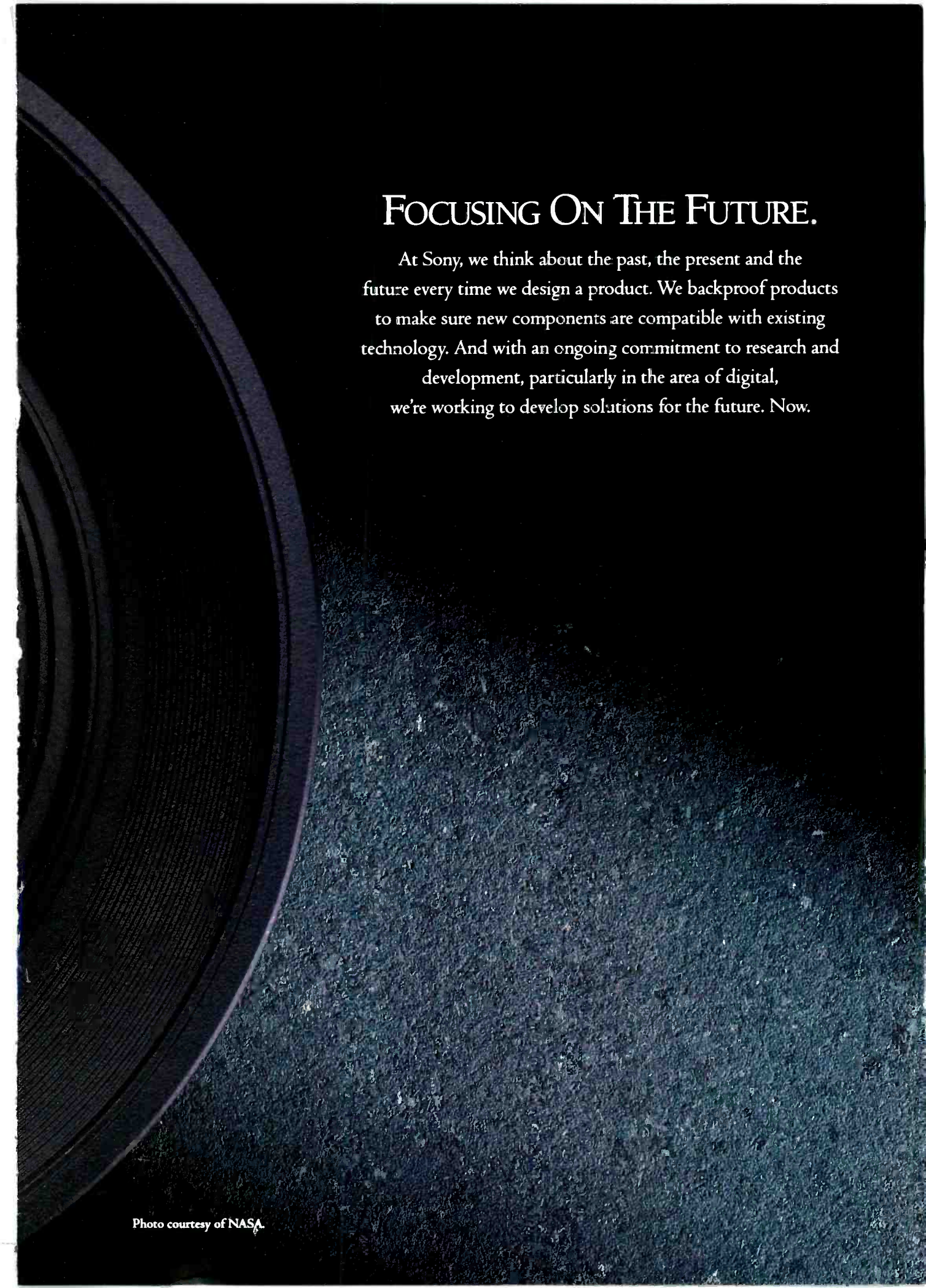
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Selecting a linear editor

The only way to finally select an editing system is to use it. Take some tapes to the dealer and actually edit something together. It is like test driving a car to see if that is the model you want. While you are at it, get the answers to the following questions and weigh them against your budget/needs.

Hardware

Is the computer platform up-to-date and expandable? Is the platform off-the-shelf or proprietary?

How many different types of VTRs and audio/video peripheral devices can it control? Make sure that it can control serial and parallel interfaces so you can easily mix and match your VTRs without expensive "adapting" hardware. Also, if your needs require it, the system should be capable of controlling the latest audio and video production switchers, as well as peripheral special effects devices.

Is its machine control hardware proprietary, or can it be upgraded with hardware from other manufacturers? If the company folds, your investment can be guaranteed with upgrades from other vendors.

Is software available from third-party vendors? In general, the more software available, the better.

If you are going to move the system around for rentals or location work, does the hardware stand up to shipping and reassembly? Make sure that all necessary cables and connectors are provided. This avoids last-minute surprises and unnecessary trips to the local Radio Shack.

Software

Some software can be successfully operated without reading through and memorizing the entire user's manual. This can say a lot for the overall human interface and the fact that new editors can get up and running without wasting valuable edit bay time. In general, an operator familiar with one QWERTY system can make an easy transition to another QWERTY system from a different manufacturer.

Is help available directly through the software (on-line), or do you have to search for the manual? In general, quality software contains built-in help and/or on-line tutorials to speed the learning curve.

What revision of software is being released? Version 1 of most software releases can be unproven and even a bit buggy. Also, be aware that some companies play games with their version and revision numbers. One company is currently marketing version 3 software of an established system name that is actually version 1 of brand new software, written from scratch.

How often are software versions updated? In general, once or twice a year is sufficient. Some manufacturers offer unlimited free updates for original owners while some offer only a software maintenance contract, which can add to the system costs.

Human interface

How much attention does the operator need to focus on the editing screen and keyboard itself? For the most part, your attention should be on the editing, not the editing system.

User/operator base

Who is currently using this editing system? Ask for a users' list or references. Call two or three at random and ask how long they have had the system, what problems they have encountered, and how responsive the manufacturer is to bug fixes and updates.

Service

Research the mundane, such as the "mean time between failures" for the hardware. Most edit bays cannot afford downtime.

Make sure that help is available on a 24-hour basis just in case you are pulling an all-nighter and have problems.

Will the manufacturer swap out boards or just repair them and make you wait?

ware itself. Residing with it is the software programmer who occasionally lets someone in to clean up. It is fair to say that it takes as long a time and as much effort to write and debug an editing controller as it takes to program VOYAGER II into launching. In general, much of the best software has been as reliable. Lining up the ducks for a video edit is no small task. Like many of the original TV editors, most of the original editing controller software authors were talented and capable TV engineers. After all, they were the only folks who knew what those 3-character abbreviations on the buttons meant.

As the software matured and became much better at handling more types of peripheral devices, it became only slightly better at addressing the changing human profile of its users. Over a period of just a few years, creative folk were insisting that they could push the buttons themselves.

Living somewhere in the cyberspace of electro never-never land is the editing software itself.

Adding to this was the proliferation of PCs and BASIC programming books that used to come with every one. Suddenly, editors were teaching themselves to program. The combined results of new and more powerful hardware and software created by editors are now well-entrenched in the marketplace. Unfortunately, the pendulum has swung so far that there is editing software on the market today written entirely by programmers who have never seen the fader side of an edit bay.

Now, back to work

So, where is linear editing going? Back to work. While the adventure seekers and video futurists are pouring today's money into tomorrow's technology, hundreds of editors sit dutifully pounding out thousands of hours of video productions on tape, and will continue to do so for years to come.

The technologies improve daily and the change to digital/non-linear is inevitable. But while we are waiting, all users and owners of linear should take heart and feel assured that your "obsolete" systems will serve you well for some time to come.

➡ *For more information on editing controllers, circle (307) on Reply Card. See also Editing Controllers on p. 13 of the BE Buyers Guide.* ■

Digital news gathering on a desktop

DNG is right around the corner.

By Stevan Vigneaux

The Bottom Line

In the 1970s, film gave way to videotape as portable cameras and videotape equipment revolutionized TV news gathering. In the 1990s, disk-based editing and field equipment may change not only news gathering, but also editing, storage and on-air playback.

During the past few years, non-linear disk-based editing has changed the post-production business. However, disk-based systems have been restricted to off-line use because video quality was not quite high enough. That has changed with the introduction of compression technologies that produce excellent image quality. Image quality from these systems has improved to the point that several leading broadcasters have gone to air with their output.

In the 1970s, the first practical videotape system and portable camera for news were introduced. Within a short time, broadcasters were abandoning film for videotape. Because tape did not need to be developed, it took less time to get it to air. TV news took on new energy. Stations competed to see who could get their reporters and photographers into the field fastest. The quality and quantity of TV news rose. ENG was one of the factors that made CNN possible.

Enter the computer

Then came the computers. IBM's PCs quickly spread through a variety of industries, and Apple's Macintosh showed how easy computing could be with a graphical interface. Word processing and spreadsheets invaded our work lives. Newsroom computers replaced typewriters and teletypes.

As computers evolved, data compression algorithms were developed. These algorithms evolved into compression systems that allowed digital audio and video to be stored on a disk drive. Today, most non-linear editing systems use the JPEG compression standard. JPEG is capable of storing approximately seven minutes of high-quality video and audio per gigabyte. It also provides real time, high-quality performance at reasonable cost and physical component size.

High-quality video compression requires careful and precise implementation. Without properly partnered hardware and software, no chip set can produce first-class video. The leaders in non-linear systems have made these advances possible by developing software that complements the hardware. Other compression technologies include fractals and MPEG. Although each holds promise, currently they are not capable of producing high-quality video in a compact package at a reasonable cost. Experts believe MPEG-2 will be standardized in mid-1994. High-quality chip sets should reach the market in 1995. Fractal compression requires major speed improvements before it becomes real time capable. Real time fractal compression is not expected until late in the decade.

All JPEG is not the same

The quality of JPEG compressed video is highly dependent on implementation. The key issue is the coding tables. Good tables produce good video by properly quantizing and coding the incoming signal for digitization and then assigning tokens for compression. Each manufac-

Vigneaux is senior product marketing manager for broadcast products, Avid Technology, Tewksbury, MA.

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turer independently implements compression tables, which leads to wide disparities in reproduced image quality.

A second implementation issue is filtering. A well-filtered input signal reduces aliasing in the digitizing process. Correct output filtering also reduces aliasing, while simultaneously diminishing the blocking effects that sometimes occur because of JPEG's 8x8 block structure.

The benefits of disk-based production

Non-linear production provides speed, flexibility, creative freedom, reliability and quality. Speed comes from the ability to randomly access data. Disk drives marry high rotational speed with extremely fast head seeking, which allows random access to any frame in any order. Random-access disks eliminate winding and rewinding through tapes. A click of the mouse instantly moves from one end of a clip to the other. Browsing also is much faster, and finding the right clip is quick and easy. A typical news story can be cut 30% faster on a non-linear system than on a linear tape-based system.

This speed also provides creative freedom and flexibility. Because the editing goes so quickly, there is time to try variations. Cut the story one way and then try it another to see which works best. Different video clips can be used to illustrate the voice-over in each version. Drop in an additional clip, and play through to see if it works. If it doesn't, take it back out with a single keystroke. Non-linear systems make it easy to create one version for the six o'clock show and a second for the 11 o'clock show to avoid viewer boredom from repeated material.

The next stage of benefits comes with disk-based playback. Every story in the system is instantly available for playback because the disks provide random instant access. When the producer calls for a change, there is no need to unload one tape to load another. Instead, click-and-drag with the mouse restructures the rundown in seconds.

Today, most non-linear editing systems use the JPEG compression standard.

The playback operator's work load plummets because tapes are eliminated. Cuing is correct and completely automatic. Reliability is high because the MTBF for drives is 300,000 hours (over 30 years). The increased flexibility, reliability and speed of disk-based playback systems greatly improves the news show's on-air performance.

Because all the media is stored digitally, generation losses that degrade picture and sound in analog systems are eliminated. The result is a product that goes to air as first generation rather than third or fourth, which is a noticeable improvement that travels all the way to the viewer's home.

Implementation

In a typical non-linear editing or playback system, the incoming video is decoded into RGB and then digitized. The digitized RGB is sent to the compression module, converted to YUV, processed for compression, and passed to the disk drive via the system bus. Audio is digitized and stored to disk at 16-bit quantization, which provides CD quality.

During video playback the process is reversed. The CPU uses the system bus to recall compressed data from the disk. The JPEG data is decompressed, converted to RGB, and changed back to analog video.

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excess of 3Mbytes/s. Attention must be given to proper data transmission and file management. This is why most system manufacturers have chosen to use existing Macintosh and 486 systems. These platforms provide solid, dependable, thoroughly debugged performance at much lower cost than developing a proprietary device.

Media sharing

Once the material is on disk, the obvious question becomes how to share and move it around the facility. The most straightforward approach takes advantage of the networking technologies developed for the computer information industry. This solution makes sense because the compressed video and audio are computer files. They can be transferred across a network, data phone line or satellite data channel as easily as a spreadsheet.

Comprehensive media sharing systems will be introduced as new technologies support additional capabilities. Each succeeding stage will provide increased file transfer speed and flexibility in sharing the media.

Interchange

One of the potential threats to the success of non-linear disk-based news production is interchange. Once multiple vendors offer products, it will be necessary to exchange media between systems. The Open Media Framework (OMF) interchange standard provides audio, video, stills, graphics and sequence information (similar to an EDL) to be exchanged between devices. Currently, OMF is supported by more than 100 major broadcast and computer manufacturers.

Storage technologies

Only magnetic hard drives are currently capable of supporting the data rates for high-quality video and audio. The best erasable optical drives are limited to less than one megabyte per second while recording. There is the potential for new optical systems within the next few years, but they remain only possibilities.

The most straightforward approach takes advantage of the networking technologies developed for the computer information industry.

Today's faster hard drives support transfer rates as high as five megabytes per second, which makes them capable of meeting the demands of disk-based editing and playback systems. Access times are fast enough for true random access on a frame-by-frame basis.

Perhaps the best news about drive storage is that capacity is doubling and cost is halving on an average of every two years. RAM storage systems are not practical in the foreseeable future because the phenomenal storage capacities required make it impractical. Even if high-speed RAM costs were reduced to $25 per megabyte, storing 20 minutes of video and audio could cost $75,000.

The dockable disk recorder

The last piece of a complete digital non-linear news production system is the dockable disk recorder. It is possible that NAB 1994 will see a prototype or technology demonstration of a dockable disk recorder. It will most likely use a removable hard disk for recording because, as mentioned earlier, only hard drives support the high data rates required. Future

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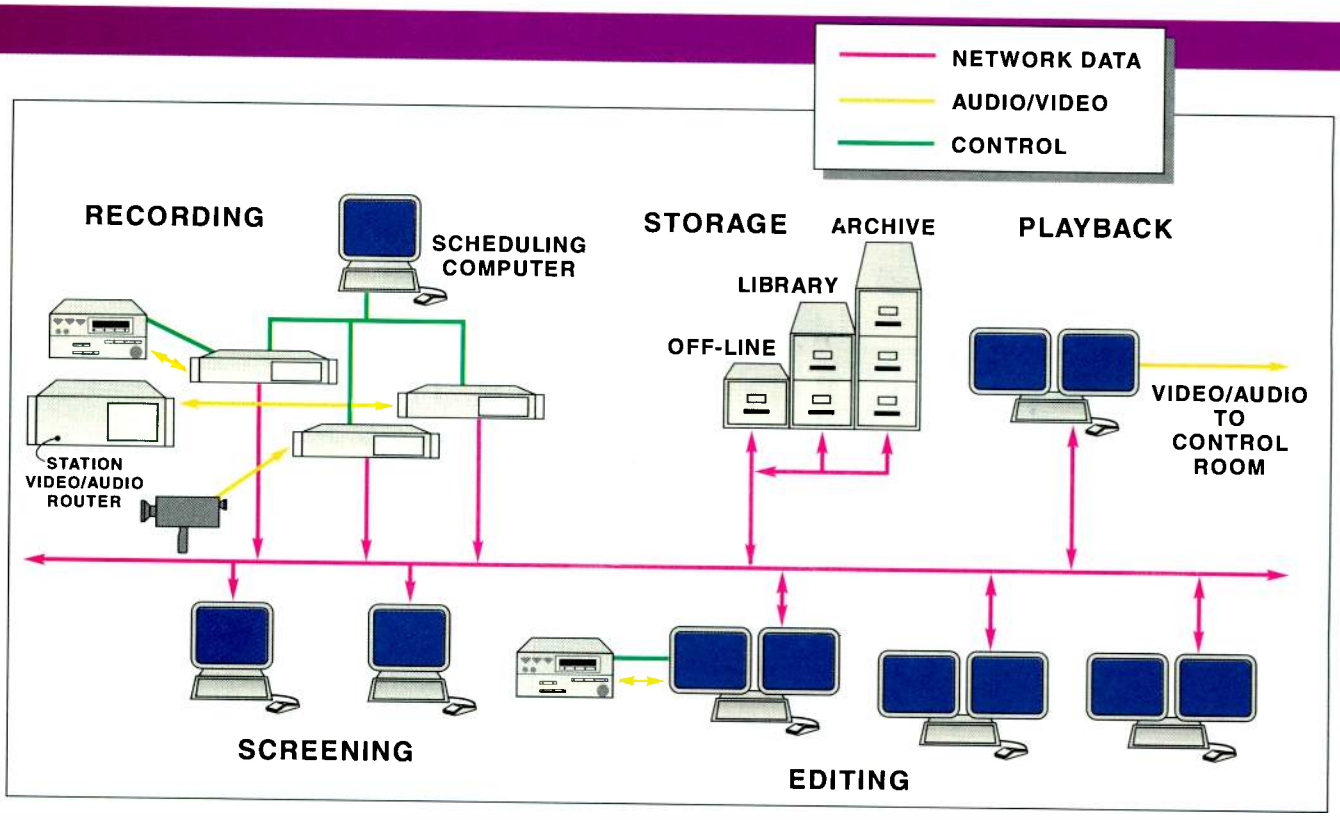

Figure 1. *Possible layout of a networked news system. Block diagram has areas for recording, screening, storage, editing and playback. Individual stations have access to other areas through the network.*

dockable disk recorders will support removable optical disks once they can provide the necessary data throughput.

Time table

One manufacturer demonstrated all the key elements of a complete desktop news production system at this year's NAB, while a second showed a disk-based playback system with possible news applications. With these building blocks in place, it is possible for stations to begin putting this technology to use.

It was strongly suggested that a sophisticated media sharing system using a server would be available for shipment soon after NAB 1994. If this prediction is fulfilled, a complete non-linear production system will be a reality in less than one year.

Transition strategies

Most users will have to make a staged transition to non-linear production systems. This means first making use of non-linear systems in islands where they can provide immediate benefits. Once enough of these islands are served by disk-based systems, media sharing can be added via a basic point-to-point file transfer system. As capacity demands climb, network speed can be increased and then a server's library functions added to provide a smooth, gradual transition to a complete integrated system.

Likely candidates for islands are in two areas. The first is in editing news features. Their complexity and length are perfect for non-linear editing because of the creative freedom and flexibility non-linear provides.

The second is playback-to-air of material that is used repeatedly, such as program opens. Newscasts typically require a dozen or more of these repeating tapes, including the open, bumpers, segment opens and the close. Loading, cuing and playing these tapes adds to the workload of the tape operator and the VCRs. Numerous tape changes increase the possibility of errors. Off-loading these items to a disk-based player effectively removes them from the operator's workload and eliminates the possibility of tape jams, miscues or loading problems. Placing opens, closes and so forth on a non-linear player is a reasonable first step toward total disk-based playback.

When selecting desktop news products, consideration should be given to making each piece part of an integrated media sharing system. Although islands will be the first step in a transition to a complete non-linear production system, it will be media sharing that really ties it together and brings the most important speed and productivity improvements.

Futures

What comes next? Increased compression ratios? Hard drives with greater capacity and speed at lower cost? Networks with faster-than-real time file transfers? Dockable recorders using low-cost removable media? Microwave and fiber links that support digital media transmission? Intimate 2-way links with newsroom computer systems? Probably all of the above, it is just a matter of when.

Another element of the future will certainly be new video formats. Every time the industry has faced this kind of change in the past it has meant massive capital expenditures to replace the video recorders. One of the many benefits of desktop systems is their ability to be upgraded rather than replaced. If a new compression technology appears, change out a board. If aspect ratios change, then change the I/O board. Despite these changes, the user interface stays the same, eliminating the need for retraining.

Conclusion

Advances in compression systems, increased hard drive data rates, the availability of low-cost standard computer platforms, new approaches to software development and human interfaces have made desktop news production an available reality.

Industry leaders are embracing the technology because it provides real and measurable benefits, including speed, reliability, efficiency and ease of use. Within the next few years, non-linear production systems will spread through the industry, bringing with them the same energy, flexibility and creative power gained from newsroom computer systems and electronic graphics systems.

➡ *For more information on digital news gathering, circle (308) on Reply card.* ■

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Production suite technology

Building a facility in such transitional times presents major challenges.

By Tom Canavan

The Bottom Line

Today's greatest facility design problem is constructing a workplace that is not only state-of-the-art the day it goes up, but also flexible and upwardly compatible enough to keep it that way. Achieving world-class status on opening day can be done with good planning and deep pockets. Coming up with a design that remains expandable, cost-effective and continually up-to-date is considerably more difficult. Here is how one current project was handled.

$

Five years ago, USA Networks completed construction of its post-production facility in New York City. Immediately thereafter, the cable TV network began to research opportunities for housing all of its rapidly expanding services — operations, production and post — under one roof. The result of this effort is due to go on-line Jan. 1, 1994: A new, ground-up installation in Jersey City, NJ, will comprise network origination/playback capability and full digital audio/video post.

The design leaves sufficient room for the operation center to expand, both in quantity (for a possible service expansion to Europe and, eventually, to Latin America and the Far East) and in method of delivery and format. The latter includes modes ranging from 16 x 9 NTSC through compression technologies and HDTV. Interactive capability and a virtual reality-like format that could enable home viewers to change camera angles or shots of a sports telecast (perhaps by simply moving their heads or eyes) also are under serious consideration.

The key to the 46,000-square-foot facility's extensive upward-compatibility is its fully digital nature. A.F. Associates was hired in October 1992 to design, fabricate, test and manage the project as a turnkey installation under the network's design concepts.

Another important factor in this design was an integrated technology approach, both in the Network Operation Center (NOC) and in the post facility. This was done in part by restricting the purchase of equipment and technology to individual, key vendors. This was done to allow these vendors to work as partners in technology development, and to ensure continuity of compatibility and support. Other criteria of the design included ensuring adequate, round-the-clock back-up and incorporating an exponential increase in operating efficiency.

Canavan is vice president and general manager of A.F. Associates, Northvale, NJ.

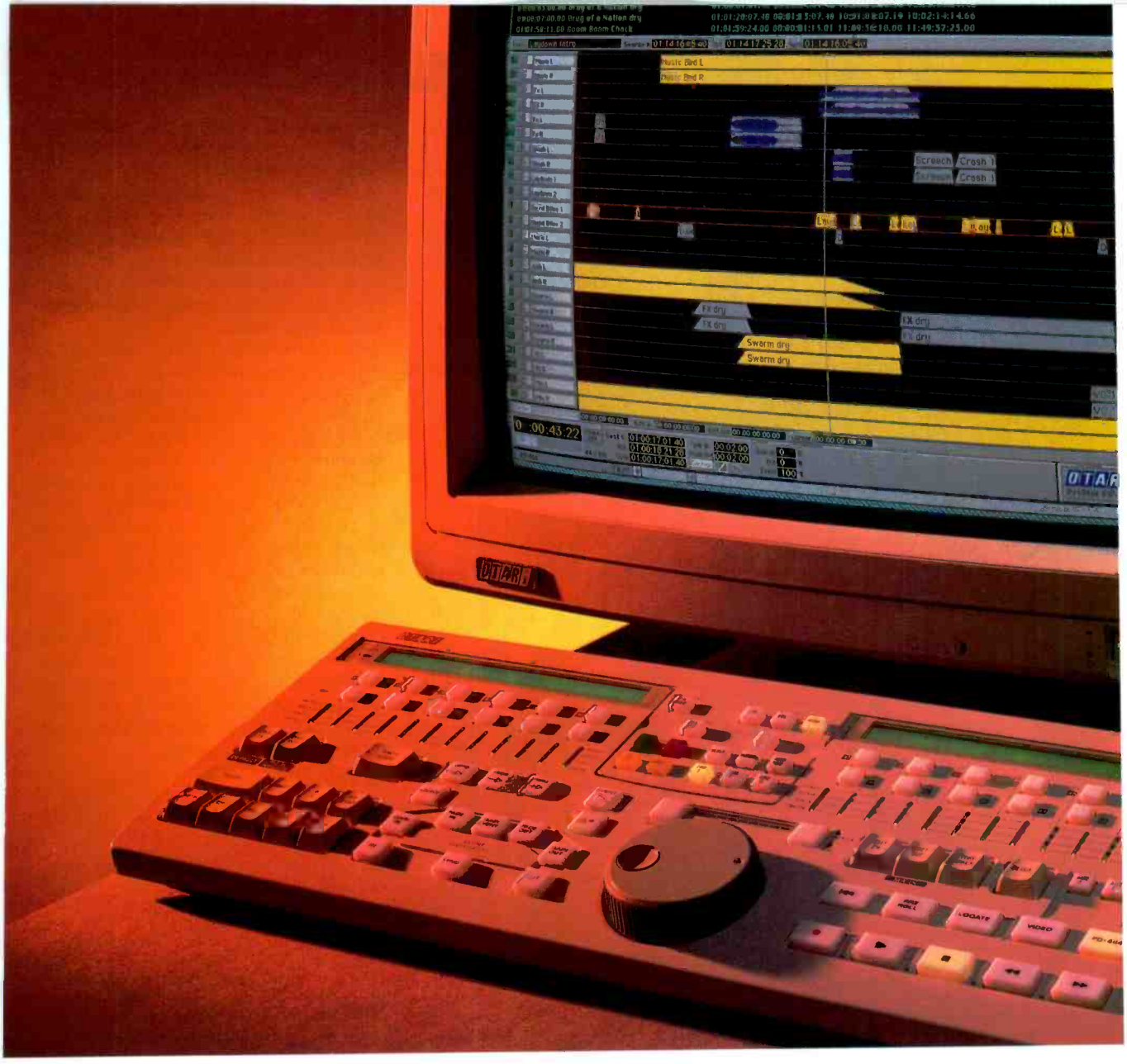
Capabilities

As matters will stand when the facility opens, the current network origination will require three active control rooms: a dual control room for *USA East* and its time-delayed sibling, *USA West*; a second, stand-alone room for the feed for the *Sci-Fi Channel*; and a third stand-alone room to handle alternative programming, such as when certain sports events require local blackouts. The single feed for the Sci-Fi control room is expandable to two, and three additional dual control rooms can be made operational as required.

The post facility contains four full-digital high-end edit suites, with room to expand to another three. (See Figure 1.) Editing for the system is carried out in 525-line NTSC. Finished projects will be converted before transmission for overseas applications or bicycled abroad on tape.

Staying ahead of technology

One of the network's and the designers' prime mandates was to acquire formats and equipment that can grow, and to



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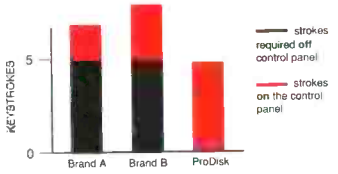

Otari's ProDisk 464 is fast and easy to use. Here's proof: To record a file and trim head and tail,* it requires fewer total keystrokes. Even more significantly, ProDisk lets you work totally on the control panel while its two competitors force you to supplement with either keyboard or mouse.

*Comparison of many other functions show similar keystroke savings.

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specify manufacturers willing to work with the network to develop evolving technology. USA is currently conducting experiments with Bell Atlantic on interactive capabilities, for example. The entire new facility, both NOC and post, is designed around a 13-level serial digital routing system.

The NOC will use digital composite D-3 machines, 40 (from a total of 72) of which will be operated in a double-redundant automated library management system, for eventual playback of all commercials, programming and interstitials, including sports material. (Typically, the network delivers up to 500 commercial inserts a day.)

There also will be facilities for live audio and announcements (primarily to accommodate remote sports feeds) and for bringing in Hi8 video, but no live video studio is planned. In addition, the design firm is custom-building the center's monitor and distribution services, which feed two fiber-optic paths and a microwave trunk line to remote uplink facilities. The facility was designed both in terms of use of space and in the design of infrastructure to accommodate new formats and new services. All cables were fabricated, tested and labeled before installation into equipment racks, and tested again as part of a complete system check after installation on-site.

A main technical design concept for the post-production area was to keep all operations in the digital domain, including editing, routing and audio post.

Although primarily based on digital composite technology, the post-production facility also was carefully designed to interface easily with any other video format, including digital component, Betacam, Betacam SP, Hi8, 1-inch Type-C and other prevailing analog formats.

The initial post setup includes the four on-line edit rooms, two screening rooms, two off-line video edit suites, and two graphics rooms (one of which will open in January, the other in the future). An audio announce control room, announce booth and post-production/broadcast room complete the layout.

An important factor in this design was an integrated technology approach.

The audio and mix-to-picture capabilities are purposely high-end, based on the designers' feeling that audio is frequently shortchanged in the in-house broadcast/cable production process. Audio production and post is implemented via a random-access digital editing/mixing system. The acoustics of the audio control room and announce booth were given significant emphasis as well, with treatment by acoustical consultant Russ Berger, working in conjunction with project architect Hans Knutzen.

USA Networks transmits stereo (with an SAP in Spanish), but currently does not use surround sound or other audio treatment systems. USA is one of the first cable networks to make a commitment to extensive Spanish language services, providing play-by-play coverage of sporting events via the SAP channel.

Video post includes sophisticated on-line, off-line and effects capability. The four on-line rooms are each equipped with a production switcher, an editing system, a digital audio mixer and a video effects system. Each room also includes a 2-channel digital disk recorder and Type C, D-2, D-3, 3/4-inch, Betacam SP and Hi8 formats. The off-line rooms each contain

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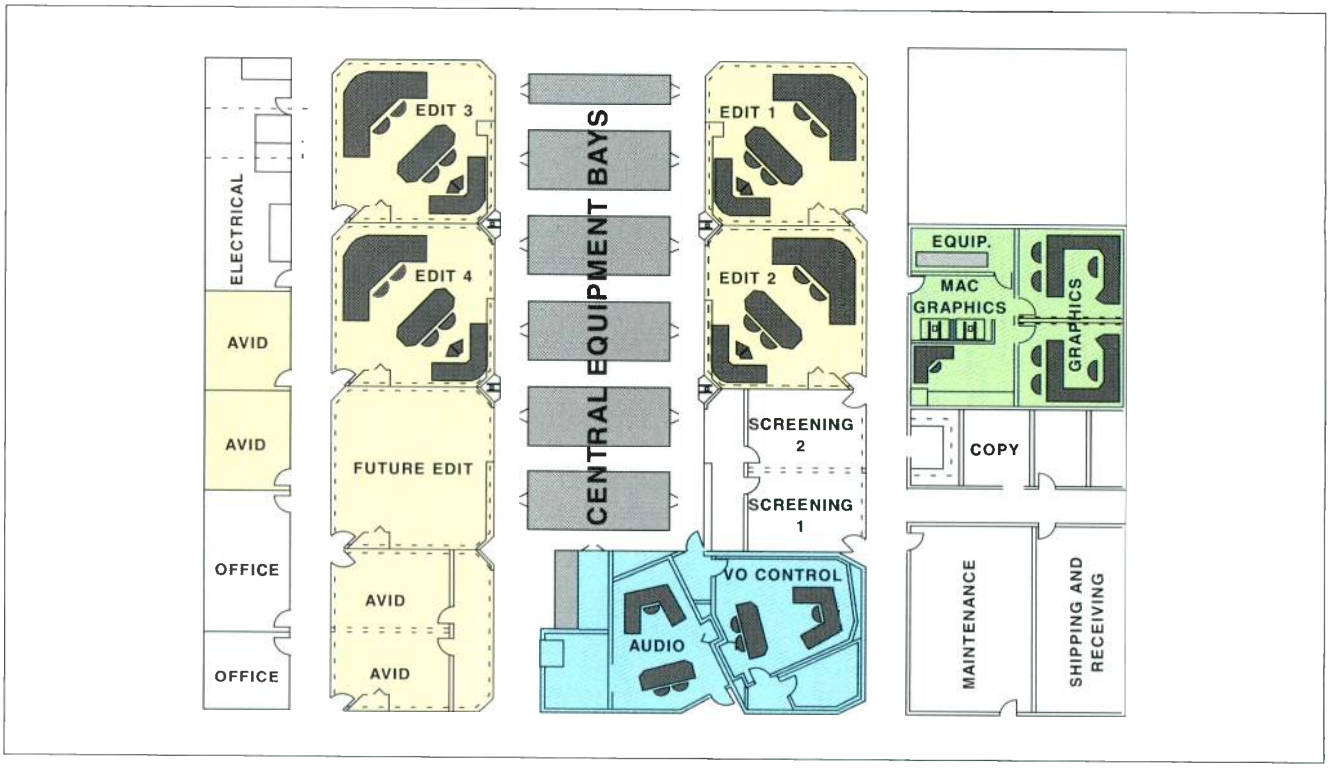

Figure 1. Plan of a portion of USA Networks' new facility, showing post-production area.

a random-access editing system. The graphics rooms will include random-access recorders and D-5 VTRs.

Automation and redundancy

Today's appropriate facility design mandates operation in a manpower-conservative mode. This implies a high degree of automation in the facility's playback capabilities. Consequently, all of the networks' programming, spot and interstitial material will air from an automated cart system. Alternate service, stereo transmission and the SAP subchannel and operation of closed-captioning coding and verification equipment also will air from the automated system. (Live events can be closed-captioned as well.) Furthermore, the automation network is integrated with the facility's traffic system.

Extensive fail-safe systems and procedures have been designed to support network automation and control operations. The three NOC control rooms are centered on central switchers and a double-redundant digital cart playback system deploying a total of four automated library management systems. All material, including programming delivered on film, will be transferred to D-3 format for air via the automated cart system.

Two pairs of automated cart machines will be operated as a redundant round-the-clock system. Each machine contains 10 D-3 VTRs and measures 13 feet in length. A 2-month staff training and preparation period will be completed by the facility's sign-on date. USA Networks, the facility designer and the cart system's manufacturer have been working for a year developing software to handle complicated spot sequencing. Anything required to maintain on-air programming is supported either by redundant system design, backup power supplies or bypass modes.

Audio is frequently shortchanged in the in-house broadcast/cable production process.

In post, hardware failure is less of a problem. Equipment downtime can be easily addressed by moving either hardware or projects between similarly configured rooms.

The facility also has multiple redundant paths to its uplink site. Each of two fiber-optic routes leave the building from separate locations and follow different geographical paths to the uplink site. The microwave link follows yet another separate route. In addition, the facility's complete automated air-conditioning and heating infrastructure operates under computer supervisory control and is power-protected by a UPS system and diesel-generator backup.

Such a design epitomizes the solutions to the substantial problems faced by facility designers today. State-of-the-art quality must be implemented in hardware of proven reliability, with cost-effectiveness maximized by a high degree of automation. Meanwhile, forethought and modularity in design are the defenses against the inexorable progress of technology.

Acknowledgments: Thanks to the following project leaders for their assistance with this article: Dick Ross, vice president of engineering and operations, USA Networks; Meryl Altman, vice president, systems division and Jim McGrath, project manager, A.F. Associates.

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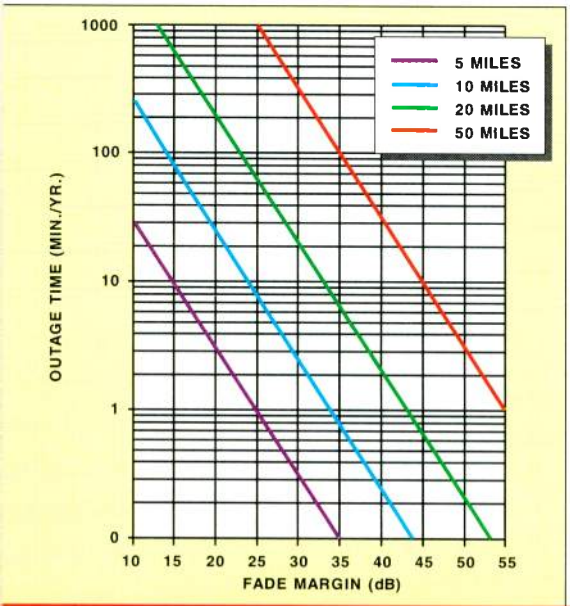

New program delivery systems

Digital STLs are widening a traditional bottleneck.

By Dick Bell and Kevinn Tam

The Bottom Line

With much of a radio station's studio equipment and storage media moving to the higher levels of fidelity that today's audio technology provides, the studio-to-transmitter link (STL) becomes a limiting factor to broadcast quality. The improvements in this area provided by a new generation of digital STLs are timely and welcome. These new STLs also can provide higher reliability and greater efficiencies in spectral occupancy, power and antenna-size requirements.

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Bell is general manager and Tam is director of marketing for the Communications Products Group at Dolby Laboratories, San Francisco.

Digital audio has allowed many advances in studio equipment over the past several years. More recently, however, digital techniques have moved to the RF domain for broadcasters, specifically in the realm of studio-to-transmitter links (STLs).

In addition to perceptible sonic benefits of digital audio, such systems also provide some other technical assets when applied to signal transmission. For example, a digital STL provides the potential for increased signal robustness and spectrum efficiency, and thereby creates new opportunities for broadcasters. This article will discuss how a digital STL system's combination of bit-rate reduction (data compression), digital audio and digital microwave radio technologies provides improved transmission reliability without complicating installation or maintenance.

Choosing the right audio coding format

One of the major advantages of digital STLs is their purported improvement in sound quality over analog systems. This is certainly the case when it comes to maintaining a low noise floor. Yet, ultimate audio quality depends largely on the designer's choice of audio coding format.

The standard linear 16-bit PCM CD format cannot be used to modulate an aural STL carrier because the resulting occupied bandwidth of 1MHz or more would exceed the authorized channel bandwidth for such services. Thus, bit-rate reduction is a necessary component of digital STL systems. Also desirable is a digital modulation scheme that maintains the ability for the FM signal to be conveyed in composite form, or the use of a completely new approach that allows further improvements in spectrum efficiency and signal robustness.

Several different digital audio bit-rate reduction techniques are incorporated in current digital STL implementations, and each offers its own set of trade-offs in capacity, throughput delay and sound quality. Subjective quality is directly affected by how well an audio coding system conforms to psychoacoustic models. As a general rule, however, regardless of the type of coding, the use of *higher data rates* for transmission (i.e., less compression) minimizes audible artifacts and can, in some systems, contribute to lower throughput delays. Avoiding the temptation to use lower data rates also will minimize the deterioration attributed to cascading multiple rate-reduction generations.

Some audio coding systems also incorporate error correction (such as Reed-Solomon) into their formats. In some digital STL designs, this error correction adjusts for errors that may be introduced by a higher-order modulation technique. In others, it can correct random bit-errors caused by RF noise or interference, thus providing a more robust signal.

One of the drawbacks of bit-rate reduction is its unavoidable introduction of

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some time delay between input and output. All bit-rate reduction techniques require computation time, resulting in time delays that vary from a few milliseconds to several hundred milliseconds. Announcers and DJs will notice this time delay if they monitor the station's signal off-the-air. With shorter delays (under 10ms or so), perceptible reiterations (echoes) are not produced. Instead, an announcer's voice undergoes a timbral change caused by the comb filtering effects of mixing delayed audio from the headphones with undelayed sound heard acoustically. Most announcers can become accustomed to this relatively subtle spectral effect, however.

In cases where the throughput delay is too bothersome (either from strong spectral effects or actual echoes caused by systems with longer delays), the problem can be eliminated by feeding the headphones with *program signal* rather than air monitor audio. This is best done only when the announcer mic is keyed on, leaving the standard air monitor feed in the headphones at other times. Alternatively, instead of using program audio straight from the board, this feed can be derived after the station's on-air audio processing but prior to the digital STL.

Maintaining compatibility with older equipment

Apart from the choice of bit-rate reduction scheme, STL manufacturers have taken two distinct approaches in the design of digital STLs: encoder/modulator add-ons to analog composite STLs and new from-the-ground-up designs. For stations with existing composite installations, the ability to add digital capabilities at a modest increase in price is attractive. The complete-system approach bears careful scrutiny as well. Because these systems do not require compromises to accommodate older analog technologies, dramatic improvements in spectrum efficiency (especially critical in overcrowded markets) become possible.

Figure 1 shows a spectrum analyzer display from a field test in Chicago, where two stations were able to coexist in a single 500kHz aural STL channel. This spectral efficiency also gives the engineer the flexibility to offset STL frequency, thereby circumventing co-channel or other interference-related problems.

In cases where consolidations or expansions bring a second service into an existing station's studio and transmitter facilities, the spectral efficiency of digital STLs may allow both stations to use an existing single STL channel.

Analog STLs can serve as backups to digital systems under most circumstances. In such instances, switching of auxiliary baseband and subcarrier signals must be performed somehow (such as by us-

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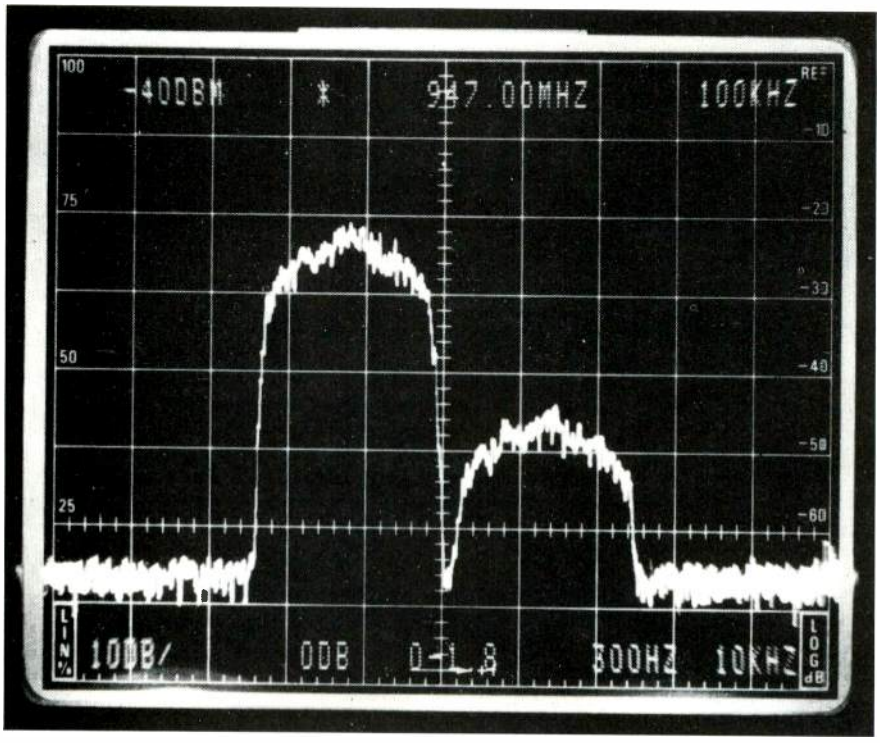

Figure 1. *Spectrum analysis of a 947MHz aural STL, showing two separate STL signals each occupying less than 250kHz within the 500kHz channel. (X-axis graticule is 100kHz/div.)*

ing hot standby units to switch between systems). At least one analog interface unit on the market automatically provides a switchover to the analog receiver when digital transmission has been disrupted and when the presence of an FM composite STL signal is detected. Without such switchover, the analog receiver accepts the digital signal and its demodulator will produce white noise.

Fade margin vs. outage time

A primary benefit cited for digital STL systems is a substantial improvement in fade margin. Some broadcasters may not have a real understanding of what their STL's fade margin is or, more important, what it means to them in terms of *outage time*. In analog systems, outage time is defined as periods when signal quality deteriorates beyond acceptable levels. In digital systems, it refers to when the signal is muted.

As a figure of merit, outage time is a concept to which anyone can relate. Figure 2 shows that an STL system with 30dB of fade margin on a path over 30 miles of smooth terrain in humid weather could exhibit an outage time of more than 60 minutes per year. Few station owners would tolerate that much outage. Yet, the fade-margin recommendations contained in the last two editions of the *NAB Engineering Handbook* do not take into account the STL path's terrain or weather, both of which can affect fade margin and therefore outage time. By shifting the emphasis on path calculations from fade margin to the more significant outage time, a station engineer or broadcasting consultant can optimize the design of an STL system with greater assurance of meeting the needs of the licensee.

Although an analog system's outage time could be reduced by the use of larger antennas or RF amplification, these solutions usually provide only minor improvements in comparison to their costs. Digital STLs, on the other hand, exhibit 20dB to 30dB of digital processing gain that directly translates to increased sensitivity and decreased outage time. Although an analog STL receiver may require a -67dBm (100μV) input signal for 60dB of audio signal-to-noise ratio (S/N), the digital STL may only need a -100dBm signal at its squelch threshold. (Also consider that although the 60dB S/N in this example provides an acceptable audio quality, it is less than the analog system's full quieting, which would require a greater received RF level. On the other hand, the digital STL is at full quieting any time it is not muted.)

This 20dB or more advantage translates via Figure 2 to an outage time improvement of 100:1. The 60-minute outage time described earlier is now reduced to a more manageable 600ms, which over the course of a year may not even be perceptible.

This margin could be the "magic 20dB" that eliminates those outages caused by the deep fading of thermal inversions (some broadcasters have been fighting these problems for many years). In other cases, STL system consultants have found that a digital STL can reduce the number of hops needed in multihop installations because the increased fade margin can be used to extend path lengths or to "brute-force" signals around obstructions. The 20dB improvement also allows the use of lower RF output power. This minimizes interference to adjacent stations and, in some cases, can allow for increased reuse of channels. Finally, smaller or lower-mounted STL antennas may be used, decreasing cost (for new installations) and windloading on towers.

The exact amount of improvement that a digital STL can offer over an analog system is dependent on the RF output power level, the modulation format, the number of channels and the receiver's noise figure. Some digital STLs that use high-order modulation formats require higher input levels than others — in some cases as much as 15dB. This still can yield performance improvements over analog systems in other, non-path-related areas (for example, a lower noise floor).

"Virtual composite" operation

When replacing an existing composite analog system, transport of subcarrier signals must somehow be accommodated on the new STL. Because all digital STLs accept baseband audio signals, subcarrier generators need only be supplied at the transmitter site for signals that are actually broadcast. Some so-called "hybrid" digital STL systems allow one or two analog subcarriers to fit in the allotted STL channel along with the digital main program. Although this approach does not maximize spectrum efficiency and signal robustness, it may simplify the transition process and costs.

Similarly, integrating audio processing with a digital STL system need not be complex. Although most digital STLs accept only discrete left and right main channel audio, systems providing integral stereo generators can provide significant utility for broadcasters accustomed to composite STLs. Audio processing can remain at the studio, and the stereo generator built into the digital STL receiver generates the FM multiplex signal prior to the broadcast exciter. This implies that the new digital STLs are capable of accepting fully processed audio. Such an approach also places the audio processing ahead of the bit-rate reduction system, avoiding the oft-cited difficulty of post-processing a rate-reduced digital signal after reconstruction into analog audio.

This systems-design direction allows the designer to include specialized digital signal processing software and a digitally implemented stereo generator, thus ensuring optimum performance free of overshoots and spurious RF. Such a digital,

Continued on page 72

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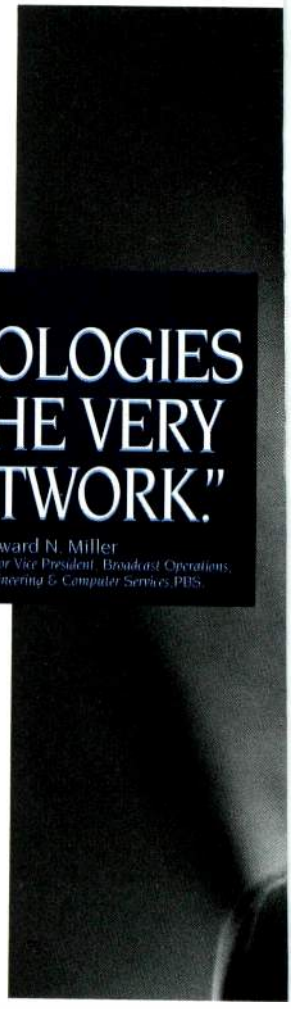
DIGITAL LEADERS.

"PBS has embarked on a project to distribute a wide variety of programming on a digitally-based nationwide satellite network. Through extensive use of state-of-the-art digital compression technologies, this new network can serve the expanded distribution needs of public television for the next 10-15 years. It will enable PBS member stations and other educators to share 80 or more channels of entertainment and educational programming throughout the 50 states. The quality of this programming can vary, hour-by-hour, from slow-scan conference grade video through HDTV.

"The video content will be accessed through on-line cart machines utilizing composite digital and an enhanced version of a D-5 component digital tape system. The component digital technology will eventually enable us to record and play back compressed forms of HDTV plus some non-video forms of data.

"When we looked at the alternatives available to us from video manufacturers, it was crucial to understand the direction they were taking—not just the hardware that might meet our current needs. Our decision to select digital composite VTRs was made with reasonable knowledge of where Panasonic was heading with component digital.

"The ability to play back composite digital recordings in the component domain is helpful, to be sure. But our primary interest in a component system is that it be a full bit-rate, 10-bit recording system.



"NEW VIDEO TECHNOLOGIES WILL DETERMINE THE VERY NATURE OF OUR NETWORK."

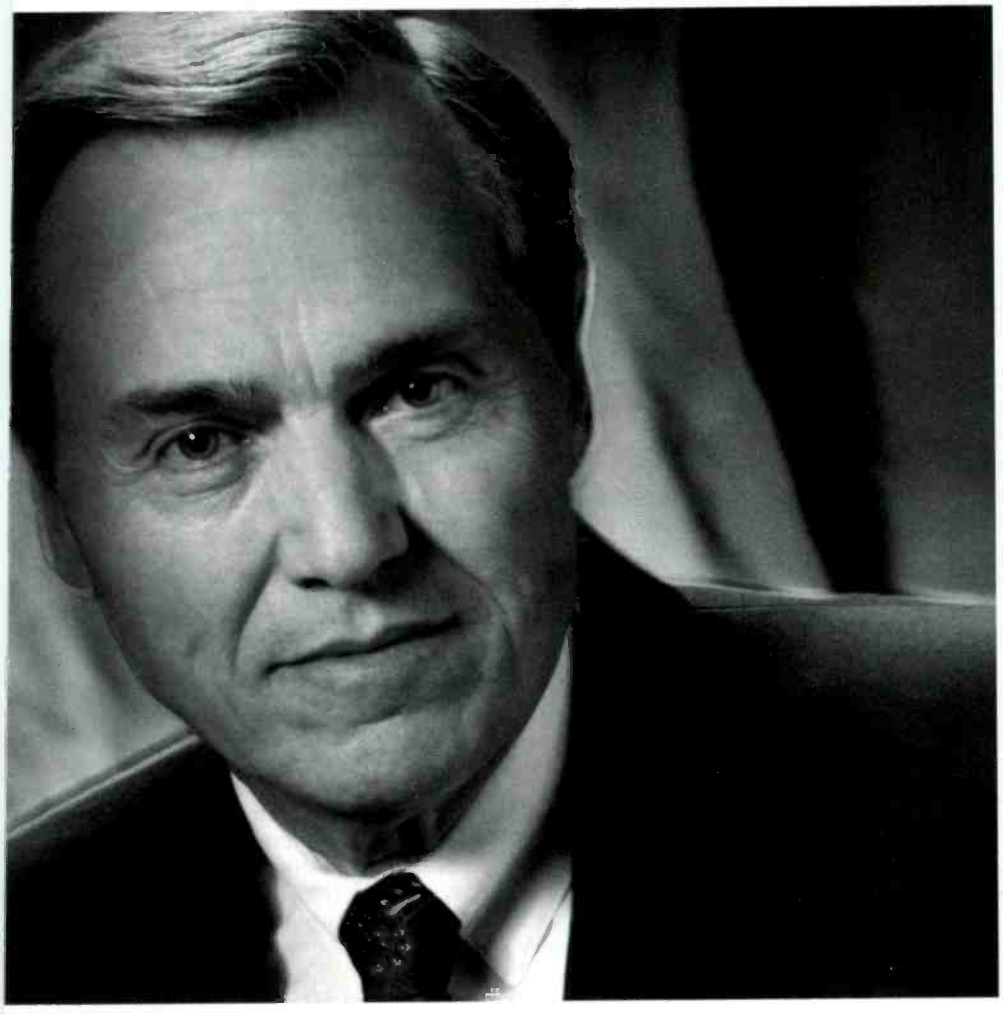
Howard N. Miller
Senior Vice President, Broadcast Operations, Engineering & Computer Services, PBS

That means we can take maximum advantage of the high bit-rate capability of these machines, and consider them for future upgrades to HDTV—as well as for some services that are not video-based at all.

"Currently, we are using some of our D-3 equipment to conduct subjective evaluations of video performance at various compression levels. Using a transparent digital tape system, we introduce no

further degradation in our compression testing; any quality differences are obviously associated with variations in the transmission path, not differences introduced by the recording medium.

"Because of the evolving nature of the television industry, it's unacceptable to have a traditional buyer/seller relationship. Before



we enter into any contract with any company, we emphasize how essential it is for us to collaborate to achieve better results. From our perspective, as new video technologies emerge that will determine the very nature of our network, we must have good working relationships with our equipment suppliers."

Panasonic's strategy offers a simple, combined composite and component digital system that provides all digital solutions for diverse video recording applications through the eventual HDTV era.

Panasonic believes that digital composite and component equipment will continue to co-exist for many years.

We see integrated D-3/D-5 facilities with equipment performing the tasks to which it is best suited.

Howard Miller, Public Broadcasting Service's senior technologist, has been breaking new ground throughout his 35-year engineering career. His current challenge is to fashion computer, video, compression, and transmission technologies into a complete digital signal distribution network for PBS.

It's the industry's visionaries who see a clear path to the future.

Panasonic
Broadcast & Television Systems Company

Continued from page 68

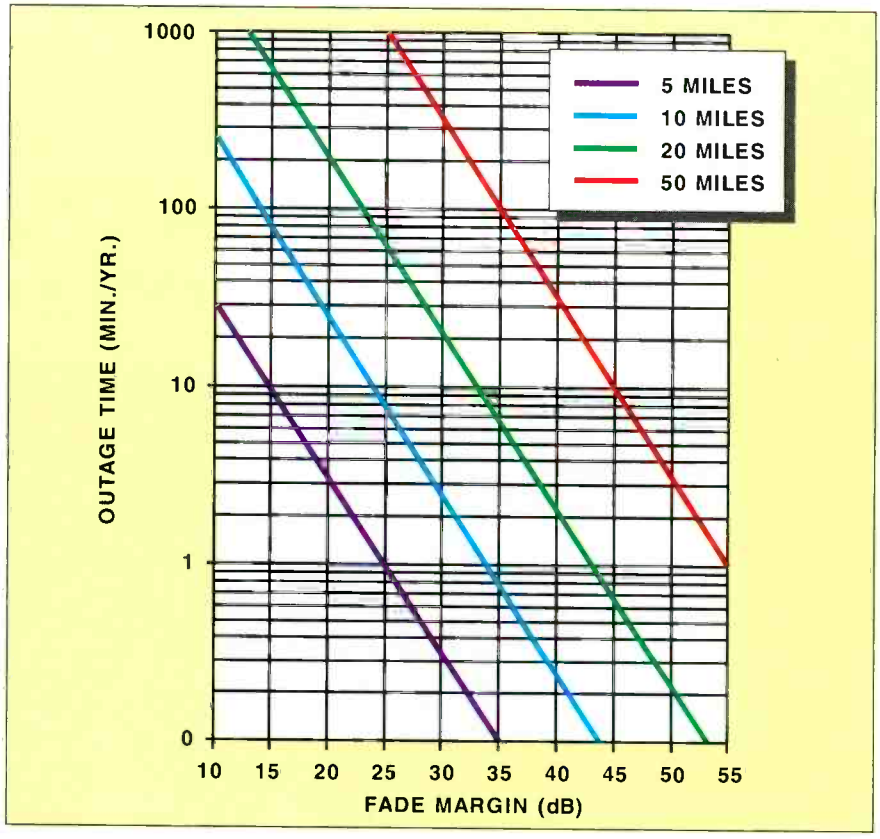


Figure 2. *Calculated cumulative outage time as a function of fade margin and distance for a 950MHz STL. Calculations assume smooth terrain and humid weather.*

virtual composite operation emulates a traditional analog composite system, conveniently keeping the audio signal processing and auxiliary service origination at the studio, and running all of a station's audio and data services to the transmitter on the same path.

Multihop systems

Digital STLs can be applied to significant advantage in multihop systems. Despite the improvements in fade margin (and thus path length) that digital STLs provide, certain paths simply cannot be accomplished in a single hop. These include particularly long paths or any path with large obstructions, around which RF signal diffraction will not provide reliable performance. In these instances, digital STL systems permit multiple hops free of signal degradation — at intermediate sites, the digital signal can be regenerated. If each path is designed for adequate fade margin, signal degradation will be negligible. In hybrid systems, simple *repeating* (without digital regeneration) may be possible, although perhaps with tighter restrictions.

Key to reliability in the newest generation of digital STLs is the choice of RF power components. These used to be the weakest link in any STL system — bipolar RF power devices exhibit a history of electro-migration failure because of high current densities and aluminum interconnections. Although the application of exotic metal systems has reduced these failures, bipolar RF technology does not have the linearity needed for some of the more advanced digital modulation techniques. Therefore, highly linear and reliable Gallium arsenide (GaAs) FETs are used, similar to those found in 4GHz commercial and military satellite service. Operating in the aural STL bands less than 1GHz provides considerable stress-margin for these devices, which translates to exponential improvements in reliability.

Conclusion

The digital STL offers the potential for improved audio and RF performance, and it has exhibited the capability of solving numerous path problems. Life becomes a little simpler when STL problems fade away.

Finally, when implementing any such STL improvement, remember to update your FCC license to reflect any changes that you make in your STL system.

➡ *For more information on digital STLs, circle (310) on Reply Card. See also STL Components, Electronics, p. 21 of the BE Buyers Guide.* ■

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AES show preview

Live from New York — it's AES.

By Stefanie Kure, associate editor

The Big Apple plays host to the 95th AES Convention, which will be held from Thursday, Oct. 7 to Sunday, Oct. 10 at the Jacob K. Javits Convention Center in New York. The theme of this year's convention, "Audio in the Age of Multimedia," reflects the realization that the audio profession is no longer independent of video, computers and other forms of telecommunication.

Exhibits and sessions

A record number of exhibitors — more than 300 — are expected to attend what is perhaps the largest exhibition of professional audio technology and equipment in the world. Exhibit hours run from noon to 6 p.m. on Thursday, Oct. 7; from 10 a.m. to 5 p.m. on Friday, Oct. 8; from 10 a.m. to 6 p.m. on Saturday, Oct. 9; and from 10 a.m. to 4 p.m. on Sunday, Oct. 10.

In keeping with this year's convention theme, many of the technical papers will address the topic of "Audio in the Age of Multimedia." Other subjects to be discussed include digital music, DSP theory and applications, and perceptual coding. More traditional topics, such as auralization; tests, measurements and specifications; microphones and loudspeakers; psychoacoustics; and architectural acoustics, also will be addressed. Following each author's presentation, the audience will be invited to participate in a question-and-answer session.

In addition, convention registrants are welcome to attend Technical Committee meetings. Attendees will help track the trends in order to recommend to the society special papers sessions, standards projects, publications and awards in their respective fields. The four committees include Acoustics and Sound Reinforcement (TCASR), Signal Processing (TCSP), Transducers (TCoT) and Transmission (TCTr). The meetings are scheduled to follow the appropriate papers sessions, except the TCASR, which will meet following the Friday, Oct. 8 workshop on *Auralization* in the same room.

Workshops and seminars

Convention attendees also can choose from more than a dozen workshops and seminars, where skilled professionals will share the techniques that have contributed to their increased knowledge and success. These workshops and seminars will offer practical advice and will cover a wide range of interesting topics.

A record number of exhibitors - more than 300 - are expected to attend this year's AES Convention

Technical tours

New York has endless tour possibilities for audio professionals — everything from backstage visits to world-famous recording studios to guided excursions to nationally recognized broadcast stations. AES has selected six tour sites at which convention attendees will be able to observe and discuss audio in action. Scheduled tours include Channel 13/WNET/PBS, A Vinyl Record Plant in Manhattan, Rodgers and Hammerstein Archives of Recorded Sound, East Side Audio and Video, Clinton Recording Studios, and Radio Stations WQXR-FM and WQEW-AM.

To be included in a tour group, interested parties must sign up in the convention lobby after registering for the full 4-day program, as space is limited. Buses will be provided from the Jacob K. Javits Convention Center at a small charge to the participants.

Important meetings

The annual AES business meeting will be held on Thursday, Oct. 7 at 8:30 a.m. It is open to all AES members in good standing.

The Standards Committee meetings and meeting of its subcommittees and working groups also are open to the public. All people materially affected by any standard are urged to attend. The meetings will take place at the New York Hilton before the convention and at the Jacob K. Javits Convention Center during the convention. The meeting schedule was published in the 1993 July/August issue of *JAES* and is continuously updated on the AESSC Document Exchange, which can be accessed via modem.

"Don't miss" events

On Sunday, Oct. 10 at 9 a.m., Roy Pritts, chairman of the AES Education Committee, will host a tables fair for schools, colleges, universities and other programs offering audio education opportunities. This fair will give attendees a chance to speak with representatives from worldwide institutions and to gather literature related to educational needs.

Also, be sure to attend the 95th Reception and Awards Banquet on Friday evening, Oct. 8 at the New York Hilton Hotel. Food, wine and entertainment will be provided, followed by the presentation of the society's coveted awards for those who have made outstanding contributions to audio and the AES.

For those who prefer a more casual setting, an informal social gathering has been planned for Thursday night, Oct. 7.

Attendees who want a true New York City experience can pick up information, schedules, maps and helpful hints at the registration area. In addition, several modestly priced tours have been planned. Inquire on-site for more details.

The 95th AES Convention promises to be educational as well as entertaining. For more information, contact the Audio Engineering Society at 60 E. 42nd St., Suite 2520, New York, NY 10165-2520; phone 202-661-8528 or 800-541-7299 (except in New York); fax 212-682-0477.

Photo courtesy of the New York Convention and Visitors' Bureau ■

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SBE/RTNDA show preview

"Hot Technology" sizzles in Miami.

By Stefanie Kure, associate editor

From Sept. 29 to Oct. 2, thousands of engineers will descend upon Miami for the SBE National Convention. This year marks the first-ever NEWSTECH '93 Trade Show — the result of a joint venture between SBE and RTNDA. The theme of the convention, "Hot Technology," describes what the climate will be like on and off the NEWSTECH '93 show floor. Exhibit hours are from 2 p.m. to 6 p.m. on Wednesday, Sept. 29; from 8 a.m. to 3:30 p.m. on Thursday, Sept. 30; and from 8 a.m. to 4:30 p.m. on Friday, Oct. 1.

This year marks the first NEWSTECH '93 - the result of a joint venture between SBE and RTNDA.

Ennes Workshops

Once again, special manufacturer-conducted workshops will be offered to paid registrants of the Engineering Conference. However, there is an additional fee to attend. Sponsored by the Ennes Foundation, these workshops will be held Wednesday, Sept. 30. Each of the sessions is designed to provide detailed maintenance and operation instruction on key types of equipment.

The workshops are half-day sessions. All morning sessions begin at 8:30 a.m. and end at 11 a.m. Afternoon sessions begin at noon and end at 2 p.m. Upon completion of the Ennes Workshops, participants will receive a certificate of completion.

Because of the intensive, hands-on nature of these sessions, seating is limited to 25 people per session. Registration is on a first-come, first-serve basis, and you must be pre-registered.

Informative sessions

In addition to the workshops and exhibits, SBE is offering a variety of educational sessions to help you stay on top in your field. TV sessions will include such topics as "Digital Video Developments;" "Building and Operating a Multiformat, All-Digital TV Plant;" "HDTV Progress Report;" and "TV Automation." Radio sessions are scheduled to include the following issues: "New Technology for Radio," "Emergency Broadcast Systems Testing," "Digital Radio Broadcasting Progress Report" and "Digital Radio Format Proposals."

Spanish-speaking attendees will want to make time for the "Special Session in Spanish." This session will be presented by AMITRA (the Mexican Society of Broadcast Engineers and Technicians) and moderated by Sergio Beristain. Subjects to be discussed include safety for technicians and tariffs; level impedance and coupling of audio equipment; and tips for radio maintenance.

Saturday, Oct. 2 has been designated as the FCC Regulatory Day. The entire day will be devoted to FCC-related issues, such as "NAL Shopping List: What the FCC is Now Proposing;" "Common-Mode TV Transmitters: What the FCC Expects, What You Should Demand;" "Broadcast Auxiliary Licensing: Who's on First?" and "FCC vs FAA: Round 5." Be sure to attend.

Annual banquet and receptions

The annual SBE awards banquet will be held on Saturday, Oct. 2 at 7:30 p.m. The banquet is in honor of those special members and chapters who have gone the extra mile to promote and support SBE and the broadcast engineering profession.

The evening will begin with an informal reception for all members, spouses and invited guests. After the reception, enjoy good food, good company and good conversation at the awards banquet. SBE will hold an awards ceremony as a special tribute. To cap off the evening, a special guest speaker (TBA) will address the group.

If you feel like doing some extra socializing, then don't miss the SBE Attendee Reception on Thursday, Sept. 30 from 7 p.m. to 10 p.m. or the Ham Radio Reception on Friday, Oct. 1 from 5 p.m. to 6 p.m.

The SBE awards banquet will be held on Saturday, Oct. 2 at 7:30 p.m.

The sightseeing scene

SBE will be offering a 2-day spouse/guest program that will provide a scenic view of Miami Beach and surrounding areas. The program is open to the spouses and guests of paid registrants for the SBE Convention and Engineering Conference, exhibitors, and those attending exhibits only. There will be a one-time charge of $85 for the 2-day program.

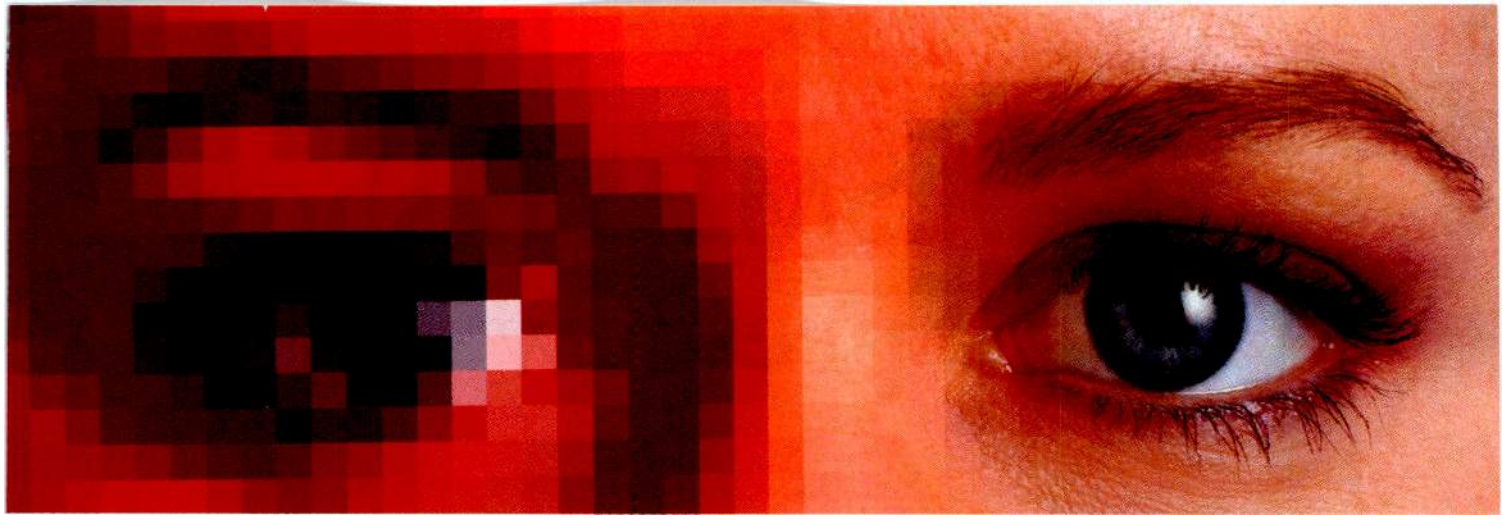
A hospitality suite for the program will be held at the Fontainebleau Hilton, where a continental breakfast will be served. Breakfast will begin at 8:30 a.m. on Thursday, Sept. 30 and Friday, Oct. 1. Immediately following breakfast, the shuttle bus will depart from the Fontainebleau.

Thursday's tour begins with a 14-mile tram journey through the Everglades prairie. Friday's tour will be an excursion into Miami, including stops at the DeSoto Plaza, Venetian Pool, the Biltmore Hotel, Coconut Grove, Key Biscayne and Bayside Marketplace.

Exhibit hours

- Wednesday, Sept. 29: 2 p.m. to 6 p.m.
- Thursday, Sept. 30: 8 a.m. to 3:30 p.m.
- Friday, Oct. 1: 8 a.m. to 4:30 p.m.

Photo courtesy of the Greater Miami Convention and Visitors' Bureau. ■



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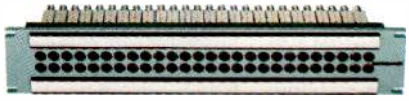

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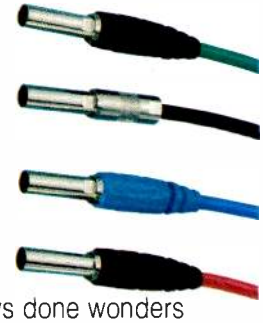

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SMPTE show preview

The SMPTE show is more than just exhibits, it's an education.

By Dawn Hightower, senior associate editor

It's that time of year again when attendees will be flocking to the City of Angels on Oct. 29 through Nov. 2 for the 135th SMPTE Technical Conference and Exhibit at the Los Angeles Convention Center. This year's theme, "Integrating Technologies in the Digital Era," will offer in-depth coverage of a wide range of topics pertinent to image makers in all fields.

Agenda addresses traditional and specialized issues

The technical conference sessions will address traditional areas of motion-picture, television and computer imaging. Specialized subjects will include multimedia applications, integrating technology in the digital era, digital terrestrial broadcasting in North America, film and the environment, laboratory practices, digital compression/format conversion, digital video/audio, digital sound in film, film formats, and IDTV and widescreen television.

Tutorials provide educational opportunity

To enhance the learning experience, the conference will be preceded by three all-day tutorials on Oct. 29. They will focus on digital terrestrial TV broadcasting (DTTB), digital motion imaging and special venues.

The 2-day DTTB workshop presented on Oct. 29 and Nov. 1 will be a joint effort by SMPTE and the ITU-RB. The focus will be on technologies integral to the development and implementation of DTTB.

The Digital Motion Imaging workshop will get attendees started with emphasis on practical applications of computer-based motion imaging. The tutorial will be divided into four areas: Video and Computer Integration, Data Storage and Exchange, Digital Film Effects Systems and Getting the Color Right.

The third tutorial on special venues will concentrate on non-traditional areas of image making.

Photo courtesy of the Los Angeles Convention Center & Visitors Bureau/C 1991 Michele and Tom Grim.

Overview of conference program

Friday, Oct. 29
- Tutorials

Saturday morning, Oct. 30
- Opening session
- Introduction
- Welcoming address
- Engineering reports
- Keynote address

Saturday afternoon
- Integrated Technologies

Sunday morning, Oct. 31
- Session A: Digital Television
- Session B: Interactive Multimedia

Sunday afternoon
- Session A: Special Venues
- Session B: Interactive Multimedia

Monday morning, Nov. 1
- Session A: Video/Broadcast Formats
- Session B: SMPTE/ITU DTTB Tutorial
- Session C: Film — Digital Images

Monday afternoon
- Session A: Video/Broadcast Formats
- Session B: SMPTE /ITU DTTB Tutorial
- Session C: Film – Digital Sound

Tuesday morning, Nov. 2
- Session A: Laboratory Practices
- Session B: Video–Processing and Color

Tuesday afternoon
- Session A: Film Origination/ Preservation
- Session B: Video Compression

Exhibit highlights

The SMPTE conference would not be complete without an impressive equipment exhibit that will feature more than 200 manufacturers showing the industry's latest products and innovations. In addition to the exhibit, several events from previous conventions will be highlighted. They include a Student Fair, the distribution of Bonus Certificate Booklets, the New Technology Room, a delegates seminar (which is free to registrants) demo rooms, a literature display, free Creativity Clinics, continuous HDTV demonstrations and hands-on workshops. For more information on the SMPTE equipment exhibit, call Alan Ehrlich at SMPTE headquarters, 914-761-1100; fax 914-761-3115.

The SEEC system

The SMPTE Engineering Electronic Communications (SEEC) system has recently opened on CompuServe. Attendees will be able to view it at the convention. The SEEC system is a supplement to face-to-face engineering meetings, and offers users access via computers to calendars of SMPTE meetings and activities. An engineering committee bulletin board and library and message sections are accessible only to the individual committees and their subcommittees.

Take time for the social events

Numerous social events will balance out the days of roaming equipment exhibits and attending tutorials. The Exhibitors Opening Reception will be held Friday evening Oct. 29; the Honors and Awards Luncheon will take place Saturday Oct. 30; The Fellows Reception and Luncheon will be Sunday, Oct. 31; and the Annual Banquet will be held on Monday Nov. 1. A Partners Program also will be offered.

And the awards go to...

SMPTE will announce the recipients of its annual honors and awards at a presentation during the Honors and Awards Luncheon. The society also has elevated 15 members to the status of Fellow. They will be recognized at the Fellows Luncheon.

Tying the technologies together

If you're looking forward to tutorials, hands-on demonstrations, a bigger equipment exhibit and in-depth coverage of a variety of topics, "Integrating Technologies in the Digital Era" will set the scene. For attendees, the 135th SMPTE Technical Conference is more than just a show, it's an educational program. ■

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Skip Como, Group Engineer, WRZE, Hyannis, MA

I wouldn't even consider any of the others.

Jim Bender, Chief Engineer, KZLO, Bozeman, MT

It's the most transparent STL we've ever used.

Don Ford, Director of Engineering, KACV, Amarillo, TX

Both systems were a breeze to install and they work great on our paths.

Craig Bowman, Director of Engineering, Liggett Broadcasting, WLHT, Grand Rapids, MI; WLQT, Dayton, OH

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Grady Moates, Consulting Engineer WWKX, Providence, RI

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Michael Bradford, Consulting Engineer, WUPS, Mt. Pleasant/Houghton Lake, MI

It's perfection!

Lyle Henry, Director of Engineering, KUSC, Los Angeles, CA

The management says they can't believe how much better it sounds.

Mario Hieb, Chief Engineer, KXRK, Salt Lake City, UT

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Ed Tromley, Chief Engineer, WSAE, Spring Arbor, MI

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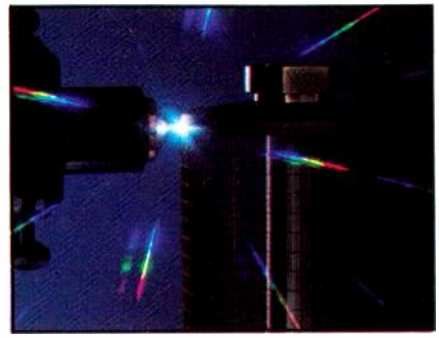
Applied Technology

Panasonic D-5



By Phil Livingston

At this year's NAB, Panasonic demonstrated the AJ-D580, a D-5 component digital VTR, which is scheduled for delivery in the fourth quarter of this year. Benefits of the new digital format include non-compressed 10-bit component recording, D-3 playback capability, and projected compatibility with advanced TV systems and HDTV.

The 1/2-inch D-5 VTR format is based on D-3 composite technology. The digital processing system, channel coding, shuffling, and error correction and concealment techniques developed for D-3 are used in the component format. The common transport and similar head arrangements allow D-3 tapes to play back in the D-5 VTR. This inter-relationship provides users with a systems migration path that supports existing equipment.

The 1/2-inch D-5 VTR format is based on D-3 composite technology.

In as much as digital post-production systems offer full 10-bit processing with minimal compromise, tape formats should provide no less. The D-5 format offers full 10-bit recording, and is fully transparent because that 10-bit recording is done with no compression (bit-rate reduction). The component digital I/O conforms to the CCIR-601 SMPTE 125M standard, and fully conforms to the revised CCIR-601 and CCIR-656 standard specified to 10-bit resolution for parallel and serial interfaces.

A full two hours of recording time is available on one cassette, while maintaining full bit-rate recording and the implicit signal transparency of a device without compression.

D-3 technology platform

The D-5 VTR is based upon the proven, robust D-3 recording methods and uses the same track width, cassette and transport. Other features include similar packing density and format footprint to D-3, a data rate approaching 300Mbits/s, no data compression or bit-rate reduction and sophisticated operational features.

In addition to the physical similarities, the signal processing techniques developed for D-3, such as 8-14 modulation coding, have been used as a platform for the development of D-5. Popular D-3 operational features, such as pre-read, insert editing, four independent digital audio channels, user setup memories, multicue and the easy-to-use menu structure of the control panel, have been included in the D-5 VTR.

The reliability of the D-3 format provides a stable base for the development of a compact component digital recording system. This application of field-proven D-3 technology to the D-5 component recorder reduces concerns about ruggedness, interchange performance, format robustness and overall reliability.

The additional recording capacity required for component recording (virtually double composite recording) is achieved by approximately doubling the linear tape speed and reconfiguring head assemblies while maintaining the same track width. Achieving higher levels of circuit integration (VLSI) for signal processing allows the same form-factor (VTR size) to be maintained.

The sophisticated low-tension head-to-tape interface developed for D-3 requires virtually no changes for the component recorder. Scanner rotation speed is the same as D-3, as is tape tension and basic transport design. This dictates that head life will be virtually the same as D-3.

D-5's operating modes

The three basic operating modes for the D-5 recorder are:

1. Recording and playback of digital audio and 13.5MHz sample rate digital component video (CCIR 601) in full 10-bit form. In this mode, the component VTR is suitable for the highest quality applications for both 4:3 aspect ratio and 16:9 aspect ratio

The Panasonic AJ-D580, a D-5 component digital VTR.

Livingston is assistant general manager, Panasonic Broadcast & Television Systems Company, Secaucus, NJ.

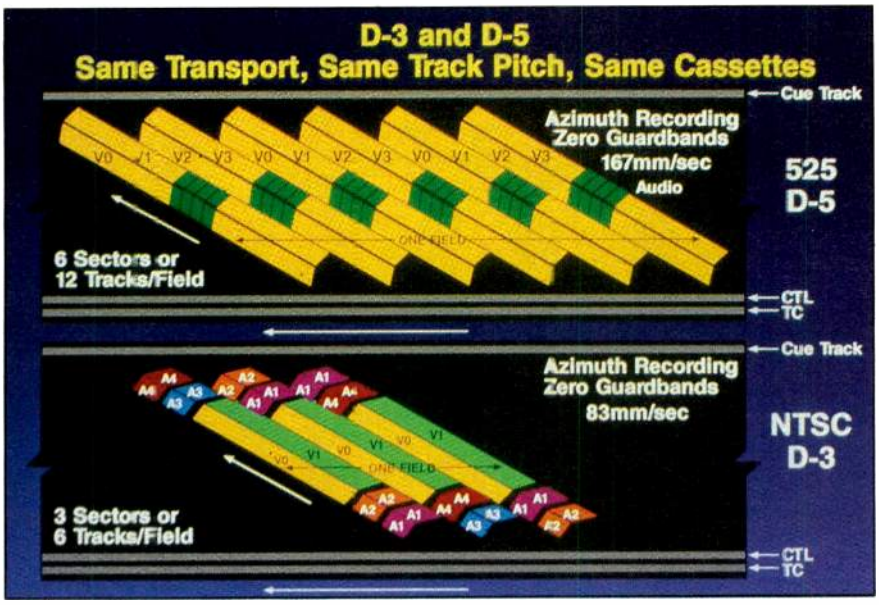
pictures. No modification is necessary because the VTR is not sensitive to aspect ratio. Eight-bit video from existing devices is passed transparently. VTR interfaces include the 270Mbits/s serial digital interface.

2. Recording and playback of digital audio and digital component video with a digital sample rate of 18MHz. Although not actively proposing such a signal structure, the manufacturer has provided a manually switchable record mode to process the increased video sample rate. Later, when the tapes are played back, the VTR autoselects the proper mode. Should the current interest in 18MHz develop into a 16:9 production standard, the capability already exists, and the inclusion of this feature imposes a negligible cost impact.

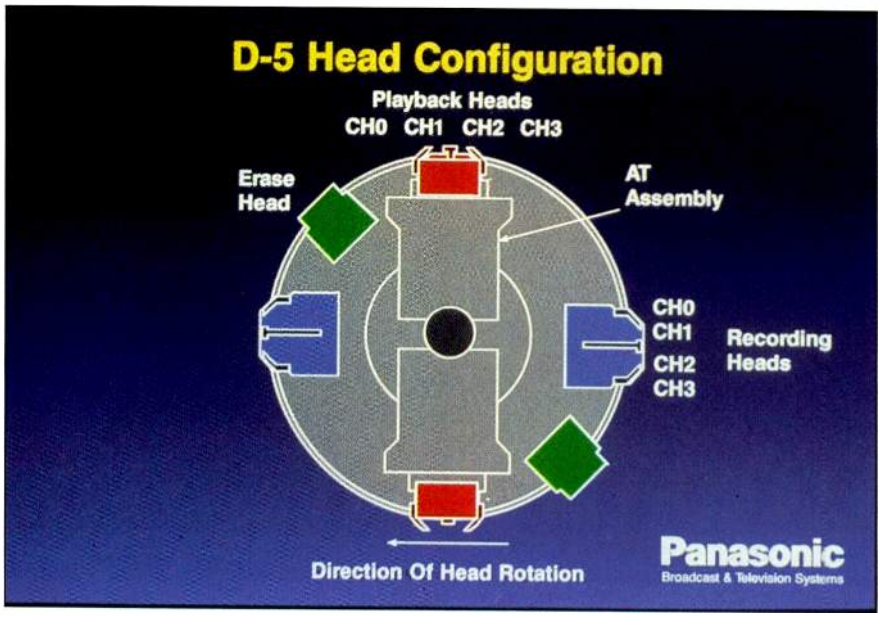
Mixed D-3/D-5 operations can be performed in an elegant manner without complex external switching systems.

3. Playback of D-3 composite digital recordings in the component digital VTR. Because of the close relationship between recording parameters and recorded footprints between D-3 and D-5, playback compatibility is achieved without large amounts of additional circuitry or technical compromise in either the choice of parameters for the component format itself or in the D-3 playback quality. The VTR automatically selects the correct linear tape speed for D-3 playback (one-half that of component recordings), and internal digital sample rate conversion and digital decoding circuits provide composite or component outputs.

By providing output signals in either composite or component form, regardless of whether a composite or component recording is being played, overall facility



A comparison of the footprints of both the D-3 and D-5 tape formats.



Configuration of heads in a D-5 upper drum assembly.

and systems design can be greatly simplified. Mixed D-3/D-5 operations can be performed in an elegant manner without the need for complex external switching, systems or peripheral equipment. This compatibility protects the investment in current and future productions on the D-3 format, simplifies actual operation, and allows field acquisition to be made on an all-digital format. The high quality attainable from D-3 digital audio and digital video in the field ensures that the high performance available from a totally digital production center is maximized.

The reliability of the D-3 format provides a stable base for the development of a compact component digital recording system.

The CCIR 601 processing standard and the CCIR 656 interface standard were created to provide adequate resolution in the horizontal plane (5.75MHz) and 10-bit resolution for signal amplitude. The luminance sampling rate selected was 13.5MHz because of the commonality between 525/60 and 625/50 TV standards. Modern post-production devices, such as advanced DVEs, graphics systems and some limited capacity disc recorders, fully implement the CCIR standard with 10-bit resolution. However, the D-1 component recorder only records eight bits because in the early 1980s, 216Mbits/s was the highest data rate possible given the available technology. Ten-bit recording implies 270Mbits/s.

The D-5 format's uncompressed data processing allows the full CCIR-601 10-bit video signal to be recorded along with 20-bit digital audio. This ensures transparent performance during complex post-production operations.

Formats and future TV standards

Many proposals have been made to enhance existing TV standards, such as 16:9 (525/625) widescreen, line doubling, (1,050/1,250) and full HDTV. These proposals must be considered when developing new studio production equipment. The potential for quality improvements in home reception and the need to provide a mechanism for delivering widescreen pictures cannot be ignored. In time, HDTV may justify the ultimate use of component digital recorders.

Currently, there are two proposals for 525/625 widescreen (16:9) production standards. The existing CCIR 601 4:2:2 standard could be used for all processing and recording by simply altering the aspect ratio of the camera and the display. Alternatively, an extended 4:2:2 system could use the proposed proportionally higher sampling rate of 18MHz to maintain current 4:3 horizontal resolution. The use of the existing 4:2:2 system prevents the establishment of another digital interface standard, and protects the investment already made in standard 4:2:2 equipment. However, many of these existing systems do not fully exploit the CCIR 601 system, so further investment for 16:9 may be required regardless of which standard is adopted.

Because these issues remain topics for industry debate, Panasonic's 1/2-inch D-5 component digital VTR offers record and playback modes for the standard 4:2:2 CCIR 601 signal (13.5MHz sampling/10-bit quantizing, 270Mbits/s) and the proposed extended 4:2:2 signal (18MHz sampling/8-bit quantizing, 288Mbits/s).

D-5: HDTV ready

D-5's 300Mbits/s recording capacity provides a logical and cost-effective path for recording future HDTV standards. It is estimated that future TV systems will have a data rate of approximately 1.2Gbits/s. Compression technology will mature rapidly over the next three to four years, providing more elegant, efficient and transparent compression schemes, which may possibly lead to industry standardization. The 1.2Gbits/s HDTV data rate, reduced by a 4:1 ratio, would become a 300Mbits/s signal that the D-5 could easily record on the same compact D-3/D-5 cassette with two hours duration. The lack of internal compression within D-5 eliminates the possibility of unwanted and unpredictable interaction between differing compression schemes, and the additional information contained in the HDTV picture structure allows vastly improved system performance.

By providing output signals in either composite or component form, regardless of whether a composite or component recording is being played, overall facility systems design can be greatly simplified.

The D-5 product family

As with D-3, a family of D-5 products will be offered. The first D-5 product, the AJ-D580, will be the same size as the AJ-D350 D-3 composite recorder (six units high) and will include high-quality A/D and D/A converters, allowing direct connection to analog systems. It will be equipped with high-performance serial digital interface ICs that allow connection to a wide variety of serial composite and component digital products, including the current 270Mbits/s interface and the new 360Mbits/s interface referred to in SMPTE S.17.394.

Early next year, the AJ-D560 will be available. It is similar to the AJ-D580, but lacks variable speed playback. Also at NAB '93, a prototype of a D-5 field recorder was shown and the future availability of a lightweight digital component camcorder was suggested.

➡ *For more information on Panasonic's D-5, circle (317) on Reply Card.* ■

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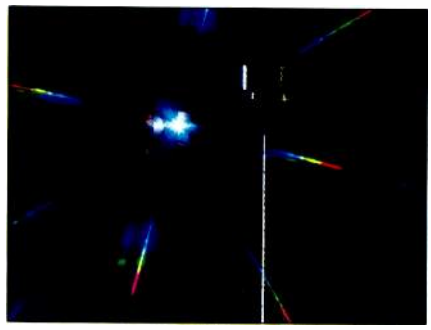
Fostex RD-8 digital multitrack



By Dave Oren

The goal: To design a compact, high-value linear digital 8-track production recorder without "reinventing the wheel."

• *The criteria:* Ease of operation for short learning curve and fast productivity increase; quick setup for use in digital or analog, audio and video environments; low-cost media; onboard synchronizer and time-code generator/reader; and familiar interconnection suitable for all production environments.

• *The resulting product:* The Fostex RD-8.

By combining the computer industry's approach of multiprocessors in a distributed-intelligence architecture, the device fits into either analog or digital facilities. Prior to starting a project, a user defines the master clock (timing reference), initializes the time-code generator/reader and enables the synchronizer.

The table of contents (TOC) stores all of the setup data for the deck at the beginning of each tape.

Helical scan recording is used, which is a well-proven technology from the video and computer worlds. Another design concept adapted from the computer is the table of contents (TOC), which is designed to store all of the setup, memory, locate and control data for the deck at the beginning of each tape.

Oren is vice president of product planning and development at Fostex Corporation of America, Norwalk, CA.

Proven technology

Familiar S-VHS tape technology and the ADAT recording format provide robust, low-cost digital media. A/D and D/A converters and digital signal processors (DSPs) come from proven digital audio and computer systems. Nevertheless, these elements had to be integrated with a strong and intuitive user-interface, while requiring strong value engineering and proprietary silicon development. These elements were combined with conservative firmware and software design to provide a complete product.

Along the way, engineering decisions were required regarding which CPU to select and at what frequency the system clock should run. Regarding tape format, a conservative approach was taken in that track data is not interleaved. Each input signal is recorded in its own separate place on the tape.

The tape

Because more than 350 million VHS recorders are in use, and at last count more than 3 million S-VHS recorders, it is apparent that the shell and tape manufacturing processes have been refined to yield consistent performance in any VHS product.

As with any professional recording, the user is always advised to use the best tape available. The cost of S-VHS tape is so much less than equivalent analog tape that even buying the most expensive tape will result in greatly reduced expenditures for a multitrack production facility.

Interface and setup

The audio I/O interface is supplied in a number of formats: analog unbalanced 1/4-inch connectors at -10dBV, analog input on 25-pin D connectors at +4dBu, and digital ADAT format (8-channel optical) on Toslink connectors. Cables are easy to fabricate if you make your own, and are readily available from many suppliers. Third-party products can be used to import and export AES and SPDIF digital audio signals.

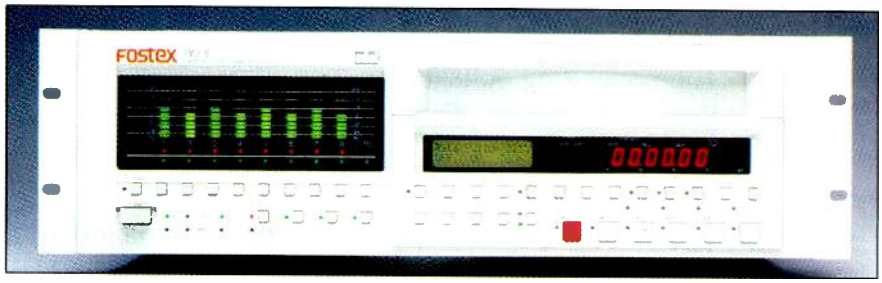
S-VHS technology and ADAT recording format provide robust, low-cost digital media.

The user controls on the RD-8 recorder are similar to those of analog or digital multitrack recorders, with large transport buttons and a large LED numerical display. Thus, the learning curve for operators is short.

The front panel is outfitted with gray and tan buttons. Their color coding is significant. Gray buttons are *speed keys* for setup procedures. For example, holding the *data edit* button while pressing one of the gray function keys moves the LCD display to the setup page for that function. This simplifies the process of setting or changing parameters.

The numerical display, LCD display and status LEDs provide as much information as possible on current system status. Functions whose status must be known or frequently checked by the operator are given LED indicators (e.g., Is the pitch control enabled? Is an offset enabled? Is the system locked? Has a track slipped?).

Each input signal is recorded in its own place on the tape.



The Fostex RD-8 digital multitrack system.

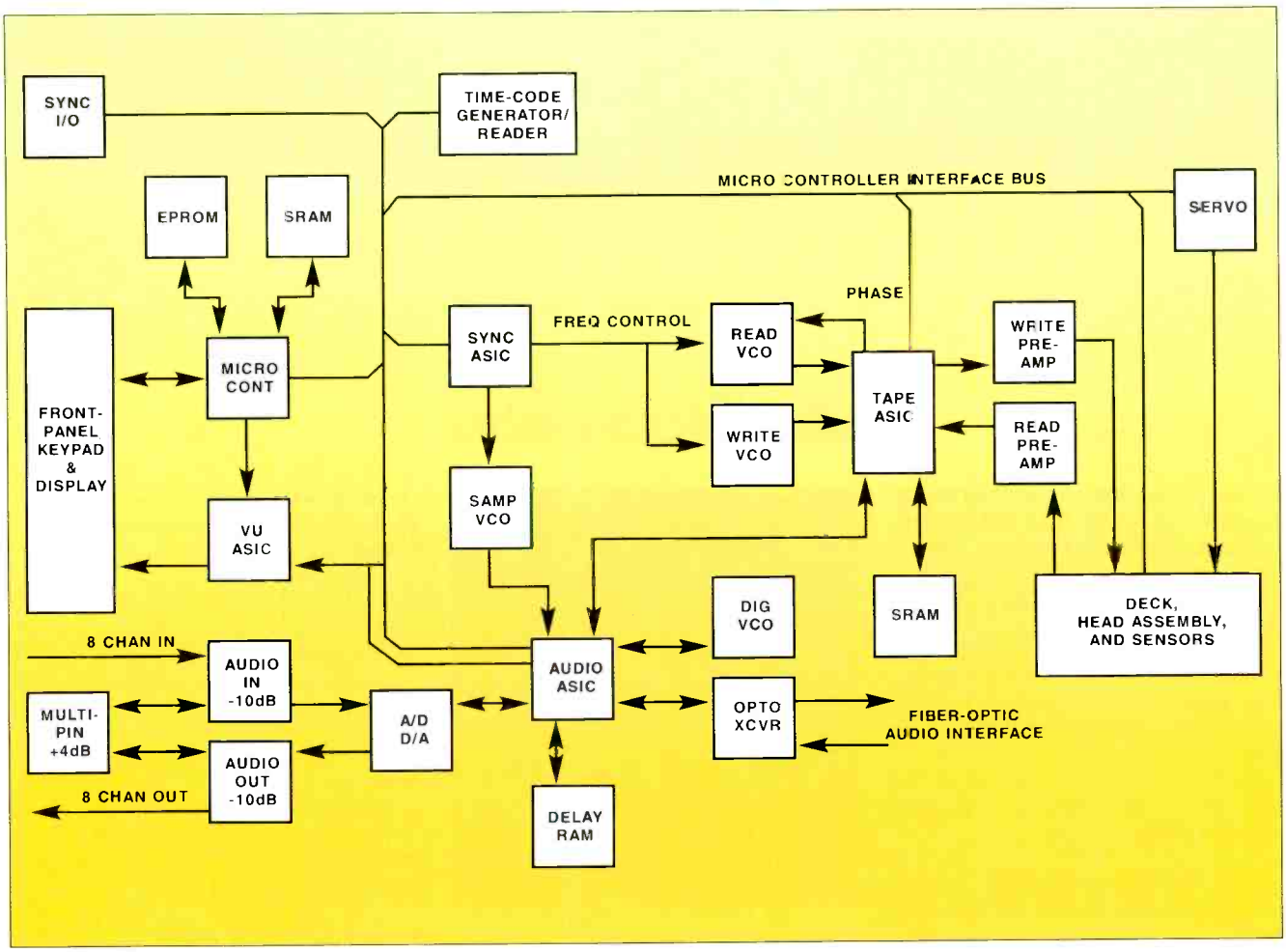


Figure 1. *Block diagram of the RD-8 system.*

Modularity

"Buy only what you need, and use what you buy to the maximum," is good advice for obtaining high return on investment (ROI). Multiple RD-8 decks can be synchronized to each other with sample accuracy when interconnected. This improves ROI for equipment because machines can be configured as the requirements arise. A 16-track recorder may never have been a justifiable expenditure, but a "stackable" 8-track, such as this device, can be configured as an 8-, 16- or 24-track system on demand. Up to 16 recorders can be interfaced for a 128-track configuration.

Up to 16 recorders can be interfaced for a 128-track configuration.

Time-code synchronization

The device is equipped with an onboard synchronizer, SMPTE time-code generator, high-speed code reader and transcoder for tape playback. Master clock can be set to the recorder's internal crystal for analog or non-synchronous transfer of time-code recording, or external video sync can be used when working to picture. Digital word sync also is available as a master time reference for digital transfers and pull-up (48.048kHz) or pull-down (44.056kHz) for film-to-video transfers.

An RS-422 port is fitted on the back panel, carrying the Sony P2 protocol for connection to an editing system. MIDI connectors output MIDI time code for integrating electronic music components.

Expanded functionality

The system can eliminate the need for retakes and re-recording to achieve precise timing with multitrack audio. The *track slip* function allows any single track (or a section of it) to be moved backward up to 170ms.

All setup parameters, *track slip* data, synchronizer information, locate and auto-record information can be recorded on the TOC of the work tape before it is removed from the recorder. The data will be reloaded each time the tape is placed back in the deck.

Serviceability

All mechanical devices require periodic maintenance, but the RD-8's modular design simplifies such servicing. The tape path can be aligned in the field with factory alignment tapes and tools, and the transport can be replaced as an assembly. Technicians who are familiar with VCRs and digital audio products will feel comfortable with the system.

The track slip function allows any single track (or a section of it) to be moved backward up to 170ms.

Such serviceability adds to the system's user-friendliness, providing a flexible and cost-effective digital multitrack recording system that can bring the advantages of digital audio to many audio-only or audio-for-video applications for the first time.

➡ *For more information on the Fostex RD-8, circle (318) on Reply Card.* ■

Field Report

Denon DN-970FA CD cart player

By Chriss Scherer

In 1987, Denon introduced the DN-950F compact disc player. This unit took the approach of having the player respond like a cart machine. This proved to be a popular approach, and today more than 6,000 units are in the field.

The 950 (since replaced by the DN-951FA) suited the needs of on-air applications. However, in the production studio there were certain features that users missed. Denon's response was the DN-970FA. The 970 is based on the 950 but gives the user some extra features better suited for production use.

Getting acquainted

Although the front of the 970 has many controls, it is still easy to use. Becoming familiar with the unit should not take operators long, and loading and playing discs is as easy as with the 950/951 model. Both systems require each CD to be enclosed in a special carrier (called a CD-cart or the ACD-5B accessory).

The main digital display shows track number, index number, minutes, seconds and frames, as well as memory status and presence of external sync. The index indicator allows the operator to cue to individual indices within a track. This is great for production libraries, in which each track has multiple indices.

An additional display shows the varispeed setting. The select knob below the display adjusts the varispeed in 0.2% increments from -10% to +10%.

The PLAY/PAUSE and STBY/CUE buttons have guards on either side to prevent accidental pressing.

Seven more buttons and a select knob together control several functions:

• *Repeat* makes the machine repeat what it is doing until told to quit. This could be playing a track or a portion of a track in memory.

• *Remain* toggles the main display between elapsed time and remaining time. This was set by a dip switch on the 950.

• *Search* sets the function of the select knob while searching. In track and index modes, the knob selects either tracks or indices. In manual mode, the knob acts as a scrub wheel. Scrubbing can be in discrete frames in normal search mode, or users can enter a fast search mode by holding in the select knob while searching. (An internal dip switch setting can make a fast search with a push on/push off function of the select knob.)

• The *A* and *B* buttons select the beginning and ending points for memory locations. Use the *save* and *resume* buttons to save, edit and recall these passages.

Depending on one of the dip switch settings inside the machine, removing a disk can cause all the memory information to be saved. Otherwise, the machine will default to its original settings and clear the memory. The unit also includes a front-mounted headphone jack with a volume control.

Performance at a glance:

- *Cues to audio*
- *Many user-assignable options*
- *Switchable for on-air or production*
- *8x oversampling, 18-bit D/A conversion*
- *Includes power cord, instruction manual and 10 CD cases*
- *Optional programmable automatic track selection/lockout*
- *Plays non-TOC discs*
- *AES/EBU digital output*
- *Varispeed ±10%*

Connecting the DN-970FA

The unit has three type-D connectors for remote control and tally indications. Remote 1 is a parallel connection and remote 2 is serial. The 970 uses a pulse to ground for parallel remote control.

All of the functions of the machine can be accessed through the remote-control connectors. Consult the manual for each particular installation.

The rear panel has XLRs for left and right audio and digital out, and there are BNC connectors for external sync in and out. There also is a power connector and fuse holder.

Inside the cabinet

Several dip switches determine the audio cue detect level, eject memory, end of message, time select and index out. The switches also select test functions, delay start, fade in/fade out duration, end recue, initial display and end detect. These switchers are located on the CPU board, behind the front panel.

The fine points to these options are detailed in the manual. Some of these options include:

• The *delay start*, an on/off setting, causes a 100ms delay from the time the start button is pressed until audio is output. This allows the deck to mimic the delay in a cart machine of the solenoid engaging the pinch roller.

• The *end recue* will be helpful in production. When recue is off, the machine will wait where it stops after it plays a cut. To replay the same cut or section, the operator must press CUE and then PLAY. When recue is on, the cue step is eliminated. The laser will go back to the beginning of the cut and enter STANDBY. This means no more turning the knob one click forward and one click back to recue repetitive sound effects.

• The *initial display* switch tells the machine whether to display time elapsed or time remaining upon track selection.

• When *end detect* is off, the display will show track time as contained in the disc's address track. When it is on, the player will examine the beginning and end of the selected track, and show the actual time of program audio. If six seconds of silence are at the end of the track, it will deduct this from the time and show a remaining time that truly reflects program length. This prevents having to scan through the entire cut to see how accurate the timing is.

The placement of dip switches behind the face panel may seem awkward. There is no room on the rear panel, and the

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

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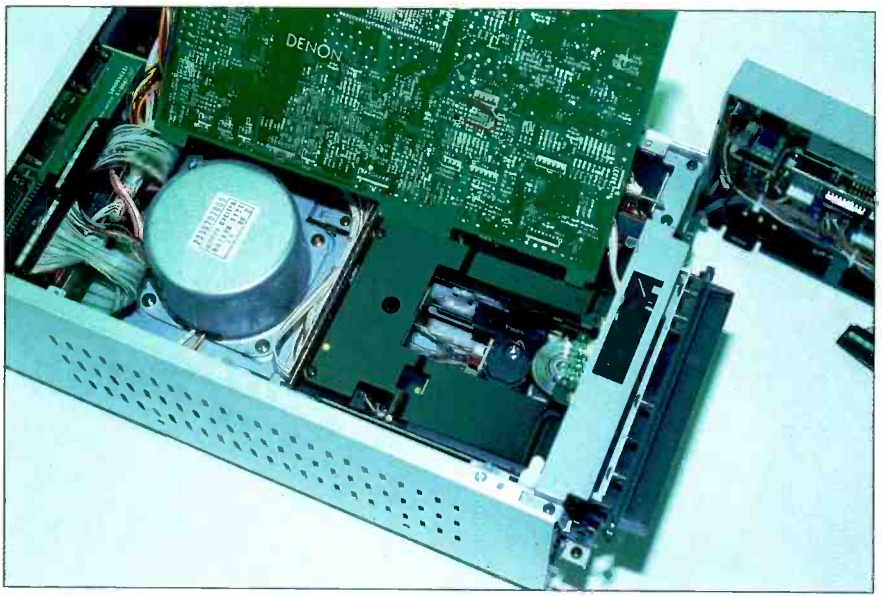
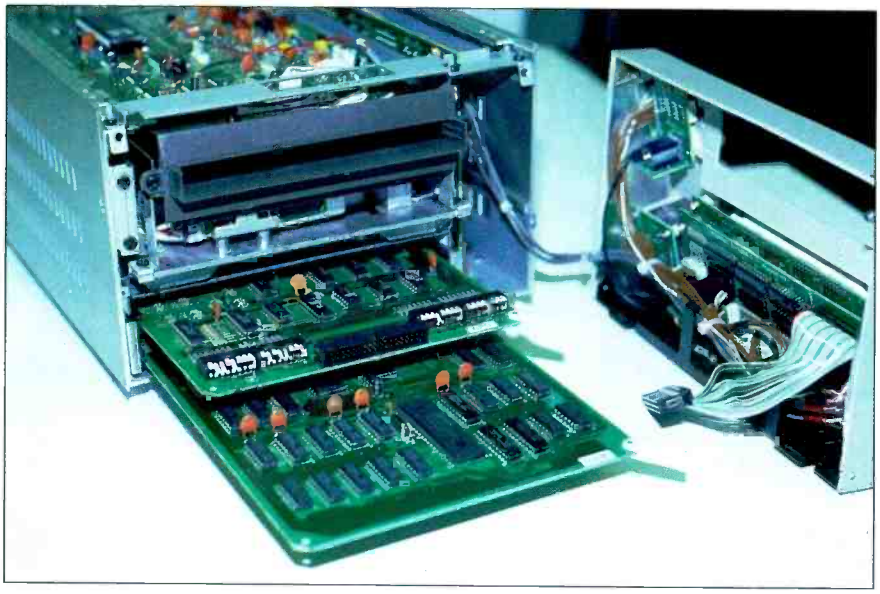


The servo board lifts out easily for access to the lens assembly. (Photo by Jon DeHart.)



Dip switches on the CPU board provide many options for control of the unit. The switches are accessible while the unit is rack mounted. (Photo by Jon DeHart.)

manufacturer says this location was chosen so that switches could be changed while the unit is still rack-mounted. The front panel is held in place with two screws, which are removed from the front.

About the cards

There are four circuit boards: the servo board, located on top as you remove the top cover; the audio board, mounted sideways next to the servo mechanism; the CPU board; and the RAM board, located at the bottom of the unit. All wiring to the boards uses polarized and, in some cases, color-coded connectors.

The servo board has all the servo adjustments on it. These can be accessed by removing the top cover. This board is held in place with one screw and two plastic PC board squeeze mounts. It lifts out easily for access to the lens assembly.

The audio board has the level set pots and the distortion adjust for the D/A. These pots are mounted on the edge of the PC board. Unlike the 950, the top cover must be removed for level setting. This should not be a concern, however, because this is a set-and-forget function.

The audio board is held in place at the side of the player with two screws. When these are removed, the audio board lifts out. The CPU and RAM boards are mounted below the transport. These are on slide-out rails with connectors on the rear.

All of the components on the circuit boards are labeled, and the pots also have their functions screened next to them. This aids adjustment because you do not have to keep referring to a diagram for part locations. The test points on the servo board are actually connectors. This facilitates service because a test jig can easily be made or purchased.

The function of the pins on the test points also are screened on the board. The labels are abbreviations, but it is something to go by.

A small fan on the rear of the player provides ventilation for the voltage regulators. It is a brushless DC motor and does not create much noise.

Ready for action

In one of the production studios at WYCL-FM, Reading, PA, a Denon DN-950FA was replaced by a DN-970FA. Everyone observed the change, but nobody came running for instructions on how to use it. All of the operators could load and play CDs with no additional training.

In a few days, the operators were given training on some of the unit's more elaborate features, but most of them had discovered the additional functions on their own. This shows the unit's simplicity of use.

A unique feature of the unit is its ability to play back CDs before they have been given a table of contents (TOC). This feature is normally found only on CD recorders. As more CD recorders come into use, this likely will be a welcomed feature. It allows users to preview a CD-R on the DN-970FA before writing the TOC on the disc, after which the recording becomes permanent.

The manufacturer has added another potentially useful feature. Using pre-coded labels that adhere to the clamp ring on the CD case, the player can automatically locate a specific track or lock that track out.

There are three operational modes to this feature. In mode 1, when the cartridge loads, the machine cues to the predetermined track. Turning the search knob does not allow you to select any other track. In mode 2, when you load the cartridge, the machine automatically cues to the pre-selected track, but other tracks can still be selected. In mode 3, the machine cues to track 1 (unless it is locked out). The user can then select any track except one that is locked out.

Although Denon does not make a rack mount for the 970, an approved rack-mount kit is available from another manufacturer in single and dual rack-mounting configurations.

The DN970-FA is an example of natural progression. It adds useful new features to an already proven design and is suitable for on-air and production.

Editor's note: Field reports are an exclusive *BE* feature for broadcasters. Each report is prepared by the staff of a broadcast station, production facility or consulting company.

These reports are performed by the industry and for the industry. Manufacturer's support is limited to providing loan equipment, and to aiding the author if requested.

It is the responsibility of *Broadcast Engineering* to publish the results of any device tested, positive or negative. No report should be considered an endorsement or disapproval by *Broadcast Engineering* magazine.

➡ *For more information on the Denon DN-970FA, circle (315) on Reply Card.* ■

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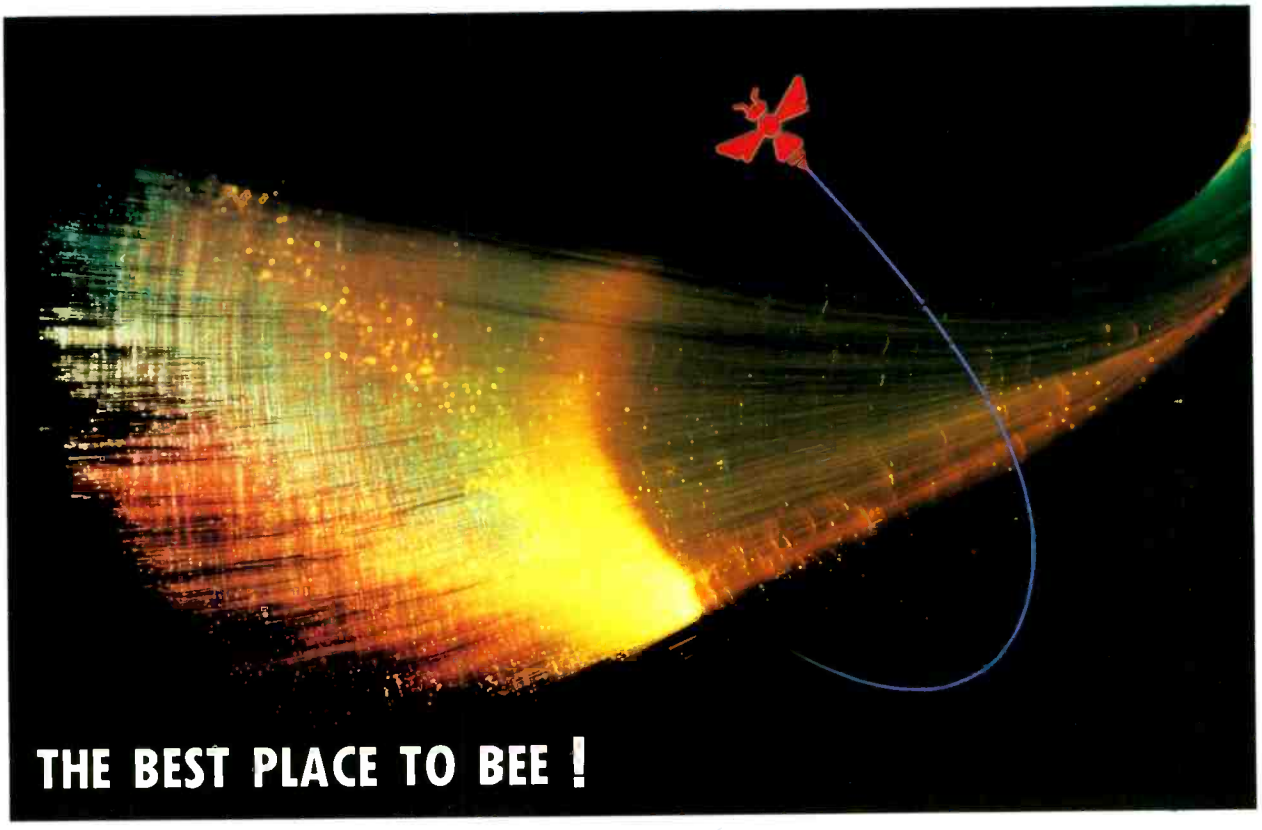

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BE looks at the financial state-of-affairs of its readership. This is sought-after information all year long.

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- **Computer Platforms for Graphic Systems**

Learn how important the selection of a platform for your graphics system is to its overall capability and performance.

- **Radio in Transition**

A look at the wide range of products that are available for radio remote prduction.

- **Using Wireless Microphones**

Learn how to select a wireless mic for your particular application.

NOVEMBER...

10th Annual Facility Maintenance Report

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Today, testing audio and video signals takes only seconds with the right equipment. Learn what automated equipment is out there.

- **Automated Test Equipment for Video**

See what technology is available to make video tests quickly and accurately.

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With the array of oscilloscopes out there choosing one can be confusing. We will show you how to select one suited to your needs.

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- **RF Cable Testing**

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- **Radio in Transition**

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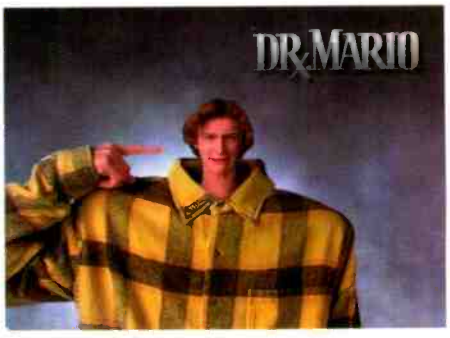

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Circle (75) on Reply Card

Field Report

Ramsa WX-RP410/RP700 wireless microphone system

By Ryan Steward

Ramsa has introduced its first wireless microphone system, aimed at the ENG/EFP markets as a high-end, versatile product for broadcast and production operations. The system is superior to cabled audio in many situations. The hazards, weight and inconveniences of a cabled microphone are eliminated. The need for time-consuming, expensive and cumbersome setups also are eliminated, which allows for quick and easy use for news and production shoots.

By using one of the 49 easily selectable channels available on the system, the operator can quickly eliminate interference problems. The package includes cabling and mounting hardware for the battery-powered receiver to cover almost any need. With the included miniature condenser lavalier microphone and a cable for use with a hand-held mic or mixer feed, the system is easily customized. The complete system consists of a WX-RP700 receiver and a WX-RP410 transmitter.

Receiver details

The WX-RP700 receiver uses a phase-locked loop (PLL) synthesized oscillator to achieve its 49-channel capability. These frequencies are field-selectable through two side-mounted selector switches. The frequencies appear in the carrier sections of channels 68 and 69 of the UHF band (797MHz-803MHz), selectable in 125kHz steps. The receiver's housing is silk-screened with a frequency chart for switch-setting in the field. A space-diversity, digitally switched, double-superheterodyned reception format is used to minimize drop-outs from multipath. The receiver uses two 1/4-wavelength flexible whip antennas connected to top-mounted SMA connectors. Top-mounted and easily viewable indicators for battery condition, receive level, antenna on-line and audio output are all protected by a clear removable cover. Controls for power and frequency selection are under another clear cover.

Steward is a maintenance engineer at KSMO-TV, Kansas City, KS.

Performance at a glance:

- *Compact, high-quality, rugged UHF wireless microphone system*
- *Battery-powered, diversity receiver designed for easy camcorder mounting*
- *Six-hour continuous battery life for both transmitter and receiver*
- *Up to 49 channels available with in-the-field switchability*
- *Uses standard AA batteries*
- *Optional programmable automatic track selection/lockout*
- *Dynamic range of 100dB*
- *Frequency response of 45Hz to 20kHz*
- *Includes high-quality, ultraminiature lavalier microphone*
- *Supplied adapter cable allows any standard microphone to be used with system*

By using one of the 49 easily selectable channels, the operator can quickly eliminate interference.

Output audio is 200Ω balanced on a standard 3-pin XLR male connector at -60dBm. The receiver uses four AA batteries, which are cassette-mounted and provide enough power for approximately six hours of use. A second cassette is provided for quick battery changes and storage. Battery cassettes can be changed through the bottom of the receiver's case, even while it is installed on a camera.

A camera-mounting bracket with quick release mechanism comes with the receiver, along with a shoulder strap. The receiver size is 112mm (w) x 95.5mm (h) x 31.5mm (d), and weight with batteries is 500g.

Transmitter specifications

The WX-RP410 transmitter boasts an equally long list of convenient, functional features. The frequencies are switchable in the same manner as on the receiver, with a companion silk-screened chart on the case providing switch positions for the desired frequency. The transmitter accepts either the included lavalier condenser microphone or other balanced mic-level audio sources through a supplied XLR adapter cable. An input-level trim provides adjustment from -80dBm to -40dBm. Peak-level and battery condition LED indicators are top-mounted.

The transmitter uses two AA batteries, mounted in a cassette-type carrier with a spare provided. Battery life also is quoted in the six hour range for the transmitter. Typical range is 260 feet without noise.

Two windscreens are included for the lavalier microphone — one metal and one foam. A belt clip on the transmitter allows upside-down and horizontal mounting. The transmitter uses companding to achieve dynamic range of 100dB. The power output of transmitter is 30mW and it also uses 1/4-wavelength antenna with an SMA connector. Dimensions of the transmitter case (not including antenna) are 103mm (l) x 64mm (w) x 18mm (h). Weight with batteries is 210g. Like any professional wireless microphone system, the transmitter requires FCC licensing before use.

Installation, operation and applications

The receiver mounting bracket is designed for mounting on an MII camcorder, but installation onto a Sony Betacam unit employing the NP-1,A,B battery format only required removing and reinstalling three mounting screws. The receiver case is wider than the Beta deck and clearance does create possibilities of snag. Antenna orientation is well above the deck, and its handle does not interfere with reception. A standard XLR cable is required to connect the receiver's output to the camcorder's audio input.

The system seems well-suited for news, production and specialty applications. Channel selection is achieved with a small

screwdriver. Quick and simple setup, operation and troubleshooting make the system welcome during active news pursuit. Studio applications include use on the news set, especially for the weathercaster, where ease of mobility from set to chroma wall comes in handy.

The system seems well-suited for news, production and specialty applications.

For production applications, users can quickly and easily change their locations without the need to rewire and hide cables at each new spot. Special applications, such as children's shows, allow fast-paced action sequences to proceed safely without worry over cabling. With 49 available channels, up to six units can be operated in close proximity without interference.

Product evaluation

Both studio and field evaluations of this system were performed. The KSMO *Kids Crew* team, which generally uses wireless microphones, was asked to compare the Ramsa system to its existing units. The reactions to the evaluation were quite positive. Reception range in open areas was excellent, with almost no interruption of signal, even near motorized vehicles and their ignition interference. Audio quality and clarity also were maintained, even in situations of high sound levels and background noise. Talent voice quality remained natural in tone throughout.

Battery consumption is always an area of great concern to wireless microphone users, and the Ramsa system performed to its specifications. Slightly more than the 6-hour rating was often achieved in the KSMO tests. Much of a field crew's shooting is of one-time-only events, so battery-level indication is important as well. This crew's testing found the system's display simple to read with just a quick glance.

Camcorder-mounting of WX-RP700 receiver, along with hand-held microphone feeding WX-RP410 beltpack transmitter, shown during KSMO-TV's evaluations.

The *Kids Crew* testing concluded with some studio shooting, confirming the wireless microphone system's good performance around studio lighting and other equipment without picking up additional noise or hum.

Further testing included general engineering department evaluations around the KSMO facility. The station's home is a 3-story concrete and steel office building with steel flooring, containing many computer systems and currently undergoing renovation. This provided a good environment for testing the system's range and susceptibility to interference.

Quick and simple setup, operation and troubleshooting make the system welcome during active news pursuit.

For these tests, the wireless receiver was installed *inside* a metal rack, with its output connected to a mixer and monitor. The output was monitored for dropouts, noise and diversity switching. On a tour of all three floors (including the tech center containing station equipment), no dropouts or noises were detected. RF loss was not detectable, nor was diversity receiver switching.

During battery life timing tests, it was observed that once the transmitter's battery life LED turned from green to red, power quickly diminished. On the receiver, after its LED changed color, it continued to operate well for a much longer time.

When the transmitter went out of range and the signal became noisy, the receiver went into a squelched mode of operation. The same situation occurred when the transmitter was off.

Final tests were conducted at the KSMO transmitter site. The site is shared with another UHF station, two FMs, a cable head-end (with microwave links) and an MCI telephone hub. KSMO's operating frequency of UHF Channel 62 fell close to the wireless mic's operating frequency range. Considering all of the additional RF at the site, this provided an excellent place to test the system's RF section for sensitivity and discrimination.

The wireless system's transmitter and microphone were brought inside the transmitter site's shack and placed next to an acoustical sound source. The receiver was connected to a portable mixer running on battery power, and headphones fed by the mixer were used for monitoring the received signal as the receiver was moved about the site. Despite the receiver's continuous switching between antenna A and B, audio quality was excellent and switching was undetectable. Range remained up to the specification of 260 feet, even under severe RFI conditions.

With 49 available channels, up to six units can be operated in close proximity without interference.

Maintenance

The system is small and compact, as is its internal layout and the choice of parts used. Many internal parts are surface-mounted and placed in tight quarters. Construction of the transmitter internally seems a bit flimsy and frail, although the case is of thick construction. On the other hand, the receiver's internal construction is quite sturdy, with a heavy die-cast frame protecting both sides and

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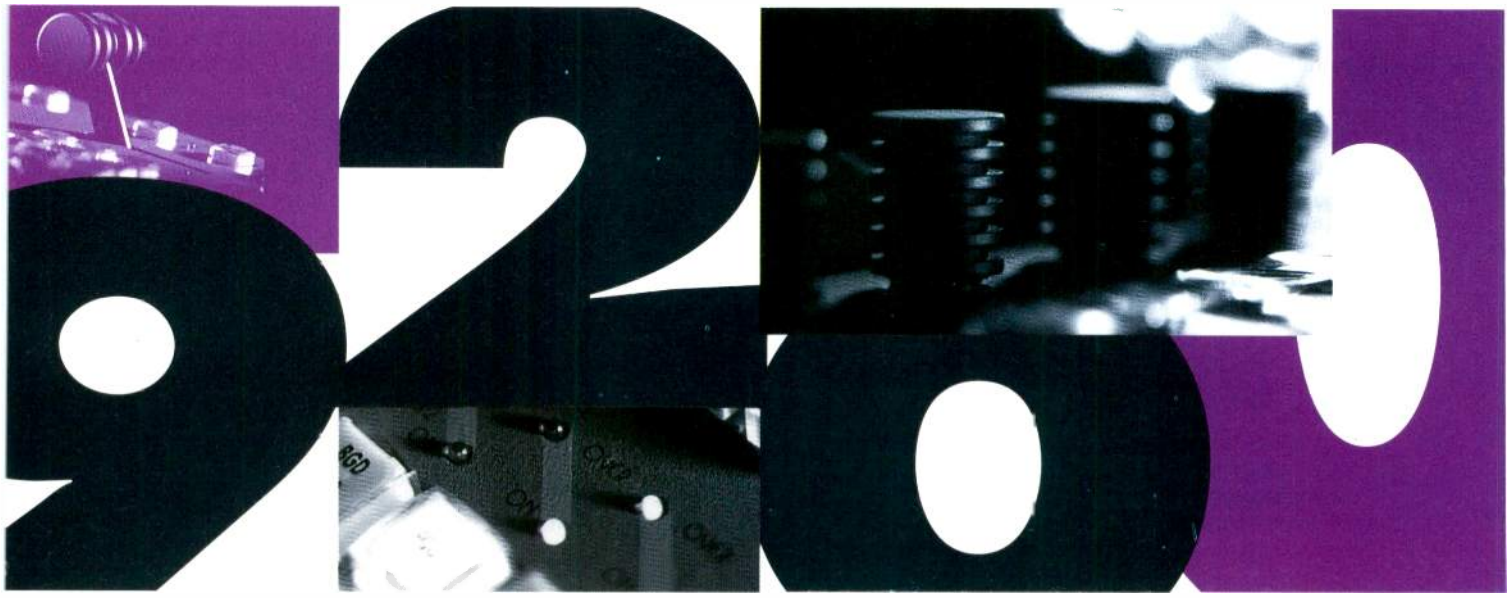

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the top. It also securely holds both circuit boards, which are double-sided and use surface-mount components. The RF sections of the receiver are open and do not seem to be affected by outside RF. On the other hand, the RF sections of the transmitter are enclosed and look potentially difficult to troubleshoot. Construction overall is of good quality and seems well thought out.

Like other miniature condenser lavaliers, the system's supplied microphone and cable connectors are small and require accuracy during repair. Small and careful soldering is required.

Limitations and drawbacks

Because the system operates in the UHF range of Channel 68 and 69, FCC licensing is required. The transmitter is licensed as low-power television under Section 74, Sub-part H. The licensing fee is $85, and processing time is approximately 40 days.

The audio input trim control on the transmitter extends above the top surface approximately one-quarter of an inch, perhaps making it susceptible to accidental breakage or unintended adjustment during use. The actual application of the gain trim is somewhat difficult because the transmitter does not have any audio level indicators other than a peak flasher. (The receiver has an audio level meter.)

Frequency selection controls are difficult to get to on the transmitter while it is in its carrying case. Switching of these controls requires a small screwdriver, which is included, but it is small and easily misplaced. Keys, pens, pencils, or the like will not move the controls easily in an emergency.

The documentation for the transmitter and receiver is clear and easily understood.

The receiver LEDs are greenish yellow and can be difficult to read in bright sunlight.

Finally, for some users, the most significant drawback will be the top-drawer price of the unit, although it is competitive with others of its class.

Documentation

The documentation for the transmitter and receiver is clear and easily understood. It covers features, precautions, layouts and operations as any good documentation should, but the diagramming and explanation of complex special features is unusually well done.

A frequency list appears on two pages and is presented in chart form, both for desired frequencies and for switch settings. The noise-reduction system is explained in detail. The transmitter documentation contains a handy conversion chart for sound pressure to dBV and for frequency deviation to dBm, as employed in the system. An application for licensing the unit also is included.

Editor's note: Field reports are an exclusive *BE* feature for broadcasters. Each report is prepared by the staff of a broadcast station, production facility or consulting company.

These reports are performed by the industry and for the industry. Manufacturer's support is limited to providing loan equipment, and to aiding the author if requested.

It is the responsibility of *Broadcast Engineering* to publish the results of any device tested, positive or negative. No report should be considered an endorsement or disapproval by *Broadcast Engineering* magazine.

➡ *For more information on the Ramsa WX-RP410/RP700 wireless microphone system, circle (316) on Reply Card.* ■

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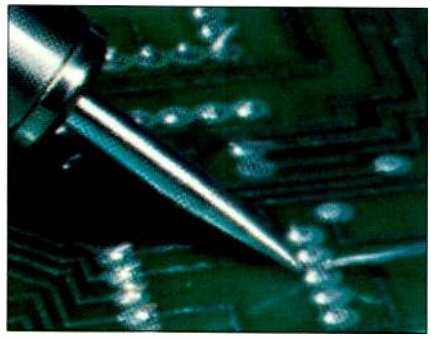
Station to Station



Using infrared imaging for transmission line inspection

By Eric Bergman

Last October, WHAS-TV experienced one of a chief engineer's worst fears — a 4-inch transmission line burned up in an incident that took the station off the air for 7½ hours. Luckily, the problem occurred only 60 feet above the base of the tower, and a tower crew was working at another site nearby. Other help came from broadcast engineers in the area who heard of the station's plight and called or came by with offers of assistance.

As soon as the problem was determined to be in the transmission line, a time domain reflectometer (TDR) was put on the line. It indicated a short at 137 feet from the transmitter patch panel — a distance that equated to 60 feet up the tower. The tower crew arrived, and replaced the damaged section and the two sections above it because there was evidence of contamination of these sections. (The smoke and combustion by-products from melted copper and burned teflon insulators typically affects several sections around a burnout.)

After the repair was made, the TDR was used to pulse the line again, and no more problems were detected. The station then signed back on and resumed regular broadcasting.

A case of burnout

An investigation of the damaged sections revealed that the problem was at a flange joint where the line sections met. A failure in the inner conductor was suspected, possibly the *bullet*, a silver-plated copper splice that joins the inner conductors together. This was not certain, however, because the damage to the bullet and the inner conductor was quite severe. (See Photo A.) The exact cause of the "burnout" remained a mystery, although many possibilities were identified. The most likely causes included:

• *Thermal wearing.* During construction of the line, a bullet can be installed improperly and operate for years before it begins heating to the point of failure. Being outdoors, the continual thermal expansion and contraction cycling of the line causes friction, which can lead to copper dust or particles settling onto the flange insulators and forming a conductive path that will develop into a short.

• *Dehydrator effluents.* Dirt and debris from dehydrators also can settle in the line and cause a result similar to that in thermal wearing.

• *Physical damage.* External rubbing and chafing of the line components against the tower or each other can cause deformations or weaknesses in the line that can lead to failure.

Could it happen again?

Once the station was back on the air, it was time to evaluate the situation more thoroughly. What had caused the first failure? Were there other problems in the line and, if so, where? The station's 1,000-foot transmission line is made up of 50 20-foot sections. Without the luxury of a spare line and/or spare antenna, it was not going to be easy to check the sections and remain on the air. A manual, visual inspection of the interior of the line would be difficult, expensive and require interruption of service. If an alternative existed, it would be worth pursuing.

The 0.2°C resolution of this system is much more sensitive than human touch.

The engineering staff discussed the problem and came up with an idea. Several years earlier, the station had hired a local company, Thermographic Consultants, to perform an infrared thermographic survey of the main electrical switch gear and

Photo A. *Failed inner conductor after removal from WHAS-TV transmission line.*

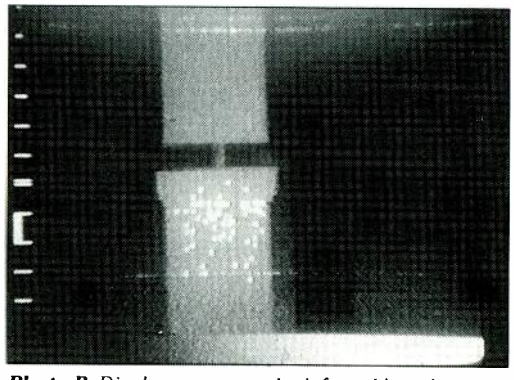


Photo B. *Display screen on the infrared imaging device detecting a hot spot.*

Photo C. *The transmission line section detected by the infrared imaging shown in Photo B. Note discoloration from excessive heating at top of inner conductor section.*

Bergman is director of engineering and operations for WHAS-TV, Louisville, KY.

distribution system at the studio and transmitter. This is a diagnostic tool used to locate problems in such systems by detecting the heat caused by poor connections, overloading or failing components. Utilities also use such services to inspect high-tension lines for bad splices or bad insulators. The station believed this could work for inspecting its transmission line.

Thermographic Consultants agreed to try. It employed a unit called the Inframetrics 525, which is a cryogenically-cooled infrared imaging system. The station picked an overcast, cold day to do the survey. Overcast conditions helped to even out the background radiation and lessen uneven solar heating of the objects under examination. The cold weather was the luck of the draw for Kentucky in October.

Infrared examination

The method used for the survey was quite simple. The operator got on the elevator car and rode up the tower, looking for any "hot spots." At approximately 750 feet, he found one. This joint was 5°C hotter than the surrounding line, and the heat signature was visible for two feet on either side of the flange. The operator adjusted the range and resolution of the system to further determine that the hottest area was on the bottom half of the joint, corresponding to where the bullet was fixed to the inner conductor by means of a bolt and a watchband-type spring. (See Photo B.)

This difference in temperature was not evident by feeling the line, and may not have shown up during the annual tower inspection. The 0.2°C resolution of this system is more sensitive than human touch.

This approach was non-intrusive, allowed inspection while under load, and kept the station on the air.

A tower crew was hired to open the line at that point, and both sections of line involved at that joint were replaced. Subsequent inspection revealed that the watchband spring had deteriorated and was the cause of the heating. As a result of this heating, the bullet and surrounding inner conductor were badly discolored, and probably would not have lasted much longer before they failed. (See Photo C.) The burnout incident that caused WHAS-TV to go off the air was most likely also the result of a failed watchband spring.

Recommendations

The experiences at WHAS-TV indicate that this method can be used for finding severe pre-failure heating problems. However, additional field work must be done to refine the scope of its use. Relating exterior heat to the internal temperature and condition of components may allow for a more refined diagnosis. In addition, the device used for the survey was large and bulky, making it inconvenient or impractical for use on towers without elevators. Smaller, hand-held units are available that may help in that regard.

In summary, infrared imaging yielded positive results as a method of inspecting broadcast transmission lines for hot spots. Several advantages were presented by this approach:

1. it was non-intrusive,
2. the line was inspected while under load, and
3. the station remained on the air.

The system had adequate resolution and sensitivity to permit accurate diagnosis of heat-related problems. WHAS-TV used it to locate and repair a problem in an efficient manner, before an extremely costly failure occurred. ■

Industry Briefs

BUSINESS SCENE

Sony, Montvale, NJ, has sold DMX-E3000 audio-for-video consoles to Machine Room Ltd., SVC, Tele-Cine, Chrysalis Television, TVS, Molinare and Carlton Television, which are all located within the United Kingdom.

Sony also has delivered a PCM-3348 DASH multitrack recorder to Kuwait Radio. In addition, NRK ORTO 94 has received the first of 47 Digital Betacam production units that it ordered at the end of June. STAR TV has selected Sony's new Digital Betacam format for its 5-channel direct digital broadcast satellite service.

Also, Sony has already received orders for almost 1,000 Digital Betacam VTRs, including 300 for Hughes Communications' DirecTV, the first domestic direct digital broadcast satellite service, which will begin taking delivery this summer.

Pioneer, Upper Saddle River, NJ, has installed a Projection CUBE system for VidiAd, which operates a video wall display advertising system in McCarran International Airport, Las Vegas.

Panasonic, Secaucus, NJ, has sold an AJ-D350 D-3 studio VTR at the Academic Media Services department of the University of Colorado, Boulder, CO.

Abekas, has installed an A84 digital component switcher at Lamb & Company, Minneapolis.

Also, Post Effects, Chicago, has taken delivery of an A83 digital component production switcher.

AKG, San Leandro, CA, has provided C410Q microphones on the set of "Dinosaurs," a half-hour sitcom on ABC-TV.

Fujinon, Wayne, NJ, has equipped the production truck at Oklahoma State University's Telecommunications Center, Stillwater, OK, with 55X, 44X and 18X lenses.

Harris Allied, Quincy, IL, has added the DAD 486x digital audio delivery system to its radio studio product line. The DAD 486x is manufactured by Enco Systems, St. Louis.

In addition, Harris has received an order for FM broadcast transmission equipment from the Shanghai Radio & Television Bureau in the People's Republic of China. Also, the Autonomous Community of the Basque Country, Spain, has ordered five DX Series digital solid-state medium-wave transmitters. Harris has taken an order from Syrian Radio & TV for two DX 50, 50kW digital solid-state medium-wave transmitters and associated equipment as well. Egypt Radio & TV Union also has bought a DX 100, 100kW digital solid-state medium-wave broadcast transmitter.

Furthermore, Harris has installed the world's first digital FM exciter, the Harris Digit, at KRNA-FM, Iowa City, IA.

Avid, Tewksbury, MA, has provided CBS-TV, New York, with Media Composer digital non-linear editing systems to be used to produce upcoming TV specials: "60 Minutes" 25th anniversary special and a new documentary on the year 1968.

Ampex, Redwood City, CA, has sold 12 DCT 700d tape drives to Warner Bros. Studios, Hollywood.

Also, WETK-TV, Colchester, VT, has made plans to use its ACR-225 automated cassette system to significantly change its on-air operations. Within the next year, the system will be loaded with all of the station's short-length (under 30-minutes) educational programming material that is broadcast to Vermont and New England regional schools.

Solid State Logic (SSL), Oxford, England, has delivered a 64-input SL 4000 G series console with Total Recall to Cherokee Studios, Hollywood. Sound On Sound Recording, New York, has purchased a 64-input SL 4000 G Plus console as well.

Vyvx, Tulsa, OK, and Fibrcom, San Antonio, TX, have entered into a local access agreement whereby Fibrcom will provide first- and last-mile service connections within San Antonio for Vyvx's nationwide fiber-optic TV transmission system.

Emcee, White Haven, PA, has concluded an agreement with Hong Kong-based Pan Asian Systems, giving Pan Asian Systems rights to distribute Emcee's wireless cable products in Asia and the Middle East.

NTL, Hampshire, England, has been chosen by the Family Channel in an agreement that includes the Children's Channel on a shared transponder. The combined 24-hour service began on Sept. 1.

NSN Network Services, Avon, CO, and Gilat Satellite Networks have reached an agreement whereby NSN has become Gilat's first North American distributor for its OneWay VSAT.

Antenna Technology, Mesa, AZ, has been chosen to provide two Simulsat multibeam satellite earthstations as downlinking antennas for United States Satellite Broadcasting's (USSB) Digital Satellite System (DSS) uplinking facility, Oakdale, MN.

Vistek, Buckingham, England, has been awarded another contract by Wharf Cable, Hong Kong, to provide four VECTOR-VMC standards converters to the project.

A.F. Associates, Northvale, NJ, has delivered a Radamec EPO RP2H heavy-duty pedestal to CNN, Atlanta. A.F. Associates represents Radamec EPO exclusively in the United States.

Avid, Tewksbury, MA, has formed separate business units for its desktop video, broadcast and professional products, in order to best serve the needs of a broad spectrum of digital media markets. The business units will have their own engineering, marketing, sales and customer support staffs.

Philip Drake Electronics, Herts, England, has appointed Sistem Letronik Maju Sdn Bhd as its Maylaysian distributor.

Accom, Menlo Park, CA, has received the 1993 Monitor Award for Special Achievement in Engineering Excellence from the International Teleproduction Society (ITS) for its D-Bridge 221 digital decoding system and its D-Bridge 122 digital encoding system.

Abekas, Redwood City, CA, has reduced the price of its latest generation of component digital disk recorders, the A65 and A66, in an effort to make digital video more available to computer animator and graphics users.

Tektronix, Beaverton, OR, is conducting another series of Cable TV Measurement seminars. Open to the public, the seminars are scheduled for the following cities: Cincinatti, Sept. 27; Omaha, NE, Sept. 29; and Phoenix, AZ, Oct. 1.

The full-day seminars offer a discussion of theory and application-oriented training in RF and baseband measurements. Each seminar participant receives a workbook containing valuable reference information about signal distortion and measurement methods. To make reservations or obtain additional information, contact Kathy Richards at 503-627-1555.

Broadcast Electronics, Quincy, IL, has acquired Broadcast Programming, Seattle, and its sister company, Sentry Systems.

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Circle (64) on Reply Card

Industry Briefs

Vistek, Buckingham, England, has appointed Intelligent Structures Inc. (ISI), to provide technical support in the Los Angeles area. In addition to providing technical support, ISI will maintain a comprehensive inventory of spares to support the installed product base.

TTC, Louisville, CO, has signed a Memorandum of Understanding with Larcan Inc., Mississauga, Ontario, Canada. The agreement calls for Larcan to acquire a controlling interest in TTC and is subject to the fulfillment of a number of conditions.

Allied Film & Video, Chicago, is now offering open, closed and real time video captioning in 24 languages from its Chicago location.

Panasonic Broadcast & Television Systems Company, Secaucus, NJ, has named five sales organizations to represent its line of video conferencing systems and components.

These companies include: R.P.C. Video Inc., Pittsburgh; Crimson Tech, Cambridge, MA; Videoplay, Rockville, CT; ECI Video, Dallas; and Technical Industries, Atlanta.

Zero Stantron, Pacoima, CA, has opened an East Coast manufacturing facility in Monson, MA. The facility will provide direct warehousing and manufacturing access to Stantron's East Coast user base.

Otari Corporation, Foster City, CA, has established a direct sales office in New York City. The territory covered by this office includes Boston, New York, Philadelphia and Washington, DC. The official title for this office is Otari Northeast Regional Sales Office.

Tape machine and studio console warranty service and sales technical support will be handled by New York Technical Support Inc., 35 Hardscrabble Hill Road, Chappaqua, NY 10514-3009 (mailing address) or 424 W. 45th Street, New York, NY 10036 (shipping address); phone 212-246-0227; fax 914-238-6823.

Pro Disk and post-production console warranty service and sales technical support will be handled by Film-Tek and Associates Inc., 26-07 Broadway, Suite 24, Fair Lawn, NJ 07410; phone 201-797-4999; fax 201-797-7274.

PEOPLE

James Utterson has been selected as non-executive director for Philip Drake Electronics, Herts, England.

Henry T. Evers and **Kenneth M. Sampson** have been appointed to positions with Pioneer New Media Technologies, Upper Saddle Rivers, NJ. Evers is vice president in charge of sales, engineering and marketing for its Multimedia Systems Division. Sampson is district sales manager for the Southeast territory.

Ted Snider, owner of KARN-AM and the Arkansas Radio Network, Little Rock, AR, has been named the 1993 recipient of the National Radio Award by the National Association of Broadcasters.

Steve A. Claterbaugh has been named broadcast sales manager for all of Canada for Continental Electronics Corporation, Dallas.

Industry Briefs

Morgan D. Rees and **Bob Titus** have been appointed to positions with BTS, Simi Valley, CA. Rees is business unit manager. Titus is business unit manager for digital recorders and telecines.

Samuel Edward (Ed) Hawkins Jr., Dean A. Pomeroy and **Ronald C. Frillman** have been named to positions with Harris Allied Broadcast Division, Quincy, IL. Hawkins is government/consultant relations manager. Pomeroy is controller. Frillman is manager of marketing communications.

Roger C. Cady has been chosen as vice president of business development for Dynatech, Burlington, MA.

Dennis M. Houlihan has been named president of Roland Corporation US, Los Angeles.

Sean C. Bowers has been appointed as a sales representative for Computer Concepts' (Lenexa, KS) new Denver office.

Tony Peterman has been promoted to division manager of the Chicago and Elk Grove Village, IL, facilities for Allied Film & Video, Chicago.

Eric Wahlberg has been appointed Northeast regional sales manager for Microtime, Bloomfield, CT.

Phil Clement and **David C. Cuyler** have been promoted to positions with Rank Organisation Plc., London. Clement is president and CEO of Rank Film Labs (worldwide). Cuyler is president and CEO of Rank Video Service America.

Mike Kerry and **James Griffin** have been named regional sales managers for Videotek, Pottstown, PA. Kerry is Midwest regional sales manager, and Griffin is southeast regional sales manager.

Mark Northeast has been promoted to district manager of the Canadian provinces for Quantel, Darien, CT.

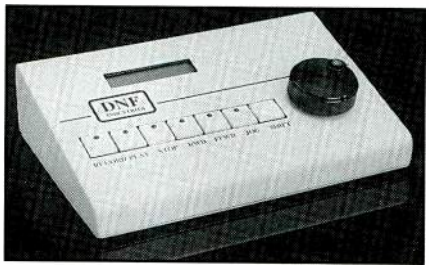
Bob Festa and **Michael Jackson** have been appointed to positions with Hollywood Digital, Hollywood. Festa is a colorist and Jackson is an editor.

New Products

Filters
By Matthey Electronics
• **X601**: designed for use in space-critical applications, such as Extended Eurocard formats; allows greater component integration than previously possible; available in fully sealed modules; 100% tested for user confidence.

Circle (350) on Reply Card

VTR controller
By DNF Industries
• **ST100**: includes all of the features of the ST60 VTR controller plus an integral time-code display, keypad and jogwheel; allows operator to control D-1, D-2, D-3, Betacam, MII, 3/4-inch, 1-inch, S-VHS and Hi8 formats via serial RS-422, using only one controller; functions also can be customized to meet clients' exact needs.



Circle (355) on Reply Card

VHF duplet antenna
By Harris Allied
• **TAD-HD**: newest addition to Deltawing line; for VHF TV highband applications through 60kW; can be used on new or existing towers; cosine version available for 3-around towers; cosine squared version designed for 4-around towers.

Circle (351) on Reply Card

ADAT upgrades
By Alesis
• **ADAT digital multitrack recorder upgrades**: free upgrade for all ADAT owners who want to make their units BRC compatible; for more information, contact Alesis at 1-800-5-ALESIS or 3630 Holdrege Ave., Los Angeles, CA 90016.

Circle (352) on Reply Card

Disk drive
By Driver Software Design
• **Disk drive unit**: can replace an 8-inch drive in the Chyron RGU, 4100, 4100EX, 41000EXB, 4200 character generators; comprised of two 5.25-inch drives, rack, power supply and cables; pre-assembled; physically fits into the place of one 8-inch drive; allows four on-line floppy dives; allows storage on both sides of disk.

Circle (356) on Reply Card

Tetrode
By Thomson Tubes Electroniques
• **TH 576**: brings increased efficiency to medium- and short-wave transmitters; includes Pyrobloc grids; delivers 550kW in SW and 650kW in MW with an anode efficiency of 90% in the SW and high gain.

Circle (353) on Reply Card

Processing/communication system
By Remote Monitoring of America
• ***RemoteLINQ***: allows cost-effective, real time monitoring and analysis of mission-critical operations at remote locations; can be attached to almost any standard analog or digital sensor, gauge or detector; uses analog and digital signal processing; encased in a 15.7"x13.8"x6.1" metal box with a microprocessor and stored logic; has eight analog and eight digital input ports (extra ports optional); can hold up to a megabyte of memory.

Circle (354) Reply Card

Wide-angle lenses
By Fujinon
• **A8.5X5.5EVM and S8.5X4.2EVM**: hand-held TV zoom lenses for 2/3-inch and 1/2-inch cameras, respectively; combine extremely wide-angle zoom with inner focus, Aspheric Technology (AT) and a V-Grip servo design; allow user to adjust zoom speed in five steps from seven second to one second wide-to-tele; Electron Beam Coatings provide substantial reduction in ghostings and flare.

Circle (361) on Reply Card

Tape products
By Fujinon
• **Hi8 M221E videotape**: world's first metal particle (MP) tape that delivers performance equal to metal evaporated (ME) tape; designed to be used with the hardware's selector switch set in the ME position; uses Super Double Coating technology; incorporates non-magnetic layer of TITAN FINE particles for its bottom layer and a high-energy, ultrathin metal magnetic layer for the top layer.
• **M221MP Hi8 videotape**: uses Double Coating technology; new base film offers significant reduction in spacing loss and modulation noise.

Circle (358) on Reply Card

Crimping tool/die kits
By RF Industries
• **RFA-4005**: supplied with one RFA-4005-020 crimping tool frame and an RFA-4005-01 die set used to crimp RG58 and 59U, RG142/U as well as RG8X, proflex and various video cables; die features a 0.052-inch hex cavity to crimp mini-UHF connector center pins and is the only die of its type; kit also is supplied with an RFA-4005-02 die set used to crimp RG8/U, RF213/U and RF214/U cables as well as the ferrule and center pin on Belden 9913 cable; /125-inch center pin cavity for 9913 also is the only die of its type in the industry.
• **RFA-4006**: same as RFA-4005, except it is supplied with two crimping tool frames rather than one.

Circle (362) on Reply Card

Cabinets
By Zero Stantron
• **Cabinet frame wedge**: provides users with increased space for additional equipment storage; available in several 30° and 45° angles as well as several different heights and depths.

Circle (357) on Reply Card

UHF antenna
By Pesa Micro Communications
• **All-band UHF TV emergency antenna**: easy to transport; quick to install; panel VSWR is less than 1.10 from 470-800MHz (CH 14-69); low ripple omnidirectional patterns can be obtained using new offset techniques; package includes four all-band panel, all interconnecting cable and bracketry, a power divider and three

New Products

1/8 EIA input connectors with one 5/8 EIA adapter (six 1/8 EIA adapters optional).

Circle (360) on Reply Card

TBC/synchronizer

By Feral Industries

• **FERAL EFFECT**: compresses video vertically and horizontally; designed for desktop video and studio applications; available as a board-level product that plugs into any auxiliary slot in either Amiga or IMB PC, or as a 1-U high, rack-mountable stand-alone unit; ideal for use with the Video Toaster or during video broadcasting; features digital comb filtering and true 8-bit, 4:2:2 processing for high-bandwidth, high-resolution picture output; accepts composite and Y/C video.

Circle (365) on Reply Card

Composite video tool

By Ultech

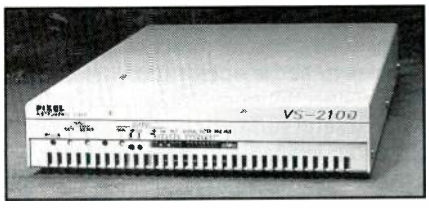
• **TV Trigger Mate**: provides a stable trigger for oscilloscopes; can sync on weak and copy-protected video; works with NTSC, PAL and SECAM video; offers individual line selection and combinations of four color fields; can trigger on all field and within a TV scan line in increments of 125ns with a maximum jitter of +/-8ns.

Circle (378) on Reply Card

Video synchronizer

By Pixel Instruments

• **VS2100**: NTSC and PAL video synchronizer provides transparent synchronizing of satellite feeds and high-quality microwave links, and retiming of intersuite connections or in-house signal feeds; by operating without an external reference, it can be used as a transparent, fixed video delay for timing and other applications; input video is 10-bit oversampled at 40MHz, digitally filtered, processed and D-A converted at 12 bits; stores eight full fields of 12-bit digital video, eliminating the need for a chroma inverter.



Circle (369) on Reply Card

3-D rendering engine

By NewTek

• **Screamer**: external rendering engine for the Video Toaster; includes four parallel MIPS R4400 64-bit superpipelined RISC processors; 150MHz clock speed; program memory expandable to 1Gbyte; comes with NTSC video in and out.

Circle (359) on Reply Card

Editing system

By Avid Technology

• **Media Composer 1000**: digital nonlinear on-line editing system; designed specifically for corporate TV professionals, post-production facilities serving corporate and industrial clients, and independent producers to edit and produce master programs directly from disk; features include 60-field on-line resolution, real time digital video effects and titling tool, professional editing model, finishing-quality audio, and tools to streamline the work flow process; 3Gbytes of storage; system includes a Macintosh Quadra 950 with a 230Mbyte internal hard drive; two 14-inch multisync monitors; video, advanced JPEG, audio and SCSI-II boards; an effect module; speakers; cables; and documentation.

Circle (363) on Reply Card

Expandable sleeving

By Techflex

• **Flexo**: lightweight jacketing for bundling and protecting wire, cables and hoses; braided from high-temperature yarns; ex-

New Products

pands up to four times its normal diameter; chemical resistant; flame retardant; for aerospace, electronics computers, automotive and industrial applications.

Circle (364) on Reply Card

Software

By CDS

• **RFCAD**: propagation prediction software package for PCs; runs under Microsoft Windows; can plot almost limitless site propagation and service contour studies on a single display; computer and device independent.

Circle (366) on Reply Card

Editing system

By Strassner Editing Systems

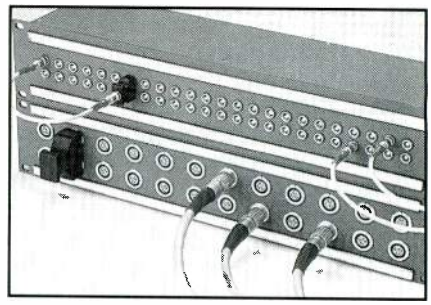
• **EdiQit**: low-cost, high-end kit version of the SES line of professional editing systems; fully operational using a standard mouse-driven interface or an industry-standard, color-coded keyboard; uses V-LAN intelligent control network; fully upgradeable to any other SES system; comes with editing controller software, a V-LAN control network board set (for two VTRs), cables, security key and manual.

Circle (367) on Reply Card

Patch panels

By Lemo USA

• **LEMO patch panels**: designed with push-pull connectors; 19-inches long; can accommodate an array of connector designs from 50Ω or 75Ω single or multicoaxial/triaxial inserts to a variety of signal or mixed insert variations; internal patch panel linking can be direct or made with microswitched adapters; individually isolated connections prevent signal crosstalk; painted satin surface is highly resistant to abrasion; available in standard black or gray, or can be heat treated or anodized in other colors.



Circle (371) on Reply Card

Software upgrade

By Avid Technology

• **Version 2.0 for Media Suite Pro**: includes new 60-field option, EDL output option and new effects, such as motion control and user-definable picture-in-picture effects.

Circle (368) on Reply Card

Alarm interface unit

By Critical Designs

• **RS-1**: recognizes alarm codes sent over a modem and sounds an external (user supplied) alarm; installed between user's modem and PC/terminal RS-232 serial port; recognizes a control-G (BEL), and also can be custom-programmed to recognize any character or string of characters; reset by pressing a button on the RS-1 unit or by a contact closure; user can connect any alarm system that operates from an open collector driver.

Circle (370) on Reply Card

Antenna tuning unit

By LBA Technology

• **TTU-1A**: economical AM antenna tuning unit designed to accommodate lower-power AM broadcasters; performs all essential matching functions for typical AM antenna towers; options include local and remote RF meters, interlock and lightning protection systems; operates with series fed or folded unipole antenna systems; four frequency coverage options accommodate the entire 540-1,700kHz AM band.

Circle (372) on Reply Card

Software option

By Data Translation

• **FX Option**: Media 100 software for creating on-line quality, full-frame video effects for the Media 100 non-linear environment; integrated "plug in" architecture (first introduced in Adobe Premiere) with Media 100 proprietary software and hardware allows users the option to render, play, edit and record more than 60 existing effect types as high-quality video.

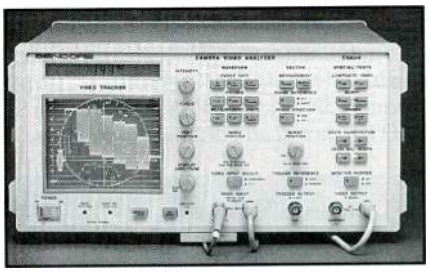
Circle (373) on Reply Card

New Products

Condenser mic
By AKG Acoustics
• **Vintage TL**: new version of the transformerless C414B/TL that includes the capsule from the C12; 1-inch dual-diaphragm pressure gradient microphone offers four polar patterns: cardioid, hypercardioid, omnidirectional and figure eight; 12.5V/Pa sensitivity; 12dB/octave, 75Hz or 150Hz bass cut; -10dB or -20dB switchable pre-attenuation pad.

Circle (374) on Reply Card

Camera video analyzer
By Sencore
• **CVA94 Video Tracker**: accurately analyzes camera video signals with time-saving digital measurement, waveform and vector displays, and exclusive special tests designed for fast camera servicing and alignment; includes waveform monitor and vectorscope functions with digital measurements; selectable video inputs compatible with composite and high-resolution Y/C camera outputs.



Circle (375) on Reply Card

Modular audio console
By Fidelipac
• **Model MX18E**: available in 8, 10, 12, 14, or 18 channels; features include fader start, pre-fader patch points, independent gain controls for A and B inputs, remote module on/off, and remote start terminals to simplify installation.

Circle (376) on Reply Card

Expander/gate
By dbx
• **274 quad expander/gate**: features four independent channels of expansion or gating, front panel configurable as four mono, two mono and one stereo or dual stereo channels of processing; 3-LED threshold status indicator on each channel speeds setup and provides clear visual indication of gate operation; features VCA and RMS detection circuitry.

Circle (379) on Reply Card

Video filters
By KR Electronics
• **Low-cost video filters**: available in three performance levels; feature group delay equalization, flat passband response and small PCB mount packaging; optional Sin(X)/X shaping for post D/A conversion; available in luminance and chrominance bandwidths.

Circle (380) on Reply Card

Scope/analyzers
By Rohde & Schwarz
• **Video/audio TV scope VTA 62**: half 19-inch width scope; also offers vectorscope function; can analyze CCVS and component signals of the Beta, SMPTE, EBU and MII standards; can monitor phase and level of audio stereo signals on an audio display; can display audio and video signals in any combination; front-panel setting defined by user can be stored and called up at any time.
• **VTA 7x video analyzer series**: includes VTA 71, VTA 72 and VTA 73; ideal for use in studios, monitoring rooms in research and development labs or in the test shop; stores operator-defined test parameters in the integrated memory or on a PC; two operating levels provided: level 1 permits display of waveforms, vectors, pictures and one SC/H phase; level 2 offers a range of tools for the development engineer, such as digital line selects, quad SC/H phase displays, cursors and digital readouts and a 3-D display.

Circle (381) on Reply Card

Intensity control
By Frezzolini
• **Mini-Fill intensity control**: features a built-in intensity control circuit embedded into the Mini-Fill; intensity control knob replaces the on-off switch on the standard Mini-Fill, which is located on the back of the light; intensity control knob includes a built-in on-off switch that varies the intensity of the lamp from 10% to 100% output.

Circle (377) on Reply Card

Wireless systems
By Shure
• **EC series**: transmitters/receivers; available in six lavalier and hand-held configurations; designed to meet the exacting RF standards of Germany and the United Kingdom; feature a new digitally controlled, frequency-synthesized design; transmitter features a new PowerGain antenna that provides up to 10dB more radiated power than competitive transmitters.

Circle (382) on Reply Card

Audio monitoring units
By Vortex
• **PPM-200**: available in stereo and mono versions, with optional 8-way input switching; can be supplied as 2U rack-mounted monitors or as 3U Eurocard modules for integration in larger audio systems; includes internal loudspeaker and amplifier, headphone socket, LED stereo phase and overload indicator, left/right and sum/difference PPM monitoring, and VCA-controlled balanced line output drivers.

Circle (383) on Reply Card

New Products

Desktop systems
By Silicon Graphics

• **Indy**: features its own digital color video camera, an engaging user environment and a host of digital media capabilities with advanced 3-D graphics, imaging and computer performance; supports up to 256Mb of RAM, 2GB of internal disk storage and seven fast SCSI-2 devices.

• **Indigo² systems**: available in three models: XL, XY, and Extreme; offer users CAD, chemistry, animation, CASE, visual simulation, professional video and increased publishing market access.

Circle (384) on Reply Card

User interface
By Silicon Graphics

• **Indigo Magic**: allows technical and non-technical users to easily manage computer tasks and manipulate everyday media.

Circle (385) on Reply Card

Earth station equipment
By LNR Communications

• **LNR TRAMP**: provided as a tripod-mounted flyaway or a trailer-mounted drive-away terminal; gives user flexibility to locate the antenna remotely from the trailer-mounted electronics for operational or geographical reasons; 2.4M multisegment antenna/pedestal meets the need for transportability and rapid deployment with minimum manpower; accommodates worldwide satellite communications through INTELSAT, PANAMSAT, DSCS/NATO, regional and domestic satellites.

Circle (386) on Reply Card

Compressor/gate
By dbx

• **266 dual compressor/gate**: features two fully independent channels of compression and gating that can be master/slave coupled for stereo operation, RMS detection and VCA technology, and attack and release circuitry.

Circle (387) on Reply Card

Fiber-optic transmission system
By T-Tech

• **Audio-Fiber**: complete professional audio transmitter and receiver system for converting analog signals (95dB range) to fiber-optic signals and back again; digital portion of the Audio-Fiber system is designed for four channels; analog circuitry configuration establishes 4-channel or 2-channel operation; applications include broadcast studio-to-transmitter link, with lower loss than possible with committed point-to-point wire line and 100% immunity to interference, noise and hum pickup; TV network stereo audio distribution systems with immunity to hum, interference and noise pickup.

Circle (388) on Reply Card

Catalog
By Plainview Batteries

• **Battery catalog**: features standard and custom miniature rechargeable batteries (Nickel-Cadmium and Nickel Metal Hydride) in a variety of form factors: axial and

New Products

radial leads, flat-paks; in Eco-Pak battery holders with double and single mounting pins (vertical and horizontal); and 7.2V, 8.4V and 9.6V assemblies; also includes complete line of button cells in both chemistries for custom assemblies and performance curves and recommended charge rates for all products described.

Circle (389) on Reply Card

Circuits

By United Technologies Photonics

• **Fiber-optic gyro (FOG) circuits**: designed to operate at either 0.8µm or 1.3µm wavelengths; 0.8µm devices available in reduced sizes (20mm or 25mm lengths) for space-limited applications; fabricated from lithium niobate.

Circle (391) on Reply Card

Computer charger

By Frezzi Energy Systems

• **AR124 NP**: computer charger streamlined for people who use NP1 and BP-90 type batteries between 4.8V to 14.4V, 1-7 Ah; uses ACS; automatic fast charging; recovery program brings over-discharged batteries up to correct voltage for fast charging; maintains peak voltage level of batteries for best performance; detects batteries that have severe faults; compact; adjusts to any AC outlet worldwide.

Circle (392) on Reply Card

Digital video power analyzer

By Hewlett Packard

• **HP 8992A**: features special waveform math functions that can be used to measure broadcast transmitter performance under modern digital-modulation conditions; designed for advanced engineering work in HDTV broadcast; first product of its kind; features screen annotations for peak and average power; special firmware measures cumulative probability density function (CDF).

Circle (393) on Reply Card

Pedestal-mounted fiber-optic link

By United Technologies Photonics

• **Pedestal-mounted multichannel fiber-optic link**: for antenna remoting applications; housed in a compact weatherproof enclosure; operates reliably over a wide range of ambient conditions without a temperature-controlled shelter; rack-mount version available for indoor use; designed for antenna farms or for use with multi-aperture antennas; will transmit at least eight polarizations at an intermediate frequency from a low-noise block down-converter output.

Circle (390) on Reply Card

Radio

By Nucomm

• **Mast-mounted radio:** no mast head power amp; no separate power supply necessary; powered from DC or AC; includes pan and tile control for Quickset pan and tilt mast top unit.

Circle (394) on Reply Card ■

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ELECTRONICS FIELD/SHOP ENGINEER. Swiderski Electronics, Inc. located in the Chicagoland area, is looking for an Electronics Field/Shop Service Engineer with a min. of 2 years exp. Individual to work with Broadcast/Industrial $^1/_2$", $^3/_4$" & 1" VTR's and related equipment. Full time position. Full company benefits. Send resume & salary history to: Human Resources Dept., 1200 Greenleaf Ave., Elk Grove Village, IL 60007. Fax resume to: (708) 364-5019.

COLONIAL BROADCASTING IS ACCEPTING APPLICATIONS for assistant engineer Candidates must have broadcast technical experience or related electronic training. Knowledge of computers desirable. Send resume: WLWI AM/FM, Larry Wilkins, P.O. Box 4999, Montgomery, AL 36103-4999. Phone number: (205) 240-9274.

FULLTIME ENGINEER needed for UHF network affiliate located in the recreational South. Applicant should have UHF XMTR, TCR/Video tape experience. Impressive salary and benefits package. Send complete work history and references to: Broadcast Engineering, Dept. 737, P.O. Box 12901, Overland Park, KS 66212-2901. EOE.

WANTED: RENTAL MANAGER/SCHEDULING COORDINATOR for fast-paced video production company providing location equipment rentals and crew coordination. Knowledge of state-of-art broadcast equipment necessary. Location production experience helpful. Send resume & salary requirements in confidence to: Clark Production Associates, Inc., 601 N. 6th Street, Allentown, PA 18102. NO CALLS.

IN TOUCH MINISTRIES, an Evangelical Christian Ministry, has an immediate opportunity for a Television Maintenance Engineer. The applicant must possess a BS in electrical engineering with communication emphasis, or equivalent experience is required. Must be able to troubleshoot equipment. Excellent benefits. Salary-commensurate with education/experience. Send resume and salary requirements to: In Touch Ministries, 777 W. Peachtree Street, NW Atlanta, GA 30308. Attn: Ovie Sparks.

COMMUNICATIONS SPEC-DESIGN, develop & manage installation & maint. of outdoor broadcast racenet system (incl. audio & video). Provide relief for & improve quality of existing line networks. Resp. for plant & network maint. on underground & overhead lines utilizing digital fault location techniques. Need 4 yrs exp. $2,522/mo. 40 hrs/wk. Send resume to: Job Service of Florida, 2660 W., Oakland Pk. Blvd., Ft. Lauderdale, FL 33311-1347, attn: J.O.#FL0891699.

UHF BROADCAST ENGINEER: Religious television network has an immediate opening in Tennessee for an experienced UHF broadest engineer. Successful candidate will have experience as a chief engineer in transmitter maintenance, microwave, translator, as well as the ability to trouble shoot and repair master control, video tape and audio production systems. FCC or SBE certifications preferred. Travel required. Only resumes that include references and salary histories will be considered. Forward to Chief of Staff, P.O. Box 81521, Mobile, Alabama 36689. Equal Opportunity Employer.

MAINTENANCE TECHNICIAN SHOP/FIELD SERVICE. Immediate opening for a video technician with a minimum of 2 years experience. Person to service $^1/_2$", 8mm, $^3/_4$" VTR's and related equipment. Video projector repair and/or system installation experience a plus. Competitive pay and benefits. Send resume and salary history to: Engineering Manager, AVR, 3830 N. 7th St., Phoenix, AZ 85014. EOE.

TOP CHICAGO POST-PRODUCTION HOUSE seeks Video and Audio Electronic Engineer. Applicants should have an AS degree in electronics (or equivalent experience) and hands-on experience with component level repair on state-of-the-art equipment. System design and installation experience helpful. Salary comparable to experience. Send resume to Engineering, P.O. Box 11536, Chicago, IL 60611.

ASSISTANT DIRECTOR OF ENGINEERING. Midwest ABC affiliate, top 50 market, number one station with a strong commitment to news is looking for someone to lead and direct the department. Strong technical, administrative, and communication skills needed. Also studio, ENG and UHF/VHF transmitter experience required. SBE certification a plus. Send resume to: Human Resources, WHAS-TV, 520 W. Chestnut St., Louisville, KY 40202. EOE.

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