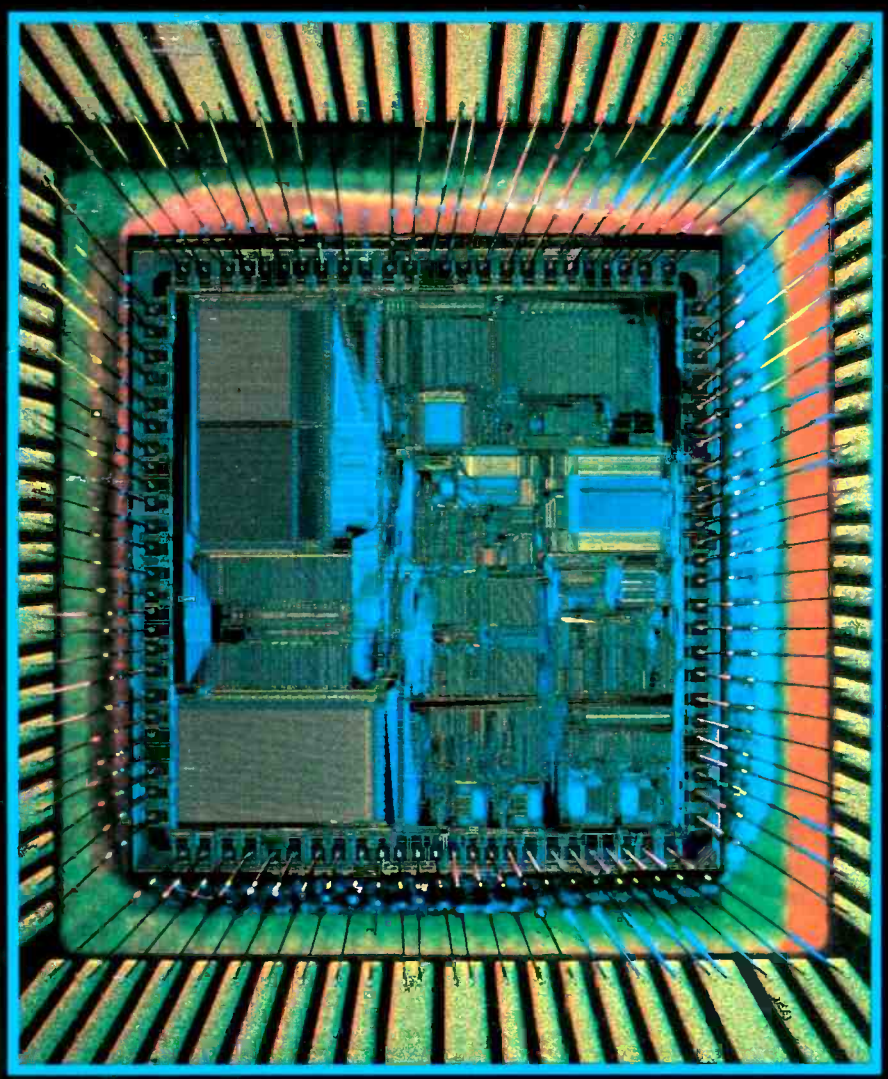
BROADCAST engineering®

AN INTERTEC PUBLICATION

February 1991/$4.50



Winning with digital technology

Electromagnetic radiation p. 48

INTRODUCING THE NEW

SYSTEM 5

100 MHz BANDWIDTH ROUTING SWITCHER

SYSTEM 5 takes the guesswork out of selecting a routing switcher ...for any size facility. Its ultra wide 100MHz video bandwidth gives you the confidence required to plan for future signal formats and is essential today for RGB graphics, HDTV and component video.

And SYSTEM 5's sixteen levels, virtual matrix mapping, and "honest" expansion capability to 1024 x 1024 eliminate your anxieties when buying today for tomorrow's challenges.

Its packaging density offers the most crosspoints per rack unit. For routine maintenance, standard multiple sourced components protect you from unnecessary delays and costs.

SYSTEM 5's controller uses proven designs, is built to exacting specifications with total redundancy for high reliability. It is most flexible ...on-line matrix reconfiguration and diagnostics, RS232/422 ports, internal audio summing and stereo channel reversal, reverse audio path management and a wide range of 8-character down-loadable control panels give you complete command. *(It can be retrofitted to over 1000 of our installed Series H and 40x matrices).*

When it comes to predicting future industry changes, our crystal ball isn't any better than yours, but you can rely on our experience gained from thousands of operating systems...from simple 15x1s to an Olympic communications complex.

Take the guesswork out of your planning. Call now for details and a demo disc for your PC.

Pesa America Inc., 2102 West Ferry Way, Huntsville, AL 35801
205-880-0795 FAX 205-881-4828
West: Burbank, CA 800-323-7372 East: New York City 800-328-1008

A SWITCH INTO THE FUTURE

PESA

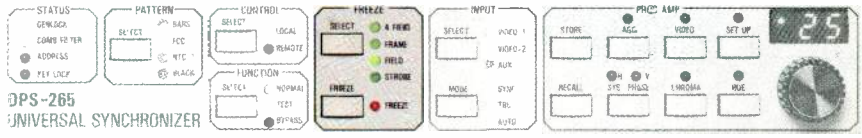
Circle (1) on Reply Card

The Whole is Greater Than the Sum of Its Parts.

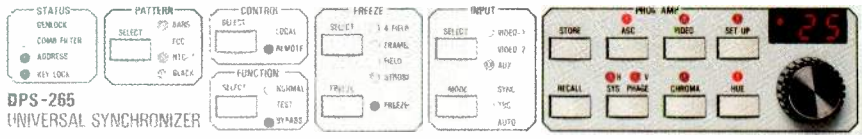
. . . . . The Price is $13,000 Less.

Starting with a Four-Field Wide Band Synchronizer for $5,995.*

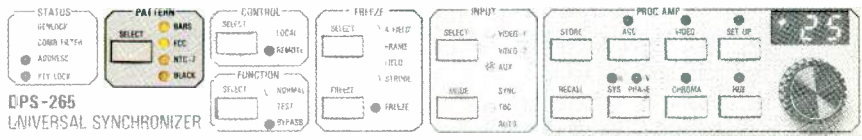
An infinite window TBC for $4,995.*



A Digital Proc Amp with AGC, Black/White Clip and 10 memory presets for $2,580.*



A 4-Pattern Digital Test Signal Generator with programmable VITS Inserter will set you back another $4,995.*

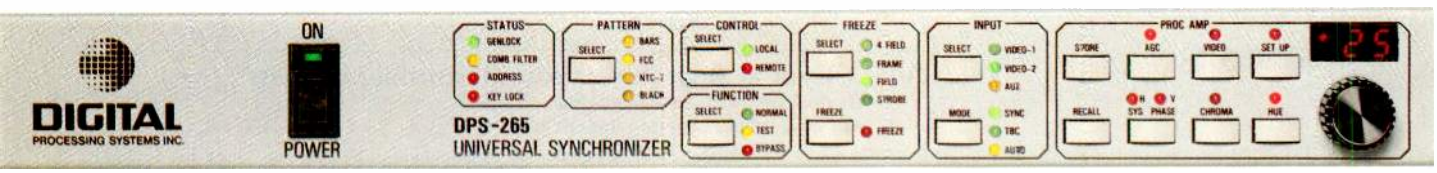


Add it all together and you've spent $18,565.*

But now you can have all these capabilities. And more. In a single unit. For a single low price.

The DPS-265 Universal Synchronizer TBC. Everything you need. And more. For $13,000 less.

Just $5,495



the SOURCE

MIDWEST
Communications Corp.

Four Tesseneer Drive
Highland Heights, KY 41076
(606) 781-2200

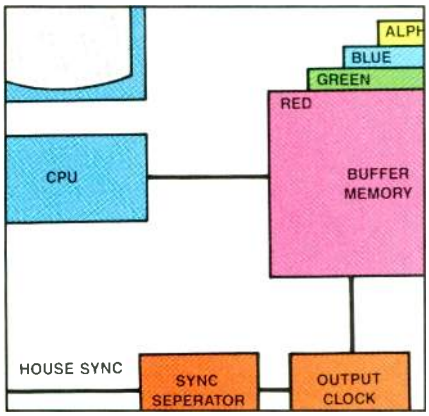
Circle (4) on Reply Card

*Based on published list price of leading industry manufacturers.

Contents

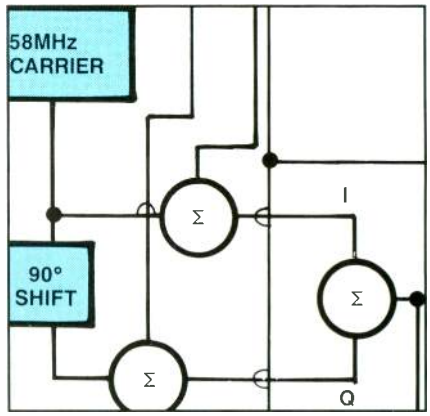
February 1991 • Volume 33 • Number 2

BROADCAST engineering



Page 26

Page 48



Page 54

WINNING WITH DIGITAL TECHNOLOGY:

Today's video and audio products rely more on digital technology than ever. Sophisticated circuits, many based on computers, offer the user features and quality never before possible. As engineers struggle to keep up with the break-neck pace of this advancing technology, viewers and listeners are raising their expectations for even more high-quality service from their favorite radio and TV stations. This month, we examine two key areas where digital technology is leading the way toward better broadcast signals: computer-based systems and video recording formats. We will also discuss RF radiation in broadcast facilities.

DEPARTMENTS

FEATURES:

ON THE COVER

The future of broadcast technology lies with digital processing. Shown on the cover is a Motorola DSP56001 digital signal processor. New digital devices can provide uses with many exciting new capabilities and high-quality features. (Cover Credit, Photograph courtesy Motorola, design, Joni Harding, *BE* graphic designer.)

It's time for new directions in television audio.

Television audio has been changing even faster than the rest of the industry. It's time to take a fresh look at the requirements of today's television station—and to find more effective methods of meeting them.

That's precisely what the designers at PR&E have done. The result, our new STX, is ready for your most challenging on-air and production assignments. Three mainframe sizes are available, each with up to four stereo submaster modules, eight mix-minus buses, four aux buses, and three stereo outputs.

This is a genuine stereo console, with stereo CUE and SOLO, plus a stereo effects return. Operators can check pre- or post-fader level and balance on accurate true VU meters before sending program to air. Built-in distribution amplifiers on the three stereo outputs make routing audio to multiple locations easy.

Your STX will be configured to your operators' needs—input and submaster modules can be located anywhere on the mainframe. Mono and stereo input modules have over thirty dB of headroom to handle the widest possible range of source levels. Multiple switchable inputs with rapid gain adjustment get the source up fast. Electronically controlled switching ensures silent, long term reliability. Differential (balanced) bus summing minimizes noise and eliminates RF interference.

A stereo television console this reliable, with this level of performance and this complement of intelligent features, could only come from one manufacturer—PR&E. For more than two decades, we've had just one goal—to design and build audio equipment that functions superbly in the broadcast workplace. For more information on how our STX Stereo Television Console fulfills that purpose, call us direct at (619) 438-3911.

STX

The Stereo Television Console

Pacific Recorders & Engineering Corporation
2070 Las Palmas Drive • Carlsbad, CA 92009
Tel 619-438-3911 • Fax 619-438-9277

News

By Dawn Hightower, senior associate editor

Philips unveils new digital tape format

Philips debuted its digital compact cassette (DCC) format at the Consumer Electronics Show in Las Vegas last month. Although the system will use a new type of cassette for digital recording, it will also play back standard analog audiocassettes.

The DCC system is the first commercial recording medium to implement a psychoacoustically modeled digital compression system, such as those under consideration for digital radio broadcasting. Philips' algorithm for the format, called precision adaptive subband coding (PASC), uses 32-subband processing to achieve a 4:1 reduction in data rate, operating at 32kHz, 44.1kHz or 48kHz. Recording of the resultant 384kbit/s stereo audio data is accomplished on eight parallel tracks across approximately one-half of the DCC's tape width. An additional track is used for alphanumeric data. The system is auto-reverse bidirectional, with a single thin-film, full-width multitrack head used for analog and digital record/play operations. Maximum recording time is said to be 60 minutes per side (two hours total), and the first production units are scheduled to be available sometime in 1992.

SuperNTSC advanced TV system ready for commercialization

Dramatically sharper TV pictures may be less than two years away according to Faroudja Research Enterprises. The company has withdrawn its SuperNTSC system as a proponent for the FCC's advanced TV systems standard-setting process, and is proceeding to commercialize the system.

The SuperNTSC system uses a standard TV broadcast channel, and requires only low-cost modification of broadcast and cable equipment. It is fully compatible with current televisions.

As the first step in the commercialization of SuperNTSC, the company will, in the near future, conduct public over-the-air demonstrations and consumer testing in major markets around the country.

ATTC converter passes initial tests

The Advanced Television Test Center (ATTC) has successfully demonstrated the process of format conversion, which permits several different incompatible forms of advanced TV signals (ATV) to be recorded in real time on a commercially available high-definition digital videotape recorder.

The demonstration took place in Beaverton, OR, where the ATTC Format Convertor, a new device, has been under development by Tektronix, for the test center for the past year. Charles Rhodes, ATTC chief scientist, invented the converter.

The format conversion process is vital to the plans of the FCC Advisory Committee on Advanced Television Service for testing the several different ATV transmission systems seeking to become the U.S. TV standard.

Mexican government selects Motorola

Motorola has announced that the Communications and Transports Secretariat for the government of Mexico has selected its C-Quam AM stereo system as the technical standard for the transmission of stereophonic sound by AM radio broadcasters in that country. The selection resulted from a 3½-year effort to test and institute a single system standard for broadcast use in Mexico.

Museum of Communications looks back into history

The relocated National Museum of Communications offers visitors a look back into history in several communication areas, including broadcasting and printing. The museum is located at Four Dallas Communications Complex, 6305 N. O'Connor, Suite 123, Irving, TX.

The museum displays many early forms of communication, some which may be used by visitors. Working teletypes, complete 1940-era radio broadcast studios and 100-year-old telephones are available for demonstration. Century-old books and ancient scrolls from biblical times also are on exhibit.

The museum operates from donations in terms of financial support and exhibition items. Stations with equipment to donate or those who have questions about the museum can call 214-556-1234.

EDITORIAL
Brad Dick, *Editor*
Carl Bentz, *Special Projects Editor*
Rick Lehtinen, *Technical Editor*
Skip Pizzi, *Technical Editor*
Tom Cook, *Senior Managing Editor*
Dawn Hightower, *Senior Associate Editor*
Stefanie Cudnik, *Associate Editor*
Sharmion Linseisen, *Editorial Assistant*
Pat Blanton, *Directory Editor*

ART
Joni Harding, *Graphic Designer*

BUSINESS
Cameron Bishop, *Group Vice President*
Duane Hefner, *Group Publisher*
Jerry Whitaker, *Associate Publisher*
Tom Brick, *Marketing Director*
Evelyn Hornaday, *Promotions Manager*
Jon Newman, *Promotions Coordinator*
Dee Unger, *Advertising Business Manager*
Mary Birnbaum, *Advertising Production Supervisor*
Sally Nickoley, *Advertising Coordinator*

ADMINISTRATION
R.J. Hancock, *President*
Doug Wilding, *Circulation Manager*
Customer Service: 913-541-6633

TECHNICAL CONSULTANTS
Eric Neil Angevine, *Broadcast Acoustics*
John H. Battison, *Antennas/Radiation*
Dennis Ciapura, *Radio Technology*
Dane E. Ericksen, *Systems Design*
John Kean, *Subcarrier Technology*
Donald L. Markley, *Transmission Facilities*
Harry C. Martin, *Legal*
Elmer Smalling III, *Cable/Satellite Systems*

MEMBER ORGANIZATIONS
Sustaining Members of:
- Acoustical Society of America
- Society of Broadcast Engineers
- Society of Motion Picture and TV Engineers

Member, Association of Business Publishers ABP
Member, Business Publications Audit of Circulation BPA

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

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

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

CORRESPONDENCE
Editorial and Advertising: P.O. Box 12901, Overland Park, KS 66212-9981. Telephone: 913-888-4664; telex: 42-4156 Intertec OLPK; fax: 913-541-6697. Circulation correspondence should be sent to the above address, under P.O. Box 12937.

Advertising offices listed on page 79.

INTERTEC PUBLISHING CORPORATION

Introducing The Nikon S19x8B

There'll be times it's the only lens for the job.

In the world of ENG/EFP, disasters aren't planned. So you've got to plan ahead. After all, the biggest disaster is being on the scene but too far back to get the shot. That's why Nikon went to great lengths to create the S19x8B Lens for CCD cameras.

For a lens of this range, it's wonderfully light and maneuverable. So you never have to get too close to get close enough. The smooth zoom whisks viewers right into the heart of the subject matter.

From making our own glass to the final QC tests, we make sure the S19x8B is worthy of the Nikon name. Extra-Low Dispersion (ED) glass, Nikon anti-reflection coating, high-flat MTF curve, it has it all, and more, all wrapped up in a rugged housing of magnesium alloy.

And never a time it isn't.

The S19x8B may well be the only lens you ever need. Forget about lugging around a variety of lenses and fumbling around mounting them. The S19x8B's minimum object distance (37") and 8mm minimum focal length, providing expansive wide angle coverage, make it ideal for everyday use as well. That's unsurpassed range for an ENG/EFP lens.

To guarantee you can use it every day, the S19x8B comes with something else that's unsurpassed — Nikon's unique Express Loaner Service. If disaster ever strikes your lens, we'll get you a loaner lens overnight. So now there will never be a time you're really 'out' in the field.

To find out more or for our complete brochure, call 800-NIKON-US or (516) 547-4355 or write: Nikon Electronic Imaging, Dept. D1, 101 Cleveland Avenue, Bayshore, NY 11706.

Nikon
ELECTRONIC IMAGING

Circle (6) on Reply Card

Selecting a digital radio standard

A guest editorial

Within one year, digital radio broadcasting (DRB) has catapulted from obscurity to one of the hottest telecommunications issues of the '90s. The entire radio industry is excited about the future of DRB. However, in the rush to adopt technology, it is easy to make a mistake.

As with many of the electronic developments of the '70s and '80s (VCRs, CD, DAT), it seems that American innovation has been left at the starting blocks. This may again be the case with DRB. Currently, only one DRB proposal has undertaken on-the-air testing. However, others are in the wings.

In the FCC's Notice of Inquiry on *Digital Audio Radio Services*, an important consensus emerged: Radio's means of transmission must keep pace with competitors, but such a fundamental change must be implemented only after careful consideration.

The FCC has, in essence, given a yellow light to DRB. The commission is telling us to proceed into this exciting new territory, but with an abundance of caution. In legal venues, this is called making a best judgment based on the *totality of the circumstances*.

The primary examination for communications standards was established some 60 years ago. It's called *the public interest standard*. This standard must be applied to the selection of DRB. The formidable task for the commission will be, on balance, what is best for the American people?

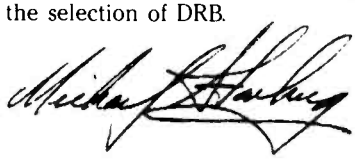
FCC chairman Al Sikes recently noted that just three years ago, America was barely contemplating how to match the foreign developments in ATV. However, thanks to the high stakes and the spur of a reasonable, yet essentially arbitrary, deadline, American know-how has kicked in the afterburners and left the pioneers of HDTV in the backwaters. Digital radio will likely be no exception — if given the chance.

The commission established an elegant model for selecting an ATV standard. Although some time is required to complete the process, the process ensures that the best interests of the American public (including broadcasters) will be met.

There can be only one digital radio standard. Fowler's folly with marketplace selection was a disaster no one wants to repeat. Although the European Eureka project has creatively demonstrated the viability of DRB technology, few would argue that no further development is warranted or possible.

Broadcast technology has several examples of early technology not being the best option. America could have stayed with the original mechanical color-wheel standard for color television. Or, the commission could have standardized on the original MUSE HDTV standard. However, when it comes to technological innovation, the industry has been better serviced by a careful and thorough examination of all the alternatives. We need a DRB standard, but it must be one selected through careful examination of all the options.

Inscribed over the west entrance of the U.S. Department of Commerce building is the phrase, "Let us raise a standard to which the wise and honest may repair." The rigorous examination required by the public interest standard has guided American communications since the beginning. That same high principle should be applied to the selection of DRB.



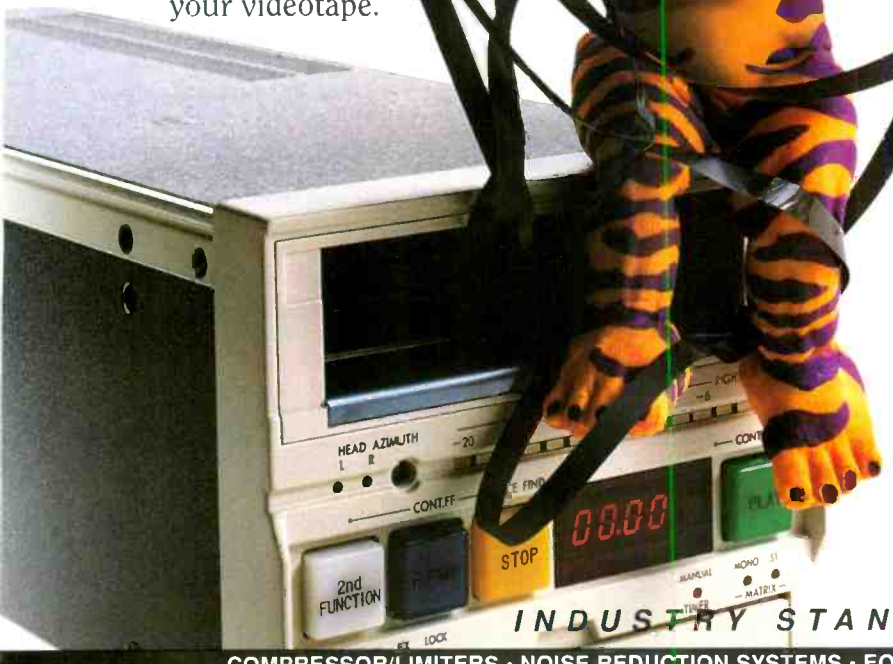
Michael Starling,
Co-chair, Committee for Digital Radio Broadcasting (CDRB), Washington, DC.

Double-Barreled Noise Patrol

The Noise Gremlins wage a constant battle to make your audio worse than your competition's. They sabotage your ratings by making your carts sound noisier than CD's...making your remote feeds sound remote...and making the audio sound many generations older than the video on your videotape.

Neutralize the Gremlins with proven dbx® Type-II protective processing. Available in two different configurations to suit your logistics and war chest, the dbx Type-II system delivers as much as 40dB of additional quiet to your audio without requiring alignment tones or critical level adjustments.

The results are immediate and obvious, and as close as your favorite hardware supplier. So call today, and let our noise control veterans win the battle for you—so you can get back to winning the ratings war!



dbx PROFESSIONAL PRODUCTS

INDUSTRY STANDARD

A division of
AKG Acoustics, Inc.
1525 Alvarado Street
San Leandro,
California 94577, USA
Tel: (1) 415/351-3500
Fax: (1) 415/351-0500

COMPRESSOR/LIMITERS • NOISE REDUCTION SYSTEMS • EQUALIZERS • MODULAR PROCESSORS

Circle (7) on Reply Card

FCC update

Hearing procedures streamlined

By Harry C. Martin

At its meeting on Dec. 13, the FCC adopted new rules designed to expedite the resolution of comparative hearing cases involving new applicants.

- The hearing fee in broadcast comparative cases will be due approximately 30 days after the deadline for petitions to deny, which is well before hearing designation.
- Standardized document production orders and integration statements have been prescribed. In its comments on the proposed hearing reforms, the Federal Communications Bar Association recommended standardization in these areas, which have been treated differently, depending on the administrative law judge assigned to the case.
- Time limits for the completion of depositions, interrogatories and other discoveries have been imposed. Discovery must be completed within 90 days after issuance of the hearing designation order.
- Time guidelines have been established for various phases of the hearing and the preparation of the initial decision. Direct case written exhibits will be due 30 days after the conclusion of discovery. The hearing will commence 15 days thereafter. Proposed findings will be due 45 days after the conclusion of the hearing, with replies due 15 days thereafter.
- Limitations on oral argument and time guidelines on the completion of the review process have been imposed. Oral argument before the review board will not be permitted unless the board finds it useful to resolution of an appeal. The board will be expected to act on appeals within five months after the initial decision. The commission has committed itself to deciding appeals from board decisions within six months after release of the decision.

In addition, the commission amended its "Rurach" policy to ensure that integration and divestiture commitments made during the comparative hearing process may be abandoned only if a case is settled before the deadline for notices of appearance. Furthermore, applicants entering into partial settlements through mergers will not be permitted to upgrade their comparative standings in hearings.

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

The commission also declined to eliminate or alter the "Anax" doctrine, which permits applicants to exclude limited partners and non-voting stockholders from their calculations in determining their comparative credit for integration of ownership into management and for diversification.

In a separate statement, commissioner James Quello recommended that the commission initiate a new rulemaking proceeding to re-examine the agency's policies for evaluating competing applications. Quello said that among the new criteria that should be considered is a "finder's preference" for applicants who search and find a vacant allotment.

Settlement payments limited

The commission has limited the amount of payments that can be made to settle comparative hearing cases involving applications for new broadcast stations. Under the commission's new rule, dismissing applicants may receive only their legitimate and prudent out-of-pocket expenses up to the point that the trial phase of the hearing commences. After that, payments are prohibited.

The commission said these limitations will help deter sham applicants and prevent exploitation of the comparative process, while expediting the hearing process through early settlements.

Permitting settlements before hearing, as well as limiting recovery to legitimate and prudent expenses, will encourage only bona fide applicants to apply. This is because expenses could be recouped only up to the point at which a realistic assessment can be made of the probabilities of success in the hearing.

Parties seeking approval of a settlement before the start of the trial phase of the hearing will be required to submit the following items:

1. Certifications that they have not received and will not receive money or other consideration in excess of their legitimate and prudent expenses.
2. An account of the exact nature and amount of any consideration promised or paid.
3. An itemized accounting of the expenses for which they seek reimbursement.
4. The term of any oral agreement relating to the dismissal or amendment of the application.

Applicants dismissing after the start of the trial phase will be required to certify that they have received no consideration.

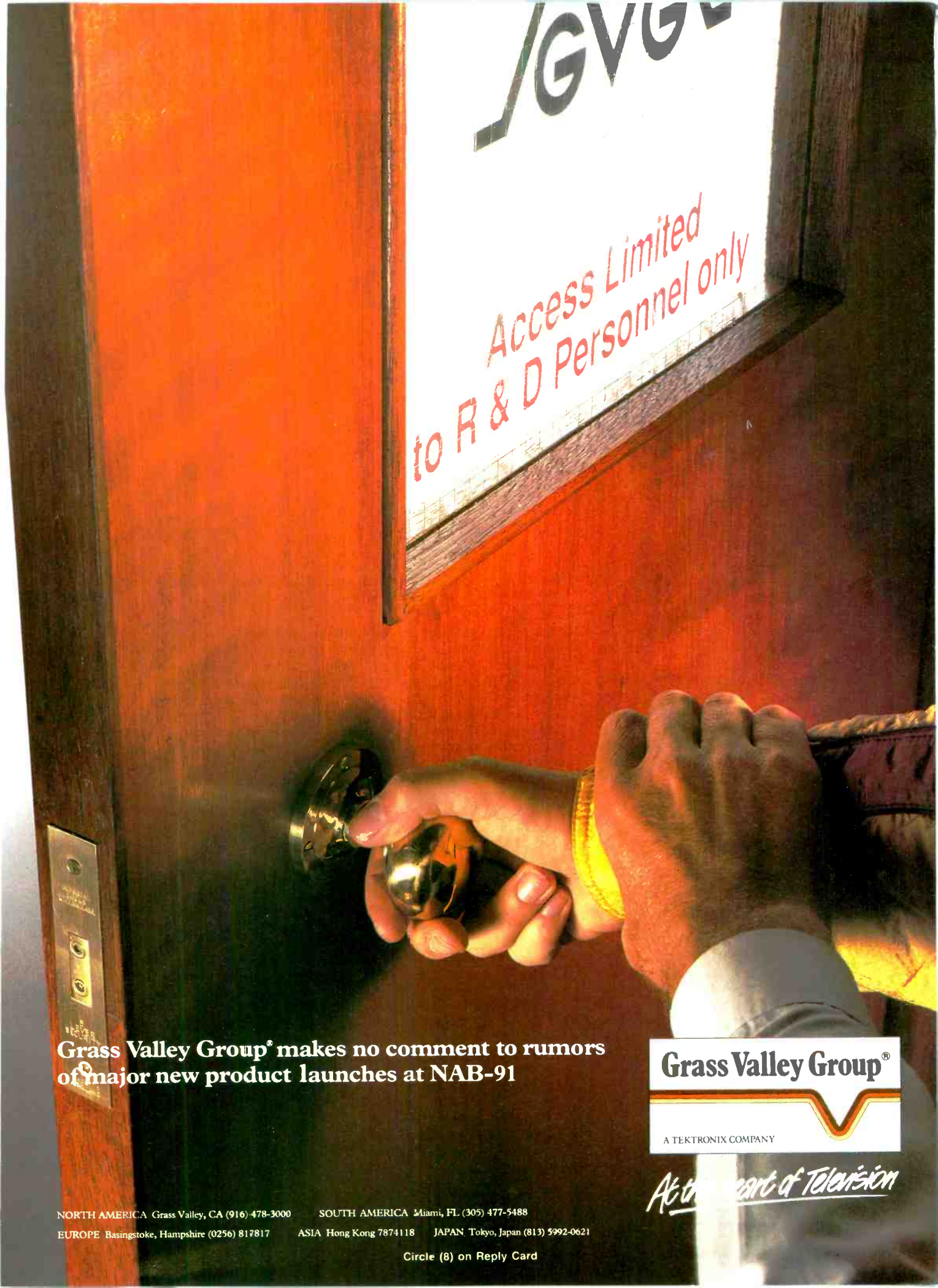
The commission has clarified that itemizations of professional expenses may be submitted in statement form and that principals of applicants are not entitled to reimbursement for services performed on behalf of the applicant. Settling parties will be required to submit any ancillary agreements they have made, such as consulting agreements, or to certify that no such agreements exist.

The new rules will apply to all applications, including those that are currently pending. However, it is expected that there will be a 90-day grace period, because the rule changes must be approved by the Office of Management and Budget.

FCC studying criteria

The commission is proposing to change its "3-signal standard" (whether three TV signals can be received off the air) for determining whether a cable system is subject to effective competition, and thus exempt from local franchising authority rate regulation. It is proposing that effective competition be presumed to exist if one of the following three tests is met:

- An independently owned, competing multichannel video delivery system (for example, another cable system, MMDS or DBS) is available to 50% of the homes passed by the system and is subscribed to by at least 10% of such homes.
- Six unduplicated, over-the-air TV signals are available in the cable community, and cable penetration is below 50%.
- The incumbent cable operator provides a basic service tier at a competitive price level, as well as a minimum level of customer service. The system would be deemed subject to effective competition if it offered a package of basic tier services corresponding in rates and quantity to those in communities where competition is readily apparent.



Grass Valley Group® makes no comment to rumors of major new product launches at NAB-91

Grass Valley Group®

A TEKTRONIX COMPANY

At the heart of Television

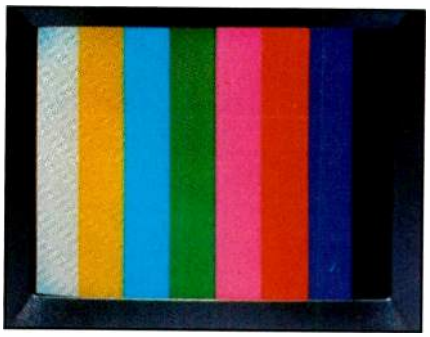
NORTH AMERICA Grass Valley, CA (916) 478-3000 SOUTH AMERICA Miami, FL (305) 477-5488

EUROPE Basingstoke, Hampshire (0256) 817817 ASIA Hong Kong 7874118 JAPAN Tokyo, Japan (813) 5992-0621

Circle (8) on Reply Card

Part 2

Strictly TV



Teaching "non-techies" about color

By Andrew Suk

Engineers have long been involved in the informal training of equipment users. Certainly, not every director, producer or camera operator needs a degree in electrical engineering. However, individuals involved in producing or controlling a video image should have a working knowledge of the basic parameters of that image. Let's take a closer look at the color video signal, and things you might teach non-technical co-workers about its adjustment.

Burst levels

The video signal has two parts: luminance, the black-and-white portion, and chrominance, the color information. Look at a waveform monitor displaying color bars from a color-bar generator. Switch the scope into 2H sweep. Select "flat" response.

Notice that the signal starts with +20IRE to −20IRE of color burst. The 40-unit color-burst signal is a color reference signal. The level of burst should never vary from 40IRE. If it does, the operator control used to adjust the burst height is probably labeled "burst gain," "burst amplitude," "burst level" or, possibly, "color reference level."

Moving from left to right, the next step on the color-bar signal is an unmodulated (flat) step. This first flat step corresponds to the white bar on the picture monitor. Not all color-bar generators are the same. The bar signal could be 100IRE or 77IRE, depending on which generator you're using.

The next six bars on the scope are the actual colored bars that you see on the picture monitor. Note that the first two bars top out at 100IRE, and the last two bars drop to −16IRE. The last step is another unmodulated bar at 7.5IRE. This is the black bar in the pattern.

Setting video levels

The six colored bars are modulated with a subcarrier frequency. This greatly increases their "bulk" on the waveform display. Move the "flat" switch to the "IRE filter" or "low-pass filter" position. This removes color burst and chrominance from the waveform display, and what remains is luminance. Monitor and set video-luminance levels with the switch in this position.

Video levels higher than 100IRE cause problems. Studio equipment can tolerate slight overshoots, such as scene highlights. But levels that are too hot may cause an annoying audible buzz during transmission. In most facilities, protective processing equipment limits or "clips" the levels to some preset maximum, usually 105IRE. In the clipping process, hot scenes saturate and wash out.

Conversely, if the peak white of your video does not approach the 100IRE mark, your image will appear dark and have poor contrast. True black in an NTSC video image is 7.5IRE. If the black level drops below that mark, the video is "crushed." The natural brightness is destroyed as the contrast range is stretched. The image becomes muddy, and portions of the image that should be black become some shade of gray.

Remember that all scenes do not contain strong whites or darks. There is nothing wrong with having a waveform with no active video approaching either 100IRE or 7.5IRE. If peaks and blacks (when they occur) reach 100IRE and 7.5IRE, respectively, the intervening video levels are probably fine.

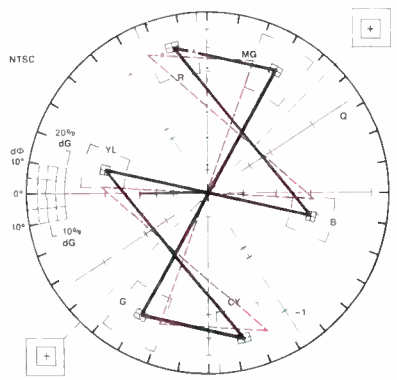


Figure 1. A vectorscope display showing (a) correctly set-up chroma levels, (b) a chroma phase or hue problem, (c) chroma level too low, and (d) chroma level too high.

Vectorscopes

Just as the waveform monitor measures luminance levels, the vectorscope measures chroma or color levels. This is not the instrument's sole function — it can also make some important engineering measurements involving system timing, SC/H phase and non-linear distortions. However, for this discussion, I will deal only with chroma levels and minor hue adjustments.

Let's view some color bars on the vectorscope. (See Figure 1.) Rotate the phase control of the scope so the burst vector is at the 9 o'clock position. With a proper color-bar signal, the color-bar dots will center on the crosshairs inside the small boxes. Should the whole array of dots appear rotated to either the left or right of the boxes, the vectorscope is indicating incorrect color phase. Minor shifts away from the crosshairs are common. If the dots fall within the small boxes, the signal is usually acceptable. The small boxes represent a 2% error window. The surrounding larger boxes represent a 20% error. The operator control for this is a "hue," "color-phase" or "chroma-phase" adjustment. (Warning: Do not confuse this with the "burst-phase" or "subcarrier-phase" adjustments. These controls affect system timing and SC/H phase, and are better left to the engineering staff.)

If the color-bar dots measured radially from the center of the screen exceed or fall short of the small boxes, the vectorscope is indicating a chroma-level error. Adjust the "chroma gain" or "chroma level" control to correct this problem.

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

Shure L Series brings reliability and professional performance to affordable wireless.

Why spend more than you have to?

Maybe you thought you had to spend a lot of money for a wireless system that would offer reliability and broadcast-quality performance. The Shure L Series will live up to all of your expectations, and the price will pleasantly surprise you.

L Series wireless microphone systems are designed and built in the U.S.A. by Shure, the company that set the standard for professional broadcast audio equipment with the SM7 studio microphone and the M267 production mixer. Now we're setting a new standard for performance and value in wireless microphone systems.

We didn't forget the details.

Unlike many other systems in the same price range, L Series systems include many of the features that set professional-quality wireless products apart from the "toys." Shure L Series receivers are sturdy, metal-cased, and rack mountable. Antennas are detachable and may be remoted to provide excellent performance in situations where many other wireless systems have trouble.

Our L1 Body-Pack Transmitter has features like a separate audio mute switch and a universal 4-pin "Tiny QG" connector that accepts a variety of microphones and other signal sources. And L Series lavalier systems come with the 839W, a reliable Shure condenser lavalier microphone designed for clear, natural vocal pickup.

The L2 Handheld Transmitters, available with interchangeable SM58, SM96, and Beta 58 capsules, offer durability, compact size, light weight, and provide the same distinctive sound as their wired counterparts.

The Performance You Demand.

Even though L Series components are affordably priced, they incorporate sophisticated RF technology. The L4 Diversity Receiver utilizes "intelligent" MARCAD™ circuitry to monitor signals from its two independent RF sections, blending them in the optimum proportion—not merely switching them. The result is reliable, uninterrupted audio with no clicks, no pops. And all L Series systems feature Shure "Mirror Image" companding, plus high-gain, low-noise MOSFETSs, a broadcast-quality quadrature detector, and a 3-pole Chebyshev audio filter. It all adds up to outstanding audio quality with exceptional freedom from noise and distortion.

Why not take advantage of the reliable performance L Series wireless systems provide?

You need dependable wireless systems, but now you don't have to spend a lot for them. So why bother with more expensive systems when reliable and affordable wireless is available from Shure?

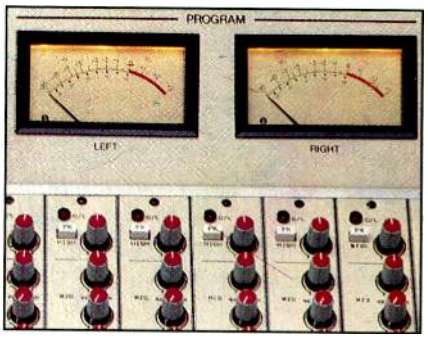
For more information about the Shure L Series, call Shure Customer Services at 1-800-25-SHURE. The Sound of the Professionals®...Worldwide.

THE SHURE WIRELESS

L SERIES

Circle (9) on Reply Card

Radio recollections



By John Battison, P.E.

Sitting at my computer, reading about DAB and DAT, and thinking about the fantastic strides radio broadcasting has made since it was born in the 1920s, my memory slipped back to 1923 when I first heard the crystal wireless set my father had built. That's when I first became smitten with the medium.

In England, radio broadcasting originated with G2LO, generally known as 2LO, where the cheery voices of BBC announcers proclaimed, "This is London calling!" I've forgotten its wavelength (all British and European stations were generally listed in meters), but it was somewhere around the middle of the MF band. Then a long-wave station, G5XX Daventry, came on around 2,000m. It could be heard all over England and much of Europe. Soon, the long-wave band of 1,500m to 2,000m became popular because of its ideal groundwave characteristics, and many of the surrounding countries established such installations.

In those days, receiving antennas were constructed of two parallel 60-foot lengths of insulated antenna wire, spread approximately three feet apart, with insulators at each end. These contraptions were hung at rooftop level.

My father's receiver worked well, but I wondered why he had an additional piece of insulated wire connected to the receiver. The other end was soldered to a cigarette tin and rested on the table. The tin was filled with dirt from the garden, and appeared to do nothing. Eventually, I discovered that the tin was supposed to be buried in the ground to make an *earth*. My father had misread the instructions. A few years later, he let me help him build a 3-valve receiver that operated from a storage battery (accumulator), with a dry-cell B+ supply (high-tension battery) of approximately 100V.

About this time, Herbert White, a man to whom I owe a great deal, opened a radio shop. From then on, I spent more time talking to him than his customers did. I built receivers and transmitters, and discovered amateur radio. The BBC was stodgy in those days, and dance music was rare except for live remotes from London hotels late at night. Music was still legal on ham bands, and on Sundays from noon until 2 p.m., a neighborhood radio store owned by a ham, G5OK, broadcasted gramophone records.

Progress continued, and in the late 1920s, a local man and his friend invented the battery eliminator. This was a device that replaced the costly 100V high-tension battery. The two men formed the EKCO Radio Company and became one of the largest prewar radio manufacturers in England.

Our electric power was delivered at 230VDC. I promptly made eliminators for our radios and for many of my friends. The parts consisted of an LF choke of some unknown value, a 2F paper capacitor and a few resistors to form a voltage divider for the various voltages. Effective, but deadly — although I never heard of anyone being fatally zapped from this hot 230VDC supply to ground. A few years later, the town's mains supply was modernized and converted to AC at 230V, 50Hz. The power company paid compensation to have transformers, rectifiers and filters installed in everyone's eliminators. This made for safer operation.

In 1928 or '29, the BBC started to broadcast 30 minutes of television at 11 a.m. on Tuesdays and Thursdays. The 30-line transmissions consisted of close-ups of male and female singers, with vision on 2LO and sound on the second BBC MF station, around 440m.

My receiver consisted of a "beehive" neon night-light lamp, an LF amplifier connected to the receiver to drive the neon, a whirling 16-inch aluminum disc with 30 holes in a ragged spiral and an electric motor. Speed control was performed by a crude governor. Good reception was elusive — but I once saw a dim red image. I didn't bother about the sound, though. It was during this time that I first realized that modulation is something that messes up a nice, clean carrier!

I used to read *Amateur Radio* and *Wireless World* avidly, and joined ARRL, subscribing to that magazine as well. I progressed from regenerative receivers to superheterodynes. But I occasionally had problems understanding construction details. It was not until 1945, when I came to the United States and saw an American Quaker Oats box, that I understood why we were told to "wind 30 turns of No. 20 enamelled wire on a Quaker Oats box." The English Quaker Oats boxes were, and are still, floppy rectangular cardboard cartons.

Five meter operation, using unity coupling (a thin grid wire running through a small diameter copper tube for plate tuning) came into vogue. Around that time, I became interested in flying. We formed a club and built the "Flea" ultralight aircraft. I had a fine, 1-way, 5m connection to the aircraft for our instructor to help students — until the authorities closed down my transmitter.

Car radios were becoming popular, but high battery drain was a hindrance. We used rotary generators to power our receivers for a time, until the vibrator power supply was perfected. Radar was a secret word we never heard nor used, but stories were around. In 1937, EKCO brought out a TV receiver with a 10-inch tube to receive the daily BBC TV programs. These included remotes from all over the country in addition to the usual studio productions, and the service was extremely popular.

My last radio job before the war involved the design and production of radio equipment for the RAF. Looking back, it's almost impossible to understand how any of it ever worked in our aircraft; unfortunately, it often didn't. Even in 1939, radio equipment used clumsy, dry-cell B batteries. During the war, our radio often failed because of a run-down battery.

I remember vividly one piece of ground-receiving equipment. It was a superhet. Every tuned stage had a separate variable capacitor, and the IFs were individually tuned in the same manner.

I left the Air Ministry to become a flying instructor. Shortly thereafter, on active RAF duty in 1939, I learned first hand how well some of our radio equipment worked.

In 1945, I joined KMBC, and my love affair with U.S. broadcasting began. Although broadcasting has changed, the fascination is still there for me, and for many other engineers as well — despite digital operations. [:-)))]

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

Extreme Measures

High-performance Audio Testing With System One + DSP

DESIGNING, MANUFACTURING and MAINTAINING high-performance analog & digital audio equipment places **extreme** demands on your test equipment. Your test set must have **extremely** low residual noise and distortion as well as **extremely** high accuracy…and the variety of systems under test calls for **extremely** flexible test set-up and control.

System One + DSP from **Audio Precision** is the solution. The trace below is a **System One + DSP** FFT spectrum display showing the residual distortion performance of our generator and analyzer. 2nd harmonic distortion of the sine wave is 125dB below the 1kHz fundamental level before nulling. The 3rd, 5th & 7th are all even lower!

This self test is typical of the high-performance, high-accuracy measurement capability of **System One + DSP**.

System One + DSP features include:

- Dual Channel FFT Analyzer – Signals up to 80kHz may be acquired and analyzed with 16 bit resolution.
- Waveform Capture – Acquire and display signals on the PC screen for analysis in time domain "digital storage oscilloscope" mode.
- Harmonic Analysis – Perform harmonic analysis such as measurements of individual distortion components, with automatic tracking to 9th harmonic.
- Processing Power – Dual high-speed 24 bit internal DSPs and precision 16 bit analog I/O conversion.
- Low residual THD + N – Total analog system THD + N (22kHz bw) .001%. DSP analysis permits resolution of distortion as low as 145 dB below fundamental.

System One + DSP…When you're serious about performance.

System One

Audio precision

P.O. Box 2209, Beaverton, OR 97075
503/627-0832 1-800/231-7350
FAX: 503/641-8906, TELEX: 283957 AUDIO UR

Circle (10) on Reply Card

SBE seeks support

By Bob Van Buhler

The SBE has begun its most ambitious Washington project to date. Based upon a long-term goal of board member Dane Ericksen, the society will seek a major improvement in the overall composition of the FCC. The SBE proposal would require that at least one FCC commissioner be an engineer.

Since the creation of the FCC in 1934, only eight of the 64 commissioners can be classified as engineers. Charles D. Ferris, who served on the FCC during the Carter administration, was the last commissioner to have a background in engineering. No other commissioners with an engineering-related background have served on the FCC since the mid-1960s.

Engineering expertise

Although the FCC deals with many regulatory facets, its basic purpose is to regulate communications technology. The society believes this purpose would be better served with more engineering involvement. The Communications Act of 1934 permits each commissioner to appoint up to three adviser-assistants, but only commissioner Quello has seen fit to do so.

How you can help

SBE members can support the campaign by writing to their congressional leaders, especially those who are members of the communication subcommittees. Ask them to support the legislation. Addresses for each subcommittee member may be obtained from the SBE office at P.O. Box 20450, Indianapolis, 46220. Letters and telephone calls by chapter chairs and members are important. Writing to your congressman or senator can be particularly effective.

Take a chapter vote to see how your members feel. Then have the chapter chair call the representatives and senators. This can be effective if the chapter chair can say that he or she is representing a group of professionals that share the same position.

FCC proposes adoption of SBE suggestion

The FCC recently proposed the implementation of an SBE petition for rulemaking to define the term "congested area," and to set minimum standards of antenna performance in those areas.

The term *frequency-congested area* has been used by the commission since 1981. Unfortunately, it was never officially defined in the original rulemaking. In a recent notice of proposed rulemaking (NPRM), the FCC suggested the adoption of the basic elements of the SBE plan.

The SBE petition defines all Census Bureau standard metropolitan statistical areas (SMSAs) as congested areas, and specifies minimum dish size for various Part 74 point-to-point microwave bands. The measure was given enforcement by specifying that stations authorized prior to 1981 have a 10-year grandfather period that would expire Oct. 1, 1991. If improved (defined as *Category A*) antennas are not installed and documented by that date, then the Part 74 license would not be renewed. Lower performance, or *Category B antennas*, are permitted in areas outside of SMSAs.

The NPRM also seeks to have the FCC establish a *congested site* list to address sites on mountaintops or tall buildings that have become heavily congested because of their favorable location. Many of these are located outside of the SMSAs, but still produce congested spectrum usage.

The measure has a safety valve provision to prevent design overkill, which could result in smaller SMSAs being required to use antennas with excessive performance capabilities when they're actually not needed. The SBE says exemptible SMSAs should also be identified.

The measure is a necessary part of efficient spectrum management and proper frequency coordination. The SBE is currently working with its nationwide network of frequency coordination committees to identify congested sites for the FCC list. Contact your local frequency coordinator for more information. To find out who your coordinator is, call Paul Lentz, SBE secretary, at 419-882-5906.

House Telecommunications and Finance Subcommittee

Chairman:	
Edward J. Markey	
Members:	
Edward R. Madigan	Thomas J. Manton
Jack Fields	Thomas J. Tauke
Jim Cooper	Tony P. Hall
Jim Slatterly	W.J. (Billy) Tauzin
John Bryant	Al Swift
Matthew J. Rinaldo	Bill Richardson
Michael G. Oxley	Cardiss Collins
Michael L. Synar	Carlos J. Morehead
Rick Boucher	Dan L. Schaefer
Ron Wyden	Dennis Eckart
Thomas J. Bliley	Don Ritter

Senate Communications Subcommittee

Chairman:	
Daniel K. Inouye	
Members:	
Albert Gore, Jr.	Larry Pressier
Slade Gorton	John Breaux
John McCain	J. James Exon
John D. Kerry	Ernest D. Hollins
Wendell H. Ford	Conrad Burns
Ted Stevens	Robert Packwood
Lloyd M. Bentsen	

Need help with chapter programs?

Ed Karl, former SBE treasurer, has announced the beginning of the national program coordination process. The first step is the formation of a national SBE speakers' bureau. The bureau will be a clearing-house for chapters in need of programs and companies, and for speakers interested in providing programs.

The bureau is expected to give greater exposure to good programs through the coordination of travel for presenters. The process will allow a company or individual to visit a number of chapter meetings within a geographical area by making only one trip.

The national coordination process will benefit those chapters that want top-notch programs but are too small to make a long trip cost-effective for a company. By coordinating meeting dates and travel, a company will be able to visit with more engineers, while at the same time limiting travel expenses.

If your chapter or company is interested in participating, contact Ed Karl at 508-252-9711. Members who have creative program suggestions may contribute to the success of the program by calling in their suggestions.

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

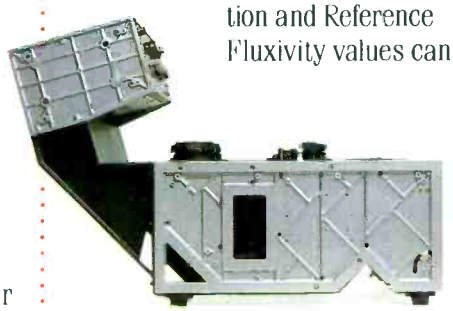
Fortunately for us, most radio engineers look before they leap.

Three cue locations and a zero memory can be accessed via the MX-55NM's built-in locator.

You've always been an analytical bunch, so we're sure you know that our MX-55NM 2-track not only gives you the features you need, but that it's also priced several thousand dollars below its nearest competitor.

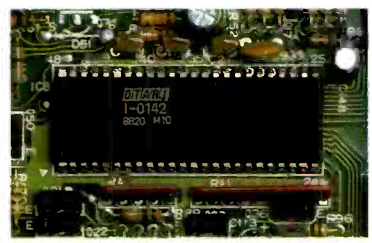
We know you're not about to overlook *major* features, like HX-Pro™ bias optimization, or gapless seamless punch-in punch-out, or that famous Otari sound. However, here's some fine points to examine as you do your "apples-to-apples" with our competitors.

For example, the MX-55NM incorporates a printed-circuit capstan motor (like that used on our MX-80 multitrack machine). This not only gives you low wow and flutter right out of the chute, but very fast start times. It's also worth noting that EQ selection and Reference Fluxivity values can be changed with a flip of a switch. And as you put the deck through its paces, notice that the varispeed control provides 0.01% step resolution. This means you can make precise changes, and perhaps more importantly, you can repeat a change *exactly* when necessary.



A 1.5" cast alloy deckplate, plus cast side frames give the MX-55NM the rigidity and ruggedness you've come to expect from Otari. (Do our competitors show you the inside of their machines?)

For your convenience, an optional voice editing module maintains normal pitch at twice normal speed. And the meterbridge keeps knobs and switches out of the way while you're editing.



Because we know how hard you use our machines, we use a double-sided glass epoxy transport circuit board, and we silkscreen both sides of our PCBs so you can locate the components easily.

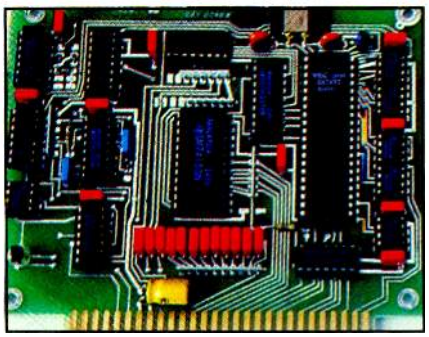
In the Otari tradition, we make the MX-55NM easy to service. Only four screws get you into the transport electronics. And when you get there, all servicing can take place with wiring intact. We also hinge all service panels, and use locking cable interconnects.

The specs? Why not call your nearest Otari dealer, or Otari at (415) 341-5900 and check them out. Like everything else, you'll find them "right on the money."

OTARI®

Part 6

Circuits



Building with microcontrollers

By Gerry Kaufhold II

When designing station projects with microcontrollers, remember that the memory interface is critical. Once you achieve a working design, however, you can use it for all future microcontroller projects. Let's look in detail at how the memory interface operates.

Once you achieve a working design, you can use it for all future microcontroller projects.

Microcontroller port 1 multiplexes eight address bits and eight databits. An external latch captures and holds the eight address bits. With these bits held constant, port 1 is available to read or write data to the external memory location, whose address is stored in the latch.

Four memory control signals

Figure 1 shows the timing diagram for interfacing external memory to the Z-8681. There are 12 address lines. Lines A-8 through A-11 go from port 0 directly to the external memory's address select pins. Lines A-0 through A-7 come from port 1 and go to the external memory via the external latch.

There are four signals that provide control and timing for the memory cycles: address strobe, read/write, data strobe and data memory. These four signals appear on individual pins of the Z-8681. They do not require special programming. They are automatically activated during every external memory access cycle.

At the start of a memory access cycle, address bits 0 through 7 appear on port 1. (See Figure 1, step 1.) These eight bits hold constant until the address strobe signal toggles.

The address strobe (/AS) is an active low signal that latches the eight address bits from port 1 into the external latch. (See Figure 1, step 2.) The latch loads at the trailing edge (low-to-high transition) of /AS. The external latch will be a standard logic device, such as a 74LS74, 74LS75, 74LS245, 74LS373 or 74LS374. Refer to the data sheets of the chosen device for specific parameters.

After the /AS loads the address bits into the external latch, port 1 is ready to transfer data. Read/write (R/W) is active low for writing to external memory, and active high when reading from external memory. R/W is set after the address strobe and before data strobe. (See Figure 1, step 3.)

The data strobe (/DS) is an active low signal that controls the actual output of data from the external memory. (See Figure 1, step 4.)

Data memory (/DM) is an active low signal used to select between data memory (RAM) and program memory (EPROM). /DM uses one of the I/O ports (port 3, bit 4).

Four extra bits

Port 1 and 0 mode registers were programmed to use port 0's lower nibble (bits 0, 1, 2 and 3) for memory addressing. The Z-8681 sets the four address bits (A-8, A-9, A-10 and A-11) to their correct values, and holds them constant throughout the entire memory-access cycle. These lines do not require external logic circuitry.

Next month, I will present a sample schematic diagram for an external memory interface to a 2K-by-8 EPROM.

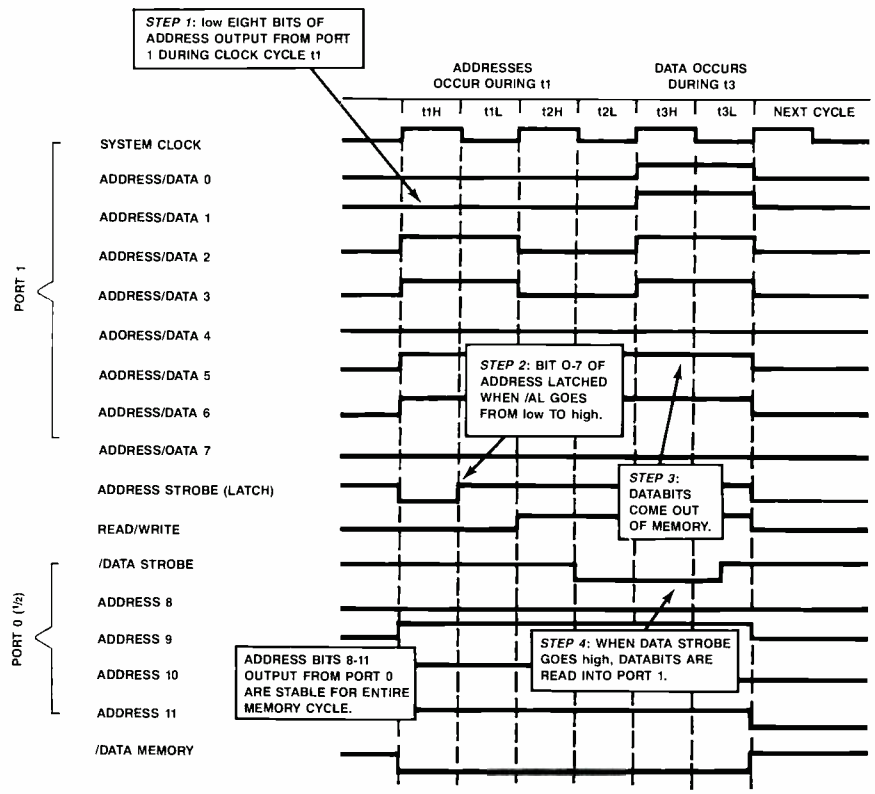


Figure 1. *The timing diagram for microcontroller external memory interface shows how I/O port 1 multiplexes address bits 0 through 7 and databits 0 through 7. The address latch signal clocks the lower eight address bits into an external latch. The port is then free to transfer data into or out of the addressed location. Port 0 provides the upper four address bits directly, with no external latching.*

Kaufhold is a market development engineer for SGS-Thomson Microelectronics, Phoenix.

The Orban Family of Broadcast Products

OPTIMOD-FM

8100A1 OPTIMOD-FM Audio Processor: The dominant choice for highest quality FM audio processing, on all continents.

XT2 Six Band Limiter: Accessory to OPTIMOD-FM. Adds more competitive loudness, punch, and brightness.

222A Stereo Spatial Enhancer: Gives your station the competitive *leading edge* sound by naturally magnifying the stereo image.

OPTIMOD-AM/HF

9100B OPTIMOD-AM Audio Processor: Achieves extraordinarily natural audio quality on both voice and music, with loudness, intelligibility, remarkable source-to-source consistency, and FM-like brightness. Mono or stereo.

9105A OPTIMOD-HF Shortwave Audio Processor: Louder than OPTIMOD-AM; punches through noise, fading, and interference with outstanding intelligibility.

OPTIMOD-TV

8182A OPTIMOD-TV Audio Processor: For both stereo and mono television; works with all stereo systems (BTSC, NICAM, dual-carrier, EIAJ). Controls levels from any source artfully and automatically, without audible processing artifacts. Effectively controls loudness of commercials.

BTSC TV Stereo (for NTSC countries): BTSC TV Stereo, Second Audio Program (SAP) and Professional Channel (PRO) Generators. Meets the highest specifications.

AND OUR NEW TRANSMISSION LIMITER

4000A Transmission Limiter: We aimed for undetectable peak limiting... And we reached our goal. The sound is so transparent that you can't hear it work.

Orban OPTIMOD products are used by tens of thousands of broadcast stations all around the world, by local broadcasters and the world's most influential national broadcast organizations. Orban products are known for their high standard of construction and reliability. We're proud of our products and stand behind them with technical support from broadcast engineers who understand your needs.

Orban, a division of AKG Acoustics, Inc.
1525 Alvarado Street, San Leandro, CA 94577 USA
Tel 415/351-3500 Fax 415/351-0500

orban®

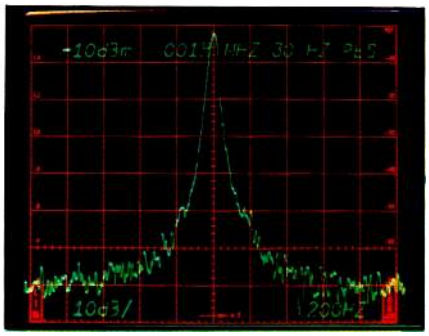
LISTEN TO THE DIFFERENCE.

Part 5

Troubleshooting

Servicing your klystrons

By Colin Erridge



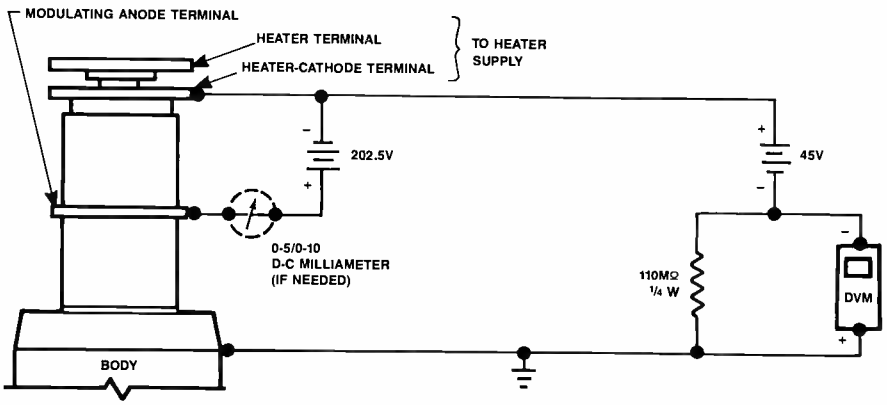


Figure 1. *Klystron gas-checking test diagram.*

A test for vacuum integrity should be performed on spare klystrons approximately every 90 days. In the gas-checking procedure outlined here, the electron gun of the klystron is used as a triode ionization gauge.

The equipment required for this test includes a digital voltmeter (DVM) of at least 11MΩ resistance, one 45V battery, three 67.5V batteries (connected in series to provide 202.5VDC), a 110MΩ 0.25W resistor, and, possibly, a DC milliammeter with 0-5mA or 0-10mA range. (A single digital multimeter [DMM] fitting these specifications may be used in lieu of both meters, because they are not required simultaneously.)

To avoid the possibility of contaminated results from ground loops, ripple current and EMI, use batteries instead of AC supplies here. Current drain on these batteries will be low, so a single set should serve for many such tests.

Set up the test rig as shown in Figure 1, keeping all connecting leads as short as possible. Use an outboard supply or the transmitter's for the klystron heater. In the latter case, disconnect the negative high-voltage lead from the klystron's cathode.

Begin observations after all connections have been made, but *before* applying heater voltage. Verify that the DVM reading is near zero and stable. Body motion near the tube or test rig may cause some fluctuation. If there is a significant meter reading, check and clean all connections, wipe exposed ceramics with alcohol and look for any leakage paths in the test setup. Once the meter reading has been reduced to a small and steady value, note any remaining leakage current for subtraction from later measurements. Then apply the heater voltage, allowing five to 15 minutes for cathode warm-up.

During the warm-up time, observe that the DVM reading will typically rise, come to a peak value, fall off a bit, then stabilize. A steady reading of less than 0.1V on the DVM indicates a gas current below 0.01mA, denoting an excellent vacuum within the klystron under test. Vacuum integrity is considered satisfactory with DVM readings of less than 5V, corresponding to gas currents up to 0.5mA. Measurements of 5V or more show that the tube should be put into service for a few days to reduce its gas current below 0.5mA. Once spare tubes have been reconditioned in this manner, they should be returned to storage but remain on the test schedule. Keep written records of all tube checking and reconditioning.

In some cases, no reading will be seen on the DVM. To verify that this is the result of an extremely good vacuum, and not a fault in the test, the DC milliammeter or DMM in series with the 202.5V battery is used, as shown in Figure 1. For this test, the DVM, its resistor and the 45V battery may be disconnected, but the heater supply should be left up and running. A good vacuum is verified by a milliammeter reading between 1mA and 4mA.

While performing this test, never energize a klystron heater for more than 30 minutes without some auxiliary forced-air cooling.

Electron gun leakage

Klystrons that have been in operation for a while may be susceptible to high-voltage breakdown faults when they are moved from visual to aural operation, or from continuous to pulsed service. With either of these moves, the range of potential that the tube encounters is greater than what it has been used to, and this can cause internal arcing. A build-up of electrical leakage between elements is a normal part of tube aging, but the process can be slowed by reducing filament voltage.

High-potting, the application of a high DC potential across a klystron's elements, can be used to check electron gun leakage and to recondition these elements in many cases as well. The only equipment needed is a continuously variable DC supply with a range of 0-30kV; its output must be current-limited to a 5mA maximum.

To perform the operation, turn off the klystron's heater and give the cathode an hour or two to completely cool off. Then connect the negative terminal of the high-potter to the heater-cathode terminal of the klystron, and the positive ground terminal to the modulating anode. Observe the leakage current drawn from the supply and slowly increase the voltage of the supply's output.

Stop increasing the voltage when the leakage current reads approximately 2mA. Wait for it to drop or "burn off." Then continue to increase voltage, holding each time the 2mA level is reached. Repeat until the voltage of the supply is equal to the normal operating voltage of the klystron. At this voltage, try to burn off leakage current to the 200-400A range, and then stop.

Now reconnect the *negative* terminal of the supply to the modulating anode of the klystron, and move the positive ground to the tube body. Repeat the above process to check and reduce leakage between these two elements.

Erridge is product manager, Varian Associates, Palo Alto, CA.

Just say "S"

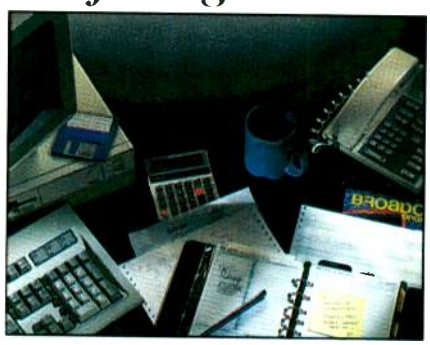
JVC's S-VHS, that is. From camcorders to editing systems, to duplication and distribution, JVC offers you a complete ***single format video solution.*** At very reasonable prices with proven operating cost savings. For more information on JVC's growing line of PROFESSIONAL S products, call 1-800-JVC-5825.

JVC®
PROFESSIONAL

Circle (13) on Reply Card

Part 5

Management for engineers



Project management for engineers

By Judith E.A. Perkinson

As soon as someone mentions reports, most people shrink away in horror. No one wants to create a paperwork nightmare, but some form of reporting is necessary for any project. Here are some tricks-of-the-trade that will help you as you document your project.

The basic document of any project is the plan. I devoted an entire article to the development of the plan. (See the October 1990 "Management for Engineers" column.) There are four other general categories of documentation that you may find useful and/or be required to produce during the life of a project.

An effective proposal

Projects need to be approved before they are managed. A sound proposal can go a long way in helping you get the approval you want for the project you need. A proposal that makes it easy for management to approve your request is one that answers questions before they are asked.

A basic format for effective proposal writing does not have to be lengthy, just clear, to the point and well-presented. Your plan can serve as the basis for the proposal or vice versa. This means that the initial planning effort can be used to serve both purposes.

Your plan should contain the following:

- *Purpose.* Start at the beginning. As in your plan, be sure to state clearly what the project will accomplish.
- *Need.* Briefly justify the need for the project. People are more likely to say "yes" if they can see a need for something.
- *Plan.* You don't have to use your entire plan in the proposal. This kind of detail is generally unnecessary. Your proposal should convince the powers-that-be that you have given it great thought and that the project can be done. Generally, if you use the basic components from your plan in outline form, it will establish the soundness of your planning.
- *Timetable.* Again, the detail doesn't have to be as complete as your plan. A general overview of the time frame, key points and time line are sufficient.
- *Needed resources.* This should include the cost, personnel requirements, equipment needs, space requirements and the potential sources for all of the above.

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

Project management notebook

As mentioned in the November 1990 "Management for Engineers" column, some kind of an organizational structure must be used to keep track of the paper and necessary information on the project. A notebook (or a 3-ring binder) is a valuable organizational tool. Not only do you have a record of your work and effort, but you also have the information where you and others can find it.

Progress reports

Progress reports are not used in every project. When necessary, they serve to report on the project, and give you a definitive view of where you are and what else you need to do. Regardless of the need for formal reports, as a project manager, you should always keep track of your progress on the project.

If your tracking system is working, you should be able to pull your progress reports out of it. They should contain:

1. Progress to date — taken straight from the tracking system and matched with the plan.
2. Where your current position fits into the time line — are you ahead, behind or on time.
3. Adjustments — what, why and when.
4. Projections of activities to be completed by the next reporting section (optional).

Progress reports make you stop and examine where you are. More often than not, they are viewed as a bother. But if you are in trouble with your project, they can be the diagnostic tool you need to get yourself out of difficulty and back on track.

Final reports

Final reports should not be used as an attempt to prove that someone did something and should not be measured by the pound. When done well, a final report can be a blueprint for the future.

Too often, final reports are seldom read and never used. If a final report is to be used, then the information in the report should be accessible, clearly stated and well-organized.

There are three common final report formats:

1. Point-by-point re-creation of the project. This is the most common style of report. It includes procedures and accomplishments. It tends to be lengthy and difficult to digest. This report format is not recommended.
2. Findings, conclusions and recommendations. This style of report can be effectively used when the project purpose involves fact-finding or problem-solving.

It begins with a clear statement of what was found as a result of the work. (Notice I said "what was found" and not "it was found.") This is followed by the conclusions of the project team as a result of the findings. Once again, be sure to state what, not how.

3. Summary, critique and recommendations. This style of report is effective when reporting on an installation or rebuild type of project.

The first section is a summary of the results of the project. Once again, it is a *summary* of the results, not the process.

This is followed by a *critique* of the projection operation. The critique should include what was good, what was bad and what was learned from both.

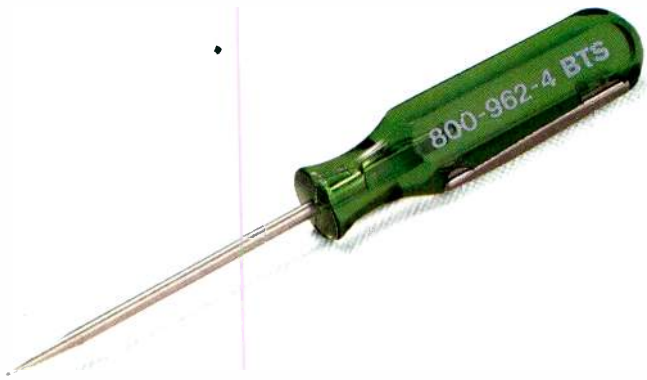
The final section is the *recommendations* for future projects. It's your chance to do it over again the right way. More important, it's your chance to ensure that old mistakes are not repeated and that your future project management is improved by your experience.

If you still think that reports should be measured by their weight, you can always append your plan, progress reports and other supporting material. Either of the last two kinds of final reports will provide you with a tool for the future and make it worth the effort put into a final report.

Project management

Over the past five months, I have looked at project management. The tools discussed in this series can help you become a successful project manager. Many of the good habits you can build from using these tools can be translated into your everyday department management.

This could be the most valuable tweaker you'll ever own.



If you don't own a BTS frame transfer CCD camera, you could probably use a tweaker...and we'd be happy to give you one.

Then, when you're ready to step up to BTS camera quality and reliability, we'll let you trade your tweaker in for up to $2,000 credit toward the purchase ...which will make it the most valuable tweaker you ever owned.

To get your tweaker today, just pick up the phone and call 1-800-962-4BTS... toll free.

Step up to BTS cameras...for the big shots.

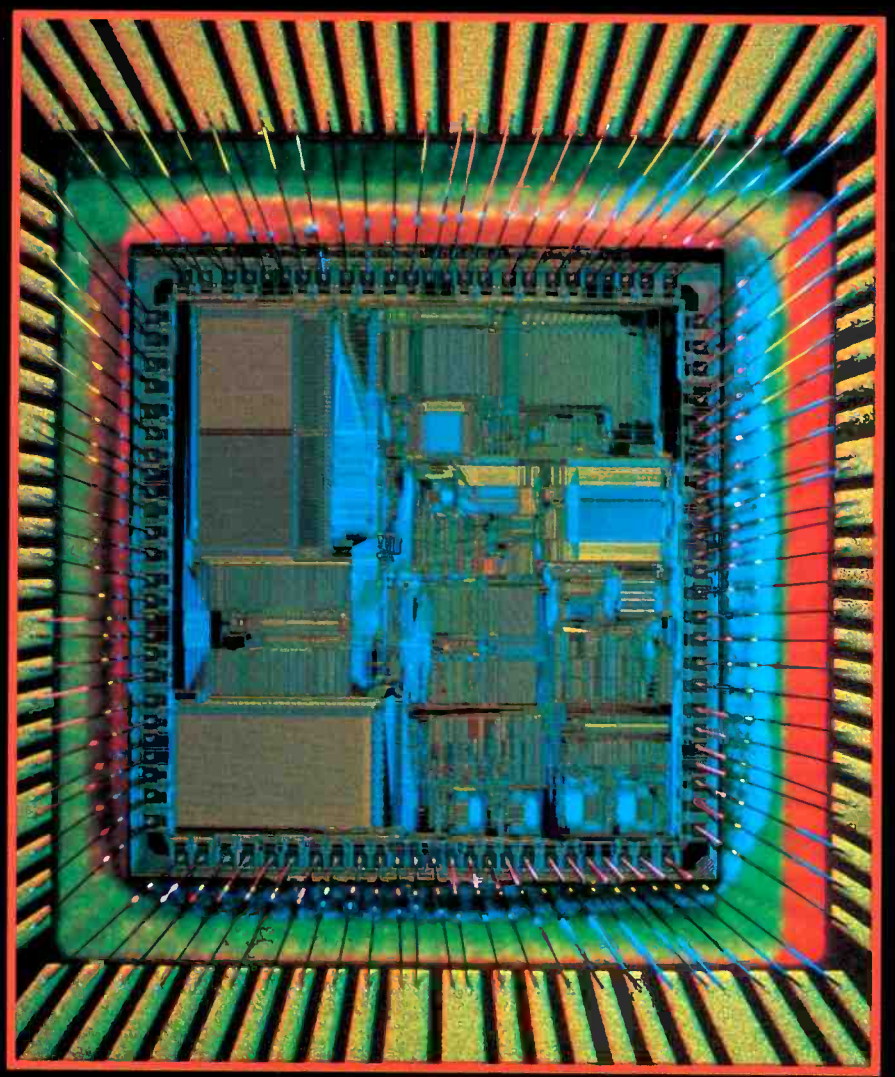
BTS **Broadcast Television Systems, Inc.**

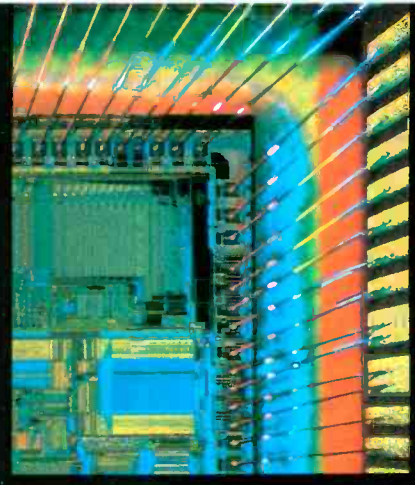
A joint company of Bosch and Philips.

Phone 1-800-962-4BTS.

Circle (14) on Reply Card

Winning with digital technology





One step ahead.

Ever notice how technology grows in stages? Engineers who are winners are the ones who always seem to be just ahead of the wave.

At one time, electronics used tubes. Winning engineers were those who could list the ins and outs of a few dozen devices, who could tell a glowing filament from a dead one, and who could remember to keep one hand in their pockets to avoid electrocution.

Then came transistors. Much was written about them. There were many debates about their advantages and disadvantages. Winners quickly learned the ins and outs of a few common circuits, learned how to tell PNP from NPN with an ohmmeter, and taught themselves how to solder with small irons.

Next came ICs. Rapidly moving through RTL and DTL, the field paused at TTL. Before long, winning engineers knew a dozen part numbers by heart, and a smattering of knowledge about op-amps and CMOS devices were enough to catch the digital wave.

It now appears that personal computers are the next fundamental technology. More and more, broadcast equipment manufacturers are using PCs as human interface or control devices as hosts for specialized boards, and, in some cases, as broadcast systems in their own right. Winning engineers have learned or are learning the basics. Those engineers who know a few DOS commands, and a few characteristics of each major PC family, are poised to score another win.

Understanding the latest technology is no option for today's engineering managers. Not only is this knowledge necessary for proper operation, it can also mean the difference between profit and loss. In this issue, we will look closely at some areas of rapidly moving technology that can affect your station.

In the article, "Using Computer-Based Effects Systems," we see how the computer is playing an increasing role in effects systems for broadcast and post-production facilities.

"Radio Frequency Radiation" is an often-mentioned, but just as often misunderstood, concern. Parts 1 and 2 of this article provide an inside look at the problems and solutions to stations' RFR problems

Finally, "A Look at High-Performance Recording Formats" provides you with a behind the front panel look at how the D-1 and D-2 tape formats operate and the advantages they may offer your station.

Don't let technology leave you behind. Sometimes the winning engineers aren't smarter, just more adept at knowing how to use new technology to stay ahead.

By Rick Lehtinen, technical editor

If you think there's no diffe monitors, we have a few p

Wouldn't it be great to have a TV station monitor that could help you detect problems in your other equipment. A monitor with SMPTE C phosphors to prevent COLOR INCONSISTENCY between monitors. And over 600 lines of horizontal resolution to eliminate FUZZY details.

Of course, it would be really great if it had a beam current feedback system to stop COLOR DRIFT. And a broadcast CRT with an aperture grille designed to handle higher brightness without WARPING or DOMING – while maintaining color purity and uniformity. And if it had a FLATTER screen to provide you with a truer PERSPECTIVE and an auto set up system to let you avoid TWEAKING, that would be ideal.

Well, that's the right word for Sony's BVM-1915. It was specifically designed to meet the broadcast industry's tough standards for precise COLOR reproduction and reliability.

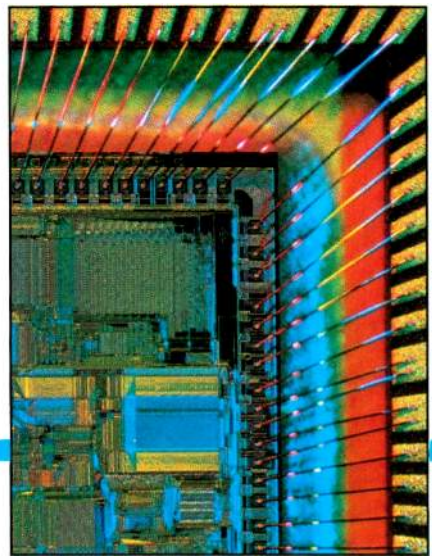
If you're using anything else, your idea of what a TV station monitor can do for you may be a bit CLOUDY.

For more information on how easily the newest

rence between TV station oints we'd like to illustrate.

member of the BVM family can fit into your budget, just give us a RING at 1-800-635-SONY. SONY

BUSINESS AND PROFESSIONAL GROUP



Graphics, animation and effects systems have found homes in computers.

Using computer-based effects systems

By Rick Lehtinen, technical editor

The computer's influence on video production is profound. Once tools for accountants and scientists, computers today have found their way into station automation, program production, editing, and the creation and manipulation of video images. A computer offers production personnel the same advantage a word processor offers authors. Users can pick up and put down images as quickly as writers can shift paragraphs.

The computers used can be of any type: PCs with add-on cards or chassis to make them equal to the video task, mid-size computers dedicated to video work, or proprietary computers built by broadcast equipment manufacturers to their own specifications.

Computer-based effects systems fall into three broad categories: paint or graphics, animation and video manipulation or effects. Computer graphics and animation are established technologies. Computer-based video manipulation is an emerging technology. This article will explain each process in some detail.

The ubiquitous PC is making its presence known in each of these areas. In some cases, PCs offer better price/performance ratios than traditional equipment lines. Many manufacturers are betting that the low-end desktop video revolution will drive a thriving high-end market from now well into the future.

I-graphics: Painting by the numbers

Computer graphics have been an important part of broadcasting since they first appeared in the late 1970s. Since that time, these systems have undergone continuous evolution. The basic philosophy, however, has remained the same. The computer fills a memory array called a *frame buffer* with bit patterns corresponding to the colors of pixels on the screen.

The computer fills the frame buffer with pixel data at whatever speed it is able. The pixels are clocked out of the frame buffer at the scan rate of the TV system in use (NTSC, PAL, 240M [HDTV]). The system converts the output pixel data to either digital video (D-1, D-2), analog RGB, Component analog video (CAV) or S-Video, or composite (NTSC, PAL). The output format depends on the make of the system, and whether any extra conversion devices, such as encoders or transcoders, are installed. (See Figure 1.)

The numeric codes that describe each hue are proportionate to the amount of red, green and blue primaries used to create the hue. For broadcast use, each of these primaries usually requires five to eight bits of precision. A 5-bit system yields 32,000 possible shades: 5-bit samples = 2^5 = 32 intensities. Three colors at 32 possible intensities each = 32 * 32 * 32 = 32,768 possible hues.

Five-bit-per-color systems are usually marketed as *16-bit color* systems. The extra bit is often used as a transparency or keying bit.

Systems using 8-bits-per-color provide more than 16 million possible hues. Eight-bit samples yield 2^8 or 256 possible values of each color. Three colors at 256 values each equals (256 * 256 * 256) = 16,777,216 hues. These are called *24-bit color* systems.

To provide a linear key signal, some manufacturers include an additional 8-bit signal, often called the *alpha channel*. This allows a variable key intensity for transparent overlays. Such systems are usually called *32-bit* systems.

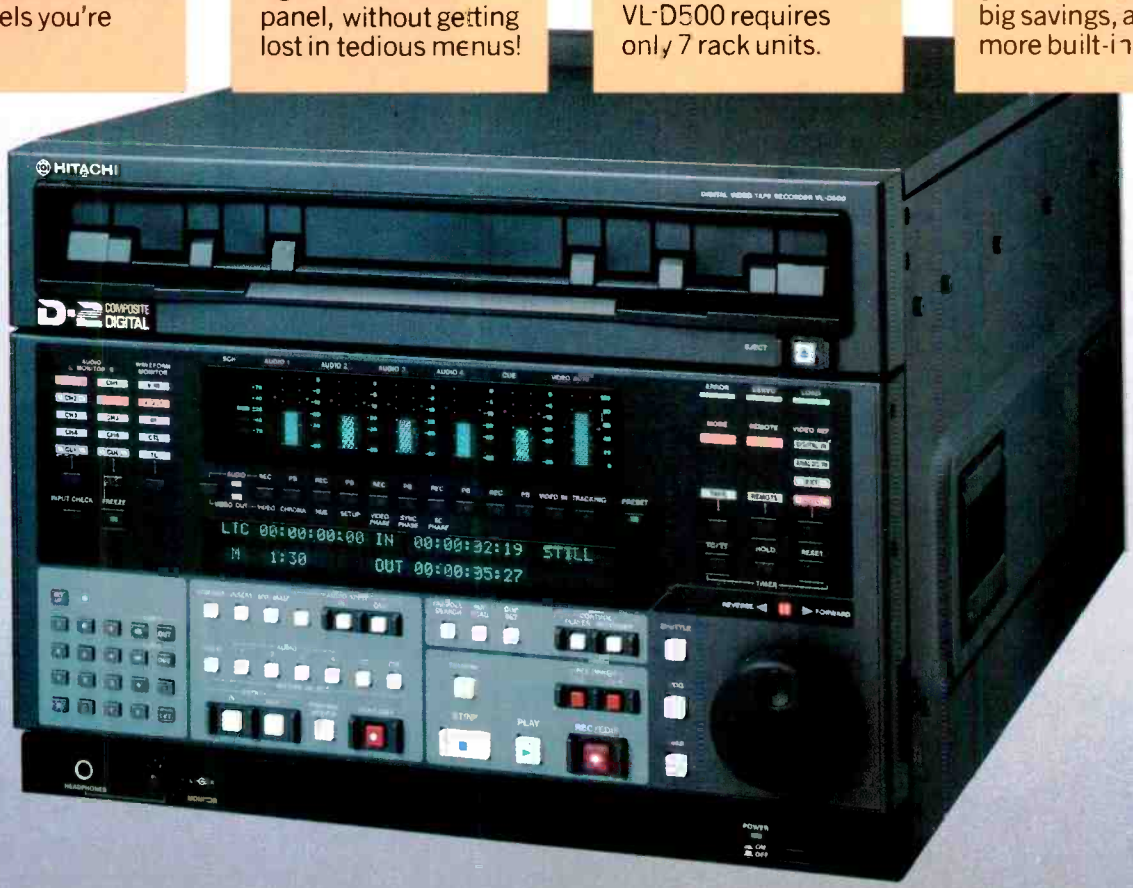
Some systems offer 24-bit color, but allow only 256 colors on the screen at a time. These systems use a color look-up table (CLUT). Each of the 256 addresses in the CLUT holds a corresponding 24-bit color. To change the *palette* of colors in use, the software must update the CLUT.

Our new panel design — Take a close look at our new front panel. The VL-D500 capitalizes on the easy operation built into Hitachi's 1-inch video recorders. Functionally, it even resembles the 1-inch VTR panels you're used to.

New menus that set you free—Now you can do all your everyday operating functions with controls right on the front panel, without getting lost in tedious menus!

Smaller and more efficient—It's smaller than any other S/M/L-cassette D-2 VTR, and less than half the size of a 1-inch video recorder. The Hitachi VL-D500 requires only 7 rack units.

Built-in digital test generator — Eliminates the need to buy a separate test generator. That's a big savings, and more built-in value.



Hitachi D-2. The 2nd generation.

Presenting the second generation of Hitachi's VL-D500. With a new panel design and a streamlined menu system, this is the simplest and most efficient broadcast quality D-2 VTR ever conceived.

The VL-D500 can flatten your digital learning curve—and make your transition into D-2 fast, easy and affordable.

Learn more about the new VL-D500. Contact the Hitachi Denshi America regional office nearest you.

HITACHI

NEW YORK 516-921-7200 • ATLANTA 404-451-9453
CHICAGO 708-250-8050 • DALLAS 214-891-6381
LOS ANGELES 213-328-6116 • CANADA 416-299-5900

Circle (15) on Reply Card

Now, D-2 is even easier—Easier to learn, and easier to use, the VL-D500 makes digital recording and editing more *productive*.

Digital compression—Time compression and expansion is simple on the VL-D500. And of course, with digital signal processing, your program is compressed without losing a generation.

All three D-2 cassette sizes—Hitachi's VL-D500 gives you the max in versatility.

Longer and more comprehensive warranty — Only Hitachi offers *one full year on site*, for both parts and labor. No other D-2 recorder comes close to the VL-D500.

Although CLUTs are somewhat clumsy, they make possible a simple form of animation called *color cycling*.

Future color

As venerable as the frame buffer is, it would certainly be convenient to eliminate it. A promising new development is the appearance of 16- and 24-bit video VGA cards. These cards operate in the VGA mode common to many computer-aided design (CAD) systems. The CAD market is many times larger than all of the broadcast and post-production markets put together. This keeps the cost of these cards low. However, the capabilities of some newer VGA cards and other computer displays equal, and in some cases exceed, the capability of the familiar color video signal. (See Chart 1.)

This comes about because the computer-color manufacturers started with some unfair advantages. Computer signals are digital, and meant to travel only the short distance from the computer to a monitor. The video signal is analog, and is designed to travel comfortably down a coaxial cable with minimal degradation. The video signal is composite; it fits down one wire.

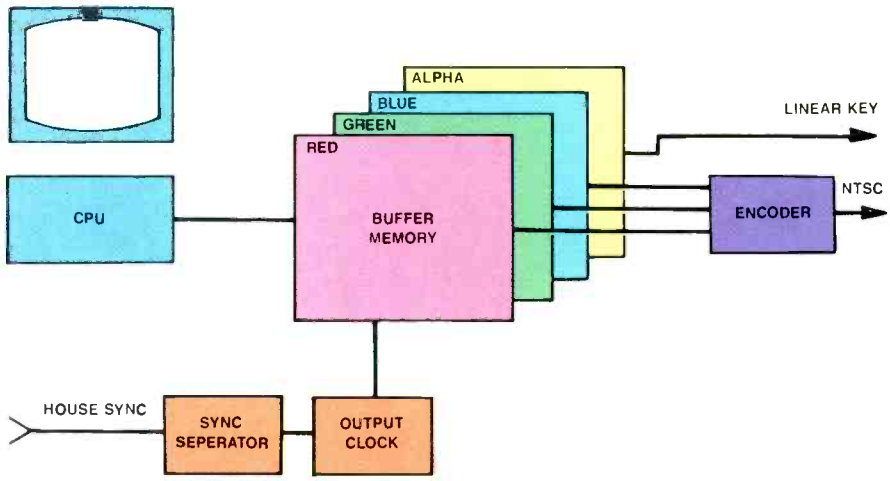


Figure 1. A frame buffer is the heart of most graphics systems. Data representing pixels fills the buffer at the computer's native speed. The data is clocked out in time with house sync.

Most computer video signals use several pairs for transmission. Finally, color television is backwards-compatible with the monochrome television that preceded it. The several computer output standards often bear little relationship to one another, although manufacturers of VGA cards often build in the ability to emulate certain earlier standards.

There has begun a thrust by the VGA people to see if they can't get their signals more video friendly. Many CAD users wish to record their drawings for viewing without a need for computers. In addition to

Fortunately, there is
one tape company that's as demanding as you are.

In this business, people are always striving for perfection. Constantly demanding more from themselves. And more from their tape. At 3M, we share that commitment. We know you can't afford a tape problem. And neither can we. That's why we laser test our 480xst Video Tape to ensure consistently high quality. If you demand perfection, it's the one-inch tape you should try. In our products and service, we have one primary goal: **We won't be satisfied until you are.**

3M

increasing the color capability of their VGA cards, many manufacturers now provide NTSC or S-video outputs.

The potential of VGA color is great. At least one manufacturer is toying with creating video equipment that processes video in a VGA environment, as opposed to more conventional formats. Such equipment would likely have a lower price tag than much of today's video equipment, mostly because the market for VGA-compatible equipment is so huge.

Punching the clock

There is also some industry exploration into making video processing and output a function of the computer proper, not of add-on cards. One approach includes moving the computer's internal clock frequencies to some multiple of the TV color subcarrier frequency. This would simplify conversion of computer-generated images into true video images.

One PC maker apparently foresaw the advantage of this tactic. A provision was built in for synchronizing the computer's internal timing circuits to an external video reference.

In situations where the clock frequencies are hopelessly incompatible, one answer is to use a scan converter. Scan converters can create NTSC, or analog RGB at NTSC line rates (NTSC RGB),[1] from the signals used to drive the computer's monitor. The process is similar to converting NTSC to PAL.

Scan converters range in cost and complexity. Top-of-the-line units come as 19-

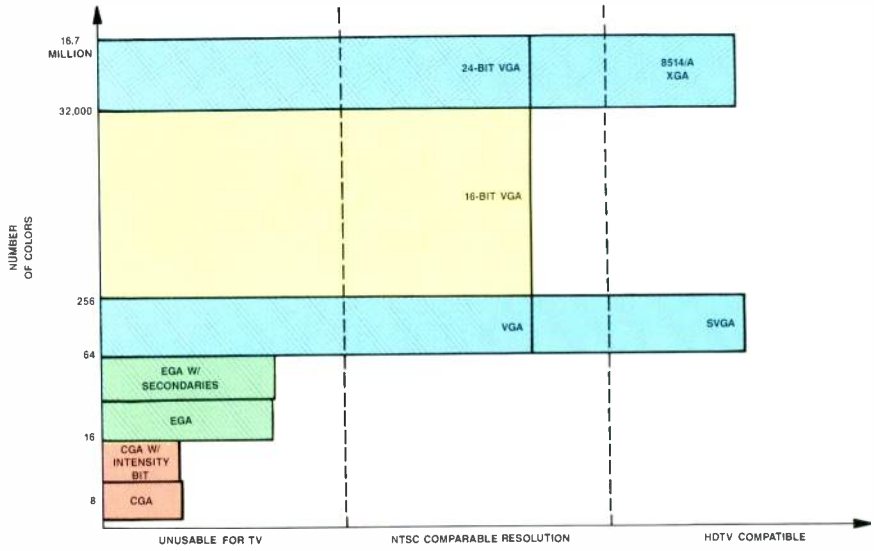
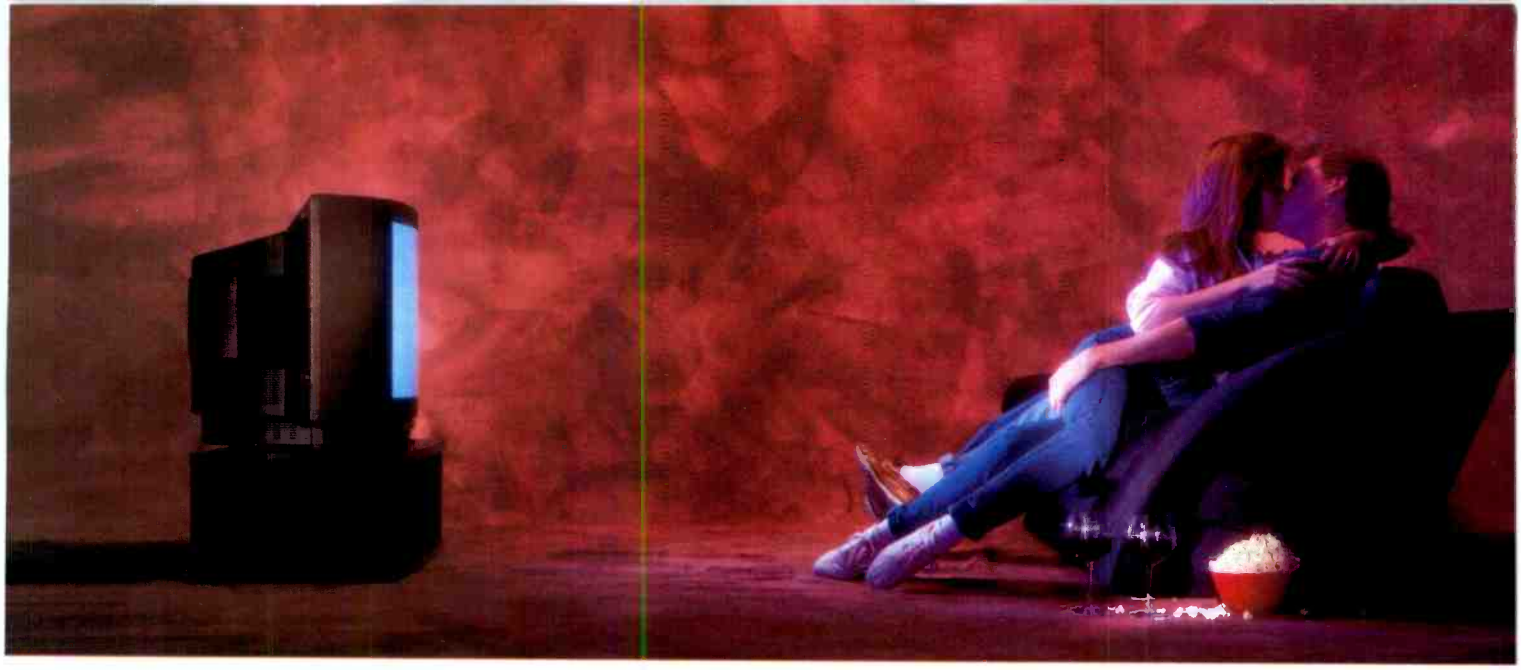


Chart 1. *The graphics output cards used in computers for non-video applications have matched and, in some cases, exceeded some capabilities needed to produce video. These cards have low price points, and could force a change in the video industry.*



Only SIAT® lets you test audio quality during program time.

Without disturbing your audience.

Everyone knows it's not polite to interrupt. But the fact is, the need to test audio quality is most critical *during* key programming times. Which is precisely when testing for noise, distortion, crosstalk and more is most difficult and intrusive.

You have to contend with heavy carrier signal traffic. You have to risk disturbing—and losing—listeners and viewers.

Or, you have to settle for inaudible test systems that can't measure noise at program levels—and that fail to account for poor transient response or distortion caused by overload.

But now, there's SIAT®, the in-service audio testing solution from Schmid Telecommunication.

Only SIAT can test up to 10 critical parameters of your audio transmission in 5 seconds or less.

That's fast enough to test during program breaks or station IDs, without disturbing your audience. And it's fast enough to test lines that are busy 24 hours a day.

Best of all, SIAT is fully automated and incredibly easy to use. Tests can be pre-programmed and conducted automatically. Or they can be triggered manually by pushing a single button. Tests can even be pre-recorded and aired with program material.

Give your audio the SIAT advantage. Call 1-800-955-9570 today for more information and a free SIAT video.

The SIAT Advantage Technical Characteristics

- ☐ 5-second stereo test includes frequency response, phase response, differential gain, THD, second harmonic distortion, crosstalk left, crosstalk right, terminated noise weighted, terminated noise RMS flat and channel transposition.*
- ☐ Go/no-go reports based on pre-set tolerances *you* program
- ☐ Network software available, as well as optional hardware for full automation
- ☐ Signal generators and receivers identified individually for network testing purposes
- ☐ Common-mode rejection: 60 dB (50 Hz - 20 kHz; V in≦1 kV)
- ☐ Maximum input: 1.5 kV differential
- ☐ Balanced input and output; electrically isolated
- ☐ Self-contained processor and printer
- ☐ External alarming and triggering of tests
- ☐ Built-in intelligence allows measurement of audio characteristics only when transmission is fully stabilized
- ☐ RS-232 modem port for easy telecommunication, fully automatic operation and collection of test results from remote sites

*SIAT tests 19 different audio parameters, including intermodulation distortion. Up to 10 parameters can be included in a 5-second test.

Schmid Telecommunication

Intelligent by design℠

15 West 26th Street ☐ New York, NY 10010

Circle (20) on Reply Card

inch chassis, two or three rack units high. Lower-priced versions clip onto the RAMDAC in the PC and sit on the table behind the computer. In most cases, these conversion units also provide a key signal output.

A lower-priced solution is called a *genlock*. These units attempt to synchronize the computer to a video input, and convert the computer's output to an NTSC signal. Some gen-locks allow the computer to key computer-generated text and graphics over the video, a function called *gen-lock with overlay*.[2]

Some of these devices are available for well under a thousand dollars. But let the buyer beware. Never buy any appliance that claims to convert computer output into video until you have examined its output with a trusted waveform monitor and vectorscope.

One for all

When computer graphics entered the TV arena, many station designers moved from the drawing board to the digitizing tablet. Stations' expensive electronic art systems were generally dedicated to news and weather. Other art functions stayed at the drawing table.

As the artists became familiar with the electronic graphics systems, they may have desired to use it on other station projects. It was often easier to create something electronically than on the board. This was especially true if the project involved combining parts of several images, or doctoring photographs. Unfortunately, technological limitations made it difficult to move art between the drawing board and the computer, particularly when going from video to hard copy.

A new trend is emerging in which the design station is constant, regardless of whether the intended output is for print, projection or video. Changing the output media merely involves changing the resolution at which an image is rendered, and directing the output to the appropriate device. (See Figure 2.)

For instance, suppose a producer requests a special station logo treatment for a spring promotion. The artist first creates the design on a computer. Next, the same graphic files are sent to several destinations:

1. An electronic printing press that prepares a run of stationary keyed to the promotion.
2. A pre-press center that makes 4-color separations of the promotional artwork for use in the newspaper, two regional magazines, and potentially some billboards.
3. A video rendering service that prepares a disk pack for the still-store. Also, a short animated version on tape for station breaks.
4. A film recorder that records the art on

Continued on page 36

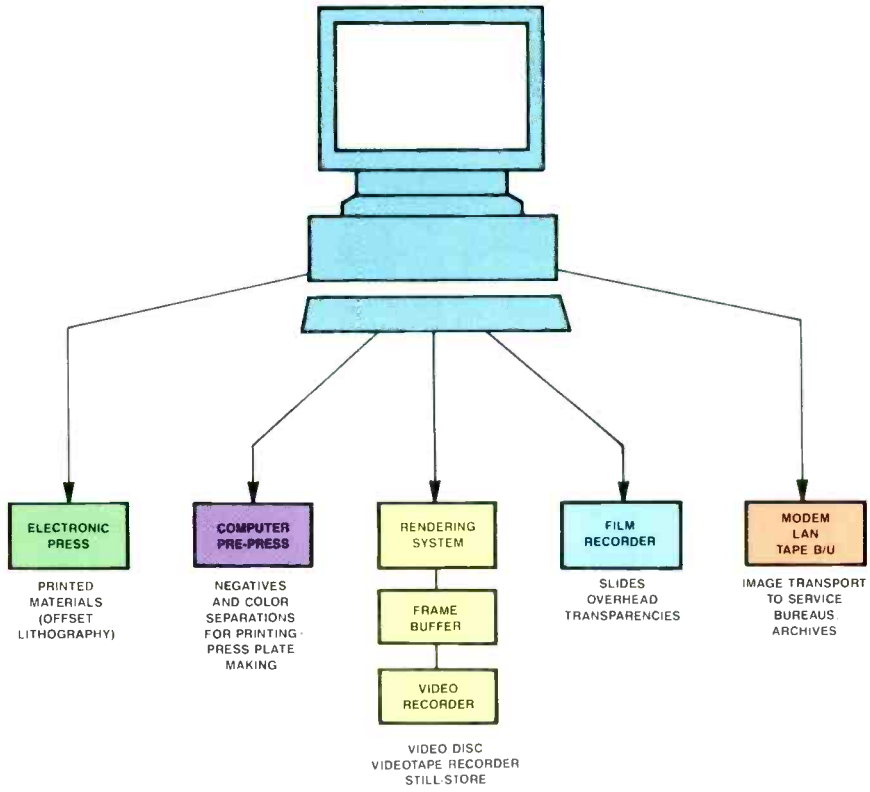
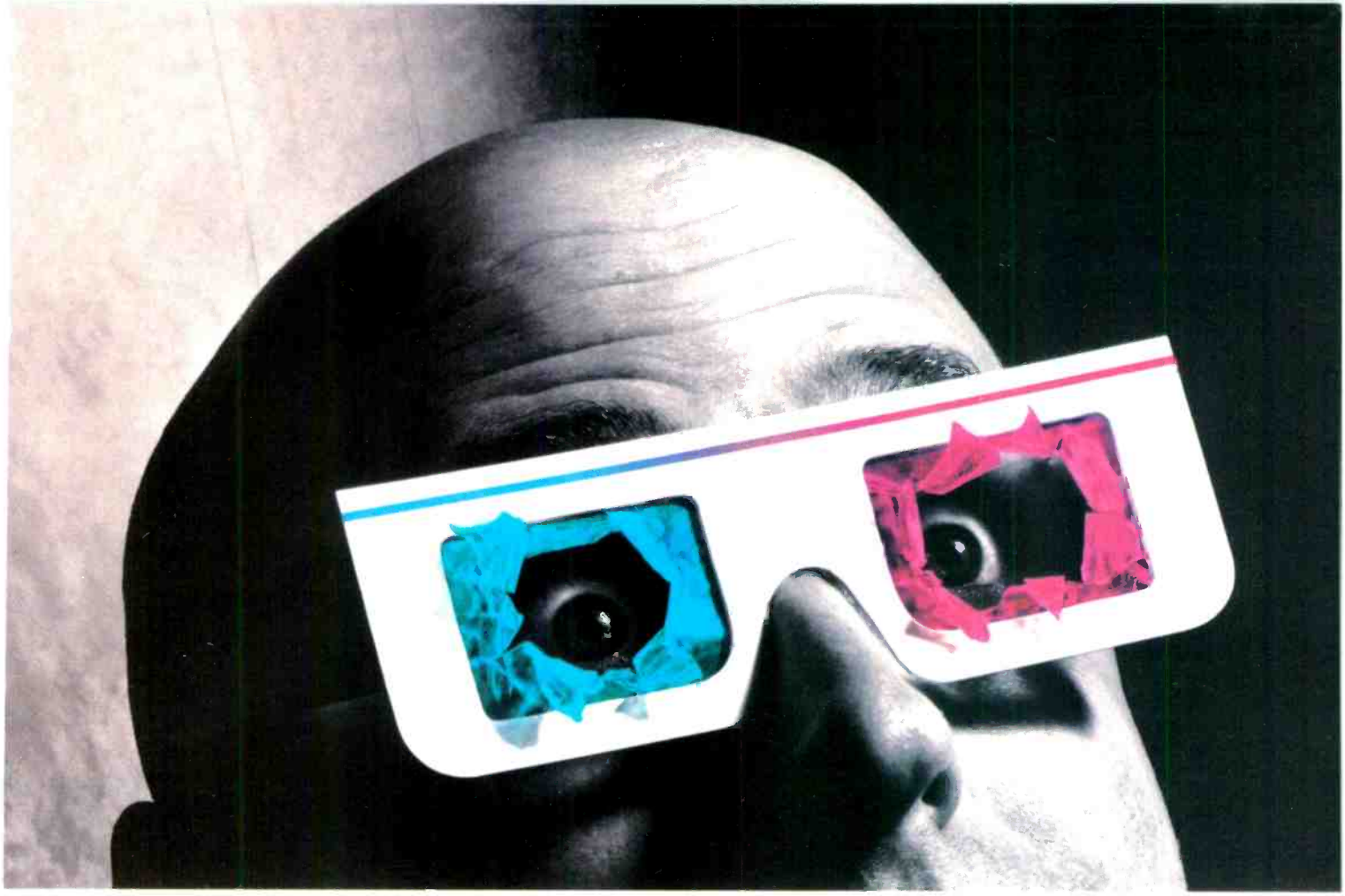


Figure 2. *One design station will soon be able to feed several different output devices. The design remains constant, output resolution becomes a function of the output device.*



ANNOUNCING A BREAKTHROUGH IN 3D ANIMATION FOR YOUR PC.

Autodesk 3D Studio.
You'd buy it even if it didn't cost thousands less.

True, you can spend a lot more for 3D animation. But do you really need to? Maybe you should take a good look at Autodesk 3D Studio.™ Because once you do, you may never look at a more expensive 3D animation software program again.

Big features, small price.

Autodesk 3D Studio software has all the professional features to produce broadcast quality 3D animation. All in one powerful, easy-to-use integrated user interface. Like a modeler, materials editor, renderer, keyframer and more.

Create sophisticated, high resolution animation. In less time. For less money. Render 32 bits of color to a variety of industry standard file formats. Then view them on everything from VGA to high resolution graphic displays like TARGA.™ Or output to videotape, film recorders or color printers.

Unleash full-blown 3D animation.

Professional quality 3D animation is now possible and affordable on a PC. The Autodesk 3D Studio keyframer creates movements automatically—and does it with amazing speed. Then the renderer produces finished animations so quickly, you won't believe your eyes.

Wide range of tools. Wide-eyed effects.

Combine fonts and powerful drawing features with built-in 3D geometry to model objects. Use the extensive materials library, or create your own with shades and textures of startling photo-realistic quality. And bit map images or even 2D animations can be applied to objects for special effects.

Add drama with cast shadows and camera moves.

Like roll and dolly. Illuminate your scene with spotlights of animated color, hotspot and falloff. Or use automatic squash and stretch or ease in/out to create convincing lifelike movements. The only limitations are the boundaries of your imagination.

Sure, the features are eye-popping—but the real eye-opener is the price. Only $2995. Why you'd want another program is the $64,000 question.

AUTODESK

For more information, or the name of your nearest Authorized Multimedia Reseller, call **1-800-879-4A3D. (1-800-879-4233)**

Panasonic Introduces The Perfect Formula For Professional Editing.

SVHS + TBC + DNR + VITC/LTC①

Panasonic® has refined the criteria for post production with the perfect formula for professional editing. With the introduction of the AG-7750 Pro Series SVHS Editing VCR. It combines the most comprehensive video production format with every essential signal processing component. For a price that makes alternatives a thing of the past.

The formula starts with the outstanding performance of the *SVHS* format. With improved processing circuitry for even greater Y/C component accuracy through multiple generations of recording.

The multi-generation performance is further enhanced by the unit's built-in digital time base corrector *(TBC)*. It even eliminates

+ RS-422A + XLR = $6,500

jitter, skew, head impact error and color blurring. The Panasonic AG-7750 also incorporates field coefficient dynamic noise reduction *(DNR)*. It increases the signal-to-noise ratio by reducing video noise during playback for optimal results.

To insure frame accurate editing, there's vertical interval *(VITC)* and longitudinal *(LTC)* time code capability. Both internally through an optional plug-in board, or through external connection.

For advanced system integration, the Panasonic AG-7750 has a built-in *RS-422A* interface. So you can easily take advantage of the unit's high performance with virtually every professional and broadcast video system available.

There's even *XLR* audio connectors with individual three-position level selectors. To help preserve the high quality sound of your productions throughout the editing process.

And it only adds up to *$6,500* (suggested list price).② That's about half of what you would pay for a comparable editing VCR package. And that's no alternative.

Let the perfect formula for professional editing work for you. With the Panasonic AG-7750 SVHS Editing VCR. For more information, call 1-800-524-0864.

Panasonic
Broadcast & Television Systems

① Price does not include VITC/LTC optional board.
② Suggested list price indicates the price at which we believe our products can be most successfully merchandised. No representation is hereby made that substantial sales are, or will be made at the suggested price.

Circle (23) on Reply Card

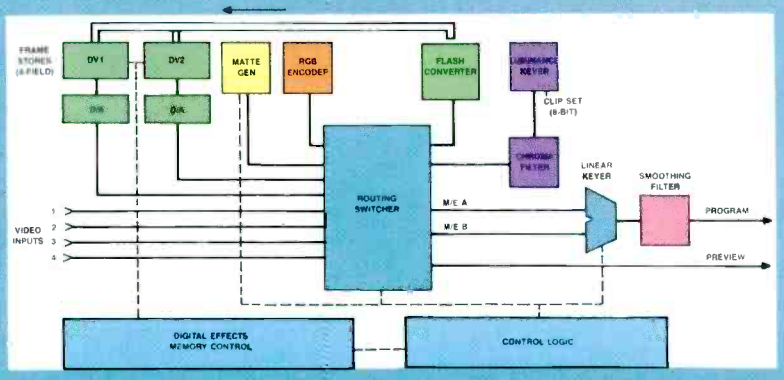
Continued from page 32

35mm slides for presentation to the sales staff and clients.

5. A streaming-tape backup system, for archival, and onto a modem, for transmission to different design stations or service bureaus.

The time pressures of news production, and the increased graphic content of newscasts, may still make the news department the primary consumer of electronically produced art. Dedicated systems remain popular. The one-seat approach will likely update the promotion and production sides of the station art department.

PC-based effects systems



Visionaries have long predicted the day when functions that once occupied entire rack frames would be implemented on printed circuit cards. Some have even suggested that equipment could use a common rack frame. A switcher card by manufacturer A could be slipped in next to an effects module by manufacturer B, along with manufacturer C's character generator. (See "Rethinking Switchers," by Robert R. Ramsaur, *BE* February 1990, p. 106.) What the visionaries might not have anticipated is that one of the possible platforms for this new broadcast facility could be a humble PC. This article examines one such system.

Simple to complex

Three major platforms for PC-based video processing include: the IBM PC and compatibles, the Macintosh and the Amiga. Some workstations and personal workstations also sport some video capability, with many more soon to appear.

One popular PC-based video production solution has generated a lot of interest since the 1990 NAB, where it was introduced. It offers four channels of video switching, digital effects, two channels of still-store, paint, modeling and animation systems, and a character generator. It all fits onto one card that operates on an Amiga computer. It is a hybrid D-2/analog device. Processing is performed in whichever format is the most cost-effective at that point in the circuit. (See Figure 1.)

This device has no dedicated control panel. Instead, the user controls it by using the mouse and icons. This provides flexibility, because the user display can be updated by software. It also reduces cost; there is no panel to manufacture.

The four video inputs plus some other signals go into a series of analog switches that act as a miniature routing switcher. One of these signals is the matte generator, which digitally creates 4,096 distinct hues. A second input is the RGB encoder, used to convert RGB signals from the host computer into composite for processing.

There are also two digital channels, called DV1 and DV2. These are the outputs of the unit's twin 4-field framestores. These feed into the routing switcher through two D/A converters. The card's paint and 3-D animation systems use these framestores, as does the on-board digital effects system. Digital effects are performed by manipulating the addresses that read out of the framestores.

Router outs

One routing switcher destination is the luminance keyer, which gets its input from the chrominance filter that precedes it. The output from this filter is available to the rest of the switcher as a black-and-white effect. A clip level provides software control of the keyer with eight bits of precision.

Another output is a flash converter that changes the incoming analog signals into digital. This converter feeds the framestores for special effects. This allows special effects. Although it hasn't yet been implemented, this converter also forms a D-2 output from the system.

One of the routing switcher outputs is the preview channel. This output follows the preview bus.

The heart of the device is the linear keyer and switch. There are two inputs, which come from the routing switcher. Any of the router's eight inputs can be selected in any desired proportion of A to B on a pixel-to-pixel basis.

Following the switch is a smoothing filter, which ensures the video meets NTSC specifications. This is followed by a video buffer that sets levels. The completed output signal appears at a BNC jack on the card's rear panel.

Digital effects

The card's effects capability comes from three facts. First, the routing switcher inputs can be toggled between inputs quickly. Second, the control of the A-to-B output of the switch is variable pixel by pixel. Third, the card uses a unique system for controlling the addresses from which output pixels are read. Essentially, the second still-store is loaded with instructions for the first. This puts the tremendous volume of addressing information needed for complex effects within instant reach of the read address lines.

Video friendly

The designers made the device video friendly. The inputs are single ended, but they are terminating or non-terminating under software control. A coming upgrade will sense the incoming level on the line and make termination automatic. To enable facilities to integrate the system with other broadcast equipment, the manufacturer plans to introduce an external H-phase and subcarrier phase control module. An external linear key signal will be provided as well.

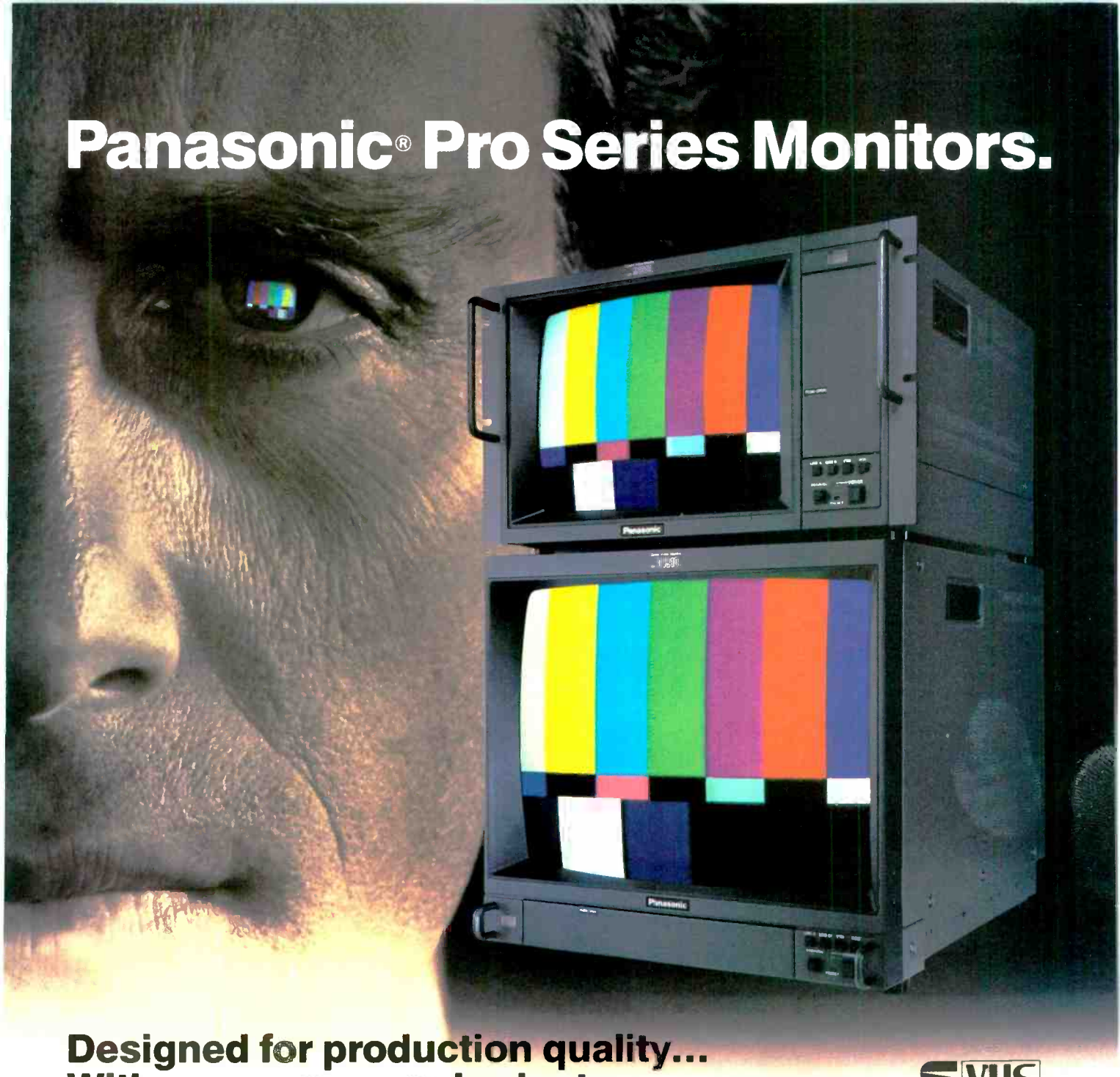
The unit overcomes systems timing issues, such as you would expect to meet when combining a switcher, digital effects system and character generator, through software, and by mounting all the facilities on a common card.

This device operates on input video signals as would any professional video device. Relative timing of the input video sources is as important as it is in any traditional video system. If the source is a VTR, this requires use of a TBC. To fill this need, many TBC manufacturers have begun development of TBCs that mount in a PC. These products are envisioned to be important in the developing multimedia market. Users will plug VCRs directly into their computers. As it happens, there is a slot in the system's host computer that accommodates cards designed for DOS machines.

Many paths

Switching and effects systems are under development for all the major PCs. Some of these are digital, others analog. Capability varies from system to system, as does price. It is anticipated that any system that make use of the PC as a user interface and a power supply will cost less than conventional video equipment. Only time will tell.

Panasonic® Pro Series Monitors.



Designed for production quality... With an eye on your budget.

S-VHS

Panasonic presents two very versatile, high-grade color monitors – the BT-D1920Y and the BT-M1310Y. Built for performance, these BT-Series monitors offer you the quality and reliability you've come to expect from Panasonic. Not to mention a wide array of features at an affordable price.

Our BT-Series provides you with the controls and connections necessary for studio applications – while serving a host of industrial, educational and professional video needs.

For maximum performance and versatility, both monitors offer complete, direct compatibility with the new S-VHS format – in addition to conventional signals. And video reproduction on the BT-Series is superb. As a matter of fact, the BT-M1310Y boasts a horizontal resolution of more than 560 lines, while the BT-D1920Y offers you greater than 550 lines.

What's more, each monitor provides you with a full set of front panel controls. Like Line A/B split, S-Video input connectors, Blue signal-only switch, pulse-cross circuit, preset picture off/on, comb/trap filter selectable and normal/underscan switch, just to name a few.

So when you are looking for professional quality, but still need to keep an eye on your budget, look into the Panasonic BT-Series high-grade monitors. For more information, call 1-800-524-0864.

Panasonic
Broadcast & Television Systems

Circle (24) on Reply Card

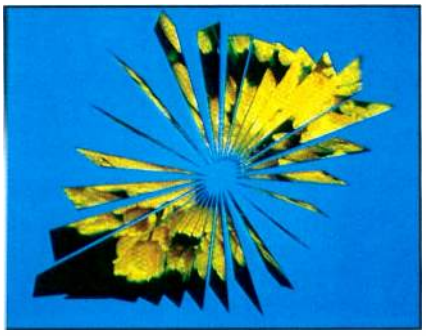
Starting their designs at desktop terminals, the artists can later transport the images to the larger graphics system for finishing.

II-animation: Making moving pictures

From the video user's perspective, there really isn't such a thing as a single frame of video. Even if nothing in an image changes color or position, as in a freeze frame or a fixed camera shot, a new frame is still created each 1/30th of a second. On the other hand, if everything changes, and each pixel goes to a new color, the new frame must still be generated within 1/30th of a second.[3]

This timing requirement has proven to be a stumbling stone for computer animation systems. Computers to date haven't had the processing power necessary to duplicate the moving video signal. For this reason, computer animation systems have developed several tricks for simulating real time moving images:

• *Color cycling*. One of the simplest and fastest animation techniques. This method works by rapidly changing the codes in the CLUT. The appearance of motion comes by changing the object's old position to the background color, while turning its new position to the object's color. Color cycling is used in some weather graphics systems, where it modulates the front lines and jet streams. It is also used in some character generators.



The newest effects systems can map video onto moving objects in real time. (Courtesy of Microtime.)

• *Delta animation*, or *hold-and-modify (HAM)*. Each pixel's starting value is mapped onto the screen. From then on, only those pixels with changing values are modified. In situations where all the pixels must change, the system usually masks the delay as a video transition, such as a wipe or dissolve.

• *Reduced-size images*. Although the computer cannot update the entire video screen of 640×480 pixels in 1/30th of a second, it can update a smaller portion of the screen in that time. Several systems use this technique to produce animated over-the-shoulder keys for newscasts.

• *Image compression*. By restricting the allowable domain for each pixel, the computer can increase processing speed to the point that mimics real time video. Sophisticated compression algorithms throw out unneeded data in such a manner that the artifacts produced by the compression are difficult for the human eye to perceive.

Some of these compression schemes resemble the ARC or ZIP files found on computer bulletin boards. Others use run length encoding, similar to that used in some character generators. Some systems use mathematical curve-fitting techniques to derive formulas that can re-create the image. The systems then discard the image, saving and transmitting only the formulae. Still other systems make use of fractals, recursive mathematical figures that draw themselves by replication. Fractal seeds are stored in the correct position on the screen to re-create the image.

Continued on page 42

par•a•gon \'par-e-, gän, -gen\ *n* **1:** a fully digital transmission processor for all broadcast environments.

2: *Featuring:* No clipper, meaning no clipping artifacts; 4-band compressor and 4-band limiter;

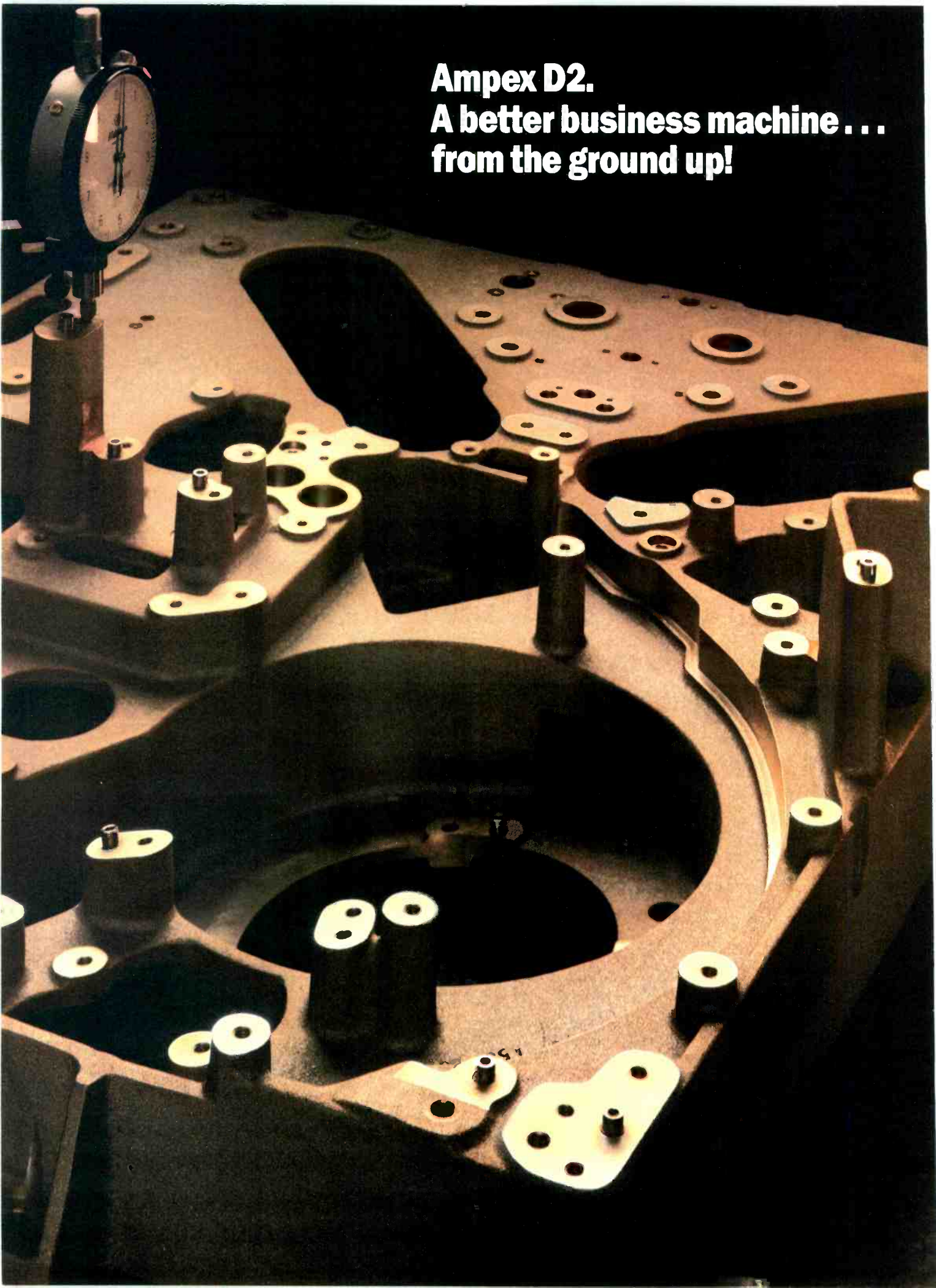
9" VGA touch-screen equipped video monitor; factory-loaded sound library; on-air A/B comparison; remote controllable. *User installable options* will include a Digital 10-band Graphic EQ, Stereo Generator and AES/EBU digital I/O.

paragon
digital audio transmission processor

AUDIO ANIMATION INCORPORATED

6632 Central Avenue Pike ▮ Knoxville, Tennessee 37912 ▮ (615) 689-2500

Circle (26) on Reply Card


Ampex D2.
A better business machine . . .
from the ground up!

Yes, it's true that our new VPR-200 and VPR-250 D2 video recorders are designed and built specifically for broadcast operations. It's also true that they offer the broadcaster superior signal quality. But a much more important consideration is that these machines make *business sense*. Here's how.

You probably amortize your recorders over 5 or 7 years, but the "200" and "250" are built to be around a lot longer than that—you're not going to find any "bent metal" here! Precision-milled castings and pre-aligned guide assemblies not only give you dependable long life, but also low maintenance costs. Replaceable heads and easy access components reduce downtime.

Time-code information, error messages, even audio level bargraphs can be displayed over a separate video output. On-board speakers reduce equipment costs, save rack space, and make installation easier.

We've given your operators some help, too. For example, these are the only D2 machines designed specifically for broadcast that make it easy to change program length. With *program compression*, your operators merely enter the program length required and the machine does the rest. You get no bounce, no blur video, and recovery of all four audio channels! And because all machine selections are clearly displayed and easily changed without cumbersome menus, operator training time and operator errors are significantly reduced.

Streamlined control functions reduce operator errors and cut training costs. All machine selections are clearly displayed and easily changed without cumbersome menus.

Then there's virtually instant lock-up and 60 × shuttle speed to save you time and money,

The VPR-200 mounts all 3 cassette sizes for flexibility from spots to movies. The VPR-250 handles small and medium size cassettes if that's all you need.

plus air lubricated tape guides, and . . . but you get the idea.

You may not have thought of video recorders as "business machines" before, but we think your first VPR-200 or 250 will change your mind. Call **1-800-25AMPEX** for more information.

AMPEX

BE-021-V200

Continued from page 38

Compression is in its infancy, but working systems are now available. The Joint Photographic Experts Group (JPEG) and Moving Picture Expert Group (MPEG) standards will likely form the base of the first systems. Digital video interactive (DVI) is another computer-based video technology that promises to make full-motion video available on the desktop, using personal computers and local area networks (LANs). The ultimate impact of compressed video and computers on broadcasting and video production is still undetermined. Some industry pundits predict these things will take the place of the viewing systems we now call HDTV.

Heavy duty animation

Restrictions on image size or number of colors are not acceptable in a broadcast environment. As a result, rendering each frame of a complex animation can take from a few seconds to several hours. The time depends on the complexity of the image and the speed of the computer. Because in video anything more than 1/30th of a second is not real time, this requires a storage and buffering procedure. Efforts at shortening rendering time have been aimed at reducing the time from hours to seconds per frame.

Rendering is computer intensive. Generally, while a computer is rendering, it can't be used for anything else. This limits the time an artist can use the computer for designing. Some facilities get around this by giving the task of rendering to a separate computer, dedicated to the purpose. In most stations, the drill for rendering is much simpler: the artists give the computer a list of things to chew away at before they go home for the night. First thing in the morning, they check to see how much got done.

Several general procedures have developed for rendering:

1. Recording and editing. When a frame is completely rendered, a person or computer starts a nearby VTR, recording 30 seconds or so. The machine stops, the rendered frame is discarded, and a new frame starts rendering in its place. The process then repeats. Later on, one frame from each segment is edited into a master tape, hopefully using some form of automated editor.

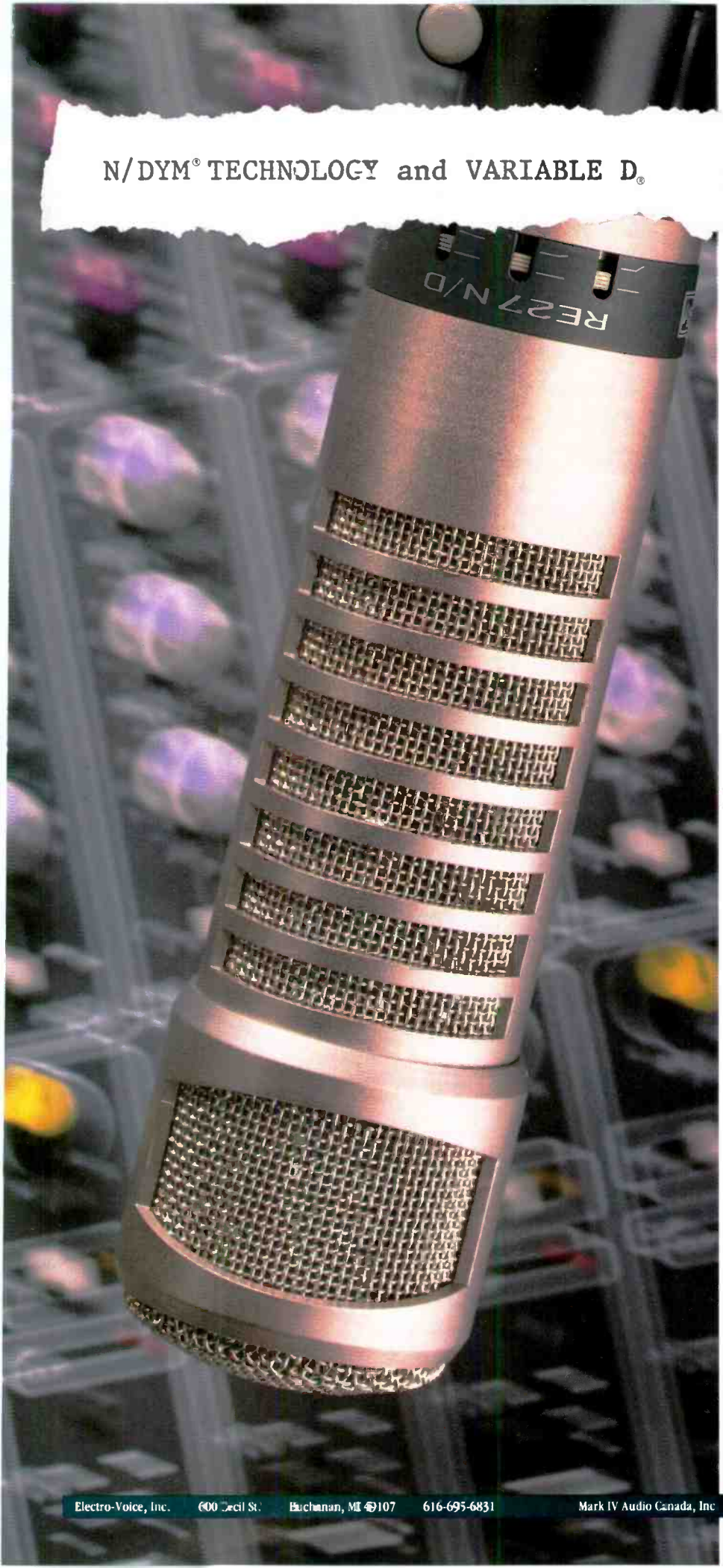
This is a patchwork system, useful where economy overrides convenience and reliability. The method also has the problem of adding an extra generation loss. A far more realistic scenario is single-frame recording using a machine control system.

2. Single-frame recording. In single-frame recording, the computer operates a tape machine via the VTR's remote-control system. When a frame is ready, the computer rolls the VTR and records it. The system then renders the next frame, and the process repeats.

Single-frame recording under computer control is easy and accurate. The disadvantage is that computer-graphic system manufacturers need the current protocols for several brands, models and revisions of VTRs. To avoid this difficulty, some manufacturers avoid controlling VTRs directly. Instead, they support half a dozen machine control systems. These machine control systems act as liaisons between the tape machines and the computers.

3. Batch processing. In batch processing, the computer writes the contents of the rendered frames in the frame buffer to disk. At record time, the frames are called up sequentially and recorded to tape.

The advantage of batch processing is that it gives the artist an opportunity to check and touch up each frame before committing it to tape. This prevents having to make single-frame correction edits.



N/DYM® TECHNOLOGY and VARIABLE D®

THE RE27N/D

Neodymium-Aligned Technology and Variable-D® Design are Combined to Create the New RE27N/D

Twenty years ago, Electro-Voice introduced the legendary RE20, which soon became an industry standard in broadcast production and recording. Today, the Variable-D design concept pioneered by the RE20 is still world class.

The new RE27N/D not only utilizes this time-proven design, but takes it one step further with the addition of EV's N/DYM® technology. Electro-Voice was the first audio manufacturer to harness the power of this rare-earth super magnet. N/DYM actually delivers four times the power of conventional magnets. The RE27N/D also offers three switchable filters, one high frequency and two low frequency. Due to the increased sensitivity provided by N/DYM, the switchable filters enable the selection of either a flat high-end response or a shelving emphasis above 4 kHz for enhanced vocal presence, and the option of two low-frequency rolloffs.

The net result: a microphone that is designed in the tradition of the RE20, but exhibits higher output and even wider frequency response, providing a high-performance version of the Variable-D design concept.

N/DYM and Variable-D are the ingredients of a perfect blend — the new RE27N/D.

For additional information, contact Ivan Schwartz of Electro-Voice at 616/695-6831.

Electro-Voice®
a MARK IV company

Electro-Voice, Inc. 600 Cecil St. Buchanan, MI 49107 616-695-6831 Mark IV Audio Canada, Inc 345 Herbert St. Gananoque, ON K7G2V1 613-382-2141

Circle (2) on Reply Card

The disadvantage of batch processing is that the rendered frames rapidly consume disk space. The memory might fill before the artist returns, which means the equipment sits idle.

Counting the costs

A sad fact of life in the computer-graphics business is that the most expensive hardware may not be the computer animation system, but rather the video backbone necessary to support it. This is particularly the case with systems that can input video images as well as create them.

However, there is a ray of hope. Increasing use of animation by event videographers has driven an emerging market for low-end machine control systems. This, in turn, may lower the price of systems suitable for use in broadcasting. Some of these low-priced controllers use RS-232 ports on the tape machines. Others use the so-called *IR port*. The computer emulates a hand-held remote-control unit.

Additionally, the emergence of the recordable laser disk may eliminate the use of VCRs in computer animation. These systems can efficiently capture single or multiple frames without waiting for a preroll and without elaborate time-code systems.

Modern character generators include several paint and animation features. Fonts are resizable. Letters and words can be animated. Backgrounds can be moving video. (Courtesy of Ampex.)

One of the brightest new lights is the digital disk recorder. These systems, although costly at present, simplify the creation and editing of digital animation and effects. High-end systems use digital disk recorders to great advantage, especially when complex jobs require the overlaying of several moving images.

Ill-effects: Playing with the pictures

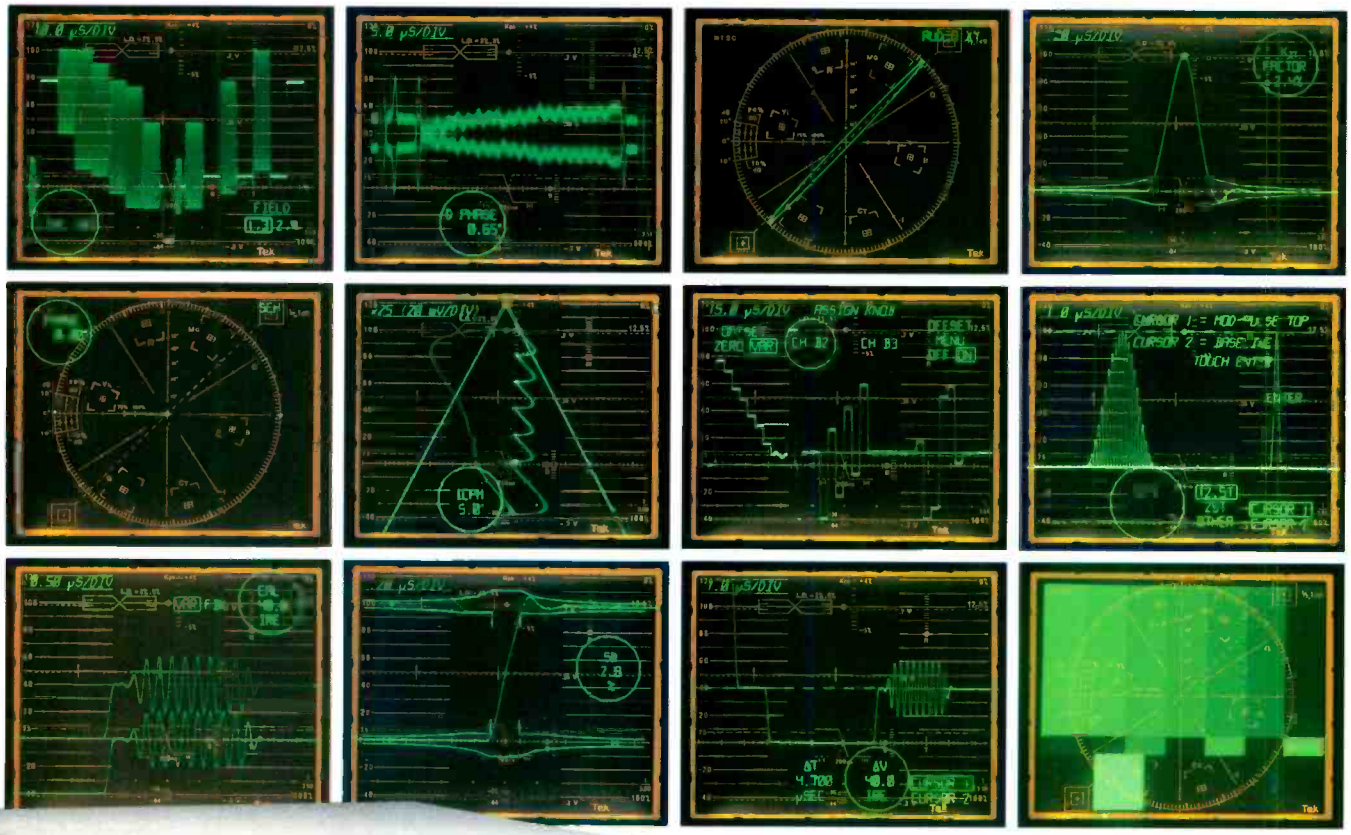
One of the simplest video effects is character generation. It is also one of the first areas in which computers entered the video arena. Today, essentially all character generators are computers under the skin.

Today's most powerful character generators include an amalgam of features found in paint and digital effects systems. They can manipulate characters individually or as groups in real time, and can do so on several layers or levels. Layering capability enables effects to exhibit hierarchy, that is, some elements seem closer to the viewer than others. Backgrounds that appear beneath the characters can be moving video if desired.

Fonts, once the primary selling point of CGs, are now available in any style imaginable. They are resizable, italisizable, and can be oriented any way on the screen. Characters can be mapped to arbitrary lines on the screen, and can follow elaborate animation paths. Character motions can accelerate and decelerate at different points in their movements, giving the illusion of having mass.

Also, most high-end character generators now come with their own paint systems, including image capture. These features are used for creating logos and backgrounds.

The Tek 1780R: We don't mind if you judge by appearances.



Nobody's watching closer.

Even at first glance, you can see that the Tek 1780R is in a class by itself. Only the 1780R offers full-bandwidth analog measurement capabilities with separate, complementary waveform and vector displays. Component and composite capabilities are provided through four video inputs and a front-panel probe input. You get polar SCH presentation, precision differential gain and phase displays required to test modern television systems, and more. All made easy enough for even first-time operators.

But enough said. Ask your nearest Tektronix representative for a demonstration of the 1780R: by all appearances, the most advanced analog video measurement set you can buy!

Tektronix
COMMITTED TO EXCELLENCE

Circle (32) on Reply Card

At the lower end of the CG scale, there are many software packages that allow PCs to provide character generator functions. An advantage to this approach is that the computer can donate enormous horsepower to the human interface, simplifying operations. Additionally, the computer can be put to other tasks when it is not busy doing video production.

Moving targets

Less than a decade ago, simple X–Y translations that resized images wowed the masses. These effects have since become commonplace. The transitions available on higher-end systems today are indescribable by comparison. Some of the newest systems can map moving video over moving, multifaceted objects. Digital recursive effects resample the video buffer after a delay. This results in effects that contain sparkles, trails and decays.

These systems require powerful dedicated processors. Such horsepower puts this kind of effect out of the reach of many potential users. However, effects systems manufacturers have not only been busy expanding the horizons of video production. They have also been developing systems for those on a budget — a benefit of improved production and test techniques and application-specific integrated circuit (ASIC) technology. This has resulted in an increasing state of the art, and in more capabilities for less money.

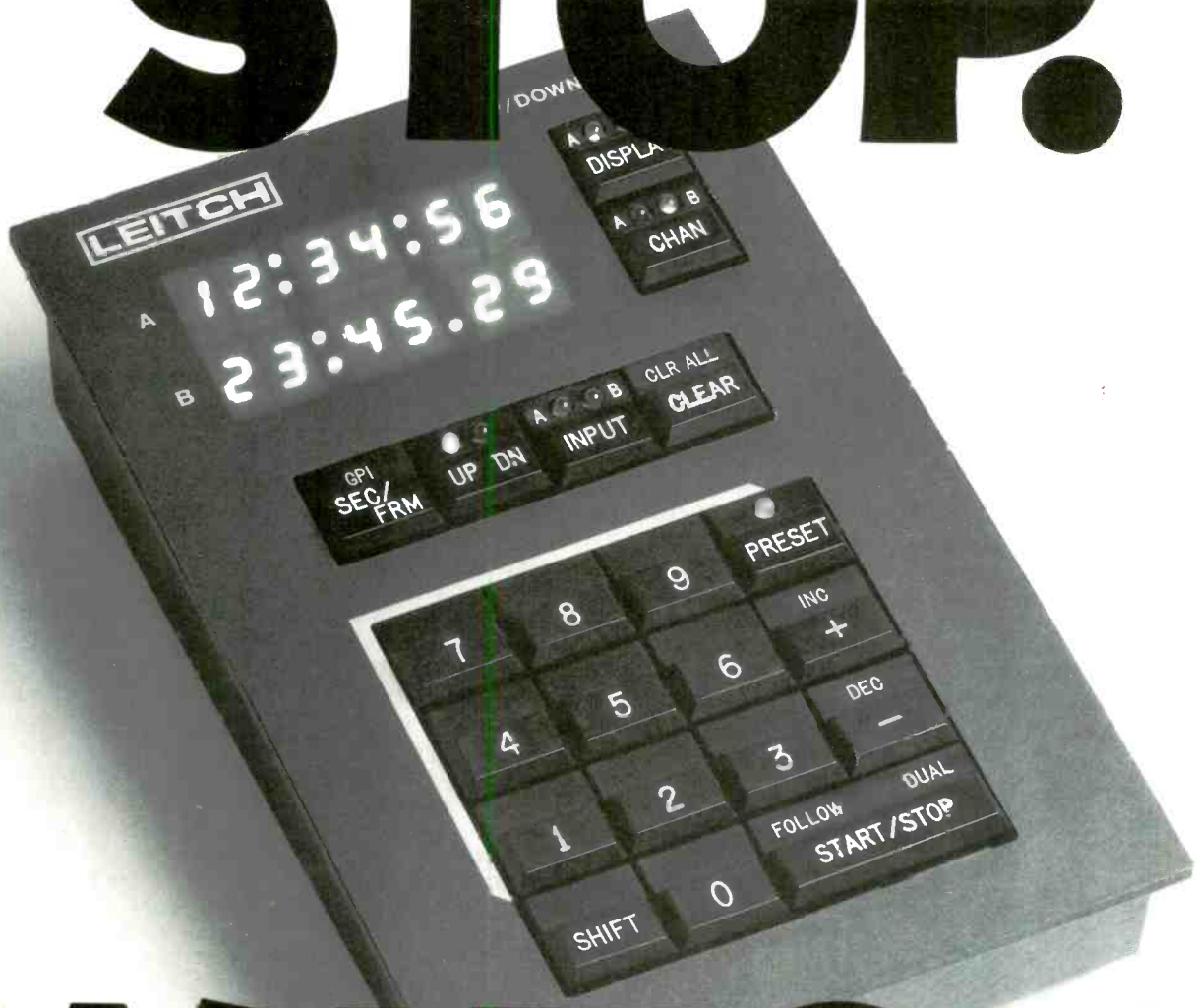
Off-line effects

One manufacturer recently published the effects control protocol for its high-end effects system. The goal was to make it possible for users to develop programs to match digital effects system moves to the moves of physical devices, such as cameras. However, in opening the protocol, the manufacturer may have also opened a new era in digital effects production. It is now conceivable that a small, relatively inexpensive effects system could generate motion paths and size information data. This data could be imported into larger systems. This could, in effect, allow small systems to serve as off-lines to larger ones. This follows the trend of using a single design seat to create graphics for video and for print.

Different strokes

One manufacturer sees this taking the form of integrating several production devices on some sort of network. The central equipment core would consist of banks of shared resources: picture manipulators, mix/key engines, CGs and recorders. Users would access this core with interfaces tailored specifically to their job function. Artists could create graphics and motion paths at design stations, and store them in a file server. Editors would call up the information, as well as

STOP.



WATCH.

Take a close look at the new Leitch Up/Down Timer.

Now more wizardry from Leitch. What you're looking at is a remarkable, compact time code calculator/stopwatch. With dual channels. For instance, while one channel is being used for counting up or down, the other can handle calculations. The keypad is fast and simple to use. And the Up/Down Timer gives you twenty programmable "softkeys".

For more information, just call these numbers. We can show you all the ins and outs of the Leitch UDT-5700 Up/Down Timer. When it comes to production timing, this is the Time Machine.

1-800-231-9673 U.S.A.
1-800-387-0233 Canada

LEITCH®

Leitch Video of America Inc., 825K Greenbrier Circle, Chesapeake, VA 23320 Tel: (804) 424-7920 Fax: (804) 424-0639
Leitch Video International Inc., 220 Duncan Mill Rd., Suite 301, Don Mills, Ont., Canada M3B 3J5 Tel: (416) 445-9640 Fax: (416) 445-0595
Leitch Europe Limited, 35 Maiden Lane Centre, Lower Earley, Reading, Berks, U.K. RG3 3HD Tel: (0734) 352377 Fax: (0734) 352431

Circle (34) on Reply Card

previously stored font pages, from edit control panels. After using the controller's joystick to make minor trims on the various elements, the editor would then merge and record them using the resources of the core.

PC power

Real time manipulation of video signals is one of the last fields entered by the computer. This is because of the tremendous bandwidth video occupies. Recently, several graphics card manufacturers have announced transputer-based cards. These cards, actually powerful chunks of supercomputer, draw power from the host PC, and use the PC for disk operations. The PC's bus is not fast enough for video data manipulation. For this reason, the card makers are providing several alternate bus structures that operate in parallel with the PC bus.

In most cases, system builders start with a frame buffer card. This card also serves to get video into and out of the computer. Additional cards include processors, keyers, mixers and other video devices not yet revealed. Manufacturers are mum about the ultimate potential for this type of system, but video switching and digital processing have been mentioned.

Modern effects systems can perform trails, sparkles and decays using recursive digital techniques. (Courtesy of Ampex.)

These cards, with the special processors and buses fittings, are fairly expensive. One new system, however, manipulates video, is a character generator function, has two still-stores, a paint system, a 3-D modeling and animation system and digital video effects — all for under $2,000. (See the related article, "PC-Based Effects Systems," pg. 36.)

At some point, you must question the ultimate role of the PC in video. Will there ever be a time when a PC with some expansion cards truly takes the place of expensive, dedicated chassis? The answer is yes and no.

One popular high-end 2-D/3-D system uses a PC, but is not PC- based. In the system architecture, a rack-mounted, industrial version 486-based PC is called the user interface. Video processing is performed in the video interface. This section uses proprietary hardware that operates on a VME bus.

The manufacturer at one time thought to perform user interface on a simple PC, one that was available to fit the VME bus. The manufacturer elected not to, and has discovered in hindsight the choice was advantageous. By including a PC, the manufacturer has been able to take advantage of the DOS world's huge following to provide such functions as filing, operating the disk media, and performing 3-D processing. By using a standard DOS environment, the manufacturer was able to quickly add convenient options, such as magneto optical storage, as soon as they become available and with minimal development expense.

On the other hand, the manufacturer quickly dismissed using the PC for high-speed interface with the system's digital disk recorder. That interface is performed in the VME environment. Clearly, there is a time to take advantage of PCs, and there is a time to ignore them.

End of the world?

Some manufacturers see the PC's encroachment into the computer-based effects environment as a threat. Others, such as the case just mentioned, consider the PC a useful tool to be exploited when convenient. One thing is certain, PCs won't go away.

Advocates of the pint-sized processors point out that the emergence of desktop publishing has put few printers out of business. Rather, it has increased their opportunities. Users that never would have considered printing because of its cost can now experiment and develop products that truly meet their needs. Similarly, video users who previously would never have dreamed of using graphics and effects can now do so at low cost. They can then graduate and make use of a full-service facility that can meet all of their needs when required.

Manufacturers opposed to PCs counter with a one-two punch. In the first place, they point out the computer screen is only one of several possible user interfaces. Different interfaces have different ideal applications. Even if a PC's graphical user interface (GUI) is attractive for some applications, other uses — such as sports or other fast-moving productions — still need the one-function-per-button capability of standard video switchers. Thus, even if the desktop video and low-end production eventually merge, there will always be a place for traditional video equipment.

Secondly, manufacturers of dedicated video equipment point out that they have not been standing still. Equipment that once took an entire rack frame now occupies a single card. What once took a card or two now fits in an ASIC. Modernized and automated manufacturing and test techniques will allow manufacturers to increase the perceived value of units by lowering their cost and increasing their functionality. |:-)))|

Footnotes

1. The jargon-makers in the computer world have had a field day in the video domain. To a computer user, *RGB* is a 3-wire video signal with one color per wire. *Analog RGB* implies a 3-wire video signal that is not digital. Neither of these terms imply line frequency, interlace or field repetition. *NTSC RGB* is an analog, interlaced, 3-wire video signal at *NTSC* line and field rates.
2. To a video user, overlay implies keying a signal or graphic on top of a video signal and viewing the results on a video monitor, or recording them. In the computer-video industry, overlay is coming to mean importing a video signal into a computer, overlaying it with computer-generated text and graphics, and then viewing it on the computer's monitor, in the computer's format. The composite image then may or may not be converted to a video output, depending on the overlay device. Computer users plan to use this kind of overlay device for multimedia applications.
3. Real time to a video user means one frame every 1/30th of a second, one field every 1/60th of a second. Real time to a computer user often means "without delay." If something happens fast enough to not cause an annoying wait, it is real time.

Acknowledgments: The author wishes to thank Doug Hirnihara, Dynatech Colorgraphics, Madison, WI; Michael Guess and Ed Hobson, Grass Valley Group, Grass Valley, CA; Dave Detmers, Ampex, Redwood City, CA; Paul McGoldrick, Magni, Beaverton, OR; and Mark Podesta, Microtime, Bloomfield, CT, for their help in preparing this article

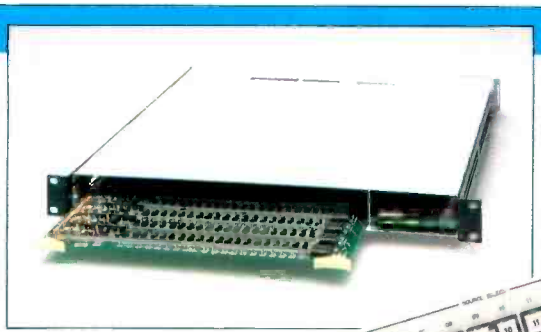
CELEBRATING OUR 20th YEAR

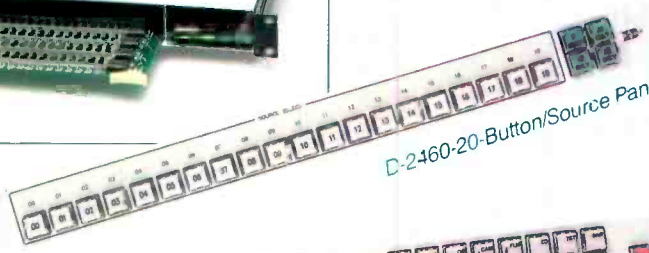
DATATEK D-2500 SERIES
20 x 10/20 x 20 ROUTING SWITCHERS

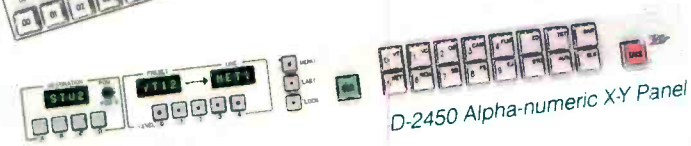
VIDEO
STEREO AUDIO
RS-422 DATA
RELAY

The Datatek D-2500 series — latest addition to Datatek's extensive line of routing switchers — provides 20x10 routing, expandable to 20x20, of video, component video, stereo audio, bi-directional RS-422 data and bi-directional 2-wire or 4-wire relay. Each of these units can operate independently or in combination with the others, or as part of larger Datatek routing switcher systems.

- Video – 40 MHz bandwidth
  Stereo Audio – .05% THD at +26dBu
  RS-422 Data – at 2MBaud rate
  Relay – 2 wire or optionally
  4 wire/crosspoint
- Basic units 20x10 expandable to 20x20
- Each unit can operate alone or in combination with the other 20x10's
- 8 Independent control levels for 10 destinations; 4 Levels for 20 destinations
- Plug-in modules, accessible behind snap-on front cover
- RS-232C or RS-422 Control included as standard for computer or control via modem
- Battery backup RAM for up to 10-year matrix memory retention
- A simple terminal can be used to reconfigure these units, with input/output transcoding, salvo edit, salvo execute, etc.
- Optional Redundant Power Supplies
- Wide selection of control panels available; X-Y, Alpha-numeric, pushbutton per source, etc.
- Very cost effective




D-2460-20-Button/Source Pane


D-2450 Alpha-numeric X-Y Panel


D-2460-20/10 Pushbutton X-Y Panel

Circle (39) on Reply Card

DATATEK CORP.

For more information, please contact us:
1121 BRISTOL ROAD, MOUNTAINSIDE, NJ 07092 • PHONE: 201-654-8100
TOLL FREE: 800-882-9100 • FAX: 201-232-6381 • TELEX: 833541

WHY WAIT...

If you're going to replace an accepted format like one-inch, Type C, you shouldn't just be different. You should be better. So most teleproduction and broadcast users are still waiting for a digital system to offer things like:

- A camera/recorder so you can go from shoot-to-edit on the same cassette
- A 245 minute half-inch cassette
- Cassette interchange robust enough for editing and cart machine use
- Edit point guard band for stable, accurate edits
- Enhanced error correction
- Variable speed digital audio
- A small appetite for rack space and archive real estate
- Lower tape consumption
- Viewable video at shuttle speeds up to 100X
- Potential for worldwide acceptance

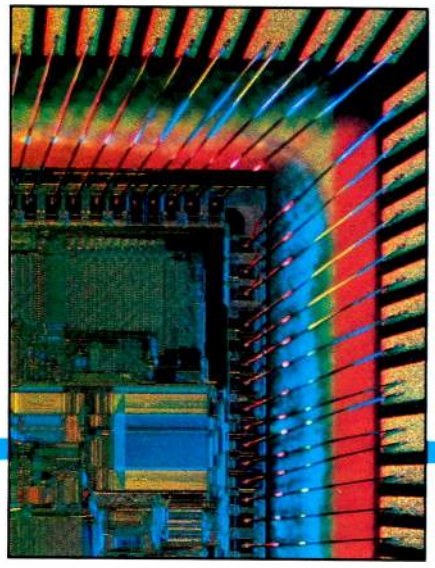
Panasonic Half-Inch Digital Recording Systems bring you all this and one more thing worth waiting for—affordability.

FOR PANASONIC 1/2 INCH DIGITAL.

1/2" DIGITAL

Panasonic
Broadcast & Television Systems

One Panasonic Way, Secaucus, NJ 07094
For more details call: 1-800-524-0864



Actual field measurements are the last word on RF radiation.

Radio frequency radiation

Part 1 — a case study

By Don L. Markley, P.E.

For a long time, broadcasters and antenna farm operators have been concerned about the possibility of injury to tower workers caused by radiation from antenna systems. This concern has broadened in recent years to include residents of homes near antenna sites, apartment building and condominium tenants, and the general public in the vicinity of large sources of non-ionizing radiation.

Studies have been completed and are under way to determine the impact of exposure to non-ionizing radiation (RF). Although the book is still incomplete, it has been widely accepted that a level does exist below which no adverse health impact will occur. It should be understood that no one standard had been totally accepted by all parties involved. As has been discussed in this journal and in other publications, many professional and citizens' groups have made efforts to set their own standard. These standards have varied from realistic and meaningful, to those that are of the "me-too-only-even-stricter" variety. The Federal Communications Commission (FCC) has determined that one standard will be specified as the accepted national guideline for radio frequency exposure.

Markley, *BE's* consultant on transmission facilities, is a consulting engineer based in Peoria, IL.

The American National Standards Institute (ANSI) adopted a standard in its "Radio Frequency Protection Guides." The particular standard of concern to broadcasters is "Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300kHz to 100GHz," which is commonly known as ANSI C95.1-1982. The FCC has clearly recognized this standard and has required all broadcasters to demonstrate that their facilities do not expose personnel to RF levels in excess of the specified values.

More important, operators should be concerned about RF levels for the simple protection of workers at their facilities. The first lawsuits for damages have long since been filed, claiming injury from RF. Broadcasters simply cannot permit anyone to be exposed to levels that exceed the ANSI standard. To do so opens the door to all sorts of claims, real or imaginary, which could result in financial ruin for all parties involved. But beyond financial concerns, it must be considered wholly unacceptable for any conscientious operator to expose workers to unsafe conditions.

A case in point

As a result of this list of issues, Sears, Roebuck and Company, who was then owner and operator of the Sears Tower in Chicago, decided to have all necessary measurements performed to ensure that no one in the building could be exposed to hazardous radiation. This study was not to be limited to RF sources in or on the building, but was to include external facilities. Those external sources were subsequently determined to be from microwave facilities that were essentially operated by common carriers.

With the exception of its superlative height, the 110-story Sears Tower is representative of the majority of building-mounted antenna farms. The types of RF sources found there vary over virtually the entire range of the spectrum. The building currently supports five full-power TV stations (two VHF, three UHF), six FM stations, microwave facilities ranging from 950MHz to 23GHz, and a wealth of business radio services using all available frequency bands. However, this wide range of frequencies presents a new set of problems. ANSI C95.1-1982 identifies the maximum level at each frequency that should not be exceeded when averaged over a period of 0.1 hours (six minutes). (See Figure 1.) Because the maximum permissible amount is a function of frequency, a complete evaluation at each particular point

would involve a measurement of the fields involved, a spectrum analysis to determine the stations participating in the total available RF energy, and a set of calculations to determine if the standard was actually exceeded.

Fortunately, there is an easier way to deal with such a multi-user site. A commercially available broadband isotropic radiation meter and probe system can be used to measure the field. The frequency response of the probe used in this case is shaped to correspond to the curve found in the ANSI standard. The meter is calibrated in percent of the ANSI standard over three ranges, the highest being 200% of the standard. Two different probes are used in this system. One probe covers frequencies up to 1.5GHz; the other handles frequencies from 300MHz to 26GHz. With these instruments, all sources within the range of the probe currently in use are combined. The resultant reading then indicates how well the total measured RF energy at that point complies with the standard.

Testing methodology

When surveying a building such as the Sears Tower, the first concern is that the maximum safe limit not be exceeded. It doesn't matter who is contributing to the RF level, as long as the total of all sources is still well within safe limits. If it is found that the ANSI standard is exceeded at a given location, spectrum analysis and the associated calculations can then be performed to determine which stations are the primary problems. These problems can either be resolved by corrections to the source antennas or by refusing entry to personnel in the area. (The latter is, of course, the simpler solution.) For this particular project, an arbitrary level of 10% of the ANSI standard was selected as a first level of protection for all normally occupied spaces. As long as that level was not exceeded in the measurements, no effort was made to determine the identity of the contributors. Where the measured RF value did exceed this 10% level, spectrum analysis measurements were completed.

The measurements usually proved the obvious. That is, the primary contributor is usually the nearest large antenna, although some surprises were encountered. For example, the highest RF level found in any tenant space was in a transmitter room on floor 101. Here, the RF level reached 65% of the ANSI standard near the window. The source was not a big transmitter, but a 450MHz link being used for transmitter-to-studio telemetry. The 65% number was only reached in the immediate vicinity of the transmitting antenna (within one foot). As long as no one uses that antenna for a seat or a pillow, no problem results from that source.

The first measurements taken were on the lower floors of the building. In particular, measurements were taken at numerous locations on those floors that would be in a line-of-sight path from numerous microwave dishes at an AT&T facility. On all floors below those occupied by broadcast transmitters, the total RF energy never exceeded 0.1% of the ANSI standard.

The next place of major concern was the observation area that occupied all of the 103rd floor. To date, several million visitors have taken an express elevator to view a truly spectacular area. Obviously, Sears was interested in confirming that none of its visitors were exposed to hazardous RF levels. It was found that the highest RF level was only 2.1% of the ANSI standard. This confirmed the original belief that visitors to the building were in no danger.

The floors that were occupied by broadcasters and other RF sources were examined in detail. In particular, every room that contained a transmitter of any type received careful attention. The measurements in these spaces confirmed the results of measurements at many other transmitter facilities — namely that the level of RF inside transmitter rooms is extremely low. The FCC's cabinet radiation restrictions, along with the care taken by modern equipment manufacturers, are extremely effective in providing a safe working environment. So those who have spent years babysitting big transmitters should rest assured that their health has not been impaired.

To this point, it had been determined that all interior spaces were quite safe. This included the observation deck, the equipment spaces in the penthouse and on the upper floors, and the areas where the broadcast and other transmitters were located. The next and final set of measurements included the several rooftop locations of the building.

Some interesting results

The bottom of the Sears Tower is square. The building design is made up of nine smaller square sections (3×3) or modules. Seven of these modules do not extend to the top. Only the center and west-center modules are full height. Two of the modules that terminate at the 89th floor are topped with business or common-carrier antenna farms. These were the first farms checked. No location accessible to personnel was found to have an RF level greater than 20% of the ANSI standard. Therefore, people can occupy that level at any time without concern of RF exposure.

The towers on the top of the building are actually supported by steel cylinders more than 11 feet in diameter, which extend to approximately 80 feet above the roof. The towers stretch nearly 200 feet further above these cylindrical pedestals. The cylinders are connected to the building's structural steel down to floor 101. This not only provides the support for the tower bases, but is also a natural route for all of the coaxial cables and waveguides leading to the transmitting antennas.

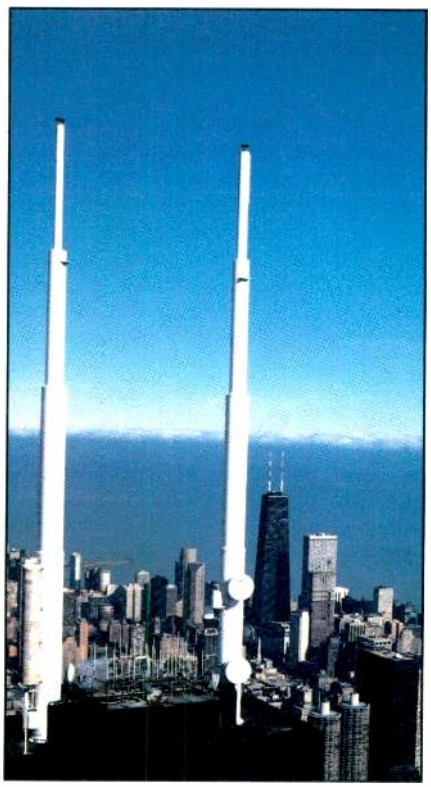


Photo A. *Antenna farm atop Sears Tower, Chicago, the world's tallest building. Photo looks northeastward, with the west tower at left. The lowest/widest section of each tower structure is a "cylinder" base, with the upper three sections being radome-covered antenna masts. Note the large circularly polarized antenna on the left side of the west cylinder, and the 2-way/microwave farm atop the penthouse roof between towers. The tall, tower-topped building in the background is the 100-story John Hancock Center.*

Measurements were performed inside the cylinders up until the point where the ANSI standard was reached. It was found that workers could safely climb to the top of the cylinders without their exposure exceeding the ANSI standard. Above the cylinders, on the towers, the RF levels quickly became hazardous. Further testing revealed, however, that no hazard was caused to workers on the east tower structure by the TV stations on the west tower. In addition to the isolation created by the spacing of the two towers, the UHF antennas on the west tower are all directional, and the signal being radiated toward the east tower is attenuated. Therefore, it could be concluded that the hazardous radiation in each tower structure was caused only by the antennas on that tower.

A large, circularly polarized VHF antenna is mounted on the west cylinder. It was used for earlier TV-CP tests, and still serves as a standby antenna for two VHF TV stations. Measurements quickly confirmed that the western third of the building roof surface was hazardous when either station was using that standby antenna (although radiation from this antenna was not at hazardous levels up on either tower). This was exactly the type of information that the study sought. No hazard would exist as long as the concerned TV stations were on their main antennas. However, no work is permitted on the roof if the auxiliary antennas are in use.

Since the measurements described here were performed, two FM stations have constructed auxiliary antennas on a short pylon between the west cylinder and the northwest corner of the building. A warning light has been installed over the access door to the roof. It is wired into the antenna-switching system for the two stations. When either FM station is using its standby antenna, the light warns that no one is allowed to work on the roof.

Determining how far work could progress up into the towers was checked quite simply. The meter used has an aural alarm that can be set to any desired level on the meter. This alarm was set to sound at 100% of the ANSI standard. The meter and probe were connected to a rope and raised up into the tower until the alarm sounded. This permitted accurate deter-

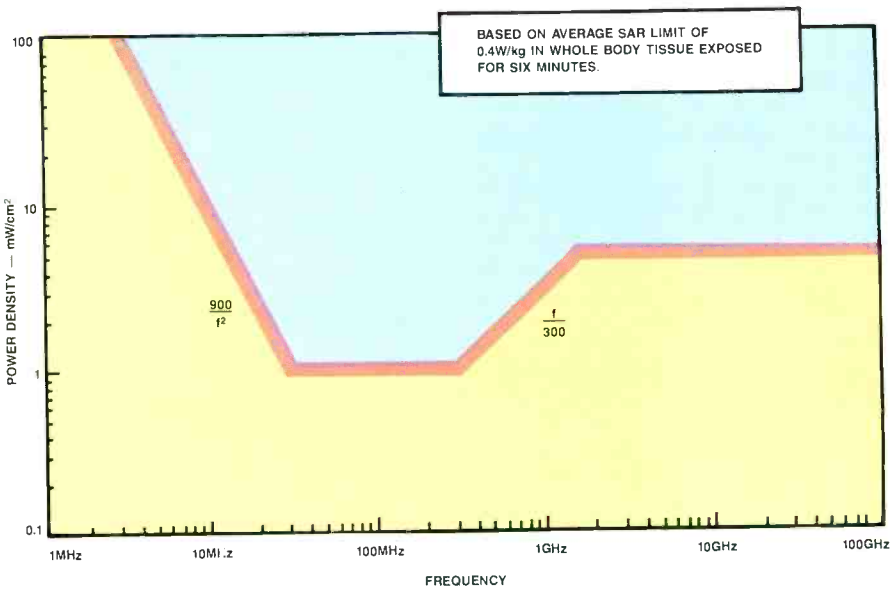
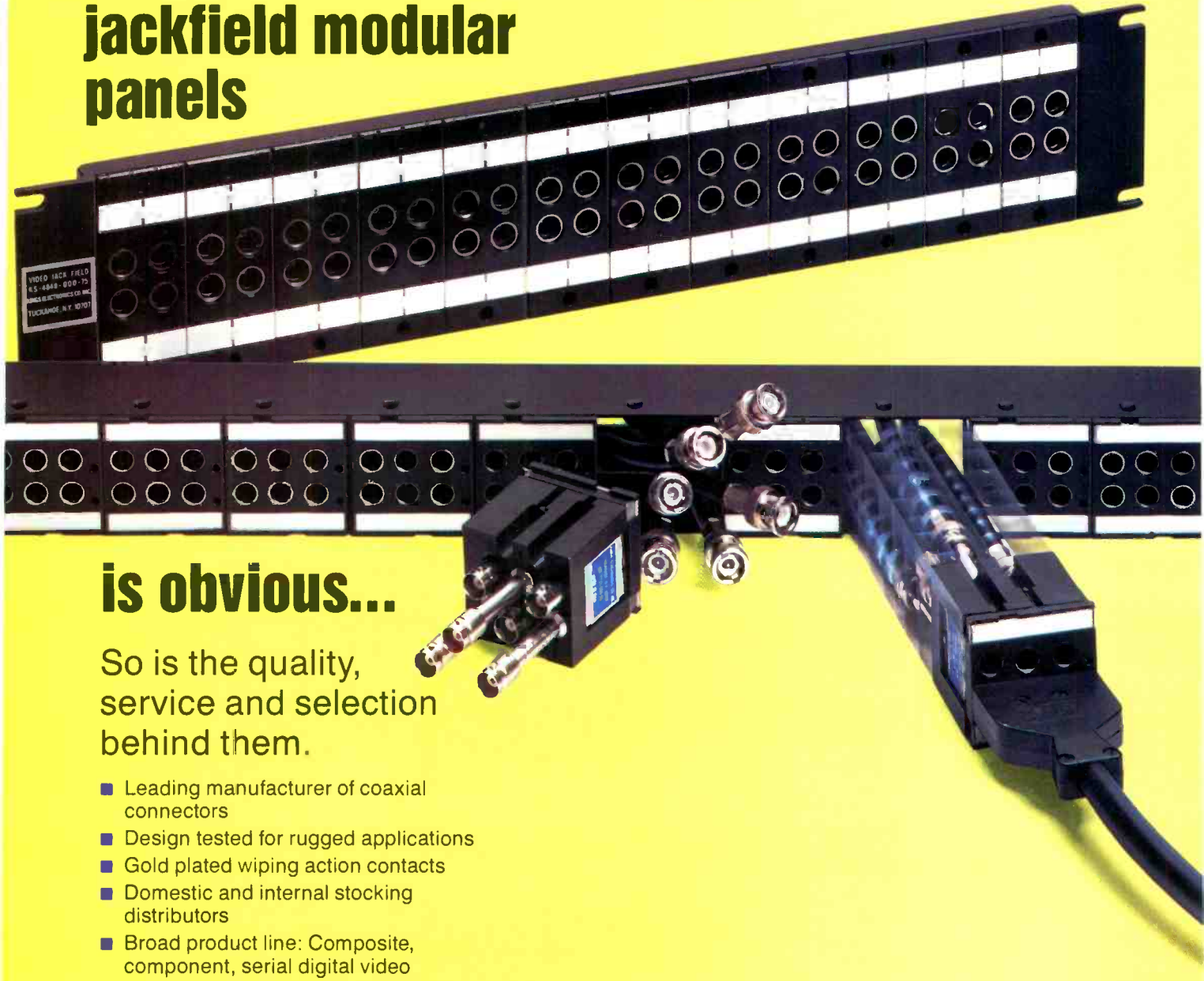


Figure 1. *The ANSI C95.1-1982 RF exposure limit. It is based on the calculated rate of energy absorbed in an organism known as the average specific absorption rate (SAR), measured in watts per kilogram.*

The advantage of KINGS front load video jackfield modular panels



is obvious...

So is the quality, service and selection behind them.

- Leading manufacturer of coaxial connectors
- Design tested for rugged applications
- Gold plated wiping action contacts
- Domestic and internal stocking distributors
- Broad product line: Composite, component, serial digital video
- Panel Options: Front load and solid to 26 positions with standard size jacks to 32 positions, 1 rack unit high with miniature size jacks
- Circuits: Normal self-terminating and non-normal

For Literature or Application Assistance, Contact KINGS ELECTRONICS COMPANY, INC., 40 Marbledale Road, Tuckahoe, NY 10707. (914) 793-5000 • FAX (914) 793-5092

KINGS

Circle (41) on Reply Card

mination of the safe areas without exposing the measurement crew to possible hazard.

The last set of tests involved the large communications and microwave antenna farm on the roof of the penthouse between the two towers. There was concern that this area would be hazardous because of the large TV antennas that are mounted low on the towers, not far above the penthouse roof. It was found that all areas of the penthouse roof measured far below the ANSI standard, and that the area was safe whenever all stations were using their primary antenna systems.

An excess of caution?

These measurements have confirmed that work can progress in the vicinity of broadcast antenna systems without exceeding the exposures in ANSI C95.1-1982. The FCC has published a document identified as OST bulletin 65. (See "Part 2—An Update" pg. 66.) That bulletin contains methods that are to be used to determine RF levels around AM, FM and TV towers. The methods used, absent vertical patterns for the antennas, are based upon the worst possible case for all variables involved. For AM antennas, for example, energy is assumed to be radiated from the base of the tower, regardless of its height. For directional arrays, energy is considered to be radiated from each of the towers in the array. Measurements confirm that these calculations are totally unrealistic. The high fields below FM and TV antennas or around AM towers that are predicted by OST bulletin 65 do not exist.

The high fields below FM and TV antennas or around AM towers predicted by OST bulletin 65 do not exist.

It should be pointed out that OST bulletin 65 takes this cautious approach to ensure that adequate protection is provided to those near broadcast antennas. It succeeds. On the other hand, the author has a magical symbol over the bar in his office that is intended to keep elephants out of the bourbon. It works as well as OST bulletin 65. No elephant tracks have ever been observed near the bottles.

The measurements taken on the Sears Tower determined that all areas of the building are safe from hazardous exposure to RF radiation. In addition, all areas of the roof are safe when all stations are using their primary antennas. Signals originating off-site do not cause significant problems anywhere in the building. Finally, those areas that were not safe during standby antenna use were documented.

The position of the building management concerning exposure to RF radiation was simple. If the level exceeded ANSI C95.1-1982, no one was allowed into that area for any period of time. This is far safer than trying to deal with averaging exposure over periods of time to ensure the safety of your staff or others. No station's operation is more important than personal safety. If you are concerned about the levels in the vicinity of your antenna system, have the necessary measurements performed. These measurements are simple when using the test equipment mentioned here, and they will end any need for concern by those who work in the area or by station management.

Part 2—An Update

Continued on page 66

A Timely Announcement from the TBC Masters:

The Newest FOR.A Digital Time Base Corrector FA-310 Is Now Available.

Up to 9 dB of motion-compensated luminance and chrominance noise reduction.

With composite, Y/C 358 and component YP_BP_R* full-frame correction, and format transcoding.

Y/C H and V delay control. And more. Lots more. More of what the true pro is looking for.

Enough said.

Because when your very name is synonymous with TBC... a lot of words just aren't necessary.

Ask for complete information on the FA-310 and other FA series TBC products, all of which comply with FCC standards: FA-210, FA-300, FA-700, FA-425, and FA-800.

*Option on Input

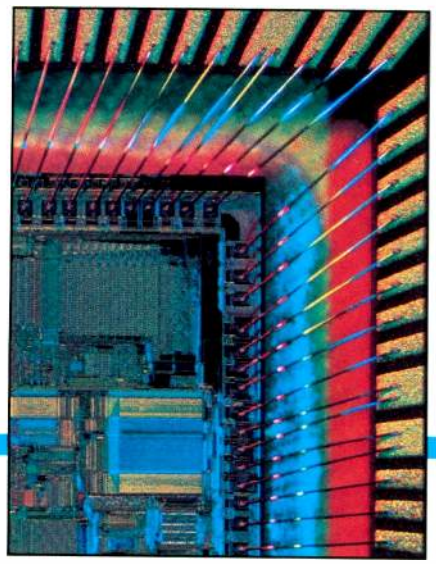
See us at NAB booth 5901

FOR.A®
INNOVATIONS IN VIDEO and AUDIO TECHNOLOGY

FOR.A Corporation of America 313 Speen Street Natick, MA 01760

Boston: (508) 650-3902 • **Chicago**: (708) 964-1616 • **Houston**: (713) 894-2668 • **Los Angeles**: (714) 894-3311

Circle (43) on Reply Card



Knowing what's new can benefit you.

A look at high-performance recording formats

By Rick Lehtinen, technical editor

"There is no new thing under the sun...It hath been already of old time, which was before...."[1]

At first, this verse seems to have been penned without reference to today's emerging videotape formats. Venerable NTSC is 30 years old. At least five new formats now confront broadcasters, and there are important benefits to each.

At a second look, however, the formats aren't so new — different might be a better word for them. This article will overview D-1, D-2, the composite format sometimes called D-3, and two analog formats with broadcast potential, S-VHS and Hi-8, and explain how they are closer to existing tape technology than it might seem. The article will then look forward to what formats may lay ahead.

Nothing new under the sun

All current video formats can fit somewhere between two extremes. At one end of the spectrum is RGB. This is the raw material from which the rest of the formats are built. RGB has been considered hard to work with. It's bandwidth intensive, and it has to occupy three channels (plus sync) to travel anywhere.

At the other end of the spectrum are the composite signals NTSC, PAL and SECAM. These signals carry the color information of RGB, plus sync. They are all one-wire systems, which is convenient. However, getting from RGB to composite typically involves sacrificing some quality.

Today's digital formats are merely digitized versions of one of the analog formats. However, manufacturers have taken great pains to see that what goes on tape is exactly what comes off it. These processes deserve study.

From here to there

A refresher on the process of going from RGB to composite may be in order, because this is fundamental to understanding the digital formats. (See Figure 1.)

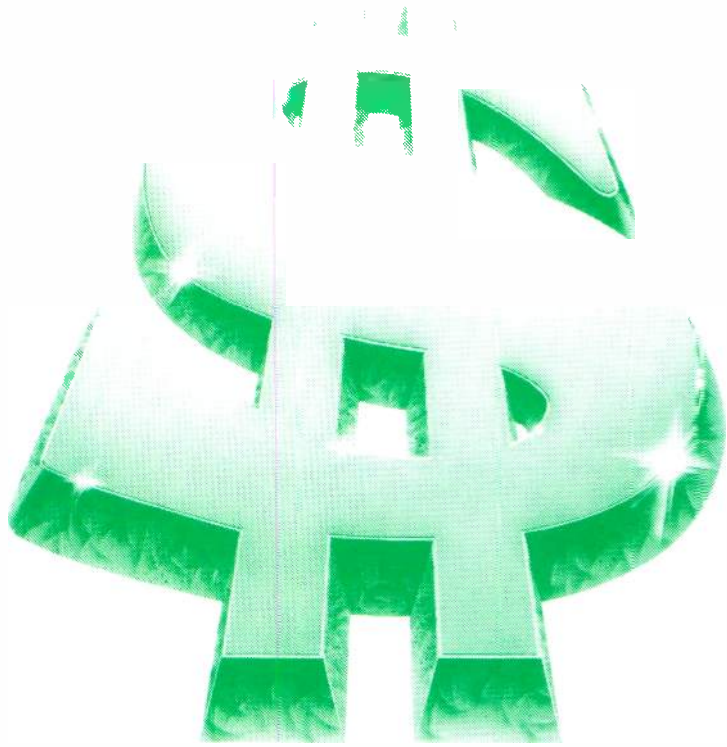
First, a black-and-white signal called luminance (Y) is created in a matrix by combining appropriate amounts of red, green and blue. When you view a black-and-white picture on a color television, you are watching a luminance signal.

Because the Y signal is made from red, green and blue, algebra can show that red minus Y (R–Y) and blue minus Y (B–Y) will contain the same color information as RGB. This 3-wire Y/R–Y/B–Y signal is the component analog video (CAV) signal system.

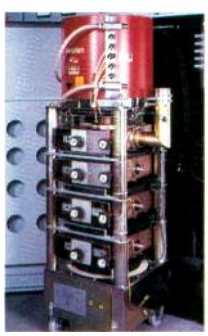
Going from RGB to Y/R–Y/B–Y requires little technology. More important, it does little to distort the video signal. This is why CAV signals often look better than NTSC. Of course, CAV switchers are more complex, and signal routing is more costly.

The CAV signal is the analog precursor to D-1. It is the convention to take one sample of Y, then one of R–Y, then one of Y, then one of B–Y. This means that for every four samples of Y, there are two of

STOP WASTING ENERGY AND MONEY!



Varian Klystrode® and MSDC Klystron—The Only Energy Efficient Alternatives In The High Power Broadcast Market.



MSDC KLYSTRON

Look to Varian, the people who pioneered and developed the Klystron, for the best energy efficient and money saving broadcast tubes available today!

Varian's world-class operation is the leader in UHF-TV broadcasting devices, with over 95% of the energy efficient transmitter market. Based on thousands of hours of operating experience, Varian now offers two outstanding energy saving alternatives. The Klystrode® and MSDC Klystron are the most energy efficient broadcast tubes in today's high power transmitter market.

Don't wait to buy or upgrade your transmitters. Start saving money now. Look at the Klystrode® and MSDC Klystron to see which one fits your needs—and begin lowering your operating costs and increasing your profits today.

KLYSTRODE®

varian

Varian Power Grid & X-ray Tube Products / 301 Industrial Way / San Carlos, CA 94070 / 415 592-1221

Varian Microwave Power Tube Products / 811 Hansen Way / Palo Alto, CA 94304-1031 / 415 493-4000

Circle (44) on Reply Card

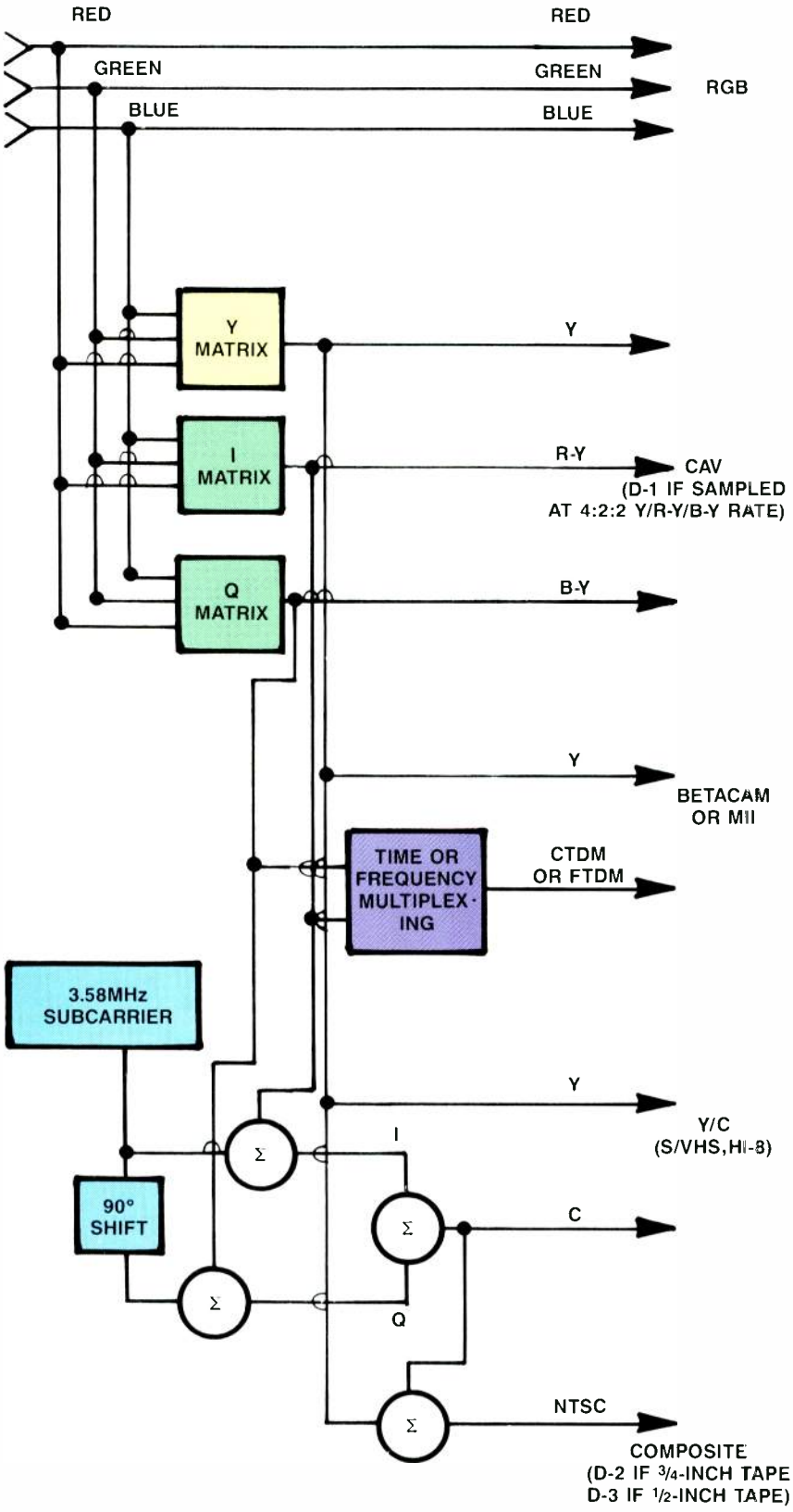


Figure 1. *All of today's tape formats can be derived by tapping into the conversion process between RGB and composite formats, such as NTSC and PAL. Today's digital formats are derived by digitizing one of the existing formats.*

R—Y and two fo B—Y. For this reason, D-1 is sometimes called *4:2:2*.

Analog recorders for the CAV signal first combine the color-difference signals R–Y and B–Y into one channel. *Betacam* performs this multiplexing by compressed time-domain multiplexing. *MII* uses frequency multiplexing.

Further combining the R—Y and B—Y signals is the next step toward creating a composite signal. The first process is to modulate them onto different phases of a *subcarrier.* R—Y becomes *I*, a signal in phase with the subcarrier. B–Y becomes *Q*, a signal 90° out of phase to I, or in quadrature. Summing I and Q creates the color signal, *chrominance* (C).

Y is now on one wire, *C* is on another. This 2-wire system is the *Y/C* format. Y/C is the basis for the S-VHS and hi-band 8mm formats. Subcarrier modulation, with its attendant bandwidth limitations, will cause some degradation of the color-difference channels. Y/C systems thus have inherently less quality than CAV systems. However, they are simpler to use, with only two wires, than component.

Adding C and Y gives NTSC. With certain modifications, this is also the process by which we form PAL and its distant cousin, SECAM. All of these are composite formats, because they combine the color, luminance and sync information onto one wire. A one-wire system is convenient, but it is not good because the signal quality is often compromised compared to CAV and RGB. This is particularly so because the C and Y interact, causing *encoding artifacts.*

Were this composite signal digitized and recorded on special 3/4-inch tape cartridges, it could be D-2. Recorded on 1/2-inch cartridges, it could be "the half-inch composite digital format." It's likely that it will eventually be designated D-3.

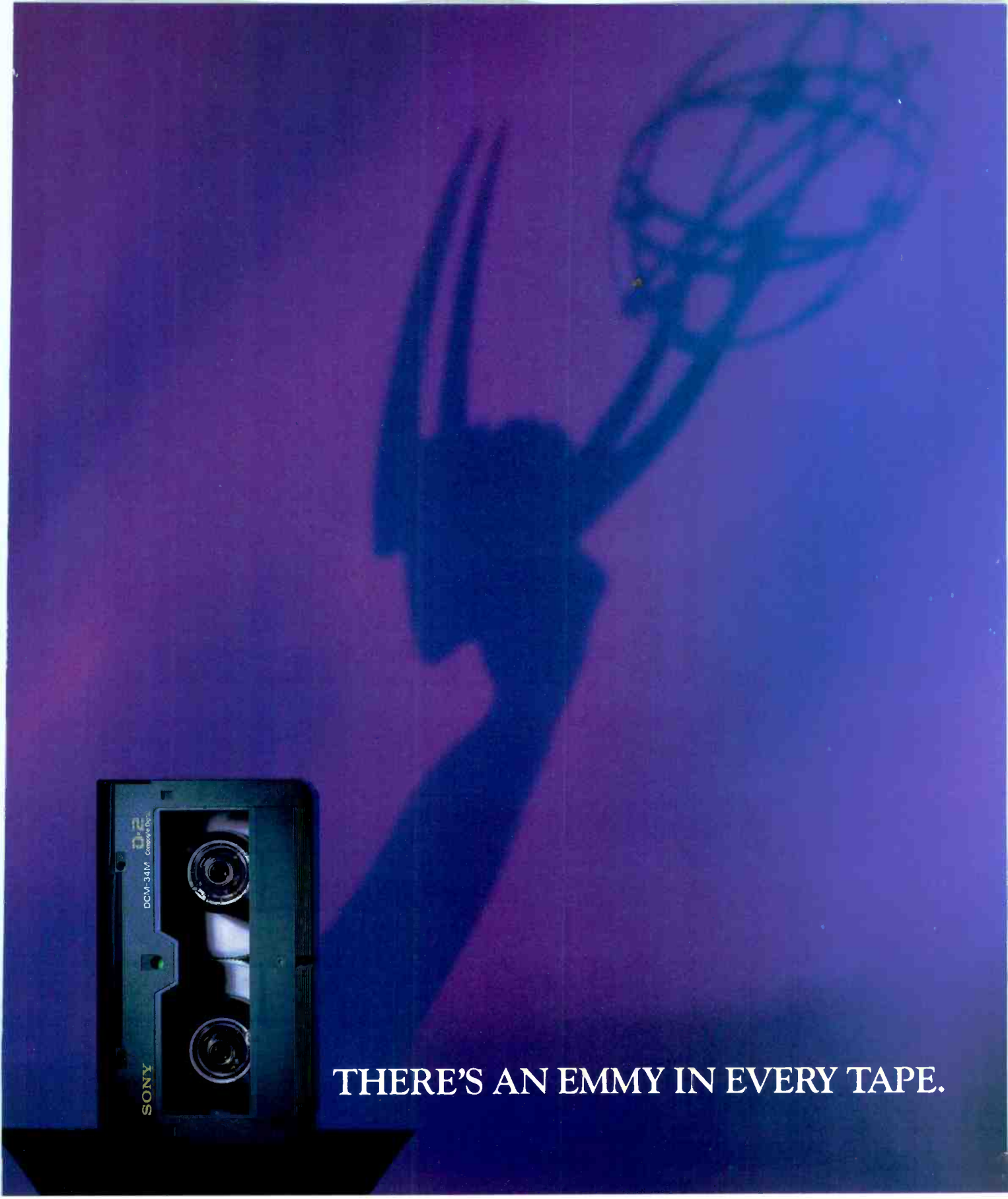
What are the pluses?

Now that it has been shown where all the formats come from, it is time to consider what each is good for.

- *D-1*

The component digital format is probably the highest-quality recording option available today. D-1 has found extensive application in computer graphics, where high quality and the ability to withstand multiple generations of recording are paramount concerns.

D-1 is expensive, and it requires special care to route it around a facility. It is also at the focus of a future tradeoff. Recall that D-1 uses a 4:2:2 sample pattern. Each color-difference signal has half the luminance bandwidth. Some users consider this unacceptable. Furthermore, advanced graphics applications often require a linear key channel, sometimes called the *alpha* channel. The alpha channel is used



To Sony, an Emmy is more than a trophy. It's an affirmation. Winning the Emmy for "Developments in Metal Particle Tape Technology" is further proof of our metal tape's astounding picture and sound clarity. A critically acclaimed examination of our ultrafine metal particles in a mirror-smooth base film and exclusive binder system. After all, people who live to create see the artistry in every single Sony professional tape. And that's why Sony is the leader that video leaders follow. SONY® PROFESSIONAL VIDEOTAPE

Circle (45) on Reply Card

for compositing images in multilayered effects. Having the key signal fixed to the video signal eliminates the need to make separate recordings (traveling mattes).

To capture these advantage, some users slave two D-1 devices, and record Y and R–Y on the first; and B–Y and alpha on the second. This sampling system is called *4:4:4:4*. Such systems are not yet generally available.

Digital error correction

Error correction is the heart of the digital difference. Error correction can be fascinating, but it is complicated. In essence, information added to the digital video code words flags errors, and also aids in correcting them.

The concept of *parity* is well known to broadcast engineers. Parity works by counting all the ones in a digital word, and attaching a parity bit to the word's end. The parity bit is set to one to indicate even or odd numbers of ones, depending on the system in use.

After transmission, a *parity check* counts the ones and compares them with the state of the parity bit. If parity is okay, the word is considered valid. If there is a *parity error*, the data is considered corrupt.

A 2-D parity check will not only determine if there has been a failure, but will help point to it. (See Figure 1.) A failure of bit 12, for instance, will be flagged by parity errors in row P3 and column Q4.

Multiple errors can outwit simple parity tests. Also, knowing a bit is faulty doesn't correct it. Embedding parity bits inside the word can narrow down the bad bit to a specific location. This is the technique used in a *Hamming code*, which can detect errors and correct them.

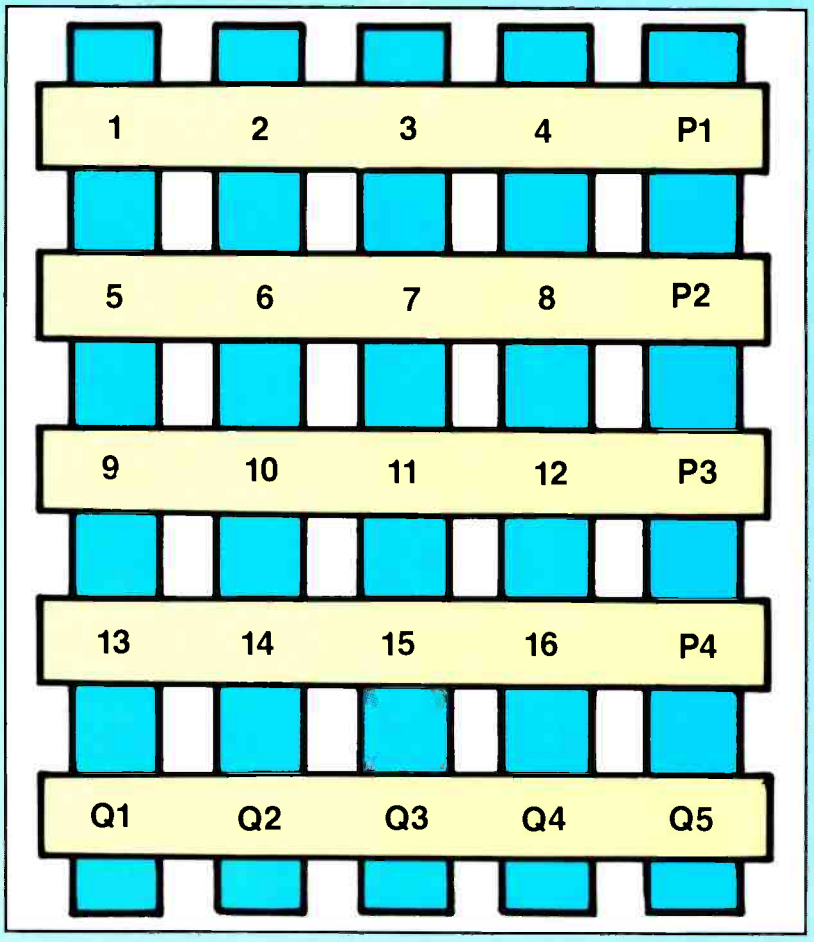


Figure 1. *A 2-D parity-checking system can detect errors, and can give some clue as to their locations.*

IND

"This is one system that works for both engineering and the business manager"
— Fred Baumgartner
WTTV

CBS

"It does everything you could ask and then some. Plus, it does it well"
— Lacy L. Worrell
WMAZ-TV

NBC

"The cooperation from Panasonic has been outstanding"
— Wayne G. Tiner
WECT-TV6

FOX

"It passed the 'smoke' test."
— Rex L. McArthur
KTRV

NBC

"I especially like the ability to take an 'off-the-shelf' VTR and plug it right into the M A R C"
— Jerry Agresti
KCRA-TV

NBC

"Panasonic made four systems come together beautifully thanks to the M A R C II"
— Allan C. Buch
KSNW-TV3

CBS

"Quality and dependability are synonymous with the M A R C II — the machine just works"
— Wilbur W. Brann
WRAL-TV

ABC

"Our M.A.R.C. 100 is our on air master control. We are very happy with it."
— Thomas A. Thompson
WDAY-TV

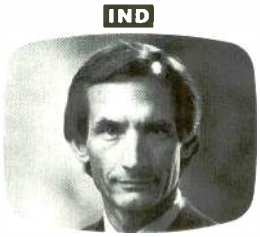
NBC

"With the M.A.R.C. we wanted to have even more efficiency — and we have"
— Kenneth Erickson
WHO-TV

IND

"The M.A.R.C. is great! The walkaway time sure beats having engineers load tapes."
— Robert W. Bell
WSBT-TV

IND



"We've been extremely happy with the M A R C at both stations — Panasonic technical support has been absolutely super!"
— Jim Wright
KPLR-TV, KRBK-TV

NBC

"Excellent quality pictures and stereo sound. Spot mortality almost non-existent"
— Hilliard Gates
WKJG-TV

IND

"Sleep at night and enjoy your weekends"
— Jack Davis
KRBK-TV

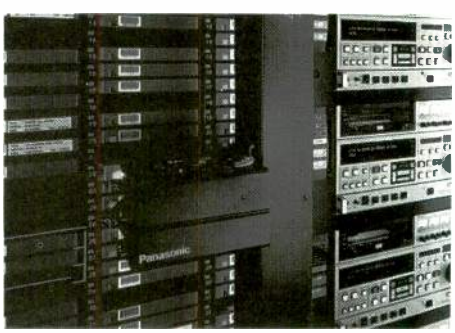
IND

"The M.A.R.C. 800 was on-air 9 days after delivery. Performance is excellent."
— Robert Strutzel
WGN-TV

NBC

"So quiet and reliable, I hardly know its there"
— Ken Smith
KCEN-TV

THE BEST PRAISE OF ALL FOR A LIBRARY SYSTEM.



These customers and their praise say it all. Call Panasonic Broadcast & Television Systems today to find out how your station can put the M.A.R.C. to work. Better yet, call M.A.R.C. users like those above. Let *them* tell you about M.A.R.C.'s most exciting features. Let them tell you about *satisfaction.* Then, join the growing list of stations that run 35,000 perfect spots every day.

© NATAS

One Panasonic Way, Secaucus, NJ 07094
For more details call: 1-800-524-0864

Panasonic
Broadcast & Television Systems

Circle (46) on Reply Card

• *D-2*

This composite digital format brings the advantages of digital to mainstream video. Prices on these units are falling rapidly. If you don't already use this format, you should seriously consider upgrading. A D-2 recorder can make multiple generations without loss, and most offer time-compression capabilities and other appealing features.

An unexpected freebie that came with D-2's introduction was the "one-machine" edit. It is possible to take advantage of the units' read-before-write capability to add certain effects, such as supers, in one pass with one VTR. The audio capability of D-2 is also unheralded. Four 48kHz digital channels, plus an analog cue track, allow users to build simple audio mixes right on the VTR.

The downside to D-2 is cost of operation. Some reports state that it costs more per hour to operate a D-2 machine than a one-inch machine because of the cost of replacement heads.

• *D-3*

This proposed composite digital format shares the advantage of D-2, but has the form factor and long-play capability of an "all-applications" analog system, such as MII. This may result in cost advantages to facilities, because they need stock only one kind of tape for all applications.

• *S-VHS*

S-VHS is beginning to find a home in low-end production. The quality advantage over existing VHS is that it avoids encoding artifacts. It never encodes. Chrominance and luminance stay separate throughout the system. Several manufacturers now make Y/C TBCs, switchers, character generators and even digital effects units to accommodate this format.

The principle advantage of Y/C to broadcasters is probably low cost. Stations can field a lot of Y/C camcorders for the price of one EFP/ENG unit. Of course, quality is an issue. However, if you compare one of today's S-VHS systems to what was considered acceptable in ENG work a few years ago, S-VHS may deserve a second look.

• *Hi-band 8mm*

This format is under development, but the first units look promising. Hi-8's advantage is its light weight and low cost. At least one network has considered using this format as a disposable camera in dangerous spots. Shooters could gather footage, then abandon the camera and smuggle out the tapes.

Why digital?

Inherent in every analog format was a weakness, known as *generation loss*. Briefly, the electrical and mechanical errors of a given tape machine show up as minute faults in the video. These errors accumulate as video is recorded and rerecorded. After a few generations, in the worst case, to just over 12, in the best, the accumulated *artifacts* build up until the signal is unusable.

This *multiple-generation syndrome* is one of the factors that has shaped post-production equipment. Switchers use several M/Es, with large input buses. This is needed to build elaborate effects sequences without resorting to multiple tape passes.

One of the worst of these multigenerational degradations is *chroma noise*. At length, researchers found it to consist mostly of phase modulation, transport jitter and improper machine setup. Digital formats incorporated safeguards to reduce this and other analog problems.

Enough said.

More than 115 large library management video cart systems playing direct to air.

NATAS

Odetics Broadcast

1515 South Manchester Avenue, Anaheim, California 92802-2907 (800) 243-2001 or (714) 774-2200

Director of Sales	Northeast	Southeast	South Central	West	North Central
Bill Keegan	Ray Baldock	Emerson Ray	Ron Phillips	Chuck Martin	Bill Boyd
(913) 862-2824	(201) 305-0549	(813) 960-0853	(817) 468-1090	(818) 999-9796	(612) 894-2121

Circle (49) on Reply Card

The first is that digital systems make *saturated* recordings. Like the ones and zeros of TTL logic, every message is clear. This is unlike analog systems, where variable properties of tape can cause signal errors for which signal system electronics cannot compensate.

Dropout dilemma

A second difficulty with recording tape is that certain regions lack an adequate supply of magnetic domains. Normal tape wear will produce this effect. These show up as *dropouts*, which are holes in the signal. Analog systems typically cover for dropout by delaying a portion of the playback signal, and re-introducing it when the *dropout detector* triggers. Although effective to the viewer, these systems don't really fix dropout, they conceal it.

Digital formats today compensate for dropout with a multilevel *error-correction* scheme. A series of *checksums* are appended to each packet. This process is called *outer coding*. Second, the rows of a block of several packets are transformed through a mapping algorithm into columns. More checksums are applied. This process is called *inner coding*. These checksums not only indicate if an error has occurred, they also have the ability to set it right. (See the related article, "Digital Error Correction," p. 58.)

The video data plus the error-correction information is written onto tape, but not until it is channelized, that is, spread out over the tape in such a manner that adjacent portions of the tape never contain adjacent portions of the video image. The net effect is that any disruption, either a tape defect, a momentary head clog or an electrical transient, will affect several portions of the screen just a little, it won't affect any section a lot. (See "Applied Technology: The D-1 and D-2 Formats," by Rick Lehtinen and Carl Bentz, *BE* August 1988, p. 76.)

The error-correction systems are extremely powerful. One expert has estimated that a continuous scratch, 1mm wide, across the recorded side of a D-2 tape will not be visible on playback.

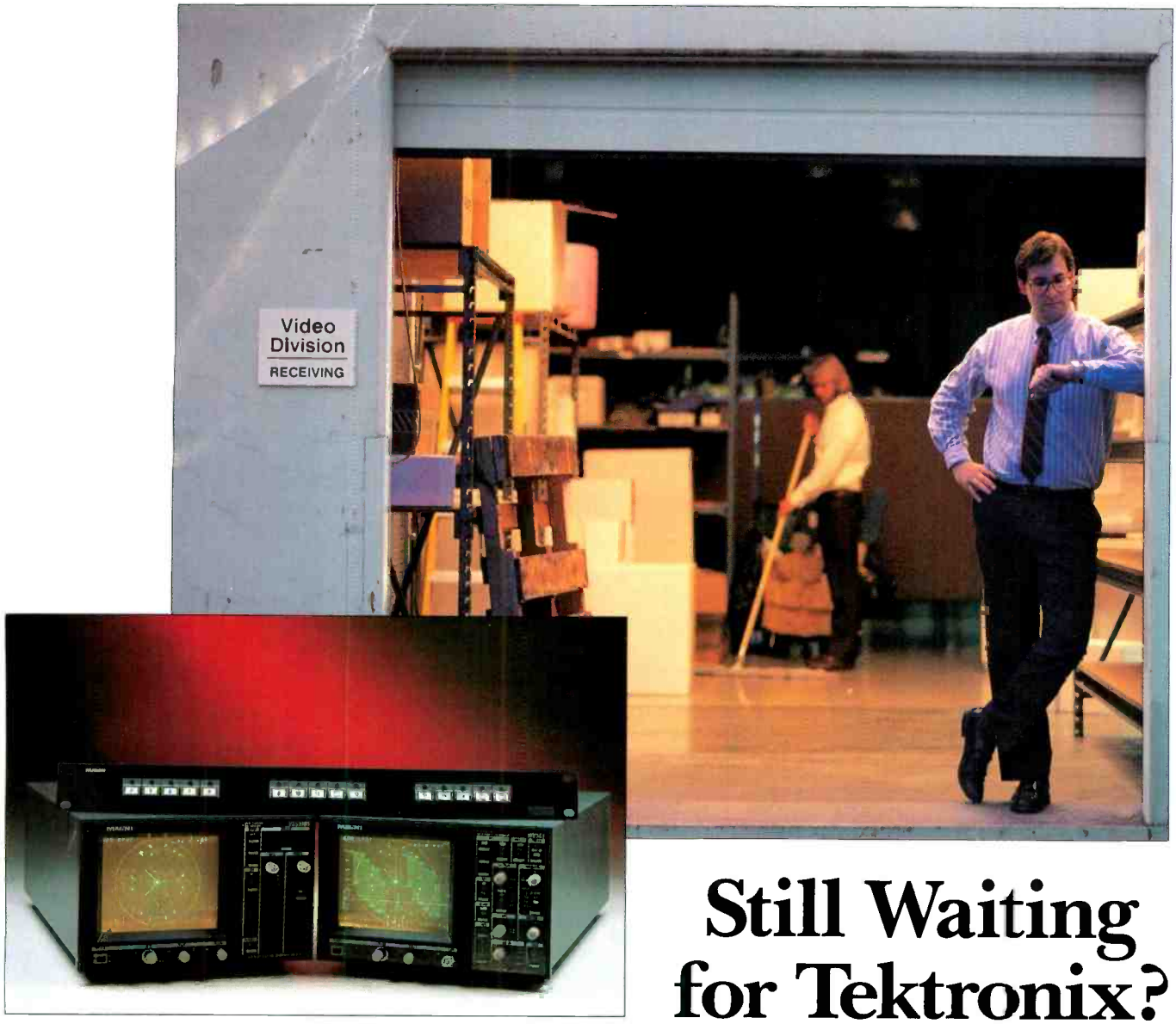
Protection doesn't stop there. One of the variables in the format is the signal processing that can occur. *Error concealment* algorithms can digitally reconstruct damaged portions of the signal that are too far gone for the error-correction system to fix. These systems typically work by sampling pixels all around a missing one, then mathematically approximating what the missing one would be.

Digital development

Although it would be comforting to imagine that these new formats came about as quickly as technology allowed, the evolution came about for different reasons. According to some experts, the digital formats actually got their start because of a perceived need to replace aging automatic spot playback machines that used 2-inch tape. The logical upgrade would have been to go to one-inch, which at that time was proven and popular. Unfortunately, it was discovered that the head wrap of one-inch was incompatible with a cartridge-based machine.

Major manufacturers investigated cassette-based machines, but apparently found them inadequate. The answer would be some kind of digital VTR that uses a cassette. The digital experiments started fairly early. In the mid-1970s, a few insiders witnessed demonstrations of a digital quadrature machine. It could record and rerecord color bars dozens of times without degradation.

All of the digital formats marketed today are digitizations of existing analog formats. The most important advantage wrought by digital is clever error-correcting systems. Some pundits feel digital has greater potential. Where, for in-



Still Waiting for Tektronix?

Magni delivers solutions for your test and measurement needs.

You rely on your T&M equipment to keep your entire operation up and running. And when you need it, you need it promptly, not months from now.

Call Magni and wait no longer. Whether your equipment is NTSC or PAL, component or digital, our flexible test and measurement products offer the perfect fit, with features that aren't just announced: they're deliverable.

Just look at our newest addition, the VS531DS. This patented dual-standard vectorscope provides advanced measurement and monitoring functions for both NTSC and PAL. SC/H phase measurement, cursors and on-screen readouts make complex readings a snap. All at a price no other manufacturer can match for the same features.

For more extensive, multi-format needs, the 560 product range adds 525- and 625-line component capabilities, easily accessed from the optional remote panel. The high-powered WV561 even combines waveform and vector monitoring for NTSC, PAL and component formats in a single unit.

If your backorders are still backordered, consider Magni for cost-effective performance you can take home today. We're ready to deliver.

MAGNI®

Magni Systems, Inc.
9500 SW Gemini Drive
Beaverton, OR 97005 USA
(800) 237-5964
(503) 626-8400
FAX (503) 626-6225

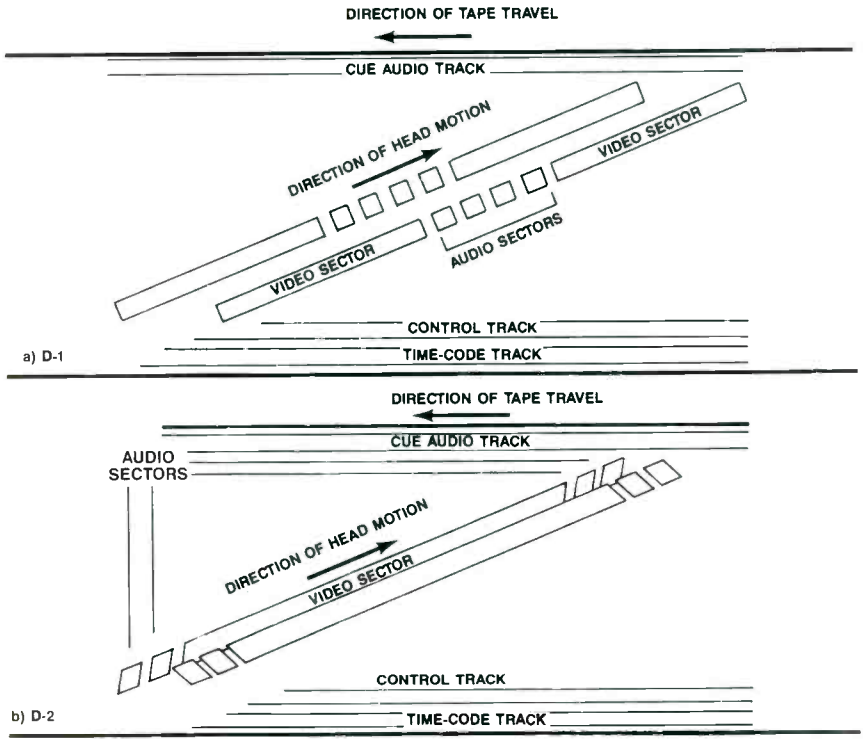


Figure 2. *The D-1 format (a) records audio data in the center of the head track. The D-2 format (b) records audio data at either end of the head track. D-2 also uses azimuth recording, which increases record time by eliminating the guard band between tracks.*

stance, is the video equivalent of the ARC file used in computer bulletin board systems (BBS)? Proposed compression standards are available in the computer industry for still images (JPEG) and moving images (MPEG). Major research dollars from the computer industry have also produced a chipset for digital video interactive (DVI). It would seem that the computer industry has designs on becoming video capable.

No matter how things change

The new analog formats are all created by tapping off the signal at some point in the conversion between RGB and composite. The new digital formats consist of digitizing an analog format. Thus, the new formats may be new to users, but they are not truly new. They have been here all along, but have only recently been brought to the VTRs' rear panel.

Once the computer industry enters the game of video presentation, the rules will change. All the technical riddles are not yet solved, but more than a few industry prognosticators are pointing to a video/computer merger as being in the cards.

Footnote

1. Ecclesiastes 1:9-10 (King James Version).

JUST SAY NO TO GRASS.

To create a switcher better than a Grass Valley was our goal when we began design on the Pegasus. The result? One terrific production switcher.

Specifications. Features. Design. Price. From any perspective, the new ALTA Pegasus production switcher looks better than the toughest competition.

The best part is that the Pegasus can make **you** look like a million. Smart and cost-effective. Elegant and easy. The result: dazzling on-air performance.

NEW

And like our other products, the Pegasus is built to deliver the reliability that our customers say is like money in the bank.

Pegasus—designed to meet the needs of the toughest industry professionals.

Let us show you how good the Pegasus switcher really is. Call or fax us today for more information, or to request our demo tape.

1-800-677-ALTA or
Fax 408-297-1206.

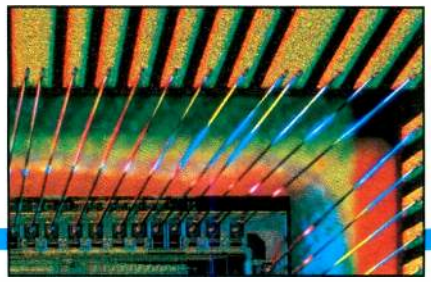
Ask about another new ALTA product—the new Pictoris EDE—enhanced digital effects.

	GVG-100N	Pegasus	GVG-200-1
Video formats	Composite only	Y/C or composite	Composite only
No. of inputs w/color & blk	10	10	20
No. of video levels on-air	3	4	5
Color wash gen.	No	Yes	Yes
Mem. system w/event storage	16 events Opt.	100 events Std.	Std.
No. of wipe patterns	10	27	30
No. of ext. key inputs	2	4	6
No. of keys over wipe insert	1	2	3
Key priority assign	No	Yes	No

535 Race Street, San Jose, California 95126

ALTA GROUP, INC
Dynatech Broadcast Group

Circle (53) on Reply Card



RF radiation from broadcast facilities is still a "hot" issue.

Part 2 — an update

By Tim McCartney

The first five years of broadcaster compliance with radio frequency radiation (RFR) standards has brought a variety of new requirements to the industry.

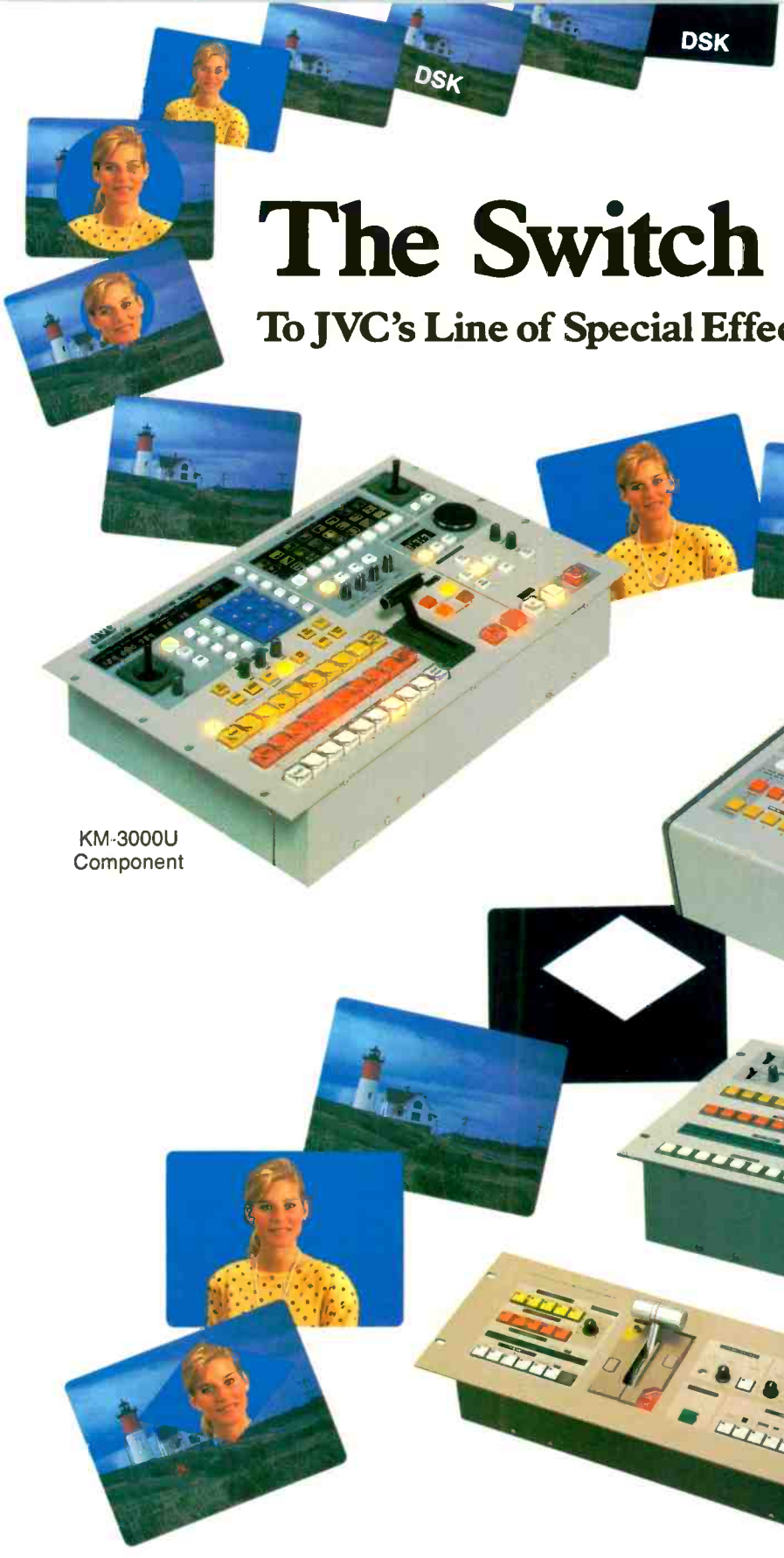
Decades of research preceded the 1982 American National Standards Institute (ANSI) establishment of RF radiation standards. Three years later, the FCC adopted the standards. "Evaluating Compliance With FCC-Specified Guidelines for Human Exposure to Radio Frequency Radiation" is the formal title of the document that is better known as OST No. 65, published in 1985 by the FCC Office of Science and Technology. It related the ANSI standards for broadcasters. Although the new FCC rules became effective on Jan. 1, 1986, clarifications of the document have continued since that time. The National Association of Broadcasters (NAB) first interpreted OST No. 65 in its November 1985 primer, "A Broadcaster's Guide To FCC Radiation Regulation Compliance," and later suggested changes to the document.

McCartney is technical coordinator for National Public Radio's satellite distribution system upgrade project, Washington, DC.

Although RFR activities have primarily involved the FCC and broadcasters, other agencies have developed agendas closely related to the ANSI standards. The Environmental Protection Agency (EPA) considered the establishment of a more stringent RFR standard, but later dropped the project. (The FCC had indicated that it would adopt whatever updated standards the EPA might have established.) Further complicating the matter, field enforcement of RFR standards among broadcasters is handled by the Occupational Safety and Health Administration (OSHA). The FCC requests statements of RFR compliance only at license renewal time. However, a broadcaster is required to maintain consistent compliance at all times — that's where OSHA fits in.

In addition, local and state governments have adopted standards more stringent than the federal guidelines; further human exposure research has been carried out; operators of transmitting aperture antennas, such as satellite uplinks and terrestrial microwaves, have been evaluating RFR; and FM antenna manufacturers have designed and produced $^1/_2$-wave spaced antenna systems.

The commission has clarified aspects stemming from the standard, most recently with regards to translators and boosters. In 1990, the FCC changed its rulings on multiple-use sites and measurement of "hot spots," which are defined as intense, localized fields.



The Switch Is On

To JVC's Line of Special Effects Generators

At JVC, we've created just the right switcher for you. Our special effects generators are designed to meet all of your application and budget needs while providing reliable and outstanding performance. To find out why the switch is on to JVC, call 1-800-JVC-5825.

JVC®
PROFESSIONAL

Circle (99) on Reply Card

The most significant problem with ANSI compliance remains at multiple-use transmitter sites. FCC activity to date in this area is perhaps the best available predictor of how it will resolve the remaining problems in the next few years.

Industry responses to OST No. 65

So far, greater emphasis in RFR matters has been placed on public safety than on occupational hazards. Approaches taken in this regard or under consideration include:

1. Installation of protective obstacles, such as fences, gates, warning signs or, in the case of ski slopes, ski patrol personnel.
2. Designation of a site as sufficiently remote in its location to protect the public.
3. Use of antennas with reduced downward radiation patterns, such as $^1/_2$-wave spaced and panel systems.
4. Relocation of antennas to more remote locations or taller structures.
5. Permanent reduction in transmitted power.
6. Abandonment of a planned site altogether.

The importance of occupational exposure to RFR is likely to launch the next wave of action from OST No. 65. The following list of options is time-related:

1. Reduction of transmitter power during tower or other maintenance.
2. Shutdown of one or more transmitters during tower or other maintenance.
3. Restrictions in the amount of RF exposure time by personnel on the job.
4. Use of an auxiliary antenna at the same site or at a different site during maintenance.

Multiple-use sites

Federal Aviation Administration (FAA) efforts to cluster antenna sites, coupled with generally higher urban land values, have led to the concentration of transmission facilities at antenna farms. Although it resolves some problems, this approach has increased radiation concentrations. Most broadcasters have been able to meet the new requirements, but those who encounter problems typically have antennas transmitting near populated areas or at antenna farm settings. Multiple-use sites include antennas on building-tops, located near floors on which people work. (See "Part 1—A Case Study," pg. 48.) Many other hub sites are located on mountains, where towers exist only to support antennas, not to provide elevation.

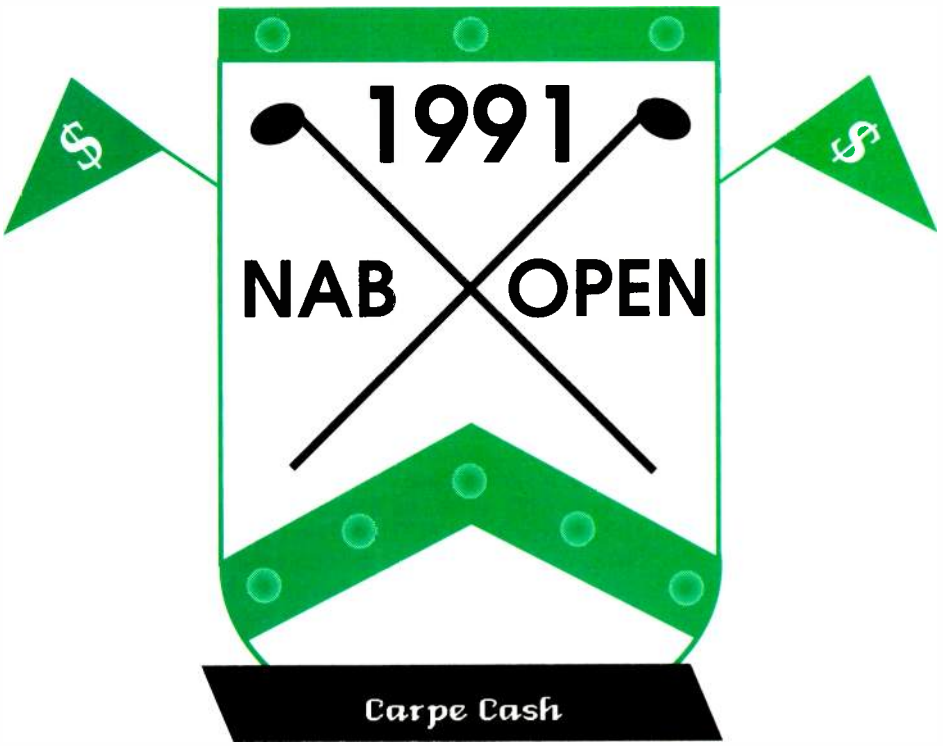
Because the biological effects of RFR are related to total energy absorbed by the human body, the ANSI standards require consideration of all RF energy sources at a given location. Because of radiation attenuation characteristics, an antenna mounted 200 feet above occupied sites is less likely to meet ANSI standards than the same antenna mounted at 600 feet.

RFR analysis

AM transmitter locations pose less of a problem than their FM or TV counterparts. At AM installations, potentially excessive fields are typically predictable and fairly localized. On the other hand, FM and TV fields tend to vary considerably, even over small distances. An additional theoretical problem involves the multiple reflections possible in antenna farms, because of the vagaries of VHF propagation. In practice, however, these difficulties are often reduced for TV licensees because of the typical tower-top locations of their antennas, significantly higher than the usual side-mounted FM antennas on the same structures. Nevertheless, the combination of many FM and/or TV signals at a crowded RF site may require numerous measurements for an accurate analysis. One sophisticated computer program for rooftop RFR analysis inputs more than 100 measurements, while attending to reradiation from metallic objects at the site.

Actual on-site measurements provide the most accurate information, but they may not always be necessary. Calculations

You can win! Thousands of dollars in prizes! Play our:



Your chance at $1,000's in prize money is as easy as 1, 2, 3.

1. Get your official game card in the March issues of *Broadcast Engineering* or *Video Systems*.

2. Complete our special convention center course in Las Vegas.

3. Mail your completed official game card to tournament headquarters by April 30, 1991.

For more details on how you can play to win $1,000 at NAB, see the March issues of *Broadcast Engineering* or *Video Systems*.

BROADCAST engineering

VIDEO Systems

are adequate for ANSI compliance when radiation levels don't approach allowable limits. The FCC has accepted multiple-use site calculations in which radiation levels are well under ANSI limits. Accurate on-site measurements, done correctly, can be expensive and time consuming. However, they are the best answer in situations where high RFR is suspected.

Responsibility and management

The 1985 NAB primer interpreted OST No. 65 to call for cooperation among broadcasters so that each facility at multiple-use sites could accurately determine its adherence to the standards.

In 1987, a petition sought removal of some multiple-use sites from FCC enforcement of the ANSI standards. Proposed for exemption from RF evaluation were those facilities in multiple-use sites that contributed 5% or less to the ANSI limit at FM frequencies. The petitioner cited the ANSI limit's criterion that RF be 10 times lower than fields assumed to produce any biological effects, concluding that elements radiating less than 5% of that were truly negligible.

In 1990, the FCC adopted new rules on multiple transmitter sites, with some important exclusions. While reaffirming the shared responsibility of all licensees at multiple-use sites, licensees whose transmitters contributed less than 1% to the overall exposure limits were excluded. This included FM boosters with transmitter power of 10W or less.

Occupational exposure

The general response in the field to occupational exposure requirements has been mixed since OST No. 65. Some tower crews have worked under full RF conditions, thereby exceeding ANSI standards. Meanwhile, others have requested power reductions before climbing. A few have even mandated complete shutdown for relamping and inspections, citing the risk of future litigation from climbers.

The FCC suggested that procedures be instituted for working in the vicinity of high RF sources, such as restricting the amount of time an individual can be exposed or reducing power to increase the time permitted. An auxiliary transmitter at another location could also be used during such maintenance.

In its 1985 primer on OST No. 65, the NAB advised that FCC radiation regulations be applied to public and occupational exposure. It argued that "allowing workers to be exposed to RF radiation levels in excess of ANSI standards, after certifying compliance with the FCC, will be considered a 'misrepresentation' to the commission and acted on as such."

In 1988, Richard Tell, former chief of the electromagnetics branch of the EPA, climbed AM towers to take actual measurements. Predictions had been made that ANSI absorption standards could be exceeded by a parallel field driving current through a climber's hands and the loop formed by the tower and the climber's hands. Tell measured the strongest emissions at the tops of AM towers, but found that body currents were not as strong as had been expected. He concluded that good judgment was required to determine if transmitter power would need to be reduced to stay below ANSI limits.

The ongoing ANSI revision process will specify current limits, and will allow licensees to determine the amount of current that can be on the tower in order to meet the standards. Until then, actual measurements of RF fields along the paths of climbers on towers may still be appropriate in some cases.

A management plan can be established once current levels are known. At many stations, long-established tower climbing procedures and/or engineers' access to sites may need to be radically changed. The management plan could include time limits on exposure, how the use of aux-

iliary transmitters/antennas can improve access and what happens when tower lights are changed. Multiple-site users who find it difficult to agree on such a plan might hire an outside consultant, not associated with any station, to recommend operating procedures.

Even when tower climbers are unconcerned about excessive RF exposure, broadcasters should be diligent because of potential future liabilities. The fact that a licensee has complied with established federal guidelines may be a persuasive argument in defense of such a suit. In any case, when a licensee certifies to the FCC that ANSI standards are complied with, this assertion must actually be true, including occupational safety requirements. Lack of compliance could result in the loss of a station's license.

Exposure for station engineers

RF exposure above the standards is a concern not limited to tower climbers. Engineers at multiple-use sites should also remain vigilant, realizing that strong RF signals may still be present when their station's individual transmitter is turned off. An antenna at a multiple-use site can transfer RF energy to the transmitter power amplifier cavity, thus presenting unknown levels of RF to the engineer working in that section of the transmitter.

The cavity should be measured, and if excessive levels are identified, an appropriate response must follow. For example, it may be possible to lower the energy to acceptable levels by grounding the transmission line's center conductor or by opening the transmission line leading to the antenna. Be careful when touching the center conductor, because it may contain considerable energy.

Compliance

Near the end of last year, the FCC began returning license renewal applications, requesting additional information on ANSI compliance. In the past, the FCC has allowed a simple self-certification, with a check off to question 7 on the renewal form. Now, applications are being returned with requests for additional support of licensees' assertions that the facilities in question do not pose non-ionizing electromagnetic radiation hazards. The FCC insists on a formal narrative describing how a station has determined compliance.

The commission has indicated that it would be satisfactory to include the pertinent formulas as outlined in Section 2 of OST No. 65. Those stations not in compliance using the formulas may have field measurements performed, a practice that typically yields substantially lower radiation fields than the formula method. Specific inquiries may be directed to the FCC Audio Services Renewal staff at 202-632-6485.

Meanwhile, despite some confusion over the precise roles of ANSI, EPA, OSHA, FCC and local setting of standards and enforcement, broadcasters generally understand and comply with the OST No. 65 guidelines. It's clear that the FCC expects the public and workers to be protected from excess radiation. Although strict occupational protection at a few multiple sites may be lagging behind public protection, most broadcasters appear to be exercising appropriate caution. OST No. 65 deserves a spot on every broadcast engineering department's bookshelf.

Bibliography

Cleveland, Robert F. "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radio Frequency Radiation," (OST Bulletin No. 65), Office of Science and Technology, Federal Communications Commission, Washington, DC, October 1985.

"Further Guidance for Broadcasters Regarding Radio Frequency Radiation and the Environment," Public Notice, Federal Communications Commission, Washington, DC, Jan. 28, 1986.

Smith, Milford K., Jr. "RF Radiation Compliance," *Proceedings* of the 1989 SBE and *Broadcast Engineering* Conference," Denver, October 1989.

Umansky, Barry D. and Haiman, Connie L. "A Broadcaster's Guide to FCC Radiation Regulation Compliance," National Association of Broadcasters, Washington, DC, November 1985.

New products

Robotic camera control

By A.F. Associates

• **Portable ARC system:** advanced robotic control units for camera placements not necessarily suited for camera operators; No. 421 pan/tilt head with 60°/s speeds; 500-event presets; tilt, zoom, focus operations.

Circle (351) on Reply Card

Effects enhancement

By Ampex

• **WARP SPEED effects:** for ADO 100 digital effects unit; adds improved on-air "shot box" operation with additional interfaces to AVC switchers, GVG 100 and 300 switchers, Betacam emulation; NTSC and PAL versions.

Circle (355) on Reply Card

Digital switcher enhancement

By Abekas Video Systems

• **A84 switcher software:** expanded layering capability in component digital format; layer timeline for separate keyframe-based effects in each of eight keying layers; effect memory recall triggers; A84-4 reduced size unit permits complex digital compositing for editing suite; dual full-capacity pattern generators offer background transitions, key basking; digital color correction; key border generator; ASPIK linear processing.

Circle (352) on Reply Card

Sound control products

By Alpha Audio Acoustics

• **Audio Seal:** absorber blankets, quilted fiber glass absorber and barriers; blankets act as reflective sound absorbers; absorber, barrier combinations block sound transmission; construction of high-density vinyl sheets with Limp Mass sound barrier properties.

Circle (354) on Reply Card

Expanded effects range

By Electrohome

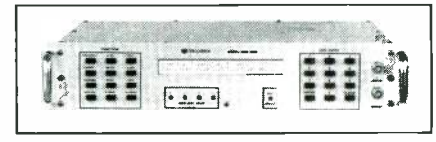
• **JAZZ TEMPO, ENSEMBLE:** digital video effects units combined with switcher functions; control dissolves between foreground and background; programmable phase control; retrofit kit for existing systems bring them to the level of the ENSEMBLE system; 4μs delay range for key output signal; expanded effects capability at reduced cost.

Circle (379) on Reply Card

Uplink exciter

By Microdyne

• **CSD-BQX:** satellite audio-video exciter; satisfies RS-250B, C, NTC-7 and FCC ATIS requirements; one video, four audio channels; available for C- or Ku-band; microprocessor control with menu/prompt operation; RS-232 port for remote control, adjustment of modulation bandwidth.



Circle (395) on Reply Card

Equipment protection cases

By Kriz-Kraft Cabinets & Cases

• **IMPACT-AT and PC-DUTY:** shock-protected rack enclosures for audio, video and computer equipment; meets ATA spec. 3000 cat. 1; framed outer case enhances strength, sturdiness; Polyester and Ethyfoam between inner and outer cases; 1/2-inch plywood laminated with ABS styrene or fiber glass; various configuration options.

Circle (391) on Reply Card

The future is D2 . . . and Ampex has it now. Our 319 D2 videocassettes are available in all three sizes and in a variety of play lengths, from 3 minutes to over 3 hours. Each offers you our high-coercivity metal-particle formulation for sharp images and highly saturated colors. And each offers you our advanced-technology precision cassette design, with high-impact ABS antistat plastic shells and low-friction Teflon-impregnated spool bearings to reduce debris during fast forward and rewind cycles. All built to the most exacting standards to deliver the most outstanding reliability. And all backed by the industry's most acclaimed service and support organization. It's a future whose time has come. From Ampex.

THE PROFESSIONAL CHOICE

Ampex Recording Media Corporation
401 Broadway, Redwood City,
CA 94063, (415) 367-3809

Circle (69) on Reply Card

High-output mics

By Audio-Technica US

• **High-energy models:** PRO 10HE, ATM41HE, ATM61HE microphones with sensitivities of approximately −55dBm; copper-clad aluminum wire for low-mass voice coil; hypercardioid polar pattern for optimum gain before feedback.

Circle (360) on Reply Card

Mic accessory

By AudioControl Industrial

• **Model AC-10:** A and C weighting filter, packaged as in-line XLR device; operates on 12V to 48V phantom power with 2-position switch selection of the two weighting values; allows emulation with sound level meter of human ear sensitivity characteristics at 70dB.

Circle (361) on Reply Card

PRO channel receiver

By Avocet Instruments

• **Pro-Line 102:** for IFB or remote-control telemetry applications; operates on any standard TV channel; headphone or integral speaker monitoring; XLR output to feed wireless mic, audio switcher; RJ-11 output for text or data signals.

Circle (362) on Reply Card

White displays

By Tektronix

• **Opt 74 CRT:** white P4 CRT phosphor for 1700 series vector and waveform monitors; results in improved judgment of color picture quality in film/tape transfer, graphics or color-correction environment.

Circle (430) on Reply Card

Component analog switcher

By Videotek

• **Prodigy C:** 10-input video switcher accommodates eight primary inputs with black and color background; multilevel effects for background, key and DSK transitions; 100-event memory system; pattern memory includes modifiers; key memory retains key clip and gain settings; gen-locks to composite sync reference; for Betacam, MII, EBU, RGB, Y/R−Y/B−Y formats; serial interface, stereo audio-follow options.

Circle (435) on Reply Card

Noise reduction

By C-T Audio Marketing

• **GT-4B:** 4-channel noisegate; self-powered system based on an optical device and resistive L-pad; gate triggering by the signal or a key signal; attack control, ducking.

• **GTS noisegate:** 2-channel unit with 24dB/octave high-, low-

pass filters; hold, release, attack, threshold, sidechain listening features; masking, continuous envelop triggering.

Circle (367) on Reply Card

Equipment guide

By Calibron Instruments

• **Instrumentation catalog:** 288-page guide to meters, timers, transformers, scope probes and numerous other electronic test products; includes glossaries, data, conversion charts and discussions of terminology.

Circle (368) on Reply Card

Temperature monitor

By Solder Absorbing Technology

• **CelsiClock:** thermally sensitive labels indicate temperature of small surface area; 10mm diameter stick-on labels available in eight ranges from +40°C to 260°C; color of indicator changes from white to black permanently when the individually specified temperature is exceeded for less than one second.

Circle (421) on Reply Card

Enhanced CCD camera

By Sony

• **DXC-327:** 3-CCD system uses third-generation HAD-type interline transfer devices; optical magnification through integral on-chip light magnifying lenses condenses incoming light to each pixel for greater sensitivity; 768-pixel horizontal with 700-line vertical structure in CCDs; 2H image enhancement, vertical edge detail; S/N rated to 60dB with F/5.0 sensitivity.

Circle (422) on Reply Card

Signal source, CRTs

By Tektronix

• **TSG-273:** PAL composite digital and analog format generator uses 10-bit resolution to develop various test signals; direct digital output requires no digitizer between the generator and a digital system input; includes 800Hz or 1kHz audio tone in parallel and serial digital and analog form.

Circle (431) on Reply Card

VCR tension measurements

By Tentel

• **T2-H5-SLCB:** Teltelometer gauge for MII VCR adjustments; high-resolution scale ranges from 7g to 40g in 1g increments; probes spread for easier positioning with reduced chance of damage to tape; package includes calibration weight, adjustment wrench, instruction manual and carrying case.

Circle (432) on Reply Card

Power protection

By Tripp Lite

• **ISOBAR-GS:** surge-suppression systems with Gold Seal Warranty; models with two, four, six and eight outlets; UL 1449 listing permits as low as 330V let-through; UL 1283 noise suppression and isolation rating; warranty replaces ISOBAR and users equipment if surge damage occurs.

Circle (433) on Reply Card

Lighting control

By Videssence

• **VLC:** lighting controller; expandable unit controls four to 256 lighting channels for the company's ionic lighting fixtures; memory retains stored effects; AC/DC powering in studio or field production operation.

Circle (436) on Reply Card

Professional services

Preview

March...

NAB CONVENTION PREVIEW

- **NAB Engineering Convention Preview**

A summary of the major technical papers and issues to be addressed at the convention.

- **Products and Exhibitors Preview**

A complete roundup of exhibitors that will be attending the show, along with the products they plan to display. This year's coverage will list the products by product category, thereby making it easy for the readers to locate the companies they need to see.

- **Map of the NAB Show**

Even though we return to Las Vegas, the show's configuration and dates have been changed. Attendees won't get lost with their personal *BE* guide to the show floor.

- **Facility Design Special Report**

The checkbooks are open and engineers are buying new equipment for their stations. This report looks at some of the newest techniques in modern studio design.

April...

AUTOMATION — TYING IT ALL TOGETHER

- **Implementing PC-Based Automation**

A station doesn't have to spend millions to obtain some of the features offered by automation. This article looks at some improvements available with PC-based systems. Today's systems are a far cry from the error-prone systems of yesterday.

- **Planning for a Library System**

Video library systems are taking over many tape rooms. However, because the systems are extremely complex, proper implementation requires careful planning. This feature will examine the process that must be undertaken to realize the benefits these systems offer.

- **Engineering Profit Center**

Station engineers become part of the profit picture when they show their managers how to use digital technology to generate new financial opportunities for their stations.

Classified

HELP WANTED

GRAPHIC DESIGNER: Midwest network affiliate TV seeks graphic designer with experience on TOPAS 3-D Animation System. Send resume to Mike Smith, KGAN-TV, Box 3131, Cedar Rapids, Iowa 52406. EOE. 02-91-1t

TV MAINTENANCE ENGINEER
needed for a national Christian studio post production satellite uplink facility. Three years component level maintenance experience. Ampex, AVC, ADO, VPR-3, Beta, Scientific Atlanta Uplink. Positions available in San Diego and Dallas. Competitive salary and benefits (Paid vacations, holidays, incentive programs, medical & dental insurance) with an exciting organization. Send resume to: Personnel Dept., Word of Faith, P.O. Box 819099, Dallas, TX 75381-9099

CORPORATE CHIEF ENGINEER Major market radio broadcast company seeks hands on corporate chief engineer to direct and supervise all aspects of the technical operations of company's AM & FM stations. Minimum of 10 years varied experience as station and/or corporate chief engineer. Knowledge of all aspects of FM and AM (including directionals) operations is required. Please send resume with salary history and requirements to Broadcast Engineering, Dept. 721, P.O. Box 12901, Overland Park, KS 66212. Equal Opportunity Employer. 2-91-1t

HELP WANTED

NORTHWEST MOBILE TELEVISION has been a leader in location broadcasting for more than 20 years. Our commitment to quality and service is without equal in the industry. We currently seek an individual with those same ideals for the following position:

MAINTENANCE ENGINEER
Minneapolis, Minnesota

The successful applicant must have a demonstrated work history repairing/maintaining a variety of broadcast equipment. Remote television experience preferred. Excellent compensation and benefits package. Send resume to:

NORTHWEST MOBILE TELEVISION,
Attn: Human Resources Dept., 12698 Gateway Dr., Seattle, WA 98168.
1-800-242-0642. FAX# (206) 241-6042. EOE.
NORTHWEST MOBILE TELEVISION

WDSU-TV IN NEW ORLEANS, LA. IS SEEKING AN ENGINEERING MANAGER The position requires good people skills, strong maintenance background and five (5) years management or supervisory experience. Ground floor involvement in design of new building. Send resume to Carolyn Simmons, personnel coordinator, WDSU-TV, 520 Royal St., New Orleans, LA 70130. No phone calls, please. E.O.E. 02-91-1t

EQUIPMENT WANTED

WANTED: USED VIDEO EQUIPMENT. Systems or components. **PRO VIDEO & FILM EQUIPMENT GROUP:** the largest USED equipment dealer in the U.S.A. (214) 869-0011. 04-90-tfn

SITUATIONS WANTED

SENIOR MAINTENANCE ENGINEER 18 years, D2, Betacart, Chryron, VPR, TCR, BVW75SP, IKEGAMI, Calgary & Seoul Olympics, Major Market, Post, Studio & Remotes. Resume (204) 831-5249 02-91-1t

TRAINING

FCC GENERAL CLASS LICENSE. Cassette recorded lessons with seminars in Washington, Newark, Philadelphia. Bob Johnson Telecommunications. Phone (213) 379-4461. 05-90-tfn

BUSINESS OPPORTUNITIES

SECRET LOANS! We lend money by mail-$300 to $5000 in absolute privacy. Borrow for any good reason. No cosigners. No mortgages. Write for details and application-no obligation. Financial Services, Dept. L, Box 454, Nicholls, Georgia 31554. Enclose Envelope! 11-90-tfn

Classified

SERVICES

FINALLY!

2 GHZ. VIDEO MICROWAVE EQUIPMENT AVAILABLE FOR RENT ANYTIME!

21 Channel Selectable 3/12 Watt Portable AC/DC Transmitters & Receivers with 2 Channel Audio • Also — Dishes, Dualrods, Tripods, Back-up Units, Wireless Cameras, Live Truck & Eng. Crews

• **SPECIAL DISCOUNTS** for Long Term & Multiple System Rentals

• Emergency/Rush Delivery Capable 24 Hours a Day

216/494-9303

Image Video LIVELINK SERVICES 6755 Freedom N.W. N. Canton OH 44720

Replace incandescent indicator lamps with high reliability LED equivalents.

Bright LED's Standard Lamp Bases

- 100,000 hour (11 year) shockproof life
- 4, 5, 6, 12, 14, 24, 28 VOLTS
- Midget flanged, grooved, bi-pin, telephone slide bases
- red, green, or yellow LED colors

RIGHT BULB, RIGHT PRICE, RIGHT DELIVERY

LAMP TECHNOLOGY, INC.
1645 Sycamore Ave
Bohemia, NY 11716
516-567-1800
FAX: 516-567-1806

1-800-KEEP LIT

Circle (80) on Reply Card

MAILING LISTS
AM FM TV
Labels or Diskette
StationBase
(800) 359-2818

TRANSMITTER TUBE REBUILDING SINCE 1941: 3CX2500, 4CX5000, 4CX15000 and many others. Write for details. FREELAND PRODUCTS INC., 75412 Hwy. 25, Covington, LA 70433. (504) 893-1243 or (800) 624-7626. 01-91-tfn

---

NOW AVAILABLE—Qualified, experienced, degreed engineer offering consultation, design, and installation services for video/audio systems. Resume and references available. Write to Thompson and Associates, 1108 Alegria Rd, Austin, TX 78757, or call (512) 451-1268. 12-90-3t

---

FOREIGN STANDARDS CONVERSIONS

STATE-OF-THE-ART, 8 BIT, 4 FIELD PROCESS
PAL BETACAM SP • PAL 1" • S-VHS
3/4" • D-2 • VIDEO -8 • 1/2" • HI-8
FREE FED-EX MASTER PICK-UP
FROM ANYWHERE IN USA
SAME DAY/OVERNIGHT TURNAROUND
1-800-USA-DUB1
1-800-872-3821
USA STUDIOS

FOR SALE

National Foam Inc.

SPECIAL PRICES!
•BELOW WHOLESALE
•50% LOWER THAN ANY COMPETITOR

Excellent Soundproofing for most applications

2" depth, 74"×32" - $16.95 (grey)
4" depth, 74"×32" - $18.95 (blue)
$22.95 (grey)

Supercoustic Acoustic Foam
1-800-247-4497
in CA (213) 650-8906

VISA MasterCard

---

(3) RCA TKP-45 ONE INCH-TUBE CAMERA SYSTEMS with original 11 to 80 millimeter Angenieux lenses and two spare Fujinon lenses. Also included, 300 ft. length multicore cable runs in full CCU unit. Any reasonable offer accepted. Call Dennis, 212-972-1010. 02-91-1t

---

MAP

FREE 56-PG CATALOG

Complete line of audio modules and accessories for all engineered sound & broadcast applications

MODULAR AUDIO PRODUCTS
1-800-333-7697•516-345-3100•FAX 516-345-3106
DIV. OF MODULAR DEVICES, INC. • 1 RONED RD. • SHIRLEY, NY 11967

SONY, PANASONIC, JVC
Authorized Parts Distributor
SEI ELECTRONICS
2520-22 N. Broad St., Philadelphia, PA 19132
215-223-9400 • 800-523-0894
FAX: 215-223-9423

Circle (81) on Reply Card

FOR SALE

FACTORY DIRECT

Custom Cases	Acoustic Foam	Custom Stands	Studio Furniture
			

Request Catalogue 800-343-1433, 516-563-0633
Island Cases, 1121-20 Lincoln Ave., Holbrook NY 11741

Sound-with-Picture Application Specialists

Speakers: Altec "Voice of the Theatre" (3) A-7s; Tannoy "Gold Standard" Coax GRF Autograph Series; EV, JBL, Yamaha near field monitors. **Digital Audio:** Sony PCM-1630 w/DMR-4000 CD Mastering pkg; AMS Audiofile IV Upgradable 4 hr. system from top DAW mfr; Mitsubishi X-850 32-trk w/meter bridge & Apogees; Sony PCM-2500 DAT w/AES/EBU in/out; Panasonic SV-3500 DAT digital I/O; Yamaha DMP-7D 8-in mixer; Amiga, Mac, PC-based systems from 2 channel to multi-track...call for information. **Analog Audio:** Adams-Smith 2600 3-machine synchronizer; Sony MXP-3030 30-modules, non-automated; Soundcraft Delta w/24 modules/4 subs; Soundcraft 200 BVE w/serial I/F; Neve 5315/24 (2) 22-in.; Massenburg 8200 EQ-5 band/2 ch w/ps; Focusrite ISA 110 EQ 4-band/mic pre w/ps. **Microphones:** Neumann U67/U87 (6); Sennheiser Shotguns MKH-416s and 815T-U; Nady Wireless systems (3); Sony ECM-50 lavs (6).

PRO AUDIO RESOURCES
A Division of PROVID Supply Corp.
CALL FRANK AGNELLO AT
(708) 670-PROS (-7767)

25KW PYE UHF TV TRANSMITTER with Klystrons presently tuned to Channel 20. 400 ft. 3⅛-inch transmission line. Available June 1991. Contact Bill Welty. 213-478-1818. 2-91-1t

---

Affordable Excellence!

Benchmark Media Systems has become the industry reference for quality audio. No-compromise performance, unequaled versatility, and 100% test and calibration are a part of every one of our products. Our product line includes:

- Audio DAs with Remote Gain & Mode Control
- Peak and VU Metering Systems
- Interface Systems and Modules
- Microphone Preamplifier Systems and Mic-Pre DAs
- Numerous *NEW* products not yet in our catalog.

Benchmark ... the measure of excellence.™

BENCHMARK MEDIA SYSTEMS, INC.
5925 Court Street Road Syracuse, NY 13206
Call 800-262-4675 • 315-437-6300 • FAX 437-8119

Classified

Advertising sales offices

NEW YORK, NEW YORK
Diane Gottlieb-Klusner
Telephone: (212) 332-0633
Telefax: (212) 332-0663
Mike Trerotoli
Telephone: (212) 332-0632
Telefax: (212) 332-0663
888 7th Avenue, 38th Floor
New York, NY 10106

CHICAGO, ILLINOIS
Vytas Urbonas
Telephone: (312) 435-2361
Telefax: (312) 922-1408
55 East Jackson
Suite 1100
Chicago, IL 60604

SANTA MONICA, CALIFORNIA
Herbert A. Schiff
Telephone: (213) 393-9285
Telefax: (213) 393-2381
Jason Perlman
Telephone: (213) 458-9987
Telefax: (213) 393-2381
Schiff & Associates
501 Santa Monica Blvd, Ste. 504.
Santa Monica, CA 90401

OXFORD, ENGLAND
Nicholas McGeachin
Intertec Publishing Corp.
Roseleigh House
New Street
Deddington
Oxford OX5 4SP
England
Telephone: (0869) 38794
Telefax: (0869) 38040
Telex: 837469 BES G

TOKYO, JAPAN
Mashy Yoshikawa
Orient Echo, Inc.
1101 Grand Maison
Shimomiyabi-Cho 2-18
Shinjuku-ku, Tokyo 162, Japan
Telephone: (03) 235-5961
FAX: (03) 235-5852
Telex: J-33376 MYORIENT

FREWVILLE, SOUTH AUSTRALIA
John Williamson
Hastwell, Williamson, Rep. Pty. Ltd.
109 Conyngham Street
Frewville 5063
South Australia
Phone: 799-522
FAX: 08 79 9522
Telex: AA87113 HANDM

CLASSIFIED ADVERTISING
OVERLAND PARK, KANSAS
Renée Hambleton
P.O. Box 12901
Overland Park, KS 66212
913-888-4664

FOR SALE

CAPACITORS OVERNIGHT
- Power Supply—computer grade: up to 450VDC
- Transmitting - MICA — Sangamo, Cornell-Dubilier
- Oil Filled — Non-PCB Oval, Rectangular

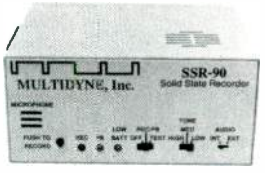
Relays • Filters • Transistors
Any Parts starting with 1N or 2N

1-800-323-0460 FAX 1-802-425-3664
Kellner Electronics, Inc., Charlotte, VT 05445

SONY 1 INCH: •BVH-1100A, 1100, or 1000s — Warrantee. BVW-40, Cameras, TBCs, Decks, Monitors, and RCA Film Chains and parts. We buy clean late model equipment. **(609) 786-1709.** 02-91-1t

COPPER! All sizes of wire and strap for AM, FM and TV. Construction, counter poise, grounding. (800) 622-0022. 08-90-8t

SSR-90 AUDIO SOURCE IDENTIFICATION with SOLID STATE MESSAGE RECORDER



INEXPENSIVE, PORTABLE, BATTERY POWERED
- Records up to **96 seconds** of high quality speech for audio source identification.
- Alternates between message and **3 selectable frequencies of tone** or external audio.
- Message repeated every 1 to 40 seconds (internally adjustable).
- Includes internal microphone and speaker for message verification.
- Powered by internal 9 Volt battery or external DC.
- Low battery indicator and low power consumption.

MULTIDYNE ELECTRONICS, INC.
PROFESSIONAL BROADCAST EQUIPMENT
244 BAYVILLE AVE., NY 11709
1-(800)-765-8200, (516)-628-1495

(2) ITEP-1 Pneumatic Studio Pedestals with **ITEH-2** heads in great condition. **(12K New) $4500.00 ea. (1) JVC CR-8250** edit recorder, low hours in excellent condition, **$2875.00. (2) Sony 2850** Editors. as is **$100.00 ea. (1) Sony 2850** Editor. In good condition, **$250.00. 504-928-4814.** 2-91-1t

Classified advertising now available as Classified Display or By-the-word.

Classified Display: $107 per column inch, per insertion, with frequency discounts available. 1 inch minimum, 10 inches maximum per ad. Blind ads $40 additional. Reader Service number $50 additional. Spot color available for $150 (color determined by publisher).

By-The-Word: $1.75 per word, per insertion. Initials and abbreviations count as full words. Blind ads $40 additional. Minimum charge $40 per insertion. No agency discounts allowed for classified ads.

Contact Renée Hambleton, at (913) 888-4664, for information on frequency and pre-payment discounts. To place your classified ad send your order and materials to Broadcast Engineering, Classified Ad Mgr., P.O. Box 12901, Overland Park, KS 66212.

FOR SALE

DEMO & USED EQUIPMENT BROKER
Hundreds of items listed up to 70% off!
Mobile Trucks–New 36 foot production truck on Volvo chassis, completed and ready for equipment. 3 access doors, computer floor, air ride-$200,000; New Model S-22 14 foot mobile unit on Ford E350 chassis, no interior work-$39,000; **Complete A/B Roll Edit Suite**-SP U-Matic recorders, Callaway editor. Sony MXP-29 audio mixer, Ross 210A switcher, Quanta QCG-500 character generator, FORA MF-2000 2D DVE, sync, test, monitors and racks-$OFFER; 1" **VTR'S**–Sony BVH-2000/BVT-2150-$35,000; Ampex VPR-2B/TBC-2B-$16,000; Hitachi HR-200B/TBC-200-$12,500. **Betacam & M2**–Sony BVW-40-$12,500; Sony BVW-15 DT players-$11,000; Sony BVW-25 portable-$6,400; JVC KR-M820 (demo) studio M2-$7,100; **Cameras**–Ikegami EC-35 full package-$29,000; Ikegami HL-79E AL w/14X lens-$16,500; Ikegami ITC-730AP plumbicon w/18X, studio package-$13,000 for 2; JVC KY-25/BR-S410 package w/13X lens-$6,400; JVC KY-15UL10 3 chip w/10C lens demo-$3,720; **Switchers**–FORA CVM-500 component serial switcher-$10,000; Sony SEG-2000-$3,000; Ampex Vista 10-$16,500; Sony SEG-2550-$5,500; **Character Generators**–Chyron 4200 2-channels with Motion & encoder/keyers, CCM, Dual Vididisc, MGM, factory refurb.-$41,800; Chyron 4200-2 channel w/Motion, encoder/keyers, factory refurb. $37,900; Quanta Q8 (demo) with camera capture-$8,500; Laird 1500-$5,500; **U-Matic & S-VHS**–many units available including factory "B" stock; **Special Demo Tripods**–Miller System 80 fluid head, tripod & dolly-$4,900; Miller System 20-good for light cameras-$1,050; Miller System 40 (old style with 119 head)-$2,174; Miller "F" head on 331 tripod good for light cameras-$595; Miller VG-50 (50 lb capacity) new head on used Midi tripod, includes new ball level-$1,476; many Miller tripods available.

Let us shop for you!!
New address & phone numbers!!
PROVID SUPPLY CORP.
(708) 670-PROS FAX: (708) 670-7892

BCS BROADCAST STORE, INC.
VIDEO/AUDIO/RF
Buy • Sell
Consign • Service
Over 3000 items
in inventory
Burbank, CA 818.845-7000
New York, N.Y. 212.268-8800
Circle (82) on Reply Card

TUBES 4CX1000A, 4CX250B, 4-1000A, 4CX15000A, and more. We carry large inventory, all major brands (EIMAC, AMPEREX, RCA) Call Stew 1-800-842-1489. 01-91-tfn

Portable Sound Panels

- Isolate specific areas
- Many sizes and options
- Panels start at $19.95/ea Complete w/foam

Island Cases *Write for free catalog*
1121-I Lincoln Ave., Holbrook, N.Y. 11741
800 343-1433 • In N.Y. 516-563-0633

Use BE classified ads

Ad index

Advertiser	Page Number	Reader Service Number	Hotline
Adams-Smith	46	33	508/562-3801
Alta Group, Inc.	65	53	800/677-ALTA
Amber Electro Design, Inc.	30	19	514/333-8748
Ampex Corp. (AVSD)	40-41,77		800/25-AMPEX
Ampex Recording Media	73	69	415/367-3809
Anvil Cases, Inc.	50	75	800/359-2684
Audio Animation, Inc.	39	26	615/689-2500
Audio Precision	13	10	800/231-7350
Audio-Technica U.S., Inc.	72	64	216/686-2600
Audio-Video Engineering	70	68	516/546-4239
Audiolab Electronics	48	35	916/348-0200
Autodesk	33	22	800/879-4A3D
BCS, Broadcast Store, Inc.	79	82	818/845-7000
Belar Electronics Laboratory, Inc.	60	59	215/687-5550
Bird Electronic Corp.	28	16	216/248-1200
Broadcast Video Systems, Ltd.	70	67	416/764-1584
BTS Broadcast Television Systems	21	14	800/962-4BTS
Clear-Com Intercom Systems	72	63	415/527-6666
Computer Assisted Technology	60	48	212/360-2591
Consultronics	64	52	416/738-3741
Continental Electronics	52	42	214/381-7161
Control Concepts Co.	42	27	607/724-2484
Datatek, Inc.	48A	39	800/882-9100
dbx	7	7	415/351-3500
Dynair Electronics, Inc.	66	74	800/854-2831
Electro-Voice, Inc.	43	2	616/695-6831
ESE	71	60	213/322-2136
Fast Forward Video	44	29	714/852-8404
For-A Corp. of America	53	43	508/650-3902
Full Compass Systems	74	66	800/356-5844
Grass Valley Group, Inc.	9	8	916/478-3000
Hitachi Denshi America Ltd.	27	15	516/921-7200
illbruck	IBC	57	800/662-0032
Jampro Antennas, Inc.	32	21	916/383-1177
JVC Professional Products Co.	19,67	13,99	800/JVC-5825
Kings Electronics	51	41	914/793-5000
Lamp Technology	78	80	516/567-1800
Leitch Video of America, Inc.	47	34	800/231-9673
3M Pro Audio/Video Prod.	29	18	612/733-1959
Magni Systems, Inc.	63	51	800/237-5964
Midwest Communications	1	4	606/781-2200
Nikon Corporation	5	6	800/NIKON-US
Odetics, Inc.	61	49	800/243-2001
Opamp Labs, Inc.	60	62	213/934-3566
Orban, Div. of AKG Acoustics, Inc.	17	12	800/227-4498
Otari Corp.	15	11	415/341-5900
Pacific Recorders & Engineering Corp.	3	5	619/438-3911
Panasonic Broadcast & Television Systems	48B-E,59	40,46	800/524-0864
Panasonic Broadcast & Television Systems/Professional	34-35,37	23,24	800/553-7222
Pesa America	IFC	1	205/880-0795
Polyline Corp	28	17	708/390-6464
Polyphaser Corp	62	70	702/782-2511
Queue Systems	60	73	213/656-0258
Ramko Research	38	25	800/678-1357
RF Industries	62	71	800/233-1728
Rohde & Schwarz USA, Inc.	68	54	301/459-8800
Schmid Telecommunications	31	20	800/955-9570
SEI Electronics	78	81	215/223-9400
Shure Brothers, Inc.	11	9	800/25-SHURE
Sony Business & Professional Group	24-25		800/635-SONY
Sony Pro Video Tape	57	45	800/635-SONY
Staco Energy Products Corp.	50	50	513/253-1191
Standard Tape Laboratory, Inc.	60	61	415/786-3546
Stantron	44	30,31	800/821-0019
Tascam, Div. TEAC Corp. of America	75	72	213/726-0303
Tektronix, Inc.	45	32	800/TEK-WIDE
Varian, Eimac	55	44	415/592-1221
Wheatstone Corporation	BC	3	315/455-7740
Winsted Corp.	74	65	800/447-2257

SONEX

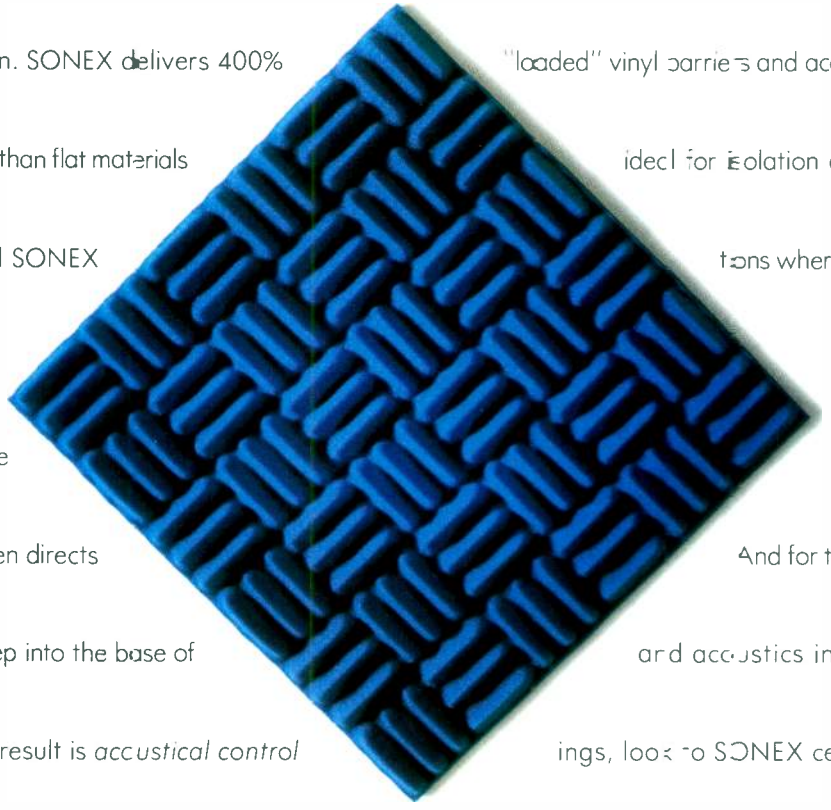
We Bring Science To The Art Of Sound.

There is more than art to good sound. You need the science of SONEX to create an environment with *clean and true* acoustics, an environment free of resonance and reverberation. SONEX delivers 400% more surface area than flat materials plus the patented SONEX anechoic wedge "collects" noise from all angles then directs and deflects it deep into the base of the material. The result is *accustical control* which leaves nothing but true and accurate sound.

...over 400% more surface area...

And now SONEX is available in new sizes which ship UPS When more than absorption is needed, our ProSPEC *Barriers and Composites* will deliver. These "loaded" vinyl barriers and acoustical foams are ideal for isolation and other applications where transmission loss and noise reduction are needed. And for the best aesthetics and acoustics in suspended ceilings, look to SONEX ceilings. For more information *call or write today:* illbruck, inc., SONEX Acoustical Products Division, 3800 Washington Ave. N., Minneapolis, MN 55412. 1-800-662-0032 or 612-521-3555 in MN.

...new sizes that ship UPS...



illbruck

The TV-500: Designed for One Reason . . .

April 16, 1990

Gary C. Snow, President
WHEATSTONE CORPORATION
6720 V.I.P. Parkway
Syracuse, New York 13211

Dear Gary:

When National Video Center decided to upgrade the audio rooms for our TV–1 and TV–2 studios, we knew we needed consoles that could take us into the 1990s by giving us the ability to handle musical entertainment shows, game shows and dramatic series as well as other demands placed on us by clients.

During the course of the next several months we reviewed designs from approximately ten console manufacturers. After many days of discussion we all decided upon the Wheatstone TV–500 for its performance, flexibility, features and ease of operation.

The cooperativeness of your engineering staff has been wonderful. There were severe time constraints for delivery of the consoles. Installation was required in a matter of days to fit around productions that were scheduled in the studios. They really cared about the process, and have been professional from start to finish. With all of the customizations we ordered for the consoles, we were concerned that all of our needs would be met. To our pleasant surprise, we were able to uncrate the consoles, install them and start production immediately. All systems operated flawlessly.

The response from our clients has been extremely favorable. Our studio productions have utilized the boards to the limit, for series such as Nickelodeon's *Eureeka's Castle* and MTV's *Unplugged* as well as live shows, teleconferences and home video productions. The basic input/output architecture exactly matched our expectations for the needs of the 1990s.

Your custom boards are priced similarly to other consoles, but we've gotten far more value and technical performance from the TV–500s. We are completely satisfied with their performance in live, analog and digital recording environments.

Thanks to Tim, Andy, Paul, all the staff at Wheatstone and especially to you for providing us with a colorful, natural-sounding, state-of-the-art console to service the industry.

Sincerely,
Al Centrella
Al Centrella, Audio Engineer
NATIONAL VIDEO CENTER

Al Centrella, Audio Engineer

Clients Demand Production Power

This console will give you what you need: a totally stereo signal path—inputs, sends, subgroups, cues, and IFBs. It includes powerful EQ, VCA mastering, complete with twin stereo mixes and triple mono outputs. The TV–500 is the console to use for live local and international events, or for the most demanding clients in your production suite.

And, because Wheatstone makes it, you can count on engineering excellence, prompt delivery, and first class technical support.

Our sales engineers can help you configure the TV–500 to exactly match your needs. Draw on our experience—call a Wheatstone sales engineer today!

Wheatstone® Corporation

Exclusive Canadian Distributor: Neve
Rupert Neve Canada, Inc., 260 The Esplanade, Toronto, Ontario M5A 1J2
(Telephone 416-365-3363/Facsimile 416-365-1044)

6720 V.I.P. Parkway, Syracuse, NY 13211 (315-455-7740/FAX 315-454-8104)

Circle (3) on Reply Card