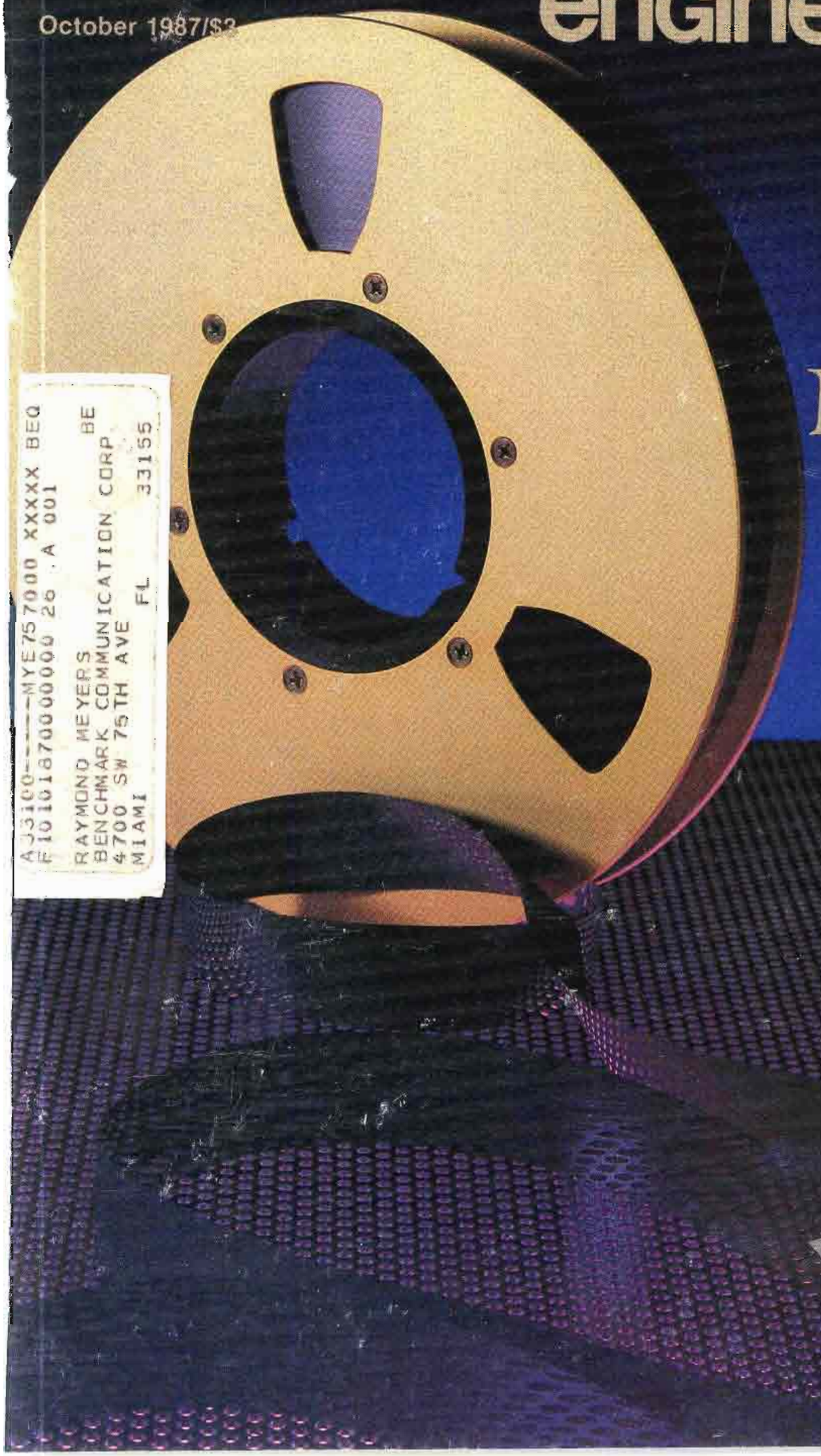
BROADCAST engineering®

AN INTERTEC PUBLICATION

October 1987/$3



Magnetic media special report

1987 Salary Survey pg. 22

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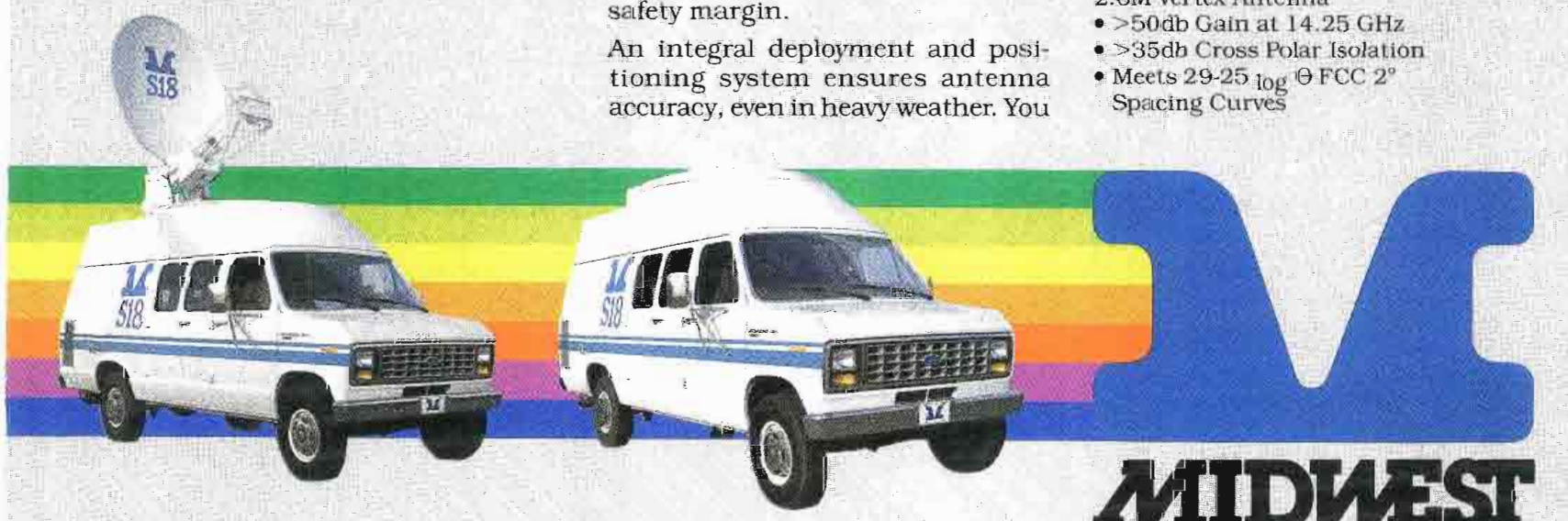

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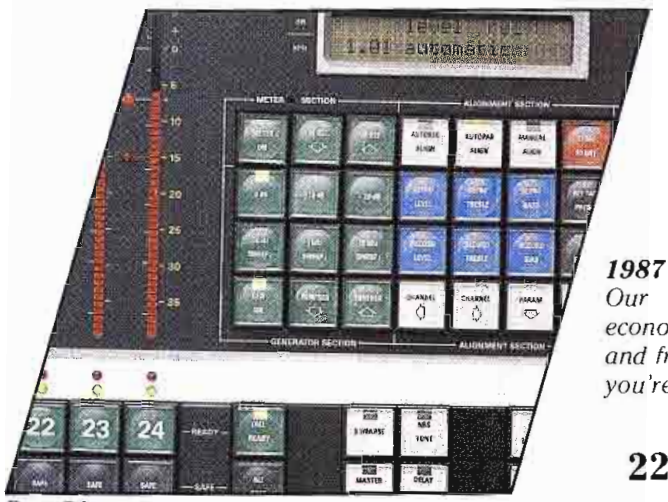

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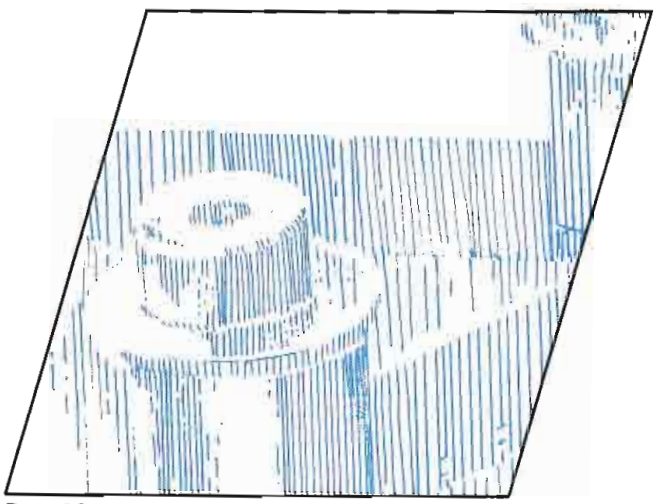

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ON THE COVER
Magnetic recording tape is a crucial element in the broadcast industry. It is often taken for granted, but its portability and flexibility make it a convenient storage medium. The cover design concept was conceived by **BE** graphic designer Kristi Sherman. Photography courtesy of Doug Schwartz, Flightspeed Graphics. (Tape reel provided by Sony.)

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1987 SALARY SURVEY:
Our 7th annual salary survey examines the state of the economy for broadcasters. Detailed breakdown on pay scales and fringe benefits will let you know where you stand whether you're in engineering, operations or management.

MAGNETIC MEDIA SPECIAL REPORT:
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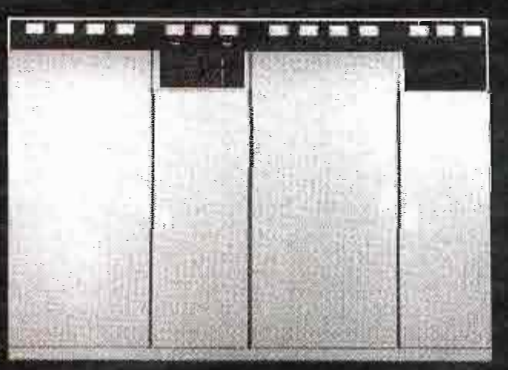

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SMPTE agrees on HDTV parameters

The Society of Motion Picture and Television Engineers (SMPTE) working group on high-definition electronic productions has approved a document specifying signal parameters of the 1,125-line/60-field high-definition TV system.

Following final approval by the SMPTE, the standard will be submitted to the American National Standard Institute (ANSI) for acceptance as an American national standard.

The document specifies the HDTV system parameters, which are critical for ensuring the compatibility of equipment and the ease of program interchange. An important part of the document is the specification on colorimetry, which was contributed to the working group by an ad hoc group chaired by Leroy Demarsh of the Eastman Kodak Company. The specification, one of the most complete and unambiguous colorimetry specifications ever detailed, is seen as an important step in a planned development aimed at achieving a wide color gamut, constant luminance HDTV system.

The work by the society on HDTV was undertaken in response to requests from the U.S. Advanced Television Systems Committee (ATSC), the Canadian Broadcasting Corporation and the CTV Network in Canada. The specifications for the signal parameters were prepared by an HDTV ad hoc group chaired by Keith Field of the CBC, then submitted to the working group. The ad hoc group's efforts received the active support of many companies and organizations, including HDTV equipment manufacturers and users of the Broadcast Technology Association of Japan.

FM radio improves road safety in Italy

Radio-televisione Italia (RAI) is installing "roadside radio" as its contribution to improving highway safety in Italy. A single FM frequency (103MHz) will be used to cover all main roads.

Tests have shown this mode of operation to be feasible if a few simple precautions are observed. Areas of approximately equal field strength (mush zones) must be minimized; modulation delays must be kept to a few microseconds; modulation depths must be maintained to within a few tenths of a decibel; and the carriers should be kept as nearly coherent as possible.

Trials have been completed on a section of the main highway between Florence and Bologna. Fiber-optic cables are used to carry the signals to the individual transmitters. The system has been engineered to meet these criteria. "Leaky cables" will be used to carry the signal in highway tunnels. It is planned to extend the system so that it will eventually cover all main roads in Italy.

The roadside radio stations will broadcast road condition information in an effort to reduce the high number of accidents on Italian thoroughfares.

Continued on page 176

BROADCAST ENGINEERING

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SUBSCRIPTIONS: BROADCAST ENGINEERING is mailed free to qualified persons within the United States and Canada in occupations described here. Non-qualified persons may subscribe at the following rates: United States and Canada, one year, $25.00. Qualified and non-qualified persons in all other countries; one year, $30.00 (surface mail); $108.00 (air mail). Back issue rates, $5, except for the Buyers Guide/Spec. Book, which is $20. Rates include postage. Adjustments necessitated by subscription termination at single copy rate. Allow 6-8 weeks for new subscriptions or for change of address. Second class postage paid at Shawnee Mission, KS.

BROADCAST ENGINEERING Volume 29, No. 10 (USPS 338-130) is published monthly (except in the fall, when two issues are published) by Intertec Publishing Corporation, 9221 Quivira Road, P.O. Box 12901, Overland Park, KS 66212. Second class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address changes to BROADCAST ENGINEERING, P.O. Box 12983, Overland Park, KS 66212.

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The bottom line

The following letter, received as a part of the annual **Broadcast Engineering** salary survey, outlines one engineer's frustration with the salary and working conditions he experienced as a broadcast engineer:

> Although job security and pride in one's profession are important factors in staying with a form of employment, they are only a part of the overall picture. In the long run, whether one stays with any particular job still comes down to money.
>
> I saw broadcast engineering as the ultimate goal for the electronic technician. These experts rely on sophisticated, high-powered equipment to provide both a public service and a quality product. Broadcasting was, to me, a job with both prestige and a future.
>
> After spending hours and hours of work and study to become a qualified broadcast engineer, I found that I had to make do with little or no equipment, or poor equipment and non-existent funding, which made me feel like the station garbage man, rather than the station engineer. Finally, after three years of trying to eke out a living in the broadcast-related sector, the conditions left me bitter—and working for someone else.
>
> Broadcast management feels, especially in the smaller markets, that there is a surplus, a never-ending supply of qualified people, both technical and operational. Station managers often seem to use and exploit these individuals, who are then cast off like empty pop cans. After all, can't they simply be replaced by someone else? Besides, aren't new hires cheaper than those with experience?
>
> Those of us who want to be a cut above the rest can't work in that kind of atmosphere. Washers, toasters and 100kW radio stations are not created equal. The people who repair each need different levels of expertise. Lumping them together as "fix-it-men" is quite a mistake.
>
> Personally, I left for the one reason I stated at the beginning...money, an immediate 38% salary increase to start and more to come. I guess my mistake was that I forgot the saying of a dear friend and mentor, when he said, "Never forget—it's all show biz!"

The letter might not have received so much attention at **BE** had it not so closely reflected many of the other comments contained within the survey results. Surveys such as ours always contain negative comments about salary levels and working conditions. Yet, a high percentage of this year's respondents seemed concerned about two general industry conditions—low pay and unsupportive management.

One broadcast-related vendor recently remarked that his goal was to work in a manufacturing plant that required only one operator—him. This philosophy seems to be reflected in how some of today's stations are run. Old and obsolete equipment is not replaced, new people are not properly trained, skilled staff are not properly rewarded and, as a result, many believe that the product quality is deteriorating. Station managers who are looking to automation and less-skilled (cheaper) people to improve their bottom line truly are shortsighted.

Success in an industry is measured over the long term. Managers who make decisions based only on the daily bottom line and treat their employees as disposable commodities will not last. Managers who invest in their stations, by properly rewarding and meeting the needs of their staff, will become successful. Their station's success will be reflected not only by their own efforts, but also by the work of a grateful and supportive staff.

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Enforcement of fairness doctrine ends

By Harry C. Martin

The FCC has determined that the fairness doctrine violates broadcasters' First Amendment constitutional rights and, therefore, the commission no longer will enforce the doctrine.

Under the fairness doctrine, broadcasters were required to provide coverage of controversial issues of public importance and to afford a reasonable opportunity for presentation of contrasting viewpoints on such issues. In 1984, the commission decided that the licensee of a TV station in Syracuse, NY, had violated the fairness doctrine. In its decision, the agency did not rule on the licensee's claim that the doctrine was unconstitutional under the First Amendment. The station appealed the commission's decision to the U.S. Court of Appeals for the District of Columbia Circuit, again raising the constitutional issue. The court found that the commission's refusal to rule on the station's constitutional argument was arbitrary and capricious and ordered the commission to resolve the question.

The commission subsequently conducted an inquiry proceeding on the fairness doctrine. The record it compiled, combined with the record in the Syracuse case, convinced the agency that the doctrine reduces, rather than enhances, discussion of controversial issues of public importance. Therefore, the commission found the doctrine to be unconstitutional and contrary to public interest. In its decision, the commission noted that the rapid growth in the number of broadcast stations had eliminated justification for different treatment of print media and broadcasters.

In response to a congressional directive, the commission also issued a comprehensive review of alternatives to the doctrine. The study concluded that broadcasters should be allowed to fulfill their journalistic duties as professionally as their print media counterparts, and criticized the fairness doctrine as disserving public interest and contravening fundamental principles of free speech.

Efforts are under way in Congress, where the fairness doctrine enjoys considerable popularity, to incorporate the doctrine into the Communications Act. Also, the commission's decision to set the doctrine aside has been appealed to the U.S. Court of Appeals for the District of Columbia Circuit.

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

Curbing misuses of petition procedures

In a rulemaking proceeding initiated in August, the commission asked for comments on ways to stem abuses in its licensing and frequency-allocation processes by persons who file, or threaten to file, petitions to deny or allocate counterproposals merely to extort money from legitimate applicants.

The commission is concerned with situations where individuals or groups are using petitions to deny, not for the legitimate purpose of informing the commission of an applicant's qualifications, but rather to extract money in return for dismissal of the petition. The same problem exists in the context of frequency-allocation proceedings where counterproposals are being filed by persons whose only interest is in a payoff. Currently, the commission rules do not bar such payoffs and many applicants have chosen to pay for the dismissal of petitions in order to avoid the risk, expense and delay involved in an FCC proceeding.

The commission noted that allocation proceedings are particularly susceptible to the kind of abuse the agency is seeking to prevent. It is easy to fashion a counterproposal that is unbeatable under the commission's system of allocation priorities. Cross-filers with an interest only in extorting money have wide latitude in proposing an allocation that will fall into a higher category than the original petitioner's. The commission's tentative view on this subject is that persons filing counterproposals without the intention of actually seeking a license would be made liable for a fine or forfeiture.

Abuses of the system also could be prevented by a rule limiting payments to the amounts petitioners actually have spent in preparing and prosecuting their petitions. The proposed rule would require full, detailed disclosure of all such payments and would prohibit payments not representing reimbursement of legitimate expenses. Such a rule would not deter petitioners acting in good faith, because such people would not refrain from filing a petition to deny merely because they would not reap a windfall profit by agreeing to withdraw the petition. Relatedly, the commission proposes to adopt a rule that would prohibit all payments to those who merely *threaten* to file a petition.

Re-study of nighttime use of foreign clear channels

As a result of a court remand, the commission has invited comments on the acceptance criteria to be used in allocating new AM stations on the Canadian, Mexican and Bahamian Class 1-A clear channels. Neither the court's remand nor the agency's current proceeding affects an earlier decision that permitted nighttime operation by eligible daytime-only stations, which already were operating on the foreign clears.

Allocation criteria for the foreign clears was the subject of a 1984 rulemaking that followed ratification of international agreements, which made possible the use of Canadian, Mexican and Bahamian clears more extensively at night. In its 1984 rulemaking notice, the commission originally proposed allocation criteria similar to those used in allowing new stations on the 25 U.S. Class 1-A clear channels. Under that approach, only minorities and non-commercial entities were eligible to apply for the newly available spectrum in urban areas.

Based on the record developed in the proceeding, as well as staff studies, the commission decided to follow a different course in allocating new stations on the foreign clears. It decided that the first priority would be to accommodate existing daytime stations occupying the channels. Also, provision was made for the filing of applications for new full-time stations in areas not subject to preclusion by the existing stations. But, because few such opportunities existed in urban areas, the commission decided not to make any special provisions for minority or noncommercial applicants.

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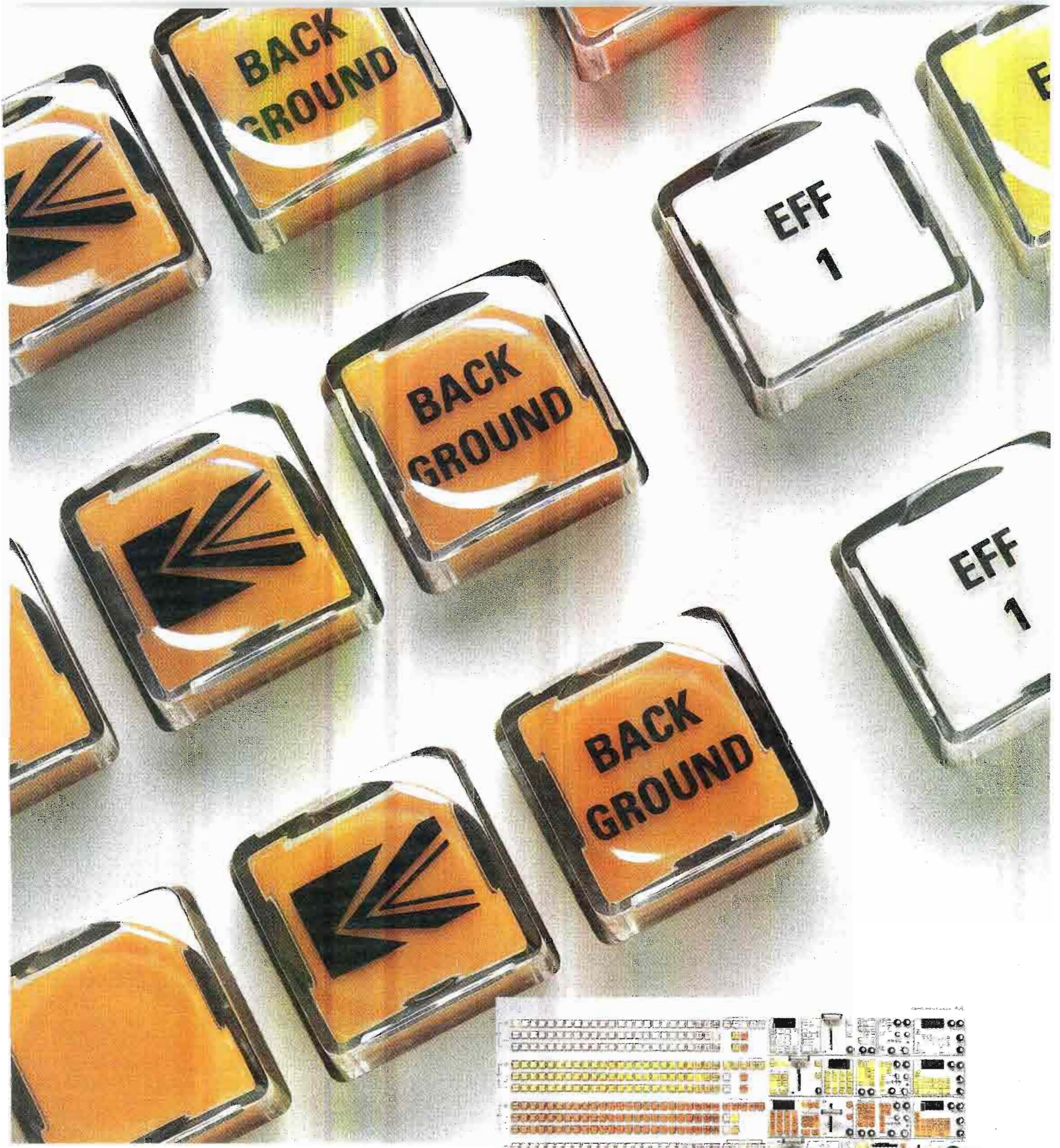

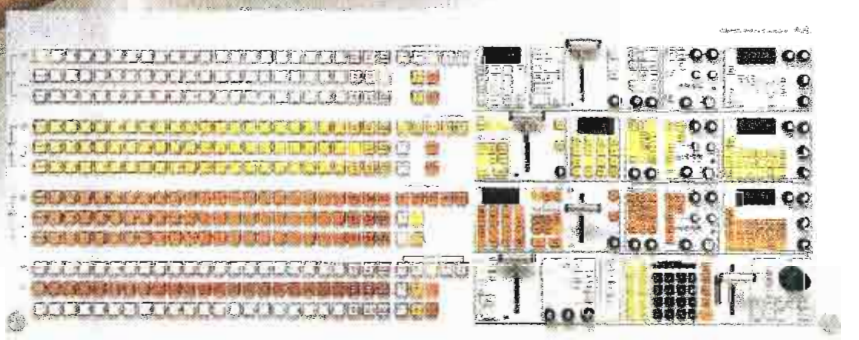

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601 and half a dozen others

Carl Bentz, technical and special projects editor

The search for background information for articles often takes me to back issues of various trade publications. That is why I picked up an October 1982 issue of "The EBU Review-Technical" not long ago. Several items in that issue intrigued me because, aside from a report of a sad event, the topics seemed so familiar.

The sad event was the passing of Professor Vladimir Zworkin. Dr. Zworkin, who, at the time of his death, was only one day away from his 93rd birthday, was a major player in the development of television as we know it.

Emigrating to the United States in 1918, Zworkin was hired by Westinghouse Electric and Manufacturing Company. In 1923, he demonstrated an entirely electronic TV system to Westinghouse corporate officials. Instead of whirling disks, the key to the system was a unique tube-pickup device. The image to be televised was projected onto a charge storage, photoelectric surface, the reverse side of which was scanned by an electron beam.

The official report of the demonstration indicated that those at the corporate level thought he should be concentrating on more useful research subjects. He would later leave Westinghouse (in 1929) to join RCA as director of electronic research, where he guided the perfecting of the iconoscope camera tube in 1934.

Much progress has taken place since the iconoscope, but one might question how well things have gone since Zworkin's passing. For example, consider the other topics discussed in that 1982 EBU Review.

First, CCIR recommendation 601 became official shortly before the issue was printed. In light of that landmark recommendation, one article presented a discussion of studio digital interface standards. Today's marketplace includes a number of products that could be linked digitally via the 601 specification, but five years later, the standard still has not met industrywide agreement.

Another area of note in the EBU publication was the appearance of official EBU technical texts on audio and video automatic measurement equipment. Many of the specifications of each area may be found in use in some of today's automatic measurement systems. Those in the video area may be recognized by reference to CCIR recommendation 569-1.

A third topic was that the U-matic H format was being considered by the EBU as a single format for TV videocassette recorders integrated with TV cameras. The goal was to arrive at a simplified method of interchanging ENG materials with 625/50 and 525/60 TV systems. Since then, the 19mm videocassette (¾-inch, yes, but not necessarily the H format cassette per se) has become the medium for digital video recorders, both composite and component.

Fourth, a specialist group on parameters, quality and the derivation of a single HDTV format held its first meeting in Killarney, Ireland. Participants were treated to demonstrations of the CBS/NHK 1,125/60 HDTV system. On hand, predicting the likely possibility of HDTV transmissions to American homes between 1986 and 1990, was Joe Flaherty (of CBS engineering). Also present at that demonstration were George Waters (now director of the EBU, then director general of RTE, Radio Telefis Eirann/Ireland) and Dr. Takahashi, director of engineering, NHK. All three have played important roles in trying to establish one worldwide HDTV standard. Today, the efforts continue.

The "worth reading" section of the 1982 publication listed books and articles from around the world. The topics included: the choice of a digital VTR format, technical and aesthetic problems of stereo audio and television, digital audio as the solution to every problem (?) and protective suits to guard against RF electromagnetic field exposure near transmitting equipment.

It is intriguing to me that these topics still draw major attention at nearly all technical seminars today. Later this month, for example, a number of the topics at the 129th SMPTE Technical Conference and Equipment Exhibition will be HDTV, a still-undecided transmission medium; ESbus, the EBU-SMPTE studio interconnection for machine control; analog/digital video-component handling in post-production environments; and digital video recording. Certainly, commendations should go to those who have participated in the many discussions in these and other areas for the time and effort that has been expended. However, it sometimes seems that much of the energy is used for relatively unproductive discussion.

Perhaps the observations are too superficial or certain aspects are not apparent. Yes, these *new* technologies do take time to catch on. They embody complexities that must be worked out before their widespread use. As the NTSC improvement efforts continue, it has become obvious that even old technologies embody concepts that prove "everything old is new again." Logic tells us that the same must be true of any new approach. It is a matter of time to discover the possibilities. Just as with computer programming, a machine as simple as the C64 has numerous capabilities that have not yet been unleashed because programmers have not combined the right set of machine language codes.

It also is important to realize that the business of broadcasting continues to have the same basic needs, no matter how *high tech* the environment may become. Ways must be found to integrate tomorrow's methods and equipment in logical and compatible ways. As the melding picks up speed, new topics will come before us, preparing us for the next step in this evolving industry. Meanwhile, watchful eyes, receptive ears and open minds will be invaluable in helping us learn from the industry gurus who are trying to lead us into the future. One thing that never ceases is our ability to grow, if we will just let it happen.

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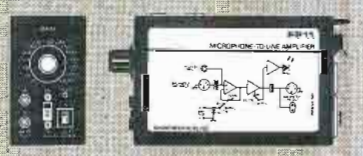

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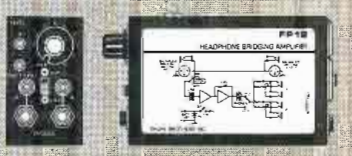

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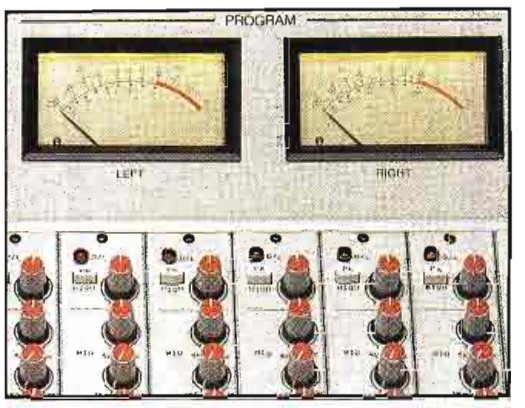
Maintaining your transmission system



By John Battison, P.E.

In today's era of deregulation (unregulation?), consulting engineers occasionally find stations that have failed to properly maintain their transmission system. It is easy to let transmitter and antenna readings slide, because conditions have a habit of changing over a period of time. This is especially the case if the station does not have a full-time staff engineer.

Even those stations lucky enough to have full-time engineers can still face the same problems. What engineer hasn't noticed a tower-base current or other parameter slightly shifting, perhaps in the middle of winter, and failed to follow through with proper maintenance?

Track down the problem

Let's examine what checks might be made for a 2-tower array operating with a licensed power of 5,000W. The station, being licensed for 5,000W, can actually feed 5,080W into the system. The extra 80W is to take care of I^2R losses. The system operates with a ratio of 1, providing 2,500W into each tower. If the station is experiencing some reception or meter reading problems, walking through some of the maintenance steps may help identify the source of transmission problems.

First, insert an in-line bridge at the base connection of each tower, immediately following the base ammeter. Read the base-operating impedance and base current. Repeat the measurement for each tower. Calculate the RF power and expect to find approximately equal power in each tower (in this example). Don't be surprised if the tower-base impedances and currents are different. In fact, it might be surprising if they were both exactly the same, even though each tower has the same power. It is not often that two similar towers have exactly the same operating characteristics.

The total power from the two towers should be close to the common point power calculated from Icp and Zcp. The difference is the system loss. If the total power calculated from the two towers differs greatly from that at the common point, further investigation is in order.

Examine the transmission lines, ATUs, phasor—and anything else connected into the antenna system. There has to be an identifiable reason for any discrepancy. (Don't forget the necessity for properly calibrated meters. See the September column for further information on this topic.)

These types of checks are quite valuable when faced with complaints of signal degradation. The complaints often result from small, but cumulative, changes that take place over a long period of time. In these cases, the specific cause may not be immediately identifiable. In any case, a careful step-by-step procedure usually will lead you to the cause.

Monitor points

Although the FCC no longer requires weekly, or even monthly, monitor-point readings, it is a good idea to perform these checks on a regular basis. Properly logging these readings can often help indicate changes before they suddenly occur.

A monitor point that is consistently high in value in the absence of continued cold weather usually is an indication that something has changed since the last measurement. If there are local changes near the monitoring point (MP), take additional readings at points before and after the MP. Then, compare these readings with those from a recent proof of performance. If the changes seem unreasonable, look for new construction near the MP, overhead wires, nearby towers or even buildings.

Check the field-intensity meter maximum orientation. It should point to the station. If it did originally, but now points off by a large amount, a reradiator is probably near at hand. Follow the indication of the meter and look along the maximum signal direction for a reradiator. When you see something that resembles one, approach it and measure the reradiation from it. If it is considerable, you most likely have found the culprit.

If you suspect that cold weather may be the cause of the MP increase, rerun the entire radial, being sure to use the original measuring point locations. Plot the results on log-log paper. (Remember, the commission issued new metric curves and insists that anything filed with the commission be plotted on metric paper.) If, on analysis, you find the conductivity has increased along the radial in question, your worries are probably over. Check to ensure that radiation remains within either standard or augmented values.

If there is an actual increase in radial conductivity, and it can be blamed on the cold, it may be possible to file an application for a different radial conductivity for the winter months. It also might be possible to file for a relaxation in protection requirements, if you can show that the increased distance to measured radials will not cause interference.

Paper problems

As a station engineer, you are responsible to the commission for keeping and operating a proper log. Of course, if you have a non-DA station, an operating log is not required. But, it is the casual engineer who does not insist that operators keep an operating log of some kind. If you have a directional antenna, you have no choice—a log is required.

Radio inspectors often have faulted stations because of shoddy log keeping when the logs appeared to show the station to be operating outside its licensed parameters even though it was not.

When you examine and sign the logs every seven days, or less, *read* them, and when you find questionable values challenge the operator. If necessary, instruct the announcer in meter reading and log keeping. It is the duty of the licensee to see that all the air staff know how to operate the transmitter and how to keep a log. This is delegated to the engineer, who in turn, has the responsibility of doing it. If announcers consistently turn in logs that show improper operation, instruct them, and if necessary, report them to their boss.

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

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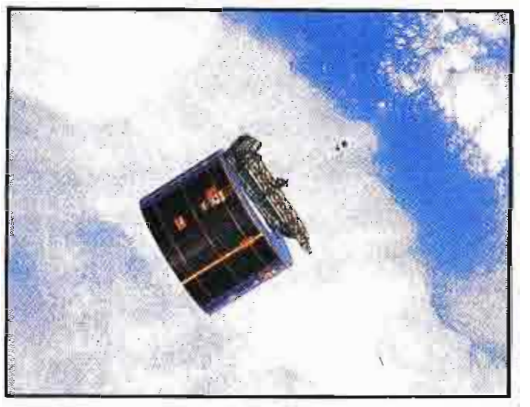
Flat antennas



By Elmer Smalling III

From the start of satellite communications, one factor that has limited the widespread use of the medium has been the size of the antenna. Most satellite-dish antennas are parabolic surfaces, which can be as small as three feet in diameter and as large as 33 feet. With the same dimension from front to back (along the boresite axis) at maximum size, a working space of 30,000 cubic feet may be required.

The preference for the parabolic-reflector antenna shape is its inherent focusing of all impinging waves to a focal point in-phase. This gives a parabolic reflector a rather narrow acceptance angle, but a relatively high gain. Spherical antenna reflectors are used to capture many satellites simultaneously as a result of their relatively wide acceptance angles, but these units also are physically larger than their parabolic brothers.

A truly flat antenna is the dream of many satellite communicators—especially for those antennas that must be mounted in awkward locations or in areas where parabolic antennas are considered aesthetically undesirable. For many years, the military has used flat antennas for radar applications, although those systems may cost hundreds of thousands of dollars and may require sophisticated terminal equipment. Also, they must be able to transmit and be steered rapidly from point to point.

Most of the flat radar antennas are *phased arrays* where the antenna actually consists of hundreds of tiny dipole elements, each driven by its own circuitry and all under computer control. Instead of turning the antenna from side to side, as is done with parabolic systems, the phased array is electronically scanned. Waves arriving from a desired angle are enhanced, while those from off-axis are rejected. By varying the phase, a fair-gain figure can be obtained from the flat antenna.

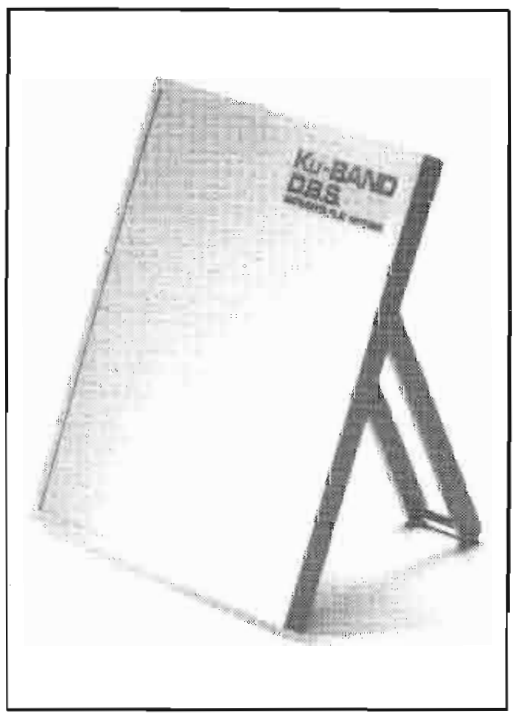
This year, two flat antenna systems have been introduced, targeted at non-military applications. One of them, intended for DBS reception, consists of a large substrate on which waveguide has been etched, as in an integrated circuit. The gain of this receive-only unit is about 3dB to 4dB less than a parabolic offset-feed antenna of roughly the same size. Continued research with the resin substrate and waveguide pattern is expected to increase the gain to equal the parabolic unit. In general, the antenna construction follows the microstrip circuitry previously discussed in this column.

The second antenna system comes in two sizes. For DBS reception in Japan and Europe, the preferred antenna model is approximately one foot square. The model for fixed services (business) use is four feet square. Both antenna designs are for receive-only from single satellites and are projected to cost about the same as a comparable offset-feed parabolic-reflector antenna. Adding electronic steering and transmit capability to flat antennas adds a great deal to the cost at this point in the technology evolution.

In the past, some of the flat antennas were merely parabolics machined to a flat surface (squashed parabolics), which included feedhorns protruding above the surface of the flat reflector by as much as eight feet. Potential users should check for the following when researching a flat antenna system:

- Is it a true phased-array antenna, rather than a squashed parabolic-reflector system with protruding feedhorn?
- What is the gain of the antenna? It should be no more than 3dB less than a comparable parabolic unit.
- Will it interface with an existing preamplifier/converter or does it include its own?

Phased-array flat antennas are perfectly suited for use as mobile or SNV antennas, which will mount to the roof or wall of a truck, van, train or airplane. Once the microstrip-like antenna circuitry is perfected and reliable steerability and transmit functions become part of the flat antenna package, many more users will find satellite communications attractive.



A flat Ku-band DBS antenna need only be about one foot square. Photo courtesy of Comsat and Matsushita.

Smalling, **BE**'s consultant on cable/satellite systems, is president of Jenel Systems and Design, Dallas.

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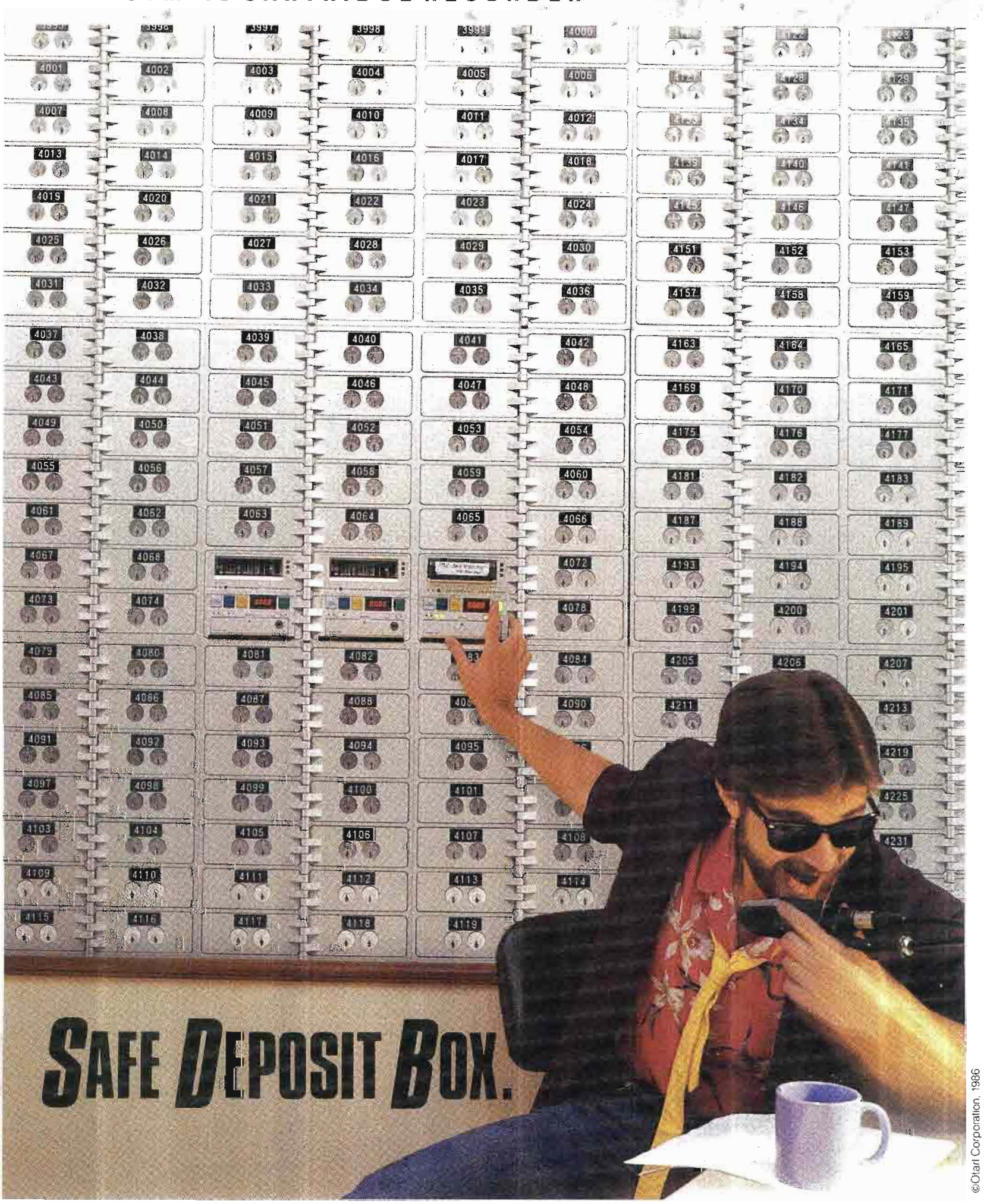

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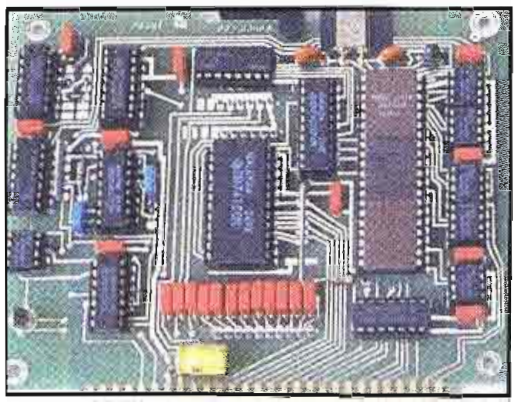
Part 13

Inside digital technology



By Gerry Kaufhold II

Technology is constantly changing in the broadcast industry and engineers must continually work to keep up with it. Perhaps nowhere in our industry is this need more important than in the application and maintenance of hardware using microprocessors.

Although many different microprocessors are available, the fundamental mode of operation can be modeled by the *Z-80 microprocessor*. The Z-80 has become a de facto standard for use in products that control machines in real time. Many station automation products contain several Z-80 devices, so what is presented here should find immediate application at your facility. Furthermore, understanding the operation of the Z-80 will help you maintain any microprocessor-based system.

Several types of Z-80 devices currently are in production. The basic unit runs at a clock speed of 2.5MHz. Improved versions include the Z-80-A and Z-80-B. The Z-80-A will run at 5MHz, and the Z-80-B will run at 6MHz. The suffix should be visible on the chip package. When replacement is necessary, make special note of the suffix. Replacing a high-speed Z-80-B with a basic Z-80 might give unpredictable results. If the suffix is not visible on the part, check the frequency stamped on the clock-crystal case to determine the operating speed of the device in question.

Microprocessors are created on a silicon-integrated circuit that is organized just like a larger control system. Photomicrographs show distinct portions of the chip that are used for the various functions that the device performs. In fact, the circuits of a microprocessor are interconnected using a parallel bus similar to the address and databuses discussed in previous "Circuits" columns.

Power supply

The +5V power supply connects to pin 5. (See Figure 1.) The supply connection must be decoupled close to the pin because of the milliamp-range pulses of current that pass through the IC as it operates. Usually, a 10μF tantalum capacitor is used, sometimes in parallel with a 0.01μF disk capacitor, to control EMI radiation.

The ground lead is pin 11. The ground trace on the printed circuit board should be wide enough to provide a low-impedance return path.

Clock circuit

Early microprocessors required separate clock circuitry. Newer devices incorporate the necessary oscillator into the processor chip itself. The oscillator circuit generally must provide at least two phases of the clock frequency. Typically, the oscillator divides the basic crystal frequency by two or four to produce the actual bus clock cycles.

The Z-80 contains circuitry to drive the master-clock lines of the internal microprocessor bus. The clock crystal is connected to pin 6. An external oscillator circuit can be used instead of the crystal so that several Z-80s can be driven simultaneously by the same oscillator.

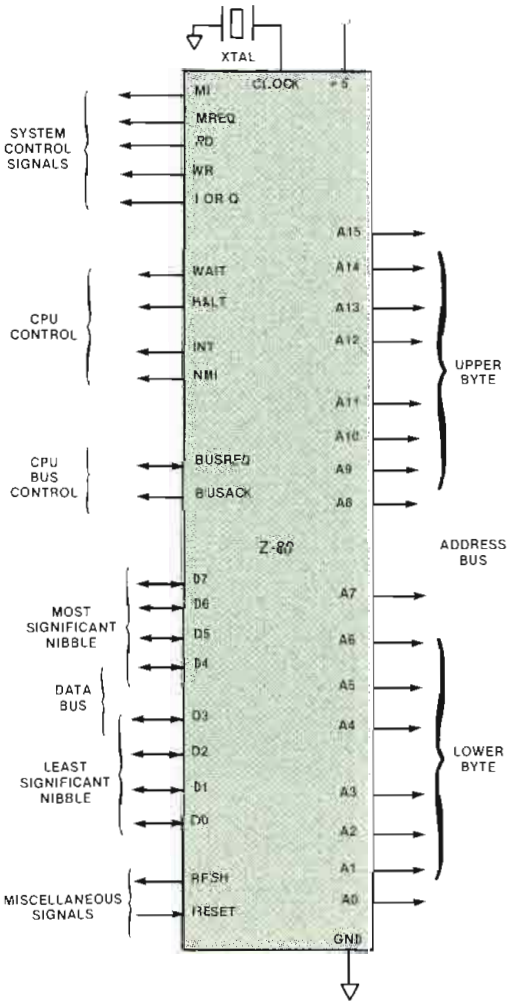


Figure 1. *Signals used by the Z-80 microprocessor chip, grouped by function.*

Control signals

Three types of control signals are used by the Z-80. The *system control lines* are used by the device to manage reading and writing data from devices connected on the bus. M-1 is used in conjunction with MREQ (memory request), IORQ (request for input/output), RD (read from memory) and WR (write to memory).

The HALT line is an output that can be used to stop the master clock until some external event restarts it. Other CPU control lines are used for signals going into the Z-80 from external devices. For example, WAIT is used to tell the Z-80 to suspend operation while a slow external device is completing its work. The lines labeled INT and NMI are used for interrupts, which will be discussed later.

CPU bus controls connect the microprocessor to the parallel bus, and are used to control access between the Z-80 and other chips that wish to transfer data. The term *direct-memory-access* (DMA) is used to describe what happens when some external device wishes to write or read data into the same memory chips used by the Z-80. The bus control lines manage this process and prevent the Z-80 from colliding with a DMA process.

Address and data

The system control signals work in conjunction with the address lines and data lines to transfer data to and from the Z-80. The address lines are used to set up a valid memory address on the bus.

The address bus is used for four functions. Instruction operation codes can be fetched from read-only memory (ROM). Read-write memory (RAM) can be written into or read from. Input/output cycles can be performed.

Kaufhold is an independent consultant located in Tempe, AZ.

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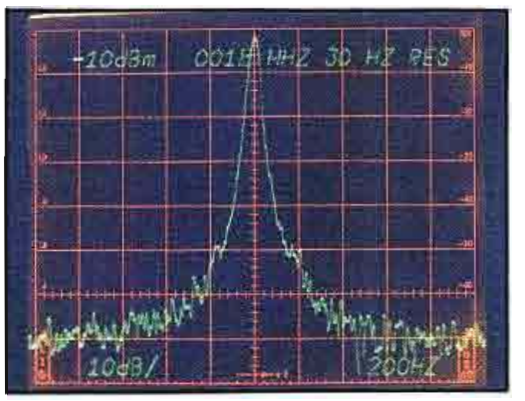
Part 3

Troubleshooting



Maintaining switching-voltage regulators

By Gerry Kaufhold II

If you are intimidated by switching-power supplies, you're not alone. These circuits provide excellent regulation and efficiency, but they are not the easiest pieces of equipment to service. The key to troubleshooting *switch-mode* supplies lies in understanding how they work.

Switching-power supplies, like the forward-converter regulator (discussed in last month's column), operate directly from the ac line and use an inductor/transformer to accomplish the required ac-line isolation and voltage regulation. Basically, a current is driven through an inductor at high frequency to efficiently produce an isolated dc voltage.

Unlike a typical ac transformer, which steps voltage up or down, the switch-mode supply produces an output voltage by switching currents. If the ac-line voltage decreases, the current being pumped through the inductor of the switching supply goes up, this results in the regulated output voltage remaining constant. Switch-mode power supplies are designed to convert power—not just voltage—into useful energy.

Line-operated switching supplies are more tolerant of utility company brownouts than series-pass circuits. For this reason, they will become more popular for use in high-precision broadcast equipment.

Before you attempt to troubleshoot a line-operated switch-mode power supply, it is helpful to divide the circuit into subsections. You can then take an organized approach through each element of the system.

Kaufhold is an independent consultant located in Tempe, AZ.

The ac-line input stage

Figure 1 shows a basic operational block diagram of a switch-mode power supply. Section A is the power-handling switch. Inductor element L1 is a flyback-type transformer. Note the diode bridge (D1) and filter capacitor (C1) on the input of the flyback. If the base of switching transistor Q1 is connected to the emitter with a low-value resistor to cut off the transistor, approximately 300Vdc will appear across the capacitor. Several volts of ripple may be observed with an oscilloscope.

The current stored on the plates of C1 is pulled through the inductor whenever Q1 saturates. Flyback L1 stores energy in its magnetic field, and when Q1 is cut off, the collapsing magnetic field induces current flow in all three of the secondary windings.

A blocking filter usually precedes the diode bridge to keep high-frequency current pulses from being transmitted back into the ac-power line.

Regulated output stage

When the magnetic field of the primary inductor builds or collapses, current flows in the secondary windings. Each voltage output must be rectified, filtered and closely regulated. This part of the switch-mode supply is shown in section B of Figure 1. The regulated output that must handle the greatest amount of current, and that requires the closest regulation tolerance, usually feeds the control section of the supply (section D of the figure).

Many times, a maintenance engineer may find 3-terminal series-pass voltage regulators as the final regulating element for the auxiliary voltages of a line-operated switch-mode supply. The switching part of the power supply can efficiently provide a preregulated voltage with excellent line regulation for the 3-terminal IC. By preregulating the input voltage of the series-pass regulator to within the minimum permissable value, maximum efficiency is obtained.

Low-voltage supply stage

Switching transistor Q1 must be controlled by using feedback from the regulated output section. Because the power-handling circuitry must be isolated from the regulated output stage, an isolated power supply is required to produce the needed voltages for the control stage. This supply is shown in section C of Figure 1. Input ac usually is taken from a line-operated transformer connected in parallel with diode bridge D1.

A simple diode bridge and filter capacitor provide rectified and filtered dc, which may be regulated by a 3-terminal series-pass IC, depending on the requirements of the control circuits.

We will look at the control stage of the switching-power supplies next month.

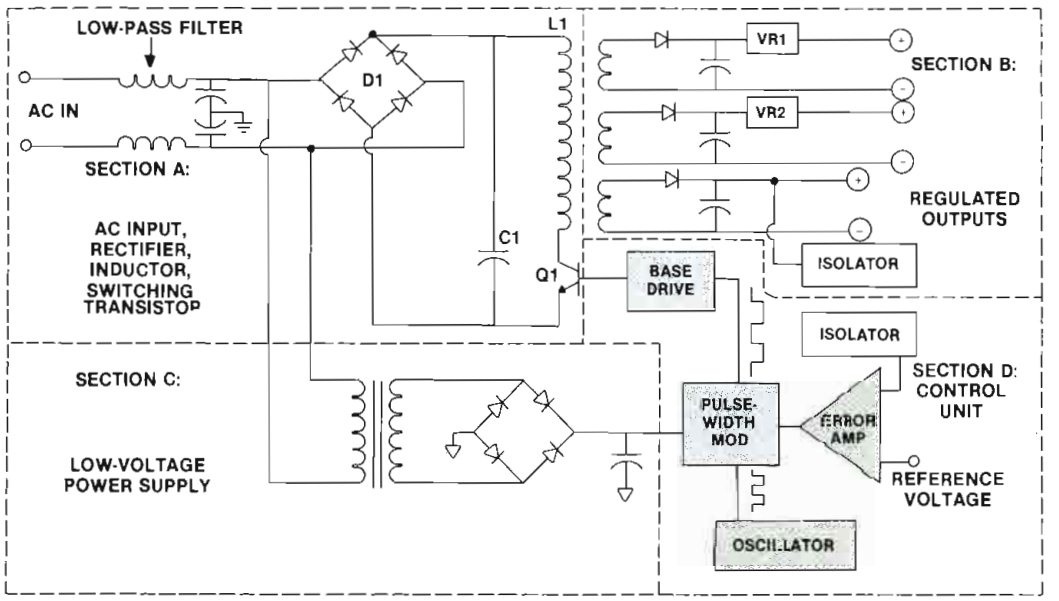


Figure 1. *Simplified block diagram of a line-operated switching-power supply. The system is divided into four operational sections for easier troubleshooting.*

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Part 4

Management for engineers

Managing upward

By Brad Dick, radio technical editor

Last month's column outlined a basic process that might be useful as you attempt to secure a raise. Let's continue on this subject by planning for possible objections that might be raised. (After all, no one said getting a raise would be easy.)

Plan the meeting

The important meeting must be carefully planned. Don't go into the meeting without having done your homework. Know your facts and present them clearly, without emotion.

You may be rebuffed at first. Don't let that stop you. Assuming your manager has not closed the door on discussions, outline your accomplishments. Here's where those quarterly reports that were discussed in last month's column will come in handy. Emphasize your value to the company by listing your important contributions.

Do not, under any circumstances, make threats. This meeting is not the time to let threats cloud the issue. It may be difficult to remain cool and unruffled, especially if your manager begins to list all the reasons for not giving you a raise. However, stick to your addenda.

Don't demand an immediate response. Your manager may first have to obtain approval for your raise from others, but may not need approval to say no. Give your boss time to consider your point of view and to get back to you later. This takes the pressure off and allows your boss to look for ways to say yes.

Counter the objections

Let's assume that you will encounter some objections to your pay-raise request. An argument that is often used for not granting a raise is company wage guidelines. Although such documents may sound forbidding, they do not always need to be an impediment to receiving that raise.

Find out all you can about the company's guidelines. Do they apply to everyone and how strictly are they enforced? If exceptions are discussed, be prepared to justify their use in your particular case. Try to show how the exceptions listed apply to your request. List any exceptions that were granted in previous situations. If you can find even one person who "beat the system," at least your foot will be in the door for similar consideration.

Unfortunately, this information may be difficult to obtain. All the rules are not necessarily written down in a company manual. Even when the rules are documented, there are often more loopholes than you can imagine.

The best solution, especially in a large organization, is to have a friend with several years of experience in the area. These people can often provide examples of how others were successful in bypassing the system.

There is not enough money. If you buy this objection, you may be giving up too easily. Show how you saved the station money. Document the extra life you squeezed from the transmitter's power tube. Remind your supervisor how you worked at home writing custom computer programs for the station. (Never mind that you like doing such work.) Remind your boss how much more it might cost to hire a consultant to do some of the things you've accomplished.

Consider more than salary or wages in your request. It may be easier for your supervisor to provide other benefits besides money, such as gasoline allowance, compensatory time off or extra vacation. In some cases, non-monetary benefits may even be worth more to you.

What if you fail?

It's possible you won't be successful in getting that raise. If your boss says no and you can't even negotiate non-monetary perks, it's time to re-evaluate your situation.

A negative response can mean many things. It could mean that you don't deserve the raise. If so, that is something with which you will have to deal. It also could mean that your boss really cannot grant the request. As mentioned in the previous columns, know the authoritative level of your boss. Requesting a raise from someone who does not have the authority to grant it can place both of you in a difficult situation. In this case, without support from your supervisor, success in getting your pay raise may be unlikely.

If no raise will be forthcoming, you must determine the exact reason. It could be that you have a problem you didn't even know about. In this situation, the problem must be resolved before there are any further discussions about a raise.

Retaliation

Everyone has heard stories about a boss who refused to grant requested raises. Even worse, some stories tell of supervisors who retaliated against their employees just because they asked for a raise.

Employees should be able to discuss the pay-raise issue without incurring any retribution. Unfortunately, a superior's reaction may not be rational. When this happens, this can mean the supervisor felt threatened in some way by your request.

If you have been around your boss for any length of time, you probably would be able to predict such a response. If you know in advance that requesting a raise may damage your chances within the company, carefully consider your action. It may be better to forego the raise and continue to enjoy a comfortable relationship with your supervisor.

Suppose, on the other hand, you go ahead and request the raise only to be greeted with a Scrooge-like response? If this happens, one option is to continue working as if nothing happened. You can then hope that your performance is sufficiently good that your boss will reconsider or at least forget the issue.

The ultimate decision on getting that raise may not rest with you, but if you are not satisfied with the result, you can either live with it or attempt a position change. If you choose to change positions, you need not leave the company. It may be possible for you to transfer to another department that may offer more opportunities. We'll discuss promotions and career changes next month.

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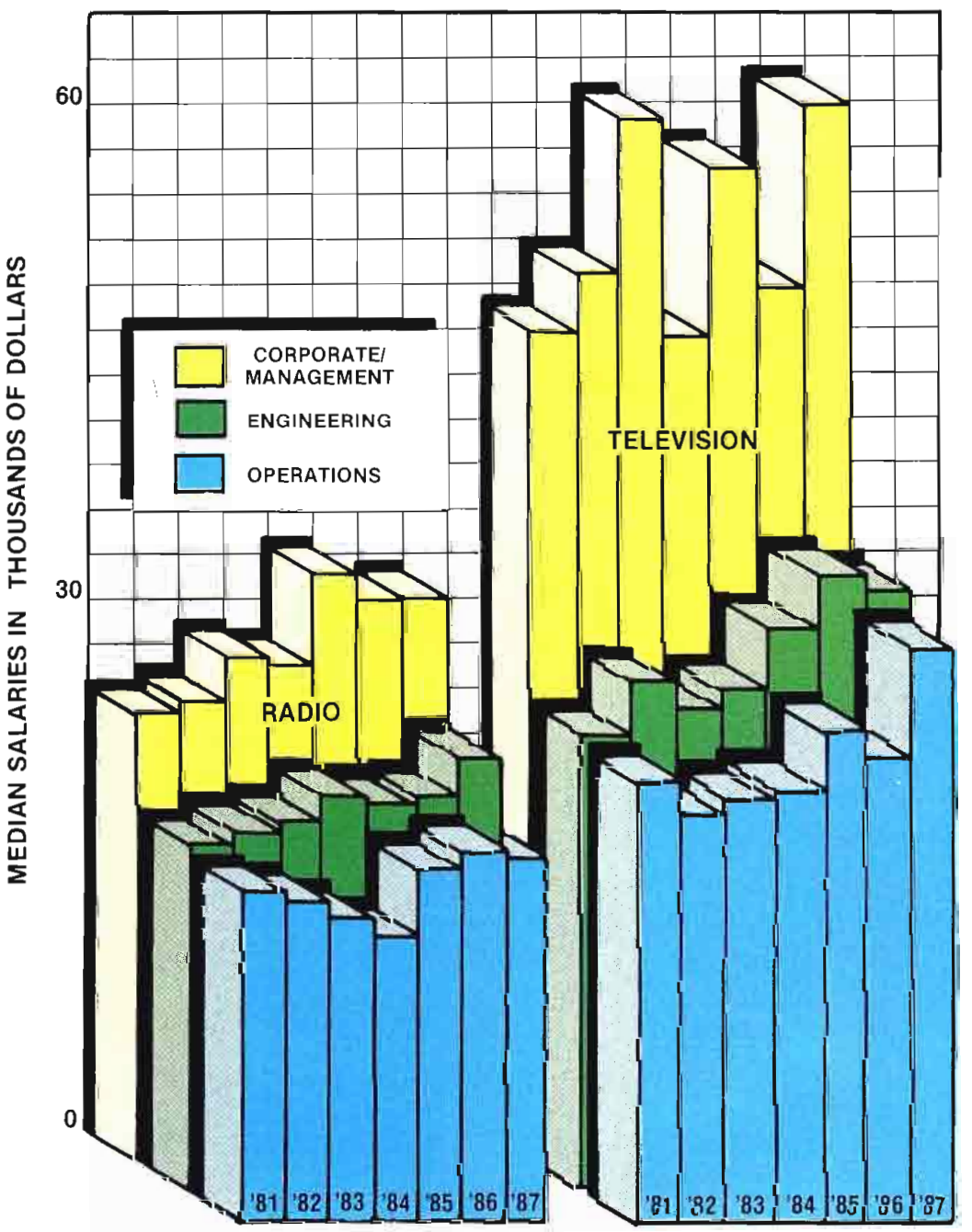
1987 Salary Survey

By Brad Dick, radio technical editor

Smaller increases and greater stability are the trends in broadcast salaries.



One of the more eagerly awaited **Broadcast Engineering** articles is the annual salary survey. It seems to be natural to want to compare your income with national norms to see how it stacks up. This year's survey, like its predecessors, will help you do just that.

The survey also provides another important function. Broadcast salaries reflect, to an extent, the general health of the industry. The data obtained from the survey reflects how the people who make the industry work are faring. The employees are the lifeblood of the business. If they are doing well, the industry is probably healthy. On the other hand, if employee incomes are down, it may reflect hard times within the industry.

The salary survey is only half of the picture, however. The other half of the industry "portrait" will be published in the December issue's "state of the industry" survey. The combined results of these two surveys will provide an insightful look into the overall status of broadcasting in this country.

The salary survey

The survey is designed to, first of all, allow you to compare your paycheck with those of broadcast employees in other positions across the industry. The survey data is sufficiently detailed to also provide information on valuable employee benefits, which, in today's tax-sheltered society, are increasingly important.

Tabular results

The 1987 results are summarized in Tables 1 through 7. Table 1 profiles the management and corporate staff. Table 2 details the results for the engineering and technical categories, and Table 3 covers the operations staff.

Tables 4 and 5 summarize the median salary data for both radio and TV categories, by market size, over the past two years. These tables allow you to determine quickly how your salary compares according to market size, which is a primary factor in the determination of overall salary levels.

Table 6 tracks salary information for the past four years. This table helps identify industry salary trends by job category. The data contained in the table will be used in a number of the comparisons to be discussed in this article.

The information contained in Table 7 is an abbreviated summary of the data contained in Tables 1, 2 and 3. To help in the spotting of trends, comparable data from the 1985 and 1986 surveys also is shown.

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Keep in mind that the results are based on *median* salaries. These figures may be quite different from *average* salaries. The median salary is a midpoint value for the group being considered. Half of the group has a higher value, and half has a lower value. The median value provides a better statistical representation of the overall data and is used throughout this report.

The 1987 **BE** salary survey was scientifically conducted by the marketing research department of Intertec Publishing, under the direction of Kate Smith. On June 2, 2,807 questionnaires were mailed to recipients of **BE** on an "nth name" basis. On Aug. 27, 1,032 completed forms had been returned, providing a response rate of 36.8%. The data contained within this report is based on those responses.

Broadcast engineering is not a job—it's a form of art!

Slow, but steady, growth

This year's survey shows little change from last year's salary levels. Percentage salary increases, measured over all markets, were down across the board. These smaller salary increases may be a reflection of weakness in the industry or they may mean that inflation is temporarily under control.

Also, the changes in individual categories were more moderate than in previous years. In comparison, last year's survey revealed a number of wide fluctuations in salaries. The industry seems to have come to grips with most of these dramatic changes, and, for the most part, salaries have leveled out. Fortunately, the general trend in compensation appears to be up.

The data across all markets and job categories is summarized in Table 7. The data shows a small decrease of 5% in median TV corporate salaries. The same comparison for the engineering category shows no change from last year's median salary of $29,800. Operator salaries increased by 4%, from $23,500 to $24,450.

A detailed look

Salaries this year, for the most part, reflected subtler changes than last year's survey. Radio corporate salaries, when compared across all markets, moved up only 2%, from $31,400 to $31,900. The 1987 corporate radio salary still is below the 7-year high of $34,800 experienced in 1985. Even so, this year's increase of 2% is better than last year's decrease of 10%.

Radio engineering salaries moved up sharply by 9%, from $23,650 to $25,800, continuing a general trend over the past seven years. Radio engineers did suffer a 1-year decrease in 1985, however. Because the 1986 increase was only 3%, radio engineers can feel good about this year's results.

Radio operations salaries continue to be the lowest registered by this survey. The 1987 radio operator salary increased by 3%, from $20,350 to $20,950. As with the radio engineering salaries, the gains registered by radio operators seem to be small, but consistent.

The corporate TV salaries, which saw a 12% decrease in 1986, vaulted back up to the stratosphere this year. Today's median corporate TV salary is $61,250, which represents a whopping 21% increase. This year marks a recovery of sorts for TV executives. In 1983, median salaries shot up to $60,000, only to fall to $42,250 in 1984. The recovery has taken three years, and most of the gain came in 1985. During the 7-year history of the survey, this salary category has been more volatile than any other.

TV engineering salaries are down by 2% this year, which is a long way from the 11% increase seen last year. TV operators did quite well this year, registering the second-largest increase with a 14% pay hike that brought their median salary to $30,900. This represents a nice improvement from the 6% drop registered in 1986.

TV pays big

If you work in radio, you may want to skip this part. However, if you are interested in how your TV cousin is making out, read on. Measuring across all markets (see Table 6), the TV corporate executive earns almost twice as much as the radio corporate executive: $61,250 vs. $31,900. The TV engineer's median salary is almost $10,000 higher than the equivalent radio salary.

A similar differential exists between TV and radio operator salaries. TV operators earn a median salary of $30,900; radio operators earn $20,950. The pockets just seem to run deeper in television. But then, you probably already knew that.

Compare market size

Looking at the results according to market size provides some interesting information about corporate radio salaries. In the top 50 markets, median corporate radio salaries decreased 33%. Similarly, in the top 100 markets, the median salary dropped by 14%. Could these changes be a reflection of the turmoil caused by increased sales of radio properties? When considered over all markets, radio corporate salaries rose a measly 2%.

Radio engineers fared only slightly better. The overall median change of 9% hides some much larger changes in the top 50 and top 100 markets. In the top 50, salaries fell by 11%. In the top 100, salaries rose by 19%. Radio engineering salaries rose in the below top 100 markets by 8%.

The percentage changes in TV salaries were much greater than in radio. TV corporate salaries across all markets rose by 21%. The changes, by market size, are: top 50, 20%; top 100, 37%; and below top 100, 10%.

Religious broadcasting is hell.

TV engineering salaries hit a brick wall. Measured across all markets, salaries fell by 2%. The top 50 markets saw the same decrease. The top 100 market salary rose by a minuscule 4%, and the below top 100 markets fell by 7%. Any engineer looking for quick gains here would be disappointed.

The percentage changes in TV operations salaries, by market size, were almost as dramatic as TV corporate salaries. Over all markets, these salaries rose by 14%. The top 50 market TV operator's median salary rose by a whopping 31%. The top 100 TV operator's median salary fell by 5%, and the below top 100 market median salary rose by a healthy 14%.

Move to the big time

One way to make more money is simply to move to a larger market. Let's look at the percentage differences in median salaries based on market size. For radio, a large increase in median salary accompanies moves from the below top 100 markets to the top 100 markets. For management, the median salary increases by 21%. The median engineering salary increases by 44% and the median operations salary by 25%. This trend does not hold true for TV markets.

For TV engineering and operations categories, the major increases in median salary go to those who move from the

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TABLE 1. – MANAGEMENT STAFF PROFILE*

	ALL MARKETS	TELEVISION				RADIO			
	Total %	Total TV %	Top 50 %	Top 100 %	Below Top 100 %	Total Radio %	Top 50 %	Top 100 %	Below Top 100 %
Salary Level									
Less than $15,000	11.4	4.0	4.5	5.0	3.0	14.2	3.3	20.0	15.6
$15,000 to $24,999	15.1	5.3	4.5	5.0	6.1	18.8	20.0	10.0	19.7
$25,000 to $34,999	19.1	10.7	4.5	10.0	15.2	22.3	13.3	15.0	25.3
$35,000 to $49,999	20.5	17.3	18.2	5.0	24.2	21.8	30.1	25.0	19.7
$50,000 to $74,999	13.6	26.7	22.7	35.0	24.2	8.6	13.3	10.0	7.5
$75,000 or more	17.7	34.7	45.6	35.0	27.3	11.2	20.0	15.0	8.8
No answer	2.6	1.3	.....	5.0	.....	3.1	.....	5.0	3.4
Median =	$37,250	$61,250	$70,000	$66,000	$51,500	$31,900	$41,600	$36,500	$30,100
Received Salary Increase During Past Year	44.2	68.0	72.7	75.0	60.7	35.0	53.3	40.0	30.5
Percentage of increase									
Less than 3%	0.7	.....	.....	.....	.....	1.0	.....	.....	1.4
3% to 4%	4.8	8.0	4.5	15.0	6.1	3.6	.....	15.0	2.7
5% to 9%	21.7	44.0	45.5	40.0	45.5	13.2	30.0	15.0	9.5
10% to 14%	8.5	12.0	13.6	15.0	9.1	7.1	13.3	5.0	6.1
15% or more	7.0	4.0	9.1	5.0	.....	8.1	10.0	.....	8.8
No answer	1.5	.....	.....	5.0	.....	2.0	.....	5.0	2.0
Median =	8.7	8.0	10.0	7.8	7.7	9.5	9.5	5.9	10.6
Fringe Benefits Received (Adds to more than 100% due to multiple answers)									
Medical insurance (paid)	79.0	85.3	86.4	85.0	84.8	76.6	83.3	65.0	76.9
Dental insurance (paid)	33.1	53.3	63.6	55.0	45.5	25.4	46.7	25.0	21.1
Life insurance (paid)	56.6	73.3	72.7	80.0	69.7	50.3	53.3	65.0	47.6
Sick leave	72.4	86.7	86.4	80.0	90.9	67.0	76.7	75.0	63.9
Vacation	83.1	90.7	95.5	85.0	90.9	80.2	90.0	70.0	79.6
Stock purchase plan	8.5	13.3	27.3	5.0	9.1	6.6	.....	5.0	8.2
Profit sharing plan	15.8	21.3	36.4	10.0	18.2	13.7	13.3	25.0	12.2
Savings plan	8.5	17.3	27.3	15.0	12.1	5.1	10.0	10.0	3.4
Pension plan	28.3	48.0	40.9	65.0	42.4	20.8	26.7	35.0	17.7
Bonus	25.7	36.0	45.5	10.0	45.5	21.8	26.7	20.0	21.1
Trade show/convention/ seminar expenses paid	52.9	62.7	59.1	60.0	66.7	49.2	56.7	55.0	46.9
Tuition refund plan	15.4	25.3	36.4	15.0	24.2	11.7	20.0	20.0	8.8
Automobile furnished	44.1	50.7	36.4	60.0	54.5	41.6	46.7	55.0	38.8
Years in Present Job									
1 or 2	21.7	16.0	22.7	5.0	18.2	23.8	23.5	15.0	25.1
3 or 4	11.8	10.7	9.1	15.0	9.1	12.2	13.3	15.0	11.6
5 to 9	21.3	32.0	27.3	40.0	30.3	17.3	13.3	30.0	16.3
10 to 14	12.9	6.7	4.5	5.0	9.1	15.2	13.3	10.0	16.3
15 to 24	20.2	25.3	31.9	25.0	21.2	17.8	20.0	15.0	18.4
25 or more	9.2	5.3	4.5	.....	9.1	11.2	13.3	5.0	10.9
No answer	2.9	4.0	.....	10.0	3.0	2.5	3.3	10.0	1.4
Median =	8.6	8.4	8.4	8.2	8.5	8.7	9.4	7.5	8.9
Years in Broadcast Industry									
Less than 5	4.8	2.7	4.5	.....	3.0	5.6	3.3	10.0	5.4
5 to 9	8.5	8.0	13.6	10.0	3.0	8.6	6.7	5.0	9.5
10 to 14	12.9	14.7	13.6	15.0	15.1	12.2	13.3	10.0	12.2
15 to 24	29.0	33.3	31.8	30.0	36.4	27.4	26.7	35.0	26.5
25 or more	41.5	37.3	36.5	40.0	36.4	43.2	43.3	30.0	45.0
No answer	3.3	4.0	.....	5.0	6.1	3.0	6.7	10.0	1.4
Median =	22.8	22.5	20.0	23.2	23.1	22.9	23.8	21.3	23.1
Do Part-Time or Free-Lance Work	33.1	29.3	27.3	35.0	27.3	34.5	40.0	40.0	32.7
Education									
High school	12.9	8.0	9.1	.....	12.1	14.7	16.7	5.0	15.6
Two years of college	19.5	14.7	22.7	10.0	12.1	21.3	6.7	25.0	23.8
Four years of college	34.2	40.0	50.0	35.0	36.4	32.0	23.3	45.0	32.0
Post-graduate college	28.7	32.0	18.2	40.0	36.4	27.4	40.0	20.0	25.9
Voc/tech school	16.2	12.0	18.2	15.0	6.1	17.8	23.3	10.0	17.7
No answer	2.6	4.0	.....	10.0	3.0	2.0	3.3	5.0	1.4
Age, Years									
Under 25	1.1	1.3	4.5	.....	.....	1.0	.....	.....	1.4
25 to 34	11.8	6.7	13.6	10.0	.....	13.7	26.7	15.0	10.9
35 to 44	31.5	30.6	31.9	20.0	36.4	32.0	13.3	40.0	34.6
45 to 54	24.3	25.3	27.3	15.0	30.3	23.8	30.0	10.0	24.5
55 to 64	19.9	26.7	13.6	45.0	24.2	17.3	10.0	25.0	17.7
65 or over	9.2	6.7	9.1	5.0	6.1	10.2	16.7	5.0	9.5
No answer	2.2	2.7	.....	5.0	3.0	2.0	3.3	5.0	1.4
Median =	46.8	48.9	45.0	55.3	49.0	46.0	47.8	43.1	46.0

*Management staff: president, owner, partner, vice president, general manager.

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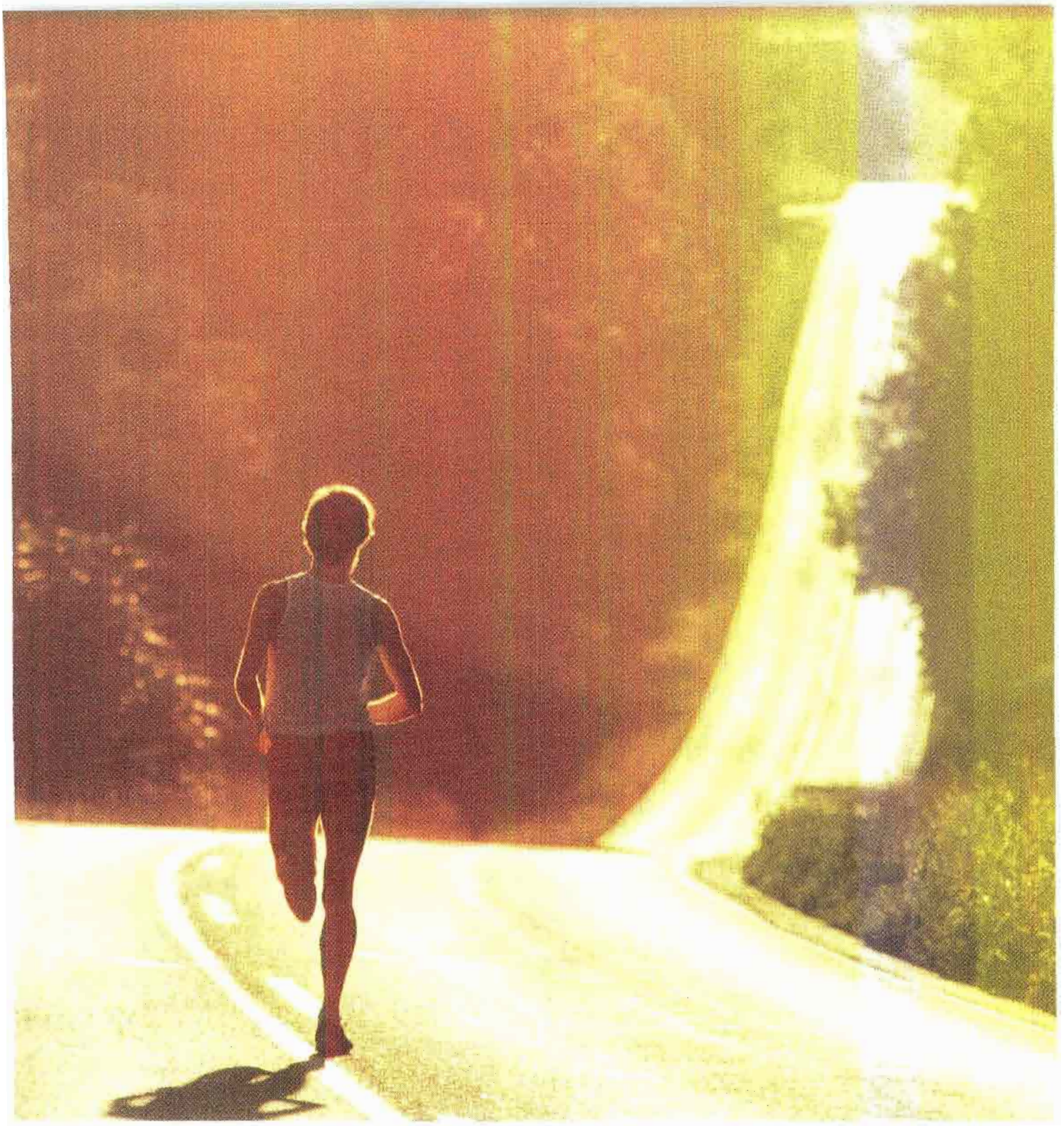

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TABLE 2. – ENGINEERING AND TECHNICAL STAFF PROFILE*

	ALL MARKETS	TELEVISION				RADIO			
	Total %	Total TV %	Top 50 %	Top 100 %	Below Top 100 %	Total Radio %	Top 50 %	Top 100 %	Below Top 100 %
Salary Level									
Less than $15,000	10.1	4.2	1.6	4.2	8.8	16.1	6.2	2.9	29.8
$15,000 to $24,999	25.2	19.6	8.9	25.0	35.3	30.9	19.6	28.6	42.2
$25,000 to $34,999	30.3	27.9	22.6	35.3	32.4	32.6	34.0	51.4	25.0
$35,000 to $49,999	22.9	32.1	41.1	27.1	19.1	13.6	25.7	17.1	1.0
$50,000 to $74,999	9.0	12.9	21.0	4.2	4.4	5.1	12.4	.....	.....
$75,000 or more	2.1	2.9	4.8	2.1	.....	1.3	2.1	.....	1.0
No answer	0.4	0.4	.....	2.1	.....	0.4	.....	.....	1.0
Median =	$29,800	$34,300	$41,150	$30,600	$26,800	$25,800	$32,100	$28,600	$19,900
Received Salary Increase During Past Year	67.9	75.0	81.4	68.9	67.6	60.6	73.2	62.8	48.1
Percentage of increase									
Less than 3%	3.6	2.5	1.6	4.2	2.9	4.7	4.1	5.7	4.8
3% to 4%	20.4	25.8	29.0	29.2	17.7	14.8	24.7	17.1	4.8
5% to 9%	29.6	35.0	34.7	31.3	38.2	24.2	28.9	22.9	20.2
10% to 14%	7.4	5.4	7.3	2.1	4.4	9.3	10.3	11.4	7.7
15% or more	4.6	3.8	4.8	2.1	2.9	5.5	2.1	5.7	8.7
No answer	2.3	2.5	4.0	.....	1.5	2.1	3.1	.....	1.9
Median =	6.5	6.2	6.2	5.2	6.7	7.1	6.1	6.9	8.4
Fringe Benefits Received (Adds to more than 100% due to multiple answers)									
Medical insurance (paid)	80.0	83.8	84.7	79.2	85.3	76.3	89.7	65.7	67.3
Dental insurance (paid)	45.8	55.4	65.3	47.9	42.6	36.0	49.5	42.9	21.2
Life insurance (paid)	58.4	65.4	66.1	66.7	63.2	51.3	68.0	42.9	38.5
Sick leave	82.1	89.2	90.3	87.5	88.2	75.0	84.5	85.7	62.5
Vacation	90.5	95.0	94.4	91.7	98.5	86.0	90.7	94.3	78.8
Stock purchase plan	15.5	22.1	31.5	22.9	4.4	8.9	15.5	11.4	1.9
Profit sharing plan	16.4	20.0	21.0	12.5	23.5	12.7	18.6	17.1	5.8
Savings plan	23.1	30.4	43.5	16.7	16.2	15.7	24.7	17.1	6.7
Pension plan	45.2	58.8	66.1	58.3	45.6	31.4	40.2	40.0	20.2
Bonus	13.0	15.0	16.1	14.6	13.2	11.0	11.3	5.7	12.5
Trade show/convention/ seminar expenses paid	36.8	33.8	29.0	37.5	39.7	39.8	48.5	48.6	28.8
Tuition refund plan	30.5	35.0	46.8	25.0	20.6	25.8	39.2	22.9	14.4
Automobile furnished	14.1	12.5	8.1	14.6	19.1	15.7	17.5	37.1	6.7
Years in Present Job									
1 or 2	27.5	24.6	25.0	22.9	25.0	30.4	32.0	34.2	27.9
3 or 4	16.2	17.9	20.2	12.5	17.7	14.4	15.5	11.4	14.4
5 to 9	24.7	26.2	26.6	20.8	29.3	23.3	23.6	28.6	21.2
10 to 14	12.0	10.4	12.1	12.5	5.9	13.6	15.5	14.3	11.5
15 to 24	12.0	12.1	9.7	16.7	13.2	11.9	7.2	2.9	19.2
25 or more	5.5	6.3	4.0	10.4	7.4	4.7	4.1	2.9	5.8
No answer	2.1	2.5	2.4	4.2	1.5	1.7	2.1	5.7	.....
Median =	6.1	6.2	5.7	8.0	6.2	5.9	5.4	5.3	6.8
Years in Broadcast Industry									
Less than 5	8.2	8.8	7.3	8.3	11.8	7.6	4.1	11.4	9.6
5 to 9	17.7	19.6	25.0	8.3	17.7	15.7	14.4	17.1	16.4
10 to 14	19.3	18.3	17.7	18.8	19.1	20.3	20.6	17.1	21.2
15 to 24	27.9	22.1	23.4	22.9	19.1	33.9	42.3	28.7	27.8
25 or more	24.2	27.9	24.2	35.4	27.9	20.8	16.5	20.0	25.0
No answer	2.7	3.3	2.4	6.3	4.4	1.7	2.1	5.7	.....
Median =	16.1	15.8	14.7	20.4	14.8	16.3	16.8	15.4	15.9
Do Part-Time or Free-Lance Work	47.5	35.4	37.9	37.5	29.4	59.7	61.9	48.6	61.5
Education									
High school	25.0	23.8	18.5	33.3	26.5	26.3	19.6	31.4	30.8
Two years of college	33.2	31.3	29.8	25.0	38.2	35.2	43.3	31.4	28.8
Four years of college	25.2	25.8	33.1	20.8	16.2	24.6	23.7	17.1	27.9
Post-graduate college	6.5	5.8	6.5	4.2	5.9	7.2	5.2	14.3	6.7
Voc/tech school	44.1	45.8	40.3	52.1	51.5	42.4	37.1	45.7	46.2
No answer	2.3	2.9	2.4	4.2	2.9	1.7	2.1	5.7	.....
Age, Years									
Under 25	4.0	2.1	1.6	2.1	2.9	5.9	5.2	8.6	5.8
25 to 34	34.5	35.0	36.3	27.0	38.2	33.9	38.1	37.1	28.8
35 to 44	26.5	25.0	31.5	25.0	13.2	28.0	37.1	20.0	22.1
45 to 54	16.6	17.5	14.5	16.7	23.7	15.7	7.2	17.1	23.1
55 to 64	13.2	15.4	11.3	20.8	19.1	11.0	7.2	8.6	15.4
65 or over	2.7	2.1	2.4	4.2	.....	3.4	3.1	2.9	3.8
No answer	2.5	2.9	2.4	4.2	2.9	2.1	2.1	5.7	1.0
Median =	38.9	39.6	38.5	42.5	40.6	38.3	36.5	35.7	41.7

*Engineering and technical staff: technical manager, chief engineer, engineer.

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TABLE 3. – OPERATIONS STAFF PROFILE*

	ALL MARKETS	TELEVISION				RADIO			
	Total %	Total TV %	Top 50 %	Top 100 %	Below Top 100 %	Total Radio %	Top 50 %	Top 100 %	Below Top 100 %
Salary Level									
Less than $15,000	15.5	5.1	1.6	8.6	7.9	25.0	4.8	25.0	35.4
$15,000 to $24,999	36.4	27.9	17.5	31.4	42.1	43.9	50.0	33.3	44.0
$25,000 to $34,999	23.9	27.2	23.8	37.1	23.7	20.9	28.6	29.2	14.6
$35,000 to $49,999	14.4	24.3	28.5	20.0	21.1	5.4	9.5	12.5	1.2
$50,000 to $74,999	7.7	12.5	23.8	2.9	2.6	3.4	7.1	.....	2.4
$75,000 or more	0.7	1.5	3.2	.....	.....	.....	.....	.....	.....
No answer	1.4	1.5	1.6	.....	2.6	1.4	.....	.....	2.4
Median =	$24,450	$30,900	$38,300	$27,700	$24,750	$20,950	$24,300	$22,500	$18,050
Received Salary Increase During Past Year	70.6	76.5	82.7	68.7	73.7	64.8	76.2	70.8	57.3
Percentage of increase									
Less than 3%	2.5	2.9	1.6	2.9	5.3	2.0	.....	.....	3.7
3% to 4%	14.8	19.9	25.4	22.9	7.9	10.1	7.1	20.8	8.5
5% to 9%	35.2	42.7	42.9	40.0	44.7	28.4	38.1	41.7	19.5
10% to 14%	7.8	5.1	4.8	2.9	7.9	10.1	14.3	.....	11.0
15% or more	8.5	3.7	4.8	.....	5.3	12.8	16.7	8.3	12.2
No answer	1.8	2.2	3.2	.....	2.6	1.4	.....	.....	2.4
Median =	7.5	6.7	6.5	6.1	7.5	8.5	9.1	6.8	.....
Fringe Benefits Received (Adds to more than 100% due to multiple answers)									
Medical insurance (paid)	77.5	84.6	85.7	88.6	78.9	70.9	83.3	79.2	62.2
Dental insurance (paid)	45.1	54.4	66.7	42.9	44.7	36.5	50.0	54.2	24.4
Life insurance (paid)	58.8	75.0	77.8	74.3	71.1	43.9	57.1	50.0	35.4
Sick leave	78.5	88.2	84.1	88.6	94.7	69.6	81.0	75.0	62.2
Vacation	93.0	96.3	95.2	100.0	94.7	89.9	92.9	91.7	87.8
Stock purchase plan	14.1	21.3	33.3	17.1	5.3	7.4	19.0	4.2	2.4
Profit sharing plan	19.4	29.4	28.6	28.6	31.6	10.1	21.4	.....	7.3
Savings plan	16.9	25.7	34.9	14.3	21.1	8.8	21.4	4.2	3.7
Pension plan	40.1	53.7	61.9	48.6	44.7	27.7	40.5	29.2	20.7
Bonus	17.6	19.9	23.8	14.3	18.4	15.5	11.9	12.5	18.3
Trade show/convention/ seminar expenses paid	34.2	41.2	41.3	37.1	44.7	27.7	26.2	37.5	25.6
Tuition refund plan	27.8	38.2	42.9	31.4	36.8	18.2	26.2	16.7	14.6
Automobile furnished	8.1	8.1	11.1	5.7	5.3	8.1	2.4	8.3	11.0
Years in Present Job									
1 or 2	37.7	31.6	25.5	51.4	23.7	43.2	52.3	29.2	42.6
3 or 4	21.1	23.5	22.2	22.9	26.2	18.9	19.1	29.2	15.9
5 to 9	17.6	19.1	23.8	17.1	13.2	16.2	19.1	8.3	17.1
10 to 14	9.5	8.1	7.9	2.9	13.2	10.8	9.5	20.8	8.5
15 to 24	7.4	8.1	12.7	.....	7.9	6.8	.....	4.2	11.0
25 or more	1.8	3.7	1.6	.....	10.5	.....	.....	.....	.....
No answer	4.9	5.9	6.3	5.7	5.3	4.1	.....	8.3	4.9
Median =	3.9	4.3	4.9	2.9	4.8	3.5	2.9	4.1	3.6
Years in Broadcast Industry									
Less than 5	10.2	6.6	6.3	5.7	7.9	13.5	4.8	8.3	19.5
5 to 9	20.4	21.3	15.9	31.5	21.0	19.6	16.7	33.3	17.1
10 to 14	24.3	22.8	22.2	28.6	18.4	25.7	33.3	20.9	23.2
15 to 24	26.1	22.8	28.7	11.4	23.7	29.0	35.7	25.0	26.8
25 or more	14.1	20.6	20.6	17.1	23.7	8.1	9.5	4.2	8.5
No answer	4.9	5.9	6.3	5.7	5.3	4.1	.....	8.3	4.9
Median =	13.5	14.2	16.1	11.8	15.0	12.9	14.3	11.0	12.4
Do Part-Time or Free-Lance Work	43.7	36.8	38.1	40.0	31.6	50.0	61.9	54.2	42.7
Education									
High school	12.0	8.1	9.5	.....	13.2	15.5	21.4	8.3	14.6
Two years of college	19.0	15.4	12.7	8.6	26.3	22.3	21.4	12.5	25.6
Four years of college	45.4	52.9	60.3	54.3	39.5	38.5	35.8	50.0	36.6
Post-graduate college	17.3	16.2	11.1	25.7	15.8	18.2	21.4	20.8	15.9
Voc/tech school	12.7	11.0	12.7	8.6	10.5	14.2	19.0	12.5	12.2
No answer	4.9	5.9	6.3	5.7	5.3	4.1	.....	8.3	4.9
Age, Years									
Under 25	8.5	2.9	1.6	5.7	2.6	13.5	9.5	8.3	17.1
25 to 34	39.3	40.5	39.7	45.7	36.9	38.6	38.1	33.3	40.3
35 to 44	30.3	30.1	31.7	31.4	26.3	30.4	35.7	33.3	26.8
45 to 54	12.0	14.0	14.3	8.6	18.4	10.1	14.3	12.6	7.3
55 to 64	3.5	5.1	4.8	2.9	7.9	2.0	.....	4.2	2.4
65 or over	1.1	1.5	1.6	.....	2.6	0.7	.....	.....	1.2
No answer	5.3	5.9	6.3	5.7	5.3	4.7	2.4	8.3	4.9
Median =	34.9	36.2	36.8	34.1	38.0	33.9	35.3	36.3	32.6

*Operations staff: operations manager, station manager, production/program manager.

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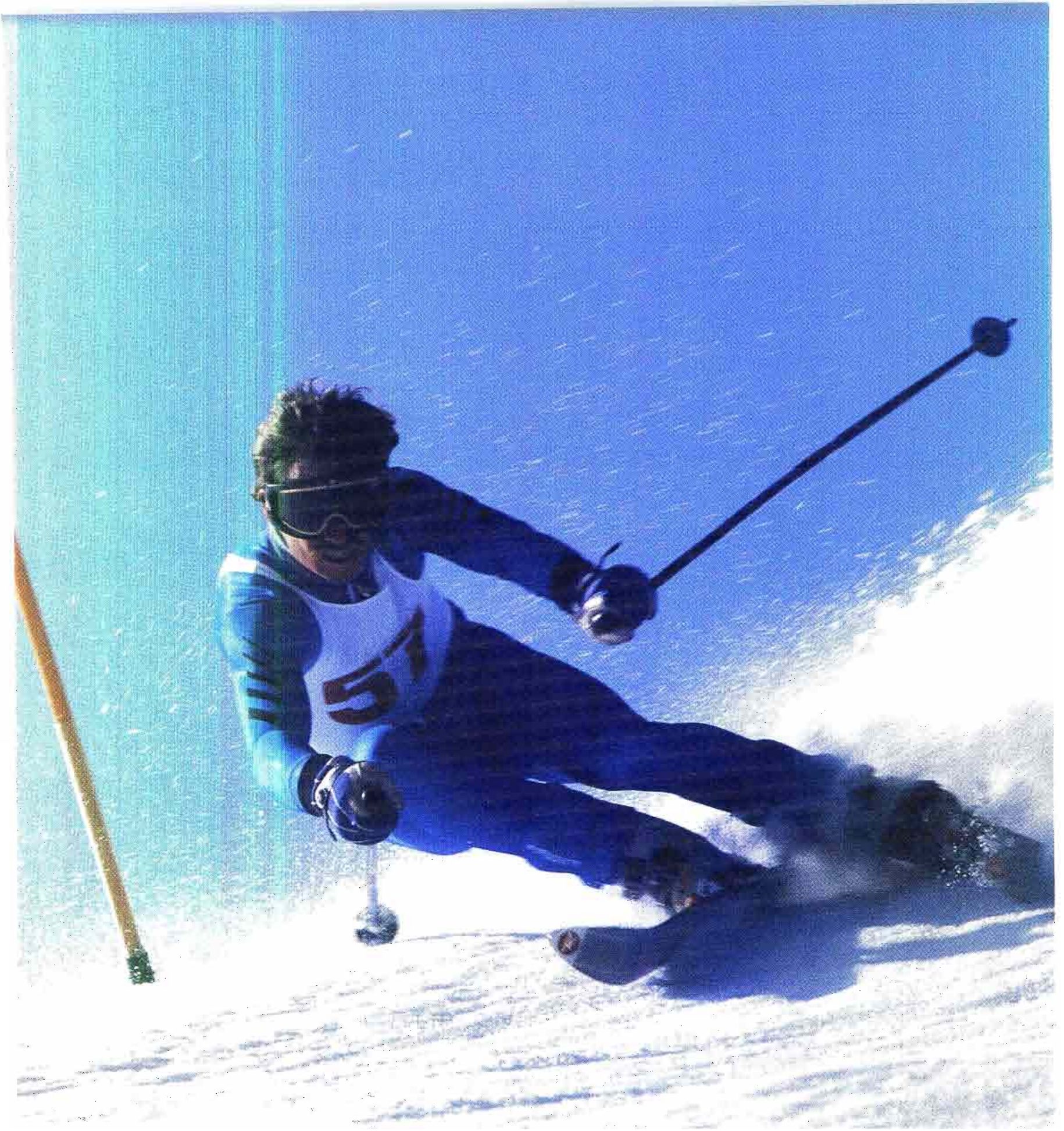

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TABLE 4.—MEDIAN SALARY SUMMARY FOR 1986 AND 1987, TV

	1986 SURVEY				1987 SURVEY			
Category	All Markets	Top 50	Top 100	Below Top 100	All Markets	Top 50	Top 100	Below Top 100
Management	$50,750	$58,250	$48,200	$46,700	$61,250	$70,000	$66,000	$51,500
Engineering	$34,900	$42,050	$29,400	$28,700	$34,300	$41,150	$30,600	$26,800
Operations	$27,200	$29,200	$29,200	$21,800	$30,900	$38,300	$27,700	$24,750

TABLE 5.—MEDIAN SALARY SUMMARY FOR 1986 AND 1987, RADIO

	1986 SURVEY				1987 SURVEY			
Category	All Markets	Top 50	Top 100	Below Top 100	All Markets	Top 50	Top 100	Below Top 100
Management	$31,400	$62,500	$42,500	$27,400	$31,900	$41,600	$36,500	$30,100
Engineering	$23,650	$36,050	$24,000	$18,400	$25,800	$32,100	$28,600	$19,900
Operations	$20,350	$21,550	$25,600	$18,900	$20,950	$24,300	$22,500	$18,050

TABLE 6.—MEDIAN SALARIES ACROSS ALL MARKETS

	TELEVISION				RADIO			
Category	1984	1985	1986	1987	1984	1985	1986	1987
Management	$46,250	$57,750	$50,750	$61,250	$28,300	$34,800	$31,400	$31,900
Engineering	$28,900	$31,500	$34,900	$34,300	$23,700	$23,000	$23,650	$25,800
Operations	$25,300	$28,800	$27,200	$30,900	$16,500	$20,000	$20,350	$20,950

TABLE 7.—MEDIAN VALUE PROFILE OF BROADCASTERS (Radio and TV Combined)

	MANAGEMENT			ENGINEERING			OPERATIONS		
Category	1985	1986	1987	1985	1986	1987	1985	1986	1987
Salary Level	$41,000	$39,350	$37,250	$27,800	$29,800	$29,800	$24,700	$23,500	$24,450
Received Salary Increase	58.9%	58.2%	44.2%	75.5%	74.6%	67.9%	77.7%	75.3%	70.6%
Amount of Increase	9.4%	9.2%	8.7%	7.6%	7.1%	6.5%	8.2%	7.8%	7.5%
Years in Present Job	7.1	6.6	8.6	6.0	6.7	6.1	4.4	3.8	3.9
Years in Broadcasting	23.1	20.7	22.8	16.1	16.0	16.1	13.5	12.7	13.5
Does Free-Lance Work	28.3%	26.9%	33.1%	48.4%	41.8%	47.5%	48.0%	43.7%	43.7%
College >2 years	83.2%	80.7%	82.4%	63.5%	71.3%	64.9%	82.8%	82.7%	81.7%
Age, Years	44.5	45.8	46.8	39.8	39.1	38.9	33.9	33.6	34.9

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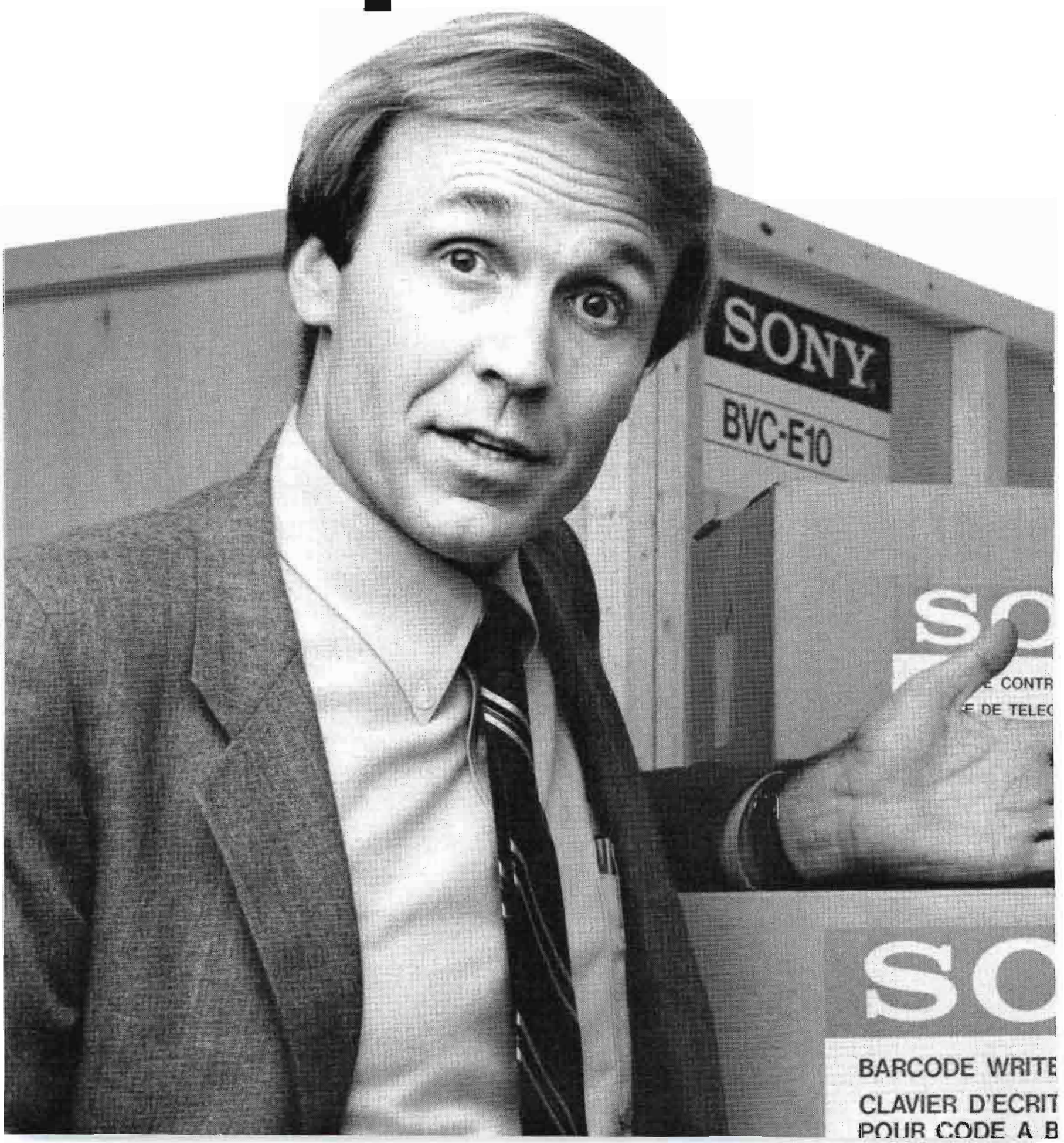

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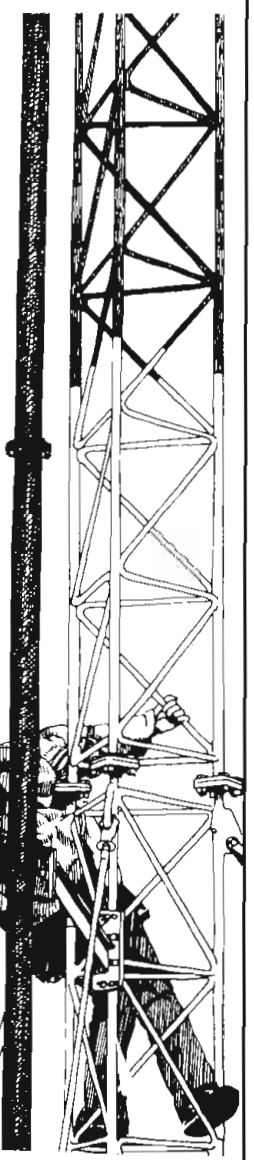

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Does SBE certification pay?

For the second year, the **BE** salary survey identified data regarding SBE certification. The intent was to examine the broadcast industry's response to the SBE program in terms of employee compensation. This year's results parallel the 1986 survey results.

The table below breaks out the comparison data, by market size, into salaries for both certified and non-certified engineers. Using the median salary for the appropriate market, the median salaries of certified and non-certified respondents can be compared.

The results, in many cases, are dramatic. In the top 50 markets, the certified radio engineer's median salary is 30% higher than that of the non-certified radio engineer. In the top 100 markets, the certified radio engineer's median salary is 15% higher than that of the non-certified counterpart. In the below top 100 markets, the differential is 18%.

An additional element was examined: the percentage raises received. In each category, the certified respondents received a higher-percentage salary increase than non-certified respondents. Across all markets, for both radio and TV engineers, the salary increases were 16% higher for SBE-certified engineers than non-certified engineers. The certified TV engineer salary increases were 22% higher than the median non-certified value, while the radio engineer's salary increase was 6% greater.

SBE certification continues to show steady growth. Over all, certification increased by 5% during the past year. Today, more than 21% of all engineers hold some form of certification. Two subcategories are worth mentioning. The number of engineers holding the TV engineer certification level rose by 61%. The number of radio engineers holding the AM/FM certification level grew by 11%.

Is SBE certification worth the effort? Is it worth $1,500? This figure represents the difference in median salaries measured across all engineering categories and markets between certified and non-certified personnel. In one case (top 50 radio markets), the differential is even greater. Here, the certified radio engineer's median salary is $9,100 higher than that of the non-certified radio engineer.

This is not to say that becoming certified will automatically qualify you for a higher salary. It does mean, however, that in spite of the demise of the first-class license, you still can earn an industry-recognized stamp of competence.

If you are interested in learning more about SBE certification, contact the SBE national office at 317-842-0836. Or write to the certification secretary, Society of Broadcast Engineers, 3002 Graham Road, Suite 118, Indianapolis, IN 46220.

ENGINEERING AND TECHNICAL STAFF SBE CERTIFICATION PROFILE*

Categories	Total %	Total TV %	Total Radio %
Hold SBE Certification	21.0	18.8	23.3
Certification Level			
Senior TV	4.0	7.1	0.8
Senior AM/FM	5.3	1.7	8.9
TV engineer	3.6	7.1	....
AM/FM engineer	5.7	2.1	9.3
Broadcast technologist	3.8	4.6	3.0
Professional broadcast engineer	0.8	....	1.7

*Engineering and technical staff: technical manager, chief engineer, engineer.

top 100 to the top 50 markets: 34% for engineers and 38% for operations personnel. TV corporate salaries increased by only 6% when moves were from the top 100 to the top 50 markets. Although similar differentials in salaries between markets were shown in last year's study, the data does not support long-term trends between markets. This year, the salary differences based on market size usually were smaller. In some cases, the differences were only one-third of those seen last year.

Compare other data

It is important to make salary comparisons in several ways. The first comparison might be with the median salaries shown in Tables 4 or 5. However, the results may not completely describe your situation.

For instance, even if your salary falls near the median shown, other factors should be considered. It may be useful to see if your salary falls in the same category as that most often paid for similar positions. This comparison may be made

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The result is rather eye-catching. Both longitudinal and lateral chromatic aberrations are significantly reduced. MTF is increased, and picture quality is greatly enhanced.

Lightweight and compact with a sturdy weather proof housing, the TV-56 is the type of rugged performer you'll value for other reasons, too.

It has a 2X extender, macro focus, and a unique servo iris control built into the zoom pistol grip. The TV-56 is available with positional servo focus. And the lens accepts a wide range of EFP accessories, including an aspheric attachment for superwide fixed focal length.

So if you're concerned about your image, do something about it. Get Schneider's new TV-56 APO-VARON Zoom.

For more information or a demo, contact: Schneider Corporation of America, 400 Crossways Park Drive, Woodbury, NY 11797, (516) 496-8500.

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by looking at Figures 1, 2 and 3. With these pie charts, it is easy to see if your salary falls within the more common salary brackets.

The tables and charts presented here can be useful references for negotiating for a raise. Just stating that your salary is lower than some industry median may not be persuasive enough. If, for example, you can show that 65% of the salary categories are above what you earn, you can add more weight to your argument.

The industry is being overtaken by accountants. God save us all.

General trends

From the assembled data, it appears that a leveling out of salary increases is occurring. With inflation seemingly under control, companies appear to be providing smaller increases. Double-digit salary increases were common several years ago. Today, such increases are the exception rather than the rule.

If you are in broadcasting strictly for the money, television is the only place to go. That is not to say that adequate salaries are not available in radio, but year after year, the data shows that TV personnel—at the corporate, engineering and operations levels—earn more, usually a lot more, than their radio counterparts. Fortunately, salaries appear to be keeping up with inflation, so far.

Another factor, SBE certification, continues to be reflected in salaries. The survey shows that SBE certification often can provide the extra measure of value that may mean extra money in your pocket. See the related story, "Does SBE Certification Pay?," for more information.

Feedback

This year's survey provided more enlightening feedback than ever before. Many respondents provided thought-provoking and well-developed insights into the way they see their jobs, the industry and its future.

It was surprising to see several common threads of concern extend across not only markets, but also through each job category (management, engineering and operations). An often-noted concern was the changing ownership of broadcast properties. Employees view with great anxiety and distaste the trafficking of stations. Many see the issue as something akin to trading marbles and say it shows little regard for the audience.

One respondent suggested that nonbroadcast ownership of stations was harmful not only to today's industry, but also to the long-term health of broadcasting. The term "bean counter" often is used to describe a person who, despite a background and interest in the financial

Good jobs aren't hard to find—good engineers are.

area, is in a position to make decisions about broadcasting. Bean counters took a lot of heat for the industry's condition.

Engineers seemed particularly insightful when it came to some of the problems and their causes. "Radio stations are now being run by investors (bean counters), not broadcasters," one engineer wrote. "As a result, short-term profit is the

Continued on page 42

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Dead air is a broadcaster's biggest nightmare. In fact, everyone agrees that time is indeed money in broadcasting. To help keep your station alive and humming, rely on a source whose components are responsible for keeping untold hours of music and conversation flowing across the airwaves.

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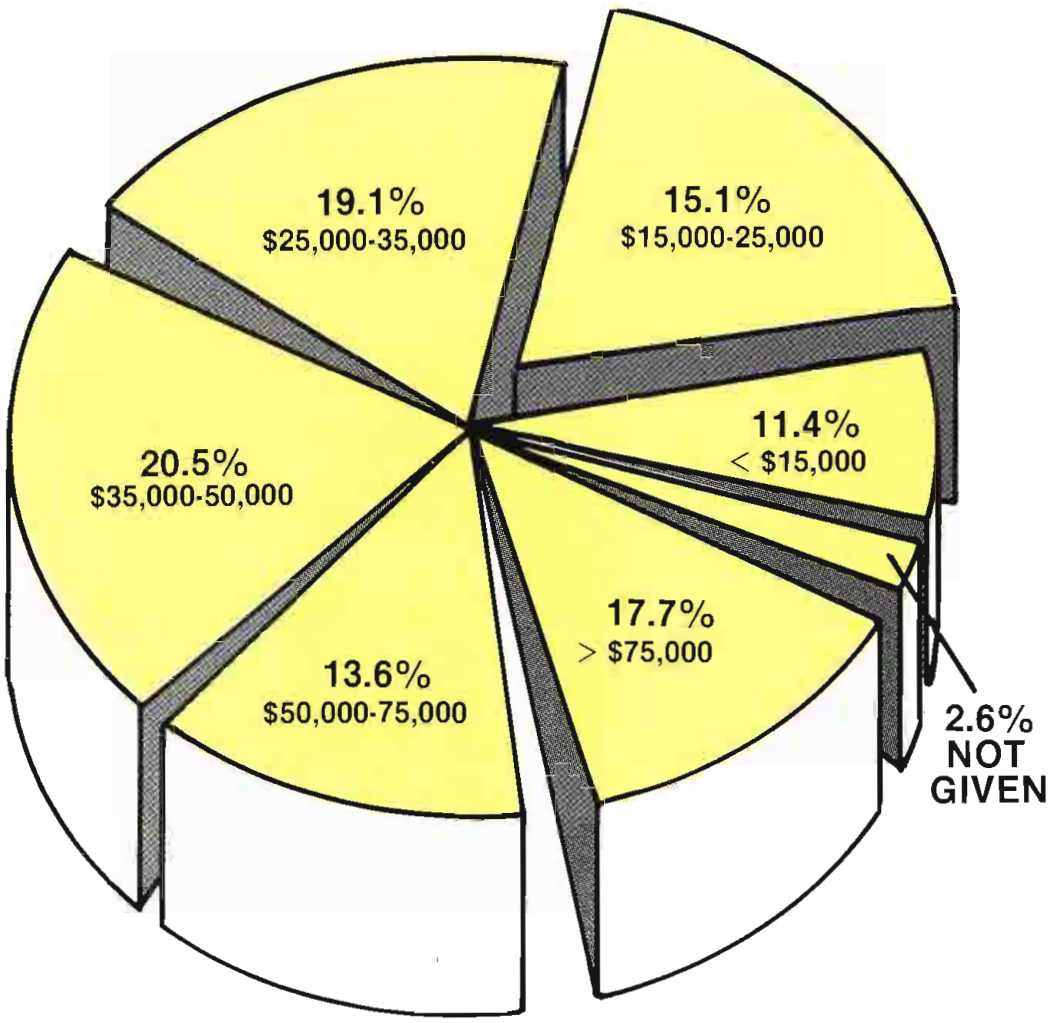

Figure 1. *Median salaries of management personnel, by salary category.*

Continued from page 38

primary motivation for management decisions." More succinct comments such as, "Get the bean counters out of the business," also were common.

Managers also seemed to be concerned about station trafficking. "A major concern is the rapid turnover of radio station ownership and its effect on station personnel," said one manager. "One hundred percent of our staff has been affected by multiple station sales this year. And some staff members have experienced the trauma of five ownership changes in a 4-year period."

Besides low salaries, another recurring theme was the state of the AM industry. For the most part, the comments were that the FCC was to blame for the current state of affairs. A typical response was: "The FCC needs to take a stand and help the AM industry; add nighttime authority to daytimers, set a stereo standard and reduce interference. AM is dying—the new AM standard (NRSC) is a flash in the pan."

Similar blame was heaped on the FCC for crowded markets and other industry ills. "Docket 80-90 will be a disaster for broadcasters. Deregulation has hurt the

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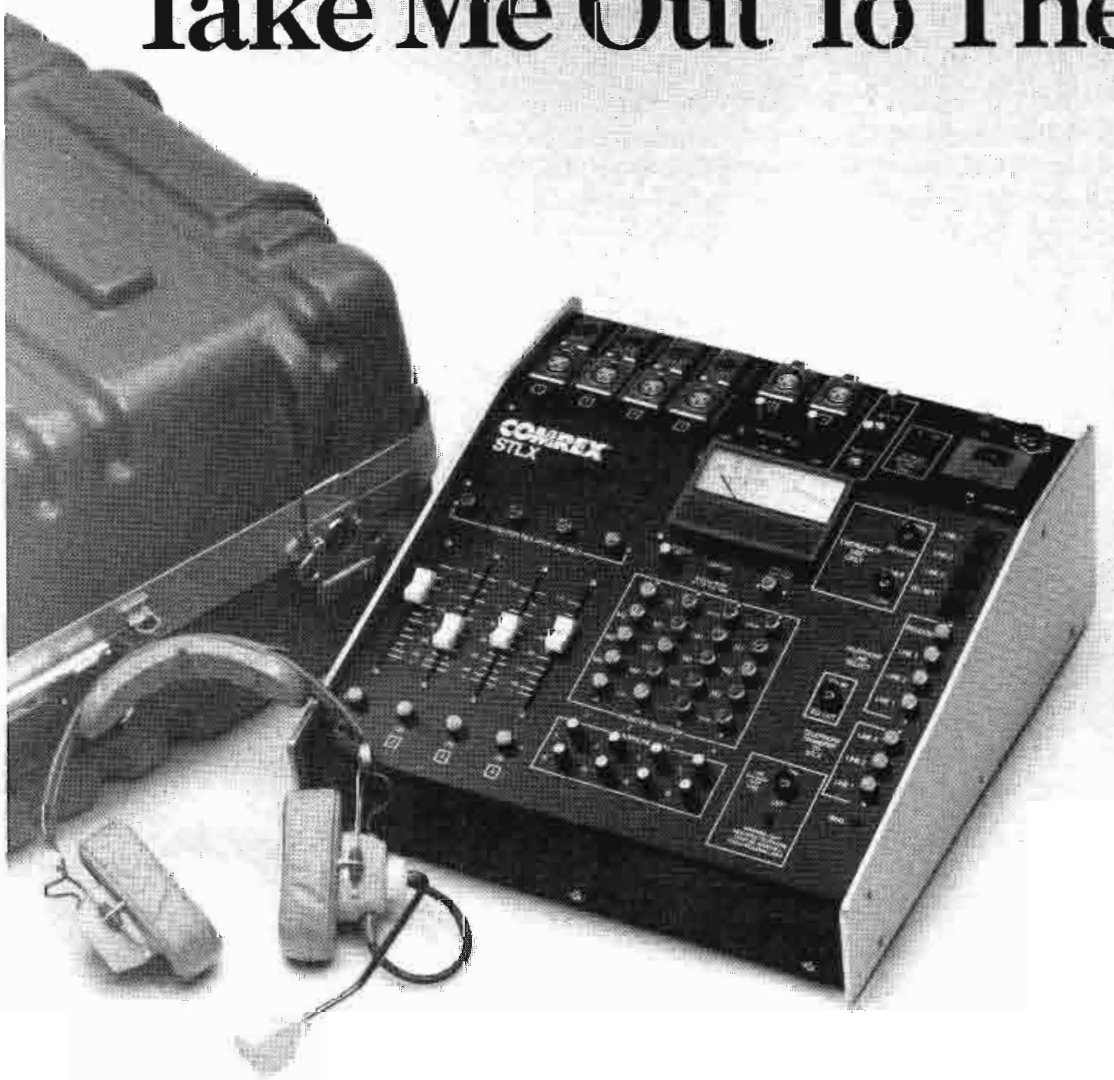

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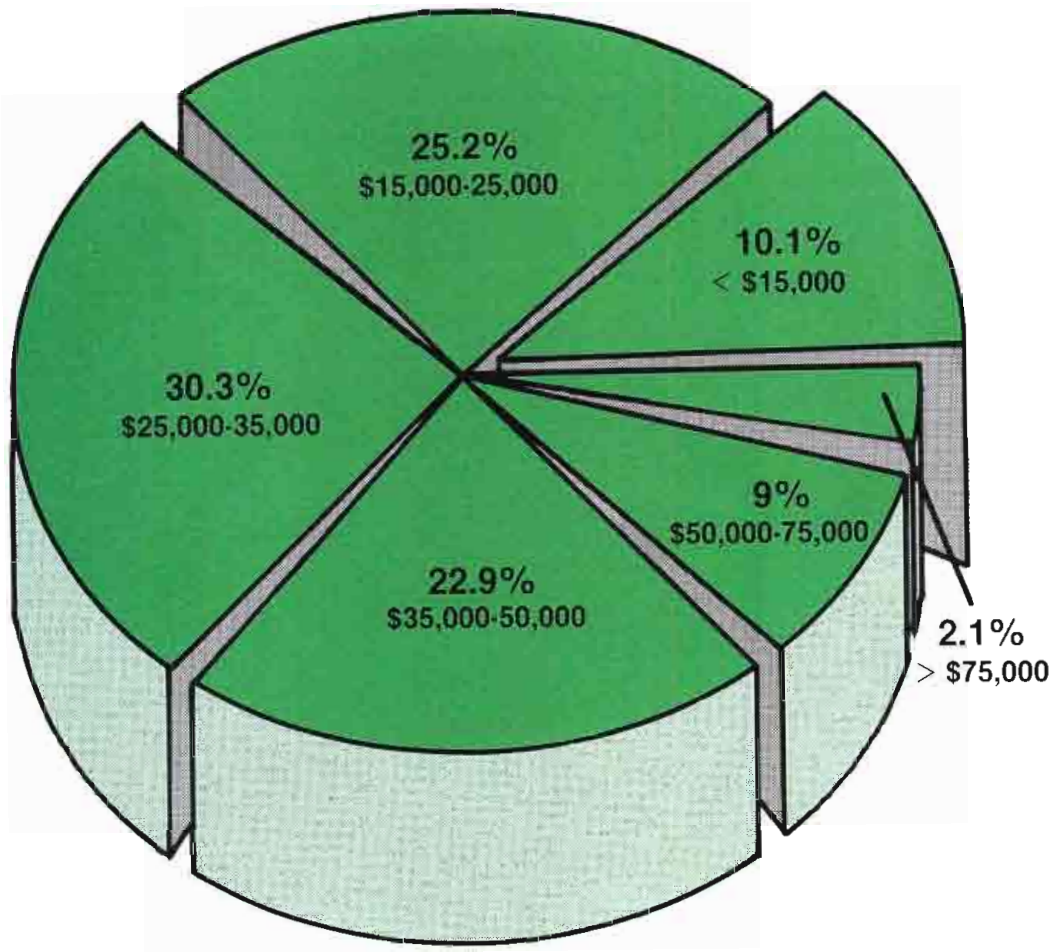

Figure 2. *Median salaries of engineering personnel, by salary category.*

engineer. Now, stations don't give a damn about anything but staying on the air. The technical competency of operations has gone downhill since the FCC eliminated the third-class license. The FCC has destroyed the financial basis of our industry by slicing the economic pie too thin."

One engineer viewed the station's situation with somewhat bitter humor. "We have an uncertain future. The good news—the owners successfully fought off a takeover attempt. The bad news—the station must now be sold to pay off the debt. Only in America."

Low pay, little recognition

Engineers and operators often complained of low wages and limited opportunities. An assistant chief engineer wrote, "While I enjoy my work, there are too few opportunities for me, and I don't want to wait 20 years until the current chief engineer retires." Said another engineer, "I knew that I wouldn't get rich in this business, but I didn't take a vow of poverty either." Perhaps the comments of this engineer best summarized the issue: "Engineering personnel are leaving because of low pay. Driving a taxi pays better, requires fewer hours, and you get

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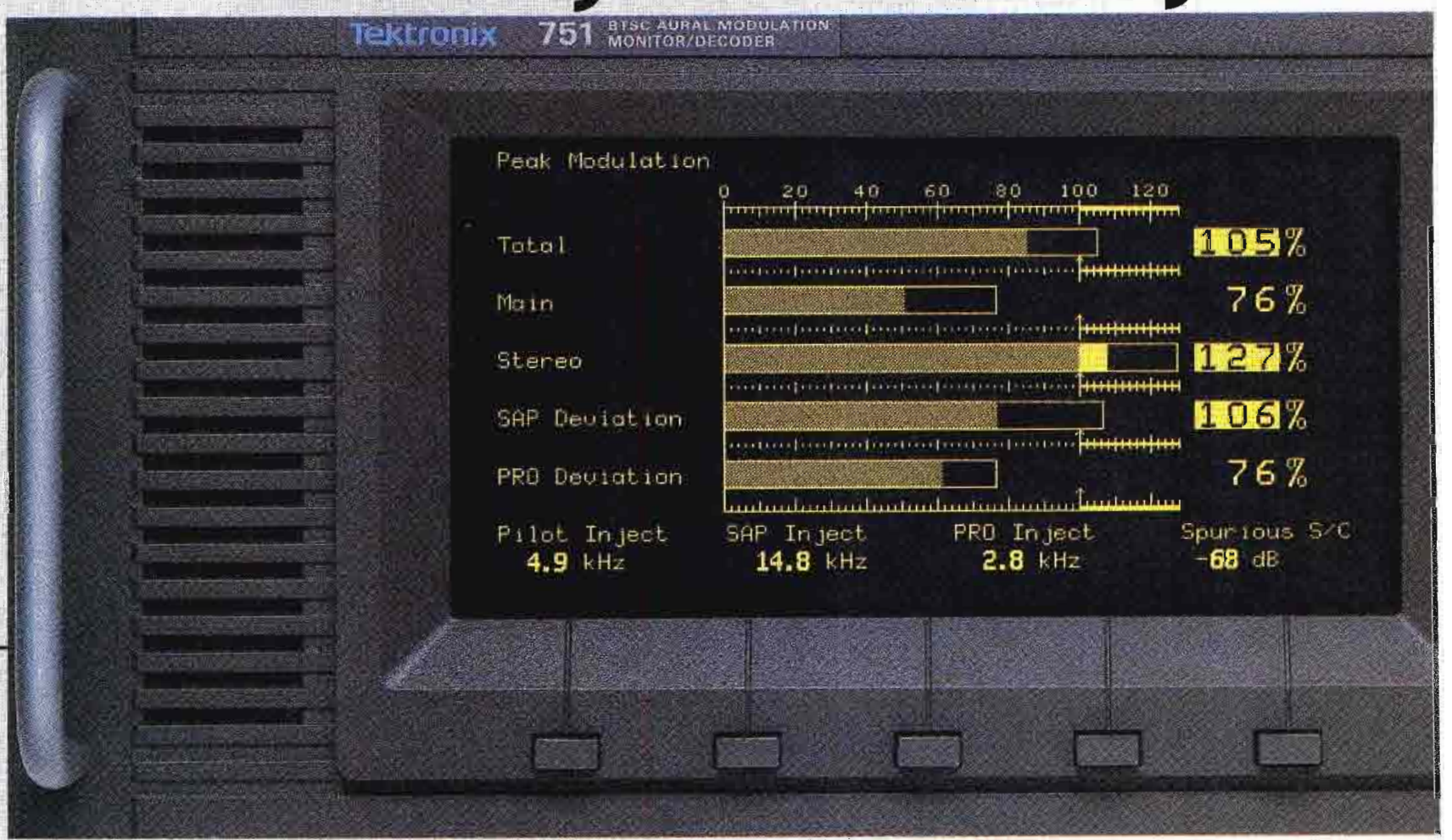

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better treatment."

Along with complaints of low wages, several voiced concern about the apparent lack of qualified young people entering the business. "Where are all the young people?" one asked. "The average age of our technical department is 50 years. We old-timers outnumber the youngsters in our market by an 8:1 ratio—what a shame."

Not all comments were negative. Some people wrote about how good the industry has been to them. "I wish I was 25 again and knew what I know today, and could spend another 45 years in the business. With today's technology, what a wonderful opportunity for a young person." Another wrote, "Opportunities are good for engineers with advanced technical training and experience." In the same vein, another said, "I still believe there are good opportunities for good engineers."

Viewing the issue from a practical perspective, one respondent noted, "There will be a few excellent opportunities in radio for talented, multidisciplined individuals who have the special blend of electronics, computers and knowledge and experience in audio. Things may be bleak for others." Well said.

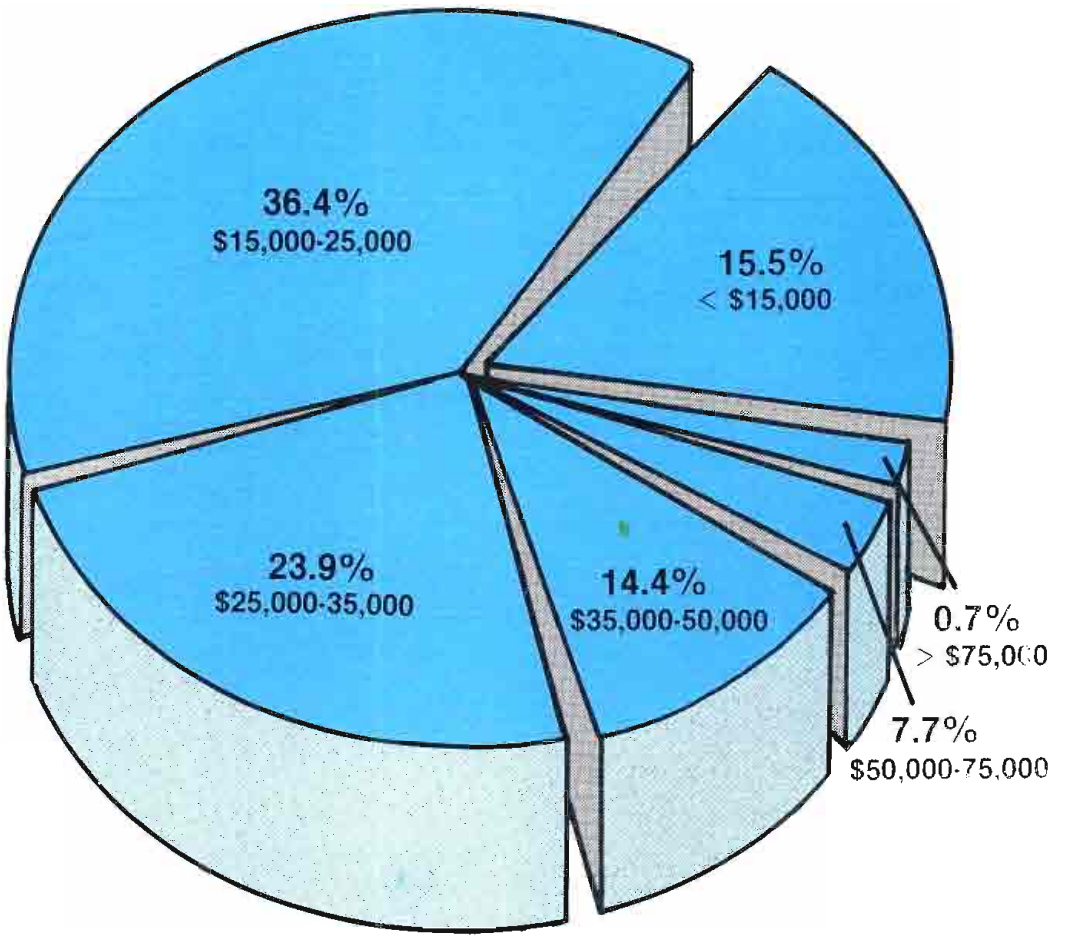

Figure 3. *Median salaries of operations personnel, by salary category.*

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Magnetic media

special report

Brad Dick, issue editor

Could today's broadcasters operate without magnetic tape? Probably not. Although hardware remains the backbone of the industry, the magnetic tape used by much of the equipment is a critical element.

Recording tape is sometimes taken for granted. Yet, this unique medium is flexible, portable and provides high-quality program storage. And, as hardware performance improves, so too does the performance of the tape.

The following series of articles examines the use of recording tape from several aspects. In "Tape as a Recording Medium," you'll look at types of tape and learn what processes are involved in developing a new formulation. The article also will discuss how tape performance can be optimized to meet the demands of the various recording formats.

"The Evolution of Audio Recording" takes you back through history to the beginnings of audio recording. You'll even peek into the crystal ball to see what the future might hold for DAT.

The developments in videotape over the past 20 years are almost legendary. "The Evolution of Video Recording" examines several video formats and discusses the importance of tape parameters in the success or failure of a new format.

Although tape is considered a consumable, improper care can make it more expensive than it should be. Some common causes of tape deterioration are explained in "Preserving Magnetic Tape." From an operational perspective, the article also will detail proper handling procedures that can help prevent tape damage.

Tape erasure is becoming an important performance element, but because of their high output levels, today's tapes can be difficult to erase. However, thorough erasure is crucial, whether it's because the tapes contain proprietary or confidential information or because residual signals can create interference. "Erasing Magnetic Tape" outlines new equipment and procedures for properly erasing audiotape, videotape and data tapes.

Even if the future affords the possibility of replacing recording tape with another medium, the change is many years away. Today, audiotape and videotape are central to the operation of the broadcast industry. The more you understand about magnetic tape, the better equipped you will be to take advantage of its capabilities.

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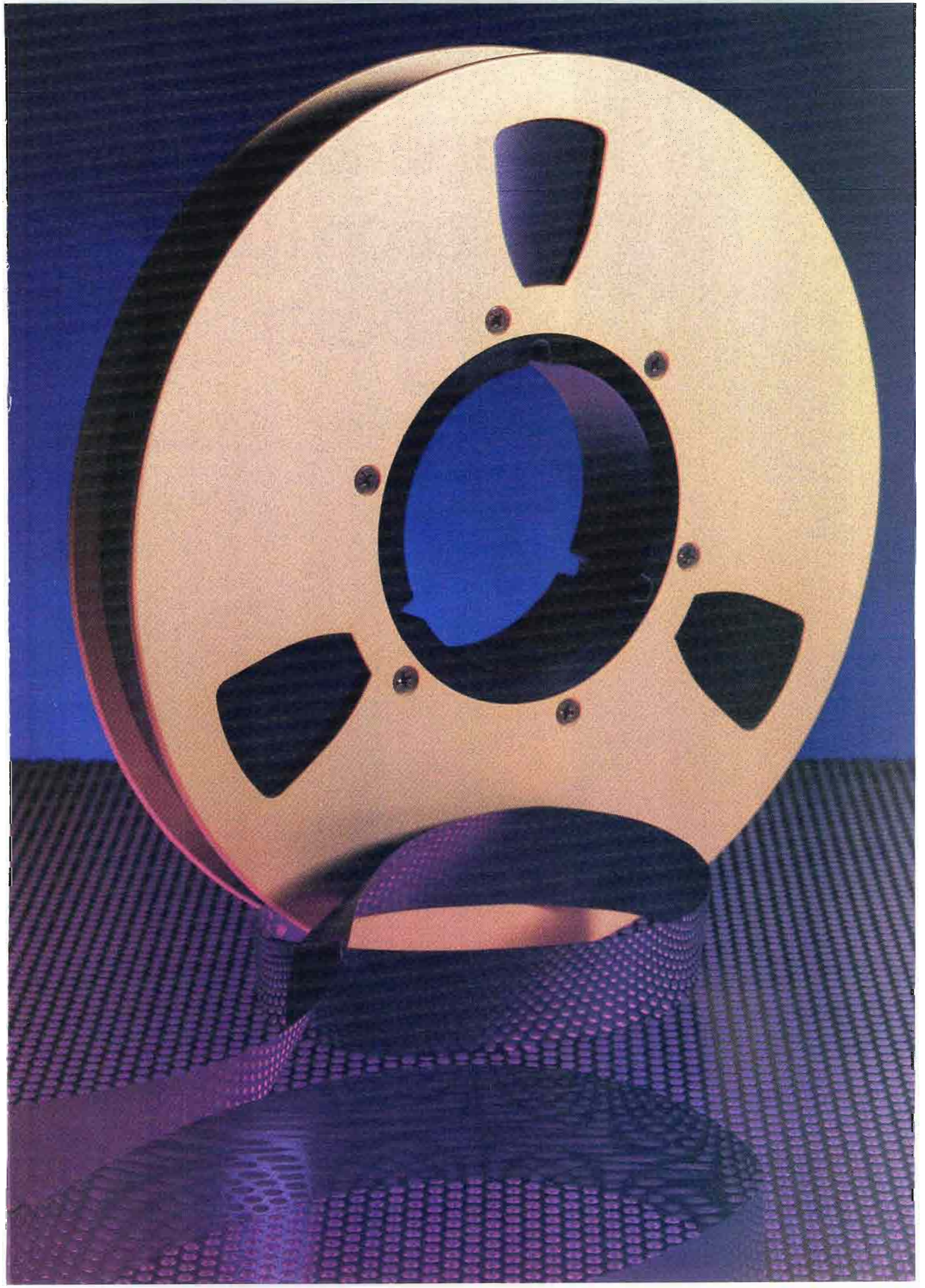

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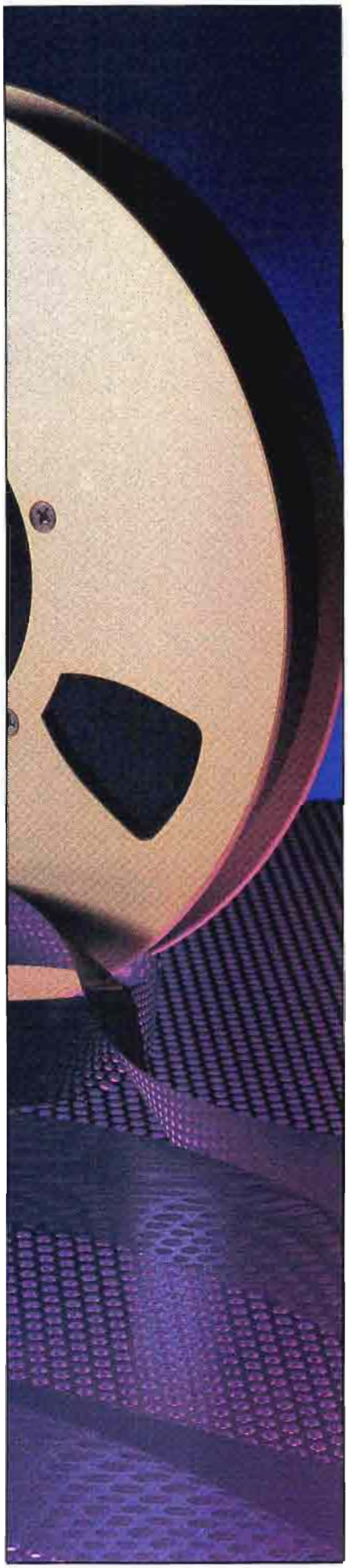

Tape as a recording medium

By Robert N. Herman

A magnetic tape formulation is a mix of black magic and functional requirements.

It is commonly assumed that when a videotape recorder manufacturer comes up with an improved recording format, videotape manufacturers simply adapt an existing tape formulation to fit into the new recorder's cassette specifications. Unless you are in the tape or hardware manufacturing business, you might not realize that not only do most new formats require a substantially different tape formulation, but in some cases, the development of a new tape chemistry can help guide equipment manufacturers in refining recording schemes.

How, specifically, are tape formulations and recording formats related? One of the most important factors is *coercivity*, the responsiveness of the tape to the magnetic signal from the video heads. It is in this area that tape has undergone its most profound changes over the years.

Tape for 2-inch quad decks, manufactured with gamma ferric oxide, has a coercivity of 300 Oe to 350 Oe. Subsequent developments by tape manufacturers have produced the generation of cobalt-doped oxide tapes used for the component digital D-1, U-matic, U-matic SP, Betacam, VHS and 1-inch helical formats of today. For this tape, cobalt has been added to the basic ferrite mixture to modify the surface of the iron oxide particles, making them more responsive and raising the coercivity to the 600 Oe-to-700 Oe level. The recently introduced Super VHS format requires an oxide formulation with a coercivity in excess of 900 Oe.

Work with metal-particle tape continues. The eventual result will be tape with a coercivity in excess of 1,500 Oe, designed for the Betacam SP, M-II and proposed D-2 composite digital formats, as well as improved media for 8mm.

Herman is product manager for professional video products, 3M Magnetic Media Division, Minneapolis.

Design factors

The magnetic response of tape, however, is only one of the characteristics that must be considered in the creation of a new tape formulation. Every video recording format that has ever existed, or ever will exist, possesses a unique combination of physical and magnetic characteristics. The tape construction must conform to these.

From the tape manufacturer's viewpoint, the process is a continual juggling act. If you were designing a tape from scratch, and you wanted to provide a product with the best possible magnetic performance, you might want a formulation made with nothing but magnetic particles. But what would that mean in terms of the physical durability of the tape or its capability to keep the heads from clogging? Therefore, you add some abrasiveness. You realize a concern about the danger of fungus growth, so you add a little fungicide.

As you add each of the ingredients, how do they mix together? Does the combination provide a smooth, homogenous coating? And if the coating can be made smooth, is the polyester backing material to which it is applied also smooth enough to prevent a bumpy surface? As you add new ingredients to the formulation, how do you keep the tape from getting so thick that it doesn't wrap properly around the head? Does the thickness cut down too much on the amount of the tape that will fit onto a reel? How can you be sure that the magnetic material on the surface of the tape

Continued on page 52

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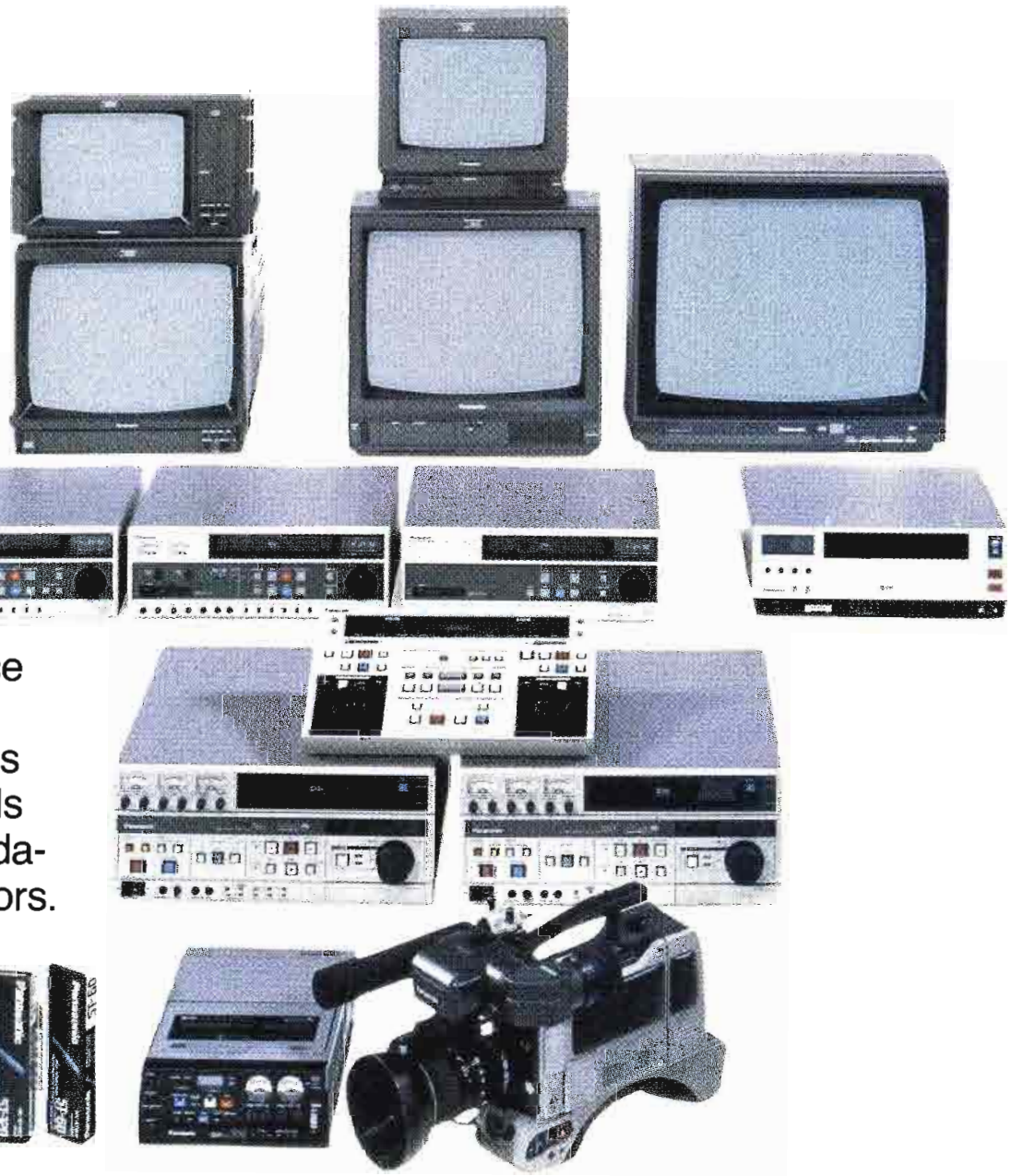

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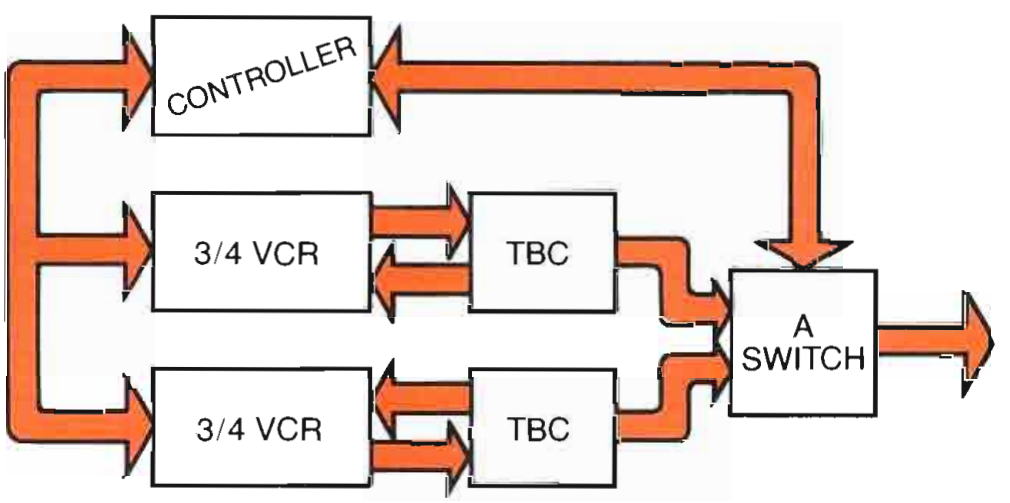

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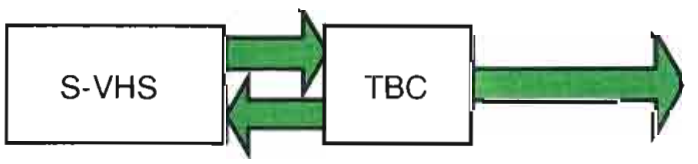

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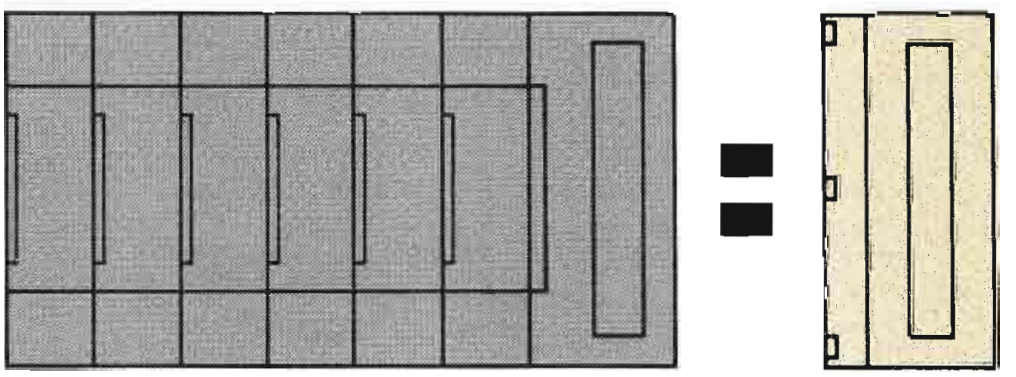

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Continued from page 48

won't stick to the backing when the tape is wound onto a reel?

On top of all these other considerations, tape designers must always bear in mind the question of manufacturability. It is desirable to reduce the size of the oxide particles so that more of them are included, allowing more densely stored information on the tape. But as particles become smaller, they tend to stick together. Can a manufacturing process be found that will keep the particles separate, yet maintain the tape's desirable characteristics?

The designer also must take into account the margin of error in manufacturing, so that if a portion of the assembly-line process is not 100% up to specification, the tape still can perform within tolerable limits. Above all, how much will it cost to manufacture the tape so that users will be able to afford the results of the R&D efforts?

Case in point

The design of a new tape formulation for the S-VHS recording format involved special factors for consideration. The design process actually began in 1984 with samples of a newly formulated, smaller-particle, high-coercivity tape. The new formulation offered the performance potential to operate under the noise threshold of the VHS VCR, which had been a related goal of the research. Attributes of the formulation included cobalt-doped ferric oxide, of smaller dimensions than that used for VHS, to achieve a 2dB to 3dB increase in carrier-to-noise performance.

The primary purpose of S-VHS was to achieve higher recording frequencies. Different signal-processing techniques and narrow-gap heads were necessary, as was the medium for recording. Four criteria were noted specifically as needed improvements:

1. The luminance signal needed to be moved to a higher, wider carrier frequency band for an increase in horizontal resolution to more than 400 lines. VHS luminance recording could shift from 3.4MHz-4.4MHz to 5.4MHz-7MHz.
2. Separated Y and C recording, a technique already found desirable with other ½-inch formats, would improve performance.
3. The bandwidth could be expanded from 1MHz to 1.6MHz with a non-linear input signal subemphasis system. Subemphasis, variable according to the input signal level, would result in an improved signal-to-noise ratio.
4. A higher-luminance signal frequency would decrease crosstalk with the chrominance signal. Consequently, cross-color disturbance and moire also would be reduced.

Physical properties

Beyond the signal-performance characteristics, any new format—and the tape meeting the format specifications—includes a unique set of physical properties. Among these, the head-to-tape touch pattern is probably the most important. Exactly how do the video heads couple to the surface of the tape that is wrapped around them? This factor determines, or at least predicts, how much headwear is produced by the tape and, simultaneously, how abrasive the tape must be to keep the heads clean.

Frictional characteristics of the format also demand concern. As the tape is shuttled back and forth, bent around corners and passed over guide bars, it must flow as smoothly as possible to prevent timing errors during recording and playback. Frictional demands differ from machine type to machine type within the same recording format. The portable VTR, for example, may force the tape to make sharper bends than the more spacious studio version, which affords a longer, more circuitous pathway.

Friction becomes a factor in specific tape applications. Because portable recorders often are used in environmental conditions beyond the control of the operator, tapes designed for field use must be even more smooth-flowing than their studio counterparts of greater length. For computer-assisted editing and frame-by-frame animation, in which tape is shuttled back and forth repeatedly, it is especially important that the tape moves smoothly.

Although the S-VHS formulation is intended to meet a specific format application, what is its applicability to other formats, particularly those that require small particle size and high coercivity? Perhaps the question should be reworded: Can other format designs, such as those presently suggesting the use of metal-particle tape, be altered to allow the use of the lower-cost, small-particle oxide medium of S-VHS?

Metal tape

As the S-VHS format emerges, one of the greatest challenges to the tape-manufacturing industry is to resolve the difficulties with and make improvements to metal-particle tape. Equipment based on the use of metal tape already exists in the form of some audiocassette systems and all 8mm videocassette systems. The 8mm format specification challenges some of the fundamental rules of recording. It must perform well at shorter wavelengths and higher frequencies. However, the writing speed of 8mm is quite low, meaning the S/N must be as high as possible.

The high-frequency and noise-level problems can be solved, at least in part, by the use of smaller and smaller particles in the magnetic material. As particle size is reduced, however, even metals begin to exhibit a proportional increase in pyrophoric properties. Simply put, reducing particle size creates a greater propensity for the material to catch fire, just as dust in grain elevators becomes explosive under certain temperature, pressure and humidity conditions.

An understandable concern about metal tape regarding its cost, if nothing else, is the expected longevity. Users of the professional recording formats, such as Betacam SP, M-II and D-2, question the possibility of oxidation of the metal particles if moisture and air come in contact with them. Although a neutralizing agent surrounds each particle in the magnetic layer, there is interest in additional coatings to aid in stabilizing the material during long-term storage.

Finding the ultimate

The search for new magnetic media never ends. Perhaps an ultimate medium does not exist, but the next step in that direction is *evaporated-metal tape*, in which a thin film of metal is electroplated onto the backing. The manufacturing process for this medium is quite different from the techniques to achieve oxide-coated media. The film deposition must be accomplished in a vacuum.

Evaporated-metal tape possesses physical characteristics that are much different from those of other types of tape. It can be employed in relatively simple recording situations, such as for micro audiocassettes for dictation, but its use with video recording will require the development of new recording and reading techniques by hardware and tape manufacturers.

Another material that is being explored as a magnetic medium is barium ferrite. Although barium as an element does not exhibit vast magnetic properties, its mixture with ferrite material shows excellent magnetic properties. It also will allow manufacturing of tape using current processes, making it of interest economically.

Have oxide tapes reached the end of their potential growth? Certainly not. New magnetic materials are being studied, yet the standard gamma ferric oxide development has not come to a standstill. The recording industry can expect to see yearly gains of 0.5dB to 0.6dB in oxide performance. In many areas of research today, the outward appearance is that the limits have been reached, and all possible improvements have been made. However, as in the case of computers and data processing, the only real limitation is the software or the processing technology by which new goals can be attained. |:-)))|

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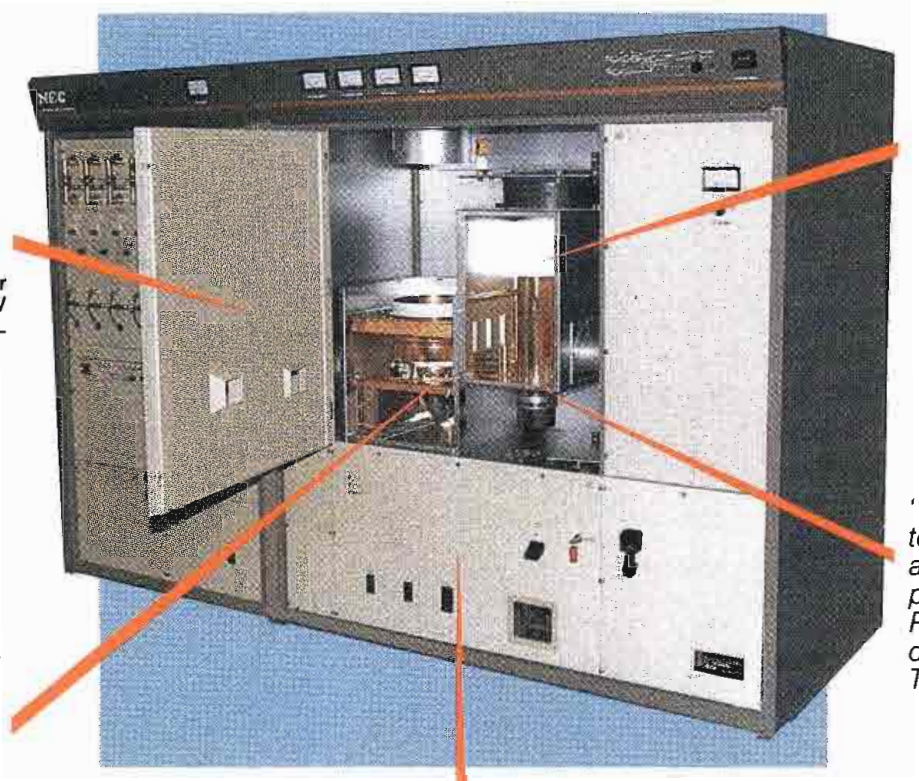

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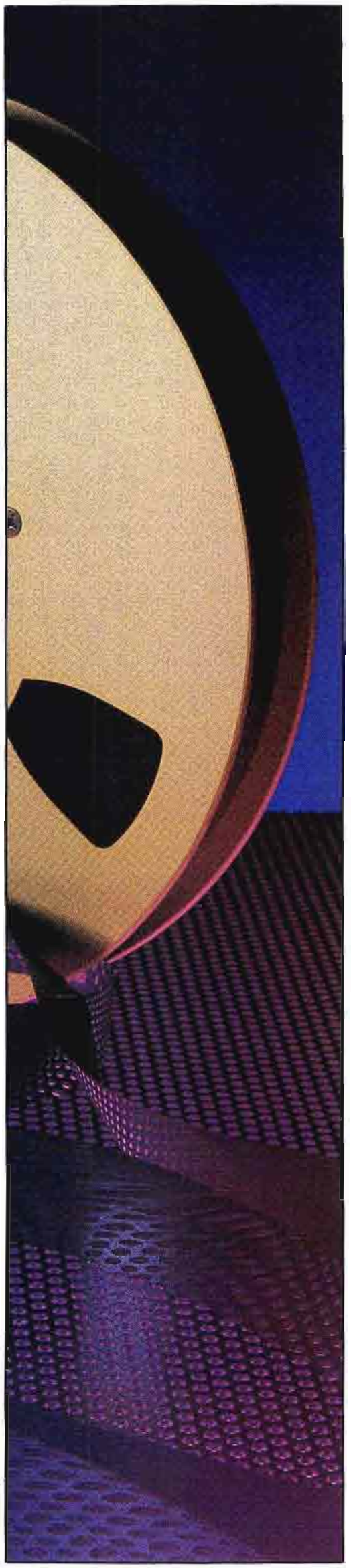

The evolution of audio recording

By Doug Beard

One keypad and a liquid-crystal display replace 384 trimpots. What would Bing think?

Changes in audio-recording technology have produced some unexpected effects. For example, sales of small, green-handled screwdrivers are reportedly plummeting. These tiny tools, prone to frequent misplacement and replacement, simply are not needed to tweak the latest generation of analog recorders.

If the hardware store is missing out on a few sales, the drugstore isn't, because the sale of headache remedies is on the upswing. The best customers are the CEs and GMs who are contemplating the prospect of junking studios full of analog gear to bring in costly, not-yet-standardized digital audio-recording equipment.

Yes, a revolution is at hand, but before we look at the drastic changes digital will bring, let's look back at the half-century life span of analog recording.

Recorder essentials

The basics of analog recording haven't changed significantly since Bing Crosby crooned into the first Ampex decks shortly after World War II. An audio signal enters the record amplifier, the signal is mixed with an ultrasonic bias current to provide a more linear transfer characteristic, and the combined signal goes to the record head. The frequency variations in the audio signal generate corresponding variations in the magnetic field surrounding the record-head gap. A tape composed of ferrous particles on a polyester backing passes at constant speed over this gap, and the particles are magnetized. When the tape passes over the gap in the playback head, the magnetized particles regenerate the signal, any remaining bias is removed, the signal is amplified and—presto!—it sounds just like "White Christmas."

Another thing that has changed little over the decades is basic audio-head design parameters. That's because the fundamentals are fixed by laws of physics and the bandwidth of the audio spectrum. Even in precomputer days, engineers could figure out the optimum inductances and gap widths for the record and playback heads. Typical gap specifications (about 7 microns for the record head and 3.5 microns for the reproduce head), therefore, have remained relatively constant.

Beard is director of technical and marketing services for Studer Revox America, Nashville, TN.

A contemporary broadcast recorder (the A807).

Heads and amps

But between Bing and the Bangles, just about everything else in the analog recorder has undergone major changes: head materials, record and reproduce electronics, headblock design, recording levels, noise-reduction techniques and methods for setting alignment parameters. All this doesn't even touch on the significant advancements in tape transport control systems, which are outside the scope of this article.

Materials for audio heads have evolved through several generations. The original premise was that the ideal audio head would provide flat frequency

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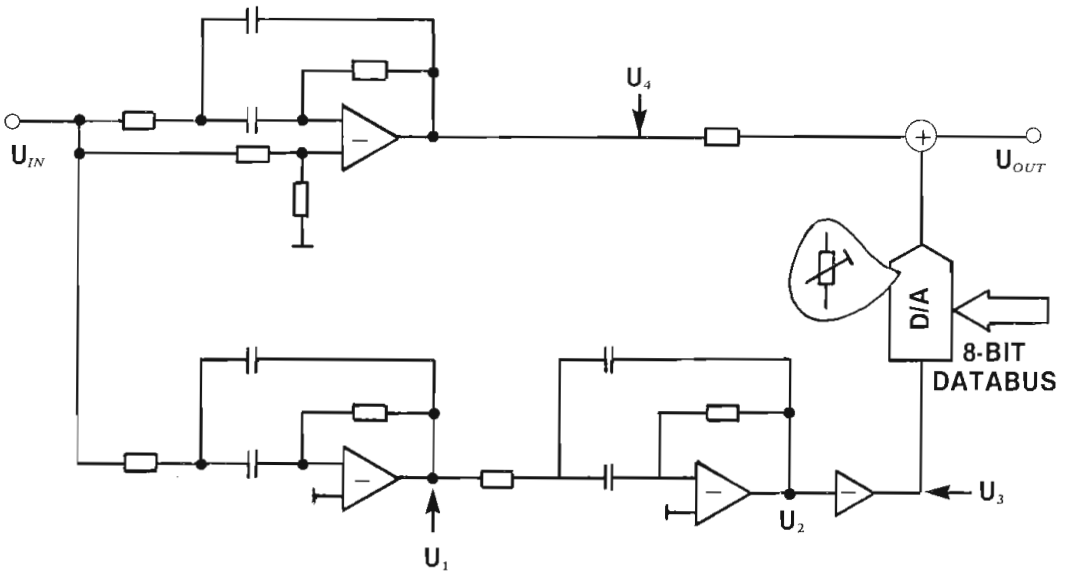

Figure 1. *This phase-correction circuit uses digital control technology.*

response, exhibit no crosstalk between channels, require only modest levels of bias, be magnetically soft and not build up residual magnetism. Yet, it should be mechanically hard enough to last thousands of hours before requiring replacement.

Unfortunately, no one material was available immediately to answer all the requirements. As a general rule, the harder the material mechanically, the lower its magnetic permeability. You could have optimum magnetic properties on a head that wore out quickly, or a long-wearing head that required more current to drive it. But you couldn't have both.

Engineers have been working on this puzzle for decades, trying various approaches. The first heads consisted of relatively soft pole pieces molded into a plastic (epoxy) housing and shielded by a mu-metal can. However, they suffered from inconsistent responses and had short life spans. So engineers went back to their drawing boards and tried various all-metal designs of different alloys, finally developing the laminated, high-permeability mu-metal heads that have become the standard in recent years.

Ferrite heads have enjoyed some success along the way. Advantages of ferrite include mechanical hardness, desirable magnetic properties and lack of eddy-current losses caused by stacked laminations. However, ferrite heads are prone to gap erosion, and the shape of some ferrite heads can cause low-end frequency-response problems or introduce scrape flutter.

The future of audio heads seems to be in the new amorphous designs, which are metal with a crytallized glass surface. The amorphous head is magnetically soft, yet features an extremely hard surface and low friction coefficient—the best combination to date for performance and long life span. A few of the newer recorders offer amorphous heads, and they can be expected on future introductions.

Analog recorders have benefited from

Put the Tascam CD-501 next to any other broadcast compact disc player, and you'll find there's no comparison.

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Inside THE TAPELESS STUDIO™

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Evolution in design has brought significant changes to modern recorders.

improvements in the mechanical stability of the headblock and other tape-path components. In order for the heads to do the job, the tape must pass over each of them at a constant speed, with exactly the same tension, at exactly the same height and angle, and without mechanical vibration.

Advancements in manufacturing technology, as well as new CAD (computer-aided design) tools, have improved greatly the stability and precision of all mechanical components. High-quality professional recorders are built around a die-cast aluminum alloy chassis with heads mounted on a separate, precision-machined headblock that allows removal and replacement without requiring readjustment. Improvements in this regard have been substantial. Bing did well with mechanics equivalent to a '47 Mercury; the Bangles do better with precision that might be compared to that of an '87 Mercedes.

Another fairly recent innovation has been the development of reproduce pre-amplifiers built into the headblock. Because the signal generated by the repro head is so small (from microvolts to a maximum of a few millivolts), problems of noise build-up and/or high-frequency rolloff can be experienced over a 3-foot length of wire running from the head down to a card rack under the transport. The headblock pre-amplifier, by providing 20dB to 30dB of gain, significantly improves overall recorder performance.

On the record side of the signal chain, some notable improvements have been made in amplifier and bias drive circuits. In addition to the standard equalization curves that conform with NAB or European CCIR standards, newer recorders also incorporate phase-compensation circuitry to correct for losses occurring during the record/reproduce process.

These high-frequency losses—caused by gap-loss attenuation, coating thickness attenuation and self-erasure—could be corrected by a simple RC equalizer system, but this would introduce major phase errors. The preferred solution, implemented in some new recorders, is that two special bandpass filters with a frequency-proportional amplitude response are used to boost the high-frequency response. A delay network is inserted into the main network to compensate for the unavoidable bandpass delay. The net result is a record/reproduce frequency response that is phase-corrected.

Before going to the heads, the audio is combined with the high-frequency bias. The important factors for the bias stage are purity of the bias signal and frequency stability; also, the bias signal must be equal to, or synchronized with, the erase

Raise your standards.

To understand the superiority of the Tascam ATR-60/2N, begin with the heads: no other 2-track production recorder has heads that can provide sync response fully equal to repro response—an advantage that allows you to save time by making critical audio decisions without rewinding.

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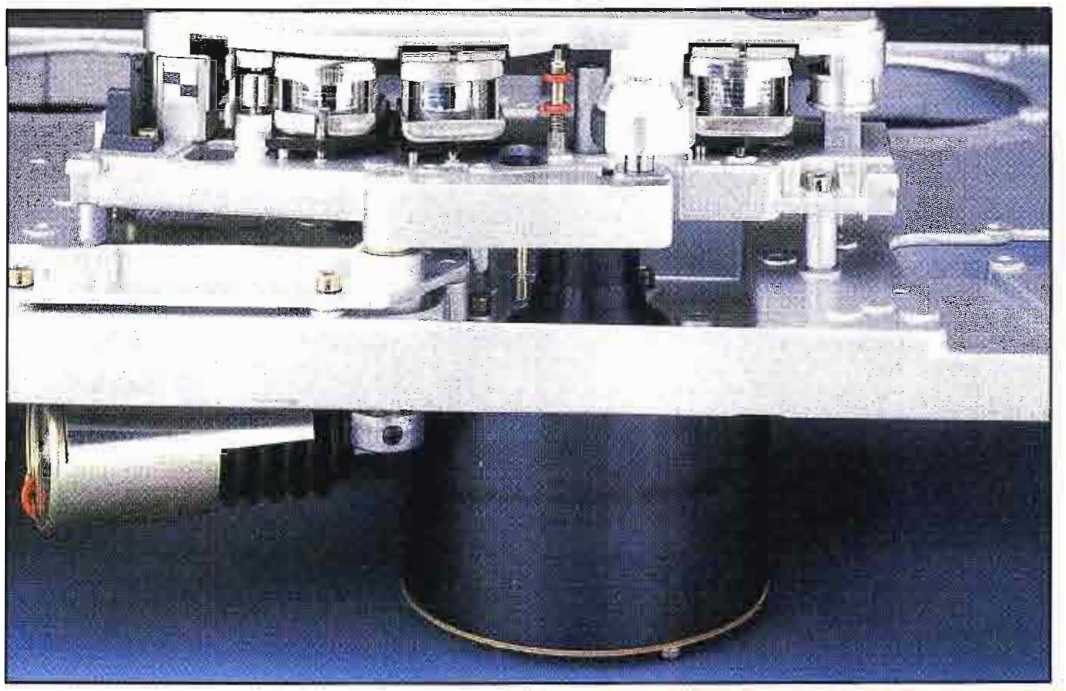

Mechanical stability of today's audio recorder is possible through die-cast components.

signal for other channels of the recorder. The distortion level of the bias must be kept as low as possible because any harmonic content will increase residual tape noise level. Bias frequencies usually are in the range of 120kHz to 500kHz.

New techniques

Although improvements in recorder electronics are significant, the changes have been gradual, and the everyday user does not have to deal with them. Not so with audio alignment of the new recorders.

Forget the trimpots. Throw out the green-handled tweaker. Audio parameters on the newest recorders are set and stored digitally. At the heart of this new technology are devices called multiplying digital-analog converters (DACs). These are not voltage-controlled amplifiers but, rather, switches that control the gain of a circuit (in 256 discrete steps) by connecting various combinations of resistors into the input/feedback circuits.

Working under directions from a central microprocessor, these DACs are used to set levels for record, reproduce, bias and equalization. In addition to eliminating trimpots, this technology has allowed greater flexibility in recorder design. It is now possible to build a recorder with four standard tape speeds with complete alignment for two tape formulations at all four speeds for both NAB and CCIR equalizations. One keypad and LCD replace 384 trimpots.

Other advantages of this new design include the capability to store tape-alignment data and reload it into the machine; the capability to read alignment data through standard RS-232 serial port for computer storage or print out for record keeping; and automatic alignment of the

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That's due in part to an ingeniously accurate tape handling system, and in part to Tascam's unique head technology. (Its heads provide sync response fully equal to repro, so you don't waste time rewinding to make audio decisions.)

And because the 42B probably offers more features per dollar than any equivalent machine, it makes everything else seem downright expensive, too. (+4 dBm balanced inputs and outputs, plus easy-access calibration are just a few of its standard features.)

For more information, call or write about the Tascam 42B today. It's a new and vastly improved way to keep meeting your deadlines.

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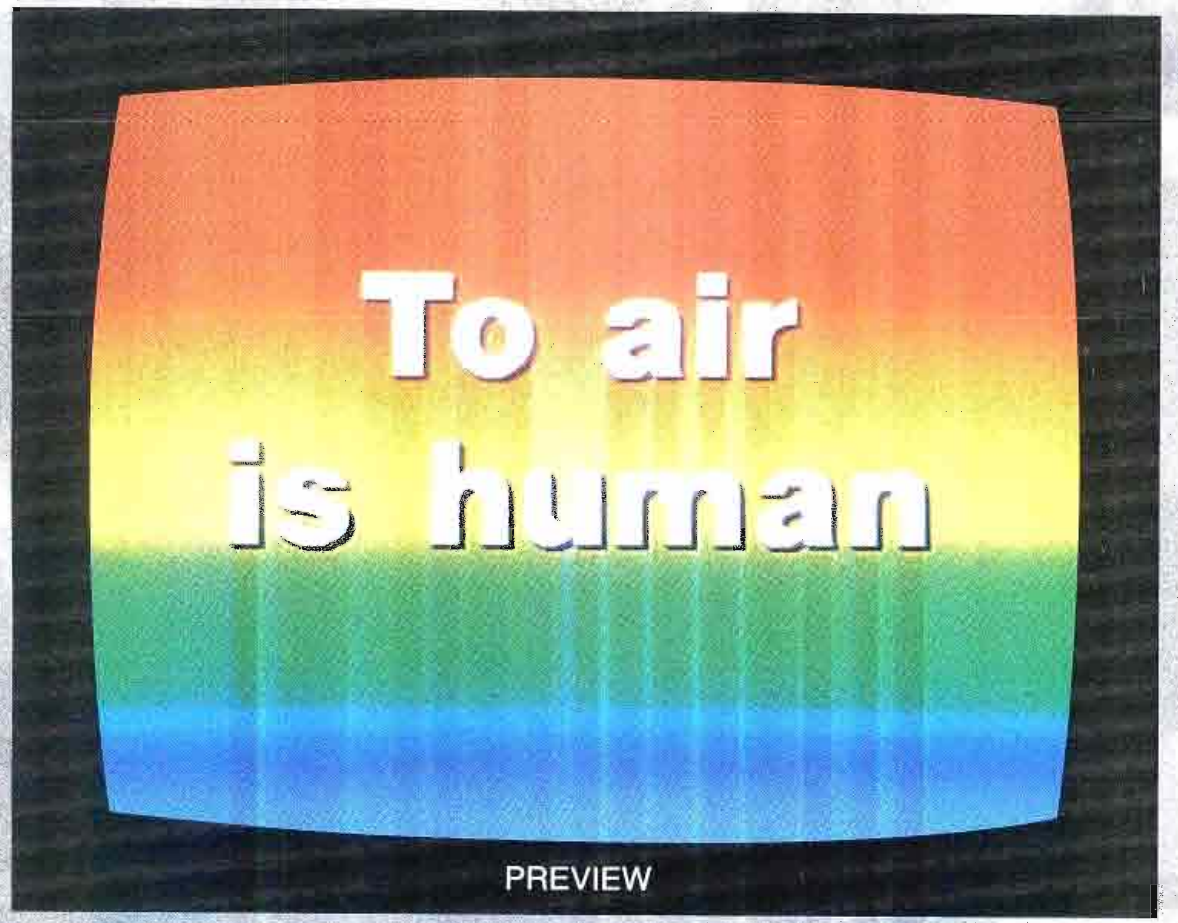

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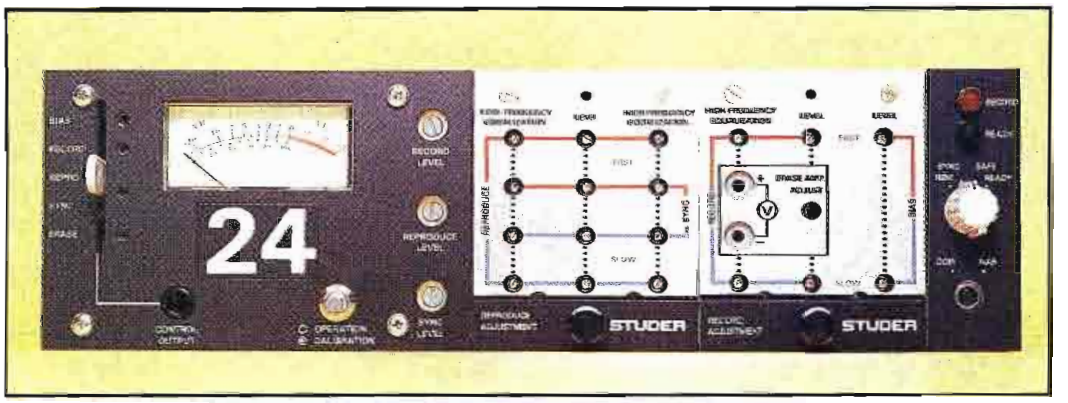

The old way: channel electronics of a 24-track recorder show trimpots for adjustments.

recorder with bus-controlled test equipment and an external computer.

Effect on tape

When you go to the keypad to set your tape levels on that new machine, you can set them much higher than you could have in Bing's day. Recorder manufacturers have played leapfrog with tape manufacturers for 40 years. As advancements in electronics reduced the noise inside the machine, pressure was on tape suppliers to reduce residual noise levels. Later, high-output/high-bias tapes brought about improved tape machines with sufficient bias drive and headroom to take full advantage of the new formulations.

Today's tapes operate at levels unheard of even 20 years ago. For years, the NAB set the standard at a level of 185nWb/m with 3% distortion at +6dB or 370nWb/m. But many recording studios today use operating levels as high as 510nWb/m with 3% distortion at +6dB or 1,020nWb/m.

Using new "hot" tapes and 30ips tape speed, today's analog recorders can provide signal-to-noise ratios beyond 75dB with frequency response extending to 22kHz. Add to that the newest generation of noise-reduction systems, and you can squeeze out S/N and dynamic range specs into the high 90s and beyond.

Highly evolved analog recorders are likely to be the mainstay of broadcasting for years to come. However, digital is on the way, with virtually no noise, no wow or flutter and the intriguing possibilities for editing and data manipulation. When that comes, it will be a quantum leap.

DASH and PD

Two totally different types of tape transports are used for digital audio recording: the rotary head and the stationary head. For the sake of direct comparison and brevity, this article will not discuss rotary-head designs, which really have more in common with VTRs, and, instead, will focus on the stationary-head approach.

Stationary-head digital tape recorders (DTRs) may look like their analog counterparts, and they often have similar transport features, but that's where the similarities end. In the way the system records (writes) and reproduces (reads), a DTR really has more in common with a computer and disk drive.

First, the analog signal is converted into 16-bit words at a sampling rate of 48kHz. The data is encoded to include redundant information along with a

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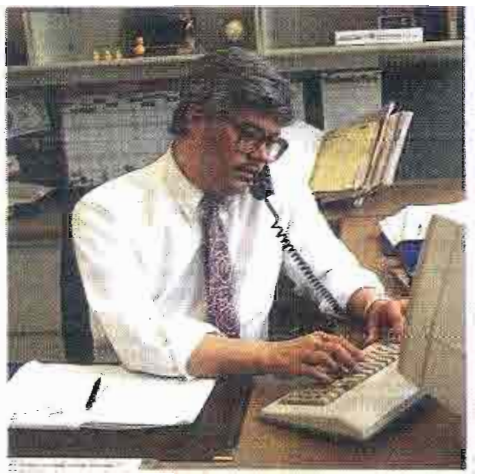

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The new way: the control keypad handles parameter settings of all 24 channels of an A820.

checksum to allow reconstruction in case errors are introduced. Data is interleaved (spread out) to reduce the effect of dropouts, then formed back into blocks with a sync word and CRC (cyclic redundancy check) for additional error protection. Finally, a modulation technique is applied to limit the bandwidth of the signal going to the heads to about 500kHz.

Unlike analog, in which one track of the tape takes care of one channel of audio, the audio signal in digital is split up over several tracks. In the DASH (digital audio stationary-head) format, for example, a single audio channel may use two or four tracks, depending on the tape speed or the need for extra error protection, or to allow for interpolation-free editing. With four additional tracks allotted for time code, reference and auxiliary/cue signals, the 2-channel DASH recorder actually operates with a total of 12 data tracks.

DASH and PD (professional digital) are the two competing formats for stationary-head digital audio. Although both use the same raw tape (a special formulation for digital) and encode 16 bits at 48kHz, they are not compatible. The digital data is processed in completely different ways. If you attempt to play a PD tape on a DASH machine, you'll get an LCD reading proclaiming the alphanumeric equivalent of "Huh?"

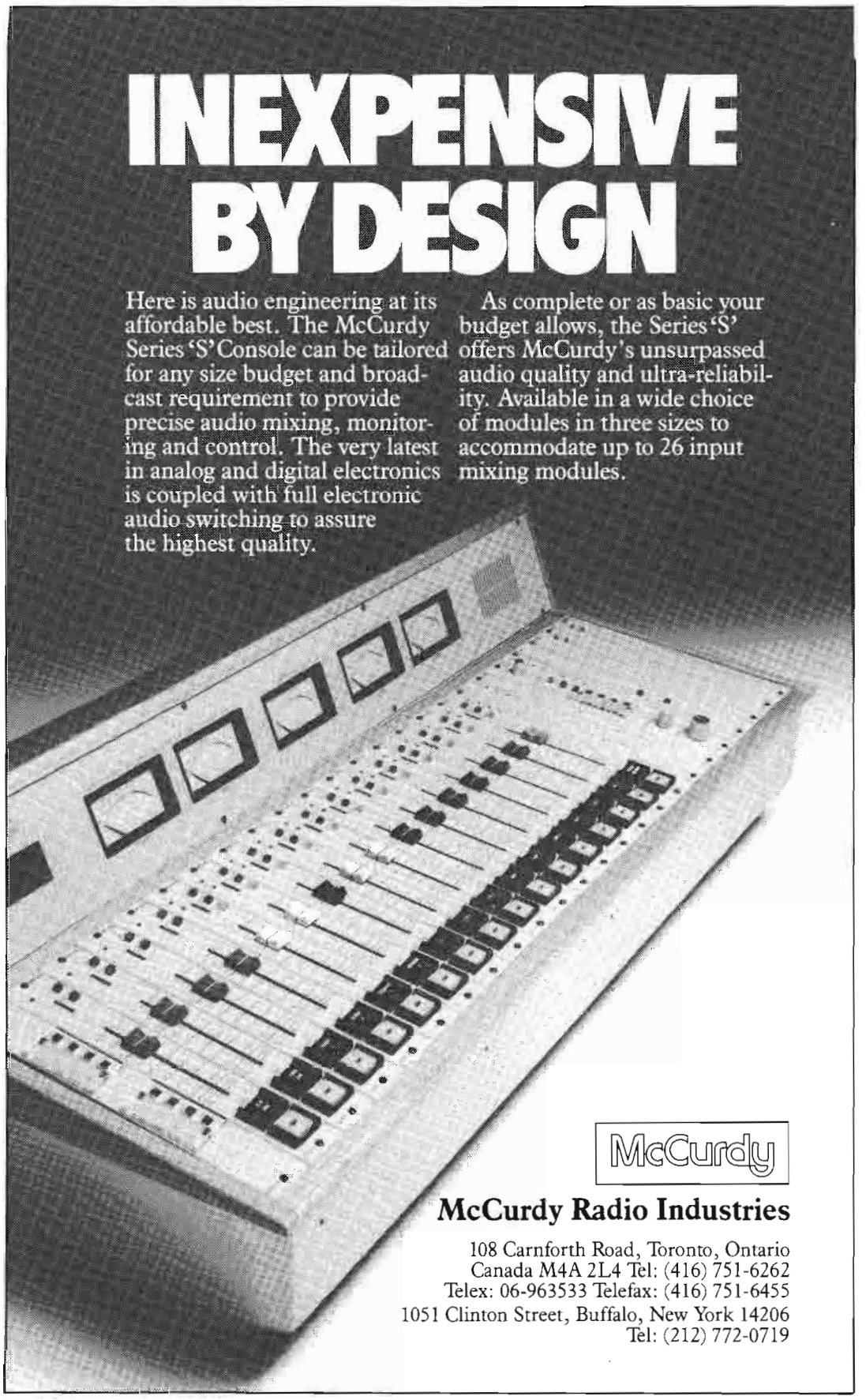
Familiar parameters of bias and EQ are unknown in digital. The only possible "alignment" is adjusting the "write current" to vary the level on the tape.

In contrast to analog, for which metal is preferred, ferrite and new *thin-film* heads are the choice for DTRs. (Thin-film heads use hybrid circuit technology to deposit magnetic material on a ferrite substrate or base. This allows them to be much more precise and to replay the signals with much less crosstalk.)

On the horizon

The way audio signals are stored on tape is undergoing a major revolution. Today's DTR is a hybrid of a computer and the familiar ATR (or VTR). Not surprisingly, audio recorders of the future will be more like computers. Research is already under way to explore hard-disk, solid-state and optical-disc storage systems. One area that is particularly promising is the recordable optical disc. Using a combination of magnetic and optical technologies, such a disc would be recorded magnetically and replayed with a laser-optic pickup, similar to the laser found in compact disc players. Advantages include large capacity and random access to data on the disc.

Although the technology is advancing rapidly, it will be a number of years before the typical broadcast facility has digital audio from signal source to transmitter input. In the meantime, you might want to sharpen your skills in software debugging and computer repair. Because when digital goes haywire, you can't tell Bing from the Bangles. |:-)))|



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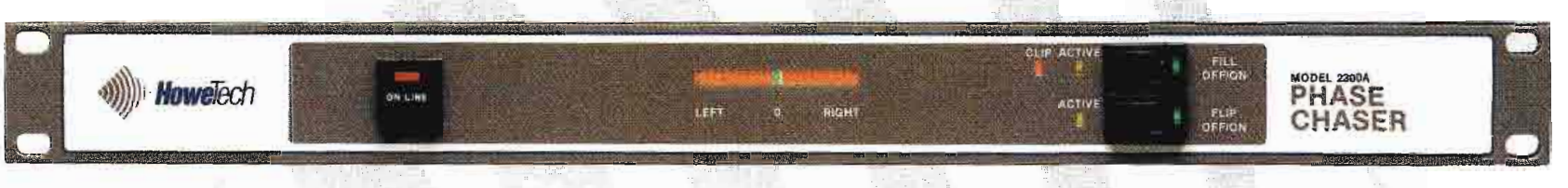

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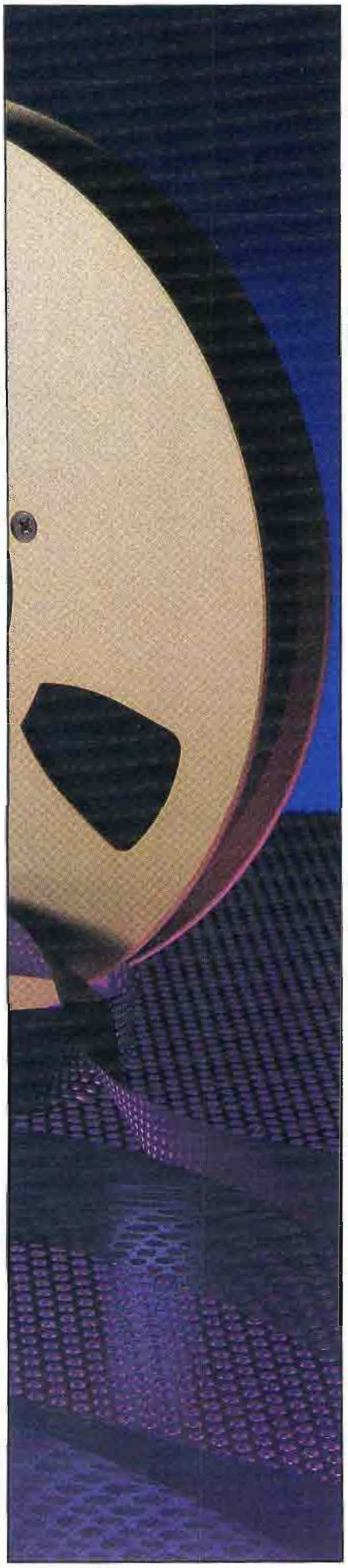

The evolution of video recording

By Carl Bentz,
technical and special projects editor

The concepts of an 1898 experiment in magnetic recording led to the video formats of today.

It would be interesting to know if, in 1956, anyone had an inkling of what the VTR would one day mean for television. Or, in 1898, at the first demonstration of magnetic recording, do you suppose magnetic image storage was even remotely considered? When videotape recording was introduced as a commercially viable product more than 30 years ago, it filled a definite need. At that time, programming was either live or was reproduced from kinescope films, but there just had to be a better way.

The better way, then, was *quad*. Quadruplex videotape images were much better than those from kinescopes. Tape needed no chemical processing and would eventually become more economical because it was reusable. Several copies could be made simultaneously for distribution. With electronic editing, introduced in the early '60s, tape became a predominant medium for TV production and post-production. Film still maintains a foothold of significant proportion outside the TV studio, but most in-house work involves tape.

The 2-inch quad VTR held sway in video recording for nearly 30 years. Modifications and improvements through the years led to the development of portable models. Approximately 15,000 quad machines were sold in the Western Hemisphere, and perhaps another 2,000 to 3,000 worldwide, through licensing agreements. Exactly how many remain in service is unknown, but the number is thought to be significant even though no new quad machines have been sold since the early '80s.

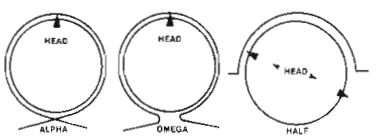

Figure 1. *Alpha (α) and omega (Ω) wraps on 1-inch formats are supplanted by the half-wrap on ½-inch equipment, made possible with multiple heads in the smaller format.*

A new tradition

In the late '60s a new player appeared in the ¾-inch U-matic H format. *Helical scan* was not an innovation with ¾-inch equipment, but it met with wide approval for several reasons. The smaller, more lightweight type H was much more portable, making it possible to increase production outside the studio. Equipment and media costs were lower. The cassette made tape easier to handle.

Oddly, although the ¾-inch format originally was not intended as a broadcast system, it formed the basis of ENG with the aid of time base correction. It is estimated that 1.4 to 1.5 million type H units have been sold since their introduction. The type H was expected to be a consumer system, but it never caught on in that market.

Helical scan, when first demonstrated in the early '60s, used 1-inch tape and a different concept than quad. (At least one 2-inch helical-scan model was produced, but its use in broadcast was limited.) Instead of four heads writing transversely across the tape and breaking each video field into segments (which often showed as stripes in the picture if the head was clogging or the EQ was misadjusted), one track containing an entire field ran diagonally across the tape.

Tape was wrapped around the head in a spiral in order to create the *slant track*. An alpha (α) wrap turned out to be somewhat cumbersome for operators, while the omega (Ω) wrap, common to today's type B and C systems, promoted much faster threading and easier tape-motion control by the transport. See Figure 1.

Helical scan provided other operational advantages. Because additional

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heads were placed on the drum in balanced pairs, both assembly and insert editing became much simpler. One set of heads handled playback, while a second set was poised to energize at the exact moment of the edit. Another set could be added for video confidence, a feature that was impossible with the quad format. A picture of sorts could be viewed, even when the transport was operating in fast-forward or rewind. But there was a problem in tracking, which resulted in the development of *automatic-scan tracking* or *dynamic-tracking* heads in the original 1-inch type A machines. Type A equipment primarily served airborne, military applications. (See Figure 2.)

The 1-inch systems emerged in the '60s, but it was not until the digital time base corrector and refined automatic tracking that types B and C began to supplant quad as the primary recording format. To date, some 30,000 type C systems have been in service in the world market. Type B originally gave PAL system recordings better signal-to-noise performance, but today, only a hard-to-detect difference of a few decibels exists between NTSC and PAL performance with either machine. Type B does not adapt well to automatic tracking, making it less inviting in post-production, where slow motion is desired.

What began in the mid-1970s as consumer, educational and industrial formats exploded into the broadcast world in the early '80s. The ½-inch analog component system had arrived. Among several current format camps, seven different ½-inch formats find some use in the broadcast station, but only three provide significant on-air and production applications. The smaller-width ¼-inch and 8mm formats remain under investigation, as far as broadcast service is concerned.

Within the past two years, digital video recording has made its debut. Using cassette-based media with a 19mm width, digital technology offers a number of advantages compared with all previous formats. Digital systems exist for both component and composite signal methods.

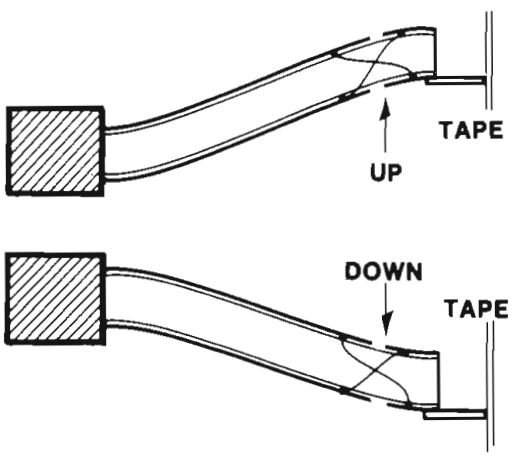

Figure 2. *The head, mounted on a piezoelectric crystalline material, is driven from a feedback signal, based upon the VTR and TBC search for the greatest recovered signal strength.*

Fundamentals

In all, about 15 formats are used in the *professional* video market. Most are incompatible with one another. Yet, they all are similar if the tape footprint, that is, the manner in which signals are arranged on the tape medium, is set aside.

The history of video recording makes for a dramatic story, but from the first acruate scan demonstration to the development of the latest products in 8mm and ¼-inch helical-scan systems, certain fundamental truths have prevailed. These fundamentals date back to 1898, when Valdemar Poulsen first proved the capability of information storage through magnetic recording.

The magnetic recording process (see Figure 3) starts when a medium is moved at a constant speed in the vicinity of a varying magnetic field, the variations representing information to be recorded. The bandwidth of the recorded and reproduced signal is determined, to a great extent, by the velocity of the tape motion relative to the recording head. The higher the writing speed, the wider the recordable bandwidth.

The density or strength of the recording signal must be sufficient to cause alignment of the magnetic particles of the medium. The particles in the medium must retain enough of the field to be sensed later during reproduction. The amount of noise in the reproduced video images is determined by the amount of signal that can be read from the tape. Noise is caused by two primary sources: the inherent noise of electronic circuitry and the effects of non-aligned magnetic particles in the medium.

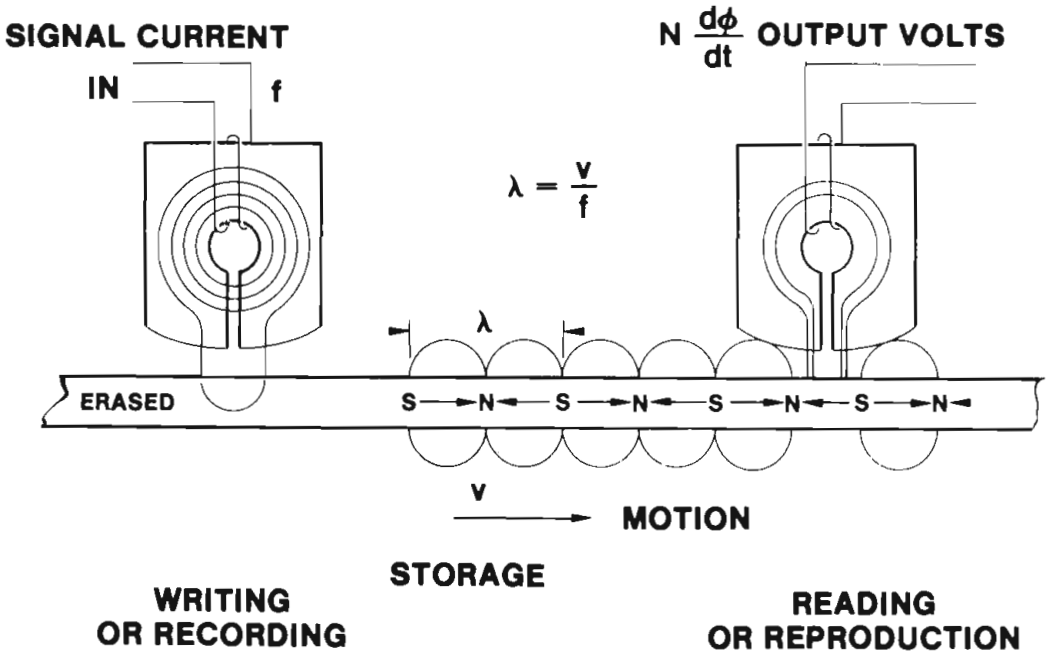

Figure 3. *The fundamental processes of recording and reproducing magnetically stored information on tape.*

Building from quad

It was nearly three years after the initial work on the first video recorder that the acruate head geometry gave way to the transverse scan that characterized the 2-inch quadruplex VTR. The acruate geometry, originally selected to prevent the impact of tape heads against the edge of the medium, operated at a tape velocity of 30ips, while the flat head spun at 240rps, producing an equivalent writing velocity of 1,700ips. (See Figure 4.)

When seemingly insurmountable timing problems emerged with the flat acruate head, the concept of the transverse scan was tried. A head drum just slightly larger than 2 inches in diameter holds four heads, each mounted in quadrature, or at 90° angles to one another. With the tape moving at 15ips and the head drum rotating at 240rps, the effective writing speed is 1,550ips. (See Figure 5.) For 50Hz systems the drum rotates at 250rps, producing an effective speed of 1,600ips.

Each 0.01-inch track recorded across the width of the tape contains about 16 lines of picture information. In order to record a complete frame of 525 lines, the head drum makes eight complete rotations, writing four tracks per revolution. If the strength of the magnetic stripe

Continued on page 72

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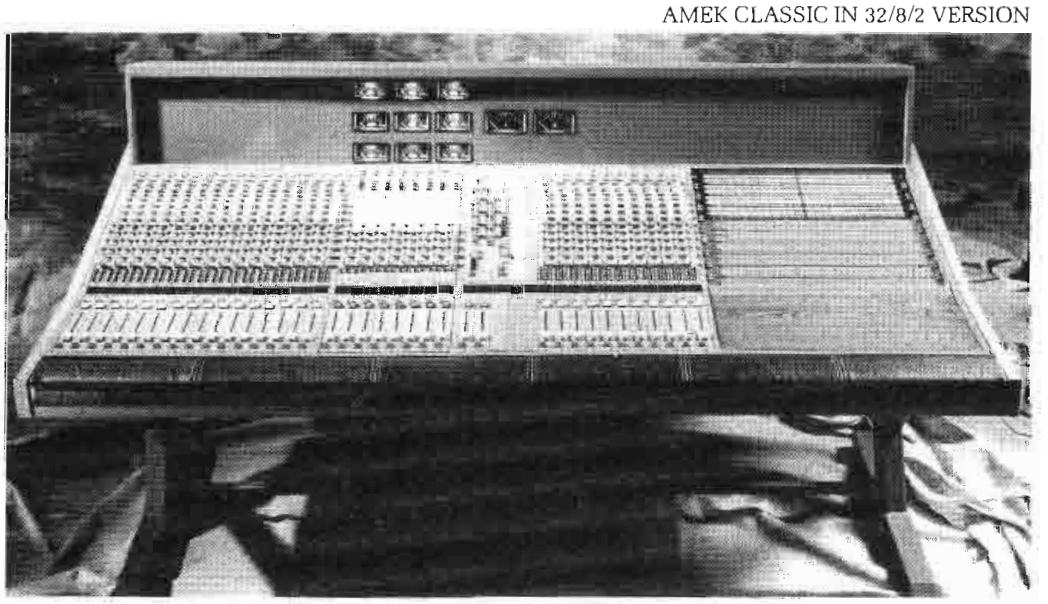

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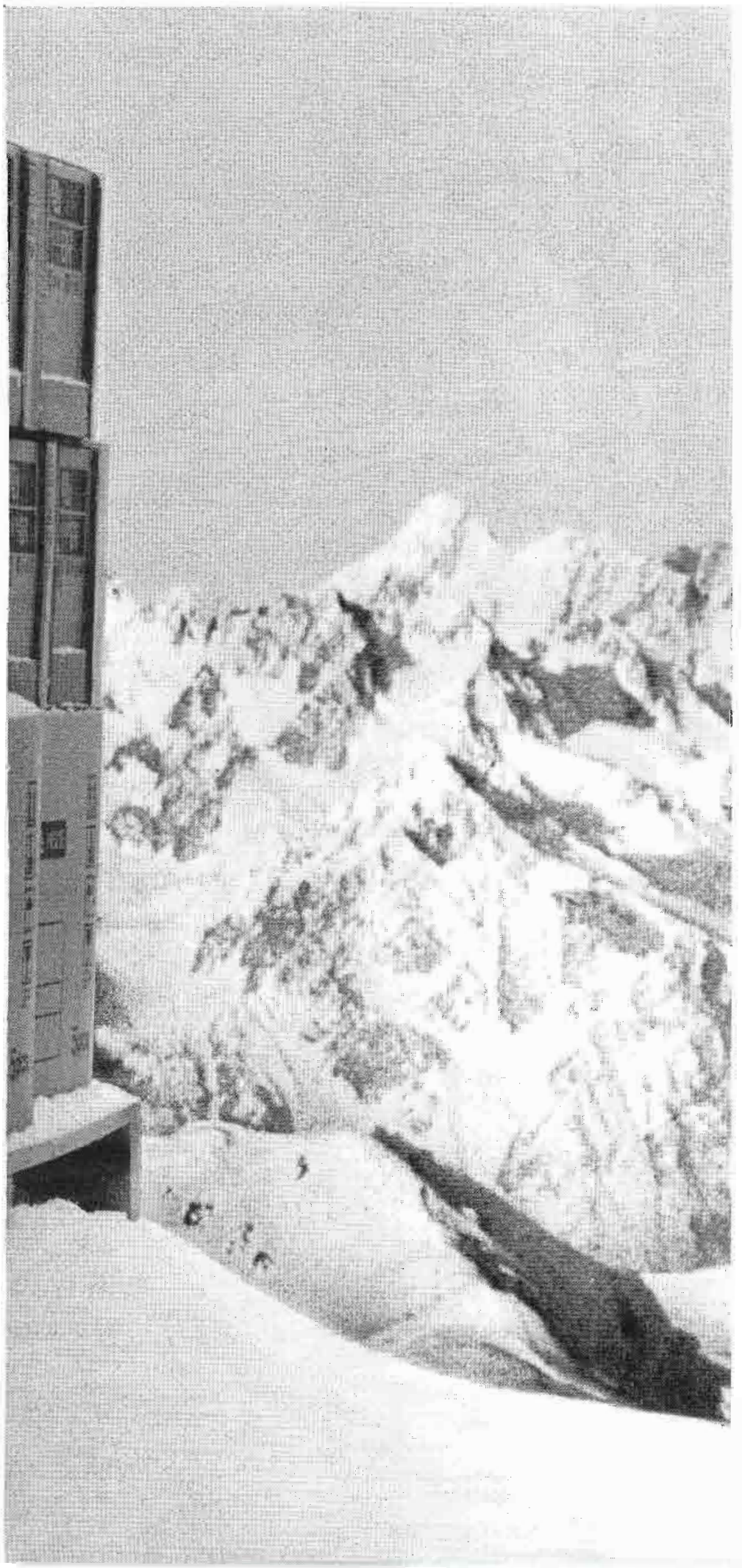

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Continued from page 68
placed on the tape by each head is the same, and if the reproduction electronics of the 4-head, 4-channel system are balanced, the resulting image does not belie the fact of segment recording. If there is any imbalance between the heads and electronics, the result is a striped picture with eight bands across the screen.

Making tracks

The complexity of any videotape format is increased by the matter of including one or more audio, control and even data or time-code tracks with the video. In the format drawings, there appears to be a significant distance between each type of track. In reality, video is recorded across the width of the quad tape. The audio and control information is placed on the tape after video, causing relatively complete erasure of the video near the edges. What could be critical, however, are the possibilities of the recorded flux (magnetic polarity) from one signal track to another.

Intertrack effects are reduced significantly if a guard band is used between parallel tracks or the recording head gap directions are set at various angles relative to one another for the different tracks. The difference in track data content also helps to reduce problems. The angular orientation and placement of tracks form only part of a recording format. (While quad had a 0.05-inch guard

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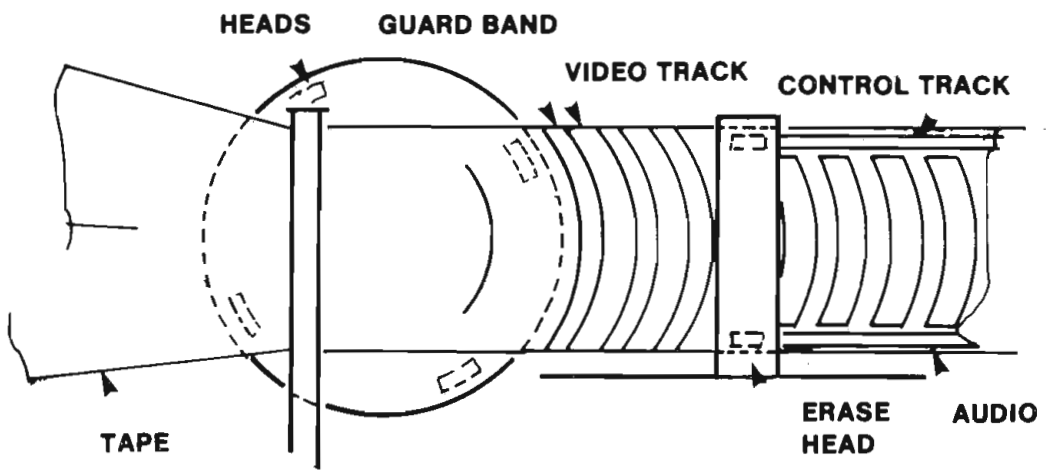

Figure 4. *The acruate format used heads in a planar structure.*

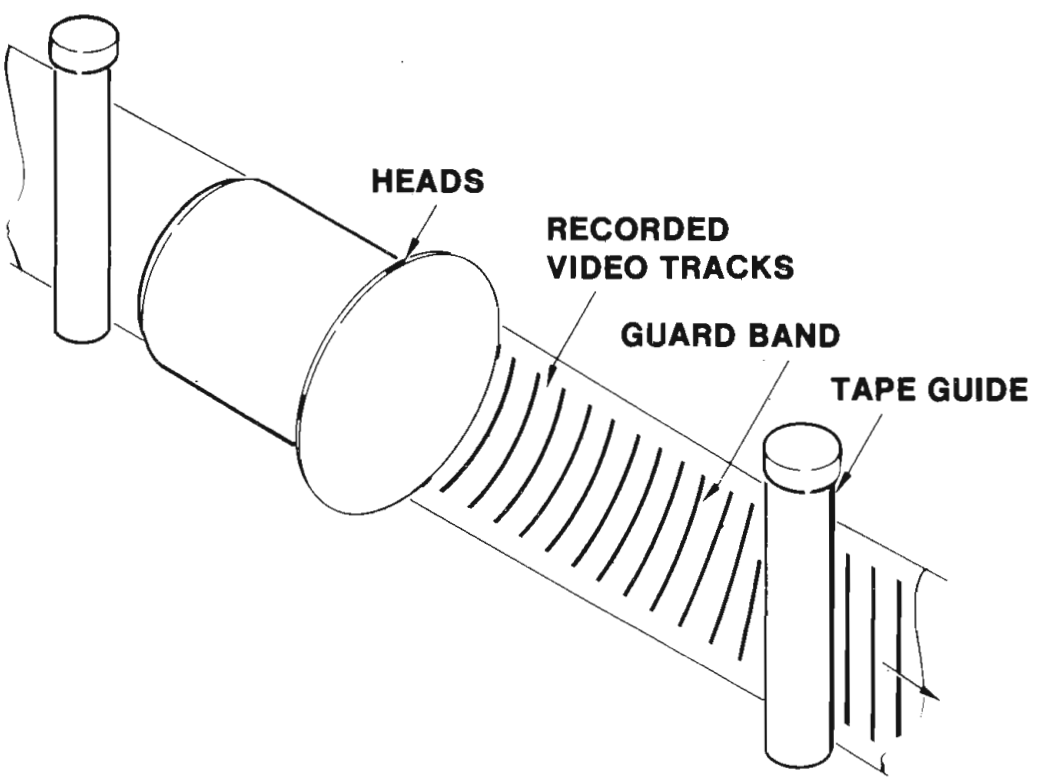

Figure 5. *The quadruplex format places heads around a rotating cylinder, writing magnetic tracks transversely across a tape that is forced into a circular arc against the head drum.*

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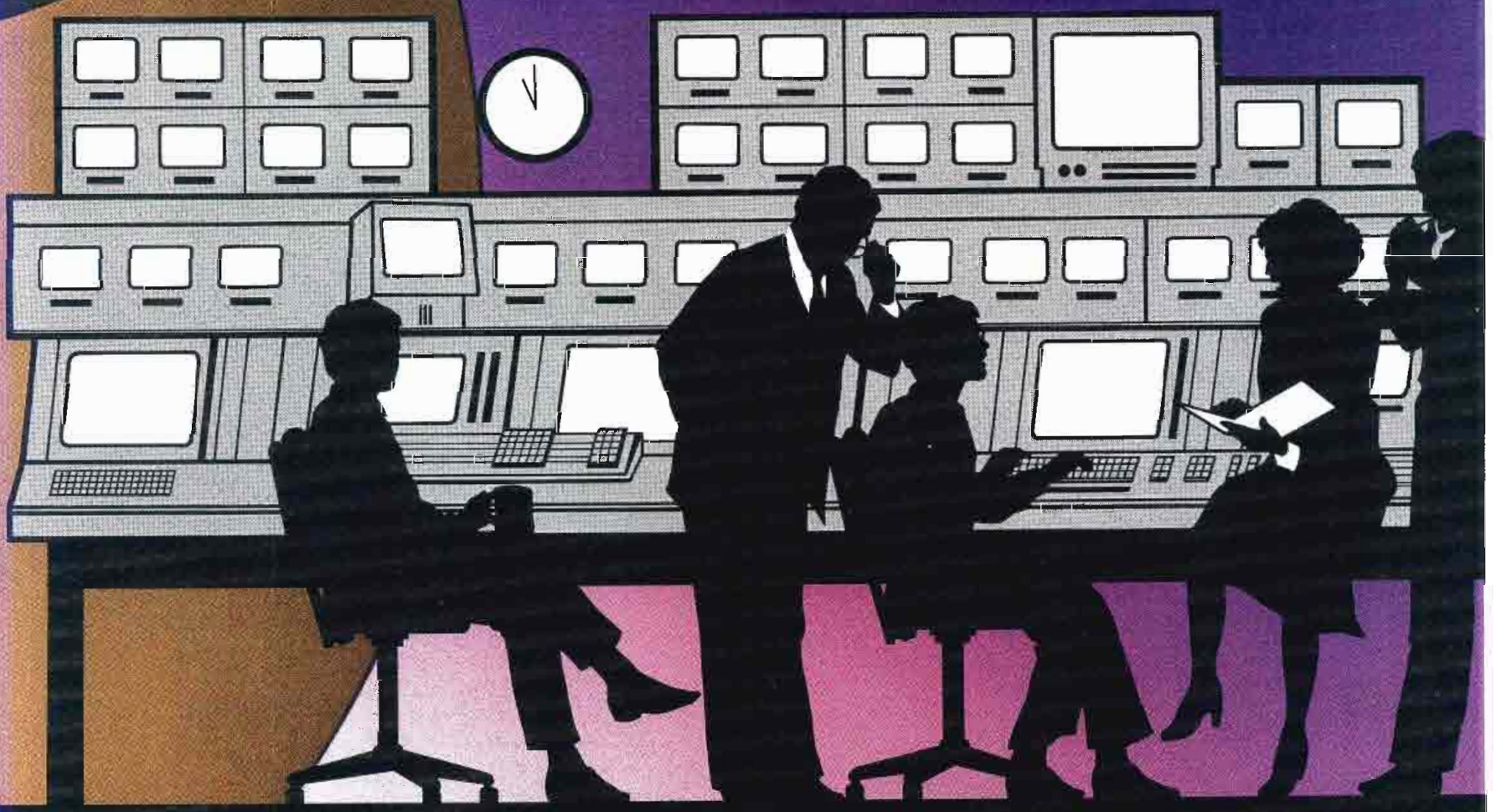

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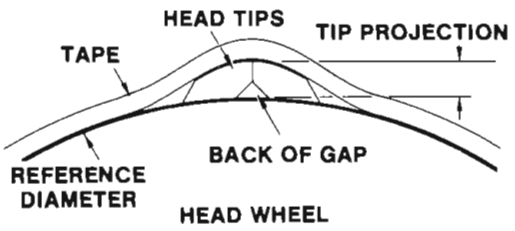
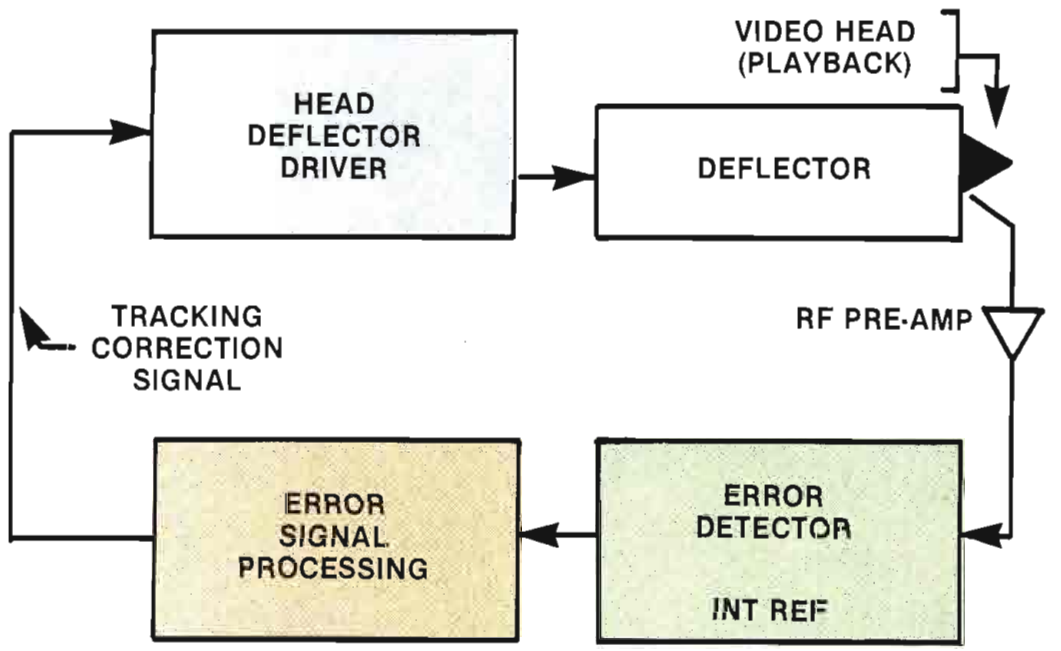


Figure 6. *In any format, head protrusion must remain constant as the head moves along its path against the tape.*

Figure 7. *Shown in block diagram form, a servo system compares the existing condition with a reference condition. The difference is determined, and a correction is generated to be fed back prior to the comparison point.*



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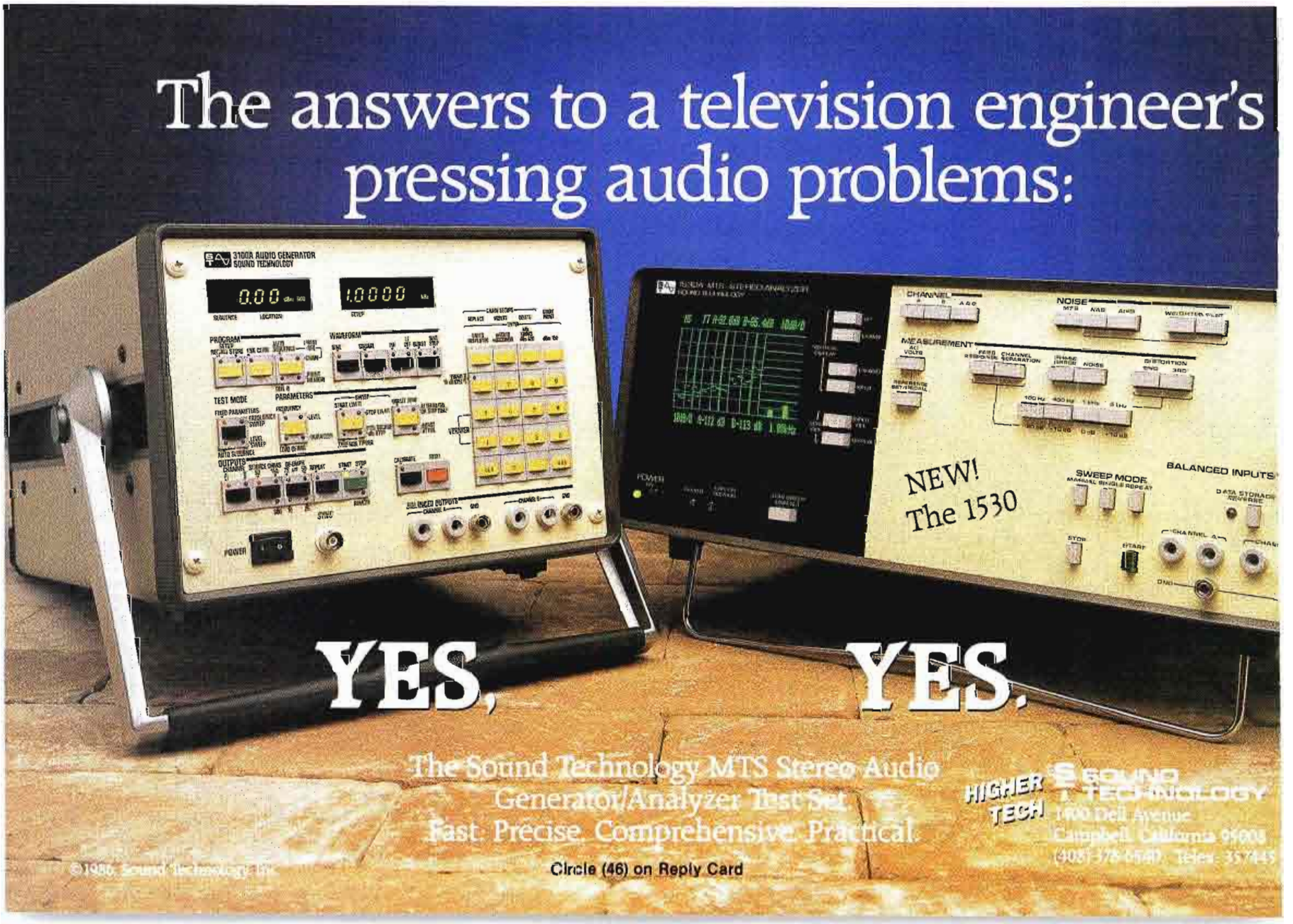
band, some of the present smaller formats forego the guard band and, starting with smaller video tracks, rely on track-alignment orientation to avoid intertrack interference.)

Other factors entering the record and reproduce process are more mechanical. Remember that the tape is moving at a constant speed through the deck. At the same time, the instantaneous speed of head motion across the tape also must be constant. If there is any variation, the effect adds to the striping effect of misadjusted or defective heads and channel electronics. *Velocity compensation*, often *velcomp* for short, electronically corrects such head-velocity errors.

Another mechanical factor is the protrusion of the video head against the tape. Ideally, the amount of protrusion is the same around the entire arc during which the head is in contact with the tape. (See Figure 6.) Practically, a constant amount of protrusion can almost be achieved through physical adjustment of the tape guide that directs the tape medium past the rotating head, holding the tape in the proper shape with the aid of a vacuum. Protrusion plays a part in both the record and reproduce functions.



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Control of the tape velocity through the transport unit is another mechanical problem that can be solved largely through electronics. The rotation of the capstan and pinch roller is controlled by a *servo system*. In essence, a servo system measures or senses a variable parameter, compares it to a fixed or reference value and performs a calculation to produce a correction signal. The correction is then fed back to a component that can exert some influence on the variable component.

Some functions in a VTR may even have a multilevel servo control, one to handle gross errors and a second to maintain tight tolerances. In effect, locking the VTR to house sync follows a stepped process involving horizontal and vertical sync as well as subcarrier, all through servo links. (See Figure 7.)

The rotational velocity of the head drum is handled by a second servo. Both of these speed-control systems must operate in close relationship to one another and to the timing of horizontal and vertical sync and the color-reference subcarrier signal of video. But minute timing errors, resulting from mechanical components, remain for eventual solution by a time base corrector.

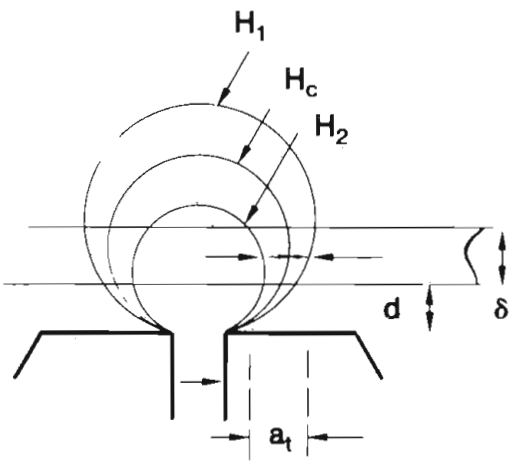

Figure 8. *The theoretical field contours around a typical recording head illustrate the importance of tape making proper contact with the head structure.*

Different similarities

Two major mechanical differences exist between the quad recorder and helical scan, which includes all 1-inch, ¾-inch, ½-inch, 8mm and ¼-inch. One is that the written video track covers an extended distance at an angle to the longitudinal axis of the tape, rather than as short tracks at almost 90° to the axis of the tape. The second difference makes possible simplified electronic editing and variable-speed playback. Each helical-scan track contains one video field and its vertical sync interval.

In type C, with a writing speed of approximately 1,000ips, there are still two motors that must operate in conjunction with one another and with the video signal. There are still velocity and time base errors that require correction. Such problems, conceivably, become less critical as the size of the format is reduced. Less velocity error should exist if the track length is reduced, assuming all else is equal.

However, a smaller format, such as ½-inch, introduces new requirements to the system. The head drum of a smaller tape format probably has a smaller diameter and less inertial mass than that of the 1-inch variety. Less inertia means that rotational and time base errors continue to be puzzles.

The smaller format brings up another point. If one track is a field, then ideally that track will contain as much information on a ½-inch tape as it does on 1-inch tape. To produce a track of the same length as on 1-inch, the tape must move faster (or a much shallower track angle might be considered) than for the 1-inch system. For an hour of recording, a longer length of tape is suggested, but for a smaller system, it would be preferable to reduce the size and mass of the tape for increased portability.

Increased data density in writing to tape solves this dilemma, packing more cycles of subcarrier into a shorter length. But to do this, two things are necessary. The physical dimensions of the recording head gap must be reduced, and the magnetic particles in the tape must be made smaller. However, if smaller particles are used, will they retain an equivalent magnetic field or must some other type of particle be considered?

It is worth considering for a moment some basic facts of recording. The physical distance that one cycle of recorded signal occupies along the tape is the wavelength (λ, or lambda). λ is directly proportional to the writing or relative velocity (v) between the head and the tape, while being inversely proportional to the frequency (f) of the recorded signal.

$$\lambda = v/f.$$

The linear packing density in recording is the number of flux reversals per unit of length along the recording medium. Two reversals or bits exist per cycle, so linear packing density may be written as:

$$\text{bits/in} = 2(1/\lambda) = 2/\lambda,$$

where λ is in inches.

Area packing density refers to the number of bits per unit area. It is the product of the number of recorded tracks per inch and the linear packing density, or:

$$\text{bits/in}^2 = (2/\lambda) \text{ tracks/inch}.$$

During recording, a temporally changing signal voltage (and current) is impressed across the windings of the recording head. The result is a magnetic field emanating from the head, which spatially approximates the voltage waveform. The instantaneous strength of the field is instrumental in producing changes in the polarity of the tape particles. To allow the greatest possible

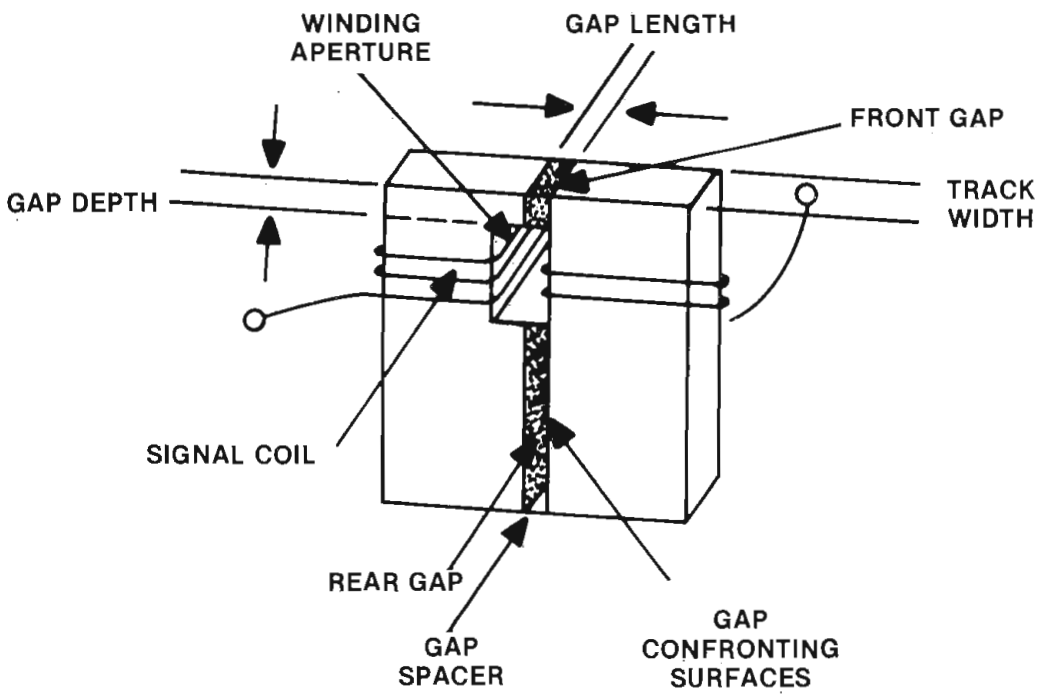

Figure 9. *The basic structure of a video record head. If the angular cut of the wiring aperture were made square with the face, as shown here, performance could be improved, but the head would be more fragile.*

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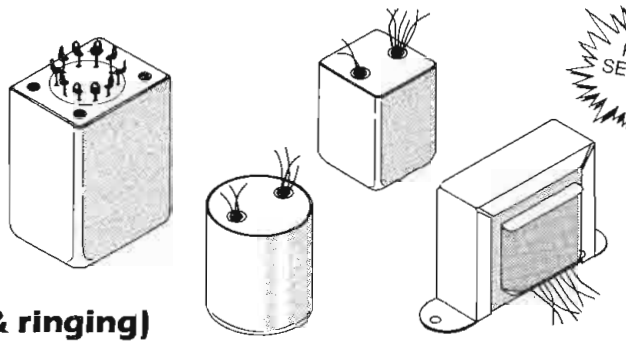

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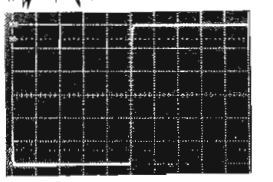

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INPUT TRANSFORMERS AND SPECIAL TYPES

Model	Application	Impedance Ratio Pri-Sec	Turns Ratio Pri:Sec	20Hz Max Input Level[1]	Typical THD Below Saturation (%) 20 Hz / 1 kHz	Frequency Response (dB ref. 1 kHz) 20 Hz / 20 kHz	Band-Width[2] –3 dB @(kHz)	20 kHz Phase Response (degrees)	Over-Shoot (%)	Noise Figure (dB)	Magnetic Shield[4] (dB)	Number of Faraday[4] Shields	Package[5]	PRICES 1-19	100-249	1000
MICROPHONE INPUT																
JE-16-A JE-16-B	Mic in for 990 opamp	150-600	1:2	+8	0.036/0.003	−0.08/−0.05	230	−8	<1	1.7	−30	1	A=1 B=2	75.42 82.89	49.87 54.81	34.40 37.81
JE-13K7-A JE-13K7-B	Mic in for 990 or I.C.	150-3750	1:5	+8	0.036/0.003	−0.09/−0.21	85	−19	<2	2.3	−30	1	A=1 B=2	75.42 82.89	49.87 54.81	34.40 37.81
* JE-115K-E	Mic in for I.C. opamp	150-15K	1:10	−6	0.170/0.010	−0.50/+0.10	100	−16	<7	1.5	−30	1	3	54.81	36.24	28.39
LINE INPUT																
JE-11P-9	Line in	15K-15K	1:1	+26	0.025/0.003	−0.03/−0.30	52	−28	<3		−30	1	1	122.22	80.82	55.75
JE-11P-1	Line in	15K-15K	1:1	+17	0.045/0.003	−0.03/−0.25	85	−23	<1		−30	1	3	52.32	34.59	27.10
JE-6110K-B JE-6110K-BB	Line in bridging	36K-2200 (10K-600)	4:1	+24	0.005/0.002	−0.02/−0.09	125	−12	<1		−30	1	B=1 BB=2	73.95 85.59	48.90 56.59	35.88 39.04
JE-10KB-C	Line in bridging	30K-1800 (10K-600)	4:1	+19	0.033/0.003	−0.11/−0.08	160	−9	<2		−30	1	3	53.17	35.16	24.53
JE-11SSP-8M	Line in / repeat coil	600/150-600/150	1:1 split	+22	0.035/0.003	−0.03/−0.00	120	−9	<3.5		−30	1	4	194.63	128.69	88.78
JE-11SSP-6M	Line in / repeat coil	600/150-600/150	1:1 split	+17	0.035/0.003	−0.25/−0.00	160	−5	<3		−30	1	5	98.39	65.06	44.88
SPECIAL TYPES																
JE-MB-C	2-way[3] mic split	150-150	1:1	+1	0.050/0.003	−0.16/−0.13	100	−12	<1		−30	2	3	44.85	29.65	23.24
JE-MB-D	3-way[3] mic split	150-150-150	1:1:1	+2	0.044/0.003	−0.14/−0.16	100	−12	<1		−30	3	3	76.19	50.37	39.42
JE-MB-E	4-way[3] mic split	150-150-150-150	1:1:1:1	+10	0.050/0.002	−0.10/−1.00	40	−18	<1		−30	4	1	114.40	75.64	52.18
JE-DB-E	Direct box for guitar	20K-150	12:1	+19	0.096/0.005	−0.20/−0.20	80	−18	<1		−30	2	6	54.56	36.07	28.23

1. (dBu) Max input level = 1% THD; dBu = dBv ref. 0.775 V
2. With recommended secondary termination
3. Specifications shown are for max. number of secondaries terminated in 1000 ohm (typical mic preamp)
4. Separate lead supplied for case and for each faraday shield
5. Except as noted, above transformers are cased in 80% nickel mu-metal cans with wire leads.

PACKAGE DIMENSIONS:

	W		L		H
1 =	15/16" Diam.			×	1 9/16"
2 =	3/16"	×	1 3/16"	×	1 5/8"
3 =	1 1/8" Diam.			×	1 1/16"
4 =	1 1/2"	×	1 3/4"		2 1/2" w/solder terminals
5 =	1 5/8" Diam.			×	1 3/4"
6 =	1 1/8" Diam.			×	15/16"

NICKEL CORE OUTPUT TRANSFORMERS[6]

Model	Construction	Nominal Impedance Ratio Pri-Sec	Turns Ratio Pri:Sec	20 Hz Max Output Level[7] across (n) windings (dBu)	(n)	600 Ω Load Loss (dB)	DC Resistance per Winding	Typical THD Below Saturation (%) 20 Hz / 1 kHz	Frequency Response (dB ref. 1 kHz) 20 Hz / 20 kHz	Band-Width –3 dB @ (kHz)	20 kHz Phase Response (degrees)	Over-Shoot (%)	Package	PRICES 1-19	100-249	1000
JE-11-BMCF	Bifilar 80% nickel	600-600	1:1	+26	1	−1.1	40Ω	0.002/0.002	−0.02/−0.00	>10MHz	−0.0	<1[9]	7	81.55	53.92	37.76
JE-11-DMCF	Bifilar 80% nickel	600-600	1:1	+21	1	−1.0	38Ω	0.004/0.002	−0.02/−0.00	>10MHz	−0.0	<1[9]	8	56.32	37.24	25.69
JE-123-BLCF	Quadfilar	600-600 150-600	1:1 1:2	+32	2	−1.1	20Ω	0.041/0.003	−0.02/−0.01	>450 170	−1.9 −4.0	<1[8]	7	73.85	43.14	29.76
JE-11SS-DLCF	Bifilar split/split	600-600 150-600	1:1 1:2	+27	2	−1.0	19Ω	0.065/0.003	−0.02/−0.01	>10MHz 245	−0.0 −2.5	<1[8]	8	53.62	35.45	24.46
JE-11-ELCF	Bifilar	600-600	1:1	+23.5	1	−1.1	40Ω	0.088/0.003	−0.03/−0.00	>10MHz	−0.0	<1[9]	9	36.36	24.04	16.59
JE-11-FLCF	Bifilar	600-600	1:1	+20.4	1	−1.6	58Ω	0.114/0.003	−0.03/−0.00	>10MHz	−0.0	<1[9]	10	27.36	18.09	12.48
JE-112-LCF	Quadfilar	600-600 150-600	1:1 1:2	+20.4	2	−1.6	29Ω	0.114/0.003	−0.03/−0.01	>450 205	−1.2 −3.2	<1[8]	10	32.80	21.69	14.96
JE-123-ALCF	Quadfilar	66.7-600	1:3	+26.5	3	−1.3	8Ω	0.125/0.003	−0.04/+0.06	190	−4.6	<6[8]	8	50.96	33.69	23.24
JE-11S-LCF	Bifilar w/ split pri.	600-600 150-600	1:1 1:2	+30	1 (sec)	−1.7	63Ω	0.058/0.002	−0.02/+0.01 −0.02/−0.05	>10MHz 155	+1.1 −4.1	<1[8]	8	50.96	33.69	23.24

6. Multifilar construction has no faraday shield: cannot be used as input transformer. All specifications are for 0Ω source, 600Ω load.
7. Max output level = 1% THD; dBu = dBv ref. 0.775 V
8. Source amplifier −3 dB @ 100 kHz
9. Source amplifier −3 dB @ 200 kHz
10. Output transformers are horizontal channel frame type with wire leads, vertical channel frames available. PC types available.

PACKAGE DIMENSIONS:

	W		L		H	Mounting Centers
7 =	1 1/2"	×	2 5/16"	×	1 15/16"	2 13/16"
8 =	1 5/16"	×	1 15/16"	×	1 5/8"	2 3/8"
9 =	1 1/8"	×	1 11/16"	×	1 3/8"	2"
10 =	1 1/16"	×	1 7/16"	×	1 3/16"	1 3/4"

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amount of retained magnetic information on the tape, there must be a maximum transfer of magnetic field to the tape.

During playback of recorded material, changes in magnetic polarity are sensed through the playback head. It is preferable that at point x all particles are oriented positively, and at point y they are aligned negatively. However, unless the tape is saturated, total alignment does not exist. Non-aligned particles detract from the field created by aligned ones and are the primary cause of tape noise.

Figure 8 plots theoretical head field contours with the recording zone in tape. H1 denotes a field gradient that will have the least effect on the tape, while H2 will have the greatest magnetizing force. The actual change made to particles in the tape depends upon the non-linear hysteresis characteristics of the formulation of the tape's magnetic material. This, in turn, involves retentivity or remanence, the capability of the particles to retain a magnetic orientation after the energizing field is removed. It also involves coercivity, the capability to change the orientation of the magnetic particles or domains.

The efficient transfer of magnetic energy to the tape depends upon head design and performance. Considerations in head design include track width, gap length, gap depth, core geometry (magnetic path length) and the magnetic properties of the head core material. The best design for an application usually means a compromise in these factors to meet requirements for short wavelength resolution (high-frequency response), extended head life and high record fields (for high-coercivity media).

Figure 9 shows the basic elements of a typical video-recording (and playback) head. An in-depth discussion of the various features leads to the physics (and mathematics) of magnetism. It is worth noting that even the winding aperture shape becomes a trade-off. On one hand is the desire to have the minimum shunting reluctance beneath the gap, that is, the effective enlarging of the gap area. On the other hand, the preferred angle creates a head structure that is subject to damage under the stress of normal operation.

No change in sight

As the industry moves toward more digital recording systems, the interest in detecting the changes in magnetic polarity becomes more pronounced. A greater importance is placed on the bits-per-inch density of the recording and the recovery of the data in its correct form. Both the composite and component digital formats for video recording go to great lengths to provide the most accurate recovery of the stored information, along with error-correction capabilities.

Error correction is the primary reason that a complex system of data shuffling is used in digital recording systems. Through the shuffling procedure, physical damage to the tape—creases, scratches and holes—can be concealed to a great extent because no two successive data words needed to reproduce the information are recorded in close physical proximity.

No matter how complex the format structure becomes, however, the fundamentals of recording remain fixed. Constant tape motion, constant head movement, high relative writing speeds, head gaps relative to the frequencies of the signals and the magnetic properties of the tape medium always must be of concern to recording system designers.

Editor's note: Background material for this article was obtained from "Videotape Recording," a publication by Ampex Corporation.

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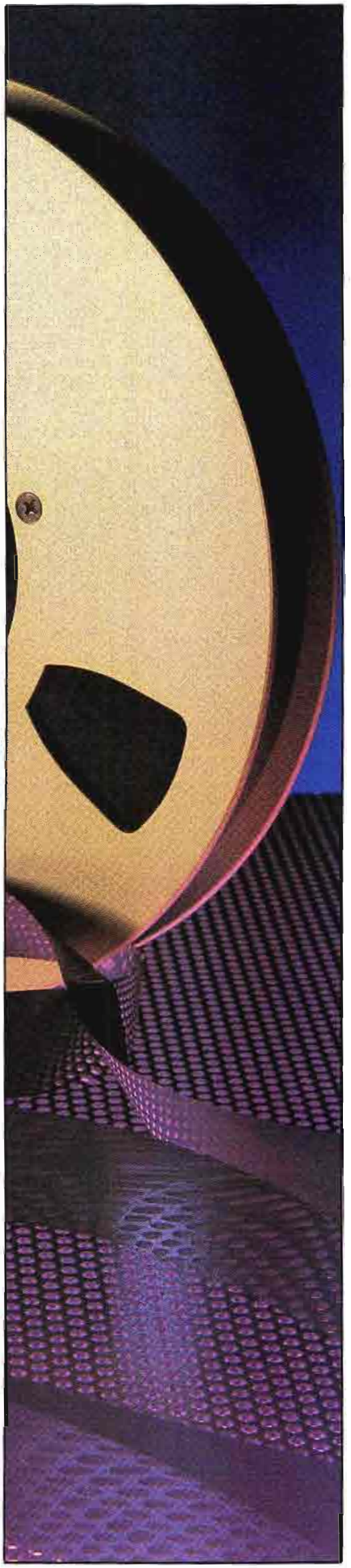

Preserving magnetic tape

By Walter E. Davies

The sounds of the world are preserved on magnetic tape. They can be kept alive for only as long as the tape lasts.

Magnetic tape has been entrusted to preserve a precious commodity, a heritage. Virtually all of the acoustical information in the world is on flexible magnetic media, which has a maximum lifetime measured in decades. Much is known about the factors that affect tape longevity. This article considers some of the more important ones.

Researchers at the National Bureau of Standards estimate that current magnetic tapes have a useful lifetime of approximately 20 years at ambient conditions.[1] Reading failures during accelerated life testing appear to be caused primarily by loss of material from the binder layer. It is worthwhile to explore the physical and chemical parameters that cause degradation of flexible magnetic media and the environmental factors that will provide the longest useful lifetime for it.

The cast of materials

Magnetic tape consists of a magnetically active coating on a flexible thin-film substrate of polyethylene terephthalate (PET). PET film retains its useful properties for hundreds of years at normal temperature and humidity (20°C and 50% relative humidity, or RH).[2]

The information-storing layer can contain oxide compounds of iron, cobalt and, sometimes, chromium. Some newer formulations contain metal particles rather than metal-oxide particles. The ferromagnetic particles are suspended in a binder that holds them to the film backing. The binder is a technical wizard's brew containing components that serve as lubricants, adhesives, dispersants, anti-static agents and stabilizers. The principal binder component usually is cross-linked polyester polyurethane, but polyvinyl chloride (PVC) and polyacrylonitrile also are used.

Tape life is determined by the physical stability of the base film and the chemical stability of the oxide coating. These factors are controlled to a great extent by the environmental conditions of temperature, humidity and cleanliness.

Base film stability

The coefficient of expansion for temperature and humidity are relatively uniform for all polyester-based magnetic tapes. For temperatures from 50°F to 110°F:

$$K_T = 1.5 \times 10^{-5} \text{ in/in/F°}.$$

For relative humidity from 20% to 90%:

$$K_H = 1.1 \times 10^{-5} \text{ in/in/\% RH}.$$

The following example shows how these coefficients relate to this discussion. Take a tape that has been in use in a hot, muggy (95°F, 90% RH) on-location recording situation. Now place that tape in a cold, dry (50°F, 40% RH) tape-storage locker. The tape, when it reaches equilibrium, will attempt to shrink by almost 6 feet in length. The pressure loading on the hub and inner layers of tape is crushing.

Humidity and headwear

The most important factor (in terms of headwear) is environmental conditions

Davies is director of research for Gamma Omega Associates (The LAST Factory), Livermore, CA.

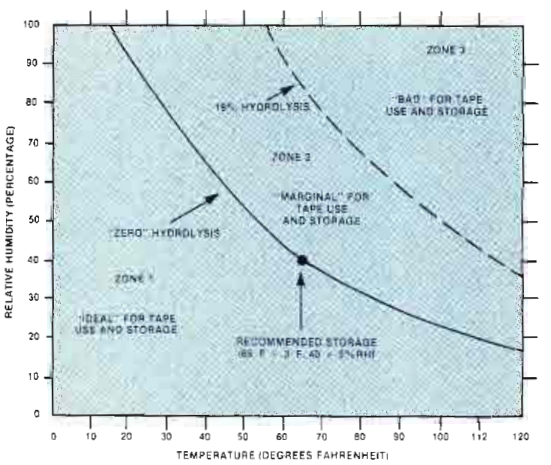

Figure 1. *Tape-storage recommendation based on the hydrolysis of the binder.*

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Static and dropouts

Small dust particles and other debris are attracted to magnetic tape by the static charge that accumulates on the tape surface during use. The force of attraction varies inversely with the square of the particle size. Particles adhering to the tape when it passes the head are driven into the tape, where they cause dropouts. In an atmosphere of low humidity, the static attraction is so great that the particles cannot be removed by gentle wiping. High speeds and low RH aggravate this problem.

To minimize static build-up, conductive material is added to the oxide to reduce its resistance and drain off the static charge. Some back coatings or back treatments achieve a low surface resistance that allows excessive static charge to drain to the hub. In addition, back coating increases interlayer friction and reduces the probability of layer-to-layer slippage due to tape contraction or expansion during storage.

rather than the physical characteristics of tape. The head-to-tape interface is particularly sensitive to environmental humidity, and wear may be five to 10 times greater at 90% RH than 40% RH.[3]

Air-filtering procedures also are critical, because air pollution, such as dust and smoke, can double the headwear rate. Therefore, humidity control and air-cleaning procedures (as well as a ban on smoking and eating) should be instituted in tape workrooms and storage areas.

Storage environments

Large swings in either temperature or humidity are detrimental to the life of stored tape. Rapid changes in temperature or humidity place enormous stress on a tape pack. If tape is stored under one set of environmental conditions and used in another, it should be allowed a period of time to condition (reach equilibrium to the new environment).

Although changes in a tape's environment can be damaging, it is the cycling back and forth over temperature and humidity gradients that is most destructive to a tape. Given the choice, the tape user, the librarian or the archivist should store tapes in a relatively constant environment that is not subject to dramatic and rapid temperature or humidity swings.

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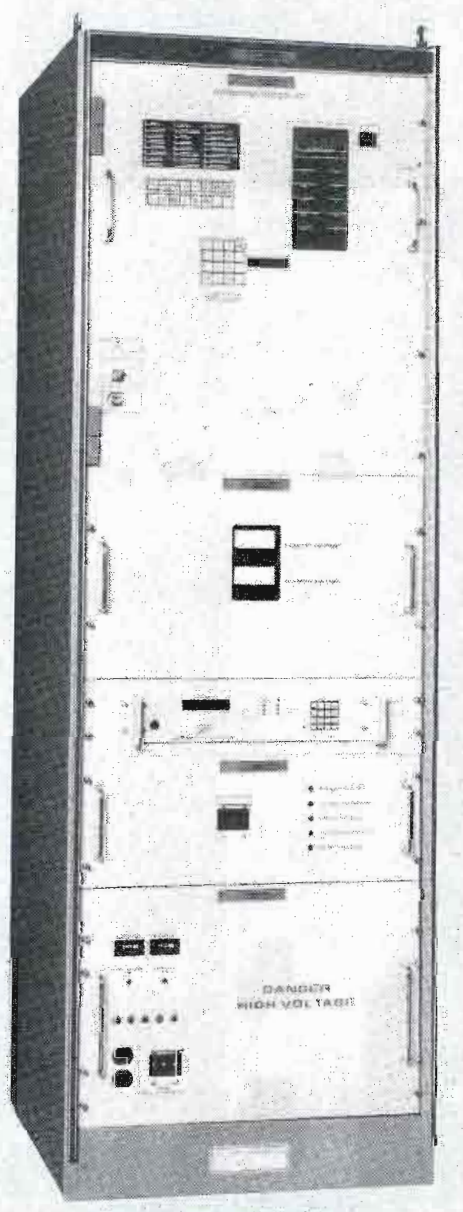

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Manufacturers recommend that tape storage be dust-free.[4] The tape should be on flanged reels for long-term support and should be placed in well-sealed polyethylene bags. The function of the bags is to prevent lubricant evaporation and to act as a hermetic seal to reduce binder degradation. The bagged tape should be boxed and stored in a vertical position on the shelf. A reasonable storage environment could be considered the range of 55°F to 75°F with a humidity range of 30% to 45% RH.

Tape binder degradation

The physical effects of environmental temperatures and humidity act primarily on the film base that carries the magnetically sensitive layer. The degradation of the binder, which contains the magnetic particle suspension, is principally a chemical process.

It was stated previously that most magnetic recording tape uses a cross-linked *polyester* polyurethane binder. A polyester is a chain of *ester* compounds. Esters are formed as a result of chemical reactions between acids and alcohols. This reaction releases water as a by-product.

Tape in the presence of atmospheric moisture is subject to *hydrolysis*. In this reaction, water combines with an ester to form carbolic acid and alcohol. Because the ester is part of the linking that holds together the binder, hydrolysis weakens the binder and results in the shedding of the oxide layer, in dropouts and the eventual loss of the tape (and its information) through severe degradation.

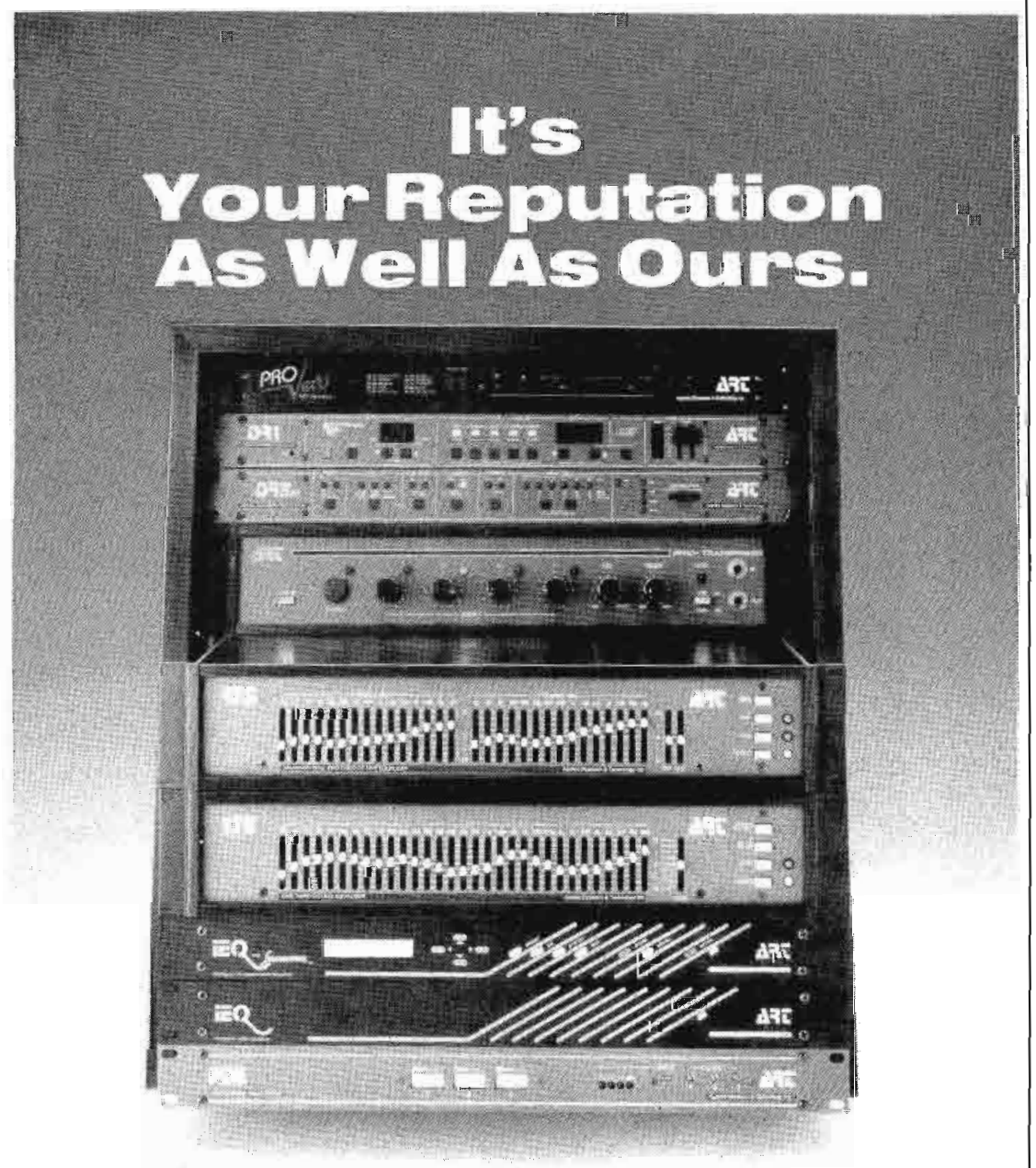
The good news is that hydrolysis is reversible and need not occur under proper storage conditions. Because hydrolysis is a chemical reaction, the rate of the reaction depends upon the concentration. And, unlike most chemical reactions, it is temperature-dependent; that is, it varies directly with temperature.

So where does all this lead? An environmental safety zone exists for the use and storage of magnetic tape. Certain combinations of temperature and humidity are only marginally safe. Finally, under some conditions, hydrolysis proceeds to a point that the tape binder cannot be used or stored safely. The graph in Figure 1 illustrates the range of environments safe for tape use and storage.[5]

The range of tape defects

Six major types of tape defects exist, each with a probable cause. Some allow recovery, while others do not.[6] The six problems are:

1. *Oxide pullout.* Recovery is impossible. The usual cause is hydrolysis.
2. *Permanent errors.* Plastic cold flow from non-uniform and excessive stress builds up in the tape when it is subjected to changes in temperature and humidity. These environmental changes cause different rates of expansion in the length and thickness of the tape, producing stresses that permanently deform the tape.
3. *Surface contamination and dimples.* Usually, dirt wrapped into a reel eventually will create dimples in adjacent layers of tape. Recovery is probable through cleaning and multiple passes on the machine used to reproduce the recorded information.
4. *Creases and scratches.* Creases usually are caused by poor wrap in the tape pack. These are aggravated by poor handling and undesirable environmental conditions. Recovery is possible if you follow the procedure recommended in item 3.
5. *Torn tape in the middle of the pack.* This is a sure sign that the tape was subjected to temperature and humidity extremes, either in storage or transit.



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Federal guidelines for magnetic tape storage

By Gerald Rosenkrantz

The following information appears in the "Handbook of Recommended Environmental Conditions and Handling Procedures for Magnetic Tape."

Environmental conditions for tape-storage rooms and buildings.

1. Tape-storage vaults and rooms shall be temperature- and humidity-controlled. A positive air pressure is desirable to prevent intrusion of dust.
2. Temperature range shall be 70°F ± 10°F in vaults and 70°F ± 20°F in workrooms.
3. Humidity range shall be 50% RH ± 10%.
4. Dust and dirt controls shall keep dust particles to 50 microns.
5. Areas used to store or condition magnetic tape should have in operation continuous temperature- and RH-recording equipment.
6. Magnetic tape should be protected from high-intensity magnetic or electrical fields. These include power-generation facilities and transmission lines, radar installations, bulk degaussers and magnetic check sorters.
7. Metal storage racks should be electrically grounded, and at least a 2-foot separation should be maintained between all electrical fixtures, power lines and storage racks.
8. Tapes must be stored in an upright position (on flange edge), not flat on their sides.
9. For any storage in excess of one year, canisters that support the reel at the hub are strongly recommended. These provide an additional level of protection against dust, handling, environmental changes, and the effects of water and smoke if automatic fire-extinguishing equipment should be triggered.
10. Buildings housing tape should be protected by lightning arresters.

Rosenkrantz is employed in the Data Archives Branch of the National Archives and Records Service, Washington, DC.

6. *Adhesion and blocking.* Adhesion of adjacent tape layers is caused by static build-up on tape surfaces and storage of tapes in extremely dry conditions. Excessively low humidity may be by design (a mistake) or because a humidifier is not being used in conjunction with air-conditioning. Blocking has no recovery procedure. Excessive humidity and temperature will cause the inner ½-inch of a tape pack to become a solid mass of base and binder. It can be prevented only by proper environmental controls.

Long-term stability

It is possible to increase the long-term stability of tape, but can anything be done for tape that has approached the 20% hydrolysis level? Polymer chemists in the tape industry have developed preservatives that address these and other questions.

The prime considerations are effectiveness, safety, compatibility and stability. A concomitant characteristic of importance to users is the capability to apply a preservative to existing magnetic media.

A preservative must act as a buffer to slow the process of hydrolysis. If it can increase the size of the safety window, so much the better (see Figure 1). It must present no safety hazard in its use or application. A preservative must be non-toxic, non-carcinogenic, non-flammable and non-injurious to personnel and tape.

The problem of compatibility is substantial. A preservative must be fully compatible with the various magnetically sensitive materials as well as with all the components in the binder matrix. Finally, this magic bullet must maintain its stability and remain effective, safe and compatible for decades.

Testing

Tests by numerous organizations have demonstrated a high level of satisfaction with a chemical family that has met these requirements and solved other tape-wear problems.

A member of this family has been used for several years as a preservation component, in small quantities, in binder applications. Because the preservative and the surface lubricant are molecularly (rather than chemically) bound in the binder matrix, a search was initiated to locate a different family member that would combine the functions of lubricant and preservative. The search has come to fruition with the development of such a component. Furthermore, the material may be applied after market, in the field. This means that its benefits are available for tape currently in use and in storage.

The preservative's effectiveness has been demonstrated through accelerated-wear tests by several test agencies. In comparing identical tapes, half of which were treated with the preservative, it was shown that abrasion of the treated tapes was cut in half, the coefficient of friction was reduced by one-third, and the life of the tape was extended by three to seven times, depending upon the type of oxide.

The preservative easily meets safety standards and is completely non-hazardous in use or application. It will not degrade under storage or use conditions for magnetic tape, and it is so stable that its lifetime approaches that of the PET base material.

To assure compatibility, the search was restricted to recognized, current product groups used in this application. In addition, tests have determined compatibility with all of the materials with which tape would come into contact during normal use. Heads, guides, rollers and capstan-drive components, as well as the many plastics that make up housings, all have been tested successfully.

Preliminary findings point to some performance benefits as well. The improved interface between head and tape has resulted in increases in signal-to-noise ratios, improvements in high-frequency response and decreases in distortion levels. These results have strong implications in the analog recording domain.

Current testing involves the factors of coercivity, retentivity, print-through and ongoing life. Experiments will continue as the industry nears the goal of preserving its acoustic and video heritage.

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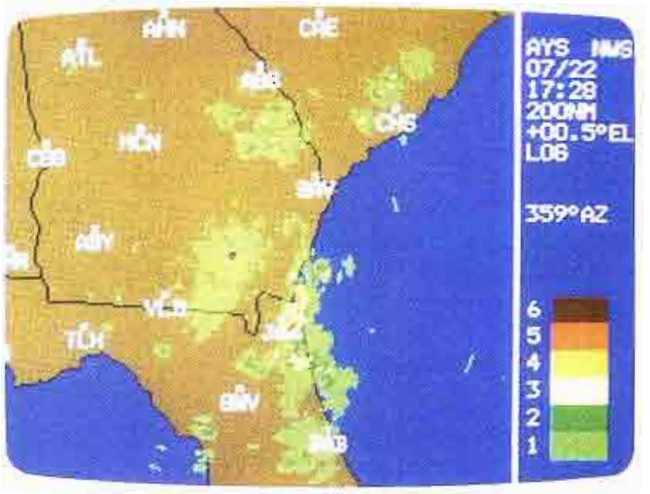
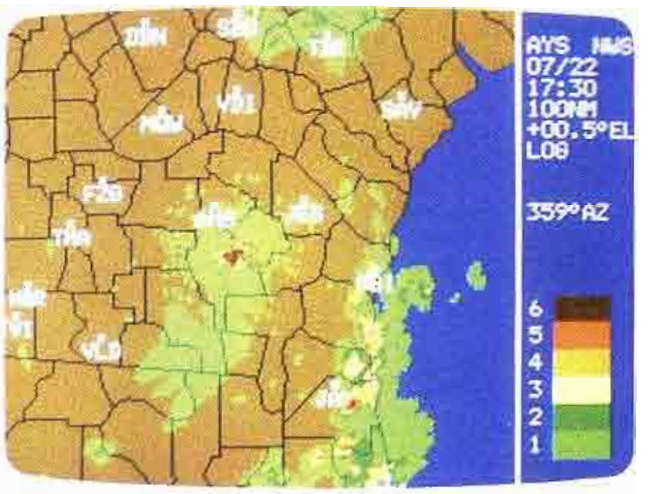
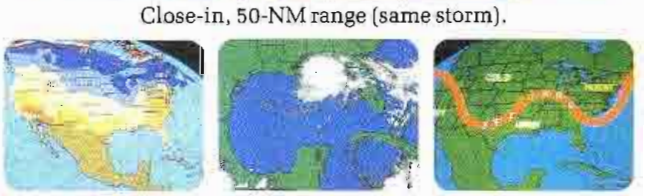


Waycross, GA: 200-nautical mile range.



Same storm, 100-NM range (with county lines).

Close-in, 50-NM range (same storm).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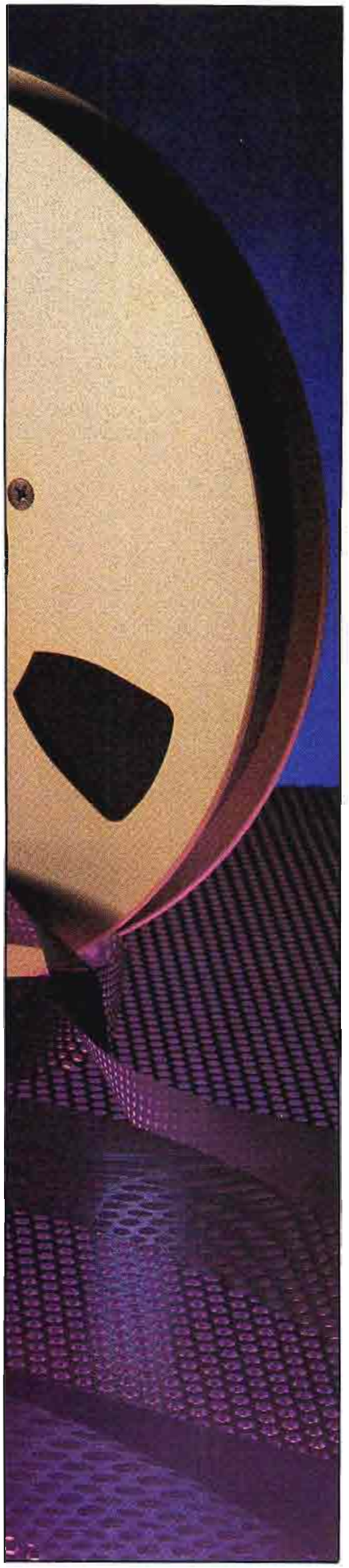

Erasing magnetic tape

By Robert A. Schultz

To erase magnetic media, be aware of Oe.

Bulk erasure of magnetic recording tape is a vital precautionary measure in the video facility. Nearly all tape recorders have erase heads. However, the recorder does not monitor the operational integrity of the erase head. In view of the tremendous production costs, rerecording programs over previous signals can prove to be a technical disaster.

Initial reports from the field note that conventional bulk erasing technologies and fully functional erase heads do not remove all signals from the emerging generation of videotape material. The problem stems from *high-energy* media, typically made of metal particle and other high-density magnetic storage material.

Some theories

When some metals are enclosed within a magnetic field, certain characteristics of the metallic structure are altered to achieve alignment with the polarity of the magnetic field. If all the magnetic domains of the metal are aligned, the metal is said to be *magnetically saturated*. The amount of magnetic field remaining after the magnetizing force is removed is called *retentivity*. The term *coercivity* is the applied field strength in oersteds (Oe) needed to demagnetize, or erase, a fully magnetized material.

Electromagnets, like transformer cores, have low coercivities. Their magnetism falls toward zero when electrical current is removed. For proper operation of these two types of equipment, any high degree of retentivity is undesirable. For a material to be useful for information storage, it must have a high degree of retentivity, or permanent magnetism, after the initial field is removed.

Non-zero coercivity materials are used for permanent magnets, including videotape. High coercivity offers the advantage of supporting shorter distances between changes in magnetic polarity. This enables tape to store more video information per unit area, which reduces tape costs and equipment size.

Table 1 compares coercivities of typical videotapes and describes their sizes or *form factors*. Manly plotted field strength for erasure of 300 Oe to 850 Oe media and stated that the results "render erase design to a straightforward engineering problem."[1] However, extended ranges of magnetic properties and physical sizes present new challenges to meeting the goals of effective and reliable erasure.

Schultz is director of research and development for Data Security, Lincoln, NE.

FORMAT	FORM FACTOR	COERCIVITY
		(Oe)
Standard energy:		
2" quad	Open reels to 14" diameter	350
High energy:		
1" type C, B	Open reels to 14" diameter	650
U-matic (¾")	Large cassettes	650
VHS/Beta, ½"	Medium cassettes	650
D-1 digital, 19mm	Medium/large cassettes	*840
VHS-C, ½"	Small cassettes	900
Metal particle:		
8mm	Small cassettes	1,000
M-II, ½"	Small/medium cassettes	1,500
Beta-SP, ½"	Small cassettes	1,500

* Increase to 1,500 Oe is planned.

Table 1. *The sizes and coercivities of videotapes.*

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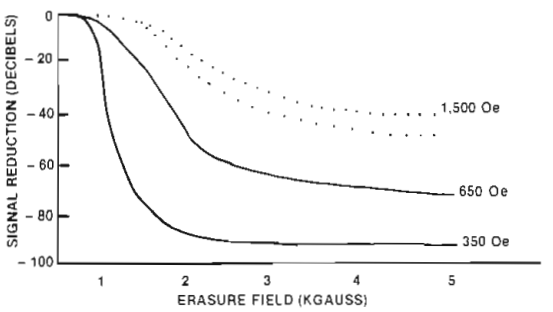

Figure 1. *Erasure performance vs. magnetic field strength. Performance of 1,500 Oe media is speculative.*

Form factors and erasure performance

A trend for placing higher-coercivity media into smaller form factors is reflected in Table 1. You might expect that higher-coercivity media could be erased effectively with stronger magnetic fields than are customary for current technology, and that these strong fields would be relatively easy to generate in the smaller volume of the new media. Although it may seem that a variety of erasers are available for different media, there is the possibility that users will place media with small form factors in machines intended for large reels with lower-coercivity tape. This could result in incomplete erasure.

Additional concerns accompany the *steamroller* approach for erasing higher-coercivity media with stronger magnetic fields. Conventional erase fields generate ac eddy currents in conductive materials. Aluminum hubs and flanges of tape reels are warmed noticeably by this effect at present erase-field levels. The possible effects of heat on new cassettes also must be considered.

Another limitation in the use of strong fields for erasure is the *performance plateau*. This effect has been well characterized using purely oriented erase fields on single layers of 350 Oe and 650 Oe tapes.[2] As shown in Figures 1 and 2, field strengths in excess of the plateau will not remove additional signals, but can cause added heating by eddy currents.

The known performance plateaus are about 95dB loss of saturated long-wavelength signals for 350 Oe tape and 70dB for 650 Oe tape, when fields are aligned with the magnetic particles in the oxide coating. It is conceivable, through extrapolation, that the performance plateau for 1,500 Oe tape would fall at about 30dB, leaving 3% of the original signals on tape after erasure. Practical bulk erasers may improve these numbers by exposing tape to a variety of field orientations. Still, the pessimistic estimate is not out of line with actual observed performance when conventional technology is applied to metal-particle tape.

Video formats

A typical videotape format stores information in four areas or tracks. The control track, located near one tape edge, aligns the video tracks with the recorder. It is analogous to the sprocket holes in movie film, which align the picture frames with the projector film gate. The video tracks are adjacent to the control track and occupy the largest amount of tape area. Audio and time-code tracks usually are located on the tape edge opposite the control track.

The audio format is similar to a standard audiocassette. The time-code track contains digital-based information for editing and indexing purposes. Beginning as a series of 4-bit words to indicate frame, second, minute, hour and others for user bits, the data is converted to a frequency-shift keying-type signal for the actual recording. As such, the signal consists of specified mark and space audible tones.

The typical format exists on tape with various sizes of reels and cassettes. One challenge to bulk erasure design is a process that is effective for each type of

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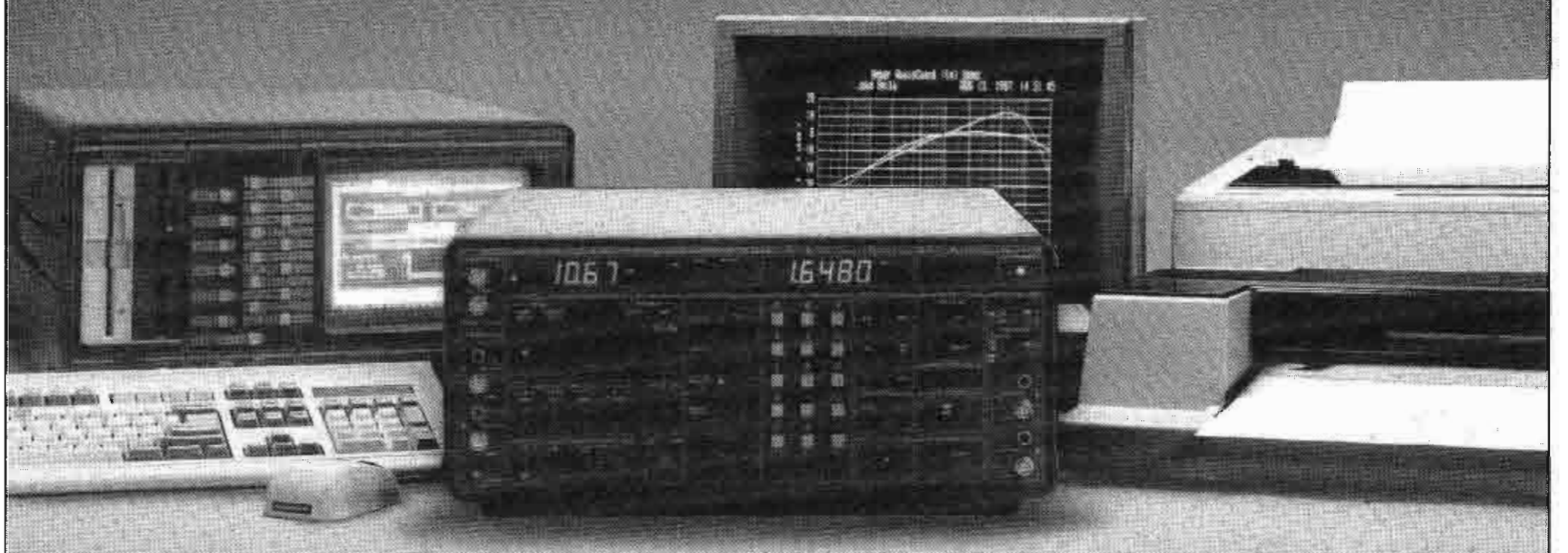

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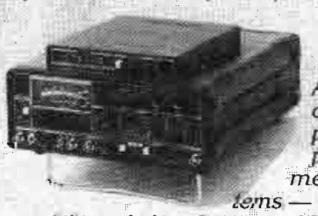

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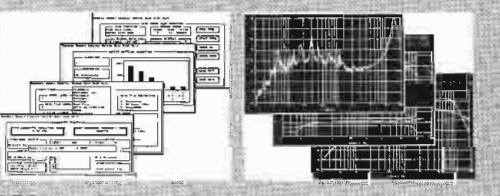

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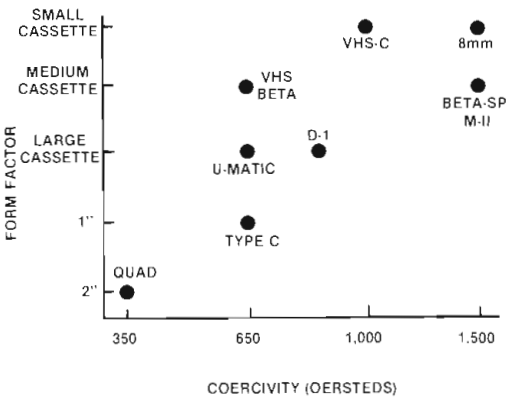

Figure 2. *Possible relationship between video formats and erase field strengths.*

track anywhere within the volume of the magnetic fields. Belt-type erasures have satisfied this goal adequately for high-energy types rated to 650 Oe.

Erasure problems

Erasure by recorder heads or bulk processes may perform differently for each track. Theory and experience prove that, through the use of an erase head with uniform magnetic fields across the tape width, video tracks are erased more effectively than the other tracks. This is a result of unsaturated recording due to the shorter wavelengths of video signals.

Bulk erasure processes must generate magnetic fields covering much greater areas than those of erase heads. In addition, the shapes and orientations of bulk fields differ considerably from those of tape in cassettes or on reels. Commonly, some type of tape motion is employed to obtain uniform erasure conditions.

In conventional belt-type erasers, the recommended motion is two passes through the erasing fields with an intermediate rotation of a one-quarter turn (90°) performed by the operator. If tape motion is inadequate, erasure performance is subject to variations along the tape. These variations usually appear as recurring events at intervals of one to several seconds, the intervals varying slowly with the diameter of the tape on the reel.

The uniformity of field strength is another factor critical to erasure performance. It is physically impractical to generate a uniform field through the entire volume involved in the erasure process. Most bulk erasers have iron cores with pole faces where the maximum magnetic field strength exists. Thus, erase fields are strongest and most effective toward one or both of the tape edges, depending on core symmetry and tape width. Erasure strength diminishes toward the center of a symmetrically magnetized volume.

Symptoms of inadequate erasure are associated with the functions of each track. If the control-track erasure is inadequate, the capability to synchronize video frames is compromised, and the video image jitters. Incompletely erased video tracks cause ghost images. Time codes from previous recordings must be removed to allow the decoder to interpret signals from new recordings. It should be possible to effect this digital process even with poor signal-to-noise ratios that would be unacceptable in audio or video tracks. If you're using time code to edit or cue tapes, inadequate performance produces errors or problems.

From the standpoint of human sensitivity, erasure of audio tracks is perhaps the most difficult, but it is the simplest to evaluate using standard equipment. Play the erased tape and turn the volume control toward maximum. Any sound recognizable as speech or music indicates a serious erasure problem. The periodic noise whump from sudden termination of the erase process is another adverse symptom that may be detected during this test. In contrast, a constant sound of white noise resulting from electronic amplifiers and tape microstructures indicates complete audio erasure.

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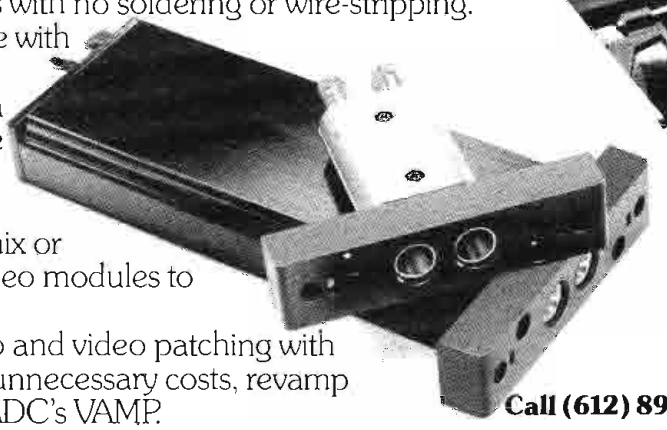

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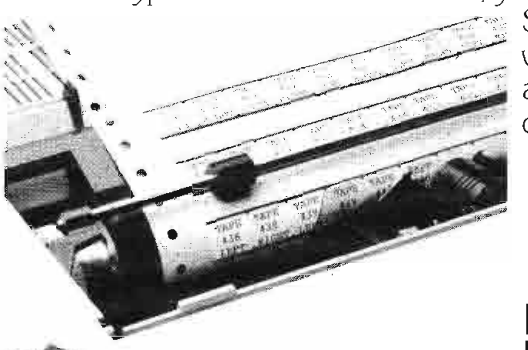

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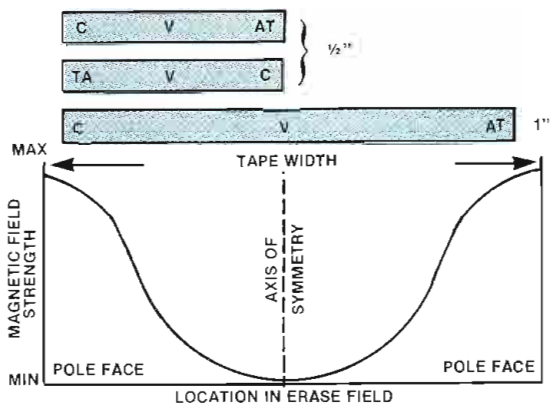

Figure 3. *The trend is higher coercivities with decreasing form factors.*

Technology outlook

The belt-type degausser constitutes the conventional technology appropriate for coercivities of 650 Oe or less in professional video applications (see Figure 3). This machine is simple to operate, but does require some manual manipulation of the media to provide an effective mixture of magnetic field orientation with respect to tape wound on reels. The possibility exists that a sloppy operator will not erase media thoroughly.

The initial users of 1,500 Oe videotapes, however, have disclosed some erasure problems with the best available belt-type degaussers. Users also may anticipate some less severe problems when VHS-C cassettes rated at 1,000 Oe are used. Fortunately, new degausser processes exist to deal with these problems. These processes have brought about new degausser configurations as well as novel erasure conditions.

A configuration consistent with high-quality erasure is the *automatic-cycle* approach. This class of machines accepts media from the operator and implements all stages of the erasure process without further intervention or the need for manual manipulation. Erasures with automatic cycles have become widely accepted in instrumentation recording, and several models have received government approval for removal of sensitive intelligence information from 350 Oe tapes. These units are generally effective for applications using 650 Oe tape, but they do not have the high throughput common to belt-type products. Conventional automatic-cycle erasures are not known to be capable of the performance required for 1,500 Oe media.

Most automatic-cycle machines implement media motions and magnetic processes through simple mechanical linkages and passive circuits. Monitoring of field currents with the familiar ammeter is the standard approach. However, the basic configuration is amenable to more sophisticated control and monitoring of the erasure process.

One novel enhancement of erasure performance is based upon pre-exposure to strong dc magnetic fields, pushing back the performance limits of magnetic tape erasure, as illustrated in Figure 1.[3] With this technique, strong fields can be applied without heating because dc fields do not generate eddy currents. However, application of ac fields also is needed because dc emphasizes tape noise induced by coating microstructures.

Prepare yourself

Today's video recording technology is changing rapidly. Shifts toward new formats and higher-energy tapes are inevitable because of lower costs and smaller equipment. Potential users of high-energy tapes must ensure that their bulk erasure technology is up to the challenge.

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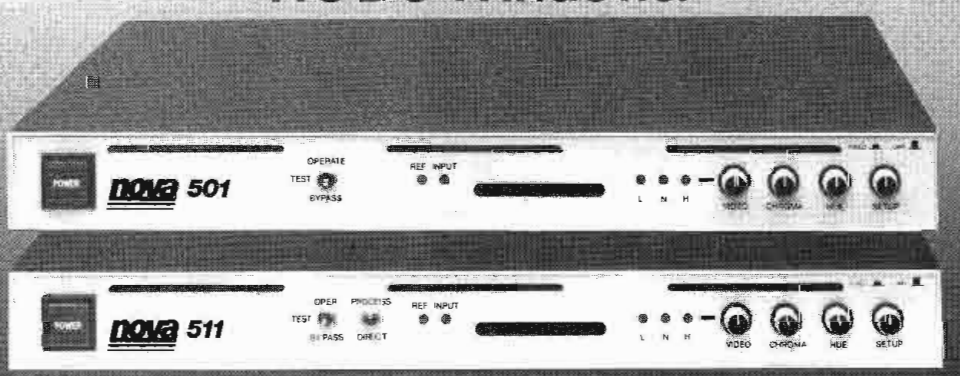

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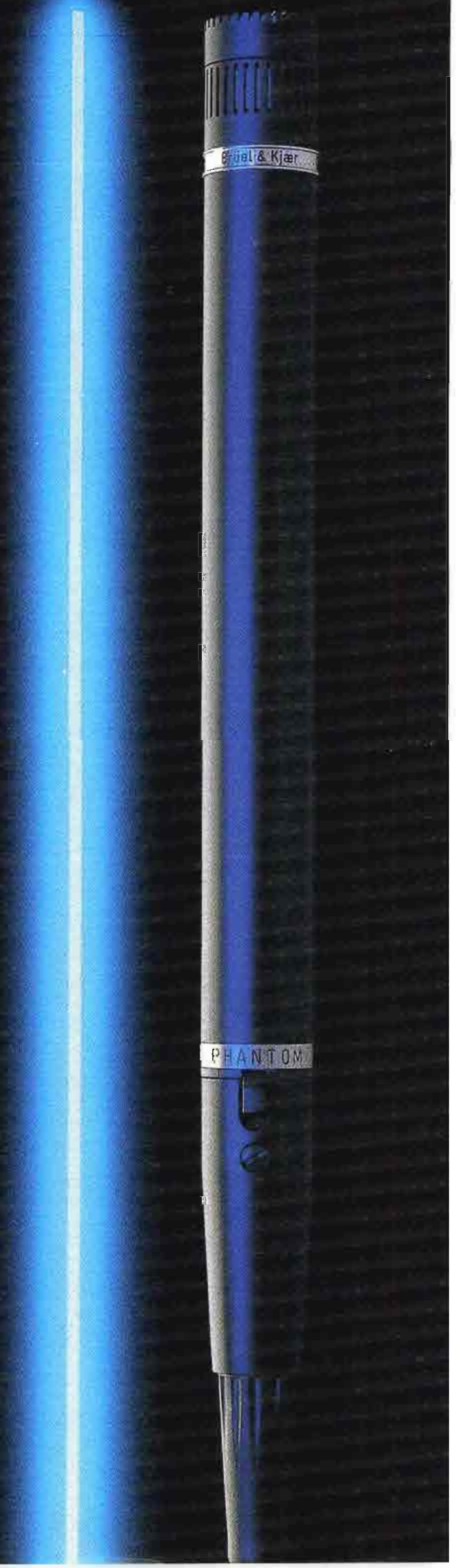
THE TYPE 4011 CARDIOID PROFESSIONAL MICROPHONE JOINS THE SERIES 4000 RANGE OF PROFESSIONAL MICROPHONES — THE PRODUCT OF TEN YEARS OF RESEARCH AND DEVELOPMENT BY A TEAM OF DEDICATED SPECIALISTS. THE 4011 IS A PREPOLARIZED CONDENSER-MICROPHONE, WITH A FIRST-ORDER CARDIOID DIRECTIONAL CHARACTERISTIC WHICH COMBINES A FLAT ON-AXIS FREQUENCY RESPONSE WITH A UNIFORMLY SMOOTH OFF-AXIS PHASE AND FREQUENCY RESPONSE. THE TYPE 4011 CAN HANDLE 158dB SPL BEFORE CLIPPING. COUPLED WITH EXTREMELY LOW DISTORTION, THIS GIVES THE TYPE 4011 A SONIC PERFORMANCE UNEQUALLED BY ANY OTHER CARDIOID. THESE DESIGN FEATURES OPEN UP A WIDE RANGE OF APPLICATION POSSIBILITIES.

THE WORK BRÜEL & KJAER'S ENGINEERS HAVE PUT INTO THE DESIGN OF THIS MICROPHONE ENSURES THAT IT WILL NOT BECOME READILY OBSOLETE DUE TO RAPID ADVANCES IN TECHNOLOGY. THE CRAFTSMANSHIP AND MATERIALS INVOLVED IN ITS CONSTRUCTION ARE WHAT MAKE THE DIFFERENCE BETWEEN A GOOD MICROPHONE AND A SUPERB MICROPHONE, AND ALLOW THE 4011 TO BE CALLED, JUSTIFIABLY, A WORK OF ART. ITS TECHNICAL SPECIFICATIONS PAINT AN IMPRESSIVE PICTURE, BUT THERE'S MORE TO IT THAN THAT. PUT THE 4011 TO USE AND YOU'LL FIND THAT, FOR ONCE, WHAT YOU READ TRANSLATES INTO WHAT YOU HEAR.



Brüel & Kjær

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Circle (63) on Reply Card

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The art of film-to-tape transfer

By Colin J. Brown

High-quality transfer work requires the proper equipment and a good deal of operator judgment.

The split screen is the testing ground of the film-to-tape transfer process. Advertising producers and directors of blockbuster films select transfer houses by comparing transfer samples side by side, rating color clarity and integrity, image crispness and the overall polish and balance of the scene.

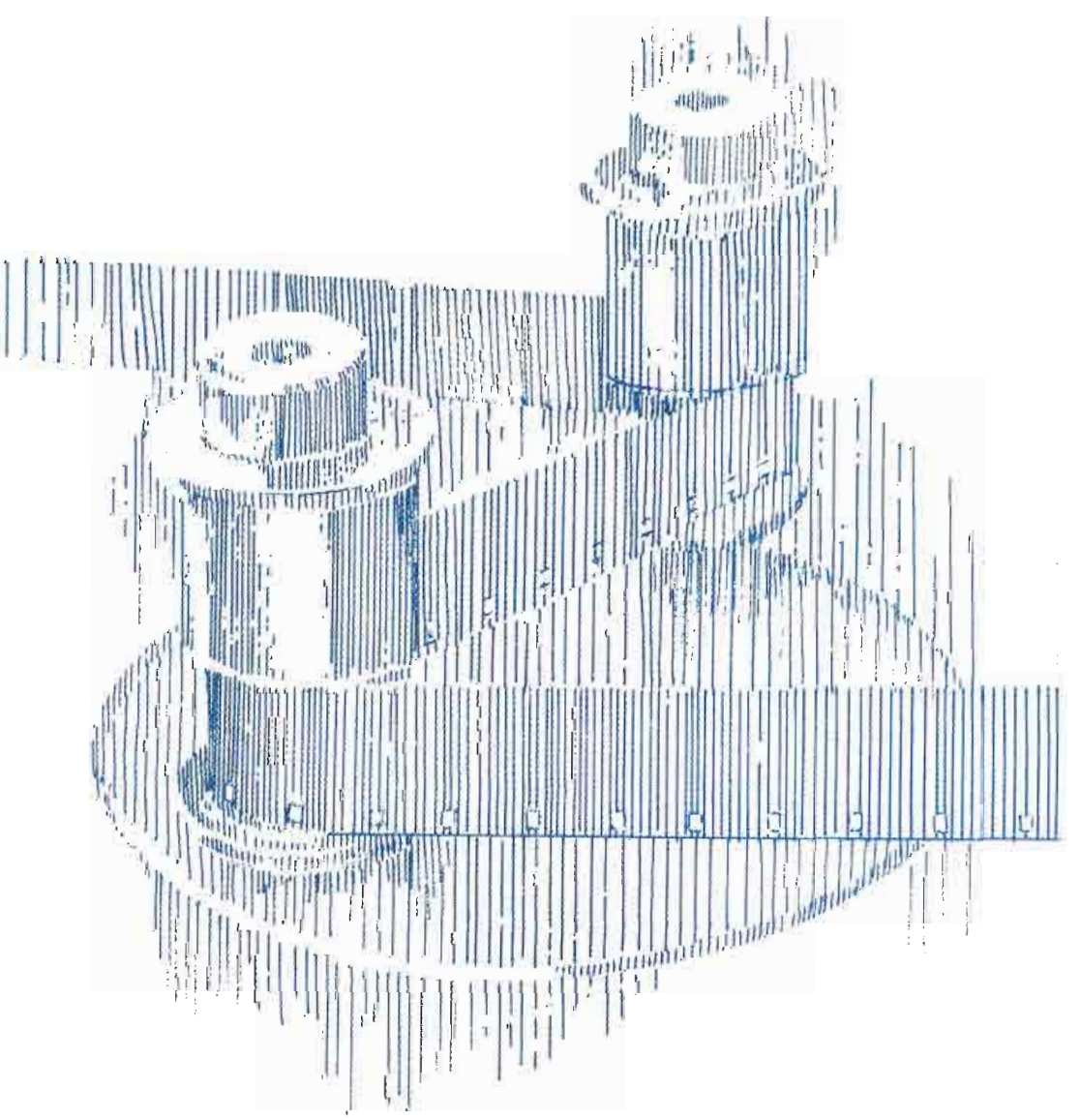
Such attention to artistic detail in the transfer from film to tape of advertisements, feature shows and movies, however, creates a dilemma for the broadcaster. Namely, no station wants to run a mediocre in-house transfer job along with advertisements that put the syndicated and local shows to shame.

The quality of advertising and network features has far surpassed the quality of the average in-house transfer. Station technical managers are starting to look for solutions, hoping that they will be found before their viewers start to notice the disparity.

The transfer process

The solution will come from new equipment and a new understanding of the main tenets of telecine transfer that apply to post-production houses and TV stations alike. A quality film-to-tape transfer is characterized by the following traits:

- Clear, sharp images, true to the direc-



Brown is executive vice president of Rank Cintel, Valley Cottage, NY.

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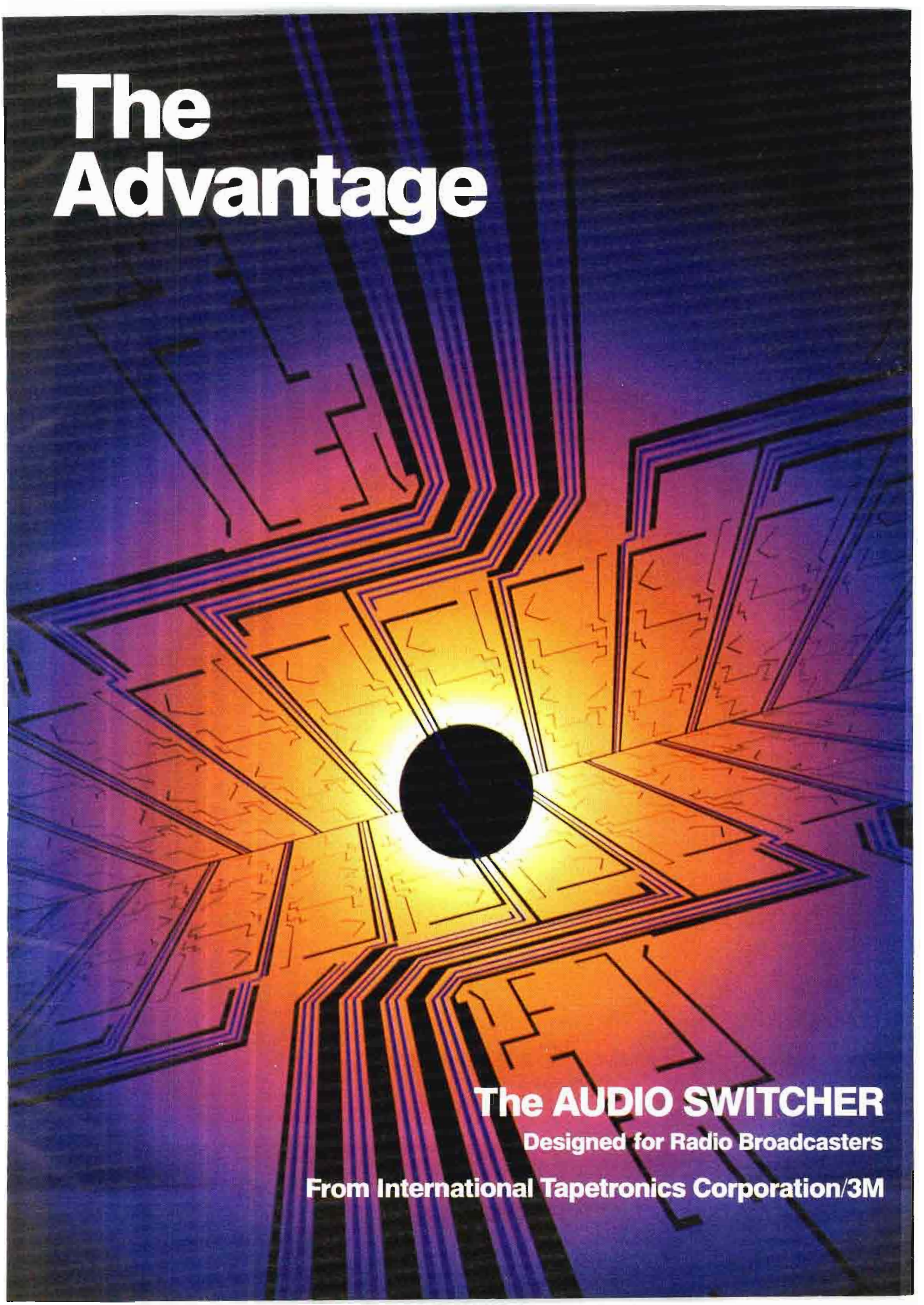
The Advantage



The AUDIO SWITCHER

Designed for Radio Broadcasters

From International Tapetronics Corporation/3M

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The AUDIO SWITCHER Designed For Radio Broadcasters

The AUDIO SWITCHER from International Tapetronics Corporation/3M is designed to replace patchbays and distribution amplifiers offering a new level of flexibility for handling today's diverse and dynamic programming requirements.

Today's broadcasters utilize an abundance of outside program sources including: satellite feeds, traffic helicopter reports, network or syndicated news feeds, promotional events from various locations, sporting events, information from weather forecasting bureaus and many others. Manually patching all of these sources into one central control unit and making them available to more than one studio at a radio station can take days and sometimes weeks of engineering time. What often results is a confusing and complicated maze of wires and patchbays.

Now all of these sources can be connected together easily and routinely through the AUDIO SWITCHER. The AUDIO SWITCHER from International Tapetronics Corporation/3M brings a cost-effective and reliable method of audio routing to radio stations.

For decades television broadcasters have depended upon video routing systems to interconnect many sources and outputs via one central control unit. International Tapetronics Corporation/3M has taken advantage of the proven reliability of 3M's advanced *video* switching technology and designed an audio routing switcher specifically for radio broadcasters.

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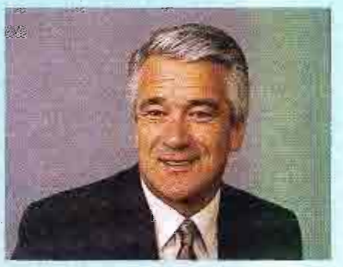
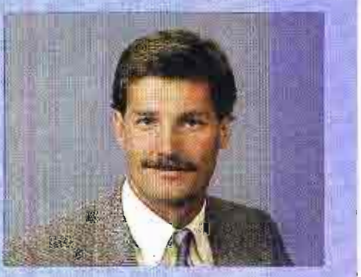
The AUDIO SWITCHER Provides "The Advantage"

	for the General Manager	for the Program Director and News Director	for the Chief Engineer
			
Reliability	Reduces likelihood of lost revenue.	Confidence in equipment allows a high degree of creative freedom.	No mechanical contacts or patchcords to fail. Reduces need for patchbays and distribution amplifiers.
Flexibility	Quick and easy manipulation of format and creative changes.	No special skills required to provide instantaneous routing from any source to any destination within the station upon demand.	Reduces wiring requirements for special or new circuits. Most audio changes controlled by simple software commands.
Reduced Maintenance	Lower maintenance costs.	Fewer studio interruptions for routine maintenance or repairs.	Designed for long component life and freedom from mechanical switching.
Audio Quality	Enhanced listener and advertiser satisfaction.	Consistent sound quality.	Facilitates uniform and consistent quality from all switch signals without degradation. Reduces complaints.
Minimal Training	Faster productivity yielding reduced operational costs. Easy for new technical and operational staff to understand.	Shorter training time for new operators. More time available for other tasks.	Promotes logical flow of audio. Easier to communicate functions with programming and operations staff.
Expandability	Modular design facilitates future growth needs.	Programming changes requiring increased capabilities are quick and easy to implement.	Minimizes rewiring needed to accommodate new requirements.
Fewer Errors	Increased efficiency and revenue potential.	Fewer program interruptions can result in higher shares and cumes.	Reduces late night or weekend trouble calls.

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Control Room

Production Room

Transmitter

Newsroom

More Flexibility

The AUDIO SWITCHER is a single matrix routing device which can route virtually any source, such as a satellite feed, to one or more studios within the broadcast facility at the press of a few keyboard buttons. Other features and benefits include:

- Easier to make major, permanent format changes
- Easier to make major, temporary format changes, such as adding sporting events, remote broadcasts and on-site news coverage
- Allows placing any source on-air without major wiring changes

Grows With You

Designed as a modular, expandable system, the AUDIO SWITCHER grows as your needs grow. A 16 *input* by 16 *output* monophonic switcher (8 x 8 stereophonic) is the smallest configuration of the AUDIO SWITCHER. As you need more inputs and/or outputs you add system modules. Expansion up to a maximum size of 256 by 256 monophonic or 128 by 128 stereophonic is possible. You can choose the size AUDIO SWITCHER from International Tapetronics Corporation/3M that is right for you today knowing the system will expand as your needs grow.

Consider "The Advantage"

Consider the advantage the AUDIO SWITCHER can bring to your station. Consider the convenience and flexibility offered by the AUDIO SWITCHER and use it as a reliable tool for handling your diverse and dynamic programming requirements. With the AUDIO SWITCHER from International Tapetronics Corporation/3M you have "The Advantage" on your side.

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Satellite Receiver

Traffic Helicopter

Weather Information

Location Remotes

Sports Broadcasts

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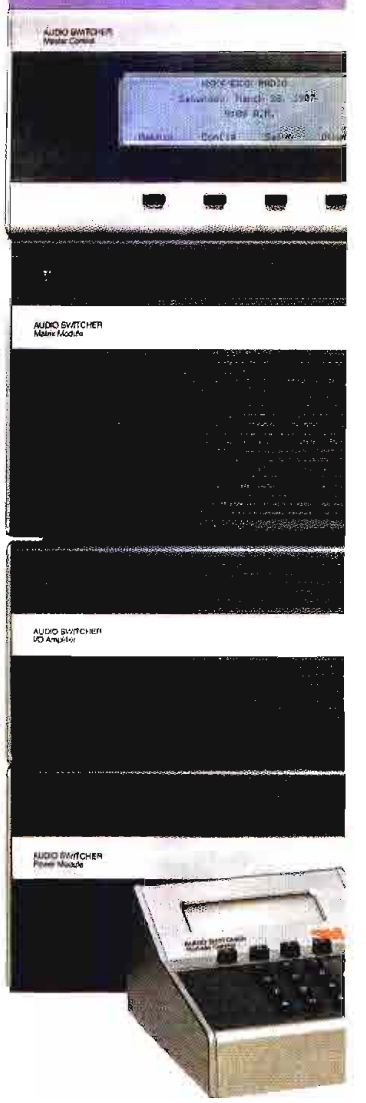
The Advantage

Saves Money

- Reduces lost air time due to faulty or defective patching
- Fewer labor costs for wiring and maintenance
- Reduces wire and patchbay cost
- Less console space required
- Eliminates the need for monitor speakers and meters (they are built into the Master Control)
- Compact size via hybrid technology reduces rack space requirements
- Includes a real-time clock and calendar
- Saves operator training time

General Manager

Pro



Self Documenting

The AUDIO SWITCHER includes a 3M *Whisper* Writer keyboard and printer as standard equipment. Once the switcher is in operation, it can provide a hardcopy printout of the system status and log.

Now even the most complex routing problem can be solved easily and quickly by referring to the log without searching through a "rat's nest" of wiring and patch systems.

Fail-Safe Memory Protection

Stored data is automatically protected, even in the event of a power failure, through the use of redundant memory. The primary memory is capacitor backed-up and retains data for up to two weeks. The secondary memory is located in a removable cartridge. This cartridge includes low power RAM and onboard batteries with a 10-year life.

Versatile Salvos

The AUDIO SWITCHER has the ability to make changes to the matrix automatically. A stored set of instructions, known as "salvos," can be initiated at such times when a known station configuration is needed. Salvos could be used when a signal routing requirement always occurs at the same time, such as regular newscasts.

The AUDIO SWITCHER can hold up to five salvos at any one time. Salvos may range in size from one command to a complete configuration of the matrix. Salvos may be called upon manually, or at various assigned times by programming for one-time or recurring automatic switching via the internal clock/calendar.

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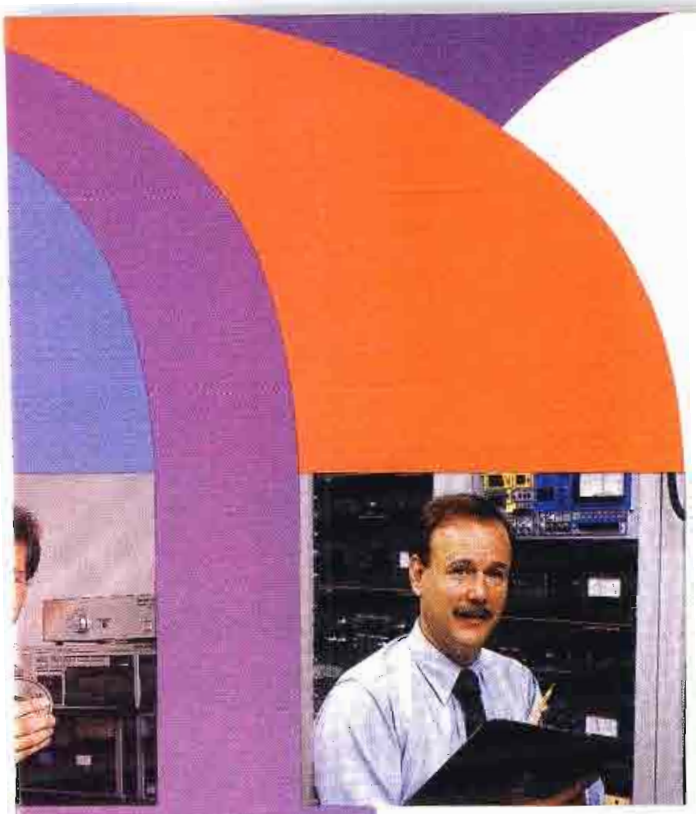

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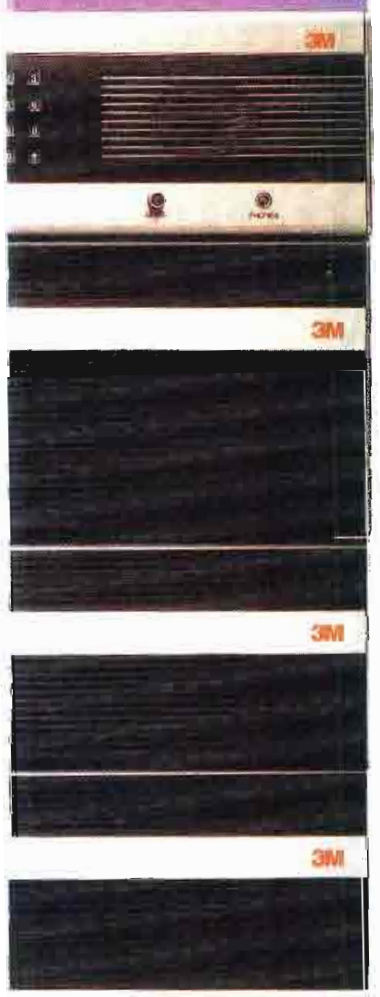
Chief Engineer



"Wild Audio" Capability

The consistent sound quality of stereo broadcasting is virtually assured by the system's "Wild Audio" feature.

Once the system has been configured for stereo, it has the "intelligence" to know when a mono source is being routed to a stereo output, and routes it to both left and right outputs. It also handles stereo source to mono outputs, mono source to mono output, and of course, stereo source to stereo output situations, automatically.

Easy Serviceability

The AUDIO SWITCHER was designed with serviceability in mind. Service is easy with:

- ITC's P.C. board exchange program
- Installation and operation manual and optional technical illustrations manual
- Factory technical consultation
- Fast shipment of parts orders
- Factory repair service available
- Many components can be removed or serviced while the AUDIO SWITCHER is in operation

Other Advantages Of Using The AUDIO SWITCHER

- No time lost patching one source to another
- No internal compensation service adjustments necessary
- No "rat's nest" of complicated wiring or cables under consoles or desks
- Facilitates quick changes when inconsistent audio signals from outside sources occur
- No time spent searching for an error source in an undocumented maze of patch wiring
- No diode-effect distortion due to dirty or corroded parts
- Left and right audio channels can be reversed internally without rewiring

Built-In Security

The system is initially configured to meet a station's requirements. This includes assigning numbers to all inputs and assigning these inputs to various outputs.

By entering a 4-digit code number, unauthorized modification of these assigned numbers can be prevented.

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The AUDIO SWITCHER From International Tapetronic Corporation/3M

Master Control

The Master Control consists of a rack-mount housing containing the microprocessor control system for the AUDIO SWITCHER. The front panel of the Master Control features a 5-line, 40-character LCD display for alpha-numerics and graphics and four "soft key" function pushbuttons. It has a 12-key pad for easy numeric data entry.

Matrix Module

The Matrix Module contains up to two matrix P.C. boards which are mounted within the frame on a slide-out tray for easy expandability and servicing. Each matrix P.C. board can support up to a 32 input x 32 output mono switch.

I/O Amplifier

Audio input and output amplifiers are contained on plug-in boards with four input or output amplifiers per board. Audio level adjustments are made here to assure a consistent sound quality without additional distribution amplifiers.

Remote Control

The Remote Control consists of a small keypad and associated LCD display which allows switching from a control room, on-air desk, or other location away from the Master Control. Each Remote Control can handle four outputs. As many as 31 Remote Controls can be used in conjunction with the Master Control.

Power Module

The Power Module mounts in its own rack housing. Provision is made for mounting an optionally available redundant power supply in the same rack housing. Power supplies are completely connectorized for quick and easy replacement in case of power failure. The AC power inputs are separated, allowing plug-in to separate power feeds.

Component Features

Master Control

- A 5-line x 40-character alpha-numeric graphics LCD display
- Four "soft key" function pushbuttons – allow you to operate the switcher and lead you through programming in conjunction with the LCD display
- Built-in meters, speaker and headphone jack – facilitates monitoring inputs at main controller without additional hardware
- A 1 farad capacitor backup for internal memory and real-time clock – provides two week memory & clock protection
- Removable cartridge contains redundant memory and battery with 10-year life
- Alarm sensors monitor many system parameters and can alert operators via contact closure and on-screen announcement
- Internal real-time clock/calendar – can be used as station master reference clock or be synched to external time source
- 3M *Whisper* Writer printer & keyboard
  – programs Master Control unit
  – provides hardcopy printout of system status and log

3M WhisperWriter printer & keyboard

Matrix Module

- Proven hybrid technology – for all audio circuits
- P.C. board holds 32 inputs x 32 outputs for mono and up to 2 boards per rack housing for 32 x 64 or 64 x 32 mono
- P.C. boards mount on slide-out trays – for easy serviceability
- Hybrid circuits are replaceable while the system is in operation
- Crosstalk better than 90dB
- Control handshaking verifies commands are implemented

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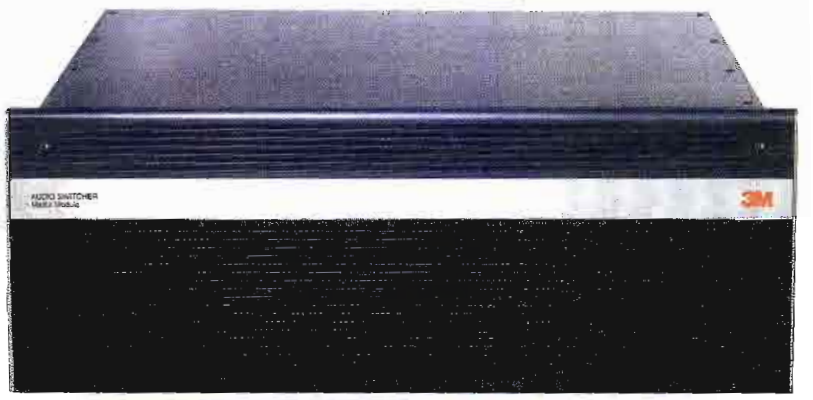

I/O Amplifier

Input Amplifier

- Active transformerless balanced input
- 20K Ohm input impedence, 600 Ohm selectable
- Variable gain – system can accommodate inputs from −30 to +20 dBm to produce 0 dBm output
- Four input amplifiers per P.C. board
  – up to 16 boards per rack housing
  – modular replacement for easy servicing
  – separate voltage regulators & fusing on each P.C. board
- Proportional filtered cooling system – stays clean for long life
- Alarm sensors detect and report overheating
- Radio frequency (RF) tested
- Common Mode Rejection Ratio (CMRR) greater than 80 dB
- P.C. boards can be installed or replaced while the system is in operation
- 15-turn trimpot input gain adjustment
- Easy to positively connect wires to terminals

Output Amplifier

- Active transformerless balanced outputs with self compensating output stage – for use in both symetrically balanced & unbalanced circuits
- Four output amplifiers per P.C. board
  – up to 16 boards per rack housing
  – modular replacement for easy servicing
  – separate voltage regulators & fusing on each P.C. board
- Capable of supplying +22 dBm in 600 Ohm load (maximum output)
- Low output impedance – for driving long lines
- Proportional filtered cooling system – stays clean for long life
- Alarm sensors detect and report overheating
- Zero group delay – system passes square waves cleanly
- P.C. boards can be installed while the system is in operation
- Easy to positively connect wires to terminals

Power Module

- Optional redundant power supply – always on line
- "Switching Power Supply" reduces heat and susceptibility to power line irregularities
- Proportional filtered cooling system – stays clean for long life
- Alarm sensors – detect and report overheating and under/over voltage conditions
- Dual AC line – feeds may be attached to separate phases
- 120V, 60Hz; 220V, 50Hz

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The AUDIO SWITCHER Preliminary Specifications

Power:
A. 90-132/180-264 VAC
B. 47-440 Hz

Power Consumption:
A. MASTER CONTROL: 43W Maximum
B. MATRIX MODULE: 22W Maximum
C. I/O AMPLIFIER: 77W Maximum
D. REMOTE CONTROL: 5W Maximum
E. POWER MODULE: Dependent on system configuration

Audio Output Configuration:
Electronically balanced output capable of grounding either side with <0.1 dB level change

Audio Output Impedance:
50 ohms

Maximum Output Level:
+22 dBm with <1% THD

Audio Input Configuration:
A. Balanced bridging transformerless
B. Input impedance: >20K, 600 ohm selectable

Input Level Range:
−30 dBm to +20 dBm

Common Mode Rejection Rate:
> 80 dB
74 dB at 0
84 dB at +10
94 dB at +20

Signal-To-Noise:
>90 dB, 20Hz to 20kHz at 0 dBm

Distortion:
<.01%, 20Hz to 20kHz at 0 dBm

Frequency Response:
±0.1dB, 20Hz to 20kHz

Crosstalk:
>90 dB, 1 kHz at +20 dBm

Phase Shift:
±0.3 degrees at 20kHz (channel to channel)

Ambient Operating Temperature:
39 to 122 degrees F. (4° to 50° C.)

Storage Temperature Range:
−40 to +185 degrees F. (−40° to +85°C.)

Relative Humidity Operating Range:
25% to 80% (without condensation)

Dimensions:
A. Width:
MASTER CONTROL: 19″ (48.26 cm)
MATRIX MODULE: 19″ (48.26 cm)
I/O AMPLIFIER: 19″ (48.26 cm)
REMOTE CONTROL: 4⅞″ (12.38 cm)
POWER MODULE: 19″ (48.26 cm)
B. Depth:
MASTER CONTROL: 21″ (53.34 cm) Add 2″ (5.08 cm) for connectors
MATRIX MODULE: 19¾″ (50.16 cm) Add 2″ (5.08 cm) for connectors
I/O AMPLIFIERS: 17¾″ (45.08 cm) Add 2″ (5.08 cm) for connectors
REMOTE CONTROL: 6 5/16″ (16 cm) Add 1¼″ (3.18 cm) for connectors
POWER MODULE: 19¾″ (50.16 cm) Add 2″ (5.08 cm) for connectors
C. Height:
MASTER CONTROL: 5¼″ (13.34 cm)
MATRIX MODULE: 7″ (17.75 cm)
I/O AMPLIFIER: 5¼″ (13.34 cm)
REMOTE CONTROL: 3 15/16″ (8.41 cm) Add ⅛″ (.318 cm) for feet
POWER MODULE: 5¼″ (13.34 cm)

Weight:
MASTER CONTROL: 25 lbs (11.36 kg)
MATRIX MODULE: 45 lbs (20.45 kg)
I/O AMPLIFIER: 24 lbs (10.9 kg)
REMOTE CONTROL: 3 lbs (1.36 kg)
POWER MODULE: 30 lbs (13.63 kg)

International Tapetronics Corporation/3M reserves the right to change products and specifications without notice.

International Tapetronics Corporation/3M "The Leader in Reliability and Service"

International Tapetronics Corporation/3M offers a variety of financial options designed to fit your needs. Call today for more information on ITC's complete line of audio equipment.

- 3M HCDA™ 3000 Digital Audio System, "An Achievement"
- The Performance System, 99B Recorders and DELTA Reproducers
- The Economy System, DELTA Recorders and OMEGA Reproducers
- AUDIO SWITCHER, "The Advantage"

When newer technology emerges, it will come from International Tapetronics Corporation/3M, "The Leader in Reliability and Service". **To order or for more information call toll free 800-447-0414.** From Alaska or Illinois, call collect 309-828-1381. In Canada, call Maruno Electronics, Ltd., 416-255-9108.

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Printed in USA

International Tapetronics Corporation/3M
2425 South Main Street
P.O. Box 241
Bloomington, Illinois 61702-0241

3M

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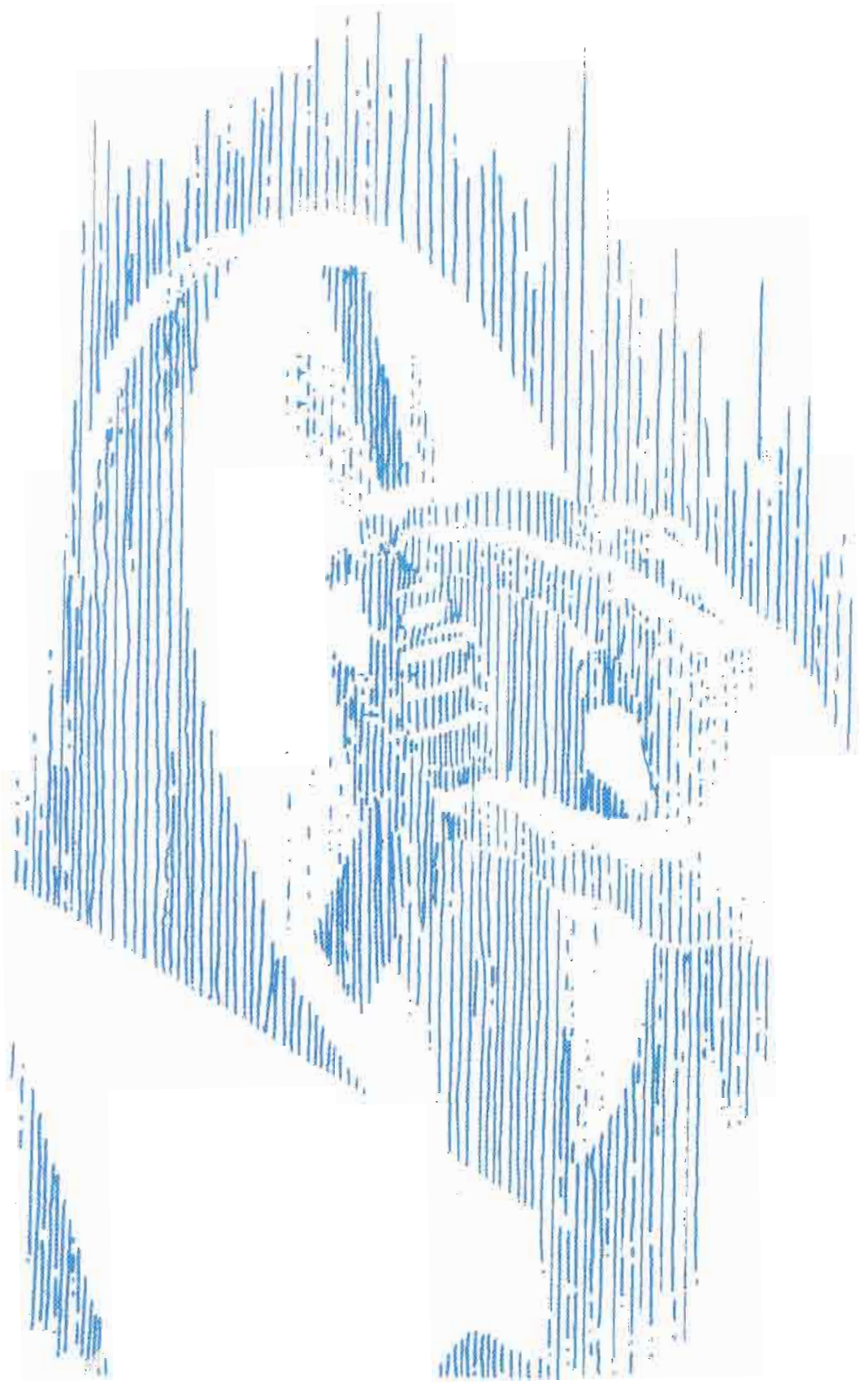
tor's original intent, that aesthetically express a mood or create an environment;
• Scenes that are clean, free of noise, and correct and consistent in color; and
• Proper use of added effects (pan and zoom) to enable picture positioning when *cinemascope* films are transferred to tape.

At post-production houses, films are painstakingly color-corrected, scene by scene, by an artist using an extensive electronic control system. This situation, obviously, is quite different from the broadcaster's environment. Yet both post-production and broadcast-transfer technicians face common problems. Oftentimes, scene segments shot at different times of day, or lit for brilliant effects in the cinema (or on the screening room's split screen), become distorted and discolored when transferred to video.

Post-production colorists rework scenes in several different ways: by adjusting *gamma*, luminance and brightness, by fine-tuning individual color vectors and by careful monitoring of color timing, saturation and hue. Although the flying-spot telecine is the clear post-production standard in both its top-of-the-line digital 4:2:2 format and in its standard (classical) form, new broadcast CCD telecines with their own 4:2:2 outputs accomplish such tasks automatically or with a minimum of training and supervision.



Trade-offs

Any telecine must compensate as much as possible for the reduction in discernable dynamic range inherent in the transfer from film to tape. In the case of low-light scenes, post-production colorists preserve vital picture detail with manual control over gamma lift and gain, color saturation and hue. Some broadcast application CCD machines come equipped with automatic black-level adjusters.

Frankly, the difference between the best post-production transfer and the best broadcast transfer is considerable. However, broadcasters still can do significantly better transfers within the real-world limitations of studio operations, budget and staffing constraints. The answer lies in new technology.

The modern alternatives to photoconductive film-chain telecines consist of, basically, two technologies. The first is a flying-spot scanner that projects, focuses and electronically steers a light beam onto the surface of moving film. The newest digital flying-spot scanners feature the best possible signal-to-noise ratios and the best "filmlike" transfer results. They are used by high-end post-production houses to transfer advertisements, feature films and TV specials, as well as network shows. (Some of the programs transferred using the flying-spot scanners include "Crime Story," "Cheers," "Amazing Stories" and "The Equalizer.")

The advantages of flying-spot systems include:
• Advanced secondary color correction. Flying-spot scanners allow operators to adjust any color of an image in the film.
• Pan, scan and zoom. Effects can be added during the transfer process.
• High-quality picture with no lag. The flying-spot technique is instantaneous.
• 4:2:2 technology. New digital flying-spot telecine systems will be an integral component in the digital studios of tomorrow.

The CCD approach

The second option, more suited to the broadcast environment, is a CCD (charge-coupled device) telecine. The CCD, unlike traditional photoconductive chains, uses photosensitive silicon chips to scan the projected film image. Its major advantages are:
• The capability to transfer unattended. CCD telecines can create neutral, balanced color imagery automatically.

Continued on page 102

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TVM-620
- 15 MHz Bandwidth
- AC or DC (optional) operation
- Flat, Low Pass, Chroma, R-Y display modes
- Multiple display combinations for signal comparisons
- Storage/recall of 4 user-programmed set-ups

VPH-360
- Generates SCH phase markers on *any* vectorscope
- Absolute SCH phase monitoring
- Normal/bypass modes
- Rack-mountable in optional DAT-1 or DAT-3 tray

DM-140S
- 140 channels (UHF/VHF/Cable)
- Frequency-synthesized varactor tuning
- MTS stereo or SAP audio outputs
- Stereo amplifier w/ext. speakers
- Unlimited favored channel programming
- Int. 3" speaker on front panel

TIMES SIX AND TIMES SIX PLUS
- Centralized control of system timing
- 6 adjustable black burst outputs
- 6 horiz./subcarrier timing adjustments
- Stand-alone or gen lock operation
- Automatically compensates for cable length/equip. drift (TIMES SIX PLUS)

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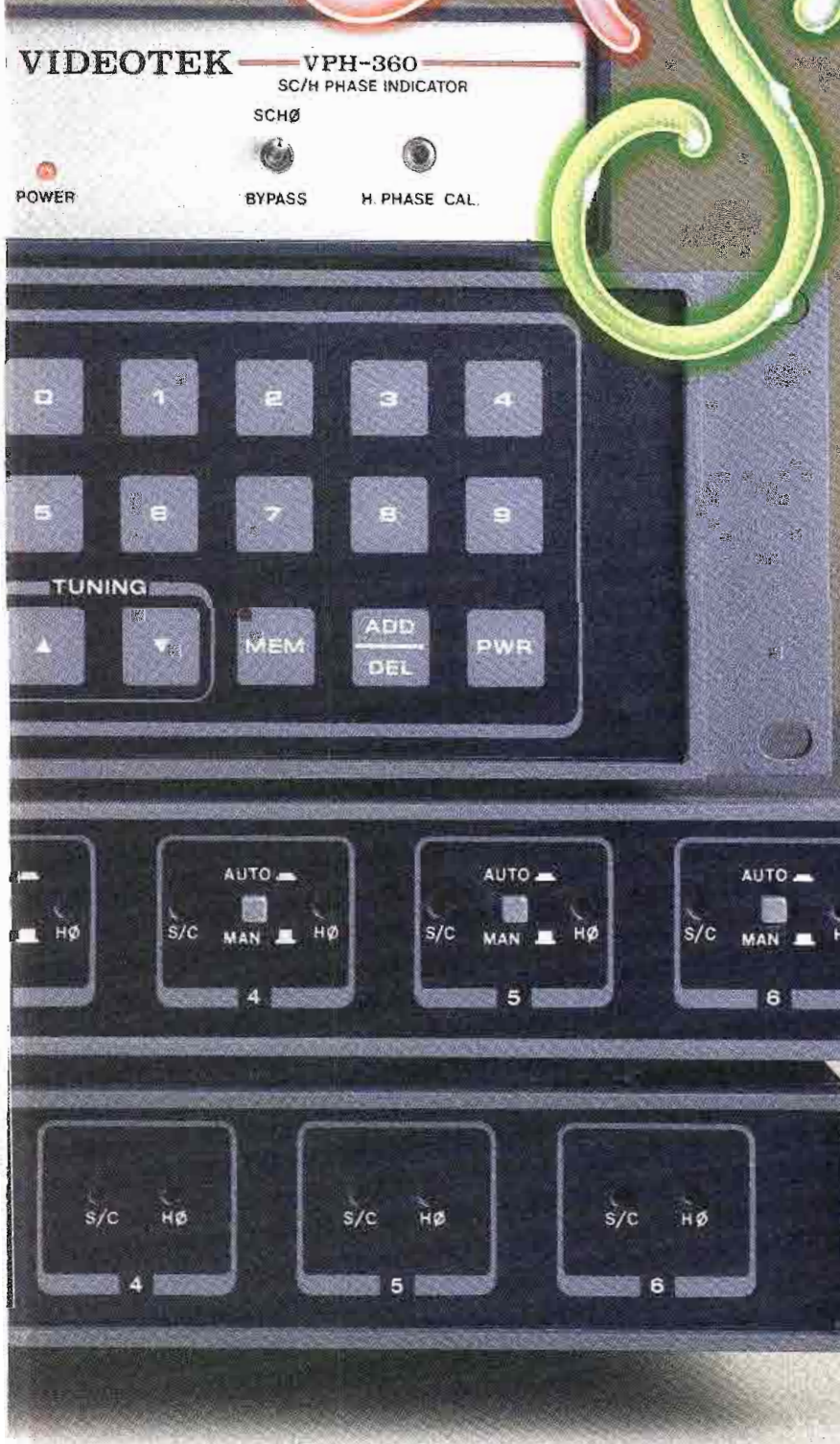
Hot Stuff!



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Extraordinary engineering and unusual economy... A rare combination—and Videotek's got it, with a unique line-up of feature-loaded new equipment for '87.

Take our new microprocessor-based TVM-620 waveform monitor/vectorscope, which boasts user-defined memory recall plus three selectable inputs. View any waveform combination simultaneously in parade mode. Or overlay waveform and/or vector displays at the gentle touch of a membrane push button.

Our new DM-140S demodulator provides 140-channel tuning capability, with balanced or unbalanced MTS stereo or SAP audio outputs and a separate monaural output. Unit comes with volume-adjustable internal speaker, external stereo speakers and tactile membrane control panel.

Get in sync with our new TIMES SIX black burst generator with individual horizontal and subcarrier timing correction for up to six video sources. Better yet, the TIMES SIX PLUS with digital horizontal lock lets you choose manual or fully automatic operation for quick set-up.

And there's more—like our VPH-360 subcarrier phase indicator, which interfaces with *any* vectorscope for inexpensive absolute SCH phase monitoring. They're all designed for ease of operation and built for reliability. Discover a new breed of video products at your Videotek dealer today.

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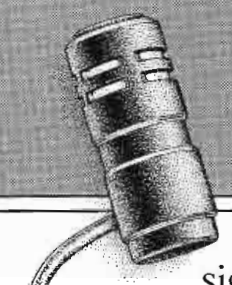

A super-cardioid pick-up pattern enables the new SM84 Condenser Microphone to reject unwanted background noise without compromising audio quality. So even if there's activity near your reporter or newscaster, the only thing the viewers hear is the news. The SM84 also provides greater gain before feedback than other lavalier condenser mics.

The microphone's tailored frequency response provides professional sound that's unusual in chest-mount applications. The 730 Hz filter compensates for chest resonance, while the high-frequency boost provides flatter, more natural response. The 12dB/octave low-end rolloff (below 100Hz) reduces room noise and other low-frequency signals. In addition, excellent shielding yields low RF interference and hum pickup.

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The mic runs on phantom power or a standard 9-volt battery. The unique side-exit cable minimizes "cable hiding" problems. And universal mounting clips are included to handle virtually all attachment requirements.

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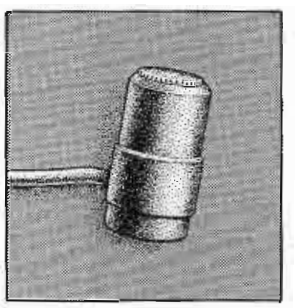

When background noise isn't a factor, consider the SM83 Omnidirectional Lavalier Microphone.

Note: mics shown actual size.

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Continued from page 99

- Cost savings. CCD telecines are less expensive than flying-spot scanners.
- Upgraded picture quality. With the right CCD machines, a broadcaster can improve the quality of programming many times over that of conventional film-chain transfers.
- Manual scratch patching, possible with some CCD telecines. A top-end unit also will provide automatic scratch and dirt concealment. Some independent stations even claim they are using the resulting "better look" of their programming as a promotional tool.
- Tape-machinelike operation. Tension-driven film drives allow operators to fast forward or rewind films as they would a videotape, making editing a clean and direct film-to-videotape process.

Optimizing the transfer

In any kind of transfer, using first-generation camera negatives helps improve overall gamma (black) quality, but this is virtually impossible for the average broadcaster who usually airs reused 16mm syndicated programming. Fortunately, much of the final quality and detail can be determined by adjustment of the luminance signal during the actual transfer process.

Broadcasters should watch for muddied low-light scenes and hidden detail in the blacker portions of the film. In many cases, it is possible to restore a good deal of the original quality and detail if attention is given to this step in the transfer process.

Color *timing errors* also are an everyday concern. Timing error refers to subjects changing color from shot to shot, a problem particularly visible in flesh tones. The problem generally arises from the original lighting design, but can be fully corrected in a scene-by-scene transfer with the use of secondary color correction. Again, in all but the most seriously mistimed sequences, a good CCD telecine also will be able to make easy, if not automatic, alterations.

Flying-spot telecines, however, offer the capability to adjust the saturation and hue of one color without affecting other colors in the picture. In this way, any color can be changed, tuned and customized—something that was never before possible without changing the entire picture's overall color balance. Advertisers often want their soup cans to look "redder," while directors often want to cast a consistent "bright" tone throughout entire productions.

Post-production experts explain that telecine transfer is essentially subjective, and at the heart of it all is judgment based on taste. Some people prefer rich images, while others respond to a brighter or "ethereal" effect. It is in this regard that

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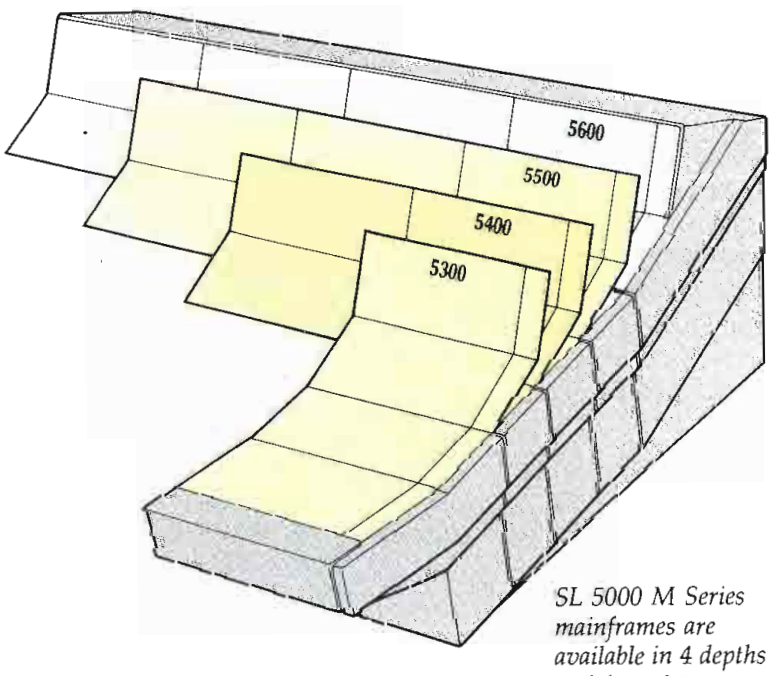

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telecine transfer is a veritable art form, involving judgment calls and artistic instinct.

Colorists talk about tapes that are "warm" or "cold." These subjective terms relate to the telecine operator's ability to overhaul the lighting of a scene to fit a specific mood. Lighting balance determines whether a tape is "realistic" or "too realistic," or whether it looks like videotape or film.

In the post-production transfer room, the eye often judges factors such as graininess and noise. For monitoring, waveform, vectorscope and RGB monitors frequently are added to the main picture display. All-important considerations are adequate depth of modulation, effective color imagery and, of course, mechanical reliability and overall stability.

Quality begins at the beginning

It should not be assumed, however, that the quality of the finished video is determined exclusively by the telecine transfer. By and large, the outcome depends just as much on the lighting and strategies employed during the shoot, as well as on framing.

Today, an increasing number of directors are planning scenes with the transfer process in mind, using lighting and blocking conducive to good transfer. A lighting design made for the theater or for the screening room may be incompatible with the video medium, making the colorist's job difficult and rendering a topnotch transfer out of the question.

Another significant consideration is the addition of motion effects, such as pan, scan and zoom, that can be applied during the transfer process. This is particularly useful when the film director has used "cinemascope" with important scenery or characters on the outer edges of the screen. Without the capability to add pans, X–Y positions and zooms to the original film, the telecine operator would be forced to lose these elements. Such advanced capabilities give directors greater artistic command in bringing their work to a TV audience.

In short, the main goal of any telecine transfer is to overcome the inadequacies of magnetic tape through careful reconstruction of the director's intent. In post-production, the art form of film-to-tape transfer takes a good eye for color, light and consistency.

In broadcast, successful film-to-tape transfer depends upon an understanding of basic "good" and "bad" image traits and the realization that new automated film chains, such as CCD systems, can best balance the demand for quality broadcast images with the real-world requirements of TV station operation. Simply put, those requirements are cost-effectiveness, operational simplicity and absolute reliability.

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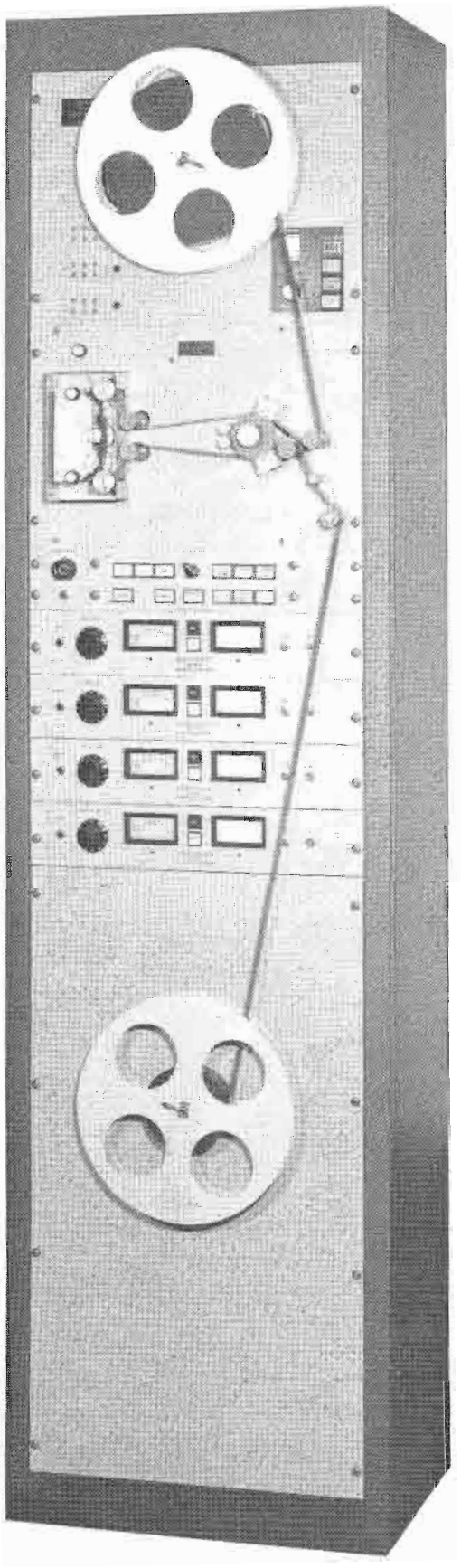

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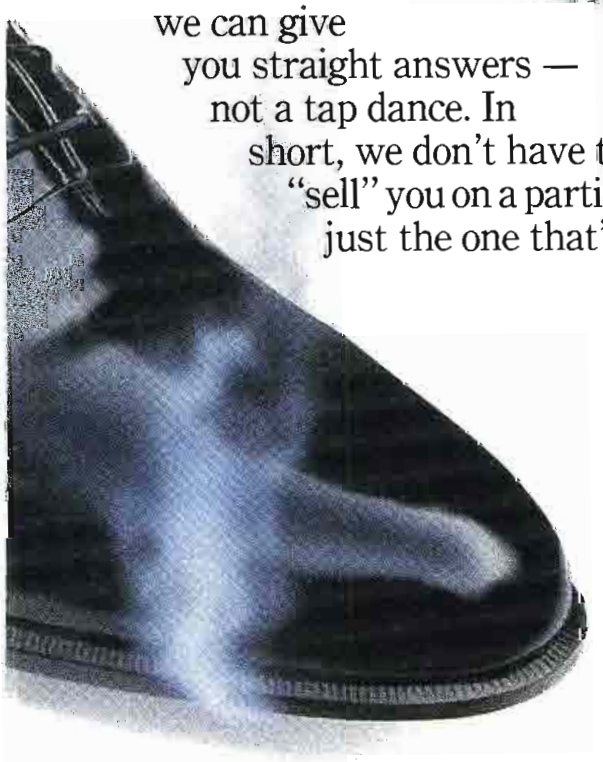

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Video in transition, Part 3

By Paul McGoldrick

The key to maintaining component video hardware is having the proper tools—and knowing how to use them.

Photo by Doug Schwartz

The introduction of new component videotape formats has led the push from composite to component video in the broadcast and post-production industries. The current transitional period requires that both composite and component signals must be produced, processed and monitored.

A wide variety of test signals is needed to satisfy the requirements of maintaining CAV (component analog video) equipment during the present transition between composite and component operation. As more component equipment is placed in the field, and as the age of that equipment increases, the requirements for close observation by operations personnel and detailed adjustments by maintenance technicians also increase. This places demands on the engineering staff of a TV station or production facility to learn how to analyze CAV hardware to determine what, if anything, might be wrong with a particular piece of equipment.

Amplitude/frequency response

All channels in a system (whether 1-, 2- or 3-wire) can be checked with multiburst or line (or field) sweep. A typical offering of multiburst is shown in Figure 1. Multiburst has frequency packets at 0.5, 1.25, 2, 3, 3.58 and 4.1MHz in a composite format for testing single-wire systems or for testing from composite input to composite output even when the signal is being separated or decoded at an intermediate point.

The split-field signal shown in Figure 2, however, has three sectors with the RGB (red, green, blue) or color-difference channels having *quiet* lines for two-thirds of the field each; a signal appears in G (or Y) for the first third, in B (or B–Y) for the second third, and in R (or R–Y) for the last third of the active video of each field. The G (or Y) sector has multiburst at 0.5,

McGoldrick is vice president of sales and marketing, Magni Systems, Beaverton. OR.

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A Clean Sweep

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Covering the downhill like it's never been covered before, Fujinon is providing a new secret weapon...the longest focal length lens ever used in broadcast television. Watch the races and see the difference.

Twenty-eight new CTV cameras will be equipped with the industry-proven A44X9.5ESM. From a wide 9.5mm out to 420mm and an F1.2 maximum aperture flat to 240mm (F2.1 at 420mm), the 44X takes first place for the best ramping characteristics in the long focal length competition!

Fujinon's brand new 13kg A34X10ESM will be on 10 new CTV cameras. No larger than the lens it replaces (the A30X11ESM), its coverage is wider and longer. From 10mm to 340mm with an F1.6 that's flat to 229mm. Naturally, it has a built-in 2X extender.

In the handheld competition, Fujinon wins hands down with 28 new CTV cameras equipped with the A14X9ERM, 7 cameras with the A8.5X5.5ERM ultrawide zoom, and five cameras with the A18X8.5ERM. All three compact, lightweight, weatherized lenses have built-in extenders.

Long the industry's favorite ENG lens, the A14X9ERM zooms from 9mm to 126mm while the maximum aperture is F1.7 out to 103mm. For events demanding wider and longer coverage, the 18X provides a 9mm to 126mm range with an F1.7 aperture constant from 8.5mm to 116mm (F2.3 at 153mm). And for wide angle abilities, nothing beats the A8.5X5.5ERM. It's an F1.7 that zooms from 5.5mm to 47mm. And even with its 1.7X extender in position, it provides a familiar 9.4mm wide angle.

In addition to the CTV cameras, most of the production companies supporting the coverage will be bringing Fujinon equipped cameras. And, naturally, Fujinon will be on hand to provide field support. After all, one reason Fujinon lenses are so widely used is Fujinon service — it's as good as gold, too.

To learn more about the lenses that scored a clean sweep, you'll get more information or a demonstration by calling the Fujinon location nearest you.

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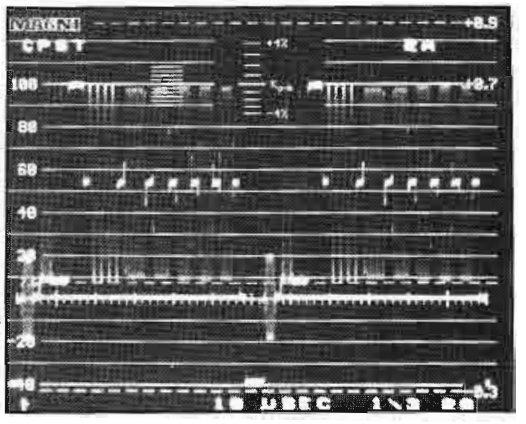

Figure 1. *Composite multiburst waveform. The frequency packets are from 0.5MHz to 4.1MHz.*

1, 1.5, 2.5, 3.58 and 5MHz, and each of the B and R channels (or color-difference channels) has multiburst at 0.5, 1, 1.5 and 3MHz.

Viewed on a picture monitor with this test signal displayed, the top third of the screen has Y information only, the middle third, B–Y only and the bottom third, R–Y only. As with other test signals in component form, the precise amplitudes used vary from one manufacturer's recorder standard to another.

Whatever test-signal generator form is employed, the fullest range of the device being tested should be exercised. In the example given in Figure 2, the luminance channel is, in fact, being tested out to 5MHz and the color-difference channels out to 3MHz. In some circumstances, this might not be sufficient, because equipment is being manufactured that specifies amplitude/frequency responses out to 30MHz (for equipment that has potential HDTV use, for example). In those circumstances a generator should be employed that has the required signal capabilities, such as field sweeps out to 30MHz.

It should be noted that the signal shown in Figure 2 also has applications for interchannel-crosstalk testing, which will be discussed in this article.

Video level and low-frequency response

Many of the selected test signals have a white reference point that can be taken as absolute for setting the gain of various components in the broadcasting chain and for reference testing. Carefully note that the remainder of the signal is not clipped when a white level is used as gain reference. There is also sufficient white in the test signals shown in Figures 1 and 8 to check *bar tilt* for low-frequency response of the system.

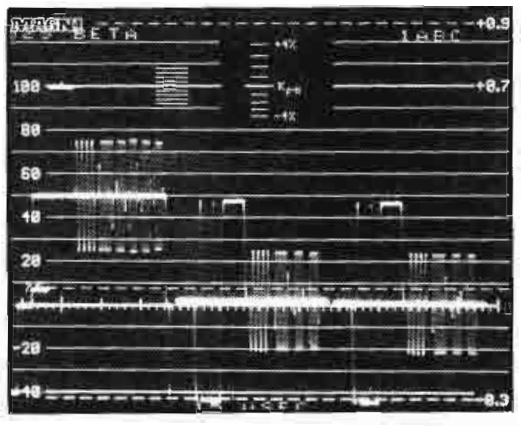

Figure 2. *Component (Y, B–Y, R–Y) multiburst waveform. Two-thirds of the field is "quiet" on an alternating basis to allow visibility of interchannel crosstalk. Frequency packets extend to 5MHz in Y (G) and to 3MHz in color-difference.*

Pulse testing

The multiburst signal of Figure 1 contains a 12.5T (1Tc) modulated sine-squared pulse and a 2T pulse.[1,2] By definition of T within a TV system, a 2T pulse and its subsequent response is a good test of the composite system out to about 4MHz, and a 1Tc pulse will test a chrominance channel adequately out to approximately 640kHz. The 2T pulse is

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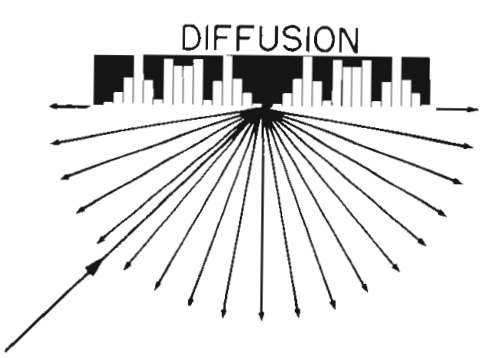

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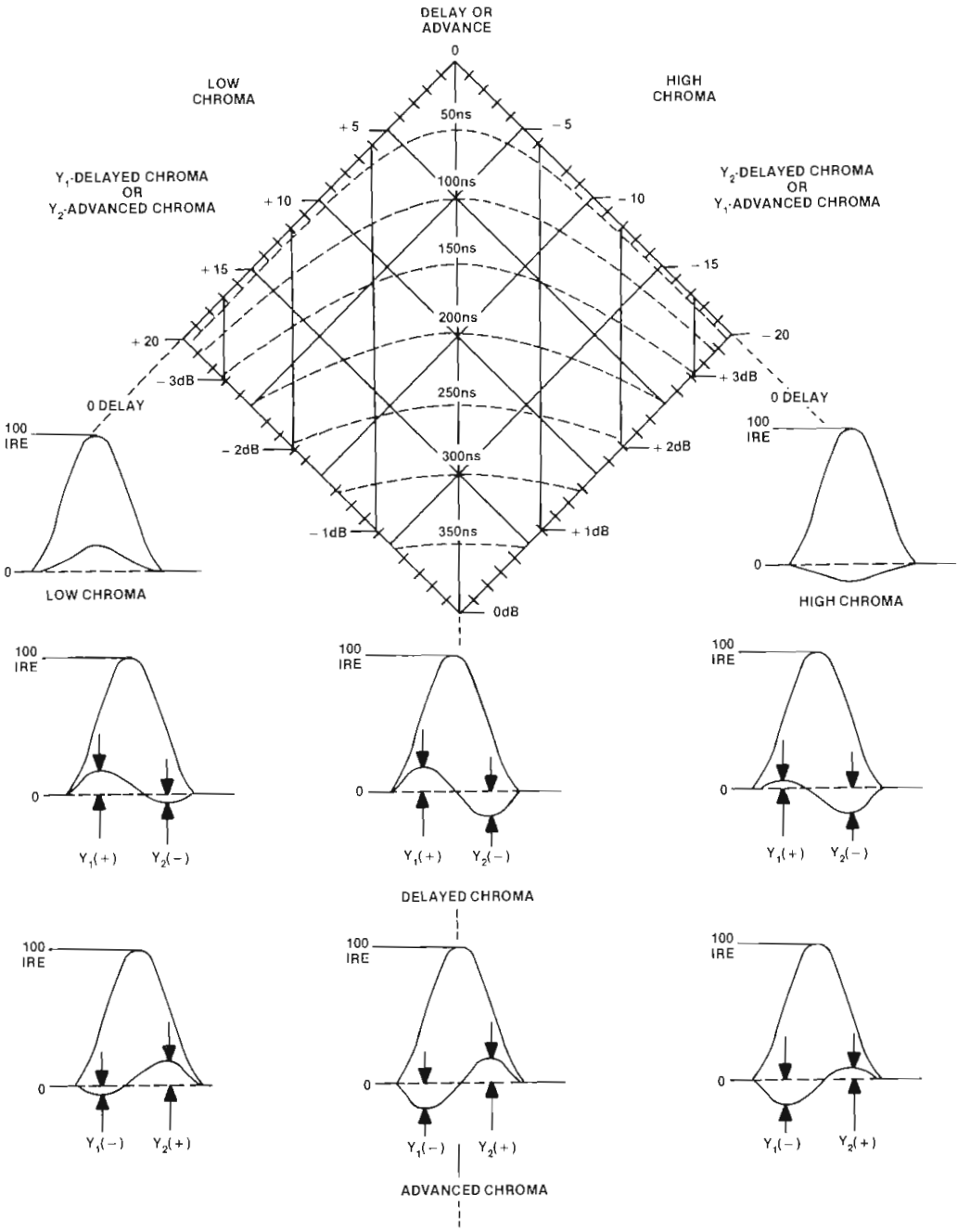

Figure 3. *Chrominance/luminance gain-and-delay inequality nomograph. (Valid for a 12.5T [NTSC] modulated pulse.)*

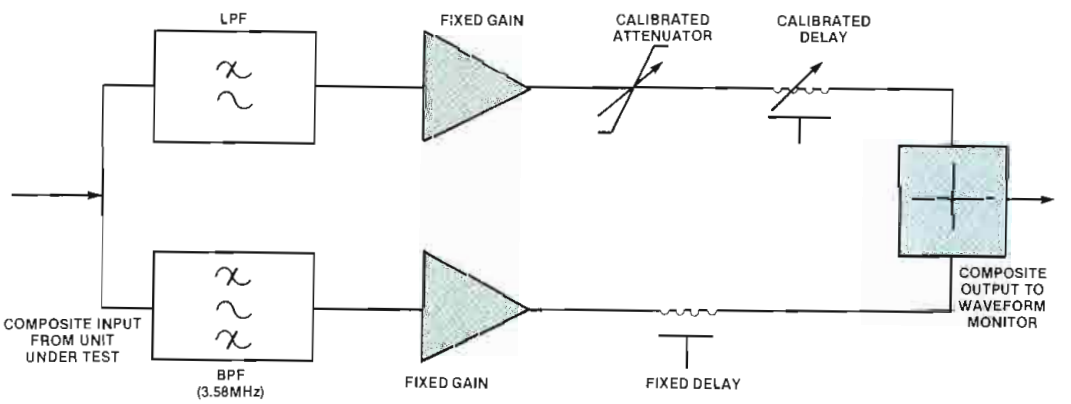

Figure 4. *Chrominance/luminance gain-and-delay inequality test set arrangement. Settings of gain and delay made to correct the pulse baseline represent the exact opposites of the errors.*

used for transient response testing (using the magnified pulse displayed on a "K" graticule), while the ratio of the pulse peak amplitude to the amplitude of the white bar gives a good idea of the system frequency response.

The modulated 12.5T pulse is used for the measurement of chrominance-to-luminance gain inequality and delay inequality—basically the difference in channel gain and delay between the low-frequency signals and subcarrier. Measurements can be made either with a nomograph (as shown in Figure 3) or by adjusting a calibrated attenuator and delay network until the signal imperfections have been reversed. The readings then represent the original errors (see Figure 4).

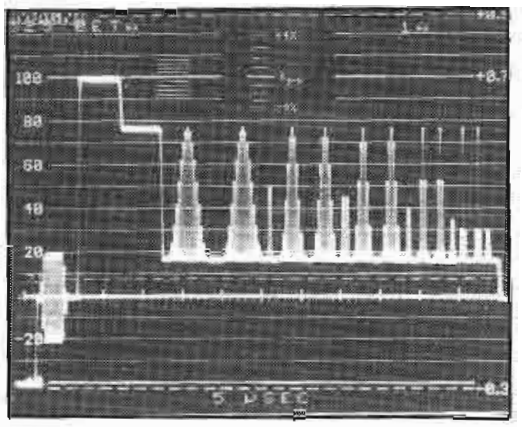

Figure 5. *Multichrominance pulses. This waveform differs from* multipulse, *which does not transcode well into and from the composite environment.*

A component form of the waveform contains similar pulses with component 4T and 2T pulses in the Y channel (with an additional inverted 2T pulse) and component 10T and 5T pulses (with an additional inverted 5T pulse) in the color-difference channels (as shown in Figure 2). The additional pulses allow for the fact that in component format in the studio environment, the frequency and transient responses of which the chrominance systems may be capable are far better than those in an NTSC transmission environment.

The 4T and 2T pulses in the Y channel test accurately to the 2.5MHz and 5MHz points. The inverted pulse may show significantly different degradation compared with the positive pulse. This will happen particularly when the signal has been through a modulation or demodulation process (creating simple or cumulative quadrature distortion).

The additional pulses in the color-difference channels offer examination of those channels out to 1MHz and 2MHz, which are realistic amplitude/frequency-response expectations in the component environment.

In terms of time accuracy, measurements off-tape with modulated sine-squared pulses are less affected by noise and jitter than measurements using cancellation techniques, such as the *Bow-Tie* test signals. It also should be noted that velocity errors in tape systems produce different degrees of degradation to modulated chrominance pulses if they occur at the early part of an active line, compared with the later part.

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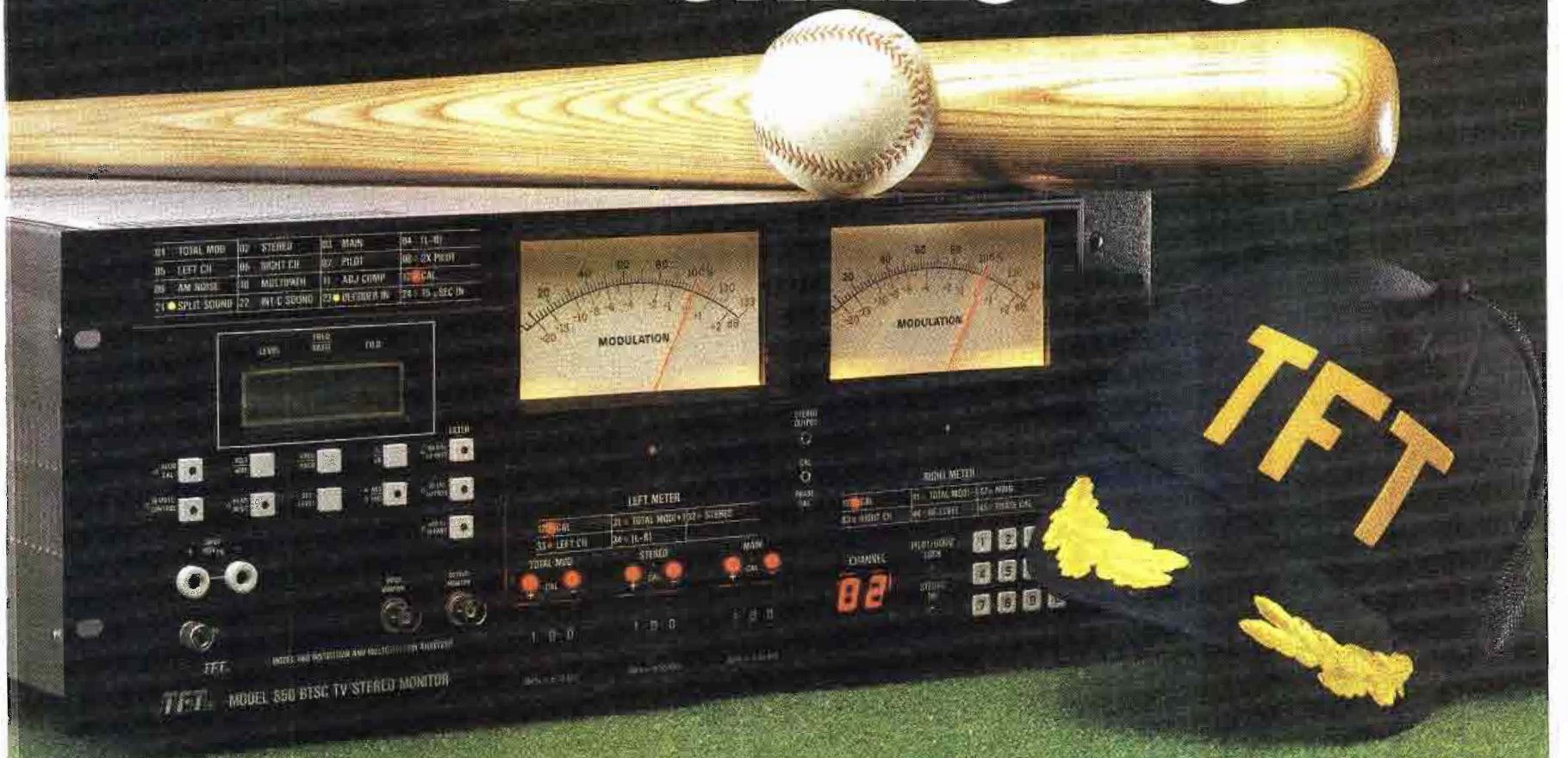

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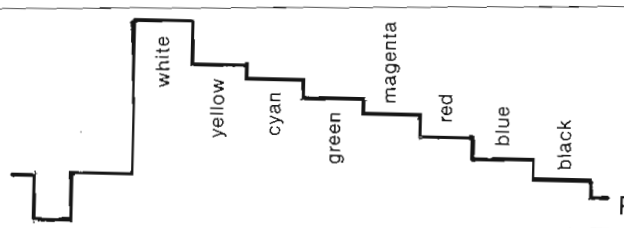
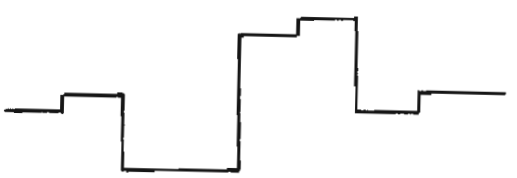
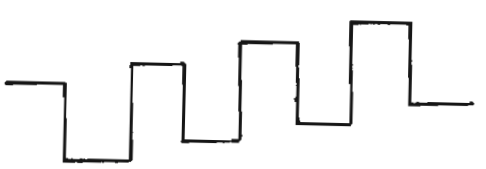
SIGNAL	COLOR BARS	LEVELS	SMPTE	BETACAM	M-II
Y		WHITE	+0.700V	+0.714V	+0.700V
		SETUP	NONE	+0.0535V	+0.0525V
		SYNC	−0.300V	−0.286V	−0.300V
		PK-TO-PK	1.000V	1.000V	1.000V
R − Y		MAXIMUM	+0.350V	+0.350V	+0.324V
		PK-TO-PK	100% 0.700V	75% 0.700V	100% 0.648V
		MINIMUM	−0.350V	−0.350V	−0.324V
B − Y		MAXIMUM	+0.350V	+0.350V	+0.324V
		PK-TO-PK	100% 0.700V	75% 0.700V	100% 0.648V
		MINIMUM	−0.350V	−0.350V	−0.324V

Table 1. *Measurement parameters for component video-recording formats.*

Group delay

Group delay over the range of typical video signals can be examined in two ways: using a low-frequency reference or a subcarrier reference. The first approach (*multipulse*) would use a range of 20T pulses, all modulated at successively higher frequencies. The second, as shown in Figure 5, uses sets of modulated chrominance pulses of different half-amplitude durations. The sets shown, which are alternately modulated by the

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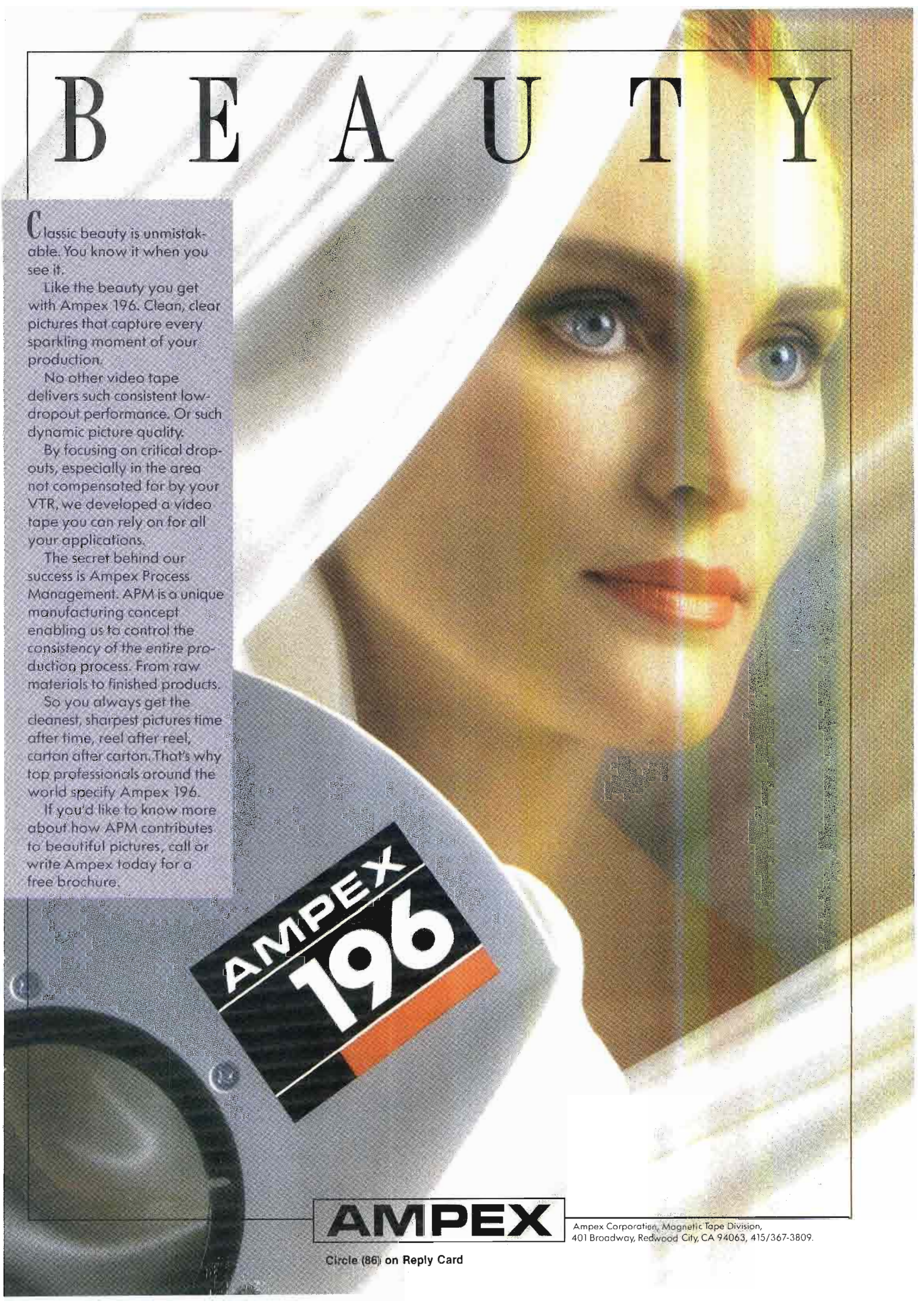

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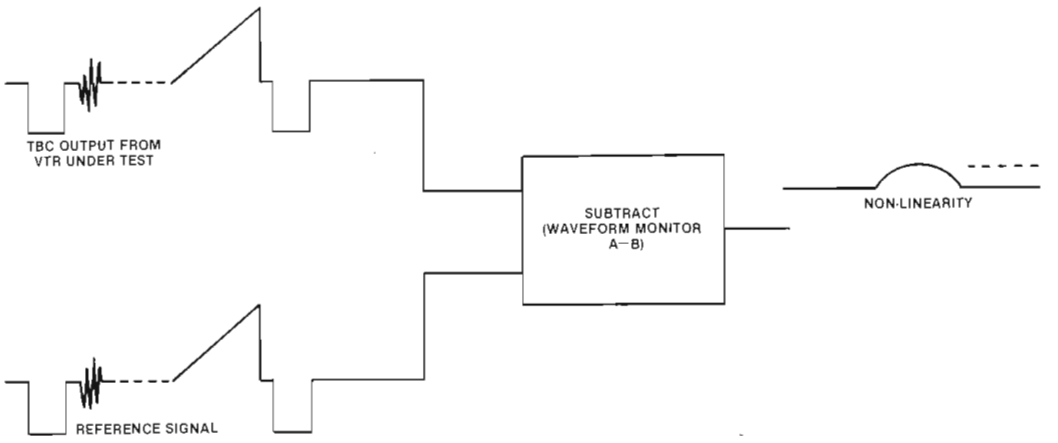

Figure 6. *Alternative A–B line-frequency linearity test setup using a monochrome ramp. This alternative is used because step staircase signals can create their own problems when passed through digital equipment.*

two color-difference channels, have pairs of pulses of 20T, 12.5T, 10T, 5T and 3T.

The range of change in chrominance-to-luminance gain inequalities exhibited by the different pulses is an excellent indicator of changing group delay over chroma-channel frequency response. In these examples, comparison is being made over a response bandwidth at ranges of 400kHz, 640kHz, 800kHz, 1.5MHz and 2.5MHz.

This signal is distinctly different from multipulse, which does not transpose well between composite and component systems and gives different results.

Line-frequency linearity

It has been common practice for many years to use a monochrome staircase signal through the equipment under test, followed by a differentiating filter, to measure the amplitude linearity at line rate of a signal channel. Although this continues to be a valid (and widely used) measurement system, there can be problems using PSDF (pulse-step differentiating filter) methods in a digital equipment environment. The nature of the digital signal process in a time base corrector, for example, means that measurement errors are likely because of sampling-phase errors and quantizing.

An alternative method is shown in Figure 6, in which part of a linearity test ramp is subtracted from a reference ramp to give a subjective indication of non-linearity. Be certain when using this method that the output signal is from the time base corrector and that the compared signals are precisely equal in peak-to-peak amplitude.

It also is common practice for line-frequency linearity testing to be performed at various average picture levels (APLs), not just the approximate 50% that a line ramp or sawtooth implies. Tests should be repeated with four out of five of the test lines at *minimum* amplitude, then four out of five at *maximum* amplitude. This test should be conducted on both the luminance and the color-difference channels.

The additional ramps shown on the signal in Figure 7 are tests for quantizing errors through ADC/DACs. Slow-rising ramps are sensitive to such errors.

It also should be noted that the linear ramps in the individual channel outputs, when converted to RGB or NTSC formats, offer a wide range of exercising activity for encoders and decoders. These offer the capability to detect abnormalities at amplitudes where they might otherwise go unnoticed.

Linearity and intermodulation

High-frequency linearity and intermodulation are measured using the split-field test signal shown in Figure 7. That signal includes a 4.5MHz signal at three different levels in the luminance channel and a 1.5MHz signal in each of the color-difference channels, also at three different levels. High-frequency nonlinearity shows itself as a change in the relative peak-to-peak amplitudes of the 4.5MHz or 1.5MHz signal packets.

When high-frequency luminance intermodulation is being produced within equipment, the problem becomes clearly visible, and measurable, if the output signal is examined after passing through a low-pass filter. This test also is valid for the color-difference channel outputs.

Clamp tests

The window signal shown in Figure 8 checks clamp circuit performance with the color-difference channels being exercised by voltage change over their maximum-to-minimum signal ranges between the areas *in* and *out* of the window. The composite, visual result is a *purple* rectangle within a *green* border.

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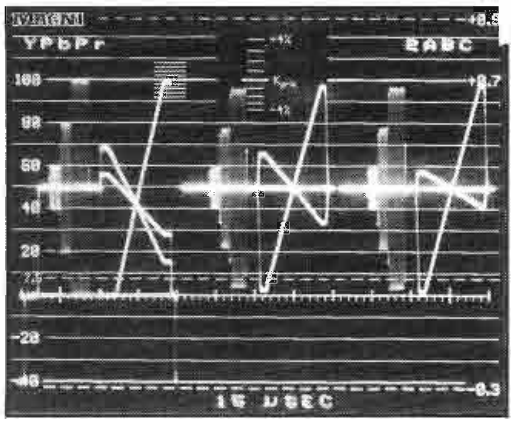

Figure 7. *Low- and high-frequency linearity and intermodulation waveform in the component format. Frequency packets are 4.5MHz in the Y channel and 1.5MHz in the color-difference channel.*

Clamp problems show themselves as saturation, hue and luminance errors or distortions after the edge changes of APL.

This also is one of the only test waveforms in which the color-difference signals are identical in amplitude, and simple subtraction on a waveform monitor should yield a 0V line.

Crosstalk between channels

The number of possible causes of crosstalk in a component system include the following:

- Luminance to one or both of the color-difference channels;
- Either of the color-difference channels into the luminance channel;
- One of the color-difference channels to the other; and
- Any combination of these situations.

The signal that can be employed for these tests has been described and shown in Figure 2 with multiburst on each of the luminance and color-difference channels. None of these multiburst signals is coincident in time with any of the others. Therefore, any crosstalk will be seen on the "quiet" part of one of the other waveforms. Crosstalk from the luminance channels will then be visible as an interfering signal in the totally quiet lines of the color-difference channels. The source of crosstalk can be identified positively in the other direction because of the split in-line production of the color-difference multibursts.

Comb-filter adjustments

One of the most useful test signals in the repertoire being discussed is known as *chroma sweep* (see Figure 9). This signal consists of a line sweep from 1.579MHz to 5.579MHz (that is, NTSC subcarrier frequency ±2MHz). Alternate lines of the signal have luminance chang-

Continued on page 120

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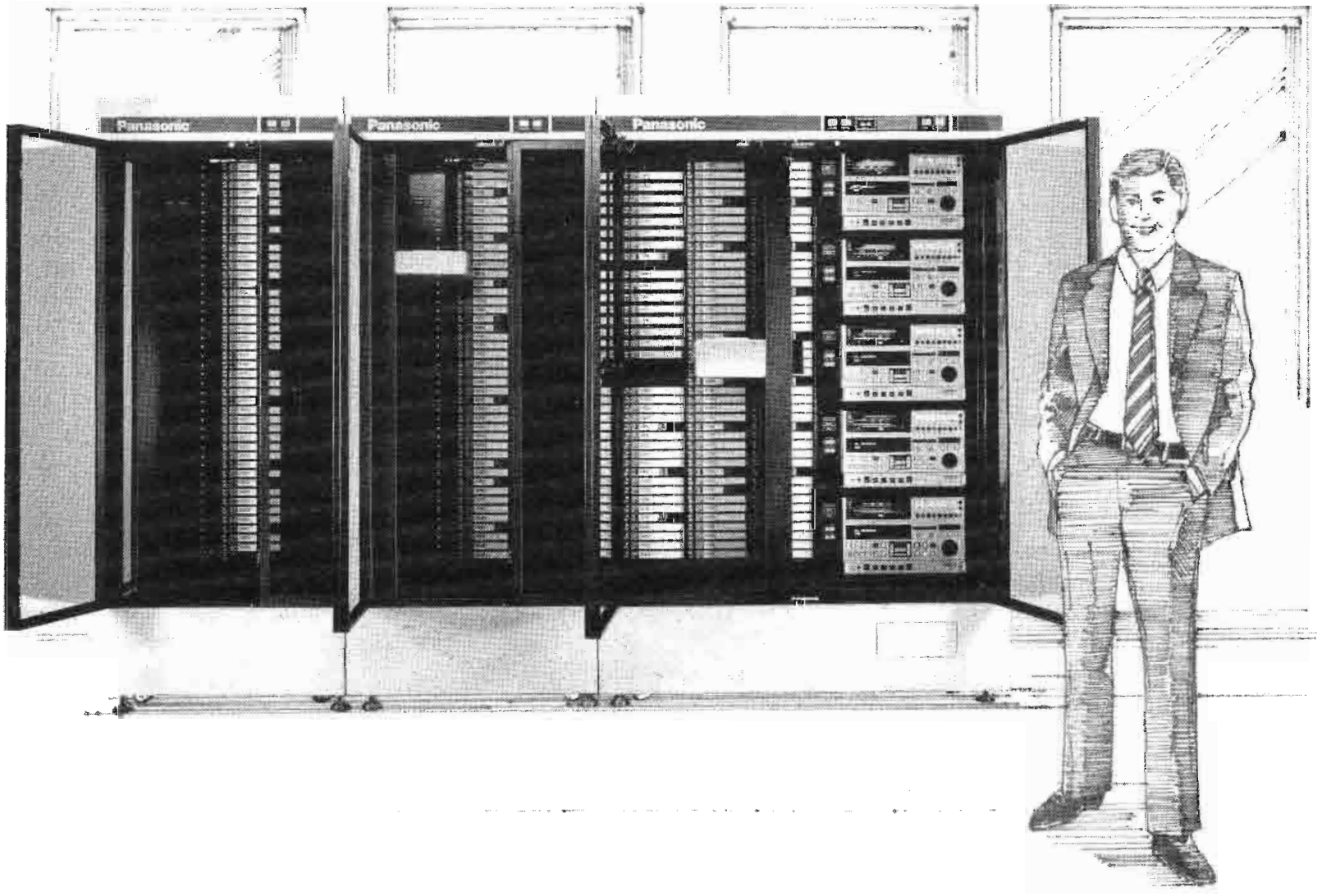

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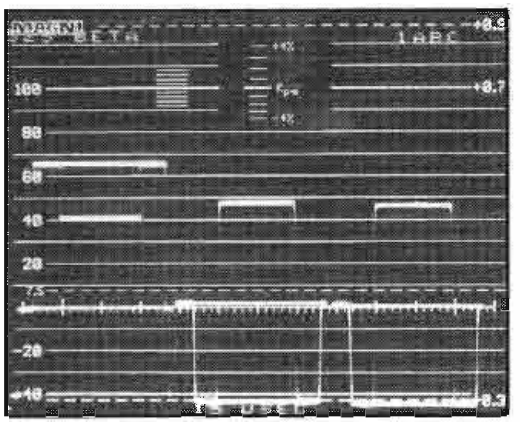

Figure 8. *Window waveform in the component format. Note that the color-difference channels are identical signals. The resulting display from this signal is a* purple *window framed by* green.

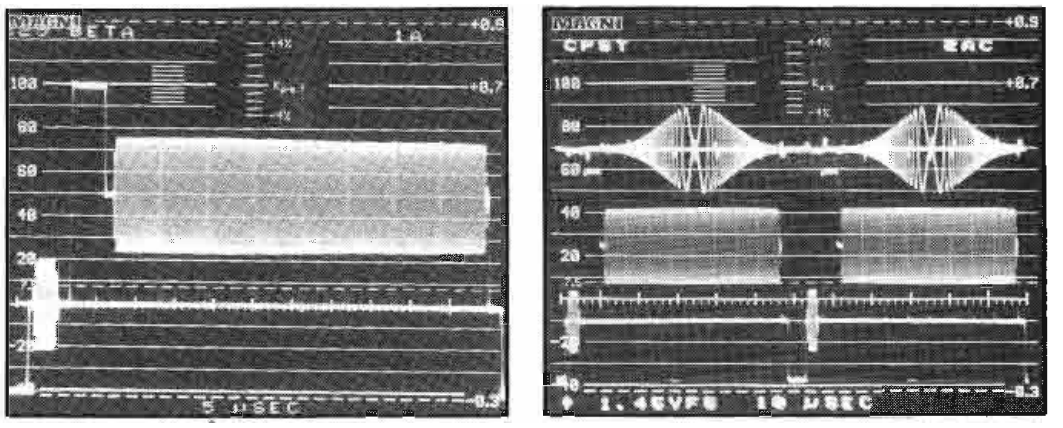

Figure 9. *Chroma-sweep waveforms. Scope photo (a) shows composite chroma sweep (1.579MHz to 5.579MHz) with markers at 0.5MHz intervals (the larger marker is the color subcarrier, 3.579MHz). Scope photo (b) shows chroma sweep and R–Y demodulated output.*

Continued from page 117

ing phase by 180°, resulting in chrominance information remaining in phase. Chrominance and luminance comb-filter circuits interpret the signal as subcarrier.

In the second part of the field, the sweep signal phases are reversed such that they interleave. This produces smoother packets and improves the visual display of the demodulated signal. Additionally, markers are placed every 0.5MHz of the sweep with a larger amplitude marker being placed at subcarrier (3.579MHz).

This signal makes it easy to adjust chrominance filters with a great deal of speed and accuracy. It also allows the performance of an amplifier or other individual component or chain of components to be analyzed near the subcarrier frequency. This signal further permits rapid adjustment of a comb filter (see Figure 10). It should be noted that in the demodulated B–Y and R–Y signals shown, the luminance artifacts caused by the markers on the signal would not have been present in a properly correlated comb filter.

Noise coring

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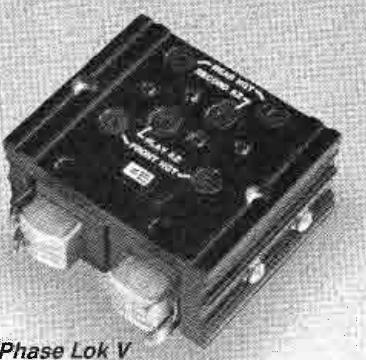

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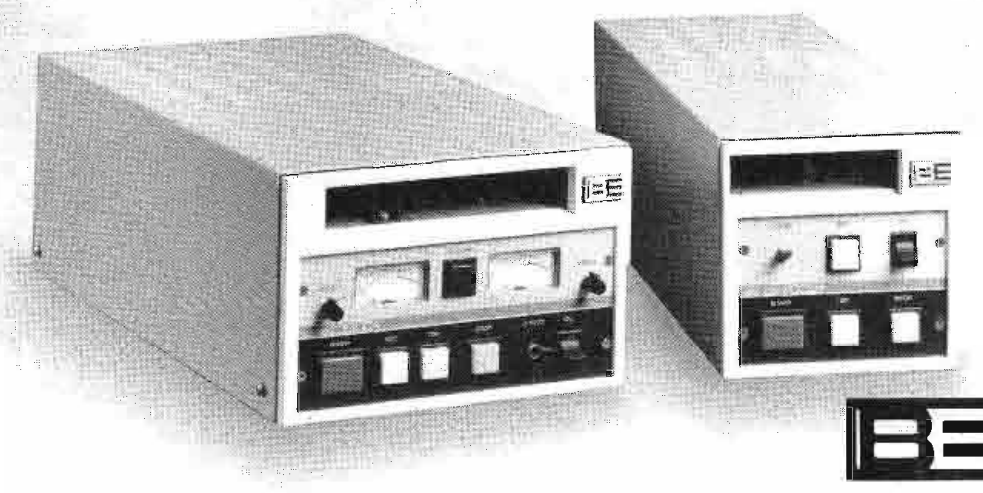

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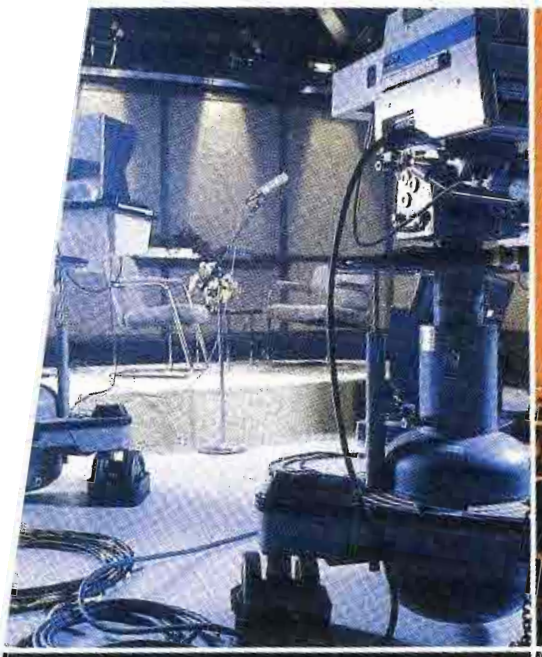

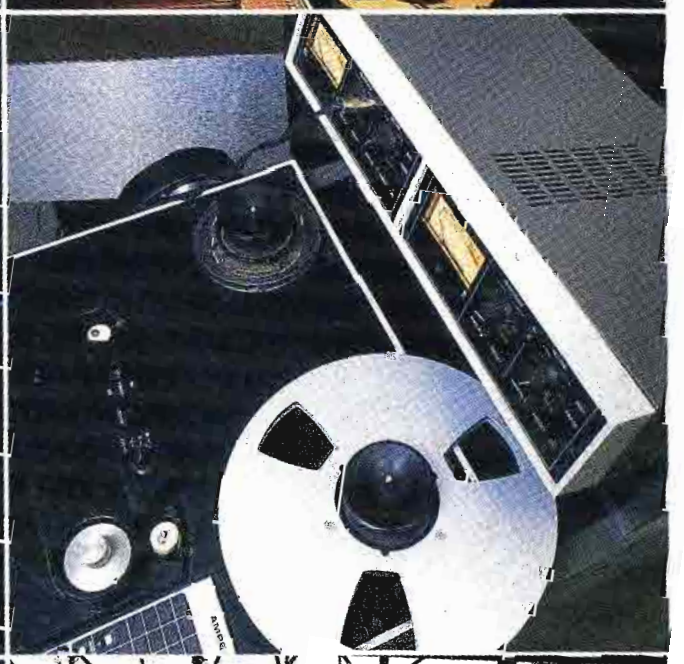

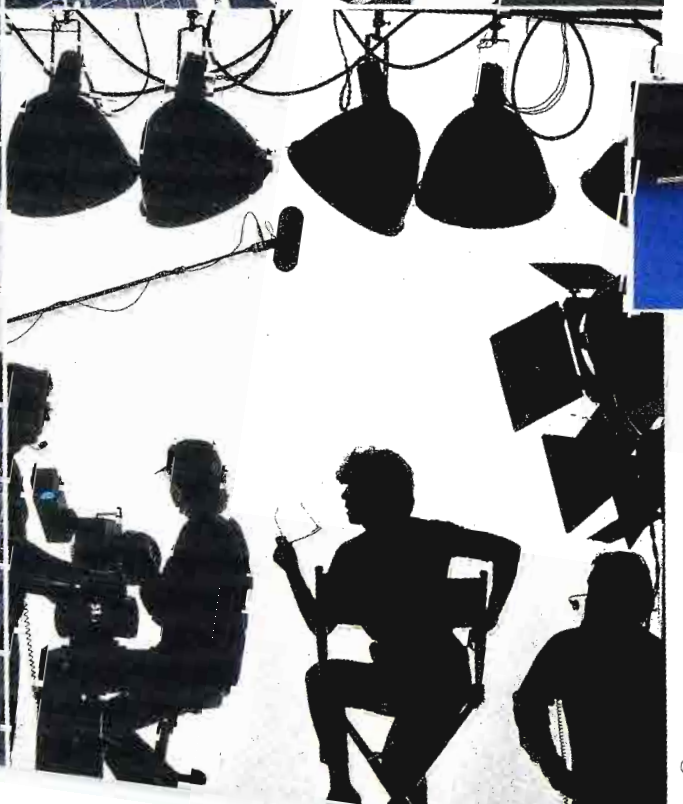

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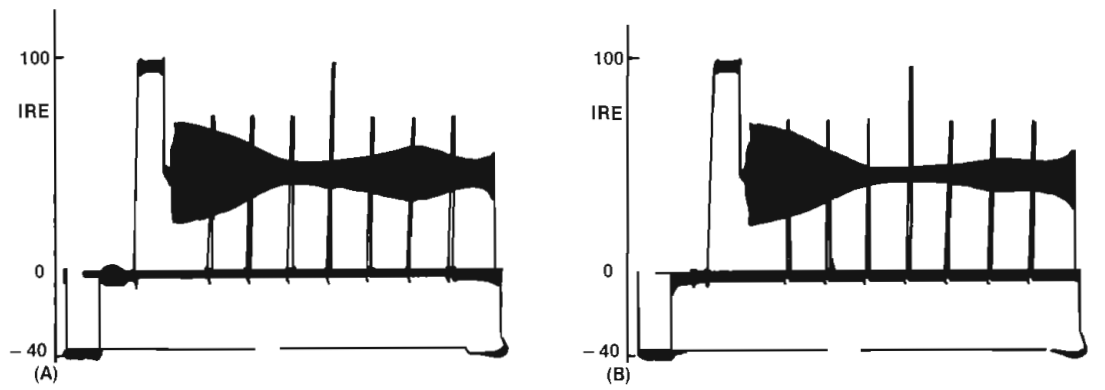


(A) Improperly adjusted (note presence of burst and "notch" effect 0.5MHz below subcarrier)

(B) Correctly adjusted

(C) Demodulated B – Y output signal from chroma sweep through notch filter

(D) Demodulated R – Y output

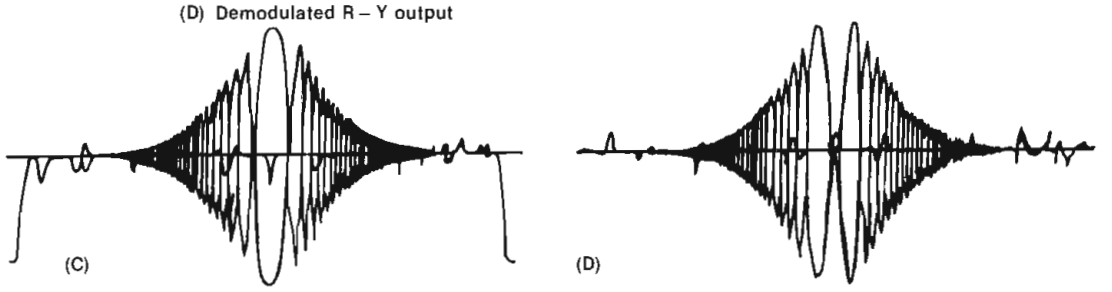
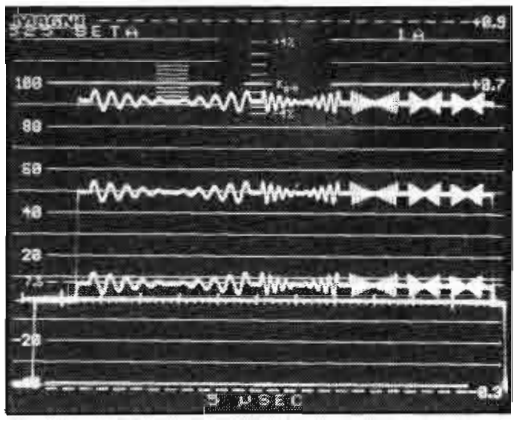


Figure 10. *Adjustment of a comb filter using the chroma-sweep test signal.*



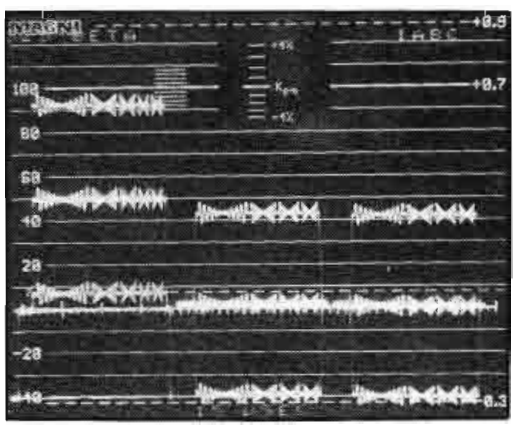


Figure 11. *Noise-coring Bow-Tie waveforms. Scope photo (a) shows noise-coring Bow-Tie on the luminance channel (with alternating pedestal levels). Scope photo (b) shows noise-coring Bow-Tie in the component format. The signal range of the five luminance Bow-Ties ranges from 0.5MHz to 4MHz.*

cuitry, which effectively removes high-frequency, low-amplitude information. The setting of these circuits is a compromise between the improvement of apparent signal-to-noise ratios and the inevitable loss of high-frequency detail in the picture.

The test signal shown in Figure 11 is an attempt to provide a standardized adjustment procedure for noise coring. The luminance channel contains 10IRE peak-to-peak Bow-Tie-shaped signals of frequencies increasing from 0.5, 1, 2, 3 to 4MHz that alternate with a line containing 50% pedestal. At different points in the split-field signal the Bow-Tie signals also sit on different amplitude pedestals.

While the noise-coring circuits are being adjusted, the effects at different luminance levels and frequencies, and the degree of the Bow-Tie coring, can be observed simultaneously. A workable compromise set of adjustments then can be reached. One positive operational condition that can be noted is that the luminance output of the "dub" mode is not affected by coring and can always be used as reference.

The color-difference channels also have their own Bow-Tie signals at frequencies of 0.5, 1, 1.5 and 3MHz, which alternate on a line-by-line basis with black.

Component levels

A question that is frequently raised (and for which there is nothing but a confusion of answers to the uninformed) is *what are the differences in levels between the various component standards?* Table 1 shows the comparative levels of SMPTE (EBU) signals, Betacam and M-II.

Of the three signal formats, SMPTE is the only current standard that has no setup in the luminance channel and is not, therefore, directly comparable to an encoded NTSC signal. The belief that setup on NTSC is to become a thing of the past is an undoubted conclusion of recent recommendations, but the removal of setup does not affect, to any real degree, the operation of an M-II or Betacam machine.

The color-difference channels in SMPTE are known as P_B and P_R, respectively, and have maximum excursions of $\pm$350mV (0.7V peak-to-peak) while the luminance channel has +0.7V video and −0.3V sync amplitudes.

M-II color-difference amplitudes are scaled directly to SMPTE with maximum excursions of $\pm$324mV (0.648V peak-to-peak), which is a scaling of 7.5%. It is not a coincidence that this scaling is directly related to the percentage of setup in a conventional signal. This percentage of setup still exists in the luminance channel of an M-II signal set at 7.5% of +0.7 (being +0.0525V). White is still at +0.7V, and sync amplitude remains at −0.3V.

The Betacam signal set amplitudes in color-difference do not allow for the luminance-channel setup in the same manner, and the peak-to-peak amplitudes are specified for 75% at $\pm$350mV (0.7V peak-to-peak), while the luminance channel is at NTSC levels of white at +0.714V, sync at −0.286V and setup at 7.5% of +0.714V at +0.0535V.

Alphabet soup

At first glance, the testing required for component video signals may make you appreciate NTSC more than ever before. Things used to be so simple. But increased performance comes with a price. And that price is complexity. Complexity of hardware and the test signals necessary to keep the hardware operating properly.

Take heart. When you get into digital recording, component video may seem like the "good old days" by comparison!

References

1. "T" is defined in this article for a 4MHz NTSC composite system at 125ns and for a 5MHz component system at 100ns. The latter is arbitrary because there is no single definition of what constitutes component "bandwidth." The definition used here is solely for convenience.
2. 1Tc = 12.5T (an arbitrary definition for this article).

Editor's note: The *Bow-Tie* signal, an invention of Tektronix, Beaverton, OR, is used with permission.

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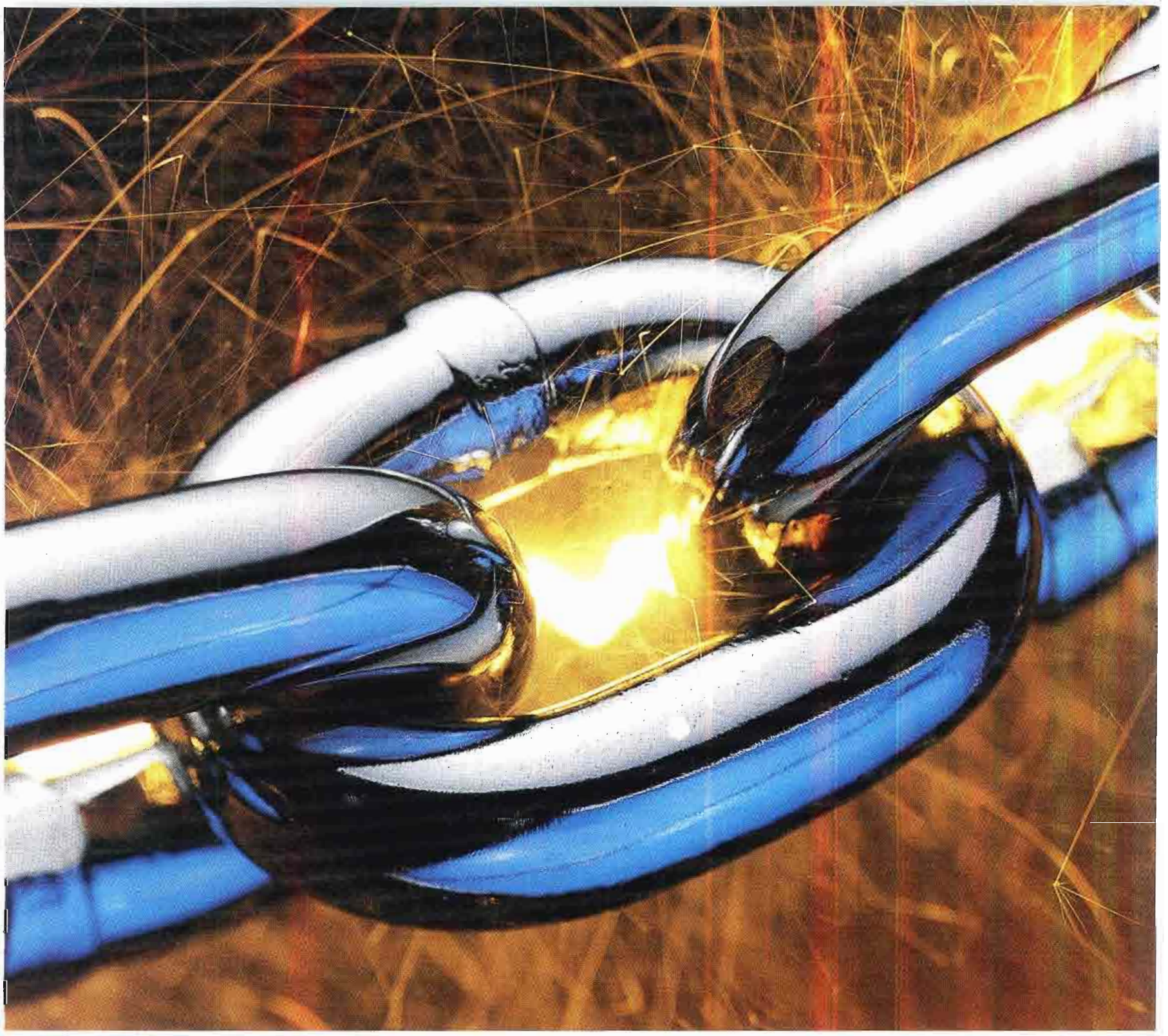

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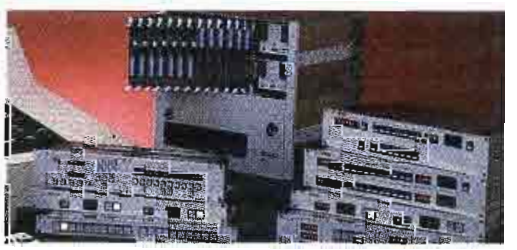

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23GHz microwave propagation

By John E. Matz

Gigahertz-range microwave systems provide many advantages, but they must first be carefully engineered.

Because of increased congestion in the remote pickup and STL bands, many stations are moving up into the microwave (gigahertz) regions for these program links. To many radio engineers, the use of such frequencies is a new experience. The equipment tends to be higher-priced, but more important, the path considerations are more complex. Seldom a factor before, atmospheric conditions now play a major role in a system's reliability. This means that transmission systems operating at the gigahertz frequencies must be carefully designed if reliability is to be ensured.

Line-of-sight propagation

Microwave point-to-point communications usually are carried out under line-of-sight conditions, that is, where the path has been engineered to provide adequate clearance for the radio waves being transmitted from site to site (see Figure 1). In this case, the loss between two isotropic antennas, one at each site, over a path of length D, is approximately equal to the path loss in free space for a path length D.

Additional losses that must be accounted for in transmission through a clear atmosphere are absorption and scattering of the waves by the air. These have been measured as functions of frequency and altitude. By knowing the transmitter power and receiver sensitivity, and adding in the transmit and receive antenna gains, you can compute the *fade margin* for the path, the difference between the normal received signal and the receiver's sensitivity. Adequate fade margin is necessary to cover the anomalies in path propagation, such as multipath fading and rain attenuation, for as much of the time as possible. The basic equations are summarized in Table 1.

Multipath fading

One of the more common causes of path outage is multipath fading. Under normal circumstances, only a single direct ray from the transmitting antenna arrives at the receiving antenna. In multipath-fading conditions, a reflected or refracted ray arrives at the receiving antenna along with the direct ray, adding to or subtracting from the direct ray. (See Figure 2.) If the two rays are approximately equal in amplitude and exactly out of phase, a nearly total cancellation, a deep fade, will occur. This cancellation

Matz is a senior staff engineer for telecommunications products with the communications sector of Motorola, Schaumburg, IL.

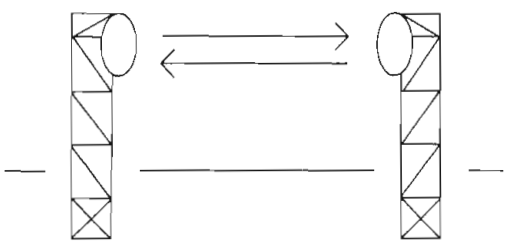

Figure 1. *Line-of-sight microwave path with adequate clearance suffers only those losses that approximate a free-space path.*

SYSTEM GAIN	$SG = P_t(dBm) - RX\ sensitivity\ (dBm)$
RANGE GAIN	$RG = SG + G_t + G_r$
FREE-SPACE PATH LOSS	$FSL = 92.4 + 20 \log D + 20 \log F$
ATMOSPHERIC GAS LOSS	$AGL = kD$
FADE MARGIN	$FM = RG - FSL - AGL$

F is the operating frequency in gigahertz.
D is the path length in kilometers.
k depends on frequency, climate and altitude.
All other parameters are in decibels.

Table 1. *Line-of-sight microwave-path calculations.*

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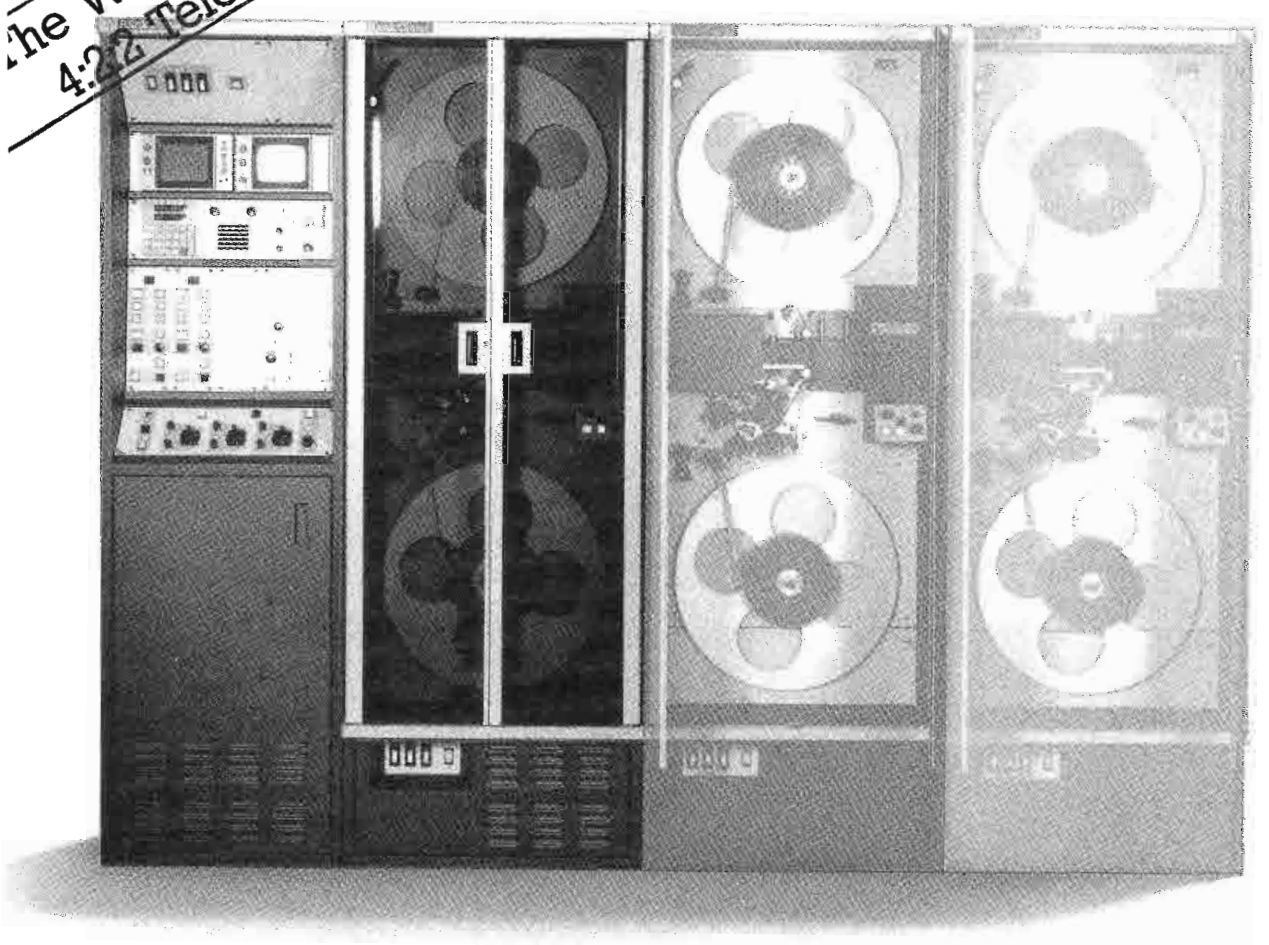

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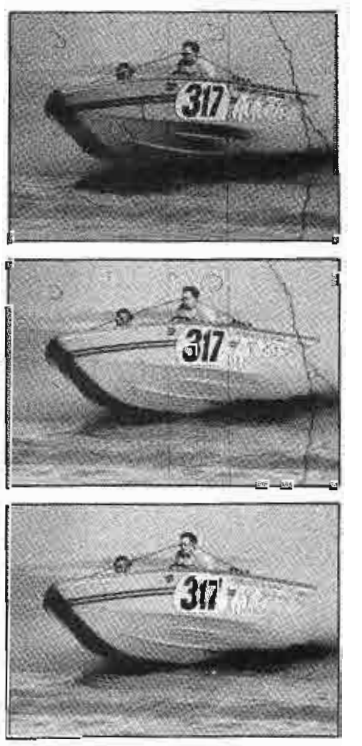

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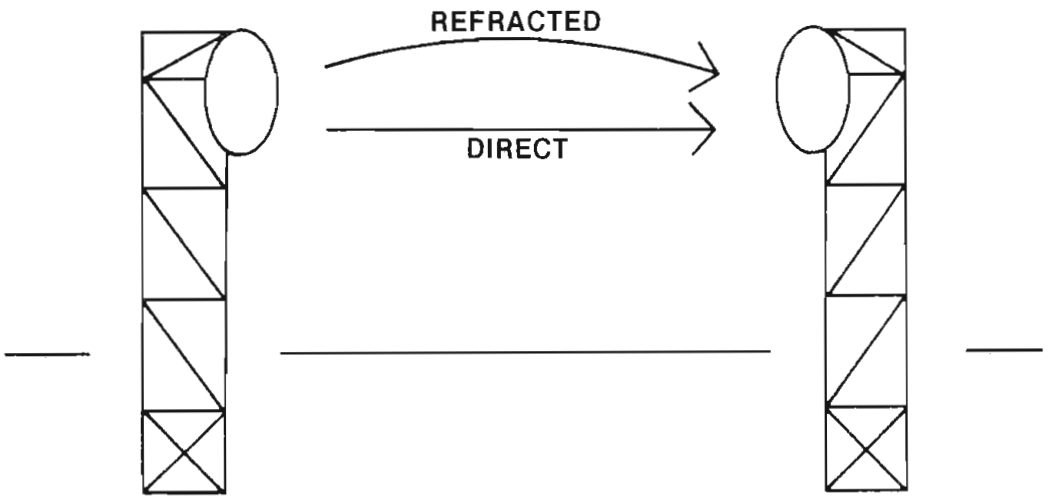

Figure 2. *The most common cause of path outage is multipath fading. A reflected or refracted ray, arriving along with the direct ray, may add to or subtract from the direct ray.*

depends heavily on frequency and antenna position, so frequency diversity or space diversity can provide excellent countermeasures to this type of fade.

Also, fade duration is inversely related to fade depth; that is, deep fades (exact cancellation) usually occur for short periods. How often multipath fading occurs depends mainly on terrain, climate, path length and operating frequency. Equations commonly used to describe multipath fading are listed in Table 2.

At higher frequencies, above a few gigahertz, as the wavelength approaches water-droplet diameter and the dielectric constant of water falls and its loss tangent rises, rain becomes a major contributor to path outage (see Figure 3). Signal attenuation by rain is due to both absorption and scattering of the radio waves. This effect is relatively broadband.

The fade depth depends on the number of raindrops with which the signal must contend on the path, meaning the rainfall rate integrated along the path. Outage occurs when the additional attenuation exceeds the fade margin. For this type of outage, neither frequency nor space diversity does much good. Only path diversity or loop diversity may improve system reliability.

Rain-rate statistics

The fraction of time of the year that a microwave radio link is unavailable due to rain depends on local climate, path length and operating frequency. Factors most likely to determine the system's unavailability are simply how much of the time it rains and how hard it rains. This information can be extracted from rain-rate statistics gathered by the National Weather Service and other agencies in a given location over a long period. Ideally, the instantaneous rainfall rate should be measured, but as a practical matter, it can be averaged over 1-minute intervals.

This data can be graphed as shown in Figure 4. The fraction of the year that the 1-minute averaged rainfall rate exceeds a given level is plotted against that level. In the example shown, the Chicago-area rain rate exceeds 50mm/hour for 0.01% of the year and 100mm/hour

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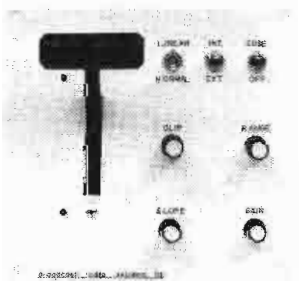

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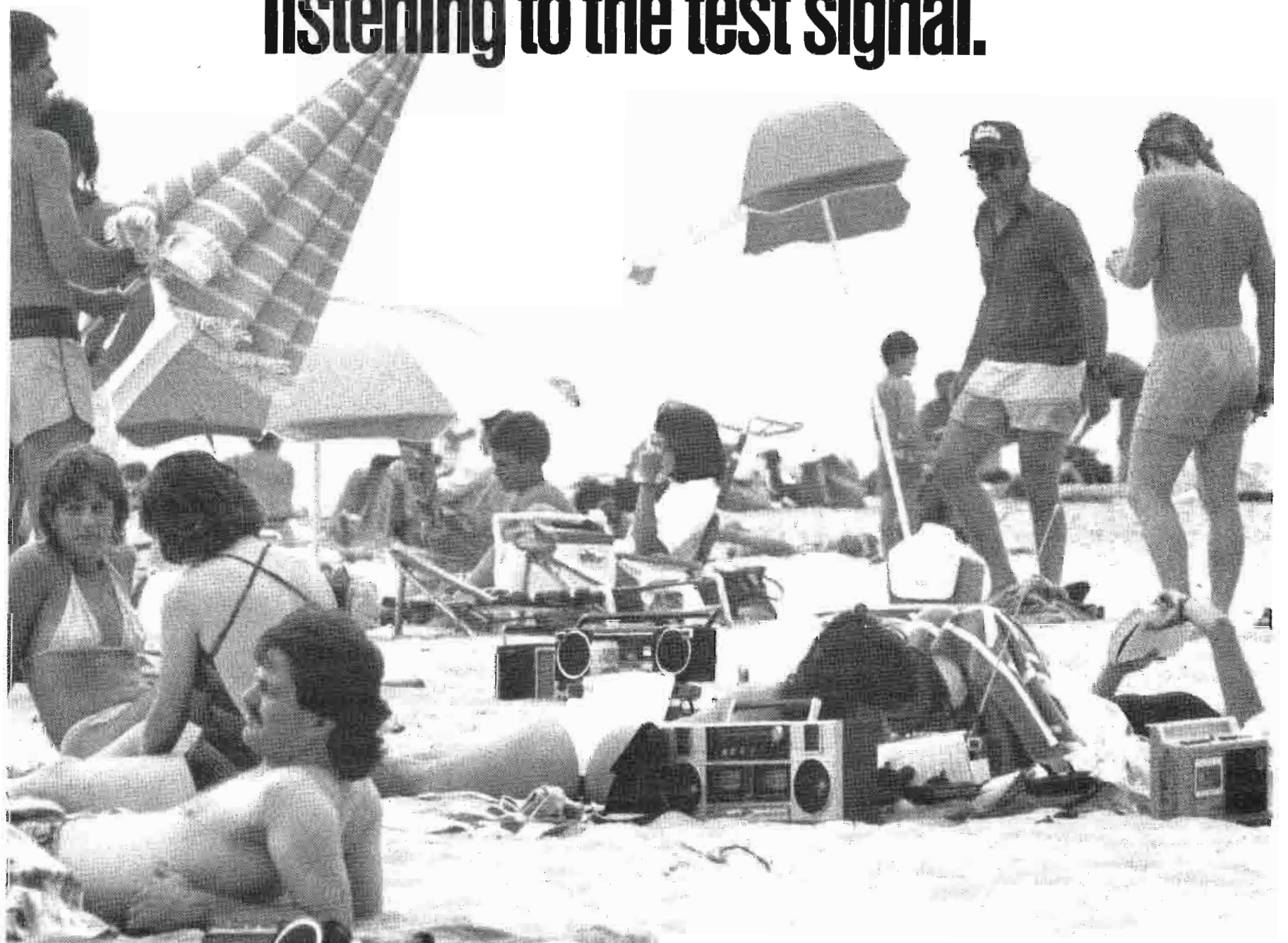

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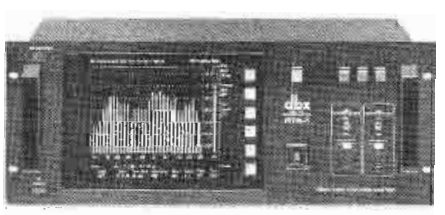

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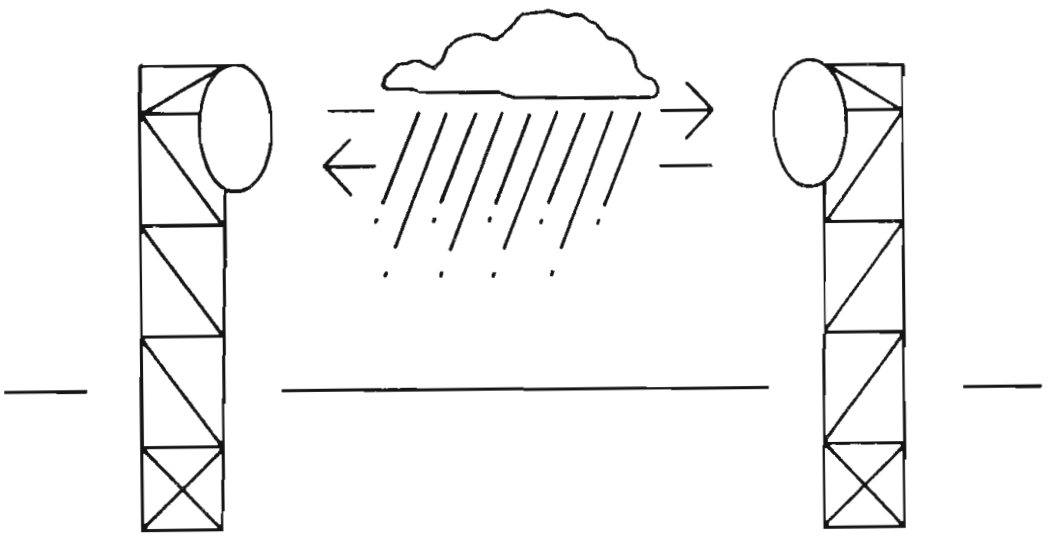

Figure 3. *Rain attenuation contributes significantly to path outage at frequencies above a few gigahertz. Attenuation results from signal absorption and scattering by water droplets.*

for 0.001% of the year. If the microwave-path fade margin can handle attenuation at a 100mm/hour rain rate, then path unavailability should be about 0.001%, or 1E−5 of the year.

Modeling rain fading

Rain-rate statistics have been developed through theoretical and experimental determination of attenuation due to rain. Some references are listed at the end of this article. Helpful research results also have been incorporated into the CCIR reports on rain attenuation, and Robert K. Crane has recommended an excellent model for rain-induced outage. (See footnotes 1-5 under "References.")

CCIR rain-fading model

A key assumption in one model that the CCIR recommends for calculating rain fading is that the total effect of the rain-rate profile along a path can be approximated by assuming a constant rain rate along a shorter *effective* path length. The model also assumes that the rain-rate distribution follows a power-law distribution in a piecewise manner. These assumptions allow a straightforward calculation of unavailability.

These are the steps used to calculate rain attenuation using the CCIR model:

(1) Determine R, the point rain rate exceeded 0.01% of the year at the desired location, from maps, graphs or tables.

(2) Calculate S, the specific attenuation in decibels per kilometer:

$$S = aR^b$$

where a and b depend on frequency.

(3) Calculate r, the path-length reduction ratio:

$$r = 90/(90 + 4D)$$

where D is the path length in kilometers.

(4) Calculate L_o, the rain loss exceeded 0.01% of the time:

$$L_o = SrD$$

(5) Adjust the unavailability U to other rain losses:

$$U_x = (0.01\%)(L_o/L_x)^q$$

where

$q=3.00$ for $0.001\% < U_x < 0.01\%$ and
$q=2.44$ for $0.01\% < U_x < 0.1\%$

Continued on page 132

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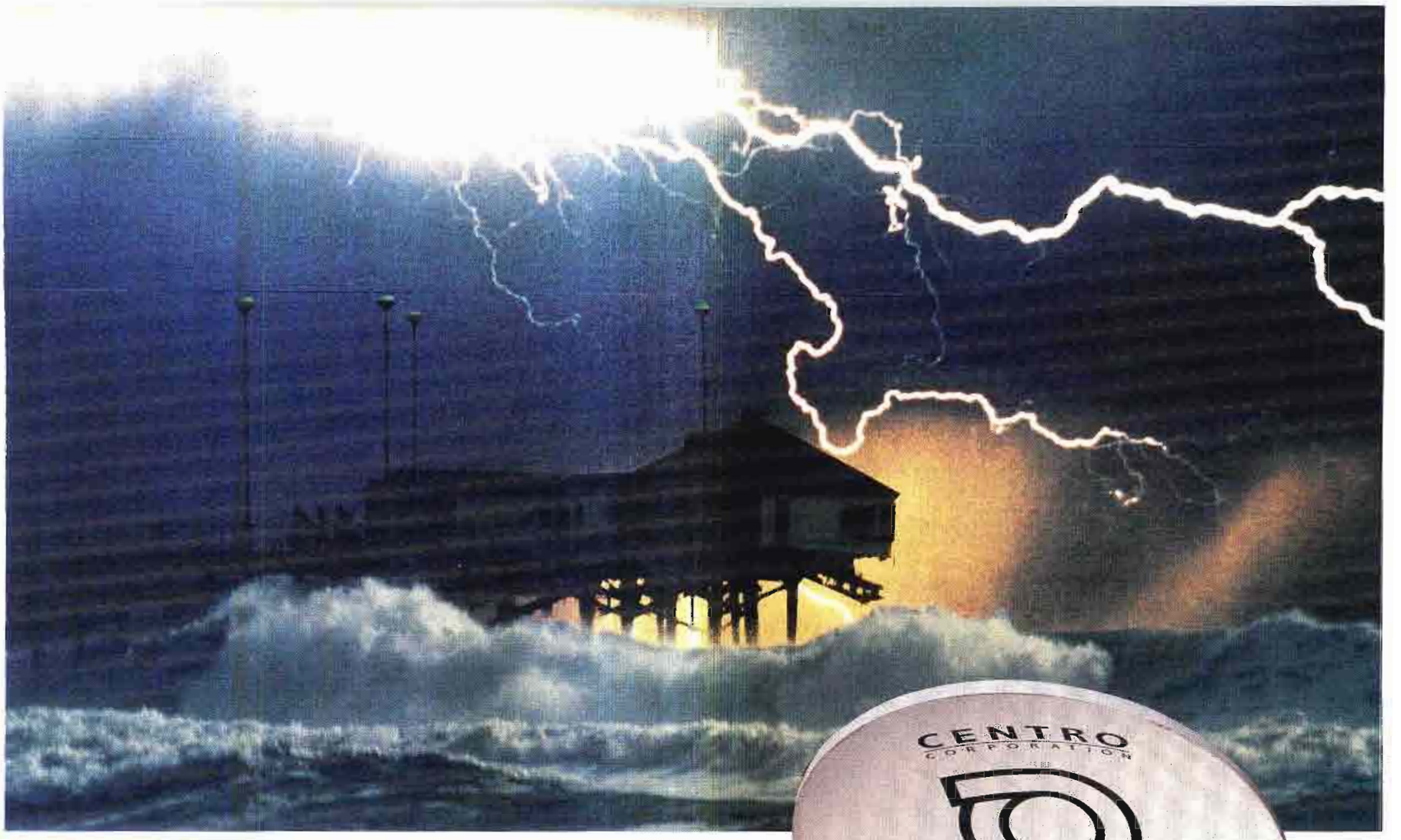

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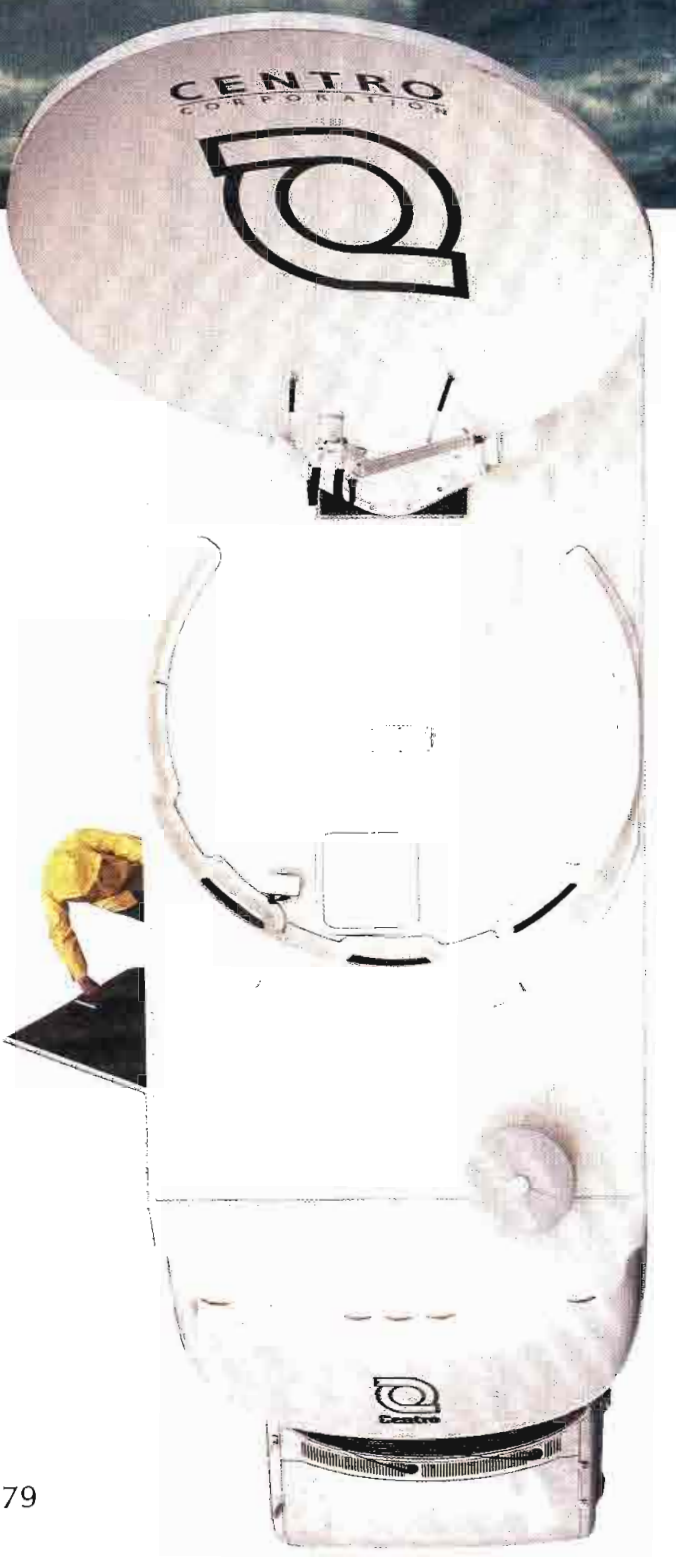

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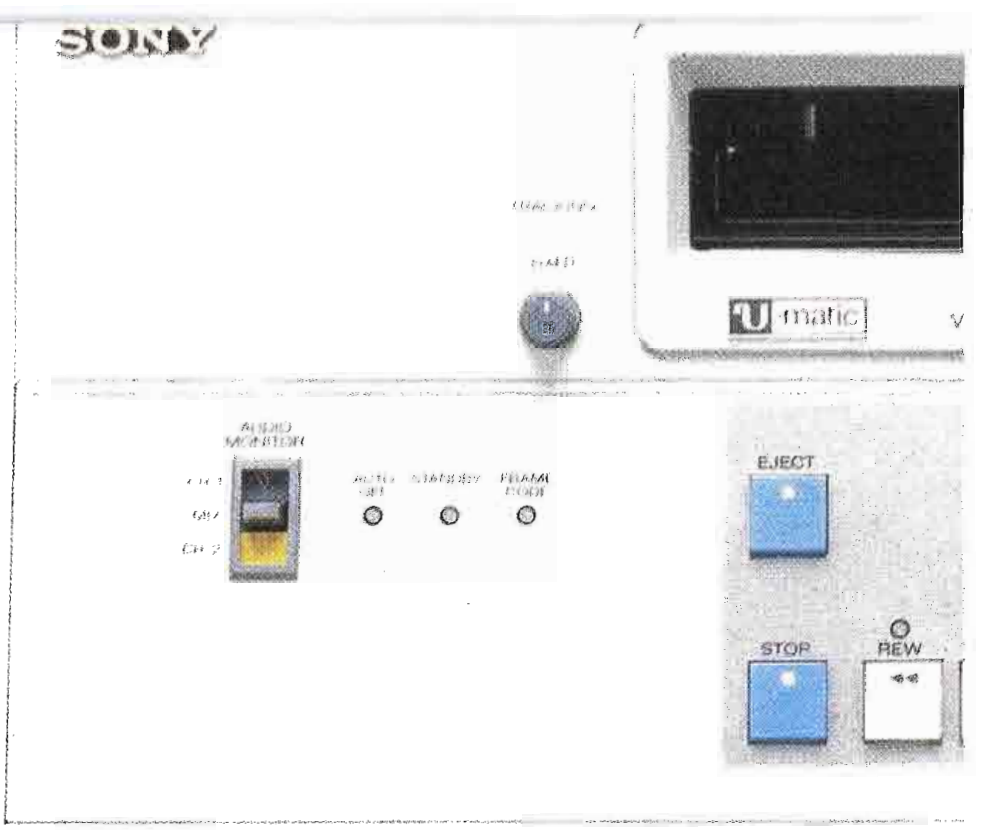

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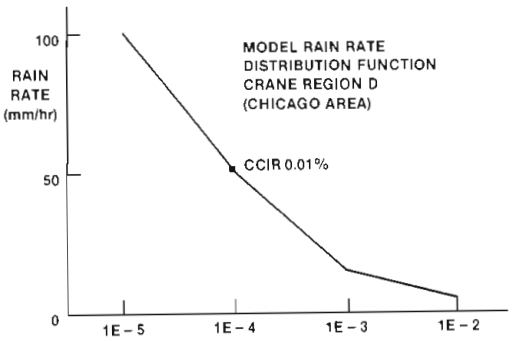


Figure 4. *An example of a rainfall data graph for the Chicago area shows the rate exceeds 50mm/hour for 0.01% of the year and 100mm/hour for 0.001%. If the microwave-path fade margin is adequate for a 100mm/hour rate, path unavailability should be approximately 0.001%, or 1E−5 of the year (5.256 minutes).*

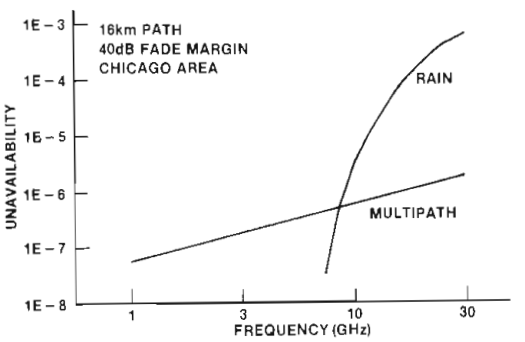
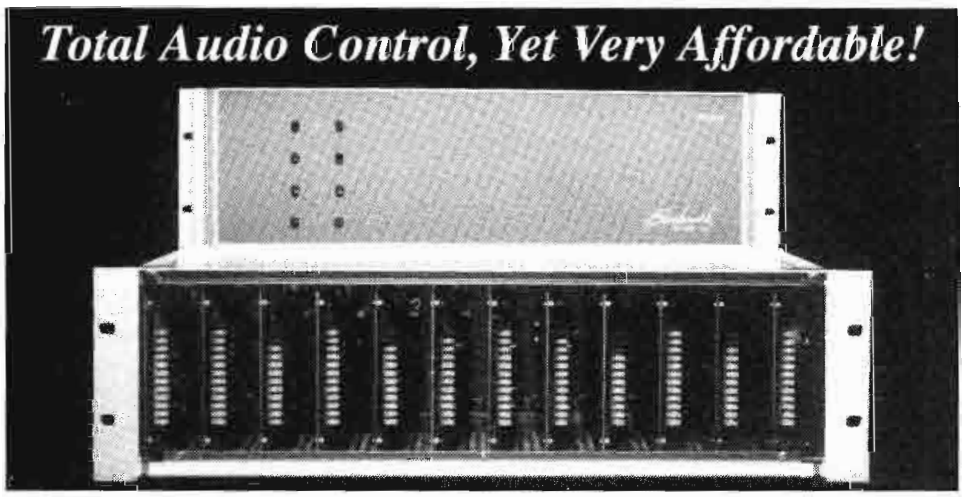


Figure 5. *This graph shows unavailability as a function of frequency for a fixed path-length fade margin. Rain outage is negligible for frequencies below approximately 7GHz, but is dominant over multipath fading outage for frequencies above about 11GHz.*



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Continued from page 128

Crane's rain-fading model

Crane has suggested a model for calculating rain fading that assumes the rain rate follows a predictable profile along the path. This rate can be integrated to yield total rain loss over the entire path.[5] Crane also recommends using rain-rate distributions tailored to each climatic area. This means that the calculation of unavailability probably requires an iterative procedure.

These are the steps used to calculate rain attenuation using Crane's model:

(1) Determine R, the point rain rate, exceeded for U fraction of the year from maps, graphs or tables.

(2) Calculate S, the specific attenuation in decibels per kilometer, from: $S = aR^b$ where a and b depend on frequency.

(3) Calculate L, the rain loss in decibels over path length D from:

$D < d$

$L = S\,(e^{ubd} - 1)/(ub)$

$D < d < 22.5$

$L = S[(e^{ubd} - 1)/(ub)] + B^h[(e^{bCD} - e^{bCd})/(bC)]$

where

$B = 2.3R^{-0.17}$

$C = 0.026 - 0.03 \ln (R)$

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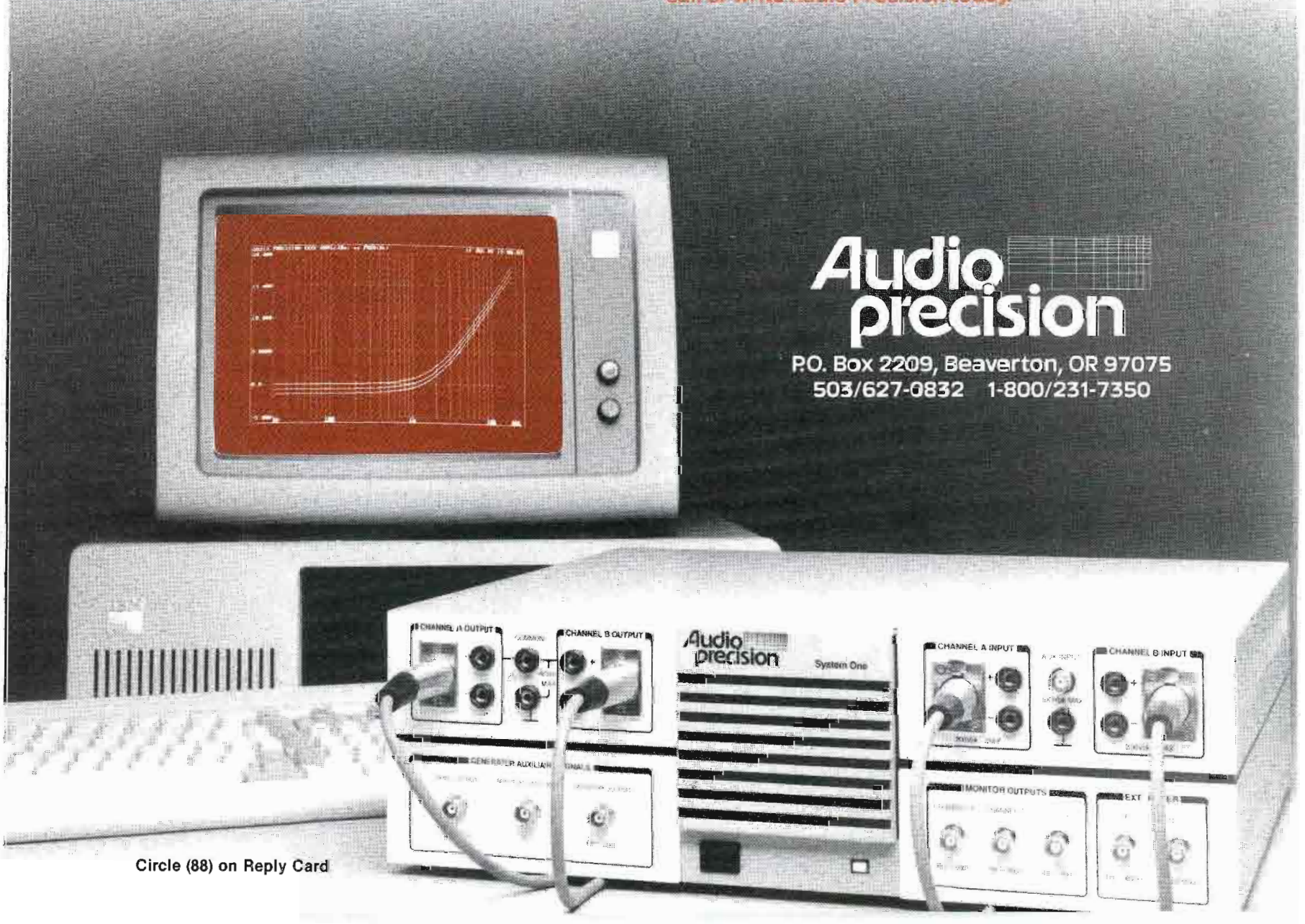

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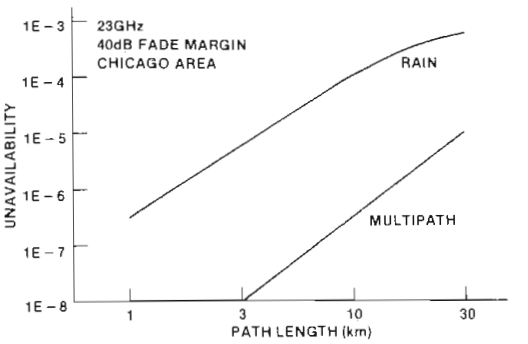

Figure 6. *Path unavailability as a function of path length due to multipath and rain-induced fading at 23GHz. Extraordinarily high path reliability (unavailability = 1E−6, or less than one minute per year) may be impossible for path lengths greater than 3km at 18GHz or 23GHz.*

$d = 3.8 - 0.6 \ln (R)$
$u = \ln (Be^{Cd})/d$

(4) Repeat for additional rain rates and unavailabilities.

Examples at 23GHz

It may be enlightening to look at examples of typical paths to compare the two rain-fading models and to see to what extent multipath fading contributes to unavailability. The different methods for figuring rain fading result in slightly different values.

• *Example 1.* 16km path near Chicago at 23GHz.

Multipath-fading calculation:
Fade margin = 30dB
Average terrain and climate (a=1 and b=0.25)
Unavailability = 1.27E−5 for 30dB fades

CCIR rain-fading calculation:
Rain intensity 0.01% of time= 50mm/hour; at 23GHz, a=0.1 and b=1.06, therefore
Specific attenuation = 6.3dB/km
Path-reduction ratio = 0.58
Rain attenuation = 0.58×16×6.3
= 59dB
Unavailability
$= 0.0001 \times (59/30)^{2.44}$
= 5.2E−4 for 30dB fades

Crane rain-fading calculation:
Rain intensity 0.05% of time = 19mm/hour
Rain attenuation = 30.2dB
Unavailability = 5E−4 for 30dB fades

• *Example 2.* 5km path near Houston at 23GHz.

Multipath-fading calculation:
Fade margin = 40dB

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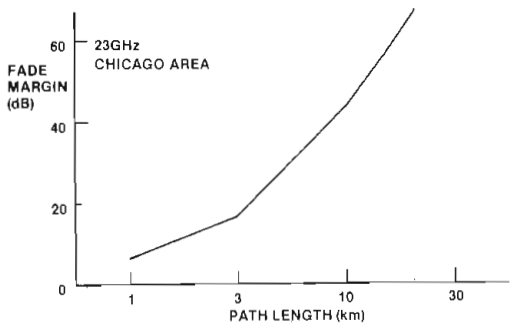


Figure 7. *Fade margin required to hold U = 1E−4 (approximately 52 minutes outage per year due to rain fading) plotted as a function of path length. Because a microwave receiver's dynamic range is approximately 50dB to 60dB, path lengths in the Central United States are limited to 16km (10 miles) for reasonable reliability at 23GHz.*

Gulf Coast terrain and climate
(a=4 and b=0.5)
Unavailability = 1.5E−8 for 40dB fades

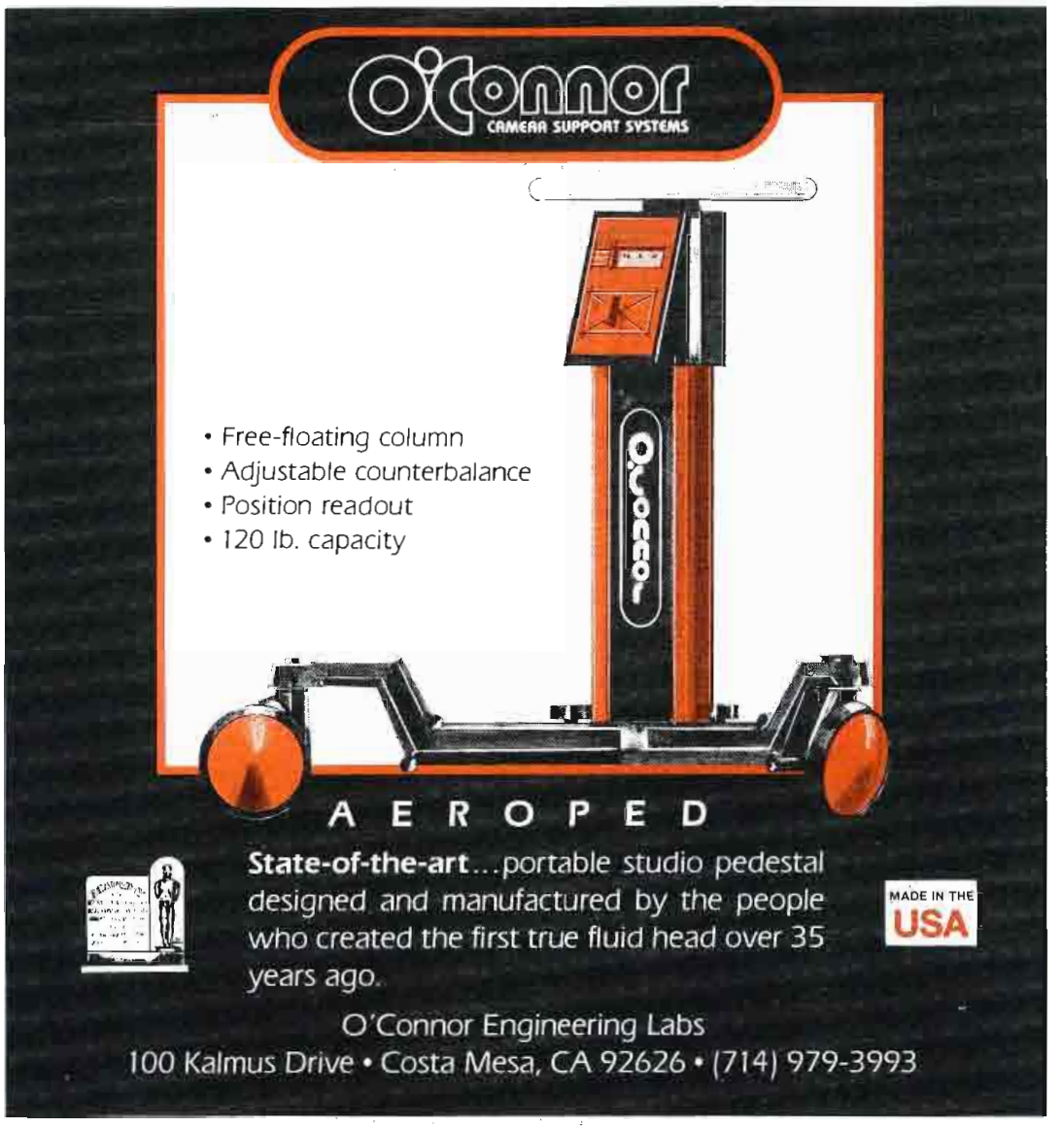
CCIR rain-fading calculation:
Rain intensity 0.01% of time = 70mm/hour at 23GHz, a = 0.1 and b = 1.06, therefore
Specific attenuation = 9dB/km
Path-reduction ratio = 0.82
Rain attenuation = 0.82×5×9
= 36.8dB
Unavailability
= 0.0001×(36.8/40)³
= 7.8E−5 for 40dB fades

Crane rain-fading calculation:
Rain intensity 0.01% of time
= 70mm/hour
Rain attenuation = 38.6dB
Unavailability = 9E−5 for 40dB fades

Comparison

It also may prove interesting to look at how operating frequency and path length affect microwave-link unavailability. Figure 5 shows path unavailability as a function of frequency for a fixed path-length fade margin. Rain outage is negligible for frequencies below about 7GHz, but dominant over multipath fading outage for frequencies above about 11GHz. Note that the annual outage at 18GHz is about one-half that at 23GHz.

Figure 6 presents the unavailability of a path, as a function of path length, due to multipath fading at 23GHz. Here it is apparent that the outage due to rain is about 100 times greater than the outage due to multipath for reasonable path lengths. Extraordinarily high path reliability (unavailability=1E−6) may be impossible for path lengths longer than 3km at 18GHz. This can be extrapolated from the curves, but even the model, based on 1-minute rain-rate averages, breaks down below U=1E−5.



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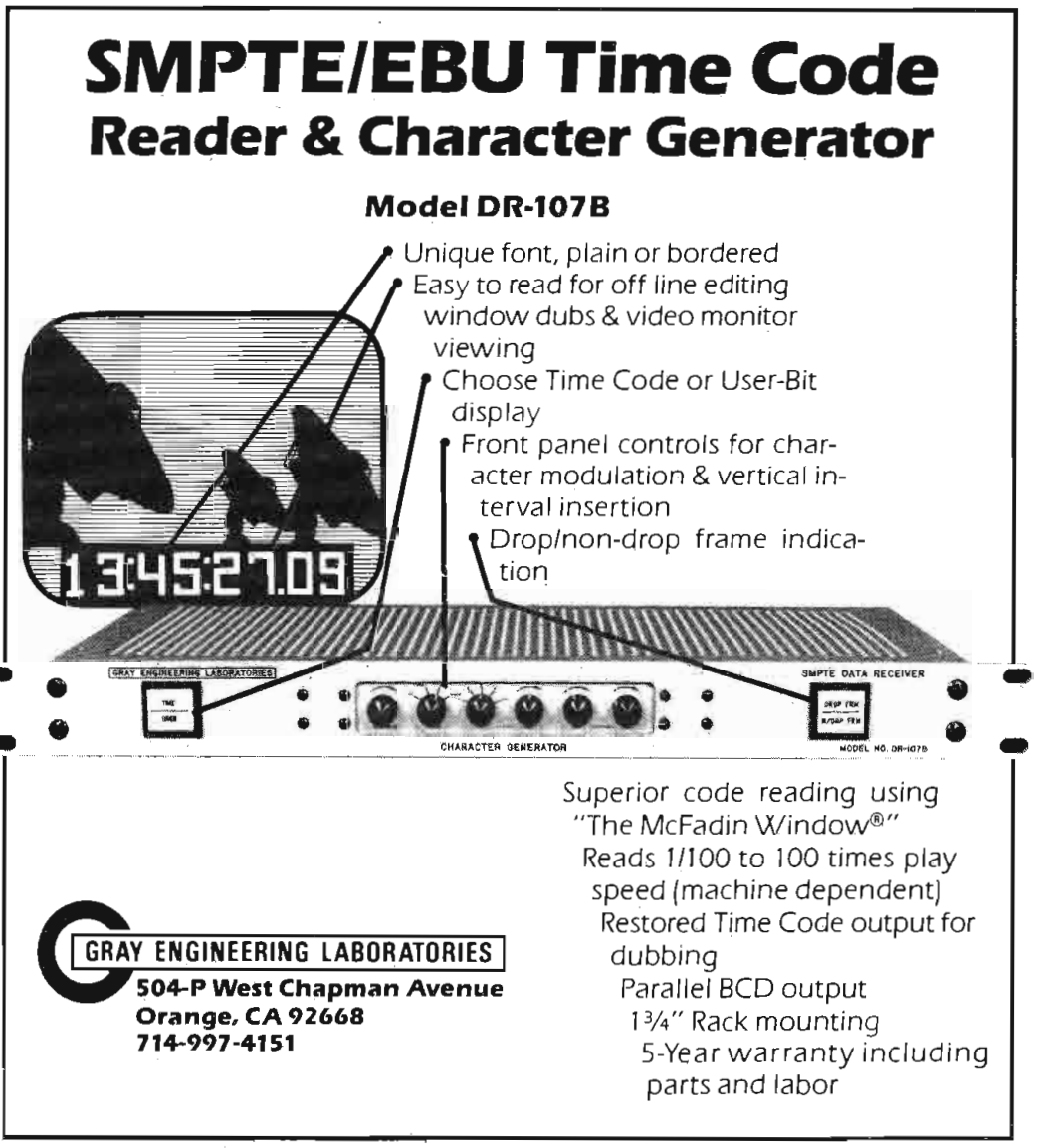

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Let U be the fraction of time a path is unavailable.

Then: availability = 1 − U

and: $10 \log (U) = 10 \log (6AB) + 10 \log F + 30 \log D - FM - 70$

where
A is a terrain factor (A = 4 to A = 0.25);
B is a climatic factor (B = 0.5 to B = 0.125);
for fraction of months in year with fading;
FM is the fade margin in decibels.

Average fade duration $T = 410 \times 10^{-(FM/20)}$

Table 2. *Equations describing multipath fading.*

Fade-margin requirements

In Figure 7, the fade margin that allows an unavailability of 0.01%, or 1E−4, is plotted as a function of path length for the Chicago area. For a 3km path, only a 17dB fade margin is needed, but a 10km path requires 40dB, and 30km requires an enormous 80dB fade margin. Because the dynamic range of many microwave receivers is only 50dB to 60dB, it is apparent that 16km, or 10 miles, is about the limit in path length for reasonable reliability at 23GHz in the Central United States.

Some observations have been made for *average* U.S. climate, such as the Midwest:

- Rain-induced fading predominates over multipath fading at frequencies above about 10GHz.
- At 23GHz, rain-induced fading predominates over multipath fading by about a factor of 100 for reasonable path lengths.
- It may be impossible to achieve unavailability U=1E−6 for any path longer than 3km at either 18GHz or 23GHz.
- Either the CCIR model or the Crane model can be used with reasonable accuracy to estimate outage due to rain.
- Countermeasures to multipath fading include frequency, space and loop diversity. Only loop (or path) diversity may be effective against rain-induced fading.

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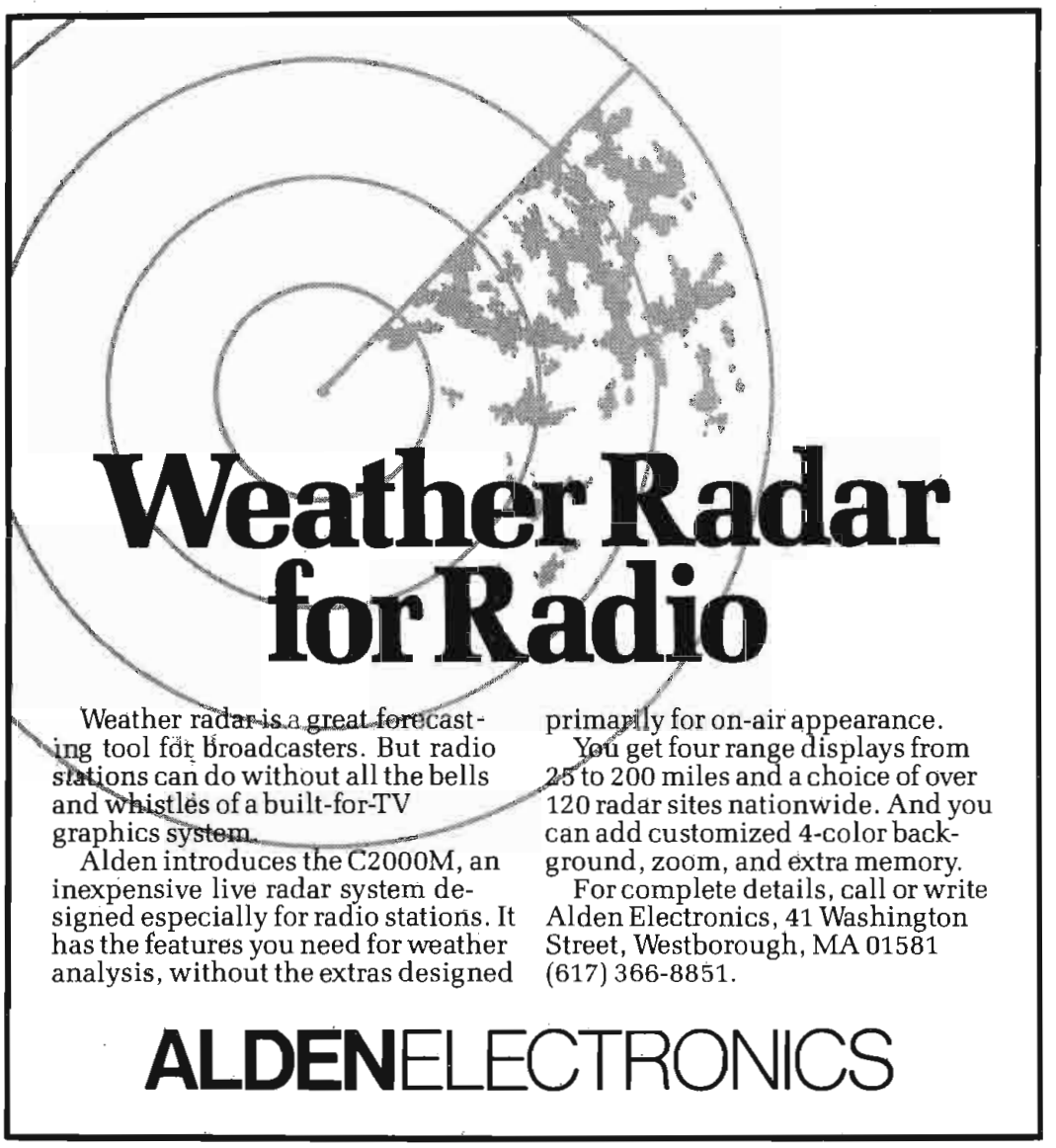

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Dolby spectral recording

By Brad Dick, radio technical editor

Although we live in the era of digital technology, the use of analog recording is and will continue to be the predominant format for years to come. The format offers several advantages that, at least for the near future, will be difficult for digital techniques to match.

Analog recording is inexpensive. The quality available from today's ¼-inch analog reel-to-reel tape recorder is really quite good. Even though a digital recorder may provide superior performance, it does so at a high price.

Analog recording also is common throughout the broadcast industry. Tapes can be transported to almost any broadcast station or recording studio with the assurance that the necessary playback equipment will be on hand.

Still, analog recording has at least one serious drawback. The process results in noise that is added to each stage of the recording, which is not the case with true digital-processing techniques. To address this need, several noise-reduction techniques have been developed.

The most common techniques rely on various forms of signal compression and expansion. One system offers sophisticated refinement on this type of noise-reduction process. *Spectral recording* (SR), developed by the Dolby Laboratories, provides a high degree of signal purity and noise reduction by relying on frequency-sensitive signal processing.

The process

The principal mechanism of SR is a group of 10 fixed and sliding-band filters with gentle slopes. The filters with fixed bandwidths are electronically controlled to vary their gain. Those filters with fixed gain can be adjusted to cover different frequency ranges. By selecting and combining from the group of filters, the SR control circuit creates an infinite number of filters through which the signal must pass before it is recorded. During playback, filters are automatically created that produce the exact opposite effect, creating a complementary process.

The filter selection and adjustment is controlled by continuous analysis of the signal spectrum and a process called *action substitution*. This process determines which of the two types of filters will predominate and how each must be adjusted to produce the optimum composite filter.

The basic SR processor is shown in Figure 1. The main signal path transmits high-level signal components. The output of the side-chain circuitry, designated the *SR signal*, point C, is added in the encoding mode and subtracted in the decoding mode. The stage circuits, as well

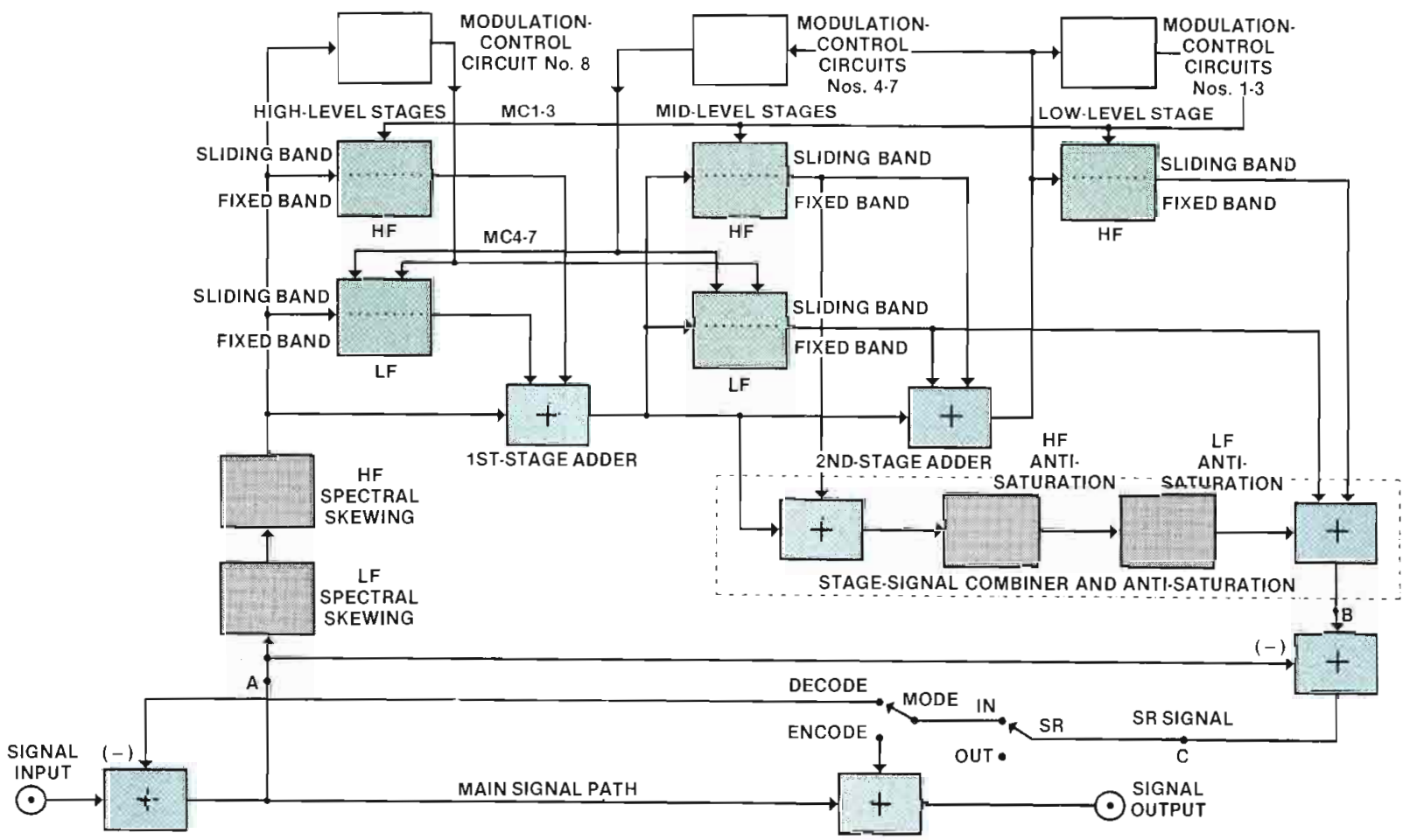

Figure 1. *Basic SR processor block diagram.*

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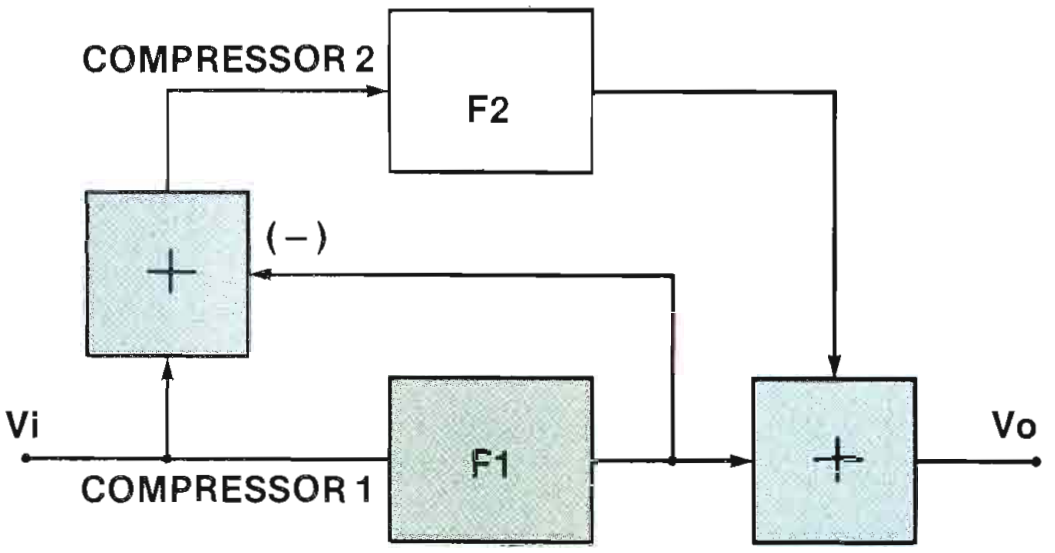

Figure 2. *Theoretical implementation of an action-substitution compressor circuit.*

as the spectral-skewing networks and anti-saturation networks, are driven from point A.

A secondary main path, which does not include any anti-saturation, is employed as the basis of the side chain. Here, the outputs of the high-level stages and mid-level stages are added in the first-stage adder and the second-stage adder. The low-level stage and modulation-control circuits 1-7 are driven directly from the second-stage adder. Modulation-control circuit 8 is driven from the spectral-skewing network.

Action substitution

In a superposed action-compressor circuit, represented by Figure 2, a signal is fed into a first-compressor circuit (F1). The output from this circuit represents the completed part of the total potential action. The uncompleted part, therefore, is the input signal minus the completed part. This signal is then fed to the next compressor circuit, which has a different characteristic.

The output of the second circuit (F2) is then added to the first circuit. The operation of the action-substitution compressor can be characterized by the following equation:

$$Vo = Vi\,[F1(V1) + F2(V1) - F1(V1)F2(V1)]$$

The equation shows that the overall transfer function is the sum of the individual transfer functions minus their product. In other words, to the extent that the transfer functions overlap, a factor is subtracted from the sum of the transfer functions. The SR implementation of such a device is depicted in Figure 3.

The advantage of such a processor is illustrated in Figures 4, 5 and 6. In a fixed-band compressor (Figure 4), all signal frequencies are treated equally. When a dominant signal component arrives, the resulting compression produces a loss of noise reduction in a uniform manner throughout the band (2dB in this example). The loss is not concentrated in any particular frequency region as it is in sliding-band circuits. (Note the 5dB loss shown in Figure 5.)

In contrast, the advantages of sliding-

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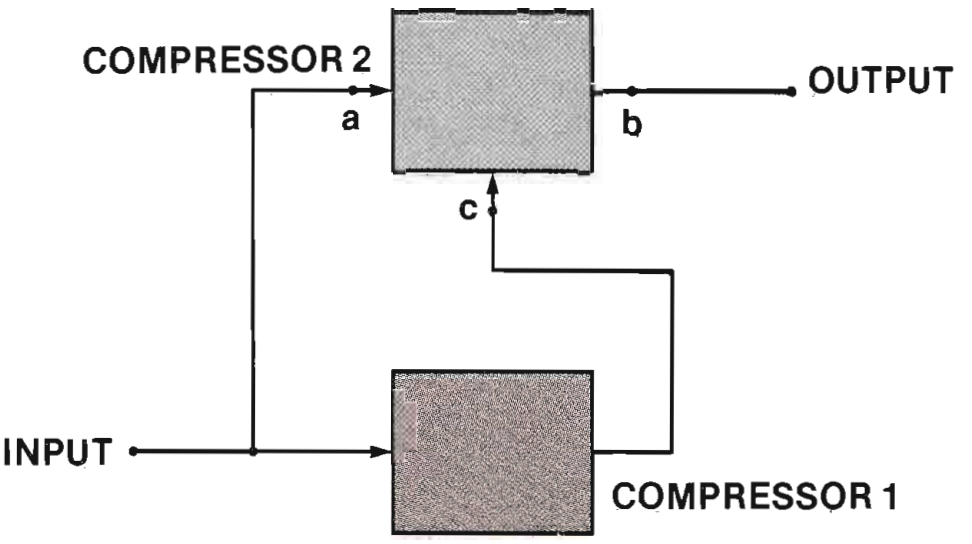

Figure 3. *Action-substitution configuration used in the SR process relies on two processors with different operating characteristics.*

band compression and expansion circuits lie in that all signal frequencies are not treated equally. It is desirable to have the benefit of fixed-band operation on the stopband side of the dominant signal frequency and sliding-band operation on the passband side. The action-substitution technique provides this useful combination.

Figure 6 shows the response of an action-substitution compressor to the same signal conditions. The output is primarily composed of the fixed-band compressor signal for frequencies up to the dominant signal component and from the sliding-band compressor above that frequency. Conversely, for a low-frequency stage, the output is composed of the fixed-band compressor signal for frequencies down to the low-frequency dominant component and from the sliding-band compressor below that frequency.

The SR process uses such action substitution in both the high- and low-frequency circuits. Both fixed-band and sliding-band dynamic actions are used in each of the five stages for a total of 10 compressor circuits. Depending on the levels and spectral conditions in each stage, fixed-band operation is substituted whenever it provides the best performance, and sliding-band operation is substituted whenever it has an advantage. This substitution takes place continuously on a frequency-by-frequency basis.

Modulation control

The B-type and C-type noise-reduction systems rely on sliding-band circuits, which follow a fixed filter. The circuit is a quasi 2-pole filter (a single-pole fixed filter plus a variable shelf characteristic).

A similar arrangement is used in the SR process. The difference is a 1-octave difference between the variable-filter turnover frequency (under quiescent conditions) and the fixed-filter cutoff frequency. Above a particular frequency threshold, the variable filter slides to the turnover frequency needed to create the overall (main path plus side-chain signal) compression law. As the input level rises, unity gain is reached (when the variable-

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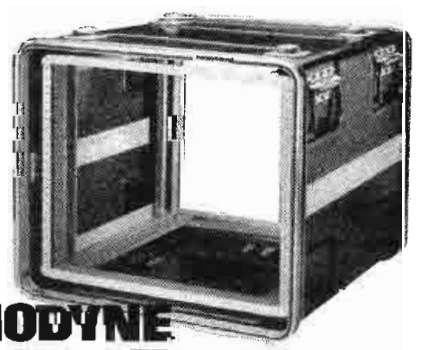

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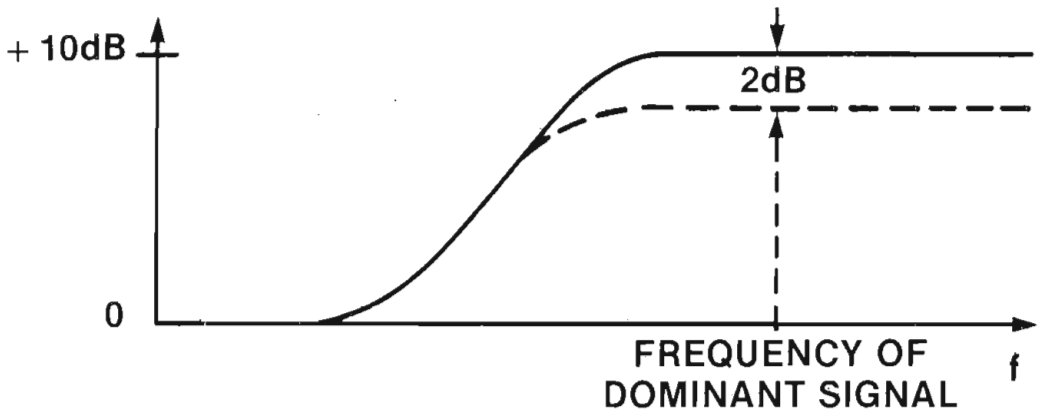

Figure 4. *Limiting characteristics of a fixed-band compressor. Any action is uniform throughout the entire frequency band.*

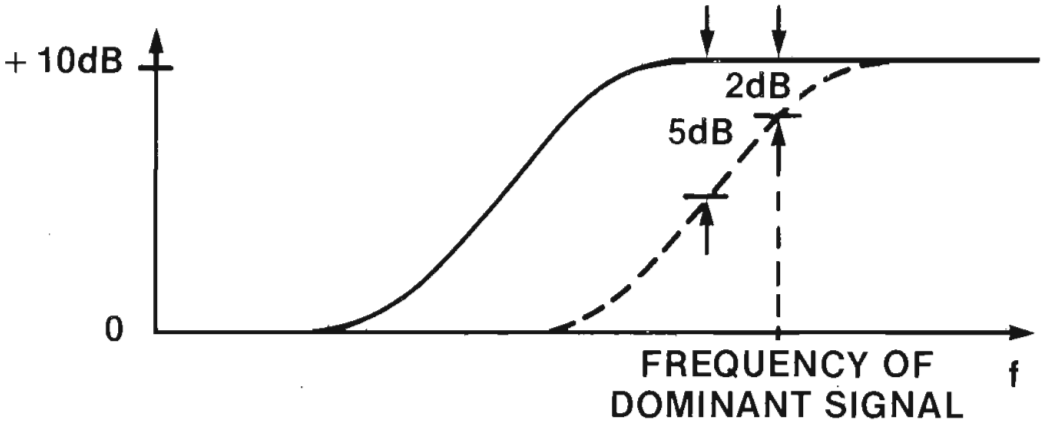

Figure 5. *Limiting characteristics of a sliding-band compressor. Limiting is frequency dependent.*

filter cutoff frequency is about two to three octaves above the dominant signal frequency) and there is no reason for further sliding of the variable filter. At this point, the modulation-control arrangement prevents further sliding of the filter. This arrangement stops unnecessary signal modulation.

The above effects for both fixed and sliding bands are created by *modulation-control circuits*. Suitably filtered or frequency-weighted signals from the main signal path are rectified, smoothed and fed in opposition to the control signals created by the other stage circuits. At higher signal levels, this tends to create a balance between the compressor-circuit control signals and the modulation-control signals. Under these conditions, the gain reduction is reduced with in-

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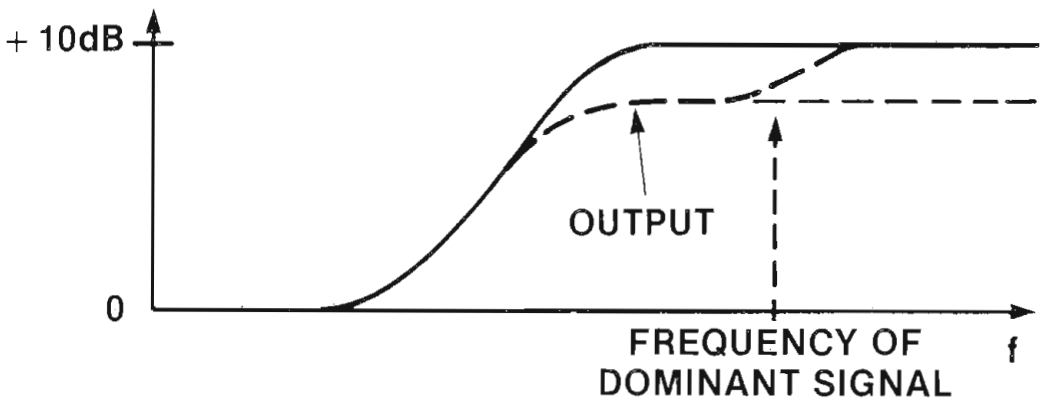


Figure 6. *An action-substitution compressor combines the favorable characteristics of both fixed and sliding-band filters.*

creasing input levels.

Figures 7 and 8 illustrate how modulation control can improve the action of a fixed-band compressor. In Figure 7, a 100Hz signal is applied to the compressor. Ideally, there should be no sliding in response to the 100Hz signal. However, with a conventional compressor circuit, when the 100Hz signal increases in level, the low-level signal boosting is reduced over the entire frequency band. This reduces the effective noise-reduction action and also can modulate higher-frequency signals, causing improper decoding.

Figure 8 shows the action of the same circuit with modulation control added. Much less attenuation occurs when the 100Hz signal is varied over the same range of levels such as in Figure 7. This

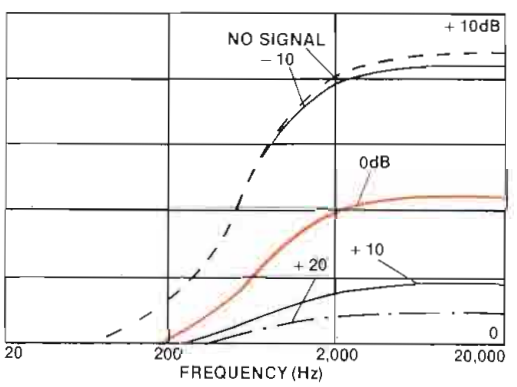


Figure 7. *Without modulation control, the application of 100Hz to a fixed-band compressor causes a loss of noise-reduction.*

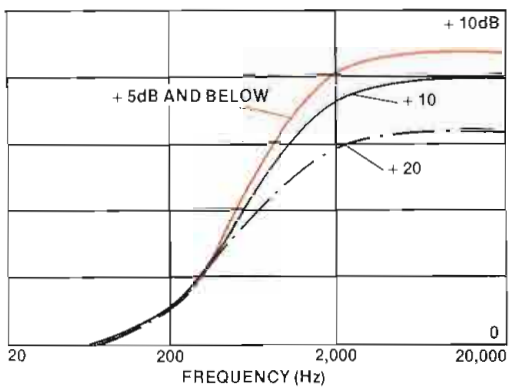
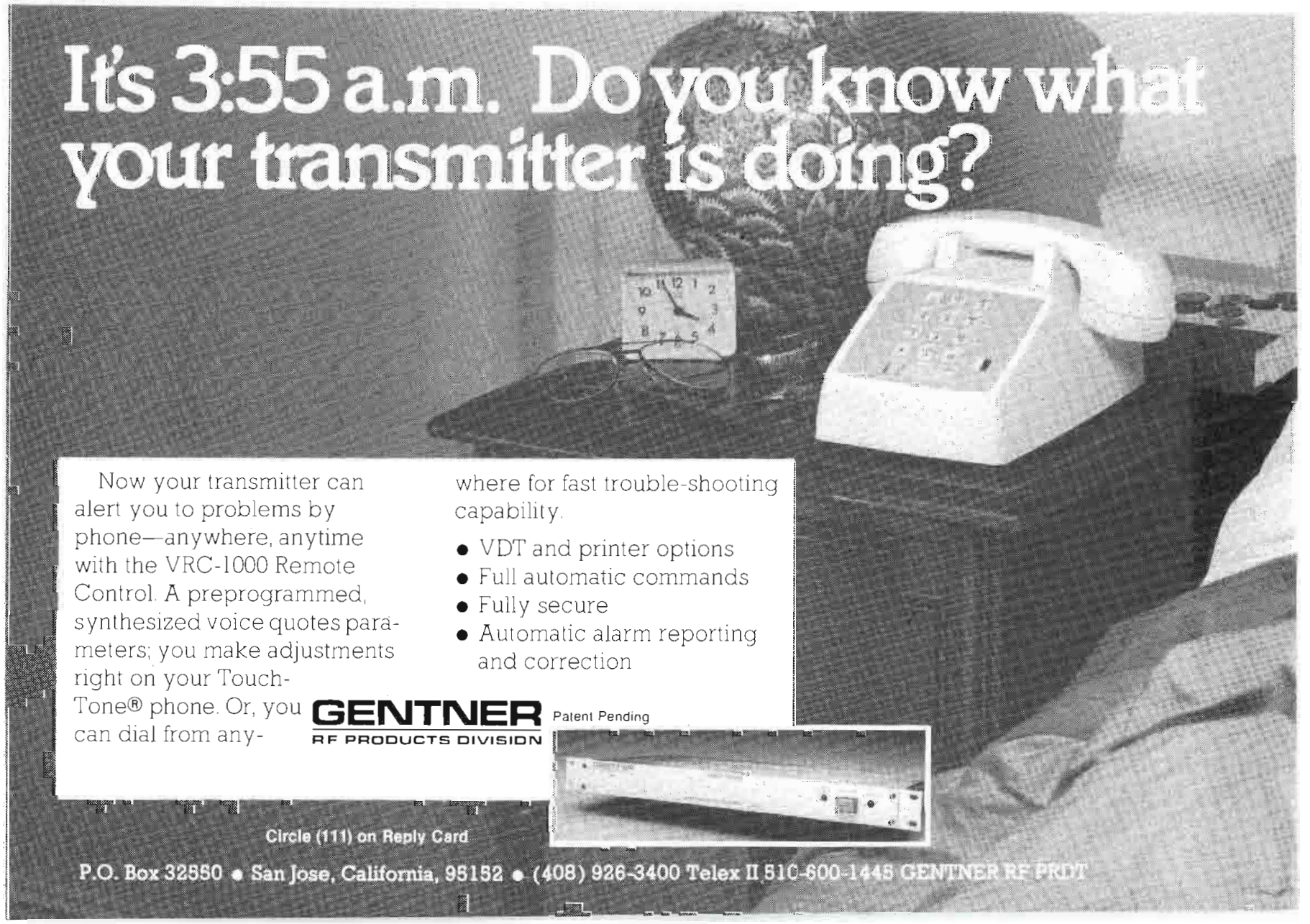


Figure 8. *Adding modulation control greatly improves the performance of the fixed-band compressor.*



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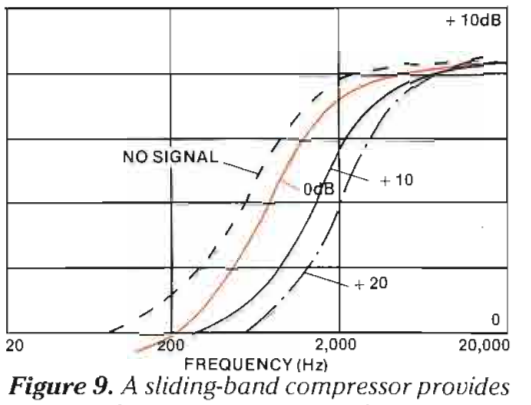

Figure 9. *A sliding-band compressor provides additional noise-reduction capability. But, as the 100Hz signal is increased, the band slides upward.*

improves the circuit's immunity to strong signals in the stopband frequency region.

In Figure 9, the operation of a sliding-band circuit under comparable conditions is shown. Again, there should be no sliding in response to the strong 100Hz signal. Even so, as the 100Hz signal increases in level, the band slides upward reducing the effective noise-reduction capability.

Figure 10 shows the same sliding-band circuit with the addition of modulation control. Note that minimal sliding occurs when the 100Hz signal is varied over the same level range (see Figure 9). This feature makes the circuit essentially immune to strong signals outside its passband.

Operating characteristics

The overall single-tone characteristics are shown in Figure 11. Low-frequency dynamic action occurs in the range from −48dB to −5dB (with respect to reference level). This produces full-level boosting in the unit's lower 35dB to 40dB dynamic range. No processing takes place in the top 25dB of the total dynamic range. A linear dynamic characteristic prevails in these two regions.

At high frequencies, dynamic action occurs in the range from −62dB to −5dB. No signal processing takes place in the lower 20dB to 25dB or the top 25dB of the dynamic range. A linear dynamic characteristic also exists in these two ranges.

In the intermediate level regions of dynamic action, the multilevel stages join together creating a compression ratio of 2:1. The overall shape of the low-

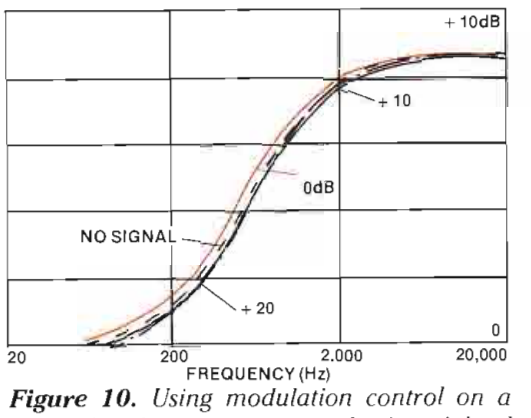

Figure 10. *Using modulation control on a sliding-band compressor results in minimal sliding and makes the circuit essentially immune to strong signals outside its passband.*

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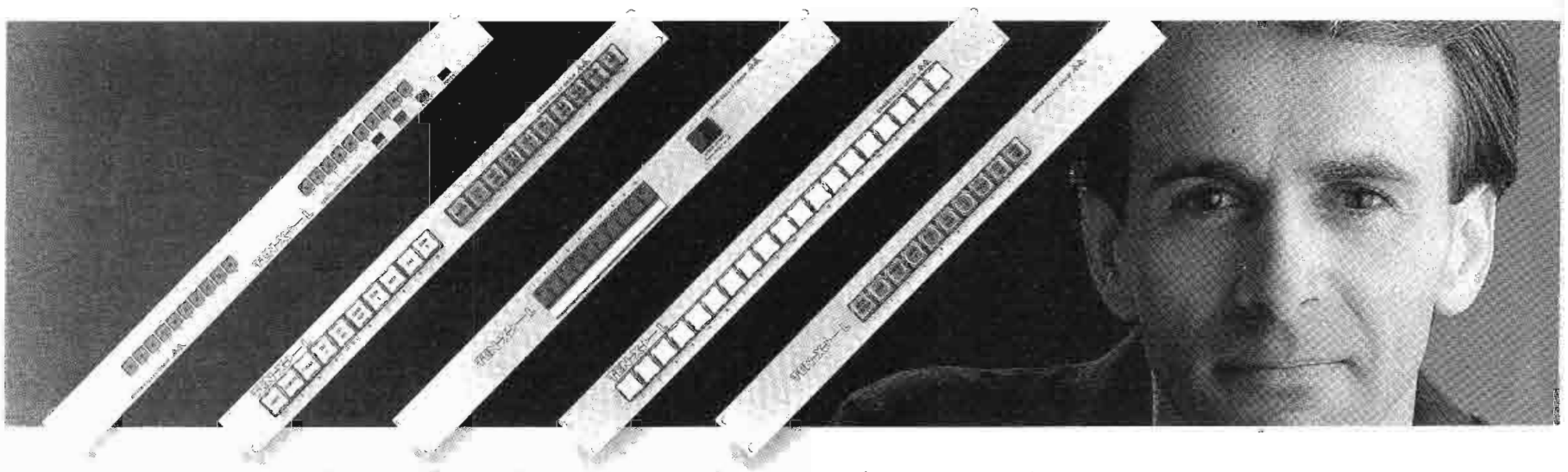

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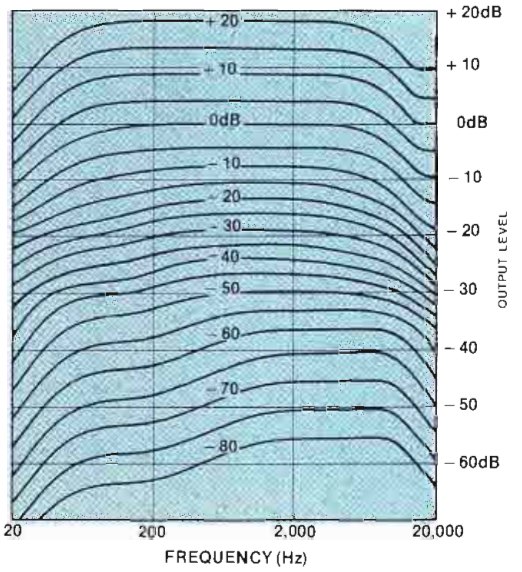

Figure 11. *Single-tone SR encoder characteristics.*

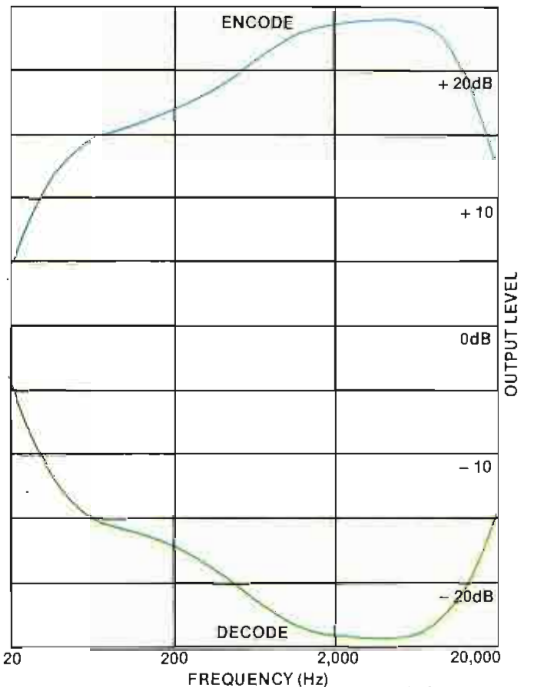

Figure 12. *Low-level (subthreshold) frequency response of the SR encoder. The upper curve is the noise level of a typical professional tape at 15ips. The lower curve is the change in level resulting from the use of SR fixed low-level equalization.*

level noise-reduction characteristic can be seen in Figure 12 and resembles the inverse of the low-level Fletcher-Munson and Robinson-Dadson curves. The encode characteristic resembles the subsequently derived CCIR noise-weighting curve.

Calibration adjustments

The SR process, similar to the A-type, B-type and C-type systems, requires that signal levels in the decoder circuit closely match those in the encoder circuit. To accommodate the encoder/decoder alignment process, the SR processor provides a pink-noise generator.

For identification purposes, the pink noise is interrupted with a 20ms "nick" every two seconds. During the recording process, this signal is fed to the tape 15dB below reference level.

During playback, the tape signal is automatically alternated with the internally generated reference pink noise in 4-second segments and passed to the monitor output. An audible comparison can then be made between the reference pink noise and that from the tape and the recorder/player adjusted as necessary.

Although not discussed here, the SR process also is applicable to transmission systems such as STLs and RPUs.

Editor's note: This examination of Dolby SR is based upon documentation provided by Dolby Laboratories. Material also was adapted from the Audio Engineering Society Preprint No. 2413 (C-b), November 1986, "The Spectral Recording Process," by Ray Dolby.

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J25x11.5BIE para cámaras de 2/3".
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Distancia focal: 11.5-288 mm (23-576 mm con extensor de 2X)
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1:2.1 en 288 mm

J20x8.5BIE para cámaras de 2/3".
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Distancia focal: 8.5-170 mm (17-340 mm con extensor de 2X)
Apertura relativa máxima: 1:1.6 hasta 130 mm
1:2.1 en 170 mm

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1:1.9 en 118 mm

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Apertura relativa máxima: 1:1.8 hasta 112 mm
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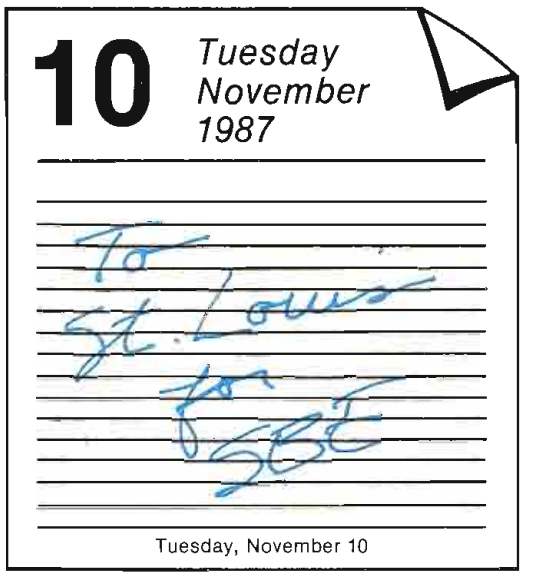
Building on last year's success

By Brad Dick, radio technical editor

The second annual national SBE Convention and **Broadcast Engineering** Conference will begin Tuesday, Nov. 10, in St. Louis. Building on last year's success, an outstanding convention and engineering conference are in order.

The convention will be even larger this year, with twice as much exhibition floor space. The convention now provides one of the largest broadcast exhibits. Last year's attendees were treated to a wealth of exciting products and services. Because of the high-quality attendees, companies usually staff their booths with technical experts who can answer their questions. If you want to see a personal demonstration on a particular piece of equipment, this is the convention to attend. Plenty of time for touring the exhibit floor has been allocated so you don't need to rush.



Engineering seminar

John Battison once again has assembled a topnotch program. Technical papers will cover topics ranging from master-clock systems to telephone hybrids to video-measurement techniques.

Convention schedule

Tuesday, Nov. 10: *joint radio/TV sessions*

10 a.m.	Welcome: *John Battison, conference chairman*
10:20 a.m.	Master-clock and time-keeping systems for broadcasters
10:50 a.m.	Improved grounding methods for broadcasters
11:20 a.m.	Fundamentals of digital audio
11:50 a.m.	Where is broadcasting going?
12:30 p.m.	Lunch
1:30 p.m.	Maintenance seminar
7:30 p.m.	The nuts and bolts of audio processing

Wednesday, Nov. 11: *radio sessions*

7:30 a.m.	Surge protection and grounding for AM transmitter sites
8 a.m.	Telephone hybrids—what they can and cannot do
8:30 a.m.	The impact of 75μs pre-emphasis
9 a.m.	The role of the audio switcher in radio
9:30 a.m.	Automation in the application of direct-to-air CDs
10 a.m.	Coffee break
10:15 a.m.	Getting the most from the NAB cartridge system
10:45 a.m.	Theoretical development of the folded unipole
11:30 a.m.	Lunch
12:30 p.m.	Electronic broadbanding of AM antennas
1 p.m.	Fundamentals of digital audio
1:30 p.m.	Automatic phase-correction for tape-cartridge machines
2 p.m.	Measuring soil conductivity inexpensively
2:30 p.m.	Dial telephone remote control
3 p.m.	Coffee break
3:15 p.m.	Report on new reduced-skywave antenna tests
3:50 p.m.	NRSC progress report
4:30 p.m.	Consultants' round table
5:30 p.m.	The FCC round table (*joint radio/TV session*)
7:30 p.m.	Nuts-and-bolts session (*joint radio/TV session*)

Wednesday, Nov. 11: *TV sessions*

7:30 a.m.	True APL picture of power of a TV transmitter
8 a.m.	Still-image library management
8:30 a.m.	Quick TV stereo proofs
9 a.m.	Uses for the network analyzer
9:45 a.m.	Correction of phase-delay error
10:15 a.m.	UHF multichannel TV antenna systems
10:45 a.m.	Coffee break
11 a.m.	A new era in video measurements
11:30 a.m.	Trends in TV audio; and Monitoring the BTSC signal
12:30 p.m.	Lunch
1:30 p.m.	Mobile mast safety considerations
2 p.m.	The engineer/artist, interface in computer graphics
2:30 p.m.	Fiber optics—the next medium
3 p.m.	Coffee break
3:15 p.m.	Advanced TV service: the next generation of TV service
4 p.m.	The 15kW Klystrode
4:30 p.m.	Consultants' round table
5:30 p.m.	FCC round table (*radio/TV joint session*)
7:30 p.m.	Nuts-and-bolts session (*joint radio/TV session*)

Thursday, Nov. 12: *joint radio/TV sessions*

7:30 a.m.	Frequency coordination and how to set up a frequency coordination committee
12:30 p.m.	Luncheon: *Wally Johnson, speaker*
2 p.m.	The engineer in transition (a panel discussion)
4 p.m.	Goodbye until next year: *John Battison, conference chairman*

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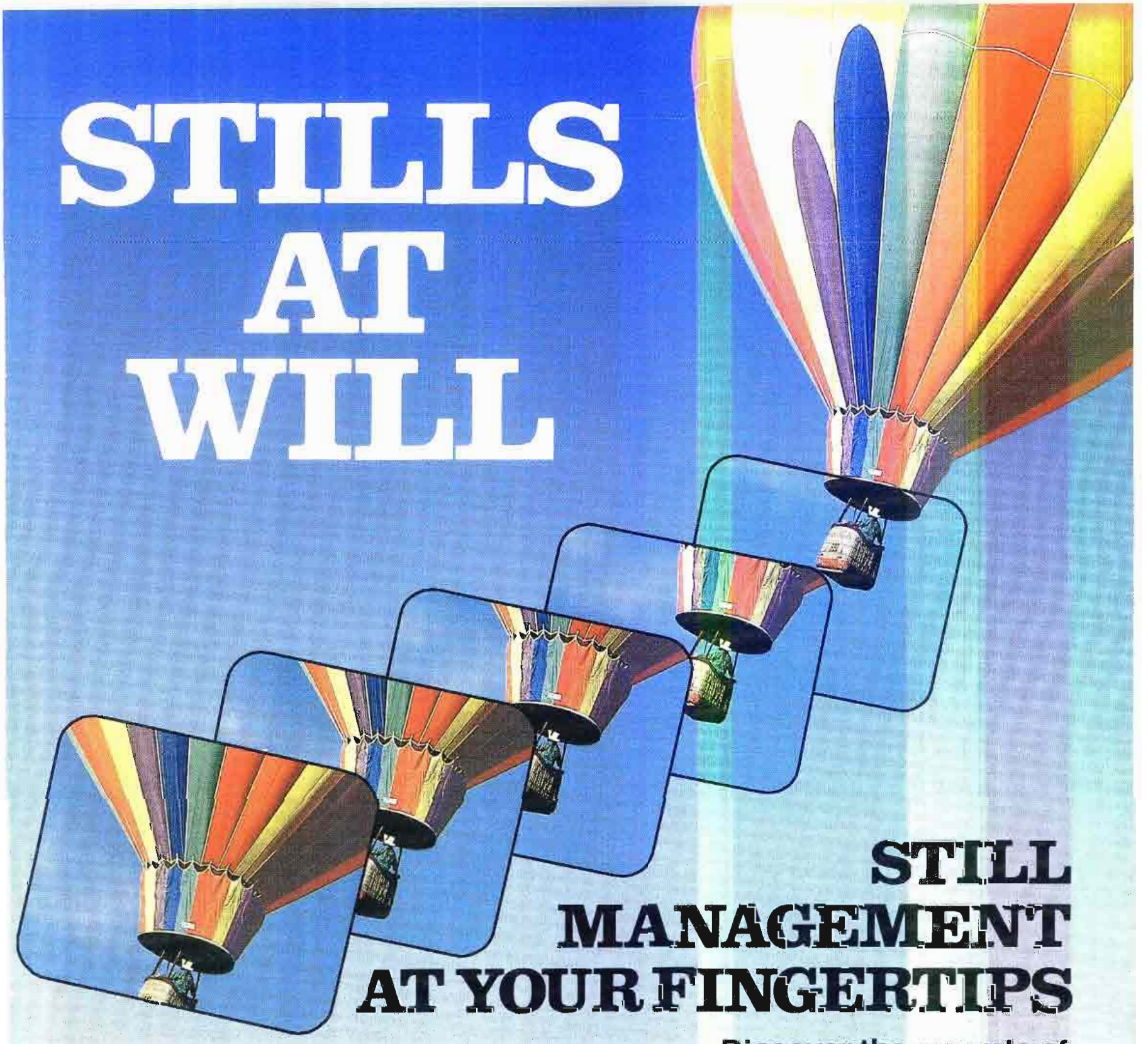

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The Tuesday joint sessions will cover subjects common to both radio and television. Grounding, maintenance techniques, tape-cartridge systems and audio processing will be discussed

The evening audio-processing session may prove to be a highlight because of the assembled panel. The panel members will represent both manufacturers and broadcasters so the discussion should be lively. Plan on attending this session.

On Wednesday, separate radio and TV seminar sessions are planned. The sessions will begin at 7:30 a.m. and will continue until late in the evening. The ever popular "nuts and bolts" discussion will begin at 7:30 p.m. As anyone who has attended these sessions can testify, the end time is highly unpredictable. What is predictable is an interesting discussion on topics of interest to both radio and TV engineers.

Thursday marks the last day of the show. An early-bird session will provide frequency coordinators with help on the organization and operation of a local frequency database. Anyone interested in setting up a frequency-coordination committee should attend.

Another convention highlight will be the Thursday luncheon. Wally Johnson, a highly respected and well-known engineer, will deliver the luncheon address. This event was sold out last year, so get your reservations in early.

The final panel discussion will begin at 2 p.m. The "Engineer in Transition" session will address the changing industry conditions faced by today's broadcast engineer. If you plan to stay in the business for any length of time, you should attend this session. The nature of our jobs is changing. See how you can adapt to make the most of those changes.

Certification exams

SBE certification examinations will be given on Wednesday in room 125. Exams begin at 1 p.m. and continue until 5 p.m. Further information on the examination process can be obtained from the SBE national office at 317-842-0836.

Don't miss it

St. Louis is a great place for the SBE convention. Excellent accommodations, reasonable prices and the opportunity to meet old and new friends should be enough reasons for you to attend. No other convention offers so much—for such an inexpensive price. It costs only $45.50 to attend all the seminars and to attend the Thursday luncheon. Also, this price includes a copy of the convention proceedings. Don't miss out. Call 314-928-6780 for registration information.

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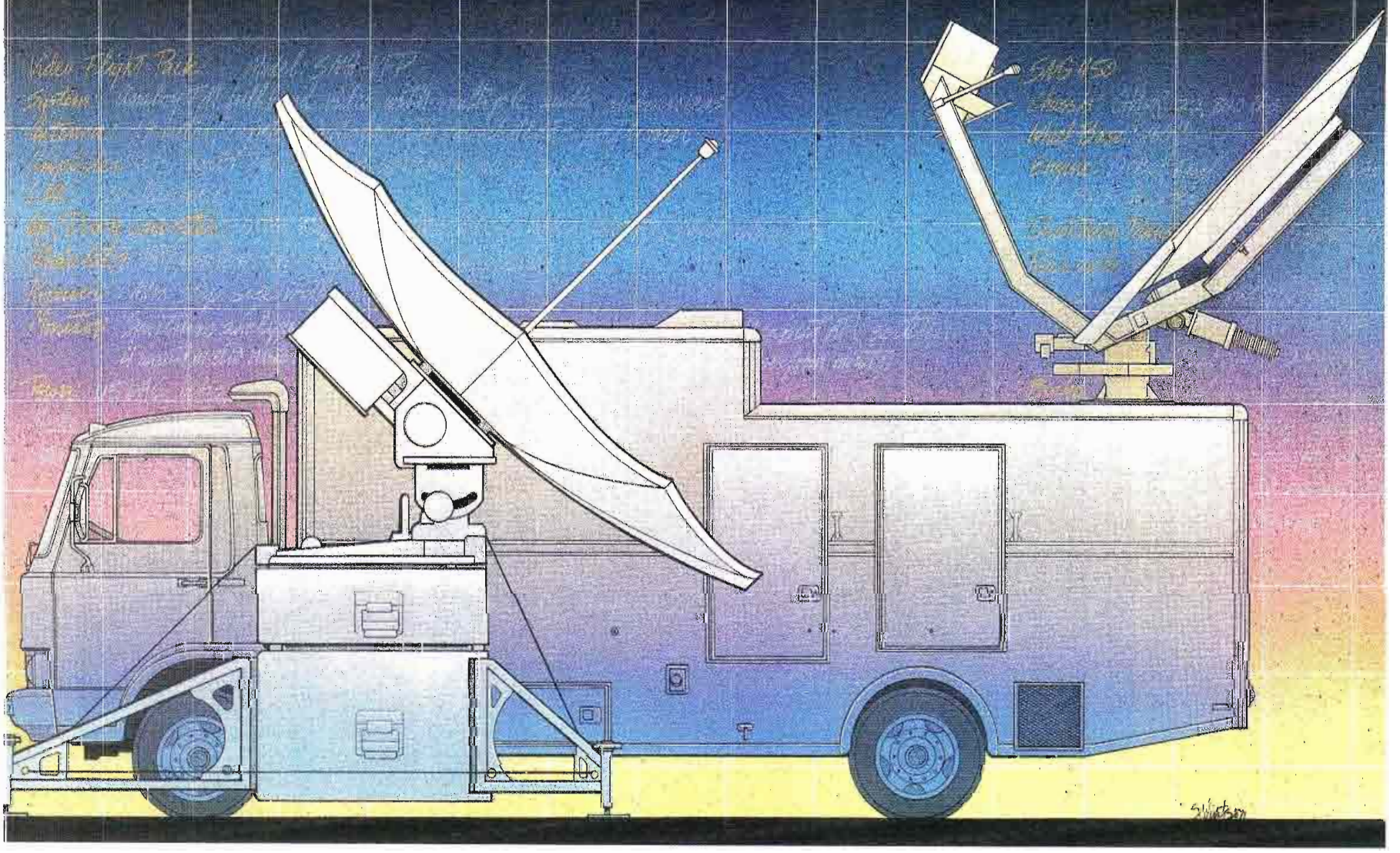

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ASP-15 Auto Setup Probe

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Consider the latest advancement in monitor technology: Auto Setup. Originally pioneered for Ikegami cameras and now available in the Ikegami 15-Series Broadcast Color Monitors.

With an optional Auto Setup Probe, the 15-Series is menu driven with data shown on the CRT. An optional Remocon Box provides for remote control operation. The CRT features a Fine Dot Pitch Shadow Mask for superior resolution, an In-line Self Converging Electron Gun, Controlled Phosphors and a Black Matrix. The 15-Series is available in 14" and 20" and uses a Digital Control System (DCS) to simplify monitor set up. When using the Auto Setup Probe, the following functions can be automatically set, at a reference level, and stored in less than 50 seconds: contrast, brightness, chrome, hue, RGB background and GB gain. Auto Setup is another Ikegami breakthrough.


TM 20-15RH Auto Setup Monitor with Probe.

The Ikegami 16-Series Low Cost Monitors feature an In-line Self Converging Electron Gun, a Black Matrix CRT, a Comb Filter/Trap, and front panel selectable A/B video and RGB video outputs. Specifically designed for a wide range of production and broadcast applications, the 16-Series is available in 14" and 20" at surprisingly low costs, making the series extremely competitive. The introduction of the 15-Series and 16-Series monitor comes as the 9-Series and

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The 10-Series Broadcast Color Monitors feature a high resolution (800 TV Lines) Delta Gun CRT, specifically developed for image quality, with nine-sector convergence controls and Feedback System (BFS) that detects and greatly reduces brightness changes due to current deviation in CRT emission. Available in 14" and 20" models, the 10-Series is remarkable for its picture quality. And this quality is equally evident in our 3H-Series Monochrome Monitors.

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Sony BVP-360 camera

By Rich Lehtinen

I'd like to say that KSL-TV purchased new cameras because the time was right, or that advances in small-tube technology made it desirable, but I can't. What really happened was that an upgrade—which was supposed to convert the cameras we were currently using, and satisfied with, to triax cable—didn't work as well as we had planned.

While the older cameras were being modified, KSL constructed a new facility, Broadcast House, and we installed triax cable in three studios and in an outdoor amphitheater. Triax cable also was installed in the Mormon Tabernacle on Temple Square, where we originate "Music and the Spoken Word" each week. When our staff and a whole string of field-service and factory personnel could not make the modified cameras meet our specifications, we decided to shop for new cameras.

No shoot-outs

The rules of the competition were simple. Our chief engineer, Tal Ball, invited camera manufacturers to come to Salt Lake City and hook up their gear so we could see how their cameras worked. The best cameras got a more thorough inspection later.

In due time, the station was crowded with engineers and salespeople toting enough equipment cases to fill several trucks. We saw many excellent and interesting products, and among the top choices it was sometimes hard to tell the various cameras apart, because they all looked good. When the demonstrations and tests were over, we selected the Sony BVP-360 camera.

Camera design

The BVP-360 is a compact and lightweight studio configuration camera. One person can assemble it. We keep our camera heads and lenses in cases whenever they are removed from their pedestals. Although the camera case requires two people to carry it, once the camera is in position, an operator can assemble it without help.

Built around ⅔-inch tubes, the camera uses a precise magnetic-focus electrostatic-deflection system. The images produced rival or surpass 1-inch tubes, because there are no irregularities introduced by yokes.

The electronics package resembles a BVP-300 ENG camera, right down to the stripe across the card edges. I suspect that the principle difference between the two cameras is the computer control used in the model 360.

Because the camera is designed for studio operation, it comes with lots of bells and whistles, which include two return video channels, two microphone inputs, an isolated utility ac output, prompter output, push-button selectable RGB outputs to the viewfinder (used in setting backfocus), 2-channel intercom and video/return video mixer.

For the viewfinder, there is a host of safe-area masks, cross hairs and fully positionable boxes, the controls for which are on the back panel. Of course, the viewfinder, camera video and test outputs are available at the camera head.

CCU

Back at the camera-control unit (CCU), there are separate camera head and CCU power switches, warning lights for cable shorts and cable opens and fault lights for both the CCU and its remote-control units.

The CCU provides four VBS (composite) video outputs, RGB outputs and Y, R−Y and B−Y outputs (for Betacam). Waveform, picture monitor and a waveform-mode connector (for parade displays) also are provided. For gen-lock, the camera can accept either sync/subcarrier or composite video. Gen-lock, return video feeds and prompter video inputs, are all loop-through bridging inputs, so daisy-chaining is easy.

Automatic setup

Unlike some systems, which share a common setup computer, each 360 CCU has its own computer. That means you can set up all the cameras at once, and begin fine-tweaking right away, without waiting for the other cameras to finish their diascope routines. I like this feature because it saves me 10 or 15 minutes each time I do a newscast. Also, the computer can perform either a full setup, or just a part of it, such as colors, registration or automatic black-and-white balances, so I don't have to fuss with circuits that don't need adjustment.

Camera control

The camera-control system has a built-in prompting feature. The feature becomes apparent when setting parameters, which offer multiple choices, like filter and gain selection. Press the gain button, and the valid choices for the leading digit of dB gain begin to flash. If the adjustment requires entering a 2-digit number, the possible second digits flash after you press the first. The selected parameters are displayed in an LCD window just above the buttons.

The camera-control system also provides scene-storage memories, setup memories and aids in painting, an offset function. This function temporarily sets the register values to zero, and records dial movements as plus or minus values from where you started. This means you can fiddle around and still get back to where you started, or back to what was best so far, without having to memorize a string of numbers.

Central video-control area

As previously mentioned, the Broadcast House camera system is built around a network of triax cables. All of these cables terminate in an area of the equipment room reserved for video control. We built a patch panel that allows each cable to connect quickly to any of the CCUs. There also are patch panels for tally, video output, intercom (via a source

Performance at a glance

- *Number of pickup devices: 3DG PbO*
- *Optical format: ⅔-inch prism f/1.2*
- *Resolution (in green): 700TVL*
- *Sensitivity: 200fc f/4.5 90%R*
- *S/N ratio: 60dB NTSC*
- *Video-output formats: RGB/enc and Y, R−Y, B−Y*
- *Digital registration*
- *Automatic setup*

Lehtinen is studio engineer at KSL-TV, Salt Lake City.

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assignment panel) and camera remote-control panels. This arrangement allows us to put any combination of cameras into any studio.

For simple shoots like art cards or talking heads, we patch camera control to the director's booth. Multicamera operations are best handled in video control, and an engineer is assigned to ride levels. In the video-control area, there is a waveform monitor, black-and-white monitor and control panel for each camera. Two monitor systems allow simultaneous productions. Each system has a color-match monitor and a switching matrix that provides the preset, program and audio feeds from the desired studio. The entire area is isolated from the rest of the shop by a large curtain that can be pulled out of the way when not in use.

Each CCU could be equipped with the full-blown BKP-3601 control panel, a large affair that sits directly on the front of the CCU door. But, because we have eight CCUs in close proximity to each other, we ordered only two of the panels and devised a switching arrangement to share them between units.

Early burn-in

Although these cameras have proven to be quite reliable, we did experience some early minor problems. The lens mount includes a narrow barrel that extends from the lens into the camera head. I found its metal too thin or too soft, and it is easily bent when mounting the lens to the camera head. If the mount is bent, the lens won't backfocus. Some facilities would probably never notice this problem, but in a remote truck, or in a situation like ours where we take the cameras apart and carry them to the Mormon Tabernacle each week, the mounting problem can be troublesome. Also, a new camera operator, used to a different mount, might not take the care required. Fortunately so far, we've been able to carefully reshape the barrels when they've been damaged.

The viewfinder has a great degree of pan and tilt freedom, which is nice. Unfortunately, its legs are a bit spindly when fully extended, and we have broken them. The legs can be repaired, but a little more strength would be helpful.

For some reason, the saticon tubes seem to burn-in easily on the red channel, and you might find yourself turning the camera into a soft light or a white wall to get rid of the worm tracks before the next commercial is over.

We have had some minor failures early in the testing. In one case, an isolation transformer for the auxiliary ac outlet on the side of the camera suffered a meltdown when a camera operator plugged too large a load into it. Unfortunately, the transformer protected its fuse. When the fuse failed to blow, the transformer got hot and smoky and melted a marshmallow-sized piece of encapsulating material out of the core. When the transformer finally shorted, it blew some fuses, taking the camera out of service. I took the camera apart, and worked my way through it and replaced the transformer. I then lectured the studio personnel in taking certain precautions.

Working through the camera in this way allowed me to examine its construction—and it is well built. The camera head is solid, well-machined and equipped with rubber grommets at every joint. It is probably watertight, although I don't intend to verify this.

There are a few exceptions though. An associate of mine, a newcomer to the shop and just out of trade school, was assigned to bring a camera into the shop for cleaning and preventive maintenance. When he got the camera back together it wouldn't turn on. Imagining the worst, the poor guy tried everything to make the camera run again. He finally

The BVP-360 shown on the news set at KSL-TV, Salt Lake City.

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gave up and went home, knowing that he would have to face the music in the morning. The next day, a couple of senior engineers retraced his steps, and then began swapping power-supply modules with an adjacent camera. To their chagrin, not only were they unable to resurrect the ailing camera, but a power supply from the donor camera ceased to operate as well.

Eventually they got out their soldering irons and reheated each of the joints in the two supplies. This cured the problems and since then there has been no trouble. This may be an isolated incident, but it concerns me that this kind of connection problem happened on two cameras.

Sony uses surface-mount components on these cards, so brush up on your soldering before you attempt any repairs. The cameras don't use multilayer PC cards though, so if you are careful, you should be able to fix things yourself.

Minor suggestions

From my perspective, there are a couple of things I would like to see added to the camera. The viewfinder already displays a great deal of information: safe-area masks, cross hairs and prompts describing which filters are in place. It seems a simple matter to add a stopwatch chip or two. This way, when one person runs the camera and cues the talent, as during single camera cut-ins, that person's hands would be free and the camera could still keep time.

I would like to see some minor changes made in the automatic setup software. Currently, if you run through an automatic setup and the camera finds trouble, it times out. Unfortunately, the error prompt is displayed only momentarily. The control panel LCD then reverts to a normal display. As a result, a failed setup gives the operator the same appearance as a completed one. The only panels giving more warning are the BK-3601s, which as mentioned in our case, are shared between a number of CPUs and might not be assigned to the camera currently in setup mode. If you have separate panels for each camera, this may not be a factor.

Some kind of prompt to flag the operator about a failed test, like a flashing bar in the LCD window, would be a helpful addition. Resetting the flag could require some kind of action, like pushing a button before the automatic setup procedure either skips over that step or aborts.

Satisfied

The Sony BVP-360 is cleanly designed and produces great pictures. The cameras will likely fill our needs for a long time to come. After spending approximately 300 hours at the controls of these cameras during the past eight months, I have found them to be easy to run, to set up and to adjust. These cameras are great for studio work, and if they work as well on the road as they do in the Mormon Tabernacle, they would work in a remote truck as well.

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

In essence, these reports are prepared by the industry and for the industry. Manufacturer's support is limited to providing loan equipment and to aiding the author if support is requested in some area.

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

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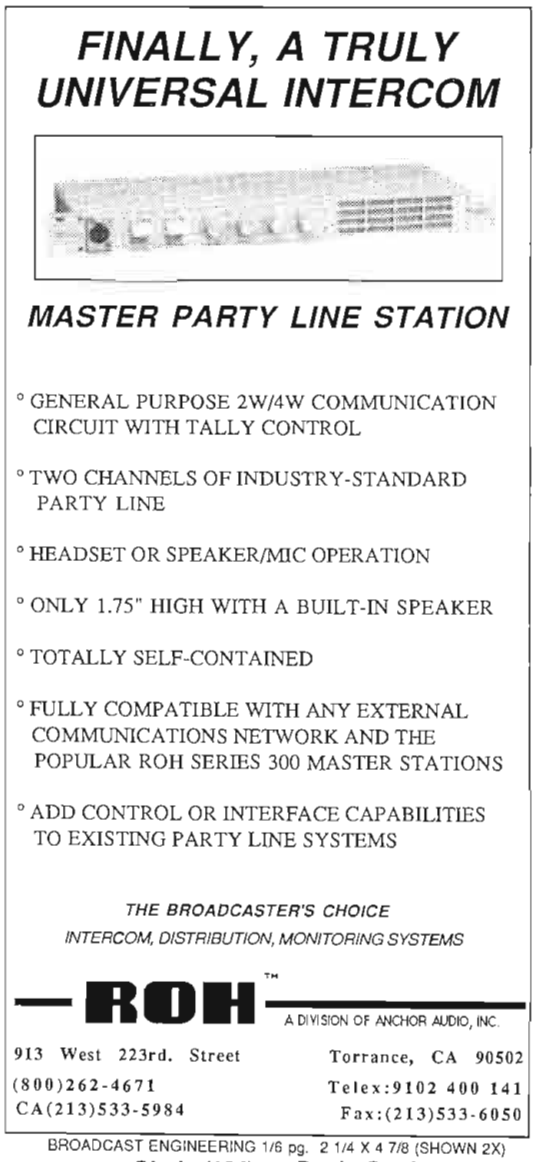

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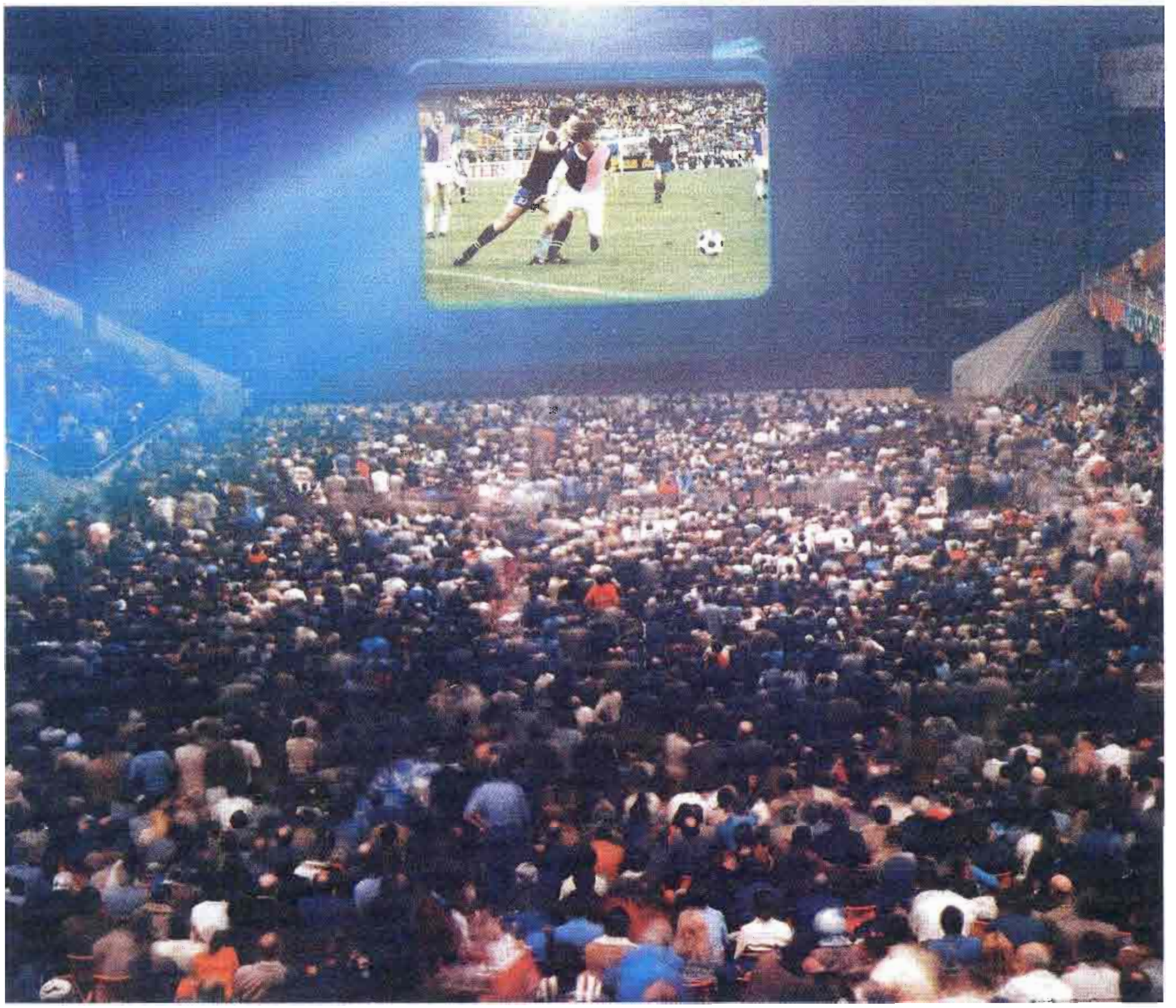

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On the receiving end, Part 2

Inside S-VHS: What's in it for the professional?

By Michael H. Heiss

Most video professionals view the ¾-inch U-matic format as their own. After all, unless you're a media mogul, you probably don't have a ¾-inch machine in your living room. Besides, how could something that has been so pervasive in the pro world for more than 15 years be associated with consumers?

In reality, U-matic was originally intended as a consumer format back in the days when video pros had little choice between quad on the high end and a collection of incompatible 1-inch formats and EIAJ ½-inch on the low end. U-matic was to be the consumer format for video in the 1970s, but cost considerations diverted it to the industrial world, leading to widespread success in broadcasting with the ENG/EJ/EFP revolution.

Most professional video users probably expect U-matic to be replaced eventually by the Betacam and M-II component formats, designed specifically for professionals. But stand by. What consumer video gave, it also can take away. The ultimate decline of U-matic may have been started by component recorders, but it is likely to be sealed by another format originally introduced for consumers: *Super VHS.*

Enter S-VHS

Super VHS, or S-VHS, is a semicompatible extension of the venerable VHS format, but with improvements designed to provide audio and video quality that is better than not only the older consumer VHS format, but better than U-matic.

The most important difference between S-VHS and conventional VHS is the higher frequency and broader bandwidth luminance carrier, recorded at 5.4MHz to 7MHz (1.6MHz deviation), as opposed to the 3.4MHz to 4.4MHz (1MHz deviation) of conventional VHS. The format also incorporates an improved method of recording *depth multiplex* high-fidelity audio for less head-switching noise and a 90dB dynamic range. Other enhancements include 950 Oe fine-element ferric-particle tape, nonlinear subemphasis and narrower-gap heads.

Another important feature of the system is the use of an *S* connector to deliver separate Y/C signals for the VCR to similarly equipped monitors. This provides pictures free of dot crawl and other color-encoding artifacts.

The result is a system with horizontal resolution of more than 400 lines, video signal-to-noise of +47dB and audio with a frequency response (on the hi-fi channel pair) of 20Hz to 20kHz. To the video professional, this kind of performance is irresistible, especially when a 120-minute tape lists for less than $20, and full-boat edit deck with flying erase heads, job/shuttle features and a standup editing control lists for at least one-third less than comparable U-matic gear. That's not much more than old-fashioned VHS, and it's only a fraction of the cost of M-II or Betacam.

Inside the format

In spite of all the excitement about S-VHS, however, some questions have been raised. It is appropriate here to answer as many of them as possible. First, keep in mind that S-VHS uses standard *color-under* recording. It is not a component recording system such as M-II or Betacam. The Y/C signals are (1) luminance and (2) the 3.58MHz color information off the tape, separated for better processing. Again, they are recorded together.

Therefore, although use of the Y/C signal will give you better dubs and pictures on Y/C monitors, it is not compatible with other component gear. You cannot dub from S-VHS to other ½-inch component systems other than by standard composite video signals. The S-VHS Y/C signal also is different from the YC-688 dub signals available on many U-matic machines, as well as the YC-629 dub signals found on some professional standard VHS decks. Those connections use the luminance demodulated from the FM signal on the tape and the 688kHz or 629kHz chrominance signal.

On the subject of signal handling, some consumer and professional S-VHS machines contain Faroudja-designed processing circuits. Many users will find this important, but the enhancements are not a requirement of the S-VHS system. If you want a machine with this circuitry, you'll have to check the spec sheets or literature for mention of it.

On the audio side, many pros will be attracted by the wide frequency response and broad dynamic range of the S-VHS hi-fi tracks. Remember, though, that because they are recorded by the video heads, it is impossible to do *audio-only* inserts or layback after picture tracks have been recorded. The audio quality of the linear audio tracks is limited by the slow tape speed, even when Dolby-B noise reduction is used. Keep in mind that many of the consumer S-VHS decks may not include Dolby circuitry, and some may not even include stereo for the linear track.

Time code for S-VHS on professional machines will be recorded on the No. 2 linear track. (This means no audio inserts or layback because the hi-fi audio is tied to the video.)

An interesting side effect of S-VHS will be the revival of the portable VCR, as opposed to the all-in-one camcorder. The Panasonic S-VHS line includes a portable recorder, rather than a camcorder, because the hardware requirements of S-VHS are hard to meet (to date) in a compact package. Given the size limitations of three CCDs and the large head drum required for hi-fi audio, it seems prudent to go with separates rather than a camcorder. It is likely that the JVC line, being announced as this issue goes to press, will follow the same idea.

Yes, S-VHS camcorders will be available on the consumer side of the fence, and they may provide adequate resolution for news stringer applications and industrial use. Most of them will be single-channel linear audio and will not have provisions for time code. Some, however, will include amazing in-the-camera digital effects features, and you will be able to pick them up for under $2,000.

Don't get the idea that the author is down on S-VHS. Quite the contrary. The first generation of professional S-VHS

Continued on page 176

Heiss is **BE**'s consulting editor specializing in the professional applications of consumer electronics products. His latest book, co-authored with Marjorie Costello, is HP Book's "The Camcorder Handbook."

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National elections in progress

By Bob Van Buhler

The SBE national officers and directors election is now in progress, so let's take a look at how democracy works in the society. The nominations committee is chaired by Doyle Thompson, SBE past president. Committee members include: Tom Weems, national director, and Chuck Morris, Chapter 6, Seattle.

The nominating committee first solicits candidate recommendations from the membership and current board. The committee verifies the qualifications of the nominees to determine their eligibility, and then presents the list of nominees to the executive committee. The executive committee was presented with the list of 1987 candidates at its July 16 meeting. The nominees are expected to have both the time and employer financial support or personal resources to fully and actively participate as board members.

Nominations also may be made by any SBE member in good standing, if accompanied by the signature of 10 members. Such nominees must be submitted to the national office no less than 60 days before the election to be included on the ballot. Write-in votes are counted and tabulated just like the printed ballot candidates.

SBE 1987 CANDIDATES

Officers:	
President:	
Jack McKain	316-265-2815
Vice president:	
Bob Van Buhler	301-467-3000
Treasurer:	
Bill Harris	303-741-5654
Secretary:	
Richard Farquhar	614-221-0966
For Board of Directors:	
Phil Aaland	602-792-9933
Terrence M. Baun	414-272-1040
Dane Ericksen	415-342-5200
Bob Goza	314-484-3718
David G. Harry	301-589-2662
Michael Hayden	212-696-9476
Wayne Kube	409-846-7777
Jesse Maxenchs	408-727-7272
Tom Weems	818-999-1711
Larry L. White	918-743-7814

Van Buhler is chief engineer for WBAL-AM and WIYY-FM, Baltimore.

The membership is notified of the slate of candidates at least 90 days before the election, either in the *SBE Signal* or through the mail. Sixty days before the election, the nominees are exposed to the membership in the form of biographical summaries and in their own policy statements, which are published in the *SBE Signal*.

Thirty days before the election date, ballots are mailed to each member. The national office uses a commercial mailing service in Indianapolis to perform this service. The completed ballots, which are returned to the national office, are stored unopened by Helen Pfeiffer, executive secretary, until the election date.

On the election date, the ballots are opened and counted by five SBE members who have been appointed by the board of directors. The counters cannot be board members or candidates. The election teller certifies the vote count in writing and the results are then notarized. All candidates are personally notified by telephone on the following day.

The election results are publicly released by the society at the annual meeting during the SBE National Convention and **Broadcast Engineering** Conference, which will take place in November. The election process also allows for write-in votes and nominations originating outside of the nominating committee.

Good luck to all, and choose your candidates thoughtfully. Members should feel free to question the candidates about their position on any issue. To encourage this communication, each candidate's phone number is listed in the accompanying table.

Meet the candidates

This year's election slate is composed of many fine candidates. Here is some background information on each candidate for officer's position:

Jack McKain has been involved in broadcasting since 1962. He is vice president of engineering for the Kansas State Network. Bob Van Buhler is an SBE director and served on the SBE National Frequency Coordination Committee. He also is director of engineering for WBAL-AM and WIYY-FM, Baltimore. Bill Harris is the Denver past chapter chairman and is technical director for KMJI-AM and KRZN-FM. Richard Farquhar is vice president of technical services for SOS Productions, Columbus, OH. He serves on the national certification committee and served as chapter chairman for both Chapter 25 and Chapter 52.

The following individuals have been nominated for board of director membership:

Phil Aaland, chief engineer, KGUN-TV; Terrence M. Baun, technical director for Multimedia Broadcasting; Dane Ericksen, senior staff engineer, Hammett & Edison; Bob Goza, engineering supervisor, KMOV-TV; David G. Harry, one of the founders of Potomac Instruments; Michael Hayden, senior engineer for the Private Satellite Network; Wayne Kube, past chapter chairman and charter member of Brazos Valley Chapter 99, Texas; Jesse Maxenchs, director of marketing for TFT; Tom Weems, district sales manager, Tektronix in San Francisco; Larry L. White, director of engineering, KVOO-AM, KUSO-FM.

More complete information on the candidates will be supplied with the ballot and members should consider carefully all relevant factors before making a decision. If you believe that others are qualified to hold office, their name can be added to the write-in blank on the ballot. Any names listed on the ballot will be treated just as though the person went through the normal nomination process.

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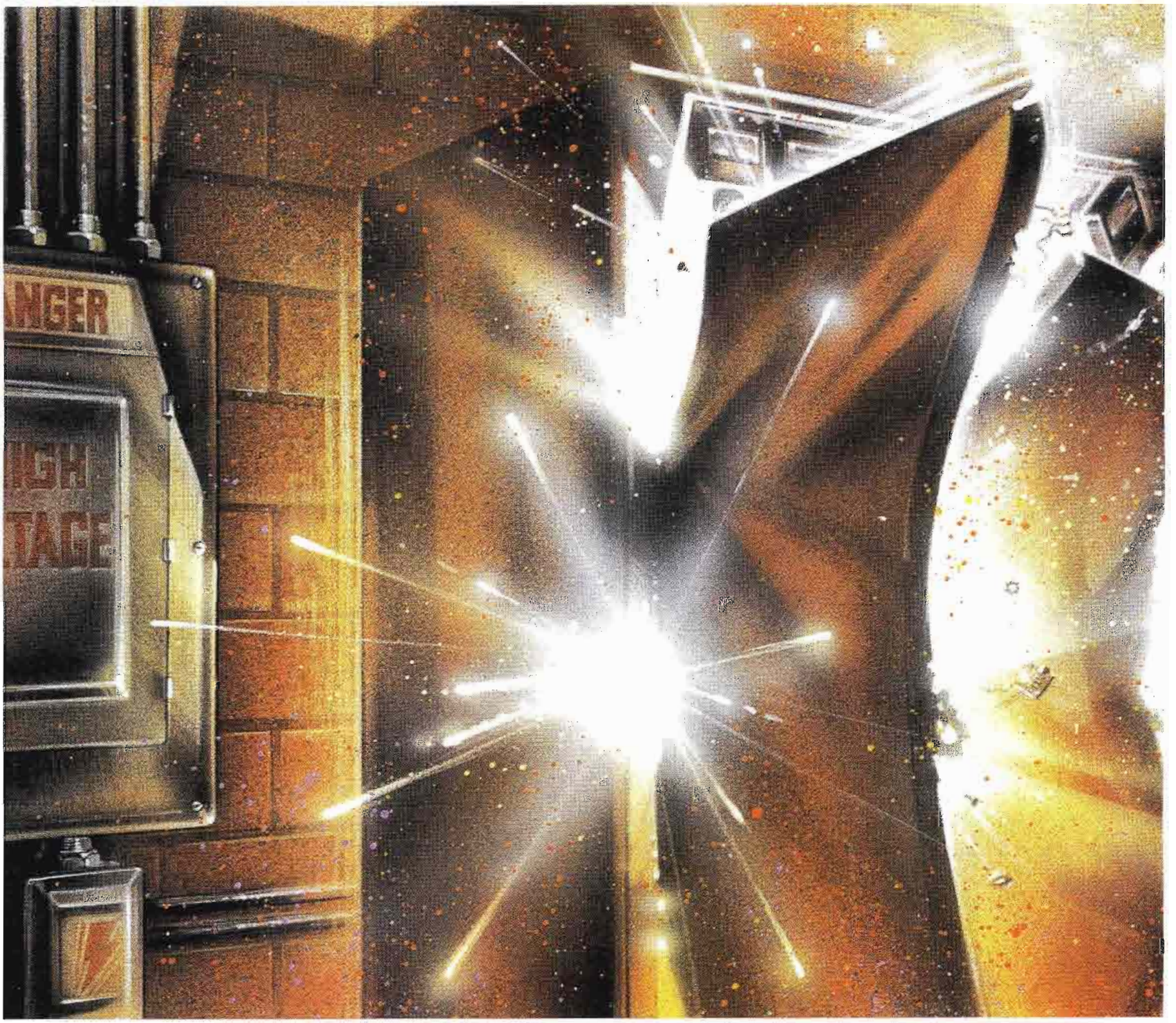

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F. Lewis Robertson
Vice President/General Manager,
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Retrieving data from a video signal

By Stephen Hobrecht

The information age has brought about an ever-increasing thirst for packing the maximum amount of data in a given amount of space—or in this case, bandwidth. The TV set can provide a veritable superhighway into the home, with data or communication equivalent to 1,000 telephone lines per TV channel. It is logical to conclude that, with 82 broadcast channels available, combined with the advantage that most American homes have televisions and, often, VCRs, that a mass communication/data system is highly desired.

Non-video transmissions already are being generated that use dead time—that time between scanned frames during the vertical interval, in order to transmit various types of information. Examples of these include vertical interval test signals (VITS), closed-captioning for the hearing impaired, and time-multiplexed binary tags broadcast to enable cable TV services. Other possible transmissions have been suggested, including financial data and internetwork communication.

The whole picture

Each channel's video signal is composed of luminance, chrominance and timing information necessary in order to reconstruct an image on the TV screen. Of the NTSC standard 525 scan lines, 483 normally contain picture information. The other 42 lines do not appear on the TV display, because a certain amount of time is needed by the TV-scanning circuits to reposition the CRT's electron beam from the bottom of the screen to the top of the screen.

Hobrecht is senior linear design engineer, RF-video, at National Semiconductor, Santa Clara, CA.

The interlaced nature of the standard signal actually provides 21 lines in each field, which are unused. Of these 21 lines, all of them contain composite-synchronization information and half of them normally contain burst-reference signal information. The first nine lines in the vertical interval include vertical equalizing and synchronizing pulses, which provide picture vertical synchronization in the final receiver.

Lines 10 through 13 have been reserved by the FCC. Lines 17 through 19 are being used for VITS and line 21 has been set aside for the closed-captioning information. This leaves only lines 14, 15, 16 and 20 presently unoccupied and available for information transmission.

The video line

Each video line is comprised of scanned video-picture information and the horizontal blanking interval. (See Figure 1.) The horizontal blanking interval essentially contains the setup information for the TV receiver. This setup includes scan-timing information, a black-level reference value and a 180° phase reference 3.58MHz color burst. Present TV receivers use highly integrated circuits in order to reproduce proper timing, contrast and color for each video line. A typical receiver uses one chip for the horizontal and vertical oscillators, synchronization and flyback functions. A second chip is used for the video black level, contrast, brightness and color-demodulation functions. Integrated circuits are doing an efficient job of performing the well-defined functions needed in a TV receiver.

However, what do you do if you want a new or different function using the TV broadcast signal? If you are looking for a piece of data on a particular line or lines within the TV signal, it may not make sense to use highly integrated circuits that require extraneous hardware, in order to decode the video information you seek.

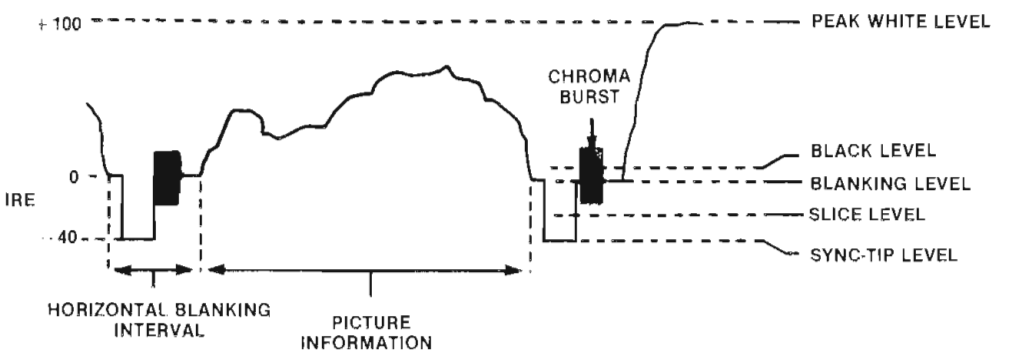

Figure 1. *A typical video line contains video and synchronization information.*

Discrete strippers

A sync stripper is needed in order to extract information transmitted on a particular line within a particular field or frame. The stripper's job is to separate out only that information relating to the timing nature within the composite video signal. This information is obtained by amplifying and clipping the video information at some point below the horizontal blanking level (0IRE) and above the composite sync-tip level (−40IRE). It is possible to obtain all other timing information from this composite sync including horizontal, vertical, field and frame sync. Combining the original signal's burst-reference signal with these sync signals allows complete reconstruction of the timing within the received video signal.

A common technique applied to perform sync stripping from the composite video waveform is to use an ac-coupled amplifier self-biased according to the expected duty cycle present in the video waveform. (See Figure 2.)

An input transistor is used to provide ac gain. A second transistor is driven between saturation and cutoff by the ac-coupled video signal. Rs, Rg and C1 are selected according to the expected duty cycle of the sync waveform. R1, C2 and D1 are added as a performance enhancement to compensate for the alternate duty cycle encountered during the vertical interval.

These components prevent the slice level from moving too close to the sync-

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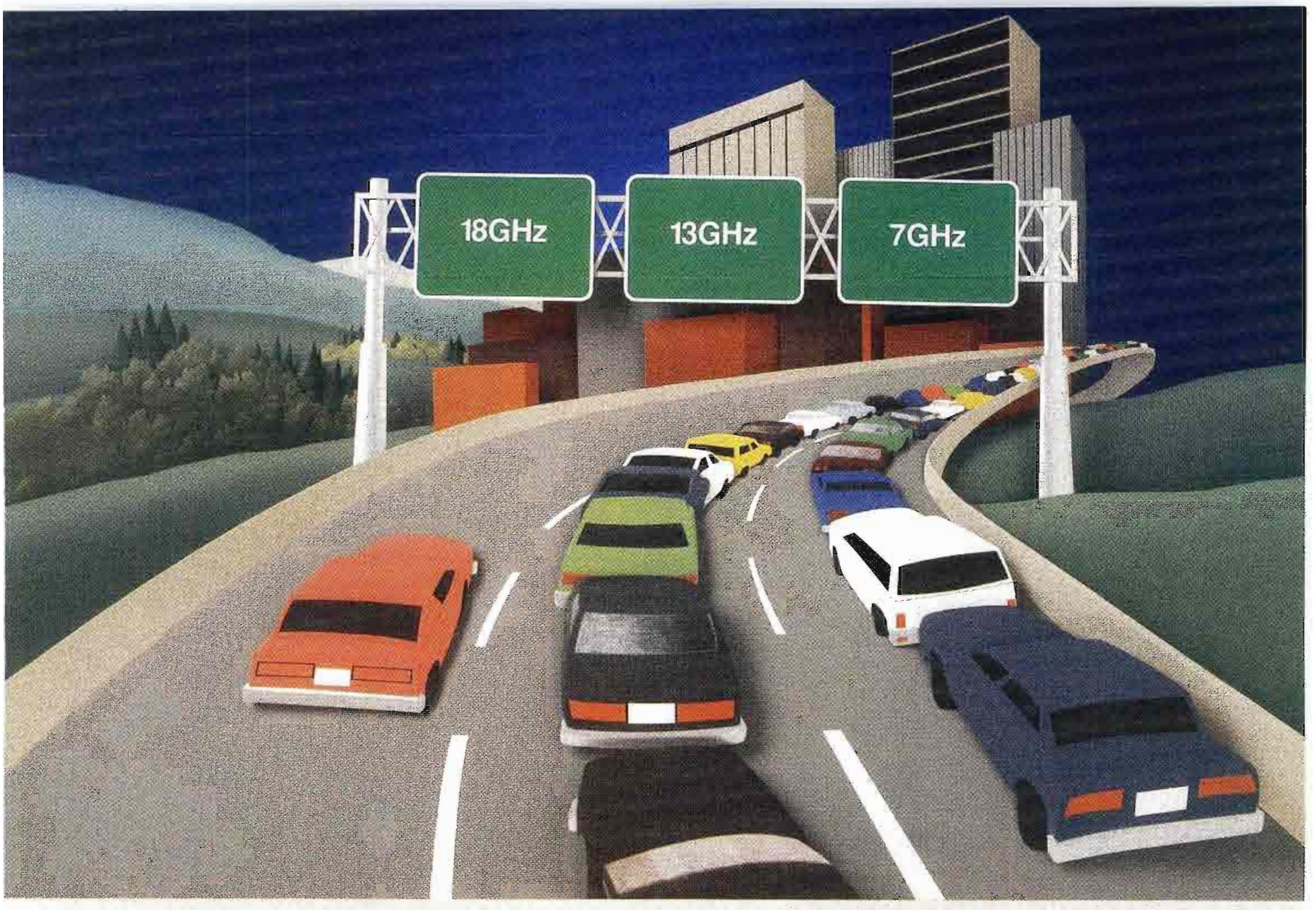

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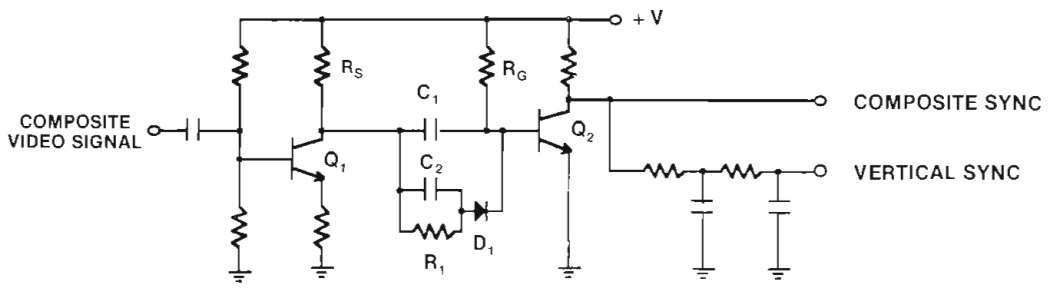

Figure 2. Simple sync-stripper circuit.

tip level during this period. Without this improvement, the displayed picture could be bent at the top of the screen or even worse—it could lose horizontal sync. Additional enhancements are added to prevent problems encountered with typical broadcast video signals. Some of these problems include atmospheric background noise, noise concomitant with signal amplification and detection, power-line-introduced motor noise and transient voltage spikes, automobile-ignition interference and multipath signal reception (ghosts).

Several results are inherent when using the discrete sync separator: 1) The output sync timing depends upon the average luminance level of the preceding line; 2) The vertical output pulse usually realized is 40μs to 120μs delayed with respect to the actual vertical sync timing; and 3) Additional output circuitry is required in order to generate other signals that a data-decoding system might require.

Integrated sync stripper

A video sync-stripper-integrated circuit has been designed that provides all of the timing necessary to extract information from a video signal. (See Figure 3.) The input signal required is a positive polarity video (increasing signal voltage signifies increasing scene brightness) from 0.5V to 2V (p-p). The output signals available include: composite sync, a vertical sync pulse, a burst gate/back-porch pulse and an odd/even field index level. The outputs are capable of driving standard TTL and CMOS logic elements. The circuit operates on a supply voltage from 5V to 12V drawing supply from current of 5mA to 10mA.

The composite-video input signal is dc restored so that the negative-going sync tip is clamped to an internal reference level of approximately 1.6V. The composite sync comparator switches at an input level of 70mV above the sync-tip level, providing a slice level that is independent of the luminance level within the video waveform. The vertical sync output is generated on the rising edge of the first serrated pulse within the vertical interval. A vertical default pulse is generated after approximately 60μs if the rising edge does not occur. This default vertical pulse might be necessary in an application that uses a simpler, non-standard waveform.

A burst/back-porch gate is generated following each rising edge of the composite sync waveform. A final output signal, not normally required by the scanning system within a TV receiver, but which might be required in a data retrieval system, is the odd/even field index. This index is the final key necessary to electronically select a particular line(s) within a given field. An external programming resistor allows differing vertical scan frequencies to be accommodated in the case of non-TV sync-related systems.

Decoding or inserting information at any defined time within the video signal easily is achieved. Information can be in any form as long as it is within the FCC-specified TV channel bandwidth. ASCII coding of alphanumeric information can

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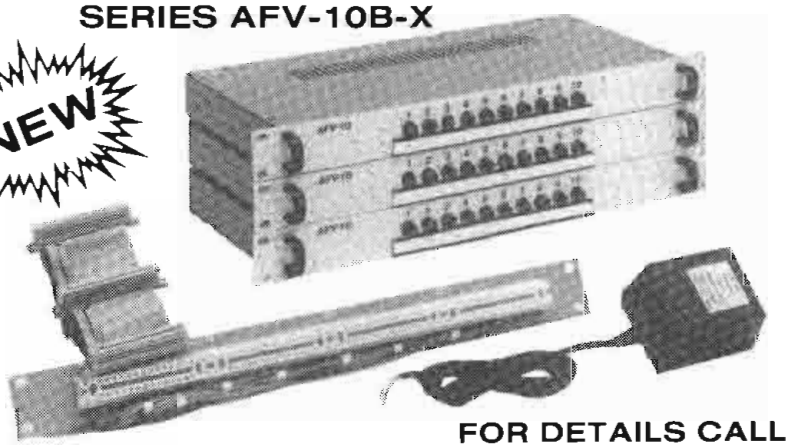

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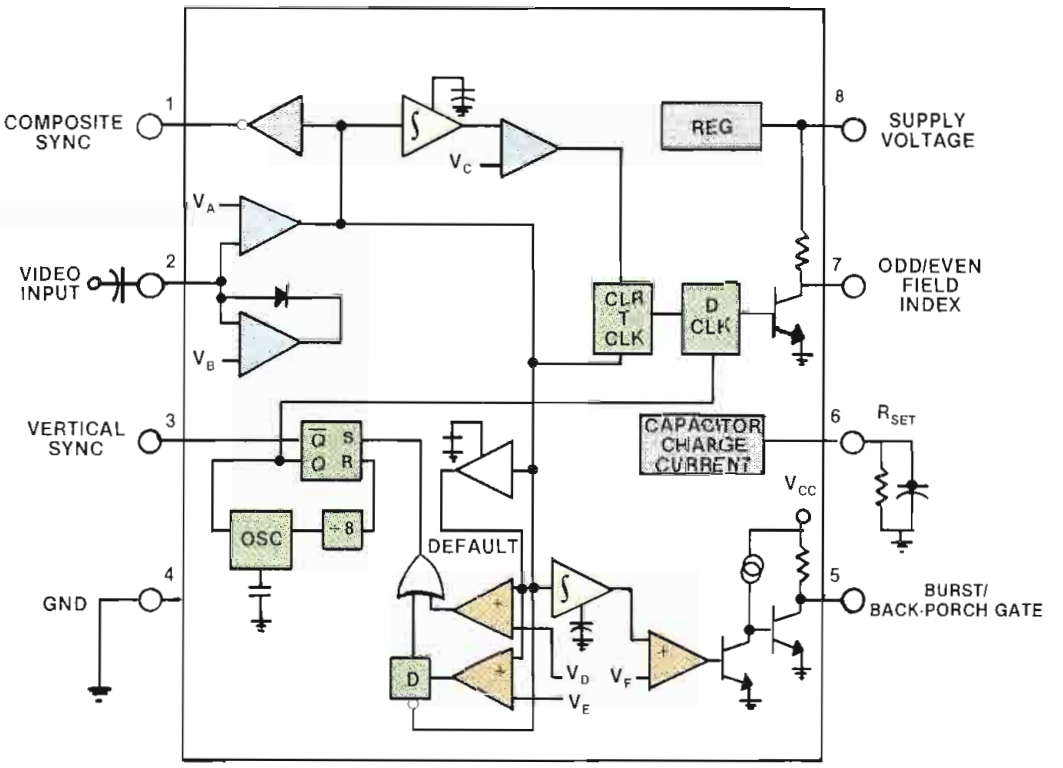

Figure 3. *An integrated-circuit sync stripper provides more sophisticated features and reliable operation.*

be employed to provide efficient use of the allowed bandwidth. The actual data rate will depend on the mode used. Teletext, for example, has been defined for two different operating modes: vertical blanking interval (VBI) and full-field mode. The full-field mode implies that teletext data is being sent during all TV lines, while VBI mode implies using only those available lines during the vertical blanking interval.

Full-field teletext has a data transmission rate of 5.72MHz for the U.S. standard NTSC signal. Teletext receivers have been described that exhibit error rates of 10^{-4} in a 20dB S/N environment. A less aggressive data rate such as that used in the closed-captioning system provides two alphanumeric characters per frame—enough information to generate a typical displayed voice channel.

The line grabber

The circuit shown in Figure 4 uses one technique for selecting a particular group of contiguous lines—in this case, lines 14 through 16. A differentiated vertical pulse is used to preload the counters, (MM74C193N), with the desired start line and number of contiguous lines desired. The counters count down on each rising edge of the composite output signal. When the final counter's least significant bit (LSB) reaches zero, the counter's output borrow line goes high and enables the analog switch. This transmission gate couples the dc-restored composite video signal to the output where data decoding can take place. The contiguous line counter(s) counts down until its LSB reaches zero, then generates a borrow-out pulse to turn off the analog switch and reset the counter enable lines.

Alternatively, if you would like to in-

Continued on page 173

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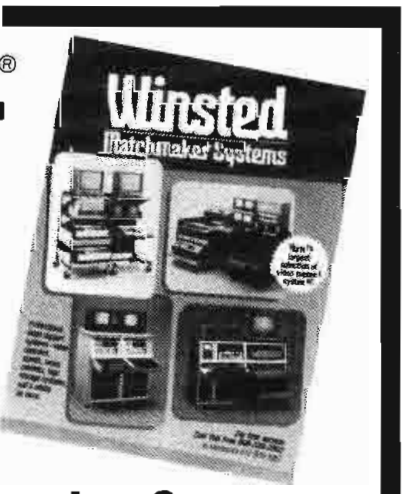

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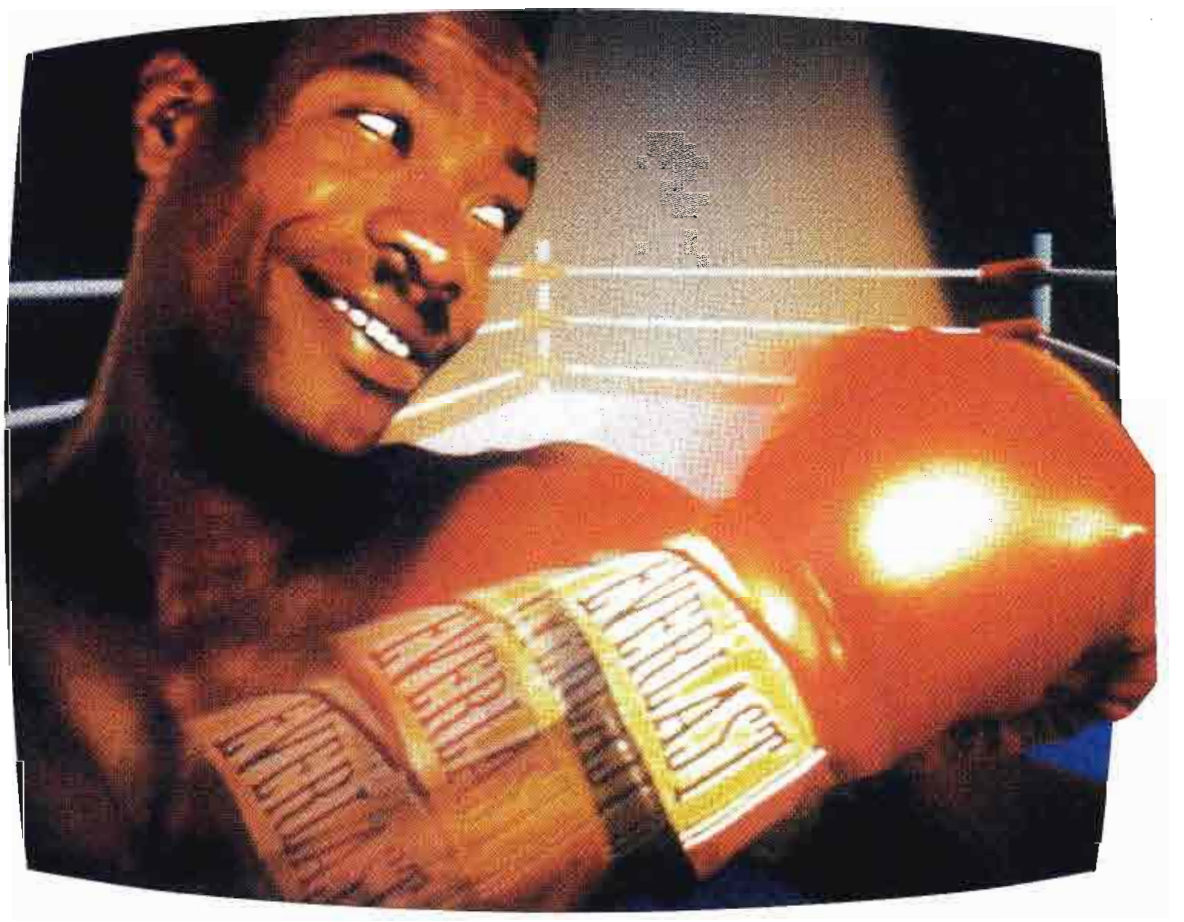

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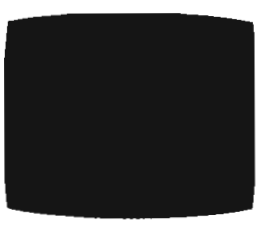

Paintbox 4X magnification.

Those are just a few reasons why hundreds of facilities are choosing Aurora these days. There are a lot more.

With Aurora, you can magnify a picture as many times as you like. With no loss of quality. Paintbox magnify degrades the picture. Which doesn't do much for your image.

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Color Cycling	*Yes*	*No*
Picture Transparency	*256 Levels*	*None*
Magnification	*No Loss*	*Degraded*
Networking Hardware	*Ethernet Choice of Standard Platforms*	*None Single Proprietary*
3-D Modeling and Animation	*Yes (Optional)*	*No*

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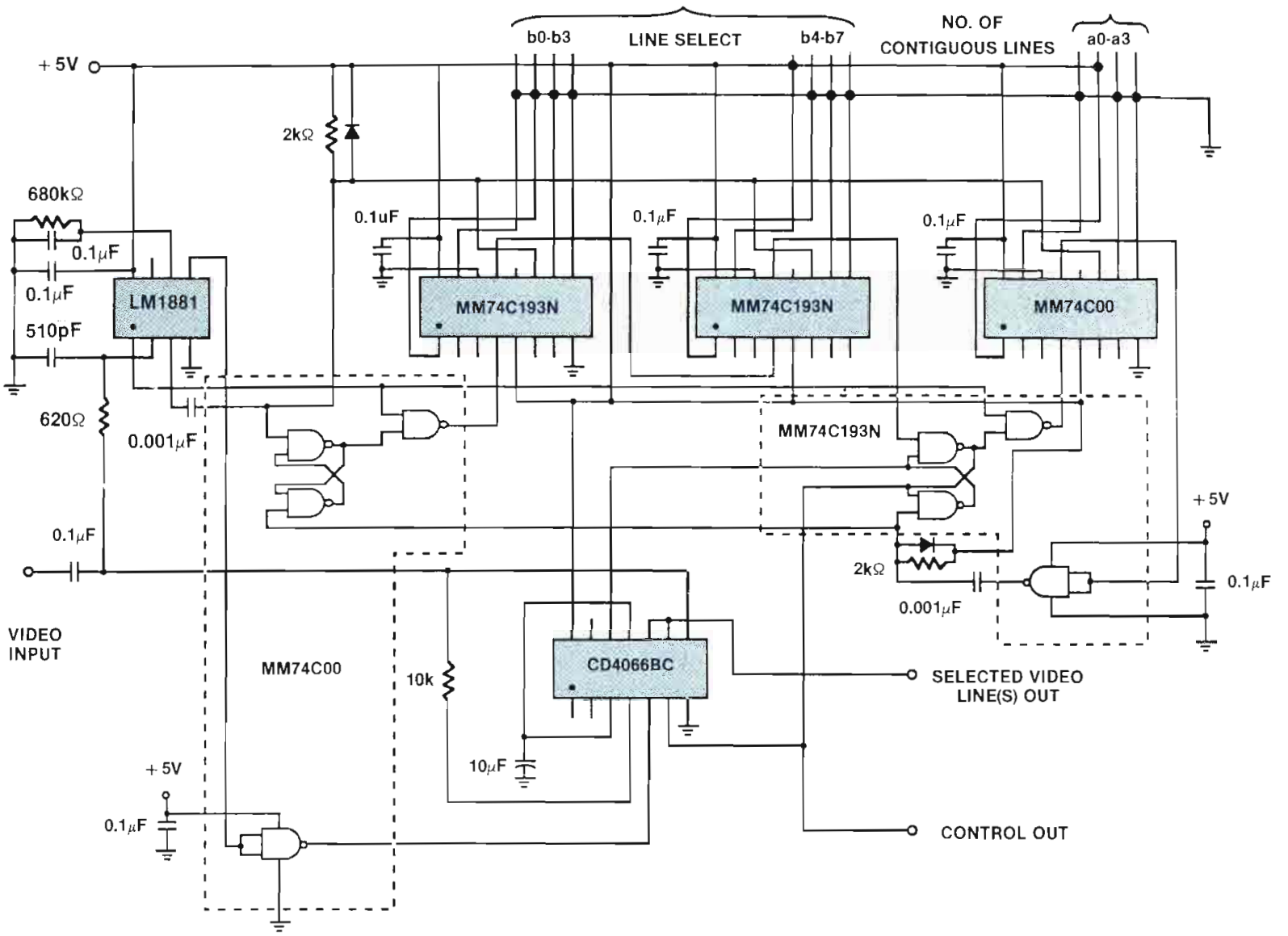

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START LINE	COUNTDOWN PRESET PROGRAMMING							
	b7	b6	b5	b4	b3	b2	b1	b0
14	0	0	0	1	0	0	0	0
15	0	0	0	1	0	0	0	1
16	0	0	0	1	0	0	1	0
17	0	0	0	1	0	0	1	1
18	0	0	0	1	0	1	1	0
19	0	0	0	1	0	1	1	1
20	0	0	0	1	0	1	1	0
21	0	0	0	1	0	1	1	1

NO. OF CONTIG LINES	LINE COUNTDOWN PRESET			
	a3	a2	a1	a0
1	0	0	0	0
2	0	0	0	1
3	0	0	1	0
4	0	0	1	1
5	0	1	1	0
6	0	1	1	1
7	0	1	1	0
8	0	1	1	1

Figure 4. *The circuit on the opposite page allows the selection of desired groups of contiguous lines—hence, the removal of the hidden data from the video signal.*

Continued from page 169

sert data on a given line, the generated output line-selector signal would be used to switch between the normal video signal and a data generator again using an analog switch. The available burst/back-porch output pulse is convenient when generating video signals, which must be compatible with the reference black level of the incoming signal. The burst output in this circuit is used to provide a dc output level equal to the video signal's black level by charging a voltage-memory capacitor when the selected line(s) output is not active. A 620Ω resistor and a 510pF capacitor is used to filter higher, non-horizontal sync-related frequency components from the input signal. In addition, this filter attenuates the 3.58MHz color subcarrier frequency by more than 20dB. Thus, by starting with a stable and predictable sync stripper, video-timing-related functions can easily be generated.

Bibliography: Jaffard, J.L., "Two ICs for Teletext Data Modulation," IEEE Transactions on Consumer Electronics, Vol. CE-31, No. 3, August 1985.

call up an effect with either our MFC1 MIDI foot controller, remote controller or just a standard footswitch (all optional).

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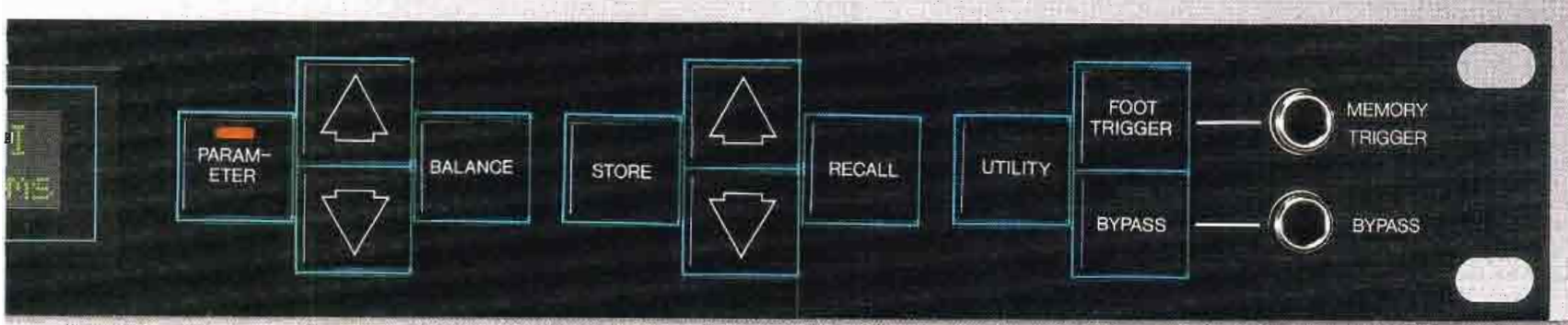

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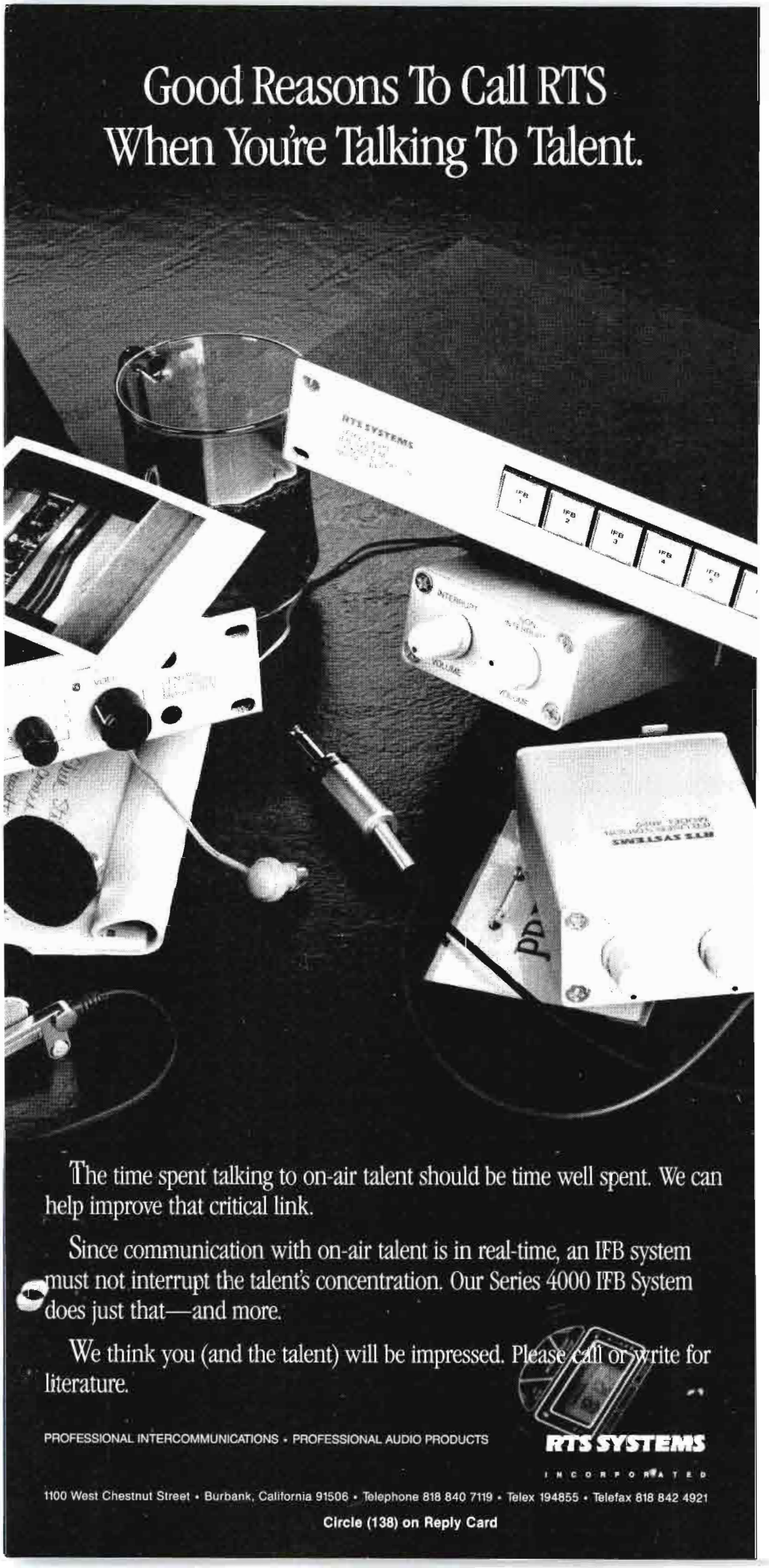

People

John Newton has been promoted to national sales manager for the broadcast TV lens division of Fujinon, Wayne, NJ. He is responsible for directing the company's industry and OEM sales as well as managing the regional sales centers in Chicago, Dallas, Los Angeles and at the new Fujinon headquarters in Wayne.

Chris Golson, Reuel Ely, John McPherson, Henry Klerx and **Cary Fischer** have been appointed to positions with Sony, Park Ridge, NJ. Golson is Northwest regional manager for the broadcast products division. Ely is director of engineering. He will oversee the development of professional audio products. McPherson is vice president, marketing, video communications products division. He is responsible for marketing professional/industrial TV production and distribution equipment and will head a 9-member national marketing group. Klerx is president, Sony Information Systems Company. He is responsible for all aspects of the Information Systems Company including new business, optical storage and dictation systems divisions, as well as the satellite communications division. Fischer is director of market development for digital audio products. He is responsible for planning and implementing sales and marketing programs for DASH-format recording systems and other professional digital audio products.

Harry Armstrong has been appointed to the newly created position of president, international operations, of the Dynatech Video Communications Division, Dallas. He will head all European sales and marketing efforts for Quanta, ColorGraphics Systems, Utah Scientific and Dynatech NewStar. He also will establish offices in London.

Gary Carter and **Gary Chapman** have been appointed to positions with FOR-A Corporation of America, Newton, MA. Carter is Western regional sales manager and Chapman is Eastern regional sales manager. They both are responsible for marketing and customer support of the broadcast product group, video products and industrial/CCTV products.

Elizabeth Coppinger has been promoted to marketing manager for Comprehensive Video Supply, Northvale, NJ. She is responsible for planning and directing sales and marketing activities including the expansion and development of new products and product lines featured in the company's annual catalogue.

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David J. Langford has been appointed general manager for the manufacturing/engineering division of the Mitsubishi Pro Audio Group, San Fernando, CA. He will oversee all manufacturing and engineering operations of the Quad Eight/Westrex division. Langford also has been appointed as a member of the executive committee.

Paula Bowen and **Andrew Wilmott** have been appointed to positions with GML America, Vienna, VA. Bowen has been promoted to general manager of operations. She is responsible for sales and administration for the Washington, DC-based operation while coordinating the activities of the company's sales representatives and dealer network. Wilmott is manager of technical services. He handles customers' technical questions and coordinates after-sale service for GML products in the United States.

R. Scott Watson, Mike Mackin and **Kuniko Yamashiro** have been appointed to positions with Ikegami Electronics, Maywood, NJ. Watson is general sales manager, professional products division. He oversees sales activities at the company's six regional offices, and is located in Maywood. Mackin is sales manager for the Southeast and Southwest regions for the professional products division. He is headquartered in Dallas. Yamashiro is office administrator at the company's Hawaiian facility.

Debbie Thomason has been appointed regional Midwest sales manager for Innovative Television Equipment, Woodland Hills, CA. She is responsible for Midwest sales and overall customer relations. She also handles trade shows and promotional activities.

Doug Akers has been appointed president of Intergroup Video Systems, Gainesville, FL.

Bob Munzner has been appointed Western regional sales manager for Lenco Electronics, Jackson, MO.

Jay LaBarge has been appointed manager of field sales at Microwave Filter Company, Syracuse, NY. He will recruit and manage a team of outside commissioned sales representatives to cover all 50 states.

Mike Griswold has been appointed Eastern regional sales manager for Cubicomp, Hayward, CA. He is responsible for all sales and sales support in 20 eastern and southern states. The territory has three district offices, located in Boston, New York City and the District of Columbia.

Dan Rau has been appointed director of sales for Modulation Sciences, Brooklyn, NY.

Tedd Jacoby has been appointed vice president of marketing and sales for Nova Systems, Canton, CT. He is responsible for determining market and product direction for the company as well as collaborating with the sales manager to enhance sales efforts.

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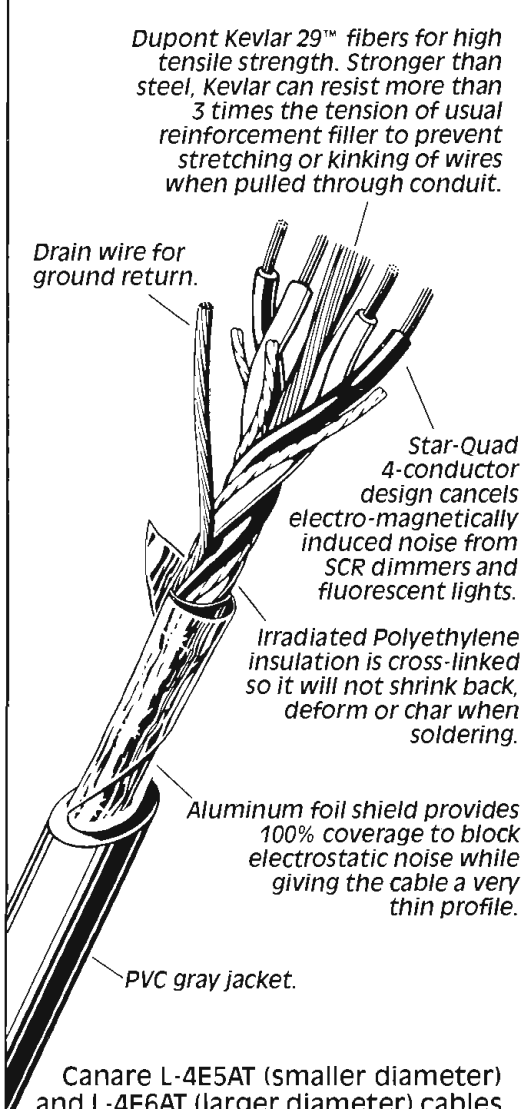

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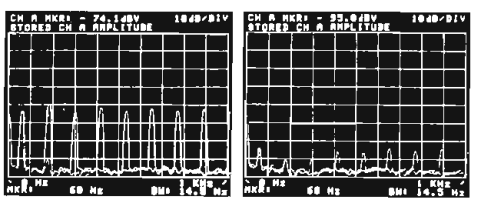

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Business

AKG distributes Soundtracs consoles

AKG Acoustics, Stamford, CT, is the exclusive U.S. distributor of Soundtracs mixing consoles. AKG and Soundtracs intend to ensure as smooth a transition as possible. There are no immediate plans to make any major changes to the existing dealer network. AKG and Soundtracs will work together, each contributing to strengthen the dealer base, increase product awareness and provide market-driven products. All marketing, sales and service will be conducted by AKG at its headquarters at 77 Selleck St., Stamford, CT 06902.

Alias opens regional offices; wins contract

Alias Research, Toronto, Canada, has opened regional offices in Princeton, NJ, Chicago and Los Angeles. Each office is complete with facilities for system demonstrations, customer training and field support. Alias also has expanded its research and development staff. The Princeton office will support the company's installed base of the 3-D computer graphic and animation systems in New York. The Chicago area will provide support for Midwest U.S. installations. The Los Angeles office will service West Coast aerospace, film and video customers.

Equipto offers engineering services

Equipto Electronics Corporation, Aurora, IL, is offering free engineering services to assist customers in designing standard and custom electronic modular enclosures that include vertical racks, sloped front consoles, work stations and instrument cabinets. Two RFI/EMI specialists are on its engineering staff to solve FCC or Tempest attenuation requirements. Prototyping for OEM projects also is available. For information, contact the company at 351 Woodlawn Ave., Aurora, IL 60506-9988; telephone 312-897-4691.

Laird Telemedia purchases ICM/Video Division

Laird Telemedia, Salt Lake City, has entered into an agreement to purchase the International Crystal Manufacturing Company Video Division from ICM, Salt Lake City. The purchase includes all inventory and equipment, as well as exclusive manufacturing and marketing rights to the ICM Video product line.

Under the terms of the agreement, all ICM Video products will be manufactured under the name and logo of Laird Telemedia. ICM Video products currrently in development will continue under the Laird name.

News
Continued from page 4

Media General converts to M-II

Media General Broadcast Group, Tampa, FL, has committed to the Panasonic Broadcast M-II format for the total conversion of its broadcast operations. The initial elements of the M-II system will be on-line almost immediately.

The Media General purchase is in excess of $1 million. The conversion to M-II at the station group is anticipated to be accomplished in early 1989 with total conversion of news-gathering equipment and commercial spot-playback systems.

The order includes AU-650 studio VTRs, AU-500 field recorders, AU-400 camera recorders, M.A.R.C. system cart machines and support equipment.

The three stations owned by Media General will use the M-II ½-inch system. They are WXFL, the NBC affiliate in Tampa, FL; WJKS, the NBC affiliate in Jacksonville, FL; and WCBD, the ABC affiliate in Charleston, SC.

News/Special Report
continued from page 160

gear includes some impressive equipment that will help to eventually send U-matic to the home for old formats (along with quad, EIAJ ½-inch and type A 1-inch). As time goes on, there may well be whole lines of signal processors built to handle the unique Y/C signal. Editing controllers are certain to pop up, along with better ways to handle time code—perhaps as a VITC or through the use of special indexing signals. New editing decks that add dynamic tracking and more to the already impressive list of features, including flying erase heads and digital servos, are likely to appear. You may even see pro S-VHS camcorders with stereo by late 1988.

Stay informed, and don't jump on a bandwagon before you know where it is heading. S-VHS is going to leave its mark on the pro video world. Just make sure you understand what it is all about so you can get good marks for your station or facility.

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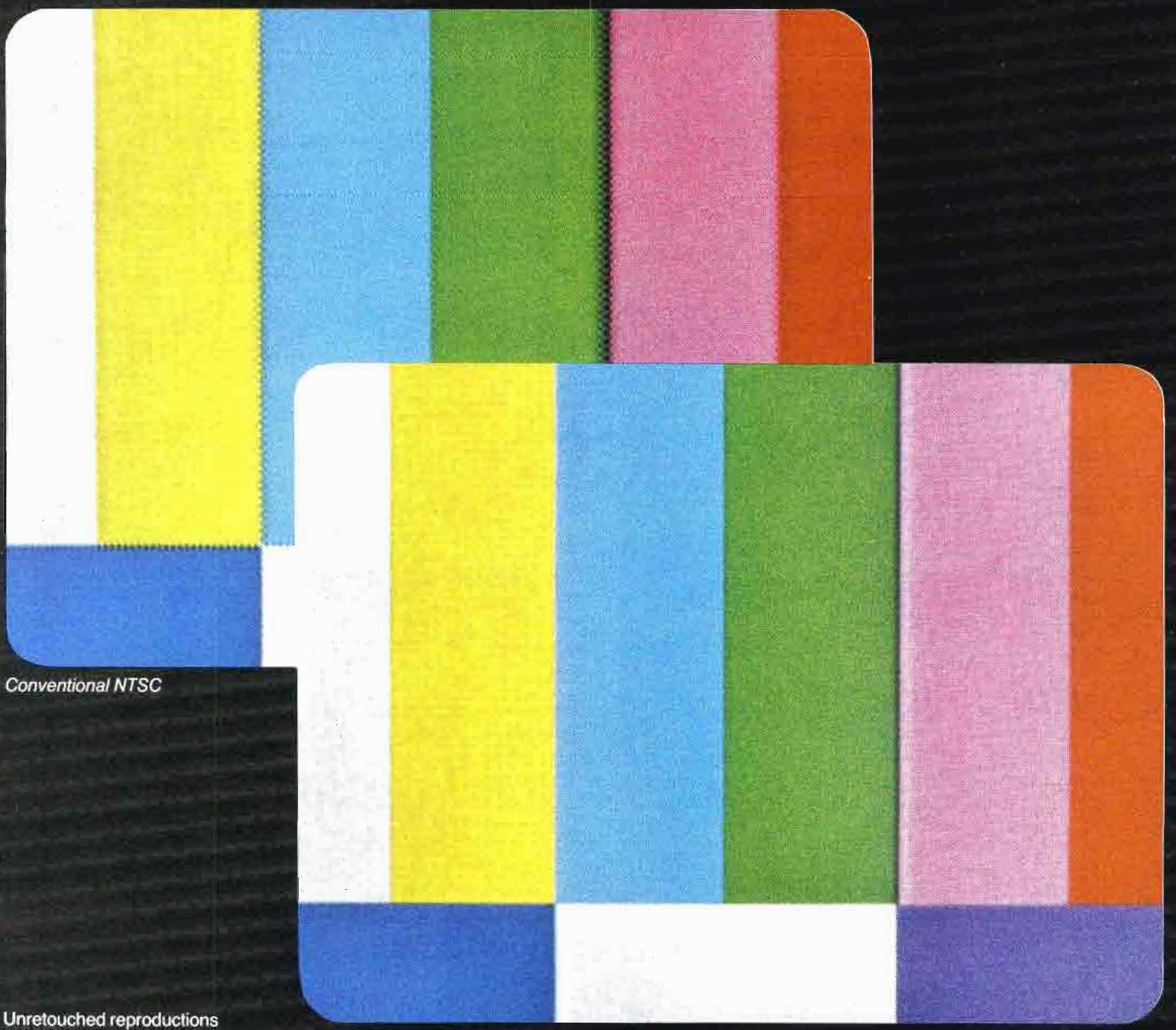

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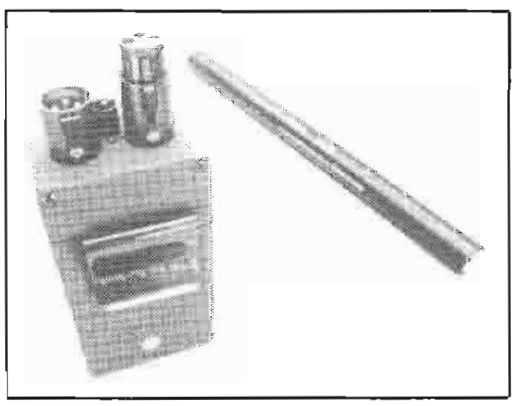
New products

Shotgun mic and power supply

Beyer Dynamic has introduced the following products:

- The MC 736 PV and MC 737 PV are short and long shotgun microphones. They feature pre-amp designs, which accept any 12V through 48V phantom power supply. The MC 736 is a short shotgun with a lobed polar pattern above 2kHz and a cardioid pickup pattern below 2kHz. The MC 737's long shotgun design produces a tightly focused lobed pattern for immediate off-axis rejection and accurate voice pickup. Switchable 12dB attenuation and low-frequency rolloff functions prevent pre-amp overload at dynamic extremes and filter unwanted frequencies below 200Hz.
- The CV 720 PV is a condenser microphone power supply and accepts any phantom power source from 12V to 48V. It includes a 10dB attenuator and a 12dB/octave LF filter. The system includes the CK 701 and 702 omnidirectional capsules, which maintain their cardioid pickup patterns uniformly across the frequency range.
- The MSB 48 N (C) 1 is a condenser microphone power supply. It holds five 9V batteries, and delivers up to 500 hours of 45V power to any compatible condenser. The system includes a range of omni, cardioid, figure-eight and shotgun capsules. The system features balanced XLR input and output connections. It also has a 3-position mini-toggle switch, which is protected against accidental contact. The switch turns the power supply on or off.



MSB 48 N (C) 1 power supply

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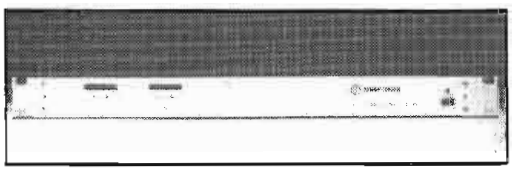
Stereo broadcast digital-audio delay line

Klark Teknik has introduced the DN 773, a compact stereo delay line with high-speed sampling and large memory capacity. It features a maximum stereo delay of 10 seconds (20 seconds mono) and uses 16-bit linear A/D and D/A conversion, a 50kHz sampling rate and proprietary thick film anti-aliasing filters to achieve product specifications. The unit's frequency response is 20Hz to 20kHz ±1dB at any delay setting. Distortion at 1kHz is less than 0.02%; dynamic range of more than 90dB (20Hz to 20kHz unweighted). The unit is rack-mountable and backed by the company's reliability control.



Circle (351) on Reply Card

Machine interfaces

Timeline has introduced the following products:

- The Sony 5850 interface for LYNX VSI and SAL modules. The interface allows Ampex, Grass Valley, CMX, Sony and other video-editing systems to control this VTR. The interface encodes and decodes editor commands for its non-standard communications port. The unit automatically controls thread and unthread functions based on the length of fast forward and rewind commands, and allows the editor to select the insert track.
- The Sony BVH-2000 serial interface for LYNX SAL synchronizer modules adds a Sony standard P-2 communications/control port to the LYNX SAL module for control of a BVH-2000 VTR. In multitransport systems, the BVH-2000 and its LYNX SAL module can function as either master or slave in relation to associated LYNX modules.

LYNX time-code module

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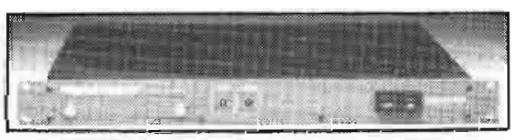
Telephone interface system



Gentner Engineering has announced the Digital Hybrid telephone interface system. It interfaces a telephone line to audio equipment for on-air calls, interviews or IFB with the capability of simultaneous 2-way conversation. The system isolates the send and receive sides of a telephone call allowing the caller's audio to be heard on overhead speakers while microphones are active in the studio. In addition, digital-signal processing keeps audio levels consistent to and from the caller while keeping line noise to a minimum. The system is automatic, adapting to each telephone line to compensate for changing conditions. Multiple units may be stacked to form a conference bridge.

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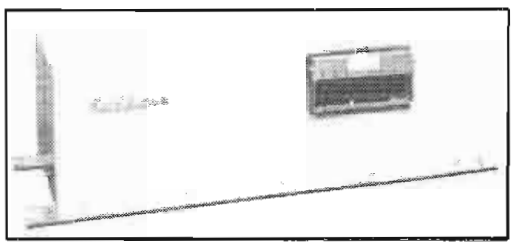
Air-conditioning systems

Heat Exchangers has introduced the Koldwave series of air-conditioning equipment:

- The KC vertical series are water-cooled conditioners and include cabinets that are internally lined with sound absorbent, thermal insulation, with removable panels providing access to components. The units contain the blower and compressor contactors, impedance relay and 24V control transformer. The condenser water connections are located at the base of the side panel. The condensate drain connection is a ¾-inch FP.
- The CM horizontal series of water-cooled air conditioners can be ceiling-mounted and include cabinets that are internally lined with sound absorbent, thermal insulation, with removable panels that provide access to components. Water connections are located on the back of the units. The condensate drain line requires a field installed trap, pitched a minimum of ¼-inch per foot.



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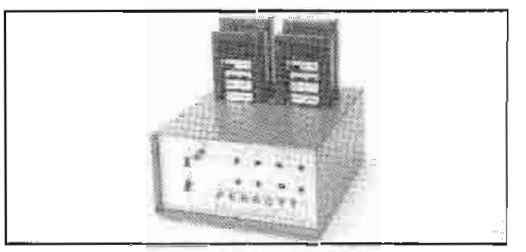
Discharger/charger unit

Perrott Engineering Labs has announced its portable 441 discharger/charger 4 gang unit. It discharges and overnight charges both NP-1 and NP-1A nicad batteries. The unit is encased in high-impact housing and contains four independent Minichargers and four independent dischargers. LEDs indicate discharge and charging cycles for each of the four independent ports. The unit exercises the NP-1 and NP-1A preventing memory and extending battery life.



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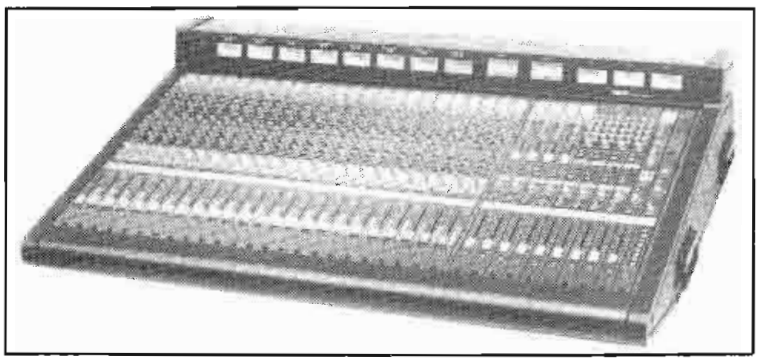
Audio equipment



PM1800 series of audio mixing consoles

The Professional Audio Division of *Yamaha International* has introduced the following products:

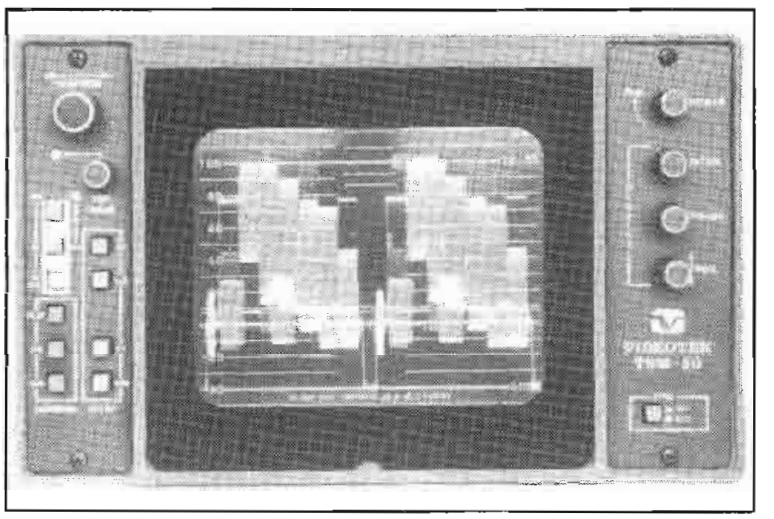
- The DMP7 digital mixing processor features an 8x2 digital mixing format, with three integral full-bandwidth digital signal processors in separate effects buses. Each input channel includes an A/D converter, a 3-band digital parametric equalizer, panning and effects bus control and motorized channel faders. The output buses feature digital compression, externally controllable output levels, D/A converters and both balanced and unbalanced analog outputs. A rack-mounting kit, operator's manual and RAM cartridge are included.
- The PM1800 series of professional audio mixing consoles are available in 16-, 24-, 32- or 40-input channels. Other features include four stereo auxiliary returns; eight group mixing buses; master stereo bus; an 8-by-4 mix matrix configuration; eight master mute groups; and cue and solo capabilities. All of the auxiliary and group buses may be operated independently. The console's inputs are differentially balanced, equipped with a 3-position attenuation pad and a continuously variable gain trim control. Each input channel includes a 4-band sweepable equalizer with an EQ in/out switch.
- The MV802 8-by-2 line mixer in a 19-inch rack-mount cabinet. The mixer includes switchable input channels for mic-level input, two independent auxiliary submix sends with stereo returns for compatibility with effects units. The mixer provides both balanced XLR and unbalanced phone jack stereo outputs for compatibility.
- The PD2500 professional series power amplifier is dual channel and capable of delivering 500W rms per channel into 2Ω loads, 1,000W in bridged mono operation into a 4Ω load. The switching frequency has been increased to 125kHz. A forced-air cooling system reduces the required heat sink area. Independent, dB-calibrated, 31-position detented input attenuators make level-matching and balancing easy.
- The GC2020B dual-channel stereo compressor/limiter. The audio is rated at 20Hz to 20kHz frequency response and no more than 0.05% total harmonic distortion. Each channel features an expander gate with variable threshold level for eliminating background noise and hiss during no-signal portions of a performance.
- The GQ1031B graphic equalizer features 31 separate, active channel filters that offer a 12dB cut or boost, and a summing network that combines the filters with minimum phase shift. Each filter is adjusted by a slider control with a positive detent in the center flat response position.

Circle (356) on Reply Card

Audio DA, program and waveform monitors

Videotek has introduced the following products:

- The ADA-408S contains two complete precision audio distribution amplifiers. Each of the DAs is designed to bridge or terminate either stereo or monaural sources. Input switching or mixing and four output distribution modes are provided for each DA. Frequency response is flat from 20Hz to 20kHz. Audio headroom is +24dBm, balanced. Both inputs and outputs may be either balanced or unbalanced. Front-panel output gain adjustments are provided for each channel, −6dB to +29dB.
- The APM-2RS is capable of checking input phase relationship between left and right stereo signals. This is accomplished by moving the front-panel mounted phase-check switch to the test position. Phase is indicated on the 10 segment bar graph VU meter.
- The TSM-50 is a half-rack width unit with a high brightness 5-inch diagonal CRT. An internal, illuminated graticule eliminates parallax errors and a non-glare contrast filter is supplied. Two selectable looping video inputs are provided as is a switchable internal/external sync input. Vertical frequency response measures flat to 6MHz. Switchable filters permit viewing of the signal in either flat, IRE or chroma modes.

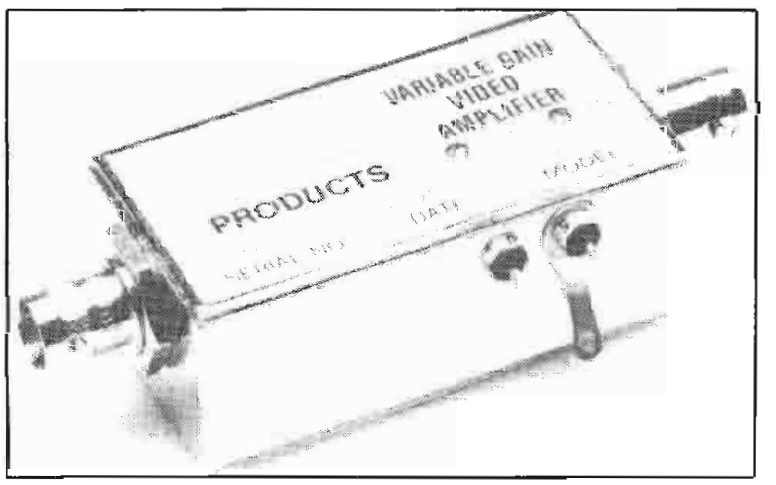


TSM-50 unit

Circle (357) on Reply Card

Video amplifiers

TIW Systems has introduced the VAB series of variable gain video amplifiers, which are designed for amplification and buffering for wideband analog and digital baseband signals. The amplifiers feature a frequency response from true dc through 40MHz, 1.5V peak-to-peak linear output voltage swing, low VSWR in and out, 25dB manual gain adjust without performance degradation, a 500V/μs slew rate and manual dc output offset trim. Two models offer input and output impedances of 500Ω and 75Ω. A third model has a ≤5Ω output impedance with 50Ω or 75Ω impedance input.



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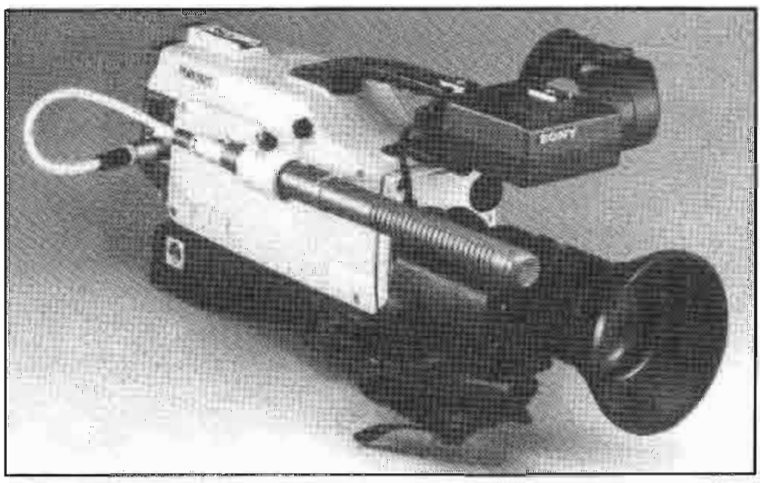
Recorders, converters, mixers and mics



ECM-672 condenser microphone on camera

Sony Professional Audio Products has introduced the following devices:

- The PCM-3402 is a 2-speed, 2-channel, ¼-inch digital audio recorder. The deck runs at the 7.5ips (DASH-S) and 15ips (DASH-M) speeds and features electronic editing with 12-second memory, plus analog-style razor-blade editing. The unit operates at sampling rates of 44.1kHz or 48kHz with 16-bit linear quantization.
- The DFX-2400 is a 2-channel digital sampling rate converter that permits transfer of digital audio signals between different formats, providing 96dB conversion accuracy. It handles 32kHz, 44.056kHz, 44.1kHz and 48kHz frequencies. The unit offers PCM-1610 and AES/EBU format input/outputs and can transmit auxiliary data in the AES/EBU mode.
- The PCM-3324 digital multitrack recorder has been expanded with the VSU-3310 Vari-Sync controller, which allows the recorder's tape speed to be varied without affecting output quality or synchronization with video signals. The unit provides switchable 44.056kHz, 44.1kHz or 48kHz word clock output frequency, each of which can be varied by ±12.5%. It also accepts pitch control input of both analog (balanced or unbalanced) or digital (APIB) signals.
- The APR-5002H is a ½-inch, 2-track version of the APR-5000 series analog recorder, with a 3dB improvement in signal-to-noise ratio. Intelligent electronics automate tape management and machine maintenance. Changes in tape type, reference fluxivity, overbias or equalization standards can be made without manual alignment.
- The MXP-29 mixer is an 8-channel stereo audio mixer that incorporates VCA for each channel and interfaces with the BVE-900 video editor and 9-pin VTRs. The mixer's channels and monitor input are +4dB balanced. The unit incorporates mic and line switching as well as 3-band EQ, 2 aux, pan and PFL on each input. Features include: 48V phantom power, bar-graph stereo LED metering, master and aux output faders, talkback to master and aux outputs, a pair of sub inputs with panning and level, monitor inputs and an oscillator.

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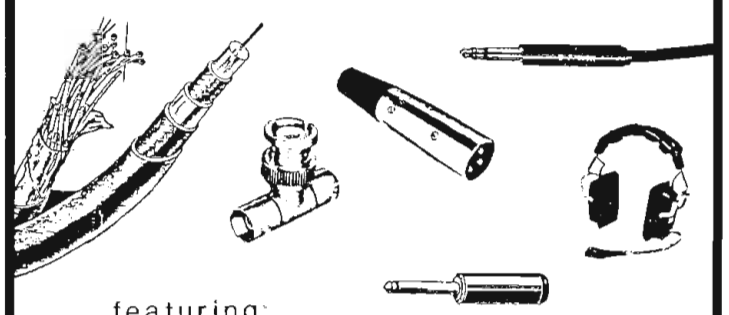

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• The BTA-210 and BTA-37 are UHF and VHF mic attachment kits. The BTA-210 VHF attachment is designed for use with the WRR-210 receiver while the BTA-37 attachment is made for the WRR-37 receiver. The BTA-210 weighs 1.8kg with the receiver. The BTA-37 weighs 1.4kg with the receiver and includes an ENG antenna adapter that reorients the receiver's antenna position for the camera-mount application.
• The ECM-672 electret condenser microphone uses a supercardioid, unidirectional pickup and can be mounted to the side of the camera and extended alongside the lens. Specifications include: frequency response of 50Hz to 15,000Hz; S/N ratio of 72dB; and maximum sound pressure input level of 115dB.

Circle (359) on Reply Card

Computer prompter

Tekskil Industries has announced the 909C, a portable, self-contained computer prompter that lets the user compose, edit and replay scripts. The prompter has 128K of memory, a display, a keyboard and a built-in microprocessor system. A proprietary software/word processor communications package and operating software are built into the unit's firmware (new capabilities will be offered on chips at no extra charge). A Text File cartridge saves text files and, with its own memory, functions as a 32K non-volatile memory that holds up to 35 minutes of prompts. The prompter operates interchangeably in PAL or NTSC and comes with its own 12V power source.

Circle (360) on Reply Card

Head-worn condenser microphone

Shure Brothers has introduced its model SM15 head-worn condenser microphone that features a smooth, natural-voice frequency response (50Hz to 15,000Hz) to produce a fuller overall sound with the fat low-end response. The mic also has a high sound-pressure level capacity (141dB), and won't overload. The mic also features a double-braced headband with special grip pads that allow the user to twist and turn without losing the microphone. A fully adjustable boom pivot locks in for precise placement of the mic on either the left or right side of the head.

Circle (361) on Reply Card

Minicomputer regulator line

Sola has announced a line of portable, plug-in minicomputer power regulators (MCR). The models feature protection against major power surges, provided by surge suppression modules that accept a 6,000V, 500A, 100kHz ringwave per ANSI/IEEE C62.41-1980, Class A and B, without damage. The added surge suppression capability, combined with noise and voltage protection, allows the MCR to guard against almost all common ac power irregularities except total line failure. The MCR is built around a ferroresonant constant-voltage sinusoidal transformer. Designed to reject two types of electrical noise, the MCRs provide transverse-mode noise attenuation exceeding 60dB and common-mode noise attenuation better than 120dB.

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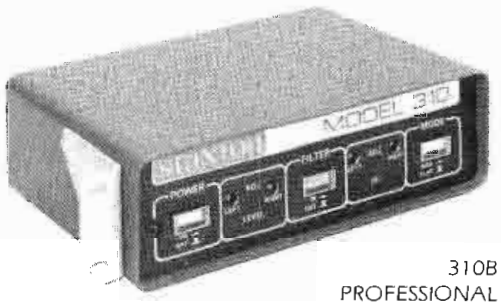

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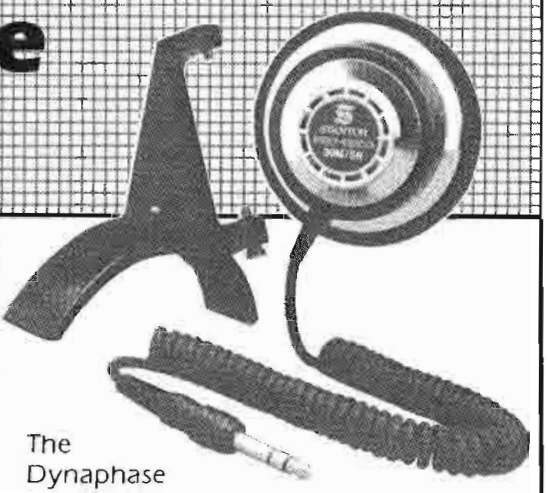

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Recorders, mixer

A807 recorder-reproducer

Studer Revox has introduced the following products:

- The A820 24-track is a multichannel recorder with fully integrated Dolby SR. The transport accepts 14-inch reels and is convertible between 1-inch and 2-inch tape widths. Tape spooling speeds are up to 50ft/s. All transport operating keys are user programmable, with a 40-function software library. Digital memories store alignment parameters for two tape formulations and 8-, 16- and 24-track headblocks. An overbridge for metering and channel selection allows for remote operation.
- The A812 is an audio recorder that incorporates three servo-controlled motors and handles reel sizes up to 12½ inches. Four tape speeds are standard and all are front-panel selectable. Other features include a 40-function software library, thumbwheel shuttle control, microprocessor control of audio alignment, phase-compensated audio electronics, and transformer or transformerless inputs and outputs.
- The A807 recorder offers digital setting and storage of audio parameters. Features include backspace, library wind, reverse play, variable speed, thumbwheel shuttle control and a tape dump function. The recorder also has two programmable keys, phase-compensation circuits, and RS-232 and parallel remote-control ports.
- The C279 audio mixer has six switchable input channels with 48V phantom power, low-cut filter, input gain control, HF and LF shelving equalizers, pan or balance control and PFL button. Built-in monitor speaker and talkback mic, headphone output, level control and XLR outputs.

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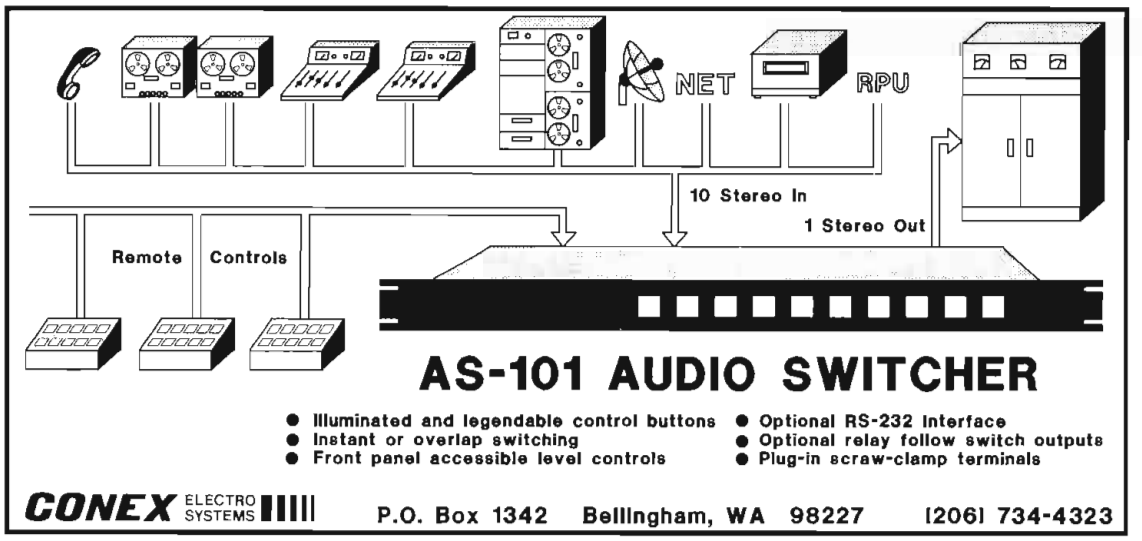

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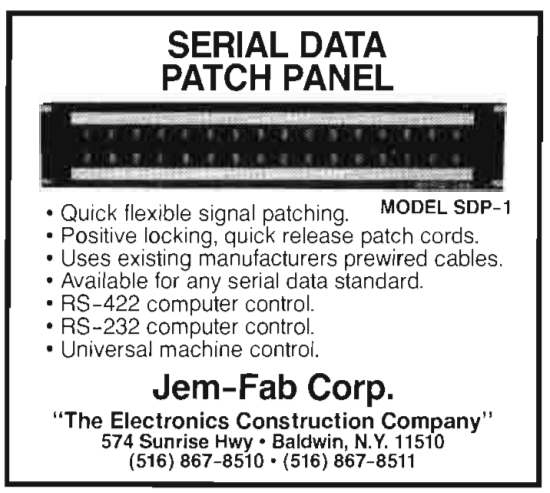

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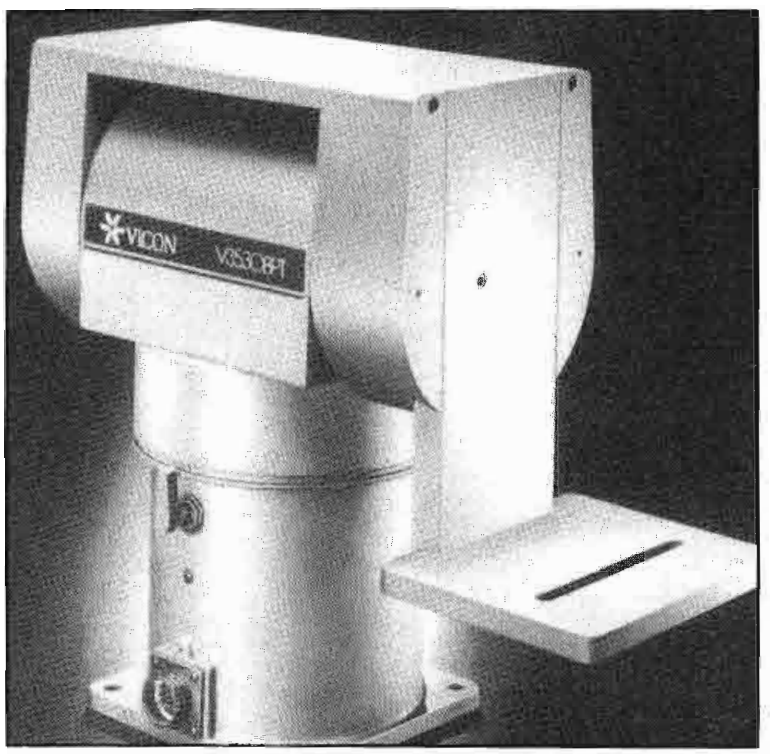

Vicon Industries has introduced the V3530BPT broadcast-quality, high-velocity servo positioner. The system offers a load rating of 60 pounds and infinitely variable pan tilt speeds over a 12:1 range, including a continuously variable pan speed of 1.2 to 15 degrees/second and a continuously variable tilt speed of 2-to-24 degrees/second. The drive system of the pan and tilt drive is designed for studio-silent operation, starting with gear materials selected for both load capacity and quiet operation. The gear train features an enclosed housing assembly that captures airborne noise and prevents sound radiation from the housing itself. Sound-absorbent and dampening materials form a silent chamber in which both azimuth and elevation motors function.

Circle (364) on Reply Card

Time align studio monitors

UREI Electronic Products has introduced the C series of time align studio monitors. The 811C has a 99dB SPL/watt/meter; the 813C has 101dB SPL; and the 815C has 103dB SPL. All three models function with a frequency response envelope to beyond 17.5kHz. Each of the monitors uses an 801C coaxial loudspeaker, which is combined with a titanium-diaphragm compression driver to provide 1-point sound source. Additional low-frequency drivers are used in the 813C and 815C. The time align technique solves time smear by considering driver placement and adjusting crossover group delay parameters to achieve simultaneous arrival of sound from the voice coils of the two transducers. The series uses the high-frequency horn with its diffraction buffer for acoustic impedance matching and out-of-band response.

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Studio computer

Solid State Logic has introduced the G Series studio computer that features high-performance hardware, fast processors, on-board memory and a 20Mbyte disk cartridge.

Circle (366) on Reply Card

Computer graphic enhancements

West End Film has announced a number of rendering enhancements to its Artwork and Videowork computer graphics packages. Artwork is a 3-dimensional graphics program for the IBM PC/AT. Videowork is a motion-scripting package for animation of images created by Artwork onto videotape. One enhancement is reflectance mapping on 3-D objects. These objects can be rendered with shiny surfaces, such as chrome or glass, which will reflect an environment that has been painted or scanned-in. The second enhancement has increased the light sources from two to 10. Each source can be independently positioned according to its direction and intensity. Artwork is now capable of creating polygon meshes to allow texture-mapping of images over an entire object.

Circle (367) on Reply Card

Consoles

TAC has introduced two consoles:

- The SR9000 superconsole features a standard mainframe of 40 inputs, 16 audio groups, 16 auxiliary sends, eight VCA groups, eight mute groups, 16x8 output matrix, 4-band parametric EQ and an on-board handwired jackfield.
- Additions to the Scorpion range include: the Scorpion PB that accommodates 45 module positions, with eight module positions occupied by the on-board TT jackfield. The XL frame accommodates a total of 53 modules. The frame allows configurations such as 40-8-2 with eight auxiliary sends and the appropriate master modules. The S1100 input module has eight auxiliary sends, using four dual concentric pots. The S1200 module is a stereo line input. It features a 3-band equalizer with switchable frequencies and four auxiliary sends.

Circle (368) on Reply Card

wired or wireless feed to the sportscaster for his cue phone.

But with the AT4462 and Modu-Comm, cue is fed through the announcer's mike cable already in place. Add a small accessory decoder to the end and plug both the cue phone and the microphone into the same cable. Cue can be program, an outside line, or "talk over" from the mixer. No extra wires, no crosstalk, and no change in audio quality! Nothing could be simpler or more efficient.

Now, No-Fuss Stereo

Actual stereo mixing is equally straightforward. The sportscaster and the color announcer in our example appear on separate panpots so they can be centered as desired in the sound field. The stereo crowd pickup goes to a stereo input, with clutch-ganged controls for one-hand level control. And there's a second stereo input for another mike or line level source (a second field mike perhaps, or for pre-show interviews on tape).

True Stereo Limiting Plus LEV-ALERT™

Adjustable limiters can operate in tandem, or individually as you prefer. And our Lev-Alert system can give you peak level audible tone warnings in your headphones when you can't watch the VU meters. Trust Lev-Alert to keep your standards high...even when it isn't easy!

Take A Close Look

When you examine the new AT4462 you'll see a host of other features to help you do your job: Cue on every channel...Separate headphone amplifier...Phantom power for all types of mikes...Three-frequency tone oscillators...Slate mike...Supplied carrying strap and protective case...Powered either by internal 9-volt batteries or any external 12-18 VDC supply, any polarity.

A New Era in Stereo Begins

We've made the new AT4462 a working tool that helps you and your staff take full advantage of the production values stereo has to offer. And a hands-on test will quickly prove it. To learn how the AT4462 can help you create better audio every day, call or write us now.

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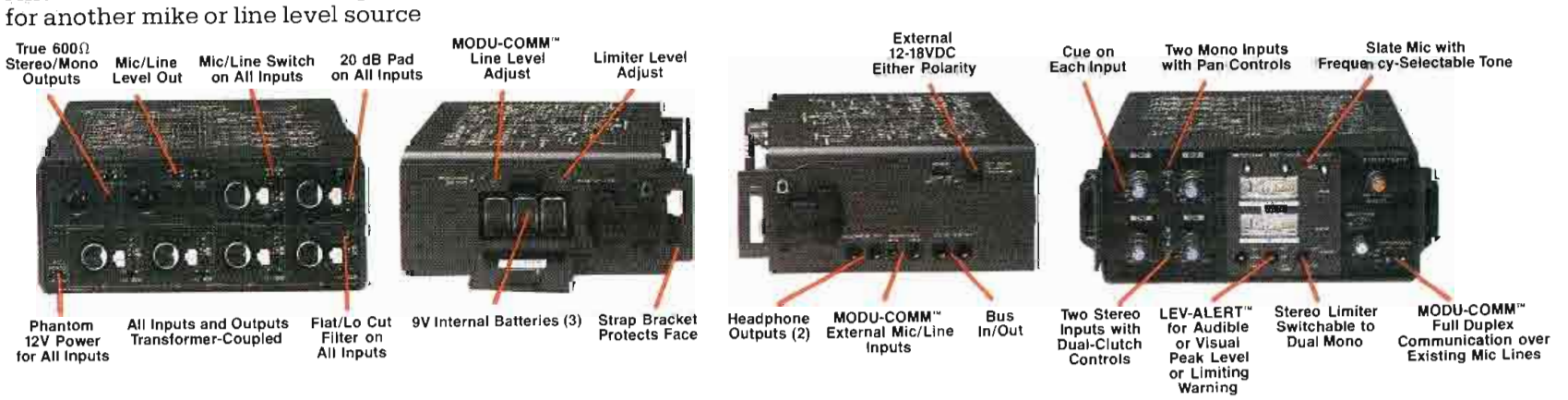

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Circle (152) on Reply Card

Sound control system

Soundforms has introduced the Soundforms sound control system. The portable sound control panels are lightweight, modular and require no tools for assembly. The system can be used to control recording environments on location or in a studio. The panels can be independently used freestanding, hanging on a wall or to create baffle walls of any size or shape. A single panel consists of a collapsible ABS plastic frame, attachable acoustic foam, a color cover, wall mounts and a storage/travel bag.

Circle (390) on Reply Card

Air-flow-sensing switches

Warren G-V has introduced the models FS and LS air-flow-sensing switches. The switches detect the presence or absence of airflow, and ignore variations in ambient temperatures. The LS is designed to withstand shock and vibration; the FS is UL-recognized for less jarring commercial and industrial applications. Contact arrangements are SPST and can be normally open or normally closed. Normal indicates the switch's contact position when unenergized, or energized with satisfactory airflow. When in use, switch contacts remain in an unoperated position when the airflow is normal. When the airflow stops or falls to low levels, the switches still function and actuate alarm or control circuits. The switches have apertures in their shells through which controlled amounts of air are allowed to pass and cool the thermal actuating strut. Insufficient airflow makes the strut heat and expand, causing the contacts to operate. The switches are self-contained units requiring no complementary circuitry. They can be supplied for operating voltage of 5V to 115V, either ac or dc. The contacts can handle resistive loads of 2A up to 115Fac and 1A up to 28Vdc.

Circle (391) on Reply Card

Anti-aliased fonts and camera

Thomson-CSF has introduced the following products:

- The full-definition, anti-aliased, foundry-based fonts for the Vidifont Graphics V/Viditext II integrated graphics system. Complementing these fonts is the downstream keyer offering 16-level interplane keying between internal text and background planes, the GraphicStore Paint and Library system and external or program video. The keyer provides an anti-aliased keying technique that mixes electronically generated graphics with external video.
- The TTV 1530 ⅔-inch studio/OB cameras are designed to take advantage of the smaller ⅔-inch format to offer a camera head that is smaller, lighter and more maneuverable than 1-inch or 1¼-inch models. A full bandwidth RGB triax system allows the images produced by the camera to be processed in RGB or component form directly.

Circle (369) on Reply Card

Multitrack recording console

Trident Audio USA has announced the Trident 24 multitrack recording console. It is available in 28- and 36-input frames with 24 discrete output buses with 24-track monitoring and metering. The console features separate mic and line inputs with phase reversal, 4-band EQ with variable high-pass filter, eight auxiliary sends, auto muting, solo in place, monitor fader reverse, direct outputs and four echo returns.

Circle (370) on Reply Card

Radio production console

Wheatstone has announced the SP-6 radio production console. It features stereo and mono input modules with machine

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control and remote on/off capabilities as well as control room and studio muting and tally system. It is available in 4- or 8-track configurations and can mix down to stereo and composite mono. It also features four auxiliary send buses, equalization, clocks, timers and tape recorder controls. The console is available in any configuration from 4- to 56-input channels.

Circle (371) on Reply Card

Videodisc subsystem

TECSTOR has announced the DVD 125/601 digital videodisc subsystem. The system incorporates DIMS 500X disk drives and the DVC 125 or 601 digital video controller. The system records and plays back in real time up to 30 seconds of digital video sequences at broadcast frequencies. It is offered as a plug and play subsystem.

Circle (372) on Reply Card

Test meter

Sencore Electronics has announced the LC76 PORTA Z meter. It checks all the parameters of a capacitor under dynamic operating conditions, including: capacitor value, leakage, dielectric absorption and ESR. The meter also dynamically tests capacitors for leakage at their working voltage. The meter performs an inductance value and ringing test on inductors. The meter also performs all the tests on both capacitors and inductors at the push of a button. The meter is a portable, battery-operated unit and provides 16 leakage voltage ranges from 1.5V to 1,000Vdc.

Circle (373) on Reply Card

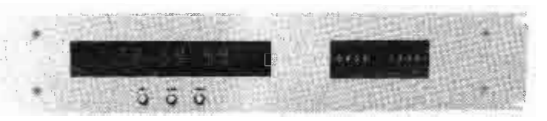
Mixer and recorders

Tascam has introduced the following products:

• The ATR-80/24 24-track 2-inch multitrack recorder features contourless synch and repro heads and bulletproof power supply. A 4-bit microprocessor and 8-bit D/A converter control system provide seamless punch in/out. The recorder accommodates 14-inch reels and offers fast wind speeds of up to 375ips. The reel motors and the PLL capstan motors use Samarium cobalt to reduce mass and produce higher torque. Additional features include: protection circuitry, and a backup memory for tape time, pitch control and amplifier mode settings.

Perfect Timing

PROGRAMMABLE CLOCKS



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One or Two Events,
Thumbwheel Programming
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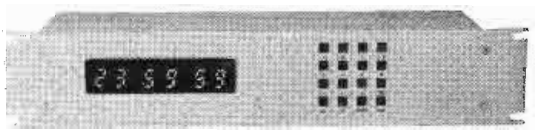

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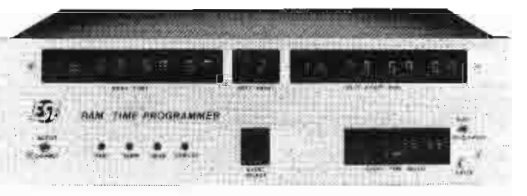

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It's the first portable with true "Hard" camera performance. Because it has F1.2 optics, a 60dB S/N ratio, and digital zonal registration. Yet it's so light, so balanced, so thoughtfully designed, that it's a superb "Soft" camera too.

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Otari's compact EC-201 SMPTE/EBU time-code reader is a natural for field or studio operation, and it costs only $495. It offers 1/20 to 60X playspeed reading, 40 hour continuous use on battery power, and reshaping circuitry on the loop output.

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Contact Otari at (415) 592-8311 for your nearest dealer. From Otari: Technology You Can Trust. Otari Corporation, 2 Davis Drive, Belmont, CA 94002.

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DYNAIR SYSTEM 21 ROUTING SWITCHER. Frames, Modules, Power Supplies, Controllers, Cables. Wired 100 by 90 Video, stuffed 50 by 60, wired 200 by 50 Audio, stuffed 70 by 50. Will piece out or divide. Call for complete list and details. Steve McNeal, 817-267-4211 or 267-4717. 8-87-3t

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TELEVISION ENGINEER: Technical maintenance and operation of professional broadcast video and audio equipment in our Corporate production facilities, as well as on location assignments. Requires minimum of 2 years basic electronic theory and troubleshooting training with additional 3 to 5 years experience in broadcast television environment. Operational and maintenance experience with equipment utilizing digital control techniques would be advantageous. Our equipment complement includes: Sony BVH-1100A, Ampex VPR-3 VTR's; Grass Valley 100 and 1600-1L, Ampex AVC production switchers; Ampex ADO, Abekas A53 digital effects; Utah Scientific router and machine control; Ikegami, Tektronix monitoring and test equipment; Orion, Ramsa, Cetec audio mixers; MCI, Ampex, Tascam, Otari ATR's; Phillips, CEI, Sony color cameras. Competitive salary and excellent benefit package. Send resume to: Ita Lauher, Sr. Employment Representative, State Farm Insurance Companies, One State Farm Plaza, Bloomington, IL 61710. Equal Opportunity Employer. 10-87-1t

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MAINTENANCE ENGINEER: A National TV Network is looking for a Maintenance Engineer with 2 years minimum experience in the maintenance and repair, at a component level, in state of the art equipment. College degree, SBE certification, and FCC license preferred. Bilingual is a good plus. Send Resume to: Univision, 27632 El Lazo Rd., Laguna Niguel, CA 92677. Atten: Jose Boveda. 10-87-1t

DEEP SOUTH station looking for Assistance Chief Engineer. Must have minimum of 3 years experience in television broadcasting and management experience. Send resume to Broadcast Engineering, P.O. Box 12901, Dept. 658, Overland Park, KS 66212. EOE, M/F. 10-87-1t

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There are a few things that don't come with the Type II bulk tape eraser.

Use your old bulk eraser on 1500 Oe metal particle video tape and you'll be seeing a lot of them.

Picture Jitter
A poorly erased control track leaves pulses that, when combined with new pulses, confuse the servo system in your video recorder. This gives your video image the shakes.

Whumping
When not completely erased, the audio track can retain a repetitious whumping caused by residual signals. This will contaminate your next recording.

WHUMP
WHUMP
WHUMP

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Tape eraser field strengths may drop near the center of the tape and fail to completely erase the video track. This means the previously recorded video will cause dual imaging and come back to haunt you.

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It is very difficult for a recorder to interpret time codes on poorly erased tape. Don't miss your cue.

:07

The Type II bulk eraser eliminates picture jitter, whumping, miscuing, and ghosting. And it's fully automated to assure uniform erasure conditions for field strength, orientation, and exposure time, without heating the tape.

The Type II actually erases 1500 Oe metal particle video tape more than -80dB. Far beyond manufacturers' specifications for rerecording integrity.

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• The M-600 series of modular mixers are available with either balanced stereo or mono input channels and 16- or 32-channel monitoring. The monitor system handles 16-track, 24-track, 32-track or two interlocked 16-track recorders. The monitor channels feature balanced line-level inputs, EQ and aux systems.

• The LV-200A laser videodisc recorder records and plays back up to two hours of program material or 108,000 still frames on a single 30cm laser videodisc. The recorder offers inputs for a video camera, an industrial VTR and two channels of audio and provides time base correction for VHS, Beta and 8mm VCR formats. An 8-bit program memory is built in. An RS-232C interface enables the recorder to be controlled by an external computer.

Circle (374) on Reply Card

Wriststraps and desolder braid

Solder Absorbing Technology has introduced the following products:

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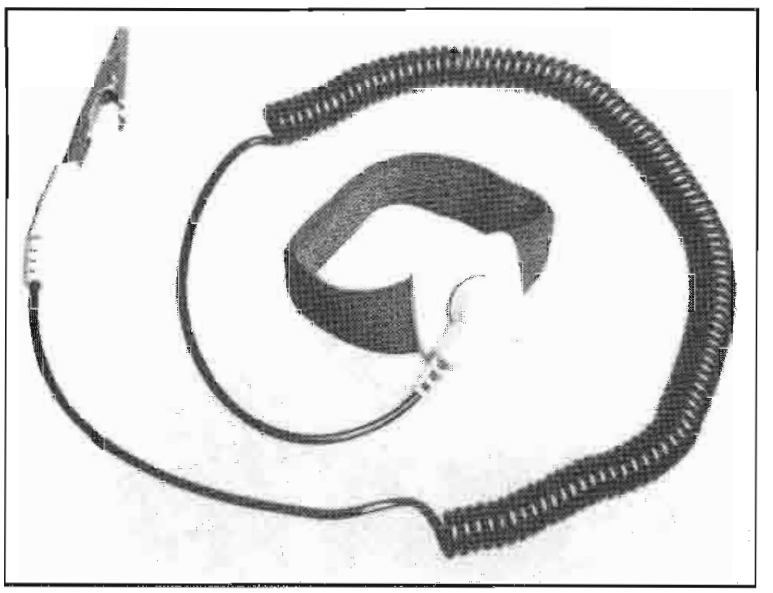

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Machine control interface

Vid Video has introduced the Translator I. It provides remote control of JVC, Panasonic and Sony Broadcast VTRs, using the Sony RM-440 edit controller. The unit makes a BR-8600, AG500, or Betacam deck look just like a Sony VO-5850, providing full editing commands, shuttle control and CTL output. By connecting to an RM-440, full editing can be accomplished from VHS to U-matic formats, U-matic to Betacam or any other combination. The unit installs between the edit controller and VTR, plugging in with no modifications required. It comes with on cable assembly.

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1. IMPORTANT: Do you wish to receive/continue to receive BROADCAST ENGINEERING FREE?
   ☐ Yes ☐ No

Your signature is required Date

Please print or type:

Name _____

Title _____

Organization or firm _____

Street or box _____

City _____ State _____ Zip _____

Phone ( ) _____

SAVE TIME: Use peel-off address label for faster service.

2. Please check the ONE type of facility or operation that best describes your business classification:
   19 ☐ Low Power TV Station
   20 ☐ TV Station
   21 ☐ AM Station
   22 ☐ FM Station
   23 ☐ AM & FM Station
   24 ☐ TV & AM Station
   25 ☐ TV & FM Station
   26 ☐ TV, AM & FM Station
   27 ☐ CATV Facility
   28 ☐ Non-Broadcast TV including Closed Circuit TV (CCTV)
   29 ☐ Recording Studio
   30 ☐ Teleproduction Facility
   31 ☐ Microwave, Relay Station or Satellite Company
   32 ☐ Government
   33 ☐ Consultant (Engineering or Management)
   34 ☐ Dealer, Distributor or Manufacturer
   ☐ Other _____ (Please specify)

3. If you checked 20 through 26 above, which of the following best describes your over-the-air station: (Check only one.)
   A ☐ Commercial
   B ☐ Educational
   C ☐ Religious
   D ☐ Campus Low Frequency
   E ☐ Community
   F ☐ Municipally Owned

4. Check the category that best describes your title: (Check only one.)
   A ☐ Company Management—Chairman of the Board, President, Owner, Partner, Director, Vice President, General Manager (other than in charge of Engineering or Station Operations Management) and other Corporate and Financial Officials
   B ☐ Technical Management & Engineering—Technical Director or Manager, Chief Engineer, Other Engineering or Technical Titles
   C ☐ Operations & Station Management/Production & Programming—VP Operations, Operation Manager/Director, Station Manager, Production Manager, Program Manager, News Director and other Operations Titles
   D ☐ Other. Specify _____

5. IMPORTANT: Check the statement that best describes your role in the purchase of major communication equipment components and accessories.
   ☐ Make final decision to buy a specific make or model
   ☐ Recommend make or model to be purchased
   ☐ Have no part in specifying or buying

SEND ME MORE INFORMATION about products or services I have circled.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192
193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224
225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256
257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288
289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
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481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512
513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544
545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576
577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608

RT7

FOR FASTER ACTION!!!

I have an immediate interest in the items I've indicated here. Please have a sales person call me.

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PLACE
FIRST CLASS
POSTAGE
HERE

Which one advertisement in this issue was of most interest to you?

Advertiser's Name _____ Circle No. _____

Comments on this issue:

BROADCAST engineering

P.O. Box 12902
Overland Park, KS 66212-0902

PLACE
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Circle (2) on Reply Card

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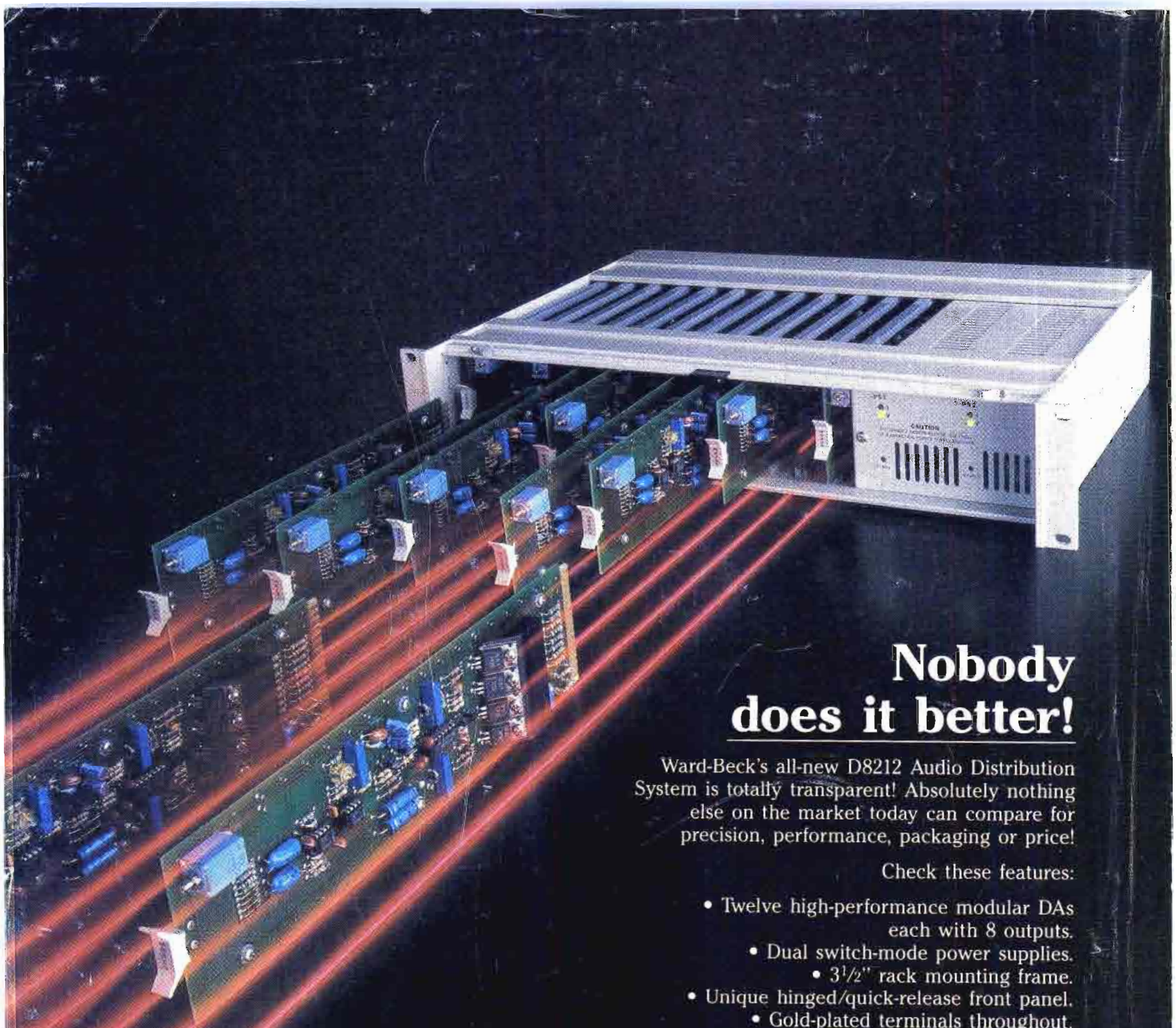

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