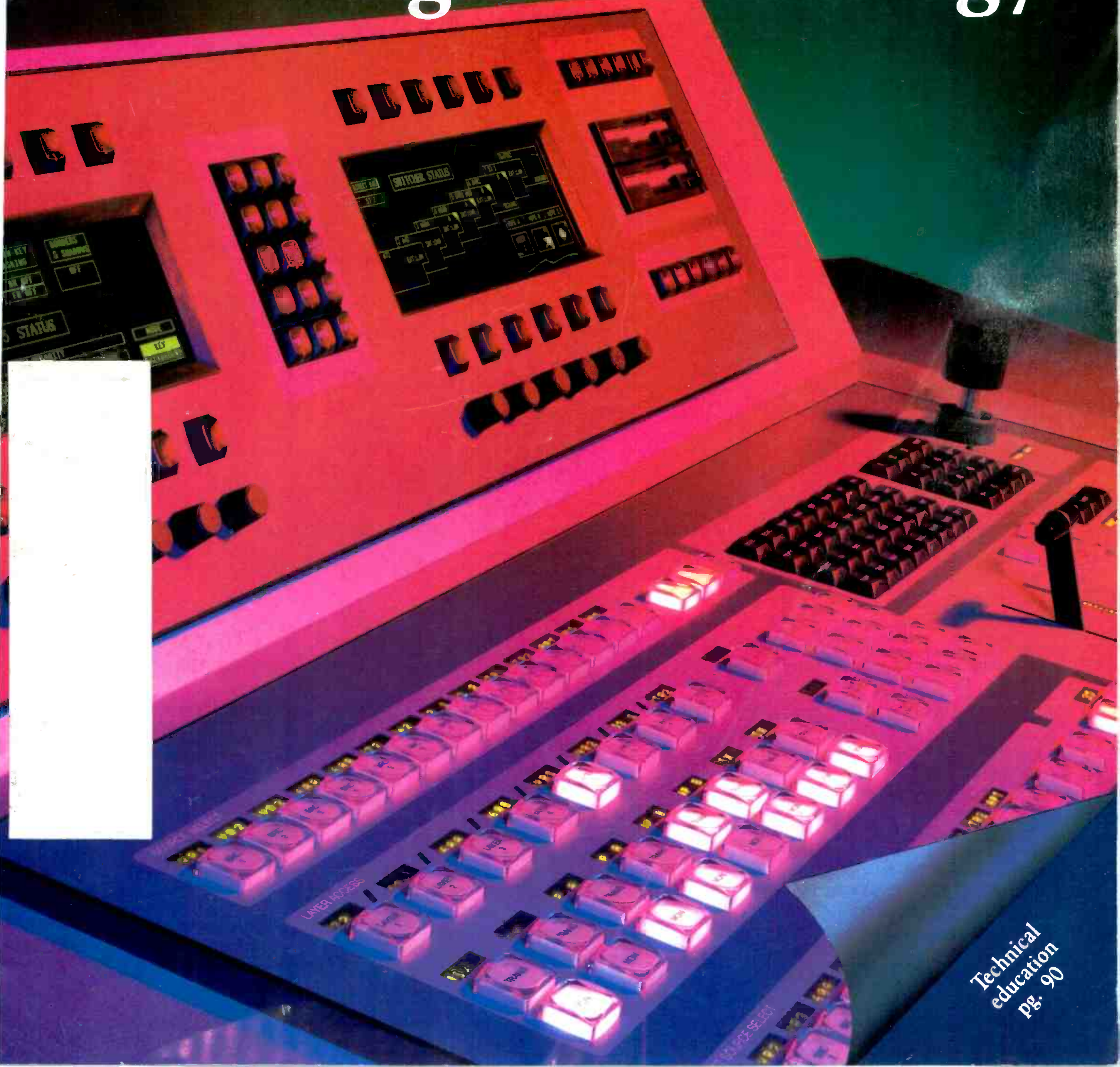
BROADCAST ENGINEERING®

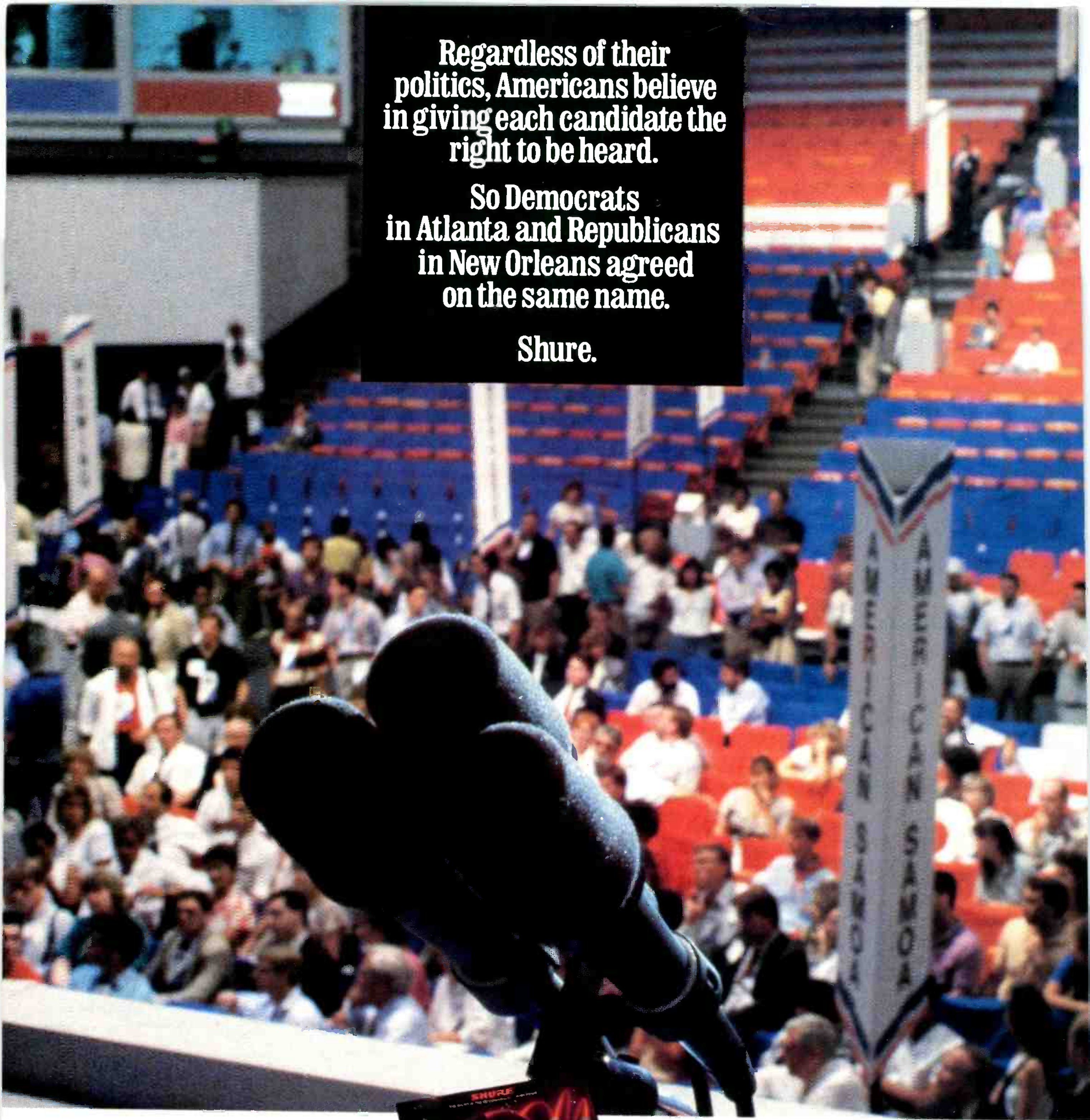
AN INTERTEC PUBLICATION

February 1989/$3

Dealing with digital technology



Technical education pg. 90



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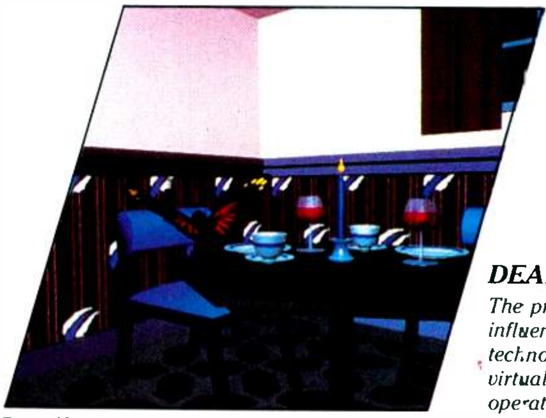

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BROADCAST engineering

DEALING WITH DIGITAL TECHNOLOGY:

The products available to radio and TV stations today are influenced in large part by advancements in digital technology. Computer-based hardware has found its way into virtually every area of broadcast and post-production operations — from cameras and audio consoles to transmitters and test equipment. This month, we take a look at some areas of recent development in the application of digital hardware. The following package of articles includes:

OTHER FEATURES:

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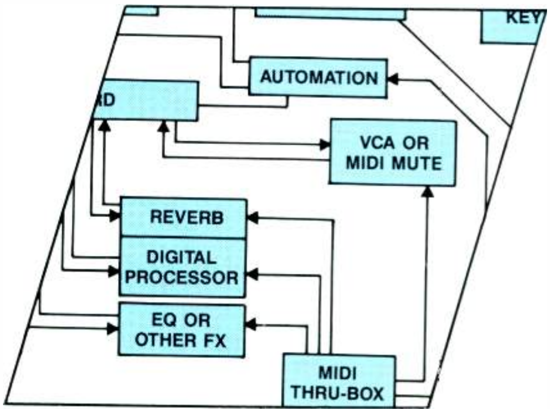

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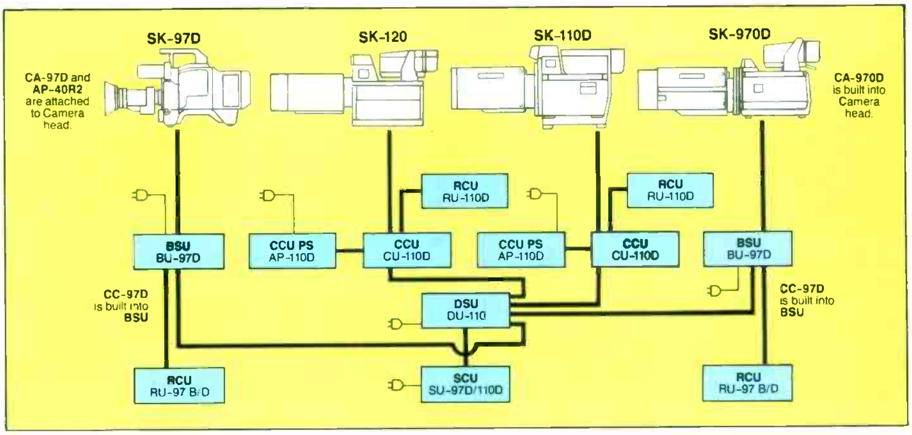
ON THE COVER

Digital technology has revolutionized the broadcast industry. The impact of computer-based systems has been felt in radio and TV stations alike. Our cover this month symbolizes the move toward the digital studio. Shown is a digital video switcher (the Abekas A84). Photo courtesy of Abekas Video Systems.

DEPARTMENTS

PROBLEM SOLVERS

How to get perfect camera setups in three minutes—with a single camera or up to 42 cameras. That's right, 42.



How Hitachi's SU-97D Auto Setup Control achieves simultaneous setups on four different camera models. System can expand to set up and control 42 cameras.

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Rear panel on Hitachi's SK-970D camera. Complete controls for automatic setup and camera operation.

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NAB approves FCC's AM technical revisions

The National Association of Broadcasters (NAB) supports the efforts of the Federal Communications Commission (FCC) to improve the technical basis of AM broadcasting, which would prevent future increases in AM interference.

The FCC's proposals consist of four items:

- Improved accuracy in the commission's groundwave and skywave propagation curves.
- Improved methods of calibrating groundwave propagation calculation methods.
- Use of a 25% exclusion principle that includes appropriately weighted adjacent-channel contributors.
- Removal of certain minimum power and city coverage requirements for Class II-S and Class III-S AM stations.

In a filing at the FCC, the NAB urged the commission to implement the proposals collectively rather than on an individual basis. The NAB also asked the agency to begin a rulemaking proceeding to establish a revised first adjacent-channel protection ratio before adopting its proposals.

SBE announces call for papers

Abstracts are now being accepted for proposed engineering papers for the 1989 **Broadcast Engineering** conference of the Society of Broadcast Engineers (SBE) national convention, Oct. 5-8, in Kansas City, MO. The technical conference will address the needs of engineers and technical managers at radio and TV stations. Sessions are being organized again by John Battison, known for his work at the annual WOSU seminars.

The deadline for submitting outlines is March 31. Those interested in participating in a panel discussion or serving in another capacity should send a letter to Battison. Only written requests will be honored.

The SBE again will publish the "Proceedings," which will be available at the convention. Authors should be prepared to submit a camera-ready manuscript by June 30. For more information, contact: John Battison, Conference Chairman, 2684 State Route 60, RD #1, Loudonville, OH 44842.

SMPTE: What's new in fiber optics?

The Society of Motion Picture and Television Engineers (SMPTE) Committee on New Television Technology will inform its membership on applications of fiber-optic transmission technology — in particular, analog HDTV, high-speed digital and high-resolution graphics — based on the findings of a new study group.

C. Robert Paulson, Artel Communications Corporation, is chairman of the study group. Participation in the group is open

Continued on page 102

BROADCAST ENGINEERING

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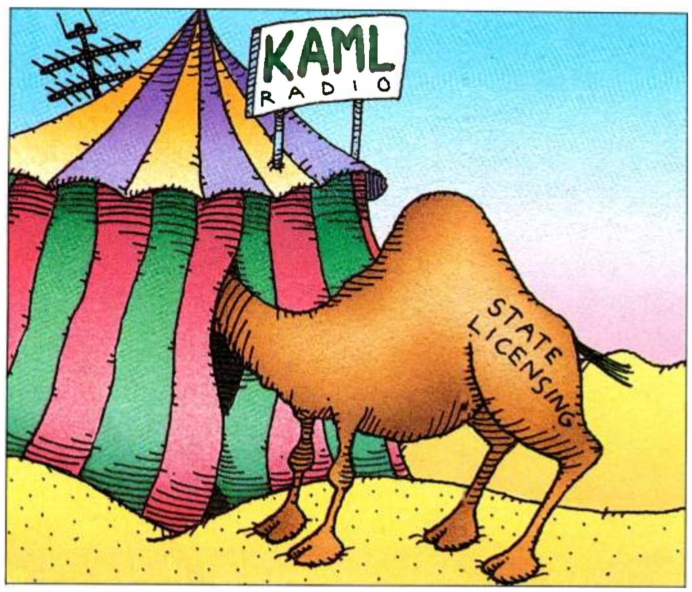
"We're just here to help"

A guest editorial



The licensing of broadcast engineers has stirred up a lot of controversy recently. Didn't the FCC deregulate that area more than five years ago? Now, however, it's not the commission that appears interested in requiring you to have a license. It's your state government.

Any attempt by states to regulate or license broadcast engineers is nothing less than a back-door attempt to obtain a measure of control over an industry that is not otherwise within state jurisdiction. Allowing individual states to establish licensing standards for broadcast engineers would create a chaotic, haphazard and conflicting series of regulations. For instance, would each state recognize the licensing of other states? If one state had a more lenient policy than the others, would broadcast engineers be tempted to apply there, rather than in their home states? If cross-licensing were not approved, how many state licenses might you be required to hold? Imagine having to obtain a driver's license for each state you wanted to drive through.

Will the proposed legislation be limited to broadcasting? Or would cable, teleproduction, industrial and educational activity be included? If such a ridiculous concept is implemented, couldn't it be expanded to include the professional licensing of general managers, camera operators, computer operators or even news anchors? After all, news anchors establish public opinion. Shouldn't they be licensed and insured to make certain that their stories are unbiased? Then there are the equipment sales representatives. We all know that they promote technical equipment and, on occasion, demonstrate and operate the equipment.

There is an Arabian proverb that seems appropriate: "If the camel once gets his nose in the tent, his body will follow." If the door of regulation is opened a crack, it eventually will be forced open wider, permitting regulation in areas never envisioned.

Who's pushing the concept of state licensing? Usually an issue such as this arises when a competing group perceives an opportunity to profit either financially or politically from the change. It's possible that an individual or organization has convinced a member of a particular state legislature that licensing broadcast engineers could generate additional revenue for the state's coffers.

The SBE must take an aggressive stance with the certification program. Each state considering the licensing of broadcast engineers should be notified that an adequate national certification program exists. States must understand that further legislation and regulation would serve only to harm the broadcast industry.

Anyone who thinks that state agencies are better qualified than the SBE to evaluate broadcast engineers is greatly mistaken. When was the last time you saw state or federal regulators do anything better, or cheaper, than it could be done in the private sector? The SBE certification is already in place and operating. Let's not waste time and taxpayers' money trying to reinvent the wheel. Let's allow the SBE to handle broadcast engineer certification, and let's prevent state licensing of broadcast engineers.

William B. Martin
President, Martin Communications
Osage Beach, MO

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Circle (6) on Reply Card

Protect your station from PCB problems

By Harry C. Martin

Polychlorinated biphenyls (PCBs) are common in the power transformers of broadcast transmitters and other electronic components manufactured before 1978. As the result of findings that PCBs are highly toxic, Congress directed the Environmental Protection Agency (EPA) in 1976 to take steps to regulate their use and disposal. Broadcasters must be aware of their responsibilities under the EPA regulations. Following is a brief overview.

The EPA's rules set forth procedures to be followed regarding the marketing of PCB items, registrations, leaks, disposal, storage and recordkeeping. Violation of these rules may result in criminal prosecution and large fines.

The most stringent regulations apply to PCB transformers, which are defined as those containing at least 500 parts per million of PCBs. Such PCB transformers:

• May not be used in any way that poses a risk of exposure to food or feed.
• May not be moved to a location in or near a commercial building.
• Must be registered with the local fire department.
• Must be registered with the owner of the building in which the transformer is located and any buildings within 30m of that transformer.
• Must be marked with labels that meet specific design requirements set by the EPA. Labels are commercially available in the various sizes required.
• Must not be stored with combustibles that are less than 5m from the transformer or its enclosure.
• Must be inspected every three months. No two inspections should be less than 30 days apart. Make a log of each inspection and maintenance action, and keep it for three years.

If a PCB transformer:

• *Leaks:* Contain the leak immediately, make daily inspections until it is repaired and begin cleanup as soon as possible. Under no circumstances should cleanup begin more than 48 hours after the leak is discovered.
• *Is involved in a fire-related incident:* Immediately notify the National Response Center (1-800-424-8802) and your local fire department of the situation. Take all possible measures to protect the water supply from contamination.
• *Is to be disposed of:* PCB transformers and contaminated items must be disposed of in a manner approved by the EPA. In general, liquids and capacitors containing PCBs must be incinerated properly by a licensed facility. Discarded transformers and other PCB articles must be disposed of at an EPA-approved chemical waste landfill. Transportation of PCBs to storage or a disposal site must be licensed in advance and should, under most circumstances, be contracted out to a third party who has the expertise to cope with the contaminated articles under federal and state regulations.

PCBs also may be contained in other electrical components of a transmitter. These components are subject to many of the same regulations regarding marketing, disposal, registration, resale and cleanup.

The "Superfund" law, which provides money for the cleanup of toxic spills and also provides for the recovery of costs from those responsible for the spill, may have a direct impact on stations that have disposed of PCB items or are planning to.

The law says that anyone associated with an eventual spill can be held responsible. This includes owners and operators of a site that requires cleanup, previous owners and operators of the site, anyone who ever has arranged to have waste disposed of at the site in question, and any party involved in the transportation of hazardous materials to the site. Because of these provisions, it is crucial that a station research its waste-disposal procedures carefully to ensure that there is no PCB contamination at the disposal site it is using and that the site is otherwise properly managed.

If you currently are involved in the purchase of a station that may have PCB equipment on the premises, it is important that you make a careful check of the grounds and equipment before committing to the sale. Such an examination might include soil testing, examination of all pre-1980 equipment, a review of the maintenance logs for that equipment and a thorough search for possible past abuses involving toxic substances on the property. If possible, include a clause in the sales agreement that exonerates you from any future PCB-related problems.

In all cases, careful compliance with the rules and meticulous documentation of all inspections, disposal and research concerning possible toxic materials at your station are the best lines of defense against legal action by the government or private parties.

24-hour ban on indecent broadcasts

In response to a law passed by Congress last fall, the commission has extended its ban on the broadcast of "indecent" material to all hours of the day. Previously, the commission's policy had been to restrict broadcasts of indecent material to times when children were not likely to be in the audience. This so-called safe harbor period had been defined in various FCC enforcement actions as the period between midnight and 6 a.m.

The commission's definition of indecency, which has withstood court scrutiny, is "language or material that, in context, depicts or describes in terms patently offensive, as measured by contemporary community standards for the broadcast medium, sexual or excretory activities or organs."

The new law, as well as the regulations implementing it, are being challenged in court on First Amendment grounds.

Anti-trafficking status quo

The commission has denied the requests of several public interest groups for review of its decision not to reinstate rules that restricted station sales and resales.

These "anti-trafficking" rules generally required a 3-year holding period between sales of a station and did not permit resale for a profit during that time. The rules were eliminated in 1982, but their reinstatement was debated widely by congressional committees and other policymakers during the mid-1980s, particularly after the Metromedia leveraged buyout and other station resale transactions. No consensus ever developed on reinstating the rules, however.

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

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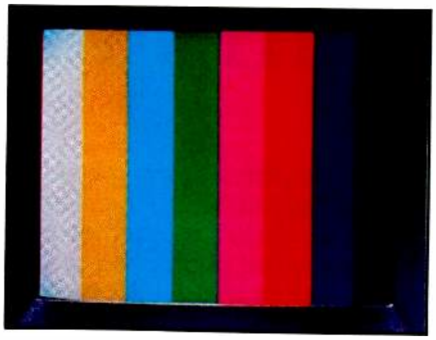

A new beginning for HDTV?

By Rick Lehtinen, TV technical editor

One of the first rules of digital encoding is that you have to use enough samples to do the job. Use any less than a prescribed number, and you introduce errors. But there is nothing that says you can't take all the samples you need and write them in shorthand. Do this, and suddenly you open up tremendous potential for terrestrial TV transmission.

Genesys

One system that does just that is the Genesys system, from Production Services Inc. (PSI), Tucson, AZ. The system can encode a 3MHz auxiliary video signal over an existing 6MHz signal, apparently without disturbing or causing artifacts in the original signal. Developers hope that future incarnations will put a full-bandwidth (30MHz) HDTV signal, or several NTSC signals, and a multitude of top-quality audio channels over an existing NTSC signal without any serious modification to the signal system, switchers or transmitter in a TV station. (The TV transmitter should use IF modulation.) If you think these claims seem sort of incredible, that's natural. Keep an open mind, and read on.

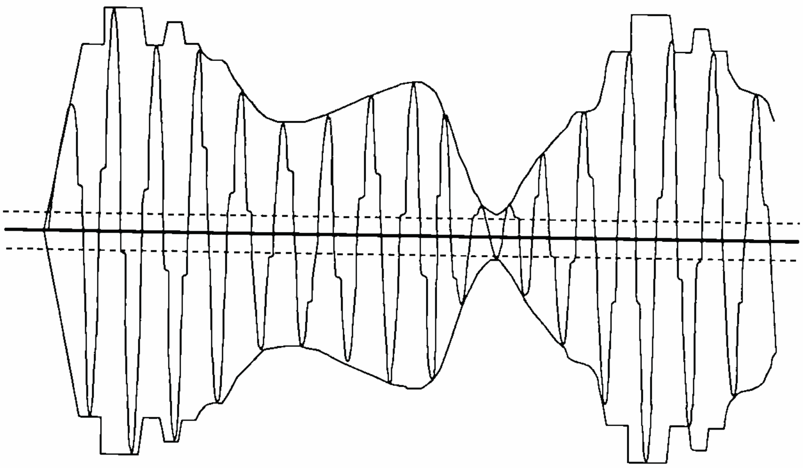

Figure 2. Genesys carrier wave is modulated in normal fashion, in IF-modulated TV transmitters.

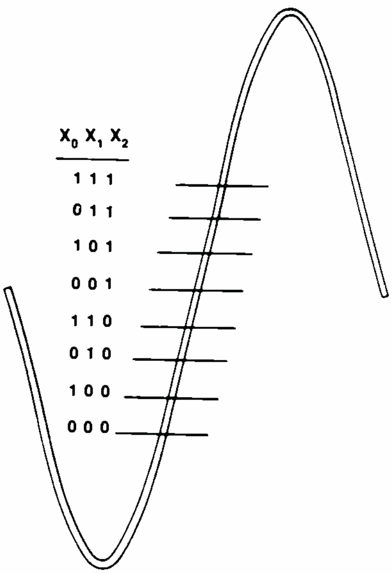

Figure 1. Position of Genesys "bump" on carrier wave conveys three bits. Both rising and falling slopes are used, yielding six bits per cycle.

Modulation

Historically, a waveform has been modulated by varying its frequency, phase or amplitude. Some waves, such as the color subcarrier signal, were modulated in more ways than one (phase for hue, amplitude for saturation). We generally assume the modulated wave, or carrier, is a sinusoid. It needn't be, however, and by modulating the shape of the carrier wave, we can achieve an additional form of modulation, waveform modulation.

In the Genesys system, the transmitted carrier is given inflections, or bumps, on the rising and falling slope of each cycle. Other parts of the wave are modified to keep its "harmonic signature" (Fourier constituent waves) and rms value close to that of a sinusoid. The position of these bumps conveys six digital (not binary) bits each cycle (see Figure 1). The result is a funny-looking carrier wave that does everything it's supposed to, plus carries extra information.

Extra bits

Of course, six bits doesn't go too far in the binary world. The real power of the Genesys system lies in its ability to tightly compress data into those six non-binary bits. The textbook name for the encoding process is adaptive delta modulation. In Genesys, digital words can be delta or binary, depending on which will resolve the fastest. This "digital shorthand" increases Genesys throughput.

Transmitted Genesys

Most IF-modulated TV transmitters mix a fixed IF of about 45MHz with whatever local oscillator frequency will add up to the transmitter's assigned output frequency. Genesys premodulates this IF (see Figure 2). Modulation circuitry is common, inexpensive and straightforward.

Receiver compatibility

Receiver compatibility is a key to upgrading the broadcast system. Proponents say Genesys is extremely compatible, because the TV carrier frequency, waveform-modulated or not, is rejected during detection. Genesys encoding, therefore, should be transparent to viewers who don't need it, but allow viewers so equipped to receive whatever kind of HDTV eventually is selected. (Genesys is an open system.) If successful, such an approach would solve many HDTV compatibility problems.

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Circle (8) on Reply Card

Some thoughts about the "good old days"

By John Battison, P.E.

I was involved recently with several AM stations suffering from the ravages of age. Some of these stations were staffed by young station engineers. While working with these capable fellows, I was struck by the contrast between their experience and what was typical many years ago. The comparison leads me to reminisce about some of the changes that have taken place in broadcast engineering training.

Trained engineers

I joined the radio ranks at KMBC-AM (and later, FM) in Kansas City, MO, in 1945. The 5kW station employed several engineers, an RF chief (Ray Moler) and a studio chief (Kenny Krahl). I've forgotten how many audio and RF technicians were employed. In those days, someone had to be on duty at the transmitter at all times. The 30-minute intervals between meter readings required a fairly large number of engineers.

Both chief engineers had been with the station for many years and grew up in the business. Some of the transmitter engineers used their time on duty to improve their technical skills. In fact, many of the men obtained undergraduate degrees while employed at the station. At least one went on to gain a Ph.D.

Learning from others

For me, working under Kenny and Ray was a wonderfully inspiring and instructional introduction to radio engineering. In those days, our work *was* engineering because we were developing technology through everyday operating practice. Solutions to problems that are today covered in textbooks or in technical and manufacturer's literature were not as well-known then. In many cases, the station engineer was forced to find solutions that had not yet been published.

New broadcast technology was being discovered almost daily. High-band FM broadcasting was commencing. Engineers were faced with working not in the 550kHz to 1,600kHz band, but with high frequencies such as 40MHz or even 100MHz. Unexpected oscillations in the PA stages began to occur. Plumbing took the place of nice, convenient coils of wire and direct, simple wire leads. Even when a station bought a new FM transmitter, there was no guarantee that it would work consistently.

I consider myself fortunate to have known such greats as C.M. Jansky, Stewart Baily, Harraden Pratt, George Baily, George Brown, Alan DuMont, Major Armstrong, Commissioner George Stirling and Peter Goldmark. The work of these and other talented individuals made lasting impressions on the radio broadcast engineering profession.

All these men were graduate engineers, holding influential positions in their companies. Few of the old-time greats are working in this industry today. Their places were taken by the youngsters who entered the field in the post-World War II years. This second generation also made its mark on a profession that has more than doubled its rate of growth and technical change every decade or so. The second-generation engineers now have retired or are nearing their time to do so.

Changing regulations

Today's technical and regulatory environment is greatly different from the one faced by the original broadcast engineers. In many cases, new rules represent a lowering of technical standards. Equipment became more reliable, and FCC rules allowed announcers to become *engineers* overnight. New technology made it possible for management to remove many of the safeguards that were required in past years.

Today's technicians learn quickly, are smarter and know more than we old-timers about current equipment. On the other hand, many of these people are less familiar with certain types of broadcast technology. Some of them have never had the opportunity to be trained on equipment by a person thoroughly familiar with its operations.

Proper terminology

You may have noticed my use of the term "technician." I use it to indicate a technical expert. There is continuing discussion and debate within the industry about the use of the term "engineer" to describe someone who is not registered as a professional engineer. The first-class license never bestowed the title of engineer on its holder. No FCC license ever has.

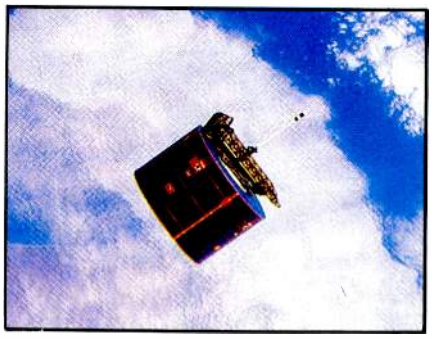
The engineer appellation has been expanded so much over the years that it has almost lost its meaning. Today we classify garbage collectors as sanitary engineers. Janitors who look after the steam-heating systems are called steam or stationary engineers. Do you really think that the title engineer means much any more? The term technician is growing in usage and application. To my mind, it is an honorable and descriptive term, which is applied increasingly to top professionals in both engineering and medicine. However, we seem to be caught up in a barrage of words about what engineer means.

In fact, the argument has been going on for so long that some of us have forgotten when it started. When I edited the "Journal of the Society of Broadcast Engineers" in the mid-1960s, most issues contained articles or correspondence from members on this topic. (Editor's note: John Battison is the founder and first president of the SBE.)

Nothing was resolved then, and it still isn't today. Now, however, some states seem to be trying to take over jurisdiction of technical workers in the broadcast field. It behooves the SBE to continue its ongoing and strenuous efforts to obtain national recognition of SBE certification as a mark of accomplishment. Under the great leadership of Jim Wulliman and the past SBE presidents, the certification work has continued and prospered. Don't forget that he still needs all the support and encouragement we can provide.

Perhaps now is the time for the SBE to consider establishing a contract engineer certification program. Would the professional certification program suffice? I welcome your comments.

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



Spread spectrum technology

By Elmer Smalling III

Spread spectrum modulation techniques are becoming popular for satellite and terrestrial communications. *Very small aperture terminal* (VSAT) satellite communications, by which hundreds of asynchronous users share a single transponder, is a logical use of this new technology.

Because *spread spectrum multiple access* (SSMA) communications systems use extremely large bandwidths, they are tolerant of interference. So tolerant, in fact, that a multitude of users can occupy a single channel simultaneously, relying on digital communications techniques and error-correcting codes to sort things out.

CDMA

One spread spectrum technique, which uses an addressing system, is *code division multiple access* (CDMA). This means that the characteristic that separates one signal from all others is not time, as in *time domain multiple access* (TDMA) or frequency, as in *frequency domain multiple access* (FDMA); rather, it is a data address or code. FDMA is inefficient because of the waste of spectrum during periods when no information is transmitted, and TDMA is tricky to decode without using extremely accurate time standards and clocking.

CDMA encoding spreads the spectrum of a carrier because of the addition of address information. If the address is modulated directly on the carrier, the process is called DS-CDMA or direct-sequence CDMA. If the address is used to continually change the frequency of the carrier, the process is called FH-CDMA or frequency-hopped CDMA. Frequency-hopped CDMA is used primarily by the military for security reasons.

CDMA modulation is a rather simple process: The data signal or bitstream, which is the information to be transmitted, is modulated by a higher-frequency signal consisting of bits of much smaller duration (higher frequency). This higher-frequency modulating signal consists of repeating address information that is detected by the receiver as it examines the entire bandwidth of the CDMA channel.

Because it is many times higher in frequency, the address information will determine the bandwidth required for the channel. Let's say you have a data signal that you wish to feed over a transponder whose center frequency is 4,020MHz. This transponder has a usable bandwidth of 30MHz. Your data signal would be modulated by a 30MHz address signal for transmission.

This signal, in its most basic form (not including error checking or special address routines), is a 30MHz datastream with the address of your station repeating continuously. The bits that form the high-frequency address signal are called chips. In the most common type of spread spectrum modulation, one databit takes the time of eight address chips. If you could listen to the received signal using a filter to eliminate the FSK data information, you would hear a cacophony of address signals.

Front-end computers and processors have the task of picking out the correct address by matching one in file and keeping the appropriate data signal in coherence. This gets trickier for the front-end processor as more signals are added, and when the noise approaches symbol and crosstalk levels.

VLSI

The equipment required for CDMA signal detection is far more complicated than that used for standard frequency or time domain techniques. LSI (large-scale integration) is important for SSMA. Although the circuitry required for detection is more complicated than that used for older modes of multiple-access transmission, such circuitry can be found in a few ICs rather than on several circuit boards.

Wave of the future?

Even systems as humble as outdoor residence meter reading employ spread spectrum modulation to conserve spectrum space and circuit-power consumption. CDMA will be the predominant spread spectrum type of modulation in the future.

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

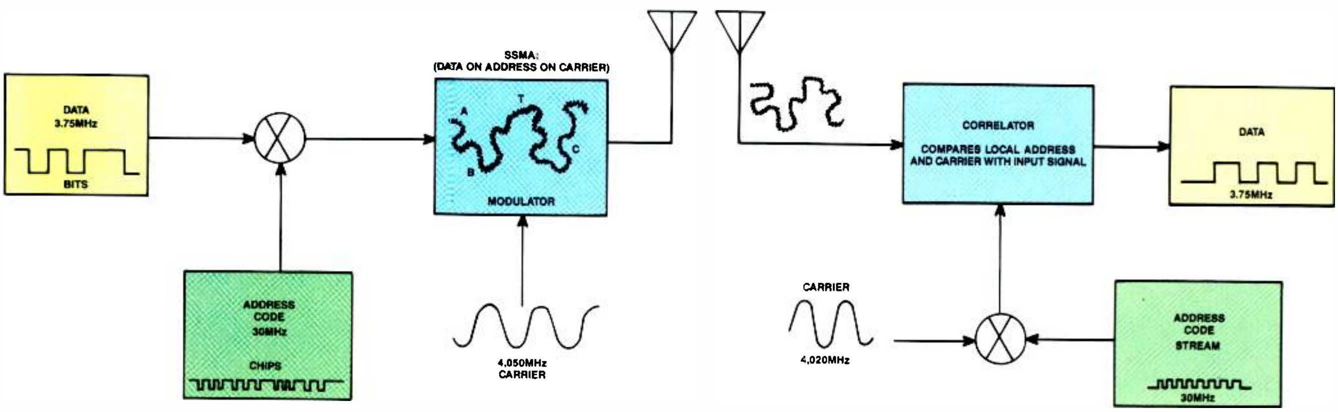
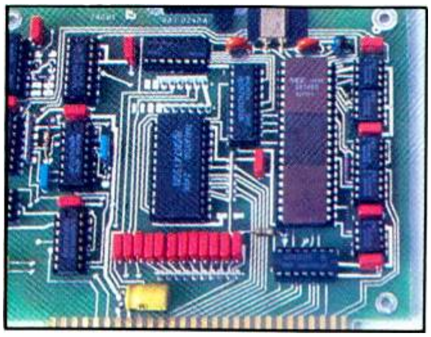


Figure 1. *A spread spectrum communication system spreads the datastream with address chips. The correlation detector recovers data at the receiver.*



Technology builds on the basic telephone

By Gerry Kaufhold II

Although radio is "wireless," broadcasters know the importance of the telephone system. For remote broadcasts, for remote control and for transmission of news script files and other data, broadcasters often depend on the phone system.

Telcos and businesses constantly are installing upgraded equipment. Fancy PBX systems that can find the least expensive path for a call, voice mail systems that distribute "audio memoranda," automatic call-in vote counters and dial-up message systems all can be useful to broadcasters. Although these new technologies bring exciting possibilities, we must not forget the basics. Let's look at the plain old telephone service (POTS).

Patch panels

Early telephone connections were hand-patched by an operator. Because the wires were open when not connected, early systems used hand-cranked electrical generators to signal operators in the Central Office. When you wanted to make a call, you turned the crank.

The operator's patch panel used connectors that had a metal tip, shielded by an insulator and surrounded by a cylindrical ring. This is where the terms *tip* and *ring* come from in broadcast patch panels.

POTS today

The receive circuit in most telephone systems is similar to the one shown in Figure 1. It works along the lines of the system just discussed. When on-hook (disconnected), the telephone draws no currents except the trickle current due to capacitor leakage.

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

A low-level ac current can be sensed by the Central Office to verify that the line is continuous. This feature was installed as a means for continuity-checking by the Central Office. When the handset is lifted off-hook (connected) a spring-loaded switch shorts the circuit, pulling enough current to energize a relay at the local Central Office.

For devices such as transmitter remote controls and studio transmitter links, the station probably pays a substantial fee to the Regional Bell Operating Company (R-BOC) for continuous-duty leased lines. These lines do not detect on- or off-hook, because they are in service around the clock (always off-hook).

Regional differences

The voltage that appears across tip and ring is typically 48Vdc, but different geographic regions have different voltage levels, and polarity might be random.

When a call is placed from the Central Office out to a subscriber, an ac voltage of 60Vrms to 90Vrms is applied at a frequency between 15Hz and 67Hz. This voltage is great enough to energize the bell (ringer) in spite of the series resistor in line with the phone line.

Regardless of local system voltage, note that each device that hangs in parallel across the incoming telephone line must not degrade the dc line impedance. If you want to measure the dc resistance across a telephone to verify that varistors or other protection devices have not shorted or become low-impedance, always disconnect the phone from the telco line. The resistance when on-hook (hung up) should be high; when off-hook, the resistance should be about 3,000.

Circuit protection

Of course, phones aren't the only devices broadcasters connect to their phone lines. When a solid-state device is being used to sense the ring signal, circuitry must be used to protect the device from transient voltages in the 300V range. The collapsing magnetic fields of electromechanical ringers connected on the line cause inductive kickback voltages to appear randomly throughout the Public Service Telephone Network (PSTN).

Another consideration when connecting equipment to the PSTN is electrostatic discharge (ESD). Because telephone lines often are strung above ground and are made of insulated conducting wire, they act as antennas for ESD and for lightning. In dry regions, it is common to find redundant overvoltage protection devices installed at the connection point to the PSTN.

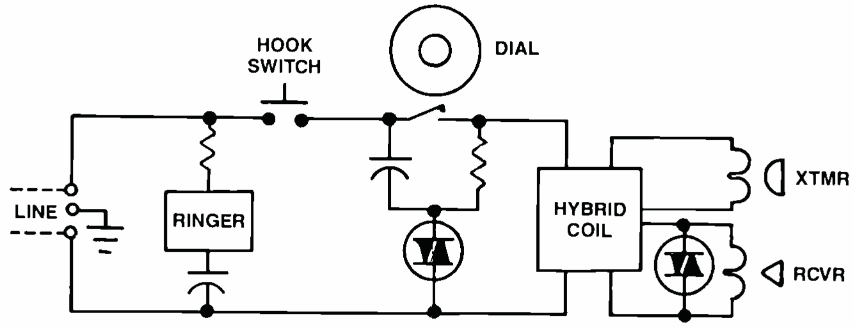


Figure 1. Basic "pots" telephone circuit.

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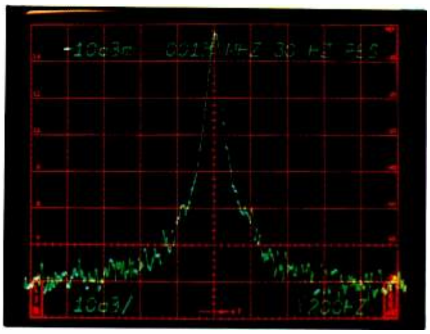

In pursuit of the elusive intermittent

By Roald Steen

Finding intermittent problems with mobile equipment is one of the toughest challenges maintenance engineers face. Consistent faults are repaired more readily. Intermittents often go unrepaired because the engineer may be unable to duplicate the field conditions that are causing the fault.

Major causes for intermittents include:

- RF noise
- Temperature
- Vibration
- Moisture
- Dirt and corrosion

Intermittents can occur in the device or in the external components, or both. Let's look at some suggested repair procedures to track down these elusive problems.

RF noise

Intermittent reception problems may be caused by the vehicle's electrical system. Today's cars and the widespread use of microprocessors and semiconductors can generate noise on many frequencies. If any of the generated frequencies fall on a receiver's tuned image or IF frequency, problems are sure to be noticed. High-amplitude noise may penetrate even the best of receiver shielding.

Electrical noise usually can be traced to two sources: the alternator or the ignition system. An open diode in the alternator system can cause extremely strong radio noise. The vehicle's engine and electrical accessories may operate almost normally despite the open diode. To verify an open diode, connect a short, insulated wire to an oscilloscope's vertical input, and hold the wire near the alternator. Look for extremely strong noise pulses when the engine is running.

The wide spectrum of frequencies that may be present in radio noise can cause unusual problems. In one instance, a unit's receiver could not be unsquelched when the vehicle was driven at certain speeds. Replacing the transceiver with a different model made by the same manufacturer solved the problem.

Steen is an electronics instructor and free-lance writer in Woodbury, MN.

Temperature

Intermittents may be caused by heat, a condition difficult to duplicate in the maintenance shop. A vehicle trunk, where radios often are mounted, may undergo enormous swings in temperature. Trunk temperatures as low as −30°F are not unusual during winter at northern latitudes. During the summer, trunk temperatures may be so high that trunk-mounted equipment are too hot to touch.

The vehicle's exhaust system can add to the heat problem. When a car is moving, exhaust system heat is exchanged with the air that flows around the vehicle. This prevents heat from the exhaust system from radiating into the trunk.

When a vehicle is stationary, the exhaust system heat rises, which can increase the temperature in the trunk. The problem usually occurs during summer when the driver idles the engine to power the air conditioner.

Vibration

Mobile radios are subjected to a wide range of vibration. Some vibration originates from the engine and changes with motor speed. Much more vibration comes from the road, ranging from violent jolts to constant rattles.

These types of intermittents are unlikely to occur when the vehicle is parked in the station parking lot. Hitting the radio (carefully) with the fist can sometimes duplicate the problem. Usually it's best to find out where the unit failed and try to drive over the same path. It sometimes takes a certain type of vibration to trigger the failure.

Never attempt to drive the vehicle while you're looking for the problem. Let someone else drive the car. This leaves you free to poke around or shake the cables as necessary to trigger the intermittent.

Moisture

Pure water is an electrical insulator. However, adding even a little dirt or corrosion changes the insulator into a conductor. In this way, moisture may cause intermittents. On a chilly morning, for example, dew may form inside the radio and on other components, causing a fault. As the air warms, the dew evaporates, and the intermittent may disappear.

Exposed components such as the antenna are especially vulnerable to moisture. Check inside the antenna mount for moisture and signs of dirt and corrosion. If the connector is corroded, replace it. Be sure any antenna connector or fitting is properly sealed against water.

In cold climates, a vehicle's roof occasionally may be covered with snow. Although snow does not conduct electricity well, it still can cause intermittents. For example, a short UHF antenna may be covered by snow for most of its length. The communication problem will disappear as the snow melts.

Dirt and corrosion

Dirt and corrosion often combine with moisture to cause intermittents. Eliminate these intermittents by thoroughly cleaning connection points and switches. Isopropyl alcohol or special cleaners can be used. Don't use cleaners that leave behind an oily residue. Such cleaners will compound your problems as the oil collects dirt and dust.

Dirt and corrosion may introduce resistance to connection points. The added resistance may not be a problem if low currents are used. However, as the current increases, so does the voltage drop. The lower voltage can cause a variety of problems within radios.

Logs

Because intermittents are sometimes difficult to identify, logs can be a great help. Keep separate logs for the vehicle and for the radio. The logs will reveal whether the problems follow the vehicle or the radio.

Log details of repairs performed. The maintenance engineer can use the logs as a troubleshooting guide. When attempting to make repairs, it's often helpful to know the unit's previous problems. Accurate records also help the maintenance engineer avoid repeating ineffective remedies.

Intermittents are a formidable repair challenge. Following the guidelines presented here can help shorten the time the unit is down. Most important, proper servicing practices can help ensure that failures do not recur.

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Part 2

Management for engineers

Management profiles and personalities

By Walter Borys Jr.

Building on last month's discussion of personalities and management style, let's look at some examples. Using these illustrations, see whether you recognize patterns in your behavior or that of your supervisor.

Different perceptions

Virtually everyone is someone's employee. We all need to ensure that the boss is happy with our performance. However, given the differences in personalities, philosophies, outlooks and values, this can be somewhat of a problem. Let's look at three people, with three different personalities, and how they might view the same problem differently.

John Laidback works in the maintenance shop and is a darned good employee. He is a crack maintenance technician, can repair a camera faster than anyone on the staff and usually ends up doing more work than the other techs. Most important, he's concerned about the quality of the station's air product. John, however, is a bit of a free spirit and a late riser. He just can't seem to make it to work on time. He doesn't consider this a big deal, and he normally works later than would be required to make up the time.

John does have a serious problem, however. His supervisor, Allen Stoneface, is a stickler for rules. He's been with the station for almost 20 years and runs his life in an orderly fashion. He arrives promptly at 8 a.m., wears sensible clothes and always brings a tuna salad sandwich, which he eats promptly at 12:15 p.m. in the employee's lounge. Allen's department is well-run and efficient. Although Allen knows that John does his work, he sees him as disorganized and lackadaisical. According to Allen, "You can't depend on anyone who can't get to work on time." Allen does not consider John a good employee.

Allen's boss, Pete Rusharound, is the dedicated, hard-working type. He always has plenty to do. So much, in fact, that he comes in at 7 a.m. on most days, usually works through lunch, and is lucky to leave the office by 6:30 p.m. He frequently comes in on Saturdays and often takes work home.

The problem

Pete's not all that crazy about Allen. He knows that he does his job. However, he doesn't think anyone can truly be doing their best if they don't arrive until 8 a.m., then always take a lunch break. He wishes that Allen would stop putting his personal needs ahead of the job and would exhibit more of what he perceives to be old-fashioned dedication and loyalty to the station.

Curiously, Pete thinks that John Laidback is an excellent employee. He knows that John is normally still at work plugging away, long after Stoneface has left for the day. He's sometimes impressed that John can perform so well with such a lackadaisical supervisor.

Each of the three employees in the example appears to be competent, productive and interested in his job. At the same time, each has substantially different views of the world. These differing viewpoints skew the ways in which each views the other. Although these employees are trying their best and performing well, it is probable that they are not receiving the positive strokes, good appraisals or recognition they deserve. This can lead to friction, conflict and reduced productivity.

The supervisor is normally in a position of power. When there is a conflict of values or perceptions, it's likely that the boss already has done something about it in either a direct or indirect manner. The boss may well have conveyed a sense of distrust or disappointment to the employee. Perhaps the employee has received a poor performance appraisal or has been denied a bonus. Simply ignoring an employee or withholding positive comments also sends a clear message. Supervisors often provide indirect, perhaps even unconscious, feedback to employees that reveals their perspective on matters.

Employee's role

Employees, however, are not totally powerless in this situation and often can influence the way the manager perceives their abilities. This ability to influence the supervisor is the employee's key to resolving this interpersonal conflict.

You are probably already a good employee. You do your job and are respected by your co-workers. However, because of conflicting management styles, perhaps your boss does not think you are doing all that is expected. Resolving this conflict doesn't mean you have to work harder or put in longer hours. The key is to attempt to influence your supervisor's opinion and perception of your value to the organization.

Productive results

John, Pete and Allen tried this technique and were able to successfully resolve their conflicts. For John Laidback, the solution was simple. He was allowed to go to a flexible time schedule to allow him more latitude on his morning starting time. He now comes in some time before 9:30 a.m. and works eight hours from that time. He still puts in plenty of extra hours on his own, but no longer has any starting time conflicts with Stoneface.

After several meetings, Pete Rusharound now understands that Allen Stoneface is an efficient, dedicated and caring employee. Allen has explained that he leads an active social life and cares for his aged parents, which limits the number of extra hours he can work. Pete now knows that these commitments are the reason Allen does not work 60 hours a week, not because he is lazy.

Pete still works too long and too hard. But at least now he admits to himself that he enjoys it that way. He also better understands his other employees and their career needs. He no longer expects Allen and John to approach work exactly as he does.

The key to this strategy is communication between the supervisor and the employee. If you suspect that conflicting management styles are causing problems on the job, it's essential to discuss the matter with your boss in private. Most supervisors will be pleased that you are demonstrating interest, and they probably will gladly provide assistance in solving these problems. Such meetings help reinforce that the employee and supervisor are on the same team.

Borys is a project manager at the Voice of America, Washington, DC.

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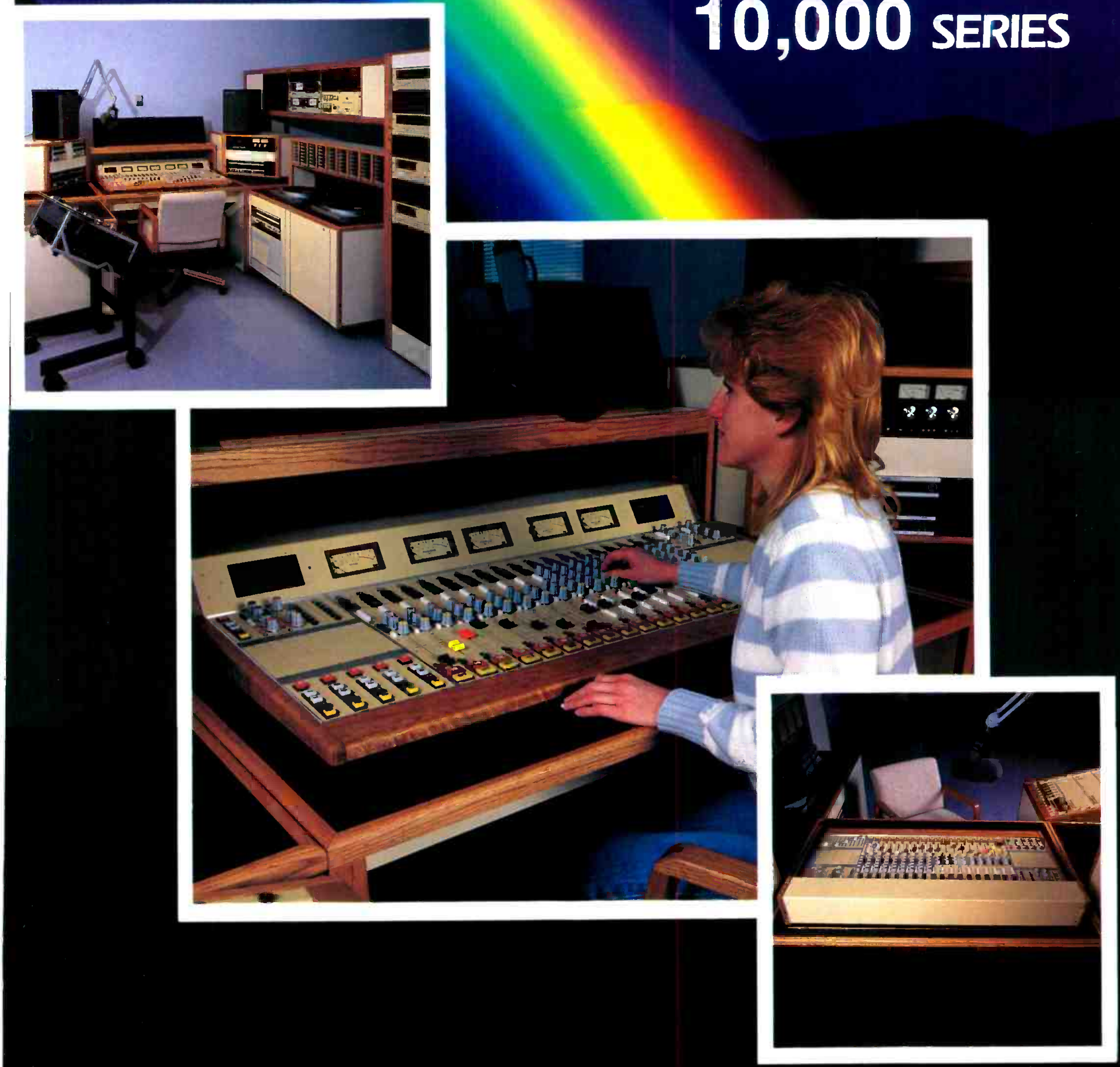

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Dealing with digital technology

By Brad Dick, technical editor

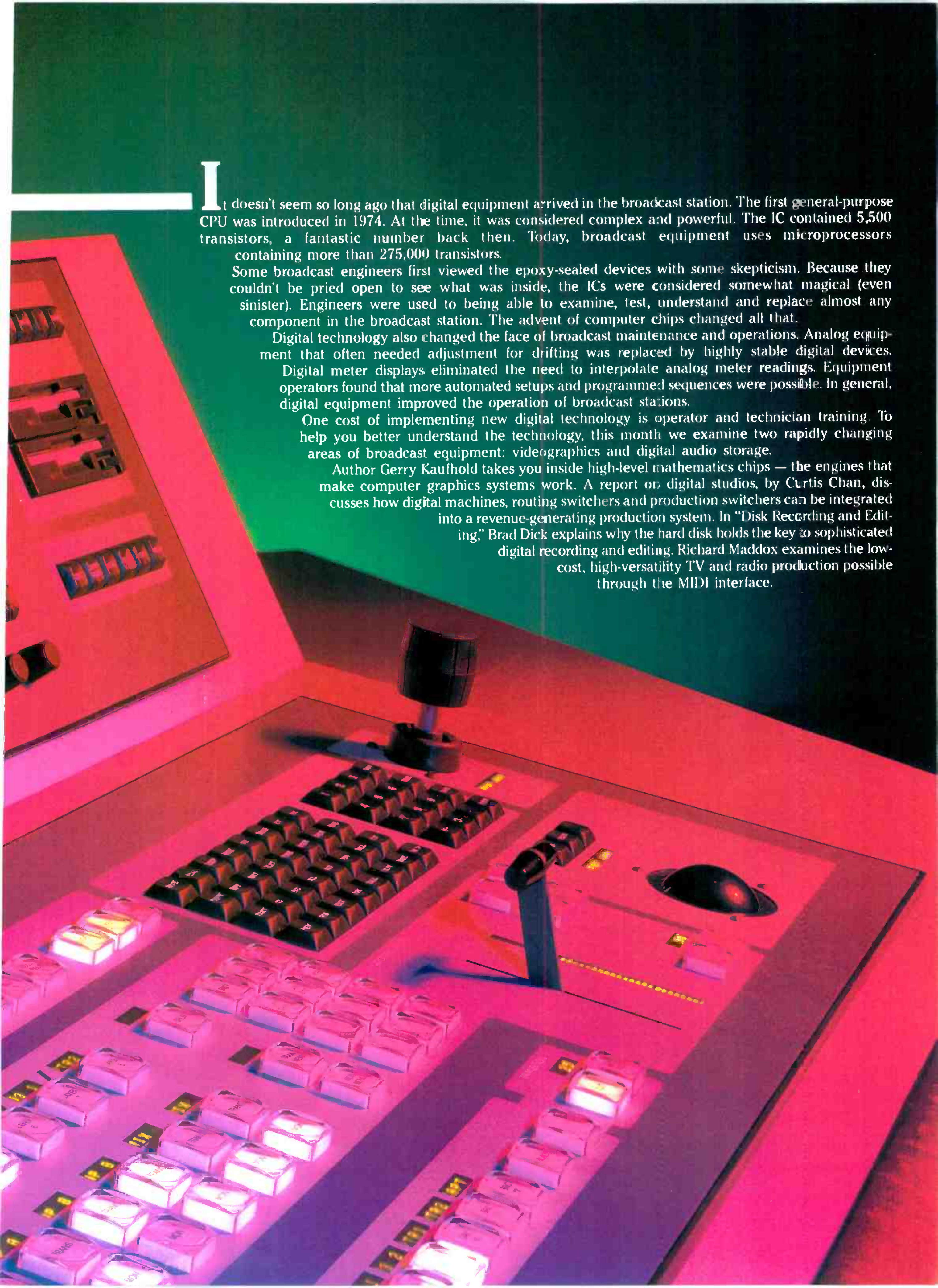
It doesn't seem so long ago that digital equipment arrived in the broadcast station. The first general-purpose CPU was introduced in 1974. At the time, it was considered complex and powerful. The IC contained 5,500 transistors, a fantastic number back then. Today, broadcast equipment uses microprocessors containing more than 275,000 transistors.

Some broadcast engineers first viewed the epoxy-sealed devices with some skepticism. Because they couldn't be pried open to see what was inside, the ICs were considered somewhat magical (even sinister). Engineers were used to being able to examine, test, understand and replace almost any component in the broadcast station. The advent of computer chips changed all that.

Digital technology also changed the face of broadcast maintenance and operations. Analog equipment that often needed adjustment for drifting was replaced by highly stable digital devices. Digital meter displays eliminated the need to interpolate analog meter readings. Equipment operators found that more automated setups and programmed sequences were possible. In general, digital equipment improved the operation of broadcast stations.

One cost of implementing new digital technology is operator and technician training. To help you better understand the technology, this month we examine two rapidly changing areas of broadcast equipment: videographics and digital audio storage.

Author Gerry Kaufhold takes you inside high-level mathematics chips — the engines that make computer graphics systems work. A report on digital studios, by Curtis Chan, discusses how digital machines, routing switchers and production switchers can be integrated into a revenue-generating production system. In "Disk Recording and Editing," Brad Dick explains why the hard disk holds the key to sophisticated digital recording and editing. Richard Maddox examines the low-cost, high-versatility TV and radio production possible through the MIDI interface.

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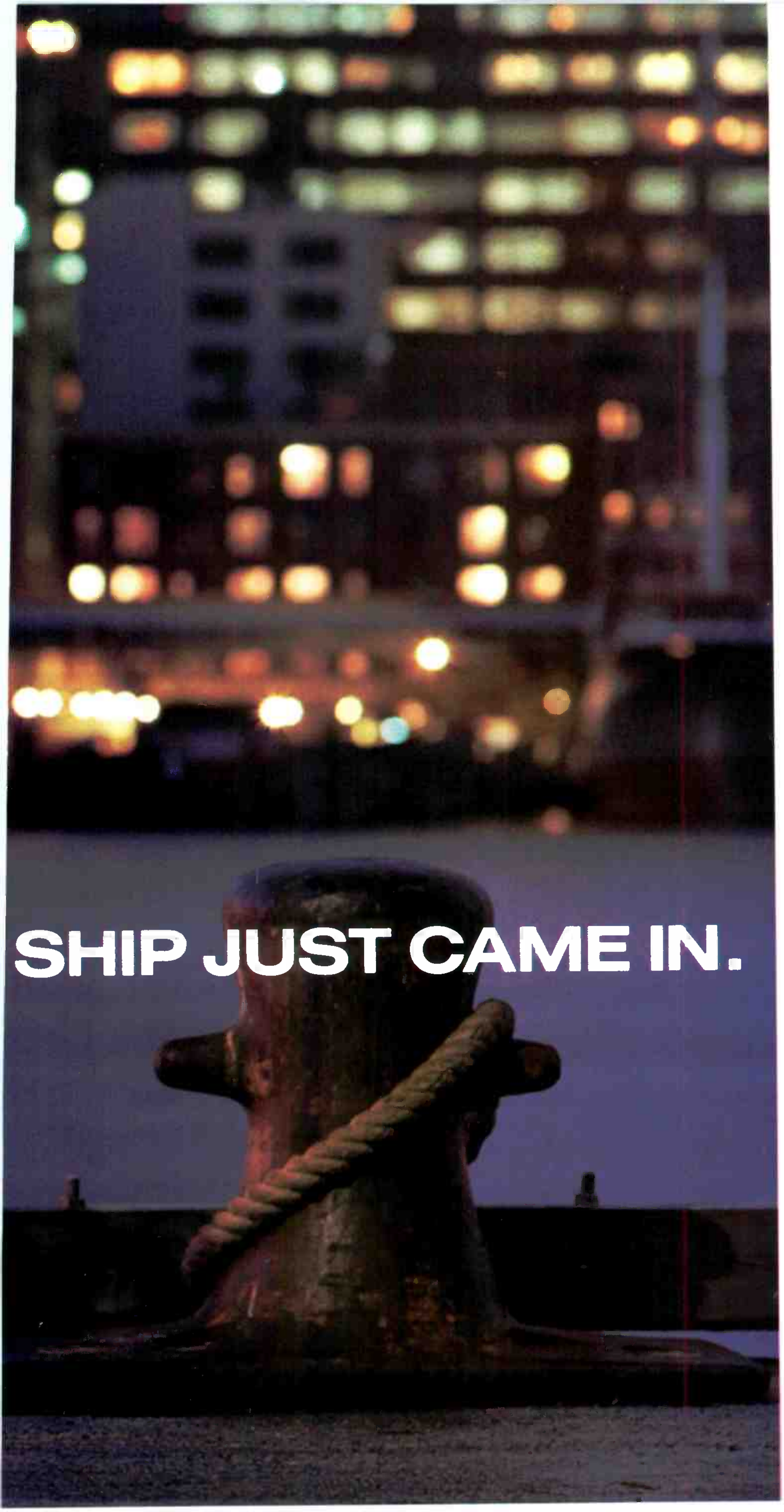

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Inside mathematics processors

By Gerry Kaufhold II

Are sum chips better than others?

Since the early days of broadcast television, producers and the viewing public have called for creative special effects.

Kaufhold, author of the monthly "Circuits" column, is a market development engineer for SGS-Thomson Microelectronics, Phoenix, AZ.

Special-effects technology has evolved from the original lap-dissolve and scene-wiping switchers to today's digital effects switchers, which perform zoom-in, zoom-out and scene rotation in real time. (Real time means that the effects take place frame to frame, without interrupting the video signal.)

The related field of computer-generated graphics also has emerged. Even personal computers are now capable of 3-D modeling and photorealistic shading. Integrated

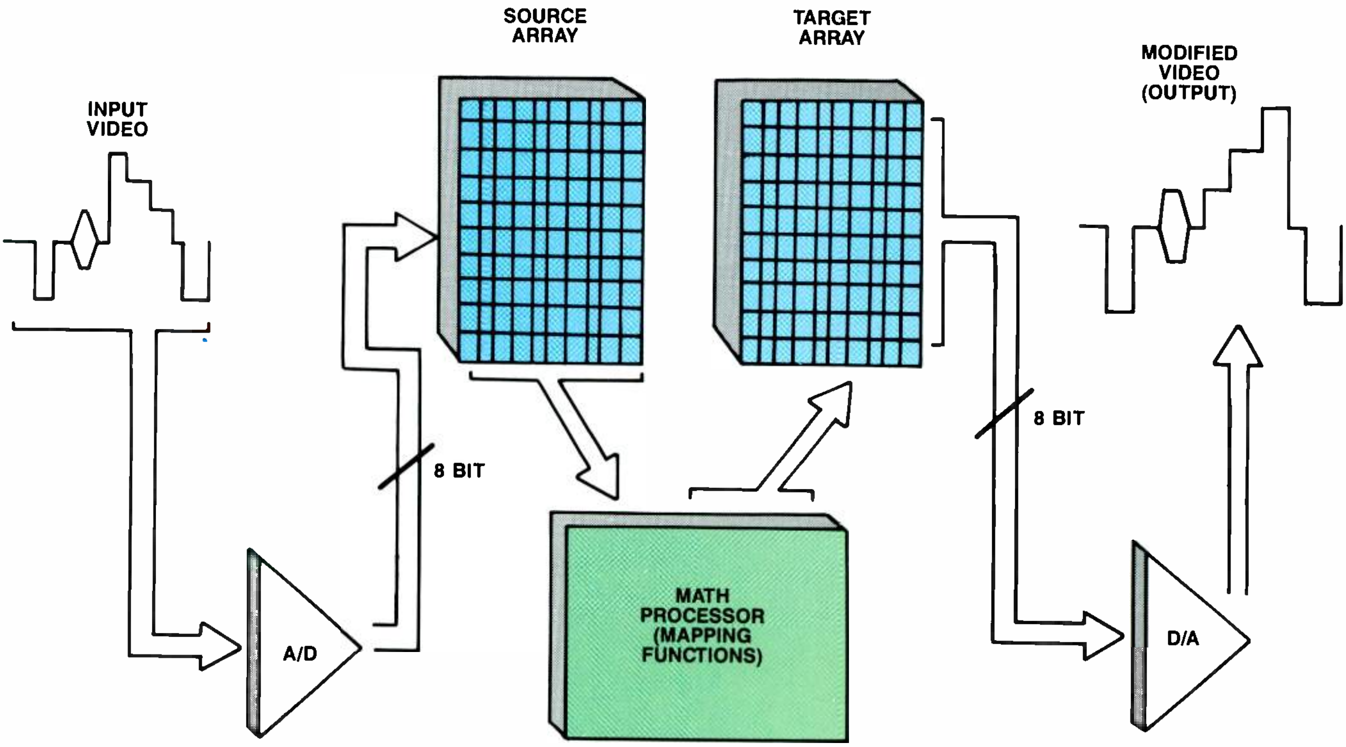

Figure 1. Functional diagram of modern digital video effects system.

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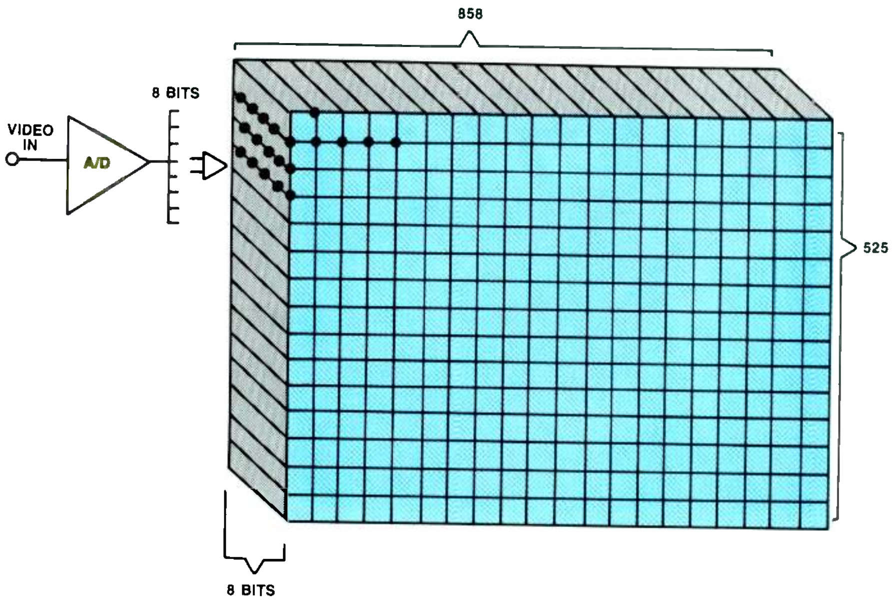

Figure 2. Digitized video is stored in memory arrays before and after matrix processing.

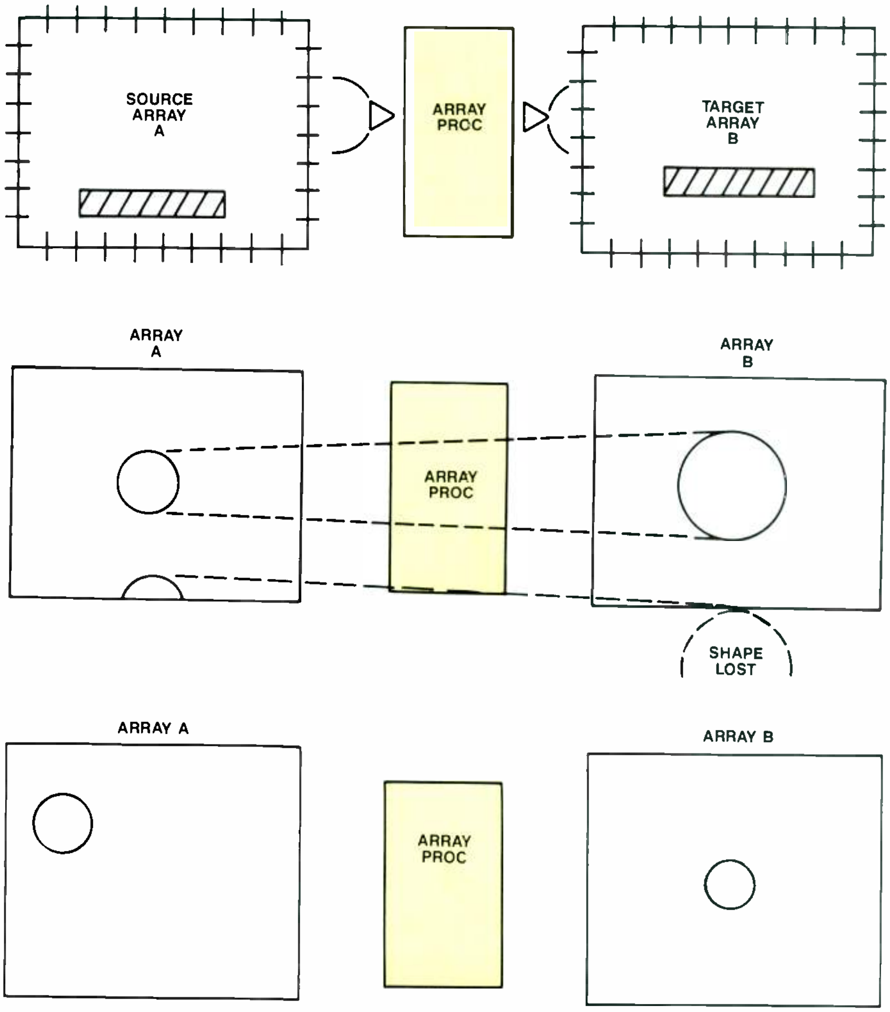

Figure 3. At top, video position transposed using offsets. Zooming and reduction are accomplished, center, via multiplication and division. Combined transposition and zoom can keep images at focal point in spite of size change, as shown at bottom.

circuit manufacturers have developed graphics chips and digital signal-processor chips to manipulate images on video screens. However, computer graphics are generated in "computer time," sometimes taking 30 minutes to create a single complicated frame. Video can't wait that long. This article will show how graphics techniques are used to create special video effects in real time.

NTSC going array

The NTSC video signal, well-known by TV engineers, is defined by the EIA standard RS-170A. The picture begins with the vertical interval blanking pulse, scans 262.5 lines (odd field) horizontally, resets during the next vertical interval, then scans another 262.5 lines (even field). Each field is scanned in approximately 1/60-second. To process one frame (odd plus even field), the signal must be digitized and stored in digital memory circuits.

CCIR 601 standard for digital video (to which D-1 conforms) specifies that the luminance portion of video will be digitized into 8-bit words at a rate of 13.5 million samples per second.[1] This means that a new 8-bit word must scoot into memory every 74ns (0.000 000 074s). To manipulate video in real time, a processed 8-bit word must be output every 74ns as well. This 74ns time constraint dominates the design and performance of digital video switchers.

As a comparison, so-called very fast static RAM memory devices have access times of 20ns. This means that the digital processing in digital video effects units must take place at lightning speed.

The conversion process

Let's look at how a conversion takes place (see Figure 1). The analog video signal starts with the vertical interval blanking pulse, which also resets the memory input pointer in the memory array. Every 74ns, 8-bit representations of the video signal are placed into sequential memory locations. At the end of the frame, the memory can be thought of as a 3-D array storing enough information to re-create the frame. The size of the array is approximately 858 × 525 × 8, or 450kbytes. There are 858 digitized samples per horizontal line of video and 525 horizontal lines. (See Figure 2.)

A typical 21-inch picture tube has about 350,000 phosphor dots for each color. Dividing 350,000 phosphor dots by the 525 horizontal lines of the broadcast picture gives 666 dots per line. This means that the digitized video sample has slightly better resolution than the viewing screen, so the errors incurred by the analog-to-digital (A/D) conversion and subsequent digital-to-analog (D/A) conversion should

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not cause visible distortion to the processed signal.

Once the digitized signal is in the array, it can be operated on, using mapping functions. The source array (the digitized video input) is transformed through a functional block (a math unit) and mapped, point by point, onto the target array (the processed video output). This will be clocked out of the array and will become the video output of the effects device.

The designers of a digital video effects switcher face several major hurdles. The processing operations must be defined, then so highly optimized that they can be executed in the narrow time window of 74ns. Next, the designers must ensure that the output analog signal is free of noticeable distortion. This might include invoking special anti-aliasing math routines.

To prevent picture jitter, caused by time delays in picture processing, the switcher output goes through a recombining circuit that adds the appropriate timing and clamping information. Finally, the output analog signal must be resynchronized with exactly one frame of delay.

Math arrays

Digital video switchers use math to modify what's on the screen. Because the video is stacked up in arrays, effects devices can use special matrix mathematics — matrix algebra. With it, they can change the position of video on the screen (*transpose*), enlarge or zoom in on images (*multiply*), reduce or zoom out from images (*divide*) and tilt images (*rotate*).

For now, let's consider a 2-D array. A shape in graph A is to be mapped onto graph B (see Figure 3a.) If the operation is transposition, simply add the offset value to each member of graph A, and plot it on graph B.

$$\text{New } X = X + \text{offset}$$
$$\text{New } Y = Y + \text{offset}$$

If the offset is too big, part of the shape will be lost. If the operation is to multiply graph A by a constant, then each member of graph A is multiplied, and the result is mapped onto graph B. (See Figure 3b.)

$$\text{New } X = X \times \text{multiplier}$$
$$\text{New } Y = Y \times \text{multiplier}$$

If the multiplier is too large, some of the shape gets lost. Combining transposition and multiplication lets the operator pick a focal point and zoom into that point, regardless of where the focal point appears on the screen (see Figure 3c).

$$\text{New } X = \text{multiplier} \times (X + \text{offset})$$
$$\text{New } Y = \text{multiplier} \times (Y + \text{offset})$$

If the operation is to divide, then:

$$\text{New } X = X / \text{divisor}$$
$$\text{New } Y = Y / \text{divisor}$$

If the divisor is too large, the picture reduces to a black dot. The most important operation is rotation. The equations that define matrix rotation are:

$$\text{New } X = X \cos + Y \sin$$
$$\text{New } Y = Y \cos - X \sin$$

Fortunately, if the sine and cosine of the rotation angle are known, this operation reduces to four multiplications and a pair of additions/subtractions per point. Combining zoom with tilt has so many steps that special techniques must be used to accomplish the task in the 74ns time frame.

Mathematics coprocessors

To implement matrix algebra operations at high enough speeds for real time digital

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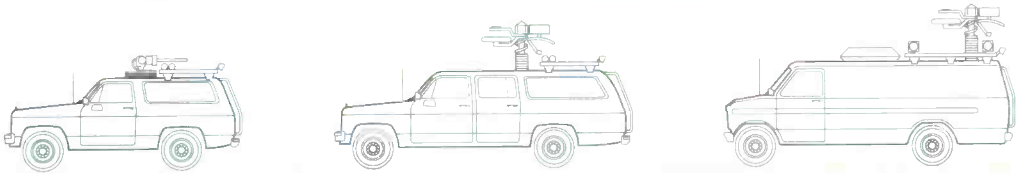

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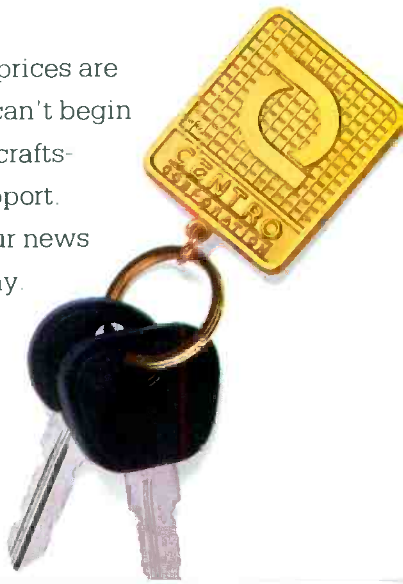

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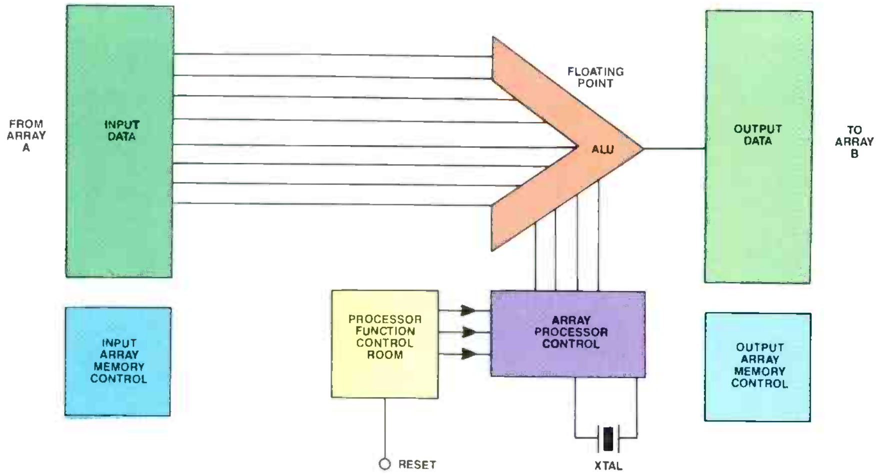

Figure 4. *Math processor determines addresses and values for each video pixel.*

video signal processing, special circuits must be used.

The video signal originally was digitized and loaded into the memory array as a series of 8-bit words. These 8-bit words carry true analog voltage information. Each bit represents 1/256th of 1V P-P video, or about 3.9mV per bit. Each voltage level can be expressed as a floating point number. For example, 0.5V = 0.1000 0000 B 0 in binary floating point.

Besides the input video being stored as floating point, the values of sine and cosine will be floating point, and results of division will be floating point. Most computer graphics chips cannot process floating point operations in the 74ns time frame prescribed by CCIR 601. Designers must use special math coprocessor chips.

As a measure of speed, a complete floating point operation is defined to be one *FLOP*. One million floating point operations per second make up a *megaFLOP*. To perform one complete floating point operation in 74ns, the digital math processor must operate at a speed of more than 20 megaFLOPs to allow time for other operations following the mathematics. It turns out that the mathematics processing power required to perform real time digital video signal processing is pushing the state-of-the-art of mathematics processor design.

In fact, the popular Ampex ADO does not use a math coprocessor, but contains proprietary circuits to execute matrix algebra at the required speed. Some of the newer math coprocessor circuits have the required speed for handling floating point arithmetic, however. The Kaleidoscope by Grass Valley Group uses the Intel 8087 coprocessor in a dedicated circuit for calculating trig functions, and some future equipment may make use of the Texas Instruments TSG 34060 digital signal processor.

A block diagram of a math coprocessor (or digital signal processor) is shown in Figure 4.

Continued on page 36

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Chrominance (AM)	51.8	47.5	51.4	44.5
Chrominance (PM)	44.3	40.1	43.8	35.2

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repeated add-shift-add procedures, a 16-bit floating point multiplication could take 48ns, leaving just enough time for memory accessing (20ns) and for the D/A converter to settle before the next operation has to begin.

In addition to performing the mathematics functions fast enough for real time video processing, the math processor has to read data from the memory arrays, as well as read and decode instructions from its own internal ROM program.

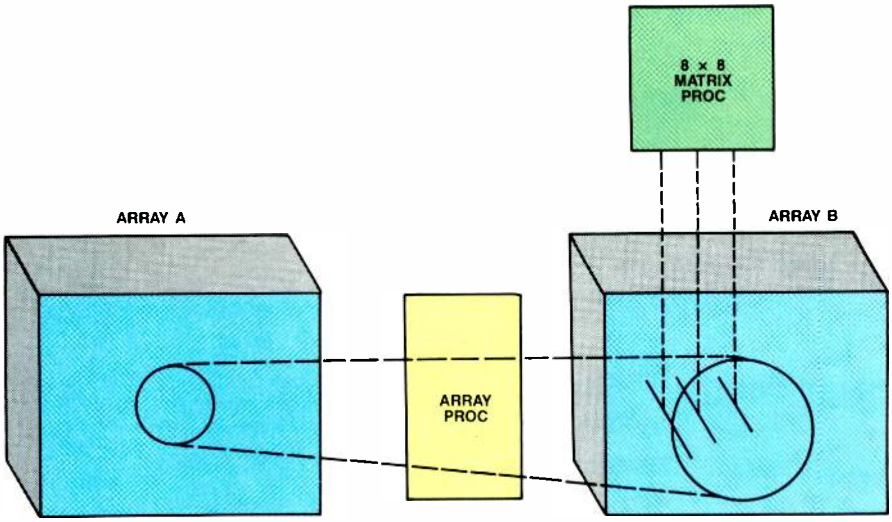

Figure 5. *When a pixel is mapped to a non-existent location "between" two screen dots, an interpolation matrix is used to approximate its value by averaging surrounding dots.*

Continued from page 32

Addressing

In addition to performing floating point math operations extremely quickly, the chip has to manage the addressing for the source memory array and calculate results that become addresses in the target memory array.

For real time digital video signal processing, the array is 3-dimensional. X and Y values are the address/position pointers into the target (output video) memory array, and the Z value is the 8-bit word that represents the analog voltage value of the digitized input video signal.

Calculating the new X and new Y positions for the selected function is straightforward. The math processor is given the beginning addresses for X and Y and calculates the resultant new X and new Y values as it sequentially walks through the memory space. Out-of-bounds values for new X and new Y are ignored, and the results of floating point operations are rounded off or truncated for the sake of simplicity.

Video value

Coming up with the 8-bit analog voltage value that gets stored in the new location is somewhat complicated. If, for example, the calculated new X and new Y values fall somewhere between two video monitor pixel locations, the processing system must adjust the value of the 8-bit word that gets stored in the new location to prevent a video "glitch."

For the Ampex ADO, this situation is resolved by taking the average of an 8 × 8 matrix that is centered on the value of the output pixel value. To do this, 64 8-bit additions must be executed and averaged while the new X and new Y values are being calculated. (See Figure 5.)

Dual-ported memories

Each manufacturer of digital video switchers has a unique and proprietary method for resolving the problems that occur when performing special effects in real time. As mentioned, combining position changes and rotation is difficult. To crunch all the numbers within the time frame permitted usually requires multiple operations to be performed simultaneously.

If two or more math processors are used to provide the necessary numerical processing power, the memory circuitry must be capable of being accessed by more than one processor. Such multiport memories are expensive, especially when they must be fast access memories to keep up with the processing speed of the super fast math coprocessors. Most of these high-speed multiport memories use a combination of CMOS and bipolar technology. This mixed semiconductor technology is known as bipolar CMOS, or BICMOS. Not surprisingly, BICMOS is at the forefront of technology and is still quite expensive.

Pushing the limits

Math coprocessors used for real time digital video special effects must accomplish a lot in extremely short time spans. Recall that digital adder circuits are made up of combinations of AND, OR and INVERT gates. A typical full adder circuit that includes a carry bit and a zero flag bit has nine gates. In high-speed CMOS circuitry, delays within an integrated circuit are 300ps per gate (1/3ns).

Nine gates times 1/3ns per gate equals 3ns for the addition alone. Because digital circuits perform multiplication through

Pipelines and parallel paths

The faster the processor chews through numbers, the more chewing it can do in 74ns. This enables the effects device to perform even more complex effects. Digital designers have created ingenious ways to boost throughput on math processors. Two popular methods are pipelining and parallel processing. These can be illustrated with a simple analogy.

Imagine you're in a laundromat. Conventional processing would be to put a load of clothes in the washer, and when it's done, transfer the clothes to the dryer. To speed things up, you would start a new load in the washer as soon as you loaded the dryer, and have a sorted load, detergent and bleach standing ready to dump into the washer as soon as the present load is finished. That's pipelining.

On the other hand, if you could take charge of several washing machines, and have them all running at once, that's parallel processing.

In a crowded laundromat, the problem is getting your quarters from your pocket and into the machine before someone else does. In computers, the problem is getting all the data into and out of memory. If you're not fast enough, you'll have to wait for the next available machine. If your computer memory is slow, it requests the processor to enter a *wait state*, which freezes its operation. Wait states are the nemesis of fast processing.

In pipelining, the computer fetches the next instruction and data while the current instruction is executing. This is called prefetching, which is a standard acceleration tool. Unfortunately, sometimes pipelining architectures fail because the previous instruction is a branch or jump instruction, which invalidates the prefetched instructions and data and causes wait states to occur.

RISCy business

Another idea in vogue is reduced instruction set computers, or RISC. A RISC machine executes one instruction per clock cycle. To achieve this, designers must make use of parallel processing.

Parallel processing requires strict timing adherence, and much forethought must go into designing the flow of procedures so

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that none of the parallel processors gets "stuck" waiting for the results of a previous operation to become available.

One technique used to prevent this is called *scoreboarding*. Scoreboarding is a sophisticated technique that allows the processor to determine for itself how it will solve its problems. The list of operations is scanned to determine which can be solved immediately, and which must wait for intermediate results. Then the processor starts chewing through its list in the most efficient order. This ability to autonomously decide which step must come first represents the beginnings of artificial intelligence.

As the computational intensity of digital video effects increases, expect to hear more about the importance of specialized math processors and other high-performance silicon devices. Parallel processing, in particular, should increase in popularity, because of its increasing use by manufacturers for large computers as well as for superpowerful PCs.

References

1. In equipment based on the CCIR 601 standard, chrominance information is stored and processed separately, but using similar means.

Acknowledgment: The author wishes to thank Jim Duca of Ampex and Peter Symes of Grass Valley Group for assistance in preparing this article.

Digital signal processors

The AT&T DSP-32-C digital signal processor (DSP) is a high-speed, programmable integrated circuit, specially designed to perform matrix operations at a high throughput level. The circuits inside the DSP have been fine-tuned for this application, and the critical path gate-delays have been minimized by creative silicon design.

In many aspects, the DSP is a state-of-the-art microelectronic product. In most of its features, it is similar to other mathematics coprocessors. The main difference between a DSP and a math coprocessor is that the math coprocessor has a more generalized set of features and, therefore, it usually runs slower.

The DSP-32-C has two execution units. One part manages the address functions of reading data from large memory arrays, and the other performs the actual floating point mathematics and error recovery.

The DSP-32-C is capable of 12.5 million instructions per second, or *MIPS*. MIPS do not translate directly into megaFLOPs. The DSP must accomplish a lot of "housekeeping" before it can begin crunching numbers.

Like a microprocessor, a DSP has a program that tells it what to do. The program is stored in ROM. Recall that even fast static rams have access times of 20ns. As a way to speed up instruction timing, the instructions of a program loop will be called into internal registers, so that the DSP can operate without having to read from external memory. The technique of pulling a program loop out of main memory into higher-speed internal registers is called *caching*.

Instructions for the DSP can be tuned to the specific application. At the beginning of the program, the size of the data words and the number of bits of precision for the math routines are specified. For digital video, we would use an 8-bit data word and 16-bit math. (Note that if two 8-bit words are multiplied, a 16-bit answer results.)

To optimize data throughput, the DSP program will be matched closely to the signals coming in from the data-acquisition module. For example, an interrupt on the DSP goes off when the A/D converter has deposited one byte of information into the source memory. The DSP then grabs the X and Y values of the address of this byte and calculates the new X and new Y address for mapping into target memory.

If the new X and new Y, being floating point numbers, do not fall exactly into a part of the upcoming horizontal scan line, the DSP must perform an interpolation among nearby points and adjust the value stored in new X and new Y to prevent video glitches. As soon as the current item of data has been handled, the DSP updates its address pointers to the next location that will receive a new databyte, then it waits for an interrupt.

Using the compact instructions designed for the DSP, the entire program of *get data, process data, interpolate data*, and *wait for next data* might require only three instructions. With an instruction cycle speed of 50ns, the DSP-32-C would need 150ns to perform the functions. Unfortunately, the time window for real time video is only 74ns. Thus, although its speed of 12.5 MIPS is faster than that of many general-purpose microprocessors, it cannot perform real time video processing. The DSP-32-C is used by AT&T for slow-scan video (videophone).

Even if they were operated in parallel, the chips still would be limited by their internal floating point speed. The next generation of the device, however, will run at video speeds. Several manufacturers have products in development that will use these chips.

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State of the digital studio

By Curtis Chan

"And D-1 and D-2..." Digital formats work in concert.

The digital studio is no longer an experiment, but a revenue-generating reality. Yesterday's embryonic technologies have become expanding product lines from many manufacturers, addressing needs ranging from production and post-production to broadcast.

The spotlight in the digital video arena has shifted recently from the D-1 standard

Chan is vice president of marketing and product development, Centro Corporation, Salt Lake City.

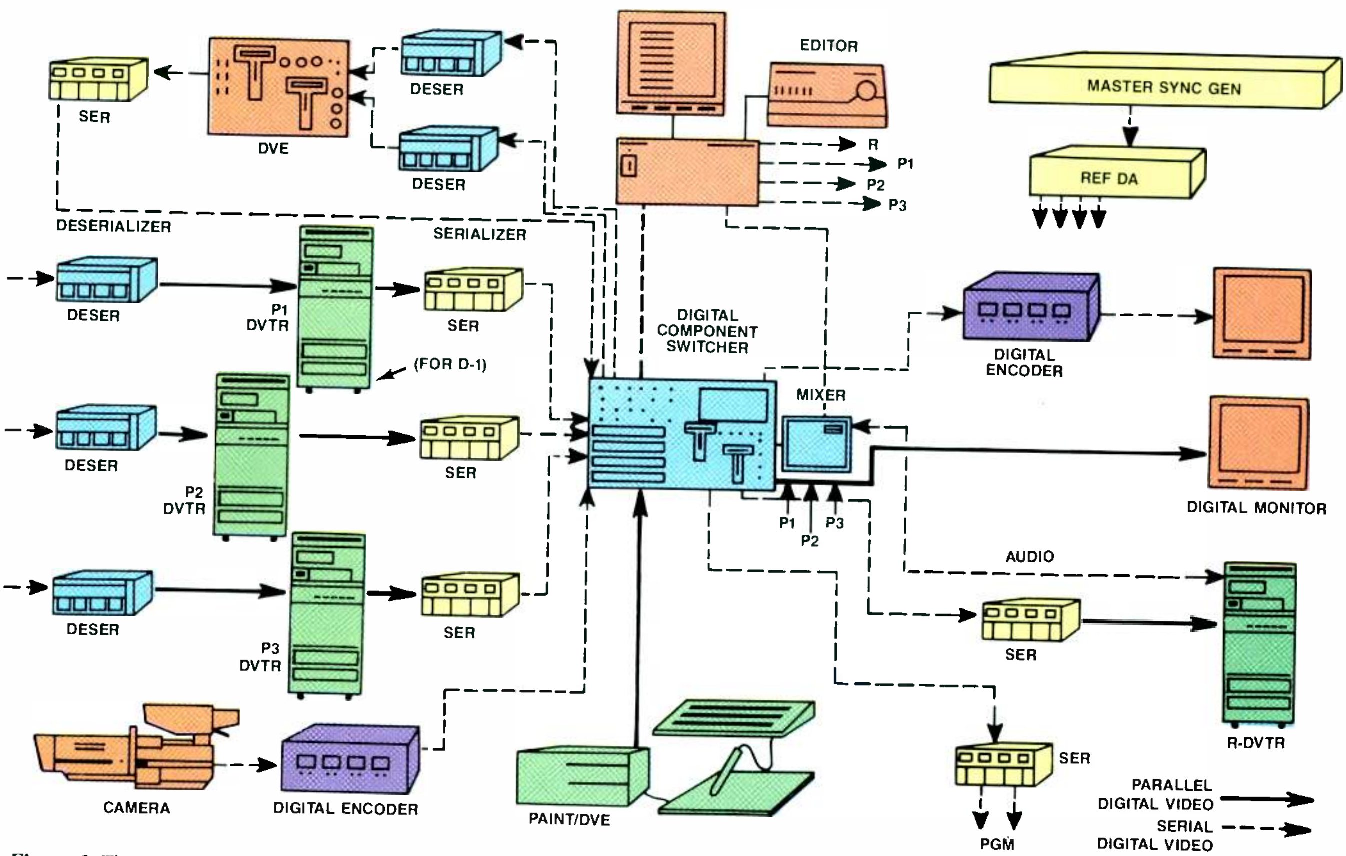

Figure 1. The digital editing facility, showing techniques for incorporating analog, as well as digital, input. Serializers will eventually be 1-chip devices.

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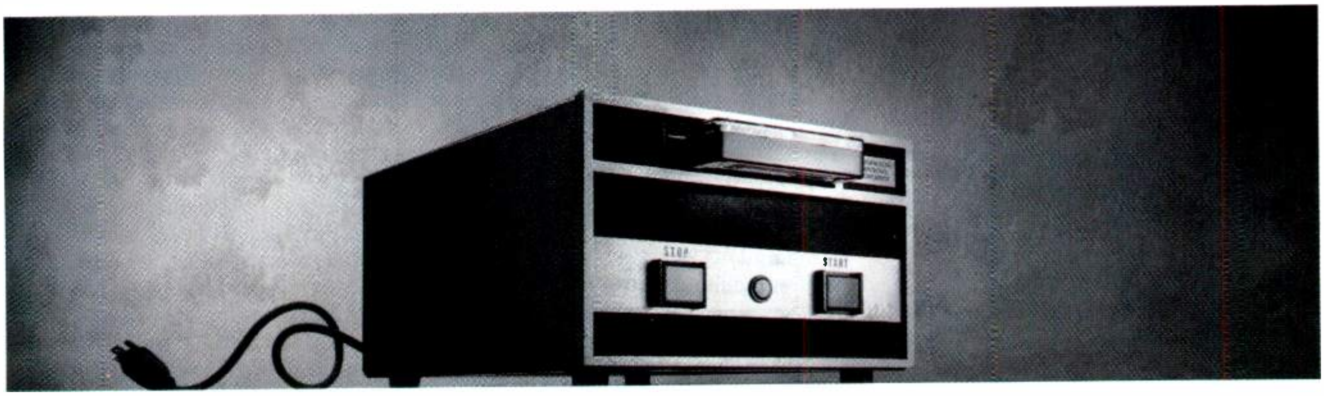

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and its support products to D-2 products. The acceptance of D-2 is based, in part, on user demands for a functional and economical DVTR, one that is compatible with existing analog standards. But both formats are viable, and combining them in a digital production/post-production system may yield interesting benefits.

Routing, distribution and interfacing

Figure 1 depicts a typical digital suite, including DVTRs, effects units, cameras, paint and editing system. Assume it uses either a composite or a component digital system. Although it is not illustrated, you can assume also that it is able to use conventional analog ATRs and VTRs in various formats.

This system requires distribution and routing of intermixed composite, analog component, digital video and audio, timecode and control signals — quite a challenge. Analog distribution and routing practices are fairly routine, so let's concentrate on the special problems associated with digital component and composite signals.

Parallel problems

The (525/60) parallel video interface consists of nine unidirectional pairs of wires for D-1, and 11 for D-2. In D-1, eight pairs are for data, and the ninth carries a synchronous clock signal. In D-2, 10 pairs are for data and the 11th for clock.

Early digital facilities attempted to use loop-through connectors and computer-style ribbon cable. High data rate, crosstalk and impedance variations soon forced them to convert to a system of digital distribution amplifiers for occasions when the signal must go to multiple destinations. Furthermore, they adopted special screened, circular cable.

This cable is costly, because care must be taken to keep all conductors the same length to avoid clock-to-data skew. High-quality conductors and connectors also help prevent attenuation losses.

The pairs operate using ECL parameters. The SMPTE-recommended practice (RP) 125 specification suggests that the cables be up to 50m long, or 300m, with proper equalization. Pulse widths may suffer from conversion between ECL and TTL, and vice versa.

If parallel routers are used, the number of crosspoints involved in even a small routing switcher is huge. This can be overcome in part by applying special crosspoint reduction techniques. One technique popular in digital audio routers, *time domain multiplexing*, is not yet feasible for video, because it would require in excess of 3GHz bandwidth. "Multistaging" routers, in which a large matrix is replaced by several small matrices controlled by a "smart" control system capable of reassigning paths to avoid blockages, are under development. These techniques result in a small exponential rise in crosspoint count, but do so with a reduced physical size and cost savings, compared with their analog counterparts.

All this points to the importance of serial communication.

Serial

If serial transmission is used, the cost of routing signals must incorporate the overhead of serial-to-parallel and parallel-to-serial conversion. However, the advantage of serial transmission is that signals can be sent down one wire, either a coax or an optical fiber, similar to present video wiring. Routing switchers that can pass the serial datastream for both D-1 and D-2 are under development and should be introduced soon.

Facilities now use digital serializers and deserializers along distribution paths. VLSI chip technology will replace these "black boxes" with a serializer/deserializer chip set that can be built into each product. It is possible that this chip set can be used for both the D-1 and D-2 formats, handling bit-rates from 143Mb/s to 300Mb/s and adding savings and flexibility.

Cabling

Cable composition is important in digital video. Because there is interest in extending serial data formats from eight bits to 10 bits, cable should be tested to at least 450MHz to allow for the additional bandwidth. Tentative conclusions favor double-foil shielded coax with the braid in-between the foil. This appears to provide better RFI shielding than double-braided coax or double braid over a single-foil shield.

Foam core coax can exhibit impedance variations due to manufacturing tolerances in the foam-extruding process. These cables are best used for long runs, where reflections caused by poorer impedance characteristics are attenuated by coax losses. Solid dielectric coax can be used for short runs.

Because of the high bandwidths of serial digital video, it is important to use high-quality BNC connectors, with good RF grounding, to minimize radiation. Any movement of a coax cable will result in skewing of the BNC connector. This can result in RFI leakage, at various frequencies, at the BNC interface to the cable.

Transparent, multilevel routing

If you want to route analog composite and component video, analog audio, digital video and audio, time code and machine control signals, the routing matrix must accommodate each of these signals. This requires an extremely flexible router hierarchy. These different levels of routing can accommodate complicated

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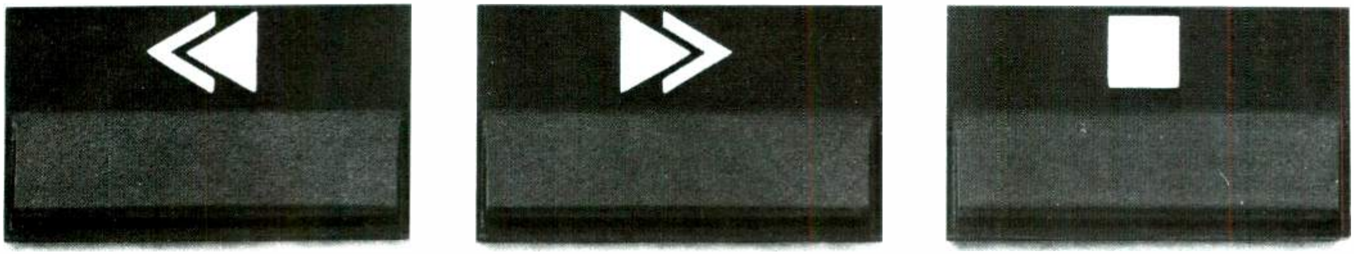

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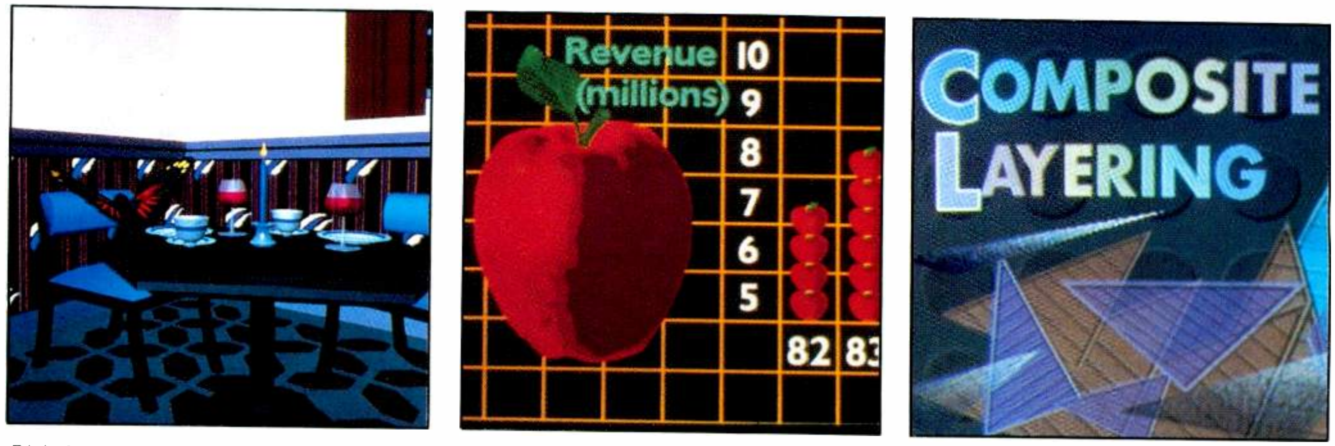

Digital technology has given television a fresh look. The problem for the industry now is how to deal with the increasing amount of digital effects and processing equipment used at stations and post-production facilities.

digital-domain effects, such as multilayering, yet provide flexibility in the analog domain.

The routing-switcher control system should provide transparency. The user should not have to be concerned with the type of signal coming from a given device. Routing a digital machine of a given format to a second machine of the same format should result in a digital-to-digital connection. However, commanding the router to feed a digital machine to an analog

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composite machine should automatically feed the digital machine's composite output, or else automatically route the machine's digital output through a transcoding device.

It is interesting that many facilities are implementing computer-based systems to track and optimize routing operations.

Analog interface

A digital system must interface with the analog world. This requires digital video codecs. The digital video decoder should be able to accept digital component (SMPTE RP-125/EBU 3246-E) and output RGB, with or without sync, as well as Y, R–Y, B–Y, with or without setup. Similarly, the encoder should accept RGB and Y, R–Y, B–Y and output digital component. The same applies in digital composite encoding and decoding.

It also would be convenient if digital codecs had inputs and outputs for either serial or parallel digital video. This would eliminate the need for serialization/deserialization conversions if parallel cabling is adequate. The codecs also should be able to retime picture and sync information, using digital processing to minimize degradation.

Synchronization

One of the most critical aspects of a digital production system is system timing. For the present, timing a digital facility is similar to analog facility timing. Normally, the device with the longest path length is taken as the reference device. Delays then are introduced to all other devices to make them coincident with the reference source.

This can be done either by delaying the composite video signal from the source equipment to the zero time point or delaying the reference signals to the source equipment.

In systems with multiple edit suites, source devices may have to feed two or more switchers. In this case, judicious use of auto-delay DAs can correct errors of up to about ±15ns. The isophasing DAs, which are equipped with an electrically modifiable delay line, compare their input video to a reference signal and correct their output if it drifts out of time. The isophasing DAs can be located at a critical timing point, such as the input to a switcher, or they can be used as a fan-out device, which keeps all signals properly subcarrier-timed with the zero time point. This prevents constantly having to make drift adjustments or having to trim the timing of video sources.

In cases in which the delay is beyond the range of the DA, timed cables (1.5ns per foot) also can be of benefit by putting the signal in range.

Timing by varying the reference signal fed to video devices usually takes the form of a master sync generator that slaves several source sync generators. The timing of the source sync generator can be varied either according to timing presets, which are programmed in advance, or by a comparator-generated control signal, which samples timing at the time-zero point.

Automatic synchronization systems prevent constantly having to make drift adjustments and trim the timing of video sources. They provide the additional advantages of sync system redundancy, sync hierarchy protection, and the ability for facility growth without major redesign.

A brief comment about component timing is in order. It is imperative that all lines are timed precisely, to avoid interchannel distortion. Color-coded coaxial wires can supplement wire labels as a means of

Continued on page 52

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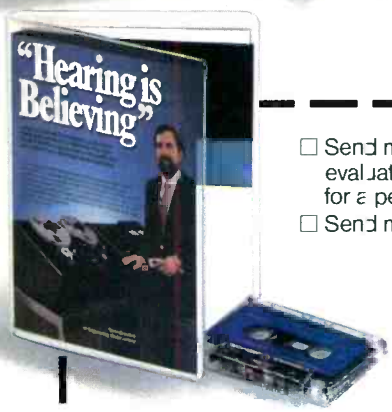

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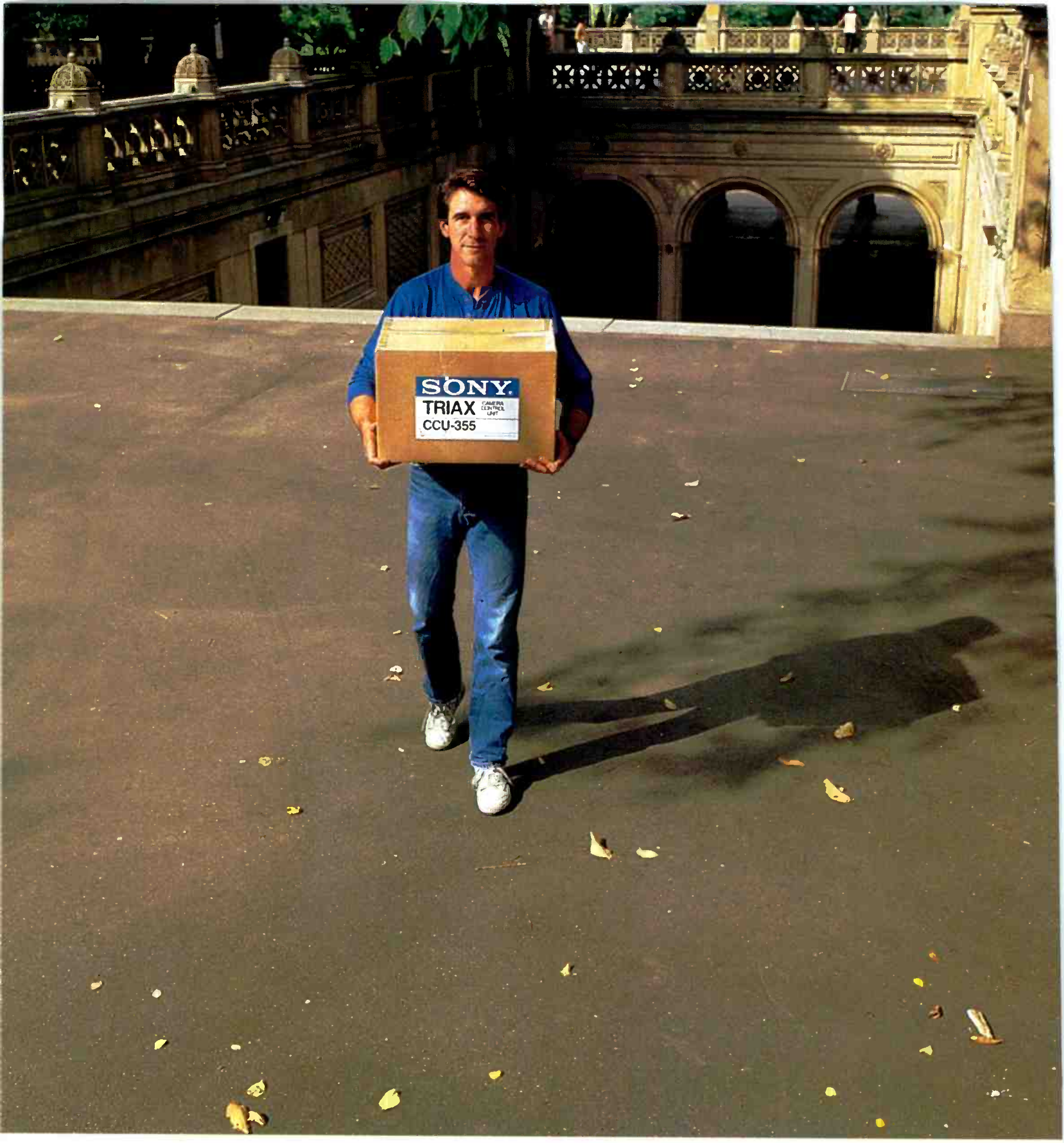

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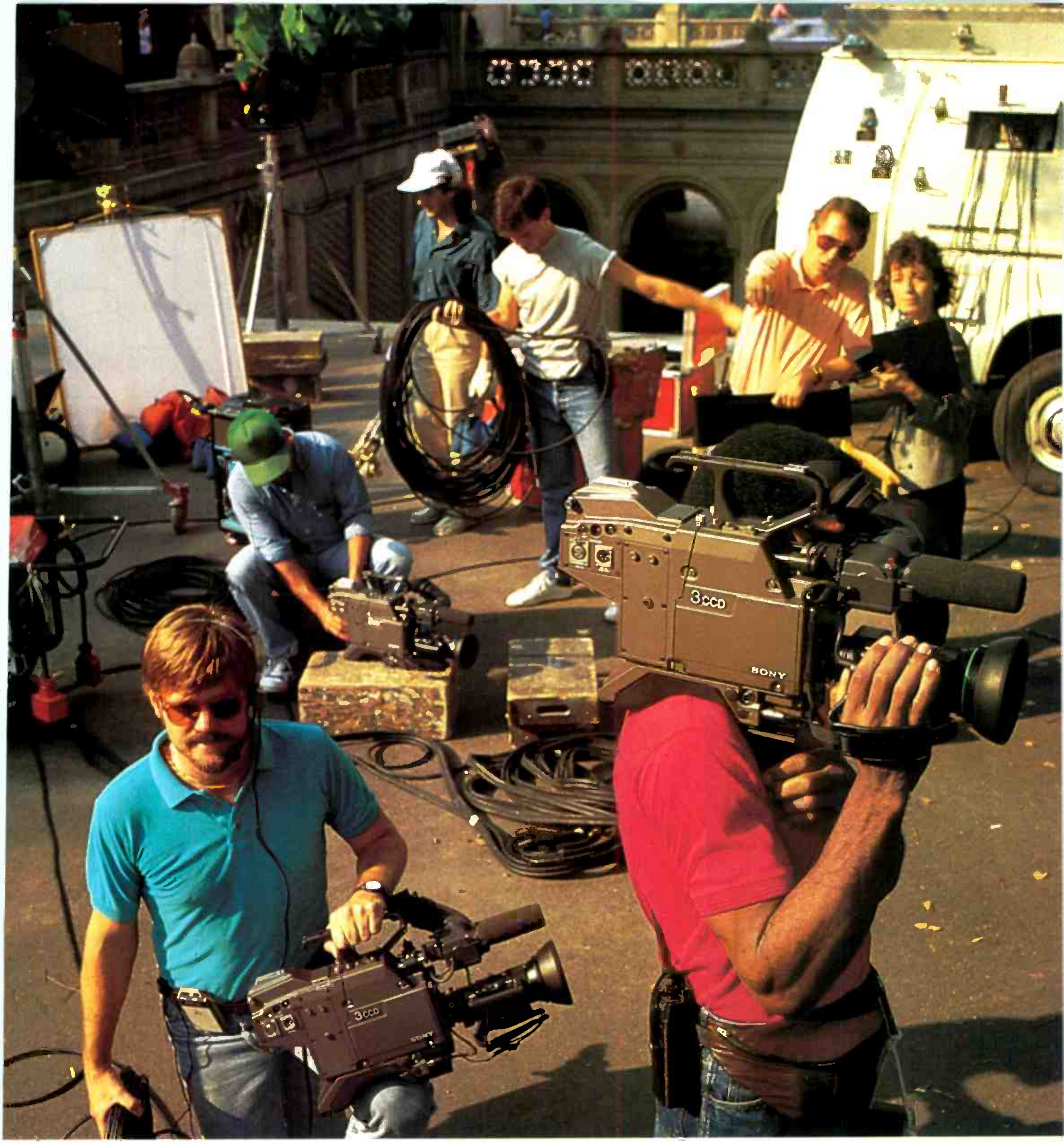

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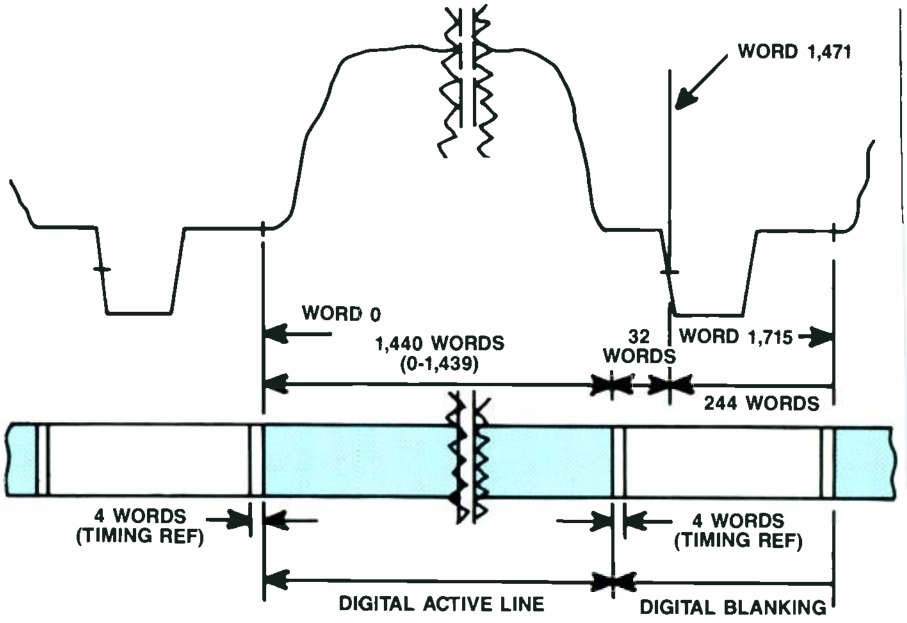

Figure 2. *Digital timing signals allow system timing in the digital domain.*

Continued from page 48

cable identification in complex systems.

The system timing design of a facility should encompass the patch panel. Digital-ready patch panels incorporate zero-timed ports with recommended patch cord lengths.

As stated, system timing in the digital studio is, for now, a matter of adjusting devices so they are in time when converted to the analog domain, as in a switcher. Some digital formats have timing sync words built in that could allow timing in the digital domain (see Figure 2). In D-1, for instance, the timing word consists of a 3-word preamble. This is followed by a word that indicates even or odd field, whether or not the line is in the vertical interval, and marks the transition between active video and blanking. A new generation of devices that will enable automatic timing, regeneration and equalization probably will be introduced to capitalize on this feature.

The digital switcher

The digital production switcher will play a key role in the overall performance of the system. The digital switcher gives the advantage of multilevel compositing in real time. Single-layer compositing has been used successfully with the availability of the DVTR and the digital disk recorder, but it has two drawbacks. One is that compositing must be done one layer at a time, which increases the time of the production. The other is that many complex productions are dependent upon the spatial relationships between layers, which can be established only when all the relevant layers can be seen at the same time. The use of a digital production switcher capable of multilevel compositing can eliminate these concerns.

Artifact generation due to multilevel effects processing is a concern in the design of the digital switcher. The process of keying and effects processing requires successive multiplication of digitized video signals by control signals, such as key and wipe waveforms. The interpolation process is also multiplicative, resulting in extra bits of data in the form of fractions. To minimize the effects of rounding, some switcher and graphic device manufacturers are maintaining a 10-bit path throughout all multiplication and combining stages, significantly reducing the artifacts generated.

The digital switcher should have the ability to accept multiple inputs with differing formats and I/O standards. In the case of the component switcher, the ability to accept and output analog composite, analog component and digital component in either serial or parallel form would be convenient. Similarly, the composite digital switcher should accept and output analog composite, as well as digital composite, in either parallel or serial form.

We must maintain image quality from non-digital sources. This can be done through the use of appropriate encoders. For instance, the camera's RGB output can be sent through a digital encoder/serializer. Similarly, all effects devices and monitoring I/Os should be in the digital domain, to preserve image quality.

Input to the switcher also will involve

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the use of cable equalizers and autophasing systems. This is predicated upon the fact that signals sent through long runs of coax will be attenuated and have time-artifact anomalies. Again, it is not inconceivable that these functions can be designed onto PCBs and incorporated into the switcher. At present, judicious use of a master generator and timing modules for each machine affords the user a safety margin in cable-length error when installing the system.

Given the flexibility of source and effects devices depicted in Figure 1, the digital switcher should have the ability to act in either a production or post-production capacity. Features of such a switcher may include:

- Eight to 48 inputs with serial inputs and outputs in accordance with SMPTE and EBU interface standards.
- Internal mixer/effect subsystems capable of handling up to eight picture planes.
- Downstream chroma-keying capable of accepting either digital component or composite with the appropriate translators.
- Downstream digital color correction.
- Automatic phasing of input signals.
- Digital processing providing pattern generation, wipes, keyers, borders, character generation, color background and matting, and framestore.
- Storage and learn capabilities with adjustable transitions along with exponential, log and "S" non-linear transitions.
- On-board diagnostics and computer port for remote testing.

At least in the short term, digital switchers will operationally emulate present analog switchers. The high degree of sophistication available today should make it possible to keep processing, equalization, switching, control, mixing and effects generation transparent to the user.

Equipment, heal thyself

It will not be uncommon for digital switchers to include automatic test systems that will locate faults to a block level. Remote computer interfaces will allow diagnosis by outside computers. Test instruments, in addition to accepting and outputting both digital and analog video, will be controllable by the device under test. In this manner, digital routers and switchers will be able to automatically sweep themselves, reporting problems before failures occur, similar to advanced telecommunications equipment. Furthermore, expect to see greater fault tolerance and software recovery routines that will prolong equipment operation in spite of failures.

Test generators should be able to supply a diversity of signals and syncs, such as RGB plus H-drive, V-drive and tri-level sync. Similarly, test monitors should be able to accept analog or digital, convert back to analog and be compared with the original source signal.

Format and rate conversion

A final issue is that of format and rate conversion. It is likely that digital video, in current as well as emerging formats, will at some point intermingle. Companies already have addressed this concern and have put products onto the market to do rate conversion. As an example, one company markets two rate converters for both the D-1 and D-2 formats. In the case of the D-1 to D-2 rate converter, the device converts 4:2:2 component digital signals to 4×fsc composite digital video signals. It also encodes Y/R–Y/B–Y to a composite digital NTSC signal, with correct I and Q bandwidths. Similarly, the D-2 to D-1 rate converter changes 4×fsc signals to 4:2:2 signals, as well as from I and Q to Y/R–Y/B–Y.

With the progression of MTS broadcasting and the proliferation of stereo programming, production companies are paying more attention to audio. Presently, audio sweetening is still a separate function, in which audio tracks are sweetened and conformed to the final edited product. This step could be integrated into the video post-production process, and recent equipment introductions seem to point to this trend.

Both the D-1 and D-2 formats use the 48kHz sampling frequency standard, while different digital audio processors sample at frequencies ranging from 30kHz to 50kHz. Luckily, digital audio sampling rate converters are available. Such units will accept sampling frequencies from 30kHz to 50kHz, and output, among others, the 48kHz standard. This keeps the audio in the digital domain, preventing quantization errors and other distortion occurring from excessive analog-to-digital transformations.

A variable-sync unit is used to lock a DATR to video. The unit will lock its internal clock to input video reference and output word sync to vary the speed of the DATR.

Bringing it home

A decade ago, the digital studio was a dream. Standards committees and manufacturers have labored many years to create a standard by which competitive products can be built. Two digital video formats now have emerged, and others are waiting in the wings. Each format and its respective complement of equipment offers unique performance attributes not found in the analog world. By recognizing and implementing these maturing formats, you can bring the digital advantage home to your facility.

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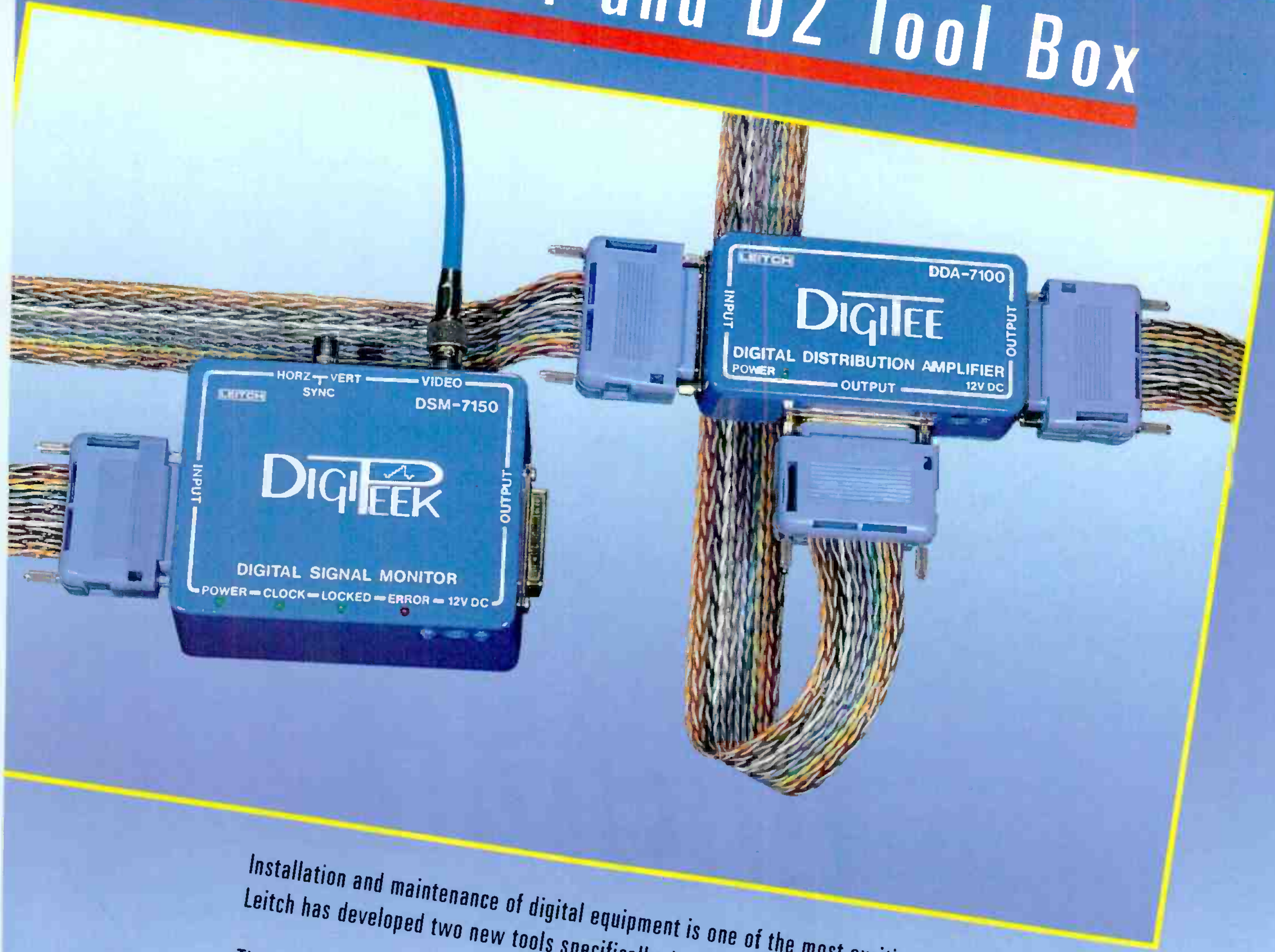

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LEITCH

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Disk recording and editing

By Brad Dick, radio technical editor

Hard disk storage is the key to digital recording and editing.

It doesn't take a rocket scientist to recognize that the era of digital recording and editing techniques finally has arrived. No longer confined to film and post-editing suites, today's hard-disk-based systems are now finding application in radio and TV stations.

Some digital audio techniques, such as delay and reverb, have been around for years. However, complete recording and editing systems have become available only recently. Digital techniques that used to be possible only with systems costing $250,000 now are available for perhaps one-tenth to one-fifth that amount. Although the larger and more sophisticated systems do offer additional features, even personal-computer-based digital editing systems are finding a home in radio and TV stations. As digital editing stations continue to improve and costs are lowered, more stations will move from analog to digital production systems.

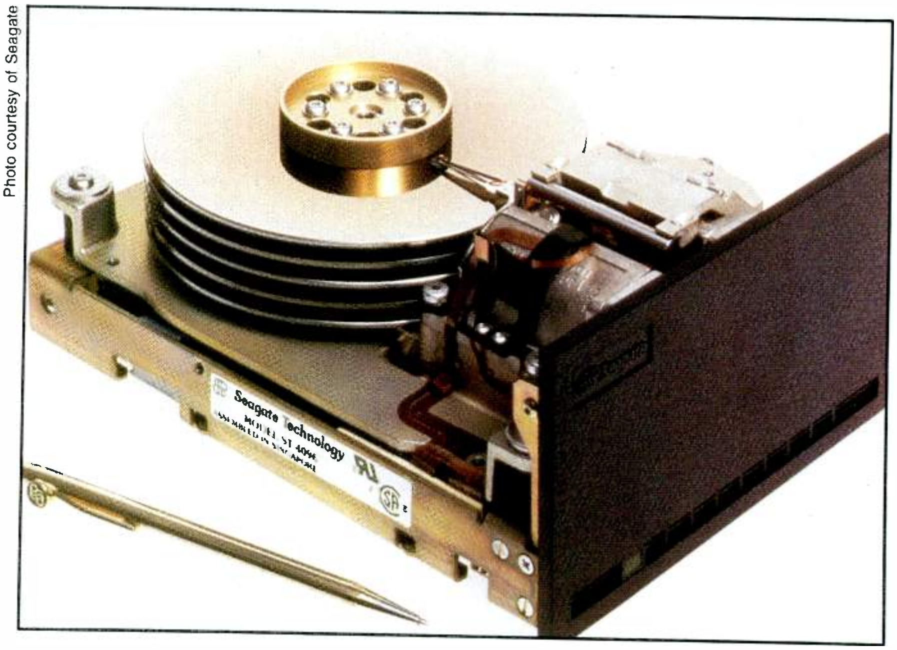

Photo courtesy of Seagate

Digital benefits

Analog signal processing is a mature technology, and the quality of analog


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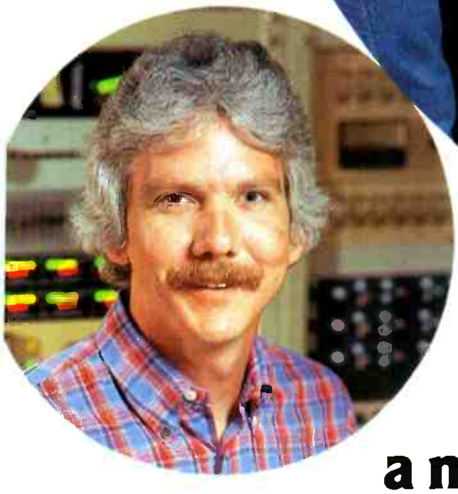

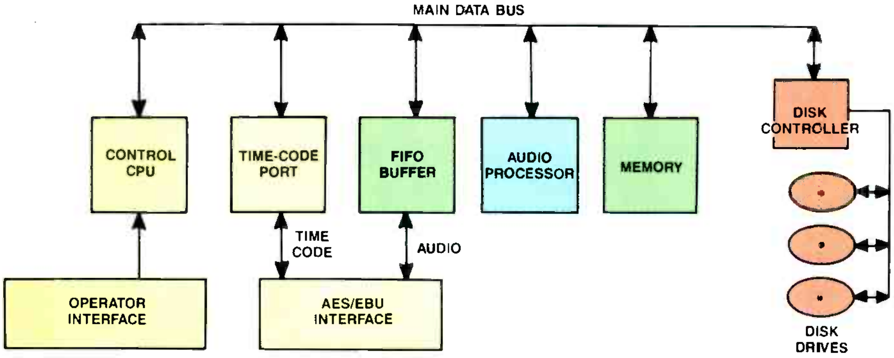

Figure 1. *The major components of a digital editing system resemble those of a computer. A key element in both systems is the hard disk storage system.*

broadcast signals can be quite good. Even so, digital processing of audio has many unique advantages. At some stations, the advantages offered by digital production systems are not only thought to justify their cost, but also result in new marketing tools.

In the hands of a skilled operator, a digital editing system can produce sophisticated audio effects. Some of these effects, even if they could be accomplished in the analog domain, would be costly and time-consuming. Today's digital systems offer comprehensive audio processing, including equalization, mixing and dynamics. The precise control offered in the digital domain allows production techniques never before possible.

Rotary storage

The block diagram of a typical digital recording and editing system is shown in Figure 1. Comparing this diagram to that of a computer reveals many similarities. In fact, many of the circuits used in today's editing systems were developed for the computer industry.

An important key to sophisticated digital editing is the hard disk. Although digital audio processing has been possible for some time, the availability of high-capacity, low-cost disk drives may have been the key to making digital recording and editing cost-effective.

The first hard disk drive was built by IBM in 1953. It contained 50 disks, each measuring 24 inches in diameter. Despite its size, the huge drive stored only 5Mbytes of data. Fortunately, the personal computer industry created such a demand for digital storage that technology and American enterprise improved upon the original idea.

The advent of the personal computer, or PC, was the genesis of today's small disk drives. The PC disk drive became popular in 1980. Early designs boasted a 5Mbyte, 5-inch disk with an access time of 170ms. The drives were expensive too, costing $1,500. Today, only eight years later, a 20Mbyte drive with a 65ms access time costs less than $300. Disk drive manufacturers now can produce a hard disk drive for approximately one-tenth of what it would have cost only seven years ago. As

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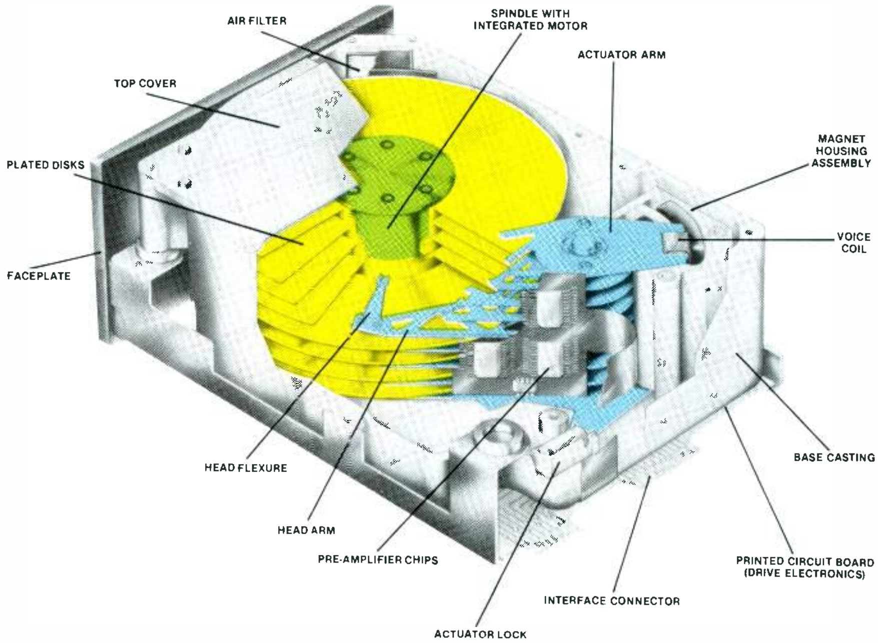


Figure 2. *A typical high-capacity disk drive, shown in cutaway form. As many as eight platters, providing 15 surfaces, are available for data storage. The 16th platter surface contains the manufacturer-recorded servo information.*

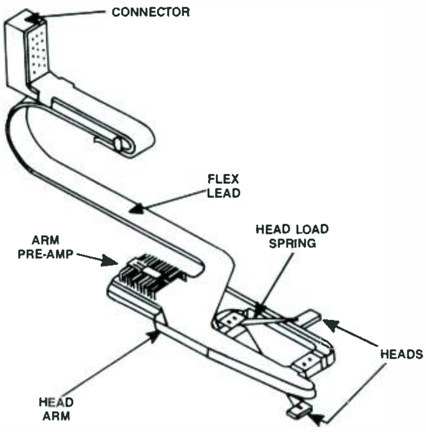


Figure 3. *Typical head-arm assembly. The head-load spring helps position the head correctly above the disk. At the proper rotational speed, the head rides 10 to 18 micro-inches above the disk on a cushion of air developed by the spinning disk.*

drive manufacturers improved their designs, more storage became available. This additional storage approached hundreds of megabytes and, coupled with faster access times and improved reliability, it made the technology ripe for audio applications.

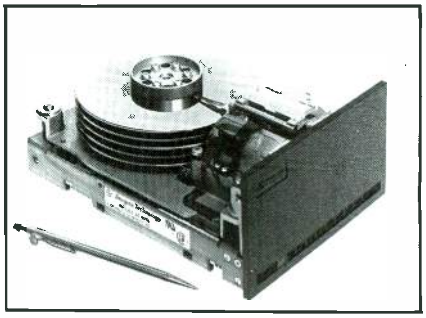
Basic system

A hard disk drive is similar to a floppy drive in that a circular medium or platter is used to store the data. However, the floppy drive spins at 360rpm, and the hard disk spins at 3,600rpm. (The exact speed is manufacturer-dependent and of little importance to the user.) The major components within a disk drive are shown in Figure 2.

Disk drives usually provide several platters for data storage. One or both sides of the platters can be coated for recording. The more platters (surfaces) a drive has, the more available storage. Each recording surface has one or more read/write heads. However, unlike the floppy drive, in which the read/write head touches the media, hard disk read/write heads do not touch the disk surface.

The high storage capacities are achieved, in part, by increasing the relative head-to-media speed. Today's disk drive produces a head-to-media speed greater than 100mph.

To read the data at such speeds requires that the head be placed extremely close to the media surface. Using a bit of aerodynamics, the head flies 10 micro-inches to 18 micro-inches above the disk on a cushion of air. This phenomenon resulted in the term *flying head.* Balanced against the air cushion is a small head-load spring, shown in Figure 3. The spring forces the read/write head toward the disk surface. The air pressure between the head and surface varies according to disk speed. At the proper speed, the force of the head-load spring pressing the head toward the disk surface and the opposing force of the air cushion are balanced. This



In a high-capacity drive, there may be up to two recording surfaces per platter, each with a read/write head and a common voice-coil actuator.

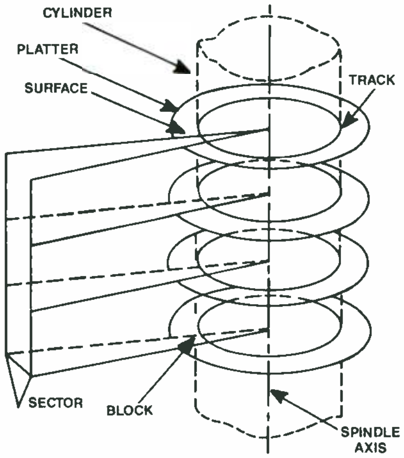


Figure 4. *Disk terminology. Tracks are narrow concentric bands that cover the disk surface. Cylinders are the vertical shapes representing all tracks of the same radius. A sector is the angular subdivision of a track. A block is that part of a track within one sector. Each block has a unique cylinder, head and sector address.*

permits the heads to fly at the correct height above the disk.

Because of the high relative head-to-disk speed, the last thing you want is for the head to touch the disk. Such an event is known as a head crash or disk crash. If this happens, both the disk and head may be destroyed. Even if the parts are not destroyed, important data could be lost. Fortunately, today's hard disk drives are quite reliable, and head crashes are quite rare.

Assigning space

Engineers unfamiliar with computer technology may be confused by the recording scheme used in disk-based recording systems. Unlike tape, digital storage is

Continued on page 68

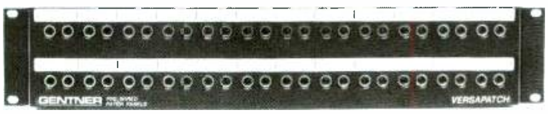
UNCOMMON STOCK

If you could solve the lion's share of your equipment needs in one place, you could spend less time running from dealer to dealer, catalog to catalog, and more time running your operation. That's why Gentner Electronics, with over 72 high performance products in stock, is an uncommon company providing innovative solutions to your common problems.

VRC 1000

Digital Hybrid

Routing Distribution Amplifier



Versapatch

Solutions like the VRC-1000 Remote Control which has allowed countless engineers to monitor and operate their transmitters through any Touch-Tone™ phone. A preprogrammed synthesized voice gives you the parameters, you make the adjustments with the touch of a button. Nothing is simpler or more dependable.

Our Digital Hybrid™ is another example of innovation in our line of telephone interface products. It is an auto-nulling telephone hybrid with precision filtering and noise reduction. It solves your interface problems and uses advanced digital signal processing to analyze, isolate and stop leakage between receive and send signals. This greatly reduces the "hollow" sound that plagues broadcast or teleconferencing applications.

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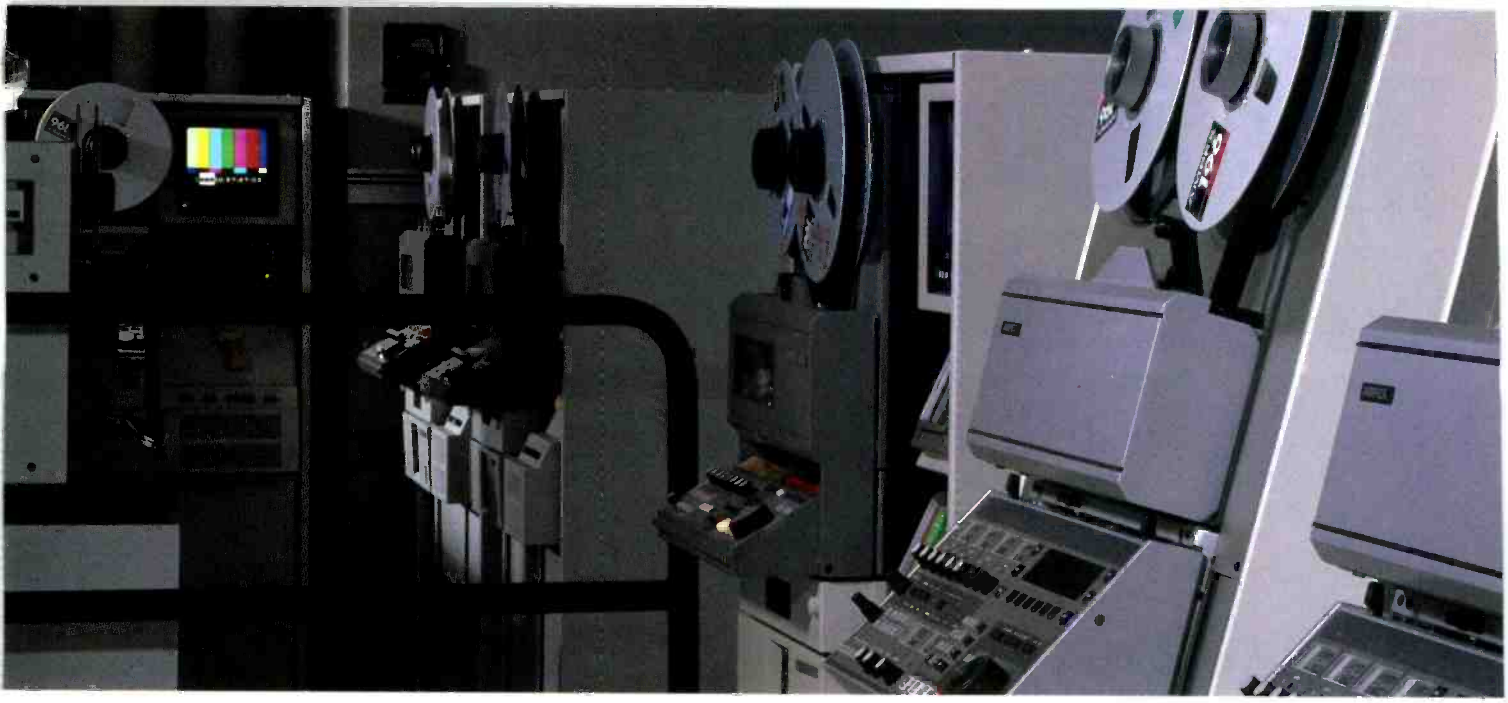
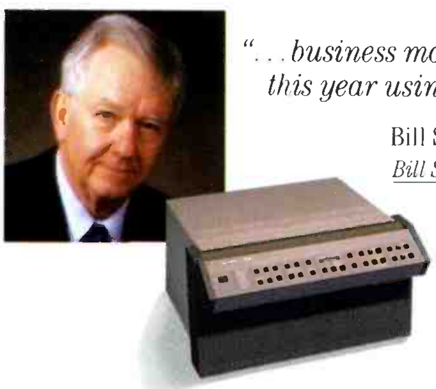


A convincing argument for Type C from a company that invented D2.

We didn't spend five years pioneering the world's first D2 composite digital recorder just to win technology awards—selling D2 machines is one of our top priorities.

But another and even more important priority for us is to make sure that the video professionals we serve have appropriate equipment for their jobs. And that they continue to look to Ampex



". . . business more than tripled this year using Type C . . ."

Bill Stokes,
Bill Stokes Associates

Ampex Zeus Advanced Video Processor

for the straight story about that equipment and its applications.

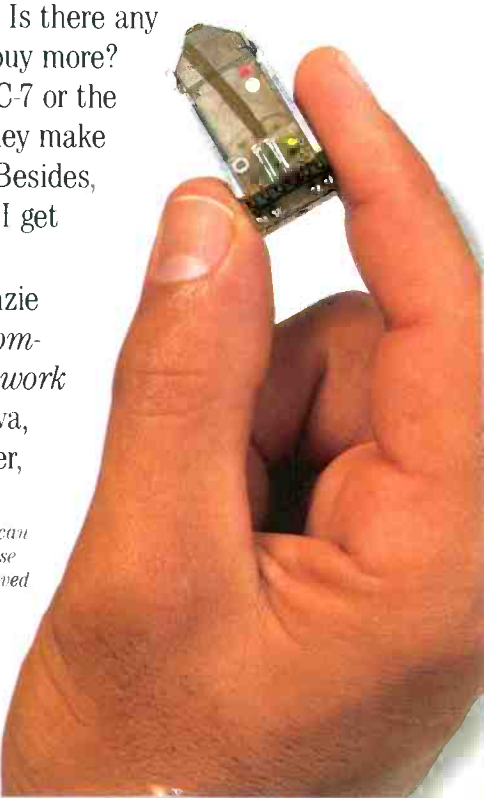
A case in point is the question we recently asked several of our customers who purchased Type C *after* we introduced D2.

"With the introduction of D2, why did you purchase Type C?"

We think the answers we got may interest you if you're considering the purchase of *any* video machine.

Bill Stokes (*Bill Stokes Associates* in Dallas), came right to the point. "My business has more than tripled this year, and I'm using Ampex Type C machines. Is there any better reason to buy more? With the new TBC-7 or the Zeus processor they make perfect pictures. Besides, I like the service I get from Ampex."

Jerry McKinzie with *Cycle-Sat Communications Network* in Forest City, Iowa, (a satellite courier,



The VPR-80's Automatic Scan Tracking head and its erase head are both easily removed and replaced with only a screwdriver.

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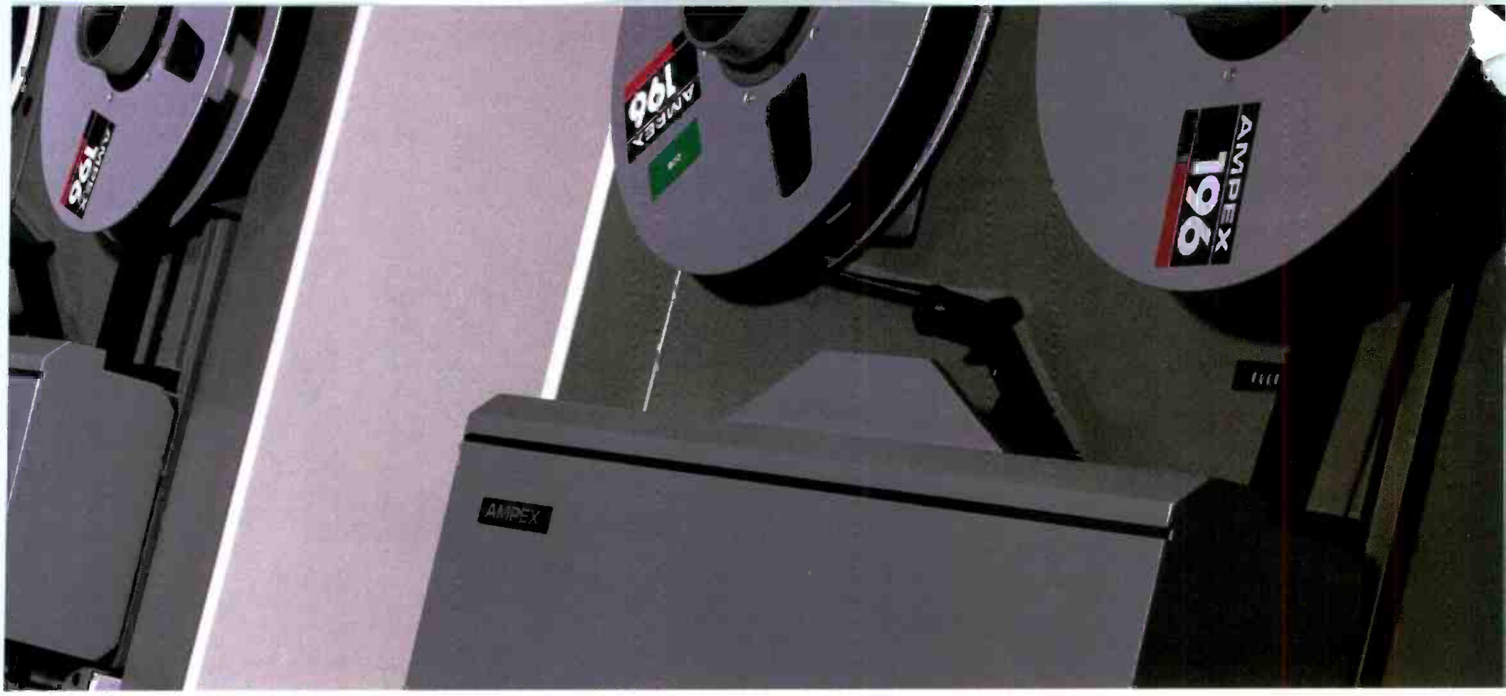
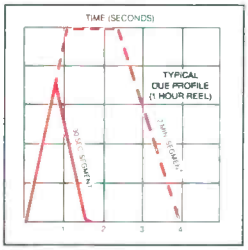


production, and post-production business), thinks it's important to be able to update easily as his business changes. "The hardware and software upgrades Ampex makes in their equipment allow me to keep my facility current, and to always give my customers the newest look. I like that, and my customers demand it."



The VPR-3's incomparable acceleration allows a 30 second segment to be re-cued and synchronously played in 2 seconds, using one hour reels.

Darrell Anderson, whose company *Anderson Video* in Los Angeles, recently purchased several

". . . Type C business is readily available . . ."

Darrell Anderson, *Anderson Video*

VPR-3s, pointed out that the Zeus port allows interface with D2. Darrell believes that, "Type C and D2 will co-exist successfully in a well-managed facility. Type C business is readily available." We were gratified to hear that he, "bought the best Type C machine he could find."

Consider your purchase decision carefully. When the excitement of a new equipment introduction passes, and you've put the pros and cons down on paper, Type C may be exactly the right machine for your application. After all, it's still the world's broadcast interchange and distribution standard.

". . . hardware and software upgrades keep my facility current . . ."

Jerry McKinzie,
Cycle-Sat Communications Network

And it is obviously the perfect choice for facilities that are moving up from ¾-inch.

We'd like to be involved in your decision-making process, and we're as close as your telephone. Call your nearest Ampex sales engineer at an office listed below or call 1-800-333-1234 for some real help with a difficult decision.

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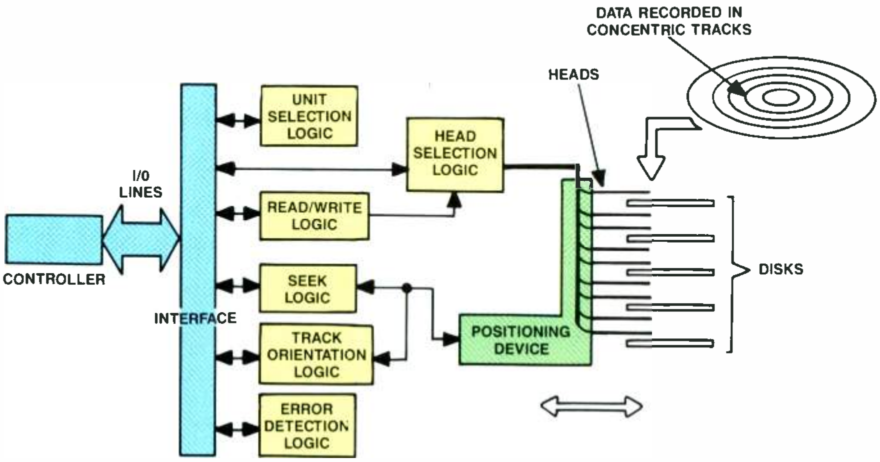


Figure 5. *Functional block diagram of a 5-platter drive. All drive activities are directed by the controller.*

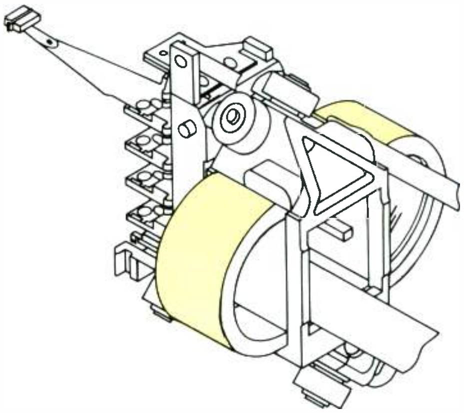


Figure 6. *This 5-platter carriage provides one head for each recording surface. Only one head is shown for clarity. The shaded area represents voice-coil wiring.*

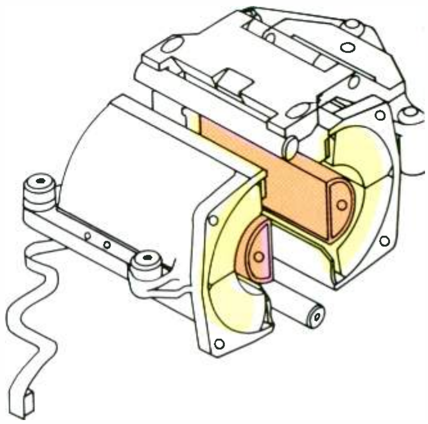


Figure 7. *Voice-coil drive. Shaded areas represent the inner and outer magnetic assembly.*

Continued from page 64

not *assigned space*. A stereo editing system does not physically assign space within the drive for each channel of audio.

The audio is stored in blocks of data throughout the disk. A continuous sound needn't be recorded in continuous blocks or sectors. You may have encountered the term *fragmented file* with your computer. This simply means that the blocks of the file are spread throughout the disk, rather than in a continuous form. About all this means to the user is that accessing the data may take more time. This access time becomes important, however, as you will see.

In theory, the hard disk can be divided into as many output channels as desired. However, as the number of output channels increases, the heads must access more and more data almost simultaneously. Even with a large buffer, the seek times become a factor. With today's systems, a total of eight output channels is considered the practical limit.

Storage capacity also determines the maximum available recording time. Assuming 800Mbytes of storage, more than 138 minutes of monophonic storage is possible. Doubling the number of tracks, from mono to stereo, would reduce the available playing time by half, or 69 minutes.

In a practical sense, multitrack applications seldom require as much storage space as originally thought. Unlike a tape, all the tracks in a hard disk system are not recorded continuously. Some tracks may contain only brief selections or cuts used sporadically in the final mix. A tape machine must allocate an entire track for these effects, thereby requiring more real-time storage space. The disk system must only provide sufficient space to hold all

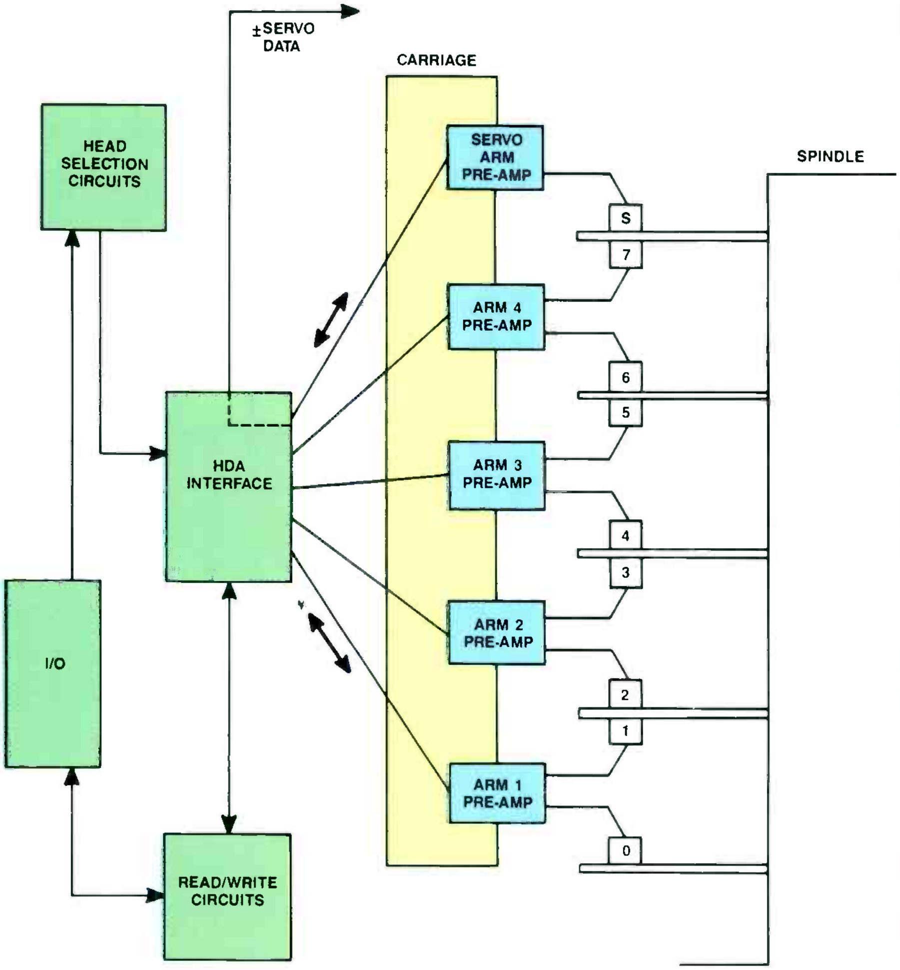


Figure 8. *Typical 9-head control assembly provides eight data recording surfaces. Note that the upper platter surface is devoted to servo data.*

the desired samples. This means that the total playing time may be greater than expected.

Arranging the data

Each drive is composed of three to eight platters. Depending on the design, data may be recorded on one or both sides of each platter. Figure 4 illustrates how the data is arranged within the drive.

Concentric circles (*tracks*) are created on the platter as the disk records the data. This is unlike a record, where a continuous track extends from the outside to the inside of the disk. *Cylinders* represent the vertical set of similarly placed tracks.

Each disk surface is divided into pie-shaped patterns called *sectors*. A *block* represents that part of a track within one sector. This arrangement allows each block to have a unique location composed of cylinder, head and sector address.

Positioning the heads

The key to rapidly accessing the data is an efficient head-positioning system. Early disk drives relied on stepper motors and linear drive shafts. As the stepper motor turned once, it advanced the actuator arm one track on the disk. Twenty motor rotations placed the head at track 20. Drives with access times 65ms or slower rely on stepper motors.

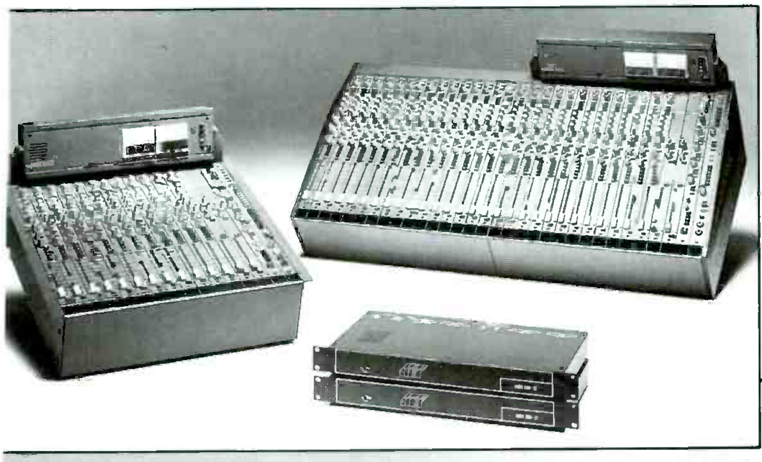
High-capacity drives use multiple platters, and they may rely on one read/write head for each recording surface. A functional block diagram for a 5-platter drive is shown in Figure 5.

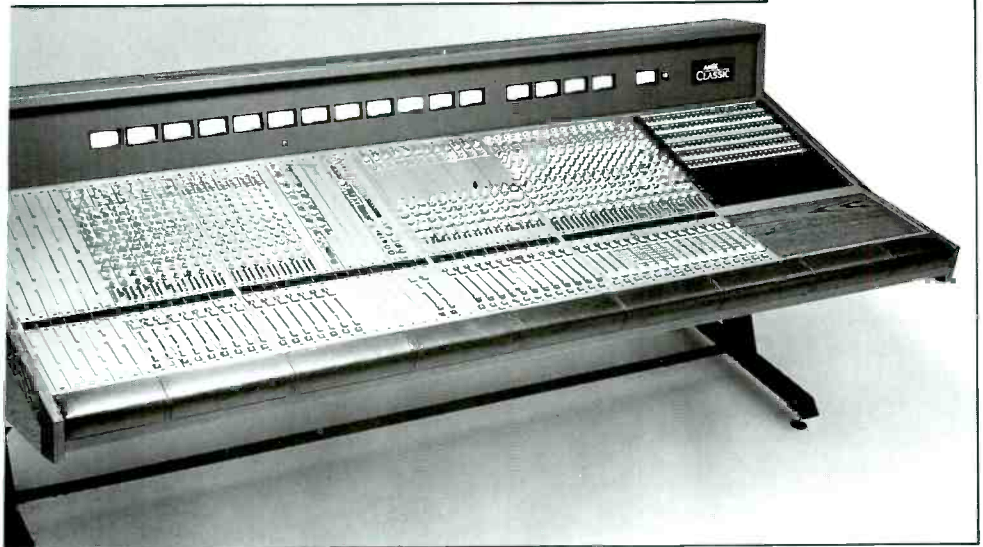
The mechanics required to position individually nine separate heads would be extremely complex and costly. The solution is to mount all the heads on a single carriage assembly like that shown in Figure 6. The drive then can electronically switch between the heads, or recording surfaces, as desired. (Note that, for clarity, the drawing shows only one head attached to the carriage assembly.)

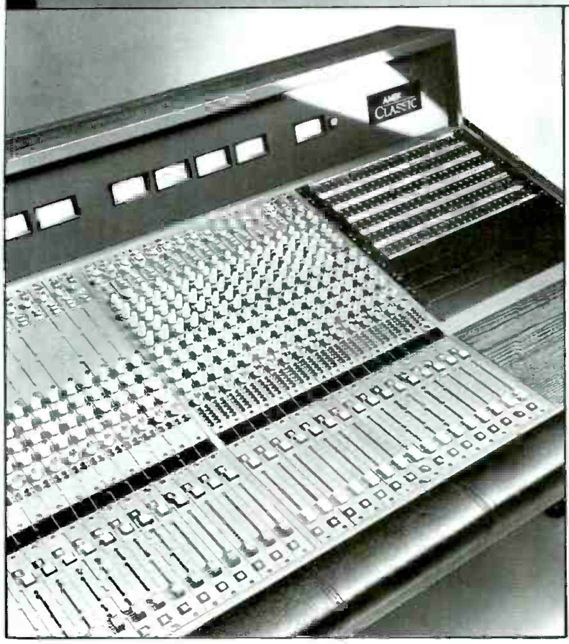
The carriage assembly is mounted within a permanent magnetic structure shown in Figure 7. The heads are posi-

Continued on page 74

Versatility, responsiveness, and a total solution to broadcast audio mixing from Amek







AMEK's large range of advanced audio consoles offers an unequalled choice to Broadcast and Video Post facilities.

For situations where compactness and simplicity of operation count, AMEK BCII has many desirable features. The BCII equipped with our ESM32 AFV (Audio Follow Video) interface provides a simple package solution to problems of integrating a complete audio control system into a Video Edit environment. BCII/ESM32 provides quality audio - not 'video' audio - with monitoring and preview of audio sources. Audio can follow or be independant, and various cross-fade patterns are allowed for. The protocols support a vast range of equipment from major editor suppliers such as AMPEX, CMX, GRASS VALLEY and PALTEX. Standard AMEK-specified packages of desk and interface are readily available, but custom flexibility is catered for.

Beyond the package stage, AMEK BCII offers a wide range of options. CONFIGURATIONS as diverse as a simple 6-in, 1-out through to 24-in, 4-subgroup, 2-out can be provided with ease.

MODULES include Mono and Stereo inputs, Mono and Stereo subgroups and outputs - with or without Dynamics - and several monitor sections for all control room, studio and production gallery requirements.

CHASSIS not only include 16, 24 and 32-position frames in table top, drop through and portable formats but also a complete free-standing studio desk which can include jackfields and extra racking space.

METERING is moving coil-type and options include VU,BBC and DIN-spec PPM.

AMEK CLASSIC is built on a much larger scale and is eminently suited for use not only in Broadcast and Video production but also in Film Post, with or without multitrack Buss/Tape monitoring facilities.

Many configurations are possible. Standard features include 4-band fully-swept equalization, 8 auxiliary send busses, 8 mono or 8 stereo subgroups, and two seperate stereo busses.

Stereo input modules are fully M/S capable and Image Width control as well as Pan is provided. DYNAMICS modules which include compressor-limiters and expander-gates can be fitted.

CLASSIC is also available with the GML Moving Fader automation system for up to 96 faders, or with various VCA-based systems if less sophistication is required.

Beyond this, various multitrack and video-post production console exist in the general range, including AMEK G2520 and the fully-digitally-controlled APC1000 which features Recall, Reset and Assignable system.

AMEK consoles are used in many of the world's major production facilities, such as the BBC, ITN, MOLINARE, NBC and THAMES TV. We have a complete capability and without doubt are counted as one of the world's leaders in audio mixing technology.

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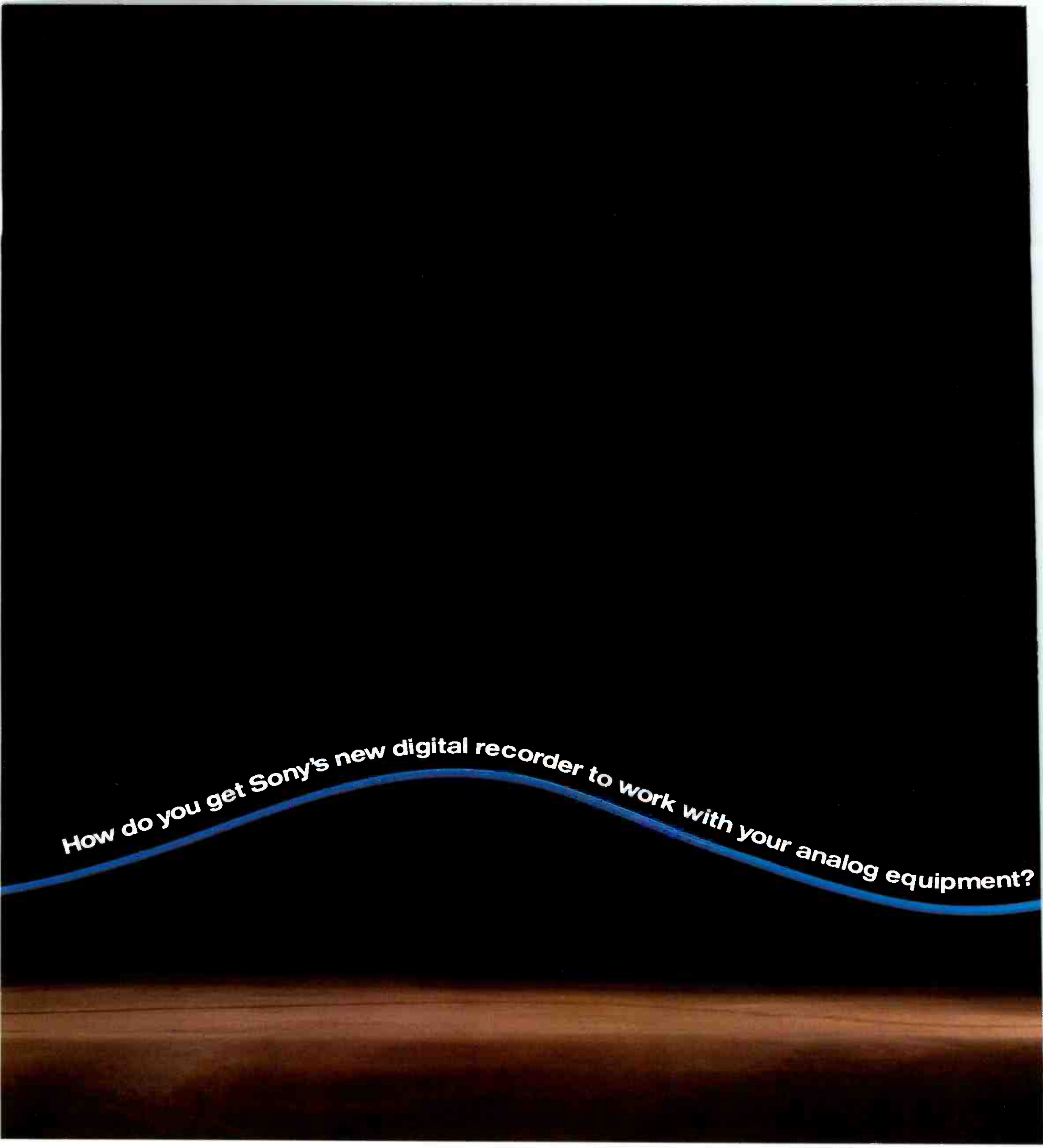
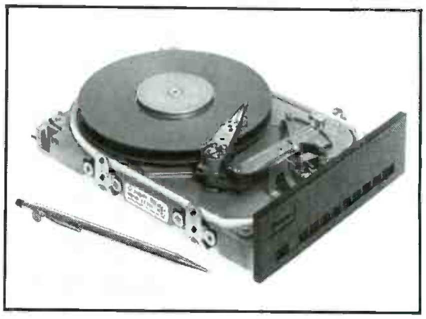


You can slip Sony's new composite digital video recorder right into your current editing suite. With its analog inputs and outputs, it connects directly to your existing equipment.

Yet it does what only digital can do. For example, the Sony DVR-10 composite DTTR gives you more than 20 generations of transparent digital dubbing. And with its write-after-read capability, one machine can operate simultaneously as both a source and recorder.

The DVR-10 is physically small—half the size of a BVH-2000 recorder—and its price is as compact as its size.


SONY
D-2
Composite Digital
Just plug it in.



Today's disk drives provide high performance at a low cost. This 2-platter drive provides 20 Mbytes of storage.

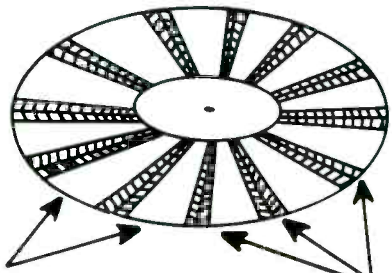


Figure 9. *Drives with only one or two platters rely on servo information embedded between the data to control disk movements.*

Continued from page 70

tioned by moving the entire assembly in and out of the magnet. The scheme places all the heads over identical tracks on each platter.

Engineers may recognize this design as being similar to a speaker *voice coil*. In fact, drives that use this head-positioning technique are called voice-coil drives. The design permits rapid and highly accurate head positioning. Although more expensive than the servo design, voice-coil disk drives are much faster, with access times often less than 16ms.

Servo systems

Finding the desired data on a drive is a complex task. The key is knowing where the heads are positioned currently. This is where the servo system comes into play.

The drive reads to and writes data from the platters under the direction of the controller. These operations cannot be performed randomly. Otherwise, it would be impossible to later recover the recorded data.

A reference map, called servo data, is prerecorded by the manufacturer onto one of the platter's surfaces. In a multiplatter drive, one entire disk surface may be devoted to servo information. The top disk surface in Figure 8 contains the servo information. This technique won't work with single-platter systems. Dedicating an entire platter surface to servo information

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How can we make a full-featured, dual channel still store for less than the cost of other single-channel systems? Simple. We've been doing it for years. In fact, ALTA engineers were among the pioneers of the digital still store. That's why our warranty is twice as long, and our still store gives you twice the value.

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Bandwidth	4.2 MHz (±0.25 dB)	**5.5 MHz (-3 dB)**	5.9 MHz (±5 dB)	5.0 MHz (±0.5 dB)
Signal to Noise	52 dB	**58 dB**	?	56 dB
Storage Capacity*	200 fields 100 frames	**250 fields 125 frames**	207 fields 207 frames	200 fields 200 frames
Synchronizer	—	**Dual**	—	Dual
TBC	—	**Dual**	—	—
Production Effects	1 wipe dissolve —	**9 wipes dissolve 7 digital**	1 wipe dissolve —	3 wipes dissolve 3 digital
Warranty	1 year	**2 years**	1 year	1 year
Single Channel / Dual Channel	$19,900 / $24,900	**— / $16,900**	— / $31,500	$26,333 / $30,995

*Basic System

Based on available data as of June, 1988.

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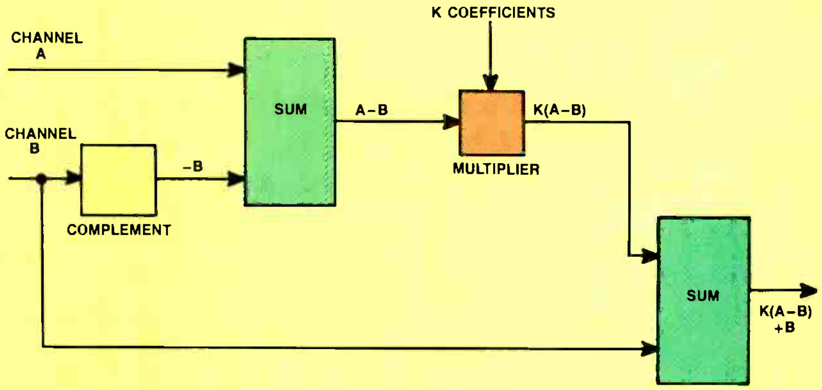
Digital effects

Many digital effects can be accomplished simply by controlling the gain of the desired channels. Cuts, fades, crossfades and other techniques all rely on gain changes.

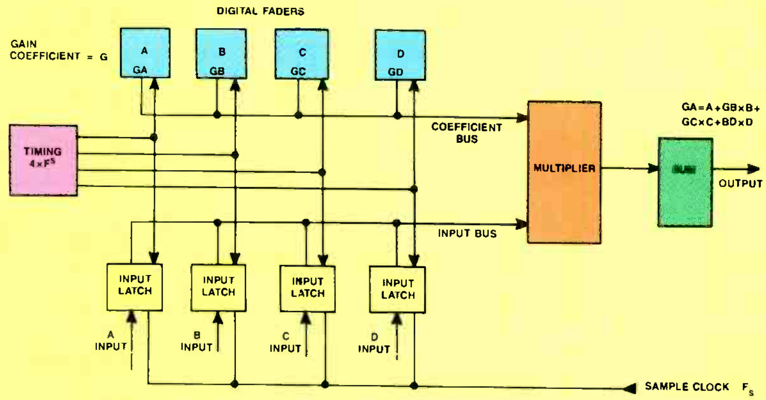
Gain in the digital domain is controlled by multiplying each sample by some fixed coefficient. If the coefficient is less than one, the gain is reduced. If the coefficient is greater than one, amplification is obtained.

Unfortunately, multiplication in binary circuits is complex, but more important, it is expensive. For these reasons, digital circuit designers often try to reduce the number of multipliers required within a system.

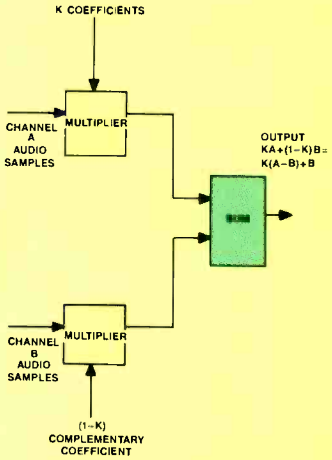
The circuit illustrated below is a simple 2-channel mixer. The two inputs are multiplied by the desired coefficients to control their respective levels, then are added to obtain a mix. This design requires a multiplier for each input channel. By rearranging the circuit, as shown in the top right illustration, one of the multipliers can be eliminated.



By reconfiguring the circuit, it's possible to eliminate one of the multipliers.



This 4-input mixer relies on time-sharing techniques. This allows one multiplier and accumulator to serve all four inputs.



Controlling gain in the digital domain requires the use of multipliers. Note that one multiplier is required for each input channel.

A digital mixer could be implemented with only one multiplier as shown above. Four audio inputs are supplied to the lower input of the multiplier. The desired gain coefficients are supplied by the digital faders to the upper multiplier input.

The timing block operates at four times the sample rate. This permits all four inputs and corresponding gain coefficients to be processed during one sample period. The multiplier's products are stored in the accumulator for one sample period. At the end of one sample period (four block periods) the accumulator holds the sum of all the products — the digital mix. The process then repeats for the next sample period.

could result in a loss of 50% of the available storage space. These drives embed the servo information between data on the platter surface, as shown in Figure 9.

The servo surface provides three basic types of information: radial head movement, rotational disk position and disk speed. The servo head is mounted on the same positioner as the data heads. Thus, movements of the servo head across the servo surface correspond exactly to movements of the data heads across the data surfaces. By reading the servo information, it is possible for the controller to precisely and quickly locate the desired data.

Filling the gaps

Because all the heads are mounted on the same carriage, each head is always positioned above the same track. What happens when an audio sample is too long to be contained within a single track? It might be possible to stop the recording process, move the head over one track

Why we called it HARRY

It sometimes seems as if the only thing we *haven't* given Harry is a proper name. But to name it, you've got to define it. We asked five users to help us out. Here's what they said:

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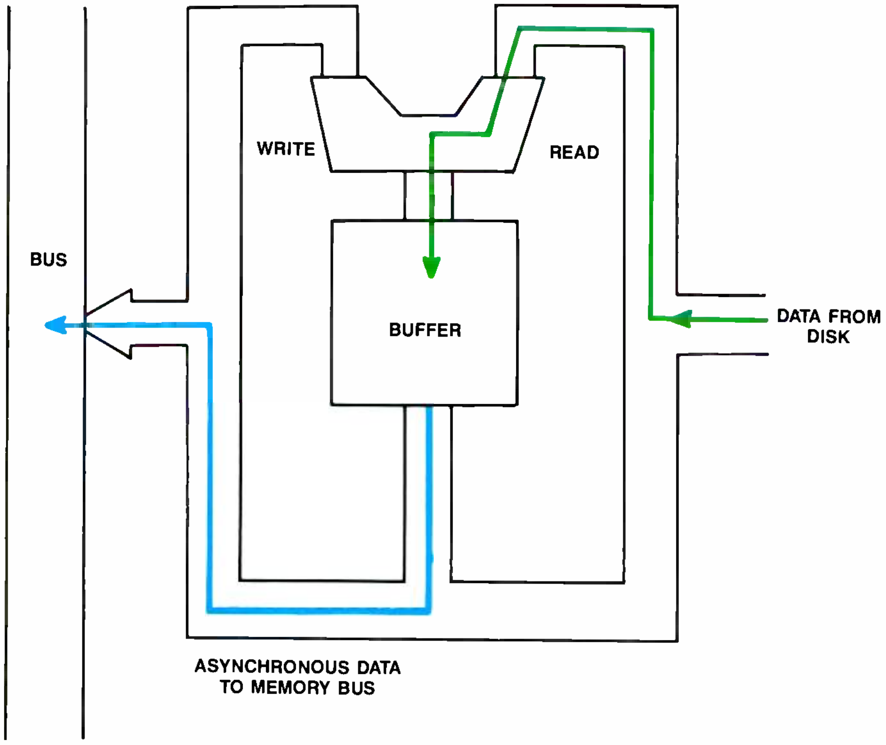

Figure 10. *The irregular intervals with which data is processed from the disk head require the use of a buffer. The buffer ensures that the asynchronous circuits are provided with continuous data.*

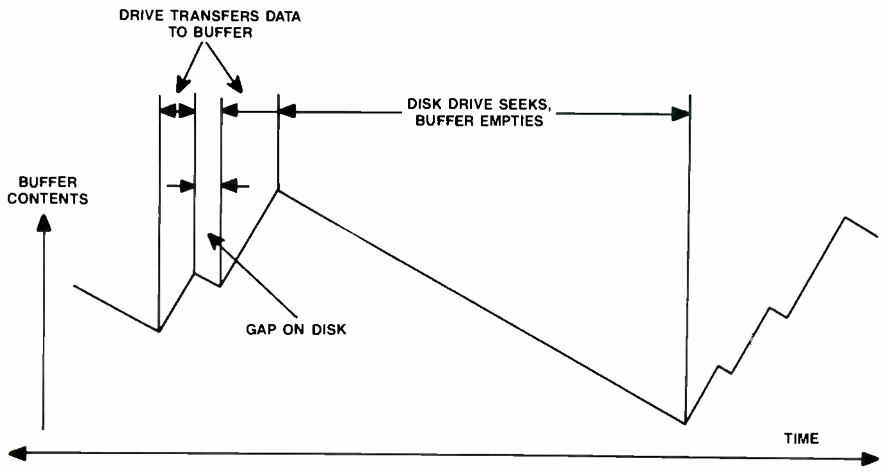

Figure 11. *During a read command, the buffer is emptied at a constant rate. The buffer is simultaneously refilled at irregular rates by the disk.*

and continue recording. However, this process would create significant delays as the head repositioned itself.

A more efficient scheme is used by the disk drive. Data that exceeds the length of a single track is written not to the next track on the same platter, but to the same track on another platter. This avoids the delay of repositioning the head to another track.

Even with this head-switching technique, today's disk drives still are not fast enough to process audio on a real-time basis. In addition, because the data is not recorded continuously, gaps in the datastream result when the information is read back from the disk.

Digital audio-processing circuits require that the data be presented on an asynchronous basis — without discontinuity. The solution lies in the use of a RAM buffer between the disk output and the audio-processing input. Data from the disk is read into a buffer, as shown in Figure 10. The incoming data is processed on a first-in-first-out (FIFO) basis.

The buffer ensures that, no matter how much work the disk drive must do to locate the data, the rate at which data is transferred to the audio-processing section is unaffected. The drive transfers the data in real time to the buffer at intervals determined by the disk and data locations. Any gaps are filled with the stored data from the buffer.

This process is symbolized in Figure 11. After the buffer contains a certain amount of data, the data is output in an asynchronous manner to the memory bus. The CPU monitors the amount of data in the buffer. If the buffer begins to near its capacity, the CPU instructs the disk controller to cease reading data.

As the data is processed out of the buffer, the level is reduced, and the drive is again commanded to retrieve data to fill the buffer.

The reverse process is used to record data back to the drive. During a write instruction, an entire block of data must be provided to the disk at one time. The CPU ensures that the buffer is prefilled before allowing the writing process to begin. As the disk drive skips bad sectors, servo gaps and moves from track to track, the buffer output is halted. Because these operations take place in milliseconds, the editing system's operation is not affected.

Editing in the digital domain

Today's digital editing systems offer so many advantages compared to traditional analog techniques that it is difficult to list all of them. Not only do disk-based editing systems allow almost instant access to recorded material, they also provide creative freedom not available in the analog domain. Most systems permit nondestructive editing. This means that the original files are not destroyed by the editing process. Every edit can be changed or modified without fear of losing the original audio tracks.

Let's see how two audio samples might be edited together. Figure 12 illustrates how audio samples, called files, might be stored on a hard disk. The files might be as short as a single sound, word or effect, or as long as a section of dialogue.

The intent is to edit the end of file A to the beginning of file B. An edit list (sequence of instructions) is produced by first locating the begin and end points of each file. This sequence of instructions forms the basis for the action to be taken by the editing system.

The disk controller first will locate file A and place it in memory. As the edit point approaches, the controller also places blocks of file B into memory. The

What's in the Winchester name?

The term "Winchester" has been applied to hard disk drives since their early development, but it's not clear where the name originated.

Two competing explanations cite IBM's use of the term as an interim code name for its model 3340 direct-access storage device, or DASD, introduced in 1973. One theory says the name was based on the device's original "30-30" design, which relied on two 30Mbyte hard disk modules. According to this theory, the drive was named after the famous Winchester 30-30 rifle. The second theory points to IBM's development laboratory located in Winchester, England. This location was responsible for much of the company's research into hard disk storage devices.

A more American theory also is based on geography. Many of the early third-party hard disk manufacturers were located in Silicon Valley. The manufacturers were located on a street named — you guessed it — Winchester Road.

Perhaps the most plausible answer comes from Ken Haughton, dean of engineering at Santa Clara University, Santa Clara, CA. Haughton named the IBM prototype that later became the model 3340. He indicated that his inspiration was his own Winchester 30-30 rifle.

The term now is applied to any hard disk drive, no matter what size or manufacturer.

combination of fast access times and the buffers permit the drive to perform such seemingly simultaneous tasks. Before the edit point, only file A will output to the audio-processing circuits.

As the edit point approaches, samples of both A and B files are accessed and fed to the audio-processing circuits to create a crossfade. The crossfade becomes the edit. The operator can determine how rapidly the crossfade is performed. Once the desired edit is achieved, the system can record the final result. Until this point, the edit has not been stored, nor has the original data been modified. For a further explanation of how gain is controlled in the digital domain, see the related article, "Digital Effects."

Purchasing considerations

It's probably safe to say that if you've seen a skillful operator using a digital editing system, you want one too. The results produced on even a medium-priced system seem almost magic. However, before you try to convince the station manager that your station needs a digital workstation, give the matter careful thought.

First, be sure you understand thoroughly what to expect from the editing system. Your application should determine the desired features. For instance, will you need to sync audio to video? Is control over other devices or SMPTE time code important? Are selectable sampling rates important? How many output channels are needed? What types of I/O are required, analog or digital?

Second, consider carefully the human interface or work surface. Some editing systems rely on computerlike or piano-type keyboards. Other systems offer hybrid interfaces consisting of faders, scrub knobs and keyboards. Some workstations rely on touch-screen or graphic-tablet designs. This portion of the system is perhaps more critical to the creative effort than any of the digital processing. Be sure that the operator interface you select is compatible with the abilities and desires of your staff. Don't overlook the comfort factor. Your operators will be spending a lot of time with the system. It's crucial that the operators find the work surface comfortable.

Long-term considerations also are important. Will the hardware selected today be compatible with tomorrow's options? Can portions of a system be upgraded, or will the entire system need to be replaced? Will future software enhancements work on your current system?

Finally, don't overbuy in the beginning. It's unwise to purchase more system than you really need. Instead, buy expandability. It makes economic sense to wait until technology reduces upgrade costs, especially with systems requiring large amounts of RAM storage. The price of the ICs used in RAM has risen dramatically over the past year. Only now are prices beginning to drop. It may be in your best interest to hold off purchasing large amounts of RAM until prices fall.

The digital advantage

Today's engineer is faced with implementing digital technology in many areas. For the past several years, that technology has been directed toward equipment control and business applications. Now the computer age has reached the audio-production area. Although early claims of all-digital on-air playback have not yet been realized, that day may not be too far off.

A few years ago, the advent of digital TV production techniques resulted in a visual battle among stations. It seemed that every station was trying to outdo the next by using more flying screens and fancy graphics than the next station. It became almost impossible to watch a local commercial or newscast without being overwhelmed with examples of digital production effects.

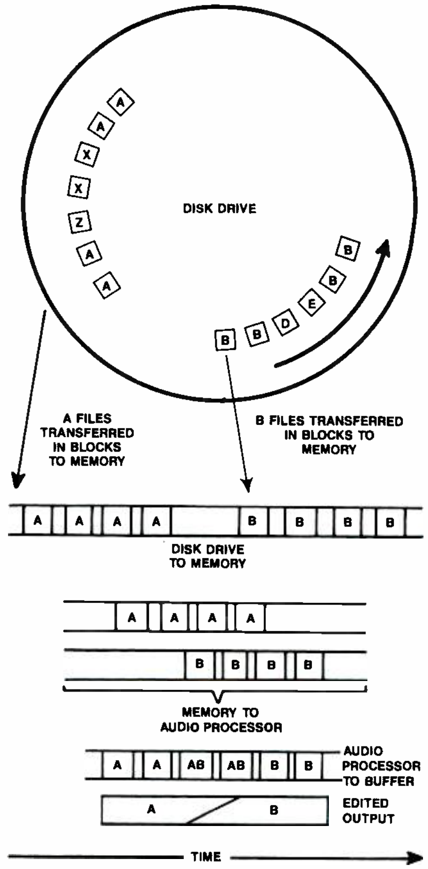

Figure 12. *Editing audio samples together. The audio data is stored as files spread throughout the disk. Blocks from files A and B are brought into RAM sequentially. The audio processor, under control of the system software, accesses both files and performs a crossfade between them.*

Could a similar practice develop with audio? Will stations flood the airwaves with examples of digital looping, synthesized sounds and fancy editing just to exhibit their new-technology device? Perhaps not. The stations that use the new technology effectively will be the ones to reap the benefits.

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MIDI: What's in it for broadcasters

By Richard Maddox

A new interface standard opens the door to inexpensive digital production techniques.

It doesn't take a degree in electrical engineering to interface today's digital audio production equipment. Thanks to a relatively new standard called MIDI (musical instrument digital interface), it's now easy to add sophisticated and versatile control functions to your production studio.

Musical interface

The original MIDI specifications were aimed at developing a standard method of interfacing digital synthesizers and musical instruments. The intent was to come up with a common interface similar to the RS-232 used for computers. A key requirement was that the interface be inexpensive and flexible. Manufacturers recognized the importance of such a standard in extending a product's useful sales life.

Similar to RS-232 protocol, the MIDI standard uses a current loop to send logic highs and lows between equipment. A MIDI logic low is represented by a 5mA current at 5Vdc. A logic high is represented by no current flow. A MIDI input (IN) circuit converts the current loop into standard TTL/CMOS logic levels. The MIDI output circuit (OUT) reverses the process, switching the current on and off in response to TTL/CMOS level commands. The rate at which data is transferred in MIDI is 31,250b/s ±1%. Because the system uses asynchronous communication, each byte contains 10 bits (eight data and two start/stop).

Maddox is an audio engineer for Muzak, Seattle.

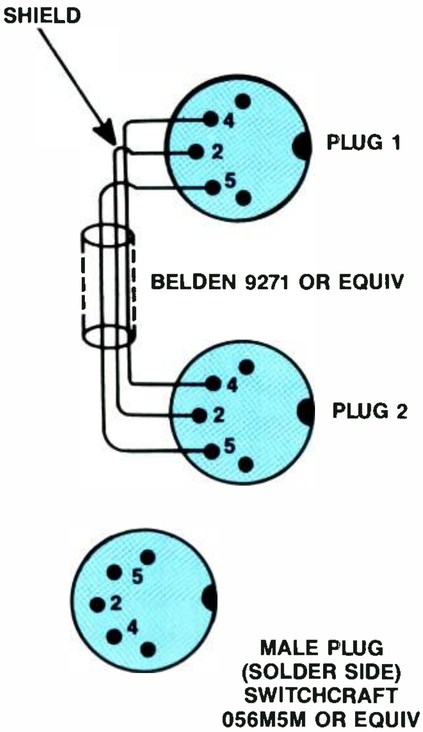

Figure 1. A MIDI cable uses a twisted-pair cable, terminated in a 5-pin DIN connector. Note that the cable shield is tied only to pin No. 2. There is no connection to the connector case.

MIDI hardware

A standard 5-pin DIN connector and shielded-pair cable is used for all MIDI connections. The MIDI standard specifies three types of ports: *MIDI IN*, *MIDI OUT* and *MIDI THRU*. Each port is labeled next to the connector. Almost any type of low-capacitance, low-loss cable can be used to interconnect equipment.

Connector wiring for MIDI plugs is shown in Figure 1. The center pin (No. 2) is connected to the cable shield. This pin is grounded to the chassis only on the MIDI OUT connections. Pin No. 2 on the MIDI IN is floating from the chassis. This provides ground-loop isolation, which is a major MIDI feature. Pins No. 4 and 5 carry the current loop signal. Pins No. 1 and 3 are unused under the MIDI specification. (Note that the Atari ST computer uses pins No. 1 and 3 as a MIDI THRU output, which requires the use of a Y-cord adapter.) Unlike the XLR connection method, all cables use male plugs, and chassis connectors are sockets.

Typical MIDI IN, OUT and THRU circuits are shown in Figure 2. Pins No. 4 and 5 carry the current loop signal among devices. An optical isolator is used on input circuits to translate the MIDI current into TTL/CMOS receive levels. The MIDI OUT circuitry converts the TTL/CMOS logic highs and lows into the proper levels to drive the current loop. MIDI THRU is simply a MIDI OUT circuit that is connected to the output of the MIDI IN optocoupler.

MIDI software

The MIDI software specifications are not as tightly defined as the hardware specifications. This allows manufacturers to add features as new products develop. (Any additions to the software specifications must be approved by an international pair of governing bodies.) The open-architecture approach to software encourages manufacturers to adopt and support the MIDI interface standard without fear of obsolescence.

The serial datastream is sent to all devices connected in the MIDI chain. Much like a computer bus, all devices connected receive all the data. This means that each device must be addressable if the system is to perform properly.

The data signal consists of three parts: *channel messages*, *system messages* and *timing signals*. The datastream is further divided into information packets representing up to 16 separate channels. Data that is specifically directed to one of these 16 channels is preceded by a channel message. The desired channel is awakened to receive and process the data that follows. Typically, a channel message contains both voice and mode data.

Combined with the channel data are system messages. A system common message is received by every component in the chain. The message generally contains status information such as tune request, song select or song position. *System exclusive* (SysEx) messages are generated specifically for use by one device. These messages typically contain specific patch parameter setup information or sample retrieval information.

Timing messages often are referred to as system messages because they fall under the *system real time* classification. These messages contain timing data to be used by sequencers, drum machines and SMPTE-to-MIDI converters to control sound-generating components.

MIDI time code

Only two time provisions originally were designed into the MIDI specification: timing clock pulses (clock) and a song position pointer (SPP). The lack of a frame-based clock timing reference proved to be a drawback for broadcast and video post-production applications. Since the early MIDI specifications were developed, software and hardware enhancements have eased the MIDI-to-tape machine interface problem.

The MIDI clock is a time reference — a single-byte word that occurs every 1/24th of a quarter note. The clock was designed to designate tempo. The SPP is a 3-byte word containing a status byte and two databytes. It's used to identify location within a song (or sequence). Note that neither reference is based on a real-time clock, but rather on the tempo.

Because SMPTE time code is the common method of synchronizing tape machines, it wasn't long before SMPTE-to-MIDI converters began to appear. First-generation converters took the SMPTE

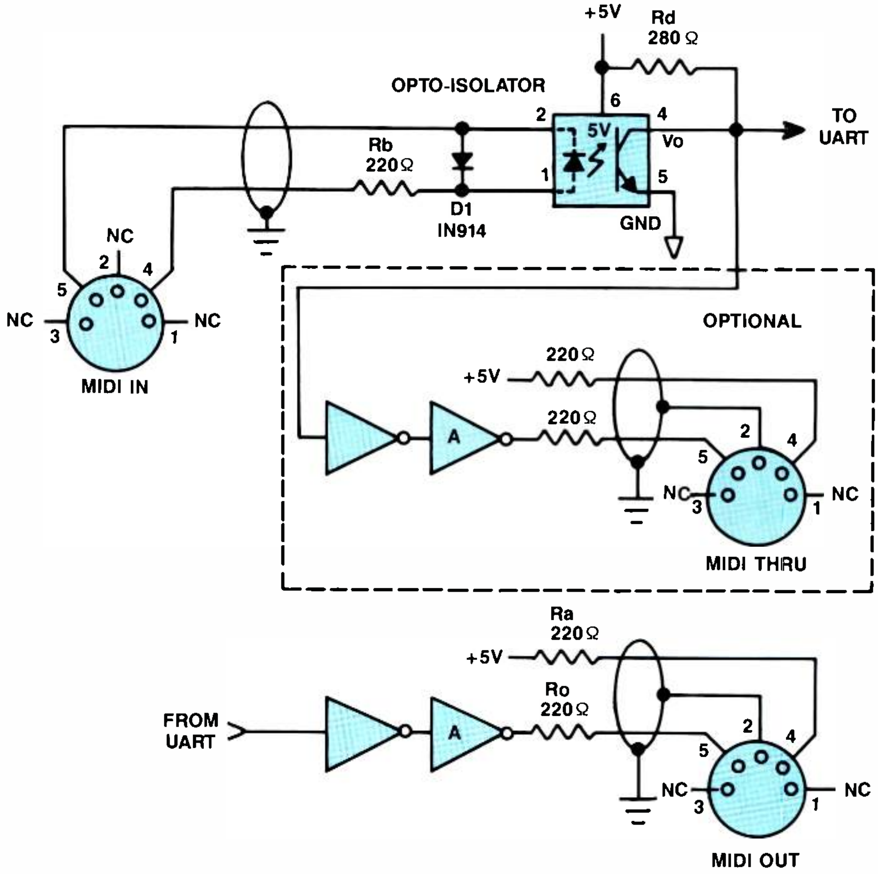

Figure 2. *Typical circuitry for MIDI IN, OUT and THRU jacks.*

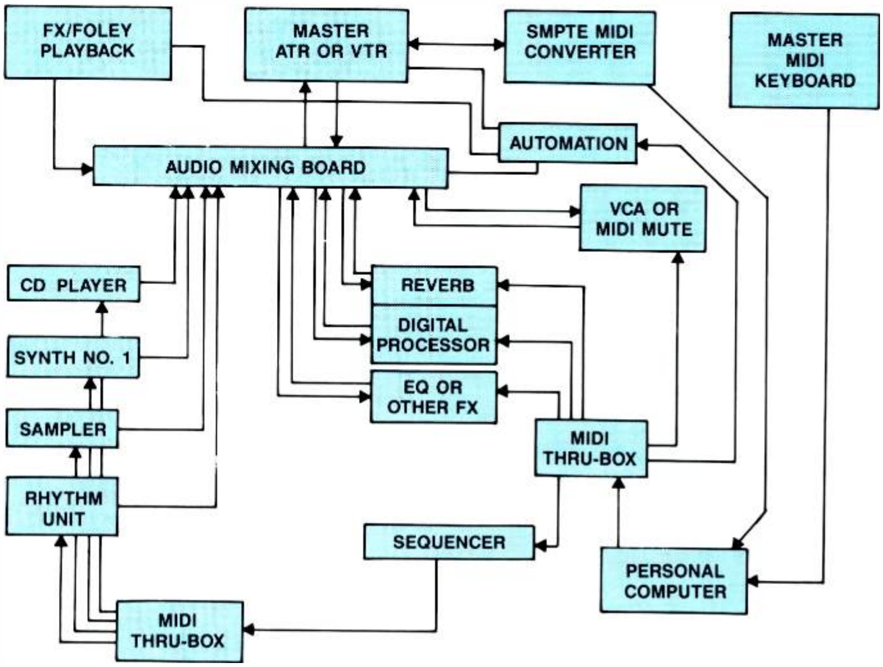

Figure 3. *A typical MIDI implementation for post-production work. Notice that there are two MIDI chains, one for the music-generating equipment, and one for the sound-effects-generating equipment.*

code and created MIDI SPP and clock pulses. This approach had limited success because of the complexity of changing tempos and storing these changes.

Today's MIDI devices rely on *MIDI time code*, which replaces the SPP and clock for time-coded events. This permits start/stop operations and editing without the loss of location information. The time code relies on an unused SysEx command to designate that the following data is a time-code message.

The message consists of eight 2-byte words that are used to lock everything together as the system is running. Because the first byte is always a hex F1, these messages have become known as F1 messages. It takes four bytes to send each part of the F1 message (two bytes each for frame number, seconds, minutes and hours). Four messages are sent per frame, thereby marking quarter-frame boundaries.

The MIDI time code has the advantage of requiring only a small portion (8%) of the system's usable bandwidth. Yet, the time is updated roughly every 8ms to 10ms. If this isn't accurate enough for your particular application, some MIDI devices can interpolate, providing more precise time references.

Setup messages are transmitted to define a particular event in SMPTE or MIDI time. The setup message is similar to a cue list. The list is transmitted to all devices at the beginning of a sequence to tell each component what to do and when to do it. This information is stored by each device. This scheme reduces the amount of data that must be transmitted on a real-time basis, when multiple events must occur simultaneously.

The setup message can address 127 devices and accommodate approximately 16,000 events. In addition, there is expansion room for more than 100 general addresses and another 16,000 special setup messages.

MIDI in the broadcast station

What can MIDI do in a broadcast station where SMPTE time code and several automation standards already are common? One useful application centers on music production. Any audio production requiring digital effects or precise timing can benefit from MIDI-equipped devices.

MIDI is seeing widespread use in the area of audio special effects. Compact discs containing hundreds of sound effects are readily available. When coupled with a MIDI-equipped CD player, the effects can be triggered through the MIDI IN port. (Note that the new CD+MIDI CD players are equipped only with a MIDI OUT port and cannot be triggered from MIDI.) A SMPTE-to-MIDI converter and program sequencer are used to provide the automated program sequence information. This allows the effects to be triggered automatically at the proper time.

Raw effects also can be sampled or digitally recorded by a device called a sampler. The sampler and required editor then can be used to modify the length, dynamic range, timbre and other parameter of the sound to exactly fit the video. Sequencers are often controlled through MIDI ports.

Figure 3 shows an idealized post-production MIDI setup. The heart of the control system is the computer. The computer is used to enter the tracking notes, referenced to SMPTE time code before the recording session begins. This rough effects cue sheet is then modified by the operator as needed to trigger the various effects from CD, sampler, synthesizer or tape at the proper time.

A dedicated sequencer, under the control of the computer, can be used to store the various electronic music segments for playback. This frees the computer to control the mixer levels, playback machines and effects devices. In this application, the MIDI line is available to control musical aspects of the production.

The future

Digital recording and the MIDI protocol seemed to arrive at about the same time with complementary features. Yet, the development of these two technologies over the past six years has been along parallel paths. It's now possible, using MIDI equipment and a digital recorder, to produce a finished recording without analog equipment.

When MIDI first became available, it was used primarily by musicians. It wasn't long before producers and recording engineers recognized the advantages. For instance, a post-production session can be considered as a sequence of sound (effects, Foley, dialogue or music) directed by an electronic score. When combined with digital storage of the sounds, MIDI then becomes a useful production tool for both film and video production.

As more software packages and MIDI interfaces become available, computerizing your post-production work with MIDI will become easier. New MIDI-equipped devices such as digital equalizers, hard disks, mic processors, reverb units and digital mixing boards offer exciting production possibilities. Because the standard is both inexpensive and widely used, much of the new semi-pro audio equipment now comes equipped with MIDI presets or programmability. You may even see a MIDI connector on your next piece of broadcast production equipment.

(See glossary on page 86.)

A MIDI glossary

Auto-correct: A sequencer function to improve rhythmic accuracy and correct playing or timing errors. Similar to autocorrelation used with tape machines.

Drum machine: A dedicated rhythmic sound generator usually used to emulate drums or percussion instruments.

Edit: To go back through a MIDI file and change parameter. Usually accomplished with a computer and editing software.

MIDI: Musical instrument digital interface. An international specification for interfacing sound-production equipment.

MIDI channel: One of 16 possible addresses used by MIDI components. Allows individual or multiple addressing of components through selected channels.

MIDI clock: A timing signal that uses 24 pulses per quarter note. Used to synchronize the various MIDI components for music performance.

Monophonic: A single-voice instrument (such as a flute or trumpet), or a synthesizer that can play only one note at a time.

Multitimbral: A synthesizer or musical instrument that can produce more than one sound or tone at the same time.

Note on: The simplest MIDI message. Can be used to turn on an oscillator in a synthesizer or start up a playback sequence in a CD or other effects device. It is preceded by a channel message to identify the channel, or a SysEx message for a specific device.

Polyphonic: An instrument (piano, organ, guitar, synthesizer) that can produce multiple voices (notes) with the same tone at the same time.

Preset: A preprogrammed sound, parameter or timbre.

Sampling: Recording sounds using digital storage. The recorded sound can be played back as is, modified or used as a voice for a keyboard.

Sequencer: A hardware device that records and plays back timing and control information for MIDI devices. Some sequencers are software-based, storing their information on floppy or hard disk.

Step-time: Entering information one segment or step at a time as opposed to entering it in real time. Most often used during editing.

Sync: Internal clock pulses related to the tempo of the music. MIDI uses two types of sync and time code, which is linked to the SMPTE code on a video or audio track. Time code is independent of tempo.

Synthesizer: A musical instrument that uses analog or digital sound generators and modifiers to create common or unique timbres. It is most often in the form of a keyboard controller, but rack-mounted units are available.

SysEx: Short form of system exclusive message, a MIDI word that designates that the information that follows is sent for one specific device only.

VCA: Voltage-controlled amplifier, used to automate volume control in audio mixing boards. Many boards can be modified to accept MIDI VCA control signals.

Voicing program: A software program that allows editing of the parameter of a MIDI device.

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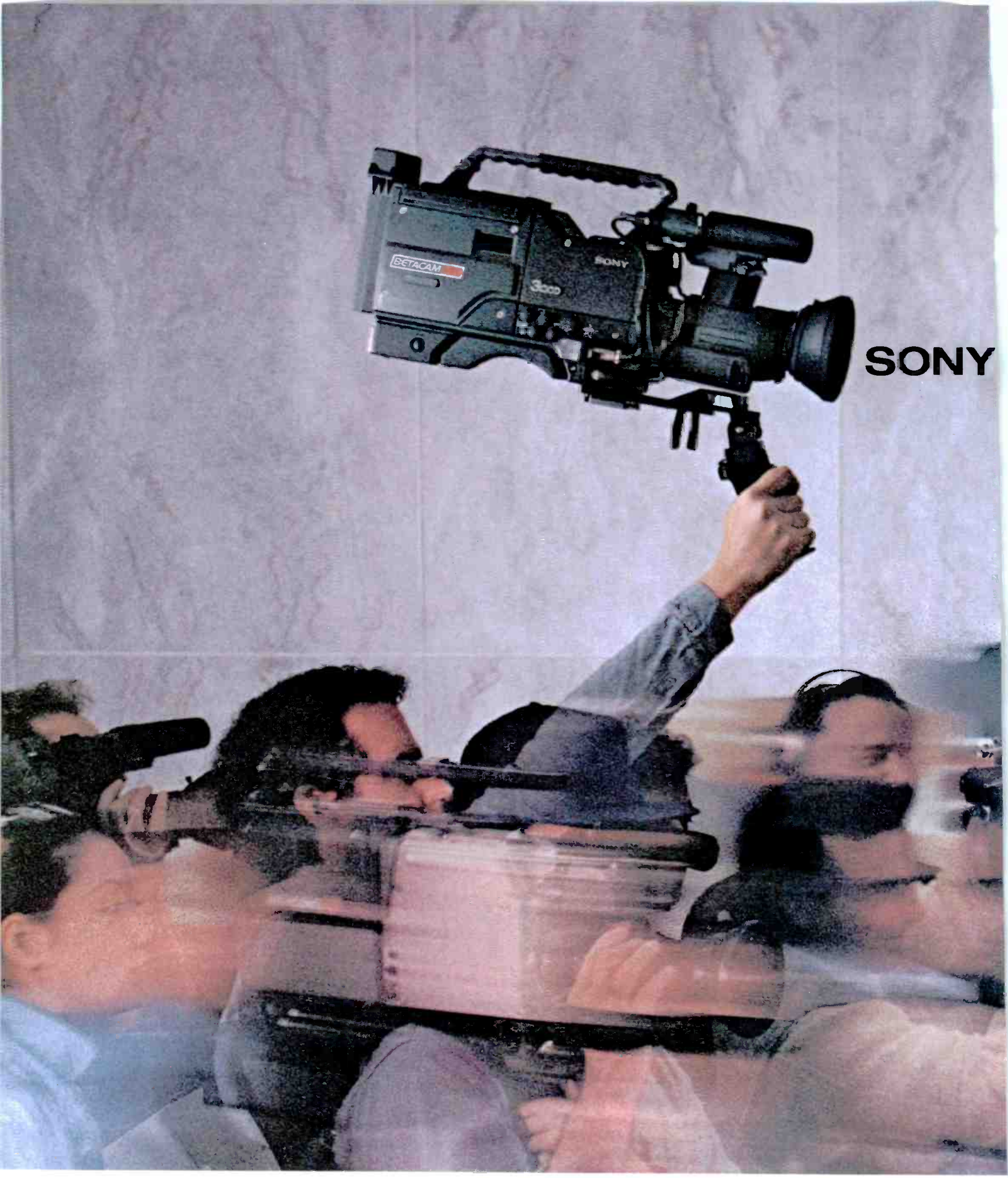

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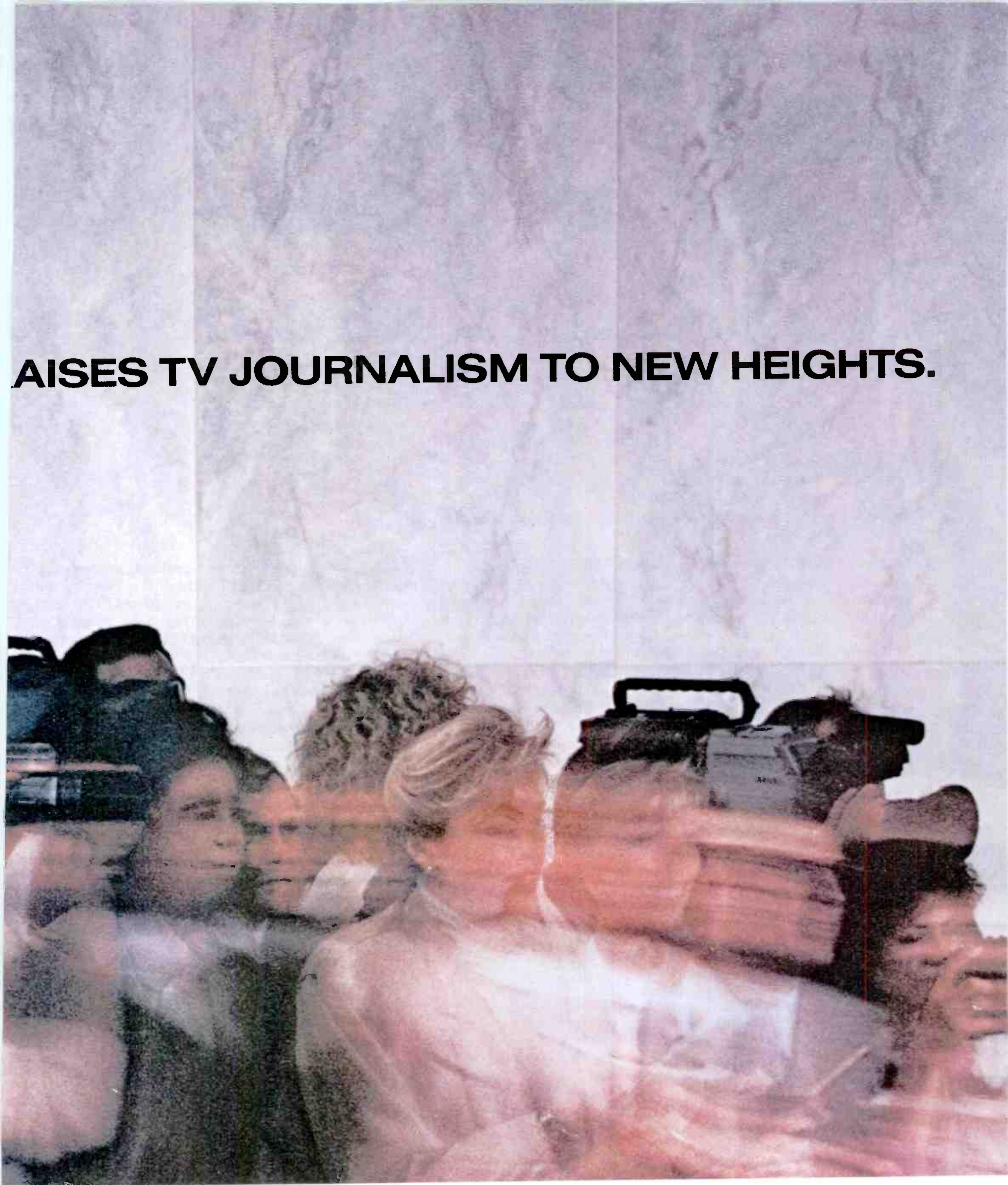

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BROADCAST PRODUCTS

Technical education for broadcast engineers

By F. David Harris, P.E.

Becoming a broadcast engineer requires self-study.

Today's successful broadcast engineer must have a combination of technical, communication and interpersonal skills. It's also important that the engineer be able to continually assimilate new technical knowledge. Obtaining the training to become a broadcast engineer is often difficult. The key to beginning a career in the broadcast engineering field is a good basic education in electronics.

Training programs

Electrical/electronic engineering technology (EET) programs are offered at many colleges and universities. Community and junior colleges offer 2-year programs that lead to an Associate in Applied Science (AAS) degree.

The EET programs at senior colleges and universities are structured in various ways. The most common program arrangement is known as the *two-plus-two* curriculum. This type of program awards an AAS degree after two years of study. A bachelor's degree is awarded after an additional two years of study.

A somewhat less common arrangement is the *integrated 4-year program* that has no exit point after the first two years of study. The integrated programs limit exposure to electronics material until the third and fourth years.

A few universities offer a *plus-two* program. This type of program contains the last two years of a two-plus-two program. The plus-two program is most often found in areas that have several junior colleges offering the AAS degree. Through *articulation agreements* between the area's 2-year feeder colleges and the plus-two institutions, a 4-year education is possible. This allows the student to attend a local college for two years. Only the last two years require attendance at a university, which may be located some distance away. Through such a plan, a student can reduce the total education expense by living at home during the first two years.

Four-year EET programs require approximately the same amount of core courses as do electrical/electronic engineering (EE) programs. Core curriculums include English and other liberal arts subjects, written and oral communication skills and computer-language classes. The EET programs rely less on mathematics and science courses, but they do require more electronics classes. Virtually all the electronics courses emphasize laboratory work. An EET curriculum stresses the use of engineering techniques. Electrical engineering curriculums stress the development of these engineering techniques.

Post-secondary vocational programs in electronics exist, and a certificate usually is granted when the program is successfully completed. These non-academic programs seldom emphasize either mathematics or science. They concentrate the student's efforts on electronics training and laboratory experience.

Different emphasis

An electronic engineering curriculum

MATHEMATICS (algebra, trig and calculus)	12 credits
PHYSICS	4 credits
FUNDAMENTALS OF ELECTRICITY AND ELECTRONICS (digital and analog)	16 credits
ADVANCED ELECTRONICS (digital and analog)	8 credits
SPECIALIZED ELECTRONIC COURSES	12 credits
COMPUTER PROGRAMMING	3 credits
DRAFTING	3 credits
ENGLISH, SOCIAL STUDIES, ORAL AND WRITTEN COMMUNICATION SKILLS	9 credits
TOTAL	67 credits

Table 1. *A typical 2-year ABET-accredited electrical or electronics engineering technology program might require these courses.*

Harris is a professor of electrical engineering technology at Purdue University Calumet, Hammond, IN.

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emphasizes theoretical and analytical studies. Laboratory experience is less important to the student's success. The laboratory instruction stresses the development of skills in scientific methodology rather than hands-on circuit analysis.

In an engineering technology curriculum, the laboratory work is equally important to the theoretical and analytical experiences. These programs develop skills in the use of laboratory and industrial instrumentation. The student is encouraged to practice the design and diagnostic techniques learned in the classroom.

In a vocational curriculum, the hands-on laboratory experience is emphasized. The training is aimed at developing skill in the use of test instruments in troubleshooting and repairing electronic equipment.

Accreditation of programs

ABET (Accreditation Board for Engineering and Technology) is responsible for accrediting EET programs. The board ensures that minimum standards are met in several areas, such as courses offered, faculty qualifications, instructional quality and institutional support. Programs meeting ABET's standards are required to offer a certain number of credit hours in mathematics, physics, English composition, humanities and oral and written communication courses. In addition, these programs must have appropriate and up-to-date electronics specialty courses. (See Table 1.) These schools are inspected periodically to help ensure that high standards are maintained.

The number of jobs for electronics technicians is expected to grow by 50% in the next decade.

Growth industry

The future for electronics technicians looks quite good. Some of the fastest-growing areas are office and factory automation, telecommunication systems, microprocessor-based control systems in motor vehicles, industrial instrumentation and consumer products. The number of jobs for electronics technicians is expected to grow by 50% (from 400,000 to 600,000) in the next decade.

A different situation exists in the broadcast industry. Several factors have combined to reduce the need for more broadcast engineers. Deregulation, remote control, program automation and the increased use of contract maintenance will continue to limit job growth. Over the next 10 years, the number of broadcast engineering jobs will grow by approximately 20%, to 33,000.

Each year, 6,000 2-year EET graduates emerge. This may result in only 60,000 graduates to fill the 200,000 jobs that will be created during that 10-year period. The jobs having a larger manual or repair component will be filled with men and women from trade school or vocational high school backgrounds.

From this perspective, it is easy to see

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why few 2-year EET programs emphasize broadcast engineering. Educators recognize the importance of providing training of a more general nature. Students who are well-trained in the area of fundamental electrical concepts can apply their skills in a wide range of applications. Such an approach better prepares the student for changing job and market demands.

Don't criticize the schools for this training philosophy. The electronics industry also has endorsed this approach through joint industry-academy councils and program-advisory boards. Support for this approach is evident in other ways too, such as hiring practices, cooperative education programs, internships and formal, on-the-job training programs for new graduates.

Specialized electronics courses

Today's accredited electronics programs don't include highly specialized electronics courses because there simply isn't time. To best prepare graduates for the work place, the programs must be general in nature. Example courses might emphasize microprocessor technology, power and machinery, instrumentation, process control and electronic communications.

Over the next 10 years, the number of broadcast engineering jobs will grow by approximately 20%.

Associate-degree electronic communications programs emphasize the design and analysis of basic electronic circuits. AM and FM modulation schemes and basic television usually are covered. An introduction to transmission lines, antennas and propagation also may be included.

Some curriculums offer advanced courses in microwaves, digital communications, antennas and propagation. Such courses are offered only in the last two years of a program. It is rare that broadcast engineering topics are covered thoroughly. Today's job market dictates a more general approach to telecommunications subjects.

Industry training

The proliferation of new electronic technology places changing demands on technical personnel. As the circuits become more complex, more highly skilled troubleshooting is required. This means that experienced staff members should be offered opportunities to upgrade their skills. The evidence shows that the broadcast industry is well-served by those who maintain their skills.

A recent survey of experienced broadcast engineers, conducted by the author, revealed several important factors. Broadcast engineers read several trade journals and use the material to improve their job skills. Engineers also benefit from the technical presentations at various meetings and conventions. The survey respondents said they would take technical courses to upgrade their skills if such courses were available locally.

Of those who responded, 75% mentioned that specific technical courses are needed by practicing broadcast engineers. The topics they suggested are listed by priority, based on the number of times they were mentioned:

1. Digital electronics
2. Microprocessor fundamentals
3. RF fundamentals
4. Antennas and transmission lines
   Basic electronics and broadcast applications
5. Audio
6. Recording techniques
   Satellite technology
   Computer usage
   Mathematics

The challenge

A look at the five certification study guides published by the Society of Broadcast Engineers (SBE) confirms what has been discussed previously. The number of general electronics questions (not specifically related to a broadcast engineering topic) is low. Less than 10% of the questions deal with digital topics.

The remainder of the questions are directed at specific broadcast engineering applications. Even an extremely competent electronic technician would be unlikely to answer them correctly without some practical broadcast experience.

The challenge facing the industry and its professional organizations is how to provide applicable course material. The key is training programs that address the needs of the practicing broadcast engineer.

Short, intensive seminars, commonly offered at conventions and conferences, are quite useful. So, too, are the interactions with equipment suppliers and manufacturers on exhibit floors. Even so, these are only part of the answer.

On-the-job experience is crucial to developing competence in any specialized area of electronics. This means that broadcast organizations need to provide internships and cooperative education opportunities to electronics students who show an interest in broadcasting. On the other hand, because the number of persons entering the industry is relatively small, providing additional training to current broadcast engineers probably would have a more positive impact.

The Electronic Industries Association (EIA) provides training material for those working with consumer electronics equipment. The SBE should at least explore the possibility of developing broadcast-related course materials. These materials could address the need for individual self-study courses as well as the need for local chapter study groups.

Each year, 6,000 2-year EET graduates emerge. This may result in only 60,000 graduates to fill the 200,000 jobs that will be created during that 10-year period.

Some of the skills broadcast engineers need can be developed almost anywhere. Computer literacy, analog, digital and microprocessor fundamentals and mathematics skills can be learned in a variety of ways. Broadcast engineers always have been willing to train themselves. The popularity of the "NAB Engineering Handbook" and the (now out-of-print) series of books by Harold E. Ennes attest to the tradition of self-study.

The issue for the broadcast industry is not whether there is a need for further education. Rather, it is finding a source for the necessary training materials.

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Annual convention is in the works

By Bob Van Buhler

Abstracts now are being accepted for proposed engineering papers for the 1989 **Broadcast Engineering** conference, which will be held in conjunction with the SBE National Convention in Kansas City, MO, Oct. 5-8. The technical conference, under the direction of John Battison, will address the practical needs of today's broadcast engineers and technical managers.

If you are interested in presenting a paper, submit an abstract outlining the topic and its importance to the industry. Abstracts should be received by March 31. If you would like to participate in a panel discussion or serve in another capacity, submit a letter to Battison indicating your desire and qualifications. Because of the project's magnitude, only written abstracts and letters of interest can be accepted.

SBE will again publish the conference "Proceedings." Copies will be available at the convention. Authors should be prepared to submit a camera-ready manuscript by June 30. Address all correspondence to: John Battison, Conference Chairman, 2684 State Route 60 RD #1, Loudonville, OH 44842.

Must-attend event

This year's conference will provide training in several new areas. Broadcast technology is changing rapidly. To be successful, today's broadcast engineer needs a wide variety of skills. One of the best places to obtain these skills is at the **BE** conference and SBE convention.

This convention also should prove to be fun. A special effort is being made to plan social activities around the serious business of the convention. If you've found other broadcast conventions to be all work and no play, don't miss this one.

Bob Flanders retires

Bob Flanders, SBE past president and chairman of the admissions committee, is retiring from his position as vice president and director of engineering at Channel 6, WRTV-TV, in Indianapolis. Flanders, who has served as chairman of the admissions committee since 1975, also will retire from his SBE duties.

He served two terms as SBE president, 1971-1972, and two as vice president, 1969-1970. The society owes him a debt of gratitude for his many years of faithful service and wise counsel. President Jack McKain, the other officers, the board of directors and all SBE members send best wishes and congratulations to Bob as he retires from broadcasting. Flanders will be succeeded at WRTV-TV and on the admissions committee by Dick Pratt.

Certification and AFRN

The Ennes Foundation is developing a cooperative agreement with the Armed Forces Radio Network. Under the arrangement, the skill-training programs of the Armed Forces Radio Network will coincide with SBE certification requirements.

Initially, graduates of Armed Forces Radio and Television Service (AFRTS) entry-level training, conducted at Lowery Air Force Base in Colorado, will receive their certification as SBE broadcast technologists.

A goal is to certify higher skill levels at the corresponding SBE standard certification level. This is not a grandfathering program, but one involving the same requirements any member would face for certification. The certification committee is investigating the compatibility of the training and experience at higher skill levels with SBE requirements. Military on-the-job-training programs incorporate a well-balanced mix of academic training, practical experience and supervisory requirements. These factors help make military-trained individuals prime candidates for future positions as broadcast engineers.

Uplink training program

On Jan. 11, the SBE and NAB announced the establishment of a new broadcast technical seminar to train satellite uplink operators. The announcement was made at the society's winter media luncheon in Washington, DC.

According to Michael Rau, NAB vice president of science and technology, a survey of broadcasters in the top 50 markets indicated a need for such a training program. Most thought it was important for their personnel to be adequately trained on the use of uplink equipment. Most of the stations surveyed planned to send their uplink operators to the seminar.

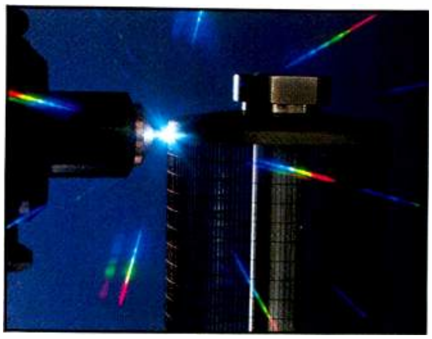
The training will be geared specifically to the skills needed by the mobile uplink operator. Instruction will be provided on all skills that SNV and other uplink operators should have.

Successful completion of the satellite uplink seminar should prove to be an important credential for uplink engineers and operators. It also may enhance their employability and earnings potential. The society will develop a special class of certification for this new area. Those who complete the course will receive SBE certification.

Additional information on topics and scheduling will be provided soon by the SBE and the NAB. The classes will be held in Washington in March.

President Jack McKain hailed this as an example of the cooperative relationship that SBE has developed with NAB's department of science and technology. He noted the joint training program was possible because it served the needs of both the engineers in the field and management.

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



Batteries for field applications

By Anton Wilson

A recent survey shows that when an ENG/EFP crew experiences an equipment malfunction, the problem often is the battery. Because of the high reliability level attained with modern video equipment, the batteries represent the weakest link in the portable video chain. Logic dictates that the selection of a battery system is as critical as the choice of a camera/recorder. This does not seem to be the practice, however, and the unfortunate result is numerous field problems traceable to improper selection and incorrect use of batteries.

How can battery problems be eliminated? One way is to analyze the most frequently reported types of battery problems and determine the causes for each. Properly applied, this information can help you create a battery system as reliable as the equipment it powers.

Wrong voltage

If equipment is designed to operate optimally from 13.2V or 14.4V NiCad batteries, what results can you expect when using 12V batteries? The end-of-discharge voltage (EODV) of a 12V battery is 10V, which is less than the minimum voltage requirement for the equipment. The results can be inconsistent performance, loss of capacity and complete failure during cold temperature or "memory" conditions. The survey showed that many people who experienced these problems were powering their cameras and camcorders with 12V batteries.

Would 13.2V or 14.4V versions eliminate the problem? The higher-voltage batteries have EODVs of 11V and 12V, which are above the minimum specification for equipment. They deliver 100% of available capacity under all conditions, and failures due to memory are eliminated for all practical purposes.

Insufficient capacity

A film camera draws significant current only when film is rolling. This translates to a direct relationship between battery capacity and the number of film magazines that can be exposed with a single battery. Video applications are quite different, however, because a video camera operator can expend an entire battery before rolling a second of tape. There is no clear relationship between battery capacity and the number of cassettes being used.

As a result, battery change interruptions are perceived as being random and unpredictable. The frustration, inconvenience and expense of battery change interruptions can be reduced significantly by selection of a battery with sufficient capacity for the equipment to be powered. The experiences of several hundred video professionals suggest some capacity guidelines.

If you choose a battery that provides two or more hours of run time, you will perceive few, if any, battery change interruptions. A battery rated for at least 1.5 hours of operation will cause a minor, but tolerable, number of interruptions. A battery offering less than 1.5 hours of run time can impede the efficiency of the operation with frequent and unpredictable interruptions. Batteries rated for less than one hour of continuous operation present an intolerable number of interruptions.

Battery pack construction

Some battery problems reflect characteristic pack designs. Excessive self-discharge, unbalanced batteries and shorted cells are common anomalies produced by mechanical stresses on the cells. Even minor bumps or drops can cause enough internal stress to pinch the thin plate separators, causing separator breakdown. A battery pack made of a group of cells in a shrink-wrap sleeve or plastic box is afforded little physical protection. Although better, a battery belt of soft vinyl or leather may prove insufficient to protect the cells inside.

Before purchasing a battery, consider its construction. High-impact cases, custom-molded to protect the cells inside, offer a higher level of physical security than

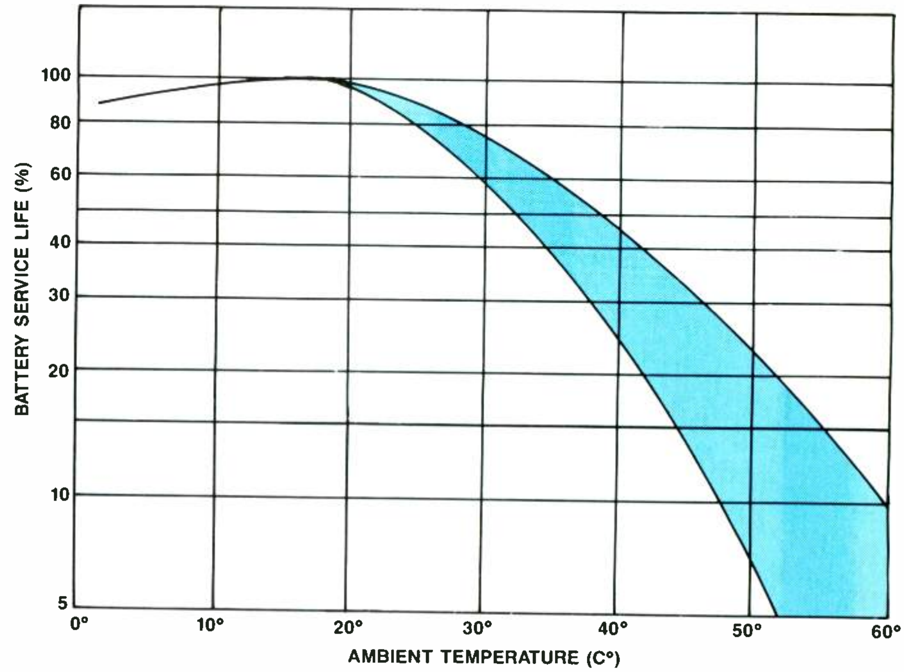


Figure 1. *Constant slow charging can raise the internal temperature of a fully charged battery to 45°C to 55°C. At these temperatures, the battery will deliver only 10% to 20% of its normal service life. The battery is thus aging up to 10 times faster than normal.*

Wilson is president of Anton/Bauer, Shelton, CT.

shrink-wrap or plain box-type batteries. The ruggedness of other physical components, such as the mounting system and strain relief on cables and connectors, suggests a design that will protect the cells from the normal abuse of ENG/EFP.

In spite of their design, batteries can be damaged through careless handling. Never put loose batteries in the trunk of a vehicle. The sliding impact forces that occur when the vehicle goes around corners are sufficient to cause damage.

Charging

The greatest single influence on battery performance and life is the charging method. An inappropriate charging regimen can cut the life expectancy of a battery to less than one-fifth of its full potential, causing inconsistent performance and substantially reduced capacity. A charger can create battery problems in various ways.

Despite some popular myths, modern NiCad cells accept fast-charge currents well. A fast charge at approximately the "C" rate (1-hour charge) usually results in optimum charge acceptance and maximum performance. A slow charge (overnight) can result in reduced capacity.

A problem begins when the battery — or, more accurately, the first cell — reaches full charge. All sealed NiCad cells have an internal mechanism to absorb a certain amount of overcharge current. The fast-charge current is typically 10 times greater than the maximum overcharge that the cell can absorb safely. Obviously, this extremely high rate of charge must be terminated immediately when the first cell(s) reach full charge. Otherwise, they will be damaged or destroyed. Many premature battery failures and problems can be traced to inaccurate fast-charge termination techniques.

The key to an accurate and safe fast-charge termination system is information. To identify properly the full charge status, the charger must have accurate data concerning the type of battery, number of cells, cell balance and battery temperature.

Rather than choosing a universal "replacement" battery from one manufacturer and a universal charger from another, one solution is to use a dedicated battery/charger system. Such a system uses special sensors and circuits within the battery to feed the necessary data to the charger data for an accurate and safe fast-charge termination. Dependable battery performance and life are difficult to achieve without such a communication system between battery and charger.

Cell imbalance and self-discharge

Accelerated self-discharge is the usual cause of an unbalanced battery. A small amount of self-discharge, a normal occurrence within a NiCad cell, is typically insignificant in video operations. A new, fully charged NiCad battery retains 85% of full capacity after two weeks on the shelf. (Normal self-discharge is approximately 1% per day at room temperature.) However, a common NiCad ailment called a "high-impedance short" or slow short-circuit can increase the self-discharge rate of individual cells up to 50 times. This affliction may occur naturally within a cell after a period of time, but physical abuse may accelerate the problem.

Let's say a fully charged, 11-cell, 13.2V battery is removed from the charger. Two days later, someone tries to use it on a camera. Unknown to the operator, the battery has two cells suffering from a slow short and, over the two days, the cells have discharged to only 50% of full capacity. The battery runs the camera for only half the expected time and appears to be stone dead when the two slow-short cells are fully depleted. In reality, nine cells retain the other 50% of capacity. However, without the two depleted cells, there is insufficient voltage to operate the camera.

The battery now has nine cells that are 50% charged and two cells that are fully depleted. When the battery is placed on a conventional voltage cutoff (VCO) charger, the charging routine terminates and indicates ready when the nine cells reach 100% charge. However, the two defective cells now have regained only a 50% charge. The battery imbalance remains. Moreover, the imbalance is cumulative, and the battery will appear to have lost capacity each time it is used.

This problem is quite common, but it can be corrected and prevented. First, NiCad batteries can have slow-short cells with self-discharge rates more than 10 times greater than normal and still deliver 95% capacity consistently when used with the proper charging system.

With sensors for each cell within the battery, a dedicated, logic-controlled charger can identify and correct even a severe imbalance automatically during every charge cycle. If such a charger is not available, it is possible to correct imbalances by placing the battery on a slow-only charger (c/10 rate or overnight rate) for 20 to 24 hours. The battery should be removed from the slow charger after 24 hours to prevent accelerated aging due to heat build-up. Although this 24-hour slow charge will correct imbalances, it will not prevent the imbalance from recurring.

Accelerated aging

The most frequent cause of premature battery death is accelerated aging, resulting from continuous slow charging or trickle charging. Once a battery is fully charged, the charger can either turn off all charge current or continue to deliver a trickle charge. If the charge current is turned off, the battery immediately begins to self-discharge and may develop crippling imbalances. A continuous trickle charge, on the other hand, prevents self-discharge. However, the trickle charge causes the internal cell temperature to rise as high as 115°F.

Heat is the No. 1 killer of NiCad cells, causing accelerated decomposition of the organic components within the cell. A direct relationship exists between elevated temperature and reduced battery life. (See Figure 1.) Specifically, the temperatures generated during trickle charging cause a battery to age from four to eight times faster than normal. A battery that would normally deliver more than two years of service may not last six months if it is subjected to continuous trickle charging.

It's a "Catch 22." Turn off all charge current, and have a partially discharged and unbalanced battery; or maintain slow trickle charging, and simmer the battery to death. The heat from trickle charging is the greater of the two evils and must be avoided.

If your charger does not maintain a trickle, or if you have removed batteries from a trickle-type charger as recommended previously, you run the risk of having batteries that are partially discharged and unbalanced when you need them. This problem can be alleviated by placing batteries on a slow charger the night before they are needed. A fast or quick charger that does not have a balance routine cannot be used for this purpose.

These recommendations do not apply to charging systems that include a proprietary maintenance circuit. The circuit prevents self-discharge with virtually no heat build-up or accelerated aging. The maintenance circuit allows batteries to be left attached to the charger until they are to be used. Even after weeks or months, batteries will be 100% charged, balanced and ready for use without any detrimental effects from accelerated aging.

If batteries are to be out of service for a month or longer, they can be placed in a sealed plastic bag and put in a refrigerator or freezer for storage. Allow batteries stored in this manner to reach room temperature before you open the plastic bag and recharge.

If you are responsible for purchasing or maintaining the battery-operated equipment for ENG/EFP activities at your facility, remember that the success and efficiency of the operation ultimately rest on the dependability of the battery and charging system.

News
Continued from page 4

to experts in the TV, communications and computer industries. SMPTE membership is not required. For more information, contact Paulson at 508-562-2100, or Barry Detwiler, SMPTE headquarters, at 914-761-1100.

Among the study group's focuses:

- Existing applications of fiber-optic technology in long distance, metropolitan area and local area networks for transmission of TV, video, audio and ancillary data signals and high-resolution monochrome and RGB color graphic signals.
- Identification and summarization of standards-setting activities in other industry professional associations and societies.
- Standards and practices for circuit and equipment interconnection.
- Existing and potential applications in TV production, post-production, ENG and EFP backhaul, distribution and broadcasting operations.

Another concern facing the group is the need to assess the signal-format conversion implications of the standards now being set for digital recording and the transmission of analog-originated video and audio signals.

Comark ushers in new transmitter era

A Klystrode-equipped transmitter has been commissioned into full-time broadcast service by Comark Communications, Colmar, PA, at WIIB-TV 63, Bloomington, IN. A pair of Varian EIMAC 2KDW60LF Klystrode power-amplifier tubes (in parallel), driven by two solid-state drivers, are operated in multiplex, enabling the transmitter to achieve 80kW of (peak) RF output power.

The normally supplied sound high-power amplifier, diplexer and RF switching system are eliminated in this configuration, thus decreasing the initial purchase price. The two Klystrode power amplifiers' combined ac power consumption was only 70kW at 50% APL and 85kW at black level (including sound power).

Ampex, Abekas clash over patent conflicts

Ampex, Redwood City, CA, has filed suit against Abekas Video Systems, also of Redwood City, for "willful and deliberate" infringement of five Ampex video technology patents. The plaintiff claims that the Abekas A52 and A53-D special effects systems and digital effects combiners, A62 digital disk recorder and A42 video slide projector are in violation of Ampex patents.

Ampex claims to have found patent infringements in Abekas products and offered Abekas a patent license following its sale in 1985 to Carlton Communications. Negotiations continued for more than two years, but Abekas allegedly rejected the license and continued to market the products in question. Co-defendants in the suit include Abekas founders Junaid Sheikh, Bantval Yeshwant Kamath and Phillip Patrick Bennett, all of whom are former Ampex employees.

Abekas denies the allegations. No court date has been set.

By John Blau, European correspondent

NBC joins up with Visnews

NBC has acquired a 37.75% interest in the TV news agency Visnews. The majority stockholder remains the British news agency Reuters, with 51%. The BBC has an 11.25% stake in Visnews.

Clearing a path for the global TV market

The introduction of HDTV to the global TV market will result in estimated sales of $285 billion, according to Heinz Riesenhuber, head of West Germany's Ministry of Research. European involvement in the debate over high-definition standards is crucial, said Riesenhuber at a press conference on Germany's involvement in HDTV research. Developments in storage and display technologies cannot go unnoticed.

The 4Mbyte storage technology is one of the requirements for true HDTV. Similarly, research continues on producing large LCDs, which will permit flat wallscreens. German companies are among the front-runners in LCD research and development, according to Riesenhuber.

Unlike the Japanese, the European consumer electronic companies would like to see HDTV introduced in two phases. They hope that a first step in their home market will be the purchase of sets with integrated Mac decoders (625-line picture, flicker-free color and digital sound). The second step, full HD-Mac, involves doubling the number of lines for Hi-Vision. Many industry experts believe that this technology will not be available until the middle of the next decade. One of the reasons for the delay is the need to further develop bandwidth-compression techniques.

Also, a bundle of money is at stake. Project development costs are estimated at almost $300 billion. More than half this amount is being covered by Europe's consumer electronics industry and broadcasting organizations; the rest of the tab is being picked up by European governments.

1992 is the magic year for the launch of HDTV in Europe. The rush to push HD-Mac production out into the open stems mainly from the timetable of the Committe Consultative Internationale Radio Telecommunication (CCIR), the relevant arm of the International Telecommunications Union, whose aim is to set a world HDTV production standard by 1990. European governments, according to Riesenhuber, have much at stake with HDTV and have pledged full support for the Eureka HDTV project.

Traffic broadcasting to include RDS

A group of West German public service broadcasters have invested about $14 million to develop a so-called radio data system (RDS). Car owners with RDS radios can travel nationwide and receive traffic information automatically without having to readjust frequencies. The RDS system automatically selects the strongest frequency.

The next step for the 1990s is to develop a "vocoder," which will allow drivers to call up all traffic information by pressing one button without having to interrupt the radio broadcast.

The embattled British TV revolution

Prime Minister Margaret Thatcher has focused her attention on British broadcasting. The government recently promised its "White Book" policy paper to give viewers and listeners a greater choice of TV and radio programs in the 1990s, adding that quality would not be sacrificed. The easing of broadcasting controls is expected to make dozens of new TV channels and several hundred radio stations available to the public.

One of the changes has to do with BBC-TV being financed in the 1990s through subscriptions and sponsors instead of user fees. It will be similar to pay-TV, where viewers pay only for what they see. Another change will provide commercial broadcasters with about 20 new channels for satellite, cable and terrestrial transmission.

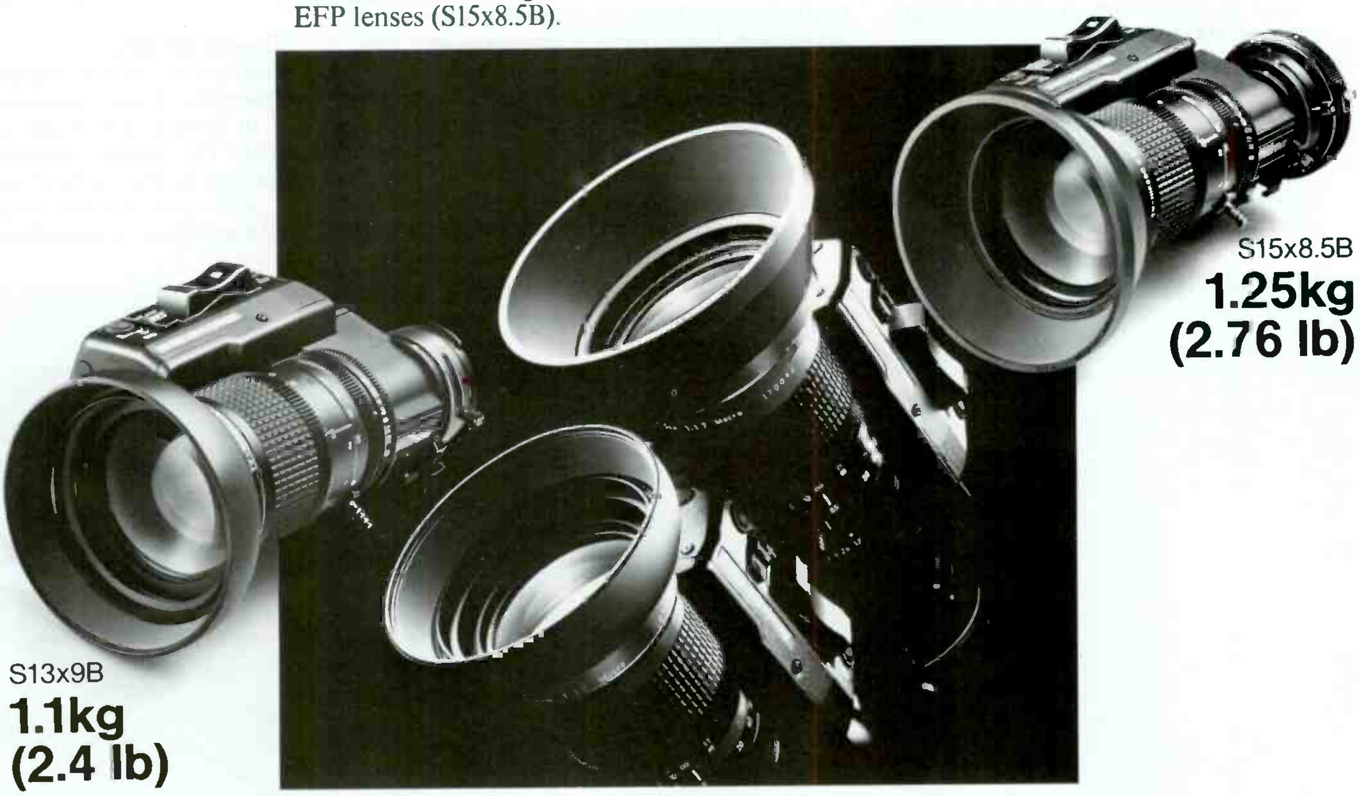
The policy paper calls for extended na-
Continued on page 109

TV-Nikkor S15X8.5B S13X9B

ENG/EFP Lens for 2/3-inch TV Cameras

Nikon improves TV lens technology

- Compact, lightweight lenses for 3-CCD cameras, with the flexibility to meet any shooting requirement.
- Nikon ED (Extra-low Dispersion) glass for faithful color rendition and minimal tracking/registration errors.
- New anti-reflection coating improves spectrum transmission ratio.
- Highly advanced optical design via CAD for improved corner resolution and high, flat MTF curve.
- 15x zooming ratio – highest among standard ENG/EFP lenses (S15x8.5B).
- Minimum focal length of 8.5mm – widest among standard ENG/EFP lenses (S15x8.5B).



S15x8.5B
1.25kg (2.76 lb)

S13x9B
1.1kg (2.4 lb)

Nikon

NIKON CORPORATION
Fuji Bldg., 2-3, Marunouchi 3-chome, Chiyoda-ku, Tokyo 100 Japan

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Australia	Maxwell Optical Industries Pty Limited Unit 5, Level B, 100 Harris Street, Pyrmont, N.S.W. 2009, Australia

Circle (55) on Reply Card

Station-to-station

Installation works in RF environment

By Gil Ludwig

When the news department of KSDK-TV, St. Louis, requested a better public service receiving station in the middle of the "RF heaven" of downtown St. Louis, I knew many obstacles lay ahead. How would it be possible to get commercial-grade reception on six inexpensive receivers; scan more than 100 channels over a 2-state, 50-mile radius; and, worst of all, do all this with an antenna feedline almost 600 feet long?

Because of our downtown location, many undesired signals were present that any antenna gain would automatically pick up. Any strong incoming signals could overdrive a high-gain amplifier, resulting in intermodulation distortion or non-linear amplification.

Ludwig is engineering supervisor and technical director at KSDK-TV, St. Louis.

Original installation

The existing receiving system used one wideband, multifrequency antenna mounted at rooftop level. It was plagued with severe intermodulation caused by nearby business band, telephone and paging services. Several of these services were located less than half a mile away. Trying to hear a distant station was like trying to talk across town on a pair of low-power hand-helds. Only occasionally could a rural transmission be picked up out of the trash from overloading signals.

The original intent was to build the best possible broadband omnidirectional multicoupler antenna system, at minimal cost. Yet, with the extreme competition among other news departments at an all-time high, this was the perfect chance to increase the station's visibility through local breaking news stories. Being first on the scene or having exclusive video always speaks well of a news department.

Design process

The first steps were to critically evaluate the RF environment through spectrum analysis and to identify potentially interfering signals. The research revealed many unsuspected sources behind the mixing and first-order images being detected on the scanners. To complicate matters, insufficient isolation between the receiver oscillators was causing even more interference. Mutual coupling between scanners often stopped the scan sequence, as though a signal were being received.

We purchased three commercial-grade, high-gain antennas — one each for 42MHz, 155MHz and 460MHz — to replace the original single-element 25MHz-575MHz antenna. A special 40-foot guyed tower was mounted on the 3-story building that houses the KSDK studios. Because St. Louis is known to encounter severe weather, special measures were taken to mount securely all the rooftop equipment. The three antennas were then combined in a multicoupler amplifier, and the 600-foot coax was fed to the newsroom.

A total of seven receivers, six of which are shown here, places severe demands on any monitoring antenna system. The keys to this installation were careful design and custom amplifiers and filters.

Custom splitter/amplifier

The multicoupler, which was custom-designed for us, has two band-reject filters for 152MHz and 158MHz. The system block diagram is shown in Figure 1. The three antennas are fed into a VHF-low, VHF-high wideband, 2-way power combiner that has a coupling loss of 3.4dB. Two hybrid amplifiers, arranged in a feed-forward configuration, provide a uniform cancellation of all second-, third- and higher-order harmonics. The second-, third- and higher-order intermodulation products typically are reduced by 25dB. The combined VHF output is then amplified in a wideband linear amplifier.

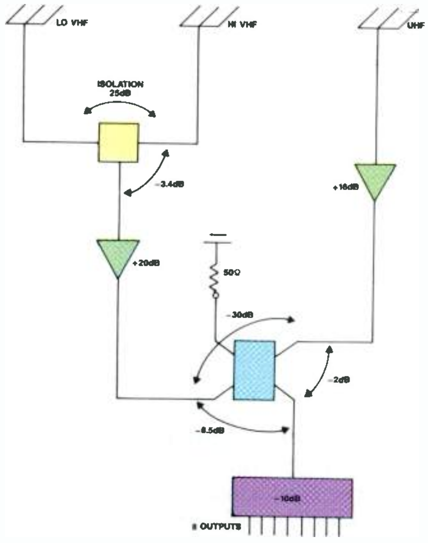
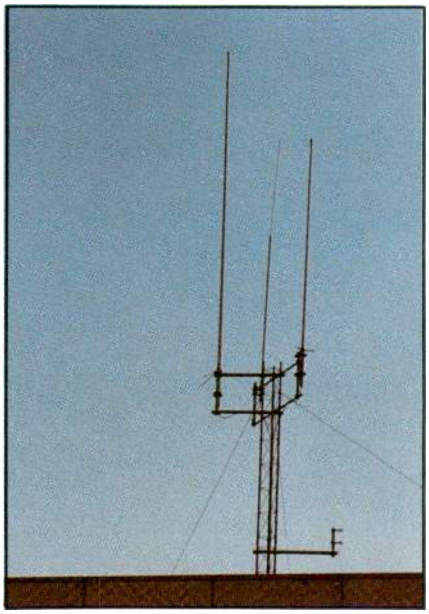


Figure 1. *The monitoring system combines two VHF antennas and one UHF antenna into a single feed. A power divider located in the newsroom splits the signal into eight feeds and prevents intercoupling between receivers.*



Mounted on a 3-story building, the equipment had to be especially secure because of high-wind conditions common to St. Louis.

The UHF signal is amplified by a wide-band amplifier operating in a push-pull configuration.

The VHF and UHF outputs are then combined in a 6dB directional coupler with output-to-output isolation of 25dB and coupling loss of less than 3.5dB. Isolation between the low and high VHF feeds is 25dB. Isolation between the VHF and UHF ports is greater than 20dB. Through-loss (UHF in to out) is 1.75dB, and coupling loss (VHF in to out) is less than 7dB.

The combined signals feed a power divider located at the end of the 600-foot run of coax cable. The divider provides each receiver with a separate, isolated feed. It also prevents any intercoupling between receivers.

The receiving system has been in operation for several months, and I can honestly say that the investment was well worth it. The six receivers in the newsroom and one in the weather center are hearing transmitters that were never heard before. Just as important, the interference, which used to be so common, is gone.

Broadcast Electronics Phase Trak 90

By Dennis Ciapura

Broadcasters seem to embrace one of two quite different schools of thought regarding audiotape reproduction. Some believe firmly that tape reproduction should be transparent and unprocessed, except perhaps for noise reduction. This group also thinks phase maintenance should be accomplished by head alignment, with source phase being an external issue. Stations with this philosophy sometimes employ a phase-correction device connected to the output of the reel-to-reel decks, which they use to play the commercial masters from agencies. Other stations worry only about in-house phase, either insisting on good masters or using outside material as it's produced.

The other philosophical position suggests that poor audio phase integrity is an unavoidable fact of life. Solving this problem requires the use of a phase-correction device in the program line so that all audio sources are processed.

Although the latest versions of broadcast phase correctors are amazingly effective in differentiating true phase errors from production effects, no design is perfect. One scheme relies on the use of a phase corrector on the output of the tape sources only. This approach, however, may require more phase correctors than the budget of a typical broadcast station allows.

Features

The new Broadcast Electronics Phase Trak 90 cart decks should be attractive to those who desire segregation of the phase-corrected sources. The PT-90 stereo record/play (r/p) and the PT-90 stereo playback units both include built-in non-encoding phase-correction circuitry.

The r/p machine also has a "learn" mode that automatically adjusts the bias, equalization and input sensitivity for up to 10 different tape characteristics. (See Figure 1.) A front-panel display functions both as a timer and as a status display for the various memory features. There is even a built-in test oscillator with eight frequencies spanning 50Hz to 16kHz. Complete electronic alignment can be accomplished from the front panel in either a manual mode or auto mode. In manual mode, the unit memorizes the settings for each tape type; in the auto mode, the machine does everything, then remembers what it did.

Ciapura is vice president, technical operations, for Noble Broadcast Group and president of TEKNIMAX Telecommunications, a San Diego-based technical management consulting firm.

Performance at a glance

- *Automatic stereo phase correction*
- *Optical tape level sensing*
- *dc servo capstan motor*
- *Frequency response ±2dB 40Hz-16kHz*
- *Distortion <1.5% THD (tape dependent)*
- *Crosstalk −50dB*
- *Stop time 80ms*
- *Start time 120ms*

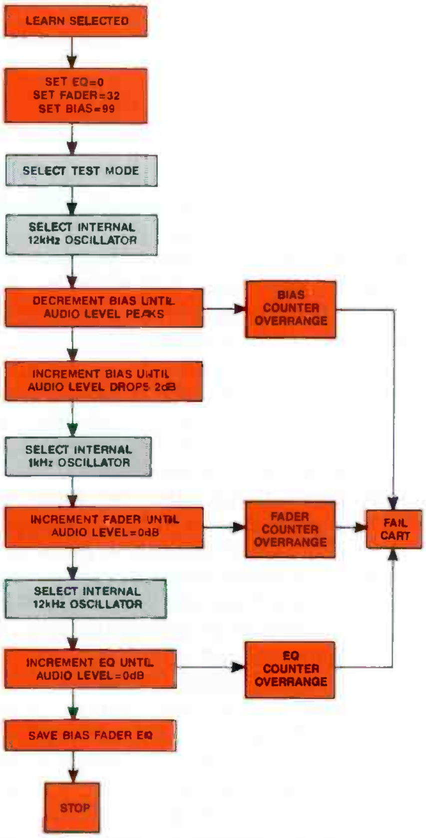


***Figure 1.** The learn mode allows the machine to store as many as 10 sets of bias, equalization and input sensitivity data for instant recall.*

The Phase Trak series of machines also employs the DYNAFEX single-ended noise-reduction system, which effectively reduces the audibility of both source and cart noise. The process is subtle in its operation. Like the phase correction, this feature is defeatable if the user prefers not to use that function or decides not to employ external equipment. A splice finder is included in the r/p machine along with a complete array of cue facilities, including cue erase.

If carts recorded at the elevated 250nWb/m level are marked with the metallic sensor tabs provided, the machine recognizes these carts automatically and adjusts the reproduce gain, thereby maintaining standard levels with a mixture of recorded levels. This feature is useful if spots are recorded on standard carts at 160nWb/m and music is dubbed to premium carts at the elevated level for improved signal-to-noise ratio. It's also possible to use this feature during transition to a higher record-level standard.

Test results

Figure 2 illustrates the machine's playback frequency response. The variation is within ±1dB from 50Hz to 16kHz. Phase error with the corrector on was nil at 16kHz, which is excellent performance by any standard. Record/play frequency response was first tested with a used, high-performance tape cartridge. Although this may seem to be an unorthodox procedure for an equipment evaluation, using only new tape cartridges does not give realistic results. A used cart is a better indicator of what can be expected from the equipment in a typical broadcast application. After all, how many stations use only new carts?

The r/p results, as shown in Figure 3, were excellent. The tests then were repeated using the automatic alignment function with the same carts, and the results were virtually identical. Distortion was 0.8% at 1,000Hz, 160nWb/m. The 3% distortion threshold was at 12dB above the 160nWb/m operating level, or 8dB above

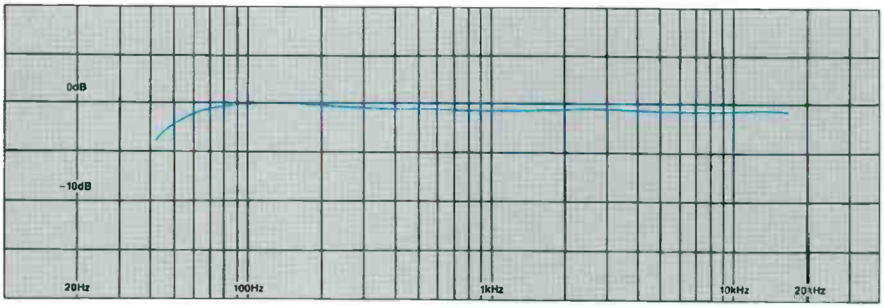
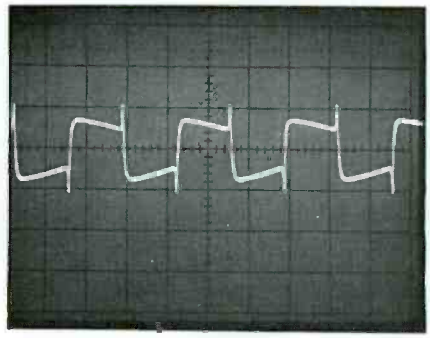


Figure 2. Typical reproduce frequency response from a record/play deck.



Record/play square-wave response measured at 400Hz, 160nWb/m.

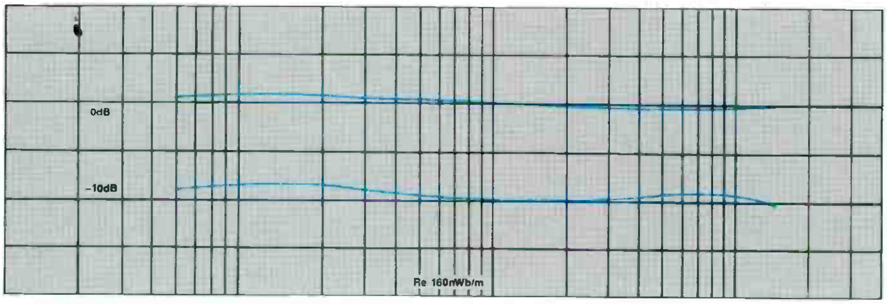


Figure 3. Typical record/play frequency response with a used tape cartridge. The used cartridge provides a more realistic indication of how the deck will perform in actual use.

REFERENCE LEVEL (160nWb/m)	OUTPUT LEVEL
0dB	0dB
−10dB	−10dB
−20dB	−23dB
−30db	−40dB
−40dB	−55dB

Table 1. The DYNAFEX gain structure provides adequate noise reduction without the need for level matching and encoder/decoders.

250nWb/m.

With the DYNAFEX function, the noise floor settled down to 58dB below the 160nWb/m operating level for a total dynamic range of 70dB. Table 1 shows the DYNAFEX gain structure. Note that it has no significant effect until the output level drops below −20dB. By −40dB, the noise is reduced to approximately the eventual noise floor. This turns out to be an appropriate characteristic for broadcast applications because it won't alter a fade. The circuit offers the additional advantage of reducing overall noise without the need for encoding and level matching.

The square-wave response was 400Hz. There was no sign of ringing from 50Hz to 7,500Hz, at which point the square wave was integrated into a sinusoid as a function of the overall system bandwidth. The moderate tilt and single overshoot are typical of an excellent tape system. Overall, the audio performance of the machines was found to be primarily tape-dependent, as any modern analog tape recorder should be. The phase-correction and noise-reduction circuits did what they were supposed to do, and the automatic alignment and memory features worked flawlessly.

Operational considerations

The mechanical construction quality of a cart machine is as important as the electrical performance, and these machines are well-built. The Phase Lok V head block is especially well-designed and rugged. Although we had to reach pretty far to come up with areas that might be improved, there are a couple of operational details worth mentioning.

The phase correction can be defeated only by moving jumpers on the playback card. The inclusion of a switch on the back of the machine would facilitate head alignment, which must be done with the phase correction off. Also, the cart insertion depth is just deep enough for the top edge of the front-panel opening to block the tension-adjustment screw on at least one brand of carts. Some users may prefer that the front-panel mode buttons that control the memory, cue and auto-alignment functions be located behind a protective cover. Otherwise, the machines appear to be almost bulletproof.

The Phase Trak 90 machines probably are suited ideally to two quite different applications that share the need for a cart machine with integral, non-encoded phase correction. For the small facility with a 1-person engineering department or the contract engineer trying to maintain everything, these machines would be a panacea, even if only the main on-air studio were equipped with playback units. Stations that have larger budgets and are looking for a top-quality machine with all the automatic features and the ability to phase correct outside sources not under the station's control also will be drawn to the decks.

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, positive or negative. No report should be considered an endorsement or disapproval by **Broadcast Engineering** magazine.

Continued from page 102

tional and local broadcasting networks, plus a fifth and eventually a sixth national channel. Local television is to be supported through a number of new microwave transmitters. Three satellite-transmitted programs are scheduled to air in mid-1990.

Furthermore, the commercial Independent Television (ITV), which was set up in 1955 to offset public-service BBC, is to be split up among interested buyers. Some fear the airwaves will be overrun with low-budget programs.

Spokespersons for British broadcasting unions have unanimously opposed the government proposals to ease broadcasting controls. They believe quality will suffer as a result.

Medium-power Astra satellite launched

On Dec. 10, 1988, Ariane 4 successfully launched the medium-power Astra 1A satellite, which was built by GE Astrospace for Societe Europeene des Satellites (SES). The satellite is expected to go into operation some time this month.

For the first time, some 73 million homes across Europe will be able to receive 16 channels from one satellite on a 60cm dish. Satellite TV in 1989 will bear little resemblance to that of 1982 when Sky Channel was launched on the Orbital Test Satellite. At that time, dishes were big and expensive (1.5m was the standard size, and dish costs averaged about $1,000). Distribution was also patchy.

Although the ultimate success of satellite television will depend on programming, the technology, manufacturing, distribution and retailing of reception equipment will play an important role. Rupert Murdoch, who has leased four transponders aboard Astra, expects one million dishes to be sold by mid-1990, running to six million by 1993.

U.S. Discovery Channel to discover Europe

United Cable's Discovery Channel, the U.S. science and wildlife program, is expected to be launched in Europe this spring. The company, which is discussing a possible joint venture with British Telecom Vision, has yet to choose a satellite to carry the program. The possibility of sharing a transponder with the Children's Channel, which looks certain to go on Astra, has not been ruled out.

Frank T. Taylor and **Jeffrey Schneider** have been named to positions with Comprehensive Video Supply, Northvale, NJ. Taylor is product manager for post-production products. He is responsible for development, implementation and technical support of the company's post-production line-up. Schneider was promoted to sales manager of post-production computer products. He will oversee sales of the PC-based Edit Master edit controller, the PC-2 character generator and other associated software.

Helge H. Wehmeier has been appointed president and CEO of Agfa-Gevaert, Ridgefield Park, NJ. He also has been elected to the board of directors and executive committee of Bayer USA, of which Agfa is a wholly owned subsidiary.

Michael Stewart and **Arnie Christensen** have been appointed to positions with Aphex Systems, North Hollywood, CA. Stewart is manager of the newly formed systems design group. He is responsible for developing a variety of MIDI-oriented control devices for musicians. Christensen is sales manager.

John Stacey has joined Aston, England, as a graphic designer. He is responsible for the daily font and logo requirements and the graphic demands generated by Aston4/Caption and the "Wallet".

Terence O'Kelly has been promoted to director of national sales for audio-video professional products for BASF Information Systems, Bedford, MA.

Charles W. Kelly has joined Broadcast Electronics, Quincy, IL, as director of international sales. He is responsible for export sales in all areas of the world except Canada.

Charles Felder has been appointed vice president of sales and marketing for BTS Broadcast Television Systems, Salt Lake City. He is responsible for overseeing the direction of the sales force and the marketing plans for the company's product lines.

Christian Tremblay has been appointed product development manager for Central Dynamics, Montreal, Canada.

Michael Montag has been appointed manager, CMX EuroService for CMX, Santa Clara, CA.

George R. Swetland has been appointed marketing manager for EECO/Convergence, Santa Ana, CA. He is responsible for directing sales development and support for all national marketing of the company's post-production editing systems.

Donald Danko has been named Central regional product engineer for For-A, Newton, MA. He is responsible for technical support and quality assurance as well as warranty repair of the company's professional video products.

Vincent J. Hewitt has been appointed president of the display products group for Conrac, Duarte, CA. He is responsible for all operations of the autonomous unit.

Rob Lingle and **Linda Murray** have been promoted to new positions with IDB Communications Group, Los Angeles. Lingle is director of audio-video systems. He is responsible for the future design and expansion of the audio and video control centers at the Los Angeles International Teleport. Murray is director of operations. She is responsible for overseeing all audio operations at the Los Angeles International Teleport and IDB's Program Booking Center. She also will direct all audio, video and data/voice transportable operations for the company.

William Liento Jr., Nicholas Mallis, Jim Smart and **William Johnson** have been appointed to positions with Lee Colortran, Burbank, CA. Liento is senior vice president of sales and marketing. Mallis is senior vice president of operations. He is responsible for all aspects of the manufacturing operations. Smart is general manager of Lee Colortran Canada. He is responsible for managing sales and marketing efforts in Canada as well as overseeing the Canadian operation. Johnson, product manager for luminaires, has expanded duties that include overseeing export sales and custom projects.

Andy Turner, JoAnn Waddell and **Quentin R. Nelson** have been appointed to positions with Magni Systems, Beaverton, OR. Turner is regional sales engineer. He is based at the Chicago branch office and will assume responsibility for sales and local dealer support activities throughout the Midwestern states. Waddell is product marketing manager. Her activities will focus on the marketing and further development of the 4000 series of video graphics encoders. Nelson is Northeast regional sales manager.

Vinod Chitkara and **Ishan Bhawnani** have been appointed to positions with Narda Microwave, Hauppauge, NY. Chitkara is manager of domestic sales. He will oversee all sales activities related to the domestic market for the company's passive and active components. Bhawnani is chief engineer of passive products. He will oversee the engineering of passive products from the design through production stages.

Ted Pine has been promoted to the position of marketing communications manager at New England Digital, White River Junction, VT. Pine is responsible for the management of all the advertising, direct mail and public relations programs. He also will assist in the development of strategic, long-term business programs to strengthen the company's position in the music composition, studio recording, film/video post-production, music publishing and broadcasting markets.

Paltex acquires EECO/ Convergence video editing division

Paltex Editing & Production Systems, Brentford, UK, has acquired the video editing division of EECO, which includes all inventory, trademarks, designs and software for the Convergence and EECO editing systems. Paltex will manufacture all products at its Tustin, CA, facility. Convergence personnel in the United States and Europe are being integrated into the organization. Paltex has leased an adjacent building in Tustin to house an expanded engineering/R&D center and to consolidate Paltex and Convergence operations in the United Kingdom into a new international headquarters.

New facilities for ITE

Innovative Television Equipment (ITE), Newbury Park, CA, has moved into a new facility. The building, at 2550 Azurite Circle, Newbury Park, CA, will allow future growth of the domestic manufacturing operations.

ITE also has opened a Southeastern regional office. The new office will stock ITE equipment and will include a service facility that supports the Eastern regional office located in New Jersey.

KRBK uses M-II format

KRBK-TV, Sacramento, CA, has purchased M-II ½-inch video format equipment from *Panasonic* Broadcast Systems Company (PBSC), Secaucus, NJ. The TV station will be using the format for field production and satellite delay.

Gentner merges RF division into Salt Lake operations

Gentner Electronics, Salt Lake City, has consolidated its San Jose RF Products Division into its Salt Lake City operations. Manufacturing and customer service of RF products will continue from Salt Lake City.

Harrison completes Voice of America order

Harrison Systems, Nashville, TN, has completed the order for 19 consoles for the Voice of America studio renovation project. The consoles were designed to Voice of America's specifications, and used the features and proprietary technology of the company's 790 series broadcast consoles.

Ampex embarks on production program

Ampex Magnetic Tape Division, Redwood City, CA, has begun a project that will lead to production, in high volume, of the metal-particle tapes, thin coatings and thin base films that will form the core of its next generation of magnetic media products. The 2-year program for the state-of-the-art production facility began in January. The program includes a production coating line, a metal-particle mix prep facility, expanded clean rooms, slitters, assembly and packaging equipment, as well as utilities expansion and waste treatment facilities.

AVS wins an Emmy for ADAC

AVS, England, has been awarded a TV engineering Emmy by the National Academy of Television Arts and Sciences for its ADAC standards and formats converter. The converters are distributed in the United States by A.F. Associates.

Barco acquires EMT-Franz

The German company EMT-Franz has become a part of *Barco-Industries*, Kortrijk, Belgium. The takeover gives Barco an opportunity to expand the scope of its business into the audio sector.

EMT-Franz has been a distributor for the company's broadcast monitors and graphic displays for more than a decade. With the takeover, the company completes its goal of a firm foothold in the three major market areas of the broadcast industry.

Battison and Associates relocate

John H. Battison & Associates, consulting radio engineers, has moved to a new address with 17 acres for antenna development. The address is 2684 State Route 60, Road No. 1, Loudonville, OH 44842; telephone 419-994-3849.

New England Digital expands European market

New England Digital, White River Junction, VT, in conjunction with Harman International, its European distributor, has formed a sales and marketing group within Harman. This group will concentrate on the sale of New England Digital workstations throughout Europe.

New England Digital and Lucasfilm Sprocket Systems Division have entered into a joint development agreement to produce a new generation of film and video sound-editing products. The two companies will develop new hardware, software and communications protocol for the editing systems.

New England Digital also has been selected to participate in the research of the Massachusetts Institute of Technology's media lab. The lab is conducting research into communication and information technologies.

Lee Colortran manufactures Fresnels in U.S.

Lee Colortran, Burbank, CA, is manufacturing baby Fresnels for distribution in the United States. The U.S. versions of these fixtures meet UL standards and are available in 2K and 5K models, which are part of a baby Fresnel line that is still being developed.

Micro Communications sets up field-service department

Micro Communications, Manchester, NH, has set up a field-service department for testing, optimizing and upgrading complete RF broadcast systems. The department is staffed with engineers trained in RF systems.

Central Dynamics changes name of product line

Central Dynamics, Quebec, Canada, has changed the product line name of its codec multidimensional signal processors for enhanced NTSC to Stage*1 E-NTSC. The product was initially introduced as PRISM*1 E-NTSC.

Digital Audio Research moves U.S. office

Digital Audio Research has moved its office from the San Francisco area to Hollywood, CA. The address is 6363 Sunset Boulevard, Suite 802, Hollywood, CA 90028; telephone 213-466-9151; fax 213-466-8793.

New products

Portable energy case

Frezzolini Electronics has introduced the Frezzi/Pag portable power-packed energy case for professional video, ENG and EFP users. Included in the case are LOK-ON mounting connectors to replace banana jack connectors used by other battery systems. For a limited time, brackets will be supplied with any Frezzi/Pag batteries and charger.

Circle (350) on Reply Card

Time-code generator/reader

Fast Forward Video has introduced the P-1 portable SMPTE time-code reader and generator. Powered by the VCR battery, the unit connects to the camera with a 14-pin cable. The time-code output connector is user-selectable. The generator can be set to run continuously, independent of camera starts and stops, or start and stop with the camera. Jam sync capability is standard.

Circle (351) on Reply Card

Enhanced graphics encoder

Magni Systems has announced Software Control for the model 4004 gen-lockable videographics encoder. The software package provides fades between video and graphics, variable fade rates, luminance keys, color zero keys and videographics cuts to be controlled from the Amiga 2000 with function keys or a mouse. An on-screen display shows the selected settings.

Circle (352) on Reply Card

Video camera boom microphone and VHF wireless system

Nady Systems has introduced the following products:

• The VCM-100 is a sensitive, superdirectional microphone. The supercardioid electret condenser element used in the mic combines wide frequency response with low noise. A single AA battery powers the element. A switch on the mic housing offers the option of normal or long-distance recording. In long-distance mode, extraneous noise is eliminated. Two cords are included: a 3-foot coil cord and shoe-mounting bracket for on-camera use and a 20-foot straight cord for remote use. A full-length windscreen also is provided.

• The 501 VR wireless system operates on VHF high-band frequencies, with five channels between 170MHz and 216MHz offered as standard. Patented companding circuitry gives the 501 VR a dynamic range of 120dB and full frequency response of 25Hz-20,000Hz. The receiver is housed in a steel case, and is internally powered by a 9V battery or externally powered from any 12V to 35V power source. The receiver includes a "rubber duck" antenna and removable metal belt clip. System transmitters are available in a choice of miniature lavalier transmitter in a body pack or a lightweight, hand-held transmitter.

Circle (353) on Reply Card

Video editing system

M&R Data Services has introduced Symphony System Six, a video editing controller with motion memory and variable-speed capabilities. Two auto assembly modes are featured with global and clock commands for edit list management. Dual and 4-channel audio is supported, as is LAN integration, through Novell SFT Netware V2.1.

Circle (354) on Reply Card

Audio processing products

Klark-Teknik has introduced the following products:

• The DN500 dual compressor/expander/limiter features two channels that provide a distortion level less than 0.05% and S/N greater than 94dB from 20Hz-20kHz.

• The DN510 dual noise gate operates as a stereo or dual mono unit with a range of 0 to −90dB and provides front-panel control of all attack, delay, hold and release parameters. THD is less than 0.5% with noise at −104dBm.

• The DN514 quad auto gate and two stereo delays include two auto attack settings for each channel with hold time scaled to the release value.

• The MIDAS XL2 console line with frame sizes of 24, 32 and 40 inputs. A 16-input channel expander connects to existing frames with a single, multipin connector. A submix from any or all of eight subgroups can be routed to two matrix outputs. An 8-scene automute programming capability includes LED indicators of all essential status buttons. An extensive talkback system includes an interface to standard intercom systems. Four-band EQ with 2-band mid-frequency parametric and bass and treble shelving controls are standard, as are Penny & Giles faders.

Circle (355) on Reply Card

Samplers and software

AKAI Professional has introduced the S950 studio sampler and interface software for the S900 sampler. With a sampling rate of 44.1kHz, the S950 includes an expanded memory to 2.25Mbytes and a high-density disk drive. An optional hard disk interface for connection to a cascade of eight hard drives also provides a CD/DAT interface with 32kHz or 48kHz sampling for DAT applications. Interfaces for the S900 sampler include version V3.1, which allows the use of four Atari hard disk units, and version V3.2 for eight Supra disk drives, which expands the memory capabilities of the IB101A and IB101S interfaces.

Circle (356) on Reply Card

Custom PC systems

Leitch Video has introduced the RacPac AT, a reconfigured AT-compatible PC for mounting in a 19-inch equipment rack. The standard system is 80286-based with 1Mbyte RAM, multifunction card with one serial and one parallel port, sockets for 1.5Mbyte of additional RAM and disk driver card with 20Mbyte hard and 5¼-inch 1.2Mbyte floppy drives. The display adapter includes EGA, CGA, MDA, Hercules or composite monochrome. Options include a 80386 CPU, SCSI controller and RS-422 adapter.

Circle (357) on Reply Card

Audio processor and interface

Aphex Systems has introduced the following products:
- The model 612 expander/gate features downward expansion with a variable ratio, a level ducker and VCA 1000 voltage-controlled amplifier device.
- The model 124 simplifies interconnection of −10dBV consumer IHF equipment with +4dBm and +8dBm professional audio products.
- The model 120 DA features electronic servo balancing of a high-impedance input and four low-impedance outputs, transformerless circuitry and a flat frequency response suitable for distribution of audio and SMPTE time code.

Circle (359) on Reply Card

Microphones and stereophones

Audio-Technica has announced the following products:
- The TriPoint RD303 incorporates three miniature, permanently polarized condenser cartridges into a single case with separate feeds from each unit. The phantom-powered microphone features a 30Hz-20kHz response.
- The AT4051 externally polarized, transformerless cardioid microphones allow interchangeable head capsules for a wide range of micing applications with a response of 20Hz-20kHz.
- The ATH900 series of stereo earphones includes the ATH909 and ATH911 open-back and the ATH910 closed-back stereophones. They include soft foam earpads for an element-to-ear seal with adjustable headbands.

Circle (360) on Reply Card

NEW FROM I.DEN

IVT-9B FULL FRAME DIGITAL TIME BASE CORRECTOR

HANDLES COMPOSITE, COMPONENT (Betacam, MII), Y/C688 AND Y/C358 (S-VHS, ED BETA)*

TRANSPARENT TIME BASE CORRECTION
Designed to meet even the most exacting broadcast standards; with its component processing technology - the IVT-9B time base corrects signals with virtual transparency. Operating at 5.5 MHz in Y/C358, Y/C688 and component (Betacam, MII) modes, the IVT-9B can process up to 450 lines of resolution with excellent picture fidelity. Moreover, its full frame of memory enables it to be used even as a low cost frame synchronizer.

INTER-FORMAT FLEXIBILITY
Not only does the IVT-9B solve multi-format headaches, but its input/output flexibility and wide bandwidth allows for system expansion well into the future. In addition to a wide selection of possible inputs, it can also function as a system transcoder from one format to another.

COMPONENT INPUT CAPABILITY
The IVT-9B's component input capability enables it to time base correct signals from portable Betacam and MII VCRs. Additionally, its full frame memory allows it to be used as a component input - composite output frame synchronizer making it especially attractive for field and SNG applications.

SERVICE CONSCIOUS DESIGN
Should anything go wrong with the product and we have done virtually everything to ensure nothing will - the IVT-9B comes in the same unique four board construction as the popular IVT-9. In the unlikely event that anything should go wrong, the four board design makes for quick fault localization and the consequent board replacement resulting in the shortest possible down time.

USER FRIENDLY AND FEATURE PACKED
The IVT-9B measures one rack unit high with front panel access of Video Level, Chroma, Set Up and Hue adjustment. Its major functions such as frame and field freeze, input select and genlock are highlighted by LEDS on the front panel. Auto-freeze is activated when there is a loss of signal. Furthermore its built-in Automatic Chroma Control (ACC) circuitry helps to eliminate many chroma problems.

LOW COST
With such high performance and flexibility; the IVT-9B, at $4,950 makes budgetary sense.

SPECIFICATIONS
INPUTS: Y/C358, Y/C688, Composite, Component & Genlock. OUTPUTS: 2 x Composite, 2 x Y/C358 & Black Burst. SAMPLING FREQUENCY: 13.5 MHz (4:1:1). QUANTIZATION: Y&C-8bits. DG/DP: 2%, 2. K FACTOR: Less than 1% (composite 2%), FREQUENCY RESPONSE: Y/C 5.5 MHz, Composite 3 MHz. S/N RATIO: 58 dB.

ALSO FROM I.DEN

TR-9 Remote Control Unit for IVT-9 Time Base Corrector • IS-80 Integrated CCTV Switcher • IP-10 Image path • IVT-9 Full Frame TBC • IVD-10 S-VHS Distribution Amplifier • IVS-10 S-VHS Transcoding/Distribution Amp

*"Betacam" is a registered trademark of Sony Corporation. MII is a registered trademark of Panasonic Broadcast)

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Circle (92) on Reply Card

Editing control systems

The ECS-190XL

EECO/Convergence has introduced the ECS-190XL and ECS-195 series of editing controllers. All systems are configured for A/B roll and 3-VTR operation. Joysticks are used for control of tape movement.

- The ECS-190XL features an integral SMPTE time-code reader/generator, sync and color black generator and includes audio editing capability with programmable fades.
- The ECS-195 series supports extensive list management with three levels of non-volatile EDL memory. The 195XL offers 450-event memory and TAG features; the 195+ enhances the list management package with add, delete, replace with or without ripple and sequential/checkerboard auto-assembly. The 195Si boosts the memory to 1,000 events and adds slo-mo and personalized VTR cue ballistics.

Circle (361) on Reply Card

Standards converter

A.F. Associates has introduced ISIS, an 8-bit, 3-field standards converter with 2-line interpolation. Expansion to 4-field operation is optional.

Signal options include SECAM, PAL-M, PAL-N and RGB/YUV inputs and outputs as well as a CCIR 601 digital interface. Performance options include comb filter decoding, a motion-adaptive temporal aperture, noise reduction and vertical detail enhancement. The unit requires approximately nine inches of a 19-inch equipment rack.

Circle (362) on Reply Card

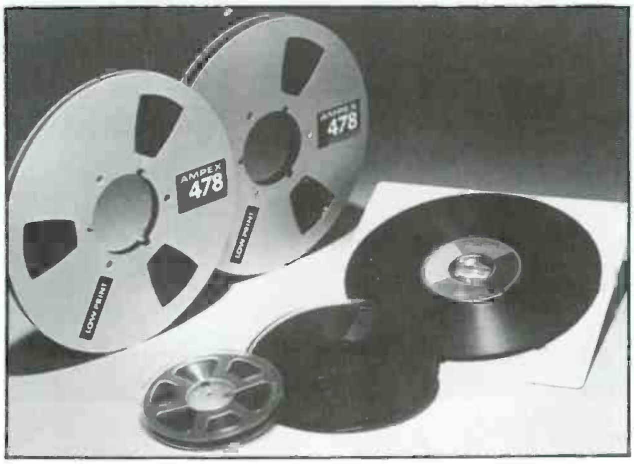
Recorder with synchronizer

Mitsubishi Pro Audio Group has introduced the X-880 digital audio recorder with CS-1 chase synchronizer. The recorder is a 32-channel system using the ProDigi format and is compatible with previous X-800 series models. It features improved A/D and D/A converters with linear, phase-active analog filters, autolocator and integral or remotable meter bridge. Options include the CS-1 chase synchronizer to allow 64-track recording with a ±20s resolution and the DIF-32 AES/EBU digital interface and IF-SSL-1 analog remote interface linking the recorder to SSL consoles.

Circle (363) on Reply Card

Low-print audiotape

Ampex Magnetic Tape Division has announced the 478 audio mastering tape for film and video post-production and recording studios. An improved low-print performance provides minimum audible print signals. Other features include a high-speed backcoating process to reduce edge damage and to allow high-speed rewinding of the tape.



Circle (364) on Reply Card

Headsets and shotgun microphone

Beyerdynamic has introduced the following products:

• The DT770/990 studio headsets feature a frequency response of 5Hz-35kHz for reproduction of complex waveforms and extended harmonics. The lightweight designs include a large, low-mass diaphragm. In the DT770, the diaphragm is embedded in a bass-reflex system, and the 990 is a circumaural semi-open air design.

• The MCE86 short shotgun microphone weighs 95g for hand-held, camera mounting or fishpole boom applications. The condenser element with a hypercardioid pattern has a phantom power range from 12Vdc-48Vdc and features a response of 50Hz-18kHz. Two elastic suspension devices are available.

Circle (365) on Reply Card

Time-code equipment

Brabury International has introduced the following products:

• The TCG-201 generator/reader is stored in a leather carrying pouch and allows free-run, record-run, jam-sync and reader modes, selectable from a soft-touch control panel. An LCD display shows time, bits and modes. The unit conforms to EBU specifications.

• The TCI-101 inserter reads time and user bits from 1/30th to 60 times normal play speed in either direction, and it inserts the information into the line driving a video monitor. The display can be positioned on the screen with this freestanding unit that conforms to SMPTE and EBU LTC recommendations.

Circle (366) on Reply Card

Circle (99) on Reply Card

Circle (102) on Reply Card

Circle (46) on Reply Card

Macrokey generator

Black Sand Digital has announced the BSD-901 macrokey generator for use with the Sony BVE-900 video editing controller. The plug-in device is powered from the editing system and stores sequences to 254 keystrokes for recall by each soft key. An LED indicator alerts the operator to the learn and do modes. Learn sequences are executed as they are learned, to eliminate errors in programming.

Circle (368) on Reply Card

Standards converter systems

Merlin, Snell & Wilcox has introduced six new standards converter systems:

- The ME-2001 accepts different HDTV signals and converts to NTSC, PAL or SECAM.
- The ME-9900 universal 4-field converter works with all world standards.
- The ME-9930 is a 4-field converter that converts the three most common standards.
- The ME-8000 series includes transparent conversion using improved motion interpolation algorithms in the ME-8100 single-in, single-out and the ME-8800 full-feature, all-standards system. In addition, 4-field upgrade kits are available for the existing ME-800 series of universal standards converter systems.

Circle (369) on Reply Card

Video graphics equipment

The Chyron Group has announced the Aurora AU/250 videographic system. The system features full-color paint, animation and 3-D capabilities with an 80386 microprocessor for improved processing speed and an SCSI peripheral interface.

Circle (370) on Reply Card

Circle (84) on Reply Card

Intercom systems

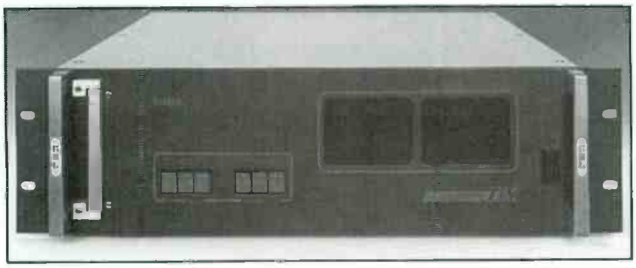
Diless has introduced ProCom, a full-duplex intercommunication system. Each station is equipped with a push-button dial, allowing all users to establish the desired connection at the touch of one button. Any station may be used as belt pack or table-mounted units with interconnection through a standard 3-core microphone cable.

Circle (372) on Reply Card

Framestore, decoder and test unit

GML has introduced the following products:

- The TIM provides two independent channels of infinite-window digital time base correction with field and frame freeze capability for PAL 625/50 color signals.
- The PCD-500 PAL-to-component decoder provides simultaneous outputs of YUV components, RGB plus sync and S-VHS with a digital interface conforming to CCIR-601 as a plug-in option.
- The MTG-205 generator produces CCIR-601 digital component, YUV component and composite outputs selected from an LCD menu display and function keys. The unit includes genlocking to an external sync source.



Circle (373) on Reply Card

Digital audio production center

Digital Audio Research has introduced 2- and 8-channel configurations of SoundStation II, a second-generation digital audio recorder and production center. Features include stereo time warp, an animated playback display, punch-in/record, long crossfades and full-chase synchronization. Inputs and outputs can be analog or digital with optional 18-bit A/D and D/A, AES/EBU digital interfacing and 1610/30 digital interface. Winchester or optical WORM disk drives may be used with the system.

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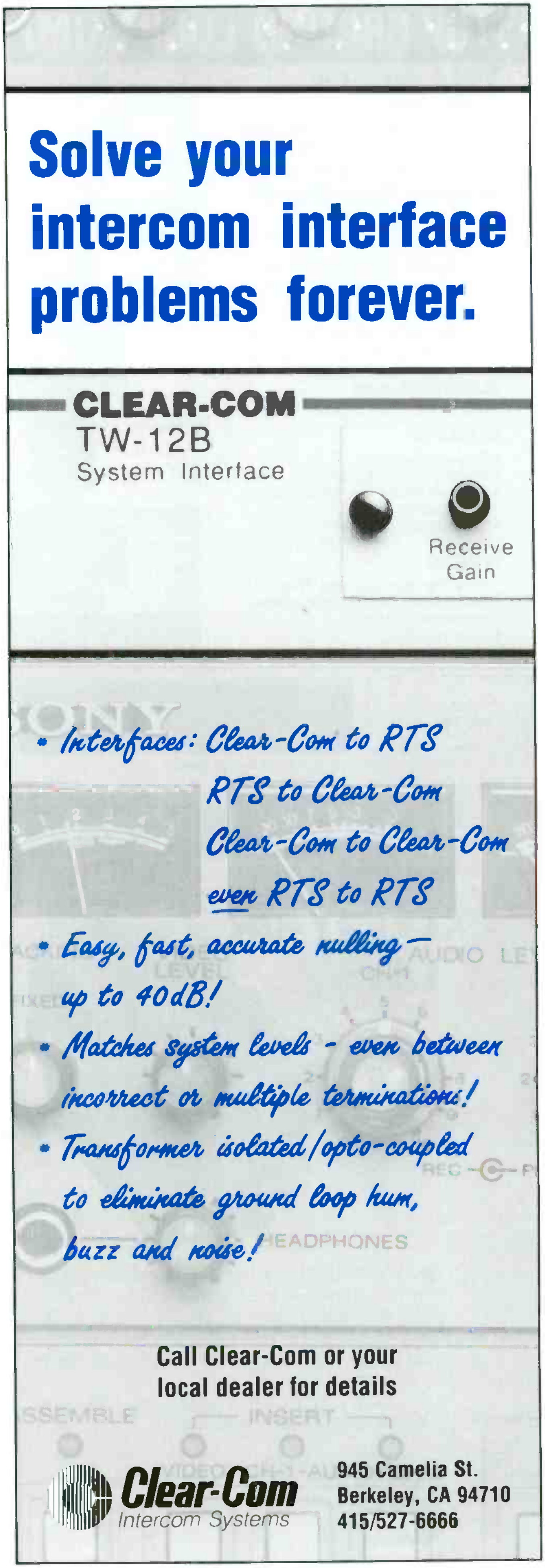

Circle (83) on Reply Card

Steadicam accessories

Cinema Products has introduced a series of accessories for the Steadicam. A telescoping balance kit enables easier adjustment of the camera mount in high and low modes with a telescoping support post for expansion or contraction of the main post. A side-to-side balancing camera base plate moves the camera by turning a knob. Also included is a fore/aft/rotating balance control and a dovetail plate for front-to-back movement of the electronics module.

Circle (375) on Reply Card

Video and pulse delay lines and video filters

Broadcast Video Systems has introduced the MINIBOX series of lumped, switched and pinnable video and pulse delay lines and video filters housed in a 3"×3"×7/8" metal case. The unit may be freestanding or rack-mounted.

Circle (376) on Reply Card

Patchbays and utility plugs

Connectronics has introduced the J-Bay and X-Bay patchbay systems and a series of Bodge plugs. J-Bay circuit card patchbays use a ¼-inch jack in the front panel with a ¼-inch jack, phono or hardwire options at the back. Twenty-two pairs of sockets can be balanced or unbalanced and used in normaled, half-normaled, listen or isolated modes. X-Bay XLR systems can be reconfigured to take a variety of sockets from BNC, MIDI, UHF and F.

XLR-based Bodge plugs have three spring-loaded terminals at one end with a 3-pin male or female XLR connector at the other. The terminals allow connections to be made for temporary, test or experimental equipment hookups.

Circle (377) on Reply Card

MIDI and video interfaces

Integrated Media Systems has introduced an audio interface for use with Abekas A-60, A-62 and A-64 digital videodisc recorders, which adds fully integrated audio. The interface also offers audio I/O for digital videotape recorders and analog outputs for standard ATR and VTR decks as well as AES/EBU, R-DAT and Sony PCM equipment. A track-ball control permits instant random access of sound and auto-bouncing where audio always follows video.

Circle (378) on Reply Card

Portable microwave transmitter

RF Technology has introduced the RF-223B miniature portable microwave transmitter. It is available in any 250MHz segment of the band (1.7GHz-2.7GHz), with the RF power output switchable (12/3W at 2GHz and 10/3W at 2.5GHz). A special "Goldline" version of the transmitter also is available that will cover both 2GHz and 2.5GHz ENG frequency bands in a single unit.

Other standard features include dual, high-quality audio channel with line-/mic-level switching, LPF video input, remote-control capability, wideband (10MHz), narrowband video, baseband switching and 12Vdc operation.

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FOR SALE: 360 ft. Truscon guyed tower, 48 inch face, solid rod, with lighting, guys, base insulator and 60 ft. pole. Bill Glasser, WHBC Radio, Canton, OH (216) 456-7166. 02-89-2t

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HELP WANTED

IMMEDIATE OPENING for Broadcast Maintenance Engineer at ABC affiliate on the Texas Gulf Coast. Must have at least five years experience and SBE Certification. Experience in VHF transmitter and studio equipment, including one-inch tape and digital systems required. Send resume to: Fred Hoffmann, Texas Television, Inc., P.O. Box 6669, Corpus Christi, TX 78466-6669. E.O.E. 02-89-1t

TELEVISION MAINTENANCE ENGINEER Lifetime Television seeks an experienced Maintenance Engineer for its new broadcast facility in Astoria, Queens, New York. Knowledge of Sony 1", ¾", Beta SP and Betacart desired. Familiarity with G.V.G. Switchers, Editors and FX a plus. Position will involve custom construction and routine maintenance. Available to work evenings. Salary commensurate with experience. Send resume with salary history to: Lifetime Television, 36-12 35th Avenue, Astoria, N.Y. 11106. Attn: Personnel Department. 02-89-1t

CHIEF ENGINEER Farmington, New Mexico, VHF network affiliate. Minimum of 5 years hands-on experience with studio and transmitter equipment. Familiar with FCC technical rules and regulations. FCC general license required. Salary commensurate with experience. Send resume to F. Bibeau, KOB-TV, Inc., P.O. Box 1351, Albuquerque, N.M. 87103, EOE M/F 02-89-1t

ATTENTION: WOMEN WHO SOUGHT EMPLOYMENT WITH THE VOICE OF AMERICA (VOA), THE UNITED STATES INFORMATION AGENCY (USIA), OR THE UNITED STATES INTERNATIONAL COMMUNICATION AGENCY (USICA) BETWEEN OCTOBER 8, 1974 AND NOVEMBER 16, 1984.

YOU MAY BE A VICTIM OF SEX DISCRIMINATION ENTITLED TO A MONETARY AWARD AND A POSITION WITH THE AGENCY.

UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA

CAROLEE BRADY HARTMAN, et al., Plaintiffs, v. CHARLES Z. WICK, Defendant	Civil Action No. 77-2019 Judge Charles R. Richey

PUBLIC NOTICE

On November 16, 1984, the United States District Court for the District of Columbia found in this class action lawsuit that the United States Information Agency (USIA or the Agency), including the Voice of America (VOA), is liable for sex discrimination against female applicants for the following positions at the Agency. The USIA was also formerly known as the United States International Communication Agency (USICA). On January 19, 1988, the Court issued its opinion ordering relief in a variety of forms to potential class members. Accordingly, this case is now in the remedial phase.

JOBS COVERED

Specifically, the Court has found that the Agency has discriminated against women in hiring in the following jobs:

- Electronic Technician (Occupational Series 856)
- Foreign Language Broadcaster (Occupational Series 1048)
- International Radio Broadcaster (Other) (Occupational Series 1001)
- International Radio Broadcaster (English) (Occupational Series 1001)
- Production Specialist (Occupational Series 1071)
- Writer/Editor (Occupational Series 1082)
- Foreign Information Specialist/Foreign Affairs Specialist/Foreign Service Information Officer/Foreign Service Officer (Occupational Series 1085 and 130)
- Radio Broadcast Technician (Occupational Series 3940)

WHO IS INCLUDED

All women who sought employment with the Agency in any of the jobs listed above between October 8, 1974 and November 16, 1984 and were not hired may be eligible for relief. Also included are those women who were discouraged from applying for these positions during that time period. Even those women subsequently hired by the Agency in some capacity may be entitled to participate in the remedial phase of this case.

Women who sought employment with the Agency as Foreign Service Officers or Foreign Service Information Officers may be eligible for different kinds of relief depending upon the date of application and whether they sought employment at the entry level or mid-level. Women who sought employment with the Agency as <u>entry</u> level Foreign Service Officers or Foreign Service Information Officers in the years 1974-1977 must use the procedure outlined below. Women who sought employment with the Agency as <u>mid-level</u> Foreign Service Officers or Foreign Service Information Officers in the years 1974-1984 must also use the procedure outlined below. However, women who sought employment with the Agency as <u>entry</u> level Foreign Service Officers or Foreign Service Information Officers in the years 1978-1984 cannot use the procedure outlined below, since the Court has ordered an alternative form of relief for them and selected women in this group will be notified individually as to their rights.

RELIEF AVAILABLE AND HOW TO OBTAIN IT

Relief available to class members may include a monetary award and/or priority consideration for a current position with the Agency. If you think you may be entitled to relief, you <u>must</u> obtain a claim form, complete it fully, and return it to counsel for the plaintiff class, Bruce A. Fredrickson, Esq., Webster & Fredrickson, 1819 H Street, N.W., Suite 300, Washington, D.C. 20006 (202/659-8515), postmarked no later than July 15, 1989.

You may obtain a claim form in person and/or in writing from several sources: counsel for the plaintiff class, whose address is listed above; in person from USIA, Front Lobby, 301-4th Street, S.W., Washington, D.C. (8:15am -5:00pm), Office of Personnel Management (OPM), Federal Job Information Center (First Floor, Room 1425), 1900 E Street, N.W., Washington, D.C. (8:30am-2:30pm), or from area OPM offices throughout the country; in writing, VOA-Hartman, P.O. Box 400, Washington, D.C. 20044. You should carefully consider all questions on the claim form, <u>sign</u> it, and return it to counsel for the plaintiffs. <u>Do not, under any circumstances,</u> return the claim form to the Judge, the Court or the Clerk of the Court. The Judge, the Court and the Clerk of the Court <u>will not accept</u> the claim forms and <u>will not forward</u> claim forms to plaintiffs' counsel.

PROCESSING OF CLAIMS

The process for handling claims has not been finally decided. Thus far, the Court has ordered that responding class members demonstrate their potential entitlement to relief at an individual hearing to be scheduled at a later date. However, the Court has reserved the right to reconsider this procedure in the event the number of claims filed makes this approach unmanageable.

Should individual hearings be used, you will be fully informed as to the date and time of your hearing. Moreover, you will be entitled to legal representation by counsel for the plaintiff class or his designee at no cost to you. Legal counsel will discuss your claim with you prior to your hearing, help you prepare your case and represent you at your hearing. You may, of course, retain your own attorney to represent you, if you so desire.

At the individual hearing, you will be asked to demonstrate your potential entitlement to relief by showing that you applied for one or more of the covered positions during the period October 8, 1974 and November 16, 1984 and that you were rejected, or that you were discouraged from applying. Evidence may be required in the form of testimony, documents, or both. Once you have demonstrated these facts, USIA is required to prove, by clear and convincing evidence, that you were not hired (for <u>each</u> position for which you applied) for a legitimate, non-discriminatory reason, such as failure to possess requisite qualifications. Should USIA make such a showing, you would then be entitled to demonstrate that the Agency's reason is merely a cover for sex discrimination or unworthy of belief.

Following the hearing, the Presiding Official will decide whether you are entitled to relief and, if so, what relief is appropriate. You may be entitled to wages and benefits you would have earned if you had been hired (back pay) from the date of your rejection until the date relief is approved. Under the law, back pay is offset by earnings you may have had during the period. In addition, you may be found to be entitled to front pay (that is, compensation into the future until an appropriate position is afforded you). Similarly, you may be found to be entitled to priority consideration for employment with the Agency. If hired, you may further be entitled to retroactive seniority with the associated benefits and the value of any promotions you would likely have had if you had not suffered discrimination.

REQUIRED STEPS TO FILE YOUR CLAIM

To participate in the remedial phase, <u>you must fully complete the claim form</u> and return it, POSTMARKED NO LATER THAN July 15, 1989, to counsel for the plaintiff class. Your failure to do so will result in your losing all rights you may have in this lawsuit. If you have questions about your rights or procedures available to you, you may contact counsel for the plaintiff class:

Bruce A. Fredrickson
Webster & Fredrickson
1819 H Street, N.W., Suite 300
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October 4, 1988	*/s/ Judge Charles R. Richey*
Date	United States District Court Judge Charles R. Richey

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One of the nation's premier telecommunications companies currently seeks an RF Service Engineer to provide customer and engineering support to sales staff and RF field service for TV transmitters.

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TV TRANSMITTER MAINTENANCE ENGINEER Fox Television, WFXT, Boston is seeking a qualified transmitter engineer with strong background in RF. Previous experience with RCA-TTU110 UHF transmitter and studio equipment preferred. FCC lic. or SBE certification required. Send resume/references to: Moses Primo, C.E., WFXT-TV, 100 2nd Ave., Needham, MA 02194. EQUAL OPPORTUNITY EMPLOYER. 02-89-1t

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TRANSMITTER/STUDIO ENGINEER needed for Worcester, Massachusetts UHF television station. Strong background in UHF transmitters. Also, studio maintenance background helpful. Contact Fran Vaccari, Chief Engineer, WHLL-TV, 617-799-2727. 7-88-tfn

CHIEF TELEVISION ENGINEER Outstanding opportunity for Chief Engineer to make an impact as a member of our creative team as we design and implement a statewide television system, using fiberoptic, ITFS and standard microwave technologies. Chief will play an integral part in the design, construction and equipping of a video production/operations facility designed to broadcast standards and scheduled for completion next year. You will supervise engineering for multi-camera production and ITFS operations, and oversee equipment specifications, installation and maintenance. Salary competitive with industry standards. Attractive benefit package. Requires at least 3 years television engineering experience, including maintenance and staff supervision, design of television systems and knowledge of digital, microwave and satellite technologies. For more information, call Fred Hurst, Operations Manager, Maine Interactive Television System, (207) 622-7131. To apply, send resume and letter of application to: Fred Hurst, Interactive Television, University of Maine at Augusta, Augusta, Maine 04330. Screening of applicants will begin March 1, 1989. THE UNIVERSITY OF MAINE IS AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER. 02-89-1t

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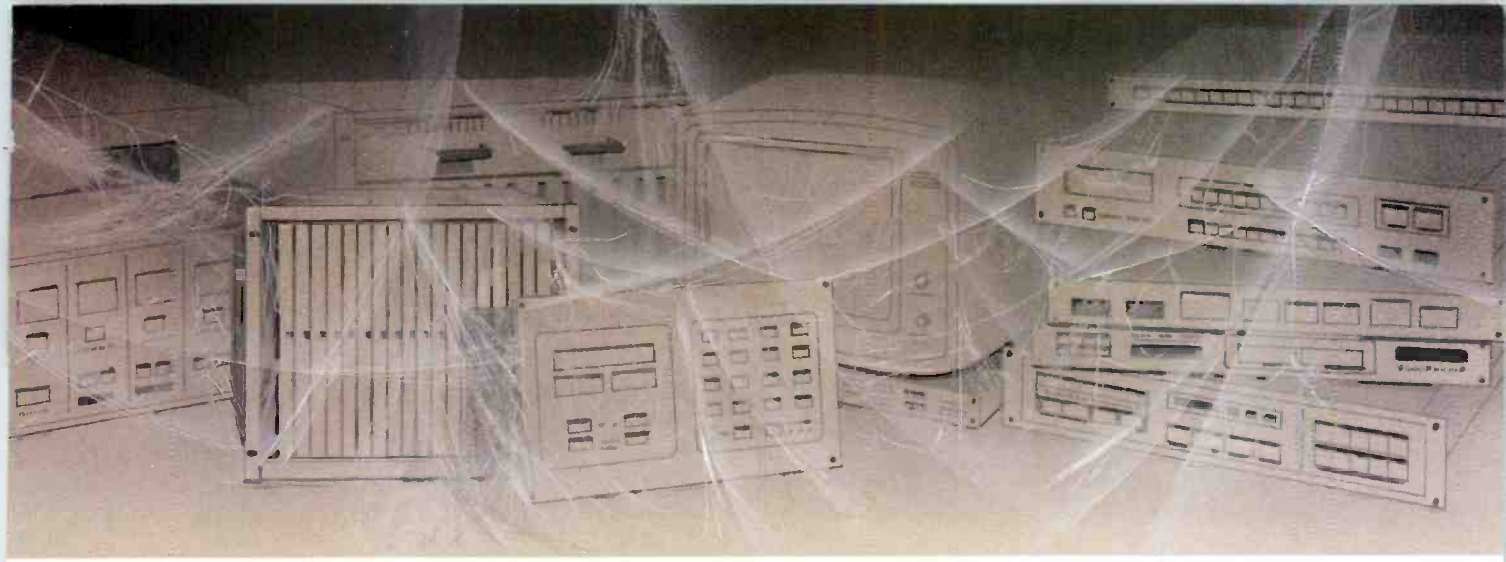
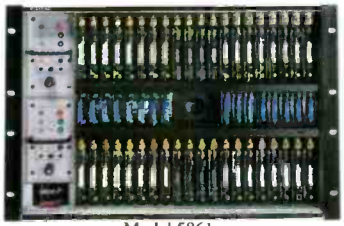
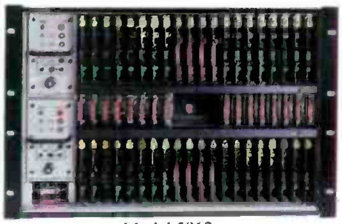
FINANCING AVAILABLE (SUBJECT TO CREDIT APPROVAL)

Circle (94) on Reply Card



DI-TECH'S VIRTUAL MATRIX MAKES OTHER ROUTERS VIRTUALLY PASSÉ


Model 5861
64 × 32 Video Switcher


Model 5862
64 × 32 Audio Switcher

Routing switchers are simple and efficient when all you need is a full AFV matrix. If you try reserving a few video only or audio only crosspoints, however, they can quickly become very clumsy and awkward. Now, you could play games moving switch cards around, tie up "spare" inputs with terminators, or rewire your router frames. But there is a better way.

Di-Tech's *virtual matrix* control system, Model 9002, maintains a software map of your router's hardware connections. This makes it easy to define single level crosspoints *anywhere* in a matrix, as well as preset breakaway switches. Special purpose routing – such as time code, RS422 or RGB – can be smoothly integrated into an 8 level master grid at any time.

Prepare for tomorrow with the company that can do it all today...Di-Tech.

di-tech inc.

48 Jefryn Boulevard, Deer Park, New York 11729
(516) 667-6300, Telex No. 971806, FAX (516) 595-1012

Circle (2) on Reply Card