BROADCAST engineering

February 1986/$3

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Audio special effects

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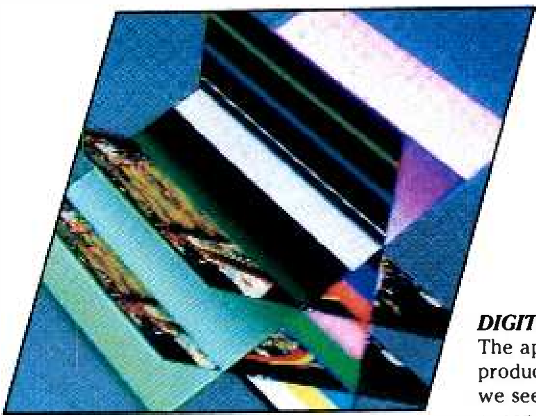

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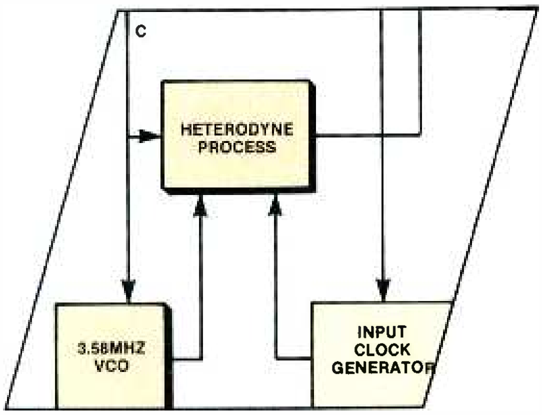

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BROADCAST engineering

DIGITAL TECHNOLOGY FOR AUDIO AND VIDEO

The application of digital signal processing to audio and video production and post-production has dramatically changed what we see and hear on the air. New hardware designs have given expanded creative tools to TV and radio stations and post-production houses. We examine some of the primary elements of this technical revolution.

ON THE COVER

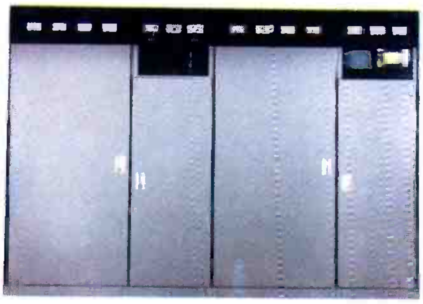
Our cover this month represents the work being done on state-of-the-art digital video effects graphics systems. Such systems have—more than anything since the advent of color television—dramatically changed what we see on the air. Contributing artists and companies include Joni Jacobson of Television Associates, Mountain View, CA; Tony Redhead and Martin Holbrook of Quantel, Palo Alto, CA; Polycom Teleproductions, Chicago; and Caesar Video, New York. Cover photography by Rick Der. Courtesy of Quantel.

DEPARTMENTS

Comark performance satisfies the most exacting customers...again and again.

Harry Pappas was so impressed with his first Comark "S" Series 220kW Transmitter, he bought a second.

You don't get to be a leader in the independent television broadcast industry by making the wrong decisions about TV transmitters. When Harry Pappas was ready to build his New Super-power station, WHNS-TV in Asheville, N.C., he chose the Comark "S" Series 220kW Transmitter. In Harry's own words: "The transmitter lived up to the promises made by the Comark people...and then some. In terms of performance, specifications and efficiency ratings, I couldn't have asked for more."



Naturally when it came to choosing the transmitter for his next station in Omaha, Nebraska, there was only one choice: Comark's "S" Series 240kW rig.

At Comark, we are especially proud to have gained the confidence of a knowledgeable industry leader like Mr. Pappas. But building superior transmitters is only a part of our story. We continue to work even harder at building a superior transmitter company.

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Klystrode makes successful test

The Klystrode, under development for more than five years, has completed a successful operational test in a UHF TV transmitter. The device, developed by EIMAC division of Varian Associates, is a hybrid combination of a tetrode and klystron. The test at Varian's San Carlos plant was made in cooperation with, and using equipment supplied by, Comark. Following the test, Comark announced plans to demonstrate the first practical application of the Klystrode in a product at the upcoming NAB convention in Dallas.

Various power levels to 60kW are planned, each of which is projected to operate at one-half the energy consumption of normal klystron systems. The device is operationally more efficient and requires less energy for cooling and support systems. The tube has only two focus coils, no modulating anode, a simpler bias system and requires no pulser to achieve its high-efficiency operation. In addition, tests show that the device does not exhibit ICPM problems commonly found with klystrons.

The hybrid device uses a pyrolytic grid structure in the tetrode portion of the tube, where amplification occurs. Power handling is accomplished through a single cavity design that requires a collector voltage approximately the same as traditional klystrons.

The initial transmitter systems will not be reduced in size, but rather will contain standard klystron cabinets, allowing an operator to configure the transmitter with either the hybrid device or normal klystrons. It is expected that the physical size of the system eventually will be reduced, as the design proves itself.

DTTR exceeds 1Gb/s data rate

A digital VTR, operating with data rates at 1.037 gigabits per second (Gb/s), has been announced by Sony Corporation. Although still in an experimental stage, the machine is one of a series of HDTV products developed in cooperation with NHK, the Japanese Broadcasting Corporation.

The bandwidth of the normal composite video signal is typically less than 5MHz. As HDTV is envisioned, however, three signals are necessary to contain the information. A 25MHz bandwidth for luminance and two 12.5MHz channels for chrominance components are planned. Without some type of bandwidth (and bit rate) reduction, digital recording methods used currently would not be able to contain all the image information.

In order to accomplish the 1.037Gb/s rate, the image to be recorded is first divided into segments. Once segmented, the digital information is passed through signal-processing circuits in a parallel, rather than serial, mode. A new concept in head design allows eight channels to be recorded simultaneously on a coated metal 1-inch tape medium, moving at 805mm/s (31.1ips).

The signal-to-noise ratio of the experimental system measures 58dB using 8-bit quantization. Although the current sampling frequencies of 64.8MHz (luminance) and 32.4MHz (chroma) do not follow the luminance/chroma sampling plan suggested by CCIR recommendation 601, adjustments are being contemplated. Error detection and correction circuits avoid undesirable image deterioration through duplication and editing steps of production.

The concept of segmenting the image and processing the segments in parallel allows the system to be designed with ex-

Continued on page 125

Broadcast Engineering

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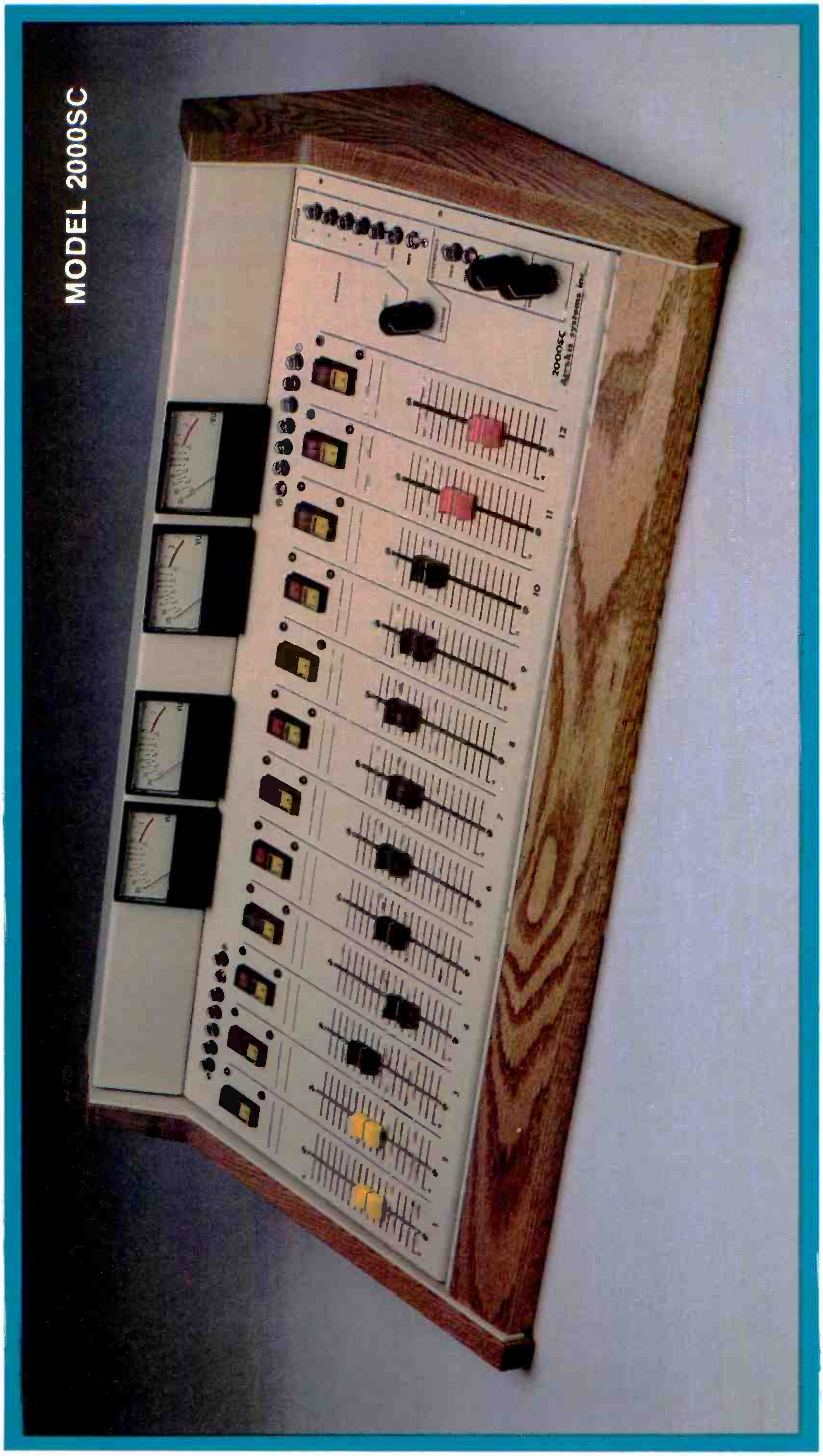

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Editorial

Invest in yourself

Are you a member of the Society of Broadcast Engineers? If not, you may be passing up the opportunity to be associated with one of the largest professional broadcast associations in the country. Membership in the SBE tells your co-workers and your employer that you are a professional and that you consider broadcast engineering a *profession.* The investment that you make in SBE membership represents a commitment to your future.

What can the SBE do for you? There are a number of benefits to joining the society. First, membership helps identify you as a professional working in the field of broadcast engineering. The SBE is the only organization actively working to promote and protect the interests of the broadcast engineer. What organization tried to protect your first-class license? What organization helps you keep that remote broadcast on the air without interference through local frequency coordination? What organization petitioned the FCC for additional STL and remote pickup frequencies? What organization regularly files petitions before the FCC to lobby for the interests of the station engineer? The Society of Broadcast Engineers.

Perhaps the two activities for which the society is best known are its certification program and frequency-coordination efforts. When the FCC threw in the licensing towel in 1981, the certification program of the SBE became the only game in town. First conceived in 1973, the certification program is designed to provide a method whereby technical personnel can be evaluated by peers. The objective of certification is to provide standards of professional competence in the practice of broadcast engineering and to recognize those who meet the standards. The program to date has certified more than 2,900 engineers and gained industrywide recognition as the best indication of experience and knowledge available to the prospective employer when hiring technical personnel. *Recognition* is what SBE certification is all about.

The society has also won praise for its frequency-coordination efforts. As the broadcast auxiliary services frequencies became scarce in major metropolitan areas during the late 1970s, the SBE recognized that only through close cooperation among licensees could stations continue to expand use of the "Part 74" aural and video channels. Accordingly, the SBE established a network of local frequency-coordination contact persons around the country to guide the process. The local frequency coordinators do not assign channels. Instead, they facilitate licensee-to-licensee contact and provide a mechanism for resolving disputes and differences.

The commission has recognized the importance of the society's coordination efforts. In Docket 85-36, the commission noted that it would rely on the cooperation of licensees through local frequency coordination to decide the most efficient use of the available spectrum in a particular area. Frequency coordination has become a fact of life for outside broadcast radio and TV activities today in all large markets, most medium markets and even some small markets. It was—in fact—the coordination process that made possible extensive on-air coverage of the Los Angeles Olympics and the 1984 national political conventions. *Cooperation* is what the SBE's frequency coordination program is all about.

Another benefit of SBE membership is participation in a national organization that is becoming more and more visible and respected. In October, the SBE will hold its first national convention, in St. Louis. This event will be a showcase for society activities and launch the SBE into a new level of visibility in the broadcast community. The popular SBE regional conventions will continue to be an important element of society activities, but the October gathering will provide a central focus for the national organization. **Broadcast Engineering** is cooperating with the SBE in its convention, organizing the technical sessions at the convention under the guidance of John Battison, one of the founding members of the society.

The joint effort will combine the excellent exhibits and attendance of the SBE Central States convention with the technical conference formerly hosted by Battison at Ohio State University. These two proven successes will make the 1986 SBE National Convention and **Broadcast Engineering** conference an event that shouldn't be missed. *Industry respect* is what the SBE national convention is all about.

More than 5,000 radio and TV engineers have made the decision to support the only organization that supports the needs and interests of the broadcast engineer—the SBE. Join their ranks today. An application blank for membership in the SBE can be found on page 115 of this issue. *Invest in yourself.* Join now.


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Duplication rules might be lifted

By Harry C. Martin

The FCC has proposed amending its rules to eliminate all restrictions on duplication of programming by co-owned AM and FM stations in the same local area. Presently, the commission's rules provide that if either station of an AM/FM combination is licensed to a community of more than 25,000 persons, the FM station may not duplicate the AM's programming more than 25% of the average program week.

The commission requested comments regarding the effects elimination of the proposed duplication rules might have on spectrum efficiency, the expansion of radio service and the viability of AM stations. Comments were due to be filed in January and action is expected within the next few months.

Construction deadline rules amended

The commission has amended its rules to provide a longer initial period of time in which to construct broadcast stations after the award of a construction permit. At the same time, it established strict guidelines concerning applications for extension of time to construct stations, for modification of construction permits and for the assignment or transfer of unbuilt stations.

Holders of construction permits granted after Dec. 10, 1985, have 24 months in which to construct a TV station or 18 months to construct a radio, other broadcast or auxiliary station. Instructional TV Fixed Service (ITFS) permittees, however, will continue to have 18 months to finish construction.

Under the commission's new policy, an application for an extension of time to build a broadcast station or for replacement of an expired construction permit will be granted only if one of the following three criteria is met:

- Construction of the station is completed and testing is already under way, looking toward the prompt filing of the license application.
- Substantial progress has been made; the permittee can demonstrate that the equipment is either on order or on hand, the site has been acquired and cleared, and construction is proceeding.
- No progress has been made "for reasons clearly beyond the control of the permittee," but the permittee has taken all possible steps to "expeditiously resolve the problem" and proceed. Reasons to justify a lack of progress include "governmental budgetary processes" and zoning problems.

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

Similar criteria issued for AM and FM applicants last May are superseded by this action. The new standards will not apply to either ITFS or International Broadcast Stations.

Those who hold construction permits granted before Dec. 10, 1985, may file an application for an automatic 6-month extension of the construction period, up to a total of 24 months for TV stations and 18 months for radio. After the total period of 24 or 18 months has been granted, permittees will be required to meet one of the three criteria described previously to qualify for another extension of time.

The commission also will apply a new policy to applications to modify authorized, but unbuilt, facilities and to long form assignments or transfer applications filed for construction permits issued after Dec. 10, 1985. These applications must be filed within nine months after issuance of the construction permit for radio and within 12 months after issuance of the construction permit for TV facilities. The applicant must certify that construction will start immediately after the modification is granted or the assignment of construction permit is consummated.

If the application for modification, assignment or transfer is filed after the 9- or 12-month time period has run out, the applicant must show that one of the three criteria described previously has been met, as well as certify that construction will begin immediately. The burden of making such a showing will increase as the construction term progresses. Furthermore, the commission states it will not accept any application for modification, assignment or transfer of a construction permit filed after the initial construction period expires.

If a modification is granted, the station must be completed within six months or within the remainder of the original construction period, whichever is longer. In cases in which an application for assignment or transfer is granted, the station must be completed within 12 months after consummation of the assignment or within the remainder of the original construction period, whichever is longer. If an applicant fails to actually modify the facilities or to actually consummate the assignment within the time allowed, the commission will cancel the construction permit.

These new rules are intended to establish clear and consistent standards in an area governed up to now by a combination of policy statements and *ad hoc* staff rulings. The failure of permittees to timely complete their authorized facilities has become a matter of great concern by the commission. The new rules, a product of this concern, will be enforced strictly.

Treatment of character issues narrowed

The commission has concluded rulemaking proceedings begun several years ago in regard to treatment of character qualifications of broadcast applicants. In the future, the following types of misconduct will be considered to be relevant to an applicant's character qualifications:

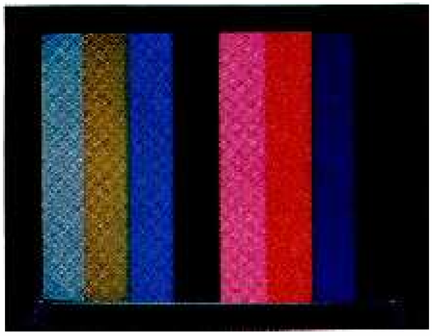
- Adjudicated cases of fraudulent conduct before another government agency.
- Criminal convictions involving fraud.
- Certain felony convictions.
- Adjudicated cases of broadcast-related antitrust or anti-competitive misconduct.

Additionally, the commission will consider misconduct that directly involves FCC directives. In this context the following four categories will be considered:

- Violations of the Communications Act.
- Violations of FCC rules or policies.
- Misrepresentations or lack of candor before the commission.
- Instances of fraudulent programming.

ATS authorization

In December the rules were amended to permit directional AM and TV licensees to use automatic transmission systems (ATS). Such systems consist of monitoring, alarm and control devices arranged to automatically maintain a broadcast station's operating parameters within authorized limits. ATS was authorized for non-directional AM and FM licensees in 1976.



By the book

By Carl Bentz, TV technical editor

Is your station in compliance with the FCC rules? Let's continue with the discussion begun in January on station documentation. Remember, if you have questions in regard to the rules, they should be discussed with your legal representatives.

We noted last month that the chief operator of the TV station must be available on call, if not on the premises, at all times. Provisions allow for times of unavailability. During periods of vacation or illness, the station management must designate an acting chief operator, who will temporarily handle the official duties.

The chief operator duties, as given in section 73.1870, entail supervision as necessary to ensure that operating requirements are fulfilled in a timely and correct manner. Such requirements include inspections and calibrations of station equipment as well as repairs and adjustments. Equally important is a weekly review of station records to verify accuracy and complete compliance with regulations.

Completion of the review is indicated when the chief operator signs and dates logged activities regarding station operation. Any corrective actions deemed necessary should be initiated and a report made to the station licensee on any recurring conditions.

Official inspections

With deregulation, the FCC's position is that stations should police themselves for compliance with the rules. However, the commission will periodically monitor and inspect station operations. For that purpose, the station is to be available for inspection during regular business hours or at any time the station is in operation. See section 73.1225.

When the FCC visits the station, you must honor any requests for special equipment tests, program tests or specific operation conditions. In addition, all station logs and any special technical records must be available for review. Such records include equipment performance measurements on both the aural and visual carriers, written designations for chief operators and any applications for transmission system modification.

Transmitter topics

The type acceptance of the TV transmitter for established stations should not be of major concern unless replaced or unless modifications have been made in the system. The station is responsible for properly documenting the action, however.

If the installation of a new transmitter is planned, no special FCC authority is required, if the new system is included on the FCC radio equipment list as acceptable. Complete performance tests must be placed in the station records within 10 days after operation with the new system is initiated.

If plans include modifications that will alter the station operation from that stated on the license, or if new equipment is to be installed that is not found on the radio equipment list, the commission must authorize the change. In such cases, the station must apply for a construction permit (CP) with the appropriate form.

By section 73.1660(b), the CP request will include a complete description and circuit diagrams of the transmitter and frequency-determining circuits. Complete operating parameters and measurement data that would be required for a grant of type acceptance must be included with the application.

For transmitter systems found acceptable by the commission, the equipment documentation should include a statement of that acceptability. A label or plaque stating acceptance should also be readily visible on the equipment.

Meter labels

Meters to determine the operating parameters of the final RF visual amplifier stage are required according to section 73.688. The function of such meters should be clearly and permanently identified, either on the instrument itself or on the panel immediately adjacent to the meter. Failure to properly label indicating instruments can lead to a citation or, possibly, fines.

If metering for the final amp becomes defective, no special operating authority is necessary if replacement or repair is accomplished within 60 days. If the defective instrument is the transmission line meter, alternative means are necessary to allow output power measurements by the indirect power method.

If restoration of the instrument is not possible within 60 days, an informal request must be made to the FCC district office for a time extension. Delays in restoration must be the result of conditions beyond the control of the licensee.

Accuracy of metering instruments must be documented by section 73.1215(f). This rule is of particular importance if an instrument has been damaged or has failed. A meter that has been repaired should not be used unless a calibration certificate is provided by the instrument repair service or the manufacturer. The certificate must state that the instrument conforms to the system manufacturer's specifications for accuracy.

You should thoroughly review section 73.1215 whenever you need to replace RF power meters. The output power parameter is of particular importance to the FCC because excessive output power may result in interference to other licensees. On the other hand, an inferior power output level may prevent the station from properly serving the public.

Limitations are also placed upon the scale and range of the replacement meter. For all mechanical movement-type meters, the length of the marked scale must be at least 2.3 inches. The accuracy of the full-scale reading must be within 2% of the indicated value. Logic and the rules call for a meter that accommodates the measured parameter at its maximum value without providing an off-scale indication. At the same time, the full-scale reading is not to be more than five times the typical minimum indication, except for square-law movements, which cannot be more than three times the minimum normal reading.

Digital meters may be used in lieu of movement types. Whether a meter, printer or numerical readout, the device must show at least three digits and be within 2% of the decimal value (or a multiple).

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Antenna field-strength measurements

By John Battison, P.E.

Has your boss ever complained about changes in the station's coverage or an increase in interference? If so, you know how difficult it is to convince someone that everything is operating properly. After all, if an important client claims to be unable to hear your station, management may wonder if anyone else can hear it.

A good engineer monitors the station's antenna and ground system on a continuing basis. Unfortunately, because the ground system is hidden from view and the tower may be in a remote field, some engineers tend to forget those elements are just as important as the transmitter.

Every AM station should have a field-strength meter, but not all stations can afford one. The FCC does require that all directional stations have one. If your station does not have one, you may have to borrow. If that option is not available, you will have to develop a different (though less accurate) method of checking your signal.

Build your own

It is possible to build a simple *reference* field-strength meter. This meter will not provide absolute field-strength meter readings. It will, however, allow you to keep track of the *relative* value of your station's field strength on an ongoing basis.

When building a reference field-strength meter, you can use an old tube car radio. The same test results can be obtained with the new integrated-circuit radios, but I prefer to use the old tube radios.

You can purchase one of these radios generally for a few dollars from a local junk yard. Select one that has push buttons. Take it home, clean it up and make sure it works properly. Locate the AGC line running from the second detector to the IF stages. You may have to look around a bit to locate the proper connection point.

A small low-range microammeter or high-resistance voltmeter should be connected to the AGC loop. The meter will measure the current or voltage, whichever is appropriate in your receiver, and will act as a *strength meter* (S meter) in your tests.

Battison, BE's consultant on antennas and radiation, owns a radio engineering consulting company in Columbus, OH.

Take some readings

Select several monitoring points that are clear of brush and away from buildings. Try to locate areas that will not be developed in the near future. Tune in your station and program it for push-button one. Tune in a competing station and program it for push-button two. At each monitoring point write down the readings for both stations. You now have relative indications of the field strength for both stations.

If you can borrow a field-strength meter, you can take accurate readings at the same time. Log these readings along with your S meter readings. You now have a crudely calibrated receiver at the two spot frequencies. It is important to remember that receiver sensitivity is not constant across the dial. Your S meter readings are only relative.

Results

Now that you have a set of readings, how can you tell if your station's radiation efficiency is correct? This test requires both a field-strength meter and an impedance bridge. Measure the antenna base operating impedance and compare it with that shown on the station's license. If the impedance has increased and you are maintaining the same base current, your station is transmitting more power than authorized (I^2R). A decrease in the resistance of the base impedance of a few ohms for a 5kW station will decrease the operating power by approximately 100W. Normally, this is not enough to cause a noticeable change in the received signal level. If your base impedance has changed by more than several ohms, however, you may have a problem for further investigation. The commission's latest rule change, effective this month, allows a ±2% change in base impedance.

Class of station	Efficiency
Class I-A and B	362mV/m at 1km
Class I-N, II and III	282mV/m at 1km
Class IV	241mV/m at 1km

To convert for other powers, multiply the radiation at 1km by the square root of the ratio of the old to the new power.

Figure 1. *The FCC specifies the typical efficiency for each class of station. The text describes how to convert these values to 1-mile readings.*

Accuracy

The FCC specifies antenna radiation efficiencies for all classes of AM stations. The required efficiency for each class is shown in Figure 1. Note that these values are for the distance of one *kilometer*, not one *mile*, as most engineers are accustomed to using. To convert the field strength at one mile to the value for one kilometer, multiply the value at one mile by 1.609344. When converting the field strength at one kilometer to a value for one mile, divide by the same constant.

Many times an engineer will take some field-strength readings at the exact 1-mile point. These readings are often considerably higher or lower than the calculated values. There is no need to panic, especially if the readings are low.

When a field-strength study is conducted, the RF field is measured over at least 20 points on each radial. These values are then plotted on log-log paper.

The field strength at the 1-mile point is located by noting the point on the vertical axis where the unattenuated field-strength line crosses the 1-mile point on the horizontal axis. If you go to the 1-mile point on any particular radial, I doubt that you will read the exact calculated value. In the case of a Class III station, this value will be 175mV/m. However, if you take several readings around the 1-mile point and average the values, you should get a number close to the nominal value for your class.

Once again, do not expect the field-strength readings to exactly correlate with the calculated values. Let's say you have a Class III station with a required efficiency of 175mV/m at one mile. If you read 140mV/m at the 1-mile point, take additional readings on other radials. If those readings are all about the same, the probable cause of the low readings is the antenna system. If the readings are consistently higher than 175mV/m, then you are lucky. Your system is operating properly.

Next month we will discuss the problems associated with directional antenna systems. Although the basic technology is the same, the measurement process is a bit more complicated.

Why Your Radio Station Needs The CRL Stereo Processing System

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Circle (8) on Reply Card

Planning for SNG

By Elmer Smalling III

To continue the series on satellite news gathering, we'll examine the equipment required for basic and advanced SNG uplink systems.

Basic systems are for those who have limited funds and do not wish to get deeply involved in SNG until they acquire operating experience and establish fiscal viability.

Advanced systems include extras such as test and backup equipment, which makes it possible to achieve a high degree of reliability. If the SNG system provides large station revenues or if it is the hub of an SNG network, reliability is a must. Our examples list the general equipment required for mobile and permanent uplinks. Exact equipment lists vary according to manufacturer and equipment applications.

Truck configurations

A basic SNG system typically includes all the equipment necessary to uplink video, audio and a communications channel, but does not include backup components or optional features, such as automatic truck leveling, automatic *satellite sweeping*, or test and production equipment. (See Figure 1.)

A basic SNG truck normally includes:

- equipment housing and air conditioning;
- equipment rack(s);
- leveling jacks;
- 12kW generator;
- 2.5m Ku-band antenna and motorized antenna mount;
- video exciter, including audio subcarrier modulators and communications modulator;
- high-power amplifier, 600W;
- frequency-agile receiver, including low-noise converter, polarizer, cable and power supplies;
- waveguide switch and dummy load;
- waveguide, cable and accessories; and
- transmission line desiccator (nitrogen).

An advanced, full-featured SNG truck would include:

- equipment housing and air conditioning;
- equipment rack(s);
- automatic leveling jacks;
- 20kW generator;
- 2.5m Ku-band antenna with motorized antenna mount;
- shore power reel with 400-foot cable;
- voltage regulator;
- automatic antenna sweep system;
- main and backup video exciter, including audio subcarrier modulators, communications modulators, failure alarm and auto-changeover system;
- main and backup HPA, including failure alarm and auto-changeover;
- main and backup agile receivers, including low-noise converters, polarizer, cable, power supplies and automatic video/audio switching;
- waveguide switch and dummy load;
- waveguide and transmission accessories; and
- audio and video test equipment, including waveform monitor, vectorscope and spectrum analyzer.

Permanent systems

Whether basic or advanced, a permanent system may consist of all of the equipment listed under either system, less the truck. The permanent uplink would be located on your station property and must have a clear vertical view to approximately 40° above the horizon with a clear sweep over an azimuth of 70° west to 140° west. These figures will vary slightly, depending upon the satellite you choose and the longitude and latitude of your location. [BE]

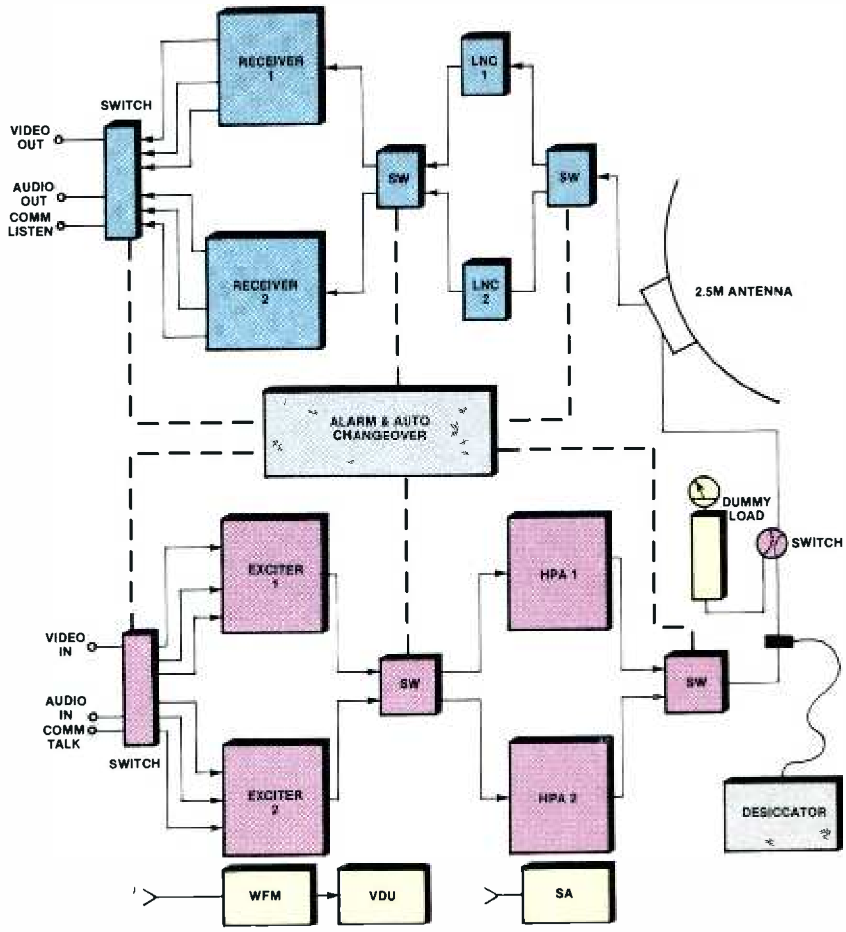

Figure 1. Block diagram of an SNG starter system. This is a limited equipment package to allow you to gain experience and begin uplinking.

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

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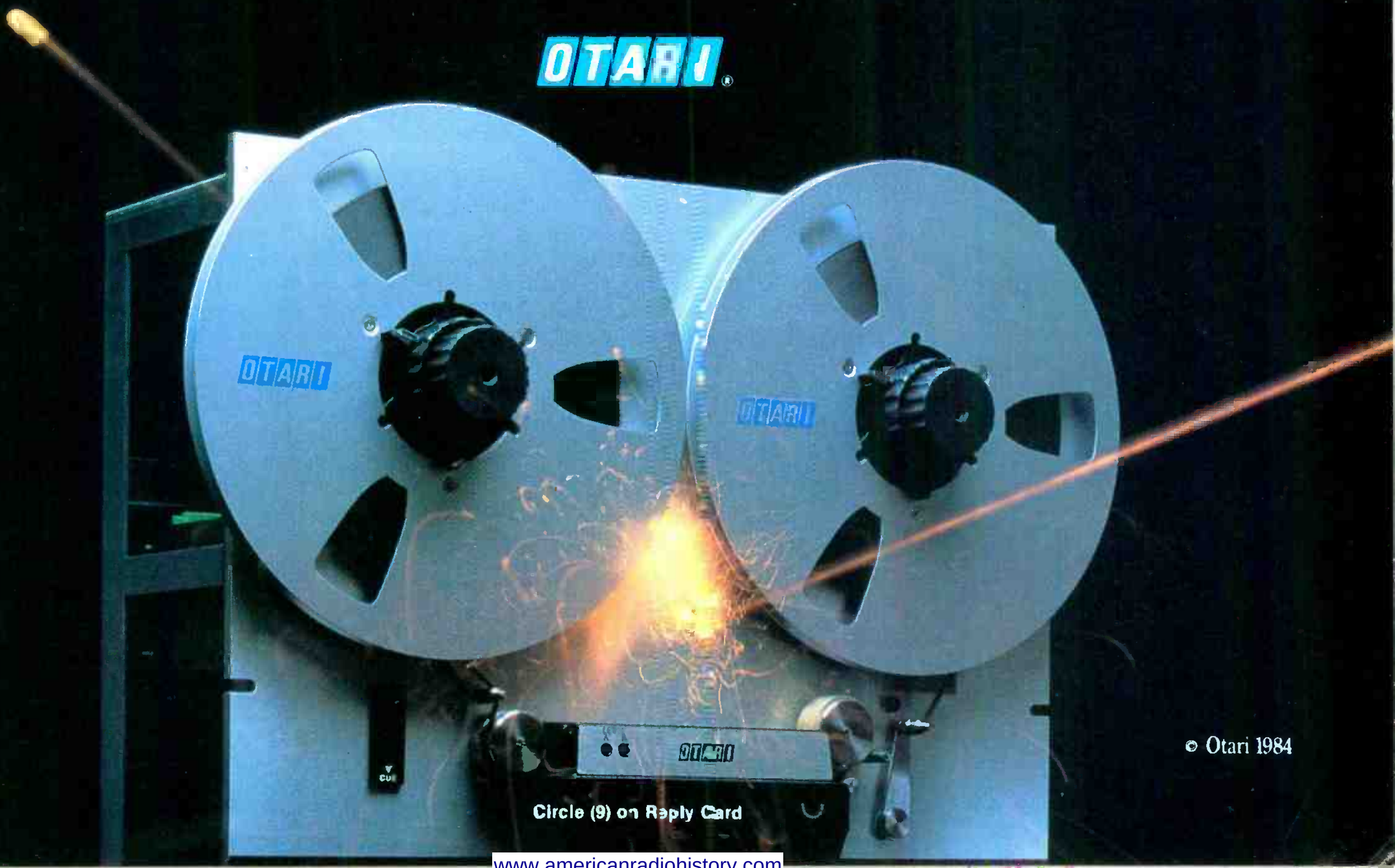
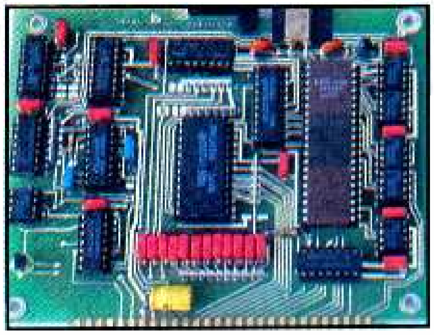


Thyristor servo systems

By Jerry Whitaker, editor



Last month, we discussed the importance of accurate and reliable firing of the thyristors of an ac power control system in a broadcast transmitter. Failure to prevent inadvertent triggering of the gate of a thyristor can result in unwanted conduction of the device. Such occurrences can be damaging to the thyristor—and to the load that it controls.

The gate circuit must be designed and configured carefully to reduce inductive and capacitive coupling that might occur between power and control circuits. Because of the high *di/dt* conditions commonly found in thyristor-controlled power circuits, power wiring and control (gate) wiring must be separated physically as much as possible.

Equipment manufacturers use various means to decrease gate sensitivity to transient sources, including placement of a series resistor in the gate circuit and/or a shunting capacitor between the gate and cathode. A series resistor has the effect of decreasing gate sensitivity, increasing the allowable *dv/dt* of the thyristor and reducing the turn-off time, which simultaneously increases the required holding and latching currents.

The use of a shunt capacitor between the gate and cathode leads reduces high-frequency noise components that might be present on the gate lead and increases the *dv/dt* withstand capability of the thyristor. The application of these techniques is the exclusive domain of the design engineer. Users should never consider *improving on* a design without detailed consultation with the engineering department of the equipment manufacturer.

Fusing

A basic method of protection for any piece of equipment operated from the utility ac line is current-limiting. The device typically used for breaking fault currents is either a fuse or circuit breaker. Some designs incorporate both components in a given circuit. So-called *semiconductor fuses* are often used in conjunction with a circuit breaker to give added protection.

Semiconductor fuses operate more rapidly (typically within 8.3ms) and more predictably than common fuses or circuit breakers. Surge currents caused by a fault can destroy a semiconductor device, such as a power thyristor, before the ac line circuit breaker has time to act.

Manufacturers of semiconductor fuses and thyristors usually specify in their data the I^2t ratings of the devices. Because the thyristor rating normally assumes that the device is operating at maximum rated current and maximum junction temperature, conditions that do not represent normal operation, a safety factor is assured.

Control flexibility

Thyristor servo control of the power supplies of a broadcast transmitter is beneficial to the user for a number of reasons. The primary benefit is the wide control over ac input voltages—and therefore, RF output power—that such systems provide. A by-product of this feature is the capability to automatically compensate for line-voltage variations. Other benefits include the capability to soft-start the high-voltage dc supply. Thyristor control circuits typically include a ramp generator that increases the ac line voltage to the power transformer from zero to full value within about five seconds. This prevents high surge currents through rectifier stacks and filter capacitors during system startup.

Thyristor servo systems are excellent from an operational standpoint. However, they are not without their drawbacks. The control system is complex and can be damaged by transient activity on the ac power line. Conventional power contactors are simple and straightforward. They either make contact or they do not. For reliable operation of the thyristor servo system, attention must be given to transient suppression at the incoming power lines.

Types of devices

Transient suppression hardware can be divided into three general categories: ac filters, crowbar devices and voltage-clamping components.

Crowbar devices include gas tubes (also known as spark-gaps or gas-gaps) and semiconductor-based active crowbar protection circuits. Although these devices and circuits have the capability to shunt a substantial amount of transient energy, they are subject to *power-follow* problems. Once a gas tube or active crowbar protection circuit has fired, the normal line voltage, as well as the transient voltage, will be shunted to ground. This power-follow current may open protective fuses or circuit breakers if a means of extinguishing the crowbar clamp is not provided.

Voltage-clamping devices are not subject to the power-follow problems common in crowbar systems. Clamping devices include selenium cells and varistors of various types. These components—although different in construction—act similarly on a circuit exposed to a transient overvoltage. Figure 1 illustrates the variable non-linear impedance exhibited by a voltage-clamping device, and shows how these components are able to reduce transient overvoltages in a particular circuit.

The voltage divider network established by the source impedance (Z_s) and the clamping device impedance (Z_c) acts to attenuate voltage excursions seen at the load. It should be understood that the transient suppressor depends upon the source impedance to aid the clamping effect. A protection device cannot be effective in a circuit that exhibits a low source impedance.

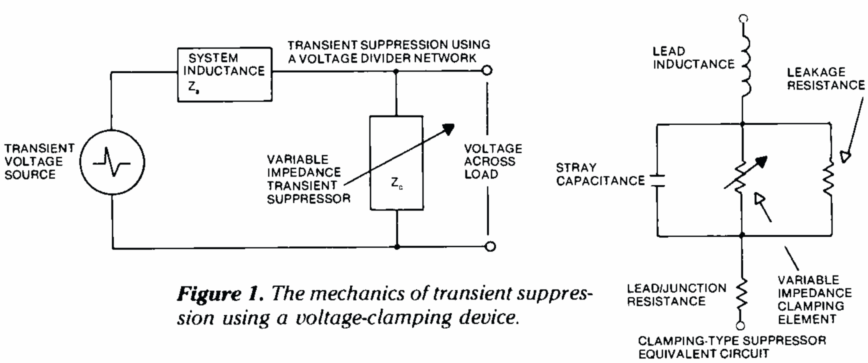


Figure 1. *The mechanics of transient suppression using a voltage-clamping device.*

Power supply failures

By Jerry Whitaker, editor

As discussed in this month's "Circuits," thyristor servo systems used to control the ac input to the high-voltage power supplies of a broadcast transmitter offer the user a number of benefits. When problems develop in such systems, however, troubleshooting can become difficult. The first step in correcting a problem in a transmitter using a thyristor power controller is to understand how the servo circuit works, or at least how it is interconnected.

Figure 1 shows a block diagram of a typical thyristor control circuit. Three gating cards are used to drive back-to-back SCR pairs, which feed the high-voltage power transformer primary windings. Although the applied voltage is three phase, the thyristor power control configuration simulates a single-phase design for each phase-to-phase leg. This allows implementation of a control circuit that consists basically of a single-phase gating card duplicated three times (one for each load phase).

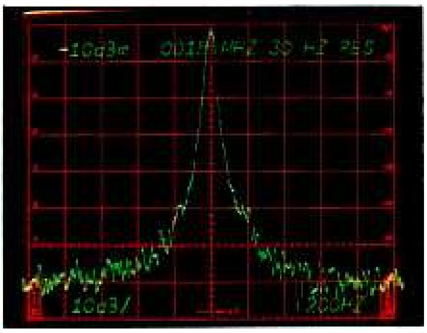
This approach has advantages from the standpoint of design simplicity, and also from the standpoint of field troubleshooting. In essence, each power control circuit is identical, allowing test voltages and waveforms from one gating card to be directly compared with a gating card experiencing problems.

When you have a failure

A failure in the thyristor power control system of a broadcast transmitter isn't easy to overlook. In the worst case, no high voltage at all will be produced by the transmitter. In the best case, power control may be erratic or uneven when using the continuously variable power adjustment mode.

If the high-voltage supply will not come up at all, your problem involves more than a failure in just one of the three gating cards. The failure of any one gating board would result in reduced power output (and other side effects), but not in zero output. Begin your search with the interlock system.

Newer transmitters provide the engineer with built-in diagnostic readouts on the status of the transmitter's interlock circuit. These may involve discrete LEDs or a microcomputer-driven visual display of some type. If you are fortunate enough to have such a transmitter, the process of locating an interlock fault is



relatively simple. If you have an older transmitter that is not so equipped, substantially more investigation will be needed.

When you reach the transmitter site, make a close observation of the status of all fuses, circuit breakers, transmitter cabinet doors and access panels. Confirm that all doors are fully closed and secured. Switch the transmitter from remote to local control (if operated remotely) to eliminate the remote control system as a possible cause of the problem. Observe the status of any control-panel indicator lamps. Some transmitters include an *interlocks open* lamp; other units provide an indication of an open interlock through the *filament on* or *plate off* push-button lamps. These indicator lamps can save you valuable minutes or even hours of troubleshooting, so pay attention to them. And, by all means, make sure to replace any burned out indicator lamps as soon as you notice them. Status lamps are of no use whatsoever if you can't trust what they are telling you.

If your front-panel indicators point to an interlock problem, pull out the schematic diagram of the transmitter, get out your DVM, shut down the transmitter and take the phone off the hook. This is going to take awhile.

If your transmitter interlock circuit operates from a low-voltage power supply, such as 24Vdc, use a voltmeter to check for the loss of continuity. Remove ac power from all sections of the transmitter except the low-voltage supply by tripping the appropriate front-panel circuit breakers. Be extremely careful when working on the transmitter to avoid any line voltage ac. If the layout of the transmitter does not permit safe troubleshooting with just the low-voltage power supply active, remove all ac from the unit by tripping the wall-mounted main breaker. Then, use an ohmmeter to check for the loss of continuity.

If your transmitter interlock circuit operates from 120Vac or 220Vac, remove all power from the transmitter by tripping the wall-mounted main breaker. Many older transmitters use line voltages in the interlock system. Do not try to troubleshoot such transmitters with ac power applied. If you do, you are asking for serious trouble.

As pointed out in last month's column, never service a transmitter with ac power applied unless a physical shield exists between you and the high voltage. Perform work inside the transmitter only after all power has been removed and after all capacitors have been discharged using the ground stick supplied with the transmitter.

Finding a problem such as an open control circuit interlock is basically a simple procedure, in spite of the time involved. Do not rush through such troubleshooting. In the long run, you will save time by taking a careful, methodical approach.

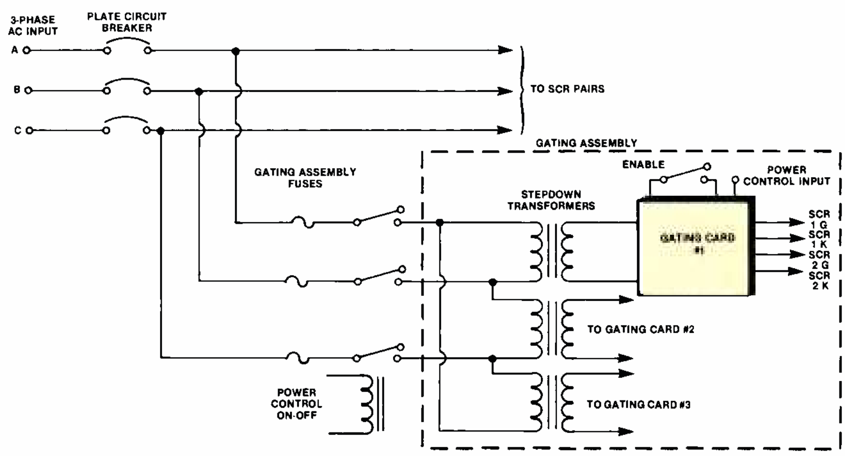


Figure 1. *Block diagram of a 3-phase thyristor power control system.*

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A professional looks the part

By the *BE* staff

You've asked Bob to join you and a sales representative in your office to offer his opinions on a contract for purchase of a new piece of equipment. Bob enters, looking as though he dressed only the front half of himself. The back of his hair is uncombed and his shirttail—tucked in the front—is hanging loose in the back. His tie reaches only to the third button on his shirt, which, like the rest of his clothes, is wrinkled.

Professionalism

Bob greets the sales representative, picks up the contract and says, "That's too much. We won't pay it."

After some discussion, he again looks at the contract and scribbles some changes on the paper. He tosses the contract on your desk, shrugs his shoulders, turns on his heel and walks out the door without another word.

How do you feel? You are probably embarrassed by Bob's appearance, annoyed by his behavior and you may even feel compelled to apologize to the sales representative. Bob may have a good mind and be technically proficient in his job, but the degree of professionalism that he communicates is non-existent.

Bob's apathy about his appearance and the impression he makes on others has locked him into a job position that will take him no higher in the organization than he is today. Bob has never learned the value of *professionalism.*

An often ill-defined term, professionalism seems to be the measure by which others evaluate our abilities and determine our success, or lack thereof. People often describe business associates as looking professional, or acting professional (regardless of the profession). Judgments are often made regarding ability and expertise based on a perceived degree of professionalism.

Webster lists professionalism as everything from "practicing a specified profession as a permanent occupation" to "playing a game for pay or gain." But when it comes to defining behavior that is professional, Webster says only, "manners or behavior suitable to or characteristic of a specific profession," which might leave you wondering just what manners and behavior you should be exhibiting to be termed professional.

Regardless of how you define it, professionalism has become a desirous trait in working relationships with others.

Whether you are selling a product, repairing a transmitter, switching the 10 o'clock news or supervising a group of employees, you must look and act the part. When it comes to selling yourself, a professional appearance and manner are noticed by others long before skill and ability can be evaluated.

- INCOME AND ECONOMIC LEVEL
- EDUCATIONAL BACKGROUND
- SOCIAL POSITION
- LEVEL OF SOPHISTICATION
- DEGREE OF SUCCESS
- MORAL CHARACTER
- TRUSTWORTHINESS

Table 1. *Seven decisions based solely on your appearance.*

The professional package

Packaging your appearance determines whether you look capable or incapable, experienced or inexperienced, successful or unsuccessful. Your appearance is truly the one factor you can control. If you package yourself to manage the impression you make on others, then their positive reinforcement will make you the person you want to be. You decide. If you want to be successful, look successful.

When was the last time you wore something besides jeans to the office? Or better yet, what would the staff say if you did? Obviously, different situations dictate different styles of dress. Remotes typically call for more casual attire, but even then, there is no reason for sloppy dress.

The matter of image and dress is not a shallow, vain or phony effort to con someone into thinking you're something you're not. It is a sound preparation for setting an emotional and physical climate for success. It is a business tool and skill.

Your occupation is the most important influence on your wardrobe. Even though your occupation might preclude your wearing a business suit every day, remember that you are still judged by what you wear and how you are groomed. Your appearance must project that you are confident, reliable and competent in your position. Also, your dress and grooming should emulate your superiors so that you may be promoted within their circle without embarrassing them by your appearance. You're only promoted into a job in which you look as if you belong.

If others are to have a positive, professional image of you, you must do certain things to mold that image. Office etiquette and overall physical appearance are often just as important in creating a professional image as business skills and expertise.

The little scenario at the beginning of this column is not so atypical. Many engineers believe that they are judged solely on their ability. As any good manager will tell you, that is not true.

First impressions

When you walk into a room full of strangers, they immediately make at least seven decisions about you, from how much money you make to how honest you are, based solely on your appearance (see table).

The degree to which these seven decisions are favorable has a considerable impact on your degree of success with these people, socially and professionally.

People rarely change those first impressions. Your business card means little. What you say may be charming, but it's secondary. Like it or not, it is the first impression that will dictate future associations, more than performance and all the time and effort you have spent to be well educated and highly skilled as a manager, technician or engineer.

Whether we admit it or not, how we look does affect how others evaluate us. And you never get the chance to repeat that first impression.

Editor's note: This was adapted from the article, "Applying Professional Polish," which originally appeared in the July 1985 issue of *Microservice Management* magazine, an Intertec publication.

Dazzle 'm with technical brilliance.

Everybody's talking about CD's and digital. It's as if all analog tape technology and the cart machine were obsolete. Although CD's are a terrific new program source, it should come as no surprise that carts are still the best way to handle the huge quantity of individual program elements that comprise a typical day in radio broadcasting.

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Carts have been around for thirty years because they're a great package—easy to handle and store, easy to record and re-record, easy to label and identify. Best of all, they're cued-up from the moment you put them in the machine. Try that with a CD, turntable or reel tape!

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Inside digital graphics

By Carl Bentz, TV technical editor

A maze of computer circuitry lies behind the screen of a digital graphics system. We explore the ins and outs of character generators, effects and paint systems.

Programming has requested a series of special holiday IDs. All must show an airborne sleigh against a background sky of stars. In each, the passenger list is to include several members of the station staff. Artistic lettering should announce "Happy Holidays," the station call letters, channel number and city of license.

Several years ago, to produce such IDs might have taken several days, perhaps even weeks. Using today's digital graphics, however, the station artist can produce the art much quicker, reportedly from six to 16 times faster than with traditional art techniques. In fact, both static and animated versions can be prepared, with the entire project completed perhaps within a matter of hours.

Graphics capabilities through digital technology are almost boundless. The secrets behind alphanumeric displays, artistic images and picture manipulation involve many similar digital techniques.

The concept

We might compare generating TV images with digital graphics systems to the display of numbers, letters or pictures with a matrix of lights. Scoreboards at sports arenas, for example, contain an X-Y matrix of high-intensity lamps. When certain lights are turned on, an image is created. Shades of gray result by lighting every other lamp in *shaded* areas. For frequently used patterns, punched *card* templates could be used. Where holes in the card are punched, contacts touch, energizing the desired lamps. In reality, for scoreboards that display pictures, the images are stored on floppy disks and a computer controls the light matrix.

Color images can be produced with the light array by using red, blue and green filters with lamps arranged in closely spaced delta triads. In theory, thousands of colors could be shown by controlling the voltage supplied to each lamp. Ambient light, however, may reduce the effectiveness of color mixing.

Video alternative

In the final analysis, creating the digital TV image involves management of the electron beam(s) in a TV CRT by the graphics equipment. The beam is *on* for light points or *off* for dark points. The resulting pattern may be keyed into another video signal or used as a standalone source.

A point, one scan line tall, requires the beam to be turned on for a matter of nanoseconds. If the spot is part of a vertical line on the screen, then the *on-time* interval of the beam must occur at a specific time after horizontal blanking along the 63.5μs horizontal scan lines that make up the TV image. The smallest spot or the shortest practical time duration that can be controlled produces a picture element or *pixel*. According to the CCIR recommendation 601, a pixel width is 74ns.

Managing the CRT beam means controlling the beam as a function of time. In creating an image on the screen, the beam switching pattern is repeated at a rate of 30 times per second in NTSC (25 times per second in PAL and SECAM). The system must remember where spot(s) on each line are to occur.

One method is a *screen memory* area containing one memory cell for each possible pixel of the image. (See Figure 1.) To create a black-and-white image, the information for a scan line is clocked sequentially from the memory array, then mixed with sync and blanking into video signal lines.

Color adds complexity with red, blue and green guns in the CRT, each requiring a separate control memory. The matrix takes on a 3-D structure (see Figure 2). The RGB information must be encoded into color difference components before being mixed with sync and blanking.

Each 3-bit-deep memory cell yields eight color conditions—red, blue, green, magenta, cyan and yellow, plus black and white. This is sufficient for many titling requirements, but a realistic picture is impossible.

Color realism requires much more color data versatility. Some of today's electronic graphic arts or paint systems use eight bits of memory for red, blue and green per pixel. That is, the matrix shown in Figure 2 becomes 24 bits for color. (An additional 8-bit layer may be included for other features, resulting in a total of 32 bits.) Up to 256 different shades of red, blue and green and all possible combinations develop the final image. A total of 16,777,216 different colors are available with the 24-bit color architecture. However, systems using less than a 24-bit display architecture must restrict the number of colors used per screen image.

To place a picture on the screen, data is clocked sequentially from memory into scan lines of the picture as before. However, instead of moving single *on* or *off* bits one by one, 24-bit groups of data move as units in parallel through digital-to-analog converters to develop the color video signal. For NTSC displays, the RGB, Y/R–Y/B–Y or Y/I/Q components from the D/A converter are encoded to the composite format.

Speed skills

Graphics image quality depends in part upon the rate at which data can be moved through the system. The sharpness of letters in titling systems, for example, depends upon the resolution in nanoseconds, or the time during which *off-on* and *on-off* transitions can be made. For high-quality displays, the internal clock rate of approximately 1MHz, found in many personal computers, is replaced with clock rates of 10MHz and even as high as 40MHz. Through anti-aliasing techniques, higher apparent resolutions are achieved for detailed artistic character typefaces such as Old English or scripts.

To a point, faster data clocking allows more pixels to portray the image. With higher speeds and more pixels, the transparency of digital processing in reproducing images is improved. In complex digital effects, speed and high pixel counts are necessary for smooth movement as the image rolls into a cylinder, moves off the screen or is reduced from a full-screen image to a 1-pixel square.

Inside the brain

How fast a microprocessor system operates is a function of the digital architecture. Most microprocessors, until recently, have operated on the *von Neumann principle* established 30 years ago. A von Neumann computer consists of interacting sections for control, arithmetic, logic, input/output and memory. See Figure 3.

The control unit orchestrates the operation, setting the pace from a clock signal, decoding instructions and directing the other sections. The arithmetic unit handles additions or subtractions re-

Continued on page 26

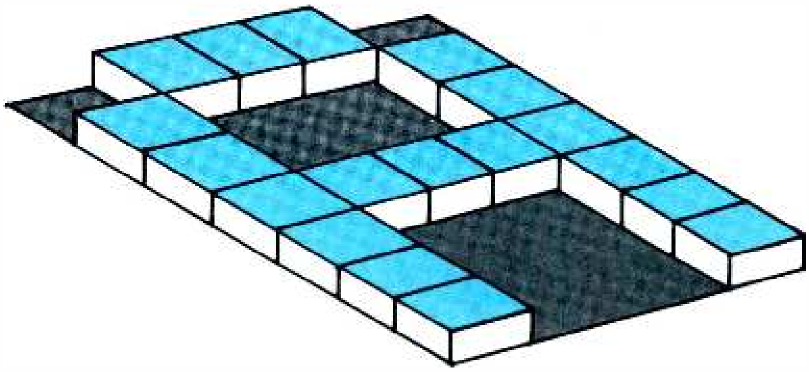


Figure 1. *A simple 5x7 matrix character can be stored as a pattern of 1s (raised blue pixels) and 0s (gray pixels).*

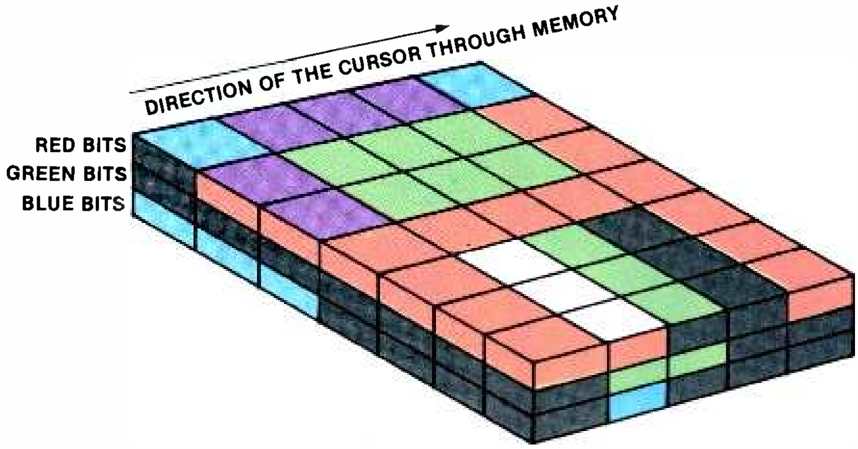
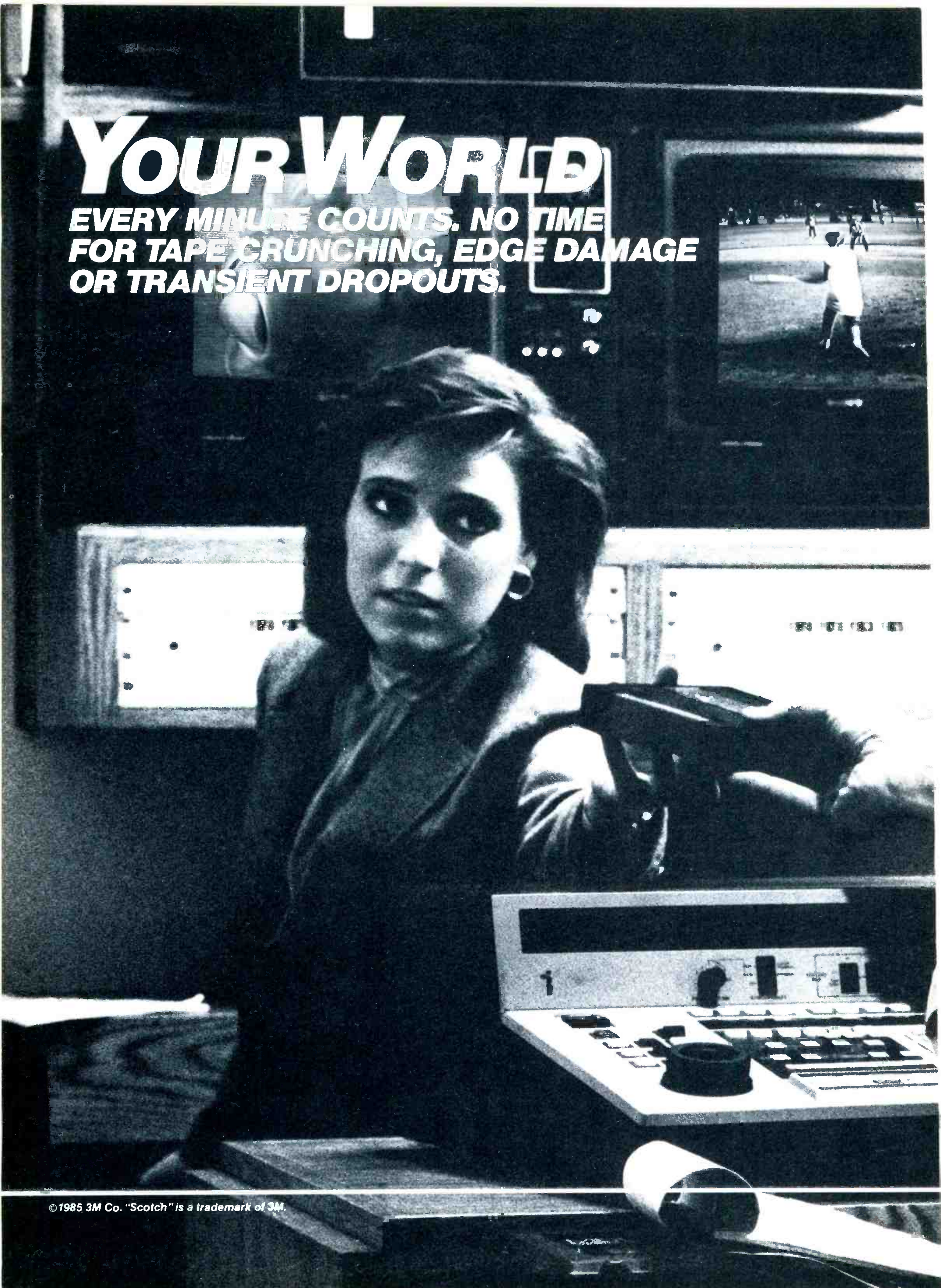


Figure 2. *A 3-bit-deep color memory. Black can be seen from the edge if the bit is a 0. If the upper layer is a 1, red appears in the screen image; if the middle layer is a 1, green appears; and if the bottom layer is a 1, blue is included in the image. The upper surface indicates what would appear on the screen from this section of the memory.*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It's available in hanger cases, including Mini U-Matics. With our red doors and hubs for easy Anti-Stat identification. With our engineers just a phone call away. With all the toughness it takes to be number one in the world of the pro.
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(in millimeters)
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Continued from page 23

quired by the instruction. The logic unit makes judgments of greater than, less than and equality between operands, and redirects the flow of instructions according to the decisions. The input/output unit directs data into and out of the microprocessor circuitry from peripheral memory or devices external to the processor. The instructions or program steps are stored in the memory.

In order for a program to run, six events must occur. An instruction is fetched from memory and decoded. Address calculation is performed, as required, and the operand(s) and data are fetched from memory. Finally, the instruction is executed upon the operand(s) and the result is stored into memory again. One instruction must be completed before the next one can be started. This approach, with every step handled in a specific sequential order, governed by the control section and its program counter, has been called the *von Neumann bottleneck*. See Figure 4.

As microprocessors have increased in size from early 4-bit devices to 8-, 16- and now, 32-bit systems, new processing methods have developed. One method, using bit *slices*, breaks a digital information group—a byte or word—into smaller segments called *nibbles*. Several nibbles are handled simultaneously to increase the overall speed. Sixteen bits of information might be broken into four 4-bit groups, allowing a maximum processing speed increase approaching four times. When a step is completed, the parts are recombined.

A second concept, first tried experimentally nearly 15 years ago, is called *pipelining*. Increased speed is achieved by overlapping processing phases. That is, instruction two of the program may be started before instruction one is completed, removing the von Neumann bottleneck.

The architecture to allow this faster system consists of three units: the pipeline, the bus controller and the sequencer. Three sections of the pipeline initially hold the instruction and associated operands. The instruction is decoded and appropriate operand information is passed to the sequencer. The sequencer performs data and address calculations. The bus controller handles all fetching and storing activity on the address and data buses.

All three sections work together, but each has a degree of independence as well. For example, if the sequencer has completed its work, but the bus controller is still busy putting data back into memory, the sequencer can begin working on the next instruction that was called into the pipeline while the sequencer was busy. In previous microprocessor systems, this overlap would not have been possible.

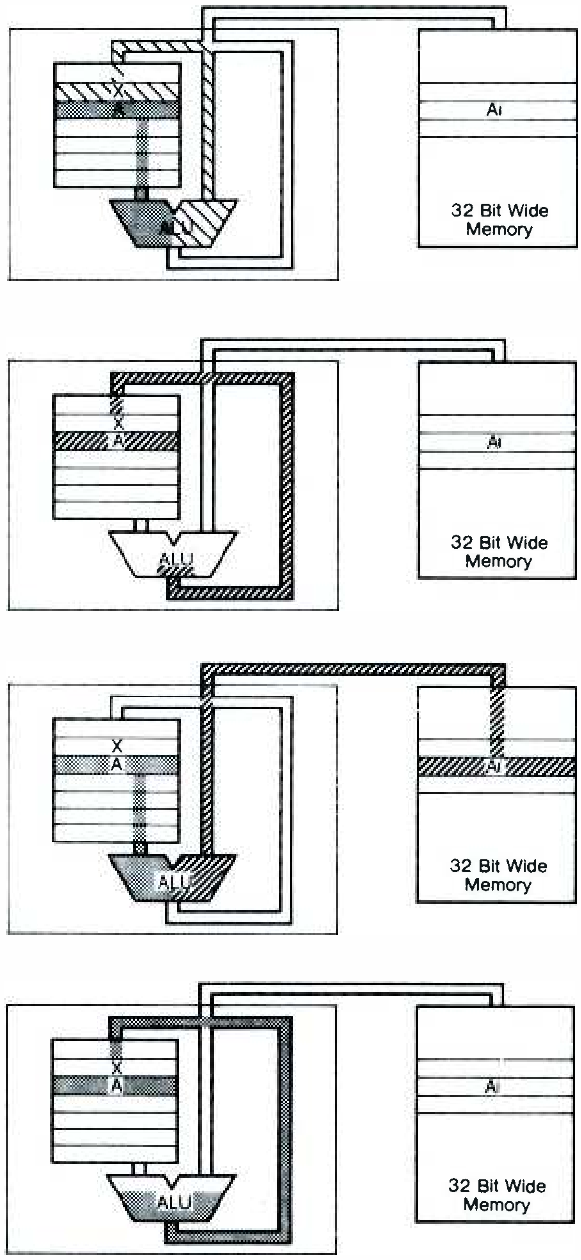
Optimum performance in pipelining may require special programming techniques to achieve the greatest speed. For example, some means of dealing with program branching, as a result of logical comparisons in the program, requires special consideration. In the normal microprocessor routine, the next sequential step would be called by the internal program counter in preparation for the next possible instruction. A branch could change program execution to a far-removed program memory address, however.

The new speeds of microprocessors are reflected in new terminology. Com-

$$A = \boxed{A * X + Ai}$$

$$A = A_0X^n + A_1X^{n-1} + \ldots A_{n-1}X + A_n$$
$$A = X((\ldots(\boxed{A_0X + A_1})X + A_2)X + \ldots A_n$$

A TYPICAL GRAPHICS OR EFFECT FUNCTION INVOLVES MULTIPLICATION OF A GIVEN VALUE BY THE VARIABLE X WITH ADDITION OF THE VALUE Ai IN MEMORY.



$$A = \boxed{A * X} + Ai$$

STEP 1. FIND THE PRODUCT A•X.

$$\boxed{A = A * X} + Ai$$

STEP 2. THE VALUE A IS REPLACED BY THE PRODUCT A•X.

$$A = \boxed{A * X + Ai}$$

STEP 3. A IS SUMMED WITH Ai, WHICH IS PULLED IN FROM ITS MEMORY LOCATION.

$$A = \boxed{A * X + Ai}$$

STEP 4. A IS REPLACED BY THE SUM.

Figure 4. *How a microprocessor calculates an arithmetic function.*

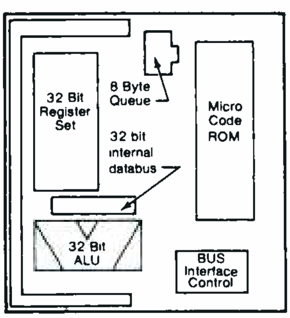


Figure 3. *The layout of sections of a 32-bit microprocessor.*

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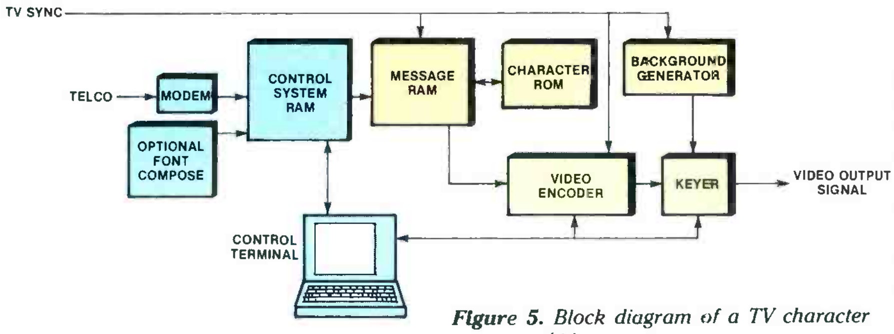


Figure 5. *Block diagram of a TV character generator/titler.*

puter manufacturers talk in millions of instructions per second (MIPS), millions of operations per second (MOPS), floating point operations per second (FLOPS) and even billions of (giga) operations per second (GOPS).

Along with bit-slice and pipelining techniques, speed is achieved with *array processors* (APs). As peripherals to computers, array processors perform repetitive computations on regular data structures at much higher rates than general-purpose microprocessors. If required, multiple pipelined operations may be performed simultaneously through the AP units acting upon 32-bit groups.

Even faster speeds will be obtained when 64- and 128-bit microprocessor chips enter the computer world. Implementing TV equipment with these advanced systems is a matter of defining and developing applications. Some TV design engineers believe a move to microprocessor bases greater than 32-bit would be overkill, and they suggest implementation of 64-bit systems is unlikely, or at least several years away. As with smaller-bit format computers, most 32-bit products spend a good deal of idle time.

TV titles

Providing information to the graphics equipment is accomplished through several means. The character generator is the simplest (see Figure 5). A section of read-only memory (ROM) holds the switching patterns or *bit maps* for each character. In fixed typeface systems, the character patterns are burned into ROM devices. In systems that load typefaces from disk or offer font generation options, the character patterns are stored in an erasable ROM.

The keyboard generates a digital code for each character, as text is entered into the message random access memory (RAM). Usually, the codes belong to the ASCII (American Standard Code for Information Interchange) set. In the code set, 128 distinct bit patterns are available in 7-bit bytes.

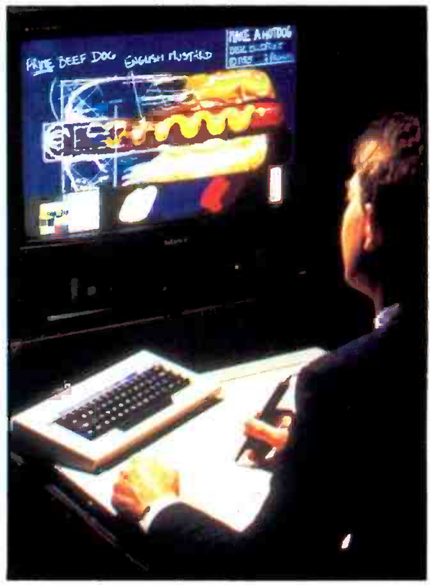
Implementing Z243.4-1985, a new code standard suggested by the Canadian Standards Association, will add another 128 usable patterns. Among them will be graphic and various European alphabetic characters.

As an invisible cursor moves sequentially through the message RAM to display the text, the character codes held there direct the system to the character patterns in ROM. On each scan of the electron beam, a 1-bit-wide slice of a character is sent to the screen. If the characters are created in a 7x9 matrix, nine passes through the character are necessary to form the complete letter.

Each ROM character address must be accessed every time the character appears on the screen. Nine passes (TV scan lines) are necessary to complete the character, and the entire process is repeated 30 times per second. Remember, for a TV raster, every other line is traced during field one, with the alternate lines filled in during field two. To avoid character flicker, the information shown during line 50 of field one must be displayed on line 50 of field two.

For simple characters, the display memory matrix may be relatively simple. Each memory location holds a *pointer* or character data address. However, adding color, border and shadow effects to each letter increases the complexity. The matrix that allows 4,096 or more different colors to be shown is obviously more complex than one that allows only six colors plus black

Many artistic capabilities are possible electronically, including the digital collage.



Drawing options on a graphics system may be indicated by a menu, at the lower left edge of the screen, and accessed from the drawing pad or keyboard. A color-mixing palette appears at the bottom of the screen.

The output signal of a slide scanner is a possible input for graphics or effects systems. These examples were taken from a component output of such a system.

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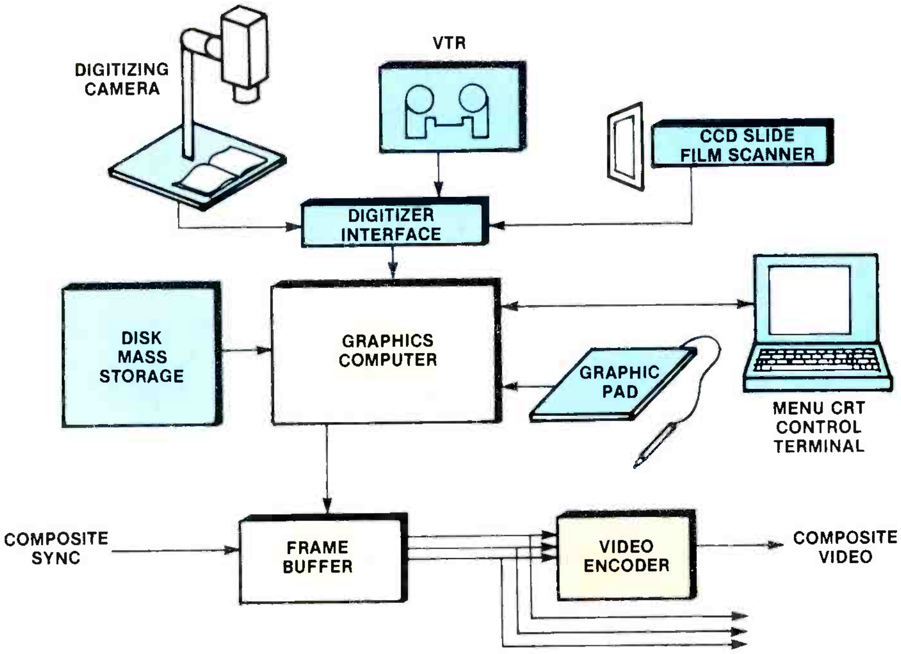


Figure 6. *Simplified block diagram of a digital graphic art system.*

and white.

Another approach to character generation uses *vector fonts*. A vector is a straight, directed line segment. In vector font generation, each character is formed through mathematical calculations from a number of short line segments. The data held in the RAM message memory is an address to which the computer must refer to find the formulas for letter calculations. Such vector font characters are smooth shapes, and are often involved in systems allowing 3-D effects.

Pictures

High-resolution pictures require much more memory than a simple character generator. In a PC-based system for drawing images, the characters are often held in eight 8-bit bytes. For high-resolution drawings, however, each bit

Making 3-D images

When you look at a tree, and you have normal vision, you see a 3-dimensional object. With normal binocular vision the brain receives cues that it interprets as scene depth. If you close one eye, however, you lose some cues and most of the apparent depth. For most of us, a flat image is all that remains.

Several cues are involved. For binocular vision, the brain superimposes the images sensed by each eye. Where lines of both views overlay exactly, objects appear flat. Differences between the two views result in points that are closer to or more distant from you.

Another cue for humans and for television is light and shade. A highlighted area faces the light source directly. Darker areas are usually surfaces that face in other directions. As a result, you see dimension in shapes emphasized by light.

In television, the camera sees with only one eye and the receiver displays the image on a flat surface. In order to put apparent depth into the picture, proper scene-lighting is important, particularly in studio settings.

The distance between you and an object (horizon perspective), the relative sizes of objects and object priority also affect how you see dimension. If you are familiar with the objects in the scene, even in a TV picture, your mind sets about ordering the items in the image without your conscious thought.

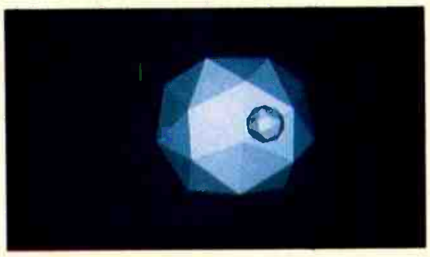
Graphics systems use all means of creating depth except, obviously, without 3-D television, the binocular type. For generated images, relative object sizes, object priority and shading account for most of the dimension put into a drawn picture. The artist may desire to force perspective in the drawing to create greater apparent depth.

The illusion of dimension through shading is simplified in some systems by algorithms in software. In some cases the shading algorithm creates depth by generating the image with polygons. Fong and Gauroud, named for their developers, are such algorithms, allowing solid polygons with hundreds of sides to be used to construct the image and to produce the desired shading.

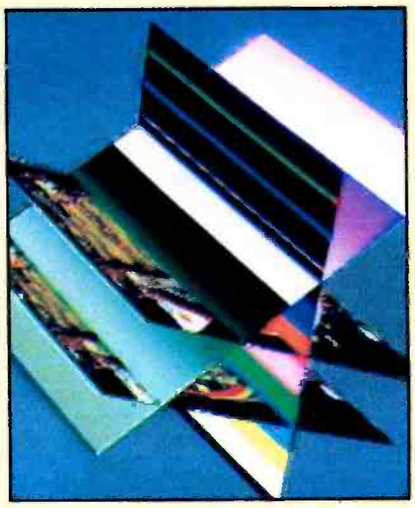
Another method is called ray tracing. In this method, the computer attempts to retrace the path light travels from a designated source to a particular point. In the calculations of the possible path, reflections and opaque objects are taken into account. The point will be shaded in accordance with the results of the calculation. The method is arithmetically intensive and requires both memory and time.

For image-manipulation systems, dimension is based largely on algorithmic control of relative sizes of objects or parts of objects. As an example of horizon perspective, if a flat plane in the center of the TV screen rotates, the edge nearest to the observer must become somewhat larger, while the more distant edge must be reduced in size.

Object priority, allowing one part of the picture to appear in front of another, plays a role in effects manipulation as well. Depth by apparent shading is not a major method of achieving dimension at present. As more powerful 64- and 128-bit microcomputers are assigned the number-crunching computational tasks, however, we may expect almost anything, even binocular imaging, to be presented.



Dimension in titling requires only three different color values. More complex structures might need a different tonal value for each face.



One live camera signal and two test patterns are combined through 3-D software. This uses object priority and perspective as a result of the viewing angle, but does not use horizon perspective.

A Sensible Solution to Your CD Dilemma.

Should you try getting by with a CD player made for home hi-fi use? Or should you invest heavily in a multi-thousand-dollar pro CD system? Fortunately, there is another alternative.

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Track Time Remaining

Disc Time Remaining

Track Time Elapsed

Disc Time Elapsed

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of every byte must be separately addressable. For a screen capable of displaying 1,000 characters, we must have 8,000 memory locations available to store the drawings.

Beyond the required amount of memory in a system, software is the secret to the capabilities of the graphics hardware. The software for broadcast graphics systems is closely related to that of industrial computer-aided design/manufacturing (CAD-CAM) systems used in design labs. CAD/CAM, however, is less concerned with the image than with the database of manufacturing information generated from that image. In video graphics the image is the end product.

Graphics systems are not limited to raster displays, that is, to a screen memory area. Just as character generators may use vector fonts, *vector graphics* can be created through a myriad of small line segments. Some systems combine both types of image generation.

At one time, the graphics designer had to enter mathematical formulas or *algorithms* to draw straight lines, circles and ellipses. Through software, however, many geometric algorithms may be included in the computer's operating system. If algorithms are resident in memory, then the designer needs only to call up the circle function, designate X-Y coordinates for the center and enter a radius length. The computer responds by placing the desired figure on the screen.

Graphics systems can be made even more intelligent through software design and the use of several different kinds of input devices. (See Figure 6.) The designer calls up the geometric function from a key on the keyboard (for circle) or from an icon on the screen menu with a stylus. Then, the stylus position on a drawing pad is read to find the center of the circle. A button on the stylus signals the computer that the current point is the desired center point. The stylus is moved to another point to indicate the length of the radius for generating the circle. When the designer presses the *enter* button a second time, the computer calculates the distance between the center point and the designated end of the radius and draws the circle.

Selecting a line width or painting brush on the graphics system is another software feature. Commonly shown as menu icons, the types of lines to be drawn are selected by moving the stylus over the pad until a cross-hair cursor on the menu screen coincides with the desired icon.

To the computer, information stored in a memory register associated with each icon tells how the next figure is to be calculated. That is, if a line is to go horizontally across the screen and is to be five scan lines wide, the program will draw five lines adjacent to one another. The soft effect of the airbrush technique is one of the most math-intensive functions in electronic graphics. Some systems may even use a special auxiliary

Improving TV typography

Have you ever closely compared the on-screen appearances of a title from the character generator and one taken by a TV camera from an art card? Size for size, and keeping the lined structure of the TV picture in mind, character generator titles often show more definite stepping imperfections along slanted and curved lines than camera-produced letters. The narrowest horizontal line of the characters will be a minimum of two scan lines tall (one line each of fields 1 and 2). Yet, if the camera zooms back from the card, the narrow horizontal line can be one TV line. Why?

Without special considerations, alias-ing *seems to be a necessary evil in interlaced scan TV systems. On the screen, aliasing appears as the jagged edges of slanted or curved lines. Aliasing also explains the necessary thickness of electronically generated characters.*

Digital flaws

Aliasing results from the manner in which digitally generated characters are created. The shape is described by a 2-dimensional matrix of pixels. Each pixel is one TV line high. In the horizontal direction, 30ns is a common value. Character shape is determined by the presence or absence of information in the pixels. The capability to show detail on a character depends upon the dimensional accuracy of the pixel. The horizontal size could be reduced, but the vertical dimension must practically remain at one TV line.

As to line thickness, if you were to display a character in only one field, you would find that the letter flickers at a 30Hz rate in NTSC. In a 25-frame TV system, the effect is more apparent. By placing the information on corresponding lines of both fields, the flicker is reduced.

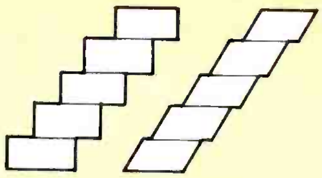
De facto filtering

When a camera scans an art card, three parameters are generated. Although we do not usually think of camera signals in terms of pixels, the vertical parameter is obvious. Second, brightness of the image is translated into the video signal level. Finally, horizontal information can be considered as a stream of discrete blocks.

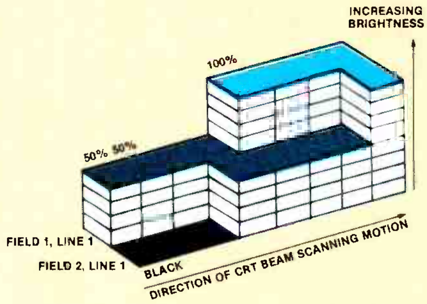
As the camera tube is scanned, the electron beam might sense all white or all black. Unlike the character generator, along an edge or in fine detail, the camera sees some value between the two extremes. The scanning process creates a low-pass filter effect that improves the appearance of the image in the 2-field display.

Jagged solutions

Various methods may be used to anti-alias *characters or other objects on the CRT. In theory, low-pass filter circuits could reduce the undesirable effect. However, some edge conditions must be handled differently than others. A fixed low-pass filter would apply a blanket correction to all. The more practical solution involves the use of a frame buffer.*



The stepped edge of the diagonal bar at left is the result of a generator with no anti-aliasing. The less ragged edge at right shows the effect of system anti-aliasing or the low-pass filtering effect of a camera scanning an art card.



If the display memory could be viewed in three dimensions, the edge of an anti-aliased screen object might resemble stacks of bit blocks.

When an artistic character face is designed, not only does the character memory define pixels as on and off, it must include some pixels in partially *on states. In other words, more than one bit must be used to describe each pixel. The presence of gray pixels along character boundaries in both fields fills in the jagged edges, allowing more detailed character sets to be shown.*

The same approach may be applied to horizontal lines. For a line that appears to be one TV line high, the corresponding line of the other field contains a gray, avoiding the flicker effect.

On pixel resolution

If a pixel is 74ns wide, as suggested for digital TV by CCIR recommendation 601, and an 8-bit pixel is used to display the character, an effective resolution of the character is approximately 9ns, that is, 74/8. When discussing character generators, you may wish to ask how the manufacturer arrives at the stated resolution value.

The apparent improvement in resolution is achieved in graphic paint systems in much the same way. For example, through the use of some bits of red, resulting in one or more shades of pink, the edge of the red image is smoothed.

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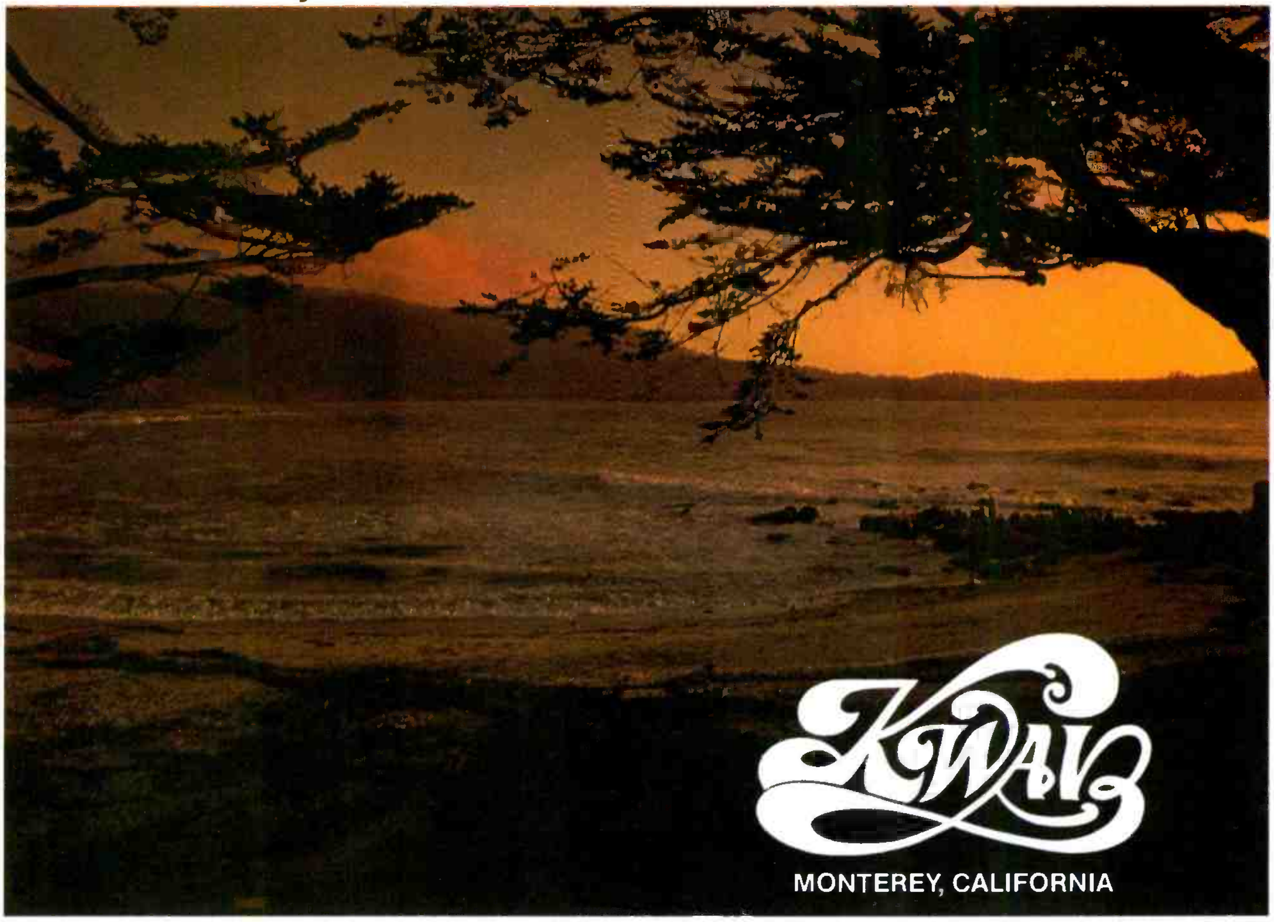

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computer to perform the function.

Color, again, adds complexity to the system. Whether all points of the drawing are of the same color or each pixel is a different color, as is the case with dimensional shading, the matrix necessary to show the color must be several bits deep. The use of eight bits of memory for each color seemingly has become standard on high-end systems, allowing 256 shades from almost white to full saturation for red, blue and green.

Mixing colors on the screen presents another intriguing feature. Suppose that a portion of the image is too dark and the artist wishes to add some white. With the stylus, the operator picks up the color from a point in the image and moves it to a mixing area of the screen. Actually a 24-bit-deep pixel is selected and replicated in the mixing area. Then, a second color is selected and brought to the area.

The digital words that represent the two colors are combined through a software algorithm to arrive at the new color. Stylus pressure on the pad may provide an input to the mixing algorithm, controlling how the bits are to be compared and combined. The result appears instantly on the screen in the mixing area. When the desired color is achieved, the artist uses the stylus to move the color from the mixing area back into the normal image display area and to replace the bit patterns that were there.

The popular artistic cut-and-paste technique may be accomplished with electronic graphics through additional memory. Another 8-bit-deep layer of memory is given priority over the normal display; that is, it is seen if, and only if, its bits are set to 1s. If they are 0s, the cut-and-paste layer pixels will appear transparent.

First, the artist selects the mode from a menu or key. Then, the portion of the picture to be moved is outlined with the stylus. Essential data to create the object is replicated in cut-and-paste memory.

The object to be relocated in the developing picture is moved under the control of the stylus and tried at various locations for the desired effect. When a final location is determined, the bits making up the image fragment replace those of the original drawing, with the cut-and-paste memory again becoming transparent.

But what if the final placement of the pasted image is not right? Can the original image be recovered? On some systems, the section that would be changed by the pasting operation is retained. Again, the memory requirements of those systems are greater and the memory management software is more complex.

Another feature that may be performed by a cut-and-paste memory is the water-color wash. The operator selects a transparent color and, through software, places the tint over the entire image.

Color animation may be performed in a similar manner, except that the 8-bit layer is assigned several color values by means of a color *look-up table* (LUT). At the command for animation, the display system must refer to the LUT to find the color for each pixel. Within the LUT memory, values are being changed or cycled. The resulting display shows colors flowing through the graphic image. Color animation is a typical feature of 8-bit systems, but is not always available on larger systems.

Styli, mice and more

The use of an electronic pencil (stylus) on the graphics pad is more complicated than it looks, at least for the equipment designer. There are several approaches to designing the pad. To allow the artist to access any one of the approximately 480 vertical by 760 horizontal pixels on the screen, the pad must provide a means to sense the position of the stylus on the pad's surface and relay that information to the graphics computer.

Graphics pads may operate as pressure-sensitive surfaces. Slight pressure applied to the surface changes the resistance of conductive material in the electronic sandwich. Through an X-Y matrix of conductors, the exact X and Y components locating a pixel are determined by a secondary microprocessor in the pad and passed to the graphics computer software for calculations.

Continued on page 38

What is C?

In order for a computer to work, it must have a sequentially ordered list of steps or instructions, called a program. Each step is a simple operation, such as adding two bytes, moving a byte from one memory location to another or comparing one byte with another. These instructions exist as specific combinations of 1s and 0s that represent meaningful information to the microprocessor.

Assembler or machine language varies for different microprocessor chips. For 8-bit 6500 series devices, an instruction is eight bits long, perhaps followed by one or two operands. To the programmer, instructions are two 4-bit hexadecimal *numbers. Hexadecimal means counting by 16s.*

The assembler instruction mnemonic LDA (load accumulator), for example, is A1, A5, A9, AD, B1, B5, B9 or BD depending upon the addressing (or operands) associated with the instruction. To the computer, these possibilities appear as groups of 0s and 1s.

A1 = 1010 0001 B1 = 1011 0001
A5 = 1010 0101 B5 = 1011 0101
A9 = 1010 1001 B9 = 1011 1001
AD = 1010 1101 BD = 1011 1101

A microprogram, stored in the microprocessor chip, decodes the instruction and determines the addressing or set of operand data to be used.

Assembler language can be difficult for some people to use because it requires logical thinking. Also, relatively simple tasks may require many steps.

To make programming easier, higher-level computer languages have been designed. BASIC (beginner's all-purpose symbolic instruction code), FORTRAN (formula translation) and COBOL (common business-oriented language) will be familiar to readers who are acquainted with computer programming. Each has attributes that make it more attractive for particular applications. C is another such programming language.

Higher-level languages allow programmers to write the program in almost readable English. Each program statement represents a number of machine language steps. When a program is run on the computer, the BASIC statements, for example, are translated by an interpreter program in the computer into machine language binary words (0s and 1s) before any action can be taken. The BASIC interpreter must be resident in the computer, when the BASIC program is used. Interpreting each statement takes time, making BASIC a rather slow language.

FORTRAN and a number of other languages require compilers, another type of translation program that converts the programmer's source statements into a machine language object program. *The object program is saved on a disk. When the program is needed, only the object version is loaded into the computer. Because the program is already in machine language, execution of the program steps is extremely fast.*

For digital graphics equipment, C has become a favored language. Although most computer languages allow programs to be written for specific microprocessors and often specific computer systems, C is a transportable language. Because C compilers exist for many popular computer systems, the same source program may be translated into binary machine language understandable by a specific microprocessor. The primary difference between the compilers has to do with input and output data control requirements, which differ for each computer system.

Developed originally by Bell Labs for computer operating systems, the C language adapts to business, science and text data-handling requirements easily. It is considered economical, because only a few C statements equate to many machine language steps. It is a structured language, making the final program more easily understood. Even though C is a high-level language, compiled C code is even more basic to the computer than many machine assembler languages.

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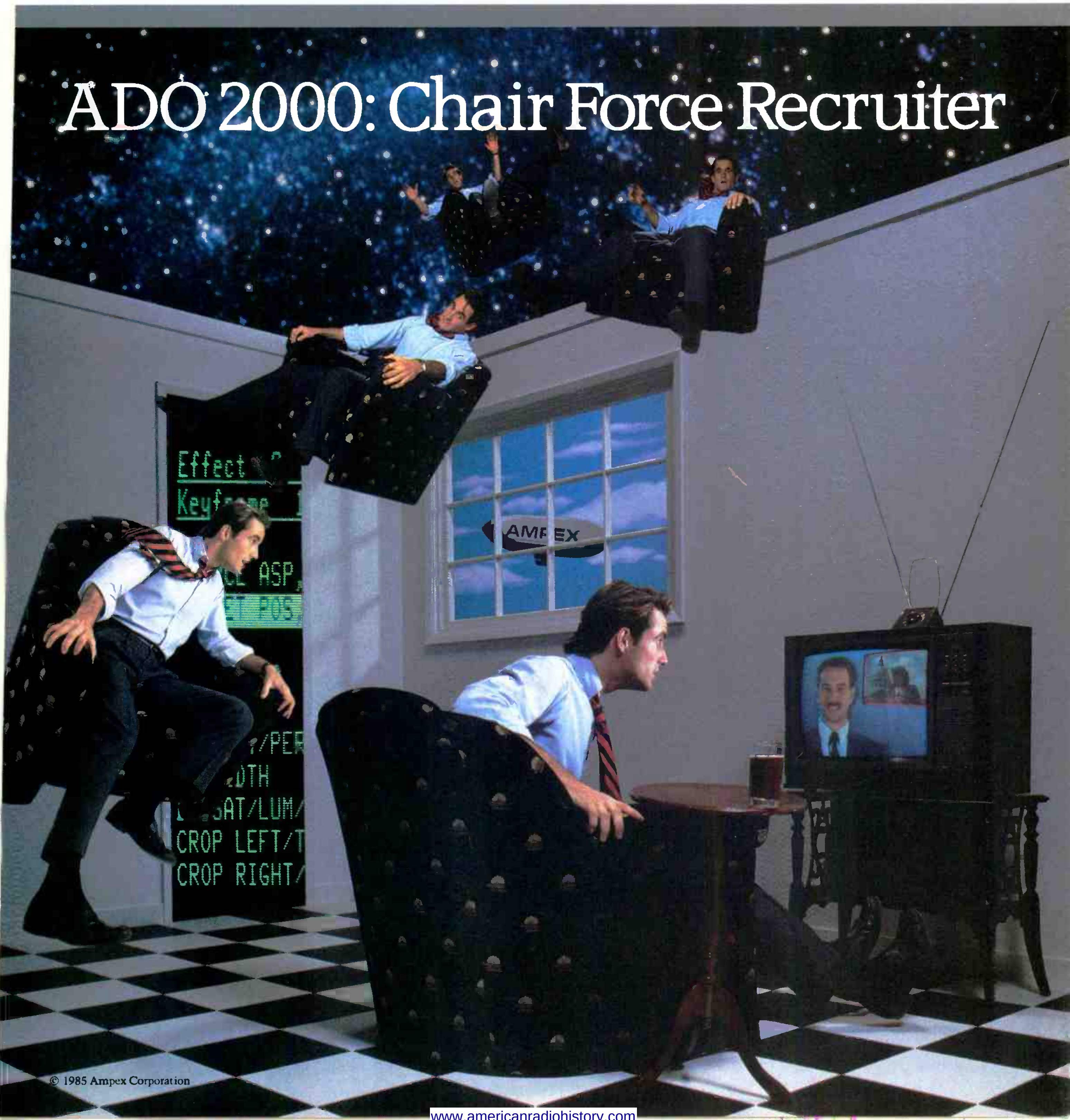


Weather systems

The display of radar or other weather information follows methods similar to those used by other graphics equipment. Units designed specifically for weather radar use, however, do not include many features of the broadcast graphics system.

In last month's issue, the article "Weather Radar Systems" described how a Doppler radar system determines the location and intensity of precipitation and air turbulence. Information taken from the radar receiver is formatted into 1,600-bit words at a data rate of 1Mb/s.

Each word contains 64 control bits, followed by 1,536 range bin bits, the data describing the atmospheric conditions. In the microprocessor-based display processor, the control bits are stripped off for system operating parameters such as range, azimuth, gain, tilt and scan speed.

With the control information in the display processor, the system begins to build the image. Range and azimuth represent distance and heading of any weather condition sensed. Those parameters, converted into X and Y Cartesian coordinates, control where the range bits for given range and azimuth values are placed on the TV screen.

Range bit information is divided into 3-bit groups, each group identifying seven levels of signal reflectivity from atmospheric precipitation. When placed into a 480x760-pixel display matrix memory, these levels present color in the display, denoting precipitation or turbulence intensities.

Once sorted from the angle/distance format into the raster image, the information may be routed line by line to an RGB monitor or through a video encoder to a composite video monitor. The image may also be recorded in a hard disk memory for delayed presentation.

The display matrix shown here uses eight bits for four levels of display priority or image planes. The lowest level is the background. With only one bit available, the background is limited to two possible conditions, usually to black (0) or to white (1). For actual display, however, when encoded to a composite video signal, it may be made any color.

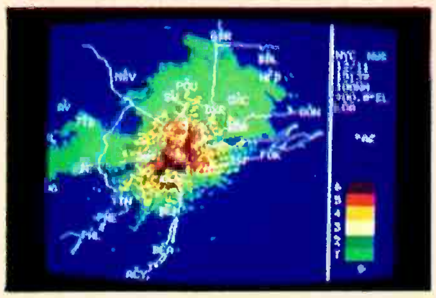
The second priority group contains three bits of weather data from the radar processor. From the three, red, blue, green, cyan, magenta, yellow, black and white colors in each pixel show turbulence and precipitation intensities. A specific color bit pattern may be selected to cause that color area to blink, drawing attention to an area of turbulence greater than a preset threshold, for example. As with the background level, however, these three bits may be encoded in various ways to achieve other colors or color saturations in the final display.

Level three contains three bits of map information. The use of color allows the display to be visually more informative. Map features, taken from a map database memory, can be clearly designated by using colors.

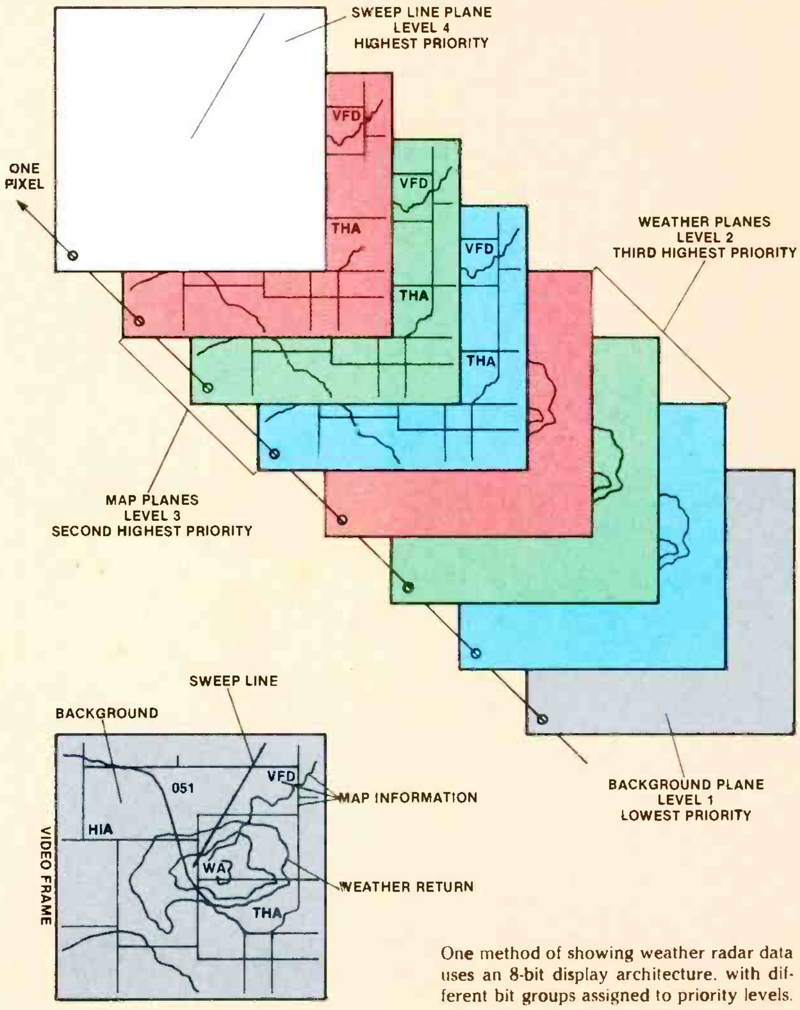
The highest priority level is a single bit to represent the radar sweep. The rotating vector may be visible only as the line along which changes in the display occur with each sweep. Alternatively, it may be made white and visibly obvious. As the sweep moves, updated information arriving from the radar signal alters the display along its length.

Other methods of displaying radar information may elect different priorities of the data. Color choices may be altered in any part of the display. Updating of the display may be done only after each complete sweep of the vector. Additional information may be shown on the screen as a legend to help understand the display. A vertical profile of the data returned from the storm is valuable to meteorologists.

Most weather graphic display systems include only an 8-bit architecture. For display on a deeper bit system, the radar data may be converted into a different bit structure. On 32-bit systems, however, such as those with cut-and-paste functions, radar data may be placed in the auxiliary 8-bit layer. In such cases, priority of the radar or the contents of the 24-bit image memory can place the weather data in the foreground or background.



A storm approaching New York City on Dec. 11, 1985. The legend at right explains the storm's structure.



One method of showing weather radar data uses an 8-bit display architecture, with different bit groups assigned to priority levels.

Continued from page 34

With a pressure-sensitive system, the amount of change in conductor resistance (in the stylus or in the pad) is digitized, the result determining the width of the point that appears on the screen. Other software options allow pressure to determine the transparency of a line drawn over existing image data stored in memory. At the same time, the previously selected color information is entered into memory for each pixel involved in the image being drawn.

Other graphics pad designs may use RF energy or magnetism to determine the location of the stylus. In RF systems, the drawing surface or the stylus may be the *transmitter* or *receiver* of the RF signal. In RF or magnetic designs, the pad microprocessor compares signals arriving from the row and column inputs. Signals may be found on several lines, but those with the strongest signals will represent the desired row and column address for the calculation.

Another type of input device is the mouse. As the mouse is moved over a surface, a sphere built into the lower side of the device touches the surface, and its rotation causes the cursor to move across the screen. The mouse may operate on the same principal as the stylus, if it is used with a graphics pad, but most mouse devices operate on any surface. The screen address, in this case, is calculated by the computer from resistive settings of continuously adjustable potentiometers (the simplest case) within the mouse housing. The latest improvement, the foot mouse, allows freedom of the hands.

A track ball, which is basically a mouse lying on its back, is another popular control device. As the sphere in the track ball is turned, X and Y movement is registered by resistive or other electrically adjustable components that are turned by the sphere. The amount of movement is read by the computer for any necessary action. Another parameter, *rotation*, may be available from the track ball for a special effects computer.

A joystick control, such as the mouse or track ball, uses resistors to sense X and Y locations. The handle of the stick may allow rotation as well.

In order for the stylus or mouse devices to be more useful, additional controls may be provided through push-button switches. The stylus may locate a point on the screen, shown by a cursor. When signaled by the push button, drawing starts. When the button is pressed again, drawing stops. The capabilities are determined by the switch configurations and the software.

Any live video may also be used as an input to graphics or effects equipment through a digitizer. A *flash* or *grab* key or icon tells the computer system to capture the current video frame. Because motion between two fields may cause an undesired effect in the captured frame, another instruction causes one of the two fields to be duplicated for an improved image.

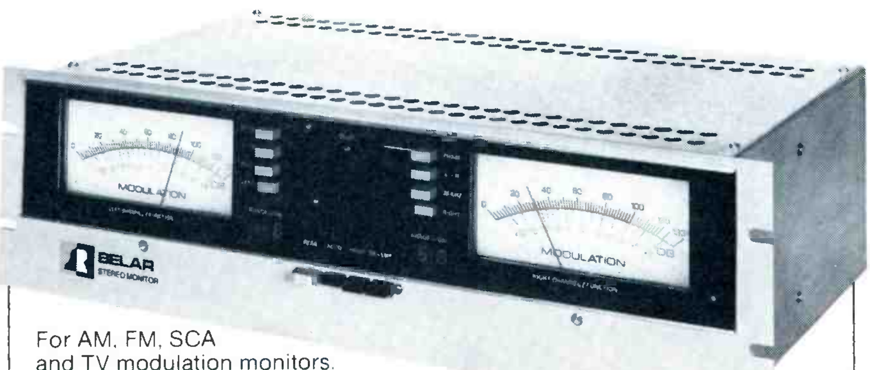
Another video input could be a digital, composite or component slide scanner, based upon a high-resolution CCD device. Once digitized into the graphics or effects equipment, the image may be manipulated or retouched with any available function.

Digital effects systems

When effects panels were introduced on video production switchers, the effects were created by simple switching between video sources. A straight line wipe, for example, signaled when switching should occur, based upon horizontal and vertical timing information. The time delays from the top of the screen and along each scan line were determined by joystick potentiometer position settings or other panel controls.

Special patterns introduced new switching determinants. Horizontal and vertical timing were used to mathematically calculate when the switch between sources would occur for circles, diamonds or other geometric shapes.

Soft edges to wipes added a new factor to switching. A period of controlled mixing transitions was triggered by the switching waveform. One source faded to black while the second faded up from



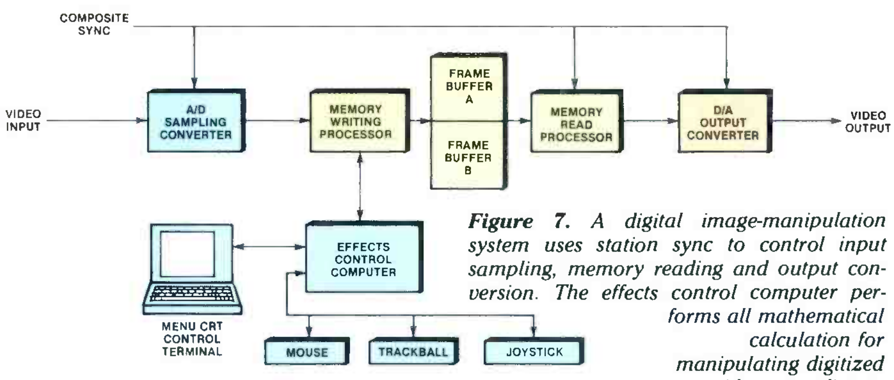


Figure 7. *A digital image-manipulation system uses station sync to control input sampling, memory reading and output conversion. The effects control computer performs all mathematical calculation for manipulating digitized video according to algorithms called by control terminal.*

black. For special edging functions, a third source, the edge generator circuit, was switched into the output signal.

Keying also added complexity. For a straight key function, the key level control adjustment selected a video signal level as the trigger point for a source-to-source transition. Chroma-keying used a selected combination and intensity of RGB information to initiate the switch function. Early chroma-keying efforts used blue as the preferred controlling color, because blue is the least intense color found in flesh tones. As improved sensing circuits were designed, restrictions on color-keying choices relaxed.

Before digital video effects added an entirely new repertoire to video signal manipulation, comparator circuits were about the closest an effect circuit came to digital concepts. These circuits made a simple determination: Is the level of the signal greater to or less than the reference? If greater, switch; if not, do nothing. Digital video effects systems, however, use computers with programs written to accomplish certain functions with much greater precision. The previous non-digital effects are still possible, but usually with various additional characteristics.

Wipe effects now include transitions such as pull-on, push-off; push-off and reveal; or pull-on and cover. The location of the switch between sources is calculated digitally, in conjunction with the effects panel fader-control settings. Video information to be displayed is moved at high speed from memories into the display frame buffer. The content of each pixel is determined by calculations associated with the selected effect.

The operator has control over effect parameters, such as beginning and ending locations of transitions and the speed of a transition across the screen. Various amounts of tension may be included to determine the amount of curvature found in non-linear effect moves. Such operator-controlled parameters are variables to the resident computer operating system.

A word on the future

The complexity of digital effects depends upon the capabilities of the computer system hardware. It depends even more, however, on the software design. (See Figure 7.) With the introduction of 32-bit microprocessors (and 64-bit systems not far away), as well as memories and function blocks, hardware has become less of a constraint. Array processing and data pipelining have added greatly to the manipulation possibilities. Software and the special algorithms to achieve the effects are now the prime limiting factors.

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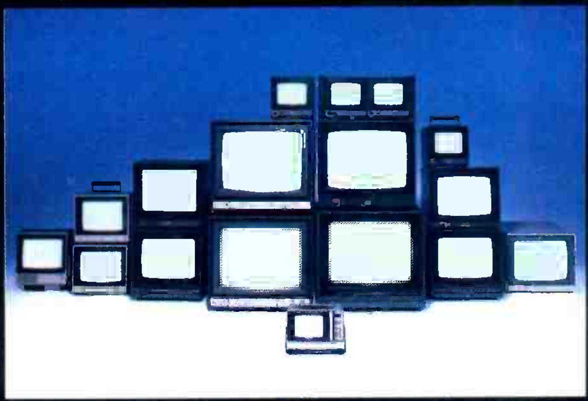

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Circle (20) on Reply Card

Using time base correctors

By Carl Bentz, TV technical editor

TV technology is changing rapidly. Time, however, remains a critical element in reproducing a stable picture on the home receiver.

Why do articles about television often begin by discussing sync? Probably because synchronization and timing in different parts of the TV system must be correct for the system to work. The coordination between horizontal and vertical pulses must be correct if the picture is to remain stable on the screen. Color information must coordinate with horizontal sync if the hues are to stay put.

Timing parameters have changed little since the specifications for the EIA monochrome system were first written. Adding color required some alterations, but the times and tolerances, originally picked for vacuum tube timing generators, remain similar and are easily achieved with solid-state generators. Now, a number of TV products include a single-IC sync generator for stand-alone operation or gen-locking into a studio system.

Mechanical maladies

In the studio, the major problems of unstable video are primarily from mechanical equipment. Videotape recorders can be unstable, and some non-digital magnetic disc systems also lack sync stability.

Minute variations in the balance of a drive motor armature translate into variations in video output signals. Bearings, no matter how carefully designed and machined, are never perfect. The geometry of head wheels and other moving parts may vary from the ideal. Tape, although manufactured from materials selected for dimensional stability, can suffer the effects of change in temperature and humidity. Contact points between the tape and tape path guides are sources of friction.

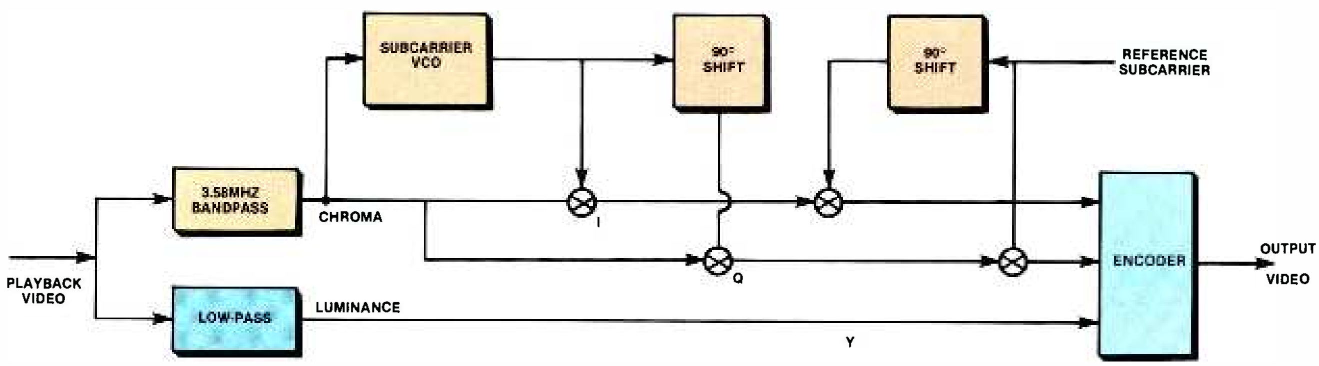
Today's VTRs are much more stable than those of only two or three years ago, but to fully overcome the sources of mechanical variation, time base correction is necessary. The TBC is integral to some VTR designs. In others, an external TBC unit must be provided. In either case, reference signals from the station sync generator drive the TBC. The time base corrector, in turn, stabilizes the VTR video. Often, the correction is through an advanced vertical sync signal driving the VTR system servos.

The correction process

The traditional process of locking a quad VTR to house sync required several steps. First, vertical lock, the easiest to perform, was achieved through the action of the capstan and head wheel servo amplifiers. Vertical sync information from the tape was compared to the reference (house) vertical sync. The time difference from the reference, whether positive or negative, caused a correction to be applied to the capstan and the head wheel drive motors through motor driver amplifiers. The correct field was also determined to avoid horizontal shifts and color-phase changes during fades or editing.

After the vertical circuits were locked, the horizontal timing was checked. Again, a servo system compared off-tape horizontal sync pulses with reference horizontal signals, adding a correction to

__Figure 1.__ The signal flow for color correction in an early TBC design.



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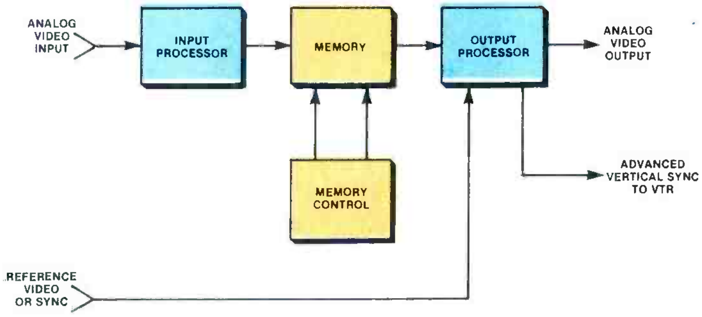

Figure 2. *Input processor, memory with control and output processor are the three major components of a digital TBC.*

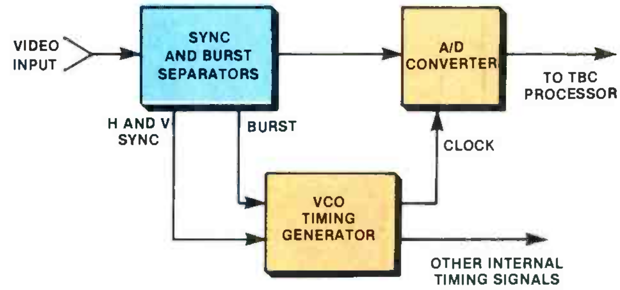

Figure 3. *In a direct-process TBC, sync and subcarrier errors control the A/D signal conversion during input processing.*

the head wheel drive motor amplifier. A residual error of about $1\mu s$ was achieved.

In addition to the speed adjustments through servo systems, voltage-controlled delay lines reduced signal instability. A comparison between playback and reference H-sync pulses determined the error correction needed in the delay system.

Finally, color burst from the tape and reference source produced a correction signal to assure the proper color phase. The residual timing error after color was locked was approximately 4ns.

Many quad VTRs remain in service today, but 1-inch and smaller helical scan formats replace the larger machines as quad maintenance becomes too expensive or time-consuming.

Following the trend

Just as other TV products have been refined, TBCs have undergone improvement. Initial TBC designs were essentially analog in nature. Charge-coupled devices (CCDs) appeared in a hybrid TBC design. The system sampled the unstable video. Then, without quantizing, the analog samples entered a CCD delay line and moved along at the sampling rate. The delay was inversely proportional to a clocking rate that varied to make the output coincident with house sync.

Soon digital designs appeared, providing greater ranges of correction. The range may now be from one or two TV lines to include full fields and frames in synchronizers and frame stores.

The first digital TBCs processed composite video, as many still do. Some felt, however, that digital processing of composite signals produced artifacts caused, at least in part, by the presence of the color subcarrier. To avoid subcarrier

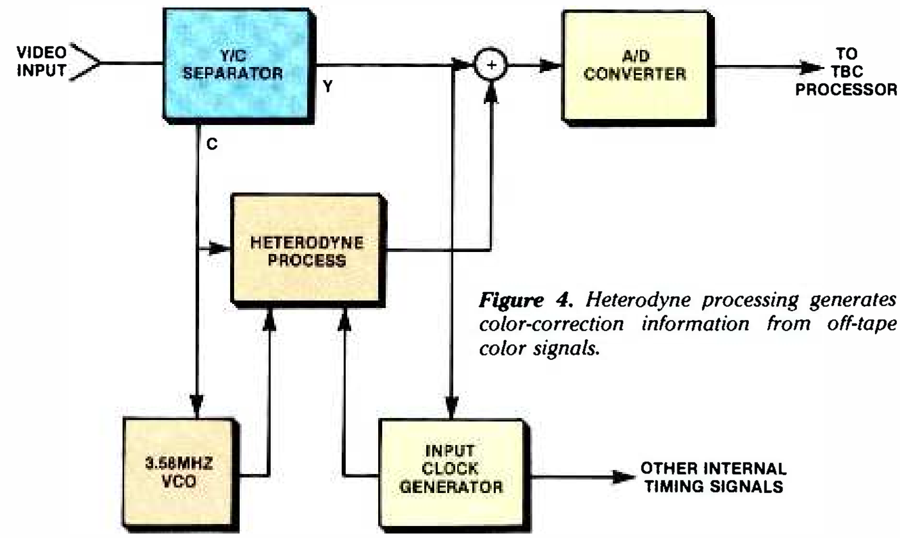

Figure 4. *Heterodyne processing generates color-correction information from off-tape color signals.*

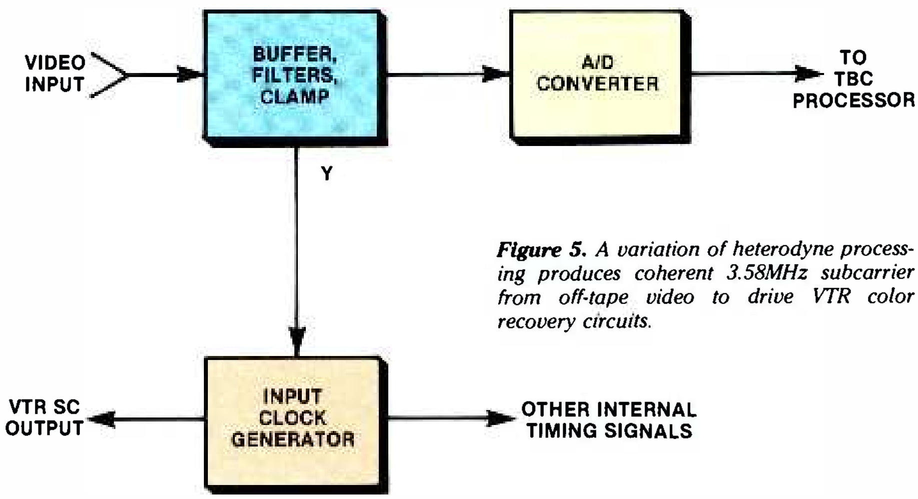

Figure 5. *A variation of heterodyne processing produces coherent 3.58MHz subcarrier from off-tape video to drive VTR color recovery circuits.*

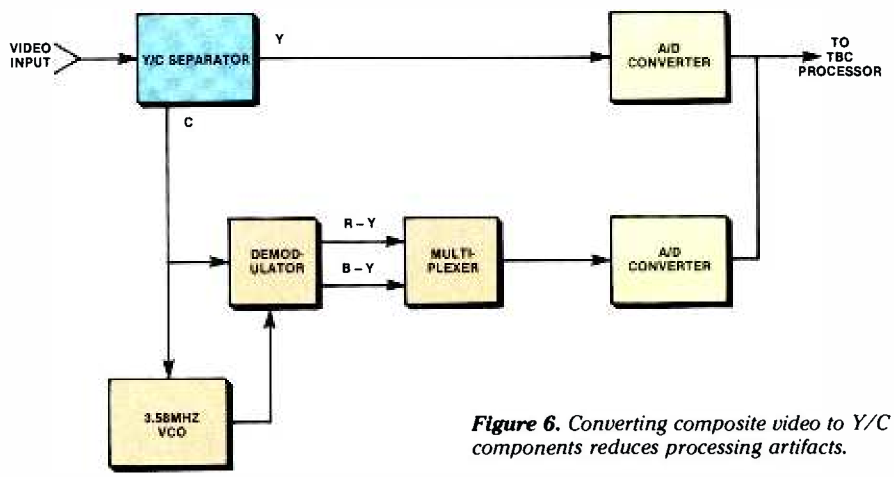

Figure 6. *Converting composite video to Y/C components reduces processing artifacts.*

degradation, the subcarrier has been removed in a generation of video component correction systems.

Digital technology easily provides other corrections such as velocity error and dropout compensation. Nonstandard playback speeds and still-frame modes have been made possible by coordinating advanced memory control signals in the TBC with more exacting servo systems in the VTR.

In order to process components, some TBC designs separate the incoming composite signal into luminance and chrominance components. Others include inputs for separated Y/C signals. Recent designs accept RGB, Y/I/Q or other component variations directly. Some models allow the user to choose from the three possible signal formats as *inputs* and *outputs*.

In essence, today's TV equipment supermarket displays TBC products to match all of the variations in VTR designs. As such, the TBC becomes a link to tie a VTR into any TV system, composite or component.

Bit by bit

The major difference between early digital TBCs and their analog counterparts involved a digital memory instead of analog delay lines. As digital devices became faster, the memory and control sections of the TBCs improved. Faster devices meant higher data-clocking rates and an increased signal-processing transparency.

Major changes between the first digital TBCs and those of today, however, are found in the interfaces to the outside world, the input and output processing sections. These changes have necessarily resulted from different design approaches of video recorders.

For most 1-inch VTRs, the *direct process* correction method is used. In direct processing, an input section of the TBC separates H- and V-sync and burst from the incoming signal. Errors found in the two sync components of the composite signal control the input A/D conversion of the video for a partial correction. Then, after digitization, standard TBC action aligns all horizontal lines of the video before an A/D conversion is performed. New sync and burst are added to the signal before the output is sent to switchers, effects systems or other devices of the TV system.

Smaller format videocassette systems, in particular ¾-inch products, depend upon *heterodyne processing* to produce stable video. *Color under* helical scan recorders separate and convert color information from sidebands at 3.58MHz to a signal surrounding 688kHz. The color and luminance are recorded and reproduced through the same channel.

Creating a colorful image

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Y/C Dub interfaces directly with VTRs to reduce ringing and distortion effects caused by cascaded filters.

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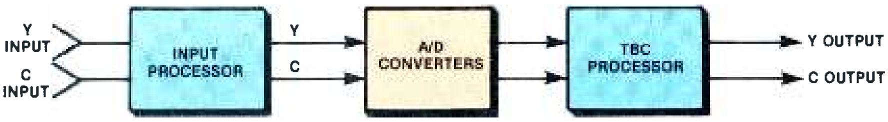

Figure 7. Direct Y/C transfers from one VCR to another improve the signal-to-noise ratio.

To avoid interaction, the color should always be well below sidebands of the luminance modulation.

In a heterodyne TBC, color is separated from luminance, and variations in the proper relationship between the two are detected. The error drives a voltage-controlled oscillator to correct the color signal before it is remixed with luminance for standard TBC processing.

A variation of heterodyne processing drives the VCR with a color subcarrier signal that is phase-locked for coherence to the luminance signal being produced by the VCR. Using subcarrier feedback correction reduces the amount of processing required in the TBC.

In a component world

Some 2-inch quad VTRs provided RF input and output connectors, allowing dubs to be made without encoding the playback to NTSC, then decoding back to RF for recording. RF dubs became even more popular with the ¾-inch systems through special dubbing connectors featuring luminance and mixed chroma signals in an RF form, directly from the reproduce head pre-amps. Signal degradation in early VCRs was quite serious, but the RF approach allowed additional generations to be made before the signal became unusable.

The advantages of component processing without degrading encoding and decoding functions was realized long before the cost of A/D and D/A devices fell to a practical level. With improved IC technology and reduced prices, Y/C component TBC processors became a reality.

At first, component processing separated mixed color information from the composite signal. Then, R–Y and B–Y demodulation took place under the control of a 3.58MHz VCO to achieve color timing corrections. The color difference components were multiplexed through one channel for A/D conversion in subsequent TBC processing.

With separated Y/C information available direct from the VCR, a logical step was to process the components separately. Encoding would be done, if necessary, for display, transmission or rerecording on a non-component recorder.

The introduction of portable camera-recorder systems with Y/I/Q, Y/R–Y/B–Y or other component formats and more cost-effective digital integrated circuits has led to the latest stage of TBC design. Because sufficient proof exists that the NTSC subcarrier is the culprit causing much of the video degradation through the production system, the ideal TBC should handle component video directly.

Called a *component interface TBC,* the corrector may be designed to accept any type of video signal, composite or component. Three separate channels perform the correction functions in parallel. At the output side, the user selects the composite or component format that interfaces to the rest of the production system. All editing and dubbing can be done in the component realm with en-

Continued on page 52

Q. If Microdyne's Ku-band downlinks are so good, why can they cost $30,000 less?

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Q. How much flexibility do I get, in bandwidth and frequency?

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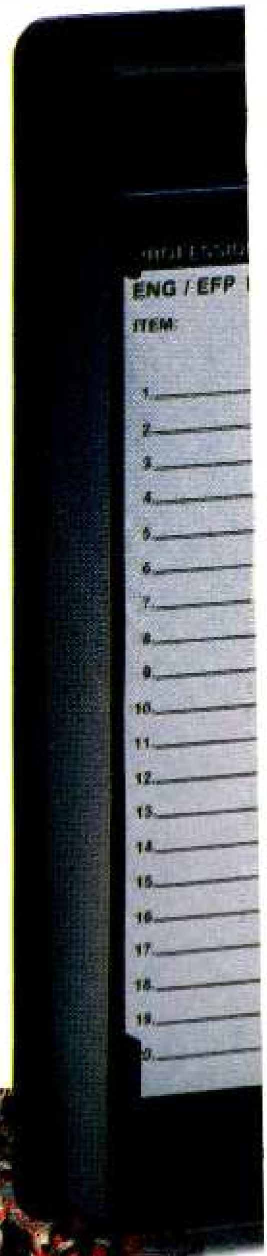

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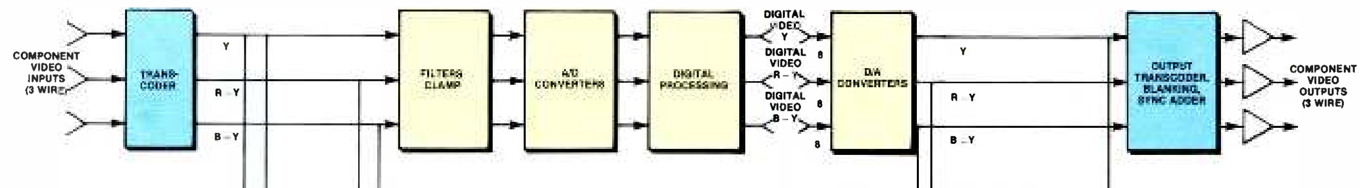
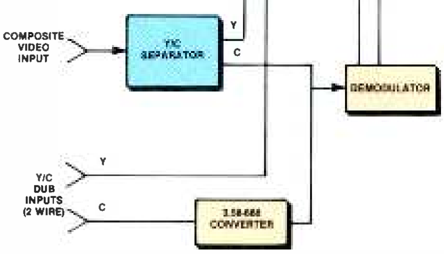




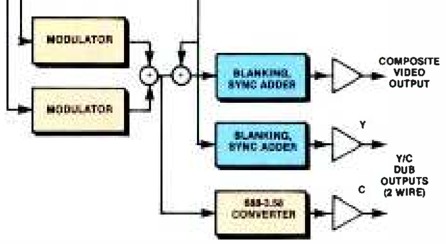


Figure 8. With TBC interface transcoding, corrections are made from any input format to any output format.

Continued from page 48

coding to composite at the time the program is previewed on a monitor, aired or copied for program distribution.

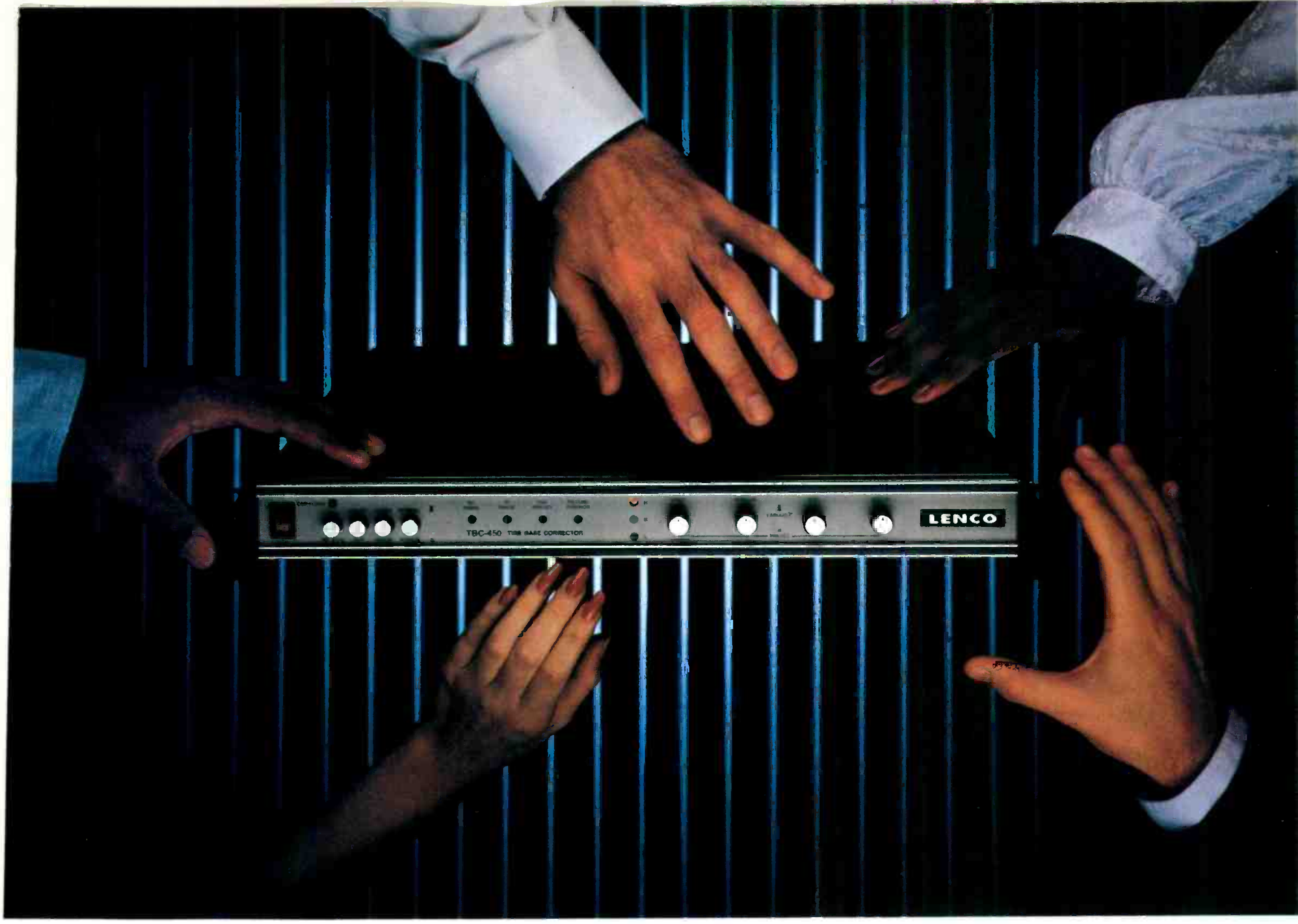
Predictions

Where does component TBC processing stand? The advantages of component video are well known, and one day most production will use component technology. For broadcasters, some confusion exists concerning which component format to use. Outstanding products are available in both the wideband R–Y/B–Y and the narrower bandwidth I/Q formats. Users have found advantages and disadvantages to both systems. Manufacturers offer transcoding devices that convert from one system to the other, which somewhat equalizes the advantages of the two formats.

Other portions of the production system now come in component models. Equipment selections include production switchers, special effects units, character generators and paint systems with component capabilities. Broadcasters have noted that each generation of component equipment shows welcome improvements. However, in some cases, the improvements produce incompatibilities.

The interfacing TBC will be the connection that brings component production equipment into the broadcast station. If the trend of including at least a limited selection of digital production effects in the TBC continues with component-based products, many economy-minded production facilities may select the component equipment. As existing equipment needs to be replaced, broadcasters are likely to follow suit.

Acknowledgment: Assistance from For-A Corporation in the preparation of this material is appreciated.



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VSP from A to D

By Bob Paulson

This is a look at the evolution of video signal processing (VSP), time base correction, digital technology and the people who made it happen.

In the 1940s and '50s, the EIA and FCC wrote the original technical specifications for the amplitudes, shapes and widths that brought synchronizing pulse time base stability. In those specs, they described the allowable time base jitter of a vacuum tube sync pulse generator (SPG). *All* signals that went on the air came from studio or telecine cameras driven by those SPGs.

A 1953 demonstration at the RCA Laboratories gave the TV world a surprising view of the future: a machine that could capture and reproduce TV signals on tape. Then, Charlie Ginsburg's stubborn and persevering engineering team at Ampex demonstrated the prototype of a practical videotape recorder at the 1956 NAB. RCA countered with the TRT-1A monochrome VTR (1957) and TRT-1AC color VTR (1958), requiring only six racks of equipment. In 1961 transistors shrank the TR-22 to a more manageable size, cutting power consumption, maintenance and air-conditioning requirements.

Paulson is a managing partner of AVP Communications, a communications management consulting company, Westborough, MA.

TBCs—the original need

What did the original VTRs do to the quasi-pristine camera signals during recording and playback processes? Among other things, they created mildly objectionable aberrations to pulse amplitudes and shapes. Signal-to-noise ratios and horizontal resolution deteriorated, but not to a commercially objectionable level. Some of the artifacts could be eliminated in *proc-amps*, but the wounds inflicted on the time base stability of the signals were grave.

Today, VTRs continue to mangle time base stability. Tape stretches and lurches along, weaving back and forth through the tape path. Tape speed and rotating video head speeds are on spec only occasionally and briefly, as they both oscillate around a zero-error condition.

Tracking and head penetration errors in the original quad VTR worsened S/N figures and created serrated *Venetian blinding* in reproduced images. Interchanged tapes displayed objectionable head band displacements because four pole tips were impossible to cement to the head disk at *precisely* 90° from one another.

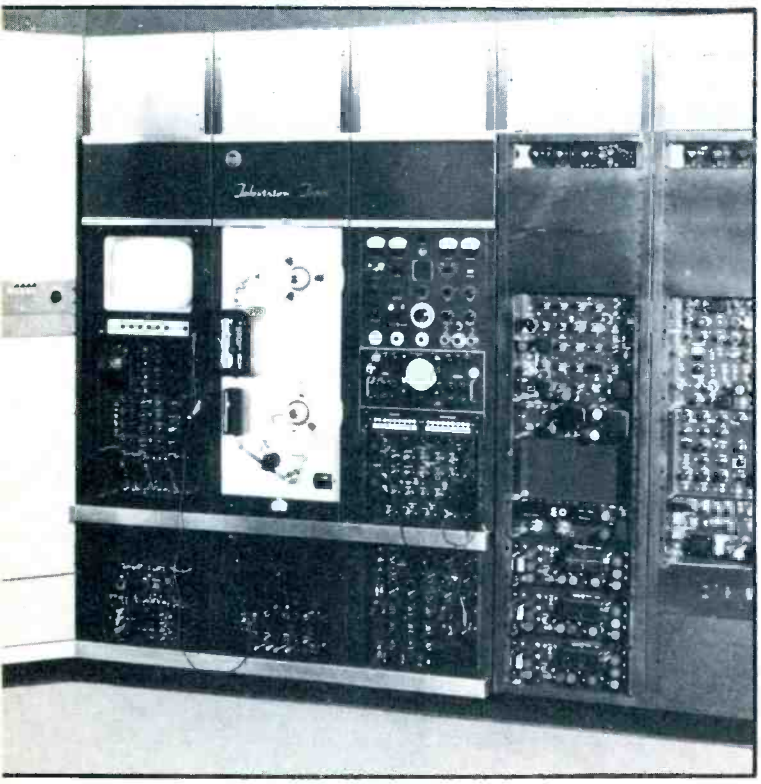
First solutions

The FCC looked the other way when monochrome VTR playbacks with time base error deficiencies first aired, but stations and teleproducers didn't.

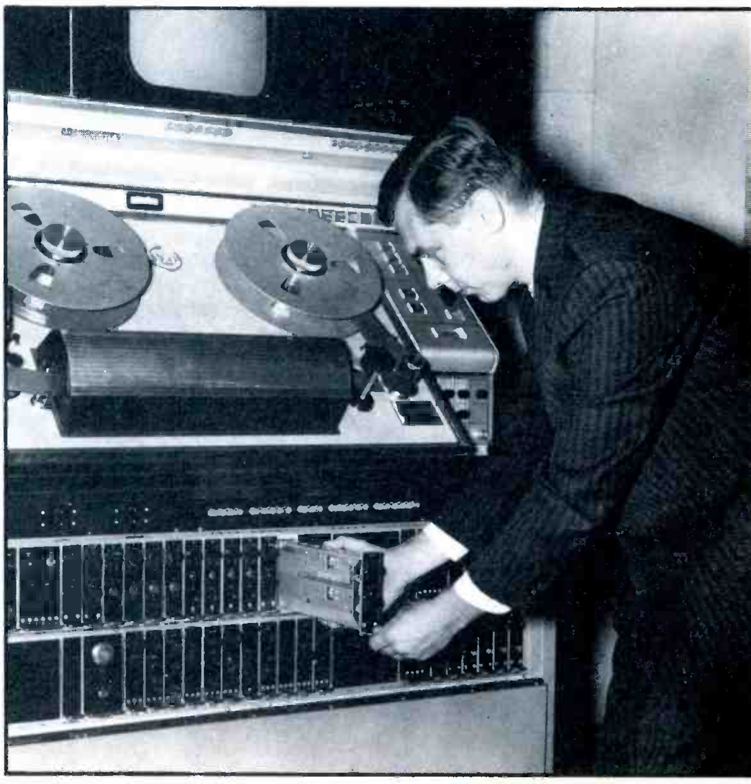
Ampex and RCA, the original and only U.S. quad VTR manufacturers, began a competition to fix the problem. Ampex worked to improve precision in assembling the pole tips on the head disk (in essence, a mechanical time base error control) and tighter servo control of head disk rotation. An electronic approach at RCA routed the off-tape signal through varying-length delay lines, after line-by-

Continued on page 58

The first RCA color VTR required six equipment racks to house vacuum tube circuitry.



The TR-22 included 750 transistors and 350 diodes.



Photos courtesy of Ampex and RCA

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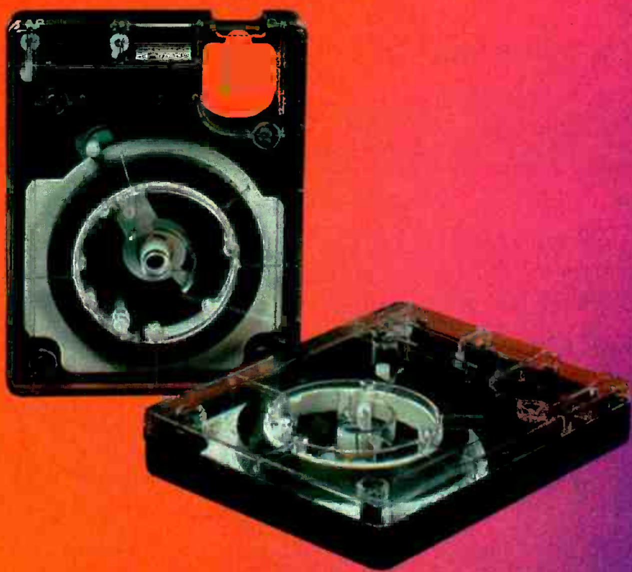

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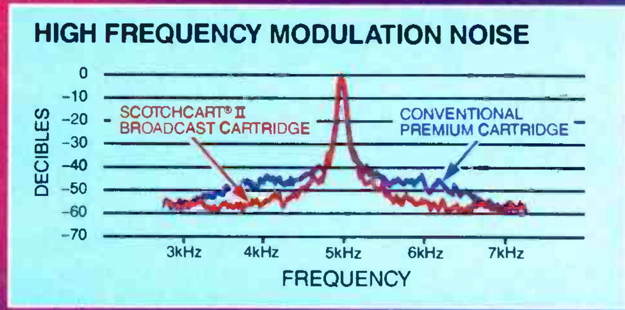
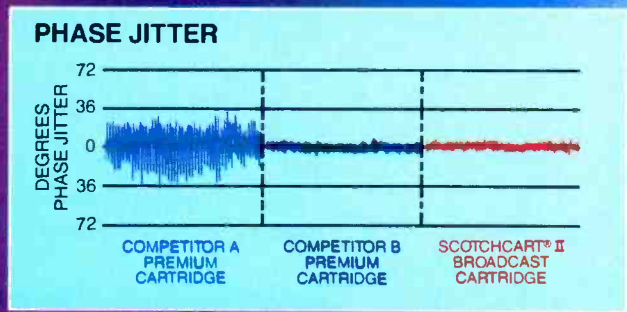
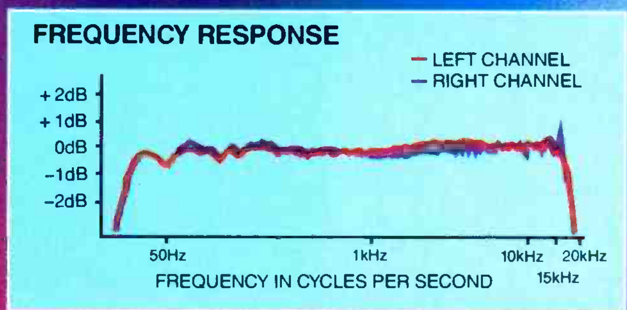


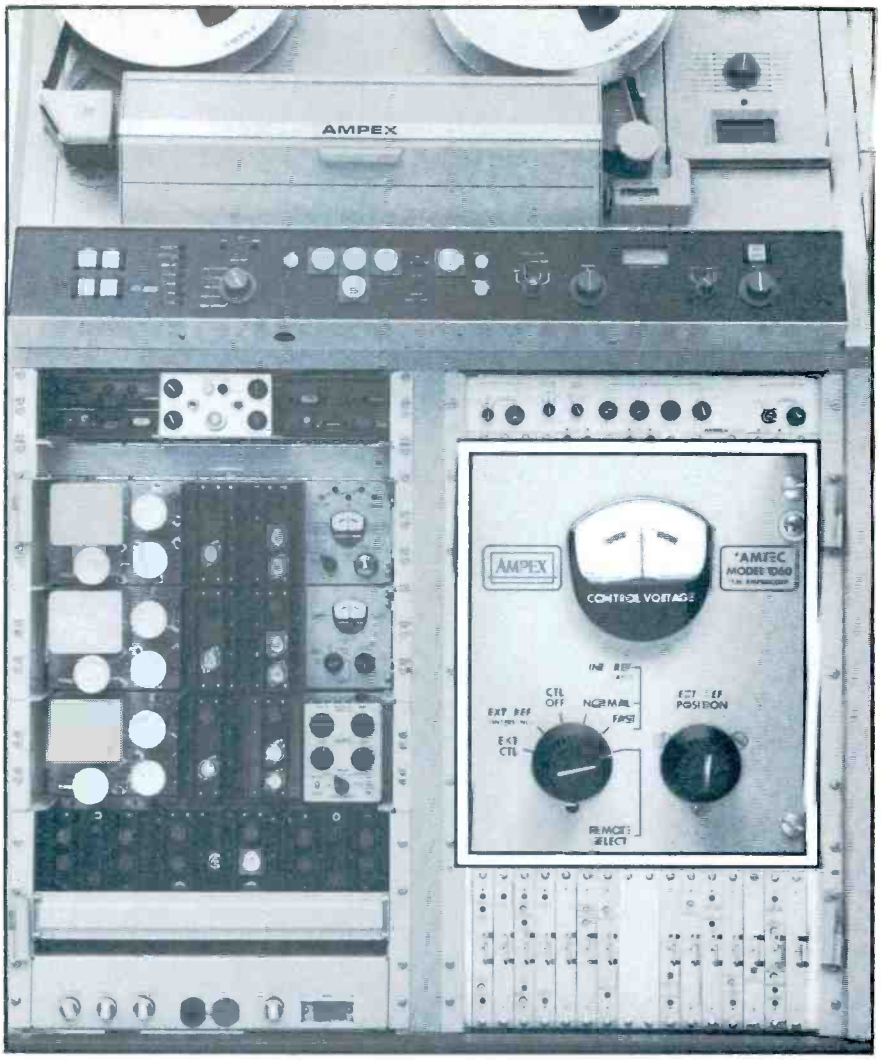
The Revolutionary ScotchCart® II broadcast cartridge design eliminates the excessive audio sideband noise which results from the rubbing effects of pressure pads and the mechanical irregularities of rotating hubs found in conventional cartridge designs.



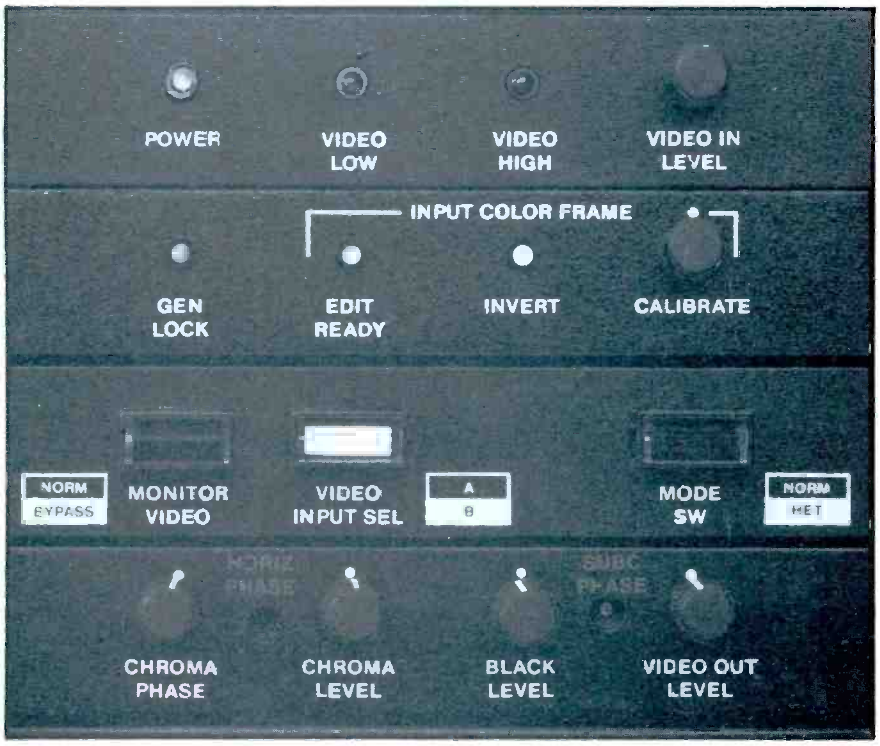
Some competitive cartridges sound muddy on the air because of excessive phase jitter. ScotchCart® II broadcast cartridges sound crisp and clean.



The new tape was conceived as an integral part of a complete cartridge system. When used with high quality equipment, such as an ITC "99B" cartridge machine, the ScotchCart® II broadcast cartridge is capable of frequency response equalling professional reel-to-reel performance.



In the electronics bay of the VR-2000, the AMTEC and companion Colortec reduced time error.



Solid-state integration reduced size and simplified expanded control over TBC processing in the '80s.

Continued from page 54

line detection and measurement of off-tape time base errors.

By the late 1950s, both companies developed analog TBCs as add-ons to yield quad VTR *broadcast standard* playbacks. The AMTEC (Ampex time element corrector) and RCA Auto-TEC, referenced to station sync, brought the jittering output within the monochrome signal stability specification.

Because the analog TBC-equipped VTR could be used in lieu of a camera, A/B-roll tape EPP (electronic post-production) editing came into existence. Proc-amp adjustments allowed off-tape pictures that matched the camera sources, but it would be another decade before digital time codes allowed control of editing transition points to match a human editor's desires.

By the time on-air monochrome VTR playbacks met the TV specs, the networks had begun NTSC color broadcasts. Multicolored playbacks from early monochrome recorders modified with *color kits* gave birth to "never twice the same color" as the operational definition of NTSC. Within the many equipment racks housing a VTR, the playback luminance signal was time base corrected, but the chroma rainbowed through the color spectrum. Again the FCC showed leniency with the initial heterodyne solution to the color time base correction need. After all, the subcarrier frequency and phase error-correction scheme (today's consumer *color-under* method) produced a seemingly stable picture on home receivers.

Ampex and RCA engineers found solutions with the Colortec and CAVEC (color amplitude and velocity error corrector), allowing color editing, but the VTR world was no longer all-quad. There were more ½-, 1- and 2-inch formats than there were companies. Time base gyrations from these early helical scan machines were many times faster and more unpredictable than those produced by the quads. Flagging visibly showed the errors as an erratic back-and-forth waving of vertical lines at the top of the picture. Older receivers with long time constants often couldn't lock onto the signals.

TBCs for quads couldn't correct the new format time base errors. Quad VTRs used head rotation, tape speed and longitudinal phasing servos to reference operation to the station sync. Early helical scan machines operated with no reference but the power-line frequency.

Later, helical scan machines were designed to operate in *V-lock*. The tape drive system used a capstan that was tied in a servo loop to the sync generator vertical sync drive pulse. Vertical interval switches between cameras and VTRs usually didn't cause pictures to roll.

H-lock helped

In the early 1970s, the Ampex

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VR-7900 and IVC 900/960 H-locked 1-inch VTRs included integral mono/color TBCs. Their outputs met FCC specifications for color time base stability. The absolute value of the 3.58MHz reference had to be 3,579,545Hz ±10Hz. Frequency drift had to be less than 0.1 cycle per second per second.

In 1972 Microtime introduced stand-alone analog direct color TBCs to work with H-locked machines, and heterocolor TBCs for the V-locked systems. Their solutions were technically clever, but broadcasters were not prepared to accept the incompatible Ampex and IVC 1-inch formats as broadcast standards. Commercial production houses continued with quad. Few corporate A-V departments could afford the H-locked 1-inch VTRs. Most preferred to latch onto the new ¾-inch U-format and its *cuts-only* editing capability.

Digital debut

NAB '73 saw a dramatic demonstration of the promise of digital time base correction. Bill Hendershot and Mike Tallent of Consolidated Video Systems used the CVS-500 digital TBC in a vertical split-screen presentation, proving that the erratic jittering of any wideband direct V-locked VTR could be brought under broadcast spec control.

Broadcasters, although impressed by

The next step in signal processing is perhaps pixel-by-pixel correction (in the Zeus-1), adding anti-aliasing to time base functions. The top photo shows a still frame before correction. The lower one shows the result of digital processing.

the show, remained unswayed. There remained in use several formats that were not interchangeable with one another, and—on occasion—not even with other machines of the same model. Eventually the B and C formats would be standardized and the more flexible, less costly 1-inch systems would terminate the long reign of 2-inch quadruplex VTRs.

Nevertheless, the CVS digital video signal-processing technology breakthrough in 1973 marked the beginning of the end for the all-analog TV era. The progression of new digital products into new digital signal-processing applications continues today, 13 years later, and the end is not in sight.

Editor's note: Bob Paulson watched the birth of the first practical videotape recorder in 1957 from his position as sales manager at Ampex. Before opening AVP Communications in 1974, he served at Microtime as marketing vice president during development of analog and digital TBCs. The invitation to prepare this overview resulted from his close association with VTR and TBC equipment.

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Digital delay and reverberation

By Dr. Richard C. Cabot, P.E.

In the fascinating world of digital reverberation and delay, there is more to technology than meets the ear.

In the days before silicon, time delays and reverbs were crude, only marginally effective and expensive. Early attempts at delay lines centered on tape loops and acoustical tubes with a microphone and speaker at opposite ends. Tape loops had obvious reliability problems and acoustical tubes were highly sensitive to external noise and mechanical vibration. Neither had a frequency response much above high C and both were difficult to operate.

Reverb devices relied on similarly marginal processes. Some of the earliest, and best, attempts used a real room with a microphone and speaker. In an effort to make the units smaller and more convenient, alternate approaches were tried with varying degrees of success. Springs and metal plates replaced rooms, and vibration transducers replaced microphones and speakers. In all of these systems a physical, understandable mechanism was directly replacing the mechanism of sound traveling in air.

With the advent of digital electronics things took a step toward the mystical. The first digital delays and reverbs were viewed with awe. The price of early commercial units also inspired awe. However, the high-volume manufacturing of digital electronics, which resulted in hand-held calculators being given away for opening a credit card account, brought digital delay price reductions by a factor of at least 10.

Cabot is vice president and principal engineer with Audio Precision, Beaverton, OR.

Still, much of the mysticism remains, fueled by some overzealous promoters who know little more about digital audio than do the purchasers. We will examine the insides of digital delays and reverbs in an effort to help you, the broadcaster, understand these devices better and to make you a formidable opponent for the spec-sheet writers.

Sampling and digitizing

One of the fundamental concepts of digital audio is the *sampling theorem.* Originally proposed by Nyquist, it is sometimes referred to as the Nyquist theorem. Simply stated, its principle is that you lose no information content in a signal if you sample it twice every cycle for the highest frequency it contains.

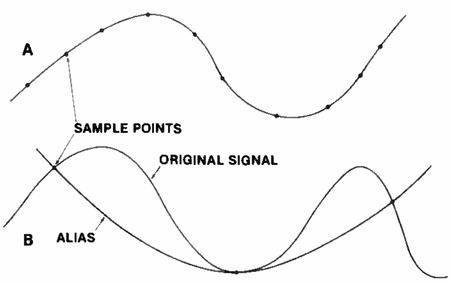

Figure 1. Two sampling rates showing the effect in the time domain. Curve A shows the effect of sampling more often than two times the input frequency. Curve B shows how an alias curve is generated when sampling less than two times the input frequency.

This implies that you must know the highest frequency contained in the signal and that you sample the signal at a frequency more than twice this value. If you reverse this idea, as is commonly done in digital audio, you don't get the same result. If the sampling frequency is fixed at 48kHz, for example, there must not be present any frequencies higher than 24kHz. This problem is often solved in digital audio systems by low-pass filtering the input signal below 24kHz to eliminate these high frequencies. This filtering eliminates portions of the signal above the cutoff frequency and adds phase distortion to the frequencies below it. In practice, these problems can usually be reduced below our limit of hearing.

Let's examine what happens when a signal is sampled and the sampling theorem is either obeyed or violated. Figure 1 shows the effect in the time domain of sampling a signal. If the signal is sampled often enough, there is only one sine wave that will fit through all of the sampled points of the original wave. If the signal is not sampled often enough, there is another, lower-frequency signal that will also fit the sampled points.

But what if there isn't a sine wave?

There is a theorem in mathematics that states that any signal may be composed by a range from one to an infinite number of sine waves. If the highest-frequency sine wave present is less than half the sampling rate, you will still be able to reconstruct the signal. Signals such as square waves contain frequencies in excess of the Nyquist limit. These

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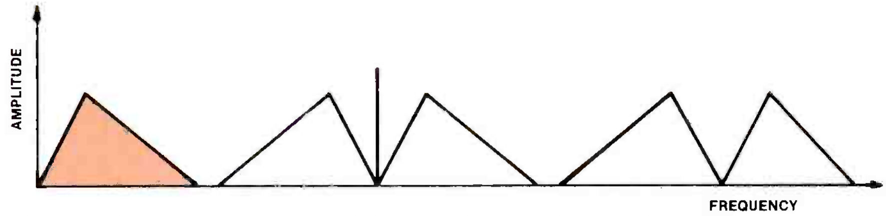

Figure 2. *The spectra of the original signal (shaded area), the sampling pulse and the composite of the sample signal.*

frequencies must be filtered out before they can be sampled.

The same effects in the frequency domain are shown in Figure 2. Because the sampling process converts the signal into a series of pulses, the spectrum of the signal is multiplied by that of the impulse train. This gives an infinite number of identical spectra mirrored around each harmonic of the impulse frequency. As long as the input spectrum does not exceed the boundary of one-half the sample rate, the original spectrum can be recovered by filtering off the higher-frequency mirror images. If the spectrum exceeds this boundary, the mirror images will begin to overlap the original spectrum, making recovery impossible.

If a digital system samples at 44kHz (the standard for compact discs), tones up to 22kHz, theoretically, will be reproduced correctly at the output. A 23kHz tone will be reproduced at 21kHz because it is above the Nyquist frequency of 22kHz. A tone at 26kHz will be reproduced at 18kHz. Similarly, any tone *above* the Nyquist rate will be reproduced an equal amount *below* it.

Quantization

Quantization is the process of assigning a number to the sampled signal value that represents its amplitude. Because the original signal was analog, its value at any time requires an infinite number of decimal places to describe it. However, in digital systems, there is a finite size or number of digits that can be used. The quantization process cuts off the extra decimal places that don't fit.

Suppose there is a digital system that allows numbers from –1,024 to +1,023, including zero. There is a total of 2,048 separate values. Make 1,023 represent 10.23V. If you have a signal sample of 5.09183V, the quantization process would make this 509 in the digital system. The extra precision in our number is, therefore, lost.

If you had a signal sample of 11.5039V, the quantization would still give 10.23V. The system has clipped. This illustrates a frequently cited problem with digital systems—*hard clipping.* When the input signal exceeds the maximum level allowed, the distortion rises radically. Most analog devices, on the other hand, produce mild distortion before they fold up completely. This gives the user some warning that the end is near.

Digitizing small signals

There is a corresponding problem at the other end of the signal level range. When the signal amplitude becomes small, there are not many numbers available to represent the samples. For example, suppose the sample value is 0.12045V. The digital system described previously would represent this as 0.12. If the sample value was 0.12951V, the digital system would also quantize it to 0.12. The difference between the samples was 1dB, but there was no change in the digital value. It is easy to see that such a numerical error could cause gross distortion of audio signals in the A/D system. (See Figure 3.)

The solution to this problem is a process called *dither.* Random noise is added to the audio signal, forcing the quantized values to be randomized by one bit.

Continued on page 68

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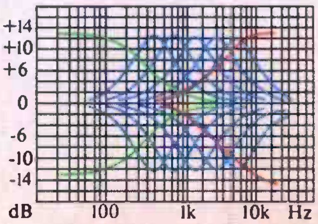

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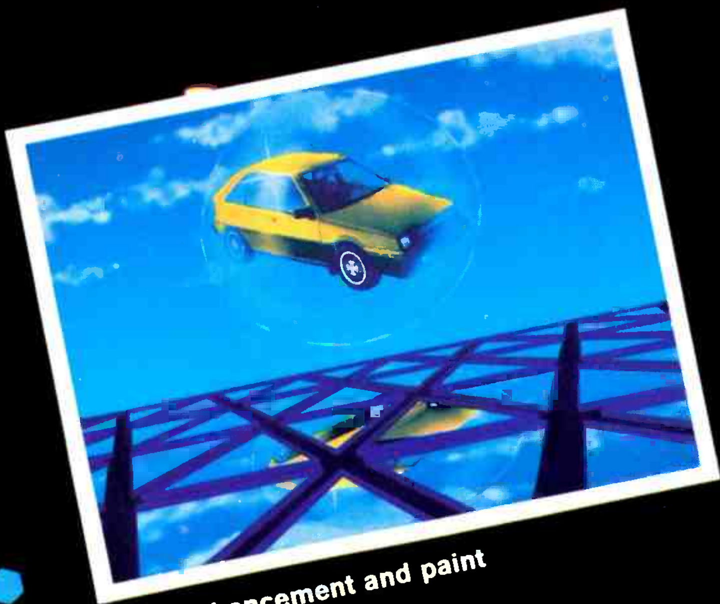

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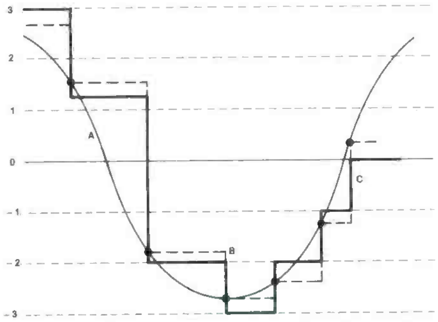


Figure 3. *An extreme example of the effects of quantizing on an audio signal. Curve A is the original signal, curve B is the sampled signal and curve C is the quantized signal.*

Continued from page 64

Working from the previous example, the 0.12951V signal usually will be pushed over the threshold to 0.13, most of the time by the noise. However, random noise will occasionally push the voltage down to 0.12. The average of these quantized values will be correct. When properly applied, dither allows small signals to be digitized and reproduced correctly.

It takes time for the A/D converter to decide what number is closest to the signal. However, because the signal is always changing, it does not necessarily remain constant long enough for the converter. Therefore, most digital systems employ a circuit, called a *sample and hold*, that holds the signal value constant while the A/D performs the conversion. This circuit usually consists of a capacitor and an electronic switch such as an FET. The switch is closed long enough for the capacitor to charge to the signal voltage and is open while the A/D performs the conversion.

Pulse code modulation

We have been dealing with decimal numbers up to this point. Digital electronics prefers to deal with *binary* numbers. In decimal numbers, a digit may be one of 10 values from 0 to 9. Each digit is a factor of 10 larger than the digit to its right. Binary digits, or bits, are allowed to be only 1 or 0. Each bit is then a factor of 2 larger than the bit to its right. For example, decimal 10 is binary 2, decimal 100 is binary 4, and so on. A binary number or word is merely a collection of bits, binary 110 being equivalent to decimal 6.

Byte is a special name for an 8-bit-long word. The largest decimal number that can be represented by an 8-bit byte is 255. A 12-bit word can represent up to 4,095; a 16-bit word can represent up to decimal 65,535. To include negative numbers in binary representation you must give up a bit to the sign information, making a 16-bit word represent +32,767 to −32,768. This process of converting an analog value into a binary word is pulse code modulation (PCM).

Delta modulation is a different approach to sampling and quantizing a signal. (See Figure 4.) Assuming you already know the value of the signal, then you need only to keep track of whether it becomes more positive or more negative. If you output a high (+) when the signal goes more positive and a low (−) when the signal goes more negative, you can track the changes in its voltage. To follow fast changes in the signal requires a high sample rate, much higher than required by the sampling

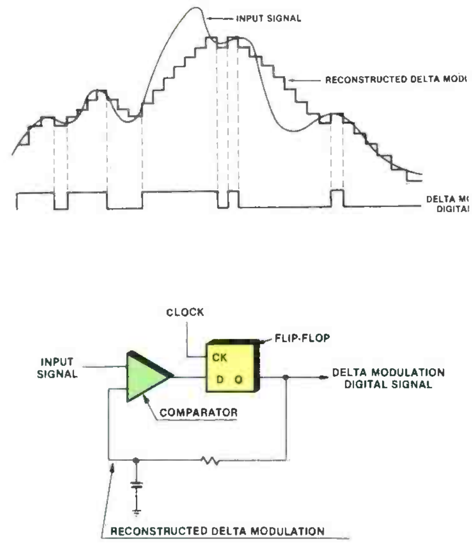
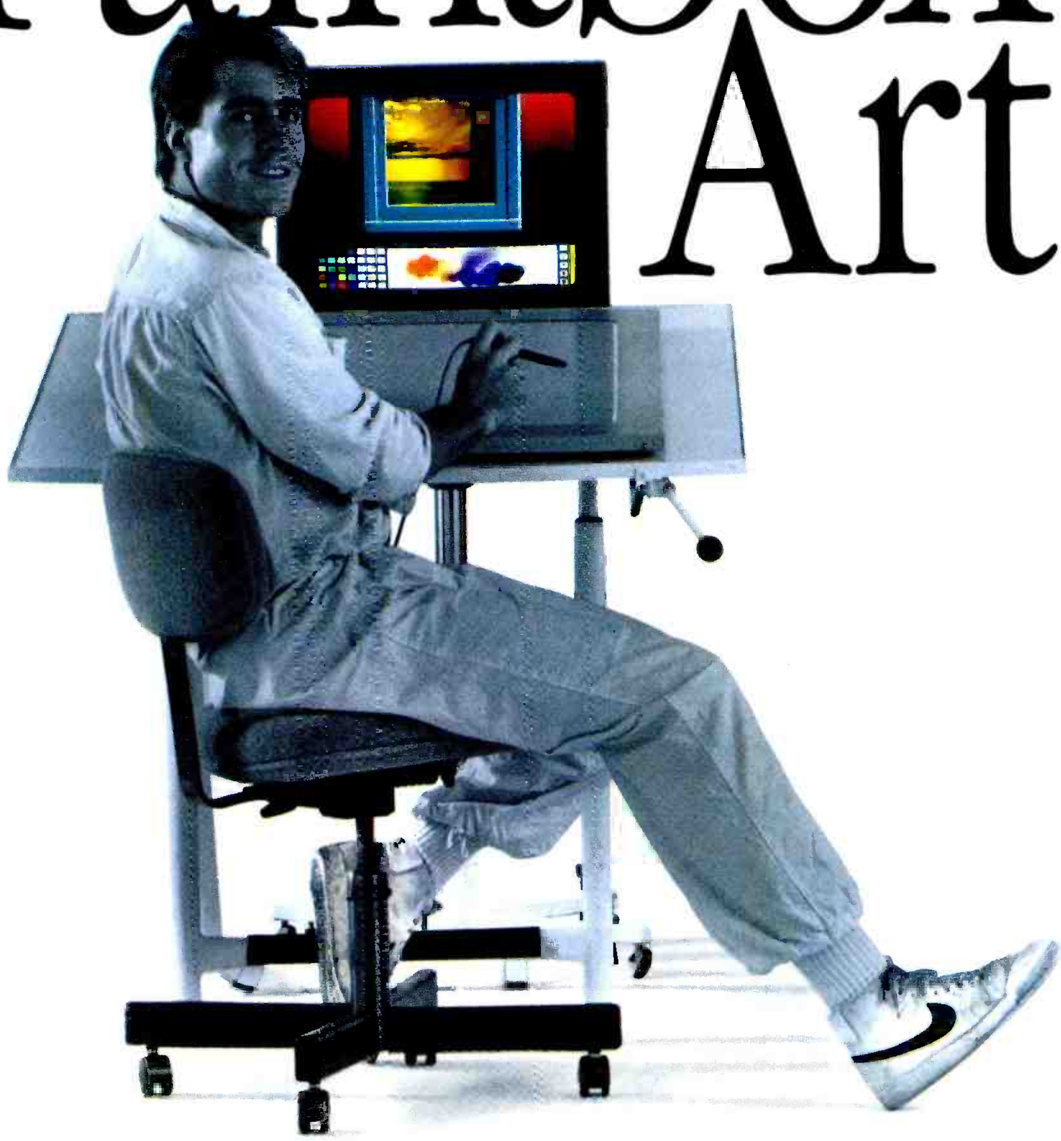


Figure 4. *A block diagram and representative signal for the delta-modulation process.*

Paintbox Art



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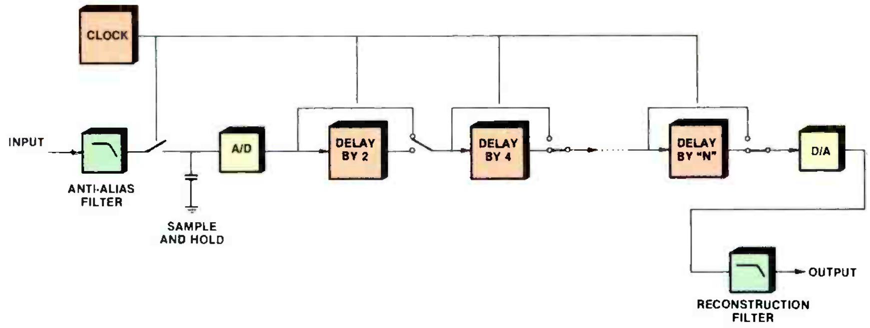

Figure 5. *A representative block diagram of a digital delay system. The signal is converted into digital format and fed to a shift register. This is considered the simplest way to construct a digital delay.*

theorem. However, the output is only one bit and requires much less precision in the design of the converter.

This technique was used widely in early digital delay units, but was abandoned in favor of the PCM approach as the cost of the A/D converters declined. It is making a comeback, with modifications, because of its wide dynamic range capability. However, the serial, high-speed bit stream is difficult to process for reverberation, so it is mainly used for delay lines and recording. It is possible to convert a delta modulation signal to PCM, but this is not yet common.

Limitations

When a D/A converter changes the digital words back into an analog waveform, the signal is composed of a series of steps. In the frequency domain, these steps create harmonics of the signal spectrum, as shown in Figure 2. It is necessary to smooth out the steps and eliminate these harmonics so they do not interfere with the high-frequency elements of the sound system. This is done with a low-pass filter, commonly called a reconstruction filter, set to half the sampling rate of the digital signal. The reconstruction filter is similar to the anti-aliasing filter used at the input.

The dynamic range of a PCM digital system is limited by the number of bits used throughout the system. The dynamic range of PCM is equal to approximately six times the number of bits. This is the dynamic range from the noise floor to hard clipping. If the signal is quantized to 12 bits, the dynamic range will be 72dB; 16 bits will give 96dB. This assumes a perfectly linear converter, which is rarely the case as one approaches 16 bits. Converters commonly used for digital audio have non-linearities (distortion) at the 14- or 15-bit level.

In an effort to use less expensive A/D converters or to conceal signal-to-noise limitations, some manufacturers have used compressor/expander circuits in their delay units. These result in a better steady-state S/N but can lead to pumping and breathing problems, inherent in some noise-reduction schemes.

A few designers have put noise reducers on digital reverb and effects devices. These devices ignore the fact that the output signal from a reverb is not the same as the input signal. Because the gain and frequency response of a noise reducer changes with time, the recirculated signals will have been compressed with a different characteristic than the direct sound. At expansion, the sensing circuits will see the average level of the direct sound and the reverb, forcing an incorrect response.

On the positive side, well-designed compressors can reduce hard clipping. Analog circuits can be designed to overload much more gracefully than digital systems, reducing the danger of high-frequency overmodulation or audi-

Continued on page 74

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Donna

We used the Unitrol system for the Atlanta Convention and Visitors Bureau meeting. We had a limited load-in and set-up time. The dimmers were great; all we had to do was hang the dimmers,plug in the instruments, power the dimmers and we were set. We had to teach the presenter how to operate the controller, and that was easy.

The Unitrol system is a good addition to our inventory. It's easy to store, transport and simple to set-up and operate. The system is ideal for small production jobs and rental orders.

Brian Rehkoph and Donna Dallas
MAGNUM-Atlanta, Georgia

George

I bought the Unitrol Lighting System over one year ago and have used it continually without any problems. It is compact, easy to operate and manipulate. This lighting system is very convenient, you can move the controller anyplace which gives me better maneuverability.

The Unitrol system has made my job easier. I highly recommend it.

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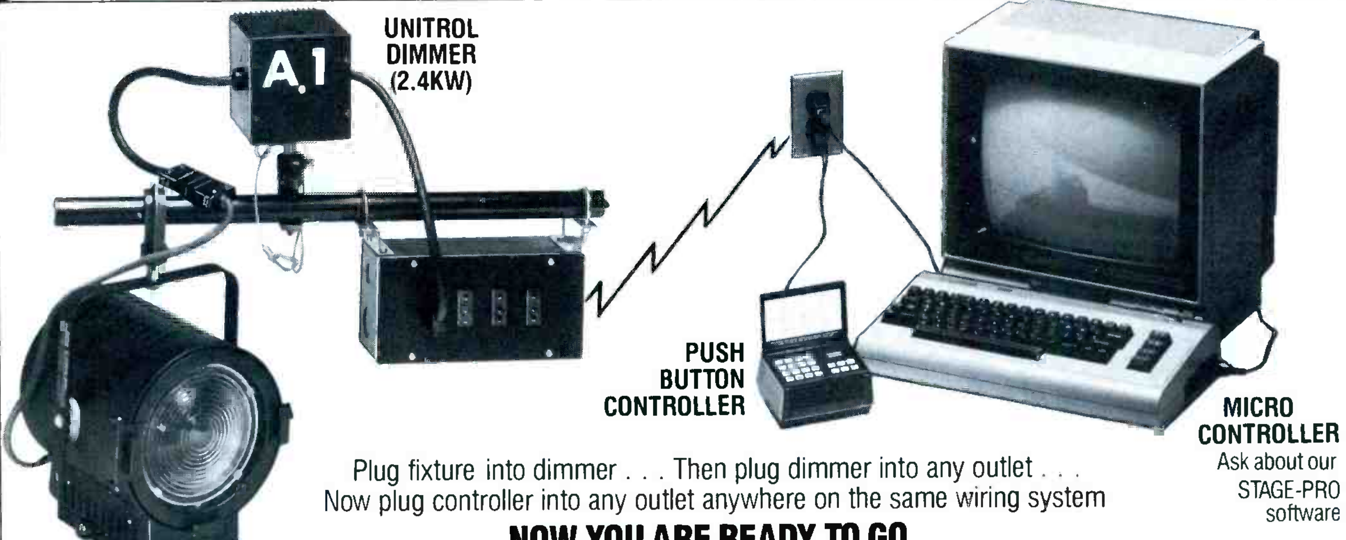

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"Not only does the SK-970 have complete auto setup, but it's a genuine studio camera that's lightweight enough to send into the field."

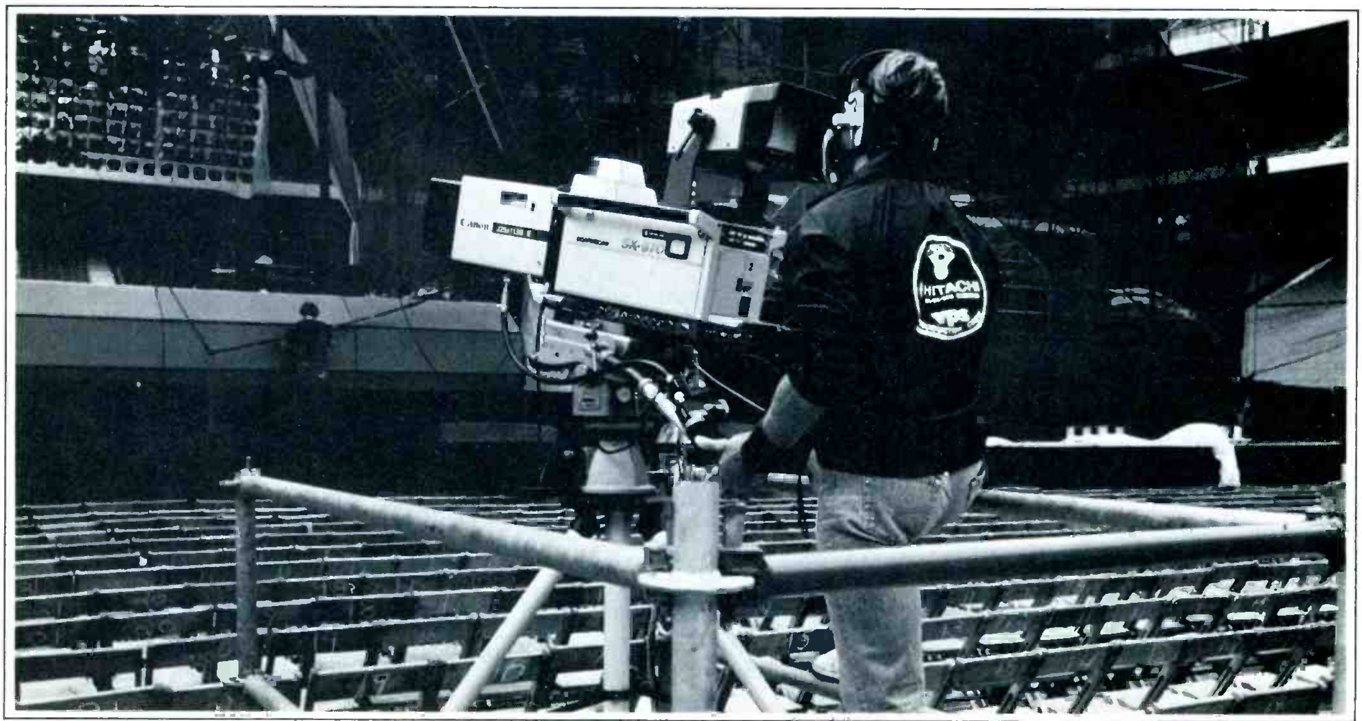
I. Jay Azimzadeh, President
Video-Pac Systems, Ltd.
Hollywood, CA

The largest producer of live concert videos in the U.S., VPS requires lightweight, low-maintenance broadcast cameras it can put on the road for long stretches.

Azimzadeh considers the SK-970 the only studio camera with 2/3-inch mobility and EFP handling. So it can meet the demands of often makeshift stadium facilities, while delivering the broadcast images that are needed for larger-screen multiple projection.

Since each of the four SK-970s and two SK-97s in the travelling package has complete self-contained auto setup, a separate box isn't needed. And any potential problems are confined to one head.

Although VPS earmarks two SK-97s and SK-970s for studio use, the ability to use both wherever they are needed is a welcome economy. Still, the greatest asset of the SK-97 and SK-970 is rockbottom reliability. To Azimzadeh, concerts are just like live TV—no one can afford any slip-ups, or an equipment failure.

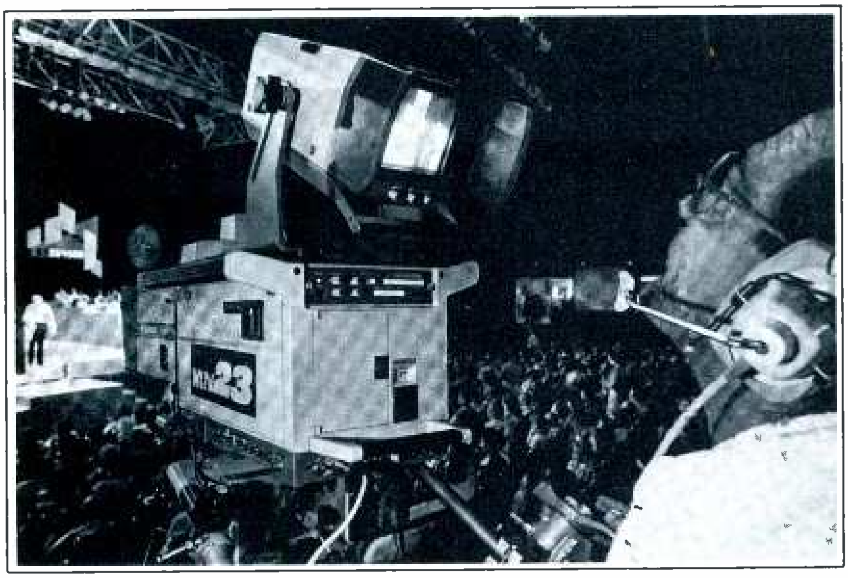


"Since each SK-97 and SK-970 has its own on-board computer, I can set everything up at the same time automatically."

Terry McIntyre, Remote Supervisor
F&F Productions, Inc.
St. Petersburg, FL

As a mobile production facility covering sports and large outdoor events for local and network TV, F&F needs broadcast quality on location.

They also need fast, independent setup. So they keep three handheld SK-97s and four compact studio SK-970s permanently stowed on one of their trucks. And with complete computerized auto setup on-board each camera, the crew can set all of them up at the same time from parameters stored in memory without having to worry about drift or last minute adjustments.



The SK-97 and SK-970 also perform superbly under low-light conditions. As a result, notes Chief Engineer Dennis Lusk, both can use very large lenses. And with real-time registration compensation automatically correcting for any changes throughout the travel of zoom lenses, the cameras are ideal for the demands of sports coverage. Resolution and colorimetry are also unsurpassed, according to Bill McKechnie, another Remote Supervisor. In fact, the SK-97 is often run by F&F as a "hard" camera, in place of the SK-970. Location recording is done on two Hitachi HR-230 1-inch VTRs.

Most important, however, is the almost complete interchangeability of both cameras. Not only are they easy to work with, but they are also easy to link up. And so similar electronically, a single set of spares can cover any potential emergency.

"The SK-97 is a real mini-cam that can be completely integrated into a total studiowide auto setup system."

Bill Weber
Vice President for Engineering
WHYY Television
Philadelphia, PA

WHYY has extensive production facilities at Independence Mall and more studios on the drawing board. To plan for this rapid growth, WHYY sought a family of broadcast cameras that was as flexibly integrated as it was advanced.

While evaluating computerized camera systems, Bill Weber and his staff found that the Hitachi SK-110 studio unit and the portable SK-97—with the same basic complete auto setup—were so perfectly matched in colorimetry and resolution that pedestal and handheld work could be combined without a hitch. And because the SK-97's auto setup is also completely self-contained, both cameras are as electronically independent as they are geared toward common console control.

Staffers like Senior Video Engineer Bob Miller consider the SK-97's auto setup easy-to-use, as well as accurate and reliable. And the on-board lens and scene files give operators instant filter and color correction at each camera head, in addition to the console. So the staff looks upon the Hitachi SK-97 as a studio camera that they can shoulder.

As facilities grow, WHYY's Weber knows that he will have the flexibility to configure and reconfigure SK-110s, SK-970s, and SK-97s to meet production requirements of most any complexity without encountering technical snags. In fact, with Hitachi cameras at other sister stations in the Eastern Educational Network, joint productions can even be assured of a common look.

For a demonstration of the SK-97 and SK-970 in your studio, contact Hitachi Denshi America Ltd., Broadcast and Professional Division, 175 Crossways Park West, Woodbury, NY 11797; (516) 921-7200, or (800) 645-7510. Canada: Hitachi Denshi Ltd. (Canada), 65 Melford Drive, Scarborough, Ontario M1B 2G6; (416) 299-5900.

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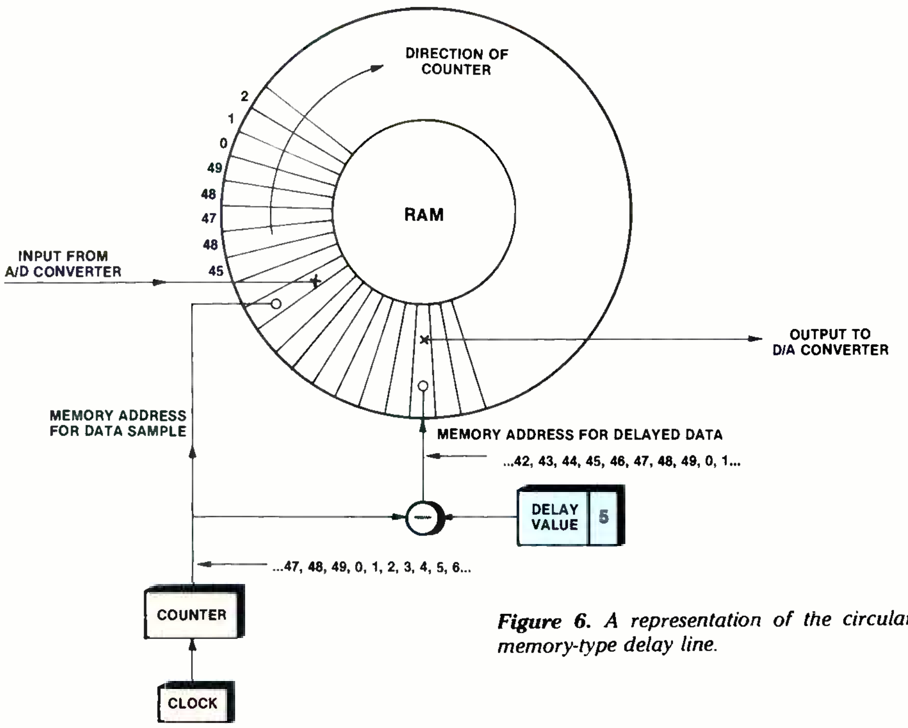


Figure 6. *A representation of the circular memory-type delay line.*

Continued from page 70

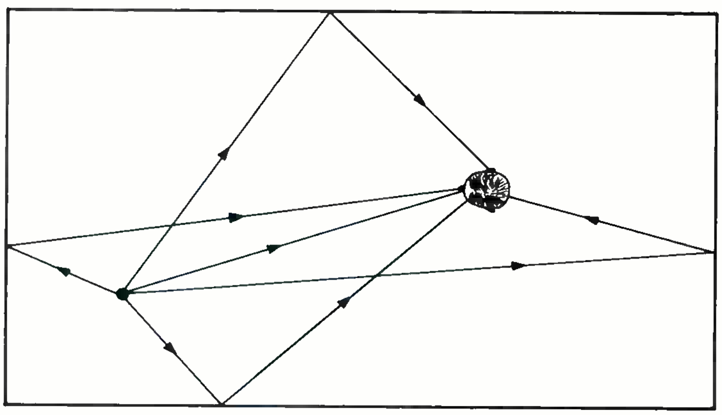
ble problems.

In most broadcast applications, the dynamic range limitations, especially clipping behavior, are noticeable. Although level-setting LEDs can help, the best cure is a delay with adequate dynamic range. Several units on the market are straight 12-bit designs. This scheme is not adequate for professional use in a system that will be called upon to handle the dynamic range of anything from a rock tape to a classical CD.

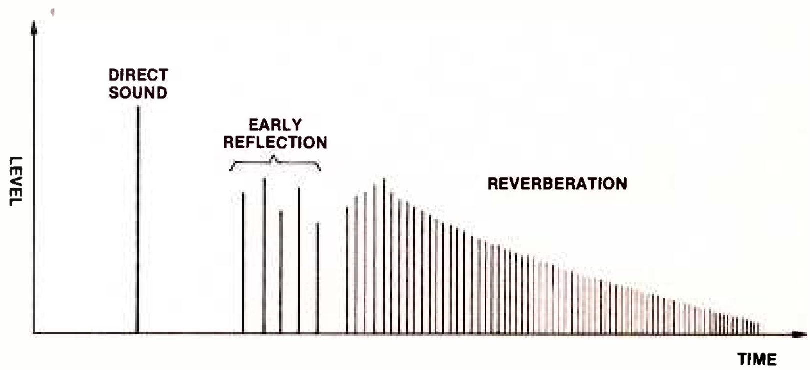
The dynamic range of digital signal-processing devices, such as reverbs, is often limited more by the number of bits used in the computations than by the converters. Artificial reverberation requires substantial computations, both multiplications and additions. (See "Sound Reverberation," below.)

If a sufficient number of bits (and, therefore, precision) is not kept in these computations, the round-off error of each calculation will add, resulting in noise. This added noise will reduce the

Sound reverberation



Two representations of reverberation signals. Above, the reflections from surfaces in a space. Below, a plotted representation of the signal content over a period of time.



The echogram, shown here, displays the basic elements of a sound in a room as heard in a typical listening position. The direct sound out of the speaker is received a short time after it is presented because of the distance between the speaker and the listener. Sound travels approximately one foot per millisecond, making this delay tens to hundreds of milliseconds long.

Another delay, the initial time delay gap, occurs between the direct sound and the arrival of the first reflection. This delay is equal to the travel time of the first reflection minus the travel time of the direct sound. Larger rooms with more distance from the listener to the walls will have a larger initial time delay gap. This is the primary determinant of the large room sound.

After the arrival of the first early reflection, several more will follow in close proximity. Their spacing, level and spectrum and the direction of arrival are important in establishing the sound quality of the room. As time goes on, the number of reflections increases and they arrive closer and closer together. The amplitude of these reflections steadily decreases with time. However, the steady increase in reflection density counters the amplitude decay in the early portion of the reverberation, causing the reverberation energy to rise first before decaying.

Reflections reaching the listener arrive from different directions, giving the reverberation a quality of fullness and spaciousness. Stereo output reverberators are an attempt to duplicate this quality of real rooms by outputting reflections randomly between the two channels. In a sound reinforcement application, these signals may be sent to speakers at opposite sides of the room to improve the diffusion of sound.

dynamic range and S/N. This is equivalent to computing interest daily with a calculator and leaving off the cents. By the end of the year, the amount could be in error by several dollars. A digital reverberator that has 16-bit input and output paths typically requires a 24-bit arithmetic circuit to avoid a significant increase in the noise floor.

Delay architectures

The simplest way to construct a digital delay is to convert the incoming signal to a digital format and feed it into a shift register. (See Figure 5.) As each new sample is taken, the old ones are shifted down the chain of memories, similar to the way a bucket of water progresses along a fire brigade.

Because the sample rate is fixed, the number of cells in the memory determines the time it takes to send the signal sample through the delay. Modulating the clock frequency modulates the time delay, making effects such as flanging possible.

However, changes of more than a few tens of percent run into bandwidth or aliasing problems. Switching memory elements into the chain lengthens the delay; tapping off earlier shortens the delay. Switching delay elements in and out during operation results in large chunks of missing or discarded data. This creates obnoxious audible defects, including clicks and missing sounds. This approach was used in early delay units and is well suited to fixed installations, which do not require delay adjustment during operation.

More recent delay units employ what is commonly called a *circular memory* architecture. Each new sample is placed into memory at the next higher address than the previous sample. (See Figure 6.) When the highest memory location is reached, the bottom location is used. The existing sample location then travels a circular path through the memory addresses.

If a delayed version of the signal is desired, the delay value is subtracted from the current sample location, yielding the address for the delayed signal in memory. If the delay is varied, there will always be data to fill in the output samples. If delay variations are made slowly, they may be inaudible, except for a slight speedup or slowdown. This allows functions such as flanging and time correcting to be performed at fixed sample rates.

If additional delayed outputs are desired, they can be read from the appropriate place in memory with an additional subtractor. An infinite repeat function may be obtained if new values are not written into memory.

In practice, the address of the current sample is decremented, rather than incremented, through memory. The delay is obtained by adding the desired value to the current sample address because the logic is easier to implement. Microprocessors have only recently achieved the capability to perform the necessary computations in real time. Therefore, many units on the market still rely on hardware logic to perform the addressing, though a microprocessor may be controlling the panel display.

The cost of memory ICs has decreased dramatically in the last few years, primarily because of the huge market for ICs in personal computers. The cost of a 256K RAM today is about the same as a 16K RAM five years ago. The price of delay lines is limited by the cost of the A/D and D/A converters. The cost of making a 2-second delay is no more than for a 200ms delay.

Full bandwidth digital delay systems were rare several years ago. Manufacturers were full of justifications for delays not needing to be as good as the undelayed signal. The main reason was, of course, that 16-bit A/D converters fast enough to pass a 20kHz signal were expensive, and that twice the bandwidth required twice the RAM.

With the rapid acceptance of the compact disc player, the cost of 16-bit audio A/D and D/A converters is also declining rapidly. There are now several delays that offer wideband operation at

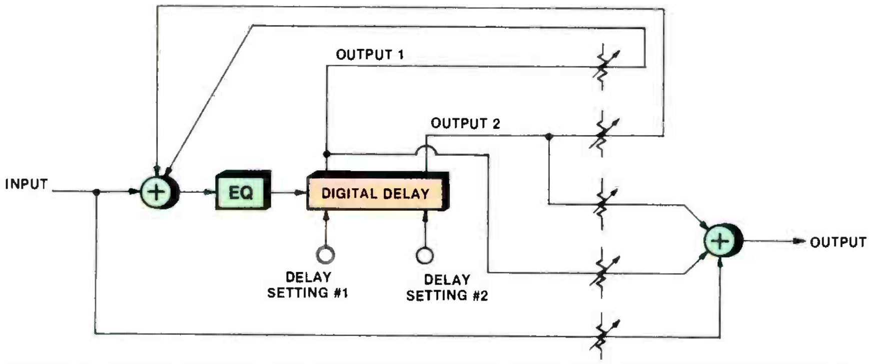


Figure 7. A block diagram of a digital reverberation device with analog signal processing.

competitive prices. In light of this, it is reasonable to expect the cost of a quality digital delay system to be comparable to a ⅓-octave EQ unit in the next few years.

Modern techniques

Early digital reverberation and effects units, and some on the market today, performed their effects processing in the analog domain. (See Figure 7.) Although this approach is inexpensive, the successive A/D and D/A conversions can add considerable noise and distortion. Because the number of discrete delays available is limited by the number of simultaneous D/A conversions, the sound quality of the reverb can be poor.

The preferred approach to generating digital effects, and the one used in a few high-quality reverbs, is to perform all processing in the digital domain. (See Figure 8.) The samples are inserted into a

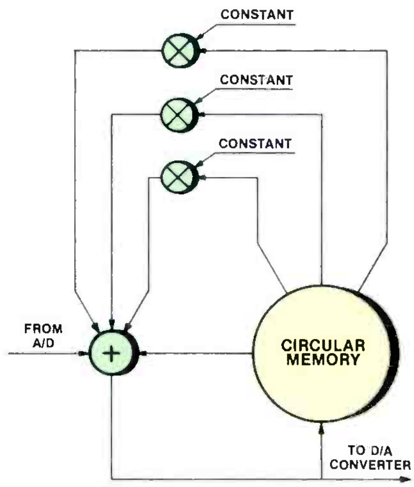
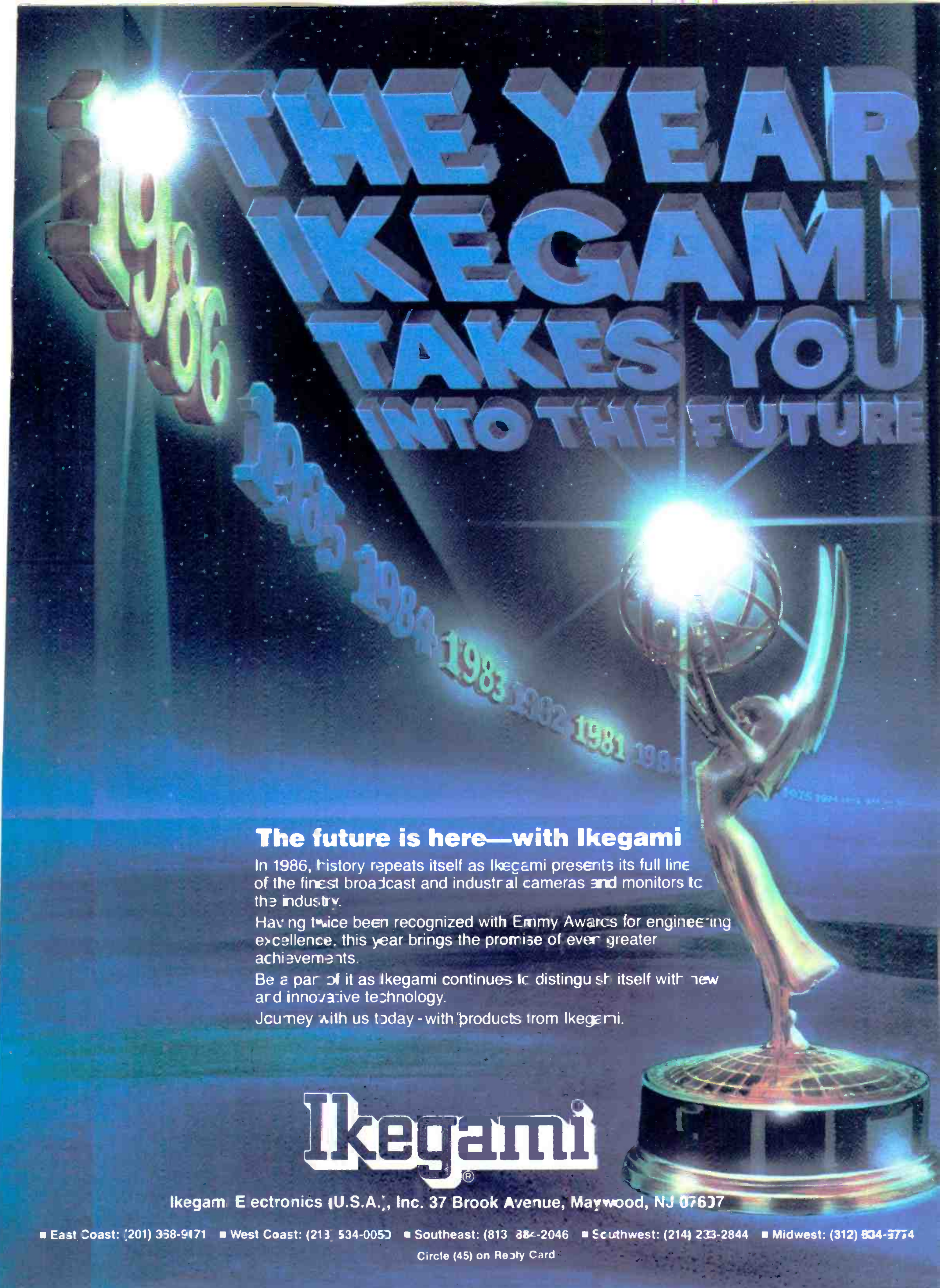


Figure 8. A simplified digital reverberation device block diagram.

circular memory along with the necessary delayed samples as they are taken. Each delayed sample is multiplied by an appropriate scale factor representing the amplitude of that particular reflection. The reflections are added together to obtain the reverberation, which is then put back into memory. In practice, the designer tries to use scale factors that are fractional powers of two (½ and ¼, for example) to simplify the multiplications. A truly natural-sounding reverberation requires that many reflections be multiplied and added, placing speed restrictions on the hardware.

Various techniques have been reported in technical literature for improving the sound quality of reverberation. These techniques differ in the number of delays recirculated and the placement of the recirculation path in the overall architecture. Simply mixing some of the output signal back in with the input, as described previously, will create a credible-sounding reverb even with a small number of delayed samples used in the calculation. Hardware designed to implement one of these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reverberation schemes involves digital adders, multipliers and delay elements. These could be wired in the right manner to implement the computations. If another architecture was desired for a different sounding effect, changes would be required.

Computer-controlled effects

Rather than limit the system's flexibility in this way, designers have sought a universal approach to digital effects and signal processing. (See Figure 9.) The computation circuits are centralized in a general-purpose computer. One memory is used for data storage and another for program storage. The memory is circular, as described previously, keeping the last second or so of data loaded into it. The input samples are placed into memory by passing through the multiplier/adder. The computation circuits are directed by commands from the program memory. As the program counter steps through the program memory locations, commands are sent to the CPU. The program usually consists of three simple commands repeated many times over in different combinations. One command retrieves a data value from memory, and another command multiplies a data value with a constant and adds it to the result of the last computation. The last command stores this result in memory. The product of these computations may also be sent to the D/A converter(s).

The program memory may be a ROM (a chip with software permanently inside) or a RAM that is loaded by a conventional microprocessor. In the latter case, the user can set various parameters from front-panel controls and the microprocessor will change the program RAM appropriately. Changes to the microprocessor operation can also be supplied as user-changeable ROMs, allowing complete update of the product.

Additional functions can be created with a digital reverberation unit, including phasing, flanging, echo-plate simulation and spring simulation. Programmable digital signal-processor units have the capability via software modification to create all of these effects and more. Once the hardware has the capability to multiply and add samples together in real time under control of software, the possible features are only limited by the user's degree of creativity and the speed of the arithmetic.

Consider just how fast this arithmetic can be. The typical devices in use can multiply two 16-bit numbers and add the 32-bit result to the previous 32-bit result in 200ns. This works out to five million multiply/add operations per second, or approximately 100 calculations per audio sample period. Some devices can improve on this time by as much as a factor of two, but this requires state-of-the-art equipment.

This means that the algorithm or process used for the effect must not require more than 100 operations or the processor will not complete its work in time for the next audio sample. Some manufacturers have lessened this problem by making complex effects operate at a reduced bandwidth. However, intelligent programming of the device allows most functions to be accomplished within these limitations.

Sifting through specs

The first thing to note in a digital delay or signal processor is the bandwidth. Some manufacturers of signal processors prominently specify bandwidth of the direct signal path but bury the delayed signal bandwidth. Also be sure there is no interaction between maximum delay and bandwidth. This was common on earlier units but is less common today.

Take a close look at the specified S/N and any statements about the number of bits. Is the S/N approximately 6dB times the number of bits? If it is higher, the unit may be using some compression/expansion technique. If it is lower, it may be an indication that the internal signal processing is losing dynamic range. Doublecheck this by looking at the noise floor spec and the output clipping level spec. These should add up to the S/N spec. If there are separate specs for different operational modes, such as delay and reverberation, check the one for which you plan to use the device.

If possible, check the distortion as a function of frequency. Some A/D converters, sample and holds, and anti-alias filter topologies are known for generating large amounts of slewing distortion (TIM). This will show up in high-frequency THD+N or high-frequency 2-tone IM distortion measurements. High-frequency THD+N tests will also show any aliasing distortion; there will be a sharp rise in distortion near one-half the sampling frequency.

If the operational requirements of the application are such that delay may have to be adjusted during use, make sure that this can be done without audible side effects. Commercial profanity delays have been designed with this in mind, but there may be some multipurpose units out there that aren't clean. Similarly, make sure the range and resolution of the adjustment suits the application.

The usual cautions about balanced I/O, RFI, reliability and so forth apply to digital devices as well. They are interfacing to an analog world and the requirements are the same as those on a crossover or equalizer.

The future

Significant price cuts are likely on all digital signal-processing devices. Delays may well become as common as ⅓-octave EQs. Simple reverbs that use a digital delay and recirculate in the analog domain should have similar reductions in price. Complex, programmable digital signal-processing units will probably remain expensive until more companies learn how to design and program the processors.

The improving naturalness of digital reverbs will allow more use of them on normal program material and announcer lines. Live studio performances can be picked up with a minimum of room reverberation (and noise from sources such as cameras) and later sweetened with the reverb.

Digital equalization units are on the horizon, and should be on the market in a few years. The technology exists for automatic room equalizers, which measure the response of the system with the normal program material and make the necessary adjustments as the audience changes. Because the hardware would already be included, such a unit could provide a display of the program spectrum in much the same way as a real time analyzer. This device also could be used to help keep a consistent sound from a radio or TV station, regardless of source limitations.

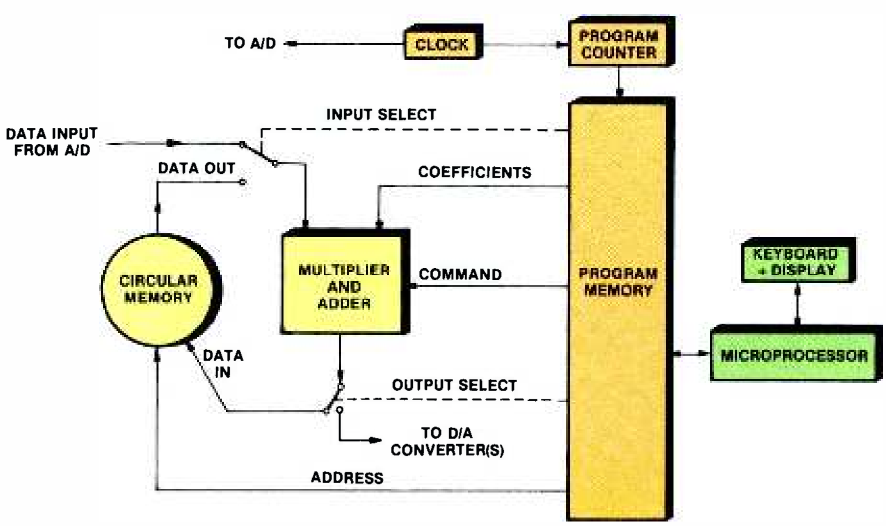
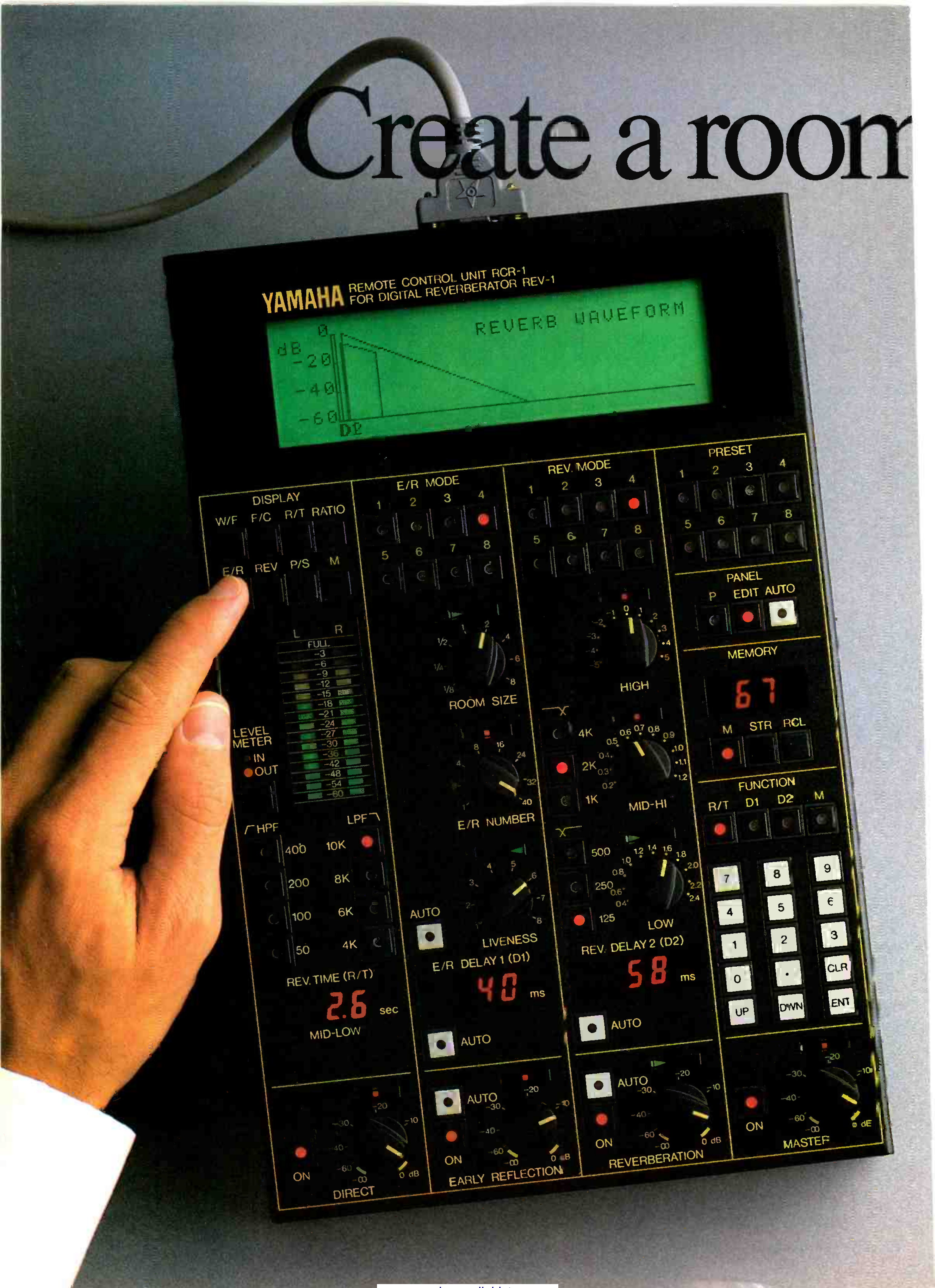


Figure 9. *A block diagram of a digital signal-processing reverberation unit.*

Create a room



with a view.

We'd like to open your eyes to the incredible REV-1 digital reverb. Because it gives you unheard-of control over virtually all reverb parameters. And something that has never been seen in any type of reverb: the capability to "look" at the sound as well as hear it.

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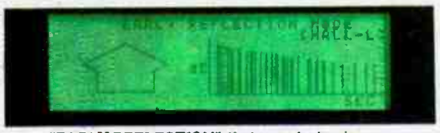
The remote also contains 9 additional RAMs so you can store programs and carry them with you to use anywhere there's an REV-1.

And there are 30 additional ROMs with factory preset sounds. Many of which can be completely edited (as can the user-programmed sounds) by using the LEDs to tell you the set value or indicate in which direction to move the control so you can easily and precisely match the value of the originally programmed sound.



"EARLY REFLECTION" display mode showing room size and relative level and time of discrete reflections.

"REVERB DENSITY" display mode showing level and relative time of subsequent reverberation.

"REVERB TIME" display mode showing difference in reverb time in each of four frequency bands.

"MEMORY TITLE" display showing the titles of internal ROM memories.

And the sound itself is far superior to any other digital reverb. The REV-1 uses specially developed Yamaha LSIs to create up to 40 early reflections and up to 99.9 seconds of subsequent reverberation. So the effect can be as natural (or unnatural) as you want it to be.

We could go on about the REV-1. Tell you about its 44.1 kHz sampling rate that provides a full 18 kHz bandwidth to prevent the natural frequency content of the input signal from being degraded.

How it has a dynamic range of more than 90 dB for the delay circuitry and more than 85 dB for the reverb circuitry.

But why not take a closer look at the REV-1 at your authorized Yamaha Professional Audio Products dealer. Or for a complete brochure, write: Yamaha International Corporation, Professional Products Division, P.O. Box 6600, Buena Park, CA 90622. In Canada, Yamaha Canada Music Ltd., 135 Milner Ave., Scarborough, Ont. M1S 3R1.

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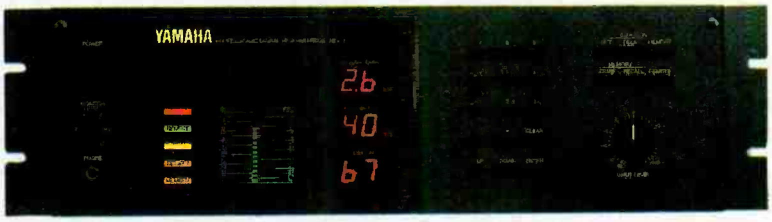

Circle (48) on Reply Card

Audio time base correction

By Brad Dick, radio technical editor

Preserving monaural compatibility is what audio time base correction is all about.

Today's monaural broadcasters soon will be faced with finding solutions to problems they never knew existed. An example might be the TV engineers, faced with the prospect of converting facilities to stereo production and operation. When operating in monaural, engineers may have been able to produce acceptable audio with little effort. Stereo operation, however, creates new situations that must be dealt with if stations are to broadcast quality audio. The added channel of audio is not the problem. The difficulty typically centers on maintaining the proper phase relationships between the two channels.

Studio problems

The marketplace readily accepts (and even expects) that broadcasters will produce the same audio quality that digital compact discs and high-fidelity videocassette recorders are capable of producing. Unfortunately for broadcast engineers, many stations are still relying on old, perhaps outdated, technology when it comes to the reproduction of audio signals. Reel-to-reel and cartridge equipment in the typical broadcast station may be several years old. In the production of monaural programming, the performance of this equipment may be acceptable, but stereo operation places additional requirements on it.

Engineers often expend considerable effort correcting amplitude problems in the broadcast plant. Equalizers, noise-reduction equipment and other devices are used to correct audio problems after the fact. Although acceptable in some instances, such techniques cannot solve the phase-related audio deficiencies that are common with reel and cartridge machines.

Wow and flutter and tape head azimuth errors can produce significant time- and phase-related distortion. These two problems are the primary causes of phase-related errors within the studio.

Transmission problems

Even if you are successful in maintaining adequate performance from your studio equipment, a completely new set of problems can develop when the signal leaves the station or studio. STL systems, satellite links, microwave relays and telephone lines affect the quality of the received audio signal. The types of problems generated by these links usually fall into three categories: channel-to-channel phase-dispersion errors, channel-to-channel time delay errors and channel phase reversal. Let's look at each of these kinds of external errors.

Phase errors

The transmission of any signal through any medium creates a phase shift in the reproduced signal. This phase shift is caused by two factors. The first is the delay caused by the medium itself. Any medium passes signals at a speed somewhat less than the speed of light. Links associated with audio, such as common shielded twisted pairs, have a velocity factor considerably less than one. This means that the signal is

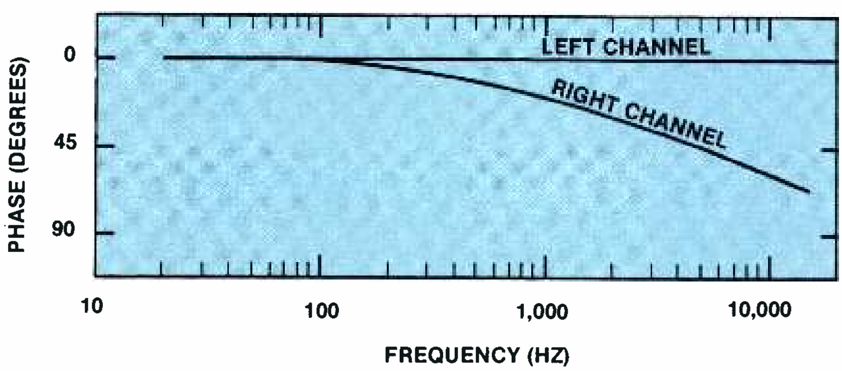

Figure 1. *Many factors can affect the phase relationship between two channels of audio. In most cases, as the frequency increases, so does phase error.*

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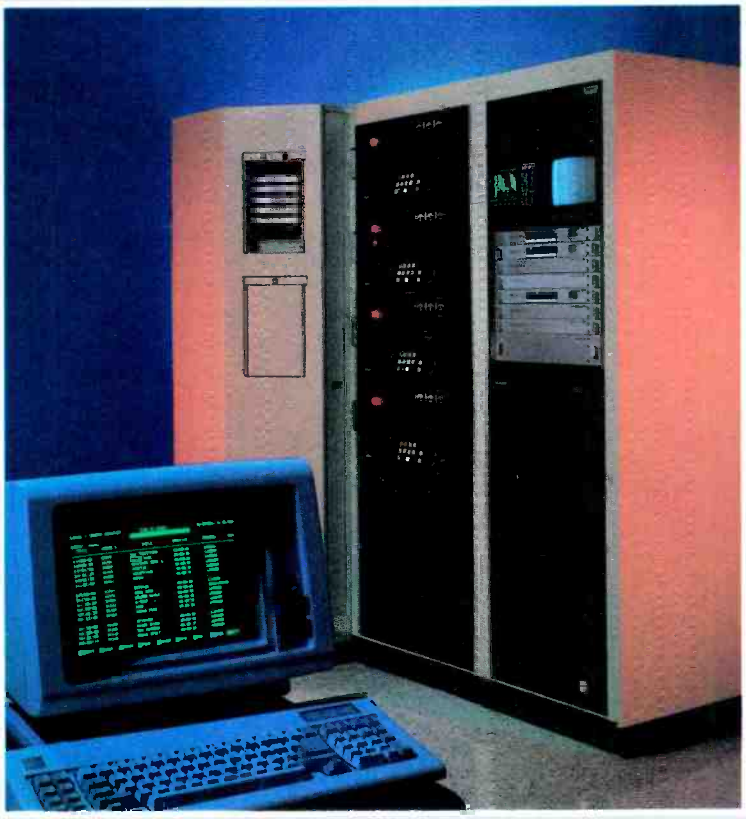

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delayed as it passes through the medium. In most cases with audio links, the medium is frequency-sensitive. In other words, as the frequency increases, so does the delay.

The second factor that causes phase shift is the restrictive bandwidth of the link. All links can be modeled as a filter. Filters, by their nature, require phase shift to roll off the undesired signals. The combination of a phase-shifted and amplitude-shifted signal with the direct signal produces a filter type of response for any given type of link.

Real-world audio interconnecting links typically have a bandwidth of no more than twice the maximum allowable audio frequency, and velocity factors of approximately 0.5. This is true even for microwave and satellite links. Such systems also require uplink and downlink filtering, decoding and processing to limit the bandwidth and to prevent adjacent channel frequency-domain and time-domain interference. Digital systems are particularly prone to these types of errors. Anti-aliasing filters are required, and the longer-than-usual time delays through the digital-to-analog data conversion add to the phase problem.

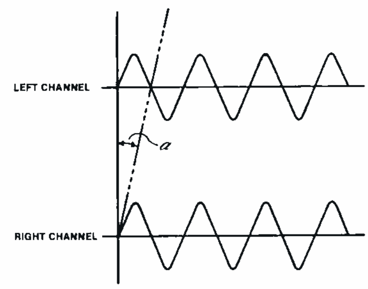

Figure 2. *These signals represent the output from a stereo recorder. The interchannel delay of 180° represents a worst-case situation for any desired monaural signal.*

This kind of error is called a phase-dispersion error. In stereo transmission, phase dispersion becomes a serious negative effect because the dispersion is not identical in both channels. Using the left channel as a reference, Figure 1 shows a typical phase difference of the right channel with increasing audio frequency. This phase difference may be attributable to not only the medium of the audio link, but also may originate from encoding, decoding, filtering, equalizing and other processing stages for the left and right channels. When these audio channels are combined, the resulting mono signal can be greatly degraded.

Time errors

Satellite, microwave and telephone audio links can have significant channel-to-channel time delay errors. Multichannel digital audio systems are also prone to this type of error because of the conversion processes involved. The most common type of time error exists with stereo tape head azimuth misalignment. The signals shown in Figure 2 represent an interchannel time delay of 180°. This type of delay is not uncommon for higher frequencies on tape and cartridge equipment. If these signals were combined to create a monaural signal, theoretically, no audio would be present.

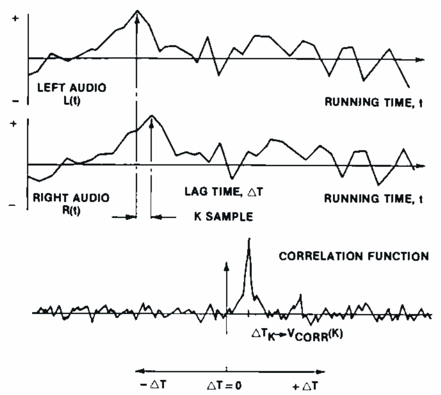

Figure 3. *The upper graph represents the left and right signals to be analyzed. The lower graph represents the output voltage from the cross-correlator corresponding to delta T.*

Phase reversal

Any engineer who has been involved in the production or transmission of

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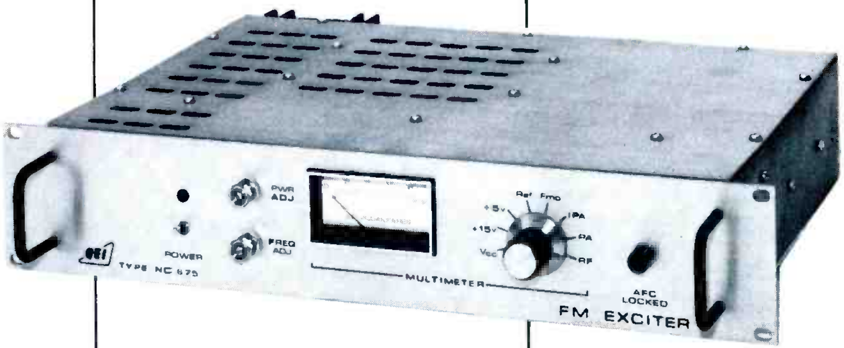

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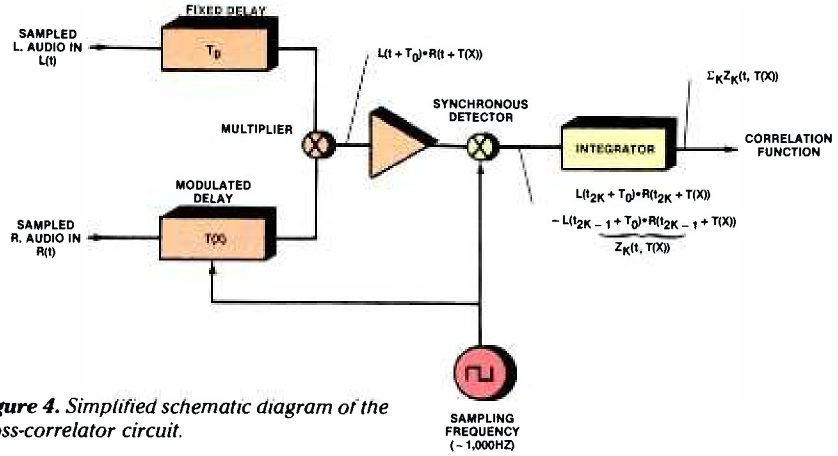

Figure 4. *Simplified schematic diagram of the cross-correlator circuit.*

stereo programming has probably been the victim of phase reversal. The delivery of stereo audio adds a new dimension of complexity to transmission systems. Keeping track of changing program events, multichannel mixing and a myriad of audio parameters increases the chance that a phase reversal may occur somewhere in the program's delivery. A phase reversal, of course, means that the L+R signal will be significantly degraded. In a worst-case situation, there will be *no* L+R signal.

We can now see that there are many opportunities for phase (delay) errors to develop in the left and right channels of audio. The first task for the engineer is to eliminate as many potential sources of error as possible. Proper maintenance will help prevent many of the problems we have discussed. However, given the state of broadcast technology and the potential for human error, we know there exists the opportunity—even the likelihood—that phase errors will occur at some point in time. What can you do about this?

Time base correctors

There are at least two common methods available to correct phase differences between two audio channels. Devices that accomplish this feat are commonly referred to as time base correctors, or TBCs. One method requires that a reference signal be encoded along with the two channels of audio. The reference phase signal is encoded on both channels of the recording medium. Prior to transmission, a decoder circuit analyzes the phase of the reference signals measured between the two channels of audio. Any difference is viewed as an error, and a digital delay circuit delays the leading signal until the reference signals match properly. This method requires both encoding and decoding for proper operation.

Cross-correlator

Another phase-correction method does not require any encoding signals. A special circuit is used to analyze the phase and amplitude relationships between the left and right signals and to make the proper adjustment. For two signals, L(t) and R(t), the degree of signal coherence is given by the average cross-correlation function defined as:

$$Z(\text{Corr. Fcn}) = \frac{1}{T} \int_{0}^{T_1} L(t)^{*}R(t+\triangle T)dT$$

This function precisely defines the extent to which the two signals are related to each other in both phase and amplitude. For non-coherent, random signals, the correlation function averages to identically zero for all values of delta T. However, for signals showing any

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degree of coherence, the average value over some sampling interval will yield a non-zero result. A common use of electronic cross-correlators is the identification of weak signals in the midst of a high degree of receiver noise, such as in the reception of signals from deep space probes.

Two signals, L(t) and R(t), feeding a cross-correlator will produce an output that is a function of relative time difference (lead or lag time). For two channels of a stereo signal showing some degree of coherence, the correlation function might look similar to the depiction in Figure 3 (page 86).

Circuitry exists that will quickly find the value of delta T, the maximum value of the correlation function, for two audio signals. The method involves finding the maximum value of the function by computing its first derivative. A block diagram of the cross-correlator is shown in Figure 4. The first derivative scheme uses a traditional synchronous modulation and demodulation lock-in of phase. The synchronous reference modulation is 1,000Hz, which produces a correlator sample every millisecond. This is an adequate sample rate for audio signals.

The cross-correlator has the capability to discriminate between a systematic time/phase error and normal phase fluctuations in stereo music material. The detection of phase error by other common schemes, such as zero-crossing or linear phase, may result in the sensing of music-related phase effects. By taking the average of a first derivative of a multiplied L(t)*R(t) signal, music phase fluctuations are not detected and only the component representing true coherence is analyzed.

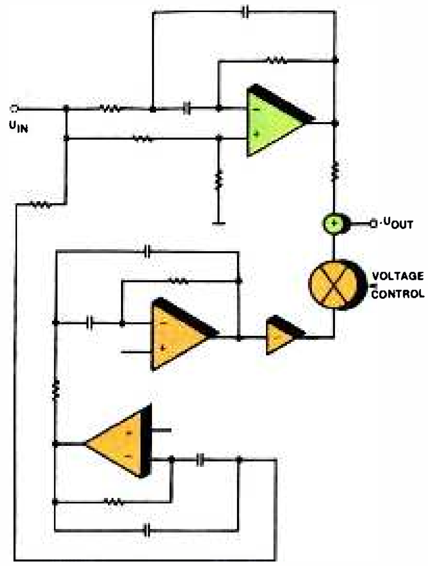

__Figure 5.__ One key to the cross-correlator circuit is the 4-pole voltage-controlled time delay network. The output audio passes through only the top amplifier.

A schematic representation of the network used in the left and right channels to be phase- and time-corrected is shown in Figure 5. The audio signal passes through only one amplifier (the top amplifier) for all values of phase shift. As the voltage control increases, a 4-pole band-limited audio signal is fed forward and summed at the output. Amplitude response is automatically normalized, but the time delay of signal harmonics is shifted relative to signal fundamentals. The circuit then emulates a time-delay network using all-pass phase-shift circuitry. There is virtually no signal degradation because of the nature of the feed-forward technique.

The cross-correlator phase-correction system (see Figure 6) is a successful electronic solution to the problem of systematic phase error between the left and right channels of a stereo audio signal. It provides a stable, time-aligned output and automatically compensates for channel-to-channel phase dispersion for optimum combining, either spatially by stereo loudspeakers, or for monaural compatibility. No other audio parameter is affected.

It is worth noting that this method is also compatible with phase error-correction schemes that require reference or subcarrier tones, which will be described next. The cross-correlator technique reads tones and subcarriers contained in the audio channels and uses this signal (along with the program material) in applying phase correction.

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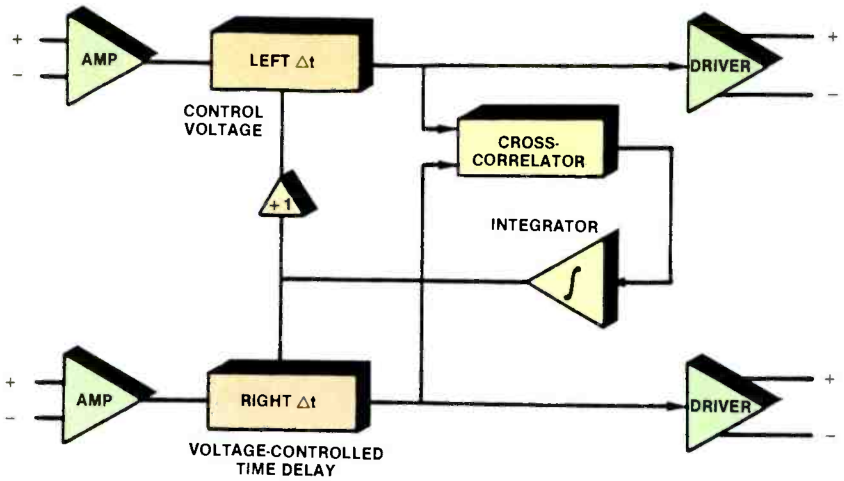

Figure 6. *Block diagram of a functional cross-correlator TBC.*

The only requirement is that the tones and subcarriers be sent in phase, a generally true initial condition.

Digital delay

In addition to the cross-correlator technique, another method can be used to reduce phase problems. This system requires both an encode and decode process with a high-frequency pilot signal recorded on both tracks of audio. With a stable phase reference in each channel, it is possible to delay the audio to compensate for any phase errors that may develop.

When the tape is decoded, the original phase reference signal is detected and used to adjust the delay of one of two variable digital audio delay lines. The delay line audio outputs are held in strict time alignment by the use of feedback, eliminating mono sum losses. A block diagram of the digital delay decoder is shown in Figure 7.

Modulated pilot

Because phase errors often exceed 360° at 19kHz, the pilot carrier is amplitude-modulated with a low-frequency 300Hz tone. The 300Hz modulation is envelope-detected and used as a phase reference, thereby eliminating any detection ambiguity.

The 300Hz modulation is used because it is high enough in frequency that phase detection can be accurate and sensitive, yet low enough that the lower sideband of the pilot remains inaudible.

The pilot amplitude is set at a level that does not cause audible signal-to-noise ratio degradation because of modulation noise. On most tape formulations, this level is 27dB below 250nW/m fluxivity.

Digital processing

In addition to the pilot signal that is added to the left and right audio channels, there must be some method of delaying the audio if the phase error is to be eliminated. The digital TBC (Figure 8) uses 16-bit linear analog-to-digital converters with a sampling frequency that hovers near 78kHz. This high sampling frequency allows the use of gently sloping anti-aliasing low-pass filters with a fairly high cutoff frequency.

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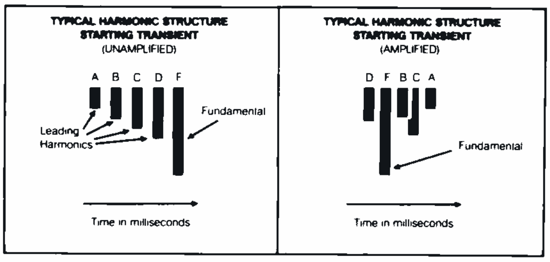

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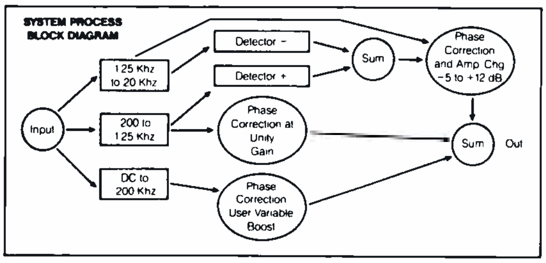
Applied to a signal just prior to transmission, the 202R puts the sparkle back into broadcast sound. We like to think of it as the "unprocessor." Rather than artificially altering the original source, BBE restores the natural harmonic balances that were present in the live performance. How? First it divides the audio spectrum into three bandwidths. Then it applies phase correction across the full spectrum and dynamic high frequency amplitude compensation as required. BBE's continual sampling of the mid/high frequency relationship allows this correction to take place automatically. Convenient front-panel controls let you boost low frequencies and regulate the amount of high frequency amplitude correction to suit your needs.

The BBE 202R is easy to install with either standard XLR or ¼" connections, balanced or unbalanced. And because BBE is *not* an encode/decode process, there's no need for special playback equipment. Anyone with an AM or FM receiver can hear the amazing difference BBE makes. On-the-air tests have proven BBE's compatibility with the type of compression and limiting equipment normally used in broadcast. And by curbing phase and amplitude distortion, the BBE 202R increases the *apparent* loudness of your signal. Your broadcast comes through strong, clean and clear.



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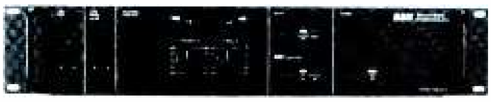

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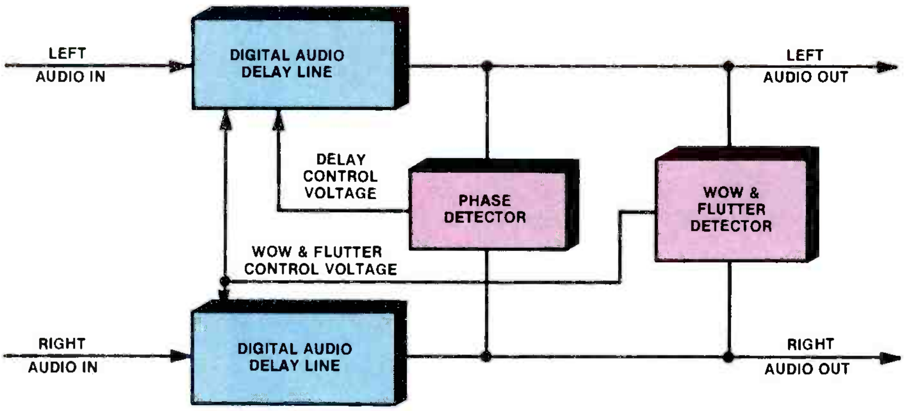


Figure 7. *Simplified block diagram of a digital TBC.*

A/D converter outputs complementary offset binary data words to a 16-bit-wide 2K-byte random-access memory. The memory address is incremented after each complete conversion. The system creates an overall maximum delay of approximately 27ms, which can be continuously varied by changing the clock frequency. The D/A converter is followed by a de-glitcher and anti-imaging low-pass filter, which reconstructs the original input waveform.

Pilot detection

The digital TBC requires a sophisticated detection circuit to properly detect the 19kHz pilot signal. Each delay line output is first high-pass-filtered with a second-order 15kHz HPF, removing unnecessary low-frequency information. The signal is then applied to an AGC amplifier with 15dB of gain control range and strong hysteresis. The pilot level can be as low as 15dB below nominal level and still be detected.

When the pilot is detected in both channels, the AGC threshold is lowered an additional 10dB, producing a strong hysteresis effect. The AGC amplifier output is bandpass-filtered at 19kHz with a cascaded second-order bandpass filter. At this point, the pilot signal is now amplitude-stabilized and heavily filtered. The 300Hz AM modulation is envelope-detected, then bandpass-filtered to remove any residual 19kHz carrier.

The absolute phase difference of the 300Hz pilot modulation is detected with a sensitive zero-crossing phase detector. The control voltage from the detector is used to vary the clock frequency, thus the delay of one of the two digital audio delay lines.

The feedback loop developed within the system forces phase and time alignment between the left and right channels. The system can correct to within 8µs of absolute delay, well below the threshold of audibility.

Wow and flutter

Wow and flutter, along with tape head azimuth errors, can produce significant time- and phase-related distortion in tape recorders and cartridge machines. One advantage of the digital TBC is that it can help to correct wow and flutter errors.

The wow and flutter signals manifest themselves as frequency modulation of the desired program signals. The TBC corrects for this error by detecting the frequency modulation of the pilot signal. The pilot signal is FM-detected with a 19kHz PLL. The PLL output represents the characteristics of the wow and flutter components on the tape. This PLL voltage is used to simultaneously vary the clock frequency, thus the delay of both left and right delay lines, as shown

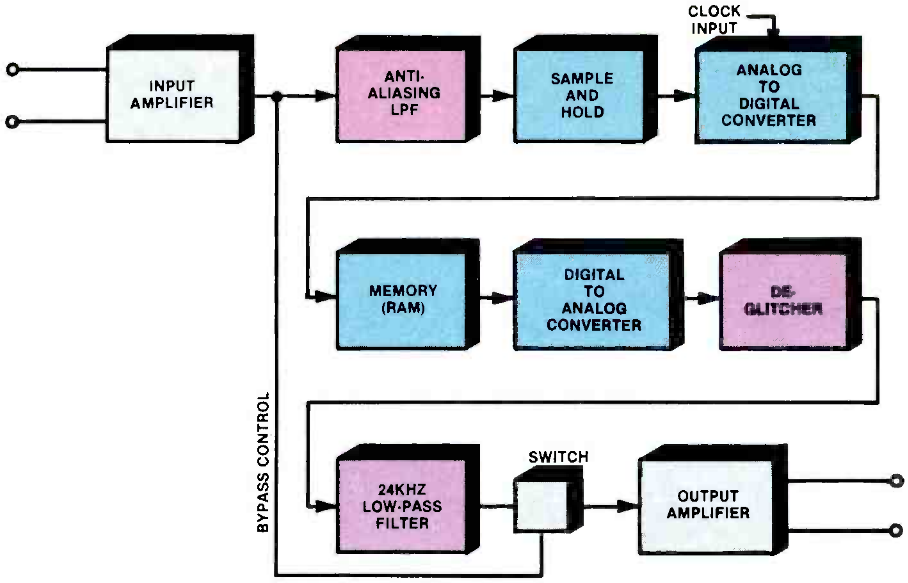


Figure 8. *The audio path for a digital TBC includes filters, storage and A/D and D/A converters.*

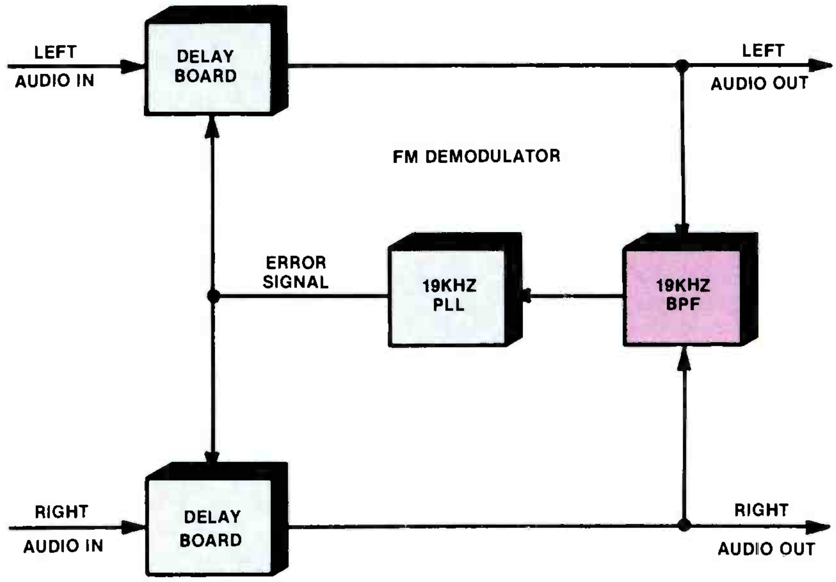


Figure 9. *The digital TBC can correct for wow and flutter errors as well as for interchannel time errors.*

in Figure 9. This process results in a reduction of wow and flutter in the audio signal.

Select a system

With the digital TBC, one encoder is needed for each tape machine used for recording material. Once the pilot tones are recorded on the tape, high-speed duplicators can be used to generate copies of the tapes. The decoder will then correct for the cumulative delay error and wow and flutter caused by any intermediate machines.

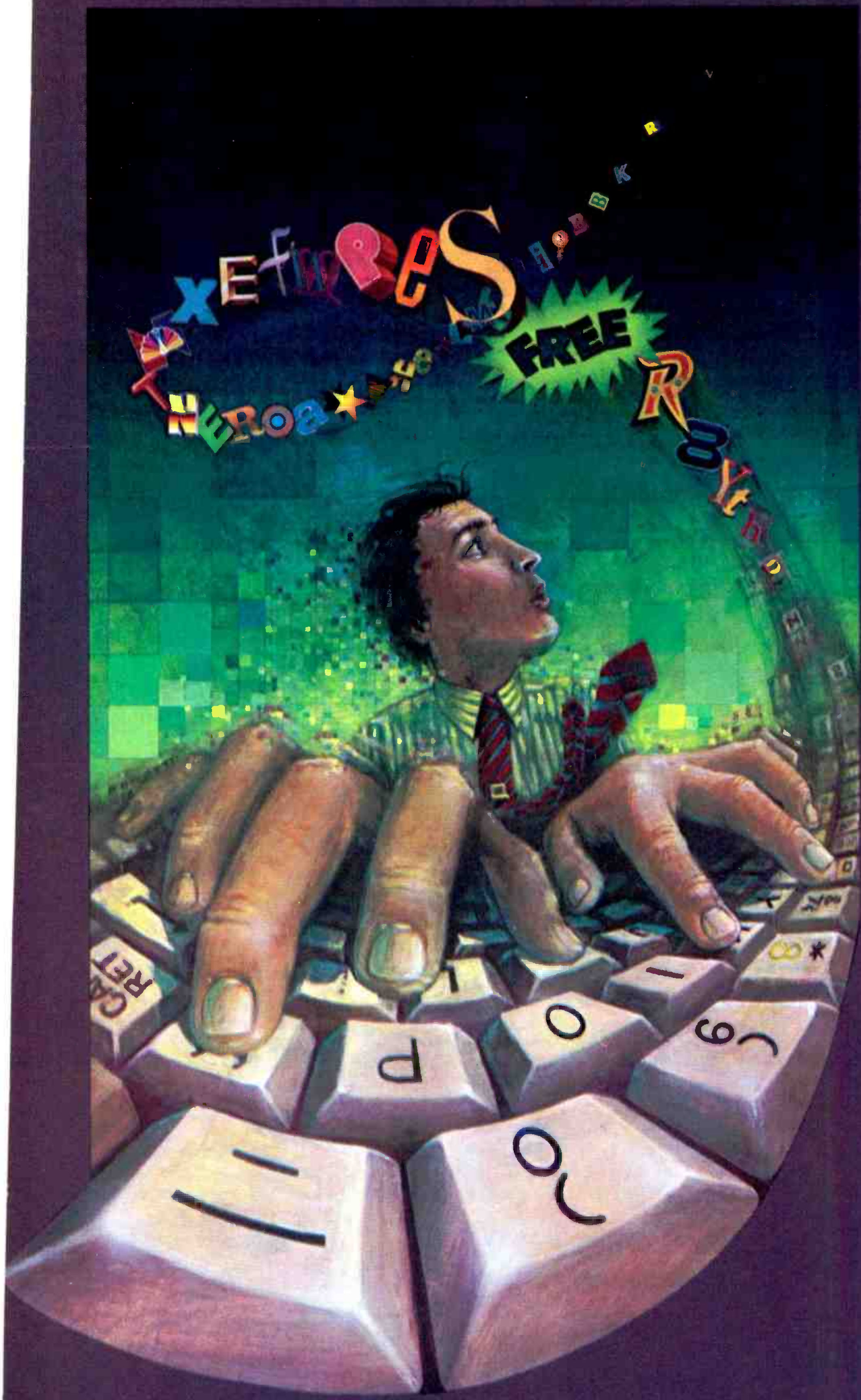
The decoder automatically switches from bypass to operate when encoded tapes are detected. Correction is applied only if valid pilot signals are detected. Action is frozen during dropouts and splices, eliminating the possibility of side effects.

One decoder is needed for each on-air facility. Ideally, decoding takes place at the transmitter plant, just before the audio-processing equipment.

The cross-correlator system of phase correction does not require encoding or pilot tones. As in the digital system, however, one decoder is required prior to the transmitter.

The particular method employed to correct phase errors is perhaps less important than the recognition that phase errors exist. Each of the correction methods discussed have unique advantages and disadvantages. The users must decide which method is appropriate for a particular application.

Editor's note: Background information for this article was obtained from *"Stereo Phase Error-Correction and Automatic Phase Correction Using an Audio Cross-Correlation Technique,"* a paper presented at the 1985 NAB Engineering Conference, by David A. Howe; and *"A Digital Audio Time Base Corrector for Linear Magnetic Recording,"* a paper presented at the Ohio State Broadcast Engineering Conference, by Thomas J. Rosback.



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Lake Systems LA-KART

By Ken Koepka

The Lake Systems LA-KART is a multicassette playback system with an established history of reliable performance in a variety of configurations and applications. The system can be used with any of the popular videotape formats, in any combination, including ¾-, 1- and ½-inch. This eliminates any constraints on the lengths of program segments. The unit's flexibility permits the system to be used for program automation, as well as for the more common station break and ENG applications.

For economy, the LA-KART system at KATV is built around 10 VP-5000 players. A spare machine is also available if needed. Tapes are prepared on a BVU-800 in the videotape center. As many as 70 individual segments can be recorded on each tape. For example, the several versions of a commercial for a movie that plays in different theaters may be recorded on a single cassette rather than tying up half a dozen cassettes with redundant material.

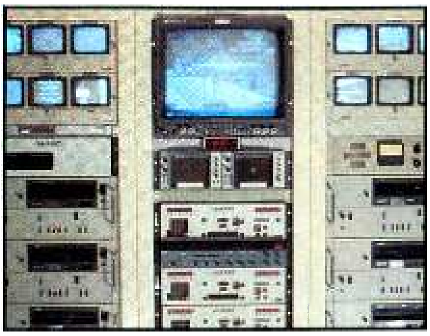
Segments are located by means of a directory recorded at the head of each tape. The directory consists of the reel number and segment *in* and *out* timecode locations. As soon as a tape is inserted into a machine, the system rewinds it, reads the directory and cues the appropriate segment. Physical identifiers, such as bar codes, are not used.

At first, we wondered if the ¾-inch tape format would be satisfactory to advertisers. However, we found that the optional component time base correction and enhancement feature offered by Lake Systems easily satisfied advertising agencies. The LA-KART was installed in July 1983, and gradually replaced a manual quad operation that required a full-time director in addition to tape and audio operators. The system is now used for all commercial breaks and syndicated programming. It uses standard, off-the-shelf videocassette or type C players or recorders. It can also interface to audio recorders.

A communications interface must be installed for each tape deck to provide machine control via the Z80 bus in the system interfaces. The communications modification is tailored to the inherent capabilities of the particular host recorder or player and enhances those capabilities as needed.

In the case of the VP-5000, the modification adds component video output, remote eject, cassette status com-

Koepka is chief engineer of KATV, Little Rock, AR.



Performance at a glance

- *Provides automated control of station breaks and normal programming*
- *Relieves operators from the task of loading tapes for each break*
- *Reduces make-goods by using computer-controlled tape machines to automate breaks*
- *Interfaces with most video and audio recorders*
- *Can be programmed by the traffic department or master control operator*
- *Offers full control of the tape machines from the operator console*
- *Multiple spots per tape*

munication and *long pause* (tape loosely wrapped around the heads). The modification does not affect a deck's normal operation in any way, and the recorders may be used for conventional recording or playback operations. No special alignment procedures are required when decks are added to the system.

Machine control

There are two levels of control in the system—machine control and system control. Each pair of recorders is serviced by a machine interface, frequently referred to as the *tributary* or *trib.* In addition to machine control (*fast forward, search,* etc.), the interfaces can read and write both VITS and longitudinal time code, locate and cue tape segments, write the directory at the head of a tape, and communicate machine status to the main terminal. This terminal is actually the system controller. The reel number, start and end time of each segment number is coded in the time-code user bits. The duration of the cut, or segment number, is computed in the tributary and not directly coded. In the recently introduced multichannel version, only the reel number is coded. All other data is recorded in a database independent of the tapes.

System control

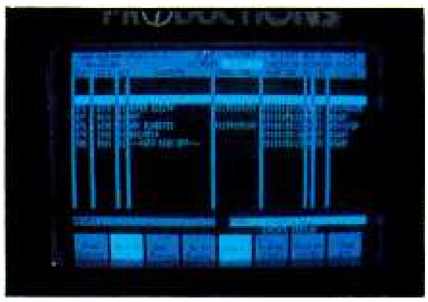
The tributaries communicate to a terminal (a computer using the Motorola 68000 chip) that provides the programming capability for the system. Early versions of LA-KART, such as the one we use, employ touch-screen terminals. However, the touch screen was little-used and later versions are usually supplied with standard terminals.

The program list can be stored entirely in computer memory, but is usually stored on 8-inch floppy disks. At KATV, the master control operator programs the system in its *off-line* mode about half a day ahead using the logs prepared in the traffic department. It is possible for the traffic department to prepare logs directly on compatible floppy disks. Having the master control operator complete the programming does, however, provide a useful check on the accuracy of the program logs.

Switching system

There are two switchers within the system: A matrix switcher, which routes the individual component signals through the TBC, and an encoded switcher, which selects between the LA-KART machines and other video sources (such as black and network). Smaller TV facilities can use the latter switcher as a master control switcher. At KATV, LA-KART appears as a source on the manual

Shown is one of the interface panels. One panel is required for each pair of tape machines.



The system computer display. The monitor provides the operator with all necessary information to control and monitor the computer's activities.

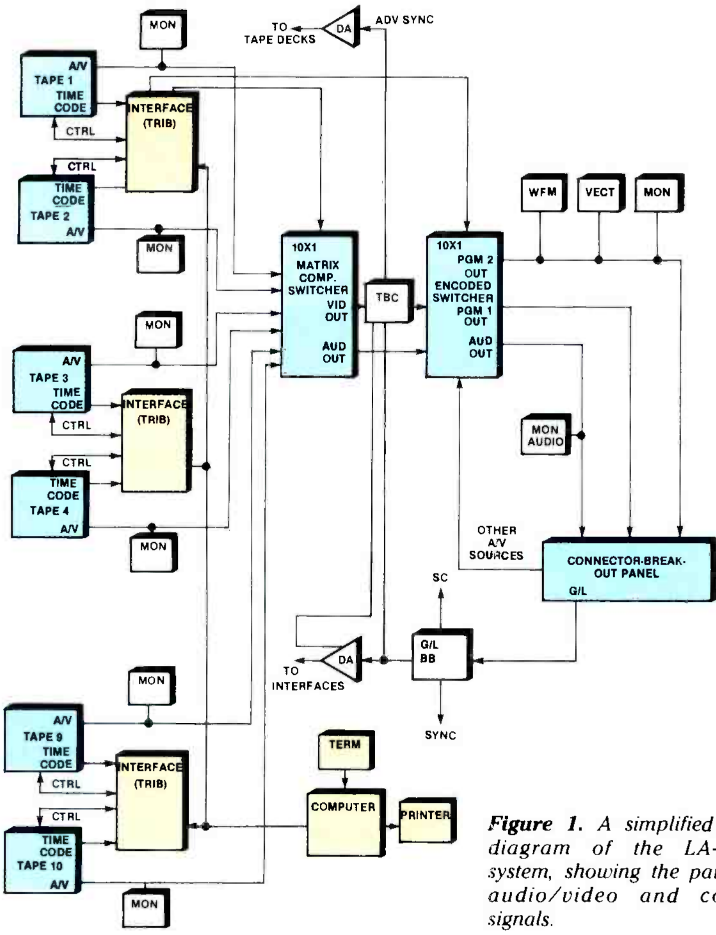


Figure 1. A simplified block diagram of the LA-KART system, showing the paths for audio/video and control signals.

master control switcher. Although station breaks are normally started manually from the switcher, the system has enough sources that the automatic execution mode is sometimes used to free the master control operator for other duties.

Flexibility

The *initialization* mode indicates the flexibility of the system. In this mode, the user can select either manual or automatic execution. The automatic mode is controlled entirely by the system's internal clock. In the manual mode, the operator manually starts the first event in each sequence. The user can also:

- control cue (preroll) time;
- choose the number of events to be displayed on the terminal screen;
- use the preview mode (allowing the operator to rehearse a break);
- operate individual machines from the system terminal; and
- select the *look ahead* window to determine the number of events ahead the system will look before ejecting the tape.

The system keeps an automatic log of events as they are executed. At KATV, this log is printed in master control and later filed with the station records.

All players and recorders in the LA-KART system operate independently. The system accesses individual cassettes solely from the directory data recorded

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at the head of each cassette or tape. After a tape segment is aired, the tape is automatically ejected, unless a segment appears within the look-ahead window. Therefore, any loaded cassettes can be regarded as pending. If an individual cassette is removed or relocated, the system will cue it up in its new location or warn the operator that the tape is missing.

Reliability and support

In more than two and a half years of service at KATV, the system has proved highly reliable. On the average, fewer than three commercials per month have been lost due to failures related to the LA-KART system. In some months there have been no losses. The majority of these mishaps relate to worn or defective tape stock and are solved by replacing the cassette. A routine VCR maintenance schedule minimizes the few remaining problems.

The compact design of the LA-KART system allows it to fit in a small control room.

Our experience

The LA-KART system has revolutionized operations at our station, reduced the number of personnel required and relieved our engineers for other duties. The system has also reduced the number of commercial failures and required make-goods.

The master control operators find the system easy to operate and appreciate how quickly they can reprogram breaks to accommodate last-minute changes or emergencies.

Our station chose the system because it offered versatile programming and machine-interfacing flexibility. It does require more individual decks than elevator-type systems, but it relies on off-the-shelf players and recorders and will interface with almost any tape deck. Overall, the LA-KART has improved our operating efficiency as well as the on-air look of KATV.

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.

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Field report

Tandberg 910 cassette recorder

By Ralph W. Haneman

With the expanding use of audiocassettes in broadcast programming, there exists a real need for a cassette deck designed specifically for the broadcaster. Although there are many consumer decks available, when it comes to heavy-duty, professional-quality cassette tape decks, there aren't many choices.

Perhaps Tandberg has sensed this need, because it recently introduced the TCD 910 master cassette recorder. This deck incorporates a number of innovative features previously unavailable—at any price. The new 3-head deck provides a number of features that make the recorder easy to use in a professional setting. The TCD 910 also provides audio quality equal to that available from reel-to-reel recorders.

Performance at a glance

- *3-head, 4-motor design*
- *Dyneq (dynamically adjusted record equalization)*
- *Microprocessor-controlled*
- *Real time tape counter*
- *Frequency response ±2dB 20Hz-23kHz (metal tape)*
- *Signal-to-noise ratio 74dB (metal tape)*
- *Wow and flutter 0.1% DIN, weighted*

Construction

The recorder can be rack-mounted or used as a tabletop unit. However, don't plan on putting it on a lightweight table; it weighs more than 21 pounds. The front panel is brushed aluminum finished in black. The large push-buttons are well identified and provide a solid feel when depressed. There is no flimsy touch here. The play button is color-coded so it doesn't get lost on the front panel when you're in a hurry. All of the motion controls also are accessible through the optional remote control unit.

Microprocessor control

The recorder can be controlled through an RS-232 interface port. This provision makes it easy to use the recorder in an automated setting, if desired. Although this may not be a widely used feature, it signifies that this recorder is capable of working in environments other than the standard production studio.

The key to the recorder's mechanical operation is the internal 8-bit microprocessor. With 32K of on-board memory, the microprocessor directs all of the recorder's tape transport functions.

A real time clock is an important element of the recorder's production capability. The real time clock and built-in autolocator allow you to actually see where you are on a cut. For those who are accustomed to using digital timers with reel-to-reel recorders, it's almost mandatory to have one on a production cassette machine.

The autolocator circuit provides up to 10 user-programmed cue points on the cassette. These cue points are stored in memory and can be recalled instantly from the front panel. In addition to these cue points, the recorder can be told to search by cut gaps or by program cut number. I really enjoyed telling the cassette recorder to find the third cut and then watching it do so. After the autolocator finds the desired spot on the tape, it automatically cues the tape to one second before the audio. How's that for fancy work?

Other useful production capabilities include the optional fast wind speeds. At the standard fast wind speed, one second of wind equals one minute of play. A slow wind and search mode is also available at half the standard speed. A cuing speed of one-fourth normal wind speed is available for those times when you want to quickly reach a spot on the tape, but still want to listen to the tape playback. When you select this mode of operation, a low-pass filter is automatically switched into the audio output stage of the recorder to protect your speakers from high-frequency energy caused by rapid tape motion.

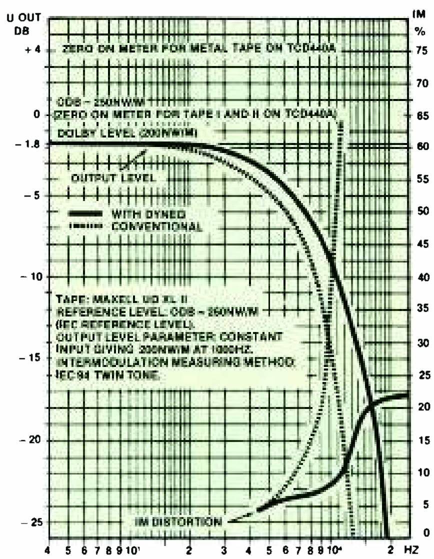

***Figure 1.** Notice how a constant input level causes lower output and high distortion at high frequencies.*

Audio features

The TCD 910 uses a special dynamic record equalization (Dyneq) circuit to reduce distortion and to extend the recorder's headroom. One of the problems with cassette tape is its incapability to provide the necessary headroom and, therefore, the necessary signal-to-noise ratio. The Dyneq circuit attempts to overcome this problem by providing a dynamically adjusted record equalization curve.

If the input level to a tape remains constant and the input frequency is increased, the IM distortion increases rapidly, as shown in Figure 1. The chart shows that when the input frequency reaches 12kHz, IM distortion is more than 60%. The Dyneq circuit brings this distortion down to 10% under these conditions, and the S/N exhibits a corresponding improvement.

Let's see why this happens. A conventional record equalization circuit (Figure 2) provides the same amount of equalization regardless of the input level. The problem, as shown in the graph, is that if the level of the input signal is high and the signal contains high-frequency material, the tape will saturate. The result is distortion, and lots of it.

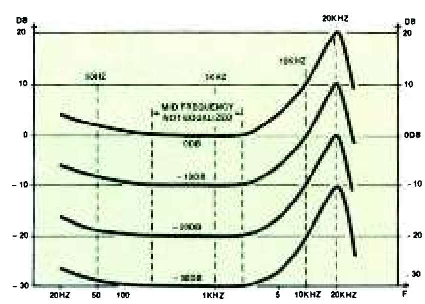

***Figure 2.** Standard record equalization curves boost the high-frequency material by the same amount at all input levels.*

Haneman is chief engineer at WDAC-FM, Lancaster, PA.

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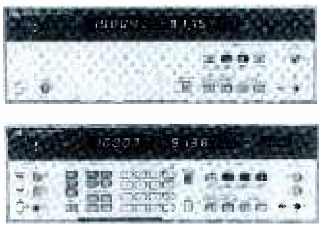

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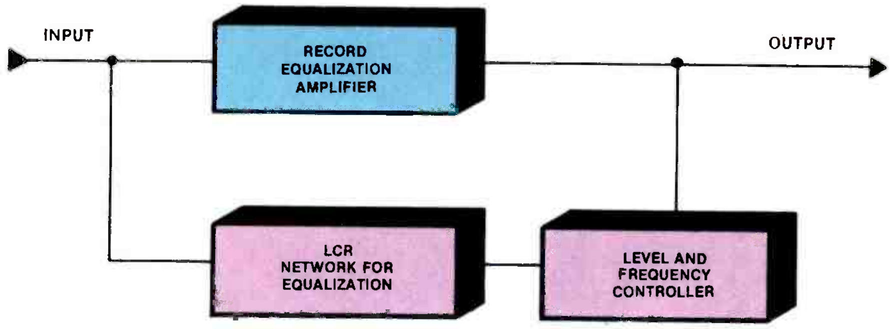

Figure 3. *The Dyneq circuit dynamically adjusts the record equalization curve as the amount of high-frequency material varies. Tapes produced on this machine are usable on any other cassette recorder.*

The Dyneq circuit adjusts the record equalization curve according to the audio signal input. A level and frequency controller (see Figure 3) monitors the output from the record equalization amplifier. If the audio contains only low-level high-frequency material, no alteration in the equalization curve occurs. However, as the level of high-frequency material increases, the amount of equalization is reduced until it provides no boost at all. In other words, at 0dB record level, the equalization is flat, as if a reel-to-reel recorder was operating at 15ips.

The net result is a reduction in distortion and an increase in high-frequency S/N. Even with the record equalization compensation, tapes produced on the 910 are fully compatible with other recorders.

Other features

The recorder uses peak-reading VU meters. If you are not familiar with peak-reading meters, they may take a bit of getting used to. A calibrated input level control adjusts the record level. The calibration on the control allows you to subjectively measure the input level from −30 to +12dBu. A separate balance control is used to match the levels of the left and right channels.

Playback and record equalization can be switch-selected for ferric, chrome or metal tapes. This is the only recorder I've seen that also allows you to adjust both record equalization and bias from the front panel. Front panel adjustments are provided for all three types of tapes.

Both Dolby B and C noise reduction are available from the front panel. No provision is made for automatic dbx interface. Even so, the dbx noise-reduction system could be connected and separately controlled.

All inputs and outputs appear on XLR connectors. The standard output level is +8dBu. However, it can be trimmed from −2 to +12dBu by a back panel screwdriver adjustment. The inputs and outputs are transformerless active circuits. Transformers are available as extra-cost options.

The master recorder has one other feature that I've never seen before. The user can actually adjust the record head azimuth from the front panel. The control drives a small servo motor coupled to the record head. While the output is being monitored, the record azimuth can be adjusted with this control until the correct phase is obtained. It's just like using an electronic screwdriver.

Serviceability

All of the circuit boards can be accessed through the top cover. After this cover is removed, the complete tape transport module can be taken out of the deck by removing four screws. All of the connecting cables to the transport module terminate in plugs, so removal is easy. There are a total of five circuit boards in the recorder: two mother boards, two Dolby processing boards and a control circuit board. Because access holes are provided in the bottom plate of the chassis, there is no need to remove any covers for electronic adjustments.

The unit is supplied with two manuals. One manual provides basic operating instructions and the other covers technical servicing. Both manuals are excellent and easily understood.

Factory service

After about three months of use, our TCD 910 developed a mechanical noise. A little investigation showed that the flywheel was slipping on the capstan shaft. A call to the factory brought quick action and the repair was made at no cost. I've been told the factory has implemented a change in the design and new units should not encounter this problem.

I am pleased with the Tandberg TCD 910 master recorder. It provides features not available with any other recorder, and its 3-head design provides superior audio quality. The recorder is not inexpensive, but you get what you pay for.

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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.

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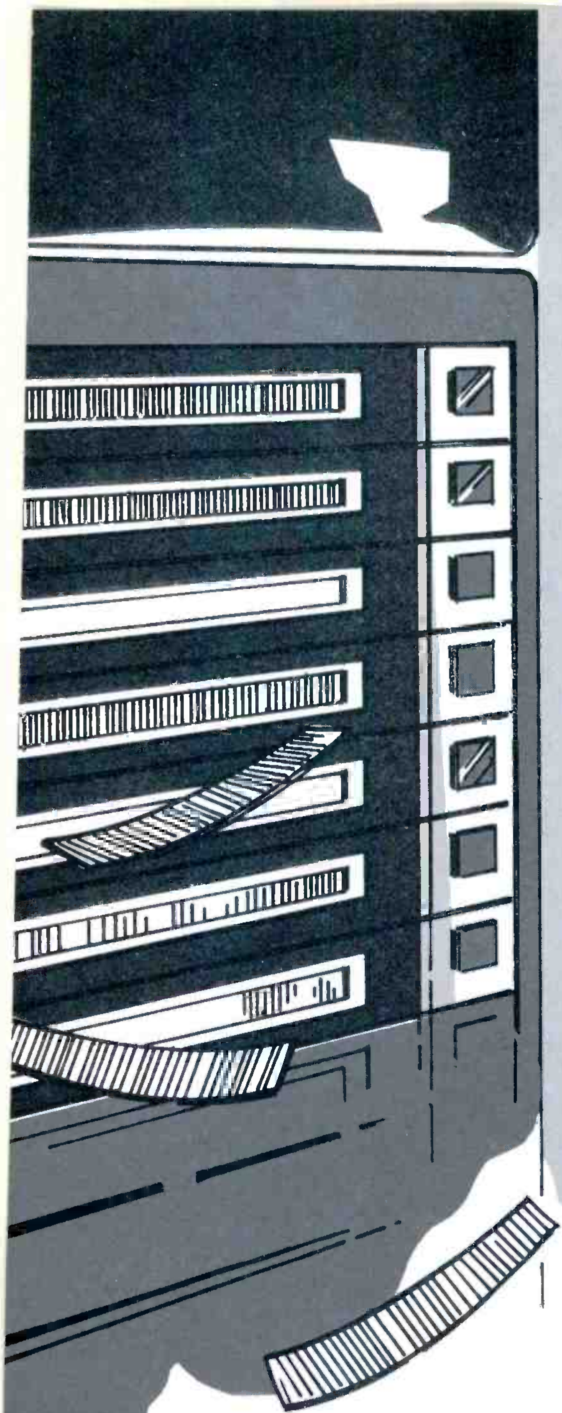

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LA-KART is the proven broadcast system in operation at TV stations throughout the country for over 3 years. Now delivering **Betacam** format systems, as well as, **"M"** and the leading **"¾"** **U-Matic** System featuring component processing for the best cost effective system in use today.

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Circle (68) on Reply Card

Clock couples accuracy and large display

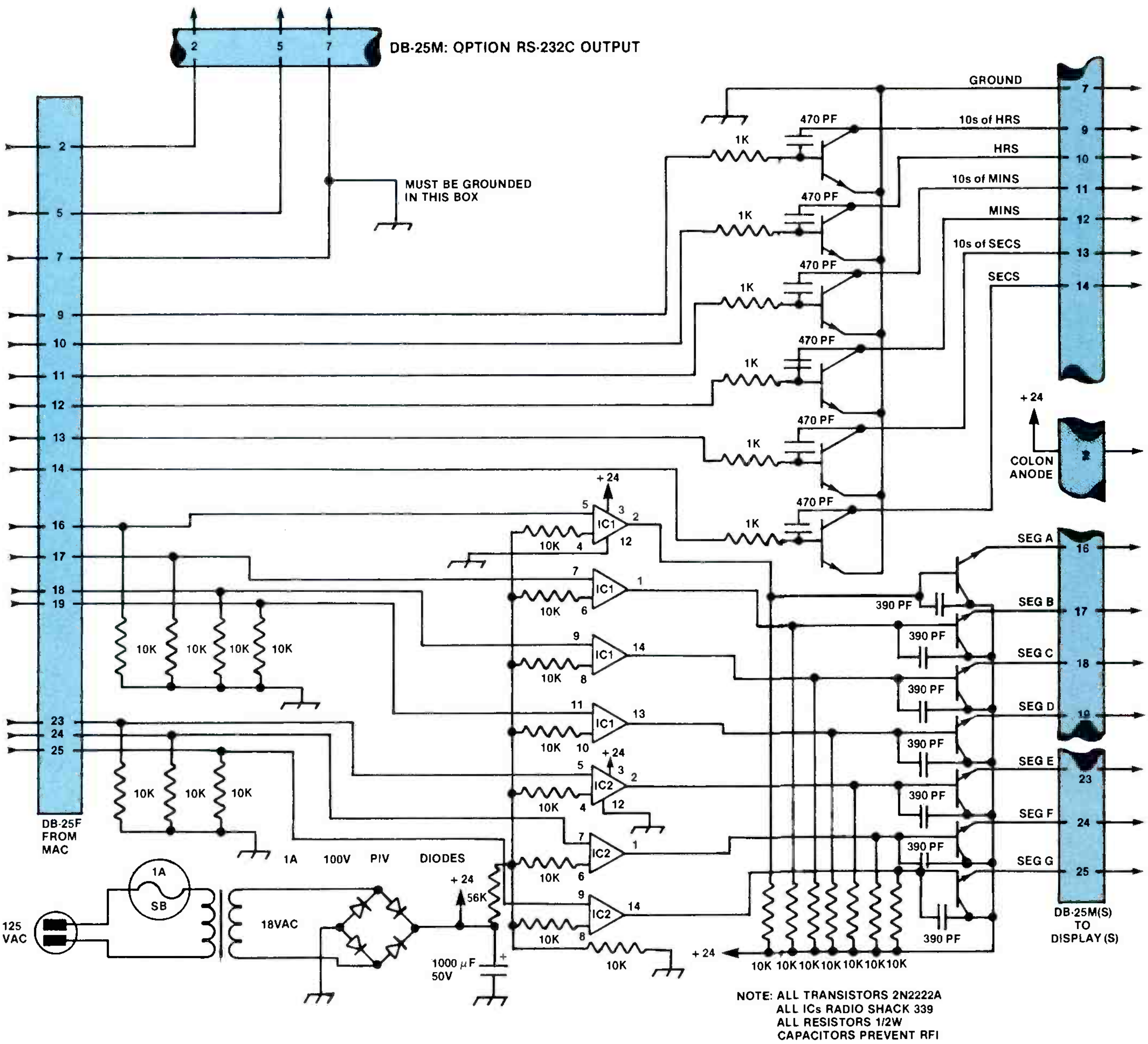
By Steve Broomell

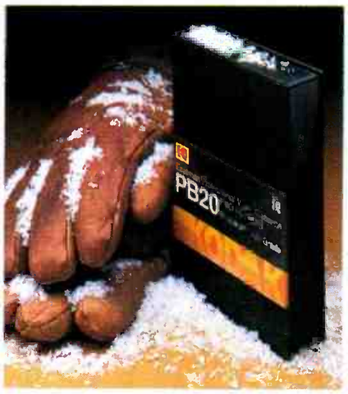
Most control rooms require an accurate clock with a display that can be seen throughout the room. Although it's possible to find accurate clocks and large display clocks, the combination of these two traits is not so easy to come by. Clocks meeting these criteria are available, but they are quite expensive.

There is, however, an alternative to spending your entire maintenance budget on a clock. The Heath Company manufactures a clock that is not only accurate, but can be coupled to a large auxiliary display. Called the GC-1000 Most Accurate Clock (MAC), it uses radio signals from WWV or WWVH to keep time. The clock will work just about anywhere in the world because it needs only to hear WWV or WWVH for three consecutive minutes a day to retain its microsecond accuracy. At our Casper, WY, location, we successfully use a 1-foot-diameter shielded loop tuned to

Broomell is director of engineering, KTWO-TV, Casper, WY.

Figure 1. The interface box provides the necessary high-voltage drivers for the large display.





EASTMAN PROFESSIONAL VIDEO TAPE CAPTURES YUKON QUEST RACE.

When Alaska Video Productions set out to cover the 1985 Yukon Quest International Sled Dog Race, it went with a winner.

It picked ½-inch PRO FORMAT EASTMAN Professional Video Cassettes with Betacam equipment to record the grueling event, which saw 28 entrants mush over a 1000-mile course from Whitehorse, in Canada's Yukon Territory, to Fairbanks, Alaska.

Says AVP partner Garry Russell, who handled most of the camera work for the production: "The Eastman tape performed flawlessly through the rigors of the two-week event, in temperatures ranging from -30°F to 40°F. In dazzling sunlight, blowing snow, and after dark."

Adds producer Alex Epstein: "The pictures we brought back were some of the finest we've ever seen of this beautiful part of the world."

Altogether, AVP shot nearly 17 hours of tape during the race. This was edited into a 30-minute production that was seen throughout Alaska via satellite, in the Pacific Northwest on McCaw Cablesystems, and in parts of Canada on CBC-North TV.

Recording "The Challenge of the North" proved to be another challenge overcome by EASTMAN Professional Video Cassettes. If you'd like to tell us how EASTMAN Professional Video Cassettes have helped you, write to Eastman Kodak Company, Dept A-3063, 343 State Street, Rochester, NY 14650.

For more information about EASTMAN Professional Video Tape, call 1 800 242-2424, Ext 80, or contact your nearest dealer in EASTMAN Professional Video Products.

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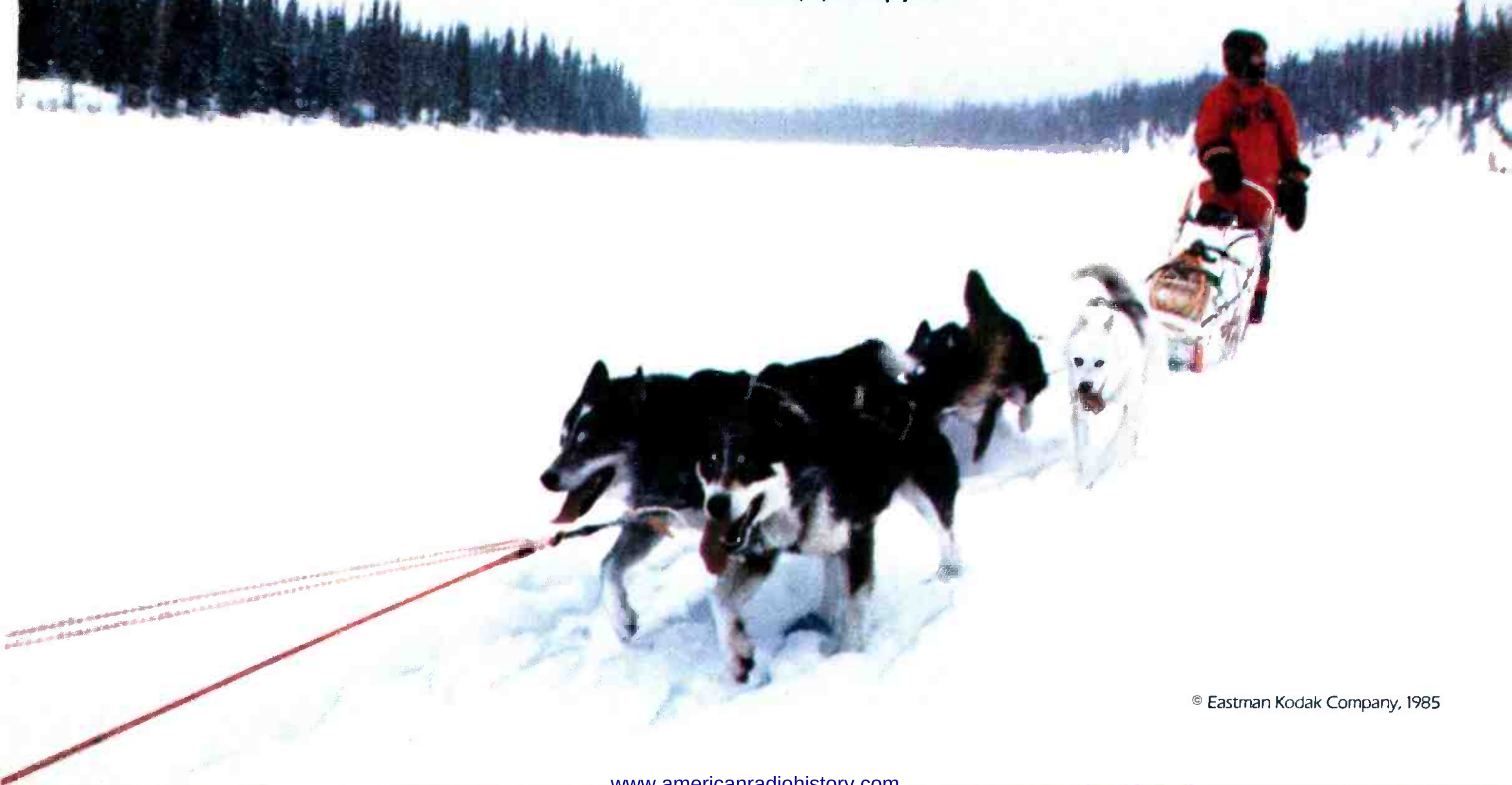
Circle (70) on Reply Card

Kodak



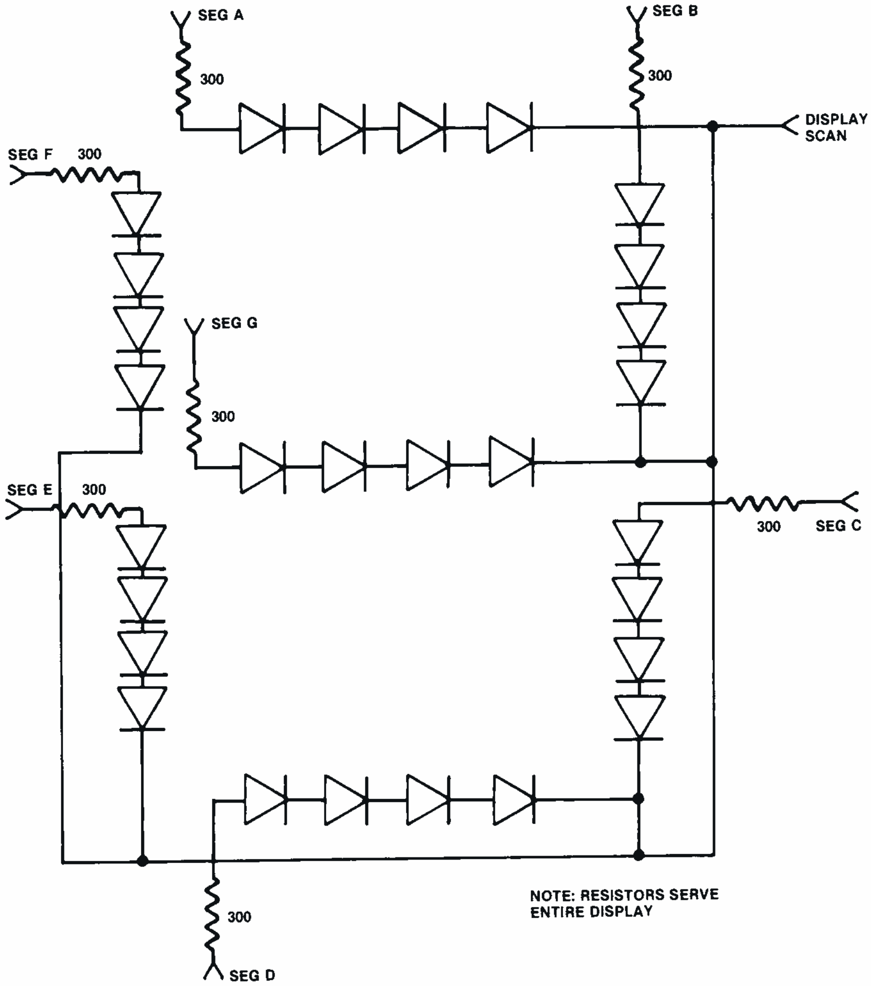


Figure 2. The large display consists of four LEDs connected in series. When supplied with a short-duration 24Vdc pulse, they provide an attractive display.

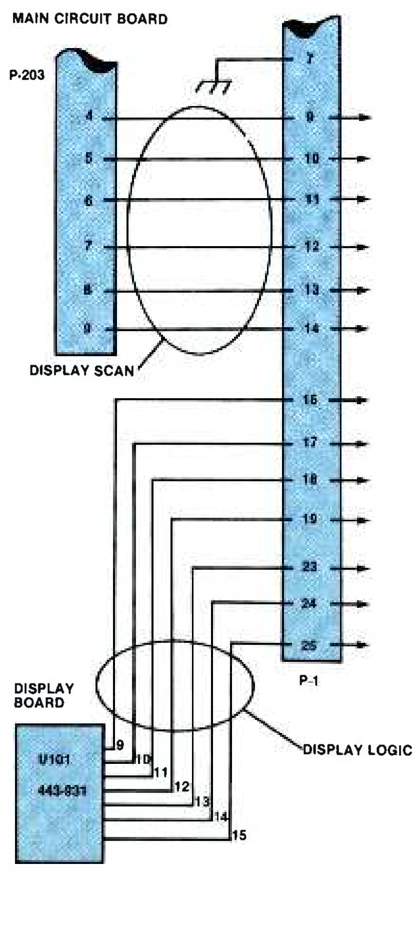


Figure 3. The interface from the clock to the display is best made with ribbon cable. Mount the connector P-1 on the back panel of the clock.

5MHz for an antenna. Other locations may require a more extensive antenna.

Display construction

The next step is to build an interface box with the necessary power supply and logic circuits to drive the display elements. The circuit in Figure 1 produces 24V at 2A and can drive up to three display panels.

The anodes of each corresponding segment of the MAC display are connected in parallel. The cathodes of all segments within each display digit also are connected in parallel. The seven common cathodes are scanned at one-seventh duty cycles and in sync with the decoded data being applied to the anodes. This design allows a tenths-of-a-second digit if desired.

The interface box converts the data from the MAC to 24V pulse trains to drive the large display segments. The interface also provides a constant voltage for the colons. Because any given segment is on for only one-seventh of real time, 24V is required to produce adequate brightness from the large LED displays. Although the peak currents are high, the duty cycle is low.

One note of caution: Not all quad comparators (IC1,2) can be used in the circuit because the outputs must go fully to 0V without outside help. If you choose a device other than the Radio Shack 229 IC, make sure it will clamp the output line down to 0V. Otherwise, your display may always read 88:88:88.

Each segment of the large display is actually four LEDs wired in series (see Figure 2). The display LEDs are laid out on the circuit board in much the same manner as they are shown on the schematic.

Mount the display board in a box that has been painted flat black inside. A red gel front window is held in place with wooden trim strips, or a large display bezel can be used.

Clock construction

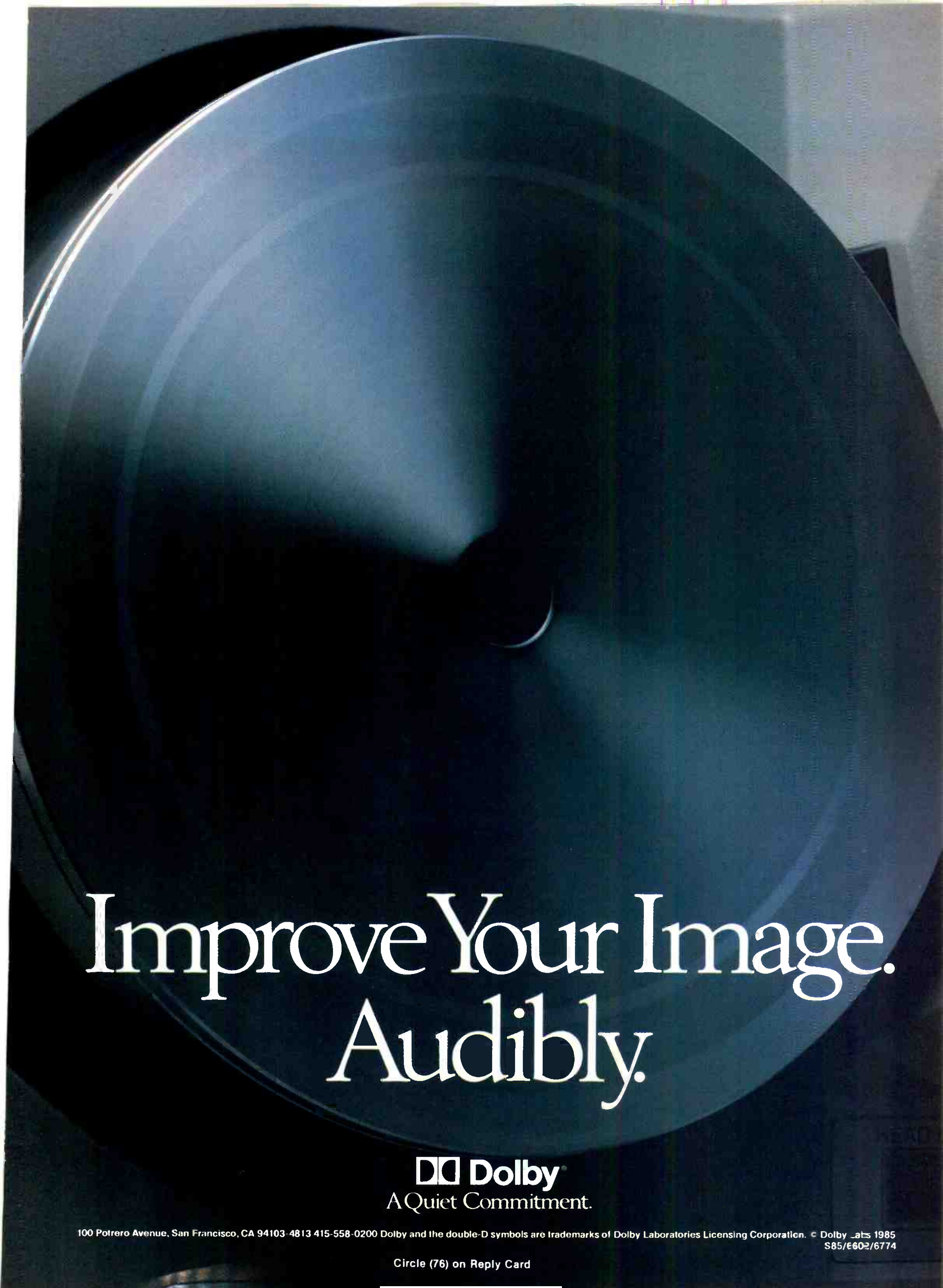
The MAC normally runs on ac power. In the event of a power failure, it switches to a backup power supply. The backup supply can be as simple as two 6V lantern batteries.

The MAC 1-inch LED display is too small to be viewed in a large area such as a TV control room. Therefore, if you want to use the clock in such a setting, a larger display is needed.

Only simple changes need to be made to the clock in order to drive a large display. Servicing is easy because the MAC continues to operate normally when disconnected from the remote display.

Figure 3 shows the connections from the circuit boards of the MAC to the added output connector P1. You can wire the connector any way you prefer, but this approach allows the MAC to be easily coupled to a computer. For a clean installation, use 6-wire ribbon cable between the P1 and P203 and a 7-wire ribbon cable between P1 and U101. Pin 7 of the back connector (DB-25M) is ground and can be connected with a single wire if you don't purchase the RS-232C option.

Our clock system has worked well for a couple of years. During power failures, the larger display goes dark, but the MAC continues to keep time until the power returns and the big display lights up again. Because the clock receives its data from WWV or WWVH, the spring/fall time change is handled automatically by the clock. We no longer have to come in at midnight or hope some operator will properly reset the clock for these time changes.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S85/6602/6774
Circle (76) on Reply Card

A commentary on communications

By Bob Van Buhler

One of the concerns some SBE members express can be summarized as, "What is the SBE doing for me?" The fact is, the national board of directors works long and hard for the membership. However, improvements can always be made.

Perhaps one of the best changes we've made at the national level is the extra effort to keep the membership informed about the activities of the national office and the board of directors. One example of this communication is the *SBE Signal.*

Publications

The *SBE Signal,* received by the membership several times a year, by necessity contains primarily undated material. A recent issue, for example, contained material developed in September and October but mailed in December. Publishing delays, part of any such effort, make it almost impossible to speed up the process.

Because some information must get to the membership on a more timely basis, *Short Circuits* was developed. This is a newsletter issued from the national office. The object is to provide information to the membership at the earliest possible date—the next SBE meeting.

Short Circuits is mailed to the chapter chairman whenever information becomes available, and it is that person's responsibility to make the information available at the next meeting.

The newsletter was developed by Chuck Kelly, who chairs the chapter liaison committee, to improve the lines of communication between the national level and the membership. If you are not receiving this information, contact your chapter chairman.

Public information

Under the guidance of Jack McKain, vice president, the society has formed an industry and public relations committee. The committee's responsibility is to enhance the image of the SBE by keeping the industry informed about society activities.

Press releases are now issued from one central point. Directors and chairmen are requested to provide information that can be developed into press releases. The goal is to disseminate the information promptly to the broadcast press. In doing so, the society's perspective on a particular story is made a part of the total picture while the issue is still fresh. Often, the leaders of the NAB, NRBA and RTNDA are unaware of the actions taken by the SBE. Unless the society makes them aware of its position on important matters, it stands to lose visibility and credibility.

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

Promotion

The society's alliance with **Broadcast Engineering,** announced in the December 1985 editorial, will help the SBE as a whole as well as the society's individual members. Even non-members will benefit, because SBE news will regularly appear.

Because of **BE**'s circulation, it is possible to reach many more non-members than with normal promotion methods, many of which are beyond SBE's resources. The result will be a stronger organization and a broader knowledge of SBE activities and opinions on important issues affecting the industry.

SBE is free to disagree with **BE** and vice versa. The wide distribution of news and information, including differing opinions, will lead to a better-informed industry, and one that will be better equipped to face the future.

Current society membership:	
Members	*4,219*
Associates	*93*
Students	*97*
Life members	*78*
Honorary members	*4*
Prof. directory	*6*
Sustaining	*79*
Complimentary	*129*
Total membership	***4,705***

Officers

Every member of the board of directors is available to the membership. Directors serve because the members elected them to serve. You will find that board members are busy people, just as engineers are. But they are accessible and want to serve the membership, so call upon them if you have a question, complaint or personal concern.

The SBE is a group of engineering *professionals.* We need to recognize this fact. Just as important, the people with whom we work need to recognize this and treat us accordingly. No matter what part of the country or what size the market, broadcast engineers should be treated as professionals.

Chapter profile

One example in a series of success stories is Baltimore's chapter 46. The chapter began in 1970 when a group of engineers met to form the Chesapeake Radio Engineers Association, later to become chapter 46. It has a membership of 85, double from last year, and triple from three years ago. The luncheon meetings typically draw from 30 to 35 members.

New members eat free at their first meeting as an official welcome to the chapter. All members in good standing dine free at the December meeting. One of the strong points of this chapter is the concern for fellowship. Perhaps this is one reason for the chapter's success.

FCC petitions

The society frequently files petitions and comments with the FCC. When issues arise that affect the interests of its members, SBE will not hesitate to make its position known to the commission. SBE has filed comments on such issues as the first class license, frequency coordination, spectrum utilization and other areas of vital concern.

Spring certification exams

The next scheduled certification exams will be from June 13-21. All applications must be received by the national office by April 18. For a copy of the program of certification booklet and applications, write the Certification Secretary, SBE, 7002 Graham Road, Suite 118, Indianapolis, IN 46220.

Membership application

This issue contains an application blank for membership in SBE. If you are not a member, consider becoming one. It is one of the most important steps you can take toward becoming a better-informed engineer. If you are already a member, pass on the application blank to a friend. We all benefit from a larger membership in SBE.

Leningrad Philharmonic Symphony Orchestra
Evgeni Mravinsky, Conductor

Meet the Maestro

Model DAS-2
Digital Audio Storage

Getting the right sound at the right time is no easy task, especially in radio broadcasting, where literally hundreds of sounds must be instantly and reliably on hand for both commercial and program use. It takes an audio file system of great versatility, a machine with a highly developed sense of timing, with fast response and unfailing memory; in short, it takes a maestro.

Enter the DAS-2 from NTI. Whether AM or FM, mono or stereo, this sophisticated sound storage system is ready with an automatic, large-capacity memory that can be linked to your business computer and sequence controller either directly or through a floppy disk. With its easy-to-use operation panel, you can program your input data and order of transmission quickly and efficiently, and obtain a run report to check on-air results.

The DAS-2 can be expanded at will and can simultaneously broadcast up to four channels without time lag. And, because it's digital, you are assured of the very best sound reproduction available. Of course, in a way such excellence is not so surprising. It's the kind of performance one expects from a maestro.

For further information, write

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SEMI-Conductor Equipments & Parts Sect.
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Phone: (03) 210-3591 Telex: 222-2063 MSKTOKJ

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Phone: (415) 494-1545 Telex: 276610

Circle (73) on Reply Card

MEMBERSHIP APPLICATION

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317-842-0836
(please type or print)

Application For: (check appropriate box)

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☐ Reinstatement (Former Member #________)	$20.00
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Please apply amount of $ ________ to Visa☐ Mastercard☐.

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If accepted, please consider me a member of ________________________ Chapter

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Type of Facility: ____

Description of Duties: ____

____

Total years of responsible Engineering Experience: ________________

Field of Activity: Radio ________ Television ________ Other ________

PROFESSIONAL LICENSES OR CERTIFICATES

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Additional Information Requested on Reverse Side

ADMISSIONS COMMITTEE ACTION

Action deferred for more information ________________________________

Admissions Committee Chairman's Signature: ________________

Date: ________________

Approved for Grade ________________

Candidate Notified ________________

Entered in Records ________________

EXPERIENCE RECORD

List in chronological order, beginning with the most recent, all formal experience in Broadcast Engineering or related employment. Indicate field or fields of specialization under 'Position.' Please do not limit yourself to the four spaces below. ATTACH A BRIEF DESCRIPTION OF DUTIES.

From Mo. Yr.	To Mo. Yr.	Company Name and Location	Position or Title	Type of Facility

EDUCATION

College, University, or Technical Institute	From Mo. Yr.	To Mo. Yr.	Credits or Yrs. Compl.	Course or Major	Degree

List Short Courses, Seminars Related to Broadcast-Communications Technology

SPECIAL ACHIEVEMENTS

List awards, patents, books, articles, etc.

REFERENCES

List two references - familiar with your work

Name	Company	Address	Phone

Sponsor: ______

Have you ever been convicted of a violation of the Communications Act of 1934, as amended. Yes ☐ No ☐. If so, describe in full.
(Use additional space if necessary) ______

_____I have enclosed the required application fee.

Signed ______ Date_____ _______19__

I agree to abide by the By-Laws of the Society if admitted.

MASTER CONTROL

Over sixty of our new MC-500 series **MASTER CONTROL** Switchers are in operation at television stations throughout the country, many with full *station automation* also supplied by Utah Scientific. These customers include some of the country's most prestigious broadcasters. Call or write for our 100% Users List to learn firsthand the many advantages offered by this state-of-the-art product.

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Circle (75) on Reply Card

KGO-TV purchases Ikegami cameras and monitors

Ikegami, Maywood, NJ, has sold six HK-322 cameras with triax, two TKC-970 telecine cameras and more than 150 color and B&W monitors to KGO-TV, an ABC-owned station in San Francisco. The equipment has been delivered and installed, with several of the monitors having previously been used for the 1984 summer and winter Olympics prior to being sent on to the KGO Center.

Previously, KGO had used HK-312s in its old facility for several years. These cameras have been transferred to ABC's Los Angeles TV and production work center. The KGO Broadcast Center features two studios of 5,000 square feet each on its main floor, along with 15,000 square feet of technical space.

Ampex signs contract with MTM Enterprises

Ampex Magnetic Tape Division, Redwood City, CA, has announced that it has signed a 3-year contract to supply MTM Enterprises with its professional broadcast quality 196 and 197 videotape.

Swiderski delivers ENG truck to WGN-TV

Swiderski Electronics, Elk Grove Village, IL, has delivered a second ENG mobile truck to WGN-TV, Chicago. The truck includes microwave transmission equipment, multiple 2-way communication radios, as well as a mobile cellular telephone system for transmitting voice and data communications.

Included was a multi-input production switcher, capable of controlling up to three external video cameras. Also included was a full audio mixing video signal feed identifier picture and waveform monitoring equipment as well as a 7.5kW Onan power generator to provide mobile capability.

Video equipment manufacturer formed

Bill Hendershot, a founder of Consolidated Video Systems and ADDA, has formed *Prime Image*, Sarotoga, CA, to develop, produce and manufacture a line of high performance, low-cost digital video equipment for industrial television and small-market broadcast.

EECO announces installations of EMME editing system

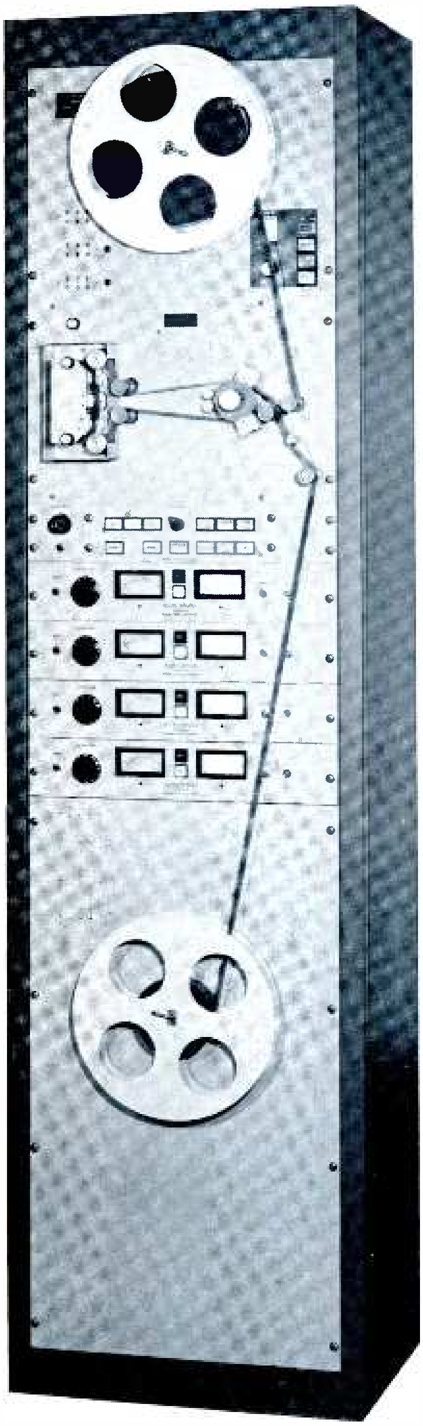
EECO, Santa Ana, CA, has announced several installations of its EMME computerized editing system. The systems installed are Maritz Communications Company of Gardena, CA; Producers Communications, St. Louis, MO; and Videogenic, Toronto, Canada.

The system allows control of multiple video recorders and a production switcher through interchangeable work stations to accommodate different editing styles. The video editing work station features a dedicated keyboard control.

Abekas delivers first of units

The first *Abekas Video Systems* A62 digital disk recorder has been shipped to Modern Telecommunications Inc. (MTI) in New York City. MTI, one of New York's largest production houses, will install the A62 at its midtown facility. The unit will be used for assembling and editing animation sequences and video special effects on a frame-by-frame basis.

MTE



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Circle (72) on Reply Card

SSL publishes report

Calling for an intensified educational effort between manufacturers and the pro audio community, *Solid State Logic*, Washington, DC, has released a report to the industry entitled *The Future of Audio Console Design-Establishing a Dialogue.*

The 40-page publication details the various issues confronting console manufacturers as they attempt to push beyond the capabilities of the standard analog audio console. It reveals the decisions that must be made, and explains the terminology and implications of various developments being offered to the industry.

The report covers the audio, computer and human engineering aspects of console design as they relate to standard analog consoles, programmable/assignable analog consoles and digital systems.

SSL is distributing the book to more than 150 schools and universities with audio education programs around the world, and will send copies upon request. Copies also will be available at SSL booths at all major audio trade shows.

Caesar Video Graphics receives first U.S. Harry

Caesar Video Graphics, New York, has taken delivery of the first Quantel Harry sold in the United States. Harry, introduced by *Quantel*, Palo Alto, CA, is a digital cel recorder designed to be used with Quantel's paintbox, for cel animation, video retouching, matte work, editing and video rotoscoping.

Features include a real time random access record/replay system; up to 2,520 cels or 84 seconds of video can be prepared and stored; replay at any speed; any cel can be edited or duplicated; SMPTE 4:2:2 recording; and digital decoder/coder. Options include digital dissolves, linear keying, SMPTE time code and free-standing control.

Lucasfilm donates EditDroids to USC

Lucasfilm, San Rafael, CA, has donated two EditDroid electronic editing systems to the USC School of Cinema-Television. The two systems, to be installed at the USC Cinema-Television Center, will be used for training student film/video editors, as well as established editors who wish to keep up with the latest techniques in electronic editing. EditDroid is a state-of-the-art editing system for film and video post-production.

The Droid Works, developer and manufacturer of EditDroid and SoundDroid, is joining Lucasfilm by contributing technical support and assistance to help launch the program.

The EditDroid project was started five years ago when George Lucas assembled a team of researchers to apply computer technology to picture and sound post-production. Lucas is donating the EditDroids to USC in honor of the EditDroid development team. Headed by Rob Lay, the team is now part of The Droid Works, and it is pursuing ongoing research and development of EditDroid as an electronic editing system.

Shook completes production trailer

Shook Electronic Enterprises, San Antonio, TX, has completed another major production trailer for John Crowe Productions, (JCP), Houston/Dallas. The mobile facility was the second network trailer Shook has manufactured for JCP.

The trailer features a production area with seating for six technical people as well as pull-out seats for observers. A sound-isolated audio room has equipment racks directly over the console for easy access to controls. The video operation console is outfitted with two standing-height camera control stools for versatile operation. Behind the console is the patchbay, switcher electronics and terminal gear. The tape room has two operation consoles. One of the consoles is used for slo-mo, and the other is used for either Chyron or still-store.

Studio Equipment appoints U.S. distributor

Studio Equipment Distribution, United Kingdom, has appointed MCI Intertek, Arlington, TX, as U.S. distributor for all Bel products. The range consists of the BD series of digital delay line/samplers, the BF20 stereo flanger, the BC3 noise reduction system and DI and wall boxes.

BASF restructures U.S. operations

BASF, Parsippany, NJ, has restructured its operations in North America. All activities will be combined in a new company, BASF Corporation. Major components will be BASF Chemicals, BASF Fibers, BASF Inmont and BASF Information Systems.

IGM completes move

Jim Wells, president of *IGM Communications*, Bellingham, WA, has announced that the company has completed its move into its new building at 282 W. Kellogg Road, Bellingham, WA 98226. The telephone number is 206-733-4567. The plant, located in Cordata Business Park, was designed to provide the latest in computer design.

How can you increase your number of cameras without buying more?


LDK 6, most popular U.S. news production camera.

By making them do double duty. The advanced design of the LDK 6 (1″) and LDK 26 (2/3″) automatic cameras with Philips unique triax system and *total* computer control make this possible . . . *with no compromise in performance*

Your camera can move between studios, locations, and applications with ease.

Users from networks, stations, production facilities and institutions prove this daily. Here's how.

Triax cable is a Philips innovation and we continue to lead the world in its use. It is many times cheaper to buy, pre-cable and service. In the studio simple triax patch panels allow cameras to be quickly and reliably relocated – while maintaining the camera's quality performance.

LDK 6 triax cameras have complete intercom, teleprompter and full bandwidth RGB for chromakeying – essential in news presentations. In the field, you can locate your camera head up to 2 miles away from the camera processing unit – without loss of picture quality, and lightweight triax is very easy to handle.

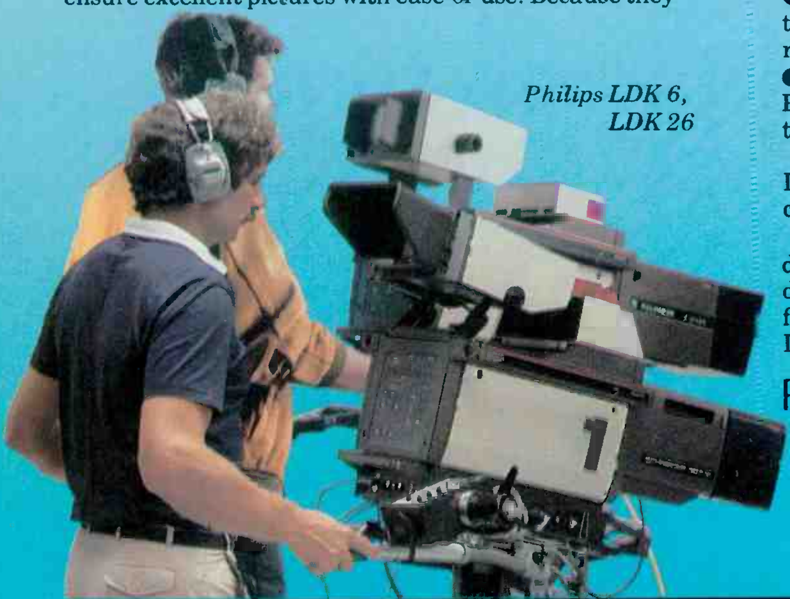
LDK 6 and LDK 26 are a new generation of cameras – with total computer control over 1000 different settings to ensure excellent pictures with ease-of-use. Because they have distributed intelligence you can connect any head to any CPU for instant power-up and operation . . . with no need for technicians to do a line-up test. Then there's full auto set-up, operational memories to recall special lighting conditions, set-up memories for storing creative effects and lens files to recall the characteristics of different lenses. So seconds after the camera is patched in and powered up, you get perfect pictures – with a speed and reliability that can't be matched by cameras with only partial computer control.

Some of the other advantages of total computer control are:

- On line 24 hour surveillance of the total camera system warns of any potential problems before faults occur.
- Adjustment for the tube ageing is automatic. Pictures from a two year old camera look as good as day one . . . proven daily in the field.
- A pick-up tube can be replaced 15 minutes before air time with no tweaking . . . and a matched tube is not required.
- *Total* computer control technology is available from Philips in all tube formats . . . the 2/3″ (18mm) LDK 26 and the choice of 1″ (25mm) or 1 1/4″ (30mm) LDK 6.

These and many other features are why the LDK 6 and LDK 26 family are the fastest selling news and production cameras in their class, with over 400 sold worldwide.

Prove the total computer difference for yourself. A demonstration will prove why they are years ahead in design, performance and cost effectiveness. Call or write for demonstration or request the descriptive LDK 6 or LDK 26 technical brochure.


Philips LDK 6, LDK 26

PHILIPS TELEVISION SYSTEMS, INC.

900 Corporate Drive, Mahwah, New Jersey 07430 Tel: (201) 529-1550

Canada: Electro & Optical Systems Ltd, 31 Progress Court, Scarborough, Ontario, Canada M1G 3VS Tel: (416) 439-9333 Telex: 065-25431

LDK 6 – the total computer control camera.

PHILIPS **Broadcast Equipment**

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Reliability through Quality

LD10

Circle (78) on Reply Card

SSL systems in Australia double

Platinum Australia recently completed an upgrade program of its facility with the installation of an SL 4000 E series master studio system from *Solid State Logic.* The program included re-design of the studio and the control room. The console is equipped with the SSL studio computer and 40 channels of total recall automation.

Also, Western Australia's audio production facility, Planet Sound Studios, has become the first studio in Perth to use a Solid State Logic master studio system. Planet's SL 4000 E series system consists of a 40-channel mainframe, an SSL studio computer and 28 channels of total recall, which provides floppy disk storage of all I/O module settings. The studio computer also controls a Studer A-800 24-track recorder.

After refurbishing, Thorn-EMI Australia has re-opened Studio B at their Studios 301 complex, Sydney, N.S.W. The control room features a comprehensive music mixing SL 4000 E series master studio system from SSL. The console has 48 mono channels and eight stereo channels for effects returns and special processing. SSL's 200 segment Plasma Metering is also fitted to the console as Studios 301 offer both analog and digital mixing services. The SSL studio computer is complete with total recall and the SSL integral synchronizer and master transport selector, interfaced with Studer A-800, A-80 and A-810 analog recorders and the Sony PCM 1610 digital mastering and editing system.

SA equipment chosen for World Cup broadcast

Scientific Atlanta, Atlanta, has announced that it has received an order from the Mexican government to provide earth station equipment for the TV broadcast of the World Cup Soccer Games, June 1986. The order will provide equipment for the broadcast from five stadiums via Morelos, Mexico's domestic satellite. The purchase also includes equipment for an international broadcast center, which will downlink the Morelos signal, then uplink other international satellites for distribution of the games worldwide.

SA's earth station equipment will be used for the establishment of broadcast sites located at Jalisco, Universitario, Corregidora, Leon and Cuauhtemoc stadiums. Equipment for the international broadcast center, located in Mexico City, will also be supplied by Scientific Atlanta.

Equipment will include a 7-meter receive/transmit antenna configured for operation at C-band and electronics for LNA, uplink and downlink subsystems.

The broadcast center will be supplied with SA's 11-meter motorized antenna and electronic subsystems and will also be configured for both television and telephony. Subsystem electronics for each installation include model 7550 exciter, model 7500 receiver, model 7630A LNA protection switch, transmit baseband switch, model 7620 video protection switch, model 411 receiver, model 461 message exciter, TWTA high-gain amplifiers, integration materials and environmentally controlled equipment shelters.

Bonneville installs Disneyland microwave system

Bonneville Telecommunications/ Satellite Systems Division, Salt Lake City, has announced that Disneyland has signed a contract with Bonneville for the design, purchase and installation of a custom microwave transmission system. The system will connect the amusement park with Bonneville's southern California microwave network and its satellite uplinks in San Diego and Los Angeles. The connection will allow Disneyland to send live and taped feeds to radio and TV stations nationwide.

With the system's interconnections, Disneyland also will be able to access other satellite common carriers and broadcast organizations using C- or Ku-band technology. The design of the system consists of two discrete microwave components. One component is a portable 11GHz microwave transmitter.

Bonneville provides satellite transmission for news service

CBS News Service and *Bonneville Telecommunications/*Satellite Systems Division, Salt Lake City, have reached an agreement for Bonneville to provide transmission services in Los Angeles, San Diego and Salt Lake City for the West Coast Regional News Cooperative.

Under the terms of the agreement, Bonneville has provided a substantial portion of the satellite transmission for the Regional News Service, using its owned and operated uplink, microwave, downlink and monitoring facilities in San Diego, Los Angeles and Salt Lake City.

The CBS Regional News Service launched Oct. 28, will use Bonneville International's KSL-TV in Salt Lake City as the regional hub.

Matsushita Foundation awards first grants

The Matsushita Foundation, New York, has announced that 11 educational organizations have been selected as the first recipients of the foundation's grants.

The initial grants, totaling $280,000, will support schools, colleges, community-school partnerships and other educational programs. The foundation, established in 1984, is the first U.S. corporate foundation to be established by a Japanese company to promote excellence in American education.

Recipients of the grants are: The Atlanta Partnership of Business and Education, Atlanta, ($50,000); Brown University Institute for Secondary Education, Providence, RI, ($20,000); Carleton College, Northfield, MN, ($50,000); Center for Educational Development, Rochester, NY, ($25,000); Central Park East Secondary School, New York, ($25,000); The Hudson School, Hoboken, NJ, ($20,000); Institute for Citizen Involvement in Education, Paterson, NJ, ($15,000); The New England Association of Schools and Colleges, Winchester, MA, ($5,000); New York University, New York, ($15,000); Smith College, Northampton, MA, ($50,000); Teachers College, Columbia University, New York, ($5,000).

MA's System 9 chosen for Multicomm Data Service

Modulation Associates, Mountain View, CA, has been awarded a contract from Mutual Broadcasting System to provide satellite data systems for the Multicomm Satellite Service. Multicomm chose the MA System 9 micro data SAT, which transmits data via satellite at 9.6 kilobits per second using spectrum efficient single channel per carrier (SCPC) technology. The System 9 delivers encrypted information from the Mutual Bren Mar uplink to receive-only earth terminals across the country. The data is then distributed throughout each area via Multicomm's FM radio broadcast subcarrier service.

Mutual chose the System 9 because it can operate with a micro, 1.8m receive antenna and use the existing Mutual C-band uplink in Bren Mar.

NEC announces System 10 deliveries

The Broadcast Equipment Division of *NEC America,* Elk Grove Village, IL, has announced additional deliveries of its DVE System 10 digital video effects generator to TV stations and teleproduction facilities across the country.

Facilities featuring the digital video effects system include WCIV-TV, Tallahassee, FL; WOFL-TV, Orlando, FL; Pace Communications, Portland, OR; WEHT-TV, Evansville, IN; Vision Design, Pensacola, FL; Ardent Teleproductions, Memphis, TN; Creative Technology, Akron, OH; Gilmore Associates, Dedham, MA; KUTP-TV, Phoenix, AZ; and KEYT-TV, Santa Barbara, CA.

Fuji introduces professional products group

Fuji Industrial Products Group, New York, has been designated the Professional Products Group as part of a reorganization to better serve the broadcast industry. The group will continue to function within the Magnetic Products Division, but will devote its resources exclusively to the needs of the growing field of professional videotape users.

Totsu orders CMX 3400A systems

Four CMX 3400A videotape editing systems from *CMX,* Santa Clara, CA, have been ordered by Totsu International, CMX distributor in Tokyo, for use by production facilities in Japan.

People

Will Morin has been promoted to video products manager at Agfa-Gevaert, Teterboro, NJ. He is a former president of The Group Four Companies.

Enos Yoder has been named engineering group manager at Crown International, Elkhart, NJ. He is responsible for managing the overall direction, cost and time of assigned engineering projects. Yoder has been with Crown for 12 years.

James Woodworth has been appointed director of marketing and sales for Circuit Research Labs, Tempe, AZ. Woodworth is a former sales manager for Compusonics.

James P. Somich has been named vice president in charge of engineering for Group One Associates, a broadcast engineering consulting company, Akron, OH. Somich was previously chief engineer.

Oscar Wilson, Mark E. Adams, Milton T. Wyatt and **Samuel E. Arnold** have been appointed positions at Ikegami, Maywood, NJ. Wilson is regional vice president, based in Torrance, CA. He is responsible for Western regional sales, administrative, engineering and related operational activities. Wilson is a former principal of Shoreline, Ltd. Adams is sales engineer and is based in Maywood. He will provide technical support for the broadcast products. He is a former field engineer for Philips Television systems. Wyatt is salesman for the Southwest region. He is responsible for the professional products division's monitors and handheld cameras. Arnold is sales engineer for the Southwest region. He will provide technical support for all broadcast products. Wyatt and Arnold are based in Dallas.

Chuck Bocan has joined Microtime, Bloomfield, CT, as Western regional manager. He is based in Los Angeles and will provide sales and service support for 13 western states. Bocan was previously employed by EEV.

Arnold Taylor and **George M. Cudabac** have been appointed positions with Quanta, Salt Lake City. Taylor is president and chief executive officer. He is responsible for daily operations. He joined Quanta in September 1984 and served as vice president of marketing for the broadcast division of RCA in Camden, NJ. Cudabac is Southeast regional sales manager. He is responsible for promoting character generators as well as the Quantapaint paint system. Cudabac is a former sales manager for Commercial Communications Inc.

Juergen F. Strube, J. Larry Jameson, Hans H. Kopper, Edwin L. Stenzel and **Frederick W. Bernthal** have been appointed new positions at the new BASF Corporation. Strube, president of BASF America, has been named chairman and president of BASF Corporation. Jameson, president-elect of BASF-Inmont, has been appointed executive vice president of the new corporation. He will be responsible for the coating and printing ink activities of BASF in North America. Kopper, president of Badische Corporation, is executive vice president of BASF Corporation and president of BASF Fibers. Stenzel, president of BASF Wyandotte, will be executive vice president of BASF Corporation and president of BASF Chemicals. Bernthal, treasurer of BASF America, is executive vice president of finance of BASF Corporation.

News

Continued from page 4

isting CMOS-LSI devices. The development of special components was not required, which will also simplify replacements if the product comes to market and eventually requires repair.

NAB to build prototype AM antenna

As part of the National Association of Broadcaster's drive to improve AM radio, the NAB Executive Committee has authorized the association to construct and field test two prototype AM antennas. The antenna designs, developed by Richard Bilby (Communications Engineering Services, Arlington, VA) and Ogden Prestholdt (A.D. Ring & Associates, Washington, DC) are expected to significantly increase AM signal strength, particularly at night when AM signals are impaired by *skywave* interference.

By directing toward the ground energy that is presently lost to the sky, the new antenna design offers separate control over AM skywave and groundwave signals, effectively combining two or more antennas at a single location.

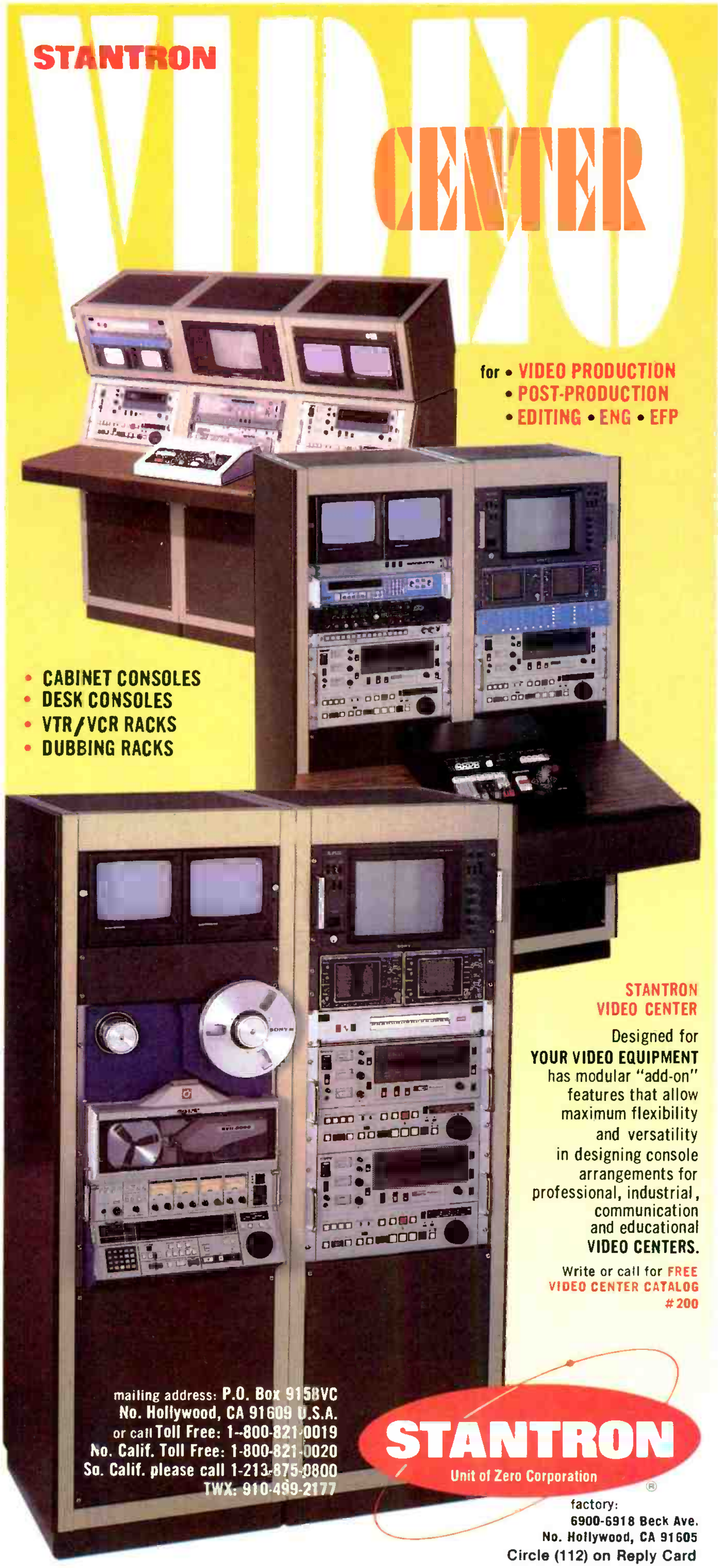
The exact site for construction of the antennas has not been determined, but will be approximately 40 miles west of Washington, DC. Work on the test systems is slated to begin in March. The project is expected to run for two years.

FCC advisory given

Anyone planning to do localized area broadcasting may find that their plans put them in violation of FCC regulations and federal law. Manufacturers, retailers and consumers using low-power video transmitters may find themselves subject to monetary fines (to $10,000), jail terms (to one year) and seizure of the equipment by federal authorities.

The transmitting device in question is designed to be connected to the VCR, TV camera, computer or other video source for transmission throughout the house to TV receivers. Operating without interconnecting coaxial cable to reduce undesirable RF radiation, the units generate field strengths that may produce interference to licensed broadcast services. Because signal bandwidths of these devices are not well controlled, they may cause interference to adjacent channel services as well. The problem is compounded if linear amplifiers with outputs up to 20W are used with the transmitters.

Devices packaged with computers and integral to VCRs already have received FCC certification and are not included in this advisory. If you have questions as to the legality of an RF-generating device, contact the FCC field office in your area for assistance.



Keith M. Gillum, Paul Sherbo and **Alan Kibbe** have been appointed positions at Colortran, Burbank, CA. Gillum is vice president of marketing. He is responsible for sales and marketing activities and will operate out of Rutherford, NJ. Gillum is a former vice president of marketing for Architel Systems. Sherbo, former regional sales manager for the Southwest for the past four years, has been promoted to director of sales, West Coast operations. Kibbe is regional sales manager for the Midwest. He is a former Northeastern regional manager for Kleigl.

Jim Peacher has been appointed to the position of national sales manager for Convergence, Irvine, CA. He has 10 years of experience in the video industry. Peacher will manage dealer sales in California and oversee the regional sales managers.

Emily Bostick and **William P. Johnson** have been appointed positions at Microwave Filter Company (MFC), East Syracuse, NY. Bostick is executive vice president and director of sales and marketing. She was most recently vice president of sales and marketing for 10 years. Bostick will be responsible for direct telephone sales, direct mail and marketing. Johnson is vice president and director of engineering. He will direct engineering operations and manage a training program for technical employees and provide assistance in the development of new markets. Johnson was a former chief engineer for MFC.

D. Drew Davis, Ennio E. Fatuzzo and **Edoardo Pieruzzi** have been named positions at 3M Magnetic Media, a new division, Saint Paul, MN. Davis is vice president. He is a former division vice president of Data Recording Products. Fatuzzo is group research and development vice president. He is a former research and development vice president for the Electronic and Information Technologies Sector. Pieruzzi is regional vice president 3M, Europe in Brussels. He is a former vice president for Magnetic Audio/Video Products.

David Dever and **Douglas Schwartz** have been appointed positions at Quantel, Palo Alto, CA. Dever has been promoted to national sales manager for broadcast products. He has been with Quantel for more than seven years and was most recently Eastern regional manager. Schwartz is marketing communications manager. He was a former advertising manager for NEC.

John Stephan Palma II, James Rouse, Martin Conry, Michael Caputo and **Robert McNabb** have been appointed positions at Agfa-Gevaert, Teterboro, NJ. Palma will serve as technical audio specialist. He will be responsible for audio evaluations and technical representation at trade shows. Rouse is technical sales representative in Los Angeles and Orange County. He was a former sales rep for ML Tape Duplicating. Conry is technical sales rep at the Lexington Marketing/Training Center. He will provide sales and service for the New England area. Caputo is technical sales rep for upstate New York, Westchester County, Queens, Brooklyn, the Bronx and Staten Island. He is a former vice president of Studio Film & Tape. McNabb has been promoted to regional sales manager for the Pacific region.

Dave Walton and **Juan Martinez** have been named positions with JVC Company of America, Elmwood Park, NJ. Walton has been promoted to marketing manager for new products. Martinez is product engineering manager. He will maintain communications with JVC's manufacturing factories and assist in training personnel on new equipment.

TV Stereo's Missing Link.

THE NEW ORBAN AUTOMATIC STEREO SYNTHESIZER

For years, Orban's popular 245F Stereo Synthesizer has proven its worth to broadcast professionals by generating compelling, dramatic pseudo-stereo from mono sources.

Now, Orban introduces the new Model 275A **Automatic Stereo Synthesizer**, precisely tailored to the needs of TV broadcasters. The unit will smoothly crossfade between true and synthesized stereo when triggered by internal automatic mono/stereo detection and/or single-channel recognition circuits; upon receipt of local or remote commands; or, upon commands from your automation system, tally, or vertical interval decoder.

Orban's switch-defeatable center-channel mono/stereo recognition circuit is carefully designed to eliminate many of the false-triggering problems of competitive units. However, because it is difficult for any electronic circuitry to distinguish between true mono and hard-center information in "stereo" sources, we offer a rational alternative—single-channel recognition. By recording or feeding mono material to **one track only**, you can use the single-channel recognition to automatically and **reliably** fade in synthesized stereo when this condition is detected. It also remains continuously alert to guard against dead channels.

The 275A employs Orban's patented, allpass-derived, complementary comb filter stereo synthesis technique. It's fully mono-compatible, and its logarithmically-spaced frequency bands avoid the disturbing and unnatural harmonic cancellation problems of delay-line-derived stereo simulators. **Two** synthesis modes are available to assure proper spatial perspective: "Wide" creates a dramatic sound similar to our 245F. The new "Narrow" mode creates a more subtle ambience which properly centers dialog. While the two modes are remote-selectable, "Narrow" can safely and effectively be used with all program material.

Single-ended Noise Reduction can be applied to the synthesized signal to reduce hiss and other noise by about 10dB without "pumping" or "breathing" while preserving low-level ambience and dialog intelligibility. This function is ideal for cleaning up older material and optical soundtracks because no encoding is required.

When not in a stereo mode, the 275A ordinarily routes its inputs directly to its outputs. In this mode ("Bypass") the 275A can detect and correct "out-of-phase" stereo material before your mono audience notices any degradation. Our sophisticated Auto Polarity detection circuitry is highly resistant to "falsing"—even with Dolby MP Matrix® material containing substantial out-of-phase surround information.

The 275A complements Orban's complete audio processing and baseband generation system for stereo TV, and provides the stability, reliability, and superb performance which have made Orban **the choice** for the TV broadcaster who is evolving to meet the needs of the contempory audience.

Contact your local Orban dealer for more information.

Orban Associates Inc.
645 Bryant St. San Francisco, CA 94107
(415) 957-1067 Telex: 17-1480

orban

Circle (81) on Reply Card

New products

Test and monitoring equipment

Tektronix has introduced the TSG-300 analog test signal generator, WFM-300 analog waveform monitor, 751 BTSC aural modulation monitor/decoder and the AVC-20 audio vector converter.

The TSG-300 provides digitally generated test signals without format transcoders. The unit includes color bars, linearity, pulse and bar and multiburst. It uses 10-bit digital signal generation at 13.5MHz.

The WFM-300 features four operating modes. Lightning display and waveform monitor functions are combined with a vectorscope and a bow-tie timing signal display. The unit monitors color gamut and RGB picture monitor output.

The 751 BTSC features an electro luminescent panel that displays a bar graph of up to 10 parameters, including deviation of the aural carrier and components making up the stereo signal. The unit is driven by baseband audio and includes SAP and PRO.

The AVC-20 turns any NTSC vectorscope into a stereo audio monitor. The unit simultaneously displays left and right audio channels and performs four checks.

Additional products introduced include 1710B waveform monitor, TSG-170A TV generator and the 760 stereo audio monitor.

Circle (395) on Reply Card

Rack mount cabinets

The Winsted Corporation has introduced a line of rack mount cabinets for security electronics equipment. Available in standard 14-, 21- and 28-inch heights, with 16-inch depth, the cabinet components are designed to house electronics equipment and offer flexibility in cabinet arrangement.

The line includes modular cabinets for arrangement of multiple cabinets. Corner filler kits are offered for use in arranging cabinets at a 90° angle. Rack wedges allow cabinets to be tilted at 15° for easier, glare-free viewing of electronics equipment.

All cabinets are standard EIA 19-inch width, available in plastic laminate in gray and beige finish and have fully vented bottoms.

Circle (352) on Reply Card

Earth resistance meter

BBC has announced the Metraterr 2 model JB-T2, a high sensitivity earth resistance meter designed to measure earth resistance of power communication and lighting conductor installations, including locations that have poor ground conductivity.

The earth resistance meter package, a water-resistant meter with a complete tool kit enclosed in a heavy-duty steel case, is designed for outdoor use. Equipped to handle up to 4-wire monitoring, the unit performs soil examinations and measures ohmic resistances and those of electrolytics.

The meter has a measuring span from 0kΩ to 9.99kΩ in four measuring ranges; measured values are given in three digits and can be read directly without any conversions.

The meter operates on six D-cell batteries. The unit is water-resistant and includes a protective cover. Its heavy-duty steel case includes all the tools and supplies necessary for measurement, including 4-wire spools with built-in handles. Four 1-piece ground rods with screw terminals for easy wire hook-up, a hammer, a screw driver, chisel, pliers, oil can and two cloth towels for convenient clean-up are also included. A wire configuration chart is conveniently located inside the tool case cover.

Circle (376) on Reply Card

Digital reverb

Alesis has announced the ST:c digital reverb. Features include a 16kHz frequency response, full stereo input and output and decay time variable from almost zero to 15 seconds, set by a single rotary control. The unit supports eight separate reverberation programs. Each may be augmented by front panel option switches for high-frequency damping, low-frequency cut and infinite hold.

Rotary controls include predelay (from 0ms to 200ms), decay time and high frequency roll (16kHz to 3kHz). The unit may be used stand-alone with instruments or connected to the sends and returns of any console. Back panel connections include stereo inputs and outputs and loop, through ¼-inch phone jacks.

Effects programs include simulations for small spaces, large rooms, large hall and gated and reverse reverb. The unit is capable of fattening drums, smoothing strings and sustaining backing vocals.

Circle (382) on Reply Card

Tracking video head

CMC Technology has introduced a dynamic parallel tracking video head. The video head features a proprietary cantilevered spring assembly designed to support the playback head, permitting the tip to remain consistently perpendicular to the recorded tape, resulting in improved tracking.

The unit is designed for use with all Ampex 1-inch VPR machines. The video head may be substituted for any of the separate heads Ampex requires for its five VPR models.

The video head is useful in slow motion editing. The head also remains perpendicular to the tape at all times, producing a uniform response across the RF bandwidth. In addition, the head eliminates jitter produced during audio-only editing.

Circle (383) on Reply Card

Foam-dielectric coax cable

Andrew Corporation has introduced the LDF6-50, a 1¼-inch heliax foam-dielectric coaxial cable. It provides the system designer an opportunity to optimize antenna feeder performance in cellular, SMR and microwave applications.

The dielectric is low-loss, closed-cell, polyolefin foam, resulting in low attenuation for the cable size. Although the cable does not require pressurization to operate, the design of the connectors allows the use of the tubular inner conductor as a pressure path, where required for air-dielectric antenna feeds. The connectors also feature self-flaring outer contacts and self-tapping inner conductors for electrical contact, high resistance to connector pull-off, and easy assembly.

The cable is available in long continuous lengths.

Circle (384) on Reply Card

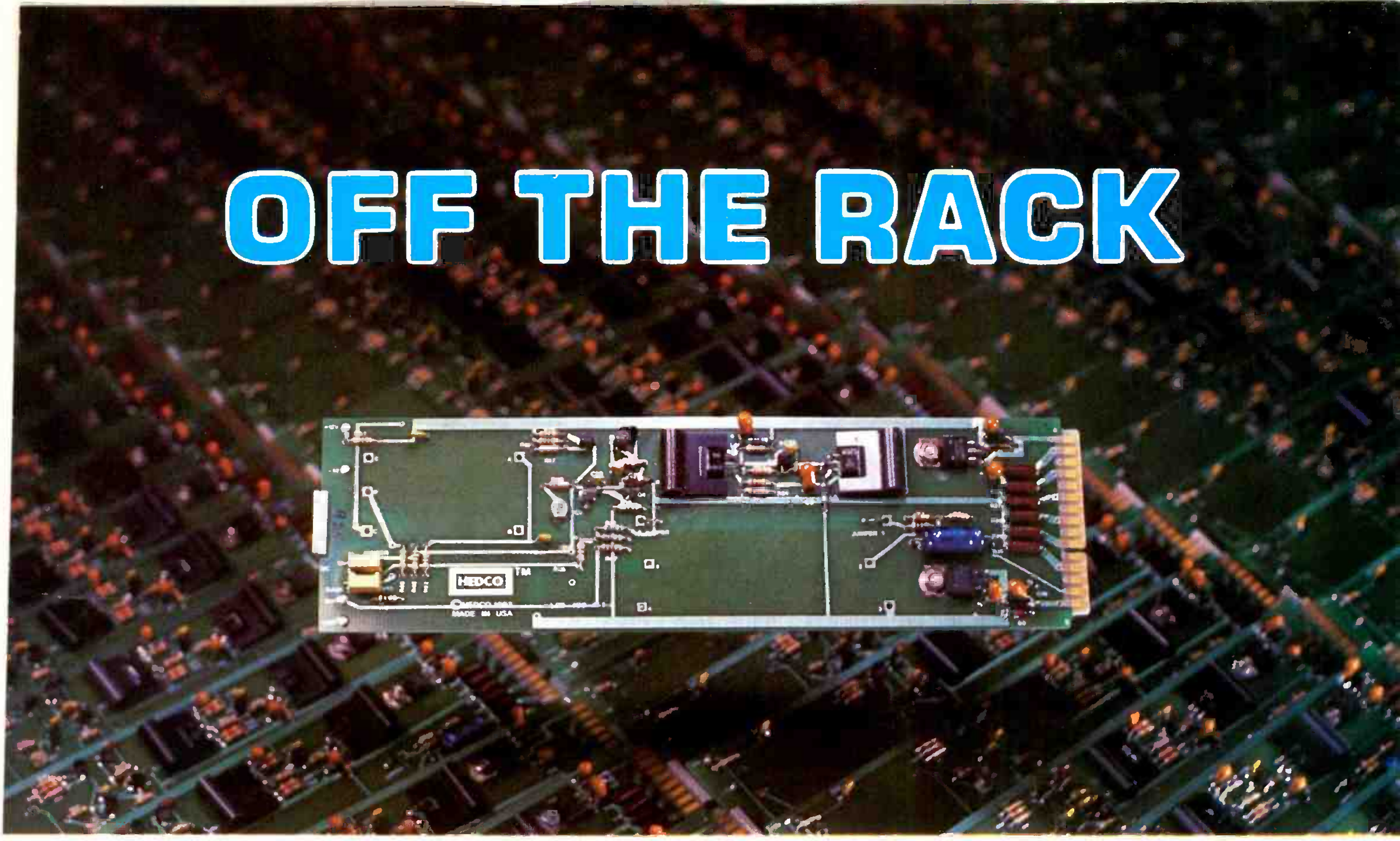
Digital probe multimeter

A. W. Sperry Instruments has announced the AWS DM-6590 electro-probe autoranging, digital probe multimeter. The DMM measures 6⅜" x 1⅛" x ¾". It is designed for reading ac voltage, dc voltage and resistance in tight, hard-to-reach areas such as crowded circuit boards. The DMM fits in the hand and contains a built-in probe tip.

Features include autoranging, 3¼ digit display, audible continuity buzzer, 200 hours continuous operation, data hold button and autozeroing.

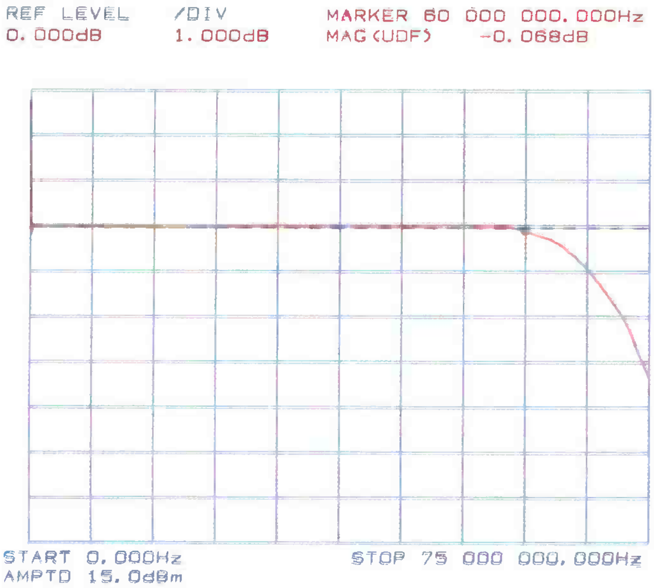
The DMM comes with one TL-40 test lead, one AG-940 detachable, insulated alligator clip, two B-6 batteries, C-34 carrying case, operating instructions and a 1-year warranty.

Circle (362) on Reply Card



Select custom performance from HEDCO's standard DA line

Typical bandwidth plot of Standard HEDCO LDA-108 as measured on a Hewlett Packard 3577A Network Analyzer Serial Number 23 33A 10135 Graph printed by Hewlett Packard 7470A Plotter Serial Number 23 08A 49675



When your signal handling requirement is broadband, HEDCO has distribution amplifiers to meet that requirement, whether it be High Resolution Television, Data Transmission or HDTV.

6

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Circle (89) on Reply Card

Commercial insert systems

Channelmatic has introduced the BBX-1A Billibox bypass and test switcher and the CIS-1A Spotmatic JR commercial insert system.

The BBX-1A interfaces with any manufacturer's equipment and any satellite cue-tone format. The unit monitors video sync pulses and automatically bypasses the commercial insert equipment if any of the videotape players suffer a loss of sync. The unit allows external audio and video test signals to be routed through the insert system for setup and testing purposes with no service interruption. The unit contains an internal high-speed DTMF tone generator for testing and alignment of satellite cue-tone decoding equipment. All switching is performed during the vertical blanking interval of satellite network video to ensure clear and glitch-free transitions.

The CIS-1A features full microprocessor-controlled spot-sequential ad insertion capability on four separate satellite networks. The system is available in plug-in form.

Circle (392) on Reply Card

Coax/twinax connector and adapters

Berk-Tek has introduced its line of twist-on connectors. The connectors are made of a 1-piece design and the mating parts are silver-plated beryllium copper for high data rates and long-lasting assemblies that resist oxidation. The connectors are designed to terminate RG-62 and RG-59 coax cable. They also are designed to operate in the 500V rms range with an impedance value of 50Ω, and they yield a low reflection up to 4GHz. Two sizes are available, one for PVC jacket cable and one for plenum cable.

Circle (385) on Reply Card

Agile exciter/SCPC modem

Microdyne has introduced the 1100 TVE frequency agile exciter and the 1100 DS(RT) single channel per carrier modem.

The exciter converts SCPC signals for data communications, as well as radio and television, to the 5.925GHz to 6.425GHz satellite uplink band. The unit has high frequency output stability, and temperature-compensated crystal oscillators provide output frequency stability of +15kHz.

The modem, for narrowband applications, is integrated with a video or SCPC uplink system. It is synthesized frequency selectable in 25kHz steps from 47.5MHz to 92.5MHz, and allows the operator to access any satellite channel on a predetermined transponder.

Circle (390) on Reply Card

Intercoms/interface units

Telex Communications has introduced the CCB-1 interface unit and the Phase 2 line of Audiocom intercom products.

The CCB-1 makes Audiocom and Clear-Com intercom systems compatible. The unit loops through and interfaces the two systems, using the Telex or Clear-Com power supply or both power supplies simultaneously. The unit also makes Telex and Clear-Com light signaling systems compatible.

Phase 2 includes the IC-2M/A 2-channel master station, which uses a full duplex audio system for simultaneous talk and receive functions, with a 20kHz light signaling system. An interrupt feedback button allows live broadcast cuing.

The IC-2A beltpack is a 2-channel headset station that allows the user to select either of two lines of communication at the remote station. The unit also includes 20kHz light signaling, and an extra connector for carbon headsets.

Circle (391) on Reply Card

Go around corners...leap tall buildings...do creative path diversion... without affecting the purity of your sound.

TFT's 8300 Series Aural STL with its unique, innovative IF Repeater approach keeps your on-air audio sounding as it does at the studio...several hops later.

The TFT IF Repeater technique is unique. At relay points, we don't take your aural signal down to audio baseband. We use the 63 MHz IF instead.

Results? How about 55 dB stereo separation even after a few 10, 20, or 25 mile hops? Or ±0.1 dB frequency response from 30 to 15,000 Hz?

Plus, we offer a selectable IF bandwidth (SAW Filter) to minimize adjacent channel interference.

The 8300 Series is available in Composite, or Dual "Hot Standby" Composite configurations.

AM Stereo? Go FM composite to your transmitter and our Stereo Decoder Option will give you left and right signals to drive your AM Stereo Exciter.

If your frequency is one of those listed by the FCC,* we guarantee delivery within 2 weeks after we accept our dealer's order.

All of this backed by a 2 Year Warranty.

Get to the top of the hill, cleanly. Go TFT. Contact your favorite TFT dealer for more details.

*¶ 74.502 of the Rules.

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Condenser unidirectional mic

Audio-Technica has announced the ATM33R phantom-powered unidirectional condenser microphone. The mic is a Lo-Z (150Ω) model recommended for recording.

The response of the mic covers a frequency range of 30Hz to 20,000Hz. Designed for hand or stand use, the microphone, measuring seven inches long, with a 1 1/64-inch head diameter and a 13/16-inch handle diameter, weighs 4.75 ounces. The microphone accepts standard 3-pin receptacles.

Circle (379) on Reply Card

EXPO radio

Motorola, communications sector, has introduced the Securenet EXPO series 2-way portable FM radio. The radio weighs 12.5 ounces and stands 13.7 inches high.

Securenet digital voice protection provides an encrypted mode of operation, which prevents eavesdroppers from monitoring private communications. The radio uses encryption techniques, where speech is converted to a digital form and encrypted using a code key dependent algorithm.

Only Securenet radios programmed with the correct code will receive an intelligent message; eavesdroppers will hear a random white noise. The radio is small enough to fit in a shirt pocket, and provides two channels with coded or clear operation, 2W of power in VHF and 1W of power in UHF. The radio is available with private-line and carrier squelch. The private-line feature can be activated when the radio is in the clear mode and silences users to all transmissions not meant for them.

Circle (380) on Reply Card

IFB system

Clear-Com has introduced a program interrupt (IFB) system that provides on-air talent with audio programming monitoring and director/producer cuing. The system is designed for all types of portable and fixed TV production setups, from mobile vans to large studios.

Configured in building block modules (four channels each), the system permits up to 96 people to monitor program and to be accessed from up to 50 locations. The system includes noise-canceling gooseneck microphones, tally lights to indicate which talent is being cued and an all IFB function that simultaneously accesses all talent. The system also is available with optional split-feed operation to allow use of binaural headsets for news and sportscasting applications.

The system has four channels with one control position, one program controller, four talent receivers, a power supply and all necessary cables.

Circle (381) on Reply Card

Production console

Wheatstone has announced the SP-5 production console. The console can be custom-configured to the client's system requirements. Both the mono and stereo inputs are offered as well as stereo subgroups, multitrack routing and matrix submixing. Composite stereo and mono mixes, in addition to four auxiliary send buses are provided. They also will provide tape machine controls, clocks, timers and user-specified frame widths.

Circle (378) on Reply Card

Cart machine series

Fidelipac has announced the Dynamax CTR 10 series of cartridge machines. The series of recorders and players features four models. The series incorporates the same construction and mechanical design as the CTR 100 series, but without the Cart Scan and Varispeed features.

Circle (377) on Reply Card

Video tripod

Bogen Photo has introduced the compact convertible video tripod with fluid head combination designed for portable VCR cameras up to six pounds. It comes with the 3126 micro fluid head. The tripod folds to 24¾-inches long. The tripod can be shot from a low of 16½ inches to a height of 60½ inches. There is a center-post travel of 8½ inches. The legs are made of tubular, hard-finished aluminum with lever locks.

Circle (369) on Reply Card

Satellite mesh dishes

Luxor North America has introduced two aluminum mesh satellite TV antennas for the U.S. market. The antenna is available in a 9-foot, 12-rib design and a 10.5-foot, 18-rib design. Each antenna incorporates deep dish parabolic geometry for maximum signal reception.

The antennas' basic structure is a 14½-inch parabolically shaped steel hub supporting heavy-duty, steel ribs in a polytransvinyl sheath. The snap-in mesh petals are rust-proof, hexagonal-patterned, expanded aluminum mesh for a high strength-to-weight ratio. The outer rim, a rigid extruded aluminum rail anchored to the ribs, forms a solid framework for the petals.

The polar mount features self-aligning bearings that minimize pivot point wear, a finely adjustable declination offset for on-line satellite tracking regardless of geographic location, and provision for a linear antenna actuator. The antennas will accommodate a Chaparral Polarotor One, dual feedhorn or sidewinder.

Circle (370) on Reply Card

Audio distribution amp

DYMA Engineering has announced the model 815 audio distribution amplifier in stereo configuration. The amp is packaged in the same configuration as the monaural versions featuring individual power supplies for each amplifier and wiring seizing connection for inputs and outputs. The amp has one stereo input and four stereo outputs with a common stereo gain control.

Circle (371) on Reply Card

Lab DMMs

OK Industries, electronics division, has introduced the 600 series of portable, benchtop digital multimeters. The three models in the series feature 29 ranges—five dc voltage scales from 200mV to 100V; five ac voltage scales, 200mV to 750V; six ac and dc current scales, 200μA to 10A; and six resistance scales, 200Ω to 200MΩ. The resistance mode at maximum scale can also be used as a diode check mode.

Model 601 offers a 0.1% basic accuracy and 3.5 LCD display; model 603, a 0.25% accuracy and 3.5 digit LED display; and model 604 a 0.25% accuracy and 3.5 digit LCD display. All models operate with optional ac adapter for the lab bench or on internal batteries for portable use.

Additional features include overrange and low-battery indicators; high, normal and common mode rejection; and overload protection.

Circle (363) on Reply Card

2-D image generator

Artronics has introduced a 2-D image generator system, a turnkey computer graphics system to combine a paint system, special effects, character generator, color cycle animation, multiple frame storage and keying. The system has 6-frame buffer for pans, zooms and tilts. Special effects include warps, tumbles, waves, distorts, bends, wipes, fades, checkerboards and compresses.

Circle (355) on Reply Card

Chemically activated electrode

Lightning Eliminators and Consultants has introduced the Chem-Rod, a rechargeable chemically activated grounding electrode that can reduce ground resistance through a process of continuous, automatic soil conditioning.

Through a patented design, special metallic salts in each electrode combine with soil moisture, increasing soil conductivity while reducing rod-earth interface resistance. The drop in resistance averages from 1/10 to 1 1/100 of that of a single solid ground rod of equivalent length. The process is automatic, so no manual soil conditioning is required.

The rate of chemical activation can be adjusted to provide low ground resistance during extremely dry soil and freezing temperature conditions.

The unit is available in vertical or horizontal designs and special application configurations. Vertical rods in 6-, 8- and 10-foot modules may be stacked to achieve any length. Several electrical connection configurations are also available. Where necessary, the unit can be furnished in stainless steel or hot-dipped galvanized iron.

Circle (373) on Reply Card

Battery phantom power supply

Crown International has introduced the PH-1 single-channel, transformer isolated, phantom power supply that operates on two 9V batteries. It supplies simplex phantom powering for the Crown PZM or PCC series microphones. The power supply also will power other condenser microphones that operate on 18V or less, simple powering. Supply voltage is +18Vdc on pins 2 and 3 with respect to pin 1 of the input connector.

Because the unit includes a 1:1 isolation transformer, the output of the unit can be unbalanced with no ill effects. The rugged steel and aluminum chassis and XLR type connectors help the unit withstand the rigors of daily professional use.

Circle (372) on Reply Card

Tripod

Sachtler has announced the Hot Pod, a tripod for level or uneven surfaces. The tripod's main feature is a central lock lever which, when released, extends each leg automatically into a stable tripod position on any kind of surface. A fine adjustment lever then levels and locks the camera in position, ready to shoot. The tripod is designed for shooting while standing on steps, on a ramp or in other unusual situations.

Other features include a fast action center column, which raises and locks at any height up to 6.6 feet, allowing an upfront position even when shooting in crowded positions.

The tripod comes equipped with a carrying grip and a shoulder strap.

Circle (368) on Reply Card

FM exciter

TTC Wilkinson has announced the model X FM exciter, designed to meet the increasing need for capabilities in digital audio reproduction and multiple subcarrier operation. Extremely low distortion and flat frequency response make the unit virtually transparent. AFC design reduces modulation robbing baseline shift. Broadband circuitry eliminates the need for tweaking and tuning.

The unit handles up to five subcarriers, and is designed to provide the ideal frequency response, distortion and signal-to-noise characteristics for digital audio reproduction.

Key specifications include FM signal-to-noise ratio of 90dB, low distortion (THD, IMD, TIM) less than .01%, frequency response within .05 from 20Hz to 100kHz.

Circle (375) on Reply Card

Reverb and effects software

Eventide has enhanced its SP2016 effects processor/reverb with four reverberation programs, a vocoder program and an automatic panner program. The RMX Simulation Plus programs provide accurate simulations of two of the AMS RMX 16 reverb programs, reverse reverb and non-linear reverb. The unit gives the user two independent channels simultaneously.

As a counterpart to these special-effect decay reverbs, a natural reverb, featuring natural decay ambience, has been introduced with a gated reverb program. Each unit comes with 10 reverberation programs and 12 effects programs.

The automatic panner program provides delay panning as well as amplitude panning functions. User-adjustable parameters make possible a wide variety of crossfade and panning effects. This program is available as an option on SP2016s as well as units in the field.

The channel vocoder ROM is also available as an option. With the channel vocoder ROM, the unit can function as an 18-band, professional quality vocoder.

Circle (365) on Reply Card

Protective casewear

Kangaroo Video Products has expanded its line of protective casewear with the KVP-6800, a video pack for the Sony VO-6800 portable videocassette recorder. The case accommodates the deck, helps to insulate it from concussion, provides in-use access to all controls and organizes outboard features and auxiliary equipment.

Three removable pockets are included with the case. One is fitted to hold two extra NP-1 batteries. Another is designed for two U-matic cassette tapes. Other equipment such as microphones or cables can be stored in the front pocket. A BVG-100 time-code pocket is optional.

Special features of the case are its dual white-balance panels, flaps with Velcro closures, a hooded port to protect cable connectors and a cable strain relief system.

Circle (366) on Reply Card

Equalizers

JBL has introduced the JBL 5547 graphic equalizer and 5549 room equalizer, designed for studio and sound reinforcement applications. They provide minimum phase shift consistent with amplitude response, and smooth minimum ripple combining action over the entire control range.

Both models have high- and low-frequency endcut filters. Additional features include 45mm throw slide posts, with center detent on the 5547; an EQ bypass switch that facilitates before and after comparisons; a hardwire bypass with power off; and a delayed turn-on that precludes power-on thump. Ground loop isolation is provided by a chassis-ground to audio-ground barrier strip jumper. A polycarbonate overlay protects the front panel graphics. The all steel housing has heavy gauge extruded aluminum rack ears.

Circle (367) on Reply Card

½-inch videotapes

Ampex Magnetic Tape Division has introduced a backcoated 188 Beta and 189 VHS format videotape. The 188 and 189 tapes are designed to meet the requirements of professional video producers. Both tapes feature a high coercivity, cobalt-doped oxide particle formulation and a tough binder system.

A tape cleaning process and a cassette mechanism that uses ABS anti-static plastic protects against dropouts. The tapes also feature precision backcoating that enhances durability, ensures smooth tape packs and dissipates static electricity.

Circle (364) on Reply Card

Sync generator and waveform monitor

Videotek has introduced the VSG-200 sync generator and the TSM-60 waveform monitor. The generator has front panel bi-LED indicators for gen-lock subcarrier and sync loss/presence. Front panel adjustments are provided for H phase and SC phase. The unit features a field one color identification pulse, SMPTE color bar generator outputs and six isolated black burst outputs.

The monitor features a selection of inputs, filter response and time base sweep accomplished via front panel pushbutton switches. When switched to the line select mode, lines 14 through 21, the unit employs an auto bright-up circuit that increases the intensity of VIR, VITs or closed-captioned signals.

Circle (388) on Reply Card

Editing system enhancements

EECO has introduced the ES-900 cuts-only audio/video switcher and a Tascam 58 ATR interface for the IVES II edit controller. The ES-900 is controlled via an RS-422 serial communication. The system allows control of multiple video recorders and a production switcher through interchangeable work stations. The video editing work station features a dedicated keyboard control panel. The cinemagraphic editing work station is a plug-in control center and uses a single-button mouse control and on-screen menus to control machine and edit functions.

The optional ATR interface for Ives II desktop post-production editing system treats the ATR as the B machine of an A/B system. In operation, the ATR option locks the Tascam 58 8-track ATR to the recording VTR for performing audio layback or locks both the ATR and the recording VTR to the playback VTR for multitrack audio mastering.

Circle (389) on Reply Card

Cameras, monitors and tapes

Sony has introduced the DXC-M2 color video camera, the SuperBeta system and the PCM-1630 digital audio processor.

The DXC-M2 has a built-in 2H vertical image enhancer for high resolution and 57dB S/N ratio from three ⅔-inch LOC diode gun Saticons. The mixed field magnetic focus/static deflection tube eliminates defocusing and beam spot spread. Features include color temperature filters, auto lens close, conductive rubber shielding, color-bar generator and gen-lock to video or black burst inputs.

The SuperBeta system features a 1-piece GCS-1 Betamovie color camera/recorder unit, GCS-50 Betamax editing videocassette recorder and the RM-E50 automatic editing control unit with stereo sound.

The PCM-1630 uses analog and digital filtering. It also has a 16-bit linear quantization and switchable sampling rate of 44.1kHz or 44.056kHz, a dynamic range greater than 90dB, harmonic distortion below 0.05% and unmeasurable wow and flutter.

Additional products recently introduced include the DXC-101 and 102 compact color cameras, EVO-510 and 210 table top and portable player/recorders, the BCT series of 5-, 10- and 20-minute videocassettes, PVM-8220, 8221 and 8020 8-inch color video monitors, the PVM 1380 13-inch color monitor, the Mavigraph VP-1100 color video printer and the DMR-4000 digital master recorder.

Circle (393) on Reply Card

Compact standby power source

Sola, a unit of General Signal, has introduced a 300VA standby power source (SPS) for use with personal computers. The SPS unit plugs into any standard ac outlet and contains a sealed, lead-acid battery. When ac line power is present, the 300VA supplies ac output via an RFI/EMI noise filter and 6,500A surge suppressor. The inverter is pre-synchronized and phase locked to commercial power. When the line voltage drops below 103V, the unit switches from line power to battery/inverter power within 4ms to 8ms. While on battery power, the output is a modified sine wave (stepped wave with correct RMS and peak) with voltage regulated to ±5% of nominal.

The unit operates on 120V, 60Hz input and features a 3A fuse and electronic overcurrent protection with current foldback. Also included are a NEMA 5-15P input along with a 6-foot power cord and four NEMA 5-15R output receptacles. The unit has a test/alarm disable rocker switch and an on/off control switch.

The unit weighs 21 pounds and measures 6.6" x 4.7" x 14.2". It will operate between 0° C and 45° C, and may be stored where the temperature range varies between -15° C and 50° C.

Circle (361) on Reply Card

Function/sweep/pulse generators

OK Industries, electronics division, has introduced the 200 series of generators. The instruments in the series include model 205, a 5MHz function generator; model 206, a 5MHz sweep/function generator; and model 207, a 5MHz pulse/function generator.

All three models offer sine, triangle, square and haversine waveforms and feature both a TTL output and a 20V, 50Ω output with adjustable dc offset and amplitude. In addition, all include variable symmetry (duty cycle), switchable attenuation, external sweep and trigger/gate modes with adjustable phase.

Model 206 adds a versatile internal sweep capability. Features include both linear and logarithmic sweep, with 1,000:1 on linear and 10,000:1 on log; full marker function; three sweep modes and separate plotter pen-control output.

Model 207 adds 5MHz pulse capability to the basic 5MHz function generator features, and offers normal, complement, low clamped and high clamped output forms.

Circle (358) on Reply Card

Monopods

Karl Heitz has announced the 563L mono reporter luxe, 564L mono studex luxe and 565L mono studex super luxe Gitzo monopods. They feature swivel head, extensible chest and shoulder support, five sections and an extended range from 19 to 78 inches, instead of the standard four sections ranging from 19 to 64 inches.

Equipped with soft grip, wriststrap, hard rubber tip (or metal spike), they work well for people 6 feet and up. Deeply anodized (1/10mm), extensions have waterproof resin washers and soft-cushioned locking rings.

Circle (360) on Reply Card

Graphics generator

Artronics has introduced the Columbus 3-D graphics generator system, an animation system for high-resolution film (4,096 x 2,732 pixels) and medium resolution video (512 x 485) production. It features real time, full-image display from start to finished product, and generates solid, shaded, anti-aliased, 3-D scene models that can be animated in real time or frame by frame.

Circle (354) on Reply Card

Portable frequency counters

OK Industries, electronics division, has announced the 500 series of portable, benchtop frequency counters. The instruments in the series include model 510, which features a frequency range of 10Hz to 200MHz, a resolution of more than 1ppm and 0.3ppm time base accuracy; and model 515, which features a frequency range of 5Hz to 600MHz, resolution to 0.1Hz and 2ppm time base accuracy.

Both models operate on internal batteries or optional ac adapter, and are housed in stackable ABS enclosures and feature an 8-digit LCD display.

In addition to frequency measurements, model 510 totalizes and measures period. Both units offer variable gate times, high and low impedance inputs and external time base input. Typical sensitivity on both models is 10mV over the entire range. Options include a 1GHz prescaler.

Circle (359) on Reply Card

Digital multimeter

Triplett has announced the model 4800 digital multimeter. Measurement capability includes dc/ac voltage, dc/ac current, resistance, frequency (channel A, 10Hz to 100kHz; channel B, 10Hz to 1,000kHz), period, dBm, diode test, continuity test and temperature (with K-type thermocouple). Also included are comparator, data hold, peak hold, relative and autoranging.

The 5-digit LCD display indicates push-button selected functions and low-line voltage or overrange conditions. Manual or autoranging is provided. A relative measurement is available that stores the applied input as a zero reference point from which subsequent measurement will be displayed as deviations.

The comparative measurement mode permits input of high and low values or percentages. The unit provides multiple fuse overload protection and recessed lead jacks. It measures 245mm x 88mm x 240mm and includes a combo carrying handle/bench stand. It will operate from standard 120V or 240V, 50Hz to 60Hz. Accessories include power cable, spare fuses, signal cable, alligator test leads and comprehensive instruction manual.

Circle (374) on Reply Card

Computer graphics console

The Winsted Corporation has introduced a mobile computer graphics console designed for operator efficiency and comfort. Ergonomically engineered to minimize operator fatigue, the console features a table that adjusts from 26 to 30 inches high. The 16" x 24" monitor riser is adjustable from 7½ to 11½ inches high. Other features include adjustable keyboard and digitizer pad shelf which tilts 0° to 5°, pulls out three inches and adjusts up or down three inches. A 19¼-inch rack mount cabinet holds most standard mountable equipment.

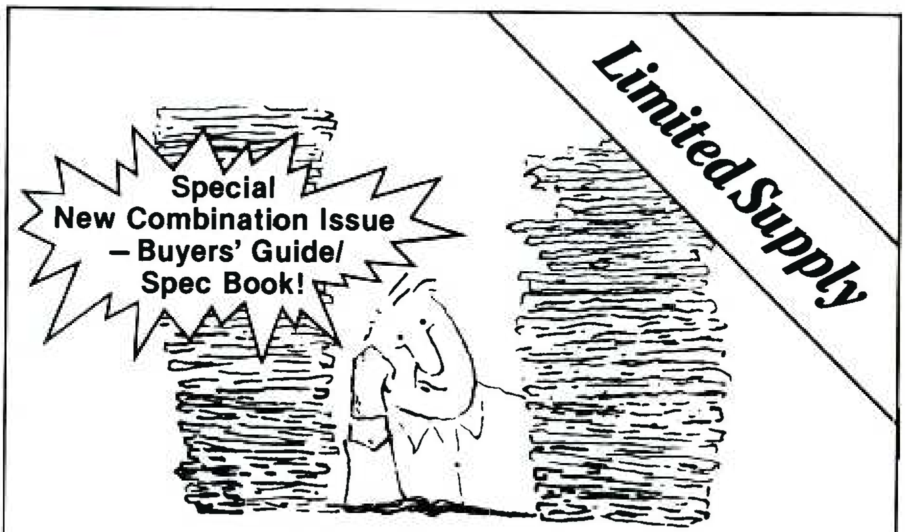
Circle (353) on Reply Card

Videocassette/tape

Fuji has introduced the H421M videocassette and the H621E videotape. The cassette is for use with ½-inch M format systems and uses a duroback coating. The cassette shell is constructed of ABS resin and features a protective case.

The H621E 1-inch tape features video, color and audio S/N improvement by +2dB. A binder system and backcoating ensure the tape will run smoothly during all playback modes.

Circle (387) on Reply Card



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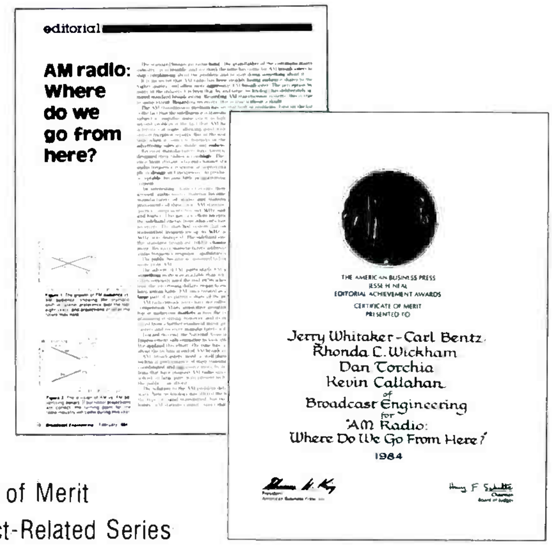

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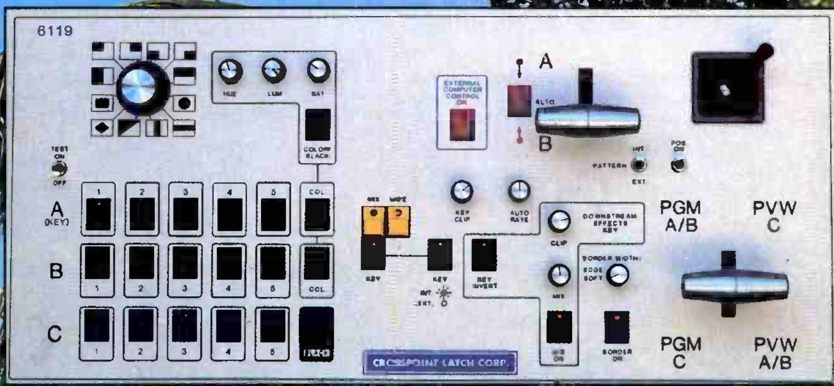

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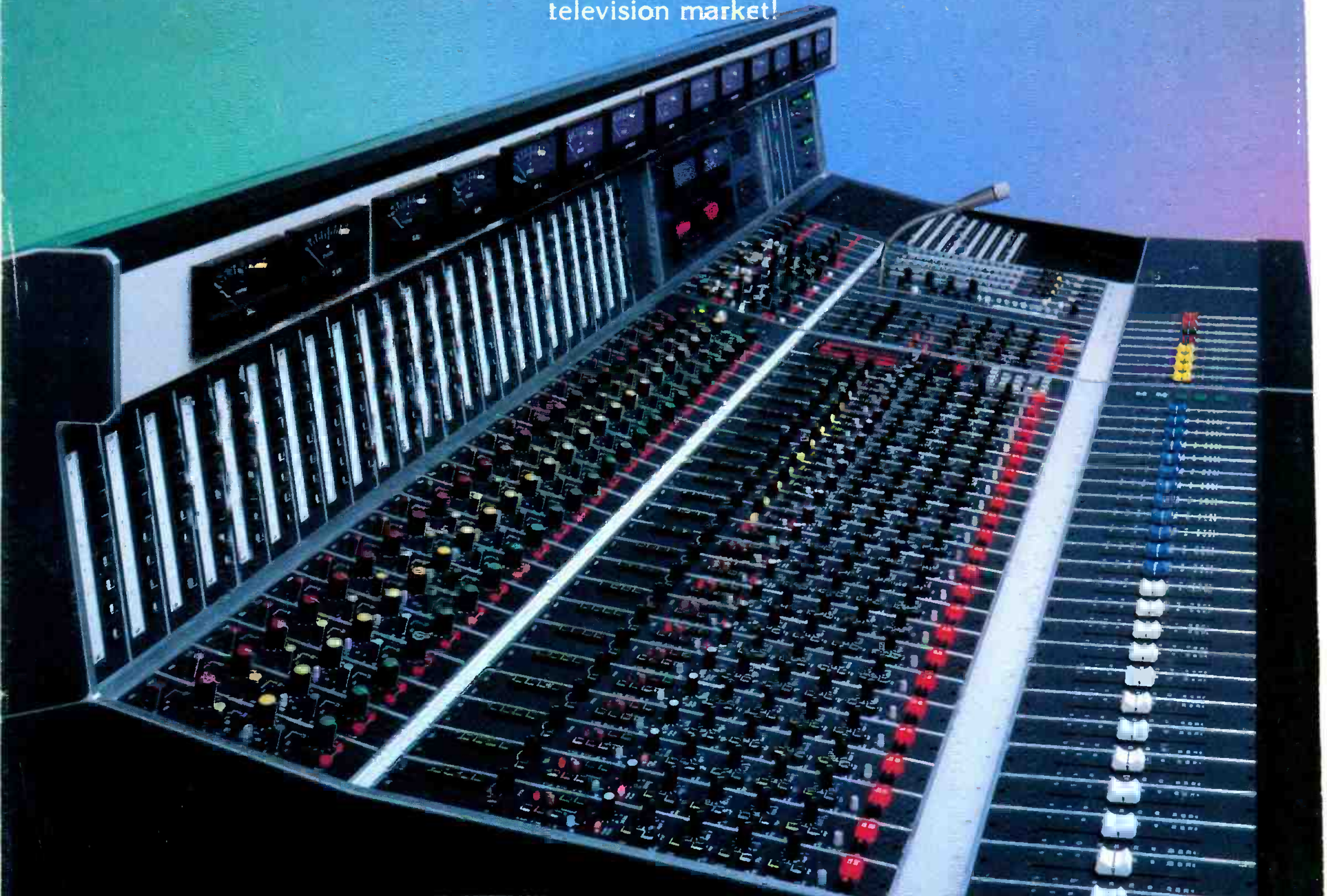

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